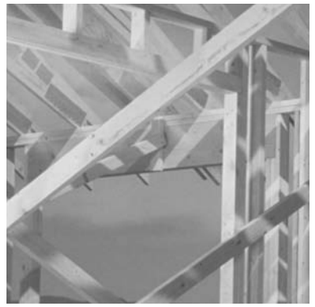


MOTOROLA
intelligence everywhere™

EP450™
Portable Radio
Detailed Service Manual

MOTOROLA

HKLN4216A

MOTOROLA
intelligence everywhere™

EP450 Portable Radio
Detailed Service Manual

VHF 146-174 MHz
UHF 403-440 MHz
UHF 438-470 MHz
UHF 465-495 MHz

Motorola, Inc.
1301 E. Algonquin Road
Schaumburg, IL 60196

HKLN4216A

Foreword

This manual is intended for use by service technicians familiar with portable two-way radios. It contains service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date may be incorporated by a complete Manual revision or alternatively as additions

Product Safety and RF Exposure Compliance

Caution

Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio.

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 68P81068810) to ensure compliance with RF energy exposure limits.

For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: http://www.motorola.com/cgiss/index.shtml.

Computer Software Copyrights

The Motorola products described in this manual may include copyrighted Motorola computer programs stored in semiconductor memories or other media. Laws in the United States and other countries preserve for Motorola certain exclusive rights for copyrighted computer programs, including, but not limited to, the exclusive right to copy or reproduce in any form the copyrighted computer program. Accordingly, any copyrighted Motorola computer programs contained in the Motorola products described in this manual may not be copied, reproduced, modified, reverse-engineered, or distributed in any manner without the express written permission of Motorola. Furthermore, the purchase of Motorola products shall not be deemed to grant either directly or by implication, estoppel, or otherwise, any license under the copyrights, patents or patent applications of Motorola, except for the normal non-exclusive license to use that arises by operation of law in the sale of a product.

Document Copyrights

No duplication or distribution of this document or any portion thereof shall take place without the express written permission of Motorola. No part of this manual may be reproduced, distributed, or transmitted in any form or by any means, electronic or mechanical, for any purpose without the express written permission of Motorola.

Disclaimer

The information in this document is carefully examined, and is believed to be entirely reliable. However, no responsibility is assumed for inaccuracies. Furthermore, Motorola reserves the right to make changes to any products herein to improve readability, function, or design. Motorola does not assume any liability arising out of the applications or use of any product or circuit described herein; nor does it cover any license under its patent rights nor the rights of others.

Table of Contents

Module 2: UHF 403-440, 438-470, 465-495 MHz

List of Figures

List of Tables

Related Publications

Chapter 1 Test Equipment, Service Aids, and Service Tools

1.1 Test Equipment

Table 1-1 lists test equipment required to service the EP450 Radios.

Table 1-1. Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2600 series	System analyzer	This item will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1074	Fluke 87 digital multimeter	True RMS metering, 200 kHz frequency counter, 32-segment bar graph with backlit display	Digital voltmeter is recommended for AC/DC voltage and current measurements
	Fluke 85 RF probe	500 MHz, 30 VAC max	Use with Fluke 87 digital multimeter for RF voltage measurements.
*R1377	AC voltmeter	1 mV to 300 mV, 10 megaohm input impedance	Audio voltage measurements
R1611	Dual channel 100 MHz oscilloscope (Agillent)	Two-channel, 100 MHz bandwidth, 200 M sample rate/sec, 2 MB memory/channel	Waveform measurements
S1339	RF millivolt meter	100 µV to 3V RF, 10 kHz to 1 GHz frequency range	RF level measurements
*R1013 or *R1370	SINAD meter or SINAD meter with RMS	Without RMS audio voltmeter or With RMS audio voltmeter	Receiver sensitivity measurements

1.2 Service Aids

Table 1-2 lists service aids recommended for working on the EP450 Radios. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 1-2. Service Aids

Motorola Part No.	Description	Application
RLN4460	Portable Test Set	Enables connection to the audio/accessory jack. Allows switching for radio testing.
RLN4510	Battery Interface	Regulates DC current and voltage between radio and power supply.
RVN4195	Customer Programming Software and Tuner Software on CD Rom	Program customer option and channel data.
AAPMKN4004	Programming Test Cable	Connects radio to RIB (RLN4008).
AAPMKN4003	Radio-to-Radio Cloning Cable	Allows a radio to be duplicated from a master radio by transferring programmed data from the master radio to the other.
RLN4008	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter.
5886564Z01	RF Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
0180305K08	Shop Battery Eliminator	Interconnects radio to power supply.
HSN9412	Wall-Mounted Power Supply	Used to supply power to the RIB (120 VAC).
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT or newer (9-pin serial port). Use B71 for older models (25-pin serial port). Connects the computer's serial communications adapter to the RIB (PLN4008).
6686533Z01	Knob Remover/Chassis Opener	Used to remove the front cover assembly.
HKN9216	IBM Computer Interface Cable	Connection from computer to RIB.
8180384N65	Housing Eliminator	Allows testing of the radio outside of the housing.
RLN5583	Flashing Adapter	Flashing/CPS cable for Authorized Service Centers

Table 1-3. Recommended Service Tools

Motorola Part No.	Description	Application
RSX4043	TORX screwdriver	Tighten and remove chassis screws
6680387A70	T6 TORX bit	Removable TORX screwdriver bit
R1453	Digital readout solder station	Digitally controlled soldering iron

Table 1-3. Recommended Service Tools (Continued)

Motorola Part No.	Description	Application
RLN4062	Hot air workstation, 120 V	Tool for hot air soldering/desoldering of surface mounted integrated circuits
0180386A78	Illuminated magnifying glass with lens attachment	Illumination and magnification of components
0180302E51	Master lens system	
0180386A82	Anti-static grounding kit	Used during all radio assembly and disassembly procedures
6684253C72	Straight prober	
6680384A98	Brush	
1010041A86	Solder (RMA type), 63/67, 0.5mm diameter, 1 lb. spool	
0180303E45	SMD tool kit (included with R1319A)	
R1319	ChipMaster (110 V)	Surface mount removal and assembly of surface mounted integrated circuits and/or rework station shields. Includes 5 nozzles.
R1321	ChipMaster (220 V)	
ChipMaster Nozzles:		
6680332E83	PLCC-28* nozzle	Soldering and Un-soldering IC's
6680332E82	PLCC-44* nozzle	
6680332E94	PLCC-52 nozzle	
6680332E96	PLCC-84 nozzle	
6680334E67	QFP-160 nozzle	
6680333E46	SOL-18 nozzle	
6680332E84	SOIC-20 nozzle	
6680332E87	SOL-20J nozzle	
6680333E45	SOL-24 nozzle	
6680333E55	TSOP-64 nozzle	

* Included with ChipMaster packages

Programming/Test Cable

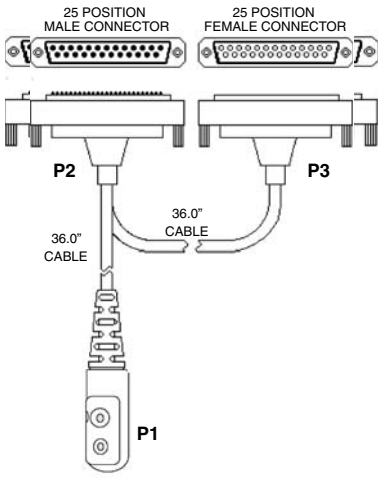


Figure 1-1. Programming/Test Cable

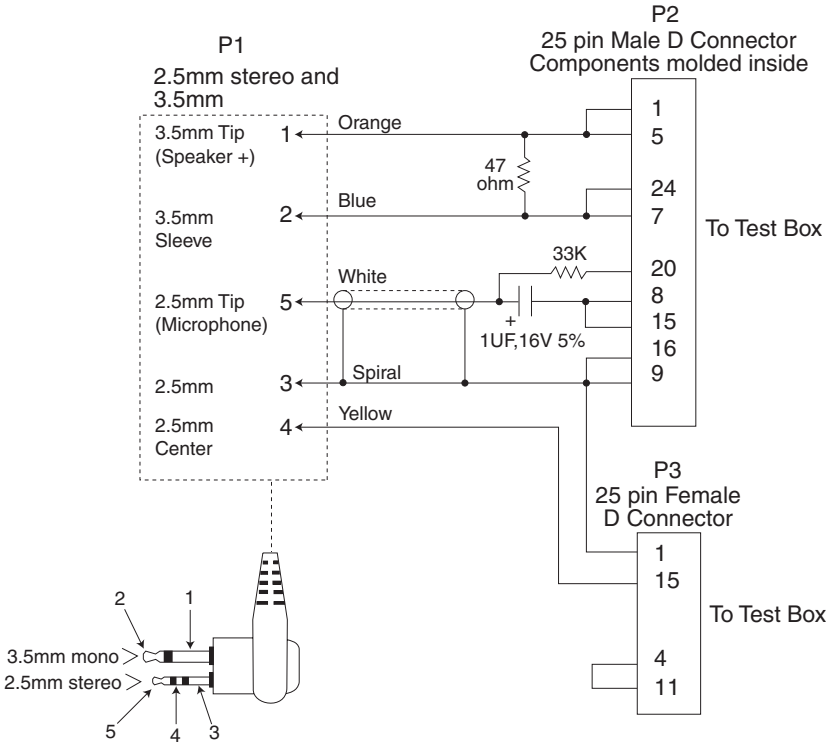


Figure 1-2. Wiring of the Connectors

Chapter 2 DC Power Distribution

2.1 DC Regulation and Distribution

A block diagram of the DC power distribution throughout the radio is shown in Figure 2-1.

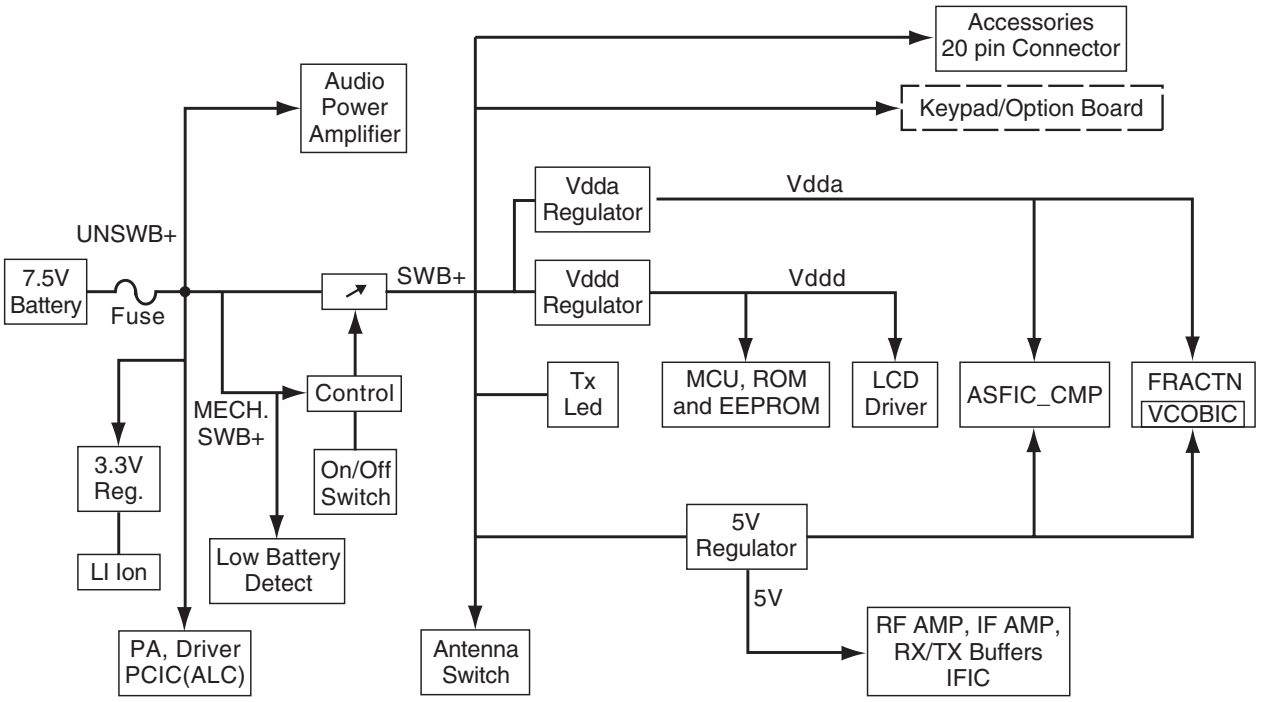


Figure 2-1. DC Power Distribution Block Diagram

Battery voltage enters at connector J301 and is routed through fuse F301 to become USWB+. VR301 protects against ESD, and D301 provides reverse polarity protection. This voltage is routed to:

- FET switch Q170 in the TX power control circuit (turned on during transmit)
- TX power amplifier module U110 (via R150)
- input pins of regulators U310, U320 and U330
- FET switch Q493 (turned on whenever the radio is on)
- on-off switch S444 (part of on-off-volume control) to become SWB+

When the radio is turned on, SWB+ is present and is applied to:

- transistor switch Q494 (pins 1 and 6) which turns on Q493
- RX audio power amplifier U490
- voltage divider R420/R421 and port PE0, a microprocessor A/D input which measures battery voltage and radio on/off status

The output of FET switch Q493 is applied to the control pins of regulators U310, U320 and U330, turning them on. The following regulators are used:

Table 2-1. Voltage Regulators

Reference No.	Description	Type
U310	5 V Regulator	TK71750S
U320	Digital 3.3 V Regulator	LP2986
U330	3 V Regulator	TK71730S

The 5 V source is applied to:

- RX back end circuitry
- synthesizer super filter input and charge pump supply
- RED/GRN LEDs
- RX audio buffer U510
- portions of ASFIC U451

The 5 V source is also applied to FET switches Q311 and Q312. Q311 is turned on by Q313 when RX_ENA (from U401 pin 49) is high, and supplies the “5R” source to the RF front end stages Q21-Q22, and the VCO RX injection buffer Q280. Q312 is turned on by Q313 when TX_ENA (from U401 pin 50) is high, and supplies the “5T” source to the first transmitter stage Q100.

The digital 3.3 volt source from U320 (D_3.3 V) is applied to:

- microprocessor U401
- EEPROM U402
- S-RAM U403
- flash ROM U404

The 3 V regulated source from U330 is applied to:

- synthesizer IC U201
- VCO/buffer IC U251
- portions of ASFIC U451
- microphone bias circuitry

While the radio is turned on, port PH3 (U401 pin 44) is held high. When the radio is turned off, SWB+ is removed and port PE0 (U401 pin 67) goes low, initiating a power-down routine. Port PH3 (pin 44) remains high, keeping the voltage regulators on via Q493 and Q494, until the operating state of the radio has been stored in EEPROM and other turn-off data functions have been completed. PH3 then goes low, turning off Q494 and Q493, and all regulated voltages are removed.

Chapter 3 Controller Theory of Operation

3.1 Controller

The controller provides the following functions:

- interface with controls and indicators
- serial bus control of major radio circuit blocks
- encoding and/or decoding of selective signaling formats such as PL, DPL, MDC-1200 and QuikCall II
- interface to CPS programming via the microphone connector
- storage of customer-specific information such as channel frequencies, scan lists, and signaling codes
- storage of factory tuning parameters such as transmitter power and deviation, receiver squelch sensitivity, and audio level adjustments
- power-up, power-down and reset routines

Figure 6-3 (VHF) shows the interconnection between the controller and the various other radio blocks. Figure 6-9 show the connections between the following circuit areas which comprise the controller block:

- microprocessor circuitry
- audio circuitry
- DC regulation circuitry (refer to Chapter 2, DC Regulations and Distribution.)
- rotary and pushbutton controls and switches
- option board interface

The majority of the circuitry described below is contained in the (VHF) Microprocessor Circuitry schematic diagrams (Figure 6-10). Portions are also found in the Audio and DC Regulation schematics (Figures 6-11 and 6-12).

3.1.1 Microprocessor Circuitry

The microprocessor circuitry includes microprocessor (U401) and associated EEPROM, S-RAM (not used in EP450 models), and Flash ROM memories. The following memory IC's are used:

Table 3-1. Radio Memory Requirements

Reference No.	Description	Type	Size
U402	Serial EEPROM	AT25128	16K x 8
U403	Static RAM	(not used)	
U404	Flash ROM	AT49LV001N_70 V	128K x 8

3.1.1.1 Memory Usage

Radio operation is controlled by software that is stored in external Flash ROM memory (U404). Radio parameters and customer specific information is stored in external EEPROM (U402). The operating status of the radio is maintained in RAM located within the microprocessor. When the radio is turned off, the operating status of the radio is written to EEPROM before operating voltage is removed from the microprocessor. See section "3.1.1.7 Microprocessor Power-Up, Power-Down and Reset Routine" on page 3-3 for a discussion of the power-down routine.

Parallel communication with U403 and U404 is via:

- address lines A(0)-A(16), from U401 port F ADDR0-ADDR13 and port G XA14-XA16
- data lines D(0)-D(7), from U401 port C DATA0-DATA7
- chip-select for U403, from PH6 (U401 pin 41)
- chip-enable for U404, from PH7 (U401 pin 38)
- output enable for U404, from PA7 (U401 pin 86)
- write-enable for both U403 and U404, from PG7_R/W (U401 pin 4)

Serial communication with U402 is via:

- the SPI bus (see section "3.1.1.3 Serial Bus Control of Circuit Blocks" on page 3-2)
- chip-select for U402, from PD6 (U401 pin 3)

3.1.1.2 Control and Indicator Interface

Ports PI3 and PI4 are outputs which control the top-mounted LED indicator. When PI3 is high, the indicator is red. When PI4 is high, the indicator is green. When both are high, the indicator is amber. When both are low, the indicator is off.

Pressing the side-mounted PTT button (S441) provides a low to port PJ0 (U401 pin 71), which indicates PTT is asserted. Side-mounted option buttons 1 and 2 (S442 and S443) are connected to Ports PJ6 (pin 77) and PJ7 (pin 78), respectively.

3.1.1.3 Serial Bus Control of Circuit Blocks

The microprocessor communicates with other circuit blocks via a SPI (serial peripheral interface) bus using ports PD2 (data into uP), PD3 (data out of uP) and PD4 (clock). The signal names and microprocessor ports are defined in Table 3-2.

Table 3-2. SPI Bus Signal Definitions

Signal Name	Microprocessor Port	Microprocessor Pin
SPI-DATA_IN	PD2-MISO	U401 Pin 99
SPI_DATA_OUT	PD3-MOSI	U401 pin 100
SPI_CLK	PD4-SCK	U401 pin 1

These signals are routed to:

- the audio filter IC (U451) to control internal functions such as gain change between 25 kHz and 12.5 kHz channels, transmit or receive mode, volume adjustment, etc.
- the synthesizer IC U201 to load receive and transmit channel frequencies
- option board connector J460-1 for internal option configuration and control
- serial EEPROM U402 (both SPI_DATA_IN and SPI_DATA_OUT are used).

In order for each circuit block to respond only to the data intended for it, each peripheral has its own chip select (or chip enable) line. The device will only respond to data when its enable line is pulled low by one of the microprocessor ports, as follows:

- port PD5 (U401 pin 2) for the audio filter IC
- port PH0 (U401 pin 47) for the synthesizer IC
- port PH4 (U401 pin 43) for the option board/display enable
- port PD6 (U401 pin 3) for the serial EEPROM.

3.1.1.4 Interface to RSS Programming

The radio can be programmed, or the programmed information can be read, using a computer with CPS (Customer Programming Software) connected to the radio via a RIB (radio interface box) or with the RIB-less cable. Connection to the radio is made via the microphone connector (part of accessory connector J471). The SCI line connects the programming contact (J471 pin 6) to ports PD0_RXD (data into uP, pin 97) and PD1_TXD (data out of uP, pin 98). Transistor Q410 isolates the input and output functions by allowing PD1 to pull the line low, but does not affect incoming data from being read by port PD0. This isolation allows high-speed 2-wire programming via TP401 and TP402 for factory programming and tuning.

3.1.1.5 Storage of Customer-Specific Information

Information that has been programmed using CPS, such as channel frequencies or selective signaling codes, are stored in the external EEPROM, where it is retained permanently (unless reprogrammed) without needing DC power applied to the microprocessor.

3.1.1.6 Sensing of Externally-Connected Accessories

Port PJ1 is used to detect the presence of externally connected accessories. Port PJ1 (U401 pin 72) is normally low, unless accessories (lapel speaker microphone, lightweight headset, etc.) are used with the radio. This port is used to detect an accessory PTT or auto sensing of a VOX accessory.

If VOX is programmed into the radio channel codeplug information, and PJ1 is high during power-up, the radio will activate VOX operation. If a low is present at port PJ1 during power-up, the radio will use this port as an external PTT indicator.

3.1.1.7 Microprocessor Power-Up, Power-Down and Reset Routine

On power-up, the microprocessor is held in reset until the digital 3.3 V regulator (U320 pin 5) provides a stable supply voltage. Once the digital supply reaches steady state and releases the reset line (U320 pin 7), the microprocessor begins to start up. The ASFIC_CMP (U451) has already started running and is providing the startup clock to the microprocessor. After reset release by all circuits, the software within the microprocessor begins executing port assignments, RAM checking, and initialization. A fixed delay of 100 ms is added to allow the audio circuitry to settle. Next, an alert beep is generated and the steady state software begins to execute (buttons are read, radio circuits are controlled).

When the radio is turned off, SWB+ is removed and port PE0 (U401 pin 67) goes low, initiating a power-down routine. Port PH3 (pin 44) remains high, keeping the voltage regulators on via Q493 and Q494, until the operating state of the radio has been stored in EEPROM. PH3 then goes low, and all regulated voltages are removed.

The microprocessor reset line (pin 94) can be controlled directly by the digital 3.3 V regulator (U320 pin 7), the microphone jack (part of accessory connector J471) via Q472 and Q471, and the microprocessor itself. U320 pulls the reset line low if the digital 3.3 V source loses regulation. This prevents possible MOS latch-up or overwriting of registers in the microprocessor because the reset line is higher in voltage than the microprocessor VDD ports (U401 pins 12, 39, 59, 88). The microprocessor can drive the reset line low if it detects a fault condition such as an expired watchdog timer, software attempting to execute an infinite loop, unplanned hardware inputs, static discharge, etc. Finally, the Q471 can pull the reset line low during use of the programming cable and CPS by the application of a sufficiently negative voltage to the microphone connector tip contact (J471 pin 4), however this reset method is not utilized.

3.1.1.8 Boot Mode Control

When power-up reset occurs, the microprocessor will boot into either normal or flash mode depending on the logic level of ports MODA (U401 pin 58) and MODB (pin 57). The Flash Adapter is a programming accessory which provides negative 9 volts dc via a 1K resistor to microphone connector J471 pin 4. This turns on Q471 and Q472 via D471 and VR472, pulling MODA and MODB low and allowing booting in the flash mode by cycling power to reset the radio. Software upgrades can then performed by loading the new software code into Flash ROM U404.

3.1.1.9 Microprocessor 7.3975 MHz Clock

The 7.3975 MHz clock signal (uP_CLK) is provided from the ASFIC_CMP (U451 pin 28). Upon startup the 16.8MHz crystal provides the signal to the ASFIC_CMP, which sends out the uP_CLK at 3.8MHz until a steady-state condition is reached and the clock is increased to 7.3975MHz for the microprocessor.

3.1.1.10 Battery Gauge

Various battery types are available having different capacities. The different battery types contain internal resistors connected from the BATT_CHARGE contact to ground (which is routed to the microprocessor as BATT_DETECT). A voltage divider is formed with R255 producing a different DC voltage for each battery type, which is read by microprocessor port PE2 (pin 65). This allows the software to recognize the battery chemistry being used and adjust the battery gauge for best accuracy.

3.1.2 Audio Circuitry

3.1.2.1 Transmit and Receive Low-Level Audio Circuitry

The majority of RX and TX audio processing is performed by U451, the Audio Filter IC (ASFIC_CMP), which provides the following functions:

- Tone PL/Digital PL encode and decode filtering
- Tone PL/Digital PL rejection filter in RX audio path
- TX pre-emphasis amplifier
- TX audio modulation limiter
- Post-limiter (splatter) filter
- TX deviation adjust (digitally-controlled attenuators)
- Programmable microphone gain attenuator
- RX audio volume control (digitally controlled attenuator)
- Carrier squelch adjustment (digitally controlled attenuator)
- Microprocessor output port expansion

- 2.5 volt dc reference source
- Microprocessor clock generation (from the 16.8 MHz reference oscillator input)

The parameters of U451 that are programmable are selected by the microprocessor via the CLOCK (U451 pin 21), DATA (U451 pin 22) and chip enable (U451 pin 20) lines.

RX audio buffer U510 amplifies the audio level from the DEMOD output of the IFIC before being applied to the audio filter IC input (DISC, U451 pin 2). The buffer is DC coupled to avoid corruption of low-frequency data waveforms such as DPL. Because such waveforms are polarity sensitive, this buffer is configured as a single-stage inverting amplifier (U510-1 only) for VHF models where high-side first injection is used, or is configured as a two-stage non-inverting amplifier (U510-1 and -2) for UHF models using low-side first injection. The gain of the buffer is 1.5 times or 3.5 dB.

Volume adjustment is performed by a digital attenuator within U451. The volume control (10KO, part of S444) is connected to D_3.3 V and ground via R506 and R507. When the volume control is rotated, it varies the dc voltage applied to microprocessor A/D input port PE1 (U401 pin 66) between approximately 0 volts dc at minimum volume to 3.3 volts dc at maximum volume. Depending on this voltage, the appropriate setting of the digital volume attenuator is selected. This technique is less susceptible to noise than a conventional analog volume control.

3.1.2.2 Audio Power Amplifier

The audio power amplifier IC U490 amplifies receiver audio from U451 pin 41 to a level sufficient to drive a loudspeaker. U490 is a bridge amplifier delivering 3.46 volts rms between pins 5 and 8 without distortion, which is sufficient to develop 500 milliwatts of audio power into the internal 24 ohm speaker or an external 24 ohm load. The audio power amplifier is muted whenever speaker audio is not required to reduce current drain. The audio amp is muted when U451 pin 14 is low. When U451 pin 14 is high, U490 pin 1 is pulled low by Q490, enabling the audio amplifier.

Because the power amplifier is a bridge-type, neither speaker terminal is grounded. Care should be taken that any test equipment used to measure the speaker audio voltage does not ground either speaker output terminal, otherwise damage to the audio power amplifier IC may result. When a 24-ohm load resistor is used it should be connected between the tip and the sleeve of accessory jack J471 (3.5mm port), never to ground. External SPKR plug insertion mechanically disconnects the internal speaker. Voltage measurements using test equipment that is not isolated from ground may be made from one side of the speaker or load resistor (either the tip or the sleeve of J471) to chassis ground, in which case the voltage indicated will be one half of the voltage applied to the speaker or load resistor. The Motorola RLN4460 Portable Test Set and AAPMKN4004 Programming Test Cable provide the proper interface between the radio's ungrounded audio output and ground-referenced test equipment.

3.1.2.3 Internal Microphone Audio Voice Path

Microphone audio from internal microphone is routed from J470-1 via C475, L471, and C470 to the ASFIC_CMP mic audio input (MICINT, U451 pin 46). During transmit, Q470 is turned on by a low at U451 pin 35, providing dc bias for the internal MIC via R478. External MIC plug insertion mechanically disconnects the internal microphone. External MIC audio is coupled through L471 and C470 to the mic audio input. An input level of 10 mV at J471 pin 4 produces 200 mV at the output of U451 pin 40, which corresponds to 60% deviation.

3.1.2.4 PTT Circuits

The internal side-mounted PTT switch (S441) is sensed directly by microprocessor port PJ0 (U401 pin 71). External mic PTT is sensed by measuring the current drawn through the accessory connector (J471-4) by the mic cartridge (which is in series with the accessory PTT switch). This current is drawn through the base (pin 5) and emitter (pin 4) of a transistor in Q470, causing its collector (pin 3) to supply a logic-high to microprocessor port PJ1 (pin 72).

3.1.2.5 VOX Operation

VOX audio accessories do not have a PTT switch. Instead, the mic cartridge is wired directly from J471-4 to ground. If the radio has been programmed for VOX operation and the VOX accessory is plugged in prior to turning the radio on, the current drawn by the cartridge will turn on Q470 (pins 3-4-5) and a logic high will be seen at port PJ1 at turn-on. The microprocessor then assumes VOX operation, with PTT controlled by the presence of audio at the mic cartridge. A dc voltage proportional to the audio level at the input of the ASFIC_CMP (U451 pin 46) is fed to an A/D input of microprocessor U401 (pin 62). During VOX operation, PTT is activated when the dc level exceeds a preset threshold.

3.1.2.6 Programming and Flashing Through Microphone Jack

The ring contact on the 2.5 mm microphone jack is used for reading, programming or re-flashing the radio using CPS. This contact (J471 pin 6) is routed to ports PD0_RXD (data into uP, pin 97) and PD1_TXD (data out of uP, pin 98). Transistor Q410 isolates the input and output functions by allowing PD1 to pull the line low, but does not affect incoming data from being read by port PD0.

To re-flash the radio (overwrite the software in the Flash ROM with new software), the radio must power up in the boot mode. This is accomplished by using a flash adapter accessory, which provides SCI communication with the programming ring contact (J471 pin 6) and also allows a negative voltage (negative 9 volts dc via a 1K resistor) to be applied to the tip contact (J471 pin 4). This voltage is sufficient to turn on the base-emitter junction (pins 1 and 2) of Q472 via L471, D471, VR472 and R471. Pin 6 of Q472 goes high, turning on Q471 (pins 3 and 4) and pulling the BOOT_ENA line (ports MODA and MODB of the microprocessor) low. Cycling power generates a reset which causes the radio to boot in the flash mode.

Chapter 4 VHF Theory Of Operation

4.1 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 6 of this manual.

4.2 VHF Receiver

The VHF receiver covers the range of 146-174 MHz and provides switchable IF bandwidth for use with 12.5 kHz or 20/25 kHz channel spacing systems. The receiver is divided into two major blocks as shown in Figure 4-1.

- Front End
- Back End

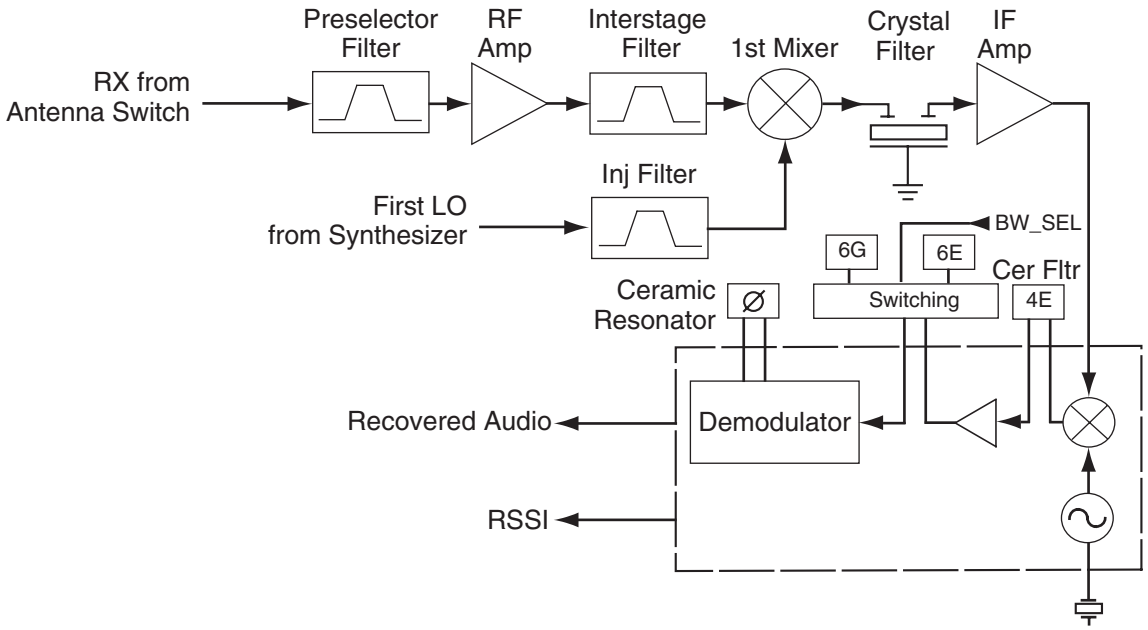


Figure 4-1. VHF Receiver Block Diagram

4.2.1 Receiver Front-End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 4-pole design using discrete elements (L1-L4 and C1-C9) in a series/shunt resonator configuration. It has a 3 dB bandwidth of 44 MHz, an insertion loss of 2 dB and image attenuation of 40 dB at 235 MHz, with increasing attenuation at higher frequencies. Diode CR1 protects the RF amplifier by limiting excessive RF levels.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 2 dB. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21

constant at 6.2 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 3-pole series-coupled resonator design having a 3 dB bandwidth of 58 MHz and insertion loss of 1.8 dB. This filter has an image rejection of 42 dB at 235 MHz, with increasing attenuation at higher frequencies.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7 dB. High-side injection from the frequency synthesizer is filtered by L40-L41 and C40-C44 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 52 MHz and an insertion loss of 1.5 dB. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies

4.2.2 Receiver Back-End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of + 6.7 kHz, a maximum 20 dB bandwidth of ±12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

	FL52	FL53	FL54
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

4.3 VHF Transmitter

The VHF transmitter covers the range of 146-174 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (5 watts) and low power (1 watt). The transmitter is divided into four major blocks as shown in Figure 4-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control

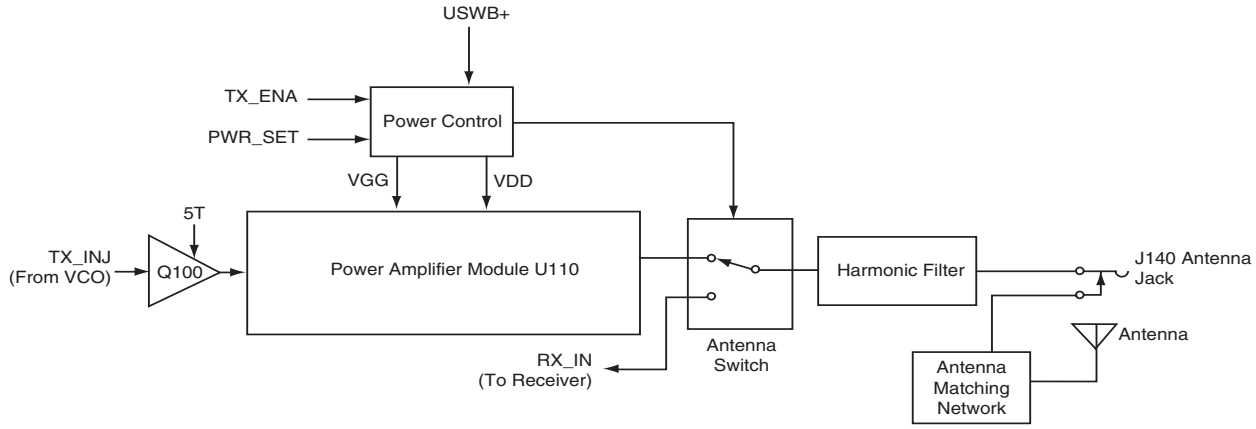


Figure 4-2. VHF Transmitter Block Diagram

4.3.1 Transmit Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class AB from the 5T source. It provides 13 dB of gain and an output of 20 mW. The current drain is typically 25mA. Components C105-C107 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

4.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 50 mA, set by R120-R122. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at VHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

4.3.3 Harmonic Filter

The harmonic filter consists of components C130-C136 and L130-L132. The harmonic filter is a seven-pole elliptical low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 210 MHz and typically less than 0.8 dB insertion loss in the passband.

4.3.4 Antenna Matching Network

The harmonic filter presents a 50 Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

4.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

4.4 VHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 4-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 4-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 4-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT, SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

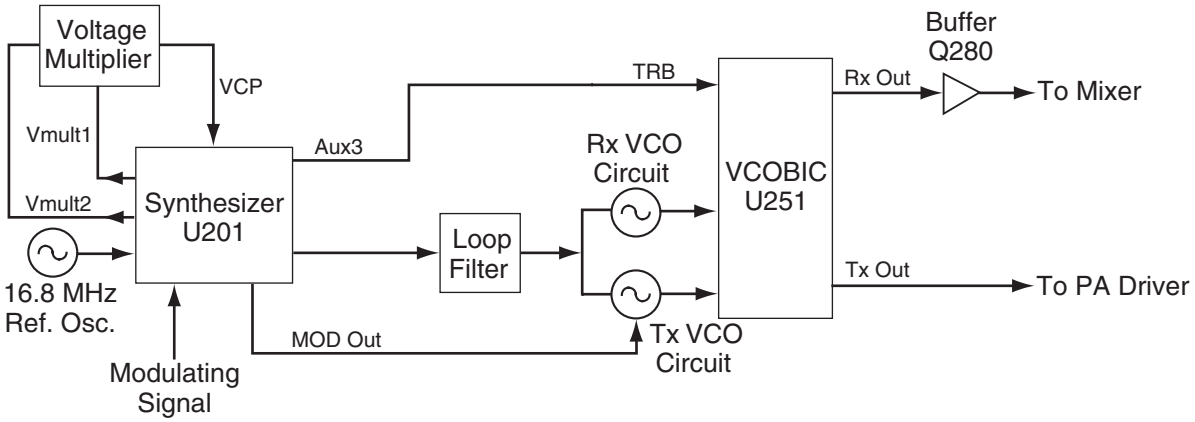


Figure 4-3. VHF Frequency Generation Unit Block Diagram

4.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 4-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60 °C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

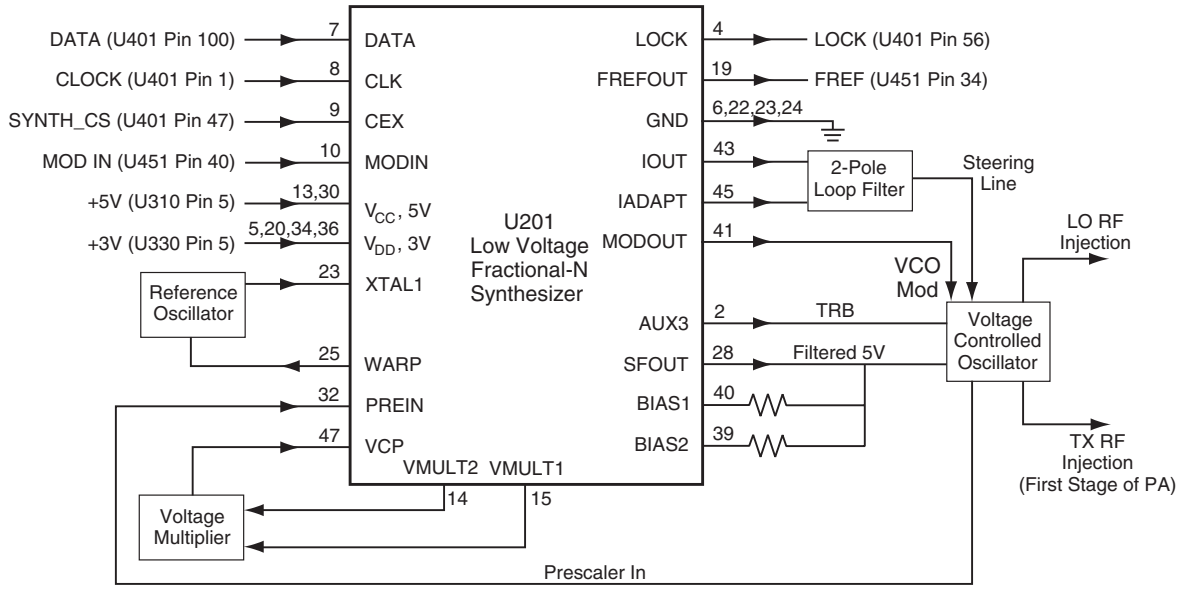


Figure 4-4. VHF Synthesizer Block Diagram

4.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 4-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3 V and 9 V. L251 and C251 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 190.85 to 218.85 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 146-174 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D262. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D261 which modulates the transmit VCO.

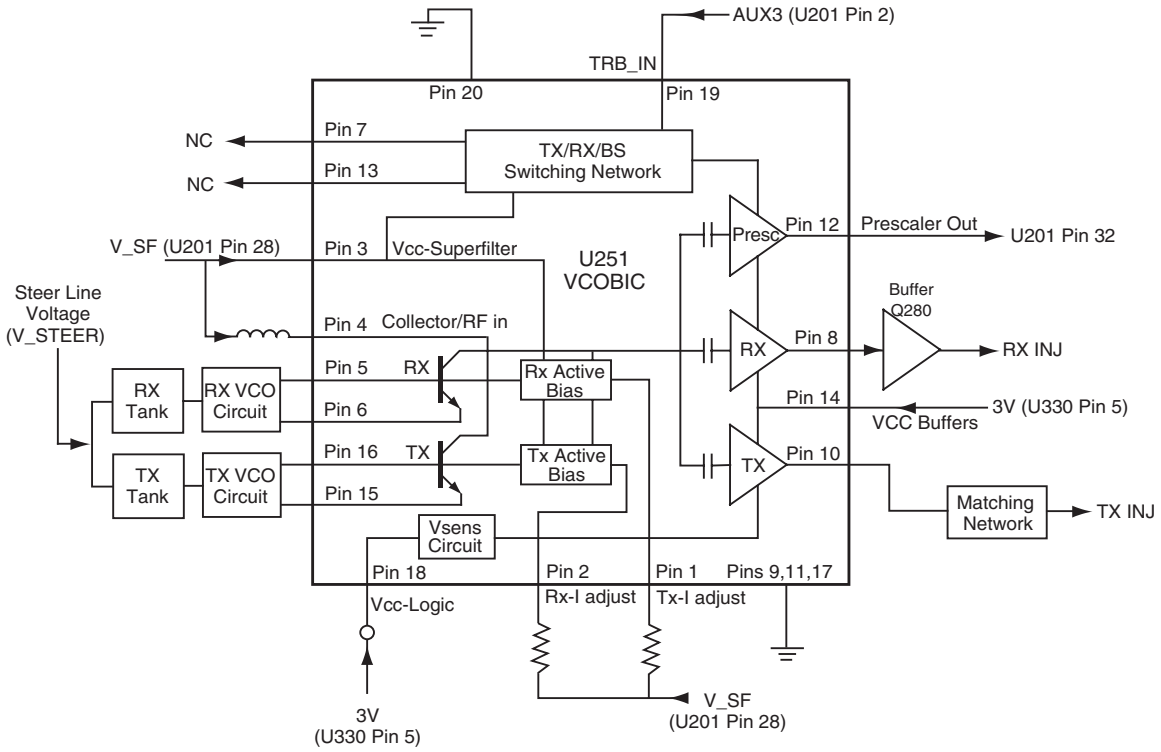


Figure 4-5. VHF VCO Block Diagram

4.5 Keypad

The keypad block diagram is shown in Figure 4-6. Pressing a key creates two distinct voltages KEYPAD_ROW and KEYPAD_COL. These voltages are sent directly to the radio's microprocessor on the main board. The microprocessor then interprets the voltage for KEYPAD_ROW and KEYPAD_COL for each key press.

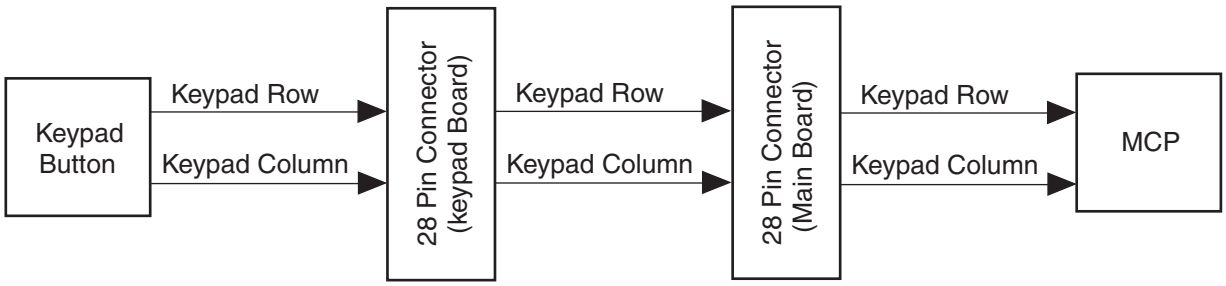


Figure 4-6. Keypad Block Diagram

Notes:

Chapter 5 VHF Troubleshooting Tables

5.1 Troubleshooting Table for Receiver

Table 5-1. Troubleshooting Table for Receiver

Symptom	Possible Causes	Procedure	Corrective Action
Radio Dead (no turn-on beep, no LED indication)	1. Battery dead or defective.	Substitute known good battery or battery eliminator.	Charge or replace battery.
	2. Defective battery contacts.	Inspect battery contacts for corrosion or bent terminals.	Clean/repair/replace J301.
	3. Blown fuse	Check voltage on each side of fuse. If blown, 0 VDC after fuse.	Check for short on output, check D301, VR301, troubleshoot/repair as needed, replace fuse.
	4. DC switching fault	Verify battery voltage present at S444 pin 5 when radio is on. Verify Q494-1 is at least 1 V dc, Q494-6 is ~0.1 V dc, Q493-3 is at Vbatt.	Check/replace on-off-volume control S444. Troubleshoot/replace Q493/4.
	5. Microprocessor not starting up.	Verify clock input to U401-90 (EXTAL) is 7.3975 MHz using high impedance probe. If clock is 3.8 MHz, check for shorts on U401 pins. Connect RIB to verify communication via CPS. Verify U401-94 (RESET) is high.	Verify 16.8 MHz signal at U451-34. If OK, troubleshoot/replace U451. If not present, troubleshoot U201 Synthesizer. Reprogram/reflash as needed. If RESET is Low, troubleshoot regulator U320. Check for shorts at U401 pins. Replace U401. Reprogram as needed.
	6. Regulator fault	Verify U310-5 is 5 V dc, U320-5 is 3.3 V dc, U330-5 is 3 V dc.	Check for shorts on outputs, troubleshoot/repair as needed, replace faulty regulator.

Table 5-1. Troubleshooting Table for Receiver (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
No Audio	1. Synthesizer out of lock	Verify U201-4 is at 3 V dc.	Troubleshoot synthesizer/VCO circuits.
	2. Defective IFIC	Verify audio is present at U51-8.	Check Q70, Y70, U51.
	3. RX audio buffer fault	Verify audio is present at U451-2.	Check U510 and associated parts.
	4. ASFIC fault	Verify audio is present at U451-41. Verify U451-14 is high.	Check squelch setting, PL/DPL programming. Troubleshoot/ replace U451.
	5. Audio PA fault	Verify U490-1 is <0.2 V dc. Verify audio is present at U490-5 and 8.	Check Q490. Check/replace U490.
	6. Defective speaker	Verify audio is present at speaker terminals.	If not, check continuity of J471-2 and 3. Check J491. If yes, replace speaker.
No Receive (squelch noise present)	1. No first injection	Check that RF level at T42-6 is approx +6 dBm. Check that RF level at U251-8 is at least -8 dBm.	Check injection filter C40-44, L40-41. If yes, check Q280 and associated parts. If no, check U251 and components on pins 5 and 6.
	2. No 5R source.	Verify U401-49 is high in RX. Verify Q311 gate is 0 V dc in RX Verify Q311 drain is 5 V dc in RX.	Check/replace U401 Check/replace Q313. Check for shorts, check/replace Q311.
	3. Harmonic filter or antenna switch fault	Apply on-channel 100 mV RF signal at antenna port. Verify RF level at jct. C1/C2 per schematic.	Check TX harmonic filter, D120-121. Should be 0 V dc on D120-121.
	4. Back end fault	Apply on-channel 100 mV RF signal at antenna port. Measure RF levels from FL51 through U51.	Check components prior to loss-of-signal point.
	5. No second injection	Measure RF level at U51-3, verify approx. 280 mV rms.	If dc voltages at U51-3 and 4 are OK, check Y51 and associated parts. If not replace U51.

5.2 Troubleshooting Table for Synthesizer

Table 5-2. Troubleshooting Table for Synthesizer

Symptom	Possible Causes	Procedure	Corrective Action
Synthesizer Out of Lock (RX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pin 2 through 6 and 10 per Table 5-4. Verify steering line voltage is between ~3 V and 10 V.	Check VCO tank components connected to U251-5 and 6. Check for shorts/opens, replace U251. Check D251 and associated components.
	2. Synthesizer fault	Verify TRB line (from U201-2 to U251-19) is low in RX mode	Check for shorts, check U201 voltages per Table 5-4, replace U201 if incorrect.
	3. Programming fault	Verify RX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (TX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pins 1,3,4,10,15,16 per Table 5-4. Verify steering line voltage is between ~3 V and 10 V.	Check VCO tank components connected to U251-15 and 16. Check for shorts/opens, replace U251. Check D261 and associated components.
	2. Synthesizer fault	Verify TRB line (U201-2 to U251-19) is high (3 V) in TX mode	Check for shorts, check U201 voltages per Table 5-4, replace U201 if incorrect.
	3. Programming fault	Verify TX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (RX and TX modes)	1. VCO fault	Check that RF level at U251-12 is at least 150 mV (VHF) or -12 to -20 dBm (UHF)	If low/missing, check L276, C276-7, R276.
	2. Synthesizer fault	Check that RF level at U201-32 is at least 150 mV (VHF) or -12 to -20 dBm (UHF). Verify steering line voltage is between ~3 V and 10 V.	If correct, check/replace U201. If incorrect, check R248 and C241. Check loop filter components R243-5 and C243-5.
	3. DC voltage fault	Verify 4.5 V dc at U201-28. Verify 12.1 V dc at U201-47	Check C231-233, etc., for shorts. If OK check/replace U201. Check for 3 V 1.05 MHz sq waves at U201-14 and 15. Check C218-228, D220-221.
	4. Programming fault	Verify channel programming is correct.	Re-program if necessary.

5.3 Troubleshooting Table for Transmitter

Table 5-3. Troubleshooting Table for Transmitter

Symptom	Possible Causes	Procedure	Corrective Action
No Transmit (no TX LED indication)	1. PTT switch defective.	Verify U401-71 goes low when PTT is pressed.	Replace PTT switch S441.
	2. EXT MIC PTT fault	Verify U401-72 goes low when J471-4 is grounded.	Check/replace Q470, L471 etc.
No Transmit (TX LED indication OK)	1. Synthesizer out of lock	Refer to Table 5-2.	Refer to Table 5-2.
	2. No TX_ENABLE	Verify U401-50 is high when pin 71 or 72 is low.	Check/replace U401.
	3. TX DC switch fault	Verify Q171-C is 0 V in TX. Verify Q170-C is at Vbatt in TX.	Replace Q171. Check for shorts, replace Q170.
	4. Power control fault	Check Q150 and U150 dc voltages per schematic and Table 5-4.	Repair/replace defective components
	5. No TX injection	Check that RF level at jct. R100/R101 per schematic.	Check U251, L291-292, C290-291.
	6. No 5T source	Verify Q312 gate is 0 V dc in TX Verify Q312 drain is 5 V dc in TX.	Check/replace Q313. Check for shorts, check/replace Q312.
	7. TX gain stage failure	Check RF levels at Q100 and U110 per schematic.	Troubleshoot Q100/U110 and associated circuitry.
	8. Antenna switch failure	Verify dc voltage at jct. R122/L120 is approx 1.5 V.	Check/replace D120-121, L120-121, R120-122, etc.

Table 5-3. Troubleshooting Table for Transmitter (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
Low Power	1. Low TX injection	Check that RF level at jct. R100/ R101 per schematic.	Check U251, L291-292, C290-291.
	2. Low gain in TX stage	Verify dc voltage at Q100-E is ~1.3 V (VHF) or ~0.5 V (UHF). Verify that RF level at U110-1 is approx. 1 V (VHF) or 1.6 V (UHF).	Verify 5T voltage is correct. Troubleshoot Q100 circuitry. Troubleshoot Q100 circuitry. Check/replace Q100.
	3. Incorrect control voltage	Verify that the dc voltage at PWR_SET (R162) is approx 1.8 V dc (at 1 watt) to 2.6 V dc (at 4-5 watts). Verify that the dc voltage at U110-2 is approx 2-3 V dc (at 1 watt) to 3-4 V dc (at 4-5 watts). (See schematic.)	Check programming. Troubleshoot controller circuitry. Check/ replace U451. Troubleshoot U150, Q150 and associated circuitry.
	4. Antenna switch defect	Verify dc voltage at jct. R122/L120 (VHF) or R121/L120 (UHF) is approx 1.7 V. *Note: Do not attempt to measure RF or DC voltages at the diodes. Damage to test equipment may occur.*	Check/replace D120-121, L120-121, R120-122, etc.
	5. Harmonic filter defect	Visually inspect components C130-137, L130-132. Check dc continuity of L130-132 *in RX mode only.*	Repair/replace if necessary.
Poor TX range, conducted power OK	1. RF test jack defective	Verify continuity of J140 pins 3 and 4 *in RX mode only.*	Replace J140.
	2. Antenna matching network fault	Visually inspect components C140-141, L140 or L141. Check dc continuity of L140 or L141*in RX mode only.*	Repair/replace if necessary.
	3. Defective or wrong antenna	Verify correct antenna is installed. Try another antenna.	Replace antenna.
No internal mic audio (EXT MIC audio OK)	1. Mic bias fault	Verify U451-35 is low when side PTT is pressed. Verify Q470-6 is high when side PTT button is pressed.	Check/replace U451. Check/replace R474, R476, and Q470.
	2. Defective mic	Verify approx 1.8 V dc across cartridge when side PTT button is pressed. Verify audio present (~10 mV rms) when speaking into mic.	Check mic connector and R478. Replace mic cartridge.
	3. Defective mic jack	Verify continuity between J471 pins 4 and 5.	Replace J471.

Table 5-3. Troubleshooting Table for Transmitter (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
No EXT MIC audio	1. Mic bias fault	Verify approx 1.8 V dc across EXT MIC cartridge in TX mode. Verify audio present (~10 mV rms) when speaking into mic.	Check Q470. R475, R477, L471. Check VR473, VR475, D470 for shorts.
	2. Audio path fault	Verify mic audio present (~10 mV rms) at U451-46. Verify amplified mic audio present (~200 mV rms) at U451-40.	Check L471, C470. Check/replace U451.
	3. Defective audio accessory	Try another accessory.	Replace defective accessory.

5.4 Troubleshooting Table for Board and IC Signals

Table 5-4. Troubleshooting Table for Board and IC Signals

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U51 IFIC	1	RF input 44.85 MHz	1.20	
	2	RF input decoupling	1.20	
	3	2nd LO osc output	4.02	
	4	2nd LO osc input	4.60	
	5	RSSI output	0.74	(no received signal)
	6	Vcc	4.70	
	7	Audio feedback	0.89	
	8	Audio output	1.44	DEMOD to stage U510
	9	RSSI feedback	0.74	(no received signal)
	10	Quad detector input	2.22	
	11	Limiter output	1.25	
	12	Limiter decoupling 2	1.30	
	13	Limiter decoupling 1	1.30	
	14	Limiter input	1.28	
	15	Ground	GND	
	16	IF amp output	1.22	
	17	IF amp decoupling 2	1.26	
	18	IF amp input	1.26	
	19	IF amp decoupling 1	1.26	
	20	2nd mixer output	3.09	
U52 BW Select Switch	1	Inverter 1 input	0	(25 kHz mode)
	2	Inverter 2 output	0	(25 kHz mode)
	3	Inverter 3 input (NU)	GND	
	4	Ground	GND	
	5	Inverter 3 output (NU)	4.96	
	6	Inverter 2 input	3.00	(25 kHz mode)
	7	Inverter 1 output	4.95	(25 kHz mode)
	8	Vcc	4.96	

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U110 RF Power Amp	1	RF input	0	(TX mode)
	2	Vgg (gate bias)	2.65 (typ)	(TX mode) (4.25 V typ at VHF)
	3	Vdd	6.59	(TX mode)
	4	RF output	--	Do not measure
	5	Ground	GND	
U150 Dual Opamp	1	Unit 1 output	4.20 (typ)	(TX mode) (5.8 V typ at VHF)
	2	Unit 1 (-) input	2.39 (typ)	(TX mode)
	3	Unit 1 (+) input	2.39 (typ)	(TX mode)
	4	Ground	GND	
	5	Unit 2 (+) input	3.30 (typ)	(TX mode)
	6	Unit 2 (-) input	3.35 (typ)	(TX mode)
	7	Unit 2 output	2.23 (typ)	(TX mode)
	8	Vcc	6.79	(TX mode)
U201 Freq Synthesizer	1	AUX2 output (NU)	0	
	2	AUX3 output (TRB)	0.03	To U251-19 (RX mode)
	3	AUX4 output (NU)	0	
	4	Lock detect output	2.98	To U401-56
	5	PD Vdd	2.98	
	6	Digital ground	GND	
	7	Serial data input	3.23	
	8	Serial clock input	0	
	9	Synth chip select	3.23	From U401-47
	10	Modulation input	1.50	From U451-40
	11	VMULT4 (NU)	2.98	
	12	VMULT3 (NU)	0	
	13	VRO	4.96	
	14	VMULT2	1.49	
	15	VMULT1	1.49	
	16	INDMULT (NU)	0	
	17	NC1	0	
	18	Ref select (NU)	0	
	19	Buffered 16.8 MHz out	1.54	
	20	Analog Vdd	3.00	
	21	V bypass (NU)	1.55	
	22	Analog ground	GND	
	23	Ref osc XTAL1	2.07	

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U201 Freq Synthesizer	24	Ref osc XTAL2	0	
	25	Ref osc warp output	3.00	
	26	Superfilter cap	4.48	
	27	Superfilter base (NU)	3.76	
	28	Superfilter output	4.52	
	29	NC2	0	
	30	Superfilter input	4.96	
	31	NC3	0	
	32	Prescaler input	1.97	
	33	Prescaler ground	GND	
	34	Prescaler Vdd	2.99	
	35	Prescaler Vref (NU)	1.97	
	36	Digital Vdd	2.99	
	37	TEST1 (NU)	0.01	
	38	TEST2 (NU)	0	
	39	Bias 2	3.38 (typ)	(1.34 V in TX mode)
	40	Bias 1	1.50 (typ)	(3.20 V in TX mode)
	41	Modulation output	3.42 (typ)	(1.62 V typ in TX mode)
	42	CCOMP (NU)	0.05	
	43	Steering line IOUT	9.62 (typ)	Depends on frequency
	44	PD ground	GND	
	45	Steering line IADAPT	9.62 (typ)	Depends on frequency
	46	Adapt switch (NU)	0	
	47	Voltage from charge pump	12.8	
	48	AUX1 output (NU)	2.98	
U251 VCO / Buffer	1	TX VCO current adjust	4.50	
	2	RX VCO current adjust	4.35	
	3	Superfiltered input	4.51	
	4	Collector RF in amp	4.35	
	5	RX VCO base	1.27	
	6	RX VCO emitter	0.48	
	7	RX switch output (NU)	0	
	8	RX buffered VCO output	3.36	
	9	GND_FLAG	GND	
	10	TX buffered VCO output	3.36	
	11	GND_BUFFERS	GND	

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U251 VCO / Buffer	12	Prescaler output	2.26	
	13	TX switch output (NU)	0.06	
	14	Vcc_BUFFERS	3.00	
	15	TX VCO emitter	0	(RX mode)
	16	TX VCO base	0	(RX mode)
	17	GND_LOGIC	GND	
	18	Vcc_LOGIC	3.00	
	19	TRB input	0.03	From U201-2 (RX mode)
	20	FLIP input	GND	
U310 5 V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	4.96	
U320 3.3 V Regulator	1	Ground	GND	
	2	Feedback	1.23	
	3	Tap (NU)	0	
	4	Vin	7.48	
	5	Vout	3.23	
	6	Sense (NU)	0	
	7	Error (reset output)	3.20	
	8	Shutdown input	7.48	
U330 3 V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	3.00	
U401 Microprocessor	1	PD4_SCK serial clock input	0	
	2	PD5_SS	3.23	ASFIC chip select
	3	PD6_VLIN	3.23	EEPROM chip select
	4	PG7_R_W	3.21	
	5	PG6_AS	3.23	
	6	PG0_XA13	3.23	
	7	PB7_ADDR15	0.026	
	8	PB6_ADDR14	0.028	
	9	PB3_ADDR11	3.06	

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	10	PB1_ADDR9	3.05	
	11	PB2_ADDR10	0.16	
	12	VDD	3.23	
	13	VSS	GND	
	14	PBO_ADDR8	3.05	
	15	PB5_ADDR13	0.13	
	16	PG1_XA14	0.20	
	17	PG4_XA17	3.17	
	18	PG5_XA18	0	
	19	PG3_XA16	3.21	
	20	PG2_XA15	0.30	
	21	PB4_ADDR12	0.22	
	22	PF7_ADDR7	3.03	
	23	PF6_ADDR6	3.08	
	24	PF5_ADDR5	3.06	
	25	PF4_ADDR4	0.16	
	26	PF3_ADDR3	0.26	
	27	PF2_ADDR2	3.06	
	28	PF1_ADDR1	3.06	
	29	PFO_ADDR0	3.05	
	30	PC0_DATA0	0.69	
	31	PC1_DATA1	0.96	
	32	PC2_DATA2	1.10	
	33	PC3_DATA3	0.81	
	34	PC4_DATA4	0.62	
	35	PC5_DATA5	0.68	
	36	PC6_DATA6	0.67	
	37	PC7_DATA7	0.73	
	38	PH7_CSPROG	3.05	
	39	VDDL	3.23	
	40	VSSL	GND	
	41	PH6_CSGP2	3.23	
	42	PH5_CSGP1	3.23	
	43	PH4_CSIO	0	
	44	PH3_PW4	3.21	On/off control output
	45	PH2_PW3	0	

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	46	PH1_PW2	3.00	
	47	PH0_PW1	3.23	Synth chip select
	48	XIRQ	3.00	
	49	PI7	1.48	RX enable
	50	PI6	0.01	TX enable
	51	PI5	3.23	
	52	PI4	0	Green LED enable
	53	PI3	0	Red LED enable
	54	PI2	0	
	55	PI1	0	
	56	PI0	2.98	Lock detect from U201-4
	57	MODB_VSTBY	3.22	Boot mode enable
	58	MODA_LIR	3.12	
	59	AVDD	3.23	
	60	PE7_AN7	3.20	
	61	PE6_AN6	3.20	
	62	PE5_AN5	2.91	VOX threshold detect
	63	PE4_AN4	0.73	RSSI input
	64	PE3_AN3	0.14	
	65	PE2_AN2	1.62	
	66	PE1_AN1	0 - 3.3 V	Volume control wiper
	67	PE0_AN0	2.48	33% of battery voltage
	68	VRL	0	
	69	VRH	3.20	
	70	AVSS	GND	
	71	PJ0_CSGP3	3.23	Side PTT button
	72	PJ1_CSGP4	0	External MIC PTT
	73	PJ2	3.23	
	74	PJ3	3.23	
	75	PJ4	3.23	
	76	PJ5	0	
	77	PJ6	3.23	Bottom option button
	78	PJ7	3.23	Top option button
	79	PA0_IC3	0	
	80	PA1_IC2	1.57	
	81	PA2_IC1	3.00	

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	82	PA3_IC4_OC5_OC1	3.00	
	83	PA4_OC4_OC1	0	Squelch detect input
	84	PA5_OC3_OC1	0	Channel activity input
	85	PA6_OC2_OC1	0	
	86	PA7_PA1_OC1	0	
	87	VSSR	GND	
	88	VDDR	3.23	
	89	ECLK (NU)	1.60	
	90	EXTAL	1.70	Clock from U451-28
	91	XTAL	1.40	Not used
	92	VDDSYN	0	
	93	XFC (NU)	0	
	94	RESET	3.20	From U320
	95	LVOUT	0	
	96	IRQ	3.20	
	97	PD0_RXD	3.23	
	98	PD1_TXD	1.9	
	99	PD2_MISO	0	
	100	PD3_MOSI	3.23	
U402 EEPROM	1	Chip select	3.23	From U401-3
	2	Serial data out	0	
	3	Write protect	3.23	
	4	Vss	GND	
	5	Serial data in	3.23	
	6	Serial clock	0	
	7	Hold	3.23	
	8	Vcc	3.23	
U404 Flash ROM	1	A11	3.06	
	2	A9	3.08	
	3	A8	3.05	
	4	A13	0.13	
	5	A14	0.31	
	6	NC	3.17	
	7	EN_WE	3.21	From U401-4
	8	Vcc	3.23	
	9	RESET	3.20	

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U404 Flash ROM	10	A16	3.17	
	11	A15	0.30	
	12	A12	0.22	
	13	A7	3.03	
	14	A6	3.08	
	15	A5	3.06	
	16	A4	0	
	17	A3	0.24	
	18	A2	3.08	
	19	A1	3.05	
	20	A0	3.05	
	21	D0	0.69	
	22	D1	0.94	
	23	D2	1.08	
	24	GND	GND	
	25	D3	0.78	
	26	D4	0.59	
	27	D5	0.66	
	28	D6	0.67	
	29	D7	0.75	
	30	EN_CE	3.01	From U401-38
	31	A10	0.16	
	32	EN_OE	0	From U401-86
U451 ASFIC_CMP	1	VDD for analog circuits	3.00	
	2	DISC audio input	1.34	From U510
	3	Ground for analog circuits	GND	
	4	DACU output	0	
	5	DACR output	0	
	6	DACG output	2.38 (typ)	Power set (TX mode)
	7	VOX peak detector output	2.91	
	8	PLCAP for DC integrator	0.40	
	9	SQIN	0.01	
	10	Universal audio input/output	0	
	11	VDD for DACs	4.95	
	12	SQCAP	0	
	13	GCB2 general purpose output	0	Audio PA_EN (unsquelched)

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U451 ASFIC_CMP	14	GCB1 general purpose output	0	
	15	GCB0 general purpose output	3.00	BW select (25 kHz mode)
	16	Squelch channel activity output	0	To U401-84
	17	Squelch detect digital output	0	To U401-83
	18	PL/low speed data I/O	1.50	
	19	High speed data I/O	3.00	
	20	Chip select	3.23	From U401-2
	21	Serial clock input	0	
	22	Serial data input	3.23	
	23	Ground for clock synthesizer	GND	
	24	Loop filter cap for clock syn	0.74	
	25	PLCAP2 for LS integrator	1.17	
	26	Not used	0	
	27	Vdd for clock synthesizer	3.00	
	28	Clock synthesizer output	1.70	
	29	1200 Hz ref for MDC decode	3.00	
	30	GNDDO	GND	
	31	Ground for digital circuits	GND	
	32	Vdd for analog switches	4.96	
	33	Vdd for digital circuits	3.00	
	34	16.8 MHz master clock input	1.54	
	35	GCB3 general purpose output	3.00	Internal MIC enable
	36	TX audio return from option	0	
	37	GCB4 general purpose output	0	
	38	GCB5 general purpose output	0	
	39	RX audio send to option	1.48	
	40	Modulation output	1.50	To U201-10
	41	RX audio out to power amp	1.51	
	42	Flat TX audio return from option	0.20	
	43	RX audio return to option	1.50	
	44	Flat TX audio send to option	1.50	
	45	Vdd for audio path I/O filters	3.00	
	46	Mic audio input	1.50	
	47	Ground for audio path I/O filters	GND	
	48	Ext mic audio input (not used)	0	

Notes:

Table 5-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U480 Dual Opamp	1	Unit 1 output	2.48	
	2	Unit 1 (-) input	2.48	
	3	Unit 1 (+) input	2.46	
	4	Ground	GND	
	5	Unit 2 (+) input	0.28	
	6	Unit 2 (-) input	0.29	
	7	Unit 2 output	0	
	8	Vcc	4.96	
U490 Audio Power Amp	1	Enable/shutdown	0.12	(Unsquelched)
	2	Bias reference	3.26	(Unsquelched)
	3	(+) input	3.26	(Unsquelched)
	4	(-) input	3.27	(Unsquelched)
	5	(-) output	3.25	(Unsquelched)
	6	Vcc	7.48	(Unsquelched)
	7	Ground	GND	
	8	(+) output	3.29	(Unsquelched)
U510 Dual Opamp	1	Unit 1 output	1.75	
	2	Unit 1 (-) input	1.56	
	3	Unit 1 (+) input	1.55	
	4	Ground	GND	
	5	Unit 2 (+) input	1.55	
	6	Unit 2 (-) input	1.56	
	7	Unit 2 output	1.38	
	8	Vcc	4.96	

1. All voltages are measured with a high-impedance digital voltmeter and expressed in volts DC relative to ground (0 V).
2. Voltages are measured with a DC input voltage of 7.50 + .02 volts DC applied to the battery connector (J301).
3. All voltages are measured in the squelched receive mode, unless otherwise indicated.
4. Voltages are identical for VHF and UHF models unless otherwise indicated.

Chapter 6 VHF Schematic Diagrams, Overlays, and Parts Lists

6.1 Introduction

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

6.1.1 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, resistance values are in ohms (K = 1000), capacitance values are in picofarads (pF) or microfarads (µF), and inductance values are in nanohenries (nH) or microhenries (µH).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. If the board has been removed from the chassis, the transmitter module mounting screws may be used for ground connection. (*Note: The antenna nut bracket is not connected to ground.*) Operating mode dependent voltages are followed by (RX) for receive mode, (TX) for transmit mode, (UNSQ) for unsquelched mode, etc.
3. RF voltages on VHF models are measured with a Fluke model 85 RF probe. The indicated voltages expressed in mV (RF) are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
4. RF voltages on UHF models are measured both with a high-impedance RF voltmeter having a bandwidth in excess of 500 MHz (levels are expressed in dBm) and with a Fluke model 85 RF probe [levels are expressed in mV (RF)]. These indicated voltages are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms, and are only approximate for UHF frequency measurements. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
5. Audio voltages are measured with a high-impedance AC rms voltmeter. The indicated voltages are expressed in mV rms. Receive mode voltages are followed by (RX) and are measured with an on-channel signal with 1 kHz modulation at 60% deviation (3 kHz for 25 kHz channels, or 1.5 kHz for 12.5 kHz channels). Transmit mode voltages are followed by (TX) and are measured with a 1 kHz, 10 mV rms signal present at the external microphone input (accessory connector J471 pin 4 hot and pin 7 ground).
6. Reference Designators are assigned in the following manner:

Ref. No. Series	Circuit Block
1-99	RF Front End
100-149	Transmitter RF Stages
150-200	Transmitter Power Control
201-250	Frequency Synthesizer
251-300	VCO

Ref. No. Series	Circuit Block
301-400	DC Regulation
401-450	Microprocessor
451-550	Audio

7. Circuit Block Interconnection Legend:

Name	Description
USWB+	Unswitched Battery Voltage (always on)
5V	5 volts (regulated)
5R	5 volts in RX mode only
5T	5 volts in TX mode only
RESET	Low-line reset signal from U320 to uP
D3_3V	Digital 3.3 volts (regulated)
3V	Analog 3 volts (regulated)
TX_ENA	Transmit enable signal from uP to transmitter
PWR_SET	DC voltage from ASFIC to TX power control
DEMOD	RX audio from backend to ASFIC
BW_SEL	Backend filter BW select from ASFIC
RSSI	RX signal strength indication from IFIC to uP
IF_IN/OUT	44.85 MHz from 1st mixer to high IF filter
RF_IN/OUT	RX signal from antenna switch to front end
MOD OUT/IN	TX modulation from ASFIC to synthesizer
16_8_MHZ	Ref osc signal from synthesizer to ASFIC
SYNTH_CS	Synthesizer chip select from uP
SPI_CLK	Serial clock from uP
SPI_DATA_OUT	Serial data from uP
LOCK	Lock detect indication from synth to uP
PRESC	VCO freq feedback from VCOBIC to synth
V_STEER	Steering line voltage from synth to VCO's
V_SF	Super-filtered 4.5 volts from synth to VCOBIC
VCO_MOD	TX modulation from ASFIC to synthesizer
TRB	TX/RX control from synth to VCOBIC
RX_INJ	Buffered RX VCO output to RX 1st mixer
TX_INJ	TX VCO output to transmitter input

6.1.2 Six Layer Circuit Board

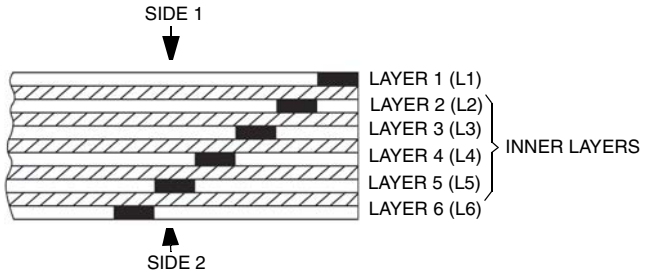


Figure 6-1. Six-Layer Circuit Board: Copper Steps in Layer Sequence

6.2 Speaker and Microphone Schematic

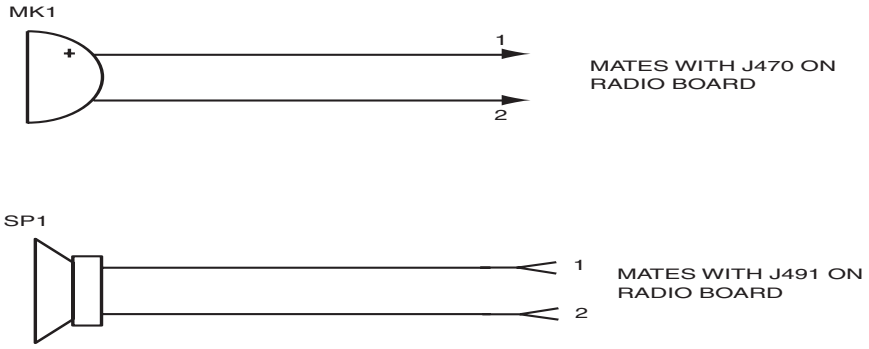


Figure 6-2. Speaker and Microphone Schematic

6.2.1 Speaker and Microphone Parts List

Reference Designator	Motorola Part No.	Description
MK1	5085880L01	Microphone, electret
SP1	5085738Z08	Speaker assembly with connector

Notes:

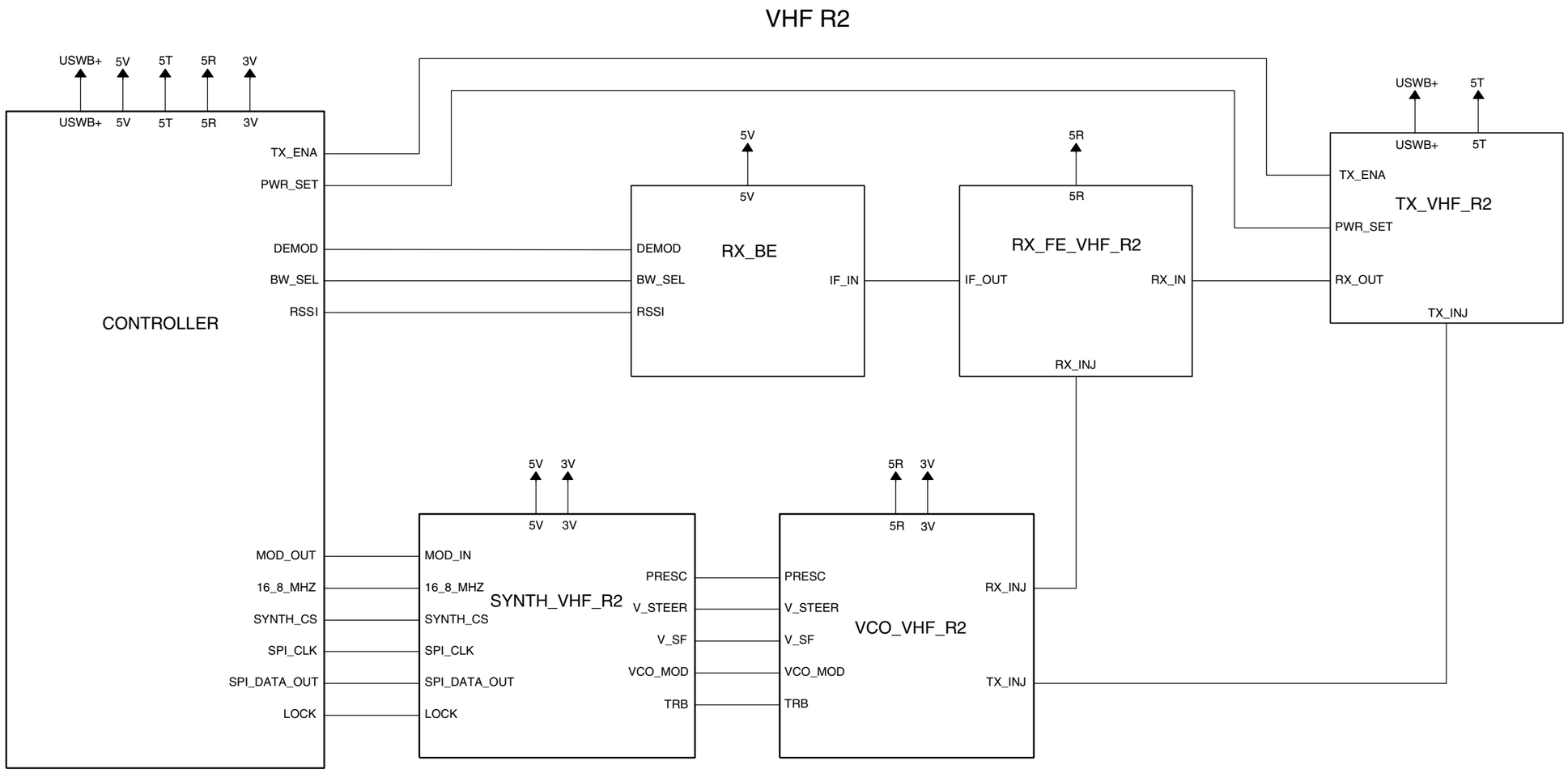


Figure 6-3. VHF (146-174 MHz) Radio Circuit Block Interconnect Diagram

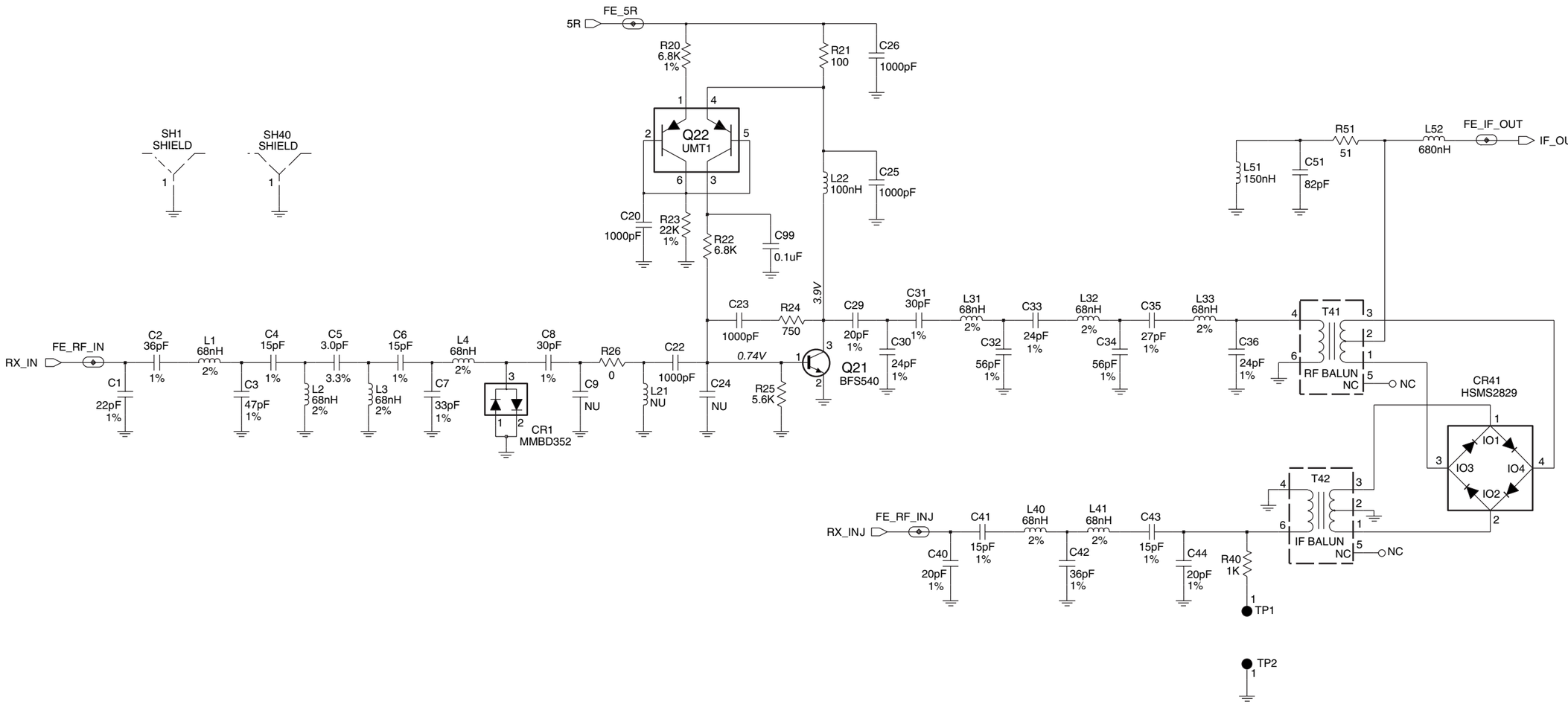


Figure 6-4. VHF (146-174 MHz) PCB 8486342Z13-C Receiver Front End Schematic Diagram

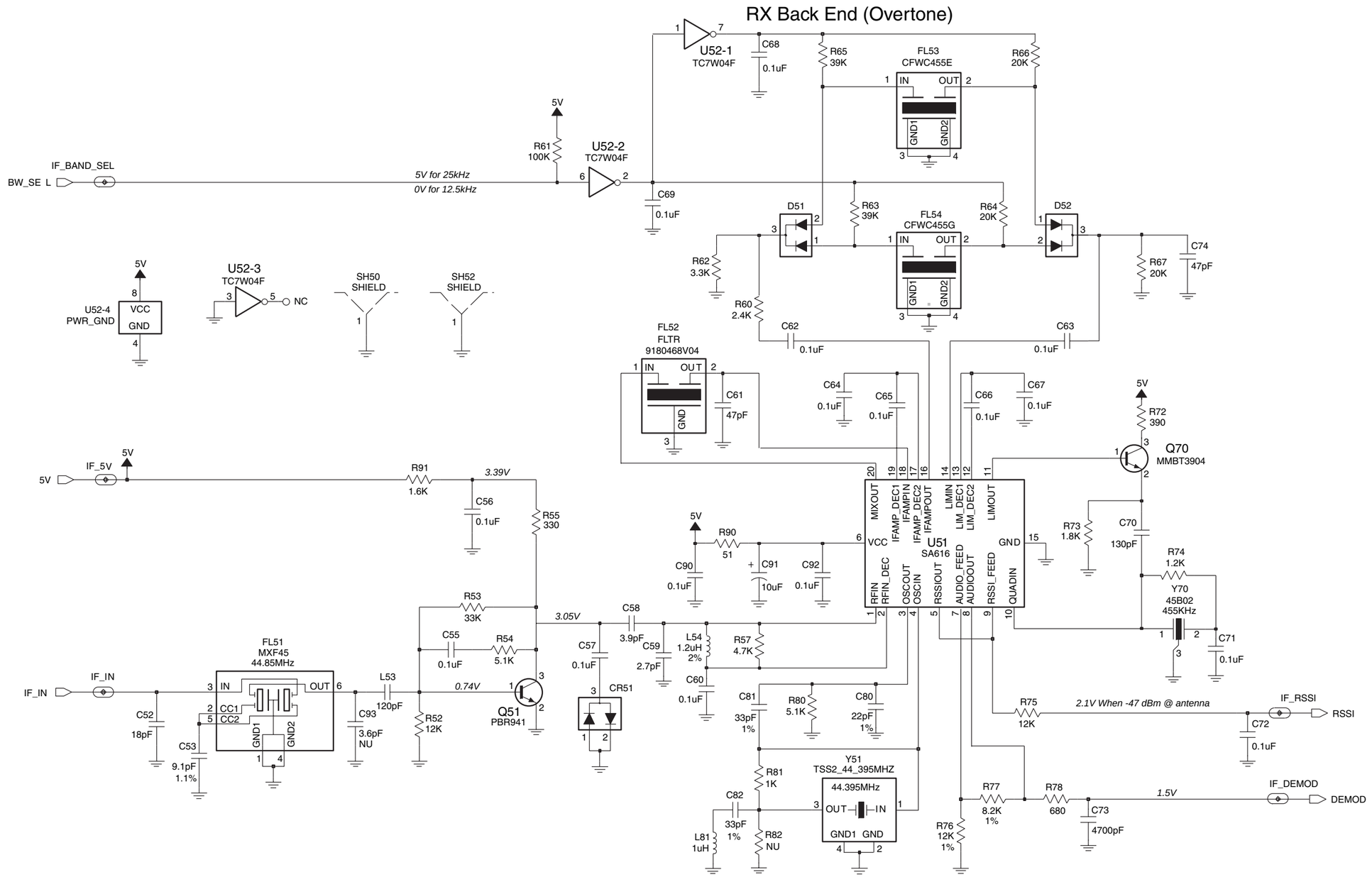
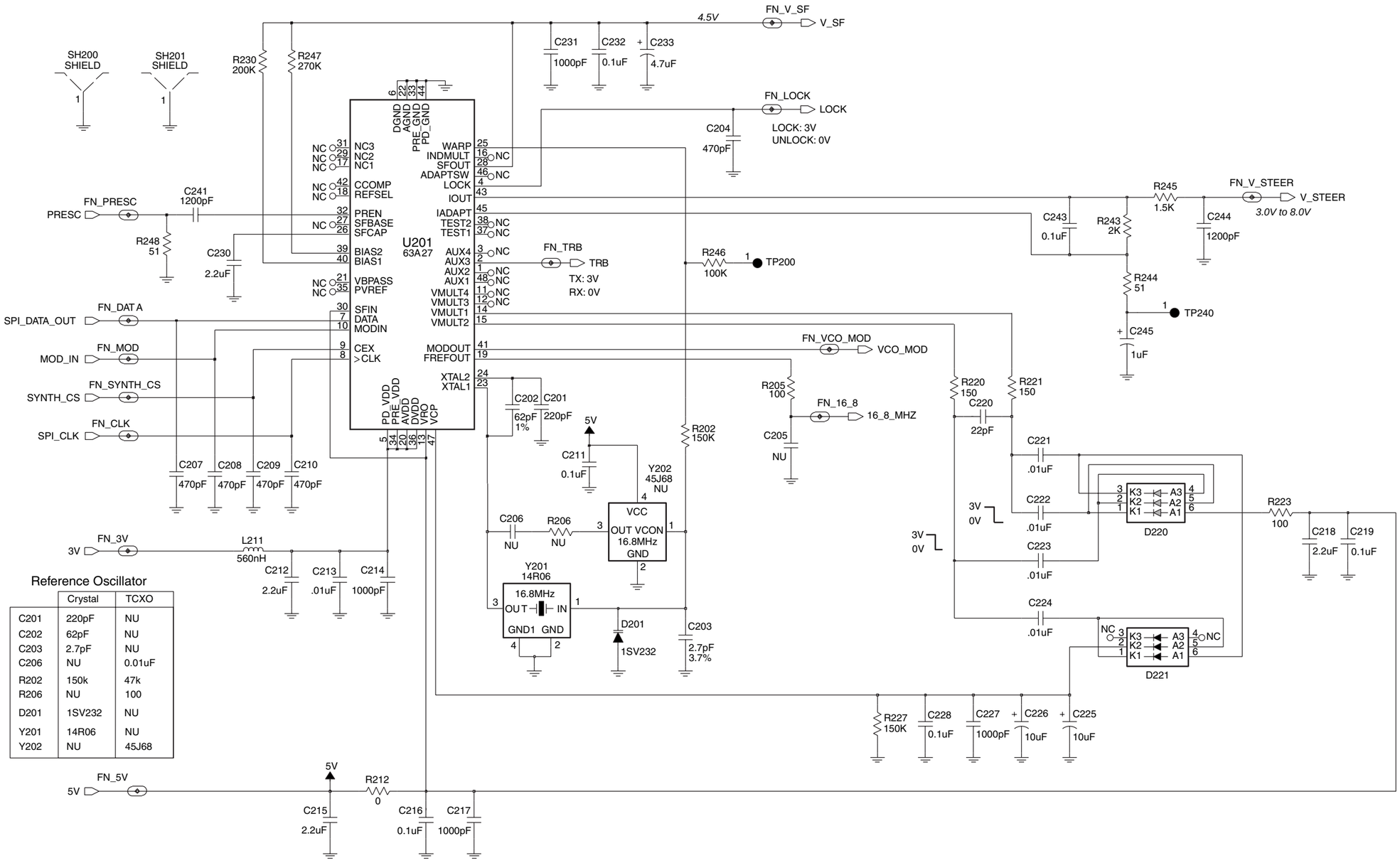


Figure 6-5. VHF (146-174 MHz) Receiver Back End Schematic Diagram

VHF R2 Synthesizer



Reference Oscillator	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 6-6. VHF (146-174 MHz) PCB 8486342Z13-C Synthesizer Schematic Diagram

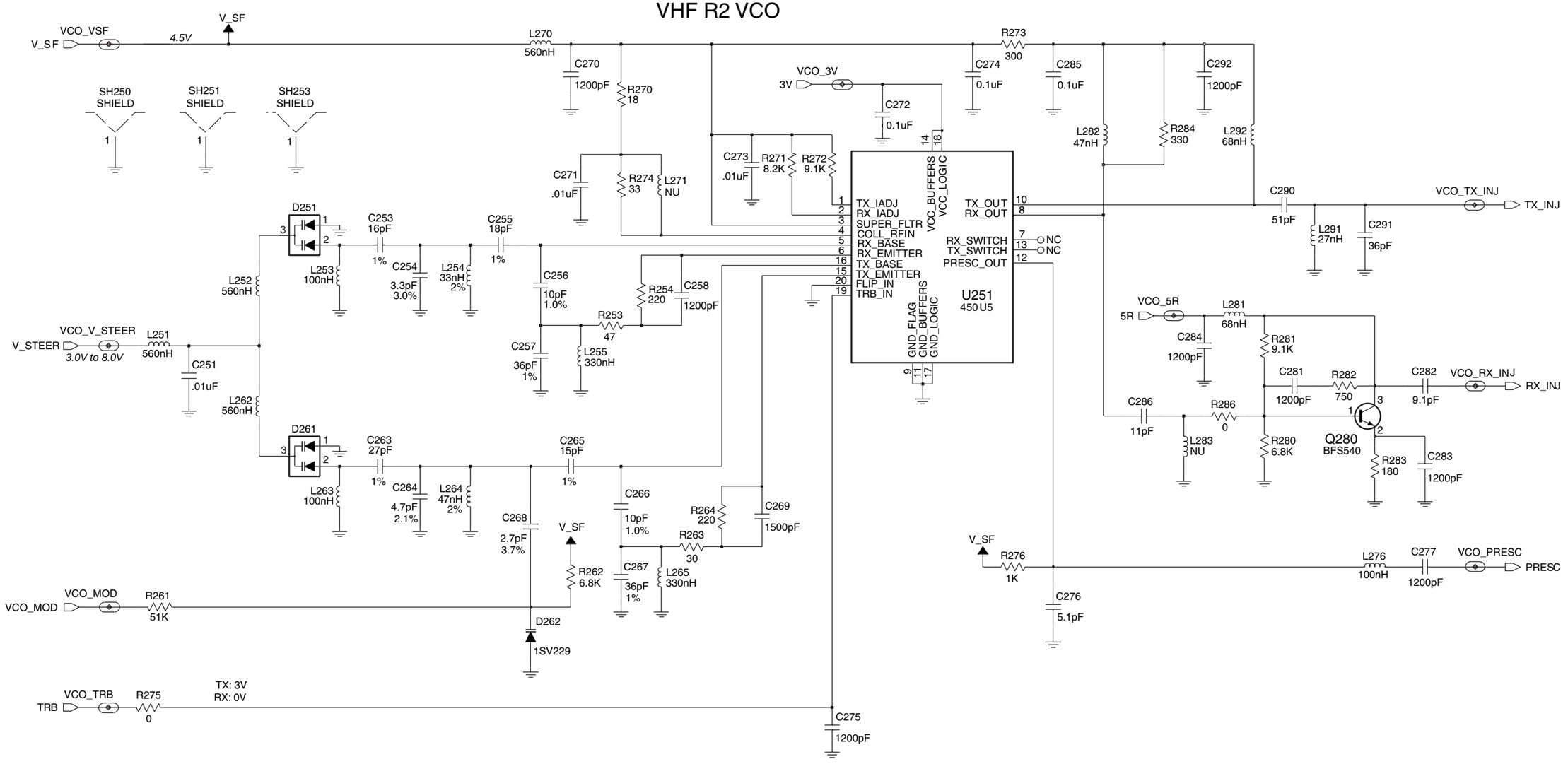


Figure 6-7. VHF (146-174 MHz) Voltage Controlled Oscillator Schematic Diagram

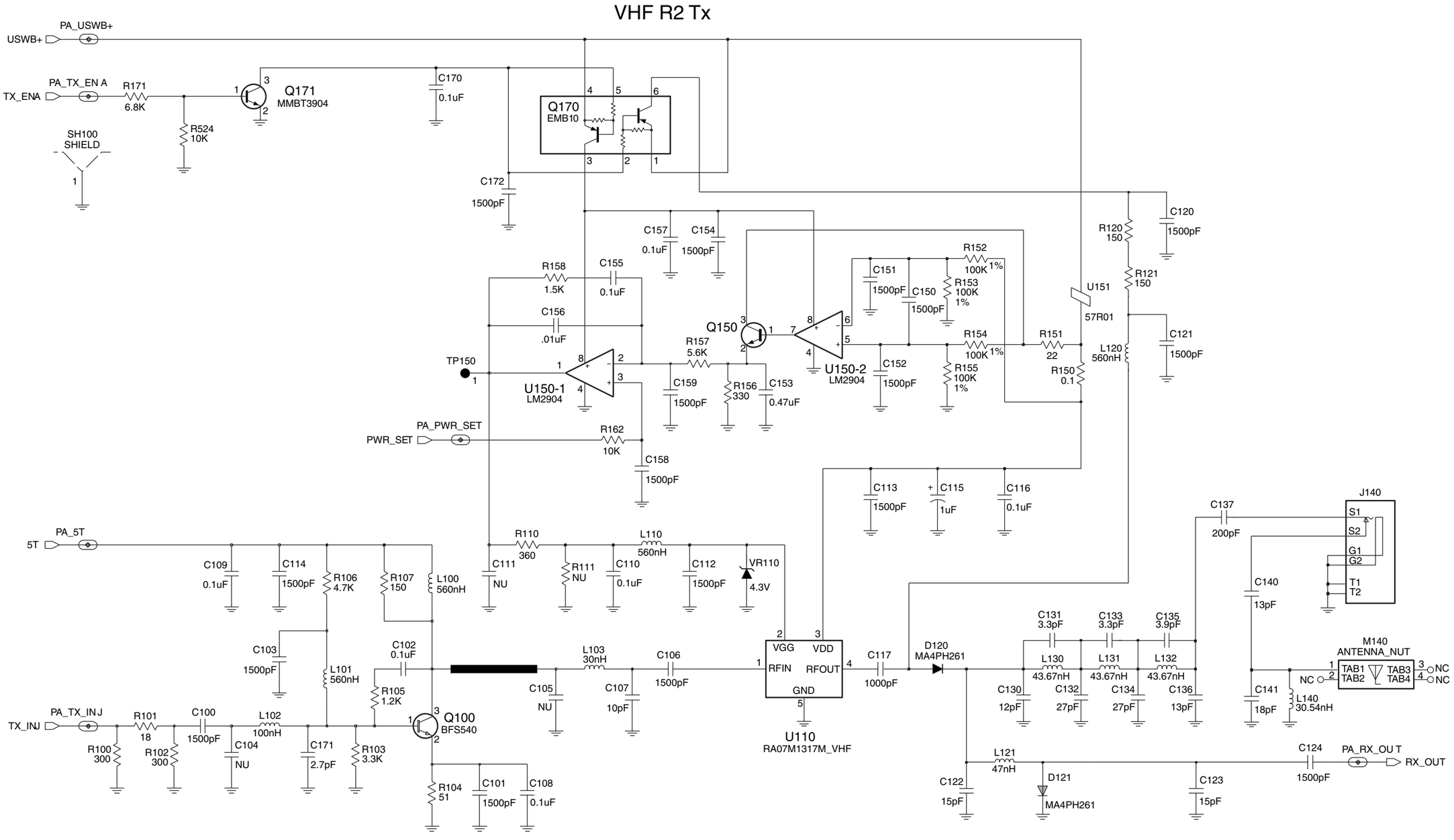


Figure 6-8. VHF (146-174 MHz) PCB 8486342Z13-C Transmitter and Power Control Schematic Diagram

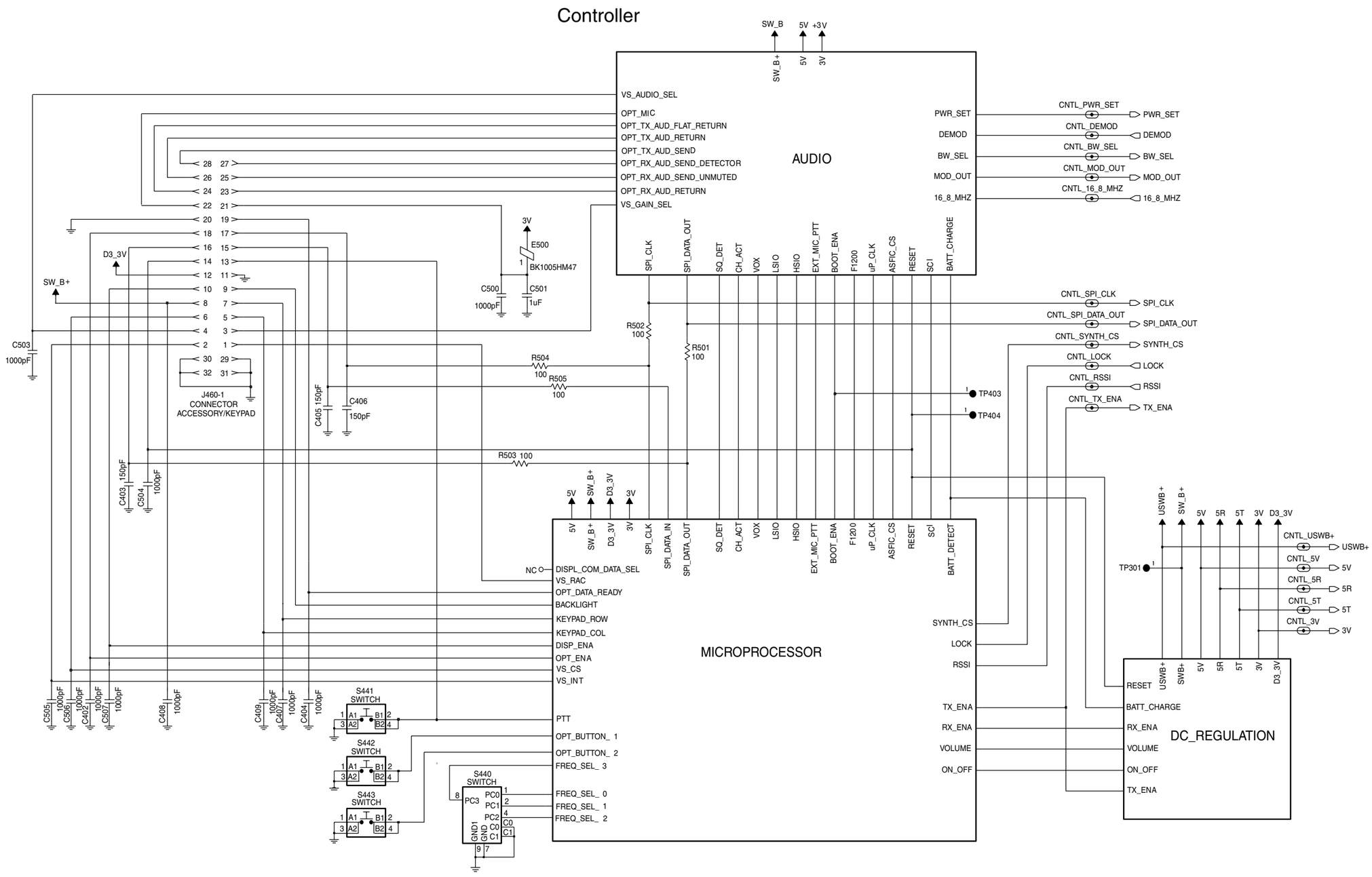


Figure 6-9. VHF (146-174 MHz) Controller Interconnect Schematic Diagram

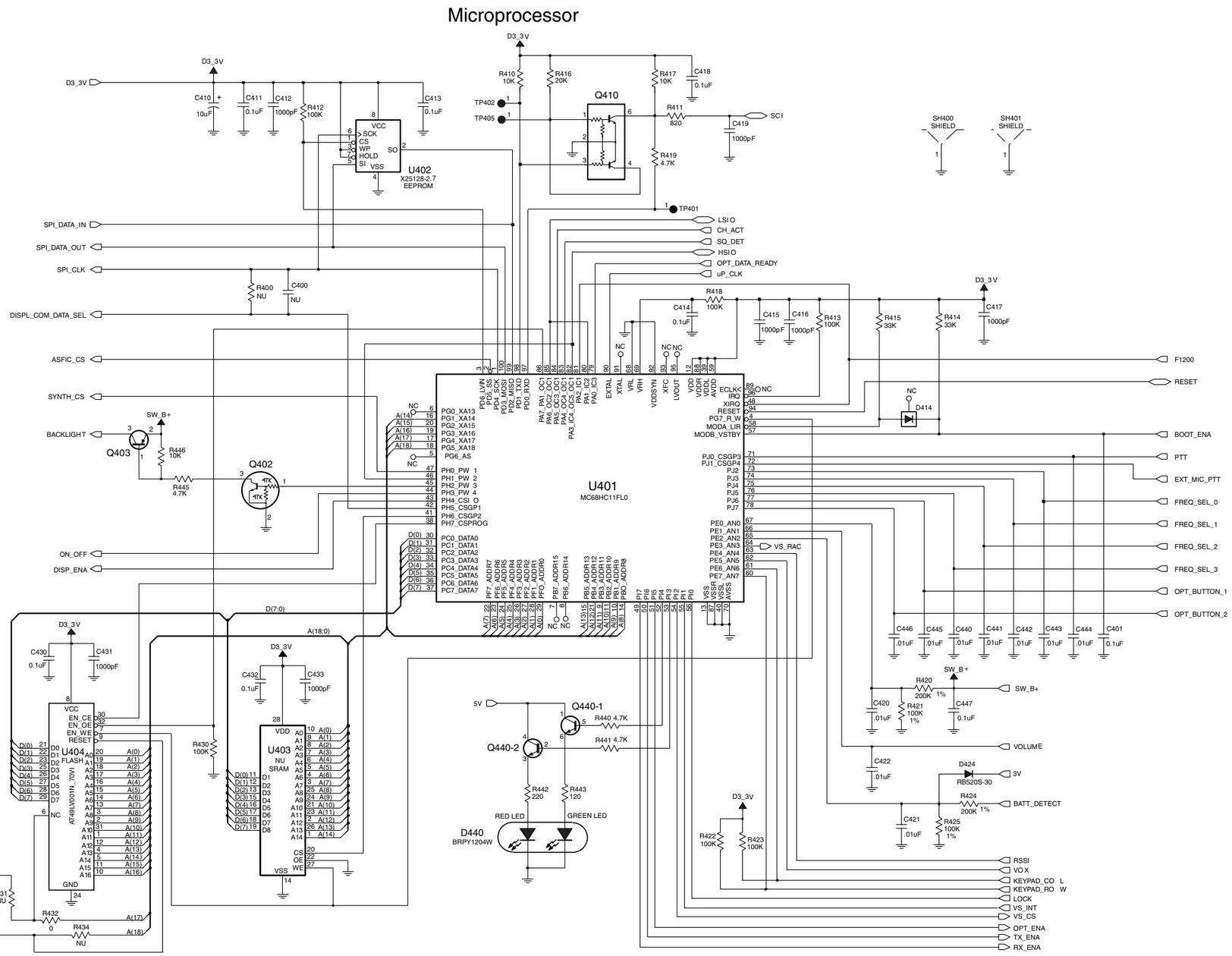
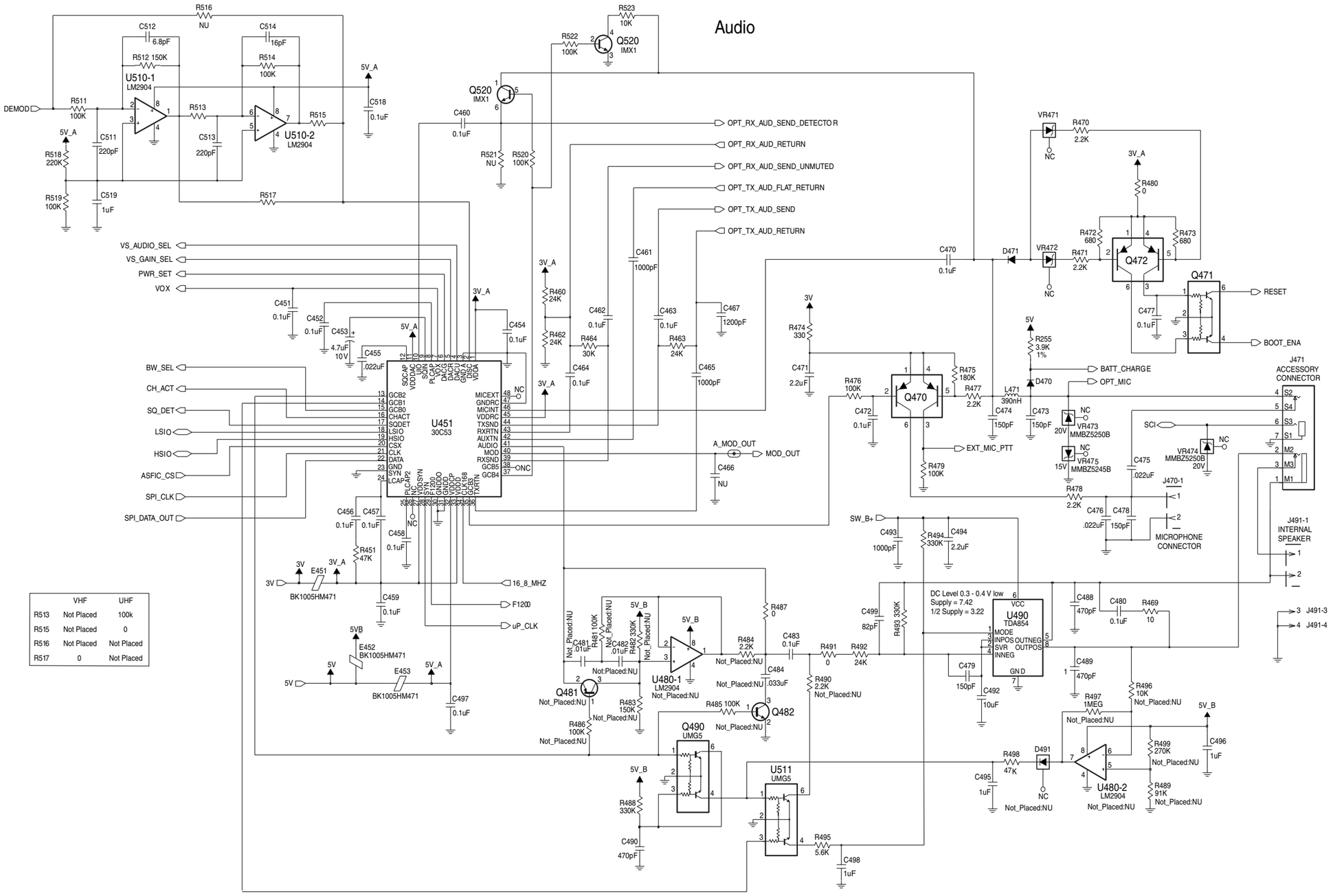


Figure 6-10. VHF (146-174 MHz) PCB 8486342Z13-C Microprocessor Circuitry Schematic Diagram



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 6-11. VHF (146-174 MHz) Audio Circuitry Schematic Diagram

DC Regulation

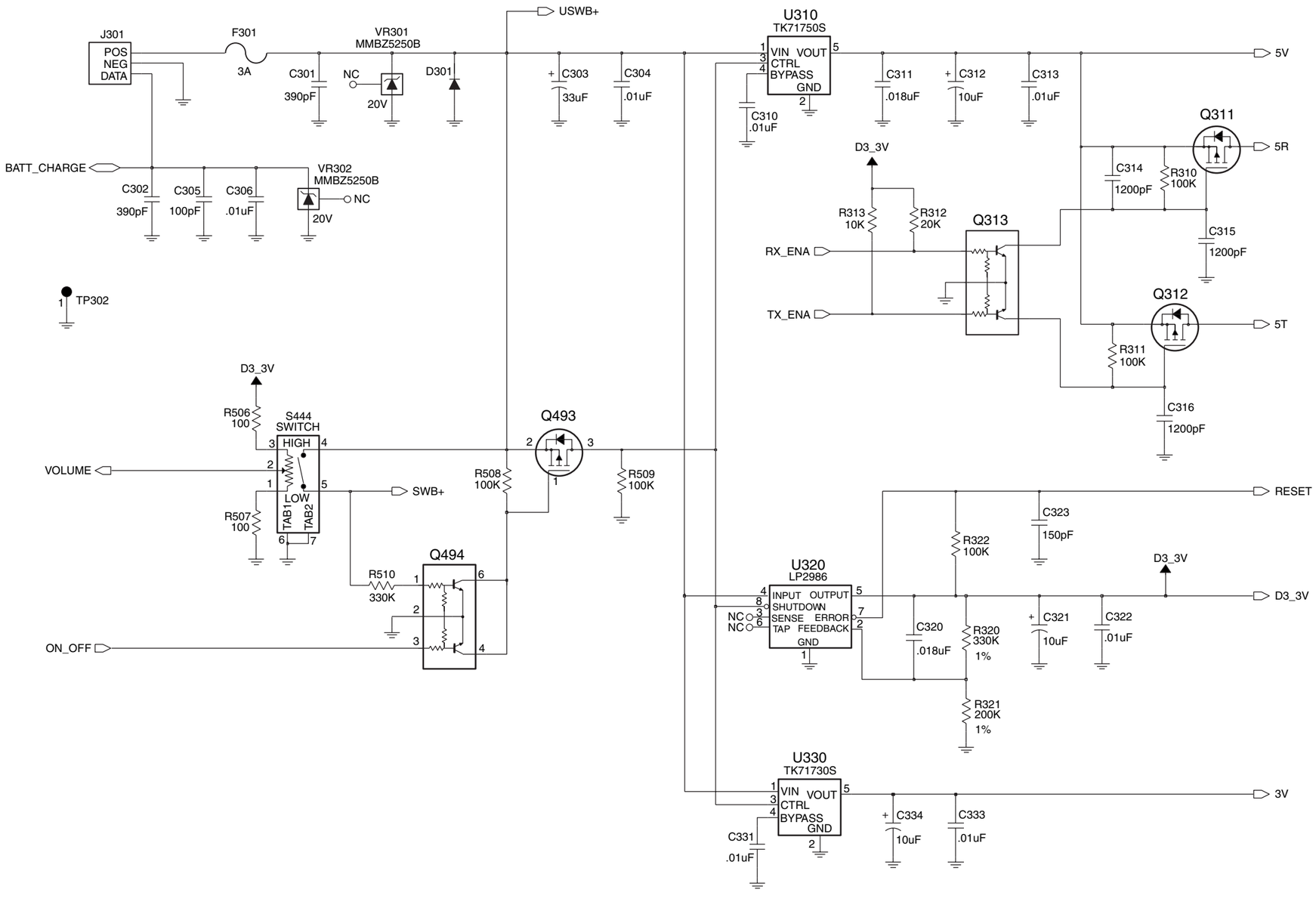
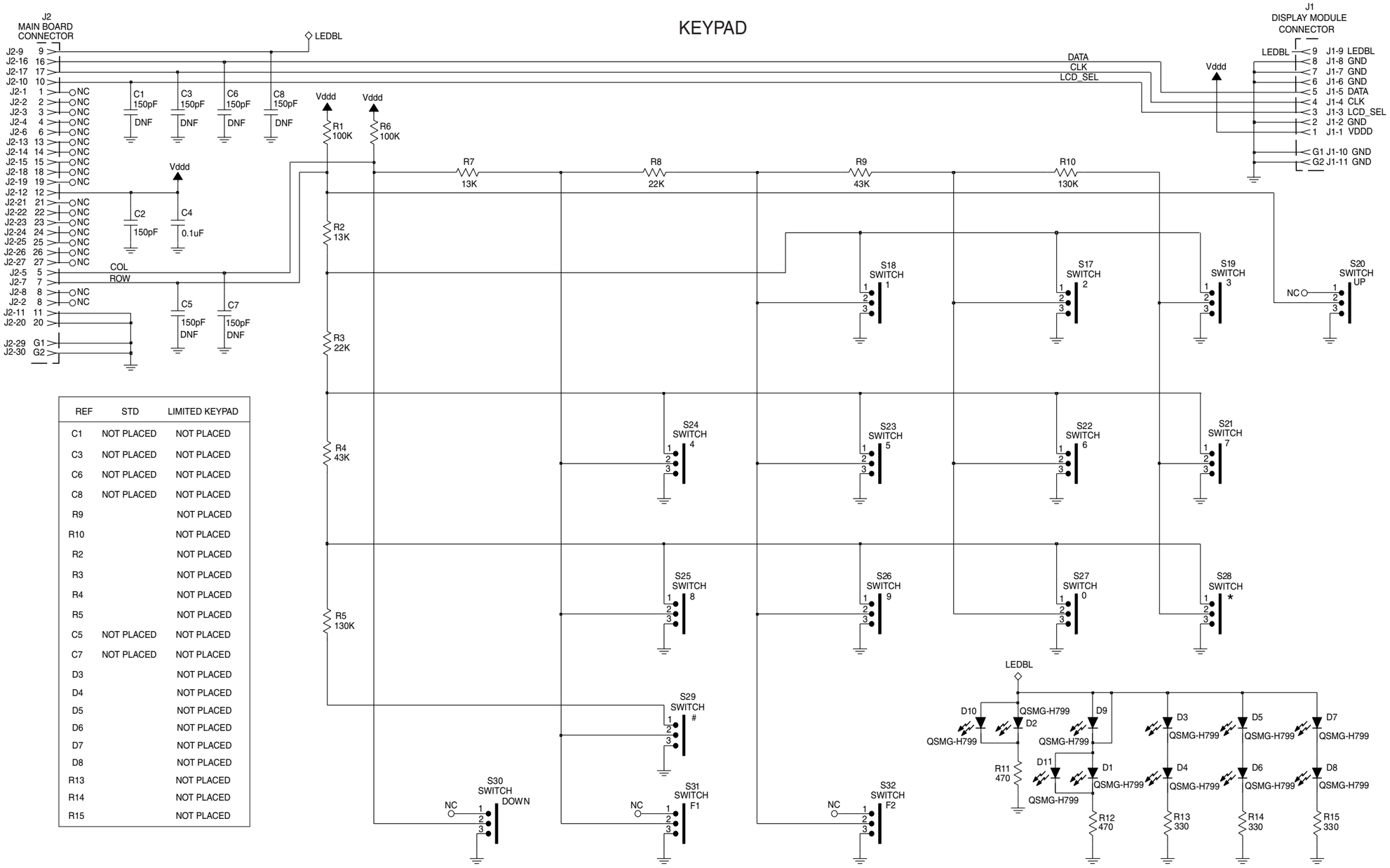


Figure 6-12. VHF (146-174 MHz) PCB 8486342Z13-C DC Regulation Schematic Diagram



REF	STD	LIMITED KEYPAD
C1	NOT PLACED	NOT PLACED
C3	NOT PLACED	NOT PLACED
C6	NOT PLACED	NOT PLACED
C8	NOT PLACED	NOT PLACED
R9		NOT PLACED
R10		NOT PLACED
R2		NOT PLACED
R3		NOT PLACED
R4		NOT PLACED
R5		NOT PLACED
C5	NOT PLACED	NOT PLACED
C7	NOT PLACED	NOT PLACED
D3		NOT PLACED
D4		NOT PLACED
D5		NOT PLACED
D6		NOT PLACED
D7		NOT PLACED
D8		NOT PLACED
R13		NOT PLACED
R14		NOT PLACED
R15		NOT PLACED

Figure 6-13. VHF (146-174 MHz) Keypad Board Schematic Diagram

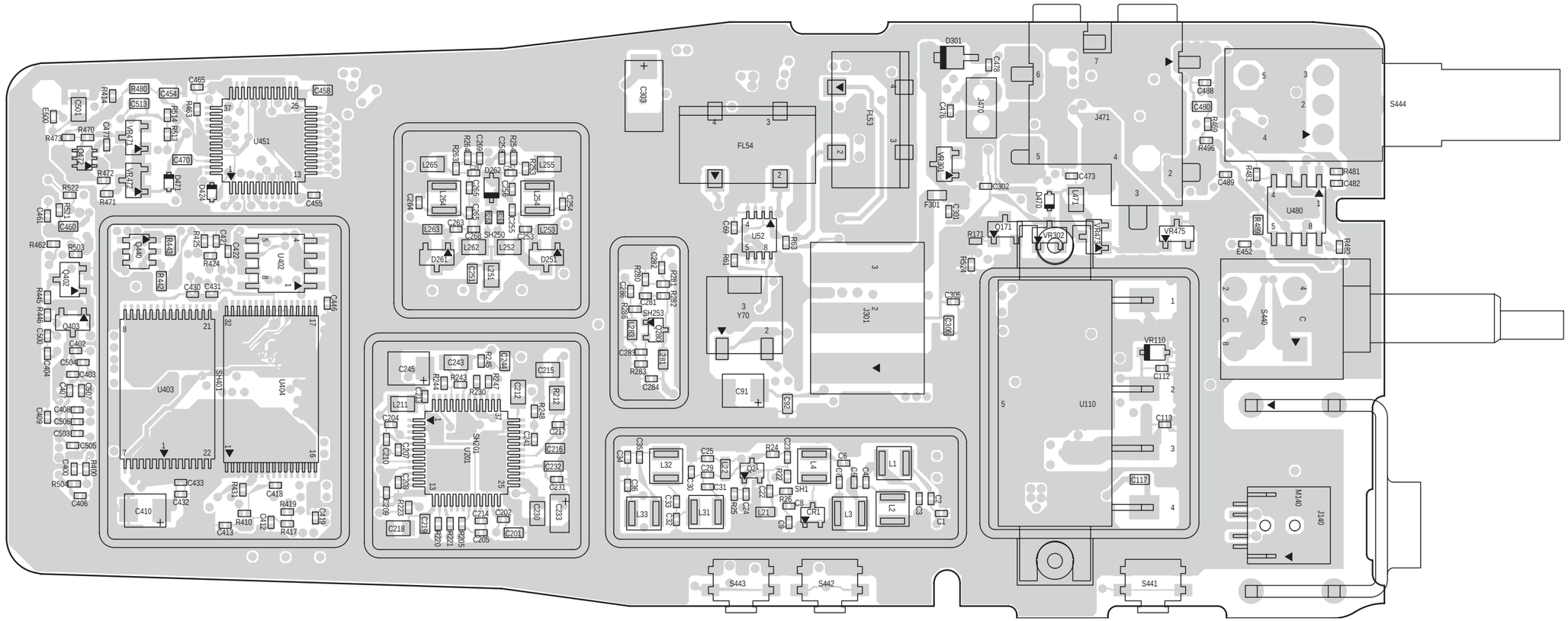


Figure 6-14. VHF (146-174 MHz) PCB 8486342Z13-C Board Component Side

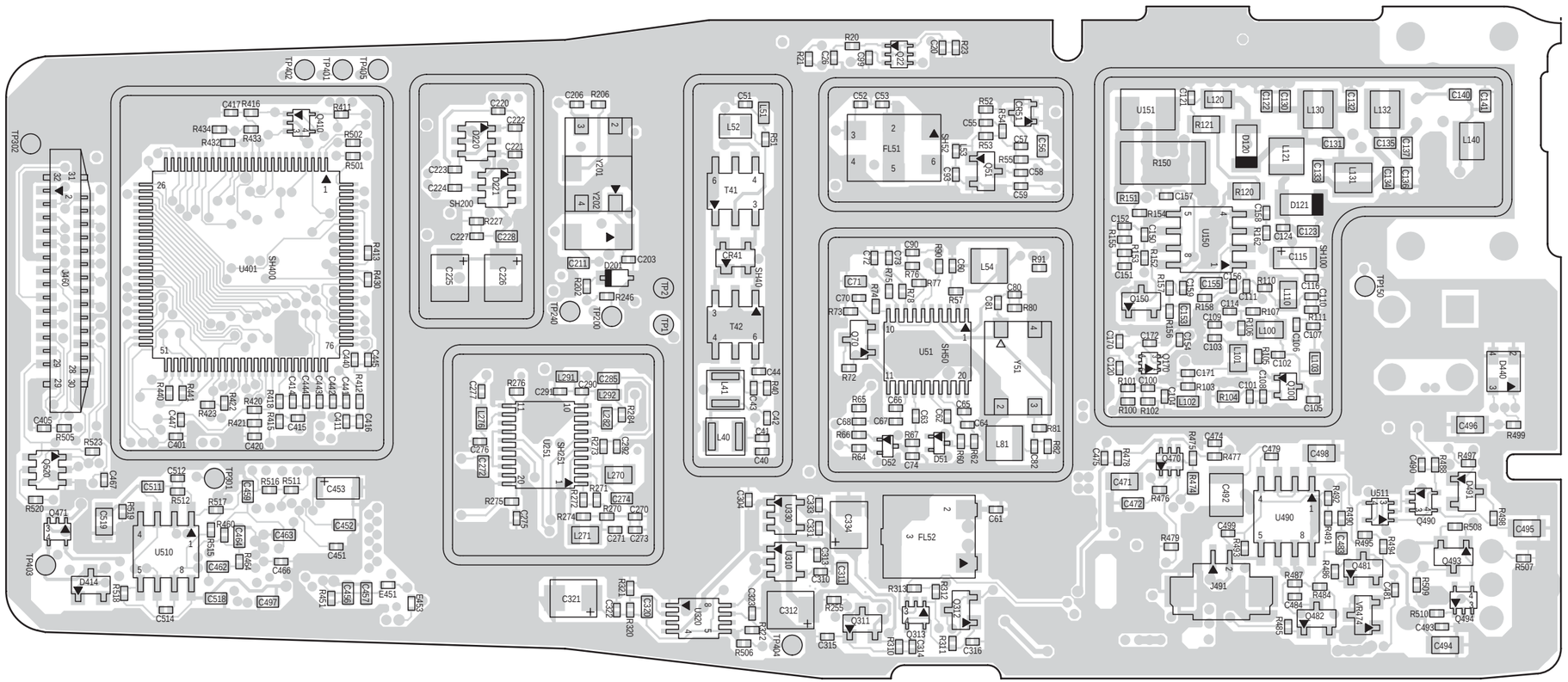
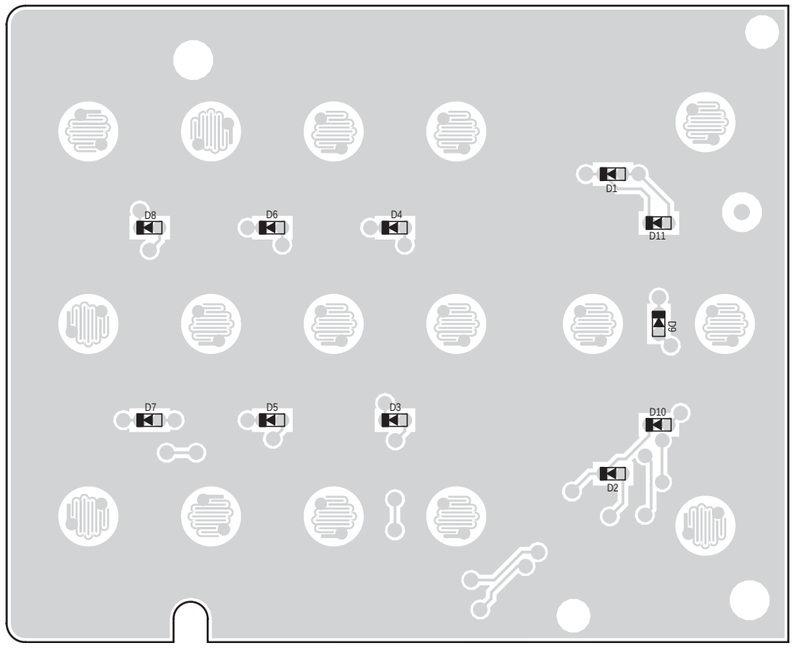
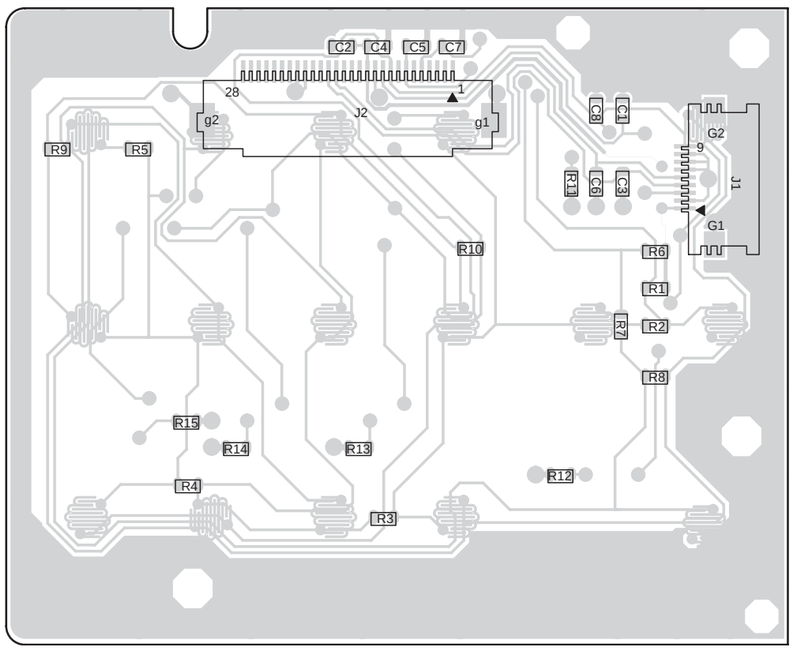


Figure 6-15. VHF (146-174 MHz) Board Solder Side View



Component Side



Solder Side

Figure 6-16. VHF (146-174 MHz) PCB 8486342Z13-C Keypad Board

VHF (146-174 MHz) Radio Parts List

Circuit Ref	Motorola Part No.	Description
C1	2109445U41	CAP, 22pF
C2	2109445U46	CAP, 36pF
C3	2109445U49	CAP, 47pF
C4	2109445U37	CAP, 15pF
C5	2109445U14	CAP, 3.0pF
C6	2109445U37	CAP, 15pF
C7	2109445U45	CAP, 33pF
C8	2109445U44	CAP, 30pF
C9	Not_Placed	CAP, 4.7pF
C20	2113743L17	CAP, 1000pF
C22	2113743L17	CAP, 1000pF
C23	2113743L17	CAP, 1000pF
C24	Not_Placed	CAP, 6.2pF
C25	2113743L17	CAP, 1000pF
C26	2113743L17	CAP, 1000pF
C29	2109445U48	CAP, 43pF
C30	2109445U42	CAP, 24pF
C31	2109445U44	CAP, 30pF
C32	2109445U51	CAP, 56pF
C33	2109445U42	CAP, 24pF
C34	2109445U51	CAP, 56pF
C35	2109445U43	CAP, 27pF
C36	2109445U42	CAP, 24pF
C40	2109445U40	CAP, 20pF
C41	2109445U37	CAP, 15pF
C42	2109445U46	CAP, 36pF
C43	2109445U37	CAP, 15pF
C44	2109445U40	CAP, 20pF
C51	2113743N48	CAP, 82pF
C52	2113743N28	CAP, 12pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U41	CAP, 22pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L21	CAP, 1500pF
C101	2113743L21	CAP, 1500pF
C102	2113743M24	CAP, 0.1uF
C103	2113743L21	CAP, 1500pF
C104	Not_Placed	CAP, 27pF
C105	Not_Placed	CAP, 10pF
C106	2113743L21	CAP, 1500pF
C107	2113743N26	CAP, 10pF
C108	2113743M24	CAP, 0.1uF
C109	2113743M24	CAP, 0.1uF
C110	2113743M24	CAP, 0.1uF
C111	Not_Placed	CAP, 1500pF
C112	2113743L21	CAP, 1500pF
C113	2113743L21	CAP, 1500pF
C114	2113743L21	CAP, 1500pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113741F25	CAP, 1000pF
C120	2113743L21	CAP, 1500pF
C121	2113743L21	CAP, 1500pF
C122	2113740F31	CAP, 15pF
C123	2113740F31	CAP, 15pF
C124	2113743L21	CAP, 1500pF
C130	2113740F29	CAP, 12pF
C131	2113740F15	CAP, 3.3pF
C132	2113740F37	CAP, 27pF
C133	2113740F15	CAP, 3.3pF
C134	2113740F37	CAP, 27pF
C135	2113740F17	CAP, 3.9pF
C136	2113740F30	CAP, 13pF
C137	2113740F58	CAP, 200pF
C140	2113740F30	CAP, 13pF
C141	2113740F33	CAP, 18pF
C150	2113743L21	CAP, 1500pF
C151	2113743L21	CAP, 1500pF
C152	2113743L21	CAP, 1500pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L21	CAP, 1500pF
C155	2113743E20	CAP, 0.1uF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L21	CAP, 1500pF
C159	2113743L21	CAP, 1500pF
C170	2113743L21	CAP, 1500pF
C171	2113743N12	CAP, 2.7pF
C172	2113743L21	CAP, 1500pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C241	2113743L19	CAP, 1200pF
C243	2113741M69	CAP, 0.1uF
C244	2113741F27	CAP, 1200pF
C245	2311049A08	CAPP, 1uF
C251	2113741F49	CAP, .01uF
C253	2109445U38	CAP, 16pF
C254	2109445U15	CAP, 3.3pF
C255	2109445U39	CAP, 18pF
C256	2109445U27	CAP, 10pF
C257	2109445U46	CAP, 36pF
C258	2113743L19	CAP, 1200pF
C263	2109445U43	CAP, 27pF
C264	2109445U19	CAP, 4.7pF
C265	2109445U37	CAP, 15pF
C266	2109445U27	CAP, 10pF
C267	2109445U46	CAP, 36pF
C268	2109445U13	CAP, 2.7pF
C269	2113743L21	CAP, 1500pF
C270	2113743L19	CAP, 1200pF
C271	2113743L41	CAP, .01uF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L19	CAP, 1200pF
C276	2113743N19	CAP, 5.1pF
C277	2113743L19	CAP, 1200pF
C281	2113743L19	CAP, 1200pF
C282	2113743N25	CAP, 9.1pF
C283	2113743L19	CAP, 1200pF
C284	2113743L19	CAP, 1200pF
C285	2113743E20	CAP, 0.1uF
C286	2113743N27	CAP, 11pF
C290	2113743N43	CAP, 51pF
C291	2113743N39	CAP, 36pF
C292	2113743L19	CAP, 1200pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF
C400	Not_Placed	CAP, .022uF
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743L17	CAP, 1000pF
C404	2113743L17	CAP, 1000pF
C405	2113743L17	CAP, 1000pF
C406	2113743L17	CAP, 1000pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF

Circuit Ref	Motorola Part No.	Description
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2113743E20	CAP, 0.1uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	2113743L41	CAP, .01uF
C483	2113743E20	CAP, 0.1uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113743F18	CAP, 2.2uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N48	CAP, 82pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
CR1	4813825A19	MMBD352
CR41	4802246J04	HSMS2829
CR51	4813825A19	MMBD352
D51	4802245J97	DAN235ETL
D52	4802245J97	DAN235ETL
D120	4880973Z02	MA4PH261
D121	4880973Z02	MA4PH261
D201	4862824C03	1SV232
D220	4802233J09	IMN10
D221	4802233J09	IMN10
D251	4805649Q13	1SV228
D261	4805649Q13	1SV228
D262	4862824C01	1SV229
D301	4813833A19	MBRM120ET3
D414	4805129M41	MMBD501
D440	4805729G49	BRPY1204W
D470	4809924D18	RB520S-30
D471	4809924D18	RB520S-30
D491	4805129M41	MMBD501
E451	2480640Z01	BK1005HM471
E452	2480640Z01	BK1005HM471
E453	2480640Z01	BK1005HM471
E500	2480640Z01	BK1005HM471
F301	6580542Z01	FUSE
FL51	9180022M11	MXF45
FL52	9180468V05	FLTR
FL53	9180469V05	CFWC455E
FL54	9180469V03	CFWC455G
J140	0986428Z01	CONN_J
J301	0986237A02	CONN_J
J460	Not_Placed	CONN_J
J470	0985818A01	CONN_J
J471	0980683Z03	CONN_J
J491	2809926G01	CONN_P
L1	2413923C09	IDCTR, 68nH
L2	2413923C09	IDCTR, 68nH
L3	2413923C09	IDCTR, 68nH
L4	2413923C09	IDCTR, 68nH
L21	Not_Placed	IDCTR, 39nH
L22	2413926N24	IDCTR, 100nH
L31	2413923C09	IDCTR, 68nH
L32	2413923C09	IDCTR, 68nH
L33	2413923C09	IDCTR, 68nH
L40	2413923C09	IDCTR, 68nH
L41	2413923C09	IDCTR, 68nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V44	IDCTR, 680nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L81	2462587N68	IDCTR, 1uH
L100	2413926K32	IDCTR, 560nH
L101	2413926K32	IDCTR, 560nH
L102	2409377M17	IDCTR, 100nH
L103	2409377M31	IDCTR, 30nH
L110	2413926K32	IDCTR, 560nH
L120	2413926K32	IDCTR, 560nH
L121	2462587N49	IDCTR, 47nH
L130	2479990N01	IDCTR, 43.67nH
L131	2479990N01	IDCTR, 43.67nH
L132	2479990N01	IDCTR, 43.67nH
L140	2479990M01	IDCTR, 30.54nH
L211	2413926K32	IDCTR, 560nH
L251	2413926K32	IDCTR, 560nH
L252	2413926K32	IDCTR, 560nH
L253	2409377M17	IDCTR, 100nH
L254	2413923C05	IDCTR, 33nH
L255	2413926K29	IDCTR, 330nH
L262	2413926K32	IDCTR, 560nH
L263	2409377M17	IDCTR, 100nH
L264	2413923C07	IDCTR, 47nH
L265	2413926K29	IDCTR, 330nH
L270	2413926K32	IDCTR, 560nH
L271	Not_Placed	IDCTR, 560nH
L276	2413926N24	IDCTR, 100nH
L281	2413926N22	IDCTR, 68nH
L282	2413926N20	IDCTR, 47nH
L283	Not_Placed	IDCTR, 270nH
L291	2413926N17	IDCTR, 27nH
L292	2413926N22	IDCTR, 68nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	ANTENNA_NUT
Q21	4802245J95	BFS540
Q22	4805723X02	UMT1
Q51	4802197J95	PBR941
Q70	4880214G02	MMBT3904
Q100	4802245J95	BFS540
Q150	4880214G02	MMBT3904
Q170	4809939C34	EMB10
Q171	4880048M01	DTC144EKA
Q280	4802245J95	BFS540
Q311	4809579E18	TP0101T
Q312	4809579E18	TP0101T
Q313	4802245J54	UMG5
Q402	4880048M01	DTC144EKA
Q403	4813824A17	MMBT3906
Q410	4802245J54	UMG5
Q440	5180159R01	IMX1
Q470	4805723X02	UMT1
Q471	4802245J54	UMG5
Q472	4805723X02	UMT1
Q481	Not_Placed	MMBT3906
Q482	4813824A10	MMBT3904
Q490	4802245J54	UMG5
Q493	4809579E18	TP0101T
Q494	4802245J54	UMG5
Q520	4813824A10	MMBT3904
R20	0662057U97	RES, 6.8K
R21	0662057M54	RES, 150
R22	0662057M94	RES, 6.8K
R23	0662057V11	RES, 22K
R24	0662057M71	RES, 750
R25	0662057M92	RES, 5.6K
R26	0662057M01	RES, 0
R40	0662057M74	RES, 1K
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K

Circuit Ref	Motorola Part No.	Description
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M61	RES, 300
R101	0662057M32	RES, 18
R102	0662057M61	RES, 300
R103	0662057M86	RES, 3.3K
R104	0662057A18	RES, 51
R105	0662057M76	RES, 1.2K
R106	0662057M90	RES, 4.7K
R107	0662057M54	RES, 150
R110	0662057M63	RES, 360
R111	Not_Placed	RES, 2.7K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A09	RES, 22
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M92	RES, 5.6K
R158	0662057M78	RES, 1.5K
R162	0662057M98	RES, 10K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M54	RES, 150
R221	0662057M54	RES, 150
R223	0662057M50	RES, 100
R227	0662057N27	RES, 150K
R230	0662057N30	RES, 200K
R243	0662057M81	RES, 2K
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K

Circuit Ref	Motorola Part No.	Description
R247	0662057N33	RES, 270K
R248	0662057M43	RES, 51
R253	0662057M42	RES, 47
R254	0662057M58	RES, 220
R255	0662057U91	RES, 3.9K
R261	0662057N16	RES, 51K
R262	0662057M94	RES, 6.8K
R263	0662057M37	RES, 30
R264	0662057M58	RES, 220
R270	0662057M32	RES, 18
R271	0662057M96	RES, 8.2K
R272	0662057M97	RES, 9.1K
R273	0662057M61	RES, 300
R274	0662057M38	RES, 33
R275	0662057M01	RES, 0
R276	0662057M74	RES, 1K
R280	0662057M94	RES, 6.8K
R281	0662057M97	RES, 9.1K
R282	0662057M71	RES, 750
R283	0662057M56	RES, 180
R284	0662057M62	RES, 330
R286	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057N06	RES, 20K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K

Circuit Ref	Motorola Part No.	Description
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	0662057N23	RES, 100K
R482	0662057N35	RES, 330K
R483	0662057N27	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	0662057N23	RES, 100K
R486	0662057N23	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	0662057A96	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	0662057N47	RES, 1MEG
R498	0662057N15	RES, 47K
R499	0662057N33	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K

Circuit Ref	Motorola Part No.	Description
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	Not_Placed	RES, 100K
R514	0662057N23	RES, 100K
R515	Not_Placed	RES, 0
R516	Not_Placed	RES, 0
R517	0662057M01	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	0662057N23	RES, 100K
S440	4080710Z06	SWITCH
S441	4070354A01	SWITCH
S442	4070354A01	SWITCH
S443	4070354A01	SWITCH
S444	1880619Z02	SWITCH
SH1	2686421Z01	SHIELD
SH40	2686419Z01	SHIELD
SH50	2686423Z01	SHIELD
SH52	2686424Z01	SHIELD
SH100	2686418Z01	SHIELD
SH200	2686424Z01	SHIELD
SH201	2686423Z01	SHIELD
SH250	2686425Z01	SHIELD
SH251	2686425Z01	SHIELD
SH253	2686422Z01	SHIELD
SH400	2686420Z01	SHIELD
SH401	2686420Z01	SHIELD
T41	2580541Z02	XFMR
T42	2580541Z02	XFMR
U51	5186144B01	SA616
U52	5109522E10	TC7W04F
U110	0186438Z01	RA07M1317M_VHF
U150	5113818A01	LM2904
U151	2484657R01	57R01
U201	5185963A27	63A27
U251	5105750U54	50U54
U310	5102478J01	TK71750S
U320	5185963A55	LP2986
U330	5102479J01	TK71730S
U401	5102226J56	MC68HC11FL0
U402*	5102463J64	X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	AT49LV001N_70VI
U451	5185130C53	30C53
U480	5113818A01	LM2904
U490	5108858K99	TDA8541
U510	5113818A01	LM2904
U511	4802245J54	UMG5
VR110	4813830A82	MM3Z4V3T1

Circuit Ref	Motorola Part No.	Description
VR301	4813830A33	MMBZ5250B
VR302	4813830A33	MMBZ5250B
VR471	4813830A18	MMBZ5235B
VR472	4813830A09	MMBZ5226B
VR473	4813830A33	MMBZ5250B
VR474	4813830A33	MMBZ5250B
VR475	4880140L20	MMBZ5245B
Y51	4802245J84	TSS2_44_395
Y70	9186145B02	45B02
Y201*	4880114R06	14R06
Y202	Not_Placed	45J68

* Motorola Depot Servicing only

VHF (146-174 MHz) Keypad Board Parts List

Circuit Ref	Motorola Part No.	Description
C1	NOTPLACED	CAP, 150pF
C2	2113740F55	CAP, 150pF
C3	NOTPLACED	CAP, 150pF
C4	2113743E20	CAP, 0.1uF
C5	NOTPLACED	CAP, 150pF
C6	NOTPLACED	CAP, 150pF
C7	NOTPLACED	CAP, 150pF
C8	NOTPLACED	CAP, 150pF
D1	4809496B11	QSMG-H799
D2	4809496B11	QSMG-H799
D3	NOTPLACED	QSMG-H799
D4	NOTPLACED	QSMG-H799
D5	NOTPLACED	QSMG-H799
D6	NOTPLACED	QSMG-H799
D7	NOTPLACED	QSMG-H799
D8	NOTPLACED	QSMG-H799
D9	4809496B11	QSMG-H799
D10	4809496B11	QSMG-H799
D11	4809496B11	QSMG-H799
J1	09_54548_0911_9pin	CONN_J
J2	09_52892_2890_28PIN	CONN_J
R1	0662057A97	RES, 100K
R2	NOTPLACED	RES, 13K
R3	NOTPLACED	RES, 22K
R4	NOTPLACED	RES, 43K
R5	NOTPLACED	RES, 130K
R6	0662057A97	RES, 100K
R7	0662057A76	RES, 13K
R8	0662057A81	RES, 22K
R9	NOTPLACED	RES, 43K
R10	NOTPLACED	RES, 130K
R11	0662057A41	RES, 470
R12	0662057A41	RES, 470
R13	NOTPLACED	RES, 330
R14	NOTPLACED	RES, 330
R15	NOTPLACED	RES, 330

Chapter 7 403-440 MHz UHF Theory Of Operation

7.1 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 11of this manual.

7.2 UHF Receiver

The UHF receiver covers the range of 403-440 MHz and provides switchable IF bandwidth for use with 20/25/30 kHz or 12.5 kHz channel spacing systems. The receiver is divided into two major blocks, as shown in Figure 7-1.

- Front End
- Back End

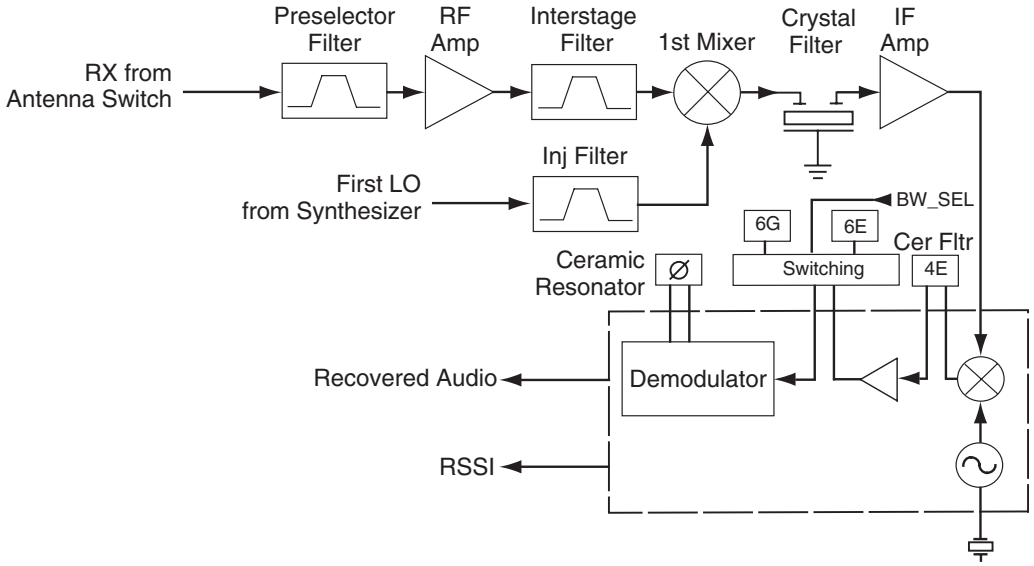


Figure 7-1. UHF Receiver Block Diagram

7.2.1 Receiver Front End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 3-pole Butterworth design using discrete elements (L1-L3, C1-C10, C12 and C523) in a shunt-resonator configuration. It has a 3 dB bandwidth of 68 MHz centered at 421 MHz, an insertion loss of 2.2 dB and image attenuation of 38 dB at 350 MHz. Diode CR1 protects the RF amplifier by limiting excessive RF levels. The filter bandwidth is considerably wider than the receive band, to achieve low insertion loss in a compact size. C523 provides a transmission-zero to improve image attenuation.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 4 dB. A BFS505 device is used for high gain, low noise figure and reduced operating current. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21 constant at 8 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 4-pole Butterworth shunt-coupled resonator design having a 3 dB bandwidth of 68 MHz centered at 462 MHz, and insertion loss of 3.5 dB. This filter yields an image rejection of 58 dB at 350 MHz, assisted by a transmission-zero at 300 MHz implemented by C524 for the reasons mentioned above.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7.2 dB. Low-side injection from the frequency synthesizer is filtered by L40-L41 and C41-C45 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 100 MHz centered at 376.15 MHz, and an insertion loss of 2.7 dB. The second-harmonic rejection is typically 45 dB or greater. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies.

7.2.2 Receiver Back End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of ±6.7 kHz, a maximum 20 dB bandwidth of + 12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

The ceramic filters have the following specifications:

	FL52	FL53	FL54
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

7.3 UHF Transmitter

The UHF transmitter covers the range of 403-440 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (4 watts) and low power (1 watt), or is factory preset to 2 watts. The transmitter is divided into four major blocks as shown in Figure 7-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

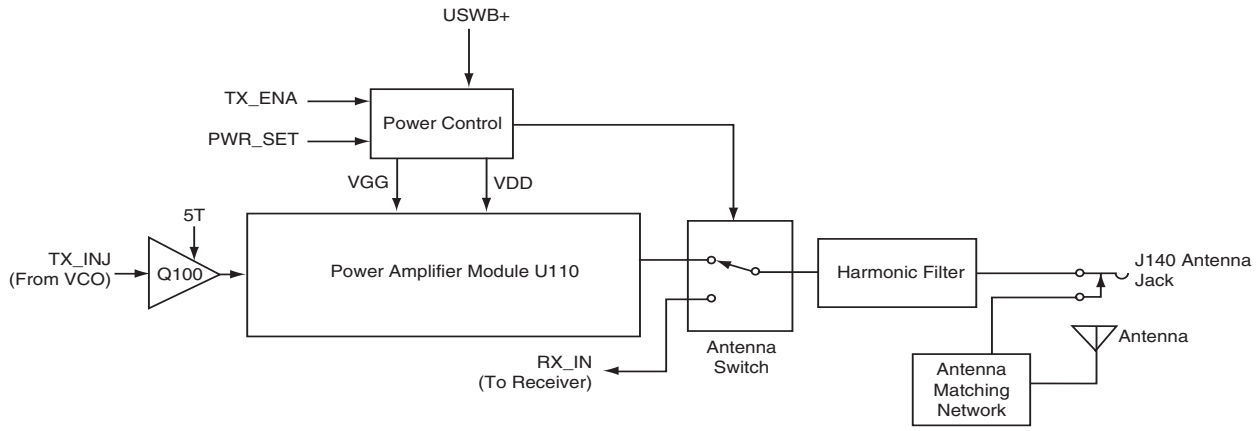


Figure 7-2. UHF Transmitter Block Diagram

7.3.1 Transmitter Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class A from the 5T source. It provides 17 dB of gain and an output of 50 mW. The current drain is typically 35mA. Components C105, C107 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

7.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 20 mA, set by R120-R121. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at UHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

7.3.3 Harmonic Filter

The harmonic filter consists of components C122 (Range 1 UHF) C136 and L130-L132. The harmonic filter is a seven-pole Chebychev low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 600 MHz and typically less than 0.8 dB insertion loss in the passband.

7.3.4 Antenna Matching Network

The harmonic filter presents a 50Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

7.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

7.4 UHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 7-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 7-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 7-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT,

SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

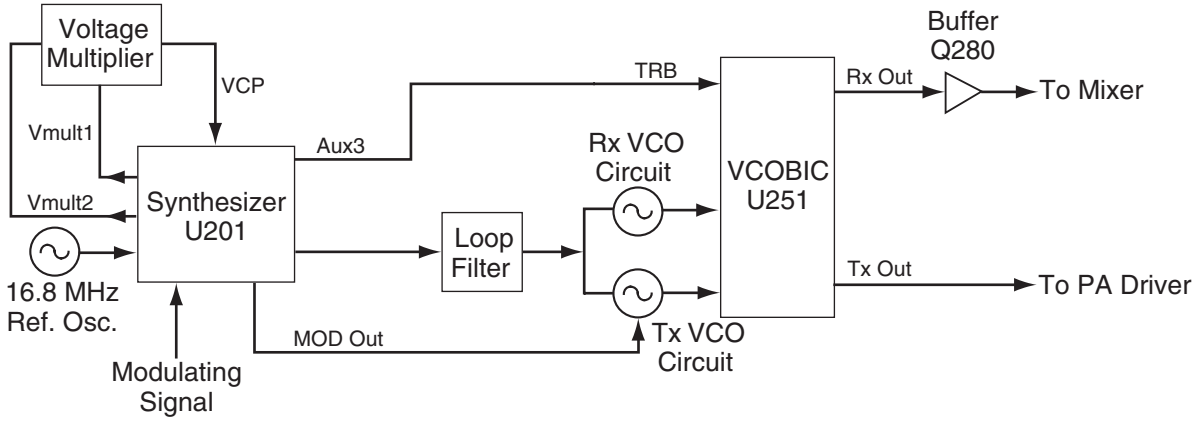


Figure 7-3. UHF Frequency Generation Unit Block Diagram

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

7.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 7-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60°C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

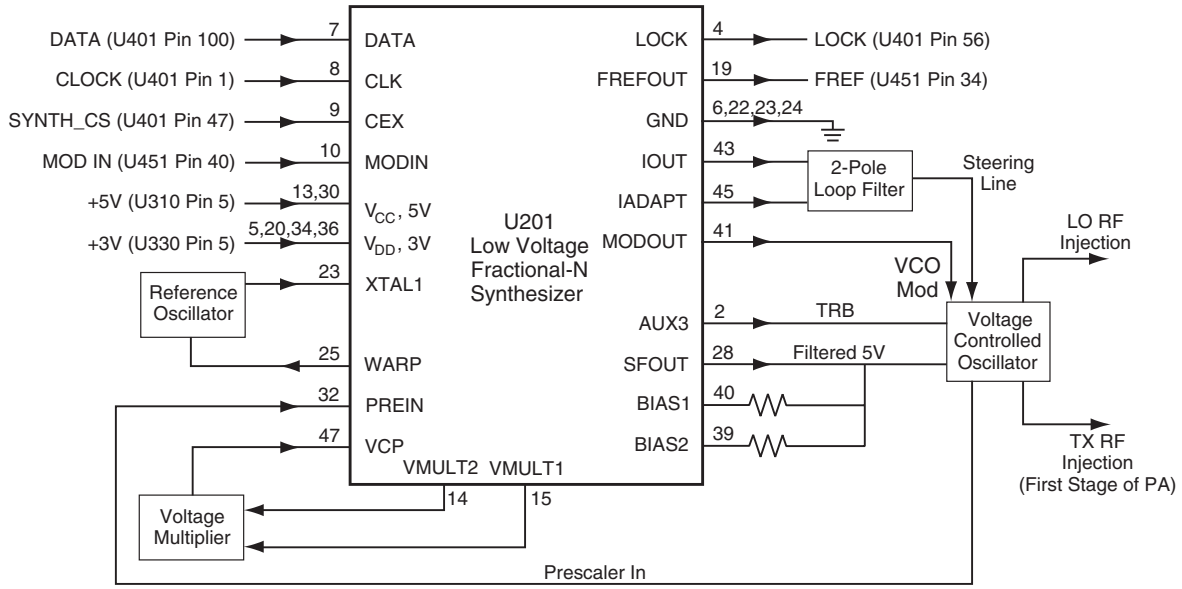


Figure 7-4. UHF Synthesizer Block Diagram

7.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 7-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3.5 V and 10 V. L251 and C252 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 358.15 to 395.15 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 438-470 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D262. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D261 which modulates the transmit VCO.

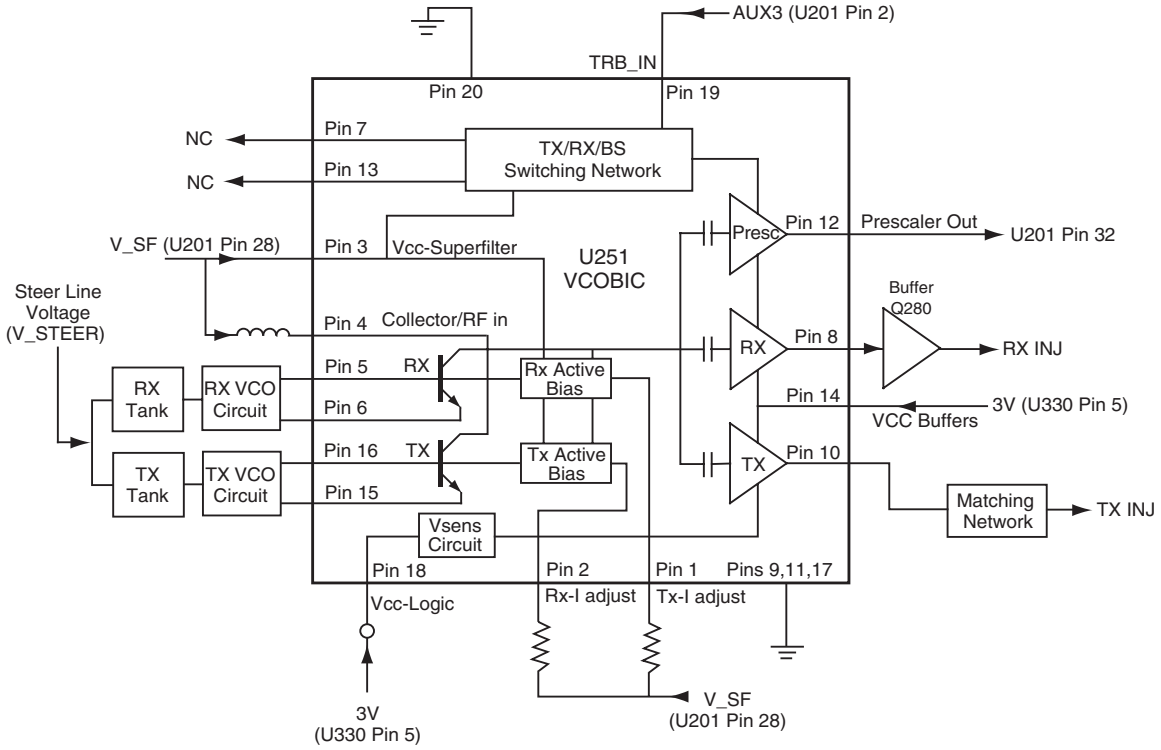


Figure 7-5. UHF VCO Block Diagram

7.5 Keypad

The keypad block diagram is shown in Figure 7-6. Pressing a key creates two distinct voltages KEYPAD_ROW and KEYPAD_COL. These voltages are sent directly to the radio's microprocessor on the main board. The microprocessor then interprets the voltage for KEYPAD_ROW and KEYPAD_COL for each key press.

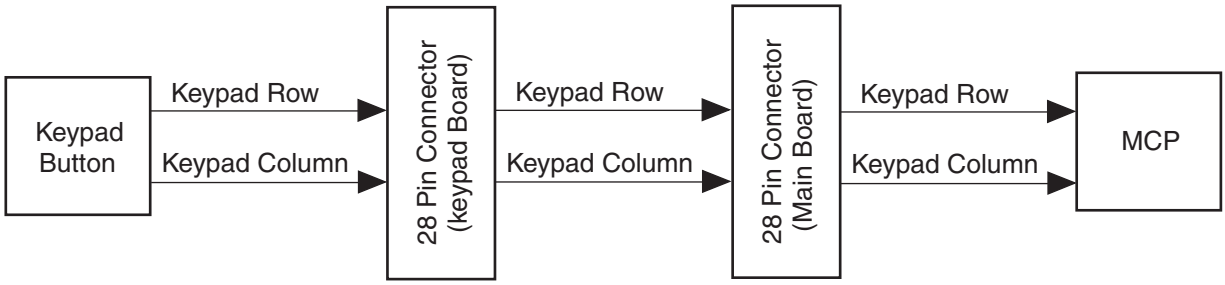


Figure 7-6. Keypad Block Diagram

Notes:

Chapter 8 438-470 MHz UHF Theory Of Operation

8.1 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 11of this manual.

8.2 UHF Receiver

The UHF receiver covers the range of 438-470 MHz and provides switchable IF bandwidth for use with 20/25/30 kHz or 12.5 kHz channel spacing systems. The receiver is divided into two major blocks, as shown in Figure 8-1.

- Front End
- Back End

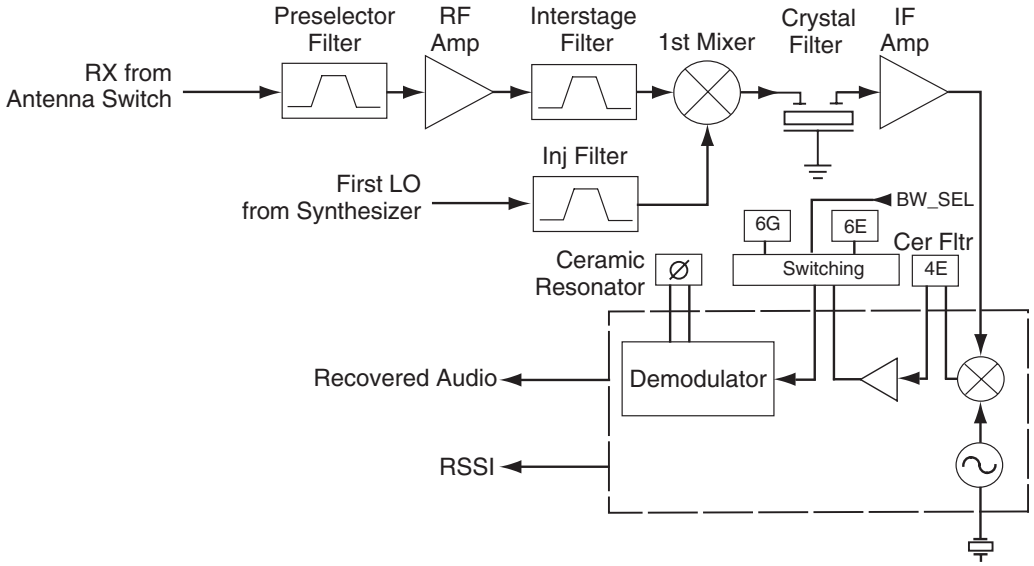


Figure 8-1. UHF Receiver Block Diagram

8.2.1 Receiver Front End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 3-pole Butterworth design using discrete elements (L1-L3, C1-C10, C12 and C523) in a shunt-resonator configuration. It has a 3 dB bandwidth of 68 MHz centered at 460 MHz, an insertion loss of 2 dB and image attenuation of 35 dB at 380 MHz. Diode CR1 protects the RF amplifier by limiting excessive RF levels. The filter bandwidth is considerably wider than the receive band, to achieve low insertion loss in a compact size. C523 provides a transmission-zero to improve image attenuation.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 4 dB. A BFS505 device is used for high gain, low noise figure and reduced operating current. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21 constant at 8 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 4-pole Butterworth shunt-coupled resonator design having a 3 dB bandwidth of 68 MHz centered at 462 MHz, and insertion loss of 3 dB. This filter yields an image rejection of 48 dB at 380 MHz, assisted by a transmission-zero at 300 MHz implemented by C524 for the reasons mentioned above.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7.2 dB. Low-side injection from the frequency synthesizer is filtered by L40-L41 and C41-C45 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 100 MHz centered at 408 MHz, and an insertion loss of 2 dB. The second-harmonic rejection is typically 40 dB or greater. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies.

8.2.2 Receiver Back End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of ±6.7 kHz, a maximum 20 dB bandwidth of + 12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

The ceramic filters have the following specifications:

	FL52	FL53	FL54
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

8.3 UHF Transmitter

The UHF transmitter covers the range of 438-470 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (4 watts) and low power (1 watt). The transmitter is divided into four major blocks as shown in Figure 8-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

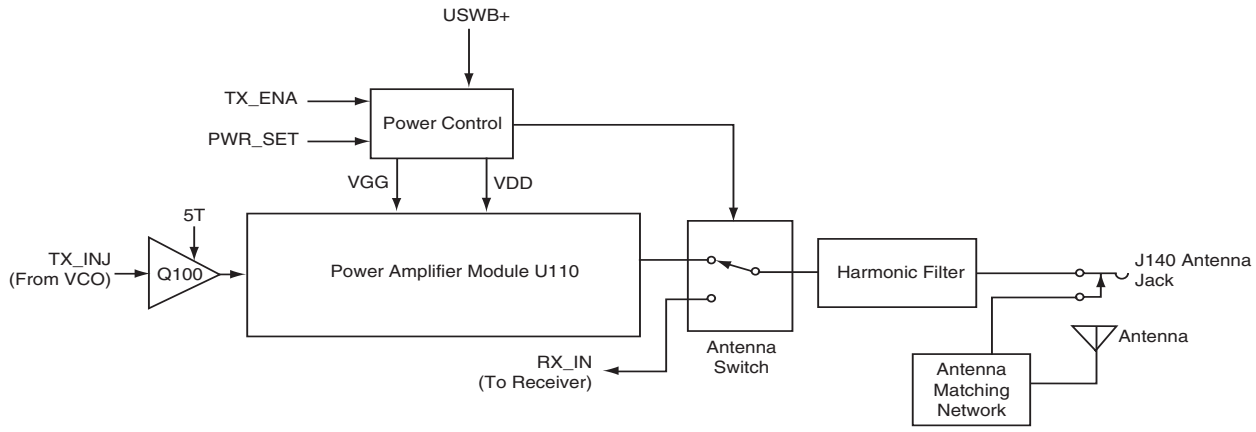


Figure 8-2. UHF Transmitter Block Diagram

8.3.1 Transmitter Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class A from the 5T source. It provides 17 dB of gain and an output of 50 mW. The current drain is typically 30mA. Components C105 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

8.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 20 mA, set by R120-R121. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at UHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

8.3.3 Harmonic Filter

The harmonic filter consists of components C130-C136 and L130-L132. The harmonic filter is a seven-pole Chebychev low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 600 MHz and typically less than 0.8 dB insertion loss in the passband.

8.3.4 Antenna Matching Network

The harmonic filter presents a 50Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

8.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

8.4 UHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 8-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 8-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 8-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT,

SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

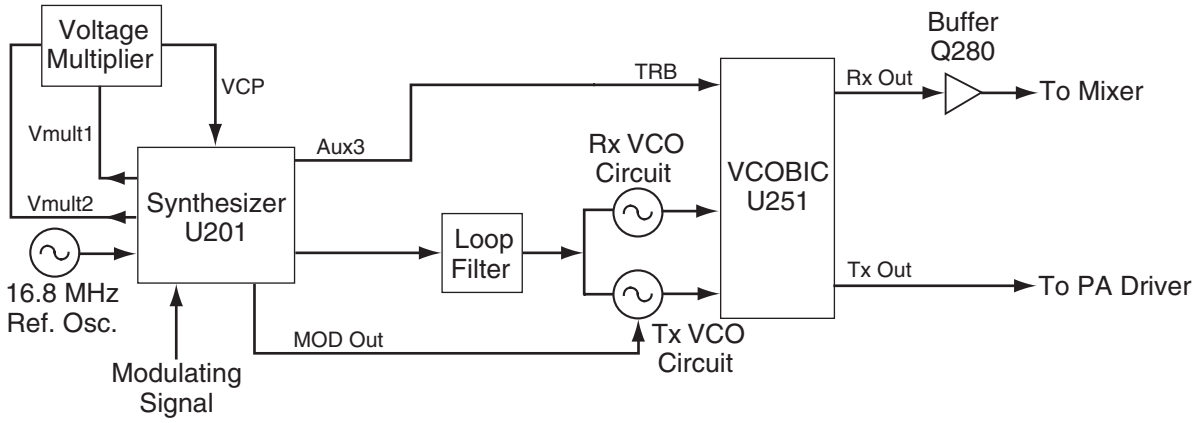


Figure 8-3. UHF Frequency Generation Unit Block Diagram

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

8.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 8-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60°C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

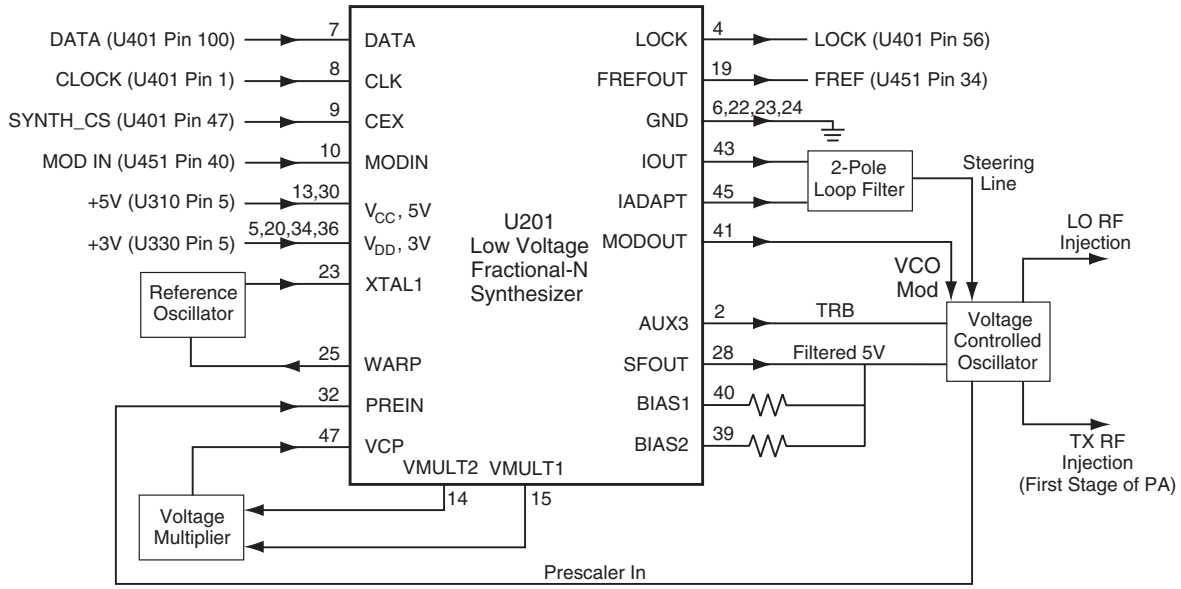


Figure 8-4. UHF Synthesizer Block Diagram

8.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 8-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3.5 V and 10 V. L251 and C252 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 393.15 to 425.15 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 438-470 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D262. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D261 which modulates the transmit VCO.

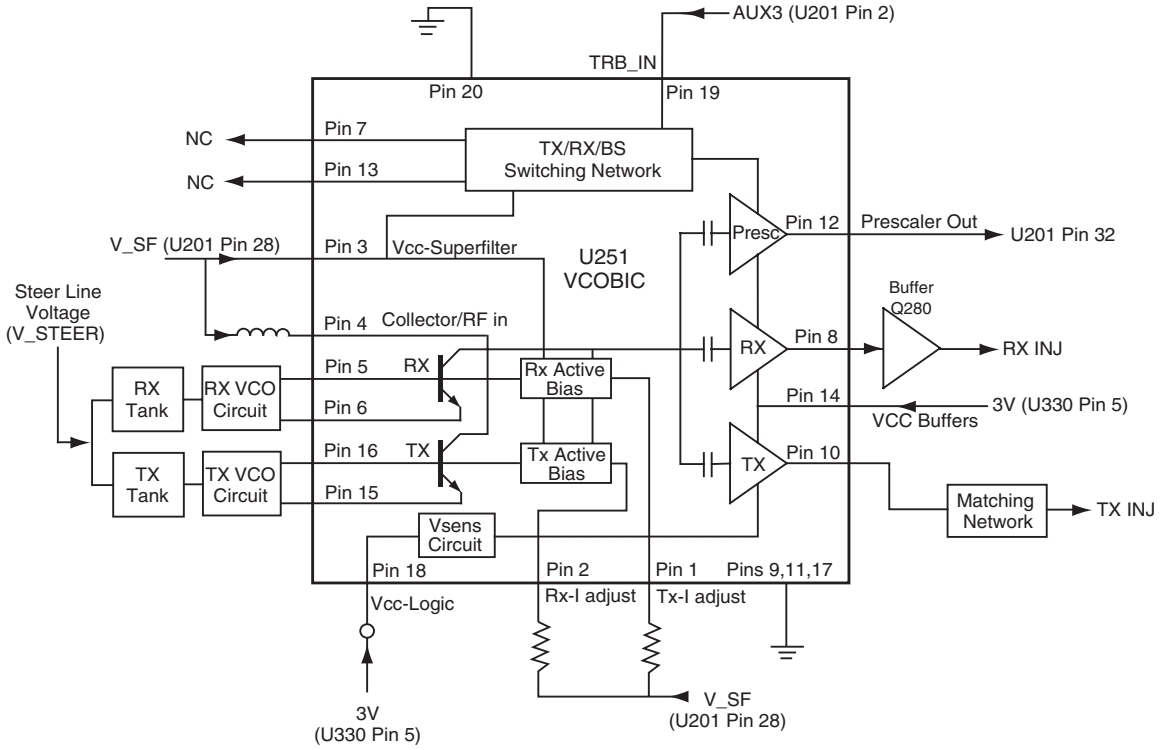


Figure 8-5. UHF VCO Block Diagram

8.5 Keypad

The keypad block diagram is shown in Figure 8-6. Pressing a key creates two distinct voltages KEYPAD_ROW and KEYPAD_COL. These voltages are sent directly to the radio's microprocessor on the main board. The microprocessor then interprets the voltage for KEYPAD_ROW and KEYPAD_COL for each key press.

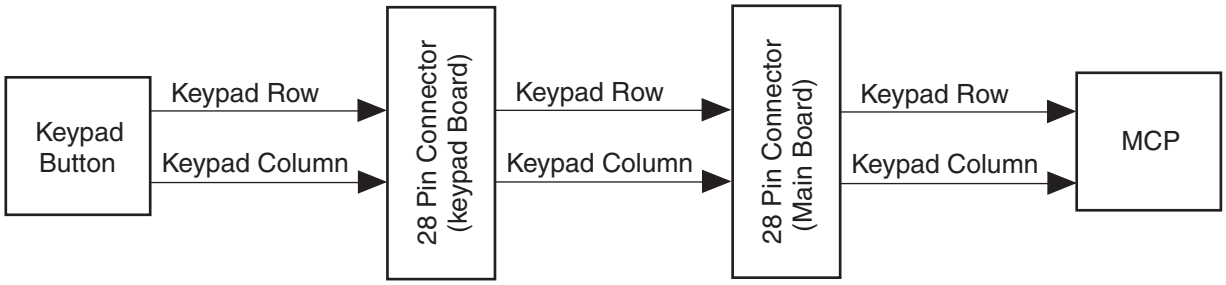


Figure 8-6. Keypad Block Diagram

Notes:

Chapter 9 465-495 MHz UHF Theory Of Operation

9.1 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 11of this manual.

9.2 UHF Receiver

The UHF receiver covers the range of 465-495 MHz and provides switchable IF bandwidth for use with 20/25/30 kHz or 12.5 kHz channel spacing systems. The receiver is divided into two major blocks, as shown in Figure 9-1.

- Front End
- Back End

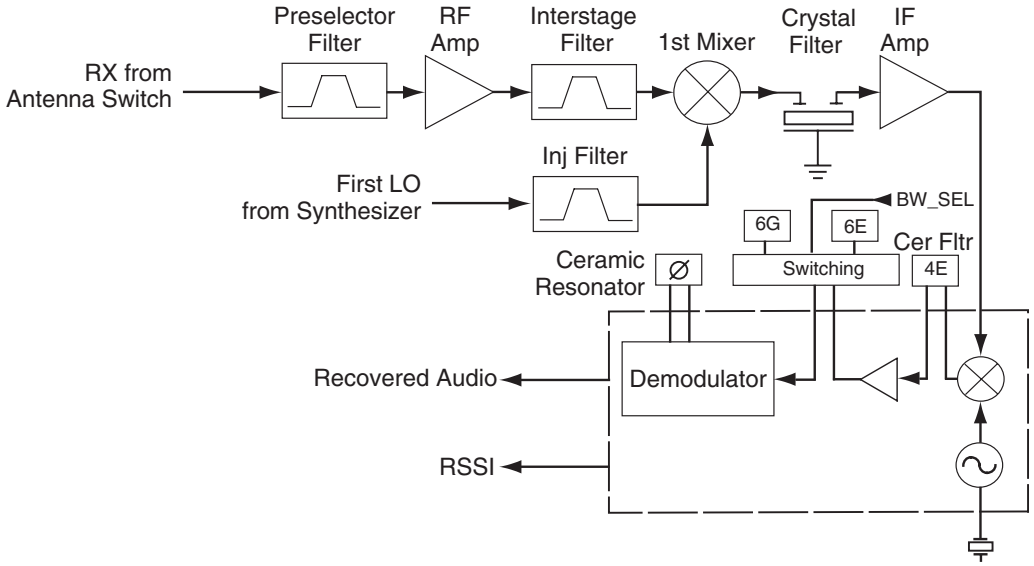


Figure 9-1. UHF Receiver Block Diagram

9.2.1 Receiver Front End

Incoming RF signals from the antenna are first routed through the harmonic filter and antenna switch, part of the transmitter circuitry, before being applied to the receiver front end. The receiver front end consists of a preselector filter, RF amplifier, an interstage filter, and a double-balanced first mixer.

The preselector filter is a fixed-tuned 3-pole Butterworth design using discrete elements (L1-L3, C1-C10, C12 and C523) in a shunt-resonator configuration. It has a 3 dB bandwidth of 68 MHz centered at 480 MHz, an insertion loss of 2 dB and image attenuation of 39 dB at 405.3 MHz. Diode CR1 protects the RF amplifier by limiting excessive RF levels. The filter bandwidth is considerably wider than the receive band, to achieve low insertion loss in a compact size. C523 provides a transmission-zero to improve image attenuation.

The output of the filter is matched to the base of RF amplifier Q21, which provides 18 dB of gain and a noise figure of 3.3 dB. A BFS505 device is used for high gain, low noise figure and reduced operating current. Operating voltage is obtained from the 5R source, which is turned off during transmit to reduce dissipation in Q21. Current mirror Q22 maintains the operating current of Q21 constant at 8 mA regardless of device and temperature variations, for optimum dynamic range and noise figure.

The output of the RF amplifier is applied to the interstage filter, a fixed-tuned 4-pole Butterworth shunt-coupled resonator design having a 3 dB bandwidth of 68 MHz centered at 480 MHz, and insertion loss of 3.3 dB. This filter yields an image rejection of 55 dB at 405.3 MHz, assisted by a transmission-zero at 300 MHz implemented by C524 for the reasons mentioned above.

The output of the interstage filter is connected to the passive double-balanced mixer consisting of components T41, T42, and CR41. This mixer has a conversion loss of 7.2 dB. Low-side injection from the frequency synthesizer is filtered by L40-L41 and C41-C45 to remove second harmonic energy that may degrade half-IF spurious rejection performance. The injection filter has a 3 dB bandwidth of 100 MHz centered at 408 MHz, and an insertion loss of 2.5 dB. The second-harmonic rejection is typically 40 dB or greater. The filtered injection signal is applied to T42 at a level of +6 dBm.

The mixer output is applied to a diplexer network (L51-L52, C51, R51) which matches the 44.85 MHz IF signal to crystal filter FL51, and terminates the mixer into 50Ω at all other frequencies.

9.2.2 Receiver Back End

The receiver back end is a dual conversion design. High IF selectivity is provided by FL51, a 4-pole fundamental mode 44.85 MHz crystal filter with a minimum 3 dB bandwidth of ±6.7 kHz, a maximum 20 dB bandwidth of + 12.5 kHz, and a maximum insertion loss of 3.5 dB. The output is matched to IF amplifier stage Q51 by L53 and C93. Q51 provides 16 dB of gain and a noise figure of 1.8 dB. The dc operating current is 1 mA. The output of Q51 is applied to the input of the receiver IFIC U51. Diode CR51 limits the maximum RF level applied to the IFIC.

The IFIC is a low-voltage monolithic FM IF system incorporating a mixer/oscillator, two limiting IF amplifiers, quadrature detector, logarithmic received signal strength indicator (RSSI), voltage regulator and audio and RSSI op amps. The second LO frequency, 44.395 MHz, is determined by Y51. The second mixer converts the 44.85 MHz high IF frequency to 455 kHz.

Additional IF selectivity is provided by two ceramic filters, FL52 (between the second mixer and IF amp) and FL53 or FL54 (between the IF amp and the limiter input). The wider filter FL53 is used for 20/25 kHz channel spacing, and the narrower filter FL54 is used for 12.5 kHz channels. When the BW_SEL line is high, the two upper diodes in packages D51 and D52 are forward biased, selecting FL53 for 20/25 kHz channels. When the BW_SEL line is low, the two lower diodes in packages D51 and D52 are forward biased, selecting FL54 for 12.5 kHz channels.

The ceramic filters have the following specifications:

	FL52	FL53	FL54
Number of Elements:	4	6	6
Insertion Loss:	4 dB	4 dB	4 dB
6 dB Bandwidth:	15 kHz	15 kHz	9 kHz
50 dB Bandwidth:	30 kHz	30 kHz	22 kHz
Stopband Rejection:	27 dB	47 dB	47 dB

Ceramic resonator Y70 provides phase vs. frequency characteristic required by the quadrature detector, with 90 degree phase shift occurring at 455 kHz. Buffer Q70 provides a lower driving impedance from the limiter to the resonator, improving the IF waveform and lowering the distortion of the recovered audio signal. The recovered audio level at the DEMOD output is 120 mV rms (25 kHz channel, 3 kHz deviation) or 60 mV rms (12.5 kHz channel, 1.5 kHz deviation). An additional RSSI output provides a DC voltage level that is proportional to RF signal level. This voltage is measured by an A/D converter contained in the microprocessor (PE4_AN4, U401 pin 63).

9.3 UHF Transmitter

The UHF transmitter covers the range of 465-495 MHz. Depending on model, the output power of the transmitter is either switchable on a per-channel basis between high power (4 watts) and low power (1 watt), or is factory preset to 2 watts. The transmitter is divided into four major blocks as shown in Figure 9-2.

- Power Amplifier
- Harmonic Filter
- Antenna Matching Network
- Power Control.

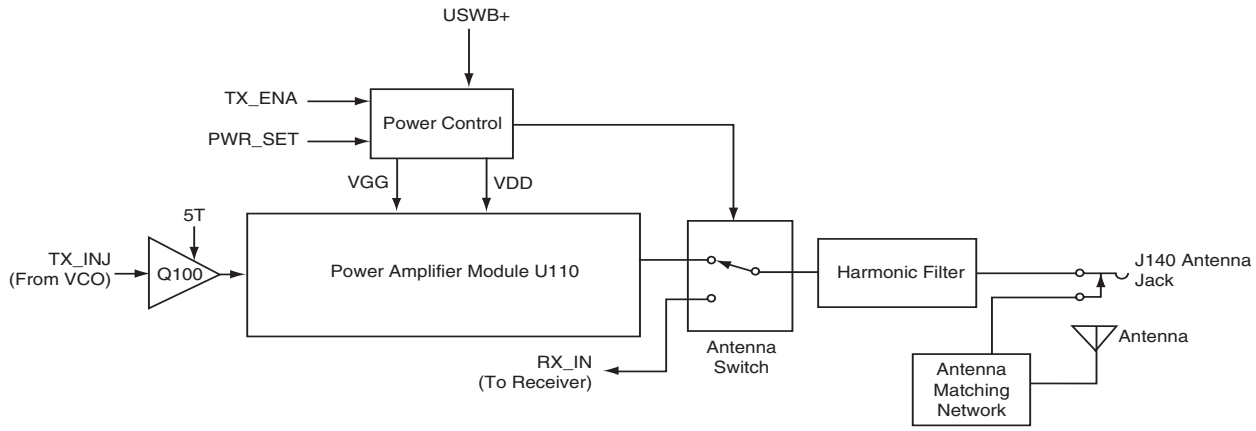


Figure 9-2. UHF Transmitter Block Diagram

9.3.1 Transmitter Power Amplifier

The transmitter power amplifier has three stages of amplification. The first stage, Q100, operates in Class A from the 5T source. It provides 17 dB of gain and an output of 50 mW. The current drain is typically 30mA. Components C105 and L103 match the output of Q100 to the 50Ω input of the module U110.

U110 is a two stage Silicon MOS FET power amplifier module. Drain voltage is obtained from UNSW B+ after being routed through current-sense resistor R150 in the power control circuit. The output power of the module is controlled by varying the DC gate bias on U110 pin 2 (VGG).

9.3.2 Antenna Switch

The antenna switch consists of two pin diodes, D120 and D121. In the receive mode, both diodes are off. Signals applied at the antenna or at jack J140 are routed, via the harmonic filter, through network C122-C124 and L121, to the receiver input. In the transmit mode, Q170 is on and TXB+ is present, forward-biasing both diodes into conduction. The diode current is 20 mA, set by R120-R121. The transmitter RF from U110 is routed through D120, and via the harmonic filter to the antenna jack. D121 conducts, shunting RF power and preventing it from reaching the receiver. L121 is selected to appear as a 1/4 wave at UHF, so that the low impedance of D121 appears as a high impedance at the junction of D120 and the harmonic filter input. This provides a high series impedance and low shunt impedance divider between the power amplifier output and receiver input.

9.3.3 Harmonic Filter

The harmonic filter consists of components C130-C136 and L130-L132. The harmonic filter is a seven-pole Chebychev low-pass configuration, optimized for low insertion loss, with a 3 dB frequency of approximately 655 MHz and typically less than 0.8 dB insertion loss in the passband.

9.3.4 Antenna Matching Network

The harmonic filter presents a 50Ω impedance to antenna jack J140. A matching network, made up of C140-C141 and L140, is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the impedance presented by the antenna, significantly improving the antenna's efficiency.

9.3.5 Power Control

The power control circuit is a dc-coupled amplifier whose output is the dc gate bias voltage (VGG) applied to the two stages of the RF power amplifier U110.

The output power of the transmitter is adjusted by varying the setting of the power-set DAC contained in the ASFICcmp IC (DACG, U451 pin 6). This PWR_SET voltage is applied to U150 pin 3.

Stage U150-2 compares the voltage drop across current sense resistor R150 to the voltage drop across resistor R151 caused by current flow through Q150, and adjusts its output (pin 7) to maintain equal voltages at pins 5 and 6. Thus the current flow through Q150, and hence its emitter voltage, is proportional to the current drawn by stage U110, which is in turn proportional to the transmitter output power. The emitter voltage of Q150 is applied to U150 pin 2, where it is compared to the power set voltage PWR_SET at pin 3.

The output of U150 pin 1 is divided by R110 and R111 and applied as a gate voltage to the power amplifier U110. By varying this gate voltage as needed to keep the voltages at U150 pins 2 and 3 equal, power is maintained at the desired setting. Excessive final current, for example due to antenna mismatch, causes a lowering of the voltage at U150 pin 6, an increased voltage at pin 2, and a lowering of the voltage at pin 1 and of the gate voltage VGG. This prevents damage to the final stage due to excessive current.

9.4 UHF Frequency Generation Circuitry

The frequency generation system, shown in Figure 9-3, is composed of two circuit blocks, the Fractional-N synthesizer IC U201, the VCO/Buffer IC U251, and associated circuitry. Figure 9-4 shows the peripheral interconnect and support circuitry used in the synthesizer block, and Figure 9-5 details the internal circuitry of the VCOBIC and its interconnections to the surrounding components. Refer to the schematic to identify reference designators.

The Fractional-N synthesizer is powered by regulated 5 V and 3 V provided by U310 and U330 respectively. 5 V is applied to U201 pins 13 and 30, and 3 V is applied to pins 5, 20, 34 and 36. The synthesizer in turn generates a super-filtered 4.5 V supply (VSF, from pin 28) to power U251. In addition to the VCO, the synthesizer also interfaces with the logic and ASFICcmp circuits. Programming for the synthesizer is accomplished through the microprocessor SPI_DATA_OUT,

SPI_CLK, and SYNTH_CS (chip select) lines (U409 pins 100, 1 and 47 respectively). A logic high (3 V) from U201 pin 4 indicates to the microprocessor that the synthesizer is locked.

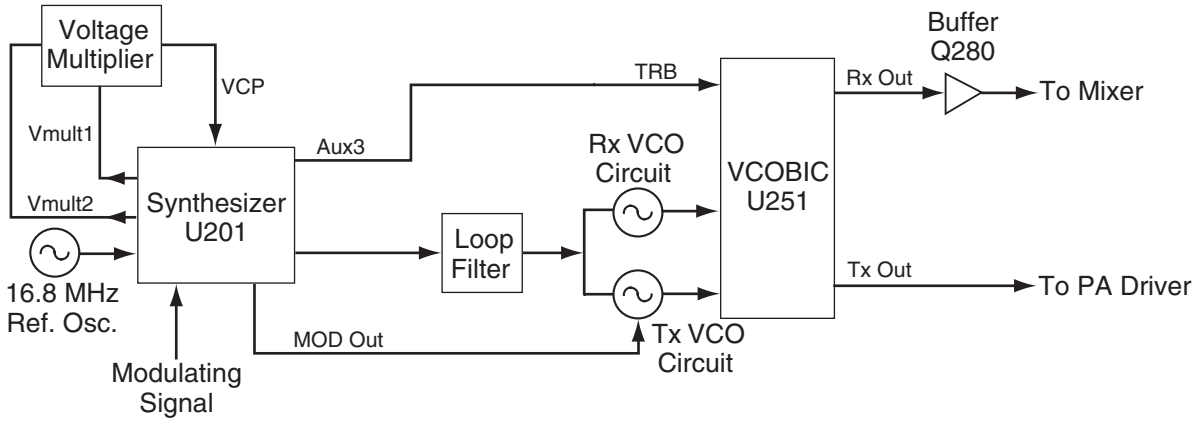


Figure 9-3. UHF Frequency Generation Unit Block Diagram

Transmit modulation from the ASFICcmp (U451 pin 40) is applied to U201 pin 10 (MOD_IN). An electronic attenuator in the ASFICcmp adjusts overall transmitter deviation by varying the audio level applied to the synthesizer IC. Internally the audio is digitized by the Fractional-N synthesizer and applied to the loop divider to provide the low-port modulation. The audio is also routed through an internal attenuator for the purpose of balancing the low port and high port modulation and reducing the deviation by 6 dB for 12.5 kHz channels, and is available at U201 pin 41 (VCO_MOD). This audio signal is routed to the VCO's modulator.

9.4.1 Fractional-N Synthesizer

The Fractional-N synthesizer, shown in Figure 9-4, uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. External components C201-C203, R202 and D201 are also part of the temperature-compensated oscillator circuit. The dc voltage applied to varactor D201 from U201 pin 25 is determined by a temperature-compensation algorithm within U201, and is specific to each crystal Y201, based on a unique code assigned to the crystal that identifies its temperature characteristics. Stability is better than 2.5 ppm over temperatures of -30 to 60°C. Software-programmable electronic frequency adjustment is achieved by an internal DAC which provides a frequency adjustment voltage from U201 pin 25 to varactor D201.

The synthesizer IC U201 further divides the 16.8 MHz signal to 2.1 MHz, 2.225 MHz, or 2.4 MHz for use as reference frequencies. It also provides a buffered 16.8 MHz signal at U201 pin 19 for use by the ASFICcmp.

To achieve fast locking of the synthesizer, an internal adapt charge pump provides higher current at U201 pin 45 to quickly force the synthesizer within lock range. The required frequency is then locked by the normal mode charge pump at pin 43. A loop filter (C243-C245 and R243-R245) removes noise and spurs from the steering voltage applied to the VCO varactors, with additional filtering located in the VCO circuit.

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier made up of C221-C224 and D220-D221. Two 3 V square waves from U201 pins 14-15 provide the drive signals for the voltage multiplier, which generates 12.1 V at U201 pin 47. This voltage is filtered by C225-C228.

One of the auxiliary outputs of the synthesizer IC (AUX3, U201 pin 2) provides the TRB signal which determines the operating mode of the VCO, either receive or transmit.

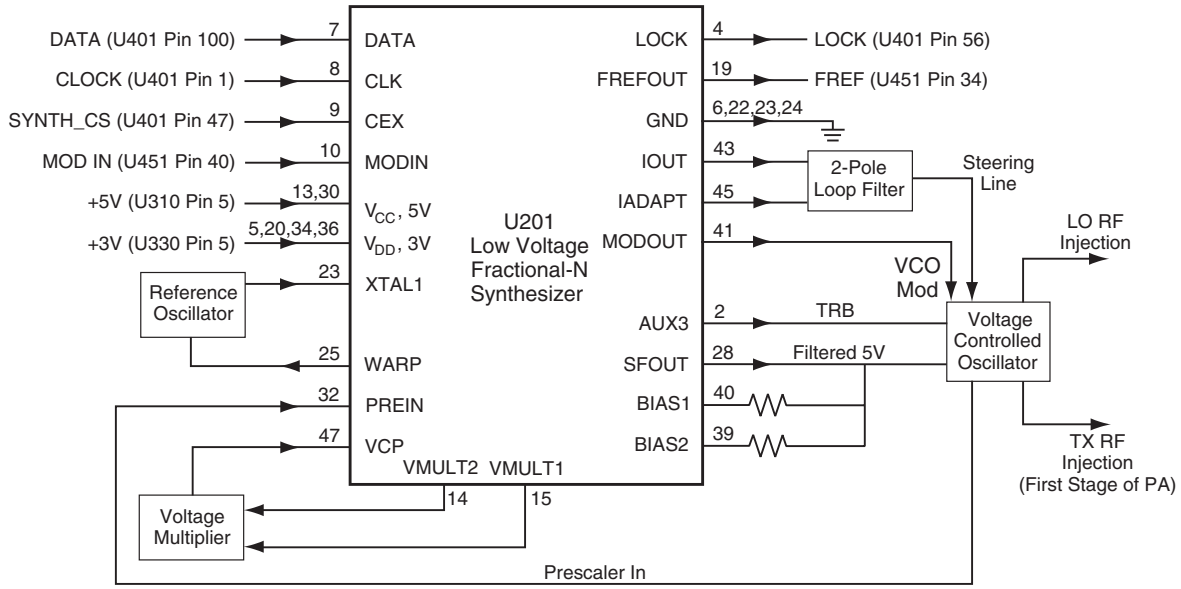


Figure 9-4. UHF Synthesizer Block Diagram

9.4.2 Voltage Controlled Oscillator (VCO)

The VCOBIC (U251), shown in Figure 9-5, in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U251 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U251 pin 12 through a low pass filter, to the prescaler input of the synthesizer IC (U201 pin 32). After frequency comparison in the synthesizer, a resultant DC control voltage is used to steer the VCO frequency. When the PLL is locked on frequency, this voltage can vary between 3.5 V and 10 V. L251 and C252 further attenuate noise and spurs on the steering line voltage.

In the receive mode, the TRB line (U251 pin 19) is low. This activates the receive VCO and the receive buffer of U251, which operate within the range of 420.15 to 450.15 MHz. The VCO frequency is determined by tank inductor L254, C253-C257, and varactor D251. The buffered RF signal at U251 pin 8 is further amplified by Q280 and applied as RX_INJ to the low-pass injection filter in the receiver front end circuit.

In the transmit mode, U251-19 is driven high by U201 pin 2, enabling the transmit VCO and buffer. The 438-470 MHz RF signal from U251 pin 10 is applied as TX_INJ to the input of the transmitter circuit via matching network C290-C291 and L291. TX VCO frequency is determined by L264, C263-

C267, and varactor D262. High-port audio modulation from the synthesizer IC is applied as VCO_MOD to varactor D261 which modulates the transmit VCO.

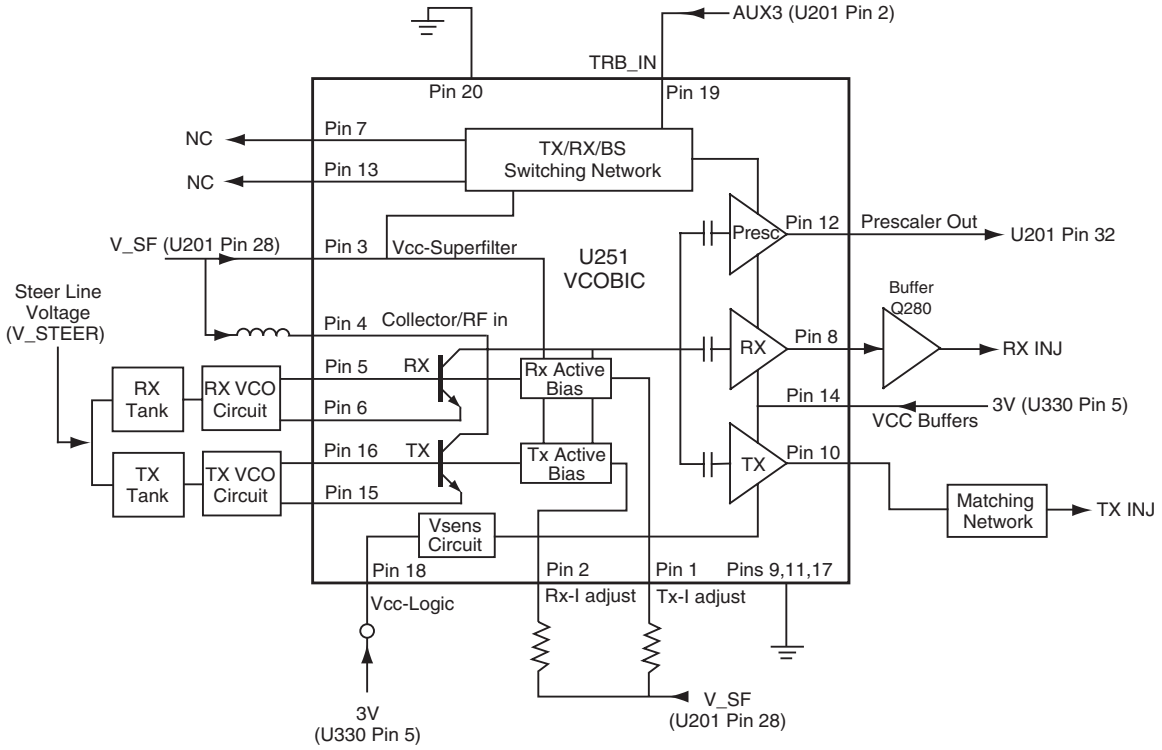


Figure 9-5. UHF VCO Block Diagram

9.5 Keypad

The keypad block diagram is shown in Figure 9-6. Pressing a key creates two distinct voltages KEYPAD_ROW and KEYPAD_COL. These voltages are sent directly to the radio's microprocessor on the main board. The microprocessor then interprets the voltage for KEYPAD_ROW and KEYPAD_COL for each key press.

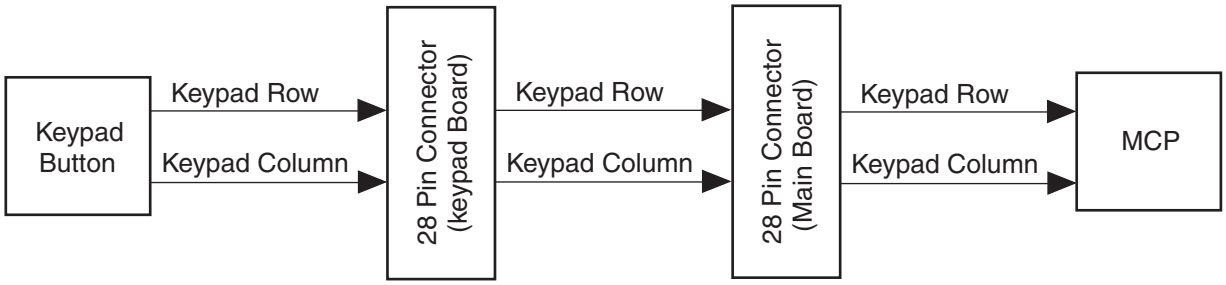


Figure 9-6. Keypad Block Diagram

Notes:

Chapter 10 UHF Troubleshooting Tables

10.1 Troubleshooting Table for Receiver

Table 10-1. Troubleshooting Table for Receiver

Symptom	Possible Causes	Procedure	Corrective Action
Radio Dead (no turn-on beep, no LED indication)	1. Battery dead or defective.	Substitute known good battery or battery eliminator.	Charge or replace battery.
	2. Defective battery contacts.	Inspect battery contacts for corrosion or bent terminals.	Clean/repair/replace J301.
	3. Blown fuse	Check voltage on each side of fuse. If blown, 0 VDC after fuse.	Check for short on output, check D301, VR301, troubleshoot/repair as needed, replace fuse.
	4. DC switching fault	Verify battery voltage present at S444 pin 5 when radio is on. Verify Q494-1 is at least 1V dc, Q494-6 is ~0.1V dc, Q493-3 is at Vbatt.	Check/replace on-off-volume control S444. Troubleshoot/replace Q493/4.
	5. Microprocessor not starting up.	Verify clock input to U401-90 (EXTAL) is 7.3975 MHz using high impedance probe. If clock is 3.8MHz, check for shorts on U401 pins. Connect RIB to verify communication via CPS. Verify U401-94 (RESET) is high.	Verify 16.8 MHz signal at U451-34. If OK, troubleshoot/replace U451. If not present, troubleshoot U201 Synthesizer. Reprogram/reflash as needed. If RESET is Low, troubleshoot regulator U320. Check for shorts at U401 pins. Replace U401. Reprogram as needed.
	6. Regulator fault	Verify U310-5 is 5V dc, U320-5 is 3.3V dc, U330-5 is 3V dc.	Check for shorts on outputs, troubleshoot/repair as needed, replace faulty regulator.

Table 10-1. Troubleshooting Table for Receiver (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
No Audio	1. Synthesizer out of lock	Verify U201-4 is at 3V dc.	Troubleshoot synthesizer/VCO circuits.
	2. Defective IFIC	Verify audio is present at U51-8.	Check Q70, Y70, U51.
	3. RX audio buffer fault	Verify audio is present at U451-2.	Check U510 and associated parts.
	4. ASFIC fault	Verify audio is present at U451-41. Verify U451-14 is high.	Check squelch setting, PL/DPL programming. Troubleshoot/ replace U451.
	5. Audio PA fault	Verify U490-1 is <0.2V dc. Verify audio is present at U490-5 and 8.	Check Q490. Check/replace U490.
	6. Defective speaker	Verify audio is present at speaker terminals.	If not, check continuity of J471-2 and 3. Check J491. If yes, replace speaker.
No Receive (squelch noise present)	1. No first injection	Check that RF level at T42-6 is approx +6 dBm. Check that RF level at U251-8 is at least -8 dBm.	Check injection filter C40-44, L40-41. If yes, check Q280 and associated parts. If no, check U251 and components on pins 5 and 6.
	2. No 5R source.	Verify U401-49 is high in RX. Verify Q311 gate is 0V dc in RX Verify Q311 drain is 5V dc in RX.	Check/replace U401 Check/replace Q313. Check for shorts, check/replace Q311.
	3. Harmonic filter or antenna switch fault	Apply on-channel 100 mV RF signal at antenna port. Verify RF level at jct. C1/C2 per schematic.	Check TX harmonic filter, D120-121. Should be 0V dc on D120-121.
	4. Back end fault	Apply on-channel 100 mV RF signal at antenna port. Measure RF levels from FL51 through U51.	Check components prior to loss-of-signal point.
	5. No second injection	Measure RF level at U51-3, verify approx. 280 mV rms.	If dc voltages at U51-3 and 4 are OK, check Y51 and associated parts. If not replace U51.

10.2 Troubleshooting Table for Synthesizer

Table 10-2. Troubleshooting Table for Synthesizer

Symptom	Possible Causes	Procedure	Corrective Action
Synthesizer Out of Lock (RX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pin 2 through 6 and 10 per Table 10-4. Verify steering line voltage is between ~3V and 10V.	Check VCO tank components connected to U251-5 and 6. Check for shorts/opens, replace U251. Check D251 and associated components.
	2. Synthesizer fault	Verify TRB line (from U201-2 to U251-19) is low in RX mode	Check for shorts, check U201 voltages per Table 10-4, replace U201 if incorrect.
	3. Programming fault	Verify RX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (TX mode only)	1. VCO fault	Verify oscillator is working, check RF level at U251-10 per schematic. Check dc voltages at U251 pins 1,3,4,10,15,16 per Table 10-4. Verify steering line voltage is between ~3V and 10V.	Check VCO tank components connected to U251-15 and 16. Check for shorts/opens, replace U251. Check D261 and associated components.
	2. Synthesizer fault	Verify TRB line (U201-2 to U251-19) is high (3V) in TX mode	Check for shorts, check U201 voltages per Table 10-4, replace U201 if incorrect.
	3. Programming fault	Verify TX channel programming is correct.	Re-program if necessary.
Synthesizer Out of Lock (RX and TX modes)	1. VCO fault	Check that RF level at U251-12 is at least 150 mV (VHF) or -12 to -20 dBm (UHF)	If low/missing, check L276, C276-7, R276.
	2. Synthesizer fault	Check that RF level at U201-32 is at least 150 mV (VHF) or -12 to -20 dBm (UHF). Verify steering line voltage is between ~3V and 10V.	If correct, check/replace U201. If incorrect, check R248 and C241. Check loop filter components R243-5 and C243-5.
	3. DC voltage fault	Verify 4.5V dc at U201-28. Verify 12.1V dc at U201-47	Check C231-233, etc., for shorts. If OK check/replace U201. Check for 3V 1.05 MHz sq waves at U201-14 and 15. Check C218-228, D220-221.
	4. Programming fault	Verify channel programming is correct.	Re-program if necessary.

10.3 Troubleshooting Table for Transmitter

Table 10-3. Troubleshooting Table for Transmitter

Symptom	Possible Causes	Procedure	Corrective Action
No Transmit (no TX LED indication)	1. PTT switch defective.	Verify U401-71 goes low when PTT is pressed.	Replace PTT switch S441.
	2. EXT MIC PTT fault	Verify U401-72 goes low when J471-4 is grounded.	Check/replace Q470, L471 etc.
No Transmit (TX LED indication OK)	1. Synthesizer out of lock	Refer to Table 10-2.	Refer to Table 10-2.
	2. No TX_ENABLE	Verify U401-50 is high when pin 71 or 72 is low.	Check/replace U401.
	3. TX DC switch fault	Verify Q171-C is 0V in TX. Verify Q170-C is at Vbatt in TX.	Replace Q171. Check for shorts, replace Q170.
	4. Power control fault	Check Q150 and U150 dc voltages per schematic and Table 10-4.	Repair/replace defective components
	5. No TX injection	Check that RF level at jct. R100/R101 per schematic.	Check U251, L291-292, C290-291.
	6. No 5T source	Verify Q312 gate is 0V dc in TX Verify Q312 drain is 5V dc in TX.	Check/replace Q313. Check for shorts, check/replace Q312.
	7. TX gain stage failure	Check RF levels at Q100 and U110 per schematic.	Troubleshoot Q100/U110 and associated circuitry.
	8. Antenna switch failure	Verify dc voltage at jct. R122/L120 is approx 1.5V.	Check/replace D120-121, L120-121, R120-122, etc.
Low Power	1. Low TX injection	Check that RF level at jct. R100/R101 per schematic.	Check U251, L291-292, C290-291.
	2. Low gain in TX stage	Verify dc voltage at Q100-E is ~1.3V (VHF) or ~0.5V (UHF). Verify that RF level at U110-1 is approx. 1V (VHF) or 1.6V (UHF).	Verify 5T voltage is correct. Troubleshoot Q100 circuitry. Troubleshoot Q100 circuitry. Check/replace Q100.
	3. Incorrect control voltage	Verify that the dc voltage at PWR_SET (R162) is approx 1.8V dc (at 1 watt) to 2.6V dc (at 4-5 watts). Verify that the dc voltage at U110-2 is approx 2-3V dc (at 1 watt) to 3-4V dc (at 4-5 watts). (See schematic.)	Check programming. Troubleshoot controller circuitry. Check/replace U451. Troubleshoot U150, Q150 and associated circuitry.
	4. Antenna switch defect	Verify dc voltage at jct. R122/L120 (VHF) or R121/L120 (UHF) is approx 1.7V. *Note: Do not attempt to measure RF or DC voltages at the diodes. Damage to test equipment may occur.*	Check/replace D120-121, L120-121, R120-122, etc.
	5. Harmonic filter defect	Visually inspect components C130-137, L130-132. Check dc continuity of L130-132 *in RX mode only.*	Repair/replace if necessary.

Table 10-3. Troubleshooting Table for Transmitter (Continued)

Symptom	Possible Causes	Procedure	Corrective Action
Poor TX range, conducted power OK	1. RF test jack defective	Verify continuity of J140 pins 3 and 4 *in RX mode only*.	Replace J140.
	2. Antenna matching network fault	Visually inspect components C140-141, L140 or L141. Check dc continuity of L140 or L141 *in RX mode only*.	Repair/replace if necessary.
	3. Defective or wrong antenna	Verify correct antenna is installed. Try another antenna.	Replace antenna.
No internal mic audio (EXT MIC audio OK)	1. Mic bias fault	Verify U451-35 is low when side PTT is pressed. Verify Q470-6 is high when side PTT button is pressed.	Check/replace U451. Check/replace R474, R476, and Q470.
	2. Defective mic	Verify approx 1.8V dc across cartridge when side PTT button is pressed. Verify audio present (~10 mV rms) when speaking into mic.	Check mic connector and R478. Replace mic cartridge.
	3. Defective mic jack	Verify continuity between J471 pins 4 and 5.	Replace J471.
No EXT MIC audio	1. Mic bias fault	Verify approx 1.8V dc across EXT MIC cartridge in TX mode. Verify audio present (~10 mV rms) when speaking into mic.	Check Q470. R475, R477, L471. Check VR473, VR475, D470 for shorts.
	2. Audio path fault	Verify mic audio present (~10 mV rms) at U451-46. Verify amplified mic audio present (~200 mV rms) at U451-40.	Check L471, C470. Check/replace U451.
	3. Defective audio accessory	Try another accessory.	Replace defective accessory.

10.4 Troubleshooting Table for Board and IC Signals

Table 10-4. Troubleshooting Table for Board and IC Signals

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U51 IFIC	1	RF input 44.85 MHz	1.20	
	2	RF input decoupling	1.20	
	3	2nd LO osc output	4.02	
	4	2nd LO osc input	4.60	
	5	RSSI output	0.74	(no received signal)
	6	Vcc	4.70	
	7	Audio feedback	0.89	
	8	Audio output	1.44	DEMOD to stage U510
	9	RSSI feedback	0.74	(no received signal)
	10	Quad detector input	2.22	
	11	Limiter output	1.25	
	12	Limiter decoupling 2	1.30	
	13	Limiter decoupling 1	1.30	
	14	Limiter input	1.28	
	15	Ground	GND	
	16	IF amp output	1.22	
	17	IF amp decoupling 2	1.26	
	18	IF amp input	1.26	
	19	IF amp decoupling 1	1.26	
	20	2nd mixer output	3.09	
U52 BW Select Switch	1	Inverter 1 input	0	(25 kHz mode)
	2	Inverter 2 output	0	(25 kHz mode)
	3	Inverter 3 input (NU)	GND	
	4	Ground	GND	
	5	Inverter 3 output (NU)	4.96	
	6	Inverter 2 input	3.00	(25 kHz mode)
	7	Inverter 1 output	4.95	(25 kHz mode)
	8	Vcc	4.96	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U110 RF Power Amp	1	RF input	0	(TX mode)
	2	Vgg (gate bias)	2.65 (typ)	(TX mode) (4.25V typ at VHF)
	3	Vdd	6.59	(TX mode)
	4	RF output	--	Do not measure
	5	Ground	GND	
U150 Dual Opamp	1	Unit 1 output	4.20 (typ)	(TX mode) (5.8V typ at VHF)
	2	Unit 1 (-) input	2.39 (typ)	(TX mode)
	3	Unit 1 (+) input	2.39 (typ)	(TX mode)
	4	Ground	GND	
	5	Unit 2 (+) input	3.30 (typ)	(TX mode)
	6	Unit 2 (-) input	3.35 (typ)	(TX mode)
	7	Unit 2 output	2.23 (typ)	(TX mode)
	8	Vcc	6.79	(TX mode)
U201 Freq Synthesizer	1	AUX2 output (NU)	0	
	2	AUX3 output (TRB)	0.03	To U251-19 (RX mode)
	3	AUX4 output (NU)	0	
	4	Lock detect output	2.98	To U401-56
	5	PD Vdd	2.98	
	6	Digital ground	GND	
	7	Serial data input	3.23	
	8	Serial clock input	0	
	9	Synth chip select	3.23	From U401-47
	10	Modulation input	1.50	From U451-40
	11	VMULT4 (NU)	2.98	
	12	VMULT3 (NU)	0	
	13	VRO	4.96	
	14	VMULT2	1.49	
	15	VMULT1	1.49	
	16	INDMULT (NU)	0	
	17	NC1	0	
	18	Ref select (NU)	0	
	19	Buffered 16.8 MHz out	1.54	
	20	Analog Vdd	3.00	
	21	V bypass (NU)	1.55	
	22	Analog ground	GND	
	23	Ref osc XTAL1	2.07	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U201 Freq Synthesizer	24	Ref osc XTAL2	0	
	25	Ref osc warp output	3.00	
	26	Superfilter cap	4.48	
	27	Superfilter base (NU)	3.76	
	28	Superfilter output	4.52	
	29	NC2	0	
	30	Superfilter input	4.96	
	31	NC3	0	
	32	Prescaler input	1.97	
	33	Prescaler ground	GND	
	34	Prescaler Vdd	2.99	
	35	Prescaler Vref (NU)	1.97	
	36	Digital Vdd	2.99	
	37	TEST1 (NU)	0.01	
	38	TEST2 (NU)	0	
	39	Bias 2	3.38 (typ)	(1.34V in TX mode)
	40	Bias 1	1.50 (typ)	(3.20V in TX mode)
	41	Modulation output	3.42 (typ)	(1.62V typ in TX mode)
	42	CCOMP (NU)	0.05	
	43	Steering line IOUT	9.62 (typ)	Depends on frequency
	44	PD ground	GND	
	45	Steering line IADAPT	9.62 (typ)	Depends on frequency
	46	Adapt switch (NU)	0	
	47	Voltage from charge pump	12.8	
	48	AUX1 output (NU)	2.98	
U251 VCO / Buffer	1	TX VCO current adjust	4.50	
	2	RX VCO current adjust	4.35	
	3	Superfiltered input	4.51	
	4	Collector RF in amp	4.35	
	5	RX VCO base	1.27	
	6	RX VCO emitter	0.48	
	7	RX switch output (NU)	0	
	8	RX buffered VCO output	3.36	
	9	GND_FLAG	GND	
	10	TX buffered VCO output	3.36	
	11	GND_BUFFERS	GND	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U251 VCO / Buffer	12	Prescaler output	2.26	
	13	TX switch output (NU)	0.06	
	14	Vcc_BUFFERS	3.00	
	15	TX VCO emitter	0	(RX mode)
	16	TX VCO base	0	(RX mode)
	17	GND_LOGIC	GND	
	18	Vcc_LOGIC	3.00	
	19	TRB input	0.03	From U201-2 (RX mode)
	20	FLIP input	GND	
U310 5V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	4.96	
U320 3.3V Regulator	1	Ground	GND	
	2	Feedback	1.23	
	3	Tap (NU)	0	
	4	Vin	7.48	
	5	Vout	3.23	
	6	Sense (NU)	0	
	7	Error (reset output)	3.20	
	8	Shutdown input	7.48	
U330 3V Regulator	1	Vin	7.48	
	2	Ground	GND	
	3	Control input	7.48	
	4	Bypass capacitor	1.26	
	5	Vout	3.00	
U401 Microprocessor	1	PD4_SCK serial clock input	0	
	2	PD5_SS	3.23	ASFIC chip select
	3	PD6_VLIN	3.23	EEPROM chip select
	4	PG7_R_W	3.21	
	5	PG6_AS	3.23	
	6	PG0_XA13	3.23	
	7	PB7_ADDR15	0.026	
	8	PB6_ADDR14	0.028	
	9	PB3_ADDR11	3.06	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	10	PB1_ADDR9	3.05	
	11	PB2_ADDR10	0.16	
	12	VDD	3.23	
	13	VSS	GND	
	14	PBO_ADDR8	3.05	
	15	PB5_ADDR13	0.13	
	16	PG1_XA14	0.20	
	17	PG4_XA17	3.17	
	18	PG5_XA18	0	
	19	PG3_XA16	3.21	
	20	PG2_XA15	0.30	
	21	PB4_ADDR12	0.22	
	22	PF7_ADDR7	3.03	
	23	PF6_ADDR6	3.08	
	24	PF5_ADDR5	3.06	
	25	PF4_ADDR4	0.16	
	26	PF3_ADDR3	0.26	
	27	PF2_ADDR2	3.06	
	28	PF1_ADDR1	3.06	
	29	PFO_ADDR0	3.05	
	30	PC0_DATA0	0.69	
	31	PC1_DATA1	0.96	
	32	PC2_DATA2	1.10	
	33	PC3_DATA3	0.81	
	34	PC4_DATA4	0.62	
	35	PC5_DATA5	0.68	
	36	PC6_DATA6	0.67	
	37	PC7_DATA7	0.73	
	38	PH7_CSPROG	3.05	
	39	VDDL	3.23	
	40	VSSL	GND	
	41	PH6_CSGP2	3.23	
	42	PH5_CSGP1	3.23	
	43	PH4_CSIO	0	
	44	PH3_PW4	3.21	On/off control output
	45	PH2_PW3	0	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	46	PH1_PW2	3.00	
	47	PH0_PW1	3.23	Synth chip select
	48	XIRQ	3.00	
	49	PI7	1.48	RX enable
	50	PI6	0.01	TX enable
	51	PI5	3.23	
	52	PI4	0	Green LED enable
	53	PI3	0	Red LED enable
	54	PI2	0	
	55	PI1	0	
	56	PI0	2.98	Lock detect from U201-4
	57	MODB_VSTBY	3.22	Boot mode enable
	58	MODA_LIR	3.12	
	59	AVDD	3.23	
	60	PE7_AN7	3.20	
	61	PE6_AN6	3.20	
	62	PE5_AN5	2.91	VOX threshold detect
	63	PE4_AN4	0.73	RSSI input
	64	PE3_AN3	0.14	
	65	PE2_AN2	1.62	
	66	PE1_AN1	0 - 3.3 V	Volume control wiper
	67	PE0_AN0	2.48	33% of battery voltage
	68	VRL	0	
	69	VRH	3.20	
	70	AVSS	GND	
	71	PJ0_CSGP3	3.23	Side PTT button
	72	PJ1_CSGP4	0	External MIC PTT
	73	PJ2	3.23	
	74	PJ3	3.23	
	75	PJ4	3.23	
	76	PJ5	0	
	77	PJ6	3.23	Bottom option button
	78	PJ7	3.23	Top option button
	79	PA0_IC3	0	
	80	PA1_IC2	1.57	
	81	PA2_IC1	3.00	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U401 Microprocessor	82	PA3_IC4_OC5_OC1	3.00	
	83	PA4_OC4_OC1	0	Squelch detect input
	84	PA5_OC3_OC1	0	Channel activity input
	85	PA6_OC2_OC1	0	
	86	PA7_PA1_OC1	0	
	87	VSSR	GND	
	88	VDDR	3.23	
	89	ECLK (NU)	1.60	
	90	EXTAL	1.70	Clock from U451-28
	91	XTAL	1.40	Not used
	92	VDDSYN	0	
	93	XFC (NU)	0	
	94	RESET	3.20	From U320
	95	LVOUT	0	
	96	IRQ	3.20	
	97	PD0_RXD	3.23	
	98	PD1_TXD	1.9	
	99	PD2_MISO	0	
	100	PD3_MOSI	3.23	
U402 EEPROM	1	Chip select	3.23	From U401-3
	2	Serial data out	0	
	3	Write protect	3.23	
	4	Vss	GND	
	5	Serial data in	3.23	
	6	Serial clock	0	
	7	Hold	3.23	
	8	Vcc	3.23	
U404 Flash ROM	1	A11	3.06	
	2	A9	3.08	
	3	A8	3.05	
	4	A13	0.13	
	5	A14	0.31	
	6	NC	3.17	
	7	EN_WE	3.21	From U401-4
	8	Vcc	3.23	
	9	RESET	3.20	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U404 Flash ROM	10	A16	3.17	
	11	A15	0.30	
	12	A12	0.22	
	13	A7	3.03	
	14	A6	3.08	
	15	A5	3.06	
	16	A4	0	
	17	A3	0.24	
	18	A2	3.08	
	19	A1	3.05	
	20	A0	3.05	
	21	D0	0.69	
	22	D1	0.94	
	23	D2	1.08	
	24	GND	GND	
	25	D3	0.78	
	26	D4	0.59	
	27	D5	0.66	
	28	D6	0.67	
	29	D7	0.75	
	30	EN_CE	3.01	From U401-38
	31	A10	0.16	
	32	EN_OE	0	From U401-86
U451 ASFIC_CMP	1	VDD for analog circuits	3.00	
	2	DISC audio input	1.34	From U510
	3	Ground for analog circuits	GND	
	4	DACU output	0	
	5	DACR output	0	
	6	DACG output	2.38 (typ)	Power set (TX mode)
	7	VOX peak detector output	2.91	
	8	PLCAP for DC integrator	0.40	
	9	SQIN	0.01	
	10	Universal audio input/output	0	
	11	VDD for DACs	4.95	
	12	SQCAP	0	
	13	GCB2 general purpose output	0	Audio PA_EN (unsquelched)

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U451 ASFIC_CMP	14	GCB1 general purpose output	0	
	15	GCB0 general purpose output	3.00	BW select (25 kHz mode)
	16	Squelch channel activity output	0	To U401-84
	17	Squelch detect digital output	0	To U401-83
	18	PL/low speed data I/O	1.50	
	19	High speed data I/O	3.00	
	20	Chip select	3.23	From U401-2
	21	Serial clock input	0	
	22	Serial data input	3.23	
	23	Ground for clock synthesizer	GND	
	24	Loop filter cap for clock syn	0.74	
	25	PLCAP2 for LS integrator	1.17	
	26	Not used	0	
	27	Vdd for clock synthesizer	3.00	
	28	Clock synthesizer output	1.70	
	29	1200 Hz ref for MDC decode	3.00	
	30	GNDDO	GND	
	31	Ground for digital circuits	GND	
	32	Vdd for analog switches	4.96	
	33	Vdd for digital circuits	3.00	
	34	16.8 MHz master clock input	1.54	
	35	GCB3 general purpose output	3.00	Internal MIC enable
	36	TX audio return from option	0	
	37	GCB4 general purpose output	0	
	38	GCB5 general purpose output	0	
	39	RX audio send to option	1.48	
	40	Modulation output	1.50	To U201-10
	41	RX audio out to power amp	1.51	
	42	Flat TX audio return from option	0.20	
	43	RX audio return to option	1.50	
	44	Flat TX audio send to option	1.50	
	45	Vdd for audio path I/O filters	3.00	
	46	Mic audio input	1.50	
	47	Ground for audio path I/O filters	GND	
	48	Ext mic audio input (not used)	0	

Table 10-4. Troubleshooting Table for Board and IC Signals (Continued)

IC Designator	Pin	Pin Function	DC Voltage	Comments (Condition)
U480 Dual Opamp	1	Unit 1 output	2.48	
	2	Unit 1 (-) input	2.48	
	3	Unit 1 (+) input	2.46	
	4	Ground	GND	
	5	Unit 2 (+) input	0.28	
	6	Unit 2 (-) input	0.29	
	7	Unit 2 output	0	
	8	Vcc	4.96	
U490 Audio Power Amp	1	Enable/shutdown	0.12	(Unsquelched)
	2	Bias reference	3.26	(Unsquelched)
	3	(+) input	3.26	(Unsquelched)
	4	(-) input	3.27	(Unsquelched)
	5	(-) output	3.25	(Unsquelched)
	6	Vcc	7.48	(Unsquelched)
	7	Ground	GND	
	8	(+) output	3.29	(Unsquelched)
U510 Dual Opamp	1	Unit 1 output	1.75	
	2	Unit 1 (-) input	1.56	
	3	Unit 1 (+) input	1.55	
	4	Ground	GND	
	5	Unit 2 (+) input	1.55	
	6	Unit 2 (-) input	1.56	
	7	Unit 2 output	1.38	
	8	Vcc	4.96	

1. All voltages are measured with a high-impedance digital voltmeter and expressed in volts DC relative to ground (0V).
2. Voltages are measured with a DC input voltage of 7.50 + .02 volts DC applied to the battery connector (J301).
3. All voltages are measured in the squelched receive mode, unless otherwise indicated.
4. Voltages are identical for VHF and UHF models unless otherwise indicated.

Notes:

Chapter 11 UHF Schematic Diagrams, Overlays, and Parts Lists

11.1 Introduction

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

11.1.1 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, resistance values are in ohms (K = 1000), capacitance values are in picofarads (pF) or microfarads (µF), and inductance values are in nanohenries (nH) or microhenries (µH).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. If the board has been removed from the chassis, the transmitter module mounting screws may be used for ground connection. (*Note: The antenna nut bracket is not connected to ground.*) Operating mode dependent voltages are followed by (RX) for receive mode, (TX) for transmit mode, (UNSQ) for unsquelched mode, etc.
3. RF voltages on VHF models are measured with a Fluke model 85 RF probe. The indicated voltages expressed in mV (RF) are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
4. RF voltages on UHF models are measured both with a high-impedance RF voltmeter having a bandwidth in excess of 500 MHz (levels are expressed in dBm) and with a Fluke model 85 RF probe [levels are expressed in mV (RF)]. These indicated voltages are DC level readings which correspond approximately 1:1 to the RF voltage level in mV rms, and are only approximate for UHF frequency measurements. RF voltages in the Receiver Front End and Receiver Back End circuits are measured with an on-channel 100 mV (-7 dBm) RF signal applied to the antenna jack J140.
5. Audio voltages are measured with a high-impedance AC rms voltmeter. The indicated voltages are expressed in mV rms. Receive mode voltages are followed by (RX) and are measured with an on-channel signal with 1 kHz modulation at 60% deviation (3 kHz for 25 kHz channels, or 1.5 kHz for 12.5 kHz channels). Transmit mode voltages are followed by (TX) and are measured with a 1 kHz, 10 mV rms signal present at the external microphone input (accessory connector J471 pin 4 hot and pin 7 ground).
6. Reference Designators are assigned in the following manner:

Ref. No. Series	Circuit Block
1-99	RF Front End
100-149	Transmitter RF Stages
150-200	Transmitter Power Control
201-250	Frequency Synthesizer
251-300	VCO

Ref. No. Series	Circuit Block
301-400	DC Regulation
401-450	Microprocessor
451-550	Audio

7. Circuit Block Interconnection Legend:

Name	Description
USWB+	Unswitched Battery Voltage (always on)
5V	5 volts (regulated)
5R	5 volts in RX mode only
5T	5 volts in TX mode only
RESET	Low-line reset signal from U320 to uP
D3_3V	Digital 3.3 volts (regulated)
3V	Analog 3 volts (regulated)
TX_ENA	Transmit enable signal from uP to transmitter
PWR_SET	DC voltage from ASFIC to TX power control
DEMOD	RX audio from backend to ASFIC
BW_SEL	Backend filter BW select from ASFIC
RSSI	RX signal strength indication from IFIC to uP
IF_IN/OUT	44.85 MHz from 1st mixer to high IF filter
RF_IN/OUT	RX signal from antenna switch to front end
MOD OUT/IN	TX modulation from ASFIC to synthesizer
16_8_MHZ	Ref osc signal from synthesizer to ASFIC
SYNTH_CS	Synthesizer chip select from uP
SPI_CLK	Serial clock from uP
SPI_DATA_OUT	Serial data from uP
LOCK	Lock detect indication from synth to uP
PRESC	VCO freq feedback from VCOBIC to synth
V_STEER	Steering line voltage from synth to VCO's
V_SF	Super-filtered 4.5 volts from synth to VCOBIC
VCO_MOD	TX modulation from ASFIC to synthesizer
TRB	TX/RX control from synth to VCOBIC
RX_INJ	Buffered RX VCO output to RX 1st mixer
TX_INJ	TX VCO output to transmitter input

11.1.2 Six Layer Circuit Board

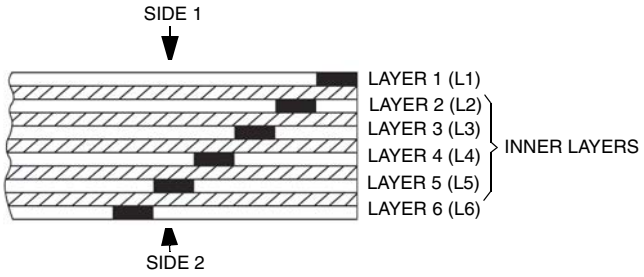


Figure 11-1. Six-Layer Circuit Board: Copper Steps in Layer Sequence

11.2 Speaker and Microphone Schematic

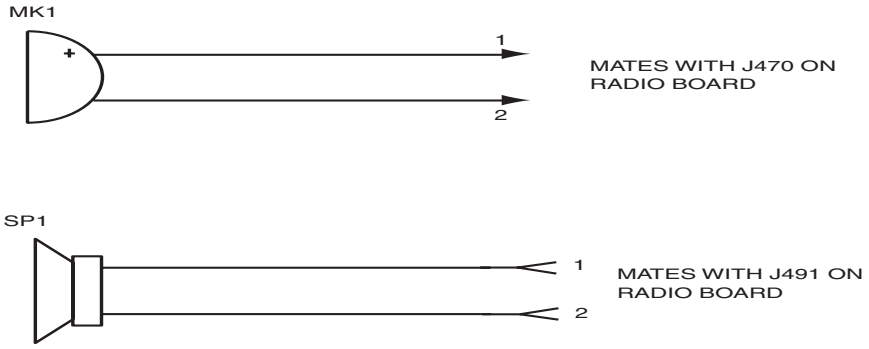


Figure 11-2. Speaker and Microphone Schematic

11.2.1 Speaker and Microphone Parts List

Reference Designator	Motorola Part No.	Description
MK1	5085880L01	Microphone, electret
SP1	5085738Z08	Speaker assembly with connector

Notes:

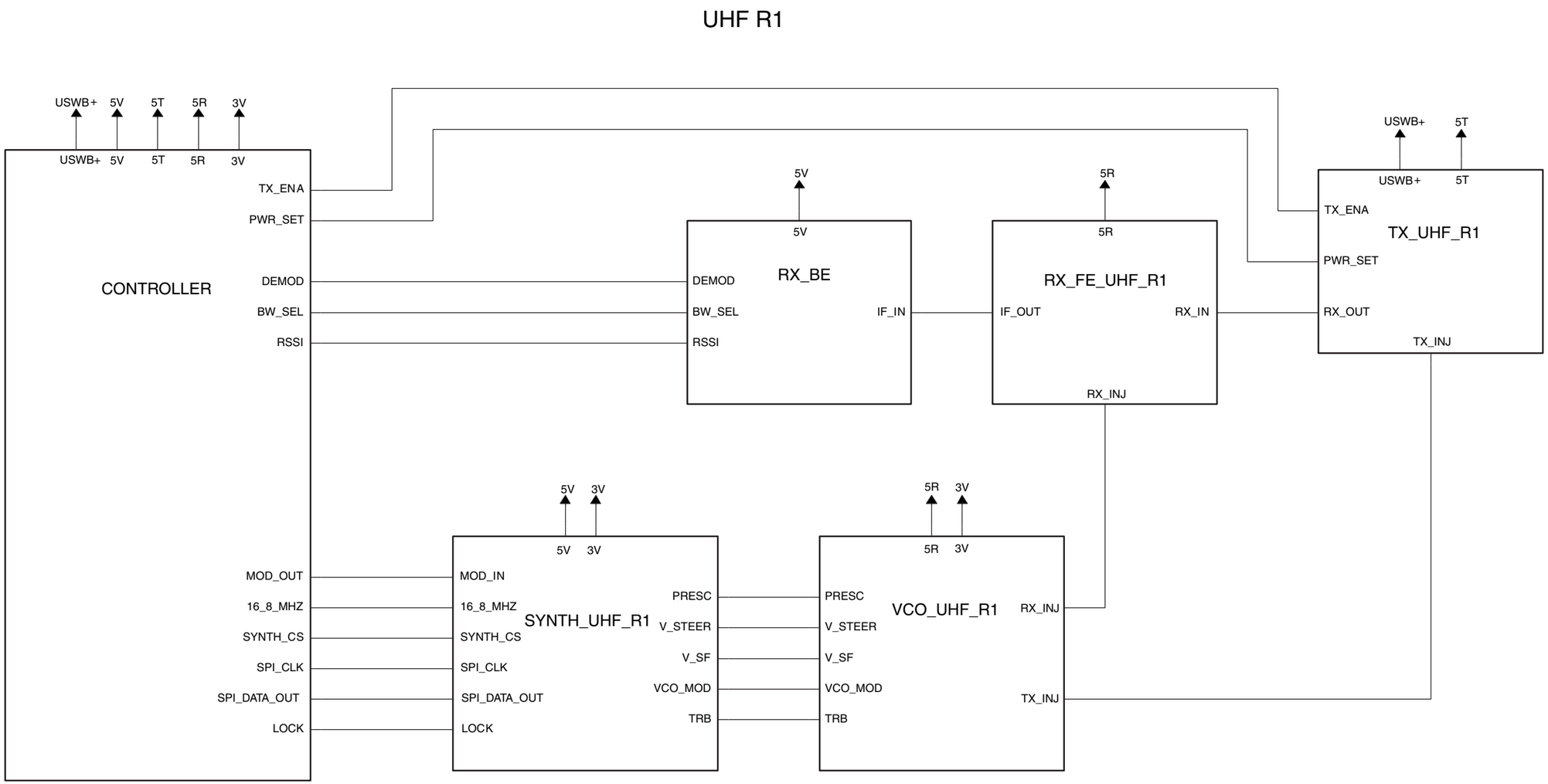


Figure 11-3. UHF (403-440 MHz) Radio Circuit Block Diagram

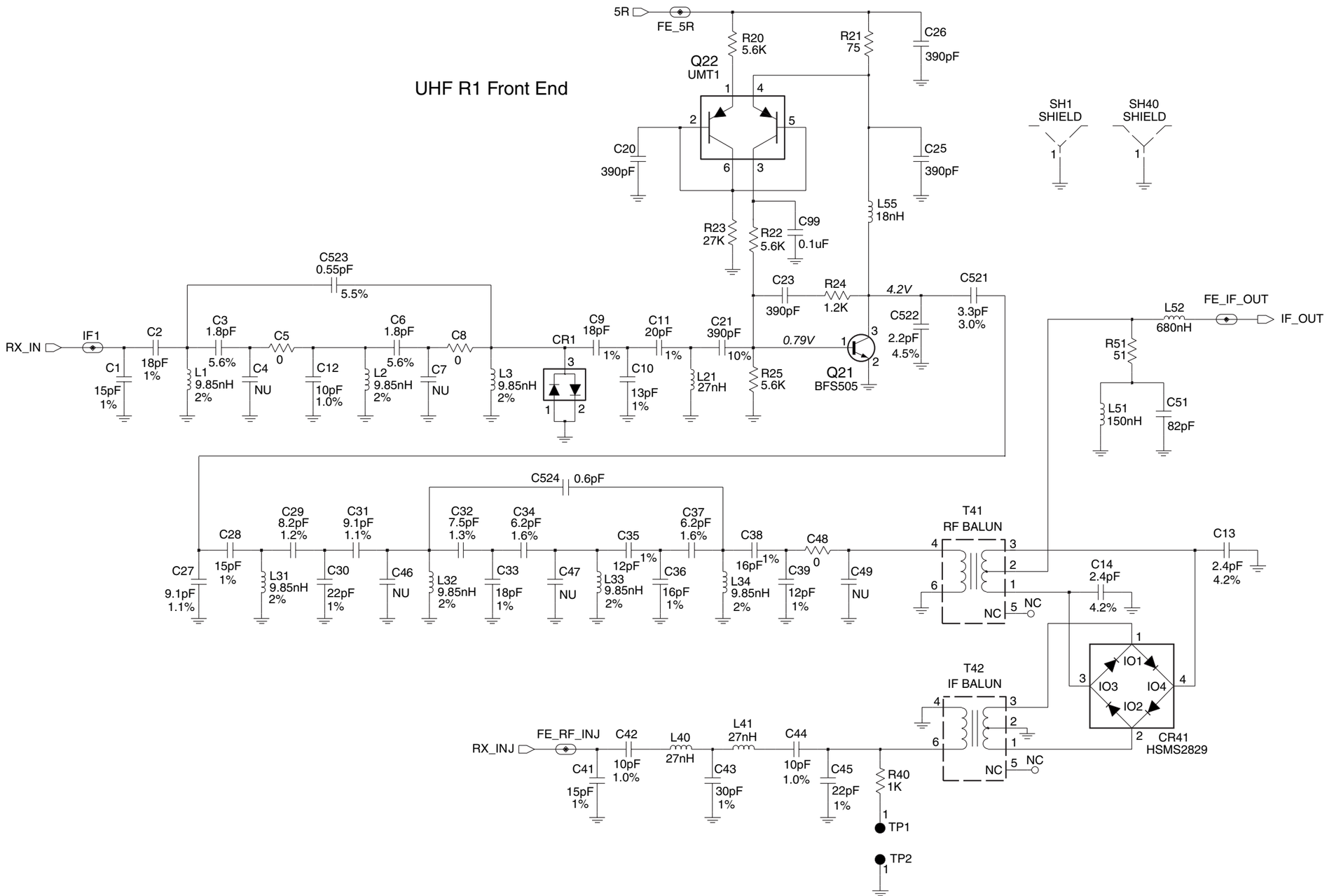


Figure 11-4. UHF (403-440 MHz) PCB 8486635Z03-O Receiver Front End Schematic Diagram

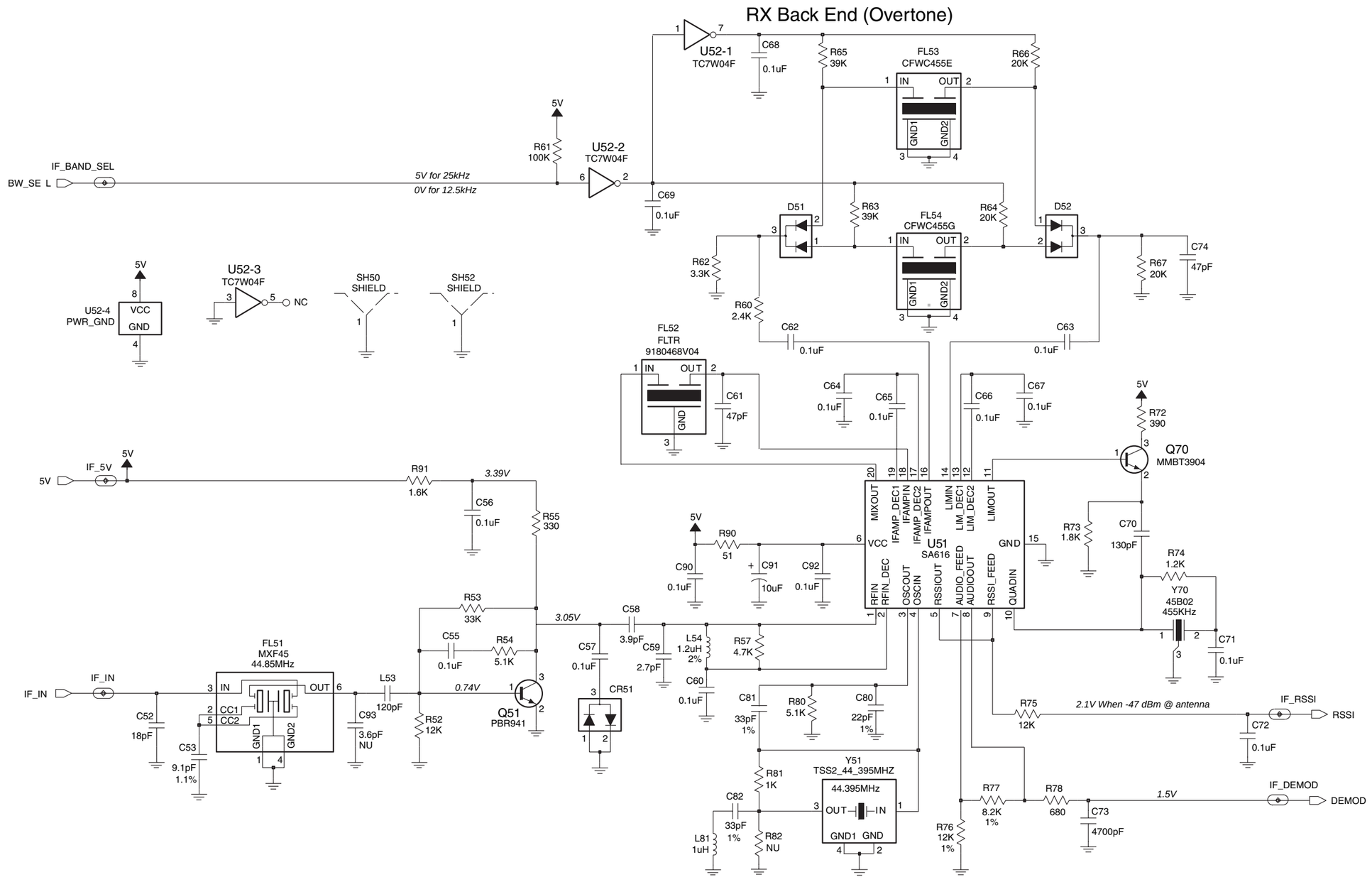


Figure 11-5. UHF (403-440 MHz) Receiver Back End Schematic Diagram

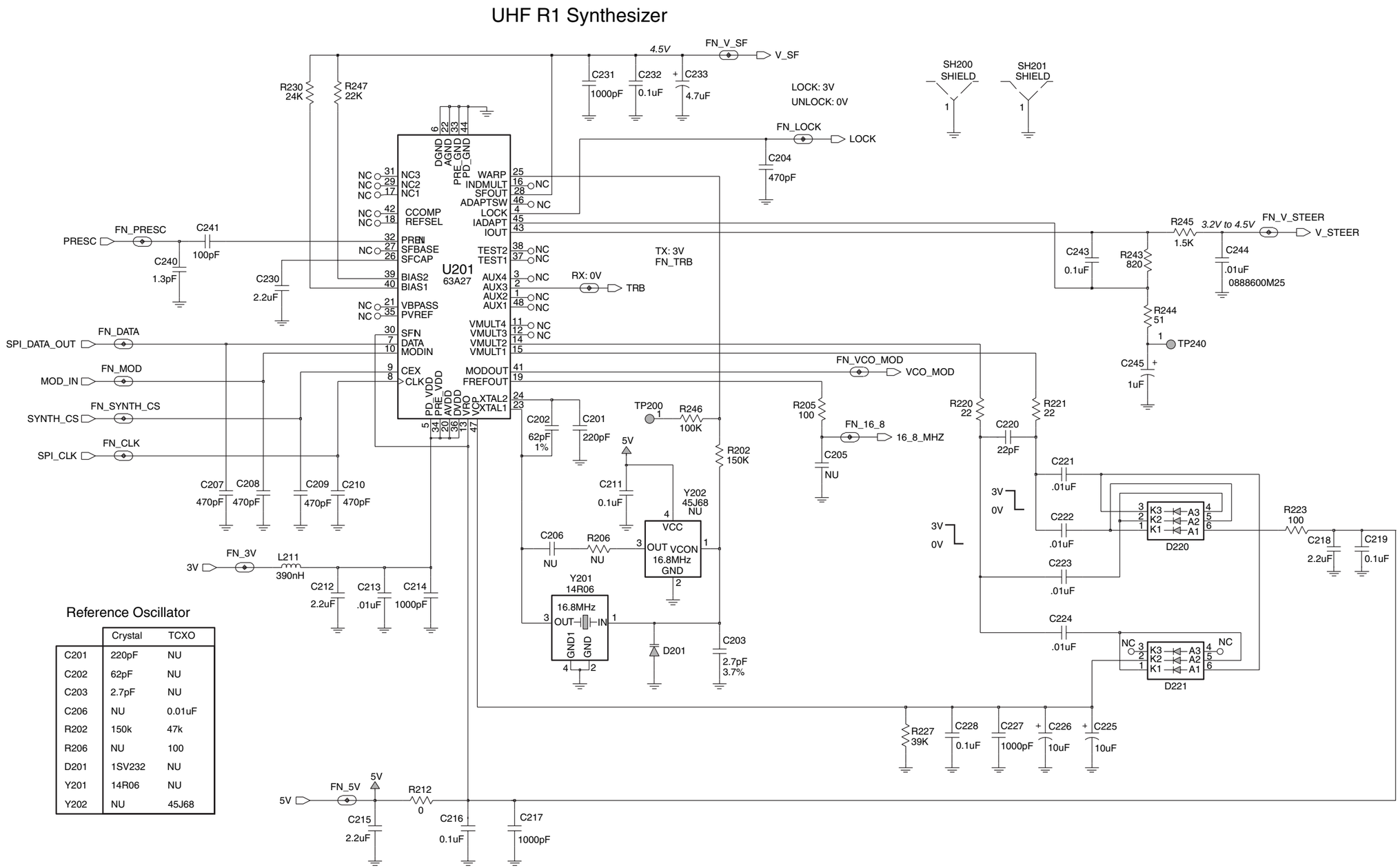


Figure 11-6. UHF (403-440 MHz) PCB 8486635Z03-O Synthesizer Schematic Diagram

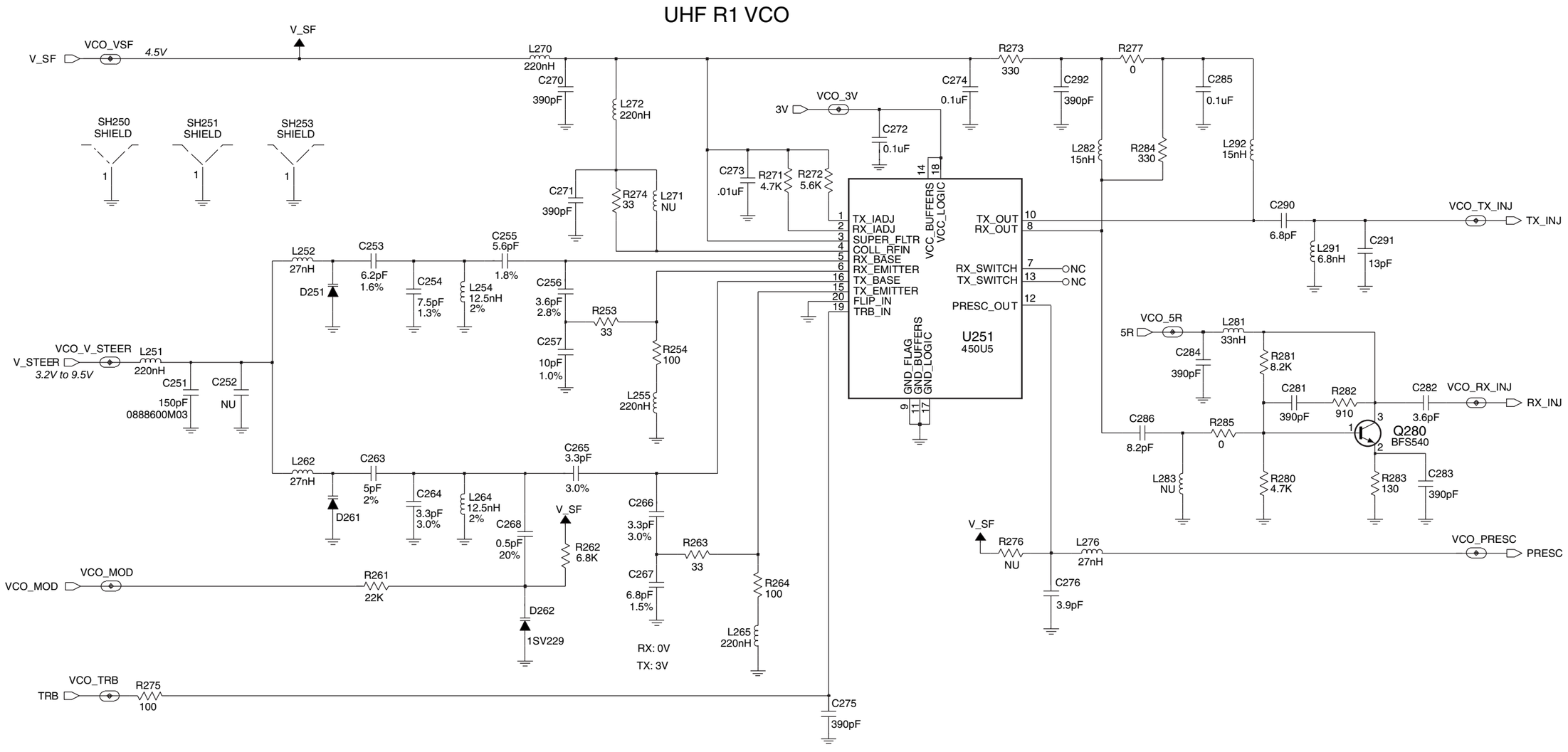


Figure 11-7. UHF (403-440 MHz) Voltage Controlled Oscillator Schematic Diagram

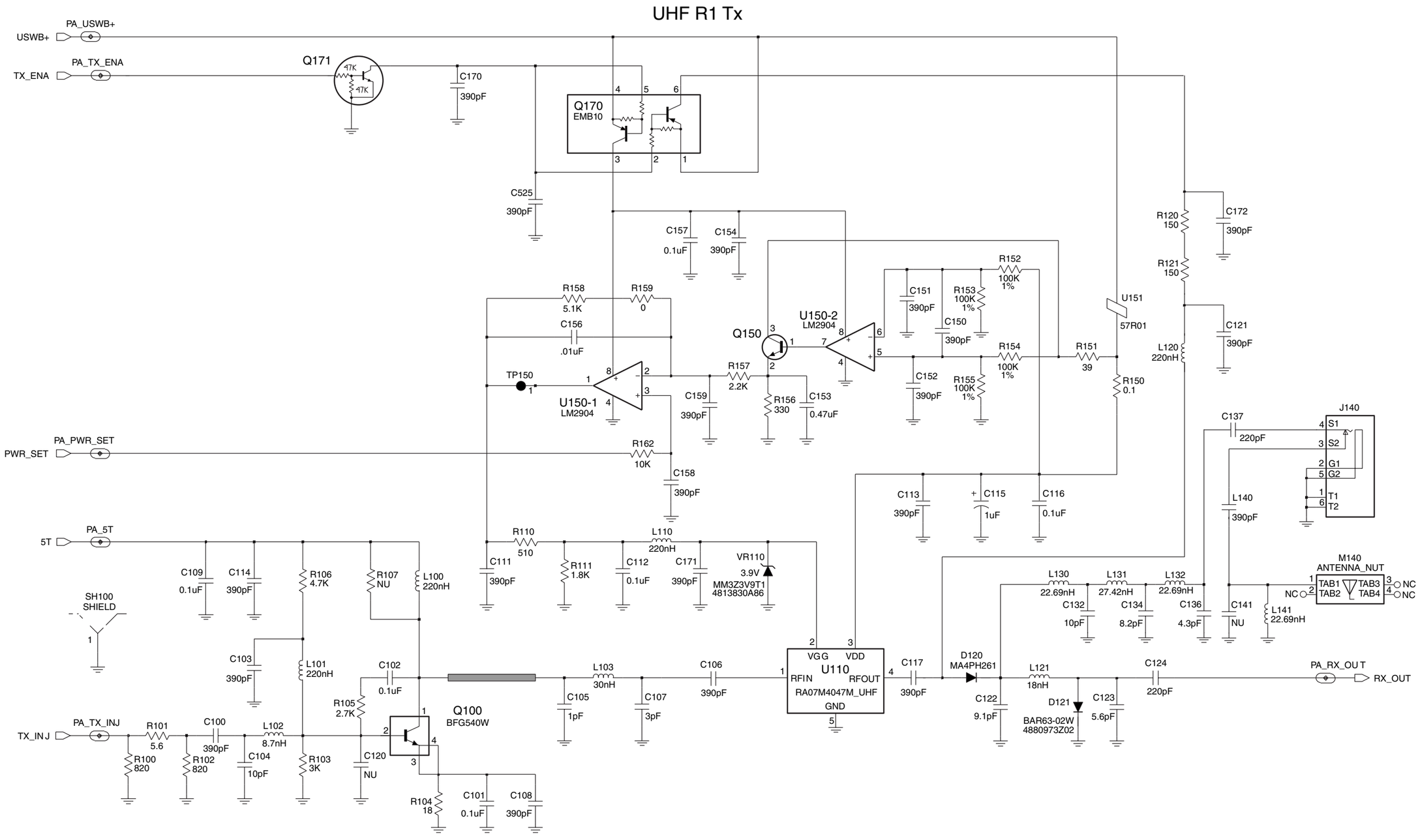


Figure 11-8. UHF (403-440 MHz) PCB 8486635Z03-O Transmitter and Power Control Schematic Diagram

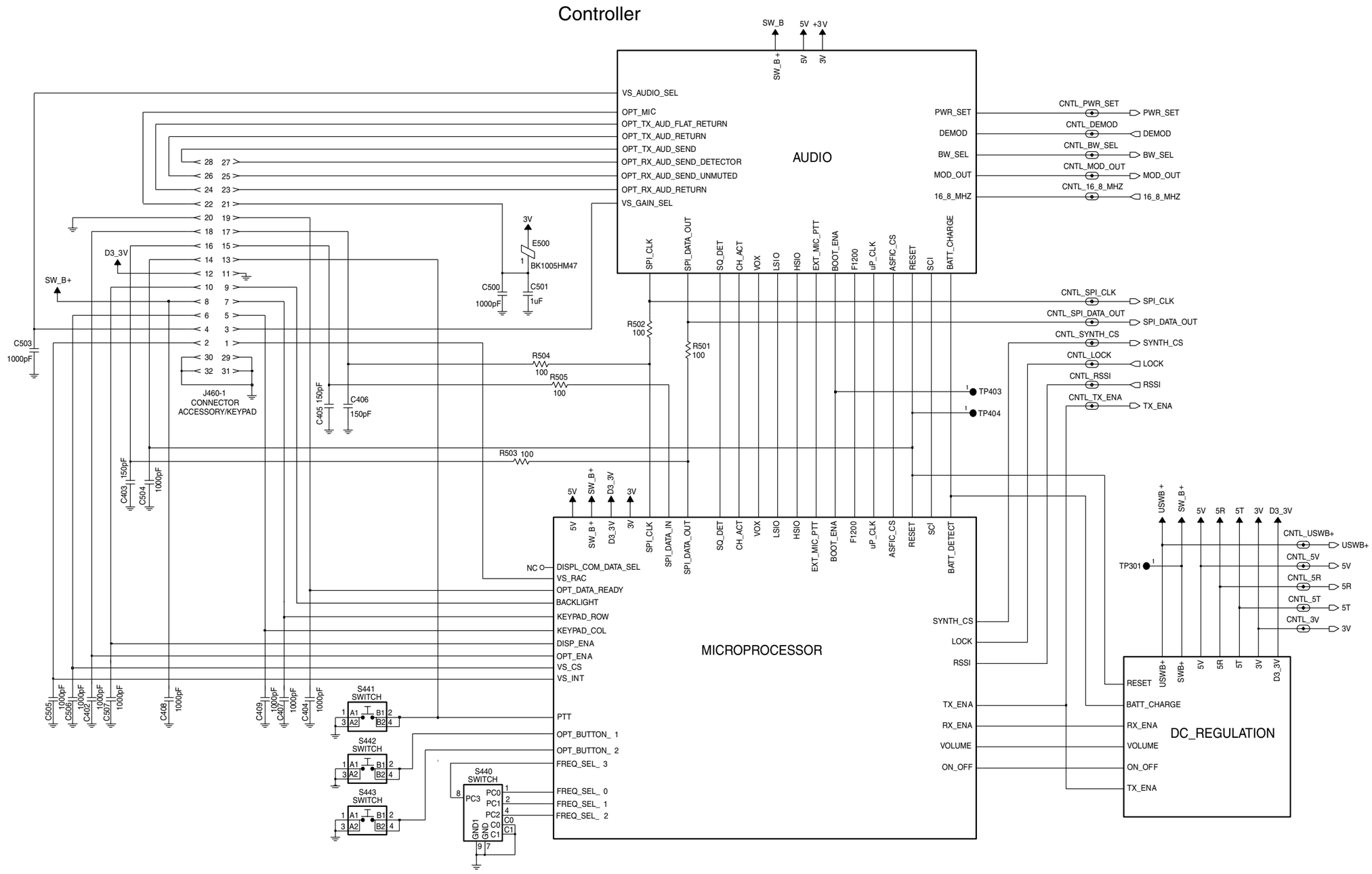


Figure 11-9. UHF (403-440 MHz) Controller Interconnect Schematic Diagram

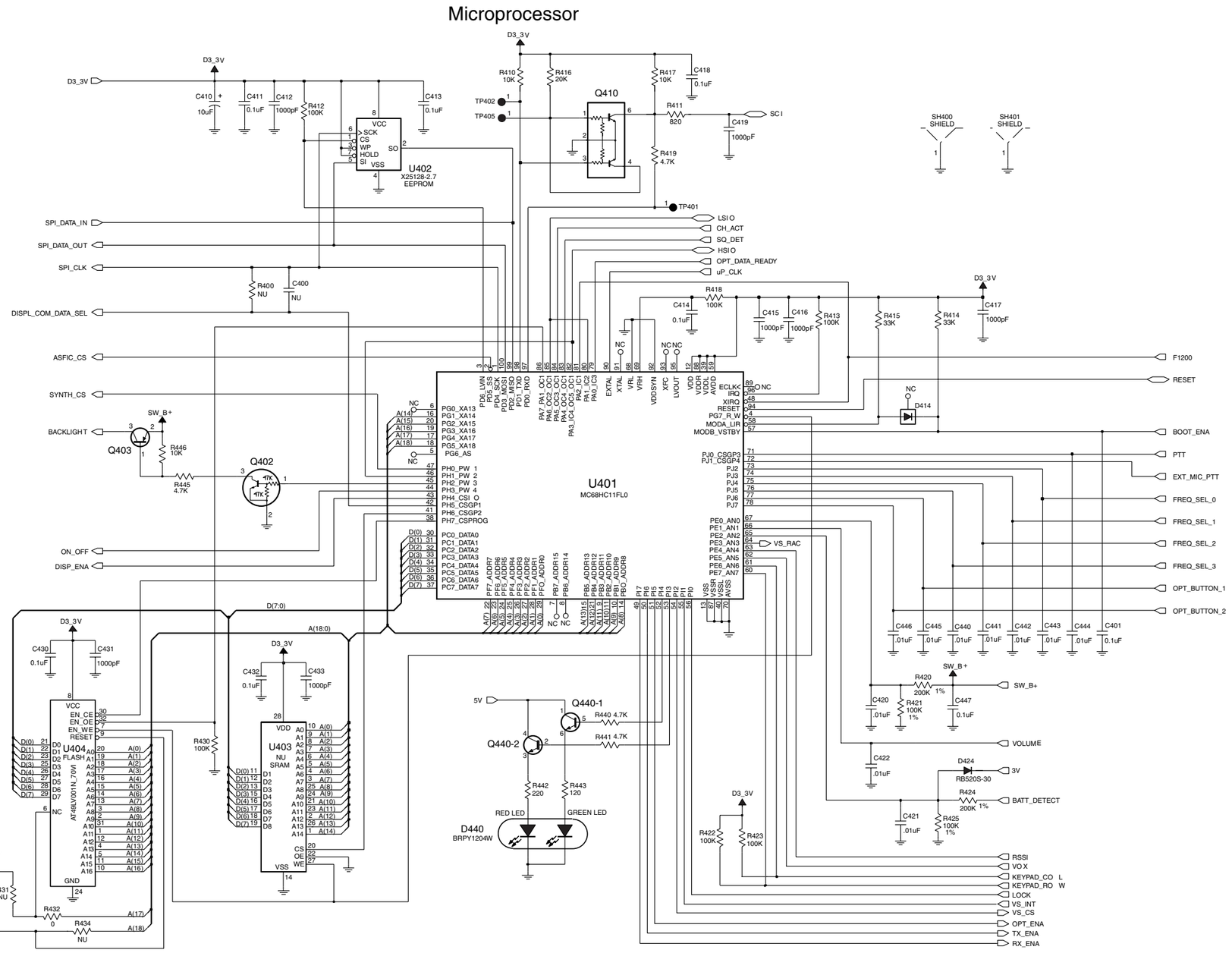
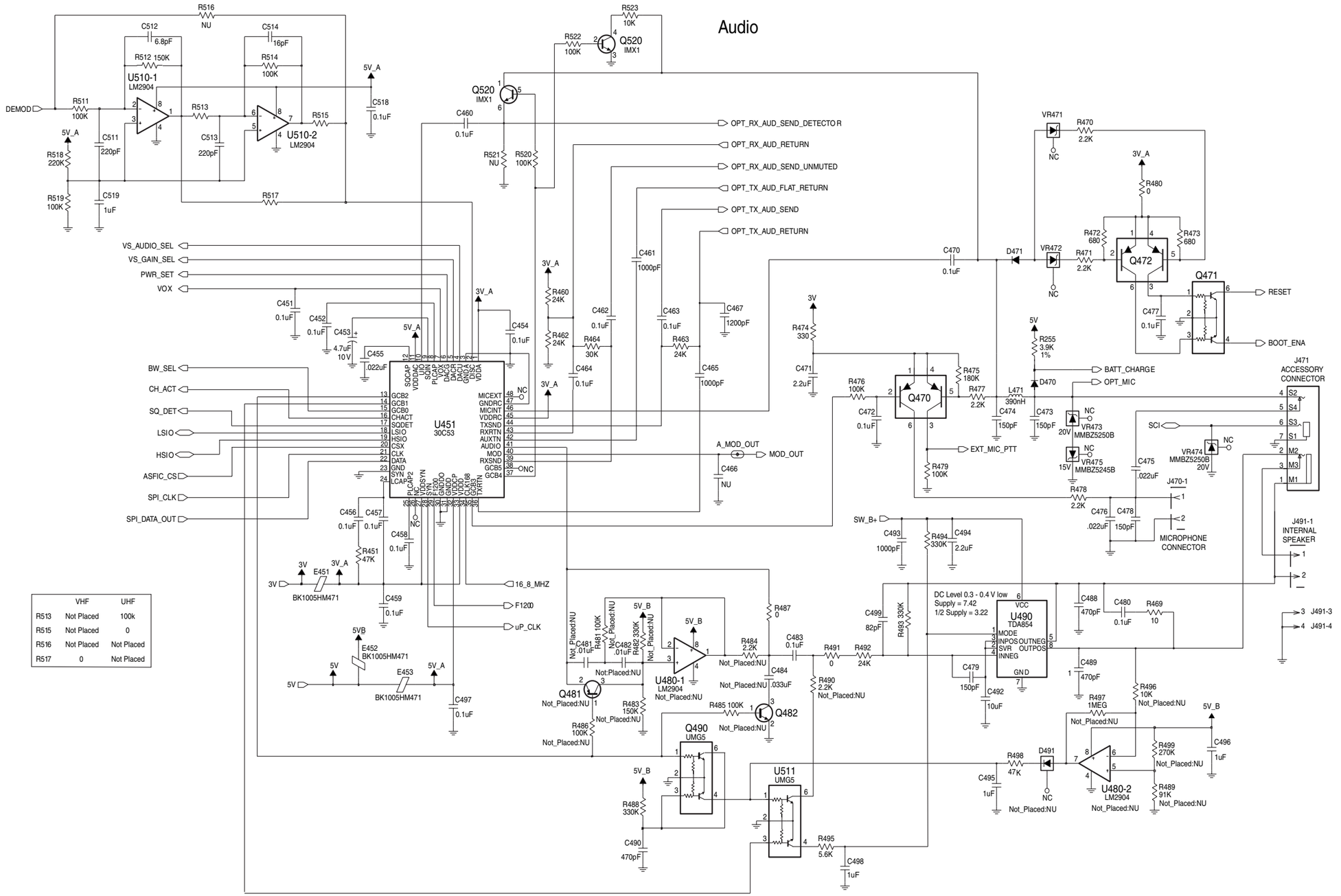


Figure 11-10. UHF (403-440 MHz) PCB 8486635Z03-O Microprocessor Circuitry Schematic Diagram



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 11-11. UHF (403-440MHz) Audio Circuitry Schematic Diagram

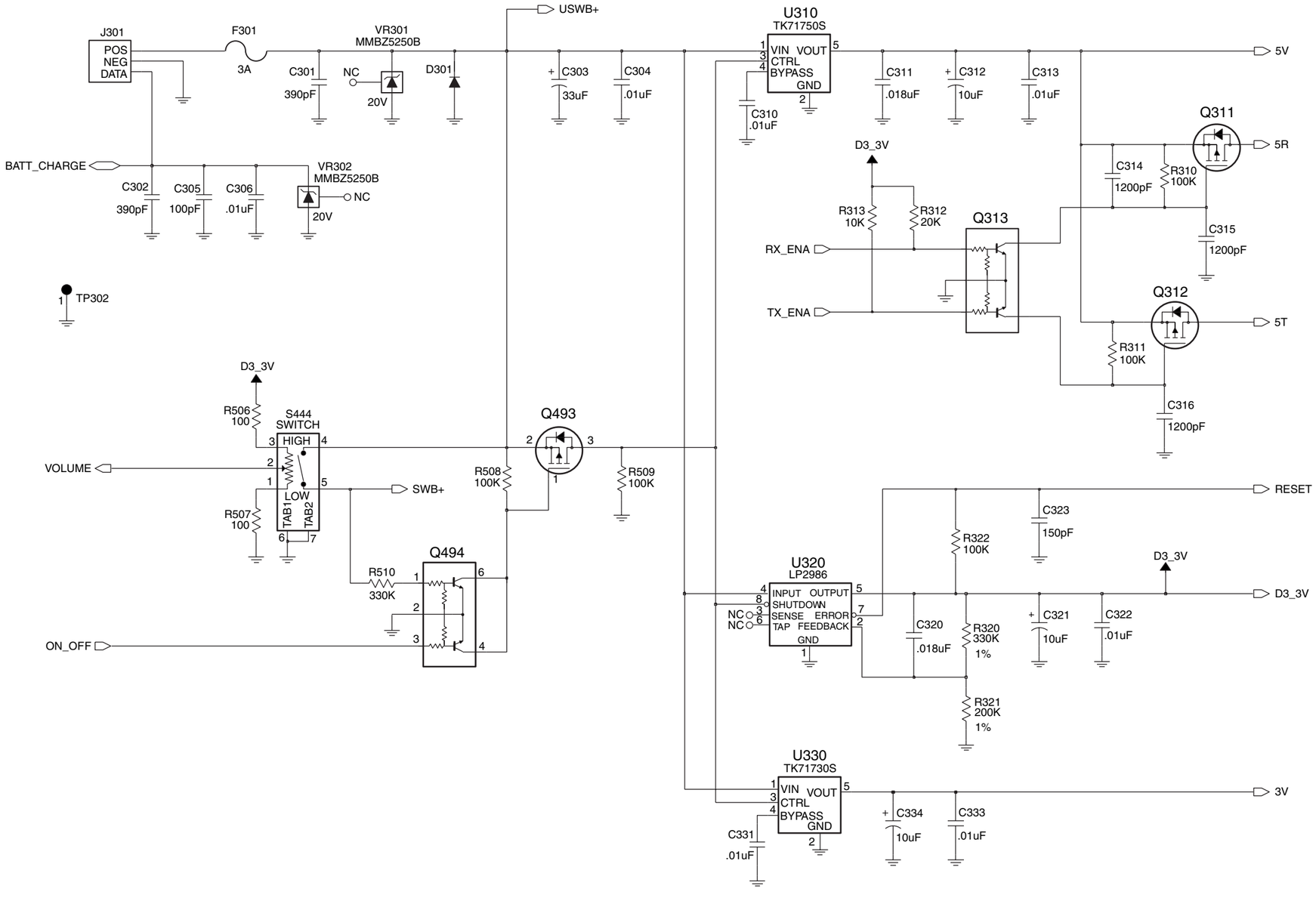
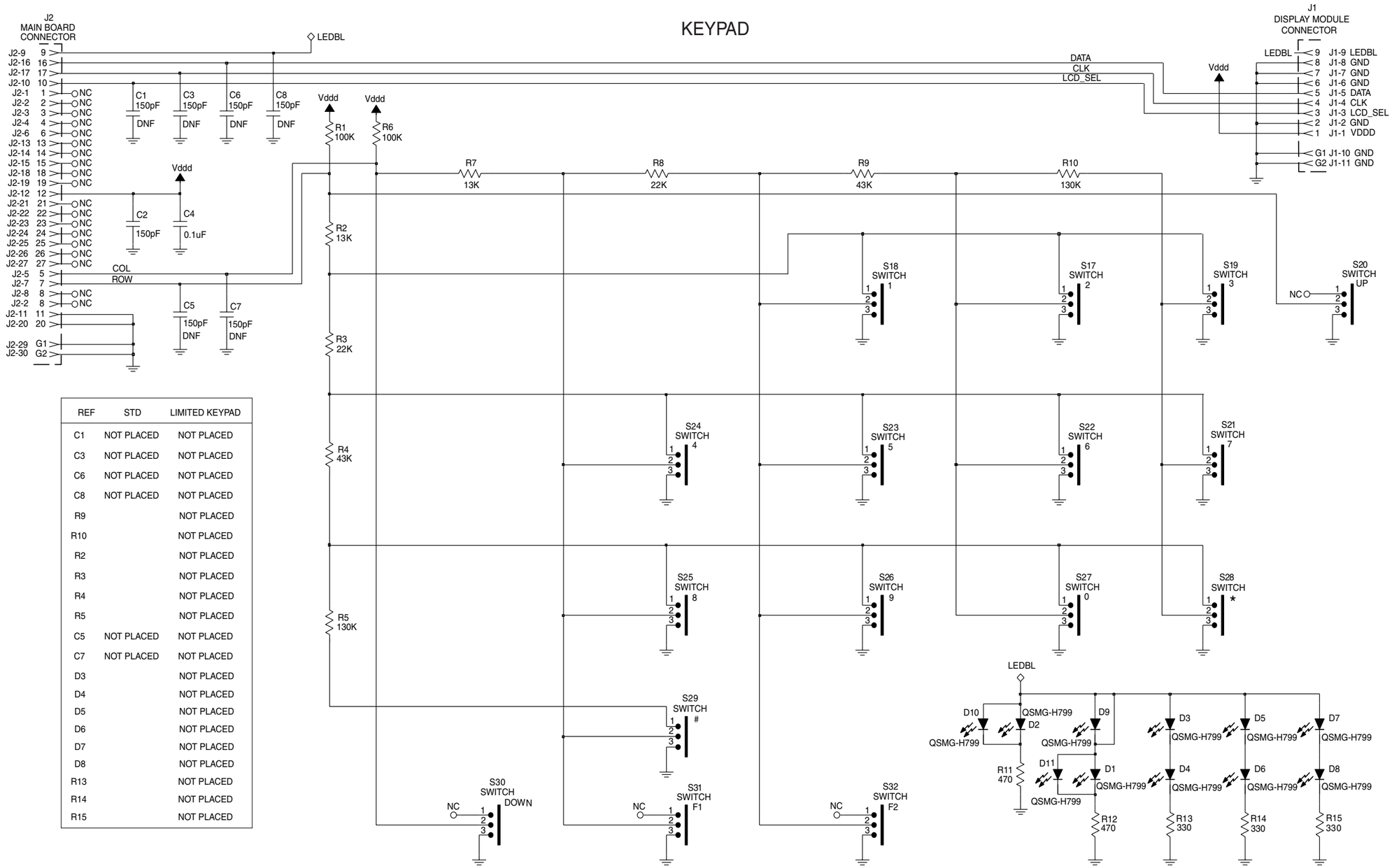


Figure 11-12. UHF (403-440 MHz) PCB 8486635Z03-O DC Regulation Schematic Diagram



REF	STD	LIMITED KEYPAD
C1	NOT PLACED	NOT PLACED
C3	NOT PLACED	NOT PLACED
C6	NOT PLACED	NOT PLACED
C8	NOT PLACED	NOT PLACED
R9		NOT PLACED
R10		NOT PLACED
R2		NOT PLACED
R3		NOT PLACED
R4		NOT PLACED
R5		NOT PLACED
C5	NOT PLACED	NOT PLACED
C7	NOT PLACED	NOT PLACED
D3		NOT PLACED
D4		NOT PLACED
D5		NOT PLACED
D6		NOT PLACED
D7		NOT PLACED
D8		NOT PLACED
R13		NOT PLACED
R14		NOT PLACED
R15		NOT PLACED

Figure 11-13. UHF (403-440 MHz) Keypad Board Schematic Diagram

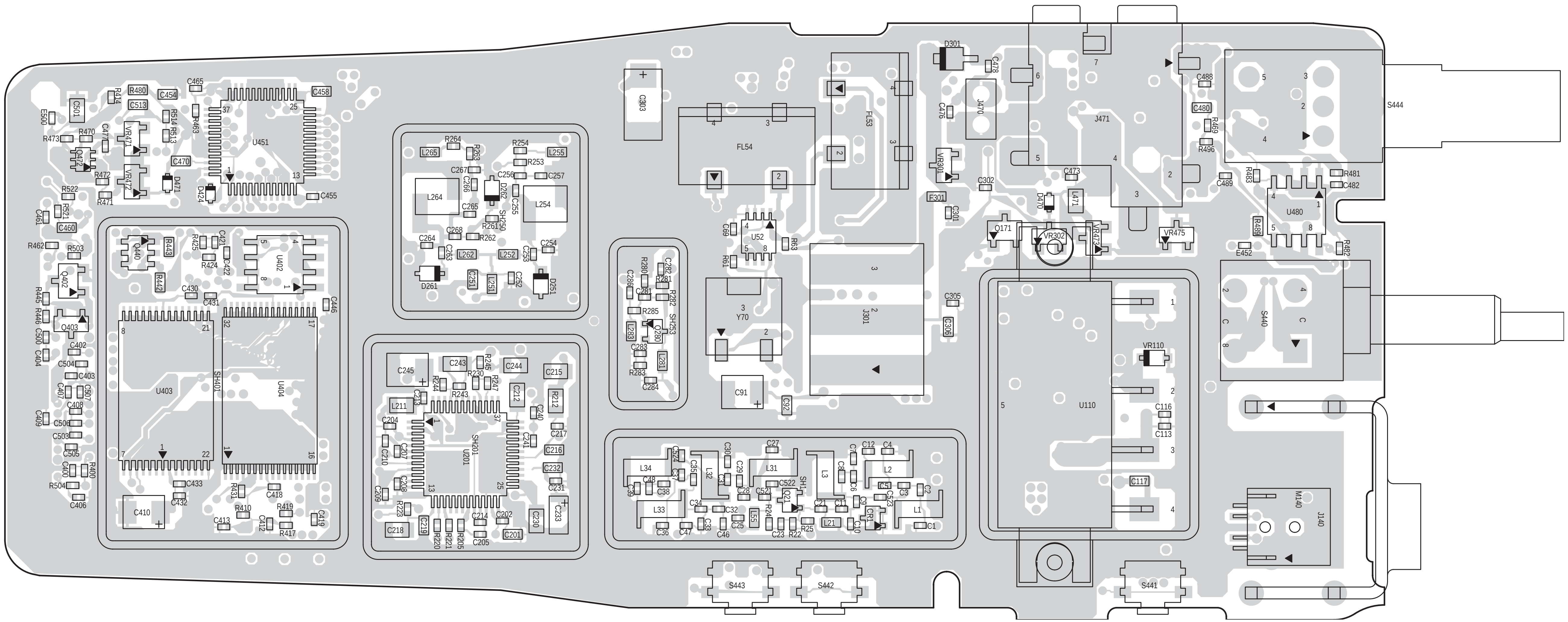


Figure 11-14. UHF (403-440 MHz) PCB 8486635Z03-O Board Component Side View

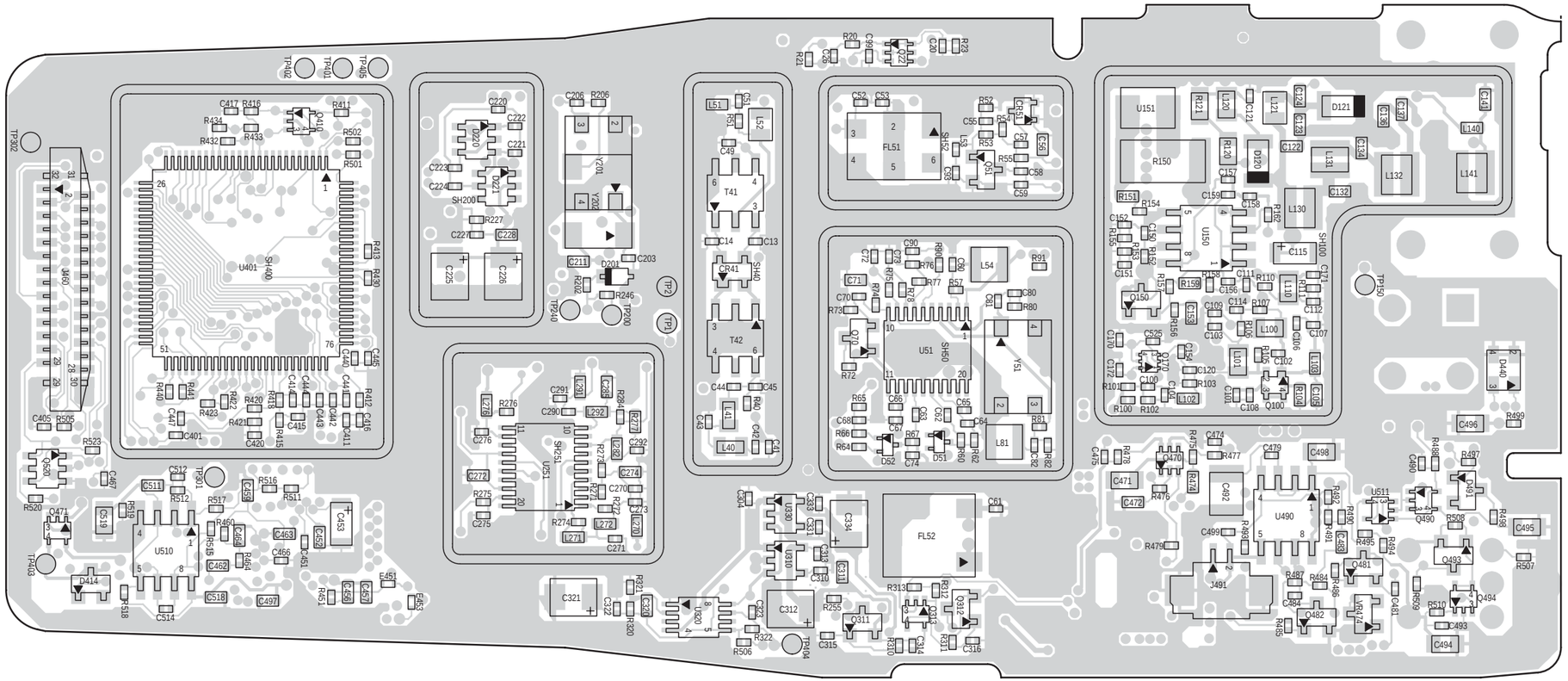
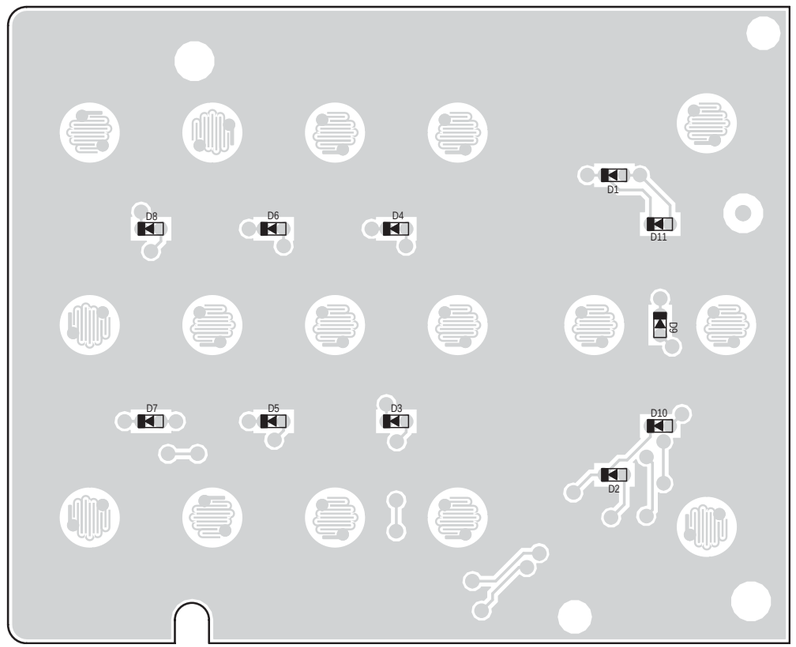
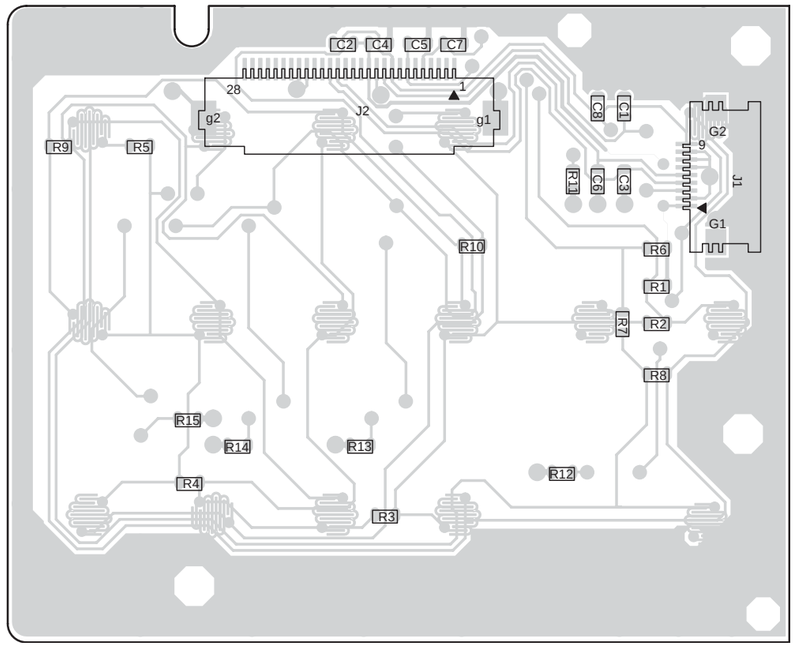


Figure 11-15. UHF (403-440 MHz) Board Solder Side View



Component Side



Solder Side

Figure 11-16. UHF (403-440 MHz) PCB 8486635Z03-O Keypad Board

UHF (403-440 MHz) Radio Parts List

Circuit Ref	Motorola Part No.	Description
C1	2109445U37	CAP, 15pF
C2	2109445U39	CAP, 18pF
C3	2109445U09	CAP, 1.8pF
C4	Not_Placed	CAP, 20pF
C5	0662057M01	RES, 0
C6	2109445U09	CAP, 1.8pF
C7	Not_Placed	CAP, 22pF
C8	0662057M01	RES, 0
C9	2109445U39	CAP, 18pF
C10	2109445U36	CAP, 13pF
C11	2109445U40	CAP, 20pF
C12	2109445U27	CAP, 10pF
C13	2109445U12	CAP, 2.4pF
C14	2109445U12	CAP, 2.4pF
C20	2113743L07	CAP, 390pF
C21	2113743L07	CAP, 390pF
C23	2113743L07	CAP, 390pF
C25	2113743L07	CAP, 390pF
C26	2113743L07	CAP, 390pF
C27	2109445U26	CAP, 9.1pF
C28	2109445U37	CAP, 15pF
C29	2109445U25	CAP, 8.2pF
C30	2109445U41	CAP, 22pF
C31	2109445U26	CAP, 9.1pF
C32	2109445U24	CAP, 7.5pF
C33	2109445U39	CAP, 18pF
C34	2109445U22	CAP, 6.2pF
C35	2109445U35	CAP, 12pF
C36	2109445U38	CAP, 16pF
C37	2109445U22	CAP, 6.2pF
C38	2109445U38	CAP, 16pF
C39	2109445U35	CAP, 12pF
C41	2109445U37	CAP, 15pF
C42	2109445U27	CAP, 10pF
C43	2109445U44	CAP, 30pF
C44	2109445U27	CAP, 10pF
C45	2109445U41	CAP, 22pF
C46	Not_Placed	CAP, 10pF
C47	Not_Placed	CAP, 10pF
C48	0662057M01	RES, 0
C49	Not_Placed	CAP, 3.9pF
C51	2113743N48	CAP, 82pF
C52	2109445U39	CAP, 18pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U45	CAP, 33pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L07	CAP, 390pF
C101	2113743M24	CAP, 0.1uF
C102	2113743M24	CAP, 0.1uF
C103	2113743L07	CAP, 390pF
C104	2113743N26	CAP, 10pF
C105	2113740F03	CAP, 1pF
C106	2113743L07	CAP, 390pF
C107	2113743N13	CAP, 3pF
C108	2113743L07	CAP, 390pF
C109	2113743M24	CAP, 0.1uF
C111	2113743L07	CAP, 390pF
C112	2113743M24	CAP, 0.1uF
C113	2113743L07	CAP, 390pF
C114	2113743L07	CAP, 390pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113740F65	CAP, 390pF
C120	Not_Placed	CAP, 8.2pF
C121	2113743L07	CAP, 390pF
C122	2113740F26	CAP, 9.1pF
C123	2113740F21	CAP, 5.6pF
C124	2113740F59	CAP, 220pF
C132	2113740F27	CAP, 10pF
C134	2113740F25	CAP, 8.2pF
C136	2113740F18	CAP, 4.3pF
C137	2113740F59	CAP, 220pF
C141	Not_Placed	CAP, 8.2pF
C150	2113743L07	CAP, 390pF
C151	2113743L07	CAP, 390pF
C152	2113743L07	CAP, 390pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L07	CAP, 390pF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L07	CAP, 390pF
C159	2113743L07	CAP, 390pF
C170	2113743L07	CAP, 390pF
C171	2113743L07	CAP, 390pF
C172	2113743L07	CAP, 390pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C240	2113743N06	CAP, 1.3pF
C241	2113743N50	CAP, 100pF
C243	0886641Z01	CAP, 0.1uF
C244	0888600M25	CAP, .01uF
C245	2311049A08	CAPP, 1uF
C251	0888600M03	CAP, 150pF
C252	Not_Placed	CAP, 390pF
C253	2109445U22	CAP, 6.2pF
C254	2109445U24	CAP, 7.5pF
C255	2109445U21	CAP, 5.6pF
C256	2109445U16	CAP, 3.6pF
C257	2109445U27	CAP, 10pF
C263	2109445U29	CAP, 5pF
C264	2109445U15	CAP, 3.3pF
C265	2109445U15	CAP, 3.3pF
C266	2109445U15	CAP, 3.3pF
C267	2109445U23	CAP, 6.8pF
C268	2109445U01	CAP, 0.5pF
C270	2113743L07	CAP, 390pF
C271	2113743L07	CAP, 390pF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L07	CAP, 390pF
C276	2113743N16	CAP, 3.9pF
C281	2113743L07	CAP, 390pF
C282	2109445U16	CAP, 3.6pF
C283	2113743L07	CAP, 390pF
C284	2113743L07	CAP, 390pF
C285	2113743E20	CAP, 0.1uF
C286	2113743N24	CAP, 8.2pF
C290	2113743N22	CAP, 6.8pF
C291	2113743N29	CAP, 13pF
C292	2113743L07	CAP, 390pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF
C400	Not_Placed	CAP, .022uF
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743N50	CAP, 150pF
C404	2113743L17	CAP, 1000pF
C405	2113743N50	CAP, 150pF

Circuit Ref	Motorola Part No.	Description
C406	2113743N50	CAP, 150pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2311049A56	CAPP, 4.7uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	Not_Placed	CAP, .01uF
C483	2113743E20	CAP, 0.1uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N48	CAP, 82pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
C521	2109445U15	CAP, 3.3pF
C522	2109445U11	CAP, 2.2pF
C523	2186463Z04	CAP, 0.55pF
C524	2186463Z05	CAP, 0.6pF
C525	2113743L07	CAP, 390pF
CR1	4813825A19	MMBD352
CR41	4802246J04	HSMS2829
CR51	4813825A19	MMBD352
D51	4802245J97	DAN235ETL
D52	4802245J97	DAN235ETL
D120	4880973Z02	MA4PH261
D121	4880973Z02	MA4PH261
D201	4862824C03	1SV232
D220	4802233J09	IMN10
D221	4802233J09	IMN10
D251	4862824C01	1SV229
D261	4862824C01	1SV229
D262	4862824C01	1SV229
D301	4813833A19	MBRM120ET3
D414	4805129M41	MMBD501
D424	4809924D18	RB520S-30
D440	4805729G49	BRPY1204W
D470	4809924D18	RB520S-30
D471	4809924D18	RB520S-30
D491	Not_Placed	MMBD501
E451	2480640Z01	BK1005HM471
E452	2480640Z01	BK1005HM471
E453	2480640Z01	BK1005HM471
E500	2480640Z01	BK1005HM471
F301	6580542Z01	FUSE
FL51	9180022M11	MXF45
FL52	9180468V04	FLTR
FL53	9180469V05	CFWC455E
FL54	9180469V03	CFWC455G
J140	0986428Z01	CONN_J
J301	0986565Z01	CONN_J
J460	Not_Placed	CONN_J
J470	0985818A01	CONN_J
J471	0980683Z03	CONN_J
J491	2809926G01	CONN_P
L1	2409348J15	IDCTR, 9.85nH
L2	2409348J15	IDCTR, 9.85nH
L3	2409348J15	IDCTR, 9.85nH
L21	2413926N17	IDCTR, 27nH
L31	2409348J15	IDCTR, 9.85nH
L32	2409348J15	IDCTR, 9.85nH
L33	2409348J15	IDCTR, 9.85nH
L34	2409348J15	IDCTR, 9.85nH
L40	2413926K16	IDCTR, 27nH
L41	2413926K16	IDCTR, 27nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V44	IDCTR, 680nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L55	2413926N15	IDCTR, 18nH
L81	2413923A19	IDCTR, 1uH
L100	2413926K27	IDCTR, 220nH
L101	2413926K27	IDCTR, 220nH
L102	2409377M26	IDCTR, 8.7nH
L103	2409377M31	IDCTR, 30nH
L110	2413926K27	IDCTR, 220nH
L120	2413926K27	IDCTR, 220nH
L121	2462587V25	IDCTR, 18nH
L130	2460591M27	IDCTR, 22.69nH
L131	2460591M32	IDCTR, 27.42nH
L132	2460591M27	IDCTR, 22.69nH
L140	2113740F65	CAP, 390pF
L141	2460591M27	IDCTR, 22.69nH
L211	2413926K30	IDCTR, 390nH
L251	2413926N28	IDCTR, 220nH
L252	2413926N17	IDCTR, 27nH
L254	2484562T11	IDCTR, 12.5nH
L255	2413926N28	IDCTR, 220nH
L262	2413926N17	IDCTR, 27nH
L264	2484562T11	IDCTR, 12.5nH
L265	2413926N28	IDCTR, 220nH
L270	2413926N28	IDCTR, 220nH
L271	Not_Placed	IDCTR, 220nH
L272	2413926N28	IDCTR, 220nH
L276	2413926N17	IDCTR, 27nH
L281	2413926N18	IDCTR, 33nH
L282	2413926N14	IDCTR, 15nH
L283	Not_Placed	IDCTR, 22nH
L291	2413926N10	IDCTR, 6.8nH
L292	2413926N14	IDCTR, 15nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	ANTENNA_NUT
Q21	4802247J01	BFS505
Q22	4805723X02	UMT1
Q51	4802197J95	PBR941
Q70	4880214G02	MMBT3904
Q100	4885593U03	BFG540W
Q150	4880214G02	MMBT3904
Q170	4809939C34	EMB10
Q171	4880048M01	DTC144EKA
Q280	4802245J95	BFS540
Q311	4809579E18	TP0101T
Q312	4809579E18	TP0101T
Q313	4802245J54	UMG5
Q402	4880048M01	DTC144EKA
Q403	4813824A17	MMBT3906
Q410	4802245J54	UMG5
Q440	5180159R01	IMX1
Q470	4805723X02	UMT1
Q471	4802245J54	UMG5
Q472	4805723X02	UMT1
Q481	Not_Placed	MMBT3906
Q482	Not_Placed	MMBT3904
Q490	4802245J54	UMG5
Q493	4809579E18	TP0101T
Q494	4802245J54	UMG5
Q520	5180159R01	IMX1
R20	0662057M92	RES, 5.6K
R21	0662057M47	RES, 75
R22	0662057M92	RES, 5.6K
R23	0662057N09	RES, 27K
R24	0662057M76	RES, 1.2K
R25	0662057M92	RES, 5.6K
R40	0662057M74	RES, 1K

Circuit Ref	Motorola Part No.	Description
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M72	RES, 820
R101	0662057M20	RES, 5.6
R102	0662057M72	RES, 820
R103	0662057M85	RES, 3K
R104	0662057A07	RES, 18
R105	0662057M84	RES, 2.7K
R106	0662057M90	RES, 4.7K
R107	Not_Placed	RES, 300
R110	0662057M67	RES, 510
R111	0662057M80	RES, 1.8K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A15	RES, 39
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M82	RES, 2.2K
R158	0662057M91	RES, 5.1K
R159	0662057B47	RES, 0
R162	0662057M98	RES, 10K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M34	RES, 22
R221	0662057M34	RES, 22
R223	0662057M50	RES, 100
R227	0662057N13	RES, 39K
R230	0662057N08	RES, 24K
R243	0662057M72	RES, 820
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N07	RES, 22K
R253	0662057M38	RES, 33
R254	0662057M50	RES, 100
R255	0662057U91	RES, 3.9K
R261	0662057N07	RES, 22K
R262	0662057M94	RES, 6.8K
R263	0662057M38	RES, 33
R264	0662057M50	RES, 100
R271	0662057M90	RES, 4.7K
R272	0662057M92	RES, 5.6K
R273	0662057M62	RES, 330
R274	0662057M38	RES, 33
R275	0662057M50	RES, 100
R276	Not_Placed	RES, 1K
R277	0662057B47	RES, 0
R280	0662057M90	RES, 4.7K
R281	0662057M96	RES, 8.2K
R282	0662057M73	RES, 910
R283	0662057M53	RES, 130
R284	0662057M62	RES, 330
R285	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057M98	RES, 10K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	Not_Placed	RES, 100K
R482	Not_Placed	RES, 330K
R483	Not_Placed	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	Not_Placed	RES, 100K
R486	Not_Placed	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	Not_Placed	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	Not_Placed	RES, 1MEG
R498	Not_Placed	RES, 47K
R499	Not_Placed	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	0662057N23	RES, 100K
R514	0662057N23	RES, 100K
R515	0662057M01	RES, 0
R516	Not_Placed	RES, 0
R517	Not_Placed	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	Not_Placed	RES, 100K
R522	0662057N23	RES, 100K
R523	0662057M98	RES, 10K
S440	4080710Z06	SWITCH
S441	4070354A01	SWITCH
S442	4070354A01	SWITCH
S443	4070354A01	SWITCH
S444	1880619Z02	SWITCH
SH1	2686421Z01	SHIELD
SH40	2686419Z01	SHIELD
SH50	2686423Z01	SHIELD
SH52	2686424Z01	SHIELD
SH100	2686418Z01	SHIELD
SH200	2686424Z01	SHIELD
SH201	2686423Z01	SHIELD
SH250	2686425Z01	SHIELD
SH251	2686425Z01	SHIELD
SH253	2686422Z01	SHIELD
SH400	2686420Z01	SHIELD
SH401	2686420Z01	SHIELD
T41	2580541Z02	XFMR
T42	2580541Z02	XFMR
U51	5186144B01	SA616
U52	5109522E10	TC7W04F
U110	0186438Z03	RA07M4047M_UHF
U150	5113818A01	LM2904
U151	2484657R01	57R01
U201	5185963A27	63A27
U251	5105750U54	50U54
U310	5102478J01	TK71750S

Circuit Ref	Motorola Part No.	Description
U320	5185963A55	LP2986
U330	5102479J01	TK71730S
U401	5102226J56	MC68HC11FL0
U402*	5102463J64	X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	AT49LV001N_70VI
U451	5185130C53	30C53
U480	Not_Placed	LM2904
U490	5108858K99	TDA8541
U510	5113818A01	LM2904
U511	4802245J54	UMG5
VR110	4813830A86	MM3Z3V9T1
VR301	4813830A33	MMBZ5250B
VR302	4813830A33	MMBZ5250B
VR471	4813830A18	MMBZ5235B
VR472	4813830A09	MMBZ5226B
VR473	4813830A33	MMBZ5250B
VR474	4813830A33	MMBZ5250B
VR475	4880140L20	MMBZ5245B
Y51	4802245J84	TSS2_44_395MHZ
Y70	9186145B02	45B02
Y201*	4880114R06	14R06
Y202	Not_Placed	45J68

Circuit Ref	Motorola Part No.	Description
R1	0662057A97	RES, 100K
R2	NOTPLACED	RES, 13K
R3	NOTPLACED	RES, 22K
R4	NOTPLACED	RES, 43K
R5	NOTPLACED	RES, 130K
R6	0662057A97	RES, 100K
R7	0662057A76	RES, 13K
R8	0662057A81	RES, 22K
R9	NOTPLACED	RES, 43K
R10	NOTPLACED	RES, 130K
R11	0662057A41	RES, 470
R12	0662057A41	RES, 470
R13	NOTPLACED	RES, 330
R14	NOTPLACED	RES, 330
R15	NOTPLACED	RES, 330

* Motorola Depot Servicing only

UHF (403-440 MHz) Keypad Board Parts List

Circuit Ref	Motorola Part No.	Description
C1	NOTPLACED	CAP, 150pF
C2	2113740F55	CAP, 150pF
C3	NOTPLACED	CAP, 150pF
C4	2113743E20	CAP, 0.1uF
C5	NOTPLACED	CAP, 150pF
C6	NOTPLACED	CAP, 150pF
C7	NOTPLACED	CAP, 150pF
C8	NOTPLACED	CAP, 150pF
D1	4809496B11	QSMG-H799
D2	4809496B11	QSMG-H799
D3	NOTPLACED	QSMG-H799
D4	NOTPLACED	QSMG-H799
D5	NOTPLACED	QSMG-H799
D6	NOTPLACED	QSMG-H799
D7	NOTPLACED	QSMG-H799
D8	NOTPLACED	QSMG-H799
D9	4809496B11	QSMG-H799
D10	4809496B11	QSMG-H799
D11	4809496B11	QSMG-H799
J1	0986632Z01	CONN_J
J2	0909059E18	CONN_J

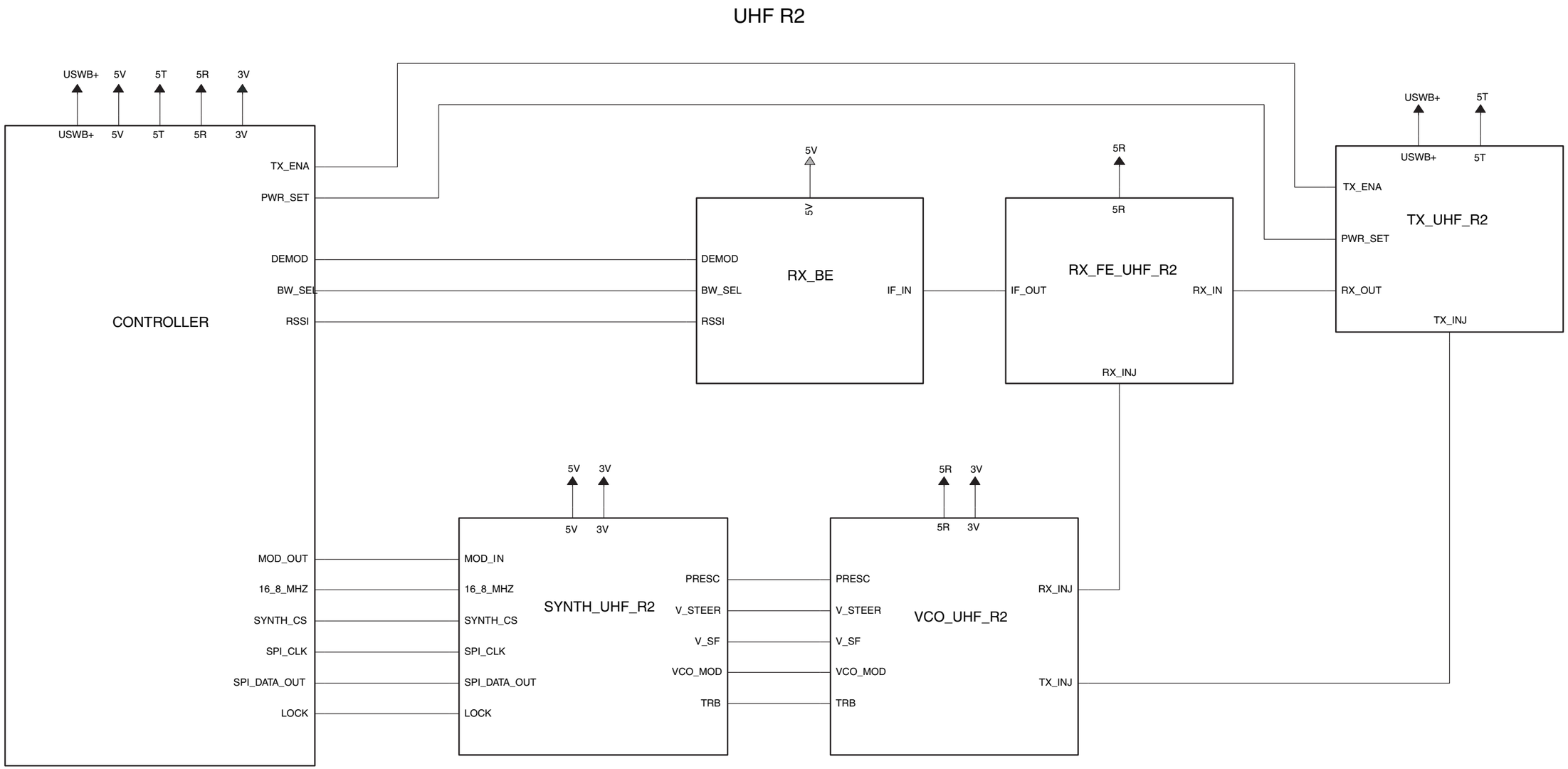


Figure 11-17. UHF (440-470 MHz) Radio Circuit Block Diagram

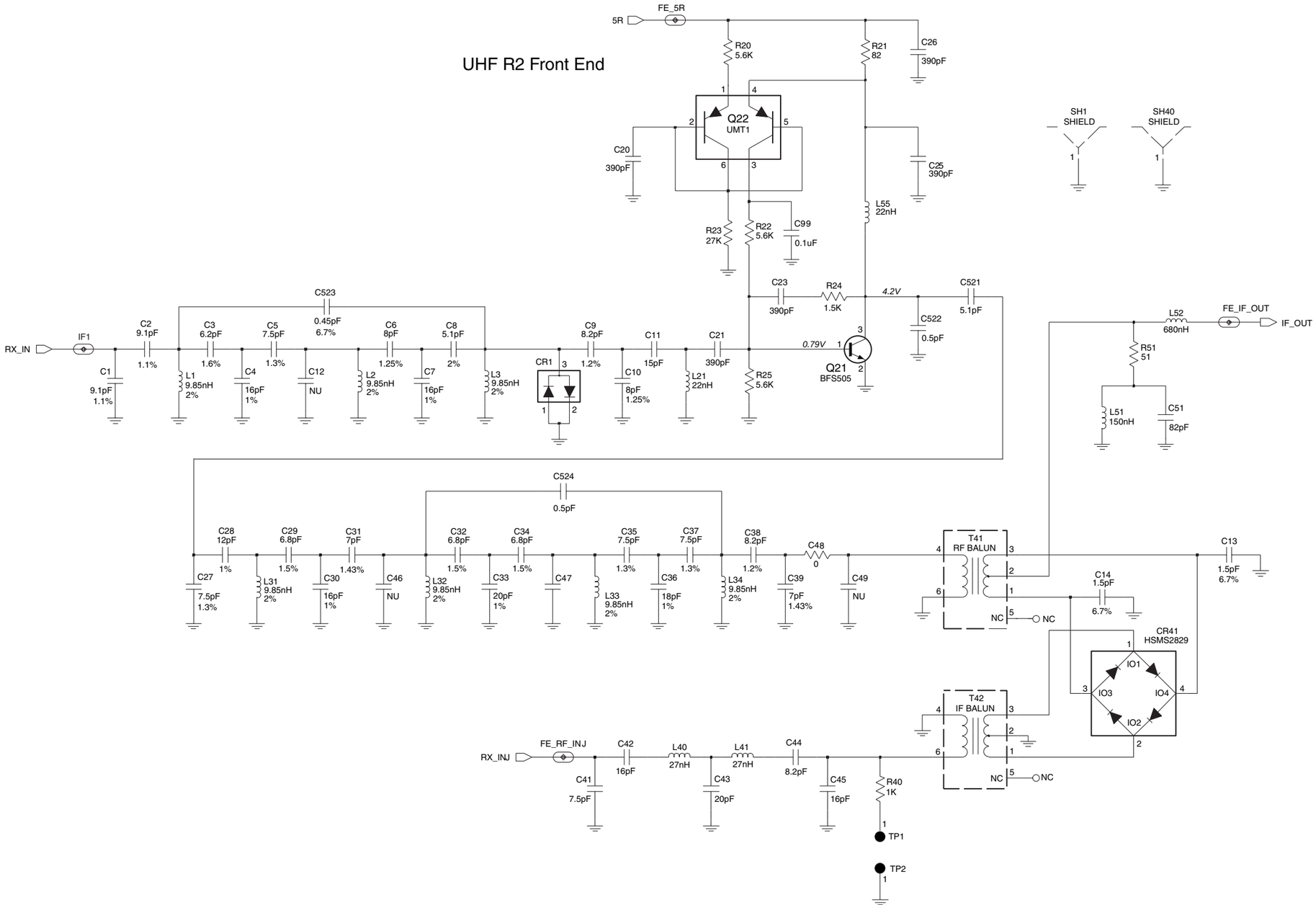


Figure 11-18. UHF (438-470 MHz) PCB 8486348Z13-C Receiver Front End Schematic Diagram

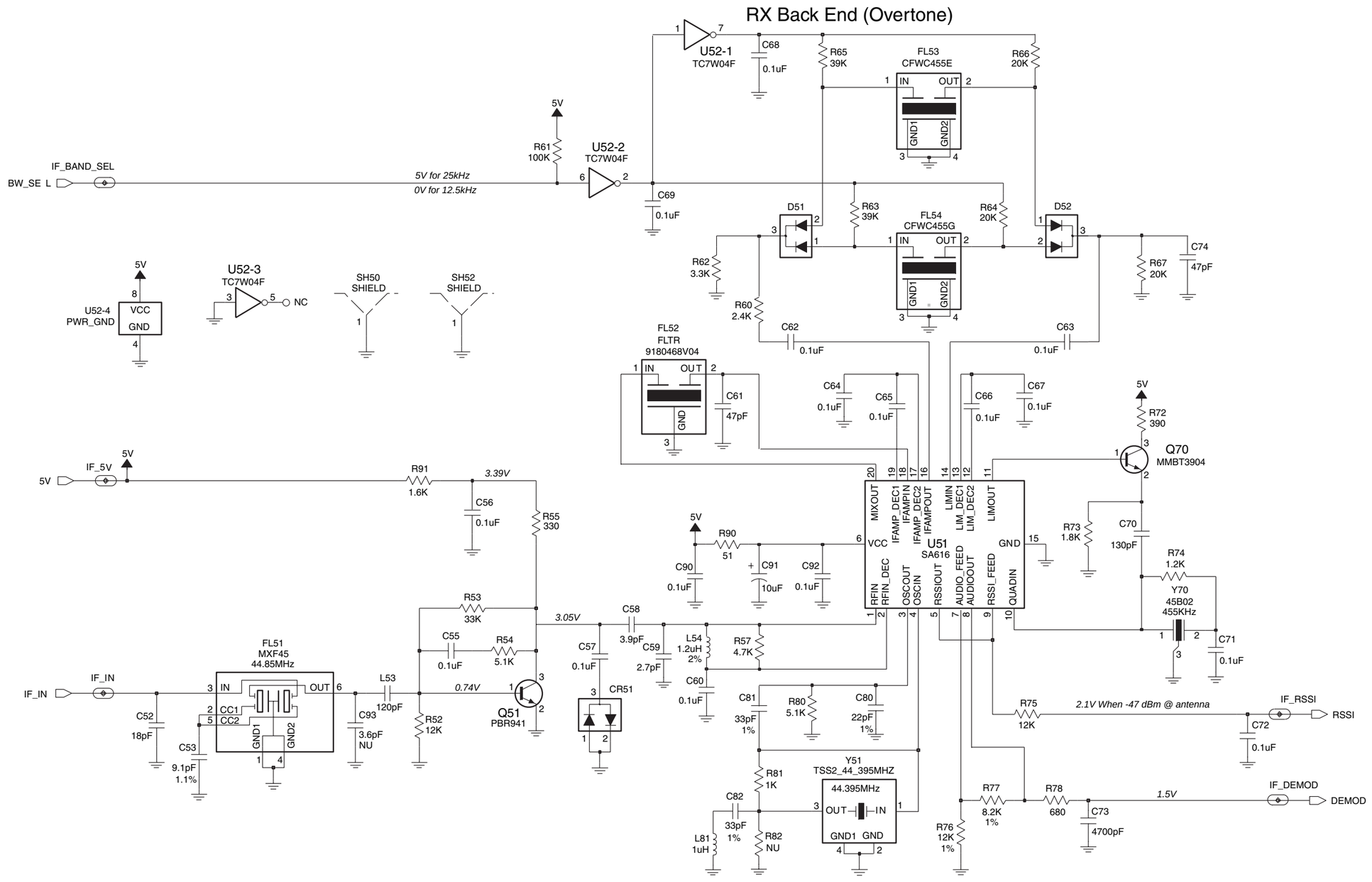


Figure 11-19. UHF (438-470 MHz) Receiver Back End Schematic Diagram

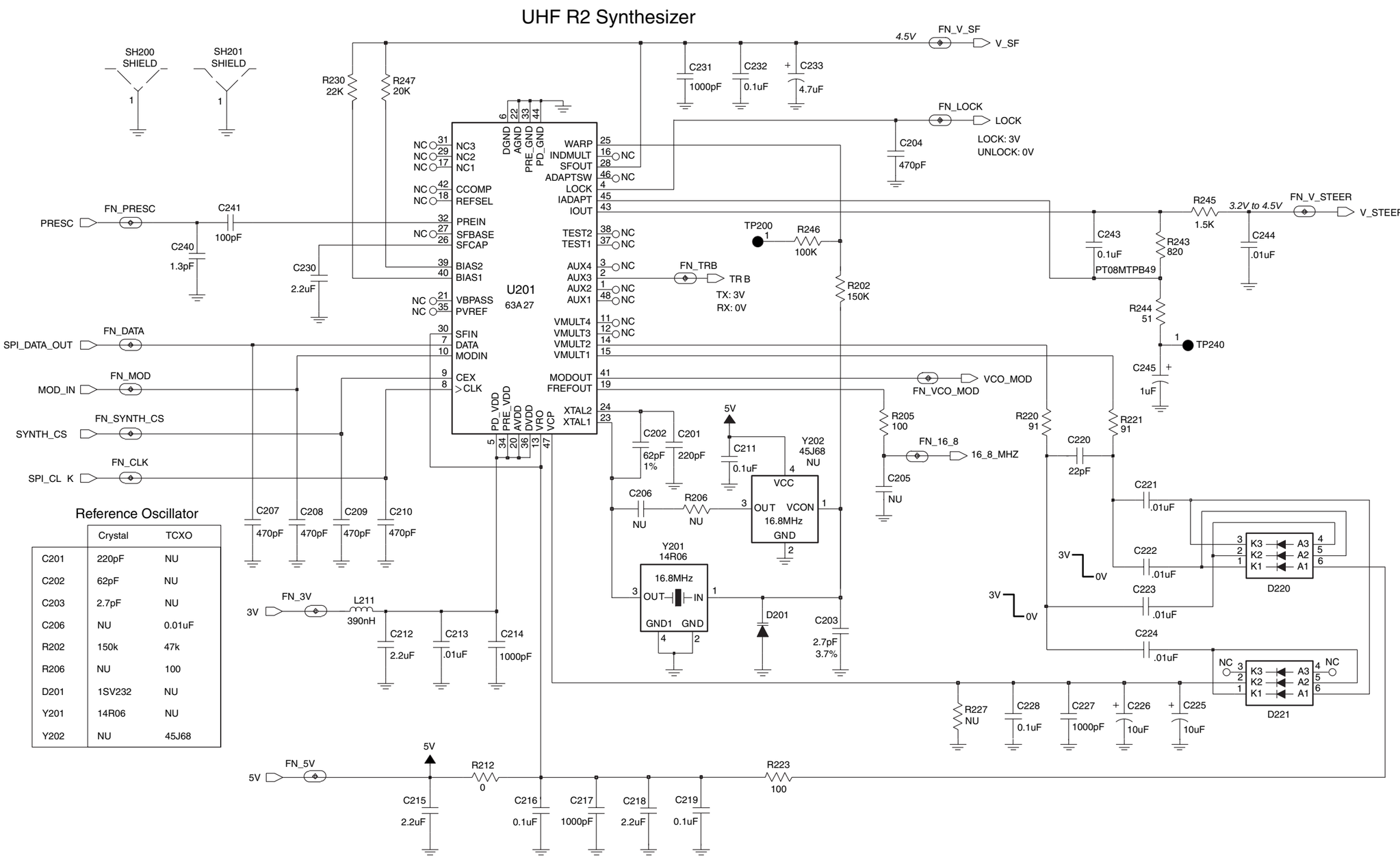


Figure 11-20. UHF (438-470 MHz) PCB 8486348Z13-C Synthesizer Schematic Diagram

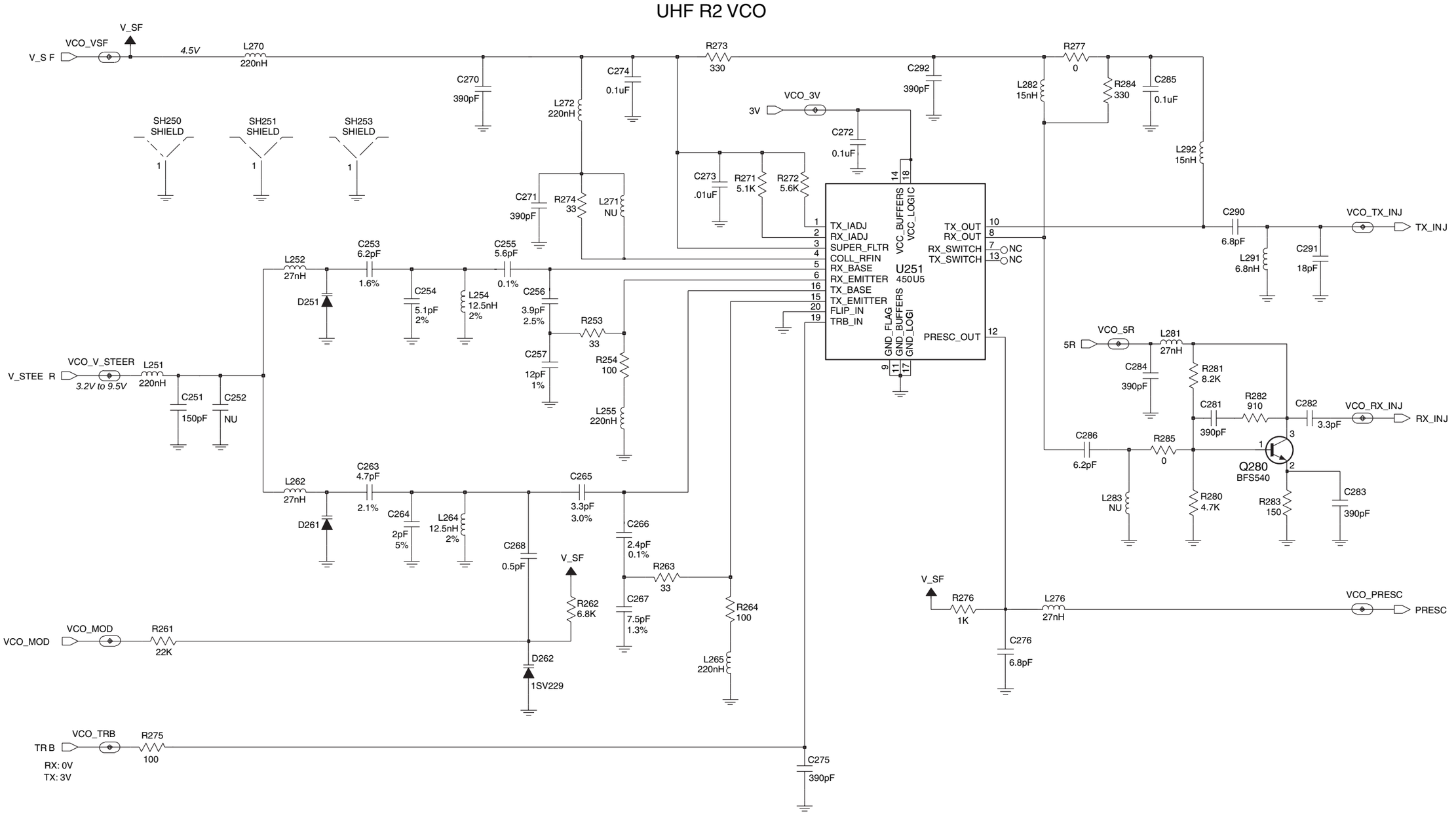


Figure 11-21. UHF (438-470 MHz) Voltage Controlled Oscillator Schematic Diagram

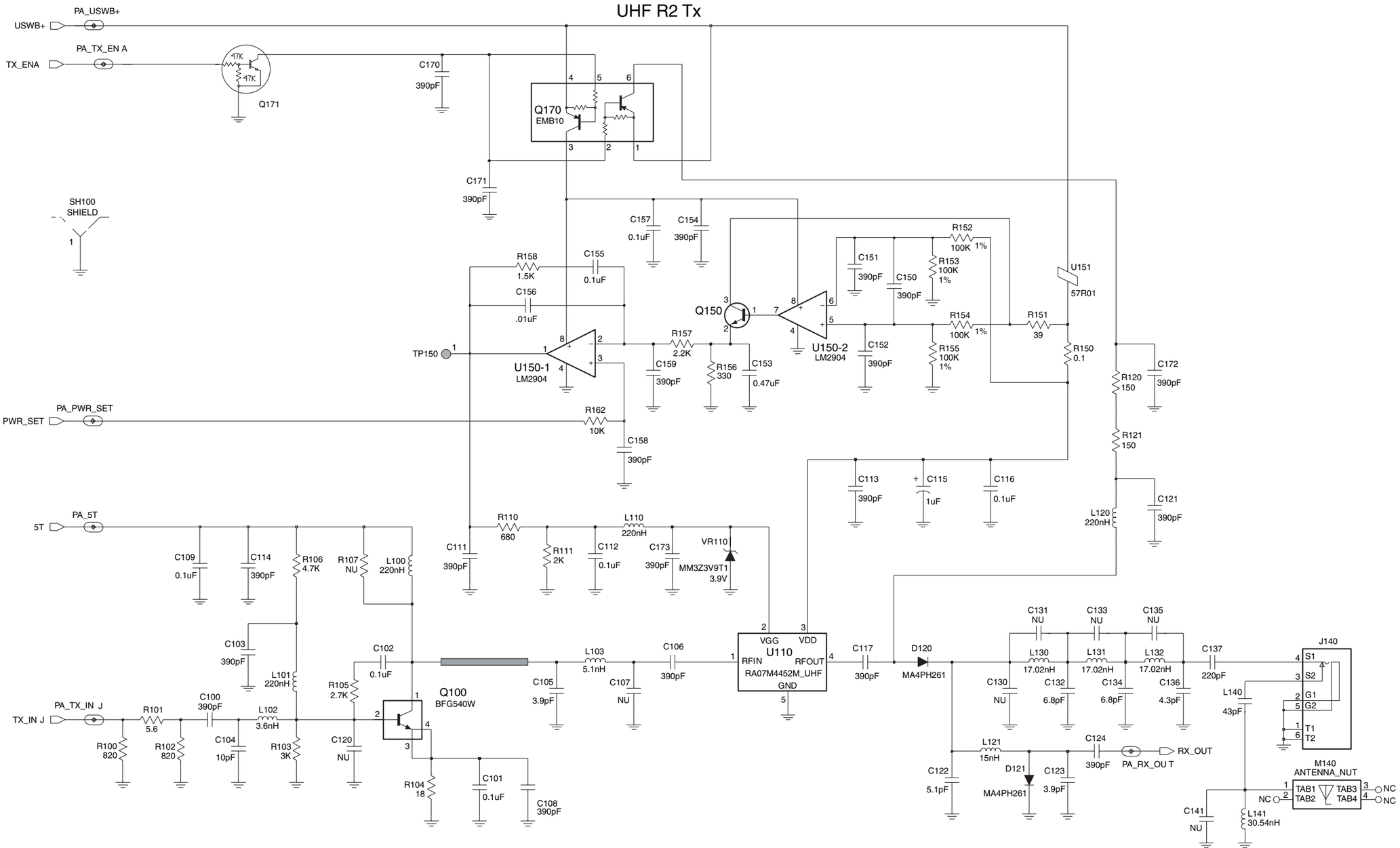
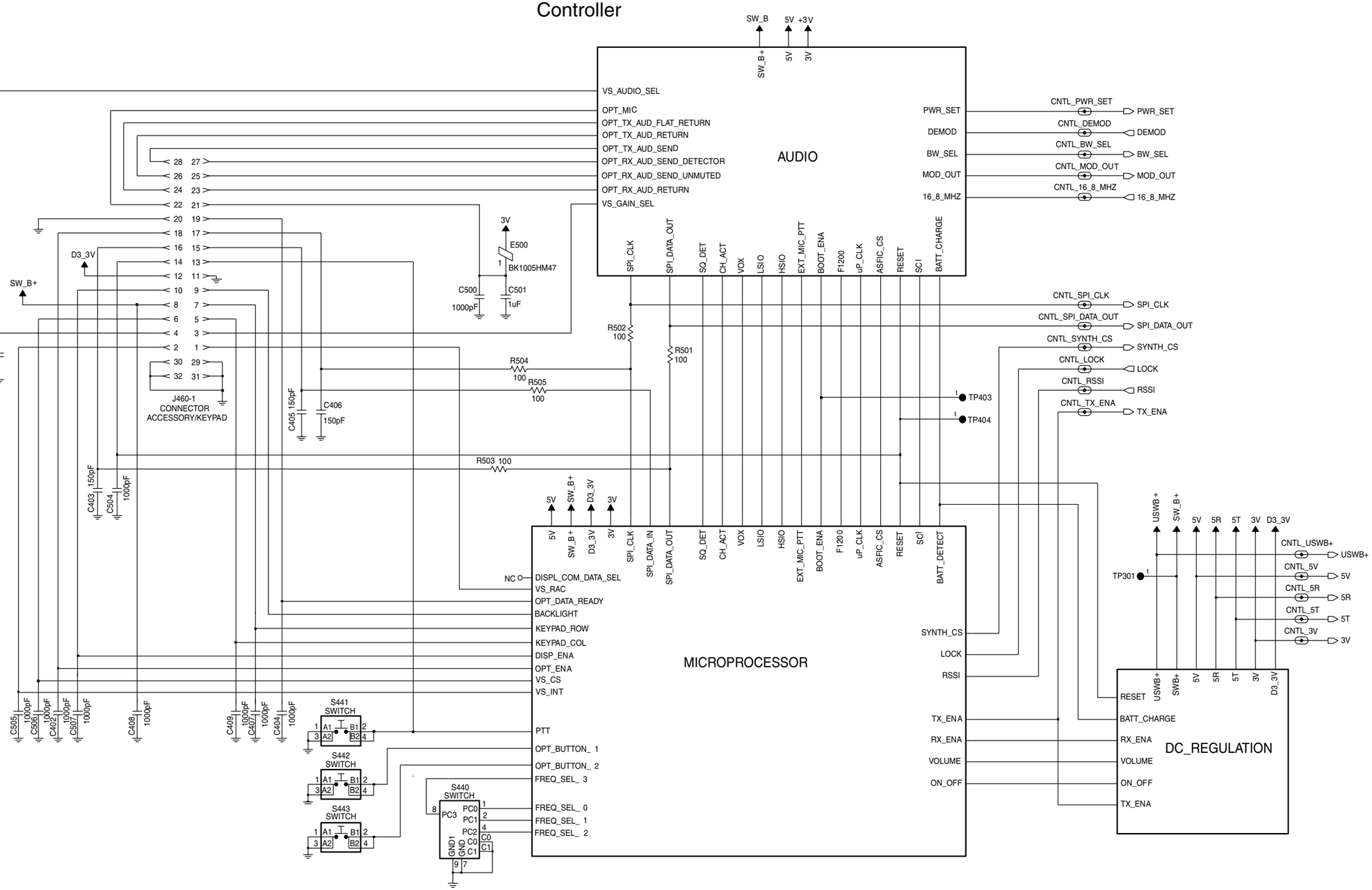


Figure 11-22. UHF (438-470 MHz) PCB 8486348Z13-C Transmitter and Power Control



Schematic Diagram

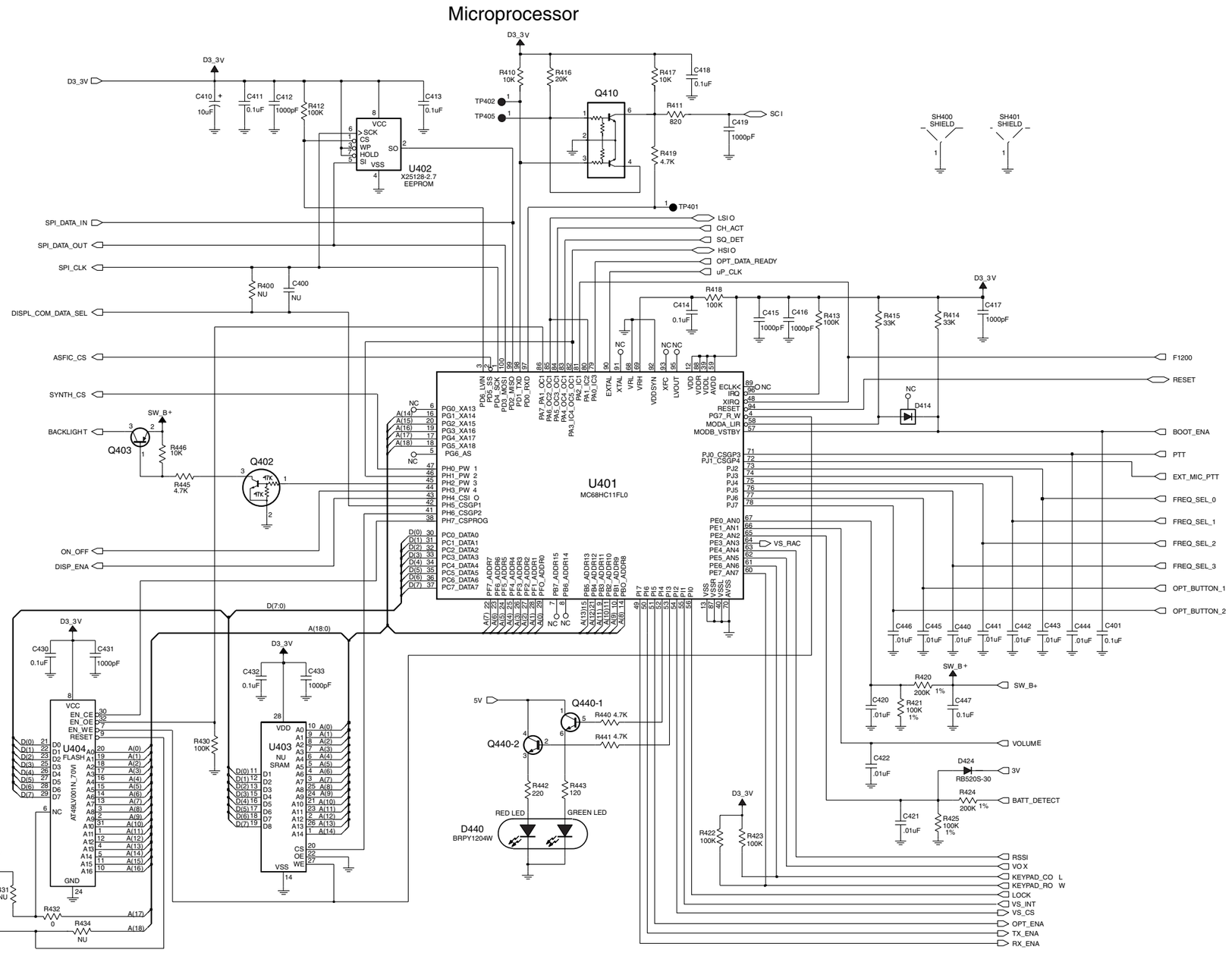
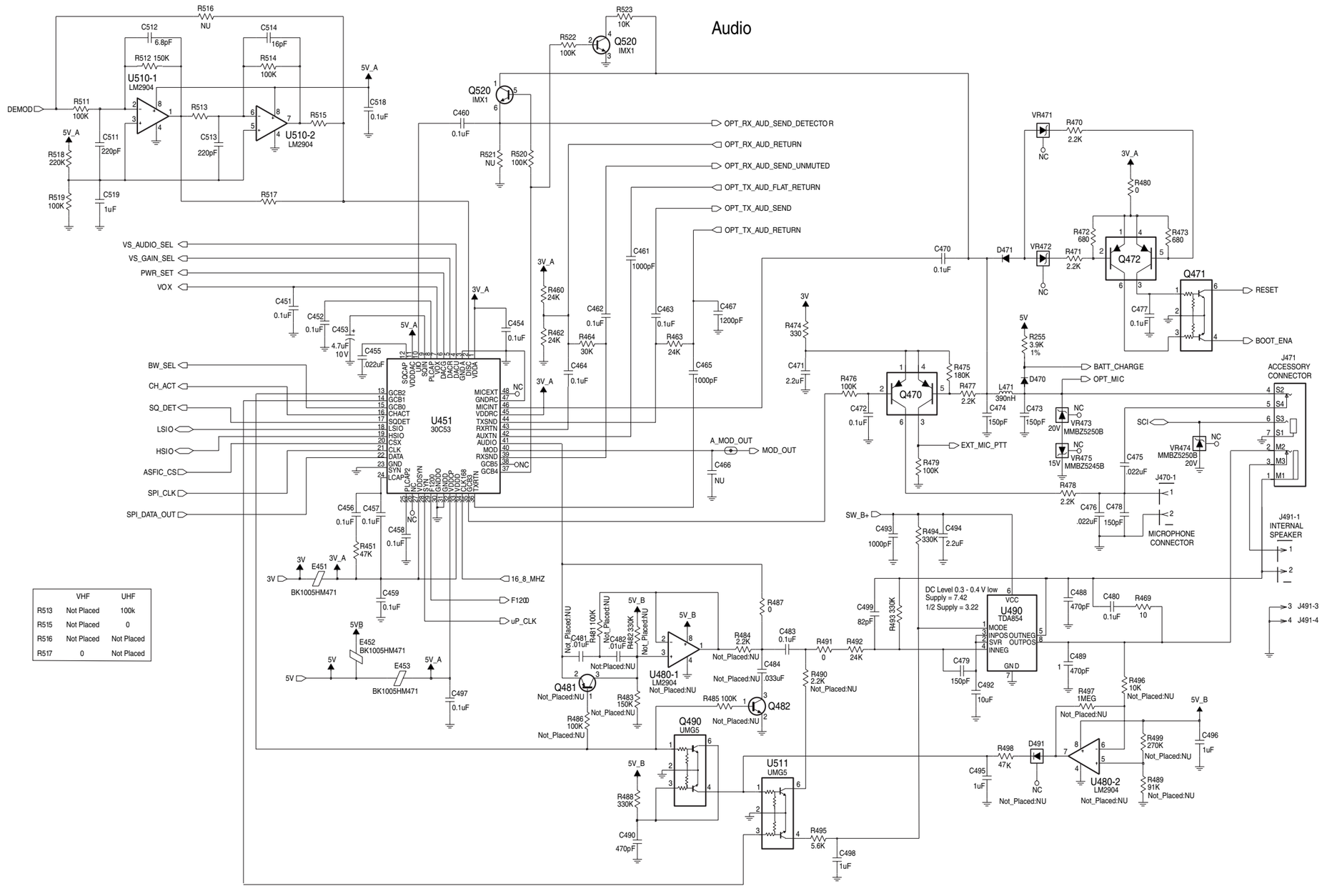


Figure 11-23. UHF (438-470 MHz) PCB 8486348Z13-C Controller Interconnect Schematic Diagram



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 11-24. UHF (438-470 MHz) Microprocessor Circuitry Schematic Diagram

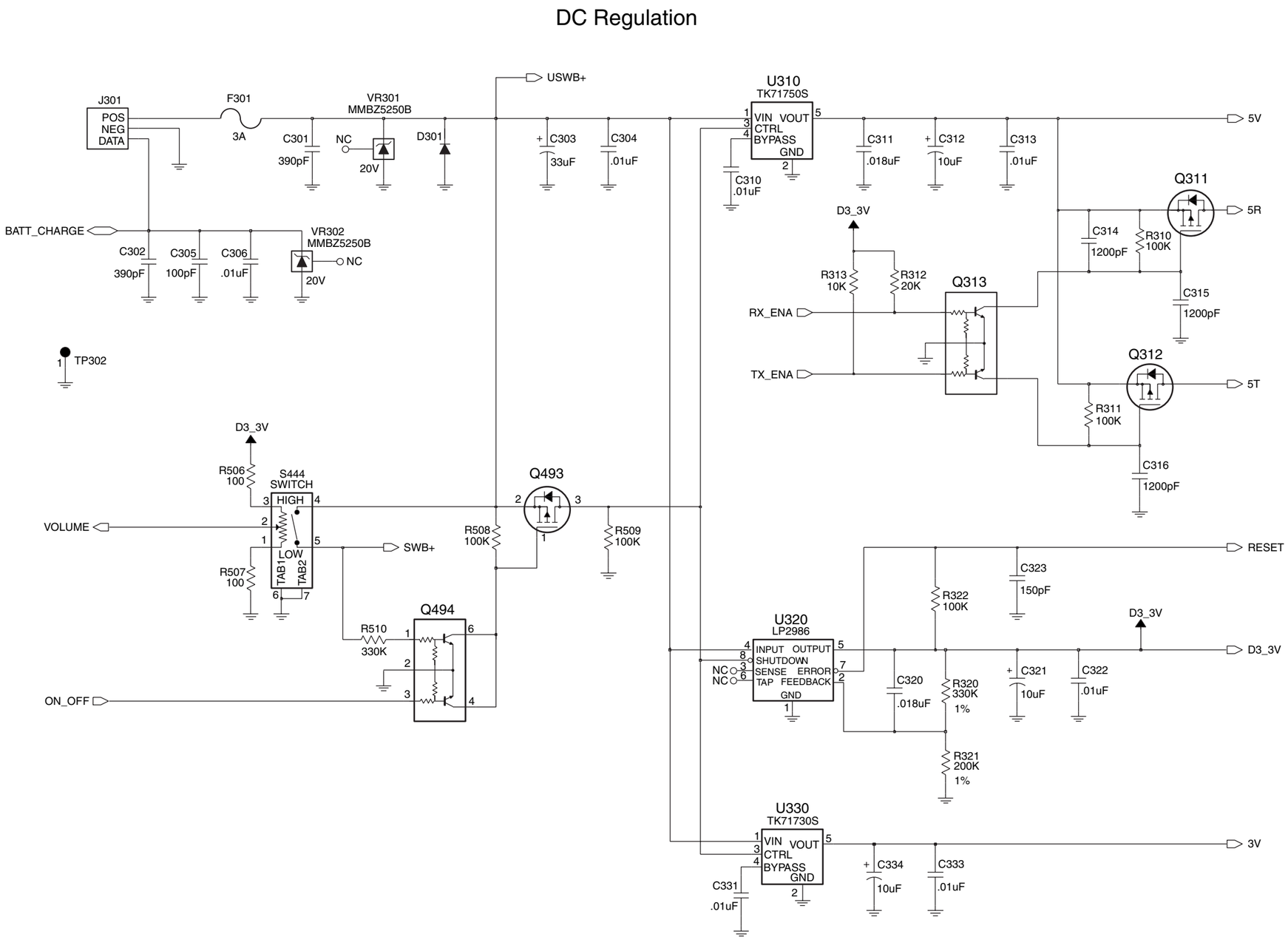
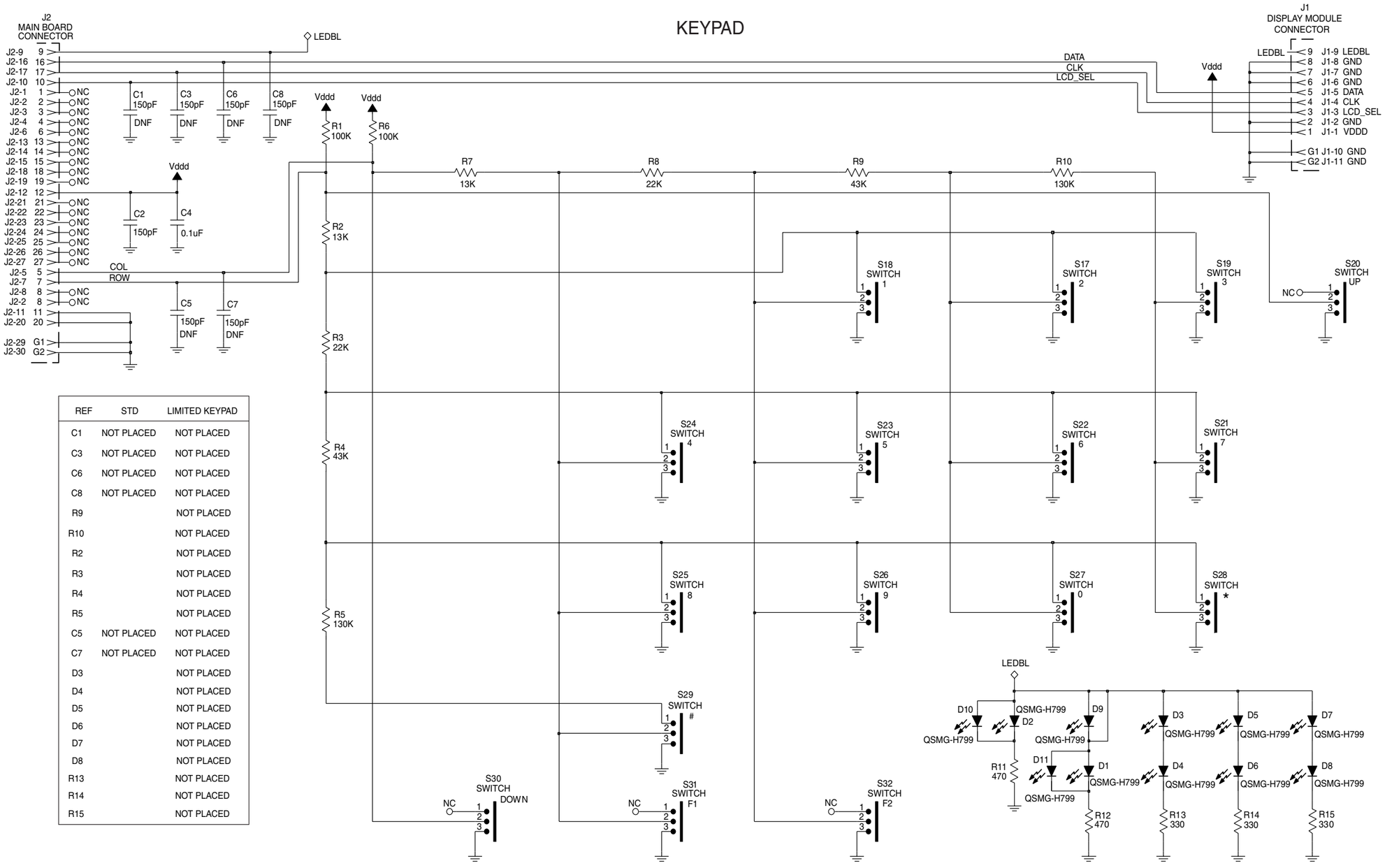


Figure 11-25. UHF (438-470 MHz) PCB 8486348Z13-C Audio Circuitry Schematic Diagram



REF	STD	LIMITED KEYPAD
C1	NOT PLACED	NOT PLACED
C3	NOT PLACED	NOT PLACED
C6	NOT PLACED	NOT PLACED
C8	NOT PLACED	NOT PLACED
R9		NOT PLACED
R10		NOT PLACED
R2		NOT PLACED
R3		NOT PLACED
R4		NOT PLACED
R5		NOT PLACED
C5	NOT PLACED	NOT PLACED
C7	NOT PLACED	NOT PLACED
D3		NOT PLACED
D4		NOT PLACED
D5		NOT PLACED
D6		NOT PLACED
D7		NOT PLACED
D8		NOT PLACED
R13		NOT PLACED
R14		NOT PLACED
R15		NOT PLACED

Figure 11-26. UHF (438-470 MHz) DC Regulation Schematic Diagram

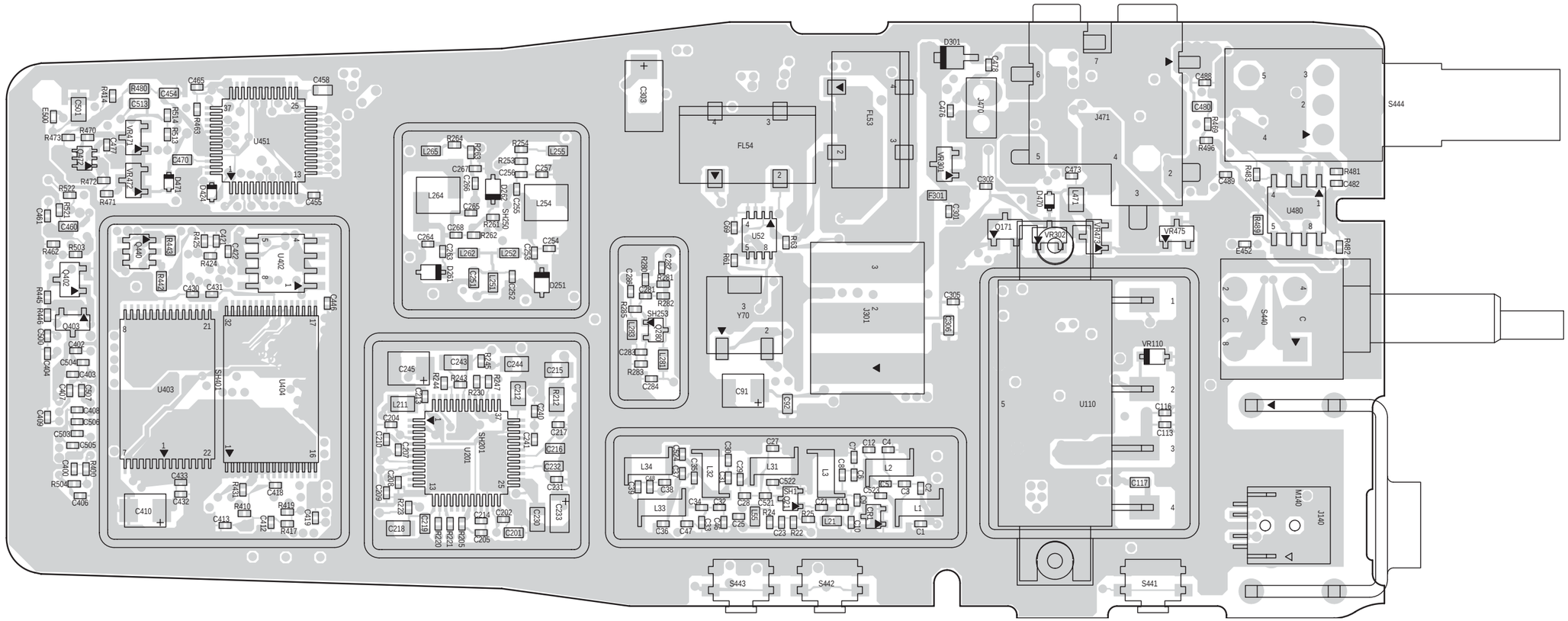


Figure 11-27. UHF (438-470 MHz) PCB 8486348Z13-C Keypad Option Schematic Diagram

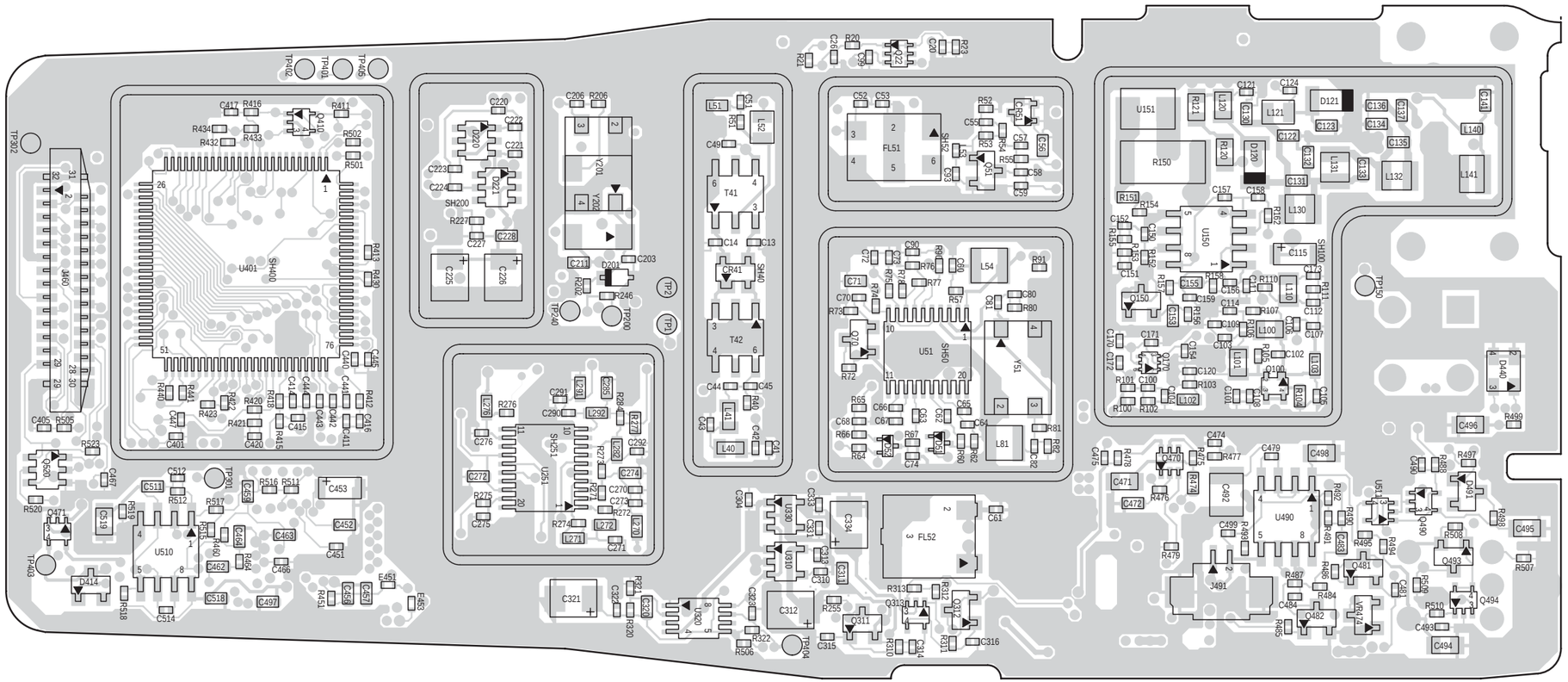
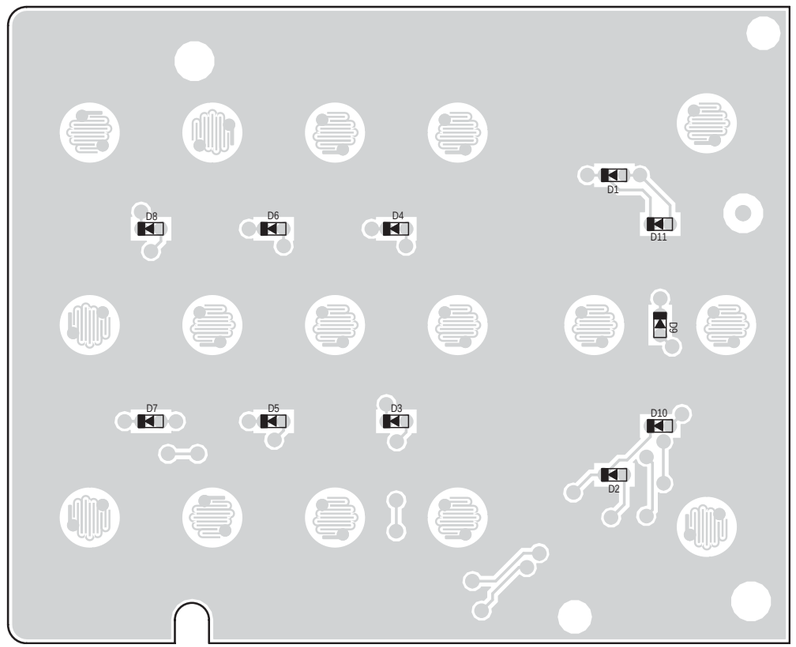
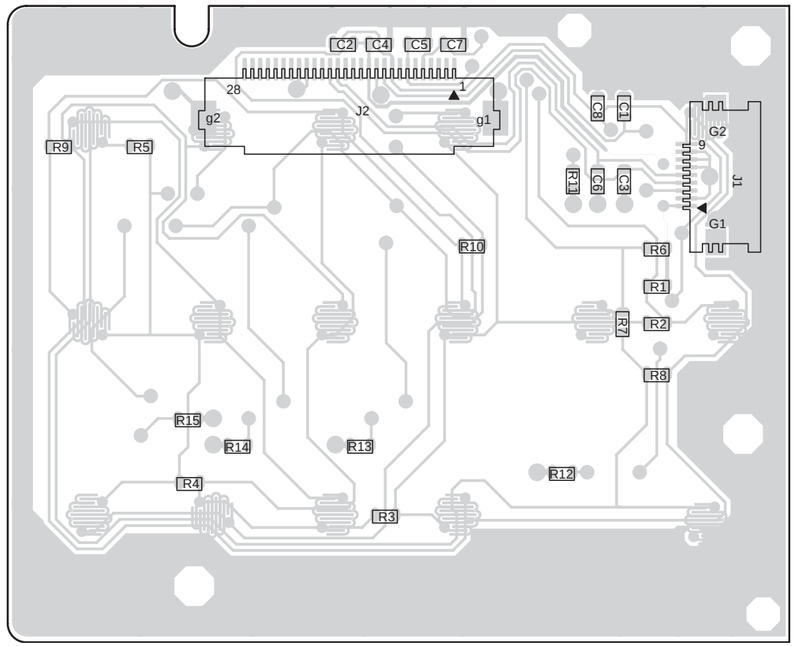


Figure 11-28. UHF (438-470 MHz) Board Component Side View



Component Side



Solder Side

Figure 11-29. UHF (438-470 MHz) PCB 8486348Z13-C Board Solder Side View

UHF (438-470 MHz) Radio Parts List

Circuit Ref	Motorola Part No.	Description
C1	2109445U36	CAP, 13pF
C2	2109445U37	CAP, 15pF
C3	2109445U07	CAP, 1.5pF
C4	Not_Placed	CAP, 20pF
C5	0662057M01	RES, 0
C6	2109445U07	CAP, 1.5pF
C7	Not_Placed	CAP, 22pF
C8	0662057M01	RES, 0
C9	2109445U37	CAP, 15pF
C10	2109445U34	CAP, 11pF
C11	2113743N30	CAP, 15pF
C12	2109445U25	CAP, 8.2pF
C13	2109445U07	CAP, 1.5pF
C14	2109445U07	CAP, 1.5pF
C20	2113743L07	CAP, 390pF
C21	2113743L07	CAP, 390pF
C23	2113743L07	CAP, 390pF
C25	2113743L07	CAP, 390pF
C26	2113743L07	CAP, 390pF
C27	2109445U32	CAP, 8pF
C28	2109445U27	CAP, 10pF
C29	2109445U23	CAP, 6.8pF
C30	2109445U40	CAP, 20pF
C31	2109445U23	CAP, 6.8pF
C32	2109445U22	CAP, 6.2pF
C33	2109445U41	CAP, 22pF
C34	2109445U22	CAP, 6.2pF
C35	2109445U31	CAP, 7pF
C36	2109445U39	CAP, 18pF
C37	2109445U31	CAP, 7pF
C38	2109445U26	CAP, 9.1pF
C39	2109445U26	CAP, 9.1pF
C41	2113743N23	CAP, 7.5pF
C42	2113743N31	CAP, 16pF
C43	2113743N33	CAP, 20pF
C44	2113743N24	CAP, 8.2pF
C45	2113743N31	CAP, 16pF
C46	Not_Placed	CAP, 10pF
C47	Not_Placed	CAP, 10pF
C48	0662057M01	RES, 0
C49	Not_Placed	CAP, 3.9pF
C51	2113743N48	CAP, 82pF
C52	2113743N28	CAP, 12pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U41	CAP, 22pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L07	CAP, 390pF
C101	2113743M24	CAP, 0.1uF
C102	2113743M24	CAP, 0.1uF
C103	2113743L07	CAP, 390pF
C104	2113743N26	CAP, 10pF
C105	2113743N16	CAP, 3.9pF
C106	2113743L07	CAP, 390pF
C107	Not_Placed	CAP, 27pF
C108	2113743L07	CAP, 390pF
C109	2113743M24	CAP, 0.1uF
C111	2113743L07	CAP, 390pF
C112	2113743M24	CAP, 0.1uF
C113	2113743L07	CAP, 390pF
C114	2113743L07	CAP, 390pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113740F65	CAP, 390pF
C120	Not_Placed	CAP, 8.2pF
C121	2113743L07	CAP, 390pF
C122	2113740F20	CAP, 5.1pF
C123	2113740F17	CAP, 3.9pF
C124	2113743L07	CAP, 390pF
C130	Not_Placed	CAP, 3.3pF
C131	Not_Placed	CAP, 2.2pF
C132	2113740F23	CAP, 6.8pF
C133	Not_Placed	CAP, 2.7pF
C134	2113740F23	CAP, 6.8pF
C135	Not_Placed	CAP, 0.5pF
C136	2113740F18	CAP, 4.3pF
C137	2113740F59	CAP, 220pF
C141	Not_Placed	CAP, 8.2pF
C150	2113743L07	CAP, 390pF
C151	2113743L07	CAP, 390pF
C152	2113743L07	CAP, 390pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L07	CAP, 390pF
C155	2113743E20	CAP, 0.1uF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L07	CAP, 390pF
C159	2113743L07	CAP, 390pF
C170	2113743L07	CAP, 390pF
C171	2113743L07	CAP, 390pF
C172	2113743L07	CAP, 390pF
C173	2113743L07	CAP, 390pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C240	2113743N06	CAP, 1.3pF
C241	2113743N50	CAP, 100pF
C243	PT08MTPB49	CAP, 0.1uF
C244	0888600M25	CAP, .01uF
C245	2311049A08	CAPP, 1uF
C251	0888600M03	CAP, 150pF
C252	Not_Placed	CAP, 390pF
C253	2109445U22	CAP, 6.2pF
C254	2109445U20	CAP, 5.1pF
C255	2109445U21	CAP, 5.6pF
C256	2109445U17	CAP, 3.9pF
C257	2109445U35	CAP, 12pF
C263	2109445U19	CAP, 4.7pF
C264	2109445U10	CAP, 2pF
C265	2109445U15	CAP, 3.3pF
C266	2109445U12	CAP, 2.4pF
C267	2109445U24	CAP, 7.5pF
C268	2109445U01	CAP, 0.5pF
C270	2113743L07	CAP, 390pF
C271	2113743L07	CAP, 390pF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L07	CAP, 390pF
C276	2113743N22	CAP, 6.8pF
C281	2113743L07	CAP, 390pF
C282	2113743N14	CAP, 3.3pF
C283	2113743L07	CAP, 390pF
C284	2113743L07	CAP, 390pF
C285	2113743E20	CAP, 0.1uF
C286	2113743N21	CAP, 6.2pF
C290	2113743N22	CAP, 6.8pF
C291	2113743N32	CAP, 18pF
C292	2113743L07	CAP, 390pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF

Circuit Ref	Motorola Part No.	Description
C400	Not_Placed	CAP, .022uF
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743L17	CAP, 1000pF
C404	2113743L17	CAP, 1000pF
C405	2113743L17	CAP, 1000pF
C406	2113743L17	CAP, 1000pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2113743E20	CAP, 0.1uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	2113743L41	CAP, .01uF
C483	2113743E20	CAP, 0.1uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113743F18	CAP, 2.2uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N48	CAP, 82pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
C521	2113743N20	CAP, 5.6pF
C522	2113743N01	CAP, 0.5pF
C523	2186463Z09	CAP, 0.4pF
C524	2186463Z01	CAP, 0.2pF
CR1	4813825A19	MMBD352
CR41	4802246J04	HSMS2829
CR51	4813825A19	MMBD352
D51	4802245J97	DAN235ETL
D52	4802245J97	DAN235ETL
D120	4880973Z02	MA4PH261
D121	4880973Z02	MA4PH261
D201	4862824C03	1SV232
D220	4802233J09	IMN10
D221	4802233J09	IMN10
D251	4862824C01	1SV229
D261	4862824C01	1SV229
D262	4862824C01	1SV229
D301	4813833A19	MBRM120ET3
D414	4805129M41	MMBD501
D440	4805729G49	BRPY1204W
D470	4809924D18	RB520S-30
D471	4809924D18	RB520S-30
D491	4805129M41	MMBD501
E451	2480640Z01	BK1005HM471
E452	2480640Z01	BK1005HM471
E453	2480640Z01	BK1005HM471
E500	2480640Z01	BK1005HM471
F301	6580542Z01	FUSE
FL51	9180022M11	MXF45
FL52	9180468V05	FLTR
FL53	9180469V05	CFWC455E
FL54	9180469V03	CFWC455G
J140	0986428Z01	CONN_J
J301	0986237A02	CONN_J
J460	Not_Placed	CONN_J
J470	0985818A01	CONN_J
J471	0980683Z03	CONN_J
J491	2809926G01	CONN_P
L1	2409348J15	IDCTR, 9.85nH
L2	2409348J15	IDCTR, 9.85nH
L3	2409348J15	IDCTR, 9.85nH
L21	2413926N16	IDCTR, 22nH
L31	2409348J15	IDCTR, 9.85nH
L32	2409348J15	IDCTR, 9.85nH
L33	2409348J15	IDCTR, 9.85nH
L34	2409348J15	IDCTR, 9.85nH
L40	2413926K16	IDCTR, 27nH
L41	2413926K16	IDCTR, 27nH
L51	2413926N26	IDCTR, 150nH
L52	2413926K33	IDCTR, 680nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L55	2413926N15	IDCTR, 18nH
L81	2462587N68	IDCTR, 1uH
L100	2413926K27	IDCTR, 220nH
L101	2413926K27	IDCTR, 220nH
L102	2409377M21	IDCTR, 3.6nH
L103	2409377M24	IDCTR, 5.1nH
L110	2413926K27	IDCTR, 220nH
L120	2413926K27	IDCTR, 220nH
L121	2462587V24	IDCTR, 15nH
L130	2460591C40	IDCTR, 17.02nH
L131	2460591C40	IDCTR, 17.02nH
L132	2460591C40	IDCTR, 17.02nH
L140	2113740F42	CAP, 43pF
L141	2479990M01	IDCTR, 30.54nH
L211	2413926K30	IDCTR, 390nH
L251	2413926N28	IDCTR, 220nH
L252	2413926N17	IDCTR, 27nH
L254	2484562T11	IDCTR, 12.5nH
L255	2413926N28	IDCTR, 220nH
L262	2413926N17	IDCTR, 27nH
L264	2484562T11	IDCTR, 12.5nH
L265	2413926N28	IDCTR, 220nH
L270	2413926N28	IDCTR, 220nH
L271	Not_Placed	IDCTR, 220nH
L272	2413926N28	IDCTR, 220nH
L276	2413926N17	IDCTR, 27nH
L281	2413926N17	IDCTR, 27nH
L282	2413926N14	IDCTR, 15nH
L283	Not_Placed	IDCTR, 22nH
L291	2413926N10	IDCTR, 6.8nH
L292	2413926N14	IDCTR, 15nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	ANTENNA_NUT
Q21	4802247J01	BFS505
Q22	4805723X02	UMT1
Q51	4802197J95	PBR941
Q70	4880214G02	MMBT3904
Q100	4885593U03	BFG540W
Q150	4880214G02	MMBT3904
Q170	4809939C34	EMB10
Q171	4880048M01	DTC144EKA
Q280	4802245J95	BFS540
Q311	4809579E18	TP0101T
Q312	4809579E18	TP0101T
Q313	4802245J54	UMG5
Q402	4880048M01	DTC144EKA
Q403	4813824A17	MMBT3906
Q410	4802245J54	UMG5
Q440	5180159R01	IMX1
Q470	4805723X02	UMT1
Q471	4802245J54	UMG5
Q472	4805723X02	UMT1
Q481	Not_Placed	MMBT3906
Q482	4813824A10	MMBT3904
Q490	4802245J54	UMG5
Q493	4809579E18	TP0101T
Q494	4802245J54	UMG5
Q520	4813824A10	MMBT3904
R20	0662057M92	RES, 5.6K
R21	0662057M50	RES, 100
R22	0662057M92	RES, 5.6K

Circuit Ref	Motorola Part No.	Description
R23	0662057N09	RES, 27K
R24	0662057M78	RES, 1.5K
R25	0662057M92	RES, 5.6K
R40	0662057M74	RES, 1K
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M72	RES, 820
R101	0662057M20	RES, 5.6
R102	0662057M72	RES, 820
R103	0662057M85	RES, 3K
R104	0662057A07	RES, 18
R105	0662057M84	RES, 2.7K
R106	0662057M90	RES, 4.7K
R107	Not_Placed	RES, 300
R110	0662057M70	RES, 680
R111	0662057M81	RES, 2K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A15	RES, 39
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M82	RES, 2.2K
R158	0662057M78	RES, 1.5K

Circuit Ref	Motorola Part No.	Description
R162	0662057M98	RES, 10K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M49	RES, 91
R221	0662057M49	RES, 91
R223	0662057M50	RES, 100
R227	Not_Placed	RES, 150K
R230	0662057N07	RES, 22K
R243	0662057M72	RES, 820
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N06	RES, 20K
R253	0662057M38	RES, 33
R254	0662057M50	RES, 100
R255	0662057U91	RES, 3.9K
R261	0662057N07	RES, 22K
R262	0662057M94	RES, 6.8K
R263	0662057M38	RES, 33
R264	0662057M50	RES, 100
R271	0662057M91	RES, 5.1K
R272	0662057M92	RES, 5.6K
R273	0662057M62	RES, 330
R274	0662057M38	RES, 33
R275	0662057M50	RES, 100
R276	0662057M74	RES, 1K
R277	0662057B47	RES, 0
R280	0662057M90	RES, 4.7K
R281	0662057M96	RES, 8.2K
R282	0662057M73	RES, 910
R283	0662057M54	RES, 150
R284	0662057M62	RES, 330
R285	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057N06	RES, 20K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K
R417	0662057M98	RES, 10K

Circuit Ref	Motorola Part No.	Description
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	0662057N23	RES, 100K
R482	0662057N35	RES, 330K
R483	0662057N27	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	0662057N23	RES, 100K
R486	0662057N23	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	0662057A96	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K
R495	0662057M92	RES, 5.6K

Circuit Ref	Motorola Part No.	Description
R496	Not_Placed	RES, 10K
R497	0662057N47	RES, 1MEG
R498	0662057N15	RES, 47K
R499	0662057N33	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	0662057N23	RES, 100K
R514	0662057N23	RES, 100K
R515	0662057M01	RES, 0
R516	Not_Placed	RES, 0
R517	Not_Placed	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	0662057N23	RES, 100K
S440	4080710Z06	SWITCH
S441	4070354A01	SWITCH
S442	4070354A01	SWITCH
S443	4070354A01	SWITCH
S444	1880619Z02	SWITCH
SH1	2686421Z01	SHIELD
SH40	2686419Z01	SHIELD
SH50	2686423Z01	SHIELD
SH52	2686424Z01	SHIELD
SH100	2686418Z01	SHIELD
SH200	2686424Z01	SHIELD
SH201	2686423Z01	SHIELD
SH250	2686425Z01	SHIELD
SH251	2686425Z01	SHIELD
SH253	2686422Z01	SHIELD
SH400	2686420Z01	SHIELD
SH401	2686420Z01	SHIELD
T41	2580541Z02	XFMR
T42	2580541Z02	XFMR
U51	5186144B01	SA616
U52	5109522E10	TC7W04F
U110	0186438Z02	RA07M4452M_UHF
U150	5113818A01	LM2904
U151	2484657R01	57R01
U201	5185963A27	63A27
U251	5105750U54	50U54

Circuit Ref	Motorola Part No.	Description
U310	5102478J01	TK71750S
U320	5185963A55	LP2986
U330	5102479J01	TK71730S
U401	5102226J56	MC68HC11FL0
U402*	5102463J64	X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	AT49LV001N_70VI
U451	5185130C53	30C53
U480	5113818A01	LM2904
U490	5108858K99	TDA8541
U510	5113818A01	LM2904
U511	4802245J54	UMG5
VR110	4813830A86	MM3Z3V9T1
VR301	4813830A33	MMBZ5250B
VR302	4813830A33	MMBZ5250B
VR471	4813830A18	MMBZ5235B
VR472	4813830A09	MMBZ5226B
VR473	4813830A33	MMBZ5250B
VR474	4813830A33	MMBZ5250B
VR475	4880140L20	MMBZ5245B
Y51	4802245J84	TSS2_44_395MHZ
Y70	9186145B02	45B02
Y201*	4880114R06	14R06
Y202	Not_Placed	45J68

* Motorola Depot Servicing only

UHF (438-470 MHz) Keypad Board Parts List

Circuit Ref	Motorola Part No.	Description
C1	NOTPLACED	CAP, 150pF
C2	2113740F55	CAP, 150pF
C3	NOTPLACED	CAP, 150pF
C4	2113743E20	CAP, 0.1uF
C5	NOTPLACED	CAP, 150pF
C6	NOTPLACED	CAP, 150pF
C7	NOTPLACED	CAP, 150pF
C8	NOTPLACED	CAP, 150pF
D1	4809496B11	QSMG-H799
D2	4809496B11	QSMG-H799
D3	NOTPLACED	QSMG-H799
D4	NOTPLACED	QSMG-H799
D5	NOTPLACED	QSMG-H799
D6	NOTPLACED	QSMG-H799
D7	NOTPLACED	QSMG-H799
D8	NOTPLACED	QSMG-H799
D9	4809496B11	QSMG-H799
D10	4809496B11	QSMG-H799
D11	4809496B11	QSMG-H799
J1	0986632Z01	CONN_J
J2	0909059E18	CONN_J
R1	0662057A97	RES, 100K
R2	NOTPLACED	RES, 13K
R3	NOTPLACED	RES, 22K
R4	NOTPLACED	RES, 43K
R5	NOTPLACED	RES, 130K
R6	0662057A97	RES, 100K
R7	0662057A76	RES, 13K
R8	0662057A81	RES, 22K
R9	NOTPLACED	RES, 43K
R10	NOTPLACED	RES, 130K
R11	0662057A41	RES, 470
R12	0662057A41	RES, 470
R13	NOTPLACED	RES, 330
R14	NOTPLACED	RES, 330
R15	NOTPLACED	RES, 330

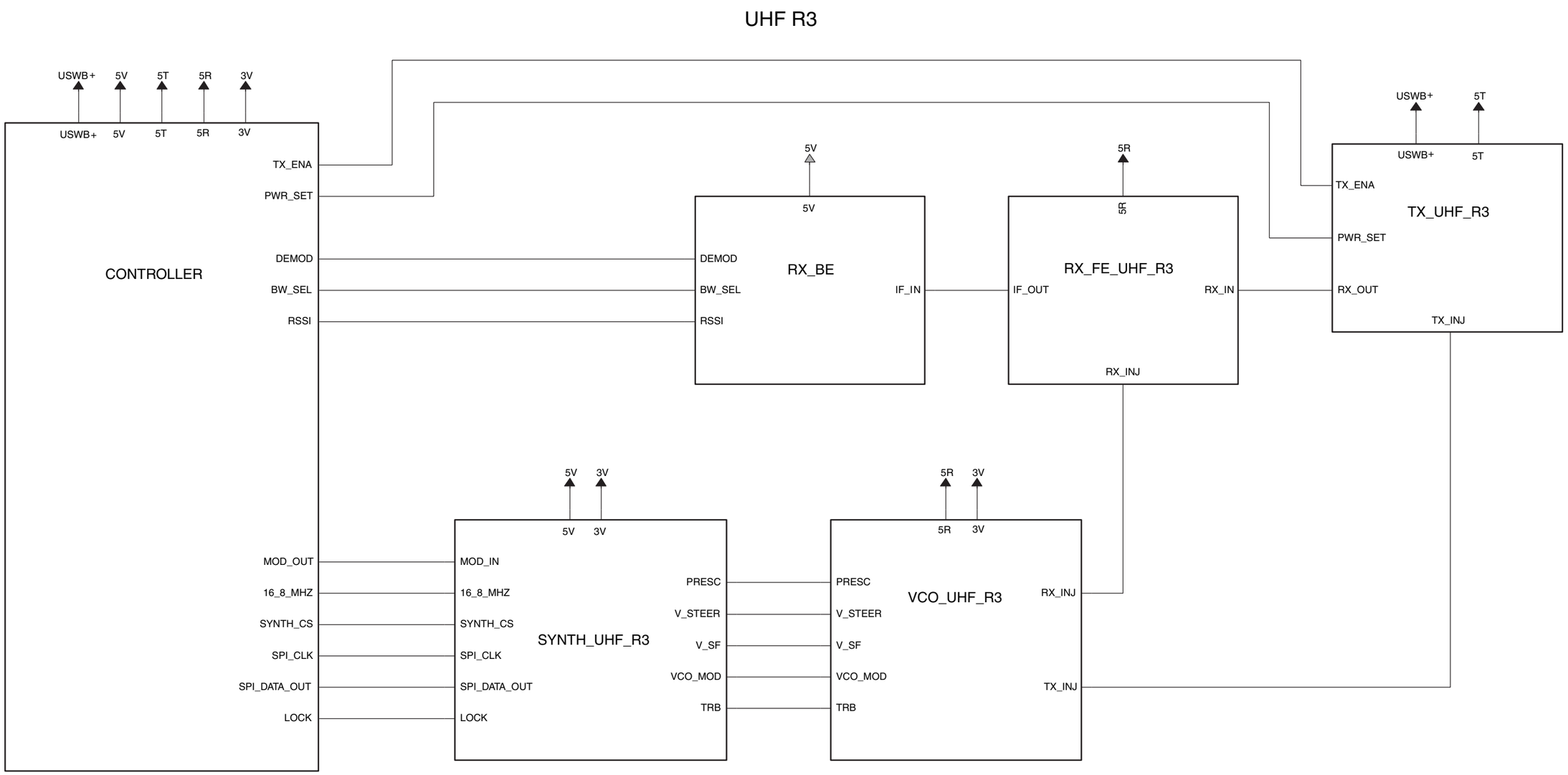


Figure 11-30. UHF (465-495 MHz) Radio Circuit Block Diagram

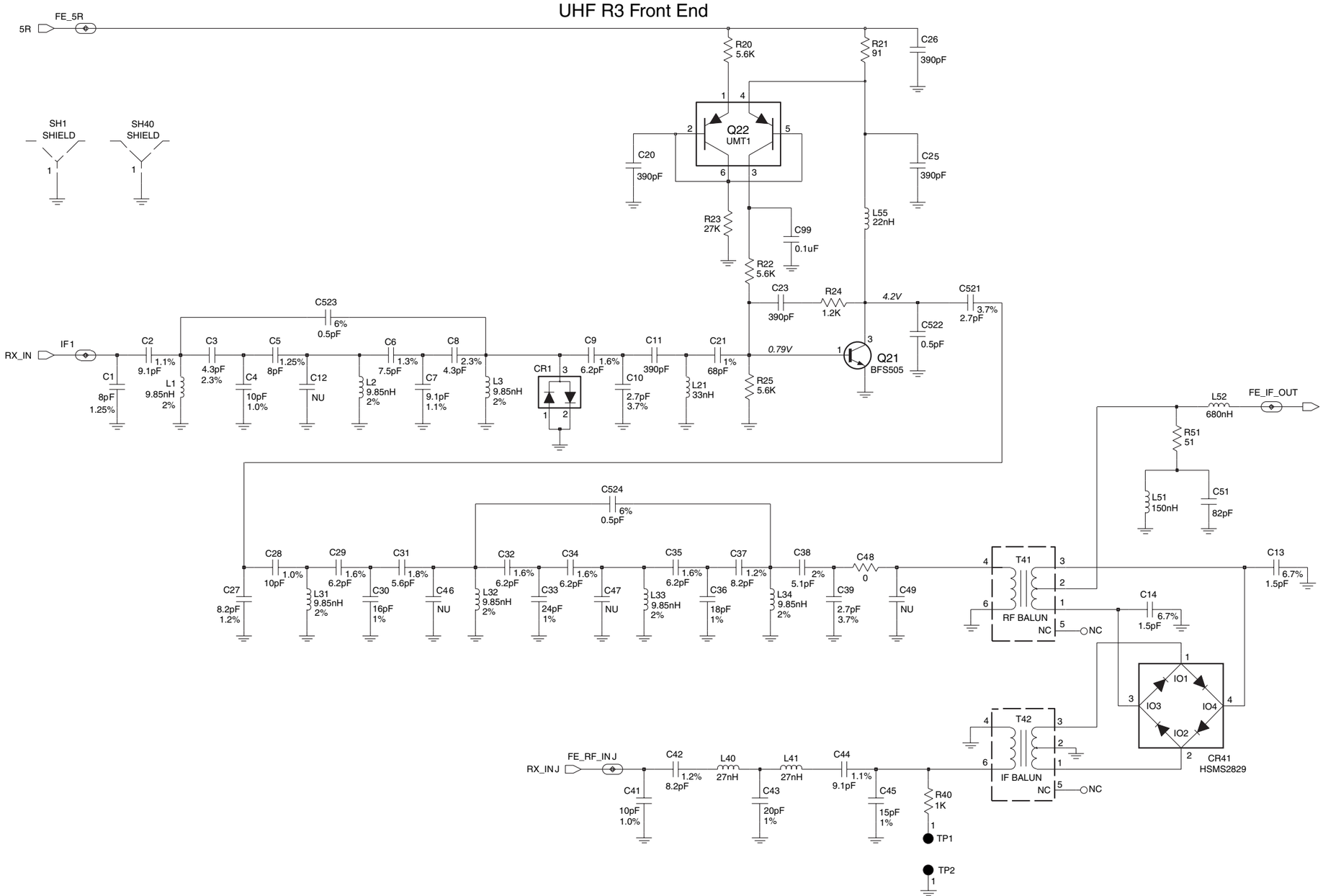


Figure 11-31. UHF (465-495 MHz) PCB8486634Z02-O Receiver Front End Schematic Diagram

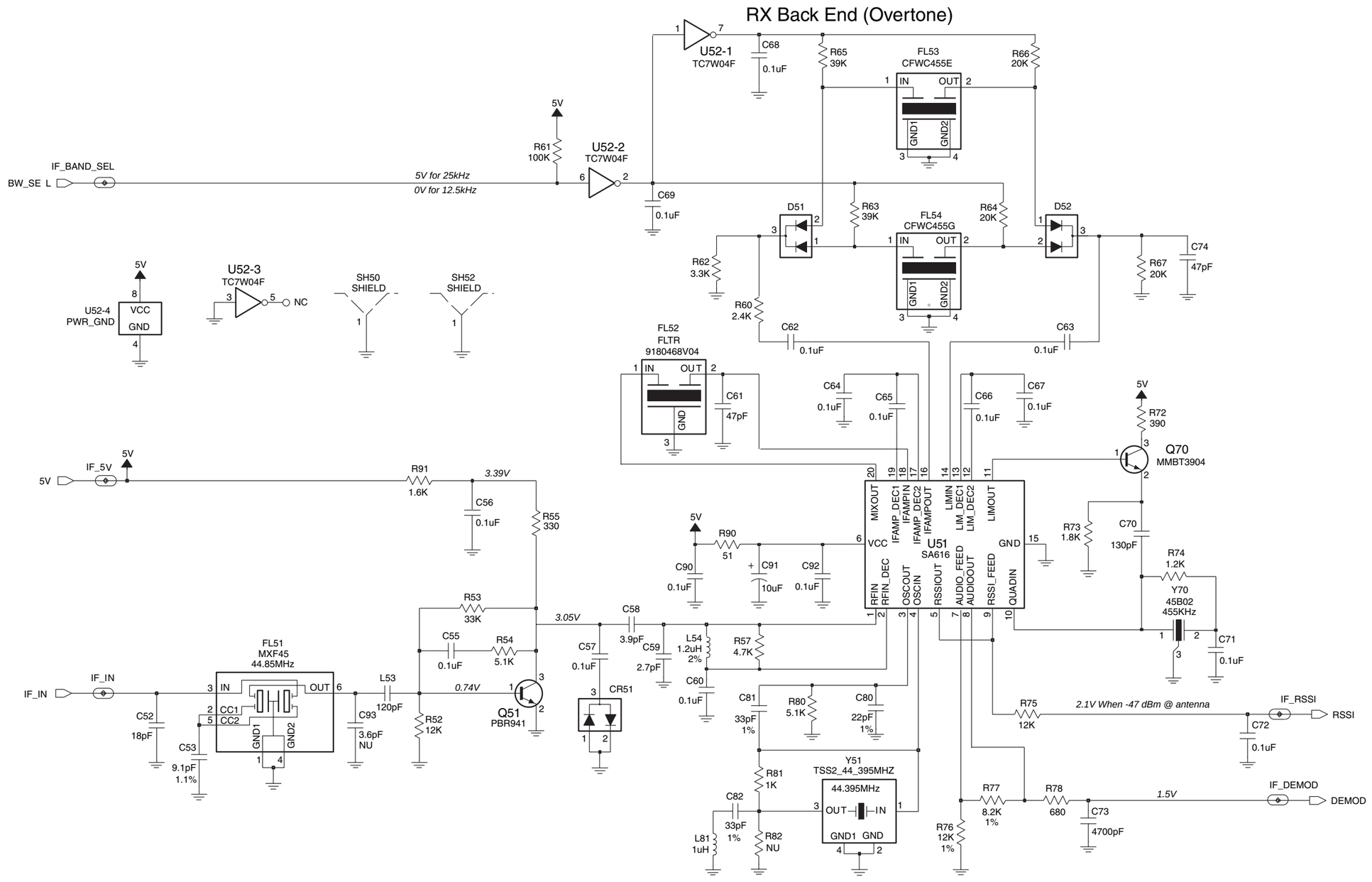
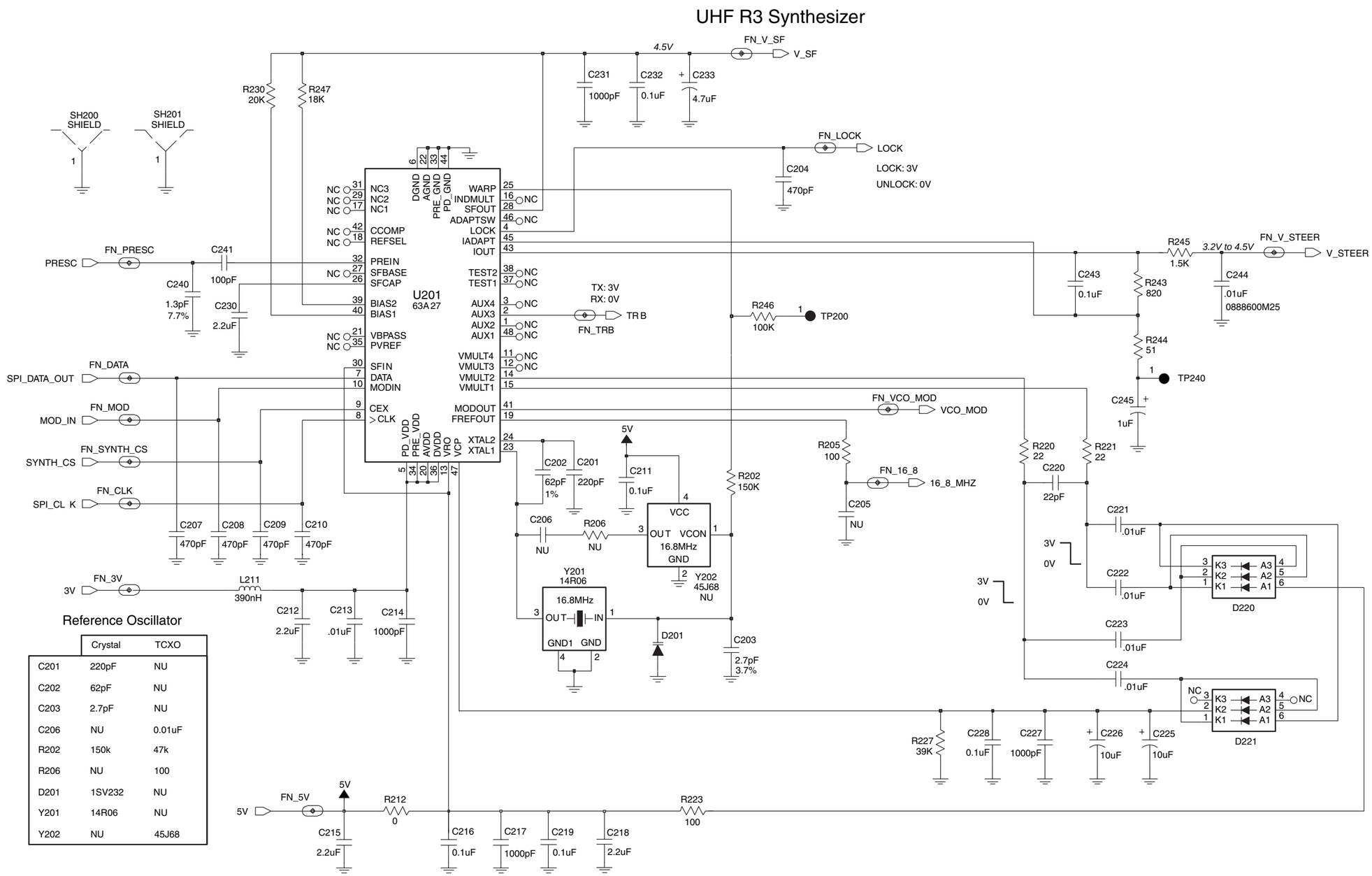


Figure 11-32. UHF (465-495 MHz) Receiver Back End Schematic Diagram



	Crystal	TCXO
C201	220pF	NU
C202	62pF	NU
C203	2.7pF	NU
C206	NU	0.01uF
R202	150k	47k
R206	NU	100
D201	1SV232	NU
Y201	14R06	NU
Y202	NU	45J68

Figure 11-33. UHF (465-495 MHz) PCB8486634Z02-O Synthesizer Schematic Diagram

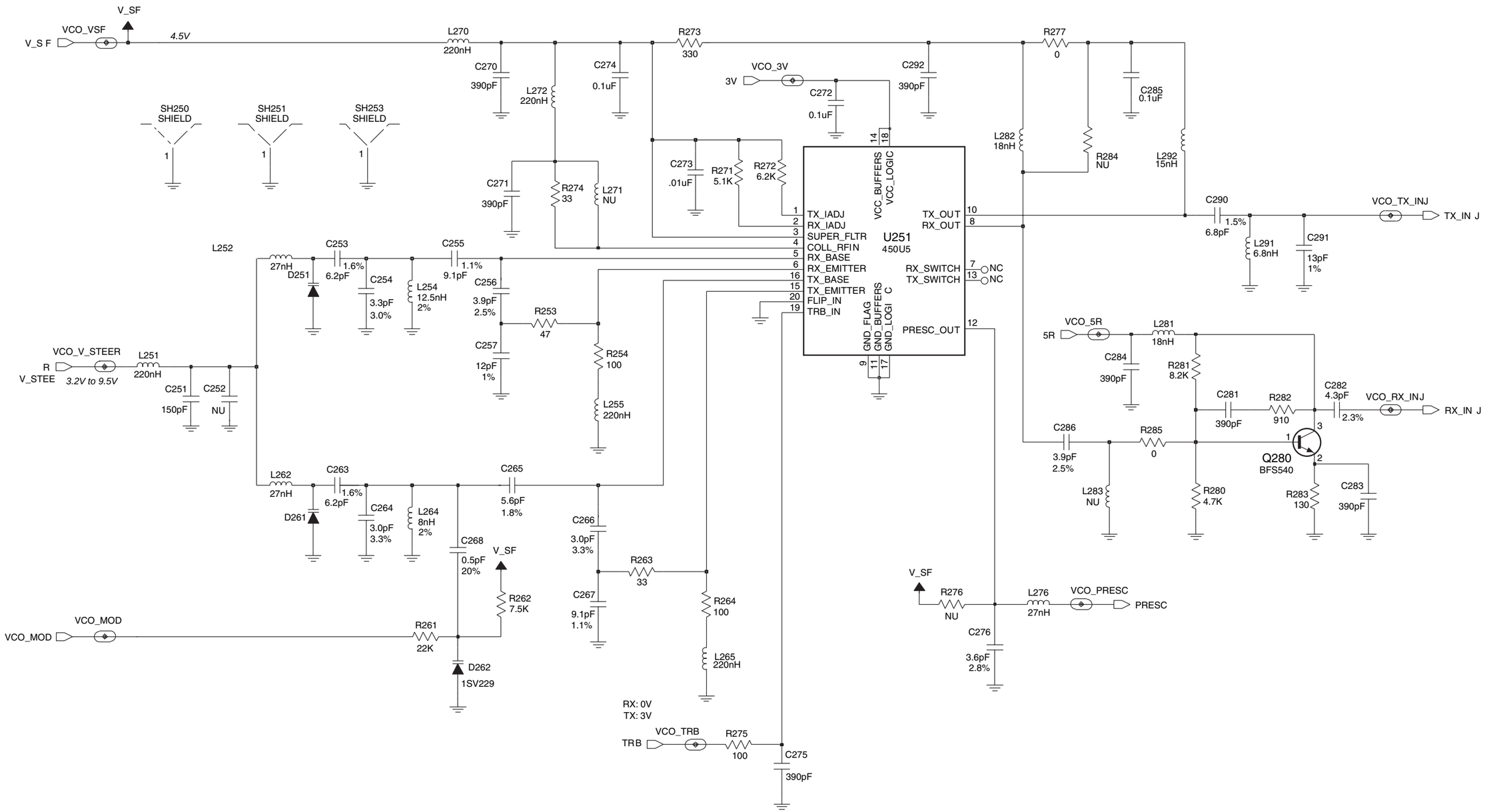


Figure 11-34. UHF (465-495 MHz) Voltage Controlled Oscillator Schematic Diagram

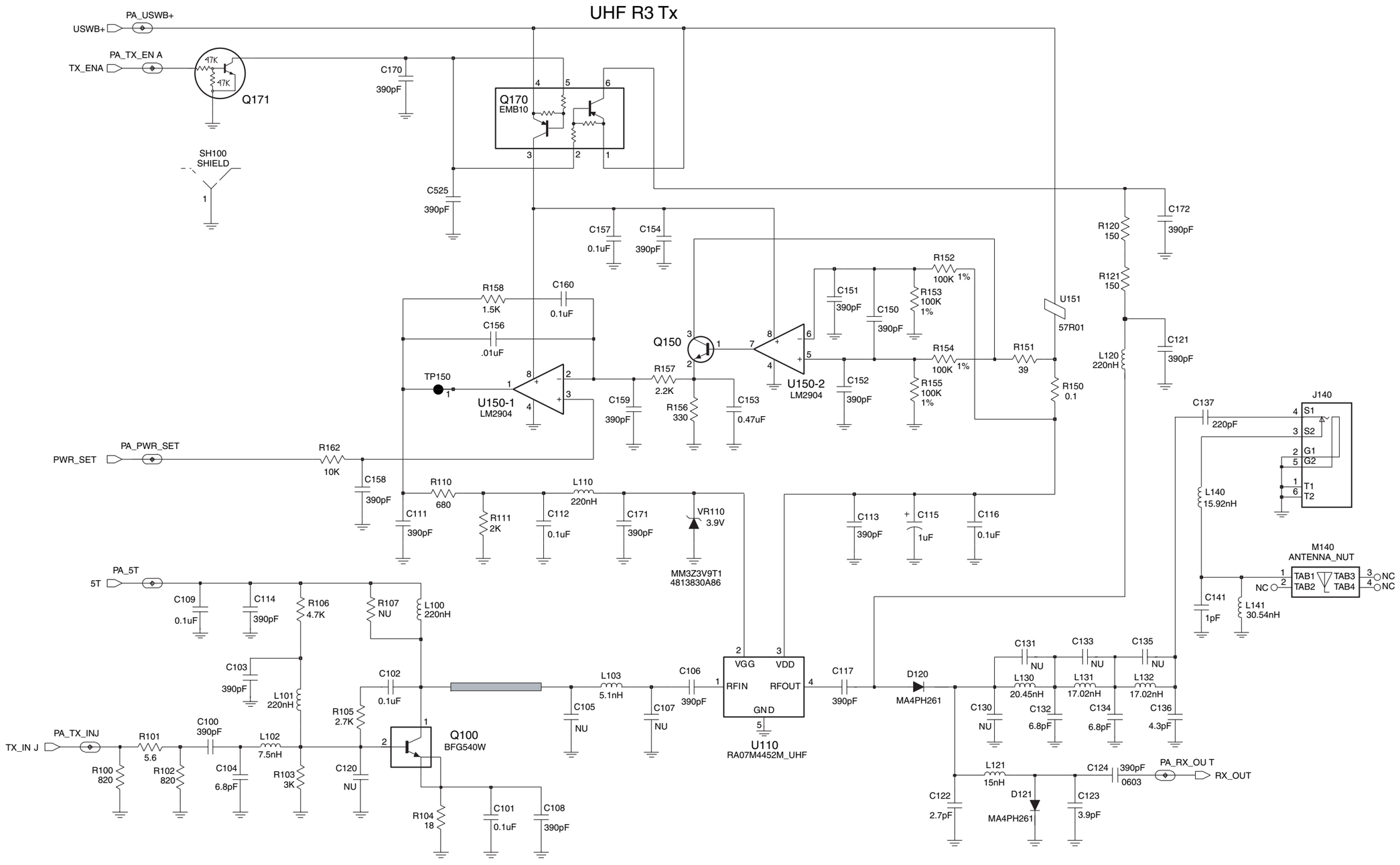


Figure 11-35. UHF (465-495 MHz) PCB8486634Z02-O Transmitter and Power Control Schematic Diagram

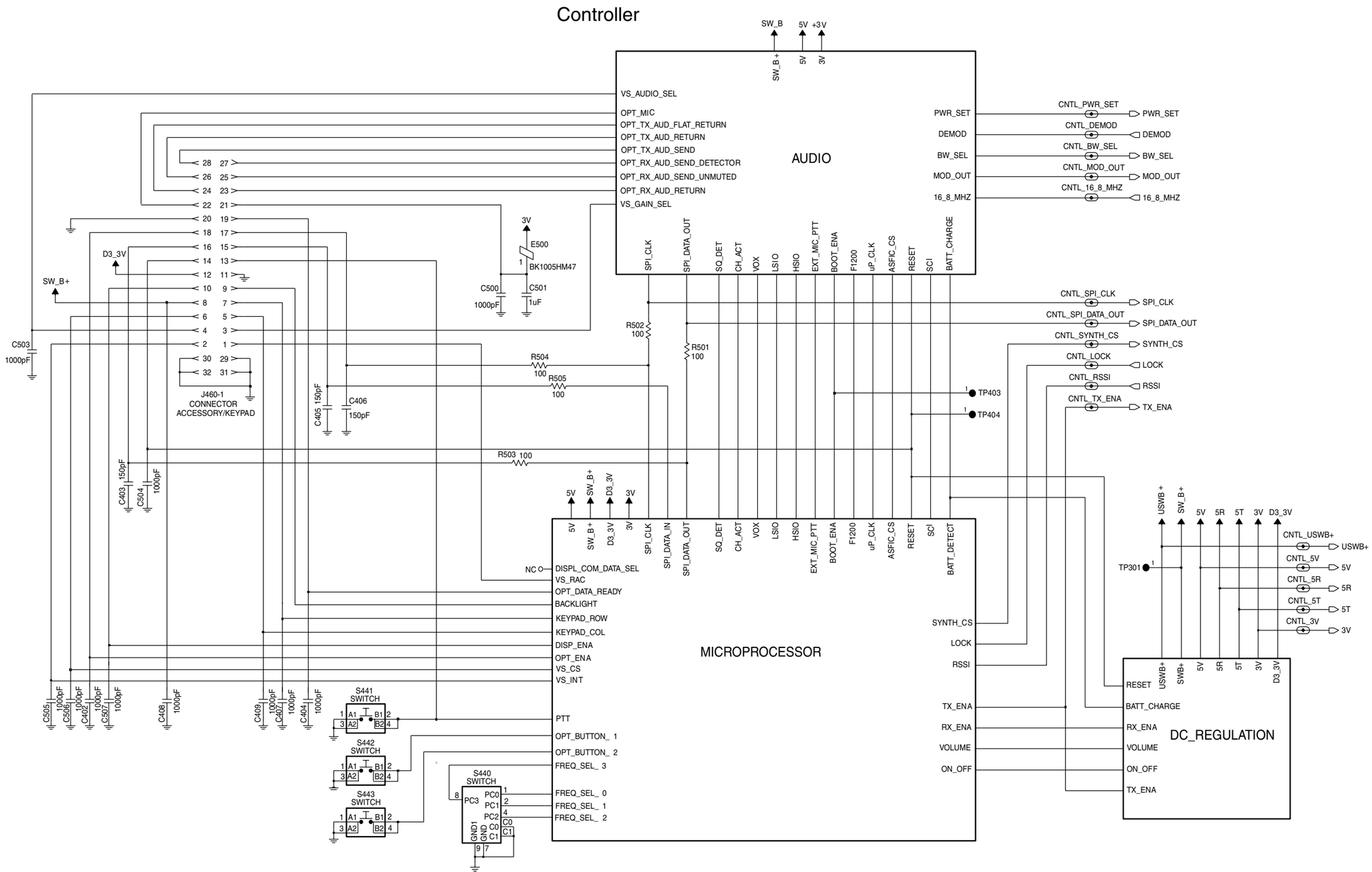


Figure 11-36. UHF (465-495 MHz) Controller Interconnect Schematic Diagram

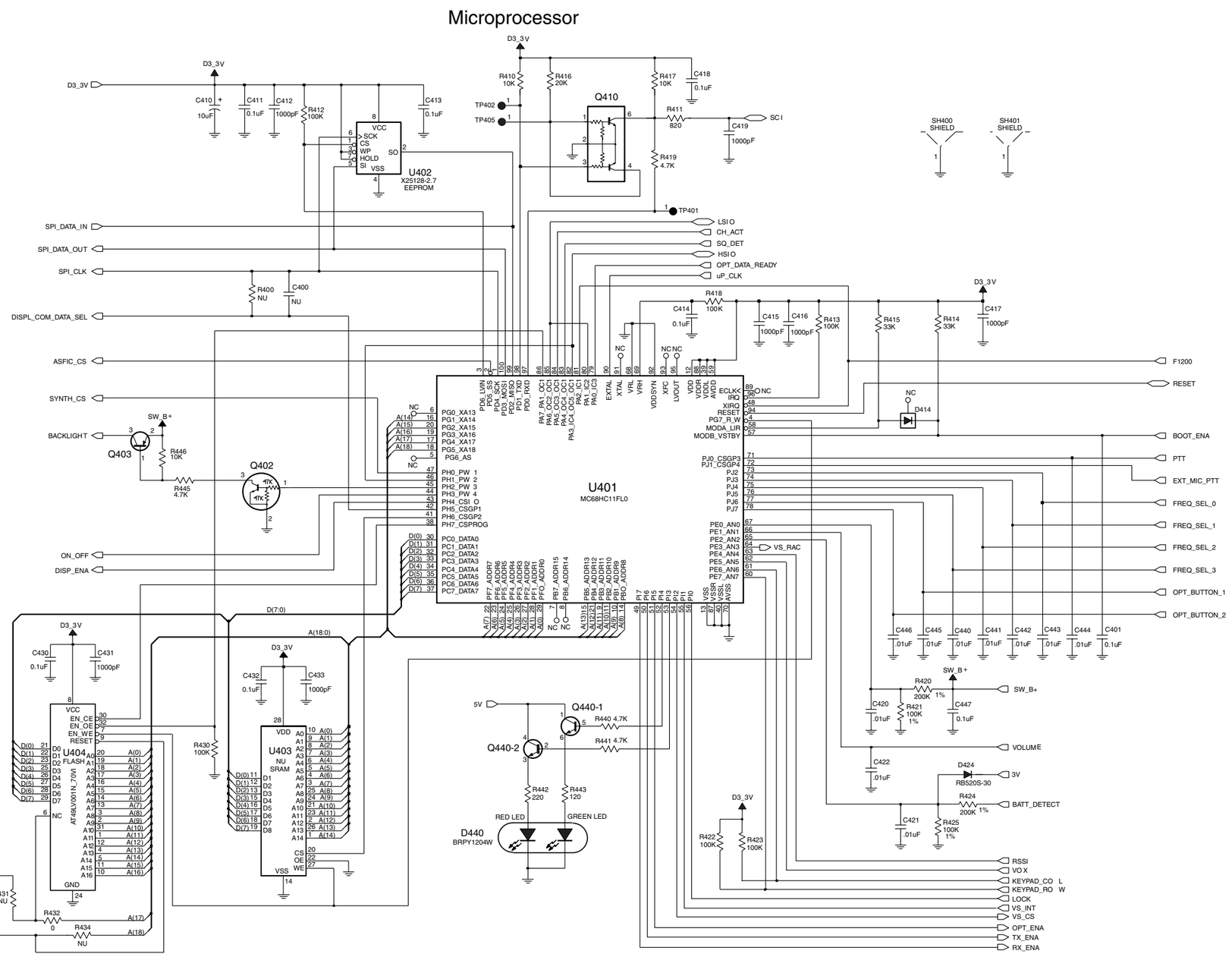
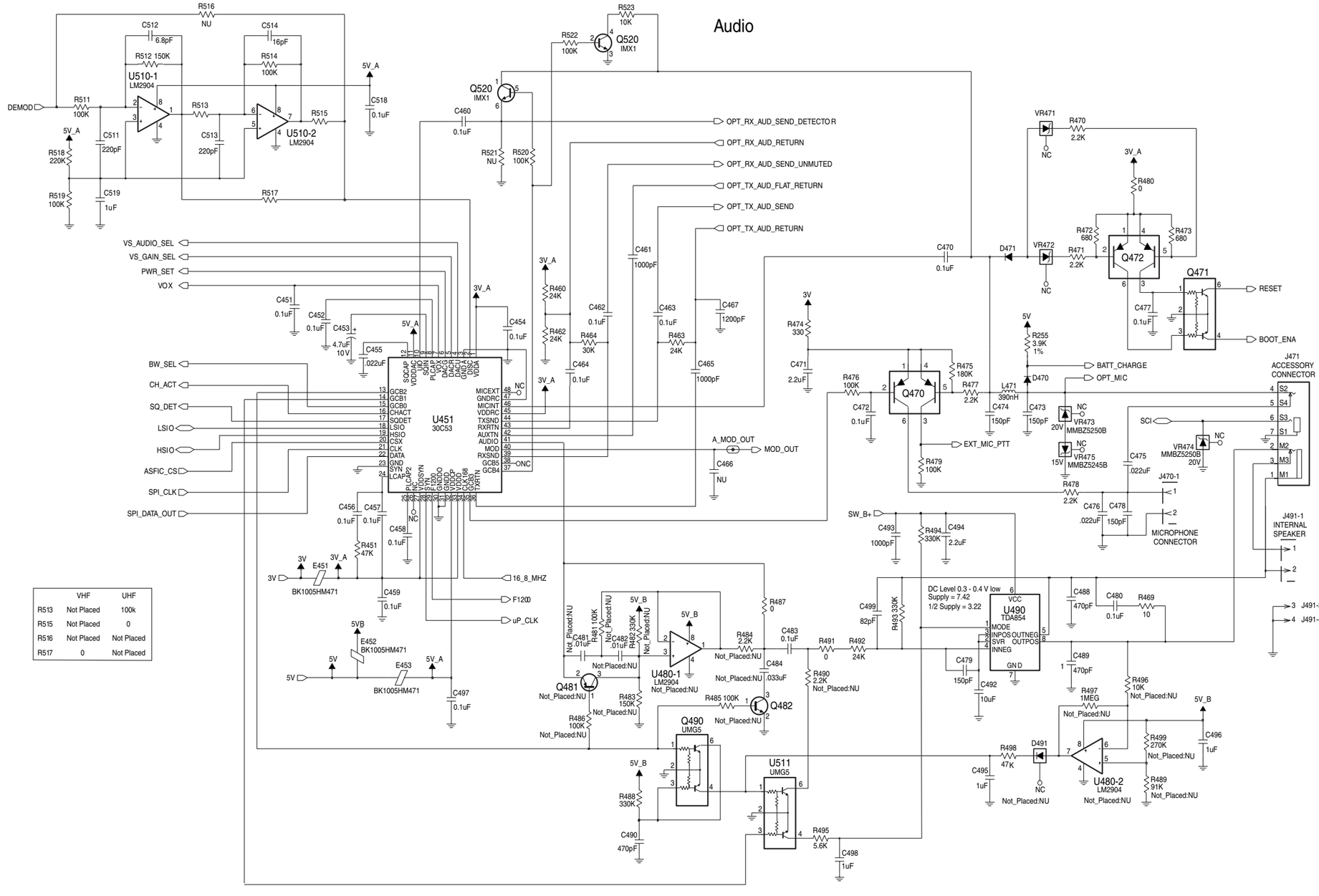


Figure 11-37. UHF (465-495 MHz) PCB8486634Z02-O Microprocessor Circuitry Schematic Diagram



	VHF	UHF
R513	Not Placed	100k
R515	Not Placed	0
R516	Not Placed	Not Placed
R517	0	Not Placed

Figure 11-38. UHF (465-495 MHz) Audio Circuitry Schematic Diagram

DC Regulation

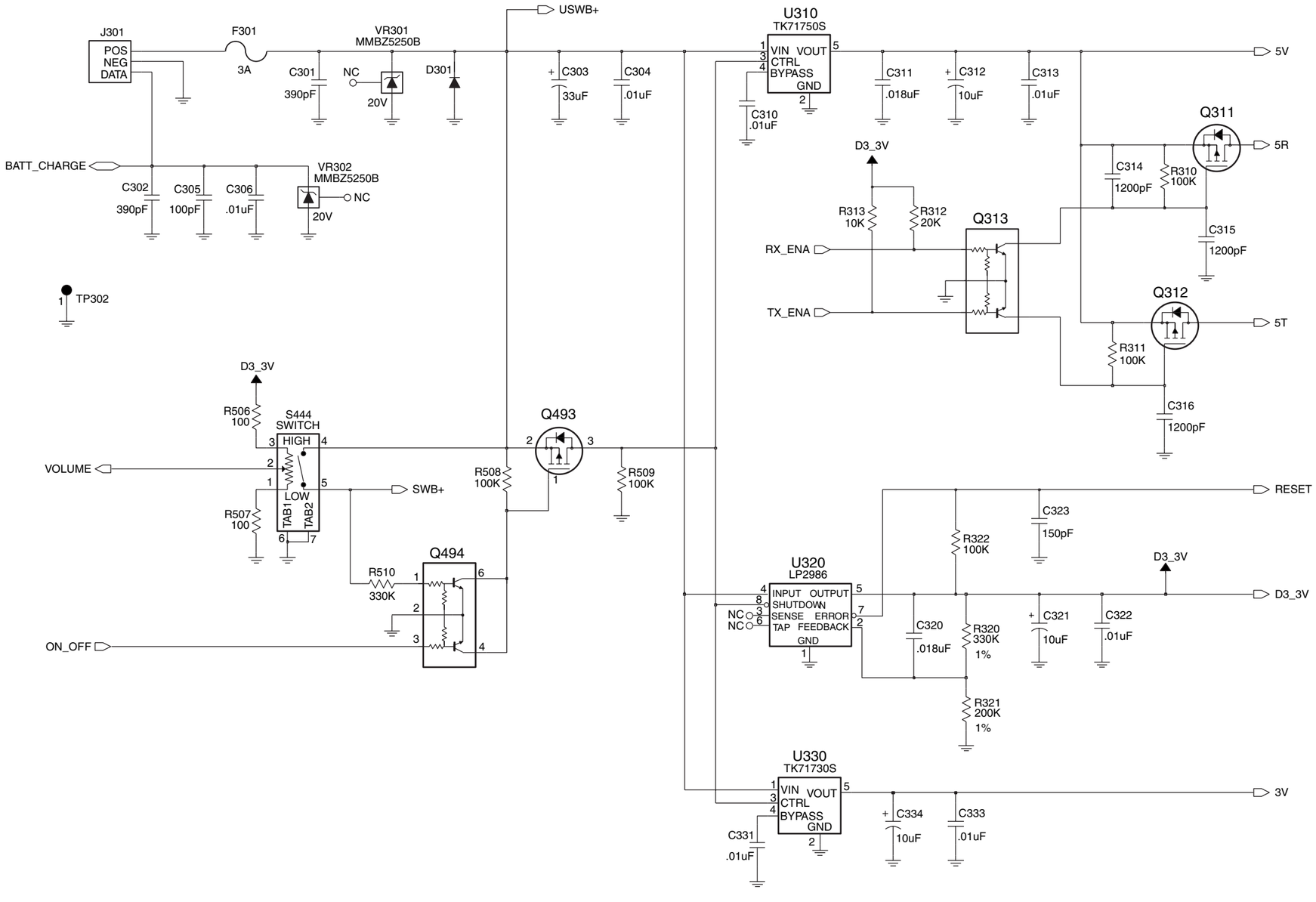
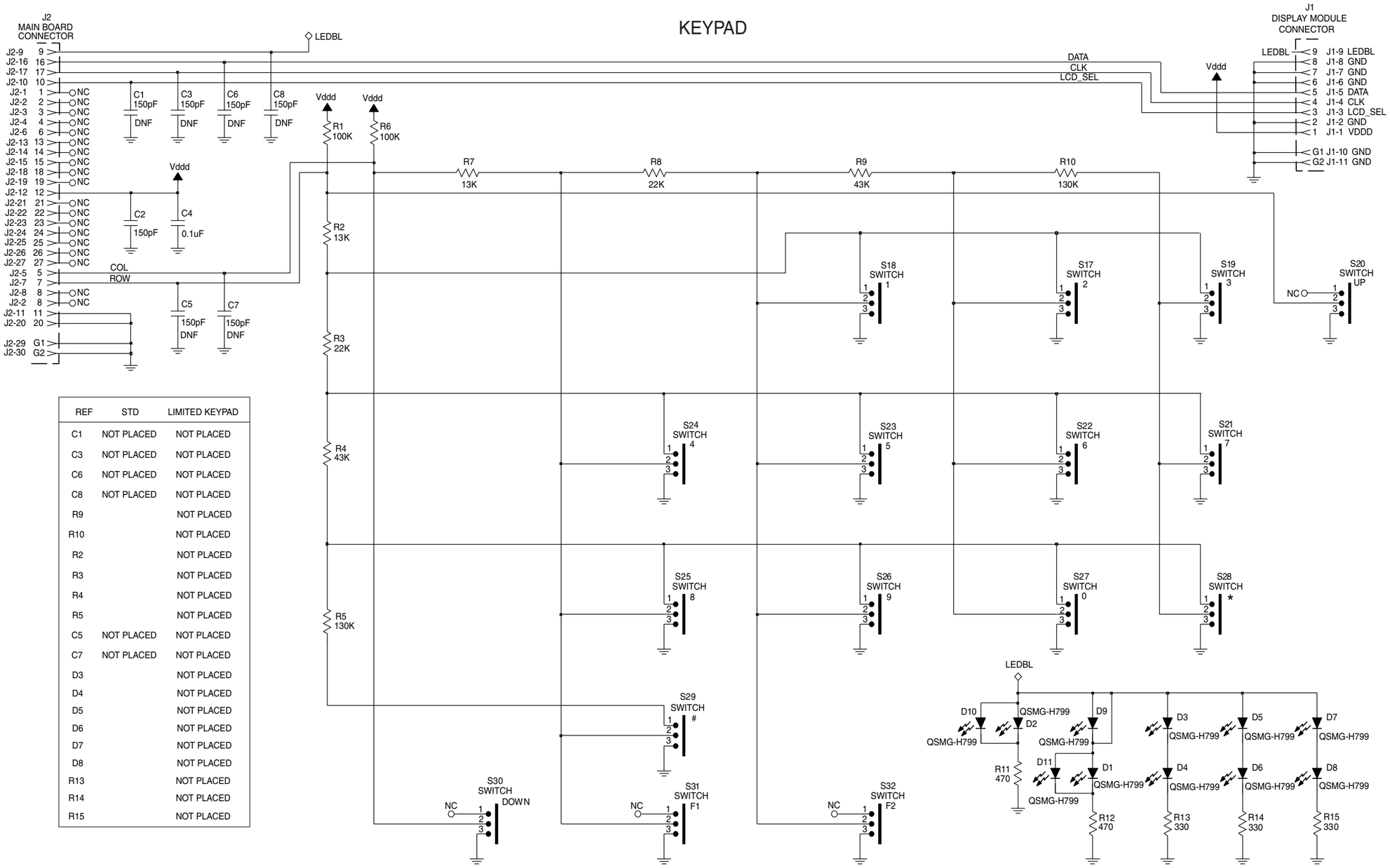


Figure 11-39. UHF (465-495 MHz) PCB8486634Z02-O DC Regulation Schematic Diagram



REF	STD	LIMITED KEYPAD
C1	NOT PLACED	NOT PLACED
C3	NOT PLACED	NOT PLACED
C6	NOT PLACED	NOT PLACED
C8	NOT PLACED	NOT PLACED
R9		NOT PLACED
R10		NOT PLACED
R2		NOT PLACED
R3		NOT PLACED
R4		NOT PLACED
R5		NOT PLACED
C5	NOT PLACED	NOT PLACED
C7	NOT PLACED	NOT PLACED
D3		NOT PLACED
D4		NOT PLACED
D5		NOT PLACED
D6		NOT PLACED
D7		NOT PLACED
D8		NOT PLACED
R13		NOT PLACED
R14		NOT PLACED
R15		NOT PLACED

Figure 11-40. UHF (465-495 MHz) Keypad Board Schematic Diagram

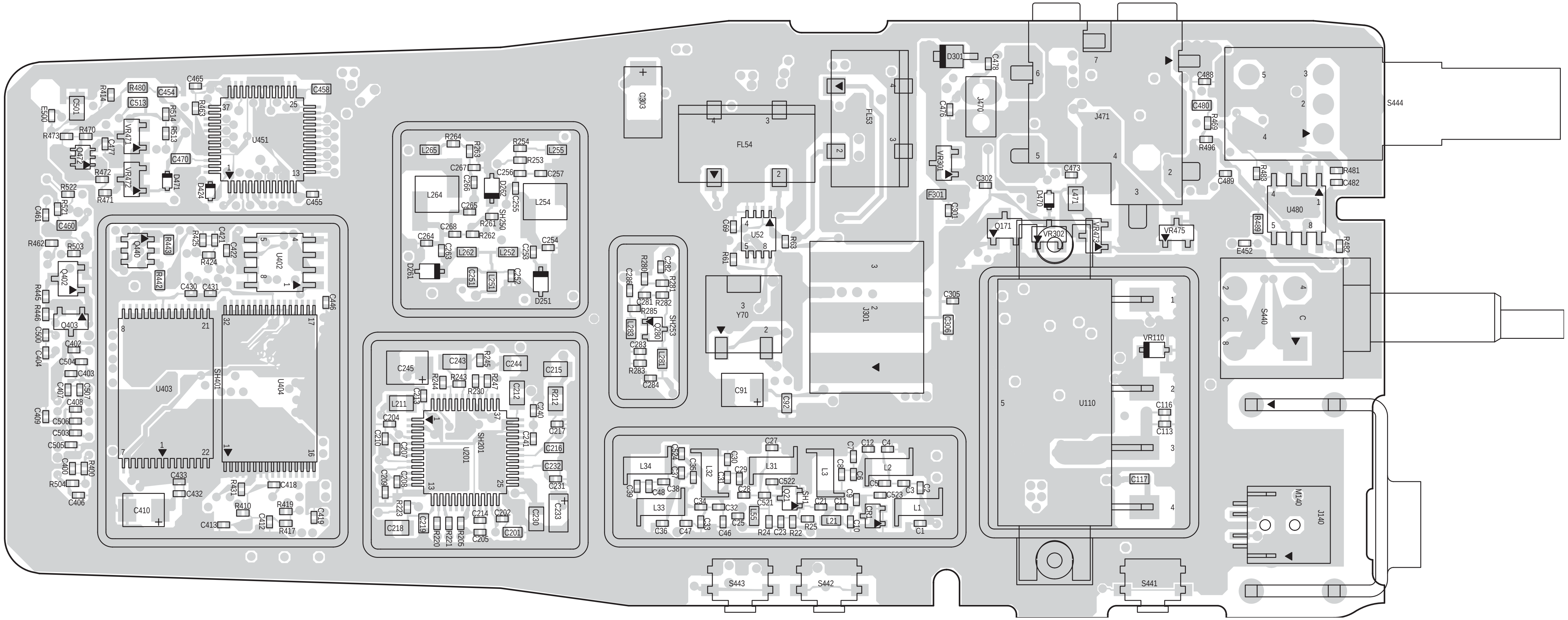


Figure 11-41. UHF (465-495 MHz) PCB8486634Z02-O Board Component Side View

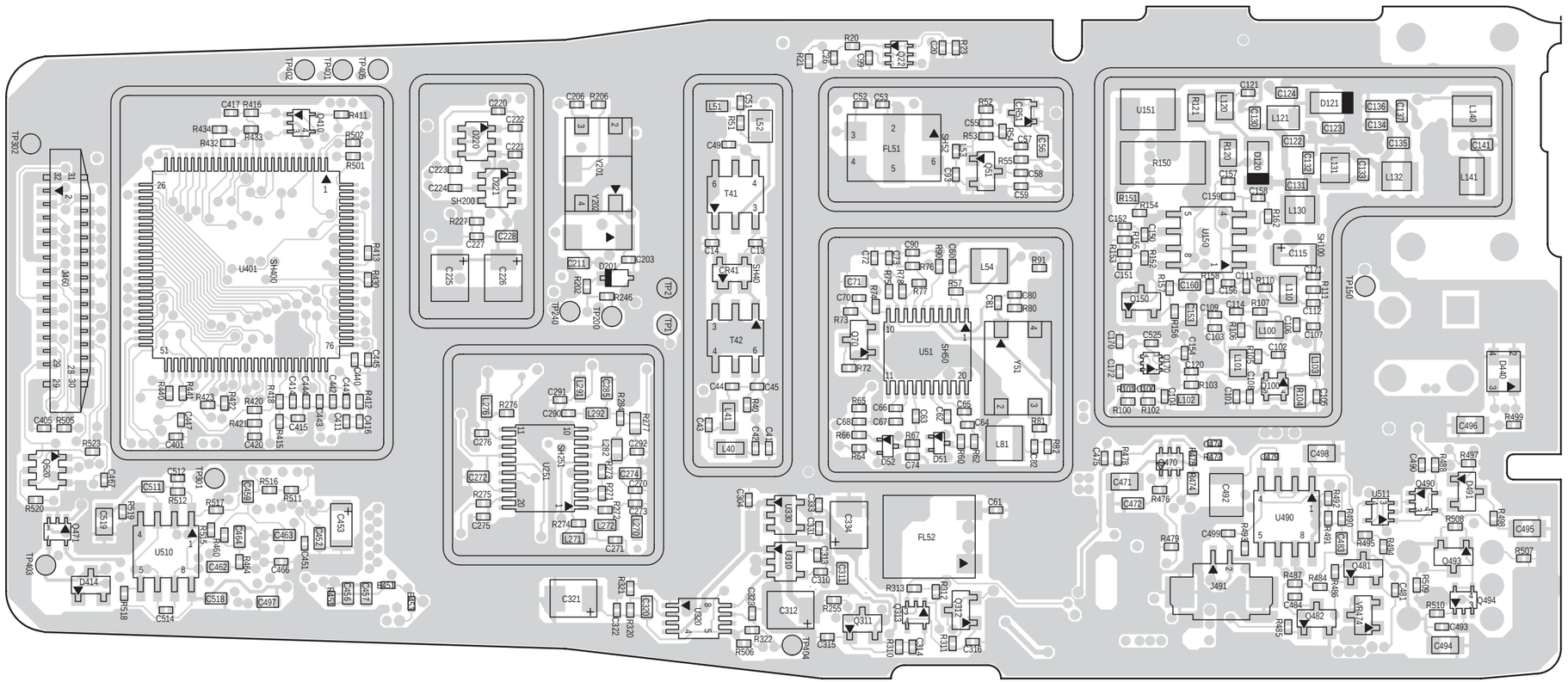
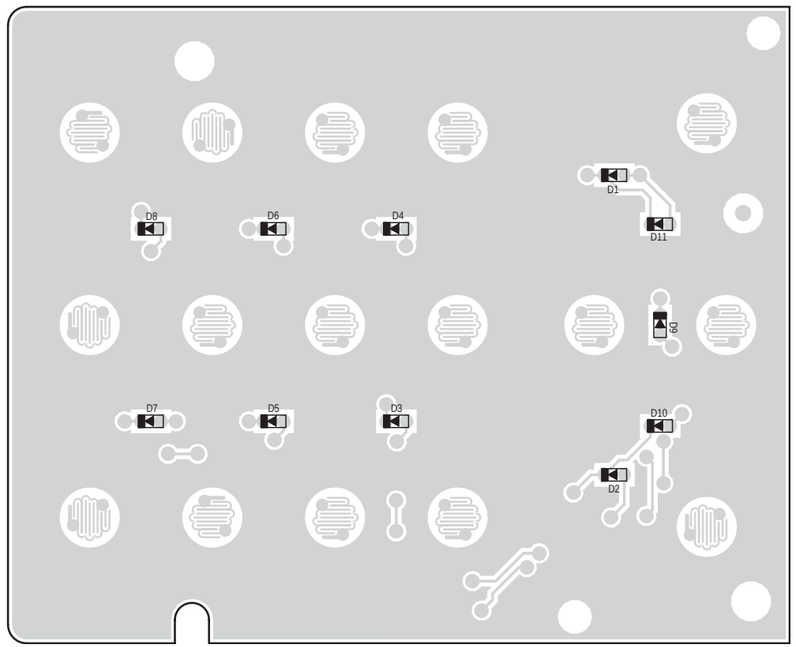
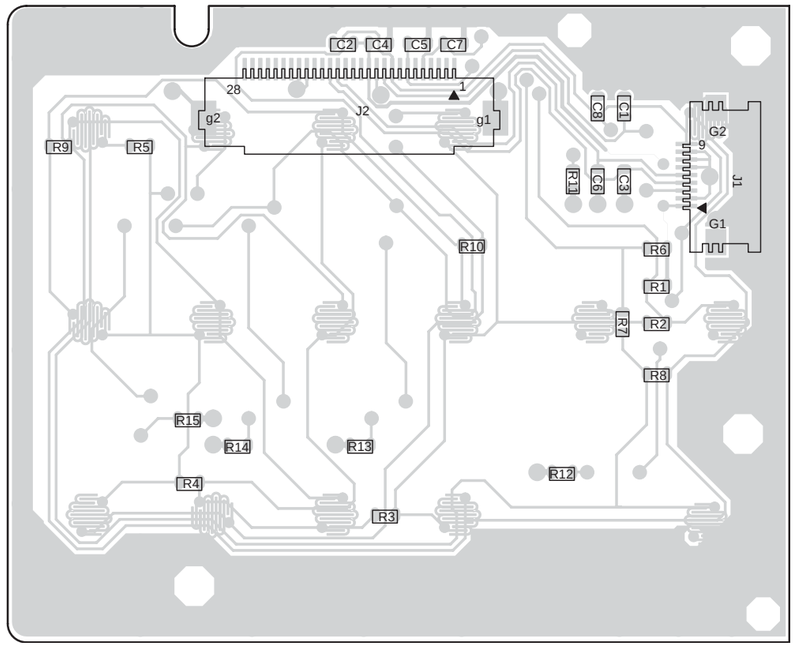


Figure 11-42. UHF (465-495 MHz) Board Solder Side View



Component Side



Solder Side

Figure 11-43. UHF (465-495 MHz) PCB8486634Z02-O Keypad Board

UHF (465-495 MHz) Radio Parts List

Circuit Ref	Motorola Part No.	Description
C1	2109445U32	CAP, 8pF
C2	2109445U26	CAP, 9.1pF
C3	2109445U18	CAP, 4.3pF
C4	2109445U27	CAP, 10pF
C5	2109445U32	CAP, 8pF
C6	2109445U24	CAP, 7.5pF
C7	2109445U26	CAP, 9.1pF
C8	2109445U18	CAP, 4.3pF
C9	2109445U22	CAP, 6.2pF
C10	2109445U13	CAP, 2.7pF
C11	2113743L07	CAP, 390pF
C12	Not_Placed	CAP, 8.2pF
C13	2109445U07	CAP, 1.5pF
C14	2109445U07	CAP, 1.5pF
C20	2113743L07	CAP, 390pF
C21	2109445U53	CAP, 68pF
C23	2113743L07	CAP, 390pF
C25	2113743L07	CAP, 390pF
C26	2113743L07	CAP, 390pF
C27	2109445U25	CAP, 8.2pF
C28	2109445U27	CAP, 10pF
C29	2109445U22	CAP, 6.2pF
C30	2109445U38	CAP, 16pF
C31	2109445U21	CAP, 5.6pF
C32	2109445U22	CAP, 6.2pF
C33	2109445U42	CAP, 24pF
C34	2109445U22	CAP, 6.2pF
C35	2109445U22	CAP, 6.2pF
C36	2109445U39	CAP, 18pF
C37	2109445U25	CAP, 8.2pF
C38	2109445U20	CAP, 5.1pF
C39	2109445U13	CAP, 2.7pF
C41	2109445U27	CAP, 10pF
C42	2109445U25	CAP, 8.2pF
C43	2109445U40	CAP, 20pF
C44	2109445U26	CAP, 9.1pF
C45	2109445U37	CAP, 15pF
C46	Not_Placed	CAP, 10pF
C47	Not_Placed	CAP, 10pF
C48	0662057M01	RES, 0
C49	Not_Placed	CAP, 3.9pF
C51	2113743N48	CAP, 82pF
C52	2109445U39	CAP, 18pF
C53	2109445U26	CAP, 9.1pF
C55	2113743M24	CAP, 0.1uF
C56	2113743E20	CAP, 0.1uF
C57	2113743M24	CAP, 0.1uF
C58	2113743N16	CAP, 3.9pF
C59	2113743N12	CAP, 2.7pF
C60	2113743M24	CAP, 0.1uF
C61	2113743N46	CAP, 68pF
C62	2113743M24	CAP, 0.1uF
C63	2113743M24	CAP, 0.1uF
C64	2113743M24	CAP, 0.1uF
C65	2113743M24	CAP, 0.1uF
C66	2113743M24	CAP, 0.1uF
C67	2113743M24	CAP, 0.1uF
C68	2113743M24	CAP, 0.1uF
C69	2113743M24	CAP, 0.1uF
C70	2113743N53	CAP, 130pF
C71	2113743E20	CAP, 0.1uF
C72	2113743M24	CAP, 0.1uF
C73	2113743L33	CAP, 4700pF
C74	2113743N42	CAP, 47pF
C80	2109445U41	CAP, 22pF
C81	2109445U45	CAP, 33pF
C82	2109445U45	CAP, 33pF
C90	2113743M24	CAP, 0.1uF
C91	2311049A57	CAPP, 10uF
C92	2113743E20	CAP, 0.1uF
C93	Not_Placed	CAP, 3.6pF
C99	2113743M24	CAP, 0.1uF
C100	2113743L07	CAP, 390pF
C101	2113743M24	CAP, 0.1uF
C102	2113743M24	CAP, 0.1uF
C103	2113743L07	CAP, 390pF
C104	2113743N22	CAP, 6.8pF
C105	Not_Placed	CAP, 3.9pF
C106	2113743L07	CAP, 390pF
C107	Not_Placed	CAP, 27pF
C108	2113743L07	CAP, 390pF
C109	2113743M24	CAP, 0.1uF
C111	2113743L07	CAP, 390pF
C112	2113743M24	CAP, 0.1uF
C113	2113743L07	CAP, 390pF
C114	2113743L07	CAP, 390pF
C115	2311049A07	CAPP, 1uF
C116	2113743M24	CAP, 0.1uF
C117	2113740F65	CAP, 390pF
C120	Not_Placed	CAP, 8.2pF
C121	2113743L07	CAP, 390pF
C122	2113740F13	CAP, 2.7pF
C123	2113740F17	CAP, 3.9pF
C124	2113740F65	CAP, 390pF
C130	Not_Placed	CAP, 3.3pF
C131	Not_Placed	CAP, 2.2pF
C132	2113740F23	CAP, 6.8pF
C133	Not_Placed	CAP, 2.7pF
C134	2113740F23	CAP, 6.8pF
C135	Not_Placed	CAP, 0.5pF
C136	2113740F18	CAP, 4.3pF
C137	2113740F59	CAP, 220pF
C141	2113740F03	CAP, 1pF
C150	2113743L07	CAP, 390pF
C151	2113743L07	CAP, 390pF
C152	2113743L07	CAP, 390pF
C153	2113743K18	CAP, 0.47uF
C154	2113743L07	CAP, 390pF
C156	2113743L41	CAP, .01uF
C157	2113743M24	CAP, 0.1uF
C158	2113743L07	CAP, 390pF
C159	2113743L07	CAP, 390pF
C160	2113743E20	CAP, 0.1uF
C170	2113743L07	CAP, 390pF
C171	2113743L07	CAP, 390pF
C172	2113743L07	CAP, 390pF
C201	2113740F59	CAP, 220pF
C202	2109445U52	CAP, 62pF
C203	2109445U13	CAP, 2.7pF
C204	2113743L09	CAP, 470pF
C205	Not_Placed	CAP, 2.7pF
C206	Not_Placed	CAP, 1000pF
C207	2113743L09	CAP, 470pF
C208	2113743L09	CAP, 470pF
C209	2113743L09	CAP, 470pF
C210	2113743L09	CAP, 470pF
C211	2113743E20	CAP, 0.1uF
C212	2113743F18	CAP, 2.2uF
C213	2113743L41	CAP, .01uF
C214	2113743L17	CAP, 1000pF
C215	2113743F18	CAP, 2.2uF
C216	2113743E20	CAP, 0.1uF
C217	2113743L17	CAP, 1000pF
C218	2113743F18	CAP, 2.2uF
C219	2113743E20	CAP, 0.1uF
C220	2113743N34	CAP, 22pF
C221	2113743L41	CAP, .01uF
C222	2113743L41	CAP, .01uF
C223	2113743L41	CAP, .01uF
C224	2113743L41	CAP, .01uF
C225	2311049A57	CAPP, 10uF
C226	2311049A57	CAPP, 10uF
C227	2113743L17	CAP, 1000pF
C228	2113743E20	CAP, 0.1uF
C230	2113743F18	CAP, 2.2uF
C231	2113743L17	CAP, 1000pF
C232	2113743E20	CAP, 0.1uF
C233	2311049A56	CAPP, 4.7uF
C240	2109445U06	CAP, 1.3pF
C241	2113743N50	CAP, 100pF
C243	0886641Z01	CAP, 0.1uF
C244	0888600M25	CAP, .01uF
C245	2311049A08	CAPP, 1uF
C251	0888600M03	CAP, 150pF
C252	Not_Placed	CAP, 390pF
C253	2109445U22	CAP, 6.2pF
C254	2109445U15	CAP, 3.3pF
C255	2109445U26	CAP, 9.1pF
C256	2109445U17	CAP, 3.9pF
C257	2109445U35	CAP, 12pF
C263	2109445U22	CAP, 6.2pF
C264	2109445U14	CAP, 3.0pF
C265	2109445U21	CAP, 5.6pF
C266	2109445U14	CAP, 3.0pF
C267	2109445U26	CAP, 9.1pF
C268	2109445U01	CAP, 0.5pF
C270	2113743L07	CAP, 390pF
C271	2113743L07	CAP, 390pF
C272	2113743E20	CAP, 0.1uF
C273	2113743L41	CAP, .01uF
C274	2113743E20	CAP, 0.1uF
C275	2113743L07	CAP, 390pF
C276	2109445U16	CAP, 3.6pF
C281	2113743L07	CAP, 390pF
C282	2109445U18	CAP, 4.3pF
C283	2113743L07	CAP, 390pF
C284	2113743L07	CAP, 390pF
C285	2113743E20	CAP, 0.1uF
C286	2109445U17	CAP, 3.9pF
C290	2109445U23	CAP, 6.8pF
C291	2109445U36	CAP, 13pF
C292	2113743L07	CAP, 390pF
C301	2113743L07	CAP, 390pF
C302	2113743L07	CAP, 390pF
C303	2311049A97	CAPP, 33uF
C304	2113743L41	CAP, .01uF
C305	2113743N50	CAP, 100pF
C306	2113741F49	CAP, .01uF
C310	2113743L41	CAP, .01uF
C311	2113743E05	CAP, .018uF
C312	2311049A57	CAPP, 10uF
C313	2113743L41	CAP, .01uF
C314	2113743L19	CAP, 1200pF
C315	2113743L19	CAP, 1200pF
C316	2113743L19	CAP, 1200pF
C320	2113743E05	CAP, .018uF
C321	2311049A57	CAPP, 10uF
C322	2113743L41	CAP, .01uF
C323	2113743N54	CAP, 150pF
C331	2113743L41	CAP, .01uF
C333	2113743L41	CAP, .01uF
C334	2311049A57	CAPP, 10uF
C400	Not_Placed	CAP, .022uF

Circuit Ref	Motorola Part No.	Description
C401	2113743M24	CAP, 0.1uF
C402	2113743L17	CAP, 1000pF
C403	2113743N50	CAP, 150pF
C404	2113743L17	CAP, 1000pF
C405	2113743N50	CAP, 150pF
C406	2113743N50	CAP, 150pF
C407	2113743L17	CAP, 1000pF
C408	2113743L17	CAP, 1000pF
C409	2113743L17	CAP, 1000pF
C410	2311049A57	CAPP, 10uF
C411	2113743M24	CAP, 0.1uF
C412	2113743L17	CAP, 1000pF
C413	2113743M24	CAP, 0.1uF
C414	2113743M24	CAP, 0.1uF
C415	2113743L17	CAP, 1000pF
C416	2113743L17	CAP, 1000pF
C417	2113743L17	CAP, 1000pF
C418	2113743M24	CAP, 0.1uF
C419	2113743L17	CAP, 1000pF
C420	2113743L41	CAP, .01uF
C421	2113743L41	CAP, .01uF
C422	2113743L41	CAP, .01uF
C430	2113743M24	CAP, 0.1uF
C431	2113743L17	CAP, 1000pF
C432	2113743M24	CAP, 0.1uF
C433	2113743L17	CAP, 1000pF
C440	2113743L41	CAP, .01uF
C441	2113743L41	CAP, .01uF
C442	2113743L41	CAP, .01uF
C443	2113743L41	CAP, .01uF
C444	2113743L41	CAP, .01uF
C445	2113743L41	CAP, .01uF
C446	2113743L41	CAP, .01uF
C447	2113743M24	CAP, 0.1uF
C451	2113743M24	CAP, 0.1uF
C452	2113743E20	CAP, 0.1uF
C453	2311049A56	CAPP, 4.7uF
C454	2113743E20	CAP, 0.1uF
C455	2113743L48	CAP, .022uF
C456	2113743E20	CAP, 0.1uF
C457	2113743E20	CAP, 0.1uF
C458	2113743E20	CAP, 0.1uF
C459	2113743E20	CAP, 0.1uF
C460	2113743E20	CAP, 0.1uF
C461	2113743L17	CAP, 1000pF
C462	2113743E20	CAP, 0.1uF
C463	2113743E20	CAP, 0.1uF
C464	2113743E20	CAP, 0.1uF
C465	2113743L17	CAP, 1000pF
C466	Not_Placed	CAP, 470pF
C467	2113743L19	CAP, 1200pF
C470	2113743E20	CAP, 0.1uF
C471	2113743F18	CAP, 2.2uF
C472	2113743E20	CAP, 0.1uF
C473	2113743N54	CAP, 150pF
C474	2113743N54	CAP, 150pF
C475	2113743L48	CAP, .022uF
C476	2113743L48	CAP, .022uF
C477	2113743M24	CAP, 0.1uF
C478	2113743N54	CAP, 150pF
C479	2113743N54	CAP, 150pF
C480	2113743E20	CAP, 0.1uF
C481	Not_Placed	CAP, .01uF
C482	Not_Placed	CAP, .01uF
C483	2113743E20	CAP, 0.1uF
C484	Not_Placed	CAP, .033uF
C488	2113743L09	CAP, 470pF
C489	2113743L09	CAP, 470pF
C490	2113743L09	CAP, 470pF
C492	2113928J08	CAP, 10uF
C493	2113743L17	CAP, 1000pF
C494	2113743F18	CAP, 2.2uF
C495	2113743F16	CAP, 1uF
C496	2113743F16	CAP, 1uF
C497	2113743E20	CAP, 0.1uF
C498	2113743F16	CAP, 1uF
C499	2113743N48	CAP, 82pF
C500	2113743L17	CAP, 1000pF
C501	2113743F16	CAP, 1uF
C503	2113743L17	CAP, 1000pF
C504	2113743L17	CAP, 1000pF
C505	2113743L17	CAP, 1000pF
C506	2113743L17	CAP, 1000pF
C507	2113743L17	CAP, 1000pF
C511	2113740F59	CAP, 220pF
C512	2113743N22	CAP, 6.8pF
C513	2113740F59	CAP, 220pF
C514	2113743N31	CAP, 16pF
C518	2113743E20	CAP, 0.1uF
C519	2113743F16	CAP, 1uF
C521	2109445U13	CAP, 2.7pF
C522	2113743N01	CAP, 0.5pF
C523	2186463Z03	CAP, 0.5pF
C524	2186463Z03	CAP, 0.5pF
C525	2113743L07	CAP, 390pF
CR1	4813825A19	MMBD352
CR41	4802246J04	HSMS2829
CR51	4813825A19	MMBD352
D51	4802245J97	DAN235ETL
D52	4802245J97	DAN235ETL
D120	4880973Z02	MA4PH261
D121	4880973Z02	MA4PH261
D201	4862824C03	1SV232
D220	4802233J09	IMN10
D221	4802233J09	IMN10
D251	4862824C01	1SV229
D261	4862824C01	1SV229
D262	4862824C01	1SV229
D301	4813833A19	MBRM120ET3
D414	4805129M41	MMBD501
D424	4809924D18	RB520S-30
D440	4805729G49	BRPY1204W
D470	4809924D18	RB520S-30
D471	4809924D18	RB520S-30
D491	Not_Placed	MMBD501
E451	2480640Z01	BK1005HM471
E452	2480640Z01	BK1005HM471
E453	2480640Z01	BK1005HM471
E500	2480640Z01	BK1005HM471
F301	6580542Z01	FUSE
FL51	9180022M11	MXF45
FL52	9180468V04	FLTR
FL53	9180469V05	CFWC455E
FL54	9180469V03	CFWC455G
J140	0986428Z01	CONN_J
J301	0986565Z01	CONN_J
J460	Not_Placed	CONN_J
J470	0985818A01	CONN_J
J471	0980683Z03	CONN_J
J491	2809926G01	CONN_P
L1	2409348J15	IDCTR, 9.85nH
L2	2409348J15	IDCTR, 9.85nH
L3	2409348J15	IDCTR, 9.85nH
L21	2413926N18	IDCTR, 33nH
L31	2409348J15	IDCTR, 9.85nH
L32	2409348J15	IDCTR, 9.85nH
L33	2409348J15	IDCTR, 9.85nH
L34	2409348J15	IDCTR, 9.85nH
L40	2413926K16	IDCTR, 27nH
L41	2413926K16	IDCTR, 27nH
L51	2413926N26	IDCTR, 150nH
L52	2462587V44	IDCTR, 680nH
L53	2113743N52	CAP, 120pF
L54	2413923A25	IDCTR, 1.2uH
L55	2413926N16	IDCTR, 22nH
L81	2413923A19	IDCTR, 1uH
L100	2413926K27	IDCTR, 220nH
L101	2413926K27	IDCTR, 220nH
L102	2409377M25	IDCTR, 7.5nH
L103	2409377M24	IDCTR, 5.1nH
L110	2413926K27	IDCTR, 220nH
L120	2413926K27	IDCTR, 220nH
L121	2462587V24	IDCTR, 15nH
L130	2460591C36	IDCTR, 20.45nH
L131	2460591C40	IDCTR, 17.02nH
L132	2460591C40	IDCTR, 17.02nH
L140	2460591L14	IDCTR, 15.92nH
L141	2479990M01	IDCTR, 30.54nH
L211	2413926K30	IDCTR, 390nH
L251	2413926N28	IDCTR, 220nH
L252	2413926N17	IDCTR, 27nH
L254	2484562T11	IDCTR, 12.5nH
L255	2413926N28	IDCTR, 220nH
L262	2413926N17	IDCTR, 27nH
L264	2484562T13	IDCTR, 8nH
L265	2413926N28	IDCTR, 220nH
L270	2413926N28	IDCTR, 220nH
L271	Not_Placed	IDCTR, 220nH
L272	2413926N28	IDCTR, 220nH
L276	2413926N17	IDCTR, 27nH
L281	2413926N15	IDCTR, 18nH
L282	2413926N15	IDCTR, 18nH
L283	Not_Placed	IDCTR, 22nH
L291	2413926N10	IDCTR, 6.8nH
L292	2413926N14	IDCTR, 15nH
L471	2413926K30	IDCTR, 390nH
M140	0286427Z01	ANTENNA_NUT
Q21	4802247J01	BFS505
Q22	4805723X02	UMT1
Q51	4802197J95	PBR941
Q70	4880214G02	MMBT3904
Q100	4885593U03	BFG540W
Q150	4880214G02	MMBT3904
Q170	4809939C34	EMB10
Q171	4880048M01	DTC144EKA
Q280	4802245J95	BFS540
Q311	4809579E18	TP0101T
Q312	4809579E18	TP0101T
Q313	4802245J54	UMG5
Q402	4880048M01	DTC144EKA
Q403	4813824A17	MMBT3906
Q410	4802245J54	UMG5
Q440	5180159R01	IMX1
Q470	4805723X02	UMT1
Q471	4802245J54	UMG5
Q472	4805723X02	UMT1
Q481	Not_Placed	MMBT3906
Q482	Not_Placed	MMBT3904
Q490	4802245J54	UMG5
Q493	4809579E18	TP0101T
Q494	4802245J54	UMG5
Q520	5180159R01	IMX1
R20	0662057M92	RES, 5.6K
R21	0662057M49	RES, 91

Circuit Ref	Motorola Part No.	Description
R22	0662057M92	RES, 5.6K
R23	0662057N09	RES, 27K
R24	0662057M76	RES, 1.2K
R25	0662057M92	RES, 5.6K
R40	0662057M74	RES, 1K
R51	0662057M43	RES, 51
R52	0662057N01	RES, 12K
R53	0662057N11	RES, 33K
R54	0662057M91	RES, 5.1K
R55	0662057M62	RES, 330
R57	0662057M90	RES, 4.7K
R60	0662057M83	RES, 2.4K
R61	0662057N23	RES, 100K
R62	0662057M86	RES, 3.3K
R63	0662057N13	RES, 39K
R64	0662057N06	RES, 20K
R65	0662057N13	RES, 39K
R66	0662057N06	RES, 20K
R67	0662057N06	RES, 20K
R72	0662057M64	RES, 390
R73	0662057M80	RES, 1.8K
R74	0662057M76	RES, 1.2K
R75	0662057N01	RES, 12K
R76	0662057V04	RES, 12K
R77	0662057U99	RES, 8.2K
R78	0662057M70	RES, 680
R80	0662057M91	RES, 5.1K
R81	0662057M74	RES, 1K
R82	Not_Placed	RES, 0
R90	0662057M43	RES, 51
R91	0662057M79	RES, 1.6K
R100	0662057M72	RES, 820
R101	0662057M20	RES, 5.6
R102	0662057M72	RES, 820
R103	0662057M85	RES, 3K
R104	0662057A07	RES, 18
R105	0662057M84	RES, 2.7K
R106	0662057M90	RES, 4.7K
R107	Not_Placed	RES, 300
R110	0662057M70	RES, 680
R111	0662057M81	RES, 2K
R120	0662057C55	RES, 150
R121	0662057C55	RES, 150
R150	0680539Z01	RES, 0.1
R151	0662057A15	RES, 39
R152	0662057V27	RES, 100K
R153	0662057V27	RES, 100K
R154	0662057V27	RES, 100K
R155	0662057V27	RES, 100K
R156	0662057M62	RES, 330
R157	0662057M82	RES, 2.2K

Circuit Ref	Motorola Part No.	Description
R158	0662057M78	RES, 1.5K
R162	0662057M98	RES, 10K
R202	0662057N27	RES, 150K
R205	0662057M50	RES, 100
R206	Not_Placed	RES, 100
R212	0662057C01	RES, 0
R220	0662057M34	RES, 22
R221	0662057M34	RES, 22
R223	0662057M50	RES, 100
R227	0662057N13	RES, 39K
R230	0662057N06	RES, 20K
R243	0662057M72	RES, 820
R244	0662057M43	RES, 51
R245	0662057M78	RES, 1.5K
R246	0662057N23	RES, 100K
R247	0662057N05	RES, 18K
R253	0662057M42	RES, 47
R254	0662057M50	RES, 100
R255	0662057U91	RES, 3.9K
R261	0662057N07	RES, 22K
R262	0662057M95	RES, 7.5K
R263	0662057M38	RES, 33
R264	0662057M50	RES, 100
R271	0662057M91	RES, 5.1K
R272	0662057M93	RES, 6.2K
R273	0662057M62	RES, 330
R274	0662057M38	RES, 33
R275	0662057M50	RES, 100
R276	Not_Placed	RES, 1K
R277	0662057B47	RES, 0
R280	0662057M90	RES, 4.7K
R281	0662057M96	RES, 8.2K
R282	0662057M73	RES, 910
R283	0662057M53	RES, 130
R284	Not_Placed	RES, 560
R285	0662057M01	RES, 0
R310	0662057N23	RES, 100K
R311	0662057N23	RES, 100K
R312	0662057N06	RES, 20K
R313	0662057M98	RES, 10K
R320	0662057V43	RES, 330K
R321	0662057V35	RES, 200K
R322	0662057N23	RES, 100K
R400	Not_Placed	RES, 100K
R410	0662057M98	RES, 10K
R411	0662057M72	RES, 820
R412	0662057N23	RES, 100K
R413	0662057N23	RES, 100K
R414	0662057N11	RES, 33K
R415	0662057N11	RES, 33K
R416	0662057N06	RES, 20K

Circuit Ref	Motorola Part No.	Description
R417	0662057M98	RES, 10K
R418	0662057N23	RES, 100K
R419	0662057M90	RES, 4.7K
R420	0662057V35	RES, 200K
R421	0662057V27	RES, 100K
R422	0662057N23	RES, 100K
R423	0662057N23	RES, 100K
R424	0662057V35	RES, 200K
R425	0662057V27	RES, 100K
R430	0662057N23	RES, 100K
R431	Not_Placed	RES, 100K
R432	0662057M01	RES, 0
R433	0662057N23	RES, 100K
R434	Not_Placed	RES, 100K
R440	0662057M90	RES, 4.7K
R441	0662057M90	RES, 4.7K
R442	0662057A33	RES, 220
R443	0662057A27	RES, 120
R445	0662057M90	RES, 4.7K
R446	0662057M98	RES, 10K
R451	0662057N15	RES, 47K
R460	0662057N08	RES, 24K
R462	0662057N08	RES, 24K
R463	0662057N08	RES, 24K
R464	0662057N10	RES, 30K
R469	0662057M26	RES, 10
R470	0662057M82	RES, 2.2K
R471	0662057M82	RES, 2.2K
R472	0662057M70	RES, 680
R473	0662057M70	RES, 680
R474	0662057A37	RES, 330
R475	0662057N29	RES, 180K
R476	0662057N23	RES, 100K
R477	0662057M82	RES, 2.2K
R478	0662057M82	RES, 2.2K
R479	0662057N23	RES, 100K
R480	0662057B47	RES, 0
R481	Not_Placed	RES, 100K
R482	Not_Placed	RES, 330K
R483	Not_Placed	RES, 150K
R484	Not_Placed	RES, 2.2K
R485	Not_Placed	RES, 100K
R486	Not_Placed	RES, 100K
R487	0662057M01	RES, 0
R488	0662057N35	RES, 330K
R489	Not_Placed	RES, 91K
R490	Not_Placed	RES, 2.2K
R491	0662057M01	RES, 0
R492	0662057N08	RES, 24K
R493	0662057N35	RES, 330K
R494	0662057V43	RES, 330K

Circuit Ref	Motorola Part No.	Description
R495	0662057M92	RES, 5.6K
R496	Not_Placed	RES, 10K
R497	Not_Placed	RES, 1MEG
R498	Not_Placed	RES, 47K
R499	Not_Placed	RES, 270K
R501	0662057M50	RES, 100
R502	0662057M50	RES, 100
R503	0662057M50	RES, 100
R504	0662057M50	RES, 100
R505	0662057M50	RES, 100
R506	0662057M50	RES, 100
R507	0662057M50	RES, 100
R508	0662057N23	RES, 100K
R509	0662057N23	RES, 100K
R510	0662057N35	RES, 330K
R511	0662057N23	RES, 100K
R512	0662057N27	RES, 150K
R513	0662057N23	RES, 100K
R514	0662057N23	RES, 100K
R515	0662057M01	RES, 0
R516	Not_Placed	RES, 0
R517	Not_Placed	RES, 0
R518	0662057N31	RES, 220K
R519	0662057N23	RES, 100K
R520	0662057N23	RES, 100K
R521	Not_Placed	RES, 100K
R522	0662057N23	RES, 100K
R523	0662057M98	RES, 10K
S440	4080710Z06	SWITCH
S441	4070354A01	SWITCH
S442	4070354A01	SWITCH
S443	4070354A01	SWITCH
S444	1880619Z02	SWITCH
SH1	2686421Z01	SHIELD
SH40	2686419Z01	SHIELD
SH50	2686423Z01	SHIELD
SH52	2686424Z01	SHIELD
SH100	2686418Z01	SHIELD
SH200	2686424Z01	SHIELD
SH201	2686423Z01	SHIELD
SH250	2686425Z01	SHIELD
SH251	2686425Z01	SHIELD
SH253	2686422Z01	SHIELD
SH400	2686420Z01	SHIELD
SH401	2686420Z01	SHIELD
T41	2580541Z02	XFMR
T42	2580541Z02	XFMR
U51	5186144B01	SA616
U52	5109522E10	TC7W04F
U110	0186438Z02	RA07M4452M_UHF
U150	5113818A01	LM2904

Circuit Ref	Motorola Part No.	Description
U151	2484657R01	57R01
U201	5185963A27	63A27
U251	5105750U54	50U54
U310	5102478J01	TK71750S
U320	5185963A55	LP2986
U330	5102479J01	TK71730S
U401	5102226J56	MC68HC11FL0
U402*	5102463J64	X25128-2.7
U403	Not_Placed	SRM2B256
U404*	5102480J01	AT49LV001N_70VI
U451	5185130C53	30C53
U480	Not_Placed	LM2904
U490	5108858K99	TDA8541
U510	5113818A01	LM2904
U511	4802245J54	UMG5
VR110	4813830A86	MM3Z3V9T1
VR301	4813830A33	MMBZ5250B
VR302	4813830A33	MMBZ5250B
VR471	4813830A18	MMBZ5235B
VR472	4813830A09	MMBZ5226B
VR473	4813830A33	MMBZ5250B
VR474	4813830A33	MMBZ5250B
VR475	4880140L20	MMBZ5245B
Y51	4802245J84	TSS2_44_395MHZ
Y70	9186145B02	45B02
Y201*	4880114R06	14R06
Y202	Not_Placed	45J68

* Motorola Depot Servicing only

UHF (465-495 MHz) Keypad Board Parts List

Circuit Ref	Motorola Part No.	Description
C1	NOTPLACED	CAP, 150pF
C2	2113740F55	CAP, 150pF
C3	NOTPLACED	CAP, 150pF
C4	2113743E20	CAP, 0.1uF
C5	NOTPLACED	CAP, 150pF
C6	NOTPLACED	CAP, 150pF
C7	NOTPLACED	CAP, 150pF
C8	NOTPLACED	CAP, 150pF
D1	4809496B11	QSMG-H799
D2	4809496B11	QSMG-H799
D3	NOTPLACED	QSMG-H799
D4	NOTPLACED	QSMG-H799
D5	NOTPLACED	QSMG-H799
D6	NOTPLACED	QSMG-H799
D7	NOTPLACED	QSMG-H799
D8	NOTPLACED	QSMG-H799
D9	4809496B11	QSMG-H799
D10	4809496B11	QSMG-H799
D11	4809496B11	QSMG-H799
J1	0986632Z01	CONN_J
J2	0909059E18	CONN_J
R1	0662057A97	RES, 100K
R2	NOTPLACED	RES, 13K
R3	NOTPLACED	RES, 22K
R4	NOTPLACED	RES, 43K
R5	NOTPLACED	RES, 130K
R6	0662057A97	RES, 100K
R7	0662057A76	RES, 13K
R8	0662057A81	RES, 22K
R9	NOTPLACED	RES, 43K
R10	NOTPLACED	RES, 130K
R11	0662057A41	RES, 470
R12	0662057A41	RES, 470
R13	NOTPLACED	RES, 330
R14	NOTPLACED	RES, 330
R15	NOTPLACED	RES, 330

INDEX

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z