



# **GP328/GP338 Portable Radios**

Detailed Service Manual

6804110J64-F

**June, 2002**

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# SAFETY AND GENERAL INFORMATION

## Information and Instructions on RF Energy Exposure and Product Safety

### READ THIS IMPORTANT INFORMATION ON SAFE AND EFFICIENT OPERATION BEFORE USING YOUR MOTOROLA HANDHELD PORTABLE TWO-WAY RADIO

The information provided in this document supersedes the general safety information contained in user guides published prior to June 2001. For information regarding radio use in a hazardous atmosphere please refer to the Factory Mutual (FM) Approval Product Listing Manual or Instruction Card, which is included with radio models that offer this capability.

## Compliance with RF Energy Exposure Standards

Your Motorola two-way radio is designed and tested to comply with a number of national and international standards and guidelines (listed below) regarding human exposure to radio frequency electromagnetic energy. This radio complies with the IEEE (FCC) and ICNIRP exposure limits for occupational/controlled RF exposure environment at duty cycles of up to 50% talk-50% listen and should be used for occupational use only. In terms of measuring RF energy for compliance with the FCC exposure guidelines, your radio radiates measurable RF energy only while it is transmitting (during talking), not when it is receiving (listening) or in standby mode. Note that the approved, supplied batteries for this radio are rated for a 5-5-90 duty cycle (5% talk - 5% listen - 90% standby), even though this radio complies with the FCC occupational exposure limits at duty cycles of up to 50% talk.

Your Motorola two-way radio complies with the following RF energy exposure standards and guidelines:

- United States Federal Communications Commission, Code of Federal Regulations; 47CFR part 2 sub-part J
- American National Standards Institute (ANSI) / Institute of Electrical and Electronic Engineers (IEEE) C95. 1-1992
- Institute of Electrical and Electronic Engineers (IEEE) C95.1-1999 Edition
- International Commission on Non-Ionizing Radiation Protection (ICNIRP) 1998
- Ministry of Health (Canada) Safety Code 6. Limits of Human Exposure to Radio frequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz, 1999
- Australian Communications Authority Radiocommunications (Electromagnetic Radiation - Human Exposure) Standard 2001
- ANATEL, Brazil Regulatory Authority, Resolution 256 (April 11, 2001) "additional requirements for SMR, cellular and PCS product certification."

## Operational Instructions and Training Guidelines

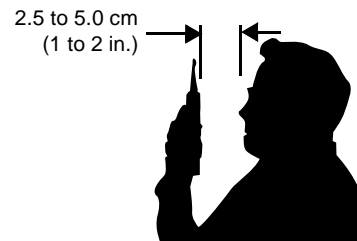
To ensure optimal performance and compliance with the occupational/controlled environment RF energy exposure limits in the above standards and guidelines, users should transmit no more than 50% of the time and always adhere to the following procedures:

### Transmit and Receive

To transmit (talk), push the Push-To-Talk (PTT) button; to receive, release the PTT button.

### Hand-held Radio Operation

Hold the radio in a vertical position with the microphone one to two inches (2.5 to 5 cm) away from the lips.



### Body-worn Operation

Always place the radio in a Motorola approved clip, holder, holster, case, or body harness for this product. Use of non-Motorola-approved accessories may exceed FCC RF exposure guidelines.

If you do not use a Motorola approved body-worn accessory and are not using the radio in the intended use position in front of the face, then ensure the antenna and the radio are kept 2.5 cm (one inch) from the body when transmitting.

## Antennas & Batteries

**Use only Motorola approved supplied antenna or Motorola approved replacement antenna.**

Unauthorized antennas, modifications, or attachments could damage the radio and may violate FCC regulations.

**Use only Motorola approved supplied batteries or Motorola approved replacement batteries.**

Use of non-Motorola-approved antennas or batteries may exceed FCC RF exposure guidelines.

## Approved Accessories

For a list of approved Motorola accessories please contact your dealer, or local Motorola representative.

## ELECTROMAGNETIC INTERFERENCE/COMPATIBILITY

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

## Facilities

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

## Aircraft

When instructed to do so, turn off your radio when on board an aircraft. Any use of a radio must be in accordance with applicable regulations per airline crew instructions.

## Medical Devices

- **Pacemakers**

The Advanced Medical Technology Association (AdvaMed) recommends that a minimum separation of 6 inches (15 centimeters) be maintained between a handheld wireless radio and a pacemaker. These recommendations are consistent with those of the U.S. Food and Drug Administration.

Persons with pacemakers should:

- ALWAYS keep the radio more than 6 inches (15 centimeters) from their pacemaker when the radio is turned ON.
- not carry the radio in the breast pocket.
- use the ear opposite the pacemaker to minimize the potential for interference.
- turn the radio OFF immediately if you have any reason to suspect that interference is taking place.

- **Hearing Aids**

Some digital wireless radios may interfere with some hearing aids. In the event of such interference, you may want to consult your hearing aid manufacturer to discuss alternatives.

- **Other Medical Devices**

If you use any other personal medical device, consult the manufacturer of your device to determine if it is adequately shielded from RF energy. Your physician may be able to assist you in obtaining this information.

## Driver Safety

Check the laws and regulations on the use of radios in the area where you drive. Always obey them.

When using your radio while driving, please:

- Give full attention to driving and to the road.
- Use hands-free operation, if available.
- Pull off the road and park before making or answering a call if driving conditions so require.

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## OPERATIONAL WARNINGS

### For Vehicles With an Air Bag

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

**WARNING**

### Potentially Explosive Atmospheres

Turn off your radio prior to entering any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas as “Intrinsically Safe” (for example, Factory Mutual, CSA, UL, or CENELEC). Do not remove, install, or charge batteries in such areas. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

**NOTE** The areas with potentially explosive atmospheres referred to above include fueling areas such as below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles, such as grain, dust or metal powders. Areas with potentially explosive atmospheres are often but not always posted.

### Blasting Caps and Areas

To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: “Turn off two-way radio.” Obey all signs and instructions.

## OPERATIONAL CAUTIONS

### Antennas

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

**Caution**

### Batteries

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





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# Section 1

## INTRODUCTION

### 1.0 Scope of Manual

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

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

### 2.0 Warranty and Service Support

Motorola offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/repair or spare parts support out of warranty. Any "return for exchange" or "return for repair" by an authorised Motorola Dealer must be accompanied by a Warranty Claim Form. Warranty Claim Forms are obtained by contacting an Authorised Motorola Dealer.

#### 2.1 Warranty Period

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

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

Prior to shipping any radio back to the appropriate Motorola warranty depot, please contact Customer Services. All returns must be accompanied by a Warranty Claim Form, available from your Customer Services representative. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

#### 2.2 After Warranty Period

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

1. Motorola's Accessories and Aftermarket Division (AAD) offers a repair service to both end users and dealers at competitive prices.
2. AAD supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

## 2.3 Piece Parts

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

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

## 2.4 Technical Support

Technical support is available to assist the dealer/distributor in resolving any malfunction which may be encountered. Initial contact should be by telephone wherever possible. When contacting Motorola Technical Support, be prepared to provide the product **model number** and the unit's **serial number**.

### Toll-Free

Country or Territory	Number
China	800-810-0976
Indonesia	0800-1-686868
Malaysia	1800-801687
Philippines	1800-16510271
Singapore	1800-4855333
Thailand	1800-225412

### Non-Toll-Free

Country or Territory	Number
China	(86-10) 6843-8231
Hong Kong SAR	(852) 2966-4188
India	(91) 80-658-7677-7678
Indonesia	(62-21) 251-3050
Korea	(822) 3466-5401
Malaysia	(603) 7803-9922
Philippines	(63-2) 810-0762
Singapore	(65) 486-7171
Taiwan	(886) 2-27058000 ext. 6308
Thailand	(66) 2254-8388
Vietnam	(84) 8-8294091
All Other Countries	IDD code + (65) 4855333

## Section 2

### SERVICE AIDS

#### 1.0 Recommended Test Tools

Table 2-1 lists the tools recommended for working on this family of radios. These tools are also available from Motorola.

*Table 2-1: Recommended Test Tools*

<b>Motorola Part No.</b>	<b>Description</b>	<b>Application</b>
6680387A59 6680387A64  6680387A65 0180382A31	Extractor, 2-contact Heat controller with safety stand or Safety stand only Portable desoldering unit	Removal of discrete surface-mounted devices
6680375A74 0180386A81  0180386A78	0.025 replacement tip, 5/pk Miniature digital readout soldering station (incl. 1/64" micropoint tip) Illuminated magnifying glass with lens attachment.	For 0180382A31 portable desoldering unit.
0180386A82 6684253C72 6680384A98 1010041A86  1080370B43	Anti-static grounding kit Straight prober Brush Solder (RMA type), 63/37, 0.020" diameter 1 lb. spool RMA liquid flux	Used during all radio assembly and disassembly procedures
R-1070A   or R-1319A	Shields and surface-mounted component - IC removal/rework station (order all heat-focus heads separately) Shields and surface-mounted component - IC removal/rework station SMD10000 M.A.P.E.	Removal and assembly of surface-mounted integrated circuits and shields  Removal and assembly of surface-mounted integrated circuits and shields



## Section 3

### POWER UP SELF-TEST

#### 1.0 Error Codes

Turning on the radio using the on/off volume control starts a self-test routine which checks the RAM, ROM checksum, EEPROM hardware and EEPROM checksum. If these checks are successfully completed, the radio will generate the Self-Test Pass Tone. If the self-test is not successful, a “bonk” is heard. Radios with displays are able to display these error messages:

- “RAM TST ERROR” for <RAM Test Error>
- “ROM CS ERROR” for <ROM Checksum Error>
- “EEPRM HW ERROR” for <EEPROM Hardware Test Error>
- “EEPRM CS ERROR” for <EEPROM Checksum Error>

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

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



# Section 4

## CONTROLLER INFORMATION

### 1.0 Overview

This section provides a detailed theory of operation for the radio and its components.

### 2.0 Radio Power Distribution

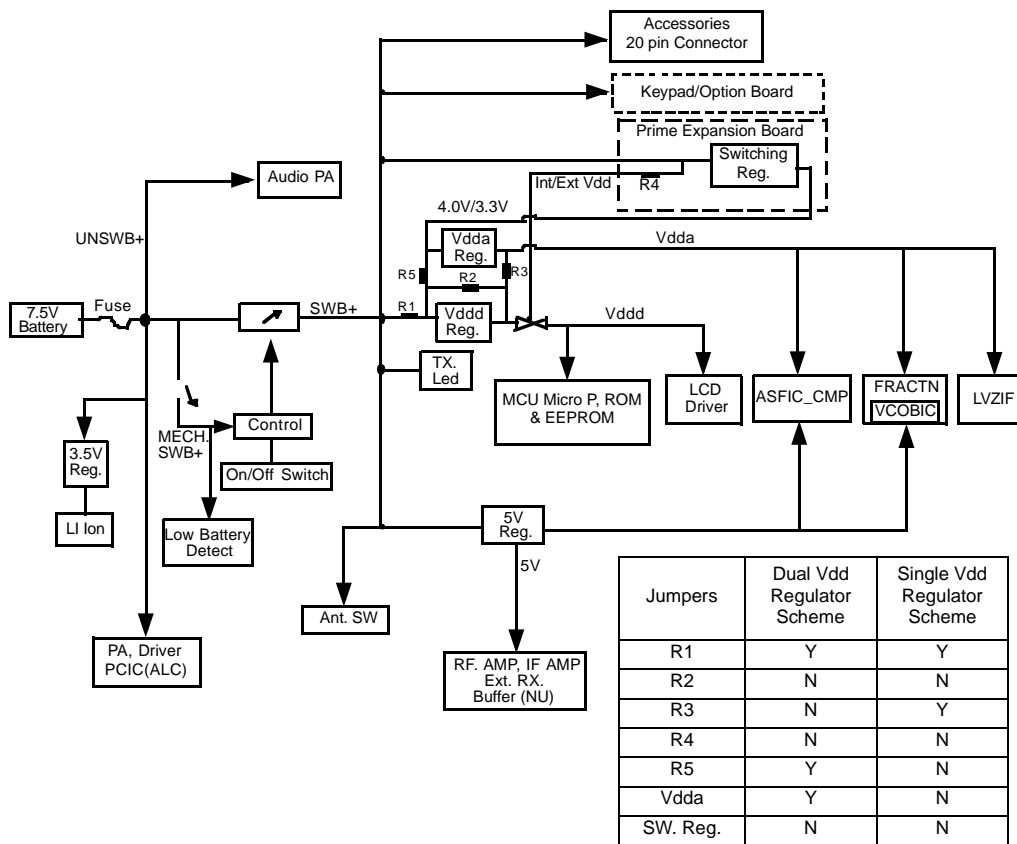


Figure 4-1: DC Power Distribution Block Diagram

Figure 4-1 illustrates the DC distribution throughout the radio board. A 7.5V battery (BATT 7.5V) supplies power directly to the electronic on/off control as UNSWB+. When the radio is turned on, MECH\_SWB+ (on/off/volume control) will trigger the electronic on/off control(momentary-on path), then SWB+ is distributed as shown in Figure 4-1. Vdda from 3.3V Vdda regulator will then supply the microprocessor. Data is then sent to ASFIC\_CMP to turn on GCB4(DAC). GCB4 will take over the momentary-on path within 12ms. SWB+ will continue to support the whole board until the radio is turned off.

Radio will be turned-off on two conditions;

1. MECH\_SWB+ turned off
2. Low battery

When low battery level is detected by the microprocessor through both conditions above, it will store the radio personality data to EEPROM before turning off.

### 3.0 Controller Board

#### 3.1 General

The controller board is the central interface between the various subsystems of the radio. It is separated into digital and audio architectures. The digital portion consists of a special Motorola microcontroller (HC11FL0). The audio power amplifier (Audio PA) and audio/signalling/filter/companding IC (ASFIC\_CMP) form the backbone of the audio/signalling architecture.

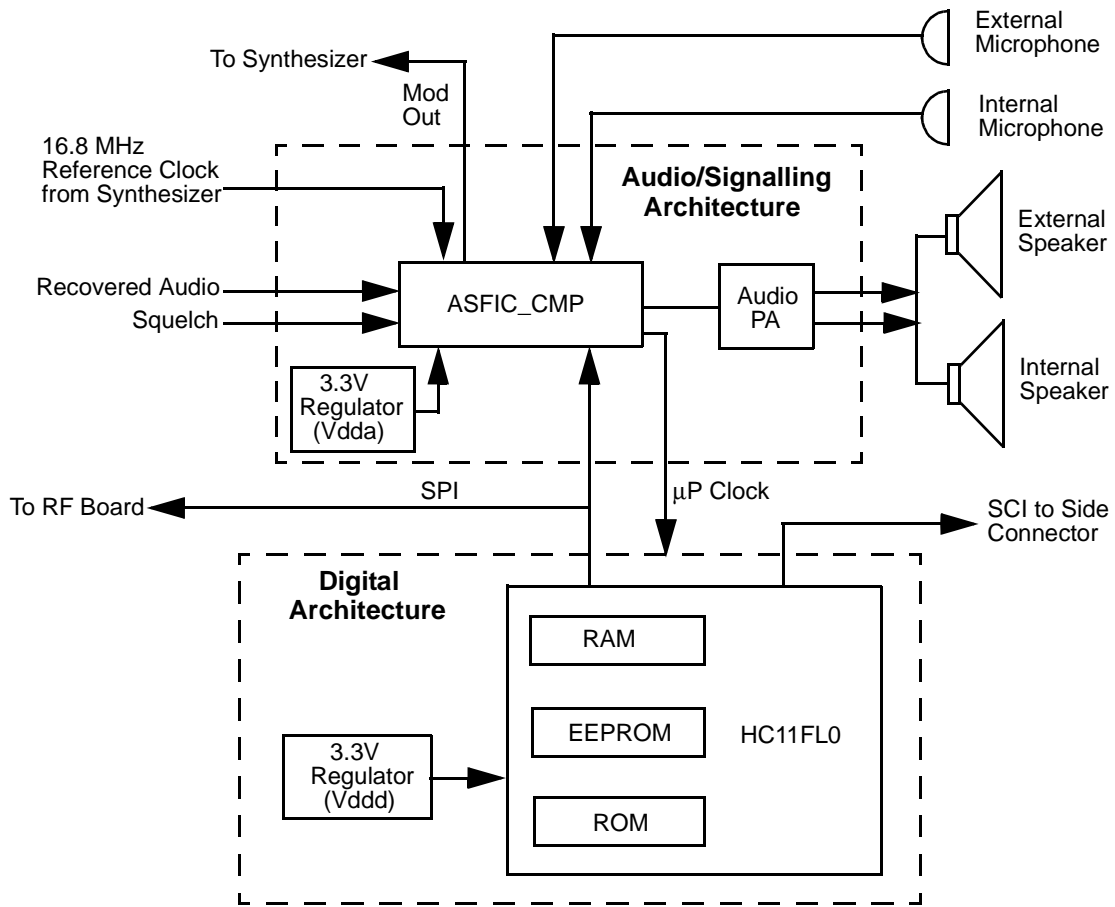


Figure 4-2: Controller Block Diagram



## 3.2 Digital Architecture

### MCU configuration

There is one common MCU architecture for low-tier as well as for the high-tier products. It covers the Conventional and Trunking portables. An open architecture system with the new HC11FL0 as the processor is used. Combinations of different size RAM, ROM and EEPROM are available for various application software.

### REAL TIME CLOCK (RTC)

This radio supports Real Time Clock (RTC) module for purposes of Message Time Stamping and Time Keeping. The RTC module resides in the micro-processor HC11FL0. It is kept alive by a back-up Lithium Ion battery when the primary battery is removed.

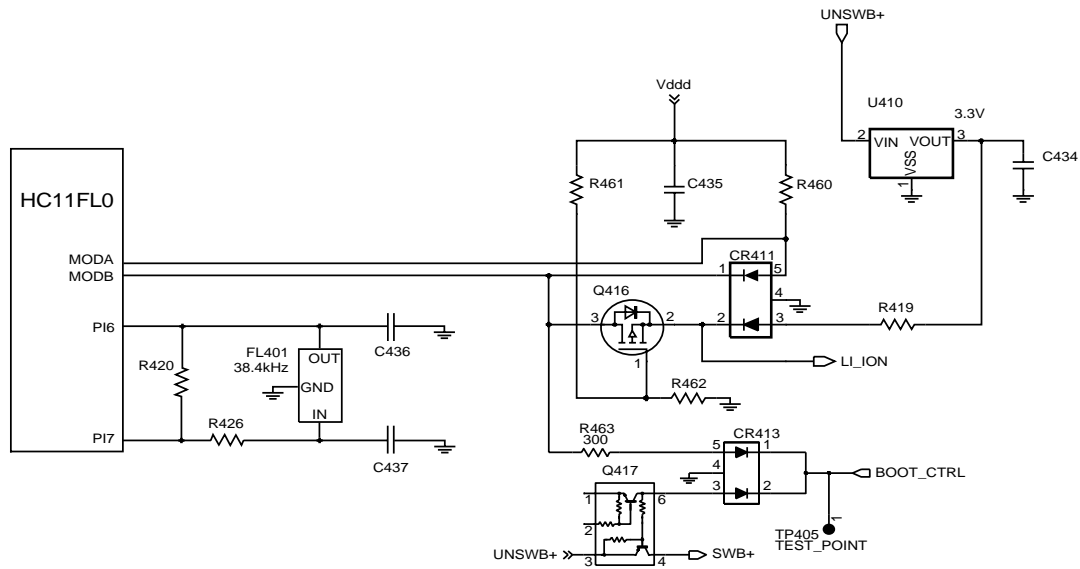


Figure 4-3: RTC Circuit

### Circuit Description

The RTC module which resides in the HC11FL0 is powered by the ModB/Vstby pin and PI6/PI7 form the crystal oscillator circuit. Clock frequency of 38.4kHz from a crystal oscillator provides the reference signal. In the processor, the frequency is divided down to 1Hz.

As the RTC module is powered separately from the processor Vdd, the RTC is kept alive through the ModB / Vstby pin when the radio is switched off. A small button Lithium Ion battery continues to feed the RTC when the primary battery is removed.

A MOSFET Q416 switches in the LiO supply when Vdd is removed. Q416 also provides isolation from BOOT\_CTRL function in the event of radio program flashing. A small 3.3V regulator is used to charge the LiO battery.

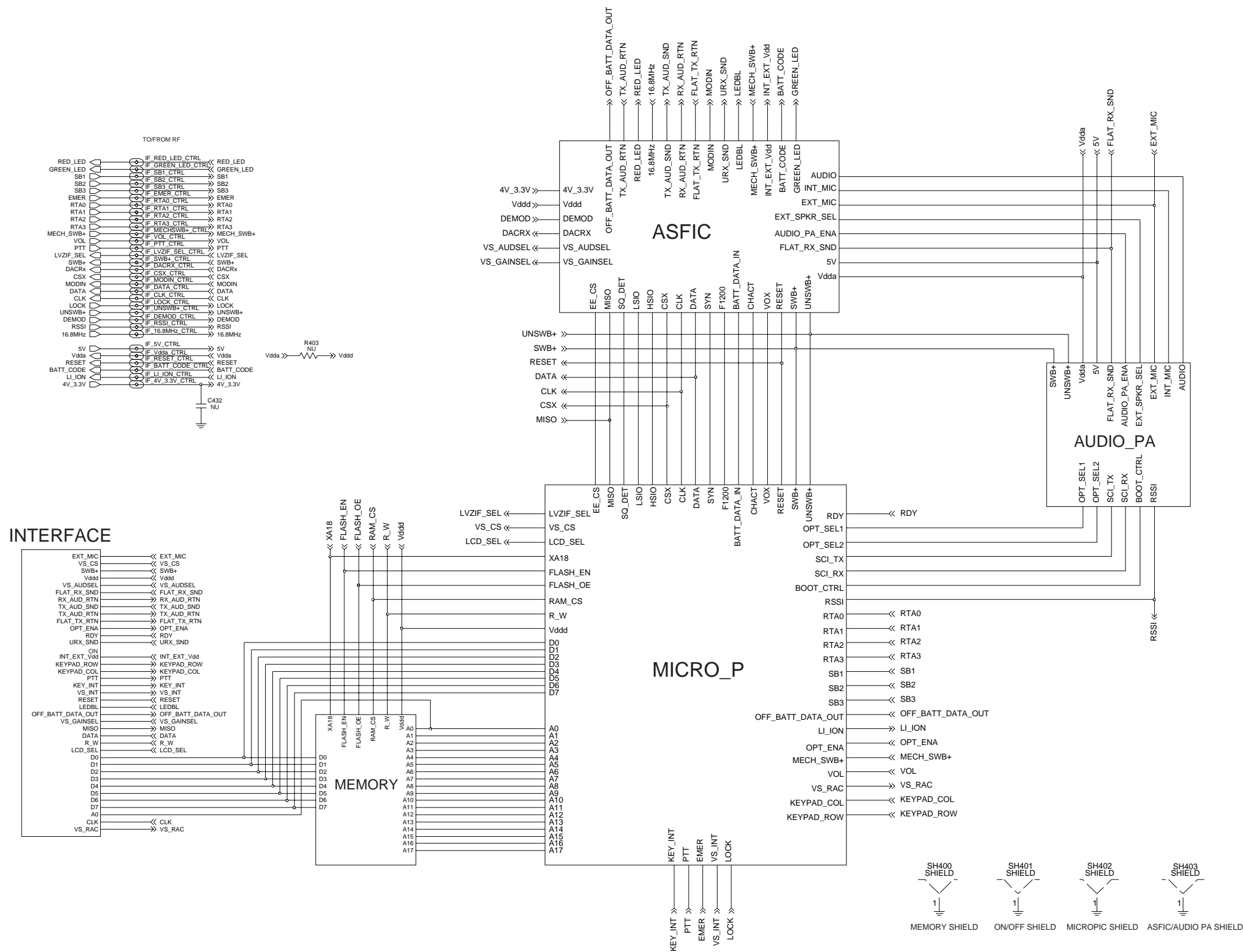
### ModB/Vstby Supply

Under various conditions, the supply to the ModB/Vstby would vary. Table 4-1 shows these conditions and circuits in operation.

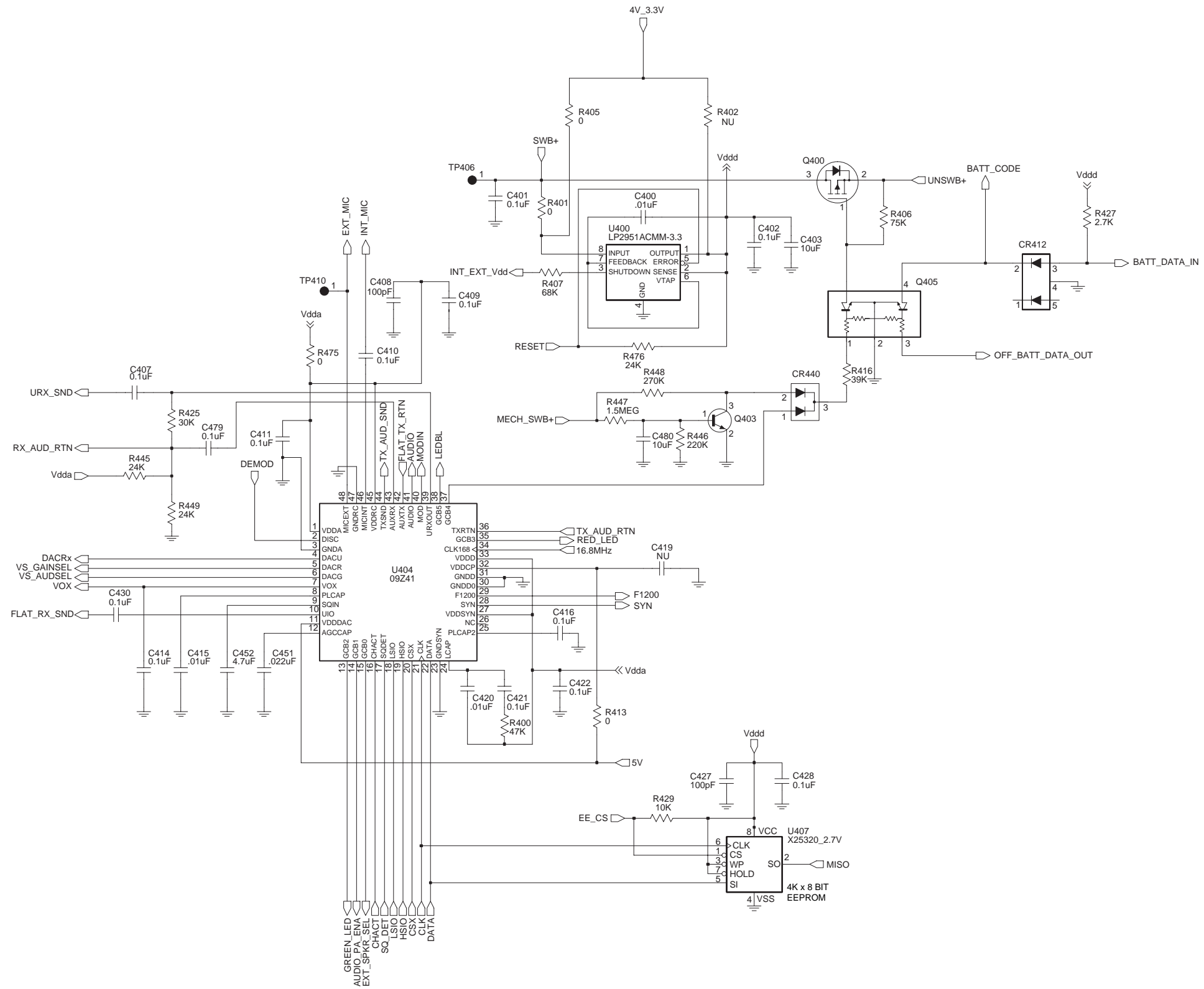
*Table 4-1: ModB/Vstby Supply Modes*

Condition	Circuit Operation
Radio On	Vdd supply voltage via CR411
Radio Off	<ul style="list-style-type: none"> <li>• Vdd turned off</li> <li>• Q416 gate is pulled low by R462</li> <li>• Q416 is switched on</li> <li>• U410 supplies 3.2V to ModB/Vstby</li> </ul>
Primary battery removed	<ul style="list-style-type: none"> <li>• Vdd turned off</li> <li>• Q416 gate is pulled low by R462</li> <li>• Q416 is switched on</li> <li>• LiO battery provides 3.2V to ModB/Vstby</li> </ul>
Flash Mode	<ul style="list-style-type: none"> <li>• Boot_Ctrl line pull low</li> <li>• ModA &amp; ModB goes low</li> <li>• Processor in boot-strap mode</li> <li>• Flashing enabled</li> </ul>

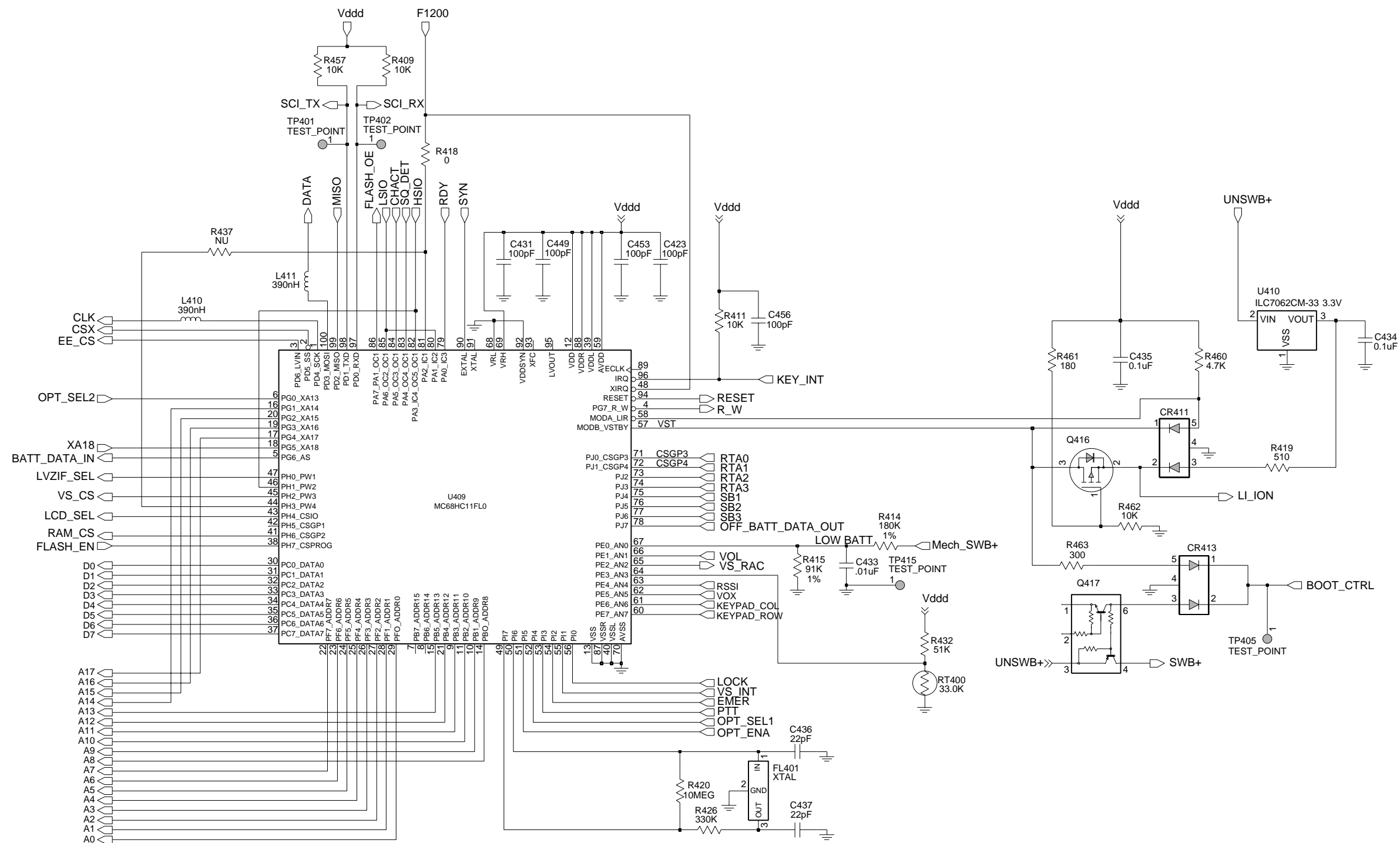
### 3.3 Controller Schematics (330-400MHz for 8485726Z01, 403-470MHz for 8480450Z03 & 450-527MHz for 8485641Z02)



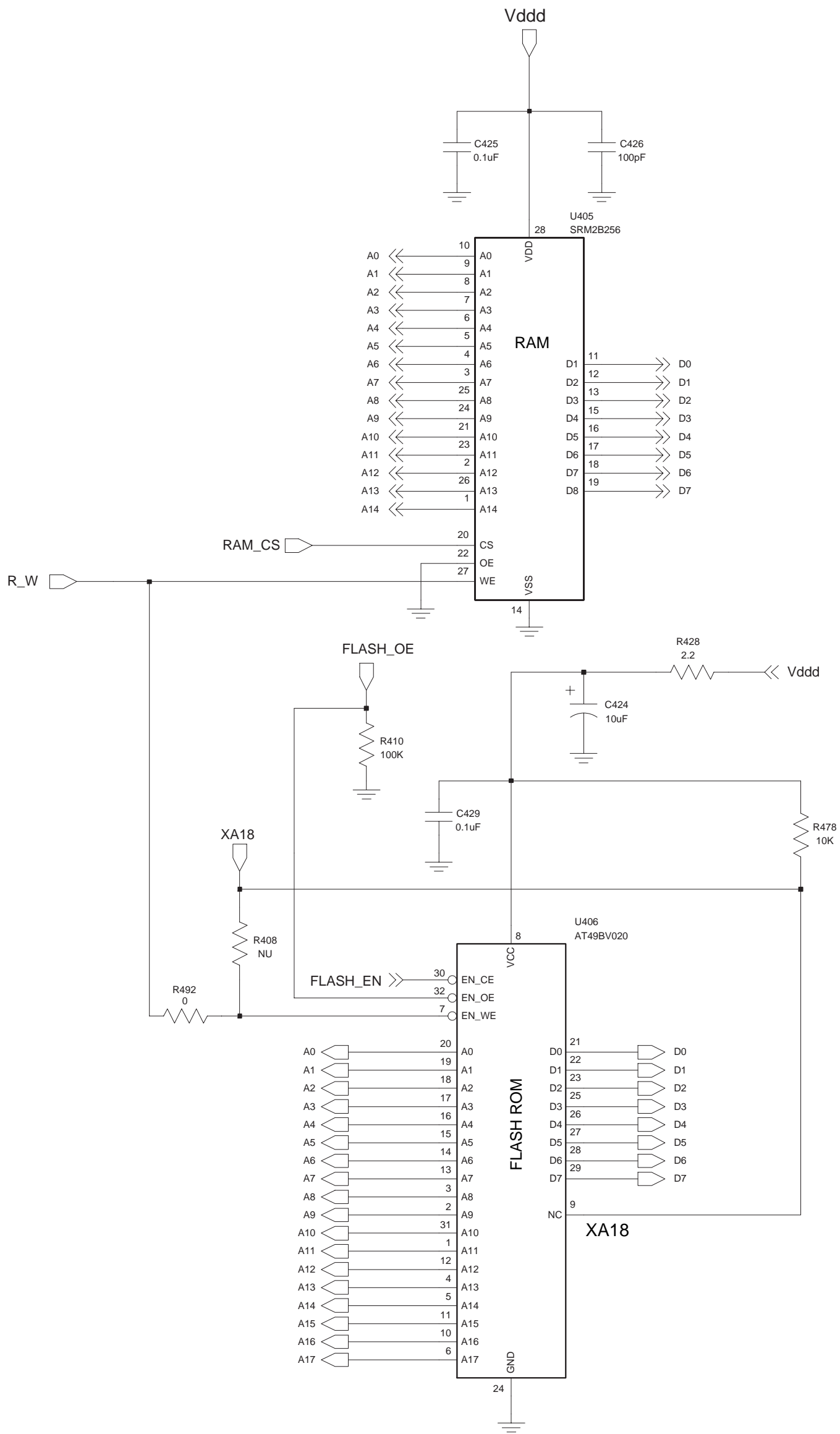
Complete Controller Schematic Diagram



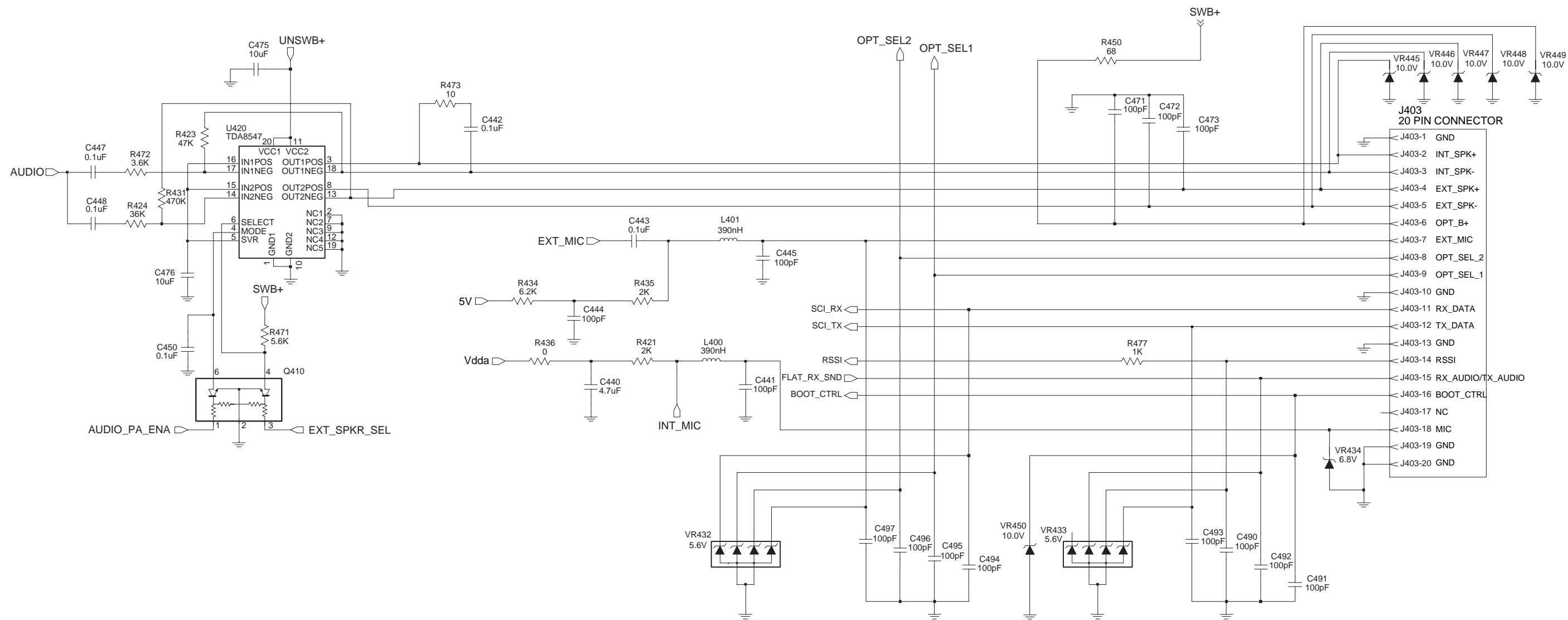
Controller ASFIC/ON\_OFF Schematic Diagram



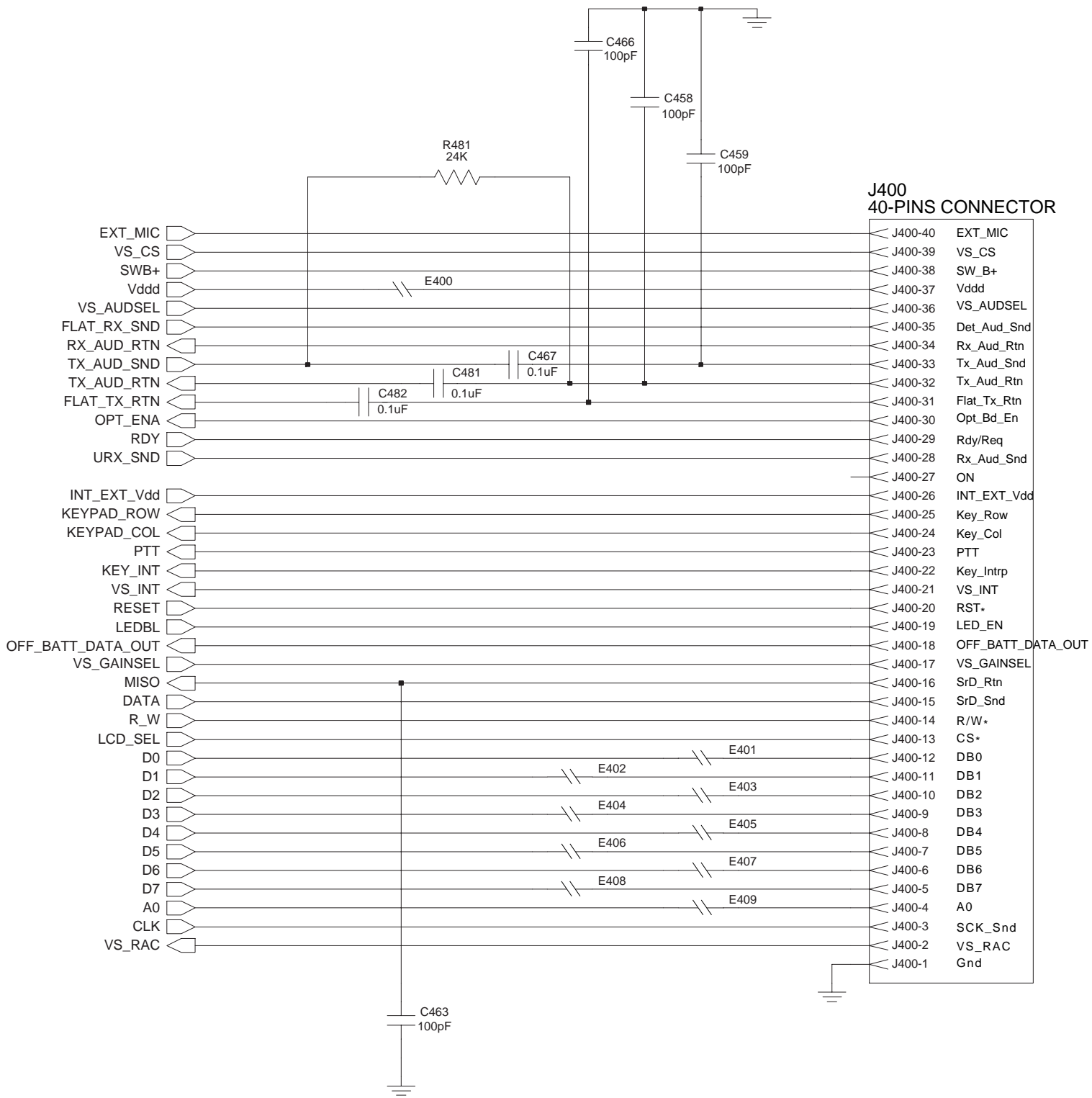
Controller Micro Processor Schematic Diagram



Controller Memory Schematic Diagram



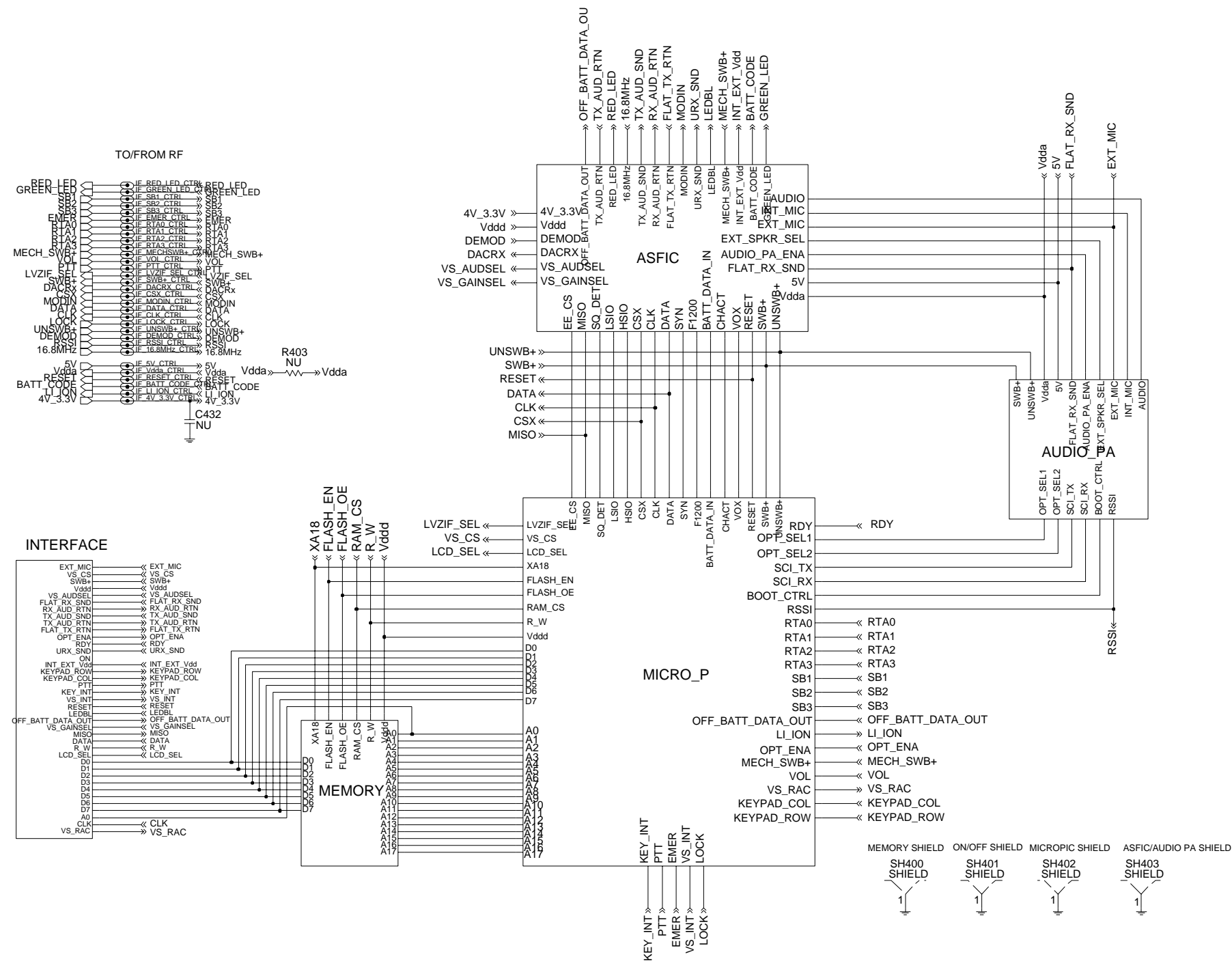
Controller Audio Power Amplifier Schematic Diagram

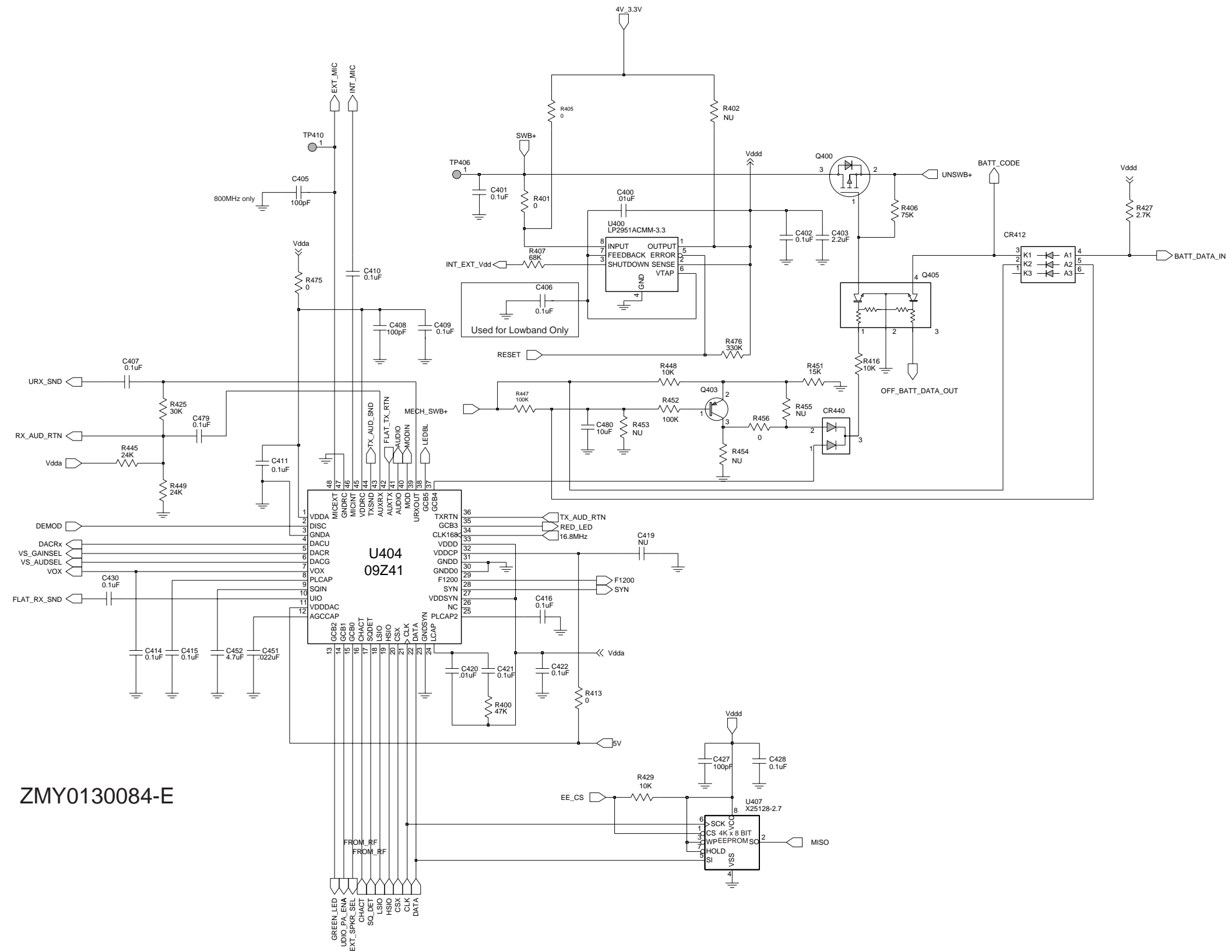


Controller Interface Schematic Diagram



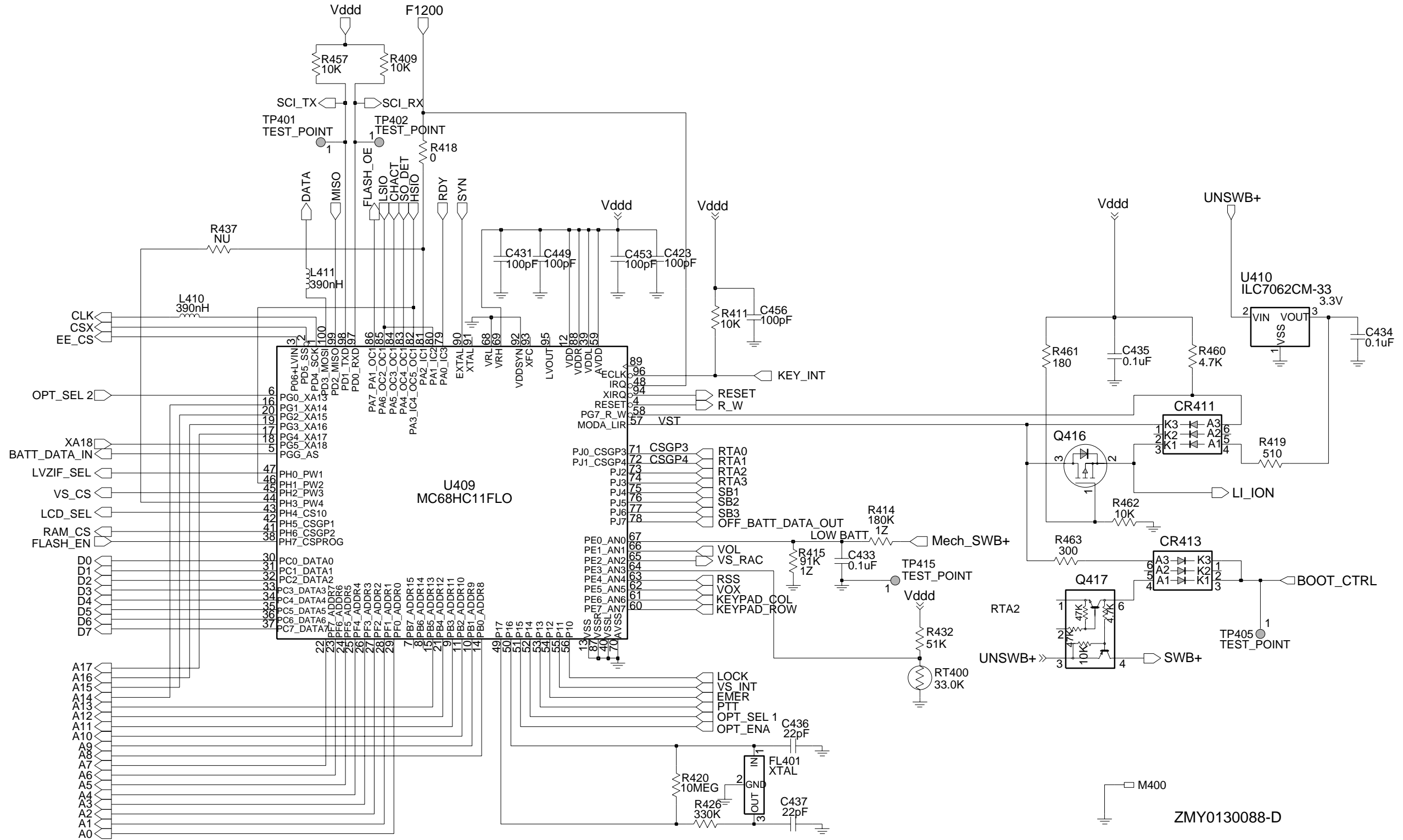
### 3.4 Controller Schematics (330-400MHz for 8485726Z04, 403-470MHz for 8480450Z13 & 450-527MHz for 8485641Z06)



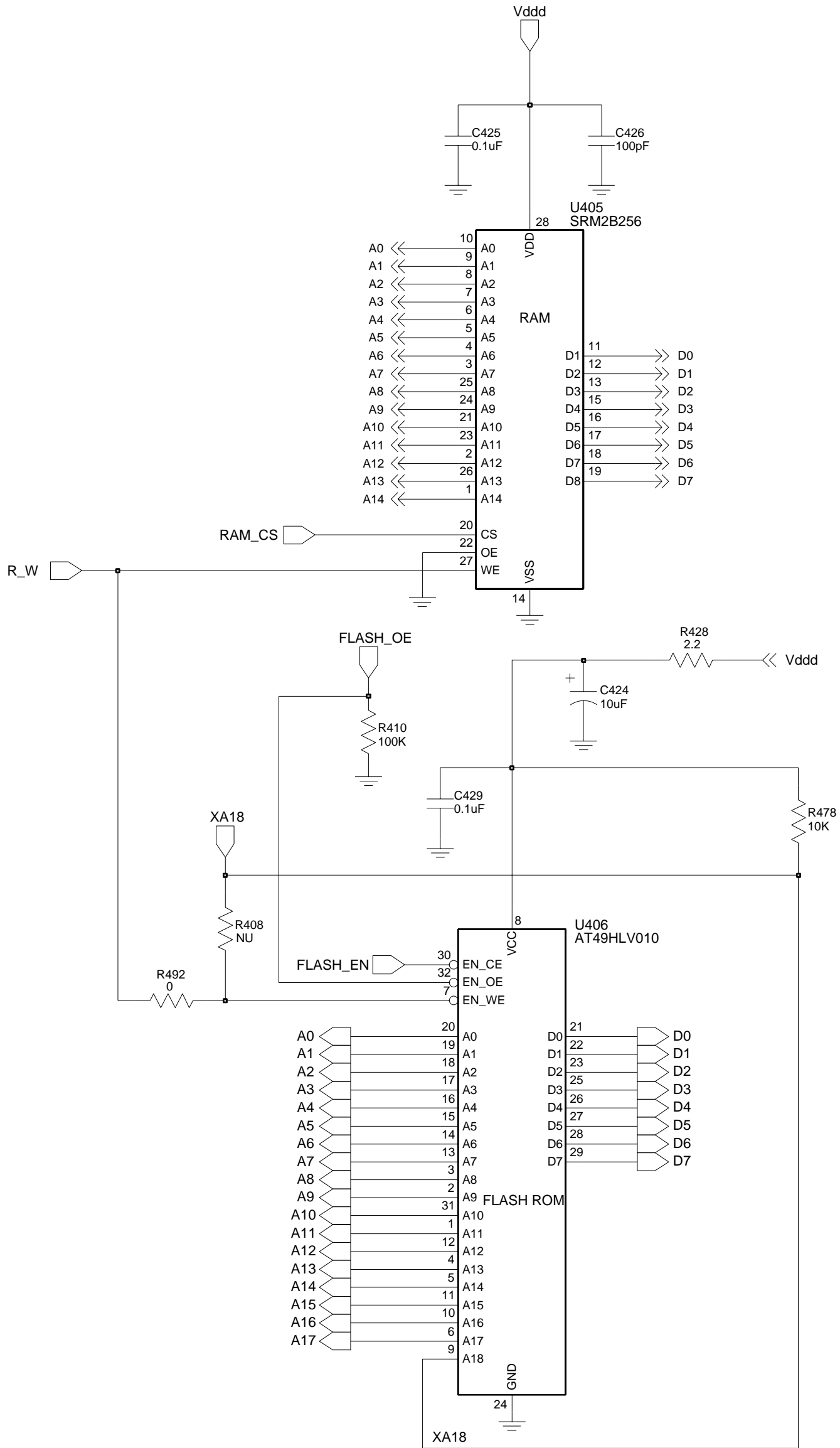


ZMY0130084-E

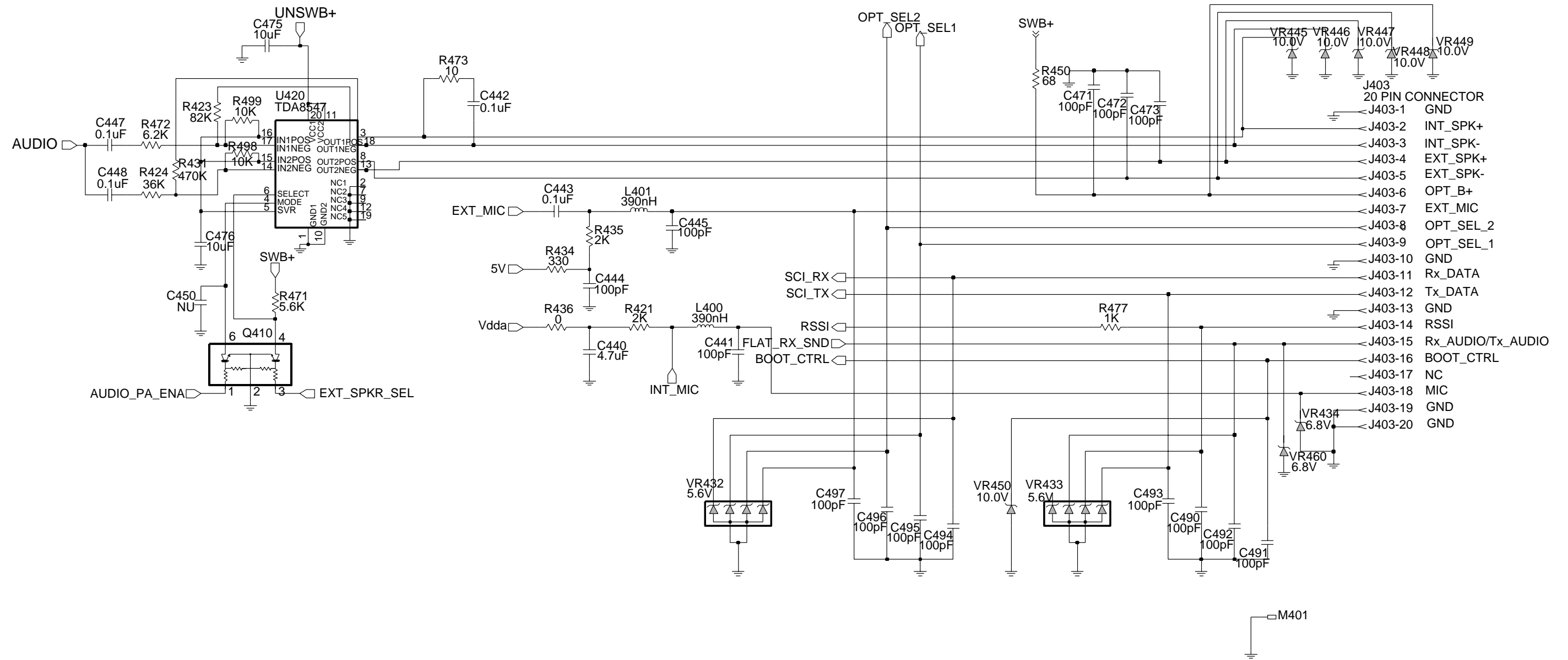
Controller ASFIC/ON\_OFF Schematic Diagram



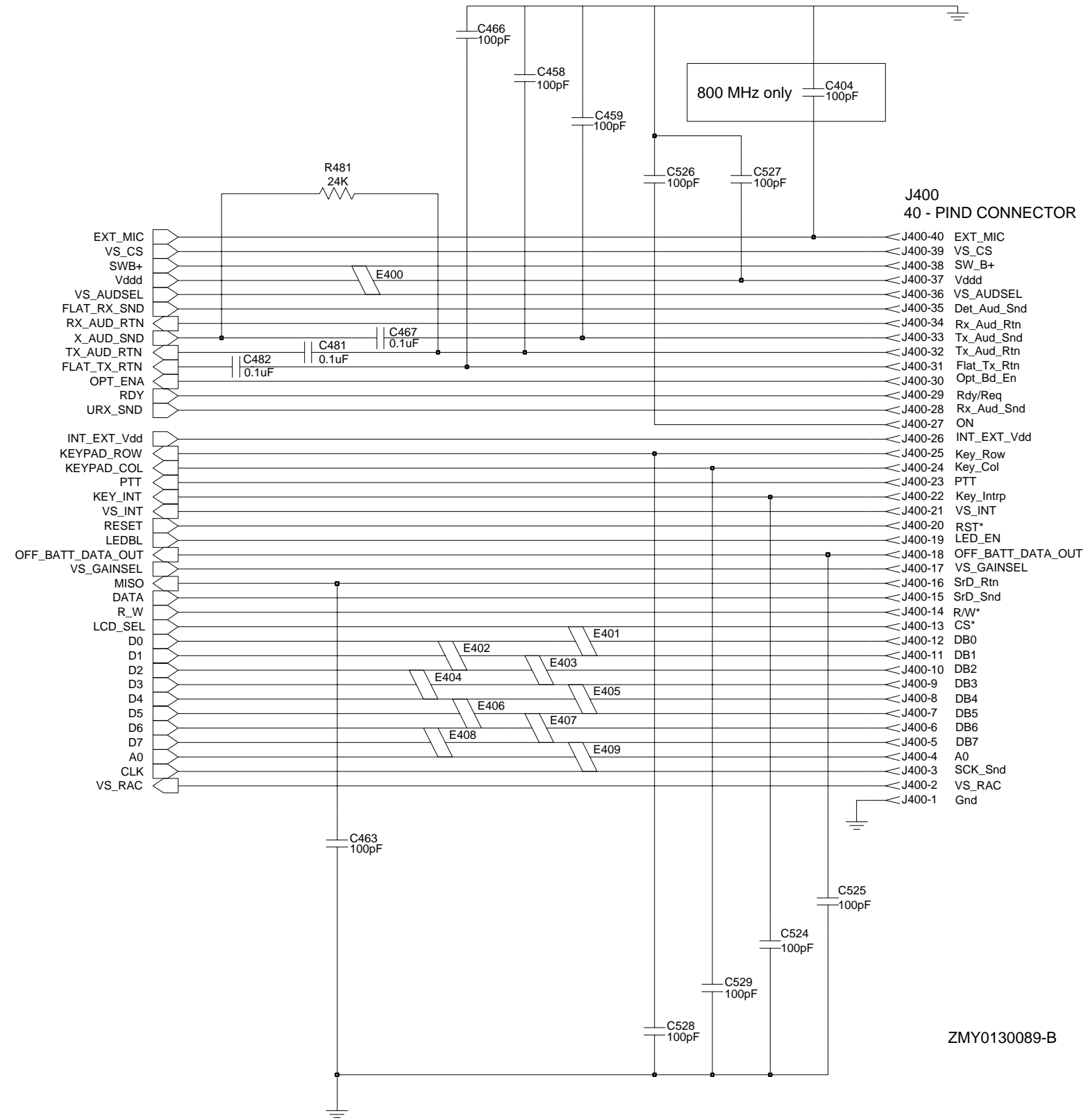
Controller Micro Processor Schematic Diagram



ZMY0130087-B

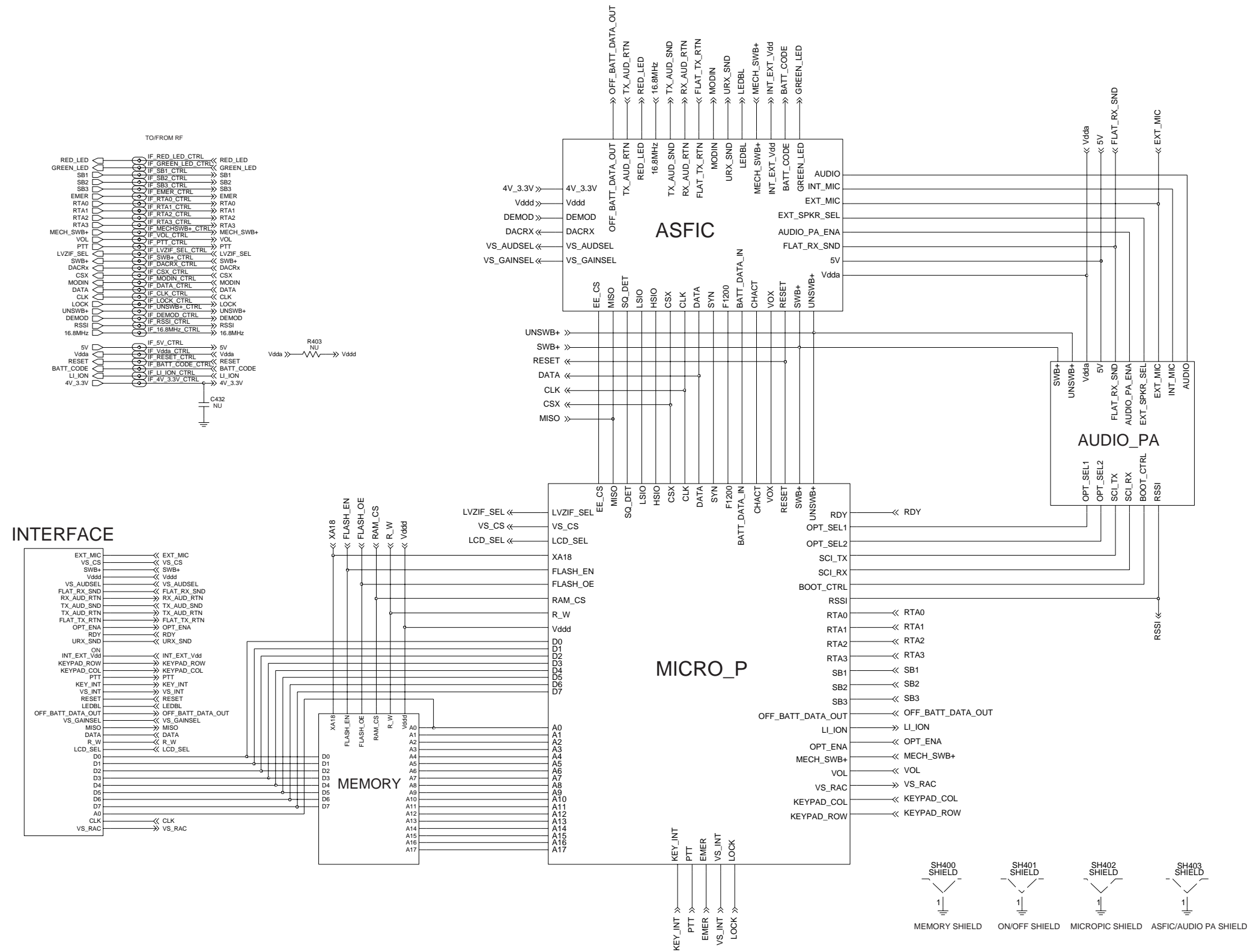


**Controller Audio Power Amplifier Schematic Diagram**

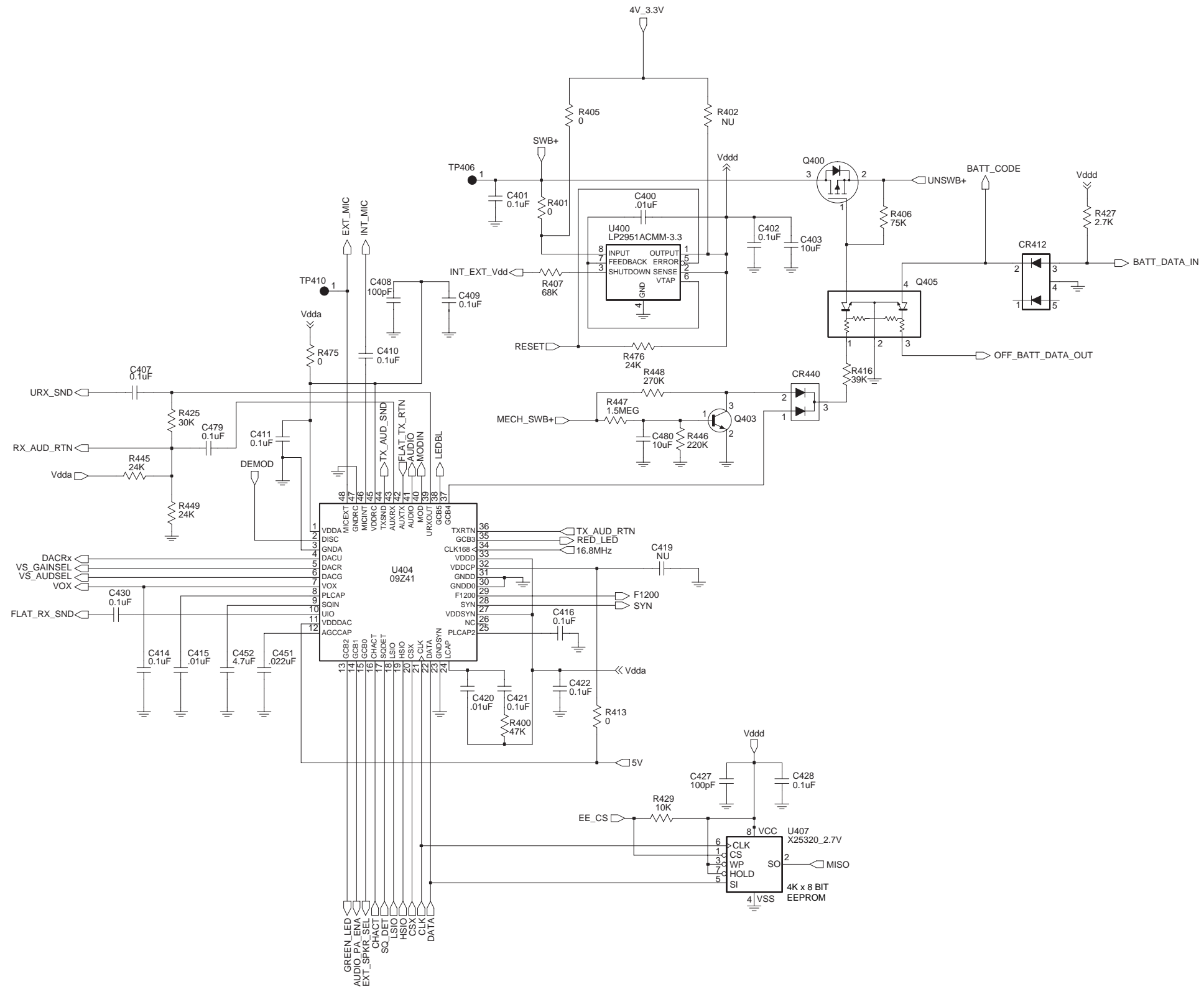


Controller Interface Schematic Diagram

### 3.5 Controller Schematics (136-174MHz for 8486062B09 & 8486062B12)

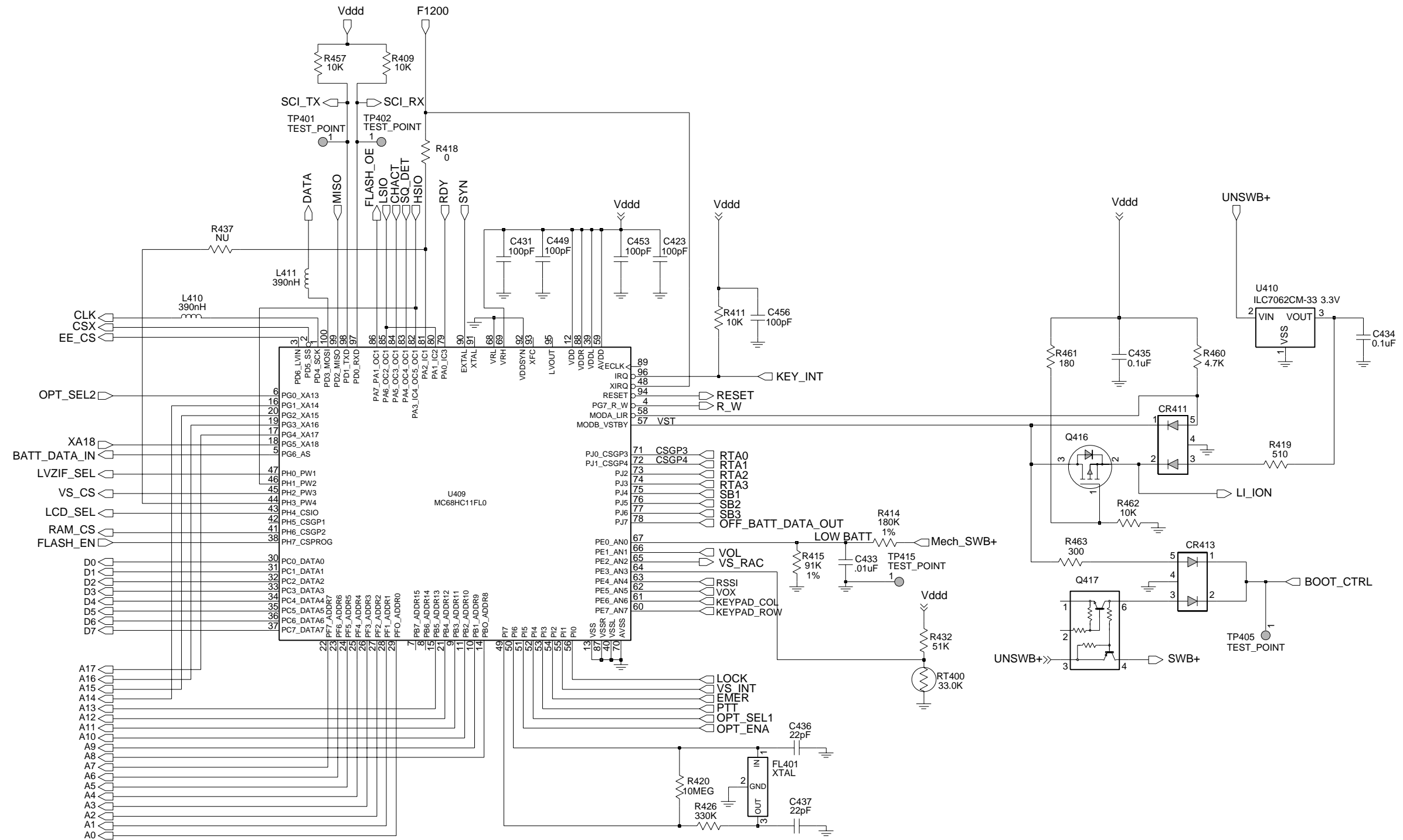


Complete Controller Schematic Diagram

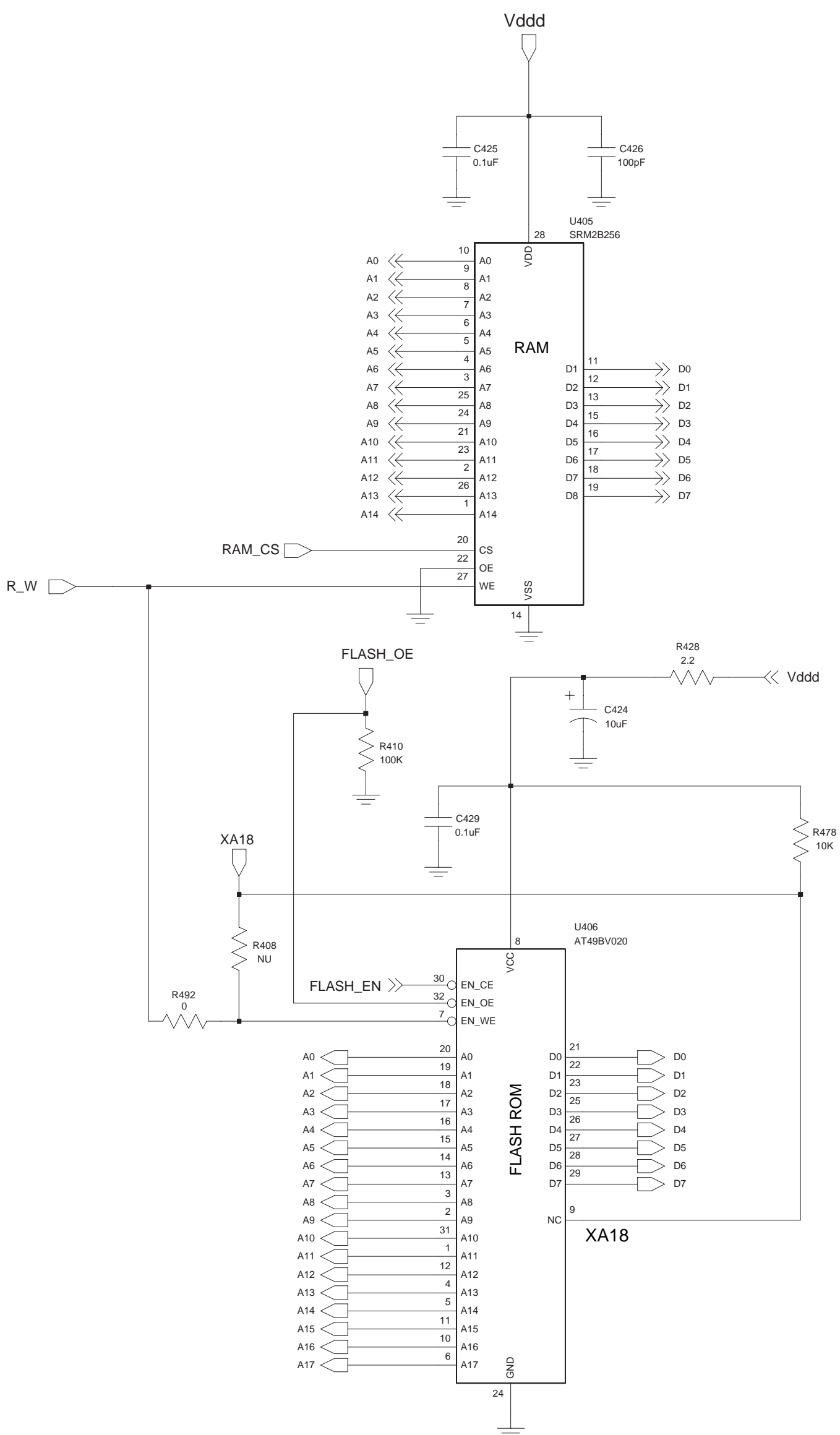


Controller ASFIC/ON\_OFF Schematic Diagram

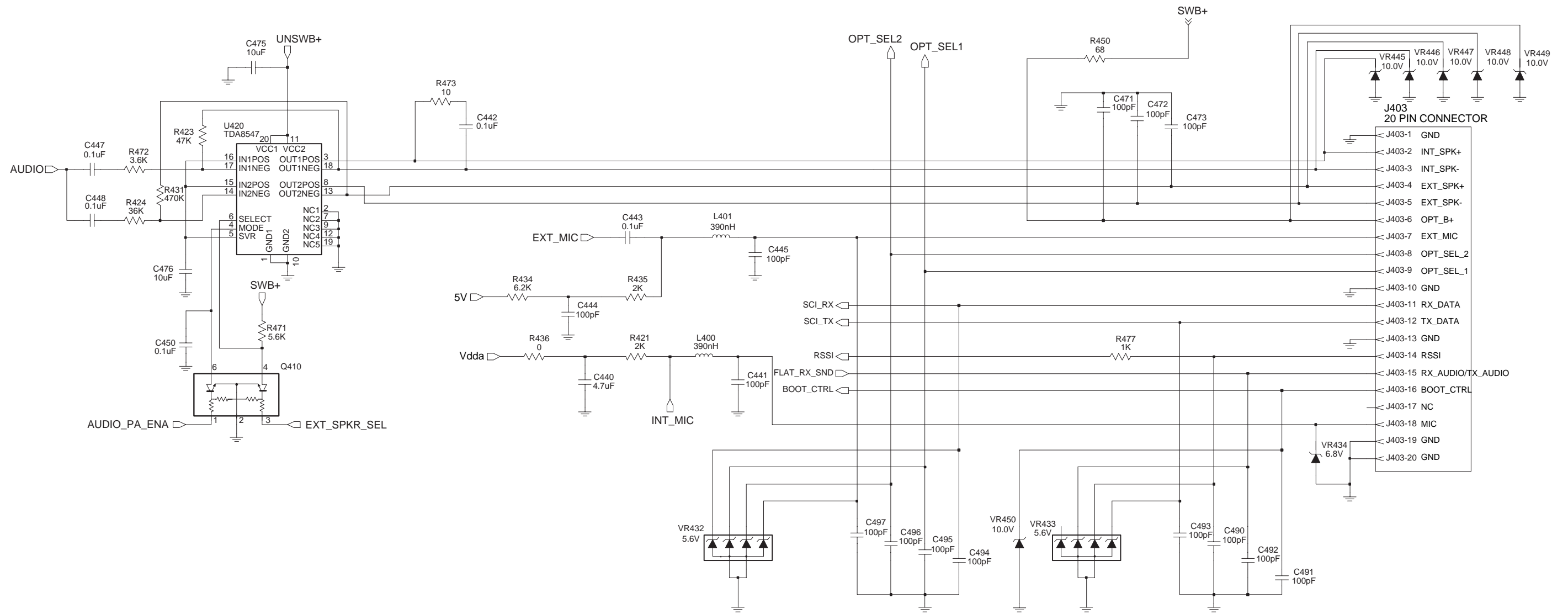




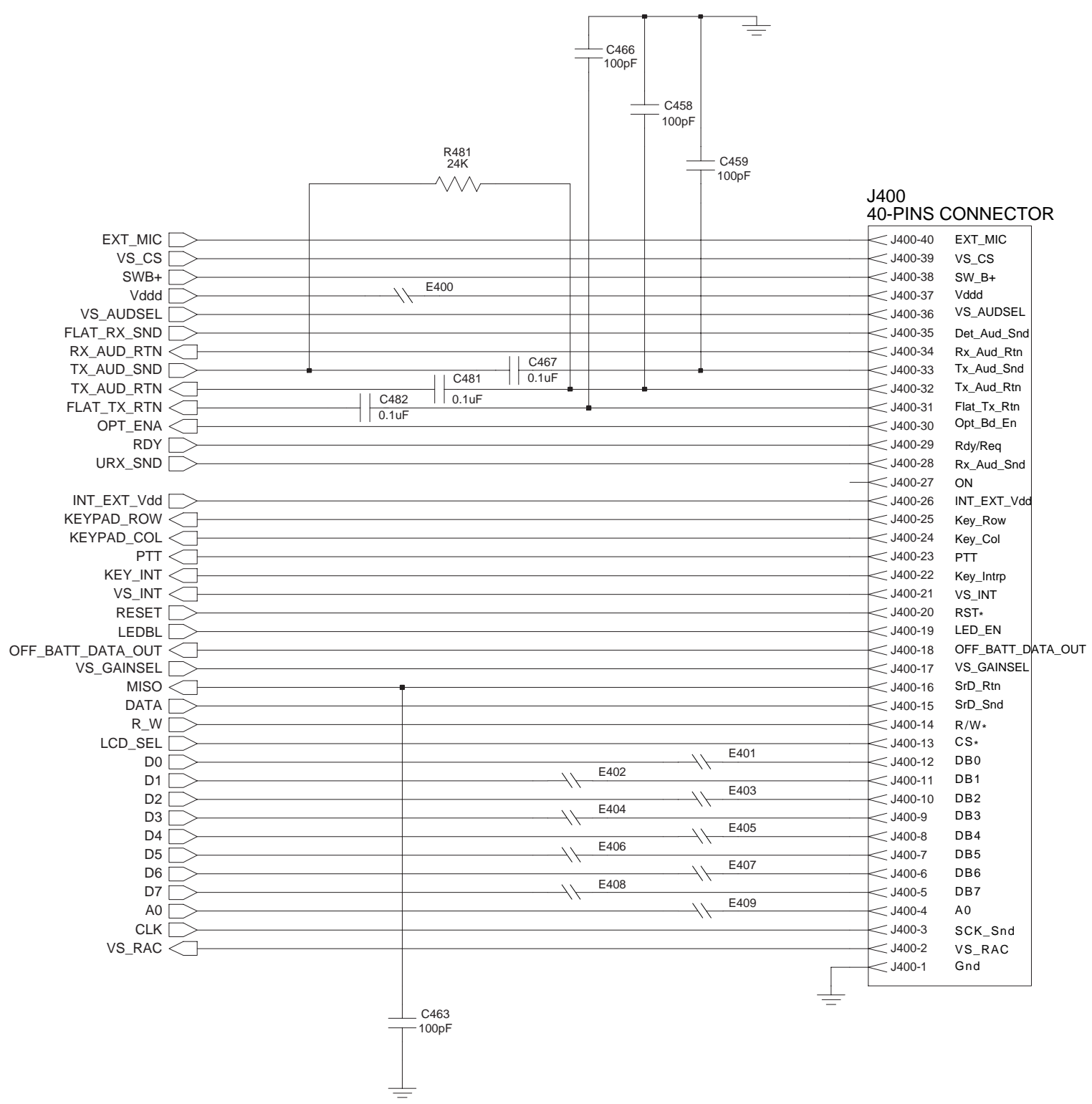
Controller Micro Processor Schematic Diagram



Controller Memory Schematic Diagram

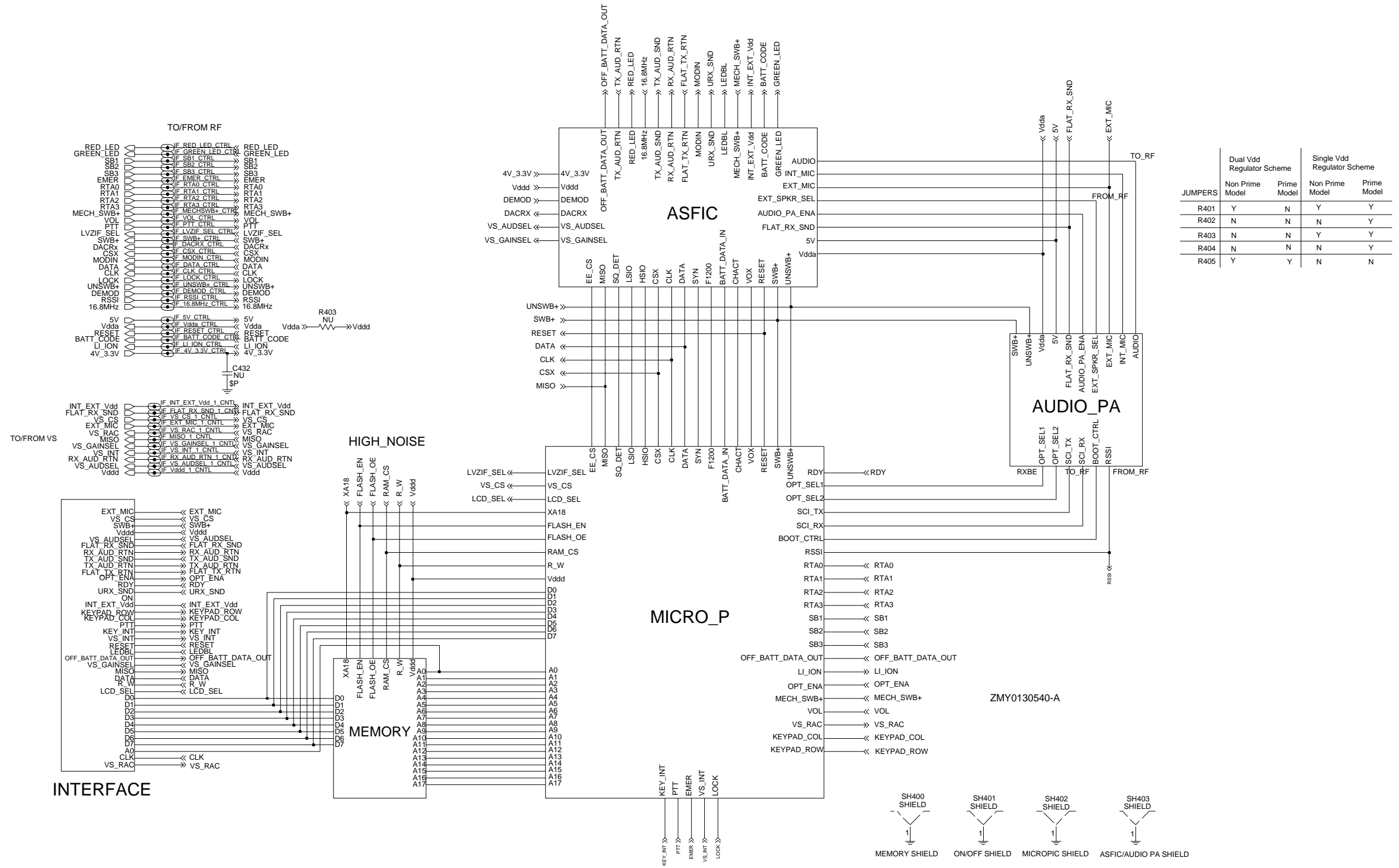


Controller Audio Power Amplifier Schematic Diagram

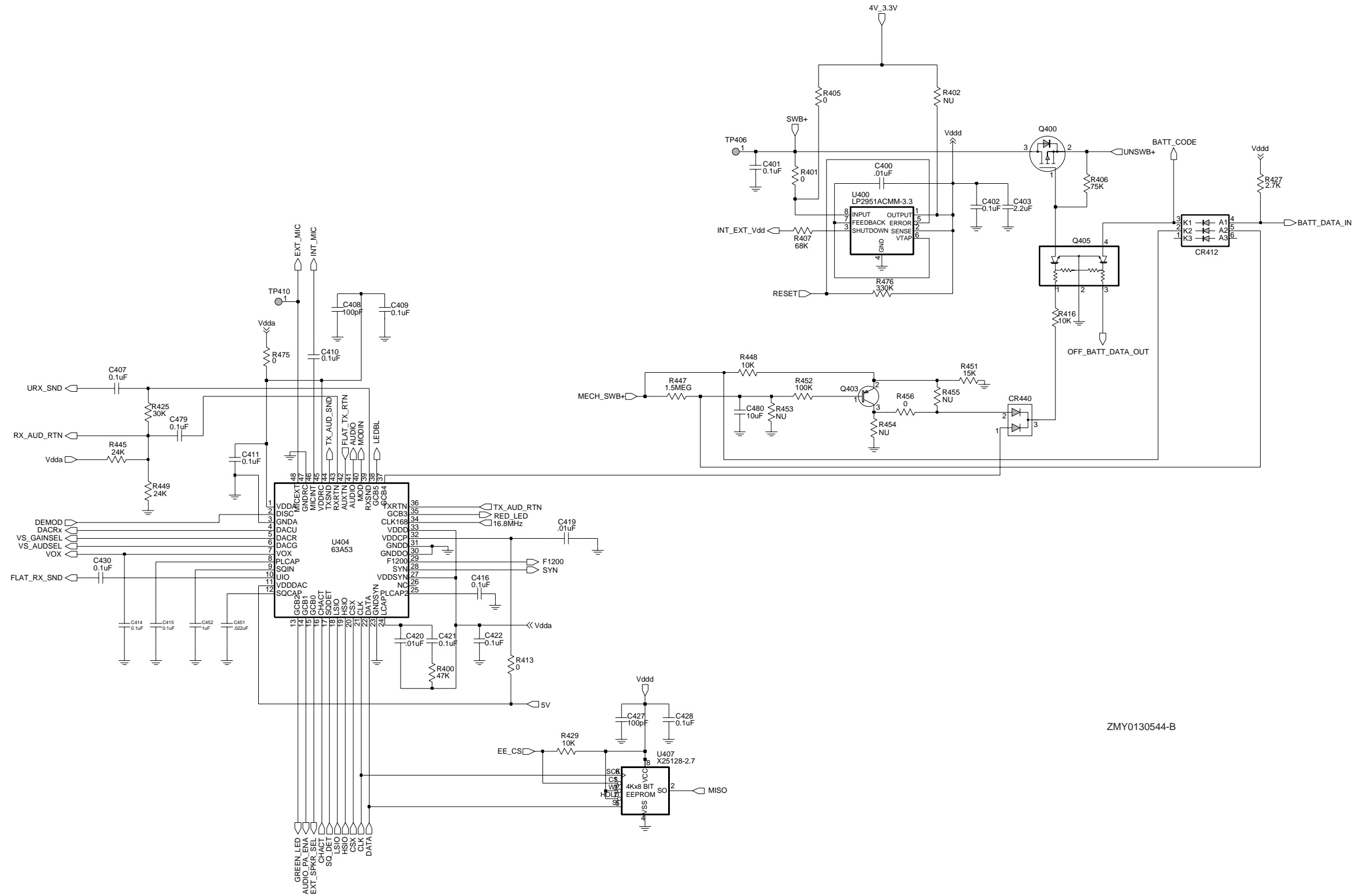


Controller Interface Schematic Diagram

3.6 Controller Schematics (136-174MHz) for PCB 8486062B16

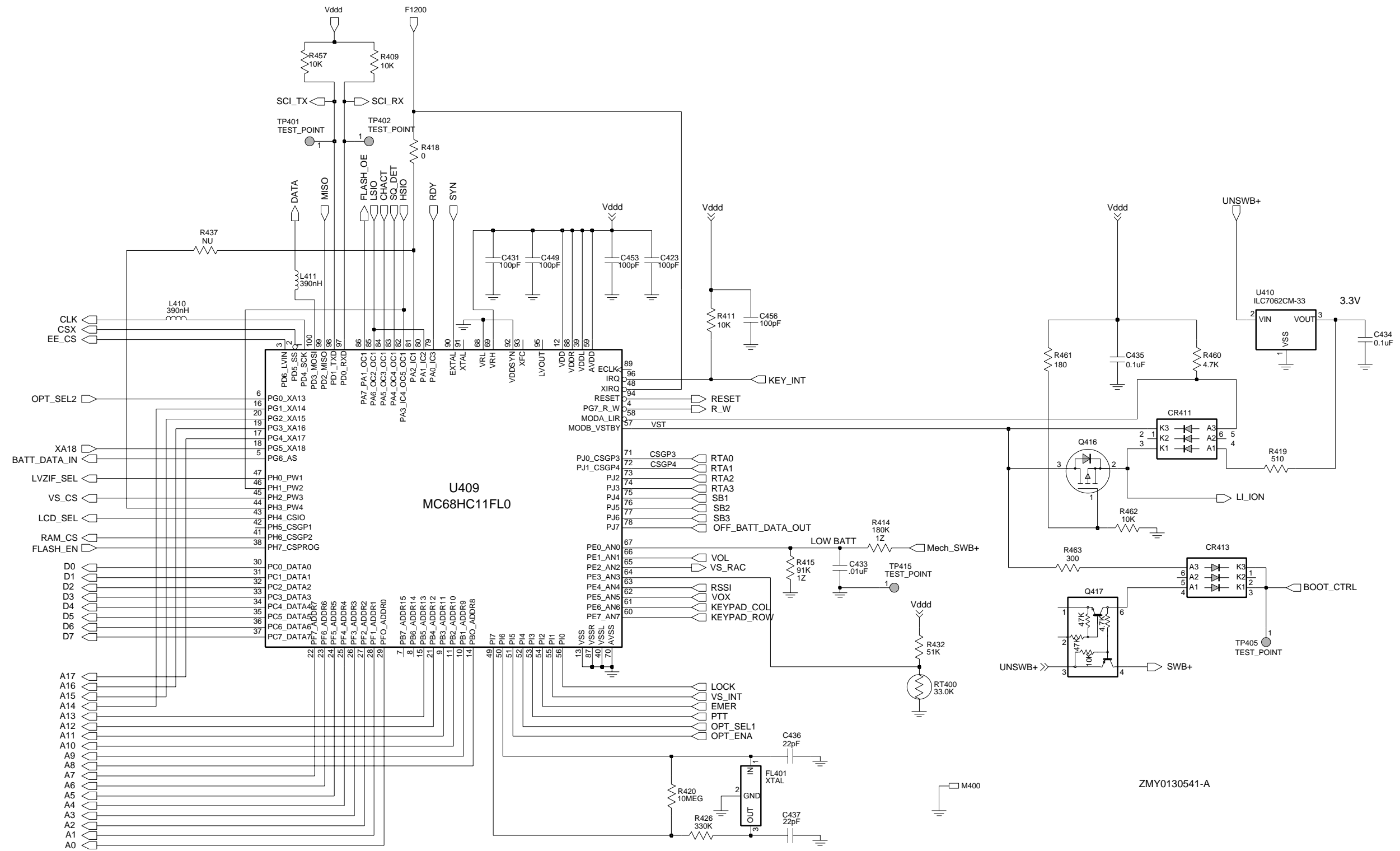


Complete Controller Schematic Diagram

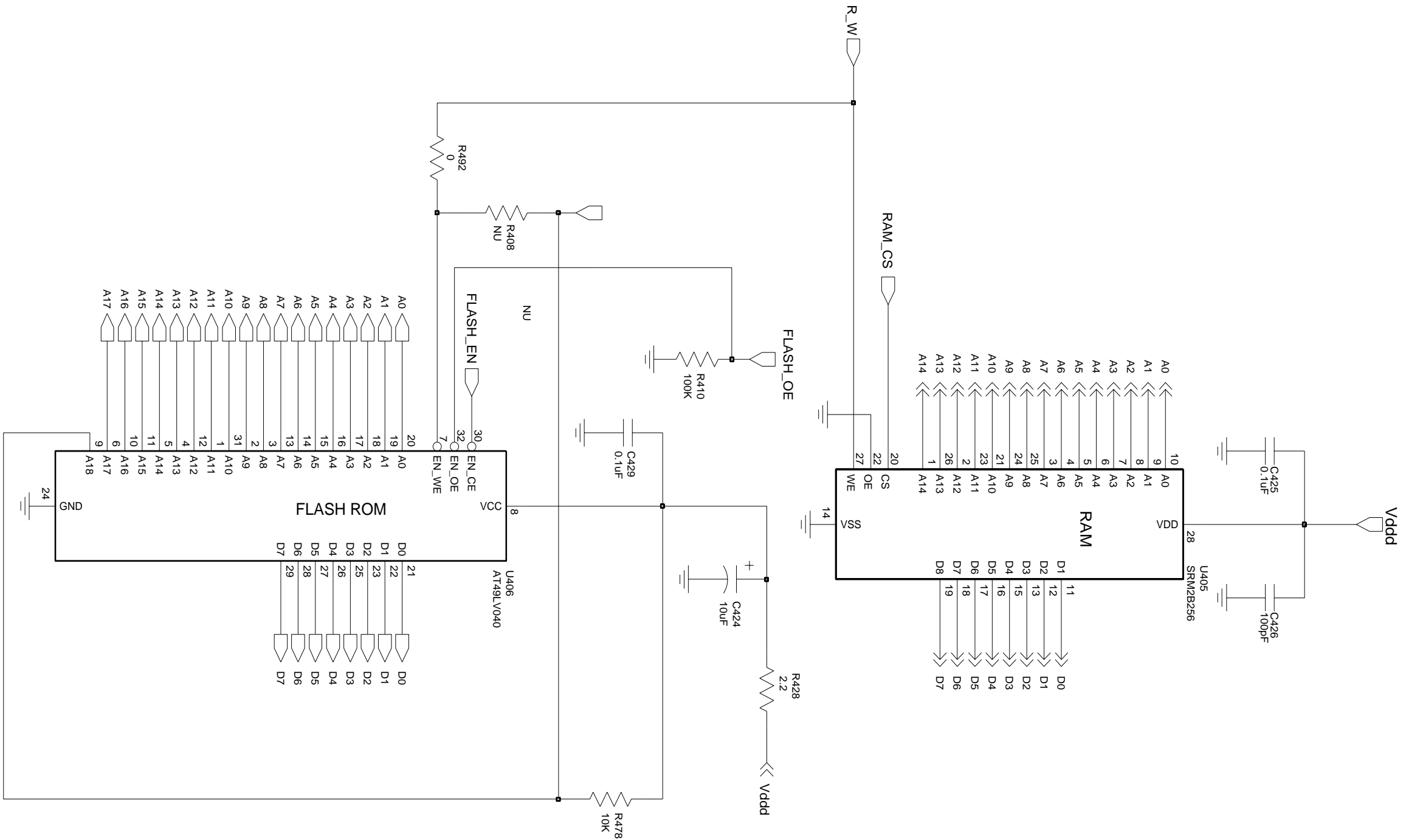


ZMY0130544-B

Controller ASFIC/ON\_OFF Schematic Diagram



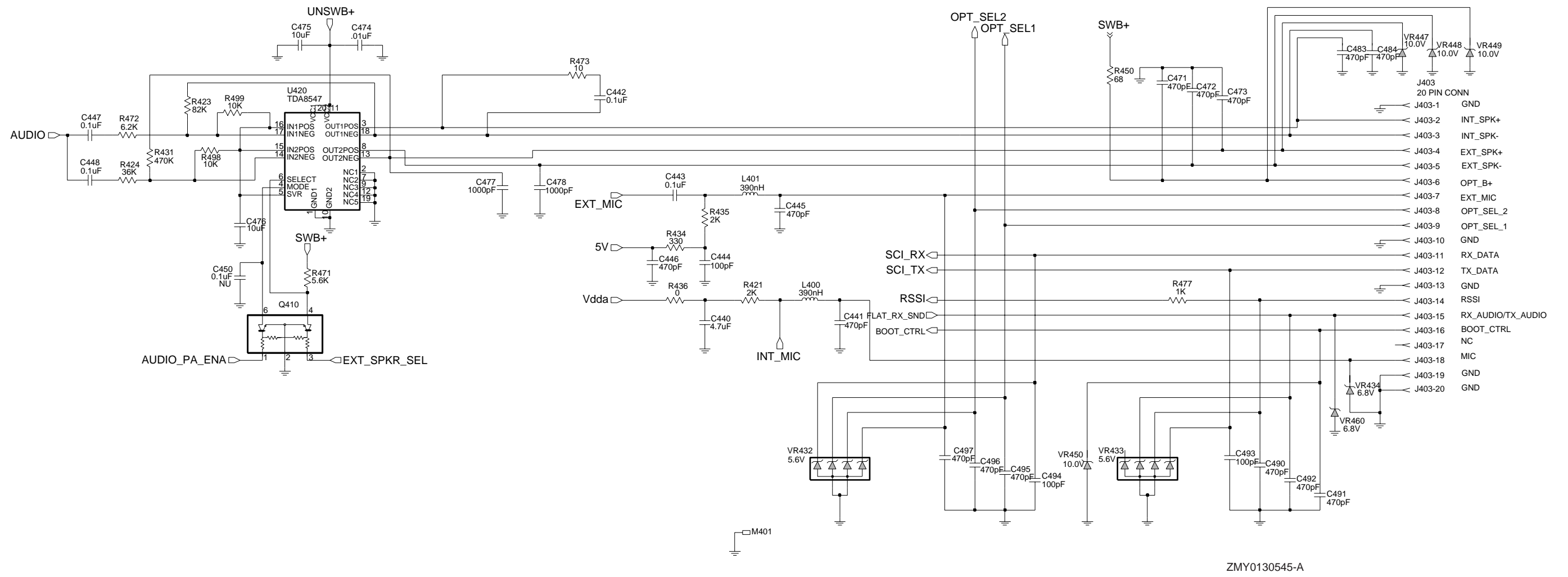
Controller Micro Processor Schematic Diagram



ZMV0130543-A

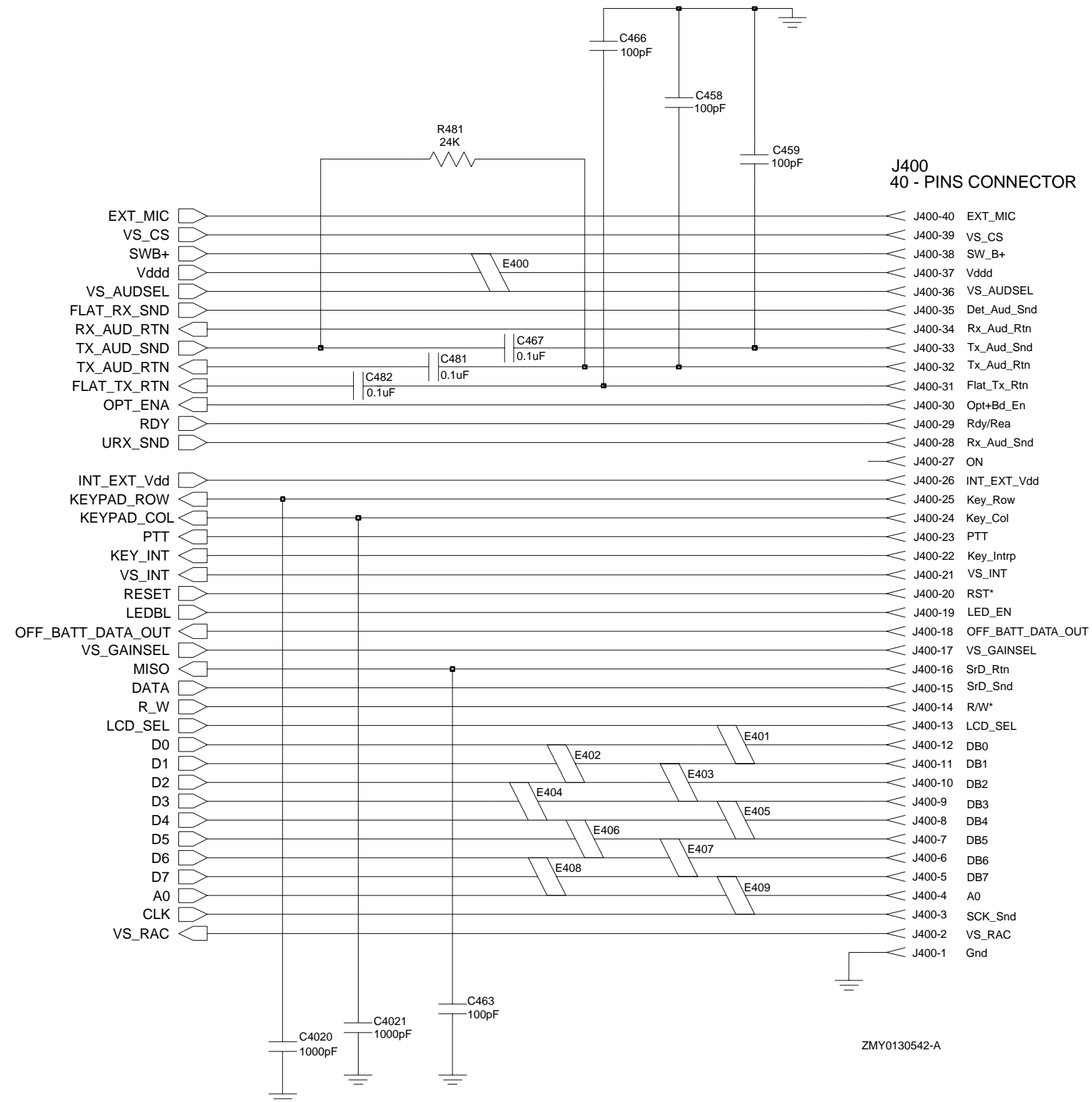
Controller Memory Schematic Diagram





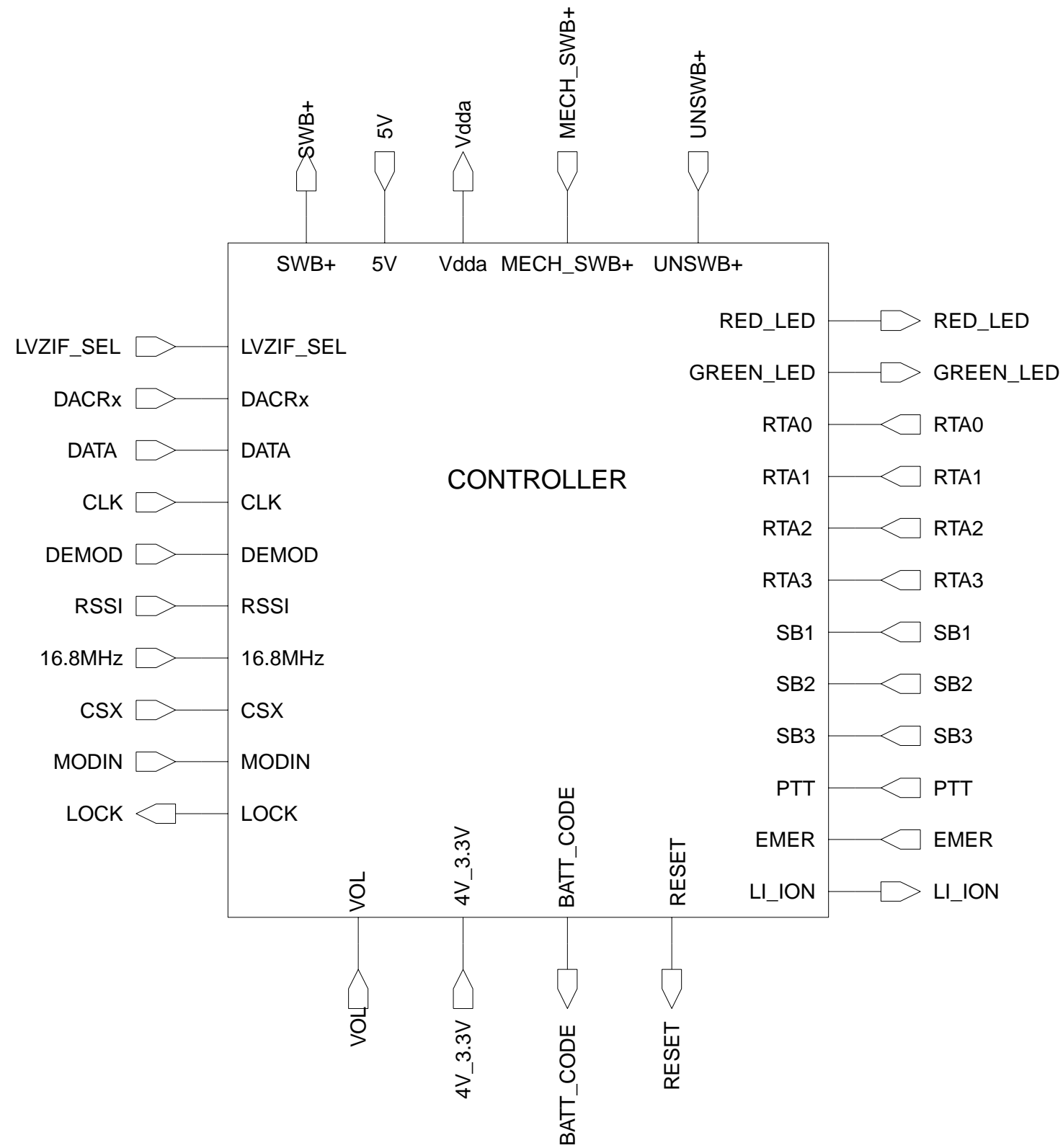
ZMY0130545-A

Controller Audio Power Amplifier Schematic Diagram

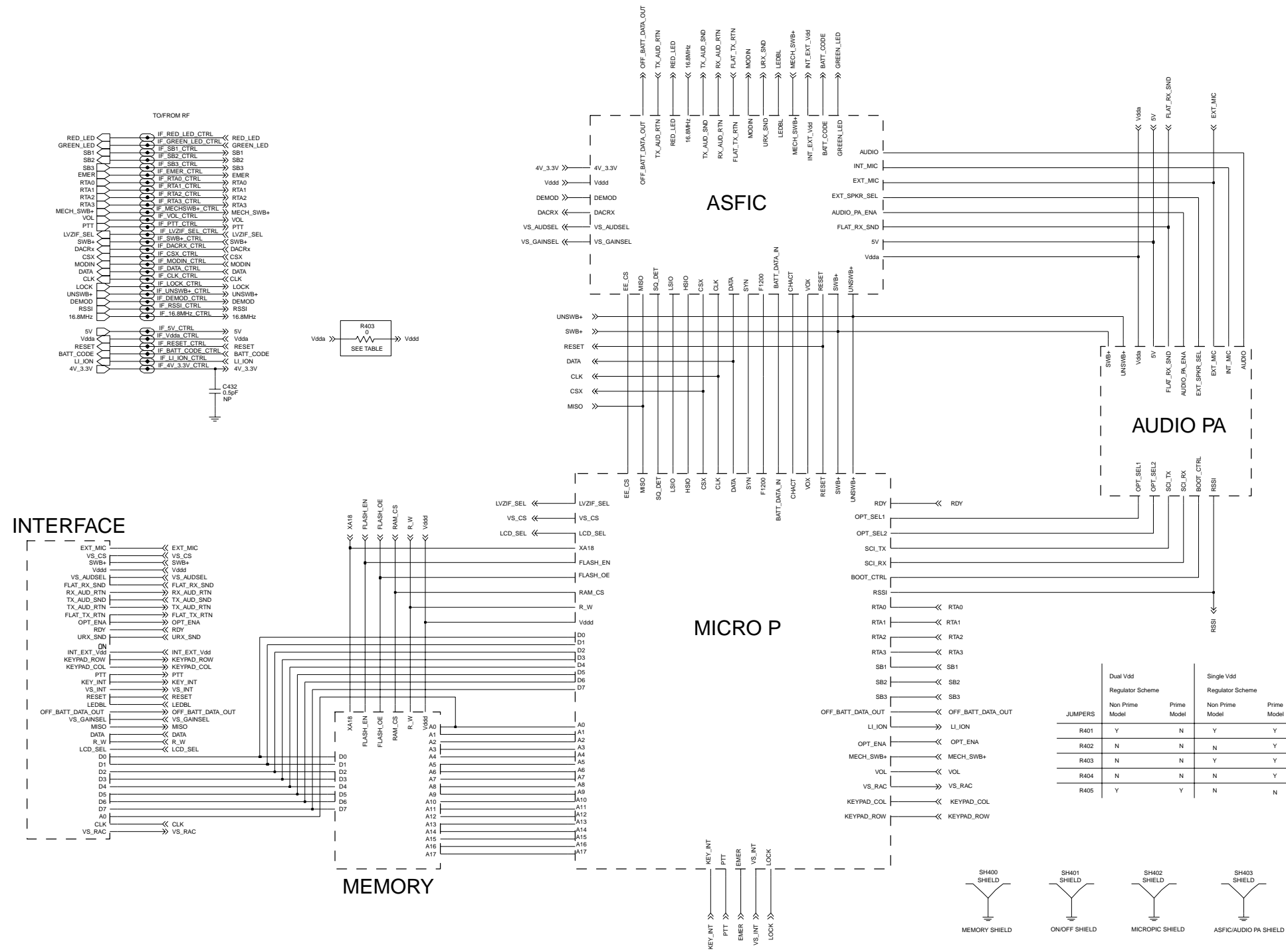


**Controller Interface Schematic Diagram**

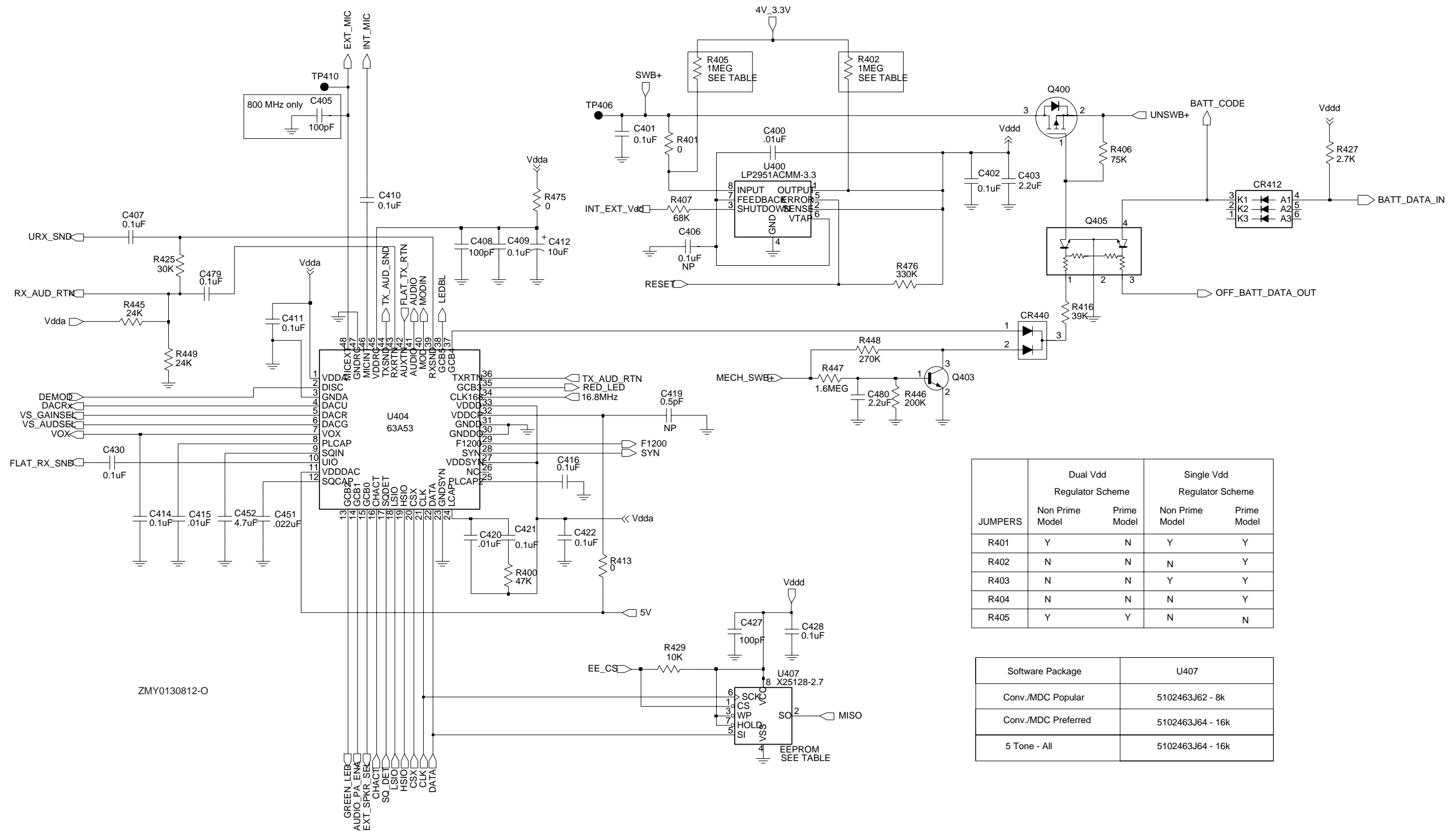
3.7 Controller Schematics (29-42/35-50MHz)



Controller Hierarchical Diagram



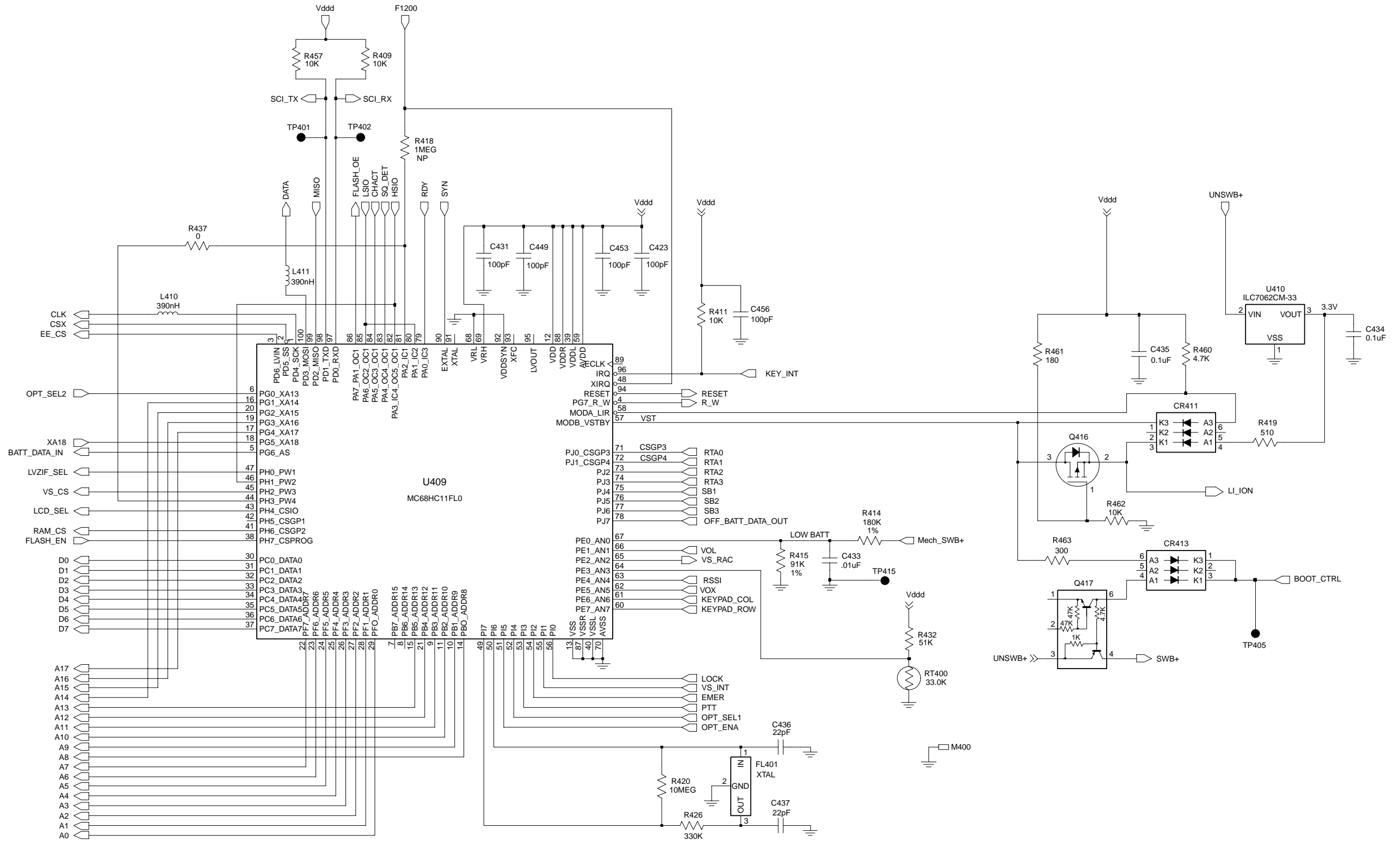
Complete Controller Schematic Diagram



JUMPERS	Dual Vdd Regulator Scheme		Single Vdd Regulator Scheme	
	Non Prime Model	Prime Model	Non Prime Model	Prime Model
R401	Y	N	Y	Y
R402	N	N	N	Y
R403	N	N	Y	Y
R404	N	N	N	Y
R405	Y	Y	N	N

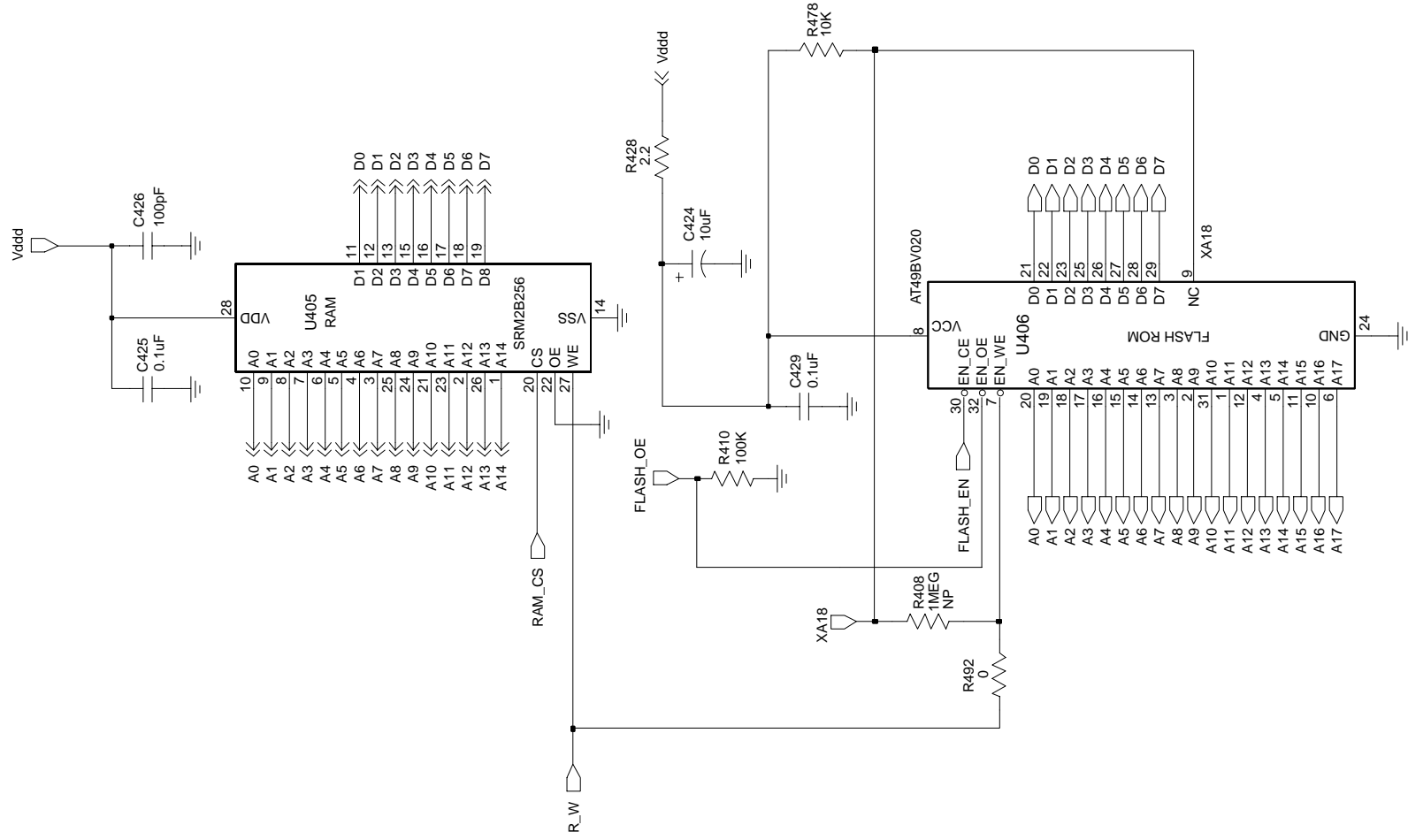
Software Package	U407
Conv./MDC Popular	5102463J62 - 8k
Conv./MDC Preferred	5102463J64 - 16k
5 Tone - All	5102463J64 - 16k

Controller ASFIC/ON\_OFF Schematic Diagram



FL08304650

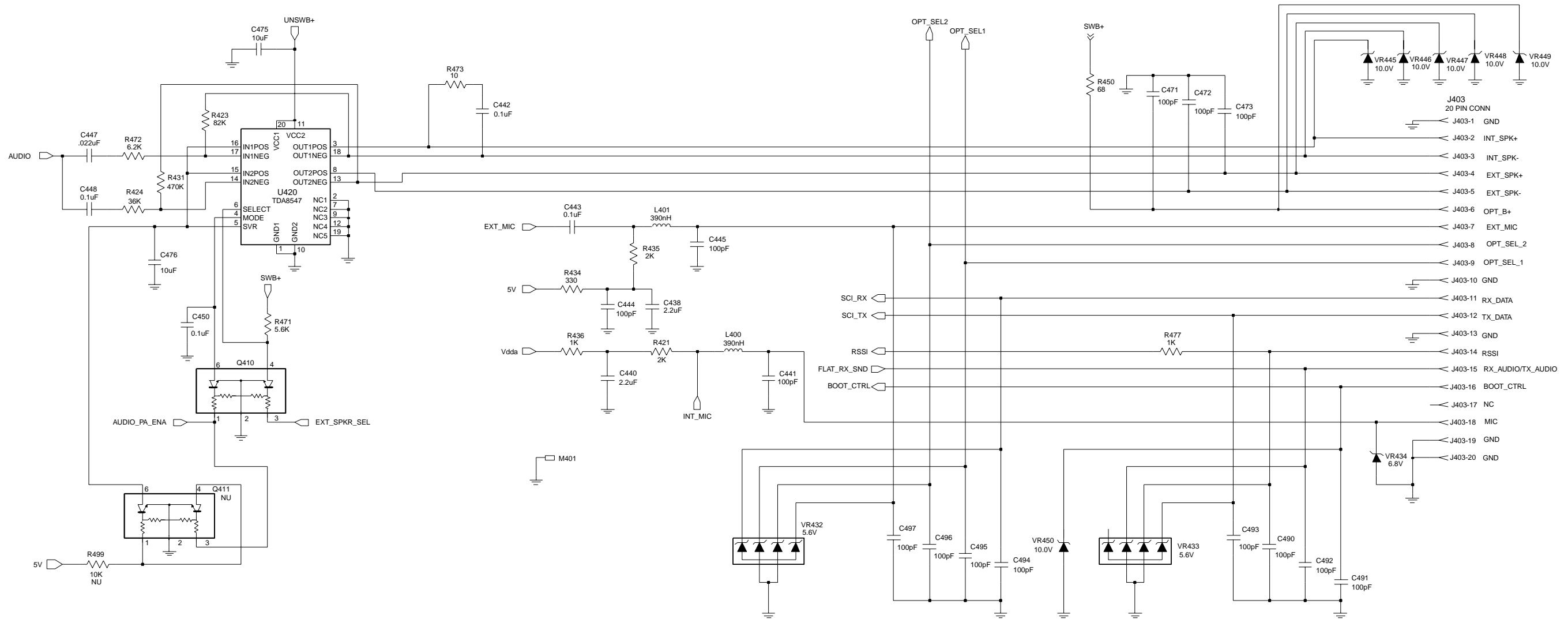
Controller Microprocessor Schematic Diagram



Software Package	U406	U405
Conventional/MDC	5102463J59 - 128k	Not used
5 Tone	5102463J60 - 512k	5102463J36 - 32k

FL08304640

Controller Interface and Memory Schematic Diagram



FL08304620

**Controller Audio Power Amplifier Schematic Diagram**



## Section 5

# KEYPAD BOARD INFORMATION

### 1.0 Theory of Operation

#### Keypad

The LED\_EN setting is set by the codeplug. When the value is set to high, the LED will not light up during power up and vice versa.

U602 is a comparator that will compare the voltage when any one of the keypad row or keypad column keys is being pressed. Therefore when a key is being pressed, it will send a message to the microprocessor through the output (KEY\_INT) telling it that a key has been pressed. The microprocessor will then sample the Analog to Digital voltages at the keypad row and keypad column and map it with the table so that the key being pressed can be identified. Once the key has been identified, the message that corresponds to the key will show up at the display.

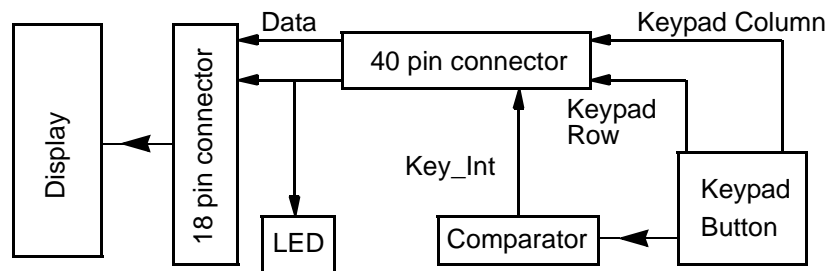


Figure 5-1: Keypad Block Diagram

## 2.0 Troubleshooting Chart

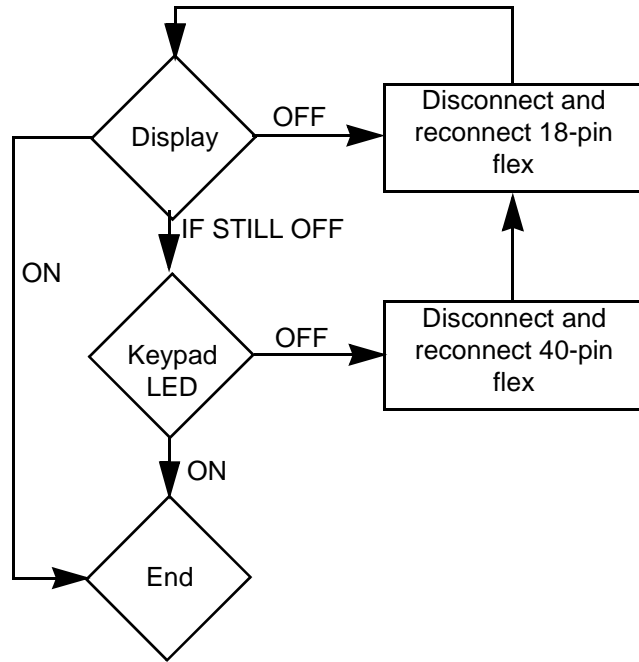


Figure 5-2: Keypad Board Troubleshooting Chart

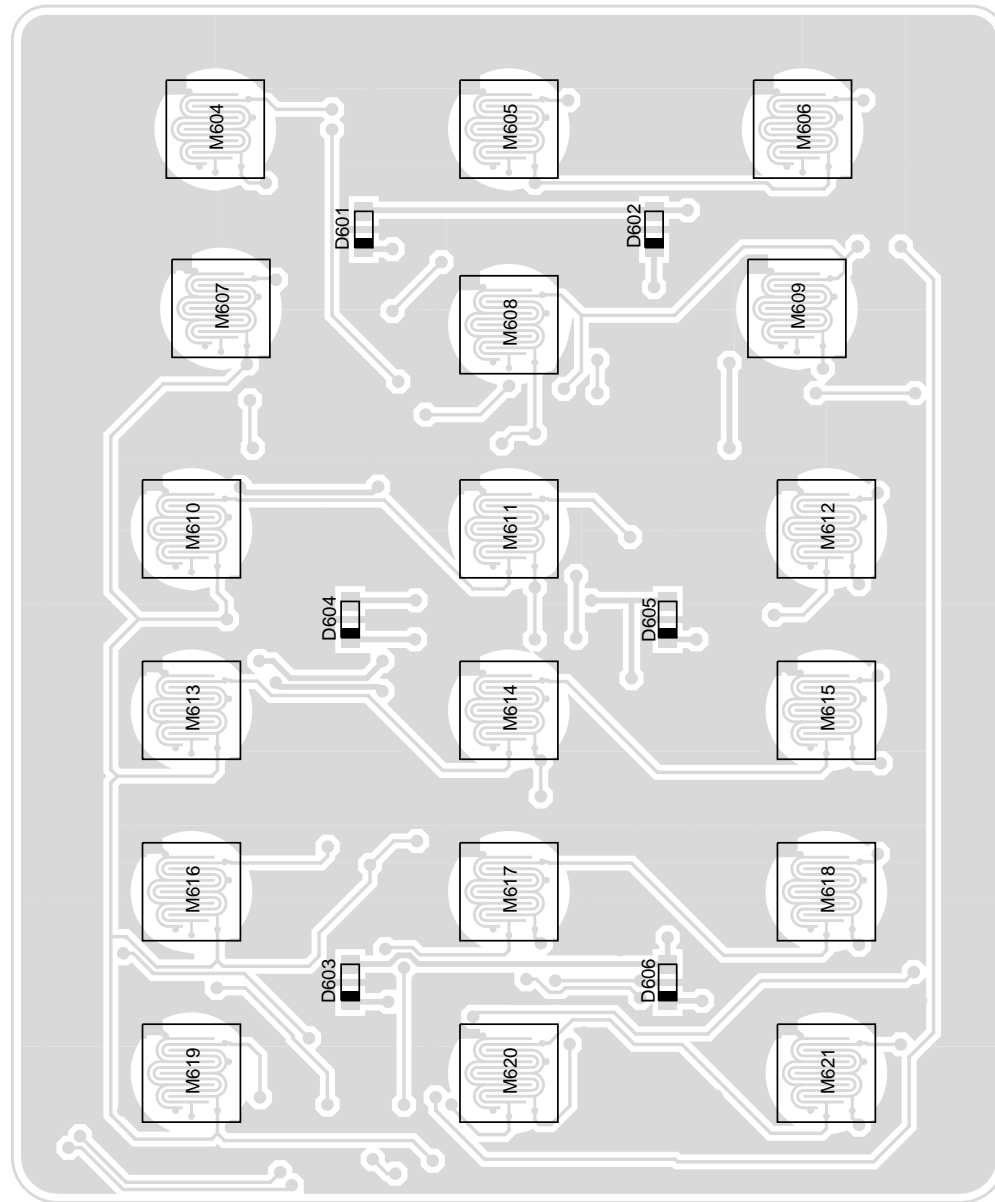
### 3.0 Parts List (Keypad Basic)

Circuit Ref	Motorola Part No.	Description
C610	2113743N50	100 pF
C611	2113743N50	100 pF
C612	2113743N50	100 pF
C613	2113743N50	100 pF
C615	2113743N50	100 pF
C616	2113743N50	100 pF
C618	2113743N50	100 pF
C619	2113743N50	100 pF
C620	2113743N50	100 pF
C621	2113743N50	100 pF
C622	2113743N50	100 pF
C631	2113743N50	100 pF
C630	2113743N43	51 pF
C632	2113743N43	51 pF
C633	2113743N50	100 pF
C634	2113743N43	51 pF
C635	2113743N50	100 pF
C636	2113743N43	51 pF
C637	2113743N50	100 pF
C638	2113743N43	51 pF
C639	2113743N50	100 pF
C640	2113743N43	51 pF
C641	2113743N50	100 pF
C642	2113743N43	51 pF
C643	2113743N50	100 pF
C644	2113743N43	51 pF
C645	2113743N50	100 pF
C646	2113743N50	100 pF
C647	2113743N43	51 pF
D601	4880479U01	79U01
D602	4880479U01	79U01
D603	4880479U01	79U01
D604	4880479U01	79U01
D605	4880479U01	79U01
D606	4880479U01	79U01
E634	2480640Z01	Ind Bead
E637	2480640Z01	Ind Bead
E638	2480640Z01	Ind Bead
E639	2480640Z01	Ind Bead
E640	2480640Z01	Ind Bead
E641	2480640Z01	Ind Bead
E642	2480640Z01	Ind Bead
E643	2480640Z01	Ind Bead
E644	2480640Z01	Ind Bead
E645	2480640Z01	Ind Bead
J601	0980521Z01	44 pin connector
J602	0905505Y03	18 pin connector
Q601	4805128M67	MMBT3906 transistor (PNP)

Circuit Ref	Motorola Part No.	Description
Q602	4880214G02	MMBT3904 transistor (NPN)
Q603	4880214G02	MMBT3904 transistor (NPN)
R601	0662057V20	51K
R602	0662057V20	51K
R603	0662057V05	13K
R604	0662057V11	22K
R605	0662057V18	43K
R606	0662057V30	130K
R607	0662057V05	13K
R608	0662057V11	22K
R609	0662057V18	43K
R610	0662057V30	130K
R611	0662057N16	51K
R612	0662057N41	560K
R613	0662057N47	1M
R614	0662057M01	0 ohm
R617	0662057M01	0 ohm
R618	0662057M74	1K
R619	0662057M74	1K
R620	0662057M74	1K
R621	0662057M74	1K
R622	0662057M74	1K
R623	0662057M74	1K
R626	0662057M01	0 ohm
R627	0662057M01	0 ohm
R631	0662057M01	0 ohm
R632	0662057N23	100K
R633	0662057N23	100K
R646	0662057N23	100K
R647	0662057M85	3K
R648	0662057N23	100K
R649	0662057N15	47K
U602	5102463J49	LMC7211 comparator
	8480574Z05	PC Board

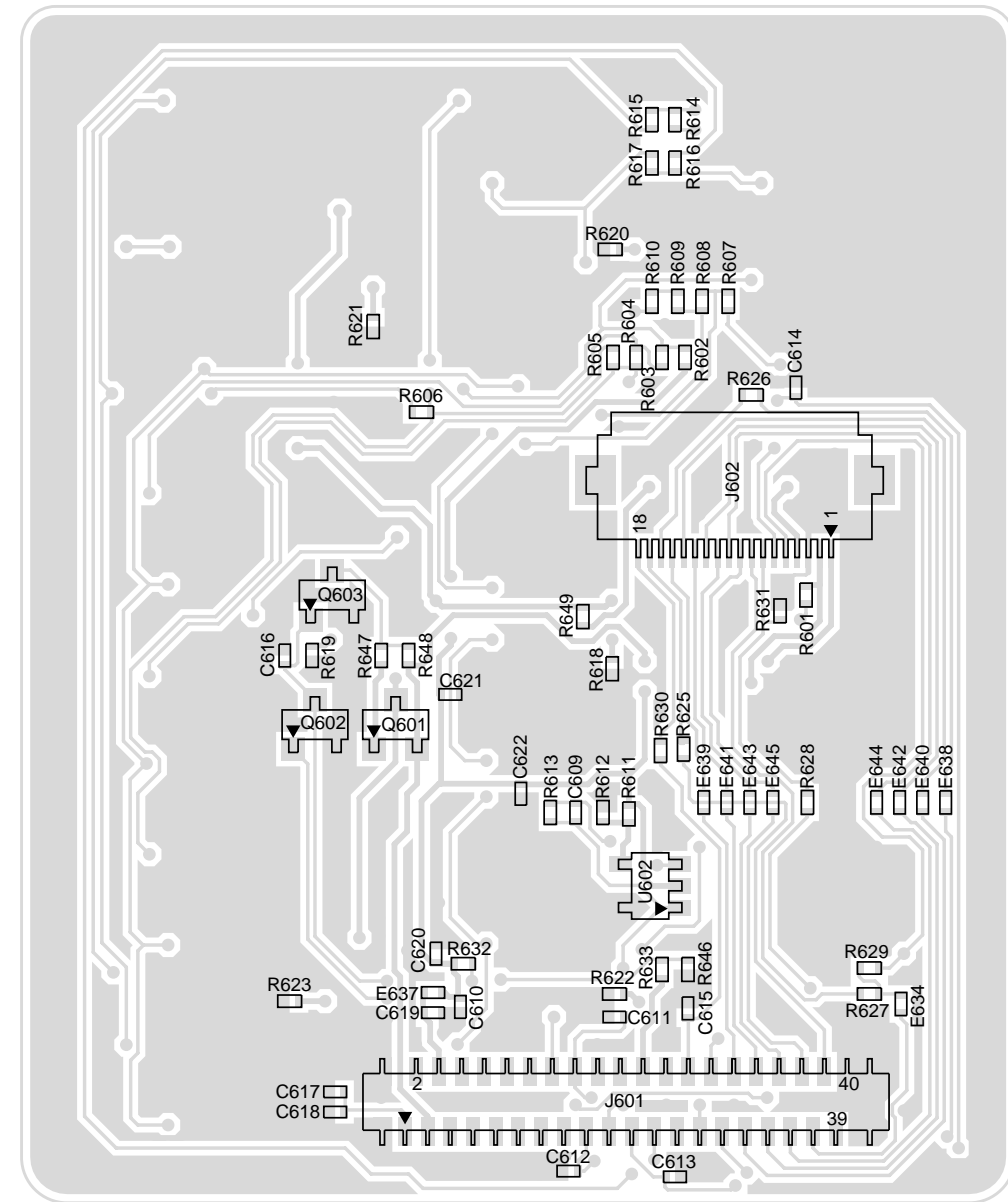


### 4.0 Keypad Board And Schematic Diagram



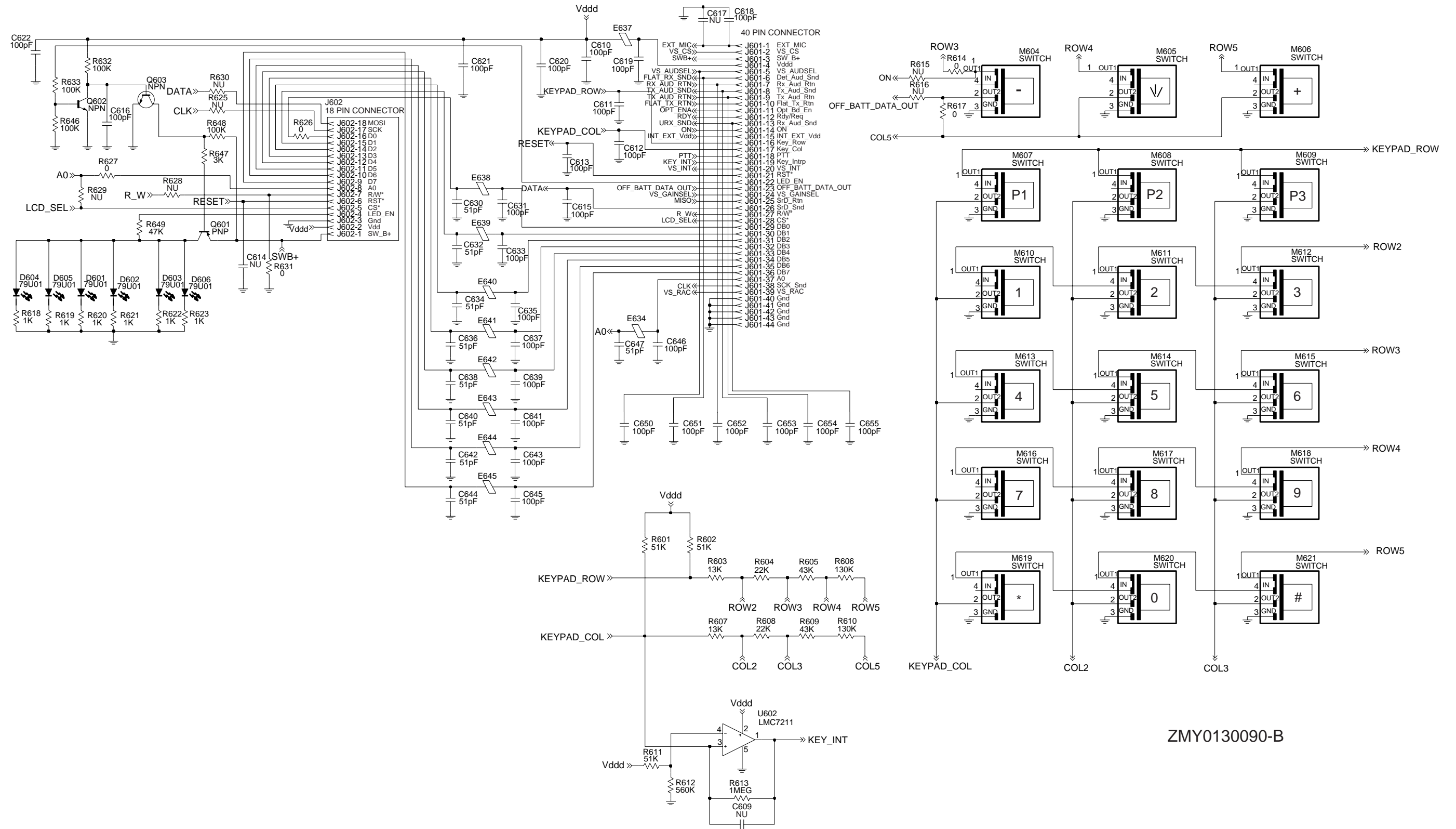
ZMY0130489-O

Top View



ZMY0130490-O

Bottom View



ZMY0130090-B

Keypad Board Schematic Diagram

## Section 6A

# MODEL CHART AND TEST SPECIFICATIONS (403-470 MHZ)

### 1.0 Model Chart

<b>GP Series, UHF, 403-470 MHz</b>				
<b>Model</b>		<b>Description</b>		
	AZH25RDC9AA2	GP328 403-470 MHz 4W 4 CH		
	AZH25RDC9AA3	GP328 403-470 MHz 4W		
	AZH25RDH9AA6	GP338 403-470 MHz 4W		
		<b>Item</b>	<b>Description</b>	
X		PMUE1563_	GP328 Super Tanapa 403-470 MHz 4W 4CH	
	X	PMUE1434_	GP328 Super Tanapa 403-470 MHz 4W	
		X	PMUE1407_	GP338 Super Tanapa 403-470 MHz 4W
X		PMUE1565_	GP328 Tanapa 403-470 MHz 4W 4CH	
	X	PMUE1448_	GP328 Tanapa 403-470 MHz 4W	
		X	PMUE1406_	GP338 Tanapa 403-470 MHz 4W
X		PMLE4171_	GP328 B/C Kit 403-470 MHz 4W 4CH	
	X	PMLE4130_	GP328 B/C Kit 403-470 MHz 4W	
		X	PMLE4109_	GP338 B/C Kit 403-470 MHz 4W
X		PMLN4348_	GP328 Front Housing Kit 4CH	
	X	PMLN4216_	GP328 Front Housing Kit	
		X	PMLN4199_	GP338 Front Housing Kit
X	X	X	NAE6483_	UHF 16 cm Monopole (Whip) antenna (403-520 MHz)
X	X	X	PMAE4002_	UHF 9 cm antenna (403-433 MHz)
X	X	X	PMAE4003_	UHF 9 cm antenna (430-470 MHz)
X	X		6804110J54	GP328 User Guide
		X	6804110J55	GP338 User Guide

x = Indicates one of each is required.

<b>GP Series, UHF, 403-470 MHz</b>					
<b>Model</b>				<b>Description</b>	
AZH25RDC9AA3 with option AZQ203AE				GP328 403-470 MHz 4W (w/o keypad, camouflage)	
AZH25RDC9AA3 with option AZH64AH				GP328 403-470 MHz 4W (w/o keypad, yellow)	
AZH25RDH9AA6 with option AZQ203AG				GP338 403-470 MHz 4W (keypad, camouflage)	
AZH25RDH9AA6 with option AZH64AJ				GP338 403-470 MHz 4W (keypad, yellow)	
<b>Item</b>				<b>Description</b>	
X				PMUE1923_	GP328 Super Tanapa 403-470 MHz 4W
	X			PMUE1919_	GP328 Super Tanapa 403-470 MHz 4W
		X		PMUE1927_	GP338 Super Tanapa 403-470 MHz 4W
			X	PMUE1921_	GP338 Super Tanapa 403-470 MHz 4W
X				PMUE1924_	GP328 Tanapa 403-470 MHz 4W
	X			PMUE1920_	GP328 Tanapa 403-470 MHz 4W
		X		PMUE1928_	GP338 Tanapa 403-470 MHz 4W
			X	PMUE1922_	GP338 Tanapa 403-470 MHz 4W
X	X			PMLE4130_	GP328 B/C Kit 403-470 MHz 4W
		X	X	PMLE4109_	GP338 B/C Kit 403-470 MHz 4W
X				PMLN4539_	GP328 Front Housing Kit
	X			PMLN4544_	GP328 Front Housing Kit
		X		PMLN4538_	GP338 Front Housing Kit
			X	PMLN4545_	GP338 Front Housing Kit
X	X	X	X	NAE6483_	UHF 16 cm Monopole (Whip) antenna (403-520 MHz)
X	X	X	X	PMAE4002_	UHF 9 cm antenna (403-433 MHz)
X	X	X	X	PMAE4003_	UHF 9 cm antenna (430-470 MHz)
X	X			6804110J54	GP328 User Guide
		X	X	6804110J55	GP338 User Guide

x = Indicates one of each is required.



## 2.0 Specifications

### General

	UHF	
Frequency:	403-470 MHz	
Channel Capacity:	GP328 : 4/16 Channels GP338 : 128 Channels	
Power Supply:	7.5 Volts $\pm$ 20%	
Dimensions with Standard High Capacity NiMH Battery:	137mm x 57.5mm x 37.5mm	
with Ultra High Capacity NiMH Bat- tery:	137mm x 57.5mm x 40mm	
Weight: with Standard High Capacity NiMH Battery:	420 g	
with Ultra High Capacity NiMH Bat- tery:	500 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity NiMH Bat- tery:	Low Pow- er	High Pow- er
Ultra High Capac- ity NiMH Battery:	>11 hrs	>8 hrs
	>14 hrs	>11 hrs
Sealing:	Passes rain testing per IP54	
Shock:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Vibration:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Dust:	Meets MIL-STD-810- C,D & E and IP54	
Humidity:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
FCC ID	AZ489FT4826	

### Transmitter

	UHF	
RF Output NiMH @ 7.5V:	Low 1W	High 4W
Frequency	403-470 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre- Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

### Receiver

	UHF 12.5kHz	UHF 20/ 25kHz
Frequency:	403- 470MHz	403- 470MHz
Sensitivity 12dB EIA SINAD:	0.35 $\mu$ V	0.35 $\mu$ V
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

### 3.0 Transmitter

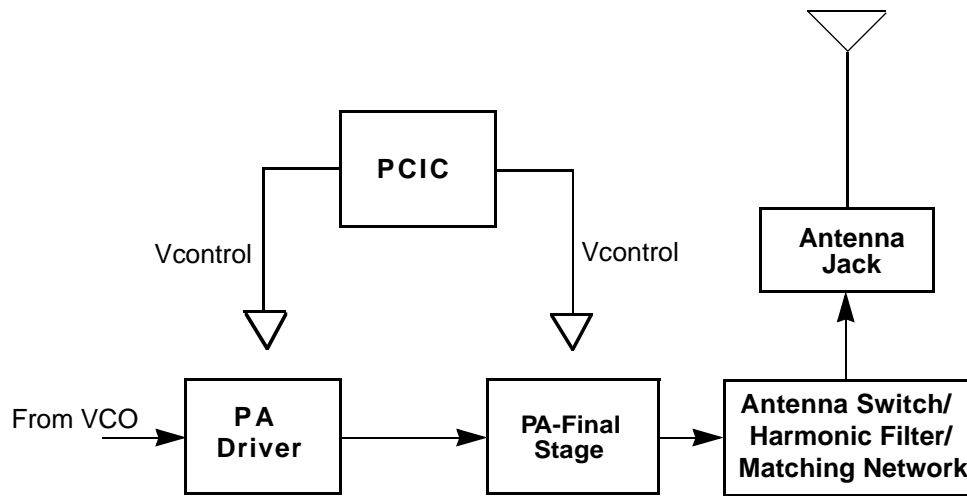


Figure 6-1: Transmitter Block Diagram

#### 3.1 General

(Refer to Figure 6-1)

The UHF transmitter contains five basic circuits:

1. power amplifier
2. antenna switch
3. harmonic filter
4. antenna matching network
5. power control integrated circuit (PCIC).

##### 3.1.1 Power Amplifier

The power amplifier consists of two devices:

1. 9Z67 LDMOS driver IC (U101) and
2. PRF1507 LDMOS PA (Q110).

The 9Z67 LDMOS driver IC contains a 2 stage amplification with a supply voltage of 7.3V.

This RF power amplifier is capable of supplying an output power of 0.3W (pin 6 and 7) with an input signal of 2mW (3dBm) (pin16). The current drain would typically be 160mA while operating in the frequency range of 403-470MHz.

The PRF1507 LDMOS PA is capable of supplying an output power of 7W with an input signal of 0.3W. The current drain would typically be 1300mA while operating in the frequency range of 403-470MHz. The power output can be varied by changing the biasing voltage.

### 3.1.2 Antenna Switch

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C107, L104 and C106), and two current limiting resistors (R101, R170). In the transmit mode, B+ at PCIC (U102) pin 23 will go low and turn on Q111 where a B+ bias is applied to the antenna switch circuit to bias the diodes "on". The shunt diode (CR102) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, and hence, there exists a low attenuation path between the antenna and receiver ports.

### 3.1.3 Harmonic Filter

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

### 3.1.4 Antenna Matching Network

A matching network which is made up of L116 is used to match the antenna's impedance to the harmonic filter. This will optimize the performance of the transmitter and receiver into an antenna.

### 3.1.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the Power Control IC (PCIC), U102 to regulate the power output of the radio. The current to the final stage of the power module is supplied through R101, which provides a voltage proportional to the current drain. This voltage is then fed back to the Automatic Level Control (ALC) within the PCIC to regulate the output power of the transmitter.

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

There are resistors and integrators within the PCIC, and external capacitors (C133, C134 and C135) in controlling the transmitter rising and falling time. These are necessary in reducing the power splatter into adjacent channels.

CR105 and its associated components are part of the temperature cut back circuitry. It senses the printed circuit board temperature around the transmitter circuits and output a DC voltage to the PCIC. If the DC voltage produced exceeds the set threshold in the PCIC, the transmitter output power will be reduced so as to reduce the transmitter temperature.

## 4.0 Receiver

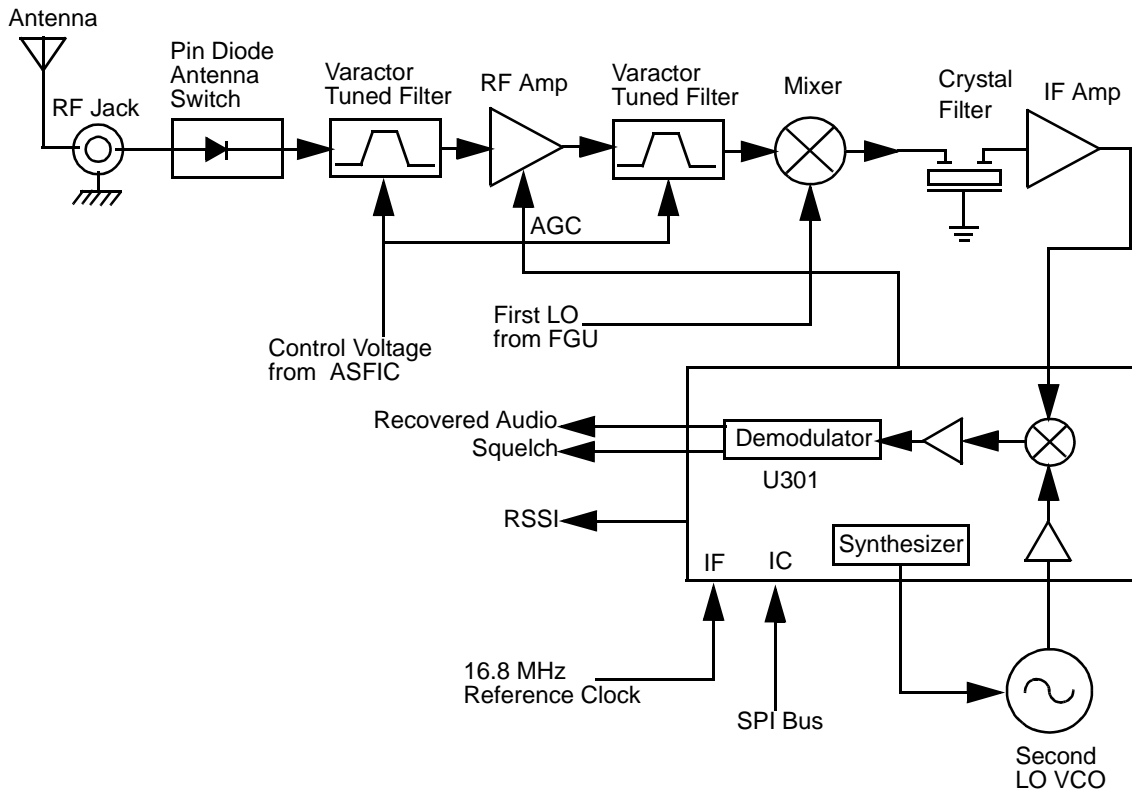


Figure 6-2: UHF Receiver Block Diagram

### 4.1 Receiver Front-End

(Refer to *UHF Receiver Front End Schematic Diagram* on page 6A-18 and *UHF Transmitter Schematic Diagram* on page 6A-22)

The RF signal is received by the antenna and applied to a low-pass filter. For UHF, the filter consists of L101, L102, C102, C103, C104. The filtered RF signal is passed through the antenna switch. The antenna switch circuit consists of two PIN diodes (CR101 and CR102) and a pi network (C106, L104 and C107). The signal is then applied to a varactor tuned bandpass filter. The UHF bandpass filter comprises of L301, L302, C302, C303, C304, CR301 and CR302. The bandpass filter is tuned by applying a control voltage to the varactor diodes (CR301 and CR302) in the filter.

The bandpass filter is electronically tuned by the DACRx from IC404 which is controlled by the microprocessor. Depending on the carrier frequency, the DACRx will supply the tuned voltage to the varactor diodes in the filter. Wideband operation of the filter is achieved by shifting the bandpass filter across the band.

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

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

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

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

## 4.2 Receiver Back-End

(Refer to *UHF Receiver Back End Schematic Diagram* on page 6A-19)

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

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

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

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

The IF IC (U301) also performs several other functions. It provides a received signal-strength indicator (RSSI) and a squelch output. The RSSI is a dc voltage monitored by the microprocessor, and used as a peak indicator during the bench tuning of the receiver front-end varactor filter. The RSSI voltage is also used to control the automatic gain control (AGC) circuit at the front-end.

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

### 4.3 Automatic Gain Control Circuit

(Refer to *UHF Receiver Front End Schematic Diagram* on page 6A-18)

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

Radio signal strength indicator, RSSI, a voltage signal, is used to drive Q315 to saturation hence turning it on. RSSI is produced by U301 and is proportional to the gain of the RF amplifier and the input RF signal power to the radio.

Resistor network at the input to the base of Q315 is scaled to turn on Q315, hence activating the AGC, at certain RSSI levels. In order to turn on Q315, the voltage across the transistor's base to ground must be greater or equal to the voltage across R319, plus the base-emitter voltage ( $V_{be}$ ) present at Q315. The resistor network with thermistor RT300 is capable of providing temperature compensation to the AGC circuit, as RSSI generated by U301 is lower at cold temperatures compared to normal operation at room temperature. Resistor R300 and capacitor C397 form an R-C network used to dampen any transient instability while the AGC is turning on.

## 5.0 Frequency Generation Circuitry

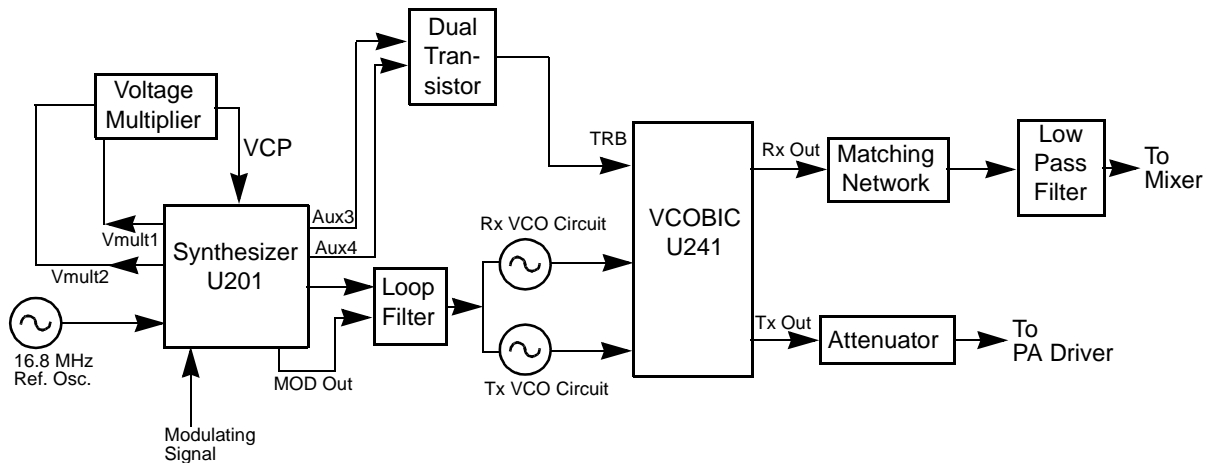


Figure 6-3: Frequency Generation Unit Block Diagram

The Frequency Generation Circuitry is composed of two main ICs, the Fractional-N synthesizer (U201), and the VCO/Buffer IC (U241). Designed in conjunction to maximize compatibility, the two ICs provide many of the functions that normally would require additional circuitry. The synthesizer block diagram illustrates the interconnect and support circuitry used in the region. Refer to the relevant schematics for the reference designators.

The synthesizer is powered by regulated 5V and 3.3V which come from U247 and U248 respectively. The synthesizer in turn generates a superfiltered 4.5V which powers U241.

In addition to the VCO, the synthesizer must interface with the logic and ASFIC circuitry.

Programming for the synthesizer is accomplished through the data, clock and chip select lines from the microprocessor. A 3.3V dc signal from synthesizer lock detect line indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFIC is supplied to pin10 of U201. Internally the audio is digitized by the Fractional-N and applied to the loop divider to provide the low-port modulation. The audio runs through an internal attenuator for modulation balancing purposes before going out to the VCO.

### 5.1 Synthesizer

(Refer to *UHF Synthesizer Schematic Diagram* on page 6A-20)

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

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

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

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

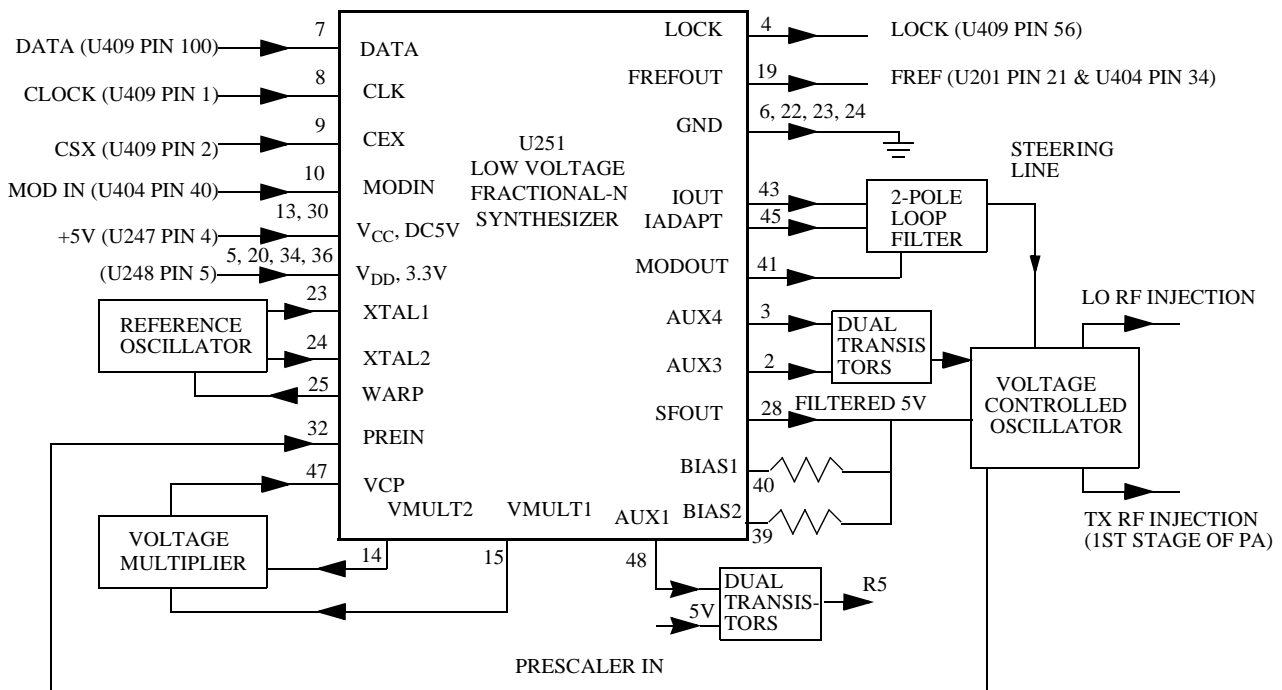
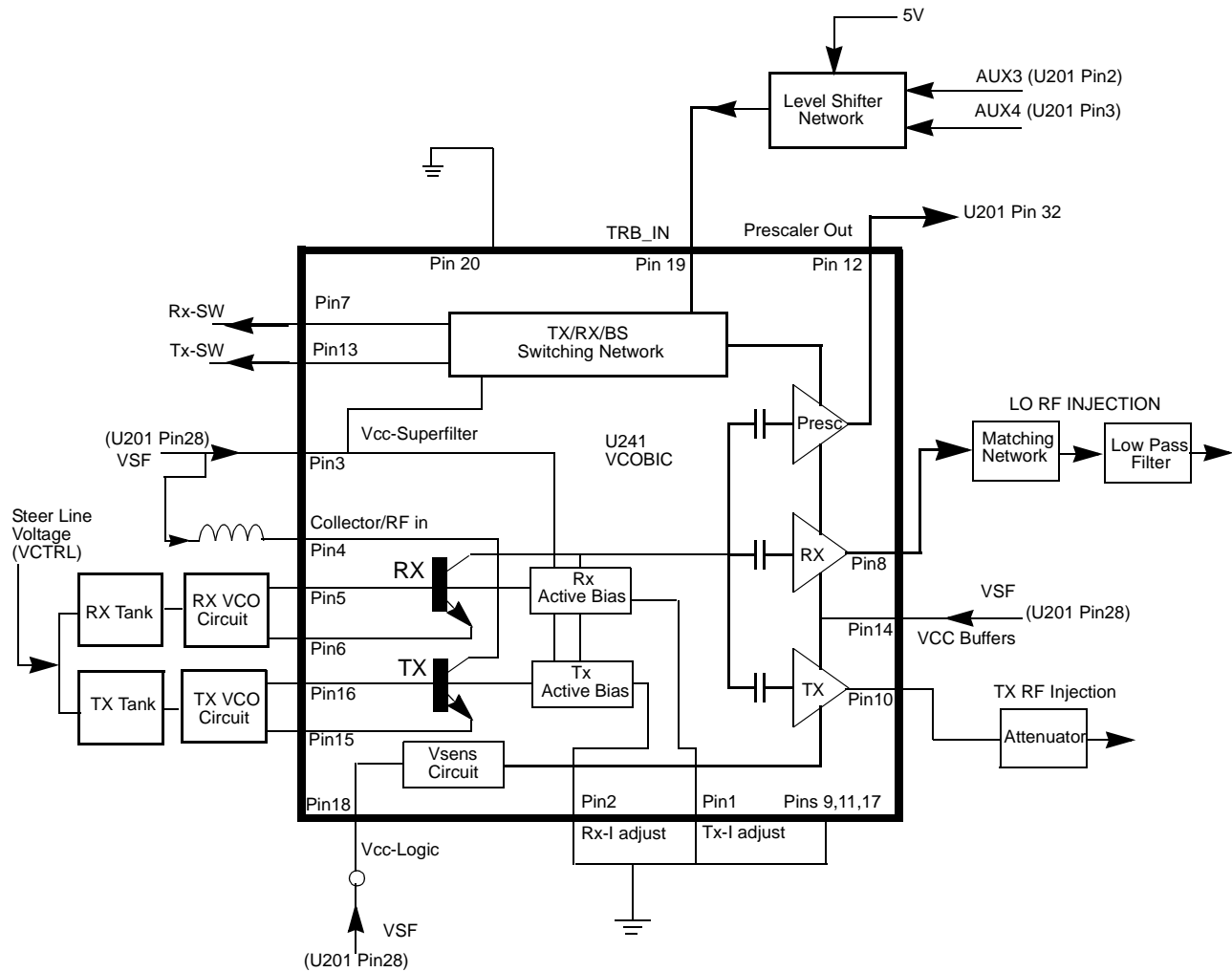


Figure 6-4 Synthesizer Block Diagram



## 5.2 VCO - Voltage Controlled Oscillator

(Refer to *UHF Voltage Controlled Oscillator Schematic Diagram* on page 6A-21)



**Figure 6-5 VCO Block Diagram**

The VCOBIC (U241) in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U241 pin 19) determines which oscillator and buffer will be enabled. A sample of the RF signal from the enabled oscillator is routed from U241 pin 12, through a low pass filter, to the prescaler input (U201 pin 32). After frequency comparison in the synthesizer, a resultant CONTROL VOLTAGE is received at the VCO. This voltage is a DC voltage between 3.5V and 9.5V when the PLL is locked on frequency.

The VCOBIC(U241) is operated at 4.54 V (VSF) and Fractional-N synthesizer (U201) at 3.3V. This difference in operating voltage requires a level shifter consisting of Q260 and Q261 on the TRB line. The operation logic is shown in Table 6-1.

*Table 6-1: Level Shifter Logic*

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

In the receive mode, U241 pin 19 is low or grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U241. The RF signal at U241 pin 8 is run through a matching network. The resulting RF signal is the LO RF INJECTION and it is applied to the mixer at T302 (refer to *UHF Receiver Front End Schematic Diagram* on page 6A-18).

During the transmit condition, when PTT is depressed, five volts is applied to U241 pin 19. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U241. The RF signal at U241 pin 10 is injected into the input of the PA module (U101 pin16). This RF signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received through the U201 pin 41.

When a high impedance is applied to U241 pin19, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive transmit and prescaler buffer are turned off.

## 6.0 Notes For All Schematics and Circuit Boards

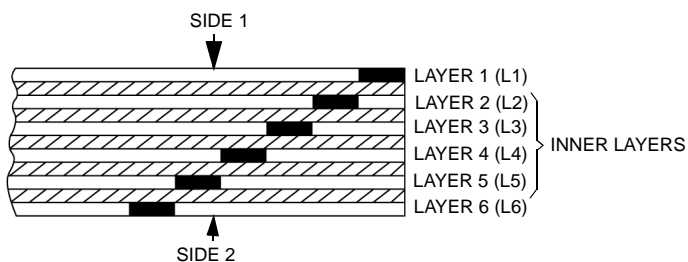
\* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

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

100 Series	=	Transmitter
200 Series	=	Frequency Generation
300 Series	=	Receiver
400/500 Series	=	Controller
600 Series	=	Keypad Board
4. Interconnect Tie Point Legend:
 

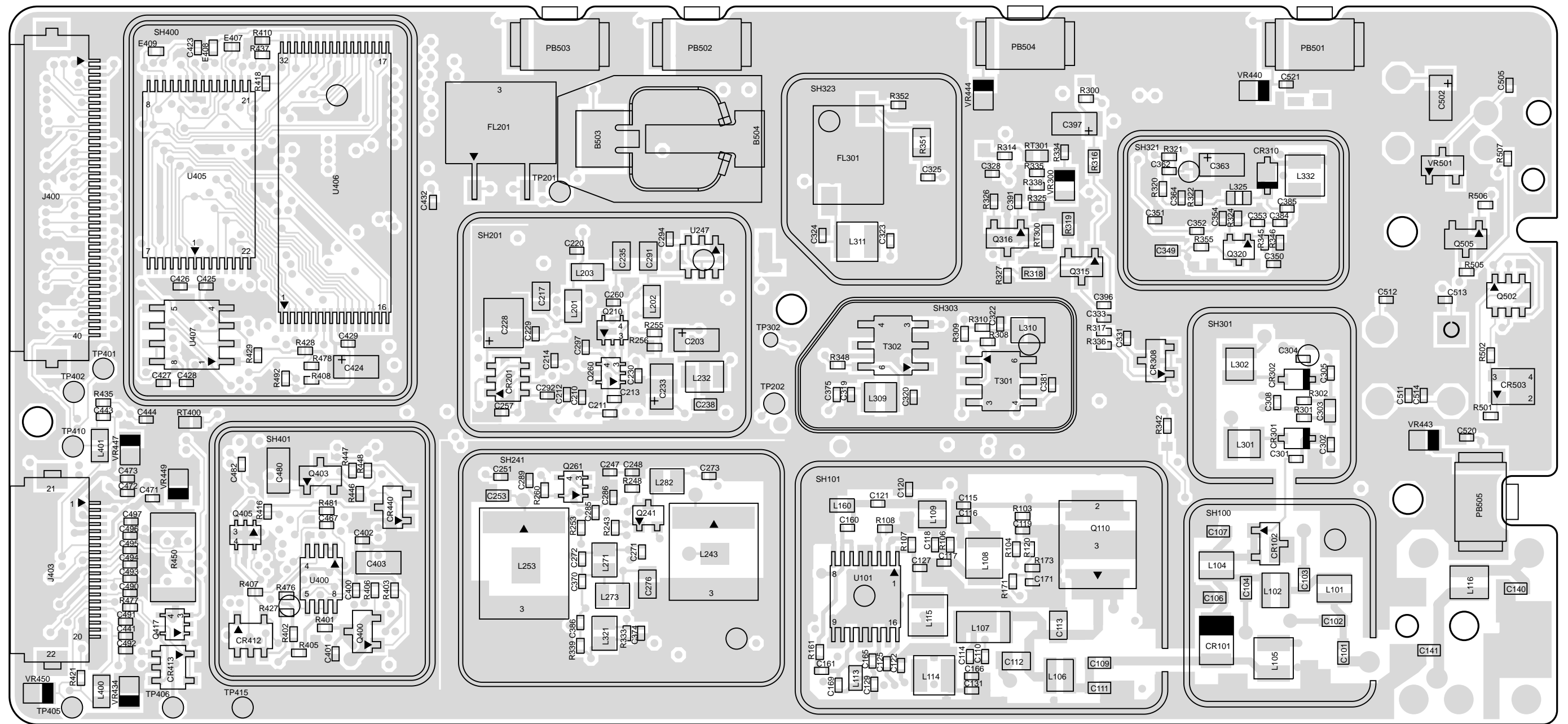
UNSWB+	=	Unswitch Battery Voltage (7.5V)
SWB+	=	Switch Battery Voltage (7.5V)
R5	=	Receiver Five Volts
CLK	=	Clock
Vdda	=	Regulated 3.3 Volts (for analog)
Vddd	=	Regulated 3.3 Volts (for digital)
CSX	=	Chip Select Line (not for LVZIF)
SYN	=	Synthesizer
DACRX	=	Digital to Analog Voltage (For Receiver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

### 6-LAYER CIRCUIT BOARD DETAIL VIEWING COPPER STEPS IN PROPER LAYER SEQUENCE

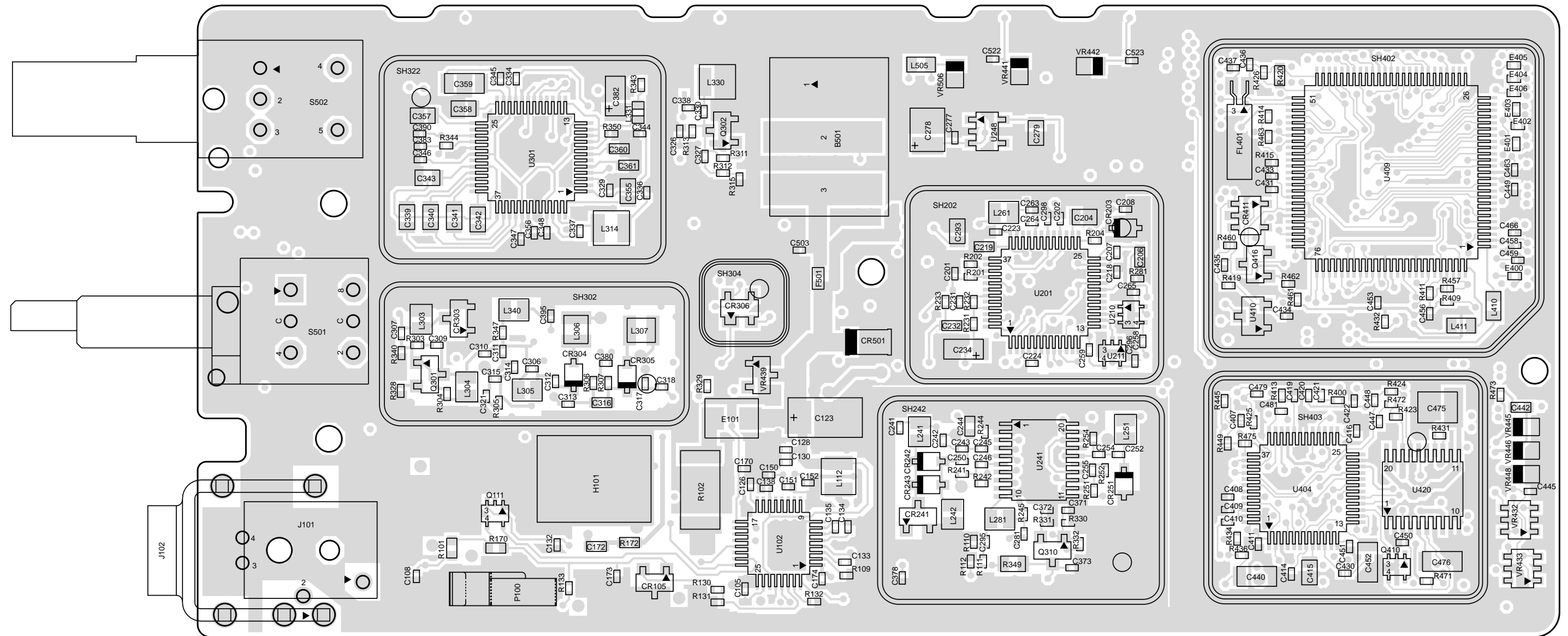




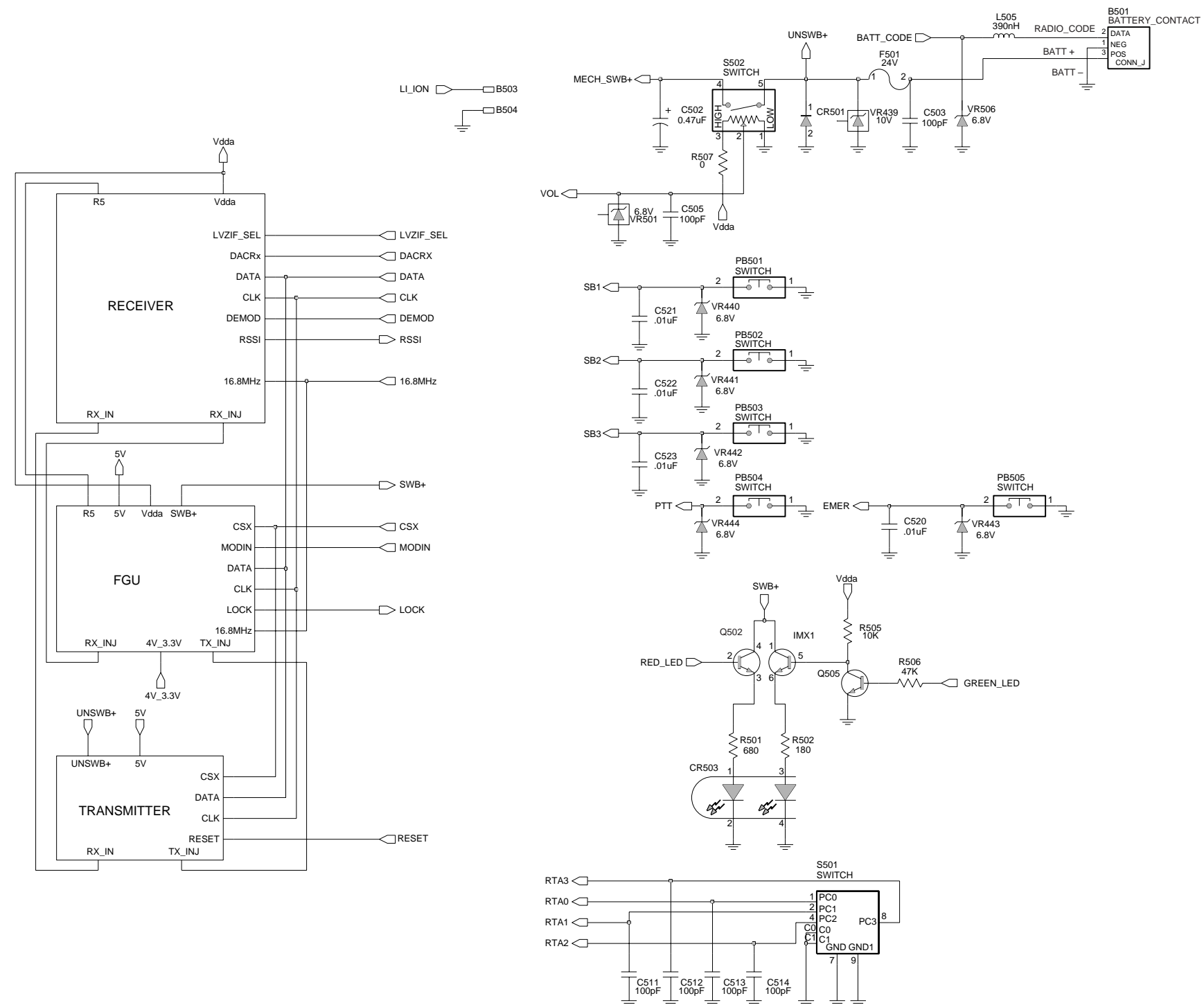
**7.0 Circuit Board/Schematic Diagrams and Parts List**



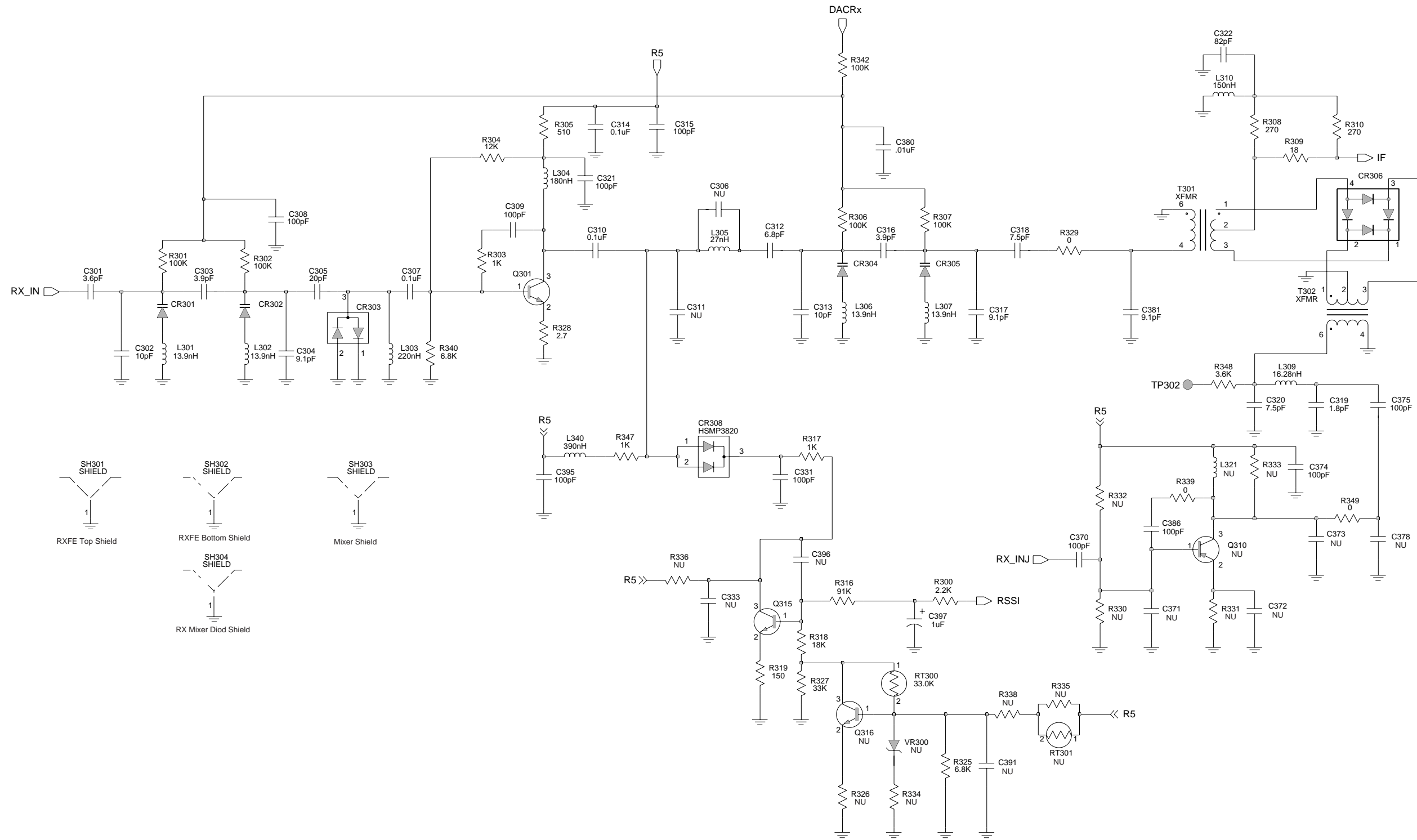
**UHF (403-470MHz) Main Board Top Side PCB No. 8480450Z03**



UHF (403-470MHz) Main Board Bottom Side PCB No. 8480450Z03

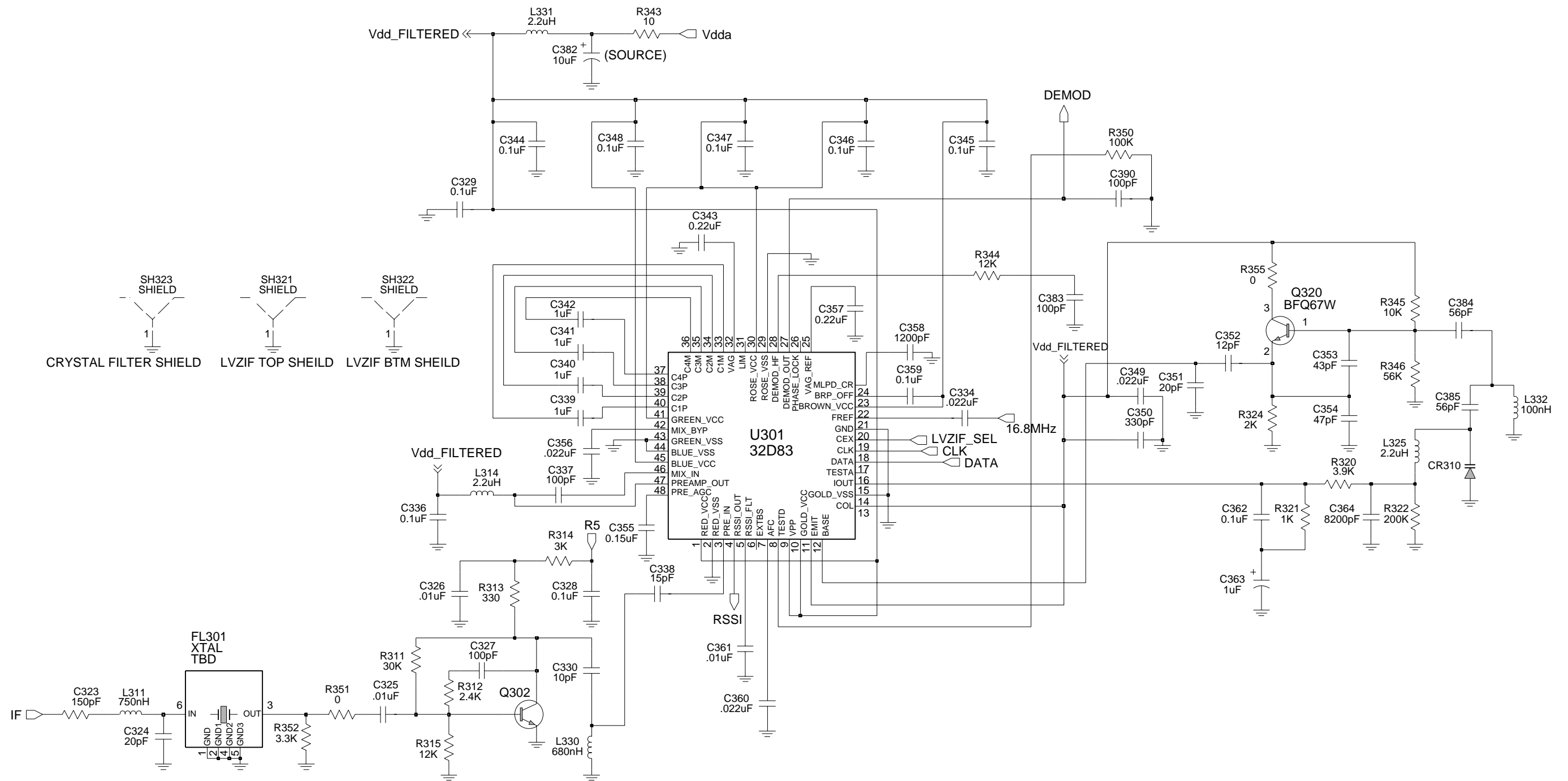


UHF Controls And Switches Schematic Diagram

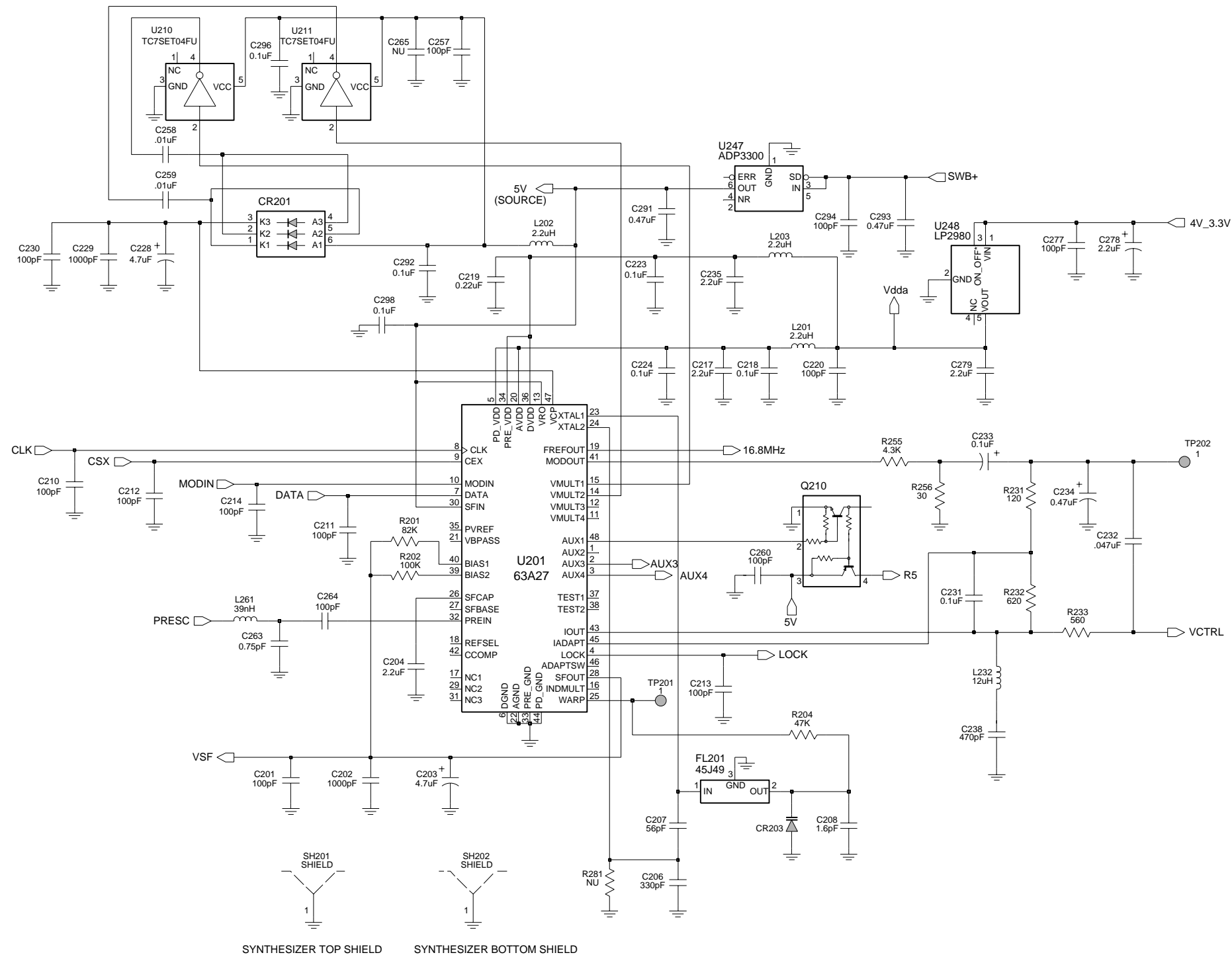


UHF Receiver Front End Schematic Diagram

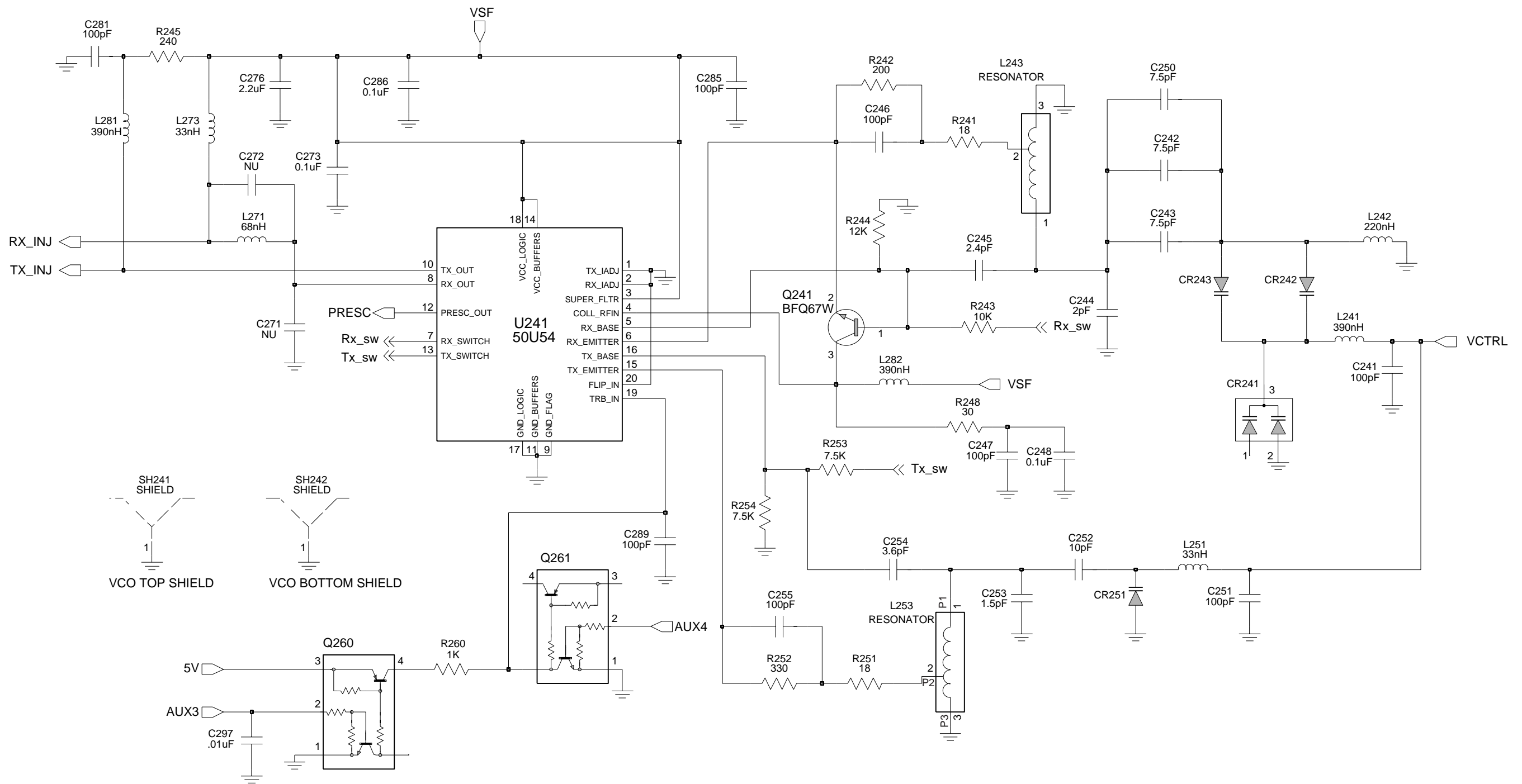




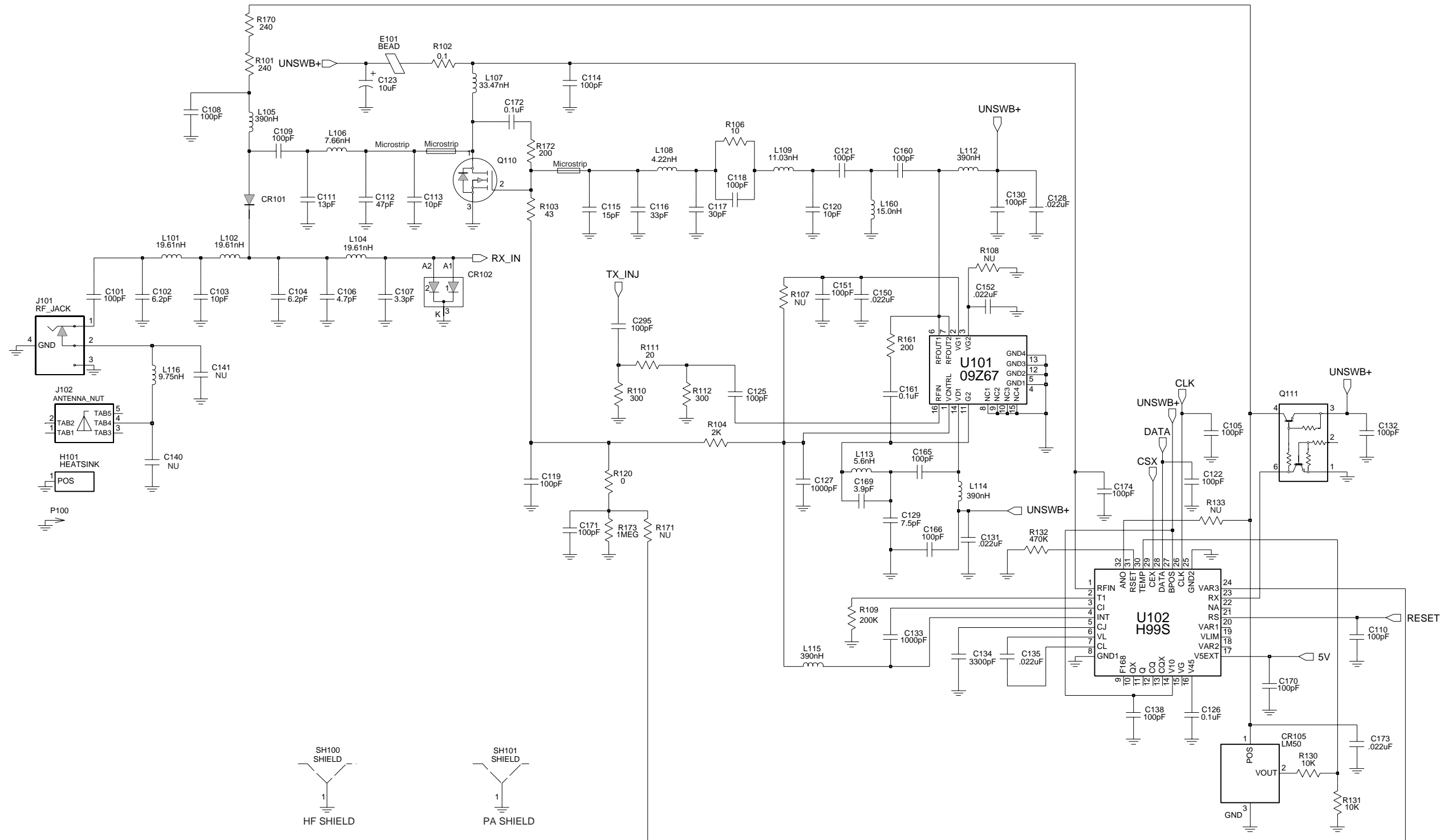
UHF Receiver Back End Schematic Diagram



**UHF Synthesizer Schematic Diagram**



**UHF Voltage Controlled Oscillator Schematic Diagram**



UHF Transmitter Schematic Diagram

## UHF Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Battery Contact Module
B503	3980502Z01	Backup Contact, B+ (not used in GP328)
B504	3980501Z01	Backup Contact, B- (not used in GP328)
C101	2113740F51	100pF
C102	2113740F22	6.2pF
C103	2113740F27	10pF
C104	2113740F22	6.2pF
C105	2113743N50	100pF
C106	2113740F19	4.7pF
C107	2113740F15	3.3pF
C108	2113743N50	100pF
C109	2113740F51	100pF
C110	2113743N50	100pF
C111	2113740F30	13pF
C112	2180605Z32	47pF
C113	2180605Z16	10pF
C114	2113743N50	100pF
C115	2113743N30	15pF
C116	2113743N38	33pF
C117	2113743N37	30pF
C118	2113743N50	100pF
C119	2113743N50	100pF
C120	2113743N26	10pF
C121	2113743N50	100pF
C122	2113743N50	100pF
C123	2311049A18	10uF
C125	2113743N50	100pF
C126	2113743M24	100000pF
C127	2113743L17	1000pF
C128	2113743M08	22000pF
C129	2113743N23	7.5pF
C130	2113743N50	100pF
C131	2113743M08	22000pF
C132	2113743N50	100pF
C133	2113743L17	1000pF
C134	0662057N47	1M
C135	2113743M08	22000pF
C138	2113743N50	100pF
C150	2113743M08	22000pF
C151	2113743N50	100pF
C152	2113743M08	22000pF
C160	2113743N50	100pF
C161	2113743M24	100000pF
C165	2113743N50	100pF
C166	2113743N50	100pF
C169	2113743N20	5.6pF
C170	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C171	2113743N50	100pF
C172	2113740F51	100pF
C173	2113743M08	22000pF
C174	2113743N50	100pF
C201	2113743N50	100pF
C202	2113743L17	1000pF
C203	2311049A56	4.7uF
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N44	56pF
C208	2113743N08	1.6pF
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C217	2104993J02	2.2uF
C218	2113743M24	100000pF
C219	2113743K16	0.22uF
C220	2113743N50	100pF
C223	2113743M24	100000pF
C224	2113743M24	100000pF
C228	2311049J11	4.7uF
C229	2113743L17	1000pF
C230	2113743N50	100pF
C231	2113743M24	100000pF
C232	2113743E12	0.047uF
C233	2311049A01	0.1uF
C234	2311049A05	0.47uF
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N23	7.5pF
C243	2113743N23	7.5pF
C244	2113740F10	2.0pF
C245	2113743N11	2.4pF
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	100000pF
C250	2113743N23	7.5pF
C251	2113743N50	100pF
C252	2113743N26	10pF
C253	2113740F09	1.8pF
C254	2113743N15	3.6pF
C255	2113743N50	100pF
C257	2113743N50	100pF
C258	2113743L41	10000pF
C259	2113743L41	10000pF
C260	2113743N50	100pF
C263	2113743N02	0.75pF
C264	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C273	2113743M24	100000pF
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A57	10uF
C279	2104993J02	2.2uF
C281	2113743N50	100pF
C285	2113743N50	100pF
C286	2113743M24	100000pF
C289	2113743N50	100pF
C291	2311049A69	10uF
C292	2113743M24	100000pF
C293	2113743A27	0.47uF
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	100000pF
C297	2113743L41	10000pF
C298	2113743M24	100000pF
C301	2113743N15	3.6pF
C302	2113743N26	10pF
C303	2113740L08	3.9pF
C304	2113743N26	10pF
C305	2113743N33	20pF
C307	2113743M24	100000pF
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	100000pF
C312	2113743N25	9.1pF
C313	2113743N26	10pF
C314	2113743M24	100000pF
C315	2113743N50	100pF
C316	2113740L08	3.9pF
C317	2113743N25	9.1pF
C318	2113743N23	7.5pF
C319	2113743N69	1.8pF
C320	2113743N23	7.5pF
C321	2113743N50	100pF
C322	2113743N48	82pF
C323	2113743N54	150pF
C324	2113743N33	20pF
C325	2113743L41	10000pF
C326	2113743L41	10000pF
C327	2113743N50	100pF
C328	2113743M24	100000pF
C329	2113743M24	100000pF
C330	2113743N26	10pF
C331	2113743N50	100pF
C334	2113743M08	22000pF
C336	2113743M24	100000pF
C337	2113743N50	100pF
C338	2113743N30	15pF
C339	2180478Z20	1uF

Circuit Ref	Motorola Part No.	Description
C340	2180478Z20	1uF
C341	2180478Z20	1uF
C342	2180478Z20	1uF
C343	2113743A23	0.22uF
C344	2113743M24	100000pF
C345	2113743M24	100000pF
C346	2113743M24	100000pF
C347	2113743M24	100000pF
C348	2113743M24	100000pF
C349	2113743E07	0.022uF
C350	2113743L05	330pF
C351	2113743N33	20pF
C352	2113743N28	12pF
C353	2113743N41	43pF
C354	2113743N42	47pF
C355	2113743A24	0.33uF
C356	2113743M08	22000pF
C357	2113743A23	0.22uF
C358	2113741A23	1200pF
C359	2109720D14	0.1uF
C360	2113743E07	0.022uF
C361	2113741F49	10nF
C362	2113743M08	22000pF
C363	2311049A40	2.2uF
C364	2113743L41	10000pF
C370	2113743N50	100pF
C374	2113743N50	100pF
C375	2113743N50	100pF
C380	2113743L41	10000pF
C381	2113743N21	6.2pF
C382	2311049A59	10uF
C383	2113743N50	100pF
C384	2113743N44	56pF
C385	2113743N44	56pF
C386	2113743N50	100pF
C390	2113743N50	100pF
C395	2113743N50	100pF
C397	2311049A05	0.47uF
C400	2113743L41	10000pF
C401	2113743M24	100000pF
C402	2113743M24	100000pF
C403	2113743G24	2.2uF
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	100000pF
C410	2113928N01	0.1uF
C411	2113743M24	100000pF
C414	2113743M24	100000pF
C415	2185895Z01	0.01uF
C416	2113928N01	0.1uF
C420	2113743L41	10000pF

Circuit Ref	Motorola Part No.	Description
C421	2113928N01	0.1uF
C422	2113743M24	10000pF
C423	2113743N50	100pF
C424	2311049A59	10uF
C425	2113743M24	10000pF
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	10000pF
C429	2113743M24	10000pF
C430	2113928N01	0.1uF
C431	2113743N50	100pF
C433	2113743L41	10000pF
C434	2113928N01	0.1uF (not used in GP328)
C435	2113743M24	10000pF
C436	2113743N34	22pF (not used in GP328)
C437	2113743N34	22pF (not used in GP328)
C440	2113743G26	4.7uF
C441	2113743N50	100pF
C442	2113743E20	10uF
C443	2113928N01	0.1uF
C444	2113743N50	100pF
C445	2113743N50	100pF
C447	2113743M08	22000pF
C448	2113928N01	0.1uF
C449	2113743N50	100pF
C451	2113743M08	22000pF
C452	2113743B29	1uF
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF
C471	2113743N50	100pF
C472	2113743L09	470pF
C473	2113743L09	470pF
C475	2113743H14	10uF
C476	2113928D08	10uF
C479	2113928N01	0.1uF
C480	2113743G26	4.7uF
C481	2113928N01	0.1uF
C482	2113928N01	0.1uF
C490	2113743N50	100pF
C491	2113743N50	100pF
C492	2113743N50	100pF
C493	2113743N50	100pF
C494	2113743N50	100pF
C495	2113743N50	100pF
C496	2113743N50	100pF
C497	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C502	2311049A05	0.47uF
C503	2113743N50	100pF
C505	2113743N50	100pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C520	2113743L41	10000pF
C521	2113743L41	10000pF
C522	2113743L41	10000pF
C523	2113743L41	10000pF
CR101	4880973Z02	Pin diode
CR102	4802245J41	Pin diode
CR105	5185963A15	Temperature Sensor
CR201	4802233J09	Triple diode (SOT 25)
CR203	4862824C03	Varactor
CR241	4805649Q13	Varactor
CR242	4862824C08	Varactor
CR243	4862824C08	Varactor
CR251	4802245J22	Varactor
CR301	4862824C08	Varactor
CR302	4862824C08	Varactor
CR303	4880154K03	Dual common anode-cathode diode
CR304	4862824C08	Varactor
CR305	4862824C08	Varactor
CR306	4802245J42	Ring Quad diode (SOT-143)
CR308	4802245J41	Pin diode
CR310	4862824C08	Varactor
CR411	4802245J47	Schottky diode
CR412	4802245J47	Schottky diode
CR413	4802245J47	Schottky diode
CR440	4813833C02	Dual common cathode diode
CR501	4880107R01	Rectifier
CR503	4805729G49	Red/Yellow LED
E101	2484657R01	Ferrite bead
E400	2480640Z01	Ferrite bead
E401	2480640Z01	Ferrite bead
E402	2480640Z01	Ferrite bead
E403	2480640Z01	Ferrite bead
E404	2480640Z01	Ferrite bead
E405	2480640Z01	Ferrite bead
E406	2480640Z01	Ferrite bead
E407	2480640Z01	Ferrite bead
E408	2480640Z01	Ferrite bead
E409	2480640Z01	Ferrite bead
F501	6580542Z01	3A fuse
FL201	4802245J49	16.8MHz Xtal oscillator
FL301	4802245J43	Xtal Filter 45.1MHz
FL401	4870368G02	Real Time clock Osc Xtal (not used in GP328)

Circuit Ref	Motorola Part No.	Description
H101	2680499Z01	Heat spreader
J101	0985613Z01	RF Jack
J102	0280519Z02	Antenna nut
J400	0905505Y04	40-pin connector
J403	0905505Y02	20-pin connector
L101	2479990B02	19.61nH
L102	2479990B02	19.61nH
L104	2479990B02	19.61nH
L105	2462587N22	390nH
L106	2479990A02	7.66nH
L107	2479990G01	33.47nH
L108	2479990A01	4.22nH
L109	2479990B01	11.03nH
L112	2462587N45	22nH
L113	2413926H09	0.3nH
L114	2462587N22	390nH
L115	2462587N22	390nH
L116	2479990A03	9.75nH
L160	2413926H14	15nH
L201	2462587Q20	2200nH
L202	2462587Q20	2200nH
L203	2462587Q20	2200nH
L232	2462587P25	12000nH
L241	2462587V41	390nH
L242	2462587V38	220nH
L243	2460593C01	Multi-layered Teflon resonator, Rx
L251	2462587V28	33nH
L253	2460593C02	Multi-layered Teflon resonator, Tx
L261	2462587V29	39nH
L271	2462587V32	68nH
L273	2462587V28	33nH
L281	2462587V41	390nH
L282	2462587V41	390nH
L301	2479990C01	13.9nH
L302	2479990C01	13.9nH
L303	2462587V26	22nH
L304	2462587V37	180nH
L305	2462587V26	22nH
L306	2479990C01	13.9nH
L307	2479990C01	13.9nH
L309	2479990C02	16.28nH
L310	2462587V36	150nH
L311	2462587N65	750nH
L314	2462587N72	2200nH
L325	2480646Z20	2.2uH
L330	2462587N64	680nH
L331	2480646Z20	2.2uH
L332	2462587N53	100nH
L340	2462587V41	390nH

Circuit Ref	Motorola Part No.	Description
L400	2462587Q42	390nH
L401	2462587Q42	390nH
L410	2462587Q42	390nH
L411	2462587Q42	390nH
L505	2462587Q42	390nH
P100	3905643V01	Ground contact finger
PB501	4080523Z01	Tactile switch
PB502	4080523Z01	Tactile switch
PB503	4080523Z01	Tactile switch
PB504	4080523Z01	Tactile switch
PB505	4080523Z01	Tactile switch
Q110	4802245J55	RF Power amplifier
Q111	4802245J50	Dual NPN/PNP Transistor
Q210	4802245J50	Dual NPN/PNP Transistor
Q241	4805218N63	RF NPN transistor
Q260	4802245J50	Dual NPN/PNP Transistor
Q261	4802245J50	Dual NPN/PNP Transistor
Q301	4802245J44	NPN Transistor
Q302	4802245J44	NPN Transistor
Q315	4880214G02	NPN Transistor
Q320	4805218N63	RF NPN transistor
Q400	4809579E18	Mosfet P-chan
Q403	4880214G02	NPN Transistor
Q405	4802245J54	Dual NPN Transistor
Q410	4802245J54	Dual NPN Transistor
Q416	4809579E18	Mosfet P-chan (not used in GP328)
Q417	4802245J50	Dual NPN/PNP Transistor
Q502	5180159R01	Dual NPN Transistor
Q505	4880214G02	NPN Transistor
R101	0662057A34	240
R102	0680539Z01	0.1
R103	0662057M41	43
R104	0662057N15	47k
R106	0662057M26	10
R108	0662057M92	5600
R109	0662057N30	200k
R110	0662057M61	300
R111	0662057M33	20
R112	0662057M61	300
R120	0662057N14	43k
R130	0662057M98	10k
R131	0662057N05	18k
R132	0662057N33	270k
R161	0662057M57	200
R170	0662057A34	240
R171	0662057N14	43k
R172	0662057A32	200
R173	0662057N29	180k
R201	0662057N21	82k
R202	0662057N23	100k

Circuit Ref	Motorola Part No.	Description
R204	0662057N15	47k
R231	0662057M52	120
R232	0662057M69	620
R233	0662057M68	560
R241	0662057M32	18
R242	0662057M57	200
R243	0662057M98	10k
R244	0662057N01	12k
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M32	18
R252	0662057M62	330
R253	0662057M95	7500
R254	0662057M95	7500
R255	0662057M89	4300
R256	0662057M37	30
R260	0662057M74	1000
R300	0662057M82	2200
R301	0662057N23	100k
R302	0662057N23	100k
R303	0662057M74	1000
R304	0662057N01	12k
R305	0662057M67	0
R306	0662057N23	100k
R307	0662057N23	100k
R308	0662057M60	270
R309	0662057M32	18
R310	0662057M60	270
R311	0662057N10	30k
R312	0662057M83	2400
R313	0662057M62	330
R314	0662057M85	3000
R315	0662057N01	12k
R316	0662057A96	91k
R317	0662057M74	1000
R318	0662057A79	18k
R319	0662057A29	150
R320	0662057M74	1000
R321	0662057M83	2400
R322	0662057N30	200k
R324	0662057M81	2000
R325	0662057M94	6800
R327	0662057N11	33k
R328	0662057M12	2.7
R329	0662057M01	0
R339	0662057M01	0
R340	0662057M94	6800
R342	0662057N23	100k
R343	0662057M26	10
R344	0662057N01	12k
R345	0662057M98	10k

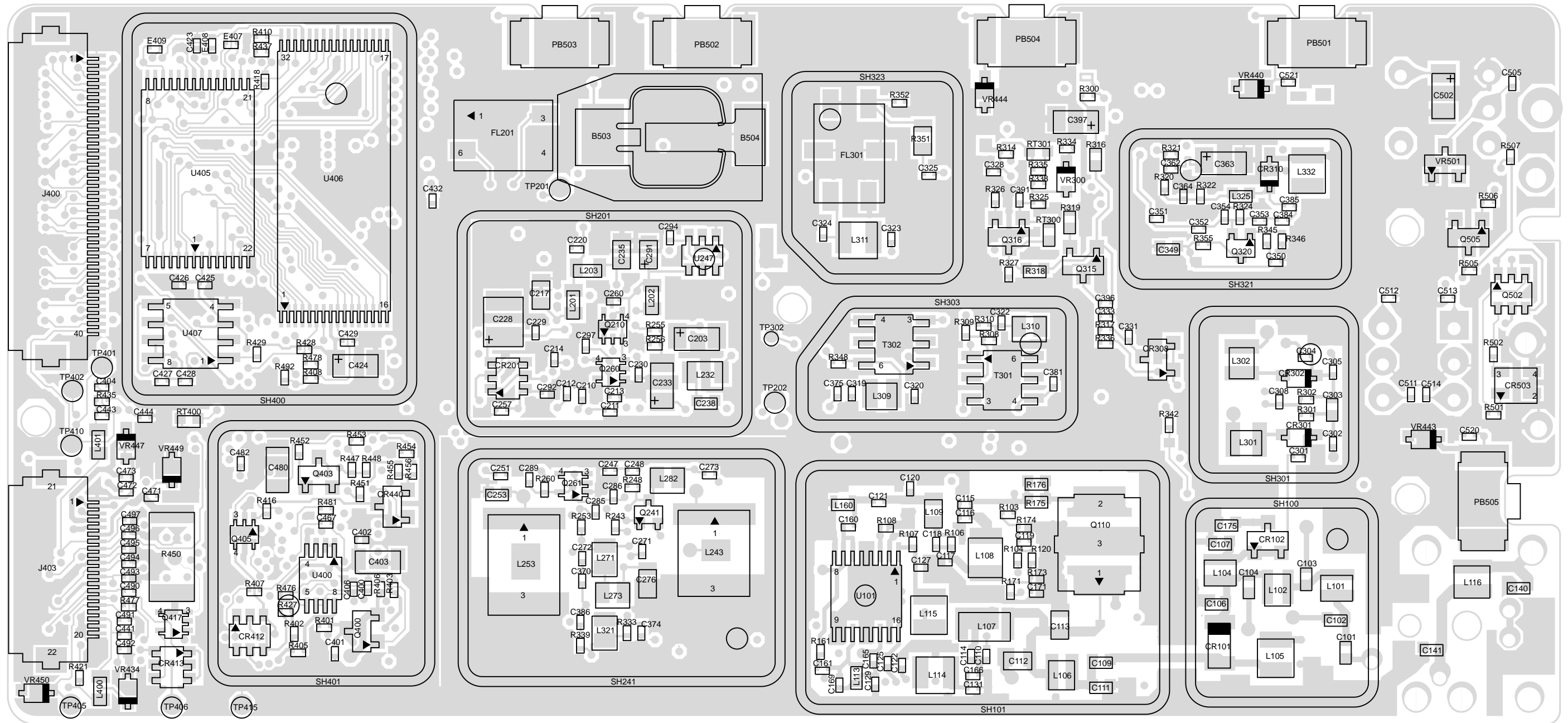
Circuit Ref	Motorola Part No.	Description
R346	0662057N17	56k
R347	0662057M74	1000
R348	0662057M87	3600
R349	0662057C01	0
R350	0662057N23	100k
R351	0662057C01	0
R352	0662057M86	3300
R355	0662057M01	0
R400	0662057N15	47k
R401	0662057M01	0
R405	0662057M01	0
R406	0662057N20	75k
R407	0662057N19	68k
R409	0662057M98	10k
R410	0662057N23	100k
R411	0662057M98	10k
R413	0662057M01	0
R414	0662057V34	180k
R415	0662057V26	91k
R416	0662057M90	4700
R418	0662057M01	0
R419	0662057M67	0 (not used in GP328)
R420	0662057B46	10M (not used in GP328)
R421	0662057M81	2000
R423	0662057N39	470k
R424	0662057N12	36k
R425	0662057N10	30k
R426	0662057N35	330k (not used in GP328)
R427	0662057M84	2700
R428	0662057M10	2.2
R429	0662057M98	10k
R431	0662057N39	470k
R432	0662057N16	51k
R434	0662057M62	330
R435	0662057M81	2000
R436	0662057M01	0
R445	0662057N08	24k
R446	0662057N22	91k
R447	0662057N38	430k
R448	0662057N06	20k
R449	0662057N08	24k
R450	0683962T45	68 ohms, 1W
R457	0662057M98	10k
R460	0662057M90	4700
R461	0662057M56	180 (not used in GP328)
R462	0662057M98	10k (not used in GP328)
R463	0662057M61	300
R471	0662057N06	20k
R472	0662057N12	36k
R473	0662057M26	10
R475	0662057M01	0

Circuit Ref	Motorola Part No.	Description
R476	0662057N35	330k
R477	0662057M74	1000
R478	0662057M98	10k
R481	0662057N08	24k
R492	0662057M01	0
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10k
R506	0662057N15	47k
R507	0662057M01	0
RT300	0680590Z01	THERMISTOR_33K
RT400	0680590Z01	THERMISTOR_33K
S501	4080710Z01	Frequency Switch
S502	1880619Z02	Volume/on-off switch
SH100	2680507Z01	Harmonic Filter shield
SH101	2680510Z01	RF PA shield
SH201	2680511Z01	Synthesizer top shield
SH202	2680511Z01	Synthesizer bottom shield
SH241	2680513Z01	Resonators shield
SH242	2680514Z01	VCO Buffer IC shield
SH301	2680554Z01	Receiver front end shield
SH302	2680555Z01	Receiver front end bottom shield
SH303	2680509Z01	Mixer shield
SH304	2680624Z01	Mixer diode shield
SH321	2680508Z01	LVZIF 2nd LO shield
SH322	2680514Z01	LVZIF shield
SH323	2680553Z01	Crystal Filter shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller on-off shield
SH402	2680515Z01	Microprocessor shield
SH403	2680516Z01	Asfic_Cmp/Audio PA shield
T301	2580541Z02	Balun transformer
T302	2580541Z02	Balun transformer
U101	5105109Z67	LDMOS driver IC
U102	5185765B28	PCIC
U201	5185963A27	LVFRACN Synthesizer IC
U210	5102463J61	Inverter
U211	5102463J61	Inverter
U241	5105750U54	VCO Buffer IC
U247	5105739X05	5V Regulator
U248	5102463J58	3.3V REGULATOR IN SOT23-5 PKG
U301	5109632D83	LVZIF IC
U400	5102463J40	3.3V Regulator
U404	5185963A53	Asfic_Cmp
U406	*5102463J59	128K X 8 FLASH ROM
U407	*5102463J64	16K X 8 EEPROM
U409	5102226J56	Microprocessor
U410	5102463J57	3.3V Regulator (not used in GP328)

Circuit Ref	Motorola Part No.	Description
U420	5102463J44	Audio amplifier
VR432	4805656W08	Zener diode-5.6V
VR433	4805656W08	Zener diode-5.6V
VR434	4802245J73	Zener diode-6.8V
VR439	4880140L17	Zener diode-12V
VR440	4802245J73	Zener diode-6.8V
VR441	4802245J73	Zener diode-6.8V
VR442	4802245J73	Zener diode-6.8V
VR443	4802245J73	Zener diode-6.8V
VR444	4802245J73	Zener diode-6.8V
VR445	4802245J53	Zener diode-10V
VR446	4802245J74	Zener diode-10V
VR447	4802245J74	Zener diode-10V
VR448	4802245J74	Zener diode-10V
VR449	4802245J74	Zener diode-10V
VR450	4802245J75	Zener diode-12V
VR501	4813830A18	Zener diode-6.8V
VR506	4802245J73	Zener diode-6.8V
	1485777Z01	Insulator
	8480450Z03	UHF Band 1 main PC Board

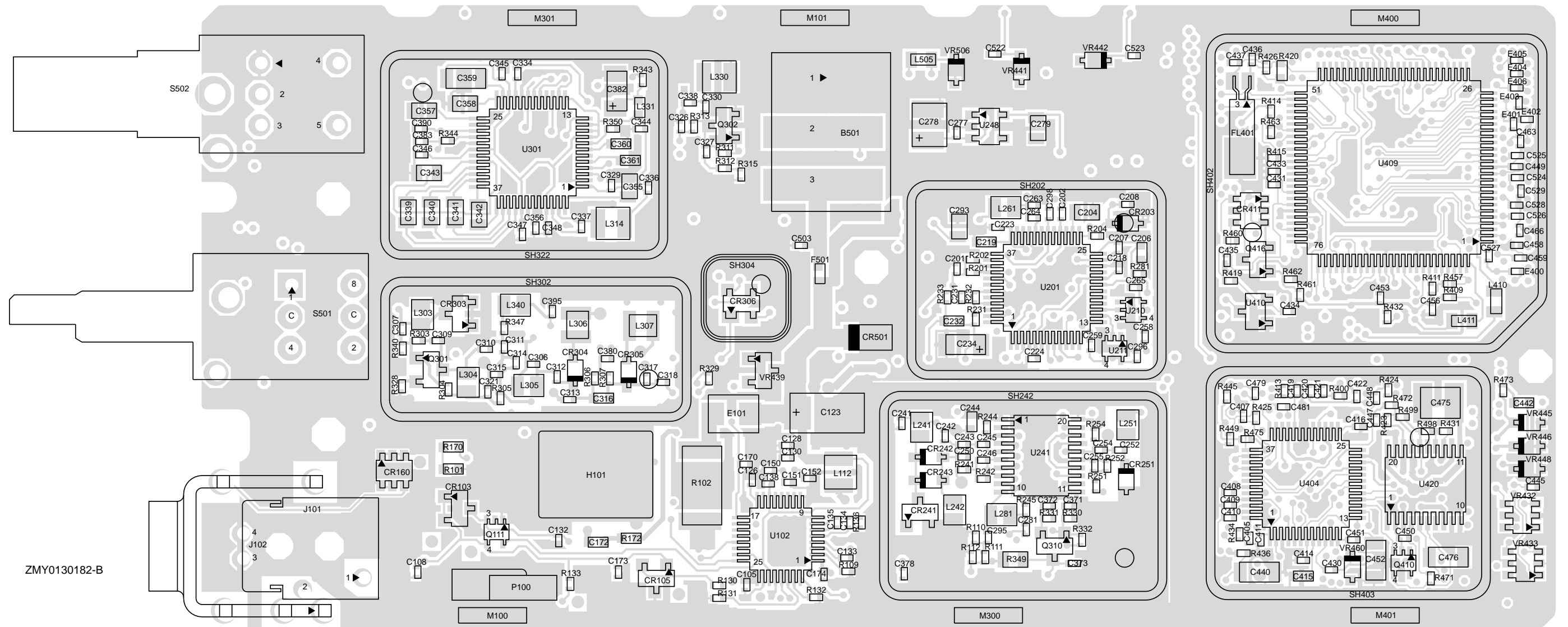
\* Motorola Depot Servicing only

### 8.0 Circuit Board/Schematic Diagrams and Parts List

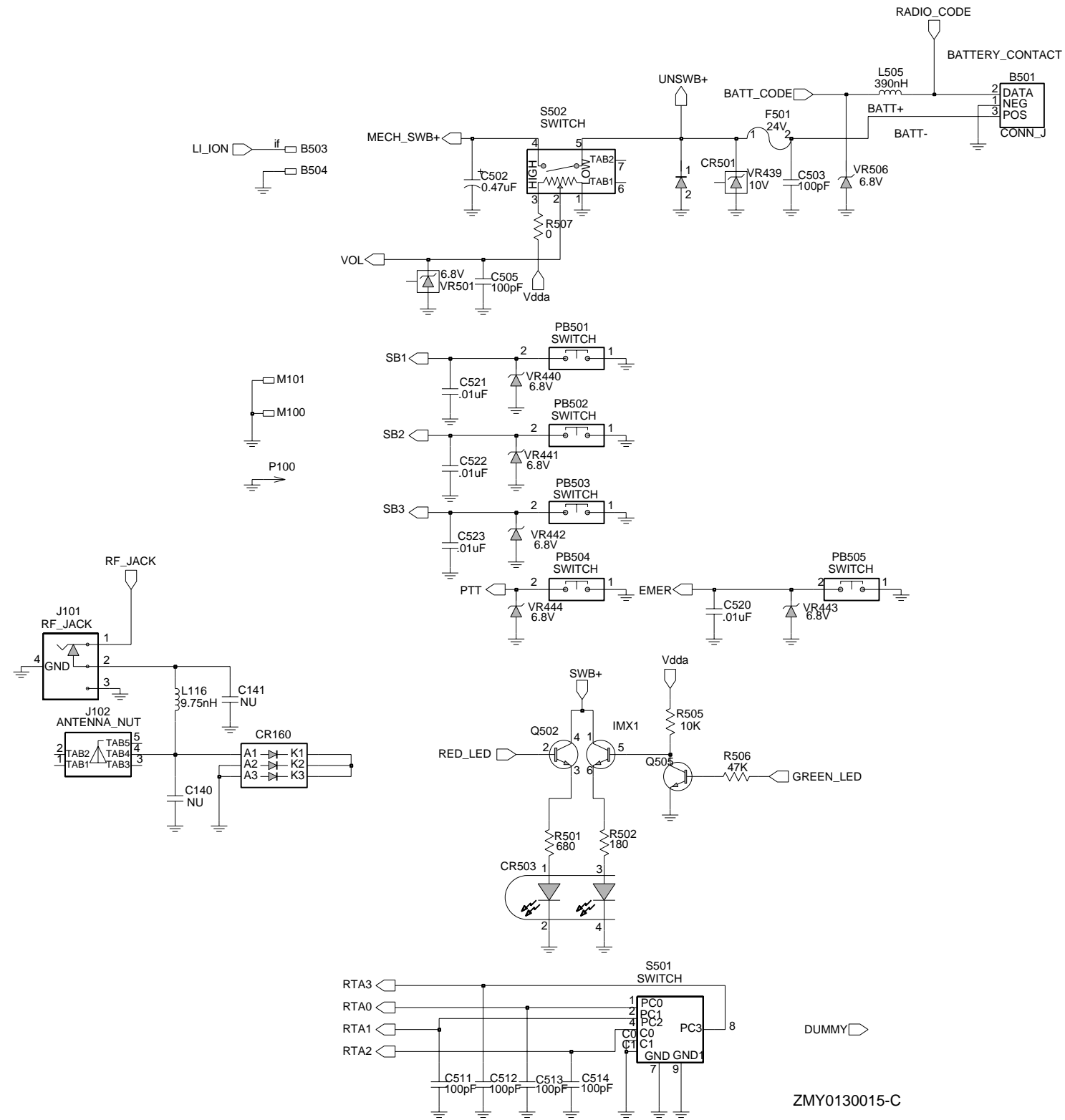


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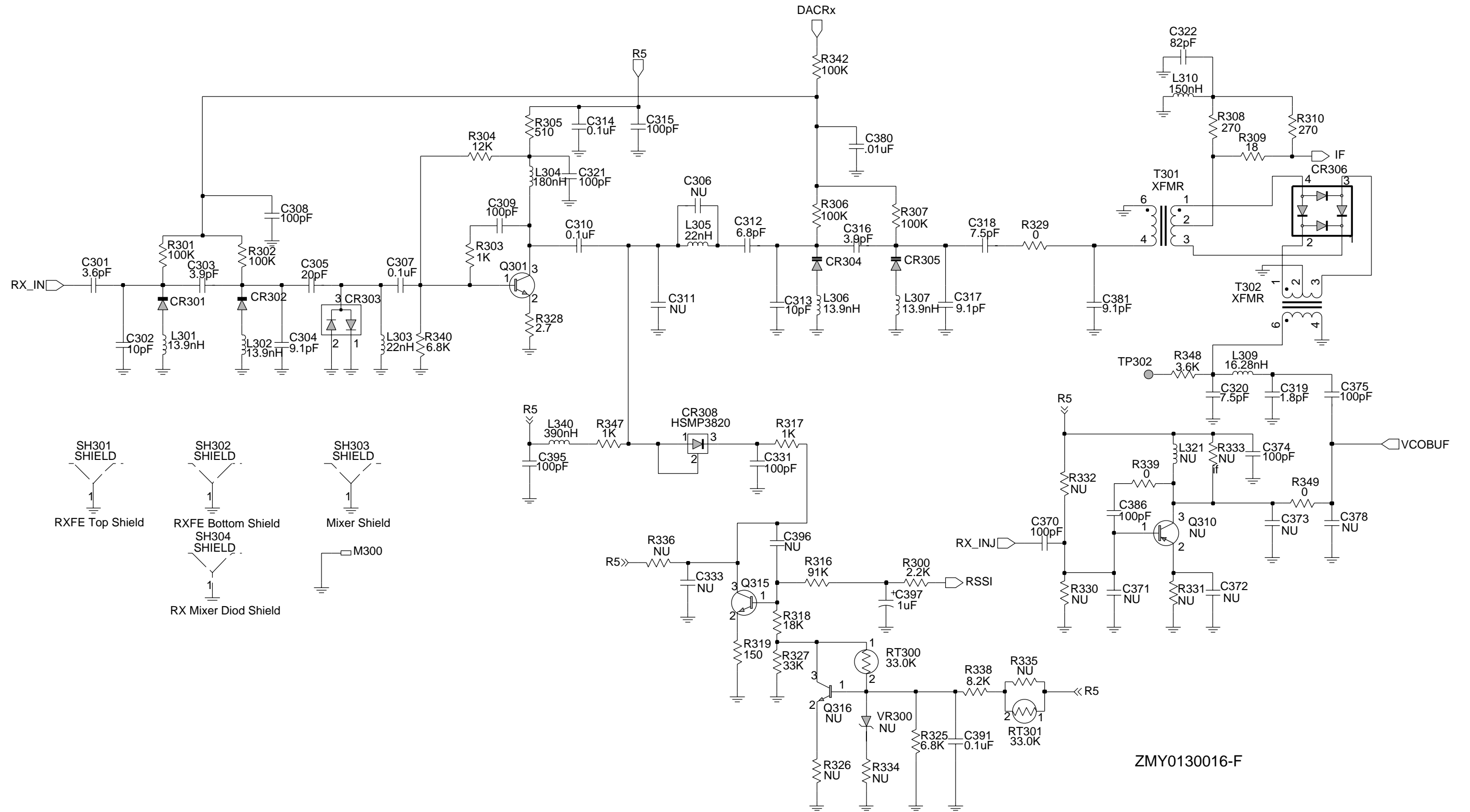




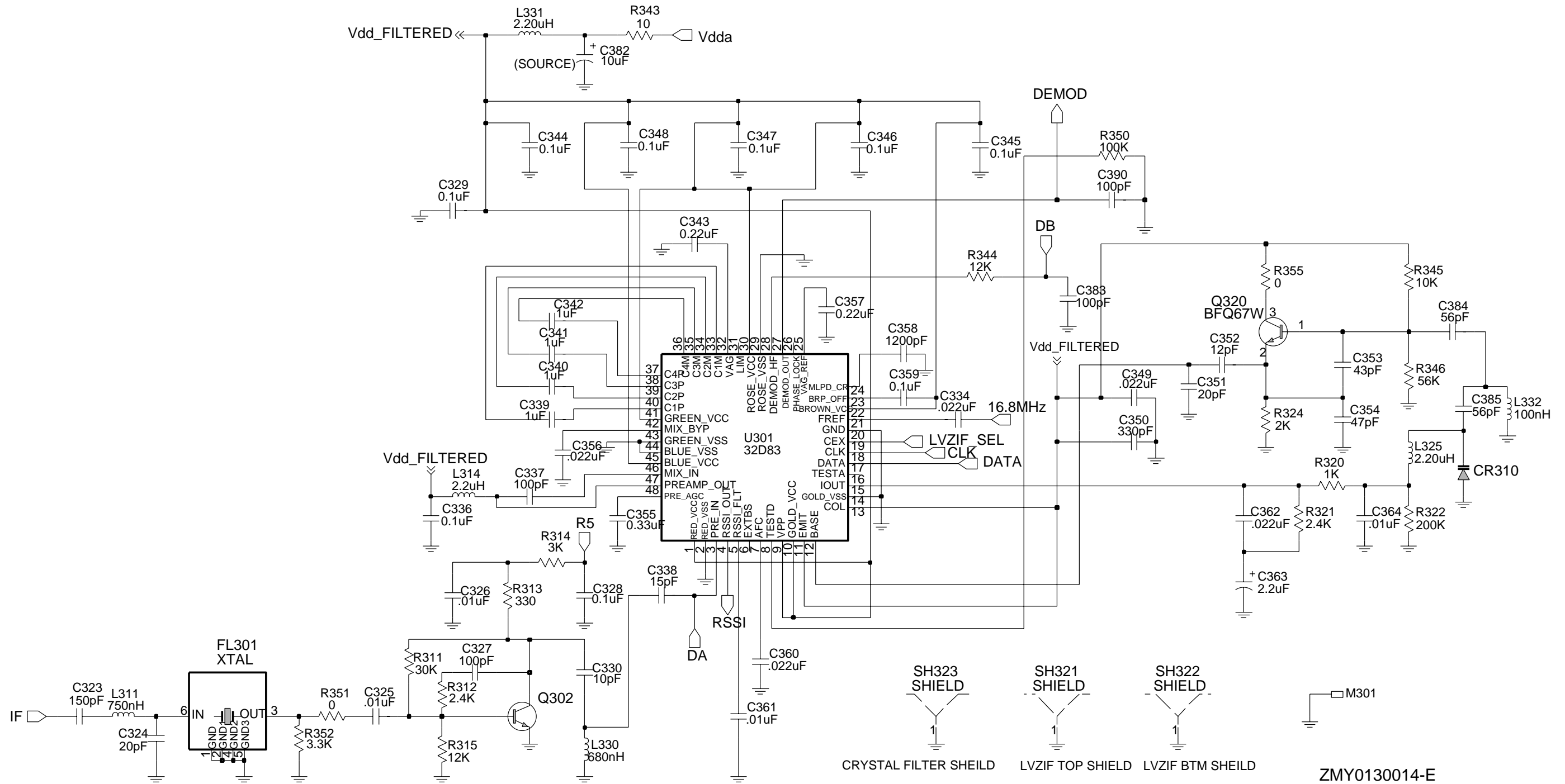
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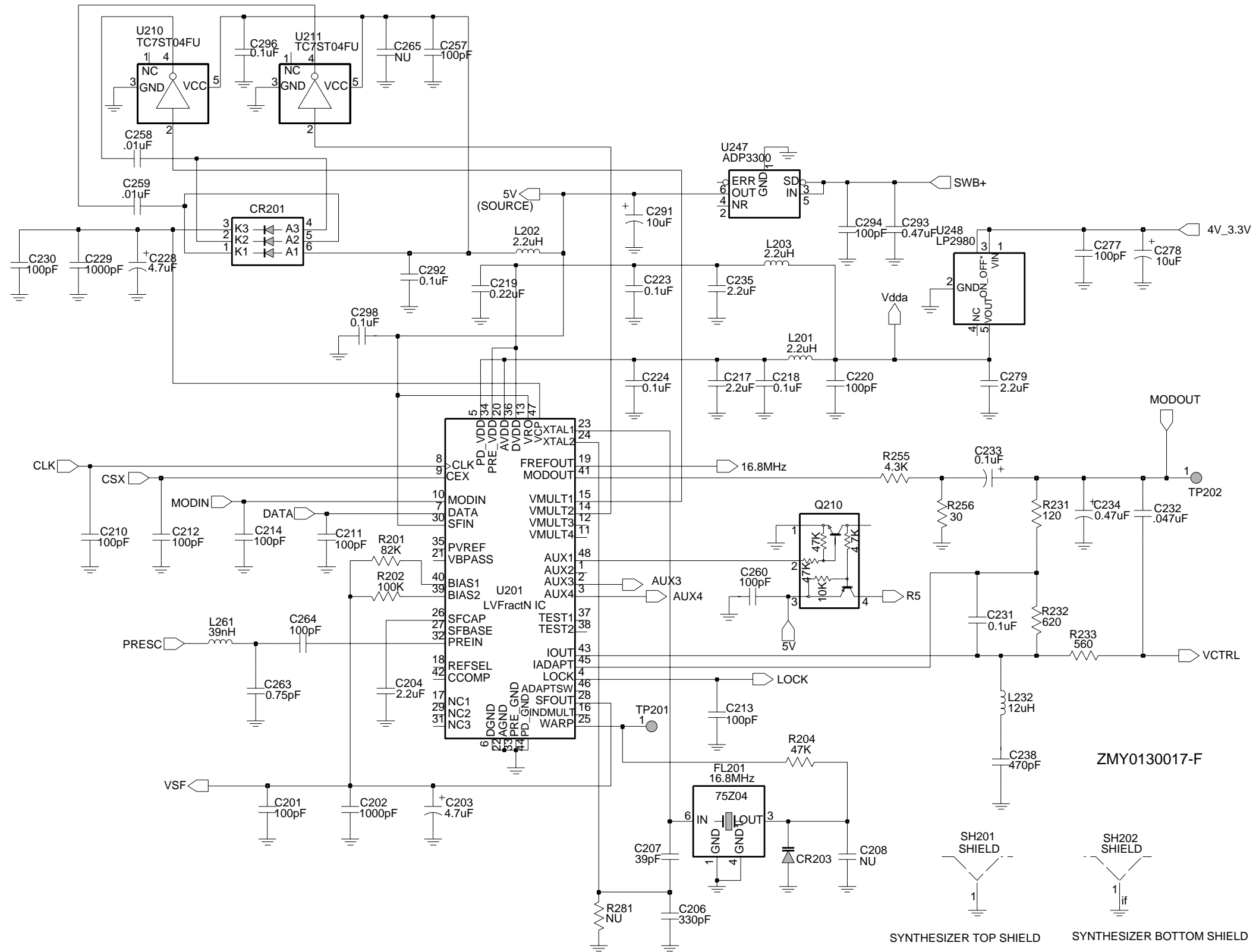
UHF Controls And Switches Schematic Diagram



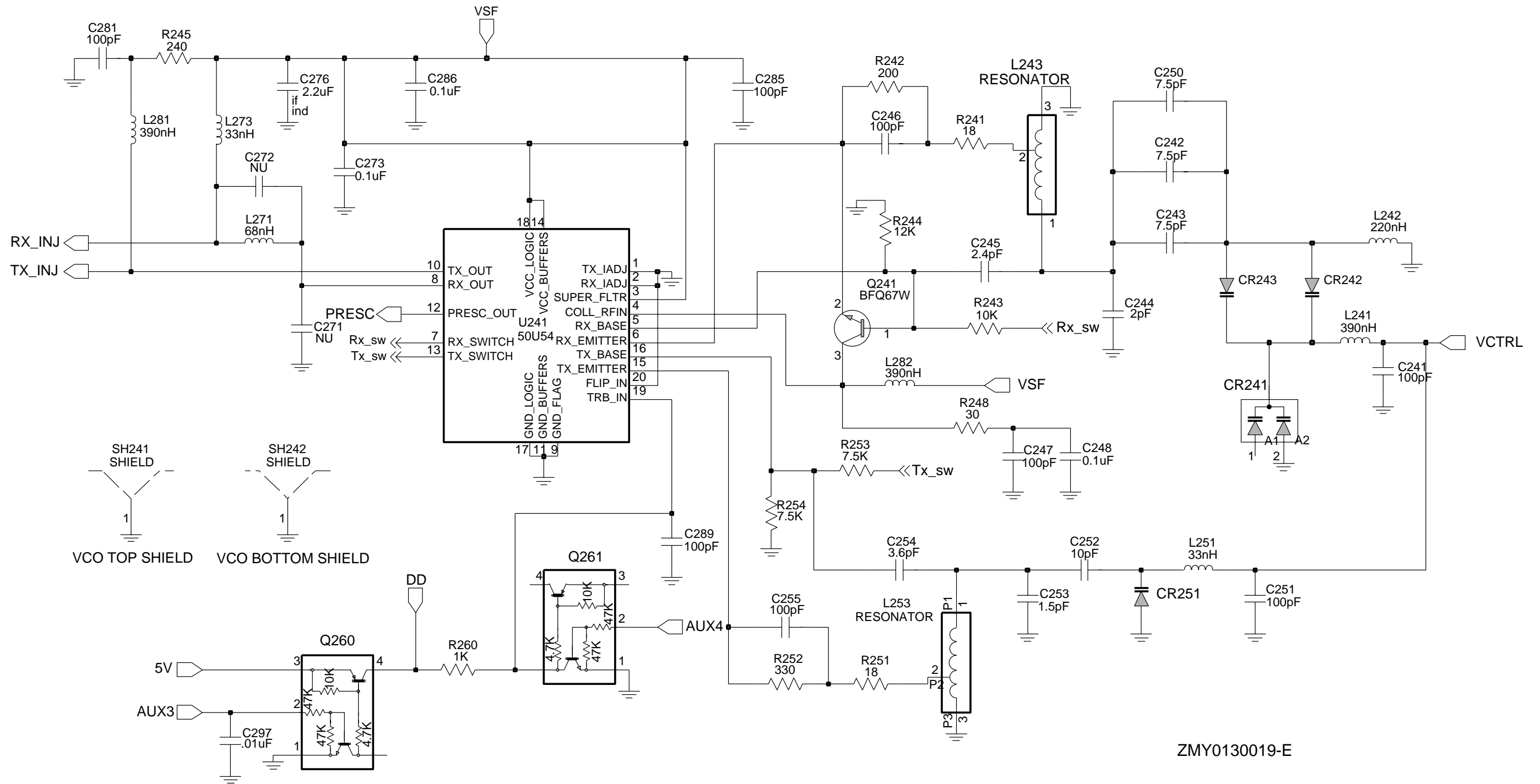
UHF Receiver Front End Schematic Diagram



UHF Receiver Back End Schematic Diagram

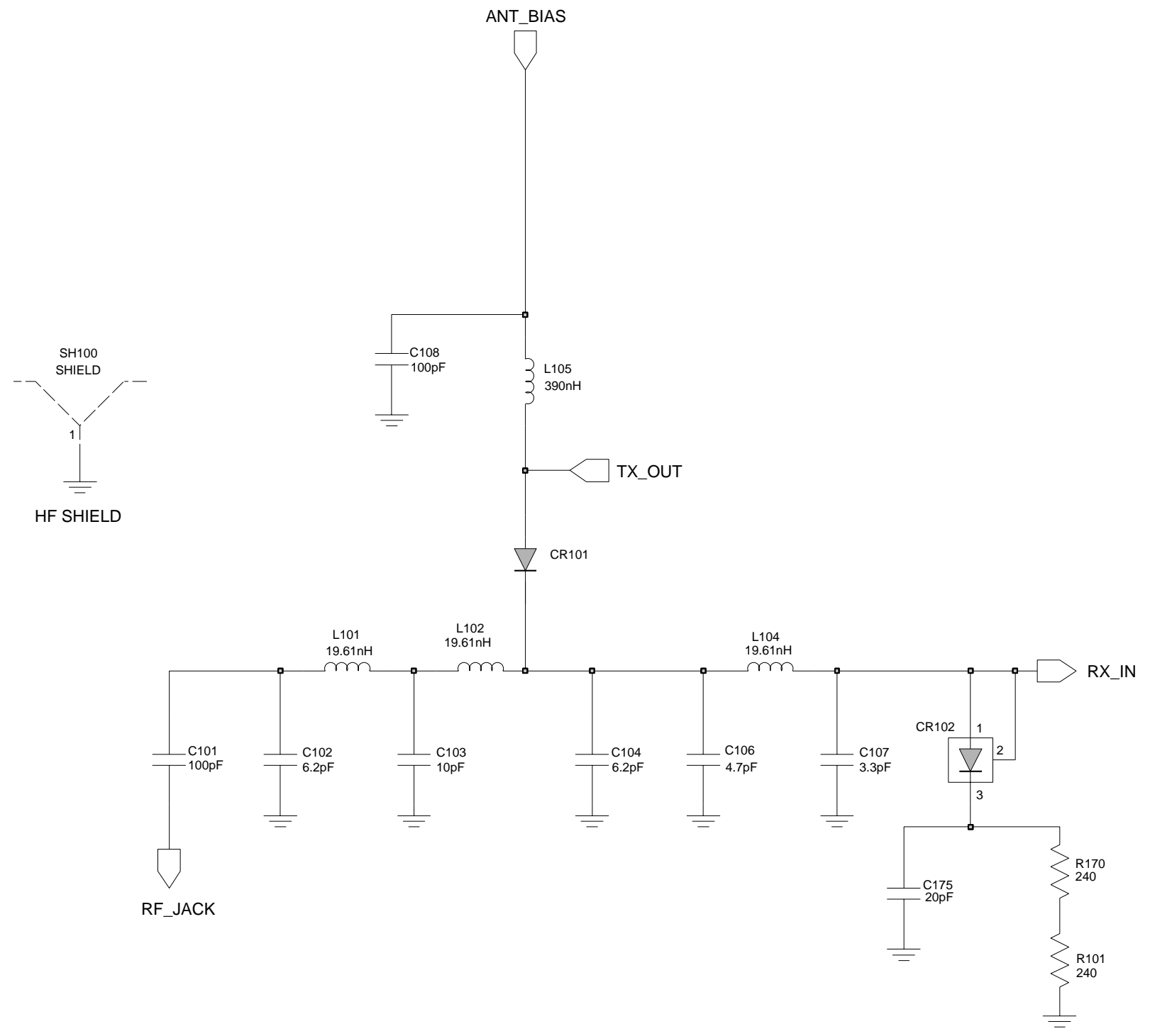


**UHF Synthesizer Schematic Diagram**



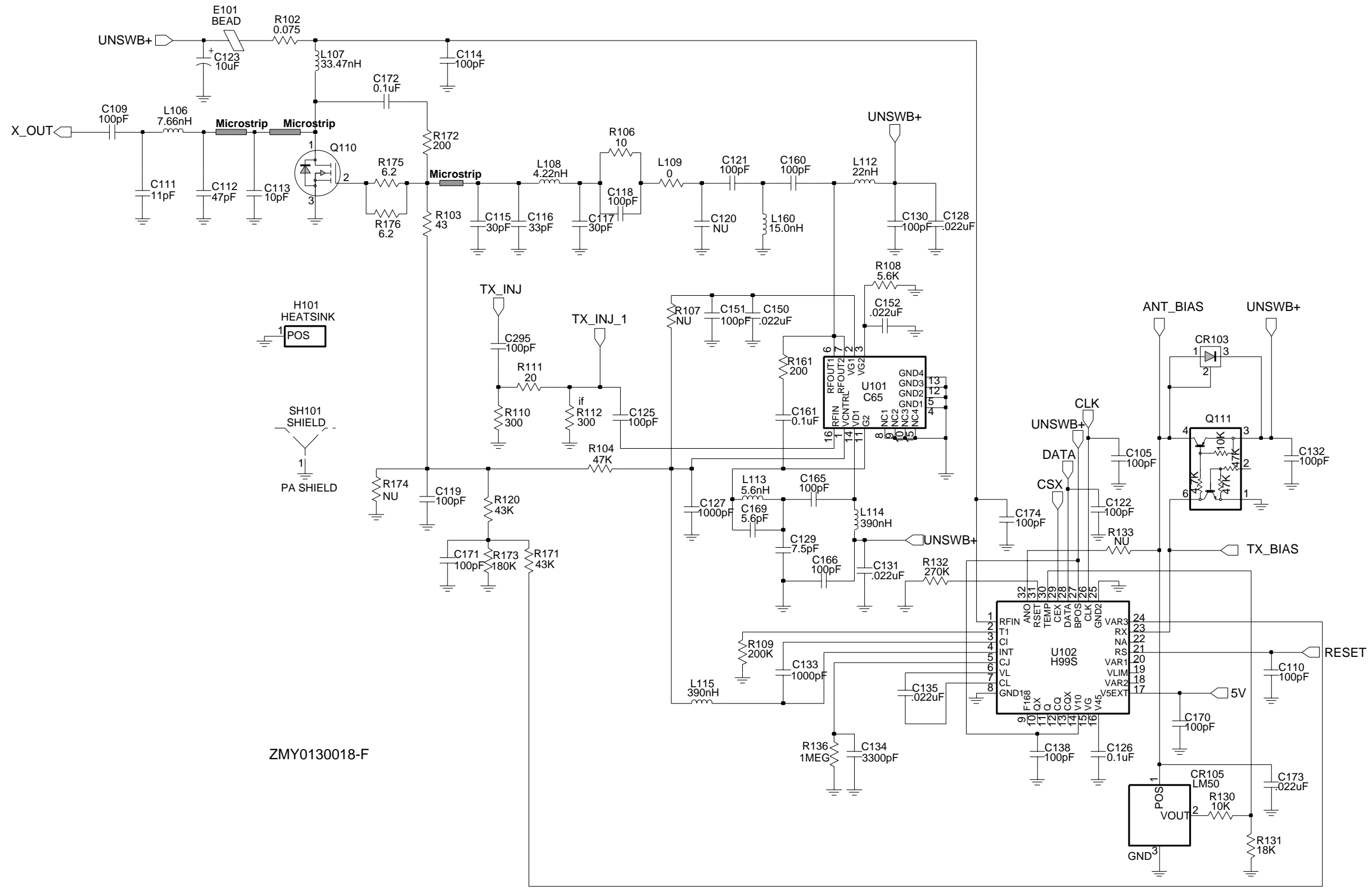
ZMY0130019-E

**UHF Voltage Controlled Oscillator Schematic Diagram**



ZMY0130486-A

**UHF Harmonic Filter Schematic Diagram**



UHF Transmitter Schematic Diagram



## UHF Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Battery Contact Module
B503	3980502Z01	Backup battery B+ (not placed in GP328)
B504	3980501Z01	Backup battery B- (not placed in GP328)
C101	2113740F51	100pF
C102	2113740F22	6.2pF
C103	2113740F27	10pF
C104	2113740F22	6.2pF
C105	2113743N50	100pF
C106	2113740F19	4.7pF
C107	2113740F15	3.3pF
C108	2113743N50	100pF
C109	2113740F51	100pF
C110	2113743N50	100pF
C111	2113740F30	13pF
C112	2180605Z32	47pF
C113	2180605Z16	10pF
C114	2113743N50	100pF
C115	2113743N30	15pF
C116	2113743N38	33pF
C117	2113743N37	30pF
C118	2113743N50	100pF
C119	2113743N50	100pF
C120	NOT PLACED	GCAM DUMMY PART NUMBER
C121	2113743N50	100pF
C122	2113743N50	100pF
C123	2311049A18	10uF
C125	2113743N50	100pF
C126	2113743M24	100000pF
C127	2113743L17	1000pF
C128	2113743M08	22000pF
C129	2113743N23	7.5pF
C130	2113743N50	100pF
C131	2113743M08	22000pF
C132	2113743N50	100pF
C133	2113743L17	1000pF
C134	2113743L29	3300pF
C135	2113743M08	22000pF
C138	2113743N50	100pF
C140	NOT PLACED	
C141	NOT PLACED	
C150	2113743M08	22000pF
C151	2113743N50	100pF
C152	2113743M08	22000pF
C160	2113743N50	100pF
C161	2113743M24	100000pF
C165	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C166	2113743N50	100pF
C169	2113743N20	5.6 pF
C170	2113743N50	100pF
C171	2113743N50	100pF
C172	2113740F51	100pF
C173	2113743M08	22000pF
C174	2113743N50	100pF
C175	2113740L25	20pF
C201	2113743N50	100pF
C202	2113743L17	1000pF
C203	2311049A56	4.7uF
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N40	39pF
C208	NOT PLACED	
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C217	2104993J02	2.2uF
C218	2113743M24	100000pF
C219	2113743K16	0.220uF
C220	2113743N50	100pF
C223	2113743M24	100000pF
C224	2113743M24	100000pF
C228	2311049J11	4.7uF
C229	2113743L17	1000pF
C230	2113743N50	100pF
C231	2113743M24	100000pF
C232	2113743E12	0.047uF
C233	2311049A01	0.1uF
C234	2311049A05	0.47uF
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N23	7.5pF
C243	2113743N23	7.5pF
C244	2113740F10	2.0pF
C245	2113743N11	2.4pF
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	100000pF
C250	2113743N23	7.5pF
C251	2113743N50	100pF
C252	2113743N26	10pF
C253	2113740F09	1.8pF
C254	2113743N15	3.6pF
C255	2113743N50	100pF
C257	2113743N50	100pF
C258	2113743L41	10000pF

Circuit Ref	Motorola Part No.	Description
C259	2113743L41	10000pF
C260	2113743N50	100pF
C263	2113743N02	0.75pF
C264	2113743N50	100pF
C265	NOT PLACED	
C271	NOT PLACED	
C272	NOT PLACED	
C273	2113743M24	100000pF
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A57	10uF
C279	2104993J02	2.2uF
C281	2113743N50	100pF
C285	2113743N50	100pF
C286	2113743M24	100000pF
C289	2113743N50	100pF
C291	2311049A69	10uF
C292	2113743M24	100000pF
C293	2113743A27	0.470uF
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	100000pF
C297	2113743L41	10000pF
C298	2113743M24	100000pF
C301	2113743N15	3.6pF
C302	2113743N26	10pF
C303	2113740L08	3.9pF
C304	2113743N26	10pF
C305	2113743N33	20pF
C306	NOT PLACED	
C307	2113743M24	100000pF
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	100000pF
C311	NOT PLACED	
C312	2113743N25	9.1pF
C313	2113743N26	10pF
C314	2113743M24	100000pF
C315	2113743N50	100pF
C316	2113740L08	3.9pF
C317	2113743N25	9.1pF
C318	2113743N23	7.5pF
C319	2113743N69	1.8pF
C320	2113743N23	7.5pF
C321	2113743N50	100pF
C322	2113743N48	82pF
C323	2113743N54	150pF
C324	2113743N33	20pF
C325	2113743L41	10000pF
C326	2113743L41	10000pF
C327	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C328	2113743M24	100000pF
C329	2113743M24	100000pF
C330	2113743N26	10pF
C331	2113743N50	100pF
C333	NOT PLACED	
C334	2113743M08	22000pF
C336	2113743M24	100000pF
C337	2113743N50	100pF
C338	2113743N30	15pF
C339	2180478Z20	1uF
C340	2180478Z20	1uF
C341	2180478Z20	1uF
C342	2180478Z20	1uF
C343	2113743A23	0.220uF
C344	2113743M24	100000pF
C345	2113743M24	100000pF
C346	2113743M24	100000pF
C347	2113743M24	100000pF
C348	2113743M24	100000pF
C349	2113743E07	0.022uF
C350	2113743L05	330pF
C351	2113743N33	20pF
C352	2113743N28	12pF
C353	2113743N41	43pF
C354	2113743N42	47pF
C355	2113743A24	0.330uF
C356	2113743M08	22000pF
C357	2113743A23	0.220uF
C358	2113741A23	1200pF
C359	2109720D14	0.1uF
C360	2113743E07	0.022uF
C361	2113741F49	10nF
C362	2113743M08	22000pF
C363	2311049A40	2.2uF
C364	2113743L41	10000pF
C370	2113743N50	100pF
C371	NOT PLACED	
C372	NOT PLACED	
C373	NOT PLACED	
C374	2113743N50	100pF
C375	2113743N50	100pF
C378	NOT PLACED	
C380	2113743L41	10000pF
C381	2113743N21	6.2pF
C382	2311049A59	10uF
C383	2113743N50	100pF
C384	2113743N44	56pF
C385	2113743N44	56pF
C386	2113743N50	100pF
C390	2113743N50	100pF
C391	NOT PLACED	

Circuit Ref	Motorola Part No.	Description
C395	2113743N50	100pF
C396	NOT PLACED	
C397	2311049A05	0.47uF
C400	2113743L41	10000pF
C401	2113743M24	100000pF
C402	2113743M24	100000pF
C403	2113743G24	2.2uF
C404	NOT PLACED	
C405	NOT PLACED	
C406	NOT PLACED	
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	100000pF
C410	2113928N01	0.1uF
C411	2113743M24	100000pF
C414	2113743M24	100000pF
C415	2185895Z01	0.01uF
C416	2113928N01	0.1uF
C419	NOT PLACED	
C420	2113743L41	10000pF
C421	2113928N01	0.1uF
C422	2113743M24	100000pF
C423	2113743N50	100pF
C424	2311049A59	10uF
C425	2113743M24	100000pF
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	100000pF
C429	2113743M24	100000pF
C430	2113928N01	0.1uF
C431	2113743N50	100pF
C432	NOT PLACED	
C433	2113743L41	10000pF
C434	2113928N01	0.1uF (not placed in GP328)
C435	2113743M24	100000pF
C436	2113743N34	22pF (not placed in GP328)
C437	2113743N34	22pF (not placed in GP328)
C440	2113743G26	4.7F
C441	2113743N50	100pF
C442	2113743E20	0.10uF
C443	2113928N01	0.1uF
C444	2113743N50	100pF
C445	2113743N50	100pF
C447	2113743M08	22000pF
C448	2113928N01	0.1uF
C449	2113743N50	100pF
C450	NOT PLACED	
C451	2113743M08	22000pF
C452	2113743B29	1uF
C453	2113743N50	100pF
C456	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF
C471	2113743N50	100pF
C472	2113743L09	470pF
C473	2113743L09	470pF
C475	2113743H14	10uF
C476	2113928D08	10uF
C479	2113928N01	0.1uF
C480	2113928D08	10uF
C481	2113928N01	0.1uF
C482	2113928N01	0.1uF
C490	2113743N50	100pF
C491	2113743N50	100pF
C492	2113743N50	100pF
C493	2113743N50	100pF
C494	2113743N50	100pF
C495	2113743N50	100pF
C496	2113743N50	100pF
C497	2113743N50	100pF
C502	2311049A05	0.47uF
C503	2113743N50	100pF
C505	2113743N50	100pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C520	2113743L41	10000pF
C521	2113743L41	10000pF
C522	2113743L41	10000pF
C523	2113743L41	10000pF
C524	2113743N50	100pF
C525	2113743N50	100pF
C526	2113743N50	100pF
C527	2113743N50	100pF
C528	2113743N50	100pF
C529	2113743N50	100pF
CR101	4880973Z02	Pin diode
CR102	4802245J41	Pin diode
CR103	4802245J41	Pin diode
CR105	5185963A15	Temperature sensor
CR160	NOT PLACED	
CR201	4802233J09	Triple diode (SOT 25)
CR203	4862824C03	Varactor
CR241	4805649Q13	Varactor
CR242	4862824C08	Varactor
CR243	4862824C08	Varactor
CR251	4802245J22	Varactor
CR301	4862824C08	Varactor

Circuit Ref	Motorola Part No.	Description
CR302	4862824C08	Varactor
CR303	4880154K03	Dual common anode-cathode diode
CR304	4862824C08	Varactor
CR305	4862824C08	Varactor
CR306	4802245J42	Ring Quad diode (SOT-143)
CR308	4802245J41	Pin diode
CR310	4862824C08	Varactor
CR411	4802245J62	Diode Schottky
CR412	4802245J62	Diode Schottky
CR413	4802245J62	Diode Schottky
CR440	4813833C02	Dual common cathode diode
CR501	4880107R01	Rectifier
CR503	4805729G49	LED Red/Yellow
E101	2484657R01	Ferrite bead
E400	2480640Z01	Ferrite bead
E401	2480640Z01	Ferrite bead
E402	2480640Z01	Ferrite bead
E403	2480640Z01	Ferrite bead
E404	2480640Z01	Ferrite bead
E405	2480640Z01	Ferrite bead
E406	2480640Z01	Ferrite bead
E407	2480640Z01	Ferrite bead
E408	2480640Z01	Ferrite bead
E409	2480640Z01	Ferrite bead
F501	6580542Z01	3A fuse
FL201	4805875Z04	16.8MHz Xtal oscillator
FL301	4802245J43	Xtal Filter 45.1MHz
FL401	4870368G02	Xtal Oscillator 38.4kHz (not placed in GP328)
H101	2680499Z01	Heat spreader
J101	0985613Z01	RF Jack
J102	0280519Z02	Antenna nut
J400	0905505Y04	40-pin connector
J403	0905505Y02	20-pin connector
L101	2479990B02	19.61nH
L102	2479990B02	19.61nH
L104	2479990B02	19.61nH
L105	2462587N22	390nH
L106	2479990A02	7.66nH
L107	2479990G01	33.47nH
L108	2479990A01	4.22nH
L109	0662057C01	0
L112	2462587N45	22nH
L113	2413926H09	5.6nH
L114	2462587N45	22nH
L115	2462587N22	390nH
L116	2479990A03	9.75nH
L160	2413926H14	15nH
L201	2462587Q20	2200nH
L202	2462587Q20	2200nH

Circuit Ref	Motorola Part No.	Description
L203	2462587Q20	2200nH
L232	2462587P25	12000nH
L241	2462587V41	390nH
L242	2462587V38	220nH
L243	2460593C01	Multi-layered Teflon resonator, Rx
L251	2462587V28	33nH
L253	2460593C02	Multi-layered Teflon resonator, Tx
L261	2462587V29	39nH
L271	2462587V32	68nH
L273	2462587V28	33nH
L281	2462587V41	390nH
L282	2462587V41	390nH
L301	2479990C01	13.9nH
L302	2479990C01	13.9nH
L303	2462587V26	22nH
L304	2462587V37	180nH
L305	2462587V26	22nH
L306	2479990C01	13.9nH
L307	2479990C01	13.9nH
L309	2479990C02	16.28nH
L310	2462587V36	150nH
L311	2462587N65	750nH
L314	2462587N72	2200nH
L321	NOT PLACED	
L325	2480646Z20	2.2uH
L330	2462587N64	680nH
L331	2480646Z20	2.2uH
L332	2462587N53	100nH
L340	2462587V41	390nH
L400	2462587Q42	390nH
L401	2462587Q42	390nH
L410	2462587Q42	390nH
L411	2462587Q42	390nH
L505	2462587Q42	390nH
P100	3905643V01	Ground contact finger
PB501	4080523Z01	Tactile switch, pushbutton
PB502	4080523Z01	Tactile switch, pushbutton
PB503	4080523Z01	Tactile switch, pushbutton
PB504	4080523Z01	Tactile switch, pushbutton
PB505	4080523Z01	Tactile switch, pushbutton
Q110	4813828A09	RF PA
Q111	4802245J50	Dual NPN/PNP transistor
Q210	4802245J50	Dual NPN/PNP transistor
Q241	4805218N63	RF NPN transistor
Q260	4802245J50	Dual NPN/PNP transistor
Q261	4802245J50	Dual NPN/PNP transistor
Q301	4802245J44	NPN Transistor
Q302	4802245J44	NPN Transistor
Q310	NOT PLACED	

Circuit Ref	Motorola Part No.	Description
Q315	4880214G02	NPN
Q316	NOT PLACED	
Q320	4805218N63	RF NPN transistor
Q400	4809579E18	Mosfet P - channel
Q403	4813824A17	Bipolar Transistor, PNP
Q405	4802245J54	Dual NPN Transistor
Q410	4802245J54	Dual NPN Transistor
Q416	4809579E18	Mosfet P - channel (not placed in GP328)
Q417	4802245J50	Dual NPN/PNP transistor
Q502	5180159R01	DUAL TRANS NPNS
Q505	4880214G02	NPN
R101	0662057A34	240
R102	0680539Z01	0.1
R103	0662057M41	43
R104	0662057N15	47k
R106	0662057M26	10
R107	NOT PLACED	
R108	0662057M92	5600
R109	0662057N30	200k
R110	0662057M61	300
R111	0662057M33	20
R112	0662057M61	300
R120	0662057N14	43k
R130	0662057M98	10k
R131	0662057N05	18k
R132	0662057N33	270k
R133	NOT PLACED	
R136	0662057N47	1M
R161	0662057M57	200
R170	0662057A34	240
R171	0662057N14	43k
R172	0662057A32	200
R173	0662057N29	180k
R174	0662057N15	47k
R175	0662057B67	6.2
R176	0662057B67	6.2
R201	0662057N21	82k
R202	0662057N23	100k
R204	0662057N15	47k
R231	0662057M52	120
R232	0662057M69	620
R233	0662057M68	560
R241	0662057M32	18
R242	0662057M57	200
R243	0662057M98	10k
R244	0662057N01	12k
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M32	18
R252	0662057M62	330

Circuit Ref	Motorola Part No.	Description
R253	0662057M95	7500
R254	0662057M95	7500
R255	0662057M89	4300
R256	0662057M37	30
R260	0662057M74	1000
R281	NOT PLACED	
R300	0662057M82	2200
R301	0662057N23	100k
R302	0662057N23	100k
R303	0662057M74	1000
R304	0662057N01	12k
R305	0662057M67	510
R306	0662057N23	100k
R307	0662057N23	100k
R308	0662057M60	270
R309	0662057M32	18
R310	0662057M60	270
R311	0662057N10	30k
R312	0662057M83	2400
R313	0662057M62	330
R314	0662057M85	3000
R315	0662057N01	12k
R316	0662057A96	91K
R317	0662057M74	1000
R318	0662057A79	18
R319	0662057A29	150
R320	0662057M74	1000
R321	0662057M83	2400
R322	0662057N30	200k
R324	0662057M81	2000
R325	0662057M94	6800
R326	NOT PLACED	
R327	0662057N11	33k
R328	0662057M12	2.7
R329	0662057M01	0
R330	NOT PLACED	
R331	NOT PLACED	
R332	NOT PLACED	
R333	NOT PLACED	
R334	NOT PLACED	
R335	NOT PLACED	
R336	NOT PLACED	
R338	NOT PLACED	
R339	0662057M01	0
R340	0662057M94	6800
R342	0662057N23	100k
R343	0662057M26	10
R344	0662057N01	12k
R345	0662057M98	10k
R346	0662057N17	56k
R347	0662057M74	1000

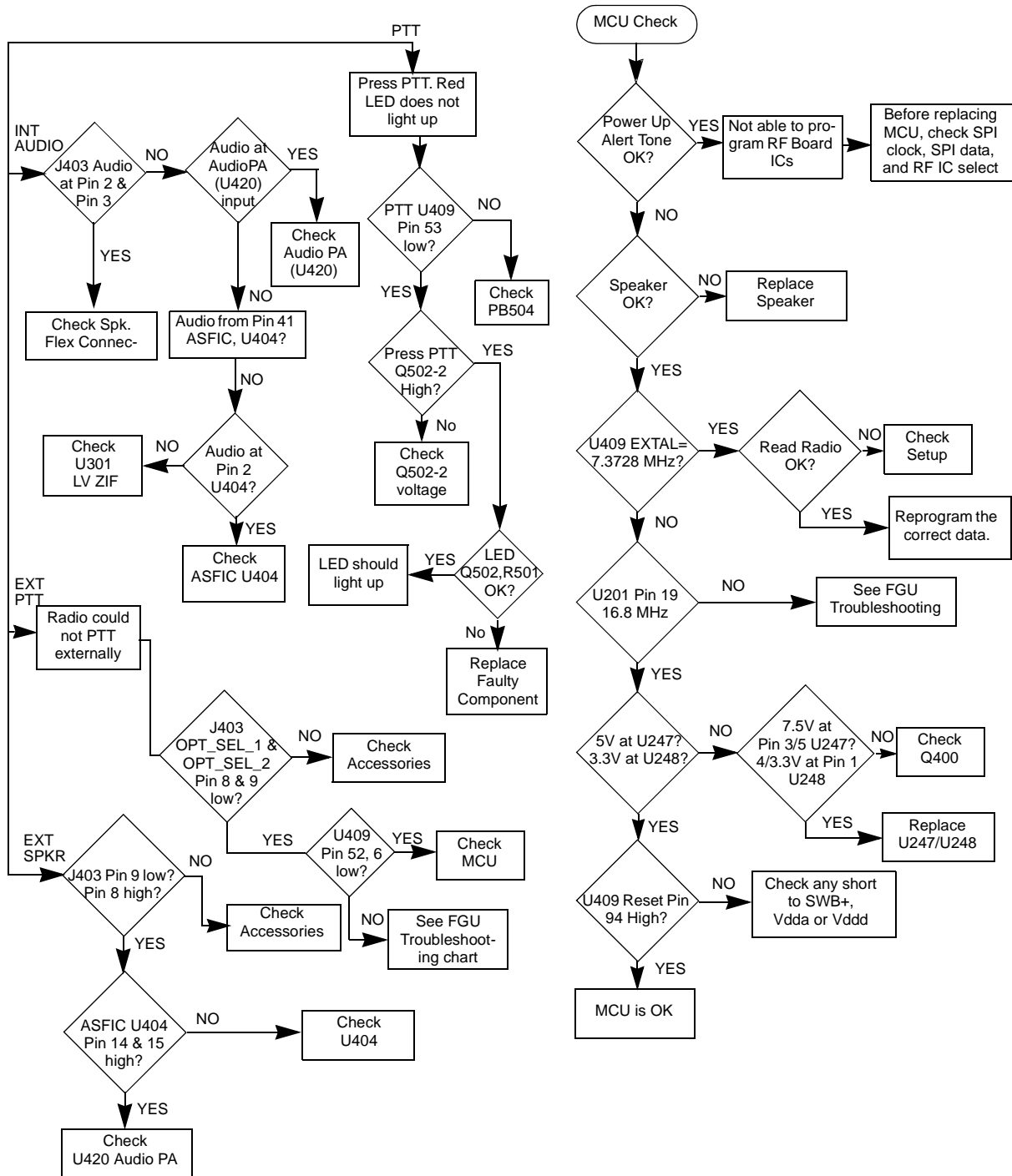
Circuit Ref	Motorola Part No.	Description
R348	0662057M87	3600
R349	0662057C01	0
R350	0662057N23	100k
R351	0662057C01	0
R352	0662057M86	3300
R355	0662057M01	0
R400	0662057N15	47k
R401	0662057M01	0
R402	NOT PLACED	
R403	NOT PLACED	
R405	0662057M01	0
R406	0662057N20	75k
R407	0662057N19	68k
R408	NOT PLACED	
R409	0662057M98	10k
R410	0662057N23	100k
R411	0662057M98	10k
R413	0662057M01	0
R414	0662057V34	180k
R415	0662057V26	91k
R416	0662057M98	10k
R418	0662057M01	0
R419	0662057M67	510
R420	0662057B46	10M (not placed in GP328)
R421	0662057M81	2000
R423	0662057N39	470k
R424	0662057N12	36k
R425	0662057N10	30k
R426	0662057N35	330k (not placed in GP328)
R427	0662057M84	2700
R428	0662057M10	2.2
R429	0662057M98	10k
R431	0662057N39	470k
R432	0662057N16	51k
R434	0662057M62	330
R435	0662057M81	2000
R436	0662057M01	0
R445	0662057N08	24k
R447	0662057N23	100k
R448	0662057M98	10k
R449	0662057N08	24k
R450	0683962T45	68 ohms, 1W
R451	0662057N03	15k
R452	0662057N23	100k
R453	NOT PLACED	
R454	NOT PLACED	
R455	NOT PLACED	
R456	0662057M01	0
R457	0662057M98	10k
R460	0662057M90	4700
R461	0662057M56	180 (not placed in GP328)

Circuit Ref	Motorola Part No.	Description
R462	0662057M98	10k (not placed in GP328)
R463	0662057M61	300
R471	0662057N06	20k
R472	0662057N12	36k
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N35	330k
R477	0662057M74	1000
R478	0662057M98	10k
R481	0662057N08	24k
R492	0662057M01	0
R498	0662057M98	10k
R499	0662057M98	10k (not placed in GP328)
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10k
R506	0662057N15	47k
R507	0662057M01	0
RT300	0680590Z01	THERMISTOR_33K
RT301	NOT PLACED	
RT400	0680590Z01	THERMISTOR_33K
S501	4080710Z01	Frequency switch
S502	1880619Z02	Volume/on-off switch
SH100	2680507Z01	Harmonic Filter shield
SH101	2680510Z01	RF PA shield
SH201	2680511Z01	Synthesizer top shield
SH202	2680511Z01	Synthesizer bottom shield
SH241	2680513Z01	Resonators shield
SH242	2680514Z01	VCO Buffer IC shield
SH301	2680554Z01	Receiver front end shield
SH302	2680555Z01	Receiver front end bottom shield
SH303	2680509Z01	Mixer shield
SH304	2680624Z01	Mixer diode shield
SH321	2680508Z01	LVZIF 2nd LO shield
SH322	2680514Z01	LVZIF shield
SH323	2680553Z01	Crystal Filter shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller on-off shield
SH402	2680515Z01	Microprocessor shield
SH403	2680516Z01	Asfic_Cmp/Audio PA shield
T301	2580541Z01	Balun transformer
T302	2580541Z01	Balun transformer
U101	5185130C65	VHF/UHF/800 MHZ LDMOS DRIVER
U102	5185765B28	PCIC
U201	5185963A27	LVFRACN Synthesizer IC
U210	5102463J61	Inverter
U211	5102463J61	Inverter
U241	5105750U54	VCO BUFFER IC
U247	5105739X05	SOT 5V Regulator

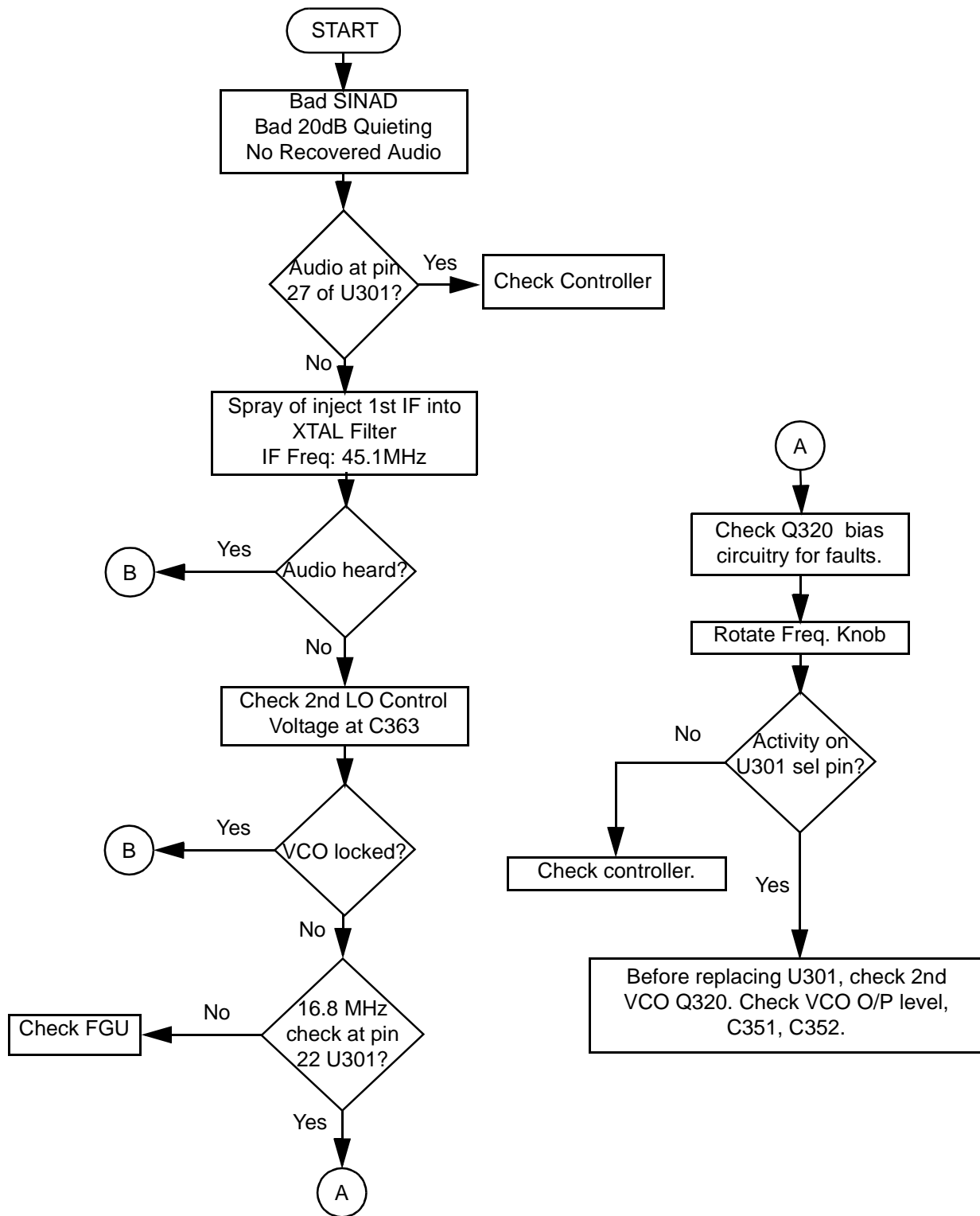
Circuit Ref	Motorola Part No.	Description
U248	5102463J58	3.3V Regulator
U301	5109632D83	LVZIF IC
U400	5102463J40	3.3V Regulator
U404	5185963A53	ASFIC_CMP IC
U405	NOT PLACED	
U406	*5102463J59	Flash ROM 128K x 8
U407	*5102463J64	16K x 8 EEPROM
U409	5102226J56	Microprocessor
U410	5102463J57	3.3V Regulator (not placed in GP328)
U420	5102463J44	Audio PA
VR432	4805656W08	5.6V Zener
VR433	4805656W08	5.6V Zener
VR434	4802245J73	ZENER DIODE-6.8V
VR439	4880140L17	Zener diode-12V
VR440	4802245J73	ZENER DIODE-6.8V
VR441	4802245J73	ZENER DIODE-6.8V
VR442	4802245J73	ZENER DIODE-6.8V
VR443	4802245J73	ZENER DIODE-6.8V
VR444	4802245J73	ZENER DIODE-6.8V
VR445	4802245J53	ZENER_DIODE-10V
VR446	4802245J74	ZENER DIODE-10V
VR447	4802245J74	ZENER DIODE-10V
VR448	4802245J74	ZENER DIODE-10V
VR449	4802245J74	ZENER DIODE-10V
VR450	4802245J75	ZENER DIODE-12V
VR460	4802245J73	ZENER DIODE-6.8V
VR501	4813830A18	6.8V Zener
VR506	4802245J73	ZENER DIODE-6.8V
	1485777Z01	INSULATOR (KAPTON)
	8480450Z13	UHF B1 main PC board

\* Motorola Depot Servicing only

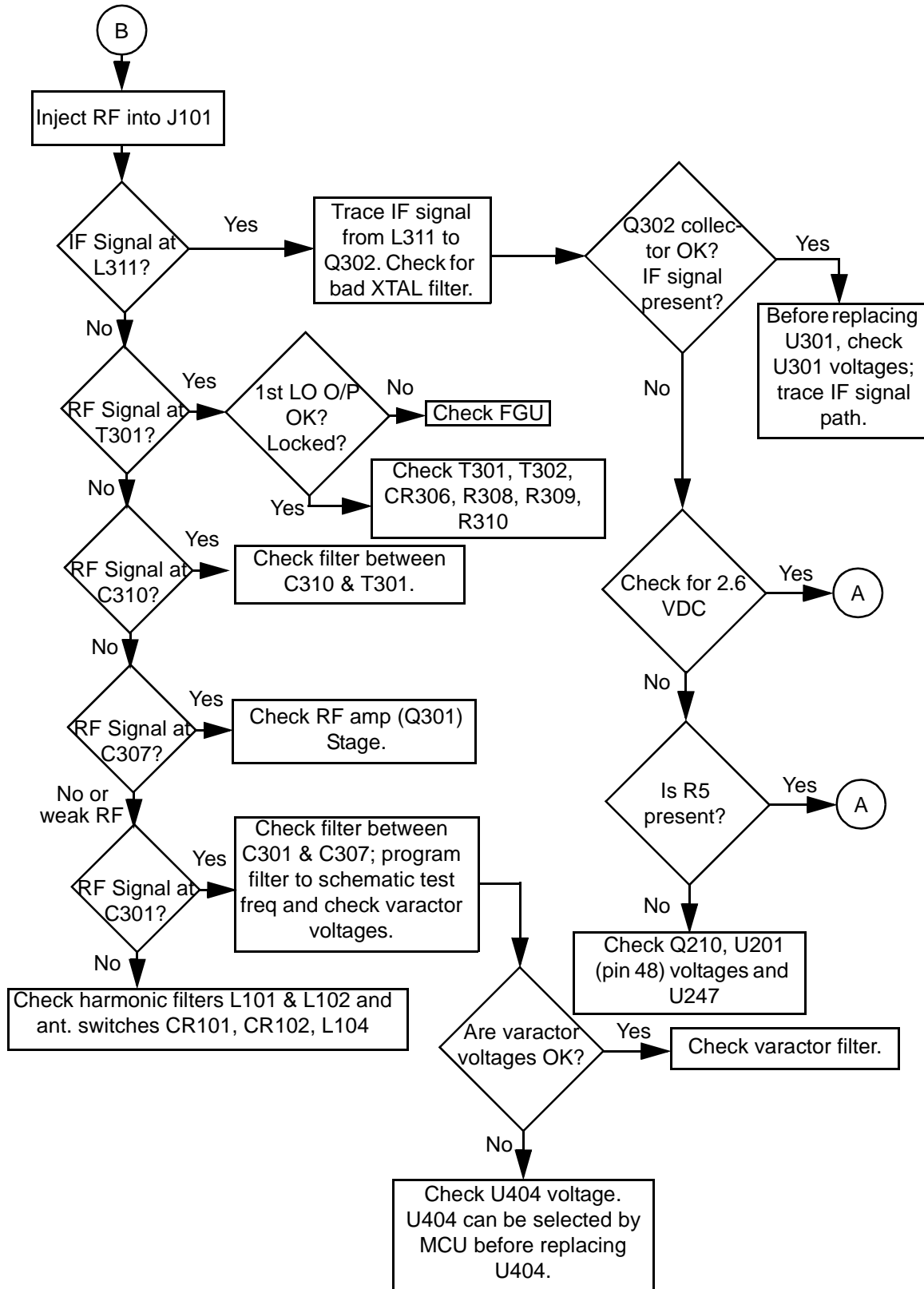
## 9.0 Troubleshooting charts



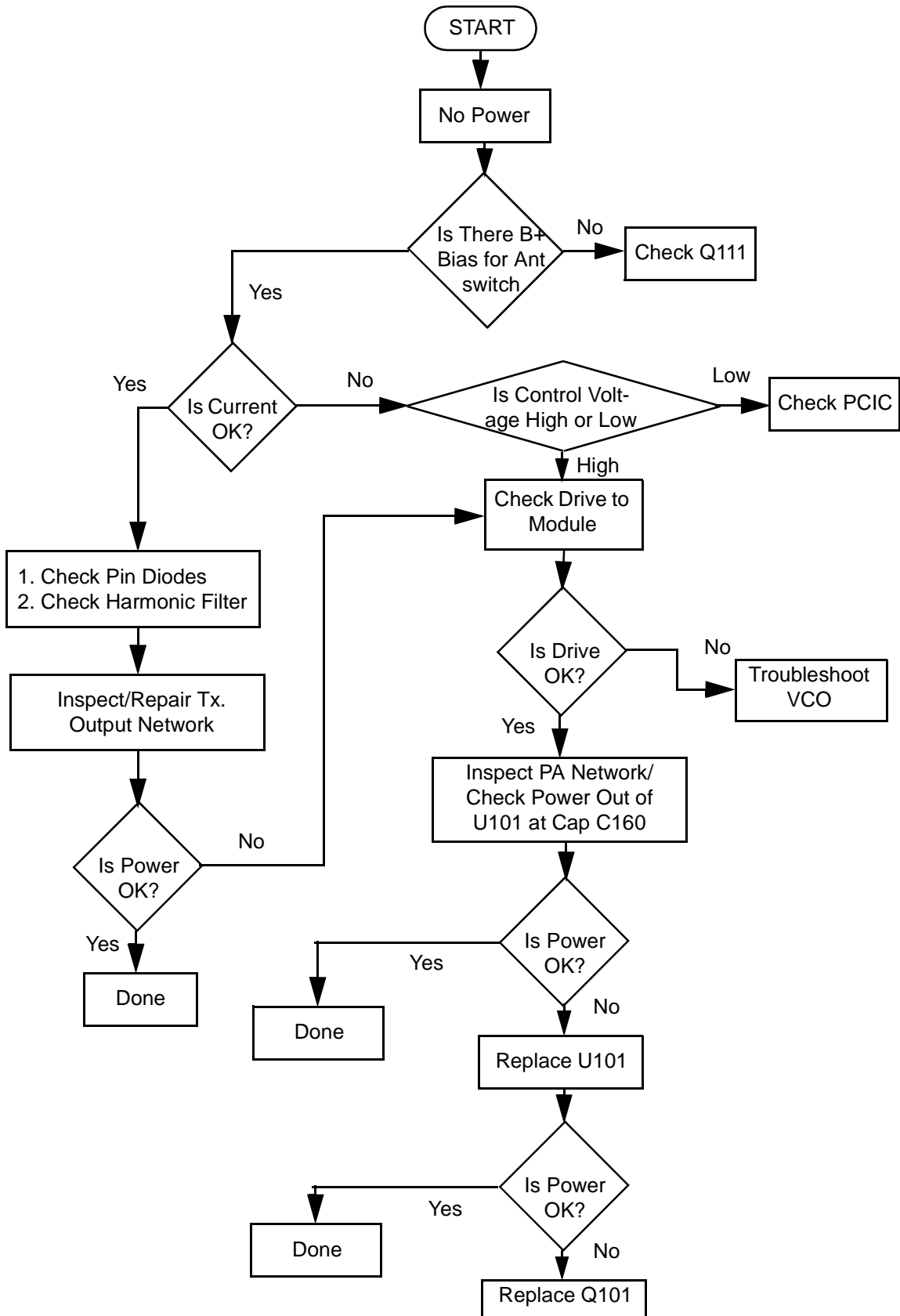
**Troubleshooting Flow Chart for Controller**



**Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)**

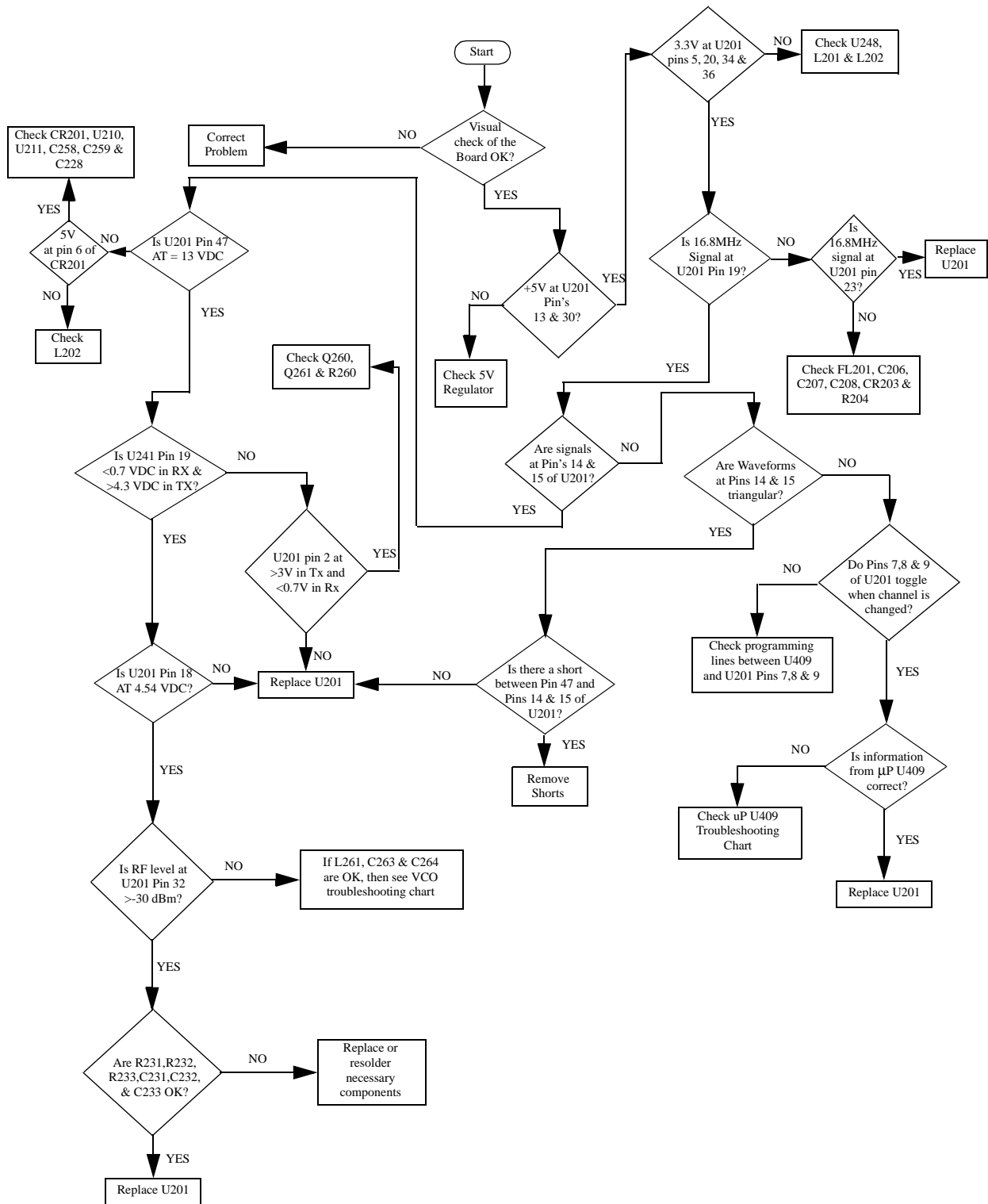


**Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)**

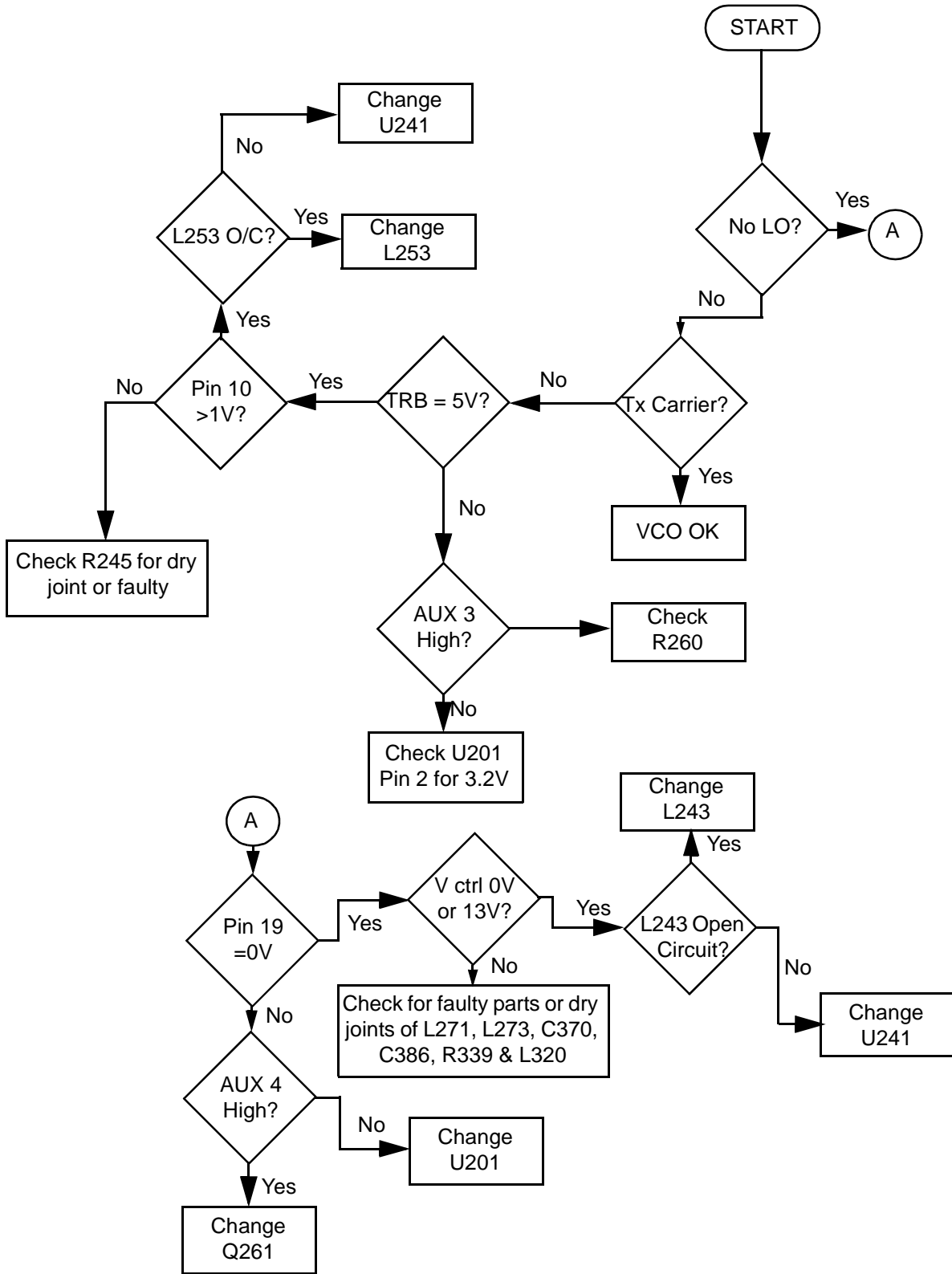


**Troubleshooting Flow Chart for Transmitter**





**Troubleshooting Flow Chart for Synthesizer**



**Troubleshooting Flow Chart for VCO**

## Section 6B

# MODEL CHART AND TEST SPECIFICATIONS (136-174 MHZ)

### 1.0 Model Chart

<b>GP Series, VHF, 136-174 MHz</b>			
<b>Model</b>			<b>Description</b>
AZH25KDC9AA2			GP328 136-174 MHz 5W 4CH
AZH25KDC9AA3			GP328 136-174 MHz 5W
AZH25KDH9AA6			GP338 136-174 MHz 5W
<b>Item</b>			<b>Description</b>
X		PMUD1573_	GP328 Super Tanapa 136-174 MHz 5W 4CH
	X	PMUD1480_	GP328 Super Tanapa 136-174 MHz 5W
		X PMUD1481_	GP338 Super Tanapa 136-174 MHz 5W
X		PMUD1574_	GP328 Tanapa 136-174 MHz 5W 4CH
	X	PMUD1495_	GP328 Tanapa 136-174 MHz 5W
		X PMUD1496_	GP338 Tanapa 136-174 MHz 5W
X		PMLD4159_	GP328 B/C Kit 136-174 MHz 5W 4CH
	X	PMLD4109_	GP328 B/C Kit 136-174 MHz 5W
		X PMLD4110_	GP338 B/C Kit 136-174 MHz 5W
X		PMLN4348_	GP328 Front Housing Kit 4CH
	X	PMLN4216_	GP328 Front Housing Kit
		X PMLN4199_	GP338 Front Housing Kit
X	X	X PMAD4012_	Antenna, 136-155 MHz Stubby
X	X	X PMAD4013_	Antenna, 155-174 MHz Stubby
X	X	X PMAD4014_	Antenna, 136-155 MHz 14 cm
X	X	X PMAD4015_	Antenna, 155-174 MHz 14 cm
X	X	X PMAD4023_	Antenna, 150-164 MHz 14 cm
X	X	X PMAD4025_	Antenna, 150-161 MHz Stubby
X	X	X NAD6579_	Antenna, 148-161 MHz 19 cm
X	X	6804110J54	GP328 User Guide
		X 6804110J55	GP338 User Guide

x = Indicates one of each is required.

<b>GP Series, VHF, 136-174 MHz</b>					
<b>Model</b>				<b>Description</b>	
AZH25KDC9AA3 with option AZQ203AD				GP328 136-174 MHz 5W (w/o keypad, camouflage)	
AZH25KDC9AA3 with option AZH64AG				GP328 136-174 MHz 5W (w/o keypad, yellow)	
AZH25KDH9AA6 with option AZQ203AF				GP338 136-174 MHz 5W (keypad, camouflage)	
AZH25KDH9AA6 with option AZH64AI				GP338 136-174 MHz 5W (keypad, yellow)	
<b>Item</b>				<b>Description</b>	
X				PMUD1804_	GP328 Super Tanapa 136-174 MHz 5W
	X			PMUD1800_	GP328 Super Tanapa 136-174 MHz 5W
		X		PMUD1806_	GP338 Super Tanapa 136-174 MHz 5W
			X	PMUD1802_	GP338 Super Tanapa 136-174 MHz 5W
X				PMUD1805_	GP328 Tanapa 136-174 MHz 5W
	X			PMUD1801_	GP328 Tanapa 136-174 MHz 5W
		X		PMUD1807_	GP338 Tanapa 136-174 MHz 5W
			X	PMUD1803_	GP338 Tanapa 136-174 MHz 5W
X	X			PMLD4109_	GP328 B/C Kit 136-174 MHz 5W
		X	X	PMLD4110_	GP338 B/C Kit 136-174 MHz 5W
X				PMLN4539_	GP328 Front Housing Kit
	X			PMLN4544_	GP328 Front Housing Kit
		X		PMLN4538_	GP338 Front Housing Kit
			X	PMLN4545_	GP338 Front Housing Kit
X	X	X	X	PMAD4012_	Antenna, 136-155 MHz Stubby
X	X	X	X	PMAD4013_	Antenna, 155-174 MHz Stubby
X	X	X	X	PMAD4014_	Antenna, 136-155 MHz 14 cm
X	X	X	X	PMAD4015_	Antenna, 155-174 MHz 14 cm
X	X	X	X	PMAD4023_	Antenna, 150-164 MHz 14 cm
X	X	X	X	PMAD4025_	Antenna, 150-161 MHz Stubby
X	X	X	X	NAD6579_	Antenna, 148-161 MHz 19 cm
X	X			6804110J54	GP328 User Guide
		X	X	6804110J55	GP338 User Guide

x = Indicates one of each is required.

## 2.0 Specifications

### General

	VHF	
Frequency:	136-174 MHz	
Channel Capacity:	GP328 : 4/16 Channels GP338 : 128 Channels	
Power Supply:	7.5 Volts $\pm$ 20%	
Dimensions with Standard High Capacity NiMH Battery:	137mm x 57.5mm x 37.5mm	
with Ultra High Capacity NiMH Bat- tery:	137mm x 57.5mm x 40mm	
Weight: with Standard High Capacity NiMH Battery:	420 g	
with Ultra High Capacity NiMH Bat- tery:	500 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity NiMH Bat- tery:	Low Pow- er	High Pow- er
Ultra High Capac- ity NiMH Battery:	>11 hrs	>8 hrs
	>14 hrs	>11 hrs
Sealing:	Passes rain testing per IP54	
Shock:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Vibration:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Dust:	Meets MIL-STD-810- C,D & E and IP54	
Humidity:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
FCC ID	AZ489FT3794	

### Transmitter

	VHF	
RF Output NiMH @ 7.5V:	Low 1W	High 5W
Frequency	136-174 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre- Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

### Receiver

	VHF 12.5kHz	VHF 20/ 25kHz
Frequency:	136- 174MHz	136- 174MHz
Sensitivity 12dB EIA SINAD:	0.35 $\mu$ V	0.35 $\mu$ V
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

### 3.0 Transmitter

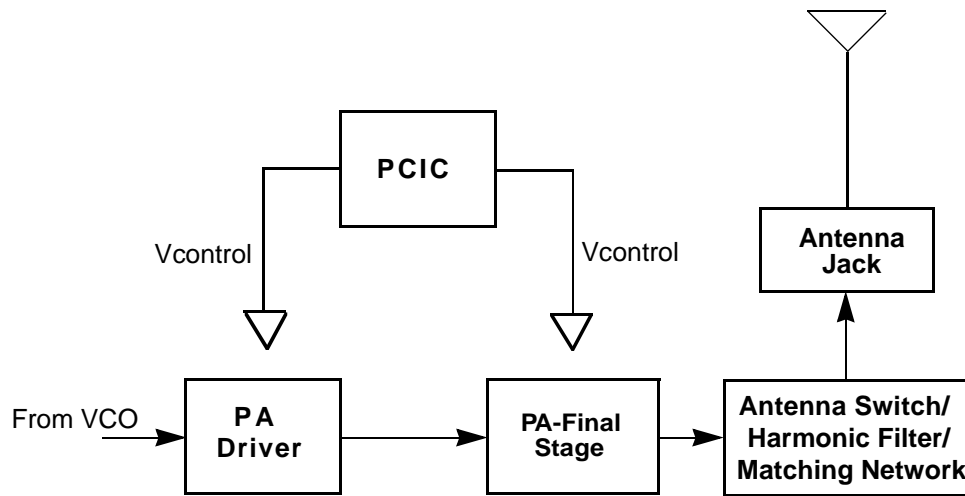


Figure 6-1: Transmitter Block Diagram

#### 3.1 General

(Refer to Figure 6-1)

The VHF transmitter contains five basic circuits:

1. power amplifier
2. antenna switch
3. harmonic filter
4. antenna matching network
5. power control integrated circuit (PCIC).

##### 3.1.1 Power Amplifier

The power amplifier consists of two devices:

1. 9Z67 LDMOS driver IC (U3501) and
2. PRF1507 LDMOS PA (Q3501).

The 9Z67 LDMOS driver IC contains a 2 stage amplification with a supply voltage of 7.3V.

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

The PRF1507 LDMOS PA is capable of supplying an output power of 7W with an input signal of 0.3W. The current drain would typically be 1800mA while operating in the frequency range of 136-174MHz. The power output can be varied by changing the biasing voltage.

### 3.1.2 Antenna Switch

The antenna switch circuit consists of two PIN diodes (D3521 and D3551), a pi network (C3531, L3551 and C3550), and three current limiting resistors (R3571, R3572, R3573). In the transmit mode, B+ at PCIC (U3502) pin 23 will go low and turn on Q3561 where a B+ bias is applied to the antenna switch circuit to bias the diodes "on". The shunt diode (D3551) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, and hence, there exists a low attenuation path between the antenna and receiver ports.

### 3.1.3 Harmonic Filter

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

### 3.1.4 Antenna Matching Network

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

### 3.1.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the Power Control IC (PCIC), U3502 to control the power output of the radio by maintaining the radio current drain. The current to the final stage of the power module is supplied through R3519 (0.1ohms), which provides a voltage proportional to the current drain. This voltage is then fed back to the Automatic Level Control (ALC) within the PCIC to keep the whole loop stable.

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

There are resistors and integrators within the PCIC, and external capacitors (C3562, C3563 and C3565) in controlling the transmitter rising and falling time. These are necessary in reducing the power splatter into adjacent channels.

U3503 and its associated circuitry acts as a temperature cut back circuitry. This circuitry provides the necessary voltage to the PCIC to cut the transmitter power when the radio temperature gets too high.

## 4.0 Receiver

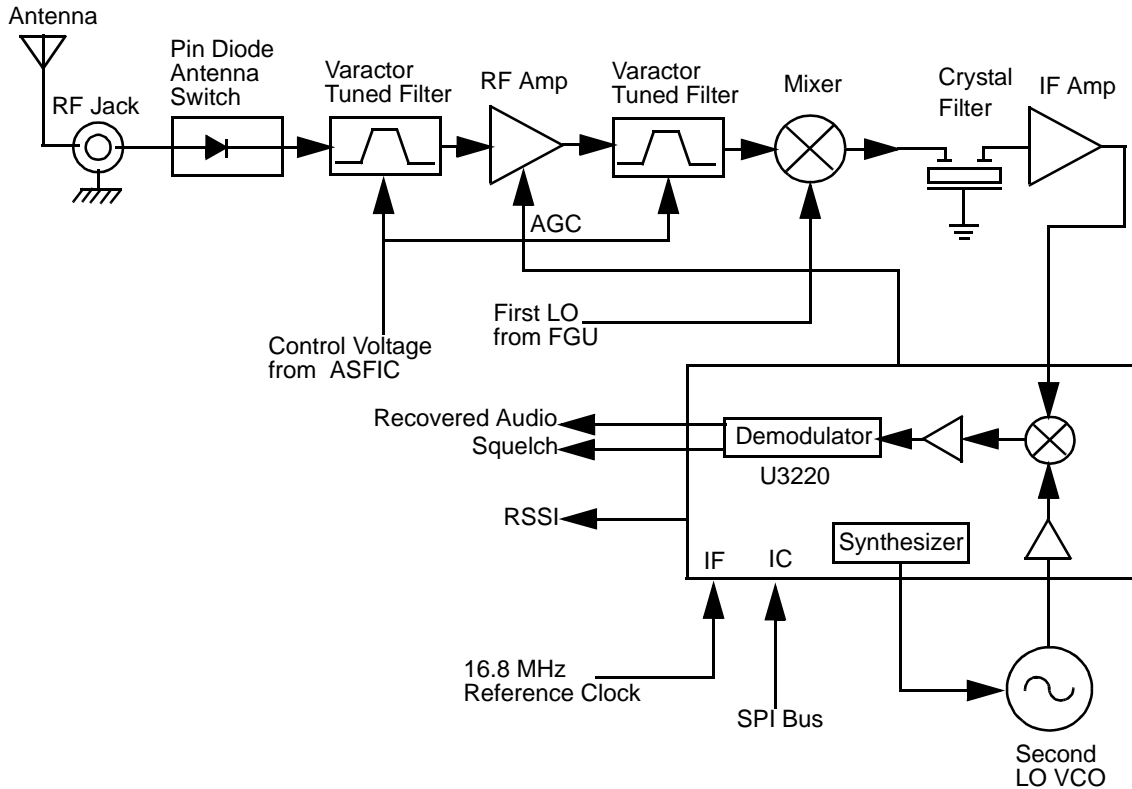


Figure 6-2: VHF Receiver Block Diagram

### 4.1 Receiver Front-End

(Refer to *VHF Receiver Front End Schematic Diagram* on page 6B-20, *VHF Receiver Back End Schematic Diagram* on page 6B-21, and *VHF Transmitter Schematic Diagram* on page 6B-24)

The RF signal is received by the antenna and applied to a low-pass filter. For VHF, the filter consists of L3531, L3532, C3532 to C3563. The filtered RF signal is passed through the antenna switch. The antenna switch circuit consists of two PIN diodes (D3521 and D3551) and a pi network (C3531, L3551 and C3550). The signal is then applied to a varactor tuned bandpass filter. The VHF bandpass filter comprises of L3301, L3303, C3301 to C3304 and D3301. The bandpass filter is tuned by applying a control voltage to the varactor diode (D3301) in the filter.

The bandpass filter is electronically tuned by the DACRx from IC404 which is controlled by the microprocessor. Depending on the carrier frequency, the DACRx will supply the tuned voltage to the varactor diodes in the filter. Wideband operation of the filter is achieved by shifting the bandpass filter across the band.

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

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



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

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

## 4.2 Receiver Back-End

(Refer to *VHF Receiver Back End Schematic Diagram* on page 6B-21)

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

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

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

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

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

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

### 4.3 Automatic Gain Control Circuit

(Refer to *VHF Receiver Front End Schematic Diagram* on page 6B-20 and *VHF Receiver Back End Schematic Diagram* on page 6B-21)

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

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

Resistors R3304 and R3305 are voltage dividers designed to turn on Q3301 at certain RSSI levels. In order to turn on Q3301 the voltage across R3305 must be greater or equal to the voltage across R3324, plus the base-emitter voltage ( $V_{be}$ ) present at Q3301. Capacitor C3209 is used to dampen any instability while the AGC is turning on. The current flowing into the collector of Q3301, a high current gain NPN transistor, will be drawn through the PIN diode to turn it on. Maximum current flowing through the PIN is limited by the resistors R3316, R3313, R3306 and R3324. C3326 is a feedback capacitor used to provide some stability to this high gain stage.

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

## 5.0 Frequency Generation Circuitry

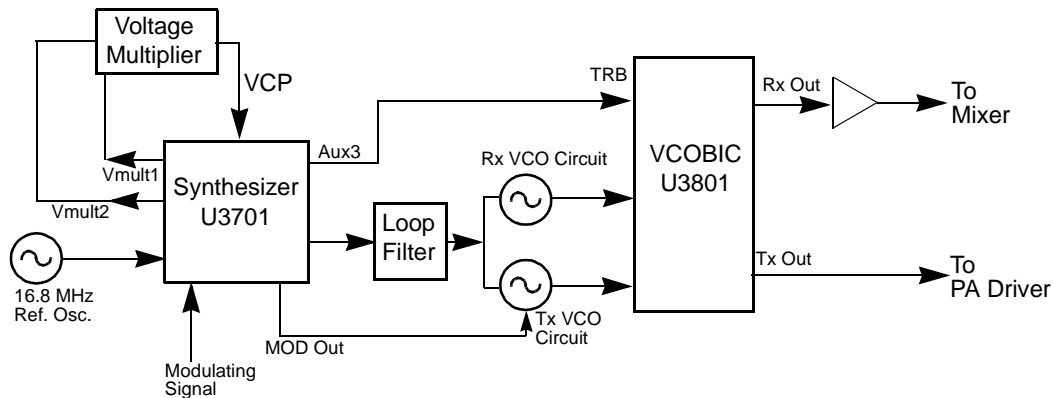


Figure 6-3: Frequency Generation Unit Block Diagram

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

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

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

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

### 5.1 Synthesizer

(Refer to *VHF Synthesizer Schematic Diagram* on page 6B-22)

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

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

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

Both the normal and adapt charge pumps get their supply from the capacitive voltage multiplier which is made up of C3701 to C3704 and triple diodes D3701, D3702. Two 3.3V square waves ( 180 deg out of phase) are first multiplied by four and then shifted, along with regulated 5V, to build up 13.5V at pin 47 of U3701.

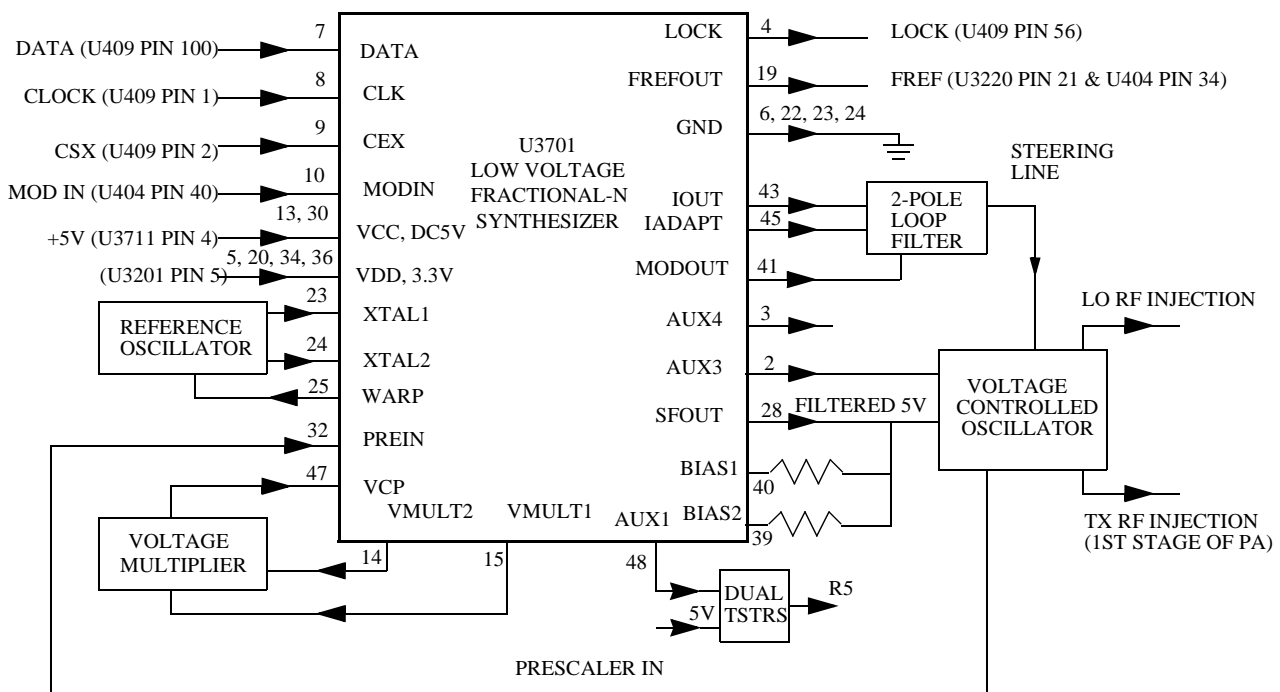


Figure 6-4 Synthesizer Block Diagram

## 5.2 VCO - Voltage Controlled Oscillator

(Refer to *VHF Voltage Controlled Oscillator Schematic Diagram* on page 6B-23)

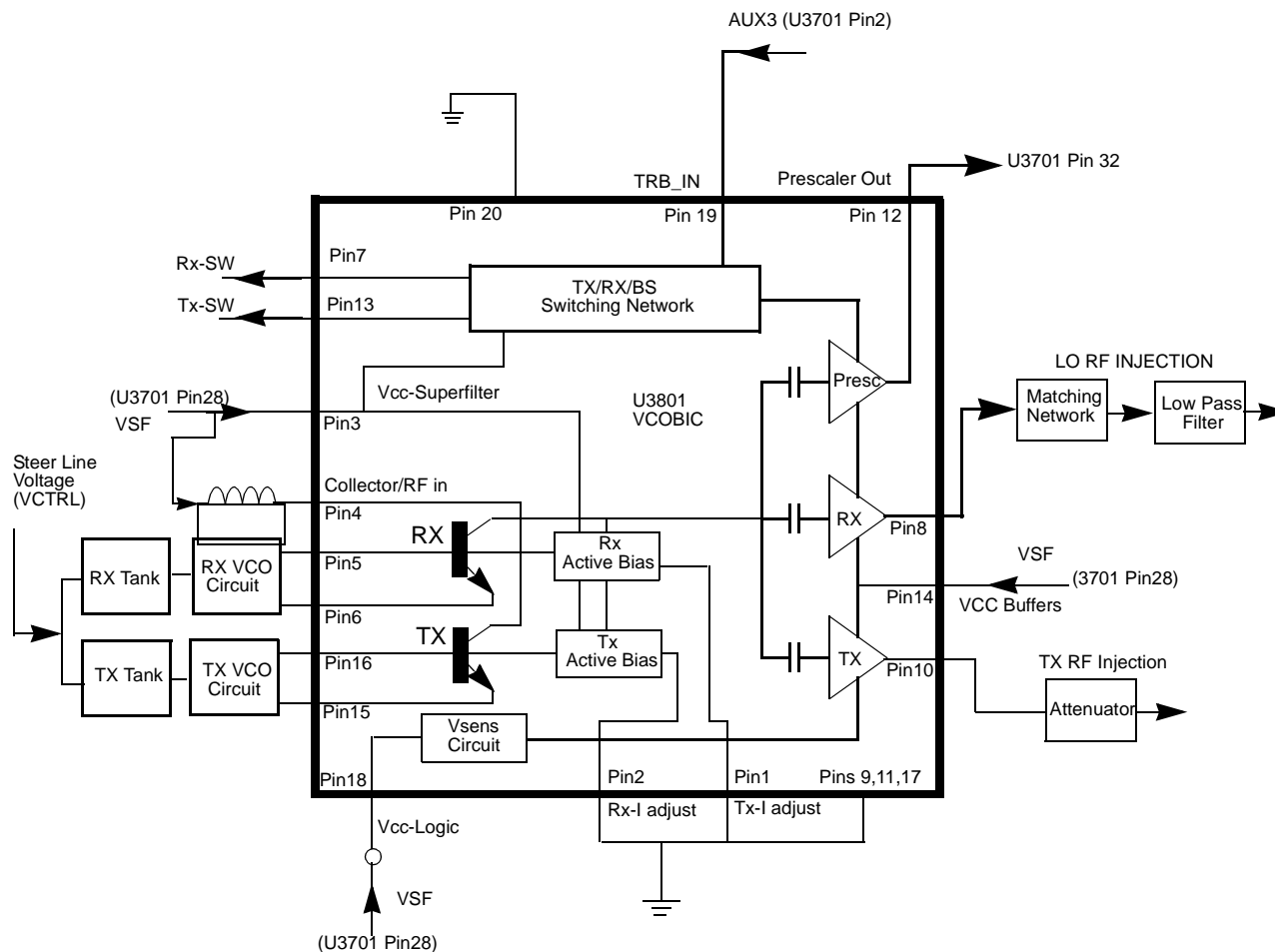


Figure 6-5: VCO Block Diagram

The VCOBIC (U3801) in conjunction with the Fractional-N synthesizer (U3701) generates RF in both the receive and the transmit modes of operation. The TRB line (U3801 pin 19) determines which oscillator and buffer will be enabled. A sample of the RF signal from the enabled oscillator is routed from U3801 pin 12, through a low pass filter, to the prescaler input (U3701 pin 32). After frequency comparison in the synthesizer, a resultant CONTROL VOLTAGE is received at the VCO. This voltage is a DC voltage typically between 3.5V and 9.5V when the PLL is locked on frequency.

The RF section of the VCOBIC(U3801) is operated at 4.54 V (VSF), while the control section of the VCOBIC and Fractional-N synthesizer (U3701) is operated at 3.3V. The operation logic is shown in Table 6-1.

*Table 6-1: VCO Control Logic*

<b>Desired Mode</b>	<b>AUX 4</b>	<b>AUX 3</b>	<b>TRB</b>
Tx	n.u.	High (@3.2V)	High (@3.2V)
Rx	n.u.	Low	Low
Battery Saver	n.u.	Hi-Z/Float (@1.6V)	Hi-Z/Float (@1.6V)

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

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

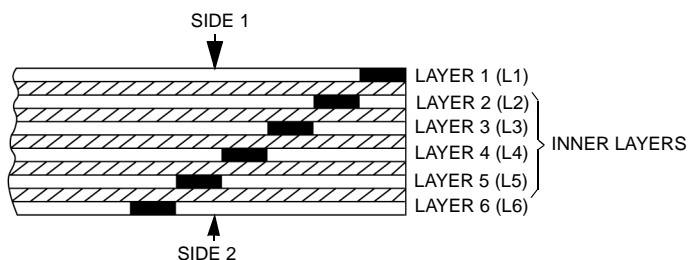
When a high impedance is applied to U3801 pin19, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive transmit and prescaler buffer are turned off.

## 6.0 Notes For All Schematics and Circuit Boards

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

1. Unless otherwise stated, resistances are in Ohms ( $k = 1000$ ), and capacitances are in picofarads (pF) or microfarads ( $\mu F$ ).
2. DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. Transmitter measurements should be made with a  $1.2 \mu H$  choke in series with the voltage probe to prevent circuit loading.
3. Reference Designators are assigned in the following manner:
  - 400/500 Series = Controller
  - 600 Series = Keypad Board
  - 3200 Series = IF Circuitry
  - 3300 Series = Receiver
  - 3500 Series = Transmitter
  - 3700 and  
3800 Series = Frequency Generation
4. Interconnect Tie Point Legend:
  - UNSWB+ = Unswitch Battery Voltage (7.5V)
  - SWB+ = Switch Battery Voltage (7.5V)
  - R5 = Receiver Five Volts
  - CLK = Clock
  - Vdda = Regulated 3.3 Volts (for analog)
  - Vddd = Regulated 3.3 Volts (for digital)
  - CSX = Chip Select Line (not for LVZIF)
  - SYN = Synthesizer
  - DACRX = Digital to Analog Voltage (For Receiver Front End Filter)
  - VSF = Voltage Super Filtered (5 volts)
  - VR = Voltage Regulator

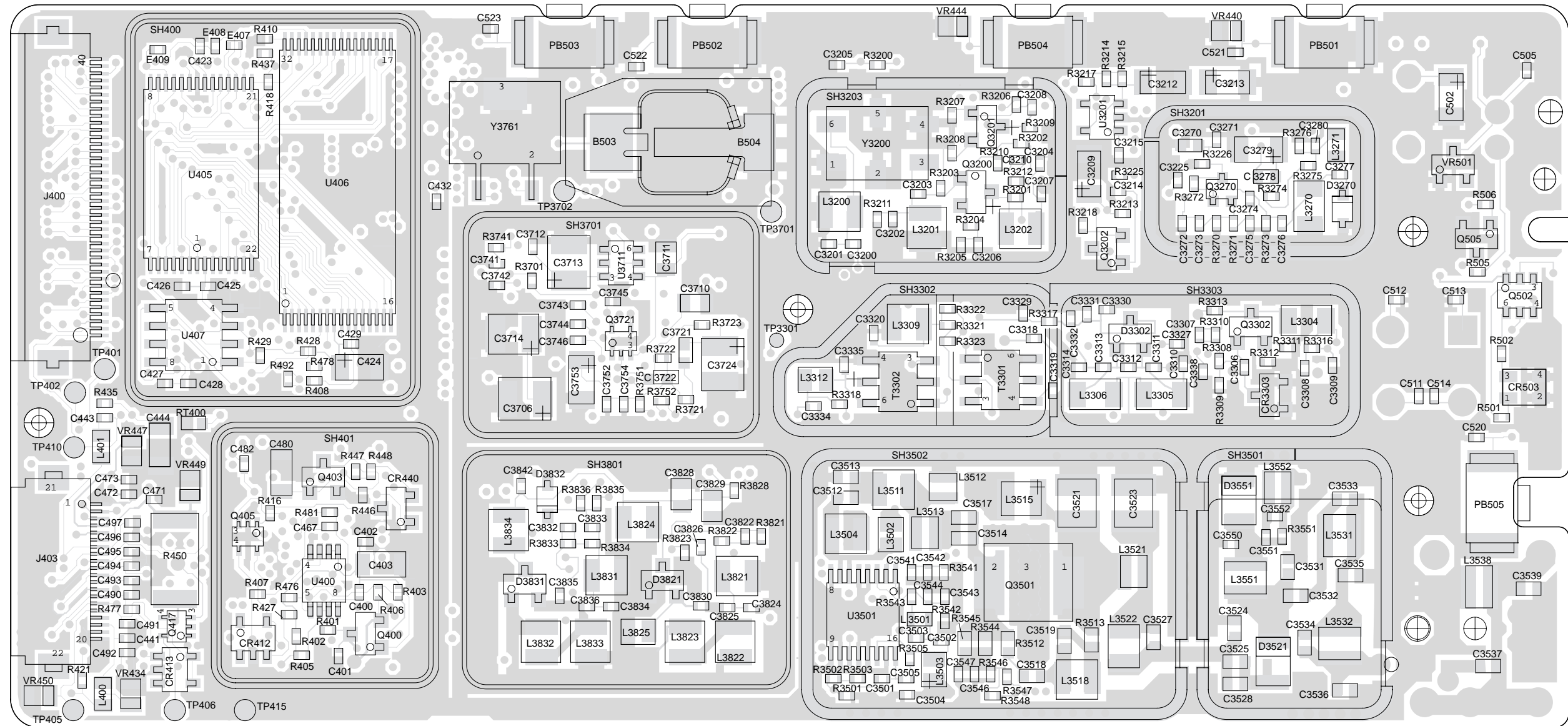
### 6-LAYER CIRCUIT BOARD DETAIL VIEWING COPPER STEPS IN PROPER LAYER SEQUENCE



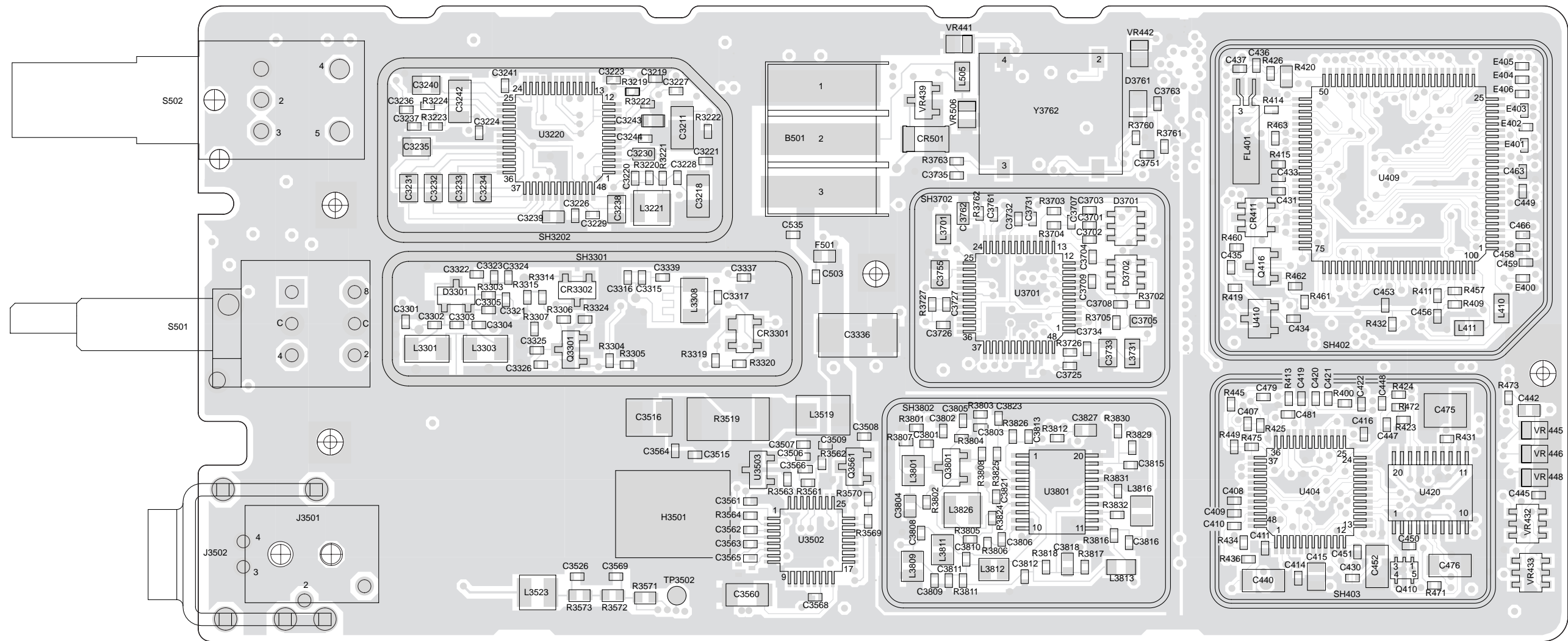




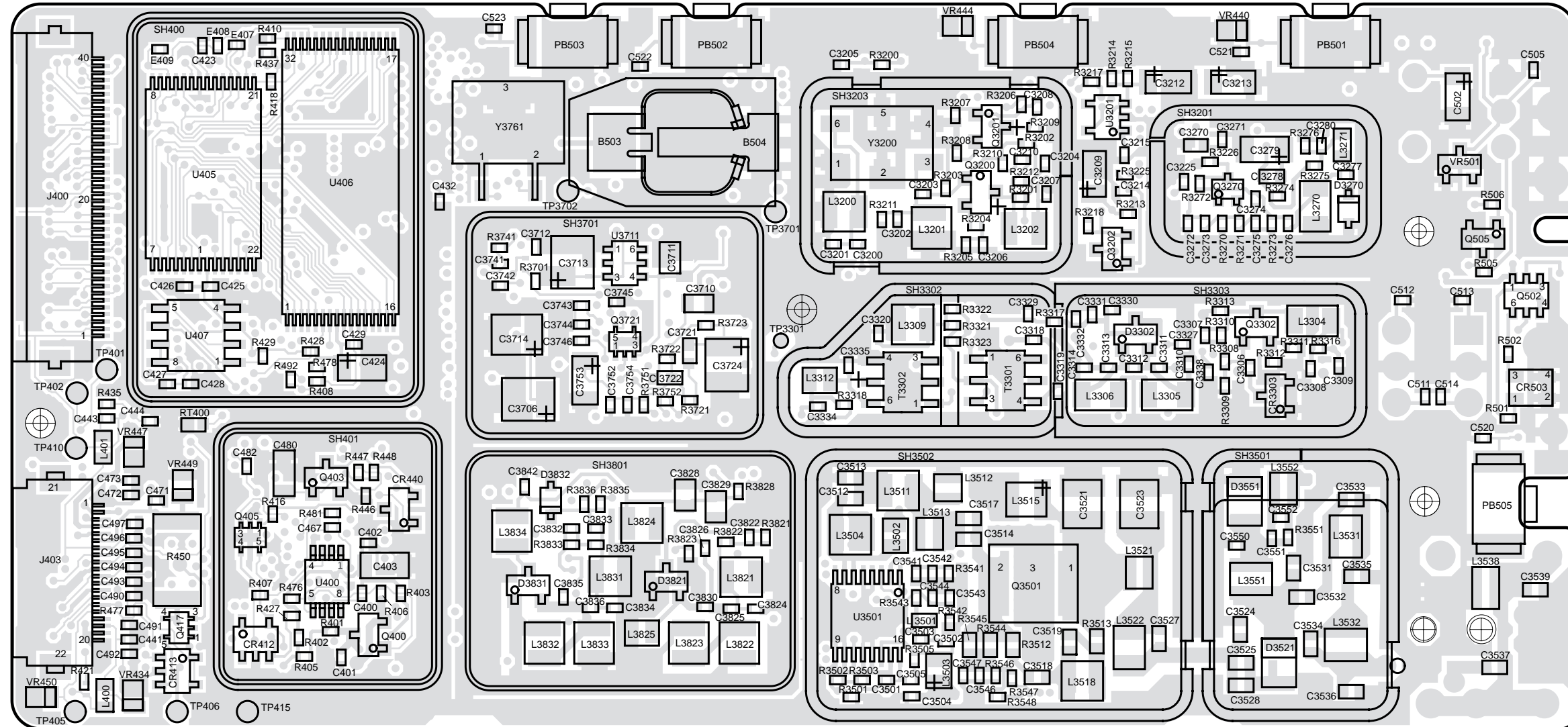
### 7.0 Circuit Board/Schematic Diagrams and Parts List



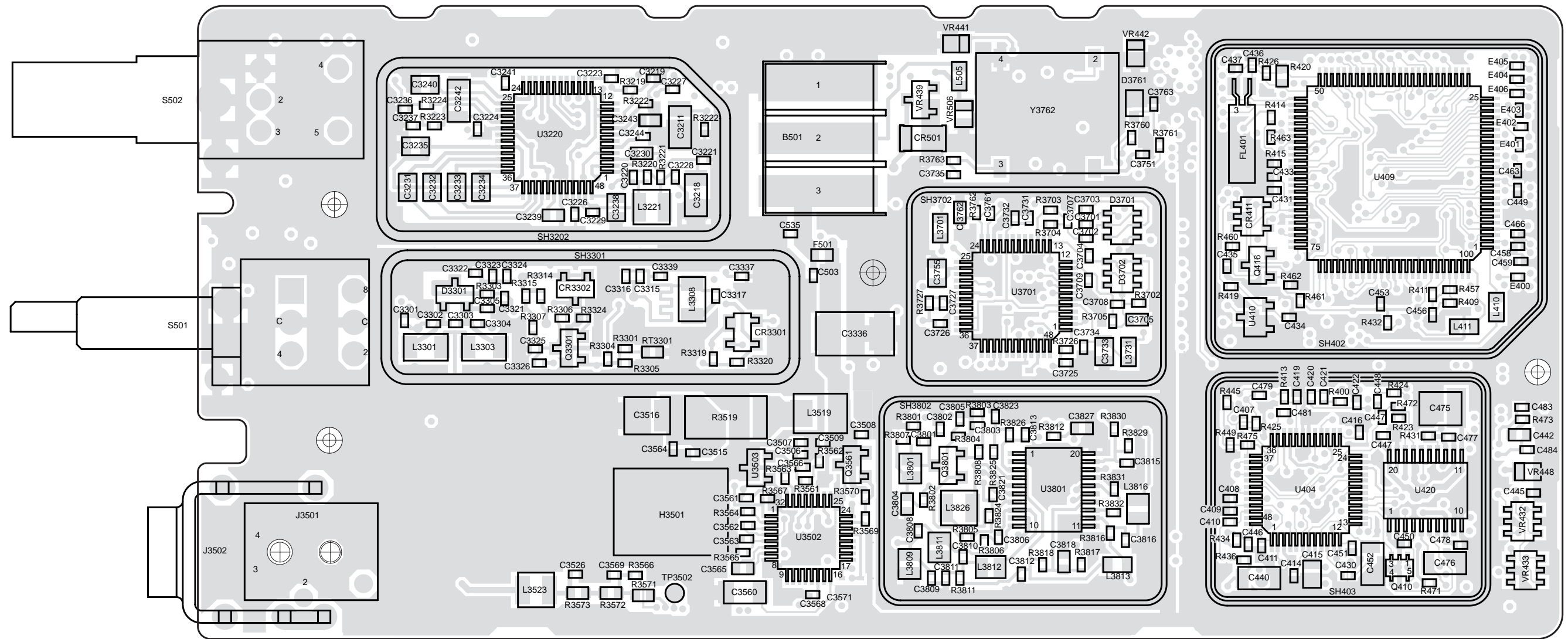
VHF (136-174MHz) Main Board Top Side PCB No. 8486062B09



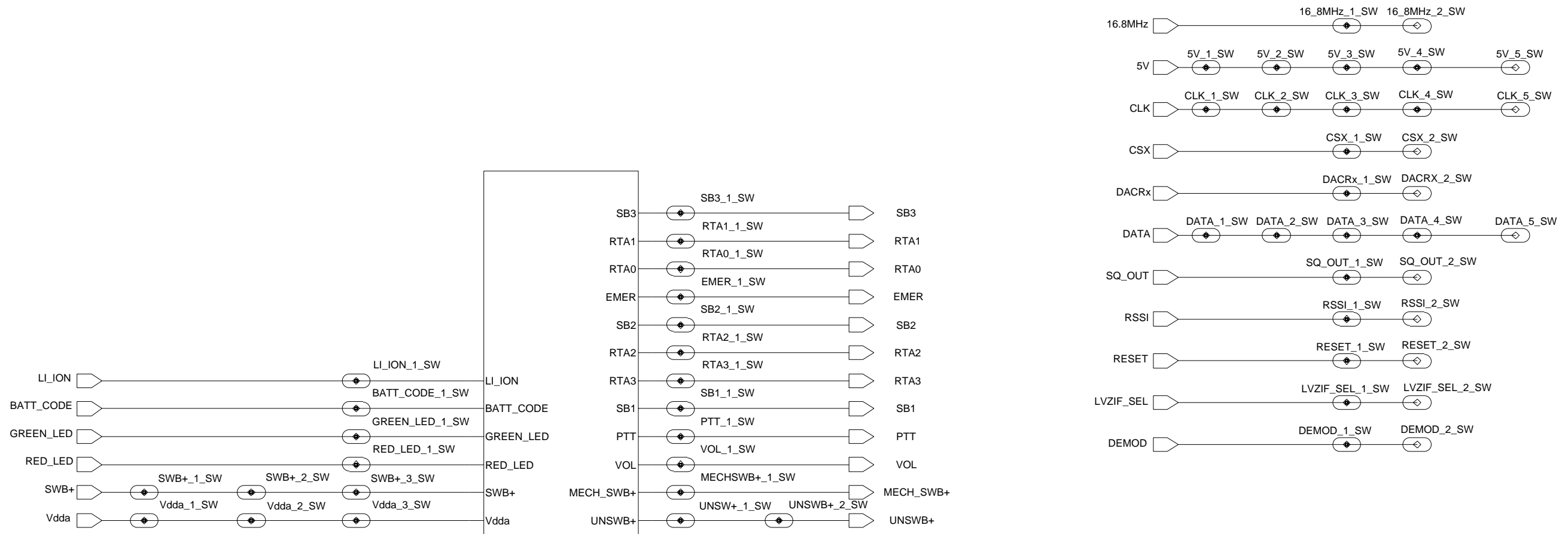
VHF (136-174MHz) Main Board Bottom Side PCB No. 8486062B09



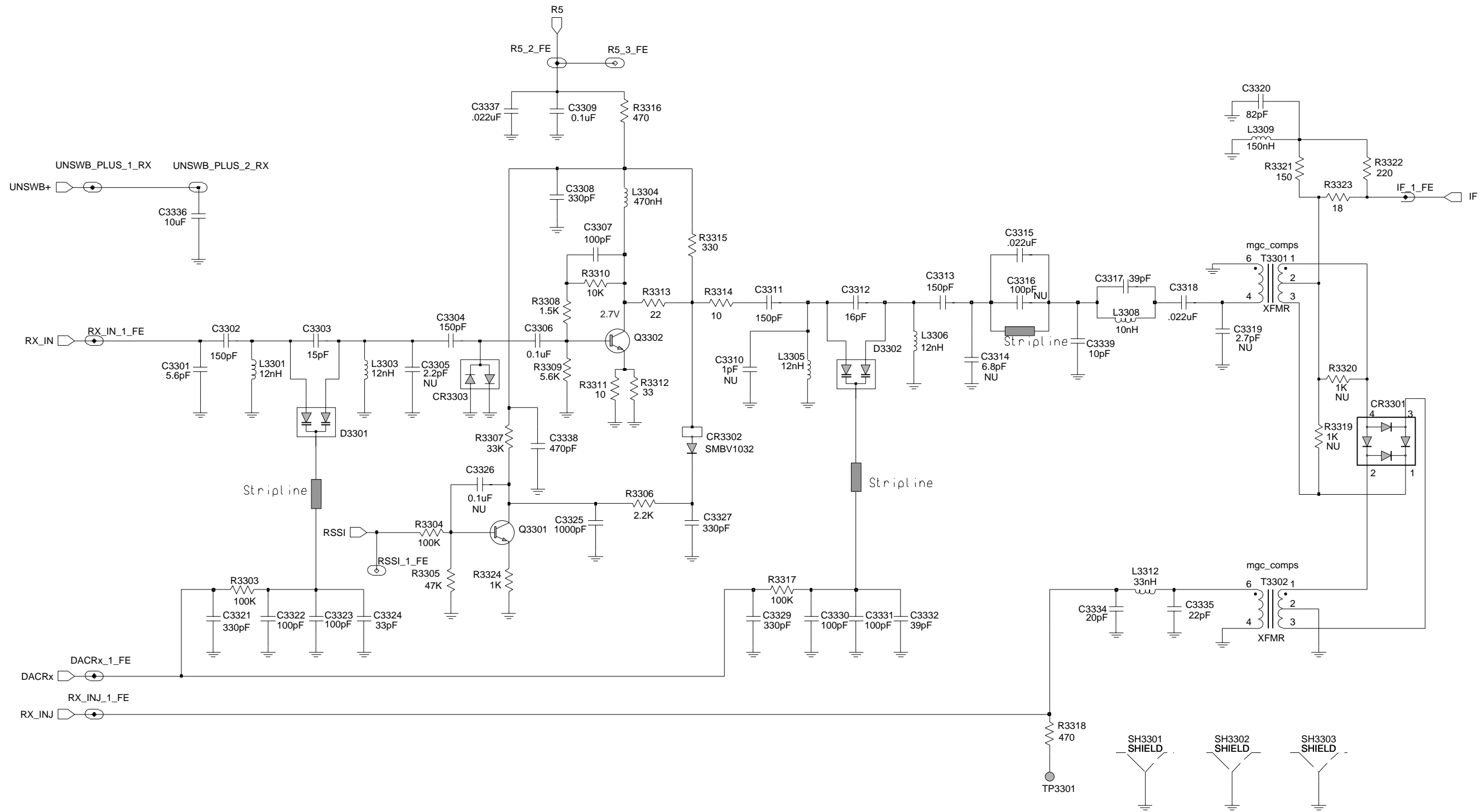
VHF (136-174MHz) Main Board Top Side PCB No. 8486062B12



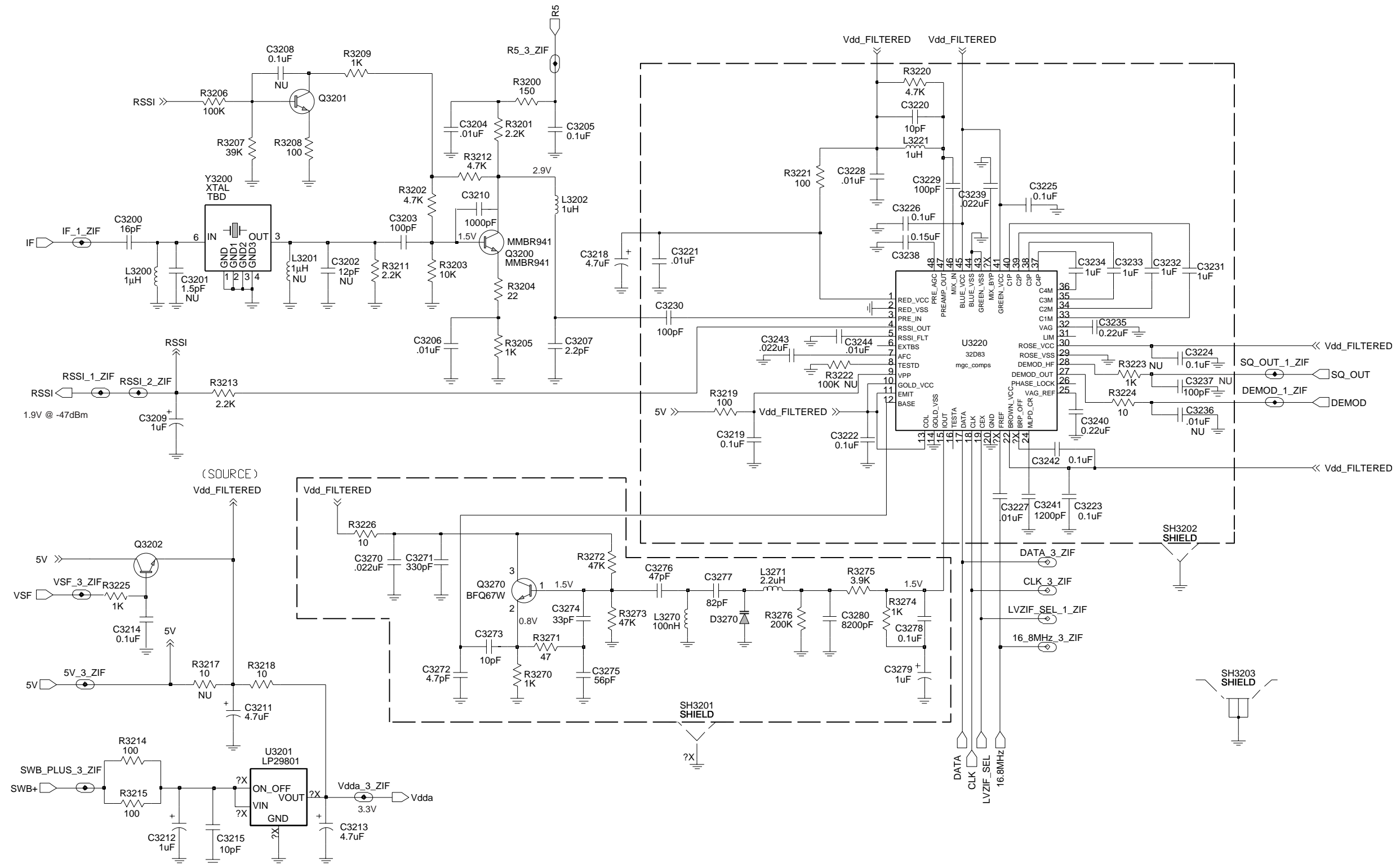
VHF (136-174MHz) Main Board Bottom Side PCB No. 8486062B12



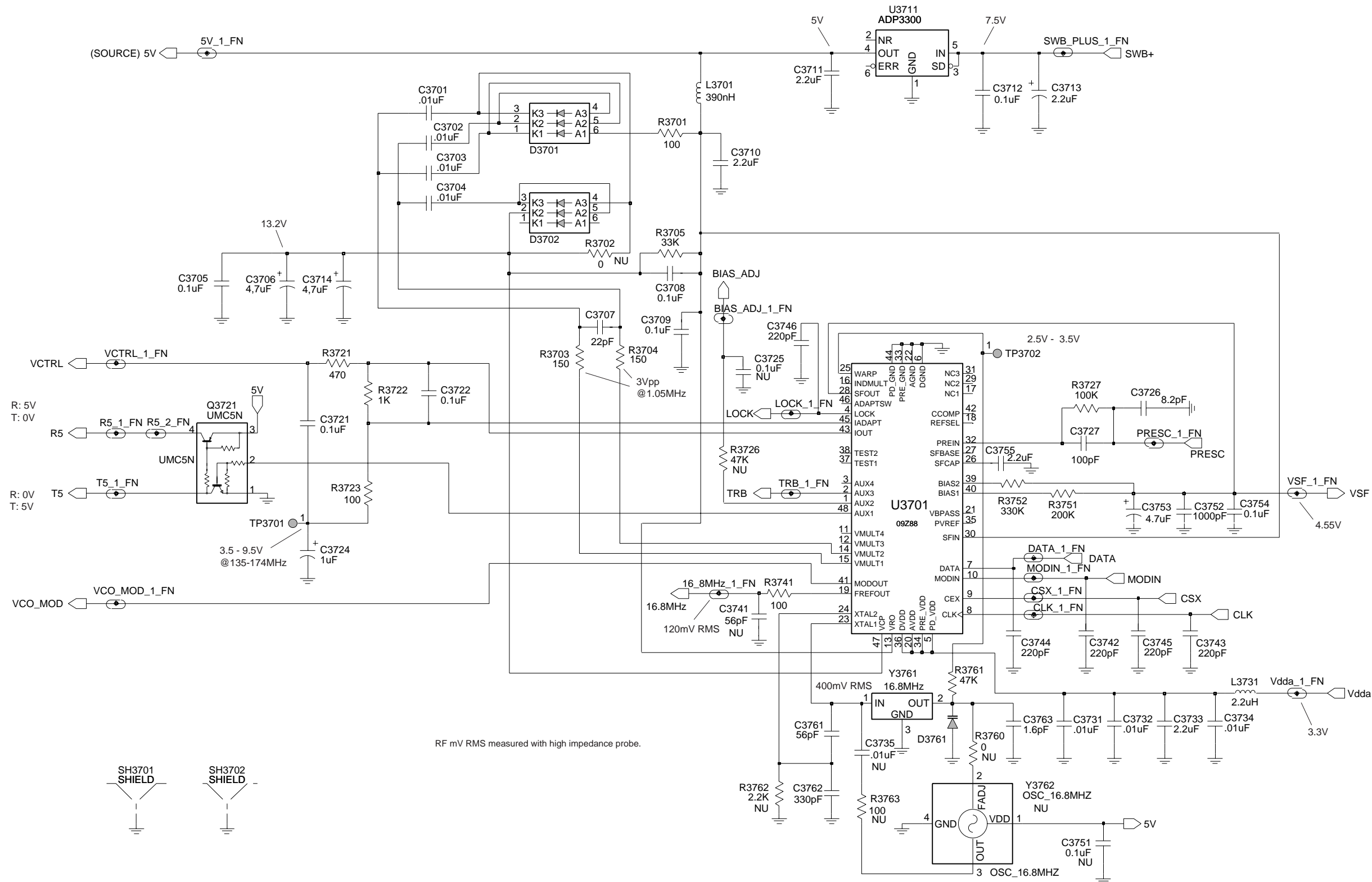
**VHF Controls And Switches Schematic Diagram**



VHF Receiver Front End Schematic Diagram

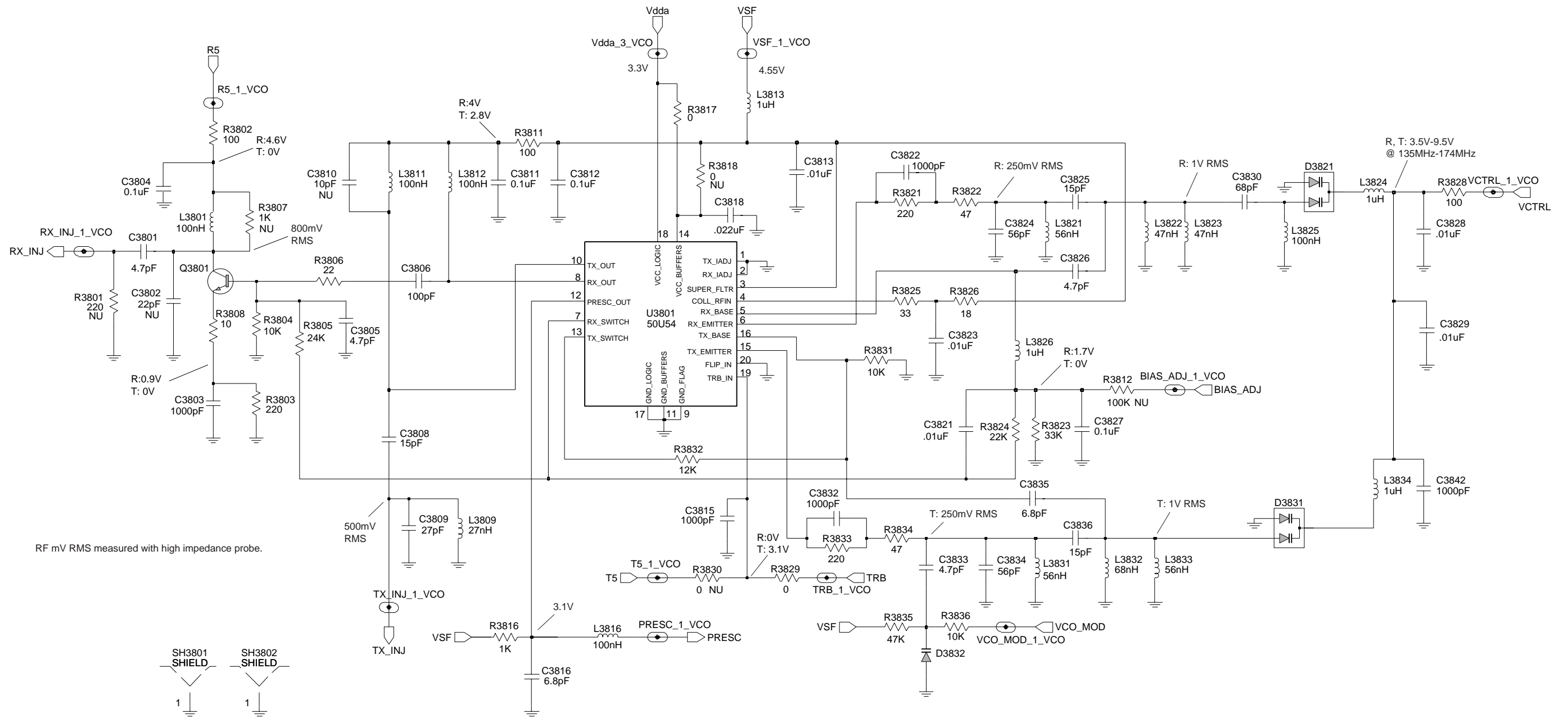


VHF Receiver Back End Schematic Diagram

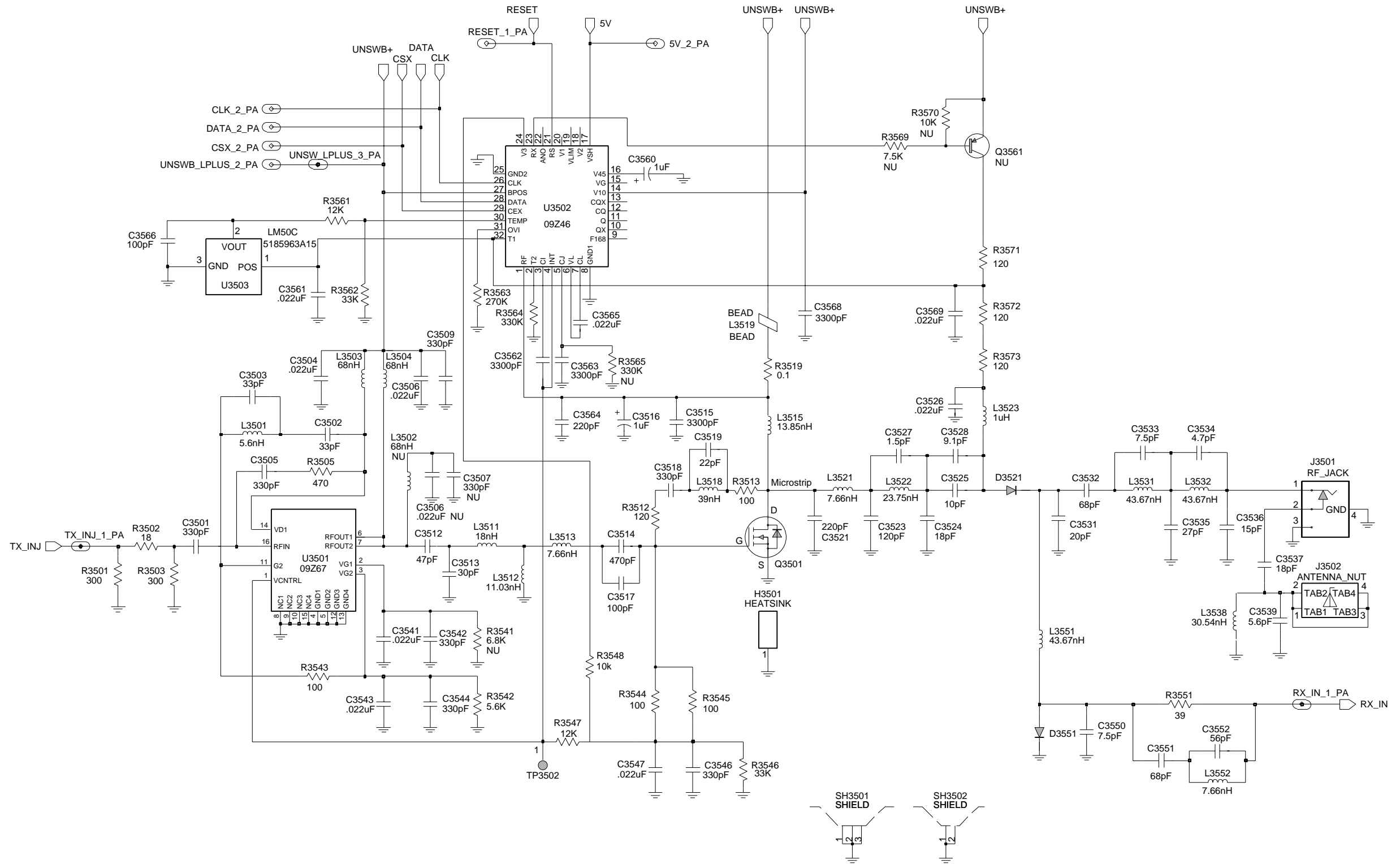


VHF Synthesizer Schematic Diagram





VHF Voltage Controlled Oscillator Schematic Diagram



VHF Transmitter Schematic Diagram

## VHF Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Connector, Contact Battery
B503	3980502Z01	Backup Contact, B+ (not used in GP328)
B504	3980501Z01	Backup Contact, B- (not used in GP328)
C3200	2113743N31	16pF
C3203	2113743N50	100pF
C3204	2113743L41	10000pF
C3205	2113928N01	0.1uF
C3206	2113743L41	10000pF
C3207	2113743N10	2.2pF
C3209	2311049A07	1uF
C3210	2113743L17	1000pF
C3211	2311049A56	4.7uF, 20%, 10V
C3212	2311049A57	10uF
C3213	2311049A56	4.7uF, 20%, 10V
C3214	2113928N01	0.1uF
C3215	2113743N26	10pF
C3218	2311049A56	4.7uF, 20%, 10V
C3219	2113928N01	0.1uF
C3220	2113743N26	10pF
C3221	2113743L41	10000pF
C3222	2113928N01	0.1uF
C3223	2113928N01	0.1uF
C3224	2113928N01	0.1uF
C3225	2113928N01	0.1uF
C3226	2113928N01	0.1uF
C3227	2113743L41	10000pF
C3228	2113743L41	10000pF
C3229	2113743N50	100pF
C3230	2113740F51	100pF
C3231	2180478Z20	1uF
C3232	2180478Z20	1uF
C3233	2180478Z20	1uF
C3234	2180478Z20	1uF
C3235	2113743A23	0.22uF
C3238	2113743A24	0.33uF
C3239	2113743E07	0.022uF
C3240	2113743A23	0.22uF
C3241	2113743L19	1200pF
C3242	2109720D14	0.1uF
C3243	2113743E07	0.022uF
C3244	2113743L41	10000pF
C3270	2113743E07	0.022uF
C3271	2113743L05	330pF
C3272	2113743N18	4.7pF
C3273	2113743N26	10pF
C3274	2113743N38	33pF
C3275	2113743N44	56pF

Circuit Ref	Motorola Part No.	Description
C3276	2113743N42	47pF
C3277	2113743N48	82pF
C3278	2113743E07	0.022uF
C3279	2311049A40	2.2uF
C3280	2113743L41	10000pF
C3301	2113743N20	5.6pF
C3302	2113743N54	150pF
C3303	2113743N30	15pF
C3304	2113743N54	150pF
C3306	2113928N01	0.1uF
C3307	2113743N50	100pF
C3308	2113743L05	330pF
C3309	2113928N01	0.1uF
C3311	2113743N54	150pF
C3312	2113743N31	16pF
C3313	2113743N54	150pF
C3315	2113743N26	10pF
C3316	2113743N14	3.3pF
C3317	2113743N40	39pF
C3318	2113743M08	22000pF
C3320	2113743N48	82pF
C3321	2113743L05	330pF
C3322	2113743N50	100pF
C3323	2113743N50	100pF
C3324	2113743N38	33pF
C3325	2113743L17	1000pF
C3327	2113743L05	330pF
C3329	2113743L05	330pF
C3330	2113743N50	100pF
C3331	2113743N50	100pF
C3332	2113743N40	39pF
C3334	2113743N33	20pF
C3335	2113743N34	22pF
C3336	2311049A18	10uF
C3337	2113743M08	22000pF
C3338	2113743L09	470pF
C3339	2113743N26	10pF
C3501	2113743L05	330pF
C3502	2113743N38	33pF
C3503	2113743N38	33pF
C3504	2113743M08	22000pF
C3505	2113743N38	33pF
C3508	2113743M08	22000pF
C3509	2113743L05	330pF
C3512	2113740F43	47pF
C3513	2113740F38	30pF
C3514	2113740F67	470pF
C3515	2113743L29	3300pF
C3516	2311049A08	1uF
C3517	2113740F51	100pF
C3518	2113740F63	330pF

Circuit Ref	Motorola Part No.	Description
C3519	2113740F35	22pF
C3521	2111078B51	220pF
C3523	2111078B44	120pF
C3524	2113740F33	18pF
C3525	2113740F27	10pF
C3526	2113743M08	22000pF
C3528	2113740F26	9.1pF
C3531	2113740F34	20pF
C3532	2113740F47	68pF
C3533	2113740F24	7.5pF
C3534	2113740F19	4.7pF
C3535	2113740F37	27pF
C3536	2113740F31	15pF
C3537	2113740F33	18pF
C3539	2113740F29	12pF
C3541	2113743M08	22000pF
C3542	2113743L05	330pF
C3543	2113743M08	22000pF
C3544	2113743L05	330pF
C3546	2113743L05	330pF
C3547	2113743M08	22000pF
C3550	2113743N23	7.5pF
C3551	2113743N46	68pF
C3552	2113743N44	56pF
C3560	2311049A07	1uF
C3561	2113743M08	22000pF
C3562	2113743L29	3300pF
C3563	2113743L29	3300pF
C3564	2113743L01	220pF
C3565	2113743E07	0.022uF
C3566	2113743N50	100pF
C3567	2113743L05	330pF
C3568	2113743L29	3300pF
C3569	2113743M08	22000pF
C3570	2113743L05	330pF
C3571	2113743L09	470pF
C3701	2113743L41	10000pF
C3702	2113743L41	10000pF
C3703	2113743L41	10000pF
C3704	2113743L41	10000pF
C3705	2113743E20	0.10uF, 10%
C3706	2311049J11	4.7uF
C3707	2113743N34	22pF
C3708	2113743M24	100000pF
C3709	2113743M24	100000pF
C3710	2104993J02	2.2uF
C3711	2311049A69	10uF
C3712	2113743M24	100000pF
C3713	2311049A09	2.2uF
C3714	2311049J11	4.7uF
C3715	2113743L09	470pF

Circuit Ref	Motorola Part No.	Description
C3721	2113743E20	0.10uF, 10%
C3722	2113743E20	0.10uF, 10%
C3724	2311049A08	1uF
C3726	2113743N24	8.2pF
C3727	2113743N50	100pF
C3731	2113743L41	10000pF
C3732	2113743L41	10000pF
C3733	2104993J02	2.2uF
C3734	2113743L41	10000pF
C3742	2113743L01	220pF
C3743	2113743L01	220pF
C3744	2113743L01	220pF
C3745	2113743L01	220pF
C3746	2113743L01	220pF
C3752	2113743L17	1000pF
C3753	2311049A56	4.7uF, 20%, 10V
C3754	2113743M24	100000pF
C3755	2104993J02	2.2uF
C3761	2113743N44	56pF
C3762	2113740F63	330pF
C3763	2113743N08	1.6pF
C3801	2113743N18	4.7pF
C3803	2113743L17	1000pF
C3804	2113743E20	0.10uF, 10%
C3805	2113743N18	4.7pF
C3806	2113743N50	100pF
C3808	2113743N30	15pF
C3809	2113743N36	27pF
C3811	2113743M24	100000pF
C3812	2113743M24	100000pF
C3813	2113743L41	10000pF
C3815	2113743L17	1000pF
C3816	2113743N22	6.8pF
C3818	2113743E07	0.022uF
C3821	2113743L41	10000pF
C3822	2113743L17	1000pF
C3823	2113743L41	10000pF
C3824	2113743N44	56pF
C3825	2113743N30	15pF
C3826	2113743N18	4.7pF
C3827	2113743E07	0.022uF
C3828	2185895Z01	0.01uF
C3829	2185895Z01	0.01uF
C3830	2113743N46	68pF
C3832	2113743L17	1000pF
C3833	2113743N18	4.7pF
C3834	2113743N44	56pF
C3835	2113743N22	6.8pF
C3836	2113743N30	15pF
C3842	2113743L17	1000pF
C400	2113743L41	10000pF

Circuit Ref	Motorola Part No.	Description
C401	2113743M24	100000pF
C402	2113743M24	100000pF
C403	2113743G24	2.2uF
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	100000pF
C410	2113928N01	0.1uF
C411	2113743M24	100000pF
C414	2113743M24	100000pF
C415	2185895Z01	0.01uF
C416	2113928N01	0.1uF
C419	2113743L41	10000pF
C420	2113743L41	10000pF
C421	2113928N01	0.1uF
C422	2113743M24	100000pF
C423	2113743N50	100pF
C424	2311049A59	10uF
C425	2113743M24	100000pF
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	100000pF
C429	2113743M24	100000pF
C430	2113928N01	0.1uF
C431	2113743N50	100pF
C433	2113743L41	10000pF
C434	2113928N01	0.1uF (not used in GP328)
C435	2113743M24	100000pF
C436	2113743N34	22pF (not used in GP328)
C437	2113743N34	22pF (not used in GP328)
C440	2113743G26	4.7uF
C441	2113743L09	470pF
C442	2113743E20	0.10uF, 10%
C443	2113928N01	0.1uF
C444	2113743N50	100pF
C445	2113743L09	470pF
C446	2113743L09	470pF
C447	2113928N01	0.1uF
C448	2113928N01	0.1uF
C449	2113743N50	100pF
C451	2113743M08	22000pF
C452	2113743B29	1uF
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF
C471	2113743L09	470pF
C472	2113743L09	470pF
C473	2113743L09	470pF

Circuit Ref	Motorola Part No.	Description
C474	2113743L41	10000pF
C475	2113743H14	10uF
C476	2113928D08	10uF
C477	2113743L17	1000pF
C478	2113743L17	1000pF
C479	2113928N01	0.1uF
C480	2113743G26	4.7uF
C481	2113928N01	0.1uF
C482	2113928N01	0.1uF
C483	2113743L09	470pF
C484	2113743L09	470pF
C490	2113743L09	470pF
C491	2113743L09	470pF
C492	2113743L09	470pF
C493	2113743N50	100pF
C494	2113743N50	100pF
C495	2113743L09	470pF
C496	2113743L09	470pF
C497	2113743L09	470pF
C502	2311049A05	0.47uF
C503	2113743N50	100pF
C505	2113743N50	100pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C520	2113743L41	10000pF
C521	2113743L41	10000pF
C522	2113743L41	10000pF
C523	2113743L41	10000pF
C535	2113743L17	1000pF
CR3301	4802245J42	Ring Quad diode
CR3302	4805129M96	Dual Bonds Pin Diode, RH Reeled
CR3303	4880154K03	Dual common anode-cathode diode
CR411	4802245J47	Schottky diode
CR412	4802245J47	Schottky diode
CR413	4802245J47	Schottky diode
CR440	4813833C02	Dual Diode Common Cathode
CR501	4880107R01	Rectifier
CR503	4805729G49	Red/Yellow LED
D3270	4862824C01	Varactor
D3301	4802081B58	Dual Diode
D3302	4802081B58	Dual Diode
D3521	4880973Z02	Pin diode
D3551	4880973Z02	Pin diode
D3701	4802233J09	Triple diode
D3702	4802233J09	Triple diode
D3761	4862824C03	Varactor
D3821	4805649Q13	Varactor

Circuit Ref	Motorola Part No.	Description
D3831	4805649Q13	Varactor
D3832	4862824C01	Varactor
E400	2480640Z01	Ferrite bead
E401	2480640Z01	Ferrite bead
E402	2480640Z01	Ferrite bead
E403	2480640Z01	Ferrite bead
E404	2480640Z01	Ferrite bead
E405	2480640Z01	Ferrite bead
E406	2480640Z01	Ferrite bead
E407	2480640Z01	Ferrite bead
E408	2480640Z01	Ferrite bead
E409	2480640Z01	Ferrite bead
F501	6580542Z01	3A Fuse
FL401	4870368G02	Real Time clock oscillator Xtal (not used in GP328)
H3501	2680499Z01	Heat spreader
J3501	0985613Z01	RF Jack
J3502	0280519Z02	Antenna nut
J400	0905505Y04	40-pin connector
J403	0905505Y02	20-pin connector
L3200	2462587N68	1000nH
L3202	2462587N68	1000nH
L3221	2462587N68	1000nH
L3270	2462587T15	100nH
L3271	2462587Q20	2200nH
L3301	2462587T35	12nH
L3303	2462587T35	12nH
L3304	2462587T23	470nH
L3305	2462587T35	12nH
L3306	2462587T35	12nH
L3308	2462587T34	10nH
L3309	2462587N55	150nH
L3312	2462587V28	33nH
L3501	2413926H09	5.6nH
L3503	2462587V32	68nH
L3504	2462587N51	68nH
L3511	2462587N44	18nH
L3512	2479990B01	11.03nH
L3513	2479990A02	7.66nH
L3515	2479990C03	13.85nH
L3518	2462587N48	39nH
L3519	2484657R01	Ferrite bead
L3521	2479990A02	7.66nH
L3522	2479990E01	23.75nH
L3523	2462587N68	1000nH
L3531	2479990N01	43.67nH
L3532	2479990N01	43.67nH
L3538	2479990M01	30.54nH
L3551	2479990N01	43.67nH
L3552	2479990A02	7.66nH
L3701	2462587Q42	390nH

Circuit Ref	Motorola Part No.	Description
L3731	2462587Q20	2200nH
L3801	2462587V34	100nH
L3809	2462587V27	27nH
L3811	2462587V34	100nH
L3812	2462587V34	100nH
L3813	2462587Q47	1000nH
L3816	2462587V34	100nH
L3821	2462587N50	56nH
L3822	2462587N49	47nH
L3823	2462587N49	47nH
L3824	2462587N68	1000nH
L3825	2462587V34	100nH
L3826	2462587N68	1000nH
L3831	2462587N50	56nH
L3832	2462587N51	68nH
L3833	2462587N50	56nH
L3834	2462587N68	1000nH
L400	2462587Q42	390nH
L401	2462587Q42	390nH
L410	2462587Q42	390nH
L411	2462587Q42	390nH
L505	2462587Q42	390nH
PB501	4080523Z01	Tactile, Pushbutton
PB502	4080523Z01	Tactile, Pushbutton
PB503	4080523Z01	Tactile, Pushbutton
PB504	4080523Z01	Tactile, Pushbutton
PB505	4080523Z01	Tactile, Pushbutton
Q3200	4813827A07	NPN Transistor
Q3201	4880214G02	NPN Transistor
Q3202	4880214G02	NPN Transistor
Q3270	4805218N63	RF Transistor
Q3301	4880214G02	NPN Transistor
Q3302	4813827A07	NPN Transistor
Q3501	4802245J55	RF Power Amplifier
Q3561	4813824A17	PNP Transistor
Q3721	4802245J50	Dual NPN/PNP Transistor
Q3801	4813827A07	NPN Transistor
Q400	4809579E18	Mosfet P-chan
Q403	4880214G02	NPN Transistor
Q405	4802245J54	Dual NPN Transistor
Q410	4802245J54	Dual NPN Transistor
Q416	4809579E18	Mosfet P-chan (not used in GP328)
Q417	4802245J50	Dual NPN/PNP Transistor
Q502	5180159R01	Dual NPN Transistor
Q505	4880214G02	NPN Transistor
R3200	0662057M54	150
R3201	0662057M82	2200
R3202	0662057M90	4700
R3203	0662057M98	10k
R3204	0662057M26	10

Circuit Ref	Motorola Part No.	Description
R3205	0662057M74	1000
R3206	0662057N23	100k
R3207	0662057N13	39k
R3208	0662057M50	100
R3209	0662057M74	1000
R3210	0662057M82	2200
R3211	0662057M82	2200
R3212	0662057M90	4700
R3213	0662057M82	2200
R3214	0662057M34	22
R3219	0662057M50	100
R3220	0662057M90	4700
R3221	0662057M50	100
R3224	0662057M26	10
R3225	0662057M74	1000
R3226	0662057M26	10
R3270	0662057M74	1000
R3271	0662057M42	47
R3272	0662057N15	47k
R3273	0662057N15	47k
R3274	0662057M83	2400
R3275	0662057M74	1000
R3276	0662057N30	200k
R3303	0662057N23	100k
R3304	0662057N23	100k
R3305	0662057N19	68k
R3306	0662057M82	2200
R3307	0662057N11	33k
R3308	0662057M78	1500
R3309	0662057M92	5600
R3310	0662057M98	10k
R3311	0662057M26	10
R3312	0662057M38	33
R3313	0662057M34	22
R3314	0662057M26	10
R3315	0662057M62	330
R3316	0662057M66	470
R3317	0662057N23	100k
R3318	0662057M66	470
R3321	0662057M54	150
R3322	0662057M58	220
R3323	0662057M32	18
R3324	0662057M58	220
R3501	0662057M61	300
R3502	0662057M32	18
R3503	0662057M61	300
R3505	0662057M62	330
R3512	0662057A27	120
R3513	0662057A25	100
R3519	0680539Z01	0.1
R3542	0662057M92	5600

Circuit Ref	Motorola Part No.	Description
R3543	0662057M50	100
R3544	0662057A25	100
R3545	0662057A25	100
R3546	0662057N11	33k
R3547	0662057N01	12k
R3548	0662057M95	7500
R3551	0662057M40	39
R3561	0662057N01	12k
R3562	0662057N11	33k
R3563	0662057N33	270k
R3564	0662057N35	330k
R3569	0662057M92	5600
R3570	0662057M98	10k
R3571	0662057A27	120
R3572	0662057A27	120
R3573	0662057A27	120
R3701	0662057M50	100
R3703	0662057M54	150
R3704	0662057M54	150
R3705	0662057N11	33k
R3721	0662057M66	470
R3722	0662057M74	1000
R3723	0662057M50	100
R3727	0662057N23	100k
R3741	0662057M50	100
R3751	0662057N30	200k
R3752	0662057N35	330k
R3761	0662057N15	47k
R3802	0662057M50	100
R3803	0662057M58	220
R3804	0662057M98	10k
R3805	0662057N08	24k
R3806	0662057M34	22
R3808	0662057M26	10
R3811	0662057M50	100
R3816	0662057M74	1000
R3817	0662057M01	0
R3821	0662057M58	220
R3822	0662057M42	47
R3823	0662057N11	33k
R3824	0662057N07	22k
R3825	0662057M38	33
R3826	0662057M32	18
R3828	0662057M50	100
R3829	0662057M01	0
R3831	0662057M98	10k
R3832	0662057N01	12k
R3833	0662057M58	220
R3834	0662057M42	47
R3835	0662057N15	47k
R3836	0662057M98	10k

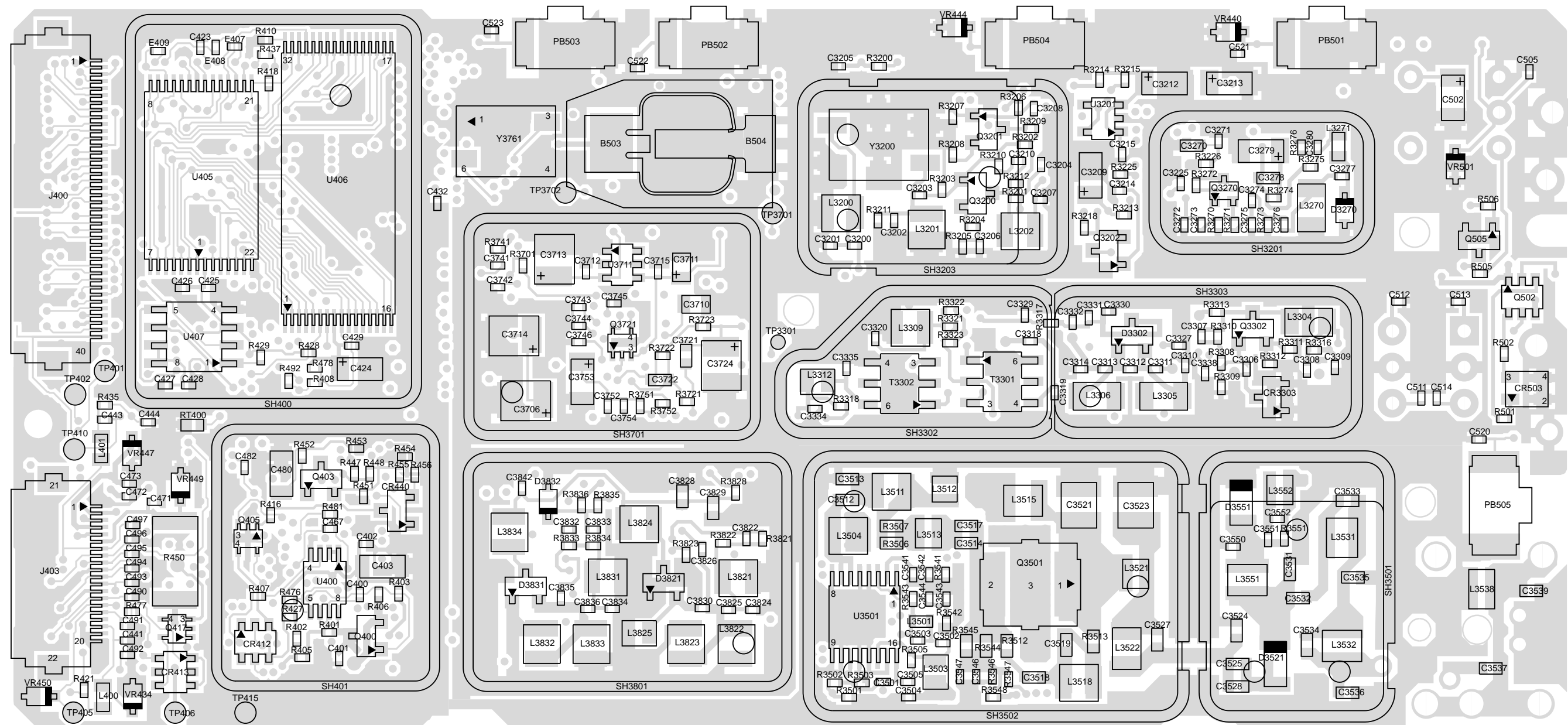
Circuit Ref	Motorola Part No.	Description
R400	0662057N15	47k
R401	0662057M01	0
R405	0662057M01	0
R406	0662057N20	75k
R407	0662057N19	68k
R409	0662057M98	10k
R410	0662057N23	100k
R411	0662057M98	10k
R413	0662057M01	0
R414	0662057V34	180k
R415	0662057V26	91k
R416	0662057M90	4700
R418	0662057M01	0
R419	0662057M67	0 (not used in GP328)
R420	0662057B46	10M (not used in GP328)
R421	0662057M81	2000
R423	0662057N21	82k
R424	0662057N12	36k
R425	0662057N10	30k
R426	0662057N35	330k (not used in GP328)
R427	0662057M84	2700
R428	0662057M10	2.2
R429	0662057M98	10k
R431	0662057N39	470k
R432	0662057N16	51k
R434	0662057M62	330
R435	0662057M81	2000
R436	0662057M01	0
R445	0662057N08	24k
R446	0662057N22	91k
R447	0662057N38	430k
R448	0662057N06	20k
R449	0662057N08	24k
R450	0683962T45	68 ohms, 1W
R457	0662057M98	10k
R460	0662057M90	4700
R461	0662057M56	180 (not used in GP 328)
R462	0662057M98	10k (not used in GP328)
R463	0662057M61	300
R471	0662057N06	20k
R472	0662057M93	6200
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N35	330k
R477	0662057M74	1000
R478	0662057M98	10k
R481	0662057N08	24k
R492	0662057M01	0
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10k

Circuit Ref	Motorola Part No.	Description
R506	0662057N15	47k
RT400	0680590Z01	THERMISTOR_33K
S501	4080710Z01	Frequency Switch
S502	1880619Z02	Volume Switch
SH3201	2602023X08	Rx Backend Top Shield
SH3202	2686081B02	LVZIF shields
SH3203	2686081B03	45.1MHz Xtal Filter Shield
SH3301	2686081B01	Rx Frontend Bottom Shield
SH3302	2686081B05	Mixer Shield
SH3303	2686081B06	Rx Frontend Shield
SH3501	2686081B03	Harmonic Filter Shield
SH3502	2686081B04	PA driver Shield
SH3701	2680511Z01	Synthesizer top shield
SH3702	2680511Z01	Synthesizer bottom shield
SH3801	2680513Z01	VCO Top Shield
SH3802	2680514Z01	VCO Bottom Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller on-off shield
SH402	2680515Z01	Controller Microprocessor shield
SH403	2680516Z01	Controller Asfic_Cmp/Audio PA shield
T3301	2580541Z02	Balun transformer
T3302	2580541Z02	Balun transformer
U3201	5102463J58	3.3V Regulator
U3220	5109632D83	LVZIF IC
U3501	5105109Z67	LDMOS Driver IC
U3502	5185765B28	PCIC
U3503	5185963A15	Temperature sensor
U3701	5185963A27	LVFRACN Synthesizer IC
U3711	5105739X05	5V Regulator
U3801	5105750U54	VCO BUFFER IC
U400	5102463J40	3.3V Regulator
U404	5185963A53	ASFIC_CMP
U406	*5102463J59	128K X 8 FLASH ROM
U407	*5102463J64	16K X 8 EEPROM
U409	5102226J56	Microprocessor IC
U410	5102463J57	3.3V Regulator (not used in GP328)
U420	5102463J44	Audio PA
VR432	4805656W08	5.6V Zener diode
VR433	4805656W08	5.6V Zener diode
VR434	4802245J73	ZENER DIODE - 6.8V
VR439	4880140L17	ZENER DIODE - 12V
VR447	4802245J74	ZENER DIODE - 10V
VR448	4802245J74	ZENER DIODE - 10V
VR449	4802245J74	ZENER DIODE - 10V
VR450	4802245J75	ZENER DIODE - 12V
VR501	4813830A18	ZENER DIODE - 6.8V
VR506	4802245J73	ZENER DIODE - 6.8V
Y3200	9186153B01	Crystal Filter

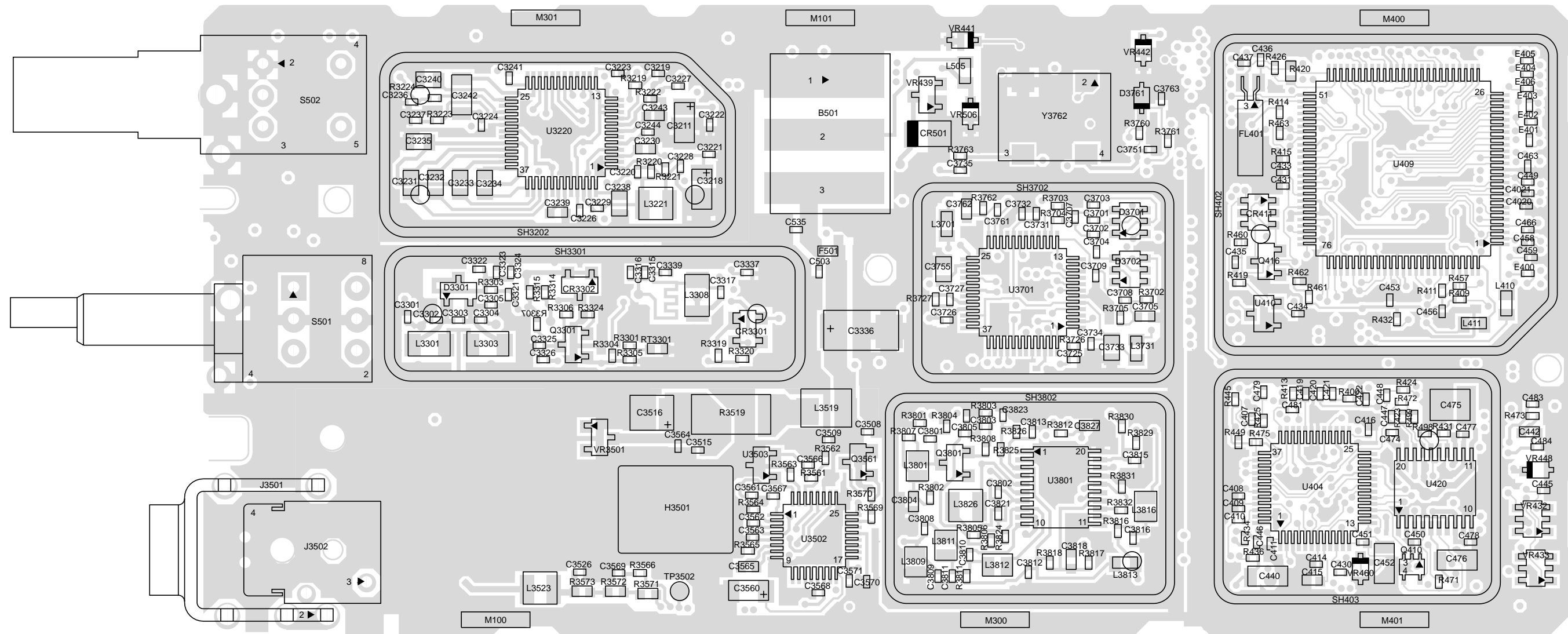
<b>Circuit Ref</b>	<b>Motorola Part No.</b>	<b>Description</b>
Y3761	4802245J49	16.8MHz Xtal Oscillator
	5480678Z01	PCB Barcode label
	8486062B12	VHF Main PC Board

\* Motorola Depot Servicing only

### 8.0 Circuit Board/Schematic Diagrams and Parts List

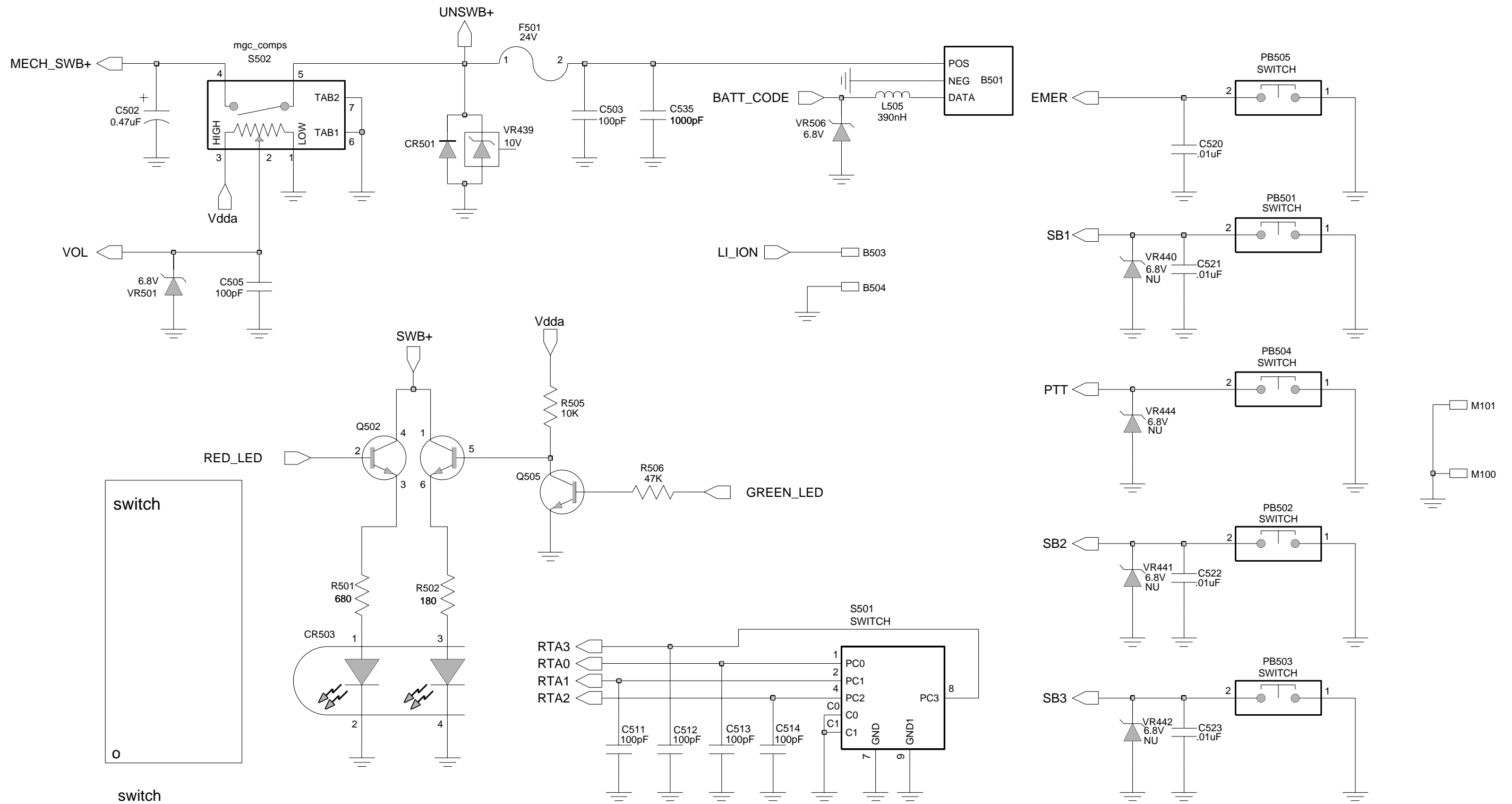


VHF (136-174MHz) Main Board Top Side PCB No. 8486062B16

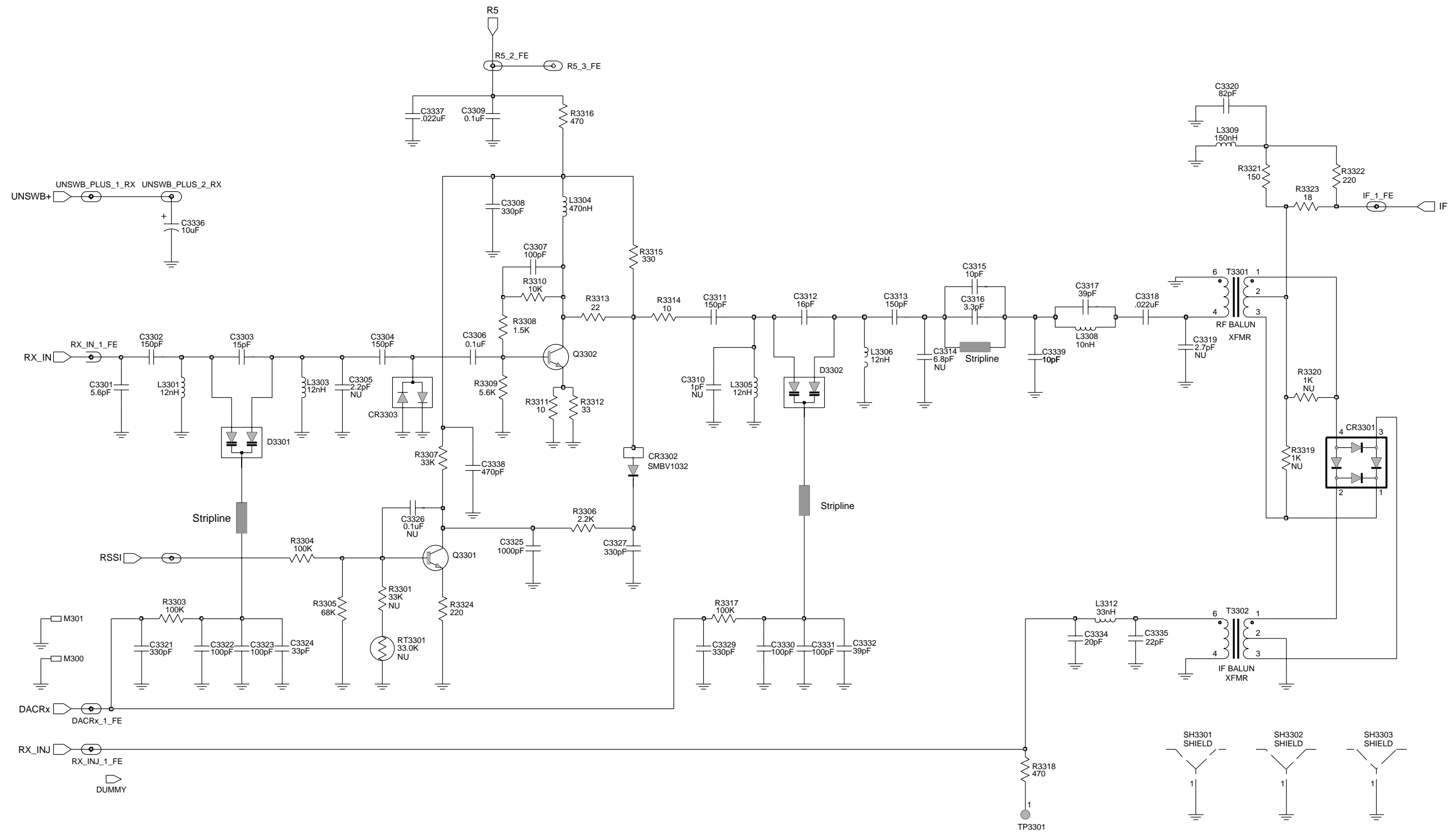


VHF (136-174MHz) Main Board Bottom Side PCB No. 8486062B16



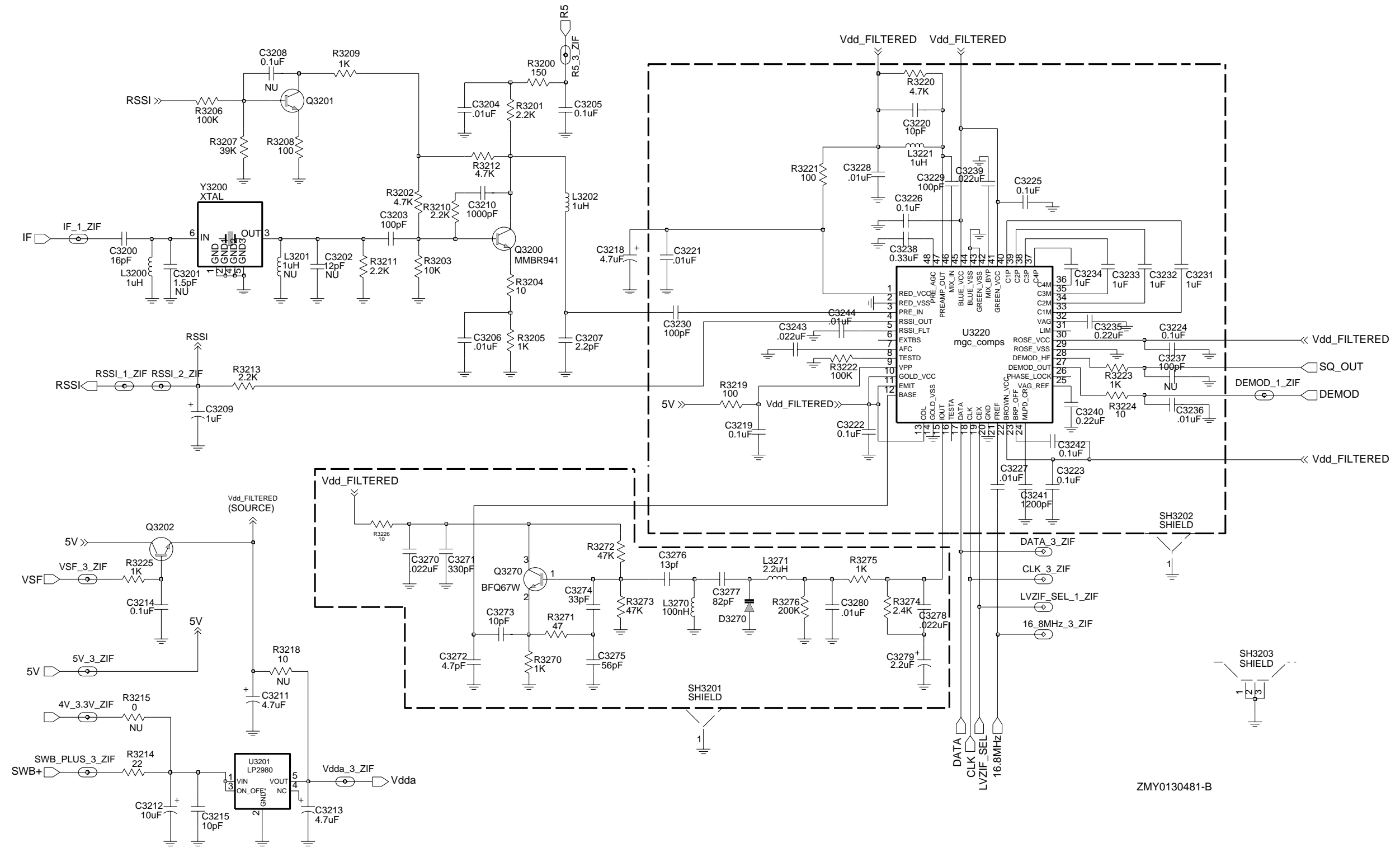


VHF Controls And Switches Schematic Diagram

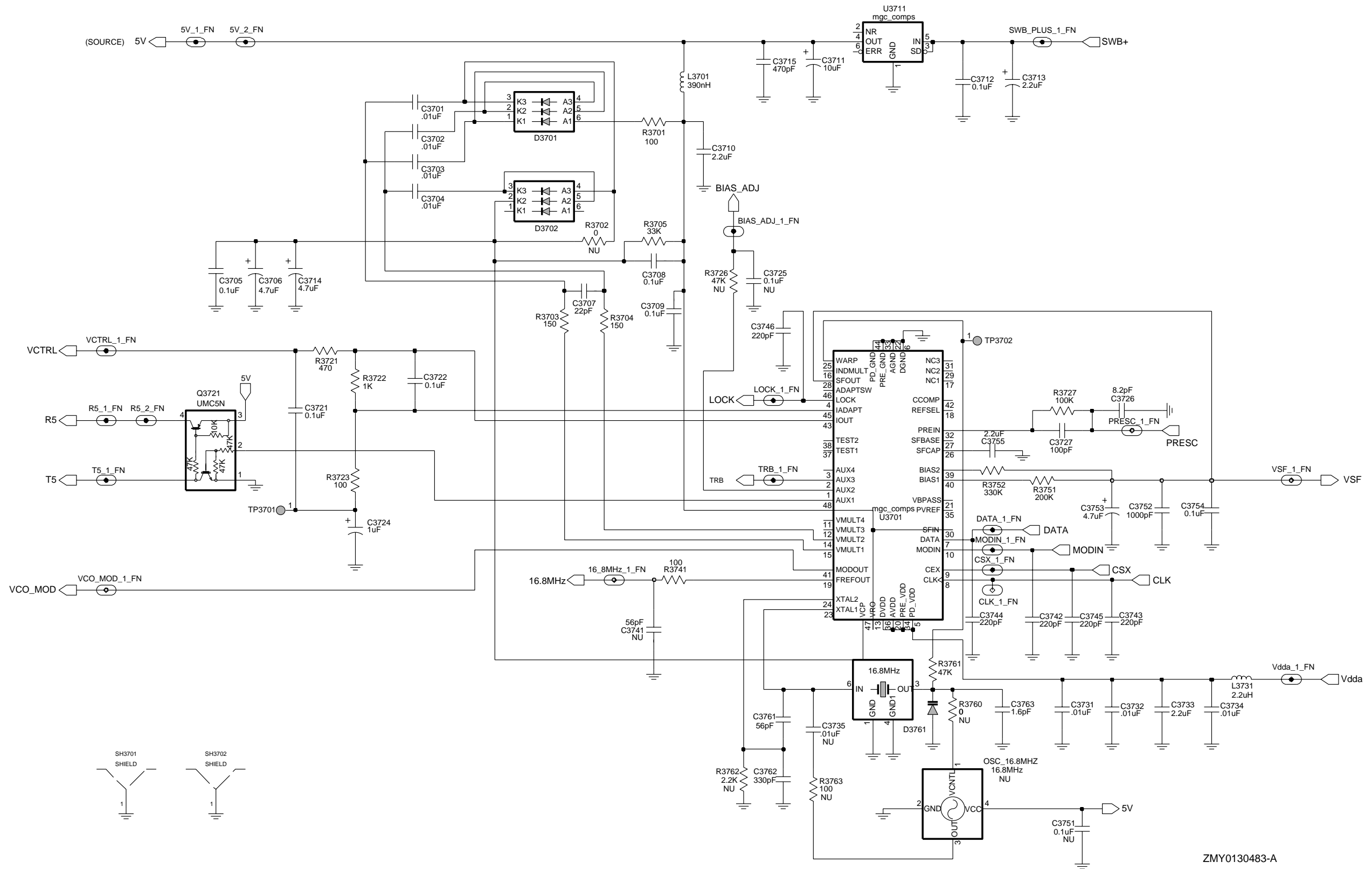


ZMY0130481-A

VHF Receiver Front End Schematic Diagram

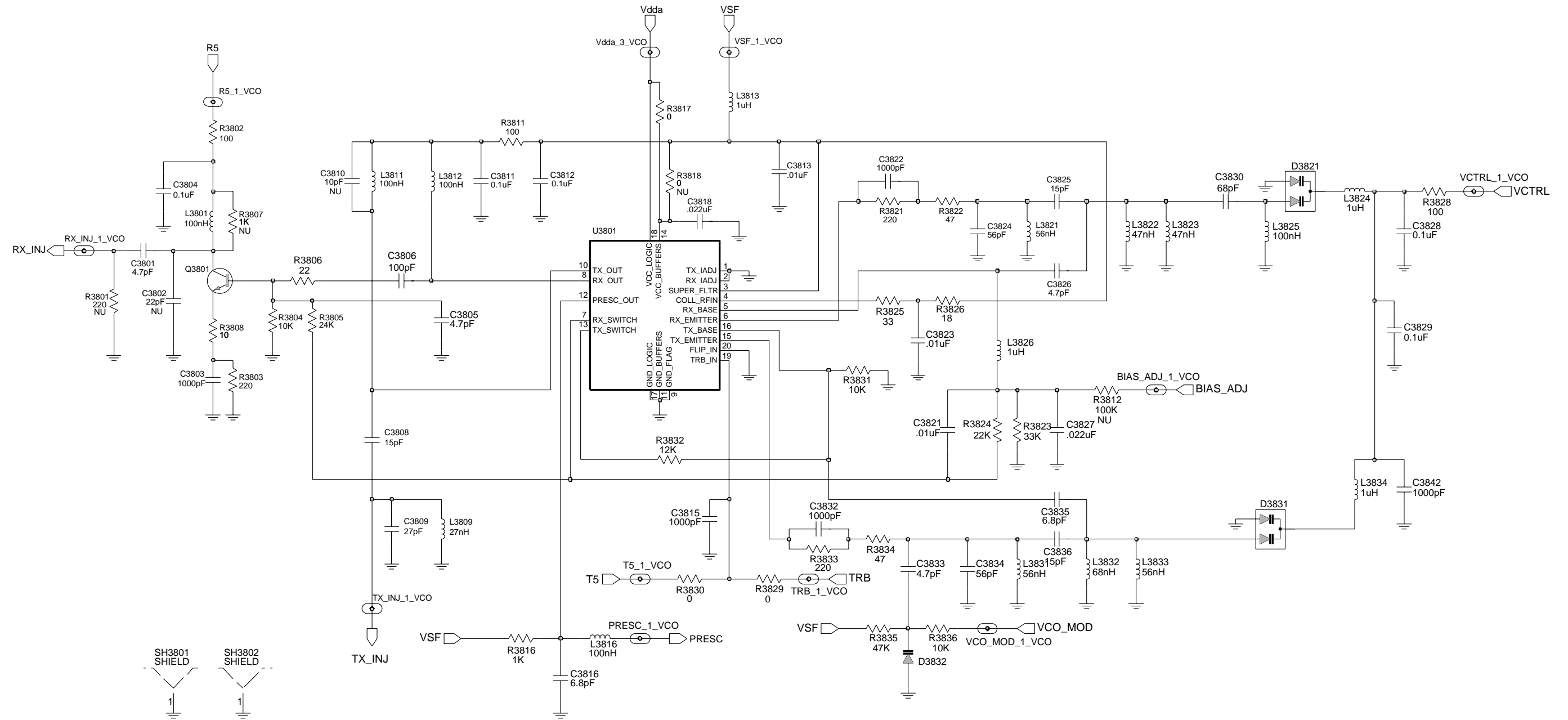


VHF Receiver Back End Schematic Diagram

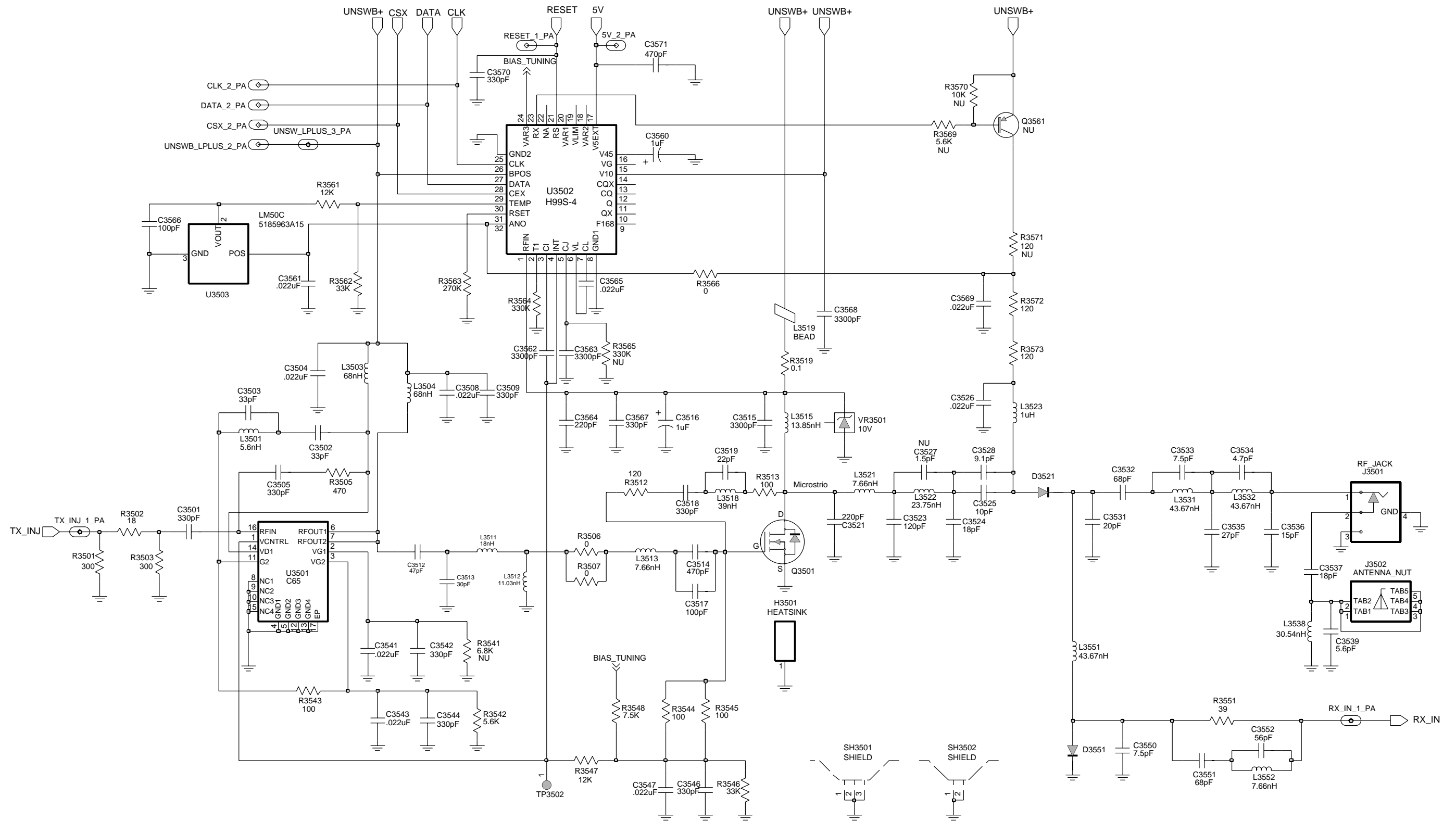


ZMY0130483-A

VHF Synthesizer Schematic Diagram



VHF Voltage Controlled Oscillator Schematic Diagram



VHF Transmitter Schematic Diagram

**VHF Radio Parts List**

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Connector, Contact Battery
B503	3980502Z01	Backup battery B+ (not placed in GP328)
B504	3980501Z01	Backup battery B- (not placed in GP328)
C3200	2113743N31	16pF
C3203	2113743N50	100pF
C3204	2113743L41	10000pF, 10%
C3205	2113928N01	0.1uF, 10%
C3206	2113743L41	10000pF, 10%
C3207	2113743N10	2.2pF
C3209	2311049A07	1uF
C3210	2113743L17	1000pF, 10%
C3211	2311049A56	4.7uF, 20%, 10V
C3212	2311049A57	10uF
C3213	2311049A56	4.7uF, 20%, 10V
C3214	2113928N01	0.1uF, 10%
C3215	2113743N26	10pF
C3218	2311049A56	4.7uF, 20%, 10V
C3219	2113928N01	0.1uF, 10%
C3220	2113743N26	10pF
C3221	2113743L41	10000pF, 10%
C3222	2113928N01	0.1uF, 10%
C3223	2113928N01	0.1uF, 10%
C3224	2113928N01	0.1uF, 10%
C3225	2113928N01	0.1uF, 10%
C3226	2113928N01	0.1uF, 10%
C3227	2113743L41	10000pF, 10%
C3228	2113743L41	10000pF, 10%
C3229	2113743N50	100pF
C3230	2113740F51	100pF
C3231	2180478Z20	1uF
C3232	2180478Z20	1uF
C3233	2180478Z20	1uF
C3234	2180478Z20	1uF
C3235	2113743A23	0.220uF
C3238	2113743A24	0.330uF
C3239	2113743E07	0.022uF
C3240	2113743A23	0.220uF
C3241	2113743L19	1200pF
C3242	2109720D14	0.1uF
C3243	2113743E07	0.022uF
C3244	2113743L41	10000pF, 10%
C3270	2113743E07	0.022uF
C3271	2113743L05	330pF
C3272	2113743N18	4.7pF
C3273	2113743N26	10pF
C3274	2113743N38	33pF
C3275	2113743N44	56pF

Circuit Ref	Motorola Part No.	Description
C3276	2113743N42	47pF
C3277	2113743N48	82pF
C3278	2113743E07	0.022uF
C3279	2311049A40	2.2uF, 10%, 16V
C3280	2113743L41	10000pF, 10%
C3301	2113743N20	5.6pF
C3302	2113743N54	150pF
C3303	2113743N30	15pF
C3304	2113743N54	150pF
C3306	2113928N01	0.1uF, 10%
C3307	2113743N50	100pF
C3308	2113743L05	330pF
C3309	2113928N01	0.1uF, 10%
C3311	2113743N54	150pF
C3312	2113743N31	16pF
C3313	2113743N54	150pF
C3315	2113743N26	10pF
C3316	2113743N14	3.3pF
C3317	2113743N40	39pF
C3318	2113743M08	22000pF, +80/-20%
C3320	2113743N48	82pF
C3321	2113743L05	330pF
C3322	2113743N50	100pF
C3323	2113743N50	100pF
C3324	2113743N38	33pF
C3325	2113743L17	1000pF, 10%
C3327	2113743L05	330pF
C3329	2113743L05	330pF
C3330	2113743N50	100pF
C3331	2113743N50	100pF
C3332	2113743N40	39pF
C3334	2113743N33	20pF
C3335	2113743N34	22pF
C3336	2311049A18	10uF
C3337	2113743M08	22000pF, +80/-20%
C3338	2113743L09	470pF, 10%
C3339	2113743N26	10pF
C3501	2113743L05	330pF
C3502	2113743N38	33pF
C3503	2113743N38	33pF
C3504	2113743M08	22000pF, +80/-20%
C3505	2113743N38	33pF
C3508	2113743M08	22000pF, +80/-20%
C3509	2113743L05	330pF
C3512	2113740F43	47pF
C3513	2113740F38	30pF
C3514	2113740F47	68pF
C3515	2113743L29	3300pF
C3516	2311049A08	1uF
C3517	2113740F47	68pF
C3521	2111078B51	220pF

Circuit Ref	Motorola Part No.	Description
C3523	2111078B44	120pF
C3524	2113740F33	18pF
C3525	2113740F27	10pF
C3526	2113743M08	22000pF, +80/-20%
C3528	2113740F27	10pF
C3531	2113740F34	20pF
C3532	2113740F47	68pF
C3533	2113740F24	7.5pF
C3534	2113740F19	4.7pF
C3535	2113740F37	27pF
C3536	2113740F31	15pF
C3537	2113740F33	18pF
C3539	2113740F29	12pF
C3541	2113743M08	22000pF, +80/-20%
C3542	2113743L05	330pF
C3543	2113743M08	22000pF, +80/-20%
C3544	2113743L05	330pF
C3546	2113743L05	330pF
C3547	2113743M08	22000pF, +80/-20%
C3550	2113743N23	7.5pF
C3551	2113743N46	68pF
C3552	2113743N44	56pF
C3560	2311049A07	1uF
C3561	2113743M08	22000pF, +80/-20%
C3562	2113743L29	3300pF
C3563	2113743L29	3300pF
C3564	2113743L01	220pF
C3565	2113743E07	0.022uF
C3566	2113743N50	100pF
C3567	2113743L05	330pF
C3568	2113743L29	3300pF
C3569	2113743M08	22000pF, +80/-20%
C3570	2113743L05	330pF
C3571	2113743L09	470pF, 10%
C3701	2113743L41	10000pF, 10%
C3702	2113743L41	10000pF, 10%
C3703	2113743L41	10000pF, 10%
C3704	2113743L41	10000pF, 10%
C3705	2113743E20	0.10uF, 10%
C3706	2311049J11	4.7uF
C3707	2113743N34	22pF
C3708	2113928N01	0.1uF, 10%
C3709	2113928N01	0.1uF, 10%
C3710	2104993J02	2.2uF
C3711	2311049A69	10uF
C3712	2113928N01	0.1uF, 10%
C3713	2311049A09	2.2uF
C3714	2311049J11	4.7uF
C3715	2113743L09	470pF, 10%
C3721	2113743E20	0.10uF, 10%
C3722	2113743E20	0.10uF, 10%

Circuit Ref	Motorola Part No.	Description
C3724	2311049A08	1uF
C3726	2113743N24	8.2pF
C3727	2113743N50	100pF
C3731	2113743L41	10000pF, 10%
C3732	2113743L41	10000pF, 10%
C3733	2104993J02	2.2uF
C3734	2113743L41	10000pF, 10%
C3742	2113743L01	220pF
C3743	2113743L01	220pF
C3744	2113743L01	220pF
C3745	2113743L01	220pF
C3746	2113743L01	220pF
C3752	2113743L17	1000pF, 10%
C3753	2311049A56	4.7uF, 20%, 10V
C3754	2113928N01	0.1uF, 10%
C3755	2104993J02	2.2uF
C3761	2113743N44	56pF
C3762	2113740F63	330pF
C3763	2113743N08	1.6pF
C3801	2113743N18	4.7pF
C3803	2113743L17	1000pF, 10%
C3804	2113743E20	0.10uF, 10%
C3805	2113743N18	4.7pF
C3806	2113743N50	100pF
C3808	2113743N30	15pF
C3809	2113743N36	27pF
C3811	2113928N01	0.1uF, 10%
C3812	2113928N01	0.1uF, 10%
C3813	2113743L41	10000pF, 10%
C3815	2113743L17	1000pF, 10%
C3816	2113743N22	6.8pF
C3818	2113743E07	0.022uF
C3821	2113743L41	10000pF, 10%
C3822	2113743L17	1000pF, 10%
C3823	2113743L41	10000pF, 10%
C3824	2113743N44	56pF
C3825	2113743N30	15pF
C3826	2113743N18	4.7pF
C3827	2113743E07	0.022uF
C3828	2185895Z01	0.01uF, 10%
C3829	2185895Z01	0.01uF, 10%
C3830	2113743N46	68pF
C3832	2113743L17	1000pF, 10%
C3833	2113743N18	4.7pF
C3834	2113743N44	56pF
C3835	2113743N22	6.8pF
C3836	2113743N30	15pF
C3842	2113743L17	1000pF, 10%
C400	2113743L41	10000pF, 10%
C401	2113928N01	0.1uF, 10%
C402	2113928N01	0.1uF, 10%

Circuit Ref	Motorola Part No.	Description
C4020	2113743L17	1000pF, 10%
C4021	2113743L17	1000pF, 10%
C403	2113743G24	2.2uF, +/-80%/-20%
C407	2113928N01	0.1uF, 10%
C408	2113743N50	100pF
C409	2113928N01	0.1uF, 10%
C410	2113928N01	0.1uF, 10%
C411	2113928N01	0.1uF, 10%
C414	2113928N01	0.1uF, 10%
C415	2185895Z01	0.01uF, 10%
C416	2113928N01	0.1uF, 10%
C419	2113743L41	10000pF, 10%
C420	2113743L41	10000pF, 10%
C421	2113928N01	0.1uF, 10%
C422	2113928N01	0.1uF, 10%
C423	2113743N50	100pF
C424	2311049A59	10uF, 10%, 6V
C425	2113928N01	0.1uF, 10%
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113928N01	0.1uF, 10%
C429	2113928N01	0.1uF, 10%
C430	2113928N01	0.1uF, 10%
C431	2113743N50	100pF
C433	2113743L41	10000pF, 10%
C434	2113928N01	0.1uF, 10% (not placed in GP328)
C435	2113928N01	0.1uF, 10%
C436	2113743N34	22pF (not placed in GP328)
C437	2113743N34	22pF (not placed in GP328)
C440	2113743G26	4.7F, + 80/-20%
C441	2113743L09	470pF, 10%
C442	2113743E20	0.10uF, 10%
C443	2113928N01	0.1uF, 10%
C444	2113743N50	100pF
C445	2113743L09	470pF, 10%
C446	2113743L09	470pF, 10%
C447	2113928N01	0.1uF, 10%
C448	2113928N01	0.1uF, 10%
C449	2113743N50	100pF
C451	2113743M08	22000pF, +80/-20%
C452	2113743B29	1uF
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF, 10%
C471	2113743L09	470pF, 10%
C472	2113743L09	470pF, 10%

Circuit Ref	Motorola Part No.	Description
C473	2113743L09	470pF, 10%
C474	2113743L41	10000pF, 10%
C475	2113743H14	10uF, +80/-20%
C476	2113928D08	10uF, +/-80%/-20%
C477	2113743L17	1000pF, 10%
C478	2113743L17	1000pF, 10%
C479	2113928N01	0.1uF, 10%
C480	2113928D08	10uF, +/-80%/-20%
C481	2113928N01	0.1uF, 10%
C482	2113928N01	0.1uF, 10%
C483	2113743L09	470pF, 10%
C484	2113743L09	470pF, 10%
C490	2113743L09	470pF, 10%
C491	2113743L09	470pF, 10%
C492	2113743L09	470pF, 10%
C493	2113743N50	100pF
C494	2113743N50	100pF
C495	2113743L09	470pF, 10%
C496	2113743L09	470pF, 10%
C497	2113743L09	470pF, 10%
C502	2311049A05	0.47uF, 10%, 25V
C503	2113743N50	100pF
C505	2113743N50	100pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C520	2113743L41	10000pF, 10%
C521	2113743L41	10000pF, 10%
C522	2113743L41	10000pF, 10%
C523	2113743L41	10000pF, 10%
C535	2113743L17	1000pF, 10%
CR3301	4802245J42	Ring Quad diode
CR3302	4805129M96	Dual Bonds Pin Diode, RH Reeled
CR3303	4880154K03	Dual common anode-cathode diode
CR411	4802245J62	Schottky diode
CR412	4802245J62	Schottky diode
CR413	4802245J62	Schottky diode
CR440	4813833C02	Dual Diode Common Cathode
CR501	4880107R01	Rectifier
CR503	4805729G49	LED Red/Yellow
D3270	4862824C01	Varactor
D3301	4802081B58	Dual Diode
D3302	4802081B58	Dual Diode
D3521	4880973Z02	Pin diode
D3551	4880973Z02	Pin diode
D3701	4802233J09	Triple diode
D3702	4802233J09	Triple diode
D3761	4862824C03	Varactor

Circuit Ref	Motorola Part No.	Description
D3821	4805649Q13	Varactor
D3831	4805649Q13	Varactor
D3832	4862824C01	Varactor
E400	2480640Z01	Ferrite bead
E401	2480640Z01	Ferrite bead
E402	2480640Z01	Ferrite bead
E403	2480640Z01	Ferrite bead
E404	2480640Z01	Ferrite bead
E405	2480640Z01	Ferrite bead
E406	2480640Z01	Ferrite bead
E407	2480640Z01	Ferrite bead
E408	2480640Z01	Ferrite bead
E409	2480640Z01	Ferrite bead
F501	6580542Z01	3A Fuse
FL401	4870368G02	Real Time Clock Oscillator XTAL (not placed in GP328)
H3501	2680499Z01	Heat spreader
J3501	0985613Z01	RF Jack
J3502	0280519Z02	Antenna_Nut
J400	0905505Y04	40-pin connector
J403	0905505Y02	20-pin connector
L3200	2462587N68	1uH
L3202	2462587N68	1uH
L3221	2462587N68	1uH
L3270	2462587T15	100nH
L3271	2462587Q20	2.2uF
L3301	2462587T35	12nH
L3303	2462587T35	12nH
L3304	2462587T23	470nH
L3305	2462587T35	12nH
L3306	2462587T35	12nH
L3308	2462587T34	10nH
L3309	2462587N55	150nH
L3312	2462587V28	33nH
L3501	2413926H09	5.6nH
L3503	2462587V32	68nH
L3504	2462587N51	68nH
L3511	2462587N44	18nH
L3512	2479990B01	11.03nH
L3513	2479990A02	7.66nH, 10%
L3515	2479990C03	13.85nH
L3519	2484657R01	Ferrite bead
L3521	2479990A02	7.66nH, 10%
L3522	2479990E01	23.75nH
L3523	2462587N68	1uH
L3531	2479990N01	43.67nH
L3532	2479990N01	43.67nH
L3538	2479990M01	30.54nH
L3551	2479990N01	43.67nH
L3552	2479990A02	7.66nH, 10%
L3701	2462587Q42	390nH, 10%

Circuit Ref	Motorola Part No.	Description
L3731	2462587Q20	2.2uF
L3801	2462587V34	100nH
L3809	2462587V27	27nH
L3811	2462587V34	100nH
L3812	2462587V34	100nH
L3813	2462587Q47	1000nH, 10%, QF45
L3816	2462587V34	100nH
L3821	2462587N50	56nH
L3822	2462587N49	47nH
L3823	2462587N49	47nH
L3824	2462587N68	1uH
L3825	2462587V34	100nH
L3826	2462587N68	1uH
L3831	2462587N50	56nH
L3832	2462587N51	68nH
L3833	2462587N50	56nH
L3834	2462587N68	1uH
L400	2462587Q42	390nH, 10%
L401	2462587Q42	390nH, 10%
L410	2462587Q42	390nH, 10%
L411	2462587Q42	390nH, 10%
L505	2462587Q42	390nH, 10%
PB501	4080523Z01	Tactile, Pushbutton
PB502	4080523Z01	Tactile, Pushbutton
PB503	4080523Z01	Tactile, Pushbutton
PB504	4080523Z01	Tactile, Pushbutton
PB505	4080523Z01	Tactile, Pushbutton
Q3200	4813827A07	NPN Transistor
Q3201	4880214G02	NPN Transistor
Q3202	4880214G02	NPN Transistor
Q3270	4805218N63	RF Transistor
Q3301	4880214G02	NPN Transistor
Q3302	4813827A07	NPN Transistor
Q3501	4813828A08	FET
Q3561	4813824A17	PNP Transistor
Q3721	4802245J50	Dual NPN/PNP Transistor
Q3801	4813827A07	NPN Transistor
Q400	4809579E18	Mosfet P - channel
Q403	4813824A17	PNP Transistor
Q405	4802245J54	Dual NPN Transistor
Q410	4802245J54	Dual NPN Transistor
Q416	4809579E18	Mosfet P - channel (not placed in GP328)
Q417	4802245J50	Dual NPN/PNP Transistor
Q502	5180159R01	Dual NPN Transistor
Q505	4880214G02	NPN Transistor
R3200	0662057M54	150
R3201	0662057M82	2200
R3202	0662057M90	4700
R3203	0662057M98	10k
R3204	0662057M26	10



Circuit Ref	Motorola Part No.	Description
R3205	0662057M74	1000
R3206	0662057N23	100K
R3207	0662057N13	39K
R3208	0662057M50	100
R3209	0662057M74	1000
R3210	0662057M82	2200
R3211	0662057M82	2200
R3212	0662057M90	4700
R3213	0662057M82	2200
R3214	0662057M34	22
R3219	0662057M50	100
R3220	0662057M90	4700
R3221	0662057M50	100
R3224	0662057M26	10
R3225	0662057M74	1000
R3226	0662057M26	10
R3270	0662057M74	1000
R3271	0662057M42	47
R3272	0662057N15	47K
R3273	0662057N15	47K
R3274	0662057M83	2400
R3275	0662057M74	1000
R3276	0662057N30	200K
R3303	0662057N23	100K
R3304	0662057N23	100K
R3305	0662057N19	68K
R3306	0662057M82	2200
R3307	0662057N11	33K
R3308	0662057M78	1500
R3309	0662057M92	5600
R3310	0662057M98	10k
R3311	0662057M26	10
R3312	0662057M38	33
R3313	0662057M34	22
R3314	0662057M26	10
R3315	0662057M62	330
R3316	0662057M66	470
R3317	0662057N23	100K
R3318	0662057M66	470
R3321	0662057M54	150
R3322	0662057M58	220
R3323	0662057M32	18
R3324	0662057M58	220
R3501	0662057M61	300
R3502	0662057M32	18
R3503	0662057M61	300
R3505	0662057M62	330
R3506	0662057B62	3.9
R3507	0662057B62	3.9
R3519	0680539Z01	0.1
R3541	0662057N13	39K

Circuit Ref	Motorola Part No.	Description
R3542	0662057M92	5600
R3543	0662057M50	100
R3544	0662057A25	100
R3545	0662057A25	100
R3546	0662057N01	12K
R3547	0662057N11	33K
R3548	0662057N07	22K
R3551	0662057M40	39
R3561	0662057N01	12K
R3562	0662057N11	33K
R3563	0662057N33	270K
R3564	0662057N35	330K
R3569	0662057M92	5600
R3570	0662057M98	10k
R3571	0662057A27	120
R3572	0662057A27	120
R3573	0662057A27	120
R3701	0662057M50	100
R3703	0662057M54	150
R3704	0662057M54	150
R3705	0662057N11	33K
R3721	0662057M66	470
R3722	0662057M74	1000
R3723	0662057M50	100
R3727	0662057N23	100K
R3741	0662057M50	100
R3751	0662057N30	200K
R3752	0662057N35	330K
R3761	0662057N15	47K
R3802	0662057M50	100
R3803	0662057M58	220
R3804	0662057M98	10k
R3805	0662057N08	24K
R3806	0662057M34	22
R3808	0662057M26	10
R3811	0662057M50	100
R3816	0662057M74	1000
R3817	0662057M01	0
R3821	0662057M58	220
R3822	0662057M42	47
R3823	0662057N11	33K
R3824	0662057N07	22K
R3825	0662057M38	33
R3826	0662057M32	18
R3828	0662057M50	100
R3829	0662057M01	0
R3831	0662057M98	10k
R3832	0662057N01	12K
R3833	0662057M58	220
R3834	0662057M42	47
R3835	0662057N15	47K

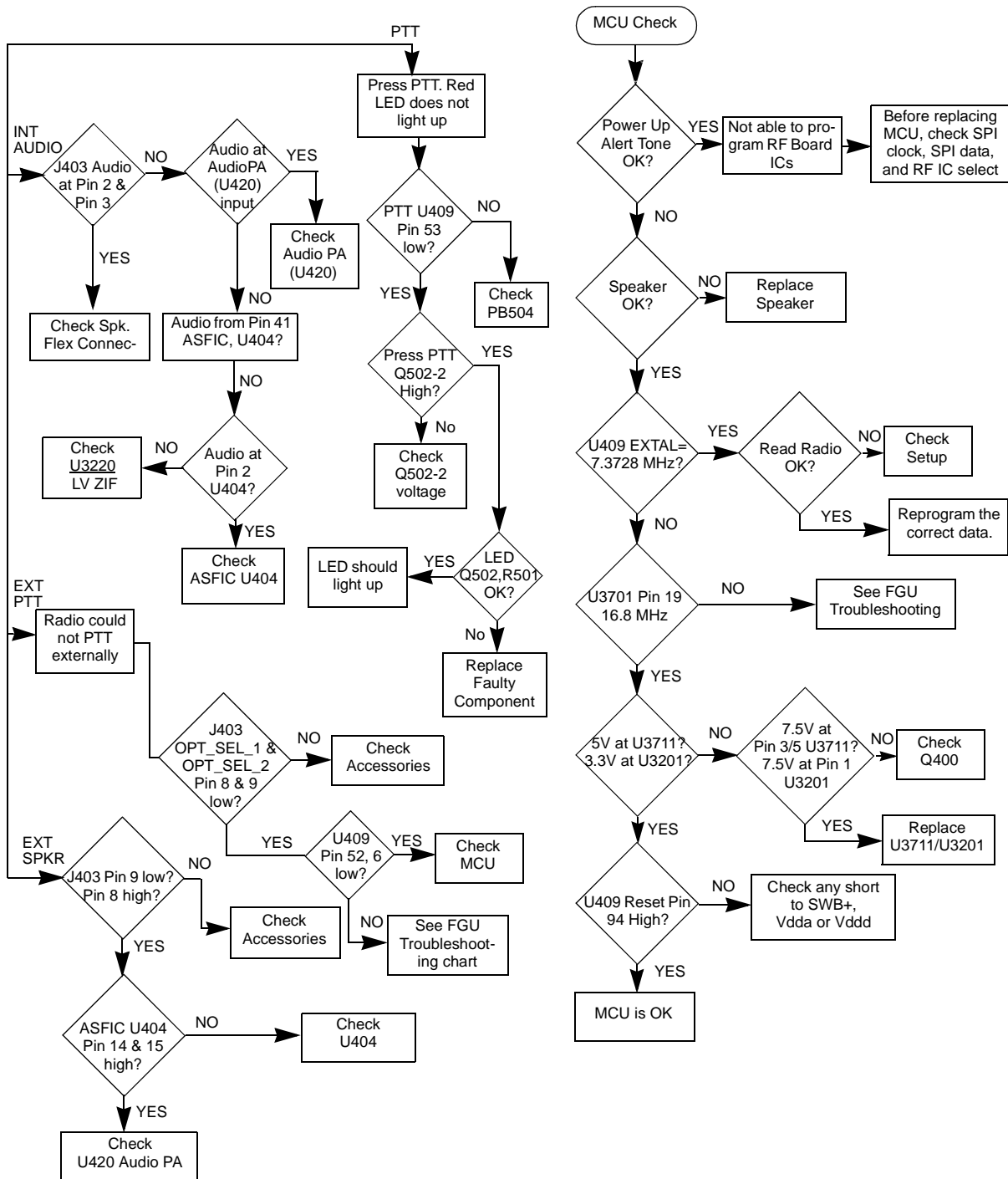
Circuit Ref	Motorola Part No.	Description
R3836	0662057M98	10k
R400	0662057N15	47K
R401	0662057M01	0
R405	0662057M01	0
R406	0662057N20	75K
R407	0662057N19	68K
R409	0662057M98	10k
R410	0662057N23	100K
R411	0662057M98	10k
R413	0662057M01	0
R414	0662057V34	180K
R415	0662057V26	91K
R416	0662057M98	10k
R418	0662057M01	0
R419	0662057M67	510 (not placed in GP328)
R420	0662057B46	10M (not placed in GP328)
R421	0662057M81	2000
R423	0662057N21	82K
R424	0662057N12	36K
R425	0662057N10	30K
R426	0662057N35	330K (not placed in GP328)
R427	0662057M84	2700
R428	0662057M10	2.2
R429	0662057M98	10k
R431	0662057N39	470K
R432	0662057N16	51K
R434	0662057M62	330
R435	0662057M81	2000
R436	0662057M01	0
R445	0662057N08	24K
R447	0662057N51	1.5M
R448	0662057M98	10k
R449	0662057N08	24K
R450	0683962T45	68 ohms, 1W
R451	0662057N03	15K
R452	0662057N23	100K
R456	0662057M01	0
R457	0662057M98	10k
R460	0662057M90	4700
R461	0662057M56	180 (not placed in GP328)
R462	0662057M98	10k (not placed in GP328)
R463	0662057M61	300
R471	0662057M92	5600
R472	0662057M93	6200
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N35	330K
R477	0662057M74	1000
R478	0662057M98	10k
R481	0662057N08	24K
R492	0662057M01	0

Circuit Ref	Motorola Part No.	Description
R498	0662057M98	10k
R499	0662057M98	10k
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10k
R506	0662057N15	47K
RT400	0680590Z01	THERMISTOR 33K
S501	4080710Z02	Frequency Switch
S502	1880619Z02	Volume Switch
SH3201	2602023X08	Rx Backend Top Shield
SH3202	2686081B02	LVZIF shields
SH3203	2686081B03	45.1MHz Xtal Filter Shield
SH3301	2686081B01	Rx Frontend Bottom Shield
SH3302	2686081B05	Mixer Shield
SH3303	2686081B06	Rx Frontend Top Shield
SH3501	2686081B03	Harmonic Filter Shield
SH3502	2686081B04	PA driver Shield
SH3701	2680511Z01	Synthesizer top shield
SH3702	2680511Z01	Synthesizer bottom shield
SH3801	2680513Z01	VCO Top Shield
SH3802	2680514Z01	VCO Bottom Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller on-off shield
SH402	2680515Z01	Controller Microprocessor shield
SH403	2680516Z01	Controller Asfic_Cmp/Audio PA shield
T3301	2580541Z01	Balun transformer
T3302	2580541Z01	Balun transformer
U3201	5102463J58	3.3V Regulator
U3220	5109632D83	LVZIF IC
U3501	5185130C65	VHF/UHF/800 MHZ LDMOS Driver
U3502	5185765B28	PCIC
U3503	5185963A15	Temperature Sense
U3701	5185963A27	LVFRACN Synthesizer IC
U3711	5105739X05	5V Regulator
U3801	5105750U54	VCO BUFFER IC
U400	5102463J40	3.3V Regulator
U404	5185963A53	ASFIC_CMP
U405	NOT PLACED	
U406	*5102463J59	128K x 8 Flash Memory
U407	*5102463J64	16K x 8 EEPROM
U409	5102226J56	Microprocessor IC
U410	5102463J57	3.3V Regulator (not placed in GP328)
U420	5102463J44	Audio PA
VR3501	4880140L17	Zener diode-12V
VR432	4805656W08	5.6V Zener diode
VR433	4805656W08	5.6V Zener diode
VR434	4802245J73	ZENER DIODE-6.8V

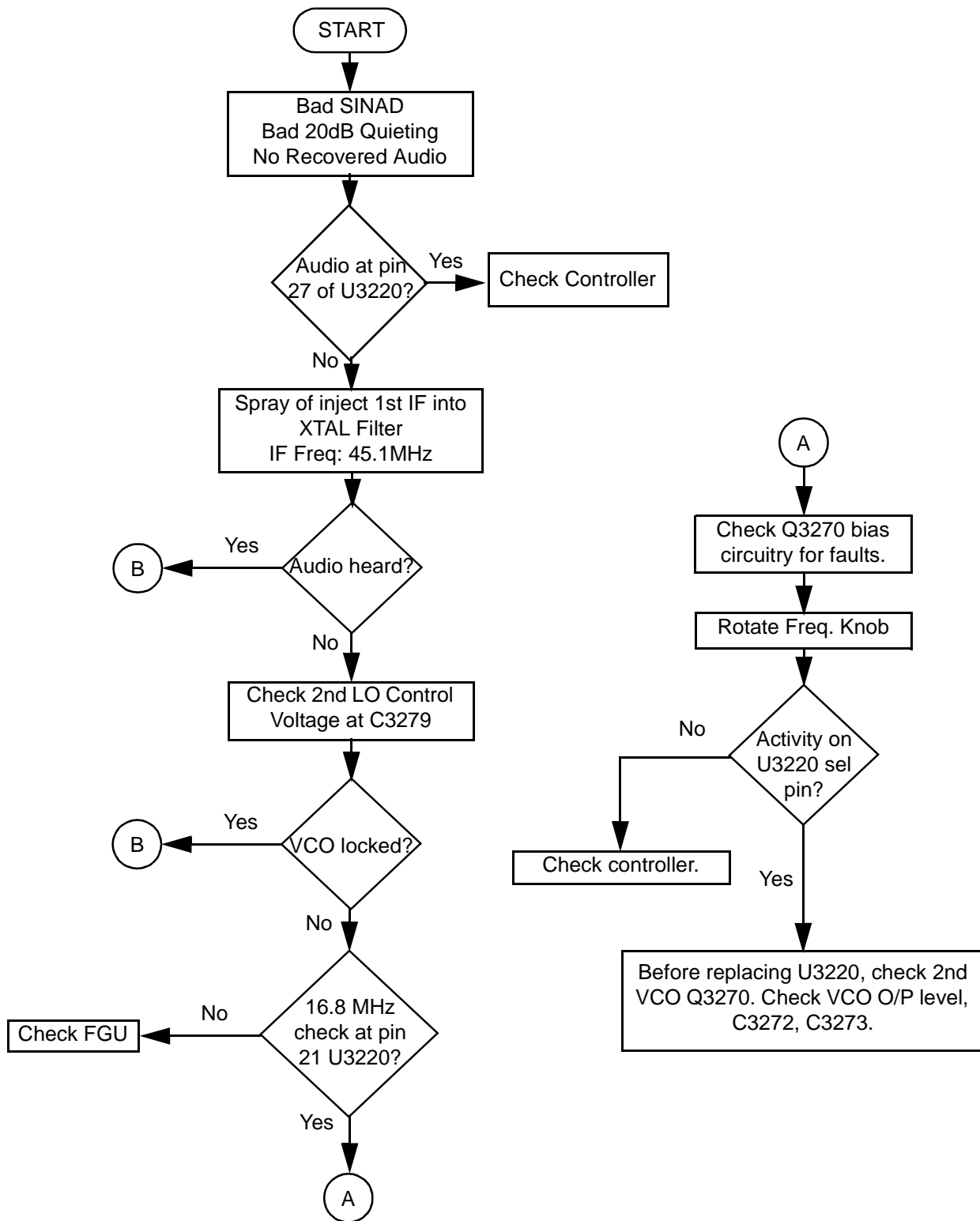
<b>Circuit Ref</b>	<b>Motorola Part No.</b>	<b>Description</b>
VR439	4880140L17	Zener diode-12V
VR447	4802245J74	ZENER DIODE-10V
VR448	4802245J74	ZENER DIODE-10V
VR449	4802245J74	ZENER DIODE-10V
VR450	4802245J74	ZENER DIODE-10V
VR460	4802245J73	ZENER DIODE-6.8V
VR501	4802245J73	ZENER DIODE-6.8V
VR506	4802245J73	ZENER DIODE-6.8V
Y3200	9186153B01	Crystal Filter
Y3761	4805875Z04	16.8MHz Xtal oscillator (SMD)
	5480678Z01	PCB Bar Code Label
	8486062B16	VHF main PC Board

\* Motorola Depot Servicing only

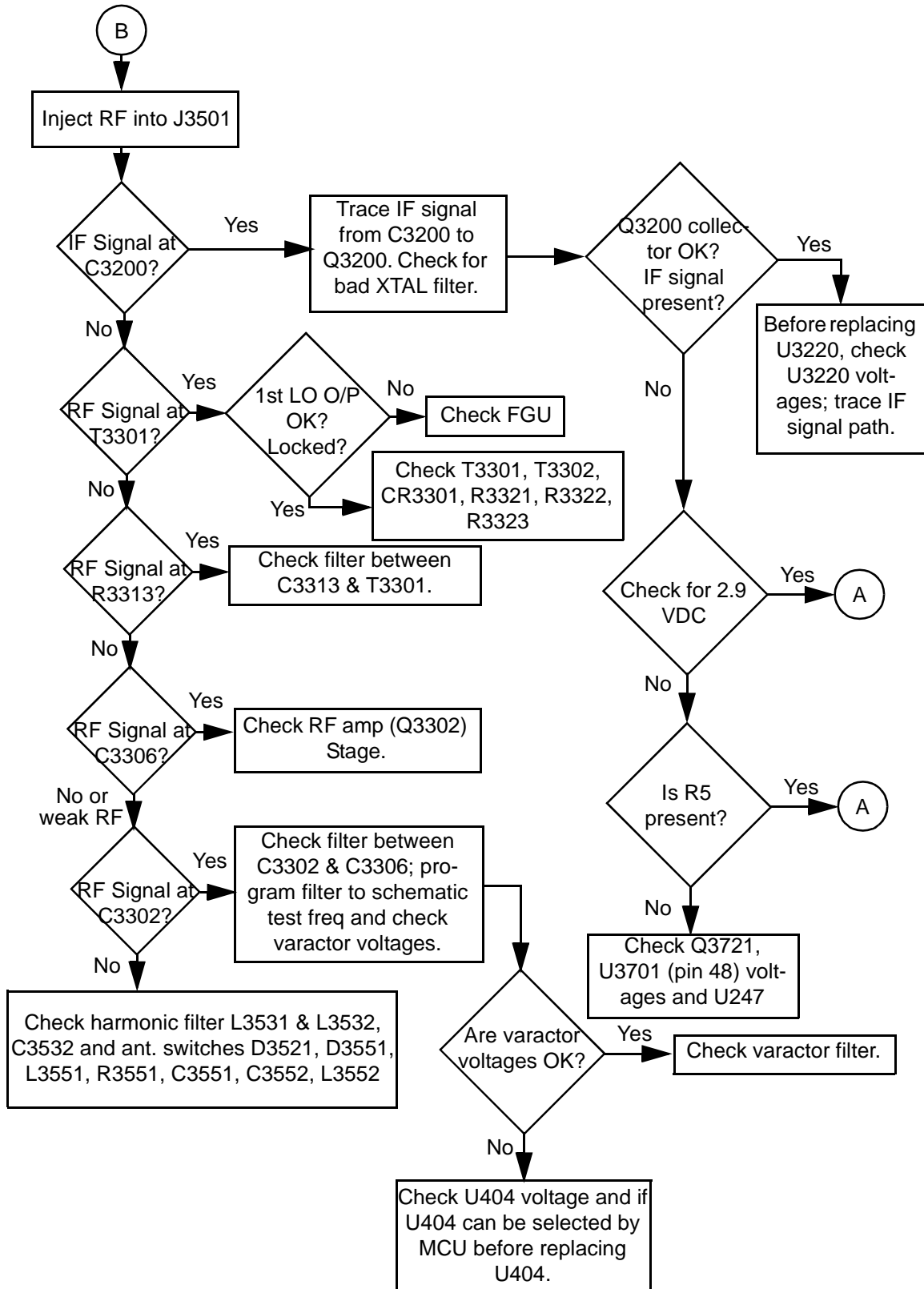
## 9.0 Troubleshooting charts



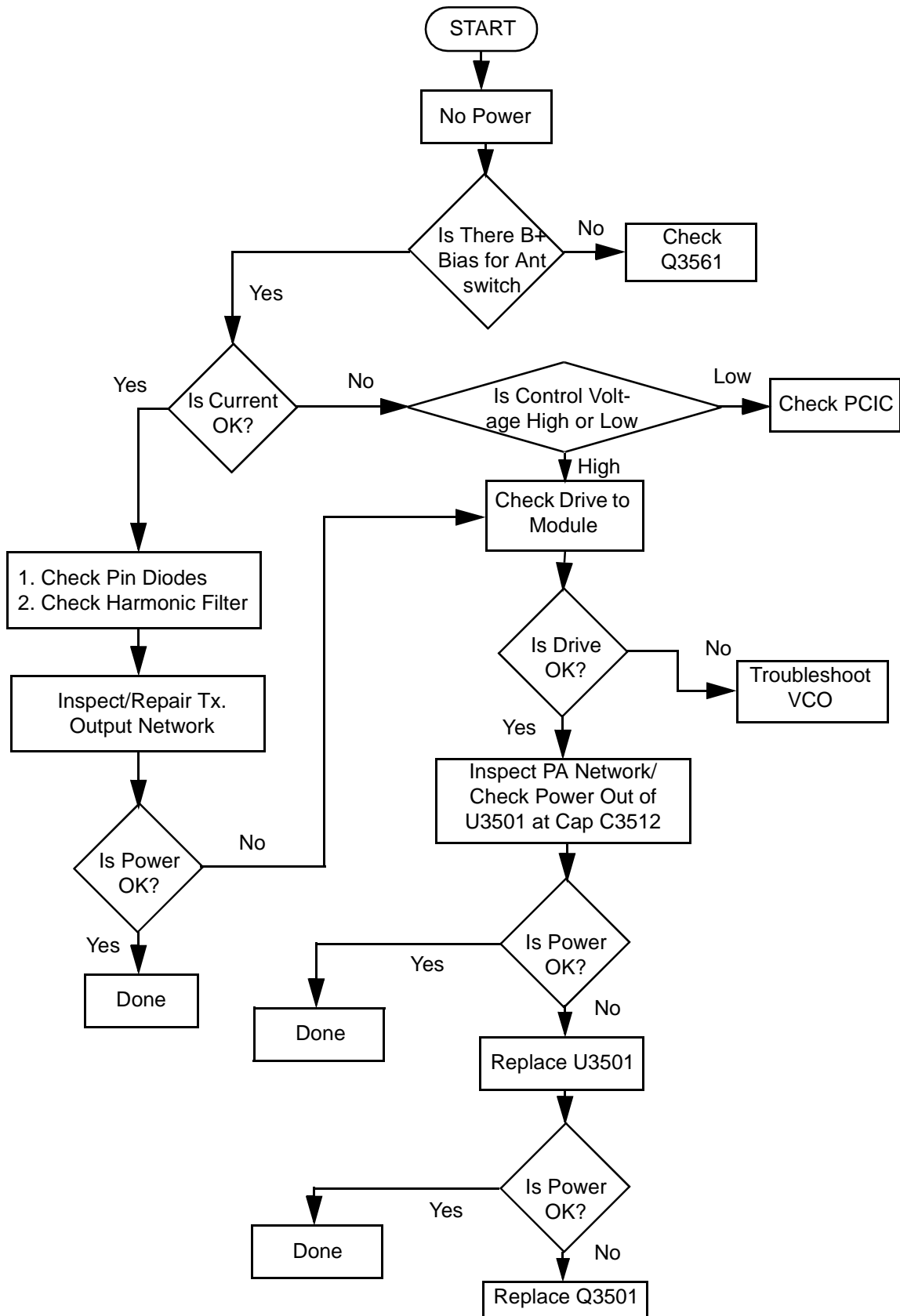
**Troubleshooting Flow Chart for Controller**



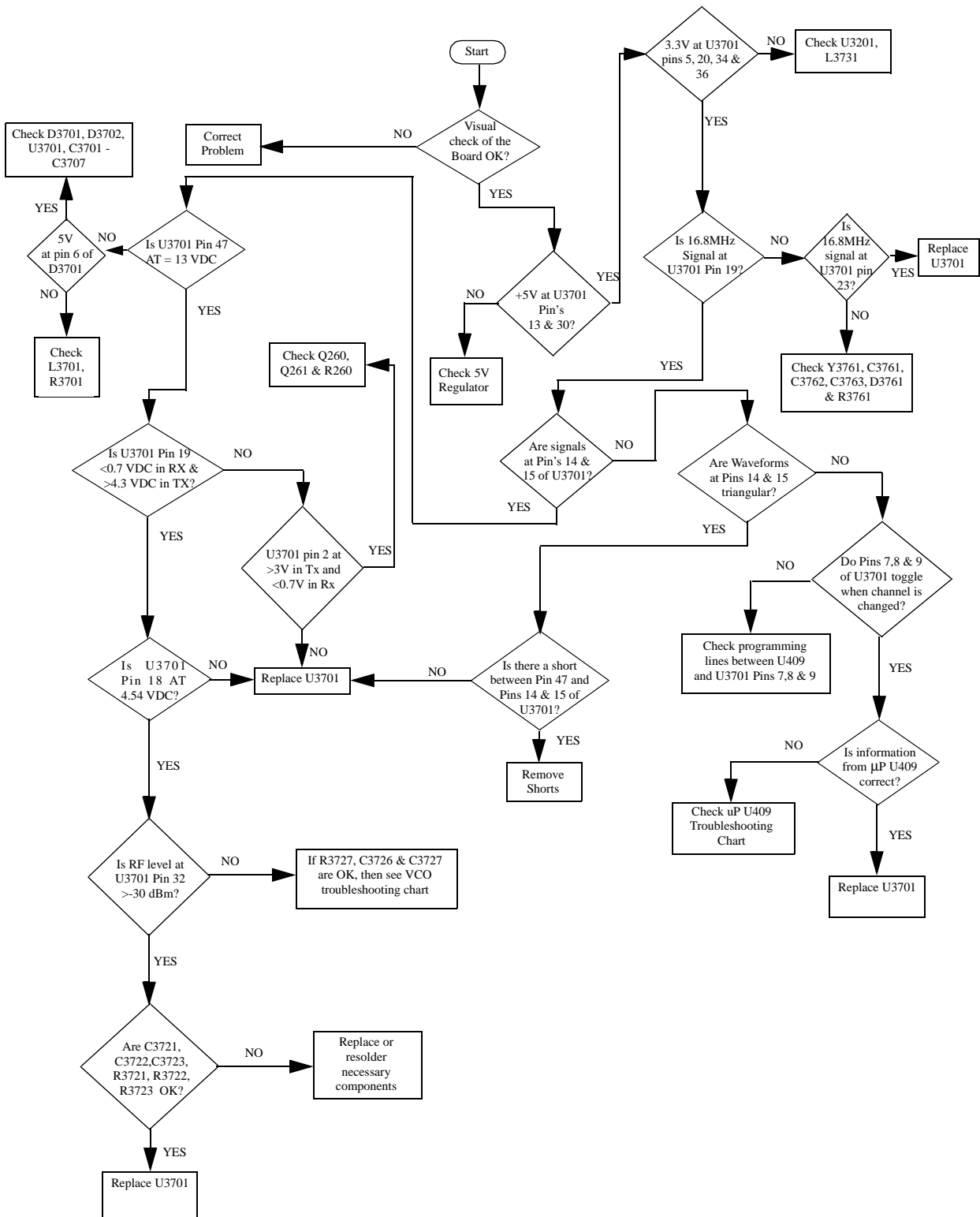
**Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)**



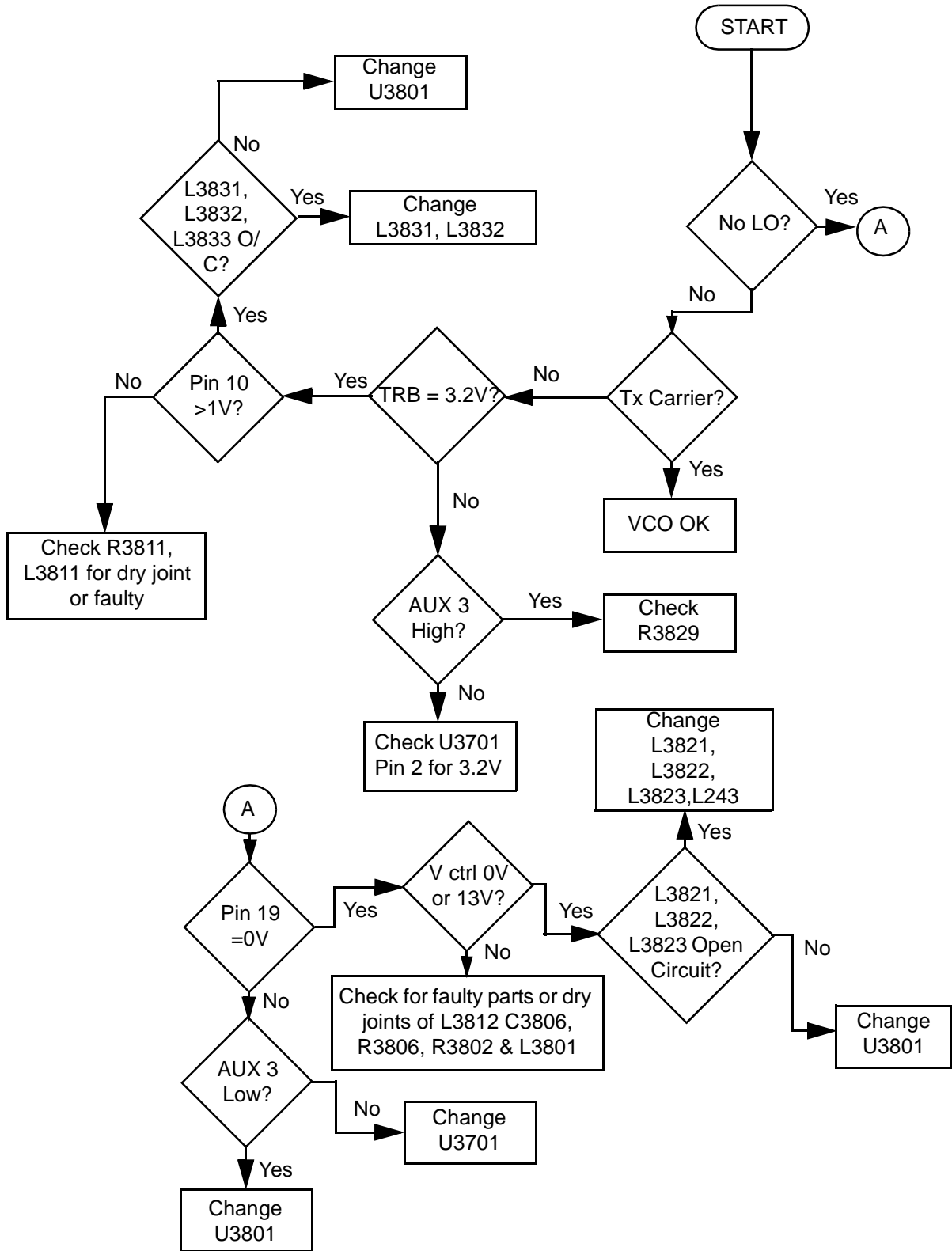
**Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)**



**Troubleshooting Flow Chart for Transmitter**



**Troubleshooting Flow Chart for Synthesizer**



**Troubleshooting Flow Chart for VCO**



## Section 6C

# MODEL CHART AND TEST SPECIFICATIONS (450-527 MHZ)

### 1.0 Model Chart

<b>GP Series, UHF Band 2, 450-527 MHz</b>				
<b>Model</b>		<b>Description</b>		
		AZH25SDC9AA2	GP328 450-527 MHz 4W 4CH	
		AZH25SDC9AA3	GP328 450-527 MHz 4W	
		AZH25SDH9AA6	GP338 450-527 MHz 4W	
		<b>Item</b>	<b>Description</b>	
X		PMUE1564_	GP328 Super Tanapa 450-527 MHz 4W 4CH	
	X	PMUE1477_	GP328 Super Tanapa 450-527 MHz 4W	
	X	PMUE1478_	GP338 Super Tanapa 450-527 MHz 4W	
X		PMUE1566_	GP328 Tanapa 450-527 MHz 4W 4CH	
	X	PMUE1489_	GP328 Tanapa 450-527 MHz 4W	
	X	PMUE1490_	GP338 Tanapa 450-527 MHz 4W	
X		PMLE4172_	GP328 B/C Kit 450-527 MHz 4W 4CH	
	X	PMLE4118_	GP328 B/C Kit 450-527 MHz 4W	
	X	PMLE4119_	GP338 B/C Kit 450-527 MHz 4W	
X		PMLN4348_	GP328 Front Housing Kit 4CH	
	X	PMLN4216_	GP328 Front Housing Kit	
	X	PMLN4199_	GP338 Front Housing Kit	
X	X	X	NAE6483_	UHF 16 cm Monopole (Whip) antenna (403-520 MHz)
X	X	X	PMAE4008_	UHF 13 cm Monopole (Whip) antenna (470-530 MHz)
X	X	X	PMAE4006_	UHF 9 cm antenna (465-495 MHz)
X	X	X	PMAE4007_	UHF 9 cm antenna (490-527 MHz)
X	X		6804110J54	GP328 User Manual
		X	6804110J55	GP338 User Manual

x = Indicates one of each is required.

## 2.0 Specifications

### General

	UHF	
Frequency:	450-527 MHz	
Channel Capacity:	GP328 : 4/16 Channels GP338 : 128 Channels	
Power Supply:	7.5 Volts $\pm$ 20%	
Dimensions with Standard High Capacity NiMH Battery:	137mm x 57.5mm x 37.5mm	
with Ultra High Capacity NiMH Bat- tery:	137mm x 57.5mm x 40mm	
Weight: with Standard High Capacity NiMH Battery:	420 g	
with Ultra High Capacity NiMH Bat- tery:	500 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity NiMH Bat- tery:	Low Pow- er	High Pow- er
Ultra High Capac- ity NiMH Battery:	>11 hrs	>8 hrs
	>14 hrs	>11 hrs
Sealing:	Passes rain testing per IP54	
Shock:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Vibration:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Dust:	Meets MIL-STD-810- C,D & E and IP54	
Humidity:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
FCC ID	AZ489FT4834	

### Transmitter

	UHF	
RF Output NiMH @ 7.5V:	Low 1W	High 4W
Frequency	450-527 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre- Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

### Receiver

	UHF 12.5kHz	UHF 20/ 25kHz
Frequency:	450- 527MHz	450- 527MHz
Sensitivity 12dB EIA SINAD:	0.35 $\mu$ V	0.35 $\mu$ V
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

### 3.0 Transmitter

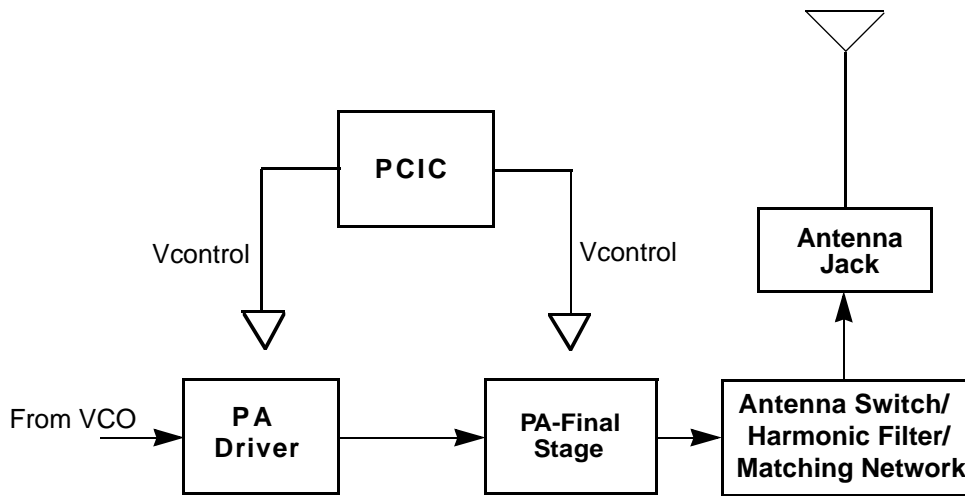


Figure 6-1: Transmitter Block Diagram

#### 3.1 General

(Refer to Figure 6-1)

The UHF transmitter contains five basic circuits:

1. power amplifier
2. antenna switch
3. harmonic filter
4. antenna matching network
5. power control integrated circuit (PCIC).

##### 3.1.1 Power Amplifier

The power amplifier consists of two devices:

1. 9Z67 LDMOS driver IC (U101) and
2. PRF1507 LDMOS PA (Q110).

The 9Z67 LDMOS driver IC contains a 2 stage amplification with a supply voltage of 7.3V.

This RF power amplifier is capable of supplying an output power of 0.3W (pin 6 and 7) with an input signal of 2mW (3dBm) (pin16). The current drain would typically be 160mA while operating in the frequency range of 450-527MHz.

The PRF1507 LDMOS PA is capable of supplying an output power of 7W with an input signal of 0.3W. The current drain would typically be 1300mA while operating in the frequency range of 450-527MHz. The power output can be varied by changing the biasing voltage.

### 3.1.2 Antenna Switch

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C107, L104 and C106), and two current limiting resistors (R101, R170). In the transmit mode, B+ at PCIC (U102) pin 23 will go low and turn on Q111 where a B+ bias is applied to the antenna switch circuit to bias the diodes "on". The shunt diode (CR102) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, and hence, there exists a low attenuation path between the antenna and receiver ports.

### 3.1.3 Harmonic Filter

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

### 3.1.4 Antenna Matching Network

A matching network which is made up of L116 is used to match the antenna's impedance to the harmonic filter. This will optimize the performance of the transmitter and receiver into an antenna.

### 3.1.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the Power Control IC (PCIC), U102 to regulate the power output of the radio. The current to the final stage of the power module is supplied through R101, which provides a voltage proportional to the current drain. This voltage is then fed back to the Automatic Level Control (ALC) within the PCIC to regulate the output power of the transmitter.

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

There are resistors and integrators within the PCIC, and external capacitors (C133, C134 and C135) in controlling the transmitter rising and falling time. These are necessary in reducing the power splatter into adjacent channels.

CR105 and its associated components are part of the temperature cut back circuitry. It senses the printed circuit board temperature around the transmitter circuits and output a DC voltage to the PCIC. If the DC voltage produced exceeds the set threshold in the PCIC, the transmitter output power will be reduced so as to reduce the transmitter temperature.

## 4.0 Receiver

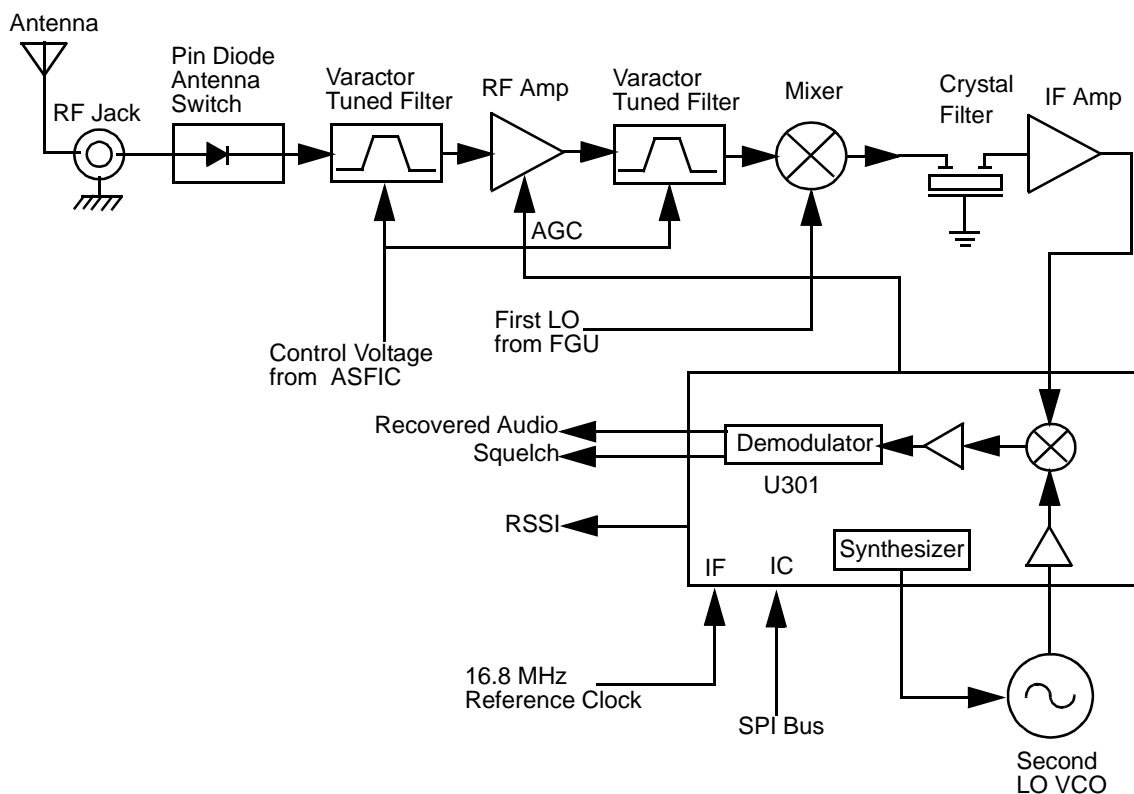


Figure 6-2: UHF Receiver Block Diagram

### 4.1 Receiver Front-End

(Refer to *UHF Band 2 Receiver Front End Schematic Diagram* on page 6C-16 and *UHF Band 2 Transmitter Schematic Diagram* on page 6C-20)

The RF signal is received by the antenna and applied to a low-pass filter. For UHF, the filter consists of L101, L102, C102, C103, C104. The filtered RF signal is passed through the antenna switch. The antenna switch circuit consists of two PIN diodes (CR101 and CR102) and a pi network (C106, L104 and C107). The signal is then applied to a varactor tuned bandpass filter. The UHF bandpass filter comprises of L301, L302, C302, C303, C304, CR301 and CR302. The bandpass filter is tuned by applying a control voltage to the varactor diodes (CR301 and CR302) in the filter.

The bandpass filter is electronically tuned by the DACRx from IC404 which is controlled by the microprocessor. Depending on the carrier frequency, the DACRx will supply the tuned voltage to the varactor diodes in the filter. Wideband operation of the filter is achieved by shifting the bandpass filter across the band.

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

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

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

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

## 4.2 Receiver Back-End

(Refer to *UHF Band 2 Receiver Back End Schematic Diagram* on page 6C-17)

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

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

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

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

The IF IC (U301) also performs several other functions. It provides a received signal-strength indicator (RSSI) and a squelch output. The RSSI is a dc voltage monitored by the microprocessor, and used as a peak indicator during the bench tuning of the receiver front-end varactor filter. The RSSI voltage is also used to control the automatic gain control (AGC) circuit at the front-end.

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

### 4.3 Automatic Gain Control Circuit

(Refer to *UHF Band 2 Receiver Front End Schematic Diagram* on page 6C-16)

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

Radio signal strength indicator, RSSI, a voltage signal, is used to drive Q315 to saturation hence turning it on. RSSI is produced by U301 and is proportional to the gain of the RF amplifier and the input RF signal power to the radio.

Resistor network at the input to the base of Q315 is scaled to turn on Q315, hence activating the AGC, at certain RSSI levels. In order to turn on Q315, the voltage across the transistor's base to ground must be greater or equal to the voltage across R319, plus the base-emitter voltage ( $V_{be}$ ) present at Q315. The resistor network with thermistor RT300 is capable of providing temperature compensation to the AGC circuit, as RSSI generated by U301 is lower at cold temperatures compared to normal operation at room temperature. Resistor R300 and capacitor C397 form an R-C network used to dampen any transient instability while the AGC is turning on.

## 5.0 Frequency Generation Circuitry

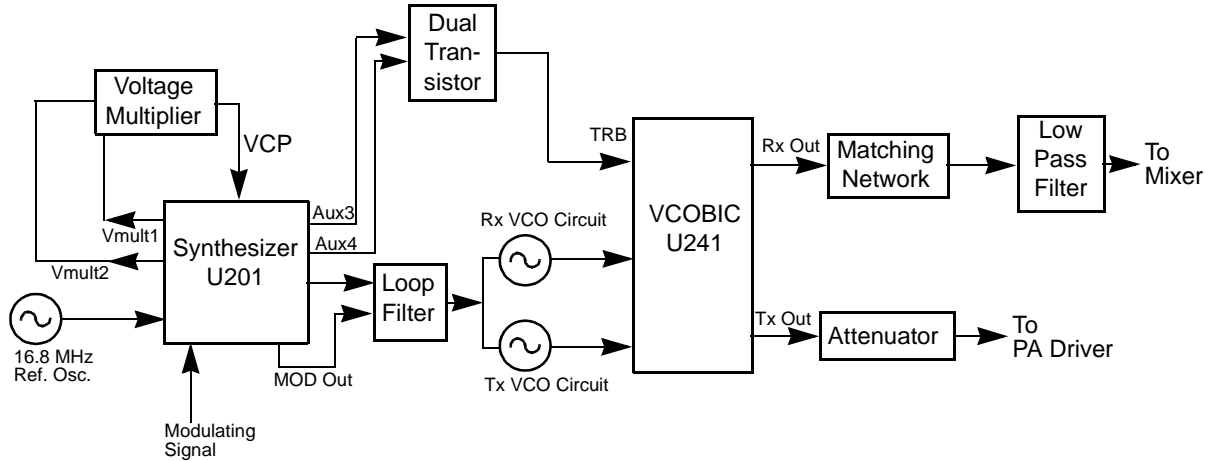


Figure 6-3: Frequency Generation Unit Block Diagram

The Frequency Generation Circuitry is composed of two main ICs, the Fractional-N synthesizer (U201), and the VCO/Buffer IC (U241). Designed in conjunction to maximize compatibility, the two ICs provide many of the functions that normally would require additional circuitry. The synthesizer block diagram illustrates the interconnect and support circuitry used in the region. Refer to the relevant schematics for the reference designators.

The synthesizer is powered by regulated 5V and 3.3V which come from U247 and U248 respectively. The synthesizer in turn generates a superfiltered 4.5V which powers U241.

In addition to the VCO, the synthesizer must interface with the logic and ASFIC circuitry.

Programming for the synthesizer is accomplished through the data, clock and chip select lines from the microprocessor. A 3.3V dc signal from synthesizer lock detect line indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFIC is supplied to pin10 of U201. Internally the audio is digitized by the Fractional-N and applied to the loop divider to provide the low-port modulation. The audio runs through an internal attenuator for modulation balancing purposes before going out to the VCO.



### 5.1 Synthesizer

(Refer to *UHF Band 2 Synthesizer Schematic Diagram* on page 6C-18)

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

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

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

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

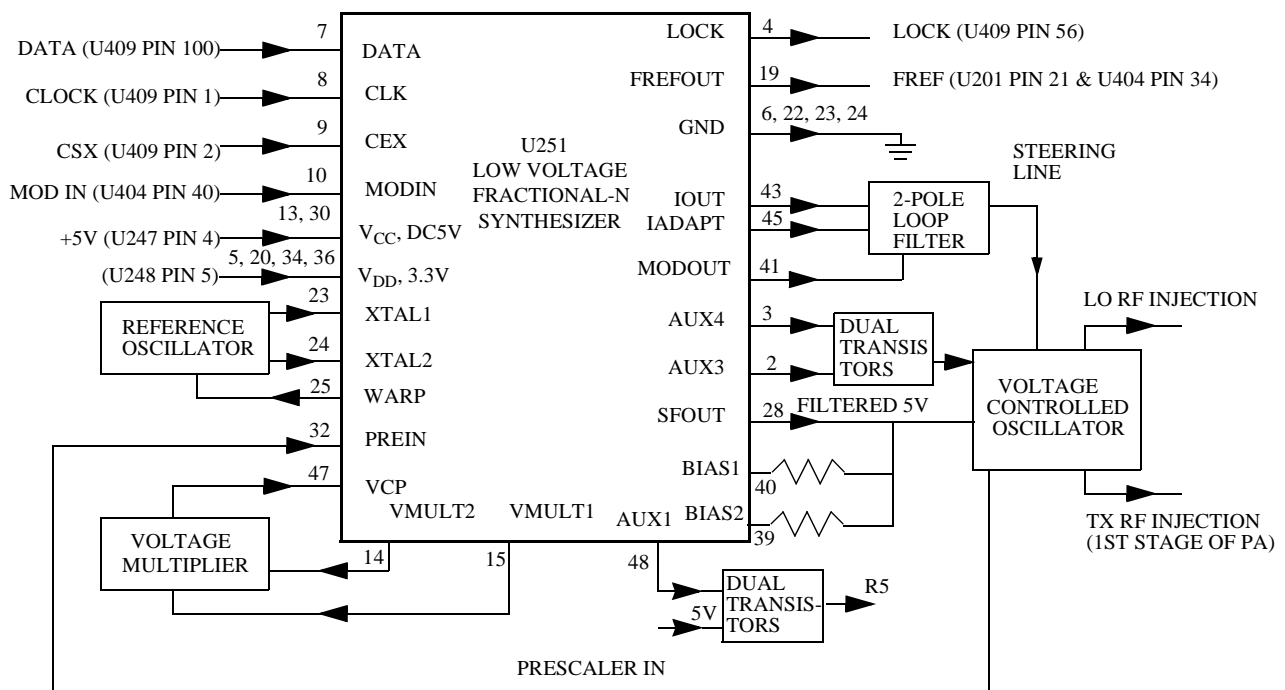


Figure 6-4 Synthesizer Block Diagram

### 5.2 VCO - Voltage Controlled Oscillator

(Refer to UHF Band 2 Voltage Controlled Oscillator Schematic Diagram on page 6C-19)

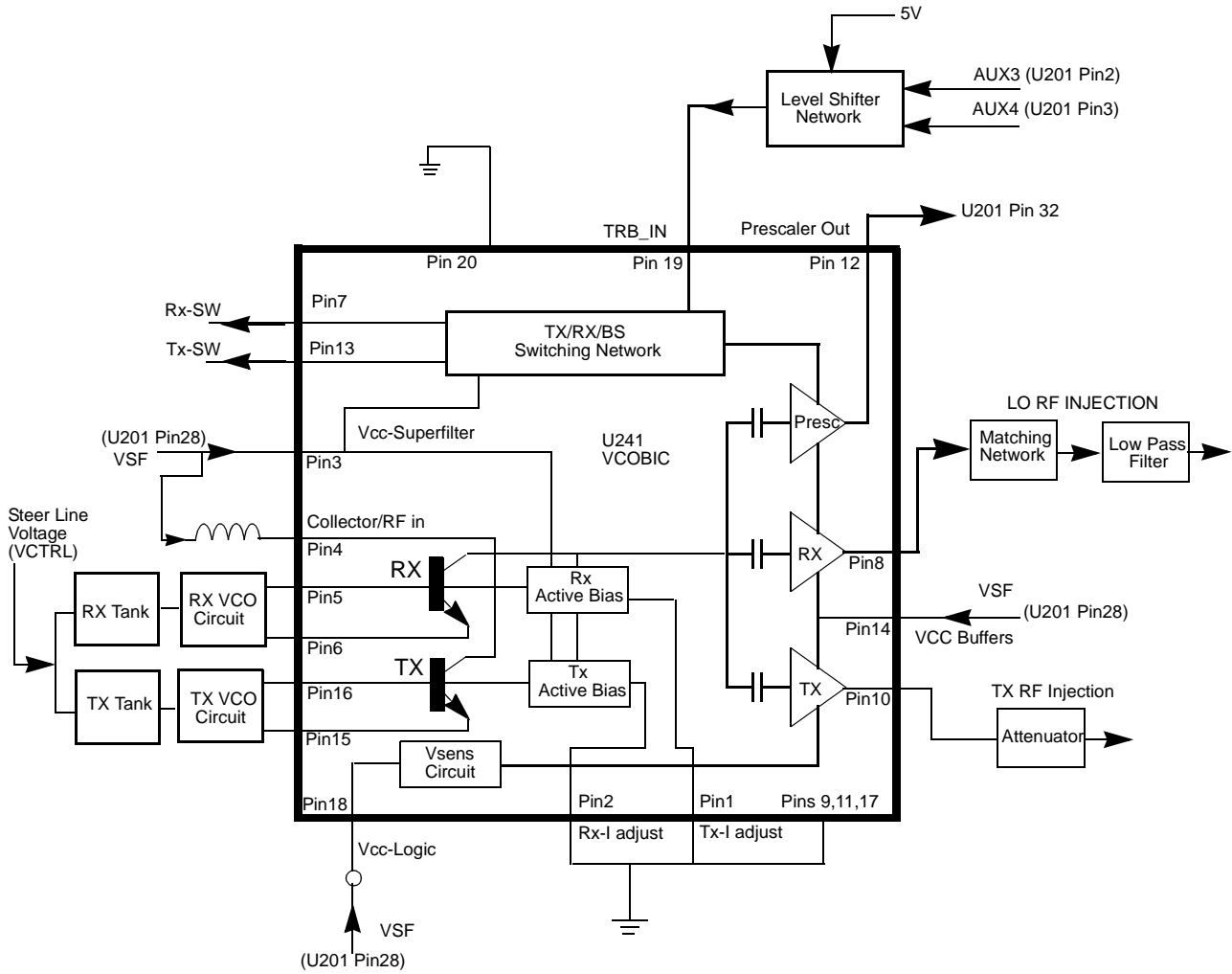


Figure 6-5 VCO Block Diagram

The VCOBIC (U241) in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U241 pin 19) determines which oscillator and buffer will be enabled. A sample of the RF signal from the enabled oscillator is routed from U241 pin 12, through a low pass filter, to the prescaler input (U201 pin 32). After frequency comparison in the synthesizer, a resultant CONTROL VOLTAGE is received at the VCO. This voltage is a DC voltage between 3.5V and 9.5V when the PLL is locked on frequency.

The VCOBIC(U241) is operated at 4.54 V (VSF) and Fractional-N synthesizer (U201) at 3.3V. This difference in operating voltage requires a level shifter consisting of Q260 and Q261 on the TRB line. The operation logic is shown in Table 6-1.

*Table 6-1: Level Shifter Logic*

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

In the receive mode, U241 pin 19 is low or grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U241. The RF signal at U241 pin 8 is run through a matching network. The resulting RF signal is the LO RF INJECTION and it is applied to the mixer at T302 (refer to *UHF Band 2 Receiver Front End Schematic Diagram* on page 6C-16).

During the transmit condition, when PTT is depressed, five volts is applied to U241 pin 19. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U241. The RF signal at U241 pin 10 is injected into the input of the PA module (U101 pin16). This RF signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received through the U201 pin 41.

When a high impedance is applied to U241 pin19, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive transmit and prescaler buffer are turned off.

## 6.0 Notes For All Schematics and Circuit Boards

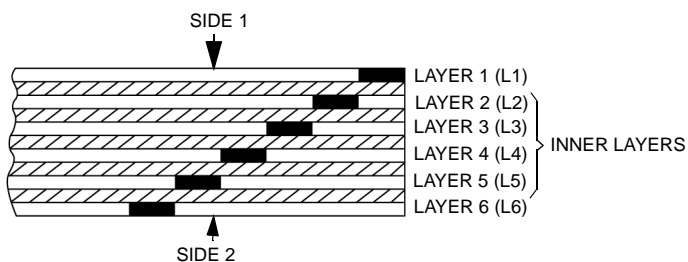
\* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

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

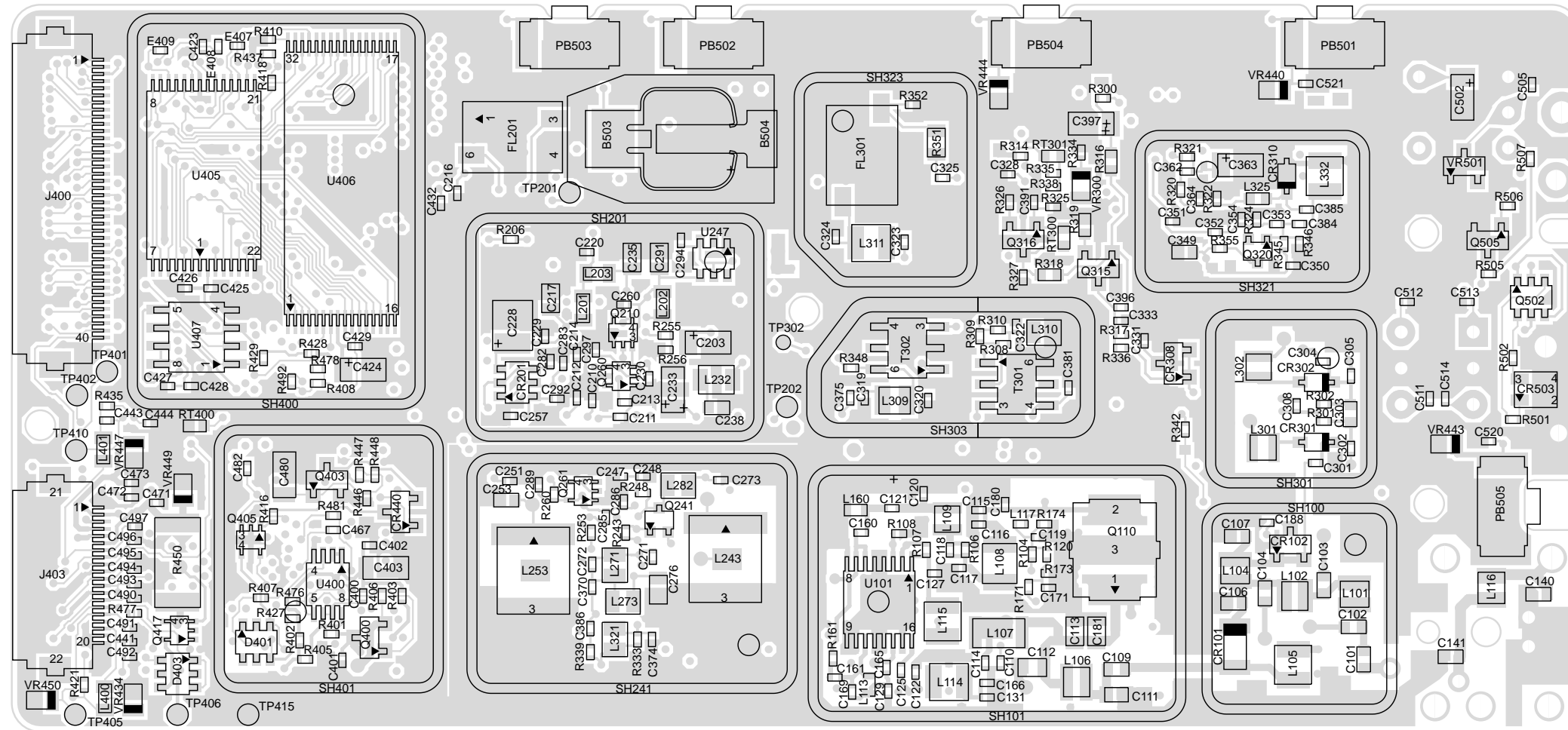
100 Series	=	Transmitter
200 Series	=	Frequency Generation
300 Series	=	Receiver
400/500 Series	=	Controller
600 Series	=	Keypad Board
4. Interconnect Tie Point Legend:
 

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

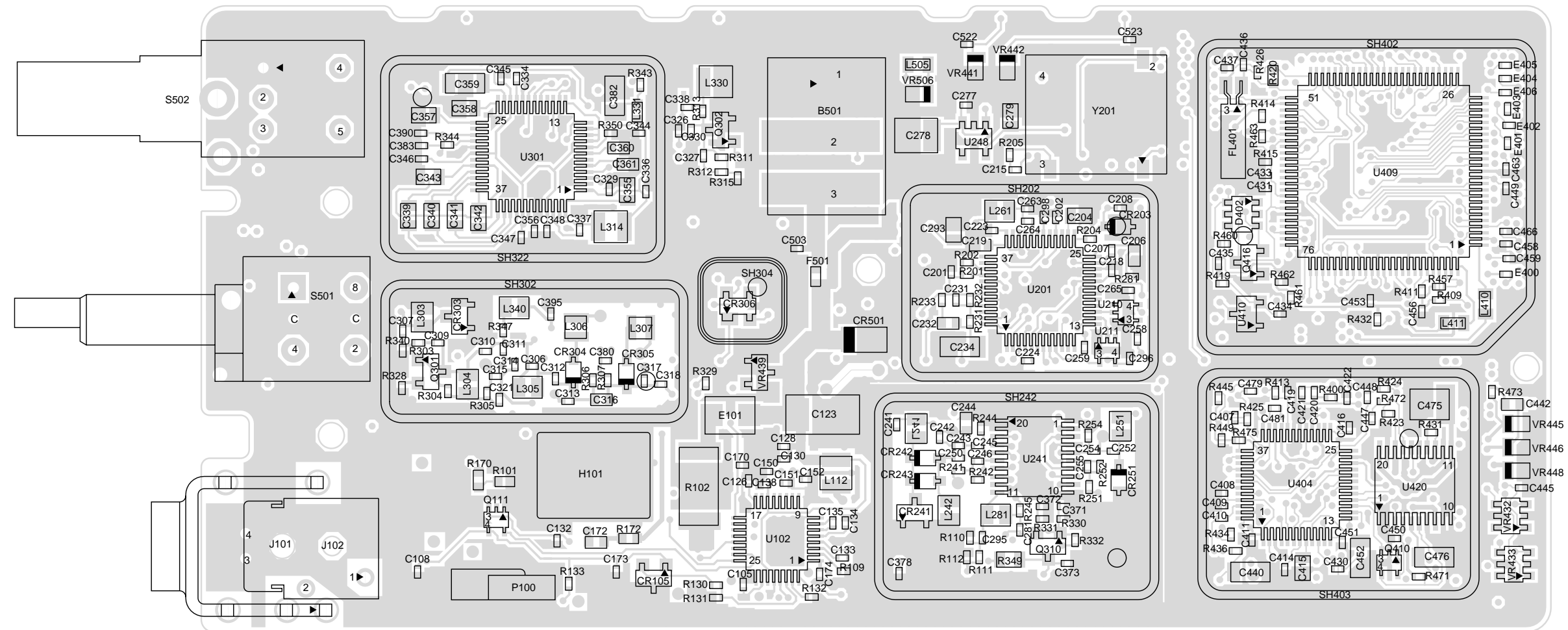
### 6-LAYER CIRCUIT BOARD DETAIL VIEWING COPPER STEPS IN PROPER LAYER SEQUENCE



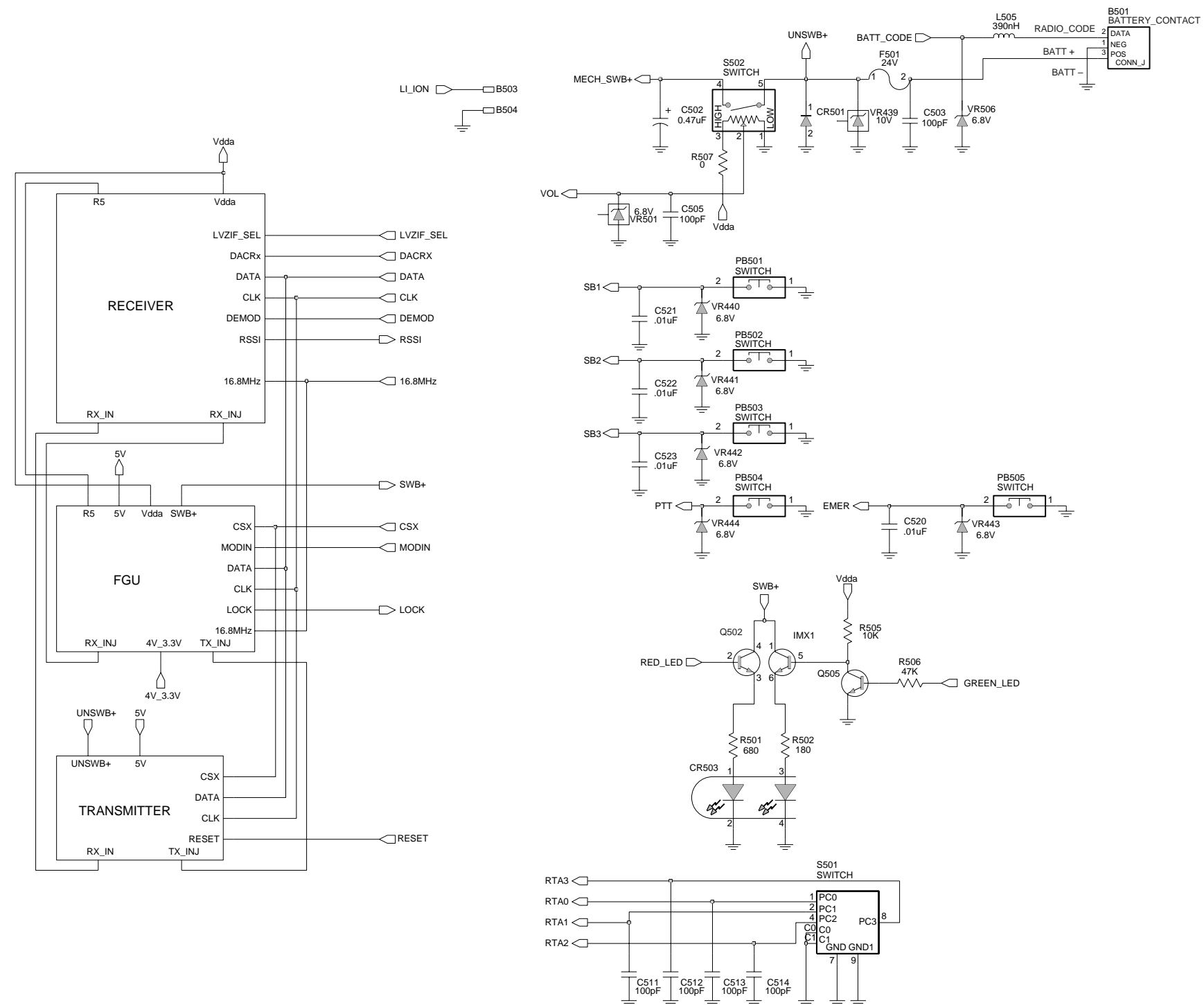
### 7.0 Circuit Board/Schematic Diagrams and Parts List



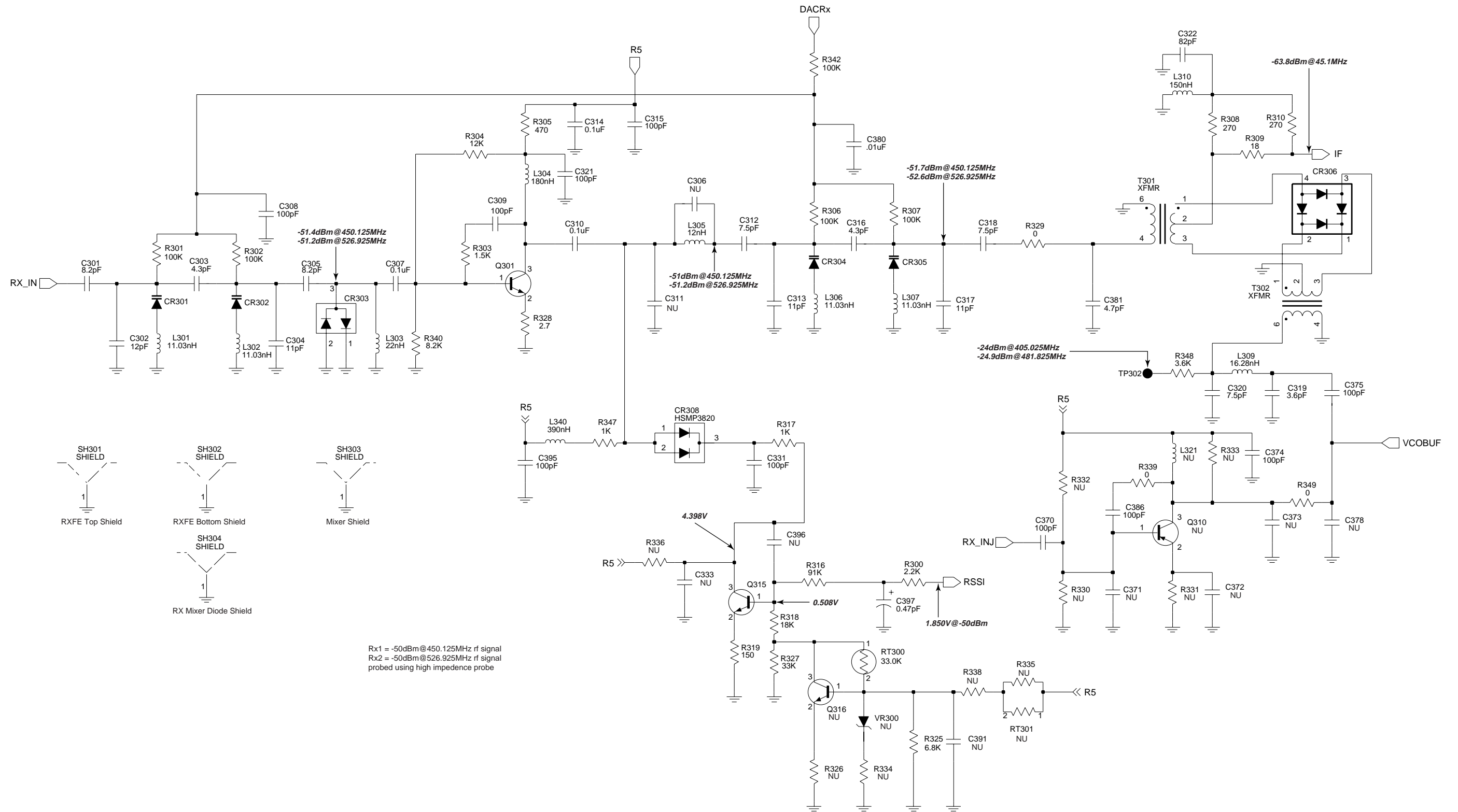
ZMY0130185-A



ZMY0130184-B



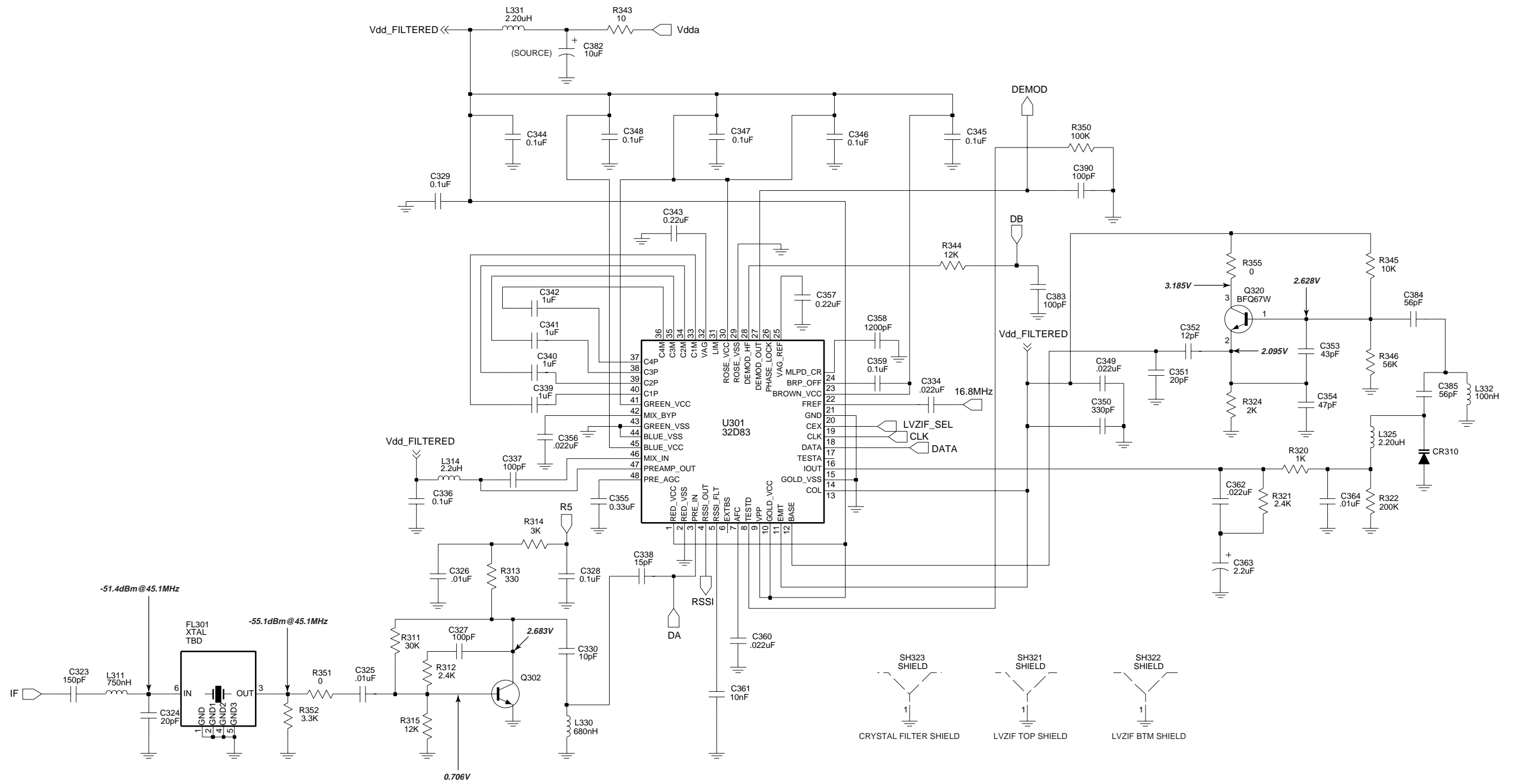
UHF Band 2 Controls And Switches Schematic Diagram



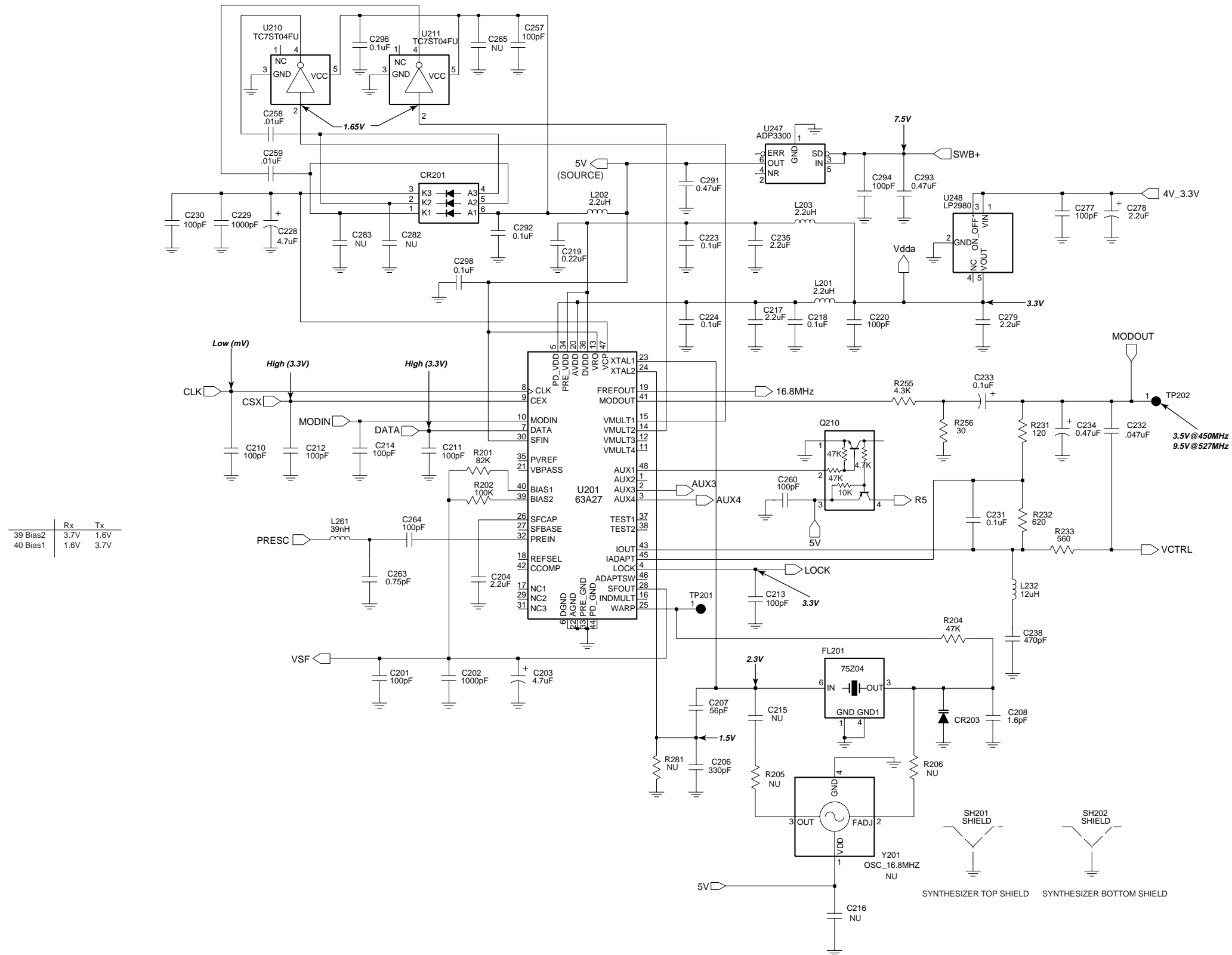
Rx1 = -50dBm@450.125MHz rf signal  
 Rx2 = -50dBm@526.925MHz rf signal  
 probed using high impedance probe

UHF Band 2 Receiver Front End Schematic Diagram

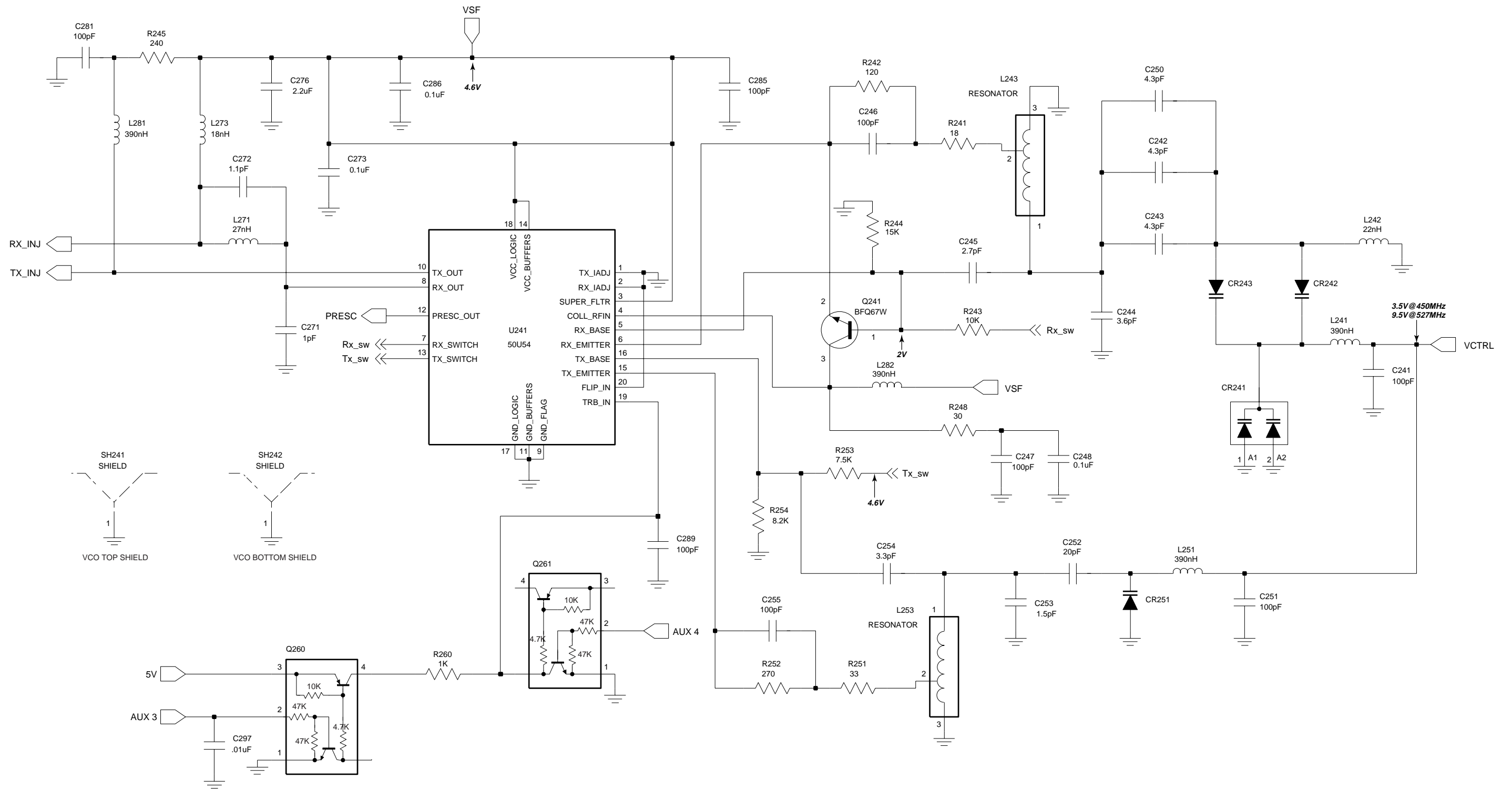




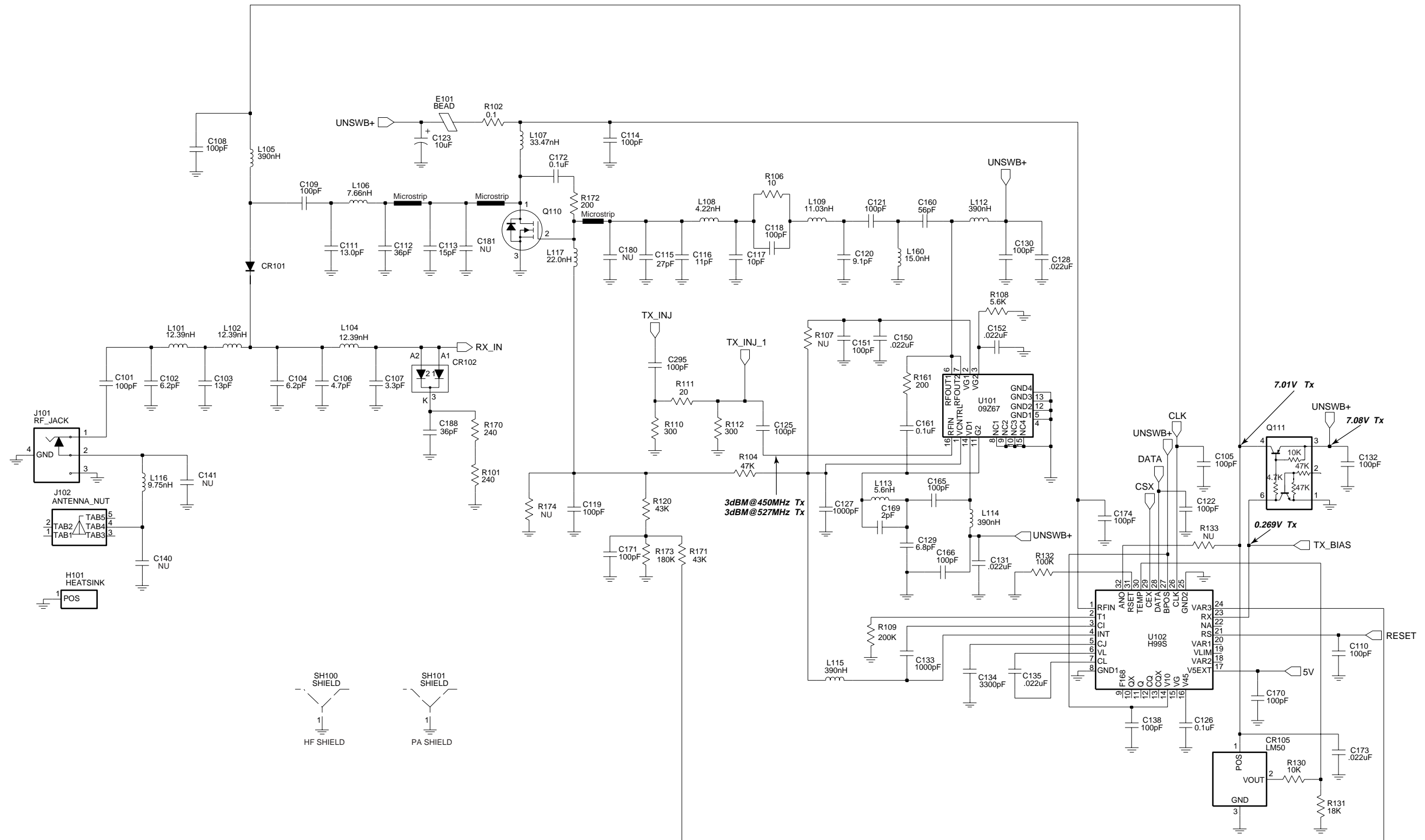
UHF Band 2 Receiver Back End Schematic Diagram



UHF Band 2 Synthesizer Schematic Diagram



UHF Band 2 Voltage Controlled Oscillator Schematic Diagram



UHF Band 2 Transmitter Schematic Diagram

## UHF Band 2 Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A01	Battery Contact Module
B503	3980502Z01	Backup Batt Contact+
B504	3980501Z01	Backup Batt Contact-
C101	2113740F51	100pF
C102	2113740F22	6.2pF, 0.1
C103	2113740F30	13pF
C104	2113740F22	6.2pF, 0.1
C105	2113743N50	100pF
C106	2113740F19	4.7pF, 0.1
C107	2113740F15	3.3pF, 0.1
C108	2113743N50	100pF
C109	2113740F51	100pF
C110	2113743N50	100pF
C111	2103689A23	13pF, ±0.05
C112	2180605Z29	36pF
C113	2180605Z20	15pF
C114	2113743N50	100pF
C115	2113743N36	27pF
C116	2113743N27	11pF
C117	2113743N26	10pF
C118	2113743N50	100pF
C119	2113743N50	100pF
C120	2113743N25	9.1pF
C121	2113743N50	100pF
C122	2113743N50	100pF
C123	2311049A18	10uF, 10%; 16V
C125	2113743N50	100pF
C126	2113743M24	0.1uF, +80%/-20%
C127	2113743L17	1000pF, 10%
C128	2113743M08	.022uF, +80%/-20%
C129	2113743N22	6.8pF, 0.5
C130	2113743N50	100pF
C131	2113743M08	.022uF, +80%/-20%
C132	2113743N50	100pF
C133	2113743L17	1000pF, 10%
C134	2113743L29	3300pF, 10%
C135	2113743M08	.022uF, +80%/-20%
C138	2113743N50	100pF
C140	Not Placed	
C141	Not Placed	
C150	2113743M08	.022uF, +80%/-20%
C151	2113743N50	100pF
C152	2113743M08	.022uF, +80%/-20%
C160	2113743N44	56pF
C161	2113743M24	0.1uF, +80%/-20%
C165	2113743N50	100pF
C166	2113743N50	100pF
C169	2113743N09	2pF, 0.25
C170	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C171	2113743N50	100pF
C172	2113743E20	0.1uF, 10%
C173	2113743M08	.022uF, +80%/-20%
C174	2113743N50	100pF
C201	2113743N50	100pF
C202	2113743L17	1000pF, 10%
C203	2311049A56	4.7uF, 20%; 10V
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N44	56pF
C208	2113743N08	1.6pF
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C217	2104993J02	2.2uF
C218	2113743M24	0.1uF, +80%/-20%
C219	2113743K16	0.22uF, +80%/-20%
C220	2113743N50	100pF
C223	2113743M24	0.1uF, +80%/-20%
C224	2113743M24	0.1uF, +80%/-20%
C228	2311049J11	4.7uF, 10%; 16V
C229	2113743L17	1000pF, 10%
C230	2113743N50	100pF
C231	2113743M24	0.1uF, +80%/-20%
C232	2113743E12	.047uF, 10%
C233	2311049A01	0.1uF, 10%; 35V
C234	2311049A05	0.47uF, 10%; 25V
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N18	4.7pF, 0.5
C243	2113743N18	4.7pF, 0.5
C244	2113740F14	3pF, 0.25
C245	2113743N12	2.7pF, 0.25
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	0.1uF, +80%/-20%
C250	2113743N18	4.7pF, 0.5
C251	2113743N50	100pF
C252	2113743N33	20pF
C253	2113740F07	1.5pF, 0.25
C254	2113743N14	3.3pF, 0.25
C255	2113743N50	100pF
C257	2113743N50	100pF
C258	2113743L41	.01uF, 10%
C259	2113743L41	.01uF, 10%
C260	2113743N50	100pF
C263	2113743N02	0.75pF, 0.25
C264	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C265	Not Placed	
C271	2113743N03	1pF, 0.25
C272	2113743N04	1.1pF, 0.25
C273	2113743M24	0.1uF, +80%/-20%
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A57	10uF, 10%; 20V
C279	2104993J02	2.2uF
C281	2113743N50	100pF
C285	2113743N50	100pF
C286	2113743M24	0.1uF, +80%/-20%
C289	2113743N50	100pF
C291	2113743A27	0.47uF, 10%
C292	2113743M24	0.1uF, +80%/-20%
C293	2113743A27	0.47uF, 10%
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	0.1uF, +80%/-20%
C297	2113743L41	.01uF, 10%
C298	2113743M24	0.1uF, +80%/-20%
C301	2113743N24	8.2pF, 0.25
C302	2113743N28	12pF
C303	2113740L09	4.3pF, 0.1
C304	2113743N27	11pF, 0.5
C305	2113743N24	8.2pF
C306	Not Placed	
C307	2113743M24	0.1uF, +80%/-20%
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	0.1uF, +80%/-20%
C311	Not Placed	
C312	2113743N23	7.5pF, 0.5
C313	2113743N27	11pF
C314	2113743M24	0.1uF, +80%/-20%
C315	2113743N50	100pF
C316	2113740L09	4.3pF, 0.1
C317	2113743N27	11pF, 0.5
C318	2113743N23	7.5pF, 0.5
C319	2113743N15	3.6pF, 0.5
C320	2113743N23	7.5pF, 0.5
C321	2113743N50	100pF
C322	2113743N48	82pF
C323	2113743N54	150pF
C324	2113743N33	20pF
C325	2113743L41	.01uF, 10%
C326	2113743L41	.01uF, 10%
C327	2113743N50	100pF
C328	2113743M24	0.1uF, +80%/-20%
C329	2113743M24	0.1uF, +80%/-20%
C330	2113743N26	10pF
C331	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C333	Not Placed	
C334	2113743M08	.022uF, +80%/-20%
C336	2113743M24	0.1uF, +80%/-20%
C337	2113743N50	100pF
C338	2113743N30	15pF
C339	2180478Z20	1.0uF, 10%
C340	2180478Z20	1.0uF, 10%
C341	2180478Z20	1.0uF, 10%
C342	2180478Z20	1.0uF, 10%
C343	2113743A23	0.22uF, 10%
C344	2113743M24	0.1uF, +80%/-20%
C345	2113743M24	0.1uF, +80%/-20%
C346	2113743M24	0.1uF, +80%/-20%
C347	2113743M24	0.1uF, +80%/-20%
C348	2113743M24	0.1uF, +80%/-20%
C349	2113743E07	.022uF, 10%
C350	2113743L05	330pF, 10%
C351	2113743N33	20pF
C352	2113743N28	12pF
C353	2113743N41	43pF
C354	2113743N42	47pF
C355	2113743A24	0.33uF, 10%
C356	2113743M08	.022uF, +80%/-20%
C357	2113743A23	0.22uF, 10%
C358	2113741A23	1200pF
C359	2109720D14	0.1uF
C360	2113743E07	.022uF, 10%
C361	2113741F49	0.1uF, 10%
C362	2113743M08	0.022uF
C363	2311049A40	2.2uF, 10%; 16V
C364	2113743L41	0.01uF
C370	2113743N50	100pF
C371	Not Placed	
C372	Not Placed	
C373	Not Placed	
C374	2113743N50	100pF
C375	2113743N50	100pF
C378	Not Placed	
C380	2113743L41	.01uF, 10%
C381	2113743N18	4.7pF, 0.5
C382	2311049A59	10uF, 10%; 6V
C383	2113743N50	100pF
C384	2113743N44	56pF
C385	2113743N44	56pF
C386	2113743N50	100pF
C390	2113743N50	100pF
C391	Not Placed	
C395	2113743N50	100pF
C396	Not Placed	
C397	2311049A07	1uF, 10%; 16V
C400	2113743L41	.01uF, 10%

Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description
C401	2113743M24	0.1uF, +80%/-20%	C467	2113928N01	0.1uF, 10%	CR501	4880107R01	Rectifier	L273	2462587V25	18nH, 5%
C402	2113743M24	0.1uF, +80%/-20%	C471	2113743LN50	100pF	CR503	4805729G49	LED Red/Yel	L281	2462587V41	390nH, 10%
C403	2113743G24	2.2uF, +80%/-20%	C472	2113743L09	470pF	D401	4802245J62	Diode Schottky, RB731U	L282	2462587V41	390nH, 10%
C407	2113928N01	0.1uF, 10%	C473	2113743L09	470pF	D402	4802245J62	Diode Schottky, RB731U	L301	2460591B04	11.03nH, 10%
C408	2113743N50	100pF	C475	2113743H14	10uF, +80%/-20%	D403	4802245J62	Diode Schottky, RB731U	L302	2460591B04	11.03nH, 10%
C409	2113743M24	0.1uF, +80%/-20%	C476	2113928D08	10uF, +80%/-20%	E101	2484657R01	Ferrite Bead	L303	2462587V26	22nH, 5%
C410	2113928N01	0.1uF, 10%	C479	2113928N01	0.1uF, 10%	E400	2480640Z01	Ferrite Bead	L304	2462587V37	180nH, 5%
C411	2113743M24	0.1uF, +80%/-20%	C480	2113928D08	10uF, +80%/-20%	E401	2480640Z01	Ferrite Bead	L305	2462587V23	12nH, 5%
C414	2113743M24	0.1uF, +80%/-20%	C481	2113928N01	0.1uF, 10%	E402	2480640Z01	Ferrite Bead	L306	2460591B04	11.03nH, 10%
C415	2109720D01	.01uF, 10%	C482	2113928N01	0.1uF, 10%	E403	2480640Z01	Ferrite Bead	L307	2460591B04	11.03nH, 10%
C416	2113928N01	0.1uF, 10%	C490	2113743N50	100pF	E404	2480640Z01	Ferrite Bead	L309	2460591C16	16.28nH, 10%
C419	Not Placed		C491	2113743N50	100pF	E405	2480640Z01	Ferrite Bead	L310	2462587V36	150nH,5%
C420	2113743L41	.01uF, 10%	C492	2113743N50	100pF	E406	2480640Z01	Ferrite Bead	L311	2462587N65	750nH,5%
C421	2113928N01	0.1uF, 10%	C493	2113743N50	100pF	E407	2480640Z01	Ferrite Bead	L314	2462587N72	2.2uH, 5%
C422	2113743M24	0.1uF, +80%/-20%	C494	2113743N50	100pF	E408	2480640Z01	Ferrite Bead	L321	Not Placed	
C423	2113743N50	100pF	C495	2113743N50	100pF	E409	2480640Z01	Ferrite Bead	L325	2480646Z20	2.2uH
C424	2311049A59	10uF, 10%; 6V	C496	2113743N50	100pF	F501	6580542Z01	Fuse 3A	L330	2462587N64	680nH, 5%
C425	2113743M24	0.1uF, +80%/-20%	C497	2113743N50	100pF	FL201	4805875Z04	16.8MHz Xtal (SMD)	L331	2480646Z20	2.2uH
C426	2113743N50	100pF	C502	2311049A05	0.47uF, 10%; 25V	FL301	4802245J43	Xtal Filter 45.1MHz	L332	2462587N53	100nH, 5%
C427	2113743N50	100pF	C503	2113743N50	100pF	FL401	4870368G02	Osc Xtal 38.4kHz	L340	2462587V41	390nH, 10%
C428	2113743M24	0.1uF, +80%/-20%	C505	2113743N50	100pF	H101	2680499Z01	Heat Spreader	L400	2462587Q42	390nH, 10%
C429	2113743M24	0.1uF, +80%/-20%	C511	2113743N50	100pF	J101	0180117S05	RF Jack Assembly	L401	2462587Q42	390nH, 10%
C430	2113928N01	0.1uF, 10%	C512	2113743N50	100pF	J102	0280519Z02	Antenna Nut	L410	2462587Q42	390nH, 10%
C431	2113743N50	100pF	C513	2113743N50	100pF	J400	0905505Y04	40-pins Connector	L411	2462587Q42	390nH, 10%
C432	Not Placed		C514	2113743N50	100pF	J403	0905505Y02	20-pins Connector	L505	2462587Q42	390nH, 10%
C433	2113743L41	.01uF, 10%	C520	2113743L41	.01uF, 10%	L101	2460591B24	12.39nH, 10%	P100	3905643V01	Gnd Contact Finger
C434	2113743M24	0.1uF, +80%/-20%	C521	2113743L41	.01uF, 10%	L102	2460591B24	12.39nH, 10%	PB501	4080523Z01	Tactile, Pushbutton
C435	2113743M24	0.1uF, +80%/-20%	C522	2113743L41	.01uF, 10%	L104	2460591B24	12.39nH, 10%	PB502	4080523Z01	Tactile, Pushbutton
C436	2113743N34	22pF	C523	2113743L41	.01uF, 10%	L105	2462587N22	390nH, 10%	PB503	4080523Z01	Tactile, Pushbutton
C437	2113743N34	22pF	CR101	4880973Z02	Pin Diode	L106	2460591A11	7.66nH, 10%	PB504	4080523Z01	Tactile, Pushbutton
C440	2113743G26	4.7uF, +80%/-20%	CR102	4802245J41	Pin Diode	L107	2460591G24	33.47nH, 10%	PB505	4080523Z01	Tactile, Pushbutton
C441	2113743N50	100pF	CR105	5185963A15	Temperature Sense	L108	2460591A01	4.22nH, 10%	Q110	4802245J55	RF Power FET
C442	2113743E20	0.1uF, 10%	CR201	4802233J09	Triple Diode	L109	2460591B04	11.03nH, 10%	Q111	4802245J50	Dual NPN/PNP
C443	2113928N01	0.1uF, 10%	CR203	4862824C03	Varactor	L112	2462587N22	390nH, 10%	Q210	4802245J50	Dual NPN/PNP
C444	2113743N50	100pF	CR241	4805649Q13	Dual Varactor	L113	2413926H09	5.6nH, 5%	Q241	4805218N63	NPN
C445	2113743N50	100pF	CR242	4862824C01	Varactor	L114	2462587N22	390nH, 10%	Q260	4802245J50	Dual NPN/PNP
C447	2113743M08	0.22uF, 10%	CR243	4862824C01	Varactor	L115	2462587N22	390nH, 10%	Q261	4802245J50	Dual NPN/PNP
C448	2113928N01	0.1uF, 10%	CR251	4862824C01	Varactor	L116	2460591A50	9.75nH, 10%	Q301	4802245J44	NPN
C449	2113743N50	100pF	CR301	4862824C01	Varactor	L160	2413926H14	15.0nH, 5%	Q302	4802245J44	NPN
C450	2113743M24	0.1uF, +80%/-20%	CR302	4862824C01	Varactor	L201	2462587Q20	2.2uH, 20%	Q310	Not Placed	
C451	2113743M08	.022uF, +80%/-20%	CR303	4880154K03	Dual Common Anode-Cathode	L202	2462587Q20	2.2uH, 20%	Q315	4880214G02	NPN
C452	2113743G26	4.7uF, +80%/-20%	CR304	4862824C01	Varactor	L203	2462587Q20	2.2uH, 20%	Q316	Not Placed	
C453	2113743N50	100pF	CR305	4862824C01	Varactor	L232	2462587P25	12uH, 5%	Q320	4805218N63	NPN
C456	2113743N50	100pF	CR306	4802245J42	Ring Quad Diode	L241	2462587V41	390nH, 10%	Q400	4809579E18	MOSFET P-Chan
C458	2113743N50	100pF	CR308	4802245J41	Pin Diode	L242	2462587V26	22nH, 5%	Q403	4880214G02	NPN
C459	2113743N50	100pF	CR310	4862824C01	Varactor	L243	2460593C03	Teflon Resonator	Q405	4802245J54	Dual NPN
C463	2113743N50	100pF	CR411	4802245J47	Schottky Diode	L251	2462587V41	390nH, 5%	Q410	4802245J54	Dual NPN
C466	2113743N50	100pF	CR412	4802245J47	Schottky Diode	L253	2460593C03	Teflon Resonator	Q416	4809579E18	MOSFET P-Chan
			CR413	4802245J47	Schottky Diode	L261	2462587V29	39nH, 5%			not used in GP328
			CR440	4813833C02	Dual Diode Common Cathode	L271	2462587V27	27nH, 5%	Q417	4802245J50	Dual NPN/PNP
									Q502	5180159R01	Dual NPN

Circuit Ref	Motorola Part No.	Description
Q505	4880214G02	NPN
R101	0662057A34	240
R102	0680539Z01	0.1, 1%
R103	Not Placed	
R104	0662057N15	47K
R106	0662057M26	10
R107	Not Placed	
R108	0662057M92	5.6K
R109	0662057N30	200K
R110	0662057M61	300
R111	0662057M33	20
R112	0662057M61	300
R120	0662057N14	43K
R130	0662057M98	10K
R131	0662057N05	18K
R132	0662057N23	100K
R133	Not Placed	
R161	0662057M57	200
R170	0662057A34	240
R171	0662057N14	43K
R172	0662057A32	200
R173	0662057N29	180K
R201	0662057N21	82K
R202	0662057N23	100K
R204	0662057N15	47K
R231	0662057M52	120
R232	0662057M69	620
R233	0662057M68	560
R241	0662057M32	18
R242	0662057M52	120
R243	0662057M98	10K
R244	0662057N03	15K
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M38	33
R252	0662057M60	270
R253	0662057M95	7.5K
R254	0662057M96	8.2K
R255	0662057M89	4.3K
R256	0662057M37	30
R260	0662057M74	1K
R281	Not Placed	-
R300	0662057M82	2.2K
R301	0662057N23	100K
R302	0662057N23	100K
R303	0662057M78	1.5K
R304	0662057N01	12K
R305	0662057M66	470
R306	0662057N23	100K
R307	0662057N23	100K
R308	0662057M60	270

Circuit Ref	Motorola Part No.	Description
R309	0662057M32	18
R310	0662057M60	270
R311	0662057N10	30K
R312	0662057M83	2.4K
R313	0662057M62	330
R314	0662057M85	3K
R315	0662057N01	12K
R316	0662057A96	36K
R317	0662057M74	1K
R318	0662057A79	18K
R319	0662057A29	150
R320	0662057M74	1K
R321	0662057M83	2.4K
R322	0662057N30	200K
R324	0662057M81	2K
R325	0662057M94	6.8K
R326	Not Placed	
R327	0662057N11	33K
R328	0662057M12	2.7
R329	0662057M01	0
R330	Not Placed	
R331	Not Placed	
R332	Not Placed	
R333	Not Placed	
R334	Not Placed	
R335	Not Placed	
R336	Not Placed	
R338	Not Placed	
R339	0662057M01	0
R340	0662057M96	8.2K
R342	0662057N23	100K
R343	0662057M26	10
R344	0662057N01	12K
R345	0662057M98	10K
R346	0662057N17	56K
R347	0662057M74	1K
R348	0662057M87	3.6K
R349	0662057C01	0
R350	0662057N23	100K
R351	0662057C01	0
R352	0662057M86	3.3K
R355	0662057M01	0
R400	0662057N15	47K
R401	0662057M01	0
R402	Not Placed	
R403	Not Placed	
R405	0662057M01	0
R406	0662057N20	75K
R407	0662057N19	68K
R408	Not Placed	
R409	0662057M98	10K

Circuit Ref	Motorola Part No.	Description
R410	0662057N23	100K
R411	0662057M98	10K
R413	0662057M01	0
R414	0662057V34	180K, 1%
R415	0662057V26	91K, 1%
R416	0662057N13	39K
R418	0662057M01	0
R419	0662057M67	510
R420	0662057B46	10MEG not used in GP328
R421	0662057M81	2K
R423	0662057N39	470K
R424	0662057N12	36K
R425	0662057N10	30K
R426	0662057N35	330K not used in GP328
R427	0662057M84	2.7K
R428	0662057M10	2.2
R429	0662057M98	10K
R431	0662057N39	470K
R432	0662057N16	51K
R434	0662057M62	330K
R435	0662057M81	2K
R436	0662057M01	0
R437	Not Placed	
R445	0662057N08	24K
R446	0662057N31	220K
R447	0662057N51	1.5M
R448	0662057N33	270K
R449	0662057N08	24K
R450	0683962T45	68, 1W
R457	0662057M98	10K
R460	0662057M90	4.7K
R461	0662057M56	180 not used in GP328
R462	0662057M98	10K not used in GP328
R463	0662057M61	300
R471	0662057M92	5.6K
R472	0662057N12	36K
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N35	330K
R477	0662057M74	1K
R478	0662057M98	10K
R481	0662057N08	24K
R492	0662057M01	0
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10K

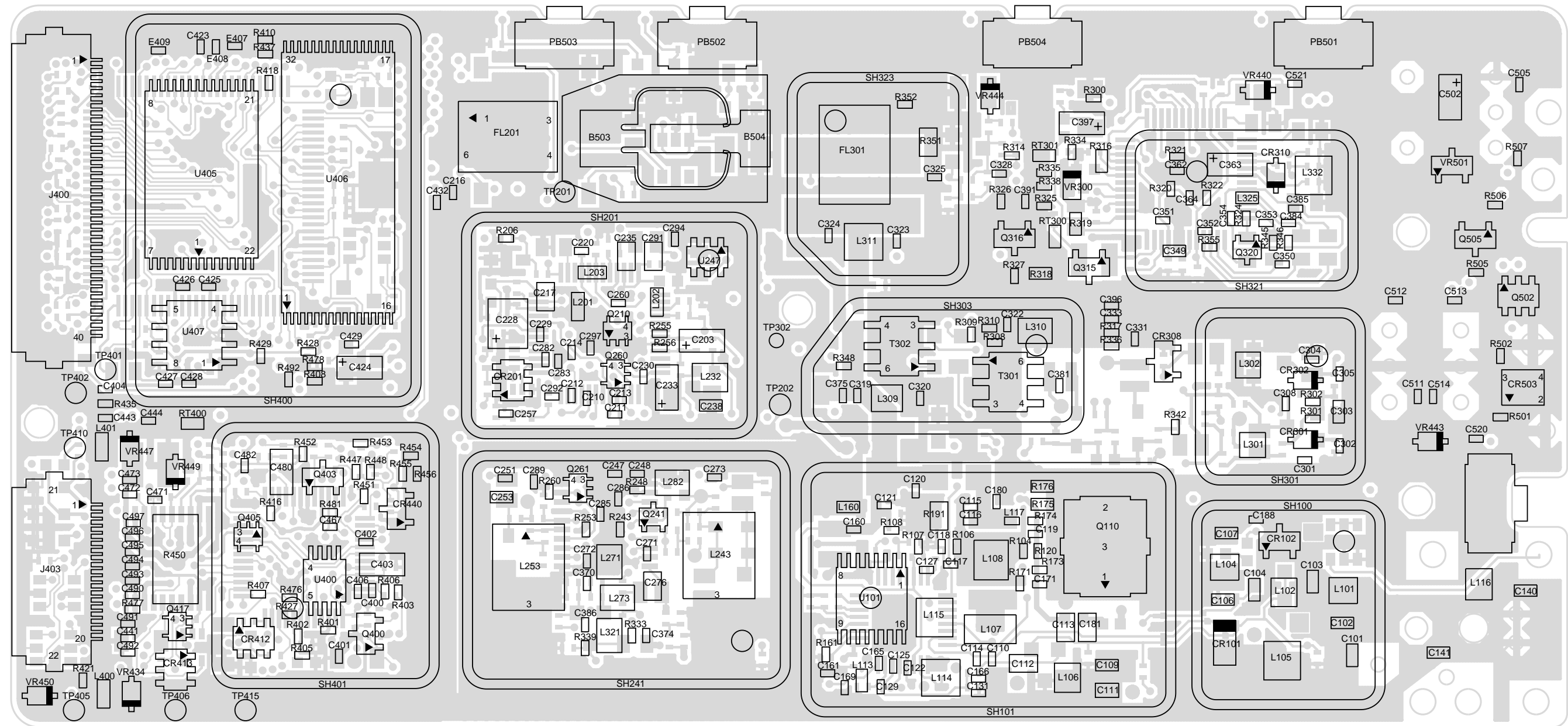
Circuit Ref	Motorola Part No.	Description
R506	0662057N15	47K
R507	0662057M01	0
RT300	0680590Z01	Thermistor 33K
RT301	Not Placed	
RT400	0680590Z01	Thermistor 33K
S501	*4080710Z01	Channel Switch
S502	1880619Z01	Volume Switch
SH100	2680507Z01	Harmonic Filter Shield
SH101	2680510Z01	PA Shield
SH201	2680511Z01	Synthesizer Top Shield
SH202	2680511Z01	Synthesizer Bottom Shield
SH241	2680513Z01	VCO Top Shield
SH242	2680514Z01	VCO Bottom Shield
SH301	2680554Z01	Rx Pre-filter shield\
SH302	2680555Z01	Rx Post-filter/RF Amp Shield
SH303	2680509Z01	Mixer Shield
SH304	2680624Z01	Mixer Diode Shield
SH321	2680508Z01	Zif 2nd LO Shield
SH322	2680514Z01	ZIF Shield
SH323	2680553Z01	Xtal Filter Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller On/Off Shield
SH402	2680515Z01	Controller Microprocessor Shield
SH403	2680516Z01	Controller AsficCmp/Audi PA Shield
T301	2580541Z01	XFMR Coil
T302	2580541Z01	XFMR Coil
U101	5105109Z67	LDMOS Driver
U102	5185765B01	Power Control IC
U201	5185963A27	LVFRACN
U210	5102463J61	Inverter
U211	5102463J61	Inverter
U241	5105750U54	VCO Buffer
U247	5105739X05	Regulator Linear
U248	5102463J58	3.3V Reg
U301	5109632D83	LVZIF
U400	5102463J40	3.3V Reg
U404	5185963A53	AsficCmp
U405	Not Placed	
U406	*5102463J59	Flash ROM 128K x 8
U407	*5102463J64	EEPROM 16K x 8
U409	5102226J56	up HC11FL0
U410	5102463J57	3.3V Reg not used in GP328
U420	5102463J44	Audio PA
VR300	Not Placed	
VR432	4805656W08	5.6V Zener
VR433	4805656W08	5.6V Zener
VR434	4802245J51	6.8V Zener
VR439	4880140L15	10V Zener

<b>Circuit Ref</b>	<b>Motorola Part No.</b>	<b>Description</b>
VR440	4802245J51	6.8V Zener
VR441	4802245J51	6.8V Zener
VR442	4802245J51	6.8V Zener
VR443	4802245J51	6.8V Zener
VR444	4802245J51	6.8V Zener
VR445	4802245J53	10V Zener
VR446	4802245J53	10V Zener
VR447	4802245J53	10V Zener
VR448	4802245J53	10V Zener
VR449	4802245J53	10V Zener
VR450	4802245J53	10V Zener
VR501	4813830A18	6.8V Zener
VR506	4802245J51	6.8V Zener

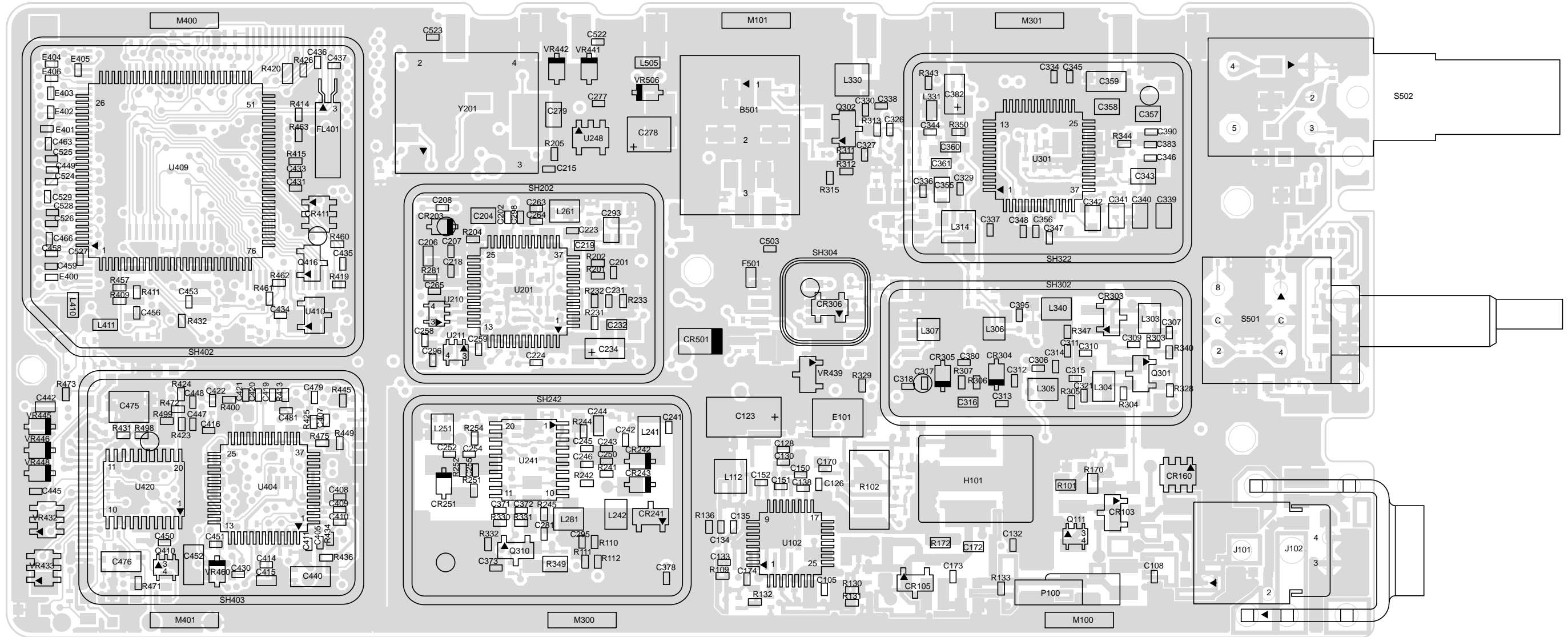
\* Motorola Depot Servicing only



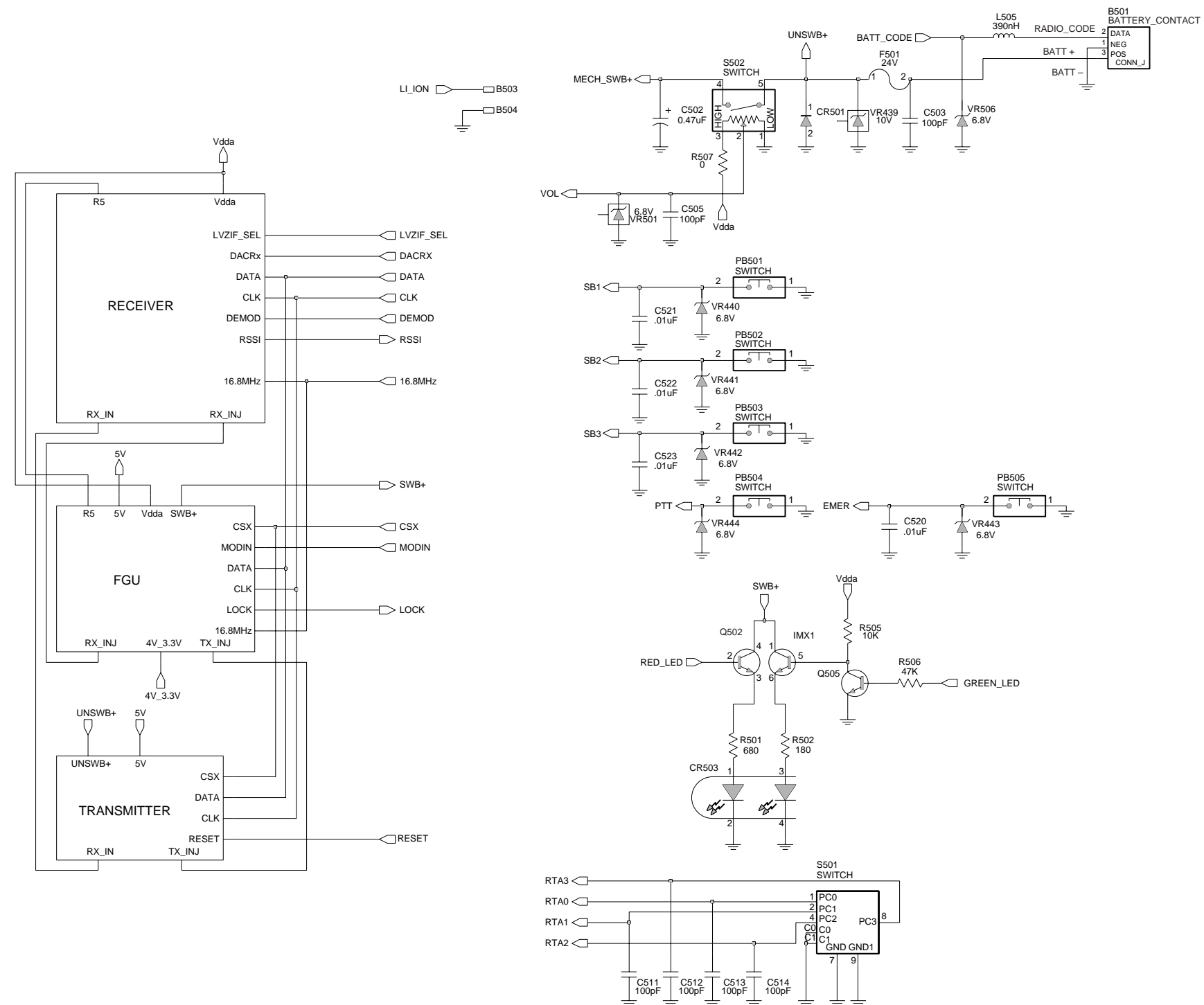
### 8.0 Circuit Board/Schematic Diagrams and Parts List



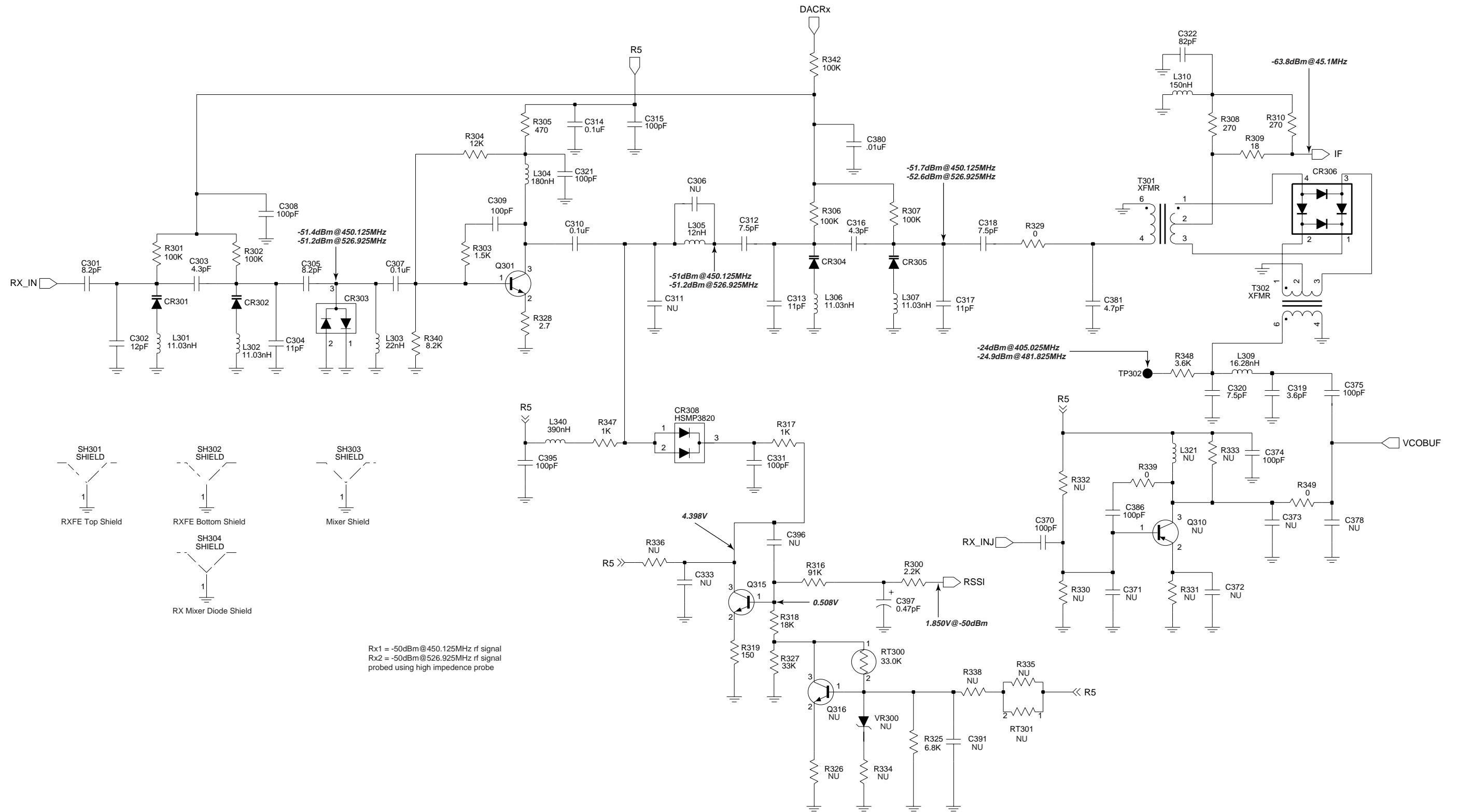
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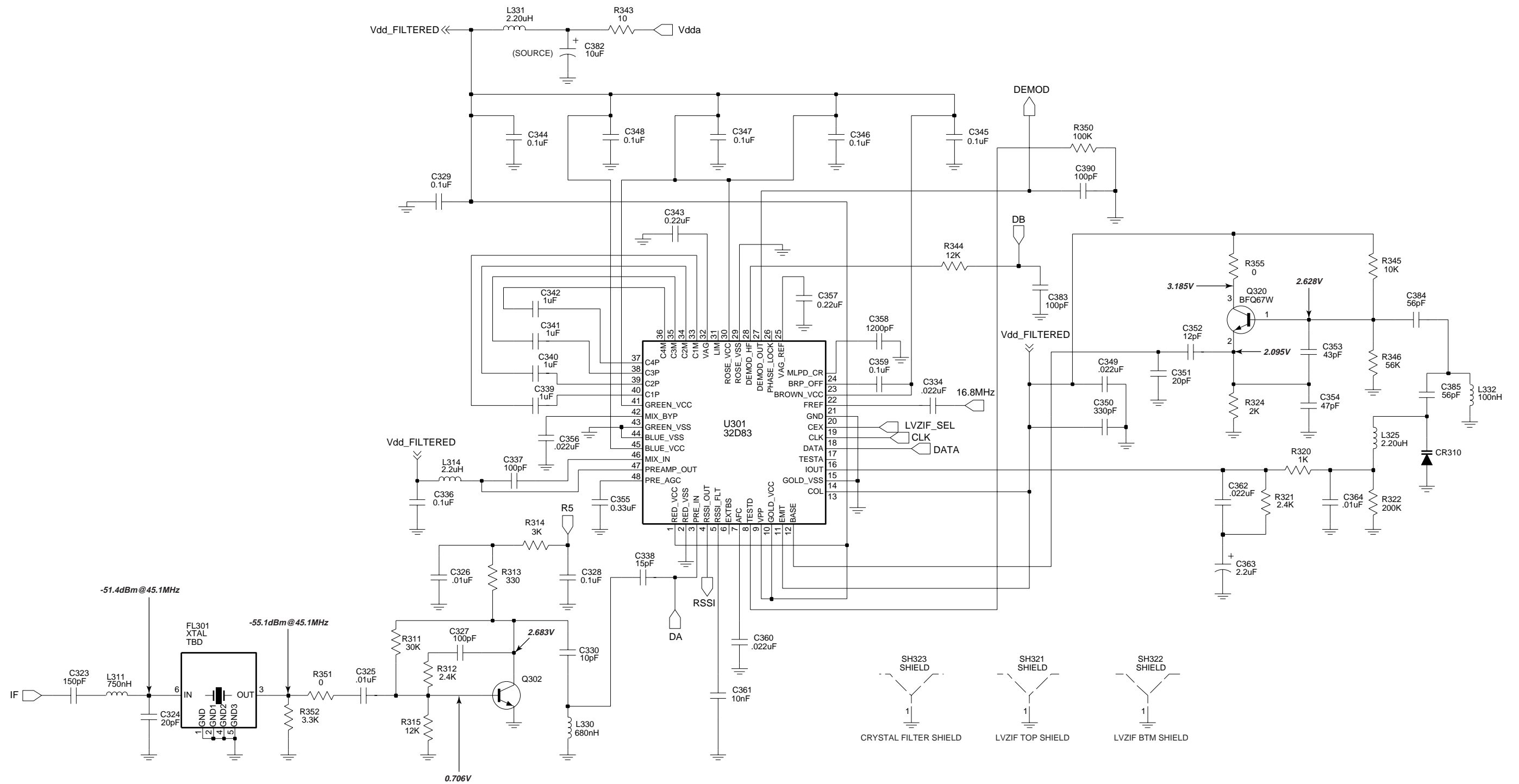
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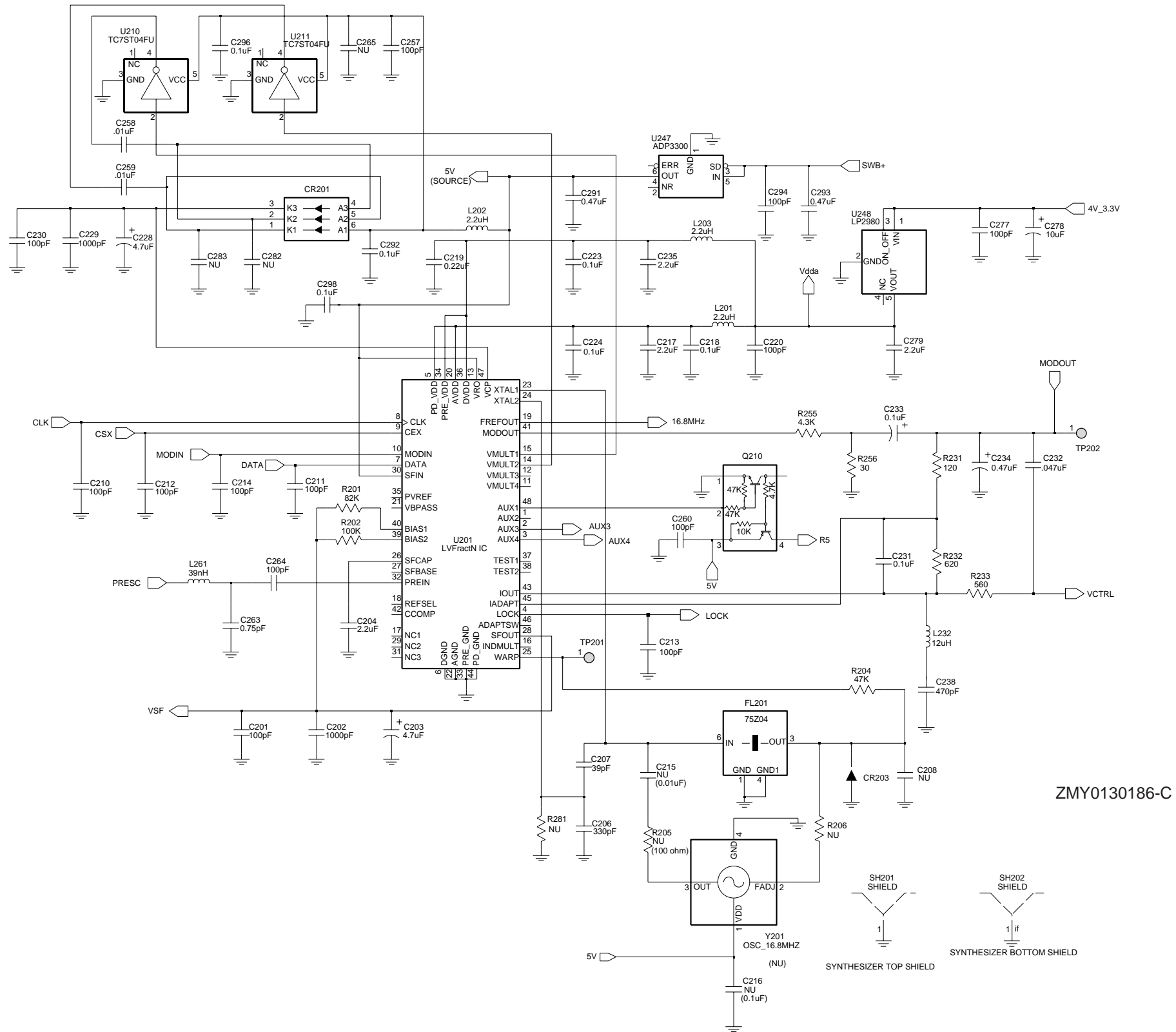
UHF Band 2 Controls And Switches Schematic Diagram



UHF Band 2 Receiver Front End Schematic Diagram

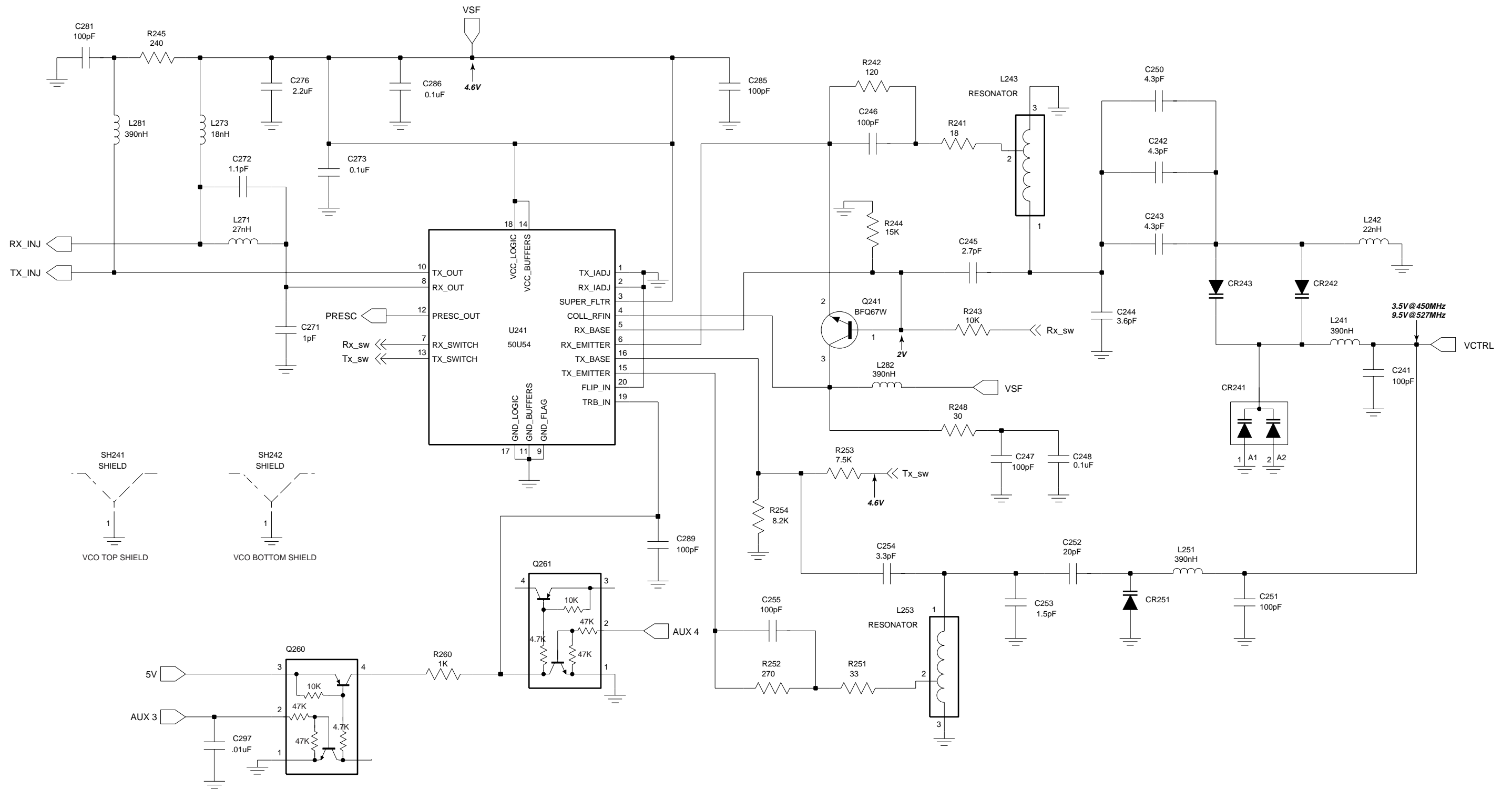


UHF Band 2 Receiver Back End Schematic Diagram

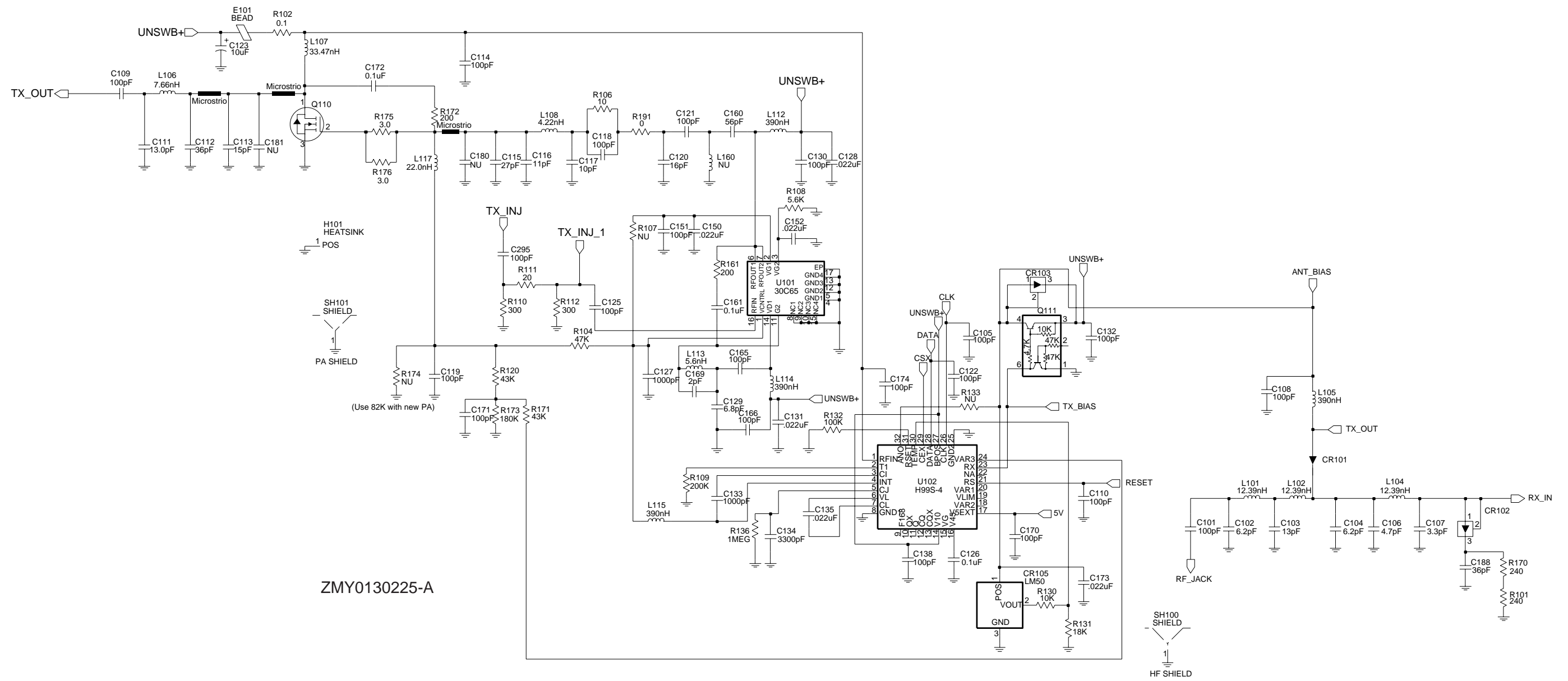


ZMY0130186-C

UHF Band 2 Synthesizer Schematic Diagram



**UHF Band 2 Voltage Controlled Oscillator Schematic Diagram**



UHF Band 2 Transmitter Schematic Diagram



## UHF Band 2 Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Battery Contact Module
B503	3980502Z01	Backup battery B+ (not used in GP328)
B504	3980501Z01	Backup battery B- (not used in GP328)
C101	2113740F51	100pF
C102	2113740F22	6.2pF
C103	2113740F28	11pF
C104	2113740F22	6.2pF
C105	2113743N50	100pF
C106	2113740F19	4.7pF
C107	2113740F15	3.3pF
C108	2113743N50	100pF
C109	2113740F51	100pF
C110	2113743N50	100pF
C111	2103689A22	11pF
C112	2180605Z28	33pF
C113	2180605Z22	18pF
C114	2113743N50	100pF
C115	2113743N36	27pF
C116	2113743N27	11pF
C117	NOT PLACED	
C118	2113743N50	100pF
C119	2113743N50	100pF
C120	2113743N23	7.5pF, 0.5
C121	2113743N50	100pF
C122	2113743N50	100pF
C123	2311049A18	10uF, 10%, 16V
C125	2113743N50	100pF
C126	2113743M24	100000pF, +80%/-20%
C127	2113743L17	1000pF, 10%
C128	2113743M08	22000pF, +80%/-20%
C129	2113743N22	6.8pF, 0.5
C130	2113743N50	100pF
C131	2113743M08	22000pF, +80%/-20%
C132	2113743N50	100pF
C133	2113743L17	1000pF, 10%
C134	2113743L29	3300pF, 10%
C135	2113743M08	22000pF, +80%/-20%
C138	2113743N50	100pF
C140	NOT PLACED	
C141	2113740F25	8.2pF
C150	2113743M08	22000pF, +80%/-20%
C151	2113743N50	100pF
C152	2113743M08	22000pF, +80%/-20%
C160	2113743N44	56pF
C161	2113743M24	100000pF, +80%/-20%
C165	2113743N50	100pF
C166	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C169	2113743N09	2.0pF, 0.25
C170	2113743N50	100pF
C171	2113743N50	100pF
C172	2113743E20	0.10uF, 10%
C173	2113743M08	22000pF, +80%/-20%
C174	2113743N50	100pF
C180	NOT PLACED	
C181	NOT PLACED	
C188	2113743N39	36pF
C201	2113743N50	100pF
C202	2113743L17	1000pF, 10%
C203	2311049A56	4.7uF, 20%, 10V
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N40	39pF
C208	NOT PLACED	
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C215	NOT PLACED	
C216	NOT PLACED	
C217	2104993J02	2.2uF
C218	2113743M24	100000pF, +80%/-20%
C219	2113743K16	0.220uF, +80%/-20%
C220	2113743N50	100pF
C223	2113743M24	100000pF, +80%/-20%
C224	2113743M24	100000pF, +80%/-20%
C228	2311049J11	4.7uF, 10%, 16V
C229	2113743L17	1000pF, 10%
C230	2113743N50	100pF
C231	2113743M24	100000pF, +80%/-20%
C232	2113743E12	0.047uF, 10%
C233	2311049A01	0.1uF, 10%, 35V
C234	2311049A05	0.47uF, 10%, 25V
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N17	4.3pF, 0.25
C243	2113743N17	4.3pF, 0.25
C244	2113740F14	3.0pF
C245	2113743N12	2.7pF, 0.25
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	100000pF, +80%/-20%
C250	2113743N17	4.3pF, 0.25
C251	2113743N50	100pF
C252	2113743N33	20pF
C253	2113740F07	1.5pF
C254	2113743N14	3.3pF, 0.25

Circuit Ref	Motorola Part No.	Description
C255	2113743N50	100pF
C257	2113743N50	100pF
C258	2113743L41	10000pF, 10%
C259	2113743L41	10000pF, 10%
C260	2113743N50	100pF
C263	2113743N02	0.75pF, 0.25
C264	2113743N50	100pF
C265	NOT PLACED	
C271	2113743N03	1.0pF, 0.25
C272	2113743N04	1.1pF, 0.25
C273	2113743M24	100000pF, +80%/-20%
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A57	10uF, 10%, 20V
C279	2104993J02	2.2uF
C281	2113743N50	100pF
C282	NOT PLACED	
C283	NOT PLACED	
C285	2113743N50	100pF
C286	2113743M24	100000pF, +80%/-20%
C289	2113743N50	100pF
C291	2311049A69	10uF, 20%, 6.3V
C292	2113743M24	100000pF, +80%/-20%
C293	2113743A27	0.470uF, 10%
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	100000pF, +80%/-20%
C297	2113743L41	10000pF, 10%
C298	2113743M24	100000pF, +80%/-20%
C301	2113743N24	8.2pF, 0.5
C302	2113743N28	12pF
C303	2113740L09	4.3pF, 0.1
C304	2113743N27	11pF
C305	2113743N24	8.2pF, 0.5
C306	NOT PLACED	
C307	2113743M24	100000pF, +80%/-20%
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	100000pF, +80%/-20%
C311	NOT PLACED	
C312	2113743N23	7.5pF, 0.5
C313	2113743N27	11pF
C314	2113743M24	100000pF, +80%/-20%
C315	2113743N50	100pF
C316	2113740L09	4.3pF, 0.1
C317	2113743N27	11pF
C318	2113743N23	7.5pF, 0.5
C319	2113743N15	3.6pF, 0.25
C320	2113743N23	7.5pF, 0.5
C321	2113743N50	100pF
C322	2113743N48	82pF

Circuit Ref	Motorola Part No.	Description
C323	2113743N54	150pF
C324	2113743N33	20pF
C325	2113743L41	10000pF, 10%
C326	2113743L41	10000pF, 10%
C327	2113743N50	100pF
C328	2113743M24	100000pF, +80%/-20%
C329	2113743M24	100000pF, +80%/-20%
C330	2113743N26	10pF
C331	2113743N50	100pF
C333	NOT PLACED	
C334	2113743M08	22000pF, +80%/-20%
C336	2113743M24	100000pF, +80%/-20%
C337	2113743N50	100pF
C338	2113743N30	15pF
C339	2180478Z20	1uF
C340	2180478Z20	1uF
C341	2180478Z20	1uF
C342	2180478Z20	1uF
C343	2113743A23	0.220uF, 10%
C344	2113743M24	100000pF, +80%/-20%
C345	2113743M24	100000pF, +80%/-20%
C346	2113743M24	100000pF, +80%/-20%
C347	2113743M24	100000pF, +80%/-20%
C348	2113743M24	100000pF, +80%/-20%
C349	2113743E07	0.022uF
C350	2113743L05	330pF, 10%
C351	2113743N33	20pF
C352	2113743N28	12pF
C353	2113743N41	43pF
C354	2113743N42	47pF
C355	2113743A24	0.330uF, 10%
C356	2113743M08	22000pF, +80%/-20%
C357	2113743A23	0.220uF, 10%
C358	2113741A23	1200pF
C359	2109720D14	0.1uF, low distortion
C360	2113743E07	0.022uF
C361	2113741F49	10nF
C362	2113743M08	22000pF, +80%/-20%
C363	2311049A40	2.2uF, 10%, 10V
C364	2113743L41	10000pF, 10%
C370	2113743N50	100pF
C371	NOT PLACED	
C372	NOT PLACED	
C373	NOT PLACED	
C374	2113743N50	100pF
C375	2113743N50	100pF
C378	NOT PLACED	
C380	2113743L41	10000pF, 10%
C381	2113743N18	4.7pF, 0.25
C382	2311049A59	10uF, 10%, 6V
C383	2113743N50	100pF

Circuit Ref	Motorola Part No.	Description
C384	2113743N44	56pF
C385	2113743N44	56pF
C386	2113743N50	100pF
C390	2113743N50	100pF
C391	NOT PLACED	
C395	2113743N50	100pF
C396	NOT PLACED	
C397	2311049A07	1uF, 10%, 16V
C400	2113743L41	10000pF, 10%
C401	2113743M24	100000pF, +80%/-20%
C402	2113743M24	100000pF, +80%/-20%
C403	2113743G24	2.2uF, +/-80%/-20%
C404	NOT PLACED	GCAM DUMMY PART NUMBER
C405	NOT PLACED	
C406	NOT PLACED	
C407	2113928N01	0.1uF, 10%
C408	2113743N50	100pF
C409	2113743M24	100000pF, +80%/-20%
C410	2113928N01	0.1uF, 10%
C411	2113743M24	100000pF, +80%/-20%
C414	2113743M24	100000pF, +80%/-20%
C415	2185895Z01	0.01uF, low distortion
C416	2113928N01	0.1uF, 10%
C419	NOT PLACED	
C420	2113743L41	10000pF, 10%
C421	2113928N01	0.1uF, 10%
C422	2113743M24	100000pF, +80%/-20%
C423	2113743N50	100pF
C424	2311049A59	10uF, 10%, 6V
C425	2113743M24	100000pF, +80%/-20%
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	100000pF, +80%/-20%
C429	2113743M24	100000pF, +80%/-20%
C430	2113928N01	0.1uF, 10%
C431	2113743N50	100pF
C432	NOT PLACED	
C433	2113743L41	10000pF, 10%
C434	2113928N01	0.1uF, 10%(not used in GP328)
C435	2113743M24	100000pF, +80%/-20%
C436	2113743N34	22pF (not used in GP328)
C437	2113743N34	22pF (not used in GP328)
C440	2113743G26	4.7uF, +80%/-20%
C441	2113743N50	100pF
C442	2113743E20	0.10uF, 10%
C443	2113928N01	0.1uF, 10%
C444	2113743N50	100pF
C445	2113743N50	100pF
C447	2113743M08	22000pF, +80%/-20%

Circuit Ref	Motorola Part No.	Description
C448	2113928N01	0.1uF, 10%
C449	2113743N50	100pF
C450	NOT PLACED	
C451	2113743M08	22000pF, +80%/-20%
C452	2113743B29	1uF, 10%
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF, 10%
C471	2113743N50	100pF
C472	2113743L09	470pF, 10%
C473	2113743L09	470pF, 10%
C475	2113743H14	10uF, +80%/-20%
C476	2113928D08	10uF, +/-80%/-20%
C479	2113928N01	0.1uF, 10%
C480	2113928D08	10uF, +/-80%/-20%
C481	2113928N01	0.1uF, 10%
C482	2113928N01	0.1uF, 10%
C490	2113743N50	100pF
C491	2113743N50	100pF
C492	2113743N50	100pF
C493	2113743N50	100pF
C494	2113743N50	100pF
C495	2113743N50	100pF
C496	2113743N50	100pF
C497	2113743N50	100pF
C502	2311049A05	0.47uF, 10%, 25V
C503	2113743N50	100pF
C505	2113743N50	100pF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C520	2113743L41	10000pF, 10%
C521	2113743L41	10000pF, 10%
C522	2113743L41	10000pF, 10%
C523	2113743L41	10000pF, 10%
C524	2113743N50	100pF
C525	2113743N50	100pF
C526	2113743N50	100pF
C527	2113743N50	100pF
C528	2113743N50	100pF
C529	NOT PLACED	
CR101	4880973Z02	Pin diode
CR102	4802245J41	Pin diode
CR103	4802245J41	Pin diode
CR105	5185963A15	Temperature sensor
CR160	NOT PLACED	

Circuit Ref	Motorola Part No.	Description
CR201	4802233J09	Triple diode (SOT 25)
CR203	4862824C03	Varactor
CR241	4805649Q13	Varactor
CR242	4862824C01	Varactor
CR243	4862824C01	Varactor
CR251	4862824C01	Varactor
CR301	4862824C01	Varactor
CR302	4862824C01	Varactor
CR303	4880154K03	Dual common anode-cathode diode
CR304	4862824C01	Varactor
CR305	4862824C01	Varactor
CR306	4802245J42	Ring Quad diode (SOT-143)
CR308	4802245J41	Pin diode
CR310	4862824C01	Varactor
CR411	4802245J62	Diode Schottky
CR412	4802245J62	Diode Schottky
CR413	4802245J62	Diode Schottky
CR440	4813833C02	Dual common cathode diode
CR501	4880107R01	Rectifier
CR503	4805729G49	LED Red/Yellow
E101	2484657R01	Ferrite bead
E400	2480640Z01	Ferrite bead
E401	2480640Z01	Ferrite bead
E402	2480640Z01	Ferrite bead
E403	2480640Z01	Ferrite bead
E404	2480640Z01	Ferrite bead
E405	2480640Z01	Ferrite bead
E406	2480640Z01	Ferrite bead
E407	2480640Z01	Ferrite bead
E408	2480640Z01	Ferrite bead
E409	2480640Z01	Ferrite bead
F501	6580542Z01	3A fuse
FL201	4805875Z04	16.8MHz Xtal oscillator (not field serviceable)
FL301	4802245J43	Xtal Filter 45.1MHz
FL401	4870368G02	Xtal Oscillator 38.4kHz (not used in GP328)
H101	2680499Z01	Heat spreader
J101	0985613Z01	RF Jack
J102	0280519Z02	Antenna nut
J403	0905505Y02	20-pin connector
L101	2460591B28	13.37nH
L102	2460591B28	13.37nH
L104	2460591B48	15.22nH
L105	2462587N22	390nH
L106	2460591A19	8.71nH
L107	2479990G01	33.47nH
L108	2479990A01	4.22nH
L112	2462587N42	12nH, 5%
L113	2413926H09	5.6nH, 0.3

Circuit Ref	Motorola Part No.	Description
L114	2462587N42	12nH, 5%
L115	2462587N22	390nH
L116	2479990C02	16.28nH
L117	2409154M17	22nH
L160	2413926H14	15nH, 5%
L201	2462587Q20	2200nH, 20%
L202	2462587Q20	2200nH, 20%
L203	2462587Q20	2200nH, 20%
L232	2462587P25	12000nH, 5%
L241	2462587V41	390nH
L242	2462587V26	22nH, 5%
L243	2460593C03	Multi-layered Teflon resonator, Rx
L251	2462587V41	390nH
L253	2460593C03	Multi-layered Teflon resonator, Tx
L261	2462587V29	39nH, 5%
L271	2462587V27	27nH, 5%
L273	2462587V25	18nH, 5%
L281	2462587V41	390nH
L282	2462587V41	390nH
L301	2479990B01	11.03nH
L302	2479990B01	11.03nH
L303	2462587V26	22nH, 5%
L304	2462587V37	180nH, 5%
L305	2462587V23	12nH, 5%
L306	2479990B01	11.03nH
L307	2479990B01	11.03nH
L309	2479990C02	16.28nH
L310	2462587V36	150nH, 5%
L311	2462587N65	750nH, 5%
L314	2462587N72	2200nH, 5%
L321	NOT PLACED	
L325	2480646Z20	2.2uH
L330	2462587N64	680nH, 5%
L331	2480646Z20	2.2uH
L332	2462587N53	100nH, 5%
L340	2462587V41	390nH
L400	2462587Q42	390nH
L401	2462587Q42	390nH
L410	2462587Q42	390nH
L411	2462587Q42	390nH
L505	2462587Q42	390nH
P100	3905643V01	Ground contact finger
PB501	4080523Z01	Tactile switch, pushbutton
PB502	4080523Z01	Tactile switch, pushbutton
PB503	4080523Z01	Tactile switch, pushbutton
PB504	4080523Z01	Tactile switch, pushbutton
PB505	4080523Z01	Tactile switch, pushbutton
Q110	4813828A09	RF Power Amplifier
Q111	4802245J50	Dual NPN/PNP transistor

Circuit Ref	Motorola Part No.	Description
Q210	4802245J50	Dual NPN/PNP transistor
Q241	4805218N63	RF NPN transistor
Q260	4802245J50	Dual NPN/PNP transistor
Q261	4802245J50	Dual NPN/PNP transistor
Q301	4802245J44	NPN Transistor
Q302	4802245J44	NPN Transistor
Q310	NOT PLACED	
Q315	4880214G02	NPN Transistor
Q316	NOT PLACED	
Q320	4805218N63	RF NPN transistor
Q400	4809579E18	Mosfet P - channel
Q403	4813824A17	Bipolar Transistor, PNP
Q405	4802245J54	Dual NPN Transistor
Q410	4802245J54	Dual NPN Transistor
Q416	4809579E18	Mosfet P - channel (not used in GP328)
Q417	4802245J50	Dual NPN/PNP transistor
Q502	5180159R01	Dual NPN Transistor
Q505	4880214G02	NPN Transistor
R101	0662057A34	240
R102	0680539Z01	0.1
R104	0662057N15	47K
R106	0662057M26	10
R107	NOT PLACED	
R108	0662057M92	5600
R109	0662057N30	200K
R110	0662057M61	300
R111	0662057M33	20
R112	0662057M61	300
R120	0662057N14	43K
R130	0662057M98	10K
R131	0662057N05	18K
R132	0662057N33	270K
R133	NOT PLACED	
R136	0662057N47	1M
R161	0662057M57	200
R170	0662057A34	240
R171	0662057N14	43K
R172	0662057A32	200
R173	0662057N29	180K
R174	0662057N15	47K
R175	0662057B59	3
R176	0662057B59	3
R191	0662057C01	0
R201	0662057N21	82K
R202	0662057N23	100K
R204	0662057N15	47K
R205	NOT PLACED	
R206	NOT PLACED	
R231	0662057M52	120
R232	0662057M69	620

Circuit Ref	Motorola Part No.	Description
R233	0662057M68	560
R241	0662057M32	18
R242	0662057M52	120
R243	0662057M98	10K
R244	0662057N03	15K
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M38	33
R252	0662057M60	270
R253	0662057M95	7500
R254	0662057M96	8200
R255	0662057M89	4300
R256	0662057M37	30
R260	0662057M74	1000
R281	NOT PLACED	
R300	0662057M82	2200
R301	0662057N23	100K
R302	0662057N23	100K
R303	0662057M78	1500
R304	0662057N01	12K
R305	0662057M66	470
R306	0662057N23	100K
R307	0662057N23	100K
R308	0662057M60	270
R309	0662057M32	18
R310	0662057M60	270
R311	0662057N10	30K
R312	0662057M83	2400
R313	0662057M62	330
R314	0662057M85	3000
R315	0662057N01	12K
R316	0662057A96	91K
R317	0662057M74	1000
R318	0662057A79	18K
R319	0662057A29	150
R320	0662057M74	1000
R321	0662057M83	2400
R322	0662057N30	200K
R324	0662057M81	2000
R325	0662057M94	6800
R326	NOT PLACED	
R327	0662057N11	33K
R328	0662057M12	2.7
R329	0662057M01	0
R330	NOT PLACED	
R331	NOT PLACED	
R332	NOT PLACED	
R333	NOT PLACED	
R334	NOT PLACED	
R335	NOT PLACED	
R336	NOT PLACED	

Circuit Ref	Motorola Part No.	Description
R338	NOT PLACED	
R339	0662057M01	0
R340	0662057M96	8200
R342	0662057N23	100K
R343	0662057M26	10
R344	0662057N01	12K
R345	0662057M98	10K
R346	0662057N17	56K
R347	0662057M74	1000
R348	0662057M87	3600
R349	0662057C01	0
R350	0662057N23	100K
R351	0662057C01	0
R352	0662057M86	3300
R355	0662057M01	0
R400	0662057N15	47K
R401	0662057M01	0
R402	NOT PLACED	
R403	NOT PLACED	
R405	0662057M01	0
R406	0662057N20	75K
R407	0662057N19	68K
R408	NOT PLACED	
R409	0662057M98	10K
R410	0662057N23	100K
R411	0662057M98	10K
R413	0662057M01	0
R414	0662057V34	180K, 1%
R415	0662057V26	91K, 1%
R416	0662057M98	10K
R418	0662057M01	0
R419	0662057M67	510
R420	0662057B46	10M (not used in GP328)
R421	0662057M81	2000
R423	0662057N39	470K
R424	0662057N12	36K
R425	0662057N10	30K
R426	0662057N35	330K (not used in GP328)
R427	0662057M84	2700
R428	0662057M10	2.2
R429	0662057M98	10K
R431	0662057N39	470K
R432	0662057N16	51K
R434	0662057M62	330
R435	0662057M81	2000
R436	0662057M01	0
R437	NOT PLACED	
R445	0662057N08	24K
R447	0662057N23	100K
R448	0662057M98	10K
R449	0662057N08	24K

Circuit Ref	Motorola Part No.	Description
R450	0683962T45	68 ohms, 1W
R451	0662057N03	15K
R452	0662057N23	100K
R453	NOT PLACED	
R454	NOT PLACED	
R455	NOT PLACED	
R456	0662057M01	0
R457	0662057M98	10K
R460	0662057M90	4700
R461	0662057M56	180 (not used in GP328)
R462	0662057M98	10K (not used in GP328)
R463	0662057M61	300
R471	0662057N06	20K
R472	0662057N12	36K
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N35	330K
R477	0662057M74	1000
R478	0662057M98	10K
R481	0662057N08	24K
R492	0662057M01	0
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10K
R506	0662057N15	47K
R507	0662057M01	0
RT300	0680590Z01	THERMISTOR_33K
RT301	NOT PLACED	
RT400	0680590Z01	THERMISTOR_33K
S501	4080710Z01	Frequency switch
S502	1880619Z02	Volume/on-off switch
SH100	2680507Z01	Harmonic Filter shield
SH101	2680510Z01	RF PA shield
SH201	2680511Z01	Synthesizer top shield
SH202	2680511Z01	Synthesizer bottom shield
SH241	2680513Z01	Resonators shield
SH242	2680514Z01	VCO Buffer IC shield
SH301	2680554Z01	Receiver front end shield
SH302	2680555Z01	Receiver front end bottom shield
SH303	2680509Z01	Mixer shield
SH304	2680624Z01	Mixer diode shield
SH321	2680508Z01	LVZIF 2nd LO shield
SH322	2680514Z01	LVZIF shield
SH323	2680553Z01	Crystal Filter shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller on-off shield
SH402	2680515Z01	Microprocessor shield
SH403	2680516Z01	Asfic_Cmp/Audio PA shield
T301	2580541Z02	Balun transformer
T302	2580541Z02	Balun transformer

Circuit Ref	Motorola Part No.	Description
U101	5185130C65	IC VHF/UHF/800 MHZ LDMOS DRIVER
U102	5185765B28	PCIC
U201	5185963A27	LVFRACN Synthesizer IC
U210	5102463J61	Inverter
U211	5102463J61	Inverter
U241	5105750U54	VCO BUFFER IC
U247	5105739X05	SOT 5V Regulator
U248	5102463J58	3.3V Regulator
U301	5109632D83	LVZIF IC
U400	5102463J40	3.3V Regulator
U404	5185963A53	ASFIC_CMP IC
U405	NOT PLACED	
U406	*5102463J59	128K x 8 Flash Memory
U407	*5102463J64	16K x 8 EEPROM
U409	5102226J56	Microprocessor
U410	5102463J57	3.3V Regulator (not used in GP328)
U420	5102463J44	Audio PA
VR300	NOT PLACED	
VR432	4805656W08	5.6V Zener
VR433	4805656W08	5.6V Zener
VR434	4802245J73	ZENER DIODE-6.8V
VR439	4880140L17	Zener diode-12V
VR440	4802245J73	ZENER DIODE-6.8V
VR441	4802245J73	ZENER DIODE-6.8V
VR442	4802245J73	ZENER DIODE-6.8V
VR443	4802245J73	ZENER DIODE-6.8V
VR444	4802245J73	ZENER DIODE-6.8V
VR445	4802245J53	ZENER DIODE-10V
VR446	4802245J74	ZENER DIODE-10V
VR447	4802245J74	ZENER DIODE-10V
VR448	4802245J74	ZENER DIODE-10V
VR449	4802245J74	ZENER DIODE-10V
VR450	4802245J75	ZENER DIODE-12V
VR460	4802245J73	ZENER DIODE-6.8V
VR501	4813830A18	6.8V Zener
VR506	4802245J73	ZENER DIODE-6.8V
Y201	NOT PLACED	
	8485641Z06	UHF B2 main PC board

\* Motorola Depot Servicing only

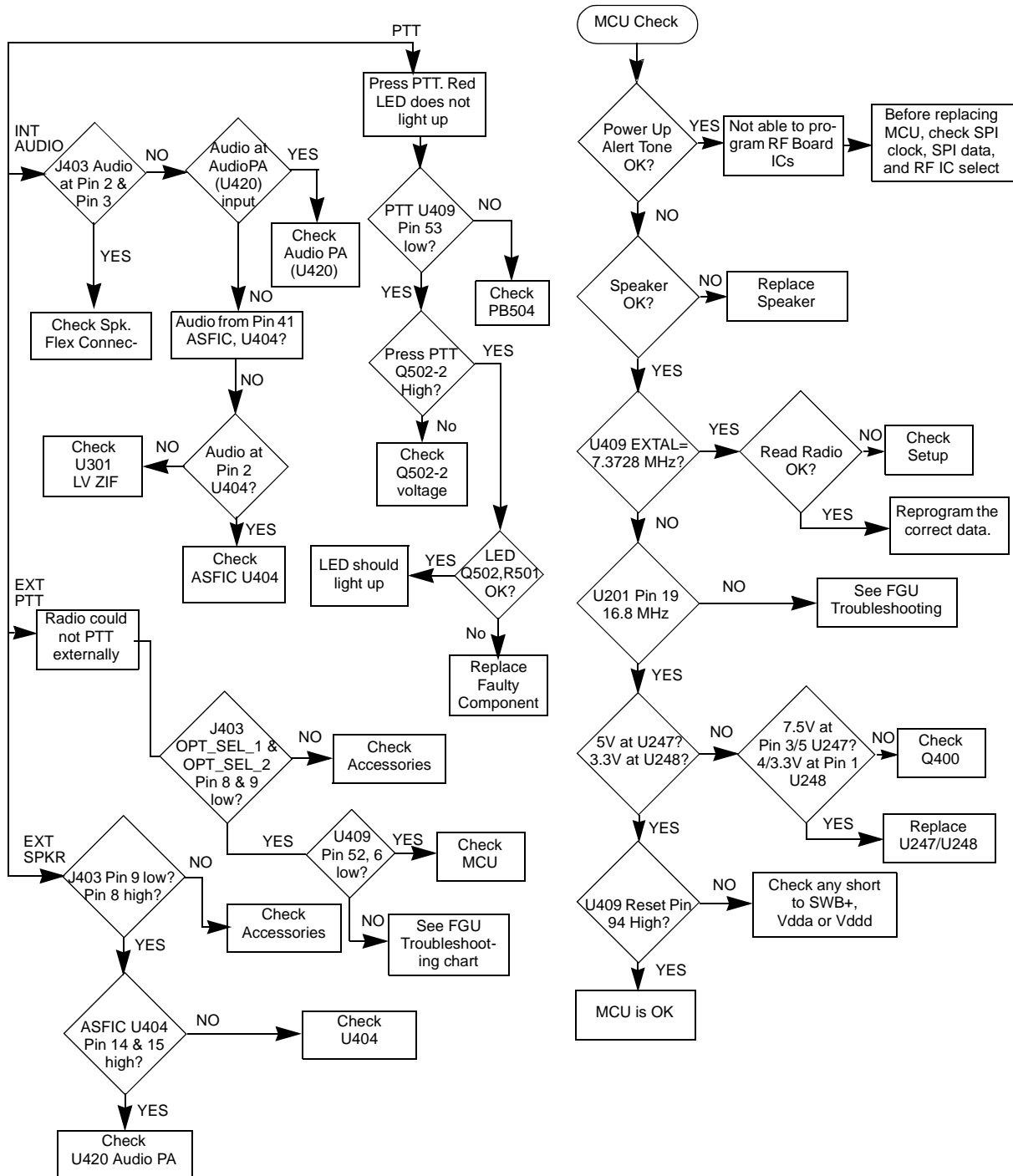
**Note:** Tolerance

Capacitor - 5% unless specified otherwise

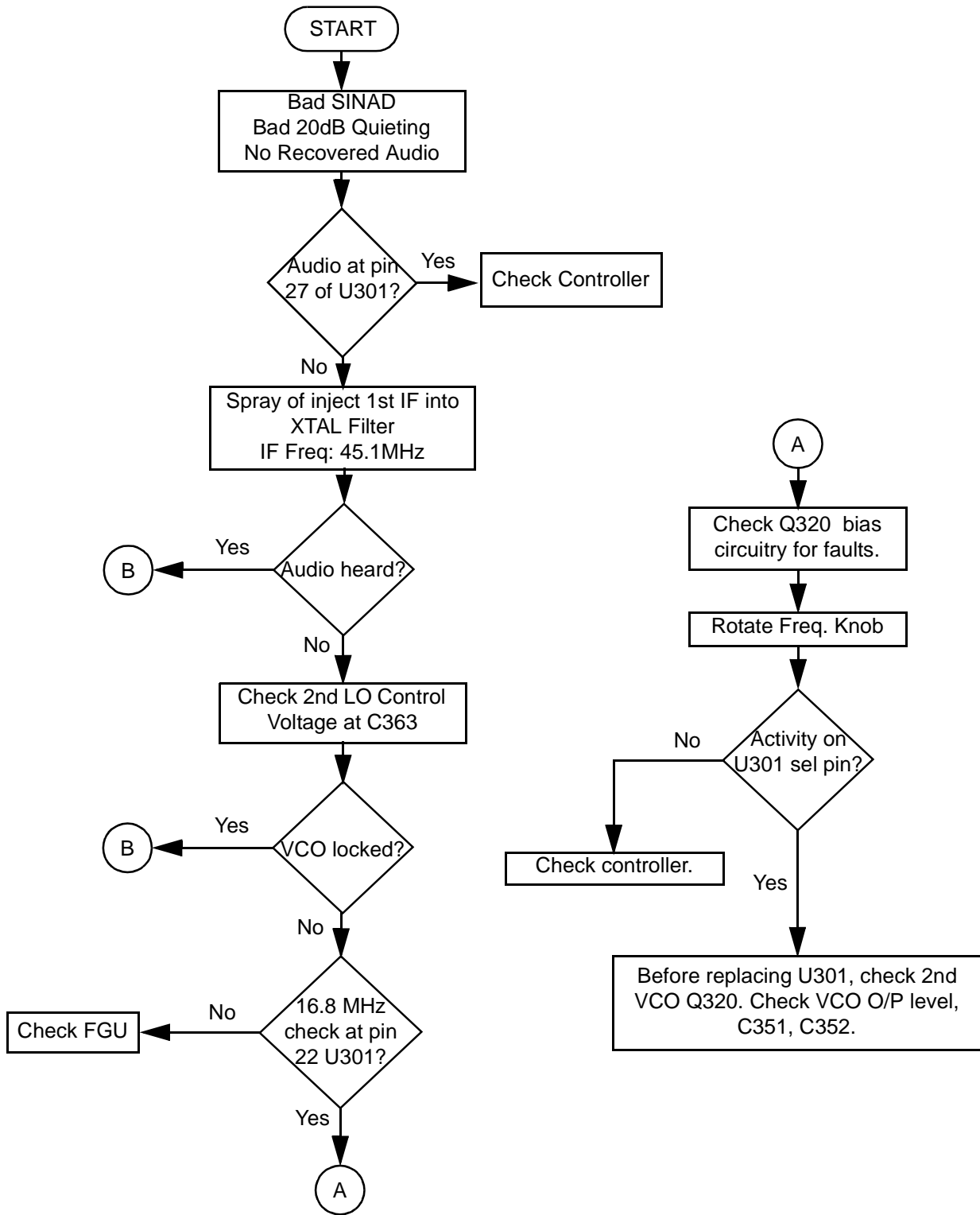
Inductor - 10% unless specified otherwise

Resistor - 5% unless specified otherwise

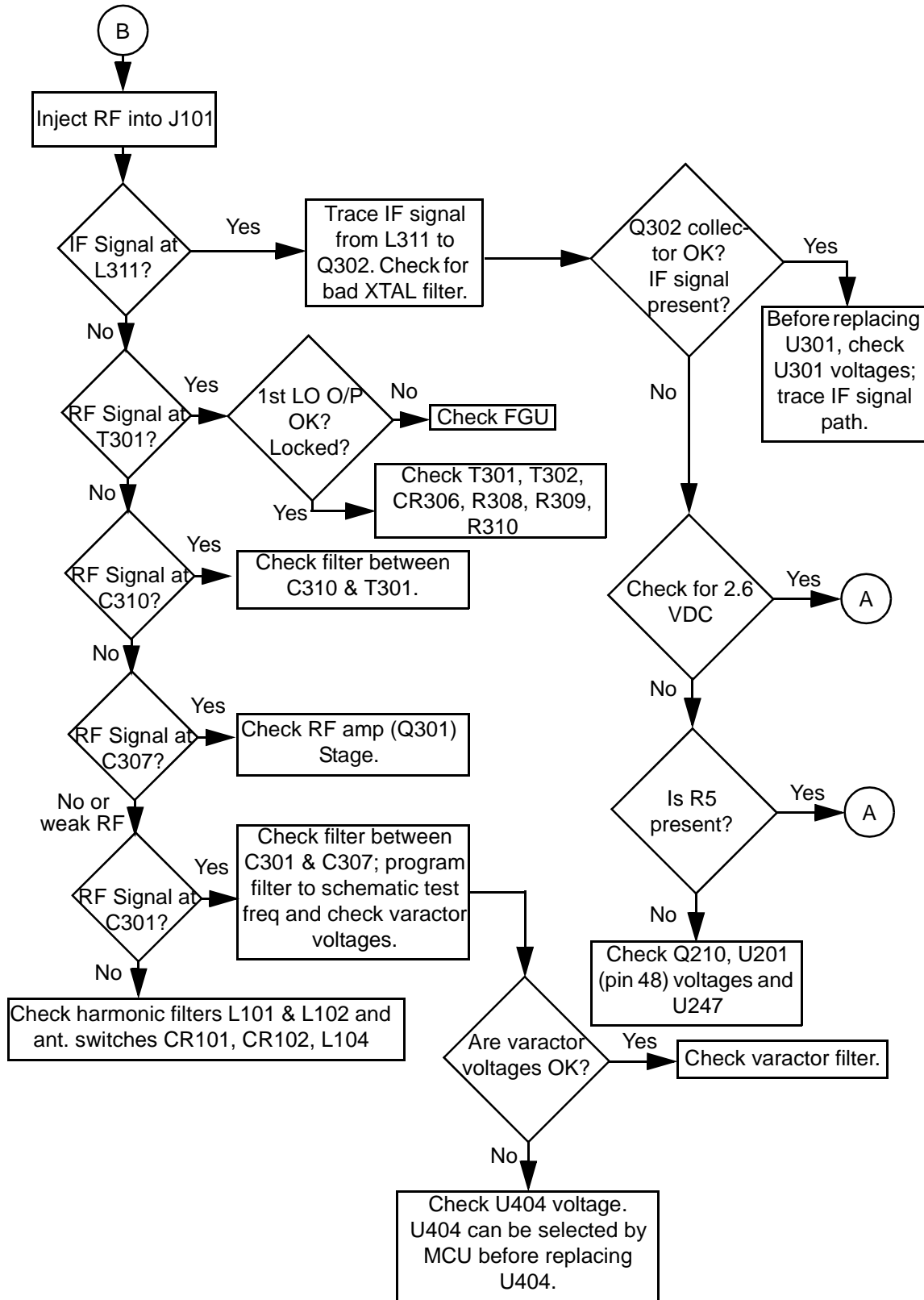
## 9.0 Troubleshooting charts



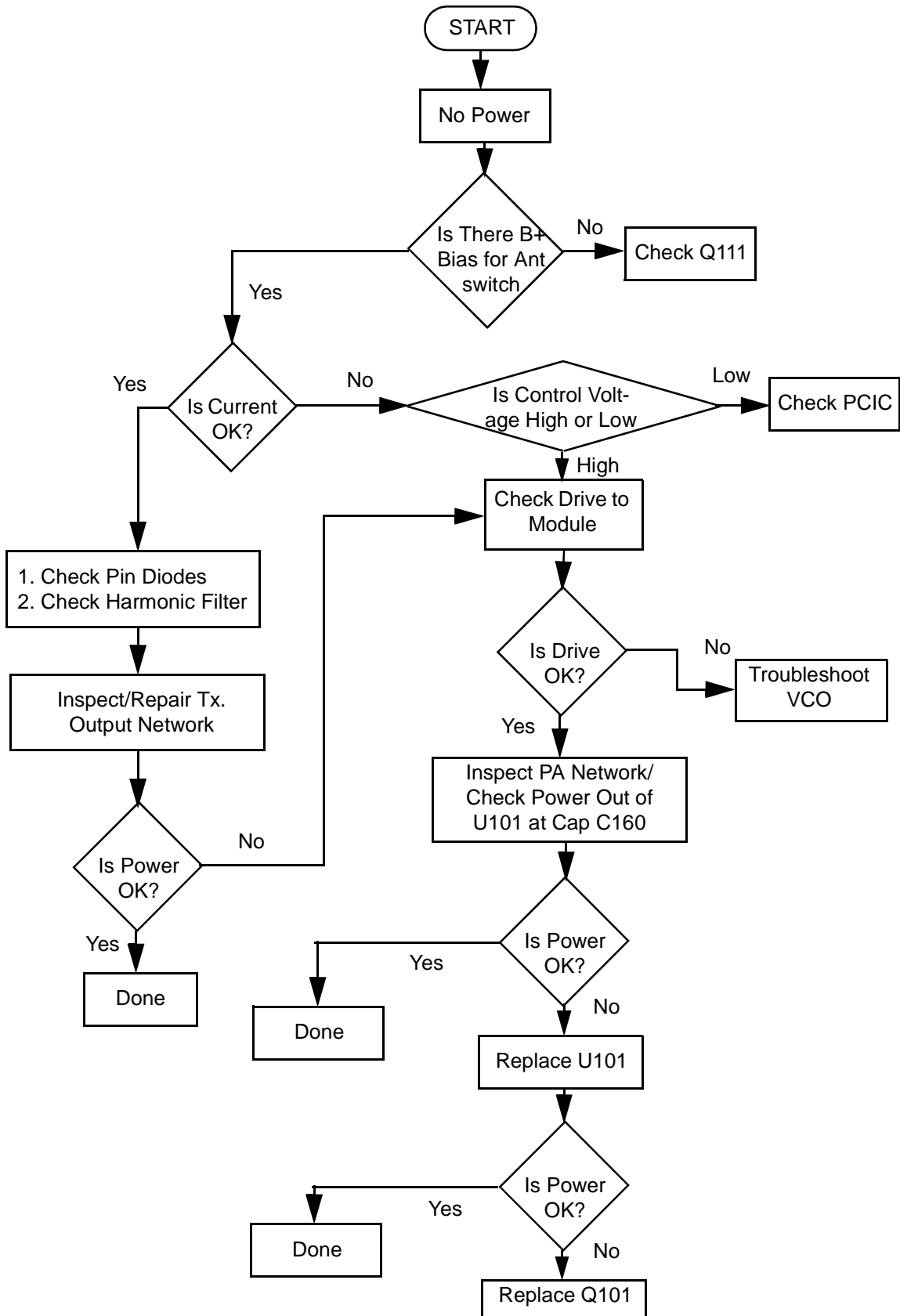
**Troubleshooting Flow Chart for Controller**



**Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)**

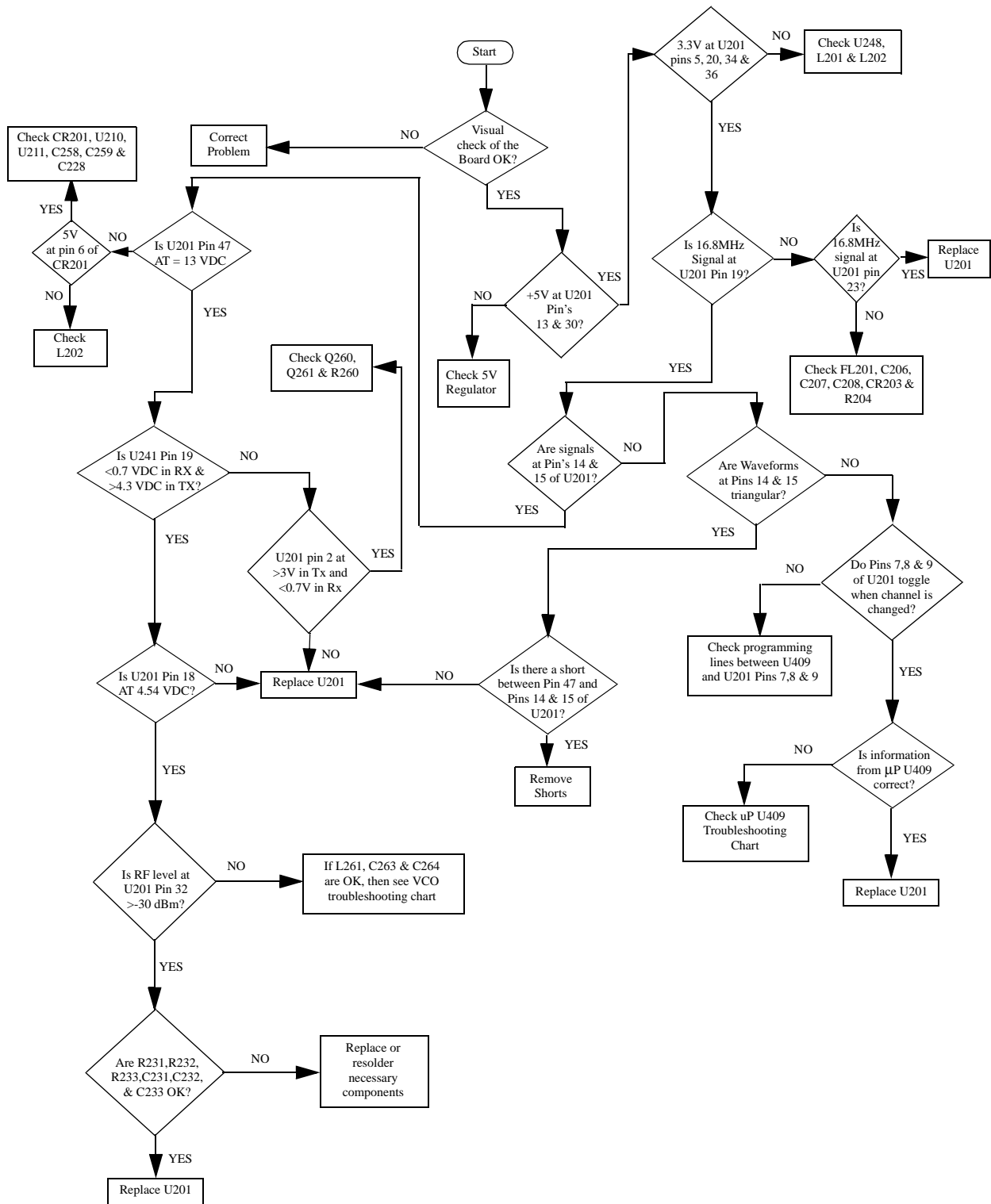


**Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)**

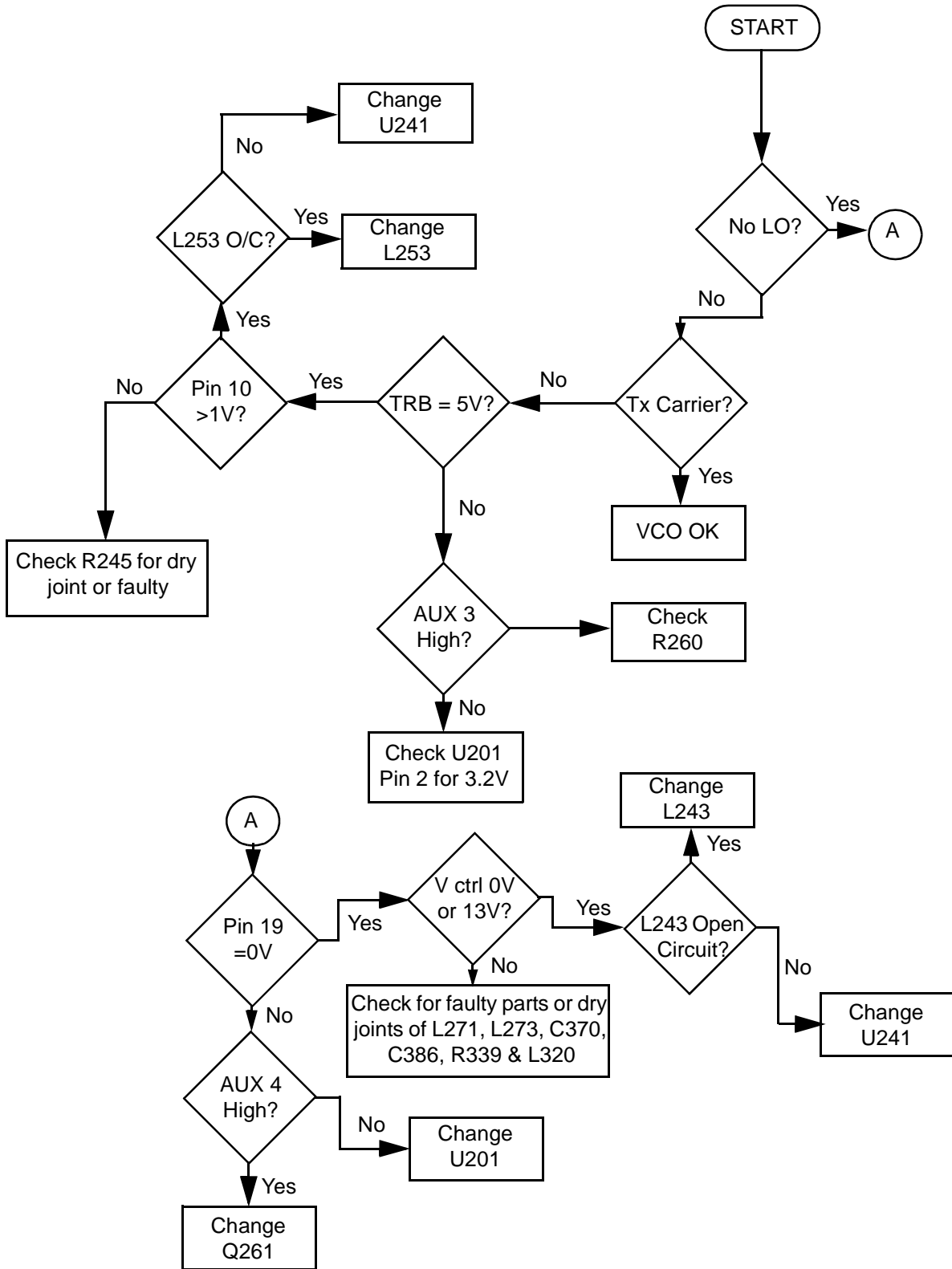


**Troubleshooting Flow Chart for Transmitter**





Troubleshooting Flow Chart for Synthesizer



**Troubleshooting Flow Chart for VCO**

## Section 6D

# MODEL CHART AND TEST SPECIFICATIONS (330-400 MHZ)

### 1.0 Model Chart

<b>GP Series, 330-400 MHz</b>			
<b>Model</b>		<b>Description</b>	
AZH25PDC9AA3		GP328 330-400 MHz 4W 16 CH	
AZH25PDH9AA6		GP338 330-400 MHz 4W 128 CH	
	<b>Item</b>	<b>Description</b>	
X	PMUD1536	GP328 Super Tanapa 330-400 MHz 4W	
	X PMUD1537	GP338 Super Tanapa 330-400 MHz 4W	
X	PMUD1541	GP328 Tanapa 330-400 MHz 4W	
	X PMUD1542	GP338 Tanapa 330-400 MHz 4W	
X	PMLD4136	GP328 B/C Kit 330-400 MHz 4W	
	X PMLD4137	GP338 B/C Kit 330-400 MHz 4W	
X	PMLN4216	GP328 Front Housing Kit	
	X PMLN4199	GP338 Front Housing Kit	
X	X PMAD4009	VHF 9 cm antenna (336-368 MHz)	
X	X PMAD4020	VHF 9 cm antenna (370-400 MHz)	
X	6804110J54	GP328 User Guide	
	X 6804110J55	GP338 User Guide	

x = Indicates one of each is required.

## 2.0 Specifications

### General

	<b>330-400MHz</b>	
Frequency:	330-400 MHz	
Channel Capacity:	GP328 : 16 Channels GP338 : 128 Channels	
Power Supply:	7.5 Volts $\pm$ 20%	
Dimensions with Standard High Capacity NiMH Battery:	137mm x 57.5mm x 37.5mm	
with Ultra High Capacity NiMH Bat- tery:	137mm x 57.5mm x 40mm	
Weight: with Standard High Capacity NiMH Battery:	420 g	
with Ultra High Capacity NiMH Bat- tery:	500 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity NiMH Bat- tery:	Low Pow- er	High Pow- er
Ultra High Capac- ity NiMH Battery:	>11 hrs	>8 hrs
	>14 hrs	>11 hrs
Sealing:	Passes rain testing per IP54	
Shock:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Vibration:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Dust:	Meets MIL-STD-810- C,D & E and IP54	
Humidity:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	

### Transmitter

	<b>330-400MHz</b>	
RF Output NiMH @ 7.5V:	Low 1W	High 4W
Frequency	330-400 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.00025%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre- Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

### Receiver

	<b>12.5kHz</b>	<b>20/25kHz</b>
Frequency:	330- 400MHz	330- 400MHz
Sensitivity 12dB EIA SINAD:	0.35 $\mu$ V	0.35 $\mu$ V
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.00025%	0.00025%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

### 3.0 Transmitter

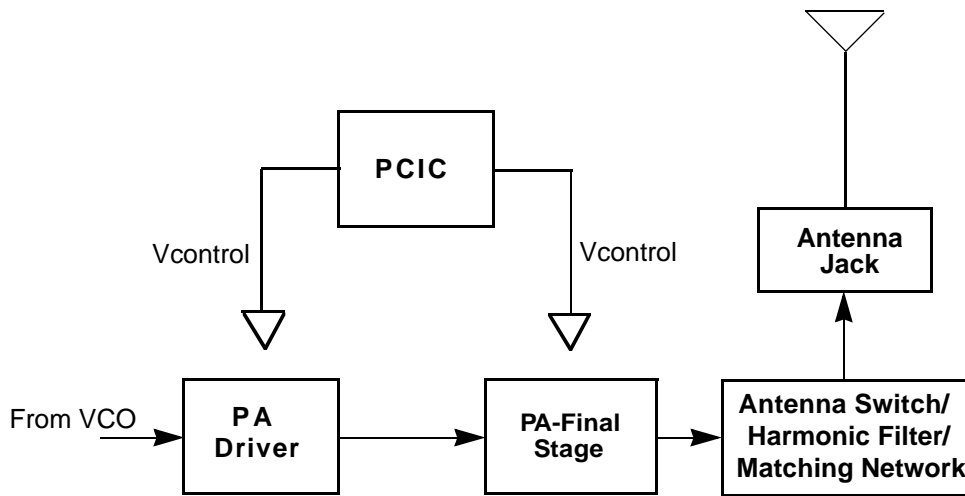


Figure 6-1: Transmitter Block Diagram

#### 3.1 General

(Refer to Figure 6-1)

The VHF transmitter contains five basic circuits:

1. power amplifier
2. antenna switch
3. harmonic filter
4. antenna matching network
5. power control integrated circuit (PCIC).

##### 3.1.1 Power Amplifier

The power amplifier consists of two devices:

1. 9Z67 LDMOS driver IC (U101) and
2. PRF1507 LDMOS PA (Q110).

The 9Z67 LDMOS driver IC contains a 2 stage amplification with a supply voltage of 7.3V.

This RF power amplifier is capable of supplying an output power of 0.3W (pin 6 and 7) with an input signal of 2mW (3dBm) (pin16). The current drain would typically be 160mA while operating in the frequency range of 330-400MHz.

The PRF1507 LDMOS PA is capable of supplying an output power of 7W with an input signal of 0.3W. The current drain would typically be 1300mA while operating in the frequency range of 330-400MHz. The power output can be varied by changing the biasing voltage.

### 3.1.2 Antenna Switch

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C107, L104 and C106), and two current limiting resistors (R101, R170). In the transmit mode, B+ at PCIC (U102) pin 23 will go low and turn on Q111 where a B+ bias is applied to the antenna switch circuit to bias the diodes "on". The shunt diode (CR102) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, and hence, there exists a low attenuation path between the antenna and receiver ports.

### 3.1.3 Harmonic Filter

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

### 3.1.4 Antenna Matching Network

A matching network which is made up of L116 is used to match the antenna's impedance to the harmonic filter. This will optimize the performance of the transmitter and receiver into an antenna.

### 3.1.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the Power Control IC (PCIC), U102 to regulate the power output of the radio. The current to the final stage of the power module is supplied through R101, which provides a voltage proportional to the current drain. This voltage is then fed back to the Automatic Level Control (ALC) within the PCIC to regulate the output power of the transmitter.

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

There are resistors and integrators within the PCIC, and external capacitors (C133, C134 and C135) in controlling the transmitter rising and falling time. These are necessary in reducing the power splatter into adjacent channels.

CR105 and its associated components are part of the temperature cut back circuitry. It senses the printed circuit board temperature around the transmitter circuits and output a DC voltage to the PCIC. If the DC voltage produced exceeds the set threshold in the PCIC, the transmitter output power will be reduced so as to reduce the transmitter temperature.

## 4.0 Receiver

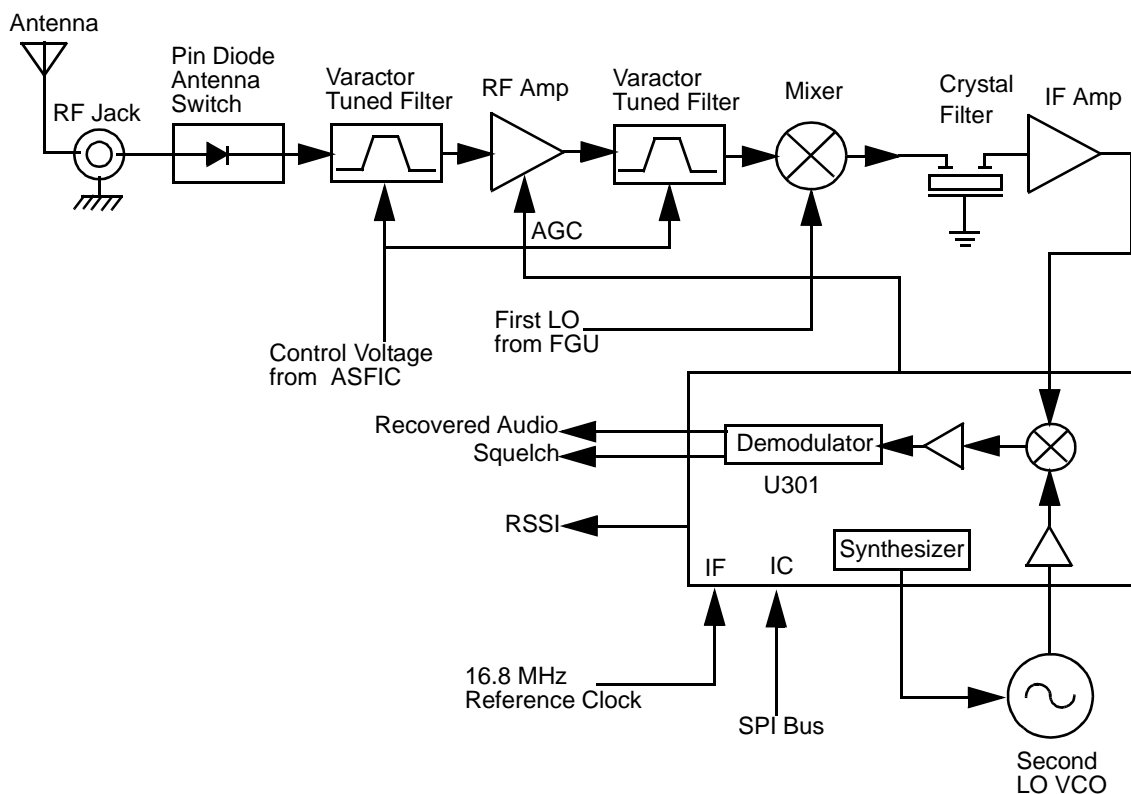


Figure 6-2: VHF Receiver Block Diagram

### 4.1 Receiver Front-End

(Refer to *330-400MHz Receiver Front End Schematic Diagram* on page 6D-16 and *330-400MHz Transmitter Schematic Diagram* on page 6D-20)

The RF signal is received by the antenna and applied to a low-pass filter. For VHF, the filter consists of L101, L102, C102, C103, C104. The filtered RF signal is passed through the antenna switch. The antenna switch circuit consists of two PIN diodes (CR101 and CR102) and a pi network (C106, L104 and C107). The signal is then applied to a varactor tuned bandpass filter. The VHF bandpass filter comprises of L301, L302, C302, C303, C304, CR301 and CR302. The bandpass filter is tuned by applying a control voltage to the varactor diodes (CR301 and CR302) in the filter.

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

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

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

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

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

## 4.2 Receiver Back-End

(Refer to *330-400MHz Receiver Back End Schematic Diagram* on page 6D-17)

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

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

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

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

The IF IC (U301) also performs several other functions. It provides a received signal-strength indicator (RSSI) and a squelch output. The RSSI is a dc voltage monitored by the microprocessor, and used as a peak indicator during the bench tuning of the receiver front-end varactor filter. The RSSI voltage is also used to control the automatic gain control (AGC) circuit at the front-end.

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



### 4.3 Automatic Gain Control Circuit

(Refer to *330-400MHz Receiver Front End Schematic Diagram* on page 6D-16)

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

Radio signal strength indicator, RSSI, a voltage signal, is used to drive Q315 to saturation hence turning it on. RSSI is produced by U301 and is proportional to the gain of the RF amplifier and the input RF signal power to the radio.

Resistor network at the input to the base of Q315 is scaled to turn on Q315, hence activating the AGC, at certain RSSI levels. In order to turn on Q315, the voltage across the transistor's base to ground must be greater or equal to the voltage across R319, plus the base-emitter voltage ( $V_{be}$ ) present at Q315. The resistor network with thermistor RT300 is capable of providing temperature compensation to the AGC circuit, as RSSI generated by U301 is lower at cold temperatures compared to normal operation at room temperature. Resistor R300 and capacitor C397 form an R-C network used to dampen any transient instability while the AGC is turning on.

## 5.0 Frequency Generation Circuitry

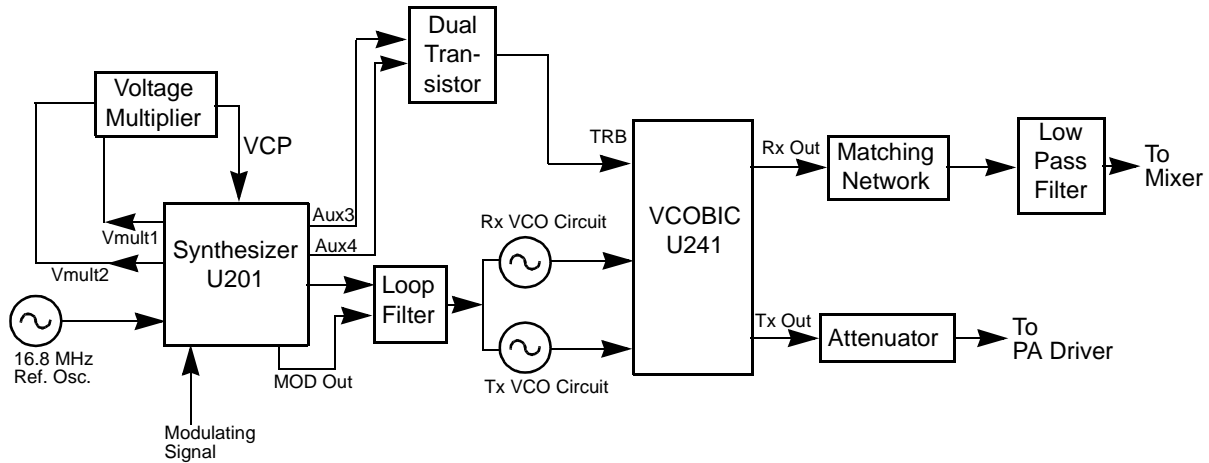


Figure 6-3: Frequency Generation Unit Block Diagram

The Frequency Generation Circuitry is composed of two main ICs, the Fractional-N synthesizer (U201), and the VCO/Buffer IC (U241). Designed in conjunction to maximize compatibility, the two ICs provide many of the functions that normally would require additional circuitry. The synthesizer block diagram illustrates the interconnect and support circuitry used in the region. Refer to the relevant schematics for the reference designators.

The synthesizer is powered by regulated 5V and 3.3V which come from U247 and U248 respectively. The synthesizer in turn generates a superfiltered 4.5V which powers U241.

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

Transmit modulation from the ASFIC is supplied to pin10 of U201. Internally the audio is digitized by the Fractional-N and applied to the loop divider to provide the low-port modulation. The audio runs through an internal attenuator for modulation balancing purposes before going out to the VCO.

### 5.1 Synthesizer

(Refer to 330-400MHz Synthesizer Schematic Diagram on page 6D-18)

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

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

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

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

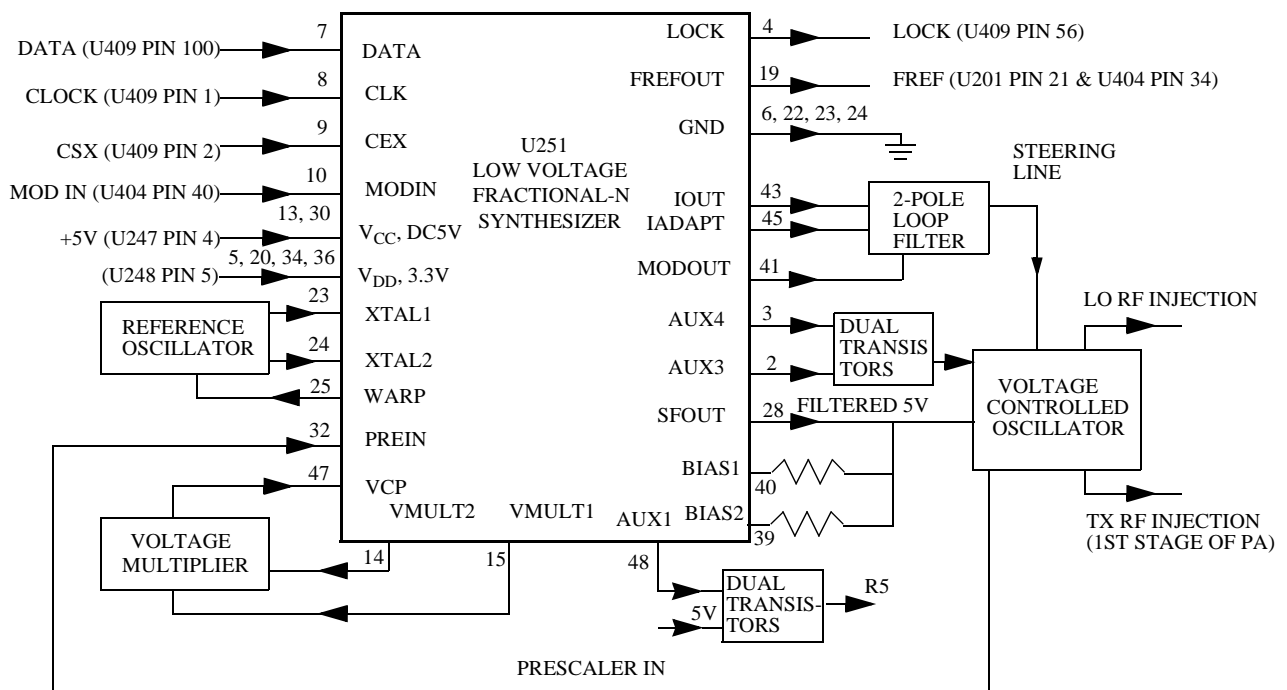
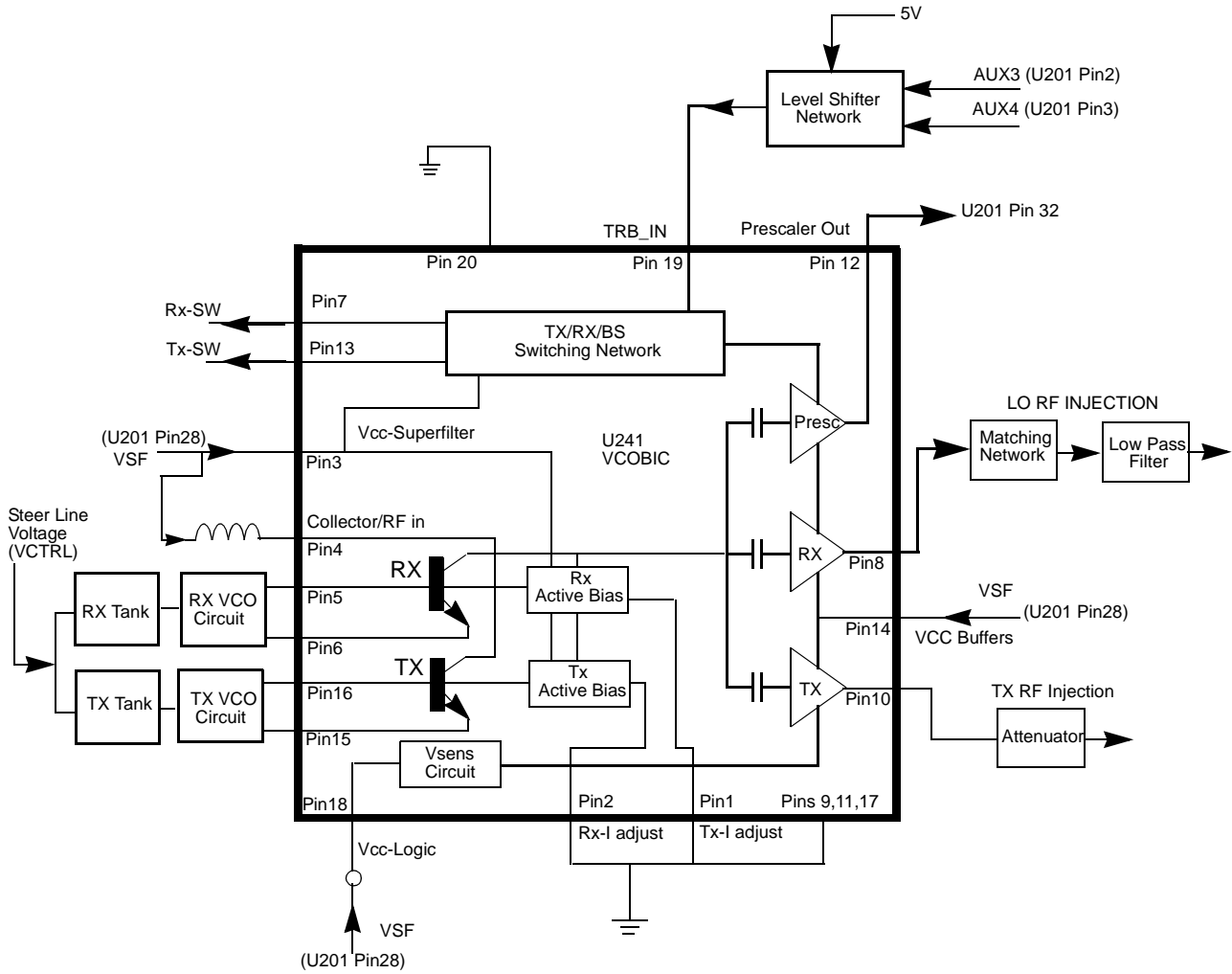


Figure 6-4 Synthesizer Block Diagram

### 5.2 VCO - Voltage Controlled Oscillator

(Refer to 330-400MHz Voltage Controlled Oscillator Schematic Diagram on page 6D-19)



**Figure 6-5 VCO Block Diagram**

The VCOBIC (U241) in conjunction with the Fractional-N synthesizer (U201) generates RF in both the receive and the transmit modes of operation. The TRB line (U241 pin 19) determines which oscillator and buffer will be enabled. A sample of the RF signal from the enabled oscillator is routed from U241 pin 12, through a low pass filter, to the prescaler input (U201 pin 32). After frequency comparison in the synthesizer, a resultant CONTROL VOLTAGE is received at the VCO. This voltage is a DC voltage between 3.5V and 9.5V when the PLL is locked on frequency.

The VCOBIC(U241) is operated at 4.54 V (VSF) and Fractional-N synthesizer (U201) at 3.3V. This difference in operating voltage requires a level shifter consisting of Q260 and Q261 on the TRB line. The operation logic is shown in Table 6-1.

*Table 6-1: Level Shifter Logic*

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

In the receive mode, U241 pin 19 is low or grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U241. The RF signal at U241 pin 8 is run through a matching network. The resulting RF signal is the LO RF INJECTION and it is applied to the mixer at T302 (refer to *330-400MHz Receiver Front End Schematic Diagram* on page 6D-16).

During the transmit condition, when PTT is depressed, five volts is applied to U241 pin 19. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U241. The RF signal at U241 pin 10 is injected into the input of the PA module (U101 pin16). This RF signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received through the U201 pin 41.

When a high impedance is applied to U241 pin19, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive transmit and prescaler buffer are turned off.

## 6.0 Notes For All Schematics and Circuit Boards

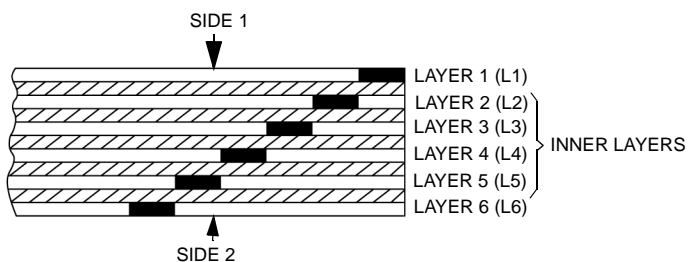
\* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

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

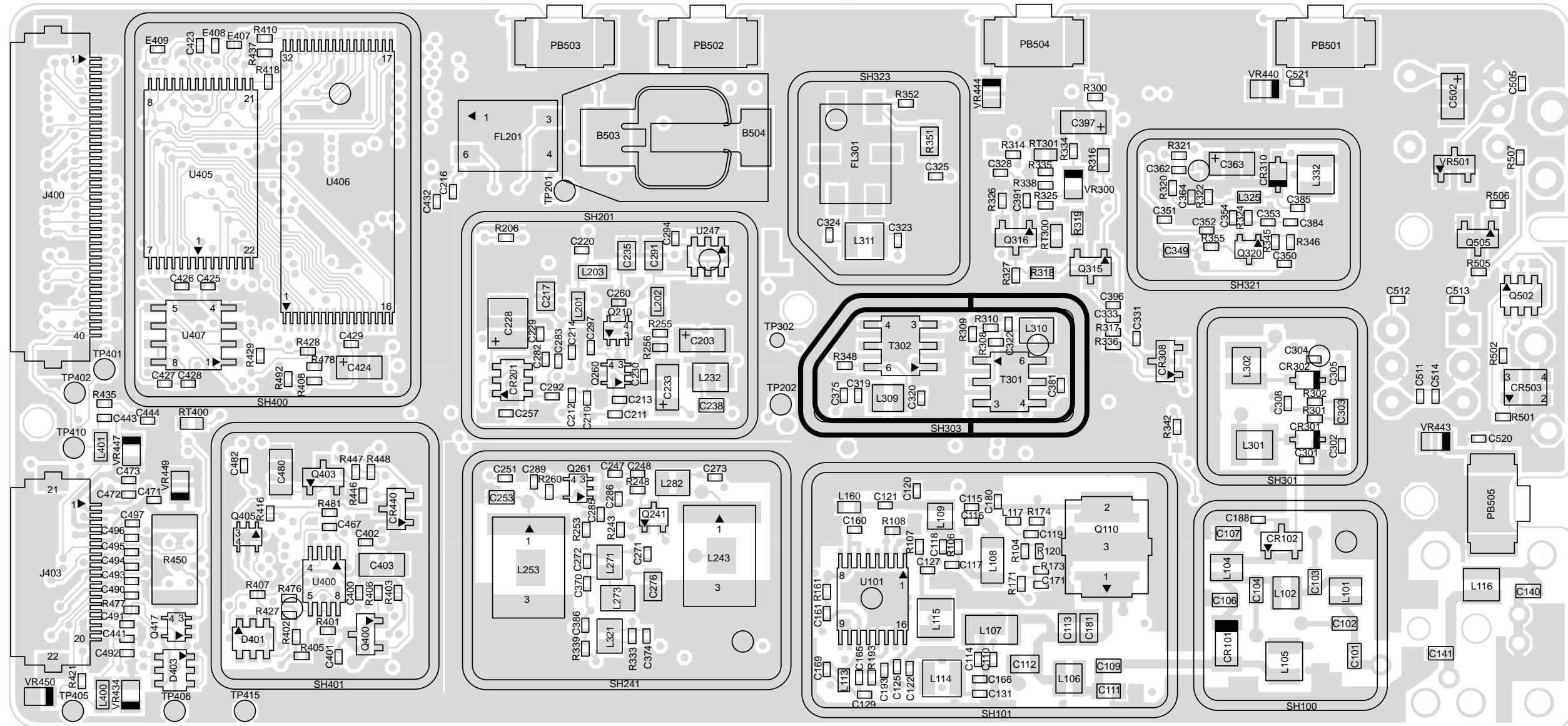
100 Series	=	Transmitter
200 Series	=	Frequency Generation
300 Series	=	Receiver
400/500 Series	=	Controller
600 Series	=	Keypad Board
4. Interconnect Tie Point Legend:
 

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

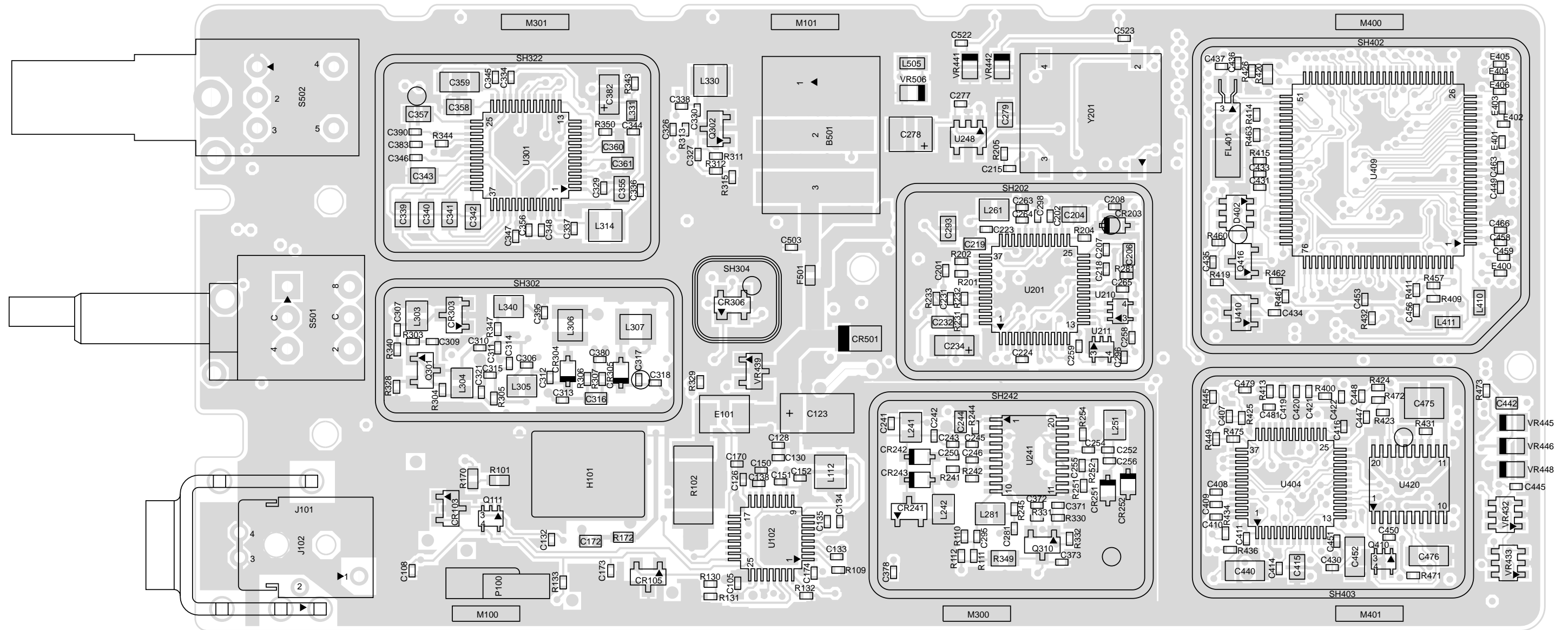
### 6-LAYER CIRCUIT BOARD DETAIL VIEWING COPPER STEPS IN PROPER LAYER SEQUENCE



### 7.0 Circuit Board/Schematic Diagrams and Parts List

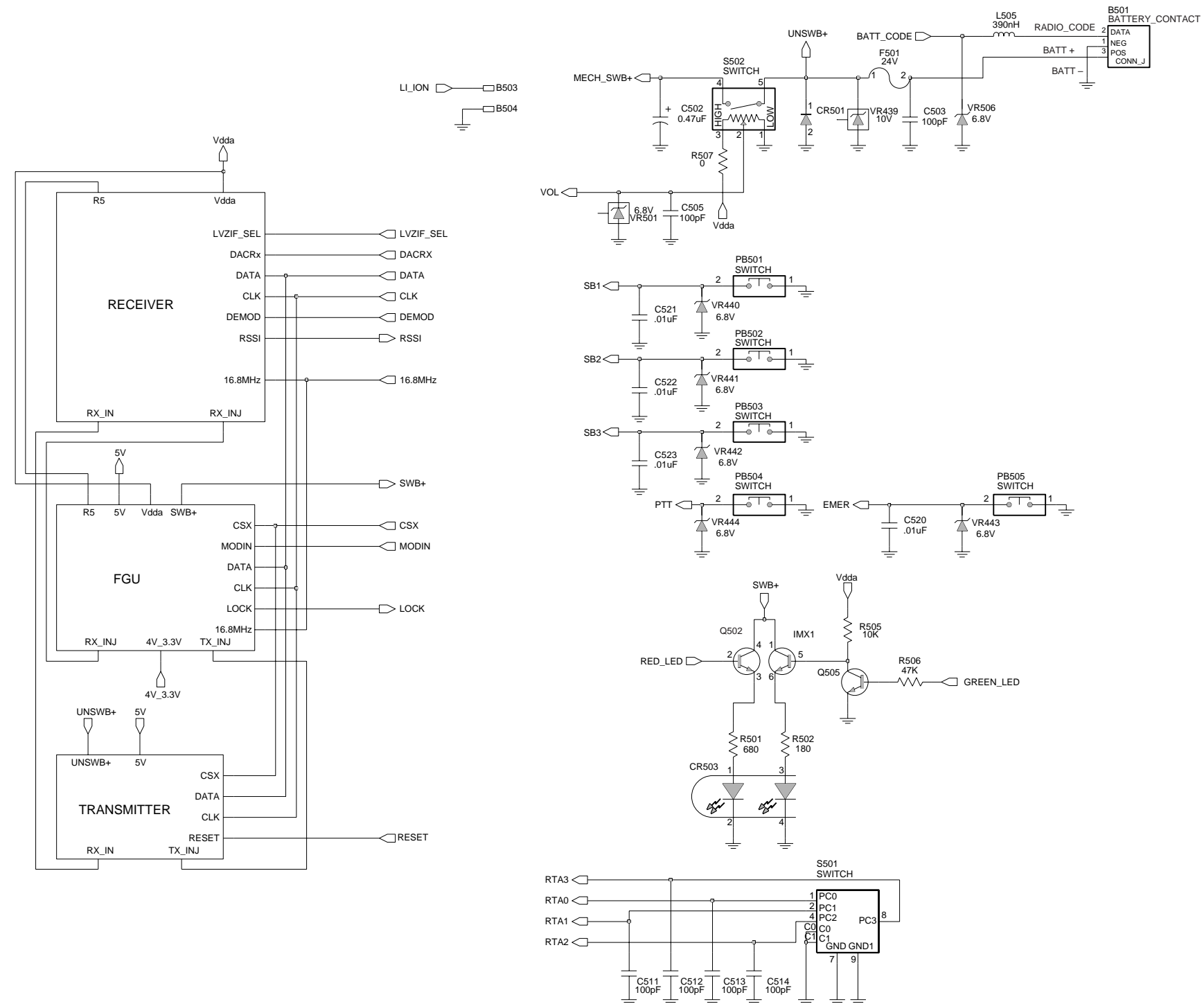


ZMY0130348-O

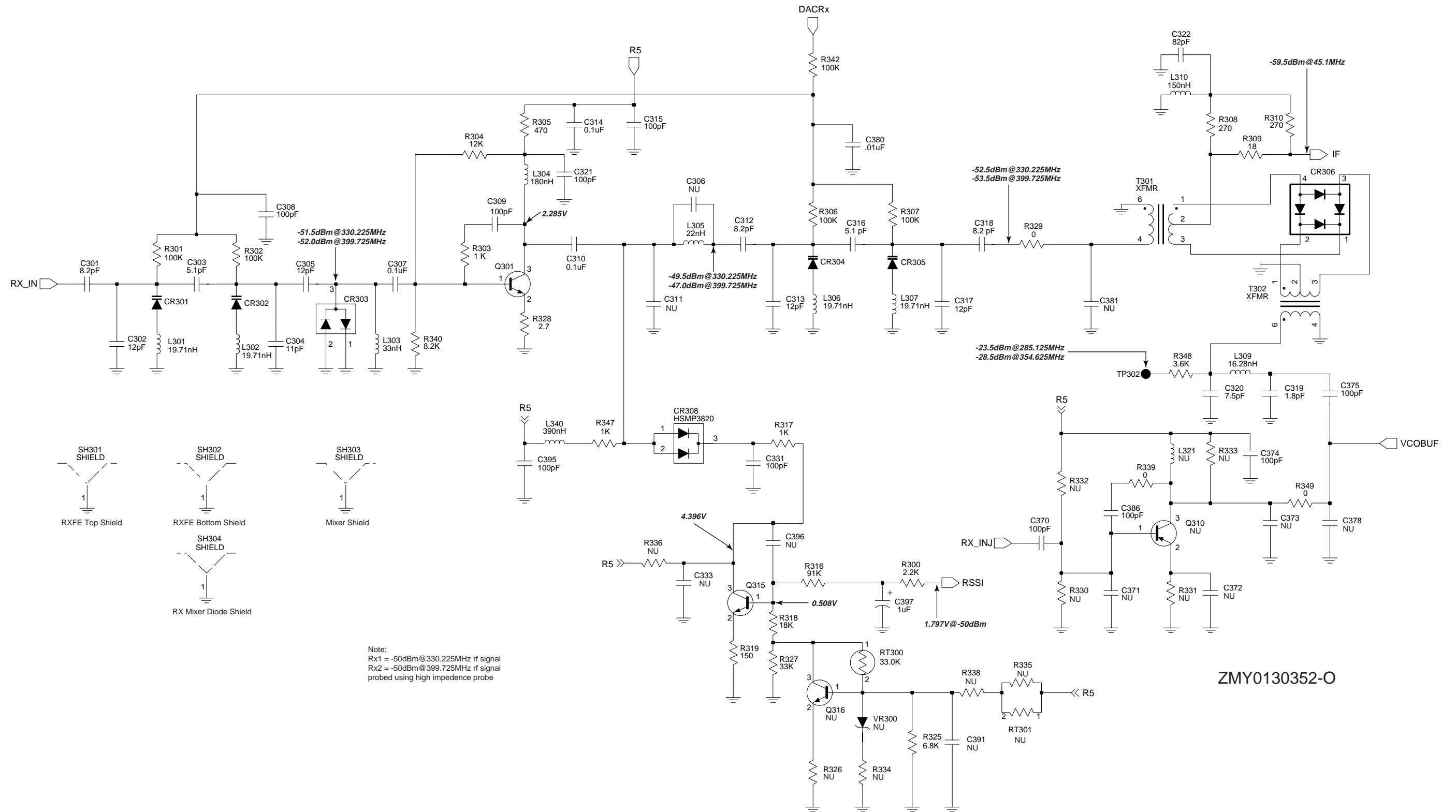


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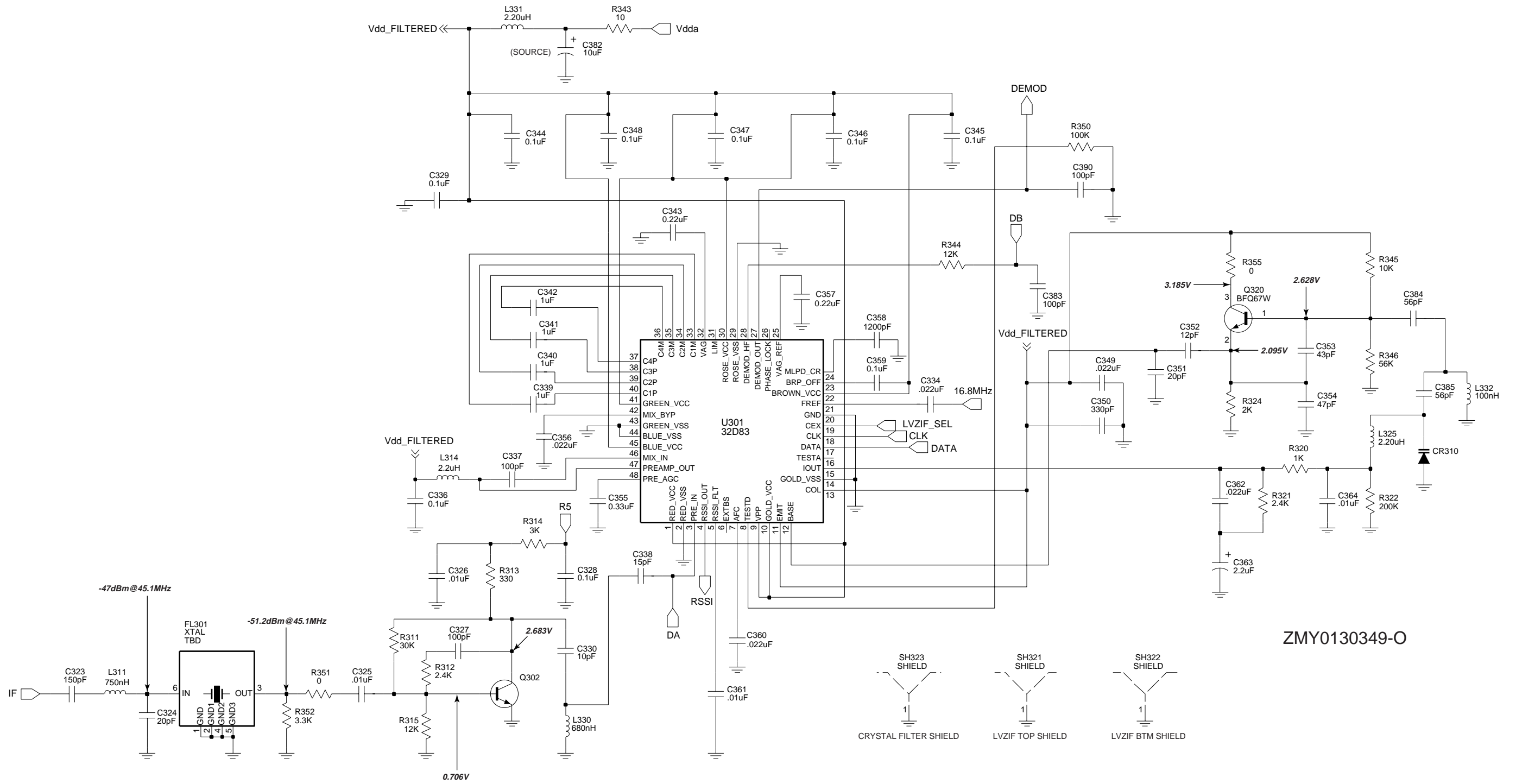




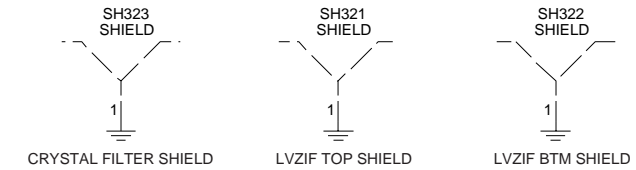
330-400MHz Controls And Switches Schematic Diagram



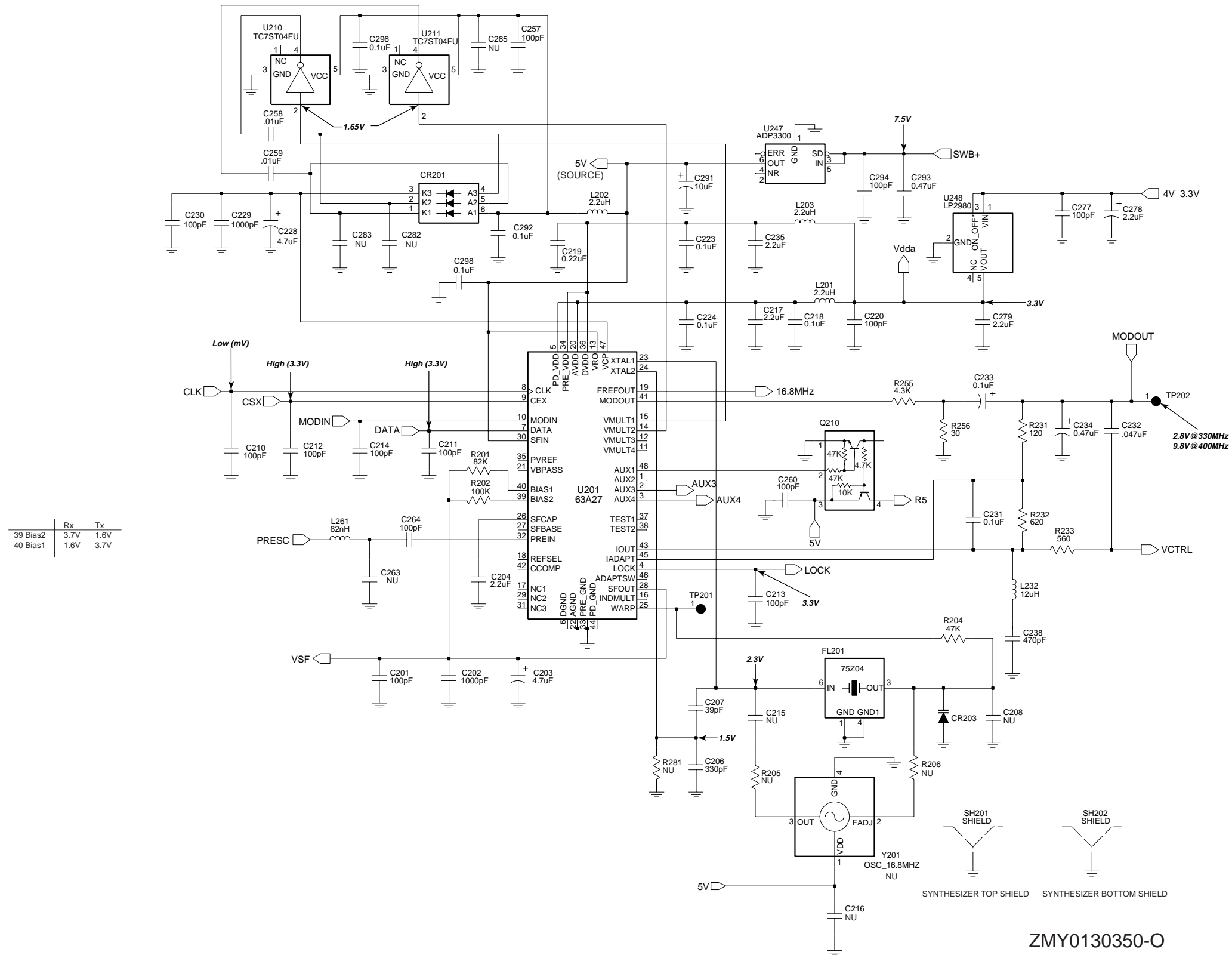
330-400MHz Receiver Front End Schematic Diagram



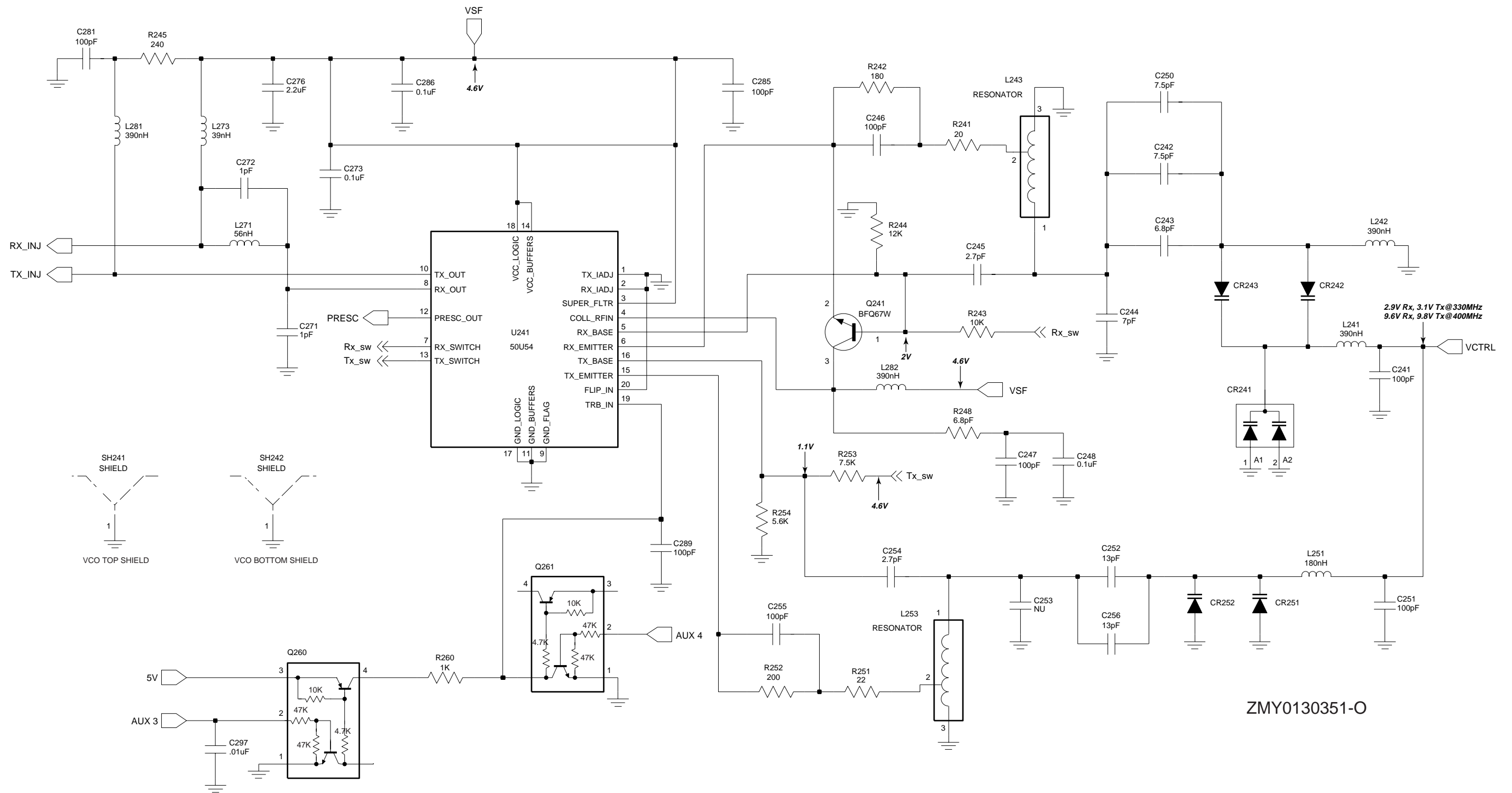
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330-400MHz Receiver Back End Schematic Diagram

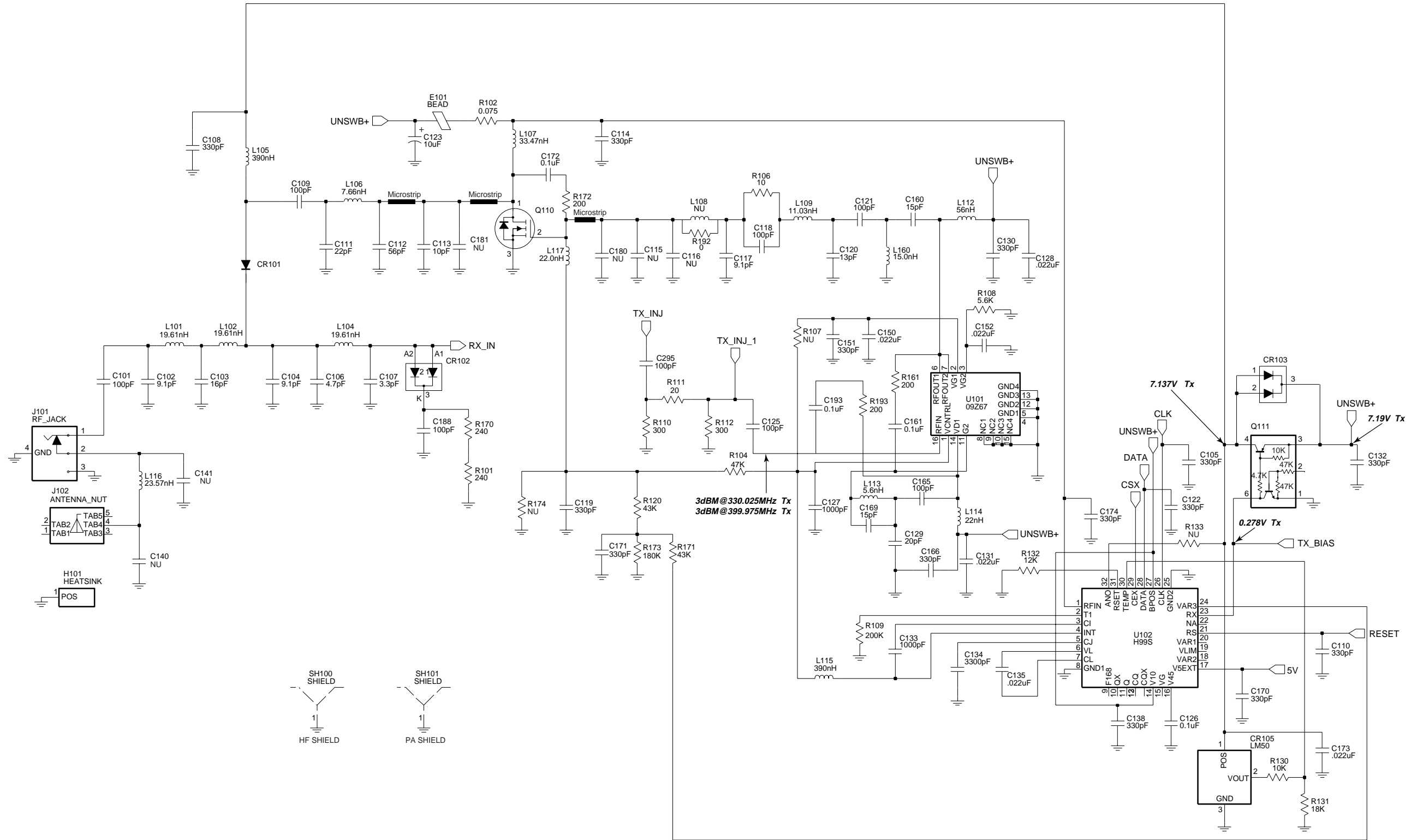


330-400MHz Synthesizer Schematic Diagram



ZMY0130351-O

330-400MHz Voltage Controlled Oscillator Schematic Diagram



ZMY0130353-O

330-400MHz Transmitter Schematic Diagram

## 330-400MHz Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Battery Contact Module
B503	3980502Z01	Backup Battery Contact, B+ ( not used in GP328)
B504	3980501Z01	Backup Battery Contact, B- ( not used in GP328)
C101	2113740F51	100pF
C102	2113740F27	10pF
C103	2113740F32	16pF
C104	2113740F27	10pF
C105	2113743L05	330pF
C106	2113740F19	4.7pF
C107	2113740F15	3.3pF
C108	2113743L05	330pF
C109	2113740F51	100pF
C110	2113743L05	330pF
C111	2103689A46	22pF
C112	2180605Z34	56pF, high Q
C113	2180605Z16	10pF, high Q
C114	2113743L05	330pF
C117	2113743N36	27pF
C118	2113743N50	100pF
C119	2113743L05	330pF
C120	2113743N25	9.1pF
C121	2113743N50	100pF
C122	2113743L05	330pF
C123	2311049A18	10uF, 16V
C125	2113743N50	100pF
C126	2113743M24	100000pF
C127	2113743L17	1000pF
C128	2113743M08	22000pF
C129	2113743N33	20pF
C130	2113743L05	330pF
C131	2113743M08	22000pF
C132	2113743L05	330pF
C133	2113743L17	1000pF
C134	2113743L29	3300pF
C135	2113743M08	22000pF
C138	2113743L05	330pF
C150	2113743M08	22000pF
C151	2113743L05	330pF
C152	2113743M08	22000pF
C160	2113743N50	100pF
C161	2113743M24	100000pF
C165	2113743N50	100pF
C166	2113743L05	330pF
C169	2113743N30	15pF
C170	2113743L05	330pF
C171	2113743L05	330pF
C172	2113743E20	0.1uF

Circuit Ref	Motorola Part No.	Description
C173	2113743M08	22000pF
C174	2113743L05	330pF
C188	2113743N50	100pF
C193	2113743M24	100000pF
C201	2113743N50	100pF
C202	2113743L17	1000pF
C203	2311049A56	4.7uF, 10V
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N40	39pF
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C217	2104993J02	2.2uF
C218	2113743M24	100000pF
C219	2113743K16	0.22uF
C220	2113743N50	100pF
C223	2113743M24	100000pF
C224	2113743M24	100000pF
C228	2311049J11	4.7uF, 16V
C229	2113743L17	1000pF
C230	2113743N50	100pF
C231	2113743M24	100000pF
C232	2113743E12	0.047uF
C233	2311049A01	0.1uF, 35V
C234	2311049A05	0.47uF, 25V
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N23	7.5pF
C243	2113743N22	6.8pF
C244	2113740F13	2.7pF
C245	2113743N12	2.7pF
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	100000pF
C250	2113743N23	7.5pF
C251	2113743N50	100pF
C252	2113743N29	13pF
C254	2113743N12	2.7pF
C255	2113743N50	100pF
C256	2113743N29	13pF
C257	2113743N50	100pF
C258	2113743L41	10000pF
C259	2113743L41	10000pF
C260	2113743N50	100pF
C264	2113743N50	100pF
C271	2113743N03	1pF
C272	2113743N03	1pF

Circuit Ref	Motorola Part No.	Description
C273	2113743M24	100000pF
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A57	10uF
C279	2104993J02	2.2uF
C281	2113743N50	100pF
C285	2113743N50	100pF
C286	2113743M24	100000pF
C289	2113743N50	100pF
C291	2311049A69	10uF, 6.3V
C292	2113743M24	100000pF
C293	2113743A27	0.47uF
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	100000pF
C297	2113743L41	10000pF
C298	2113743M24	100000pF
C301	2113743N24	8.2pF
C302	2113743N28	12pF
C303	2113740L11	5.1pF
C304	2113743N27	11pF
C305	2113743N28	12pF
C306	2113743N22	6.8pF
C307	2113743M24	100000pF
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	100000pF
C312	2113743N24	8.2pF
C313	2113743N27	11pF
C314	2113743M24	100000pF
C315	2113743N50	100pF
C316	2113740L11	5.1pF
C317	2113743N27	11pF
C318	2113743N24	8.2pF
C319	2113743N21	2.7pF
C320	2113743N20	5.6pF
C321	2113743N50	100pF
C322	2113743N48	82pF
C323	2113743N54	150pF
C324	2113743N33	20pF
C325	2113743L41	10000pF
C326	2113743L41	10000pF
C327	2113743N50	100pF
C328	2113743M24	100000pF
C329	2113743M24	100000pF
C330	2113743N26	10pF
C331	2113743N50	100pF
C334	2113743M08	22000pF
C336	2113743M24	100000pF
C337	2113743N50	100pF
C338	2113743N30	15pF

Circuit Ref	Motorola Part No.	Description
C339	2180478Z20	1uF
C340	2180478Z20	1uF
C341	2180478Z20	1uF
C342	2180478Z20	1uF
C343	2113743A23	0.22uF
C344	2113743M24	100000pF
C345	2113743M24	100000pF
C346	2113743M24	100000pF
C347	2113743M24	100000pF
C348	2113743M24	100000pF
C349	2113743E07	0.022uF
C350	2113743L05	330pF
C351	2113743N33	20pF
C352	2113743N28	12pF
C353	2113743N41	43pF
C354	2113743N42	47pF
C355	2113743A24	0.33uF
C356	2113743M08	22000pF
C357	2113743A23	0.22uF
C358	2113741A23	1200pF
C359	2109720D14	0.1uF, low distortion
C360	2113743E07	0.022uF
C361	2113741F49	10000pF
C362	2113743M08	22000pF
C363	2311049A40	2.2uF, 10V
C364	2113743L41	10000pF
C370	2113743N50	100pF
C374	2113743N50	100pF
C375	2113743N50	100pF
C380	2113743L41	10000pF
C382	2311049A59	10uF, 6V
C383	2113743N50	100pF
C384	2113743N44	56pF
C385	2113743N44	56pF
C386	2113743N50	100pF
C390	2113743N50	100pF
C395	2113743N50	100pF
C397	2311049A07	1uF, 16V
C400	2113743L41	10000pF
C401	2113743M24	100000pF
C402	2113743M24	100000pF
C403	2113743G24	2.2uF
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	100000pF
C410	2113928N01	0.1uF
C411	2113743M24	100000pF
C414	2113743M24	100000pF
C415	2185895Z01	0.01uF, low distortion
C416	2113928N01	0.1uF
C420	2113743L41	10000pF

Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description
C421	2113928N01	0.1uF	C502	2311049A05	0.47uF, 25V	FL401	4870368G02	Real Time Clock Crystal Oscillator (not used in GP328)	L340	2462587V41	390nH
C422	2113743M24	10000pF	C503	2113743N50	100pF	H101	2680499Z01	Heat Spreader	L400	2462587Q42	390nH
C423	2113743N50	100pF	C505	2113743N50	100pF	J101	0985613Z01	RF Jack	L401	2462587Q42	390nH
C424	2311049A59	10uF, 6V	C511	2113743N50	100pF	J102	0280519Z02	Antenna Nut	L410	2462587Q42	390nH
C425	2113743M24	10000pF	C512	2113743N50	100pF	J400	0905505Y04	40-pin connector	L411	2462587Q42	390nH
C426	2113743N50	100pF	C513	2113743N50	100pF	J403	0905505Y02	20-pin connector	L505	2462587Q42	390nH
C427	2113743N50	100pF	C514	2113743N50	100pF	L101	2479990B02	19.61nH	P100	3905643V01	Ground Contact Finger
C428	2113743M24	10000pF	C520	2113743L41	10000pF	L102	2479990B02	19.61nH	PB501	4080523Z01	Tactile Switch
C429	2113743M24	10000pF	C521	2113743L41	10000pF	L104	2479990B02	19.61nH	PB502	4080523Z01	Tactile Switch
C430	2113928N01	0.1uF	C522	2113743L41	10000pF	L105	2462587N22	390nH	PB503	4080523Z01	Tactile Switch
C431	2113743N50	100pF	C523	2113743L41	10000pF	L106	2479990A02	7.66nH	PB504	4080523Z01	Tactile Switch
C433	2113743L41	10000pF	CR101	4880973Z02	Pin Diode	L107	2479990G01	33.47nH	PB505	4080523Z01	Tactile Switch
C434	2113928N01	0.1uF (not used in GP328)	CR102	4802245J41	Pin Diode	L108	0611077A01	Resistor Jumper	Q110	4802245J55	RF Power Amplifier
C435	2113743M24	10000pF	CR103	4802245J41	Pin Diode	L109	2479990B01	11.03nH	Q111	4809939C05	NPN/PNP Dual Transistor
C436	2113743N34	22pF (not used in GP328)	CR105	5185963A15	Temperature Sensor	L112	2462587N50	56nH	Q210	4809939C05	NPN/PNP Dual Transistor
C437	2113743N34	22pF (not used in GP328)	CR201	4802233J09	Triple Diode (SOT-25)	L113	2413926H09	5.6nH	Q241	4805218N63	RF NPN Transistor
C440	2113743G26	4.7uF	CR203	4862824C03	Varactor	L114	2462587N45	22nH	Q260	4809939C05	NPN/PNP Dual Transistor
C441	2113743N50	100pF	CR241	4805649Q13	Varactor	L115	2462587N22	390nH	Q261	4809939C05	NPN/PNP Dual Transistor
C442	2113743E20	0.1uF	CR242	4802245J22	Varactor	L116	2460591C56	23.57nH	Q301	4802245J44	NPN Transistor
C443	2113928N01	0.1uF	CR243	4802245J22	Varactor	L117	2409154M17	22nH	Q302	4802245J44	NPN Transistor
C444	2113743N50	100pF	CR251	4862824C01	Varactor	L160	2413926H14	15nH	Q315	4880214G02	NPN Transistor
C445	2113743N50	100pF	CR252	4862824C01	Varactor	L201	2462587Q20	2200nH	Q320	4805218N63	RF NPN Transistor
C447	2113743M08	22000pF	CR301	4862824C08	Varactor	L202	2462587Q20	2200nH	Q400	4809579E18	P-chan MOSFET
C448	2113928N01	0.1uF	CR302	4862824C08	Varactor	L203	2462587Q20	2200nH	Q403	4880214G02	NPN Transistor
C449	2113743N50	100pF	CR303	4880154K03	Dual Common Anode-Cathode Diode	L232	2462587P25	12000nH	Q405	4802245J54	Dual NPN Transistor
C451	2113743M08	22000pF	CR304	4862824C08	Varactor	L241	2462587V41	390nH	Q410	4802245J54	Dual NPN Transistor
C452	2113743B29	1uF	CR305	4862824C08	Varactor	L242	2462587V41	390nH	Q416	4809579E18	P-chan MOSFET (not used in GP328)
C453	2113743N50	100pF	CR306	4802245J42	Ring Quad Diode (SOT-143)	L243	2460593C02	Rx Teflon resonator	Q417	4809939C05	NPN/PNP Dual Transistor
C456	2113743N50	100pF	CR308	4802245J41	Pin Diode	L251	2462587V37	180nH	Q502	5180159R01	Dual NPN Transistor
C458	2113743N50	100pF	CR310	4862824C08	Varactor	L253	2460593C02	Tx Teflon resonator	Q505	4880214G02	NPN Transistor
C459	2113743N50	100pF	CR440	4813833C02	Dual Common Cathode Diode	L261	2462587V33	82nH	R101	0662057A34	240
C463	2113743N50	100pF	CR501	4880107R01	Rectifier	L271	2462587V31	56nH	R102	0680539Z01	0.1
C466	2113743N50	100pF	CR503	4805729G49	Red/Yellow LED	L273	2462587V29	39nH	R104	0662057N15	47k
C467	2113928N01	0.1uF	D401	4802245J62	Schottky Diode	L281	2462587V41	390nH	R106	0662057M26	10
C471	2113743N50	100pF	D402	4802245J62	Schottky Diode	L282	2462587V41	390nH	R108	0662057M92	5600
C472	2113743L09	470pF	D403	4802245J62	Schottky Diode	L301	2460591D24	19.71nH	R109	0662057N30	200k
C473	2113743L09	470pF	E101	2484657R01	Inductor bead	L302	2460591D24	19.71nH	R110	0662057M61	300
C475	2113743H14	10uF	E400	2480640Z01	Ferrite bead	L303	2462587V28	33nH	R111	0662057M33	20
C476	2113928D08	10uF	E401	2480640Z01	Ferrite bead	L304	2462587V37	180nH	R112	0662057M61	300
C479	2113928N01	0.1uF	E402	2480640Z01	Ferrite bead	L305	2462587V23	12nH	R120	0662057N14	43k
C480	2113743G26	4.7uF	E403	2480640Z01	Ferrite bead	L306	2460591D24	19.71nH	R130	0662057M98	10k
C481	2113928N01	0.1uF	E404	2480640Z01	Ferrite bead	L307	2460591D24	19.71nH	R131	0662057N05	18k
C482	2113928N01	0.1uF	E405	2480640Z01	Ferrite bead	L309	2479990C02	16.28nH	R132	0662057N33	270k
C490	2113743N50	100pF	E406	2480640Z01	Ferrite bead	L310	2462587V36	150nH	R161	0662057M57	200
C491	2113743N50	100pF	E407	2480640Z01	Ferrite bead	L311	2462587N65	750nH	R170	0662057A34	240
C492	2113743N50	100pF	E408	2480640Z01	Ferrite bead	L314	2462587N72	2200nH	R171	0662057N14	43k
C493	2113743N50	100pF	E409	2480640Z01	Ferrite bead	L325	2480646Z20	2.2uH	R172	0662057A32	200
C494	2113743N50	100pF	F501	6580542Z01	3A Fuse	L330	2462587N64	680nH	R173	0662057N29	180k
C495	2113743N50	100pF	FL201	4805875Z04	16.8MHz Reference Oscillator	L331	2480646Z20	2.2uH	R193	0662057M57	200
C496	2113743N50	100pF	FL301	9186153B01	45.1MHz Crystal Filter	L332	2462587N53	100nH	R201	0662057N21	82k



Circuit Ref	Motorola Part No.	Description
R202	0662057N23	100k
R204	0662057N15	47k
R231	0662057M52	120
R232	0662057M69	620
R233	0662057M68	560
R241	0662057M33	20
R242	0662057M56	180
R243	0662057M98	10k
R244	0662057N01	12k
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M34	22
R252	0662057M57	200
R253	0662057N03	15k
R254	0662057M92	5600
R255	0662057M89	4300
R256	0662057M37	30
R260	0662057M74	1000
R300	0662057M82	2000
R301	0662057N23	100k
R302	0662057N23	100k
R303	0662057M74	1000
R304	0662057N01	12k
R305	0662057M66	470
R306	0662057N23	100k
R307	0662057N23	100k
R308	0662057M60	270
R309	0662057M32	18
R310	2113743N23	7.5pF
R311	0662057N10	30k
R312	0662057M83	2400
R313	0662057M62	330
R314	0662057M85	3000
R315	0662057N01	12k
R316	0662057A96	91k
R317	0662057M74	1000
R318	0662057A79	18k
R319	0662057A29	150
R320	0662057M74	1000
R321	0662057M83	2400
R322	0662057N30	200k
R324	0662057M81	2000
R325	0662057M94	6800
R327	0662057N11	33k
R328	0662057M12	2.7
R329	0662057M01	0
R339	0662057M01	0
R340	0662057M96	8200
R342	0662057N23	100k
R343	0662057M26	10
R344	0662057N01	12k

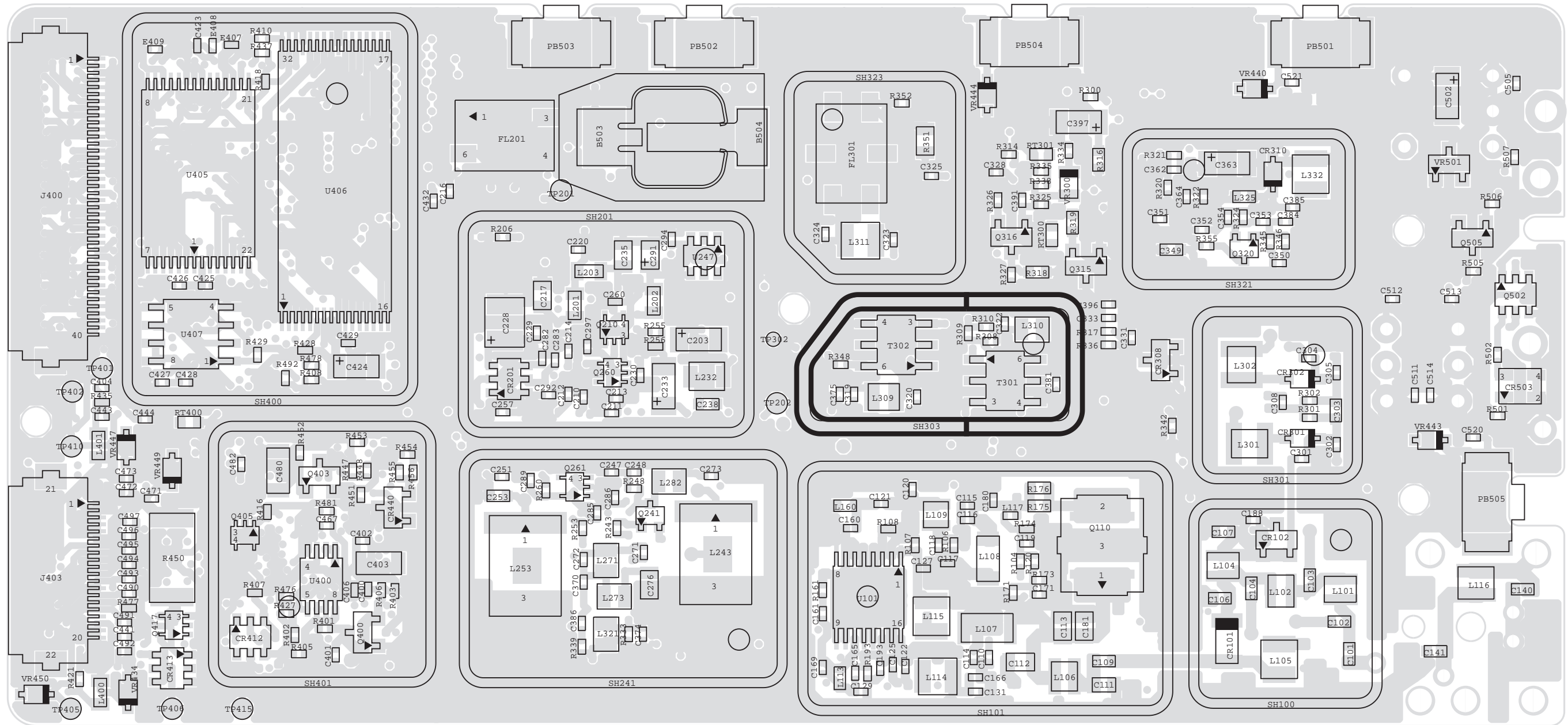
Circuit Ref	Motorola Part No.	Description
R345	0662057M98	10k
R346	0662057N17	56k
R347	0662057M74	1000
R348	0662057M87	3600
R349	0662057C01	0
R350	0662057N23	100k
R351	0662057C01	0
R352	0662057M86	3300
R355	0662057M01	0
R400	0662057N15	47k
R401	0662057M01	0
R405	0662057M01	0
R406	0662057N20	75k
R407	0662057N19	68k
R409	0662057M98	10k
R410	0662057N23	100k
R411	0662057M98	10k
R413	0662057M01	0
R414	0662057V34	180k, 1%
R415	0662057V26	91k, 1%
R416	0662057M90	4700
R418	0662057M01	0
R419	0662057M67	510 (not used in GP328)
R420	0662057B46	10M (not used in GP328)
R421	0662057M81	2000
R423	0662057N39	470k
R424	0662057N12	36k
R425	0662057N10	30k
R426	0662057N35	330k (not used in GP328)
R427	0662057M84	2700
R428	0662057M10	2.2
R429	0662057M98	10k
R431	0662057N39	470k
R432	0662057N16	51k
R434	0662057M62	330
R435	0662057M81	2000
R436	0662057M01	0
R445	0662057N08	24k
R446	0662057N22	91k
R447	0662057N38	470k
R448	0662057N06	20k
R449	0662057N08	24k
R450	0683962T45	68, 1W
R457	0662057M98	10k
R460	0662057M90	4700
R461	0662057M56	180 (not used in GP328)
R462	0662057M98	10k (not used in GP328)
R463	0662057M61	300
R471	0662057N06	20k
R472	0662057N12	36k
R473	0662057M26	10

Circuit Ref	Motorola Part No.	Description
R475	0662057M01	0
R476	0662057N35	330k
R477	0662057M74	1000
R478	0662057M98	10k
R481	0662057N08	24k
R492	0662057M01	0
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10k
R506	0662057N15	47k
R507	0662057M01	0
RT300	0680590Z01	THERMISTOR_33K
RT400	0680590Z01	THERMISTOR_33K
S501	4080710Z01	Frequency Knob
S502	1880619Z02	Volume/on-off Switch
SH100	2680507Z01	Harmonic Filter Shield
SH101	2680510Z01	RF PA Shield
SH201	2680511Z01	Synthesizer Top Shield
SH202	2680511Z01	Synthesizer Bottom Shield
SH241	2680513Z01	VCO Top Shield
SH242	2680514Z01	VCO Bottom Shield
SH301	2680554Z01	Receiver Front End Top Shield
SH302	2680555Z01	Receiver Front End Bottom Shield
SH303	2680509Z01	Mixer Shield
SH304	2680624Z01	Mixer Diode Shield
SH321	2680508Z01	LVZIF 2nd LO Shield
SH322	2680514Z01	LVZIF Shield
SH323	2680553Z01	Crystal Filter Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller On-off Shield
SH402	2680515Z01	Microprocessor Shield
SH403	2680516Z01	Asfic_Cmp/Audio PA Shield
T301	2580541Z02	Balun Transformer
T302	2580541Z02	Balun Transformer
U101	5105109Z67	LDMOS Driver IC
U102	5185765B26	PCIC
U201	5185963A27	LVFRACN Synthesizer IC
U210	5102463J61	Inverter
U211	5102463J61	Inverter
U241	5105750U54	VCO Buffer IC
U247	5105739X05	5V Regulator
U248	5102463J58	3.3V Regulator
U301	5109632D83	LVZIF IC
U400	5102463J40	3.3V Regulator
U404	5185130C53	Asfic_CMP IC
U406	*5102463J59	Flash ROM 128K x 8
U407	*5102463J64	EEPROM 16K x 8
U409	5102226J56	Microprocessor

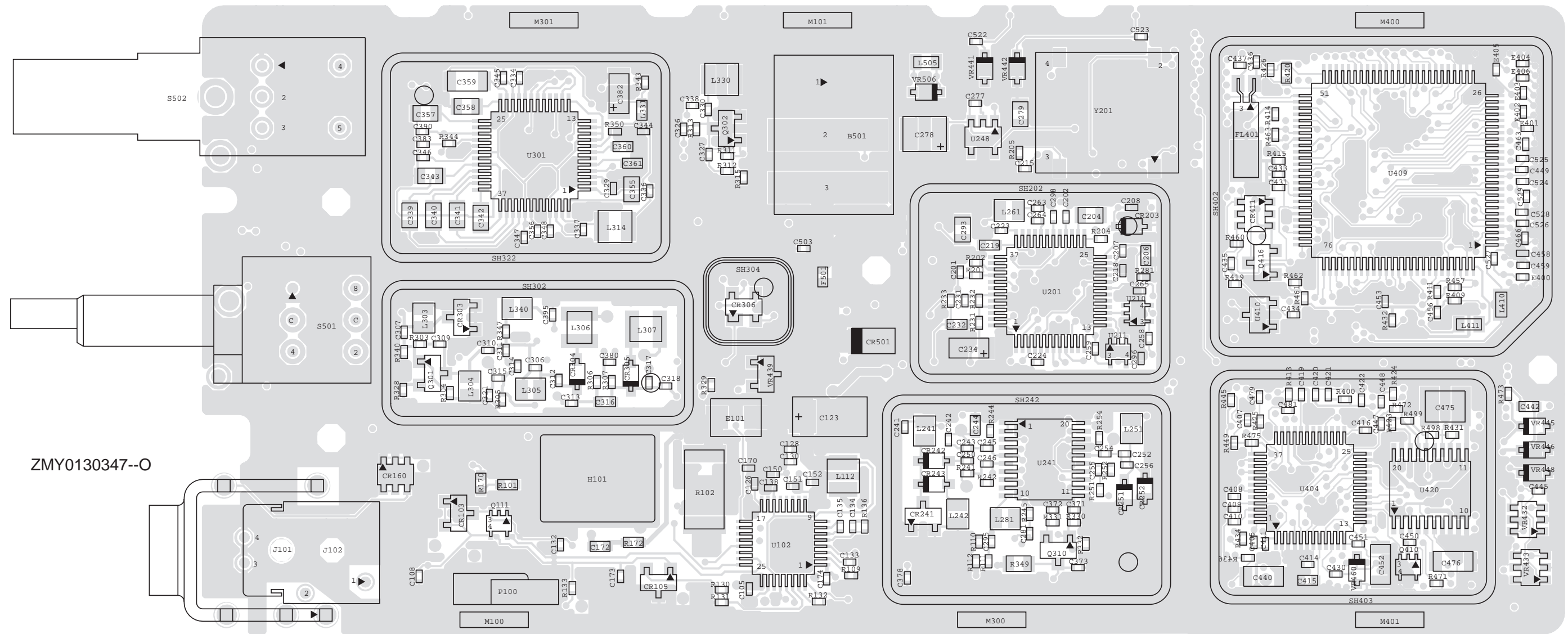
Circuit Ref	Motorola Part No.	Description
U410	5102463J57	3.3V Regulator (not used in GP328)
U420	5102463J44	Audio Amplifier
VR432	4805656W08	Quad Zener Diode
VR433	4805656W08	Quad Zener Diode
VR434	4802245J51	Zener Diode - 6.8V
VR439	4880140L17	Zener Diode - 12V
VR440	4802245J73	Zener Diode - 6.8V
VR441	4802245J73	Zener Diode - 6.8V
VR442	4802245J73	Zener Diode - 6.8V
VR443	4802245J73	Zener Diode - 6.8V
VR444	4802245J73	Zener Diode - 6.8V
VR445	4802245J53	Zener Diode - 10V
VR446	4802245J53	Zener Diode - 10V
VR447	4802245J53	Zener Diode - 10V
VR448	4802245J53	Zener Diode - 10V
VR449	4802245J53	Zener Diode - 10V
VR450	4802245J75	Zener Diode - 12V
VR501	4813830A18	Zener Diode - 6.8V
VR506	4802245J73	Zener Diode - 6.8V
	8485726Z01	UHF Band 3 Main PCB

\* Motorola Depot Servicing only

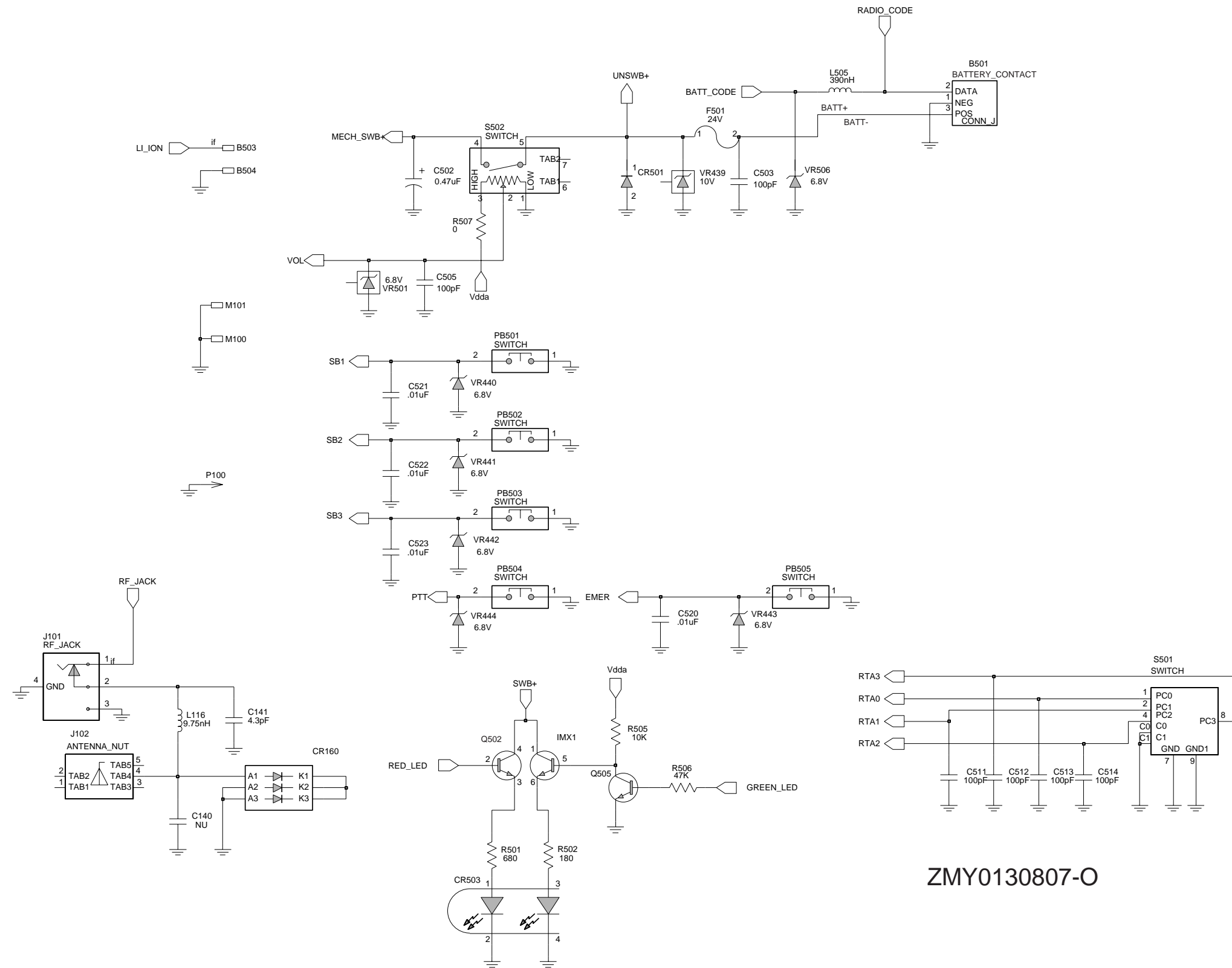
### 8.0 Circuit Board/Schematic Diagrams and Parts List



ZMY0130348-A

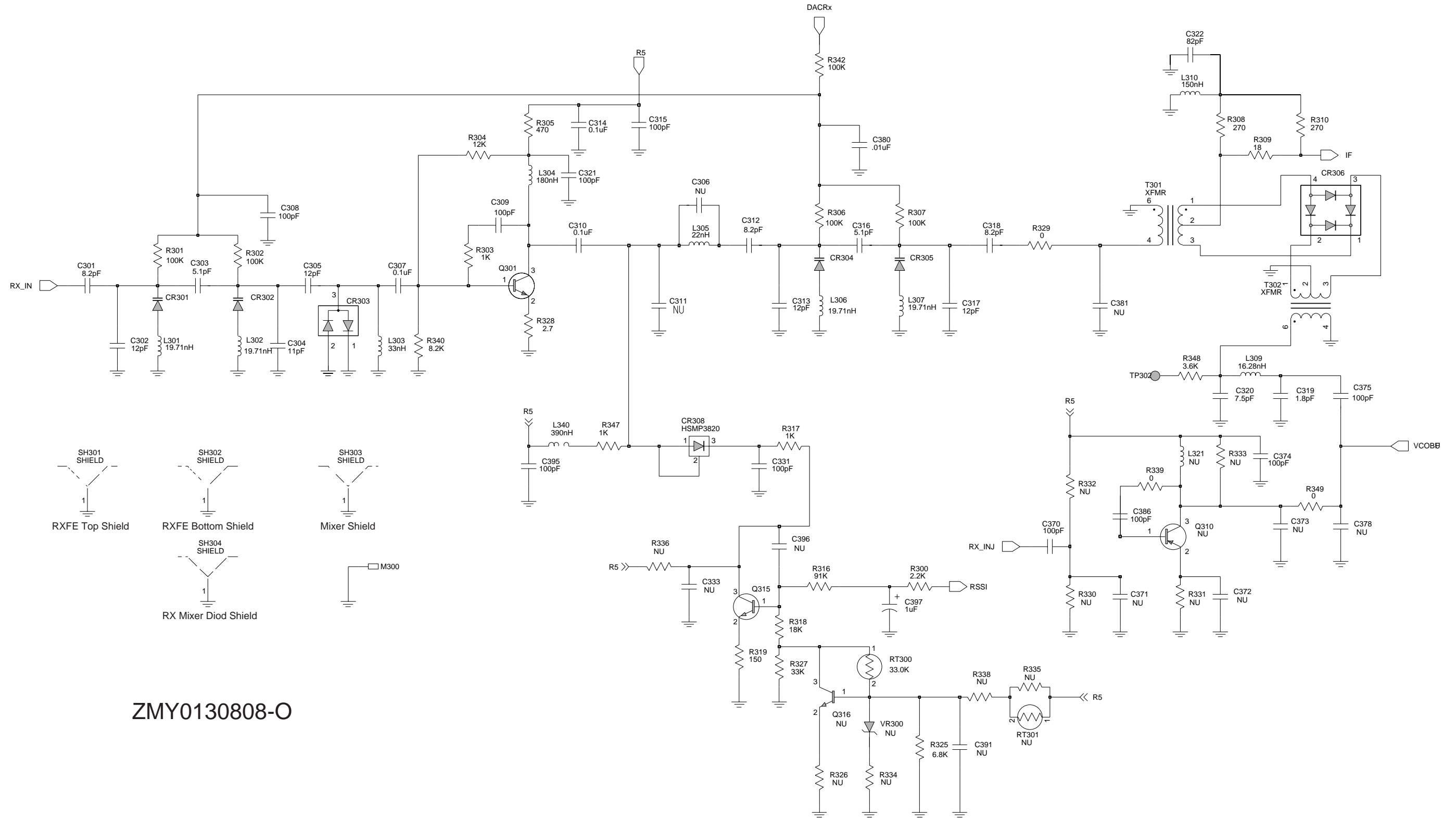


330-400MHz Main Board Bottom Side PCB No. 8485726Z04



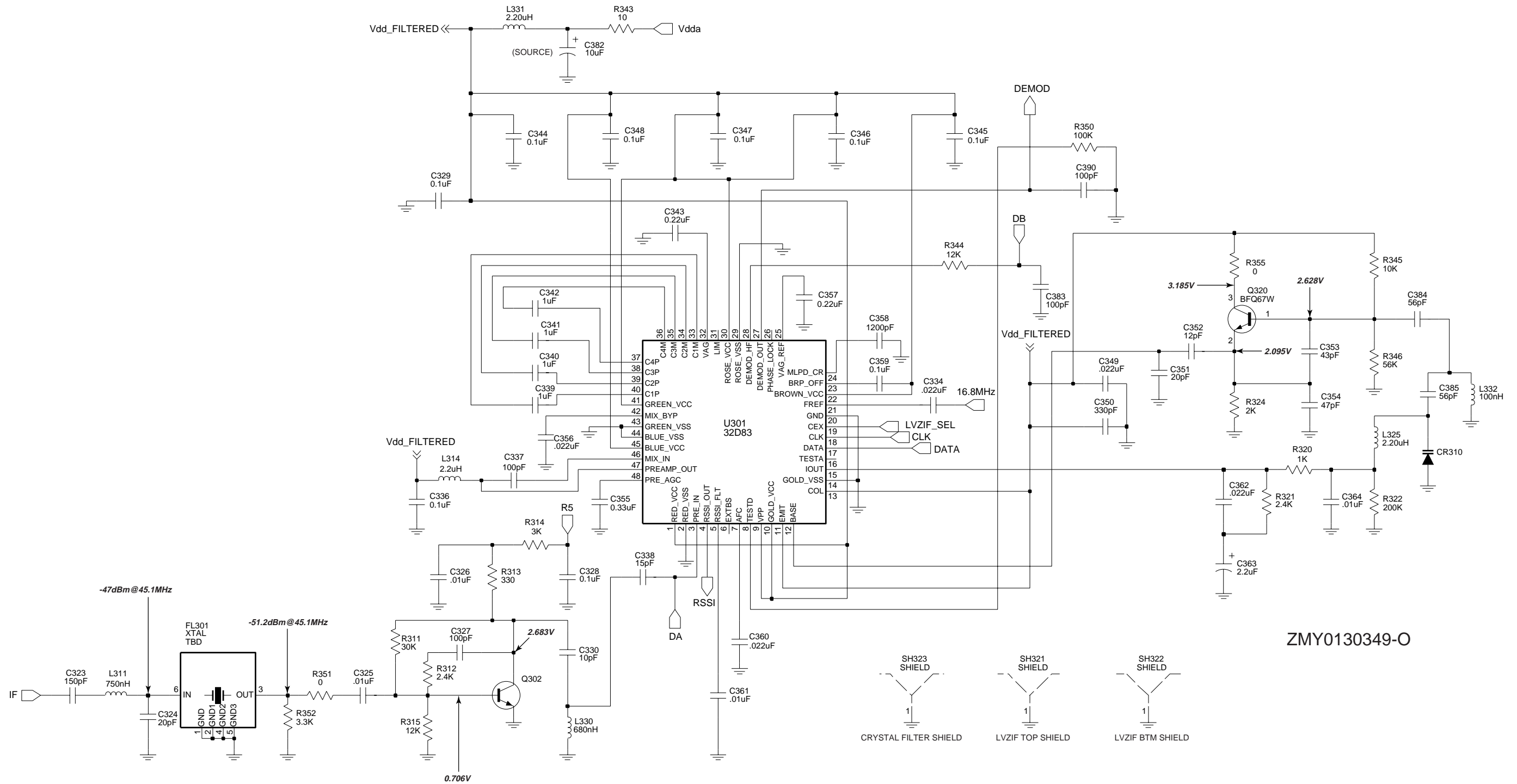
ZMY0130807-O

330-400MHz Controls And Switches Schematic Diagram



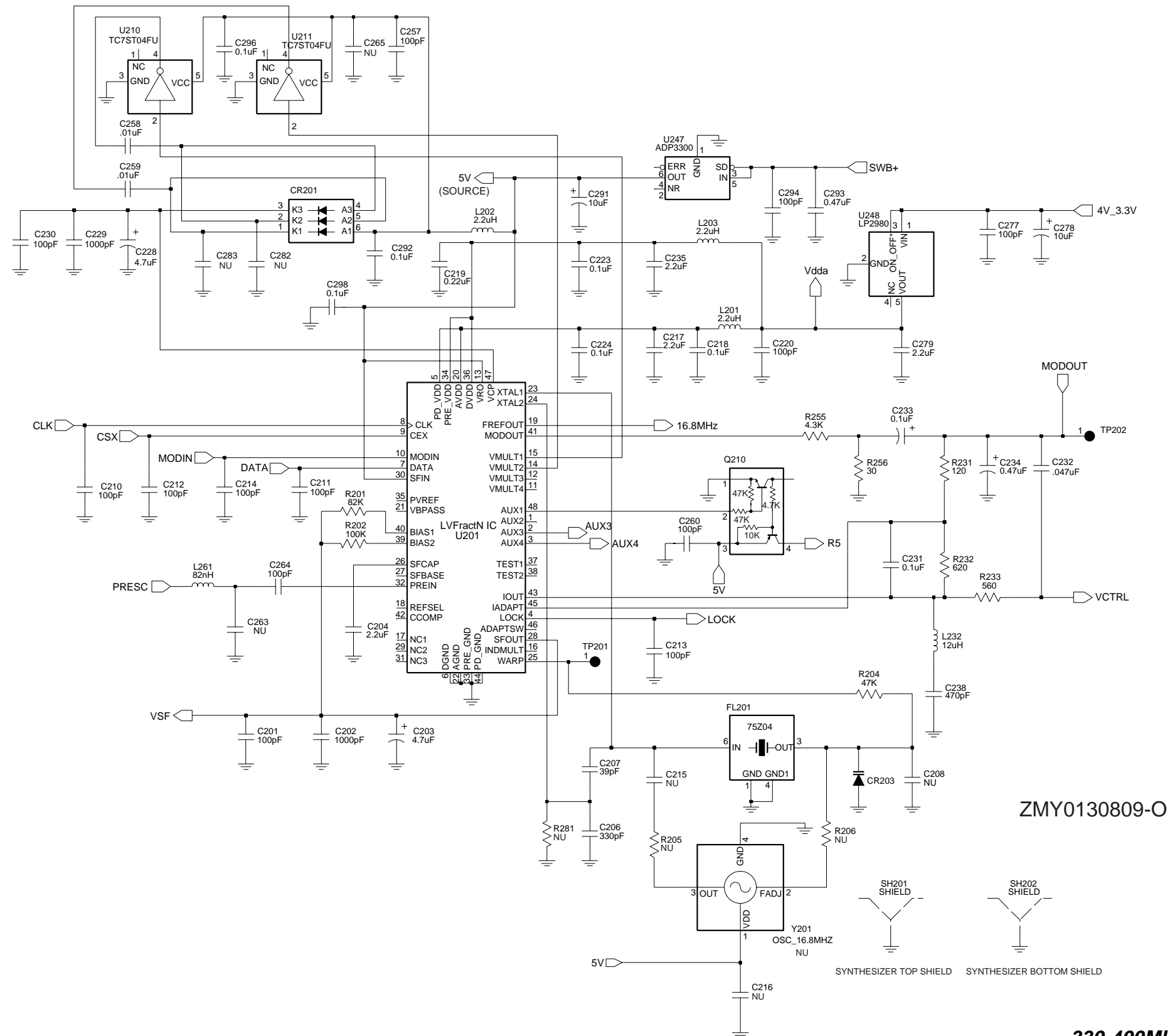
ZMY0130808-O

330-400MHz Receiver Front End Schematic Diagram



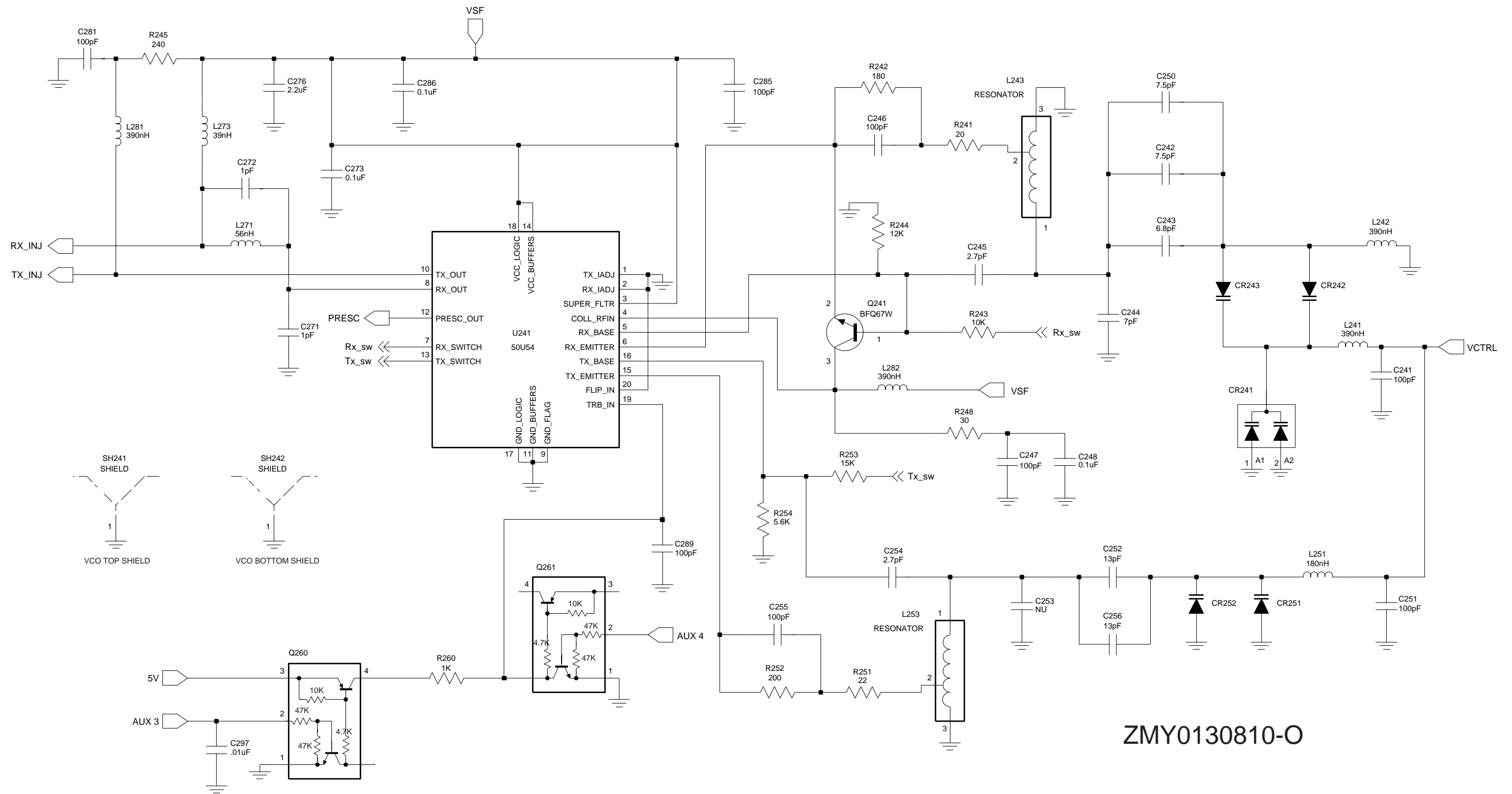
ZMY0130349-O

330-400MHz Receiver Back End Schematic Diagram



ZMY0130809-O

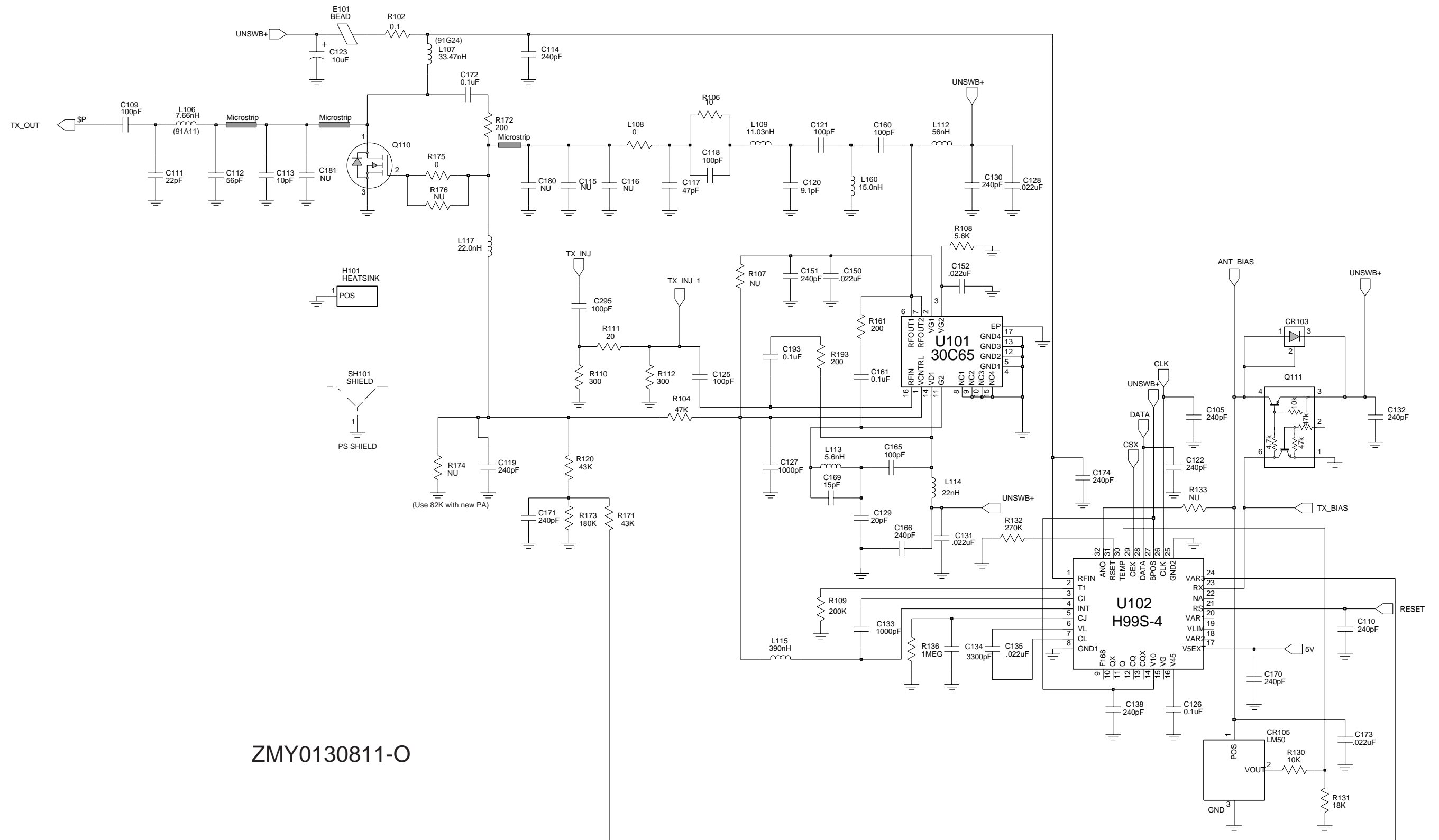
330-400MHz Synthesizer Schematic Diagram



ZMY0130810-O

330-400MHz Voltage Controlled Oscillator Schematic Diagram





ZMY0130811-O

330-400MHz Transmitter Schematic Diagram

## 330-400MHz Radio Parts List

Circuit Ref	Motorola Part No.	Description
B501	0986237A02	Battery Contact Module
B503	3980502Z01	Backup Battery Contact, B+ ( not used in GP328)
B504	3980501Z01	Backup Battery Contact, B- ( not used in GP328)
C101	2113740F51	100pF
C102	2113740F27	10pF
C103	2113740F32	16pF
C104	2113740F27	10pF
C105	2113743L05	330pF
C106	2113740F19	4.7pF
C107	2113740F15	3.3pF
C108	2113743L05	330pF
C109	2113740F51	100pF
C110	2113743L05	330pF
C111	2103689A46	22pF
C112	2180605Z34	56pF, high Q
C113	2180605Z16	10pF, high Q
C114	2113743L05	330pF
C115	NOT PLACED	
C116	NOT PLACED	
C117	2113743N36	27pF
C118	2113743N50	100pF
C119	2113743L05	330pF
C120	2113743N25	9.1pF
C121	2113743N50	100pF
C122	2113743L05	330pF
C123	2311049A18	10uF, 16V
C125	2113743N50	100pF
C126	2113743M24	10000pF
C127	2113743L17	1000pF
C128	2113743M08	22000pF
C129	2113743N33	20pF
C130	2113743L05	330pF
C131	2113743M08	22000pF
C132	2113743L05	330pF
C133	2113743L17	1000pF
C134	2113743L29	3300pF
C135	2113743M08	22000pF
C138	2113743L05	330pF
C140	NOT PLACED	
C141	NOT PLACED	
C150	2113743M08	22000pF
C151	2113743L05	330pF
C152	2113743M08	22000pF
C160	2113743N50	100pF
C161	2113743M24	100000pF
C165	2113743N50	100pF
C166	2113743L05	330pF

Circuit Ref	Motorola Part No.	Description
C169	2113743N30	15pF
C170	2113743L05	330pF
C171	2113743L05	330pF
C172	2113743E20	0.1uF
C173	2113743M08	22000pF
C174	2113743L05	330pF
C180	NOT PLACED	
C181	NOT PLACED	
C188	2113743N50	100pF
C193	2113743M24	100000pF
C201	2113743N50	100pF
C202	2113743L17	1000pF
C203	2311049A56	4.7uF, 10V
C204	2104993J02	2.2uF
C206	2113740F63	330pF
C207	2113743N40	39pF
C208	NOT PLACED	
C210	2113743N50	100pF
C211	2113743N50	100pF
C212	2113743N50	100pF
C213	2113743N50	100pF
C214	2113743N50	100pF
C215	NOT PLACED	
C216	NOT PLACED	
C217	2104993J02	2.2uF
C218	2113743M24	100000pF
C219	2113743K16	0.22uF
C220	2113743N50	100pF
C223	2113743M24	100000pF
C224	2113743M24	100000pF
C228	2311049J11	4.7uF, 16V
C229	2113743L17	1000pF
C230	2113743N50	100pF
C231	2113743M24	100000pF
C232	2113743E12	0.047uF
C233	2311049A01	0.1uF, 35V
C234	2311049A05	0.47uF, 25V
C235	2104993J02	2.2uF
C238	2113741F17	470pF
C241	2113743N50	100pF
C242	2113743N23	7.5pF
C243	2113743N22	6.8pF
C244	2113740F13	2.7pF
C245	2113743N12	2.7pF
C246	2113743N50	100pF
C247	2113743N50	100pF
C248	2113743M24	100000pF
C250	2113743N23	7.5pF
C251	2113743N50	100pF
C252	2113743N29	13pF
C253	NOT PLACED	

Circuit Ref	Motorola Part No.	Description
C254	2113743N12	2.7pF
C255	2113743N50	100pF
C256	2113743N29	13pF
C257	2113743N50	100pF
C258	2113743L41	10000pF
C259	2113743L41	10000pF
C260	2113743N50	100pF
C263	NOT PLACED	
C264	2113743N50	100pF
C265	NOT PLACED	
C271	2113743N03	1pF
C272	2113743N03	1pF
C273	2113743M24	100000pF
C276	2104993J02	2.2uF
C277	2113743N50	100pF
C278	2311049A57	10uF
C279	2104993J02	2.2uF
C281	2113743N50	100pF
C282	NOT PLACED	
C283	NOT PLACED	
C285	2113743N50	100pF
C286	2113743M24	100000pF
C289	2113743N50	100pF
C291	2311049A69	10uF, 6.3V
C292	2113743M24	100000pF
C293	2113743A27	0.47uF
C294	2113743N50	100pF
C295	2113743N50	100pF
C296	2113743M24	100000pF
C297	2113743L41	10000pF
C298	2113743M24	100000pF
C301	2113743N24	8.2pF
C302	2113743N28	12pF
C303	2113740L11	5.1pF
C304	2113743N27	11pF
C305	2113743N28	12pF
C306	2113743N22	6.8pF
C307	2113743M24	100000pF
C308	2113743N50	100pF
C309	2113743N50	100pF
C310	2113743M24	100000pF
C311	NOT PLACED	
C312	2113743N24	8.2pF
C313	2113743N27	11pF
C314	2113743M24	100000pF
C315	2113743N50	100pF
C316	2113740L11	5.1pF
C317	2113743N27	11pF
C318	2113743N24	8.2pF
C319	2113743N21	6.2pF
C320	2113743N20	5.6pF

Circuit Ref	Motorola Part No.	Description
C321	2113743N50	100pF
C322	2113743N48	82pF
C323	2113743N54	150pF
C324	2113743N33	20pF
C325	2113743L41	10000pF
C326	2113743L41	10000pF
C327	2113743N50	100pF
C328	2113743M24	100000pF
C329	2113743M24	100000pF
C330	2113743N26	10pF
C331	2113743N50	100pF
C333	NOT PLACED	
C334	2113743M08	22000pF
C336	2113743M24	100000pF
C337	2113743N50	100pF
C338	2113743N30	15pF
C339	2180478Z20	1uF
C340	2180478Z20	1uF
C341	2180478Z20	1uF
C342	2180478Z20	1uF
C343	2113743A23	0.22uF
C344	2113743M24	100000pF
C345	2113743M24	100000pF
C346	2113743M24	100000pF
C347	2113743M24	100000pF
C348	2113743M24	100000pF
C349	2113743E07	0.022uF
C350	2113743L05	330pF
C351	2113743N33	20pF
C352	2113743N28	12pF
C353	2113743N41	43pF
C354	2113743N42	47pF
C355	2113743A24	0.33uF
C356	2113743M08	22000pF
C357	2113743A23	0.22uF
C358	2113741A23	1200pF
C359	2109720D14	0.1uF, low distortion
C360	2113743E07	0.022uF
C361	2113741F49	1000pF
C362	2113743M08	22000pF
C363	2311049A40	2.2uF, 10V
C364	2113743L41	10000pF
C370	2113743N50	100pF
C371	NOT PLACED	
C372	NOT PLACED	
C373	NOT PLACED	
C374	2113743N50	100pF
C375	2113743N50	100pF
C378	NOT PLACED	
C380	2113743L41	10000pF
C381	NOT PLACED	

Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description	Circuit Ref	Motorola Part No.	Description
C382	2311049A59	10uF, 6V	C448	2113928N01	0.1uF	CR201	4802233J09	Triple Diode (SOT-25)	L112	2462587N50	56nH
C383	2113743N50	100pF	C449	2113743N50	100pF	CR203	4862824C03	Varactor	L113	2413926H09	5.6nH
C384	2113743N44	56pF	C450	NOT PLACED		CR241	4805649Q13	Varactor	L114	2462587N45	22nH
C385	2113743N44	56pF	C451	2113743M08	22000pF	CR242	4802245J22	Varactor	L115	2462587N22	390nH
C386	2113743N50	100pF	C452	2113743B29	1uF	CR243	4802245J22	Varactor	L116	2460591C56	23.57nH
C390	2113743N50	100pF	C453	2113743N50	100pF	CR251	4862824C01	Varactor	L117	2409154M17	22nH
C391	NOT PLACED		C456	2113743N50	100pF	CR252	4862824C01	Varactor	L160	2413926H14	15nH
C395	2113743N50	100pF	C458	2113743N50	100pF	CR301	4862824C01	Varactor	L201	2462587Q20	2200nH
C396	NOT PLACED		C459	2113743N50	100pF	CR302	4862824C01	Varactor	L202	2462587Q20	2200nH
C397	2311049A07	1uF, 16V	C463	2113743N50	100pF	CR303	4880154K03	Dual Common Anode-Cathode Diode	L203	2462587Q20	2200nH
C400	2113743L41	10000pF	C466	2113743N50	100pF	CR304	4862824C01	Varactor	L232	2462587P25	12000nH
C401	2113743M24	100000pF	C467	2113928N01	0.1uF	CR305	4862824C01	Varactor	L241	2462587V41	390nH
C402	2113743M24	100000pF	C471	2113743N50	100pF	CR306	4802245J42	Ring Quad Diode (SOT-143)	L242	2462587V41	390nH
C403	2113743G24	2.2uF	C472	2113743L09	470pF	CR308	4802245J41	Pin Diode	L243	2460593C02	Rx Teflon resonator
C404	NOT PLACED		C473	2113743L09	470pF	CR310	4862824C01	Varactor	L251	2462587V37	180nH
C405	NOT PLACED		C475	2113743H14	10uF	CR411	4802245J62	Schottky Diode	L253	2460593C02	Tx Teflon resonator
C406	NOT PLACED		C476	2113928D08	10uF	CR412	4802245J62	Schottky Diode	L261	2462587V33	82nH
C407	2113928N01	0.1uF	C479	2113928N01	0.1uF	CR413	4802245J62	Schottky Diode	L271	2462587V31	56nH
C408	2113743N50	100pF	C480	2113928D08	10uF	CR440	4813833C02	Dual Common Cathode Diode	L273	2462587V29	39nH
C409	2113743M24	100000pF	C481	2113928N01	0.1uF	CR501	4880107R01	Rectifier	L281	2462587V41	390nH
C410	2113928N01	0.1uF	C482	2113928N01	0.1uF	CR503	4805729G49	Red/Yellow LED	L282	2462587V41	390nH
C411	2113743M24	100000pF	C490	2113743N50	100pF	E101	2484657R01	Inductor bead	L301	2460591D24	19.71nH
C414	2113743M24	100000pF	C491	2113743N50	100pF	E400	2480640Z01	Ferrite bead	L302	2460591D24	19.71nH
C415	2185895Z01	0.01uF, low distortion	C492	2113743N50	100pF	E401	2480640Z01	Ferrite bead	L303	2462587V28	33nH
C416	2113928N01	0.1uF	C493	2113743N50	100pF	E402	2480640Z01	Ferrite bead	L304	2462587V37	180nH
C419	NOT PLACED		C494	2113743N50	100pF	E403	2480640Z01	Ferrite bead	L305	2462587V23	12nH
C420	2113743L41	10000pF	C495	2113743N50	100pF	E404	2480640Z01	Ferrite bead	L306	2460591D24	19.71nH
C421	2113928N01	0.1uF	C496	2113743N50	100pF	E405	2480640Z01	Ferrite bead	L307	2460591D24	19.71nH
C422	2113743M24	100000pF	C497	2113743N50	100pF	E406	2480640Z01	Ferrite bead	L309	2479990C02	16.28nH
C423	2113743N50	100pF	C502	2311049A05	0.47uF, 25V	E407	2480640Z01	Ferrite bead	L310	2462587V36	150nH
C424	2311049A59	10uF, 6V	C503	2113743N50	100pF	E408	2480640Z01	Ferrite bead	L311	2462587N65	750nH
C425	2113743M24	100000pF	C505	2113743N50	100pF	E409	2480640Z01	Ferrite bead	L314	2462587N72	2200nH
C426	2113743N50	100pF	C511	2113743N50	100pF	F501	6580542Z01	3A Fuse	L321	NOT PLACED	
C427	2113743N50	100pF	C512	2113743N50	100pF	FL201	4805875Z04	16.8MHz Reference Oscillator	L325	2480646Z20	2.2uH
C428	2113743M24	100000pF	C513	2113743N50	100pF	FL301	9186153B01	45.1MHz Crystal Filter	L330	2462587N64	680nH
C429	2113743M24	100000pF	C514	2113743N50	100pF	FL401	4870368G02	Real Time Clock Crystal Oscillator (not used in GP328)	L331	2480646Z20	2.2uH
C430	2113928N01	0.1uF	C520	2113743L41	10000pF	H101	2680499Z01	Heat Spreader	L332	2462587N53	100nH
C431	2113743N50	100pF	C521	2113743L41	10000pF	J101	0985613Z01	RF Jack	L340	2462587V41	390nH
C432	NOT PLACED		C522	2113743L41	10000pF	J102	0280519Z02	Antenna Nut	L400	2462587Q42	390nH
C433	2113743L41	10000pF	C523	2113743L41	10000pF	J400	0905505Y04	40-pin connector	L401	2462587Q42	390nH
C434	2113928N01	0.1uF (not used in GP328)	C524	2113743N50	100pF	J403	0905505Y02	20-pin connector	L410	2462587Q42	390nH
C435	2113743M24	100000pF	C525	2113743N50	100pF	L101	2479990B02	19.61nH	L411	2462587Q42	390nH
C436	2113743N34	22pF (not used in GP328)	C526	2113743N50	100pF	L102	2479990B02	19.61nH	L505	2462587Q42	390nH
C437	2113743N34	22pF (not used in GP328)	C527	2113743N50	100pF	L104	2479990B02	19.61nH	P100	3905643V01	Ground Contact Finger
C440	2113743G26	4.7uF	C528	2113743N50	100pF	L105	2462587N22	390nH	PB501	4080523Z01	Tactile Switch
C441	2113743N50	100pF	C529	NOT PLACED		L106	2479990A02	7.66nH	PB502	4080523Z01	Tactile Switch
C442	2113743E20	0.1uF	CR101	4880973Z02	Pin Diode	L107	2479990G01	33.47nH	PB503	4080523Z01	Tactile Switch
C443	2113928N01	0.1uF	CR102	4802245J41	Pin Diode	L108	0611077A01	Resistor Jumper	PB504	4080523Z01	Tactile Switch
C444	2113743N50	100pF	CR103	4802245J41	Pin Diode	L109	2479990B01	11.03nH	PB505	4080523Z01	Tactile Switch
C445	2113743N50	100pF	CR105	5185963A15	Temperature Sensor				Q110	4813828A09	RF Power Amplifier
C447	2113743M08	22000pF	CR160	NOT PLACED					Q111	4809939C05	NPN/PNP Dual Transistor

Circuit Ref	Motorola Part No.	Description
Q210	4809939C05	NPN/PNP Dual Transistor
Q241	4805218N63	RF NPN Transistor
Q260	4809939C05	NPN/PNP Dual Transistor
Q261	4809939C05	NPN/PNP Dual Transistor
Q301	4802245J44	NPN Transistor
Q302	4802245J44	NPN Transistor
Q310	NOT PLACED	
Q315	4880214G02	NPN Transistor
Q316	NOT PLACED	
Q320	4805218N63	RF NPN Transistor
Q400	4809579E18	P-chan MOSFET
Q403	4813824A17	PNP Transistor
Q405	4802245J54	Dual NPN Transistor
Q410	4802245J54	Dual NPN Transistor
Q416	4809579E18	P-chan MOSFET (not used in GP328)
Q417	4809939C05	NPN/PNP Dual Transistor
Q502	5180159R01	Dual NPN Transistor
Q505	4880214G02	NPN Transistor
R101	0662057A34	240
R102	0680539Z01	0.1
R104	0662057N15	47k
R106	0662057M26	10
R107	NOT PLACED	
R108	0662057M92	5600
R109	0662057N30	200k
R110	0662057M61	300
R111	0662057M33	20
R112	0662057M61	300
R120	0662057N14	43k
R130	0662057M98	10k
R131	0662057N05	18k
R132	0662057N33	270k
R133	NOT PLACED	
R136	0662057N47	1M
R161	0662057M57	200
R170	0662057A34	240
R171	0662057N14	43k
R172	0662057A32	200
R173	0662057N29	180k
R174	0662057N15	47k
R175	0662057B47	0
R193	0662057M57	200
R201	0662057N21	82k
R202	0662057N23	100k
R204	0662057N15	47k
R205	NOT PLACED	
R206	NOT PLACED	
R231	0662057M52	120
R232	0662057M69	620
R233	0662057M68	560

Circuit Ref	Motorola Part No.	Description
R241	0662057M33	20
R242	0662057M56	180
R243	0662057M98	10k
R244	0662057N01	12k
R245	0662057M59	240
R248	0662057M37	30
R251	0662057M34	22
R252	0662057M57	200
R253	0662057N03	15k
R254	0662057M92	5600
R255	0662057M89	4300
R256	0662057M37	30
R260	0662057M74	1000
R281	NOT PLACED	
R300	0662057M82	2200
R301	0662057N23	100k
R302	0662057N23	100k
R303	0662057M74	1000
R304	0662057N01	12k
R305	0662057M66	470
R306	0662057N23	100k
R307	0662057N23	100k
R308	0662057M60	270
R309	0662057M32	18
R310	2113743N23	7.5pF
R311	0662057N10	30k
R312	0662057M83	2400
R313	0662057M62	330
R314	0662057M85	3000
R315	0662057N01	12k
R316	0662057A96	91k
R317	0662057M74	1000
R318	0662057A79	18k
R319	0662057A29	150
R320	0662057M74	1000
R321	0662057M83	2400
R322	0662057N30	200k
R324	0662057M81	2000
R325	0662057M94	6800
R326	NOT PLACED	
R327	0662057N11	33k
R328	0662057M12	2.7
R329	0662057M01	0
R330	NOT PLACED	
R331	NOT PLACED	
R332	NOT PLACED	
R333	NOT PLACED	
R334	NOT PLACED	
R335	NOT PLACED	
R336	NOT PLACED	
R338	NOT PLACED	

Circuit Ref	Motorola Part No.	Description
R339	0662057M01	0
R340	0662057M96	8200
R342	0662057N23	100k
R343	0662057M26	10
R344	0662057N01	12k
R345	0662057M98	10k
R346	0662057N17	56k
R347	0662057M74	1000
R348	0662057M87	3600
R349	0662057C01	0
R350	0662057N23	100k
R351	0662057C01	0
R352	0662057M86	3300
R355	0662057M01	0
R400	0662057N15	47k
R401	0662057M01	0
R402	NOT PLACED	
R403	NOT PLACED	
R405	0662057M01	0
R406	0662057N20	75k
R407	0662057N19	68k
R408	NOT PLACED	
R409	0662057M98	10k
R410	0662057N23	100k
R411	0662057M98	10k
R413	0662057M01	0
R414	0662057V34	180k, 1%
R415	0662057V26	91k, 1%
R416	0662057M98	10k
R418	0662057M01	0
R419	0662057M67	510 (not used in GP328)
R420	0662057B46	10M (not used in GP328)
R421	0662057M81	2000
R423	0662057N39	470k
R424	0662057N12	36k
R425	0662057N10	30k
R426	0662057N35	330k (not used in GP328)
R427	0662057M84	2700
R428	0662057M10	2.2
R429	0662057M98	10k
R431	0662057N39	470k
R432	0662057N16	51k
R434	0662057M62	330
R435	0662057M81	2000
R436	0662057M01	0
R437	NOT PLACED	
R445	0662057N08	24k
R447	0662057N23	100k
R448	0662057M98	10k
R449	0662057N08	24k
R450	0683962T45	68, 1W

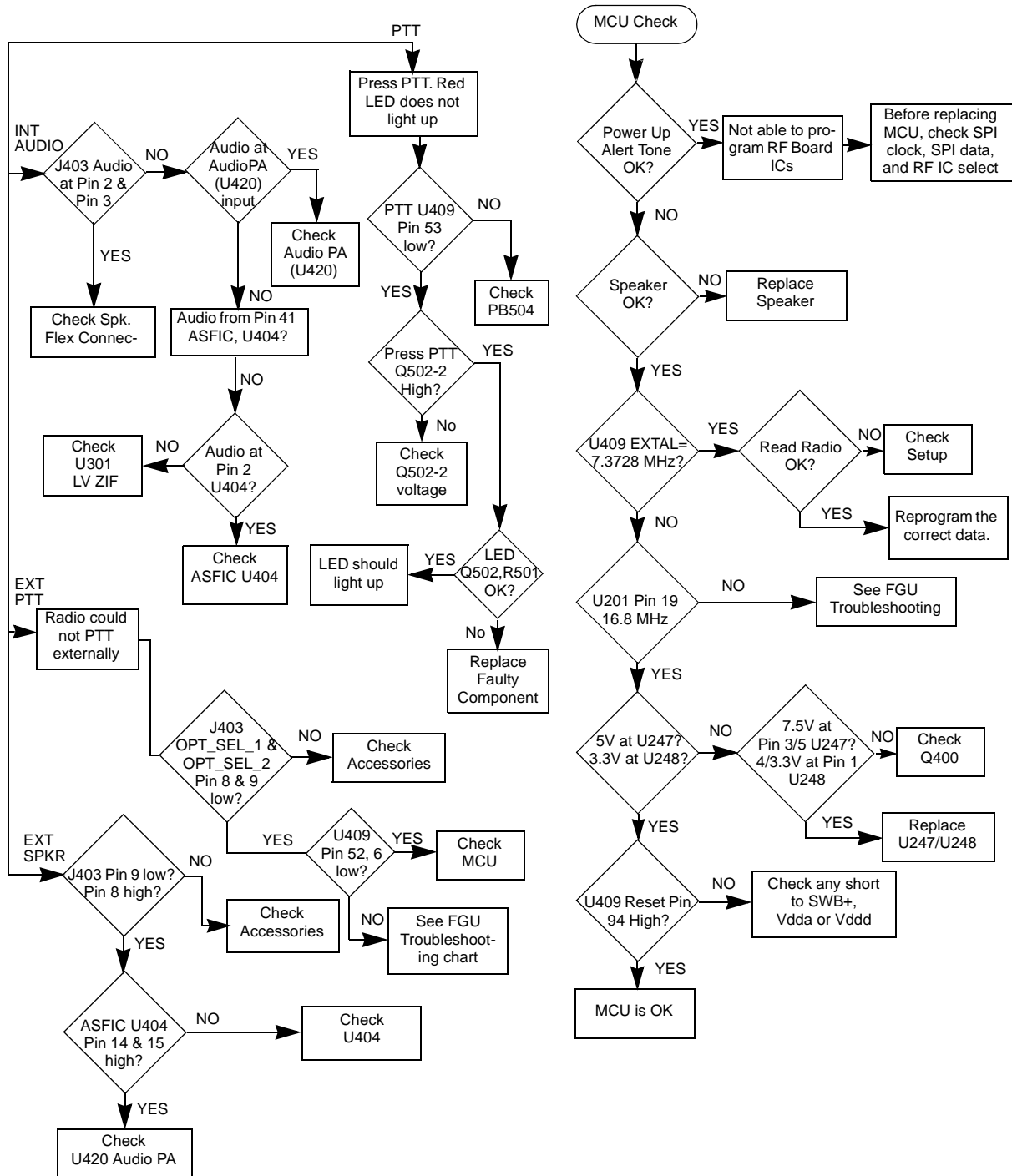
Circuit Ref	Motorola Part No.	Description
R451	0662057N03	15k
R452	0662057N23	100k
R453	NOT PLACED	
R454	NOT PLACED	
R455	NOT PLACED	
R456	0662057M01	0
R457	0662057M98	10k
R460	0662057M90	4700
R461	0662057M56	180 (not used in GP328)
R462	0662057M98	10k (not used in GP328)
R463	0662057M61	300
R471	0662057N06	20k
R472	0662057N12	36k
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N35	330k
R477	0662057M74	1000
R478	0662057M98	10k
R481	0662057N08	24k
R492	0662057M01	0
R501	0662057M70	680
R502	0662057M56	180
R505	0662057M98	10k
R506	0662057N15	47k
R507	0662057M01	0
RT300	0680590Z01	THERMISTOR_33K
RT301	NOT PLACED	
RT400	0680590Z01	THERMISTOR_33K
S501	4080710Z01	Frequency Knob
S502	1880619Z02	Volume/on-off Switch
SH100	2680507Z01	Harmonic Filter Shield
SH101	2680510Z01	RF PA Shield
SH201	2680511Z01	Synthesizer Top Shield
SH202	2680511Z01	Synthesizer Bottom Shield
SH241	2680513Z01	VCO Top Shield
SH242	2680514Z01	VCO Bottom Shield
SH301	2680554Z01	Receiver Front End Top Shield
SH302	2680555Z01	Receiver Front End Bottom Shield
SH303	2680509Z01	Mixer Shield
SH304	2680624Z01	Mixer Diode Shield
SH321	2680508Z01	LVZIF 2nd LO Shield
SH322	2680514Z01	LVZIF Shield
SH323	2680553Z01	Crystal Filter Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller On-off Shield
SH402	2680515Z01	Microprocessor Shield
SH403	2680516Z01	Asfic_Cmp/Audio PA Shield
T301	2580541Z02	Balun Transformer
T302	2580541Z02	Balun Transformer

Circuit Ref	Motorola Part No.	Description
U101	5185130C65	LDMOS Driver IC
U102	5185765B26	PCIC
U201	5185963A27	LVFRACN Synthesizer IC
U210	5102463J61	Inverter
U211	5102463J61	Inverter
U241	5105750U54	VCO Buffer IC
U247	5105739X05	5V Regulator
U248	5102463J58	3.3V Regulator
U301	5109632D83	LVZIF IC
U400	5102463J40	3.3V Regulator
U404	5185130C53	Asfic_CMP IC
U406	*5102463J59	Flash ROM 128K x 8
U407	*5102463J64	EEPROM 16K x 8
U409	5102226J56	Microprocessor
U410	5102463J57	3.3V Regulator (not used in GP328)
U420	5102463J44	Audio Amplifier
VR300	NOT PLACED	
VR432	4805656W08	Quad Zener Diode
VR433	4805656W08	Quad Zener Diode
VR434	4802245J73	Zener Diode - 6.8V
VR439	4880140L17	Zener Diode - 12V
VR440	4802245J73	Zener Diode - 6.8V
VR441	4802245J73	Zener Diode - 6.8V
VR442	4802245J73	Zener Diode - 6.8V
VR443	4802245J73	Zener Diode - 6.8V
VR444	4802245J73	Zener Diode - 6.8V
VR445	4802245J74	Zener Diode - 10V
VR446	4802245J74	Zener Diode - 10V
VR447	4802245J74	Zener Diode - 10V
VR448	4802245J74	Zener Diode - 10V
VR449	4802245J74	Zener Diode - 10V
VR450	4802245J75	Zener Diode - 12V
VR460	4802245J73	Zener Diode - 6.8V
VR501	4813830A18	Zener Diode - 6.8V
VR506	4802245J73	Zener Diode - 6.8V
Y201	NOT PLACED	
	8485726Z04	UHF Band 3 Main PCB

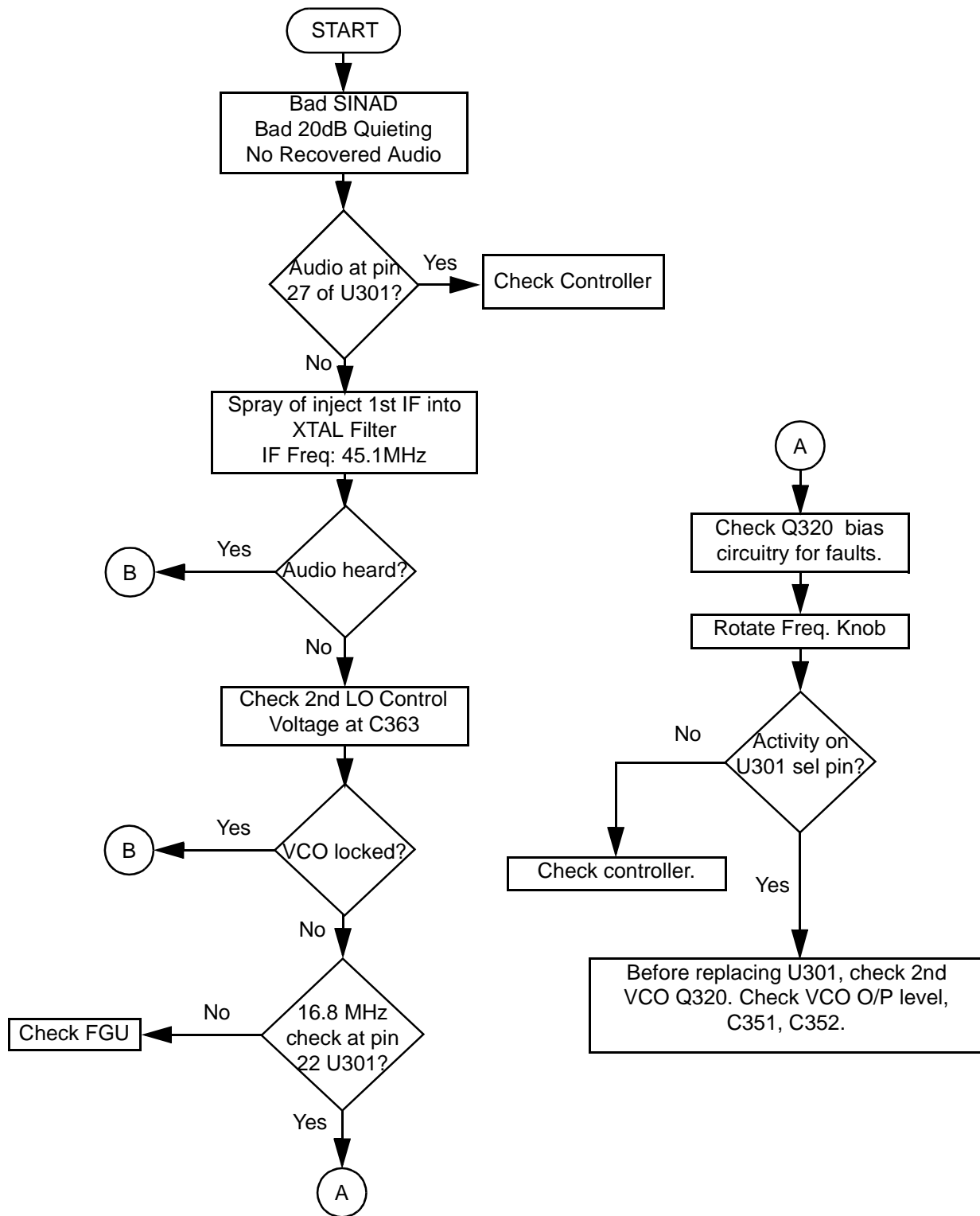
\* Motorola Depot Servicing only



## 9.0 Troubleshooting charts

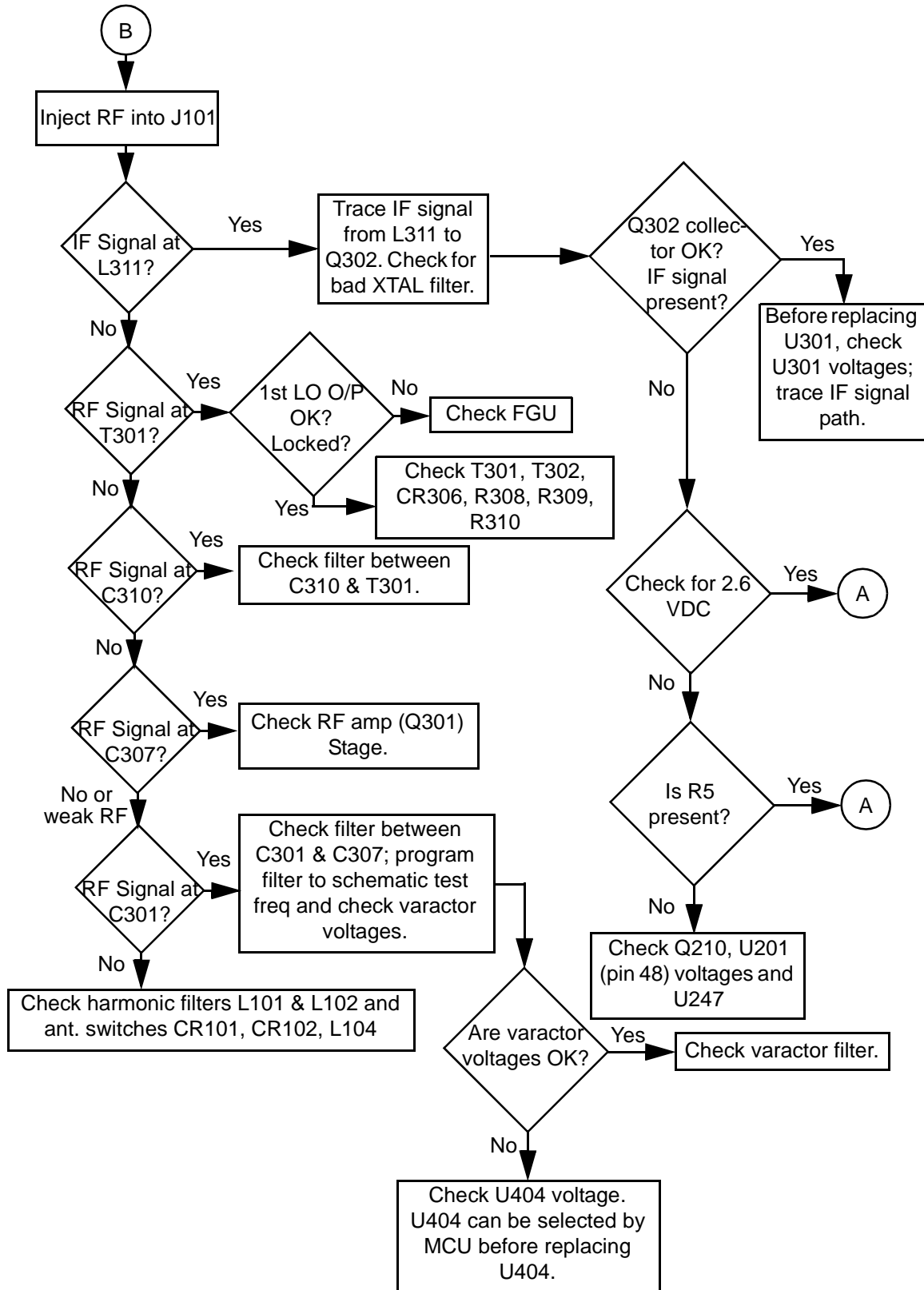


**Troubleshooting Flow Chart for Controller**

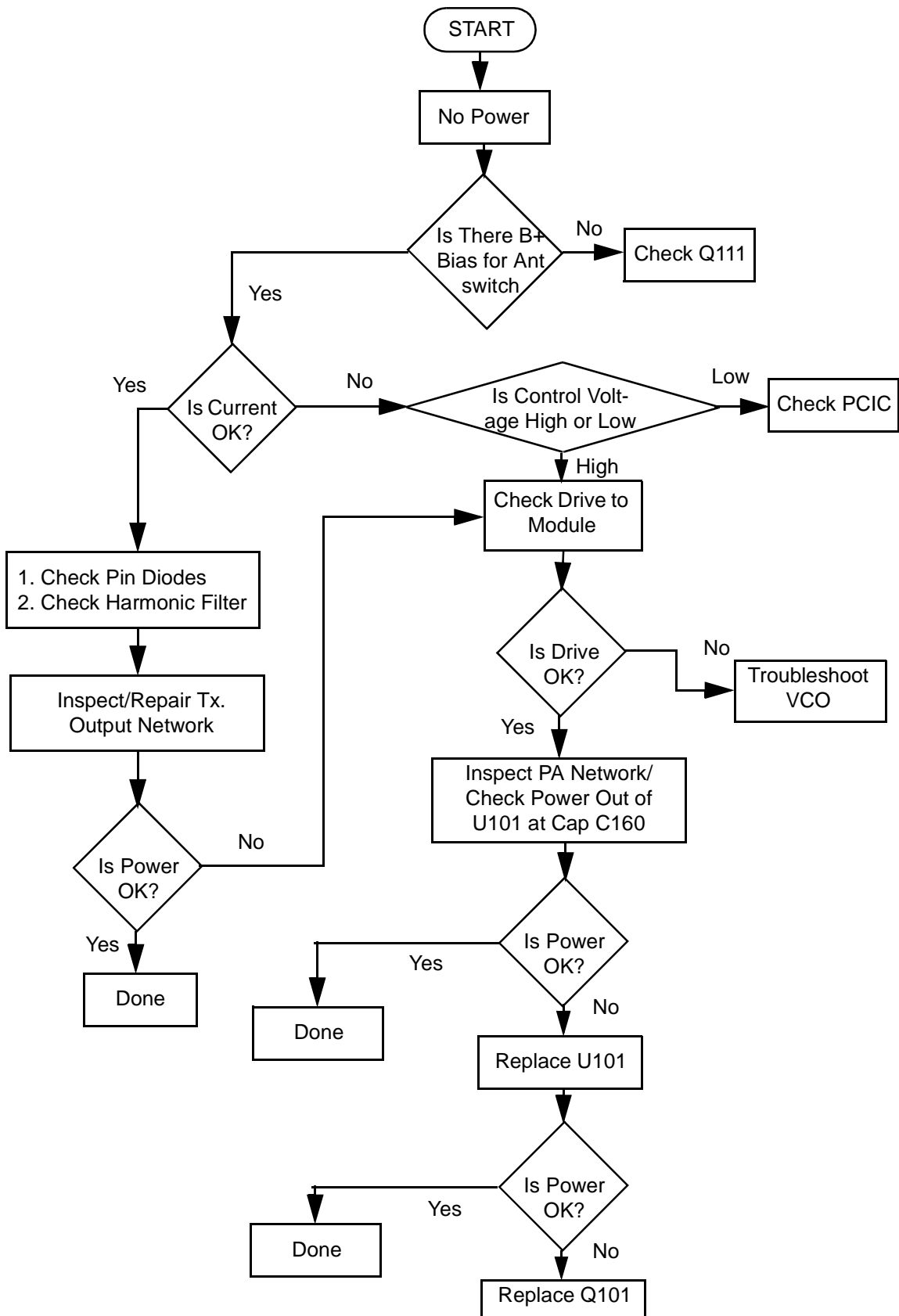


**Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)**

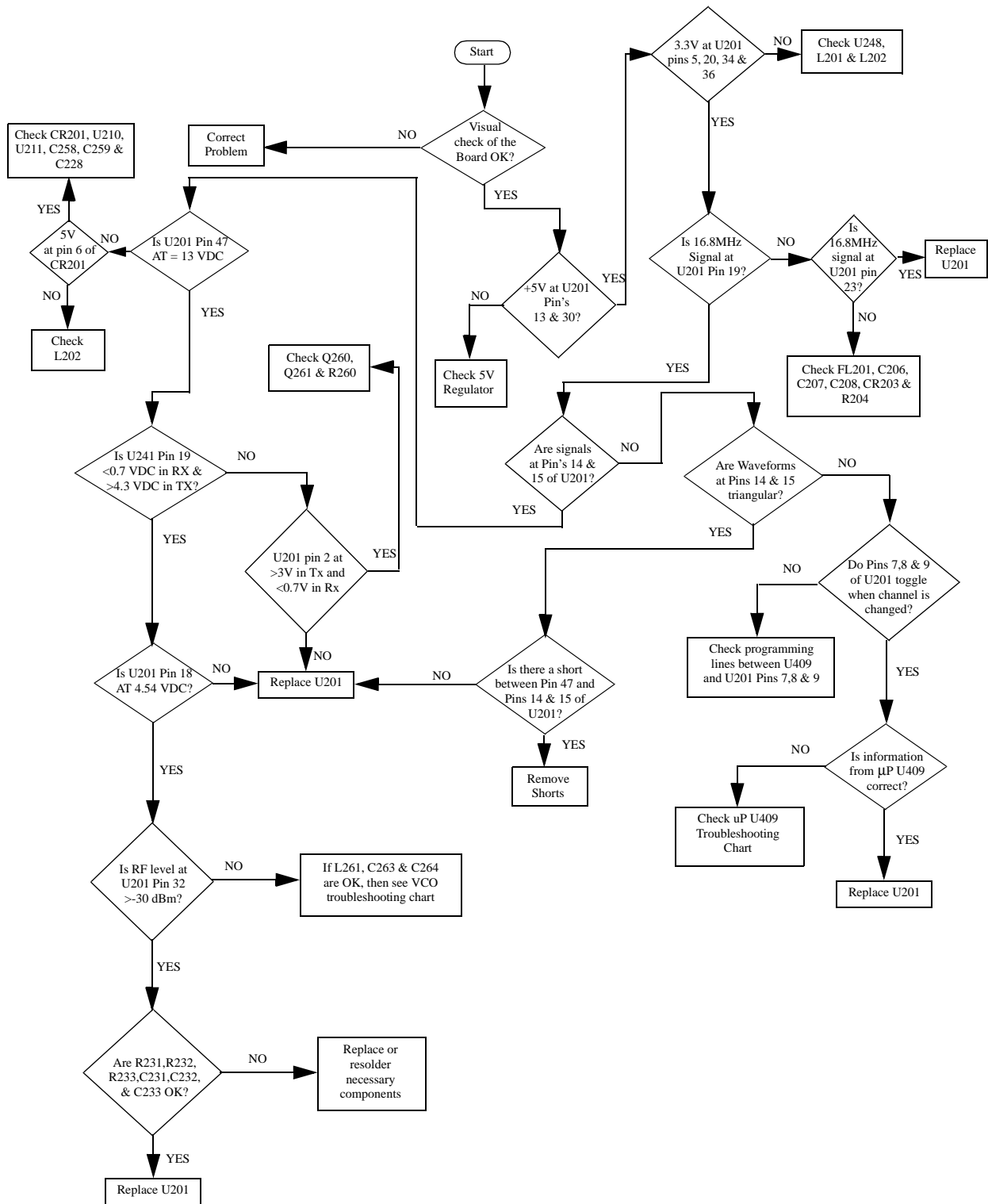




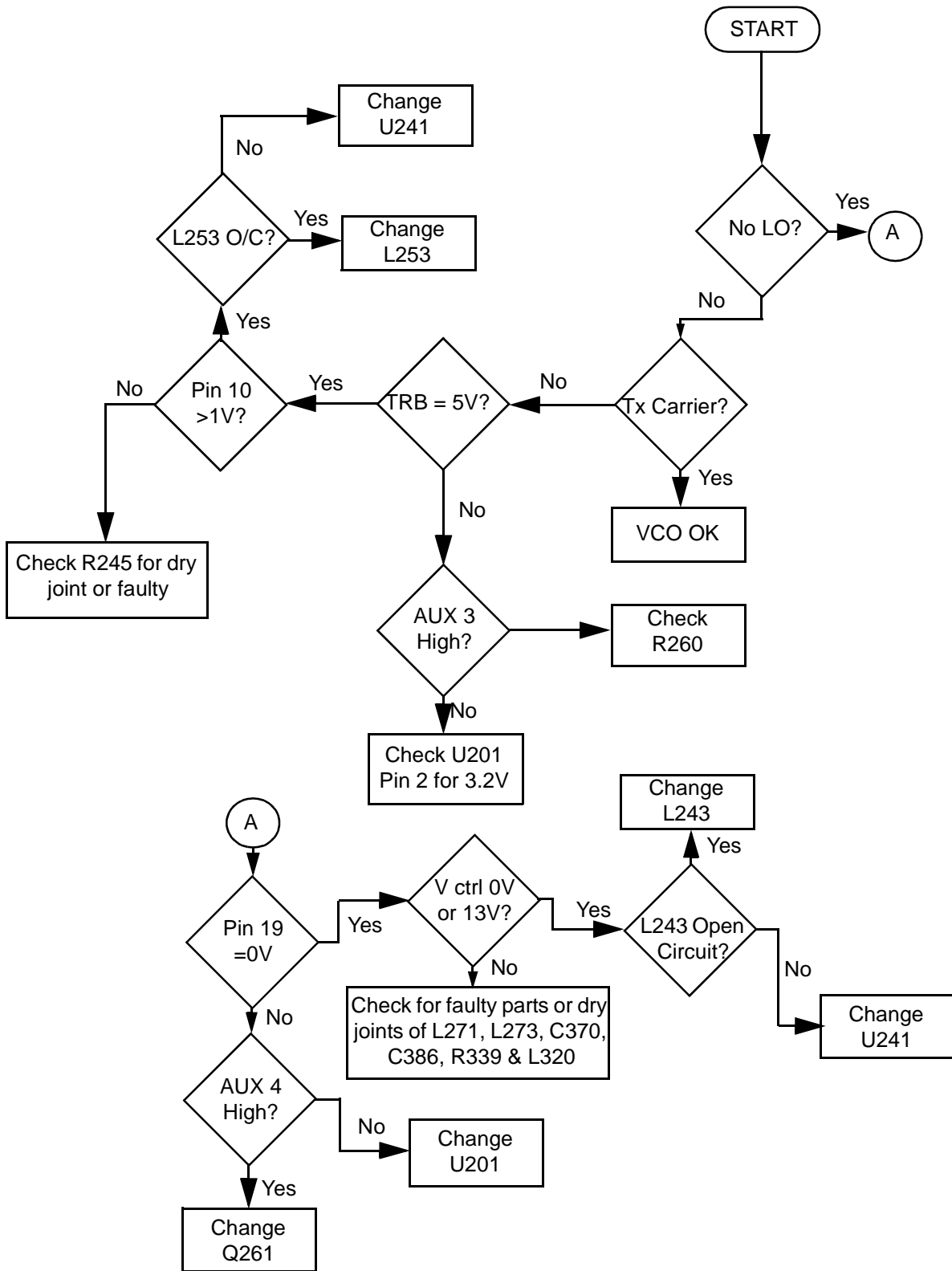
**Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)**



**Troubleshooting Flow Chart for Transmitter**



**Troubleshooting Flow Chart for Synthesizer**



**Troubleshooting Flow Chart for VCO**

## Section 6E

# MODEL CHARTS AND TEST SPECIFICATIONS (29-42/35-50MHZ)

### 1.0 Model Charts

#### 1.1 29-42MHz

<b>GP Series, LB1, 29-42 MHz</b>			
<b>Model</b>		<b>Description</b>	
AZH25BEC9AA3		GP328 29-42 MHz 6W 16CH	
AZH25BEH9AA6		GP338 29-42 MHz 6W 128CH	
	<b>Item</b>	<b>Description</b>	
X	PMUB1011	GP328 Super Tanapa 29-42 MHz 6W	
	X PMUB1013	GP338 Super Tanapa 29-42 MHz 6W	
X	PMUB1018	GP328 Tanapa 29-42 MHz 6W	
	X PMUB1020	GP338 Tanapa 29-42 MHz 6W	
X	PMLB4002	GP328 B/C Kit 29-42 MHz 6W	
	X PMLB4004	GP338 B/C Kit 29-42 MHz 6W	
X	PMLN4216	GP328 Front Housing Kit	
	X PMLN4199	GP338 Front Housing Kit	
X	X NAB6064A	Low/Mid Band Heliflex Antenna Trimmable	
X	6804110J54	GP328 User Guide	
	X 6804110J55	GP338 User Guide	

x = Indicates one of each is required.

## 1.2 35-50MHz

<b>GP Series, LB2, 35-50 MHz</b>		
<b>Model</b>	<b>Description</b>	
AZH25CEC9AA3	GP328 35-50 MHz 6W 16CH	
	AZH25CEH9AA6	GP338 35-50 MHz 6W 128CH
	<b>Item</b>	<b>Description</b>
X	PMUB1026	GP328 Super Tanapa 35-50 MHz 6W
	X PMUB1023	GP338 Super Tanapa 35-50 MHz 6W
X	PMUB1033	GP328 Tanapa 35-50 MHz 6W
	X PMUB1030	GP338 Tanapa 35-50 MHz 6W
X	PMLB4010	GP328 B/C Kit 35-50 MHz 6W
	X PMLB4007	GP338 B/C Kit 35-50 MHz 6W
X	PMLN4216	GP328 Front Housing Kit
	X PMLN4199	GP338 Front Housing Kit
X	X NAB6064A	Low/Mid Band Heliflex Antenna Trimmable
X	6804110J54	GP328 User Guide
	X 6804110J55	GP338 User Guide

x = Indicates one of each is required.

<b>GP Series, LB2, 35-50 MHz</b>		
<b>Model</b>	<b>Description</b>	
AZH25CEC9AA3 with option AZQ203AL	GP328 35-50 MHz 6W (w/o keypad camouflage)	
	AZH25CEH9AA6 with option AZQ203AM	GP338 35-50 MHz 6W (keypad, camouflage)
	<b>Item</b>	<b>Description</b>
X	PMUB1051_	GP328 Super Tanapa 35-50 MHz 6W
	X PMUB1049_	GP338 Super Tanapa 35-50 MHz 6W
X	PMUB1052_	GP328 Tanapa 35-50 MHz 6W
	X PMUB1050	GP338 Tanapa 35-50 MHz 6W
X	PMLB4010_	GP328 B/C Kit 35-50 MHz 6W
	X PMLB4007_	GP338 B/C Kit 35-50 MHz 6W
X	PMLN4539_	GP328 Front Housing Kit
	X PMLN4538_	GP338 Front Housing Kit
X	X NAB6064_	Low/Mid Band Heliflex Antenna Trimmable
X	6804110J54	GP328 User Guide
	X 6804110J55	GP338 User Guide

x = Indicates one of each is required.

## 2.0 Specifications

### General

	Lowband	
Frequency:	29-42 MHz 35-50 MHz	
Channel Capacity:	GP328 : 16 Channels GP338 : 128 Channels	
Power Supply:	7.5 Volts $\pm$ 20%	
Dimensions with Standard High Capacity NiMH Battery:	137mm x 57.5mm x 37.5mm	
with Ultra High Capacity NiMH Bat- tery:	137mm x 57.5mm x 40mm	
Weight: with Standard High Capacity NiMH Battery:	420 g	
with Ultra High Capacity NiMH Bat- tery:	500 g	
Average Battery Life @ (5-5-90 Duty Cycle) Standard High Capacity NiMH Bat- tery:	Low Pow- er	High Pow- er
Ultra High Capac- ity NiMH Battery:	>11 hrs	>8 hrs
	>14 hrs	>11 hrs
Sealing:	Passes rain testing per IP54	
Shock:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Vibration:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
Dust:	Meets MIL-STD-810- C,D & E and IP54	
Humidity:	Meets MIL-STD-810- C,D & E and TIA/EIA 603	
FCC ID	AZ489FT1625	

### Transmitter

	Lowband	
RF Output NiMH @ 7.5V:	Low 1W	High 6W
Frequency	29-42 MHz 35-50 MHz	
Channel Spacing	12.5/20/25 kHz	
Freq. Stability (-30°C to +60°C)	0.0010%	
Spurs/Harmonics:	-36 dBm < 1 GHz -30 dBm > 1 GHz	
Audio Response: (from 6 dB/oct. Pre- Emphasis, 300 to 3000Hz)	+1, -3 dB	
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<5%	
FM Noise:	-40 dB	

### Receiver

	Lowband 12.5kHz	Lowband 20/25kHz
Frequency:	29-42MHz 35-50MHz	29-42MHz 35-50MHz
Sensitivity 12dB EIA SINAD:	0.35 $\mu$ V	0.35 $\mu$ V
Adjacent Channel Selectivity ETS	-60 dB	-70 dB
Intermodulation ETS	-65 dB	-65 dB
Freq. Stability (-30°C to +60°C):	0.0010%	0.0010%
Spur Rejection:	-70 dB	-70 dB
Image Rejection:	-70 dB	-70 dB
Audio Output @ <5% Distortion	500 mW	500 mW

All specifications are subject to change without notice.

## 3.0 Transmitter

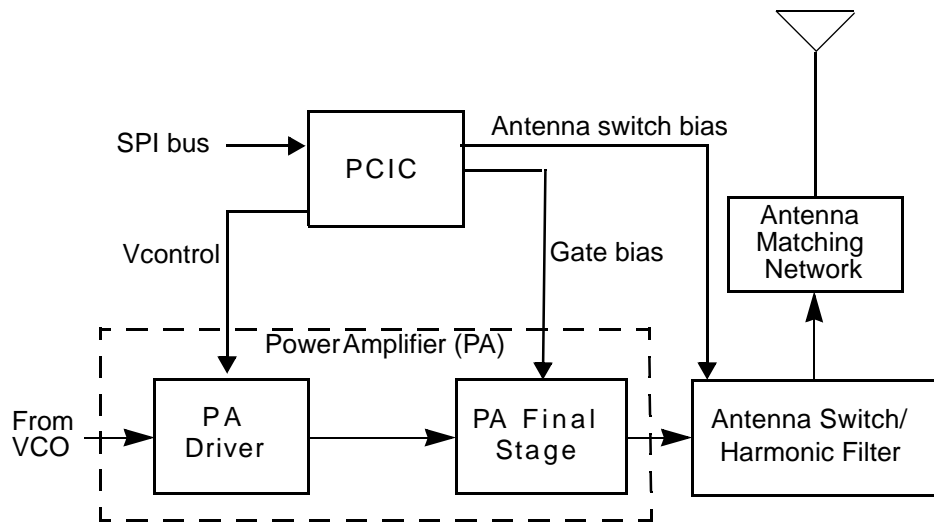


Figure 6-1: Lowband Transmitter Block Diagram

### 3.1 General

(Refer to Figure 6-1)

The Lowband transmitter consists of the following basic circuits:

1. power amplifier (PA)
2. antenna switch
3. harmonic filter
4. antenna matching network
5. power control integrated circuit (PCIC).

#### 3.1.1 Power Amplifier

The power amplifier consists of two LDMOS devices:

1. PA driver, U101 and
2. PA final stage, Q100.

The LDMOS driver (U101) provides 2-stage amplification using a supply voltage of 7.3V. The amplifier is capable of supplying an output power of 0.3W (pins 6 and 7) with an input signal of 2mW at (pin16). The current drain is typically 120mA while operating in the frequency range of 29.7 - 50 MHz. The power output of this stage is varied by the power control loop which controls the voltage on pin 1.

The LDMOS PA is capable of supplying an output power of 8W with an input signal of 0.3W. The current drain is typically 2000 mA while operating in the frequency range of 29.7 - 50 MHz. The final stage gate is bias by a voltage from PCIC pin 24. This voltage is the output of a programmable DAC inside the PCIC and the output is adjustable with the radio tuner.



### 3.1.2 Antenna Switch

The antenna switch circuit consists of two pin diodes (D100 and D101), a RF network (C147 and L103), and a DC feed network (L104, C144 and current limiting resistor R101). In the transmit mode, PCIC (U102) pin 32 goes high supplying current via the feed network to bias the diodes "on". The shunt diode (D101) shorts out the receiver port and L103 is connected from the RF path to ground. L103 and the input capacitance of the lowpass filter form a parallel resonant circuit, effectively disconnecting the receiver port from the antenna while not loading the transmit path. In the receive mode, pin 32 goes low and the diodes are off. D100 looks like a high impedance disconnecting the transmitter from the antenna while L103 and C147 form a series resonant circuit to connect the receiver to the antenna.

### 3.1.3 Harmonic Filter

The harmonic filter consists of components C103, C106, C107, C110, C111, C114, C115 and 3 inductors which are a part of the SH100 assembly. The harmonic filter for lowband is pole zero design which give greater attenuation lower in frequency where the harmonic energy of the transmitter is the greatest and less attenuation high in frequency where there is less harmonic energy. The harmonic filter insertion loss is typically less than 0.8 dB

### 3.1.4 Antenna Matching Network

The antenna matching network (T100) matches the antenna's impedance with the harmonic filter to optimize the performance of the transmitter and receiver.

### 3.1.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the PCIC (U102) to regulate the power output of the radio. To accomplish this, the voltage across R102 is sensed. This voltage drop is directly proportional to the current drawn in the final stage of the transmitter. This voltage is compared to a programmable reference inside the PCIC and the voltage on PCIC pin 4 adjusted. Pin 4 connects to the PA driver IC (U101) pin 1 via resistor R100 and varies RF output power of the driver. This controls the current drain of the final stage and sets the output power.

### 3.1.6 Temperature Cut Back Circuit

Temperature sensor VR101 and associated components are part of a temperature cut back circuit. This circuit senses the printed circuit board temperature around the transmitter circuits and outputs a DC voltage to the PCIC. If the DC voltage produced exceeds the set threshold of the PCIC, the transmitter output power decreases to reduce the transmitter temperature.

## 4.0 Receiver

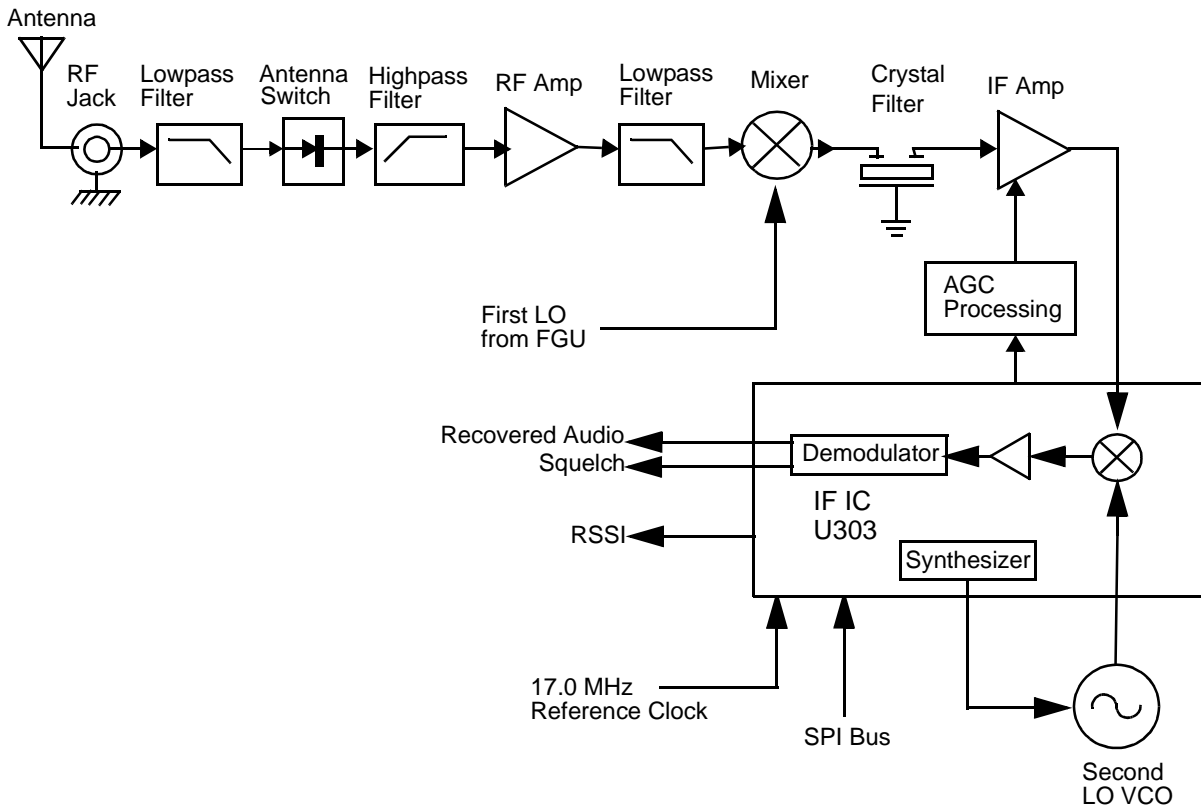


Figure 6-2: Lowband Receiver Block Diagram

### 4.1 Receiver Front-End

The RF signal received by the antenna is routed through the transmitter lowpass filter and antenna switch. These circuits are described in the transmitter section. The signal next passes through a highpass filter consisting of L501, L502, C538, C533 and C504. This filter serves to reject below band signals and has a 3 dB corner frequency of 27 MHz.

The output of the highpass filter is connected to an RF amp consisting of Q509 and associated biasing components. This is a BJT amplifier powered off 5 volts and has 13 dB of gain. The amplifier drives a lowpass filter consisting of L503, L504, L507, C534, C535, C536, C537 and C515. This filter is a pole zero design that filters off harmonic components from the RF amp. The 3 dB corner of this filter is at 56 MHz.

The output of the lowpass filter is connected to the passive double balanced mixer consisting of components T501, T502, and D501. After mixing with the first local oscillator up-converted to a 109.65 MHz IF signal.

The IF signal coming out of the mixer is transferred to the crystal filter (FL301) through a resistor pad (R507, R508 and R509) and a diplexer (C516 and L508). Matching to the input of the crystal filter is provided by L301, L302, C301 and C302. The 3 pole crystal filter provides the necessary selectivity and intermodulation protection.

## 4.2 Receiver Back-End

The output of crystal filter FL301 is connected to the input of IF amplifier transistor U301. Components L303 and C348 and R301 form the termination for the crystal filter and the signal is coupled to one gate of U301 by C303. The IF amplifier is a dual gate MOSFET powered off of the 5 volt supply. The first gate receives the IF signal as indicated previously. The second gate receives a DC voltage from U302 which serves as an AGC control signal. This signal reduces the gain of the IF amplifier to prevent overload of the IF IC, U303. The gain can be varied from a maximum of 13 dB to an attenuation of 55 dB. The output IF signal from U301 is coupled into U303 (pin 3) via C306, R304 and L304 which provides matching for the IF amplifier and U303.

The IF signal applied to pin 3 of U303 is amplified, down-converted, filtered, and demodulated, to produce recovered audio at pin 27 of U303. This IF IC is electronically programmable, and the amount of filtering, which is dependent on the radio channel spacing, is controlled by the microprocessor. Additional filtering, once externally provided by the conventional ceramic filters, is replaced by internal filters in IF IC U303.

The IF IC uses a type of direct conversion process, whereby the externally generated second LO frequency is divided by two in U303 so that it is very close to the first IF frequency. The IF IC (U303) synthesizes the second LO and phase-locks the VCO to track the first IF frequency. The second LO is designed to oscillate at twice the first IF frequency because of the divide-by-two function in the IF IC.

In the absence of an IF signal, the VCO searches for a frequency, or its frequency will vary close to twice the IF frequency. When an IF signal is received, the VCO locks onto the IF signal. The second LO/VCO is a Colpitts oscillator built around transistor Q301. The VCO has a varactor diode, CR301, to adjust the VCO frequency. The control signal for the varactor is derived from a loop filter consisting of components C308, C309, and R310.

The IF IC (U303) also performs several other functions. It provides a received signal-strength indicator (RSSI) and a squelch output. The RSSI voltage is also used to control the automatic gain control (AGC) circuit at the back end.

The demodulated signal on pin 27 of U303 is also used for squelch control. The signal is routed to U404 (ASFIC) where squelch signal shaping and detection takes place. The demodulated audio signal is also routed to U404 for processing before going to the audio amplifier for amplification.

## 4.3 Automatic Gain Control Circuit

The automatic gain control circuit provides automatic reduction of gain to prevent overloading of backend circuits. This is achieved by lowering the voltage on one gate of U301 which will reduce the drain current in that part and lower its gain.

The Radio Signal Strength Indicator (RSSI) voltage signal for the IF IC (U303) is used to drive the AGC processing circuitry consisting of R306, R307, R308, R309, C307 and U302. As the received signal gets stronger, the RSSI line will rise. When the RSSI line passes a certain threshold, the voltage at the output of U302 will begin to drop. This voltage is connected to one gate of IF amplifier U301 through resistor R305. As this voltage decreases, it will lower the drain current in U301 and reduce the gain of the stage. This will limit the power incident on the IF IC, U303.

## 5.0 Frequency Generation Circuitry

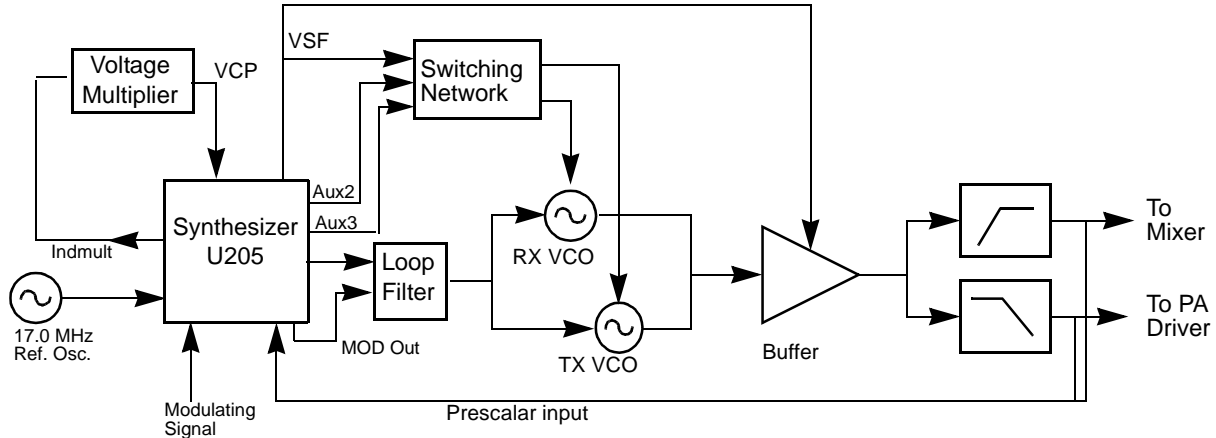


Figure 6-3: Lowband Frequency Generation Unit Block Diagram

The frequency generation circuit, shown in Figure 6-3, is composed of Low Voltage Fractional-N synthesizer U205 and discrete RX VCO, TX VCO and buffers as well as other supporting circuitry. The synthesizer block diagram illustrates the interconnect and support circuitry used in the region. Refer to the schematic for the reference designators.

The synthesizer is powered by regulated 5V and 3.3V. The 5 volt signal to the synthesizer as well as the rest of the radio is provided by U204. The 3.3 v signal is provided from U400 in the controller. The 5V signal goes to pins 13 and 30 while the 3.3V signal goes to pins 5, 20, 34 and 36 of U201. The synthesizer in turn generates a superfiltered 4.3V which powers the VCOs and buffers.

In addition to the VCO, the synthesizer also interfaces with the logic and ASFIC circuitry. Programming for the synthesizer is accomplished through the data, clock and chip select lines (pins 7, 8 and 9) from the microprocessor, U409. A 3.3V dc signal from pin 4 indicates to the microprocessor that the synthesizer is locked.

Transmit modulation from the ASFIC is supplied to pin 10 of U205. Internally the audio is digitized by the Fractional-N and applied to the loop divider to provide the low-port modulation. The audio runs through an internal attenuator for modulation balancing purposes before going out at pin 41 to the VCO.

### 5.1 Synthesizer

The Fractional-N synthesizer, shown in Figure 6-4, uses a 17.0 MHz crystal (Y201) to provide a reference for the system. Along with being used in the LVFracN, the 17.0 MHz signal is provided at pin 19 of U205 for use by the ASFIC and LVZIF.

The LVFracN IC (U205) further divides this by 8 internally to give 2.125 MHz to be used as the reference frequency in the frequency synthesis. While UHF and VHF can use other references, (divide by 7 or divide by 7/8), only the divide by 8 function is valid for lowband.

The internal oscillator device in the LVFracN together with C236, C237, C242, R219, CR211 and Y201 comprise the reference oscillator. This oscillator is temperature compensated is capable of 2.5 ppm stability over temperatures of -30 to 85°C. There is temperature compensation information that is unique to each crystal contained on Y201 that is programmed into the radio when built.

The loop filter consists of components C256, C257, C259, R224, R225 and R228. This circuit provides the necessary dc steering voltage for the VCO and determines the amount of noise and spur passing through.

To achieve fast locking for the synthesizer, an internal adapt charge pump provides higher current at pin 45 of U205 to put the synthesizer within lock range. The required frequency is then locked by normal mode charge pump at pin 43.

Both the normal and adapt charge pumps get their supply from the inductive voltage multiplier made up of C240, C246, C247, C249, D201, and L223. This circuit provides 13.3V at pin 47 of U205.

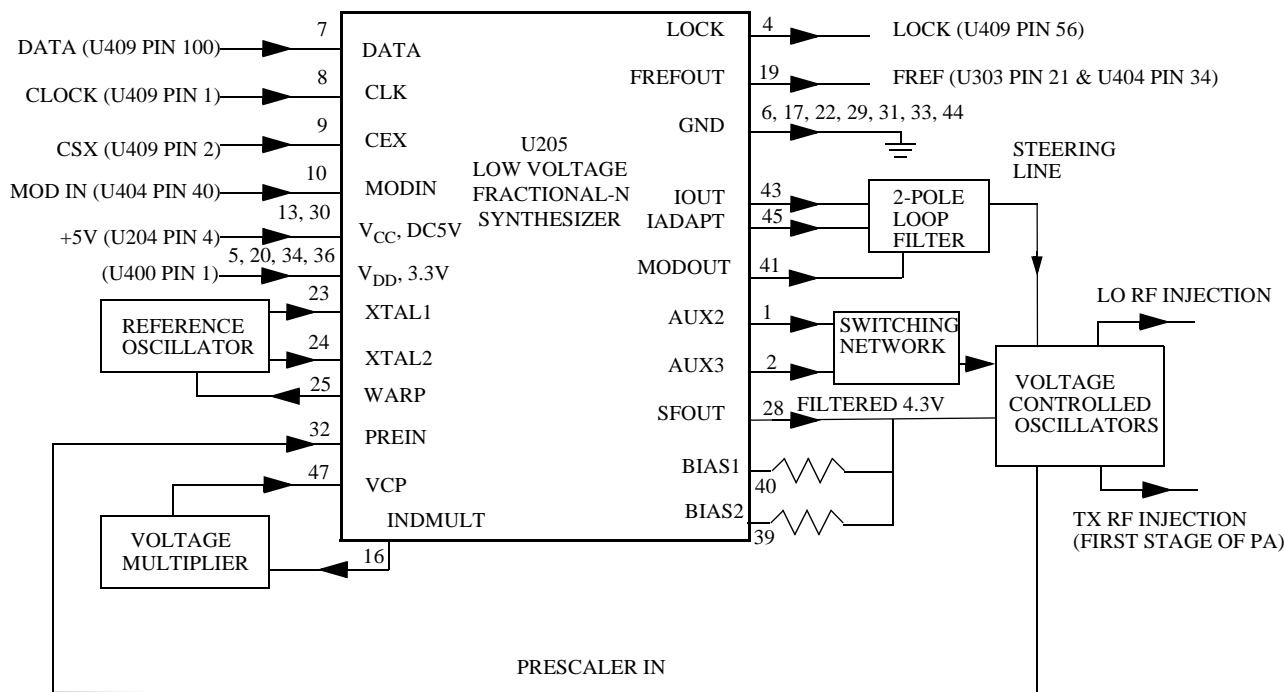


Figure 6-4: Lowband Synthesizer Block Diagram

## 5.2 VCO - Voltage Controlled Oscillator

### 5.2.1 Receive VCO

The receive VCO is a Colpitts type design and using two active devices in parallel, Q202 and Q204. The oscillator is powered off of the 4.3 volt super filter supply when the AUX3 line goes low. The oscillator operates from 139 to 160 MHz, and the frequency is tuned by varactor diodes CR201 and CR202.

### 5.2.2 Transmit VCO

The transmit VCO is a Hartley type design with active devices Q203. The oscillator is powered off of the 4.3 volt super filter supply when the AUX2 line goes low. The oscillator operates from 29.7 to 42 MHz for Range 1 and 35 to 50 MHz for Range 2. The frequency is tuned by varactor diodes in U203. Note that the values of the inductive tap, L208 and L209, and the capacitor C215 which couples the varactor to the oscillator tank vary between the ranges.

### 5.2.3 Buffer

Both the receive and transmit VCO are fed to a buffer amplifier Q201. This is a BJT amplifier that boosts the signal levels to +4 dBm and provides reverse isolation to the oscillators. The amplifier is powered off the 4.3 volt super filter supply and the feed network is combined with the transmit filter.

### 5.2.4 Diplexer and Output Filters

The output of the buffer drives a pair of parallel filters. One filter is a lowpass filter in the TX pass that passes 29.7 - 50 MHz signals for the transmitter into the power amplifier while rejecting the receive LO injection signals at 139 - 160 MHz. This filter is comprised of L204, L211, L212, C230 and C231.

The other filter is a highpass filter which passes 139 - 160 MHz signals for the receive LO into the mixer while rejecting the transmit injection signals at 29.7 -50 MHz. This filter is comprised of C228,C229,C235 and L215.

### 5.2.5 Prescalar Feedback

The prescalar input signal for receive and transmit is tapped off of the outputs of each filter by resistors R234 and R238. This signal is routed to U205 pin 32. After frequency comparison in the synthesizer, current is transferred in the loop filter and a control voltage is generated at the output of the loop filter to adjust the frequency of the VCO. This voltage is a DC voltage between 3.5V and 9.5V when the PLL is locked on frequency.

## 6.0 Notes For All Schematics and Circuit Boards

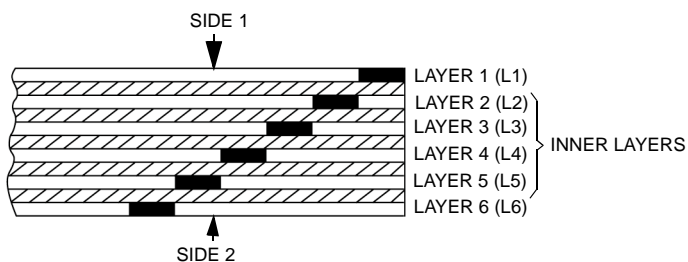
\* Component is frequency sensitive. Refer to the Electrical Parts List for value and usage.

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

100 Series	=	Transmitter
200 Series	=	Frequency Generation
300 Series	=	Receiver
400/500 Series	=	Controller
600 Series	=	Keypad Board
4. Interconnect Tie Point Legend:
 

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

### 6-LAYER CIRCUIT BOARD DETAIL VIEWING COPPER STEPS IN PROPER LAYER SEQUENCE

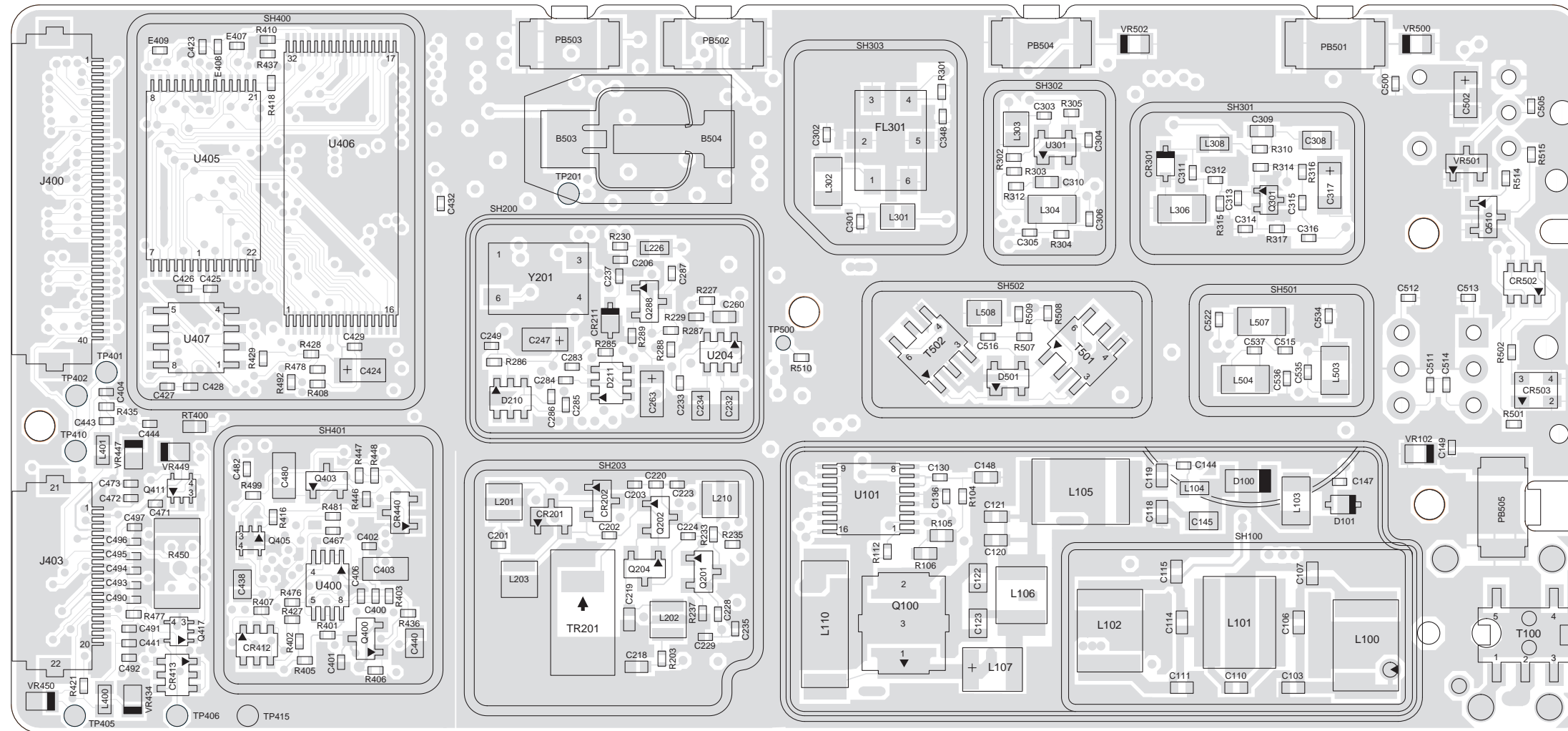






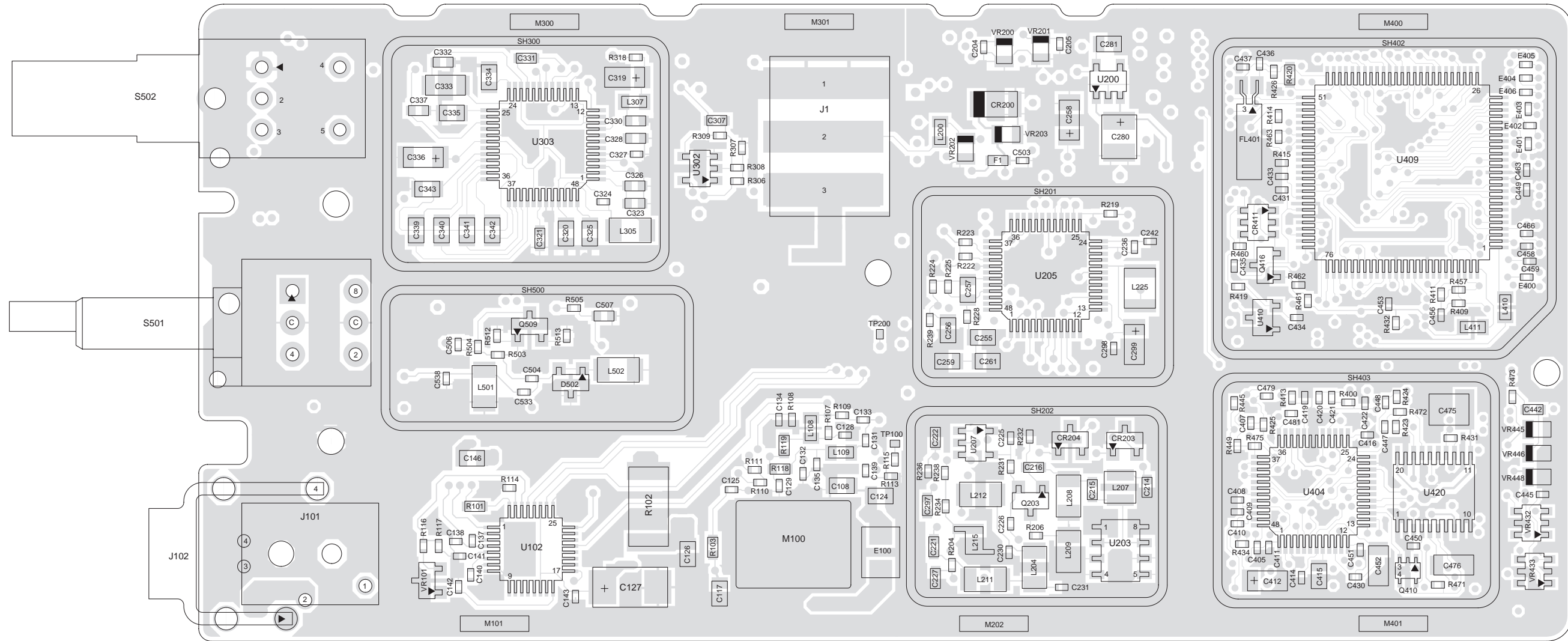
### 7.0 Circuit Board/Schematic Diagrams and Parts List

VIEWED FROM SIDE 1

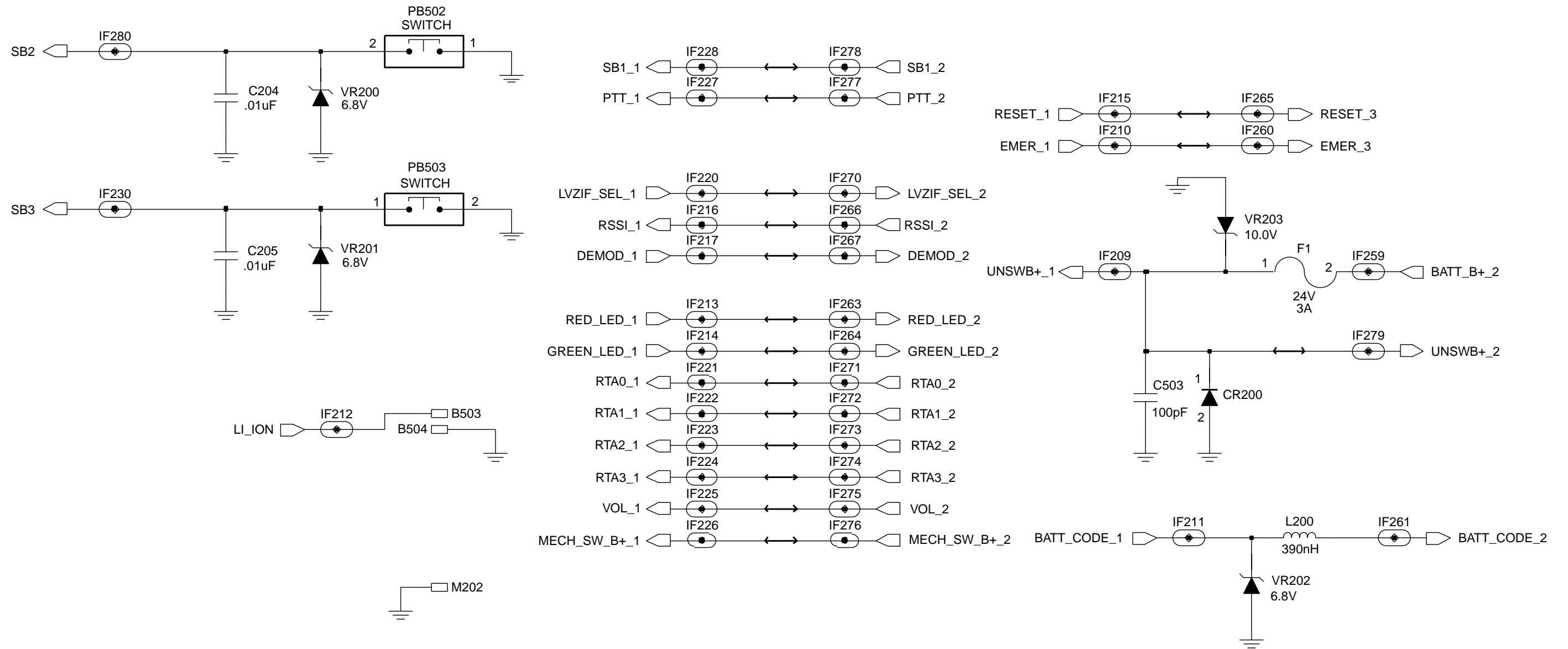


FL08304740

VIEWED FROM SIDE 2



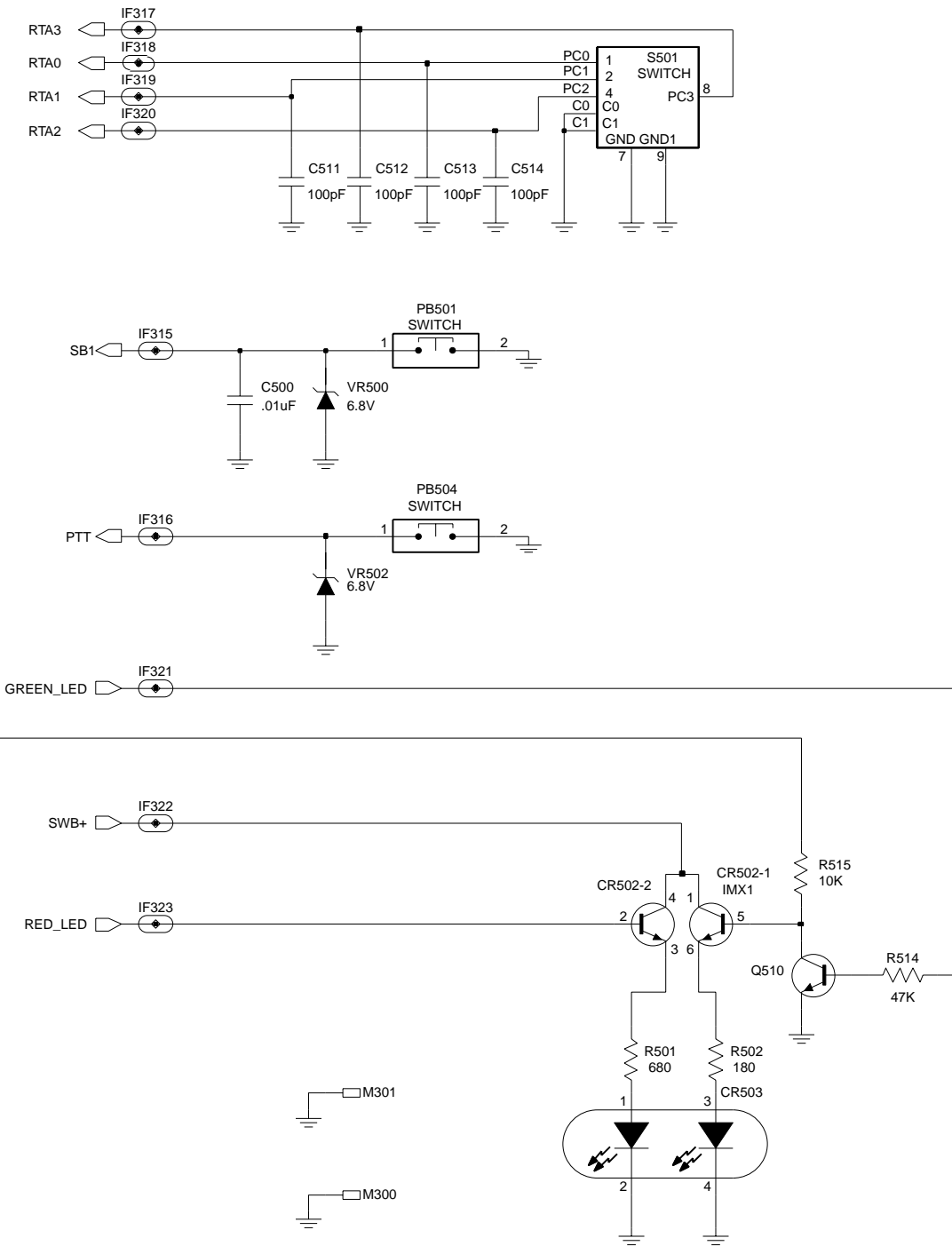
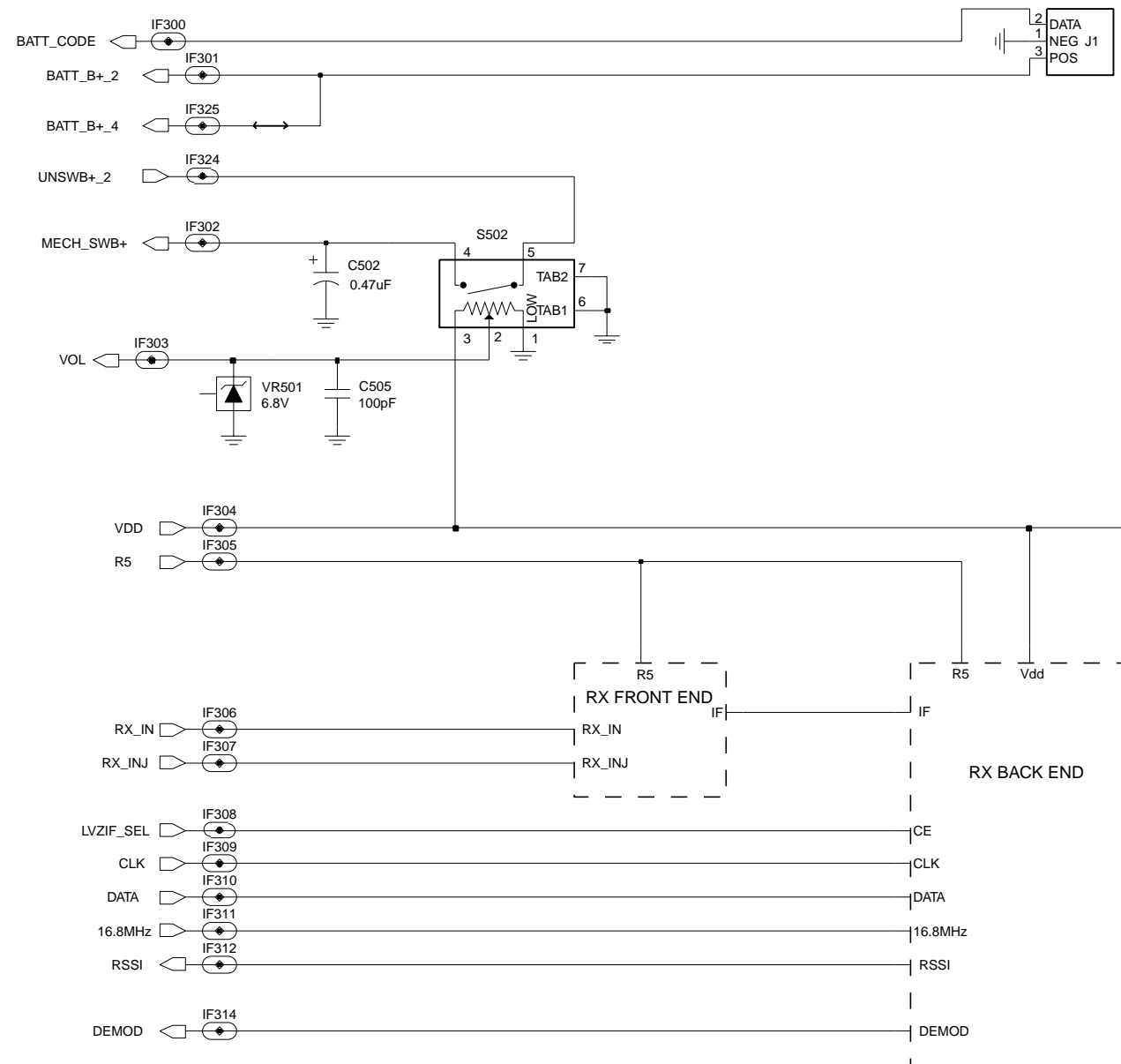
FL08304750



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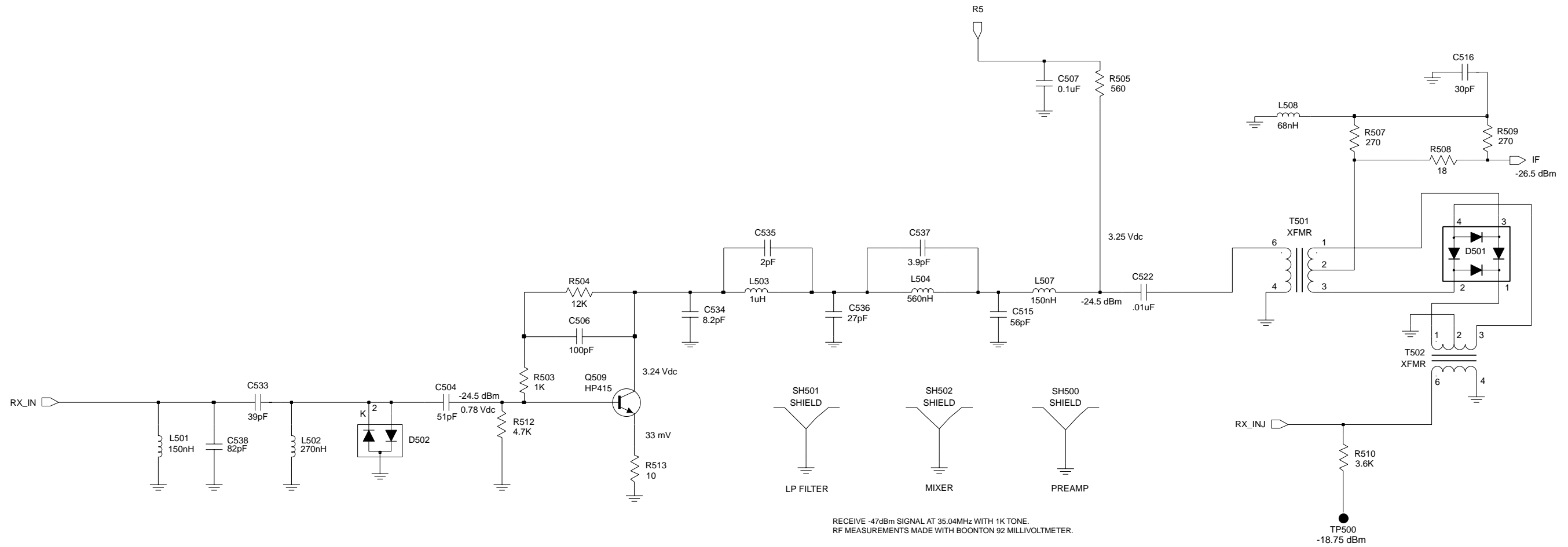
Lowband 29-42/35-50MHz Controls And Switches Schematic Diagram

Software Package	S501 - Freq. switch
Conventional/MDC	4080710Z01 - 16 position
5 Tone	4080710Z02 - continuous



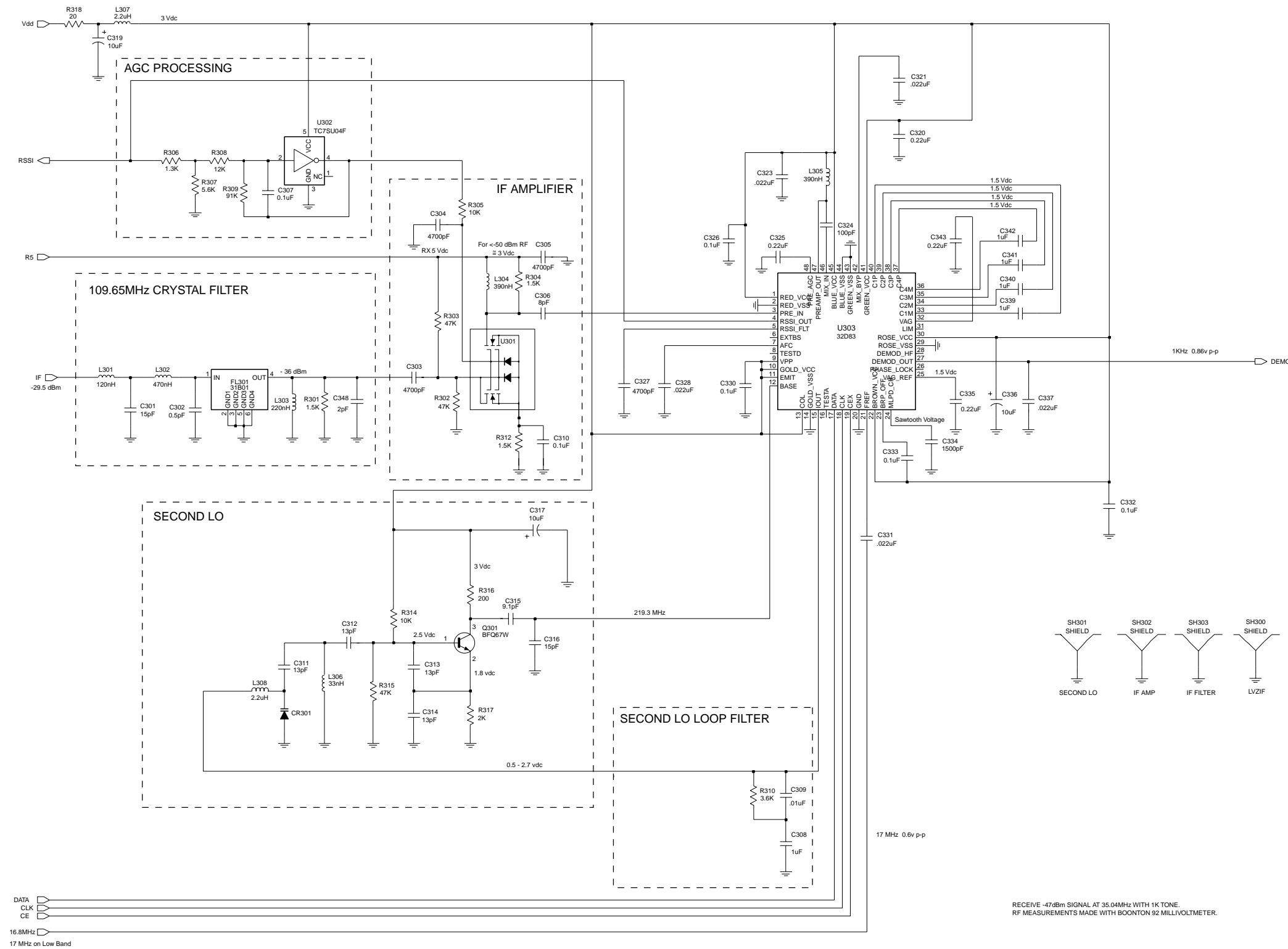
FL08304700

Lowband 29-42/35-50MHz Overall Receiver Schematic Diagram



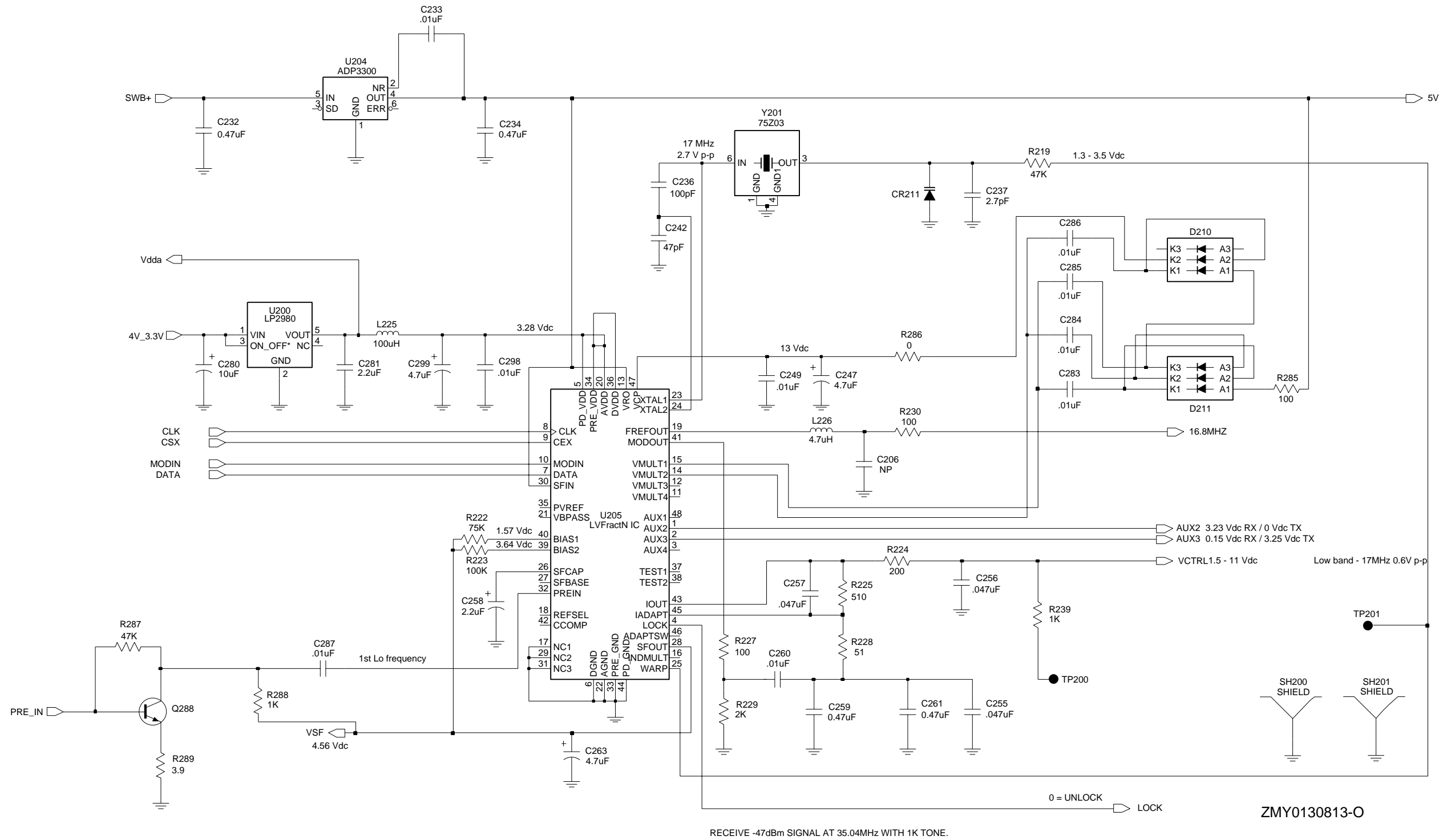
FL08304710

Lowband 29-42/35-50MHz Receiver Front End Schematic Diagram

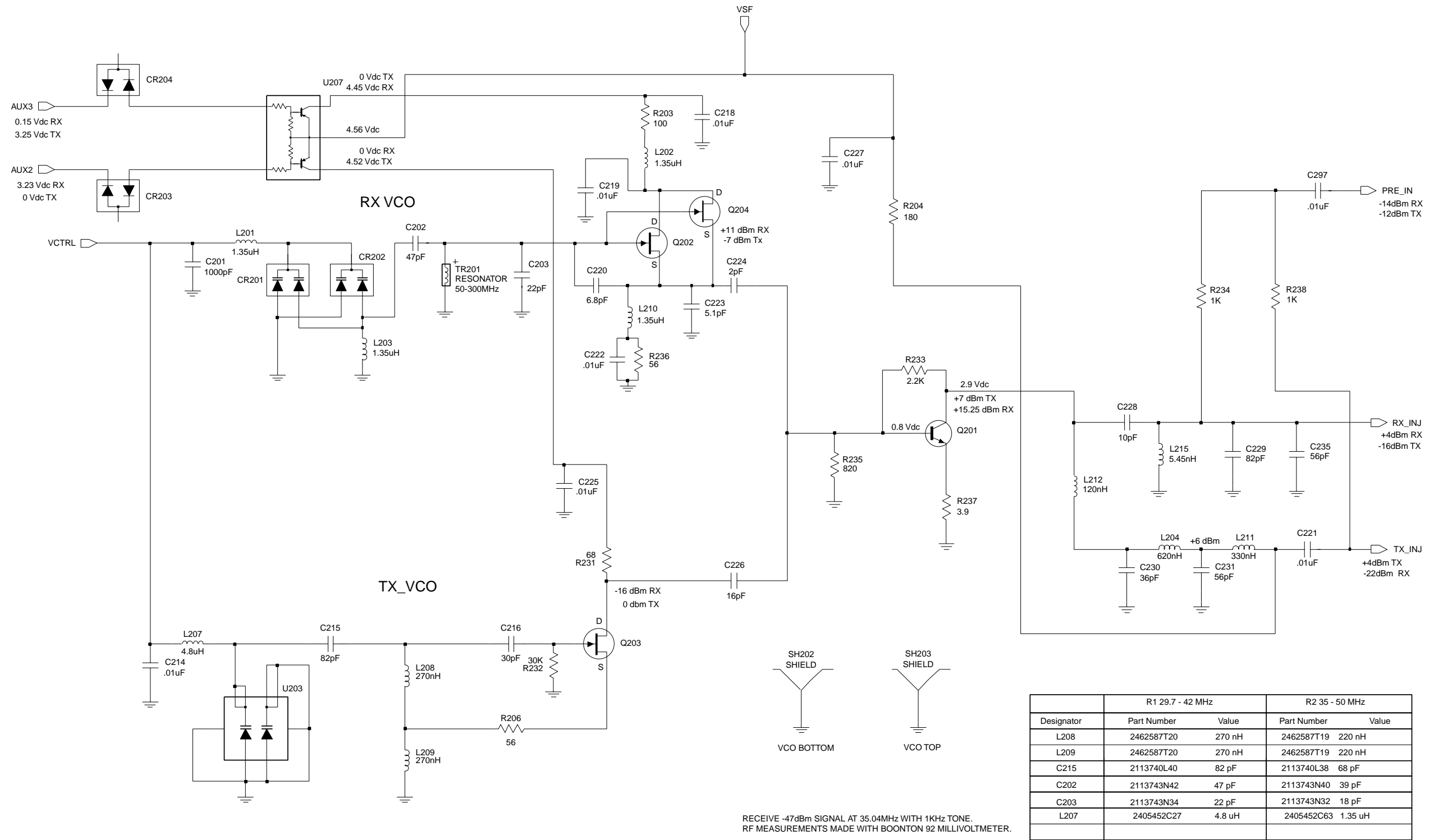


Lowband 29-42/35-50MHz Receiver Back End Schematic Diagram

FL08304720



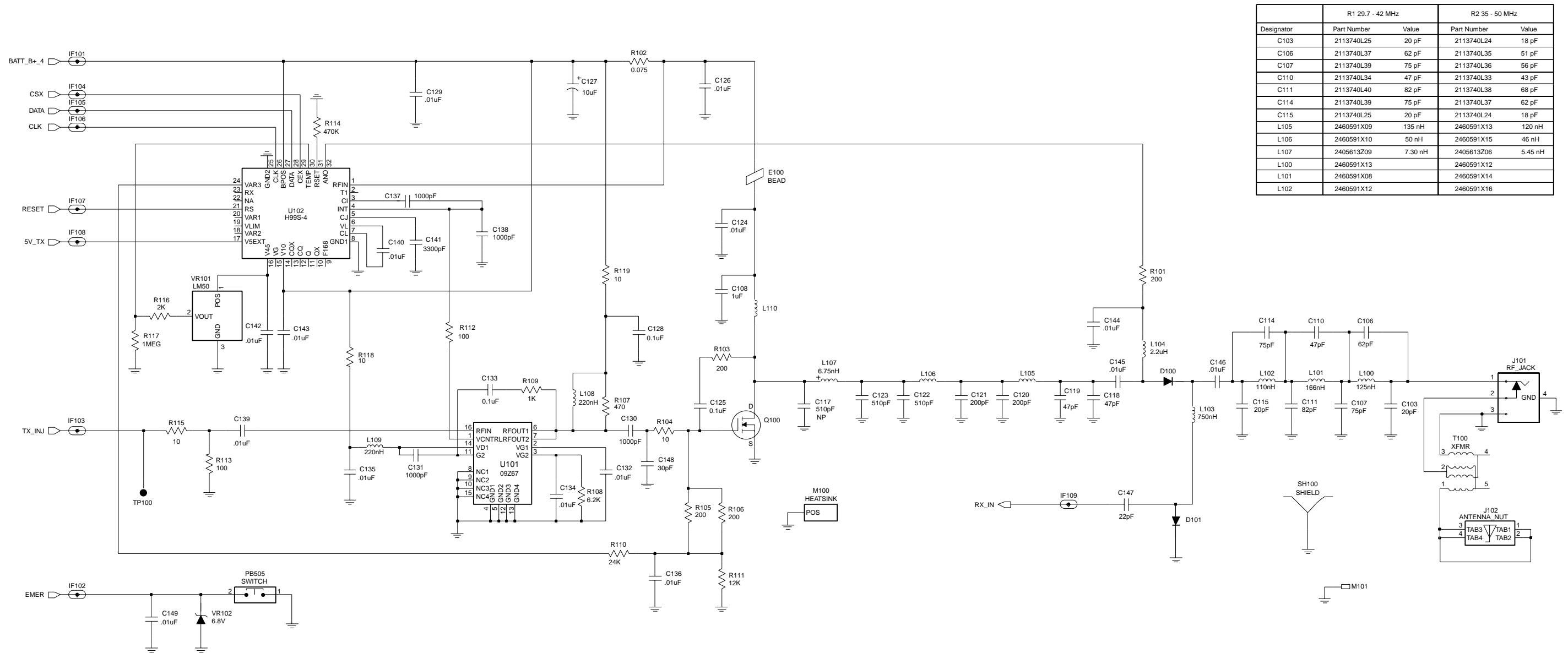
Lowband 29-42/35-50MHz Synthesizer Schematic Diagram



FL08304690

Lowband 29-42/35-50MHz Voltage Controlled Oscillator Schematic Diagram





Designator	R1 29.7 - 42 MHz		R2 35 - 50 MHz	
	Part Number	Value	Part Number	Value
C103	2113740L25	20 pF	2113740L24	18 pF
C106	2113740L37	62 pF	2113740L35	51 pF
C107	2113740L39	75 pF	2113740L36	56 pF
C110	2113740L34	47 pF	2113740L33	43 pF
C111	2113740L40	82 pF	2113740L38	68 pF
C114	2113740L39	75 pF	2113740L37	62 pF
C115	2113740L25	20 pF	2113740L24	18 pF
L105	2460591X09	135 nH	2460591X13	120 nH
L106	2460591X10	50 nH	2460591X15	46 nH
L107	2405613Z09	7.30 nH	2405613Z06	5.45 nH
L100	2460591X13		2460591X12	
L101	2460591X08		2460591X14	
L102	2460591X12		2460591X16	

FL08304730

Lowband 29-42/35-50MHz Transmitter Schematic Diagram

### Lowband 29-42/35-50MHz Radio Parts List

Circuit Ref	Motorola Part No.	Description
C103	2113740L25	20pF
C103**	2113740L24	18pF
C106	2113740L37	62pF
C106**	2113740L35	51pF
C107	2113740L39	75pF
C107**	2113740L36	56pF
C108	2113743F16	1.0uF
C110	2113740L34	47pF
C110**	2113740L33	43pF
C111	2113740L40	82pF
C111**	2113740L38	68pF
C114	2113740L39	75pF
C114**	2113740L37	62pF
C115	2113740L25	20pF
C115**	2113740L24	18pF
C118	2113740F48	47pF
C118**	2113740F49	82pF
C119	2113740F46	62pF
C119	2113740F39	33pF
C120	2113740F58	200pF
C121	2113740F58	200pF
C121**	2113740F59	220pF
C122	2113740A72	510pF
C123	2113740A72	510pF
C124	2113741A45	56pF
C125	2113743M24	0.01uF
C126	2113741A45	56pF
C127	2311049A18	10uF
C128	2113743M24	0.01uF
C129	2113743L41	0.01uF
C130	2113743L17	1000pF
C131'	2113743L17	1000pF
C132	2113743L41	0.01uF
C133	2113743M24	0.01uF
C134	2113743L41	0.01uF
C135	2113743L41	0.01uF
C136	2113743L41	0.01uF
C137	2113743L17	1000pF
C138	2113743L17	1000pF
C139	2113743L41	0.01uF
C140	2113743L41	0.01uF
C141	2113743L29	3300pF
C142	2113743L41	0.01uF
C143	2113743L41	0.01uF
C144	2113743L41	0.01uF
C145	2113741A45	56pF
C146	2113741A45	56pF
C147	2113743N34	22pF

Circuit Ref	Motorola Part No.	Description
C148	2113740F38	30pF
C149	2113743L41	0.01uF
C201	2113743L17	1000pF
C202	2113743N42	47pF
C203	2113743N34	18pF
C204	2113743L41	0.01uF
C205	2113743L41	0.01uF
C206	2113743N42	47pF
C214	2113741F49	0.1uF
C215	2113740L40	82pF
C216	2113740F38	30pF
C218	2113741F49	0.1uF
C219	2113741F49	0.1uF
C220	2113743N22	15pF
C221	2113741F49	0.1uF
C222	2113741F49	0.1uF
C223	2113743N19	5.1pF
C224	2113743N09	2pF
C225	2113743L41	0.1uF
C226	2113743N31	16pF
C227	2113741F49	0.1uF
C228	2113743N26	10pF
C229	2113743N48	82pF
C230	2113743N39	36pF
C231	2113743N44	56pF
C232	2113743A27	0.47uF
C233	2113743L41	0.01uF
C234	2113743A27	0.47uF
C235	2113932N44	56pF
C236	2113743N50	100pF
C237	2113743N12	2.7pF
C242	2113743N42	47pF
C247	2311049A56	4.7uF
C249	2113743L41	0.01uF
C255	2113741A61	0.047uF
C256	2113741A61	0.047uF
C257	2113741A61	0.047uF
C258	2311049F16	2.2uF
C259	2113743A27	0.47uF
C260	2113743F49	0.01uF
C261	2113741A27	0.47uF
C263	2311049A56	4.7uF
C280	2311049A57	10uF
C281	2104993J02	2.2uF
C283	2113743L41	0.01uF
C284	2113743L41	0.01uF
C285	2113743L41	0.01uF
C286	2113743L41	0.01uF
C287	2113743L41	0.01uF
C297	2113741F49	0.1uF
C298	2113743L41	0.01uF

Circuit Ref	Motorola Part No.	Description
C299	2311049A56	4.7uF
C301	2113743N30	15pF
C302	Not Placed	
C303	2113743R33	4700pF
C304	2113743R33	4700pF
C305	2113743R33	4700pF
C306	2113743N65	8pF
C307	2113743E20	0.1uF
C308	2180478Z20	1uF
C309	2113741F49	0.1uF
C310	2113743E20	0.1uF
C311	2113743N29	13pF
C312	2113743N29	13pF
C313	2113743N29	13pF
C314	2113743N29	13pF
C315	2113743N25	9.1pF
C316	2113743N30	15pF
C317	2311049A59	10uF
C319	2311049A59	10uF
C320	2113743A23	0.22uF
C321	2113743E07	0.022uF
C323	2113743E07	0.022uF
C324	2113743N50	100pF
C325	2113743A23	0.22uF
C326	2113743E20	0.1uF
C327	2113743R33	4700pF
C328	2113743E07	0.022uF
C330	2113743E20	0.1uF
C331	2113743E07	0.022uF
C332	2113743E20	0.1uF
C333	2109720D14	0.1uF
C334	2113740A82	1500pF
C335	2113743A23	0.22uF
C336	2311049A59	10uF
C337	2113743E07	0.022uF
C339	2113743F16	1uF
C340	2113743F16	1uF
C341	2113743F16	1uF
C342	2113743F16	1uF
C343	2113743A23	0.22uF
C348	2113743N09	2pF
C400	2113743L41	.01uF
C401	2113743M24	0.1uF
C402	2113743M24	0.1uF
C403	2113743G24	2.2uF
C404	Not Placed	
C405	Not Placed	
C406	Not Placed	
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	0.1uF

Circuit Ref	Motorola Part No.	Description
C410	2113928N01	0.1uF
C411	2113743M24	0.1uF
C412	2311049A59	10uF
C414	2113743M24	0.1uF
C415	2109720D01	0.1uF
C416	2113928N01	0.1uF
C419	Not Placed	
C420	2113743L41	.01uF
C421	2113928N01	0.1uF
C422	2113743M24	0.1uF
C423	2113743N50	100pF
C424	2311049A59	10uF
C425	2113743M24	0.1uF
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	0.1uF
C429	2113743M24	0.1uF
C430	2113928N01	0.1uF
C431	2113743N50	100pF
C432	Not Placed	
C433	2113743L41	.01uF
C434	2113743M24	0.1uF
C435	2113743M24	0.1uF
C436	2113743N34	22pF
C437	2113743N34	22pF
C438	2113743F18	2.2pF
C440	2113743F18	2.2pF
C441	2113743N50	100pF
C442	2113743E20	0.1uF
C443	2113928N01	0.1uF
C444	2113743N50	100pF
C445	2113743N50	100pF
C447	2113743M08	0.022uF
C448	2113928N01	0.1uF
C449	2113743N50	100pF
C450	Not Placed	
C451	2113743M08	0.022uF
C452	2113743G26	4.7uF
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF
C471	2113743N50	100pF
C472	2113743N50	100pF
C473	2113743N50	100pF
C475	2113743H14	10uF
C476	2113928D08	10uF
C479	2113928N01	0.1uF

Circuit Ref	Motorola Part No.	Description
C480	2113743G24	0.1uF
C481	2113928N01	0.1uF
C482	2113928N01	0.1uF
C490	2113743N50	100pF
C491	2113743N50	100pF
C492	2113743N50	100pF
C493	2113743N50	100pF
C494	2113743N50	100pF
C495	2113743N50	100pF
C496	2113743N50	100pF
C497	2113743N50	100pF
C500	2113743L41	0.01uF
C502	2311049A05	0.47uF
C503	2113743N50	100pF
C504	2113743N43	51pF
C505	2113743N50	100pF
C506	2113743N50	100pF
C507	2113743K15	0.1uF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C515	2113743N44	56pF
C516	2113928N37	30pF
C522	2113743L41	0.01uF
C533	2113743N40	100pF
C534	2113743N24	8.2pF
C535	2113743N09	2pF
C536	2113743N36	27pF
C537	2113743N16	3.9pF
C538	2113743N48	82pF
CR200	4880107R01	Varactor
CR201	4805648Q13	Dual Varactor
CR202	4805648Q13	Dual Varactor
CR203	4813833C07	Varactor
CR204	4813833C07	Varactor
CR211	4813833C03	Varactor
CR301	4813833C01	Varactor
CR411	4802245J62	Schottky Diode
CR412	4802245J62	Schottky Diode
CR413	4802245J62	Schottky Diode
CR440	4813833C02	Dual Diode Common Cathode
CR502	4880107R01	Rectifier
CR503	4805729G49	LED Red/Yellow
D100	4802482J02	Pin Diode
D101	4809948D23	Pin Diode
D102	4813825A20	Dual Diode
D103	4813825A20	Dual Diode
D104	4813825A20	Dual Diode
D210	4802233J09	Triple Diode
D211	4802233J09	Triple Diode

Circuit Ref	Motorola Part No.	Description
D501	4802245J42	Ring Quad Diode
D502	4805129M06	Dual Diode
E100	2480640R01	Ferrite Bead
E400	2480640Z01	Ferrite Bead
E401	2480640Z01	Ferrite Bead
E402	2480640Z01	Ferrite Bead
E403	2480640Z01	Ferrite Bead
E404	2480640Z01	Ferrite Bead
E405	2480640Z01	Ferrite Bead
E406	2480640Z01	Ferrite Bead
E407	2480640Z01	Ferrite Bead
E408	2480640Z01	Ferrite Bead
E409	2480640Z01	Ferrite Bead
F1	6580542Z01	Fuse 3A
FL301	4885631B01	109.65MHz Crystal Filter
FL401	4870368G02	38.4kHz Crystal Oscillator
J1	0986237A02	Connector
J101	0985613Z01	RF Jack
J102	0280519Z01	Antenna Nut
J400	0905505Y04	40-pins Connector
J403	0905505Y02	20-pins Connector
L100	2460591X13	125nH
L100**	2460591X12	110nH
L101	2460591X08	166nH
L101**	2460591X14	
L102	2460591X12	110nH
L102**	2460591X16	
L103	2462587T27	750nH
L104	2462587Q20	2.2uH
L105	2460591X13	125nH
L106	2460591X10	50nH
L106**	2460591X15	46nH
L107	2484562T03	8nH
L107**	2484562T20	5nH
L108	2462587Q08	220nH
L109	2462587Q08	220nH
L110	2460591X11	100nH
L200	2462587Q42	390nH
L201	2405452C63	1.35uH
L202	2405452C63	1.35uH
L203	2405452C63	1.35uH
L204	2462587T25	620nH
L207	2405452C27	4.7uH
L207**	2405452C63	1.35uH
L208	2462587T20	270nH
L208**	2462587T19	220nH
L209	2462587T20	270nH
L209**	2462587T19	220nH
L210	2405452C63	1.35uH
L211	2462587T21	330nH
L212	2462587T16	5.45nH

Circuit Ref	Motorola Part No.	Description
L215	2409348J04	13.85nH
L225	2462587L50	100uH
L226	2462587Q24	4.7uH
L301	2462587V35	120nH
L302	2462587T23	470nH
L303	2462587V38	220nH
L304	2462587T22	390nH
L305	2462587T22	390nH
L306	2462587T40	33nH
L307	2462587Q20	2.2uH
L308	2462587Q20	2.2uH
L400	2462587Q42	390nH
L401	2462587Q42	390nH
L410	2462587Q42	390nH
L411	2462587Q42	390nH
L501	2462587T17	150nH
L502	2462587T20	270nH
L503	2462587T30	1nH
L504	2462587T24	560nH
L507	2462587T17	150nH
L508	2462587V32	68nH
PB501	4080523Z01	Tactile, Push-button
PB502	4080523Z01	Tactile, Push-button
PB503	4080523Z01	Tactile, Push-button
PB504	4080523Z01	Tactile, Push-button
PB505	4080523Z01	Tactile, Push-button
Q100	4813828A08	FET
Q201	4802245J44	NPN
Q202	4805218N82	FET
Q203	4805218N82	FET
Q204	4805218N82	FET
Q288	4802245J44	NPN
Q301	4805218N63	NPN
Q400	4809579E18	MOSFET P-Channel
Q403	4880214G02	NPN
Q405	4802245J54	Dual NPN
Q410	4802245J54	Dual NPN
Q411	Not Placed	
Q416	4809579E18	MOSFET P-Chan
Q417	4802245J50	Dual NPN/PNP
Q509	4880214J44	NPN
Q510	4880214G02	NPN
R101	0662057A18	51
R102	0680735Z01	0.075
R103	0662057A25	100
R104	0662057M26	10
R105	0662057A32	200
R106	0662057A32	200
R107	0662057M66	470
R108	0662057M93	6.2K
R109	0662057M74	1K

Circuit Ref	Motorola Part No.	Description
R110	0662057M98	10K
R111	0662057N01	12K
R112	0662057M50	100
R113	0662057M50	100
R114	0662057N39	470K
R115	0662057M26	10
R116	0662057M81	2K
R117	0662057N47	1M
R118	0662057A01	10
R119	0662057A01	10
R120	0662057A25	100
R122	Not Placed	
R203	0662057M50	100
R204	0662057M56	180
R206	0662057U45	56
R219	0662057N15	47K
R222	0662057N20	75K
R223	0662057N23	100K
R224	0662057M57	200
R225	0662057M67	510
R227	0662057M50	100
R228	0662057M43	51
R229	0662057M81	2K
R230	0662057M50	100
R231	0662057M46	68
R232	0662057N10	30K
R233	0662057M82	2.2K
R234	0662057A41	470
R235	0662057M72	820
R236	0662057M44	56
R237	0662057M16	3.9
R238	0662057M74	1K
R239	0662057M74	1K
R285	0662057M50	100
R286	0662057M01	0
R287	0662057N15	47K
R288	0662057M74	1K
R289	0662057M16	3.9
R301	0662057M78	1.5K
R302	0662057N15	47K
R303	0662057N15	47K
R304	0662057M78	1.5K
R305	0662057M98	10K
R306	0662057M77	1.3K
R307	0662057M92	5.6K
R308	0662057N01	12K
R309	0662057N22	91K
R310	0662057M87	3.6K
R312	0662057M78	1.5K
R314	0662057M98	10K
R315	0662057N15	47K

Circuit Ref	Motorola Part No.	Description
R316	0662057M57	200
R317	0662057M81	2K
R318	0662057M33	20
R400	0662057N15	47K
R401	0662057M01	0
R402	Not Placed	
R403	Not Placed	
R405	0662057M01	0
R406	0662057N20	75K
R407	0662057N19	68K
R408	Not Placed	
R409	0662057M98	10K
R410	0662057N23	100K
R411	0662057M98	10K
R413	0662057M01	0
R414	0662057V34	180K
R415	0662057V26	91K
R416	0662057N13	39K
R418	Not Placed	
R419	0662057M67	510
R420	0662057B46	10M
R421	0662057M81	2K
R423	0662057N21	82K
R424	0662057N12	36K
R425	0662057N10	30K
R426	0662057M35	330
R427	0662057M84	2.7K
R428	0662057M10	2.2
R429	0662057M98	10K
R431	0662057N39	470K
R432	0662057N16	51K
R434	0662057M62	330
R435	0662057M81	2K
R436	0662057M74	1K
R437	0662057M01	0
R445	0662057N08	24K
R446	0662057N30	220K
R447	0662057N52	1.6M
R448	0662057N33	270K
R449	0662057N08	24K
R450	0662057T45	68
R457	0662057M98	10K
R460	0662057M90	4.7K
R461	0662057M56	180
R462	0662057M98	10K
R463	0662057M61	300
R471	0662057M92	5.6K
R472	0662057M93	6.2K
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N35	330K

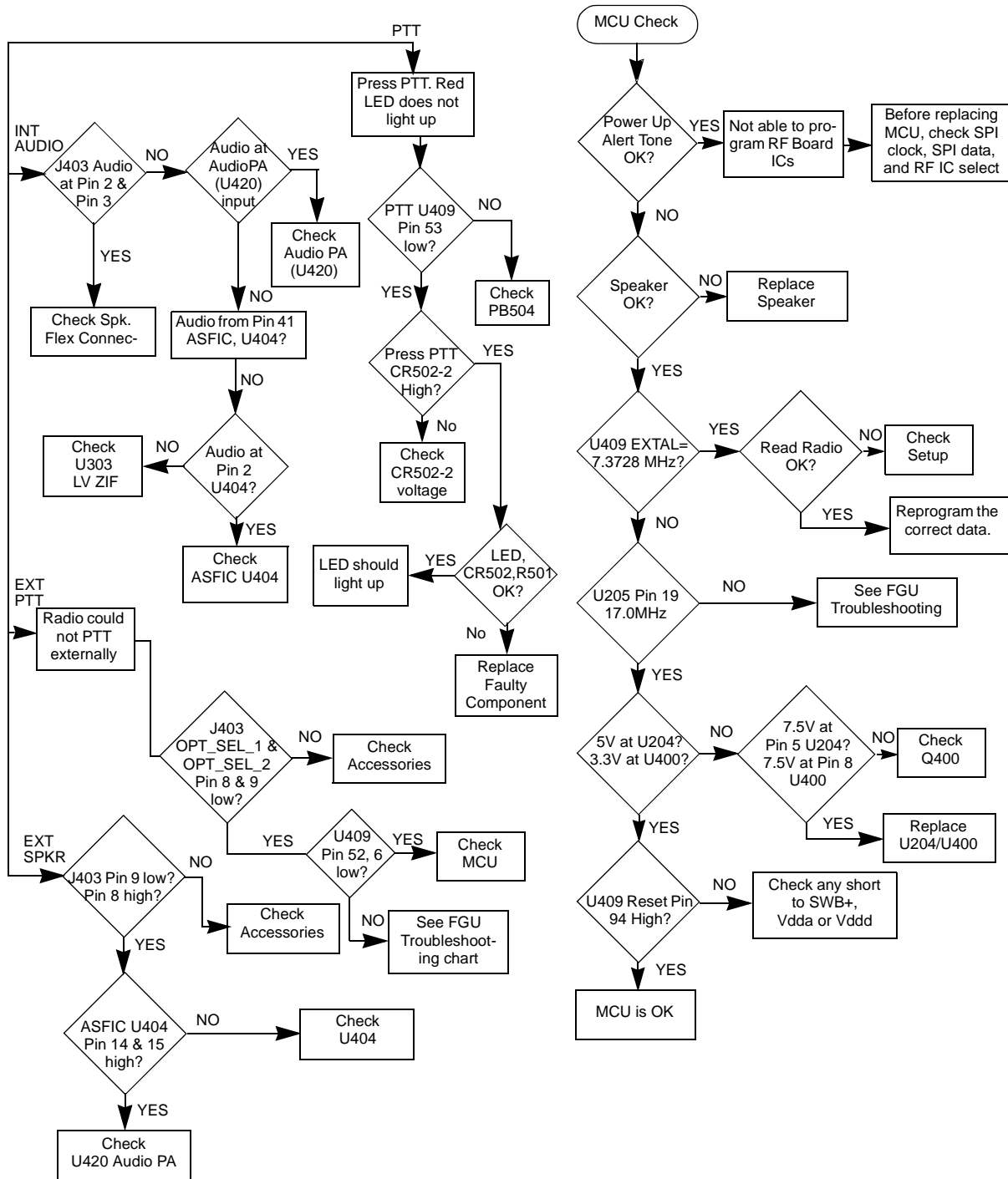
Circuit Ref	Motorola Part No.	Description
R477	0662057M74	1K
R478	0662057M98	10K
R481	0662057N08	24K
R492	0662057M01	0
R499	Not Placed	
R501	0662057M70	680
R502	0662057M56	180
R503	0662057M74	1K
R504	0662057N01	12K
R505	0662057M68	10K
R507	0662057M60	270
R508	0662057M32	18
R509	0662057M60	270
R510	0662057M87	3.6K
R512	0662057M90	4.7K
R513	0662057M26	10
R514	0662057N15	47K
R515	0662057M98	10K
RT400	0680590Z01	Thermistor 33K
S501	4080710Z01	Channel Switch
S502	1880619Z01	Volume Switch
SH100	2686076A01	Shield
SH200	2685709B02	Shield
SH201	2680511Z01	Shield
SH202	2680511Z01	Shield
SH203	2686079A01	Shield
SH300	2680516Z01	Shield
SH301	2680508Z01	Shield
SH302	2680697Z01	Shield
SH303	2680553Z01	Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller On/Off Shield
SH402	2680515Z01	Controller Microprocessor Shield
SH403	2680516Z01	Controller ASFIC Cmp/Audi PA Shield
SH500	2680555Z01	Shield
SH501	2680697Z01	Shield
SH502	2680696Z01	Shield
T100	2505515V03	Transformer Coil
T501	2580541Z01	Transformer Coil
T502	2580541Z01	Transformer Coil
TR201	2460593D01	Resonator, 50-300MHz
U101	5105109Z67	LD MOS Driver
U102	5185765B01	Power Control
U200	5102463J58	3.3V Regulator
U203	4805649Q14	Varactor Diode
U204	5105739X05	Linear Regulator
U205	5185963A27	LV Fractional N Synthesizer
U207	4805921T06	Dual PNP
U301	4885622B01	Dual Gate MOSFET

Circuit Ref	Motorola Part No.	Description
U302	5185623B01	3.3V Regulator
U303	5109632D83	Low Voltage ZIF
U400	5102463J40	3.3V Regulator
U404	5185963A53	ASFIC
U405	Not Placed	
U406	*5102463J59	Flash ROM 128K x 8
U407	*5102463J64	EEPROM 16K x 8
U409	5102226J56	Microcontroller
U410	5102463J57	3.3V Regulator
U420	5102463J44	Audio PA
VR101	5185963A15	Temperature Sense
VR102	4802245J51	6.8V Zener
VR200	4802245J51	6.8V Zener
VR201	4802245J51	6.8V Zener
VR202	4802245J51	6.8V Zener
VR203	4802245J53	6.8V Zener
VR432	4805656W08	5.6V Zener
VR433	4805656W08	5.6V Zener
VR434	4802245J51	6.8V Zener
VR445	4802245J53	10V Zener
VR446	4802245J53	10V Zener
VR447	4802245J53	10V Zener
VR448	4802245J53	10V Zener
VR449	4802245J53	10V Zener
VR450	4802245J53	10V Zener
VR500	4800245J51	6.8V Zener
VR501	4813830A18	6.8V Zener
VR502	4802245J51	6.8V Zener
Y201	4805875Z03	Crystal Oscillator

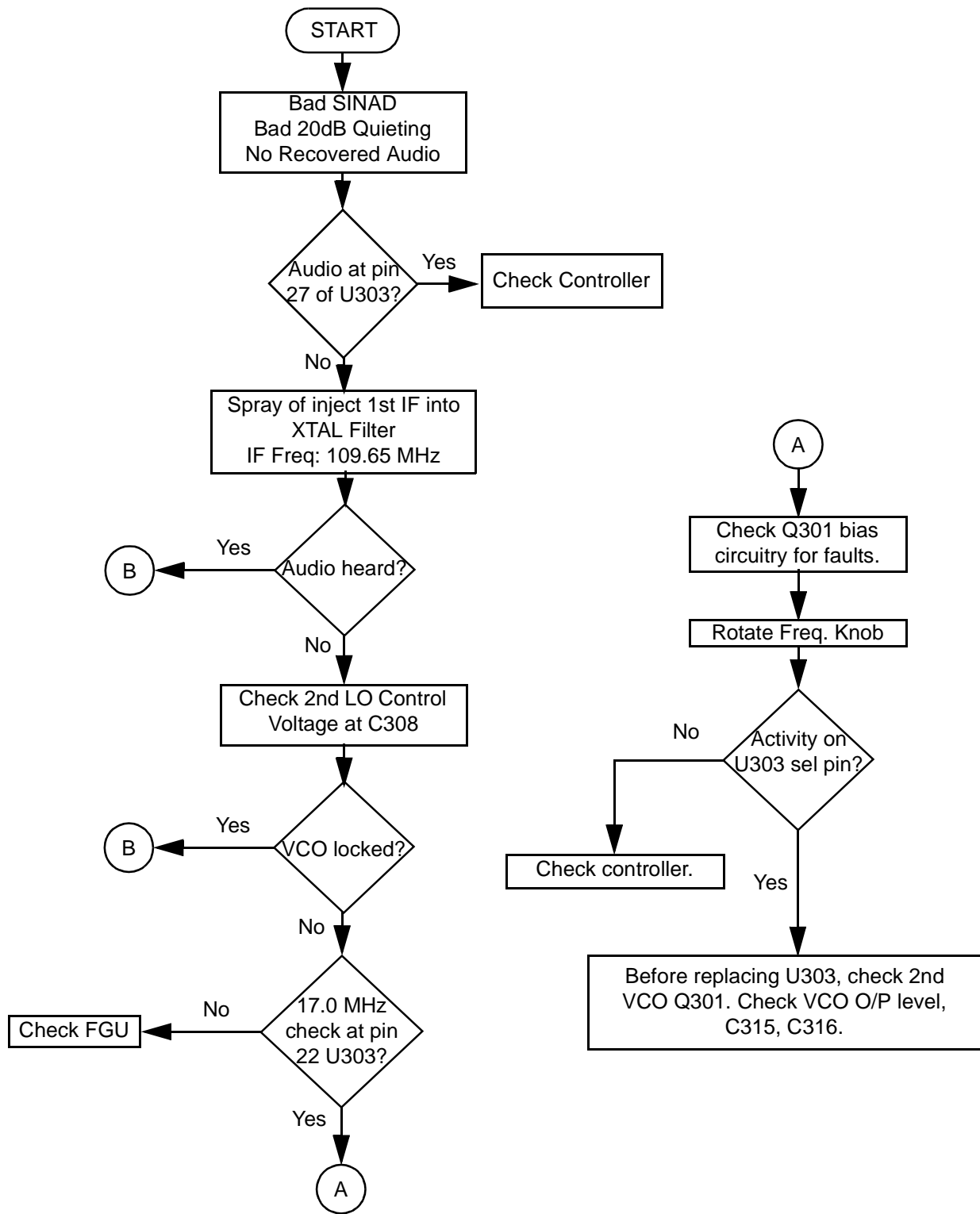
\* Motorola depot servicing only

\*\* Range 2 only

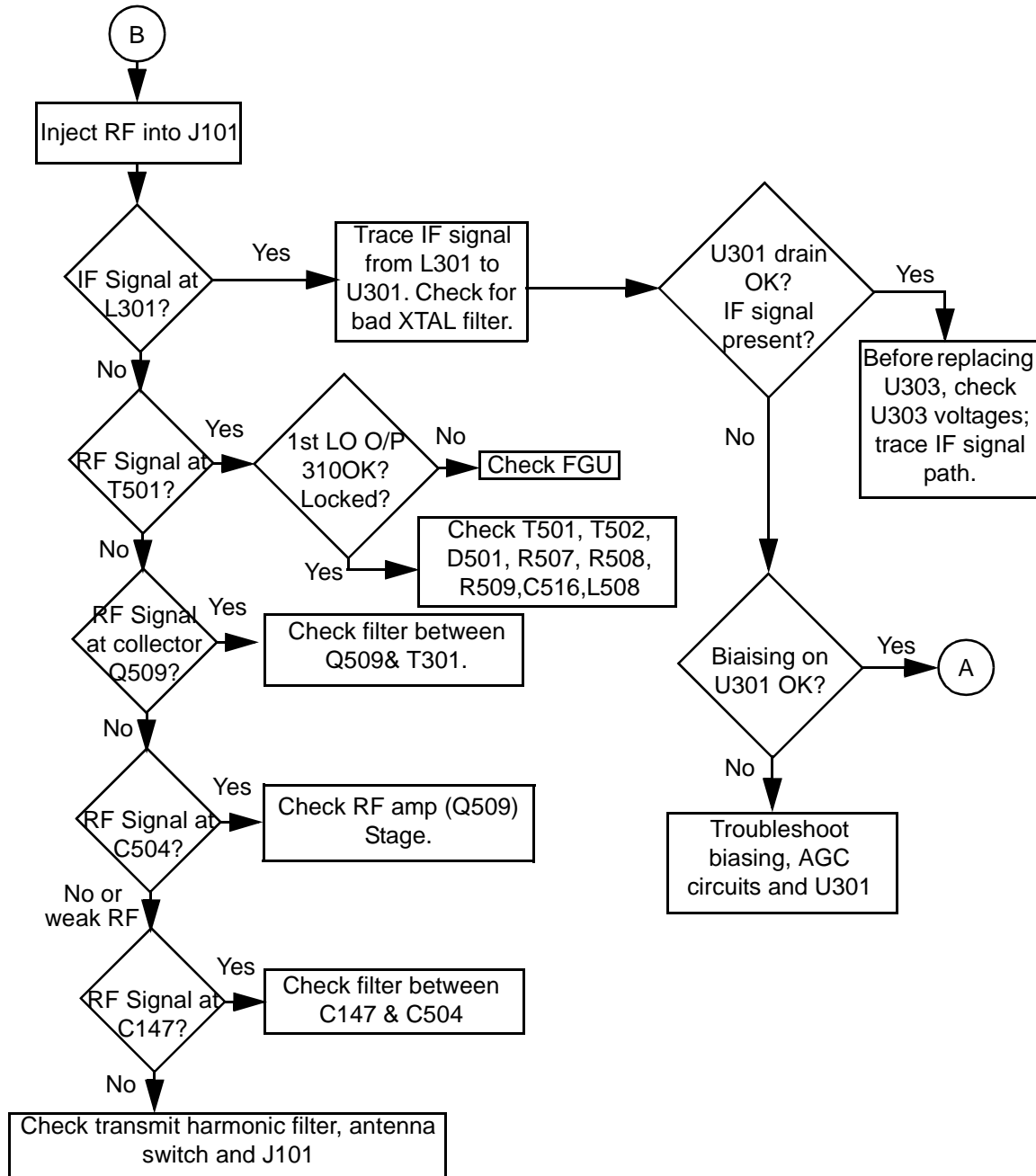
## 8.0 Troubleshooting charts



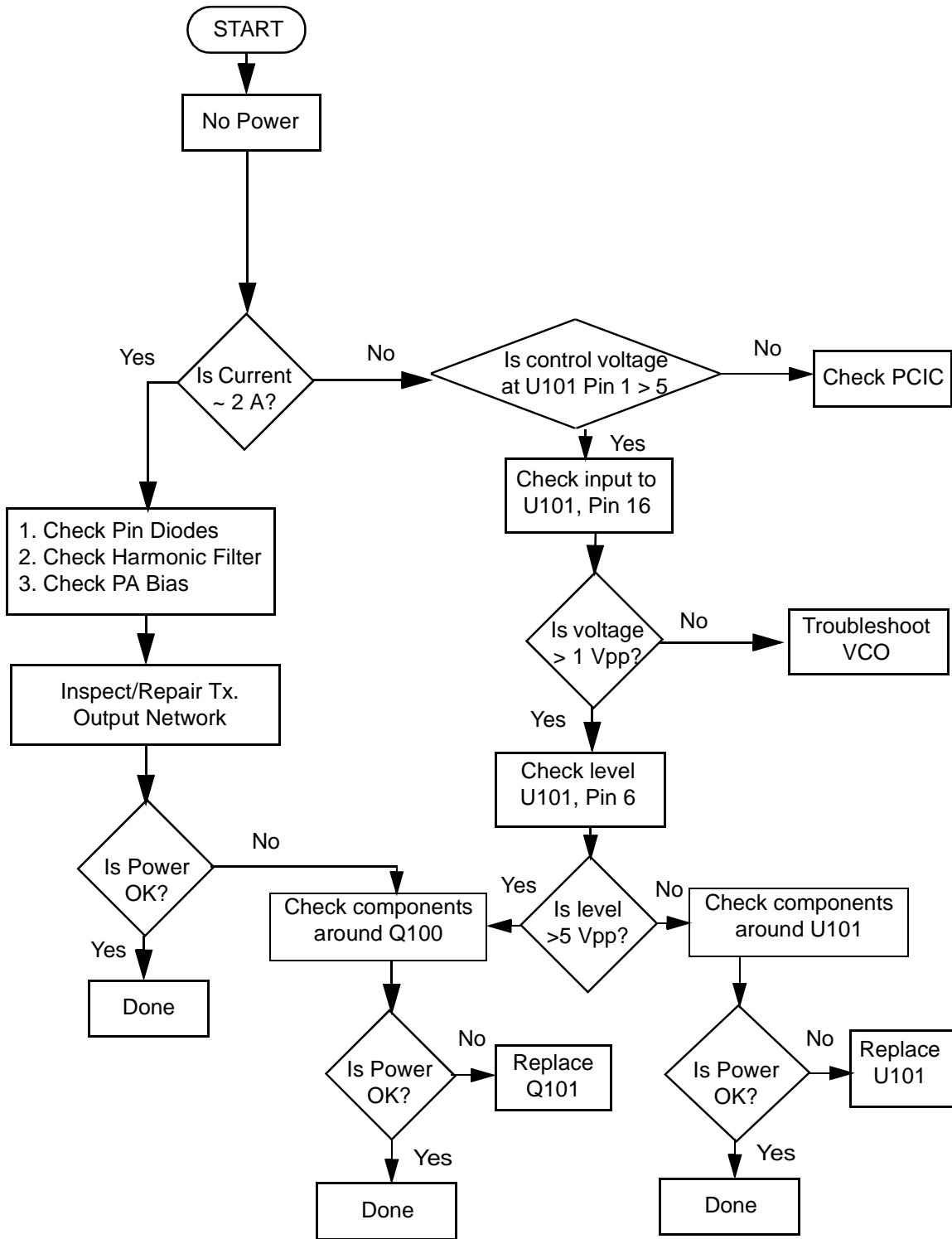
**Troubleshooting Flow Chart for Controller**



**Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)**

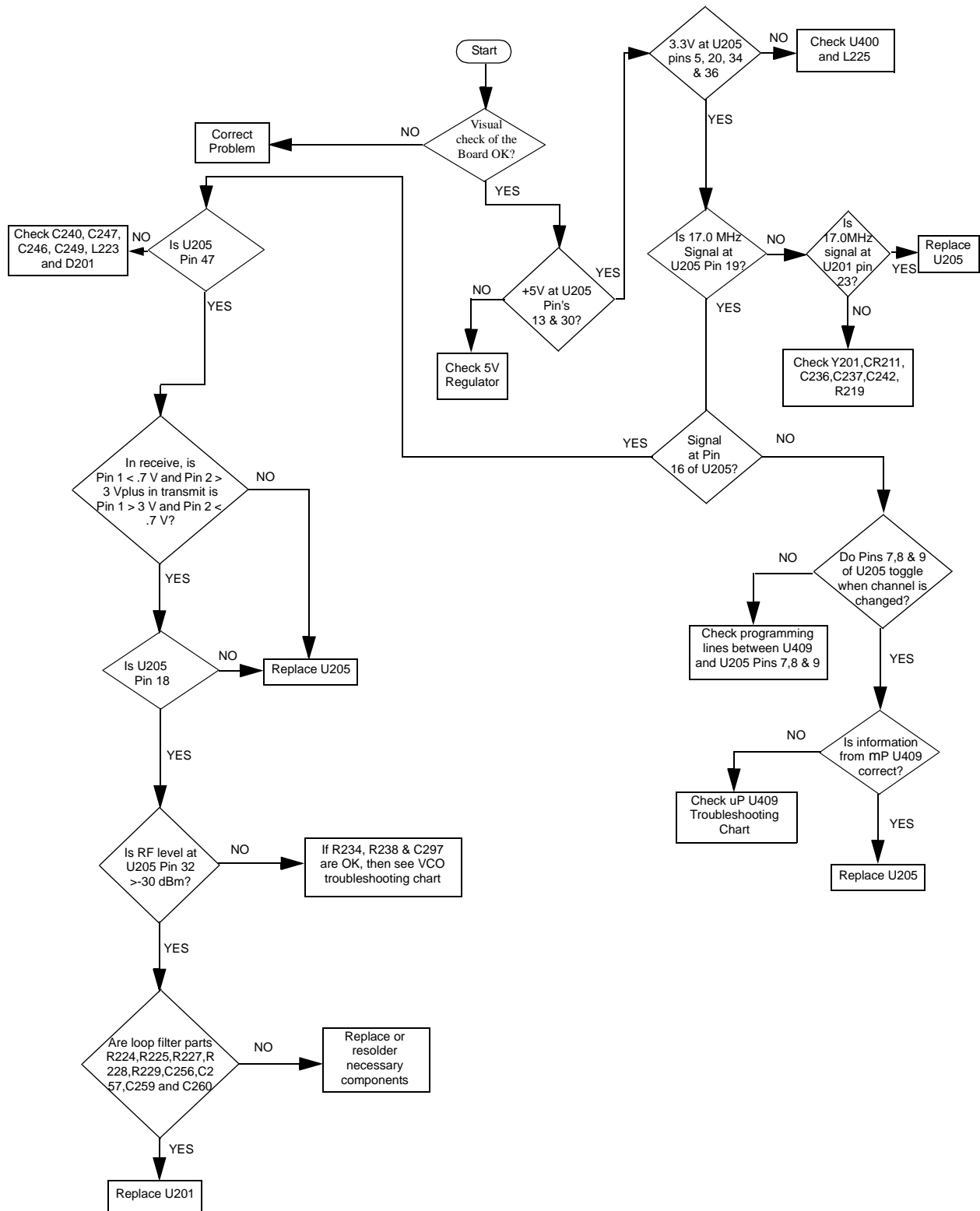


**Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)**

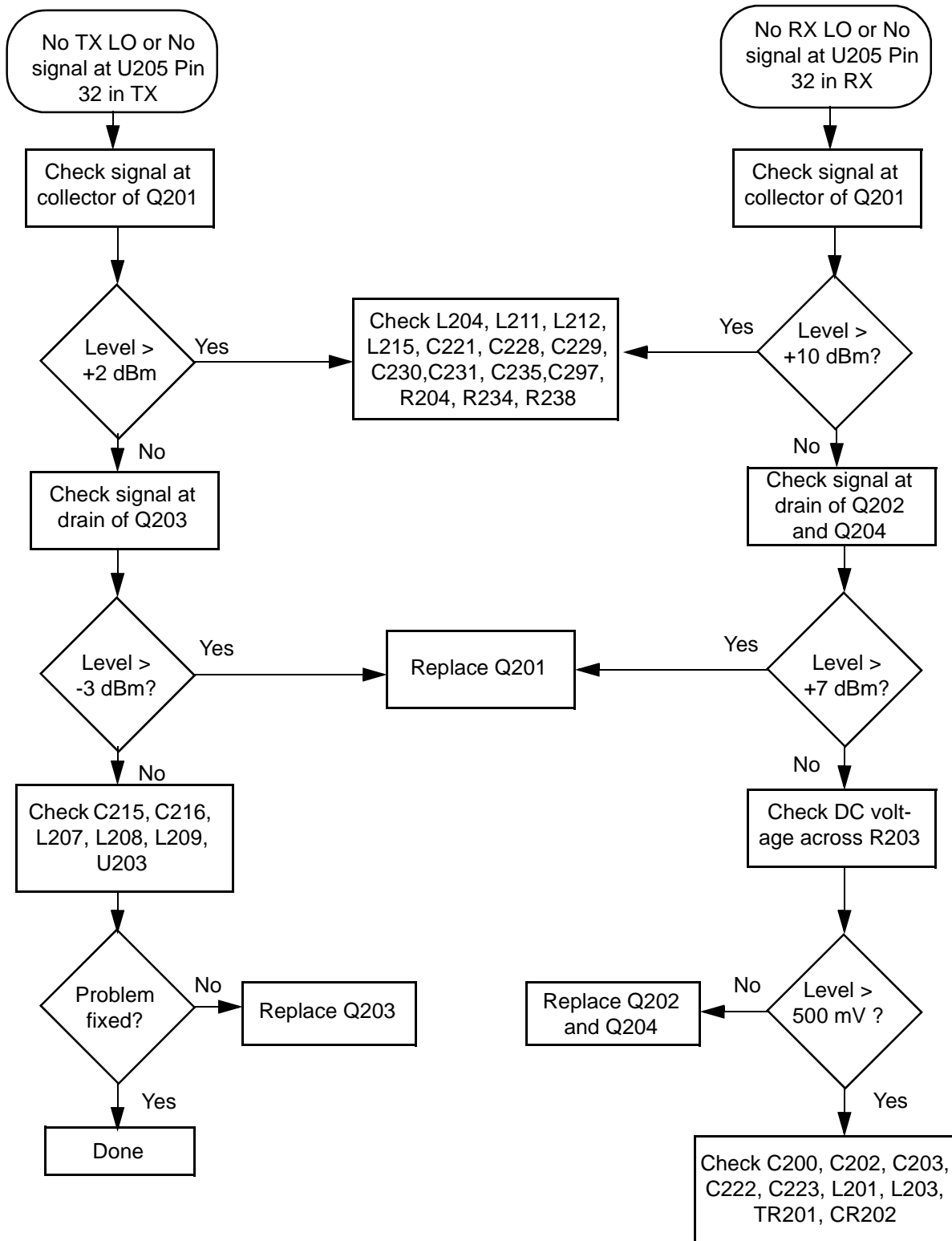


**Troubleshooting Flow Chart for Transmitter**





**Troubleshooting Flow Chart for Synthesizer**

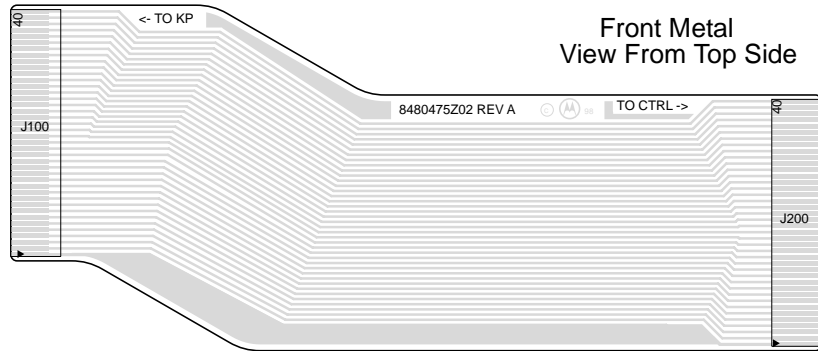


**Troubleshooting Flow Chart for VCO**

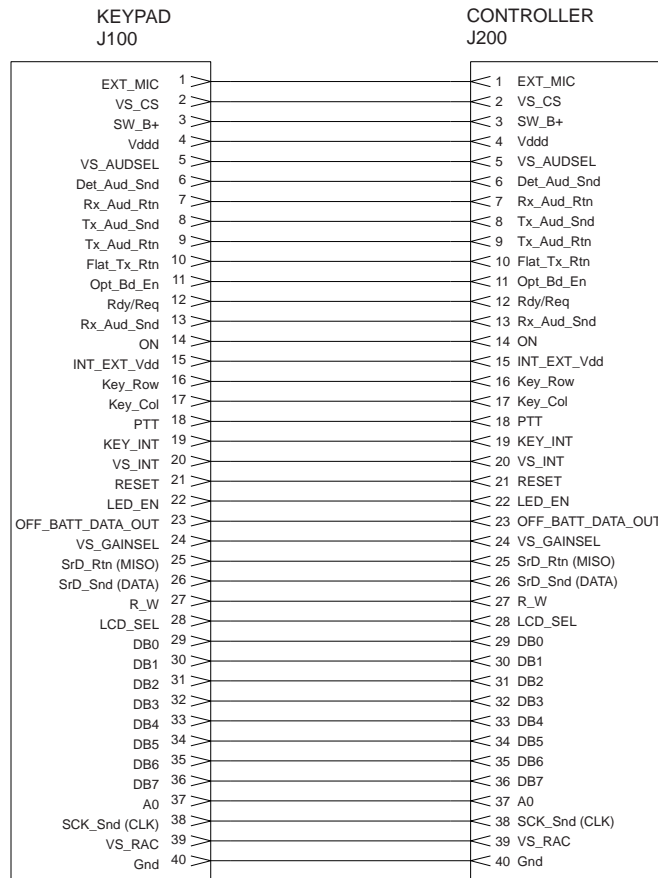
## Section 7

# FLEX LAYOUT/SCHEMATIC DIAGRAMS AND PARTS LISTS

### 1.0 Keypad-Controller Interconnect Flex



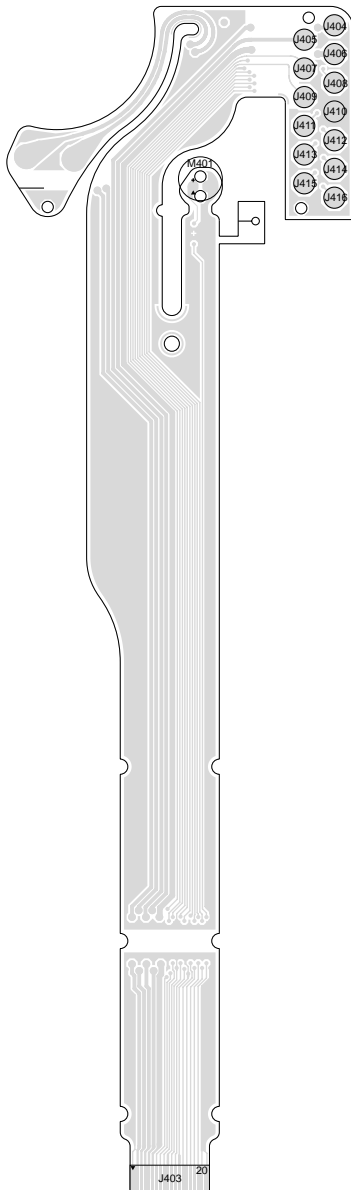
### 2.0 Schematic for Keypad-Controller Interconnect Flex



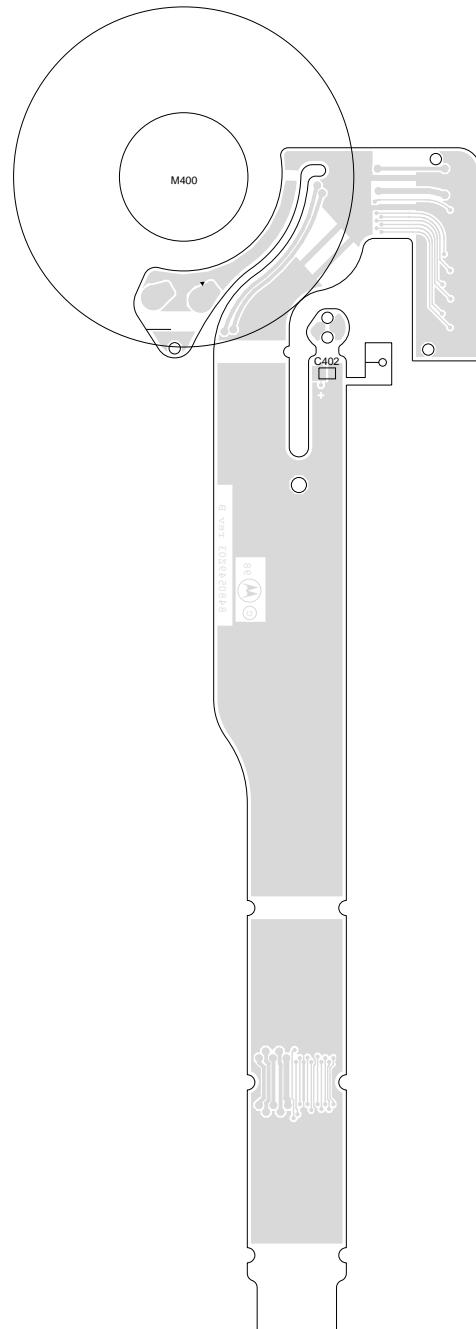
### 3.0 Parts List for Keypad-Controller Interconnect Flex

Reference Symbol	Motorola Part No.	Description
J100	0980521Z01	Connector, 40 pin
J200	0905505Y04	Speaker, 20 ohm

### 4.0 Universal Connector Flex

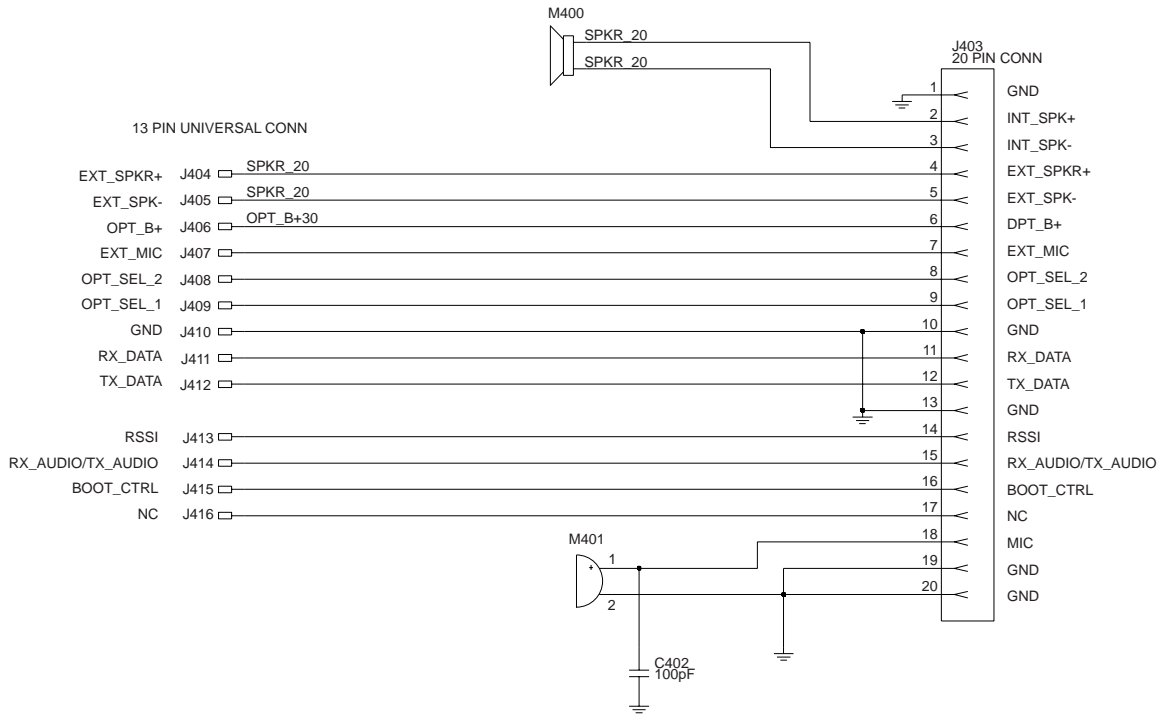


Front Metal  
View From Top Side



Back Metal  
View From Top Side

### 5.0 Schematic for Universal Connector Flex



### 6.0 Parts List for Universal Connector Flex

Reference Symbol	Motorola Part No.	Description
C402	2113740A55	Cap, 100pF
M400	5085962A02	Speaker, 20 ohm
M401	5013920A04	Mic, Mini electrec



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Alignment Procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exploded Views	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Schematic Diagrams	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Circuit Board Details	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electrical Parts List	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exploded View Parts List	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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