Professional Digital Two-Way Radio System

MOTOTRBO™ Repeater

Detailed Service Manual

XPR™ 8380 Repeater

MOTOROLA

Foreword

This manual covers all models of the XPR™ 8380 Repeater, unless otherwise specified. This manual provides sufficient information to enable qualified service technicians to troubleshoot and repair the XPR™ 8380 Repeater to the component level.

For details on radio operation or basic troubleshooting, refer to the applicable manuals available separately.

These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock, do not perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

Product Safety and RF Exposure Compliance

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

ATTENTION!

This repeater is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your product (Motorola Publication part number 6881095C99) to ensure compliance with RF energy exposure limits.

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

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Notes

Document History

The following major changes have been implemented in this manual since the previous edition:

Edition	Description	Date
68009403001-A	Initial Release.	Jan. 2010
68009403001-B	Changed Repeater and Connector board service kit numbers from PMLN5269_S and PMLN5270_S to PMLN5643_S and PMLN5644_S respectively. Repeater Board Parts List and schematic - changed R94 and R95 to 0613952Q89, 4.7K and R96 to Not Placed.	Feb. 2010
68009403001-C	Added 800/900 MHz band information.	April 2010

Notes

Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

I. What This Warranty Covers And For How Long

MOTOROLA INC. (“MOTOROLA”) warrants the MOTOROLA manufactured Communication Products listed below (“Product”) against defects in material and workmanship under normal use and service for a period of time from the date of purchase as scheduled below:

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Product Accessories	One (1) Year

Motorola, at its option, will at no charge either repair the Product (with new or reconditioned parts), replace it (with a new or reconditioned Product), or refund the purchase price of the Product during the warranty period provided it is returned in accordance with the terms of this warranty. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts of Product shall become the property of MOTOROLA.

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MOTOTRBO Repeater

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Summary of Printed Circuit Boards and Bands available:

Table below lists all the bands available in this manual and the revision of the Printed Circuit Boards used. For details, please refer to the respective chapters.

Chapter	Description	PC Board Part Number	Board Revision
2	Repeater Indicator Board (PMLN5643_)	84012135001	A
3	Connector Board (PMLN5644_) Connector Board (PMLN5579_)	84012133001	A
5	800/900 MHz, 806–941 MHz, 10–35 W	8475265H01	A

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Chapter 1

Service Maintainability

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Chapter 1 - Service Maintainability

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Section 1

INTRODUCTION

1.0 Notations Used in This Manual

Throughout the text in this publication, you will notice the use of note and caution notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.

NOTE: An operational procedure, practice, or condition that is essential to emphasize.

Caution

CAUTION indicates a potentially hazardous situation which, if not avoided, **might** result in equipment damage.

2.0 Repeater Description

The XPR 8380 repeater is available in the following frequency ranges and power levels.

Table 1-1 Frequency Ranges and Power Levels

Freq. Band	Bandwidth	Power Level
800	806–870 MHz	10–35 Watts
800/900	806–941 MHz	10–35 Watts

This repeater is among the most sophisticated two-way repeaters available. It has a robust design for users who need high performance, quality, and reliability in their daily communications. This architecture provides the capability of supporting a multitude of legacy and advanced features resulting in a more cost-effective two-way repeater communications solution.

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Section 2

MAINTENANCE

1.0 Introduction

This chapter provides details about the following:

- Preventive maintenance (inspection and cleaning).
- Safe handling of CMOS and LDMOS devices.
- Repair procedures and techniques.

2.0 Preventive Maintenance

Periodic visual inspection and cleaning is recommended.

2.1 Inspection

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

2.2 Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the repeater. External surfaces include the top cover and repeater enclosure.

Periodically clean smudges and grime from exterior enclosure. Use a soft, non-abrasive cloth moistened in a mild soap and water solution Rinse the surface using a second cloth moistened in clean water, and clean any dirt or debris from the fan grill and louvers on the front side.

NOTE: Internal surfaces should be cleaned only when the repeater is disassembled for service or repair.

The only recommended agent for cleaning the external repeater surfaces is a 0.5% solution of a mild dishwashing detergent in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).

Cleaning Internal Circuit Boards and Components

Isopropyl alcohol (100%) may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the repeater. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since this could cause the liquid to collect in unwanted places. Once the cleaning process is complete, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the top cover and repeater enclosure.

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

2.1 Safe Handling of CMOS and LDMOS Devices

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

Handling precautions are mandatory for CMOS circuits and are especially important in low humidity conditions.

DO NOT attempt to disassemble the repeater without first referring to the following CAUTION statement.

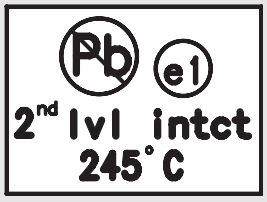
Caution

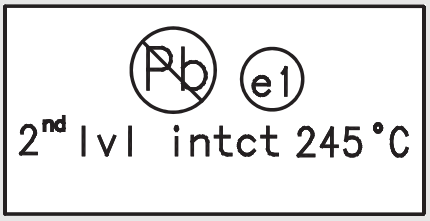
This repeater contains static-sensitive devices. Do not open the repeater unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS devices into conventional plastic “snow” trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS device. We recommend using a wrist strap, two ground cords, a table mat, and a floor mat.
- Wear a conductive wrist strap in series with a 100k resistor to ground. (Replacement wrist straps that connect to the bench top covering are Motorola part number 4280385A59).
- Do not wear nylon clothing while handling CMOS devices.
- Do not insert or remove CMOS devices with power applied. Check all power supplies used for testing CMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

2.2 Repair Procedures and Techniques — General

NOTE Environmentally Preferred Products (EPP) (refer to the marking on the printed circuit boards — examples shown below) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's **Restriction of Hazardous Substances (ROHS) Directive 2002/95/EC** and **Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC**. To maintain product compliance and reliability, use only the Motorola specified parts in this manual.





Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following table:

Table 2-1 Lead Free Solder Wire Part Number List

Motorola Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diameter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7-3.2%	217C	52171	0.015"	1lb spool

Table 2-2 Lead Free Solder Paste Part Number List

Motorola Part Number	Manufacturer Part Number	Viscosity	Type	Composition & Percent Metal	Liquid Temperature
1085674C03	NC-SMQ230	900-1000KCPs Brookfield (5rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%Ag-0.7%Cu) 89.3%	217°C

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola part number and order the part from the nearest Motorola Radio Products and Solutions Organization listed in Appendix A of this manual.

Rigid Circuit Boards

The repeater uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed through holes may interconnect multiple layers of the printed circuit. Therefore, exercise care to avoid pulling the plated circuit out of the hole.

When soldering near a connector:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins.
- Examine your work closely for shorts due to solder bridges.

Chip Components

Use the RLN4062 Hot-Air Repair Station for chip component replacement. Adjust the temperature control to 370 °C (700 °F), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

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

Shields

Removing and replacing shields is recommended to be done with an Air Blower, BOSCH GHG 600-3 or equivalent. The temperature should be set to approximately 400°C (752°F).

- **To remove the shield**:
  1. Place the circuit board in the circuit board holder.
  2. Add solder paste flux around the base of the shield.
  3. Position the heat-focus head onto the shield.
  4. Turn on the heater and wait until the shield lifts off the circuit board.
  5. Once the shield is off, turn off the heat, and grab the part with a pair of tweezers.
  6. Remove the circuit board from the circuit board holder.

- **To replace the shield:**
  1. Add solder to the shield if necessary, using a micro-tipped soldering iron.
  2. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board.
  3. Place the circuit board back in the circuit board holder.
  4. Place the shield on the circuit board using a pair of tweezers.
  5. Position the heat-focus head over the shield.
  6. Turn on the heater and wait for the solder to reflow.
  7. Once complete, turn off the heat, raise the heat-focus head and wait approximately one minute for the part to cool.
  8. Remove the circuit board and inspect the repair. No cleaning should be necessary.

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Section 3

TEST EQUIPMENT AND SERVICE AIDS

1.0 Recommended Test Equipment

The list of equipment contained in Table 3-1 includes most of the standard test equipment required for servicing Motorola repeaters.

Table 3-1 Recommended Test Equipment

Equipment	Characteristic	Example	Application
Service Monitor	Can be used as a substitute for items marked with an asterisk (*)	Motorola R2670, or equivalent.	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
Digital RMS Multimeter*	100 µV to 300 V 5 Hz to 1 MHz 10 Meg Ohm Impedance	Fluke 179 or equivalent (www.fluke.com)	AC/DC voltage and current measurements. Audio voltage measurements.
RF Signal Generator*	100 MHz to 1 GHz -130 dBM to +10 dBM FM Modulation 0 kHz to 10 kHz	Agilent N5181A (www.agilent.com), Ramsey RSG1000B (www.ramseyelectronics.com), or equivalent	Receiver measurements
Oscilloscope*	2 Channels 50 MHz Bandwidth 5 mV/div to 20 V/div	Leader LS8050 (www.leaderusa.com), Tektronix TDS1001b (www.tektronix.com), or equivalent	Waveform measurements
Power Meter and Sensor*	5% Accuracy 100 MHz to 500 MHz 50 Watts	Bird 43 Thruline Watt Meter (www.bird-electronic.com) or equivalent	Transmitter power output measurements
RF Millivolt Meter	100 mV to 3 V RF 10 kHz to 1 GHz	Boonton 92EA (www.boonton.com) or equivalent	RF level measurements

2.0 Service Aids

Table 3-2 lists the service aids recommended for working on the repeater. While all of these items are available from Motorola, most are standard workshop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

Table 3-2 Service Aids

Motorola Part Number	Description	Application
RLN4460_	Test Set	Enables connection to audio/accessory jack. Allows switching for radio testing.
RVN5115_	Customer Programming Software on CD-ROM	Allows servicer to program repeater parameters, tune and troubleshoot repeaters.
PMKN4010_	Mobile & Repeater Rear Programming Cable	Connects the radio's rear connector to a USB port for radio programming and data applications.
PMKN4016_	Mobile & Repeater Rear Accessory Programming and Test Cable	Connects the radio's rear connector to a USB port for radio programming, data applications, testing and alignment.
PMKN4018_	Mobile & Repeater Rear Accessory Connector Universal Cable	Connects the radio's rear connector to accessory devices such as desk sets. Cable contains all 26 wires and is unterminated at the user end.

3.0 Programming Cables

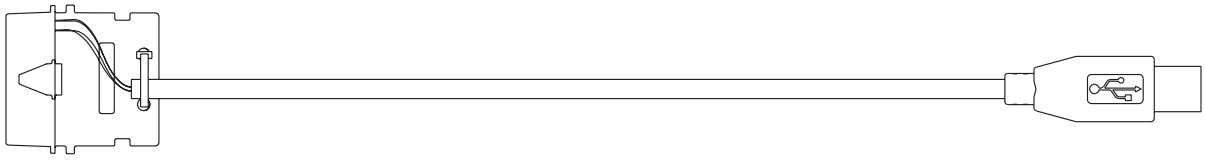
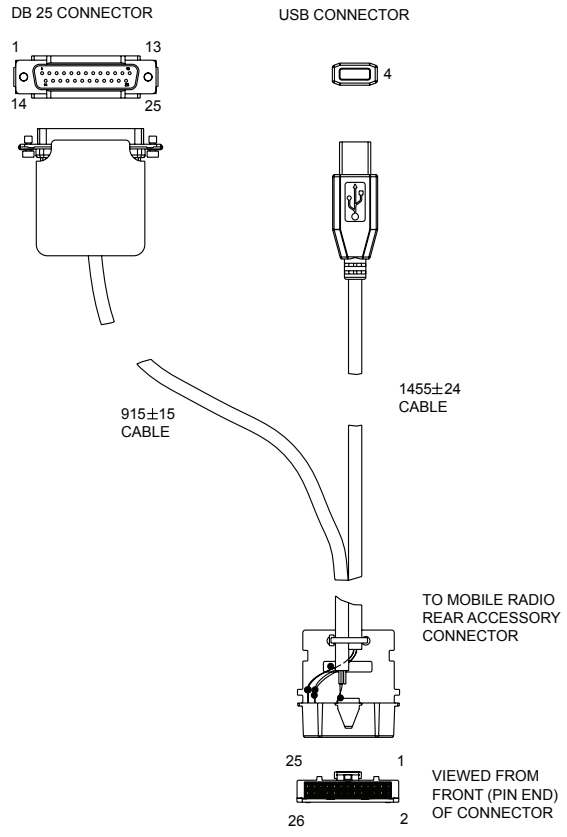


*Figure 3-1 Mobile & Repeater Rear Programming Cable PMKN4010_*



WIRE DIAGRAM			
REAR ACCESSORY CONNECTOR		USB	DB25P
PIN NO.	DESCRIPTION		
3	VCC (5 V)	1	
2	DATA -	2	
1	DATA +	3	
4	GND		
9	SPEAKER -		7
11	EXT MIC		17
17	DIGI IN 1 (EXT PTT)		20
16	GND		16
10	SPEAKER +		1

*Figure 3-2 Mobile & Repeater Rear Accessory Programming and Test Cable PMKN4016_*

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Chapter 2

Repeater Indicator Board

Service Information

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Chapter 2 - Repeater Indicator Board Service Information

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Section 1

THEORY OF OPERATION

1.0 Overview

This section provides a detailed theory of operation for the Repeater Indicator Board and its components.

2.0 Repeater Indicator Board

The Repeater Indicator board contains circuitry to drive the front panel indicator LEDs, an RTC battery for the RTC in the transmit radio, as well as an Ethernet controller.

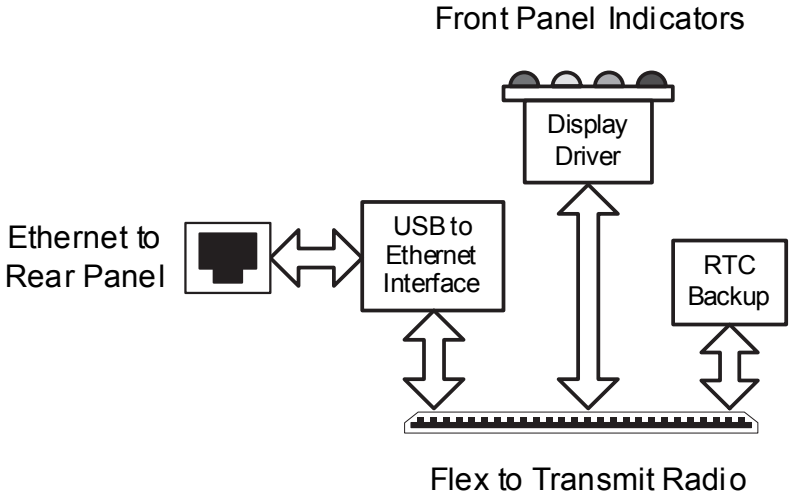


Figure 1-1 Repeater Indicator Board Block Diagram

All of the indicator LEDs that are on the front of the Repeater chassis reside on the Repeater Indicator board. Each is controlled by a shift register (U6) data out signal and a digital transistor. The shift register accepts serial data in from the transmit radio's OMAP processor via a SPI bus. A 74LVC07 buffer (U9) level shifts these signals from 3.3 V to 1.8 V.

The Repeater Disable LED is a dual-purpose LED that is hardware controlled initially at power-up. As soon as VBUS power is available on the Repeater Indicator board, the hardware circuitry for the Repeater Disable LED will cause it to blink periodically. When the software initialization is completed by the firmware, the blink circuitry will be disabled by the firmware. At that point, the Repeater Disable LED can be used for its intended purpose of displaying when the Repeater Disable function is turned on.

The power LED is the only LED that is not controlled by the software. This bi-color LED gets turned on green when the 13.8 V output from the power supply is valid. It turns on red when A/C power is lost, and the repeater's backup battery is used.

The Real Time Clock (RTC) battery (M1) is connected to the transmit radio through the Control Head Connector (J1, pin 30).

3.0 Ethernet Interface

The Repeater board uses an SMSC LAN9500 USB to 10/100 Ethernet controller (U8) to convert data from USB to Ethernet and vice-versa. An external 128 x 8 EEPROM (U2) is used to store the Ethernet MAC address and various USB configuration parameters. The transformer (T1) provides isolation between the Ethernet port and the Ethernet controller.

The LAN9500 controller integrates a 10/100 Ethernet MAC, 10/100 Ethernet PHY, USB 2.0 device controller, TAP controller, EEPROM controller, and a FIFO controller with 30 KB of internal packet buffering. The Ethernet controller supports auto-negotiation, auto-polarity correction, HP Auto-MDIX, and is compliant with the IEEE 802.3 and IEEE 802.3u standards. The internal EEPROM controller is used to load various USB configuration parameters and the device MAC address upon power-up. The USB portion of the LAN9500 integrates a High-speed USB 2.0 device controller and USB PHY. The USB device controller configures to Full-speed when communicating with the USB host controller on the TX transceiver board.

The LAN9500 integrates a 10/100 Ethernet MAC and an IEEE 802.3 PHY for twisted pair Ethernet applications. The PHY can be configured for 10Base-T (10 Mbps) or 100Base-TX (100 Mbps) and supports auto-negotiation, and full or half-duplex configurations. The controller also provides LED control signals for indicating Ethernet speed, link, and duplex configuration status. The Ethernet speed and Link LEDs reside on the Connector board's external Ethernet connector. The Link LED is the yellow LED and is lit solid when an Ethernet link is valid or blinking when there is transmit or receive activity. The speed LED is the green LED and indicates 100 Mbit operation when lit.

All of the Ethernet signals are transported to the Connector board through an Ethernet cable that connects the Repeater board to the Connector board. The LED signals are transported to the Connector board through an 8-pin cable that is also connected between the Repeater board and Connector board.

Section 2

REPEATER INDICATOR BOARD/SCHEMATICS/PARTS LIST

1.0 Allocation of Printed Circuit Board, Schematics and Parts List

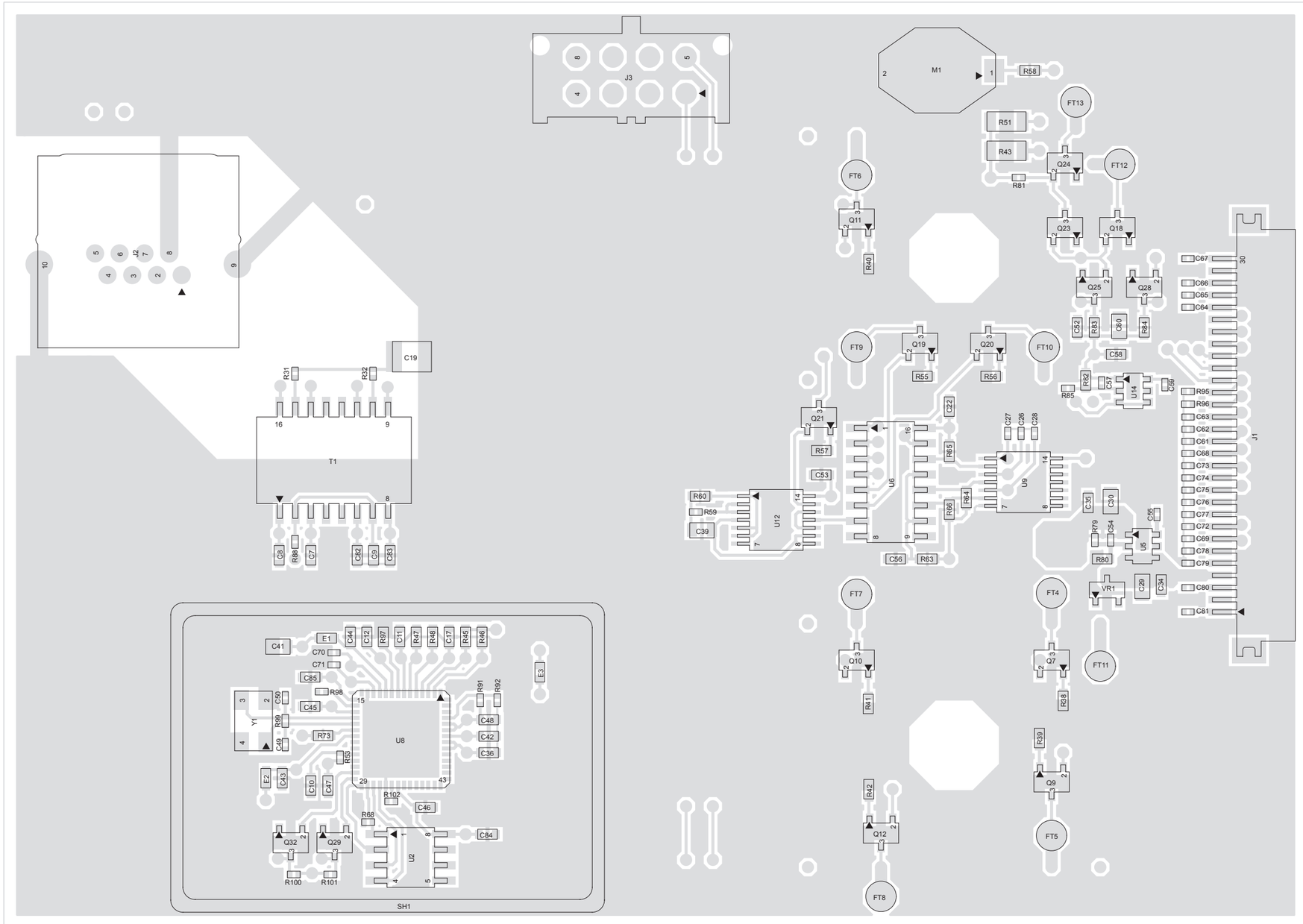
1.1 Repeater Indicator Board Circuits

This Chapter shows the Printed Circuit Board (PCB), Schematics and Parts List for the Repeater Indicator Board circuits.

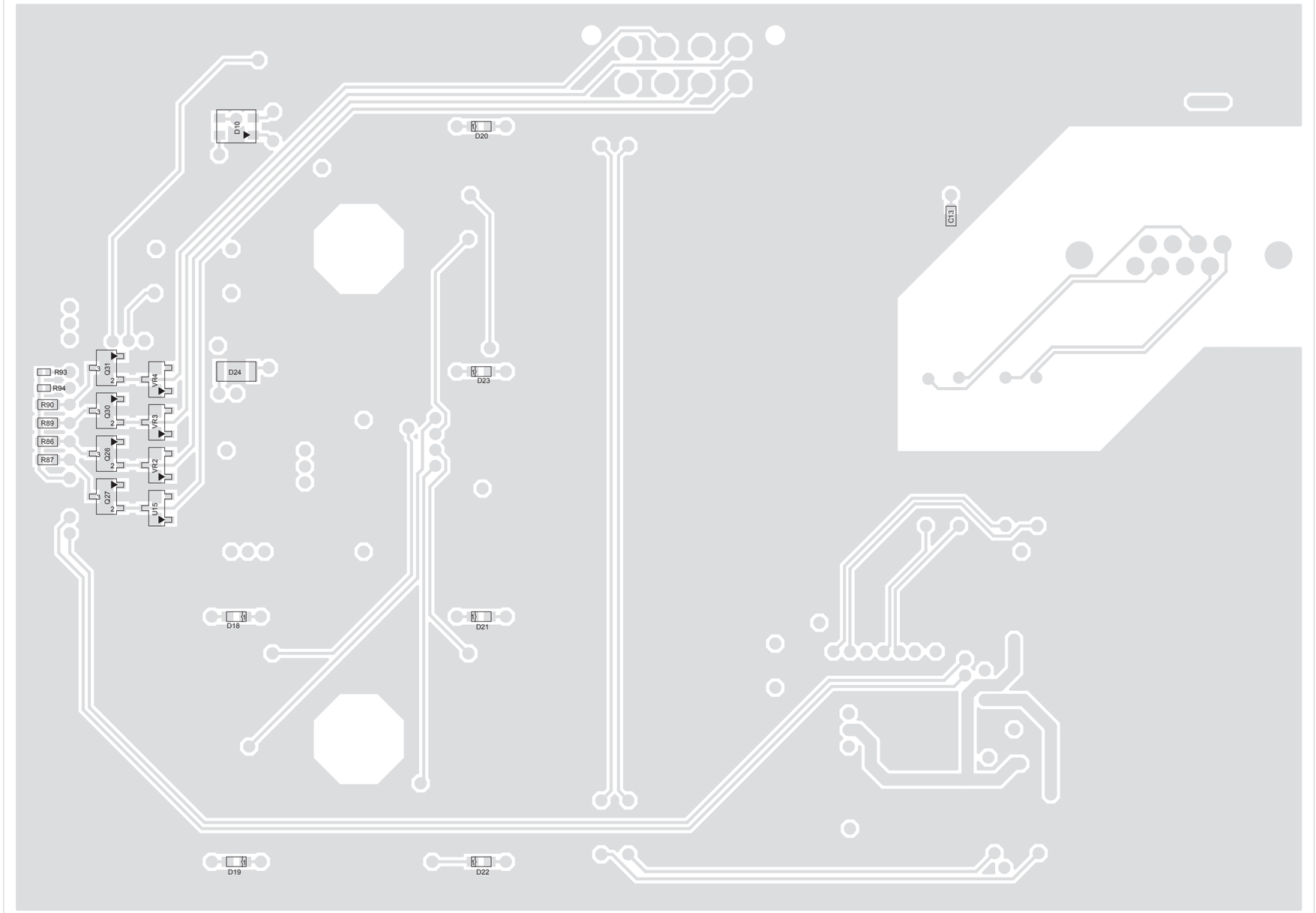
Table 2-1 Repeater Indicator Board Schematic Diagrams and Parts List

Notes

2.0 Repeater Indicator Board (PMLN5643_) PCB/Schematics/Parts List

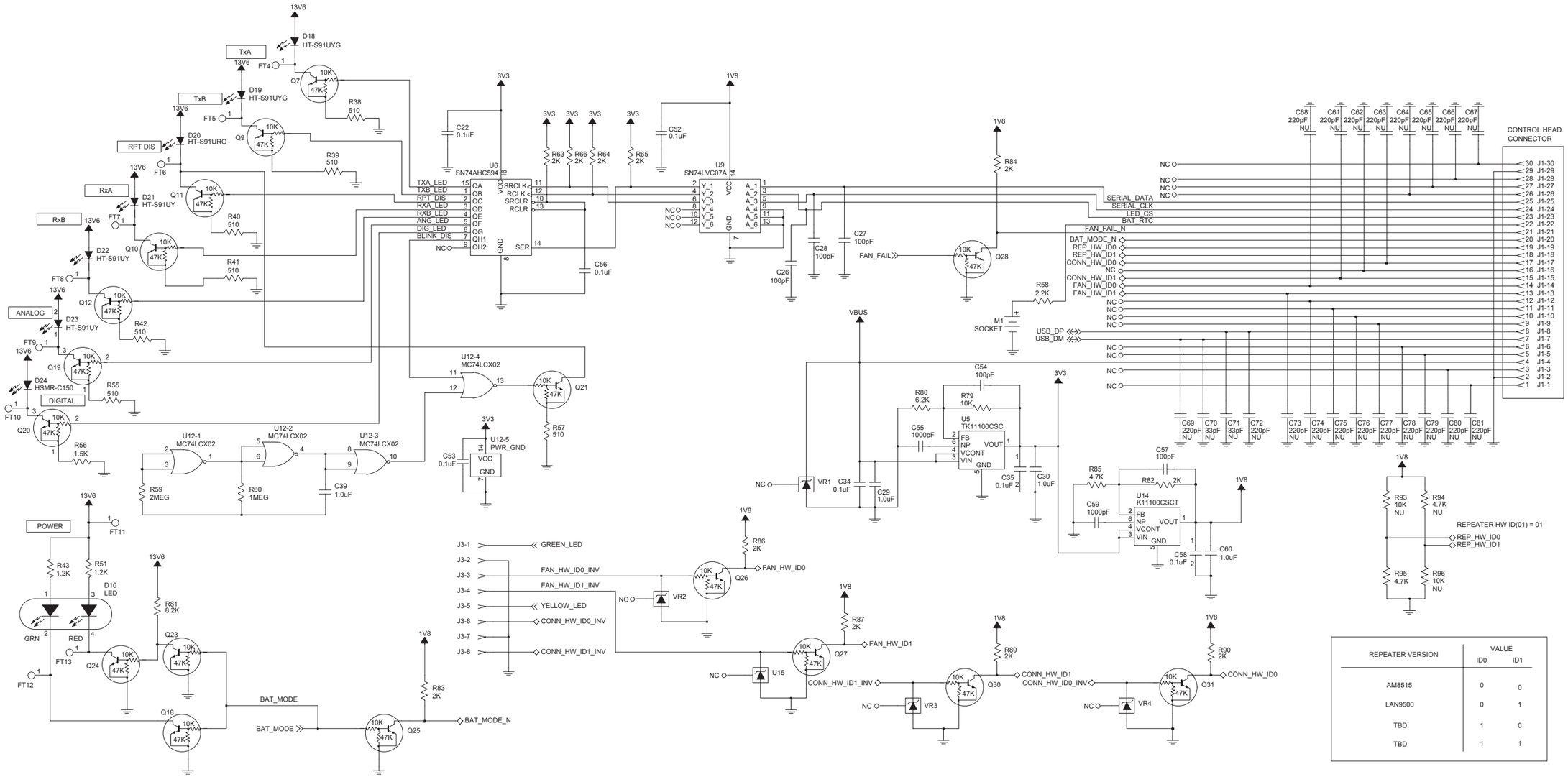


Repeater Indicator Board PCB 84012135001 (Top Side)



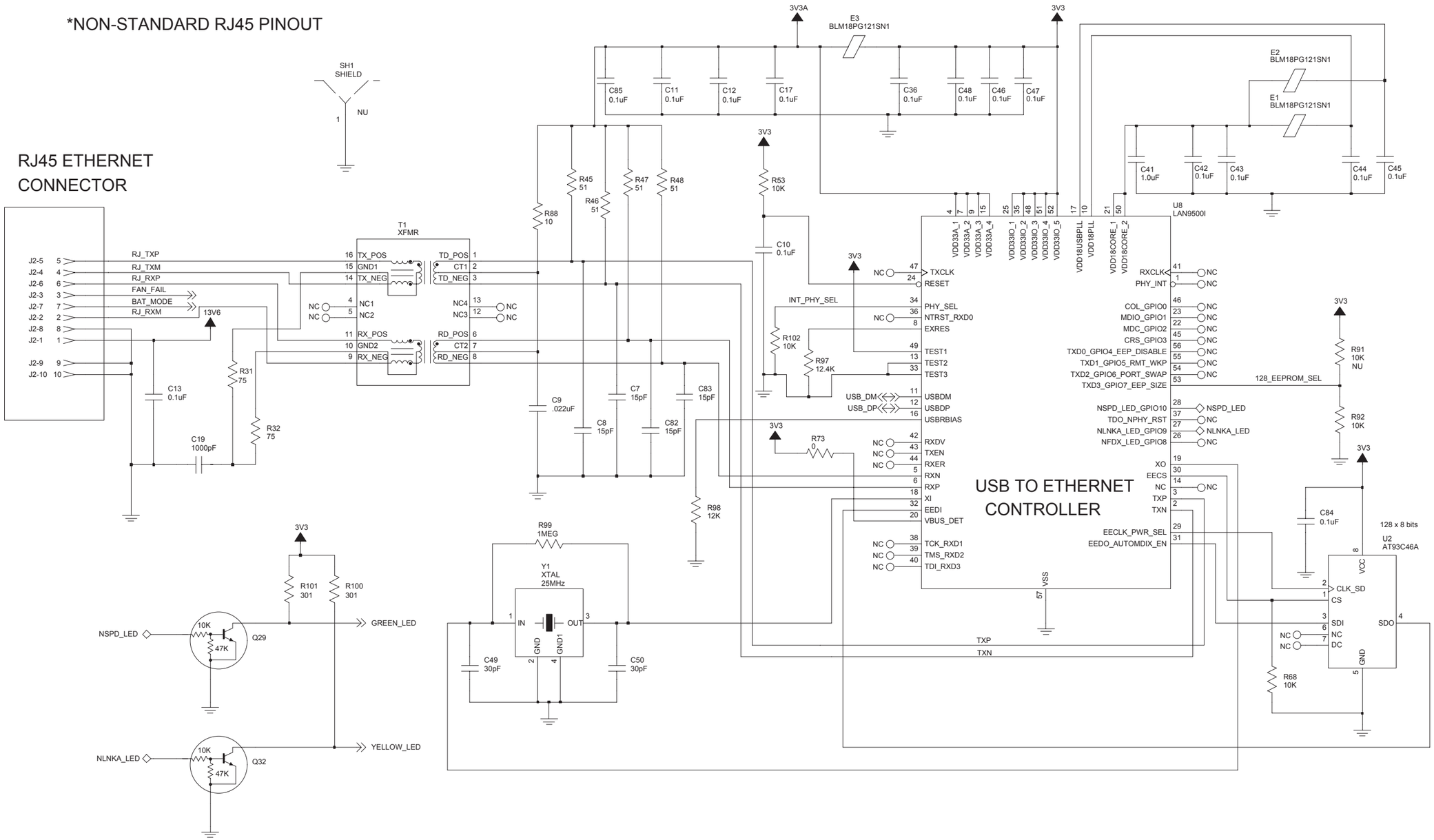
(For reference only - board is not field-repairable)

Repeater Indicator Board PCB 84012135001 (Bottom Side)



(For reference only - board is not field-repairable)

Repeater Indicator Board Schematic Diagram (Sheet 1 of 2)



(For reference only - board is not field-repairable)

Repeater Indicator Board Schematic Diagram (Sheet 2 of 2)

2.1 Repeater Indicator Board Parts List PMLN5643_

Circuit Ref	Motorola Part No.	Description
C10	2113945C31	0.1 UF
C11	2113945C31	0.1 UF
C12	2113945C31	0.1 UF
C13	2113945C31	0.1 UF
C17	2113945C31	0.1 UF
C19	2186154V01	1 NF
C22	2113945C31	0.1 UF
C26	2113944A40	100 PF
C27	2113944A40	100 PF
C28	2113944A40	100 PF
C29	2113946E02	1.0 UF
C30	2113946E02	1.0 UF
C34	2113945C31	0.1 UF
C35	2113945C31	0.1 UF
C36	2113945C31	0.1 UF
C39	2113946E02	1.0 UF
C41	2113946E02	1.0 UF
C42	2113945C31	0.1 UF
C43	2113945C31	0.1 UF
C44	2113945C31	0.1 UF
C45	2113945C31	0.1 UF
C46	2113945C31	0.1 UF
C47	2113945C31	0.1 UF
C48	2113945C31	0.1 UF
C49	2115153H44	CAP, CERAMIC
C50	2115153H44	CAP, CERAMIC
C52	2113945C31	0.1 UF
C53	2113945C31	0.1 UF
C54	2113944A40	100 PF
C55	2113945A09	1000 PF
C56	2113945C31	0.1 UF
C57	2113944A40	100 PF
C58	2113945C31	0.1 UF
C59	2113945A09	1000 PF
C60	2113946E02	1.0 UF
C61	NOT PLACED	–
C62	NOT PLACED	–
C63	NOT PLACED	–
C64	NOT PLACED	–
C65	NOT PLACED	–
C66	NOT PLACED	–
C67	NOT PLACED	–
C68	NOT PLACED	–
C69	NOT PLACED	–
C7	2113944M22	15 PF
C70	NOT PLACED	–
C71	NOT PLACED	–
C72	NOT PLACED	–
C73	NOT PLACED	–
C74	NOT PLACED	–
C75	NOT PLACED	–
C76	NOT PLACED	–
C77	NOT PLACED	–
C78	NOT PLACED	–
C79	NOT PLACED	–
C8	2113944M22	15 PF
C80	NOT PLACED	–
C81	NOT PLACED	–
C82	2113944M22	15 PF
C83	2113944M22	15 PF
C84	2113945C31	0.1 UF
C85	2113945C31	0.1 UF
C9	2113945C04	22000 PF
D10	4887557T01	LED BI COLOR RED GREEN
D18	4815809H01	GREEN LED
D19	4815809H01	GREEN LED
D20	4815809H02	RED LED
D21	4815809H03	YELLOW LED
D22	4815809H03	YELLOW LED
D23	4815809H03	YELLOW LED
D24	48010088001	BLUE LED
E1	7686949J15	FLTR,FERR
E2	7686949J15	FLTR,FERR
E3	7686949J15	FLTR,FERR
J1	0915555H01	CONNECTOR, 30 POSITION
J2	0915930H01	RJ-45, CAT5 SHIELDED, ONE PORT
J3	9012030001	8 PIN CONNECTOR
M1	0985888K02	SKT RTC BTTY LEAP
PASTE	1085674C03	PASTE/NC-SMQ230
Q10	4815261H01	TRANSISTOR, NPN
Q11	4815261H01	TRANSISTOR, NPN
Q12	4815261H01	TRANSISTOR, NPN
Q18	4815261H01	TRANSISTOR, NPN
Q19	4815261H01	TRANSISTOR, NPN
Q20	4815261H01	TRANSISTOR, NPN
Q21	4815261H01	TRANSISTOR, NPN
Q23	4815261H01	TRANSISTOR, NPN
Q24	4815261H01	TRANSISTOR, NPN
Q25	4815261H01	TRANSISTOR, NPN
Q26	4815261H01	TRANSISTOR, NPN
Q27	4815261H01	TRANSISTOR, NPN
Q28	4815261H01	TRANSISTOR, NPN
Q29	4815261H01	TRANSISTOR, NPN
Q30	4815261H01	TRANSISTOR, NPN
Q31	4815261H01	TRANSISTOR, NPN
Q32	4815261H01	TRANSISTOR, NPN
Q7	4815261H01	TRANSISTOR, NPN
Q9	4815261H01	TRANSISTOR, NPN
R100	0613952L47	301
R101	0613952L47	301
R102	0613952N01	10.0K
R31	0613952Q46	75
R32	0613952Q46	75
R38	0613952H66	510
R39	0613952H66	510
R40	0613952H66	510
R41	0613952H66	510
R42	0613952H66	510
R43	0613958S75	1200
R45	0613952H42	51
R46	0613952H42	51
R47	0613952H42	51
R48	0613952H42	51
R51	0613958S75	1200
R53	0613952N01	10.0K
R55	0613952H66	510

Circuit Ref	Motorola Part No.	Description
R56	0613952H77	1500
R57	0613952H66	510
R58	0613952H81	2200
R59	0613952R56	2.0M
R60	0613952J49	1.0M
R63	0613952H80	2000
R64	0613952H80	2000
R65	0613952H80	2000
R66	0613952H80	2000
R68	0613952N01	10.0K
R73	0613952G67	0
R79	0613952N01	10.0K
R80	0613952H92	6200
R81	0613952Q95	8200
R82	0613952H80	2000
R83	0613952H80	2000
R84	0613952H80	2000
R85	0613952Q89	4700
R86	0613952H80	2000
R87	0613952H80	2000
R88	0613952Q25	10
R89	0613952H80	2000
R90	0613952H80	2000
R91	NOT PLACED	–
R92	0613952N01	10.0K
R93	NOT PLACED	–
R94	0613952Q89	4700
R95	0613952Q89	4700
R96	NOT PLACED	–
R97	0613952E10	12.4K

Circuit Ref	Motorola Part No.	Description
R98	0613952Z55	12K
R99	0613952R49	1.0M
T1	2489647C01	TRANSFORMER
U12	5114007A02	NOR GATE
U14	5115391H01	LINEAR REGULATOR IC
U15	4813977M13	DIODE
U2	51012124001	IC,SERIAL EEPROM
U5	5115391H01	LINEAR REGULATOR IC
U6	5115476H01	8-BIT SHIFT REGISTER
U8	51009265001	LAN9500
U9	5115502H01	SN74LVC07APWR
VR1	4813977M13	DIODE
VR2	4813977M13	DIODE
VR3	4813977M13	DIODE
VR4	4813977M13	DIODE
Y1	4884121Y01	XTAL, SMT 25MHZ, 50PPM
PCB	84012135001	

XPR 8380
MOTOTRBO Repeater

Chapter 3

Connector Board

Service Information

Issue: April, 2010

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Chapter 3 - Connector Board Service Information

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Section 1 Theory of Operation

Section 2 Connector Board/Schematics/Parts Lists

Notes

Section 1

THEORY OF OPERATION

1.0 Overview

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

2.0 Connector Board

The Connector board serves multiple purposes: provides a place for the Repeater's MAP and Ethernet connectors, and a location for the Repeater's fan control circuitry and optional OCXO circuitry (on PMLN5579A only).

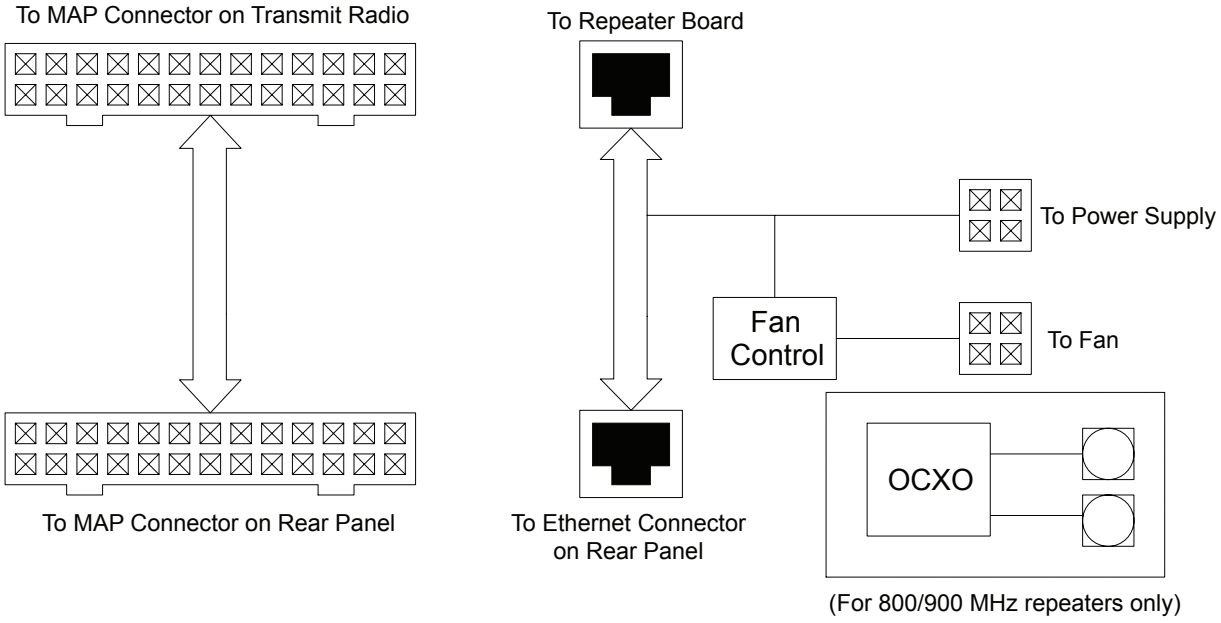


Figure 1-1 Connector Board Block Diagram

2.1 Fan

The fan control logic is provided by the fan controller IC (U51). This is a device from Cypress Semiconductor. There are basically two functions provided by the fan controller. First, it provides a PWM output based on a temperature input, and secondly, it provides detection of fan failure based on the fan tachometer reading.

The Repeater's internal chassis temperature is measured with an LM50 precision temperature sensor IC (U52). This IC outputs a voltage that is linearly proportional to temperature at 10 mV/°C, and with an offset of +500 mV. The output voltage of the LM50 ranges from +200 mV at -30°C to 1.1 V at +60°C.

The fan controller ID (U51) controls the speed of the fan by adjusting the PWM output (pin 1) from 0% to 100%. As long as the fan continues to work, pulses are output from the fan and input to the fan controller (pin 2). Should the fan controller detect that the fan has failed, it will assert the "Fan Fail" signal (pin 19). A fan failure alarm can be generated from this condition.

2.2 AC/DC Power Supply

The Repeater uses the PMPN4001A switch-mode, Power Supply Unit (PSU). It is capable of 200 W and designed for a 50 W UHF or VHF repeater system. This supply has UL, CE, and TUV regulatory approvals and is usable in all regions by using the correct line cord. The AC input is auto-ranging with no manual switch being specified to operate from 90 V-270 V and 47 Hz-63 Hz. It outputs a nominal voltage of 13.8 V with a voltage tolerance of +/- 5%.

It has Power Factor Correction circuitry and is rated at 15 A across the whole operating temperature range of -30°C to +60°C. It also has a built-in battery revert circuit with a float output available for maintaining the charge on a battery and has UL, CE, & TUV approvals. The battery revert connector is accessible in the back of the power supply.

The supply has over-load, over-voltage, and over-temperature protection. In an overload condition, the PSU goes into a hiccup mode where it recovers automatically after the fault condition is removed. During an over-voltage condition, the PSU shuts down and will have to be re-powered on to recover. In an over-temperature condition, the PSU also shuts down, but will recover after the temperature goes down.

The PSU is not designed to be field serviceable. If it is determined that the PSU is not functioning, the whole unit needs to be replaced.

2.3 Battery Backup Operation

If AC power is removed or interrupted, the repeater will switch to its battery backup until AC is restored. The battery backup operation is controlled by a voltage sensing circuit on the connector board. During DC operation, the circuit monitors the DC voltage of the battery connected to the backup terminal on the PSU and enables or disables the unit accordingly to maintain reliable repeater operation.

When the battery voltage dips below approximately 7.5V, the repeater will disable itself until either AC is restored or the battery voltage recovers to above 10.5V. When heavy loading is present, the battery voltage may swing from 7.5V to 10.5V as soon as the unit disables and the loading is removed. Intermittent functionality may occur during this mode of operation, but it is normal and expected during low battery backup operation.

2.4 OCXO

An OCXO (Oven-Controller Crystal Oscillator) is populated on the Connector board for the 800/900 repeater (PMLN5579_).

The OCXO is a high-stability 0.1 ppm oscillator that is specified to operate from -30°C to +85°C. The output from the oscillator is connected to the Rx and Tx transceiver bricks via two SMA cables. This signal overrides the TCXO signals inside the transceiver bricks through a hardware switching circuit.

Notes

Section 2

CONNECTOR BOARD/SCHEMATICS/PARTS LISTS

1.0 Allocation of Printed Circuit Board, Schematics and Parts Lists

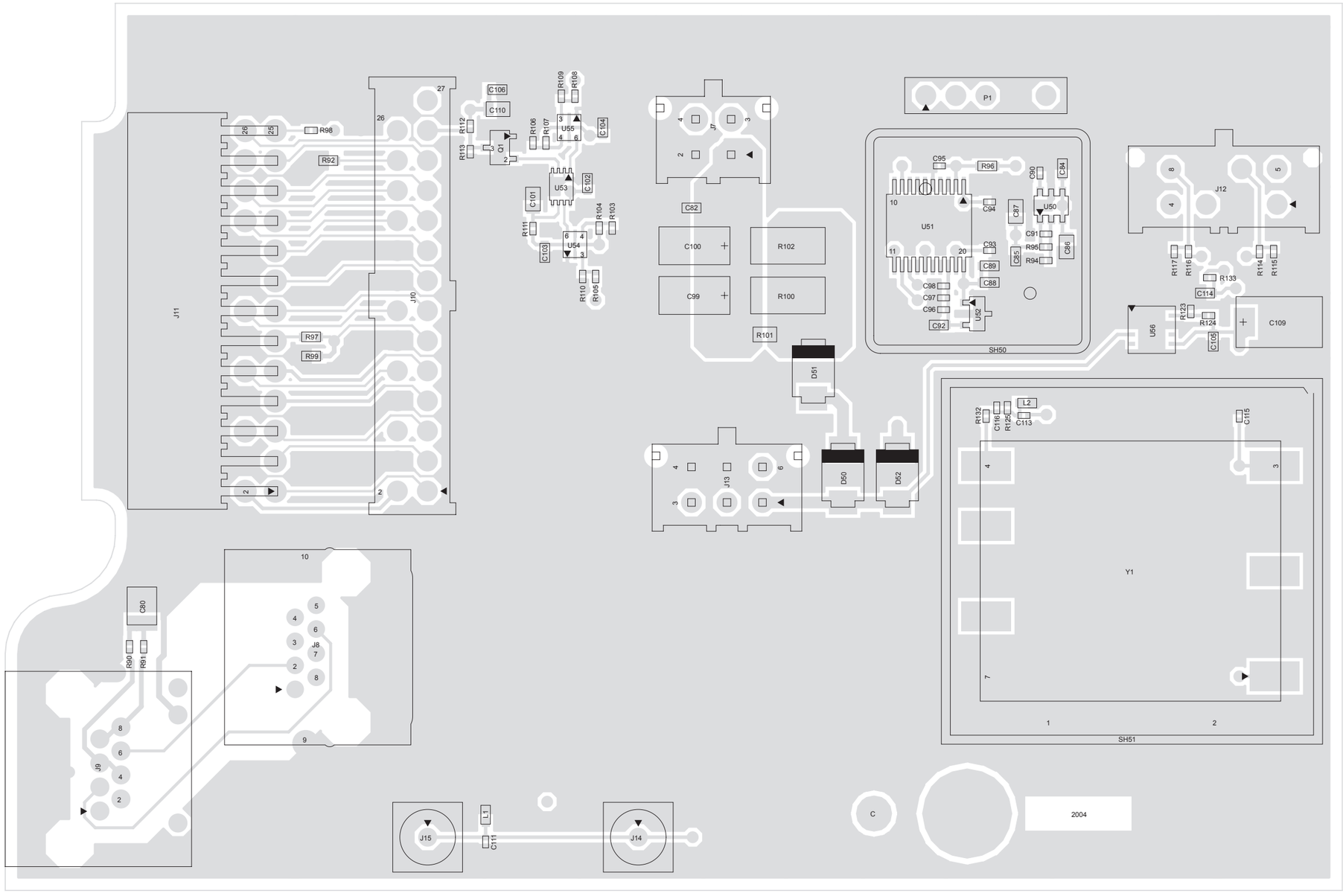
1.1 Connector Board Circuits

This Chapter shows the Printed Circuit Board (PCB), Schematics and Parts Lists for the Connector Board circuits.

Table 2-1 Connector Board Schematic Diagrams and Parts List

Notes

2.0 Connector Board PMLN5644_ & OCXO Connector Board PMLN5579_ PCB/Schematics/Parts Lists

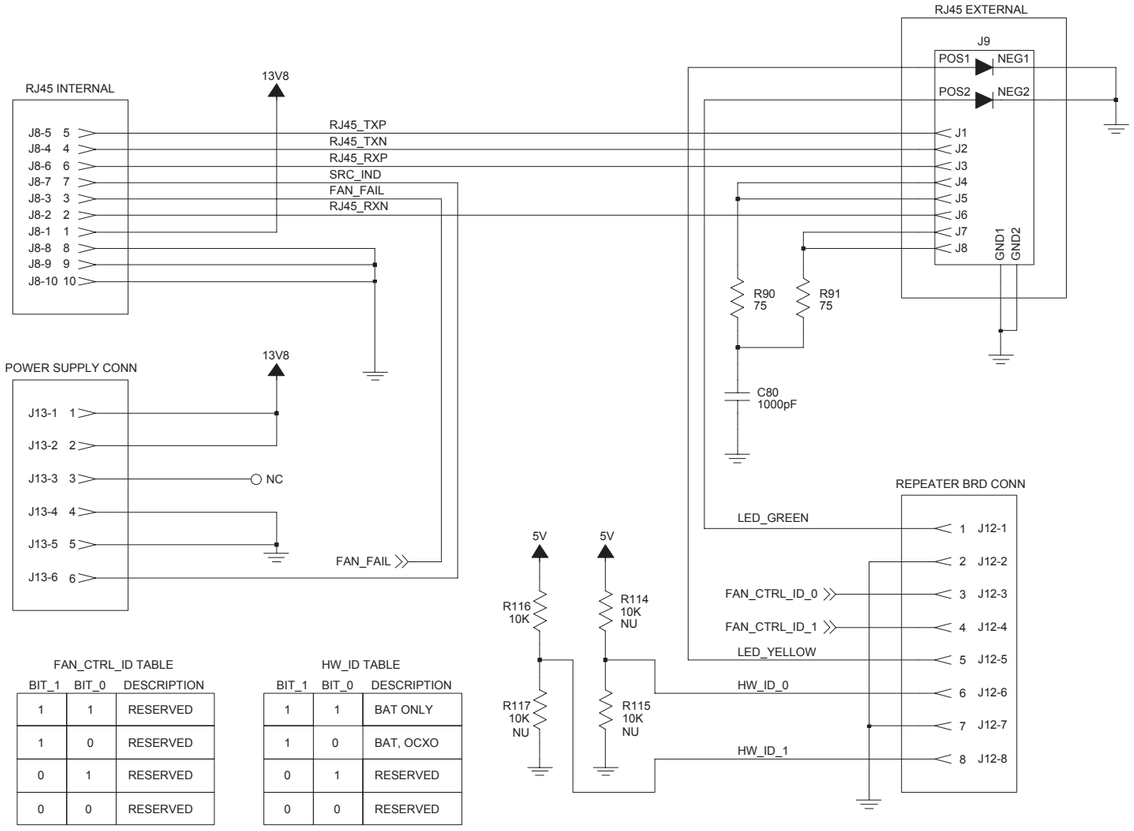


(For reference only - board is not field-repairable)

Connector Board PCB 84012133001 (Top Side)

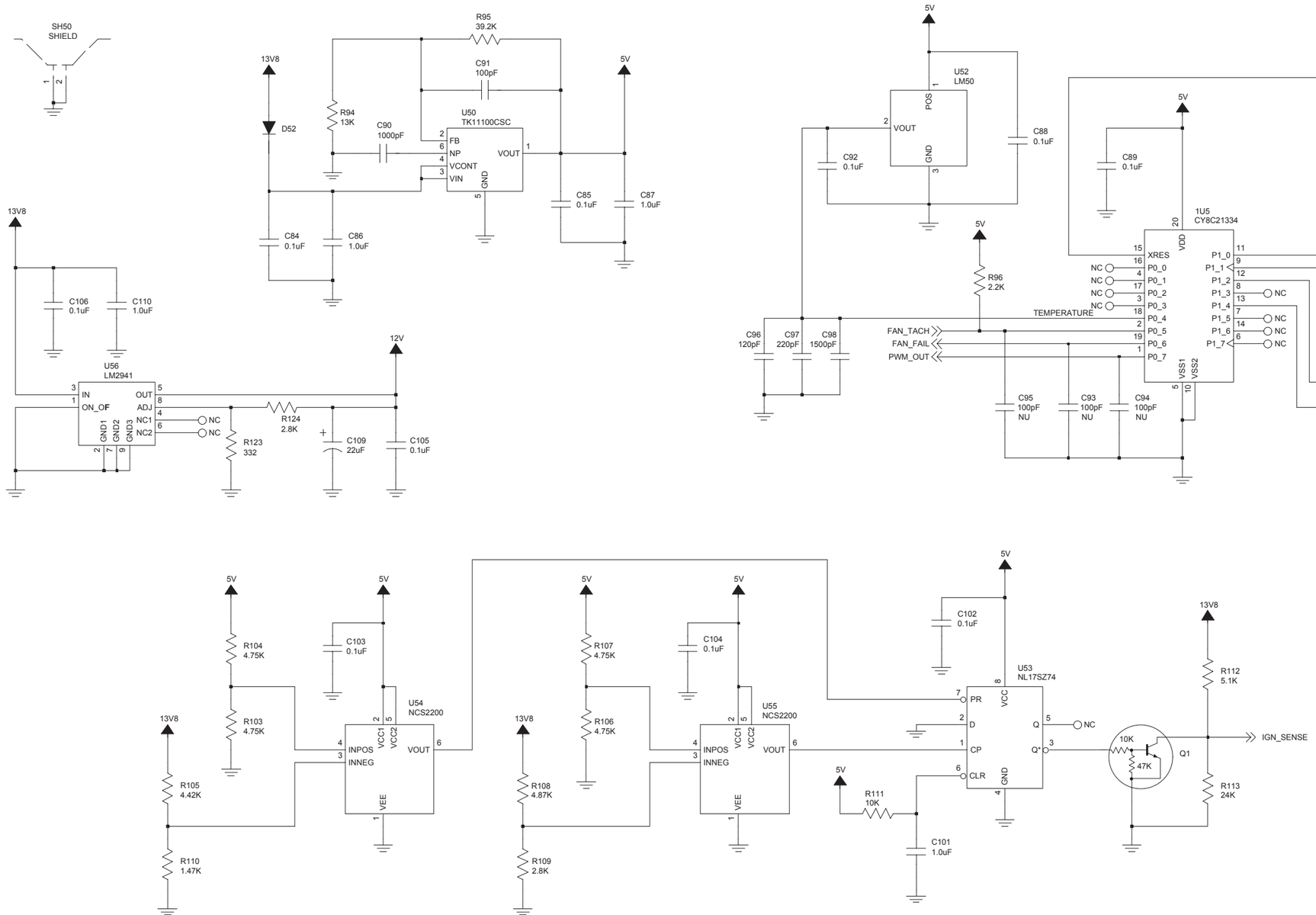
(For reference only - board is not field-repairable)

Connector Board PCB 84012133001 (Bottom Side)



(For reference only - board is not field-repairable)

Connector Board Schematic Diagram (Sheet 1 of 2)



(For reference only - board is not field-repairable)

Connector Board Schematic Diagram (Sheet 2 of 2)

2.1 Connector Board Parts List PMLN5644_

Circuit Ref	Motorola Part No	Description
C80	2186154V01	1 NF
C82	2113945C31	0.1UF
C84	2113945C31	0.1UF
C85	2113945C31	0.1UF
C86	2113946E02	1.0 UF
C87	2113946E02	1.0 UF
C88	2113945C31	0.1UF
C89	2113945C31	0.1UF
C90	2113945A09	1000 PF
C91	2113944A40	100 PF
C92	2113945C31	0.1UF
C93	NOT PLACED	–
C94	NOT PLACED	–
C95	NOT PLACED	–
C96	2113944A41	120 PF
C97	2113944A44	220 PF
C98	2113945A10	1500 PF
C99	2314030E85	33 UF
C100	2314030E85	33 UF
C101	2113946E02	1.0 UF
C102	2113945C31	0.1UF
C103	2113945C31	0.1UF
C104	2113945C31	0.1UF
C105	NOT PLACED	–
C106	NOT PLACED	–
C109	NOT PLACED	–
C110	NOT PLACED	–
C111	NOT PLACED	–
C113	NOT PLACED	–
C114	NOT PLACED	–
C115	NOT PLACED	–
C116	NOT PLACED	–
D50	4813978B01	DIODE
D51	4813978B01	DIODE
D52	4813978B01	DIODE
J7	2815631H01	CONNECTOR, 4 POSITION, PCB
J8	0915930H01	RJ-45, CAT5 SHIELDED
J9	0985459Y01	JACK, RJ45, GRN & YELLOW LEDS
J10	2816476H01	CONNECTOR, 28 POSITION
J11	0971878L01	CONNECTOR, 26 POSITION
J12	9012030001	8 PIN CONNECTOR
J13	2815632H01	CONNECTOR, 6 POSITION
J14	NOT PLACED	–
J15	NOT PLACED	–
L1	NOT PLACED	–
L2	NOT PLACED	–
P1	NOT PLACED	–
Q1	4815261H01	TRANSISTOR
R90	0613952Q46	75
R91	0613952Q46	75
R92	0613952G67	0
R94	0613952N12	13.0K
R95	0613952N58	39.2K
R96	0613952H81	2200
R97	0613952G67	0
R98	NOT PLACED	–
R99	NOT PLACED	–
R100	0613959Y09	2.2
R101	NOT PLACED	–
R102	0613959Y09	2.2
R103	0613952M66	4750
R104	0613952M66	4750
R105	0613952M63	4420
R106	0613952M66	4750
R107	0613952M66	4750
R108	0613952M67	4870
R109	0613952M44	2800
R110	0613952M17	1470
R111	0613952R01	10K
R112	0613952Q90	5100
R113	0613952R10	24K
R114	0613952R01	10K
R115	NOT PLACED	–
R116	0613952R01	10K
R117	NOT PLACED	–
R123	NOT PLACED	–
R124	NOT PLACED	–
R125	NOT PLACED	–
R132	NOT PLACED	–
R133	NOT PLACED	–
SH50	2686423Z02	SHIELD, 19 X 19 X 3.03 MM
SH51	NOT PLACED	–
U50	5115391H01	LINEAR REGULATOR IC
U51	0104036J82	CY8C21334-24PVXIT
U52	5115022H01	IC TEMPERATURE SENSOR
U53	5114007M28	17SZ74 IC
U54	5109817F82	LOW VOLTAGE COMPARATOR
U55	5109817F82	LOW VOLTAGE COMPARATOR
U56	NOT PLACED	–
Y1	NOT PLACED	–
PASTE	1085674C03	PASTE/NC-SMQ230
PCB	84012133001	

2.2 OCXO Connector Board Parts List PMLN5579_

Circuit Ref	Motorola Part No	Description
C80	2186154V01	CAP, 1000pF
C82	2113945C31	CAP, 0.1uF
C84	2113945C31	CAP, 0.1uF
C85	2113945C31	CAP, 0.1uF
C86	2113946E02	CAP, 1.0uF
C87	2113946E02	CAP, 1.0uF
C88	2113945C31	CAP, 0.1uF
C89	2113945C31	CAP, 0.1uF
C90	2113945A09	CAP, 1000pF
C91	2113944A40	CAP, 100pF
C92	2113945C31	CAP, 0.1uF
C93	NOT PLACED	–
C94	NOT PLACED	–
C95	NOT PLACED	–
C96	2113944A41	CAP, 120pF
C97	2113944A44	CAP, 220pF
C98	2113945A10	CAP, 1500pF
C99	2314030E85	CAPP, 33uF
C100	2314030E85	CAPP, 33uF
C101	2113946E02	CAP, 1.0uF
C102	2113945C31	CAP, 0.1uF
C103	2113945C31	CAP, 0.1uF
C104	2113945C31	CAP, 0.1uF
C105	2113945C31	CAP, 0.1uF
C106	2113945C31	CAP, 0.1uF
C107	NOT PLACED	–
C109	2314030J28	CAPP, 22uF
C110	2113946E02	CAP, 1.0uF
C111	NOT PLACED	–
C112	NOT PLACED	–
C113	2113945B02	CAP, .01uF
C114	2113945C31	CAP, 0.1uF
C115	2113944A48	CAP, 47 pF
C116	2113944A33	CAP, 47 pF
D50	4813978B01	DIODE
D51	4813978B01	DIODE
D52	4813978B01	DIODE
J7	2815631H01	CONNECTOR, 4 POSITION, PCB
J8	0915930H01	RJ-45, CAT5 SHIELDED
J9	0985459Y01	JACK, RJ45, GRN & YELLOW LEDS
J10	2816476H01	CONNECTOR, 28 POSITION
J11	0971878L01	CONNECTOR, 26 POSITION
J12	09012030001	8 PIN CONNECTOR
J13	2815632H01	CONNECTOR, 6 POSITION
J14	0909901V02	CONN_J
J15	0909901V02	CONN_J
L1	2415429H47	IDCTR, 390nH
L2	NOT PLACED	–
P1	NOT PLACED	–
Q1	4815261H01	TRANSISTOR
Q2	NOT PLACED	–
R90	0613952Q46	RES, 75
R91	0613952Q46	RES, 75
R92	0613952G67	RES, 0
R94	0613952N12	RES, 13K
R95	0613952N58	RES, 39.2K
R96	0613952H81	RES, 2.2K
R97	0613952G67	RES, 0
R98	NOT PLACED	–
R99	NOT PLACED	–
R100	0613959Y09	RES, 2.2
R101	NOT PLACED	–
R102	0613959Y09	RES, 2.2
R103	0613952M66	RES, 4.75K
R104	0613952M66	RES, 4.75K
R105	0613952M63	RES, 4.42K
R106	0613952M66	RES, 4.75K
R107	0613952M66	RES, 4.75K
R108	0613952M67	RES, 4.87K
R109	0613952M44	RES, 2.8K
R110	0613952M17	RES, 1.47K
R111	0613952R01	RES, 10K
R112	0613952Q90	RES, 5.1K
R113	0613952R10	RES, 24K
R114	NOT PLACED	–
R115	0613952R01	RES, 10K
R116	0613952R01	RES, 10K
R117	NOT PLACED	–
R118	NOT PLACED	–
R123	0613952L51	RES, 332
R124	0613952M44	RES, 2.8K
R125	0613952Q65	RES, 4.7K
R126	NOT PLACED	–
R127	NOT PLACED	–
R128	NOT PLACED	–
R129	NOT PLACED	–
R130	NOT PLACED	–
R131	NOT PLACED	–
R132	0613952Q66	RES, 510
R133	0613952R66	RES, 0
SH50	2686423Z02	SHIELD
SH51	26012079001	SHIELD
U50	5115391H01	LINEAR REGULATOR IC
U51	0104030J82	CY8C21334
U52	5115022H01	IC TEMPERATURE SENSOR
U53	5114007M28	NL17SZ74
U54	5109817F82	LOW VOLTAGE COMPARATOR
U55	5109817F82	LOW VOLTAGE COMPARATOR
U56	5171774H01	LM2941
Y1	93009259001	OCXO-220
PASTE	1085674C03	
PCB	84012133001	

XPR 8380
MOTOTRBO Repeater

Chapter 4

Controller

Service Information

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Chapter 4 - Controller Service Information

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Section 2 Troubleshooting Charts

Section 3 Controller Schematics/Parts Lists

Notes

Section 1

THEORY OF OPERATION

1.0 Controller

The Controller section consists of 4 main ICs. These are the Texas Instrument OMAP 1710 Host/ DSP Processor (U1000), Flash memory (U2000), SDRAM memory (U2001) and the MAKO Audio/ Power Management (U3200) chip.

Figure 1-1 shows how the Controller interfaces with the RF section, and peripherals in an XPR 8380 repeater. The Controller, RF section, and Accessory interface are placed on a single Transceiver board.

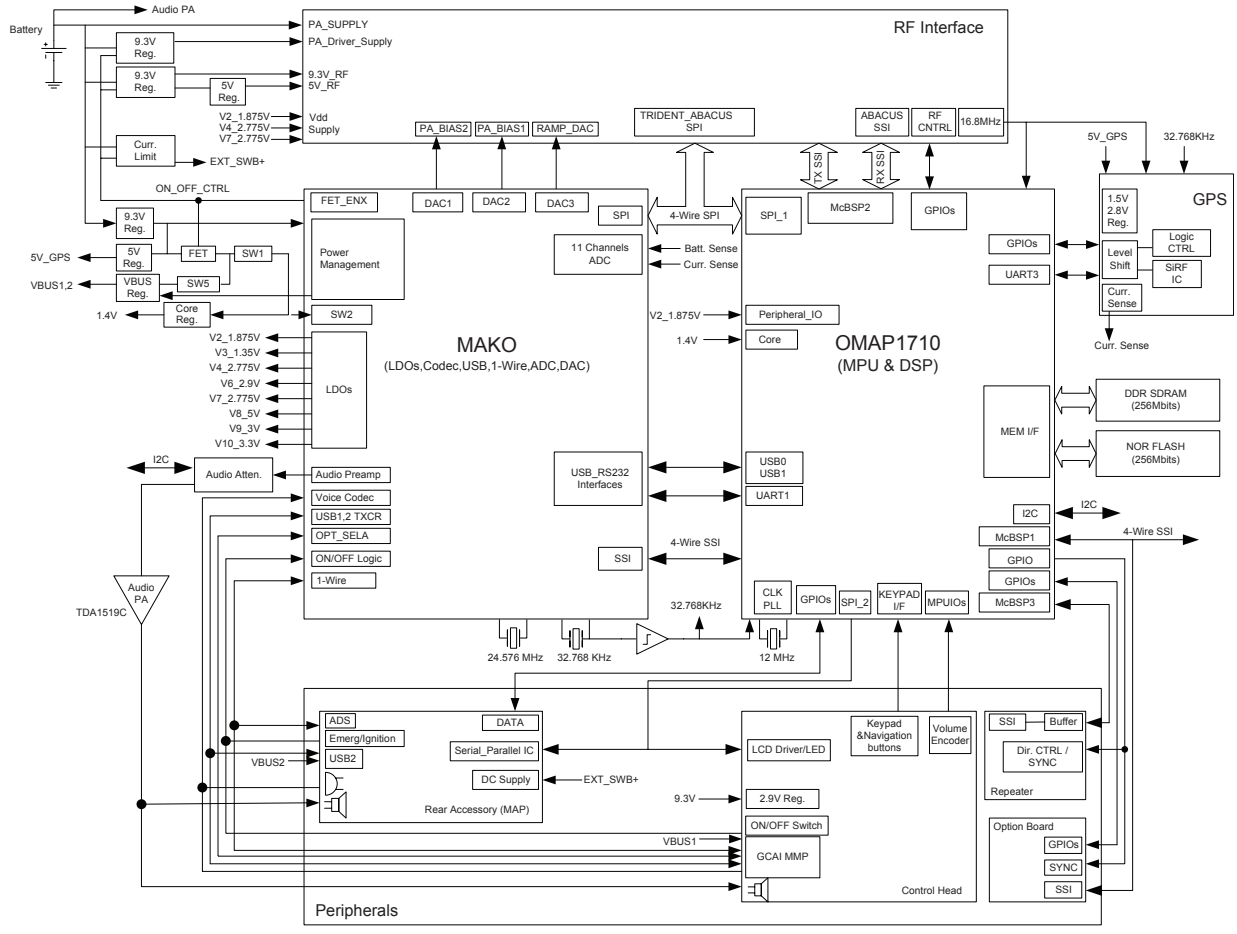


Figure 1-1 Controller Block Diagram

1.1 Radio Power Distribution

Figure 1-2 illustrates the controller DC power distribution throughout the transceiver board.

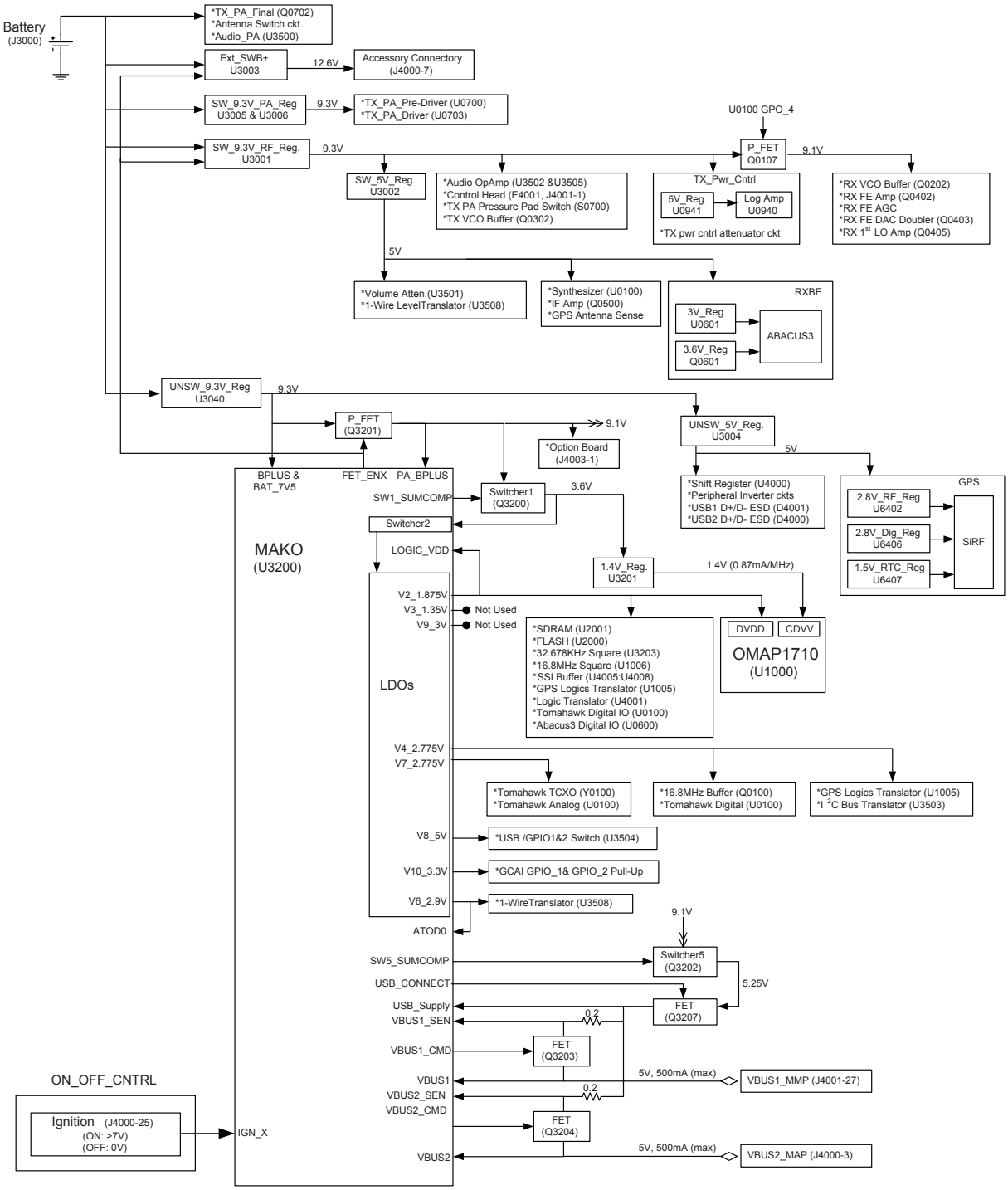


Figure 1-2 Radio DC Distribution

Voltage regulation is provided to the controller, GPS and RF sections by the following devices:

- +9.3V_PA: U3005, U3006, and U3030
- +9.3V_CNTRL: U3040 and U3030
- +9.3V_SW: U3001
- +12.6V_Ext SWB+: U3003
- +1.5V GPS RTC: U6407
- +1.4V OMAP Core: U3201
- Supplies for the Controller section: U3200 (MAKO)
- Supplies for the RF and GPS sections: U0601, U0941,U3002,U3004,U6402, and U6406

The 9V3_PA regulator uses Op Amp U3030-1 as a controlling element. The regulated output voltage is divided by R3039 and R3040 and compared with an accurate reference voltage (5.1V DC) determined by VR3040. The Op Amp's output voltage at pin 1 varies the amount of conduction in transistors Q3032, U3005 and U3006 as necessary to keep voltages equal on pins 2 and 3 of the Op Amp. A characteristic of the Op Amp which allows the regulator to start up is the fact the output is high when both inputs are low, which occurs momentarily at turn-on. Dual diode D3030 serves two purposes. Diode D3030 is used to protect transistors U3005 and U3006 if the 9.3V_PA line is grounded. When this happens Q3032's base can only be 0.7V DC and transistors U3005 and U3006 will be turned off. Diode D3030 also provides temperature compensation of the regulated output voltage. The 9V3_PA supply powers the low level and driver stages of the RF power amplifier.

The MAKO and GPS regulators are powered by the 9V3_CNTRL supply. Op amp U3030-2 functions as a controlling element for the 9V3_CNTRL regulator. The regulated output voltage is divided by R3045 and R3046 and compared with the reference voltage determined by VR3040. The Op Amp's output voltage at pin 7 varies the amount of conduction in transistors Q3040 and U3040 as necessary to keep equal voltages on pins 5 and 6 of the Op Amp. As is the case with the 9V3_PA regulator, the Op Amp characteristic allows the regulator to start up when both Op Amp inputs are momentarily low at turn-on. Dual diode D3040 serves two purposes. Diode D3040 is used to protect transistor U3040 if the 9.3V_CNTRL line is grounded. When this happens Q3040's base can only be 0.7V DC and transistor U3040 will be turned off. Diode D3030 also provides temperature compensation of the regulated output voltage.

Regulator U3001 generates the 9.3 V required by most RF, power control, and audio circuits. Input and output capacitors C3005, and C3006/C3007/C3046 are used to reduce high frequency noise. R3003 and R3004 resistor divider set the output voltage to 9.3 V. This regulator output is electronically enabled by 0 V signal at pin 2. MAKO (U3200) FET_ENX, Q3206, and Q3041 are used to control the on-off at U3001 pin 2.

Regulator U3003 generates the 12.6V required by external accessory device at connector J4000-7. Input and output capacitors C3012, and C3012 / C3013 are used to reduce high frequency noise. R3003 and R3004 resistor divider set the output voltage to 12.6V. This regulator output is electronically enabled by 0 V signal at pin 2. MAKO (U3200) FET_ENX, Q3206, and Q3041 are used to control the on-off at U3003 pin 2.

There are a total of eight other LDO regulators used to regulate the 9.3 V supply down to specific application voltages. U0941, U3002, and U3004 are set to supply 5 V output. U0601 is set to supply 3 V for the Abacus III IC. U6402 and U6406 generate 2.8V for GPS Digital IO and RF circuitry while U6407 regulator provides 1.5 V for the GPS RTC module. U3201 regulator, which is capable of handling up to 1 Amp, is set to 1.4 V for the OMAP core.

Switcher1 (Q3200) in conjunction with the MAKO power management IC (U3200) is a highly efficient dc-dc converter. In this application, it is configured as a synchronous buck dc-dc regulator. It generates an accurate 3.6 V output, which supplies directly to the MAKO internal Switcher2 circuit as well as the 1.4 V regulator for the OMAP Core (U3201). A pulse width modulated (PWM) signal is output from U3200 pin G14 to Q3200 pin 4 and controls the output voltage level. External components L3200 and C3203 are needed to filter out the dc-dc converter output. R3200 (0.1 ohm) is used for current sense and over-current circuit protection with 2 A threshold. MAKO Switcher2 output 2.3 V and supplies to the rest of MAKO internal LDOs.

Switcher5 (Q3202) circuitry is similar to Switcher1. It is also configured as a synchronous buck dc-dc regulator. It generates an accurate 5.2 V output, which supplies directly to both VBUS1 and VBUS2 supplies. External components L3202 and C3212 are needed to filter out the output. Q3208 and Q3207 prevent internal voltage leakage onto VBUS_SUPPLY (U3200 pin B13). When the radio is operated in the HOST mode, USB_CONNECT (U3200 pin L6) is toggled HIGH (3.3 V) turning on PMOS FET (Q3207) through Q3208 inverter, and thus provides 5.2 V to both Q3203 and Q3204 drains. Software will enable VBUS1_CMD and VBUS2_CMD either VBUS1 or VBUS2 port base on the detection mechanism. Note, only one of two VBUS ports can supply up to 500 mA (max) at one time. R3207 and R3208 (0.2 ohm) are used for current sense and over-current circuit protection with 800 mA threshold. In device mode, USB_CONNECT is toggled LOW to disable VBUS supply.

The MAKO power management IC (U3200) provides eight more LDOs. Some LDOs are programmable to meet the requirement for various ASIC devices. V2, V3, and V9 are programmable via SPI while V4, V5, V6, V8, and V10 are fixed. See Figure 1-2 for details.

1.2 Power On/Off

The repeater is switched ON by use of the ignition sense input. The ignition sense input is controlled by circuitry on the Connector board. It is driven high when the repeater's power supply is switched on, or when the battery voltage stays above 8.6V in battery backup mode.

When the ignition sense input is high, Q4006 is driven into saturation which pulls its collector to ground and presents an active low to MAKO IGN_X input (U3200 pin B4). When there is no voltage at J4000 pin 25, Q4006 is turned off and its collector is internally pulled high by the MAKO Vsave supply. Because of the noisy nature of ignition signal, a long debounce period of 250ms is used before it will be recognized as a valid input.

1.2.1 Power-Up Sequence

Figure 1-3 details the typical power-up sequence on the mobile radio and the following events that occur sequentially.

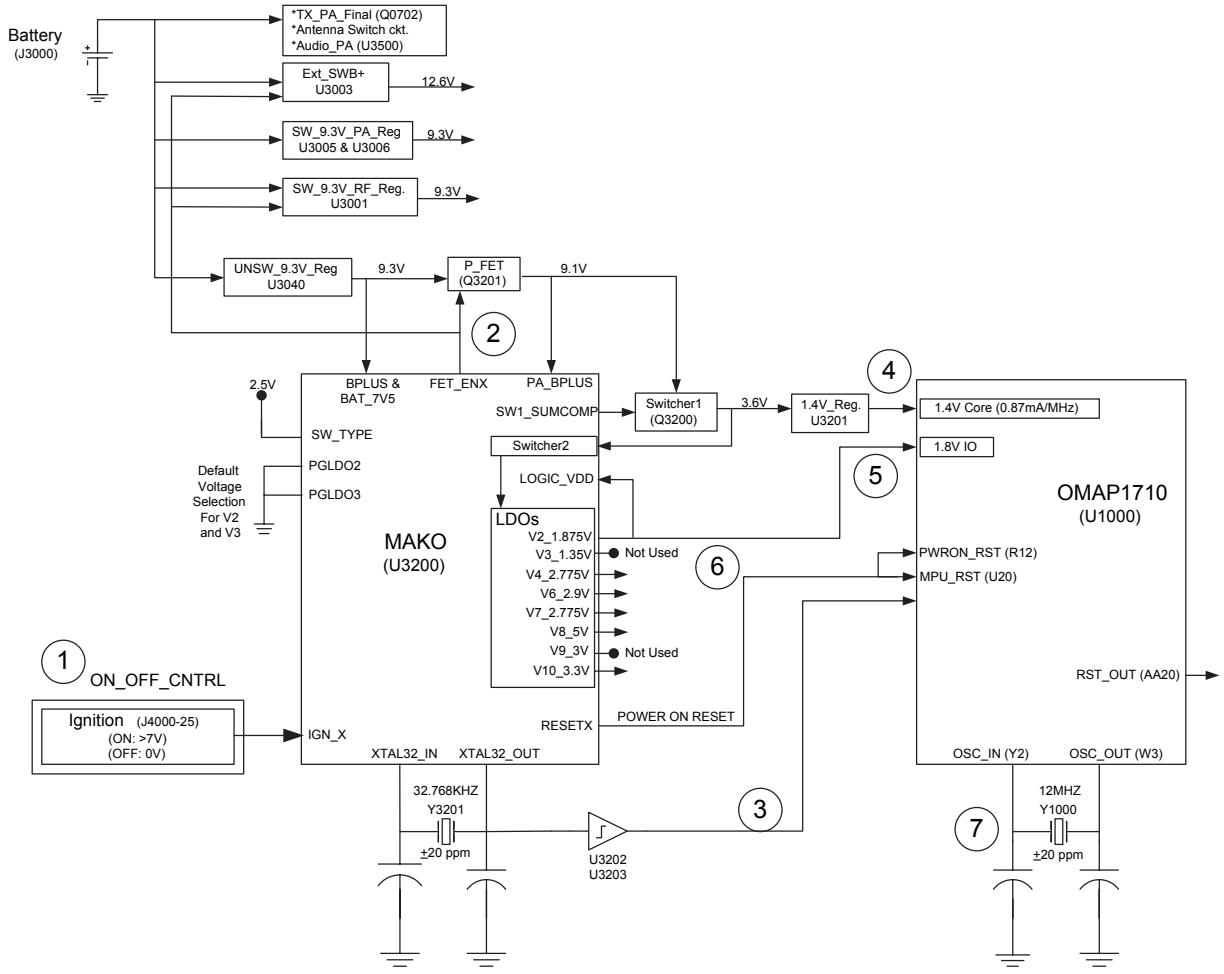


Figure 1-3 Power-Up Sequence

1. User switches on the power supply unit which initiates an ignition sense power on state.
2. The MAKO (U3200) generates an output low at FET_ENX (pin E2) once it detects a valid input at either Mech_SW (pin E4), Emerg_PB (pin F4), or IGN_X (pin B4). Q3206 dual PNP/NPN transistor acts as a double inverter between the MAKO and Q3201 power MOSFET switch as well as over voltage protection. This logic low at the gate of Q3201 results in switching 9.3 V to both Q3200 Switcher circuitry and 1.4 V regulator (U3201).
3. Next the MAKO (U3200) asserts the RESETX (pin C5) low to the OMAP for an additional 32mS after all the DC regulators are stable. It is then de-asserted, allowing the OMAP processor to start.

1.3 Clocks

Figure 1-4 illustrates the controller clocks used throughout the radio.

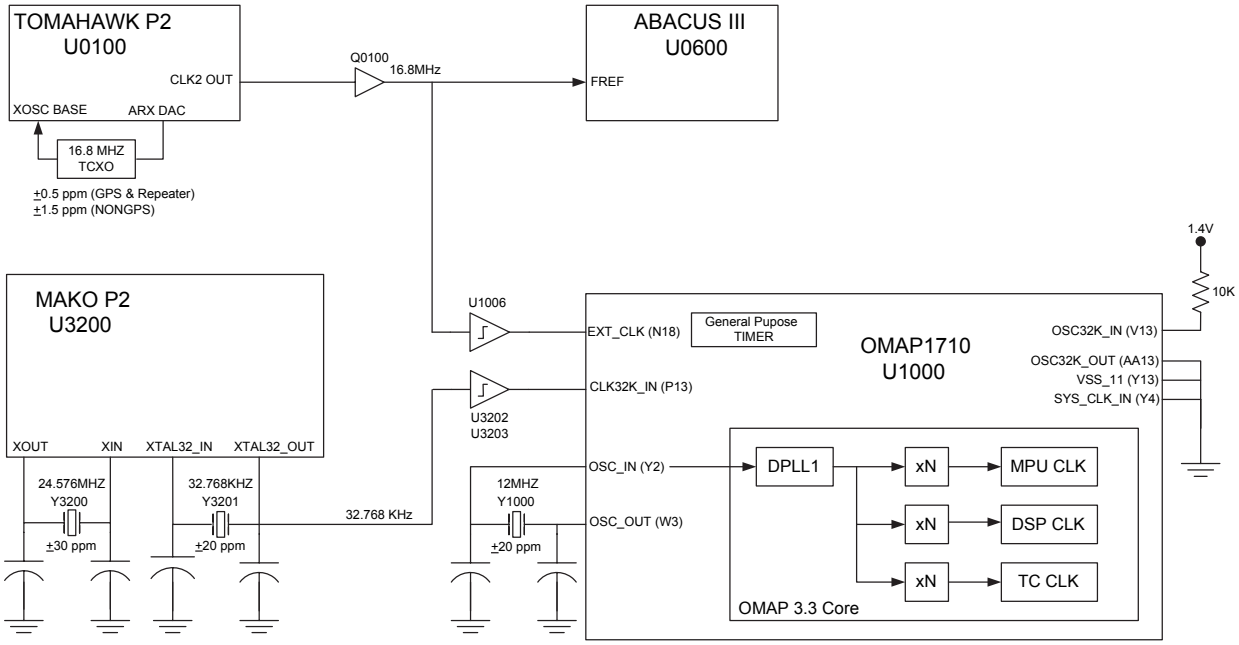


Figure 1-4 Clock Connections

The OMAP processor (U1000), which consists of an ARM and DSP core, needs three clocks for operation: a 32.768 kHz square-wave, a 12 MHz sine-wave, and a 16.8 MHz square-wave clock. The 16.8 MHz clock source is provided from the Tomahawk TCXO with its supporting circuitry Q0100 buffer amplifier, routes to squarer-circuit U1006, and feed to EXT_CLK (U1000 pin N18). The 32.768 kHz clock is generated by the MAKO crystal Y3201 oscillator; converted to a gated clock by U3202 and U3303 circuitry; then directly feed to OMAP CLK32_IN (U1000 pin P13) as well as GPS IC (U6400). The OMAP needs the 32.786 kHz to determine the input reference clock (12, 13, or 19.2 MHz) applied to OSC_IN (U1000 pin Y2). Without this 32 kHz clock, the OMAP will potentially program all the wrong dividers for USB and UART booting. The 12 MHz sine-wave is the main system reference clock for the OMAP which all the internal clocks are derived from. External pull-up on OSC32K_IN (U1000 pin V13) and grounding both OSC32K_OUT (pin AA1 and VSS_11 (pin Y13) indicating that an external 32 kHz clock is used. The 24.576 MHz crystal (Y3200) oscillator is the reference clock for MAKO CODEC and SSI clock.

1.4 Serial Peripheral Interface (SPI)

Figure 1-5 illustrates the controller SPI used throughout the radio.

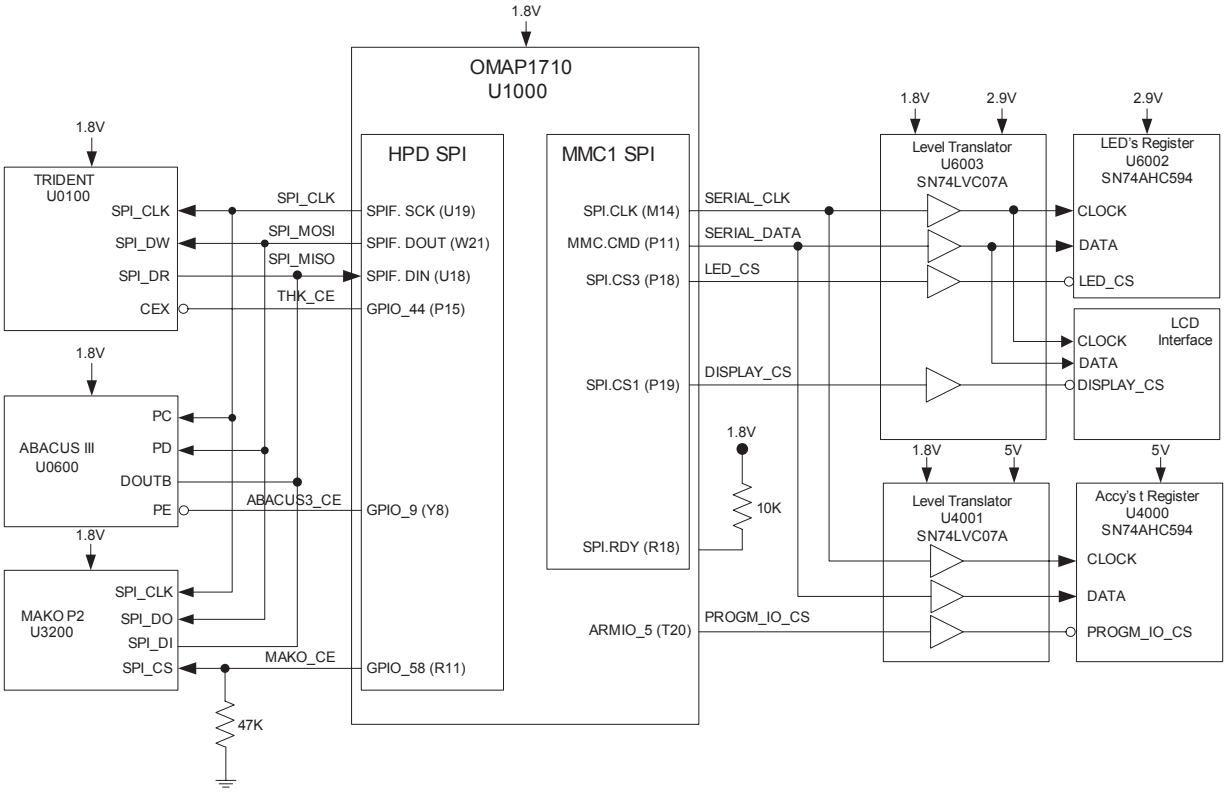


Figure 1-5 SPI Connections

The OMAP processor (U1000) has two SPI busses that it uses to communicate with the various peripheral IC's. The first is the High Performance Data (HPD) SPI bus and the second is the multi-media card (MMC) SPI.

The HPD SPI is a synchronous serial bus made up of four lines, SPI_CLK, SPI_MOSI, SPI_MISO, and chip select. The SPI_CLK line is used to control the speed of the data to/from the peripheral IC's and the OMAP processor. This clock can be adjusted to different speed based on the IC's specification.

HPD SPI module is used to interface to Tomahawk (U0100), Abacus III (U0600), and the MAKO (U3200). This interface operates at 1.8 V logic levels. SPI_MOSI, or commonly known as TRANSMIT Data, is a data string from the OMAP while SPI_MISO or RECEIVE Data is data string to the OMAP.

The MMC SPI is a 3-wire bus; consisting of SERIAL_CLK, SERIAL_DATA, and chip select. This SPI bus is used to interface to accessory Serial-Parallel IC (U4000), the repeater board LED's and LCD driver. For accessory Serial-Parallel IC, the logic level out of the processor is level shifted from 1.8 V to 5 V through U4001 and pull-up resistors R4100, R4101, and R4103.

1.5 Serial Synchronous Interface (SSI)

Figure 1-6 illustrates the controller SSI used on XPR series radios controller design.

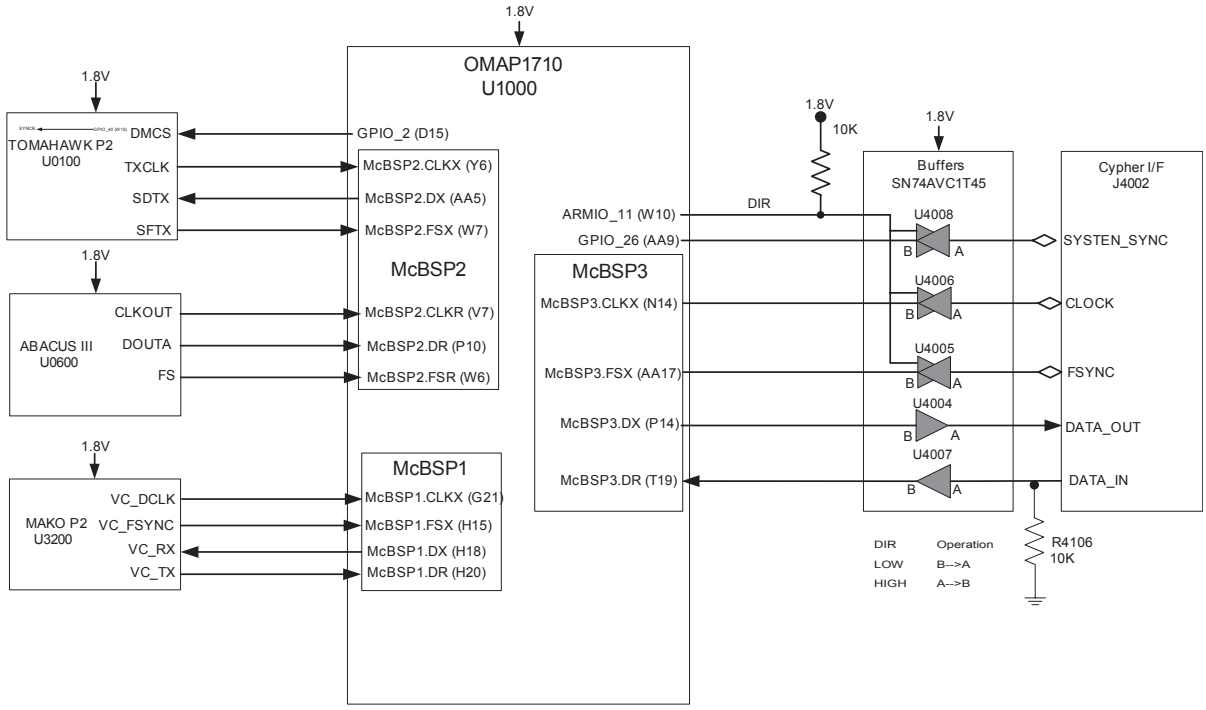


Figure 1-6 SSI Connections

The OMAP processor (U1000) has a total of three SSI or multi-channel buffer serial ports (McBSP) modules that are used to directly interface to the CODECs in the Tomahawk, Abacus, and MAKO and between Tx and Rx radios within a Repeater.

As shown in Figure 1-6, McBSP1 is a 4-wire bus and interface to the MAKO CODEC. McBSP2 is 6-wire bus; 3-wire dedicated to the Tomahawk Tx audio and the other 3-wire to Abacus Rx audio. McBSP3 is a 4-wire bus, and used primarily to interface between Tx and Rx radios within a Repeater.

1.6 ACC_ID Interface

Smart accessories use the Accessory ID (ACC_ID) Interface to help the repeater determine which smart accessory, if any, are attached to the repeater. Figure 1-7 illustrates the ACC_ID connections used within the radio.

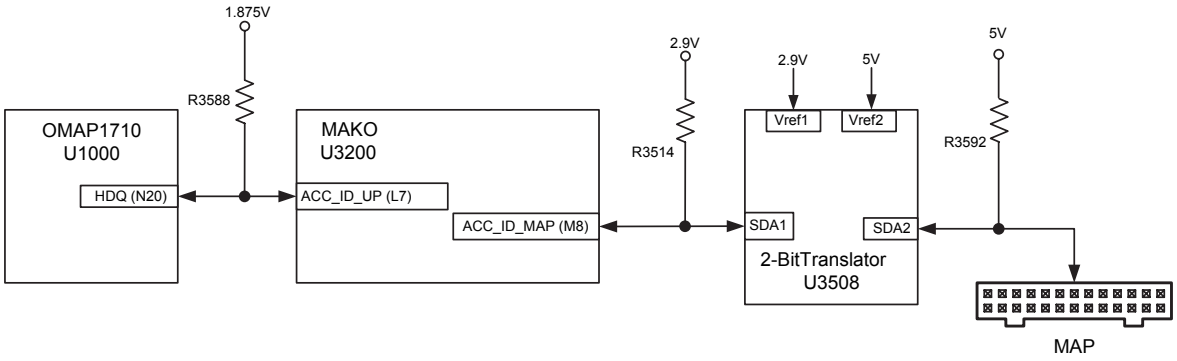


Figure 1-7 ACC_ID Interface Connections

The MAKO (U3200) serves as a driver between the OMAP ACC_ID bus and the device. Level translator (U3508) is required to level shift between 2.9 V to 5 V.

1.7 USB Interface

The OMAP processor (U1000) supports two USB ports. The radio makes use of these USB ports to communicate with smart accessories, and connection to a host computer for radio programming via CPS and tuning via the Tuner Tool. Only one of these ports is available (via the MAP connector), the other is dedicated to the Ethernet controller.

Note: The USB ports are designed to support Motorola accessories and approved applications only and will not support third party "Plug-n-Play" USB devices.

Figure 1-8 shows the details of the HSSI connections within the radio.

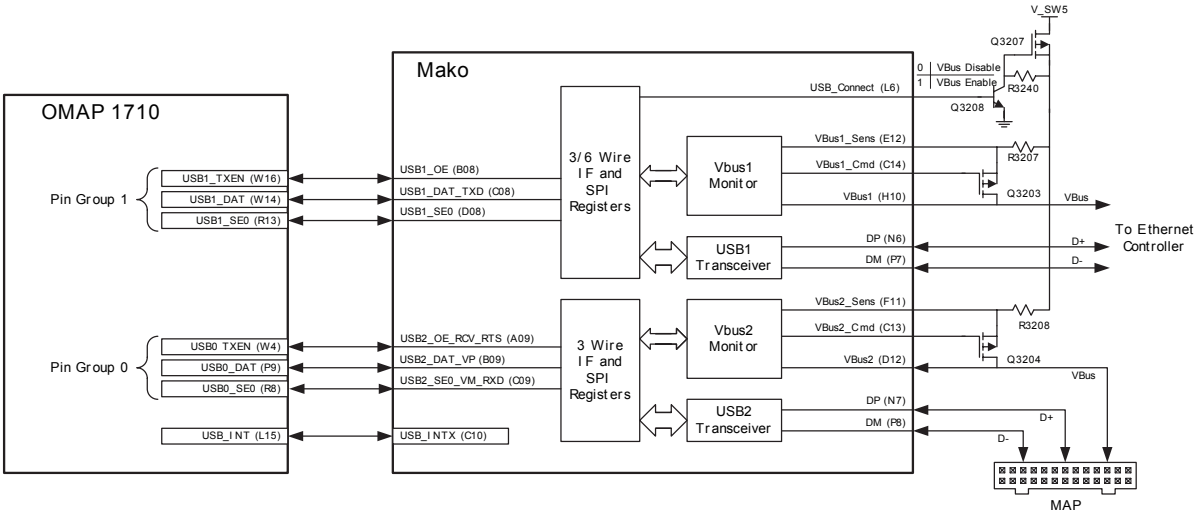


Figure 1-8 USB Interface Connections

The OMAP processor USB host controller communicates with accessories at either 1.5 Mbps or 12 Mbps data rates depending on the accessory. Either port can be used as a host or a device, the only limitation is that both ports cannot be used as a device at the same time.

The MAKO (U3200) incorporates two USB transceivers that provide the physical layer signaling for the two ports. Each transceiver generates and receives the DP and DM differential signals of the USB port. The transceiver interfaces to the OMAP processor through a three-wire interface consisting of two bi-directional signals (SE0 and DAT), and one uni-directional signal (TXEN). The MAKO also includes two bus monitors that sense the connection or removal of a device and determine whether or not to supply current to that device via Q3203 or Q3204 up to a maximum of 500 mA per port.

1.8 Mobile Accessory Port (MAP)

The Mobile Accessory Port (MAP) is a newly defined Motorola accessory port that contains audio, programmable digital I/O, serial interfaces, and accessory supply lines; and is similar in function to Motorola's legacy products accessory connectors.

Table 1-1 Mobile Accessory Port Functions

MAP Pin Number	MAP Pin Name	MAKO Pin
1	USB_D+	USB for programming or Smart Accessory
2	USB_D-	
3	V_Bus	
4	USB_Ground	
5	ACC_MAP_ID_2	Accessory Identifier
6	ACC_MAP_ID_1	
7	Ext_SWB+	Switched Battery Voltage
8	Power Ground	Ground
9	Ext_Spkr-	External Speaker
10	Ext_Spkr+	
11	Tx_Audio	Tx Audio Input
12	Audio Ground	Ground
13	Aux_Audio_Out_1	Auxiliary Audio Output (not supported in the repeater)
14	Rx_Audio	Rx Audio Output (not supported in the repeater)
15	Aux_Audio_Out_2	Auxiliary Audio Output (not supported in the repeater)
16	Ground	Ground
17	Prgm_In_1_(PTT)	Programmable Input with prescribed function of PTT
18	Ground	Ground
19	Prgm_IO_2 (Monitor)	Programmable Input/Output with prescribed function Monitor
20	Prgm_IO_6	Programmable Input/Output
21	Prgm_IO_3 (Chan_Act)	Programmable Input/Output with prescribed function Channel Activity
22	Prgm_IO_7	Programmable Input/Output

Table 1-1 Mobile Accessory Port Functions

MAP Pin Number	MAP Pin Name	MAKO Pin
23	Prgm_In_4 (Emergency)	Programmable Input with dedicated function for Emergency Switch
24	Prgm_IO_8	Programmable Input/Output (not supported in the repeater)
25	Prgm_1_5 (Ign_Sense)	Not Used
26	Prgm_Out_9 (Ext_Alarm)	Programmable Output with prescribed function of External Alarm

1.8.1 MAP Programmable I/Os

The MAP contains 7 general purpose I/Os. One is specifically an output, 1 is specifically an input, and the remaining 5 can be either input or output. The MAP also contains 2 dedicated inputs. All input signals map directly to OMAP (U1000) GPIOs, while all outputs are controlled from the OMAP through a SPI connected shift register (U4000) referred here as the Acc_Shift_Reg. While 7 of the 9 I/Os are general purpose and designed to be programmable through the CPS, several have recommended functions that will be detailed below.

All of the programmable I/Os, except the dedicated inputs, use inverted logic, IE: a 1 on the connector as an input will be seen by the OMAP as a 0 and visa versa. Also, a 1 output by the OMAP through the Acc_Shift_Reg will be seen as a 0 output on the connector.

- Prgm_In_1 (PTT): Programmable input that has the recommended function of Push-To-Talk (PTT). This signal connects to the OMAP GPIO_7 (U1000 pin M15) as an input.
- Prgm_IO_2 (Monitor): Programmable input/output that has the recommended function of Monitor. This signal connects to the OMAP GPIO_32 (U1000 pin B17) as an input. The output for this signal is driven from Acc_Shift_Reg bit 0 (U4000 pin 15).
- Prgm_IO_3 (Chan_Act): Programmable input/output that has the recommended function of Channel Activity (Chan_Act). This signal connects to the OMAP GPIO_33 (U1000 pin J14) as an input. The output for this signal is driven from Acc_Shift_Reg bit 1(U4000 pin 1).
- Prgm_I_4 (Emergency): Dedicated input that is having the function of Emergency (Emerg_Sw). This signal connects to the MAKO EMERG_PB (U3200 pin F4) as an input.
- Prgm_IO_6: Programmable input/output. This signal connects to the OMAP ARMIO_15 (U1000 pin E19) as an input. The output for this signal is driven from Acc_Shift_Reg bit 2 (U4000 pin 2).
- Prgm_IO_7: Programmable input/output. This signal connects to the OMAP ARMIO_3 (U1000 pin V8) as an input. The output for this signal is driven from Acc_Shift_Reg bit 3 (U4000 pin 3).
- Prgm_IO_8: Programmable input/output. This signal connects to the OMAP GPIO_24 (U1000 pin V5) as an input. The output for this signal is driven from Acc_Shift_Reg bit 4 (U4000 pin 4). This IO is not supported in the repeater.
- Prgm_Out_9 (Ext_Alarm): Programmable output that has the recommended function of External Alarm (Ext_Alarm). The output for this signal is driven from Acc_Shift_Reg bit 5 (U4000 pin 5).

1.8.2 MAP Serial Interfaces

The MAP includes 2 serial interfaces: an USB port and an ACC_ID interface. The USB port can be used as either a device (radio is device) or as a host (radio is host). When configured as a device, the radio can be programmed or tuned using MOTOTRBO CPS or Tuner software. When configured as a host, various smart accessories can be used with the radio. See section 1.7 on page 1-10 for more information on the USB interface.

The ACC_ID interface is used by accessories to provide the radio with information needed to configure the interface for that accessory. See section 1.6 on page 1-9 for more information on the ACC_ID interface.

Note: The USB ports are designed to support Motorola accessories and appoved applications only and will not support third party "Plug-n-Play" USB devices.

1.8.3 MAP Audio Signals

The MAP has Speaker and Tx audio input. Speaker audio is a differential output from the radio's audio PA (U3500). The speaker output available for monitor functions only. Tx audio is a mic/line level input audio for transmit, it is available in test mode only.

1.9 Repeater Interconnections Interface

The Repeater's architecture uses two mobiles, one for transmit, one for receive to form a repeater. The Repeater Interconnection Interface is used to communicate between the Tx and Rx radios within the Repeater. This is accomplished by using one of the SSI ports from the OMAP (U1000) and level shifters/drivers (U4004, U4005, U4006, and U4007). Both data and commands/responses can be passed via this interface. The interface consists of two separate serial paths, one from the Rx radio to the Tx radio; and one from the Tx radio to the Rx radio. The Tx radio is considered the master while the Rx radio is the slave, meaning that the Tx radio generates the sync and clock for both communication paths. Figure 1-9 shows the basic block diagram of this interconnection.

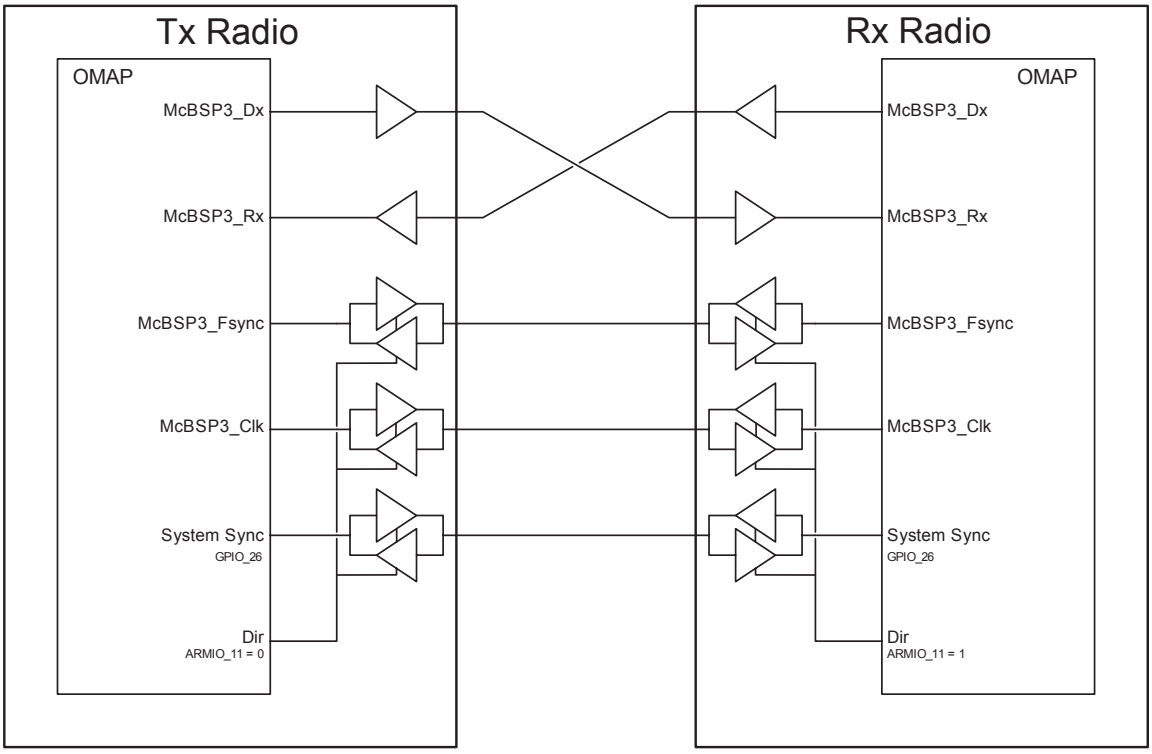
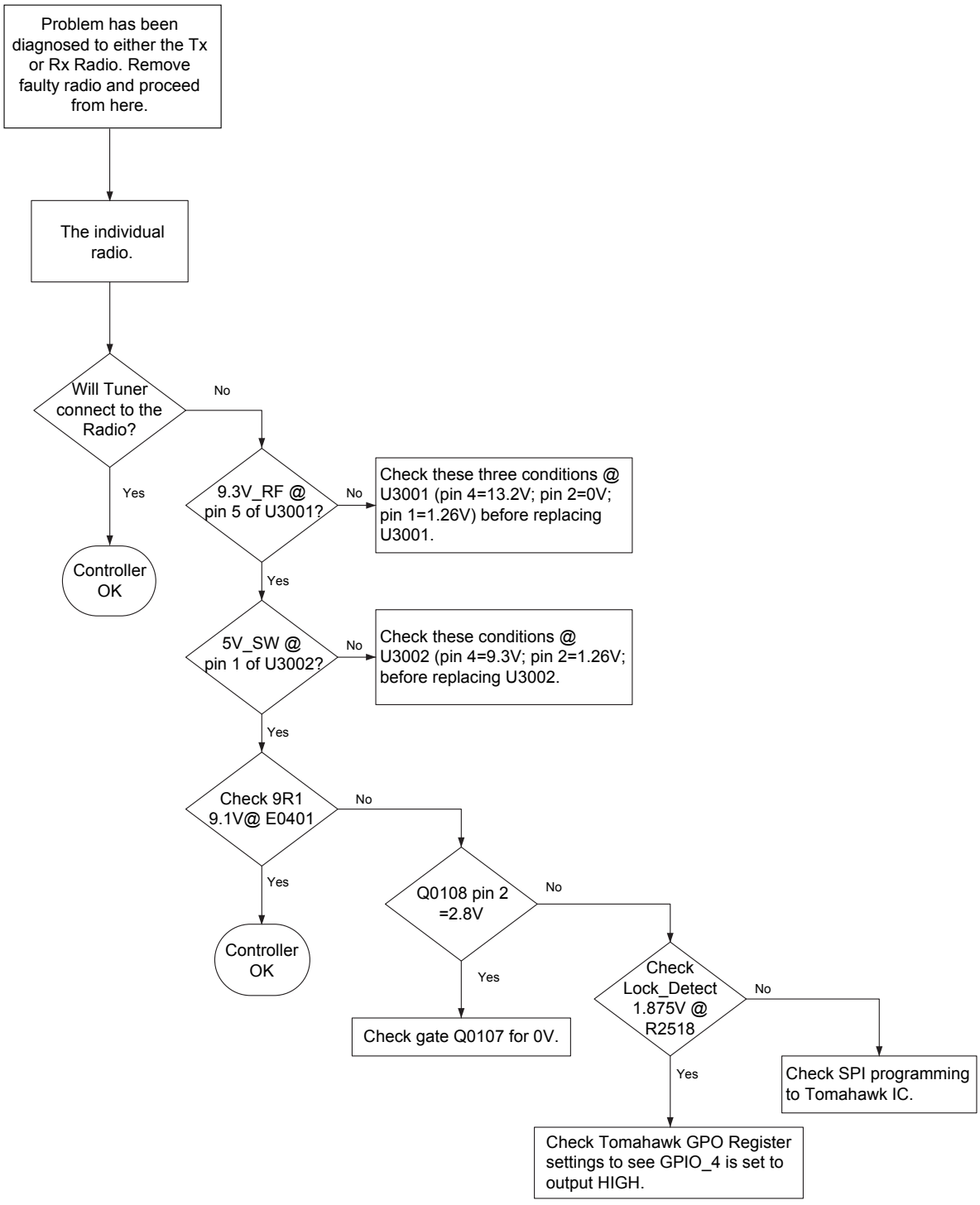


Figure 1-9 Repeater Interconnection Interface

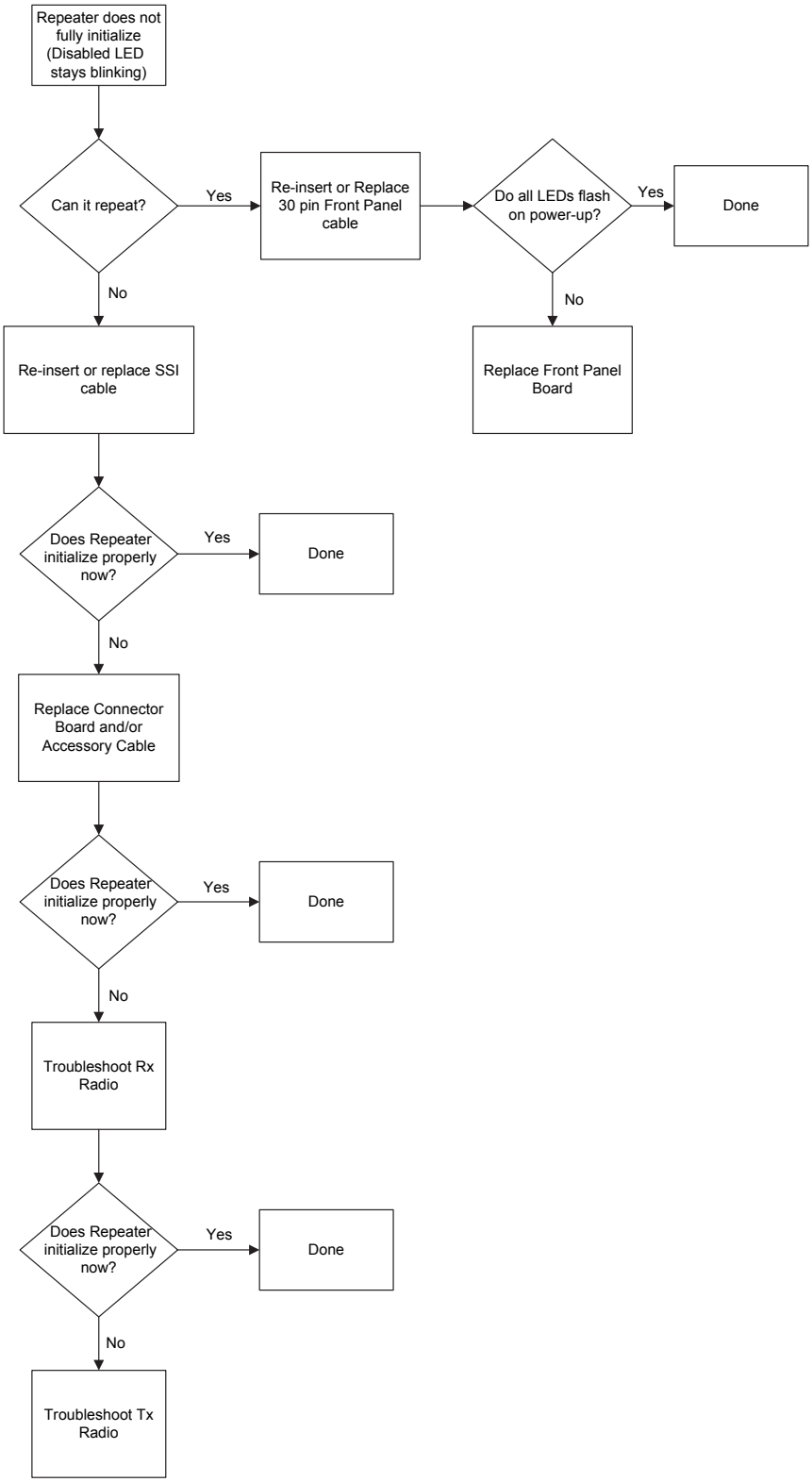
Section 2

TROUBLESHOOTING CHARTS

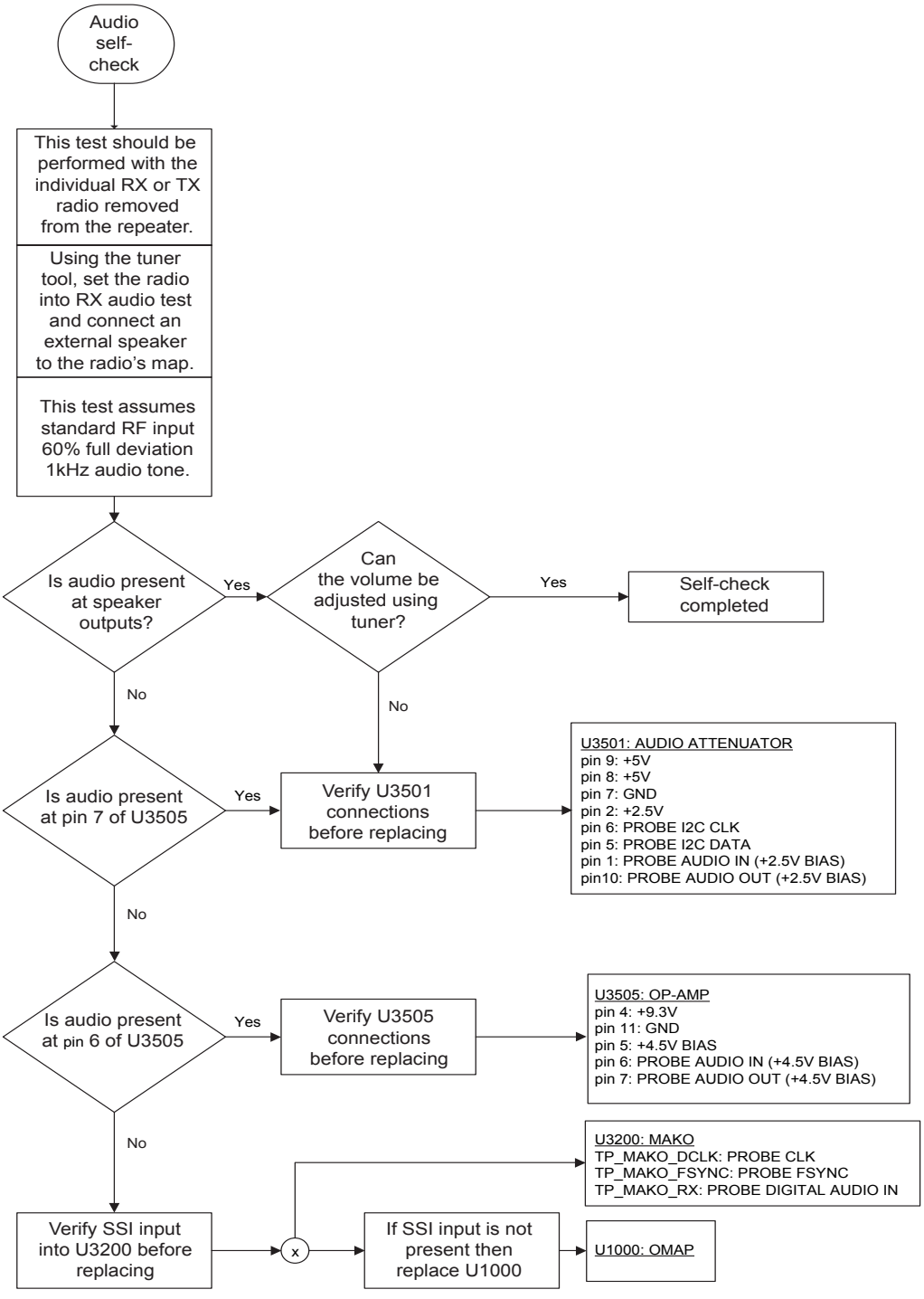
1.0 Controller Troubleshooting Chart



2.0 Power-Up Troubleshooting Chart



3.0 Audio Troubleshooting Chart



Notes

Section 3

CONTROLLER SCHEMATICS/PARTS LISTS

1.0 Allocation of Schematics and Parts List

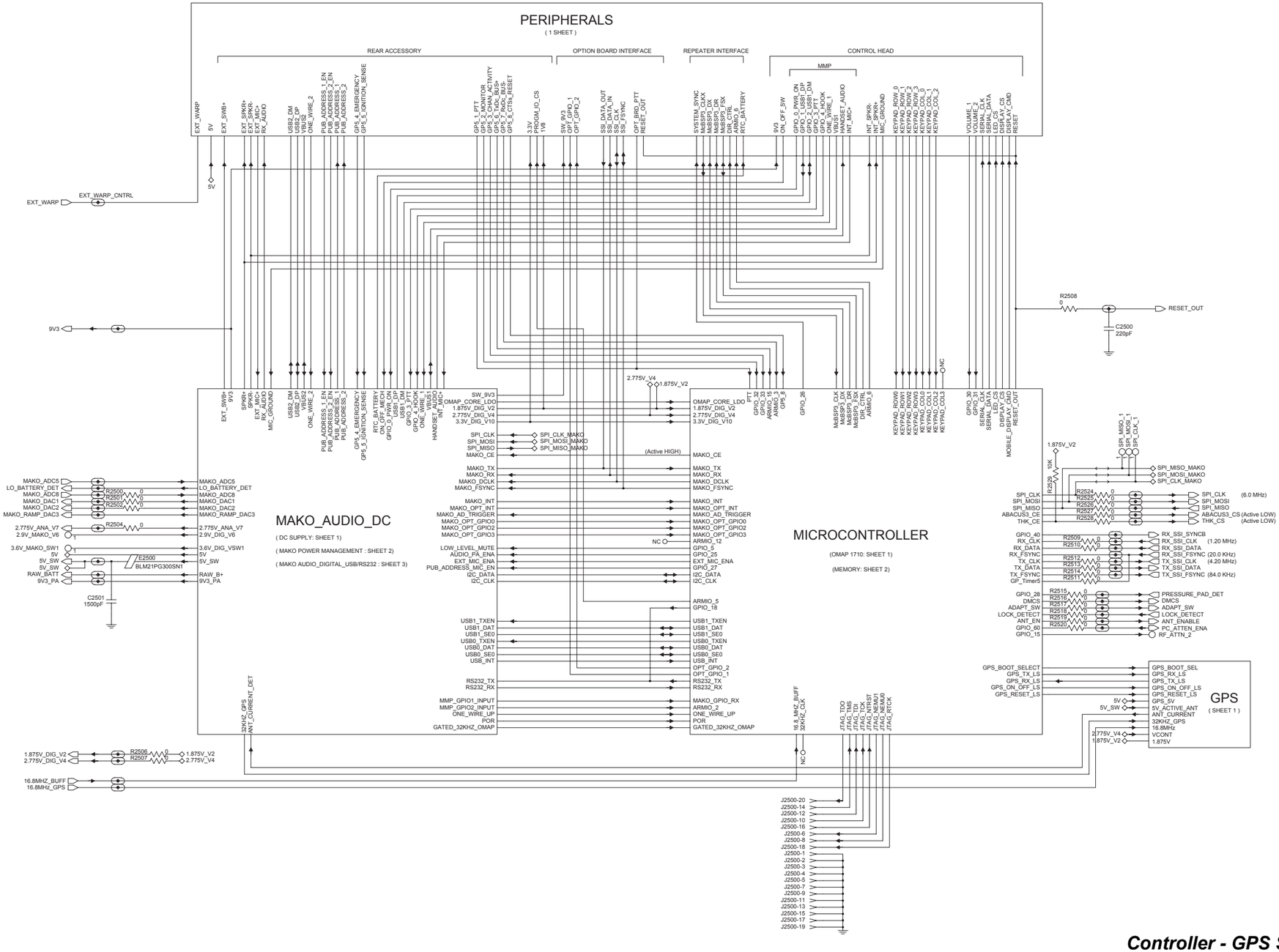
1.1 Controller Circuits

This Chapter shows the Schematics and the Parts List for the Controller circuits.

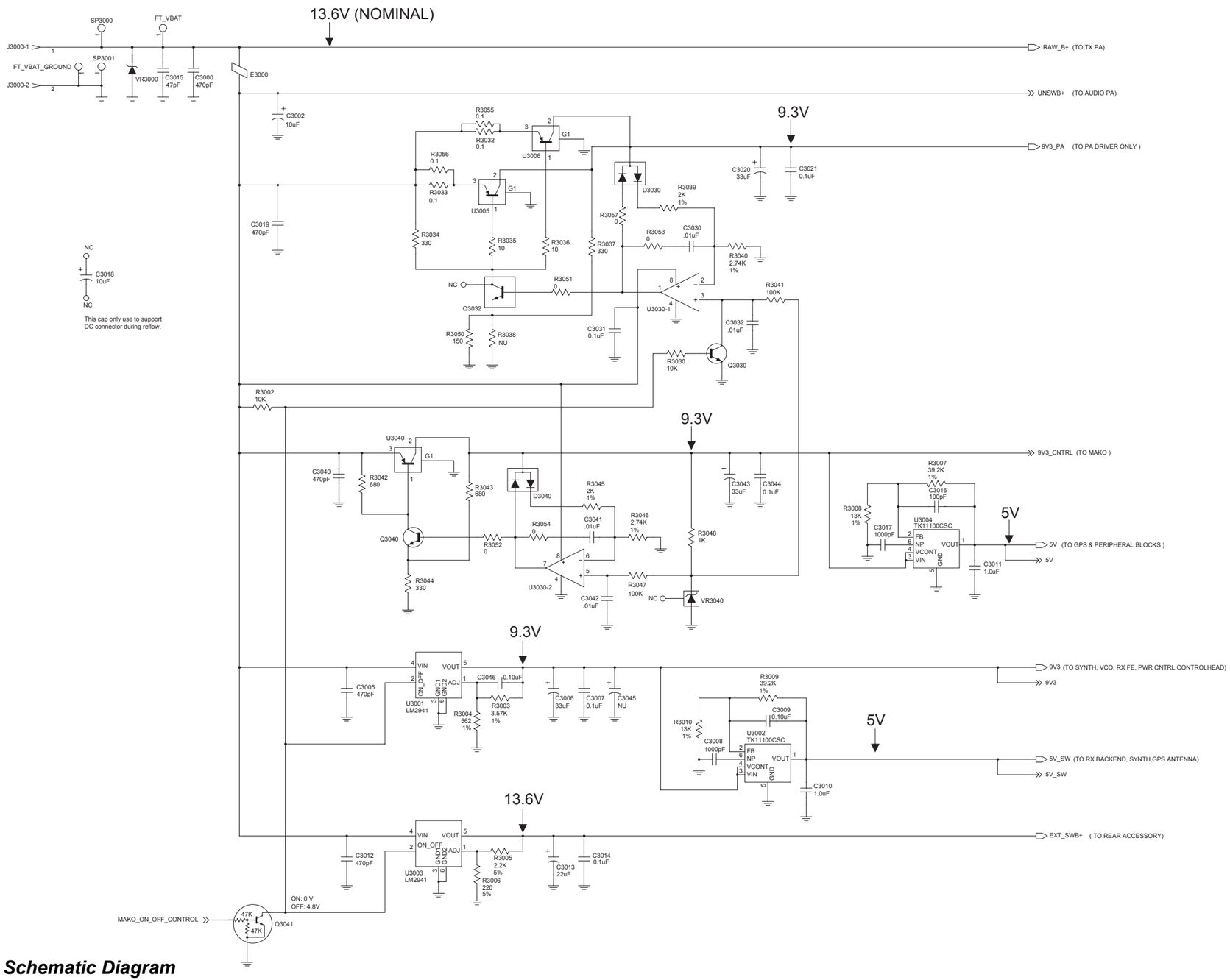
Table 3-1 Controller GPS R3 Schematic Diagrams and Parts List

Notes

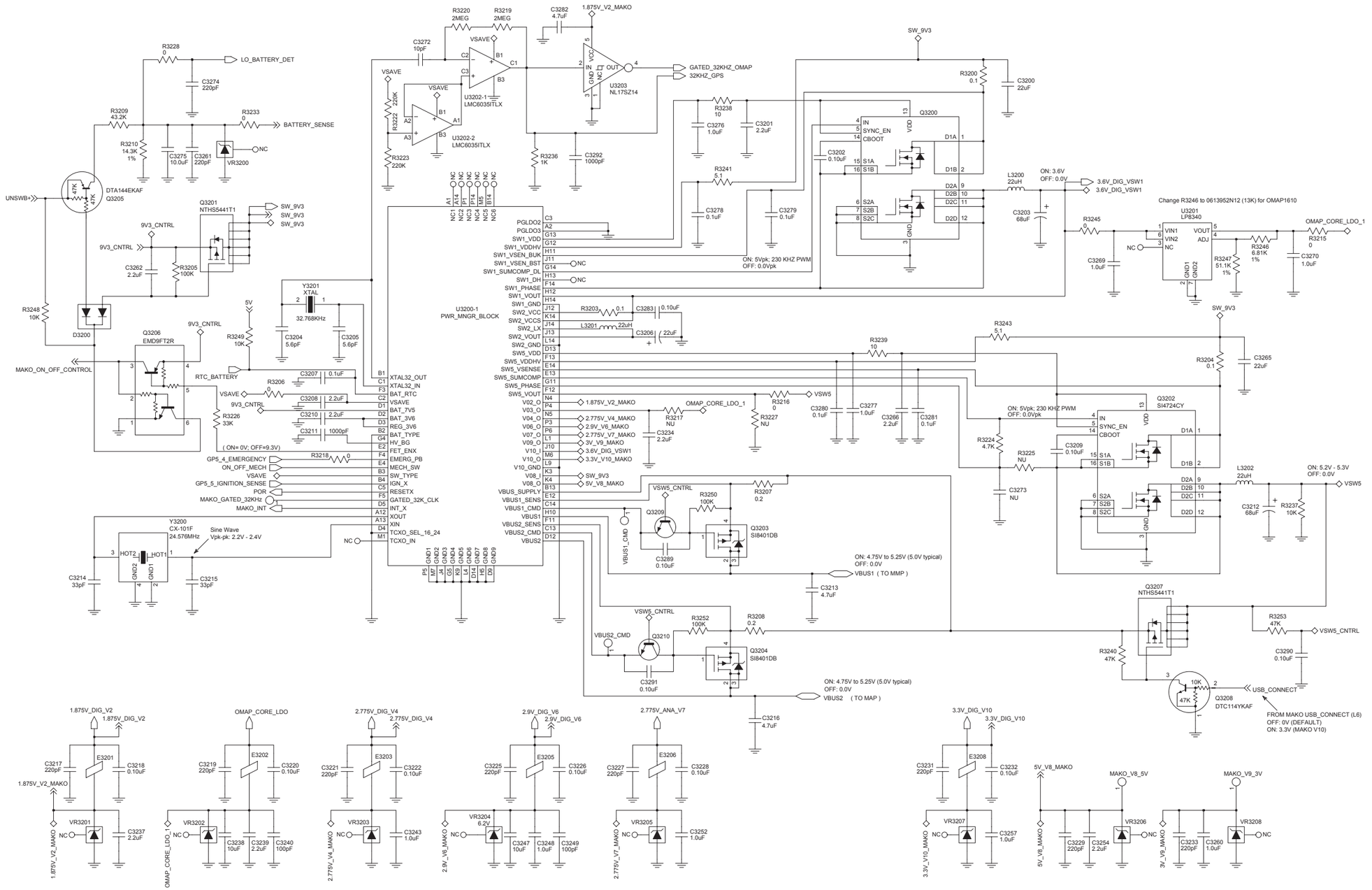
2.0 Controller R3 Schematic Diagrams



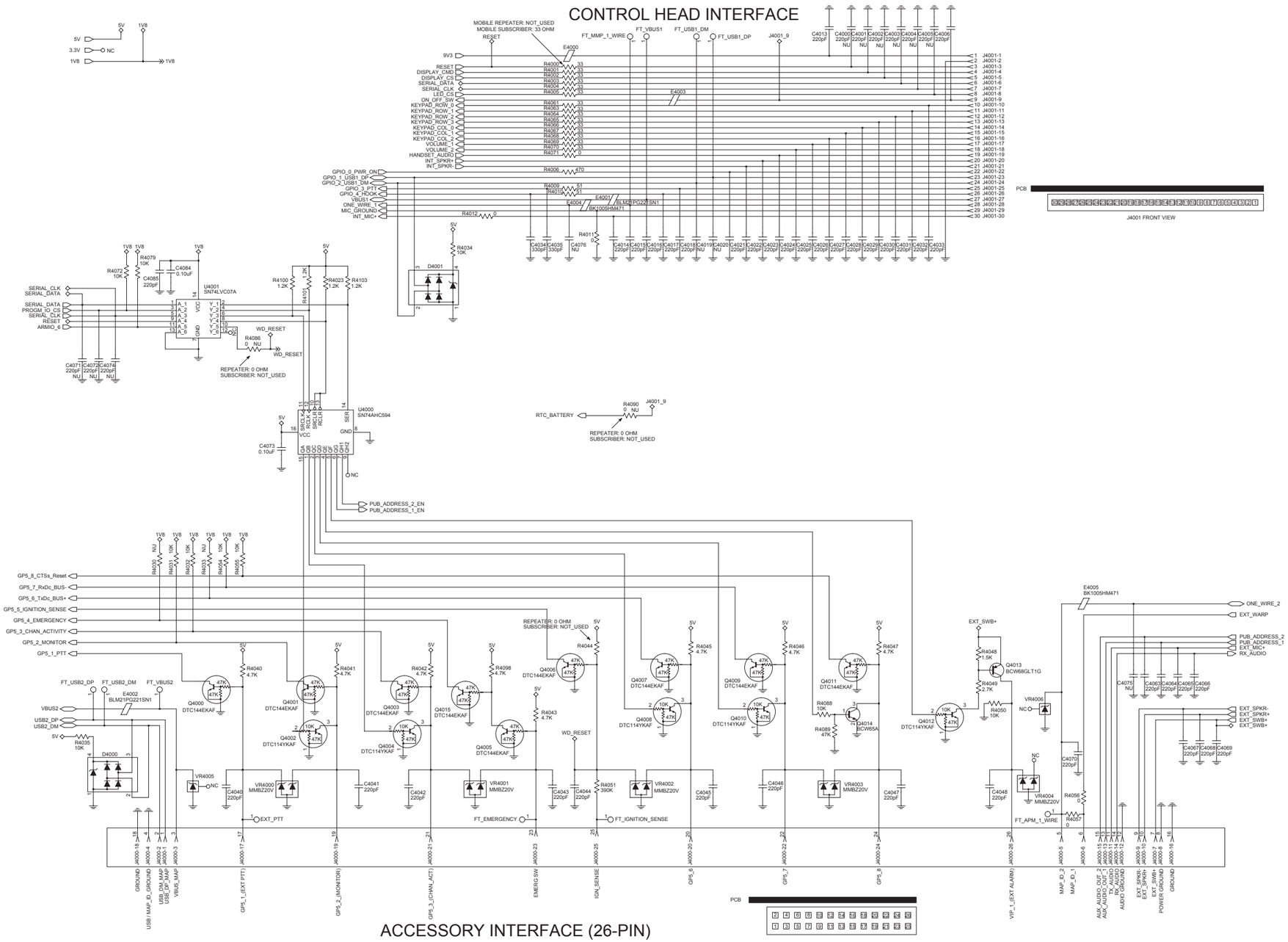
Controller - GPS Schematic Diagram



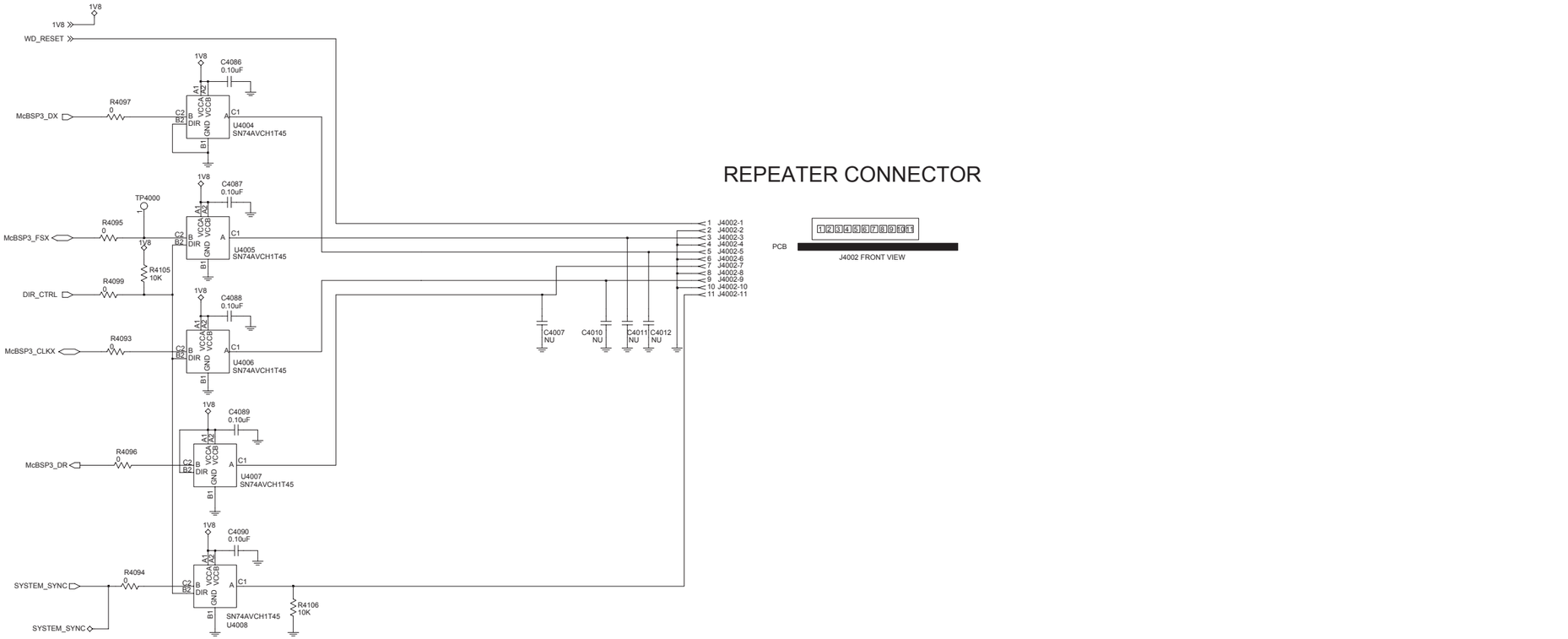
Controller DC Supply Schematic Diagram

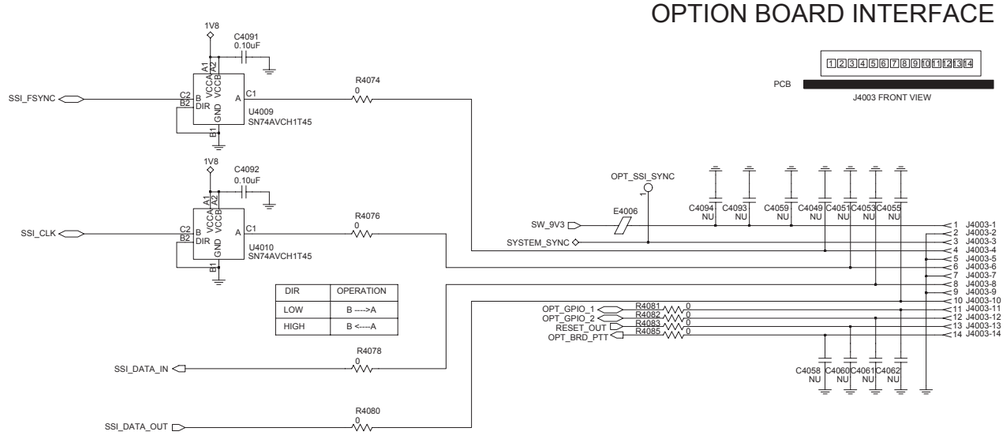


Controller DC Distribution Schematic Diagram



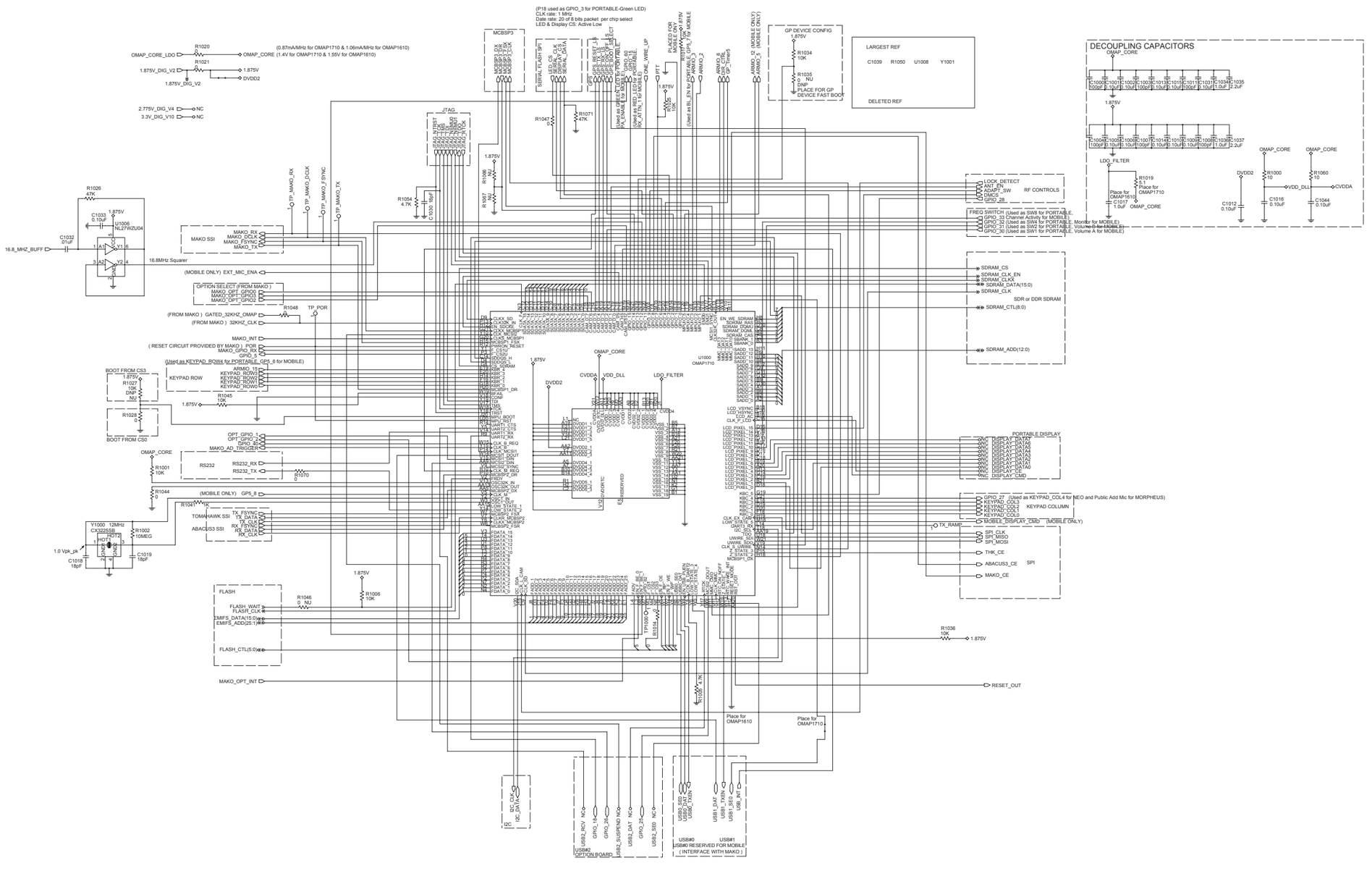
Controller Peripheral Schematic Diagram - (sheet 1 of 2)





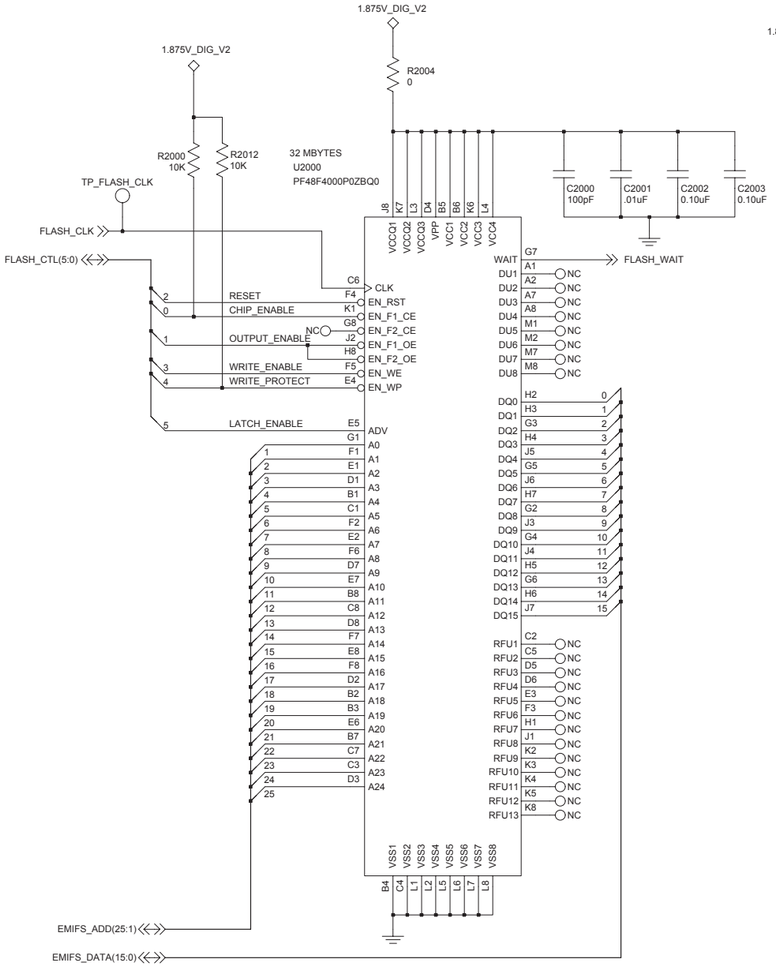
Controller Peripheral Schematic Diagram (sheet 2 of 2)

OMAP1710

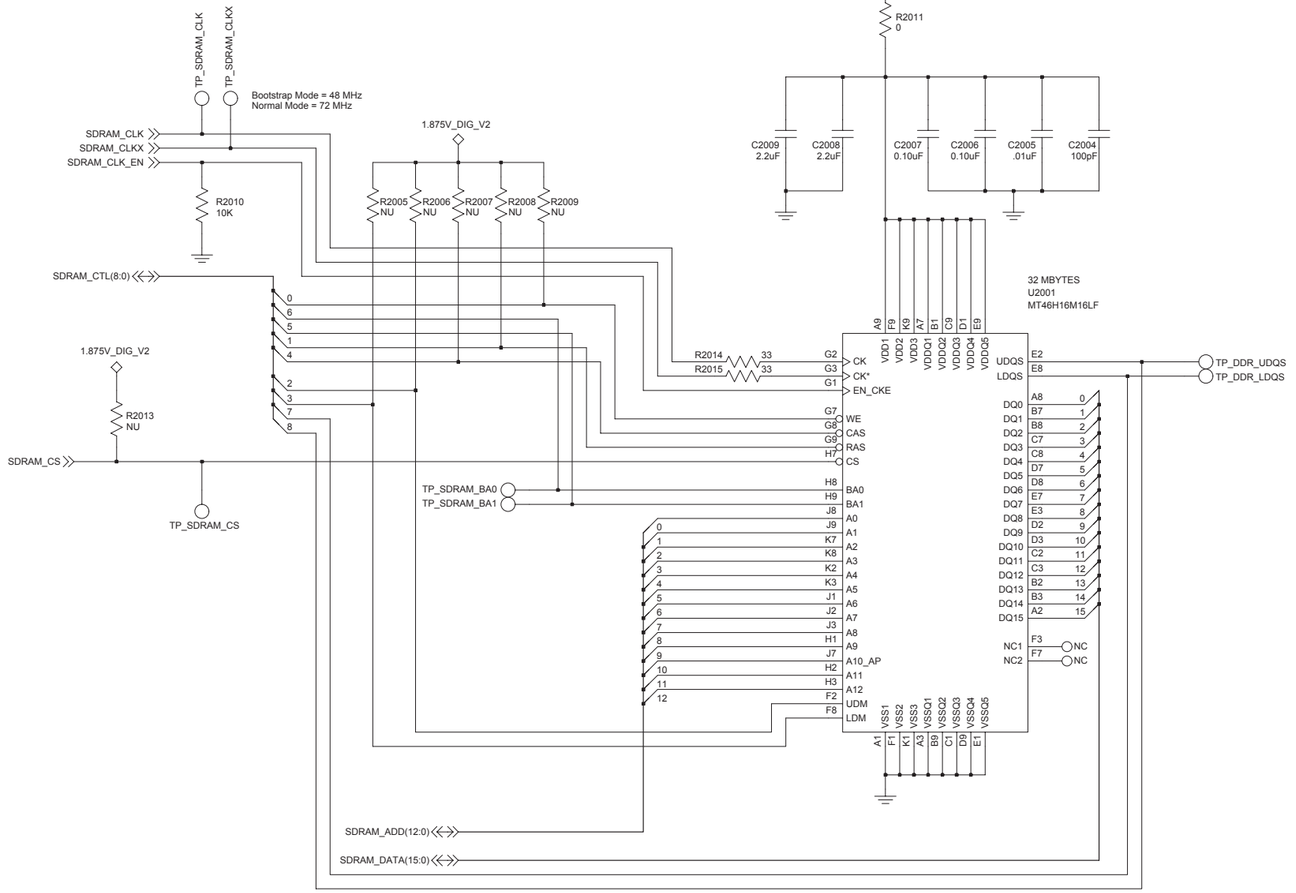


Controller Microprocessor Schematic Diagram

FLASH



DDR SDRAM



Controller Memories Schematic Diagram

HW_ID0		
MATRIX PLATFORM	R3503	R3507
MORPHEUS	NU	0
CYPHER	4.75 K	4.75 K

Controller Audio and USB Schematic Diagram

2.1 Controller R3 Parts List

Circuit Ref	Motorola Part No	Description
C1000	2113944A40	100 pF
C1001	2113945Y02	0.1 uF
C1002	2113945Y02	0.1 uF
C1003	2113944A40	100 pF
C1004	2113944A40	100 pF
C1005	2113945Y02	0.1 uF
C1006	2113945Y02	0.1 uF
C1007	2113944A40	100 pF
C1008	2113944A40	100 pF
C1009	2113945Y02	0.1 uF
C1010	2113945Y02	0.1 uF
C1011	2113944A40	100 pF
C1012	2113945Y02	0.1 uF
C1013	2113945Y02	0.1 uF
C1014	2113945Y02	0.1 uF
C1015	2113945Y02	0.1 uF
C1016	2113945Y02	0.1 uF
C1017	2113946E02	1.0 uF
C1018	2113944A28	18 pF
C1019	2113944A28	18 pF
C1030	2113944A28	18 pF
C1031	2113945Y02	0.1 uF
C1032	2113945B02	10,000 pF
C1033	2113945Y02	0.1 uF
C1034	2113946S35	1.0 uF
C1035	2113946D05	2.2 uF
C1036	2113946S35	1.0 uF
C1037	2113946D05	2.2 uF
C1044	2113945Y02	0.1 uF

Circuit Ref	Motorola Part No	Description
C2000	2113944A40	100 pF
C2001	2113945B02	10,000 pF
C2002	2113945Y02	0.1 uF
C2003	2113945Y02	0.1 uF
C2004	2113944A40	100 pF
C2005	2113945B02	10,000 pF
C2006	2113945Y02	0.1 uF
C2007	2113945Y02	0.1 uF
C2008	2113946D05	2.2 uF
C2009	2113946D05	2.2 uF
C2500	2113944A44	220 pF
C2501	2113945A10	1500 pF
C3000	2113944C06	470 pF
C3002	2371403L02	TANTALUM CAP
C3005	2113944C06	470 pF
C3006	2314030E85	33 uF
C3007	2113945C31	0.1 uF
C3008	2113945A09	1000 pF
C3009	2113945Y02	0.1 uF
C3010	2113946S35	1.0 uF
C3011	2113946S35	1.0 uF
C3012	2113944C06	470 pF
C3013	2314030J28	22 uF
C3014	2113945C31	0.1 uF
C3015	2113944C38	56 pF
C3016	2113944A40	100 pF
C3017	2113945A09	1000 pF
C3018	2389289U01	10uF
C3019	2113944C06	470 pF
C3020	2314030E85	33 uF

Circuit Ref	Motorola Part No	Description
C3021	2113945C31	0.1 uF
C3030	2113945C02	10,000 pF
C3031	2113945C31	0.1 uF
C3032	2113945B02	10,000 pF
C3040	2113944C06	470 pF
C3041	2113945C02	10,000 pF
C3042	2113945B02	10,000 pF
C3043	2314030E85	33 uF
C3044	2113945C31	0.1 uF
C3045	NOT PLACED	–
C3046	2113945Y02	0.1 uF
C3200	2113946J04	22 uF
C3201	2113946D05	2.2 uF
C3202	2113945Y02	0.1 uF
C3203	2316410H02	68 uF
C3204	2115153H21	5.6 pF
C3205	2115153H21	5.6 pF
C3206	2316410H01	22 uF
C3207	2113945C31	0.1 uF
C3208	2113946D05	2.2 uF
C3209	2113945Y02	0.1 uF
C3210	2113946D05	2.2 uF
C3211	2113945A09	1000 pF
C3212	2316410H02	68 uF
C3213	2113946F03	4.7 uF
C3214	2115153H45	33 pF
C3215	2115153H45	33 pF
C3216	2113946F03	4.7 uF
C3217	2113944A44	220 pF
C3218	2113945Y02	0.1 uF

Circuit Ref	Motorola Part No	Description
C3219	2113944A44	220 pF
C3220	2113945Y02	0.1 uF
C3221	2113944A44	220 pF
C3222	2113945Y02	0.1 uF
C3225	2113944A44	220 pF
C3226	2113945Y02	0.1 uF
C3227	2113944A44	220 pF
C3228	2113945Y02	0.1 uF
C3229	2113944A44	220 pF
C3231	2113944A44	220 pF
C3232	2113945Y02	0.1 uF
C3233	2113944A44	220 pF
C3234	2113946D05	2.2 uF
C3237	2113946D05	2.2 uF
C3238	2113946H02	10 uF
C3239	2113946D05	2.2 uF
C3240	2113944C45	100 pF
C3243	2113946S35	1.0 uF
C3247	2113946H02	10 uF
C3248	2113946S35	1.0 uF
C3249	2113944C45	100 pF
C3252	2113946S35	1.0 uF
C3254	2113946D05	2.2 uF
C3257	2113946S35	1.0 uF
C3260	2113946S35	1.0 uF
C3261	2113944A44	220 pF
C3262	2113946N03	2.2 uF
C3265	2113946J04	22 uF
C3266	2113946D05	2.2 uF
C3269	2113946S35	1.0 uF

Circuit Ref	Motorola Part No	Description
C3270	2113946S35	1.0 uF
C3272	2115153H27	10 pF
C3273	NOT PLACED	–
C3274	2113944A44	220 pF
C3275	2113946J03	10 uF
C3276	2113946S35	1.0 uF
C3277	2113946S35	1.0 uF
C3278	2113945C31	0.1 uF
C3279	2113945C31	0.1 uF
C3280	2113945C31	0.1 uF
C3281	2113945C31	0.1 uF
C3282	2113946F03	4.7 uF
C3283	2113945Y02	0.1 uF
C3289	2113945Y02	0.1 uF
C3290	2113945Y02	0.1 uF
C3291	2113945Y02	0.1 uF
C3292	2113945A09	1000 pF
C3500	2113946J03	10 uF
C3501	2113945G91	0.1 uF
C3502	2113945C31	0.1 uF
C3503	2113945A09	1000 pF
C3504	2113945A09	1000 pF
C3505	2113945A09	1000 pF
C3506	2314030F30	47 uF
C3507	2113945A11	2200 pF
C3508	2113945C31	0.1 uF
C3509	2313960D07	10 uF
C3510	2113945A03	330 pF
C3511	2113944A40	100 pF
C3512	2113945C31	0.1 uF

Circuit Ref	Motorola Part No	Description
C3513	2113944A40	100 pF
C3514	2113944A44	220 pF
C3515	2113944A44	220 pF
C3516	2113946S35	1.0 uF
C3517	2314030M51	10 uF
C3518	2113946S35	1.0 uF
C3519	2314030F30	47 uF
C3520	2113946S35	1.0 uF
C3521	2113946S35	1.0 uF
C3522	2113945A05	470 pF
C3523	2113945Y02	0.1 uF
C3524	2313960D07	10 uF
C3525	2113944A44	220 pF
C3526	2113946S35	1.0 uF
C3527	2113945C31	0.1 uF
C3528	2113945Y02	0.1 uF
C3529	2113945Y02	0.1 uF
C3530	2113944A44	220 pF
C3531	2113944A44	220 pF
C3532	2113946S35	1.0 uF
C3533	2313960D07	10 uF
C3534	2313960D07	10 uF
C3535	2113946S35	1.0 uF
C3536	2314030M51	10 uF
C3538	2113945B02	10,000 pF
C3539	2113945Y02	0.1 uF
C3540	2113945Y02	0.1 uF
C3541	2113945Y02	0.1 uF
C3542	2113945Y02	0.1 uF
C3543	2313960D07	10 uF

Circuit Ref	Motorola Part No	Description
C3545	2113944A44	220 pF
C4000	NOT PLACED	–
C4001	NOT PLACED	–
C4002	NOT PLACED	–
C4003	NOT PLACED	–
C4004	NOT PLACED	–
C4005	NOT PLACED	–
C4006	2113944A44	220 pF
C4007	NOT PLACED	–
C4010	NOT PLACED	–
C4011	NOT PLACED	–
C4012	NOT PLACED	–
C4013	2113944A44	220 pF
C4014	2113944A44	220 pF
C4015	2113944A44	220 pF
C4016	2113944A44	220 pF
C4017	2113944A44	220 pF
C4018	2113944A44	220 pF
C4019	NOT PLACED	–
C4020	NOT PLACED	–
C4021	2113944A44	220 pF
C4022	2113944A44	220 pF
C4023	2113944A44	220 pF
C4024	2113944A44	220 pF
C4025	2113944A44	220 pF
C4026	2113944A44	220 pF
C4027	2113944A44	220 pF
C4028	2113944A44	220 pF
C4029	2113944A44	220 pF
C4030	2113944A44	220 pF

Circuit Ref	Motorola Part No	Description
C4031	2113944A44	220 pF
C4032	2113944A44	220 pF
C4033	2113944A44	220 pF
C4034	2113945A03	330 pF
C4035	2113945A03	330 pF
C4040	2113944A44	220 pF
C4041	2113944A44	220 pF
C4042	2113944A44	220 pF
C4043	2113944A44	220 pF
C4044	2113944A44	220 pF
C4045	2113944A44	220 pF
C4046	2113944A44	220 pF
C4047	2113944A44	220 pF
C4048	2113944A44	220 pF
C4049	NOT PLACED	–
C4051	NOT PLACED	–
C4053	NOT PLACED	–
C4055	NOT PLACED	–
C4058	NOT PLACED	–
C4059	NOT PLACED	–
C4060	NOT PLACED	–
C4061	NOT PLACED	–
C4062	NOT PLACED	–
C4063	2113944A44	220 pF
C4064	2113944A44	220 pF
C4065	2113944A44	220 pF
C4066	2113944A44	220 pF
C4067	2113944A44	220 pF
C4068	2113944A44	220 pF
C4069	2113944A44	220 pF

Circuit Ref	Motorola Part No	Description
C4070	2113944A44	220 pF
C4071	NOT PLACED	–
C4072	NOT PLACED	–
C4073	2113945Y02	0.1 uF
C4074	NOT PLACED	–
C4075	NOT PLACED	–
C4076	NOT PLACED	–
C4084	2113945Y02	0.1 uF
C4085	2113944A44	220 pF
C4086	2113945Y02	0.1 uF
C4087	2113945Y02	0.1 uF
C4088	2113945Y02	0.1 uF
C4089	2113945Y02	0.1 uF
C4090	2113945Y02	0.1 uF
C4091	2113945Y02	0.1 uF
C4092	2113945Y02	0.1 uF
C4093	NOT PLACED	–
C4094	NOT PLACED	–
D3030	4813978P07	DIODE
D3040	4813978P07	DIODE
D3200	4813978C02	DIODE ARRAY
D4000	4866544A01	DIODE
D4001	4866544A01	DIODE
E2500	2480675U01	INDUCTOR
E3000	2485011Y01	INDUCTOR
E3201	2480675U01	INDUCTOR
E3202	2480675U01	INDUCTOR
E3203	2480675U01	INDUCTOR
E3205	2480675U01	INDUCTOR
E3206	2480675U01	INDUCTOR

Circuit Ref	Motorola Part No	Description
E3208	2480675U01	INDUCTOR
E3500	2485011Y01	INDUCTOR
E3501	2485011Y01	INDUCTOR
E3502	2485011Y01	INDUCTOR
E3503	2485011Y01	INDUCTOR
E4000	2485011Y01	INDUCTOR
E4001	7686949J14	FERRITE BEAD
E4002	7686949J14	FERRITE BEAD
E4003	NOT PLACED	–
E4004	2409134J25	FERRITE BEAD
E4005	2409134J25	FERRITE BEAD
E4006	2409134J25	FERRITE BEAD
J3000	0905902V09	CONNECTOR, POWER
J4000	0916017H01	SOCKET, 26 PIN, 2.54MM, 2X13
J4001	0915555H01	CONNECTOR, 30 POSITION
J4002	0915558H01	CONNECTOR, 11 POSITION
J4003	0915556H01	CONNECTOR, 14 POSITION
L3200	2415005H02	22 uH
L3201	2415005H02	22 uH
L3202	2415005H02	22 uH
Q3030	4813973M07	XSTR
Q3032	4813973B01	XSTR
Q3040	4813973M07	XSTR
Q3041	4815263H01	DBRT DTC144EKAF
Q3200	5185956E76	IC, MOSFET
Q3201	4813970A62	XSTR
Q3202	5185956E76	IC, MOSFET
Q3203	4805585Q23	XSTR

Circuit Ref	Motorola Part No	Description
Q3204	4805585Q23	XSTR
Q3205	4815262H01	DBRT DTA144EKAF
Q3206	4815272H01	DBRT EMD9FT2R
Q3207	4813970A62	XSTR
Q3208	4815261H01	TRANSISTOR
Q3209	4813973M07	XSTR
Q3210	4813973M07	XSTR
Q3500	4815272H01	DBRT EMD9FT2R
Q3502	4815272H01	DBRT EMD9FT2R
Q3503	4815272H01	DBRT EMD9FT2R
Q3504	4815270H01	DBRT UMZ2NFTR
Q3505	4815270H01	DBRT UMZ2NFTR
Q4000	4815263H01	DBRT DTC144EKAF
Q4001	4815263H01	DBRT DTC144EKAF
Q4002	4815261H01	TRANSISTOR
Q4003	4815263H01	DBRT DTC144EKAF
Q4004	4815261H01	TRANSISTOR
Q4005	4815263H01	DBRT DTC144EKAF
Q4006	4815261H01	TRANSISTOR
Q4007	4815263H01	DBRT DTC144EKAF
Q4008	4815261H01	TRANSISTOR
Q4009	4815263H01	DBRT DTC144EKAF
Q4010	4815261H01	TRANSISTOR
Q4011	4815263H01	DBRT DTC144EKAF
Q4012	4815261H01	TRANSISTOR
Q4013	4816023H01	QSTR PNP SOT23 LO PROFILE TAPE
Q4014	4813973A06	XSTR
Q4015	4815263H01	DBRT DTC144EKAF
R1000	0613952Q25	10

Circuit Ref	Motorola Part No	Description
R1001	0613952R01	10K
R1002	0613952J73	10 M
R1005	0613952Q89	4700
R1006	0613952R01	10K
R1014	0613952R66	0
R1017	0613952R01	10K
R1019	0613952Q18	5.1
R1020	0613952R66	0
R1021	0613952R66	0
R1025	0613952R01	10K
R1026	0613952R17	47K
R1027	NOT PLACED	–
R1028	0613952R66	0
R1034	0613952R01	10K
R1035	NOT PLACED	–
R1036	0613952R01	10K
R1041	0613952Q73	1000
R1044	0613952R66	0
R1045	0613952R01	10K
R1046	NOT PLACED	–
R1047	0613952R66	0
R1048	0613952R66	0
R1054	0613952Q89	4700
R1060	0613952Q25	10
R1066	NOT PLACED	–
R1067	NOT PLACED	–
R1070	0613952R66	0
R1071	0613952R17	47K
R2000	0613952R01	10K
R2004	0613952R66	0

Circuit Ref	Motorola Part No	Description
R2005	NOT PLACED	–
R2006	NOT PLACED	–
R2007	NOT PLACED	–
R2008	NOT PLACED	–
R2009	NOT PLACED	–
R2010	0613952R01	10K
R2011	0613952R66	0
R2012	0613952R01	10K
R2013	NOT PLACED	–
R2014	0613952Q37	33
R2015	0613952Q37	33
R2500	0613952R66	0
R2501	0613952R66	0
R2502	0613952R66	0
R2504	0613952R66	0
R2506	0613952R66	0
R2507	0613952R66	0
R2508	0613952R66	0
R2509	0613952R66	0
R2510	0613952R66	0
R2511	0613952R66	0
R2512	0613952R66	0
R2513	0613952R66	0
R2514	0613952R66	0
R2515	0613952R66	0
R2516	0613952R66	0
R2517	0613952R66	0
R2518	0613952R66	0
R2519	0613952R66	0
R2520	0613952R66	0
R2524	0613952R66	0
R2525	0613952R66	0
R2526	0613952R66	0
R2527	0613952R66	0
R2528	0613952R66	0
R2529	0613952R01	10K
R3002	0613952R01	10K
R3003	0613952M54	3570
R3004	0613952L73	562
R3005	0613952Q81	2200
R3006	0613952Q57	220
R3007	0613952N58	39.2K
R3008	0613952N12	13K
R3009	0613952N58	39.2K
R3010	0613952N12	13K
R3030	0613952R01	10K
R3032	0615871H01	0.1
R3033	0615871H01	0.1
R3034	0613952H61	330
R3035	0613952H25	10
R3036	0613952H25	10
R3037	0613959G61	330
R3038	NOT PLACED	–
R3039	0613952M30	2000
R3040	0613952M43	2740
R3041	0613952R25	100K
R3042	0613952H69	680
R3043	0613952H69	680
R3044	0613958S61	330
R3045	0613952M30	2000
R3046	0613952M43	2740
R3047	0613952R25	100K
R3048	0613952Q73	1000
R3050	0613959Q53	150
R3051	0613952G67	0
R3052	0613952G67	0
R3053	0613952R66	0
R3054	0613952R66	0
R3055	0615871H01	0.1
R3056	0615871H01	0.1
R3057	0613952R66	0
R3200	0615871H01	0.1
R3203	0615871H01	0.1
R3204	0615871H01	0.1
R3205	0613952R25	100K
R3206	0613952R66	0
R3207	0686135Z02	0.2
R3208	0686135Z02	0.2
R3209	0613952N62	43.2K
R3210	0613952N16	14.3K
R3215	0613952G67	0
R3216	0613952G67	0
R3217	NOT PLACED	–
R3218	0613952R66	0
R3219	0613952R56	2M
R3220	0613952R56	2M
R3222	0613952R33	220K
R3223	0613952R33	220K
R3224	0613952Q89	4700
R3225	NOT PLACED	–
R3226	0613952R13	33K
R3227	NOT PLACED	–
R3228	0613952G67	0
R3233	0613952R66	0
R3236	0613952Q73	1000
R3237	0613952R01	10K
R3238	0613952H25	10
R3239	0613952H25	10
R3240	0613952R17	47K
R3241	0613952Q18	5.1
R3243	0613952Q18	5.1
R3245	0613952G67	0
R3246	0613952M81	6810
R3247	0613952N69	51.1K
R3248	0613952R01	10K
R3249	NOT PLACED	–
R3250	0613952R25	100K
R3252	0613952R25	100K
R3253	0613952R17	47K
R3500	0613952Q35	27
R3501	0613952Q35	27
R3502	0613952R01	10K
R3503	0613952Z48	4.7K
R3504	NOT PLACED	–
R3505	0613952Z48	4.7K
R3506	0613952R01	10K
R3507	NOT PLACED	–
R3508	0613952R66	0
R3509	0613952Z55	12K
R3510	0613952Q35	27

Circuit Ref	Motorola Part No	Description
R3511	0613952R01	10K
R3512	0613952Q35	27
R3513	0613952R66	0
R3514	0613952R01	10K
R3515	0613952R01	10K
R3516	0613952R10	24K
R3520	0613952R10	24K
R3521	0613952R05	15K
R3523	0613952R10	24K
R3524	0613952Q67	560
R3525	0613952R25	100K
R3526	0613952R66	0
R3528	0613952R09	22K
R3529	0613952Q42	51
R3530	NOT PLACED	–
R3532	0613952Q49	100
R3533	0613952R10	24K
R3534	0613952R01	10K
R3535	0613952Q67	560
R3536	0613952R25	100K
R3537	0613952R66	0
R3538	NOT PLACED	–
R3539	0613952R10	24K
R3540	0613952Q49	100
R3541	0613952R10	24K
R3542	0613952R10	24K
R3544	0613952R10	24K
R3545	0613952Q49	100
R3546	0613952R05	15K
R3547	0613952Q67	560

Circuit Ref	Motorola Part No	Description
R3548	0613952J25	100K
R3549	0613952R12	30K
R3550	0613952R23	82K
R3551	0613952R01	10K
R3552	0613952R01	10K
R3553	0613952R01	10K
R3554	0613952R17	47K
R3555	0613952R01	10K
R3556	0613952R17	47K
R3558	0613952R01	10K
R3559	0613952R01	10K
R3560	0613952R17	47K
R3569	0613952Q73	1000
R3571	0613952Q80	2000
R3572	0613952R01	10K
R3573	0613952R01	10K
R3574	0613952R01	10K
R3575	0613952Q73	1000
R3576	0613952Q49	100
R3577	0613952N42	26.7k
R3578	0613952R32	200K
R3579	0613952R01	10K
R3580	0613952R01	10K
R3581	0613952R01	10K
R3582	0613952N21	16.2K
R3583	0613952N21	16.2K
R3584	0613952R09	22K
R3585	0613952R09	22K
R3586	0613952R66	0
R3587	NOT PLACED	–

Circuit Ref	Motorola Part No	Description
R3588	0613952N69	51.1K
R3590	0613952Q49	100
R3591	0613952Q81	2200
R3592	0613952Q81	2200
R3593	0613952R32	200K
R3594	0613952Q85	3300
R3595	0613952R01	10K
R3596	0613952H53	150
R4000	NOT PLACED	–
R4001	0613952Q37	33
R4002	0613952Q37	33
R4003	0613952Q37	33
R4004	0613952Q37	33
R4005	0613952Q37	33
R4006	0613952Q65	470
R4009	0613952Q42	51
R4010	0613952Q42	51
R4011	0613952R66	0
R4012	0613952R66	0
R4023	0613952Q75	1200
R4030	NOT PLACED	–
R4031	0613952R01	10K
R4032	0613952R01	10K
R4033	NOT PLACED	–
R4034	0613952R01	10K
R4035	0613952R01	10K
R4040	0613952Q89	4700
R4041	0613952Q89	4700
R4042	0613952Q89	4700
R4043	0613952Q89	4700

Circuit Ref	Motorola Part No	Description
R4044	NOT PLACED	–
R4045	0613952Q89	4700
R4046	0613952Q89	4700
R4047	0613952Q89	4700
R4048	0613952Q77	1500
R4049	0613958H83	2700
R4050	0613952R01	10K
R4051	0613952R05	15K
R4054	0613952R01	10K
R4055	0613952R01	10K
R4056	0613952R66	0
R4057	NOT PLACED	–
R4061	0613952Q37	33
R4063	0613952Q37	33
R4064	0613952Q37	33
R4065	0613952Q37	33
R4066	0613952Q37	33
R4067	0613952Q37	33
R4068	0613952Q37	33
R4069	0613952Q37	33
R4070	0613952Q37	33
R4071	0613952R66	0
R4072	0613952R01	10K
R4074	0613952R66	0
R4076	0613952R66	0
R4078	0613952R66	0
R4079	0613952R01	10K
R4080	0613952R66	0
R4081	0613952R66	0
R4082	0613952R66	0

Circuit Ref	Motorola Part No	Description
R4083	0613952R66	0
R4085	0613952R66	0
R4086	0613952R66	0
R4088	0613952R01	10K
R4089	0613952R17	47K
R4090	0613952R66	0
R4093	0613952R66	0
R4094	0613952R66	0
R4095	0613952R66	0
R4096	0613952R66	0
R4097	0613952R66	0
R4098	0613952Q89	4700
R4099	0613952R66	0
R4100	0613952Q75	1200
R4101	0613952Q75	1200
R4103	0613952Q75	1200
R4105	0613952R01	10K
R4106	0613952R01	10K
RT3500	0615471H01	10K NTC THERMISTOR
SP3000	1015349H03	SOLDER PREFORM
SP3001	1015349H03	SOLDER PREFORM
U1000	5102495J13	IC MICROPROCESSOR P1710ZZGE
U1006	5115001H02	NL27WZU04DFT2G INVERTER
U2000	0104032J81	PRE-FLASHED FLASH IC
U2001	51012031001	32MB DIE SHRINK DDR SDRAM IC
U3001	5164015H94	IC, LM2941, TO DROPOUT REG
U3002	5115391H01	LINEAR REGULATOR IC
U3003	5164015H94	IC, LM2941, TO DROPOUT REG
U3004	5115391H01	LINEAR REGULATOR IC
U3005	0105959T72	LEAD FORMED TRANSISTOR
U3006	0105959T72	LEAD FORMED TRANSISTOR
U3030	5116525H01	OPERATIONAL AMPLIFIER
U3040	0105959T72	LEAD FORMED TRANSISTOR
U3200	5185143E77	IC, MAKO ASIC, CMOS PWR MGMT
U3201	5115616H01	NS LP8340 1.0A LINEAR REGULATOR
U3202	5115453H01	RAIL TO RAIL OUTPUT, 8 PIN BGA
U3203	5114007A43	IC,INVTR
U3500	5102463J95	AUDIO PA TDA1519C
U3501	5115368H01	I2C AUDIO ATTENUATOR
U3502	5114016A18	IC,OP AMP
U3503	5164852H47	IC, I2C LEVEL TRANSLATOR
U3504	5171395L01	DUAL ANALOG SWITCH TS5A23166
U3505	5114016A18	IC,OP AMP
U3508	5164852H47	IC, I2C LEVEL TRANSLATOR
U4000	5115476H01	8-BIT SHIFT REGISTER
U4001	5115502H01	SN74LVC07APWR
U4004	5178395A01	TRANSCEIVER, SINGLE-BIT DUAL-SUPPLY
U4005	5178395A01	TRANSCEIVER, SINGLE-BIT DUAL-SUPPLY
U4006	5178395A01	TRANSCEIVER, SINGLE-BIT DUAL-SUPPLY
U4007	5178395A01	TRANSCEIVER, SINGLE-BIT DUAL-SUPPLY
U4008	5178395A01	TRANSCEIVER, SINGLE-BIT DUAL-SUPPLY
U4009	5178395A01	TRANSCEIVER, SINGLE-BIT DUAL-SUPPLY
U4010	5178395A01	TRANSCEIVER, SINGLE-BIT DUAL-SUPPLY
VR3000	48012043001	DIODE
VR3040	4813977M10	DIODE
VR3200	4813977M10	DIODE
VR3201	4813977M05	DIODE
VR3202	4813977M05	DIODE
VR3203	4813977M05	DIODE
VR3204	4813977M13	DIODE
VR3205	4813977M05	DIODE
VR3206	4813977M13	DIODE
VR3207	4813977M13	DIODE
VR3208	4813977M13	DIODE
VR3502	4813977A48	DIODE
VR3503	4813977A48	DIODE
VR3504	4813977A48	DIODE
VR4000	4813977A48	DIODE
VR4001	4813977A48	DIODE
VR4002	4813977A48	DIODE
VR4003	4813977A48	DIODE
VR4004	4813977A48	DIODE
VR4005	4813977M13	DIODE
VR4006	4813977M13	DIODE
Y1000	93012000001	XTAL 12MHZ,10PPM,3.2X2.5 X0.55MM SMD
Y3200	4815028H01	CX-101F 24.57MHZ KSS XTAL
Y3201	4802582S80	RESON,QRTZ,.032768 MHZ

XPR 8380
MOTOTRBO Repeater

Chapter 5

800/900 MHz Band

(806–941 MHz)

10–35W

Service Information

Issue: April, 2010

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Chapter 5 - 800/900 MHz Band Service Information

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Section 2 Troubleshooting Charts

Section 3 800/900 MHz PCB/Schematics/Parts List

Section 1

THEORY OF OPERATION

1.0 Introduction

This chapter provides a detailed theory of operation for the RF circuits in the radio. For details of the theory of operation and troubleshooting for the associated Controller circuits, refer to the Controller Section of this manual.

2.0 800/900 MHz (851–825, 896–902MHz) Band Receiver Circuitry

The receiver is dual-band operating in both the 800 MHz and 900 MHz bands capable of FM, 4-level FSK and APCO C4FM demodulation. It is a dual-conversion super-heterodyne using IF frequencies 73.35 and 2.25 MHz. This configuration allows for a dynamic range of 130 dB in both analog and digital modes. The receiver in general is divided into three sections, front-end, back-end, and DSP. The overall block diagram is shown below in Figure 1-1.

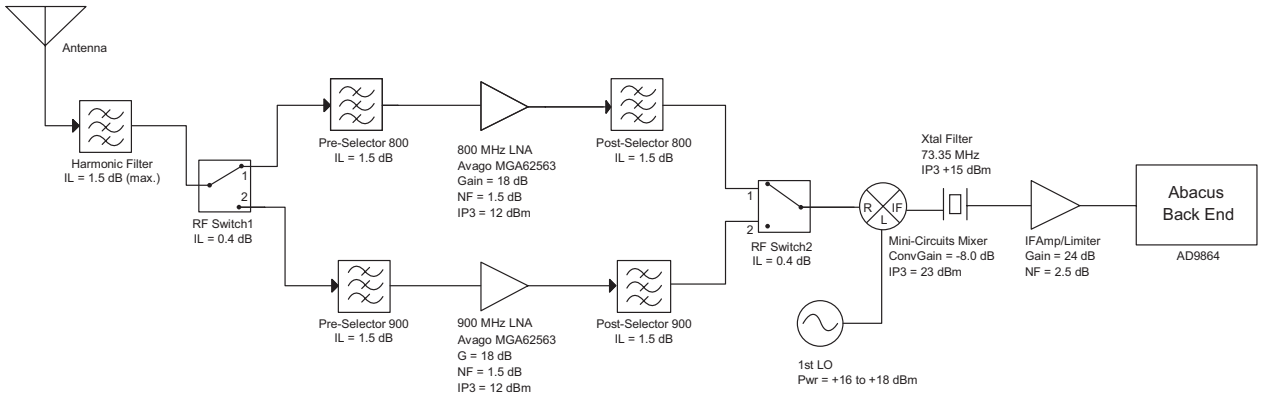


Figure 1-1 Receiver Block Diagram

2.1 Receiver Front-End

When the radio is receiving, RF energy is routed from the antenna through the External Connector (J0700) to a pin diode Transmit/Receive (T/R) antenna switch comprising of (D0700) and (D0702). The front-end provides rejection of any unwanted out-of-band energy and the initial frequency conversion to the first IF (Intermediate Frequency) of 73.35 MHz.

The receiver front-end has two line-ups, one to receive in the 800 MHz band and one to receive in the 900 MHz band. Band selection of the proper set of ceramic filters and LNA is achieved by the use of two SPDT RF switches (U0403) and (U0404). The band select signal from the main processor controls two transistor switches with outputs going to the RF Switch control inputs.

At 800 MHz band selection, receiving signal is routed to pre-selector filter (FL0401), LNA (U0401) and image band-pass filter (FL0402).

At 900 MHz band selection, receiving signal is routed to pre-selector filter (FL0403), LNA (U0405) and image band-pass filter (FL0404).

800/900 MHz band uses the same mixer (U0407) to frequency down conversion to IF 73.35 MHz.

The insertion loss of the filters is typically 1.5 dB while the insertion loss of the RF switches is about 0.4 dB.

Power protection of these line-ups is provided by a pair of Schottky diodes CR0400 & CR0401. These diodes allow operation at a maximum RF input power of +30 dBm.

The LNAs are biased to achieve a gain of approximately 18 dB and an IIP3 of +10 dBm minimum. The mixer has an IIP3 of approximately +23 dBm. A dual Schottky diode, (CR0400 and CR0401), is located between the first switch and the pre-selector filter to protect the LNA and mixer from high RF input levels.

The LO drive to the first mixer is +16dBm min. A 7-pole injection filter attenuates any unwanted harmonics before the signal reaches the mixer.

2.2 Receiver Back-End

After the first frequency conversion to 73.35 MHz, the IF signal passes though a crystal filter (FL0500) with a minimum 3 dB BW of 13 kHz. The signal is then routed through a 2-stage limiter/ amplifier (Q0500 & Q0501). The limiter/amplifier stage applies low level signals while limiting signals above -30 dBm, to help achieve a dynamic range of well over 100 dB without over-driving the ADC, internal to the AD9864 IC.

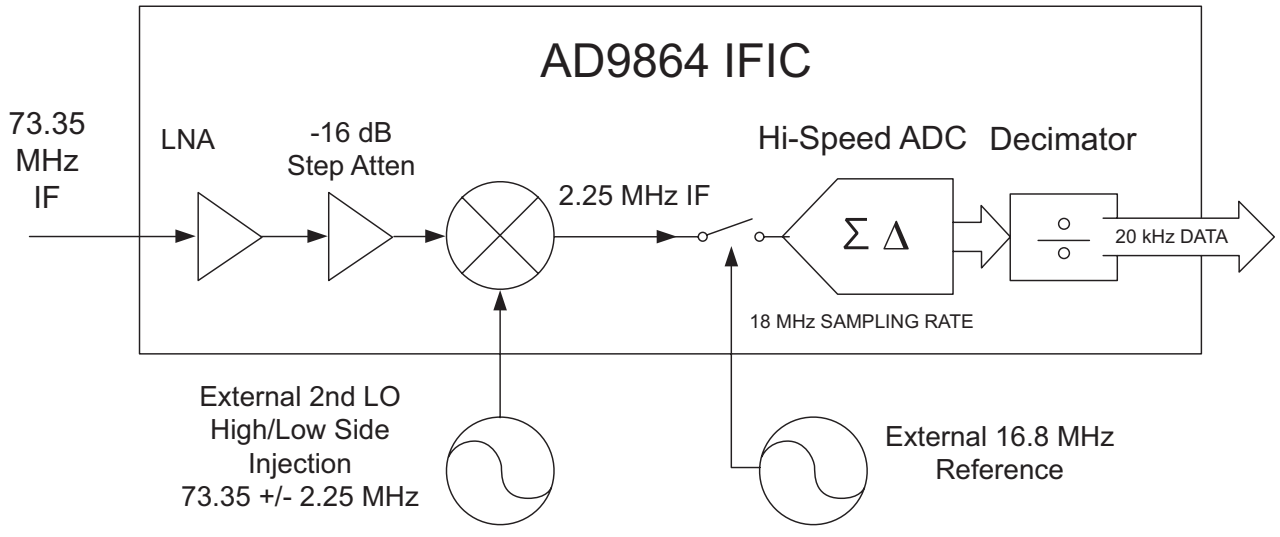


Figure 1-2 AD9864 Block Diagram

The 73.35 MHz IF signal finally reaches the AD9864 (U0600), as shown in Figure 1-2. Here another frequency down-conversion to 2.25 MHz takes place before the resultant RF voltage gets sampled by a Sigma-Delta converter. The Sigma-Delta converter is a high-speed ADC that outputs a 20 kHz data stream to the main DSP.

2.3 Receiver DSP (Digital Signal Processing)

Shown below in Figure 1-3 is the block diagram of the signal flow through the receiver back-end. All blocks within the dotted box represent the DSP software algorithms internal to U1000.

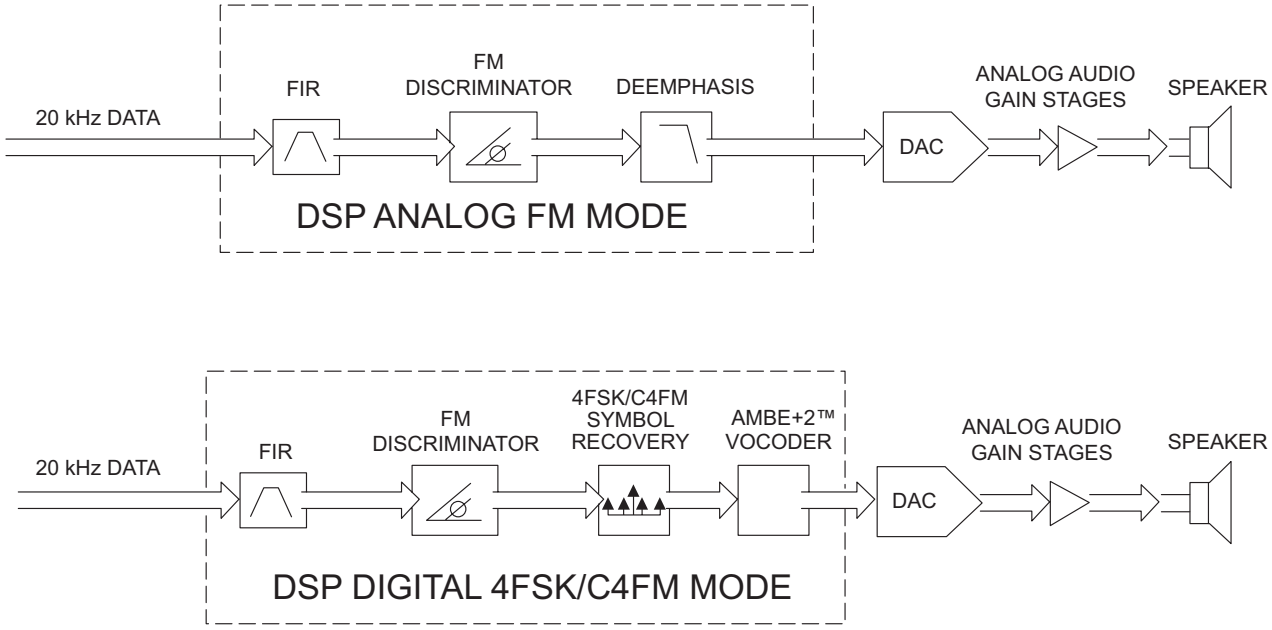


Figure 1-3 Signal Flow through Receiver Back-End

The DSP takes the incoming 20 kHz data stream and passes the information through an FIR (Finite Impulse Response) filter, which provides rejection from any in-band adjacent channel interference. The remaining filtered data is then sent through the FM Discriminator routine. This routine is primarily responsible for base-band information recovery. Depending on whether the radio is in analog or digital mode determines the kind of signal processing used. If the radio is in analog mode, the recovered base-band data is sent through FM De-emphasis and sub-audible tone (CTCSS/ CDCSS) recovery subroutines in the DSP code. If the radio is in digital mode, the recovered base-band information is sent through a Symbol Recovery routine. The resultant data is then routed through a standard AMBE+2™ vocoder for processing.

The output signal from either the analog or digital mode signal processing (still represented by hi-speed data), is sent to a DAC (U3200), which converts the data stream back into usable audio. This stage drives several additional gain stages. These gain stages consist of an I2C audio attenuator (U3501) and a high-power audio PA (U3500) providing the user with at least 3 W of power through an internal speaker and 13 W of audio to an external speaker.

3.0 Transmitter Power Amplifier (PA) 35 W (800MHz)/30 W (900MHz)

The Transmitter consists of the Power Amplifier (PA) circuitry and the Power Control circuitry. The Power Amplifier is responsible for delivering a replica of the VCO output amplified up to the desired output power level, free from distortion. The Power Control portion is responsible for ensuring the desired output power level is maintained in both analog and digital modes, as well as protecting the power amplifier from damage due to heat, antenna mismatch, out of range battery voltage, or mis-assembly.

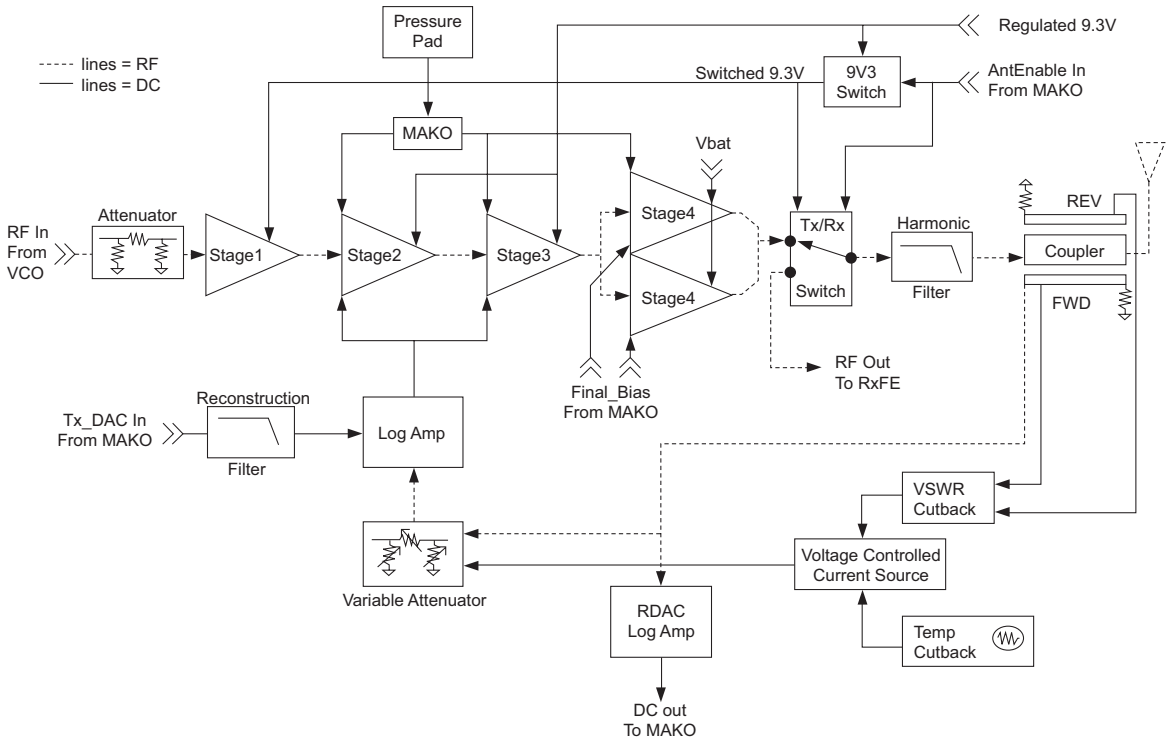


Figure 1-4 800/900 MHz Transmitter Detailed Block Diagram

3.1 Power Amplifier

The radio's power amplifier (PA) is a 4 stage amplifier which amplifies the output of the VCO to the required transmit power level. The first stage consists of a fixed gain block (ADA-4743, U0700), followed by an adjustable gain LDMOS pre-driver (RD01MUS1, Q0705), an adjustable gain LDMOS driver (RD05MMP1, Q0703), and dual fixed gain LDMOS final devices (MRF6E9045, Q0709 & Q0710). A transmit / receive (TR) switch and a harmonic filter complete the transmit lineup.

3.2 Input Stage (50 Ohm Fixed Gain Block)

The first amplifier stage (ADA-4743, U0700) is an integrated circuit with internal 50 ohm input and output impedance matching networks providing approximately 17dB power gain. It serves 2 purposes: 1) it provides reverse isolation between the PA and the VCO to lessen the risk of VCO load pull, and 2) it provides appropriate power to the pre-driver stage. The ADA-4743 is biased at 60mA during transmit by R0706, which is switched to 9V3 during TX by Q0701 (controlled by Antenna_En). The ADA-4743 is preceded by a 13 dB resistive pad to improve reverse isolation still further.

3.3 Pre-Driver Stage

The next amplifier stage is a low power LDMOS device (RD01MUS1, Q0705) which delivers up to 30dBm power to the driver stage. Its gain is controlled by varying the gate bias voltage, which varies the power gain up to 14dB. The gate bias voltage is controlled with the V_cont signal and is controlled in parallel with the Driver Stage gain.

The input matching network to this stage is a high pass topology. High pass impedance matching networks are used to minimize the chances of low frequency regeneration within the amplifier. The inter-stage impedance matching network between the pre-driver and driver stages is also arranged in a high pass topology.

3.4 Driver Stage

The next amplifier stage is a medium power LDMOS device (RD05MMP1, Q0703) which delivers up to 38.5 dBm to the final devices. Its gain is controlled by varying the gate bias voltage and varies from low gain up to approximately 10 dB power gain. The gate bias voltage is controlled with the V_cont signal, as well, and is controlled in parallel with the Pre-Driver Stage gain.

Series gate resistors are required to improve the bandwidth of the driver stage. The inter-stage impedance matching network between the driver and final device uses a low pass topology.

3.5 Final Stage

The final stage is a pair of high power LDMOS devices (MRF6E9045, Q0709 & Q0710). The packages are mounted to a copper carrier to improve thermal conductivity to the chassis, and allow a common chassis among the other frequency bands.

This stage is biased at a quiescent current of 350 mA per device and operates with a fixed gain of approximately 11dB, allowing up to 46.9 dBm output power (49 W). The quiescent currents are set by adjusting the Final_Bias signals.

The output match uses a low pass topology and has extremely critical part location requirements. Any repairs must be done with extensive care to ensure the replaced components are placed accurately and properly soldered. Additional footprints are provided on the printed circuit board to allow for possible engineering optimizations to this match. The resistor networks at the input of each of the final elements are required to improve the bandwidth of the circuit.

If the final device is replaced, the bias voltages must be re-tuned using the Customer Programming Software (CPS). Care must be taken not to damage the device by exceeding the maximum allowed quiescent current. The maximum allowable current is 750 mA, but the design is optimized for 350 mA as stated earlier. The device can tolerate up to 5 amps for brief periods of time without damage.

3.6 Antenna Switch

The Antenna Switch (T/R switch) has 2 modes, transmit mode and receive mode.

Transmit mode: The antenna switch utilizes the switched 9.3 V from Q0713. Both PIN diodes D0700 and D0702 are turned on during key-up by forward biasing them. Forward biasing is achieved by injecting 9.3 V with Q0713 and the current is set with 2 series resistors (R0723 & R0724) and a 0.8 V drop across each diode. Q0713 maintains the current through the antenna switch diodes at 160 mA. Q0713 is enabled during transmit mode by ANT_ENABLE asserting through Q0714 (an inverter) and associated circuitry. An RF short is formed through PIN diode D0702, providing a path to ground through the parallel pair of cap C0796 and inductor L0714. This path completes the DC bias and provides a quarter-wave open circuit, isolating the RX path. The values of C0796 and L0714 are chosen so that they are in parallel resonance at the center of the transmit band, making them appear as an open circuit so that a 50 ohm power path is maintained thru D0700 to the Harmonic filter and isolating the Tx signal from the Rx front end.

Receive mode: The DC current thru the PIN diodes is interrupted by turning off the switch and reverse biasing the PIN diodes. The RF path now flows from the Harmonic Filter thru inductor L0710, capacitor C0791 (to ground) and C0792. C0792 acts as a coupling capacitor, blocking DC from reaching the Rx front end.

3.7 Harmonic Filter

Inductors L0706, L0707, L0708 and capacitors C0735, C0736, C0737 and C0795 form a harmonic filter which is a 7^{th} order Chebyshev low pass filter, that is used to attenuate harmonic energy from the transmitter before it reaches the antenna. The harmonic filter also prevents high level RF signals above the receiver passband from reaching the receiver circuits, improving spurious response rejection. R0713 and L0722 are used to drain any electrostatic charges that might otherwise build up on the antenna.

3.8 Directional Coupler

The dual directional microstrip coupler is implemented at the harmonic filter output to sample both forward and reverse directed transmitter power. RF power from the transmitter PA passes through the microstrip coupler before reaching the antenna. Forward RF power is coupled to the U0940 log detector / controller via the voltage controlled attenuator (VCA) stage. This consists of pin diodes D0901, D0902, and D0903. The log detector / controller also regulates the gain of PA stages Q0703 and Q0705 (via V_cont) as necessary thus ensuring the forward power out of the radio is held to a constant value.

The directional coupler functions not only as part of the transmitter power regulation circuit but also functions as part of the VSWR load detection circuitry. Its physical location close to the antenna connector allows accurate VSWR sensing at the transmitter output. Forward and reverse coupled signals are rectified by D0904 and D0905 respectively. Resulting DC voltage FWD_DETECTED is proportional to transmit RF power, while REV_DETECTED is proportional to reflected RF power. The detected voltages are fed to the respective inputs of difference amplifier U0901. The difference amplifier output is applied to variable attenuator control stage, U0900-1. An abnormally high reflected power level may be caused by a damaged antenna. This would cause an increase in the amplifier output voltage, thereby causing a reduction in attenuation by the VCA. As a result, the controller reduces the gain of PA stages Q0703 and Q0705 to prevent damage to these devices due to an improper load.

3.9 Power Control

The transmitter uses a PA controller IC, U0940 to control the power output of the radio. A portion of the forward RF power from the transmitter is sampled by the directional coupler and delivered via the VCA to the RFIN port of the PA controller IC (pin 1). The PA controller, a log detector type, provides temperature stability and high accuracy control over a typical 50 dB dynamic range.

The MAKO contains a digital to analog converter (DAC) which provides a reference voltage (TX_DAC) at the input of reconstruction filter stage U0900-2. The filtered reference voltage at the output of U0900-2 is divided by the combination of R0942 and R0946 before reaching the VSET input of the PA controller IC (pin 3). Thermistor RT0953 is used in combination with R0954 to compensate reference voltage drift at operating temperature extremes. This reference voltage level is programmable through the SPI lines of the MAKO. It is also proportional to the desired power setting of the transmitter, and is factory programmed at several points across the frequency range of the transmitter to offset frequency response variations in the transmitter's coupled power circuits.

The PA controller IC provides a dc output voltage which is to provide gate bias for PA pre-driver and driver stages. The 0 to 5 Vdc range at U0940, pin 7, is applied as V_CONTROL to power-adjust the transmitter output power by controlling the gate bias of stages Q0703 and Q0705. Voltage divider combination R0727 and R0728 provides gate bias to Q0703 while divider combination R0750 and R0751 provides gate bias to Q0705. The ratios of each of these resistor dividers are chosen to ensure Q0703 and Q0705 are each running at its nominal design condition at rated output power. Variations in sampled forward transmitter power cause the PA controller IC to adjust the control voltage above or below its nominal value. This will raise or lower output power in order to maintain an output power level relative to the reference voltage applied to VSET.

3.10 Power Ramp Profile Control

In order to limit transient adjacent channel power at the transmitter's output, the ramped power should follow a raised cosine profile. The PA controller IC has a linear slope function when scaled in dB/V. To achieve the desired raised cosine profile of the output power, the ramped reference voltage provided by the MAKO DAC follows a raised cosine approximation. The MAKO DAC reference output is low pass filtered by the DAC reconstruction filter before it is applied to the VSET input of the PA controller IC.

Reconstruction filtering reduces spurious emissions in the RF spectrum as a result of the finite steps of the DAC. Loop filter capacitor C0926 in conjunction with resistor R0950 and the integrator within the PA controller IC, control the loop dynamics. Loop dynamics have been optimized to achieve sufficient speed to follow the required ramping profiles while meeting switching transient requirements over varied power levels. Accurate control of the power-rise (ramp-up) and power-decay (ramp-down) characteristics minimizes splatter into adjacent channels.

3.11 Thermal Protection

Thermistor RT0908 in combination with R0902 forms a voltage divider with output proportional to the sensed circuit board temperature in the vicinity of the transmitter driver and final devices. The voltage divider output is routed to an operational amplifier U0901-2 which provides a dc voltage via diode junction D0900 to control attenuation level of the VCA stage. If the case temperature threshold set by resistive divider combination R0901 and R0909 is reached, the VCA is driven to increase RFIN signal at PA controller IC (pin 1). This increase will cause the PA controller IC to adjust the PA control voltage below its nominal value to decrease transmitter output power. Temperature will be reduced by lowering transmitter output power relative to the reference voltage applied to VSET.

3.12 Out-of-Range Battery Protection

Transmitter power cutback under extended battery supply voltage operation is provided for by monitoring battery supply in the controller circuit of the radio in order to change VSET input of the PA controller IC (pin 3) for reduced transmitter output. This cutback starts when the battery voltage at the connector reaches 15.3 V and above. This results in a 2 dB drop in output power. There is also a low battery detect circuit that is implemented in hardware. This hardware cutback gives a 1.2 dB drop in RF power level when the battery voltage drops below 11.6 V and has about 0.6 V of hysteresis before it will return to normal power.

3.13 Pressure Pad Switch

The power control circuitry includes a safety switch (S0700) that consists of a conductive portion of the rubber pad which pushes the RF final transistors Q0709 and Q0710 firmly against the chassis, improving the heat-sink to the devices. When the chassis cover and rubber pad are properly assembled, the conductive portion of the pad contacts a pattern on the circuit board, electrically closing switch S0700. If the cover and pad are not in place, switch S0700 is open-circuited and the power control circuit is disabled via software in which turning off the gate bias to Q0709, Q0710, Q0703, and Q0705. This mechanism is to prevent thermal damage of the RF transistors which might occur if the transmitter is operated without adequate heat-sinking.

4.0 Frequency Generation Circuitry

The synthesizer subsystem consists of the reference oscillator (Y0100), the fractional-N synthesizer IC (U0100), and the Voltage Controlled Oscillator (VCO).

4.1 Reference Oscillator

The reference oscillator (Y0100) contains a voltage-controlled temperature compensated crystal oscillator (VC-TCXO) with a frequency of 16.8 MHz. A digital-to-analog (DAC) converter internal to U0100 and controlled by the mP via serial interface (SPI), sets the voltage at the AUX_DAC output of U0100 (pin K6) to set the frequency of the oscillator. The output of the oscillator (pin 3 of Y0100) is applied to pin K5 (REF_IN) of U0100.

4.2 Fractional-N Synthesizer

The fractional-N synthesizer IC (U0100) consists of a pre-scaler, a programmable divider with control logic, phase detector, charge pump, a D/A converter in the high frequency analog modulation path, an attenuator to balance the high and low frequency modulation paths, a serial interface for control (SPI), a serial interface for modulation (SSI), and a super filter for the regulated 8.4 Volts.

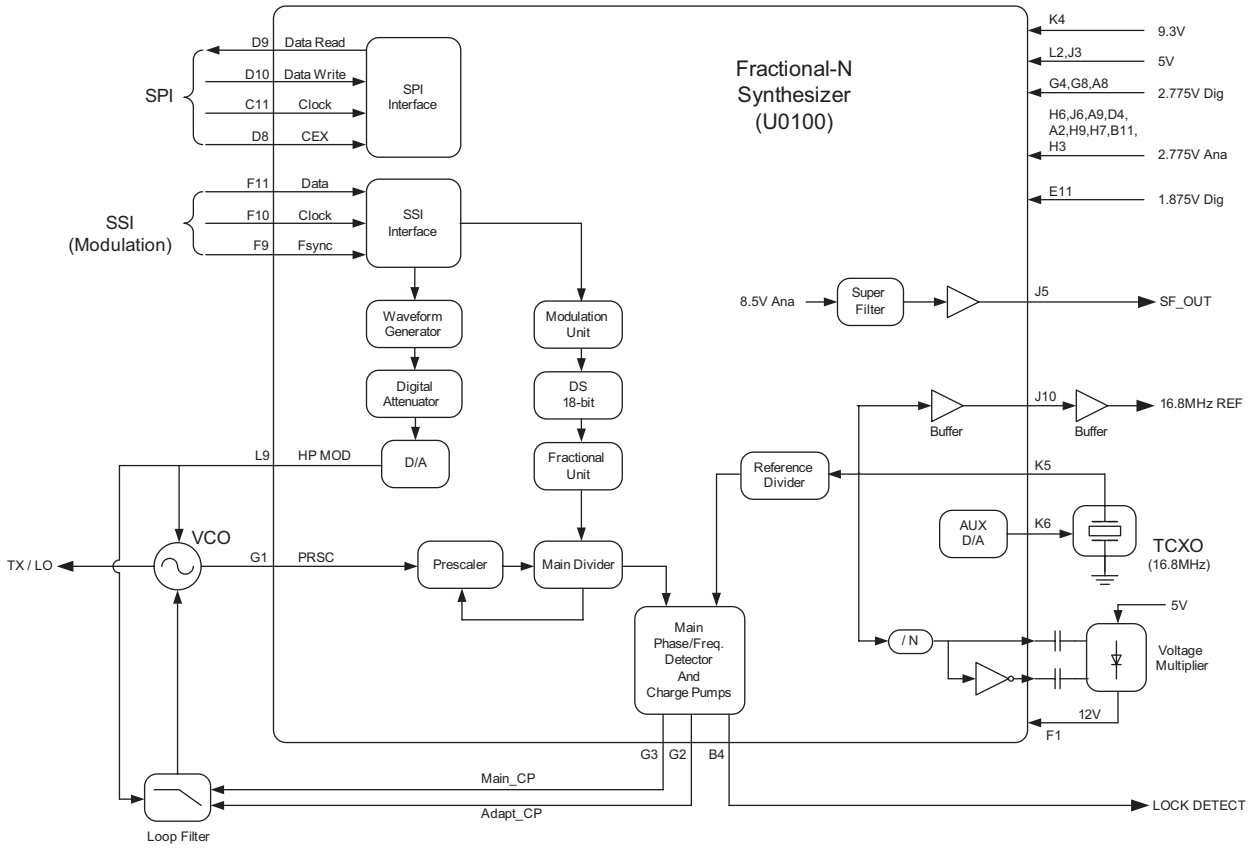


Figure 1-5 800/900 MHz Synthesizer Block Diagram

A voltage of 9.3 Volts applied to the super filter input (U0100 pin K4) supplies an output voltage of 8.4 Vdc (SF_OUT) at pin J5. This supplies the VCO and the VCO modulation bias circuit (via R0321). The super filter supply voltage is provided by the 9.3 Volt regulator, U3001. The synthesizer is also supplied by the 5 Volt regulator (U3002) as well as two 2.775 Volt regulators and a 1.875 Volt regulator within U3200.

The output signal LOCK (U0100-B4) provides information about the lock status of the synthesizer loop. A high level (1.8V) at this output indicates a stable loop. A discrete buffer amplifier (Q0100) provides a buffered 16.8 MHz reference frequency to other parts of the radio.

The serial programming interface (SPI) is connected to the mP via the data lines SPI_DW (U0100-D10) and SPI_DR (U0100-D9), clock line SPI_CLK (U0100-C11), and chip enable line CEX (U0100-D8). The serial modulation interface (SSI) is connected to the DSP via the data line SDTX (U0100-F11), clock line TXCLK (U0100-F10), and frame sync line SFTX (U0100-F9).

4.3 Voltage Controlled Oscillator (VCO)

The Voltage Controlled Oscillator (VCO) subsystem consists of two Colpitts oscillators (one for 800MHz and one for 900MHz band), a two-stage buffer amplifier with RF switch to route between TX injection or RX LO injection paths, oscillator bias control switches, and the modulation circuitry.

800/900MHz VCO
Subsystem

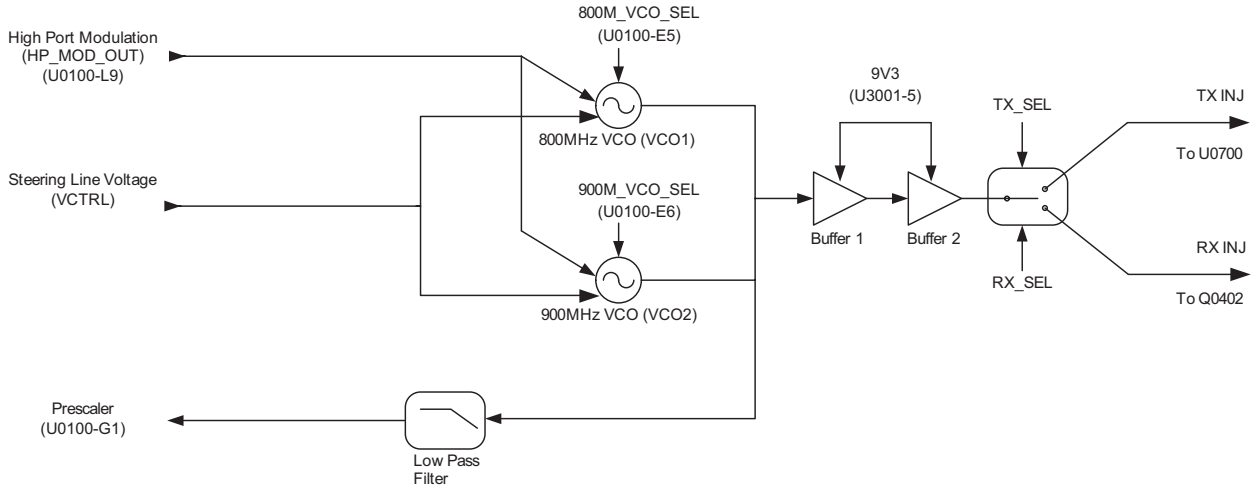


Figure 1-6 800/900 MHz VCO Block Diagram

Each varactor-tuned oscillator has a tuning range of 64MHz, sufficient to cover the RX and TX frequency ranges for both 800MHz and 900MHz bands. VCO1 (800MHz VCO) is designed to cover 806MHz to 870MHz, which is used for 800MHz TX frequencies and for 900MHz RX LO injection (low side injection). VCO2 (900MHz VCO) is designed to cover 879.35MHz to 943.35MHz, which is used for 900MHz TX frequencies and for 800MHz RX LO injection (high side injection). Two general purpose output lines (GPO1 and GPO3) from the Fractional-N Synthesizer IC (U0100-E5, E6) provide the control for independent bias selection for each oscillator (VCO1/VCO2_SEL) via digital transistors Q0291 and Q0292. A third general purpose output line (GPO4, U0100-C5) provides selection control for the RF switch (RX/TX_SEL) via digital transistors Q0111 and Q0106.

The 8.4 Volt super filtered output, SF_OUT, of the Fractional-N synthesizer IC (U0100-J5) supplies the bias to the oscillators. A portion of the VCO output signal is lightly coupled through coupling capacitor C0281, routed through a low-pass filter (formed by L0281, C0282, L0283, and C0284), and fed back to the M_PRSC input of the Fractional-N synthesizer IC (U0100-G1).

High-port modulation is scaled through a voltage divider (comprised of R0206, R0207, R0208, R0256, R0257, and R0258) and applied to the Tx modulation varactor diodes CR0205 and CR0255. The TX VCO frequency is modulated via coupling capacitors C0204 and C0254. High-port modulation is also applied to the VCO steering line (through R0139, R0140, and C0166) which modulates the main VCO tuning varactors.

The outputs of the VCOs are amplified and buffered by a 2-stage cascade design. The use of two stages for the buffer ensures the VCOs will be adequately isolated from load pull effects. Each stage uses the PBR941 configured as a common emitter amplifier. A SPDT RF (T/R) switch (Skyworks AS179-92) routs the output of the buffer to the RX or TX block.

4.4 Synthesizer Operation

The complete synthesizer subsystem is comprised mainly of the Fractional-N synthesizer IC, Reference Oscillator (crystal oscillator with temperature compensation), loop filter circuitry, VCO, DC supplies, and a capacitive voltage multiplier circuit. The VCO feedback signal, PRSC, is fed to pin G1 of U0100 (M_PRSC) via a low-pass filter (L0281, C0282, L0283 and C0284) which attenuates harmonics and provides the correct level to close the phase-locked loop.

The prescaler in the synthesizer IC (U0100) is a four-level prescaler capable of dividing by 4, 5, 6, and 7. The main loop N divider is configured to be an 8-bit divider. The divide-by-N portion of the main loop is set via the SPI. The fractional portion of the divider is realized using a 3-accumulator, 24-bit fractional divider. The SPI is used to set the desired divide ratio.

The output of the prescaler is applied to the main loop divider. The output of the main divider is sent to the phase/frequency detector, which compares the main divider's output signal with the reference signal. The reference signal is generated by dividing down the signal of the reference oscillator (Y0100). This output signal of the phase/frequency detector is a pulsed signal which is then routed to the charge pumps. A capacitive voltage multiplier (formed by diode arrays D0100 and D0101, load capacitors C0186 and C0187, and supporting circuitry) generates 12V to supply the charge pumps. The main charge pump current is programmable through the SPI with its output at pin G3 of U0100 (MN_CP). The loop filter transforms this current into a steering voltage that is then applied to the VCO.

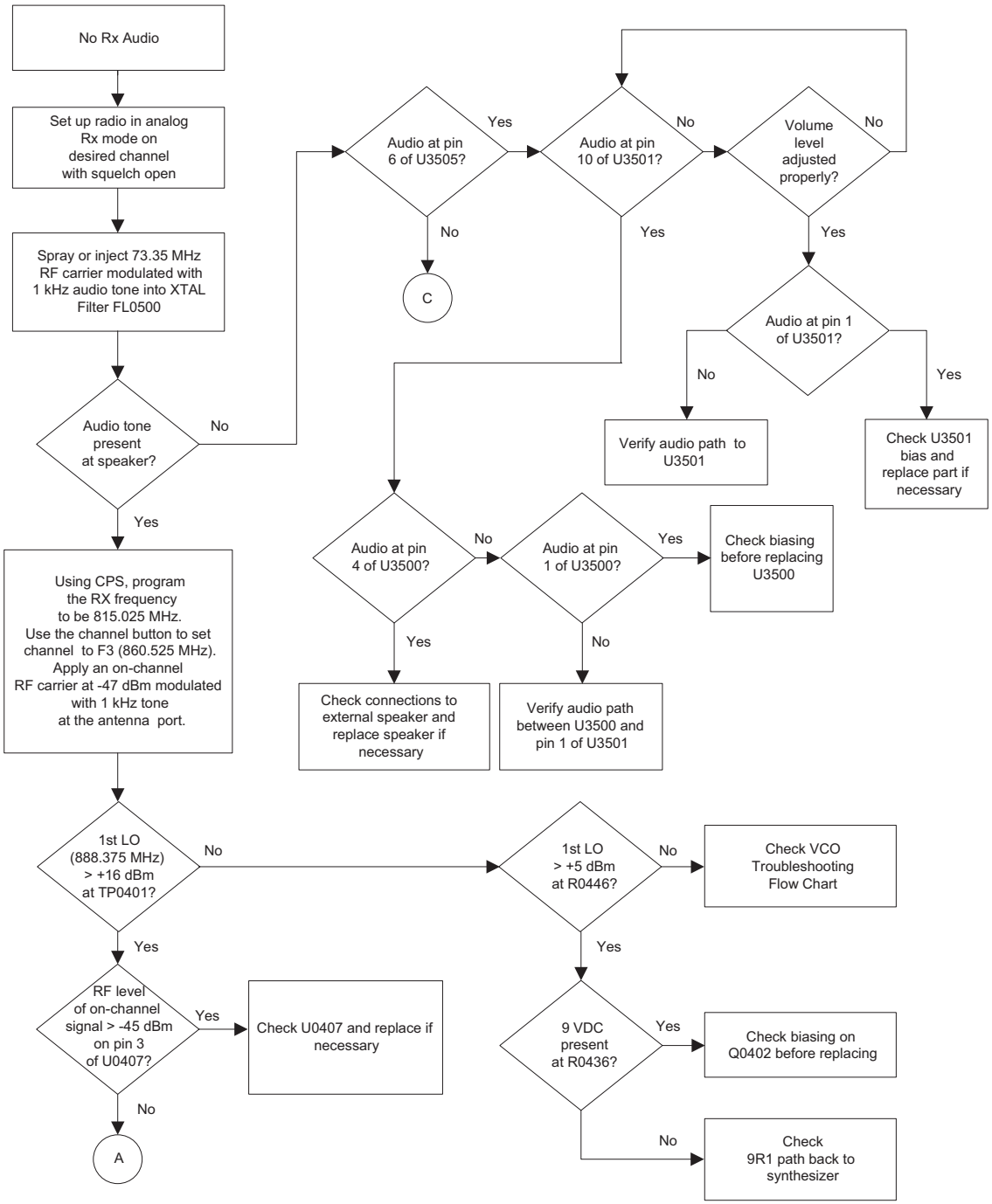
To reduce lock time when new frequency data has been loaded into the synthesizer, an adapt charge pump providing much greater current than the main charge pump is turned on for a finite amount of time to quickly charge or discharge the loop filter capacitors to steer the VCO to the desired frequency. The output of the adapt charge pump passes to the loop filter via pin G2 of U0100 (MN_ADAPT_CP). When the synthesizer is within the lock range and the adapt timer runs out, the adapt charge pump is powered down and the main charge pump takes over. A settled synthesizer loop is indicated by a high level at signal LOCK (U0100-B4), which is routed to the µP.

Modulation is performed by applying a digital data stream via the SSI bus from the DSP (U1000) to the synthesizer (U0100). In order to meet spurious and phase noise requirements, the PLL bandwidth was designed to be narrower than the full modulation bandwidth, therefore requiring the use of dual-port modulation. Internal to the synthesizer (U0100), low-port modulation is added to the fractional-N division numerator to trace out the modulation versus time while the high-port data stream passes through an interpolating waveform generator, a digital attenuator (for modulation balancing), and then gets converted to an analog signal through an 11-bit DAC before modulating the VCO. This high-port analog modulation output (HP_MOD_OUT, U0100-L9) is connected to the VCO modulation varactor diodes (CR0205 and CR0255) via C0219, R0206 and R0256, and to the loop filter via R0139, R0140, and C0166.

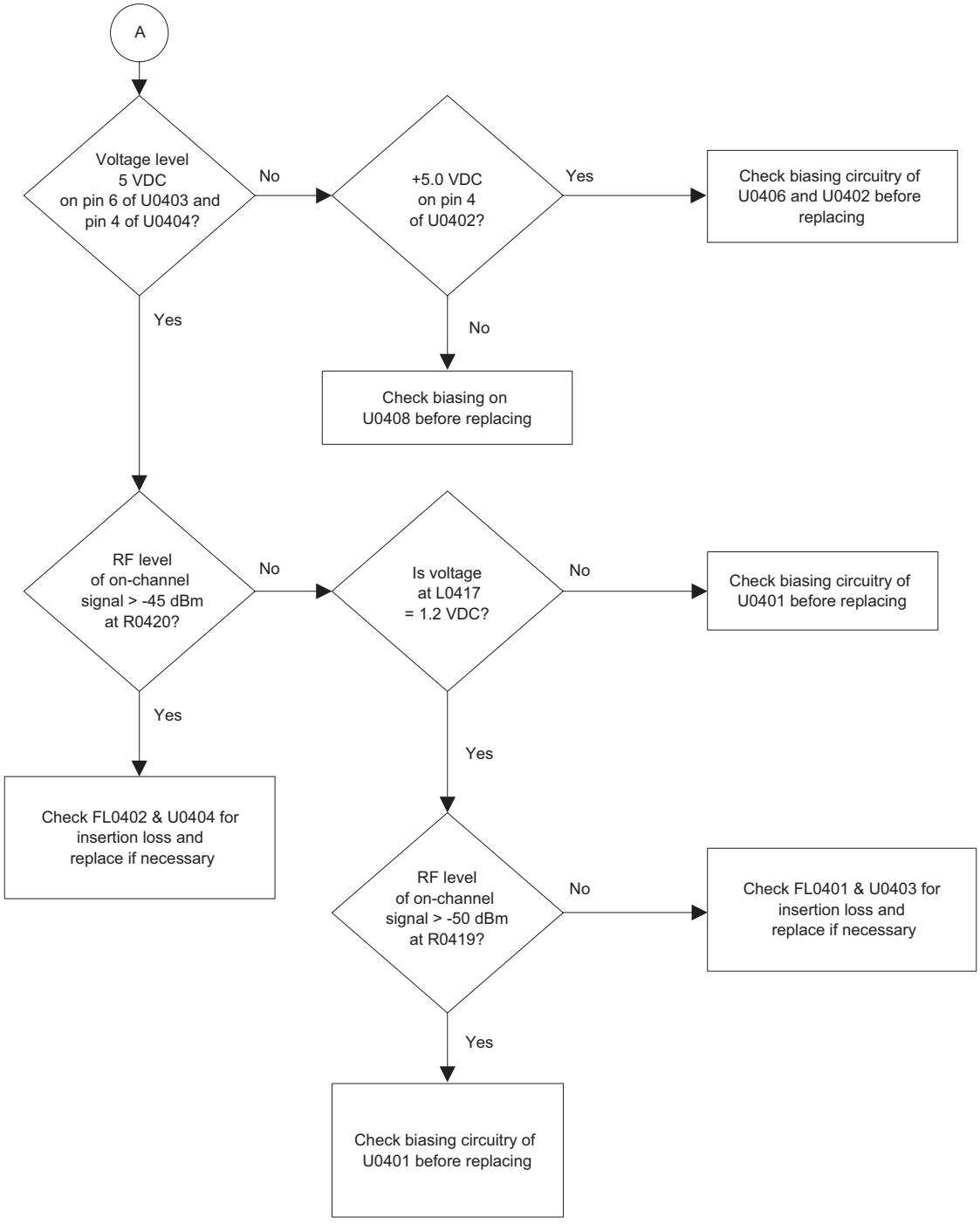
Section 2

TROUBLESHOOTING CHARTS

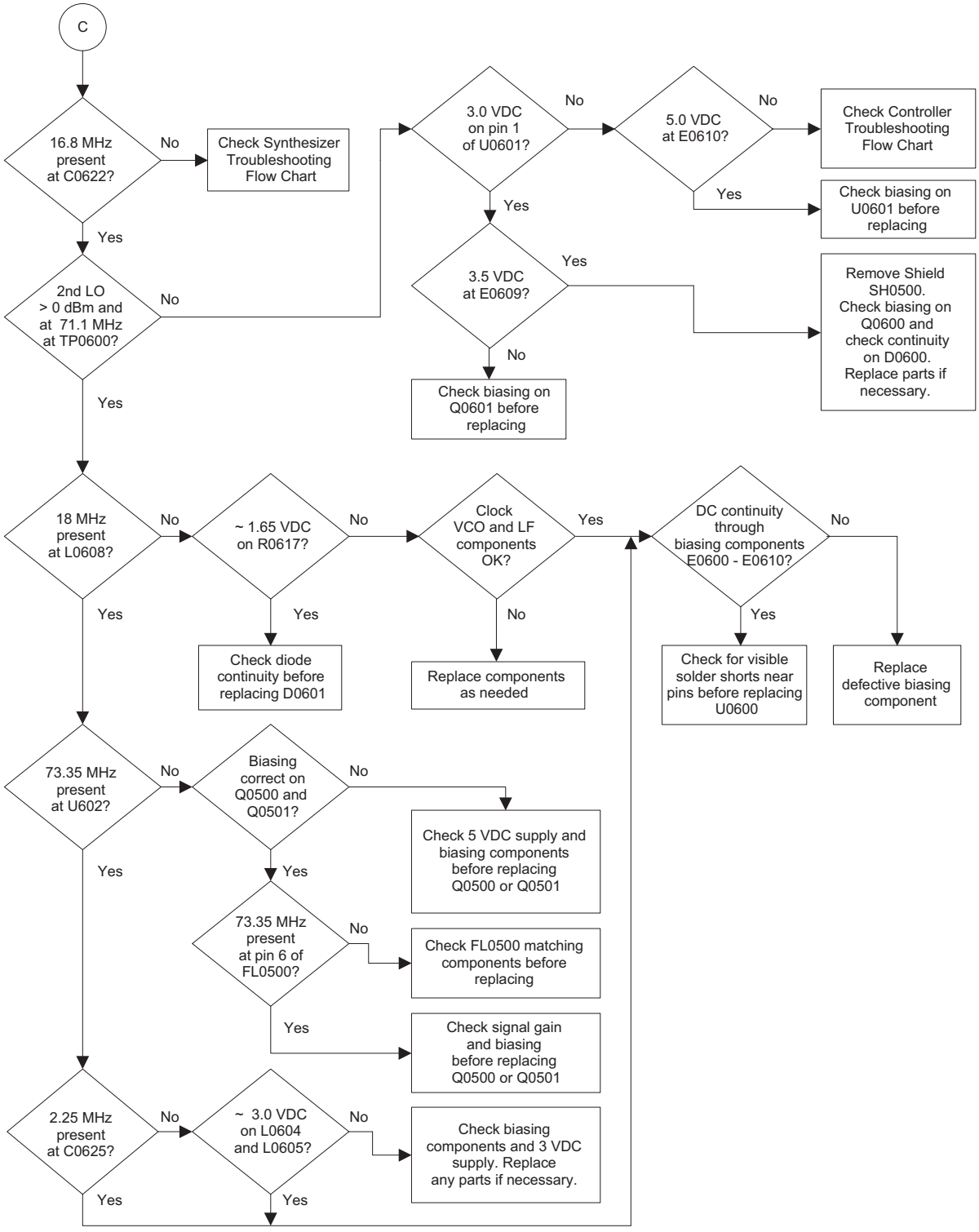
1.0 Troubleshooting Flow Chart for 800 MHz Receiver (Sheet 1 of 3)



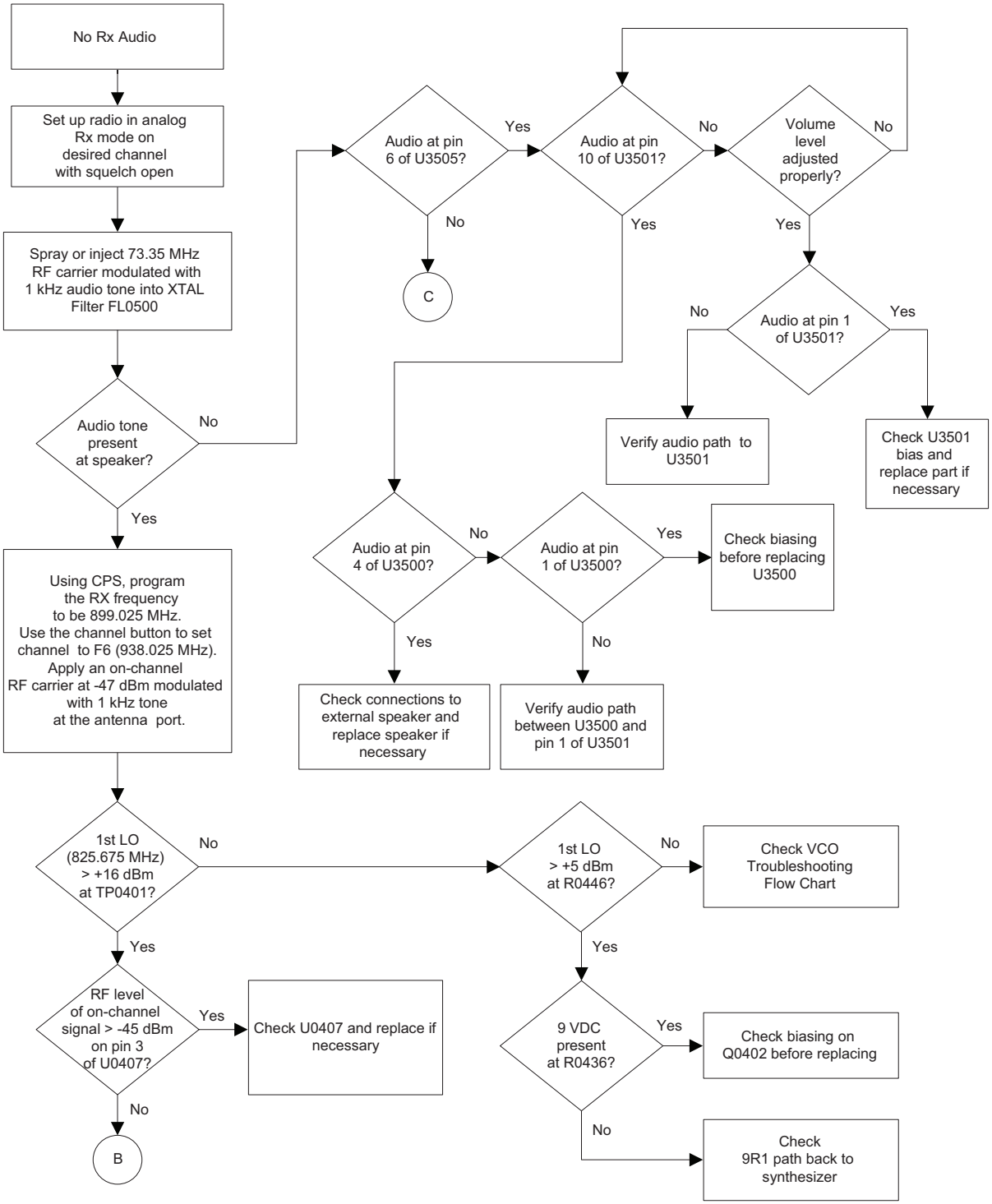
1.1 Troubleshooting Flow Chart for 800 MHz Receiver (Sheet 2 of 3)



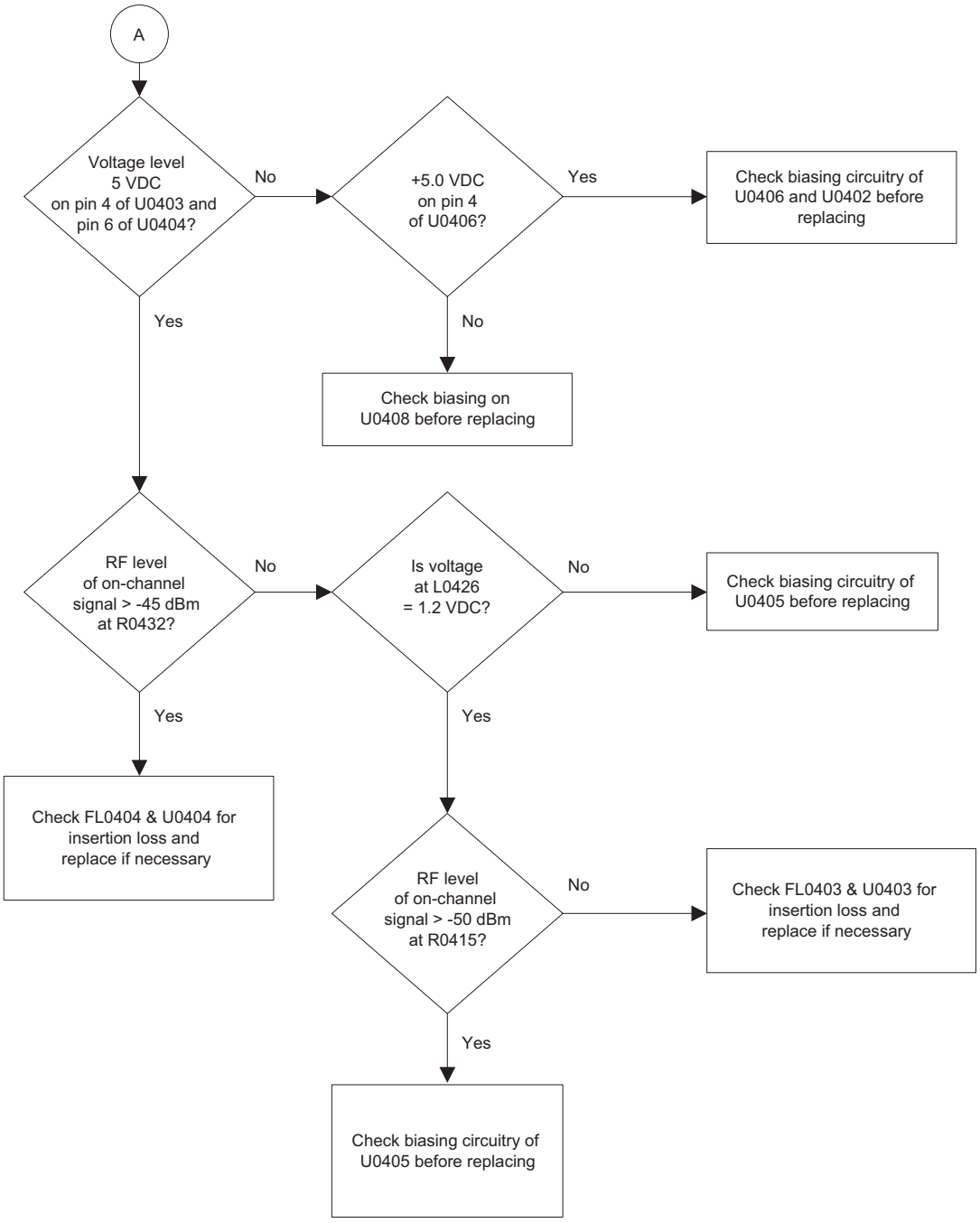
1.2 Troubleshooting Flow Chart for 800 MHz Receiver (Sheet 3 of 3)



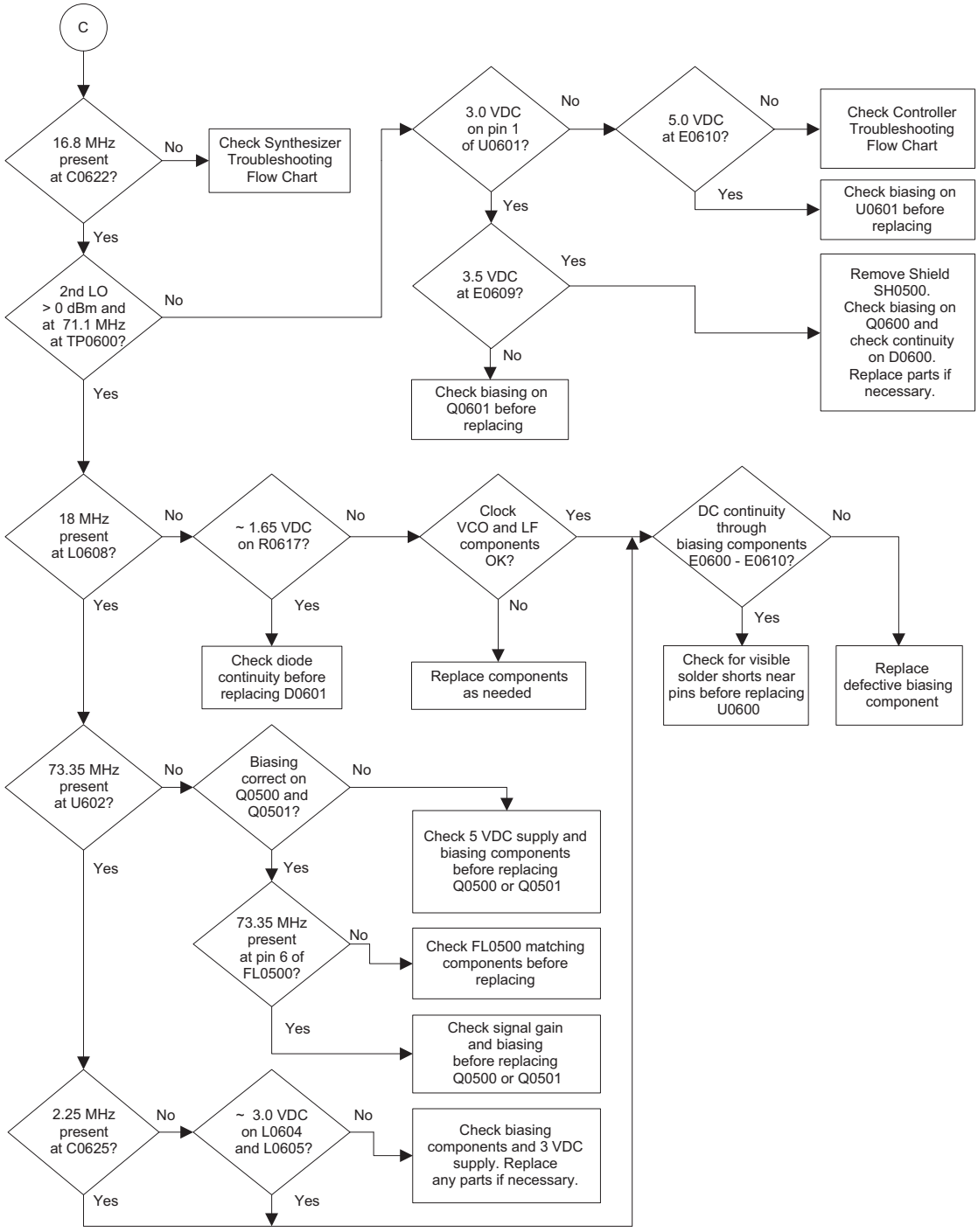
2.0 Troubleshooting Flow Chart for 900 MHz Receiver (Sheet 1 of 3)



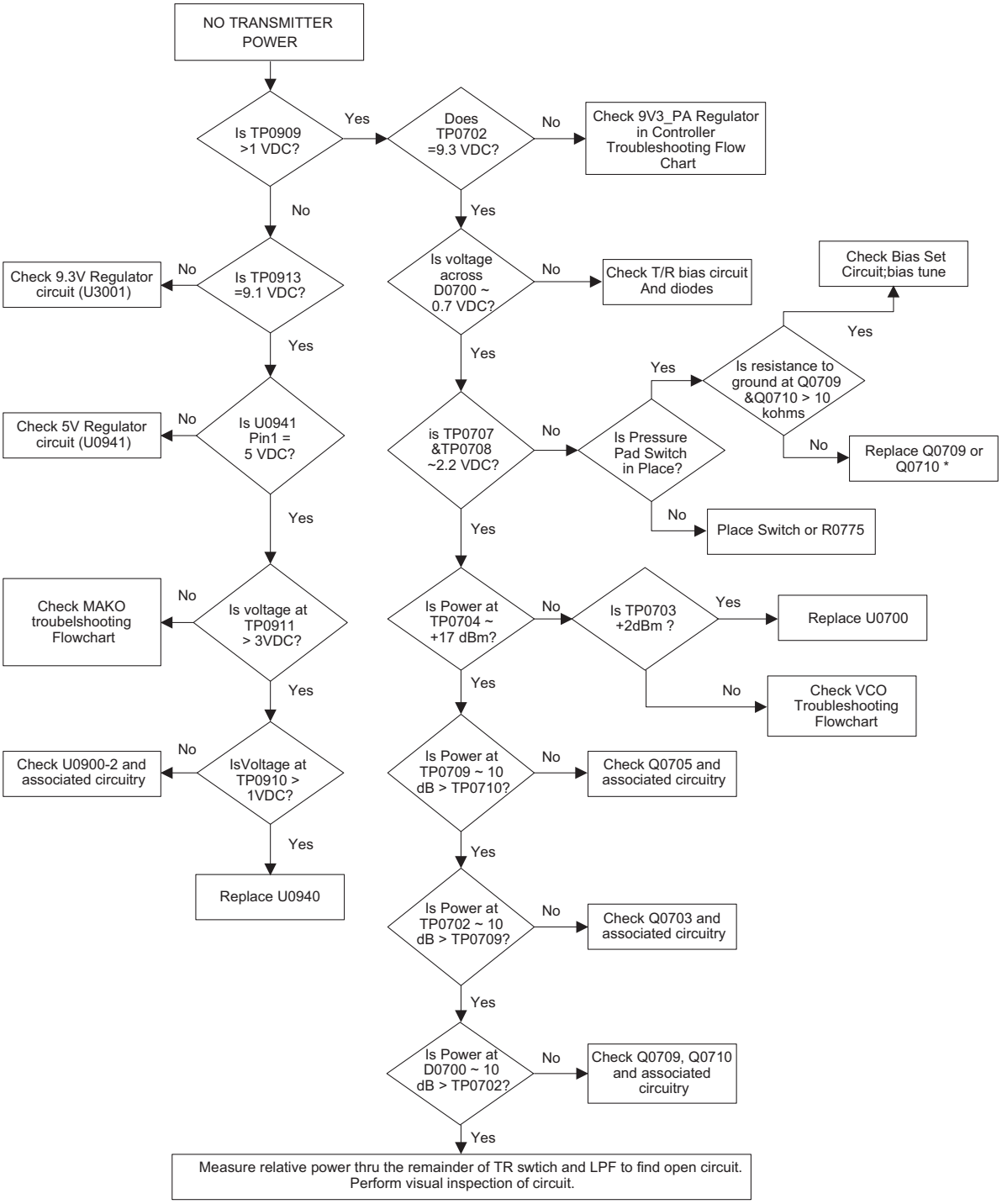
2.1 Troubleshooting Flow Chart for 900 MHz Receiver (Sheet 2 of 3)



2.2 Troubleshooting Flow Chart for 900 MHz Receiver (Sheet 3 of 3)



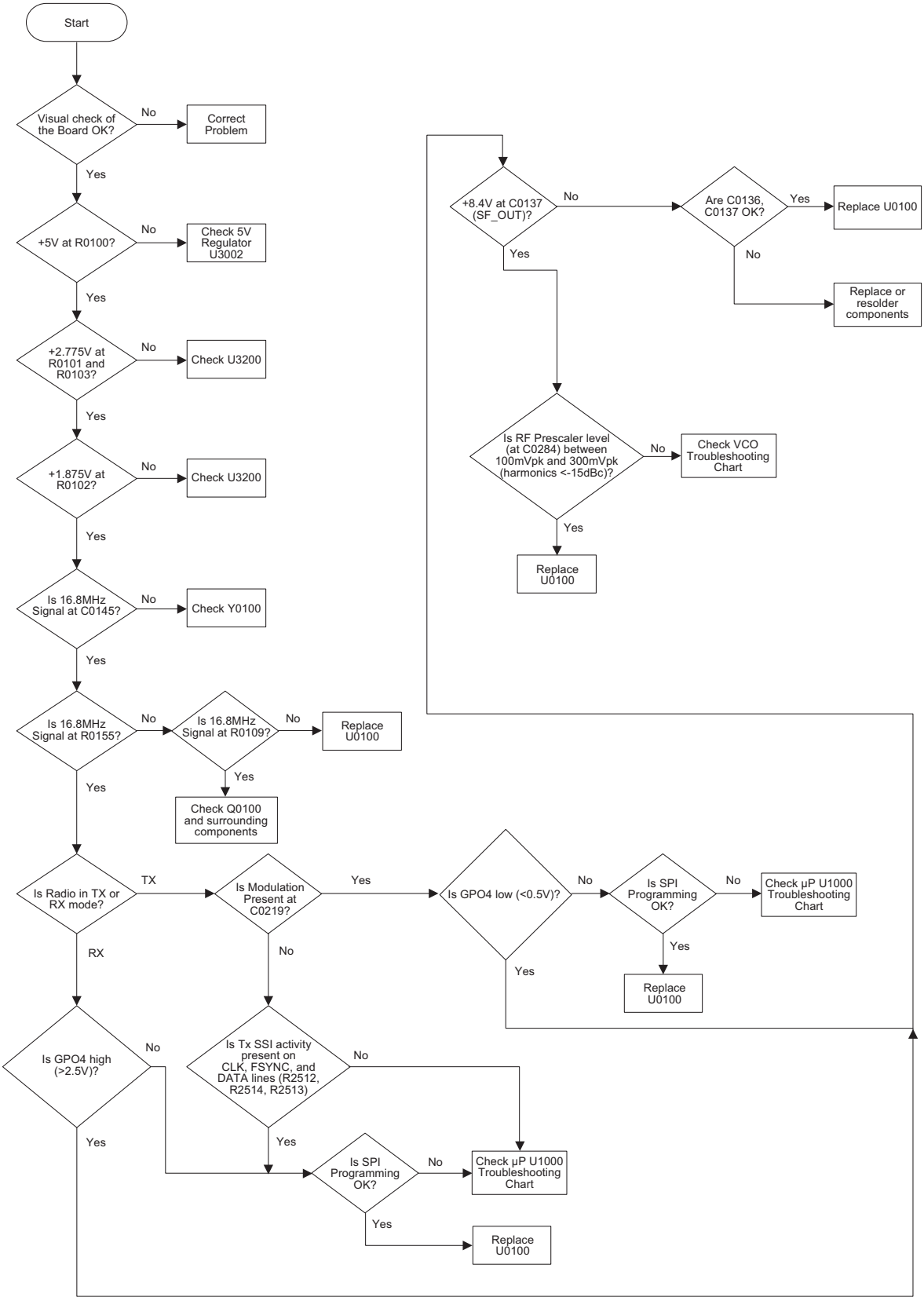
3.0 Troubleshooting Flow Chart for 800/900 MHz Transmitter



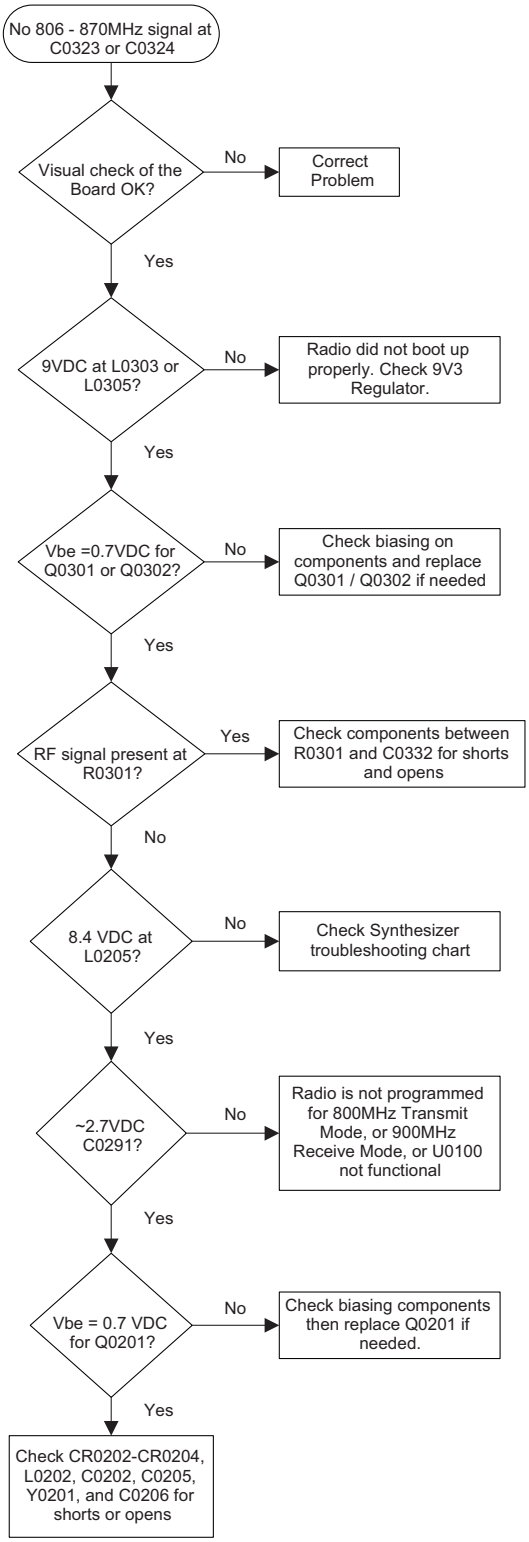
* Note: If Q0709 or Q0710 are replaced, radio must be bias set and power set.

1) Levels are during Transmit Mode (analog), 13.6V at battery connector, 50 ohm termination on transmitter.
2) Make sure PCB is screwed into chassis during these tests to avoid damage to final device
3) When making measurements within the transmitter using an RF power probe, be careful that the rating of the probe is not exceeded. The “relative” measurements listed in the flow chart should be made with a scope probe connected to a spectrum analyzer or similar instrument to avoid damaging sensitive power probes.

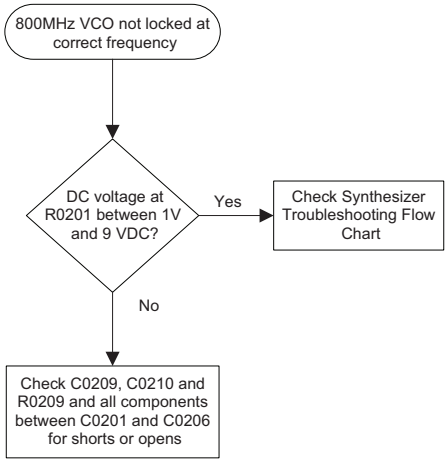
4.0 Troubleshooting Flow Chart for Synthesizer

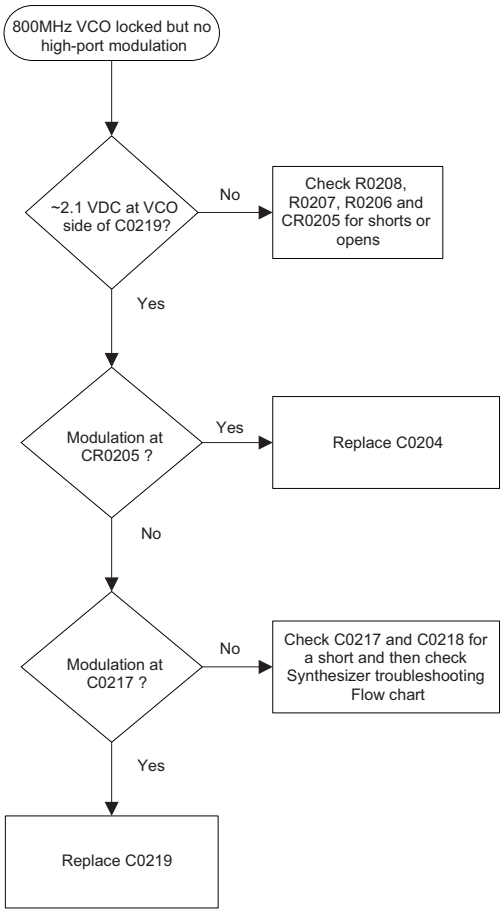


5.0 Troubleshooting Flow Chart for 800 MHz VCO (Sheet 1 of 2)

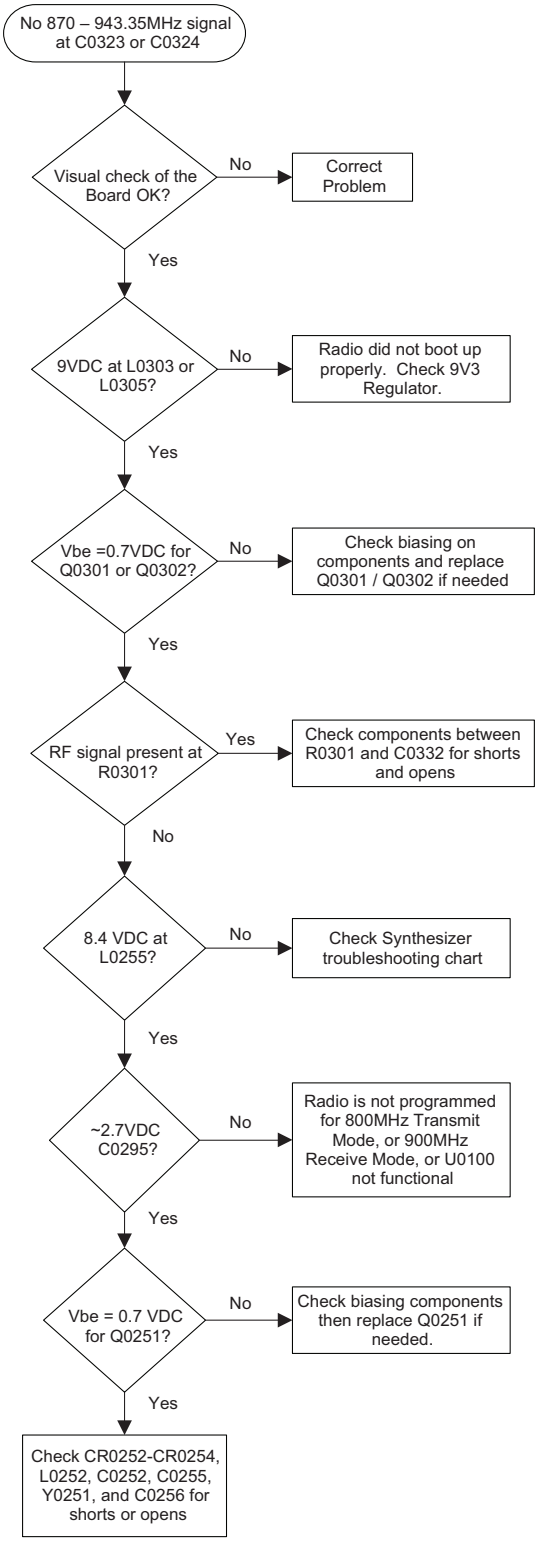


5.1 Troubleshooting Flow Chart for 800 MHz VCO (Sheet 2 of 2)

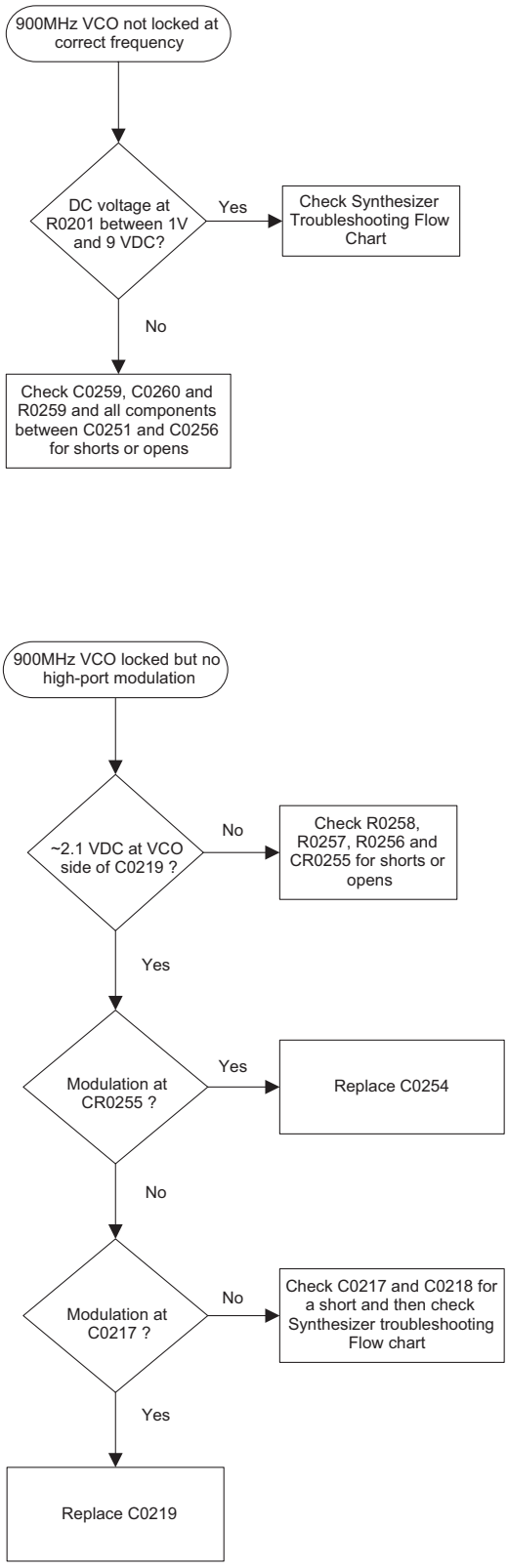




6.0 Troubleshooting Flow Chart for 900 MHz VCO (Sheet 1 of 2)



6.1 Troubleshooting Flow Chart for 900 MHz VCO (Sheet 2 of 2)



Section 3

800/900 MHZ PCB/SCHEMATICS/PARTS LIST

1.0 Allocation of Schematics and Circuit Boards

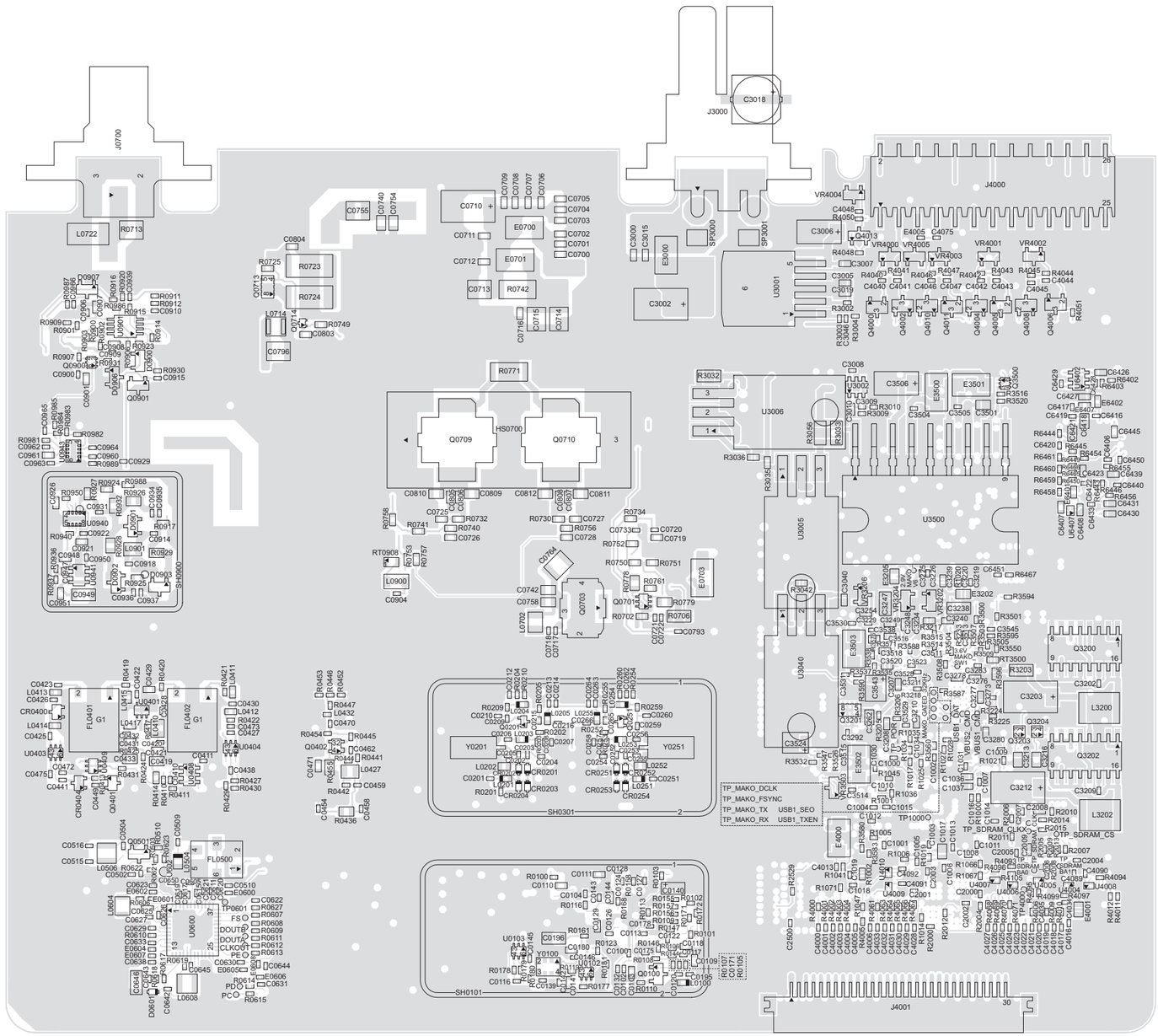
1.1 Controller Circuits

The 800/900 MHz circuits are contained on the Printed Circuit Board (PCB) which also contains the Controller circuits. This Chapter shows the schematics for the 800/900 MHz circuits only, refer to the Controller section for details of the related Controller circuits. The PCB component layouts and the Parts List in this Chapter show both the Controller and 800/900 MHz circuit components. The 800/900 MHz schematics and the related PCB and parts list are shown in the table below.

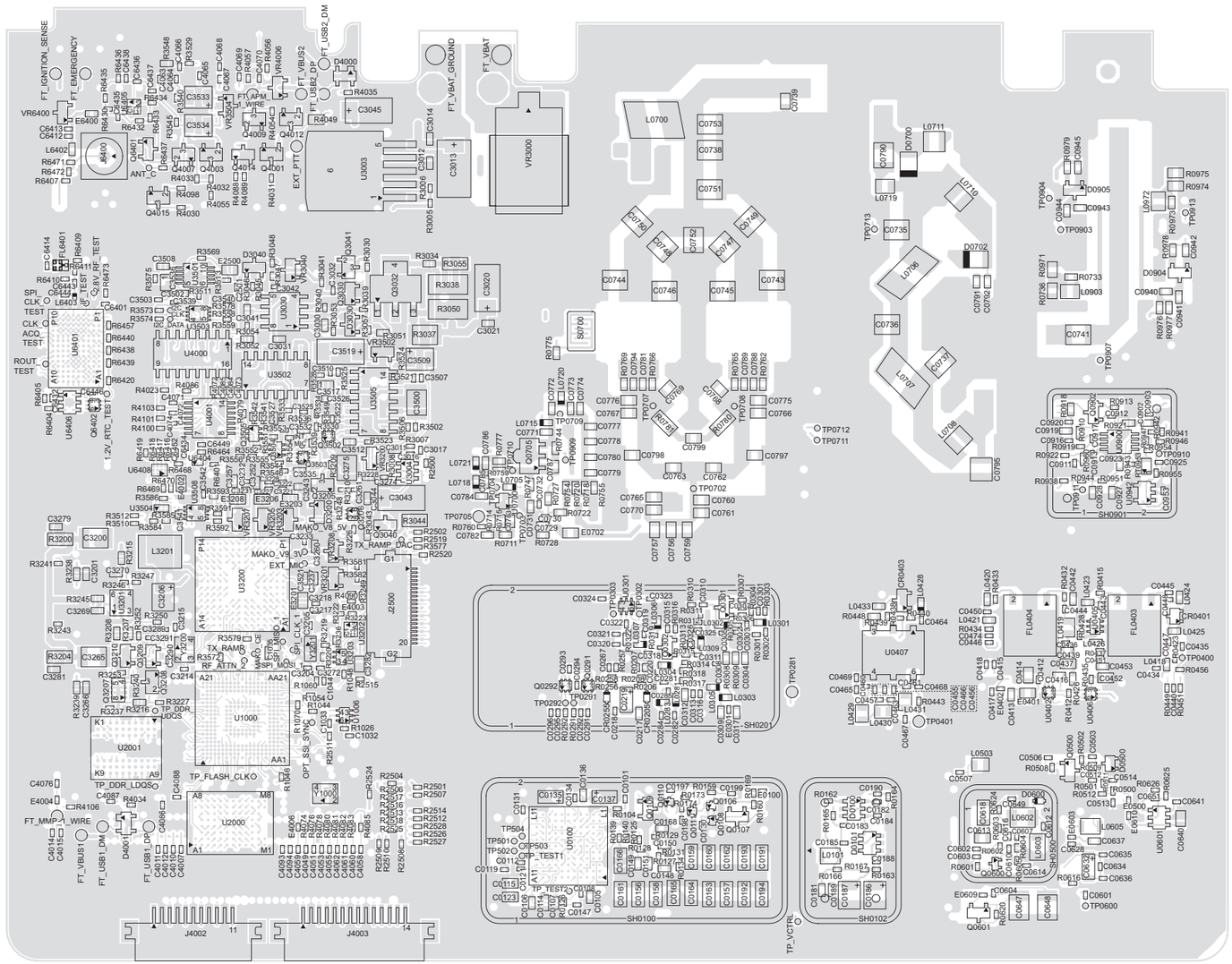
Table 3-1 800/900 MHz 10-35W Diagrams and Parts List

Notes

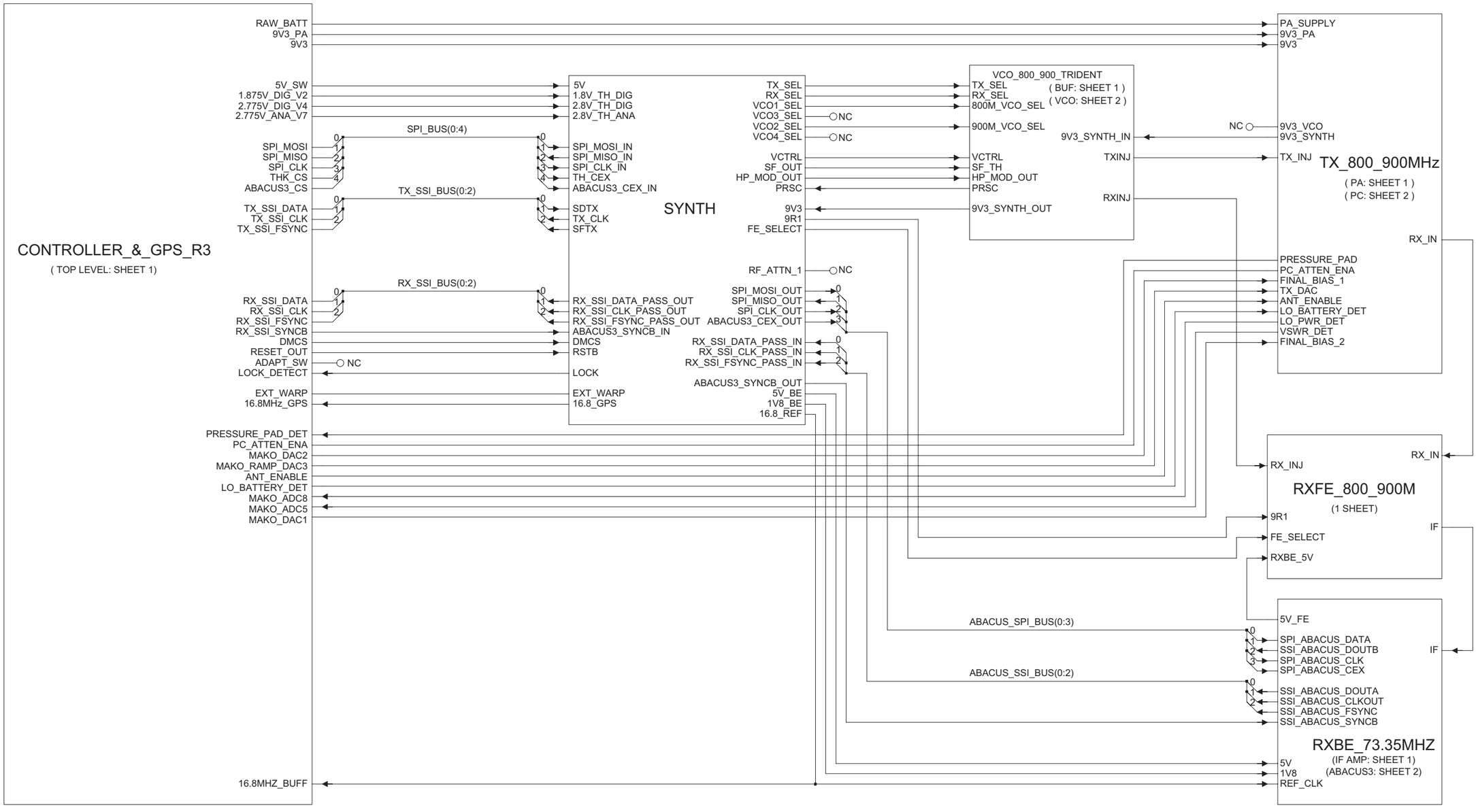
2.0 800/900 MHz (806–941 MHz) 10–35W PCB/Schematics/Parts List



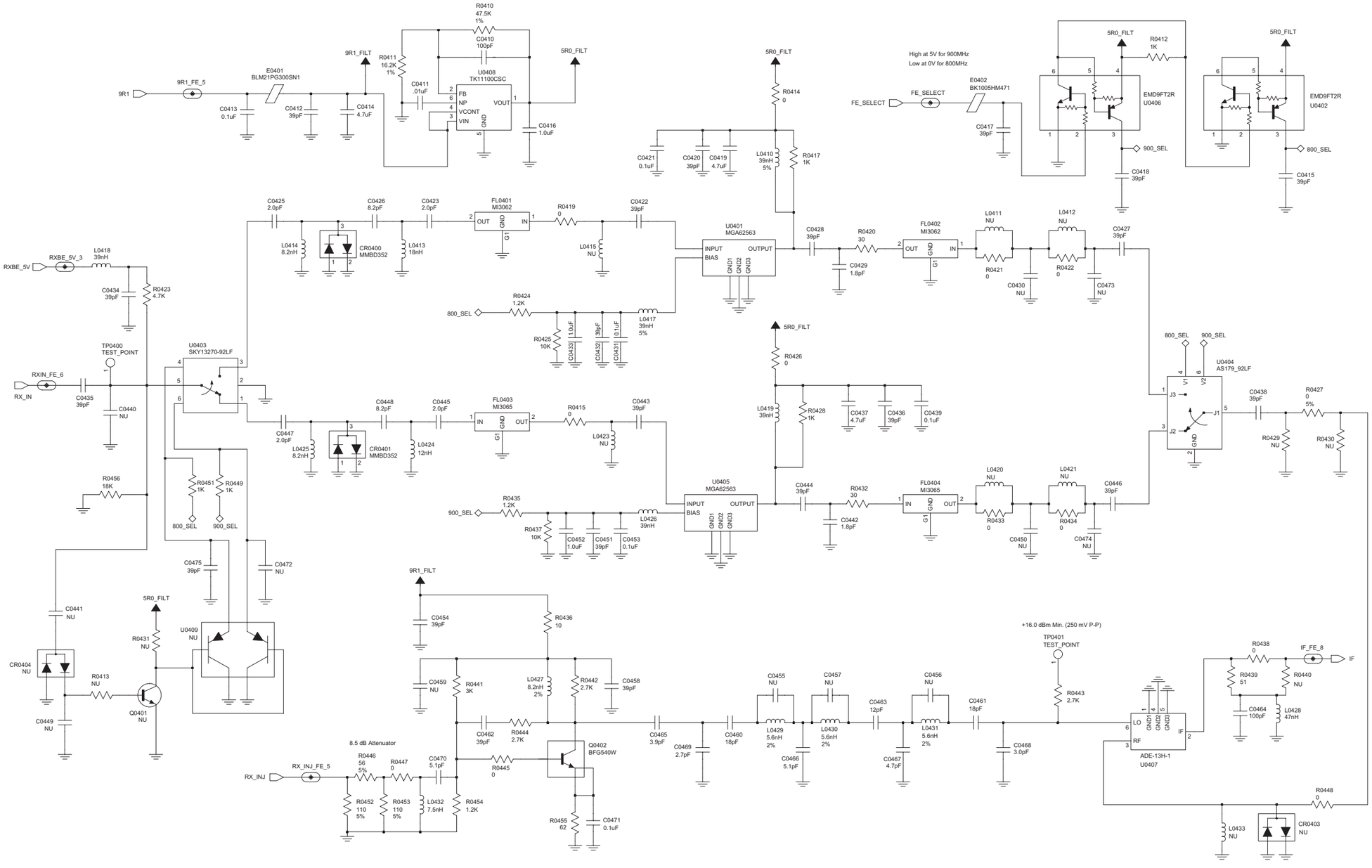
800/900 MHz (806–941 MHz) 10–35W 8475265H01 Top Side



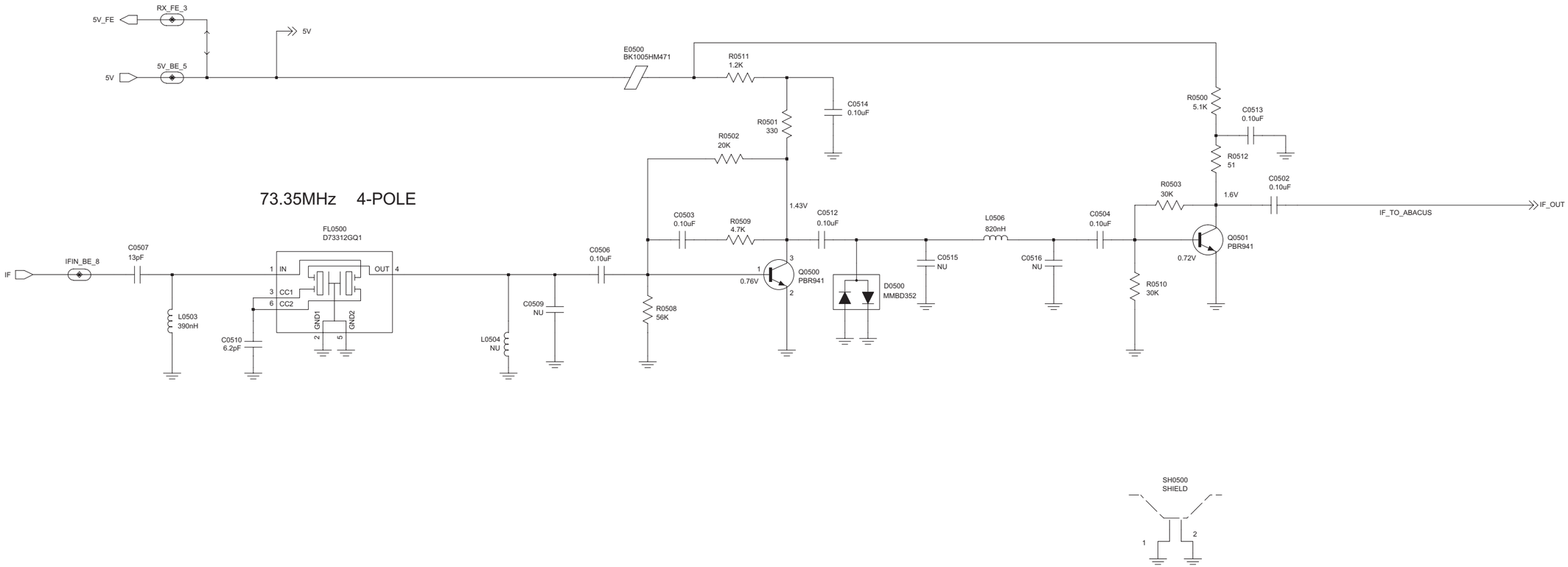
800/900 MHz (806–941 MHz) 10–35W 8475265H01 Bottom Side



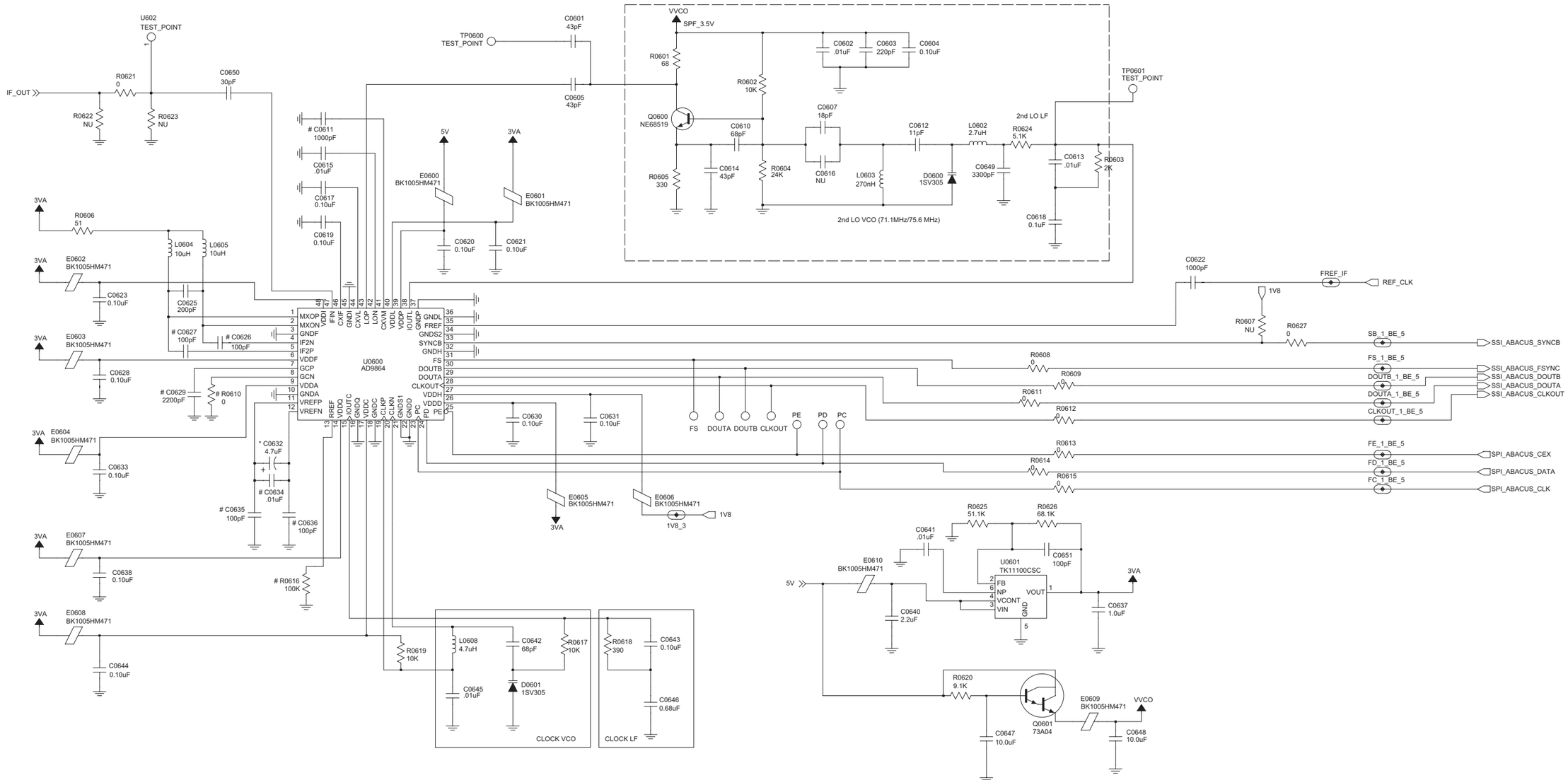
800/900 MHz (806–941 MHz) 10–35W Overall Schematic Diagram



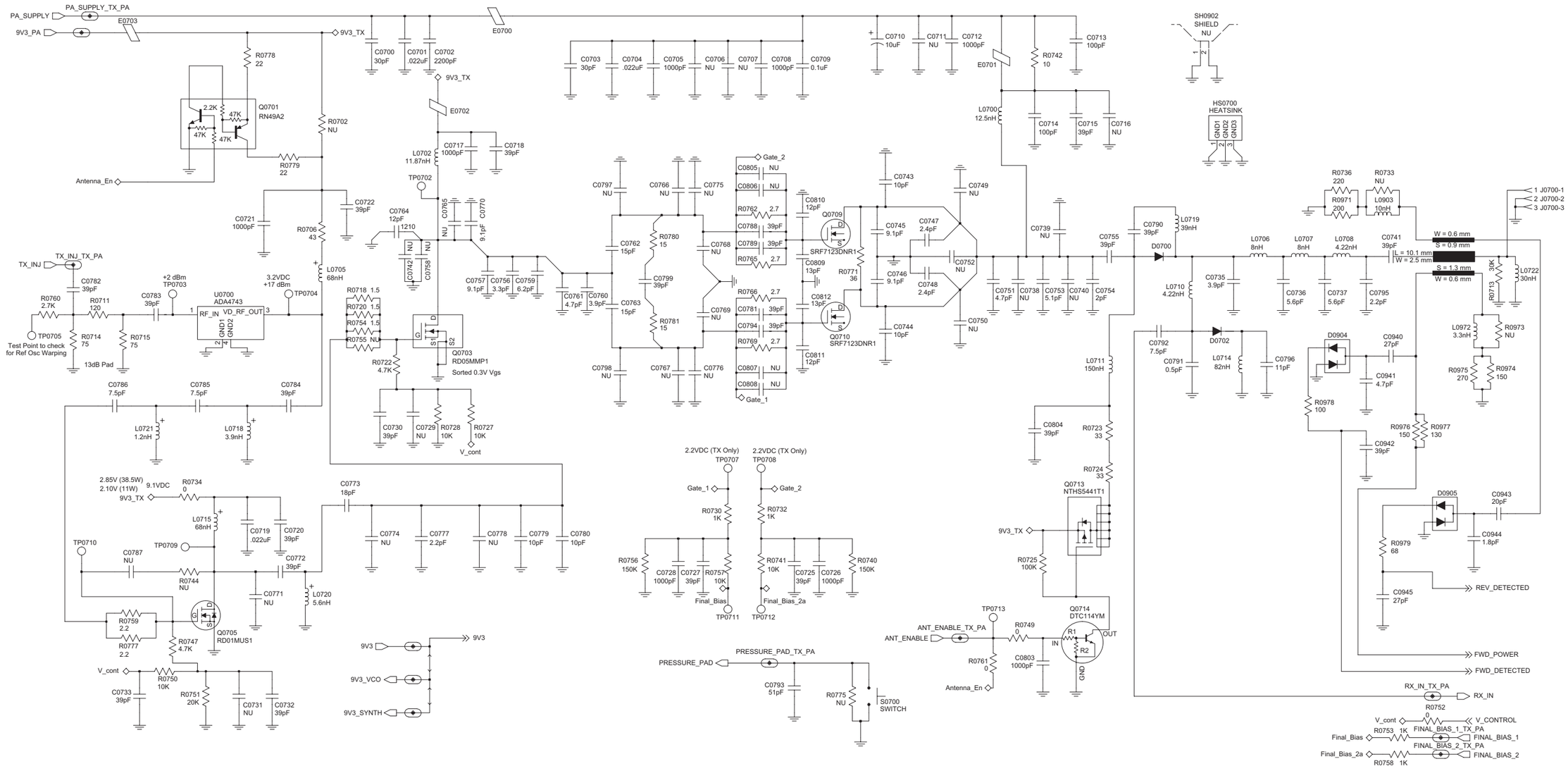
800/900 MHz (806–941 MHz) 10–35W Receiver Front-End Schematic Diagram



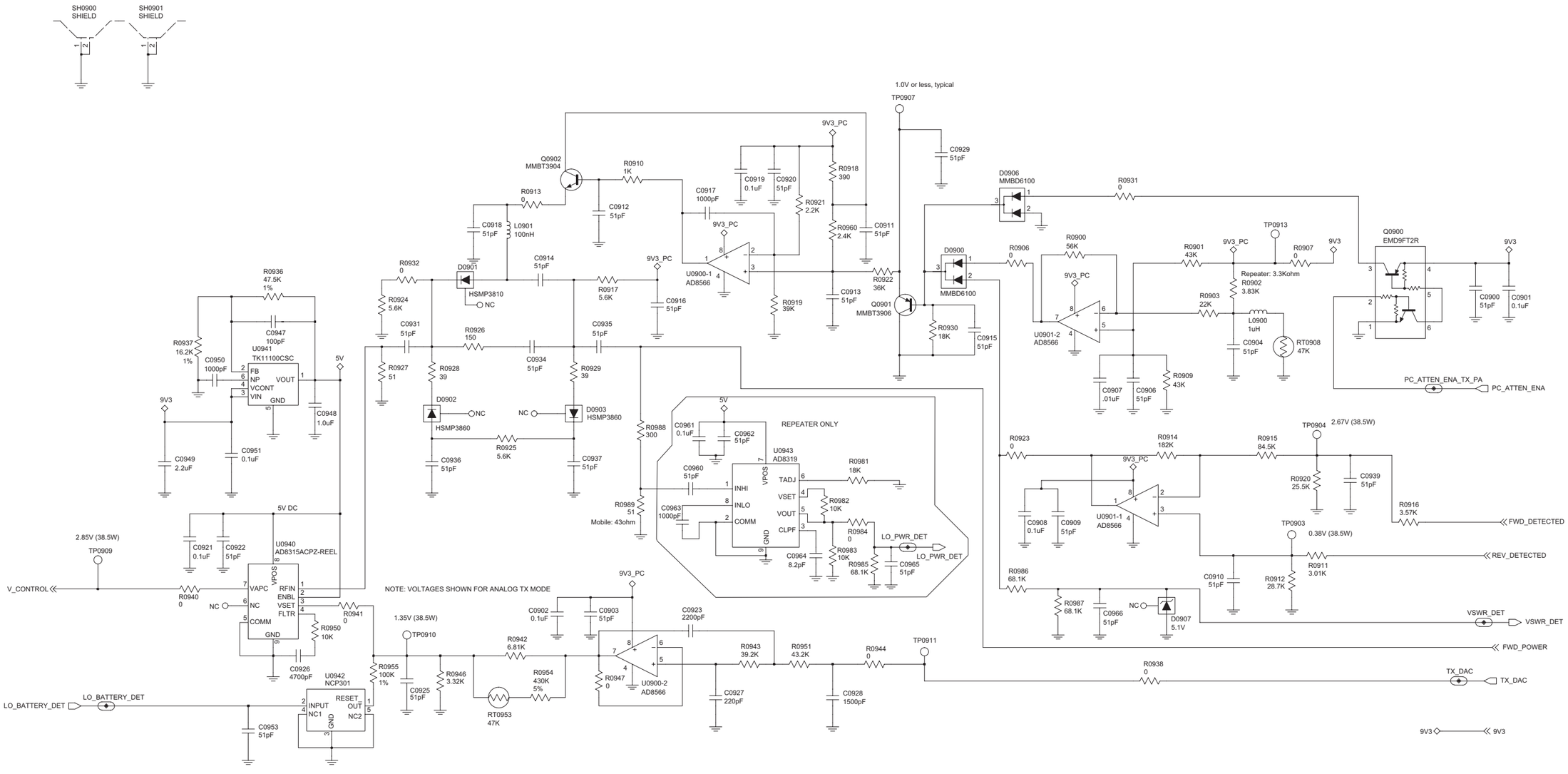
800/900 MHz (806–941 MHz) 10–35W Receiver IF Amp Schematic Diagram



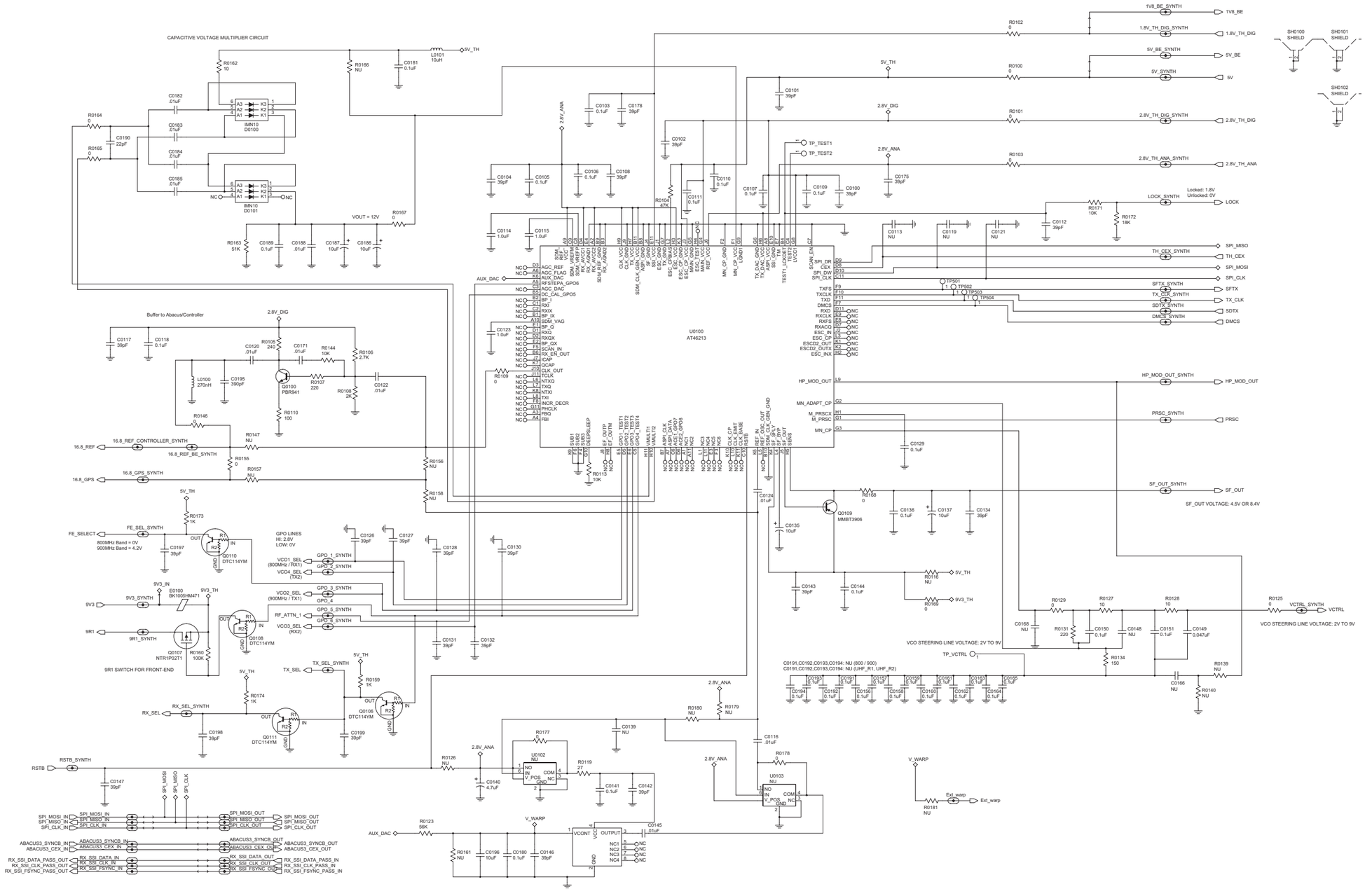
800/900 MHz (806–941 MHz) 10–35W Receiver Back-End Schematic Diagram



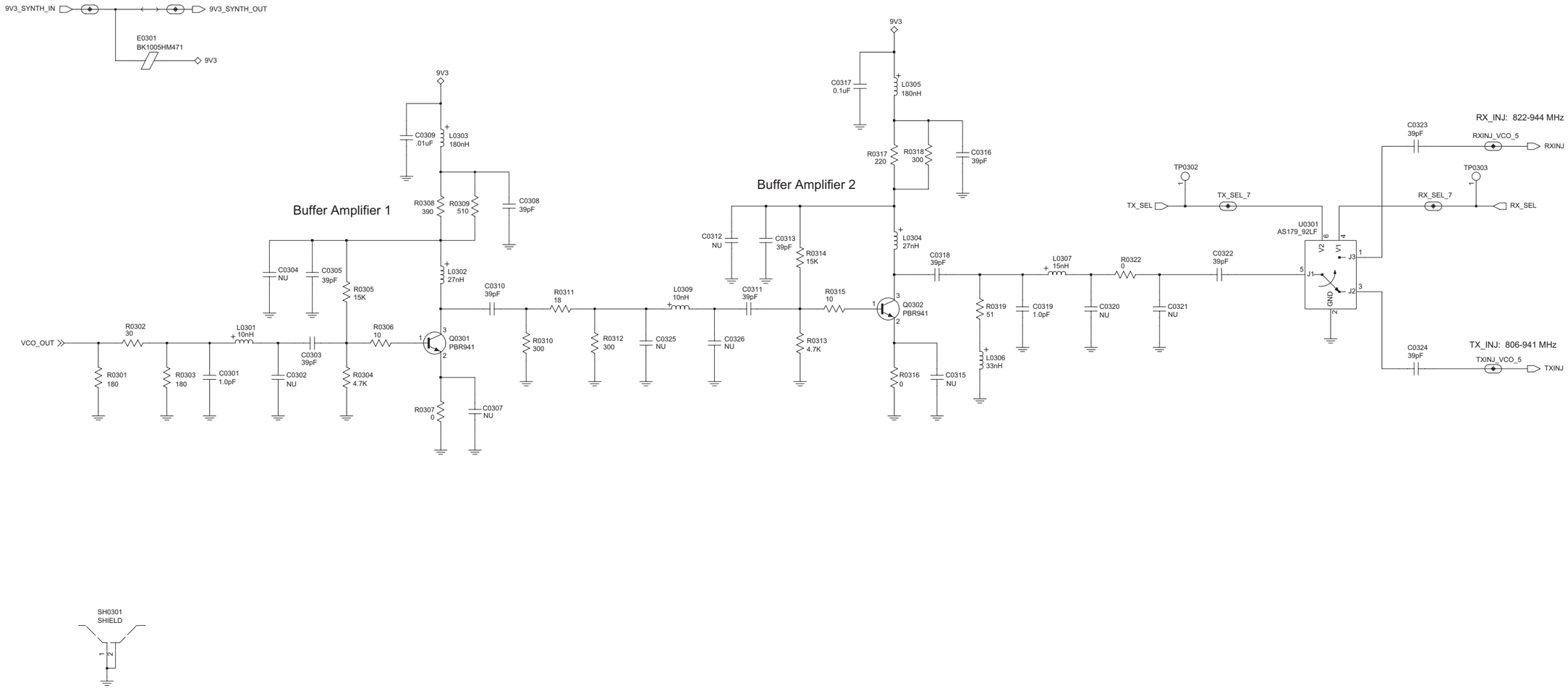
800/900 MHz (806–941 MHz) 10–35W Power Amplifier Schematic Diagram



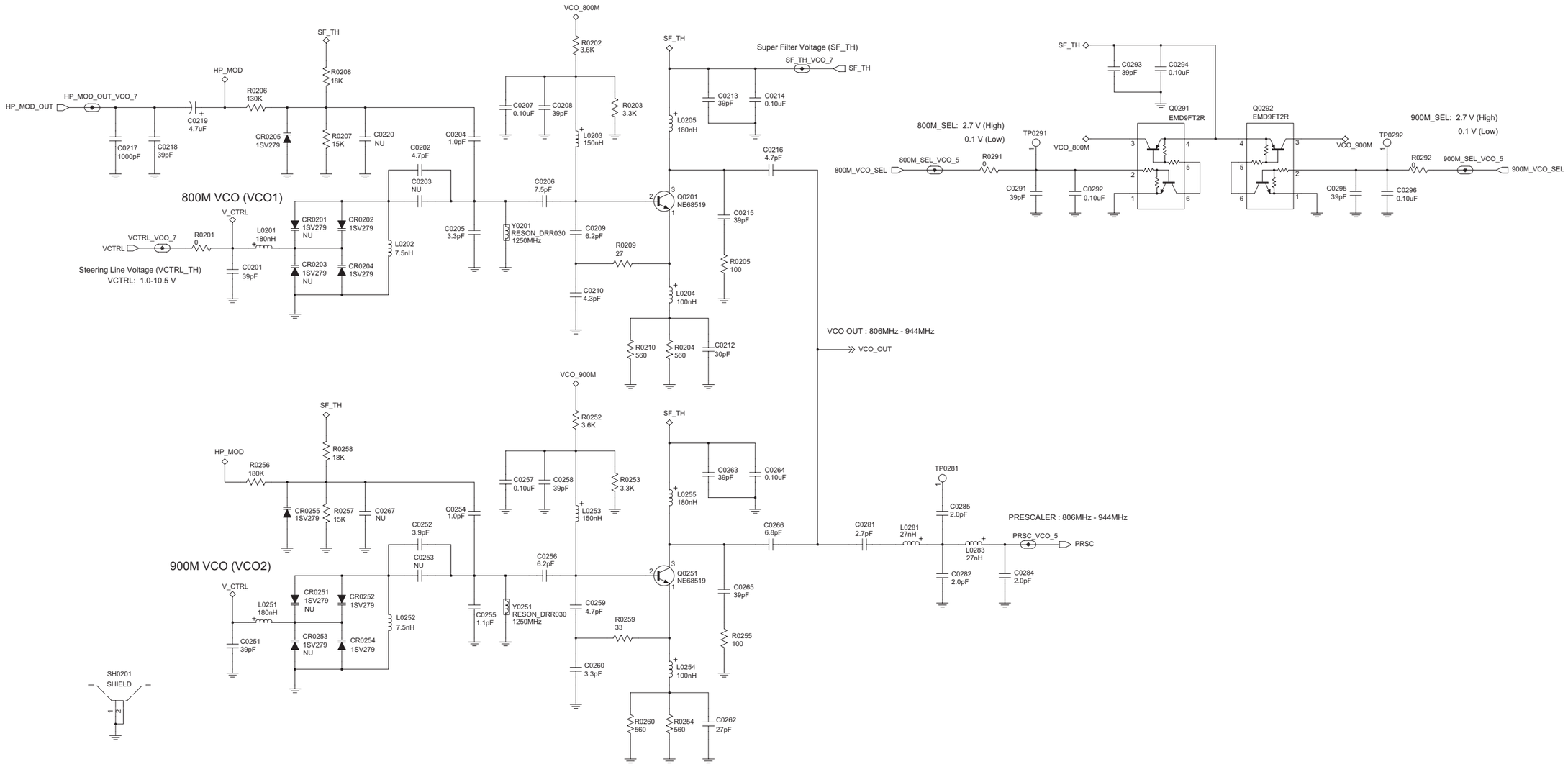
800/900 MHz (806–941 MHz) 10–35W Power Control Schematic Diagram



800/900 MHz (806–941 MHz) 10–35W Synthesizer Schematic Diagram



800/900 MHz (806–941 MHz) 10–35W VCO Buffer Schematic Diagram



800/900 MHz (806–941 MHz) 10–35W VCO Schematic Diagram

800/900 MHz PCB 8475265H01 Parts List 10–35W

Circuit Ref	Motorola Part No.	Description
C0100	2113944A32	39 pF
C0101	2113944A32	39 pF
C0102	2113944A32	39 pF
C0103	2113945C31	0.1 uF
C0104	2113944A32	39 pF
C0105	2113945C31	0.1 uF
C0106	2113945C31	0.1 uF
C0107	2113945C31	0.1 uF
C0108	2113944A32	39 pF
C0109	2113945C31	0.1 uF
C0110	2113945C31	0.1 uF
C0111	2113945C31	0.1 uF
C0112	2113944A32	39 pF
C0113	NOT PLACED	–
C0114	2113946E02	1.0 uF
C0115	2113946E02	1.0 uF
C0116	2113945B02	10,000 pF
C0117	2113944A32	39 pF
C0118	2113945C31	0.1 uF
C0119	NOT PLACED	–
C0120	2113945B02	10,000 pF
C0121	NOT PLACED	–
C0122	2113945B02	10,000 pF
C0123	2113946E02	1.0 uF
C0124	2113945B02	10,000 pF
C0126	2113944A32	39 pF
C0127	2113944A32	39 pF
C0128	2113944A32	39 pF
C0129	2113945C31	0.1 uF
C0130	2113944A32	39 pF
C0131	2113944A32	39 pF
C0132	2113944A32	39 pF
C0134	2113944A32	39 pF
C0135	2313960B32	10 uF
C0136	2113945C31	0.1 uF
C0137	2313960B32	10 uF
C0139	2113945B02	10,000 pF
C0140	2313960B30	4.7 uF
C0141	2113945C31	0.1 uF
C0142	2113944A32	39 pF
C0143	2113944A32	39 pF
C0144	2113945C31	0.1 uF
C0145	2113945B02	10,000 pF
C0146	2113944A32	39 pF
C0147	2113944A32	39 pF
C0148	NOT PLACED	–
C0149	2113945C27	.047 uF
C0150	2113945C31	0.1 uF
C0151	2113945C31	0.1 uF
C0156	2185419D06	0.1 uF
C0157	2185419D06	0.1 uF
C0158	2185419D06	0.1 uF
C0159	2185419D06	0.1 uF
C0160	2185419D06	0.1 uF
C0161	2185419D06	0.1 uF
C0162	2185419D06	0.1 uF
C0163	2185419D06	0.1 uF
C0164	2185419D06	0.1 uF
C0165	2185419D06	0.1 uF
C0166	NOT PLACED	–
C0168	NOT PLACED	–
C0171	2113945B02	10,000 pF
C0175	2113944A32	39 pF
C0178	2113944A32	39 pF
C0180	2113945C31	0.1 uF
C0181	2113945C31	0.1 uF
C0182	2113945B02	10,000 pF
C0183	2113945B02	10,000 pF
C0184	2113945B02	10,000 pF
C0185	2113945B02	10,000 pF
C0186	2313960D07	10 uF
C0187	2313960D07	10 uF
C0188	2113945B02	10,000 pF
C0189	2113945C31	0.1 uF
C0190	2115153H41	22 pF
C0191	NOT PLACED	–
C0192	NOT PLACED	–
C0193	NOT PLACED	–
C0194	NOT PLACED	–
C0195	2113945A04	390 pF
C0196	2113946H02	10 uF
C0197	2113944A32	39 pF
C0198	2113944A32	39 pF
C0199	2113944A32	39 pF
C0201	2113944A32	39 pF
C0202	2115153H19	CAP, 4.7 pF
C0203	NOT PLACED	–
C0204	2115153H03	CAP, 1.0 pF
C0205	2115153H15	CAP, 3.3 pF
C0206	2115153H24	CAP, 7.5 pF
C0207	2113945Y02	0.1 uF
C0208	2113944A32	39 pF
C0209	2115153H22	6.2 pF
C0210	2115153H18	4.3 pF
C0212	2115153H44	30 pF
C0213	2113944A32	39 pF
C0214	2113945Y02	0.1 uF
C0215	2113944A32	39 pF
C0216	2115153H19	4.7 pF
C0217	2113944C51	1000 pF
C0218	2113944A32	39 pF
C0219	2313960B30	4.7 uF
C0220	NOT PLACED	–
C0251	2113944A32	39 pF
C0252	2115153H17	3.9 pF
C0253	NOT PLACED	–
C0254	2115153H03	CAP, 1.0 pF
C0255	2115153H04	CAP, 1.1 pF
C0256	2115153H22	CAP, 6.2 pF
C0257	2113945Y02	0.1 uF
C0258	2113944A32	39 pF
C0259	2115153H19	4.7 pF
C0260	2115153H15	3.3 pF
C0262	2115153H43	27 pF
C0263	2113944A32	39 pF
C0264	2113945Y02	0.1 uF
C0265	2113944A32	39 pF
C0266	2115153H23	6.8 pF
C0267	NOT PLACED	–
C0281	2115153H13	2.7 pF
C0282	2115153H10	2 pF
C0284	2115153H10	2 pF
C0285	2115153H10	2 pF
C0291	2113944A32	39 pF
C0292	2113945Y02	0.1 uF
C0293	2113944A32	39 pF
C0294	2113945Y02	0.1 uF
C0295	2113944A32	39 pF
C0296	2113945Y02	0.1 uF
C0301	2115153H03	1 pF
C0302	NOT PLACED	–
C0303	2113944A32	39 pF
C0304	NOT PLACED	–
C0305	2113944A32	39 pF
C0307	NOT PLACED	–
C0308	2113944A32	39 pF
C0309	2113945C02	10,000 pF
C0310	2113944A32	39 pF
C0311	2113944A32	39 pF
C0312	NOT PLACED	–
C0313	2113944A32	39 pF
C0315	NOT PLACED	–
C0316	2113944A32	39 pF
C0317	2113945C31	0.1 uF
C0318	2113944A32	39 pF
C0319	2115153H03	1 pF
C0320	NOT PLACED	–
C0321	NOT PLACED	–
C0322	2113944A32	39 pF
C0323	2113944A32	39 pF
C0324	2113944A32	39 pF
C0325	NOT PLACED	–
C0326	NOT PLACED	–
C0410	2115153H57	100 pF
C0411	2113945B02	10,000 pF
C0412	2115153H47	39 pF
C0413	2113945C31	0.1 uF
C0414	2113946F03	4.7 uF
C0415	2115153H47	39 pF
C0416	2113946S35	1.0 uF
C0417	2115153H47	39 pF
C0418	2115153H47	39 pF
C0419	2113946F03	4.7 uF
C0420	2115153H47	39 pF
C0421	2113945C31	0.1 uF
C0422	2115153H47	39 pF
C0423	2115153H10	2 pF
C0425	2115153H10	2 pF
C0426	2113944A23	8.2 pF
C0427	2115153H47	39 pF
C0428	2115153H47	39 pF
C0429	2113944C12	1.8 pF
C0430	NOT PLACED	–
C0431	2113945C31	0.1 uF
C0432	2115153H47	39 pF
C0433	2113946E02	1.0 uF
C0434	2115153H47	39 pF
C0435	2115153H47	39 pF
C0436	2115153H47	39 pF
C0437	2113946F03	4.7 uF
C0438	2115153H47	39 pF
C0439	2113945C31	0.1 uF
C0440	NOT PLACED	–
C0441	NOT PLACED	–
C0442	2113944C12	1.8 pF
C0443	2115153H47	39 pF
C0444	2115153H47	39 pF
C0445	2115153H07	1.5 pF
C0446	2115153H47	39 pF
C0447	2115153H10	2 pF
C0448	2113944A23	8.2 pF
C0449	NOT PLACED	–
C0450	NOT PLACED	–
C0451	2115153H47	39 pF
C0452	2113946E02	1.0 uF
C0453	2113945C31	0.1 uF
C0454	2115153H47	39 pF
C0455	NOT PLACED	–
C0456	NOT PLACED	–
C0457	NOT PLACED	–
C0458	2115153H47	39 pF
C0459	NOT PLACED	–

Circuit Ref	Motorola Part No.	Description
C0460	2115153H39	18 pF
C0461	2115153H39	18 pF
C0462	2115153H47	39 pF
C0463	2115153H35	12 pF
C0464	2113944A40	100 pF
C0465	2115153H17	3.9 pF
C0466	2115153H20	5.1 pF
C0467	2115153H19	4.7 pF
C0468	2115153H14	3.0 pF
C0469	2115153H13	2.7 pF
C0470	2115153H20	5.1 pF
C0471	2113945C31	0.1 uF
C0472	NOT PLACED	–
C0473	NOT PLACED	–
C0474	NOT PLACED	–
C0475	2115153H47	39 pF
C0502	2113945Y02	0.1 uF
C0503	2113945Y02	0.1 uF
C0504	2113945Y02	0.1 uF
C0506	2113945Y02	0.1 uF
C0507	2115153H36	13 pF
C0509	NOT PLACED	–
C0510	2115153H22	6.2 pF
C0512	2113945Y02	0.1 uF
C0513	2113945Y02	0.1 uF
C0514	2113945Y02	0.1 uF
C0515	NOT PLACED	–
C0516	NOT PLACED	–
C0601	2115153H48	43 pF
C0602	2113945B02	10,000 pF
C0603	2113944A44	220 pF
C0604	2113945Y02	0.1 uF
C0605	2115153H48	43 pF
C0607	2115153H39	18 pF
C0610	2115153H53	68 pF
C0611	2113945A09	1000 pF
C0612	2115153H34	11 pF
C0613	2185419D03	0.01 uF
C0614	2115153H48	43 pF
C0615	2113945B02	10,000 pF
C0616	NOT PLACED	–
C0617	2113945Y02	0.1 uF
C0618	2185419D06	0.1 uF
C0619	2113945Y02	0.1 uF
C0620	2113945Y02	0.1 uF
C0621	2113945Y02	0.1 uF
C0622	2113945A09	1000 pF
C0623	2113945Y02	0.1 uF
C0625	2113944C89	200 pF
C0626	2113944A40	100 pF
C0627	2113944A40	100 pF
C0628	2113945Y02	0.1 uF
C0629	2113945A11	2200 pF
C0630	2113945Y02	0.1 uF
C0631	2113945Y02	0.1 uF
C0632	2313960B30	4.7 uF
C0633	2113945Y02	0.1 uF
C0634	2113945B02	10,000 pF
C0635	2113944A40	100 pF
C0636	2113944A40	100 pF
C0637	2113946S35	1.0 uF
C0638	2113945Y02	0.1 uF
C0640	2113946N03	2.2 uF
C0641	2113945B02	10,000 pF
C0642	2115153H53	68 pF
C0643	2113945Y02	0.1 uF
C0644	2113945Y02	0.1 uF
C0645	2113945B02	10,000 pF
C0646	2113946G04	.68 uF
C0647	2113946J03	10 uF
C0648	2113946J03	10 uF
C0649	2113945A12	330 pF
C0650	2115153H44	30 pF
C0651	2115153H57	100 pF
C0700	2113944C82	30 pF
C0701	2113945C04	22,000 pF
C0702	2113944C55	1200 pF
C0703	2113944C82	30 pF
C0704	2113945C04	22,000 pF
C0705	2113944C51	1000 pF
C0706	NOT PLACED	–
C0707	NOT PLACED	–
C0708	2113944C51	1000 pF
C0709	2113945C31	0.1 uF
C0710	2371403L02	10 uF
C0711	NOT PLACED	–
C0712	2113944C51	1000 pF
C0713	2111078B42	100.5 pF
C0714	2111078B42	100.5 pF
C0715	2111078B32	39.5 pF
C0716	NOT PLACED	–
C0717	2113945A09	1000 pF
C0718	2113944A32	39 pF
C0719	2113945C04	22,000 pF
C0720	2113944A32	39 pF
C0721	2113945A09	1000 pF
C0722	2113944A32	39 pF
C0725	2113944C37	39 pF
C0726	2113944C51	1000 pF
C0727	2113944C37	39 pF
C0728	2113944C51	1000 pF
C0729	NOT PLACED	–
C0730	2113944A32	39 pF
C0731	NOT PLACED	–
C0732	2113944A32	39 pF
C0733	2113944A32	39 pF
C0735	2111078B03	3.9 pF
C0736	2111078B07	5.6 pF
C0737	2111078B07	5.6 pF
C0738	NOT PLACED	–
C0739	NOT PLACED	–
C0740	NOT PLACED	–
C0741	2111078B32	39.5 pF
C0742	NOT PLACED	–
C0743	2111078B13	10.5 pF
C0744	2111078B13	10.5 pF
C0745	2111078B12	9.1 pF
C0746	2111078B12	9.1 pF
C0747	2185400Y19	2.4 pF
C0748	2185400Y19	2.4 pF
C0749	NOT PLACED	–
C0750	NOT PLACED	–
C0751	2111078B05	4.7 pF
C0752	NOT PLACED	–
C0753	2111078B06	5.1 pF
C0754	2113951B17	2.0 pF
C0755	2111078B32	39.5 pF
C0756	2113944F30	3.3 pF
C0757	2113944F41	9.1 pF
C0758	NOT PLACED	–
C0759	2113944F37	6.2 pF
C0760	2113944F32	3.9 pF
C0761	2113944F34	3.7 pF
C0762	2113944F46	15 pF
C0763	2113944F46	15 pF
C0764	2111078B15	12.5 pF
C0765	NOT PLACED	–
C0766	NOT PLACED	–
C0767	NOT PLACED	–
C0768	NOT PLACED	–
C0769	NOT PLACED	–
C0770	2113944F41	9.1 pF
C0771	NOT PLACED	–
C0772	2113944C37	39 pF
C0773	2113944C33	18 pF
C0774	NOT PLACED	–
C0775	NOT PLACED	–
C0776	NOT PLACED	–
C0777	2113944C14	2.2 pF
C0778	NOT PLACED	–
C0779	2113944C30	10 pF
C0780	2113944C30	10 pF
C0781	2113944C37	39 pF
C0782	2113944C37	39 pF
C0783	2113944C37	39 pF
C0784	2113944C37	39 pF
C0785	2113944C27	7.5 pF
C0786	2113944C27	7.5 pF
C0787	NOT PLACED	–
C0788	2113944C37	39 pF
C0789	2113944C37	39 pF
C0790	2111078B32	39.5 pF
C0791	2113944C61	0.5 pF
C0792	2113944C27	7.5 pF
C0793	2113944A85	51 pF
C0794	2113944C37	39 pF
C0795	2185400Y18	2.2 pF
C0796	2111078B14	11.5 pF
C0797	NOT PLACED	–
C0798	NOT PLACED	–
C0799	2113944F56	39 pF
C0803	2113944C51	1000 pF
C0804	2113944C37	39 pF
C0805	NOT PLACED	–
C0806	NOT PLACED	–
C0807	NOT PLACED	–
C0808	NOT PLACED	–
C0809	2113944F45	13 pF
C0810	2113944F44	12 pF
C0811	2113944F44	12 pF
C0812	2113944F45	13 pF
C0900	2113944A85	51 pF
C0901	2113945C31	0.1 uF
C0902	2113945C31	0.1 uF
C0903	2113944A85	51 pF
C0904	2113944A85	51 pF
C0906	2113944A85	51 pF
C0907	2113945C02	10,000 pF
C0908	2113945C31	0.1 uF
C0909	2113944A85	51 pF
C0910	2113944A85	51 pF
C0911	2113944A85	51 pF
C0912	2113944A85	51 pF
C0913	2113944A85	51 pF
C0914	2113944A85	51 pF
C0915	2113944A85	51 pF
C0916	2113944A85	51 pF
C0917	2113945A09	1000 pF
C0918	2113944A85	51 pF
C0919	2113945C31	0.1 uF
C0920	2113944A85	51 pF
C0921	2113945C31	0.1 uF
C0922	2113944A85	51 pF
C0923	2113944C55	1200 pF

Circuit Ref	Motorola Part No.	Description
C0925	2113944A85	51 pF
C0926	2113945L41	4700 pF
C0927	2113944C02	220 pF
C0928	2113944C53	1500 pF
C0929	2113944A85	51 pF
C0931	2113944A85	51 pF
C0934	2113944A85	51 pF
C0935	2113944A85	51 pF
C0936	2113944A85	51 pF
C0937	2113944A85	51 pF
C0939	2113944A85	51 pF
C0940	2113944C35	27 pF
C0941	2113944C22	4.7 pF
C0942	2113944C37	39 pF
C0943	2113944C80	20 pF
C0944	2113944C12	1.8 pF
C0945	2113944C35	27 pF
C0947	2113944A40	100 pF
C0948	2113946S35	1.0 uF
C0949	2113946G01	2.2 uF
C0950	2113945A09	1000 pF
C0951	2113945C31	0.1 uF
C0953	2113944A85	51 pF
C0960	2113945A14	4700 pF
C0961	2113945C31	0.1 uF
C0962	2113944A85	51 pF
C0963	2113945A14	4700 pF
C0964	2113944A23	8.2 pF
C0965	2113944A85	51 pF
C0966	2113944A85	51 pF
C1000	2113944A40	100 pF
C1001	2113945Y02	0.1 uF
C1002	2113945Y02	0.1 uF
C1003	2113944A40	100 pF
C1004	2113944A40	100 pF
C1005	2113945Y02	0.1 uF
C1006	2113945Y02	0.1 uF
C1007	2113944A40	100 pF
C1008	2113944A40	100 pF
C1009	2113945Y02	0.1 uF
C1010	2113945Y02	0.1 uF
C1011	2113944A40	100 pF
C1012	2113945Y02	0.1 uF
C1013	2113945Y02	0.1 uF
C1014	2113945Y02	0.1 uF
C1015	2113945Y02	0.1 uF
C1016	2113945Y02	0.1 uF
C1017	2113946E02	1.0 uF
C1018	2113944A28	18 pF
C1019	2113944A28	18 pF
C1030	2113944A28	18 pF
C1031	2113945Y02	0.1 uF
C1032	2113945B02	10,000 pF
C1033	2113945Y02	0.1 uF
C1034	2113946S35	1.0 uF
C1035	2113946D05	2.2 uF
C1036	2113946S35	1.0 uF
C1037	2113946D05	2.2 uF
C1044	2113945Y02	0.1 uF
C2000	2113944A40	100 pF
C2001	2113945B02	10,000 pF
C2002	2113945Y02	0.1 uF
C2003	2113945Y02	0.1 uF
C2004	2113944A40	100 pF
C2005	2113945B02	10,000 pF
C2006	2113945Y02	0.1 uF
C2007	2113945Y02	0.1 uF
C2008	2113946D05	2.2 uF
C2009	2113946D05	2.2 uF
C2500	2113944A44	220 pF
C2501	2113945A10	1500 pF
C3000	2113944C06	470 pF
C3002	2371403L02	10 uF
C3005	2113944C06	470 pF
C3006	2314030E85	33 uF
C3007	2113945C31	0.1 uF
C3008	2113945A09	1000 pF
C3009	2113945Y02	0.1 uF
C3010	2113946S35	1.0 uF
C3011	2113946S35	1.0 uF
C3012	2113944C06	470 pF
C3013	2314030J28	22 uF
C3014	2113945C31	0.1 uF
C3015	2113944C38	56 pF
C3016	2113944A40	100 pF
C3017	2113945A09	1000 pF
C3018	2389289U01	10 uF
C3019	2113944C06	470 pF
C3020	2314030E85	33 uF
C3021	2113945C31	0.1 uF
C3030	2113945C02	10,000 pF
C3031	2113945C31	0.1 uF
C3032	2113945B02	10,000 pF
C3040	2113944C06	470 pF
C3041	2113945C02	10,000 pF
C3042	2113945B02	10,000 pF
C3043	2314030E85	33 uF
C3044	2113945C31	0.1 uF
C3045	NOT PLACED	–
C3046	2113945Y02	0.1 uF
C3200	2113946J04	22 uF
C3201	2113946D05	2.2 uF
C3202	2113945Y02	0.1 uF
C3203	2316410H02	68 uF
C3204	2115153H21	5.6 pF
C3205	2115153H21	5.6 pF
C3206	2316410H01	22 uF
C3207	2113945C31	0.1 uF
C3208	2113946D05	2.2 uF
C3209	2113945Y02	0.1 uF
C3210	2113946D05	2.2 uF
C3211	2113945A09	1000 pF
C3212	2316410H02	68 uF
C3213	2113946F03	4.7 uF
C3214	2115153H45	33 pF
C3215	2115153H45	33 pF
C3216	2113946F03	4.7 uF
C3217	2113944A44	220 pF
C3218	2113945Y02	0.1 uF
C3219	2113944A44	220 pF
C3220	2113945Y02	0.1 uF
C3221	2113944A44	220 pF
C3222	2113945Y02	0.1 uF
C3225	2113944A44	220 pF
C3226	2113945Y02	0.1 uF
C3227	2113944A44	220 pF
C3228	2113945Y02	0.1 uF
C3229	2113944A44	220 pF
C3231	2113944A44	220 pF
C3232	2113945Y02	0.1 uF
C3233	2113944A44	220 pF
C3234	2113946D05	2.2 uF
C3237	2113946D05	2.2 uF
C3238	2113946H02	10 uF
C3239	2113946D05	2.2 uF
C3240	2113944C45	100 pF
C3243	2113946S35	1.0 uF
C3247	2113946H02	10 uF
C3248	2113946S35	1.0 uF
C3249	2113944C45	100 pF
C3252	2113946S35	1.0 uF
C3254	2113946D05	2.2 uF
C3257	2113946S35	1.0 uF
C3260	2113946S35	1.0 uF
C3261	2113944A44	220 pF
C3262	2113946N03	2.2 uF
C3265	2113946J04	22 uF
C3266	2113946D05	2.2 uF
C3269	2113946S35	1.0 uF
C3270	2113946S35	1.0 uF
C3272	2115153H27	10 pF
C3273	NOT PLACED	–
C3274	2113944A44	220 pF
C3275	2113946J03	10 uF
C3276	2113946S35	1.0 uF
C3277	2113946S35	1.0 uF
C3278	2113945C31	0.1 uF
C3279	2113945C31	0.1 uF
C3280	2113945C31	0.1 uF
C3281	2113945C31	0.1 uF
C3282	2113946F03	4.7 uF
C3283	2113945Y02	0.1 uF
C3289	2113945Y02	0.1 uF
C3290	2113945Y02	0.1 uF
C3291	2113945Y02	0.1 uF
C3292	2113945A09	1000 pF
C3500	2113946J03	10 uF
C3501	2113945G91	0.1 uF
C3502	2113945C31	0.1 uF
C3503	2113945A09	1000 pF
C3504	2113945A09	1000 pF
C3505	2113945A09	1000 pF
C3506	2314030F30	47 uF
C3507	2113945A11	27 pF
C3508	2113945C31	0.1 uF
C3509	2313960D07	10 uF
C3510	2113945A03	330 pF
C3511	2113944A40	100 pF
C3512	2113945C31	0.1 uF
C3513	2113944A40	100 pF
C3514	2113944A44	220 pF
C3515	2113944A44	220 pF
C3516	2113946S35	1.0 uF
C3517	2314030M51	10 uF
C3518	2113946S35	1.0 uF
C3519	2314030F30	47 uF
C3520	2113946S35	1.0 uF
C3521	2113946S35	1.0 uF
C3522	2113945A05	470 pF
C3523	2113945Y02	0.1 uF
C3524	2313960D07	10 uF
C3525	2113944A44	220 pF
C3526	2113946S35	1.0 uF
C3527	2113945C31	0.1 uF
C3528	2113945Y02	0.1 uF
C3529	2113945Y02	0.1 uF
C3530	2113944A44	220 pF
C3531	2113944A44	220 pF
C3532	2113946S35	1.0 uF
C3533	2313960D07	10 uF
C3534	2313960D07	10 uF
C3535	2113946S35	1.0 uF
C3536	2314030M51	10 uF
C3538	2113945B02	10,000 pF

Circuit Ref	Motorola Part No.	Description
C3539	2113945Y02	0.1 uF
C3540	2113945Y02	0.1 uF
C3541	2113945Y02	0.1 uF
C3542	2113945Y02	0.1 uF
C3543	2313960D07	10 uF
C3545	2113944A44	220 pF
C4000	NOT PLACED	–
C4001	NOT PLACED	–
C4002	NOT PLACED	–
C4003	NOT PLACED	–
C4004	NOT PLACED	–
C4005	NOT PLACED	–
C4006	2113944A44	220 pF
C4007	NOT PLACED	–
C4010	NOT PLACED	–
C4011	NOT PLACED	–
C4012	NOT PLACED	–
C4013	2113944A44	220 pF
C4014	2113944A44	220 pF
C4015	2113944A44	220 pF
C4016	2113944A44	220 pF
C4017	2113944A44	220 pF
C4018	2113944A44	220 pF
C4019	NOT PLACED	–
C4020	NOT PLACED	–
C4021	2113944A44	220 pF
C4022	2113944A44	220 pF
C4023	2113944A44	220 pF
C4024	2113944A44	220 pF
C4025	2113944A44	220 pF
C4026	2113944A44	220 pF
C4027	2113944A44	220 pF
C4028	2113944A44	220 pF
C4029	2113944A44	220 pF
C4030	2113944A44	220 pF
C4031	2113944A44	220 pF
C4032	2113944A44	220 pF
C4033	2113944A44	220 pF
C4034	2113945A03	330 pF
C4035	2113945A03	330 pF
C4040	2113944A44	220 pF
C4041	2113944A44	220 pF
C4042	2113944A44	220 pF
C4043	2113944A44	220 pF
C4044	2113944A44	220 pF
C4045	2113944A44	220 pF
C4046	2113944A44	220 pF
C4047	2113944A44	220 pF
C4048	2113944A44	220 pF
C4049	NOT PLACED	–
C4051	NOT PLACED	–

Circuit Ref	Motorola Part No.	Description
C4053	NOT PLACED	–
C4055	NOT PLACED	–
C4058	NOT PLACED	–
C4059	NOT PLACED	–
C4060	NOT PLACED	–
C4061	NOT PLACED	–
C4062	NOT PLACED	–
C4063	2113944A44	220 pF
C4064	2113944A44	220 pF
C4065	2113944A44	220 pF
C4066	2113944A44	220 pF
C4067	2113944A44	220 pF
C4068	2113944A44	220 pF
C4069	2113944A44	220 pF
C4070	2113944A44	220 pF
C4071	NOT PLACED	–
C4072	NOT PLACED	–
C4073	2113945Y02	0.1 uF
C4074	NOT PLACED	–
C4075	NOT PLACED	–
C4076	NOT PLACED	–
C4084	2113945Y02	0.1 uF
C4085	2113944A44	220 pF
C4086	2113945Y02	0.1 uF
C4087	2113945Y02	0.1 uF
C4088	2113945Y02	0.1 uF
C4089	2113945Y02	0.1 uF
C4090	2113945Y02	0.1 uF
C4091	2113945Y02	0.1 uF
C4092	2113945Y02	0.1 uF
C4093	NOT PLACED	–
C4094	NOT PLACED	–
CR0201	NOT PLACED	–
CR0202	4805656W87	DIODE
CR0203	NOT PLACED	–
CR0204	4805656W87	DIODE
CR0205	4805656W87	DIODE
CR0251	NOT PLACED	–
CR0252	4805656W87	DIODE
CR0253	NOT PLACED	–
CR0254	4805656W87	DIODE
CR0255	4805656W87	DIODE
CR0400	4813974A19	DIODE
CR0401	4813974A19	DIODE
CR0403	NOT PLACED	–
CR0404	NOT PLACED	–
D0100	4815011H01	DIODE
D0101	4815011H01	DIODE
D0500	4813974A19	DIODE
D0600	4815096H01	VARACTOR DIODE
D0601	4815096H01	VARACTOR DIODE

Circuit Ref	Motorola Part No.	Description
D0700	4802482J02	PIN DIODE
D0702	4802482J02	PIN DIODE
D0900	4813978C02	DIODE
D0901	4815023H01	RF PIN DIODE
D0902	4815024H01	RF PIN DIODE
D0903	4815024H01	RF PIN DIODE
D0904	4813974A21	DIODE
D0905	4813974A21	DIODE
D0906	4813978C02	DIODE
D0907	4813977M10	DIODE
D3030	4813978P07	DIODE
D3040	4813978P07	DIODE
D3200	4813978C02	DIODE
D4000	4866544A01	DIODE
D4001	4866544A01	DIODE
E0301	2409134J25	FERRITE BEAD
E0401	2480675U01	FERRITE BEAD
E0402	2409134J25	FERRITE BEAD
E0500	2409134J25	FERRITE BEAD
E0600	2409134J25	FERRITE BEAD
E0601	2409134J25	FERRITE BEAD
E0602	2409134J25	FERRITE BEAD
E0603	2409134J25	FERRITE BEAD
E0604	2409134J25	FERRITE BEAD
E0605	2409134J25	FERRITE BEAD
E0606	2409134J25	FERRITE BEAD
E0607	2409134J25	FERRITE BEAD
E0608	2409134J25	FERRITE BEAD
E0609	2409134J25	FERRITE BEAD
E0610	2480640Z01	FERRITE BEAD
E0700	2485011Y01	FERRITE BEAD
E0701	2485011Y01	FERRITE BEAD
E0702	7671656M01	FERRITE BEAD
E0703	2485011Y01	FERRITE BEAD
E2500	2480675U01	FERRITE BEAD
E3000	2485011Y01	FERRITE BEAD
E3201	2480675U01	FERRITE BEAD
E3202	2480675U01	FERRITE BEAD
E3203	2480675U01	FERRITE BEAD
E3205	2480675U01	FERRITE BEAD
E3206	2480675U01	FERRITE BEAD
E3208	2480675U01	FERRITE BEAD
E3500	2485011Y01	FERRITE BEAD
E3501	2485011Y01	FERRITE BEAD
E3502	2485011Y01	FERRITE BEAD
E3503	2485011Y01	FERRITE BEAD
E4000	2485011Y01	FERRITE BEAD
E4001	7686949J14	FERRITE BEAD
E4002	7686949J14	FERRITE BEAD
E4003	NOT PLACED	–
E4004	2409134J25	FERRITE BEAD

Circuit Ref	Motorola Part No.	Description
E4005	2409134J25	FERRITE BEAD
E4006	2409134J25	FERRITE BEAD
FL0401	91012000001	CERAMIC FILTER, 815MHZ
FL0402	91012000001	CERAMIC FILTER, 815MHZ
FL0403	91012001001	CERAMIC FILTER, 899MHZ
FL0404	91012001001	CERAMIC FILTER, 899MHZ
FL0500	9116854H02	73.35 MHZ 4 POLE CRYSTAL FILTER
HS0700	0104031J96	HEAT SPREADER SOLDER ASSEMBLY
J0700	0905901V12	RF CONN,BNC,RIGHT ANGLE,PCMT
J3000	0905902V09	CONNECTOR, POWER
J4000	0916017H01	SOCKET, 26 PIN, 2.54MM, 2X13
J4001	0915555H01	CONNECTOR, 30 POSITION
J4002	0915558H01	CONNECTOR, 11 POSITION
J4003	0915556H01	CONNECTOR, 14 POSITION
J6400	0909901V02	RECP SMT MCX
L0100	2414017N29	270 nH
L0101	2466505A01	10 uH
L0201	2414017N27	180 nH
L0202	2416540H07	7.5 nH
L0203	2414017N26	150 nH
L0204	2414017N24	100 nH
L0205	2414017N27	180 nH
L0251	2414017N27	180 nH
L0252	2416540H07	7.5 nH
L0253	2414017N26	150 nH
L0254	2414017N24	100 nH
L0255	2414017N27	180 nH
L0281	2414017N17	27 nH
L0283	2414017N17	27 nH
L0301	2414017N12	10 nH
L0302	2414017N17	27 nH
L0303	2414017N27	180 nH
L0304	2414017N17	27 nH
L0305	2414017N27	180 nH
L0306	2414017N18	33 nH
L0307	2414017N14	15 nH
L0309	2414017N12	10 nH
L0410	2414032F29	39 nH
L0411	NOT PLACED	–
L0412	NOT PLACED	–

Circuit Ref	Motorola Part No.	Description
L0413	2415429H26	18 nH
L0414	2415429H12	8.2 nH
L0415	NOT PLACED	–
L0417	2415429H28	39 nH
L0418	2415429H28	39 nH
L0419	2414032F29	39 nH
L0420	NOT PLACED	–
L0421	NOT PLACED	–
L0423	NOT PLACED	–
L0424	2415429H20	18 nH
L0425	2415429H12	8.2 nH
L0426	2415429H28	39 nH
L0427	2414015B25	8.2 nH
L0428	2414017N20	47 nH
L0429	2414015B33	5.6 nH
L0430	2414015B33	5.6 nH
L0431	2414015B33	5.6 nH
L0432	2415427H16	7.5 nH
L0433	NOT PLACED	–
L0503	2414015B27	390 nH
L0504	NOT PLACED	–
L0506	2414032B66	820 nH
L0602	2414032K23	2.7 uH
L0603	2414032D20	270 nH
L0604	2466505A01	10 uH
L0605	2466505A01	10 uH
L0608	2414032B76	4.7 uH
L0700	2460592A02	12.5 uH
L0702	2460591C03	11.87 nH
L0705	2414017N22	68 nH
L0706	2460592A04	8 nH
L0707	2460592A04	8 nH
L0708	2460591A01	4.22 nH
L0710	2460591A01	4.22 nH
L0711	2414015A06	150 nH
L0714	2414015A03	82 nH
L0715	2414017N22	68 nH
L0718	2414017N07	3.9 nH
L0719	2414032F29	39 nH
L0720	2414017N09	5.6 nH
L0721	2414017N01	1.2 nH
L0722	2460591E77	30 nH
L0900	2414032D30	1 uH
L0901	2414032F34	100 nH
L0903	2414032F66	10 nH
L0972	2414032F20	3.3 nH
L3200	2415005H02	22 uH
L3201	2415005H02	22 uH
L3202	2415005H02	22 uH
PASTE	1085674C03	PASTE/NC-SMQ230
Q0100	4802197J95	NPN RF TRANSISTOR

Circuit Ref	Motorola Part No.	Description
Q0106	4816134H01	DIGITAL TRANSISTOR
Q0107	4813970A59	P-CH FET
Q0108	4816134H01	DIGITAL TRANSISTOR
Q0109	4813973A13	TRANSISTOR
Q0110	4816134H01	DIGITAL TRANSISTOR
Q0111	4816134H01	DIGITAL TRANSISTOR
Q0201	4885061Y01	XSTR NPN
Q0251	4885061Y01	XSTR NPN
Q0291	4815272H01	EMD9FT2R
Q0292	4815272H01	EMD9FT2R
Q0301	4802197J95	NPN RF TRANSISTOR
Q0302	4802197J95	NPN RF TRANSISTOR
Q0401	NOT PLACED	–
Q0402	4885593U03	TRANSISTOR
Q0500	4802197J95	NPN RF TRANSISTOR
Q0501	4802197J95	NPN RF TRANSISTOR
Q0600	4885061Y01	XSTR NPN
Q0601	4813973A04	NPN DARLINGTON
Q0701	4816013H01	TRANSISTOR
Q0703	4816698H04	MOD,XSTR,FET RF PWR,950 MHZ
Q0705	4816547H01	PRE DRIVER
Q0709	4878031A02	RF POWER FET, SRF7123DNR1
Q0710	4878031A02	RF POWER FET, SRF7123DNR1
Q0713	4813970A62	P-CH MOSFET
Q0714	4816134H01	DIGITAL TRANSISTOR
Q0900	4815272H01	EMD9FT2R
Q0901	4813973A13	TRANSISTOR
Q0902	4813973M07	NPN
Q3030	4813973M07	NPN
Q3032	4813973B01	NPN
Q3040	4813973M07	NPN
Q3041	4815263H01	DTC144EKAF
Q3200	5185956E76	N-CHANNEL MOSFET
Q3201	4813970A62	P-CH MOSFET
Q3202	5185956E76	N-CHANNEL MOSFET
Q3203	4805585Q23	TRANSISTOR
Q3204	4805585Q23	TRANSISTOR
Q3205	4815262H01	DTA144EKAF
Q3206	4815272H01	EMD9FT2R
Q3207	4813970A62	P-CH MOSFET
Q3208	4815261H01	TRANSISTOR
Q3209	4813973M07	NPN
Q3210	4813973M07	NPN
Q3500	4815272H01	EMD9FT2R
Q3502	4815272H01	EMD9FT2R
Q3503	4815272H01	EMD9FT2R
Q3504	4815270H01	UMZ2NFTR
Q3505	4815270H01	UMZ2NFTR

Circuit Ref	Motorola Part No.	Description
Q4000	4815263H01	DTC144EKAF
Q4001	4815263H01	DTC144EKAF
Q4002	4815261H01	DTC114YKAF
Q4003	4815263H01	DTC144EKAF
Q4004	4815261H01	DTC114YKAF
Q4005	4815263H01	DTC144EKAF
Q4006	4815261H01	DTC114YKAF
Q4007	4815263H01	DTC144EKAF
Q4008	4815261H01	DTC114YKAF
Q4009	4815263H01	DTC144EKAF
Q4010	4815261H01	DTC114YKAF
Q4011	4815263H01	DTC144EKAF
Q4012	4815261H01	DTC114YKAF
Q4013	4816023H01	PNP
Q4014	4813973A06	NPN
Q4015	4815263H01	DTC144EKAF
R0100	0613952R66	0
R0101	0613952R66	0
R0102	0613952R66	0
R0103	0613952R66	0
R0104	0613952R17	47K
R0105	0613952Q58	240
R0106	0613952Q83	2700
R0107	0613952Q57	220
R0108	0613952Q80	2000
R0109	0613952R66	0
R0110	0613952Q49	100
R0113	0613952R01	10K
R0116	NOT PLACED	–
R0119	0613952Q35	27
R0123	0613952R19	56K
R0125	0613952R66	0
R0126	NOT PLACED	–
R0127	0613952Q25	10
R0128	0613952Q25	10
R0129	0613952R66	0
R0131	0613952Q57	220
R0134	0613952Q53	150
R0139	NOT PLACED	–
R0140	NOT PLACED	–
R0144	0613952R01	10K
R0146	0613952R66	0
R0147	NOT PLACED	–
R0155	NOT PLACED	–
R0156	NOT PLACED	–
R0157	2409134J25	FERRITE BEAD
R0158	0613952Q66	510
R0159	0613952Q73	1000
R0160	0613952R25	100K
R0161	NOT PLACED	–
R0162	0613952Q25	10

Circuit Ref	Motorola Part No.	Description
R0163	0613952R18	51K
R0164	0613952R66	0
R0165	0613952R66	0
R0166	NOT PLACED	–
R0167	0613952R66	0
R0168	0613952R66	0
R0169	0613952R66	0
R0170	2409134J25	FERRITE BEAD
R0171	0613952R01	10K
R0172	0613952R07	18K
R0173	0613952Q73	1000
R0174	0613952Q73	1000
R0177	NOT PLACED	–
R0178	NOT PLACED	–
R0179	0613952R17	47K
R0180	0613952R17	47K
R0181	0613952R66	0
R0201	0613952R66	0
R0202	0613952Q86	3600
R0203	0613952Q85	3300
R0204	0613952Q67	560
R0205	0613952Q49	100
R0206	0613952R28	130K
R0207	0613952R05	15K
R0208	0613952R07	18K
R0209	0613952Q35	27
R0210	0613952Q67	560
R0252	0613952Q86	3600
R0253	0613952Q85	3300
R0254	0613952Q67	560
R0255	0613952Q53	150
R0256	0613952R31	180K
R0257	0613952R05	15K
R0258	0613952R07	18K
R0259	0613952Q37	33
R0260	0613952Q67	560
R0291	0613952R66	0
R0292	0613952R66	0
R0301	0613952Q55	180
R0302	0613952Q36	30
R0303	0613952Q55	180
R0304	0613952Q89	4700
R0305	0613952R05	15K
R0306	0613952Q25	10
R0307	0613952R66	0
R0308	0613952H63	390
R0309	0613952H66	510
R0310	0613952Q60	300
R0311	0613952Q31	18
R0312	0613952Q60	300
R0313	0613952Q89	4700

Circuit Ref	Motorola Part No.	Description
R0314	0613952R05	15K
R0315	0613952Q25	10
R0316	0613952R66	0
R0317	0613952H57	220
R0318	0613952H60	300
R0319	0613952Q42	51
R0322	0613952G67	0
R0410	0613952N66	47.5K
R0411	0613952N21	16.2K
R0412	0613952Q73	1000
R0413	NOT PLACED	–
R0414	0613952G67	0
R0415	0613952R66	0
R0417	0613952Q73	1000
R0419	0613952R66	0
R0420	0613952Q36	30
R0421	0613952R66	0
R0422	0613952R66	0
R0423	0613952Q89	4700
R0424	0613952Q75	1200
R0425	0613952R01	10K
R0426	0613952G67	0
R0427	0613952R66	0
R0428	0613952Q73	1000
R0429	NOT PLACED	–
R0430	NOT PLACED	–
R0431	NOT PLACED	–
R0432	0613952Q36	30
R0433	0613952R66	0
R0434	0613952R66	0
R0435	0613952Q75	1200
R0436	0613958H25	10
R0437	0613952R01	10K
R0438	0613952R66	0
R0439	0613952Q42	51
R0440	NOT PLACED	–
R0441	0613952Q84	3000
R0442	0613952Q83	2700
R0443	0613952Q83	2700
R0444	0613952Q83	2700
R0445	0613952R66	0
R0446	0613952Q43	56
R0447	0613952R66	0
R0448	0613952G67	0
R0449	0613952Q73	1000
R0451	0613952Q73	1000
R0452	0613952Q50	110
R0453	0613952Q50	110
R0454	0613952Q75	1200
R0455	0613958H44	62
R0456	0613952R07	18K

Circuit Ref	Motorola Part No.	Description
R0500	0613952Q90	5100
R0501	0613952Q61	330
R0502	0613952R08	20K
R0503	0613952R12	30K
R0508	0613952R19	56K
R0509	0613952Q89	4700
R0510	0613952R12	30K
R0511	0613952Q75	1200
R0512	0613952Q42	51
R0601	0613952Q45	68
R0602	0613952R01	10K
R0603	0613952Q80	2000
R0604	0613952R10	24K
R0605	0613952Q61	330
R0606	0613952Q42	51
R0607	NOT PLACED	–
R0608	0613952R66	0
R0609	0613952R66	0
R0610	0613952R66	0
R0611	0613952R66	0
R0612	0613952R66	0
R0613	0613952R66	0
R0614	0613952R66	0
R0615	0613952R66	0
R0616	0613952R25	100K
R0617	0613952R01	10K
R0618	0613952Q63	390
R0619	0613952R01	10K
R0620	0613952Q96	9100
R0621	0613952R66	0
R0622	NOT PLACED	–
R0623	NOT PLACED	–
R0624	0613952Q90	5100
R0625	0613952N69	51.1K
R0626	0613952N81	68.1K
R0627	0613952R66	0
R0702	NOT PLACED	–
R0706	0613958S40	43
R0711	0613952H51	120
R0713	0613959H12	30K
R0714	0613952H46	75
R0715	0613952H46	75
R0718	0613952H05	1.5
R0720	0613952H05	1.5
R0722	0613952H89	4700
R0723	0613959Y37	33
R0724	0613959Y37	33
R0725	0613952J25	100K
R0727	0613952J01	10K
R0728	0613952J01	10K
R0730	0613952H73	1000

Circuit Ref	Motorola Part No.	Description
R0732	0613952H73	1000
R0733	NOT PLACED	–
R0734	0613952G67	0
R0736	0613958H57	220
R0740	0613952J29	150K
R0741	0613952J01	10K
R0742	0613959Q25	10
R0744	NOT PLACED	–
R0747	0613952H89	4700
R0749	0613952G67	0
R0750	0613952J01	10K
R0751	0613952J08	20K
R0752	0613952G67	0
R0753	0613952H73	1000
R0754	0613952H05	1.5
R0755	NOT PLACED	–
R0756	0613952J29	150K
R0757	0613952J01	10K
R0758	0613952H73	1000
R0759	0613952H09	2.2
R0760	0613952Q83	2700
R0761	0613952G67	0
R0762	0613952H11	2.7
R0765	0613952H11	2.7
R0766	0613952H11	2.7
R0769	0613952H11	2.7
R0771	0613959Q38	36
R0775	NOT PLACED	–
R0777	0613952H09	2.2
R0778	0613958H33	22
R0779	0613958H33	22
R0780	0613958S29	15
R0781	0613958S29	15
R0900	0613952R19	56K
R0901	0613952R16	43K
R0902	0613952Q82	2400
R0903	0613952R09	22K
R0906	0613952R66	0
R0907	0613952R66	0
R0909	0613952R16	43K
R0910	0613952H73	1000
R0911	0613952M47	3010
R0912	0613952N45	28.7K
R0913	0613952R66	0
R0914	0613952P26	182K
R0915	0613952N90	84.5K
R0916	0613952M54	3570
R0917	0613952H91	5600
R0918	0613952H63	390
R0919	0613952R15	39K
R0920	0613952N40	25.5K

Circuit Ref	Motorola Part No.	Description
R0921	0613952H81	2200
R0922	0613952R14	36K
R0923	0613952R66	0
R0924	0613952H91	5600
R0925	0613952H91	5600
R0926	0613958H53	150
R0927	0613952H42	51
R0928	0613958H39	39
R0929	0613958H39	39
R0930	0613952R07	18K
R0931	0613952R66	0
R0932	0613958J74	0
R0936	0613952N66	47.5K
R0937	0613952N21	16.2K
R0938	0613952R66	0
R0940	0613952R66	0
R0941	0613952R66	0
R0942	0613952M81	6810
R0943	0613952N58	39.2K
R0944	0613952R66	0
R0946	0613952M51	3320
R0947	0613952R66	0
R0950	0613952N01	10K
R0951	0613952N62	43.2K
R0954	0613952R40	430K
R0955	0613952P01	100K
R0960	0613952H82	2400
R0971	0613958H56	200
R0973	NOT PLACED	–
R0974	0613958H53	150
R0975	0613958H59	270
R0976	0613952H53	150
R0977	0613952H52	130
R0978	0613952H49	100
R0979	0613952H45	68
R0981	0613952R07	18K
R0982	0613952R66	0
R0984	0613952M01	1000
R0986	0613952N93	90.9K
R0987	0613952N64	45.3K
R0988	0613952H60	300
R0989	0613952K68	49.9
R1000	0613952Q25	10
R1001	0613952R01	10K
R1002	0613952J73	10M
R1005	0613952Q89	4700
R1006	0613952R01	10K
R1014	0613952R66	0
R1017	0613952R01	10K
R1019	0613952Q18	5.1
R1020	0613952R66	0

Circuit Ref	Motorola Part No.	Description
R1021	0613952R66	0
R1025	0613952R01	10K
R1026	0613952R17	47K
R1027	NOT PLACED	–
R1028	0613952R66	0
R1034	0613952R01	10K
R1035	NOT PLACED	–
R1036	0613952R01	10K
R1041	0613952Q73	1000
R1044	0613952R66	0
R1045	0613952R01	10K
R1046	NOT PLACED	–
R1047	0613952R66	0
R1048	0613952R66	0
R1054	0613952Q89	4700
R1060	0613952Q25	10
R1066	NOT PLACED	–
R1067	NOT PLACED	–
R1070	0613952R66	0
R1071	0613952R17	47K
R2000	0613952R01	10K
R2004	0613952R66	0
R2005	NOT PLACED	–
R2006	NOT PLACED	–
R2007	NOT PLACED	–
R2008	NOT PLACED	–
R2009	NOT PLACED	–
R2010	0613952R01	10K
R2011	0613952R66	0
R2012	0613952R01	10K
R2013	NOT PLACED	–
R2014	0613952Q37	33
R2015	0613952Q37	33
R2500	0613952R66	0
R2501	0613952R66	0
R2502	0613952R66	0
R2504	0613952R66	0
R2506	0613952R66	0
R2507	0613952R66	0
R2508	0613952R66	0
R2509	0613952R66	0
R2510	0613952R66	0
R2511	0613952R66	0
R2512	0613952R66	0
R2513	0613952R66	0
R2514	0613952R66	0
R2515	0613952R66	0
R2516	0613952R66	0
R2517	0613952R66	0
R2518	0613952R66	0
R2519	0613952R66	0

Circuit Ref	Motorola Part No.	Description
R2520	0613952R66	0
R2524	0613952R66	0
R2525	0613952R66	0
R2526	0613952R66	0
R2527	0613952R66	0
R2528	0613952R66	0
R2529	0613952R01	10K
R3002	0613952R01	10K
R3003	0613952M54	3600
R3004	0613952L73	562
R3005	0613952Q81	2200
R3006	0613952Q57	220
R3007	0613952N58	39.2K
R3008	0613952N12	13K
R3009	0613952N58	39.2K
R3010	0613952N12	13K
R3030	0613952R01	10K
R3032	0615871H01	0.1
R3033	0615871H01	0.1
R3034	0613952H61	330
R3035	0613952H25	10
R3036	0613952H25	10
R3037	0613959G61	330
R3038	NOT PLACED	–
R3039	0613952M30	2000
R3040	0613952M43	2740
R3041	0613952R25	100K
R3042	0613952H69	680
R3043	0613952H69	680
R3044	0613958S61	330
R3045	0613952M30	2000
R3046	0613952M43	2740
R3047	0613952R25	100K
R3048	0613952Q73	1000
R3050	0613959Q53	150
R3051	0613952G67	0
R3052	0613952G67	0
R3053	0613952R66	0
R3054	0613952R66	0
R3055	0615871H01	0.1
R3056	0615871H01	0.1
R3057	0613952R66	0
R3200	0615871H01	0.1
R3203	0615871H01	0.1
R3204	0615871H01	0.1
R3205	0613952R25	100K
R3206	0613952R66	0
R3207	0686135Z02	0.2
R3208	0686135Z02	0.2
R3209	0613952N62	43.2K
R3210	0613952N16	14.3K

Circuit Ref	Motorola Part No.	Description
R3215	0613952G67	0
R3216	0613952G67	0
R3217	NOT PLACED	–
R3218	0613952R66	0
R3219	0613952R56	2M
R3220	0613952R56	2M
R3222	0613952R33	220K
R3223	0613952R33	220K
R3224	0613952Q89	4700
R3225	NOT PLACED	–
R3226	0613952R13	33K
R3227	NOT PLACED	–
R3228	0613952G67	0
R3233	0613952R66	0
R3236	0613952Q73	1000
R3237	0613952R01	10K
R3238	0613952H25	10
R3239	0613952H25	10
R3240	0613952R17	47K
R3241	0613952Q18	5.1
R3243	0613952Q18	5.1
R3245	0613952G67	0
R3246	0613952M81	6810
R3247	0613952N69	51.1K
R3248	0613952R01	10K
R3249	NOT PLACED	–
R3250	0613952R25	100K
R3252	0613952R25	100K
R3253	0613952R17	47K
R3500	0613952Q35	27
R3501	0613952Q35	27
R3502	0613952R01	10K
R3503	0613952Z48	4.7K
R3504	NOT PLACED	–
R3505	0613952Z48	4.7K
R3506	0613952R01	10K
R3507	NOT PLACED	–
R3508	0613952R66	0
R3509	0613952Z55	12K
R3510	0613952Q35	27
R3511	0613952R01	10K
R3512	0613952Q35	27
R3513	0613952R66	0
R3514	0613952R01	10K
R3515	0613952R01	10K
R3516	0613952R10	24K
R3520	0613952R10	24K
R3521	0613952R05	15K
R3523	0613952R10	24K
R3524	0613952Q67	560
R3525	0613952R25	100K

Circuit Ref	Motorola Part No.	Description
R3526	0613952R66	0
R3528	0613952R09	22K
R3529	0613952Q42	51
R3530	NOT PLACED	–
R3532	0613952Q49	100
R3533	0613952R10	24K
R3534	0613952R01	10K
R3535	0613952Q67	560
R3536	0613952R25	100K
R3537	0613952R66	0
R3538	NOT PLACED	–
R3539	0613952R10	24K
R3540	0613952Q49	100
R3541	0613952R10	24K
R3542	0613952R10	24K
R3544	0613952R10	24K
R3545	0613952Q49	100
R3546	0613952R05	15K
R3547	0613952Q67	560
R3548	0613952J25	100K
R3549	0613952R12	30K
R3550	0613952R23	82K
R3551	0613952R01	10K
R3552	0613952R01	10K
R3553	0613952R01	10K
R3554	0613952R17	47K
R3555	0613952R01	10K
R3556	0613952R17	47K
R3558	0613952R01	10K
R3559	0613952R01	10K
R3560	0613952R17	47K
R3569	0613952Q73	1000
R3571	0613952Q80	2000
R3572	0613952R01	10K
R3573	0613952R01	10K
R3574	0613952R01	10K
R3575	0613952Q73	1000
R3576	0613952Q49	100
R3577	0613952N42	26.7K
R3578	0613952R32	200K
R3579	0613952R01	10K
R3580	0613952R01	10K
R3581	0613952R01	10K
R3582	0613952N21	16.2K
R3583	0613952N21	16.2K
R3584	0613952R09	22K
R3585	0613952R09	22K
R3586	0613952R66	0
R3587	NOT PLACED	–
R3588	0613952N69	51.1K
R3590	0613952Q49	100

Circuit Ref	Motorola Part No.	Description
R3591	0613952Q81	2200
R3592	0613952Q81	2200
R3593	0613952R32	200K
R3594	0613952Q85	3300
R3595	0613952R01	10K
R3596	0613952H53	150
R4000	NOT PLACED	–
R4001	0613952Q37	33
R4002	0613952Q37	33
R4003	0613952Q37	33
R4004	0613952Q37	33
R4005	0613952Q37	33
R4006	0613952Q65	470
R4009	0613952Q42	51
R4010	0613952Q42	51
R4011	0613952R66	0
R4012	0613952R66	0
R4023	0613952Q75	1200
R4030	NOT PLACED	–
R4031	0613952R01	10K
R4032	0613952R01	10K
R4033	NOT PLACED	–
R4034	0613952R01	10K
R4035	0613952R01	10K
R4040	0613952Q89	4700
R4041	0613952Q89	4700
R4042	0613952Q89	4700
R4043	0613952Q89	4700
R4044	NOT PLACED	–
R4045	0613952Q89	4700
R4046	0613952Q89	4700
R4047	0613952Q89	4700
R4048	0613952Q77	1500
R4049	0613958H83	2700
R4050	0613952R01	10K
R4051	0613952R05	15K
R4054	0613952R01	10K
R4055	0613952R01	10K
R4056	0613952R66	0
R4057	NOT PLACED	–
R4061	0613952Q37	33
R4063	0613952Q37	33
R4064	0613952Q37	33
R4065	0613952Q37	33
R4066	0613952Q37	33
R4067	0613952Q37	33
R4068	0613952Q37	33
R4069	0613952Q37	33
R4070	0613952Q37	33
R4071	0613952R66	0
R4072	0613952R01	10K

Circuit Ref	Motorola Part No.	Description
R4074	0613952R66	0
R4076	0613952R66	0
R4078	0613952R66	0
R4079	0613952R01	10K
R4080	0613952R66	0
R4081	0613952R66	0
R4082	0613952R66	0
R4083	0613952R66	0
R4085	0613952R66	0
R4086	0613952R66	0
R4088	0613952R01	10K
R4089	0613952R17	47K
R4090	0613952R66	0
R4093	0613952R66	0
R4094	0613952R66	0
R4095	0613952R66	0
R4096	0613952R66	0
R4097	0613952R66	0
R4098	0613952Q89	4700
R4099	0613952R66	0
R4100	0613952Q75	1200
R4101	0613952Q75	1200
R4103	0613952Q75	1200
R4105	0613952R01	10K
R4106	0613952R01	10K
R6472	0613952R66	0
R6473	0613952R66	0
RT0908	0615585H01	THERMISTOR, 47K OHM
RT0953	0615585H01	THERMISTOR, 47K OHM
RT3500	0615471H01	10K NTC THERMISTOR
SH0100	2615362H01	SHIELD
SH0101	2615362H01	SHIELD
SH0102	2675057M01	SHIELD
SH0201	2615362H01	SHIELD
SH0301	2615362H01	SHIELD
SH0500	2615576H01	SHIELD
SH0900	2686423Z02	SHIELD
SH0901	2686425Z02	SHIELD
SP3000	1015349H03	SOLDER PREFORM
SP3001	1015349H03	SOLDER PREFORM
U0100	5164015H28	IC,TRIDENT, INTEG SYNTH
U0102	5171779H02	SPDT ANALOG SWITCH
U0103	5171779H02	SPDT ANALOG SWITCH
U0301	5186310Y39	RF SWITCH,SPDT
U0401	5185335Y02	MGA-62563, LNA, AGILENT, MGA-62563
U0402	4815272H01	EMD9FT2R
U0403	51012115001	RF SWITCH, GAAS, 100 MHZ-2.5 GHZ
U0404	5186310Y39	RF SWITCH,SPDT

Circuit Ref	Motorola Part No.	Description
U0405	5185335Y02	MGA-62563, LNA, AGILENT, MGA-62563
U0406	4815272H01	EMD9FT2R
U0407	4878197A01	MIXER, 800 TO 1000 MHZ, CD542
U0408	5115391H01	LINEAR REGULATOR IC
U0409	NOT PLACED	–
U0600	5102495J14	AD9864
U0601	5115391H01	LINEAR REGULATOR IC
U0700	4802246J29	PA PRE-DRIVER
U0900	5115147H01	OPERATIONAL AMPLIFIER, IC
U0901	5115147H01	OPERATIONAL AMPLIFIER, IC
U0940	5180390L83	IC,CNTLR,SM,1PER PKG
U0941	5115391H01	LINEAR REGULATOR IC
U0942	5114004A35	NCP31
U0943	5178286A01	AMPLIFIER, LOG DETECTOR/ CONTROLLER
U1000	5102495J13	OMAP1710
U1006	5115001H02	NL27WZU04DFT2G INVERTER
U2000	0104032J81	PRE-FLASHED FLASH IC
U2001	51012031001	32MB DIE SHRINK DDR SDRAM IC
U3001	5164015H94	IC, LM2941
U3002	5115391H01	LINEAR REGULATOR IC
U3003	5164015H94	IC, LM2941
U3004	5115391H01	LINEAR REGULATOR IC
U3005	0105959T72	LEAD FORMED TRANSISTOR
U3006	0105959T72	LEAD FORMED TRANSISTOR
U3030	5116525H01	OPERATIONAL AMPLIFIER
U3040	0105959T72	LEAD FORMED TRANSISTOR
U3200	5185143E77	IC, MAKO ASIC, CMOS PWR MGMT
U3201	5115616H01	NS LP8340 1.0A LINEAR REGULATOR
U3202	5115453H01	DUAL OP-AMP
U3203	5114007A43	IC,INVTR
U3500	5102463J95	AUDIO PA TDA1519C
U3501	5115368H01	I2C AUDIO ATTENUATOR
U3502	5114016A18	IC,OP AMP
U3503	5164852H47	IC, I2C LEVEL TRANSLATOR

Circuit Ref	Motorola Part No.	Description
U3504	5171395L01	TI DUAL ANALOG SWITCH TS5A23166
U3505	5114016A18	IC,OP AMP
U3508	5164852H47	IC, I2C LEVEL TRANSLATOR
U4000	5115476H01	8-BIT SHIFT REGISTER
U4001	5115502H01	SN74LVC07APWR
U4004	5178395A01	TRANSCEIVER
U4005	5178395A01	TRANSCEIVER
U4006	5178395A01	TRANSCEIVER
U4007	5178395A01	TRANSCEIVER
U4008	5178395A01	TRANSCEIVER
U4009	5178395A01	TRANSCEIVER
U4010	5178395A01	TRANSCEIVER
VR3000	48012043001	DIODE
VR3040	4813977M10	DIODE
VR3200	4813977M10	DIODE
VR3201	4813977M05	DIODE
VR3202	4813977M05	DIODE
VR3203	4813977M05	DIODE
VR3204	4813977M13	DIODE
VR3205	4813977M05	DIODE
VR3206	4813977M13	DIODE
VR3207	4813977M13	DIODE
VR3208	4813977M13	DIODE
VR3502	4813977A48	DIODE
VR3503	4813977A48	DIODE
VR3504	4813977A48	DIODE
VR4000	4813977A48	DIODE
VR4001	4813977A48	DIODE
VR4002	4813977A48	DIODE
VR4003	4813977A48	DIODE
VR4004	4813977A48	DIODE
VR4005	4813977M13	DIODE
VR4006	4813977M13	DIODE
Y0100	4875188M01	CRYSTAL OSCILLATOR
Y0201	4805911Z21	RESONATOR
Y0251	4805911Z21	RESONATOR
Y1000	93012000001	XTAL 12MHZ
Y3200	4815028H01	CX-101F 24.57MHZ KSS XTAL
Y3201	4802582S80	RESON, QRTZ, 032768MHZ
	1104555J01	TAPE, THERMAL RIBBON
	3015953H01	CABLE ASSY, MCX
	3385980Z01	LABEL, THERMAL TRANSFER
	8475265H01	PCB

Notes

Appendix A Replacement Parts Ordering

A.1 Basic Ordering Information

When ordering replacement parts or equipment information, the complete identification number should be included. This applies to all components, kits, and chassis. If the component part number is not known, the order should include the number of the chassis or kit of which it is a part, and sufficient description of the desired component to identify it.

A.2 Motorola Online

Motorola Online users can access our online catalog at

http://motorola.com/businessonline

To register for online access, please call 1-800-422-4210 (for U.S. and Canada Service Centers only). International customers can obtain assistance at http://motorola.com/businessonline

A.3 Mail Orders

Mail orders are only accepted by the US Federal Government Markets Division (USFGMD).

Motorola
7031 Columbia Gateway Drive
3rd Floor - Order Processing
Columbia, MD 21046
U.S.A.

A.4 Telephone Orders

Radio Products and Solutions Organization*
(United States and Canada)
7:00 AM to 7:00 PM (Central Standard Time)
Monday through Friday (Chicago, U.S.A.)
1-800-422-4210
1-847-538-8023 (United States and Canada)

U.S. Federal Government Markets Division (USFGMD)
1-877-873-4668
8:30 AM to 5:00 PM (Eastern Standard Time)

A.5 Fax Orders

Radio Products and Solutions Organization*
(United States and Canada)
1-800-622-6210
1-847-576-3023 (United States and Canada)

USFGMD
(Federal Government Orders)
1-800-526-8641 (For Parts and Equipment Purchase Orders)

A.6 Parts Identification

Radio Products and Solutions Organization*
(United States and Canada)
1-800-422-4210

A.7 Product Customer Service

Radio Products and Solutions Organization (United States and Canada)
1-800-927-2744

* The Radio Products and Solutions Organization (RPSO) was formerly known as the Radio Products Services Division (RPSD) and/or the Accessories and Aftermarket Division (AAD).

Appendix B Motorola Service Centers

B.1 Servicing Information

If a unit requires further complete testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, please send the repeater to a Motorola Service Center as listed below.

B.2 Motorola Service Center

45D Butterfield Trail
El Paso, TX 79906
Tel: 1-800-227-6772

B.3 Motorola Federal Technical Center

4395 Nicole Drive
Lanham, MD 20706
Tel: 1-800-969-6680
Fax: 1-800-784-4133

B.4 Motorola Canadian Technical Logistics Center

Motorola Canada Ltd.
8133 Warden Avenue
Markham, Ontario, L6G 1B3
Tel: 1-800-543-3222
Fax: 1-888-331-9872 or 1-905-948-5970

Notes

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to portable and mobile subscriber radio products. All terms do not necessarily apply to all radios, and some terms are merely generic in nature.

Term	Definition
Analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals.
Band	Frequencies allowed for a specific purpose.
CPS	Customer Programming Software: Software with a graphical user interface containing the feature set of a radio.
Default	A pre-defined set of parameters.
Digital	Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals.
DPL	Digital Private-Line: A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
FCC	Federal Communications Commission.
Frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
GPIO	General-Purpose Input/Output: Pins whose function is programmable.
IC	Integrated Circuit: An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.
IF	Intermediate Frequency.
kHz	kilohertz: One thousand cycles per second. Used especially as a radio-frequency unit.
LCD	Liquid-Crystal Display: An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
LED	Light Emitting Diode: An electronic device that lights up when electricity is passed through it.
MDC	Motorola Digital Communications.
MHz	Megahertz: One million cycles per second. Used especially as a radio-frequency unit.
Paging	One-way communication that alerts the receiver to retrieve a message.
PC Board	Printed Circuit Board. Also referred to as a PCB.

Term	Definition
PL	Private-Line Tone Squelch: A continuous sub-audible tone that is transmitted along with the carrier.
Programming Cable	A cable that allows the CPS to communicate directly with the radio using USB.
Receiver	Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.
Repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
RF	Radio Frequency: The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
Signal	An electrically transmitted electromagnetic wave.
Spectrum	Frequency range within which radiation has specific characteristics.
Squelch	Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.
TOT	Time-out Timer: A timer that limits the length of a transmission.
TPL	Tone Private Line.
Transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
Transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TX	Transmit.
UHF	Ultra-High Frequency.
USB	Universal Serial Bus: An external bus standard that supports data transfer rates of 12 Mbps.
USB_DM_MAP	USB D- Connection at the rear accessory connector.
USB_DP_MAP	USB D+ Connection at the rear accessory connector.
VHF	Very High Frequency.
VIP	Vehicle Interface Port.
XPR	Refers to Digital Professional Repeater model names in the MOTOTRBO Professional Digital Two-Way Radio System.

MOTOROLA

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