



Radius CM200™ / CM300™ & Motorola PM400™

Commercial Series
VHF Mobile Radio Detailed Service Manual



CM200/CM300/PM400 Radios

**Detailed Service Manual
6802966C20-C**

Foreword

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

Note: Before operating or testing these units, please read the Product Safety and RF Exposure Compliance section.

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DOCUMENT HISTORY

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

Edition	Description	Date
6802966C20-O	Initial Release	Oct. 2003
6802966C20-C	Remove TX RF Troubleshooting flow charts. Update Warranty and Service Support Info.	May. 2009

Notes

CM200/CM300/PM400 Radios

Detailed Service Manual 6802966C20-C Contents

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Section 2	Control Head Service Information
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Section 4	VHF2 Low Power (1–25 W) Service Information (146–174 MHz)
Section 5	VHF2 High Power (25–45 W) Service Information (146–174 MHz)

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CM200/CM300/PM400 Radios

Service Maintainability

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SAFETY INFORMATION

Product Safety and RF Exposure Compliance



Caution

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

ATTENTION!

This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements.

Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 68P81095C99) to ensure compliance with RF energy exposure limits.

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

Notes

Chapter 1

INTRODUCTION

1.0 Scope of Manual

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

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

2.0 Warranty and Service Support

NOTE Only Motorola Service Centers or Approved Motorola Service Dealers can perform these functions. Any tampering by non-authorized Motorola Service Centers voids the warranty of your radio. To find out more about Motorola and its approved Service Centers, please visit <http://www.motorola.com/businessandgovernment/public/functions/home/home.aspx>

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

2.1 Warranty Period and Return Instructions

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

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

2.2 After Warranty Period

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

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

3.0 Replacement Parts Ordering

3.1 Piece Parts

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

All orders for parts/information should include the complete Motorola identification number. Request for help in identification of non-referenced spare parts should be directed to the Motorola's local area representation. 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. Orders for replacement parts which are listed in the "Parts List" section of this manual, should be placed directly on Motorola's local distribution organization or via Motorola Online (Extranet).

3.2 Motorola Online

Motorola Online users can access our online catalog at

<http://www.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://www.motorola.com/businessonline>

3.3 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.

3.4 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)

3.5 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)

3.6 Parts Identification

Radio Products and Solutions Organization*

(United States and Canada)

1-800-422-4210

3.7 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).

4.0 Radio Model Information

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

Table 1-1 Radio Model Number (Example: AAM50KNC9AA1)

	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level
AA ↑ AA = Country Code	M ↑ M = Mobile	50	K VHF1 (136–162 MHz)	N 1–25 W	C CM200	9 Programmable	AA Conventional MDC	1 4/32 mini-U 3 64 mini-U
			K VHF2 (146–174 MHz)	P 25–40 W	F CM300 PM400			

Notes

Chapter 2

MAINTENANCE

1.0 Introduction

This chapter of the manual describes:

- preventive maintenance
- safe handling of CMOS devices
- repair procedures and techniques

2.0 Preventive Maintenance

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

2.1 Inspection

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

2.2 Cleaning

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

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

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



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

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

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

3.0 Safe Handling of CMOS and LDMOS

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

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

4.0 General Repair Procedures and Techniques

Parts Replacement and Substitution

When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the component from the nearest Motorola Communications parts center listed in the "Piece Parts" section of this manual.

Rigid Circuit Boards

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

When soldering near the pin connectors:

- avoid accidentally getting solder in the connector.
- be careful not to form solder bridges between the connector pins
- closely examine your work for shorts due to solder bridges.

Chip Components

Use the RLN4062 Hot-Air Repair Station for chip component replacement. Adjust the temperature control to 390 °C (735 °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 the Air Blower, BOSCH GHG 603 or equivalent.

- **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.

5.0 Notes For All Schematics and Circuit Boards

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

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

Signal Name	Signal Description
16_8MHz	16.8MHz Reference Frequency from Synthesizer to ASFIC
3V	3V RF regulator
5V	5V RF regulator
5V_CH	Optional 5V for Control Head
9V	Regulated 9.3V Supply Voltage
9R	9V to enable RX_INJ when RX_EN is active
ASFIC_CS	ASFIC Chip Select
B+	13.8V Supply Voltage
BATT_SENSE	Battery Voltage Sense Line
BOOT_EN_IN_CH	Boot Mode Select
BW_SEL	Select BW (12.5 kHz, 25 kHz)
CH_ACT	Channel Activity Indicator Signal (Fast Squelch)
COMM_DATA_SEL_CH	Display Driver Command/ Data Select
D3_V3	Regulated 3.3V supply voltage for Voice Storage
DEMOD	Audio Output Signal from the Receiver IC
DETECTOR_AUDIO_SEND_BRD	Flat Audio to Option Board
DISPLAY_CS_CH	Control Head Chip Select
EMERGENCY_ACCES_CONN	Emergency line to switch on the radio voltage regulators
EMERGENCY_SENSE	Emergency sense to μP
EXTERNAL_MIC_AUDIO_ACCES_CONN	External (from accessory connector) microphone input
F1200	Interrupt line from ASFIC CMP
FILT_SW_B+	Switched 13.8 V supply voltage
FLAT_TX_AUDIO_INPUT_ACCESS_CONN	Flat TX input from accessory connector
HANDSE_RX_AUDIO_CH	Handset Audio Output
HOOK_CH	Hang-up switch input
HSIO	High Speed Clock In / Data Out
IGNITION	Ignition Line to switch on the radio's voltage regulator
KEYPAD_COL_CH	Keypad Matrix Column
LOC_DIST	Enable Attenuator for RX line
LSIO	Low Speed Clock In / Data Out
MIC_AUDIO_CH	Microphone Input

MIC_PTT_CH	Microphone PTT Input
MOD_IN	Modulation Signal from ASFIC
MOD_OUT	Modulation Signal to the Synthesizer
ONOFF_SENSE	On off sense switch
OPT_DATA_R_OPRD	DATA/Ready Request from Option Board
OPT_EN_OPBD	Option Board Chip Select
PA_BIAS	PA Control bias voltage
PA_CURRENT	Not used
POST_LIMITER_TX	Flat TX Input from Option Board
AUDIO_RETURN_OPT_BRD	
PROG x IN ACC y	General Purpose Input x accessory connector Pin y
PROG x INOUT ACC y	General Purpose Input/Output x accessory connector Pin y
PROG x OUT ACC y	General Purpose Input x accessory connector Pin y
PWR_SET	PA Power Control Voltage
RESET	Reset Line
RSSI	Received Signal Strength Indicator
RX	RX signal
RX AUD RTN	Option Board Input/Output of Receiver Audio Path
RX_AUDIO_OUTPUT_ACCESS_CONN	Flat or filtered audio to accessory connector
RX_EN	Enable Receiving
RX_INJ	RF signal from VCO into the Receiver
SCI_CH	Bi-directional serial communication line
SHIFT_R_CS	SPI Chip select for the Control Head
SPI_CLK	Serial peripheral interface bus CLOCK
SPI_MISO	Serial peripheral interface bus data IN
SPI_MOSI	Serial peripheral interface bus data OUT
SPKR-	Negative Audio PA Speaker Output
SPKR-	Negative Audio PA Speaker Output
SPKR+	Positive Audio PA Speaker Output
SQ_DET	Squelch Detect Signal
SYNTH_CS	Synth Chip Select
SYNTH_LOCK	µP Clock Lock Signal
TX AUDIO_RETURN_OPT_BRD	Option Board Output to Transmit Audio Path
TX AUDIO_SEND_OPT_BRD	Microphone Audio to Option Board
TX_INJ	RF signal from the VCO to transmitter PA
TX_EN	Enable transmitting
UNMUTED RX_AUDIO_SEND_OPT_BRD	Unmuted filtered audio to option board
uP_CLK	µP Clock signal
VoL_INDIRECT	Volume Pot Input
VOX	Voice operated transmit level

VS AUDIO_SEL	Switch signal to Enable option board audio output signal
VS GAIN_SEL	Voice Storage Gain Select line
VS_MIC	Voice Storage Audio Signal to microphone path
VS_INT	Voice Storage Interrupt line
VS_RAC	Voice storage Row Address Clock Signal
VSTBY	3.3 V supply for μ P when the radio is switched off

Notes

Chapter 3

SERVICE AIDS

1.0 Recommended Test Tools

Table 3-1 lists the service aids recommended for working on the radio. 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 3-1 Service Aids

Motorola Part No.	Description	Application
RLN4460_	Portable Test Set	Enables connection to audio/accessory jack. Allows switching for radio testing.
RVN4191_	Customer Programming Software (CPS) – Software on CDROM & Global Tuner	Programs customer options and channel data.
RKN4081_	Programming Cable with Internal RIB	Includes radio interface box (RIB) capability.
FKN8096_	Data/Flash Adapter Key	Used with RKN4081 (10 to 8 pin adapter for front Telco connector with Data/Flash switch).
RKN4083_	Mobile Programming/Test Cable	Connects radio to RIB (RLN4008_).via rear accessory connector
FKN8113_	Adapter Cable	Used with RKN4083 (20 to 16 pin adapter for rear accessory connector).
GTF374_	Program Cable	Connects RIB to Radio microphone input.
RLN4008_	Radio Interface Box	Enables communications between radio and computer's serial communications adapter.
HSN9412_	Wall-Mount Power Supply	Used to power the RIB. (120 V ac)
HLN8027_	Mini UHF to BNC Adaptor	Adapts radio antenna port to BNC cabling of test equipment.
8180384N64	Housing Eliminator (25W)	Test Fixture used to bench test the radio pcb.
3080369B71	Computer Interface Cable	Connects the RIB to the Computer (25-pin).
3080369B72	Computer Interface Cable	Connects the RIB to the Computer (9-pin) (Use for IBM PC AT – other IBM models use the B71 cable above).
6686119B01	Removal Tool	Assists in the removal of radio control head.
6680334F39	Hex Tool	Assists in the removal of antenna connector.

2.0 Test Equipment

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

Table 3-2 Recommended Test Equipment

Motorola Part No.	Description	Characteristics	Application
R2000, R2600, R2400, or R2001 with trunking option for Privacy Plus™ and Smartnet Systems™ †	Service Monitor	This monitor will substitute for items listed below with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049	Digital Multimeter		Two meters recommended for AC/DC voltage and current measurements
*S1100	Audio Oscillator	67 to 200Hz tones	Used with service monitor for injection of PL tones
*S1053, *SKN6009, *SKN6001	AC Voltmeter, Power Cable for meter, Test leads for meter	<ul style="list-style-type: none"> • 1 mV to 300 V • 10 MΩ input impedance 	Audio voltage measurements
R1053	Dual-trace Oscilloscope	20 MHz bandwidth, 5 mV/cm – 20 V/cm	Waveform measurements
R1443A	Broadband Wattmeter		Transmitter power output measurements
S1339	RF Millivolt Meter	100 μV to 3 V _{RF} , 10 kHz to 1.2 GHz	RF level measurements
*R1013	SINAD Meter		Receiver sensitivity measurements
S1348 (prog)	DC Power Supply	0–20 Vdc, 0–20 Amps	Bench supply for 13.8Vdc



CM200/CM300/PM400 Radios

Control Head
Service Information

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Chapter 4 CONTROL HEAD PCB / SCHEMATICS / PARTS LISTS

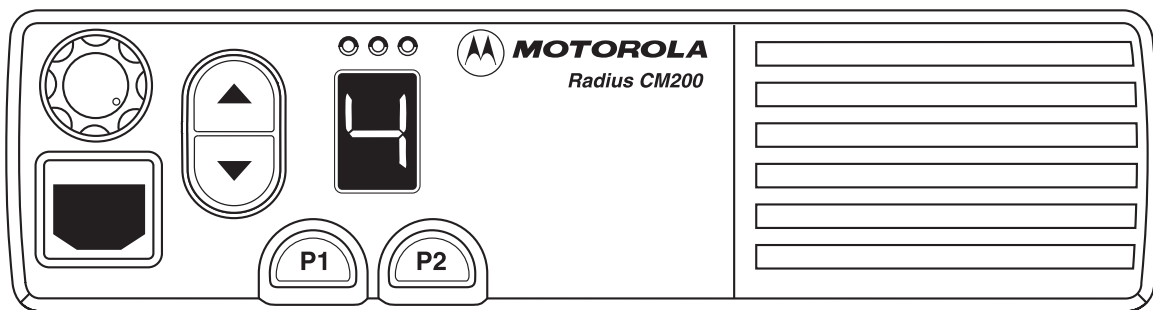
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Chapter 1

OVERVIEW

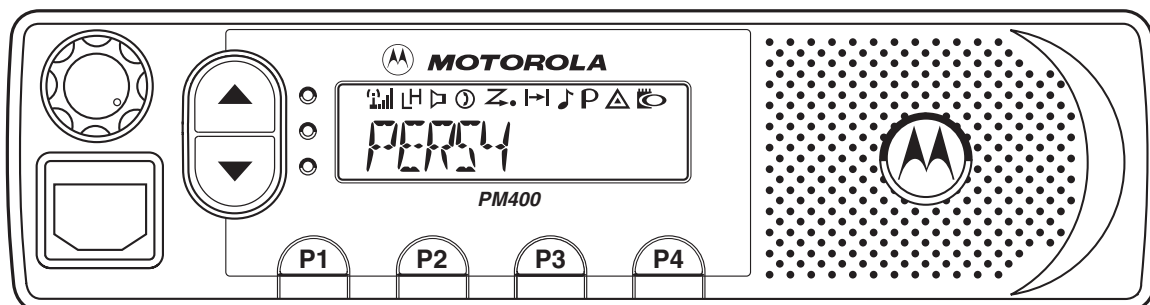
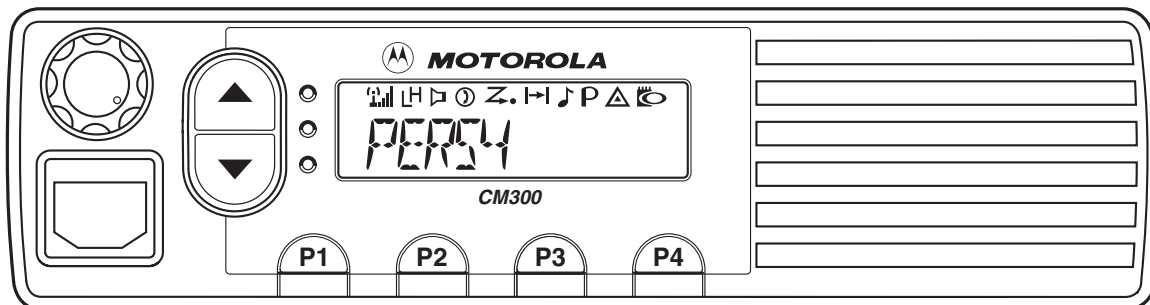
1.0 CM200 Model

The control head contains the internal speaker, the on/off/volume knob, the microphone connector, several buttons to operate the radio, three indicator Light Emitting Diodes (LED) to inform the user about the radio status, and a single character 7-segment display for numeric information e.g. channel number.



2.0 CM300/PM400 Models

The control head contains the internal speaker, the on/off/volume knob, the microphone connector, several buttons to operate the radio, three indicator Light Emitting Diodes (LED) to inform the user about the radio status, and an 8 character Liquid Crystal Display (LCD) for alpha-numerical information e.g. channel number or call address name.



Notes

Chapter 2

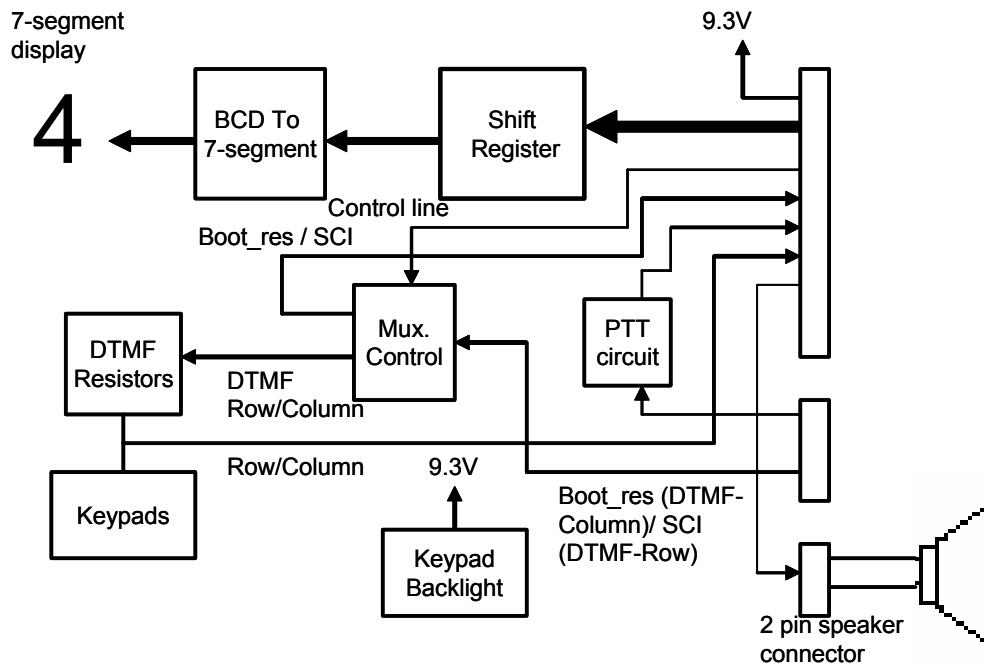
THEORY OF OPERATION

1.0 Introduction

This Chapter provides a detailed theory of operation for the Control head circuits. For details of the trouble shooting refer to the related chapter in this section.

2.0 Control Head Model for CM200

The head contains the internal speaker, the on/off/volume knob, the microphone connector, several buttons to operate the radio and three indicator Light Emitting Diodes (LED) to inform the user about the radio status and a 7-segment display for numeric information.



2.1 Power Supplies

The power supply to the head is taken from the host radio's 9.3V via connector J803-9, The 9.3V is used for the LEDs and back light, the 5V is used for the LCD driver and level shifter. The stabilized 3V is used for the other parts.

2.2 SPI Interface

The host radio (master) communicates with the head through its SPI bus. Three lines are connected to the shift register (U801): SPI clock (J803-17), SPI MOSI (J803-16) and shift register chip select (J803-15).

When the host radio needs to send data to the shift register, the radio asserts the shift register chip select and the data is loaded to the shift register. For example, the host radio sends data to change display channel or change LED status.

2.3 Keypad Keys

The head keypad is a four-key design. All keys are configured as two analog lines read by μ P. The voltage on the analog lines varies between 0V and 3.3 V depending on which key is pressed. If no key is pressed, the voltage at both lines is 3.3V. The key configuration can be thought of as a matrix where the two lines represent one row and one column. Each line is connected to a resistive divider powered by 3.3V. If a button is pressed, it will connect one specific resistor of each divider line to ground level and thereby reduce the voltages on the analog lines. The voltages of the lines are A/D converted inside the μ P (ports PE 6 – 7) and specify the pressed button. To determine which key is pressed, the voltage of both lines must be considered.

The same analog lines also support a keypad microphone. A microphone key press is processed in the same manner like a head key press.

2.4 Status LED's and Back Light Circuit

All indicator LEDs (red, yellow, and green) are driven by current sources. To change the LED status the host radio sends a data message to the head shift register via the SPI bus. The head shift register determines the LED status from the received data and switches the LEDs on or off via Q5–Q7.

The back light for the keypad is always on. The back light current for the keypad is drawn from the 9.3 V source and led by two current sources. The LED current is determined by the resistor at the emitter of the respective current source transistor.

2.5 Microphone Connector Signals

The MIC_PTT line (J802-3) is grounded when the PTT button on the microphone is pressed. When released, this line is pulled to 9.3V by R805. Two transistor stages (Q802, Q801 and associated parts) are used to level shift between 9.3V and 3.3V required for the μ P while keeping the same sense (active low for PTT pressed).

Two of the mic socket lines (J802-2,7) have dual functions depending on the type of microphone or SCI lead connected. An electronic switch (U803) is used to switch these two lines between mic keypad operation or SCI operation. The switch (mux) is led by the μ P through J803-20 with level shifting (and inversion) provided by transistor Q812. When MUX_CTRL (J803-20) is low the electronic switch is in the mic keypad mode. The mic socket (J802) pin 2 is connected to the keypad row line that goes to J803-13 and pin 7 is connected to the keypad column line that goes to J803-12. When MUX_CTRL (J803-20) is high the electronic switch is in the SCI mode. The mic socket (J802 pin 2) is connected to the SCI line that goes to J803-4 and pin 7 is connected to the BOOT_RES line that goes to J803-11.

The HOOK line (J802-6) is used to inform the μ P which type of microphone or SCI lead is connected to the microphone socket. The voltage of the HOOK line is monitored by the μ P (port PE0, MIC_SENSE) through a resistor divider on the main board. When the HOOK line is grounded (on hook condition) or floating (2.8V nominal), the μ P sets the mux (U803) for keypad operation to allow the use of microphones with a keypad. When the HOOK line is connected to 9.3V, the μ P sets the mux for SCI operation. This mode is also used to select low cost mic operation where the gain of the microphone path is increased (on the main board) to compensate for not having a pre-amp in the low cost mic.

If the BOOT_RES (J802-7) line is connected to >5V (e.g. 9.3V) at turn-on, the uP will start in boot mode instead of normal operation. This mode is used to programme new firmware into the FLASH memory (U404 mainboard).

2.6 Speaker

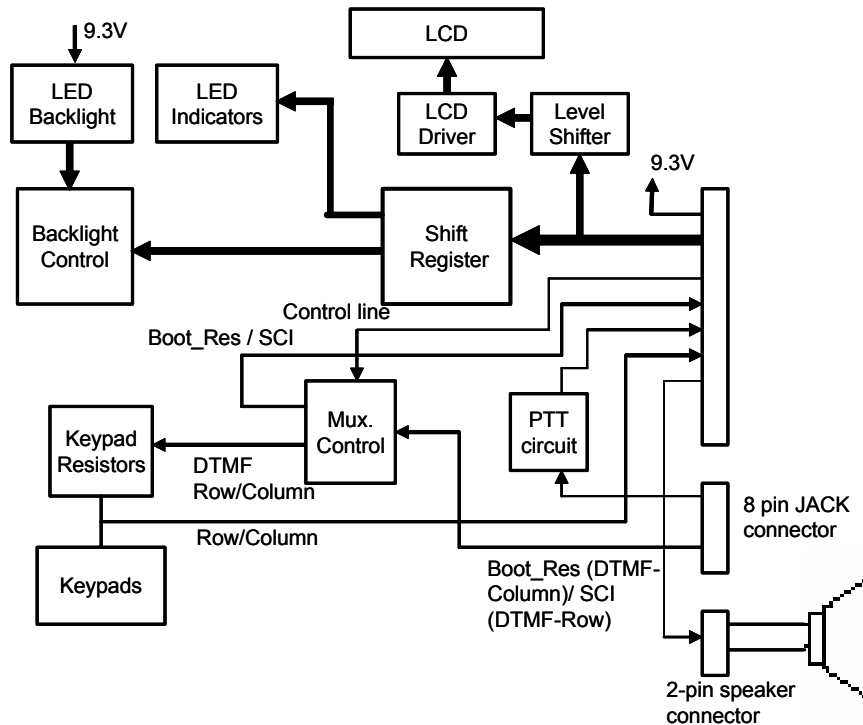
The head contains a speaker for the receiver audio. The receiver audio signal from the differential audio output of the audio amplifier located on the radio's ler is fed via connector J803-1, 2 to the speaker connector P801 pin 1 and pin 2. The speaker is connected to the speaker connector P801. The control head speaker must be disconnected if an external speaker, connected on the accessory connector, is used.

2.7 Electrostatic Transient Protection

Electrostatic transient protection is provided for the sensitive components in the control head by diodes VR801, VR802, VR803 and VR804. The diodes limit any transient voltages to tolerable levels. The associated capacitors provide Radio Frequency Interference (RFI) protection.

3.0 Control Head Model for CM300/PM400

The control head contains the internal speaker, the on/off/volume knob, the microphone connector, several buttons to operate the radio, three indicator Light Emitting Diodes (LED) to inform the user about the radio status, and an 8 character Liquid Crystal Display (LCD) for alpha-numerical information e.g. channel number or call address name.



3.1 Power Supplies

The power supply to the control head is taken from the host radio's 9.3V via connector J103-9. The 9.3V is used for the LEDs and back light, the 5V is used for the LCD driver (U3) and level shifter (U4). The stabilized 3V is used for the other parts.

3.2 SPI Interface

The host radio (master) communicates with the control head through its SPI bus. Three lines are connected to the shift register (U8): SPI clock (J103-17), SPI MOSI (J103-16), shift register chip select (J103-15) and LCD driver chip select (J103-18).

When the host radio needs to send data to the shift register, the radio asserts the shift register chip select and the data is loaded to the shift register. For example, the host radio sends data to change display channel or change LED status.

3.3 Keypad Keys

The control head keypad is a four-key design. All keys are configured as two analog lines read by μ P. The voltage on the analog lines varies between 0V and 3.3 V depending on which key is pressed. If no key is pressed, the voltage at both lines is 3.3V. The key configuration can be thought of as a matrix where the two lines represent one row and one column. Each line is connected to a resistive divider powered by 3.3V. If a button is pressed, it will connect one specific resistor of each divider line to ground level and thereby reduce the voltages on the analog lines. The voltages of the lines are A/D converted inside the μ P (ports PE 6 – 7) and specify the pressed button. To determine which key is pressed, the voltage of both lines must be considered.

The same analog lines also support a keypad microphone. A microphone key press is processed in the same manner like a control head key press.

3.4 LCD Driver

The LCD (36 x 4 segments) is controlled by U3. It has an on-board clock controlled by R28 (typically 20kHz measured on pin 2). U3 is operated from the 5V supply and is controlled over the SPI bus (SPI_CLK J103-17, SPI_MOSI J103-16, LCD chip select J103-18). Chip select is active low. U2 is used to provide level shifting between the 3.3V logic from the μ P and the 5V required by U3.

3.5 Status LED's and Back Light Circuit

All indicator LEDs (red, yellow, and green) are driven by current sources. To change the LED status the host radio sends a data message to the control head shift register via the SPI bus. The control head shift register determines the LED status from the received data and switches the LEDs on or off via Q8–Q10.

Backlighting for the LCD and keys is provided by a matrix of 21 LEDs arranged in 7 columns of 3 rows. The LEDs are driven from a constant current circuit (Q12, U1 and associated parts). There are 4 levels of backlight: off, low, medium and high, which are controlled by two outputs (pins 15, 1) from the shift register (U8). The current is controlled by transistor Q12. The op amp U1 monitors the current by measuring the voltage drop across R26, R27 and adjusting the bias of Q12 to achieve the required level as set by the combined shift register o/p's. When in the off state, Q11 is also turned on to clamp the base of Q12 so as to force it off. This ensures that the LEDs are fully off. Q11 is controlled by pin 3 of the shift register U8.

3.6 Microphone Connector Signals

The MIC_PTT line (J102-3) is grounded when the PTT button on the microphone is pressed. When released, this line is pulled to 9.3V by R33. Two transistor stages (Q14, Q13 and associated parts) are used to level shift between 9.3V and 3.3V required for the μ P while keeping the same sense (active low for PTT pressed).

Two of the mic socket lines (J102-2, 7) have dual functions depending on which type of microphone or SCI lead that is connected. An electronic switch (U41) is used to switch these two lines between mic keypad operation or SCI operation. The switch (mux) is controlled by the μ P through J103-20 with level shifting (and inversion) provided by transistor Q41. When MUX_CTRL (103-20) is low the electronic switch is in the mic keypad mode. The mic socket (J102) pin 2 is connected to the keypad row line that goes to J103-13 and pin 7 is connected to the keypad column line that goes to J103-12. When MUX_CTRL (103-20) is high the electronic switch is in the SCI mode. The mic socket (J102 pin 2) is connected to the SCI line that goes to J103-4 and pin 7 is connected to the BOOT_RES line that goes to J103-11.

The HOOK line (J102-6) is used to inform the uP which type of microphone or SCI lead is connected to the microphone socket. The voltage of the HOOK line is monitored by the uP (port PE0, MIC_SENSE) through a resistor divider on the main board. When the HOOK line is grounded (on hook condition) or floating (2.8V nominal), the uP sets the mux (U8) for keypad operation to allow the use of microphones with a keypad. When the HOOK line is connected to 9.3V, the uP sets the mux for SCI operation. This mode is also used to select low cost mic operation where the gain of the microphone path is increased (on the main board) to compensate for not having a pre-amp in the low cost mic.

If the BOOT_RES (J102-7) line is connected to >5V (e.g. 9.3V) at turn-on then the uP will start in boot mode instead of normal operation. This mode is used to programme new firmware into the FLASH memory (U404 mainboard).

3.7 Speaker

The control head contains a speaker for the receiver audio. The receiver audio signal from the differential audio output of the audio amplifier located on the radio's controller is fed via connector J103-1, 2 to the speaker connector P101 pin 1 and pin 2. The speaker is connected to the speaker connector P101. The control head speaker must be disconnected if an external speaker, connected on the accessory connector, is used.

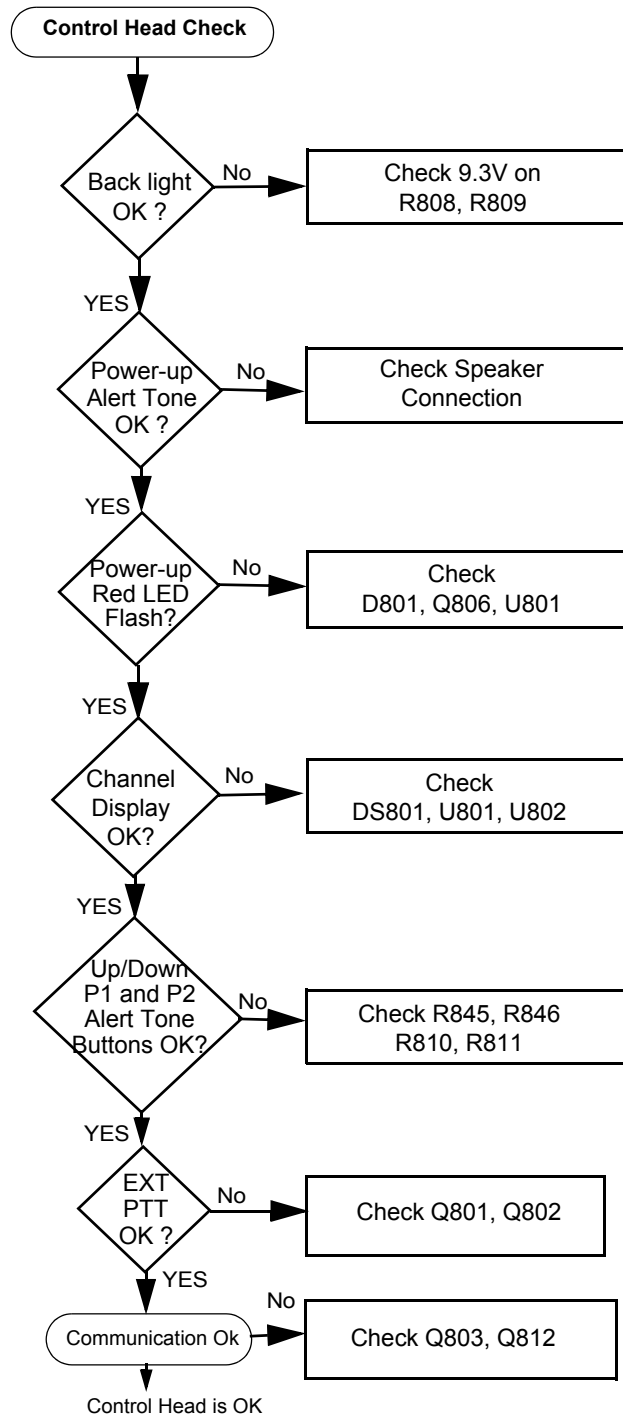
3.8 Electrostatic Transient Protection

Electrostatic transient protection is provided for the sensitive components in the control head by diodes VR1 – VR4. The diodes limit any transient voltages to tolerable levels. The associated capacitors provide Radio Frequency Interference (RFI) protection.

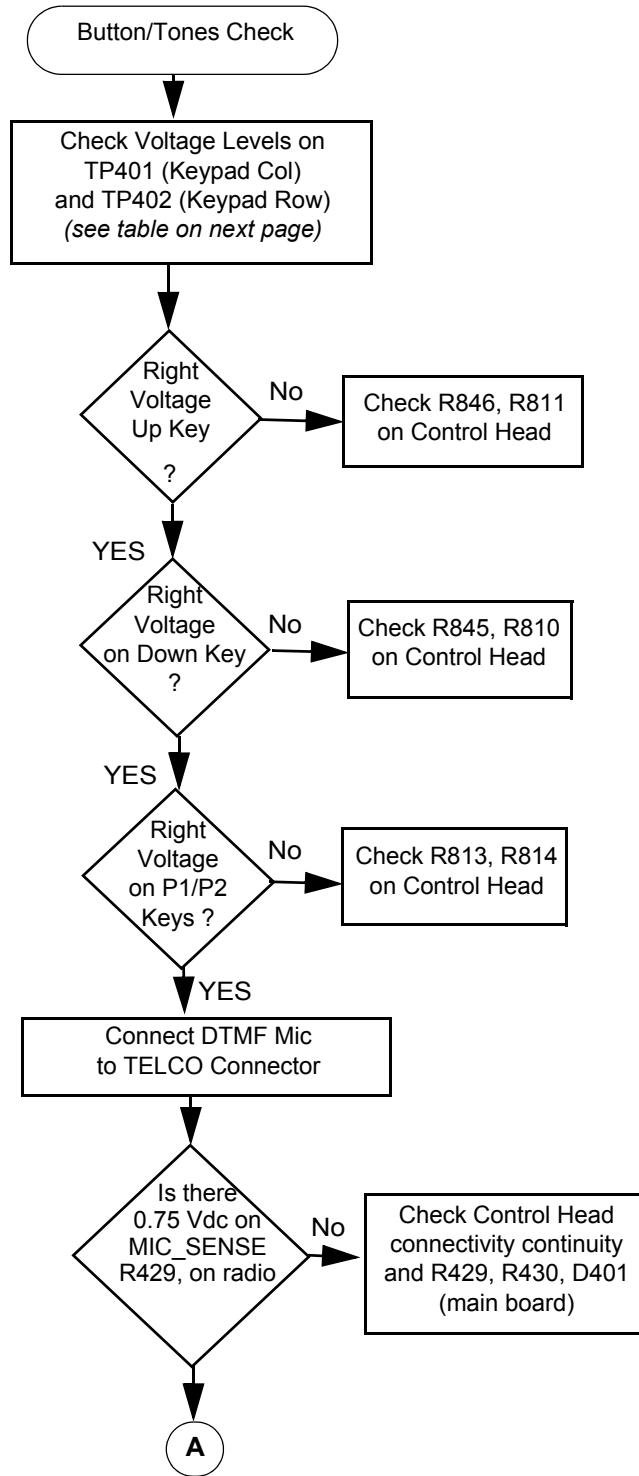
TROUBLESHOOTING CHARTS

1.0 Control Head CM200 Troubleshooting Chart

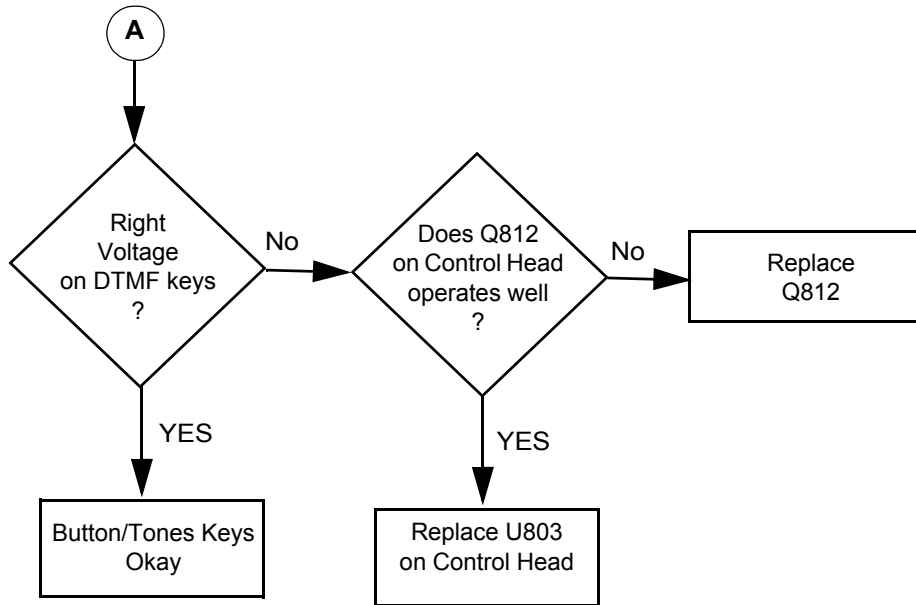
1.1 Control Head Failure



1.2 Button/Tones Select Error (Page 1 of 2)



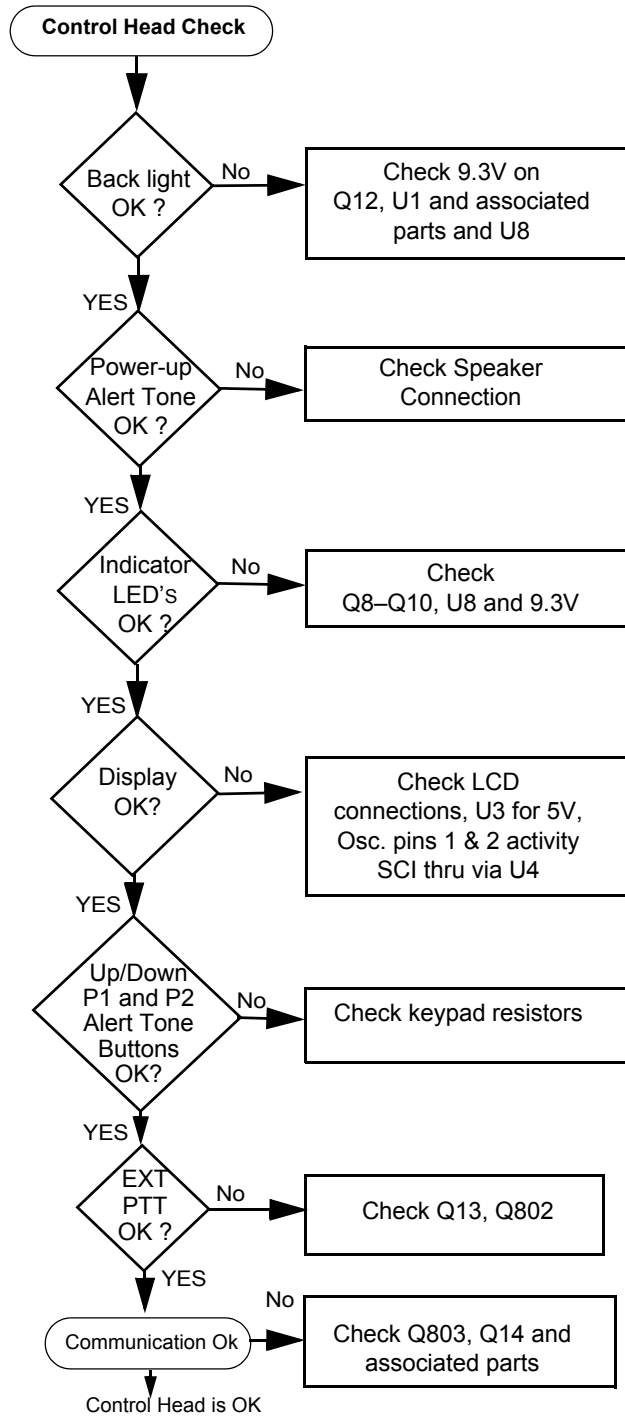
1.3 Button/Tones Select Error (Page 2 of 2)



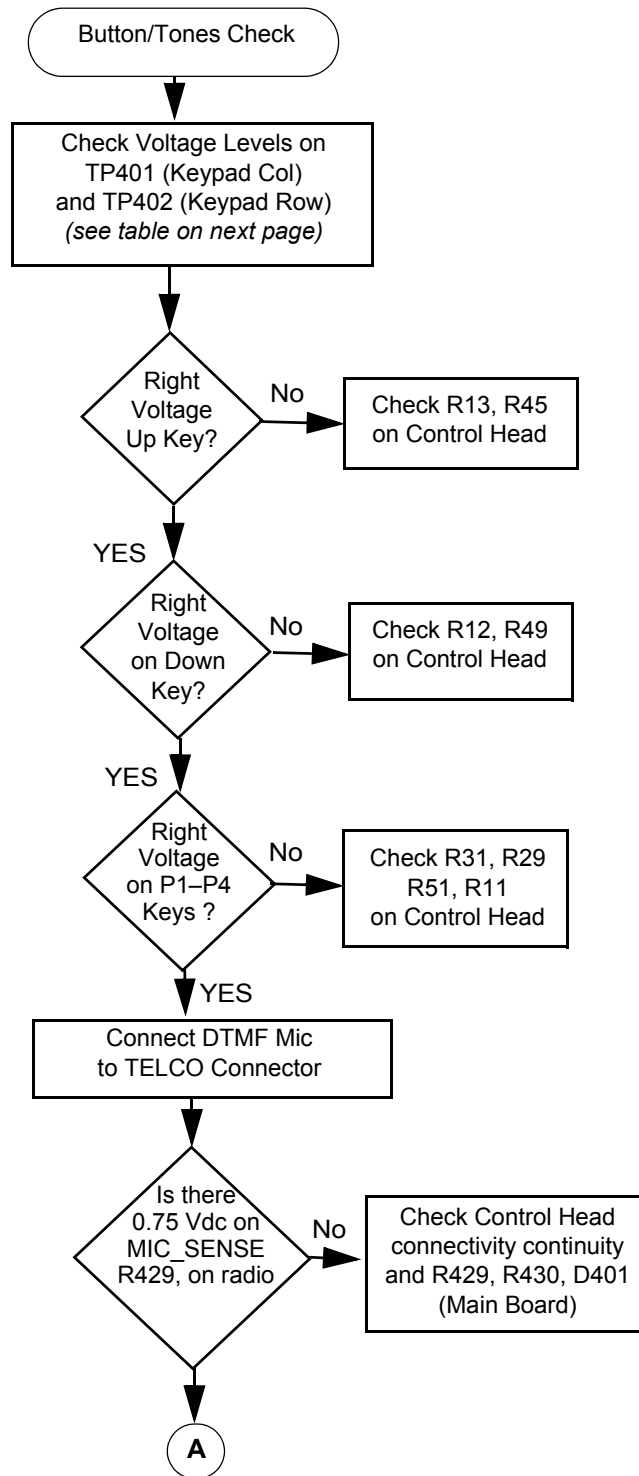
	Key_Col Voltage (TP401)	Key_Column Voltage TP401					
		0.008 V	0.675 V	1.346 V	1.997 V	2.650 V	3.300 V
Key_Row Voltage TP402	0.008 V						Up
	0.675 V			1	2	3	
	1.346 V		4	5	6	7	
	1.997 V		8	9	0	*	
	2.650 V		#	C	B	A	
	3.300 V	Down	Left Key P1	Right Key P2			Idle

2.0 Control Head CM300/PM400 Troubleshooting Chart

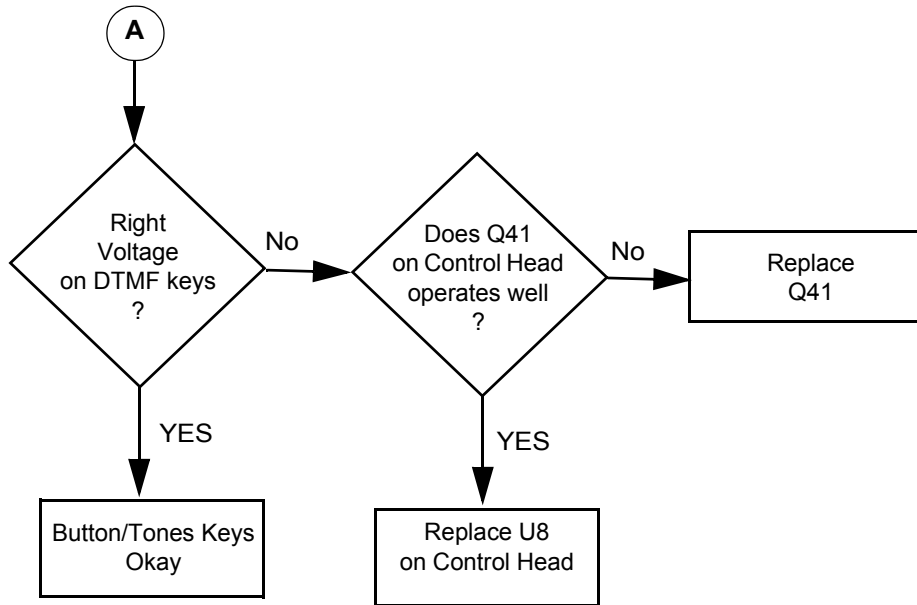
2.1 Control Head Failure



2.2 Button/Tones Select Error (Page 1 of 2)



2.3 Button/Tones Select Error (Page 2 of 2)



	Key_Col Voltage (TP401)	Key_Column Voltage TP401					
		0.008 V	0.675 V	1.346 V	1.997 V	2.650 V	3.300 V
Key_Row Voltage TP402	0.008 V						Up
	0.675 V			1	2	3	
	1.346 V		4	5	6	7	
	1.997 V		8	9	0	*	
	2.650 V		#	C	B	A	
	3.300 V	Down	Left Key P1	Right Key P2	P3	P4	Idle

CONTROL HEAD PCB / SCHEMATICS / PARTS LISTS

1.0 Allocation of Schematics and Circuit Boards

Table 4-1 Control Head Diagrams and Parts Lists

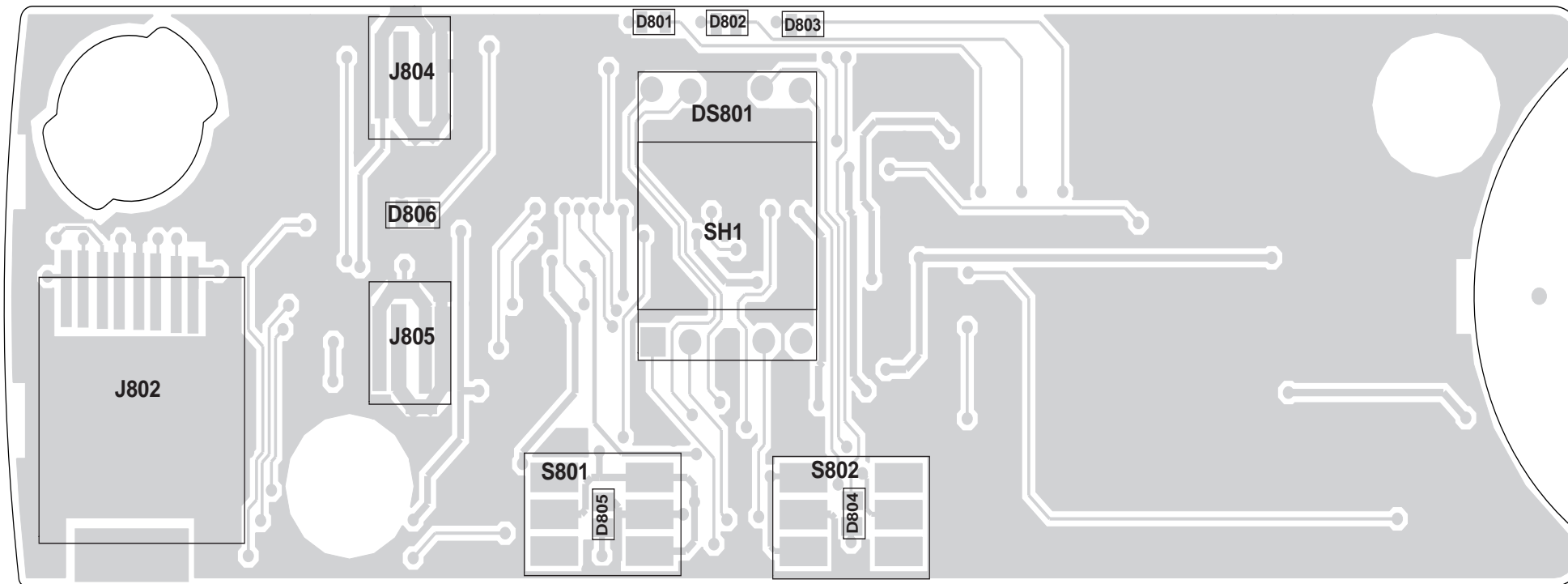
PCB : Control Head CM200 8488998U01 Main Board Top Side 8488998U01 Main Board Bottom Side	Page 4-3 Page 4-3
SCHEMATICS Sheet 1 of 1	Page 4-4
Parts List 8488998U01	Page 4-5

Table 4-2 Control Head Diagrams and Parts Lists

PCB : Control Head CM300/PM400 8489714U01 Main Board Top Side 8489714U01 Main Board Bottom Side	Page 4-6 Page 4-6
SCHEMATICS Sheet 1 of 1	Page 4-7
Parts List 8489714U01	Page 4-8

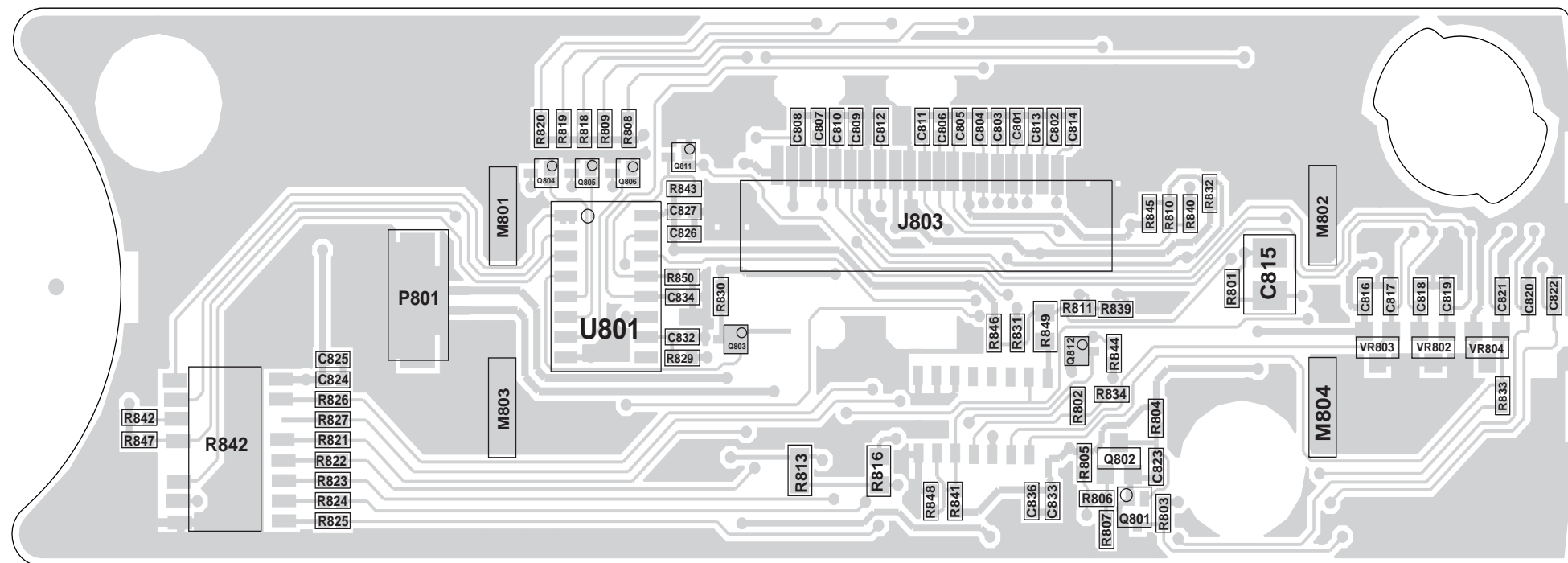
Notes

2.0 Control Head CM200 – PCB 8488998U01 / Schematics



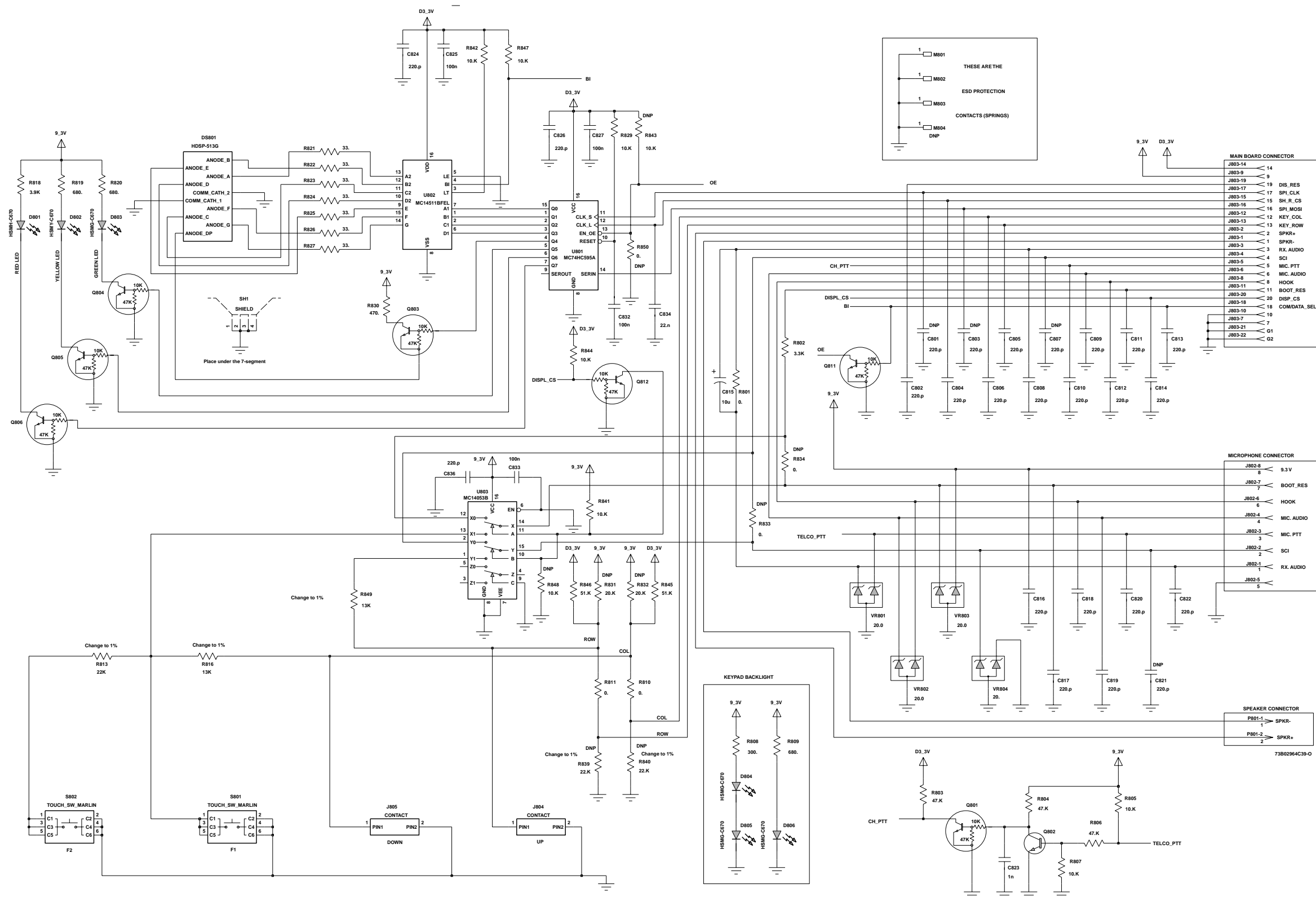
SHOWN FROM SIDE 1

Top Side



SHOWN FROM SIDE 2

Bottom Side



Control Head CM200 Schematic

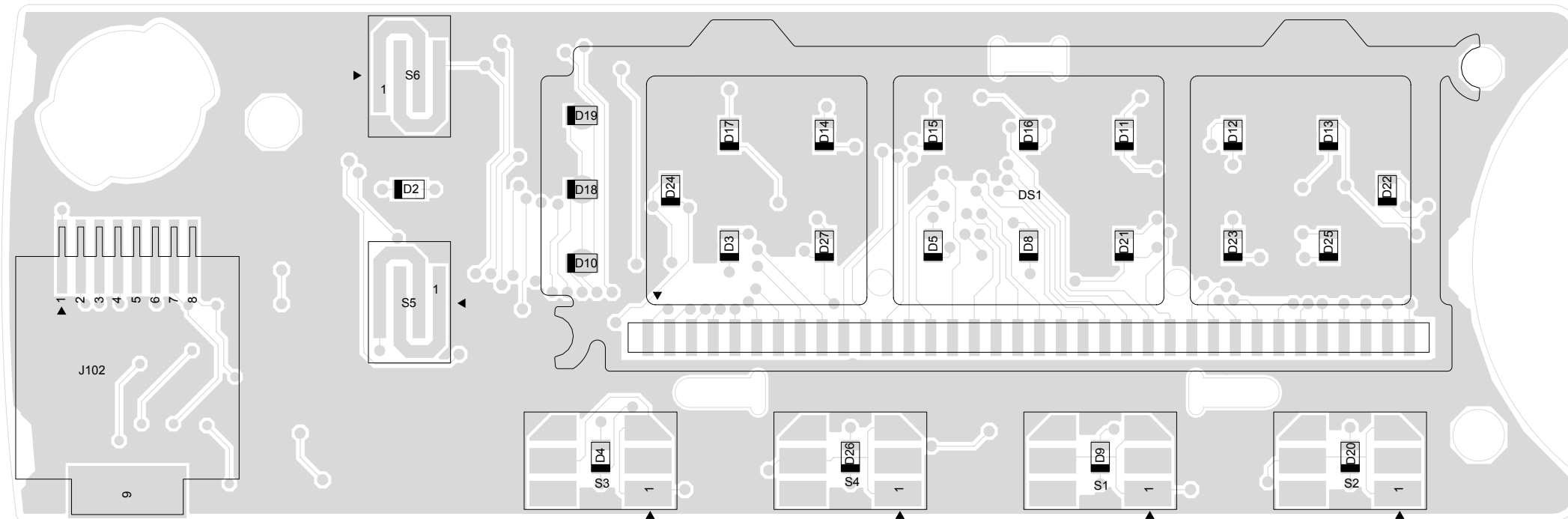
2.1 Control Head PCB 8488998U01 Parts List

Circuit Ref	Motorola Part No	Description
C802	2113740F59	CAP CHIP REEL CL13
C804	2113740F59	CAP CHIP REEL CL13
C805	2113740F59	CAP CHIP REEL CL13
C806	2113740F59	CAP CHIP REEL CL13
C808	2113740F59	CAP CHIP REEL CL13
C809	2113740F59	CAP CHIP REEL CL13
C810	2113740F59	CAP CHIP REEL CL13
C811	2113740F59	CAP CHIP REEL CL13
C812	2113740F59	CAP CHIP REEL CL13
C813	2113740F59	CAP CHIP REEL CL13
C814	2113740F59	CAP CHIP REEL CL13
C816	2113740F59	CAP CHIP REEL CL13
C817	2113740F59	CAP CHIP REEL CL13
C818	2113740F59	CAP CHIP REEL CL13
C819	2113740F59	CAP CHIP REEL CL13
C820	2113740F59	CAP CHIP REEL CL13
C822	2113740F59	CAP CHIP REEL CL13
C823	2113743K15	CER CHIP CAP .100uF
C824	2113740F59	CAP CHIP REEL CL13
C825	2113743K15	CER CHIP CAP .100uF
C826	2113740F59	CAP CHIP REEL CL13
C827	2113743K15	CER CHIP CAP .100uF
C832	2113743K15	CER CHIP CAP .100uF
C833	2113743K15	CER CHIP CAP .100uF
C834	2113743E07	CER CHIP CAP .022uF
C836	2113740F59	CAP CHIP REEL CL13
D801	4805729G74	LED SMT RED HP
D802	4805729G73	LED SMT YEL HP
D803	4805729G75	LED SMT GREEN HP
D804	4805729G75	LED SMT GREEN HP
D805	4805729G75	LED SMT GREEN HP
D806	4805729G75	LED SMT GREEN HP
DS801	5180353L02	7-SEGMENT DISPLAY
J802	0908353Y02	MODULAR 8-PIN STR
J803	0989241U02	FLEX 20-PIN 1mmTOP NON

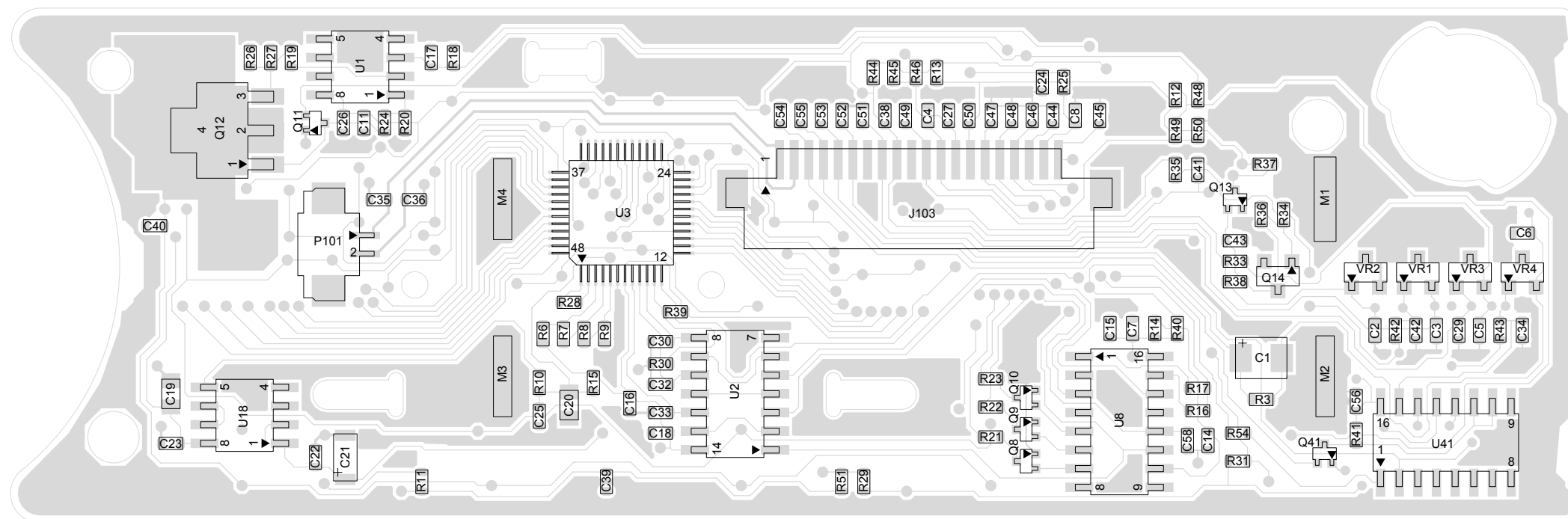
Circuit Ref	Motorola Part No	Description
M801	7588823L03	PAD GROUND LCD
M802	7588823L03	PAD GROUND LCD
M803	7588823L03	PAD GROUND LCD
M804	7588823L03	PAD GROUND LCD
P801	2809926G01	CONN 1.25MM 2PIN SURMT
Q801	4809940E02	TSTR NPN DIG DTC114YE
Q802	4813824A10	TSTR NPN 40V .2A GEN P
Q803	4809940E02	TSTR NPN DIG DTC114YE
Q804	4809940E02	TSTR NPN DIG DTC114YE
Q805	4809940E02	TSTR NPN DIG DTC114YE
Q806	4809940E02	TSTR NPN DIG DTC114YE
Q811	4809940E02	TSTR NPN DIG DTC114YE
Q812	4809940E02	TSTR NPN DIG DTC114YE
R801	0662057A01	CHIP RES 10 OHMS 5%
R802	0662057A61	CHIP RES 330 OHMS 5%
R803	0662057A89	CHIP RES 47K OHMS 5%
R804	0662057A89	CHIP RES 47K OHMS 5%
R805	0662057A73	CHIP RES 10K OHMS 5%
R806	0662057A89	CHIP RES 47K OHMS 5%
R807	0662057A73	CHIP RES 10K OHMS 5%
R808	0662057A36	CHIP RES 300 OHMS 5%
R809	0662057A45	CHIP RES 680 OHMS 5%
R810	0662057B47	CHIP RES 0 OHMS +0.5
R811	0662057B47	CHIP RES 0 OHMS +0.5
R813	0662057D08	CHIP RES 22K OHMS 5%
R816	0662057D03	CHIP RES 13K OHMS 5%
R818	0662057A63	CHIP RES 3900 OHMS 5%
R819	0662057A45	CHIP RES 680 OHMS 5%
R820	0662057A45	CHIP RES 680 OHMS 5%
R821	0662057A13	CHIP RES 33 OHMS 5%
R822	0662057A13	CHIP RES 33 OHMS 5%
R823	0662057A13	CHIP RES 33 OHMS 5%
R824	0662057A13	CHIP RES 33 OHMS 5%
R825	0662057A13	CHIP RES 33 OHMS 5%
R826	0662057A13	CHIP RES 33 OHMS 5%
R827	0662057A13	CHIP RES 33 OHMS 5%
R829	0662057A73	CHIP RES 10K OHMS 5%

Circuit Ref	Motorola Part No	Description
R830	0662057A41	CHIP RES 470 OHMS 5%
R841	0662057A73	CHIP RES 10K OHMS 5%
R842	0662057A73	CHIP RES 10K OHMS 5%
R843	0662057A73	CHIP RES 10K OHMS 5%
R844	0662057A73	CHIP RES 10K OHMS 5%
R845	0662057A90	CHIP RES 51K OHMS 5%
R846	0662057A90	CHIP RES 51K OHMS 5%
R849	0662057D03	CHIP RES 13K OHMS 5%

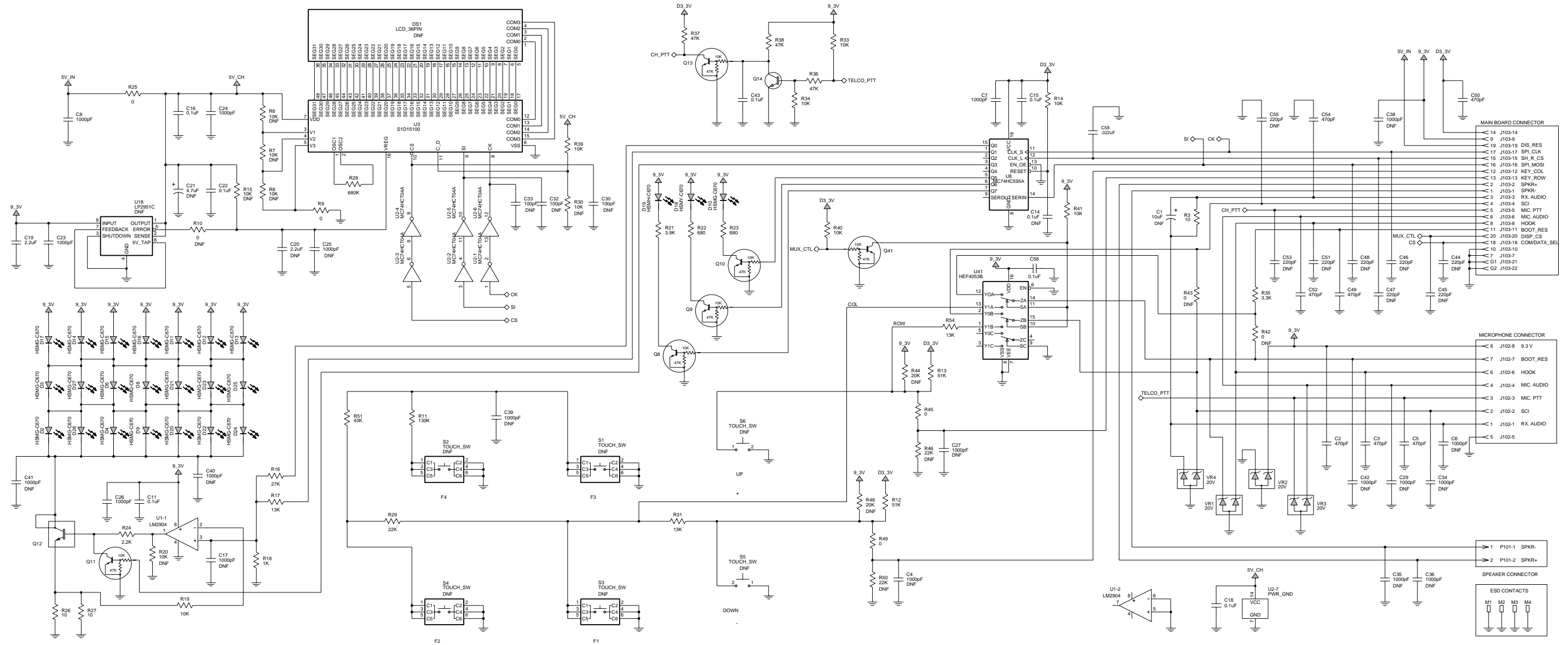
3.0 Control Head CM300/PM400 – PCB 8489714U01 / Schematics



Top Side



Bottom Side



Control Head CM300/PM400 Schematic

3.1 Control Head PCB 8489714U01 Parts List

Circuit Ref	Motorola Part No	Description
C1	NOT PLACED	CAP, 10uF
C2	2113740F67	CAP, 470pF
C3	2113740F67	CAP, 470pF
C4	2113740F29	CAP, 12pF
C5	2113740F67	CAP, 470pF
C6	2113740F29	CAP, 12pF
C7	2113741F25	CAP, 1000pF
C8	2113741F25	CAP, 1000pF
C11	2113743K15	CAP, 0.1uF
C14	NOT PLACED	CAP, 0.1uF
C15	2113743K15	CAP, 0.1uF
C16	2113743K15	CAP, 0.1uF
C17	NOT PLACED	CAP, 1000pF
C18	2113743K15	CAP, 0.1uF
C19	2113743F18	CAP, 2.2uF
C20	NOT PLACED	CAP, 2.2uF
C21	NOT PLACED	CAPP, 4.7uF
C22	2113743K15	CAP, 0.1uF
C23	2113741F25	CAP, 1000pF
C24	2113741F25	CAP, 1000pF
C25	NOT PLACED	CAP, 1000pF
C26	2113741F25	CAP, 1000pF
C27	2113740F29	CAP, 12pF
C29	2113740F29	CAP, 12pF
C30	NOT PLACED	CAP, 100pF
C32	NOT PLACED	CAP, 100pF
C33	NOT PLACED	CAP, 100pF
C34	2113740F29	CAP, 12pF
C35	NOT PLACED	CAP, 1000pF
C36	NOT PLACED	CAP, 1000pF
C38	NOT PLACED	CAP, 1000pF
C39	NOT PLACED	CAP, 1000pF
C40	NOT PLACED	CAP, 1000pF
C41	NOT PLACED	CAP, 1000pF
C42	2113740F29	CAP, 12pF
C43	2113743K15	CAP, 0.1uF
C44	NOT PLACED	CAP, 220pF
C45	NOT PLACED	CAP, 220pF

Circuit Ref	Motorola Part No	Description
C46	NOT PLACED	CAP, 220pF
C47	NOT PLACED	CAP, 220pF
C48	NOT PLACED	CAP, 220pF
C49	2113740F67	CAP, 470pF
C50	2113740F67	CAP, 470pF
C51	2113740F29	CAP, 12pF
C52	2113740F67	CAP, 470pF
C53	2113740F29	CAP, 12pF
C54	2113740F67	CAP, 470pF
C55	NOT PLACED	CAP, 220pF
C56	2113743K15	CAP, 0.1uF
C58	2113743E07	CAP, .022uF
D2	4805729G75	HSMG-C670
D3	4805729G75	HSMG-C670
D4	4805729G75	HSMG-C670
D5	4805729G75	HSMG-C670
D8	4805729G75	HSMG-C670
D9	4805729G75	HSMG-C670
D10	4805729G75	HSMG-C670
D11	4805729G75	HSMG-C670
D12	4805729G75	HSMG-C670
D13	4805729G75	HSMG-C670
D14	4805729G75	HSMG-C670
D15	4805729G75	HSMG-C670
D16	4805729G75	HSMG-C670
D17	4805729G75	HSMG-C670
D18	4805729G73	HSMY-C670
D19	4805729G74	HSMH-C670
D20	4805729G75	HSMG-C670
D21	4805729G75	HSMG-C670
D22	4805729G75	HSMG-C670
D23	4805729G75	HSMG-C670
D24	4805729G75	HSMG-C670
D25	4805729G75	HSMG-C670
D26	4805729G75	HSMG-C670
D27	4805729G75	HSMG-C670
DS1	NOT PLACED	LCD_36PIN
J102	0908353Y02	CONN_J
J103	0989241U02	CONN_J

Circuit Ref	Motorola Part No	Description
M1	7588823L03	CONTACT
M2	7588823L03	CONTACT
M3	7588823L03	CONTACT
M4	7588823L03	CONTACT
P101	2809926G01	CONN_P
Q8	4809940E02	DTC114YE
Q9	4809940E02	DTC114YE
Q10	4809940E02	DTC114YE
Q11	4809940E02	DTC114YE
Q12	4813824B01	PZT2222A
Q13	4809940E02	DTC114YE
Q14	4813824A10	MMBT3904
Q41	4809940E02	DTC114YE
R3	0662057A01	RES, 10
R6	NOT PLACED	RES, 10K
R7	NOT PLACED	RES, 10K
R8	NOT PLACED	RES, 10K
R9	0662057B47	RES, 0
R10	NOT PLACED	RES, 0
R11	0662057B01	RES, 130K
R12	0662057A90	RES, 51K
R13	0662057A90	RES, 51K
R14	0662057A73	RES, 10K
R15	NOT PLACED	RES, 10K
R16	0662057A83	RES, 27K
R17	0662057A76	RES, 13K
R18	0662057A49	RES, 1K
R19	0662057A73	RES, 10K
R20	NOT PLACED	RES, 10K
R21	0662057A63	RES, 3.9K
R22	0662057A45	RES, 680
R23	0662057A45	RES, 680
R24	0662057A57	RES, 2.2K
R25	0662057B47	RES, 0
R26	0662057A01	RES, 10
R27	0662057A01	RES, 10
R28	0662057B18	RES, 680K
R29	0662057A81	RES, 22K
R30	NOT PLACED	RES, 10K

Circuit Ref	Motorola Part No	Description
R31	0662057A76	RES, 13K
R33	0662057A73	RES, 10K
R34	0662057A73	RES, 10K
R35	0662057A61	RES, 3.3K
R36	0662057A89	RES, 47K
R37	0662057A89	RES, 47K
R38	0662057A89	RES, 47K
R39	0662057A73	RES, 10K
R40	0662057A73	RES, 10K
R41	0662057A73	RES, 10K
R42	NOT PLACED	RES, 0
R43	NOT PLACED	RES, 0
R44	NOT PLACED	RES, 20K
R45	0662057B47	RES, 0
R46	NOT PLACED	RES, 22K
R48	NOT PLACED	RES, 20K
R49	0662057B47	RES, 0
R50	NOT PLACED	RES, 22K
R51	0662057A88	RES, 43K
R54	0662057A76	RES, 13K
S1	NOT PLACED	TOUCH_SW
S2	NOT PLACED	TOUCH_SW
S3	NOT PLACED	TOUCH_SW
S4	NOT PLACED	TOUCH_SW
S5	NOT PLACED	TOUCH_SW
S6	NOT PLACED	TOUCH_SW
U1	5113818A01	LM2904
U2	5113805A05	MC74HCT04A
U3	5102109U01	S1D15100
U8	5113805A75	MC74HC595A
U18	NOT PLACED	LP2951C
U41	5184704M60	HEF4053B
VR1	4813830A75	MMBZ20VAL
VR2	4813830A75	MMBZ20VAL
VR3	4813830A75	MMBZ20VAL
VR4	4813830A75	MMBZ20VAL



CM300 Radio

VHF1 (136–162 MHz) 25–45 W
Service Information

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Notes

MODEL CHART AND TECHNICAL SPECIFICATIONS

1.0 CM300 Model Chart

VHF1, 25–45 W, 136–162 MHz		
Model		Description
AAM50JQF9AA1AN		CM300 136–162 MHz, 25–45 W, 32 CH
	Item	Description
X	PMUD1946_	CM300 Super Tanapa VHF1, 25–45 W, 32 CH
X	PMUD1962_	CM300 Tanapa VHF1, 25–45 W, 32 CH
X	PMLN4599_	Control Head
X	PMUD1962_S	CM300 VHF1 Service Board
X	6881096C22	CM300 User Guide (bilingual)
X	HKLN4220	CM300 User Guide CDROM (Bilingual)

x = Indicates one of each is required.

2.0 Technical Specifications

Data is specified for +25°C unless otherwise stated.

General	
Specification	VHF1
Frequency Range:	136–162 MHz
Frequency Stability (-30°C to +60°C, 25°C Ref.)	±2.5 PPM
Channel Capacity:	CM300 – 32 Channels
Channel Spacing:	12.5/20/25 kHz
Power Supply:	13.8 Vdc (11 Vdc – 16.6 Vdc) negative Vehicle ground
Dimensions (L x W x H)	4.65" X 6.67" X 1.73" (118mm X 169.5mm X 44mm)
Weight	2.22 lbs (1.01 kg)
FCC Description	ABZ99FT3049
Operating Temperature	-30 to 60° C (Display only -20°C to 60°C)
Storage Temperature	-40 to 85° C
Thermal Shock	-40 to 80° C
High Humidity	95% RH @ 50° C for 8 hrs
ESD	15KV air discharge
Packing Test	Impact Test

Transmitter	
Specification	VHF1
Power Output	25–45 W
Conducted/Radiated Emissions:	-26 dBm
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000 Hz)	TIA603 and CEPT
Tx Audio Distortion	< 3%
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz
FM Hum and Noise:	-40 dB@12.5 kHz -45 dB@25 kHz

Receiver	
Specification	VHF1
Sensitivity (12 dB SINAD):	0.35 μV @ 12.5 kHz 0.3 μV @ 25 kHz
Intermodulation:	65 dB@12.5 kHz 75 dB@25 kHz
Adjacent Channel Selectivity:	65 dB @ 12.5 kHz 75 dB @ 25 kHz
Spurious Response	75 dB
Rated Audio Power	4 W (typ.) Internal 7.5 W @ 5 % External
Audio Distortion	< 5 %
Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 25 kHz
Audio Response	TIA603 and CEPT
Conducted Spurious Emission per FCC Part 15:	-57 dBm <1 GHz -47 dBm >1 GHz

Specifications subject to change without notice. All electrical specifications and methods refer to EIA/TIA 603 standards.

Notes

Chapter 2

THEORY OF OPERATION

1.0 Introduction

This Chapter provides a detailed theory of operation for the VHF circuits in the radio. Details of the theory of operation and trouble shooting for the the associated Controller circuits are included in this Section of the manual.

2.0 VHF (136–162 MHz) Receiver

2.1 Receiver Front-End

The received signal is applied to the radio's antenna input connector and routed through the harmonic filter and antenna switch. The insertion loss of the harmonic filter/antenna switch is less than 1 dB. The signal is routed to the first filter (4-pole), which has an insertion loss of 2 dB typically. The output of the filter is matched to the base of the LNA (Q303) that provides a 16 dB gain and a noise figure of better than 2 dB. Current source Q301 is used to maintain the collector current of Q303. Diode CR301 protects Q303 by clamping excessive input signals. Q303 output is applied to the second filter (3-pole) which has an insertion loss of 2 dB. In Distance mode, Q304 turns on and causes D305 to conduct, thus bypassing C332 and R337. In Local mode, the signal is routed through C332 and R337, thus inserting 7 dB attenuation. Since the attenuator is located after the RF amplifier, the receiver sensitivity is reduced only by 6 dB, while the overall third order input intercept is raised.

The first mixer is a passive, double-balanced type, consisting of T300, T301 and U302. This mixer provides all of the necessary rejection of the half-IF spurious response. High-side injection at +15 dBm is delivered to the first mixer. The mixer output is then connected to a duplex network which matches its output to the XTAL filter input (FL300) at the IF frequency of 44.85 MHz. The duplex network terminates into a 50 ohm resistor (R340) at all other frequencies.

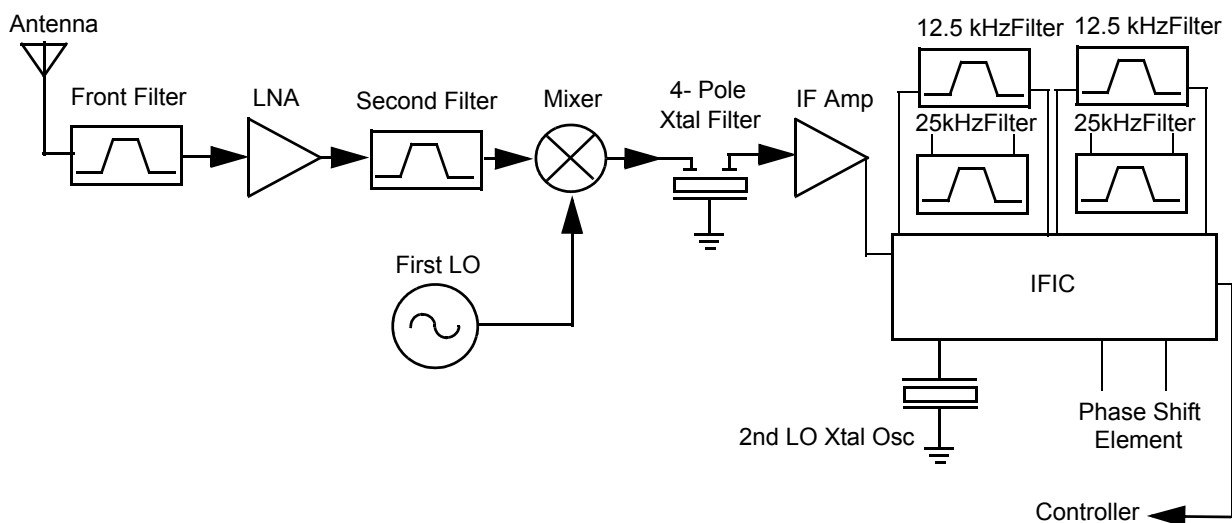


Figure 2-1 VHF Receiver Block Diagram

2.2 Receiver Back End

The IF signal from the crystal filter enters the IF amplifier which provides 20 dB of gain and feeds the IF IC at pin 1. The first IF signal at 44.85 MHz mixes with the second local oscillator (LO) at 44.395 MHz to produce the second IF at 455 kHz. The second LO uses the external crystal Y301. The second IF signal is amplified and filtered by two external ceramic filters (FL303/FL302 for 12.5 kHz channel spacing and FL304/FL301 for 25 kHz channel spacing). The IF IC demodulates the signal by means of a quadrature detector and feeds the detected audio (via pin 7) to the audio processing circuits. At IF IC pin 5, an RSSI signal is available with a dynamic range of 70 dB.

3.0 VHF Transmitter Power Amplifier (136–162 MHz)

The radio's 45 W PA is a three-stage amplifier used to amplify the output from the TX_INJ to the antenna port. All three stages utilize LDMOS technology. The gain of the first stage (U101) is adjustable and is controlled by pin 7 of U103-2 via U103-3 and U102-1. It is followed by an LDMOS driver Q105 and final stage Q100.

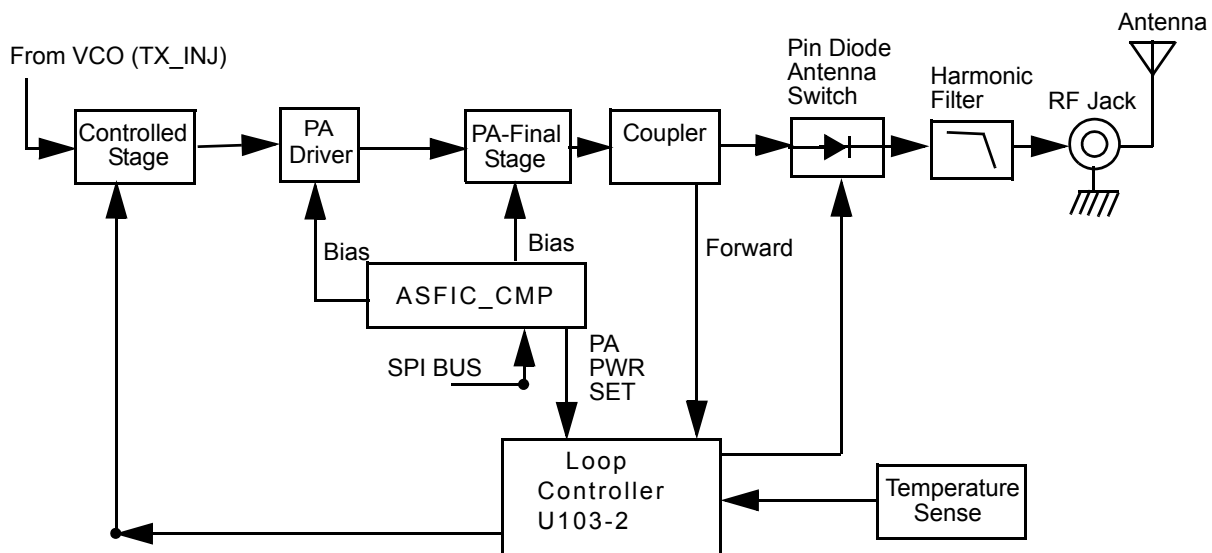


Figure 2-2 VHF Transmitter Block Diagram

Devices U101, Q105 and Q100 are surface mounted. Two screws with Belleville washers provide direct pressure ensuring good thermal contact between both the driver and final stage, and the chassis.

3.1 First Power Controller Stage

The first stage (U101) is a 20dB gain integrated circuit containing two LDMOS FET amplifier stages. It amplifies the RF signal from the VCO (TX_INJ). The output power of stage U101 is controlled by a DC voltage applied to pin 1 from the op-amp U103-3, pin 8. The control voltage simultaneously varies the bias of two FET stages within U101. This biasing point determines the overall gain of U101 and therefore its output drive level to Q105, which in turn controls the output power of the PA.

Op-amp U103-3 monitors the drain current of U101 via resistors R122 & R197 and adjusts the bias voltage of U101.

In receive mode, the DC voltage from RX_EN line turns on Q101, which in turn switches off the biasing voltage to U101.

3.2 Power Controlled Driver Stage

The next stage is an LDMOS device (Q105) which provides a gain of 12 dB. This device requires a positive gate bias and a quiescent current flow for proper operation. The bias is set during transmit mode by V_cntrl_driver which is set to provide 100–150 mA of quiescent current by the factory, and fed to the gate of Q105 via the resistive network.

The V_cntrl_driver is directly controlled by the ASFIC CMP. In receive mode, the ASFIC CMP (U504) sets V-cntrl_driver to 0 V (DACR pin 5).

3.3 Final Stage

The final stage is an LDMOS device (Q100) providing a gain of 12 dB. This device also requires a positive gate bias and a quiescent current flow for proper operation. The voltage of the line PA_BIAS is set in transmit mode by the ASFIC and fed to the gate of Q100 via the resistive network R134, R131. This bias voltage is tuned in the factory. If the transistor is replaced, the bias voltage must be tuned using the Tuner. Care must be taken not to damage the device by exceeding the maximum allowed bias voltage. The device's drain current is drawn directly from the radio's DC supply voltage input, B+, via L117 and L115.

A matching network consisting of C1004–5, C1008, C1096, C1013, C1019, L116: and two striplines, transforms the impedance to 50 ohms and feeds the directional coupler.

3.4 Bi-Directional Coupler

The bi-directional Coupler is a microstrip printed circuit, which couples a small amount of the forward and reverse power of the RF power from Q100. The coupled signal is rectified to an output power which is proportional to the DC voltage rectified by diode D105; and the resulting DC voltage is routed to the power control section to ensure that the forward power out of the radio is held to a constant value.

3.5 Antenna Switch

The antenna switch utilizes the existing dc feed (B+) to the last stage device (Q100). The basic operation is to have both PIN diodes (D103, D104) turned on during key-up by forward biasing them. This is achieved by pulling down the voltage at the cathode end of D104 to around 12.4 V (0.7 V drop across each diode). The current through the diodes needs to be set around 100 mA to fully open the transmit path through resistor R108. Q106 is a current source controlled by Q103 which is turned on in Tx mode by TX_EN. VR102 ensures that the voltage at resistor R107 never exceeds 5.6 V.

3.6 Harmonic Filter

Inductors L111, L112, L124 and L113 along with capacitors C1132, C1022, C1020, C1137, C1018, and C1017 form a low-pass filter to attenuate harmonic energy coming from the transmitter. Resistor R150 drains any electrostatic charges that might otherwise build up on the antenna. The harmonic filter also prevents high level RF signals above the receiver passband from reaching the receiver circuits to improve spurious response rejection.

3.7 Power Control

The output power is regulated by using a forward power detection control loop. The directional coupler samples a portion of the forward and reflected RF power. The forward sampled RF is rectified by diode D105, and the resulting DC voltage is routed to the operational amplifier U100. The error output current is then routed to an integrator, and converted into the control voltage. This voltage controls the bias of the pre-driver (U101) stage. The output power level is set by way of a DAC, PWR_SET, in the audio processing IC (U504), which acts at the forward power control loop reference.

The sampled reflected power is rectified by diode D107, The resulting DC voltage is amplified by an operational amplifier U100 and routed to the summing junction. This detector protects the final stage Q100 from reflected power by increasing the error current. The temperature sensor protects the final stage Q100 from overheating by increasing the error current. A thermistor RT100 measures the final stage Q100 temperature. The voltage divider output is routed to an operational amplifier U103 and then goes to the summing junction. The Zener Diode VR101 keeps the loop control voltage below 5.6 V and eliminates the DC current from the 9.3 regulator U501.

A local loop for the Pre Driver (U101) is used in order to stabilize the current for this stage.

In Rx mode, the two transistors Q101 and Q102 go to saturation and shut down the transmitter by applying ground to the Pre Driver U101.

4.0 VHF (136–162 MHz) Frequency Synthesis

The synthesizer consists of a reference oscillator (Y201), low voltage Fractional-N (LVFRAC-N) synthesizer (U200), and a voltage controlled oscillator (VCO) (U201).

4.1 Reference Oscillator

The reference oscillator is a crystal (Y201) controlled Colpitts oscillator and has a frequency of 16.8 MHz. The oscillator transistor and start-up circuit are located in the LVFRAC-N (U200) while the oscillator feedback capacitors, crystal, and tuning varactors are external. An analog-to-digital (A/D) converter internal to the LVFRAC-N (U200) and controlled by the microprocessor via SPI sets the voltage at the warp output of U200 pin 25. This sets the frequency of the oscillator. Consequently, the output of the crystal Y201 is applied to U200 pin 23.

The method of temperature compensation is to apply an inverse Bechmann voltage curve, which matches the crystal's Bechmann curve to a varactor that constantly shifts the oscillator back on frequency. The crystal vendor characterizes the crystal over a specified temperature range and codes this information into a bar code that is printed on the crystal package. In production, this crystal code is read via a 2-dimensional bar code reader and the parameters are saved.

This oscillator is temperature compensated to an accuracy of ± 2.5 PPM from -30 to 60 degrees C. The temperature compensation scheme is implemented by an algorithm that uses five crystal parameters (four characterize the inverse Bechmann voltage curve and one for frequency accuracy of the reference oscillator at 25 degrees C). This algorithm is implemented by the LVFRAC-N (U200) at the power up of the radio.

4.2 Fractional-N Synthesizer

The LVFRAC-N U200 consists of a pre-scaler, programmable loop divider, control divider logic, phase detector, charge pump, A/D converter for low frequency digital modulation, balanced attenuator used to balance the high and low frequency analog modulation, 13 V positive voltage multiplier, serial interface for control, and a super filter for the regulated 5 volts.

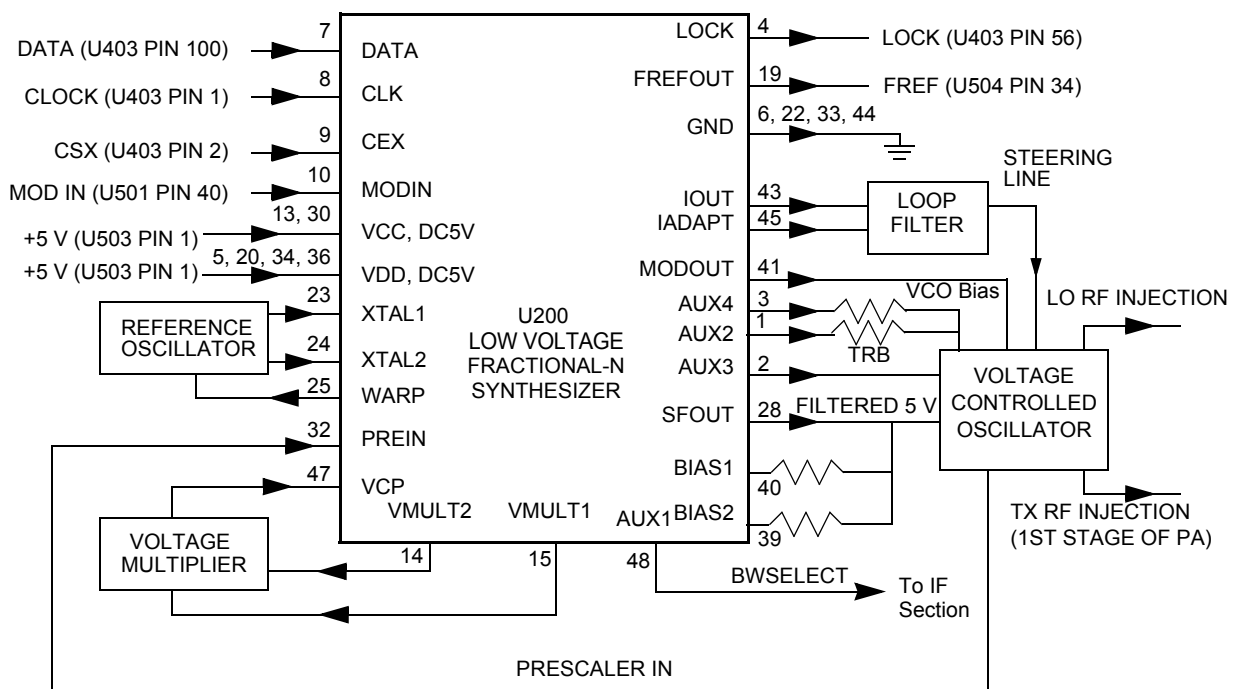


Figure 2-3 VHF Synthesizer Block Diagram

A voltage of 5 V applied to the super filter input (U200, pin 30) supplies an output voltage of 4.5 Vdc (VSF) at U200, pin 28. This supplies 4.5 V to the VCO Buffer IC U201.

To generate a high voltage to supply the phase detector (charge pump) output stage at pin VCP (U200, pin 47) while using a low voltage 3.3 Vdc supply, a 13 V positive voltage multiplier is used (D200, D201, and capacitors C2024, 2025, 2026, 2055, 2027, 2001).

Output lock (U200, pin 4) provides information about the lock status of the synthesizer loop. A high level at this output indicates a stable loop. A 16.8 MHz reference frequency is provided at U200, pin 19.

4.3 Voltage Controlled Oscillator (VCO)

The Voltage Controlled Oscillator (VCO) consists of the VCO/Buffer IC (VCOBIC, U201), the TX and RX tank circuits, the external RX amplifier, and the modulation circuitry.

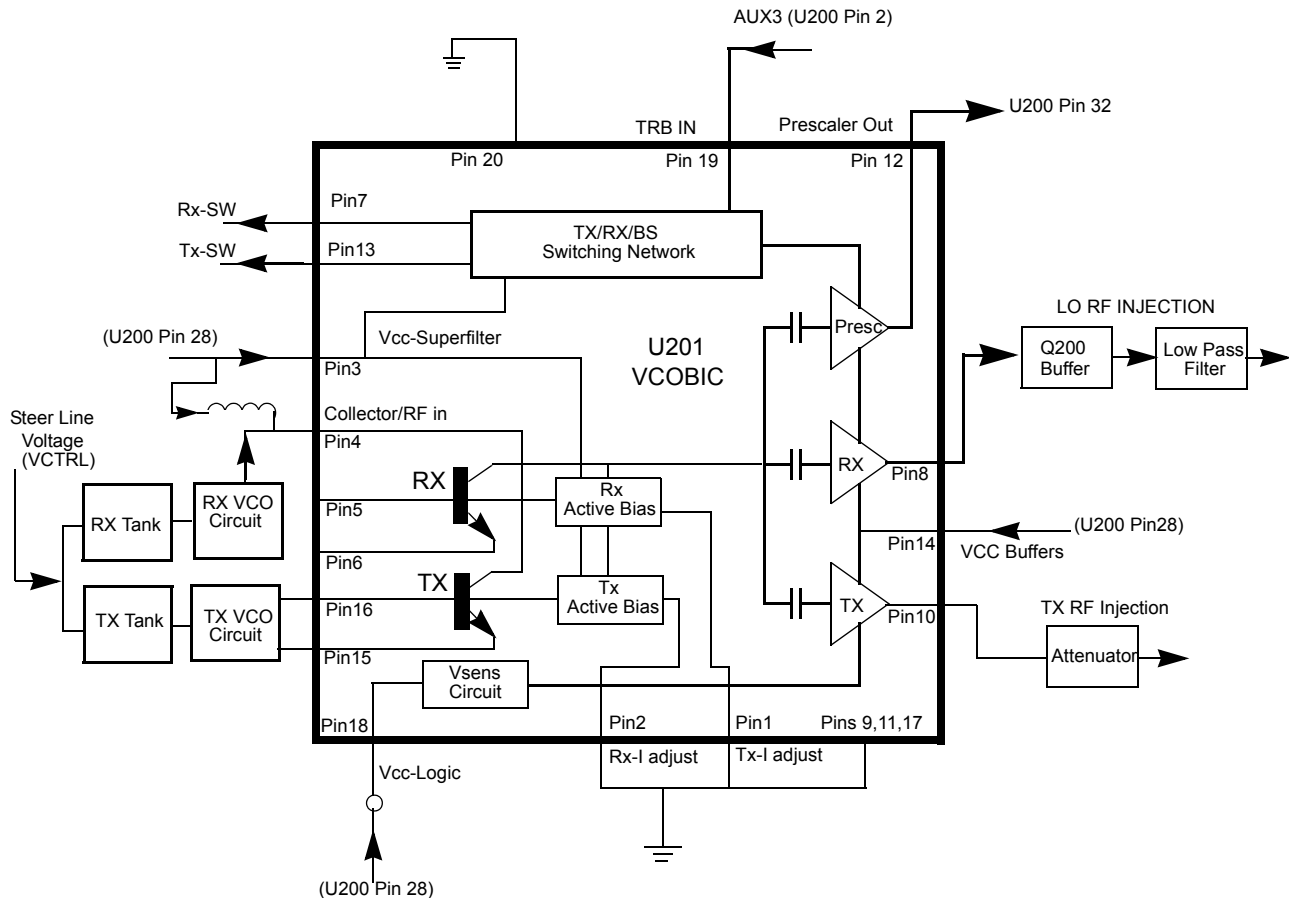


Figure 2-4 VHF VCO Block Diagram

The VCOBIC together with the LVFRAC-N (U200) generate the required frequencies in both transmit and receive modes. The TRB line (U201, pin 19) determines which VCO and buffer is enabled (high being TX output at pin 10, low being RX output at pin 8). A sample of the signal from the enabled output is routed from U201, pin 12 (PRESC_OUT), via a low pass filter to U200, pin 32 (PREIN).

A steering line voltage between 3.0 V and 10.0 V at varactor D204 tunes the TX VCO through the frequency range of 146–174 MHz, and at D203 tunes the RX VCO through the frequency range of 190–219 MHz.

The external RX amplifier is used to increase the output from U201, pin 8 from 3–4 dBm to the required 15dBm for proper mixer operation. In TX mode, the modulation signal from the LVFRAC-N (U200, pin 41) is applied to the VCO by way of the modulation circuit D205, R212, R211, C2073.

4.4 Synthesizer Operation

The synthesizer consists of a low voltage FRAC-N IC (LVFRAC-N), reference oscillator, charge pump circuits, loop filter circuit, and DC supply. The output signal (PRESC_OUT) of the VCOBIC (U201, pin 12) is fed to the PREIN, pin 32 of U200 via a low pass filter which attenuates harmonics and provides a correct input level to the LVFRAC-N in order to close the synthesizer loop.

The pre-scaler in the synthesizer (U200) is a dual modulus pre-scaler with selectable divider ratios. The divider ratio of the pre-scaler is controlled by the loop divider, which in turn receives its inputs via the SPI. The output of the pre-scaler is applied to the loop divider. The output of the loop divider is connected to the phase detector, which compares the loop divider's output signal with the reference signal. The reference signal is generated by dividing down the signal of the reference oscillator (Y201).

The output signal of the phase detector is a pulsed dc signal that is routed to the charge pump. The charge pump outputs a current from U200, pin 43 (IOUT). The loop filter (consisting of R224, R217, R234, C2074, C2075, C2077, C2078, C2079, C2080, C2028, and L205) transforms this current into a voltage that is applied to the varactor diodes D203 and D204 for RX and TX respectively. The output frequency is determined by this control voltage. The current can be set to a value fixed in the LVFRAC-N or to a value determined by the currents flowing into BIAS 1 (U200, pin 40) or BIAS 2 (U200, pin 39). The currents are set by the value of R200 or R206 respectively. The selection of the three different bias sources is done by software programming.

To modulate the synthesizer loop, a two-spot modulation method is utilized via the MODIN (U200, pin 10) input of the LVFRAC-N. The audio signal is applied to both the A/D converter (low frequency path) and the balance attenuator (high frequency path). The A/D converter converts the low frequency analog modulating signal into a digital code which is applied to the loop divider, thereby causing the carrier to deviate. The balance attenuator is used to adjust the VCO's deviation sensitivity to high frequency modulating signals. The output of the balance attenuator is presented at the MODOUT port of the LVFRAC-N (U200, pin 41) and connected to the VCO modulation varactor D205.

5.0 Controller Theory of Operation

This section provides a detailed theory of operation for the radio and its components. The main radio is a single-board design, consisting of the transmitter, receiver, and controller circuits. A control head is connected by an extension cable. The control head contains LED indicators, a microphone connector, buttons, and speaker.

In addition to the power cable and antenna cable, an accessory cable can be attached to a connector on the rear of the radio. The accessory cable enables you to connect accessories to the radio, such as an external speaker, emergency switch, foot-operated PTT, and ignition sensing, etc.

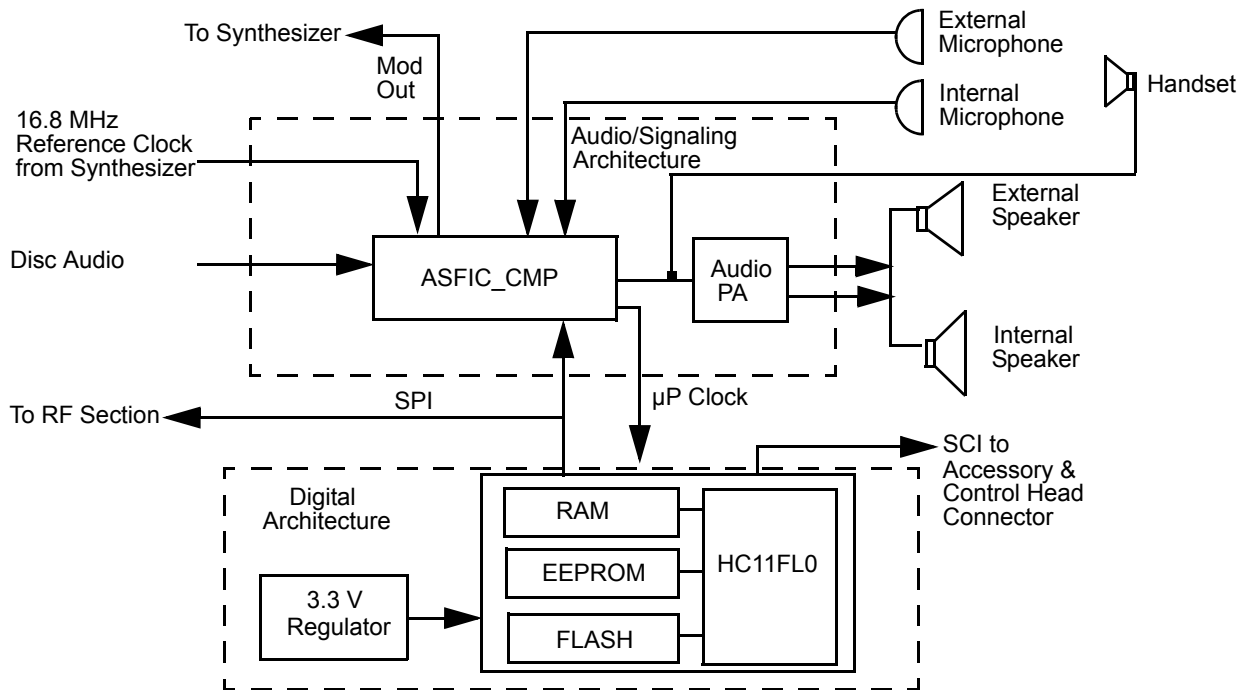


Figure 2-5 Controller Block Diagram

5.1 Radio Power Distribution

Voltage distribution is provided by five separate devices:

- U514 P-cH FET – Batt + (Ext_SWB+)
- U501 LM2941T – 9.3 V
- U503 LP2951CM – 5 V
- U508 MC 33269DTRK – 3.3 V
- U510 LP2986ILDY – 3.3 V Digital

The DC voltage applied to connector P2 supplies power directly to the following circuitry:

- Electronic on/off control
- RF power amplifier
- 12 volts P-cH FET – U514
- 9.3 volt regulator
- Audio PA

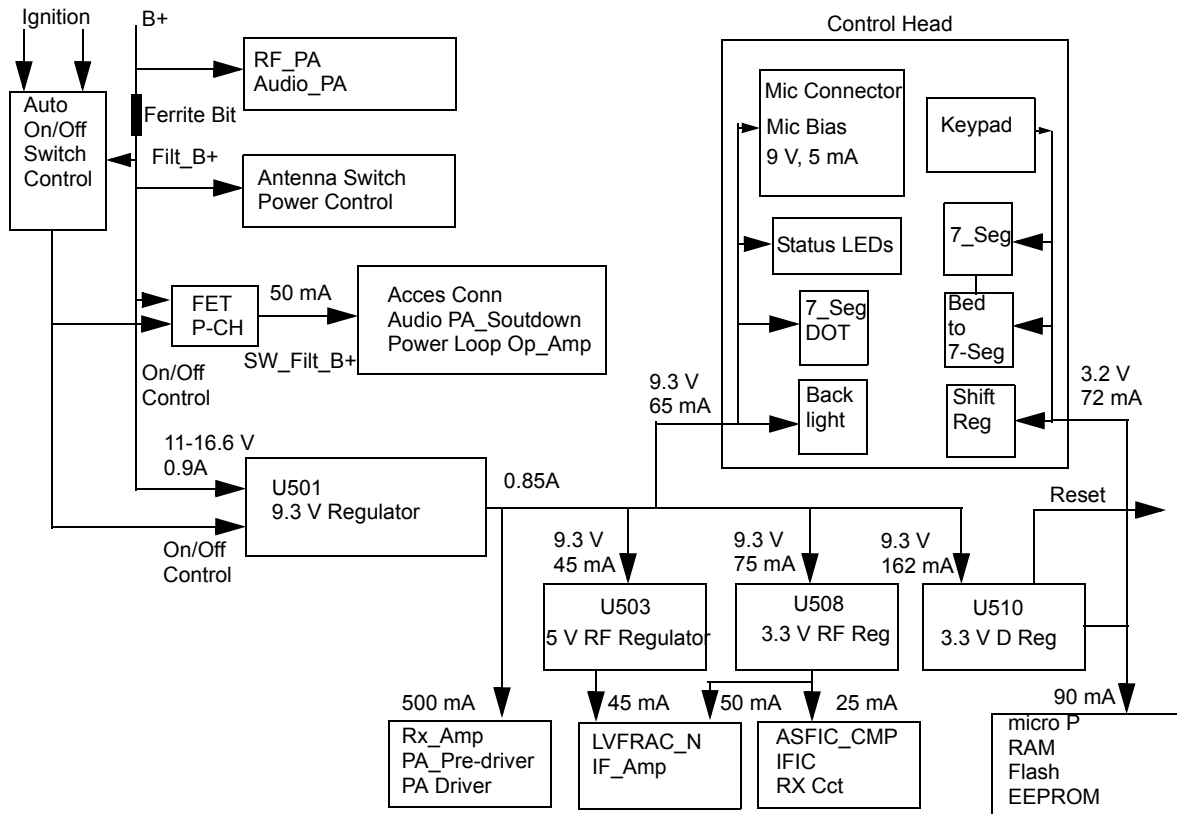


Figure 2-6 DC Power Distribution Block Diagram

Regulator U501 is used to generate the 9.3 volts required by some audio circuits, the RF circuitry and power control circuitry. Input and output capacitors are used to reduce high frequency noise. Resistors R5001 / R5081 set the output voltage of the regulator. This regulator output is electronically enabled by a 0 volt signal on pin 2. Q502, Q505 and R5038 are used to disable the regulator when the radio is turned off.

Voltage regulator U510 provides 3.3 volts for the digital circuitry. Operating voltage is from the regulated 9.3 V supply. Input and output capacitors are used to reduce high frequency noise and provide proper operation during battery transients. U510 provides a reset output that goes to 0 volts if the regulator output goes below 3.1 volts. This is used to reset the controller to prevent improper operation.

Voltage regulator U508 provides 3.3 V for the RF circuits and ASFIC_CMP. Input and output capacitors are used to reduce the high frequency noise and provide proper operation during battery transients.

Voltage regulator U503 provides 5 V for the RF circuits. Input and output capacitors are used to reduce the high frequency noise and provide proper operation during battery transients.

5.2 Protection Devices

Diode VR500 acts as protection against ESD, wrong polarity of the supply voltage, and load dump. VR692 – VR699 are for ESD protection.

5.3 Automatic On/Off

The radio can be switched ON in any one of the following three ways:

- On/Off switch. (No Ignition Mode)
- Ignition and On/Off switch (Ignition Mode)
- Emergency

5.3.1 No Ignition Mode

When the radio is connected to the car battery for the first time, Q500 will be in saturation, Q503 will cut-off, Filt_B+ will pass through R5073, D500, and S5010-pin 6 (On/Off switch). When S5010 is ON, Filt_B+ will pass through S5010-pin5, D511, R5069, R5037 and base of Q505 and move Q505 into saturation. This pulls U501-pin2 through R5038, D502 to 0.2 V and turns On U514 and U501 9.3 V regulator which supplies voltage to all other regulators and consequently turns the radio on, When U504 (ASFIC_CMP) gets 3.3 V, GCB2 goes to 3.3 V and holds Q505 in saturation, for soft turn off.

5.3.2 Ignition Mode

When ignition is connected for the first time, it will force high current through Q500 collector, This will move Q500 out of saturation and consequently Q503 will cut-off. S5010 pin 6 will get ignition voltage through R601 (for load dump), R610, (R610 & C678 are for ESD protection), VR501, R5074, and D500. When S5010 is ON, Filt_B+ passes through S5010-pin 5, D511, R5069, R5037 and base of Q505 and inserts Q505 into saturation. This pulls U501-pin 2 through R5038, D502 to 0.2 V and turns on U514 and U501 9.3 V regulator which supply voltage to all other regulators and turns the radio on, When U504 (ASFIC_CMP) get 3.3 V supply, GCB2 goes to 3.3 V and holds Q505 in saturation state to allow soft turn off.

When ignition is off Q500, Q503 will stay at the same state so S5010 pin 6 will get 0 V from Ignition, Q504 goes from Sat to Cut, ONOFF_SENSE goes to 3.3 V and it indicates to the radio to soft turn itself by changing GCB2 to '0' after de registration if necessary.

5.3.3 Emergency Mode

The emergency switch (P1 pin 9), when engaged, grounds the base of Q506 via EMERGENCY_ACCES_CONN. This switches Q506 to off and consequently resistor R5020 pulls the collector of Q506 and the base of Q506 to levels above 2 volts. Transistor Q502 switches on and pulls U501 pin2 to ground level, thus turning ON the radio. When the emergency switch is released R5030 pulls the base of Q506 up to 0.6 volts. This causes the collector of transistor Q506 to go low (0.2 V), thereby switching Q502 to off.

While the radio is switched on, the μP monitors the voltage at the emergency input on the accessory connector via U403-pin 62. Three different conditions are distinguished: no emergency kit is connected, emergency kit connected (unpressed), and emergency press.

If no emergency switch is connected or the connection to the emergency switch is broken, the resistive divider R5030 / R5049 will set the voltage to about 3.14 volts (indicates no emergency kit found via EMERGENCY_SENSE line). If an emergency switch is connected, a resistor to ground within the emergency switch will reduce the voltage on EMERGENCY_SENSE line, and indicate to the μP that the emergency switch is operational. An engaged emergency switch pulls line EMERGENCY_SENSE line to ground level. Diode VR503 limits the voltage to protect the μP input.

While EMERGENCY_ACCES_CONN is low, the μP starts execution, reads that the emergency input is active through the voltage level of μP pin 64, and sets the DC POWER ON output of the ASFIC CMP pin 13 to a logic high. This high will keep Q505 in saturation for soft turn off.

5.4 Microprocessor Clock Synthesiser

The clock source for the μP system is generated by the ASFIC CMP (U504). Upon power-up the synthesizer IC (FRAC-N) generates a 16.8 MHz waveform that is routed from the RF section to the ASFIC CMP pin 34. For the main board controller the ASFIC CMP uses 16.8 MHz as a reference input clock signal for its internal synthesizer. The ASFIC CMP, in addition to audio circuitry, has a programmable synthesizer which can generate a synthesized signal ranging from 1200 Hz to 32.769 MHz in 1200 Hz steps.

When power is first applied, the ASFIC CMP will generate its default 3.6864 MHz CMOS square wave UP CLK (on U504 pin 28) and this is routed to the μP (U403 pin 90). After the μP starts operation, it reprograms the ASFIC CMP clock synthesizer to a higher UP CLK frequency (usually 7.3728 or 14.7456 MHz) and continues operation.

The ASFIC CMP may be reprogrammed to change the clock synthesizer frequencies at various times depending on the software features that are executing. In addition, the clock frequency of the synthesizer is changed in small amounts if there is a possibility of harmonics of the clock source interfering with the desired radio receive frequency.

The ASFIC CMP synthesizer loop uses C5025, C5024 and R5033 to set the switching time and jitter of the clock output. If the ASFIC CMP synthesizer cannot generate the required clock frequency it will switch back to its default 3.6864 MHz output.

Because the ASFIC CMP synthesizer and the μP system will not operate without the 16.8 MHz reference clock it (and the voltage regulators) should be checked first when debugging the system.

5.5 Serial Peripheral Interface (SPI)

The μ P communicates to many of the IC's through its SPI port. This port consists of SPI TRANSMIT DATA (MOSI) (U403-pin100), SPI RECEIVE DATA (MISO) (U403-pin 99), SPI CLK (U0403-pin1) and chip select lines going to the various IC's, connected on the SPI PORT (BUS). This BUS is a synchronous bus, in that the timing clock signal CLK is sent while SPI data (SPI TRANSMIT DATA or SPI RECEIVE DATA) is sent. Therefore, whenever there is activity on either SPI TRANSMIT DATA or SPI RECEIVE DATA there should be a uniform signal on CLK. The SPI TRANSMIT DATA is used to send serial from a μ P to a device, and SPI RECEIVE DATA is used to send data from a device to a μ P.

In the controller section there are two IC's on the SPI BUS, ASFIC CMP (U504 pin 22), and EEPROM (U400). In the RF sections there is one IC on the SPI BUS, the FRAC-N Synthesizer. The chip select line CSX from U403 pin 2 is shared by the ASFIC CMP and FRAC-N Synthesizer. Each of these IC's check the SPI data and when the sent address information matches the IC's address, the following data is processed.

When the μ P needs to program any of these, it brings the chip select line CSX to a logic "0" and then sends the proper data and clock signals. The amount of data sent to the various IC's are different; e.g., the ASFIC CMP can receive up to 19 bytes (152 bits). After the data has been sent the chip select line is returned to logic "1".

5.6 SBEP Serial Interface

The SBEP serial interface allows the radio to communicate with the Customer Programming Software (CPS), or the Global Tuner via the Radio Interface Box (RIB) or the cable with internal RIB. This interface connects to the SCI pin via control head connector (J2-pin 17) and to the accessory connector P1-6 and comprises BUS+. The line is bi-directional, meaning that either the radio or the RIB can drive the line. The μ P sends serial data and it reads serial data via pin 97. Whenever the μ P detects activity on the BUS+ line, it starts communication.

5.7 General Purpose Input/Output

The controller provides six general purpose lines (PROG I/O) available on the accessory connector P1 to interface to external options. Lines PROG IN 3 and 6 are inputs, PROG OUT 4 is an output and PROG IN OUT 8, 12 and 14 are bi-directional. The software and the hardware configuration of the radio model define the function of each port.

- PROG IN 3 can be used as external PTT input, or others, set by the CPS. The μ P reads this port via pin 72 and Q412.
- PROG OUT 4 can be used as external alarm output, set by the CPS. Transistor Q401 is controlled by the μ P (U403 pin 55)
- PROG IN 6 can be used as normal input, set by the CPS. The μ P reads this port via pin 73 and Q411. This pin is also used to communicate with the RIB if resistor R421 is placed.
- DIG IN OUT 8,12,14 are bi-directional and use the same circuit configuration. Each port uses an output Q416, Q404, Q405 controlled by μ P pins 52, 53, 54. The input ports are read through μ P pins 74, 76, 77; using Q409, Q410, Q411

5.8 Normal Microprocessor Operation

For this radio, the μP is configured to operate in one of two modes, expanded and bootstrap. In expanded mode the μP uses external memory devices to operate, whereas in bootstrap operation the μP uses only its internal memory. In normal operation of the radio the μP is operating in expanded mode as described below.

During normal operation, the μP (U403) is operating in expanded mode and has access to 3 external memory devices; U400 (EEPROM), U402 (SRAM), U404 (Flash). Also, within the μP there are 3 Kilobytes of internal RAM, as well as logic to select external memory devices.

The external EEPROM (U400) space contains the information in the radio which is customer specific, referred to as the codeplug. This information consists of items such as: 1) what band the radio operates in, 2) what frequencies are assigned to what channel, and 3) tuning information.

The external SRAM (U402) as well as the μP 's own internal RAM space are used for temporary calculations required by the software during execution. All of the data stored in both of these locations is lost when the radio powers off.

The μP provides an address bus of 16 address lines (ADDR 0 – ADDR 15), and a data bus of 8 data lines (DATA 0 – DATA 7). There are also 3 control lines; CSProg (U403-38) to chip select U404-pin 30 (FLASH), CSGP2 (U403-pin 41) to chip select U404-pin 20 (SRAM) and PG7_R_W (U403-pin 4) to select whether to read or to write.

When the μP is functioning normally, the address and data lines should be toggling at CMOS logic levels. Specifically, the logic high levels should be between 3.1 and 3.3 V, and the logic low levels should be between 0 and 0.2 V. No other intermediate levels should be observed, and the rise and fall times should be <30ns.

The low-order address lines (ADDR 0 – ADDR 7) and the data lines (DATA 0–DATA 7) should be toggling at a high rate, e.g., you should set your oscilloscope sweep to 1us/div. or faster to observe individual pulses. High speed CMOS transitions should also be observed on the μP control lines.

On the μP the lines XIRQ (U403-pin 48), MODA LIR (U403-pin 58), MODB VSTPY (U403-pin 57) and RESET (U403-pin 94) should be high at all times during normal operation. Whenever a data or address line becomes open or shorted to an adjacent line, a common symptom is that the RESET line goes low periodically, with the period being in the order of 20ms. In the case of shorted lines you may also detect the line periodically at an intermediate level, i.e. around 2.5 V when two shorted lines attempt to drive to opposite rails.

The MODA LIR (U403-pin 58) and MODB VSTPY (U403-pin 57) inputs to the μP must be at a logic "1" for it to start executing correctly. After the μP starts execution it will periodically pulse these lines to determine the desired operating mode. While the Central Processing Unit (CPU) is running, MODA LIR is an open-drain CMOS output which goes low whenever the μP begins a new instruction. An instruction typically requires 2–4 external bus cycles, or memory fetches.

There are eight analog-to-digital converter ports (A/D) on U403 labelled within the device block as PEO–PE7. These lines sense the voltage level ranging from 0 to 3.3 V of the input line and convert that level to a number ranging from 0 to 255 which is read by the software to take appropriate action.

5.9 Static Random Access Memory (SRAM)

The SRAM (U402) contains temporary radio calculations or parameters that can change very frequently, and which are generated and stored by the software during its normal operation. The information is lost when the radio is turned off.

The device allows an unlimited number of write cycles. SRAM accesses are indicated by the CS signal U402 (which comes from U403-CSGP2) going low. U402 is commonly referred to as the external RAM as opposed to the internal RAM which is the 3 Kilobytes of RAM which is part of the 68HC11FL0. Both RAM spaces serve the purpose. However, the internal RAM is used for the calculated values which are accessed most often.

Capacitor C402 and C411 serves to filter out any AC noise which may ride on +3.3 V at U402

6.0 Control Board Audio and Signalling Circuits

6.1 Audio Signalling Filter IC and Compander (ASFIC CMP)

The ASFIC CMP (U504) used in the controller has the following four functions:

1. RX/TX audio shaping, i.e. filtering, amplification, attenuation
2. RX/TX signaling, PL/DPL/HST/MDC
3. Squelch detection
4. μ P clock signal generation

The ASFIC CMP is programmable through the SPI BUS (U504 pins-20/21/22), normally receiving 19 bytes. This programming sets up various paths within the ASFIC CMP to route audio and/or signaling signals through the appropriate filtering, gain and attenuator blocks. The ASFIC CMP also has 6 General Control Bits GCB0–5 which are CMOS level outputs and used for the following:

- GCB0 – BW Select
- GCB1 – switches the audio PA On/Off
- GCB2 – DC Power On switches the voltage regulator (and the radio) on and off
- GCB3 – Control on MUX U509 pin 9 to select between Low Cost Mic path to STD Mic Path
- GCB4 – Control on MUX U509 pin 11 to select between Flat RX path to filtered RX path on the accessory connector.
- GCB5 – Control on MUX U509 pin 10 to select between Flat TX path mute and Flat TX path

7.0 Transmit Audio Circuits

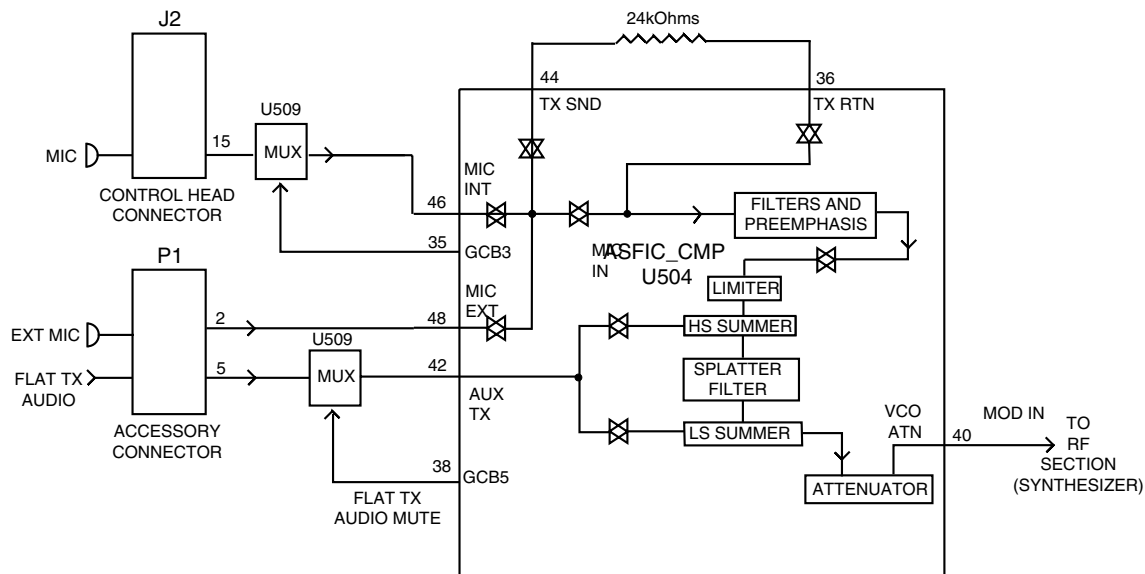


Figure 2-7 Transmit Audio Paths

7.1 Microphone Input Path

The radio supports 2 distinct microphone paths known as internal (from control head J2–15) and external mic (from accessory connector P1–2) and an auxiliary path (FLAT TX AUDIO, from accessory connector P1–5). The microphones used for the radio require a DC biasing voltage provided by a resistive network.

The two microphone audio input paths enter the ASFIC CMP at U504-pin 48 (external mic) and U504-pin 46 (internal mic). The microphone is plugged into the radio control head and connected to the audio DC via J2-pin 15. The signal is then routed via C5045 to MUX U509 that select between two paths with different gain to support Low Cost Mic (Mic with out amplifier in it) and Standard Mic.

7.1.1 Low Cost Microphone

Hook Pin is shorted to Pin 1(9.3 V) inside the Low Cost Mic, This routes 9.3 V to R429, and creates 2.6 V on MIC_SENSE (u.P U403-67) by Voltage Divider R429/R430. U403 senses this voltage and sends command to ASFIC_CMP U504 to get GCB3 = '0'. The audio signal is routed from C5045 via U509-5 (Z0), R5072, U507, R5026, C5091, R5014 via C5046 to U504- 46 int. mic (C5046 100nF creates a159 Hz pole with U504- 46 int mic impedance of 16Kohm).

7.1.2 Standard Microphone

Hook Pin is shorted to the hook mic inside the standard Mic, If the mic is out off hook, 3.3 V is routed to R429 via R458, D401, and it create 0.7 V on MIC_SENSE (u.P U403-67) by Voltage Divider R429/R430. U403 senses this voltage and sends command to ASFIC_CMP U504 to get GCB3 = '1'. The audio signal is routed from C5045 via U509-3 (Z1), R5072, U507, R5026, C5091, R5014 via C5046 to U504- 46 int mic (C5046 100nF create a 159 Hz pole with U504- 46 int mic impedance of 16Kohm). 9.3 Vdc is routed via R5077, R5075 to J2-15, It create 4.65 V with Mic Impedance. C5010 supplies AC Ground to create AC impedance of 510 Ohms via R5075. and Filter 9.3 Vdc mic bias supply.

Note: The audio signal at U504-pin 46 should be approximately 12 mV for 1.5 kHz or 3 kHz of deviation with 12.5 kHz or 25 kHz channel spacing.

The external microphone signal enters the radio on accessory connector P1 pin 2 and is routed via line EXT MIC to R5054. R5078 and R5076 provide the 9.3 Vdc bias. Resistive divider R5054/ R5070 divide the input signal by 5.5 and provide input protection for the CMOS amplifier input. R5076 and C5009 provide a 510 ohm AC path to ground that sets the input impedance for the microphone and determines the gain based on the emitter resistor in the microphone's amplifier circuit.

C5047 serves as a DC blocking capacitor. The audio signal at U504-pin 48 should be approximately 14 mV for 1.5 kHz or 3 kHz of deviation with 12.5 kHz or 25 kHz channel spacing.

The FLAT TX AUDIO signal from accessory connector P1-pin 5 is fed to the ASFIC CMP (U504 pin 42 through U509 pin 2 to U509 pin 15 via U506 OP-AMP circuit and C5057.

The ASFIC has an internal AGC that can control the gain in the mic audio path. The AGC can be disabled / enabled by the μ P. Another feature that can be enabled or disabled in the ASFIC is the VOX. This circuit, along with Capacitor C5023 at U504-pin 7, provides a DC voltage that can allow the μ P to detect microphone audio. The ASFIC can also be programmed to route the microphone audio to the speaker for public address operation.

7.2 PTT Sensing and TX Audio Processing

Internal microphone PTT is sensed by μ P U403 pin 71. Radio transmits when this pin is "0" and selects inside the ASFIC_CMP U504 internal Mic path. When the internal Mic PTT is "0" then external Mic PTT is grounded via D402. External Mic PTT is sensed by U403 pin 72 via Q412 circuits. The radio transmits when this pin is "0" and selects inside the ASFIC_CMP U504 External Mic path.

Inside the ASFIC CMP, the mic audio is filtered to eliminate frequency components outside the 300–3000 Hz voice band, and pre-emphasized if pre-emphasis is enabled. The signal is then limited to prevent the transmitter from over deviating. The limited mic audio is then routed through a summer, which is used to add in signaling data, and then to a splatter filter to eliminate high frequency spectral components that could be generated by the limiter. The audio is then routed to an attenuator, which is tuned in the factory or the field to set the proper amount of FM deviation. The TX audio emerges from the ASFIC CMP at U504-pin 40 MOD IN, at which point it is routed to the RF section.

8.0 Transmit Signalling Circuits

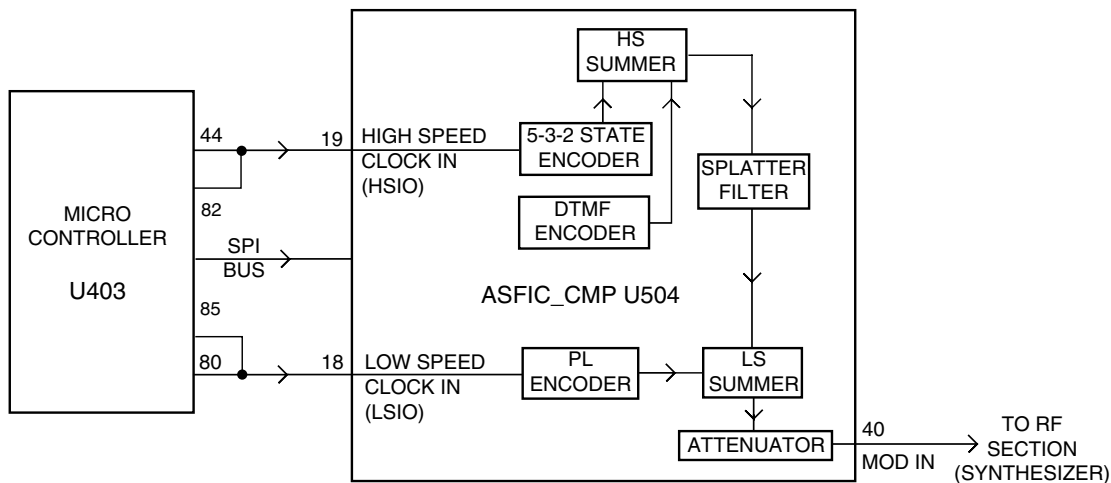


Figure 2-8 Transmit Signalling Path

From a hardware point of view, there are 3 types of signaling:

- Sub-audible data (PL / DPL / Connect Tone) that gets summed with transmit voice or signaling,
- DTMF data for telephone communication in trunked and conventional systems, and
- Audible signaling including MDC and high-speed trunking.

Note: All three types are supported by the hardware while the radio software determines which signaling type is available.

8.1 Sub-Audio Data (PL/DPL)

Sub-audible data implies signaling whose bandwidth is below 300 Hz. PL and DPL waveforms are used for conventional operation and connect tones for trunked voice channel operation. The trunking connect tone is simply a PL tone at a higher deviation level than PL in a conventional system. Although it is referred to as “sub-audible data”, the actual frequency spectrum of these waveforms may be as high as 250 Hz, which is audible to the human ear. However, the radio receiver filters out any audio below 300 Hz, so these tones are never heard in the actual system.

Only one type of sub-audible data can be generated by U504 (ASFIC CMP) at any one time. The process is as follows, using the SPI BUS, the μ P programs the ASFIC CMP to set up the proper low-speed data deviation and select the PL or DPL filters. The μ P then generates a square wave which strobes the ASFIC PL / DPL encode input LSIO U504-pin 18 at twelve times the desired data rate. For example, for a PL frequency of 103 Hz, the frequency of the square wave would be 1236 Hz.

This drives a tone generator inside U504 which generates a staircase approximation to a PL sine wave or DPL data pattern. This internal waveform is then low-pass filtered and summed with voice or data. The resulting summed waveform then appears on U504-pin 40 (MOD IN), where it is sent to the RF board as previously described for transmit audio. A trunking connect tone would be generated in the same manner as a PL tone.

8.2 High Speed Data

High speed data refers to the 3600 baud data waveforms, known as Inbound Signaling Words (ISWs) used in a trunking system for high speed communication between the central controller and the radio. To generate an ISW, the μ P first programs the ASFIC CMP (U504) to the proper filter and gain settings. It then begins strobing U504-pin 19 (HSIO) with a pulse when the data is supposed to change states. U504's 5-3-2 State Encoder (which is in a 2-state mode) is then fed to the post-limiter summer block and then the splatter filter. From that point it is routed through the modulation attenuator and then out of the ASFIC CMP to the RF board. MDC is generated in much the same way as trunking ISW. However, in some cases these signals may also pass through a data pre-emphasis block in the ASFIC CMP. Also these signaling schemes are based on sending a combination of 1200 Hz and 1800 Hz tones only. Microphone audio is muted during high speed data signaling.

8.3 Dual Tone Multiple Frequency (DTMF) Data

DTMF data is a dual tone waveform used during phone interconnect operation. It is the same type of tones which are heard when using a "Touch Tone" telephone.

There are seven frequencies, with four in the low group (697, 770, 852, 941 Hz) and three in the high group (1209, 1336, 1477 Hz). The high-group tone is generated by the μ P (U403-46) strobing U504-19 at six times the tone frequency for tones less than 1440 Hz or twice the frequency for tones greater than 1440 Hz. The low group tone is generated by the ASFIC CMP, controlled by the μ P via SPI bus. Inside U504 the low-group and high-group tones are summed (with the amplitude of the high group tone being approximately 2 dB greater than that of the low group tone) and then pre-emphasized before being routed to the summer and splatter filter. The DTMF waveform then follows the same path as was described for high-speed data.

9.0 Receive Audio Circuits

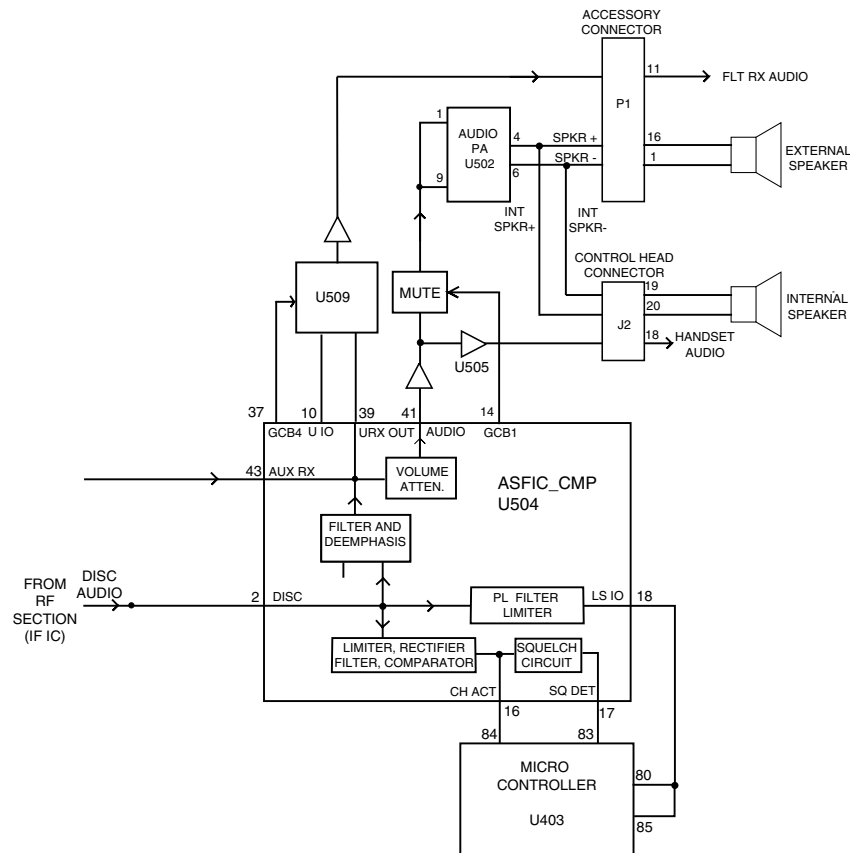


Figure 2-9 Receive Audio Paths

9.1 Squelch Detect

The radio's RF circuits are constantly producing an output at the discriminator (IF IC). This signal (DISC AUDIO) is routed to the ASFIC CMP's squelch detect circuitry input DISC (U504-pin 2). All of the squelch detect circuitry is contained within the ASFIC CMP. Therefore from a user's point of view, DISC AUDIO enters the ASFIC CMP, and the ASFIC CMP produces two CMOS logic outputs based on the result. They are CH ACT (U504-16) and SQ DET (U504-17).

The squelch signal entering the ASFIC CMP is amplified, filtered, attenuated, and rectified. It is then sent to a comparator to produce an active high signal on CH ACT. A squelch tail circuit is used to produce SQ DET (U504-17) from CH ACT. The state of CH ACT and SQ DET is high (logic "1") when carrier is detected, otherwise low (logic "0").

CH ACT is routed to the μ P pin 84 while SQ DET is routed to the μ P pin 83.

SQ DET is used to determine all audio mute / unmute decisions except for Conventional Scan. In this case CH ACT is a pre-indicator as it occurs slightly faster than SQ DET.

9.2 Audio Processing and Digital Volume Control

The receiver audio signal (DISC AUDIO) enters the controller section from the IF IC where it is DC coupled to ASFIC CMP via the DISC input U504-pin 2. The signal is then applied to both the audio and the PL/DPL paths.

The audio path has a programmable amplifier, whose setting is based on the channel bandwidth being received, an LPF filter to remove any frequency components above 3000 Hz, and a HPF to strip off any sub-audible data below 300 Hz. Next, the recovered audio passes through a de-emphasis filter (if it is enabled to compensate for Pre-emphasis which is used to reduce the effects of FM noise). The IC then passes the audio through the 8-bit programmable attenuator whose level is set depending on the value of the volume control. Finally the filtered audio signal passes through an output buffer within the ASFIC CMP. The audio signal exits the ASFIC CMP at AUDIO output (U504 pin 41).

The μ P programs the attenuator, using the SPI BUS, based on the volume setting. The minimum / maximum settings of the attenuator are set by codeplug parameters.

Since sub-audible signaling is summed with voice information on transmit, it must be separated from the voice information before processing. Any sub-audible signaling enters the ASFIC CMP from the IF IC at DISC U504-2. Once inside, it goes through the PL/DPL path. The signal first passes through one of the two low-pass filters, either the PL low-pass filter or the DPL/LST low-pass filter. Either signal is then filtered and goes through a limiter and exits the ASFIC CMP at LSIO (U504-pin 18). At this point, the signal will appear as a square wave version of the sub-audible signal which the radio received. The μ P U403 pin 80 will decode the signal directly to determine if it is the tone / code which is currently active on that mode.

9.3 Audio Amplification Speaker (+) Speaker (-)

The output of the ASFIC CMP's digital volume pot, U504-pin 41 is routed through DC blocking capacitor C5049 to the audio PA (U502 pin 1 and 9).

The audio power amplifier has one inverted and one non-inverted output that produces the differential audio output SPK+/SPK- (U502 pins 4 and 6)

The audio PA is enabled via the ASFIC CMP (U504-GCB1). When the base of Q501 is low, the transistor is off and U502-pin 8 is high, using pull up resistor R5041, and the audio PA is ON. The voltage at U502-pin 8 must be above 8.5 Vdc to properly enable the device.

If the voltage is between 3.3 and 6.4 V, the device will be active but has its input (U502-pins 1/9) off. This is a mute condition which is used to prevent an audio pop when the PA is enabled.

The SPK+ and SPK- outputs of the audio PA have a DC bias which varies proportionately with B+ (U502- pin 7). B+ of 11 V yields a DC offset of 5 V, and B+ of 17 V yields a DC offset of 8.5 V. If either of these lines is shorted to ground, it is possible that the audio PA will be damaged. SPK+ and SPK- are routed to the accessory connector (P1-pin 1 and 16) and to the control head (connector J2-pins 19 and 20).

9.4 Handset Audio

Certain handheld accessories have a speaker within them which require a different voltage level than that provided by U502. For these devices HANDSET AUDIO is available at control head connector J2 pin18.

The received audio from the output of the ASFIC CMP's digital volume attenuator is routed to U505 pin 2 where it is amplified. This signal is routed from the output of the op-amp U505 to J2-pin 18. From the control head, the signal is sent directly to the microphone jack.

9.5 Filtered Audio and Flat Audio

The ASFIC CMP output audio at U504-pin 39 is filtered and de-emphasized, but has not gone through the digital volume attenuator. From ASFIC CMP U504-pin 39 the signal is routed via R5034 through gate U509-pin 12 and AC coupled to U505-pin 6. The gate controlled by ASFIC CMP port GCB4 selects between the filtered audio signal from the ASFIC CMP pin 39 (URXOUT) or the unfiltered (flat) audio signal from the ASFIC CMP pin 10 (UIO). Resistors R5034 and R5021 determine the gain of op-amp U505-pin 6 for the filtered audio while R5032 and R5021 determine the gain for the flat Audio. The output of U505-pin 7 is then routed to P1 pin 11 via DC blocking capacitor C5003. Note that any volume adjustment of the signal on this path must be done by the accessory.

10.0 Receive Signalling Circuits

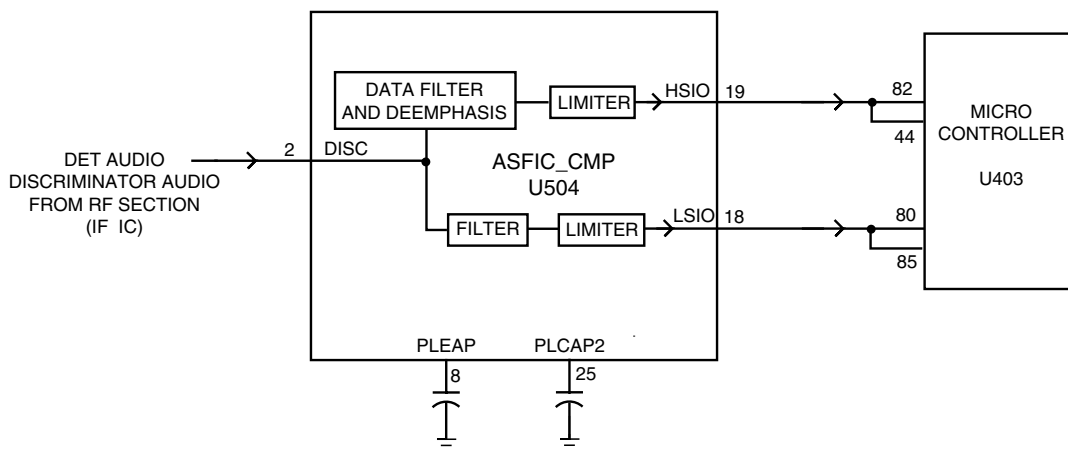


Figure 2-10 Receive Signalling Paths

10.1 Sub-Audio Data (PL/DPL) and High Speed Data Decoder

The ASFIC CMP (U504) is used to filter and limit all received data. The data enters the ASFIC CMP at input DISC (U504 pin 2). Inside U504 the data is filtered according to data type (HS or LS), then it is limited to a 0–3.3 V digital level. The MDC and trunking high speed data appear at U504-pin 19, where it connects to the μ P U403 pin 82.

The low speed limited data output (PL, DPL, and trunking LS) appears at U504-pin18, where it connects to the μ P U403-pin 80.

The low speed data is read by the μ P at twice the frequency of the sampling waveform; a latch configuration in the ASFIC CMP stores one bit every clock cycle. The external capacitors C5028, and C5026 set the low frequency pole for a zero crossings detector in the limiters for PL and HS data. The hysteresis of these limiters is programmed based on the type of received data.

10.2 Alert Tone Circuits

When the software determines that it needs to give the operator an audible feedback (for a good key press, or for a bad key press), or radio status (trunked system busy, phone call, circuit failures), it sends an alert tone to the speaker. It does so by sending SPI BUS data to U504 which sets up the audio path to the speaker for alert tones. The alert tone itself can be generated in one of two ways: internally by the ASFIC CMP, or externally using the μ P and the ASFIC CMP.

The allowable internal alert tones are 304, 608, 911, and 1823 Hz. In this case a code contained within the SPI BUS load to the ASFIC CMP sets up the path and determines the tone frequency, and at what volume level to generate the tone. (It does not have to be related to the voice volume setting.)

For external alert tones, the μ P can generate any tone within the 100–3000 Hz audio band. This is accomplished by the μ P generating a square wave which enters the ASFIC CMP at U504 pin 19. Inside the ASFIC CMP this signal is routed to the alert tone generator.

The output of the generator is summed into the audio chain just after the RX audio de-emphasis block. Inside U504, the tone is amplified and filtered, then passed through the 8-bit digital volume attenuator, which is typically loaded with a special value for alert tone audio. The tone exits at U504-pin 41 and is routed to the audio PA like receive audio.

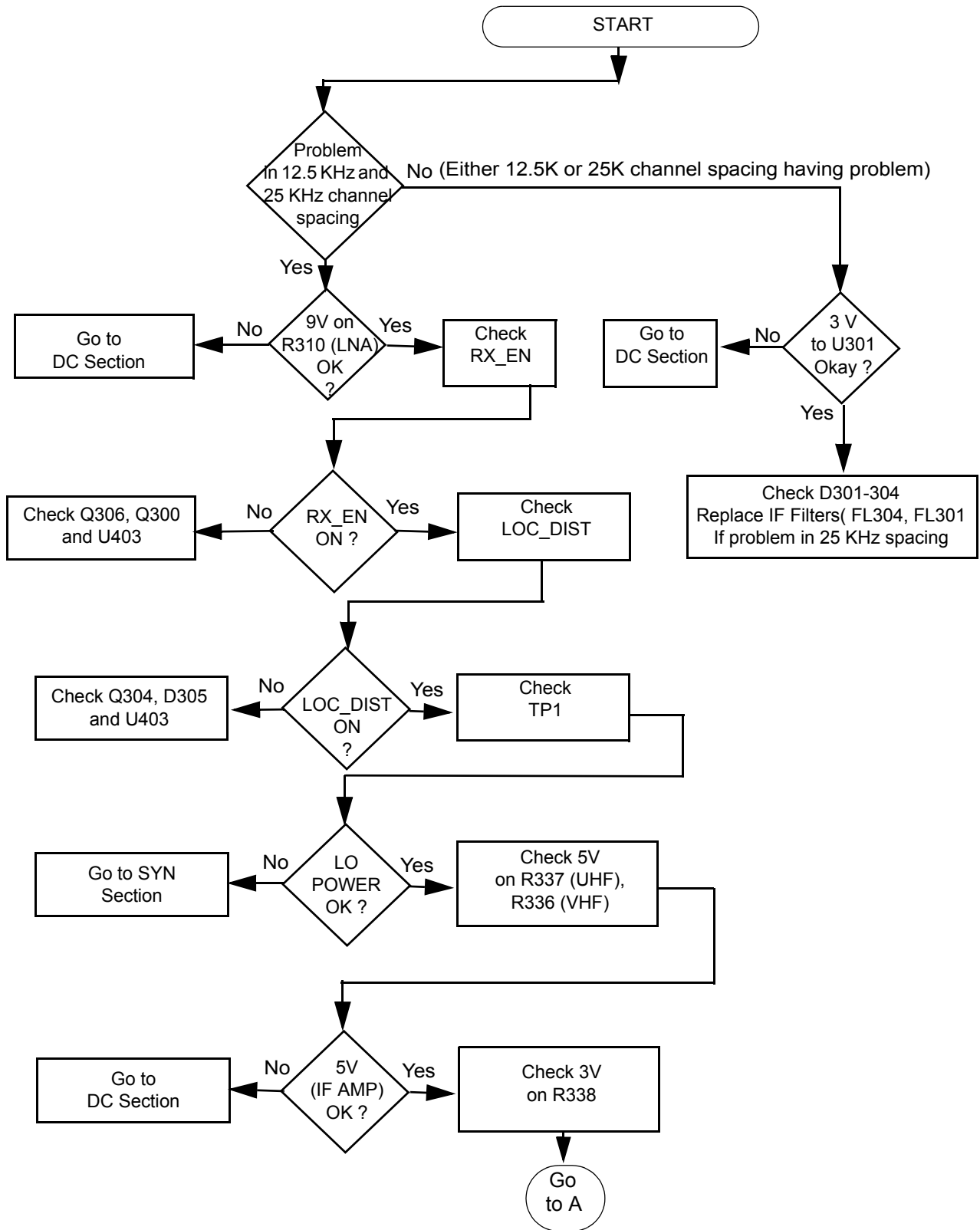
Chapter 3

TROUBLESHOOTING CHARTS

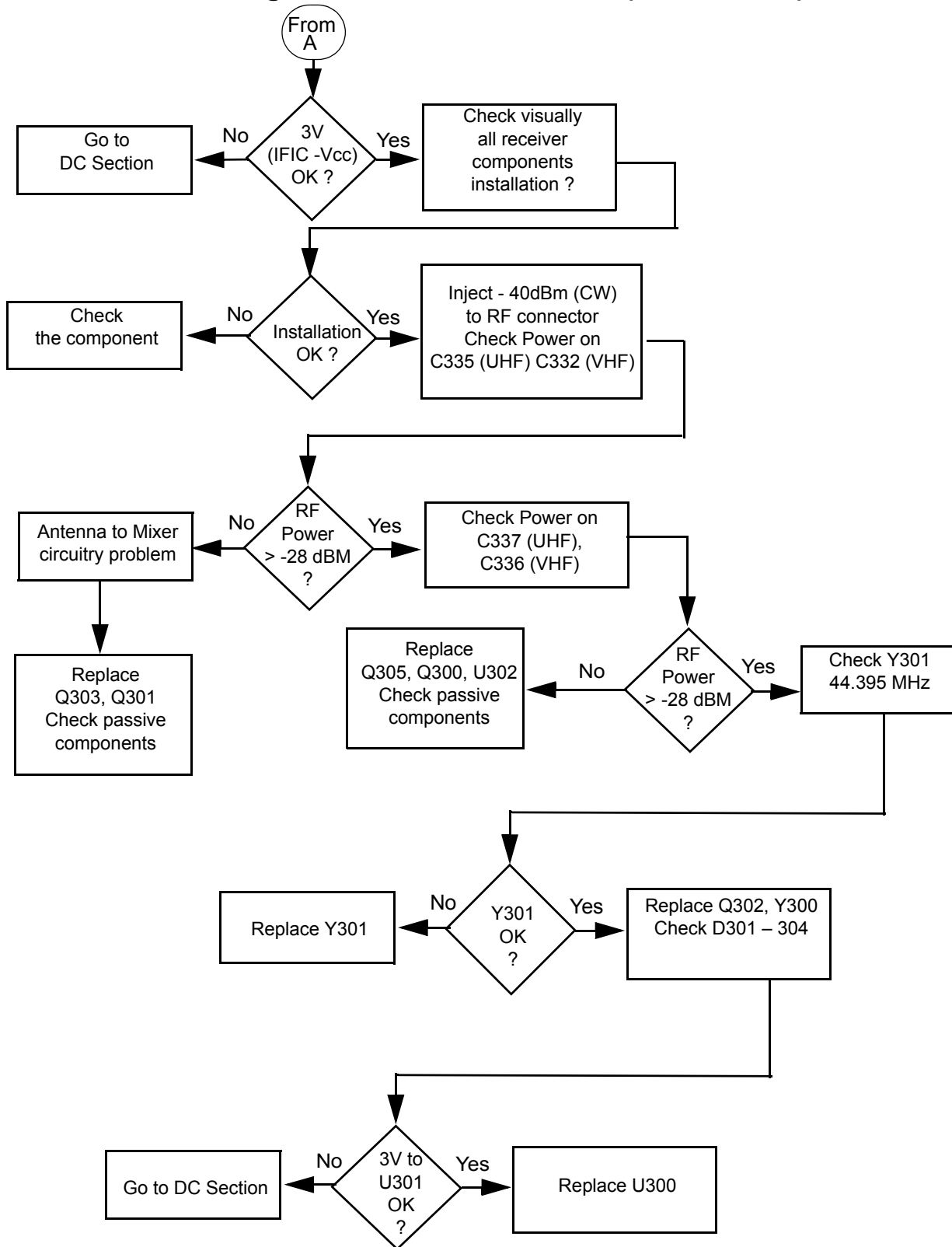
This section contains detailed troubleshooting flowcharts. These charts should be used as a guide in determining the problem areas. They are not a substitute for knowledge of circuit operation and astute troubleshooting techniques. It is advisable to refer to the related detailed circuit descriptions in the theory of operation sections prior to troubleshooting a radio.

Most troubleshooting charts end up by pointing to an IC to replace. It is not always noted, but it is good practice to verify supplies and grounds to the affected IC and to trace continuity to the malfunctioning signal and related circuitry before replacing any IC. For instance, if a clock signal is not available at a destination, continuity from the source IC should be checked before replacing the source IC.

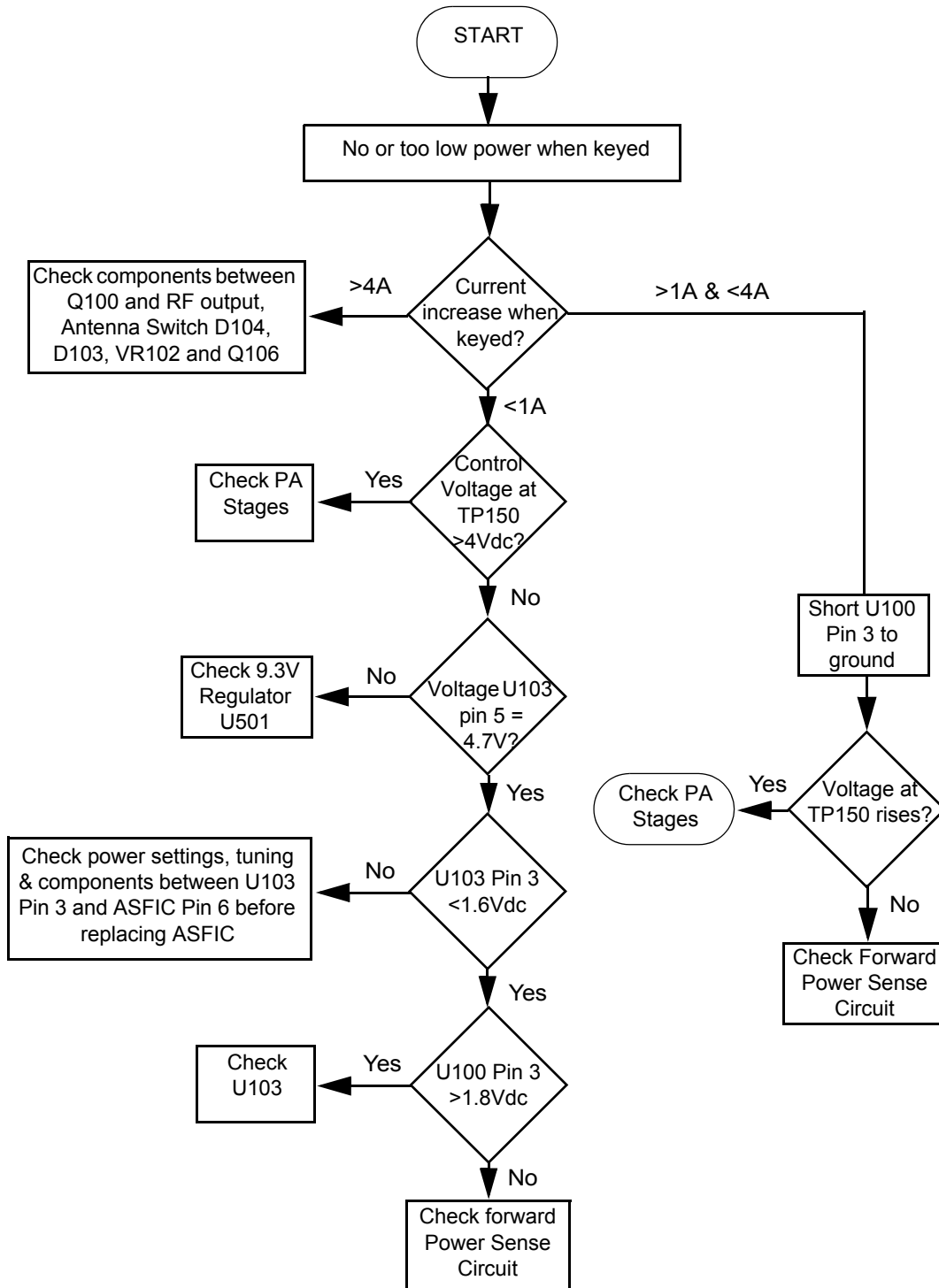
1.0 Troubleshooting Flow Chart for Receiver RF (Sheet 1 of 2)



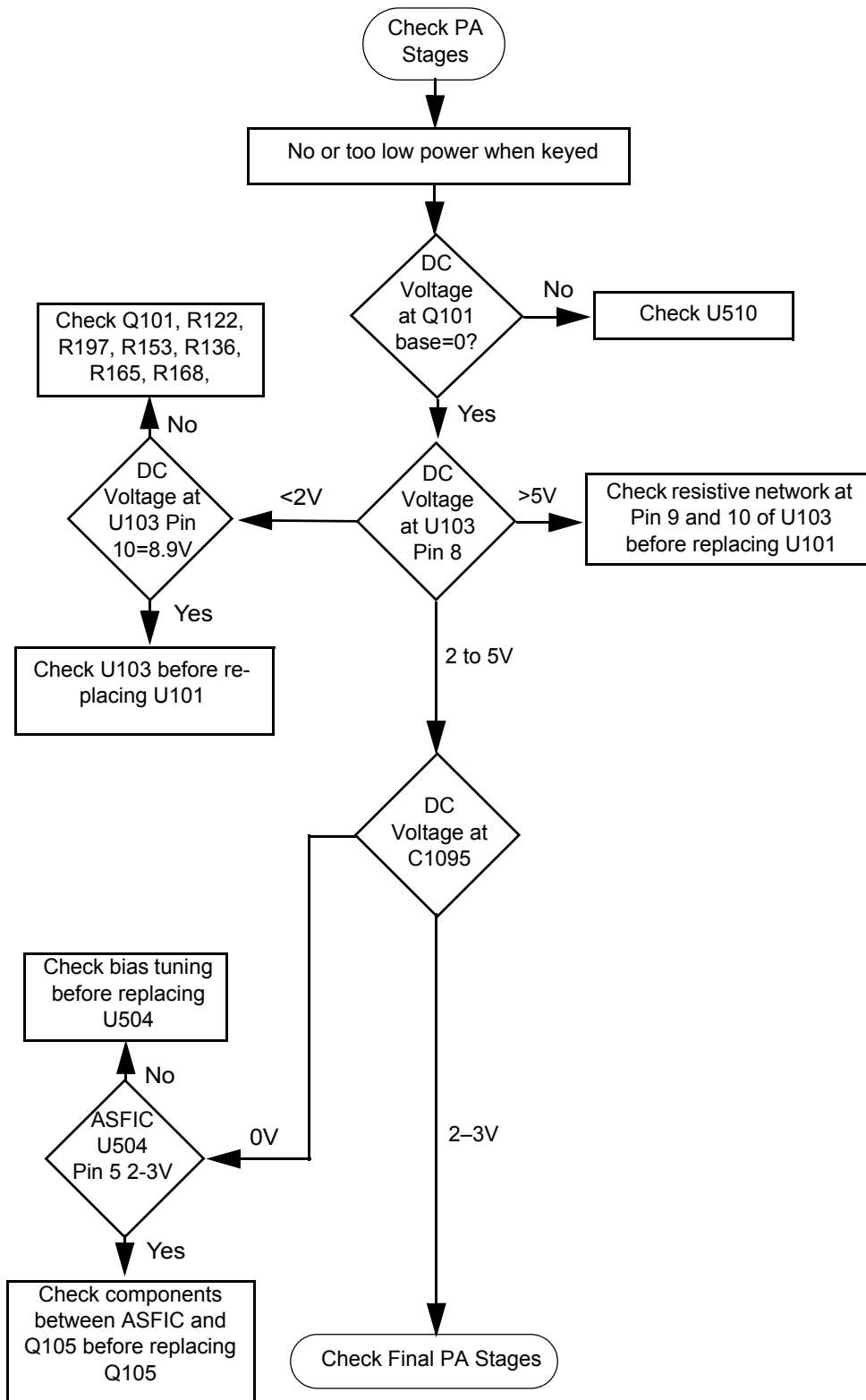
1.1 Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



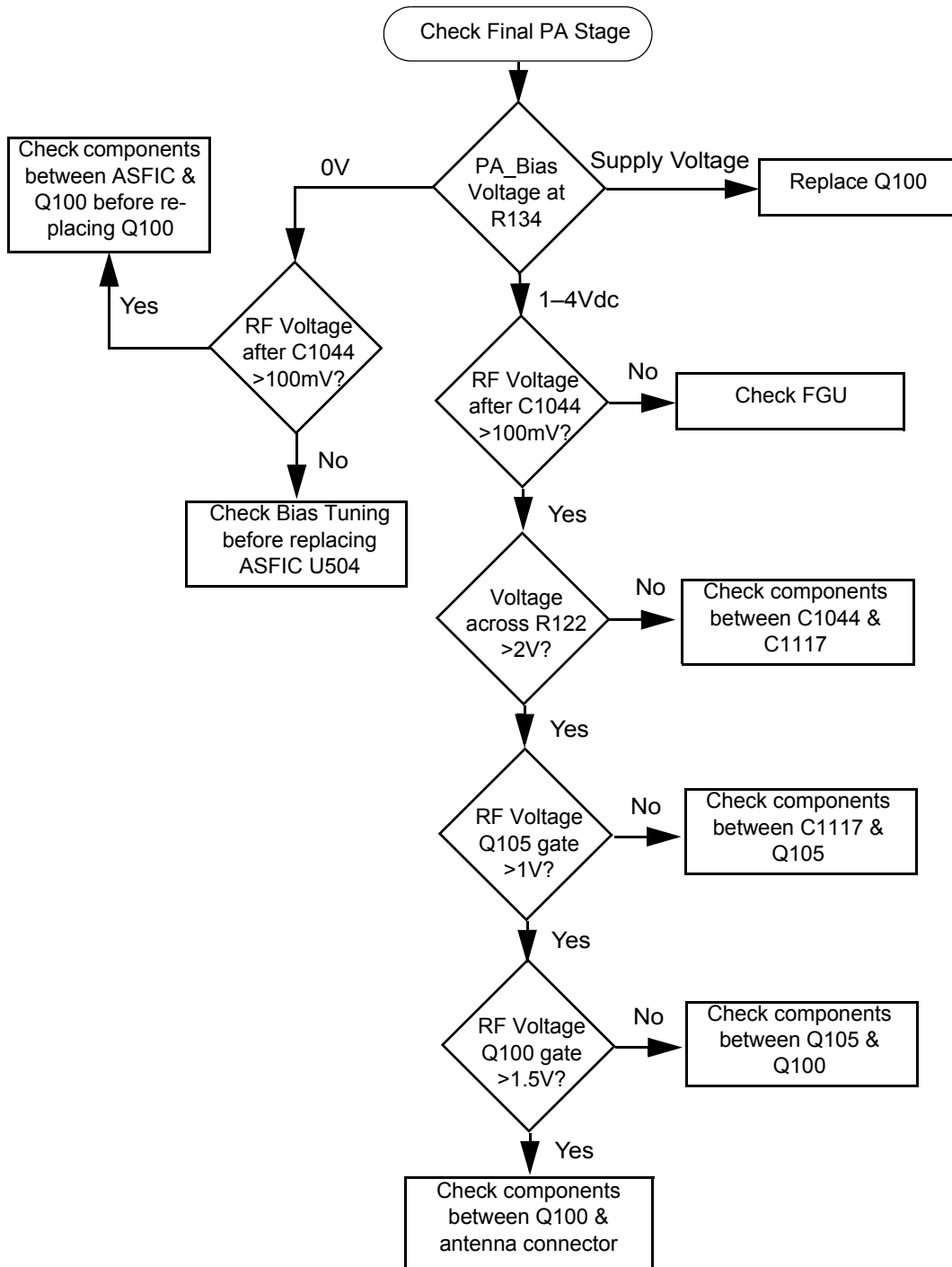
2.0 Troubleshooting Flow Chart for 45 W Transmitter (Sheet 1 of 3)



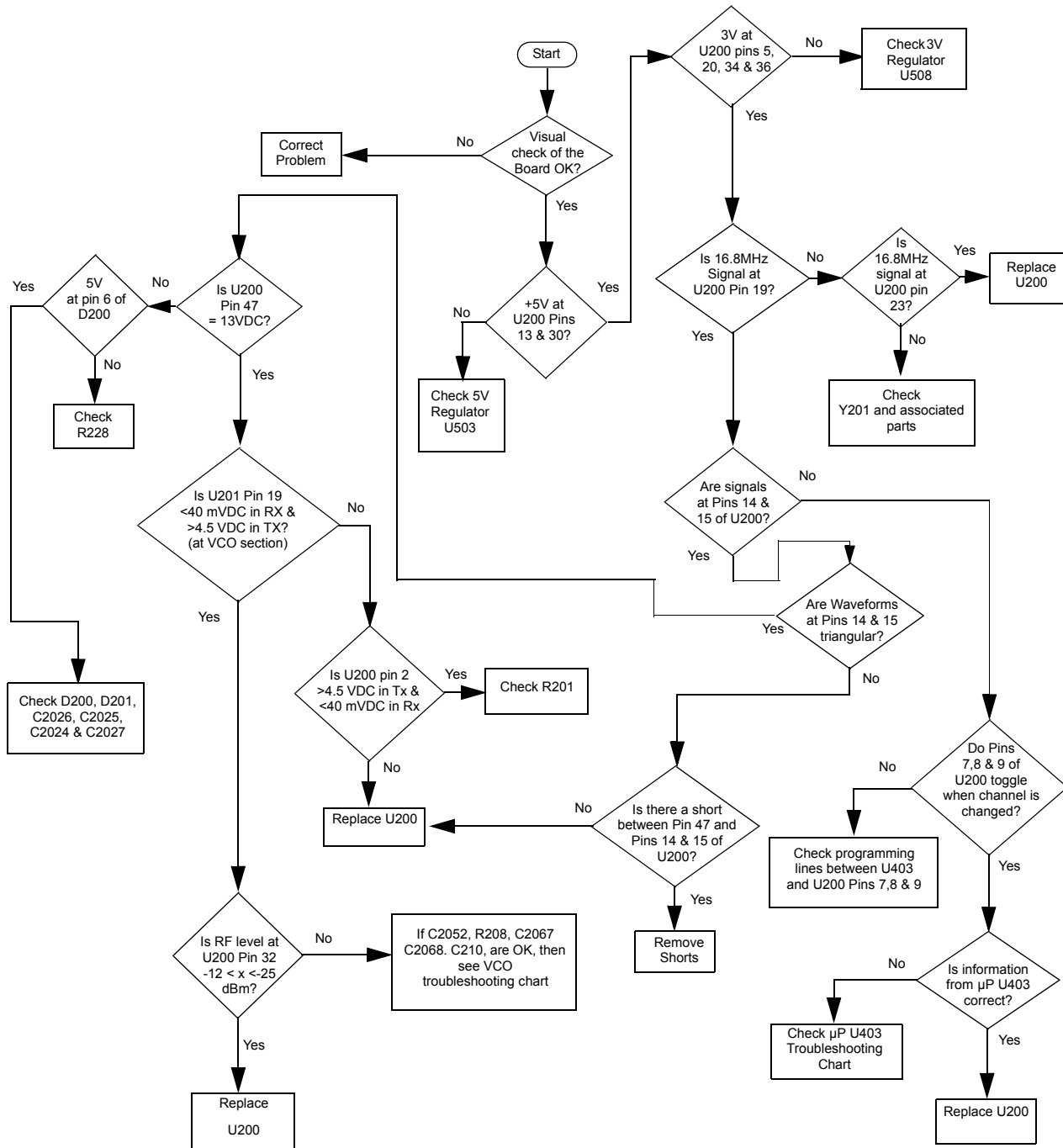
2.1 Troubleshooting Flow Chart for 45 W Transmitter (Sheet 2 of 3)



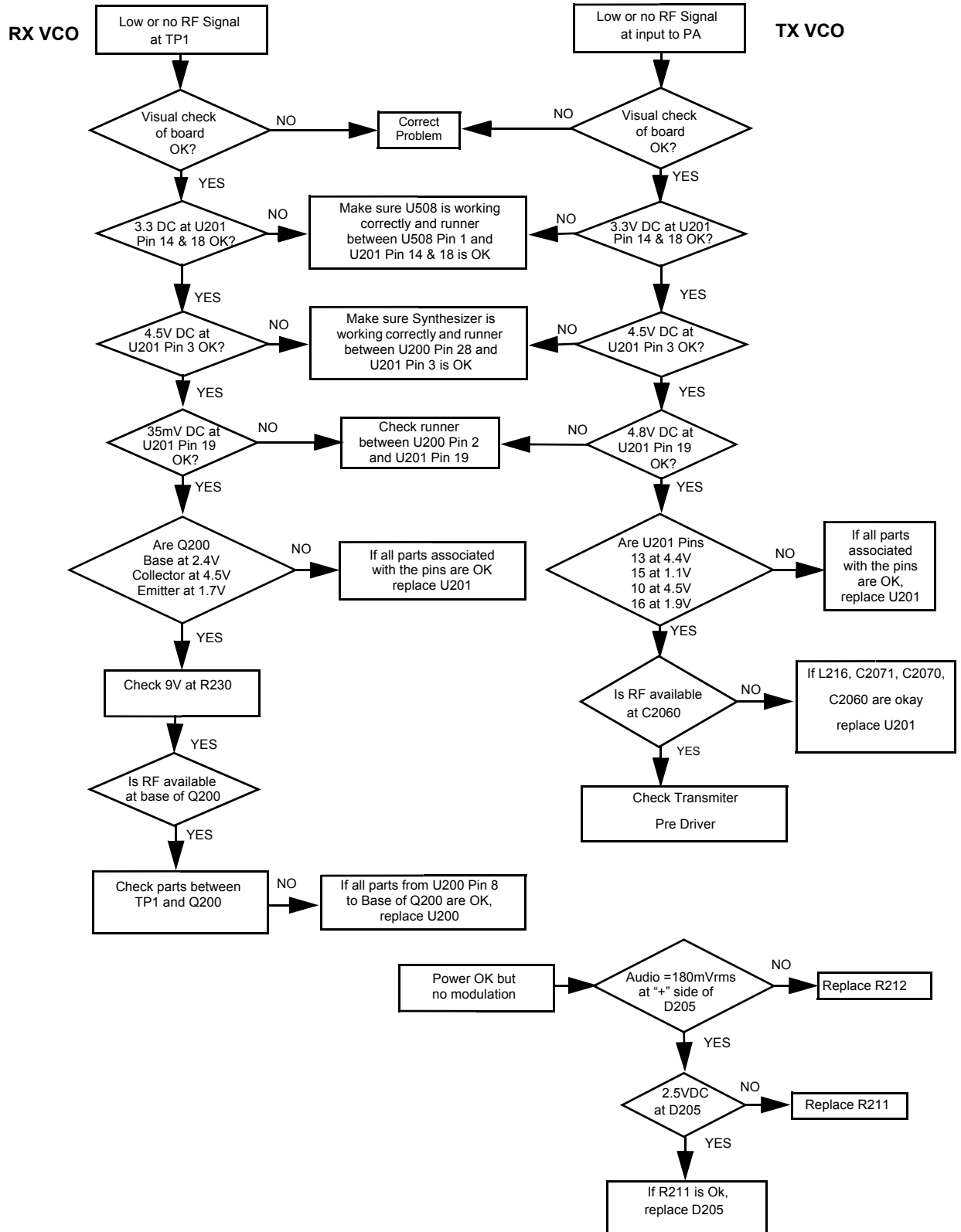
2.2 Troubleshooting Flow Chart for 45 W Transmitter (Sheet 3 of 3)



3.0 Troubleshooting Flow Chart for Synthesizer

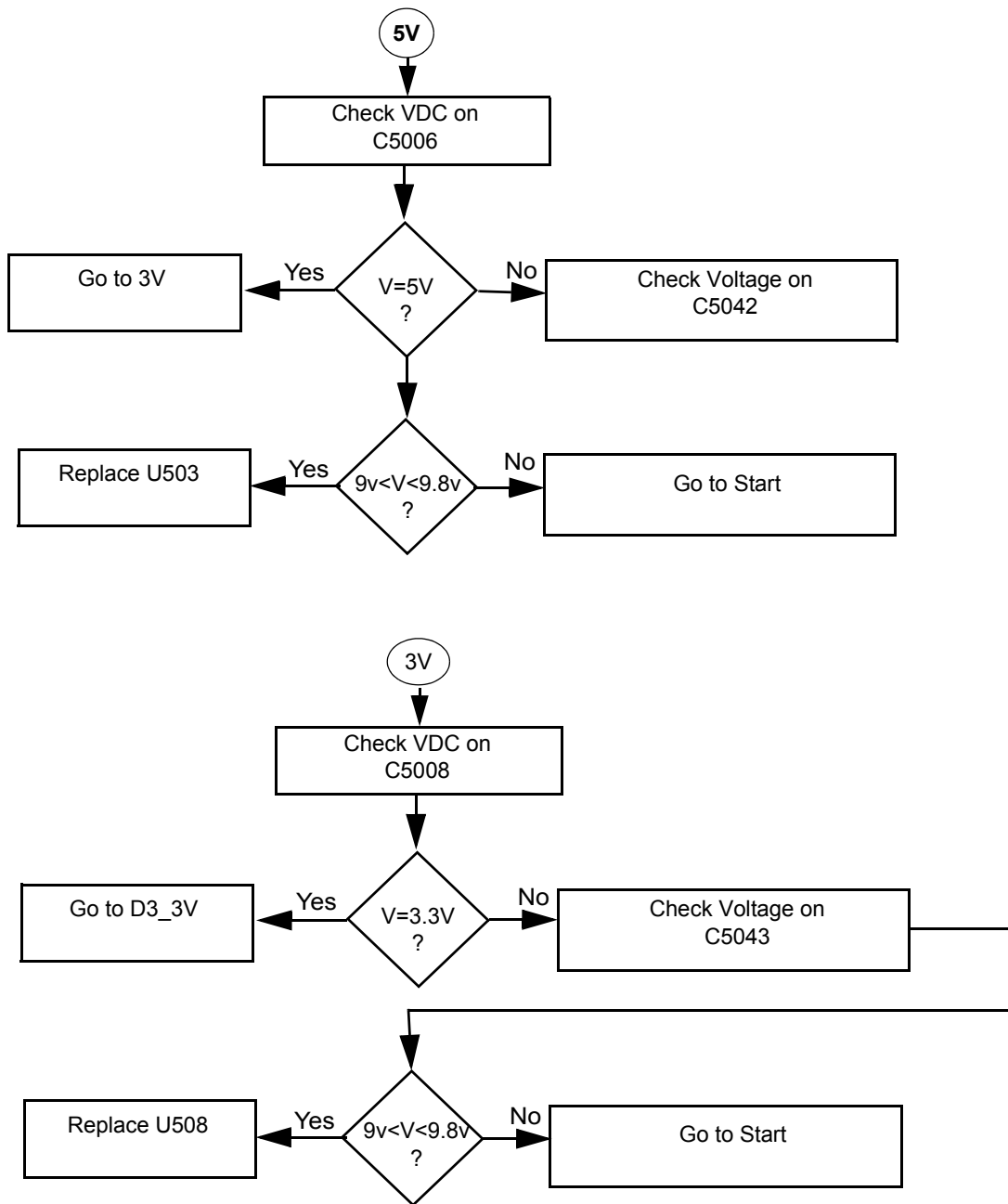


4.0 Troubleshooting Flow Chart for VCO

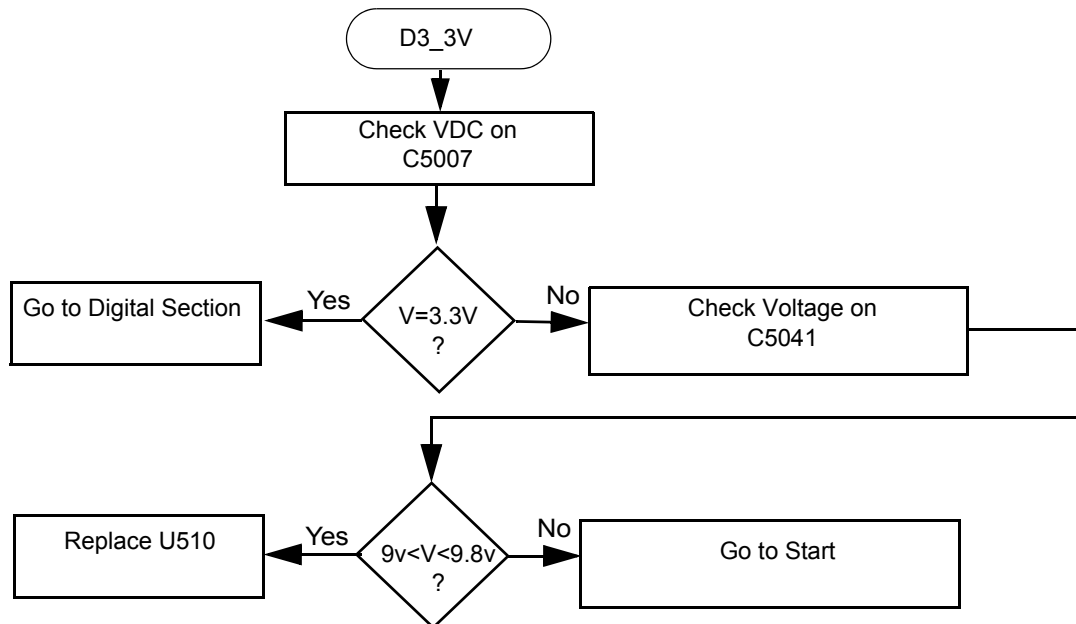


5.0 Troubleshooting Flow Chart for DC Supply (1 of 2)

Since the failure of a critical voltage supply might cause the radio to automatically power down, supply voltages should first be probed with a multimeter. If all the board voltages are absent, then the voltage test point should be retested using a rising-edge-triggered oscilloscope. If the voltage is still absent, then another voltage should be tested using the oscilloscope. If that voltage is present, then the original voltage supply in question is defective and requires investigation of associated circuitry.



5.1 Troubleshooting Flow Chart for DC Supply (2 of 2)



Chapter 4

VHF1 PCB / SCHEMATICS / PARTS LISTS

1.0 Allocation of Schematics and Circuit Boards

1.1 VHF1 and Controller Circuits

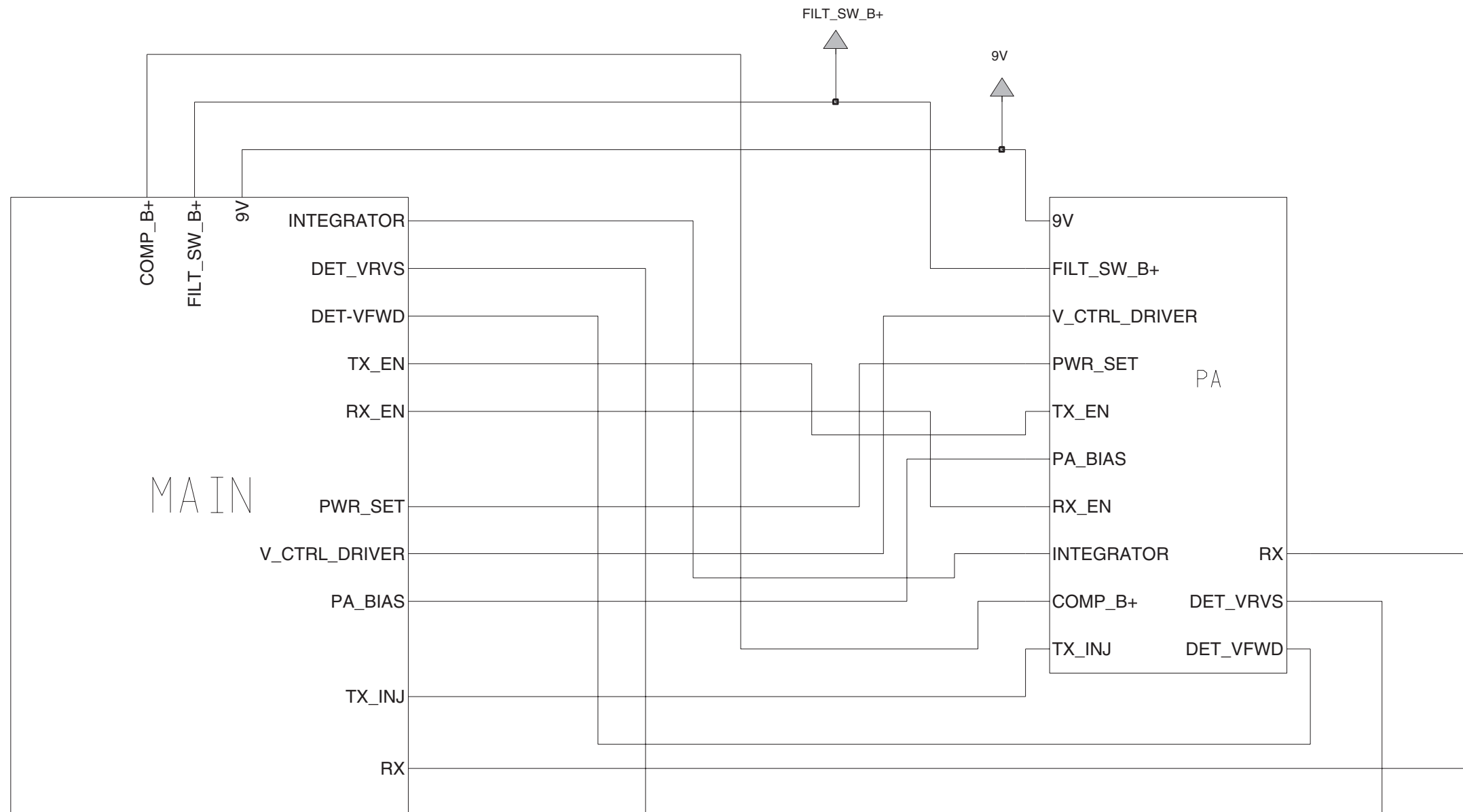
The VHF circuits are contained on the printed circuit board (PCB) which also contains the Controller circuits. This Chapter shows the schematics for both the VHF circuits and the Controller circuits. The PCB component layouts and the Parts Lists in this Chapter show both the Controller and VHF circuit components. The VHF and Controller schematics and the related PCB and parts list are shown in the tables below.

Table 4-1 VHF1 25–45 W Diagrams and Parts Lists

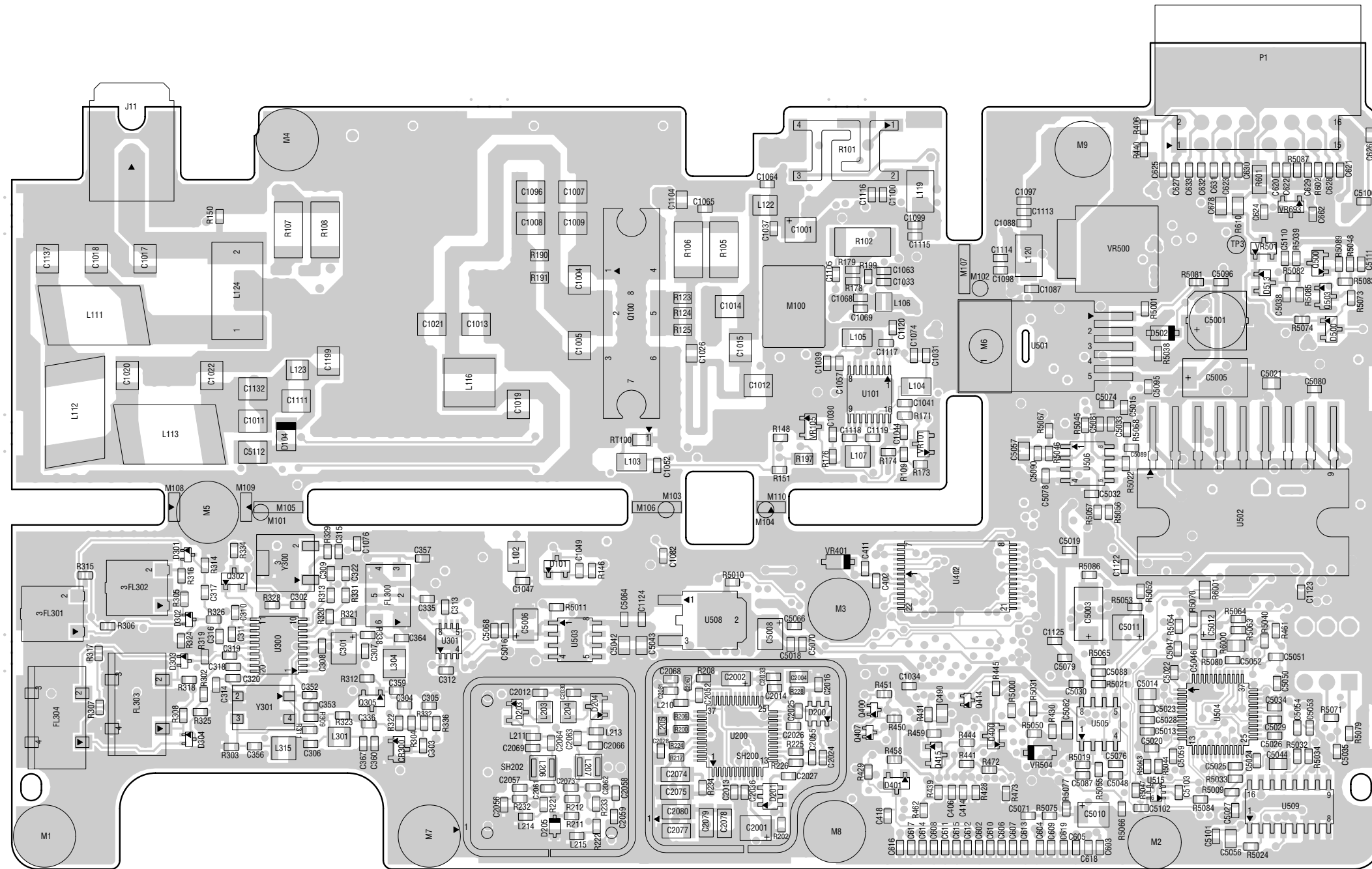
PCB : 8486487Z03 Main Board Top Side 8486487Z03 Main Board Bottom Side	Page 4-4 Page 4-5
SCHEMATICS Main Circuit Transmitter Synthesiser and VCO Receiver Front and Back End DC and Audio Ccts Microprocessor and Controller Ccts Power Control Cct	Page 4-6/Page 4-7 Page 4-8/Page 4-9 Page 4-10/Page 4-11 Page 4-12/Page 4-13 Page 4-14/Page 4-15 Page 4-16/Page 4-17 Page 4-18
Parts List 8486487Z03	Page 4-19
Controller version is T1	

Notes

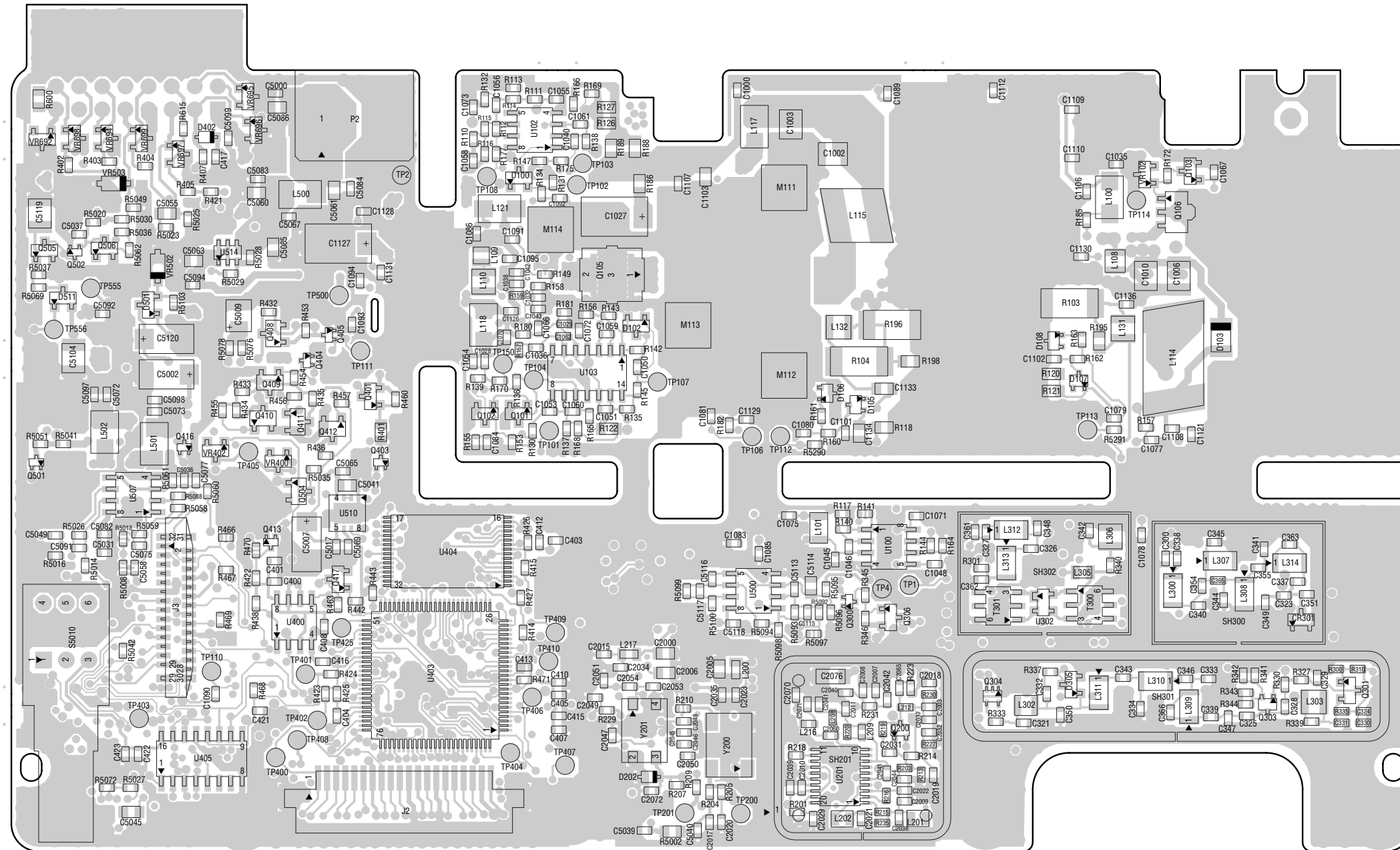
2.0 VHF 25–45 W Band 1 PCB 8486487Z03 / Schematics



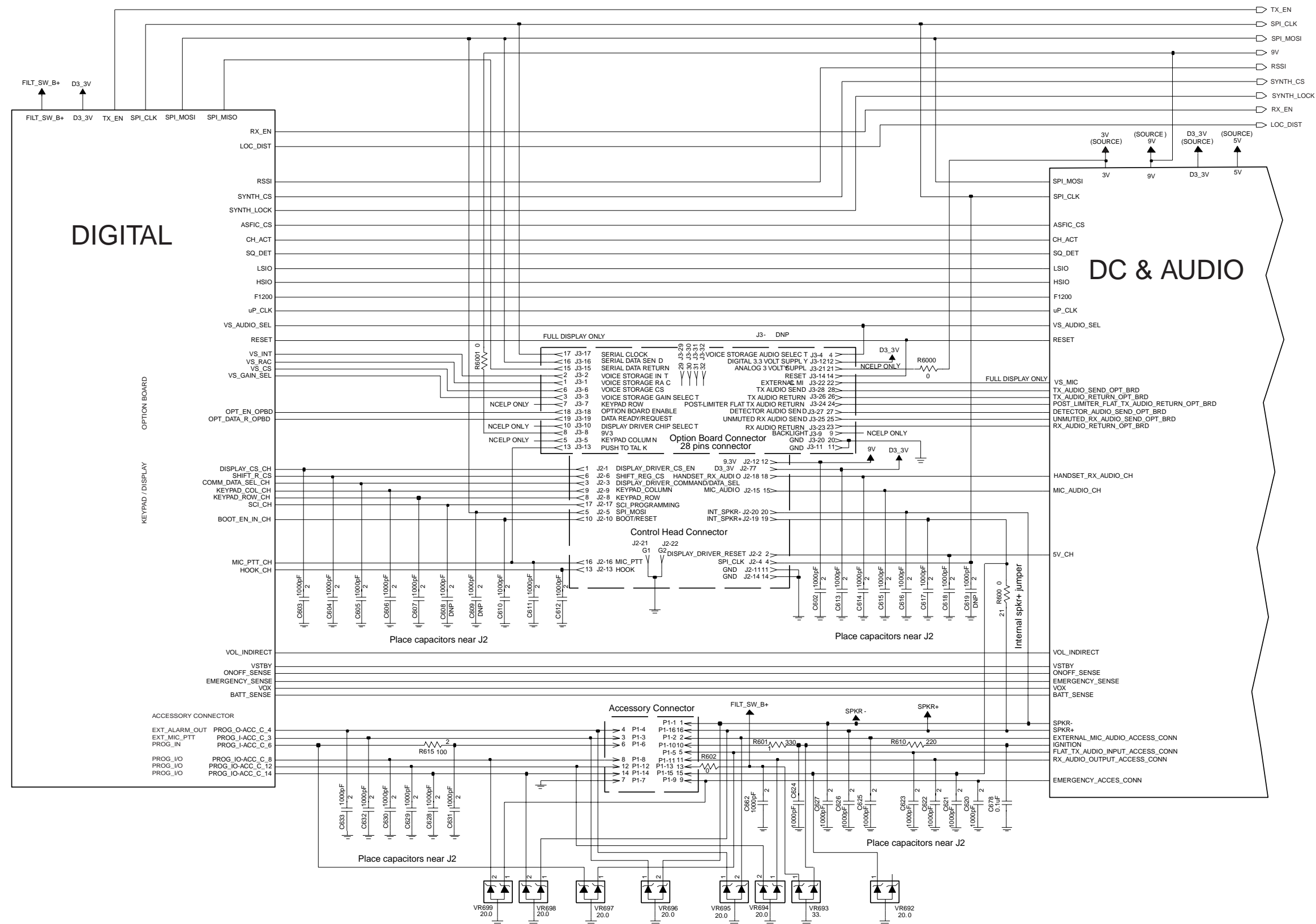
VHF 1 Interconnection between Main Board and Power Amplifier Compartment



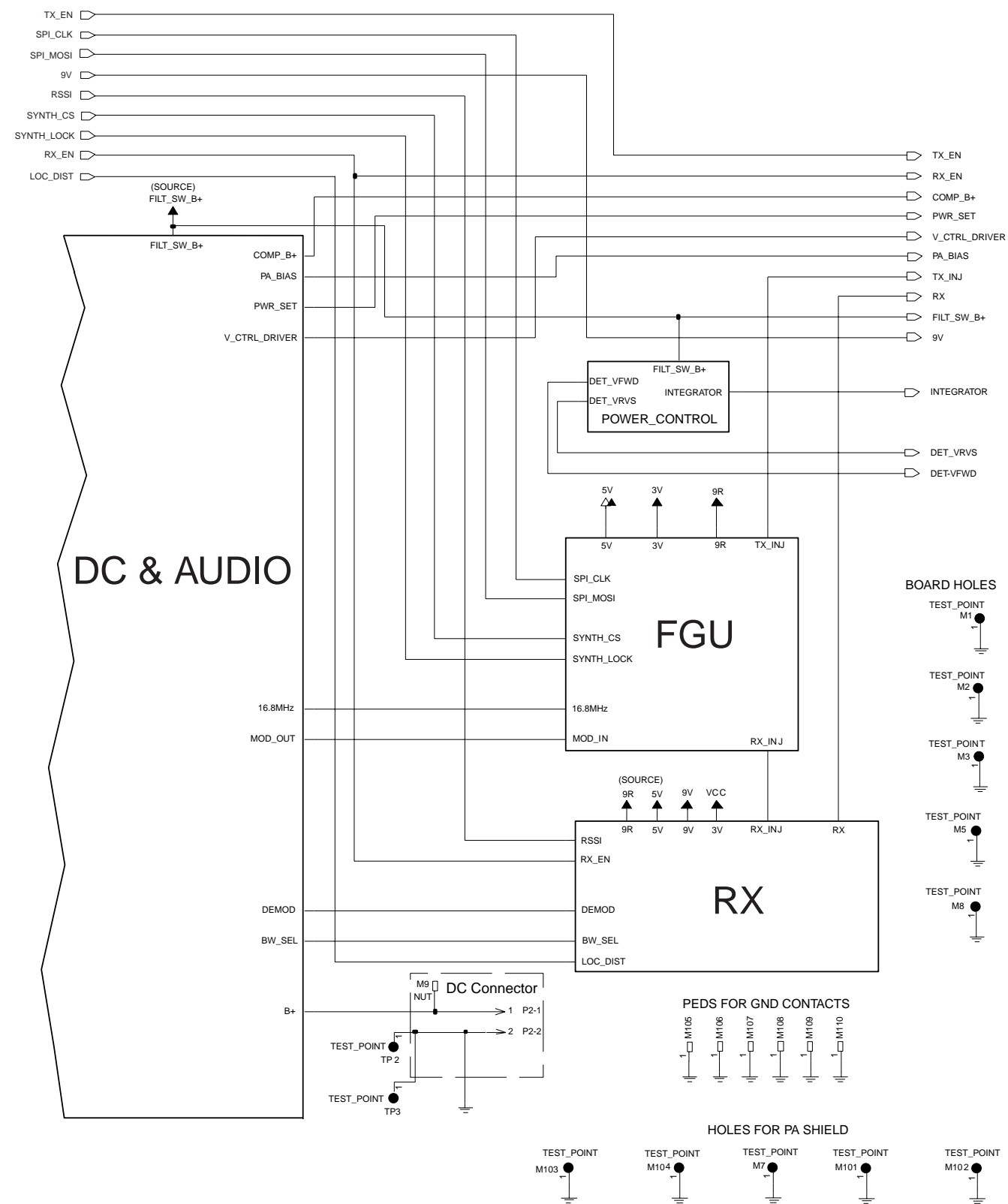
VHF 1 (136-162 MHz) 25-45 W 8486487Z03, Top Side View



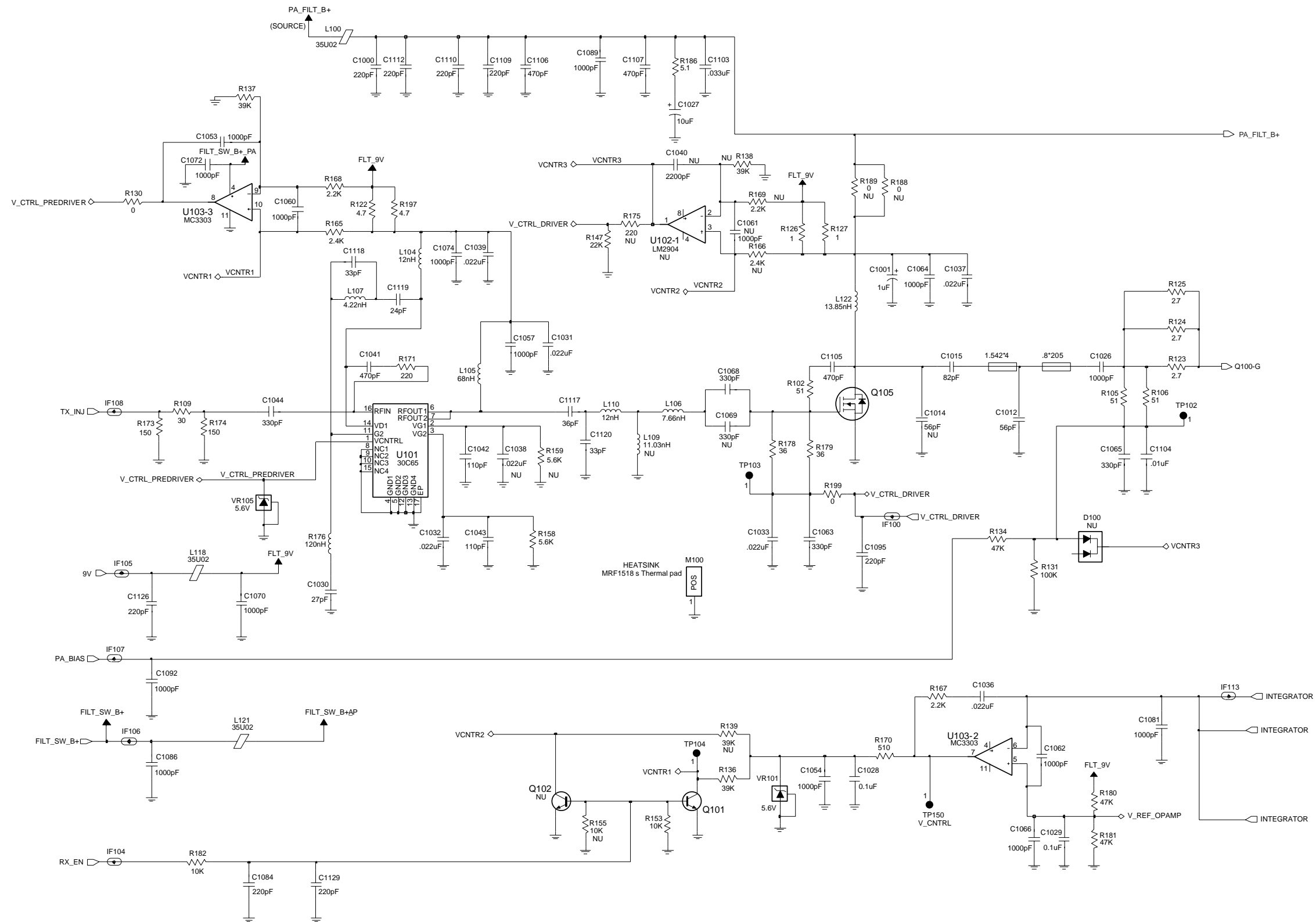
VHF 1 (136–162 MHz) 25–45 W 8486487Z03, Bottom Side View



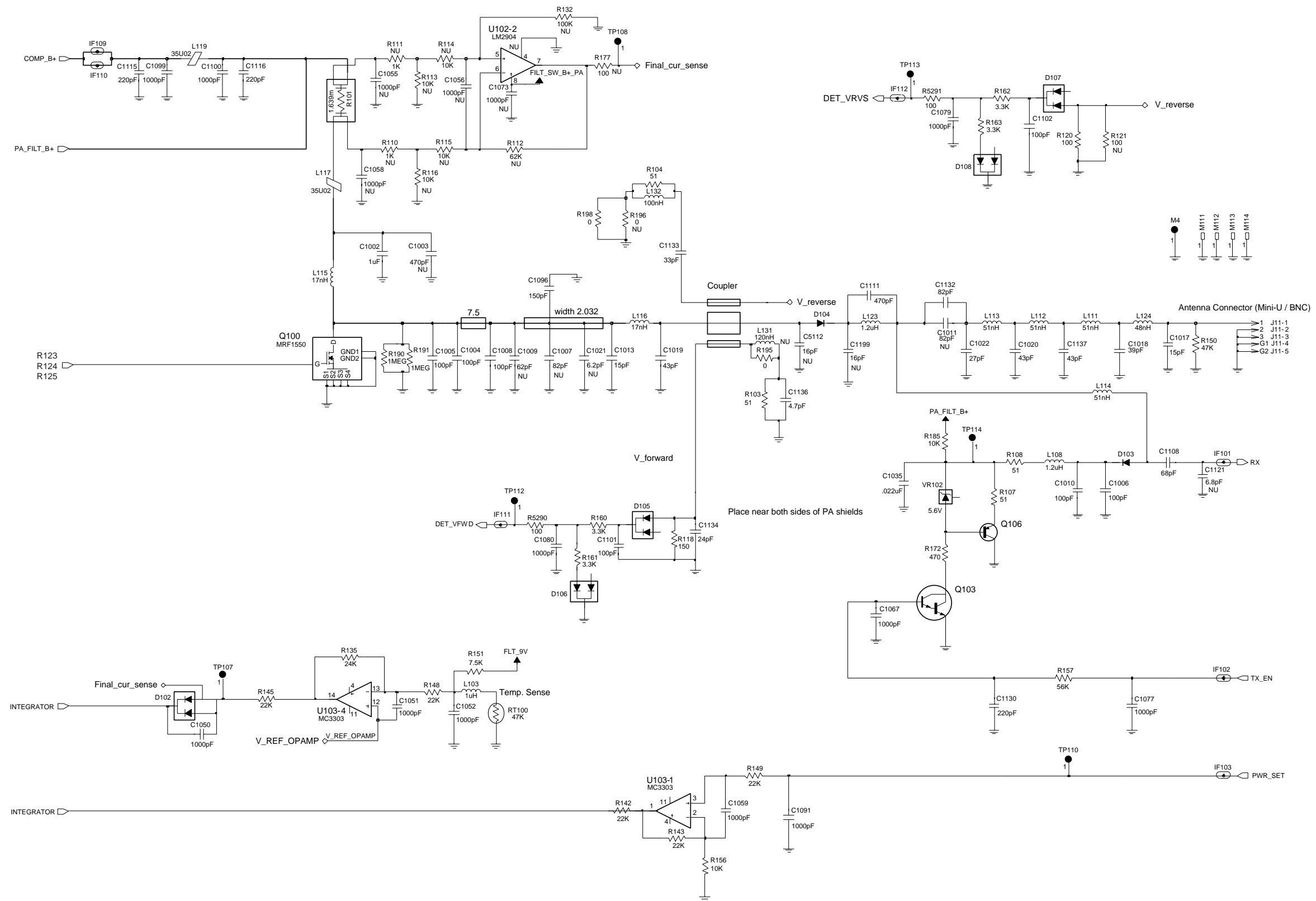
VHF 1 (136-162 MHz) 25-45 W Main Circuit (Sht 1 of 2)



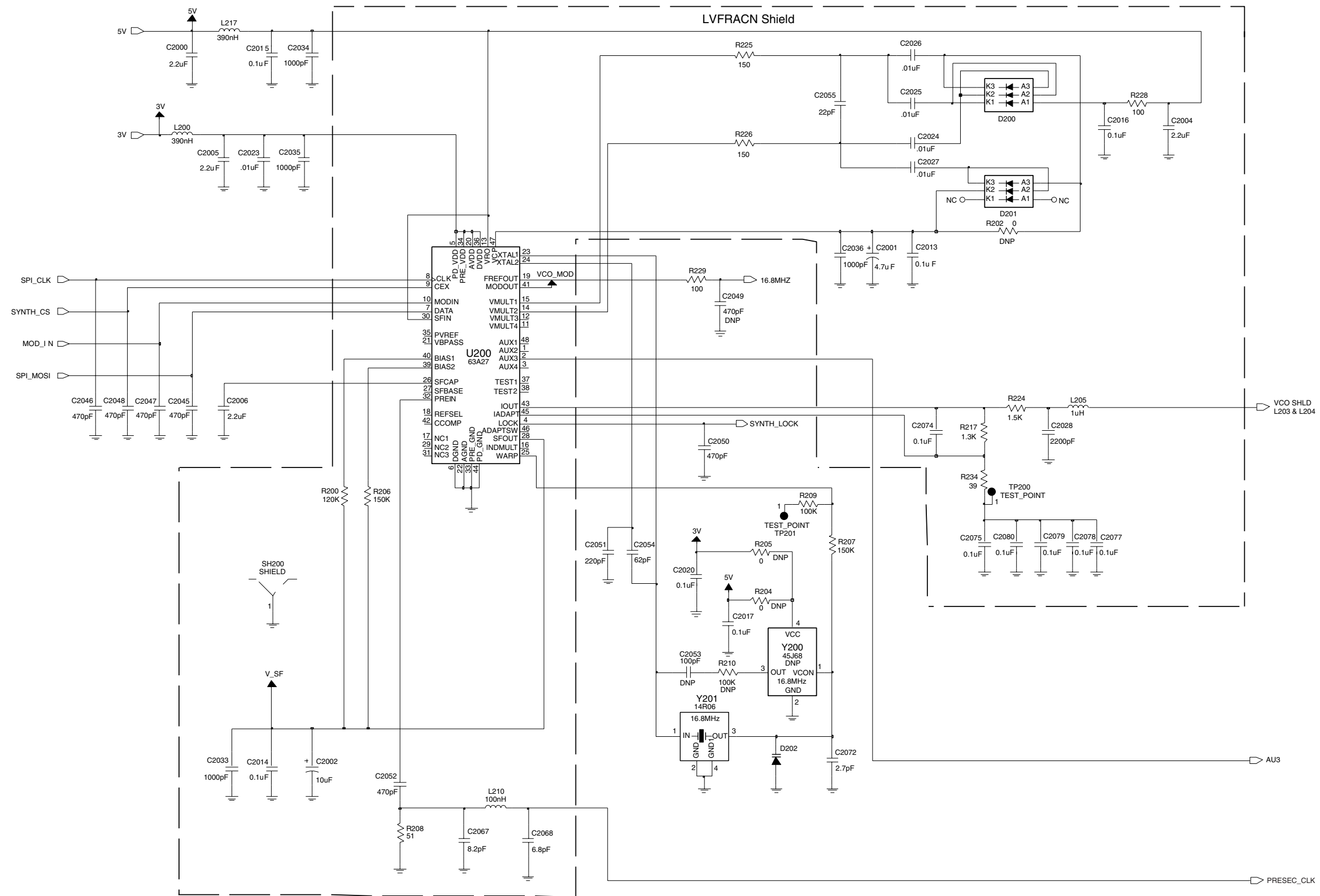
VHF 1 (136–162 MHz) 25–45 W Main Circuit (Sht 2 of 2)



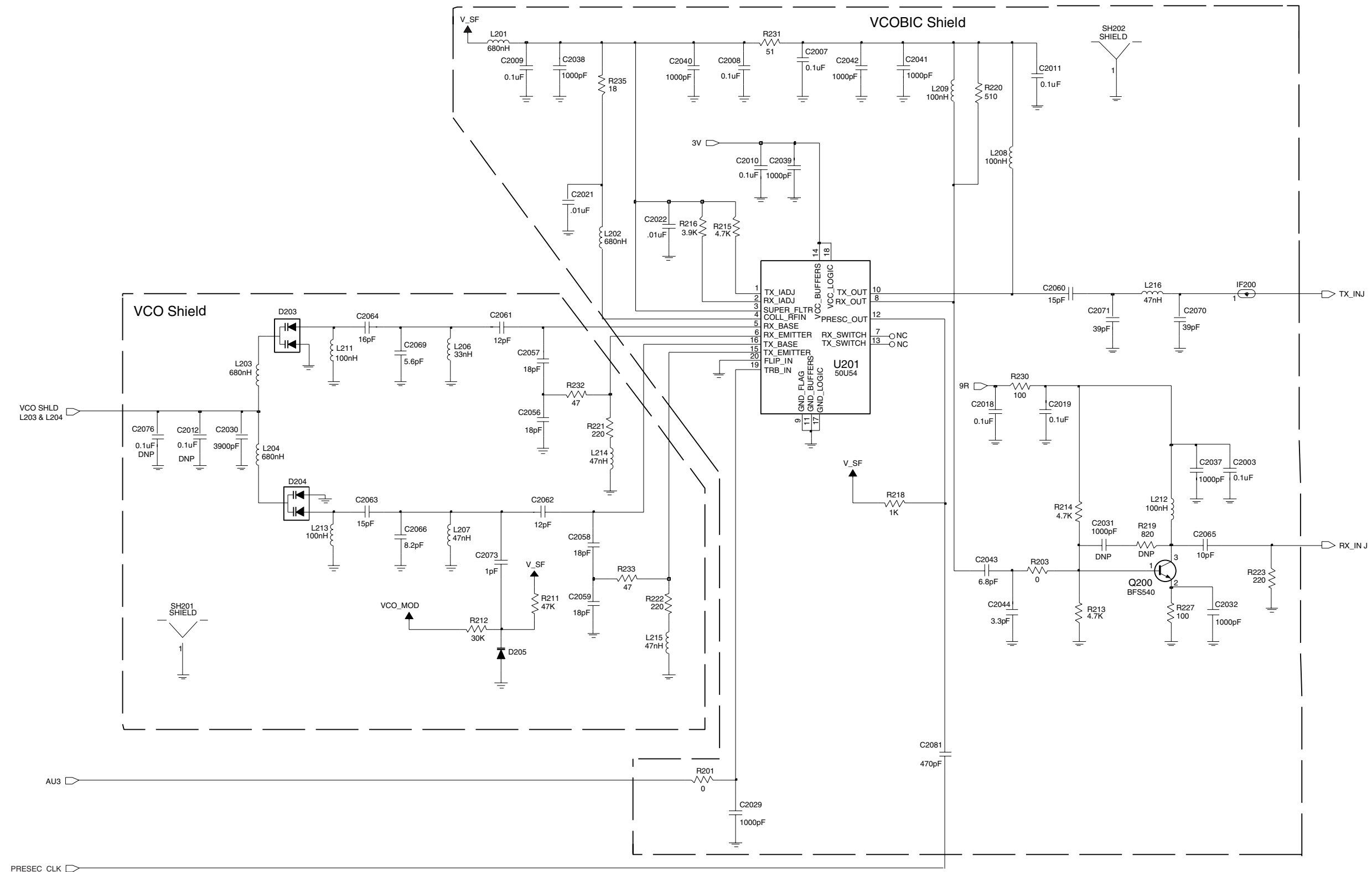
VHF 1 (136-162 MHz) 25-45 W Transmitter (Sht 1 of 2)



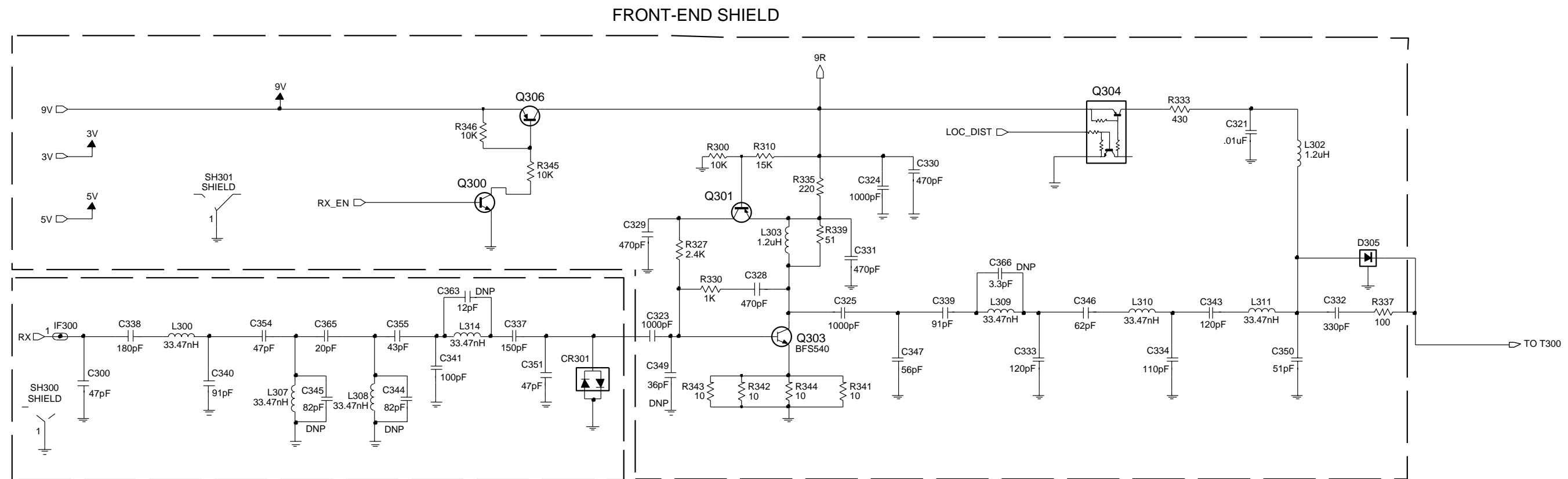
VHF 1 (136-162 MHz) 25-45 W Transmitter (Sht 2 of 2)



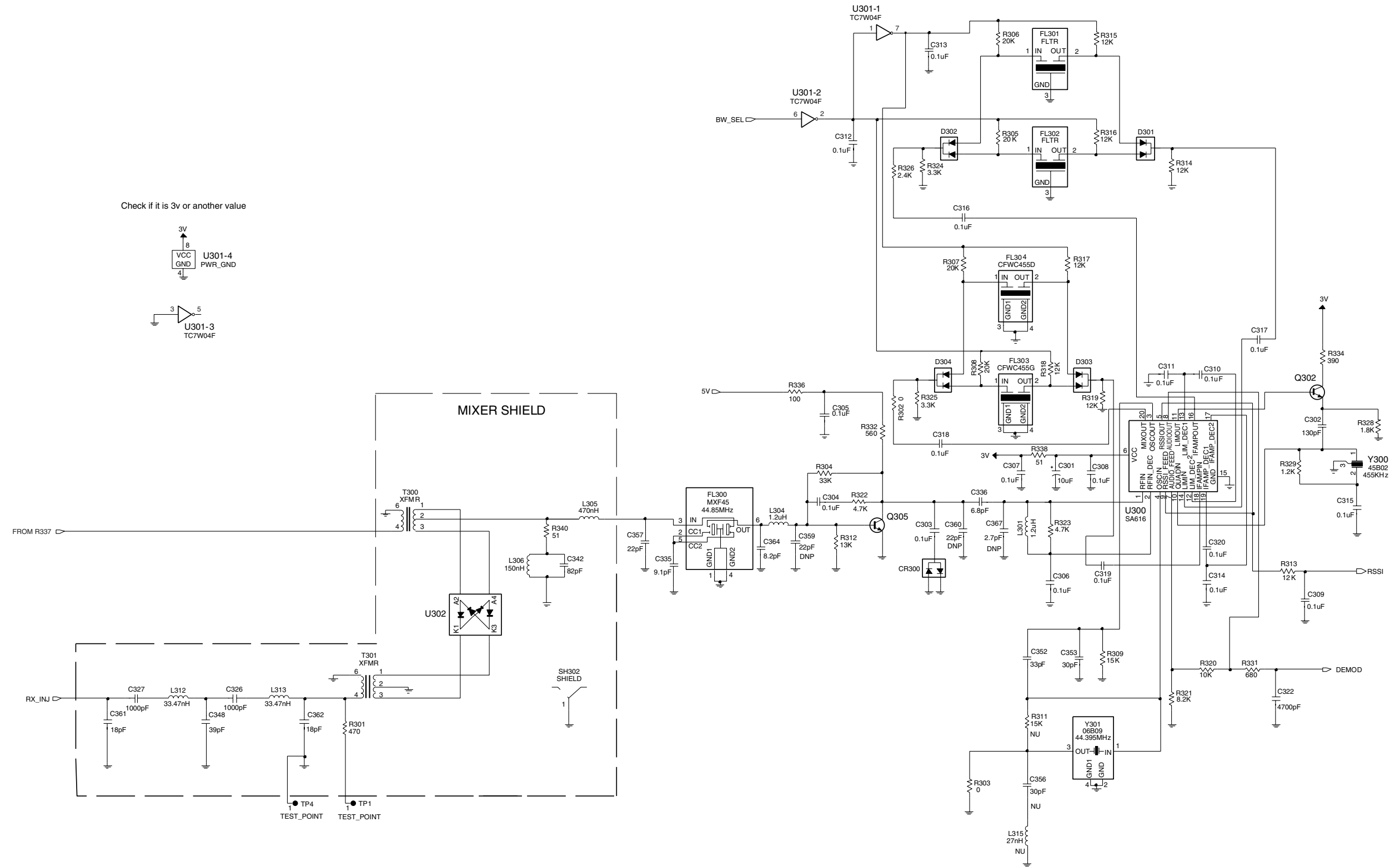
VHF 1 (136-162 MHz) 25-45 W Synthesiser and VCO (Sht 1 of 2)



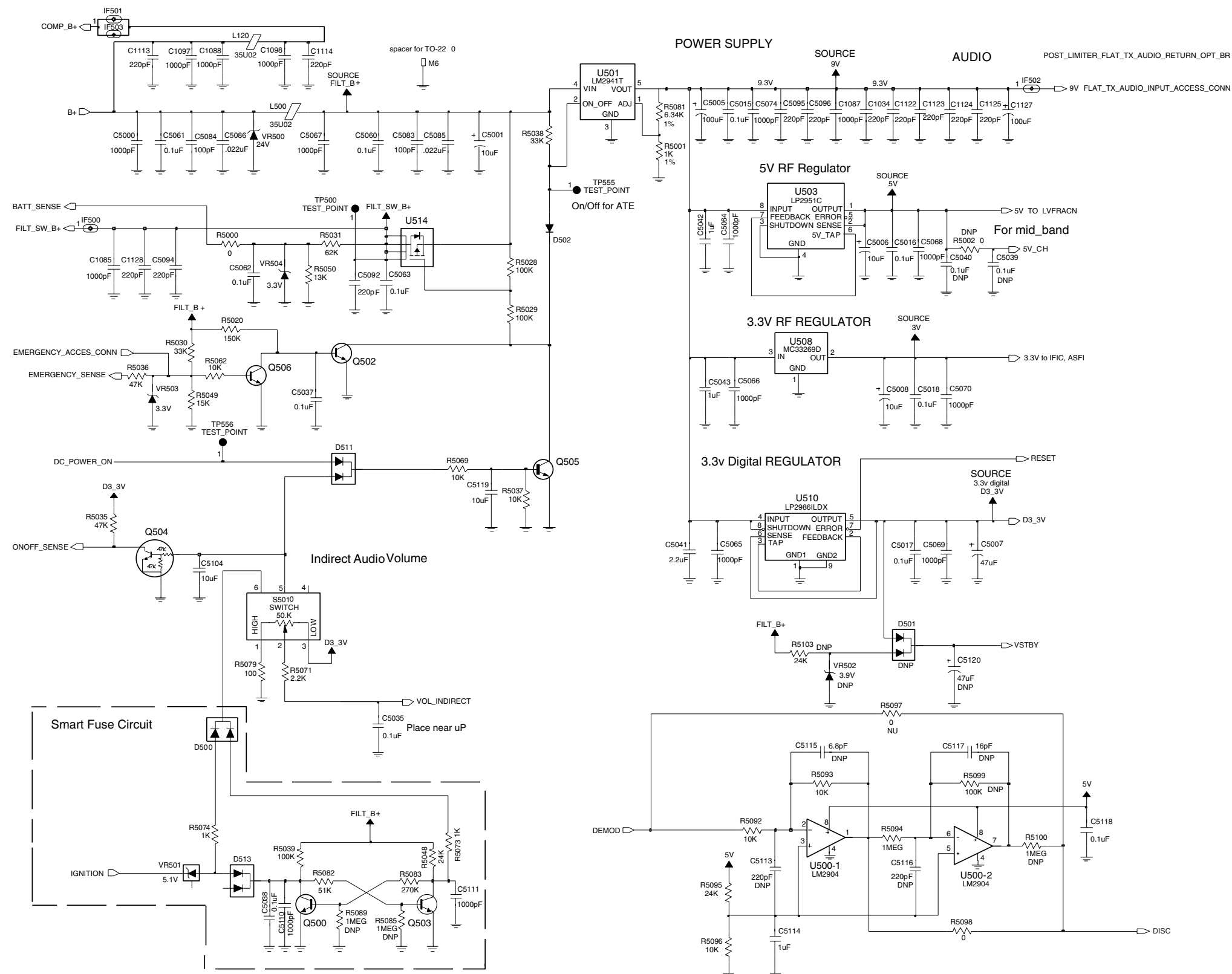
VHF 1 (136-162 MHz) 25-45 W Synthesiser and VCO (Sht 2 of 2)



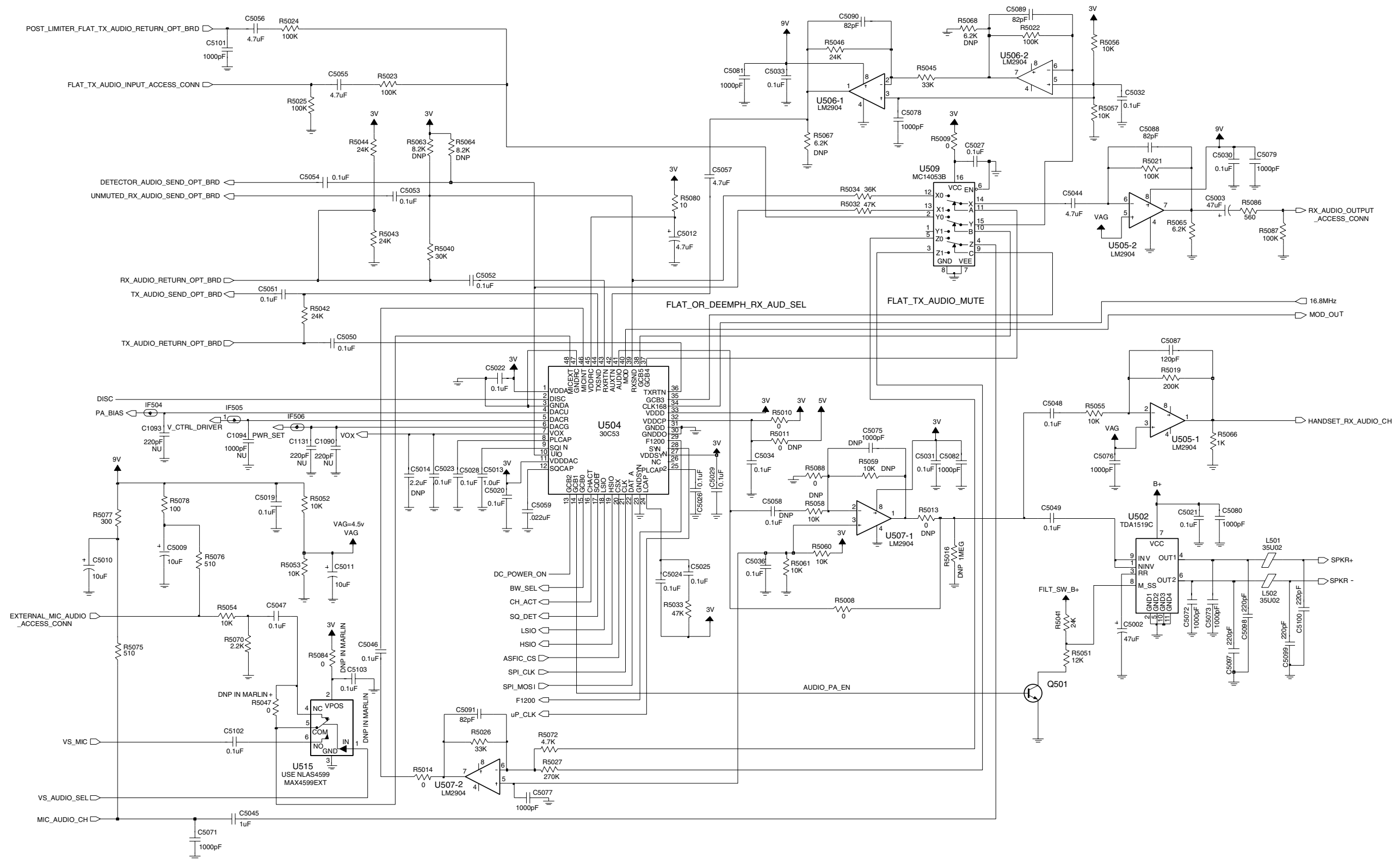
VHF 1 (136-162 MHz) 25-45 W Receiver Front and Back End (Sht 1 of 2)



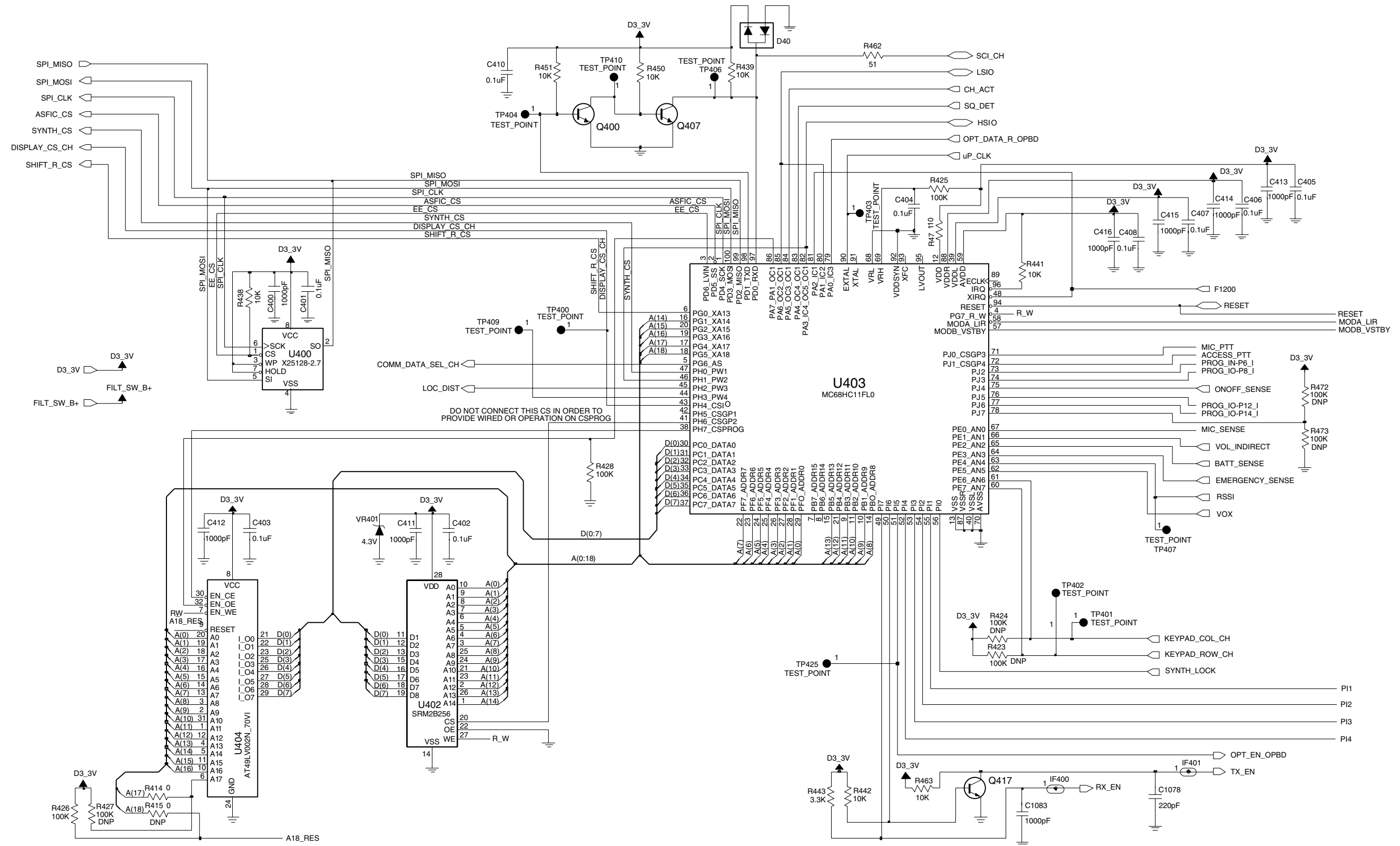
VHF 1 (136-162 MHz) 25-45 W Receiver Front and Back End (Sht 2 of 2)



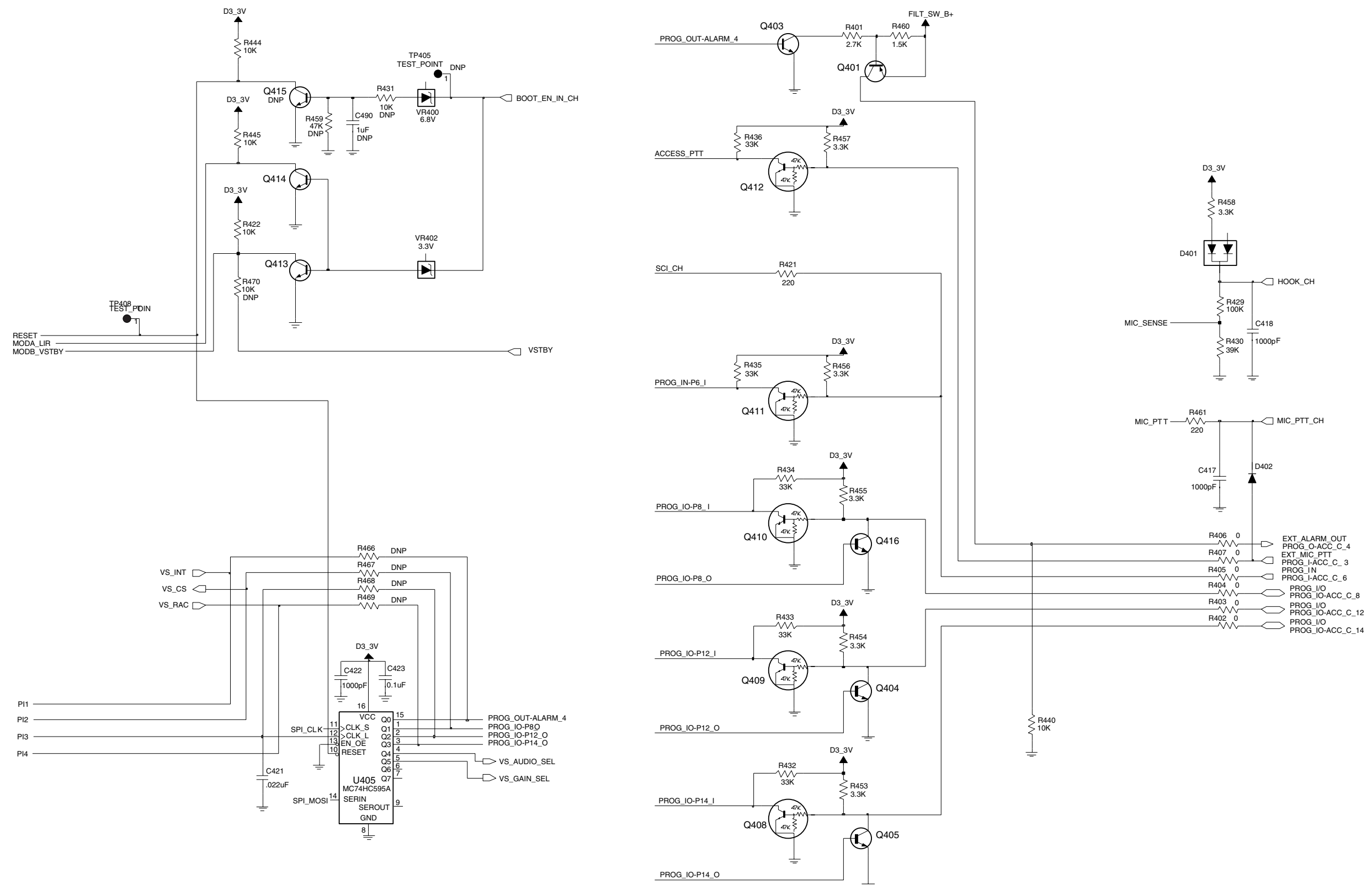
VHF 1 (136-162 MHz) 25-45 W DC and Audio Circuits (Sht 1 of 2)



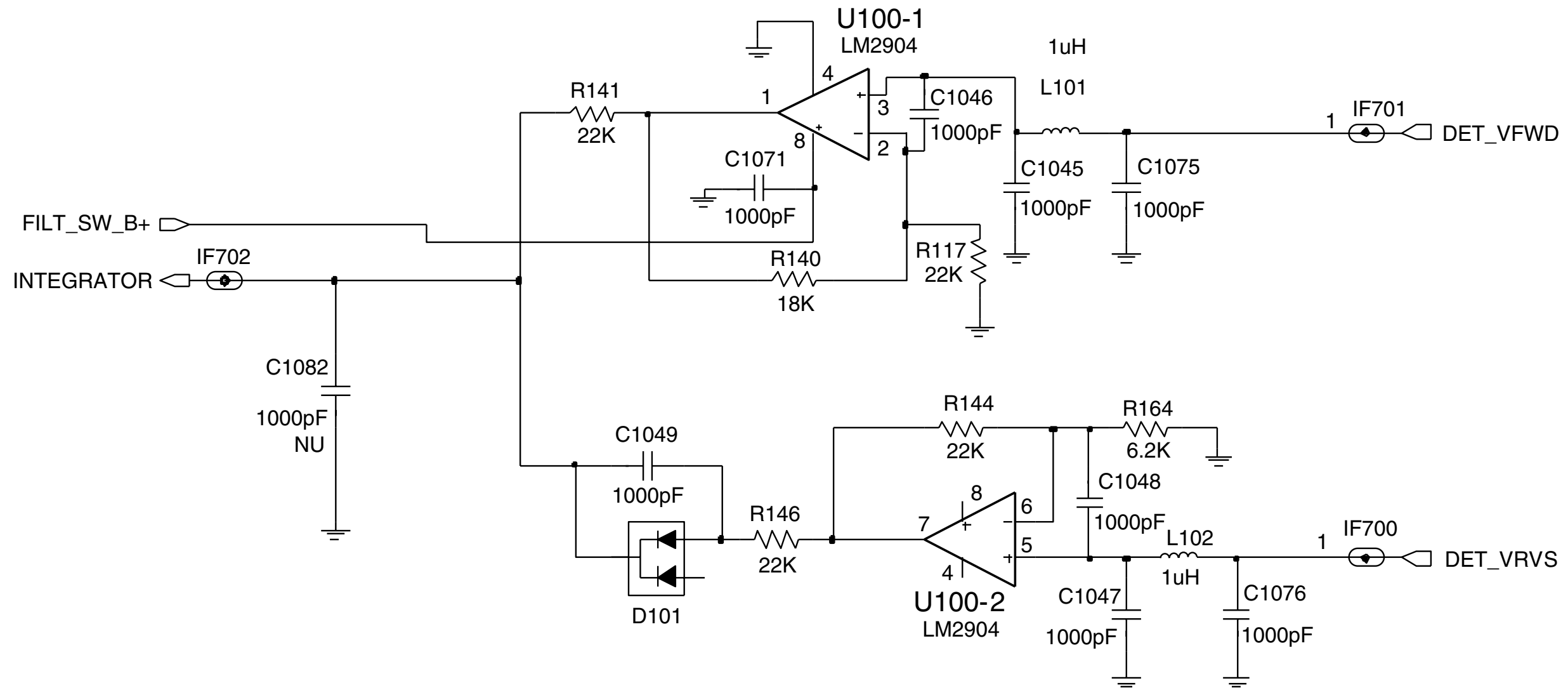
VHF 1 (136-162 MHz) 25-45 W DC and Audio Circuits (Sht 2 of 2)



VHF 1 (136-162 MHz) 25-45 W Microprocessor and Controller Circuits (Sht 1 of 2)



VHF 1 (136–162 MHz) 25–45 W Microprocessor and Controller Circuits (Sht 2 of 2)



VHF 1 (136-162 MHz) 25-45 W Power Control Circuit

2.1 VHF 1 PCB 8486487Z03 Parts List 25–45 W

Circuit Ref.	Motorola Part No.	Description
C300	2113740F43	CAP, 47pF
C301	2311049A57	CAP, 10uF
C302	2113740F54	CAP, 130pF
C303	2113743K15	CAP, 0.1uF
C304	2113743E20	CAP, 0.1uF
C305	2113743E20	CAP, 0.1uF
C306	2113743E20	CAP, 0.1uF
C307	2113743E20	CAP, 0.1uF
C308	2113743E20	CAP, 0.1uF
C309	2113743E20	CAP, 0.1uF
C310	2113743E20	CAP, 0.1uF
C311	2113743E20	CAP, 0.1uF
C312	2113743E20	CAP, 0.1uF
C313	2113743E20	CAP, 0.1uF
C314	2113743E20	CAP, 0.1uF
C315	2113743E20	CAP, 0.1uF
C316	2113743E20	CAP, 0.1uF
C317	2113743E20	CAP, 0.1uF
C318	2113743E20	CAP, 0.1uF
C319	2113743E20	CAP, 0.1uF
C320	2113743E20	CAP, 0.1uF
C321	2113741F49	CAP, .01uF
C322	2113741F41	CAP, 4700pF
C323	2113741F25	CAP, 1000pF
C324	2113741F25	CAP, 1000pF
C325	2113741F25	CAP, 1000pF
C326	2113741F25	CAP, 1000pF
C327	2113741F25	CAP, 1000pF
C328	2113740F67	CAP, 470pF
C329	2113740F67	CAP, 470pF

Circuit Ref.	Motorola Part No.	Description
C330	2113740F67	CAP, 470pF
C331	2113740F67	CAP, 470pF
C332	2113741F13	CAP, 330pF
C333	2113740F53	CAP, 120pF
C334	2113740F52	CAP, 110pF
C335	2113740L17	CAP, 9.1pF
C336	2113740L14	CAP, 6.8pF
C337	2113740F55	CAP, 150pF
C338	2113740F57	CAP, 180pF
C339	2113740F50	CAP, 91pF
C340	2113740F50	CAP, 91pF
C341	2113740F51	CAP, 100pF
C342	2113740F49	CAP, 82pF
C343	2113740F53	CAP, 120pF
C344	NOT PLACED	CAP, 82pF
C345	NOT PLACED	CAP, 82pF
C346	2113740F46	CAP, 62pF
C347	2113740F45	CAP, 56pF
C348	2113740F41	CAP, 39pF
C349	NOT PLACED	CAP, 36pF
C350	2113740F44	CAP, 51pF
C351	2113740F43	CAP, 47pF
C352	2113740F39	CAP, 33pF
C353	2113740F38	CAP, 30pF
C354	2113740F43	CAP, 47pF
C355	2113740F42	CAP, 43pF
C356	NOT PLACED	CAP, 30pF
C357	2113740F35	CAP, 22pF
C359	NOT PLACED	CAP, 22pF
C360	NOT PLACED	CAP, 22pF
C361	2113740F33	CAP, 18pF

Circuit Ref.	Motorola Part No.	Description
C362	2113740F33	CAP, 18pF
C363	NOT PLACED	CAP, 12pF
C364	2113740F25	CAP, 8.2pF
C365	2113740F34	CAP, 20pF
C366	NOT PLACED	CAP, 3.3pF
C367	NOT PLACED	CAP, 2.7pF
C400	2113741F25	CAP, 1000pF
C401	2113743K15	CAP, 0.1uF
C402	2113743K15	CAP, 0.1uF
C403	2113743K15	CAP, 0.1uF
C404	2113743K15	CAP, 0.1uF
C405	2113743K15	CAP, 0.1uF
C406	2113743K15	CAP, 0.1uF
C407	2113743K15	CAP, 0.1uF
C408	2113743K15	CAP, 0.1uF
C410	2113743K15	CAP, 0.1uF
C411	2113741F25	CAP, 1000pF
C412	2113741F25	CAP, 1000pF
C413	2113741F25	CAP, 1000pF
C414	2113741F25	CAP, 1000pF
C415	2113741F25	CAP, 1000pF
C416	2113741F25	CAP, 1000pF
C417	2113741F25	CAP, 1000pF
C418	2113741F25	CAP, 1000pF
C421	2113743E07	CAP, .022uF
C422	2113741F25	CAP, 1000pF
C423	2113743K15	CAP, 0.1uF
C490	NOT PLACED	CAP, 1uF
C602	2113741F25	CAP, 1000pF
C603	2113741F25	CAP, 1000pF
C604	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C605	2113741F25	CAP, 1000pF
C606	2113741F25	CAP, 1000pF
C607	2113741F25	CAP, 1000pF
C608	NOT PLACED	CAP, 1000pF
C609	NOT PLACED	CAP, 1000pF
C610	2113741F25	CAP, 1000pF
C611	2113741F25	CAP, 1000pF
C612	2113741F25	CAP, 1000pF
C613	2113741F25	CAP, 1000pF
C614	2113741F25	CAP, 1000pF
C615	2113741F25	CAP, 1000pF
C616	2113741F25	CAP, 1000pF
C617	2113741F25	CAP, 1000pF
C618	2113741F25	CAP, 1000pF
C619	NOT PLACED	CAP, 1000pF
C620	2113741F25	CAP, 1000pF
C621	2113741F25	CAP, 1000pF
C622	2113741F25	CAP, 1000pF
C623	2113741F25	CAP, 1000pF
C624	2113741F25	CAP, 1000pF
C625	2113741F25	CAP, 1000pF
C626	2113741F25	CAP, 1000pF
C627	2113741F25	CAP, 1000pF
C628	2113741F25	CAP, 1000pF
C629	2113741F25	CAP, 1000pF
C630	2113741F25	CAP, 1000pF
C631	2113741F25	CAP, 1000pF
C632	2113741F25	CAP, 1000pF
C633	2113741F25	CAP, 1000pF
C662	2113741F25	CAP, 1000pF
C678	2113741M69	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C1000	2113740F59	CAP, 220pF
C1001	2311049A08	CAPP, 1uF
C1002	2113741W01	CAP, 1uF
C1003	NOT PLACED	CAP, 470pF
C1004	2111078B44	CAP, 120pF
C1005	2111078B44	CAP, 120pF
C1006	2111078B42	CAP, 100pF
C1007	NOT PLACED	CAP, 82pF
C1008	2111078B42	CAP, 100pF
C1009	NOT PLACED	CAP, 62pF
C1010	NOT PLACED	CAP, 100pF
C1011	NOT PLACED	CAP, 82pF
C1012	2111078B36	CAP, 56pF
C1013	2111078B18	CAP, 15pF
C1014	NOT PLACED	CAP, 56pF
C1015	2111078B40	CAP, 82pF
C1017	2111078B18	CAP, 15pF
C1018	2111078B32	CAP, 39pF
C1019	2111078B33	CAP, 43pF
C1020	2111078B33	CAP, 43pF
C1021	NOT PLACED	CAP, 6.2pF
C1022	2111078B25	CAP, 27pF
C1026	2113740A79	CAP, 1000pF
C1027	2311049A45	CAPP, 10uF
C1028	2113743K15	CAP, 0.1uF
C1029	2113743K15	CAP, 0.1uF
C1030	2113740F37	CAP, 27pF
C1031	2113743E07	CAP, .022uF
C1032	2113743E07	CAP, .022uF
C1033	2113743E07	CAP, .022uF
C1034	2113740F59	CAP, 220pF

Circuit Ref.	Motorola Part No.	Description
C1035	2113743E07	CAP, .022uF
C1036	2113743E07	CAP, .022uF
C1037	2113743E07	CAP, .022uF
C1038	NOT PLACED	CAP, .022uF
C1039	2113743E07	CAP, .022uF
C1040	NOT PLACED	CAP, 2200pF
C1041	2113741F17	CAP, 470pF
C1042	2113740F52	CAP, 110pF
C1043	2113740F52	CAP, 110pF
C1044	2113741F13	CAP, 330pF
C1045	2113741F25	CAP, 1000pF
C1046	2113741F25	CAP, 1000pF
C1047	2113741F25	CAP, 1000pF
C1048	2113741F25	CAP, 1000pF
C1049	2113741F25	CAP, 1000pF
C1050	2113741F25	CAP, 1000pF
C1051	2113741F25	CAP, 1000pF
C1052	2113741F25	CAP, 1000pF
C1053	2113741F25	CAP, 1000pF
C1054	2113741F25	CAP, 1000pF
C1055	NOT PLACED	CAP, 1000pF
C1056	NOT PLACED	CAP, 1000pF
C1057	2113741F25	CAP, 1000pF
C1058	NOT PLACED	CAP, 1000pF
C1059	2113741F25	CAP, 1000pF
C1060	2113741F25	CAP, 1000pF
C1061	NOT PLACED	CAP, 1000pF
C1062	2113741F25	CAP, 1000pF
C1063	2113740F63	CAP, 330pF
C1064	2113741F25	CAP, 1000pF
C1065	2113740F63	CAP, 330pF

Circuit Ref.	Motorola Part No.	Description
C1066	2113741F25	CAP, 1000pF
C1067	2113741F25	CAP, 1000pF
C1068	2113741F13	CAP, 330pF
C1069	NOT PLACED	CAP, 330pF
C1070	2113741F25	CAP, 1000pF
C1071	2113741F25	CAP, 1000pF
C1072	2113741F25	CAP, 1000pF
C1073	NOT PLACED	CAP, 1000pF
C1074	2113741F25	CAP, 1000pF
C1075	2113741F25	CAP, 1000pF
C1076	2113741F25	CAP, 1000pF
C1077	2113741F25	CAP, 1000pF
C1078	2113740F59	CAP, 220pF
C1079	2113741F25	CAP, 1000pF
C1080	2113741F25	CAP, 1000pF
C1081	2113741F25	CAP, 1000pF
C1082	NOT PLACED	CAP, 1000pF
C1083	2113741F25	CAP, 1000pF
C1084	2113740F59	CAP, 220pF
C1085	2113741F25	CAP, 1000pF
C1086	2113741F25	CAP, 1000pF
C1087	2113741F25	CAP, 1000pF
C1088	2113741F25	CAP, 1000pF
C1089	2113741F25	CAP, 1000pF
C1090	NOT PLACED	CAP, 220pF
C1091	2113741F25	CAP, 1000pF
C1092	2113741F25	CAP, 1000pF
C1093	NOT PLACED	CAP, 220pF
C1094	NOT PLACED	CAP, 1000pF
C1095	2113740F59	CAP, 220pF
C1096	2111078B47	CAP, 150pF

Circuit Ref.	Motorola Part No.	Description
C1097	2113741F25	CAP, 1000pF
C1098	2113741F25	CAP, 1000pF
C1099	2113741F25	CAP, 1000pF
C1100	2113741F25	CAP, 1000pF
C1101	2113741F01	CAP, 100pF
C1102	2113741F01	CAP, 100pF
C1103	2113741A57	CAP, .033uF
C1104	2113741A45	CAP, .01uF
C1105	2113740F67	CAP, 470pF
C1106	2113740F67	CAP, 470pF
C1107	2113740F67	CAP, 470pF
C1108	2113740F47	CAP, 68pF
C1109	2113740F59	CAP, 220pF
C1110	2113740F59	CAP, 220pF
C1111	2111078B59	CAP, 470pF
C1112	2113740F59	CAP, 220pF
C1113	2113740F59	CAP, 220pF
C1114	2113740F59	CAP, 220pF
C1115	2113740F59	CAP, 220pF
C1116	2113740F59	CAP, 220pF
C1117	2113740F40	CAP, 36pF
C1118	2113740F39	CAP, 33pF
C1119	2113740F36	CAP, 24pF
C1120	2113740F39	CAP, 33pF
C1121	NOT PLACED	CAP, 6.8pF
C1122	2113740F59	CAP, 220pF
C1123	2113740F59	CAP, 220pF
C1124	2113740F59	CAP, 220pF
C1125	2113740F59	CAP, 220pF
C1126	2113740F59	CAP, 220pF
C1127	2360567A03	CAPP, 100uF

Circuit Ref.	Motorola Part No.	Description
C1128	2113740F59	CAP, 220pF
C1129	2113740F59	CAP, 220pF
C1130	2113740F59	CAP, 220pF
C1131	NOT PLACED	CAP, 220pF
C1132	2111078B40	CAP, 82pF
C1133	2113740A41	CAP, 33pF
C1134	2113740A38	CAP, 24pF
C1136	2113740F19	CAP, 4.7pF
C1137	2111078B33	CAP, 43pF
C1199	NOT PLACED	CAP, 16pF
C2000	2113743F18	CAP, 2.2uF
C2001	2311049J11	CAPP, 4.7uF
C2002	2311049A72	CAPP, 10uF
C2003	2113743K15	CAP, 0.1uF
C2004	2113743F18	CAP, 2.2uF
C2005	2113743F18	CAP, 2.2uF
C2006	2113743F18	CAP, 2.2uF
C2007	2113743E20	CAP, 0.1uF
C2008	2113743E20	CAP, 0.1uF
C2009	2113743E20	CAP, 0.1uF
C2010	2113743E20	CAP, 0.1uF
C2011	2113743E20	CAP, 0.1uF
C2012	NOT PLACED	CAP, 0.1uF
C2013	2113743E20	CAP, 0.1uF
C2014	2113743E20	CAP, 0.1uF
C2015	2113743E20	CAP, 0.1uF
C2016	2113743E20	CAP, 0.1uF
C2017	2113743E20	CAP, 0.1uF
C2018	2113743E20	CAP, 0.1uF
C2019	2113743E20	CAP, 0.1uF
C2020	2113743E20	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C2021	2113741F49	CAP, .01uF
C2022	2113741F49	CAP, .01uF
C2023	2113741F49	CAP, .01uF
C2024	2113741F49	CAP, .01uF
C2025	2113741F49	CAP, .01uF
C2026	2113741F49	CAP, .01uF
C2027	2113741F49	CAP, .01uF
C2028	2113741F33	CAP, 2200pF
C2029	2113741F25	CAP, 1000pF
C2030	2113741F39	CAP, 3900pF
C2031	NOT PLACED	CAP, 1000pF
C2032	2113741F25	CAP, 1000pF
C2033	2113741F25	CAP, 1000pF
C2034	2113741F25	CAP, 1000pF
C2035	2113741F25	CAP, 1000pF
C2036	2113741F25	CAP, 1000pF
C2037	2113741F25	CAP, 1000pF
C2038	2113741F25	CAP, 1000pF
C2039	2113741F25	CAP, 1000pF
C2040	2113741F25	CAP, 1000pF
C2041	2113741F25	CAP, 1000pF
C2042	2113741F25	CAP, 1000pF
C2043	2113740L14	CAP, 6.8pF
C2044	2113740L06	CAP, 3.3pF
C2045	2113740F67	CAP, 470pF
C2046	2113740F67	CAP, 470pF
C2047	2113740F67	CAP, 470pF
C2048	2113740F67	CAP, 470pF
C2049	NOT PLACED	CAP, 470pF
C2050	2113740F67	CAP, 470pF
C2051	2113740F59	CAP, 220pF

Circuit Ref.	Motorola Part No.	Description
C2052	2113740F67	CAP, 470pF
C2053	NOT PLACED	CAP, 100pF
C2054	2113740L37	CAP, 62pF
C2055	2113740F35	CAP, 22pF
C2056	2113740F33	CAP, 18pF
C2057	2113740F33	CAP, 18pF
C2058	2113740F33	CAP, 18pF
C2059	2113740F33	CAP, 18pF
C2060	2113740F31	CAP, 15pF
C2061	2113740F29	CAP, 12pF
C2062	2113740F29	CAP, 12pF
C2063	2113740L22	CAP, 15pF
C2064	2113740F32	CAP, 16pF
C2065	2113740F27	CAP, 10pF
C2066	2113740L16	CAP, 8.2pF
C2067	2113740F32	CAP, 16pF
C2068	2113740F32	CAP, 16pF
C2069	2113740L12	CAP, 5.6pF
C2070	2113740F41	CAP, 39pF
C2071	2113740F41	CAP, 39pF
C2072	2113740L04	CAP, 2.7pF
C2073	2113740F03	CAP, 1pF
C2074	2109720D14	CAP, 0.1uF
C2075	2109720D14	CAP, 0.1uF
C2076	NOT PLACED	CAP, 0.1uF
C2077	2109720D14	CAP, 0.1uF
C2078	2109720D14	CAP, 0.1uF
C2079	2109720D14	CAP, 0.1uF
C2080	2109720D14	CAP, 0.1uF
C2081	2113740F67	CAP, 470pF
C5000	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C5001	2389289U01	CAPP, 10uF
C5002	2311049A99	CAPP, 47uF
C5003	2311049A99	CAPP, 47uF
C5005	2360567A03	CAPP, 100uF
C5006	2311049A57	CAPP, 10uF
C5007	2311049A99	CAPP, 47uF
C5008	2311049A57	CAPP, 10uF
C5009	2311049A57	CAPP, 10uF
C5010	2311049A57	CAPP, 10uF
C5011	2311049A57	CAPP, 10uF
C5012	2311049A56	CAPP, 4.7uF
C5013	2113928P04	CAP, 1.0uF
C5014	NOT PLACED	CAP, 2.2uF
C5015	2113743K15	CAP, 0.1uF
C5016	2113743K15	CAP, 0.1uF
C5017	2113743K15	CAP, 0.1uF
C5018	2113743K15	CAP, 0.1uF
C5019	2113743K15	CAP, 0.1uF
C5020	2113743K15	CAP, 0.1uF
C5021	2113741M69	CAP, 0.1uF
C5022	2113743K15	CAP, 0.1uF
C5023	2113743K15	CAP, 0.1uF
C5024	2113743K15	CAP, 0.1uF
C5025	2113743K15	CAP, 0.1uF
C5026	2113743K15	CAP, 0.1uF
C5027	2113743K15	CAP, 0.1uF
C5028	2113743K15	CAP, 0.1uF
C5029	2113743K15	CAP, 0.1uF
C5030	2113743K15	CAP, 0.1uF
C5031	2113743K15	CAP, 0.1uF
C5032	2113743K15	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C5033	2113743K15	CAP, 0.1uF
C5034	2113743K15	CAP, 0.1uF
C5035	2113743K15	CAP, 0.1uF
C5036	2113743K15	CAP, 0.1uF
C5037	2113743K15	CAP, 0.1uF
C5038	2113743K15	CAP, 0.1uF
C5039	NOT PLACED	CAP, 0.1uF
C5040	NOT PLACED	CAP, 0.1uF
C5041	2113743F18	CAP, 2.2uF
C5042	2113743F16	CAP, 1uF
C5043	2113743F16	CAP, 1uF
C5044	2113928C04	CAP, 4.7uF
C5045	2113743F16	CAP, 1uF
C5046	2113743E20	CAP, 0.1uF
C5047	2113743E20	CAP, 0.1uF
C5048	2113743E20	CAP, 0.1uF
C5049	2113743E20	CAP, 0.1uF
C5050	2113743E20	CAP, 0.1uF
C5051	NOT PLACED	CAP, 0.1uF
C5052	2113743E20	CAP, 0.1uF
C5053	NOT PLACED	CAP, 0.1uF
C5054	NOT PLACED	CAP, 0.1uF
C5055	2113928C04	CAP, 4.7uF
C5056	2113928C04	CAP, 4.7uF
C5057	2113928C04	CAP, 4.7uF
C5058	NOT PLACED	CAP, 0.1uF
C5059	2113743E07	CAP, .022uF
C5060	2113741M69	CAP, 0.1uF
C5061	2113741M69	CAP, 0.1uF
C5062	2113741M69	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C5063	2113741M69	CAP, 0.1uF
C5064	2113741F25	CAP, 1000pF
C5065	2113741F25	CAP, 1000pF
C5066	2113741F25	CAP, 1000pF
C5067	2113741F25	CAP, 1000pF
C5068	2113741F25	CAP, 1000pF
C5069	2113741F25	CAP, 1000pF
C5070	2113741F25	CAP, 1000pF
C5071	2113741F25	CAP, 1000pF
C5072	2113741F25	CAP, 1000pF
C5073	2113741F25	CAP, 1000pF
C5074	2113741F25	CAP, 1000pF
C5075	NOT PLACED	CAP, 1000pF
C5076	2113741F25	CAP, 1000pF
C5077	2113741F25	CAP, 1000pF
C5078	2113741F25	CAP, 1000pF
C5079	2113741F25	CAP, 1000pF
C5080	2113741F25	CAP, 1000pF
C5081	2113741F25	CAP, 1000pF
C5082	2113741F25	CAP, 1000pF
C5083	2113740F51	CAP, 100pF
C5084	2113740F51	CAP, 100pF
C5085	2113741A53	CAP, .022uF
C5086	2113741A53	CAP, .022uF
C5087	2113740F53	CAP, 120pF
C5088	2113740F49	CAP, 82pF
C5089	2113740F49	CAP, 82pF
C5090	2113740F49	CAP, 82pF
C5091	2113740F49	CAP, 82pF
C5092	2113740F59	CAP, 220pF

Circuit Ref.	Motorola Part No.	Description
C5094	2113740F59	CAP, 220pF
C5095	2113740F59	CAP, 220pF
C5096	2113740F59	CAP, 220pF
C5097	2113740F59	CAP, 220pF
C5098	2113740F59	CAP, 220pF
C5099	2113740F59	CAP, 220pF
C5100	2113740F59	CAP, 220pF
C5101	NOT PLACED	CAP, 1000pF
C5102	NOT PLACED	CAP, 0.1uF
C5103	NOT PLACED	CAP, 0.1uF
C5104	NOT PLACED	CAP, 10uF
C5110	2113741F25	CAP, 1000pF
C5111	2113741F25	CAP, 1000pF
C5112	NOT PLACED	CAP, 16pF
C5113	NOT PLACED	CAP, 220pF
C5114	2113743F16	CAP, 1uF
C5115	NOT PLACED	CAP, 6.8pF
C5116	NOT PLACED	CAP, 220pF
C5117	NOT PLACED	CAP, 16pF
C5118	2113743E20	CAP, 0.1uF
C5119	2113743H14	CAP, 10uF
C5120	NOT PLACED	CAPP, 47uF
CR300	4880154K03	MMBD353, SCHOTTKY COMM AK
CR301	4880154K03	MMBD353, SCHOTTKY COMM AK
D100	NOT PLACED	MMBD6100, DUAL COMM CATH
D101	4813833C02	MMBD6100, DUAL COMM CATH
D102	4813833C02	MMBD6100, DUAL COMM CATH

Circuit Ref.	Motorola Part No.	Description
D103	4802482J02	MA4P959, PIN
D104	4802482J02	MA4P959, PIN
D105	4805218N57	RB715F, DUAL COMM CATH
D106	4805218N57	RB715F, DUAL COMM CATH
D107	4805218N57	RB715F, DUAL COMM CATH
D108	4805218N57	RB715F, DUAL COMM CATH
D200	4802233J09	IMN10, 3 DIODE ARRAY
D201	4802233J09	IMN10, 3 DIODE ARRAY
D202	4862824C03	1SV232, VARACTOR
D203	4805649Q13	1SV228, VARACTOR
D204	4805649Q13	1SV228, VARACTOR
D205	4862824C01	1SV229, VARACTOR
D301	4802245J97	DAN235ETL, DUAL COMM CATH
D302	4802245J97	DAN235ETL, DUAL COMM CATH
D303	4802245J97	DAN235ETL, DUAL COMM CATH
D304	4802245J97	DAN235ETL, DUAL COMM CATH
D305	4880142L01	MMBV3401LT, PIN
D400	4813833C07	MMBD7000, DUAL COMM AK
D401	4813833C02	MMBD6100, DUAL COMM CATH
D402	4809948D42	RB751V40, SCHOTTKY
D500	4813833C02	MMBD6100, DUAL COMM CATH
D501	NOT PLACED	MMBD6100, DUAL COMM CATH
D502	4813825A23	MMSD301T1, SCHOTTKY

Circuit Ref.	Motorola Part No.	Description
D511	4813833C02	MMBD6100, DUAL COMM CATH
D513	4813833C02	MMBD6100, DUAL COMM CATH
FL300	9180022M11	MXF45, 44.85MHz BPF
FL301	9180468V06	FLTR, 455kHz, BW 25KHZ
FL302	9180468V04	FLTR, 455kHz, BW 12.5KHZ
FL303	9180469V03	FLTR, 455kHz, BW 12.5KHZ
FL304	9180469V06	FLTR, 455kHz, BW 25KHZ
J2	0989241U02	CONNECTOR 22 PIN
J3	NOT PLACED	CONNECTOR 32 PIN
J11	2889309U01	ANTENNA CONNECTOR
L100	7686135U02	FERRITE BEAD
L101	2462587T30	IDCTR, 1uH
L102	2462587T30	IDCTR, 1uH
L103	2462587T30	IDCTR, 1uH
L104	2462587T38	IND CHIP 22NH 5% LOW PRO
L105	2462587T13	IDCTR, 68nH
L106	2460591A11	IDCTR, 7.66nH
L107	2460591A01	IDCTR, 4.22nH
L108	2462587X69	IDCTR, 1.2uH
L109	NOT PLACED	IDCTR, 11.03nH
L110	2462587N42	IDCTR, 12nH
L111	2460592B01	IDCTR, 51nH
L112	2460592B01	IDCTR, 51nH
L113	2460592B01	IDCTR, 51nH
L114	2460592B01	IDCTR, 51nH
L115	2460592A01	IDCTR, 17nH
L116	2460592A01	IDCTR, 17nH

Circuit Ref.	Motorola Part No.	Description
L117	7686135U02	FERRITE BEAD
L118	7686135U02	FERRITE BEAD
L119	7686135U02	FERRITE BEAD
L120	7686135U02	FERRITE BEAD
L121	7686135U02	FERRITE BEAD
L122	2460591C23	IDCTR, 13.85nH
L123	2462587X69	IDCTR, 1.2uH
L124	2485873L05	IDCTR, 48nH
L131	NOT PLACED	IDCTR, 120nH
L132	2462587N15	IDCTR, 100nH
L200	2462587Q42	IDCTR, 390nH
L201	2462587V44	IDCTR, 680nH
L202	2462587V44	IDCTR, 680nH
L203	2462587V44	IDCTR, 680nH
L204	2462587V44	IDCTR, 680nH
L205	2462587Q47	IDCTR, 1uH
L206	2413923C05	IDCTR, 33nH
L207	2413923C07	IDCTR, 47nH
L208	2413926N24	IDCTR, 100nH
L209	2413926N24	IDCTR, 100nH
L210	2413926N24	IDCTR, 100nH
L211	2413926N24	IDCTR, 100nH
L212	2413926N24	IDCTR, 100nH
L213	2413926N24	IDCTR, 100nH
L214	2413926H20	IDCTR, 47nH
L215	2413926H20	IDCTR, 47nH
L216	2413926H20	IDCTR, 47nH
L217	2462587Q42	IDCTR, 390nH
L300	2460591G24	IDCTR, 33.47nH
L301	2462587X69	IDCTR, 1.2uH
L302	2462587X69	IDCTR, 1.2uH

Circuit Ref.	Motorola Part No.	Description
L303	2462587N69	IDCTR, 1.2uH
L304	2483411T74	IDCTR, 1.2uH
L305	2413926K31	IDCTR, 470nH
L306	2462587N55	IDCTR, 150nH
L307	2460591G24	IDCTR, 33.47nH
L308	2460591G24	IDCTR, 33.47nH
L309	2460591G24	IDCTR, 33.47nH
L310	2460591G24	IDCTR, 33.47nH
L311	2460591G24	IDCTR, 33.47nH
L312	2460591G24	IDCTR, 33.47nH
L313	2460591G24	IDCTR, 33.47nH
L314	2460591G24	IDCTR, 33.47nH
L315	NOT PLACED	IDCTR, 27nH
L500	7686135U02	FERRITE BEAD
L501	7686135U02	FERRITE BEAD
L502	7686135U02	FERRITE BEAD
M6	4387454V01	SPACER
M9	0289511U01	NUT
M100	2680499Z01	HEATSINK
M105	7588823L03	CONTACT, METAL
M106	7588823L03	CONTACT, METAL
M107	7588823L03	CONTACT, METAL
M108	7588823L04	CONTACT, METAL
M109	7588823L04	CONTACT, METAL
M110	7588823L04	CONTACT, METAL
M111	NOT PLACED	CONTACT, METAL
M112	NOT PLACED	CONTACT, METAL
M113	NOT PLACED	CONTACT, METAL
M114	NOT PLACED	CONTACT, METAL
P1	2804503J01	CONNECTOR, 16 PIN
P2	NOT PLACED	CONNECTOR, 2 PIN DC

Circuit Ref.	Motorola Part No.	Description
Q100	4886136B01	MRF1550, LD MOS RF
Q101	4813824A10	MMBT3904, BIPOLAR NPN
Q102	NOT PLACED	MMBT3904, BIPOLAR NPN
Q103	4813824A06	MMBTA13, DARLINGTON, NPN
Q105	4886212B01	MRF1518, LD MOS RF
Q106	4805128M27	BSR33, BIPOLAR, PNP
Q200	4802245J95	BFS540, NPN
Q300	4809940E02	DTC114YE, NPN
Q301	4813824A17	MMBT3906, BIPOLAR PNP
Q302	4813824A10	MMBT3904, BIPOLAR NPN
Q303	4802245J95	BFS540, NPN
Q304	4809939C04	UMC3
Q305	4802197J95	PBR941, NPN
Q306	4813824A17	MMBT3906, BIPOLAR PNP
Q400	4809940E02	DTC114YE, NPN
Q401	4880141L03	BCW68G, BIPOLAR PNP
Q403	4809940E02	DTC114YE, NPN
Q404	4809940E02	DTC114YE, NPN
Q405	4809940E02	DTC114YE, NPN
Q407	4809940E02	DTC114YE, NPN
Q408	4880048M01	DTC144EKA, BIPOLAR
Q409	4880048M01	DTC144EKA, BIPOLAR
Q410	4880048M01	DTC144EKA, BIPOLAR
Q411	4880048M01	DTC144EKA, BIPOLAR
Q412	4880048M01	DTC144EKA, BIPOLAR
Q413	4809940E02	DTC114YE, NPN
Q414	4809940E02	DTC114YE, NPN

Circuit Ref.	Motorola Part No.	Description
Q415	NOT PLACED	MMBT3904
Q416	4809940E02	DTC114YE, NPN
Q417	4813824A10	MMBT3904, BIPOLAR NPN
Q500	4813824A10	MMBT3904, BIPOLAR NPN
Q501	4809940E02	DTC114YE, NPN
Q502	4809940E02	DTC114YE, NPN
Q503	4813824A10	MMBT3904, BIPOLAR NPN
Q504	4880048M01	DTC144EKA, BIPOLAR
Q505	4813824A10	MMBT3904, BIPOLAR NPN
Q506	4813824A10	MMBT3904, BIPOLAR NPN
R101	1705603W01	SHUNT, 1.639m
R102	0680194M18	RES, 51
R103	0683994M18	RES, 51
R104	0680194M18	RES, 51
R105	0680194M18	RES, 51
R106	0680194M18	RES, 51
R107	0680194M18	RES, 51
R108	0680194M18	RES, 51
R109	0662057A12	RES, 30
R110	NOT PLACED	RES, 1K
R111	NOT PLACED	RES, 1K
R112	NOT PLACED	RES, 62K
R113	NOT PLACED	RES, 10K
R114	NOT PLACED	RES, 10K
R115	NOT PLACED	RES, 10K
R116	NOT PLACED	RES, 10K
R117	0662057A81	RES, 22K

Circuit Ref.	Motorola Part No.	Description
R118	0662057C55	RES, 150
R120	0662057C51	RES, 100
R121	NOT PLACED	RES, 100
R122	0662057C19	RES, 4.7
R123	0662057C13	RES, 2.7
R124	0662057C13	RES, 2.7
R125	0662057C13	RES, 2.7
R126	0662057C03	RES, 1
R127	0662057C03	RES, 1
R130	0662057B47	RES, 0
R131	0662057A97	RES, 100K
R132	NOT PLACED	RES, 100K
R134	0662057A89	RES, 47K
R135	0662057A82	RES, 24K
R136	0662057A87	RES, 39K
R137	0662057A87	RES, 39K
R138	NOT PLACED	RES, 39K
R139	NOT PLACED	RES, 39K
R140	0662057A79	RES, 718K
R141	0662057A81	RES, 22K
R142	0662057A81	RES, 22K
R143	0662057A81	RES, 22K
R144	0662057A75	RES, 12K
R145	0662057A81	RES, 22K
R146	0662057A81	RES, 22K
R147	0662057A81	RES, 22K
R148	0662057A81	RES, 22K
R149	0662057A81	RES, 22K
R150	0662057A89	RES, 47K
R151	0662057A70	RES, 7.5K

Circuit Ref.	Motorola Part No.	Description
R153	0662057A73	RES, 10K
R155	NOT PLACED	RES, 10K
R156	0662057A73	RES, 10K
R157	0662057A91	RES, 56K
R158	0662057A67	RES, 5.6K
R159	NOT PLACED	RES, 5.6K
R160	0662057A61	RES, 3.3K
R161	0662057A61	RES, 3.3K
R162	0662057A61	RES, 3.3K
R163	0662057A61	RES, 3.3K
R164	0662057A68	RES, 6.2K
R165	0662057A58	RES, 2.4K
R166	NOT PLACED	RES, 2.4K
R167	0662057A57	RES, 2.2K
R168	0662057A57	RES, 2.2K
R169	NOT PLACED	RES, 2.2K
R170	0662057A42	RES, 510
R171	0662057A33	RES, 220
R172	0662057A41	RES, 470
R173	0662057A29	RES, 150
R174	0662057A29	RES, 150
R175	NOT PLACED	RES, 220
R176	2413926N25	IDCTR, 120nH
R177	NOT PLACED	RES, 100
R178	0662057A14	RES, 36
R179	0662057A14	RES, 36
R180	0660082A89	RES, 47K
R181	0660082A89	RES, 47K
R182	0662057A73	RES, 10K
R185	0662057A73	RES, 10K

Circuit Ref.	Motorola Part No.	Description
R186	0662057C20	RES, 5.1
R188	NOT PLACED	RES, 0
R189	NOT PLACED	RES, 0
R190	0662057G64	RES, 1MEG
R191	0662057G64	RES, 1MEG
R195	0662057C01	RES, 0
R196	NOT PLACED	RES, 0
R197	0662057C19	RES, 4.7
R198	0662057C01	RES, 0
R199	0662057B47	RES, 0
R200	0662057A99	RES, 120K
R201	0662057B47	RES, 0
R202	NOT PLACED	RES, 0
R203	0662057B47	RES, 0
R204	NOT PLACED	RES, 0
R205	NOT PLACED	RES, 0
R206	0662057B02	RES, 150K
R207	0662057B02	RES, 150K
R208	0662057A18	RES, 51
R209	0662057A97	RES, 100K
R210	NOT PLACED	RES, 100K
R211	0662057A89	RES, 47K
R212	0662057A84	RES, 30K
R213	0662057A65	RES, 4.7K
R214	0662057A65	RES, 4.7K
R215	0662057A65	RES, 4.7K
R216	0662057A63	RES, 3.9K
R217	0662057A52	RES, 1.3K
R218	0662057A49	RES, 1K
R219	NOT PLACED	RES, 820

Circuit Ref.	Motorola Part No.	Description
R220	0662057A42	RES, 510
R221	0662057A33	RES, 220
R222	0662057A33	RES, 220
R223	0662057A33	RES, 220
R224	0662057A53	RES, 1.5K
R225	0662057A29	RES, 150
R226	0662057A29	RES, 150
R227	0662057A25	RES, 100
R228	0662057A25	RES, 100
R229	0662057A25	RES, 100
R230	0662057A25	RES, 100
R231	0662057A18	RES, 51
R232	0662057A17	RES, 47
R233	0662057A17	RES, 47
R234	0662057A15	RES, 39
R235	0662057A07	RES, 18
R300	0662057A73	RES, 10K
R301	0662057A41	RES, 470
R302	0662057B47	RES, 0
R303	0662057B47	RES, 0
R304	0662057A85	RES, 33K
R305	0662057A80	RES, 20K
R306	0662057A80	RES, 20K
R307	0662057A80	RES, 20K
R308	0662057A80	RES, 20K
R309	0662057A77	RES, 15K
R310	0662057A77	RES, 15K
R311	NOT PLACED	RES, 15K
R312	0662057A76	RES, 13K
R313	0662057A75	RES, 12K

Circuit Ref.	Motorola Part No.	Description
R314	0662057A75	RES, 12K
R315	0662057A75	RES, 12K
R316	0662057A75	RES, 12K
R317	0662057A75	RES, 12K
R318	0662057A75	RES, 12K
R319	0662057A75	RES, 12K
R320	0662057A73	RES, 10K
R321	0662057A71	RES, 8.2K
R322	0662057A65	RES, 4.7K
R323	0662057A65	RES, 4.7K
R324	0662057A61	RES, 3.3K
R325	0662057A61	RES, 3.3K
R326	0662057A58	RES, 2.4K
R327	0662057A58	RES, 2.4K
R328	0662057A55	RES, 1.8K
R329	0662057A51	RES, 1.2K
R330	0662057A49	RES, 1K
R331	0662057A45	RES, 680
R332	0662057A43	RES, 560
R333	0662057A40	RES, 430
R334	0662057A39	RES, 390
R335	0662057A33	RES, 220
R336	0662057A25	RES, 100
R337	0662057A25	RES, 100
R338	0662057A18	RES, 51
R339	0662057A18	RES, 51
R340	0662057A18	RES, 51
R341	0662057A01	RES, 10
R342	0662057A01	RES, 10
R343	0662057A01	RES, 10

Circuit Ref.	Motorola Part No.	Description
R344	0662057A01	RES, 10
R345	0662057A73	RES, 10K
R346	0662057A73	RES, 10K
R401	0662057C85	RES, 2.7K
R402	0662057B47	RES, 0
R403	0662057B47	RES, 0
R404	0662057B47	RES, 0
R405	0662057B47	RES, 0
R406	0662057B47	RES, 0
R407	0662057B47	RES, 0
R414	0662057B47	RES, 0
R415	NOT PLACED	RES, 0
R421	0662057A33	RES, 220
R422	0662057A73	RES, 10K
R423	NOT PLACED	RES, 100K
R424	NOT PLACED	RES, 100K
R425	0662057A97	RES, 100K
R426	0662057A97	RES, 100K
R427	NOT PLACED	RES, 100K
R428	0662057A97	RES, 100K
R429	0662057A97	RES, 100K
R430	0662057A87	RES, 39K
R431	NOT PLACED	RES, 10K
R432	0662057A85	RES, 33K
R433	0662057A85	RES, 33K
R434	0662057A85	RES, 33K
R435	0662057A85	RES, 33K
R436	0662057A85	RES, 33K
R438	0662057A73	RES, 10K
R439	0662057A73	RES, 10K

Circuit Ref.	Motorola Part No.	Description
R440	0662057A73	RES, 10K
R441	0662057A73	RES, 10K
R442	0662057A73	RES, 10K
R443	0662057A61	RES, 3.3K
R444	0662057A73	RES, 10K
R445	0662057A73	RES, 10K
R450	0662057A73	RES, 10K
R451	0662057A73	RES, 10K
R453	0662057A61	RES, 3.3K
R454	0662057A61	RES, 3.3K
R455	0662057A61	RES, 3.3K
R456	0662057A61	RES, 3.3K
R457	0662057A61	RES, 3.3K
R458	0662057A61	RES, 3.3K
R459	NOT PLACED	RES, 47K
R460	0662057A53	RES, 1.5K
R461	0662057A33	RES, 220
R462	0662057A18	RES, 51
R463	0662057A73	RES, 10K
R466	NOT PLACED	RES, 0
R467	NOT PLACED	RES, 0
R468	NOT PLACED	RES, 0
R469	NOT PLACED	RES, 0
R470	NOT PLACED	RES, 10K
R471	0662057A01	RES, 10
R472	NOT PLACED	RES, 100K
R473	NOT PLACED	RES, 100K
R600	0662057C01	RES, 0
R601	0611077A62	RES, 330
R602	0662057B47	RES, 0

Circuit Ref.	Motorola Part No.	Description
R610	0662057C59	RES, 220
R615	0662057A25	RES, 100
R5000	0662057B47	RES, 0
R5001	0662057T68	RES, 1K
R5002	NOT PLACED	RES, 0
R5008	0662057B47	RES, 0
R5009	0662057B47	RES, 0
R5010	0662057B47	RES, 0
R5011	NOT PLACED	RES, 0
R5013	NOT PLACED	RES, 0
R5014	0662057B47	RES, 0
R5016	NOT PLACED	RES, 1MEG
R5019	0662057B05	RES, 200K
R5020	0662057B02	RES, 150K
R5021	0662057A97	RES, 100K
R5022	0662057A97	RES, 100K
R5023	0662057A97	RES, 100K
R5024	NOT PLACED	RES, 100K
R5025	0662057A97	RES, 100K
R5026	0662057A85	RES, 33K
R5027	0662057B08	RES, 270K
R5028	0662057A97	RES, 100K
R5029	0662057A97	RES, 100K
R5030	0662057A85	RES, 33K
R5031	0662057A92	RES, 62K
R5032	0662057A89	RES, 47K
R5033	0662057A89	RES, 47K
R5034	0662057A86	RES, 36K
R5035	0662057A89	RES, 47K
R5036	0662057A89	RES, 47K

Circuit Ref.	Motorola Part No.	Description
R5037	0662057A73	RES, 10K
R5038	0662057A85	RES, 33K
R5039	0662057A97	RES, 100K
R5040	0662057A84	RES, 30K
R5041	0662057A82	RES, 24K
R5042	0662057A82	RES, 24K
R5043	0662057A82	RES, 24K
R5044	0662057A82	RES, 24K
R5045	0662057A85	RES, 33K
R5046	0662057A82	RES, 24K
R5047	0662057B47	RES, 0
R5048	0662057A82	RES, 24K
R5049	0662057A77	RES, 15K
R5050	0662057A76	RES, 13K
R5051	0662057A75	RES, 12K
R5052	0662057A73	RES, 10K
R5053	0662057A73	RES, 10K
R5054	0662057A73	RES, 10K
R5055	0662057A73	RES, 10K
R5056	0662057A73	RES, 10K
R5057	0662057A73	RES, 10K
R5058	NOT PLACED	RES, 10K
R5059	NOT PLACED	RES, 10K
R5060	0662057A73	RES, 10K
R5061	0662057A73	RES, 10K
R5062	0662057A73	RES, 10K
R5063	NOT PLACED	RES, 8.2K
R5064	NOT PLACED	RES, 8.2K
R5065	0662057A68	RES, 6.2K
R5066	0662057A49	RES, 1K

Circuit Ref.	Motorola Part No.	Description
R5067	NOT PLACED	RES, 6.2K
R5068	NOT PLACED	RES, 6.2K
R5069	0662057A73	RES, 10K
R5070	0662057A57	RES, 2.2K
R5071	0662057A57	RES, 2.2K
R5072	0662057A65	RES, 4.7K
R5073	0662057A49	RES, 1K
R5074	0662057A49	RES, 1K
R5075	0662057A42	RES, 510
R5076	0662057A42	RES, 510
R5077	0662057A36	RES, 300
R5078	0662057A25	RES, 100
R5079	0662057A25	RES, 100
R5080	0662057A01	RES, 10
R5081	0613952D78	RES, 6.34K
R5082	0662057A90	RES, 51K
R5083	0662057B08	RES, 270K
R5084	NOT PLACED	RES, 0
R5085	NOT PLACED	RES, 1MEG
R5086	0662057A43	RES, 560
R5087	0662057A97	RES, 100K
R5088	0662057B47	RES, 0
R5089	NOT PLACED	RES, 1MEG
R5092	0662057A73	RES, 10K
R5093	0662057A73	RES, 10K
R5094	NOT PLACED	RES, 1MEG
R5095	0662057A82	RES, 24K
R5096	0662057A73	RES, 10K
R5097	NOT PLACED	RES, 0
R5098	0662057B47	RES, 0

Circuit Ref.	Motorola Part No.	Description
R5099	NOT PLACED	RES, 100K
R5100	NOT PLACED	RES, 1MEG
R5103	NOT PLACED	RES, 24K
R5290	0662057A25	RES, 100
R5291	0662057A25	RES, 100
R6000	NOT PLACED	RES, 0
R6001	NOT PLACED	RES, 0
RT100	0680361L01	THERM, 47K
S5010	1889288U01	SWITCH, 50.K
SH200	2689590U01	SHIELD
SH201	2689589U01	SHIELD
SH202	2689589U01	SHIELD
SH300	2689591U01	SHIELD
SH301	2689593U01	SHIELD
SH302	2689591U01	SHIELD
T300	2580541Z01	XFMR
T301	2580541Z01	XFMR
U100	5180932W01	LM2904
U101	5185130C65	30C65, RF PREDRIVER
U102	NOT PLACED	LM2904, OPAMP
U103	5113819A04	MC3303
U200	5185963A27	63A27, LVFRACN
U201	5105750U54	50U54, VCOBIC
U300	5186144B01	SA616, IFIC
U301	5109522E10	TC7W04F, INVERTER
U302	4808612Y05	SMS3928_023, MIXER
U400	5102463J64	X25128-2.7, EEPROM
U402	5102463J36	SRM2B256, SRAM
U403	5102226J56	MC68HC11FL0, MICRO PROC
U404	5115037H01	4M FLASH ROM IC

Circuit Ref.	Motorola Part No.	Description
U405	5113805A75	MC74HC595A, SHIFT REG
U500	5180932W01	LM2904, OPAMP
U501	5102190C33	LM2941T, 9.3V REGULATOR
U502	5102463J95	TDA1519C, AUDIO PA
U503	5105469E65	LP2951C, 5V REGULATOR
U504	5185130C53	30C53, ASFIC CMP
U505	5180932W01	LM2904, OPAMP
U506	5180932W01	LM2904, OPAMP
U507	5180932W01	LM2904, OPAMP
U508	5113816A30	MC33269D, 3.3V REGULATOR
U509	5113806A20	MC14053B, MUX
U510	5104187K94	LP2986ILDY, 3.3V REGULATOR
U514	4802393L66	SI3455ADV, 12V P-Ch FET
U515	NOT PLACED	MAX4599EXT, SWITCH
VR101	4813830A15	MMBZ5232B, 5.6V ZENER
VR102	4813830A15	MMBZ5232B, 5.6V ZENER
VR105	4813830A15	MMBZ5232B, 5.6V ZENER
VR400	NOT PLACED	MMBZ5232B, 5.6V ZENER
VR401	4813830G12	MMSZ4687T1, 4.3V ZENER
VR402	4813830A09	MMBZ5226B, 3.3V ZENER
VR500	4813832C77	MR2835S, 24V ZENER
VR501	4813830A14	MMBZ5231B, 5.1V ZENER

Circuit Ref.	Motorola Part No.	Description
VR502	NOT PLACED	MMSZ4686T1, 3.9V ZENER
VR503	4813830G09	MMSZ4684, 3.3V ZENER
VR504	4813830G09	MMSZ4684, 3.3V ZENER
VR692	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR693	4813830A77	MMBZ33VAL, 33V DUAL ZENER
VR694	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR695	4813830A77	MMBZ33VAL, 33V DUAL ZENER
VR696	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR697	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR698	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR699	4813830A75	MMBZ20VAL, 20V DUAL ZENER
Y200	NOT PLACED	45J68, TCXO
Y201	4880114R06	14R06, 16.8MHZ XTAL OSC
Y300	9186145B02	45B02, 455KHZ XTAL
Y301	4880606B09	06B09, 44.395MHZ XTAL OSC

Notes



CM200/CM300/PM400 Radios

VHF2 (146–174 MHz) 1–25 W
Service Information

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Notes

MODEL CHART AND TECHNICAL SPECIFICATIONS

1.0 CM200/CM300/PM400 Model Chart

VHF2, 1–25 W, 146–174 MHz				
Model		Description		
	AAM50KNC9AA1AN	CM200 146–174 MHz, 1–25 W, 4 CH		
	AAM50KNF9AA1AN	CM300 146–174 MHz, 1–25 W, 32 CH		
	AAM50KNF9AA3AN	PM400 146–174 MHz, 1–25 W, 64 CH		
		Item	Description	
X		PMUD1871_	CM200 Super Tanapa VHF2, 1–25 W, 4 CH	
	X	PMUD1873_	CM300 Super Tanapa VHF2, 1–25 W, 32 CH	
		X	PMUD1904_	PM400 Super Tanapa VHF2, 1–25 W, 64 CH
X		FLD1933_	CM200 Tanapa VHF2, 1–25 W 4 CH	
	X	PMUD1882_	CM300 Tanapa VHF2, 1–25 W, 32 CH	
		X	PMUD1882_	PM400 Tanapa VHF2, 1–25 W, 64 CH
X		PMLN4598_	Control Head	
	X	PMLN4599_	Control Head	
		X	FLN3108_AN	Control Head
X		FLD1933_S	CM200 VHF2 Service Board	
	X	PMUD1882_S	CM300 VHF2 Service Board	
		X	PMUD1882_S	PM400 VHF2 Service Board
X		6902966C30	CM200 User Guide (bilingual)	
	X	6881096C22	CM300 User Guide (bilingual)	
		X	6881096C32	PM400 User Guide (bilingual)
X	X	HKLN4220	CM200/CM300 User Guide CDROM (bilingual)	
		X	HKLN4219	PM400 User Guide CDROM (bilingual)

x = Indicates one of each is required.

2.0 Technical Specifications

Data is specified for +25°C unless otherwise stated.

General	
Specification	VHF2
Frequency Range:	146–174 MHz
Frequency Stability (-30°C to +60°C, 25°C Ref.)	±2.5 PPM
Channel Capacity:	CM200 – 4 CM300 – 32 PM400 – 64
Channel Spacing:	12.5/20/25 kHz
Power Supply:	13.8 Vdc (11 Vdc – 16.6 Vdc) negative Vehicle ground
Dimensions (L x W x H)	4.65" X 6.67" X 1.73" (118mm X 169.5mm X 44mm)
Weight	2.25 lbs (1.01 kg)
FCC Description	AZ492FT3805
Operating Temperature	-30 to 60° C (Display only -20°C to 60°C)
Storage Temperature	-40 to 85° C
Thermal Shock	-40 to 80° C
High Humidity	95% RH @ 50° C for 8 hrs
ESD	15KV air discharge
Packing Test	Impact Test

Transmitter	
Specification	VHF2
Power Output	1–25W
Conducted/Radiated Emissions:	-36 dBm < 1 GHz -30 dBm > 1 GHz
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000 Hz)	TIA603 and CEPT
Tx Audio Distortion	< 3%
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz
FM Hum and Noise:	-40 dB@12.5 kHz -45 dB@25 kHz

Receiver	
Specification	VHF2
Sensitivity (12 dB SINAD):	0.35 μV @ 12.5 kHz 0.3 μV @ 25 kHz
Intermodulation:	65 dB@12.5 kHz 75 dB@25 kHz
Adjacent Channel Selectivity:	65 dB @ 12.5 kHz 75 dB @ 25 kHz
Spurious Response	75 dB
Rated Audio Power	4 W (typ.) Internal 7.5 W @ 5 % External
Audio Distortion	< 5 %
Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 25 kHz
Audio Response	TIA603 and CEPT
Conducted Spurious Emission per FCC Part 15:	-57 dBm <1 GHz -47 dBm >1 GHz

Specifications subject to change without notice. All electrical specifications and methods refer to EIA/TIA 603 standards.

Notes

Chapter 2

THEORY OF OPERATION

1.0 Introduction

This Chapter provides a detailed theory of operation for the VHF circuits in the radio. Details of the theory of operation and trouble shooting for the the associated Controller circuits are included in this Section of the manual.

2.0 VHF (146–174 MHz) Receiver

2.1 Receiver Front-End

The received signal is applied to the radio's antenna input connector and routed through the harmonic filter and antenna switch. The insertion loss of the harmonic filter/antenna switch is less than 1 dB. The signal is routed to the first filter (4-pole), which has an insertion loss of 2 dB typically. The output of the filter is matched to the base of the LNA (Q303) that provides a 16 dB gain and a noise figure of better than 2 dB. Current source Q301 is used to maintain the collector current of Q303. Diode CR301 protects Q303 by clamping excessive input signals. Q303 output is applied to the second filter (3-pole) which has an insertion loss of 1.5 dB. In Distance mode, Q304 turns on and causes D305 to conduct, thus bypassing C322 and R337. In Local mode, the signal is routed through C322 and R337, thus inserting 7 dB attenuation. Since the attenuator is located after the RF amplifier, the receiver sensitivity is reduced only by 6 dB, while the overall third order input intercept is raised.

The first mixer is a passive, double-balanced type, consisting of T300, T301 and U302. This mixer provides all of the necessary rejection of the half-IF spurious response. High-side injection at +15 dBm is delivered to the first mixer. The mixer output is then connected to a duplex network which matches its output to the XTAL filter input (FL300) at the IF frequency of 44.85 MHz. The duplex network terminates into a 50 ohm resistor (R340) at all other frequencies.

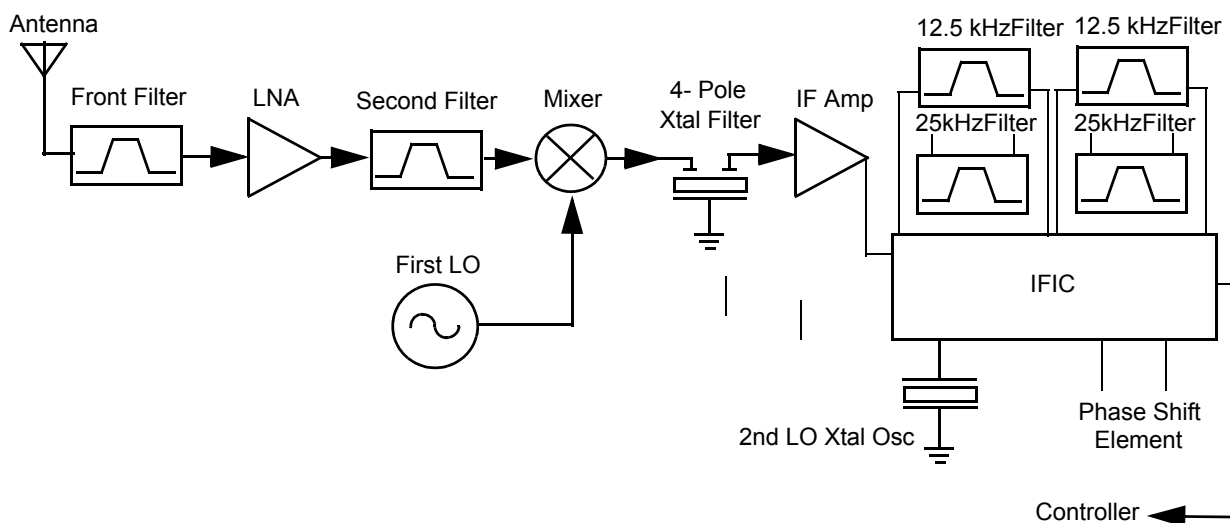


Figure 2-1 VHF Receiver Block Diagram

2.2 Receiver Back End

The IF signal from the crystal filter enters the IF amplifier which provides 20 dB of gain and feeds the IF IC at pin 1. The first IF signal at 44.85 MHz mixes with the second local oscillator (LO) at 44.395 MHz to produce the second IF at 455 kHz. The second LO uses the external crystal Y301. The second IF signal is amplified and filtered by two external ceramic filters (FL303/FL302 for 12.5 kHz channel spacing and FL304/FL301 for 25 kHz channel spacing). The IF IC demodulates the signal by means of a quadrature detector and feeds the detected audio (via pin 7) to the audio processing circuits. At IF IC pin 5, an RSSI signal is available with a dynamic range of 70 dB.

3.0 VHF Transmitter Power Amplifier (146–174 MHz)

The radio's 25 W PA is a three-stage amplifier used to amplify the output from the TX_INJ to the antenna port. All three stages utilize LDMOS technology. The gain of the first stage (U101) and the second stage (Q105) is adjustable and is controlled by pin 7 of U103-2 via U103-3 and U102-1. It is followed by an LDMOS final stage Q100.

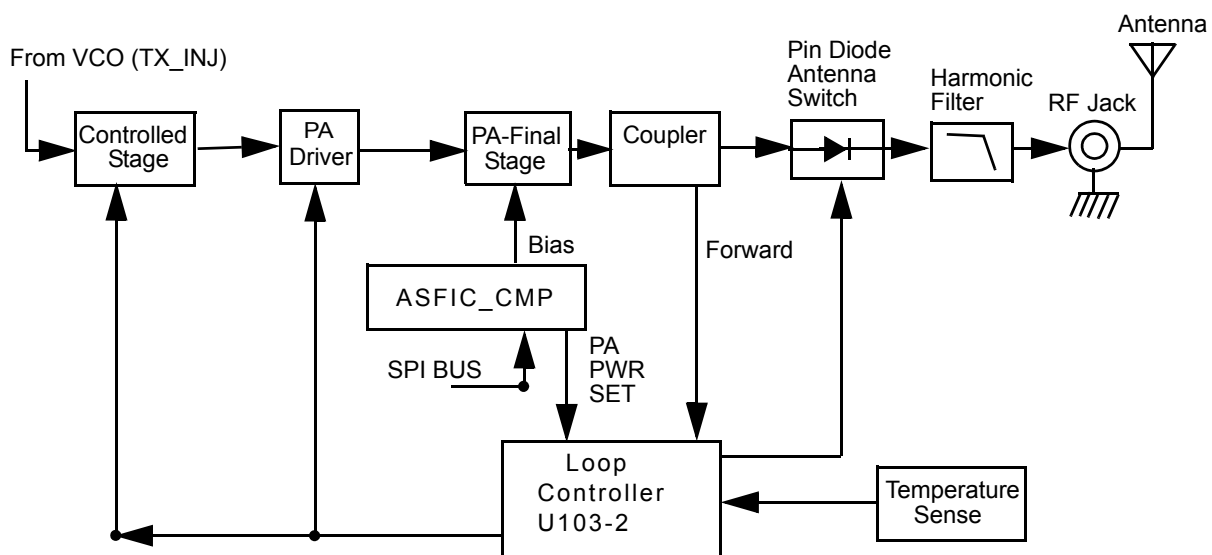


Figure 2-2 VHF Transmitter Block Diagram

Devices U101, Q105 and Q100 are surface mounted. A metal clip ensures good thermal contact between both the driver and final stage, and the chassis.

3.1 First Power Controller Stage

The first stage (U101) is a 20 dB gain integrated circuit containing two LDMOS FET amplifier stages. It amplifies the RF signal from the VCO (TX_INJ). The output power of stage U101 is controlled by a DC voltage applied to pin 1 from the op-amp U103-3, pin 8. The control voltage simultaneously varies the bias of two FET stages within U101. This biasing point determines the overall gain of U101 and therefore its output drive level to Q105, which in turn controls the output power of the PA.

Op-amp U103-3 monitors the drain current of U101 via resistor R122 and adjusts the bias voltage of U101.

In receive mode, the DC voltage from RX_EN line turns on Q101, which in turn switches off the biasing voltage to U101.

3.2 Power Controlled Driver Stage

The next stage is an LDMOS device (Q105) which provides a gain of 12 dB. This device requires a positive gate bias and a quiescent current flow for proper operation. The bias is set during transmit mode by the drain current control op-amp U102-1, and fed to the gate of Q105 via the resistive network.

Op-amp U102-1 monitors the drain current of Q105 via resistors R126-7 and adjusts the bias voltage of Q105 so that the current remains constant.

In receive mode the DC voltage from RX_EN line turns on Q102, which in turn switches off the biasing voltage to Q105.

3.3 Final Stage

The final stage is an LDMOS device (Q100) providing a gain of 12 dB. This device also requires a positive gate bias and a quiescent current flow for proper operation. The voltage of the line PA_BIAS is set in transmit mode by the ASFIC and fed to the gate of Q100 via the resistive network R134, R131. This bias voltage is tuned in the factory. If the transistor is replaced, the bias voltage must be tuned using the Tuner. Care must be taken not to damage the device by exceeding the maximum allowed bias voltage. The device's drain current is drawn directly from the radio's DC supply voltage input, B+, via L117 and L115.

A matching network consisting of C1004–5, C1008–9, C1021, C1013, C1019, L116: and two striplines, transforms the impedance to 50 ohms and feeds the directional coupler.

3.4 Bi-Directional Coupler

The bi-directional Coupler is a microstrip printed circuit, which couples a small amount of the forward and reverse power of the RF power from Q100. The coupled signal is rectified to an output power which is proportional to the DC voltage rectified by diode D105; and the resulting DC voltage is routed to the power control section to ensure that the forward power out of the radio is held to a constant value.

3.5 Antenna Switch

The antenna switch utilizes the existing dc feed (B+) to the last stage device (Q100). The basic operation is to have both PIN diodes (D103, D104) turned on during key-up by forward biasing them. This is achieved by pulling down the voltage at the cathode end of D104 to around 12.4 V (0.7 V drop across each diode). The current through the diodes needs to be set around 100 mA to fully open the transmit path through resistor R108. Q106 is a current source controlled by Q103 which is turned on in Tx mode by TX_EN. VR102 ensures that the voltage at resistor R107 never exceeds 5.6 V.

3.6 Harmonic Filter

Inductors L111, L112 and L113 along with capacitors C1011, C1024, C1025, C1022, C1020, C1016, C1017 and C1026 form a low-pass filter to attenuate harmonic energy coming from the transmitter. Resistor R150 along with L126 drains any electrostatic charges that might otherwise build up on the antenna. The harmonic filter also prevents high level RF signals above the receiver passband from reaching the receiver circuits to improve spurious response rejection.

3.7 Power Control

The output power is regulated by using a forward power detection control loop. A directional coupler samples a portion of the forward and reflected RF power. The forward sampled RF is rectified by diode D105, and the resulting DC voltage is routed to the operational amplifier U100. The error output current is then routed to an integrator, and converted into the control voltage. This voltage controls the bias of the pre-driver (U101) and driver (Q105) stages. The output power level is set by way of a DAC, PWR_SET, in the audio processing IC (U504), which acts at the forward power control loop reference.

The sampled reflected power is rectified by diode D107, The resulting DC voltage is amplified by an operational amplifier U100 and routed to the summing junction. This detector protects the final stage Q100 from reflected power by increasing the error current. The temperature sensor protects the final stage Q100 from overheating by increasing the error current. A thermistor RT100 measures the final stage Q100 temperature. The voltage divider output is routed to an operational amplifier U103 and then goes to the summing junction. The Zener Diode VR101 keeps the loop control voltage below 5.6 V and eliminates the DC current from the 9.3 regulator U501.

Two local loops for the Pre Driver (U101) and for the Driver (Q105) are used in order to stabilize the current for each stage.

In Rx mode, the two transistors Q101 and Q102 go to saturation and shut down the transmitter by applying ground to the Pre Driver U101 and for the Driver Q105 control.

4.0 VHF (146–174 MHz) Frequency Synthesis

The synthesizer consists of a reference oscillator (Y201), low voltage Fractional-N (LVFRAC-N) synthesizer (U200), and a voltage controlled oscillator (VCO) (U201).

4.1 Reference Oscillator

The reference oscillator is a crystal (Y201) controlled Colpitts oscillator and has a frequency of 16.8 MHz. The oscillator transistor and start-up circuit are located in the LVFRAC-N (U200) while the oscillator feedback capacitors, crystal, and tuning varactors are external. An analog-to-digital (A/D) converter internal to the LVFRAC-N (U200) and controlled by the microprocessor via SPI sets the voltage at the warp output of U200 pin 25. This sets the frequency of the oscillator. Consequently, the output of the crystal Y201 is applied to U200 pin 23.

The method of temperature compensation is to apply an inverse Bechmann voltage curve, which matches the crystal's Bechmann curve to a varactor that constantly shifts the oscillator back on frequency. The crystal vendor characterizes the crystal over a specified temperature range and codes this information into a bar code that is printed on the crystal package. In production, this crystal code is read via a 2-dimensional bar code reader and the parameters are saved.

This oscillator is temperature compensated to an accuracy of ± 2.5 PPM from -30 to 60 degrees C. The temperature compensation scheme is implemented by an algorithm that uses five crystal parameters (four characterize the inverse Bechmann voltage curve and one for frequency accuracy of the reference oscillator at 25 degrees C). This algorithm is implemented by the LVFRAC-N (U200) at the power up of the radio.

4.2 Fractional-N Synthesizer

The LVFRAC-N U200 consists of a pre-scaler, programmable loop divider, control divider logic, phase detector, charge pump, A/D converter for low frequency digital modulation, balanced attenuator used to balance the high and low frequency analog modulation, 13 V positive voltage multiplier, serial interface for control, and a super filter for the regulated 5 volts.

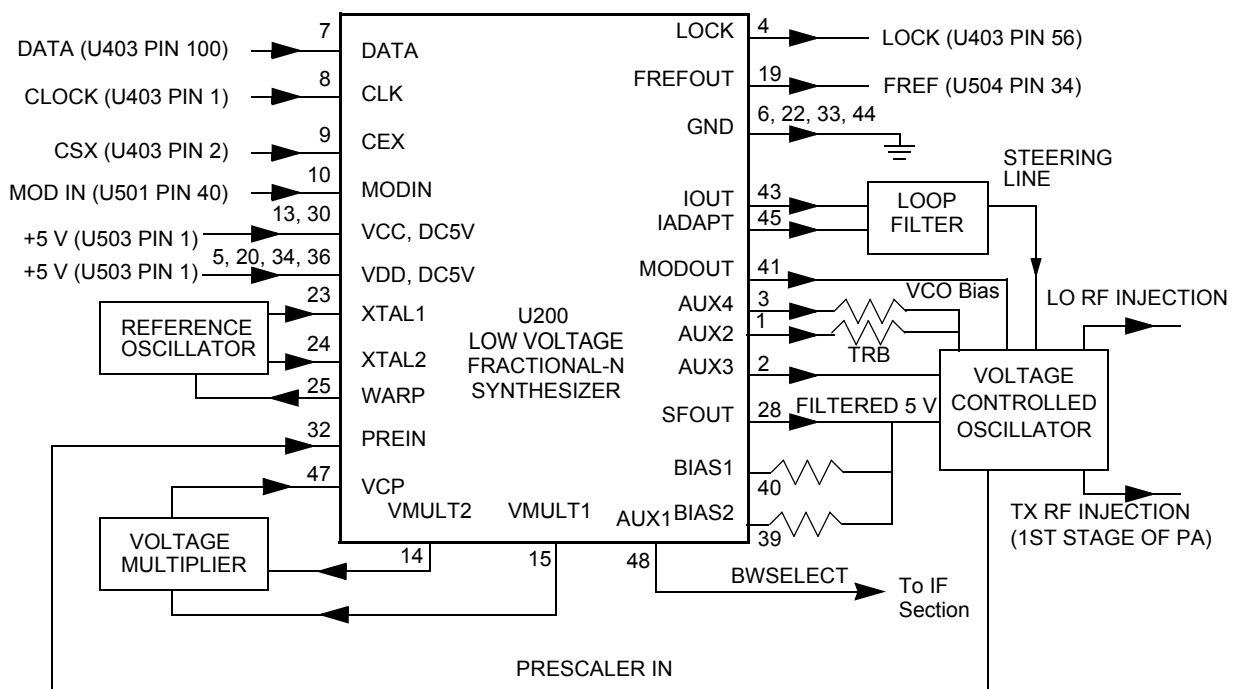


Figure 2-3 VHF Synthesizer Block Diagram

A voltage of 5 V applied to the super filter input (U200, pin 30) supplies an output voltage of 4.5 Vdc (VSF) at U200, pin 28. This supplies 4.5 V to the VCO Buffer IC U201.

To generate a high voltage to supply the phase detector (charge pump) output stage at pin VCP (U200, pin 47) while using a low voltage 3.3 Vdc supply, a 13 V positive voltage multiplier is used (D200, D201, and capacitors C2024, 2025, 2026, 2055, 2027, 2001).

Output lock (U200, pin 4) provides information about the lock status of the synthesizer loop. A high level at this output indicates a stable loop. A 16.8 MHz reference frequency is provided at U200, pin 19.

4.3 Voltage Controlled Oscillator (VCO)

The Voltage Controlled Oscillator (VCO) consists of the VCO/Buffer IC (VCOBIC, U201), the TX and RX tank circuits, the external RX amplifier, and the modulation circuitry.

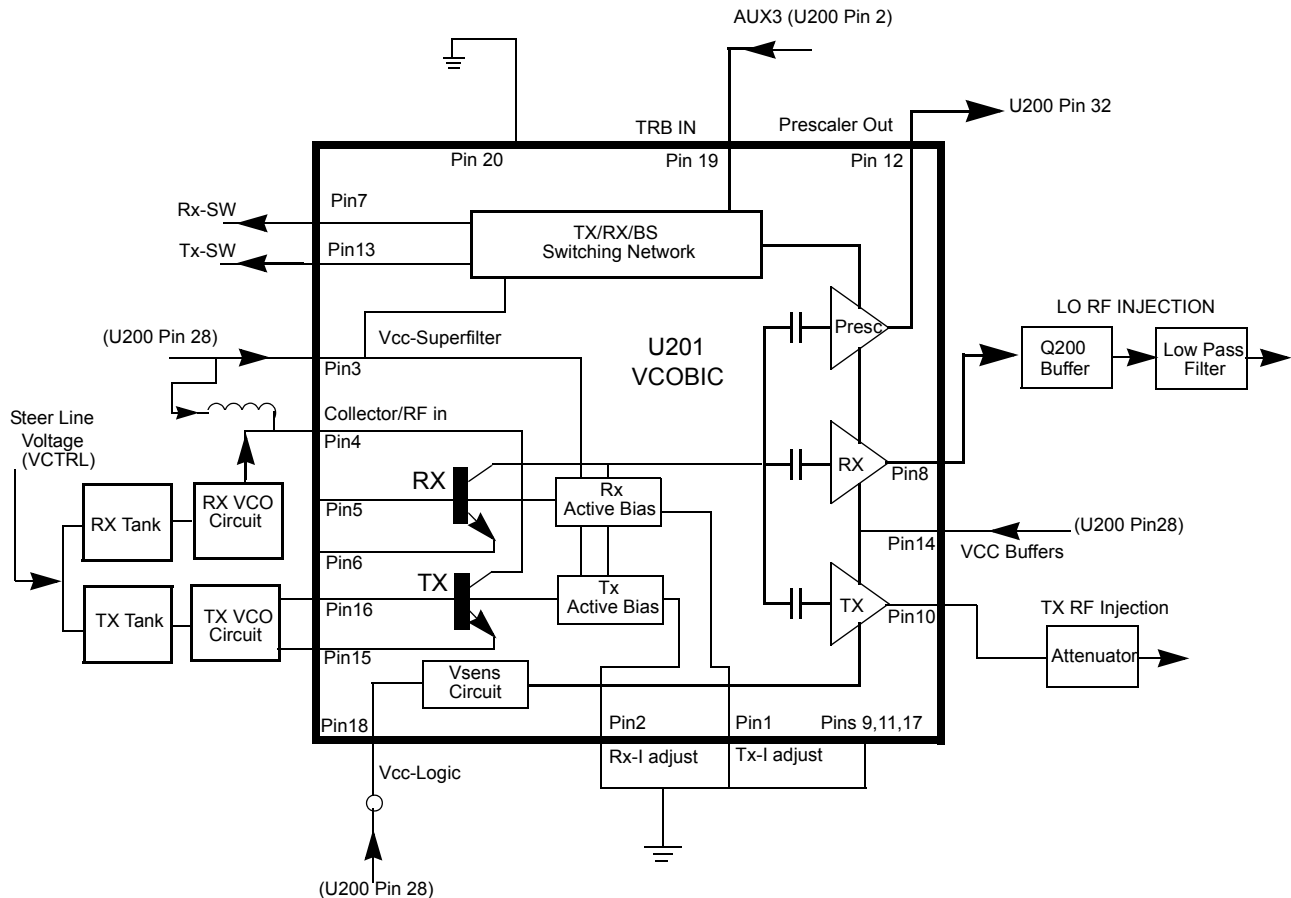


Figure 2-4 VHF VCO Block Diagram

The VCOBIC together with the LVFRAC-N (U200) generate the required frequencies in both transmit and receive modes. The TRB line (U201, pin 19) determines which VCO and buffer is enabled (high being TX output at pin 10, low being RX output at pin 8). A sample of the signal from the enabled output is routed from U201, pin 12 (PRESC_OUT), via a low pass filter to U200, pin 32 (PREIN).

A steering line voltage between 3.0 V and 10.0 V at varactor D204 tunes the TX VCO through the frequency range of 146–174 MHz, and at D203 tunes the RX VCO through the frequency range of 190–219 MHz.

The external RX amplifier is used to increase the output from U201, pin 9 from 3–4 dBm to the required 15dBm for proper mixer operation. In TX mode, the modulation signal from the LVFRAC-N (U200, pin 41) is applied to the VCO by way of the modulation circuit D205, R212, R211, C2073.

4.4 Synthesizer Operation

The synthesizer consists of a low voltage FRAC-N IC (LVFRAC-N), reference oscillator, charge pump circuits, loop filter circuit, and DC supply. The output signal (PRESC_OUT) of the VCOBIC (U201, pin 12) is fed to the PREIN, pin 32 of U200 via a low pass filter which attenuates harmonics and provides a correct input level to the LVFRAC-N in order to close the synthesizer loop.

The pre-scaler in the synthesizer (U200) is a dual modulus pre-scaler with selectable divider ratios. The divider ratio of the pre-scaler is controlled by the loop divider, which in turn receives its inputs via the SPI. The output of the pre-scaler is applied to the loop divider. The output of the loop divider is connected to the phase detector, which compares the loop divider's output signal with the reference signal. The reference signal is generated by dividing down the signal of the reference oscillator (Y201).

The output signal of the phase detector is a pulsed dc signal that is routed to the charge pump. The charge pump outputs a current from U200, pin 43 (IOUT). The loop filter (consisting of R224, R217, R234, C2074, C2075, C2077, C2078, C2079, C2080, C2028, and L205) transforms this current into a voltage that is applied to the varactor diodes D203 and D204 for RX and TX respectively. The output frequency is determined by this control voltage. The current can be set to a value fixed in the LVFRAC-N or to a value determined by the currents flowing into BIAS 1 (U200, pin 40) or BIAS 2 (U200, pin 39). The currents are set by the value of R200 or R206 respectively. The selection of the three different bias sources is done by software programming.

To modulate the synthesizer loop, a two-spot modulation method is utilized via the MODIN (U200, pin 10) input of the LVFRAC-N. The audio signal is applied to both the A/D converter (low frequency path) and the balance attenuator (high frequency path). The A/D converter converts the low frequency analog modulating signal into a digital code which is applied to the loop divider, thereby causing the carrier to deviate. The balance attenuator is used to adjust the VCO's deviation sensitivity to high frequency modulating signals. The output of the balance attenuator is presented at the MODOUT port of the LVFRAC-N (U200, pin 41) and connected to the VCO modulation varactor D205.

5.0 Controller Theory of Operation

This section provides a detailed theory of operation for the radio and its components. The main radio is a single-board design, consisting of the transmitter, receiver, and controller circuits. A control head is connected by an extension cable. The control head contains LED indicators, a microphone connector, buttons, and speaker.

In addition to the power cable and antenna cable, an accessory cable can be attached to a connector on the rear of the radio. The accessory cable enables you to connect accessories to the radio, such as an external speaker, emergency switch, foot-operated PTT, and ignition sensing, etc.

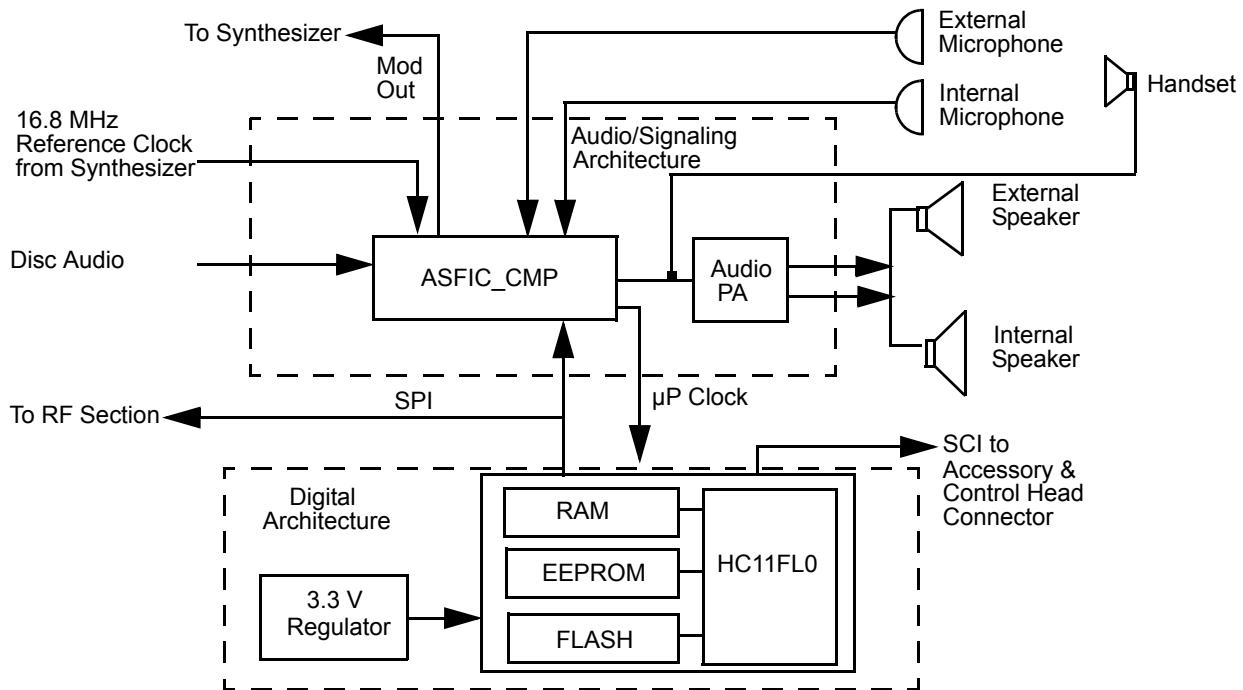


Figure 2-5 Controller Block Diagram

5.1 Radio Power Distribution

Voltage distribution is provided by five separate devices:

- U514 P-cH FET – Batt + (Ext_SWB+)
- U501 LM2941T – 9.3 V
- U503 LP2951CM – 5 V
- U508 MC 33269DTRK – 3.3 V
- U510 LP2986ILDY – 3.3 V Digital

The DC voltage applied to connector P2 supplies power directly to the following circuitry:

- Electronic on/off control
- RF power amplifier
- 12 volts P-CH FET –U514
- 9.3 volt regulator
- Audio PA

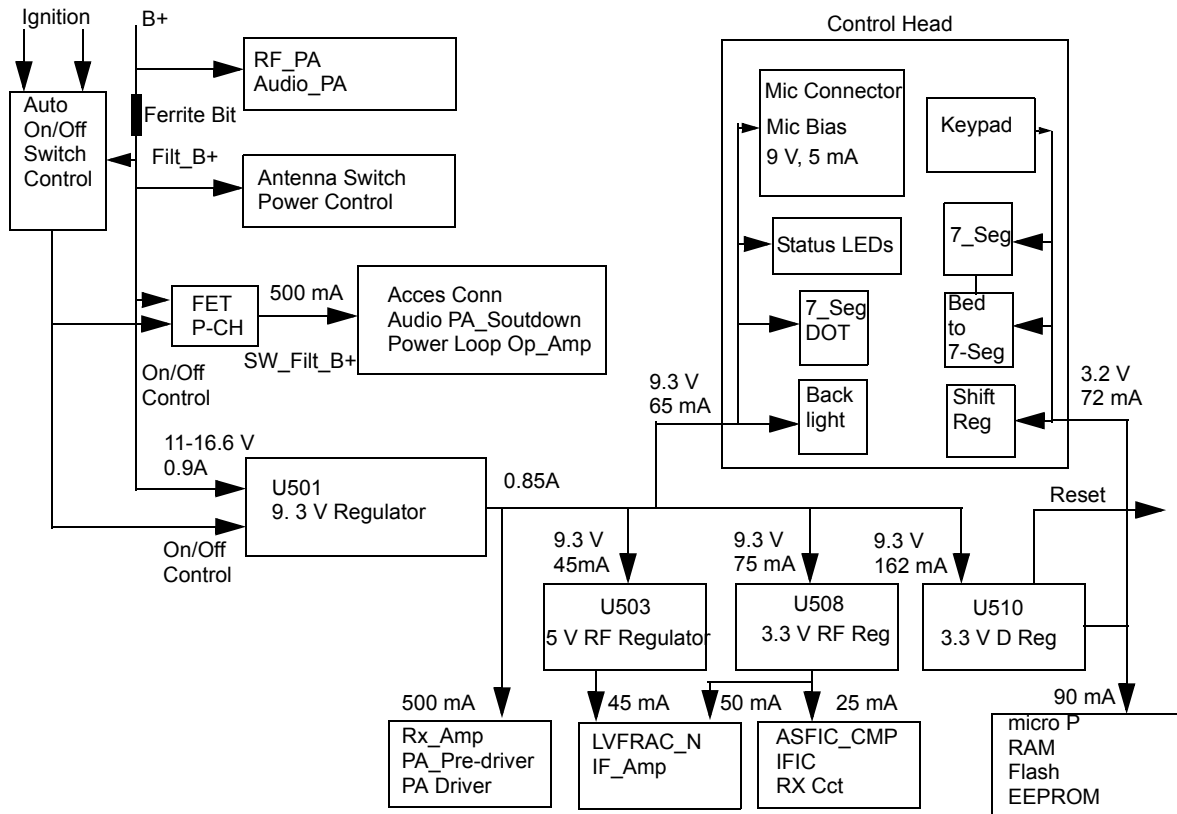


Figure 2-6 DC Power Distribution Block Diagram

Regulator U501 is used to generate the 9.3 volts required by some audio circuits, the RF circuitry and power control circuitry. Input and output capacitors are used to reduce high frequency noise. Resistors R5001 / R5081 set the output voltage of the regulator. This regulator output is electronically enabled by a 0 volt signal on pin 2. Q502, Q505 and R5038 are used to disable the regulator when the radio is turned off.

Voltage regulator U510 provides 3.3 volts for the digital circuitry. Operating voltage is from the regulated 9.3 V supply. Input and output capacitors are used to reduce high frequency noise and provide proper operation during battery transients. U510 provides a reset output that goes to 0 volts if the regulator output goes below 3.1 volts. This is used to reset the controller to prevent improper operation.

Voltage regulator U508 provides 3.3 V for the RF circuits and ASFIC_CMP. Input and output capacitors are used to reduce the high frequency noise and provide proper operation during battery transients.

Voltage regulator U503 provides 5 V for the RF circuits. Input and output capacitors are used to reduce the high frequency noise and provide proper operation during battery transients.

5.2 Protection Devices

Diode VR500 acts as protection against ESD, wrong polarity of the supply voltage, and load dump. VR692 – VR699 are for ESD protection.

5.3 Automatic On/Off

The radio can be switched ON in any one of the following three ways:

- On/Off switch. (No Ignition Mode)
- Ignition and On/Off switch (Ignition Mode)
- Emergency

5.3.1 No Ignition Mode

When the radio is connected to the car battery for the first time, Q500 will be in saturation, Q503 will cut-off, Filt_B+ will pass through R5073, D500, and S5010-pin 6 (On/Off switch). When S5010 is ON, Filt_B+ will pass through S5010-pin5, D511, R5069, R5037 and base of Q505 and move Q505 into saturation. This pulls U501-pin2 through R5038, D502 to 0.2 V and turns On U514 and U501 9.3 V regulator which supplies voltage to all other regulators and consequently turns the radio on, When U504 (ASFIC_CMP) gets 3.3 V, GCB2 goes to 3.3 V and holds Q505 in saturation, for soft turn off.

5.3.2 Ignition Mode

When ignition is connected for the first time, it will force high current through Q500 collector, This will move Q500 out of saturation and consequently Q503 will cut-off. S5010 pin 6 will get ignition voltage through R601 (for load dump), R610, (R610 & C678 are for ESD protection), VR501, R5074, and D500. When S5010 is ON, Filt_B+ passes through S5010-pin 5, D511, R5069, R5037 and base of Q505 and inserts Q505 into saturation. This pulls U501-pin 2 through R5038, D502 to 0.2 V and turns on U514 and U501 9.3 V regulator which supply voltage to all other regulators and turns the radio on, When U504 (ASFIC_CMP) get 3.3 V supply, GCB2 goes to 3.3 V and holds Q505 in saturation state to allow soft turn off,

When ignition is off Q500, Q503 will stay at the same state so S5010 pin 6 will get 0 V from Ignition, Q504 goes from Sat to Cut, ONOFF_SENSE goes to 3.3 V and it indicates to the radio to soft turn itself by changing GCB2 to '0' after de registration if necessary.

5.3.3 Emergency Mode

The emergency switch (P1 pin 9), when engaged, grounds the base of Q506 via EMERGENCY_ACCES_CONN. This switches Q506 to off and consequently resistor R5020 pulls the collector of Q506 and the base of Q506 to levels above 2 volts. Transistor Q502 switches on and pulls U501 pin2 to ground level, thus turning ON the radio. When the emergency switch is released R5030 pulls the base of Q506 up to 0.6 volts. This causes the collector of transistor Q506 to go low (0.2 V), thereby switching Q502 to off.

While the radio is switched on, the μP monitors the voltage at the emergency input on the accessory connector via U403-pin 62. Three different conditions are distinguished: no emergency kit is connected, emergency kit connected (unpressed), and emergency press.

If no emergency switch is connected or the connection to the emergency switch is broken, the resistive divider R5030 / R5049 will set the voltage to about 3.14 volts (indicates no emergency kit found via EMERGENCY_SENSE line). If an emergency switch is connected, a resistor to ground within the emergency switch will reduce the voltage on EMERGENCY_SENSE line, and indicate to the μP that the emergency switch is operational. An engaged emergency switch pulls line EMERGENCY_SENSE line to ground level. Diode VR503 limits the voltage to protect the μP input.

While EMERGENCY_ACCES_CONN is low, the μP starts execution, reads that the emergency input is active through the voltage level of μP pin 64, and sets the DC POWER ON output of the ASFIC CMP pin 13 to a logic high. This high will keep Q505 in saturation for soft turn off.

5.4 Microprocessor Clock Synthesiser

The clock source for the μP system is generated by the ASFIC CMP (U504). Upon power-up the synthesizer IC (FRAC-N) generates a 16.8 MHz waveform that is routed from the RF section to the ASFIC CMP pin 34. For the main board controller the ASFIC CMP uses 16.8 MHz as a reference input clock signal for its internal synthesizer. The ASFIC CMP, in addition to audio circuitry, has a programmable synthesizer which can generate a synthesized signal ranging from 1200 Hz to 32.769 MHz in 1200 Hz steps.

When power is first applied, the ASFIC CMP will generate its default 3.6864 MHz CMOS square wave UP CLK (on U504 pin 28) and this is routed to the μP (U403 pin 90). After the μP starts operation, it reprograms the ASFIC CMP clock synthesizer to a higher UP CLK frequency (usually 7.3728 or 14.7456 MHz) and continues operation.

The ASFIC CMP may be reprogrammed to change the clock synthesizer frequencies at various times depending on the software features that are executing. In addition, the clock frequency of the synthesizer is changed in small amounts if there is a possibility of harmonics of the clock source interfering with the desired radio receive frequency.

The ASFIC CMP synthesizer loop uses C5025, C5024 and R5033 to set the switching time and jitter of the clock output. If the synthesizer cannot generate the required clock frequency it will switch back to its default 3.6864 MHz output.

Because the ASFIC CMP synthesizer and the μP system will not operate without the 16.8 MHz reference clock it (and the voltage regulators) should be checked first when debugging the system.

5.5 Serial Peripheral Interface (SPI)

The μ P communicates to many of the IC's through its SPI port. This port consists of SPI TRANSMIT DATA (MOSI) (U403-pin100), SPI RECEIVE DATA (MISO) (U403-pin 99), SPI CLK (U0403-pin1) and chip select lines going to the various IC's, connected on the SPI PORT (BUS). This BUS is a synchronous bus, in that the timing clock signal CLK is sent while SPI data (SPI TRANSMIT DATA or SPI RECEIVE DATA) is sent. Therefore, whenever there is activity on either SPI TRANSMIT DATA or SPI RECEIVE DATA there should be a uniform signal on CLK. The SPI TRANSMIT DATA is used to send serial from a μ P to a device, and SPI RECEIVE DATA is used to send data from a device to a μ P.

There are two IC's on the SPI BUS, ASFIC CMP (U504 pin 22), and EEPROM (U400). In the RF sections there is one IC on the SPI BUS, the FRAC-N Synthesizer. The chip select line CSX from U403 pin 2 is shared by the ASFIC CMP and FRAC-N Synthesizer. Each of these IC's check the SPI data and when the sent address information matches the IC's address, the following data is processed.

When the μ P needs to program any of these Is it brings the chip select line CSX to a logic "0" and then sends the proper data and clock signals. The amount of data sent to the various IC's are different; e.g., the ASFIC CMP can receive up to 19 bytes (152 bits). After the data has been sent the chip select line is returned to logic "1".

5.6 SBEP Serial Interface

The SBEP serial interface allows the radio to communicate with the Customer Programming Software (CPS), or the Global Tuner via the Radio Interface Box (RIB) or the cable with internal RIB. This interface connects to the SCI pin via control head connector (J2-pin 17) and to the accessory connector P1-6 and comprises BUS+. The line is bi-directional, meaning that either the radio or the RIB can drive the line. The μ P sends serial data and it reads serial data via pin 97. Whenever the μ P detects activity on the BUS+ line, it starts communication.

5.7 General Purpose Input/Output

The controller provides six general purpose lines (PROG I/O) available on the accessory connector P1 to interface to external options. Lines PROG IN 3 and 6 are inputs, PROG OUT 4 is an output and PROG IN OUT 8, 12 and 14 are bi-directional. The software and the hardware configuration of the radio model define the function of each port.

- PROG IN 3 can be used as external PTT input, or others, set by the CPS. The μ P reads this port via pin 72 and Q412.
- PROG OUT 4 can be used as external alarm output, set by the CPS. Transistor Q401 is controlled by the μ P (U403 pin 55)
- PROG IN 6 can be used as normal input, set by the CPS. The μ P reads this port via pin 73 and Q411. This pin is also used to communicate with the RIB if resistor R421 is placed.
- DIG IN OUT 8,12,14 are bi-directional and use the same circuit configuration. Each port uses an output Q416, Q404, Q405 controlled by μ P pins 52, 53, 54. The input ports are read through μ P pins 74, 76, 77; using Q409, Q410, Q411

5.8 Normal Microprocessor Operation

For this radio, the μP is configured to operate in one of two modes, expanded and bootstrap. In expanded mode the μP uses external memory devices to operate, whereas in bootstrap operation the μP uses only its internal memory. In normal operation of the radio the μP is operating in expanded mode as described below.

During normal operation, the μP (U403) is operating in expanded mode and has access to 3 external memory devices; U400 (EEPROM), U402 (SRAM), U404 (Flash). Also, within the μP there are 3 Kilobytes of internal RAM, as well as logic to select external memory devices.

The external EEPROM (U400) space contains the information in the radio which is customer specific, referred to as the codeplug. This information consists of items such as: 1) what band the radio operates in, 2) what frequencies are assigned to what channel, and 3) tuning information.

The external SRAM (U402) as well as the μP 's own internal RAM space are used for temporary calculations required by the software during execution. All of the data stored in both of these locations is lost when the radio powers off.

The μP provides an address bus of 16 address lines (ADDR 0 – ADDR 15), and a data bus of 8 data lines (DATA 0 – DATA 7). There are also 3 control lines; CSProg (U403-38) to chip select U404-pin 30 (FLASH), CSGP2 (U403-pin 41) to chip select U404-pin 20 (SRAM) and PG7_R_W (U403-pin 4) to select whether to read or to write. The external EEPROM (U400-pin1).

When the μP is functioning normally, the address and data lines should be toggling at CMOS logic levels. Specifically, the logic high levels should be between 3.1 and 3.3 V, and the logic low levels should be between 0 and 0.2 V. No other intermediate levels should be observed, and the rise and fall times should be <30 ns.

The low-order address lines (ADDR 0 – ADDR 7) and the data lines (DATA 0–DATA 7) should be toggling at a high rate, e.g., you should set your oscilloscope sweep to 1us/div. or faster to observe individual pulses. High speed CMOS transitions should also be observed on the μP control lines.

On the μP the lines XIRQ (U403-pin 48), MODA LIR (U403-pin 58), MODB VSTPY (U403-pin 57) and RESET (U403-pin 94) should be high at all times during normal operation. Whenever a data or address line becomes open or shorted to an adjacent line, a common symptom is that the RESET line goes low periodically, with the period being in the order of 20ms. In the case of shorted lines you may also detect the line periodically at an intermediate level, i.e. around 2.5 V when two shorted lines attempt to drive to opposite rails.

The MODA LIR (U403-pin 58) and MODB VSTPY (U403-pin 57) inputs to the μP must be at a logic "1" for it to start executing correctly. After the μP starts execution it will periodically pulse these lines to determine the desired operating mode. While the Central Processing Unit (CPU) is running, MODA LIR is an open-drain CMOS output which goes low whenever the μP begins a new instruction. An instruction typically requires 2–4 external bus cycles, or memory fetches.

There are eight analog-to-digital converter ports (A/D) on U403 labelled within the device block as PEO–PE7. These lines sense the voltage level ranging from 0 to 3.3 V of the input line and convert that level to a number ranging from 0 to 255 which is read by the software to take appropriate action.

5.9 Static Random Access Memory (SRAM)

The SRAM (U402) contains temporary radio calculations or parameters that can change very frequently, and which are generated and stored by the software during its normal operation. The information is lost when the radio is turned off.

The device allows an unlimited number of write cycles. SRAM accesses are indicated by the CS signal U402 (which comes from U403-CSGP2) going low. U402 is commonly referred to as the external RAM as opposed to the internal RAM which is the 3 Kilobytes of RAM which is part of the 68HC11FL0. Both RAM spaces serve the purpose. However, the internal RAM is used for the calculated values which are accessed most often.

Capacitor C402 and C411 serves to filter out any AC noise which may ride on +3.3 V at U402

6.0 Control Board Audio and Signalling Circuits

6.1 Audio Signalling Filter IC and Compander (ASFIC CMP)

The ASFIC CMP (U504) used in the controller has the following four functions:

1. RX/TX audio shaping, i.e. filtering, amplification, attenuation
2. RX/TX signaling, PL/DPL/HST/MDC
3. Squelch detection
4. μ P clock signal generation

The ASFIC CMP is programmable through the SPI BUS (U504 pins-20/21/22), normally receiving 19 bytes. This programming sets up various paths within the ASFIC CMP to route audio and/or signaling signals through the appropriate filtering, gain and attenuator blocks. The ASFIC CMP also has 6 General Control Bits GCB0–5 which are CMOS level outputs and used for the following:

- GCB0 – BW Select
- GCB1 – switches the audio PA On/Off
- GCB2 – DC Power On switches the voltage regulator (and the radio) on and off
- GCB3 – Control on MUX U509 pin 9 to select between Low Cost Mic path to STD Mic Path
- GCB4 – Control on MUX U509 pin 11 to select between Flat RX path to filtered RX path on the accessory connector.
- GCB5 – Control on MUX U509 pin 10 to select between Flat TX path mute and Flat TX path

7.0 Transmit Audio Circuits

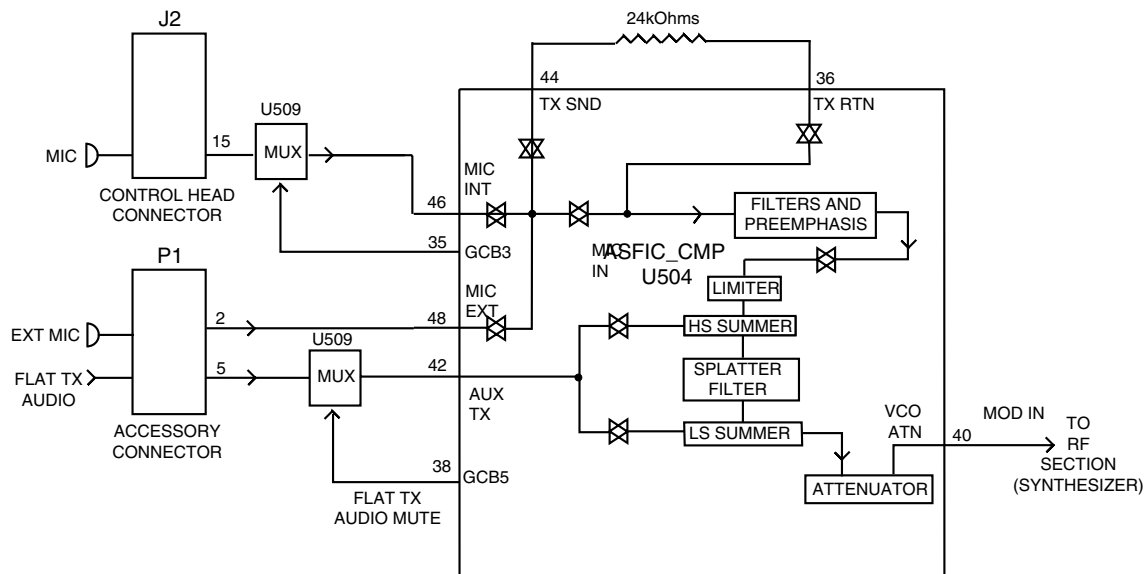


Figure 2-7 Transmit Audio Paths

7.1 Microphone Input Path

The radio supports 2 distinct microphone paths known as internal (from control head J2–15) and external mic (from accessory connector P1–2) and an auxiliary path (FLAT TX AUDIO, from accessory connector P1–5). The microphones used for the radio require a DC biasing voltage provided by a resistive network.

The two microphone audio input paths enter the ASFIC CMP at U504-pin 48 (external mic) and U504-pin 46 (internal mic). The microphone is plugged into the radio control head and connected to the audio DC via J2-pin 15. The signal is then routed via C5045 to MUX U509 that select between two paths with different gain to support Low Cost Mic (Mic with out amplifier in it) and Standard Mic.

7.1.1 Low Cost Microphone

Hook Pin is shorted to Pin 1 (9.3 V) inside the Low Cost Mic, This routes 9.3 V to R429, and creates 2.6 V on MIC_SENSE (u.P U403-67) by Voltage Divider R429/R430. U403 senses this voltage and sends command to ASFIC_CMP U504 to get GCB3 = '0'. The audio signal is routed from C5045 via U509-5 (Z0), R5072, U507, R5026, C5091, R5014 via C5046 to U504- 46 int. mic (C5046 100nF creates a 159 Hz pole with U504- 46 int mic impedance of 16Kohm).

7.1.2 Standard Microphone

Hook Pin is shorted to the hook mic inside the standard Mic, If the mic is out off hook, 3.3 V is routed to R429 via R458, D401, and it create 0.7 V on MIC_SENSE (u.P U403-67) by Voltage Divider R429/R430. U403 senses this voltage and sends command to ASFIC_CMP U504 to get GCB3 = '1'. The audio signal is routed from C5045 via U509-3 (Z1), R5072, U507, R5026, C5091, R5014 via C5046 to U504- 46 int mic (C5046 100nF create a 159 Hz pole with U504- 46 int mic impedance of 16Kohm). 9.3 Vdc is routed via R5077, R5075 to J2-15, It create 4.65 V with Mic Impedance. C5010 supplies AC Ground to create AC impedance of 510 Ohms via R5075. and Filter 9.3 dc mic bias supply.

Note: The audio signal at U504-pin 46 should be approximately 12 mV for 1.5 kHz or 3 kHz of deviation with 12.5 kHz or 25 kHz channel spacing.

The external microphone signal enters the radio on accessory connector P1 pin 2 and is routed via line EXT MIC to R5054. R5078 and R5076 provide the 9.3 Vdc bias. Resistive divider R5054/ R5070 divide the input signal by 5.5 and provide input protection for the CMOS amplifier input. R5076 and C5009 provide a 510 ohm AC path to ground that sets the input impedance for the microphone and determines the gain based on the emitter resistor in the microphone's amplifier circuit.

C5047 serves as a DC blocking capacitor. The audio signal at U504-pin 48 should be approximately 14 mV for 1.5 kHz or 3 kHz of deviation with 12.5 kHz or 25 kHz channel spacing.

The FLAT TX AUDIO signal from accessory connector P1-pin 5 is fed to the ASFIC CMP (U504 pin 42 through U509 pin 2 to U509 pin 15 via U506 OP-AMP circuit and C5057.

The ASFIC has an internal AGC that can control the gain in the mic audio path. The AGC can be disabled / enabled by the μ P. Another feature that can be enabled or disabled in the ASFIC is the VOX. This circuit, along with Capacitor C5023 at U504-pin 7, provides a DC voltage that can allow the μ P to detect microphone audio. The ASFIC can also be programmed to route the microphone audio to the speaker for public address operation.

7.2 PTT Sensing and TX Audio Processing

Internal microphone PTT is sensed by μ P U403 pin 71. Radio transmits when this pin is "0" and selects inside the ASFIC_CMP U504 internal Mic path. When the internal Mic PTT is "0" then external Mic PTT is grounded via D402. External Mic PTT is sensed by U403 pin 72 via Q412 circuits. The radio transmits when this pin is "0" and selects inside the ASFIC_CMP U504 External Mic path.

Inside the ASFIC CMP, the mic audio is filtered to eliminate frequency components outside the 300–3000 Hz voice band, and pre-emphasized if pre-emphasis is enabled. The signal is then limited to prevent the transmitter from over deviating. The limited mic audio is then routed through a summer, which is used to add in signaling data, and then to a splatter filter to eliminate high frequency spectral components that could be generated by the limiter. The audio is then routed to an attenuator, which is tuned in the factory or the field to set the proper amount of FM deviation. The TX audio emerges from the ASFIC CMP at U504-pin 40 MOD IN, at which point it is routed to the RF section.

8.0 Transmit Signalling Circuits

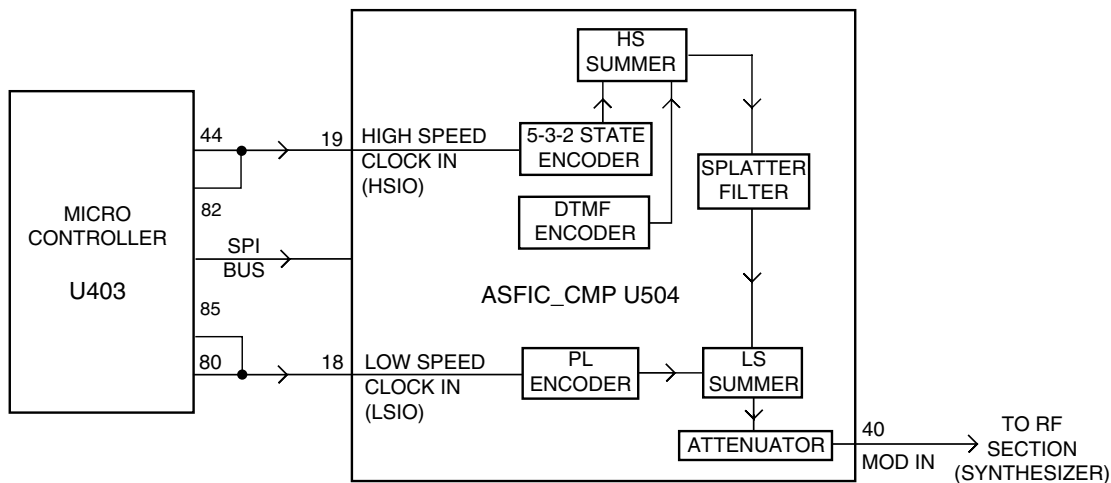


Figure 2-8 Transmit Signalling Path

From a hardware point of view, there are 3 types of signaling:

- Sub-audible data (PL / DPL / Connect Tone) that gets summed with transmit voice or signaling,
- DTMF data for telephone communication in trunked and conventional systems, and
- Audible signaling including MDC and high-speed trunking.

Note: All three types are supported by the hardware while the radio software determines which signaling type is available.

8.1 Sub-Audio Data (PL/DPL)

Sub-audible data implies signaling whose bandwidth is below 300 Hz. PL and DPL waveforms are used for conventional operation and connect tones for trunked voice channel operation. The trunking connect tone is simply a PL tone at a higher deviation level than PL in a conventional system. Although it is referred to as “sub-audible data”, the actual frequency spectrum of these waveforms may be as high as 250 Hz, which is audible to the human ear. However, the radio receiver filters out any audio below 300 Hz, so these tones are never heard in the actual system.

Only one type of sub-audible data can be generated by U504 (ASFIC CMP) at any one time. The process is as follows, using the SPI BUS, the μP programs the ASFIC CMP to set up the proper low-speed data deviation and select the PL or DPL filters. The μP then generates a square wave which strobes the ASFIC PL / DPL encode input LSIO U504-pin 18 at twelve times the desired data rate. For example, for a PL frequency of 103 Hz, the frequency of the square wave would be 1236 Hz.

This drives a tone generator inside U504 which generates a staircase approximation to a PL sine wave or DPL data pattern. This internal waveform is then low-pass filtered and summed with voice or data. The resulting summed waveform then appears on U504-pin 40 (MOD IN), where it is sent to the RF board as previously described for transmit audio. A trunking connect tone would be generated in the same manner as a PL tone.

8.2 High Speed Data

High speed data refers to the 3600 baud data waveforms, known as Inbound Signaling Words (ISWs) used in a trunking system for high speed communication between the central controller and the radio. To generate an ISW, the μ P first programs the ASFIC CMP (U504) to the proper filter and gain settings. It then begins strobing U504-pin 19 (HSIO) with a pulse when the data is supposed to change states. U504's 5-3-2 State Encoder (which is in a 2-state mode) is then fed to the post-limiter summer block and then the splatter filter. From that point it is routed through the modulation attenuator and then out of the ASFIC CMP to the RF board. MDC is generated in much the same way as trunking ISW. However, in some cases these signals may also pass through a data pre-emphasis block in the ASFIC CMP. Also these signaling schemes are based on sending a combination of 1200 Hz and 1800 Hz tones only. Microphone audio is muted during high speed data signaling.

8.3 Dual Tone Multiple Frequency (DTMF) Data

DTMF data is a dual tone waveform used during phone interconnect operation. It is the same type of tones which are heard when using a "Touch Tone" telephone.

There are seven frequencies, with four in the low group (697, 770, 852, 941 Hz) and three in the high group (1209, 1336, 1477 Hz). The high-group tone is generated by the μ P (U403-46) strobing U504-19 at six times the tone frequency for tones less than 1440 Hz or twice the frequency for tones greater than 1440 Hz. The low group tone is generated by the ASFIC CMP, controlled by the μ P via SPI bus. Inside U504 the low-group and high-group tones are summed (with the amplitude of the high group tone being approximately 2 dB greater than that of the low group tone) and then pre-emphasized before being routed to the summer and splatter filter. The DTMF waveform then follows the same path as was described for high-speed data.

9.0 Receive Audio Circuits

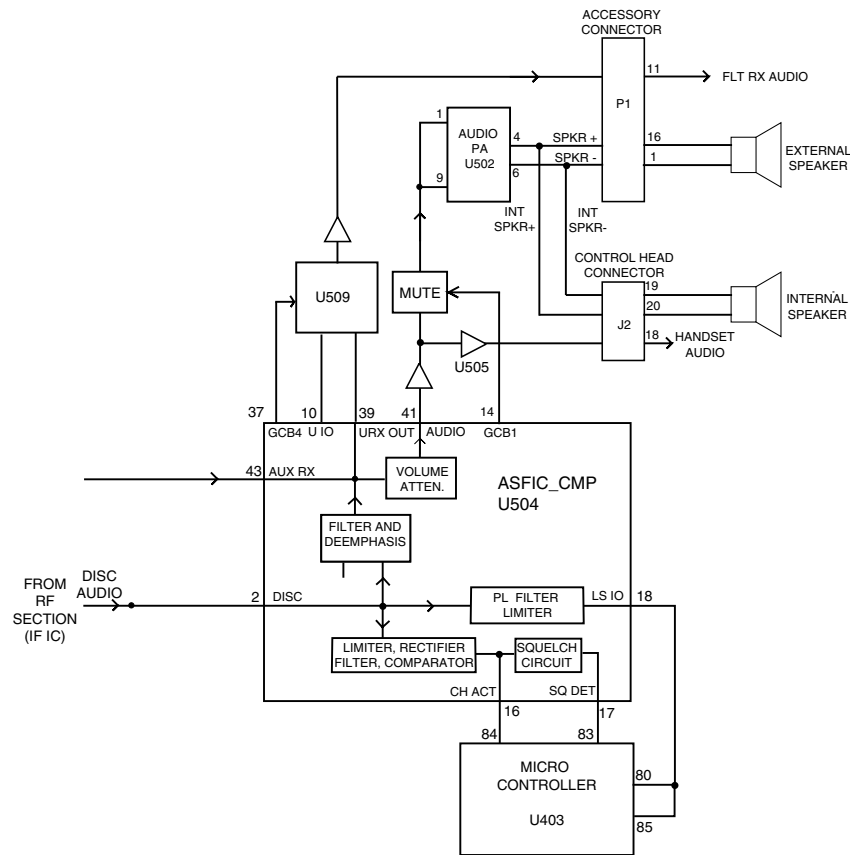


Figure 2-9 Receive Audio Paths

9.1 Squelch Detect

The radio's RF circuits are constantly producing an output at the discriminator (IF IC). This signal (DISC AUDIO) is routed to the ASFIC CMP's squelch detect circuitry input DISC (U504-pin 2). All of the squelch detect circuitry is contained within the ASFIC CMP. Therefore from a user's point of view, DISC AUDIO enters the ASFIC CMP, and the ASFIC CMP produces two CMOS logic outputs based on the result. They are CH ACT (U504-16) and SQ DET (U504-17).

The squelch signal entering the ASFIC CMP is amplified, filtered, attenuated, and rectified. It is then sent to a comparator to produce an active high signal on CH ACT. A squelch tail circuit is used to produce SQ DET (U504-17) from CH ACT. The state of CH ACT and SQ DET is high (logic "1") when carrier is detected, otherwise low (logic "0").

CH ACT is routed to the μ P pin 84 while SQ DET is routed to the μ P pin 83.

SQ DET is used to determine all audio mute / unmute decisions except for Conventional Scan. In this case CH ACT is a pre-indicator as it occurs slightly faster than SQ DET.

9.2 Audio Processing and Digital Volume Control

The receiver audio signal (DISC AUDIO) enters the controller section from the IF IC where it is DC coupled to ASFIC CMP via the DISC input U504-pin 2. The signal is then applied to both the audio and the PL/DPL paths

The audio path has a programmable amplifier, whose setting is based on the channel bandwidth being received, an LPF filter to remove any frequency components above 3000 Hz, and a HPF to strip off any sub-audible data below 300 Hz. Next, the recovered audio passes through a de-emphasis filter (if it is enabled to compensate for Pre-emphasis which is used to reduce the effects of FM noise). The IC then passes the audio through the 8-bit programmable attenuator whose level is set depending on the value of the volume control. Finally the filtered audio signal passes through an output buffer within the ASFIC CMP. The audio signal exits the ASFIC CMP at AUDIO output (U504 pin 41).

The μ P programs the attenuator, using the SPI BUS, based on the volume setting. The minimum / maximum settings of the attenuator are set by codeplug parameters.

Since sub-audible signaling is summed with voice information on transmit, it must be separated from the voice information before processing. Any sub-audible signaling enters the ASFIC CMP from the IF IC at DISC U504-2. Once inside, it goes through the PL/DPL path. The signal first passes through one of the two low-pass filters, either the PL low-pass filter or the DPL/LST low-pass filter. Either signal is then filtered and goes through a limiter and exits the ASFIC CMP at LSIO (U504-pin 18). At this point, the signal will appear as a square wave version of the sub-audible signal which the radio received. The μ P U403 pin 80 will decode the signal directly to determine if it is the tone / code which is currently active on that mode.

9.3 Audio Amplification Speaker (+) Speaker (-)

The output of the ASFIC CMP's digital volume pot, U504-pin 41 is routed through DC blocking capacitor C5049 to the audio PA (U502 pin 1 and 9).

The audio power amplifier has one inverted and one non-inverted output that produces the differential audio output SPK+/SPK- (U502 pins 4 and 6)

The audio PA is enabled via the ASFIC CMP (U504-GCB1). When the base of Q501 is low, the transistor is off and U502-pin 8 is high, using pull up resistor R5041, and the audio PA is ON. The voltage at U502-pin 8 must be above 8.5 Vdc to properly enable the device.

If the voltage is between 3.3 and 6.4 V, the device will be active but has its input (U502-pins 1/9) off. This is a mute condition which is used to prevent an audio pop when the PA is enabled.

The SPK+ and SPK- outputs of the audio PA have a DC bias which varies proportionately with B+ (U502- pin 7). B+ of 11 V yields a DC offset of 5 V, and B+ of 17 V yields a DC offset of 8.5 V. If either of these lines is shorted to ground, it is possible that the audio PA will be damaged. SPK+ and SPK- are routed to the accessory connector (P1-pin 1 and 16) and to the control head (connector J2-pins 19 and 20).

9.4 Handset Audio

Certain handheld accessories have a speaker within them which require a different voltage level than that provided by U502. For these devices HANDSET AUDIO is available at control head connector J2 pin18.

The received audio from the output of the ASFIC CMP's digital volume attenuator is routed to U505 pin 2 where it is amplified. This signal is routed from the output of the op-amp U505 to J2-pin 18. From the control head, the signal is sent directly to the microphone jack.

9.5 Filtered Audio and Flat Audio

The ASFIC CMP output audio at U504-pin 39 is filtered and de-emphasized, but has not gone through the digital volume attenuator. From ASFIC CMP U504-pin 39 the signal is routed via R5034 through gate U509-pin 12 and AC coupled to U505-pin 6. The gate controlled by ASFIC CMP port GCB4 selects between the filtered audio signal from the ASFIC CMP pin 39 (URXOUT) or the unfiltered (flat) audio signal from the ASFIC CMP pin 10 (UIO). Resistors R5034 and R5021 determine the gain of op-amp UU505-pin 6 for the filtered audio while R5032 and R5021 determine the gain for the flat Audio. The output of U505-pin 7 is then routed to P1 pin 11 via DC blocking capacitor C5003. Note that any volume adjustment of the signal on this path must be done by the accessory.

10.0 Receive Signalling Circuits

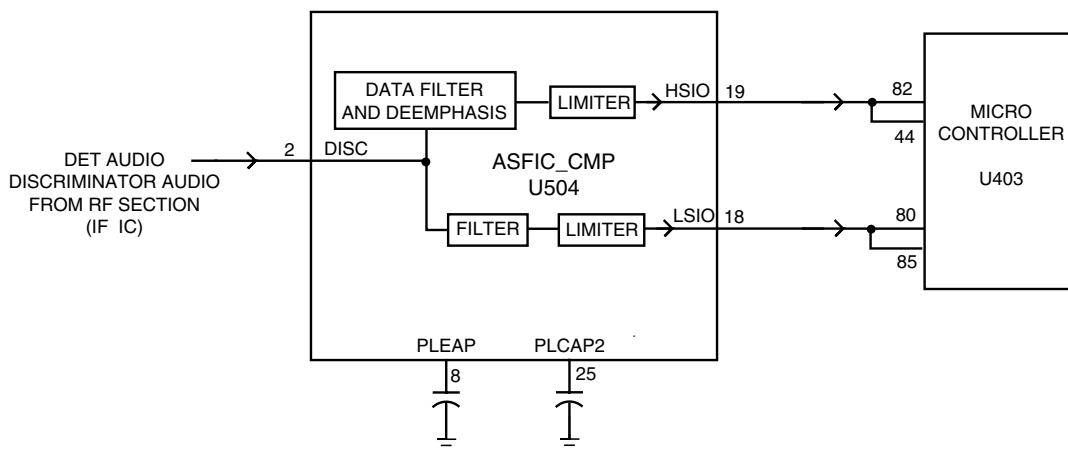


Figure 2-10 Receive Signalling Paths

10.1 Sub-Audio Data (PL/DPL) and High Speed Data Decoder

The ASFIC CMP (U504) is used to filter and limit all received data. The data enters the ASFIC CMP at input DISC (U504 pin 2). Inside U504 the data is filtered according to data type (HS or LS), then it is limited to a 0–3.3 V digital level. The MDC and trunking high speed data appear at U504-pin 19, where it connects to the μ P U403 pin 80.

The low speed limited data output (PL, DPL, and trunking LS) appears at U504-pin18, where it connects to the μ P U403-pin 80.

The low speed data is read by the μ P at twice the frequency of the sampling waveform; a latch configuration in the ASFIC CMP stores one bit every clock cycle. The external capacitors C5028, and C5026 set the low frequency pole for a zero crossings detector in the limiters for PL and HS data. The hysteresis of these limiters is programmed based on the type of received data.

10.2 Alert Tone Circuits

When the software determines that it needs to give the operator an audible feedback (for a good key press, or for a bad key press), or radio status (trunked system busy, phone call, circuit failures), it sends an alert tone to the speaker. It does so by sending SPI BUS data to U504 which sets up the audio path to the speaker for alert tones. The alert tone itself can be generated in one of two ways: internally by the ASFIC CMP, or externally using the μ P and the ASFIC CMP.

The allowable internal alert tones are 304, 608, 911, and 1823 Hz. In this case a code contained within the SPI BUS load to the ASFIC CMP sets up the path and determines the tone frequency, and at what volume level to generate the tone. (It does not have to be related to the voice volume setting.)

For external alert tones, the μ P can generate any tone within the 100–3000 Hz audio band. This is accomplished by the μ P generating a square wave which enters the ASFIC CMP at U504 pin 19. Inside the ASFIC CMP this signal is routed to the alert tone generator.

The output of the generator is summed into the audio chain just after the RX audio de-emphasis block. Inside U504, the tone is amplified and filtered, then passed through the 8-bit digital volume attenuator, which is typically loaded with a special value for alert tone audio. The tone exits at U504-pin 41 and is routed to the audio PA like receive audio.

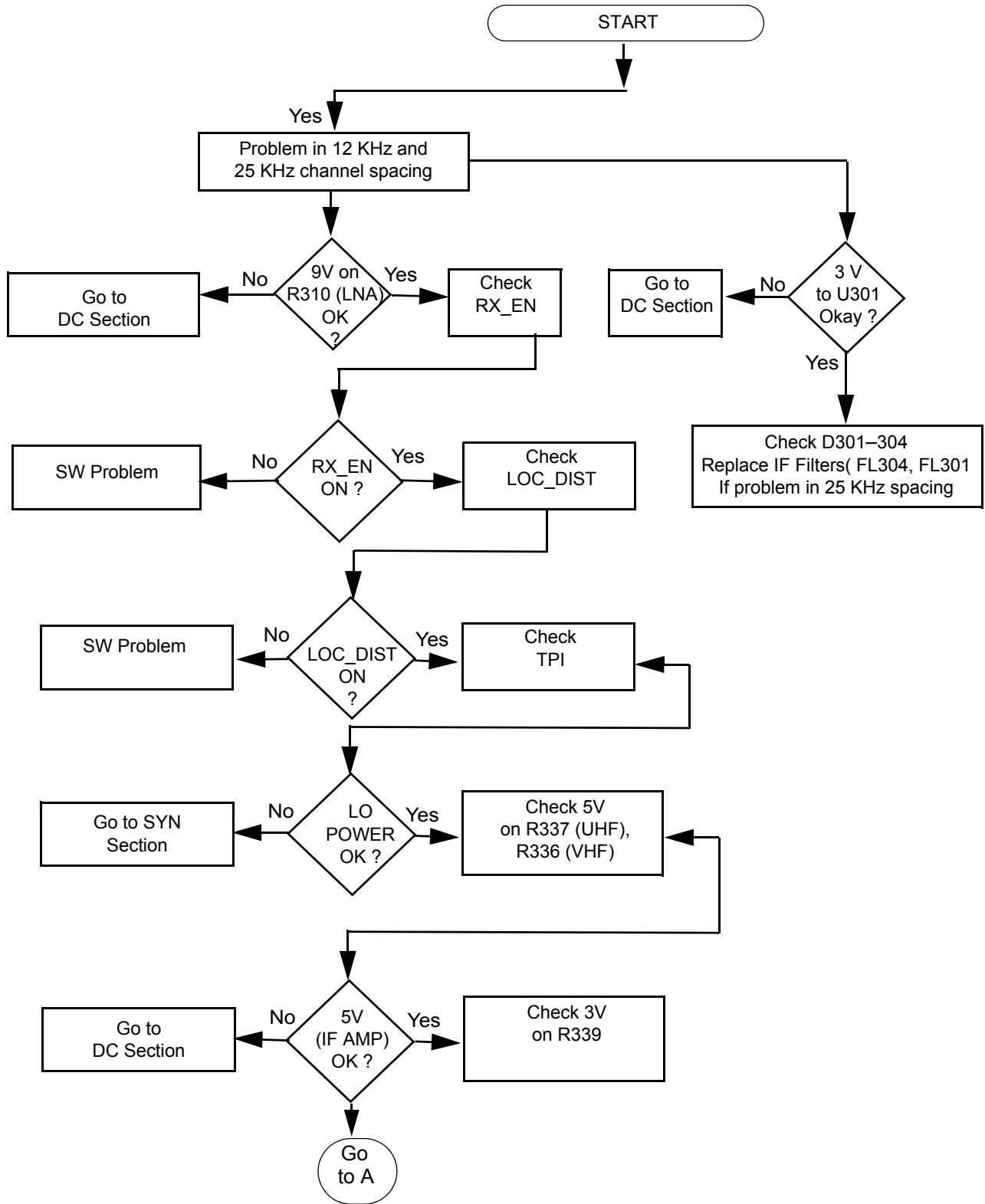
Chapter 3

TROUBLESHOOTING CHARTS

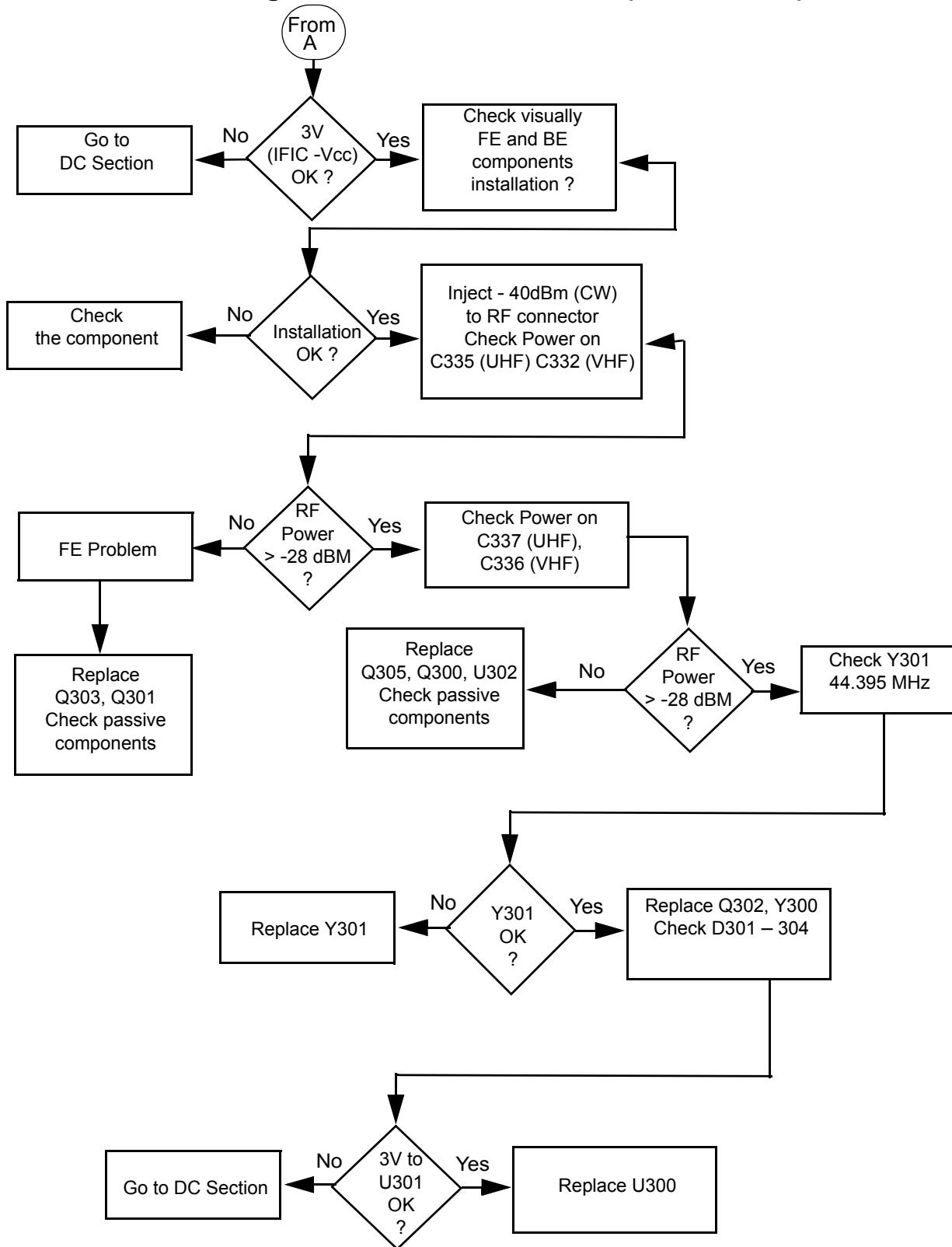
This section contains detailed troubleshooting flowcharts. These charts should be used as a guide in determining the problem areas. They are not a substitute for knowledge of circuit operation and astute troubleshooting techniques. It is advisable to refer to the related detailed circuit descriptions in the theory of operation sections prior to troubleshooting a radio.

Most troubleshooting charts end up by pointing to an IC to replace. It is not always noted, but it is good practice to verify supplies and grounds to the affected IC and to trace continuity to the malfunctioning signal and related circuitry before replacing any IC. For instance, if a clock signal is not available at a destination, continuity from the source IC should be checked before replacing the source IC.

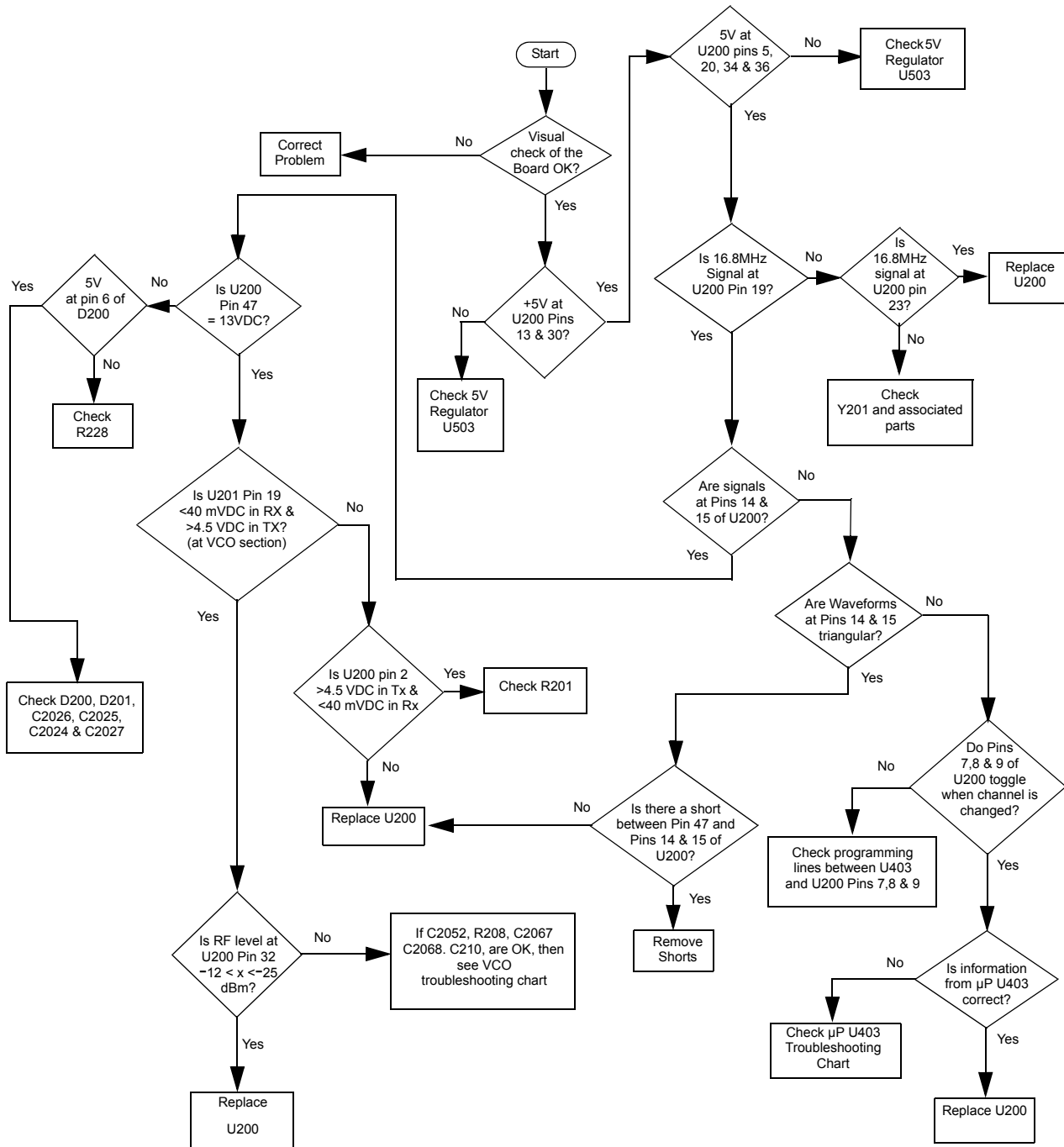
1.0 Troubleshooting Flow Chart for Receiver RF (Sheet 1 of 2)



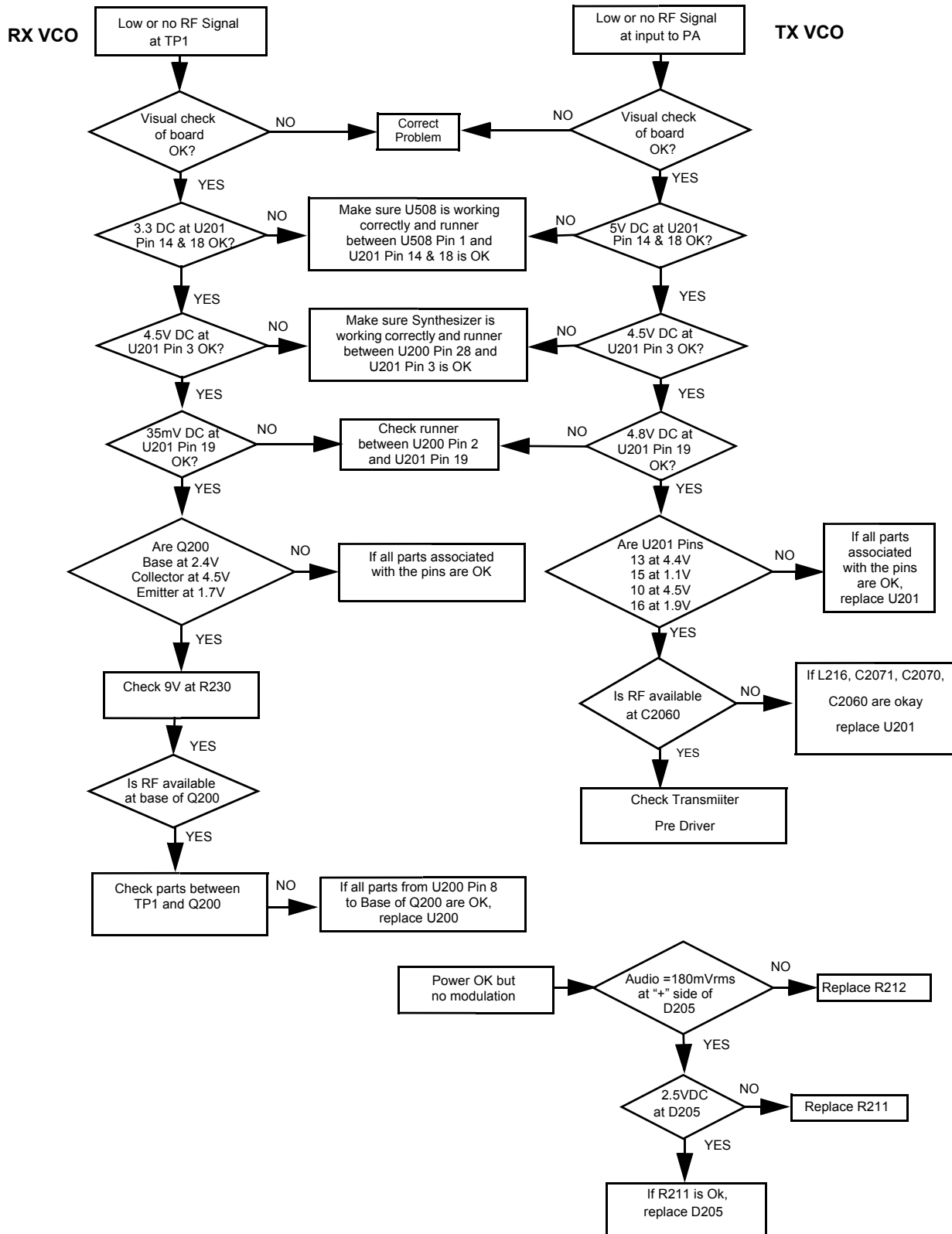
1.1 Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



2.0 Troubleshooting Flow Chart for Synthesizer

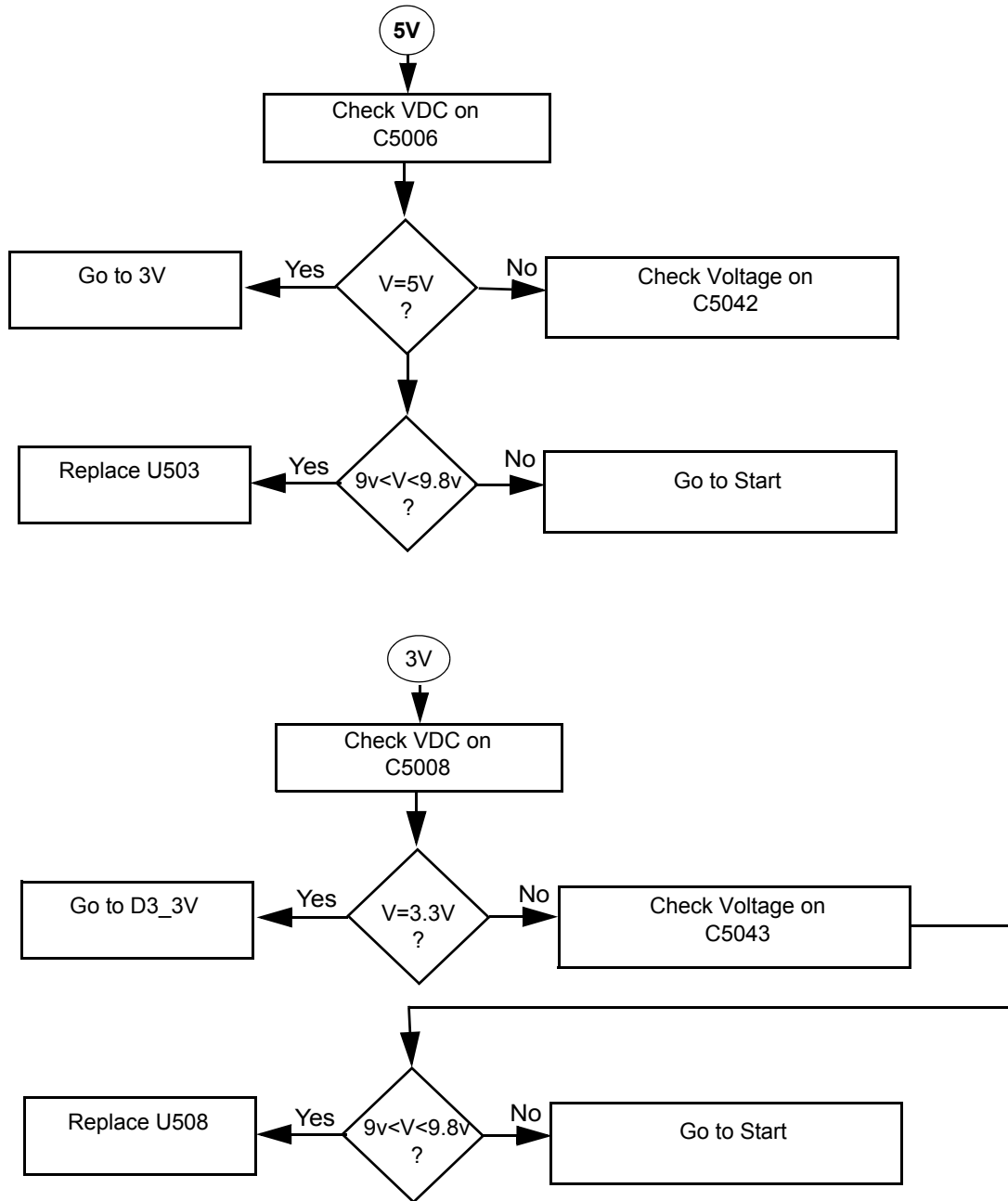


3.0 Troubleshooting Flow Chart for VCO

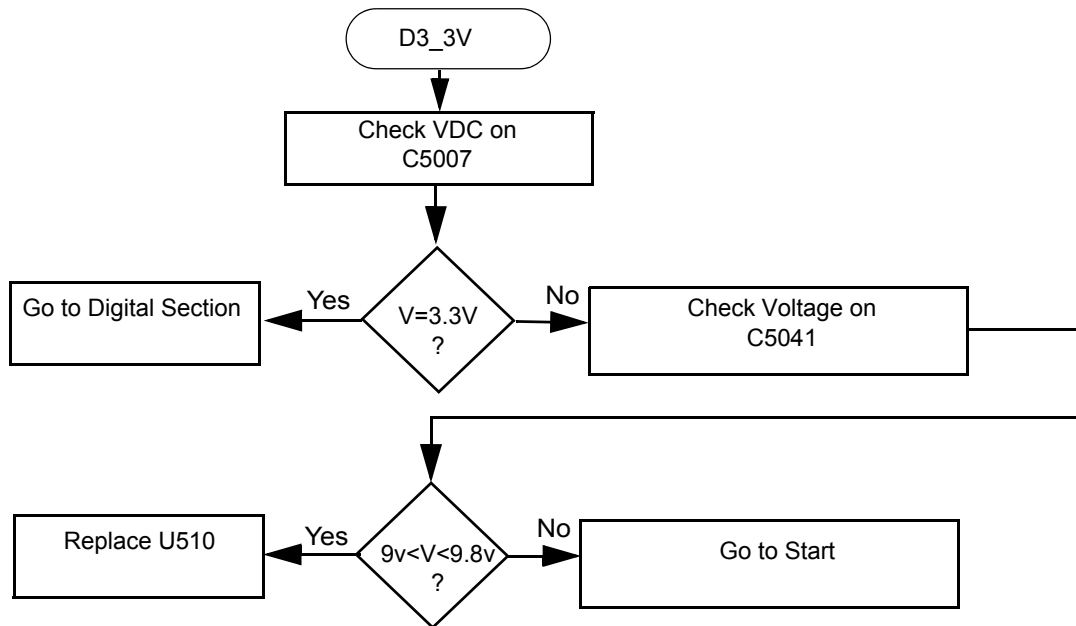


4.0 Troubleshooting Flow Chart for DC Supply (1 of 2)

Since the failure of a critical voltage supply might cause the radio to automatically power down, supply voltages should first be probed with a multimeter. If all the board voltages are absent, then the voltage test point should be retested using a rising-edge-triggered oscilloscope. If the voltage is still absent, then another voltage should be tested using the oscilloscope. If that voltage is present, then the original voltage supply in question is defective and requires investigation of associated circuitry.



4.1 Troubleshooting Flow Chart for DC Supply (2 of 2)



Notes

VHF2 PCB/ SCHEMATICS/ PARTS LISTS

1.0 Allocation of Schematics and Circuit Boards

1.1 VHF2 and Controller Circuits

The VHF circuits are contained on the printed circuit board (PCB) which also contains the Controller circuits. This Chapter shows the schematics for both the VHF circuits and the Controller circuits. The PCB component layouts and the Parts Lists in this Chapter show both the Controller and VHF circuit components. The VHF and Controller schematics and the related PCB and parts list are shown in the tables below.

Table 4-1 VHF2 1–25 W Diagrams and Parts Lists

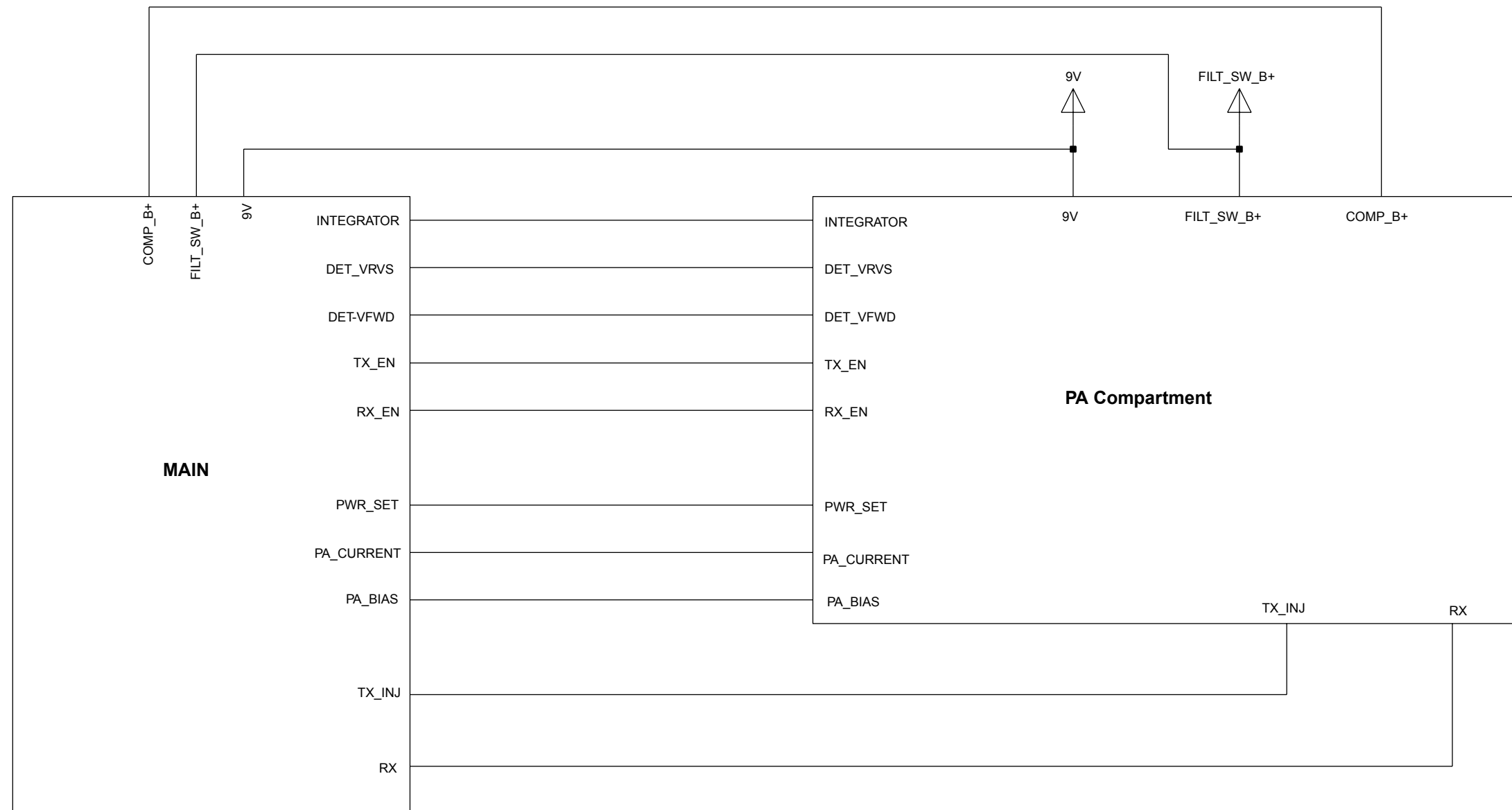
PCB : 8488977U01 (P9) Main Board Top Side 8488977U01 (P9) Main Board Bottom Side	Page 4-4 Page 4-5
SCHEMATICS Main Circuit Transmitter Synthesiser and VCO Receiver Front and Back End DC and Audio Ccts Microprocessor and Controller Ccts Power Control Cct	Page 4-6/Page 4-7 Page 4-8/Page 4-9 Page 4-10/Page 4-11 Page 4-12/Page 4-13 Page 4-14/Page 4-15 Page 4-16/Page 4-17 Page 4-18
Parts List 8488977U01 (P9)	Page 4-19
Controller version is T1	

Table 4-2 VHF2 1–25 W Diagrams and Parts Lists

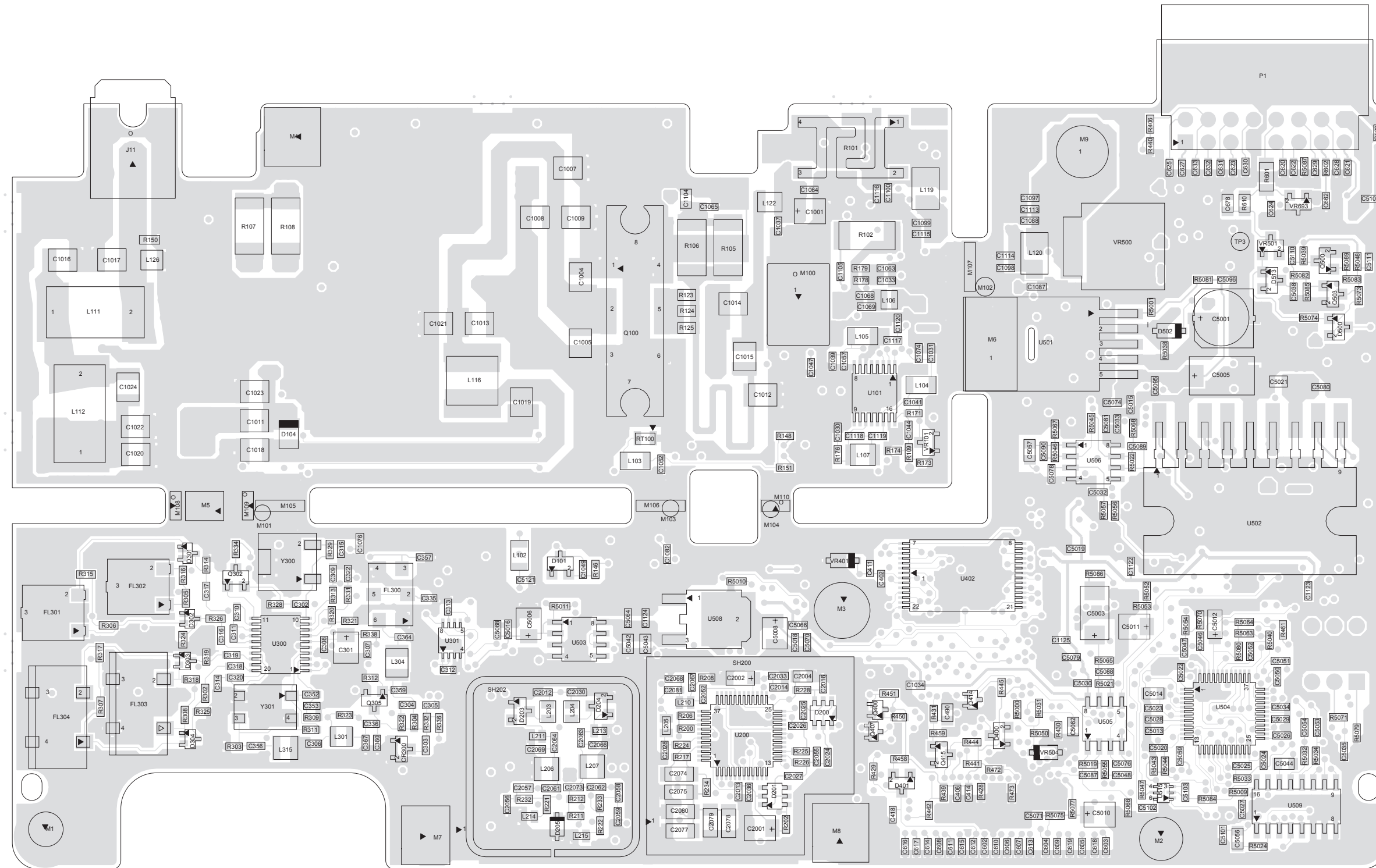
PCB : 8488972Z01 Main Board Top Side 8488972Z01 Main Board Bottom Side	Page 4-30 Page 4-31
SCHEMATICS Main Circuit Transmitter Synthesiser and VCO Receiver Front and Back End DC and Audio Ccts Microprocessor and Controller Ccts Power Control Cct	Page 4-32/Page 4-33 Page 4-34/Page 4-35 Page 4-36/Page 4-37 Page 4-38/Page 4-39 Page 4-40/Page 4-41 Page 4-42/Page 4-43 Page 4-44
Parts List 8488972Z01	Page 4-45
Controller version is T1	

Notes

2.0 VHF 1-25 W Band 2 PCB 8488977U01 (rev. P9) / Schematics



VHF2 Interconnection between Main Board and Power Amplifier Compartment



SHOWN FROM SIDE 1

OL ○ 79B02969C86-O

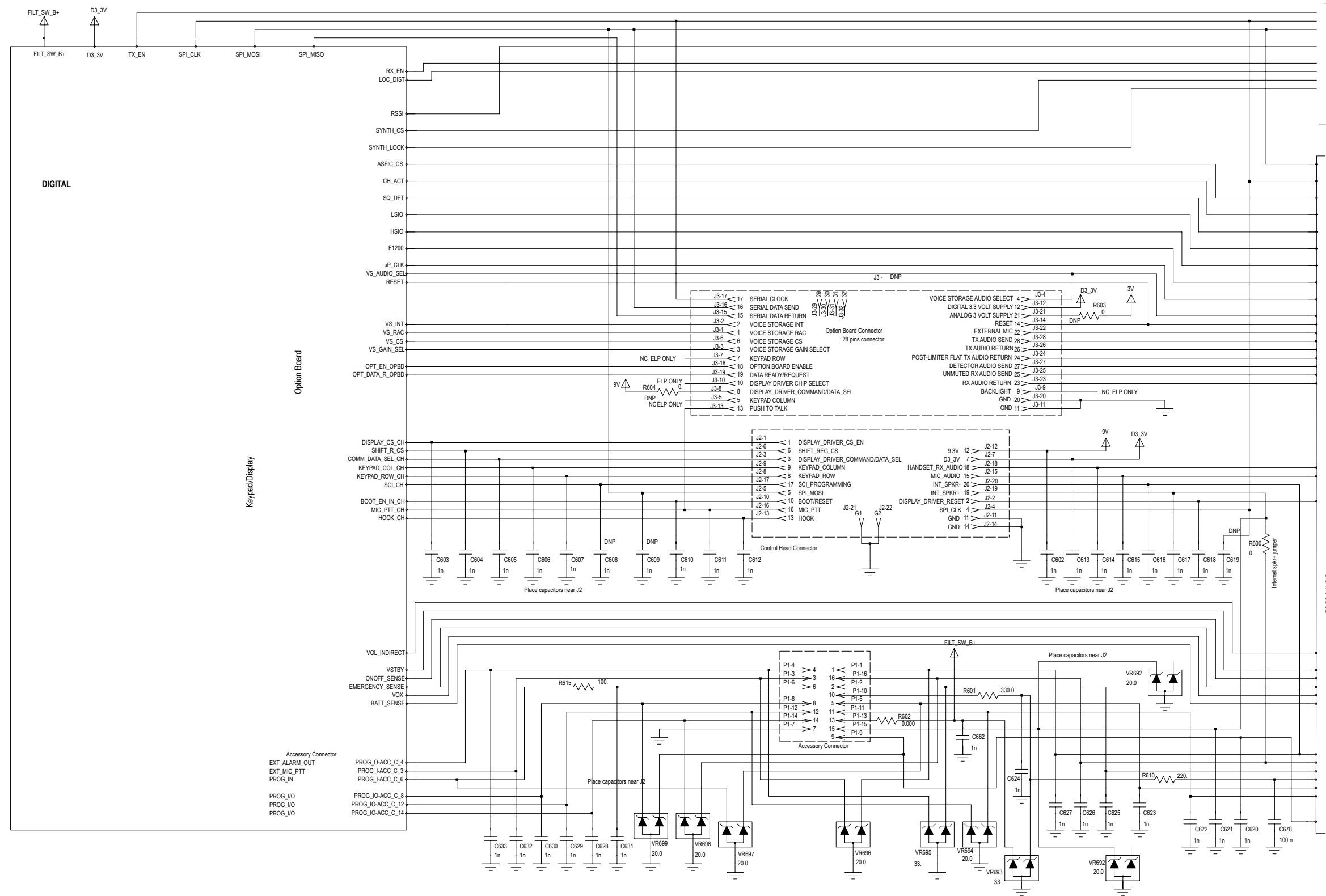
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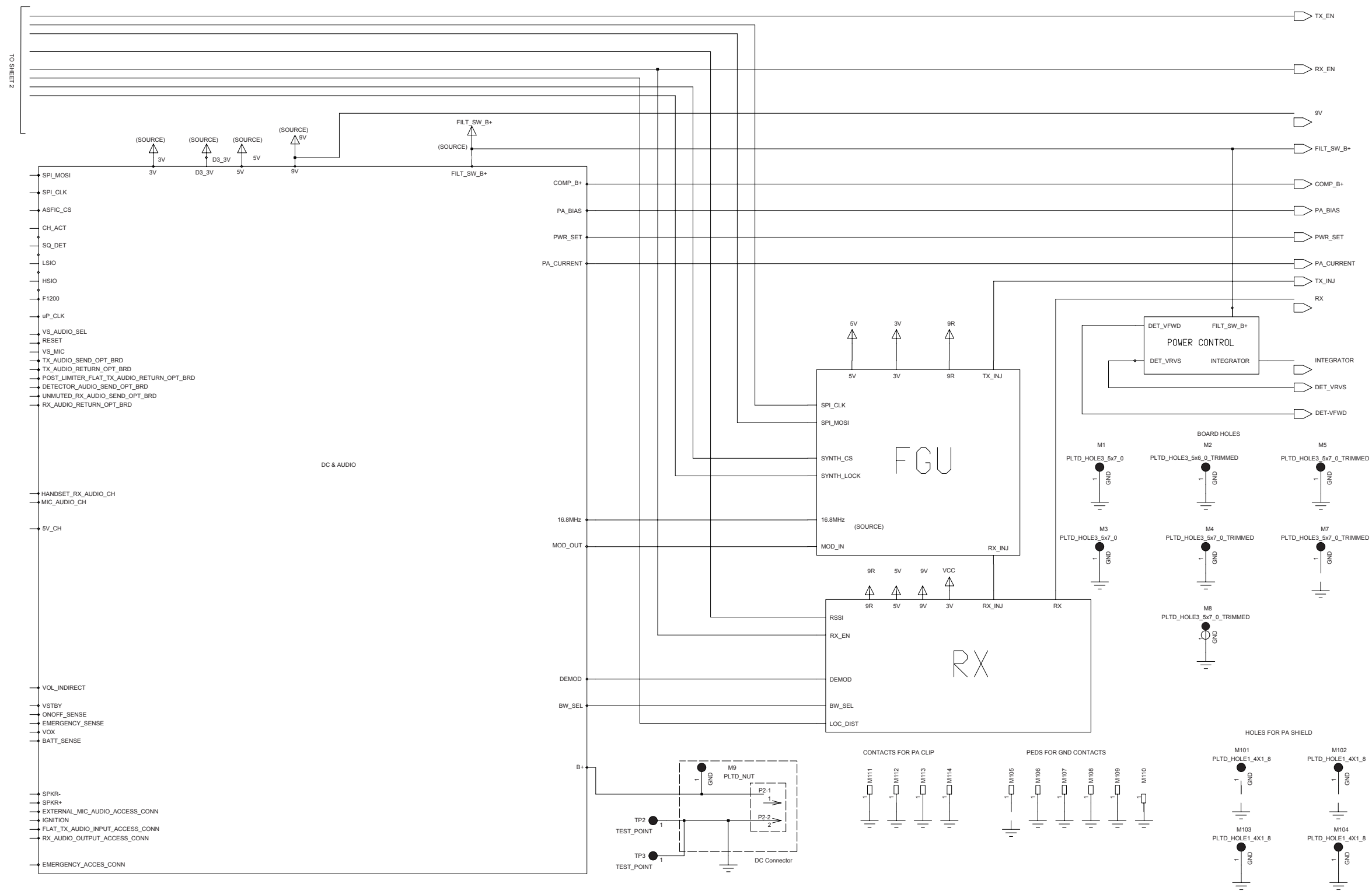
SHOWN FROM SIDE 2

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- OL ○ 79B02969C89-O

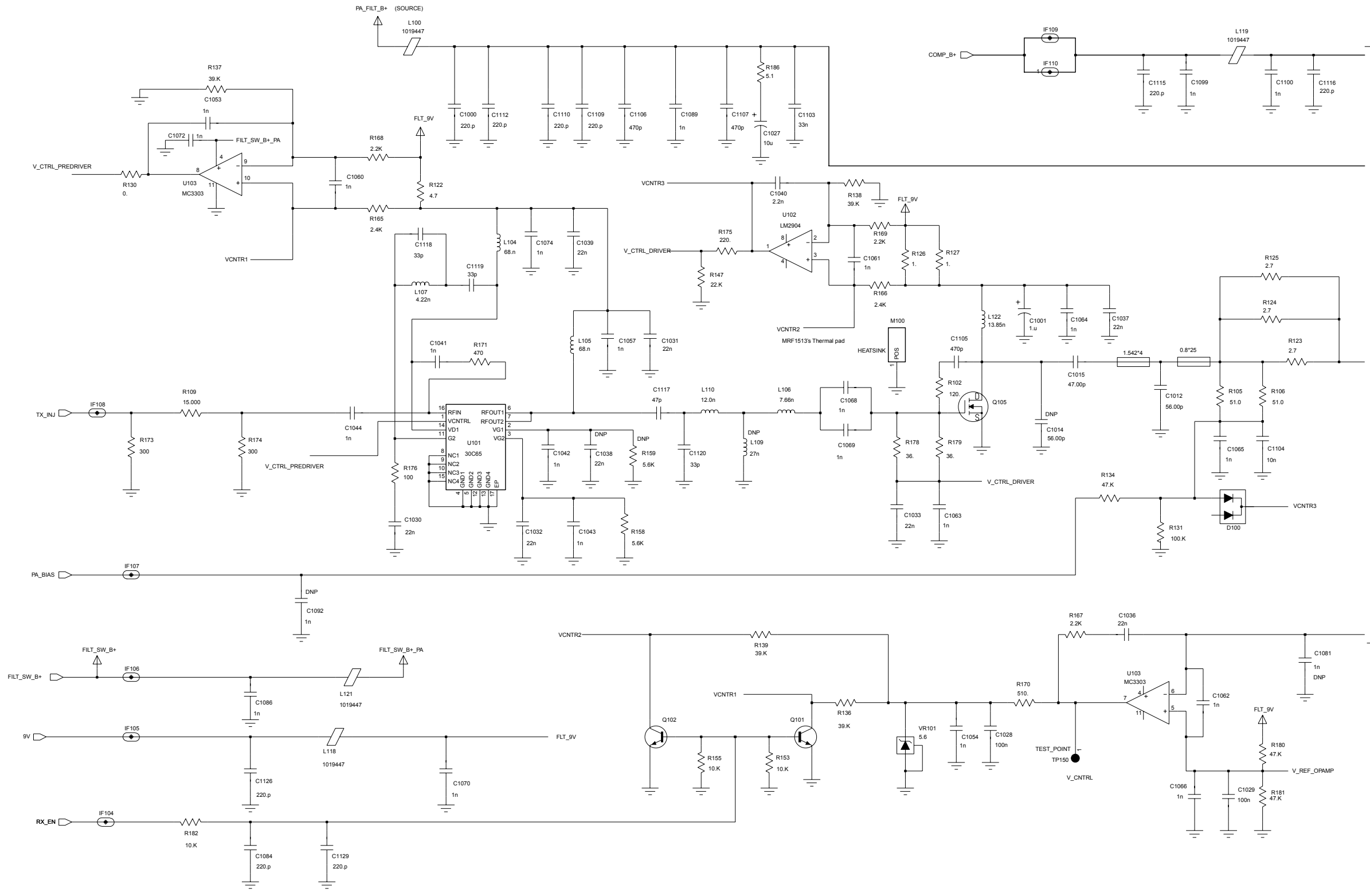
VHF2 (146-174 MHz) 1-25 W 8488977U01 (rev. P9)



VHF2 (146-174 MHz) 1-25 W Main Circuit (Sht 1 of 2)

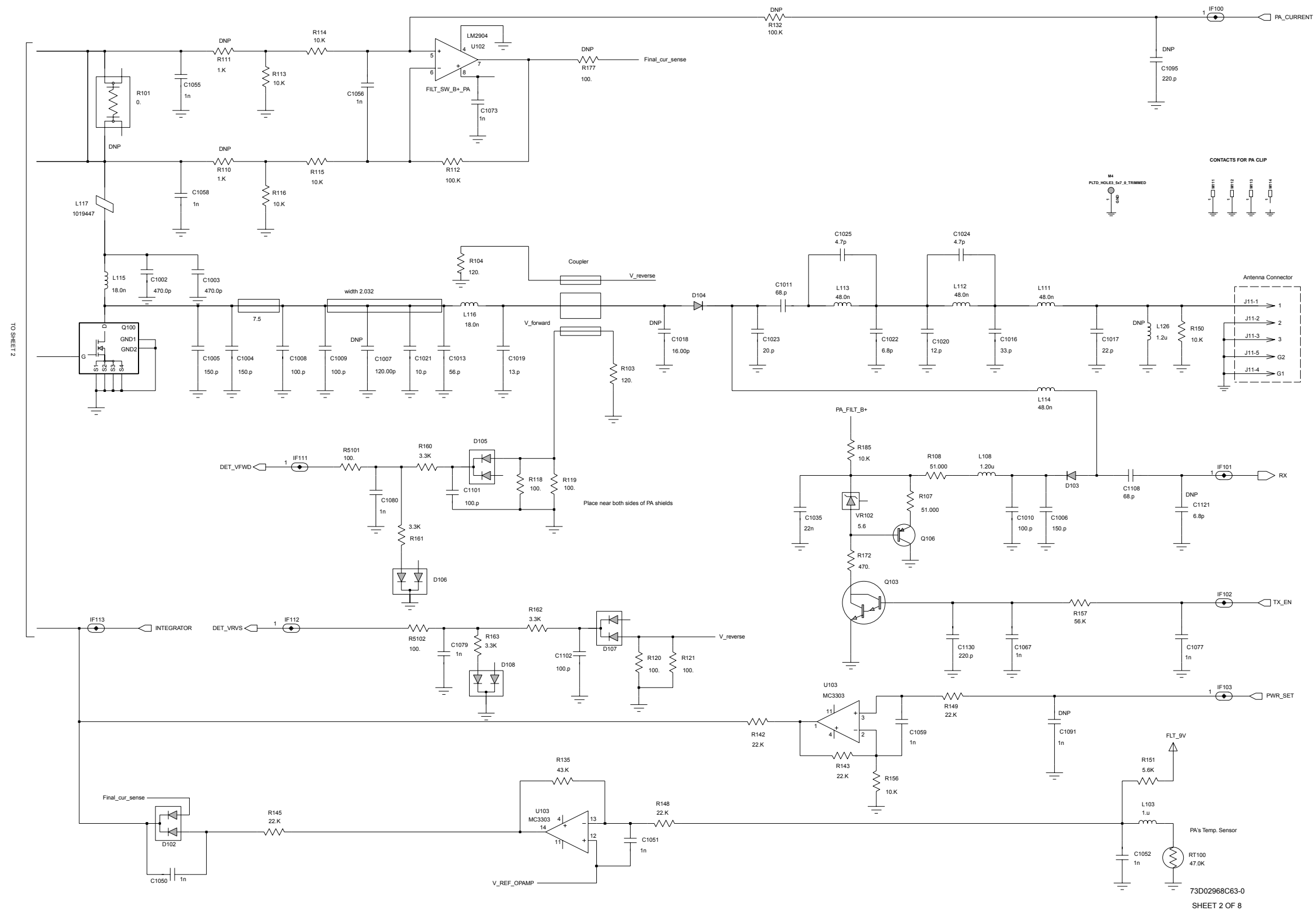


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SHEET 4 OF 8

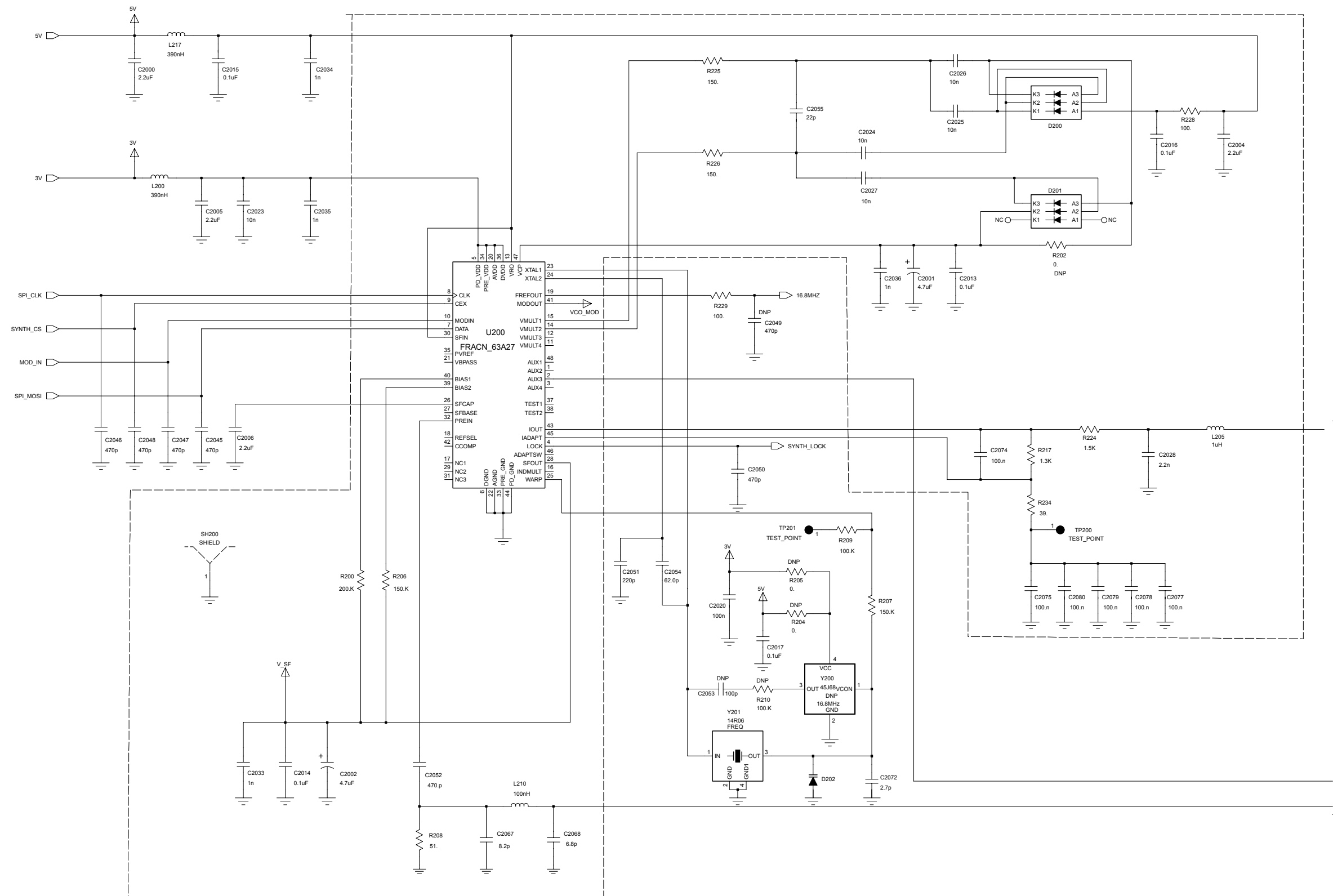


TO SHEET 1

VHF2 (146-174 MHz) 1-25 W Transmitter (Sht 1 of 2)

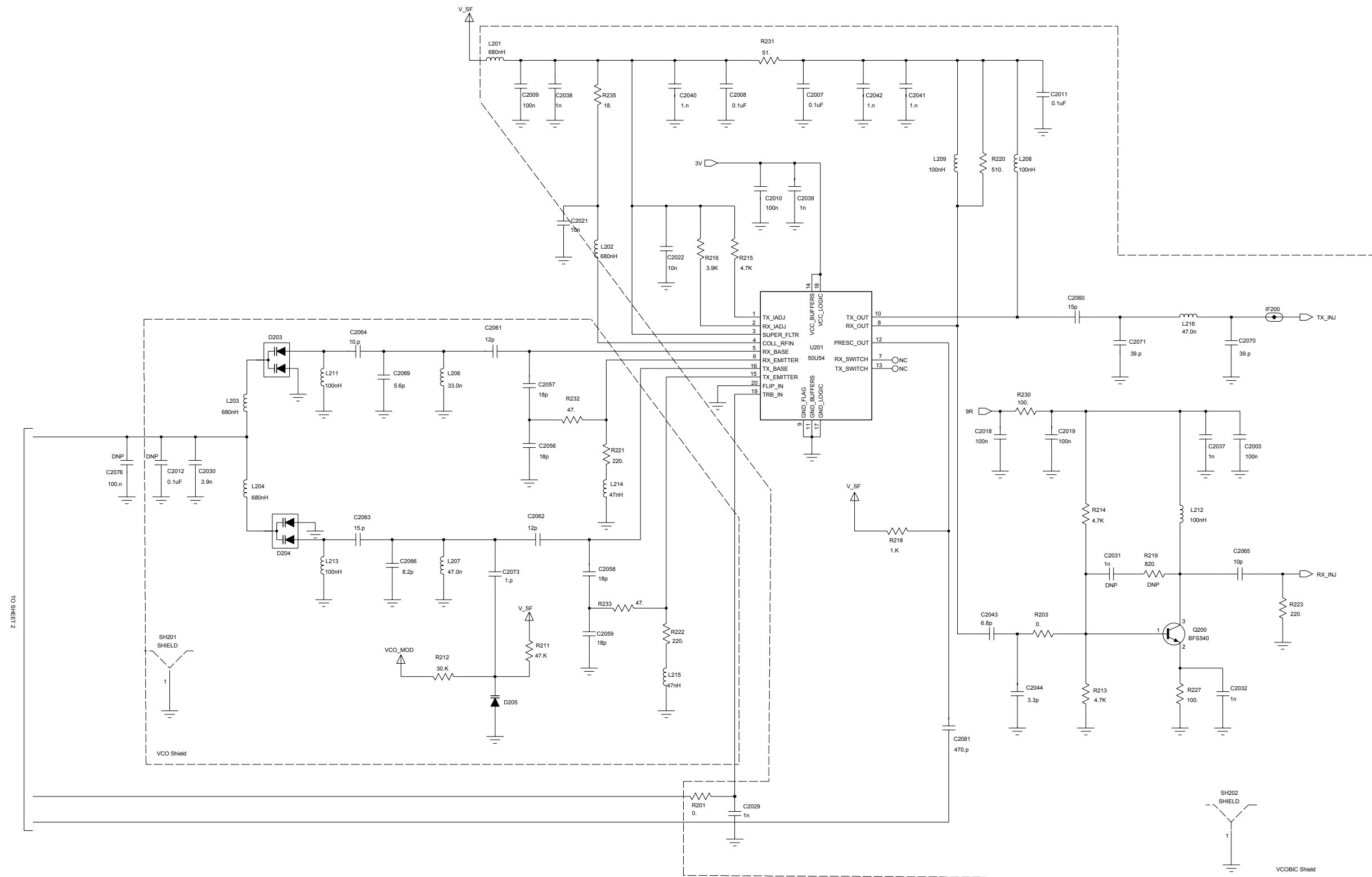


VHF2 (146-174 MHz) 1-25 W Transmitter (Sht 2 of 2)

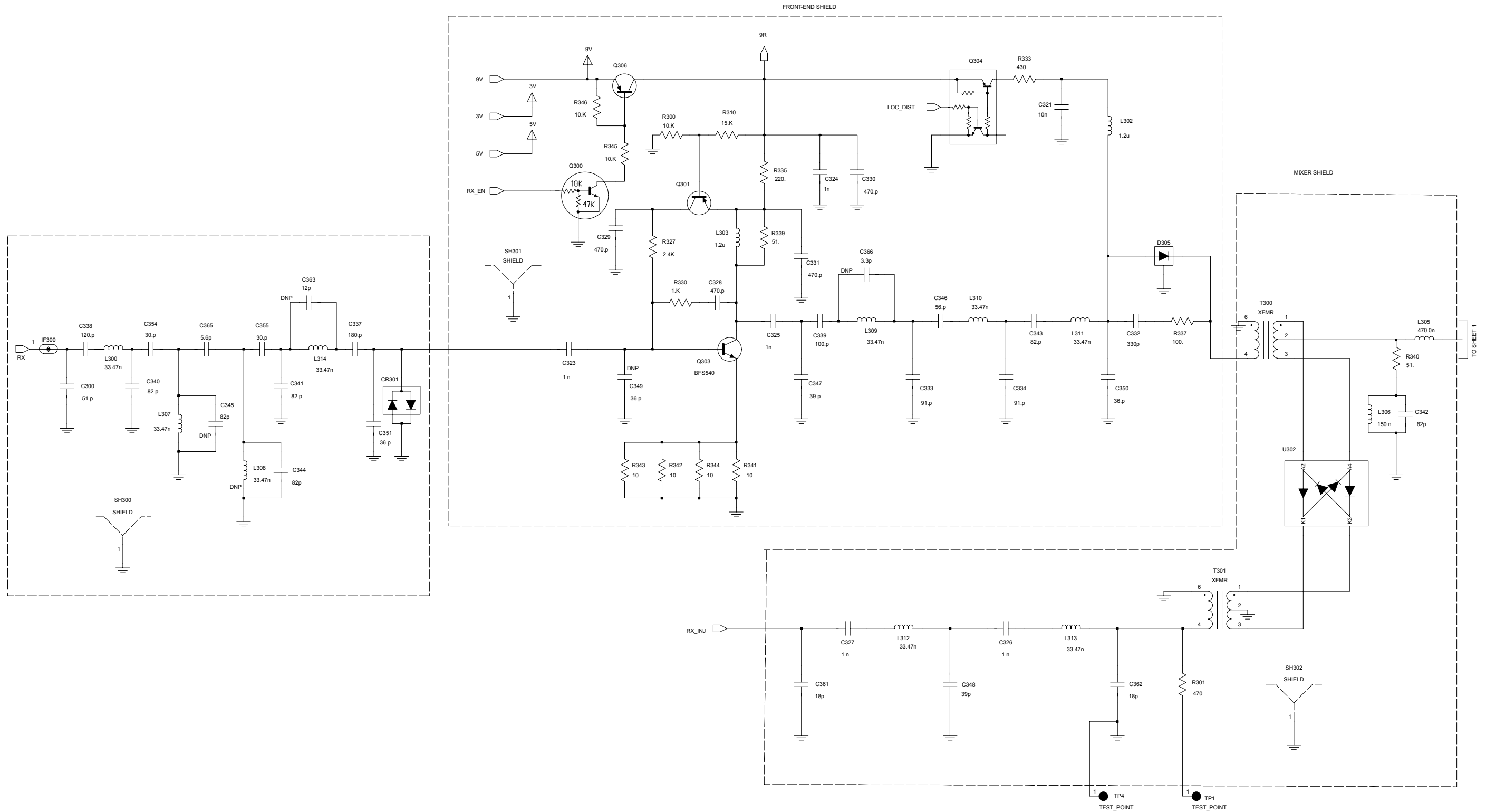


TO SHEET 1

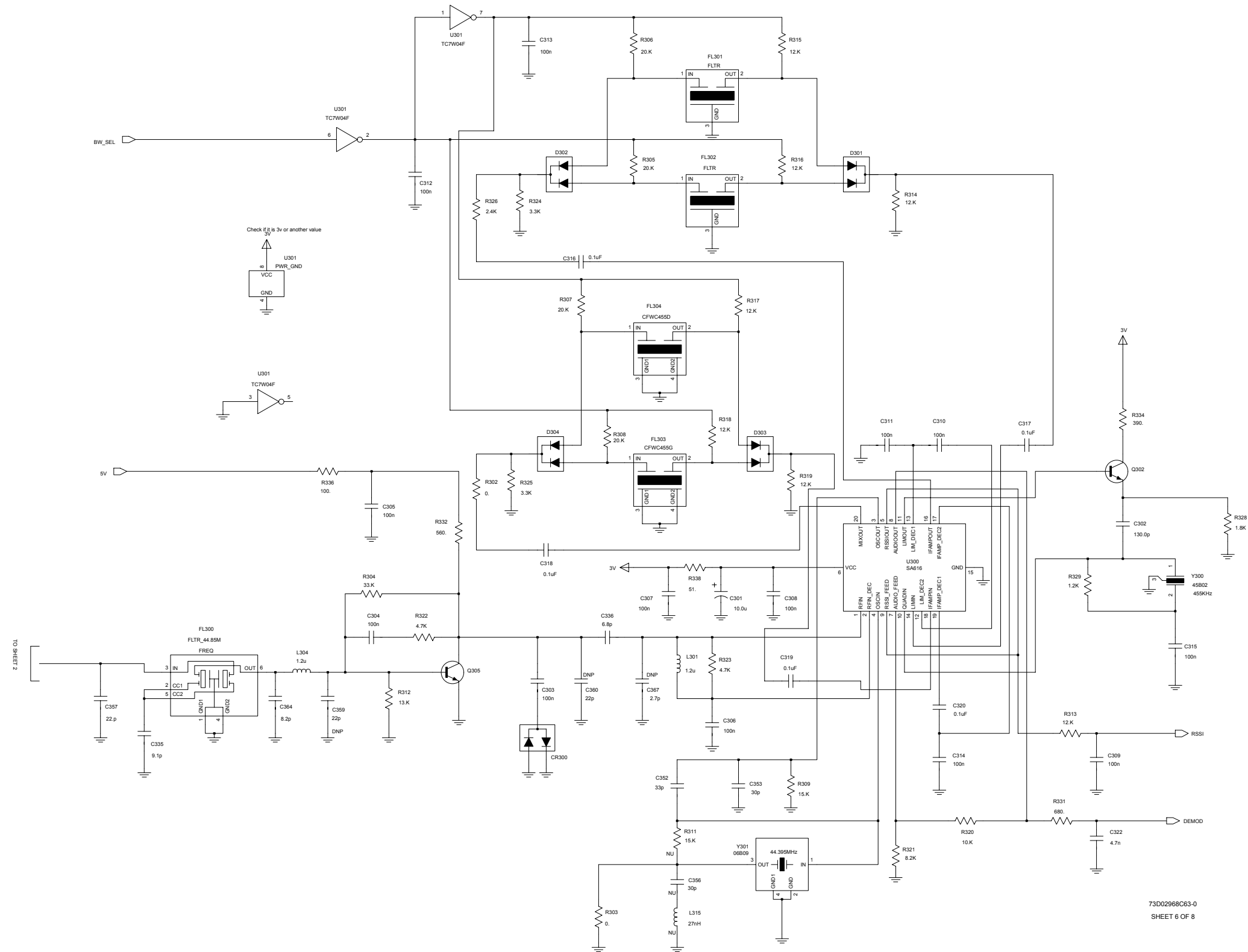
VHF2 (146-174 MHz) 1-25 W Synthesiser and VCO (Sht 1 of 2)



73D02968C63-0
SHEET 5 OF 8

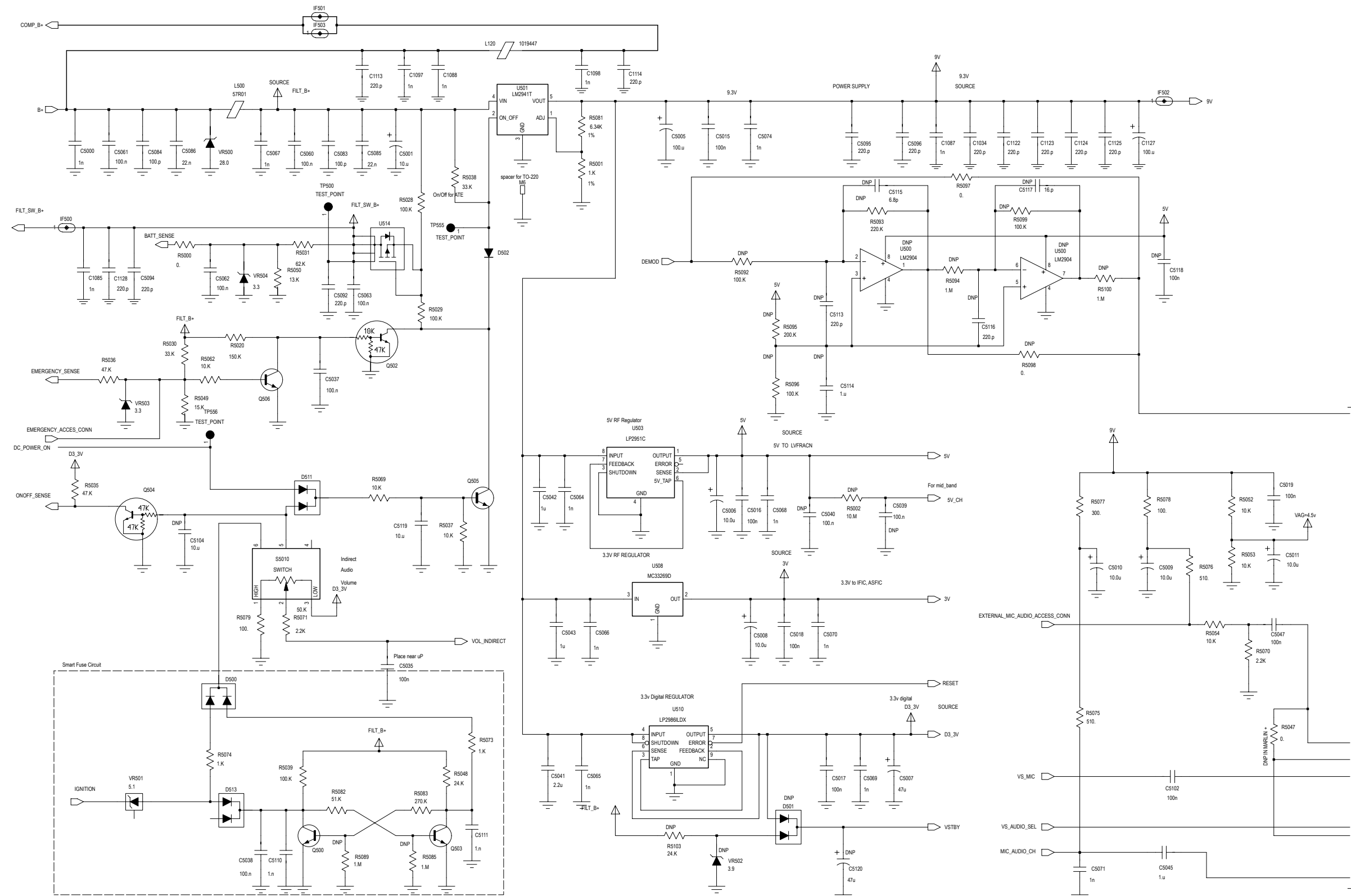


VHF2 (146-174 MHz) 1-25 W Receiver Front and Back End (Sht 1 of 2)



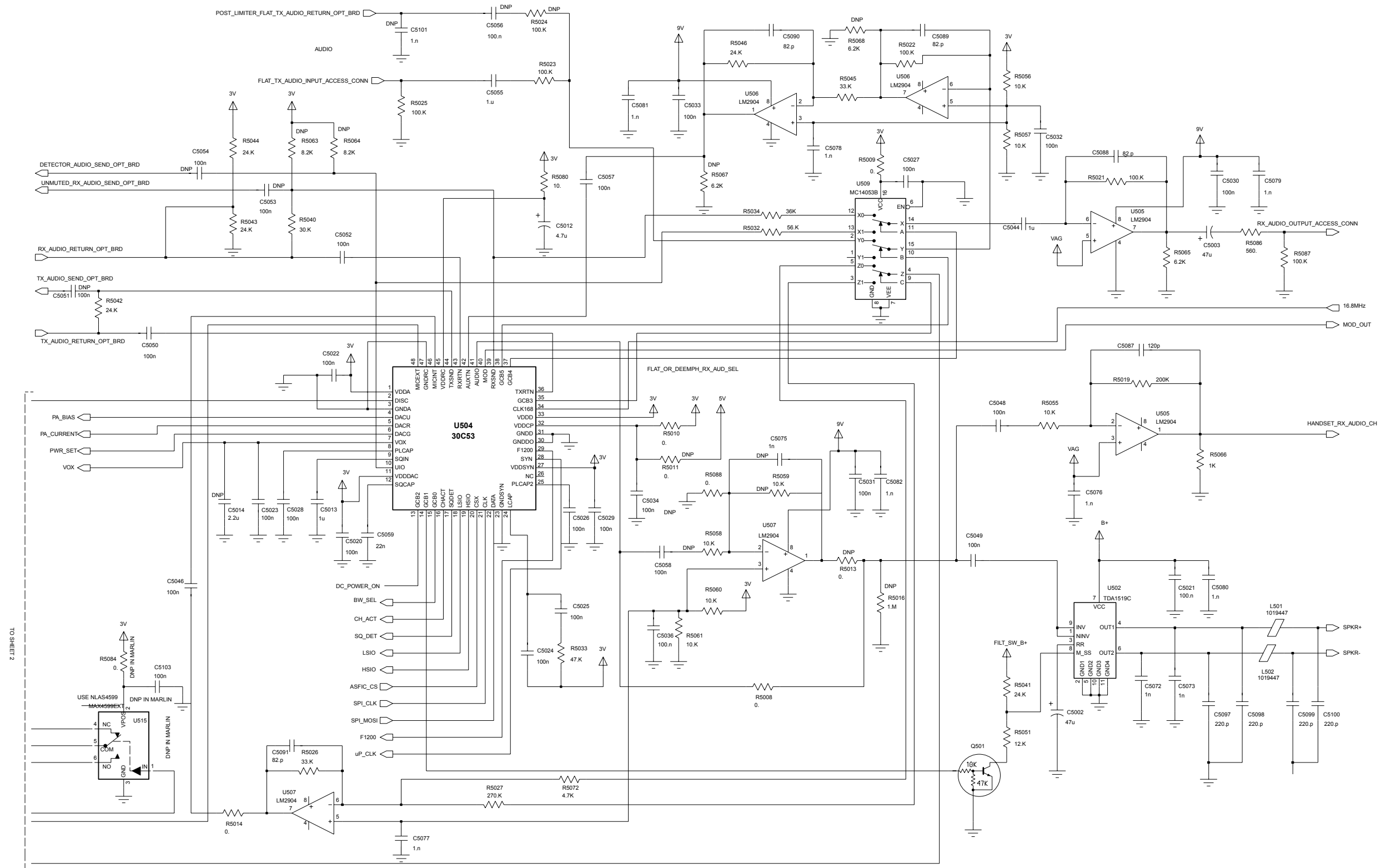
73D02968C63-0
SHEET 6 OF 8

VHF2 (146-174 MHz) 1-25 W Receiver Front and Back End (Sht 2 of 2)

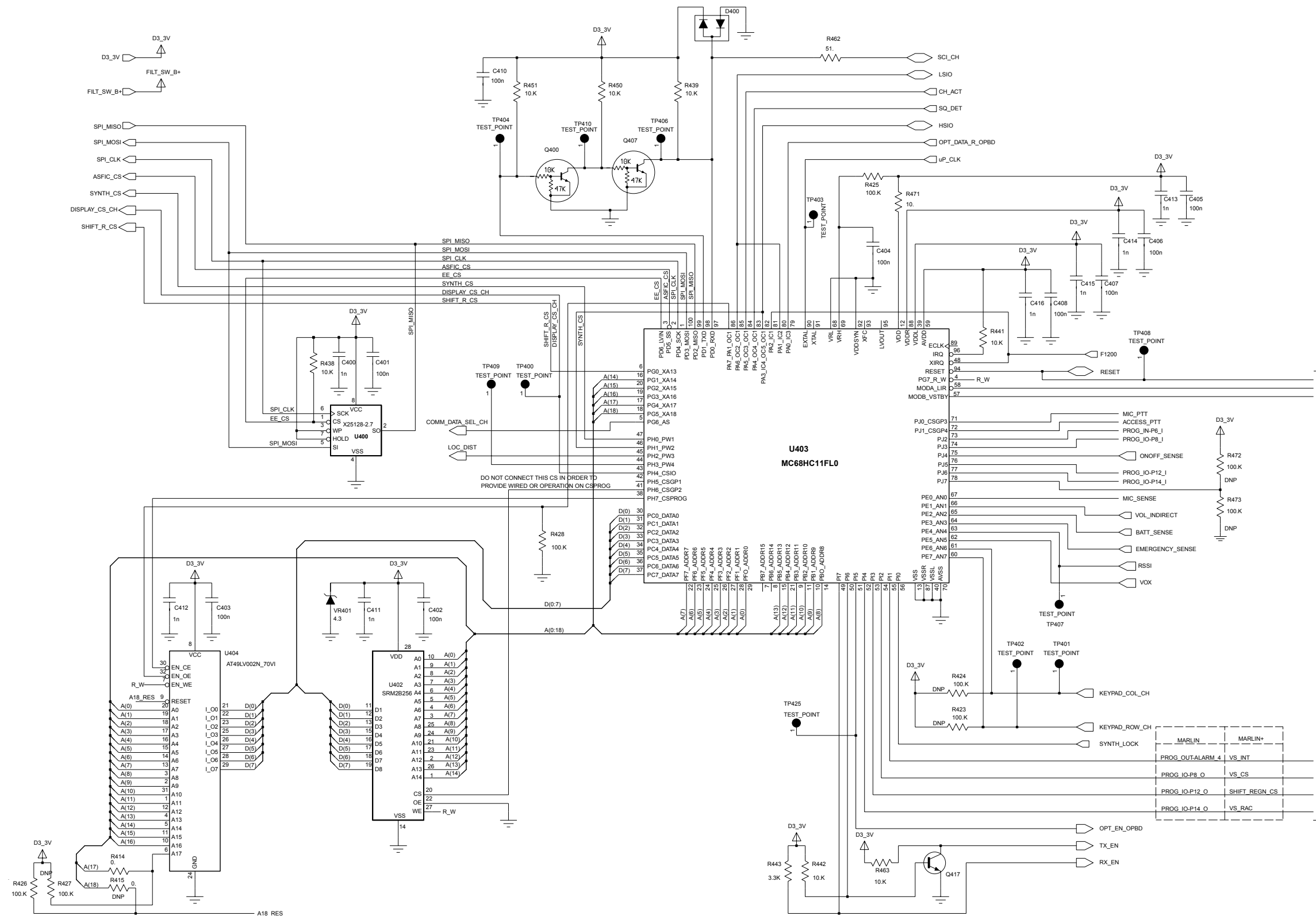


VHF2 (146-174 MHz) 1-25 W DC and Audio Circuits (Sht 1 of 2)

TO SHEET 1

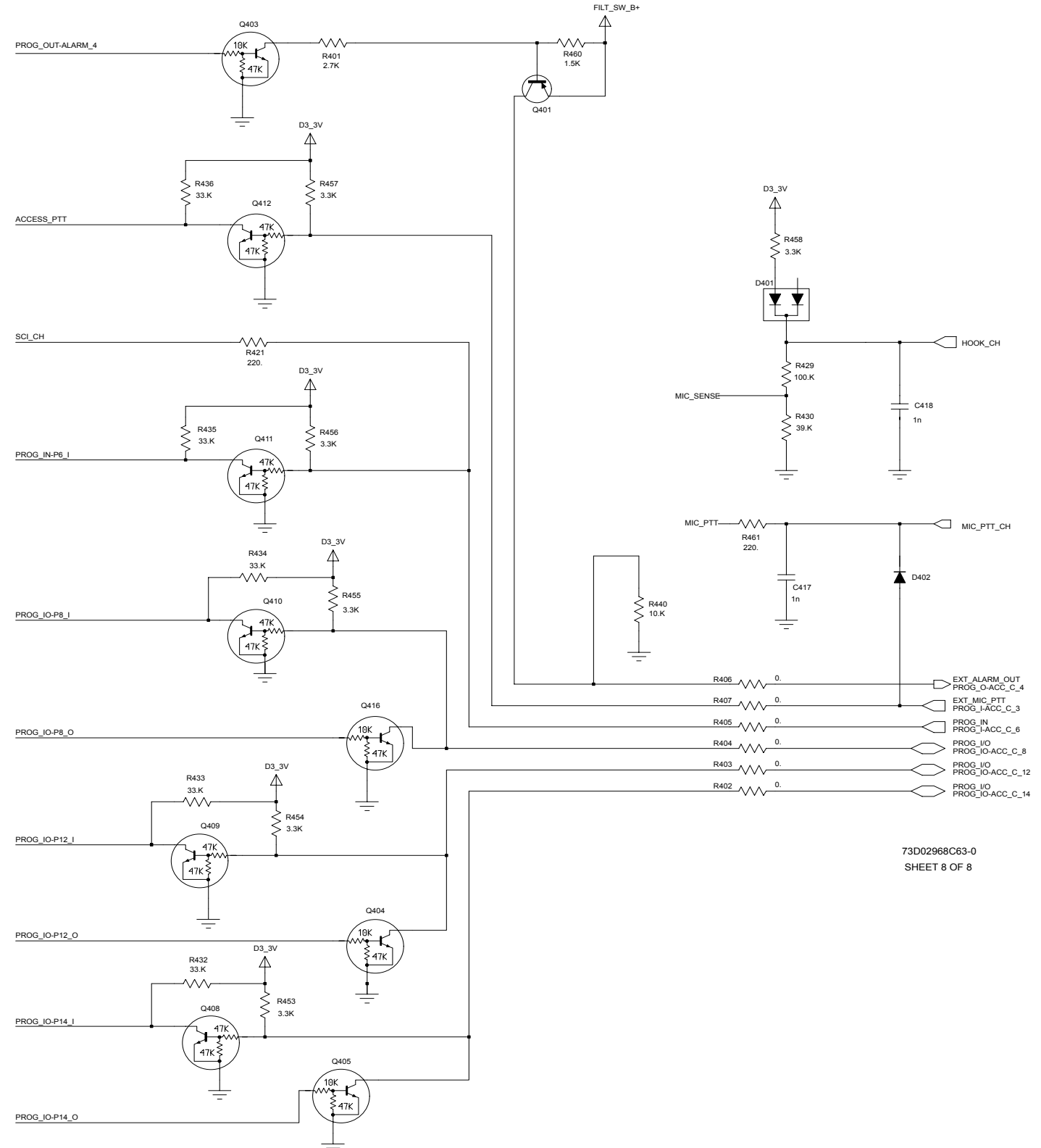
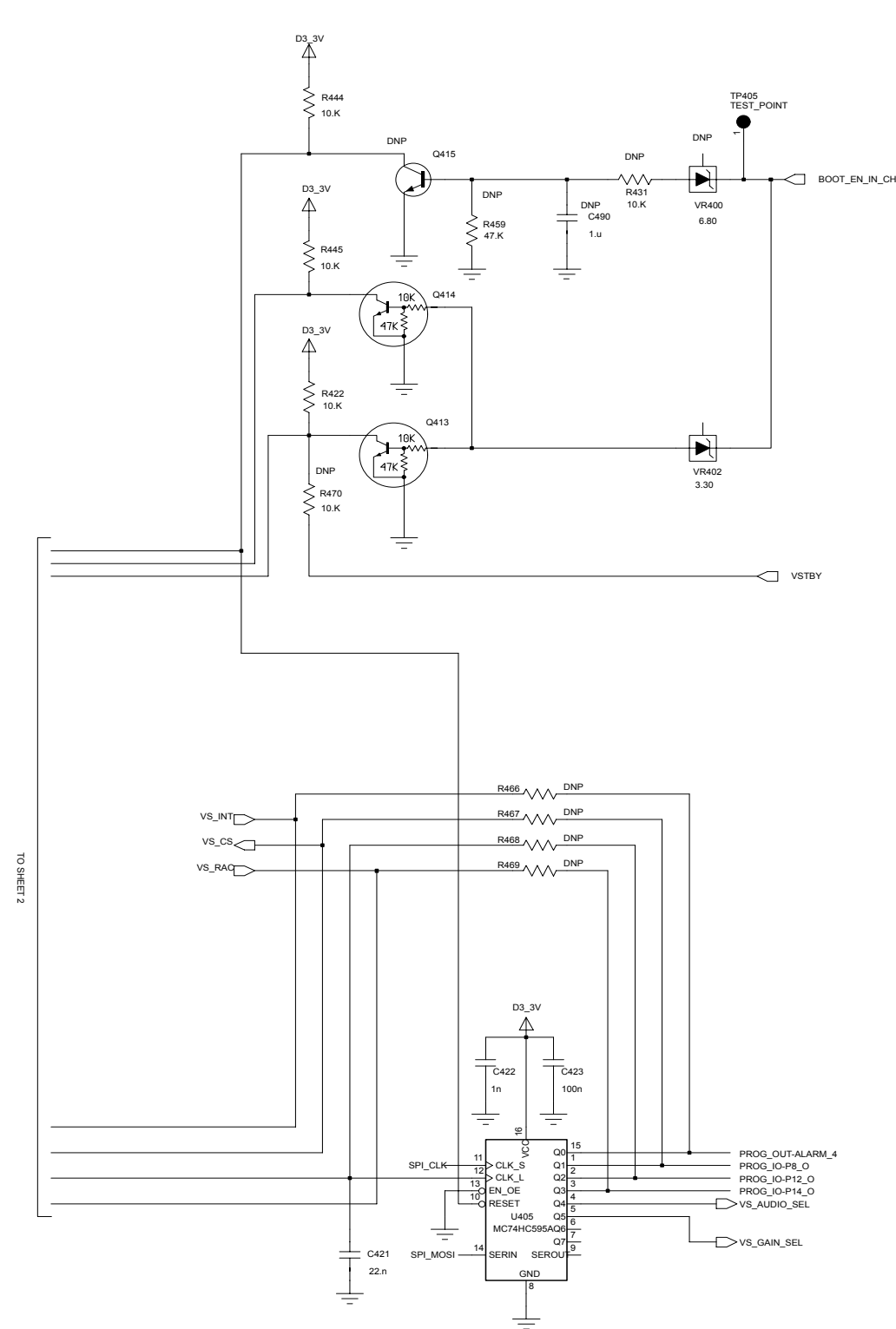


VHF2 (146-174 MHz) 1-25 W DC and Audio Circuits (Sht 2 of 2)

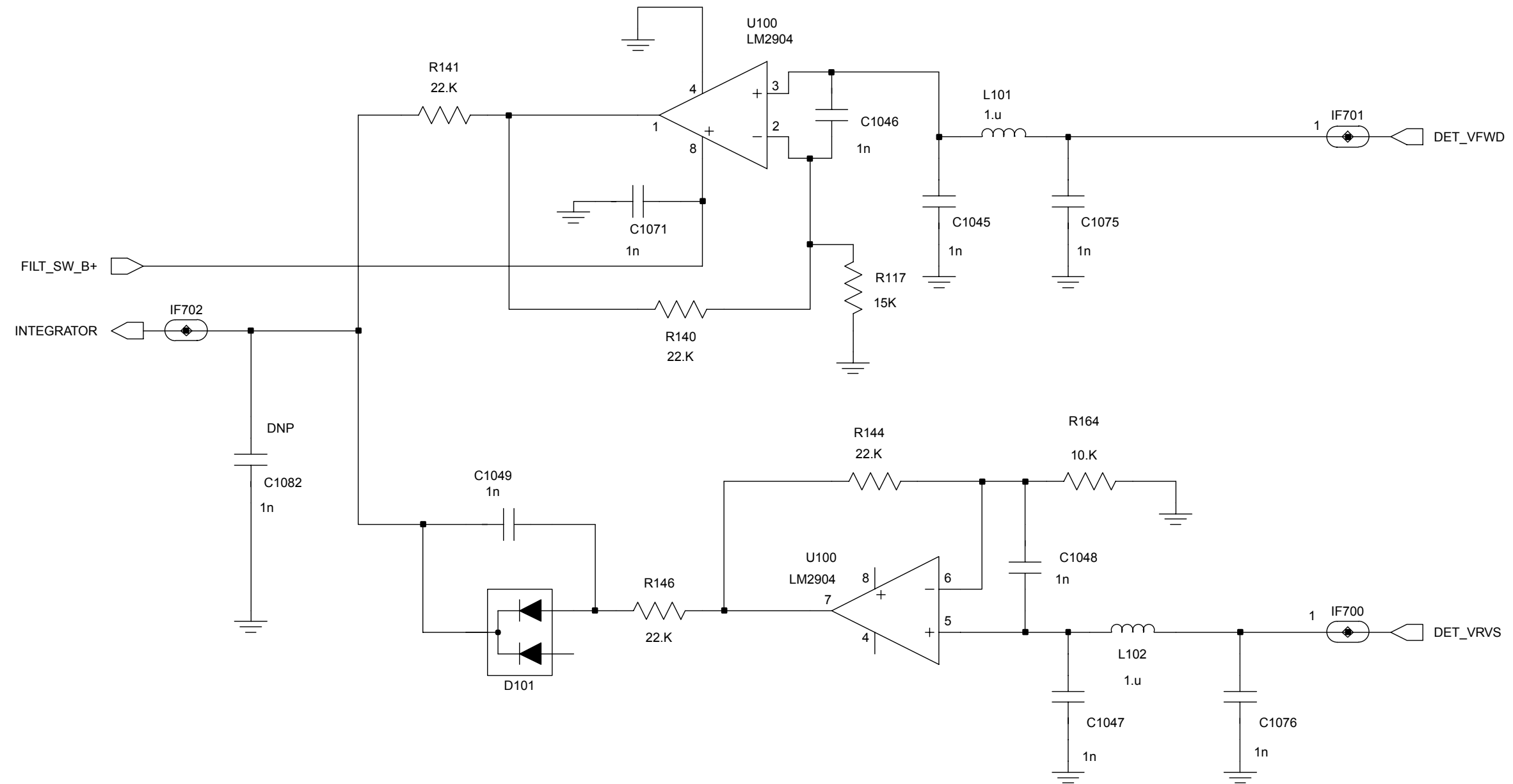


VHF2 (146-174 MHz) 1-25 W Microprocessor and Controller Circuits (Sht 1 of 2)

TO SHEET 1



73D02968C63-0
SHEET 8 OF 8



VHF2 (146-174 MHz) 1-25 W Power Control Circuit

2.1 VHF2 PCB 8488977U01 (rev. P9) Parts List 1–25 W

Circuit Ref.	Motorola Part No.	Description
C1000	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1001	2311049A08	KEMET CAPS
C1002	2111078B59	CHIP CAP RF 470 5 NPO 100V
C1003	2111078B59	CHIP CAP RF 470 5 NPO 100V
C1004	2111078B47	CAP CHIP RF 150 5 NP O 100V
C1005	2111078B47	CAP CHIP RF 150 5 NP O 100V
C1006	2111078B47	CAP CHIP RF 150 5 NP O 100V
C1007	NOT PLACED	–
C1008	2111078B42	CAP CHIP RF 100 5 NPO 100V
C1009	2111078B42	CAP CHIP RF 100 5 NPO 100V
C1010	2111078B42	CAP CHIP RF 100 5 NPO 100V
C1011	2111078B38	CAP CHIP RF 68 5 NPO 100V
C1012	2111078B36	CAP CHIP RF 56 5 NPO 100V
C1013	2111078B36	CAP CHIP RF 56 5 NPO 100V
C1014	NOT PLACED	–
C1015	2111078B34	CAP CHIP RF 47 5 NPO 100V
C1016	2111078B29	CAP CHIP RF 33 5 NPO 100V
C1017	2111078B22	CAP CHIP RF 22 5 NPO 100V
C1018	NOT PLACED	–
C1019	2111078B16	CAP CHIP RF 13 5 NPO 100V
C1020	2111078B15	CAP CHIP RF 12 5 NPO 100V
C1021	2111078B13	CAP ALT E16
C1022	2111078B09	CAP ALT E17
C1023	2111078B21	CAP ALT E35
C1024	2111078B05	CAP ALT E19
C1025	2111078B05	CAP ALT E19
C1027	2311049A45	CAP TANT CHIP 10 10 35
C1028	2113743K15	CER CHIP CAP .100UF
C1029	2113743K15	CER CHIP CAP .100UF
C1030	2113743E07	CER CHIP CAP .022UF

Circuit Ref.	Motorola Part No.	Description
C1031	2113743E07	CER CHIP CAP .022UF
C1032	2113743E07	CER CHIP CAP .022UF
C1033	2113743E07	CER CHIP CAP .022UF
C1034	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1035	2113743E07	CER CHIP CAP .022UF
C1036	2113743E07	CER CHIP CAP .022UF
C1037	2113743E07	CER CHIP CAP .022UF
C1038	NOT PLACED	–
C1039	2113743E07	CER CHIP CAP .022UF
C1040	2113741F33	CAP CHIP CL2 X7R REEL 2200
C1041	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1042	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1043	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1044	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1045	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1046	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1047	2113743K17	CAP CHIP .330 UF +80-20% 16V
C1048	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1049	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1050	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1051	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1052	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1053	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1054	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1055	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1056	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1057	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1058	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1059	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1060	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1061	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1062	2113741F25	CAP CHIP CL2 X7R REEL 1000

Circuit Ref.	Motorola Part No.	Description
C1063	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1064	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1065	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1066	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1067	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1068	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1069	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1070	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1071	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1072	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1073	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1074	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1075	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1076	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1077	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1078	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1079	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1080	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1081	NOT PLACED	–
C1082	NOT PLACED	–
C1083	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1084	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1085	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1086	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1087	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1088	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1089	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1090	NOT PLACED	–
C1091	NOT PLACED	–
C1092	NOT PLACED	–
C1093	NOT PLACED	–
C1094	NOT PLACED	–

Circuit Ref.	Motorola Part No.	Description
C1095	NOT PLACED	–
C1097	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1098	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1099	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1100	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1101	2113740F51	CAP CHIP REEL CL1 +/-30 100
C1102	2113740F51	CAP CHIP REEL CL1 +/-30 100
C1103	2113741A57	CAP CHIP 33K +-5% (2160521A31)
C1104	2113741A53	CAP CHIP CL2 X7R REEL 22000
C1105	2113740F67	CAP CHIP CL1 +/-30 470 5%
C1106	2113740F67	CAP CHIP CL1 +/-30 470 5%
C1107	2113740F67	CAP CHIP CL1 +/-30 470 5%
C1108	2113740F47	CAP CHIP REEL CL1 +/-30 68
C1109	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1110	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1112	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1113	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1114	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1115	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1116	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1117	2113740F43	CAP CHIP REEL CL1 +/-30 47
C1118	2113740F39	CAP CHIP REEL CL1 +/-30 33
C1119	2113740F39	CAP CHIP REEL CL1 +/-30 33
C1120	2113740F39	CAP CHIP REEL CL1 +/-30 33
C1121	NOT PLACED	–
C1122	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1123	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1124	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1125	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1126	2113740F59	CAP CHIP REEL CL1 +/-30 220

Circuit Ref.	Motorola Part No.	Description
C1127	2360567A03	CAP TANTALUM
C1128	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1129	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1130	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1131	NOT PLACED	–
C2000	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2001	2311049J11	CAPACITOR TANT 10% 4.7UF
C2002	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C2003	2113743K15	CER CHIP CAP .100UF
C2004	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2005	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2006	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2007	2113743E20	CAP CHIP. 10 UF 10%
C2008	2113743E20	CAP CHIP. 10 UF 10%
C2009	2113743E20	CAP CHIP. 10 UF 10%
C2010	2113743E20	CAP CHIP. 10 UF 10%
C2011	2113743E20	CAP CHIP. 10 UF 10%
C2012	NOT PLACED	–
C2013	2113743E20	CAP CHIP. 10 UF 10%
C2014	2113743E20	CAP CHIP. 10 UF 10%
C2015	2113743E20	CAP CHIP. 10 UF 10%
C2016	2113743E20	CAP CHIP. 10 UF 10%
C2017	2113743E20	CAP CHIP. 10 UF 10%
C2018	2113743E20	CAP CHIP. 10 UF 10%
C2019	2113743E20	CAP CHIP. 10 UF 10%
C2020	2113743E20	CAP CHIP. 10 UF 10%
C2021	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2022	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2023	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2024	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2025	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2026	2113741F49	CAP CHIP CL2 X7R REEL 10000

Circuit Ref.	Motorola Part No.	Description
C2027	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2028	2113741F33	CAP CHIP CL2 X7R REEL 2200
C2029	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2030	2113741F39	CAP CHIP CL2 XTR REEL 3900
C2031	NOT PLACED	–
C2032	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2033	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2034	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2035	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2036	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2037	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2038	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2039	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2040	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2041	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2042	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2043	2113740L14	CAP CER CHIP 6.8PF +/-0.1PF
C2044	2113740L06	CAP CER CHIP 3.3 PF +/-0.1PF
C2045	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2046	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2047	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2048	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2049	NOT PLACED	–
C2050	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2051	2113740F59	CAP CHIP REEL CL1 +/-30 220
C2052	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2053	NOT PLACED	–
C2054	2113740L37	CAP 62.0 PF 50V 2.0%
C2055	2113740F35	CAP CHIP REEL CL1 +/-30 22
C2056	2113740F33	CAP CHIP REEL CL1 +/-30 18
C2057	2113740F33	CAP CHIP REEL CL1 +/-30 18

Circuit Ref.	Motorola Part No.	Description
C2058	2113740F33	CAP CHIP REEL CL1 +/-30 18
C2059	2113740F33	CAP CHIP REEL CL1 +/-30 18
C2060	2113740F31	CAP CHIP REEL CL1 +/-30 15
C2061	2113740F29	CAP CHIP REEL CL1 +/-30 12
C2062	2113740F29	CAP CHIP REEL CL1 +/-30 12
C2063	2113740L22	CAP 15.0 PF 50V 2.0 %
C2064	2113740F32	CAP CHIP REEL CL1 +/-30 16
C2065	2113740F27	CAP CHIP REEL CL1 +/-30 10
C2066	2113740L16	CAP CER CHIP 8.2 PF +/-0.1PF
C2067	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C2068	2113740F23	CAP CHIP REEL CL1 +/-30 6.8
C2069	2113740L12	CAP CER CHIP 5.6PF +/-0.1PF
C2070	2113740F41	CAP CHIP REEL CL1 +/-30 39
C2071	2113740F41	CAP CHIP REEL CL1 +/-30 39
C2072	2113740L04	CAP CER CHIP 2.7 PF +/-0.1PF
C2073	2113740F03	CAP CHIP REEL CL1 +/-30 1.0
C2074	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2075	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2076	NOT PLACED	–
C2077	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2078	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2079	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2080	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2081	2113740F67	CAP CHIP CL1 +/-30 470 5%
C300	2113740F44	CAP CHIP REEL CL1 +/-30 51
C301	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C302	2113740F54	CAP CHIP REEL CL1 +/-30 130

Circuit Ref.	Motorola Part No.	Description
C303	2113743K15	CER CHIP CAP .100UF
C304	2113743E20	CAP CHIP. 10 UF 10%
C305	2113743E20	CAP CHIP. 10 UF 10%
C306	2113743E20	CAP CHIP. 10 UF 10%
C307	2113743E20	CAP CHIP. 10 UF 10%
C308	2113743E20	CAP CHIP. 10 UF 10%
C309	2113743E20	CAP CHIP. 10 UF 10%
C310	2113743E20	CAP CHIP. 10 UF 10%
C311	2113743E20	CAP CHIP. 10 UF 10%
C312	2113743E20	CAP CHIP. 10 UF 10%
C313	2113743E20	CAP CHIP. 10 UF 10%
C314	2113743E20	CAP CHIP. 10 UF 10%
C315	2113743E20	CAP CHIP. 10 UF 10%
C316	2113743E20	CAP CHIP. 10 UF 10%
C317	2113743E20	CAP CHIP. 10 UF 10%
C318	2113743E20	CAP CHIP. 10 UF 10%
C319	2113743E20	CAP CHIP. 10 UF 10%
C320	2113743E20	CAP CHIP. 10 UF 10%
C321	2113741F49	CAP CHIP CL2 X7R REEL 10000
C322	2113741F41	CAP CHIP CL2 X7R REEL 4700
C323	2113741F25	CAP CHIP CL2 X7R REEL 1000
C324	2113741F25	CAP CHIP CL2 X7R REEL 1000
C325	2113741F25	CAP CHIP CL2 X7R REEL 1000
C326	2113741F25	CAP CHIP CL2 X7R REEL 1000
C327	2113741F25	CAP CHIP CL2 X7R REEL 1000
C328	2113740F67	CAP CHIP CL1 +/-30 470 5%
C329	2113740F67	CAP CHIP CL1 +/-30 470 5%
C330	2113740F67	CAP CHIP CL1 +/-30 470 5%
C331	2113740F67	CAP CHIP CL1 +/-30 470 5%
C332	2113741F13	CAP CHIP CL2 X7R REEL 330
C333	2113740L41	CAP 91.0 PF 50V 2.0 %
C334	2113740L41	CAP 91.0 PF 50V 2.0 %

Circuit Ref.	Motorola Part No.	Description
C335	2113740L17	CAP CER CHIP 9.1 PF+-0.1PF
C336	2113740L14	CAP CER CHIP 6.8PF +-0.1PF
C337	2113740F57	CAP CHIP REEL CL1 +/-30 180
C338	2113740F53	CAP CHIP REEL CL1 +/-30 120
C339	2113740F51	CAP CHIP REEL CL1 +/-30 100
C340	2113740F49	CAP CHIP REEL CL1 +/-30 82
C341	2113740F49	CAP CHIP REEL CL1 +/-30 82
C342	2113740F49	CAP CHIP REEL CL1 +/-30 82
C343	2113740F49	CAP CHIP REEL CL1 +/-30 82
C344	NOT PLACED	-
C345	NOT PLACED	-
C346	2113740F45	CAP CHIP REEL CL1+/-30 56
C347	2113740F41	CAP CHIP REEL CL1 +/-30 39
C348	2113740F41	CAP CHIP REEL CL1 +/-30 39
C349	NOT PLACED	-
C350	2113740F40	CAP CHIP REEL CL1 +/-30 36
C351	2113740F40	CAP CHIP REEL CL1 +/-30 36
C352	2113740F39	CAP CHIP REEL CL1 +/-30 33
C353	2113740F38	CAP CHIP REEL CL1 +/-30 30
C354	2113740F38	CAP CHIP REEL CL1 +/-30 30
C355	2113740F38	CAP CHIP REEL CL1 +/-30 30
C356	NOT PLACED	-
C357	2113740F35	CAP CHIP REEL CL1 +/-30 22
C359	NOT PLACED	-
C360	NOT PLACED	-
C361	2113740F33	CAP CHIP REEL CL1 +/-30 18
C362	2113740F33	CAP CHIP REEL CL1 +/-30 18
C363	NOT PLACED	-
C364	2113740F25	CAP CHIP REEL CL1+/-30 8.2
C365	2113740F21	CAP CHIP REEL CL1+/-30 5.6
C366	NOT PLACED	-

Circuit Ref.	Motorola Part No.	Description
C367	NOT PLACED	-
C400	2113741F25	CAP CHIP CL2 X7R REEL 1000
C401	2113743K15	CER CHIP CAP .100UF
C402	2113743K15	CER CHIP CAP .100UF
C403	2113743K15	CER CHIP CAP .100UF
C404	2113743K15	CER CHIP CAP .100UF
C405	2113743K15	CER CHIP CAP .100UF
C406	2113743K15	CER CHIP CAP .100UF
C407	2113743K15	CER CHIP CAP .100UF
C408	2113743K15	CER CHIP CAP .100UF
C410	2113743K15	CER CHIP CAP .100UF
C411	2113741F25	CAP CHIP CL2 X7R REEL 1000
C412	2113741F25	CAP CHIP CL2 X7R REEL 1000
C413	2113741F25	CAP CHIP CL2 X7R REEL 1000
C414	2113741F25	CAP CHIP CL2 X7R REEL 1000
C415	2113741F25	CAP CHIP CL2 X7R REEL 1000
C416	2113741F25	CAP CHIP CL2 X7R REEL 1000
C417	2113741F25	CAP CHIP CL2 X7R REEL 1000
C418	2113741F25	CAP CHIP CL2 X7R REEL 1000
C421	2113743E07	CER CHIP CAP .022UF
C422	2113741F25	CAP CHIP CL2 X7R REEL 1000
C423	2113743K15	CER CHIP CAP .100UF
C490	NOT PLACED	-
C5000	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5001	2389289U01	10UF 50V 20% ALUMINUM SMD
C5002	2311049A99	CAP TANT CHIP 47 UF 10V 20%
C5003	2311049A99	CAP TANT CHIP 47 UF 10V 20%
C5005	2360567A03	CAP TANTALUM
C5006	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5007	2311049A99	CAP TANT CHIP 47 UF 10V 20%
C5008	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V

Circuit Ref.	Motorola Part No.	Description
C5009	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5010	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5011	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5012	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C5013	2113928P04	CAP CER CHIP 1.0UF 20% 6.3V
C5014	NOT PLACED	-
C5015	2113743K15	CER CHIP CAP .100UF
C5016	2113743K15	CER CHIP CAP .100UF
C5017	2113743K15	CER CHIP CAP .100UF
C5018	2113743K15	CER CHIP CAP .100UF
C5019	2113743K15	CER CHIP CAP .100UF
C5020	2113743K15	CER CHIP CAP .100UF
C5021	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5022	2113743K15	CER CHIP CAP .100UF
C5023	2113743K15	CER CHIP CAP .100UF
C5024	2113743K15	CER CHIP CAP .100UF
C5025	2113743K15	CER CHIP CAP .100UF
C5026	2113743K15	CER CHIP CAP .100UF
C5027	2113743K15	CER CHIP CAP .100UF
C5028	2113743K15	CER CHIP CAP .100UF
C5029	2113743K15	CER CHIP CAP .100UF
C5030	2113743K15	CER CHIP CAP .100UF
C5031	2113743K15	CER CHIP CAP .100UF
C5032	2113743K15	CER CHIP CAP .100UF
C5033	2113743K15	CER CHIP CAP .100UF
C5034	2113743K15	CER CHIP CAP .100UF
C5035	2113743K15	CER CHIP CAP .100UF
C5036	2113743K15	CER CHIP CAP .100UF
C5037	2113743K15	CER CHIP CAP .100UF
C5038	2113743K15	CER CHIP CAP .100UF

Circuit Ref.	Motorola Part No.	Description
C5039	NOT PLACED	-
C5040	NOT PLACED	-
C5041	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C5042	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5043	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5044	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5045	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5046	2113743E20	CAP CHIP. 10 UF 10%
C5047	2113743E20	CAP CHIP. 10 UF 10%
C5048	2113743E20	CAP CHIP. 10 UF 10%
C5049	2113743E20	CAP CHIP. 10 UF 10%
C5050	2113743E20	CAP CHIP. 10 UF 10%
C5051	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5052	2113743E20	CAP CHIP. 10 UF 10%
C5053	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5054	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5055	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5056	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5057	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5058	NOT PLACED	-
C5059	2113743E07	CER CHIP CAP .022UF
C5060	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5061	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5062	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5063	2113741M69	CAP CHIP CLS2 100000 PF 20V 10

Circuit Ref.	Motorola Part No.	Description
C5064	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5065	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5066	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5067	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5068	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5069	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5070	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5071	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5072	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5073	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5074	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5075	NOT PLACED	–
C5076	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5077	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5078	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5079	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5080	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5081	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5082	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5083	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5084	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5085	2113741A53	CAP CHIP CL2 X7R REEL 22000
C5086	2113741A53	CAP CHIP CL2 X7R REEL 22000
C5087	2113740F53	CAP CHIP REEL CL1 +/-30 120
C5088	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5089	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5090	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5091	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5092	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5094	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5095	2113740F59	CAP CHIP REEL CL1 +/-30 220

Circuit Ref.	Motorola Part No.	Description
C5096	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5097	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5098	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5099	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5100	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5101	2113741F25	CAP CHIP CL2 X7R REEL 1000 (Not used in GM3188/GM3189)
C5102	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5103	2113743K15	CER CHIP CAP .100UF (Not used in GM3188/GM3189)
C5104	NOT PLACED	–
C5110	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5111	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5113	NOT PLACED	–
C5114	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5115	NOT PLACED	–
C5116	NOT PLACED	–
C5117	NOT PLACED	–
C5118	2113743E20	CAP CHIP. 10 UF 10%
C5119	2113743H14	CAP CHIP 10.0 UF 16V +80-20%
C5120	NOT PLACED	–
C5121	2113741F25	CAP CHIP CL2 X7R REEL 1000
C602	2113741F25	CAP CHIP CL2 X7R REEL 1000
C603	2113741F25	CAP CHIP CL2 X7R REEL 1000
C604	2113741F25	CAP CHIP CL2 X7R REEL 1000
C605	2113741F25	CAP CHIP CL2 X7R REEL 1000
C606	2113741F25	CAP CHIP CL2 X7R REEL 1000
C607	2113741F25	CAP CHIP CL2 X7R REEL 1000
C608	NOT PLACED	–
C609	NOT PLACED	–
C610	2113741F25	CAP CHIP CL2 X7R REEL 1000
C611	2113741F25	CAP CHIP CL2 X7R REEL 1000

Circuit Ref.	Motorola Part No.	Description
C612	2113741F25	CAP CHIP CL2 X7R REEL 1000
C613	2113741F25	CAP CHIP CL2 X7R REEL 1000
C614	2113741F25	CAP CHIP CL2 X7R REEL 1000
C615	2113741F25	CAP CHIP CL2 X7R REEL 1000
C616	2113741F25	CAP CHIP CL2 X7R REEL 1000
C617	2113741F25	CAP CHIP CL2 X7R REEL 1000
C618	2113741F25	CAP CHIP CL2 X7R REEL 1000
C619	NOT PLACED	–
C620	2113741F25	CAP CHIP CL2 X7R REEL 1000
C621	2113741F25	CAP CHIP CL2 X7R REEL 1000
C622	2113741F25	CAP CHIP CL2 X7R REEL 1000
C623	2113741F25	CAP CHIP CL2 X7R REEL 1000
C624	2113741F25	CAP CHIP CL2 X7R REEL 1000
C625	2113741F25	CAP CHIP CL2 X7R REEL 1000
C626	2113741F25	CAP CHIP CL2 X7R REEL 1000
C627	2113741F25	CAP CHIP CL2 X7R REEL 1000
C628	2113741F25	CAP CHIP CL2 X7R REEL 1000
C629	2113741F25	CAP CHIP CL2 X7R REEL 1000
C630	2113741F25	CAP CHIP CL2 X7R REEL 1000
C631	2113741F25	CAP CHIP CL2 X7R REEL 1000
C632	2113741F25	CAP CHIP CL2 X7R REEL 1000
C633	2113741F25	CAP CHIP CL2 X7R REEL 1000
C662	2113741F25	CAP CHIP CL2 X7R REEL 1000
C678	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
CR300	4880154K03	SOT MMBD353 RH DIODE DUAL SCHT
CR301	4880154K03	SOT MMBD353 RH DIODE DUAL SCHT
D100	NOT PLACED	–
D101	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D102	4813833C02	DIODE DUAL 70V '5B' COMM CATH

Circuit Ref.	Motorola Part No.	Description
D103	4802482J02	PIN DIODE SMD
D104	4802482J02	PIN DIODE SMD
D105	4805218N57	DIODE DUAL
D106	4805218N57	DIODE DUAL
D107	4805218N57	DIODE DUAL
D108	4805218N57	DIODE DUAL
D200	4802233J09	DIODE TRIPLE SOT25-RH
D201	4802233J09	DIODE TRIPLE SOT25-RH
D202	4862824C03	DIODE VARACTOR
D203	4805649Q13	DIODE VCTR ISV 228
D204	4805649Q13	DIODE VCTR ISV 228
D205	4862824C01	DIODE VARACTOR
D301	4802245J97	Band Switchind Diode, Rohm DAN
D302	4802245J97	Band Switchind Diode, Rohm DAN
D303	4802245J97	Band Switchind Diode, Rohm DAN
D304	4802245J97	Band Switchind Diode, Rohm DAN
D305	4880142L01	SOT MMBV109 RH
D400	4813833C07	DIODE DUAL 100V '5C' SERIES
D401	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D402	4809948D42	DIODE SCHOTTKY RB751V-40
D500	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D501	NOT PLACED	–
D502	4813825A23	DIODE, DISCRETE SPECIALS VAR&P
D511	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D513	4813833C02	DIODE DUAL 70V '5B' COMM CATH
FL300	9180022M11	XTAL FILTER 44.85MHZ

Circuit Ref.	Motorola Part No.	Description
FL301	9180468V06	SMD455KHZ 4 ELEMENT CER FLTR
FL302	9180468V04	SMD455KHZ 4 ELEMENT CER FLTR
FL303	9180469V03	SMD455KHZ 6 ELEMENT CER FLTR
FL304	9180469V06	SMD455KHZ 6 ELEMENT CER FLTR
J11	2889309U01	MINI-UHF PCB R.A
J2	0989241U02	FLEX 20PIN 1MM TOP NON ZIF
J3	0986615Z01	CONN,ZIF,F,28CONT,TIN,CBL (Not used in GM3188/GM3189)
L100	2484657R01	INDUCTOR BEAD CHIP
L101	2462587T30	IND CHIP 1000NH 5% LOW PRO
L102	2462587T30	IND CHIP 1000NH 5% LOW PRO
L103	2462587T30	IND CHIP 1000NH 5% LOW PRO
L104	2462587T13	IND CHIP 68NH 5% LOW PRO
L105	2462587T13	IND CHIP 68NH 5% LOW PRO
L106	2460591A11	COIL AIR WOUND INDUC 7.66
L107	2460591A01	COIL AIR WOUND INDUC 4.22
L108	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L109	NOT PLACED	–
L110	2462587N42	CHIP IND 12 NH 5%
L111	2485873L05	ENCAPSULATED AIR WOUND 48NH
L112	2485873L05	ENCAPSULATED AIR WOUND 48NH
L113	2485873L05	ENCAPSULATED AIR WOUND 48NH
L114	2485873L05	ENCAPSULATED AIR WOUND 48NH
L115	2485873L01	ENCAPSULATED AIR WOUND COIL
L116	2485873L01	ENCAPSULATED AIR WOUND COIL
L117	2484657R01	INDUCTOR BEAD CHIP

Circuit Ref.	Motorola Part No.	Description
L118	2484657R01	INDUCTOR BEAD CHIP
L119	2484657R01	INDUCTOR BEAD CHIP
L120	2484657R01	INDUCTOR BEAD CHIP
L121	2484657R01	INDUCTOR BEAD CHIP
L122	2460591C23	COIL AIR WOUND INDUC 13.85
L126	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L200	2462587Q42	IND CHIP 390NH 10%
L201	2462587V44	IND CHIP 680 NH 10%
L202	2462587V44	IND CHIP 680 NH 10%
L203	2462587V44	IND CHIP 680 NH 10%
L204	2462587V44	IND CHIP 680 NH 10%
L205	2462587Q47	IND CHIP 1000 NH 10%
L206	2413923C05	IND CHIP 33 NH 2%
L207	2413923C07	IND CHIP 47 NH 2%
L208	2413926N24	IND CER CHIP 100.0 NH 5%
L209	2413926N24	IND CER CHIP 100.0 NH 5%
L210	2413926N24	IND CER CHIP 100.0 NH 5%
L211	2413926N24	IND CER CHIP 100.0 NH 5%
L212	2413926N24	IND CER CHIP 100.0 NH 5%
L213	2413926N24	IND CER CHIP 100.0 NH 5%
L214	2413926H20	IND CHIP 47.0 NH 5%
L215	2413926H20	IND CHIP 47.0 NH 5%
L216	2413926H20	IND CHIP 47.0 NH 5%
L217	2462587Q42	IND CHIP 390NH 10%
L300	2460591G24	COIL AIR WOUND INDUC 33.47
L301	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L302	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L303	2462587N69	CHIP IND 1200 NH 5%
L304	2483411T74	INDUCTOR CHIP SHIELDED
L305	2413926K31	IND CER CHIP 470.0 NH 5%
L306	2462587N55	CHIP IND 150 NH 5%
L307	2460591G24	COIL AIR WOUND INDUC 33.47

Circuit Ref.	Motorola Part No.	Description
L308	2460591G24	COIL AIR WOUND INDUC 33.47
L309	2460591G24	COIL AIR WOUND INDUC 33.47
L310	2460591G24	COIL AIR WOUND INDUC 33.47
L311	2460591G24	COIL AIR WOUND INDUC 33.47
L312	2460591G24	COIL AIR WOUND INDUC 33.47
L313	2460591G24	COIL AIR WOUND INDUC 33.47
L314	2460591G24	COIL AIR WOUND INDUC 33.47
L315	NOT PLACED	–
L500	2484657R01	INDUCTOR BEAD CHIP
L501	2484657R01	INDUCTOR BEAD CHIP
L502	2484657R01	INDUCTOR BEAD CHIP
M100	2686201B01	HEAT SPREADER WM
M105	7588823L03	PAD GROUND LCD
M106	7588823L03	PAD GROUND LCD
M107	7588823L03	PAD GROUND LCD
M108	7588823L04	PAD GROUND LCD
M109	7588823L04	PAD GROUND LCD
M110	7588823L04	PAD GROUND LCD
M111	3985994A01	CONTACT, PCB SPEAKER
M112	3985994A01	CONTACT, PCB SPEAKER
M113	3985994A01	CONTACT, PCB SPEAKER
M114	3985994A01	CONTACT, PCB SPEAKER
M9	0289511U01	NUTS
P1	2804503J01	CONNECTOR,ACCY 16 PIN
P2	NOT PLACED	–
PCB	8488977U01	MARLIN VHF
Q100	4886163B01	LD MOS SMT 35W 520MH 12V
Q101	4813824A10	TSTR NPN 40V .2A GEN PURP
Q102	4813824A10	TSTR NPN 40V .2A GEN PURP
Q103	4813824A06	XSTR NPN 30V DARLINGTON
Q105	4813828A11	TSTR 520 MHZ 3W, 12.5V RF LD MO

Circuit Ref.	Motorola Part No.	Description
Q106	4805128M27	SOT TRANS
Q200	4802245J95	BJT, NPN TRANSISTOR
Q300	4809940E02	TSTR DIG NPN DTC114YE
Q301	4813824A17	XSTR PNP40V .2A GENPB=100-300
Q302	4813824A10	TSTR NPN 40V .2A GEN PURP
Q303	4802245J95	BJT, NPN TRANSISTOR
Q304	4809939C04	TSTR DUAL PNP/NPN UMC3
Q305	4802197J95	RF TRANSISTOR PBR941
Q306	4813824A17	XSTR PNP40V .2A GENPB=100-300
Q400	4809940E02	TSTR DIG NPN DTC114YE
Q401	4880141L03	QSTR PNP SOT23 LO PROFILE TAPE
Q403	4809940E02	TSTR DIG NPN DTC114YE
Q404	4809940E02	TSTR DIG NPN DTC114YE
Q405	4809940E02	TSTR DIG NPN DTC114YE
Q407	4809940E02	TSTR DIG NPN DTC114YE
Q408	4880048M01	TSTR NPN DIG 47K/47K
Q409	4880048M01	TSTR NPN DIG 47K/47K
Q410	4880048M01	TSTR NPN DIG 47K/47K
Q411	4880048M01	TSTR NPN DIG 47K/47K
Q412	4880048M01	TSTR NPN DIG 47K/47K
Q413	4809940E02	TSTR DIG NPN DTC114YE
Q414	4809940E02	TSTR DIG NPN DTC114YE
Q415	NOT PLACED	–
Q416	4809940E02	TSTR DIG NPN DTC114YE
Q417	4813824A10	TSTR NPN 40V .2A GEN PURP
Q500	4813824A10	TSTR NPN 40V .2A GEN PURP
Q501	4809940E02	TSTR DIG NPN DTC114YE
Q502	4809940E02	TSTR DIG NPN DTC114YE
Q503	4813824A10	TSTR NPN 40V .2A GEN PURP
Q504	4880048M01	TSTR NPN DIG 47K/47K

Circuit Ref.	Motorola Part No.	Description
Q505	4813824A10	TSTR NPN 40V .2A GEN PURP
Q506	4813824A10	TSTR NPN 40V .2A GEN PURP
R101	NOT PLACED	–
R102	0683962T51	RES CHIP 120 5-1
R103	0683962T51	RES CHIP 120 5-1
R104	0683962T51	RES CHIP 120 5-1
R105	0680194M18	RES 51 OHMS 5% 1W
R106	0680194M18	RES 51 OHMS 5% 1W
R107	0680194M18	RES 51 OHMS 5% 1W
R108	0680194M18	RES 51 OHMS 5% 1W
R109	0662057A05	CHIP RES 15 OHMS 5%
R110	NOT PLACED	–
R111	NOT PLACED	–
R112	0662057P95	RES CHIP 100.0K 1% 30X60
R113	0662057P10	RES CHIP 10.0K 1% 30X60
R114	0662057P10	RES CHIP 10.0K 1% 30X60
R115	0662057P10	RES CHIP 10.0K 1% 30X60
R116	0662057P10	RES CHIP 10.0K 1% 30X60
R117	0662057P02	RES. CHIP 15K 1% 30X60
R118	0662057C51	CHIP RES 100 OHMS 5%
R119	0662057C51	CHIP RES 100 OHMS 5%
R120	0662057C51	CHIP RES 100 OHMS 5%
R121	0662057C51	CHIP RES 100 OHMS 5%
R122	0662057C19	CHIP RES 4.7 OHMS 5%
R123	0662057C13	CHIP RES 2.7 OHMS 5%
R124	0662057C13	CHIP RES 2.7 OHMS 5%
R125	0662057C13	CHIP RES 2.7 OHMS 5%
R126	0662057C03	CHIP RES 1.0 OHMS 5%
R127	0662057C03	CHIP RES 1.0 OHMS 5%
R130	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R131	0662057A97	CHIP RES 100K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R132	NOT PLACED	–
R134	0662057A89	CHIP RES 47K OHMS 5%
R135	0662057A88	CHIP RES 43K OHMS 5%
R136	0662057A87	CHIP RES 39K OHMS 5%
R137	0662057A87	CHIP RES 39K OHMS 5%
R138	0662057A87	CHIP RES 39K OHMS 5%
R139	0662057A87	CHIP RES 39K OHMS 5%
R140	0662057A81	CHIP RES 22K OHMS 5%
R141	0662057A81	CHIP RES 22K OHMS 5%
R142	0662057A81	CHIP RES 22K OHMS 5%
R143	0662057A81	CHIP RES 22K OHMS 5%
R144	0662057A81	CHIP RES 22K OHMS 5%
R145	0662057A81	CHIP RES 22K OHMS 5%
R146	0662057A81	CHIP RES 22K OHMS 5%
R147	0662057A81	CHIP RES 22K OHMS 5%
R148	0662057A81	CHIP RES 22K OHMS 5%
R149	0662057A81	CHIP RES 22K OHMS 5%
R150	0662057A73	CHIP RES 10K OHMS 5%
R151	0662057A67	CHIP RES 5600 OHMS 5%
R153	0662057A73	CHIP RES 10K OHMS 5%
R155	0662057A73	CHIP RES 10K OHMS 5%
R156	0662057A73	CHIP RES 10K OHMS 5%
R157	0662057A91	CHIP RES 56K OHMS 5%
R158	0662057A67	CHIP RES 5600 OHMS 5%
R159	NOT PLACED	–
R160	0662057A61	CHIP RES 3300 OHMS 5%
R161	0662057A61	CHIP RES 3300 OHMS 5%
R162	0662057A61	CHIP RES 3300 OHMS 5%
R163	0662057A61	CHIP RES 3300 OHMS 5%
R164	0662057A73	CHIP RES 10K OHMS 5%
R165	0662057A58	CHIP RES 2400 OHMS 5%
R166	0662057A58	CHIP RES 2400 OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R167	0662057A57	CHIP RES 2200 OHMS 5%
R168	0662057A57	CHIP RES 2200 OHMS 5%
R169	0662057A57	CHIP RES 2200 OHMS 5%
R170	0662057A42	CHIP RES 510 OHMS 5%
R171	0662057A41	CHIP RES 470 OHMS 5%
R172	0662057A41	CHIP RES 470 OHMS 5%
R173	0662057A36	CHIP RES 300 OHMS 5%
R174	0662057A36	CHIP RES 300 OHMS 5%
R175	0662057A33	CHIP RES 220 OHMS 5%
R176	0662057A25	CHIP RES 100 OHMS 5%
R177	NOT PLACED	–
R178	0662057A14	RES CHIP 36 OHM 5 1/8W
R179	0662057A14	RES CHIP 36 OHM 5 1/8W
R180	0660082A89	RES CHIP 47K OHMS 1% 1/16W
R181	0660082A89	RES CHIP 47K OHMS 1% 1/16W
R182	0662057A73	CHIP RES 10K OHMS 5%
R185	0662057A73	CHIP RES 10K OHMS 5%
R186	0662057C20	CHIP RES 5.1 OHMS 5%
R200	0662057A99	CHIP RES 120K OHMS 5%
R201	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R202	NOT PLACED	–
R203	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R204	NOT PLACED	–
R205	NOT PLACED	–
R206	0662057B02	CHIP RES 150K OHMS 5%
R207	0662057B02	CHIP RES 150K OHMS 5%
R208	0662057A18	CHIP RES 51 OHMS 5%
R209	0662057A97	CHIP RES 100K OHMS 5%
R210	NOT PLACED	–
R211	0662057A89	CHIP RES 47K OHMS 5%
R212	0662057A84	CHIP RES 30K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R213	0662057A65	CHIP RES 4700 OHMS 5%
R214	0662057A65	CHIP RES 4700 OHMS 5%
R215	0662057A65	CHIP RES 4700 OHMS 5%
R216	0662057A63	CHIP RES 3900 OHMS 5%
R217	0662057A52	CHIP RES 1300OHMS 5%05
R218	0662057A49	CHIP RES 1000 OHMS 5%
R219	NOT PLACED	–
R220	0662057A42	CHIP RES 510 OHMS 5%
R221	0662057A33	CHIP RES 220 OHMS 5%
R222	0662057A33	CHIP RES 220 OHMS 5%
R223	0662057A33	CHIP RES 220 OHMS 5%
R224	0662057A53	CHIP RES 1500 OHMS 5%
R225	0662057A29	CHIP RES 150 OHMS 5%
R226	0662057A29	CHIP RES 150 OHMS 5%
R227	0662057A25	CHIP RES 100 OHMS 5%
R228	0662057A25	CHIP RES 100 OHMS 5%
R229	0662057A25	CHIP RES 100 OHMS 5%
R230	0662057A25	CHIP RES 100 OHMS 5%
R231	0662057A18	CHIP RES 51 OHMS 5%
R232	0662057A17	RES CHIP 47 OHMS 5%
R233	0662057A17	RES CHIP 47 OHMS 5%
R234	0662057A15	CHIP RES 39 OHMS 5%
R235	0662057A07	CHIP RES 18 OHMS 5%
R300	0662057A73	CHIP RES 10K OHMS 5%
R301	0662057A41	CHIP RES 470 OHMS 5%
R302	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R303	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R304	0662057A85	CHIP RES 33K OHM 5%
R305	0662057A80	CHIP RES 20K OHMS 5%
R306	0662057A80	CHIP RES 20K OHMS 5%
R307	0662057A80	CHIP RES 20K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R308	0662057A80	CHIP RES 20K OHMS 5%
R309	0662057A77	CHIP RES 15K OHMS 5%
R310	0662057A77	CHIP RES 15K OHMS 5%
R311	NOT PLACED	-
R312	0662057A76	CHIP RES 13K OHMS 5%
R313	0662057A75	CHIP RES 12K OHMS 5%
R314	0662057A75	CHIP RES 12K OHMS 5%
R315	0662057A75	CHIP RES 12K OHMS 5%
R316	0662057A75	CHIP RES 12K OHMS 5%
R317	0662057A75	CHIP RES 12K OHMS 5%
R318	0662057A75	CHIP RES 12K OHMS 5%
R319	0662057A75	CHIP RES 12K OHMS 5%
R320	0662057A73	CHIP RES 10K OHMS 5%
R321	0662057A71	CHIP RES 8200 OHMS 5%
R322	0662057A65	CHIP RES 4700 OHMS 5%
R323	0662057A65	CHIP RES 4700 OHMS 5%
R324	0662057A61	CHIP RES 3300 OHMS 5%
R325	0662057A61	CHIP RES 3300 OHMS 5%
R326	0662057A58	CHIP RES 2400 OHMS 5%
R327	0662057A58	CHIP RES 2400 OHMS 5%
R328	0662057A55	CHIP RES 1800 OHM 5%
R329	0662057A51	CHIP RES 1200 OHMS 5%
R330	0662057A49	CHIP RES 1000 OHMS 5%
R331	0662057A45	CHIP RES 680 OHMS 5%
R332	0662057A43	CHIP RES 560 OHMS 5%
R333	0662057A40	CHIP RES 430 OHMS 5%
R334	0662057A39	CHIP RES 390 OHMS 5%
R335	0662057A33	CHIP RES 220 OHMS 5%
R336	0662057A25	CHIP RES 100 OHMS 5%
R337	0662057A25	CHIP RES 100 OHMS 5%
R338	0662057A18	CHIP RES 51 OHMS 5%
R339	0662057A18	CHIP RES 51 OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R340	0662057A18	CHIP RES 51 OHMS 5%
R341	0662057A01	CHIP RES 10 OHMS 5%
R342	0662057A01	CHIP RES 10 OHMS 5%
R343	0662057A01	CHIP RES 10 OHMS 5%
R344	0662057A01	CHIP RES 10 OHMS 5%
R345	0662057A73	CHIP RES 10K OHMS 5%
R346	0662057A73	CHIP RES 10K OHMS 5%
R401	0662057C85	CHIP RES 2700 OHMS 5%
R402	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R403	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R404	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R405	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R406	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R407	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R414	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R415	NOT PLACED	-
R421	0662057A33	CHIP RES 220 OHMS 5%
R422	0662057A73	CHIP RES 10K OHMS 5%
R423	NOT PLACED	-
R424	NOT PLACED	-
R425	0662057A97	CHIP RES 100K OHMS 5%
R426	0662057A97	CHIP RES 100K OHMS 5%
R427	NOT PLACED	-
R428	0662057A97	CHIP RES 100K OHMS 5%
R429	0662057A97	CHIP RES 100K OHMS 5%
R430	0662057A87	CHIP RES 39K OHMS 5%
R431	NOT PLACED	-
R432	0662057A85	CHIP RES 33K OHM 5%

Circuit Ref.	Motorola Part No.	Description
R433	0662057A85	CHIP RES 33K OHM 5%
R434	0662057A85	CHIP RES 33K OHM 5%
R435	0662057A85	CHIP RES 33K OHM 5%
R436	0662057A85	CHIP RES 33K OHM 5%
R438	0662057A73	CHIP RES 10K OHMS 5%
R439	0662057A73	CHIP RES 10K OHMS 5%
R440	0662057A73	CHIP RES 10K OHMS 5%
R441	0662057A73	CHIP RES 10K OHMS 5%
R442	0662057A73	CHIP RES 10K OHMS 5%
R443	0662057A61	CHIP RES 3300 OHMS 5%
R444	0662057A73	CHIP RES 10K OHMS 5%
R445	0662057A73	CHIP RES 10K OHMS 5%
R450	0662057A73	CHIP RES 10K OHMS 5%
R451	0662057A73	CHIP RES 10K OHMS 5%
R453	0662057A61	CHIP RES 3300 OHMS 5%
R454	0662057A61	CHIP RES 3300 OHMS 5%
R455	0662057A61	CHIP RES 3300 OHMS 5%
R456	0662057A61	CHIP RES 3300 OHMS 5%
R457	0662057A61	CHIP RES 3300 OHMS 5%
R458	0662057A61	CHIP RES 3300 OHMS 5%
R459	NOT PLACED	-
R460	0662057A53	CHIP RES 1500 OHMS 5%
R461	0662057A33	CHIP RES 220 OHMS 5%
R462	0662057A18	CHIP RES 51 OHMS 5%
R463	0662057A73	CHIP RES 10K OHMS 5%
R466	NOT PLACED	-
R467	NOT PLACED	-
R468	NOT PLACED	-
R469	NOT PLACED	-
R470	NOT PLACED	-
R471	0662057A01	CHIP RES 10 OHMS 5%
R472	NOT PLACED	-

Circuit Ref.	Motorola Part No.	Description
R473	NOT PLACED	-
R5000	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5001	0662057T68	RES CHIP 1.0K 1% 30*60
R5002	0662057C01	CHIP RES 0 OHMS .050 OHMS (Not used in GM3188/GM3189)
R5008	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5009	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5010	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5011	NOT PLACED	-
R5013	NOT PLACED	-
R5014	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5016	NOT PLACED	-
R5019	0662057B05	CHIP RES 200K OHMS 5%
R5020	0662057B02	CHIP RES 150K OHMS 5%
R5021	0662057A97	CHIP RES 100K OHMS 5%
R5022	0662057A97	CHIP RES 100K OHMS 5%
R5023	0662057A97	CHIP RES 100K OHMS 5%
R5024	0662057A97	CHIP RES 100K OHMS 5% (Not used in GM3188/GM3189)
R5025	0662057A97	CHIP RES 100K OHMS 5%
R5026	0662057A85	CHIP RES 33K OHM 5%
R5027	0662057B08	CHIP RES 270K OHMS 5%
R5028	0662057A97	CHIP RES 100K OHMS 5%
R5029	0662057A97	CHIP RES 100K OHMS 5%
R5030	0662057A85	CHIP RES 33K OHM 5%
R5031	0662057A92	CHIP RES 62K OHMS 5%
R5032	0662057A89	CHIP RES 47K OHMS 5%
R5033	0662057A89	CHIP RES 47K OHMS 5%
R5034	0662057A86	CHIP RES 36K OHMS 5%
R5035	0662057A89	CHIP RES 47K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R5036	0662057A89	CHIP RES 47K OHMS 5%
R5037	0662057A73	CHIP RES 10K OHMS 5%
R5038	0662057A85	CHIP RES 33K OHM 5%
R5039	0662057A97	CHIP RES 100K OHMS 5%
R5040	0662057A84	CHIP RES 30K OHMS 5%
R5041	0662057A82	CHIP RES 24K OHMS 5%
R5042	0662057A82	CHIP RES 24K OHMS 5%
R5043	0662057A82	CHIP RES 24K OHMS 5%
R5044	0662057A82	CHIP RES 24K OHMS 5%
R5045	0662057A85	CHIP RES 33K OHM 5%
R5046	0662057A82	CHIP RES 24K OHMS 5%
R5047	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS (Not used in GM3688/ GM3689)
R5048	0662057A82	CHIP RES 24K OHMS 5%
R5049	0662057A77	CHIP RES 15K OHMS 5%
R5050	0662057A76	CHIP RES 13K OHMS 5%
R5051	0662057A75	CHIP RES 12K OHMS 5%
R5052	0662057A73	CHIP RES 10K OHMS 5%
R5053	0662057A73	CHIP RES 10K OHMS 5%
R5054	0662057A73	CHIP RES 10K OHMS 5%
R5055	0662057A73	CHIP RES 10K OHMS 5%
R5056	0662057A73	CHIP RES 10K OHMS 5%
R5057	0662057A73	CHIP RES 10K OHMS 5%
R5058	NOT PLACED	–
R5059	NOT PLACED	–
R5060	0662057A73	CHIP RES 10K OHMS 5%
R5061	0662057A73	CHIP RES 10K OHMS 5%
R5062	0662057A73	CHIP RES 10K OHMS 5%
R5063	NOT PLACED	–
R5064	NOT PLACED	–
R5065	0662057A68	CHIP RES 6200 OHMS 5%
R5066	0662057A49	CHIP RES 1000 OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R5067	NOT PLACED	–
R5068	NOT PLACED	–
R5069	0662057A73	CHIP RES 10K OHMS 5%
R5070	0662057A57	CHIP RES 2200 OHMS 5%
R5071	0662057A57	CHIP RES 2200 OHMS 5%
R5072	0662057A65	CHIP RES 4700 OHMS 5%
R5073	0662057A49	CHIP RES 1000 OHMS 5%
R5074	0662057A49	CHIP RES 1000 OHMS 5%
R5075	0662057A42	CHIP RES 510 OHMS 5%
R5076	0662057A42	CHIP RES 510 OHMS 5%
R5077	0662057A36	CHIP RES 300 OHMS 5%
R5078	0662057A25	CHIP RES 100 OHMS 5%
R5079	0662057A25	CHIP RES 100 OHMS 5%
R5080	0662057A01	CHIP RES 10 OHMS 5%
R5081	0613952D78	CER CHIP RES 6340 OHM 1% 0603
R5082	0662057A90	CHIP RES 51K OHMS 5%
R5083	0662057B08	CHIP RES 270K OHMS 5%
R5084	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS (Not used in GM3188/ GM3189)
R5085	NOT PLACED	–
R5086	0662057A43	CHIP RES 560 OHMS 5%
R5087	0662057A97	CHIP RES 100K OHMS 5%
R5088	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5089	NOT PLACED	–
R5092	0662057A73	CHIP RES 10K OHMS 5%
R5093	0662057A73	CHIP RES 10K OHMS 5%
R5094	NOT PLACED	–
R5095	0662057A82	CHIP RES 24K OHMS 5%
R5096	0662057A73	CHIP RES 10K OHMS 5%
R5097	NOT PLACED	–

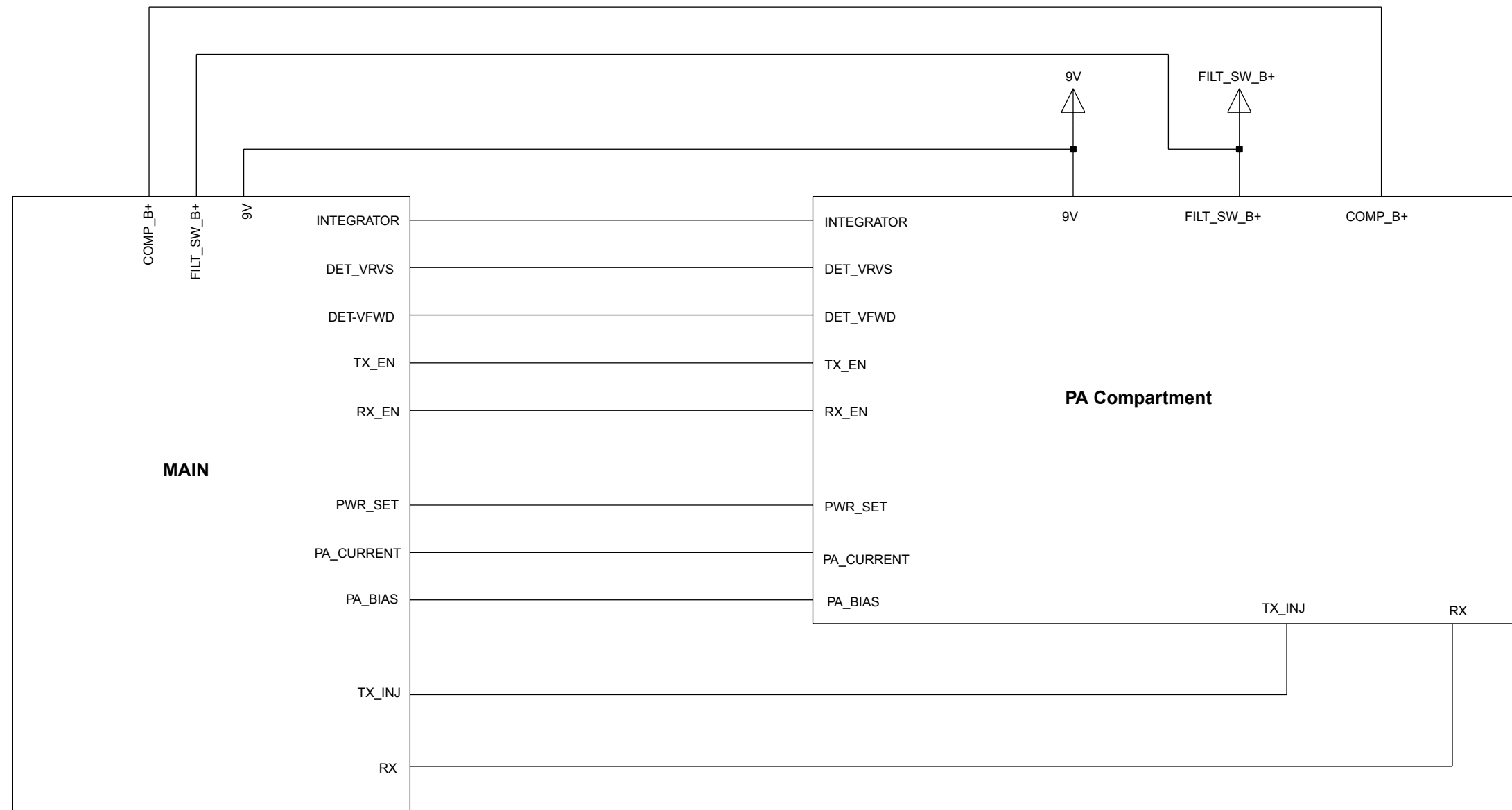
Circuit Ref.	Motorola Part No.	Description
R5098	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5099	NOT PLACED	–
R5100	NOT PLACED	–
R5101	0662057A25	CHIP RES 100 OHMS 5%
R5102	0662057A25	CHIP RES 100 OHMS 5%
R5103	NOT PLACED	–
R600	0662057C01	CHIP RES 0 OHMS .050 OHMS
R601	0611077A62	RES CHIP 330 5 1/8W
R602	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R603	0662057C01	CHIP RES 0 OHMS .050 OHMS
R604	0662057C01	CHIP RES 0 OHMS .050 OHMS
R610	0662057C59	CHIP RES 220 OHMS 5%
R615	0662057A25	CHIP RES 100 OHMS 5%
RT100	0680361L01	THERMISTOR 47KOHM
S5010	1889288U01	POTENTIOMETER W/SWITCH VOLUME
SH200	2689590U01	VCO SHIELD
SH201	2689589U01	VCO SHIELD
SH202	2689589U01	VCO SHIELD
SH300	2689591U01	MIXER SHIELD
SH301	2689593U01	FRONT ENA SHIELD
SH302	2689591U01	MIXER SHIELD
T300	2580541Z01	BALUN TRANSFORMER
T301	2580541Z01	BALUN TRANSFORMER
U100	5113818A01	IC LOW COST SING SPLY LM2904DR
U101	5185130C65	IC VHF/UHF/800 MHZ LDMOS DRIVE
U102	5113818A01	IC LOW COST SING SPLY LM2904DR
U103	5113819A04	IC QD OP AMP GEN PURP MC3303D

Circuit Ref.	Motorola Part No.	Description
U200	5185963A27	IC TESTED AT25016 48 PIN GFP
U201	5105750U54	IC PKG DIE VCO BUFFER
U300	5186144B01	FM IF IC SA616
U301	5109522E10	IC 3-INV LMOS TC7W04FU
U302	4808612Y05	CROSSOVER QUAD DIODE SMS3928-0
U400	5102463J64	16KX8 SPI SERIAL EEPROM
U402	NOT PLACED	–
U403	5102226J56	68HC11FLO_PASS5 100P IN TQFP
U404	5115037H01	4M FLASH ROM IC
U405	5113805A75	IC 8 BIT SER TO PAR/PAR HC595
U500	5113818A01	IC LOW COST SING SPLY LM2904DR
U501	0104016J81	9V REGULATOR ASSEMBLY
U502	5102463J95	AUDIO PA TDA1519C
U503	5105469E65	IC VLTG REGLTR
U504	5185130C53	IC ASFIC_CMP_R1
U505	5113818A01	IC LOW COST SING SPLY LM2904DR
U506	5113818A01	IC LOW COST SING SPLY LM2904DR
U507	5113818A01	IC LOW COST SING SPLY LM2904DR
U508	5113816A30	IC 3.3V LOW DROPOUT POS. REG.
U509	5113806A20	IC MUX/DEMUX TRIPLE 2-CHNL
U510	5104187K94	IC LP2986ILD3-3.3 VLTG REG
U514	4802393L66	MOSFET P-CH
U515	5162852A59	IC CMOS ANALOG SWITCH SPDT (Not used in GM3188/ GM3189)
VR101	4813830A15	TSTR 5.6V 5% 20MA 225MW
VR102	4813830A15	TSTR 5.6V 5% 20MA 225MW

Circuit Ref.	Motorola Part No.	Description
VR400	NOT PLACED	–
VR401	4813830G12	DIODE 4.3V 5% 'CP' 500MW _4687
VR402	4813830A09	DIODE 3.3V 5% 225MW MMBZ5226B
VR500	4813832C77	TRANS SUP. 24V HIGH PWR
VR501	4813830A14	DIODE 5.1V 5% 225MW MMBZ5231B_
VR502	NOT PLACED	–
VR503	4813830G09	DIODE 3.3V 5% 'CK' 500MW _4684
VR504	4813830G09	DIODE 3.3V 5% 'CK' 500MW _4684
VR692	4813830A75	DIODE DUAL COM ANODE
VR693	4813830A77	DIODE DL ZENER TVS 33V 1.0A
VR694	4813830A75	DIODE DUAL COM ANODE
VR695	4813830A77	DIODE DL ZENER TVS 33V 1.0A
VR696	4813830A75	DIODE DUAL COM ANODE
VR697	4813830A75	DIODE DUAL COM ANODE
VR698	4813830A75	DIODE DUAL COM ANODE
VR699	4813830A75	DIODE DUAL COM ANODE
Y200	NOT PLACED	–
Y201	4880114R06	CRYSTAL 16.8MHZ
Y300	9186145B02	CER.DISCR. CDBCA455CX36- TC
Y301	4880606B09	2ND OSC XTAL 44.395 MHZ

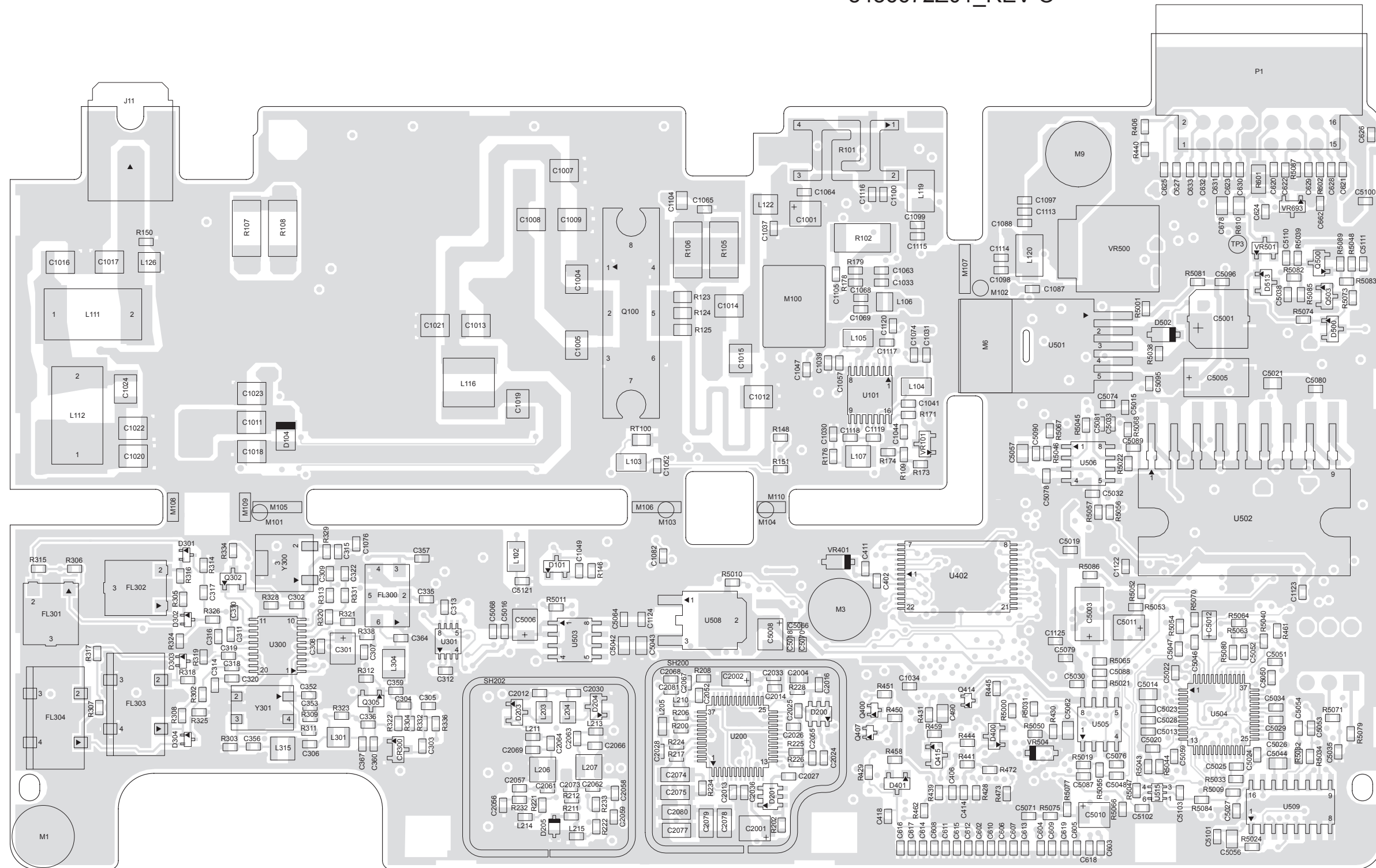
Notes

3.0 VHF 1-25 W Band 2 PCB 8486672Z01 / Schematics



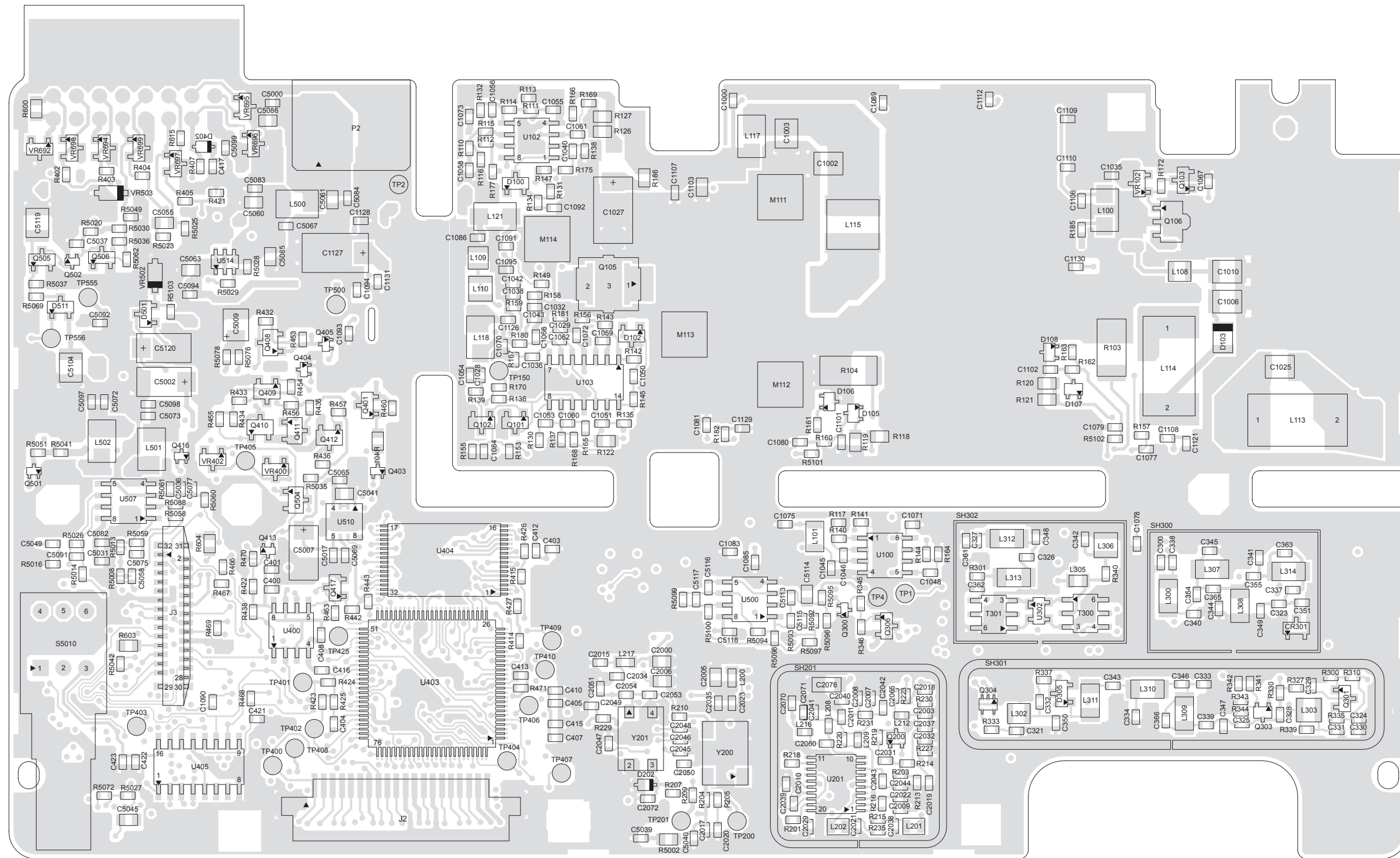
VHF2 Interconnection between Main Board and Power Amplifier Compartment

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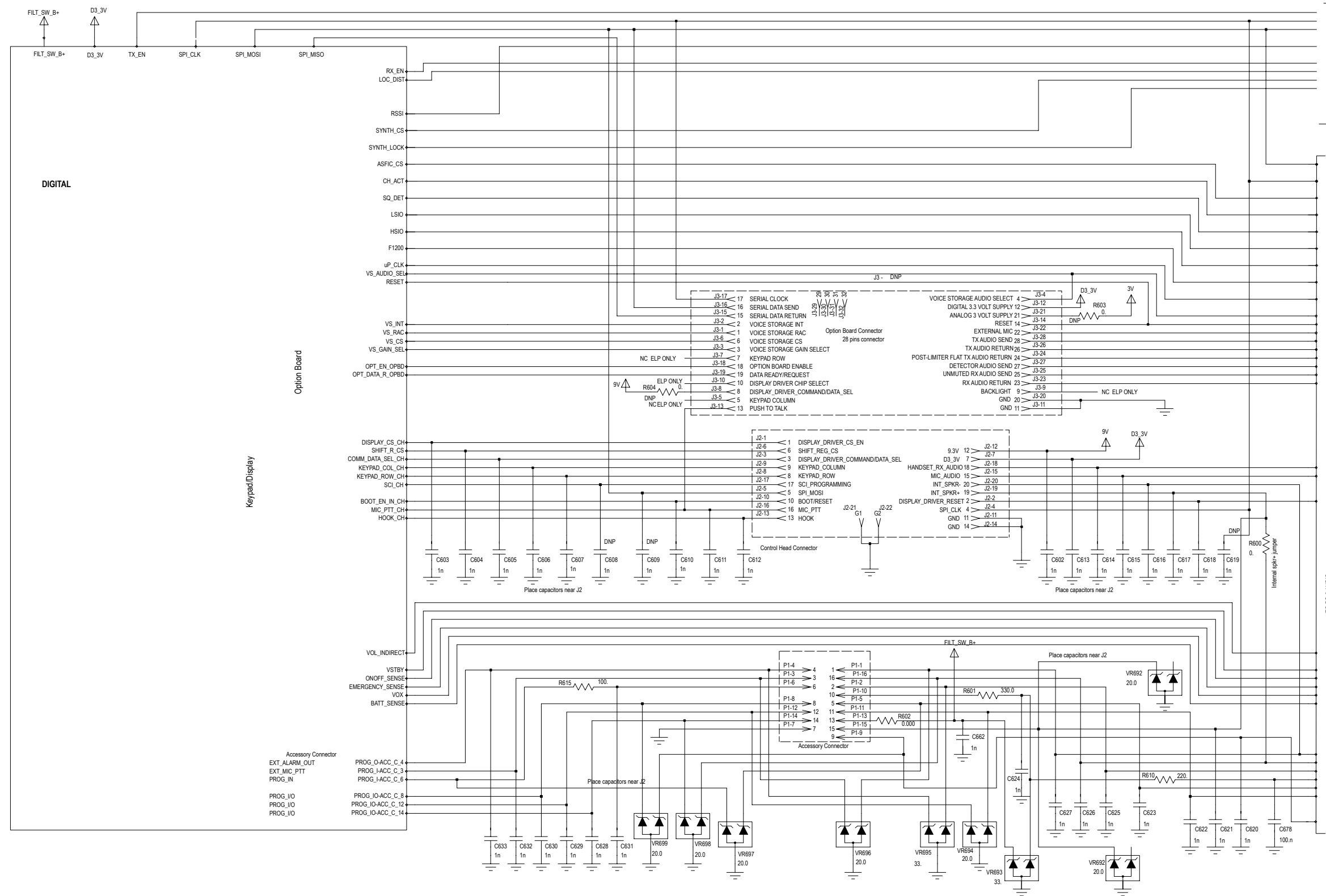


VHF2 (146-174 MHz) 1-25 W 8486672Z01, Top Side

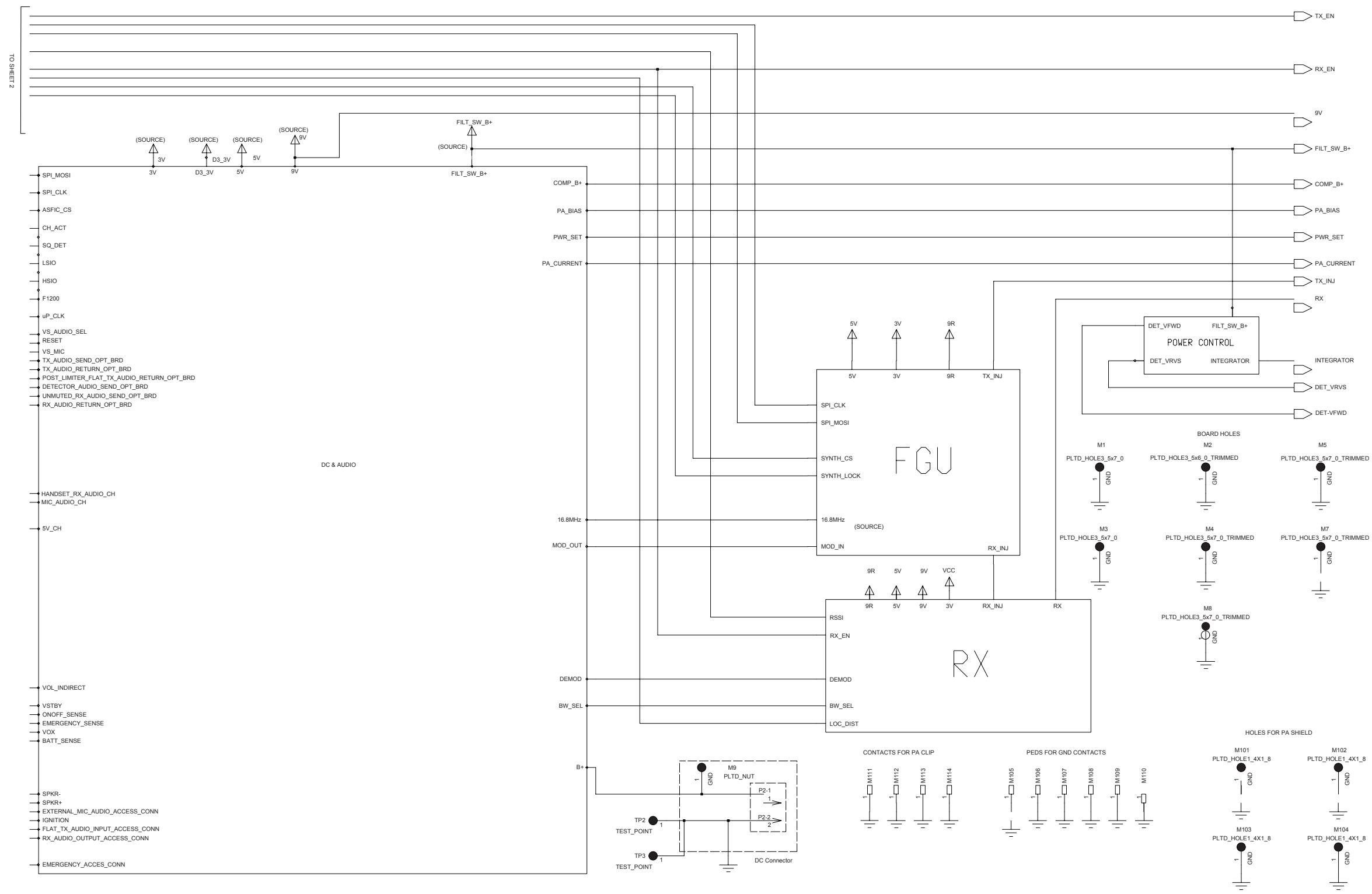
8486672Z01_REV O



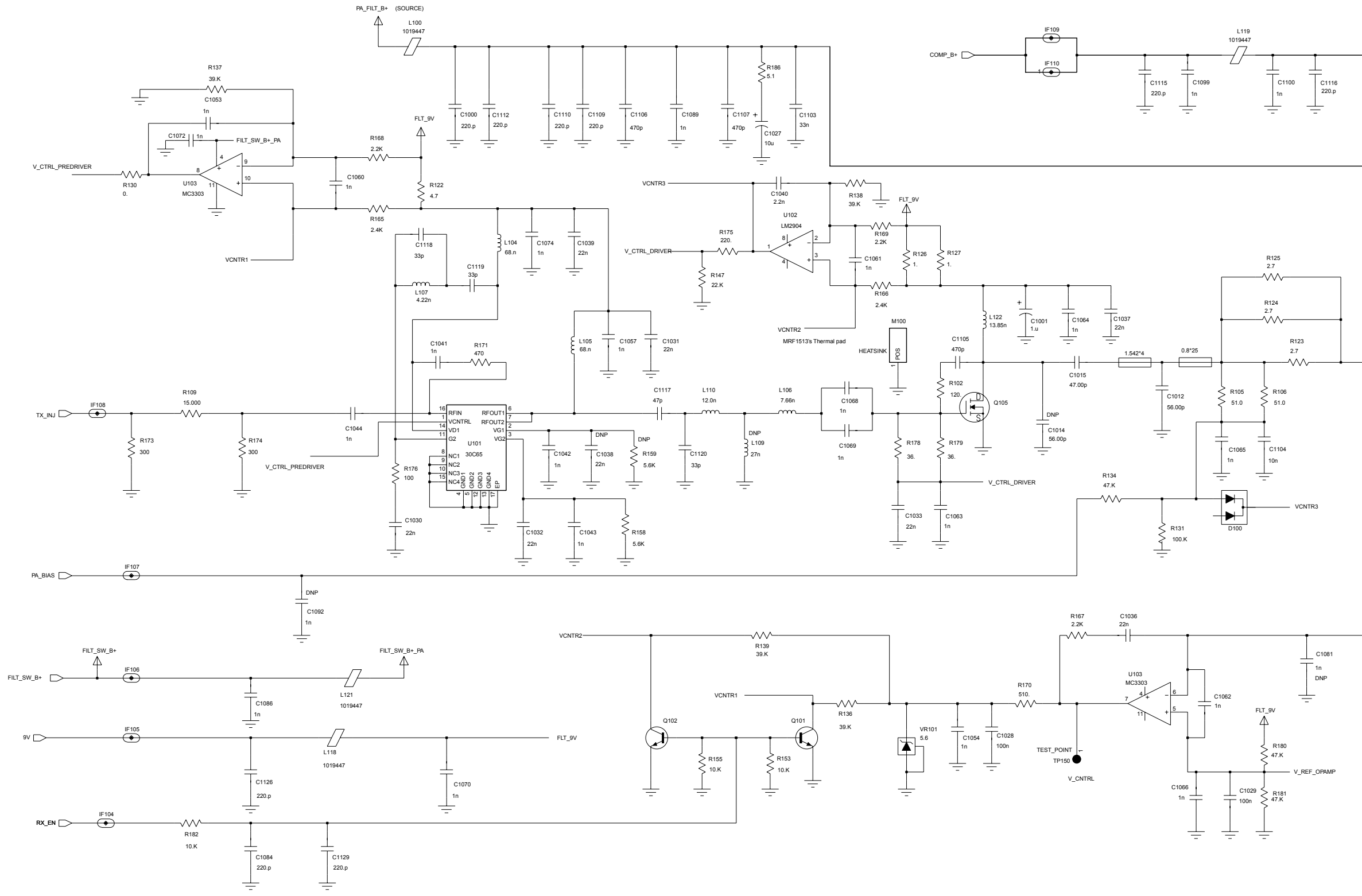
VHF2 (146-174 MHz) 1-25W 8486672Z01, Bottom Side



VHF2 (146-174 MHz) 1-25 W Main Circuit (Sht 1 of 2)

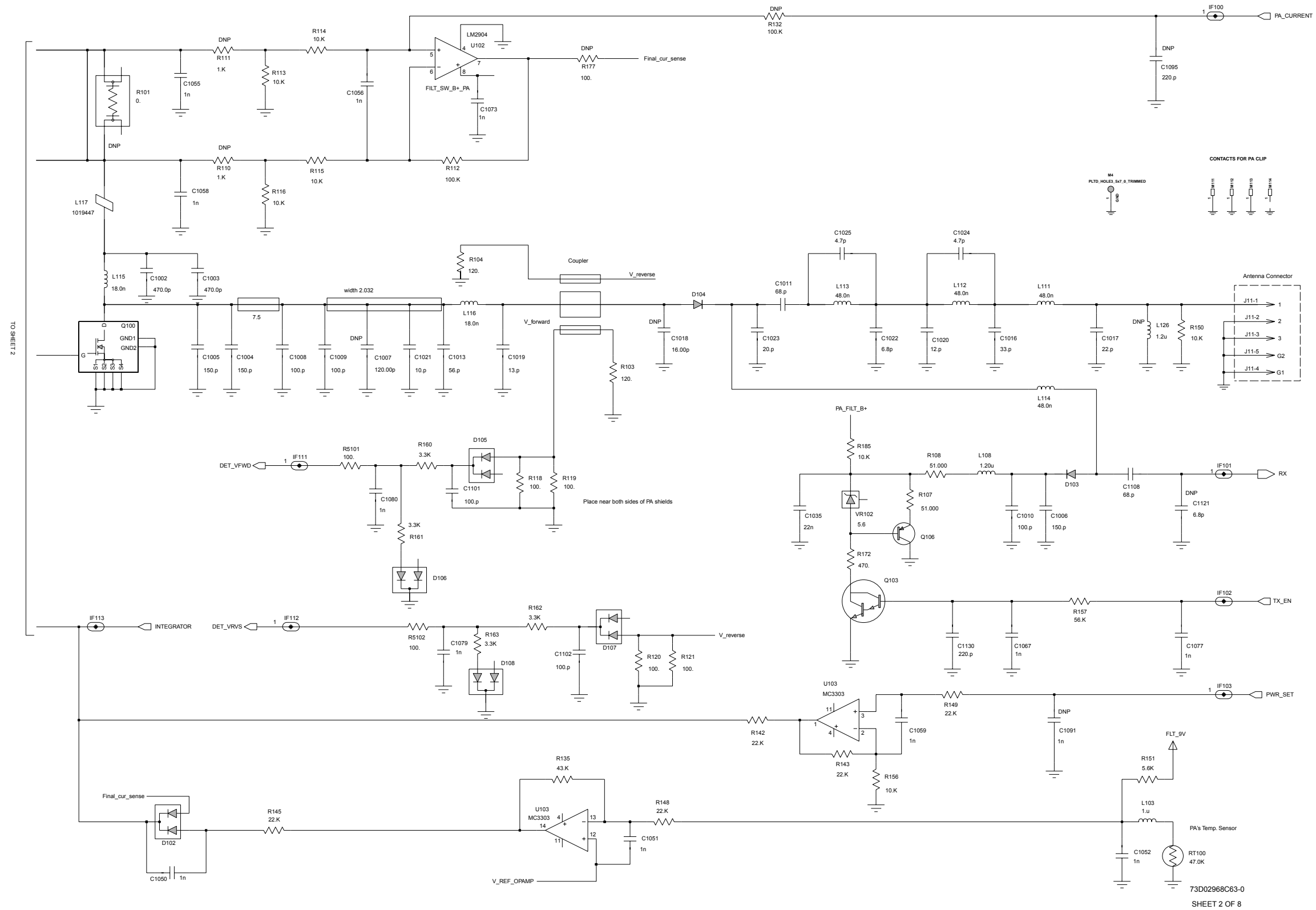


73D02968C63-0
SHEET 4 OF 8

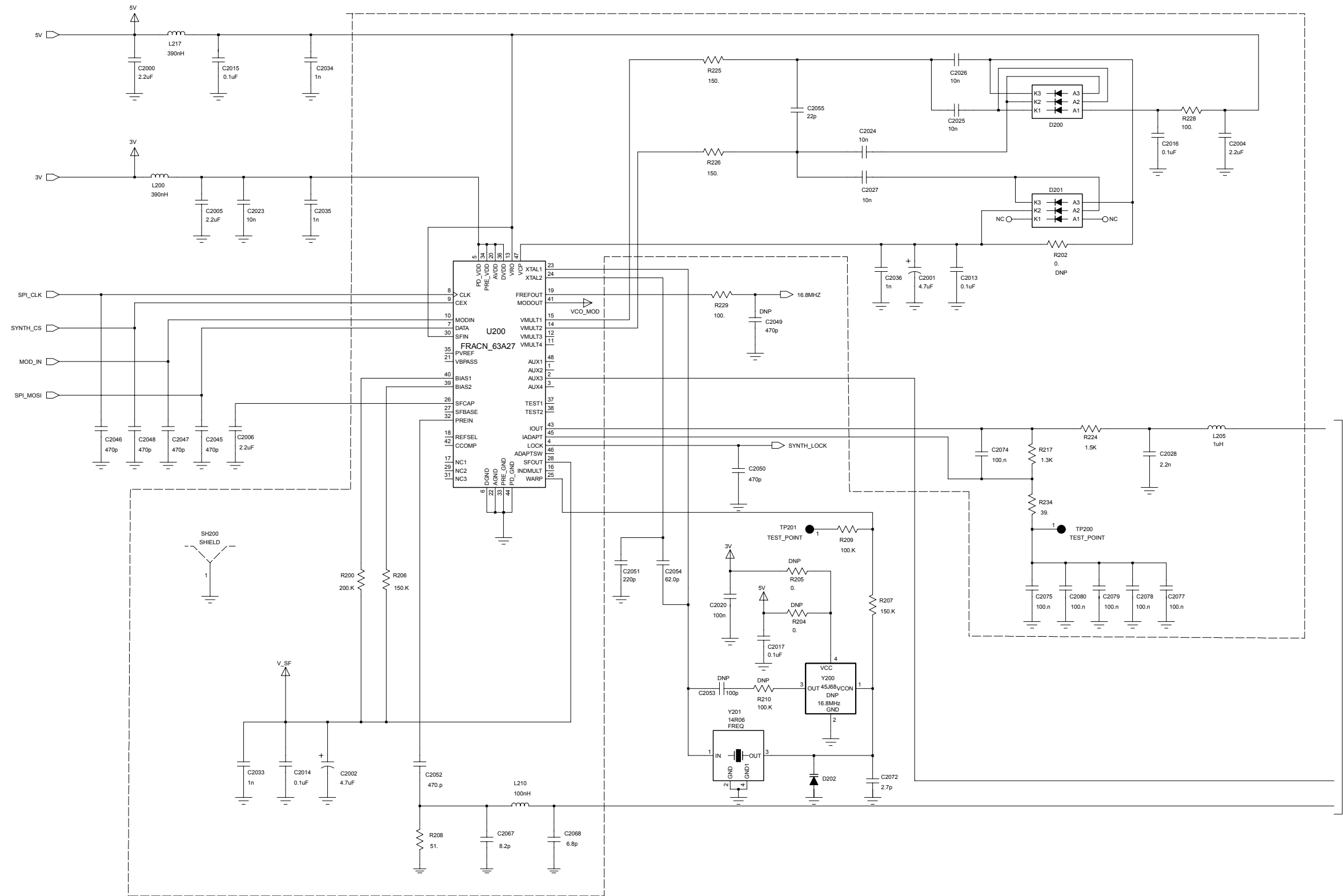


TO SHEET 1

VHF2 (146-174 MHz) 1-25 W Transmitter (Sht 1 of 2)

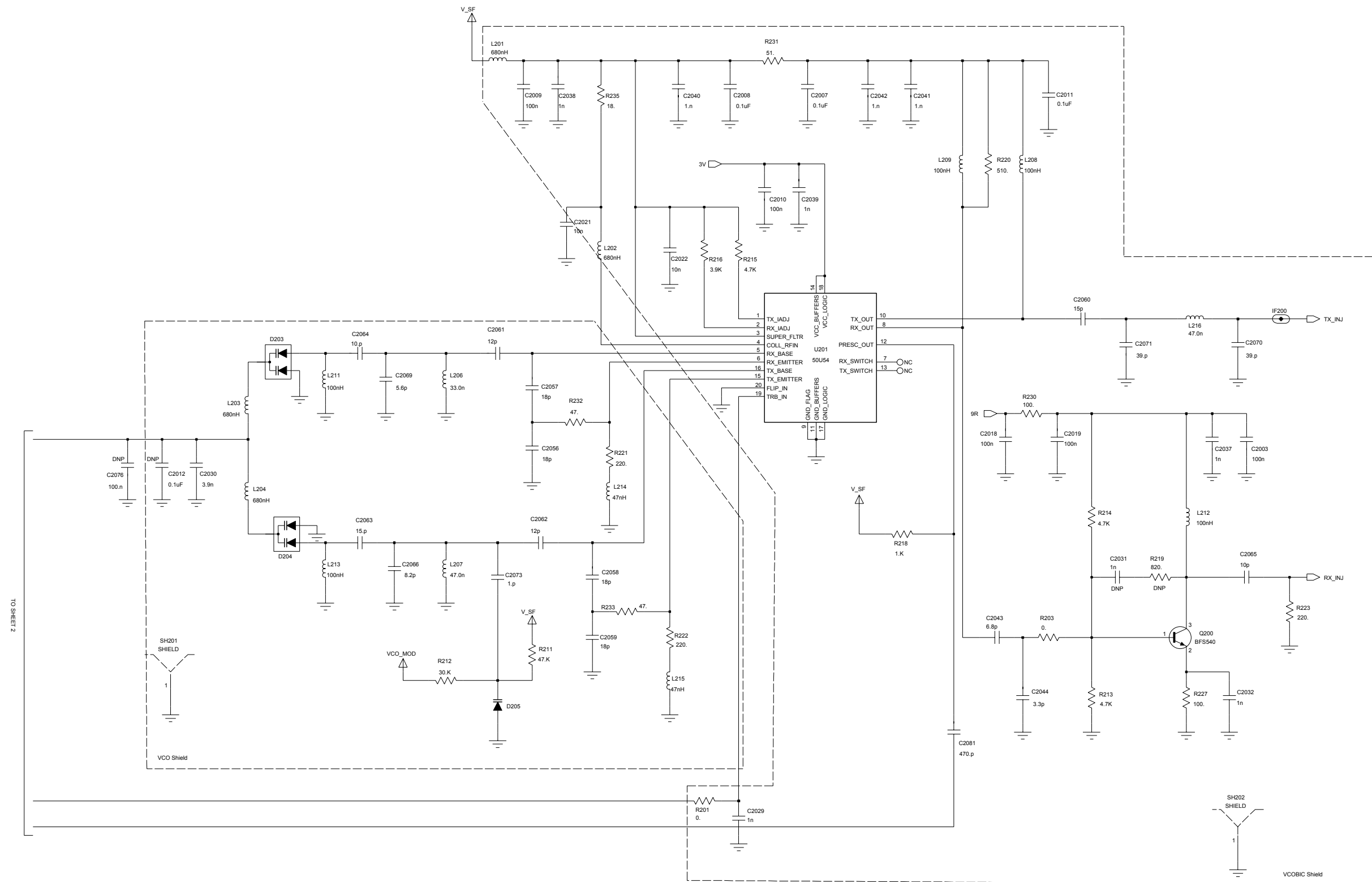


VHF2 (146-174 MHz) 1-25 W Transmitter (Sht 2 of 2)

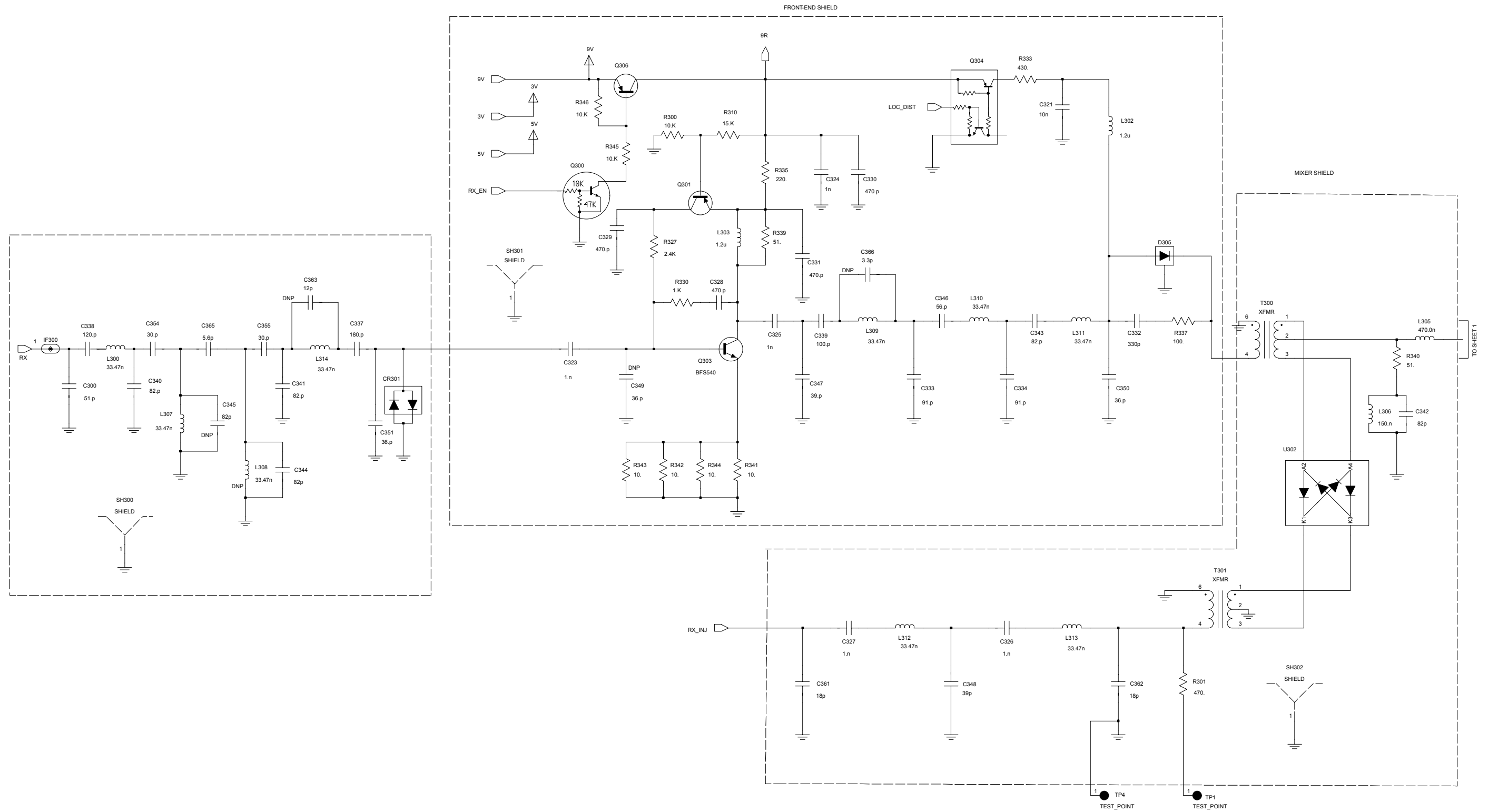


TO SHEET 1

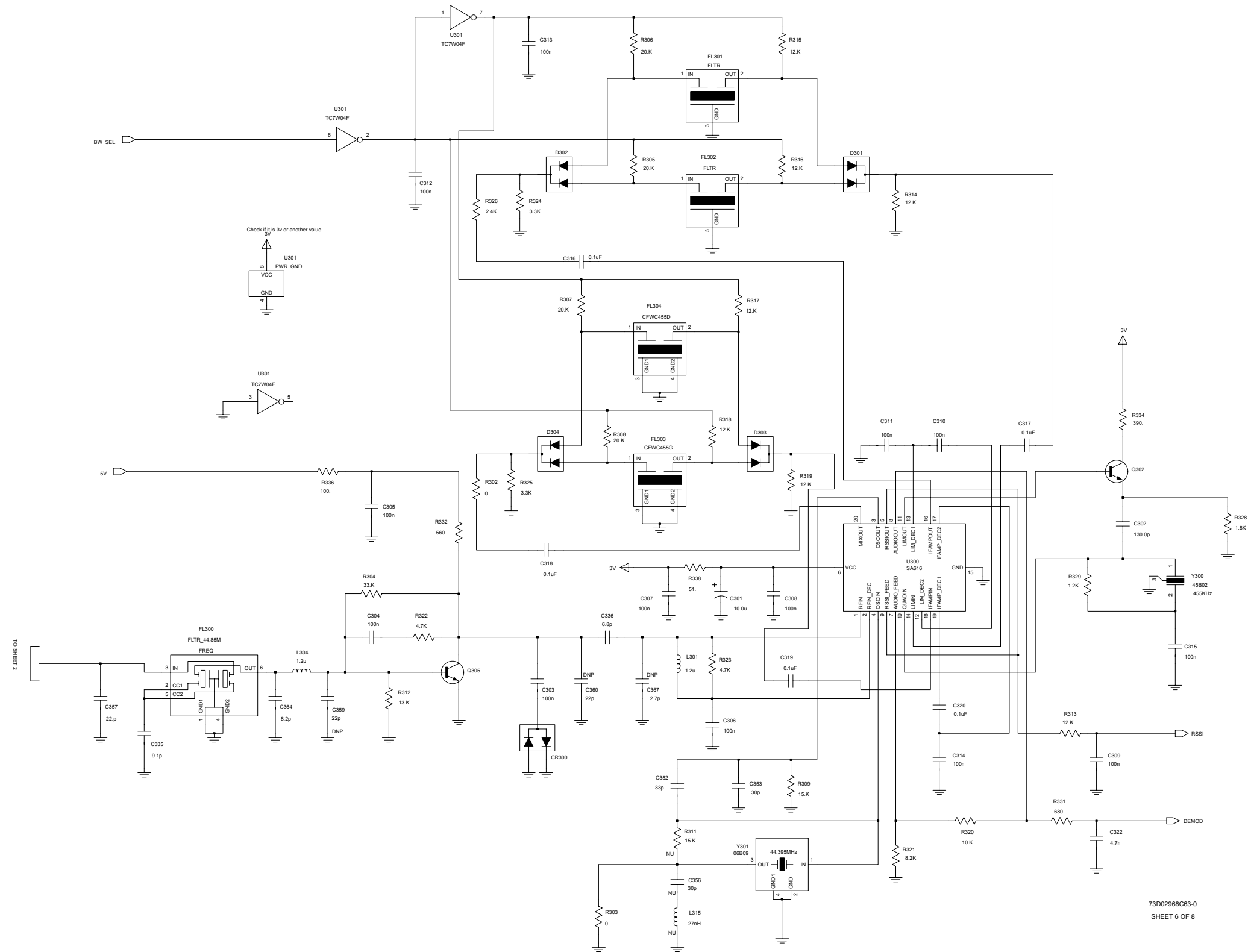
VHF2 (146-174 MHz) 1-25 W Synthesiser and VCO (Sht 1 of 2)



73D02968C63-0
SHEET 5 OF 8

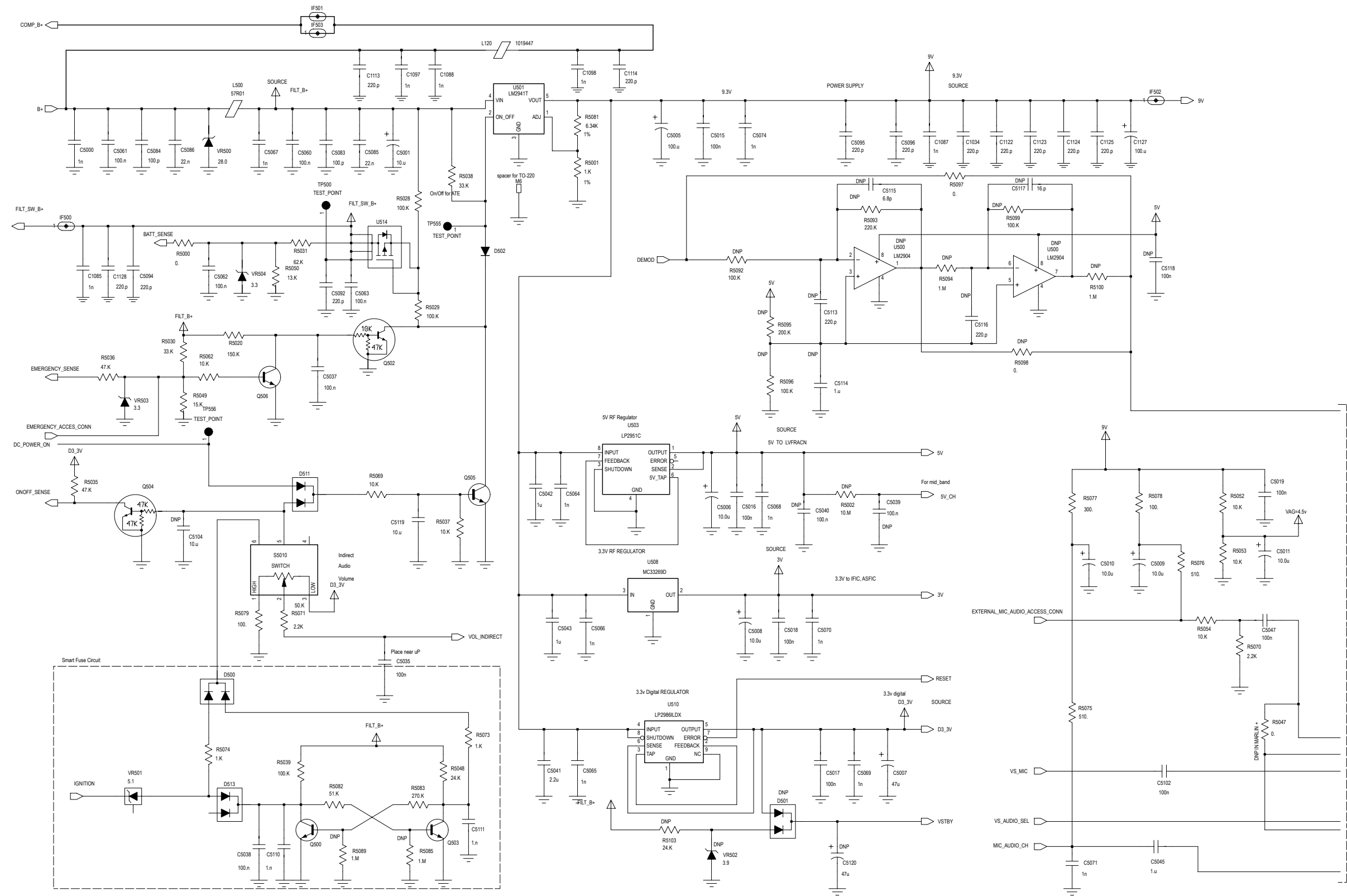


VHF2 (146-174 MHz) 1-25 W Receiver Front and Back End (Sht 1 of 2)

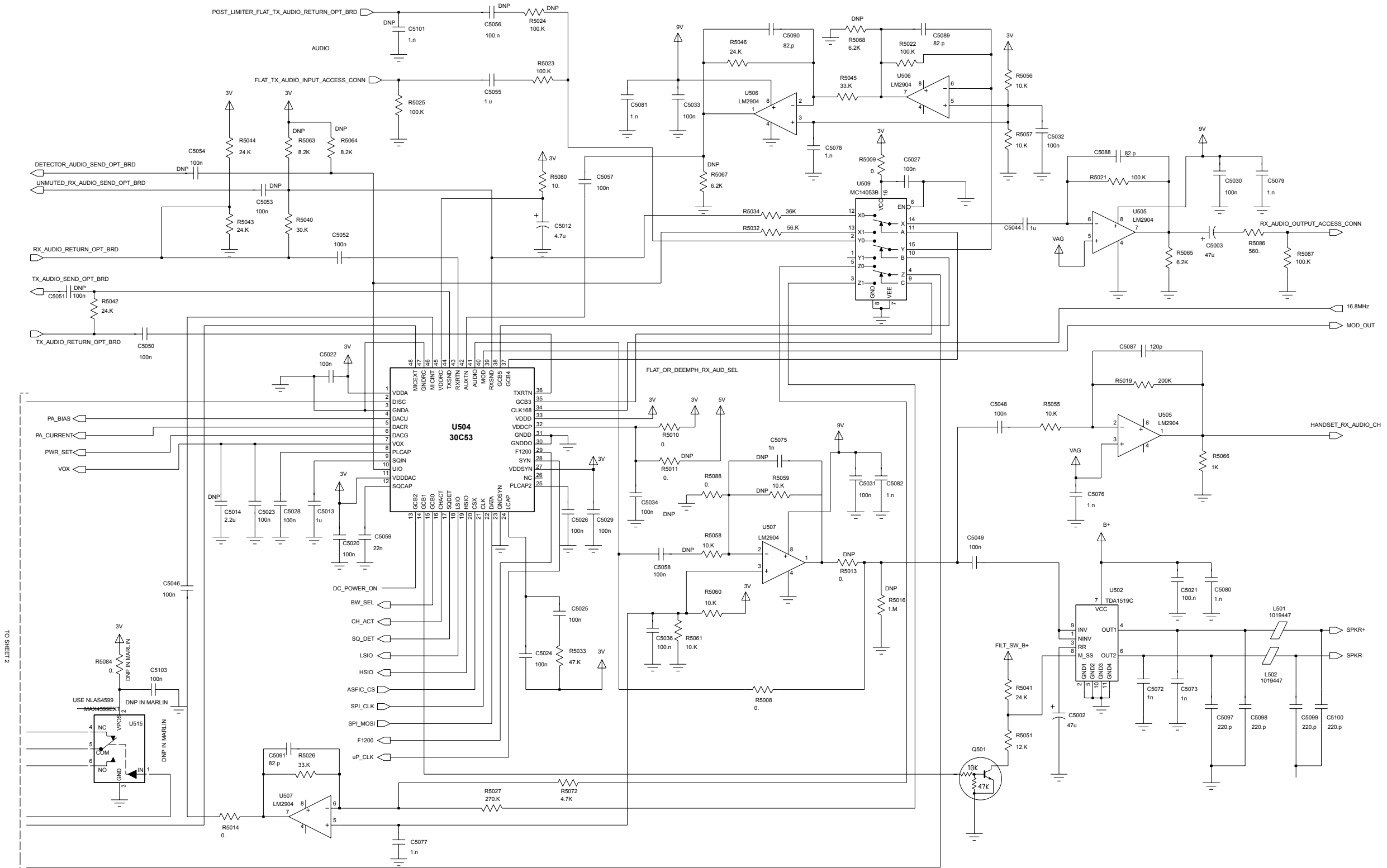


73D02968C63-0
SHEET 6 OF 8

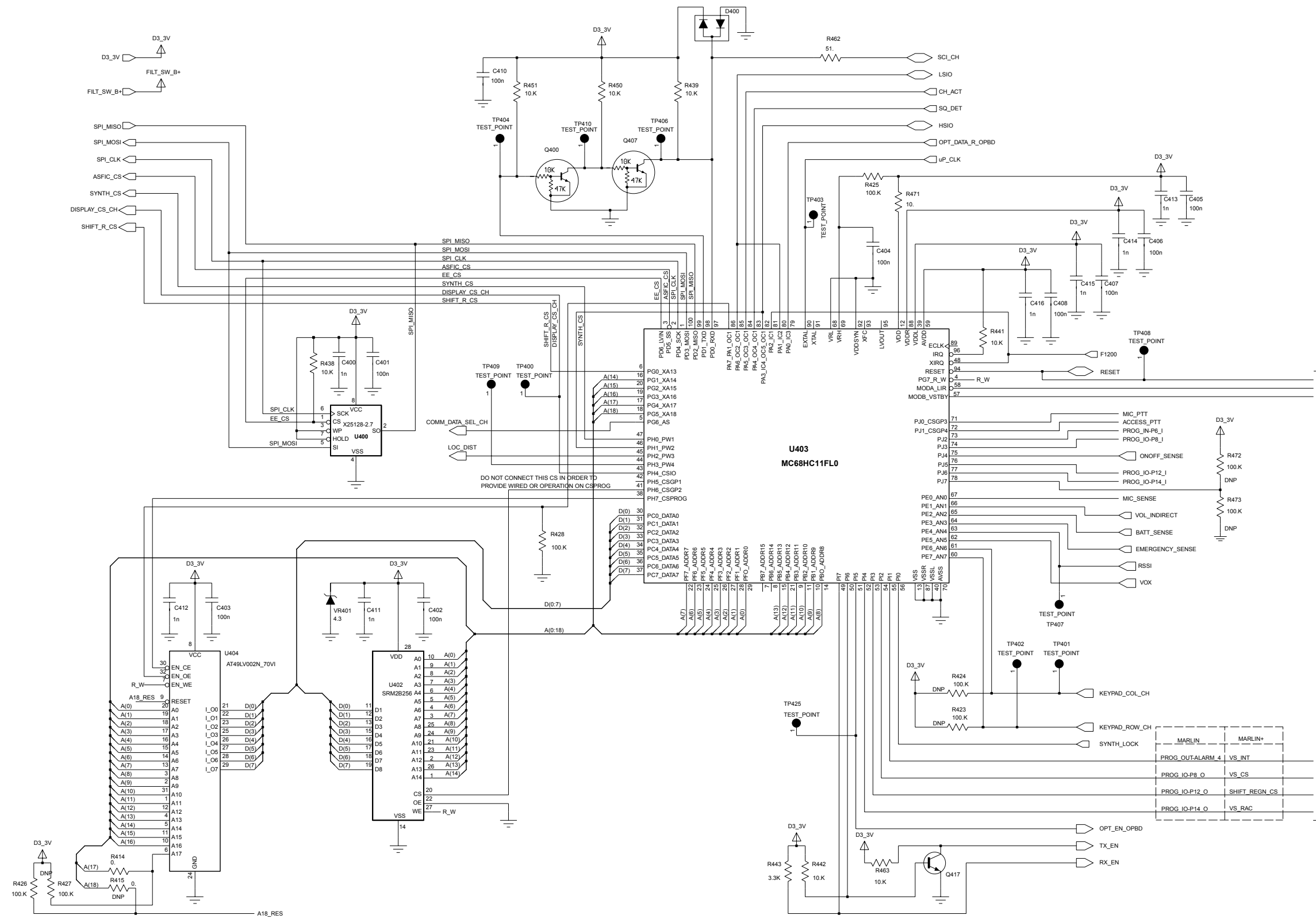
VHF2 (146-174 MHz) 1-25 W Receiver Front and Back End (Sht 2 of 2)



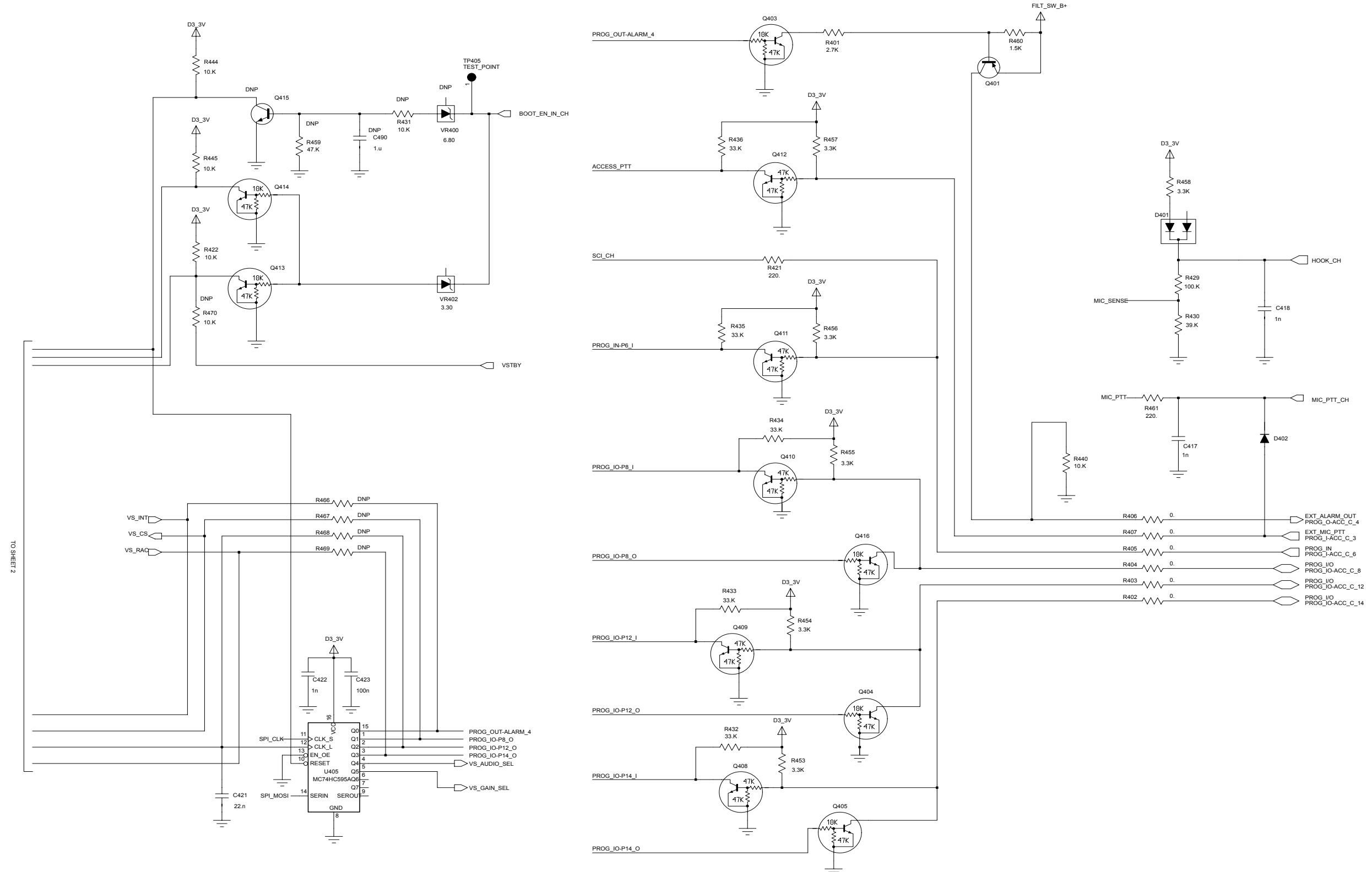
VHF2 (146-174 MHz) 1-25 W DC and Audio Circuits (Sht 1 of 2)



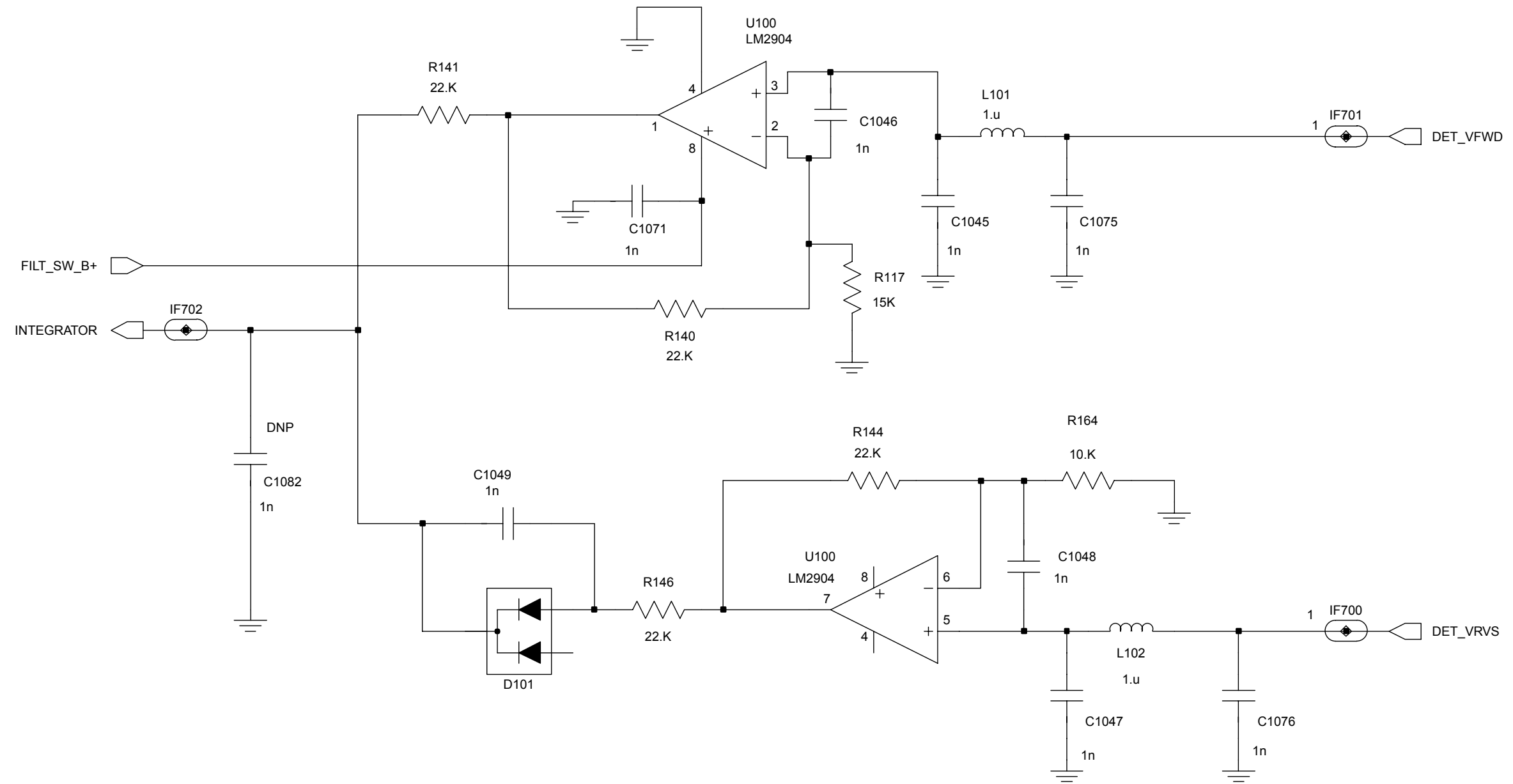
VHF2 (146-174 MHz) 1-25 W DC and Audio Circuits (Sht 2 of 2)



VHF2 (146-174 MHz) 1-25 W Microprocessor and Controller Circuits (Sht 1 of 2)



VHF2 (146-174 MHz) 1-25 W Microprocessor and Controller Circuits (Sht 2 of 2)



VHF2 (146-174 MHz) 1-25 W Power Control Circuit

3.1 VHF2 PCB 8486672Z01 Parts List 1–25 W

Circuit Ref.	Motorola Part No.	Description
C1000	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1001	2311049A08	KEMET CAPS
C1002	2111078B59	CHIP CAP RF 470 5 NPO 100V
C1003	2111078B59	CHIP CAP RF 470 5 NPO 100V
C1004	2111078B49	CAP CHIP RF 180 5 NPO 100V
C1005	2111078B51	CAP CHIP RF 220 5 NPO 100V
C1006	2111078B47	CAP CHIP RF 150 5 NPO 100V
C1007	NOT PLACED	–
C1008	2111078B45	CAP CHIP RF 130 5 NPO 100V
C1009	2111078B45	CAP CHIP RF 130 5 NPO 100V
C1010	2111078B45	CAP CHIP RF 130 5 NPO 100V
C1011	2111078B38	CAP CHIP RF 68 5 NPO 100V
C1012	2111078B36	CAP CHIP RF 56 5 NPO 100V
C1013	2111078B36	CAP CHIP RF 56 5 NPO 100V
C1014	NOT PLACED	–
C1015	2111078B34	CAP CHIP RF 47 5 NPO 100V
C1016	2111078B31	CAP CHIP RF 36 5 NPO 100V
C1017	2111078B27	CAP CHIP RF 30 5 NPO 100V
C1018	NOT PLACED	–
C1019	2111078B21	CAP CHIP RF 20 5 NPO 100V
C1020	2111078B15	CAP CHIP RF 12 5 NPO 100V
C1021	2111078B13	CAP ALT E16
C1022	2111078B09	CAP ALT E17
C1023	2111078B21	CAP ALT E35
C1024	2111078B03	CAP CHIP RF 3.9.25 NPO 100V
C1025	2111078B07	CAP CHIP RF 5.6.25 NPO 100V
C1027	2311049A45	CAP TANT CHIP 10 10 35
C1028	2113743K15	CER CHIP CAP .100UF
C1029	2113743K15	CER CHIP CAP .100UF
C1030	2113743E07	CER CHIP CAP .022UF

Circuit Ref.	Motorola Part No.	Description
C1031	2113743E07	CER CHIP CAP .022UF
C1032	2113743E07	CER CHIP CAP .022UF
C1033	2113743E07	CER CHIP CAP .022UF
C1034	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1035	2113743E07	CER CHIP CAP .022UF
C1036	2113743E07	CER CHIP CAP .022UF
C1037	2113743E07	CER CHIP CAP .022UF
C1038	NOT PLACED	–
C1039	2113743E07	CER CHIP CAP .022UF
C1040	2113741F33	CAP CHIP CL2 X7R REEL 2200
C1041	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1042	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1043	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1044	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1045	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1046	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1047	2113743K17	CAP CHIP .330 UF +80-20% 16V
C1048	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1049	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1050	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1051	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1052	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1053	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1054	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1055	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1056	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1057	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1058	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1059	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1060	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1061	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1062	2113741F25	CAP CHIP CL2 X7R REEL 1000

Circuit Ref.	Motorola Part No.	Description
C1063	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1064	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1065	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1066	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1067	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1068	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1069	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1070	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1071	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1072	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1073	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1074	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1075	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1076	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1077	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1078	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1079	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1080	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1081	NOT PLACED	–
C1082	NOT PLACED	–
C1083	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1084	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1085	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1086	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1087	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1088	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1089	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1090	NOT PLACED	–
C1091	NOT PLACED	–
C1092	NOT PLACED	–
C1093	NOT PLACED	–
C1094	NOT PLACED	–

Circuit Ref.	Motorola Part No.	Description
C1095	NOT PLACED	–
C1097	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1098	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1099	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1100	2113741F25	CAP CHIP CL2 X7R REEL 1000
C1101	2113740F51	CAP CHIP REEL CL1 +/-30 100
C1102	2113740F51	CAP CHIP REEL CL1 +/-30 100
C1103	2113741A57	CAP CHIP 33K +-5% (2160521A31)
C1104	2113741A53	CAP CHIP CL2 X7R REEL 22000
C1105	2113740F67	CAP CHIP CL1 +/-30 470 5%
C1106	2113740F67	CAP CHIP CL1 +/-30 470 5%
C1107	2113740F67	CAP CHIP CL1 +/-30 470 5%
C1108	2113740F69	CAP CHIP REEL CL1 +/-30 560
C1109	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1110	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1112	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1113	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1114	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1115	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1116	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1117	2113740F43	CAP CHIP REEL CL1 +/-30 47
C1118	2113740F39	CAP CHIP REEL CL1 +/-30 33
C1119	2113740F39	CAP CHIP REEL CL1 +/-30 33
C1120	2113740F39	CAP CHIP REEL CL1 +/-30 33
C1121	2113740F35	CAP CHIP REEL CL1 +/-30 22
C1122	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1123	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1124	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1125	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1126	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1127	2360567A03	CAP TANTALUM

Circuit Ref.	Motorola Part No.	Description
C1128	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1129	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1130	2113740F59	CAP CHIP REEL CL1 +/-30 220
C1131	NOT PLACED	–
C2000	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2001	2311049J11	CAPACITOR TANT 10% 4.7UF
C2002	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C2003	2113743K15	CER CHIP CAP .100UF
C2004	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2005	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2006	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C2007	2113743E20	CAP CHIP. 10 UF 10%
C2008	2113743E20	CAP CHIP. 10 UF 10%
C2009	2113743E20	CAP CHIP. 10 UF 10%
C2010	2113743E20	CAP CHIP. 10 UF 10%
C2011	2113743E20	CAP CHIP. 10 UF 10%
C2012	NOT PLACED	–
C2013	2113743E20	CAP CHIP. 10 UF 10%
C2014	2113743E20	CAP CHIP. 10 UF 10%
C2015	2113743E20	CAP CHIP. 10 UF 10%
C2016	2113743E20	CAP CHIP. 10 UF 10%
C2017	2113743E20	CAP CHIP. 10 UF 10%
C2018	2113743E20	CAP CHIP. 10 UF 10%
C2019	2113743E20	CAP CHIP. 10 UF 10%
C2020	2113743E20	CAP CHIP. 10 UF 10%
C2021	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2022	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2023	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2024	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2025	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2026	2113741F49	CAP CHIP CL2 X7R REEL 10000
C2027	2113741F49	CAP CHIP CL2 X7R REEL 10000

Circuit Ref.	Motorola Part No.	Description
C2028	2113741F33	CAP CHIP CL2 X7R REEL 2200
C2029	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2030	2113741F39	CAP CHIP CL2 X7R REEL 3900
C2031	NOT PLACED	–
C2032	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2033	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2034	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2035	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2036	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2037	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2038	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2039	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2040	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2041	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2042	2113741F25	CAP CHIP CL2 X7R REEL 1000
C2043	2113740L14	CAP CER CHIP 6.8PF +/-0.1PF
C2044	2113740L06	CAP CER CHIP 3.3 PF +/-0.1PF
C2045	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2046	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2047	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2048	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2049	NOT PLACED	–
C2050	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2051	2113740F59	CAP CHIP REEL CL1 +/-30 220
C2052	2113740F67	CAP CHIP CL1 +/-30 470 5%
C2053	NOT PLACED	–
C2054	2113740L37	CAP 62.0 PF 50V 2.0%
C2055	2113740F35	CAP CHIP REEL CL1 +/-30 22
C2056	2113740F33	CAP CHIP REEL CL1 +/-30 18
C2057	2113740F33	CAP CHIP REEL CL1 +/-30 18
C2058	2113740F33	CAP CHIP REEL CL1 +/-30 18
C2059	2113740F33	CAP CHIP REEL CL1 +/-30 18

Circuit Ref.	Motorola Part No.	Description
C2060	2113740F31	CAP CHIP REEL CL1 +/-30 15
C2061	2113740F29	CAP CHIP REEL CL1 +/-30 12
C2062	2113740F29	CAP CHIP REEL CL1 +/-30 12
C2063	2113740L22	CAP 15.0 PF 50V 2.0 %
C2064	2113740F32	CAP CHIP REEL CL1 +/-30 16
C2065	2113740F27	CAP CHIP REEL CL1 +/-30 10
C2066	2113740L16	CAP CER CHIP 8.2 PF +/-0.1PF
C2067	2113740F32	CAP CHIP REEL CL1 +/-30 16
C2068	2113740F32	CAP CHIP REEL CL1 +/-30 16
C2069	2113740L12	CAP CER CHIP 5.6PF +/-0.1PF
C2070	2113740F41	CAP CHIP REEL CL1 +/-30 39
C2071	2113740F41	CAP CHIP REEL CL1 +/-30 39
C2072	2113740L04	CAP CER CHIP 2.7 PF +/-0.1PF
C2073	2113740F03	CAP CHIP REEL CL1 +/-30 1.0
C2074	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2075	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2076	NOT PLACED	–
C2077	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2078	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2079	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2080	2109720D14	CAP CER CHIP LOW DIST 0.1UF
C2081	2113740F67	CAP CHIP CL1 +/-30 470 5%
C300	2113740F43	CAP CHIP REEL CL1 +/-30 47
C301	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C302	2113740F54	CAP CHIP REEL CL1 +/-30 130
C303	2113743K15	CER CHIP CAP .100UF
C304	2113743E20	CAP CHIP. 10 UF 10%
C305	2113743E20	CAP CHIP. 10 UF 10%

Circuit Ref.	Motorola Part No.	Description
C306	2113743E20	CAP CHIP. 10 UF 10%
C307	2113743E20	CAP CHIP. 10 UF 10%
C308	2113743E20	CAP CHIP. 10 UF 10%
C309	2113743E20	CAP CHIP. 10 UF 10%
C310	2113743E20	CAP CHIP. 10 UF 10%
C311	2113743E20	CAP CHIP. 10 UF 10%
C312	2113743E20	CAP CHIP. 10 UF 10%
C313	2113743E20	CAP CHIP. 10 UF 10%
C314	2113743E20	CAP CHIP. 10 UF 10%
C315	2113743E20	CAP CHIP. 10 UF 10%
C316	2113743E20	CAP CHIP. 10 UF 10%
C317	2113743E20	CAP CHIP. 10 UF 10%
C318	2113743E20	CAP CHIP. 10 UF 10%
C319	2113743E20	CAP CHIP. 10 UF 10%
C320	2113743E20	CAP CHIP. 10 UF 10%
C321	2113741F49	CAP CHIP CL2 X7R REEL 10000
C322	2113741F41	CAP CHIP CL2 X7R REEL 4700
C323	2113741F25	CAP CHIP CL2 X7R REEL 1000
C324	2113741F25	CAP CHIP CL2 X7R REEL 1000
C325	2113741F25	CAP CHIP CL2 X7R REEL 1000
C326	2113741F25	CAP CHIP CL2 X7R REEL 1000
C327	2113741F25	CAP CHIP CL2 X7R REEL 1000
C328	2113740F67	CAP CHIP CL1 +/-30 470 5%
C329	2113740F67	CAP CHIP CL1 +/-30 470 5%
C330	2113740F67	CAP CHIP CL1 +/-30 470 5%
C331	2113740F67	CAP CHIP CL1 +/-30 470 5%
C332	2113741F13	CAP CHIP CL2 X7R REEL 330
C333	2113740F53	CAP 120 PF 50V 2.0 %
C334	2113740F52	CAP 110 PF 50V 2.0 %
C335	2113740L17	CAP CER CHIP 9.1 PF +/-0.1PF
C336	2113740L14	CAP CER CHIP 6.8PF +/-0.1PF
C337	2113740F55	CAP CHIP REEL CL1 +/-30 150

Circuit Ref.	Motorola Part No.	Description
C338	2113740F57	CAP CHIP REEL CL1 +/-30 180
C339	2113740F50	CAP CHIP REEL CL1 +/-30 91
C340	2113740F50	CAP CHIP REEL CL1 +/-30 91
C341	2113740F51	CAP CHIP REEL CL1 +/-30 100
C342	2113740F49	CAP CHIP REEL CL1 +/-30 82
C343	2113740F53	CAP CHIP REEL CL1 +/-30 120
C344	NOT PLACED	-
C345	NOT PLACED	-
C346	2113740F46	CAP CHIP REEL CL1 +/-30 62
C347	2113740F45	CAP CHIP REEL CL1 +/-30 56
C348	2113740F41	CAP CHIP REEL CL1 +/-30 39
C349	NOT PLACED	-
C350	2113740F51	CAP CHIP REEL CL1 +/-30 44
C351	2113740F43	CAP CHIP REEL CL1 +/-30 47
C352	2113740F39	CAP CHIP REEL CL1 +/-30 33
C353	2113740F38	CAP CHIP REEL CL1 +/-30 30
C354	2113740F43	CAP CHIP REEL CL1 +/-30 47
C355	2113740F42	CAP CHIP REEL CL1 +/-30 43
C356	NOT PLACED	-
C357	2113740F35	CAP CHIP REEL CL1 +/-30 22
C359	NOT PLACED	-
C360	NOT PLACED	-
C361	2113740F33	CAP CHIP REEL CL1 +/-30 18
C362	2113740F33	CAP CHIP REEL CL1 +/-30 18
C363	NOT PLACED	-
C364	2113740F25	CAP CHIP REEL CL1 +/-30 8.2
C365	2113740F34	CAP CHIP REEL CL1 +/-30 20
C366	NOT PLACED	-
C367	NOT PLACED	-
C400	2113741F25	CAP CHIP CL2 X7R REEL 1000
C401	2113743K15	CER CHIP CAP .100UF
C402	2113743K15	CER CHIP CAP .100UF

Circuit Ref.	Motorola Part No.	Description
C403	2113743K15	CER CHIP CAP .100UF
C404	2113743K15	CER CHIP CAP .100UF
C405	2113743K15	CER CHIP CAP .100UF
C406	2113743K15	CER CHIP CAP .100UF
C407	2113743K15	CER CHIP CAP .100UF
C408	2113743K15	CER CHIP CAP .100UF
C410	2113743K15	CER CHIP CAP .100UF
C411	2113741F25	CAP CHIP CL2 X7R REEL 1000
C412	2113741F25	CAP CHIP CL2 X7R REEL 1000
C413	2113741F25	CAP CHIP CL2 X7R REEL 1000
C414	2113741F25	CAP CHIP CL2 X7R REEL 1000
C415	2113741F25	CAP CHIP CL2 X7R REEL 1000
C416	2113741F25	CAP CHIP CL2 X7R REEL 1000
C417	2113741F25	CAP CHIP CL2 X7R REEL 1000
C418	2113741F25	CAP CHIP CL2 X7R REEL 1000
C421	2113743E07	CER CHIP CAP .022UF
C422	2113741F25	CAP CHIP CL2 X7R REEL 1000
C423	2113743K15	CER CHIP CAP .100UF
C490	NOT PLACED	-
C5000	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5001	2389289U01	10UF 50V 20% ALUMINUM SMD
C5002	2311049A99	CAP TANT CHIP 47 UF 10V 20%
C5003	2311049A99	CAP TANT CHIP 47 UF 10V 20%
C5005	2360567A03	CAP TANTALUM
C5006	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5007	2311049A99	CAP TANT CHIP 47 UF 10V 20%
C5008	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5009	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5010	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V

Circuit Ref.	Motorola Part No.	Description
C5011	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5012	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C5013	2113928P04	CAP CER CHIP 1.0UF 20% 6.3V
C5014	NOT PLACED	-
C5015	2113743K15	CER CHIP CAP .100UF
C5016	2113743K15	CER CHIP CAP .100UF
C5017	2113743K15	CER CHIP CAP .100UF
C5018	2113743K15	CER CHIP CAP .100UF
C5019	2113743K15	CER CHIP CAP .100UF
C5020	2113743K15	CER CHIP CAP .100UF
C5021	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5022	2113743K15	CER CHIP CAP .100UF
C5023	2113743K15	CER CHIP CAP .100UF
C5024	2113743K15	CER CHIP CAP .100UF
C5025	2113743K15	CER CHIP CAP .100UF
C5026	2113743K15	CER CHIP CAP .100UF
C5027	2113743K15	CER CHIP CAP .100UF
C5028	2113743K15	CER CHIP CAP .100UF
C5029	2113743K15	CER CHIP CAP .100UF
C5030	2113743K15	CER CHIP CAP .100UF
C5031	2113743K15	CER CHIP CAP .100UF
C5032	2113743K15	CER CHIP CAP .100UF
C5033	2113743K15	CER CHIP CAP .100UF
C5034	2113743K15	CER CHIP CAP .100UF
C5035	2113743K15	CER CHIP CAP .100UF
C5036	2113743K15	CER CHIP CAP .100UF
C5037	2113743K15	CER CHIP CAP .100UF
C5038	2113743K15	CER CHIP CAP .100UF
C5039	NOT PLACED	-
C5040	NOT PLACED	-
C5041	2113743F18	CAP CHIP 2.2 UF 16V +80-20%

Circuit Ref.	Motorola Part No.	Description
C5042	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5043	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5044	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5045	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5046	2113743E20	CAP CHIP. 10 UF 10%
C5047	2113743E20	CAP CHIP. 10 UF 10%
C5048	2113743E20	CAP CHIP. 10 UF 10%
C5049	2113743E20	CAP CHIP. 10 UF 10%
C5050	2113743E20	CAP CHIP. 10 UF 10%
C5051	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5052	2113743E20	CAP CHIP. 10 UF 10%
C5053	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5054	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5055	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5056	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5057	2113928C04	CAP CER CHIP 4.7UF 6.3V10%0805
C5058	NOT PLACED	-
C5059	2113743E07	CER CHIP CAP .022UF
C5060	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5061	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5062	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5063	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
C5064	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5065	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5066	2113741F25	CAP CHIP CL2 X7R REEL 1000

Circuit Ref.	Motorola Part No.	Description
C5067	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5068	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5069	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5070	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5071	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5072	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5073	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5074	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5075	NOT PLACED	-
C5076	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5077	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5078	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5079	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5080	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5081	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5082	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5083	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5084	2113740F51	CAP CHIP REEL CL1 +/-30 100
C5085	2113741A53	CAP CHIP CL2 X7R REEL 22000
C5086	2113741A53	CAP CHIP CL2 X7R REEL 22000
C5087	2113740F53	CAP CHIP REEL CL1 +/-30 120
C5088	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5089	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5090	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5091	2113740F49	CAP CHIP REEL CL1 +/-30 82
C5092	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5094	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5095	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5096	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5097	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5098	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5099	2113740F59	CAP CHIP REEL CL1 +/-30 220

Circuit Ref.	Motorola Part No.	Description
C5100	2113740F59	CAP CHIP REEL CL1 +/-30 220
C5101	2113741F25	CAP CHIP CL2 X7R REEL 1000 (Not used in GM3188/GM3189)
C5102	2113743E20	CAP CHIP. 10 UF 10% (Not used in GM3188/GM3189)
C5103	2113743K15	CER CHIP CAP .100UF (Not used in GM3188/GM3189)
C5104	NOT PLACED	-
C5110	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5111	2113741F25	CAP CHIP CL2 X7R REEL 1000
C5113	NOT PLACED	-
C5114	2113743F16	CAP CHIP 1.0UF 16V+80-20%
C5115	NOT PLACED	-
C5116	NOT PLACED	-
C5117	NOT PLACED	-
C5118	2113743E20	CAP CHIP. 10 UF 10%
C5119	2113743H14	CAP CHIP 10.0 UF 16V +80-20%
C5120	NOT PLACED	-
C5121	2113741F25	CAP CHIP CL2 X7R REEL 1000
C602	2113741F25	CAP CHIP CL2 X7R REEL 1000
C603	2113741F25	CAP CHIP CL2 X7R REEL 1000
C604	2113741F25	CAP CHIP CL2 X7R REEL 1000
C605	2113741F25	CAP CHIP CL2 X7R REEL 1000
C606	2113741F25	CAP CHIP CL2 X7R REEL 1000
C607	2113741F25	CAP CHIP CL2 X7R REEL 1000
C608	NOT PLACED	-
C609	NOT PLACED	-
C610	2113741F25	CAP CHIP CL2 X7R REEL 1000
C611	2113741F25	CAP CHIP CL2 X7R REEL 1000
C612	2113741F25	CAP CHIP CL2 X7R REEL 1000
C613	2113741F25	CAP CHIP CL2 X7R REEL 1000
C614	2113741F25	CAP CHIP CL2 X7R REEL 1000
C615	2113741F25	CAP CHIP CL2 X7R REEL 1000

Circuit Ref.	Motorola Part No.	Description
C616	2113741F25	CAP CHIP CL2 X7R REEL 1000
C617	2113741F25	CAP CHIP CL2 X7R REEL 1000
C618	2113741F25	CAP CHIP CL2 X7R REEL 1000
C619	NOT PLACED	-
C620	2113741F25	CAP CHIP CL2 X7R REEL 1000
C621	2113741F25	CAP CHIP CL2 X7R REEL 1000
C622	2113741F25	CAP CHIP CL2 X7R REEL 1000
C623	2113741F25	CAP CHIP CL2 X7R REEL 1000
C624	2113741F25	CAP CHIP CL2 X7R REEL 1000
C625	2113741F25	CAP CHIP CL2 X7R REEL 1000
C626	2113741F25	CAP CHIP CL2 X7R REEL 1000
C627	2113741F25	CAP CHIP CL2 X7R REEL 1000
C628	2113741F25	CAP CHIP CL2 X7R REEL 1000
C629	2113741F25	CAP CHIP CL2 X7R REEL 1000
C630	2113741F25	CAP CHIP CL2 X7R REEL 1000
C631	2113741F25	CAP CHIP CL2 X7R REEL 1000
C632	2113741F25	CAP CHIP CL2 X7R REEL 1000
C633	2113741F25	CAP CHIP CL2 X7R REEL 1000
C662	2113741F25	CAP CHIP CL2 X7R REEL 1000
C678	2113741M69	CAP CHIP CLS2 100000 PF 20V 10
CR300	4880154K03	SOT MMBD353 RH DIODE DUAL SCHT
CR301	4880154K03	SOT MMBD353 RH DIODE DUAL SCHT
D100	NOT PLACED	-
D101	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D102	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D103	4802482J02	PIN DIODE SMD
D104	4802482J02	PIN DIODE SMD
D105	4805218N57	DIODE DUAL
D106	4805218N57	DIODE DUAL

Circuit Ref.	Motorola Part No.	Description
D107	4805218N57	DIODE DUAL
D108	4805218N57	DIODE DUAL
D200	4802233J09	DIODE TRIPLE SOT25-RH
D201	4802233J09	DIODE TRIPLE SOT25-RH
D202	4862824C03	DIODE VARACTOR
D203	4805649Q13	DIODE VCTR ISV 228
D204	4805649Q13	DIODE VCTR ISV 228
D205	4862824C01	DIODE VARACTOR
D301	4802245J97	Band Switchind Diode, Rohm DAN
D302	4802245J97	Band Switchind Diode, Rohm DAN
D303	4802245J97	Band Switchind Diode, Rohm DAN
D304	4802245J97	Band Switchind Diode, Rohm DAN
D305	4880142L01	SOT MMBV109 RH
D400	4813833C07	DIODE DUAL 100V '5C' SERIES
D401	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D402	4809948D42	DIODE SCHOTTKY RB751V-40
D500	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D501	NOT PLACED	-
D502	4813825A23	DIODE, DISCRETE SPECIALS VAR&P
D511	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D513	4813833C02	DIODE DUAL 70V '5B' COMM CATH
FL300	9180022M11	XTAL FILTER 44.85MHZ
FL301	9180468V06	SMD455KHZ 4 ELEMENT CER FLTR
FL302	9180468V04	SMD455KHZ 4 ELEMENT CER FLTR
FL303	9180469V03	SMD455KHZ 6 ELEMENT CER FLTR

Circuit Ref.	Motorola Part No.	Description
FL304	9180469V06	SMD455KHZ 6 ELEMENT CER FLTR
J11	2889309U01	MINI-UHF PCB R.A
J2	0989241U02	FLEX 20PIN 1MM TOP NON ZIF
J3	0986615Z01	CONN,ZIF,F,28CONT,TIN,CBL (Not used in GM3188/GM3189)
L100	2484657R01	INDUCTOR BEAD CHIP
L101	2462587T30	IND CHIP 1000NH 5% LOW PRO
L102	2462587T30	IND CHIP 1000NH 5% LOW PRO
L103	2462587T30	IND CHIP 1000NH 5% LOW PRO
L104	2462587T13	IND CHIP 68NH 5% LOW PRO
L105	2462587T13	IND CHIP 68NH 5% LOW PRO
L106	2460591A11	COIL AIR WOUND INDUC 7.66
L107	2460591A01	COIL AIR WOUND INDUC 4.22
L108	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L109	NOT PLACED	-
L110	2462587N42	CHIP IND 12 NH 5%
L111	2485873L05	ENCAPSULATED AIR WOUND 48NH
L112	2485873L05	ENCAPSULATED AIR WOUND 48NH
L113	2485873L05	ENCAPSULATED AIR WOUND 48NH
L114	2485873L05	ENCAPSULATED AIR WOUND 48NH
L115	2485873L01	ENCAPSULATED AIR WOUND COIL
L116	2485873L01	ENCAPSULATED AIR WOUND COIL
L117	2484657R01	INDUCTOR BEAD CHIP
L118	2484657R01	INDUCTOR BEAD CHIP
L119	2484657R01	INDUCTOR BEAD CHIP
L120	2484657R01	INDUCTOR BEAD CHIP
L121	2484657R01	INDUCTOR BEAD CHIP
L122	2460591C23	COIL AIR WOUND INDUC 13.85

Circuit Ref.	Motorola Part No.	Description
L126	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L200	2462587Q42	IND CHIP 390NH 10%
L201	2462587V44	IND CHIP 680 NH 10%
L202	2462587V44	IND CHIP 680 NH 10%
L203	2462587V44	IND CHIP 680 NH 10%
L204	2462587V44	IND CHIP 680 NH 10%
L205	2462587Q47	IND CHIP 1000 NH 10%
L206	2413923C05	IND CHIP 33 NH 2%
L207	2413923C07	IND CHIP 47 NH 2%
L208	2413926N24	IND CER CHIP 100.0 NH 5%
L209	2413926N24	IND CER CHIP 100.0 NH 5%
L210	2413926N24	IND CER CHIP 100.0 NH 5%
L211	2413926N24	IND CER CHIP 100.0 NH 5%
L212	2413926N24	IND CER CHIP 100.0 NH 5%
L213	2413926N24	IND CER CHIP 100.0 NH 5%
L214	2413926H20	IND CHIP 47.0 NH 5%
L215	2413926H20	IND CHIP 47.0 NH 5%
L216	2413926H20	IND CHIP 47.0 NH 5%
L217	2462587Q42	IND CHIP 390NH 10%
L300	2460591G24	COIL AIR WOUND INDUC 33.47
L301	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L302	2462587X69	IND CHIP LO-PRO 1200 NH 5%
L303	2462587N69	CHIP IND 1200 NH 5%
L304	2483411T74	INDUCTOR CHIP SHIELDED
L305	2413926K31	IND CER CHIP 470.0 NH 5%
L306	2462587N55	CHIP IND 150 NH 5%
L307	2460591G24	COIL AIR WOUND INDUC 33.47
L308	2460591G24	COIL AIR WOUND INDUC 33.47
L309	2460591G24	COIL AIR WOUND INDUC 33.47
L310	2460591G24	COIL AIR WOUND INDUC 33.47
L311	2460591G24	COIL AIR WOUND INDUC 33.47
L312	2460591G24	COIL AIR WOUND INDUC 33.47

Circuit Ref.	Motorola Part No.	Description
L313	2460591G24	COIL AIR WOUND INDUC 33.47
L314	2460591G24	COIL AIR WOUND INDUC 33.47
L315	NOT PLACED	-
L500	2484657R01	INDUCTOR BEAD CHIP
L501	2484657R01	INDUCTOR BEAD CHIP
L502	2484657R01	INDUCTOR BEAD CHIP
M100	2686201B01	HEAT SPREADER WM
M105	7588823L03	PAD GROUND LCD
M106	7588823L03	PAD GROUND LCD
M107	7588823L03	PAD GROUND LCD
M108	7588823L04	PAD GROUND LCD
M109	7588823L04	PAD GROUND LCD
M110	7588823L04	PAD GROUND LCD
M111	3985994A01	CONTACT, PCB SPEAKER
M112	3985994A01	CONTACT, PCB SPEAKER
M113	3985994A01	CONTACT, PCB SPEAKER
M114	3985994A01	CONTACT, PCB SPEAKER
M9	0289511U01	NUTS
P1	2804503J01	CONNECTOR,ACCY 16 PIN
P2	NOT PLACED	-
PCB	8486672Z01	MARLIN VHF
Q100	4886163B01	LDMOS SMT 35W 520MH 12V
Q101	4813824A10	TSTR NPN 40V .2A GEN PURP
Q102	4813824A10	TSTR NPN 40V .2A GEN PURP
Q103	4813824A06	XSTR NPN 30V DARLINGTON
Q105	4813828A11	TSTR 520 MHZ 3W, 12.5V RF LDMO
Q106	4805128M27	SOT TRANS
Q200	4802245J95	BJT, NPN TRANSISTOR
Q300	4809940E02	TSTR DIG NPN DTC114YE
Q301	4813824A17	XSTR PNP40V .2A GENPB=100-300
Q302	4813824A10	TSTR NPN 40V .2A GEN PURP

Circuit Ref.	Motorola Part No.	Description
Q303	4802245J95	BJT, NPN TRANSISTOR
Q304	4809939C04	TSTR DUAL PNP/NPN UMC3
Q305	4802197J95	RF TRANSISTOR PBR941
Q306	4813824A17	XSTR PNP40V .2A GENPB=100-300
Q400	4809940E02	TSTR DIG NPN DTC114YE
Q401	4880141L03	QSTR PNP SOT23 LO PROFILE TAPE
Q403	4809940E02	TSTR DIG NPN DTC114YE
Q404	4809940E02	TSTR DIG NPN DTC114YE
Q405	4809940E02	TSTR DIG NPN DTC114YE
Q407	4809940E02	TSTR DIG NPN DTC114YE
Q408	4880048M01	TSTR NPN DIG 47K/47K
Q409	4880048M01	TSTR NPN DIG 47K/47K
Q410	4880048M01	TSTR NPN DIG 47K/47K
Q411	4880048M01	TSTR NPN DIG 47K/47K
Q412	4880048M01	TSTR NPN DIG 47K/47K
Q413	4809940E02	TSTR DIG NPN DTC114YE
Q414	4809940E02	TSTR DIG NPN DTC114YE
Q415	NOT PLACED	-
Q416	4809940E02	TSTR DIG NPN DTC114YE
Q417	4813824A10	TSTR NPN 40V .2A GEN PURP
Q500	4813824A10	TSTR NPN 40V .2A GEN PURP
Q501	4809940E02	TSTR DIG NPN DTC114YE
Q502	4809940E02	TSTR DIG NPN DTC114YE
Q503	4813824A10	TSTR NPN 40V .2A GEN PURP
Q504	4880048M01	TSTR NPN DIG 47K/47K
Q505	4813824A10	TSTR NPN 40V .2A GEN PURP
Q506	4813824A10	TSTR NPN 40V .2A GEN PURP
R101	NOT PLACED	-
R102	0683962T51	RES CHIP 120 5-1
R103	0683962T51	RES CHIP 120 5-1
R104	0683962T51	RES CHIP 120 5-1

Circuit Ref.	Motorola Part No.	Description
R105	0680194M18	RES 51 OHMS 5% 1W
R106	0680194M18	RES 51 OHMS 5% 1W
R107	0680194M18	RES 51 OHMS 5% 1W
R108	0680194M18	RES 51 OHMS 5% 1W
R109	0662057A05	CHIP RES 15 OHMS 5%
R110	NOT PLACED	-
R111	NOT PLACED	-
R112	0662057P95	RES CHIP 100.0K 1% 30X60
R113	0662057P10	RES CHIP 10.0K 1% 30X60
R114	0662057P10	RES CHIP 10.0K 1% 30X60
R115	0662057P10	RES CHIP 10.0K 1% 30X60
R116	0662057P10	RES CHIP 10.0K 1% 30X60
R117	0662057P02	RES. CHIP 15K 1% 30X60
R118	0662057C51	CHIP RES 100 OHMS 5%
R119	0662057C51	CHIP RES 100 OHMS 5%
R120	0662057C51	CHIP RES 100 OHMS 5%
R121	0662057C51	CHIP RES 100 OHMS 5%
R122	0662057C19	CHIP RES 4.7 OHMS 5%
R123	0662057C13	CHIP RES 2.7 OHMS 5%
R124	0662057C13	CHIP RES 2.7 OHMS 5%
R125	0662057C13	CHIP RES 2.7 OHMS 5%
R126	0662057C03	CHIP RES 1.0 OHMS 5%
R127	0662057C03	CHIP RES 1.0 OHMS 5%
R130	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R131	0662057A97	CHIP RES 100K OHMS 5%
R132	NOT PLACED	-
R134	0662057A89	CHIP RES 47K OHMS 5%
R135	0662057A88	CHIP RES 43K OHMS 5%
R136	0662057A87	CHIP RES 39K OHMS 5%
R137	0662057A87	CHIP RES 39K OHMS 5%
R138	0662057A87	CHIP RES 39K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R139	0662057A87	CHIP RES 39K OHMS 5%
R140	0662057A81	CHIP RES 22K OHMS 5%
R141	0662057A81	CHIP RES 22K OHMS 5%
R142	0662057A81	CHIP RES 22K OHMS 5%
R143	0662057A81	CHIP RES 22K OHMS 5%
R144	0662057A81	CHIP RES 22K OHMS 5%
R145	0662057A81	CHIP RES 22K OHMS 5%
R146	0662057A81	CHIP RES 22K OHMS 5%
R147	0662057A81	CHIP RES 22K OHMS 5%
R148	0662057A81	CHIP RES 22K OHMS 5%
R149	0662057A81	CHIP RES 22K OHMS 5%
R150	0662057A73	CHIP RES 10K OHMS 5%
R151	0662057A67	CHIP RES 5600 OHMS 5%
R153	0662057A73	CHIP RES 10K OHMS 5%
R155	0662057A73	CHIP RES 10K OHMS 5%
R156	0662057A73	CHIP RES 10K OHMS 5%
R157	0662057A91	CHIP RES 56K OHMS 5%
R158	0662057A67	CHIP RES 5600 OHMS 5%
R159	NOT PLACED	-
R160	0662057A61	CHIP RES 3300 OHMS 5%
R161	0662057A61	CHIP RES 3300 OHMS 5%
R162	0662057A61	CHIP RES 3300 OHMS 5%
R163	0662057A61	CHIP RES 3300 OHMS 5%
R164	0662057A73	CHIP RES 10K OHMS 5%
R165	0662057A58	CHIP RES 2400 OHMS 5%
R166	0662057A58	CHIP RES 2400 OHMS 5%
R167	0662057A57	CHIP RES 2200 OHMS 5%
R168	0662057A57	CHIP RES 2200 OHMS 5%
R169	0662057A57	CHIP RES 2200 OHMS 5%
R170	0662057A42	CHIP RES 510 OHMS 5%
R171	0662057A41	CHIP RES 470 OHMS 5%
R172	0662057A41	CHIP RES 470 OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R173	0662057A36	CHIP RES 300 OHMS 5%
R174	0662057A36	CHIP RES 300 OHMS 5%
R175	0662057A33	CHIP RES 220 OHMS 5%
R176	0662057A25	CHIP RES 100 OHMS 5%
R177	NOT PLACED	-
R178	0662057A14	RES CHIP 36 OHM 5 1/8W
R179	0662057A14	RES CHIP 36 OHM 5 1/8W
R180	0660082A89	RES CHIP 47K OHMS 1% 1/16W
R181	0660082A89	RES CHIP 47K OHMS 1% 1/16W
R182	0662057A73	CHIP RES 10K OHMS 5%
R185	0662057A73	CHIP RES 10K OHMS 5%
R186	0662057C20	CHIP RES 5.1 OHMS 5%
R200	0662057A99	CHIP RES 120K OHMS 5%
R201	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R202	NOT PLACED	-
R203	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R204	NOT PLACED	-
R205	NOT PLACED	-
R206	0662057B02	CHIP RES 150K OHMS 5%
R207	0662057B02	CHIP RES 150K OHMS 5%
R208	0662057A18	CHIP RES 51 OHMS 5%
R209	0662057A97	CHIP RES 100K OHMS 5%
R210	NOT PLACED	-
R211	0662057A89	CHIP RES 47K OHMS 5%
R212	0662057A84	CHIP RES 30K OHMS 5%
R213	0662057A65	CHIP RES 4700 OHMS 5%
R214	0662057A65	CHIP RES 4700 OHMS 5%
R215	0662057A65	CHIP RES 4700 OHMS 5%
R216	0662057A63	CHIP RES 3900 OHMS 5%
R217	0662057A52	CHIP RES 1300OHMS 5%05
R218	0662057A49	CHIP RES 1000 OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R219	NOT PLACED	-
R220	0662057A42	CHIP RES 510 OHMS 5%
R221	0662057A33	CHIP RES 220 OHMS 5%
R222	0662057A33	CHIP RES 220 OHMS 5%
R223	0662057A33	CHIP RES 220 OHMS 5%
R224	0662057A53	CHIP RES 1500 OHMS 5%
R225	0662057A29	CHIP RES 150 OHMS 5%
R226	0662057A29	CHIP RES 150 OHMS 5%
R227	0662057A25	CHIP RES 100 OHMS 5%
R228	0662057A25	CHIP RES 100 OHMS 5%
R229	0662057A25	CHIP RES 100 OHMS 5%
R230	0662057A25	CHIP RES 100 OHMS 5%
R231	0662057A18	CHIP RES 51 OHMS 5%
R232	0662057A17	RES CHIP 47 OHMS 5%
R233	0662057A17	RES CHIP 47 OHMS 5%
R234	0662057A15	CHIP RES 39 OHMS 5%
R235	0662057A07	CHIP RES 18 OHMS 5%
R300	0662057A73	CHIP RES 10K OHMS 5%
R301	0662057A41	CHIP RES 470 OHMS 5%
R302	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R303	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R304	0662057A85	CHIP RES 33K OHM 5%
R305	0662057A80	CHIP RES 20K OHMS 5%
R306	0662057A80	CHIP RES 20K OHMS 5%
R307	0662057A80	CHIP RES 20K OHMS 5%
R308	0662057A80	CHIP RES 20K OHMS 5%
R309	0662057A77	CHIP RES 15K OHMS 5%
R310	0662057A77	CHIP RES 15K OHMS 5%
R311	NOT PLACED	-
R312	0662057A76	CHIP RES 13K OHMS 5%
R313	0662057A75	CHIP RES 12K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R314	0662057A75	CHIP RES 12K OHMS 5%
R315	0662057A75	CHIP RES 12K OHMS 5%
R316	0662057A75	CHIP RES 12K OHMS 5%
R317	0662057A75	CHIP RES 12K OHMS 5%
R318	0662057A75	CHIP RES 12K OHMS 5%
R319	0662057A75	CHIP RES 12K OHMS 5%
R320	0662057A73	CHIP RES 10K OHMS 5%
R321	0662057A71	CHIP RES 8200 OHMS 5%
R322	0662057A65	CHIP RES 4700 OHMS 5%
R323	0662057A65	CHIP RES 4700 OHMS 5%
R324	0662057A61	CHIP RES 3300 OHMS 5%
R325	0662057A61	CHIP RES 3300 OHMS 5%
R326	0662057A58	CHIP RES 2400 OHMS 5%
R327	0662057A58	CHIP RES 2400 OHMS 5%
R328	0662057A55	CHIP RES 1800 OHM 5%
R329	0662057A51	CHIP RES 1200 OHMS 5%
R330	0662057A49	CHIP RES 1000 OHMS 5%
R331	0662057A45	CHIP RES 680 OHMS 5%
R332	0662057A43	CHIP RES 560 OHMS 5%
R333	0662057A40	CHIP RES 430 OHMS 5%
R334	0662057A39	CHIP RES 390 OHMS 5%
R335	0662057A33	CHIP RES 220 OHMS 5%
R336	0662057A25	CHIP RES 100 OHMS 5%
R337	0662057A25	CHIP RES 100 OHMS 5%
R338	0662057A18	CHIP RES 51 OHMS 5%
R339	0662057A18	CHIP RES 51 OHMS 5%
R340	0662057A18	CHIP RES 51 OHMS 5%
R341	0662057A01	CHIP RES 10 OHMS 5%
R342	0662057A01	CHIP RES 10 OHMS 5%
R343	0662057A01	CHIP RES 10 OHMS 5%
R344	0662057A01	CHIP RES 10 OHMS 5%
R345	0662057A73	CHIP RES 10K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R346	0662057A73	CHIP RES 10K OHMS 5%
R401	0662057C85	CHIP RES 2700 OHMS 5%
R402	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R403	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R404	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R405	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R406	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R407	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R414	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R415	NOT PLACED	-
R421	0662057A33	CHIP RES 220 OHMS 5%
R422	0662057A73	CHIP RES 10K OHMS 5%
R423	NOT PLACED	-
R424	NOT PLACED	-
R425	0662057A97	CHIP RES 100K OHMS 5%
R426	0662057A97	CHIP RES 100K OHMS 5%
R427	NOT PLACED	-
R428	0662057A97	CHIP RES 100K OHMS 5%
R429	0662057A97	CHIP RES 100K OHMS 5%
R430	0662057A87	CHIP RES 39K OHMS 5%
R431	NOT PLACED	-
R432	0662057A85	CHIP RES 33K OHM 5%
R433	0662057A85	CHIP RES 33K OHM 5%
R434	0662057A85	CHIP RES 33K OHM 5%
R435	0662057A85	CHIP RES 33K OHM 5%
R436	0662057A85	CHIP RES 33K OHM 5%
R438	0662057A73	CHIP RES 10K OHMS 5%
R439	0662057A73	CHIP RES 10K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R440	0662057A73	CHIP RES 10K OHMS 5%
R441	0662057A73	CHIP RES 10K OHMS 5%
R442	0662057A73	CHIP RES 10K OHMS 5%
R443	0662057A61	CHIP RES 3300 OHMS 5%
R444	0662057A73	CHIP RES 10K OHMS 5%
R445	0662057A73	CHIP RES 10K OHMS 5%
R450	0662057A73	CHIP RES 10K OHMS 5%
R451	0662057A73	CHIP RES 10K OHMS 5%
R453	0662057A61	CHIP RES 3300 OHMS 5%
R454	0662057A61	CHIP RES 3300 OHMS 5%
R455	0662057A61	CHIP RES 3300 OHMS 5%
R456	0662057A61	CHIP RES 3300 OHMS 5%
R457	0662057A61	CHIP RES 3300 OHMS 5%
R458	0662057A61	CHIP RES 3300 OHMS 5%
R459	NOT PLACED	-
R460	0662057A53	CHIP RES 1500 OHMS 5%
R461	0662057A33	CHIP RES 220 OHMS 5%
R462	0662057A18	CHIP RES 51 OHMS 5%
R463	0662057A73	CHIP RES 10K OHMS 5%
R466	NOT PLACED	-
R467	NOT PLACED	-
R468	NOT PLACED	-
R469	NOT PLACED	-
R470	NOT PLACED	-
R471	0662057A01	CHIP RES 10 OHMS 5%
R472	NOT PLACED	-
R473	NOT PLACED	-
R5000	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5001	0662057T68	RES CHIP 1.0K 1% 30*60
R5002	0662057C01	CHIP RES 0 OHMS .050 OHMS (Not used in GM3188/GM3189)

Circuit Ref.	Motorola Part No.	Description
R5008	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5009	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5010	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5011	NOT PLACED	-
R5013	NOT PLACED	-
R5014	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5016	NOT PLACED	-
R5019	0662057B05	CHIP RES 200K OHMS 5%
R5020	0662057B02	CHIP RES 150K OHMS 5%
R5021	0662057A97	CHIP RES 100K OHMS 5%
R5022	0662057A97	CHIP RES 100K OHMS 5%
R5023	0662057A97	CHIP RES 100K OHMS 5%
R5024	0662057A97	CHIP RES 100K OHMS 5% (Not used in GM3188/GM3189)
R5025	0662057A97	CHIP RES 100K OHMS 5%
R5026	0662057A85	CHIP RES 33K OHM 5%
R5027	0662057B08	CHIP RES 270K OHMS 5%
R5028	0662057A97	CHIP RES 100K OHMS 5%
R5029	0662057A97	CHIP RES 100K OHMS 5%
R5030	0662057A85	CHIP RES 33K OHM 5%
R5031	0662057A92	CHIP RES 62K OHMS 5%
R5032	0662057A89	CHIP RES 47K OHMS 5%
R5033	0662057A89	CHIP RES 47K OHMS 5%
R5034	0662057A86	CHIP RES 36K OHMS 5%
R5035	0662057A89	CHIP RES 47K OHMS 5%
R5036	0662057A89	CHIP RES 47K OHMS 5%
R5037	0662057A73	CHIP RES 10K OHMS 5%
R5038	0662057A85	CHIP RES 33K OHM 5%
R5039	0662057A97	CHIP RES 100K OHMS 5%
R5040	0662057A84	CHIP RES 30K OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R5041	0662057A82	CHIP RES 24K OHMS 5%
R5042	0662057A82	CHIP RES 24K OHMS 5%
R5043	0662057A82	CHIP RES 24K OHMS 5%
R5044	0662057A82	CHIP RES 24K OHMS 5%
R5045	0662057A85	CHIP RES 33K OHM 5%
R5046	0662057A82	CHIP RES 24K OHMS 5%
R5047	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS (Not used in GM3688/ GM3689)
R5048	0662057A82	CHIP RES 24K OHMS 5%
R5049	0662057A77	CHIP RES 15K OHMS 5%
R5050	0662057A76	CHIP RES 13K OHMS 5%
R5051	0662057A75	CHIP RES 12K OHMS 5%
R5052	0662057A73	CHIP RES 10K OHMS 5%
R5053	0662057A73	CHIP RES 10K OHMS 5%
R5054	0662057A73	CHIP RES 10K OHMS 5%
R5055	0662057A73	CHIP RES 10K OHMS 5%
R5056	0662057A73	CHIP RES 10K OHMS 5%
R5057	0662057A73	CHIP RES 10K OHMS 5%
R5058	NOT PLACED	–
R5059	NOT PLACED	–
R5060	0662057A73	CHIP RES 10K OHMS 5%
R5061	0662057A73	CHIP RES 10K OHMS 5%
R5062	0662057A73	CHIP RES 10K OHMS 5%
R5063	NOT PLACED	–
R5064	NOT PLACED	–
R5065	0662057A68	CHIP RES 6200 OHMS 5%
R5066	0662057A49	CHIP RES 1000 OHMS 5%
R5067	NOT PLACED	–
R5068	NOT PLACED	–
R5069	0662057A73	CHIP RES 10K OHMS 5%
R5070	0662057A57	CHIP RES 2200 OHMS 5%
R5071	0662057A57	CHIP RES 2200 OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R5072	0662057A65	CHIP RES 4700 OHMS 5%
R5073	0662057A49	CHIP RES 1000 OHMS 5%
R5074	0662057A49	CHIP RES 1000 OHMS 5%
R5075	0662057A42	CHIP RES 510 OHMS 5%
R5076	0662057A42	CHIP RES 510 OHMS 5%
R5077	0662057A36	CHIP RES 300 OHMS 5%
R5078	0662057A25	CHIP RES 100 OHMS 5%
R5079	0662057A25	CHIP RES 100 OHMS 5%
R5080	0662057A01	CHIP RES 10 OHMS 5%
R5081	0613952D78	CER CHIP RES 6340 OHM 1% 0603
R5082	0662057A90	CHIP RES 51K OHMS 5%
R5083	0662057B08	CHIP RES 270K OHMS 5%
R5084	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS (Not used in GM3188/ GM3189)
R5085	NOT PLACED	–
R5086	0662057A43	CHIP RES 560 OHMS 5%
R5087	0662057A97	CHIP RES 100K OHMS 5%
R5088	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5089	NOT PLACED	–
R5092	0662057A73	CHIP RES 10K OHMS 5%
R5093	0662057A73	CHIP RES 10K OHMS 5%
R5094	NOT PLACED	–
R5095	0662057A82	CHIP RES 24K OHMS 5%
R5096	0662057A73	CHIP RES 10K OHMS 5%
R5097	NOT PLACED	–
R5098	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R5099	NOT PLACED	–
R5100	NOT PLACED	–
R5101	0662057A25	CHIP RES 100 OHMS 5%
R5102	0662057A25	CHIP RES 100 OHMS 5%

Circuit Ref.	Motorola Part No.	Description
R5103	NOT PLACED	–
R600	0662057C01	CHIP RES 0 OHMS .050 OHMS
R601	0611077A62	RES CHIP 330 5 1/8W
R602	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R603	0662057C01	CHIP RES 0 OHMS .050 OHMS
R604	0662057C01	CHIP RES 0 OHMS .050 OHMS
R610	0662057C59	CHIP RES 220 OHMS 5%
R615	0662057A25	CHIP RES 100 OHMS 5%
RT100	0680361L01	THERMISTOR 47KOHM
S5010	1889288U01	POTENTIOMETER W/SWITCH VOLUME
SH200	2689590U01	VCO SHIELD
SH201	2689589U01	VCO SHIELD
SH202	2689589U01	VCO SHIELD
SH300	2689591U01	MIXER SHIELD
SH301	2689593U01	FRONT ENA SHIELD
SH302	2689591U01	MIXER SHIELD
T300	2580541Z01	BALUN TRANSFORMER
T301	2580541Z01	BALUN TRANSFORMER
U100	5113818A01	IC LOW COST SING SPLY LM2904DR
U101	5185130C65	IC VHF/UHF/800 MHZ LDMOS DRIVE
U102	5113818A01	IC LOW COST SING SPLY LM2904DR
U103	5113819A04	IC QD OP AMP GEN PURP MC3303D
U200	5185963A27	IC TESTED AT25016 48 PIN GFP
U201	5105750U54	IC PKG DIE VCO BUFFER
U300	5186144B01	FM IF IC SA616
U301	5109522E10	IC 3-INV LMOS TC7W04FU
U302	4808612Y05	CROSSOVER QUAD DIODE SMS3928-0

Circuit Ref.	Motorola Part No.	Description
U400	5102463J64	16KX8 SPI SERIAL EEPROM
U402	NOT PLACED	–
U403	5102226J56	68HC11FLO_PASS5 100P IN TQFP
U404	5115037H01	4M FLASH ROM IC
U405	5113805A75	IC 8 BIT SER TO PAR/PAR HC595
U500	5113818A01	IC LOW COST SING SPLY LM2904DR
U501	0104016J81	9V REGULATOR ASSEMBLY
U502	5102463J95	AUDIO PA TDA1519C
U503	5105469E65	IC VLTG REGLTR
U504	5185130C53	IC ASFIC_CMP_R1
U505	5113818A01	IC LOW COST SING SPLY LM2904DR
U506	5113818A01	IC LOW COST SING SPLY LM2904DR
U507	5113818A01	IC LOW COST SING SPLY LM2904DR
U508	5113816A30	IC 3.3V LOW DROPOUT POS. REG.
U509	5113806A20	IC MUX/DEMUX TRIPLE 2-CHNL
U510	5104187K94	IC LP2986ILD3.3 VLTG REG
U514	4802393L66	MOSFET P-CH
U515	5162852A59	IC CMOS ANALOG SWITCH SPDT (Not used in GM3188/ GM3189)
VR101	4813830A15	TSTR 5.6V 5% 20MA 225MW
VR102	4813830A15	TSTR 5.6V 5% 20MA 225MW
VR400	NOT PLACED	–
VR401	4813830G12	DIODE 4.3V 5% 'CP' 500MW _4687
VR402	4813830A09	DIODE 3.3V 5% 225MW MMBZ5226B
VR500	4813832C77	TRANS SUP. 24V HIGH PWR

Circuit Ref.	Motorola Part No.	Description
VR501	4813830A14	DIODE 5.1V 5% 225MW MMBZ5231B_
VR502	NOT PLACED	-
VR503	4813830G09	DIODE 3.3V 5% 'CK' 500MW _4684
VR504	4813830G09	DIODE 3.3V 5% 'CK' 500MW _4684
VR692	4813830A75	DIODE DUAL COM ANODE
VR693	4813830A77	DIODE DL ZENER TVS 33V 1.0A
VR694	4813830A75	DIODE DUAL COM ANODE
VR695	4813830A77	DIODE DL ZENER TVS 33V 1.0A
VR696	4813830A75	DIODE DUAL COM ANODE
VR697	4813830A75	DIODE DUAL COM ANODE
VR698	4813830A75	DIODE DUAL COM ANODE
VR699	4813830A75	DIODE DUAL COM ANODE
Y200	NOT PLACED	-
Y201	4880114R06	CRYSTAL 16.8MHZ
Y300	9186145B02	CER.DISCR. CDBCA455CX36- TC
Y301	4880606B09	2ND OSC XTAL 44.395 MHZ

Notes



CM200/CM300/PM400 Radios

VHF2 (146–174 MHz) 25–45 W
Service Information

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Notes

MODEL CHART AND TECHNICAL SPECIFICATIONS

1.0 CM200/CM300/PM400 Model Chart

VHF2, 25–45 W, 146–174 MHz			
Model		Description	
	AAM50KQC9AA1AN	CM200 146–174 MHz, 25–45 W, 4 CH	
	AAM50KQF9AA1AN	CM300 146–174 MHz, 25–45 W, 32 CH	
	AAM50KQF9AA3AN	PM400 146–174 MHz, 25–45 W, 64 CH	
		Item	Description
X		PMUD1875_	CM200 Super Tanapa VHF2, 25–45 W, 4 CH
	X	PMUD1877_	CM300 Super Tanapa VHF2, 25–45 W, 32 CH
		X PMUD1905_	PM400 Super Tanapa VHF2, 25–45 W, 64 CH
X		PMUD1884_	CM200 Tanapa VHF2, 25–45 W 4 CH
	X	PMUD1886_	CM300 Tanapa VHF2, 25–45 W, 32 CH
		X PMUD1886_	PM400 Tanapa VHF2, 25–45 W, 64 CH
X		PMLN4598_	Control Head
	X	PMLN4599_	Control Head
		X FLN3108_AN	Control Head
X		PMUD1884_S	CM200 VHF2 Service Board
	X	PMUD1886_S	CM300 VHF2 Service Board
		X PMUD1886_S	PM400 VHF2 Service Board
X		6902966C30	CM200 User Guide (bilingual)
	X	6881096C22	CM300 User Guide (bilingual)
		X 6881096C32	PM400 User Guide (bilingual)
X	X	HKLN4220	CM200/CM300 User Guide CDROM (bilingual)
		X HKLN4219	PM400 User Guide CDROM (bilingual)

x = Indicates one of each is required.

2.0 Technical Specifications

Data is specified for +25°C unless otherwise stated.

General	
Specification	VHF2
Frequency Range:	146–174 MHz
Frequency Stability (-30°C to +60°C, 25°C Ref.)	±2.5 PPM
Channel Capacity:	CM200 – 4 Channels CM300 – 32 Channels PM400 – 64 Channels
Channel Spacing:	12.5/20/25 kHz
Power Supply:	13.8 Vdc (11 Vdc – 16.6 Vdc) negative Vehicle ground
Dimensions (L x W x H)	4.65" X 6.67" X 1.73" (118mm X 169.5mm X 44mm)
Weight	2.25 lbs (1.01 kg)
FCC Description	ABZ99FT3046
Operating Temperature	-30 to 60° C (Display only -20°C to 60°C)
Storage Temperature	-40 to 85° C
Thermal Shock	-40 to 80° C
High Humidity	95% RH @ 50° C for 8 hrs
ESD	15KV air discharge
Packing Test	Impact Test

Transmitter	
Specification	VHF2
Power Output	25–45 W
Conducted/Radiated Emissions:	-26 dBm
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000 Hz)	TIA603 and CEPT
Tx Audio Distortion	< 3%
Modulation Limiting:	±2.5 kHz @ 12.5 kHz ±4.0 kHz @ 20 kHz ±5.0 kHz @ 25 kHz
FM Hum and Noise:	-40 dB@12.5 kHz -45 dB@25 kHz

Receiver	
Specification	VHF2
Sensitivity (12 dB SINAD):	0.35 μV @ 12.5 kHz 0.3 μV @ 25 kHz
Intermodulation:	65 dB@12.5 kHz 75 dB@25 kHz
Adjacent Channel Selectivity:	65 dB @ 12.5 kHz 75 dB @ 25 kHz
Spurious Response	75 dB
Rated Audio Power	4 W (typ.) Internal 7.5 W @ 5 % External
Audio Distortion	< 5 %
Hum and Noise:	-40 dB @ 12.5 kHz -45 dB @ 25 kHz
Audio Response	TIA603 and CEPT
Conducted Spurious Emission per FCC Part 15:	-57 dBm <1 GHz -47 dBm >1 GHz

Specifications subject to change without notice. All electrical specifications and methods refer to EIA/TIA 603 standards.

Notes

Chapter 2

THEORY OF OPERATION

1.0 Introduction

This Chapter provides a detailed theory of operation for the VHF circuits in the radio. Details of the theory of operation and trouble shooting for the the associated Controller circuits are included in this Section of the manual.

2.0 VHF (146–174 MHz) Receiver

2.1 Receiver Front-End

The received signal is applied to the radio's antenna input connector and routed through the harmonic filter and antenna switch. The insertion loss of the harmonic filter/antenna switch is less than 1 dB. The signal is routed to the first filter (4-pole), which has an insertion loss of 2 dB typically. The output of the filter is matched to the base of the LNA (Q303) that provides a 16 dB gain and a noise figure of better than 2 dB. Current source Q301 is used to maintain the collector current of Q303. Diode CR301 protects Q303 by clamping excessive input signals. Q303 output is applied to the second filter (3-pole) which has an insertion loss of 1.5 dB. In Distance mode, Q304 turns on and causes D305 to conduct, thus bypassing C332 and R337. In Local mode, the signal is routed through C332 and R337, thus inserting 7 dB attenuation. Since the attenuator is located after the RF amplifier, the receiver sensitivity is reduced only by 6 dB, while the overall third order input intercept is raised.

The first mixer is a passive, double-balanced type, consisting of T300, T301 and U302. This mixer provides all of the necessary rejection of the half-IF spurious response. High-side injection at +15 dBm is delivered to the first mixer. The mixer output is then connected to a duplex network which matches its output to the XTAL filter input (FL300) at the IF frequency of 44.85 MHz. The duplex network terminates into a 50 ohm resistor (R340) at all other frequencies.

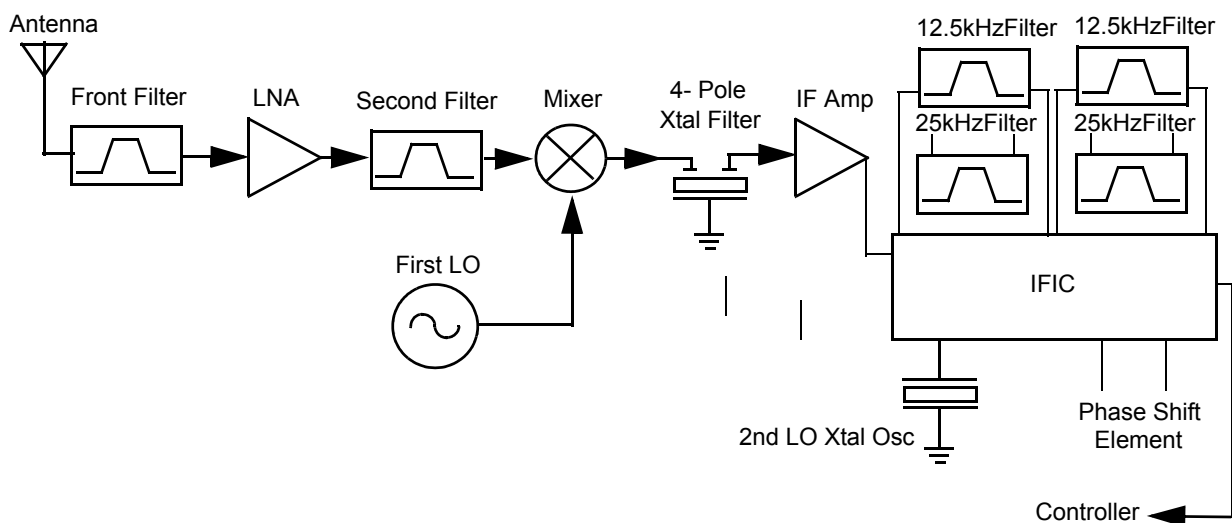


Figure 2-1 VHF Receiver Block Diagram

2.2 Receiver Back End

The IF signal from the crystal filter enters the IF amplifier which provides 20 dB of gain and feeds the IF IC at pin 1. The first IF signal at 44.85 MHz mixes with the second local oscillator (LO) at 44.395 MHz to produce the second IF at 455 kHz. The second LO uses the external crystal Y301. The second IF signal is amplified and filtered by two external ceramic filters (FL303/FL302 for 12.5 kHz channel spacing and FL304/FL301 for 25 kHz channel spacing). The IF IC demodulates the signal by means of a quadrature detector and feeds the detected audio (via pin 7) to the audio processing circuits. At IF IC pin 5, an RSSI signal is available with a dynamic range of 70 dB.

3.0 VHF Transmitter Power Amplifier (146–174 MHz)

The radio's 45 W PA is a three-stage amplifier used to amplify the output from the TX_INJ to the antenna port. All three stages utilize LDMOS technology. The gain of the first stage (U101) is adjustable and is controlled by pin 7 of U103-2 via U103-3 and U102-1. It is followed by an LDMOS driver Q105 and final stage Q100.

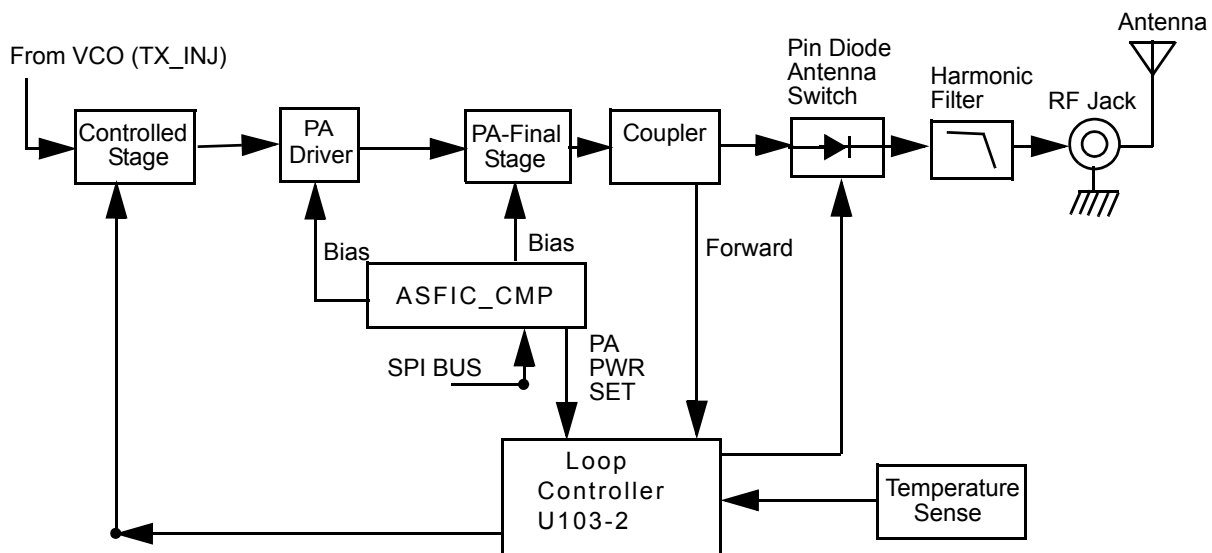


Figure 2-2 VHF Transmitter Block Diagram

Devices U101, Q105 and Q100 are surface mounted. Two screws with Belleville washers provide direct pressure ensuring good thermal contact between both the driver and final stage, and the chassis.

3.1 First Power Controller Stage

The first stage (U101) is a 20dB gain integrated circuit containing two LDMOS FET amplifier stages. It amplifies the RF signal from the VCO (TX_INJ). The output power of stage U101 is controlled by a DC voltage applied to pin 1 from the op-amp U103-3, pin 8. The control voltage simultaneously varies the bias of two FET stages within U101. This biasing point determines the overall gain of U101 and therefore its output drive level to Q105, which in turn controls the output power of the PA.

Op-amp U103-3 monitors the drain current of U101 via resistors R122 & R197 and adjusts the bias voltage of U101.

In receive mode, the DC voltage from RX_EN line turns on Q101, which in turn switches off the biasing voltage to U101.

3.2 Power Controlled Driver Stage

The next stage is an LDMOS device (Q105) which provides a gain of 12dB. This device requires a positive gate bias and a quiescent current flow for proper operation. The bias is set during transmit mode by V_cntrl_driver which is set to provide 100–150 mA of quiescent current by the factory, and fed to the gate of Q105 via the resistive network.

The V_cntrl_driver is directly controlled by the ASFIC CMP. In receive mode, the ASFIC CMP (U504) sets V-cntrl_driver to 0 V (DACR pin 5).

3.3 Final Stage

The final stage is an LDMOS device (Q100) providing a gain of 12dB. This device also requires a positive gate bias and a quiescent current flow for proper operation. The voltage of the line PA_BIAS is set in transmit mode by the ASFIC and fed to the gate of Q100 via the resistive network R134, R131. This bias voltage is tuned in the factory. If the transistor is replaced, the bias voltage must be tuned using the Tuner. Care must be taken not to damage the device by exceeding the maximum allowed bias voltage. The device's drain current is drawn directly from the radio's DC supply voltage input, B+, via L117 and L115.

A matching network consisting of C1004-5, C1007-9, C1096, C1021, C1013, C1019, L116: and two striplines, transforms the impedance to 50 ohms and feeds the directional coupler.

3.4 Bi-Directional Coupler

The bi-directional Coupler is a microstrip printed circuit, which couples a small amount of the forward and reverse power of the RF power from Q100. The coupled signal is rectified to an output power which is proportional to the DC voltage rectified by diode D105; and the resulting DC voltage is routed to the power control section to ensure that the forward power out of the radio is held to a constant value.

3.5 Antenna Switch

The antenna switch utilizes the existing dc feed (B+) to the last stage device (Q100). The basic operation is to have both PIN diodes (D103, D104) turned on during key-up by forward biasing them. This is achieved by pulling down the voltage at the cathode end of D104 to around 12.4 V (0.7 V drop across each diode). The current through the diodes needs to be set around 100 mA to fully open the transmit path through resistor R108. Q106 is a current source controlled by Q103 which is turned on in Tx mode by TX_EN. VR102 ensures that the voltage at resistor R107 never exceeds 5.6 V.

3.6 Harmonic Filter

Inductors L111, L112, L124 and L113 along with capacitors C1132, C1022, C1020, C1137, C1018, and C1017 form a low-pass filter to attenuate harmonic energy coming from the transmitter. Resistor R150 drains any electrostatic charges that might otherwise build up on the antenna. The harmonic filter also prevents high level RF signals above the receiver passband from reaching the receiver circuits to improve spurious response rejection.

3.7 Power Control

The output power is regulated by using a forward power detection control loop. The directional coupler samples a portion of the forward and reflected RF power. The forward sampled RF is rectified by diode D105, and the resulting DC voltage is routed to the operational amplifier U100. The error output current is then routed to an integrator, and converted into the control voltage. This voltage controls the bias of the pre-driver (U101) stage. The output power level is set by way of a DAC, PWR_SET, in the audio processing IC (U504), which acts at the forward power control loop reference.

The sampled reflected power is rectified by diode D107, The resulting DC voltage is amplified by an operational amplifier U100 and routed to the summing junction. This detector protects the final stage Q100 from reflected power by increasing the error current. The temperature sensor protects the final stage Q100 from overheating by increasing the error current. A thermistor RT100 measures the final stage Q100 temperature. The voltage divider output is routed to an operational amplifier U103 and then goes to the summing junction. The Zener Diode VR101 keeps the loop control voltage below 5.6 V and eliminates the DC current from the 9.3 regulator U501.

A local loop for the Pre Driver (U101) is used in order to stabilize the current for this stage.

In Rx mode, the two transistors Q101 and Q102 go to saturation and shut down the transmitter by applying ground to the Pre Driver U101.

4.0 VHF (146–174 MHz) Frequency Synthesis

The synthesizer consists of a reference oscillator (Y201), low voltage Fractional-N (LVFRAC-N) synthesizer (U200), and a voltage controlled oscillator (VCO) (U201).

4.1 Reference Oscillator

The reference oscillator is a crystal (Y201) controlled Colpitts oscillator and has a frequency of 16.8 MHz. The oscillator transistor and start-up circuit are located in the LVFRAC-N (U200) while the oscillator feedback capacitors, crystal, and tuning varactors are external. An analog-to-digital (A/D) converter internal to the LVFRAC-N (U200) and controlled by the microprocessor via SPI sets the voltage at the warp output of U200 pin 25. This sets the frequency of the oscillator. Consequently, the output of the crystal Y201 is applied to U200 pin 23.

The method of temperature compensation is to apply an inverse Bechmann voltage curve, which matches the crystal's Bechmann curve to a varactor that constantly shifts the oscillator back on frequency. The crystal vendor characterizes the crystal over a specified temperature range and codes this information into a bar code that is printed on the crystal package. In production, this crystal code is read via a 2-dimensional bar code reader and the parameters are saved.

This oscillator is temperature compensated to an accuracy of ± 2.5 PPM from -30 to 60 degrees C. The temperature compensation scheme is implemented by an algorithm that uses five crystal parameters (four characterize the inverse Bechmann voltage curve and one for frequency accuracy of the reference oscillator at 25 degrees C). This algorithm is implemented by the LVFRAC-N (U200) at the power up of the radio.

4.2 Fractional-N Synthesizer

The LVFRAC-N U200 consists of a pre-scaler, programmable loop divider, control divider logic, phase detector, charge pump, A/D converter for low frequency digital modulation, balanced attenuator used to balance the high and low frequency analog modulation, 13 V positive voltage multiplier, serial interface for control, and a super filter for the regulated 5 volts.

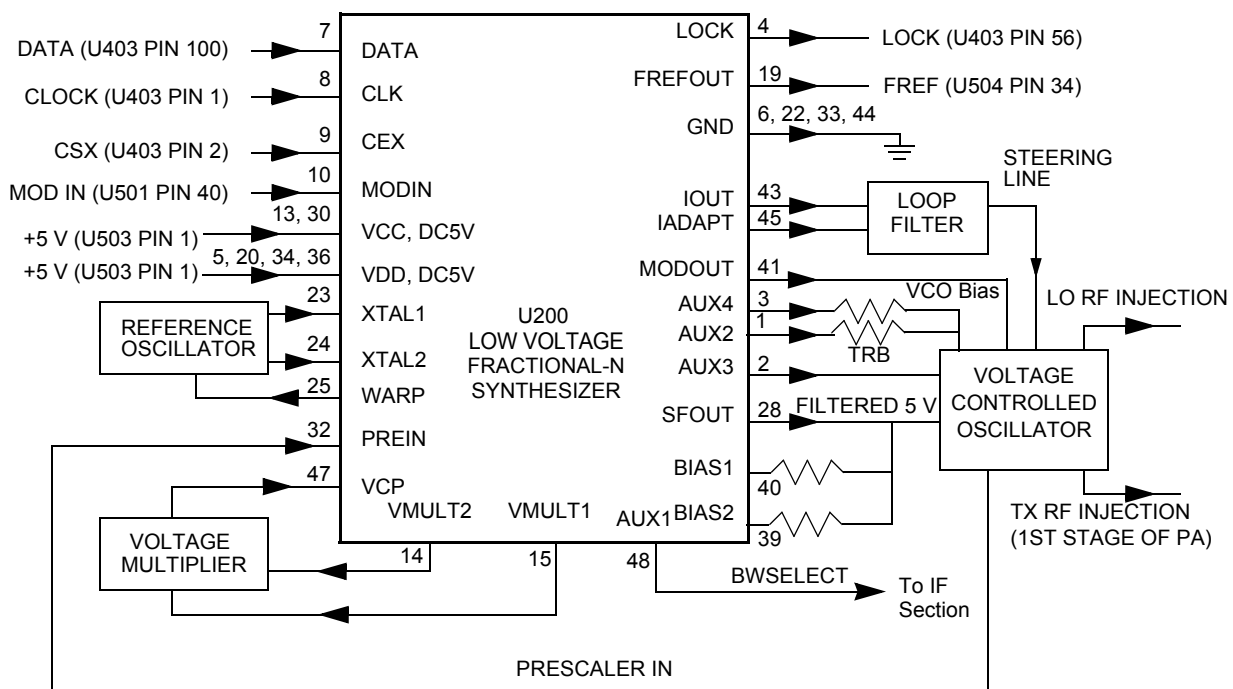


Figure 2-3 VHF Synthesizer Block Diagram

A voltage of 5 V applied to the super filter input (U200, pin 30) supplies an output voltage of 4.5 Vdc (VSF) at U200, pin 28. This supplies 4.5 V to the VCO Buffer IC U201.

To generate a high voltage to supply the phase detector (charge pump) output stage at pin VCP (U200, pin 47) while using a low voltage 3.3 Vdc supply, a 13 V positive voltage multiplier is used (D200, D201, and capacitors C2024, 2025, 2026, 2055, 2027, 2001).

Output lock (U200, pin 4) provides information about the lock status of the synthesizer loop. A high level at this output indicates a stable loop. A 16.8 MHz reference frequency is provided at U200, pin 19.

4.3 Voltage Controlled Oscillator (VCO)

The Voltage Controlled Oscillator (VCO) consists of the VCO/Buffer IC (VCOBIC, U201), the TX and RX tank circuits, the external RX amplifier, and the modulation circuitry.

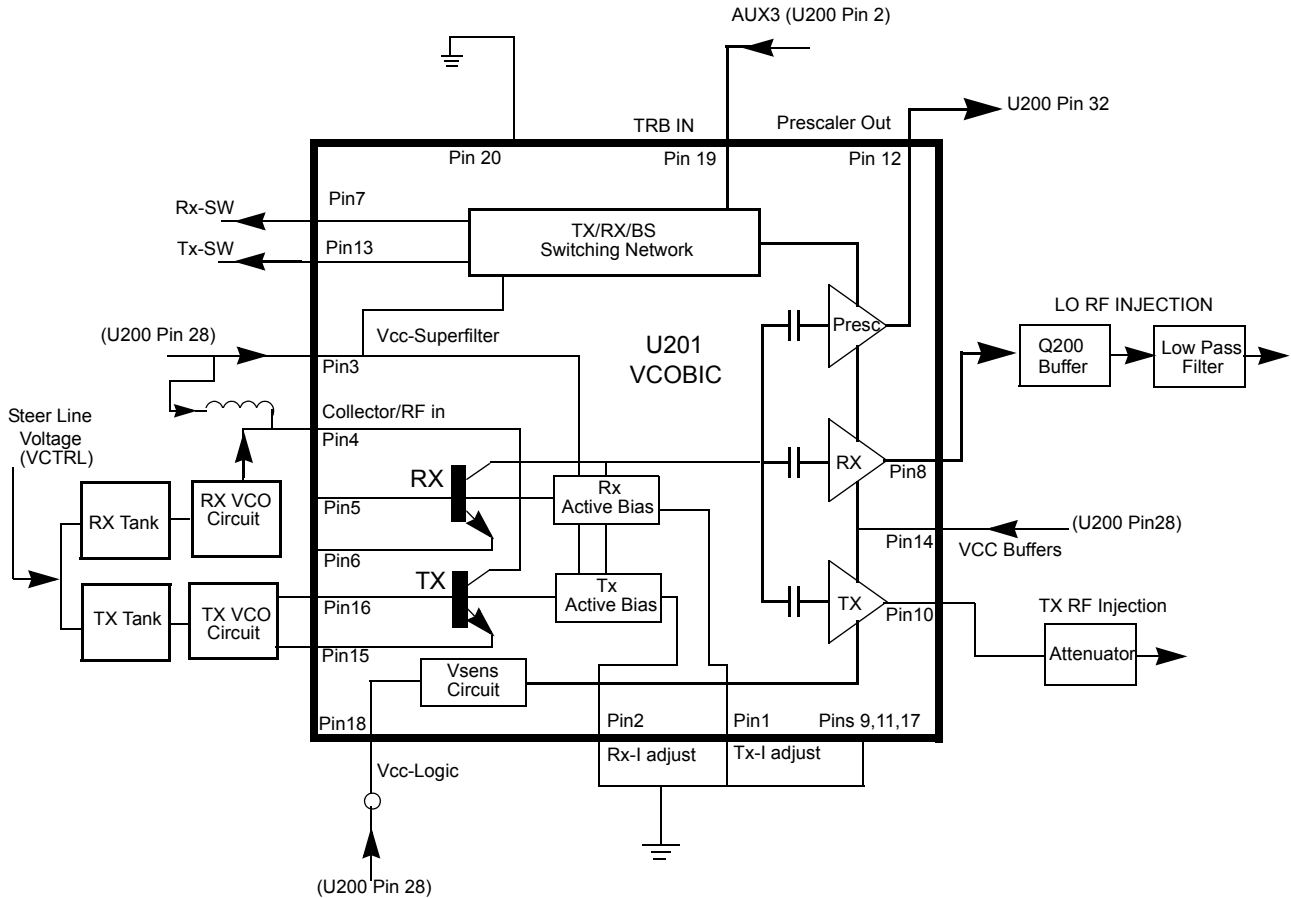


Figure 2-4 VHF VCO Block Diagram

The VCOBIC together with the LVFRAC-N (U200) generate the required frequencies in both transmit and receive modes. The TRB line (U201, pin 19) determines which VCO and buffer is enabled (high being TX output at pin 10, low being RX output at pin 8). A sample of the signal from the enabled output is routed from U201, pin 12 (PRESC_OUT), via a low pass filter to U200, pin 32 (PREIN).

A steering line voltage between 3.0 V and 10.0 V at varactor D204 tunes the TX VCO through the frequency range of 146–174 MHz, and at D203 tunes the RX VCO through the frequency range of 190–219 MHz.

The external RX amplifier is used to increase the output from U201, pin 9 from 3–4 dBm to the required 15dBm for proper mixer operation. In TX mode, the modulation signal from the LVFRAC-N (U200, pin 41) is applied to the VCO by way of the modulation circuit D205, R212, R211, C2073.

4.4 Synthesizer Operation

The synthesizer consists of a low voltage FRAC-N IC (LVFRAC-N), reference oscillator, charge pump circuits, loop filter circuit, and DC supply. The output signal (PRESC_OUT) of the VCOBIC (U201, pin 12) is fed to the PREIN, pin 32 of U200 via a low pass filter which attenuates harmonics and provides a correct input level to the LVFRAC-N in order to close the synthesizer loop.

The pre-scaler in the synthesizer (U200) is a dual modulus pre-scaler with selectable divider ratios. The divider ratio of the pre-scaler is controlled by the loop divider, which in turn receives its inputs via the SPI. The output of the pre-scaler is applied to the loop divider. The output of the loop divider is connected to the phase detector, which compares the loop divider's output signal with the reference signal. The reference signal is generated by dividing down the signal of the reference oscillator (Y201).

The output signal of the phase detector is a pulsed dc signal that is routed to the charge pump. The charge pump outputs a current from U200, pin 43 (IOUT). The loop filter (consisting of R224, R217, R234, C2074, C2075, C2077, C2078, C2079, C2080, C2028, and L205) transforms this current into a voltage that is applied to the varactor diodes D203 and D204 for RX and TX respectively. The output frequency is determined by this control voltage. The current can be set to a value fixed in the LVFRAC-N or to a value determined by the currents flowing into BIAS 1 (U200, pin 40) or BIAS 2 (U200, pin 39). The currents are set by the value of R200 or R206 respectively. The selection of the three different bias sources is done by software programming.

To modulate the synthesizer loop, a two-spot modulation method is utilized via the MODIN (U200, pin 10) input of the LVFRAC-N. The audio signal is applied to both the A/D converter (low frequency path) and the balance attenuator (high frequency path). The A/D converter converts the low frequency analog modulating signal into a digital code which is applied to the loop divider, thereby causing the carrier to deviate. The balance attenuator is used to adjust the VCO's deviation sensitivity to high frequency modulating signals. The output of the balance attenuator is presented at the MODOUT port of the LVFRAC-N (U200, pin 41) and connected to the VCO modulation varactor D205.

5.0 Controller Theory of Operation

This section provides a detailed theory of operation for the radio and its components. The main radio is a single-board design, consisting of the transmitter, receiver, and controller circuits. A control head is connected by an extension cable. The control head contains LED indicators, a microphone connector, buttons, and speaker.

In addition to the power cable and antenna cable, an accessory cable can be attached to a connector on the rear of the radio. The accessory cable enables you to connect accessories to the radio, such as an external speaker, emergency switch, foot-operated PTT, and ignition sensing, etc.

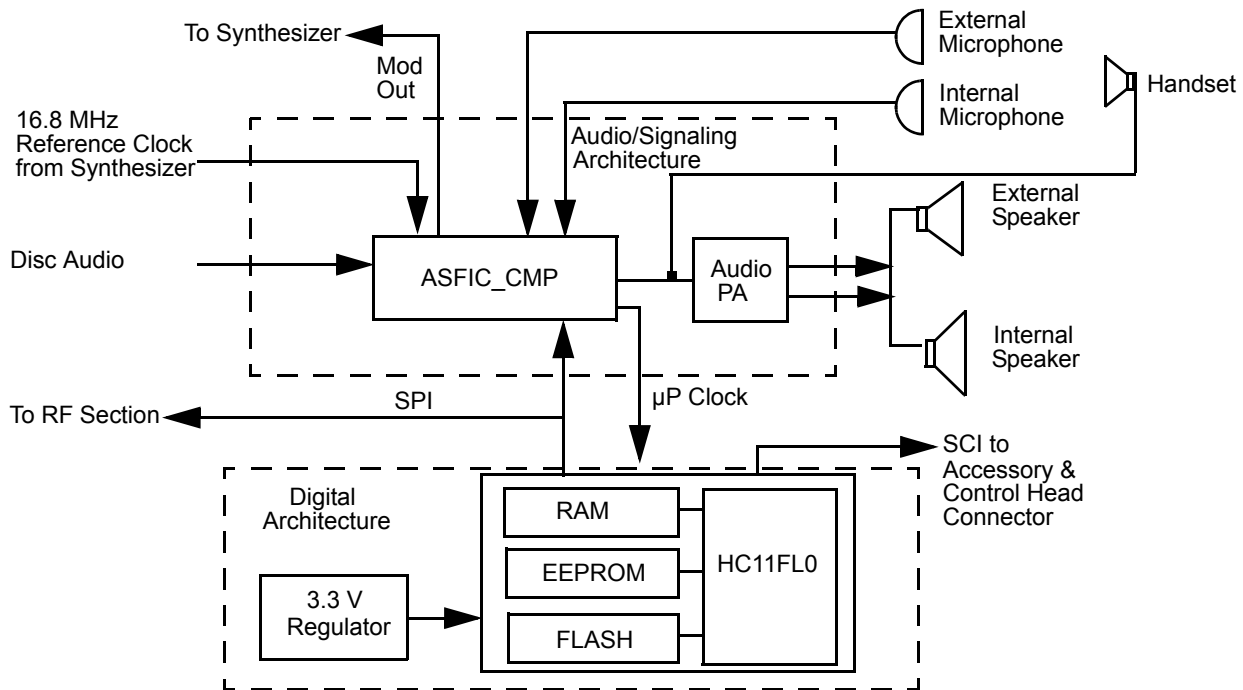


Figure 2-5 Controller Block Diagram

5.1 Radio Power Distribution

Voltage distribution is provided by five separate devices:

- U514 P-cH FET – Batt + (Ext_SWB+)
- U501 LM2941T – 9.3 V
- U503 LP2951CM – 5 V
- U508 MC 33269DTRK – 3.3 V
- U510 LP2986ILDY – 3.3 V Digital

The DC voltage applied to connector P2 supplies power directly to the following circuitry:

- Electronic on/off control
- RF power amplifier
- 12 volts P-cH FET -U514
- 9.3 volt regulator
- Audio PA

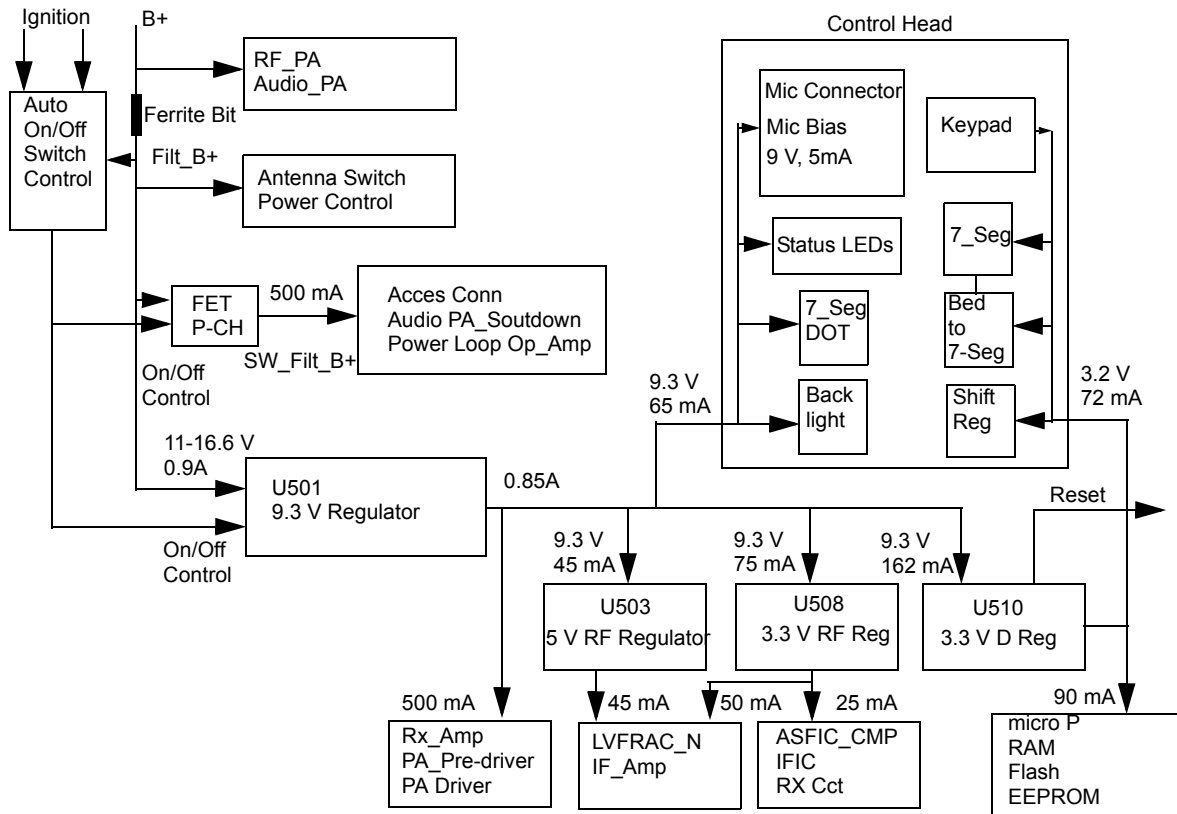


Figure 2-6 DC Power Distribution Block Diagram

Regulator U501 is used to generate the 9.3 volts required by some audio circuits, the RF circuitry and power control circuitry. Input and output capacitors are used to reduce high frequency noise. Resistors R5001 / R5081 set the output voltage of the regulator. This regulator output is electronically enabled by a 0 volt signal on pin 2. Q502, Q505 and R5038 are used to disable the regulator when the radio is turned off.

Voltage regulator U510 provides 3.3 volts for the digital circuitry. Operating voltage is from the regulated 9.3 V supply. Input and output capacitors are used to reduce high frequency noise and provide proper operation during battery transients. U510 provides a reset output that goes to 0 volts if the regulator output goes below 3.1 volts. This is used to reset the controller to prevent improper operation.

Voltage regulator U508 provides 3.3 V for the RF circuits and ASFIC_CMP. Input and output capacitors are used to reduce the high frequency noise and provide proper operation during battery transients.

Voltage regulator U503 provides 5 V for the RF circuits. Input and output capacitors are used to reduce the high frequency noise and provide proper operation during battery transients.

5.2 Protection Devices

Diode VR500 acts as protection against ESD, wrong polarity of the supply voltage, and load dump. VR692 – VR699 are for ESD protection.

5.3 Automatic On/Off

The radio can be switched ON in any one of the following three ways:

- On/Off switch. (No Ignition Mode)
- Ignition and On/Off switch (Ignition Mode)
- Emergency

5.3.1 No Ignition Mode

When the radio is connected to the car battery for the first time, Q500 will be in saturation, Q503 will cut-off, Filt_B+ will pass through R5073, D500, and S5010-pin 6 (On/Off switch). When S5010 is ON, Filt_B+ will pass through S5010-pin5, D511, R5069, R5037 and base of Q505 and move Q505 into saturation. This pulls U501-pin2 through R5038, D502 to 0.2 V and turns On U514 and U501 9.3 V regulator which supplies voltage to all other regulators and consequently turns the radio on, When U504 (ASFIC_CMP) gets 3.3 V, GCB2 goes to 3.3 V and holds Q505 in saturation, for soft turn off.

5.3.2 Ignition Mode

When ignition is connected for the first time, it will force high current through Q500 collector, This will move Q500 out of saturation and consequently Q503 will cut-off. S5010 pin 6 will get ignition voltage through R601 (for load dump), R610, (R610 & C678 are for ESD protection), VR501, R5074, and D500. When S5010 is ON, Filt_B+ passes through S5010-pin 5, D511, R5069, R5037 and base of Q505 and inserts Q505 into saturation. This pulls U501-pin 2 through R5038, D502 to 0.2 V and turns on U514 and U501 9.3 V regulator which supply voltage to all other regulators and turns the radio on, When U504 (ASFIC_CMP) get 3.3 V supply, GCB2 goes to 3.3 V and holds Q505 in saturation state to allow soft turn off.

When ignition is off Q500, Q503 will stay at the same state so S5010 pin 6 will get 0 V from Ignition, Q504 goes from Sat to Cut, ONOFF_SENSE goes to 3.3 V and it indicates to the radio to soft turn itself by changing GCB2 to '0' after de registration if necessary.

5.3.3 Emergency Mode

The emergency switch (P1 pin 9), when engaged, grounds the base of Q506 via EMERGENCY_ACCES_CONN. This switches Q506 to off and consequently resistor R5020 pulls the collector of Q506 and the base of Q506 to levels above 2 volts. Transistor Q502 switches on and pulls U501 pin2 to ground level, thus turning ON the radio. When the emergency switch is released R5030 pulls the base of Q506 up to 0.6 volts. This causes the collector of transistor Q506 to go low (0.2 V), thereby switching Q502 to off.

While the radio is switched on, the μP monitors the voltage at the emergency input on the accessory connector via U403-pin 62. Three different conditions are distinguished: no emergency kit is connected, emergency kit connected (unpressed), and emergency press.

If no emergency switch is connected or the connection to the emergency switch is broken, the resistive divider R5030 / R5049 will set the voltage to about 3.14 volts (indicates no emergency kit found via EMERGENCY_SENSE line). If an emergency switch is connected, a resistor to ground within the emergency switch will reduce the voltage on EMERGENCY_SENSE line, and indicate to the μP that the emergency switch is operational. An engaged emergency switch pulls line EMERGENCY_SENSE line to ground level. Diode VR503 limits the voltage to protect the μP input.

While EMERGENCY_ACCES_CONN is low, the μP starts execution, reads that the emergency input is active through the voltage level of μP pin 64, and sets the DC POWER ON output of the ASFIC CMP pin 13 to a logic high. This high will keep Q505 in saturation for soft turn off.

5.4 Microprocessor Clock Synthesiser

The clock source for the μP system is generated by the ASFIC CMP (U504). Upon power-up the synthesizer IC (FRAC-N) generates a 16.8 MHz waveform that is routed from the RF section to the ASFIC CMP pin 34. For the main board controller the ASFIC CMP uses 16.8 MHz as a reference input clock signal for its internal synthesizer. The ASFIC CMP, in addition to audio circuitry, has a programmable synthesizer which can generate a synthesized signal ranging from 1200 Hz to 32.769 MHz in 1200 Hz steps.

When power is first applied, the ASFIC CMP will generate its default 3.6864 MHz CMOS square wave UP CLK (on U504 pin 28) and this is routed to the μP (U403 pin 90). After the μP starts operation, it reprograms the ASFIC CMP clock synthesizer to a higher UP CLK frequency (usually 7.3728 or 14.7456 MHz) and continues operation.

The ASFIC CMP may be reprogrammed to change the clock synthesizer frequencies at various times depending on the software features that are executing. In addition, the clock frequency of the synthesizer is changed in small amounts if there is a possibility of harmonics of the clock source interfering with the desired radio receive frequency.

The ASFIC CMP synthesizer loop uses C5025, C5024 and R5033 to set the switching time and jitter of the clock output. If the ASFIC CMP synthesizer cannot generate the required clock frequency it will switch back to its default 3.6864 MHz output.

Because the ASFIC CMP synthesizer and the μP system will not operate without the 16.8 MHz reference clock it (and the voltage regulators) should be checked first when debugging the system.

5.5 Serial Peripheral Interface (SPI)

The μ P communicates to many of the IC's through its SPI port. This port consists of SPI TRANSMIT DATA (MOSI) (U403-pin100), SPI RECEIVE DATA (MISO) (U403-pin 99), SPI CLK (U0403-pin1) and chip select lines going to the various IC's, connected on the SPI PORT (BUS). This BUS is a synchronous bus, in that the timing clock signal CLK is sent while SPI data (SPI TRANSMIT DATA or SPI RECEIVE DATA) is sent. Therefore, whenever there is activity on either SPI TRANSMIT DATA or SPI RECEIVE DATA there should be a uniform signal on CLK. The SPI TRANSMIT DATA is used to send serial from a μ P to a device, and SPI RECEIVE DATA is used to send data from a device to a μ P.

In the controller section there are two IC's on the SPI BUS, ASFIC CMP (U504 pin 22), and EEPROM (U400). In the RF sections there is one IC on the SPI BUS, the FRAC-N Synthesizer. The chip select line CSX from U403 pin 2 is shared by the ASFIC CMP and FRAC-N Synthesizer. Each of these IC's check the SPI data and when the sent address information matches the IC's address, the following data is processed.

When the μ P needs to program any of these, it brings the chip select line CSX to a logic "0" and then sends the proper data and clock signals. The amount of data sent to the various IC's are different; e.g., the ASFIC CMP can receive up to 19 bytes (152 bits). After the data has been sent the chip select line is returned to logic "1".

5.6 SBEP Serial Interface

The SBEP serial interface allows the radio to communicate with the Customer Programming Software (CPS), or the Universal Tuner via the Radio Interface Box (RIB) or the cable with internal RIB. This interface connects to the SCI pin via control head connector (J2-pin 17) and to the accessory connector P1-6 and comprises BUS+. The line is bi-directional, meaning that either the radio or the RIB can drive the line. The μ P sends serial data and it reads serial data via pin 97. Whenever the μ P detects activity on the BUS+ line, it starts communication.

5.7 General Purpose Input/Output

The controller provides six general purpose lines (PROG I/O) available on the accessory connector P1 to interface to external options. Lines PROG IN 3 and 6 are inputs, PROG OUT 4 is an output and PROG IN OUT 8, 12 and 14 are bi-directional. The software and the hardware configuration of the radio model define the function of each port.

- PROG IN 3 can be used as external PTT input, or others, set by the CPS. The μ P reads this port via pin 72 and Q412.
- PROG OUT 4 can be used as external alarm output, set by the CPS. Transistor Q401 is controlled by the μ P (U403 pin 55)
- PROG IN 6 can be used as normal input, set by the CPS. The μ P reads this port via pin 73 and Q411. This pin is also used to communicate with the RIB if resistor R421 is placed.
- DIG IN OUT 8,12,14 are bi-directional and use the same circuit configuration. Each port uses an output Q416, Q404, Q405 controlled by μ P pins 52, 53, 54. The input ports are read through μ P pins 74, 76, 77; using Q409, Q410, Q411

5.8 Normal Microprocessor Operation

For this radio, the μP is configured to operate in one of two modes, expanded and bootstrap. In expanded mode the μP uses external memory devices to operate, whereas in bootstrap operation the μP uses only its internal memory. In normal operation of the radio the μP is operating in expanded mode as described below.

During normal operation, the μP (U403) is operating in expanded mode and has access to 3 external memory devices; U400 (EEPROM), U402 (SRAM), U404 (Flash). Also, within the μP there are 3 Kilobytes of internal RAM, as well as logic to select external memory devices.

The external EEPROM (U400) space contains the information in the radio which is customer specific, referred to as the codeplug. This information consists of items such as: 1) what band the radio operates in, 2) what frequencies are assigned to what channel, and 3) tuning information.

The external SRAM (U402) as well as the μP 's own internal RAM space are used for temporary calculations required by the software during execution. All of the data stored in both of these locations is lost when the radio powers off.

The μP provides an address bus of 16 address lines (ADDR 0 – ADDR 15), and a data bus of 8 data lines (DATA 0 – DATA 7). There are also 3 control lines; CSProg (U403-38) to chip select U404-pin 30 (FLASH), CSGP2 (U403-pin 41) to chip select U404-pin 20 (SRAM) and PG7_R_W (U403-pin 4) to select whether to read or to write.

When the μP is functioning normally, the address and data lines should be toggling at CMOS logic levels. Specifically, the logic high levels should be between 3.1 and 3.3 V, and the logic low levels should be between 0 and 0.2 V. No other intermediate levels should be observed, and the rise and fall times should be <30 ns.

The low-order address lines (ADDR 0 – ADDR 7) and the data lines (DATA 0–DATA 7) should be toggling at a high rate, e.g., you should set your oscilloscope sweep to 1us/div. or faster to observe individual pulses. High speed CMOS transitions should also be observed on the μP control lines.

On the μP the lines XIRQ (U403-pin 48), MODA LIR (U403-pin 58), MODB VSTPY (U403-pin 57) and RESET (U403-pin 94) should be high at all times during normal operation. Whenever a data or address line becomes open or shorted to an adjacent line, a common symptom is that the RESET line goes low periodically, with the period being in the order of 20ms. In the case of shorted lines you may also detect the line periodically at an intermediate level, i.e. around 2.5 V when two shorted lines attempt to drive to opposite rails.

The MODA LIR (U403-pin 58) and MODB VSTPY (U403-pin 57) inputs to the μP must be at a logic "1" for it to start executing correctly. After the μP starts execution it will periodically pulse these lines to determine the desired operating mode. While the Central Processing Unit (CPU) is running, MODA LIR is an open-drain CMOS output which goes low whenever the μP begins a new instruction. An instruction typically requires 2–4 external bus cycles, or memory fetches.

There are eight analog-to-digital converter ports (A/D) on U403 labelled within the device block as PEO–PE7. These lines sense the voltage level ranging from 0 to 3.3 V of the input line and convert that level to a number ranging from 0 to 255 which is read by the software to take appropriate action.

5.9 Static Random Access Memory (SRAM)

The SRAM (U402) contains temporary radio calculations or parameters that can change very frequently, and which are generated and stored by the software during its normal operation. The information is lost when the radio is turned off.

The device allows an unlimited number of write cycles. SRAM accesses are indicated by the CS signal U402 (which comes from U403-CSGP2) going low. U402 is commonly referred to as the external RAM as opposed to the internal RAM which is the 3 Kilobytes of RAM which is part of the 68HC11FL0. Both RAM spaces serve the purpose. However, the internal RAM is used for the calculated values which are accessed most often.

Capacitor C402 and C411 serves to filter out any AC noise which may ride on +3.3 V at U402

6.0 Control Board Audio and Signalling Circuits

6.1 Audio Signalling Filter IC and Compander (ASFIC CMP)

The ASFIC CMP (U504) used in the controller has the following four functions:

1. RX/TX audio shaping, i.e. filtering, amplification, attenuation
2. RX/TX signaling, PL/DPL/HST/MDC
3. Squelch detection
4. μ P clock signal generation

The ASFIC CMP is programmable through the SPI BUS (U504 pins–20/21/22), normally receiving 19 bytes. This programming sets up various paths within the ASFIC CMP to route audio and/or signaling signals through the appropriate filtering, gain and attenuator blocks. The ASFIC CMP also has 6 General Control Bits GCB0–5 which are CMOS level outputs and used for the following:

- GCB0 – BW Select
- GCB1 – switches the audio PA On/Off
- GCB2 – DC Power On switches the voltage regulator (and the radio) on and off
- GCB3 – Control on MUX U509 pin 9 to select between Low Cost Mic path to STD Mic Path
- GCB4 – Control on MUX U509 pin 11 to select between Flat RX path to filtered RX path on the accessory connector.
- GCB5 – Control on MUX U509 pin 10 to select between Flat TX path mute and Flat TX path

7.0 Transmit Audio Circuits

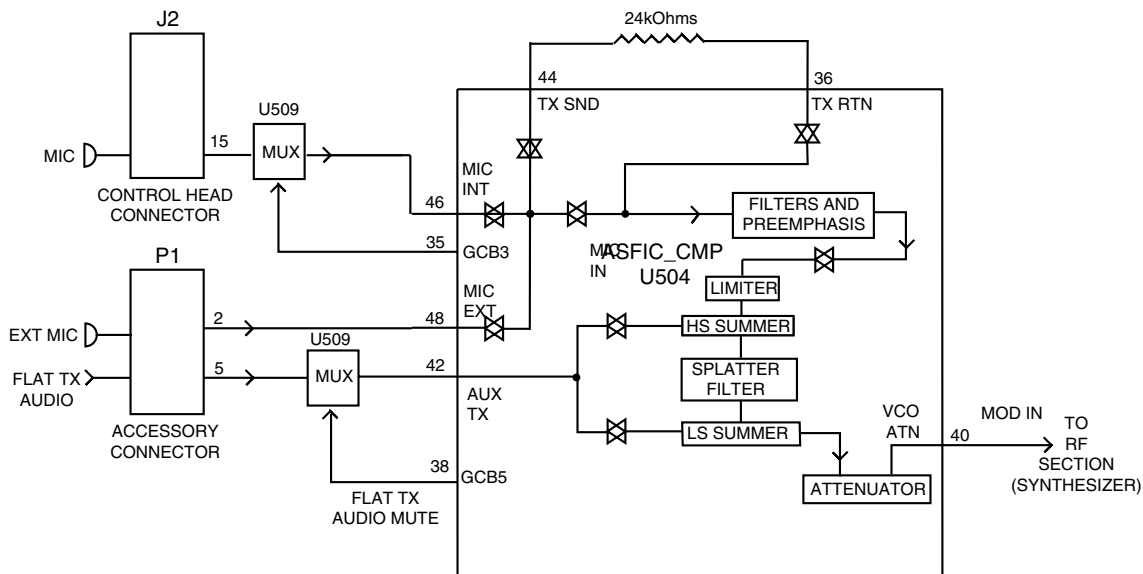


Figure 2-7 Transmit Audio Paths

7.1 Microphone Input Path

The radio supports 2 distinct microphone paths known as internal (from control head J2–15) and external mic (from accessory connector P1–2) and an auxiliary path (FLAT TX AUDIO, from accessory connector P1–5). The microphones used for the radio require a DC biasing voltage provided by a resistive network.

The two microphone audio input paths enter the ASFIC CMP at U504-pin 48 (external mic) and U504-pin 46 (internal mic). The microphone is plugged into the radio control head and connected to the audio DC via J2-pin 15. The signal is then routed via C5045 to MUX U509 that select between two paths with different gain to support Low Cost Mic (Mic with out amplifier in it) and Standard Mic.

7.1.1 Low Cost Microphone

Hook Pin is shorted to Pin 1 (9.3 V) inside the Low Cost Mic, This routes 9.3 V to R429, and creates 2.6 V on MIC_SENSE (u.P U403-67) by Voltage Divider R429/R430. U403 senses this voltage and sends command to ASFIC_CMP U504 to get GCB3 = '0'. The audio signal is routed from C5045 via U509-5 (Z0), R5072, U507, R5026, C5091, R5014 via C5046 to U504- 46 int. mic (C5046 100nF creates a 159 Hz pole with U504- 46 int mic impedance of 16Kohm).

7.1.2 Standard Microphone

Hook Pin is shorted to the hook mic inside the standard Mic, If the mic is out off hook, 3.3 V is routed to R429 via R458, D401, and it create 0.7 V on MIC_SENSE (u.P U403-67) by Voltage Divider R429/R430. U403 senses this voltage and sends command to ASFIC_CMP U504 to get GCB3 = '1'. The audio signal is routed from C5045 via U509-3 (Z1), R5072, U507, R5026, C5091, R5014 via C5046 to U504- 46 int mic (C5046 100nF create a 159 Hz pole with U504- 46 int mic impedance of 16Kohm). 9.3 Vdc is routed via R5077, R5075 to J2-15, It create 4.65 V with Mic Impedance. C5010 supplies AC Ground to create AC impedance of 510 Ohms via R5075. and Filter 9.3 Vdc mic bias supply.

Note: The audio signal at U504-pin 46 should be approximately 12 mV for 1.5 kHz or 3 kHz of deviation with 12.5 kHz or 25 kHz channel spacing.

The external microphone signal enters the radio on accessory connector P1 pin 2 and is routed via line EXT MIC to R5054. R5078 and R5076 provide the 9.3 Vdc bias. Resistive divider R5054/ R5070 divide the input signal by 5.5 and provide input protection for the CMOS amplifier input. R5076 and C5009 provide a 510 ohm AC path to ground that sets the input impedance for the microphone and determines the gain based on the emitter resistor in the microphone's amplifier circuit.

C5047 serves as a DC blocking capacitor. The audio signal at U504-pin 48 should be approximately 14 mV for 1.5 kHz or 3 kHz of deviation with 12.5 kHz or 25 kHz channel spacing.

The FLAT TX AUDIO signal from accessory connector P1-pin 5 is fed to the ASFIC CMP (U504 pin 42 through U509 pin 2 to U509 pin 15 via U506 OP-AMP circuit and C5057.

The ASFIC has an internal AGC that can control the gain in the mic audio path. The AGC can be disabled / enabled by the μ P. Another feature that can be enabled or disabled in the ASFIC is the VOX. This circuit, along with Capacitor C5023 at U504-pin 7, provides a DC voltage that can allow the μ P to detect microphone audio. The ASFIC can also be programmed to route the microphone audio to the speaker for public address operation.

7.2 PTT Sensing and TX Audio Processing

Internal microphone PTT is sensed by μ P U403 pin 71. Radio transmits when this pin is "0" and selects inside the ASFIC_CMP U504 internal Mic path. When the internal Mic PTT is "0" then external Mic PTT is grounded via D402. External Mic PTT is sensed by U403 pin 72 via Q412 circuits. The radio transmits when this pin is "0" and selects inside the ASFIC_CMP U504 External Mic path.

Inside the ASFIC CMP, the mic audio is filtered to eliminate frequency components outside the 300–3000 Hz voice band, and pre-emphasized if pre-emphasis is enabled. The signal is then limited to prevent the transmitter from over deviating. The limited mic audio is then routed through a summer, which is used to add in signaling data, and then to a splatter filter to eliminate high frequency spectral components that could be generated by the limiter. The audio is then routed to an attenuator, which is tuned in the factory or the field to set the proper amount of FM deviation. The TX audio emerges from the ASFIC CMP at U504-pin 40 MOD IN, at which point it is routed to the RF section.

8.0 Transmit Signalling Circuits

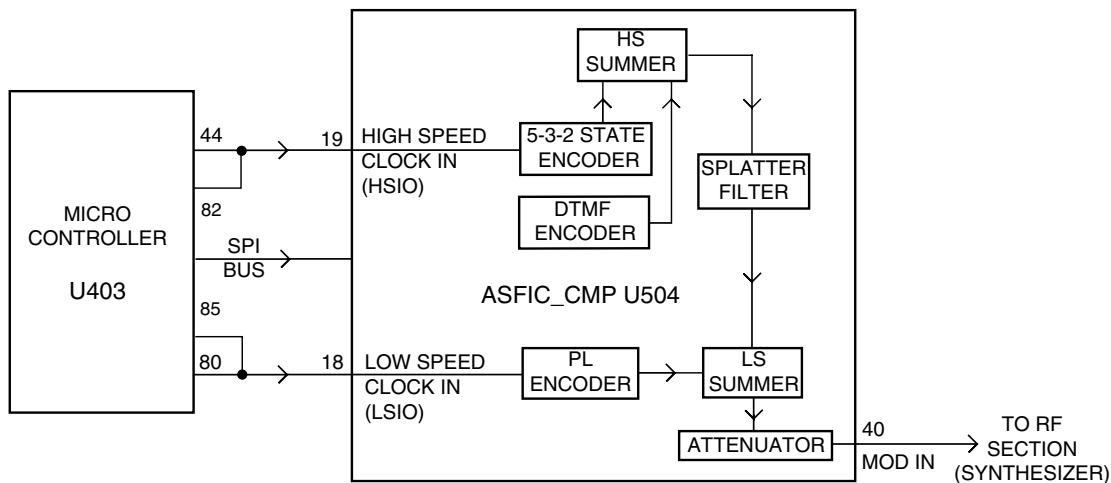


Figure 2-8 Transmit Signalling Path

From a hardware point of view, there are 3 types of signaling:

- Sub-audible data (PL / DPL / Connect Tone) that gets summed with transmit voice or signaling,
- DTMF data for telephone communication in trunked and conventional systems, and
- Audible signaling including MDC and high-speed trunking.

Note: All three types are supported by the hardware while the radio software determines which signaling type is available.

8.1 Sub-Audio Data (PL/DPL)

Sub-audible data implies signaling whose bandwidth is below 300 Hz. PL and DPL waveforms are used for conventional operation and connect tones for trunked voice channel operation. The trunking connect tone is simply a PL tone at a higher deviation level than PL in a conventional system. Although it is referred to as “sub-audible data”, the actual frequency spectrum of these waveforms may be as high as 250 Hz, which is audible to the human ear. However, the radio receiver filters out any audio below 300 Hz, so these tones are never heard in the actual system.

Only one type of sub-audible data can be generated by U504 (ASFIC CMP) at any one time. The process is as follows, using the SPI BUS, the μP programs the ASFIC CMP to set up the proper low-speed data deviation and select the PL or DPL filters. The μP then generates a square wave which strobes the ASFIC PL / DPL encode input LSIO U504-pin 18 at twelve times the desired data rate. For example, for a PL frequency of 103 Hz, the frequency of the square wave would be 1236 Hz.

This drives a tone generator inside U504 which generates a staircase approximation to a PL sine wave or DPL data pattern. This internal waveform is then low-pass filtered and summed with voice or data. The resulting summed waveform then appears on U504-pin 40 (MOD IN), where it is sent to the RF board as previously described for transmit audio. A trunking connect tone would be generated in the same manner as a PL tone.

8.2 High Speed Data

High speed data refers to the 3600 baud data waveforms, known as Inbound Signaling Words (ISWs) used in a trunking system for high speed communication between the central controller and the radio. To generate an ISW, the μ P first programs the ASFIC CMP (U504) to the proper filter and gain settings. It then begins strobing U504-pin 19 (HSIO) with a pulse when the data is supposed to change states. U504's 5-3-2 State Encoder (which is in a 2-state mode) is then fed to the post-limiter summer block and then the splatter filter. From that point it is routed through the modulation attenuator and then out of the ASFIC CMP to the RF board. MDC is generated in much the same way as trunking ISW. However, in some cases these signals may also pass through a data pre-emphasis block in the ASFIC CMP. Also these signaling schemes are based on sending a combination of 1200 Hz and 1800 Hz tones only. Microphone audio is muted during high speed data signaling.

8.3 Dual Tone Multiple Frequency (DTMF) Data

DTMF data is a dual tone waveform used during phone interconnect operation. It is the same type of tones which are heard when using a "Touch Tone" telephone.

There are seven frequencies, with four in the low group (697, 770, 852, 941 Hz) and three in the high group (1209, 1336, 1477 Hz). The high-group tone is generated by the μ P (U403-46) strobing U504-19 at six times the tone frequency for tones less than 1440 Hz or twice the frequency for tones greater than 1440 Hz. The low group tone is generated by the ASFIC CMP, controlled by the μ P via SPI bus. Inside U504 the low-group and high-group tones are summed (with the amplitude of the high group tone being approximately 2 dB greater than that of the low group tone) and then pre-emphasized before being routed to the summer and splatter filter. The DTMF waveform then follows the same path as was described for high-speed data.

9.0 Receive Audio Circuits

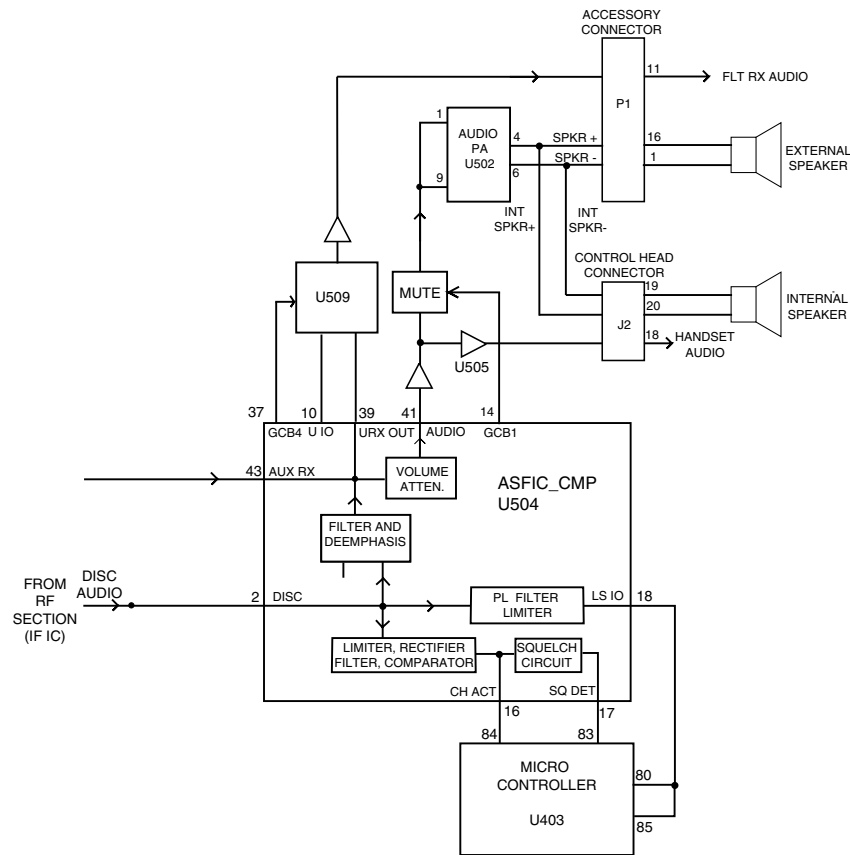


Figure 2-9 Receive Audio Paths

9.1 Squelch Detect

The radio's RF circuits are constantly producing an output at the discriminator (IF IC). This signal (DISC AUDIO) is routed to the ASFIC CMP's squelch detect circuitry input DISC (U504-pin 2). All of the squelch detect circuitry is contained within the ASFIC CMP. Therefore from a user's point of view, DISC AUDIO enters the ASFIC CMP, and the ASFIC CMP produces two CMOS logic outputs based on the result. They are CH ACT (U504-16) and SQ DET (U504-17).

The squelch signal entering the ASFIC CMP is amplified, filtered, attenuated, and rectified. It is then sent to a comparator to produce an active high signal on CH ACT. A squelch tail circuit is used to produce SQ DET (U504-17) from CH ACT. The state of CH ACT and SQ DET is high (logic "1") when carrier is detected, otherwise low (logic "0").

CH ACT is routed to the μ P pin 84 while SQ DET is routed to the μ P pin 83.

SQ DET is used to determine all audio mute / unmute decisions except for Conventional Scan. In this case CH ACT is a pre-indicator as it occurs slightly faster than SQ DET.

9.2 Audio Processing and Digital Volume Control

The receiver audio signal (DISC AUDIO) enters the controller section from the IF IC where it is DC coupled to ASFIC CMP via the DISC input U504-pin 2. The signal is then applied to both the audio and the PL/DPL paths.

The audio path has a programmable amplifier, whose setting is based on the channel bandwidth being received, an LPF filter to remove any frequency components above 3000 Hz, and a HPF to strip off any sub-audible data below 300 Hz. Next, the recovered audio passes through a de-emphasis filter (if it is enabled to compensate for Pre-emphasis which is used to reduce the effects of FM noise). The IC then passes the audio through the 8-bit programmable attenuator whose level is set depending on the value of the volume control. Finally the filtered audio signal passes through an output buffer within the ASFIC CMP. The audio signal exits the ASFIC CMP at AUDIO output (U504 pin 41).

The μ P programs the attenuator, using the SPI BUS, based on the volume setting. The minimum / maximum settings of the attenuator are set by codeplug parameters.

Since sub-audible signaling is summed with voice information on transmit, it must be separated from the voice information before processing. Any sub-audible signaling enters the ASFIC CMP from the IF IC at DISC U504-2. Once inside, it goes through the PL/DPL path. The signal first passes through one of the two low-pass filters, either the PL low-pass filter or the DPL/LST low-pass filter. Either signal is then filtered and goes through a limiter and exits the ASFIC CMP at LSIO (U504-pin 18). At this point, the signal will appear as a square wave version of the sub-audible signal which the radio received. The μ P U403 pin 80 will decode the signal directly to determine if it is the tone / code which is currently active on that mode.

9.3 Audio Amplification Speaker (+) Speaker (-)

The output of the ASFIC CMP's digital volume pot, U504-pin 41 is routed through DC blocking capacitor C5049 to the audio PA (U502 pin 1 and 9).

The audio power amplifier has one inverted and one non-inverted output that produces the differential audio output SPK+/SPK- (U502 pins 4 and 6)

The audio PA is enabled via the ASFIC CMP (U504-GCB1). When the base of Q501 is low, the transistor is off and U502-pin 8 is high, using pull up resistor R5041, and the audio PA is ON. The voltage at U502-pin 8 must be above 8.5 Vdc to properly enable the device.

If the voltage is between 3.3 and 6.4 V, the device will be active but has its input (U502-pins 1/9) off. This is a mute condition which is used to prevent an audio pop when the PA is enabled.

The SPK+ and SPK- outputs of the audio PA have a DC bias which varies proportionately with B+ (U502- pin 7). B+ of 11 V yields a DC offset of 5 V, and B+ of 17 V yields a DC offset of 8.5 V. If either of these lines is shorted to ground, it is possible that the audio PA will be damaged. SPK+ and SPK- are routed to the accessory connector (P1-pin 1 and 16) and to the control head (connector J2-pins 19 and 20).

9.4 Handset Audio

Certain handheld accessories have a speaker within them which require a different voltage level than that provided by U502. For these devices HANDSET AUDIO is available at control head connector J2 pin18.

The received audio from the output of the ASFIC CMP's digital volume attenuator is routed to U505 pin 2 where it is amplified. This signal is routed from the output of the op-amp U505 to J2-pin 18. From the control head, the signal is sent directly to the microphone jack.

9.5 Filtered Audio and Flat Audio

The ASFIC CMP output audio at U504-pin 39 is filtered and de-emphasized, but has not gone through the digital volume attenuator. From ASFIC CMP U504-pin 39 the signal is routed via R5034 through gate U509-pin 12 and AC coupled to U505-pin 6. The gate controlled by ASFIC CMP port GCB4 selects between the filtered audio signal from the ASFIC CMP pin 39 (URXOUT) or the unfiltered (flat) audio signal from the ASFIC CMP pin 10 (UIO). Resistors R5034 and R5021 determine the gain of op-amp U505-pin 6 for the filtered audio while R5032 and R5021 determine the gain for the flat Audio. The output of U505-pin 7 is then routed to P1 pin 11 via DC blocking capacitor C5003. Note that any volume adjustment of the signal on this path must be done by the accessory.

10.0 Receive Signalling Circuits

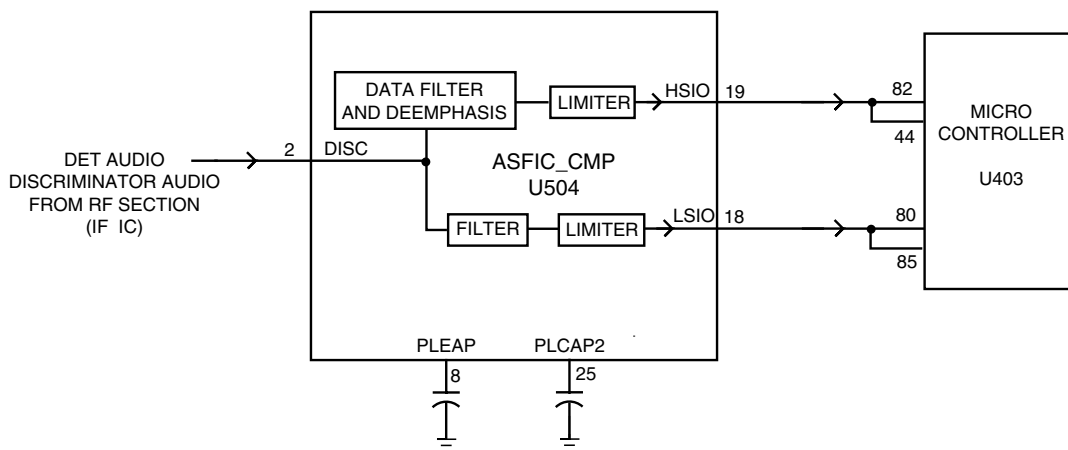


Figure 2-10 Receive Signalling Paths

10.1 Sub-Audio Data (PL/DPL) and High Speed Data Decoder

The ASFIC CMP (U504) is used to filter and limit all received data. The data enters the ASFIC CMP at input DISC (U504 pin 2). Inside U504 the data is filtered according to data type (HS or LS), then it is limited to a 0–3.3 V digital level. The MDC and trunking high speed data appear at U504-pin 19, where it connects to the μ P U403 pin 82.

The low speed limited data output (PL, DPL, and trunking LS) appears at U504-pin18, where it connects to the μ P U403-pin 80.

The low speed data is read by the μ P at twice the frequency of the sampling waveform; a latch configuration in the ASFIC CMP stores one bit every clock cycle. The external capacitors C5028, and C5026 set the low frequency pole for a zero crossings detector in the limiters for PL and HS data. The hysteresis of these limiters is programmed based on the type of received data.

10.2 Alert Tone Circuits

When the software determines that it needs to give the operator an audible feedback (for a good key press, or for a bad key press), or radio status (trunked system busy, phone call, circuit failures), it sends an alert tone to the speaker. It does so by sending SPI BUS data to U504 which sets up the audio path to the speaker for alert tones. The alert tone itself can be generated in one of two ways: internally by the ASFIC CMP, or externally using the μ P and the ASFIC CMP.

The allowable internal alert tones are 304, 608, 911, and 1823 Hz. In this case a code contained within the SPI BUS load to the ASFIC CMP sets up the path and determines the tone frequency, and at what volume level to generate the tone. (It does not have to be related to the voice volume setting.)

For external alert tones, the μ P can generate any tone within the 100–3000 Hz audio band. This is accomplished by the μ P generating a square wave which enters the ASFIC CMP at U504 pin 19. Inside the ASFIC CMP this signal is routed to the alert tone generator.

The output of the generator is summed into the audio chain just after the RX audio de-emphasis block. Inside U504, the tone is amplified and filtered, then passed through the 8-bit digital volume attenuator, which is typically loaded with a special value for alert tone audio. The tone exits at U504-pin 41 and is routed to the audio PA like receive audio.

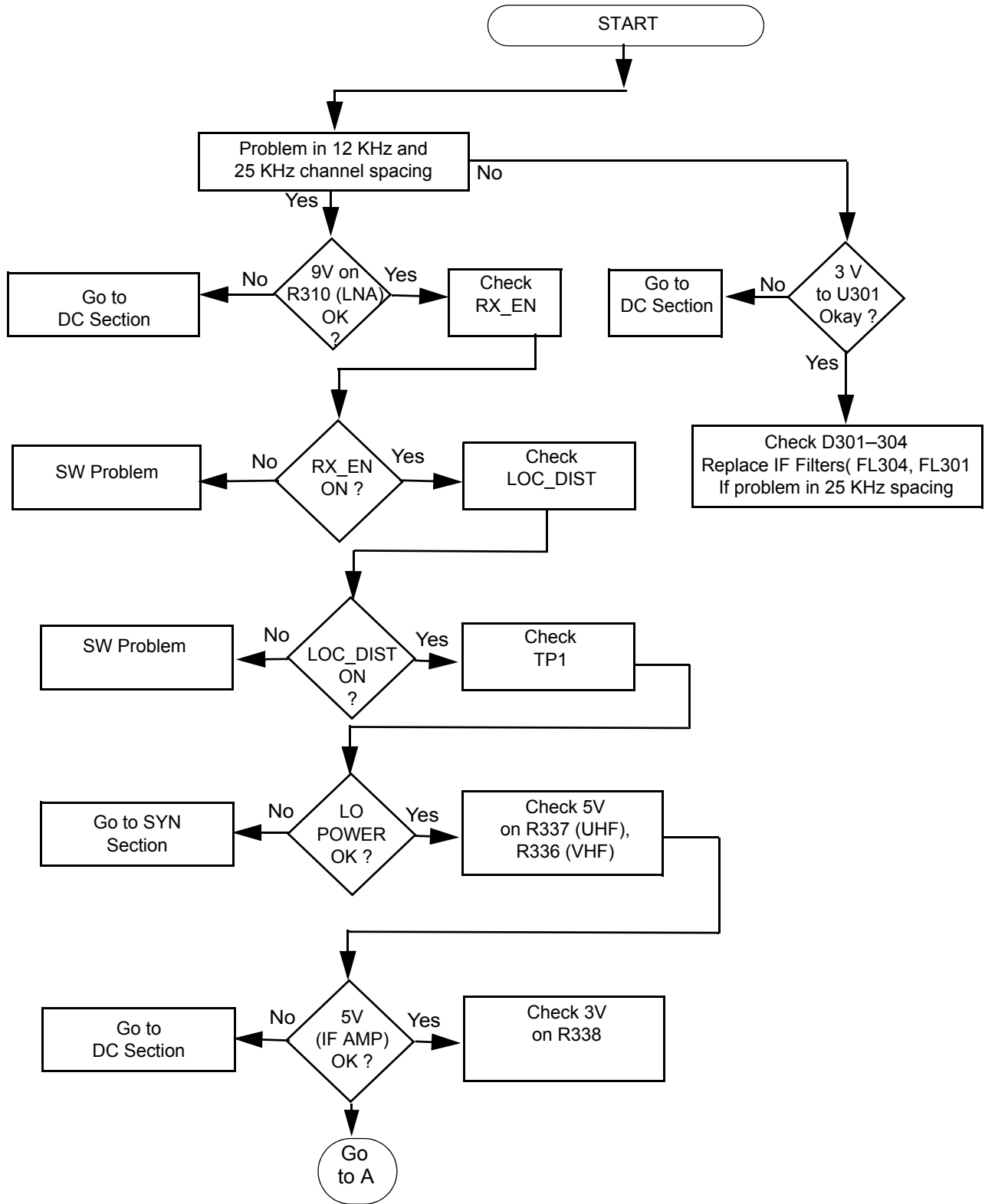
Chapter 3

TROUBLESHOOTING CHARTS

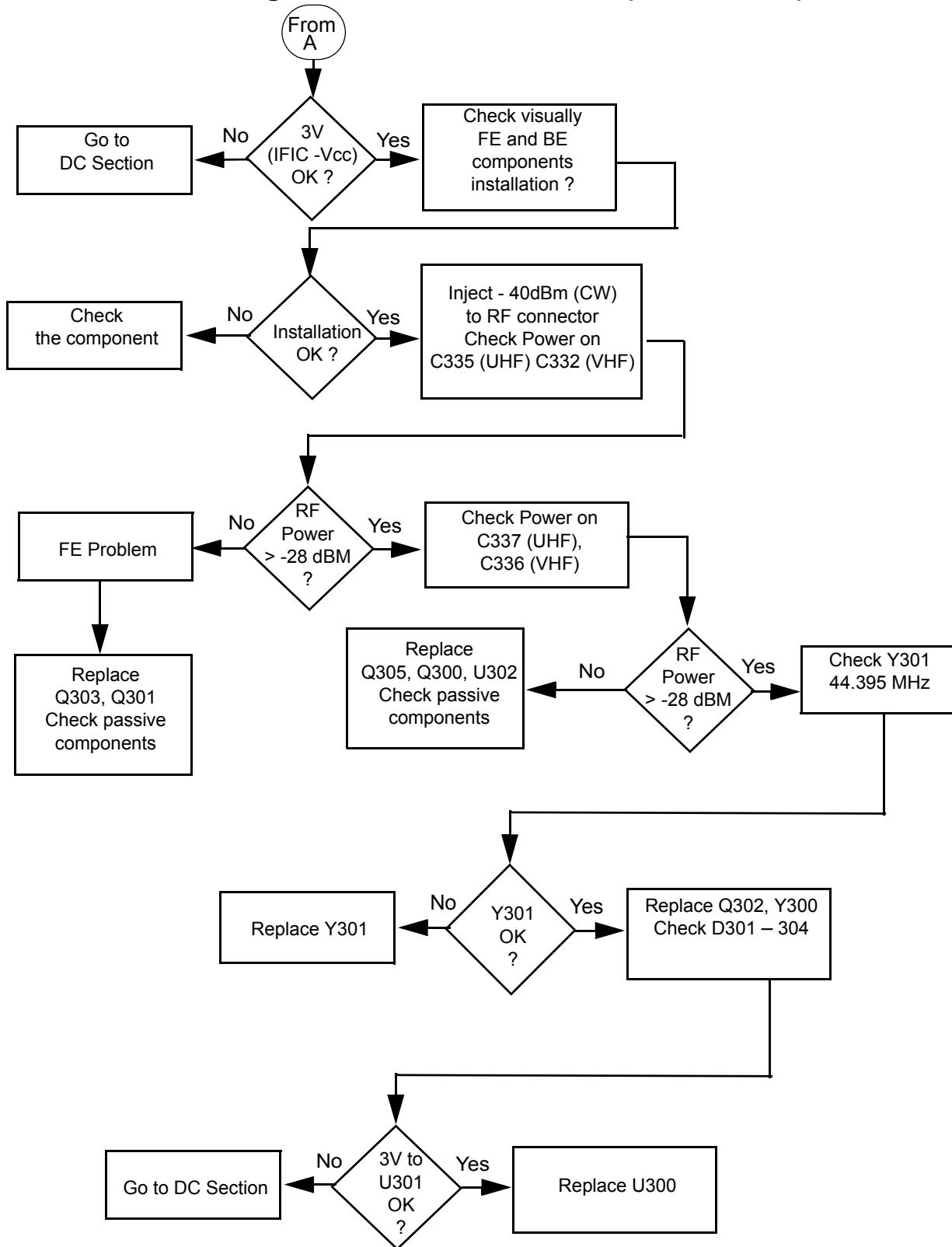
This section contains detailed troubleshooting flowcharts. These charts should be used as a guide in determining the problem areas. They are not a substitute for knowledge of circuit operation and astute troubleshooting techniques. It is advisable to refer to the related detailed circuit descriptions in the theory of operation sections prior to troubleshooting a radio.

Most troubleshooting charts end up by pointing to an IC to replace. It is not always noted, but it is good practice to verify supplies and grounds to the affected IC and to trace continuity to the malfunctioning signal and related circuitry before replacing any IC. For instance, if a clock signal is not available at a destination, continuity from the source IC should be checked before replacing the source IC.

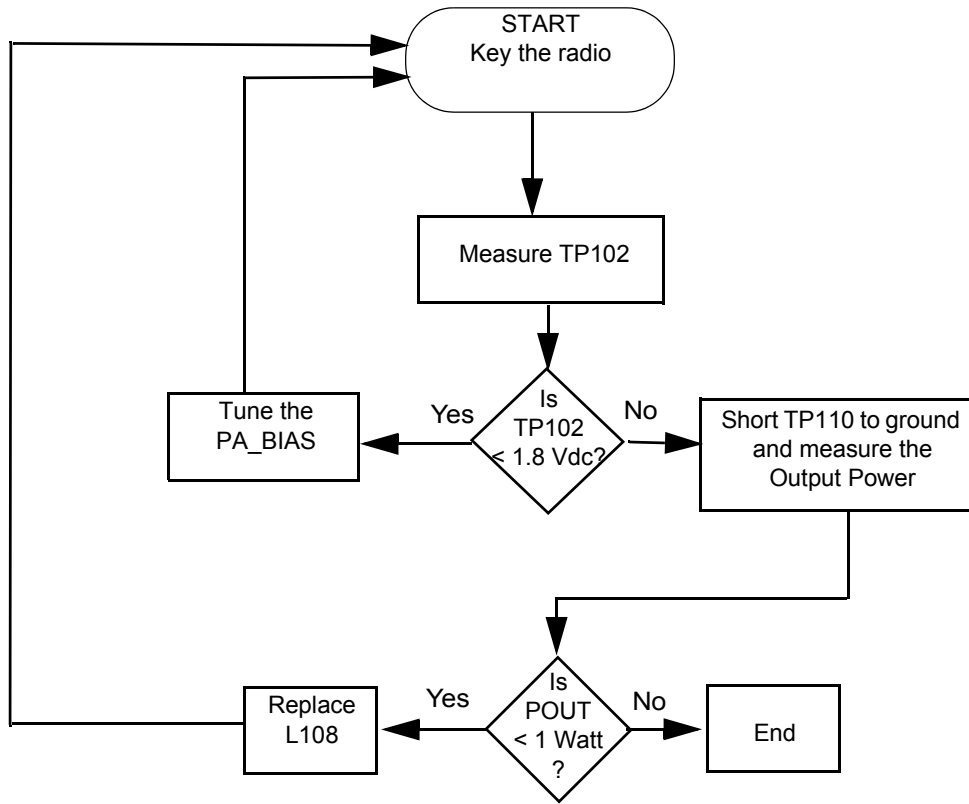
1.0 Troubleshooting Flow Chart for Receiver RF (Sheet 1 of 2)



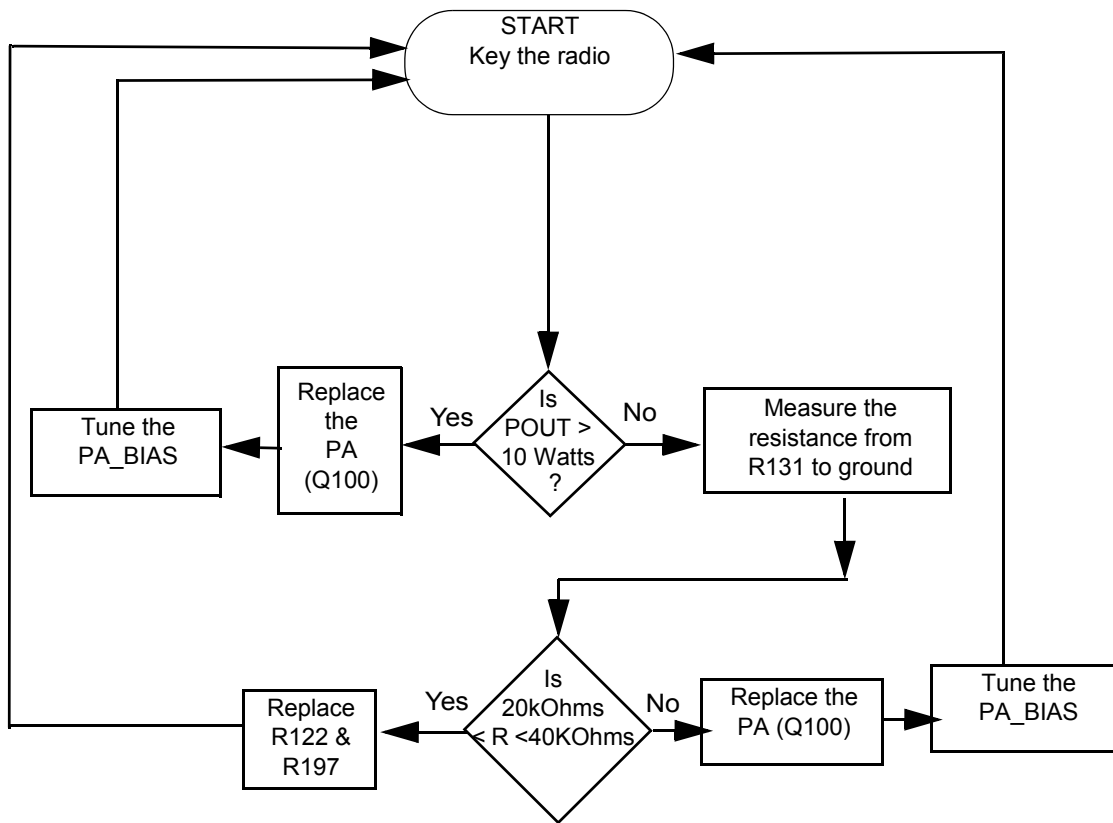
1.1 Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



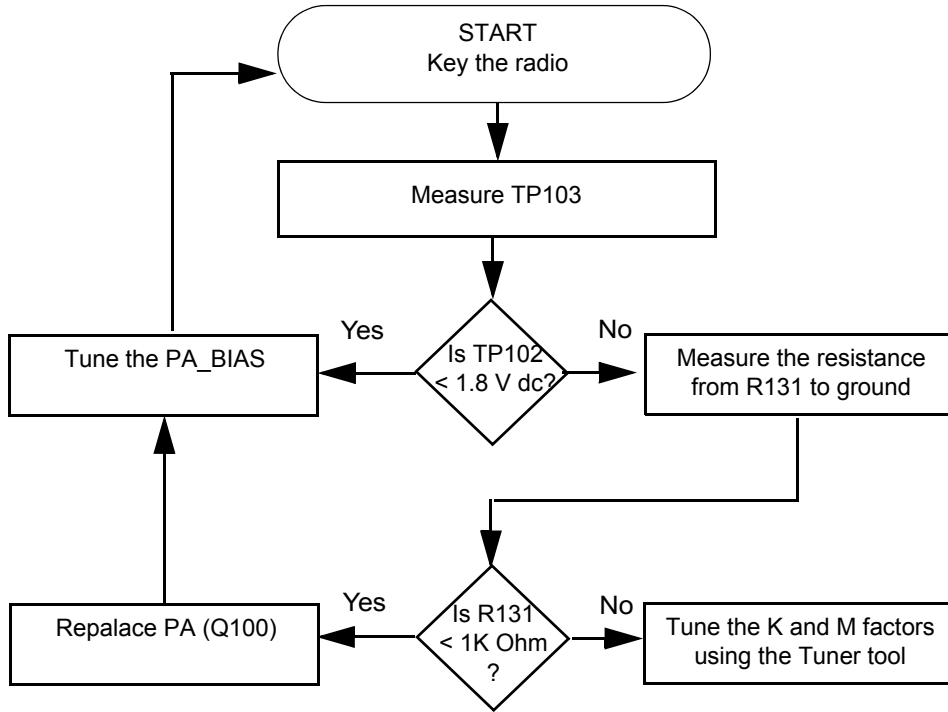
2.0 Troubleshooting Flow TX RF (No Output Power)



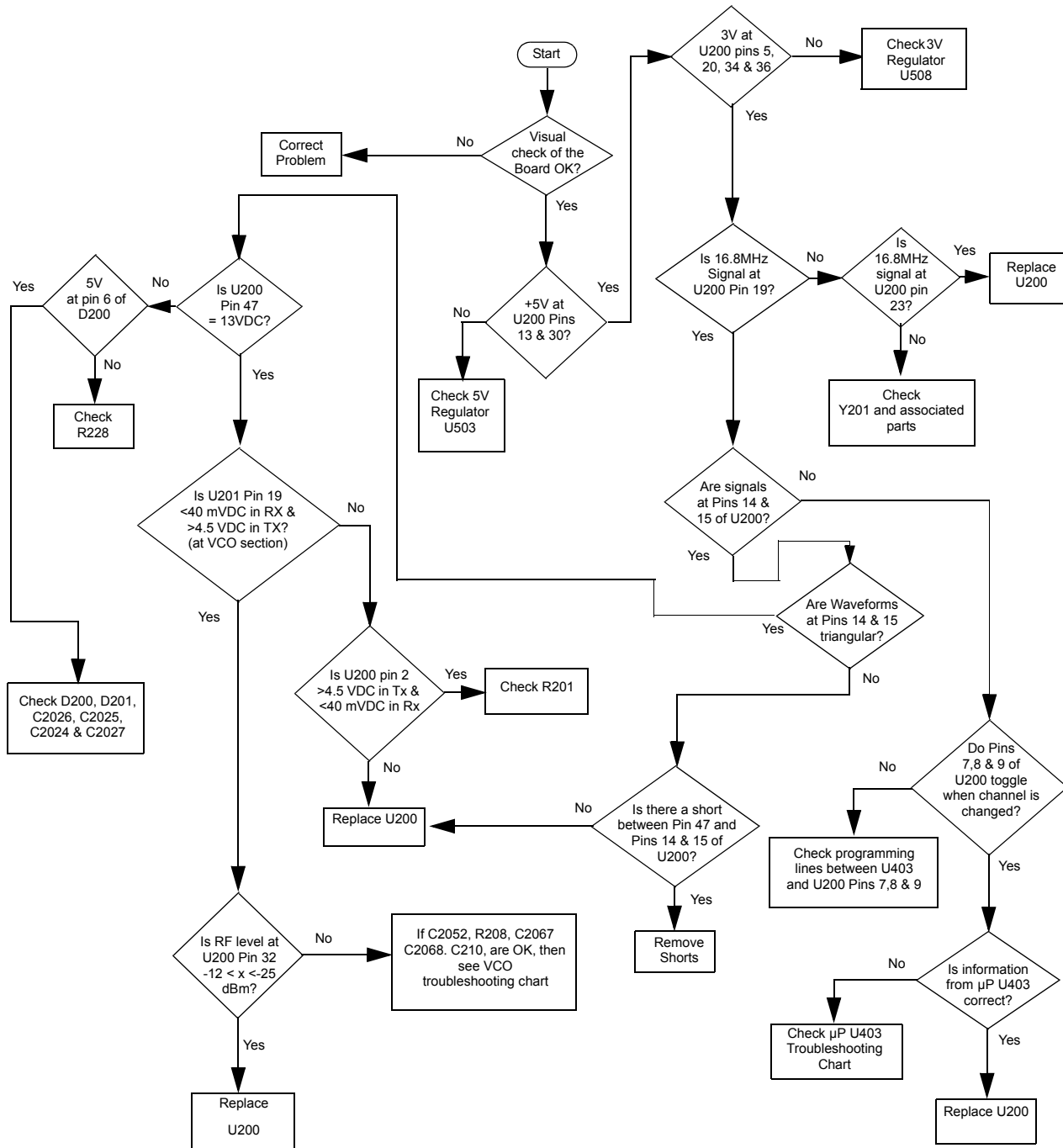
2.1 Troubleshooting Flow TX RF (No Output Power/No Current)



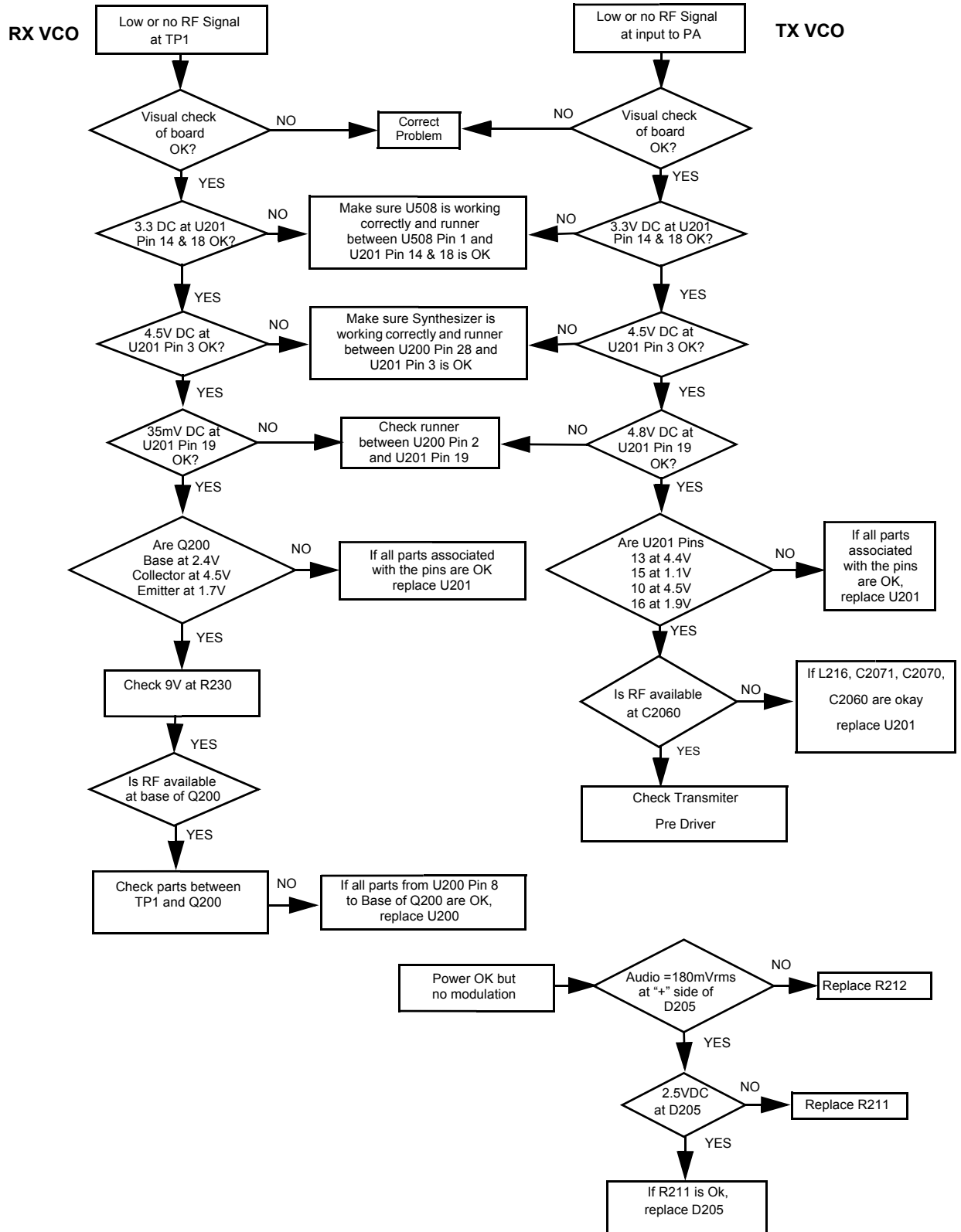
2.2 Troubleshooting Flow TX RF (Not Txing at Nominal power)



3.0 Troubleshooting Flow Chart for Synthesizer

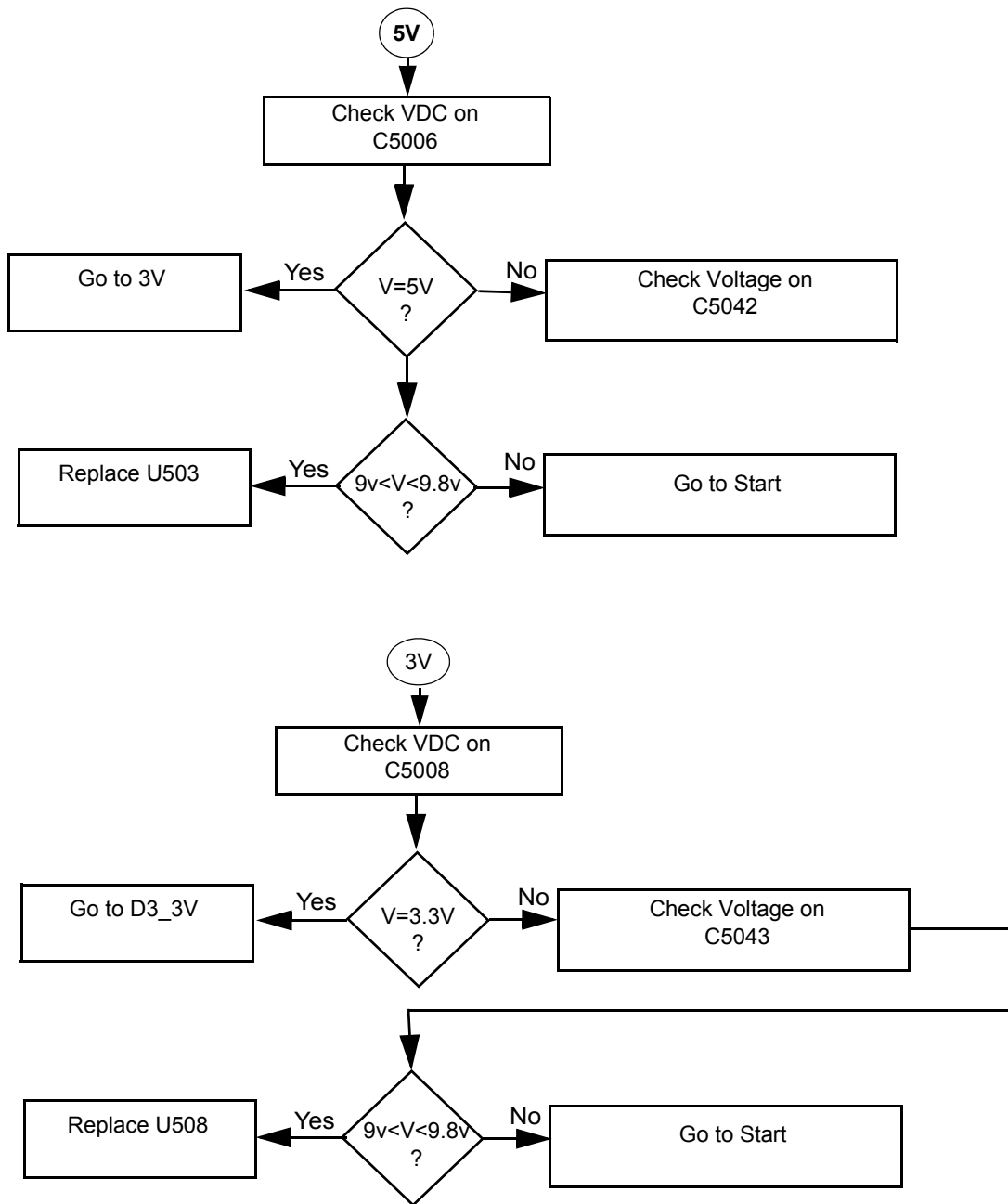


4.0 Troubleshooting Flow Chart for VCO

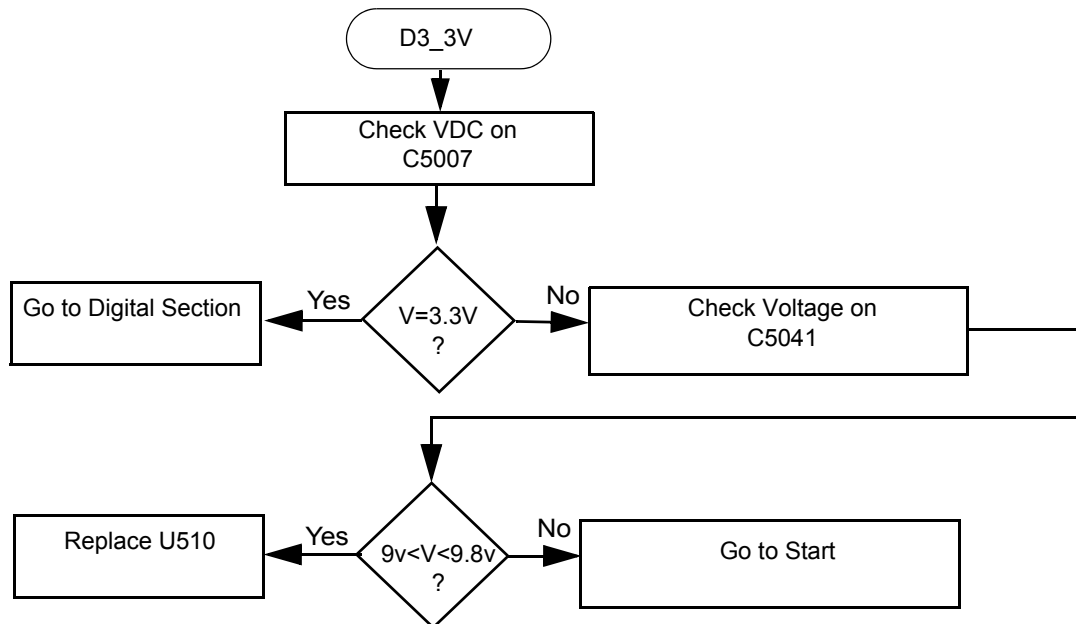


5.0 Troubleshooting Flow Chart for DC Supply (1 of 2)

Since the failure of a critical voltage supply might cause the radio to automatically power down, supply voltages should first be probed with a multimeter. If all the board voltages are absent, then the voltage test point should be retested using a rising-edge-triggered oscilloscope. If the voltage is still absent, then another voltage should be tested using the oscilloscope. If that voltage is present, then the original voltage supply in question is defective and requires investigation of associated circuitry.



5.1 Troubleshooting Flow Chart for DC Supply (2 of 2)



VHF2 PCB / SCHEMATICS / PARTS LISTS

1.0 Allocation of Schematics and Circuit Boards

1.1 VHF2 and Controller Circuits

The VHF circuits are contained on the printed circuit board (PCB) which also contains the Controller circuits. This Chapter shows the schematics for both the VHF circuits and the Controller circuits. The PCB component layouts and the Parts Lists in this Chapter show both the Controller and VHF circuit components. The VHF and Controller schematics and the related PCB and parts list are shown in the tables below.

Table 4-1 VHF2 25–45 W Diagrams and Parts Lists

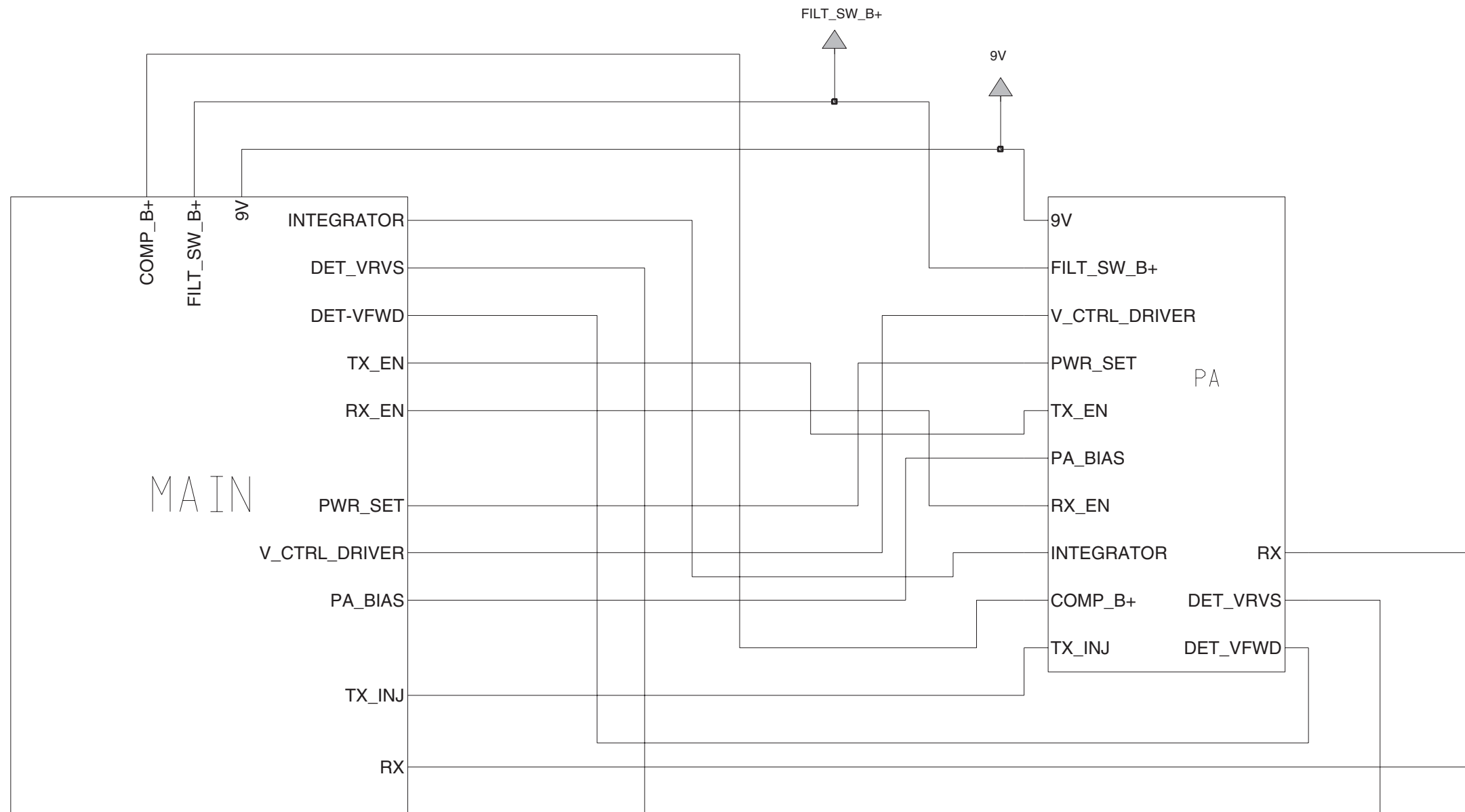
PCB : 8486487Z03-B Main Board Top Side 8486487Z03-B Main Board Bottom Side	Page 4-4 Page 4-5
SCHEMATICS Main Circuit Transmitter Synthesiser and VCO Receiver Front and Back End DC and Audio Ccts Microprocessor and Controller Ccts Power Control Cct	Page 4-6/Page 4-7 Page 4-8/Page 4-9 Page 4-10/Page 4-11 Page 4-12/Page 4-13 Page 4-14/Page 4-15 Page 4-16/Page 4-17 Page 4-18
Parts List 8486487Z03-B	Page 4-19
Controller version is T1	

Table 4-2 VHF2 25–45 W Diagrams and Parts Lists

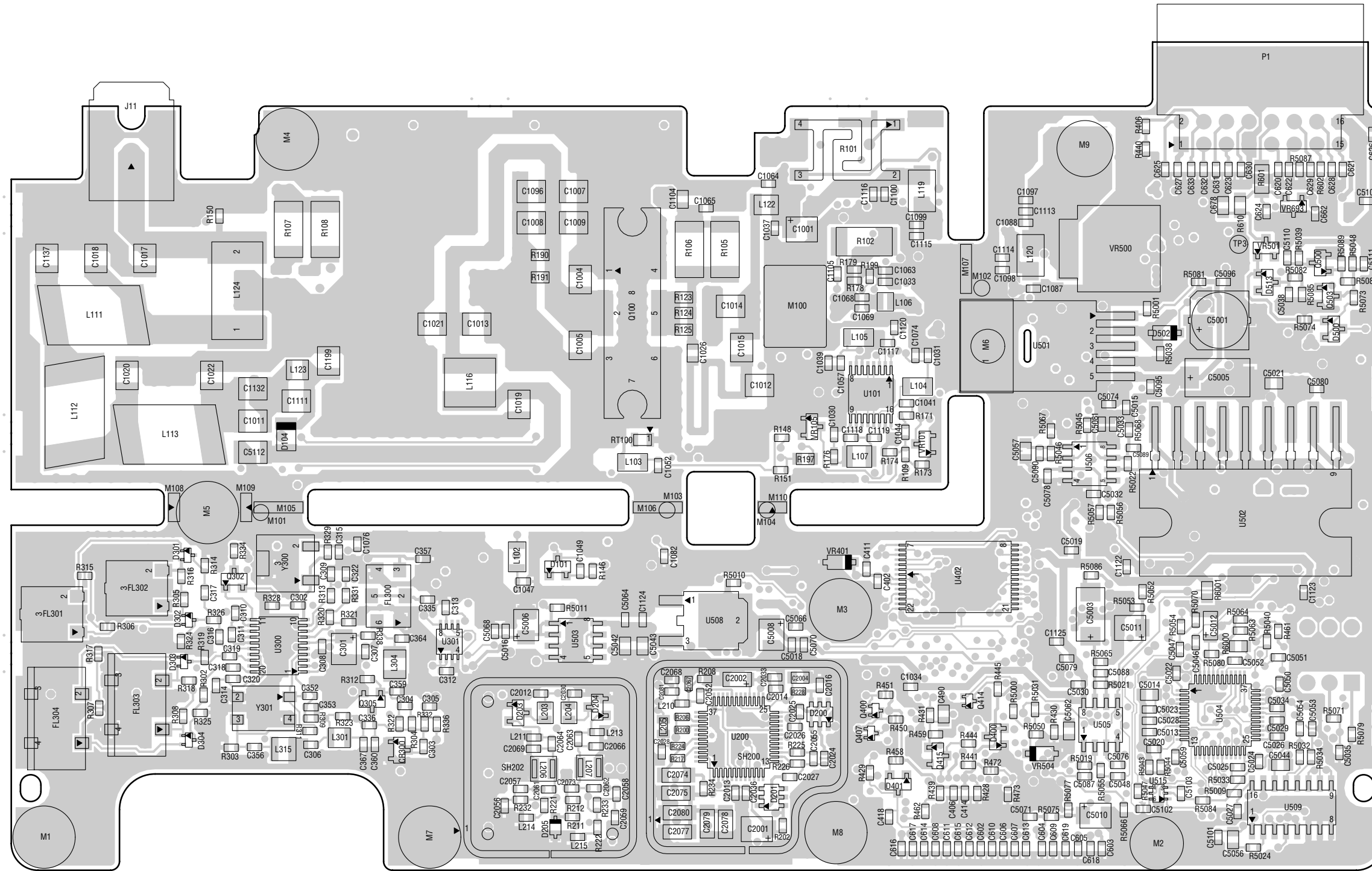
PCB : 8486487Z04 Main Board Top Side 8486487Z04 Main Board Bottom Side	Page 4-29 Page 4-30
SCHEMATICS Main Circuit Transmitter Synthesiser and VCO Receiver Front and Back End DC and Audio Ccts Microprocessor and Controller Ccts Power Control Cct	Page 4-31/Page 4-32 Page 4-33/Page 4-34 Page 4-35/Page 4-36 Page 4-37/Page 4-38 Page 4-39/Page 4-40 Page 4-41/Page 4-42 Page 4-43
Parts List 8486487Z4	Page 4-44
Controller version is T1	

Notes

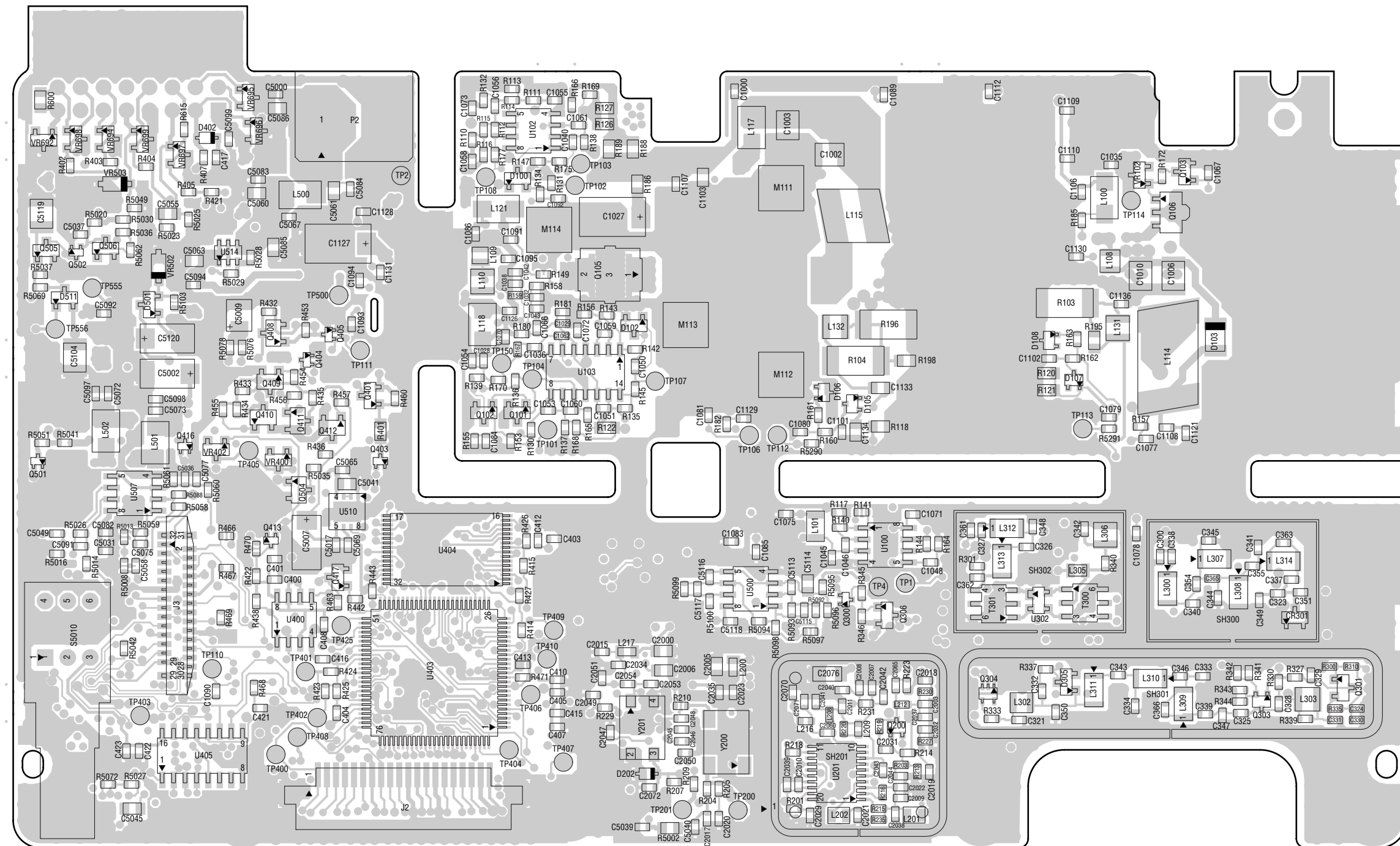
2.0 VHF 25–45 W Band 2 PCB 8486487Z03-B / Schematics



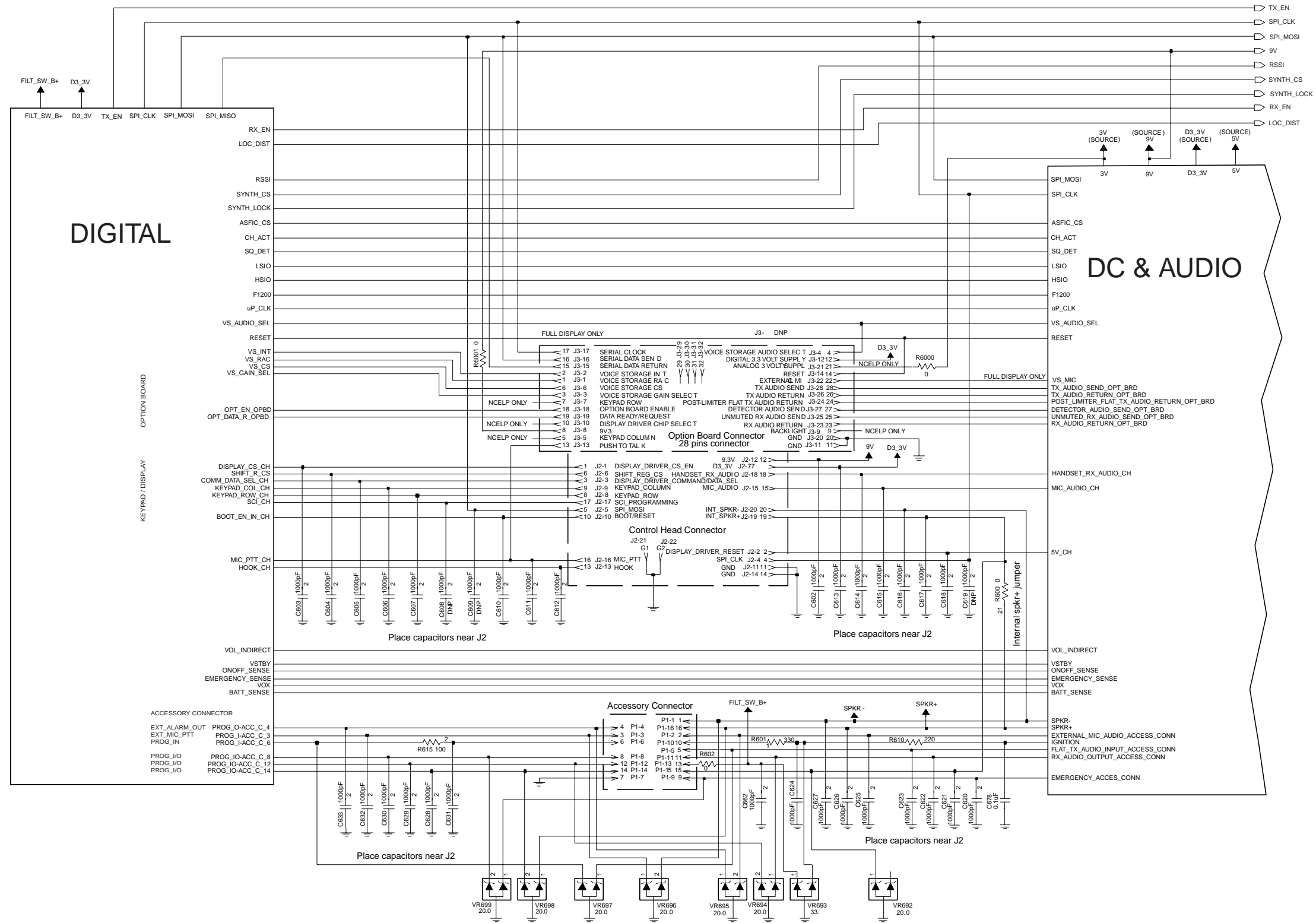
VHF 2 (146–174 MHz) 25–45 W Interconnection between Main Board and Power Amplifier Compartment



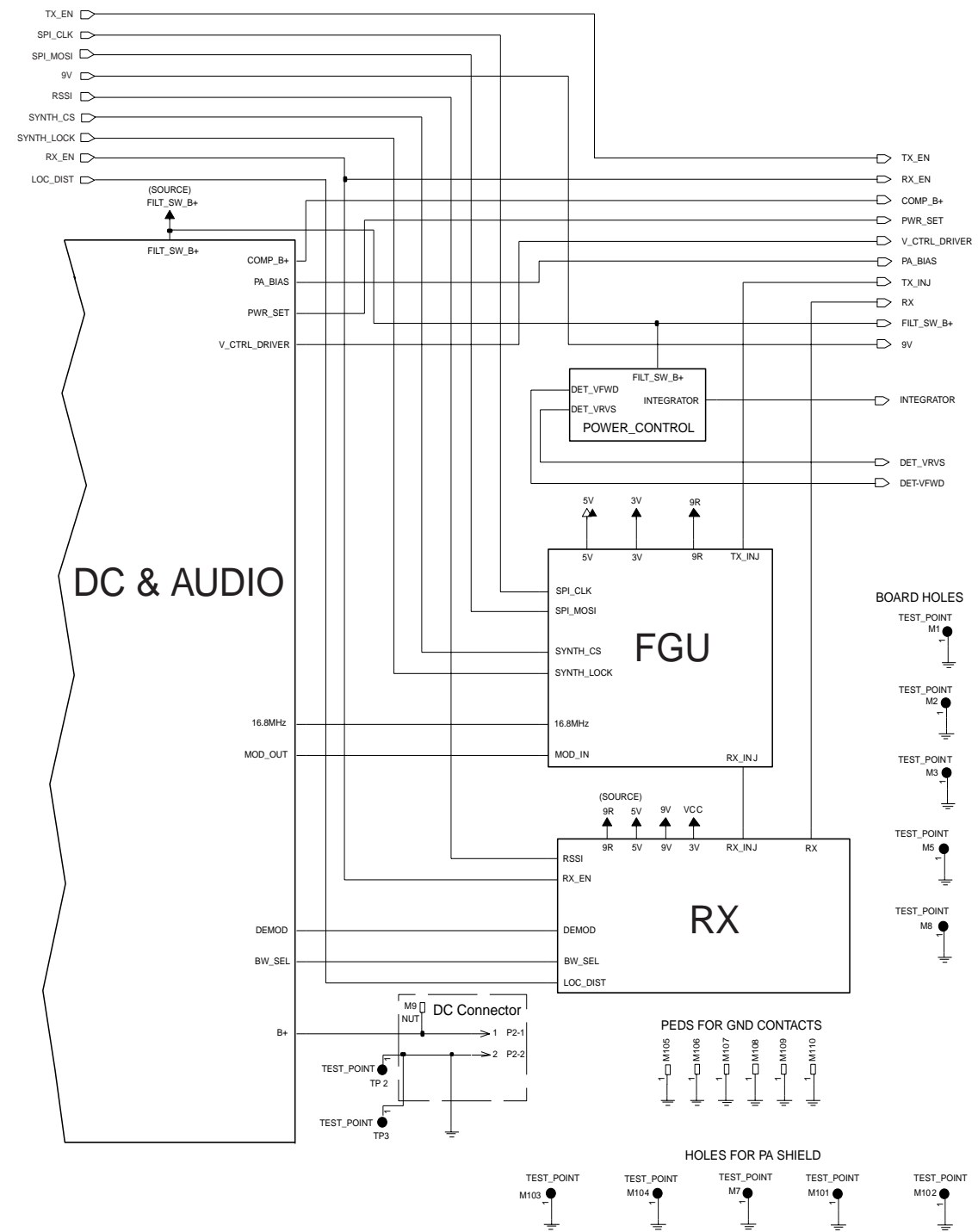
VHF 2 (146-174 MHz) 25-45 W 8486487Z03-B, Top Side View



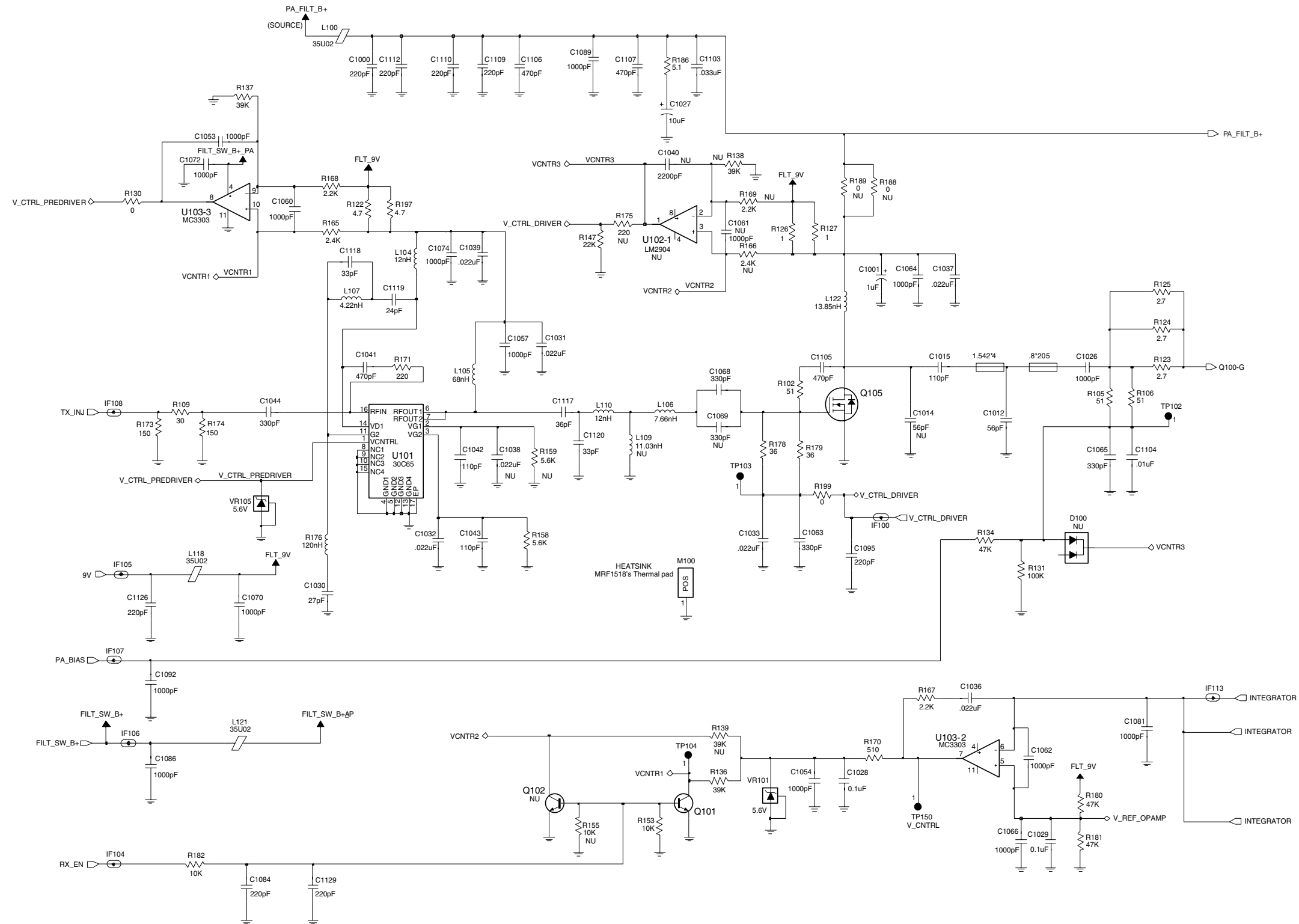
VHF 2 (146-174 MHz) 25-45 W 8486487Z03-B, Bottom Side View



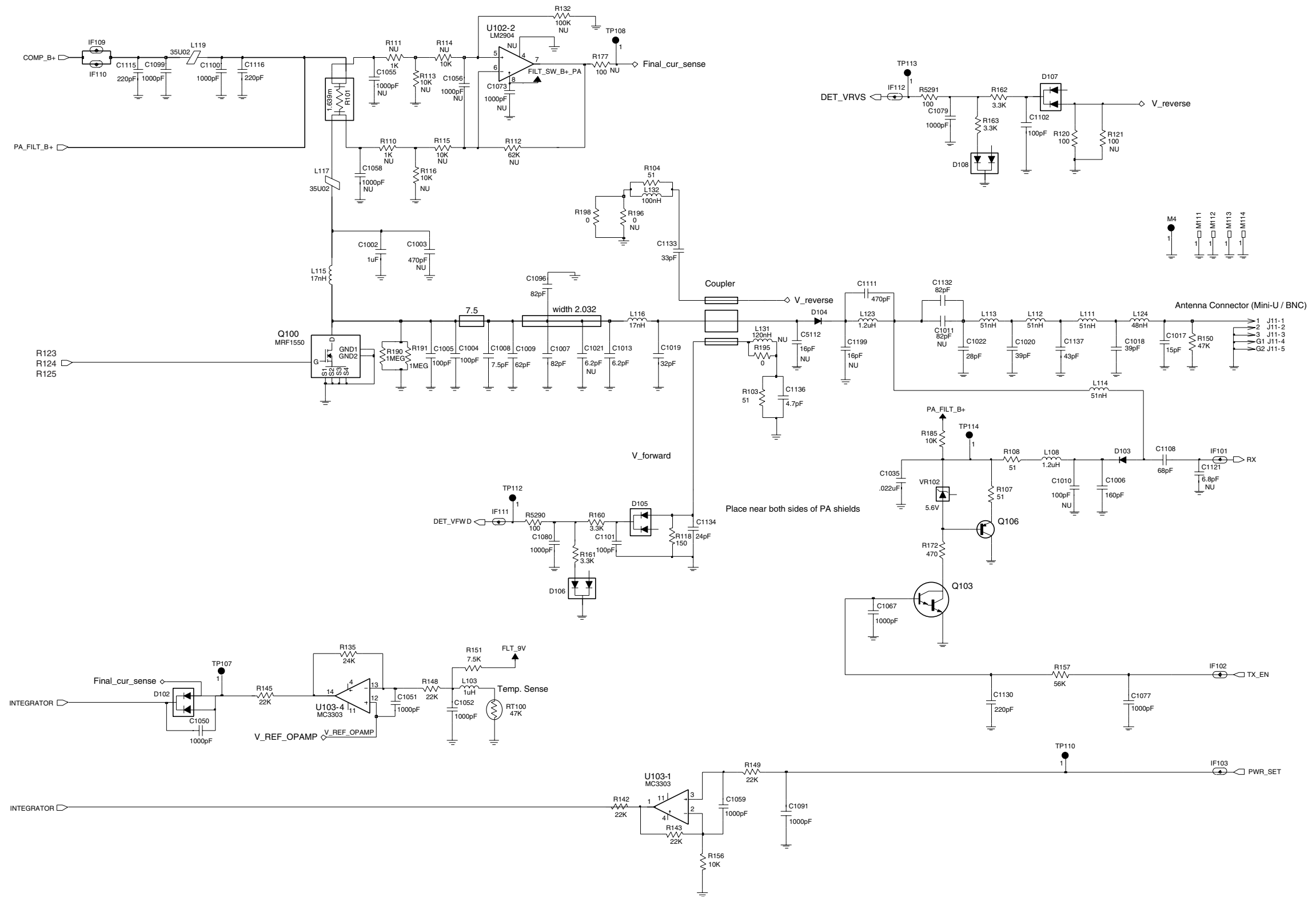
VHF 2 (146-174 MHz) 25-45 W Main Circuit (Sht 1 of 2)



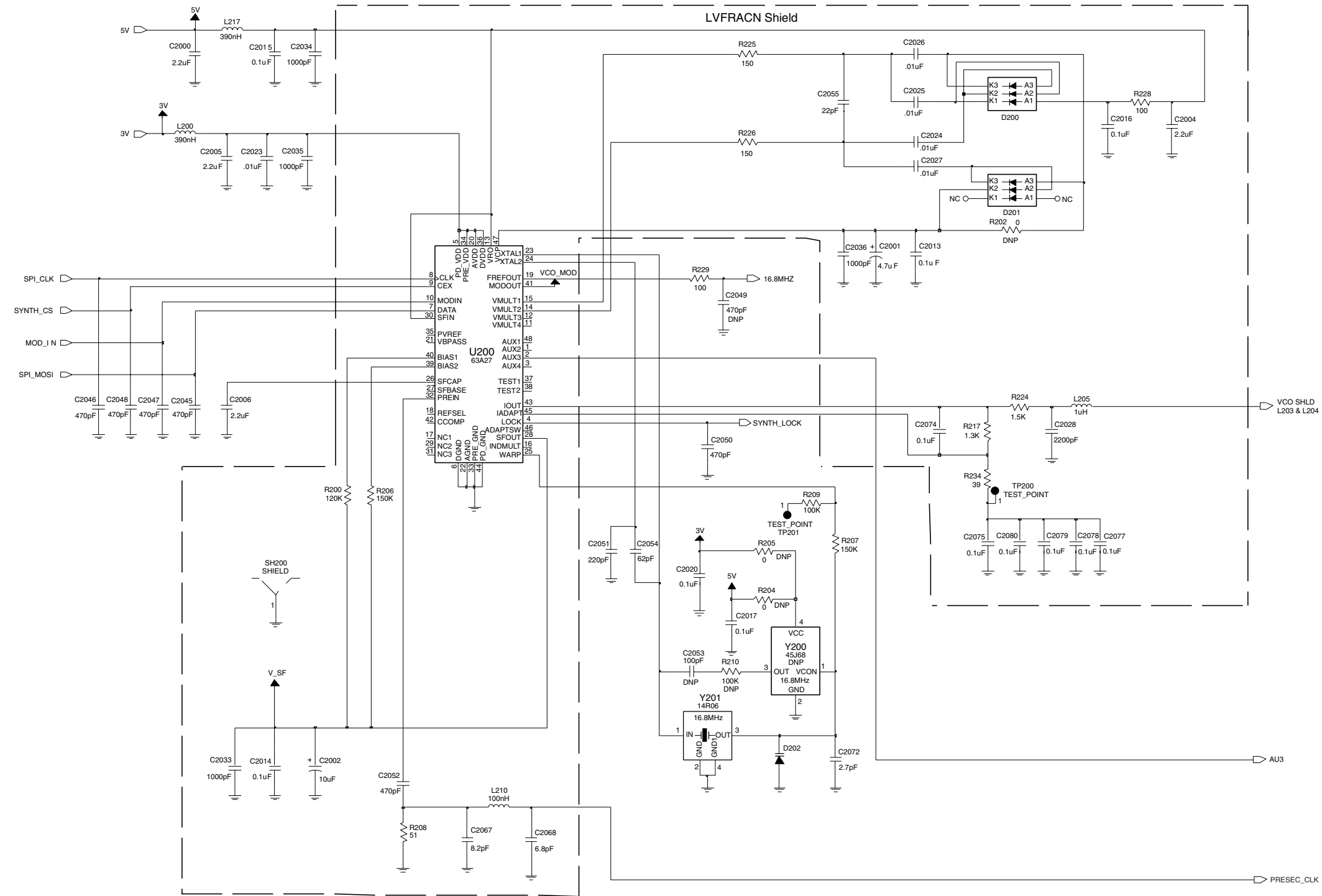
VHF 2 (146-174 MHz) 25-45 W Main Circuit (Sht 2 of 2)



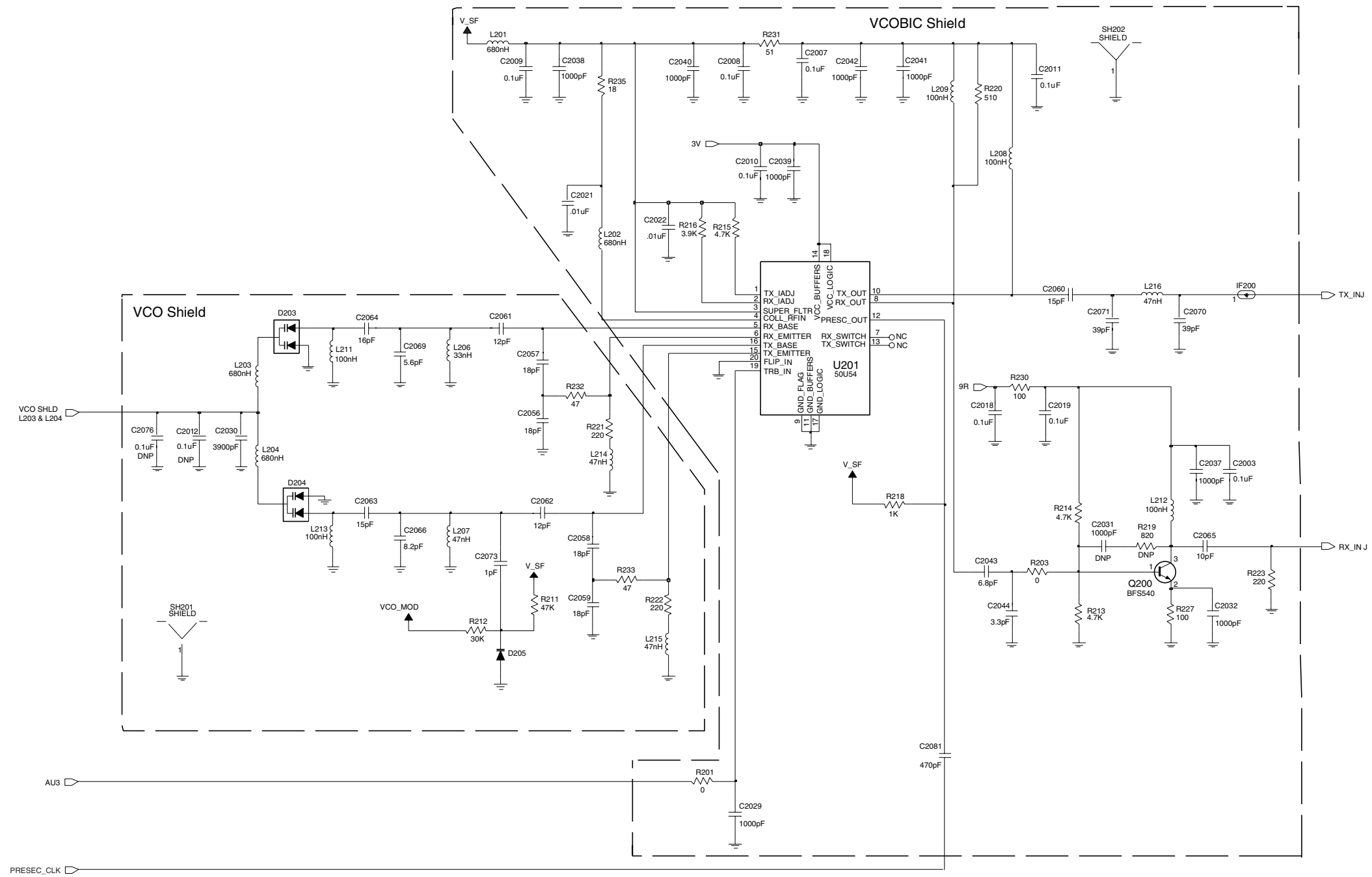
VHF 2 (146-174 MHz) 25-45 W Transmitter (Sht 1 of 2)

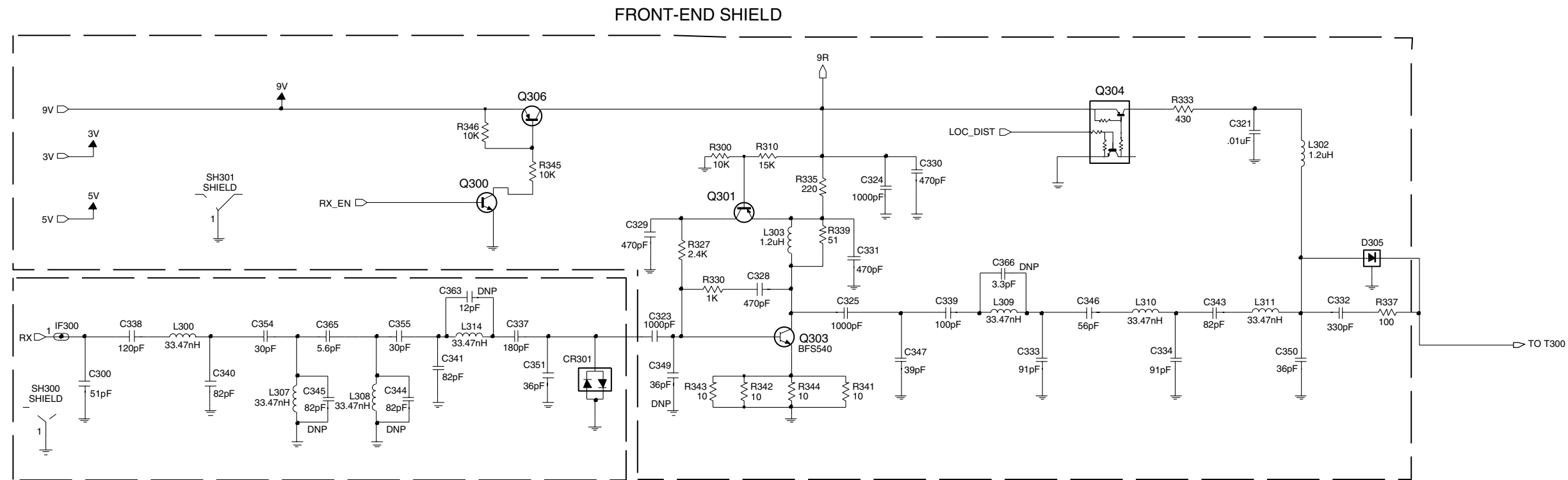


VHF 2 (146-174 MHz) 25-45 W Transmitter (Sht 2 of 2)

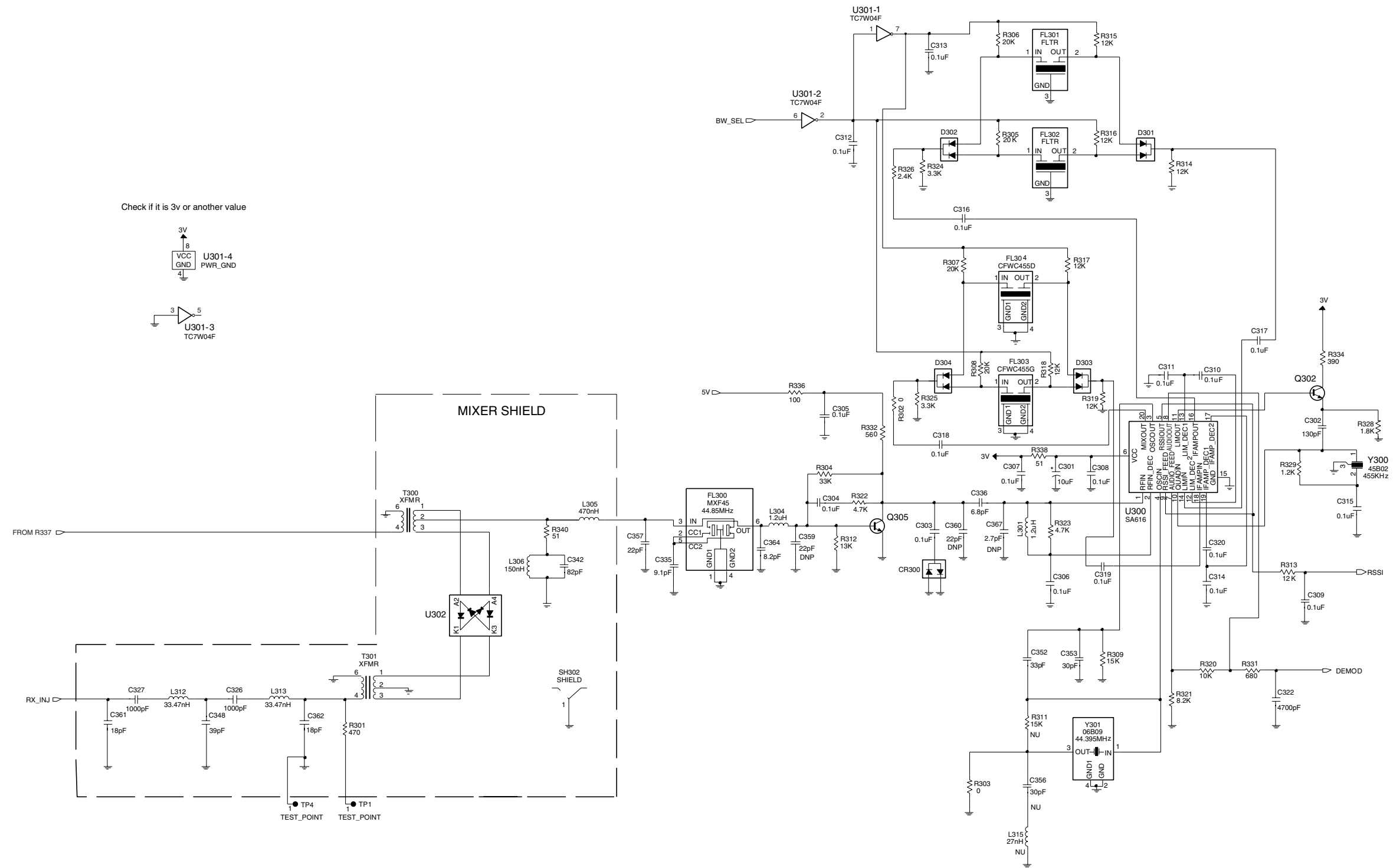


VHF 2 (146-174 MHz) 25-45 W Synthesiser and VCO (Sht 1 of 2)

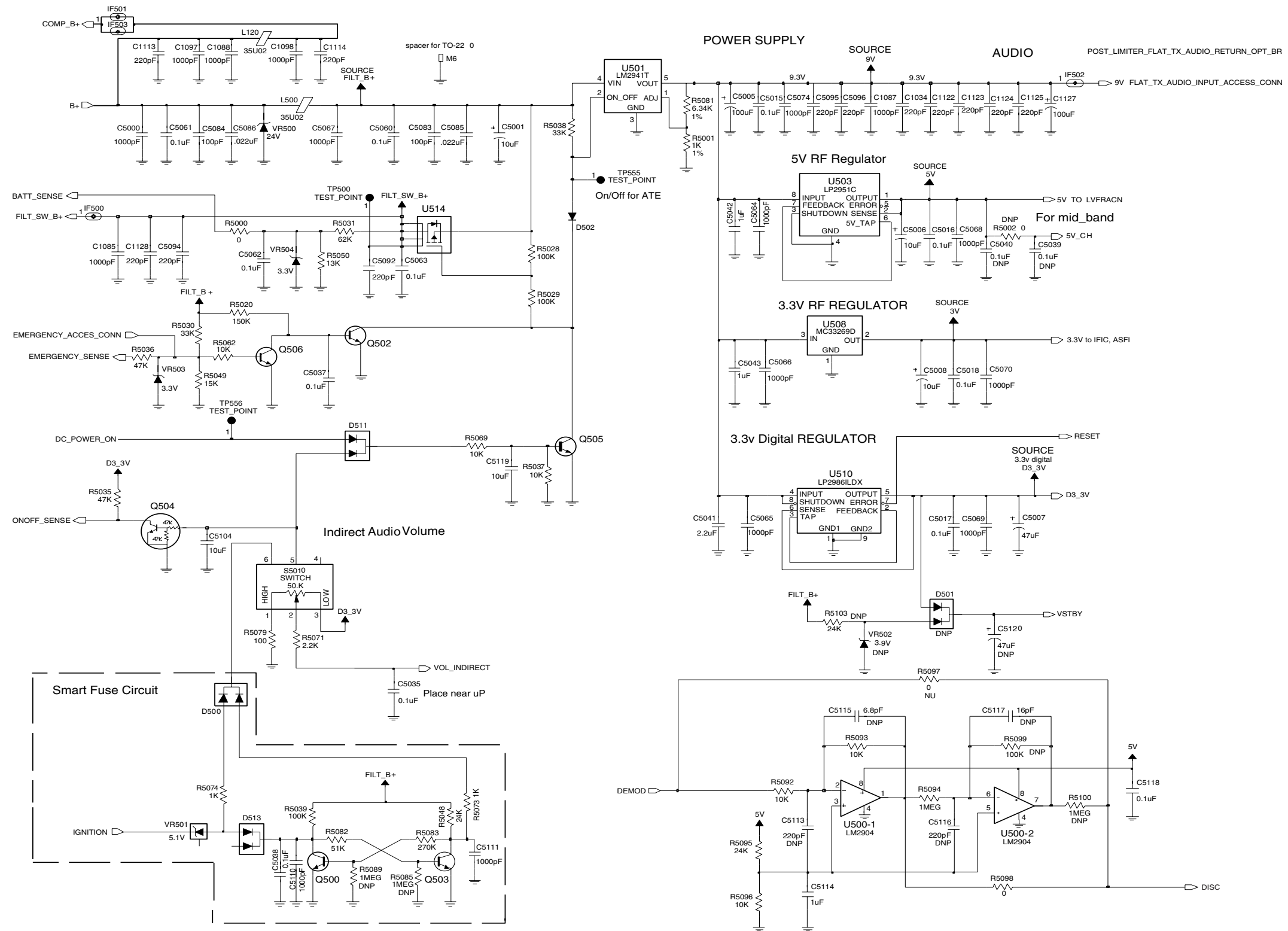




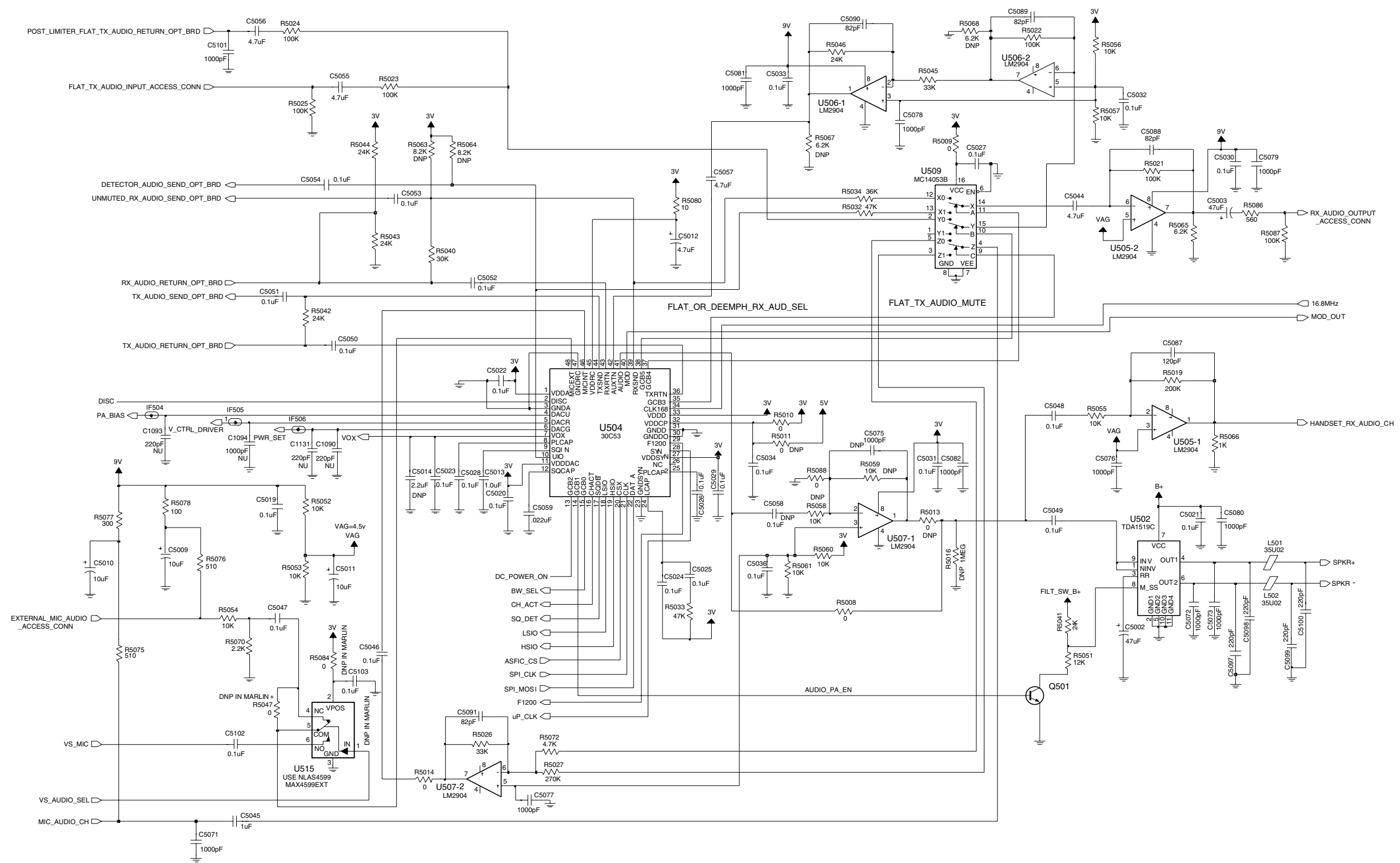
VHF 2 (146-174 MHz) 25-45 W Receiver Front and Back End (Sht 1 of 2)



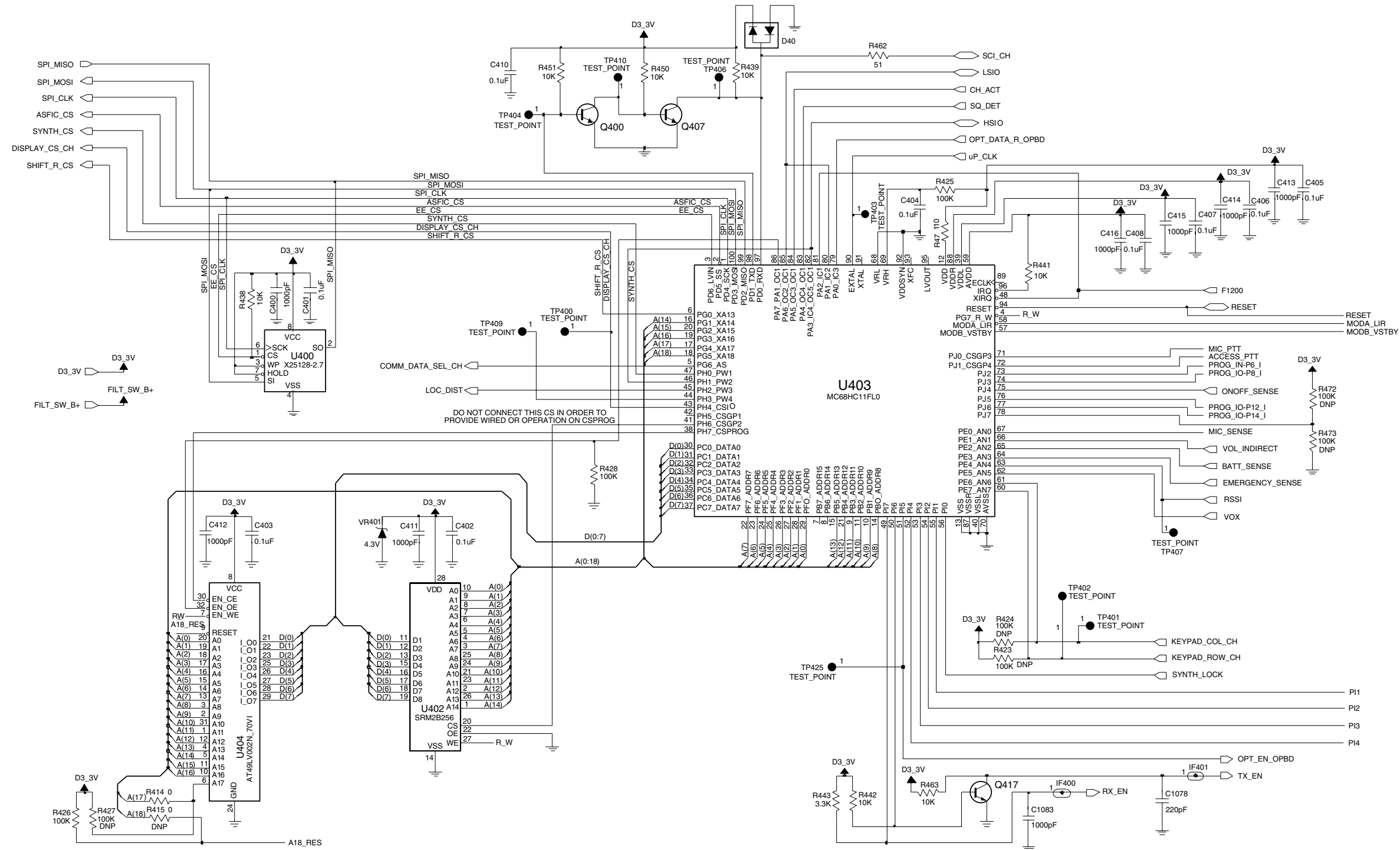
VHF 2 (146-174 MHz) 25-45 W Receiver Front and Back End (Sht 2 of 2)



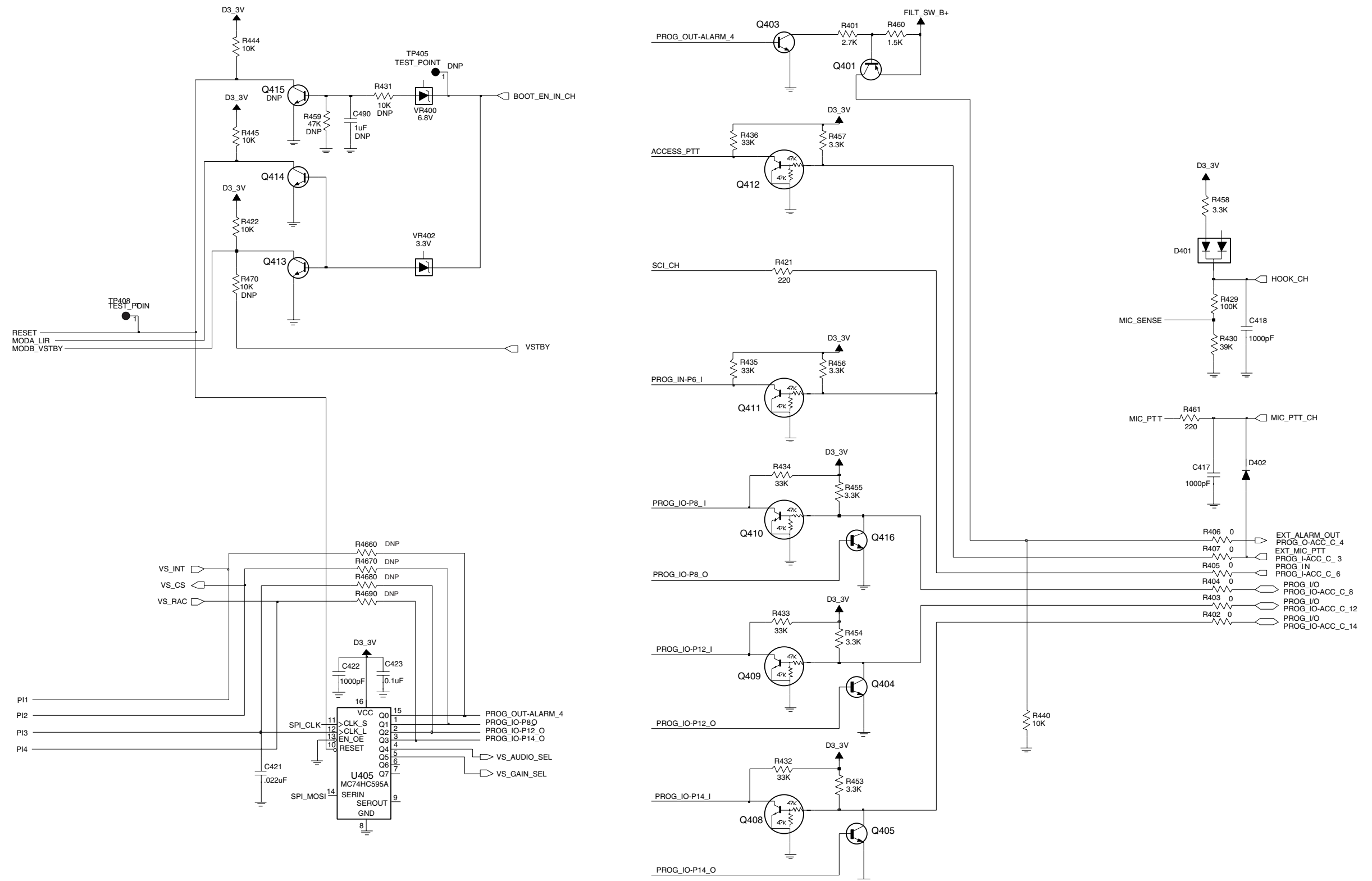
VHF 2 (146-174 MHz) 25-45 W DC and Audio Circuits (Sht 1 of 2)



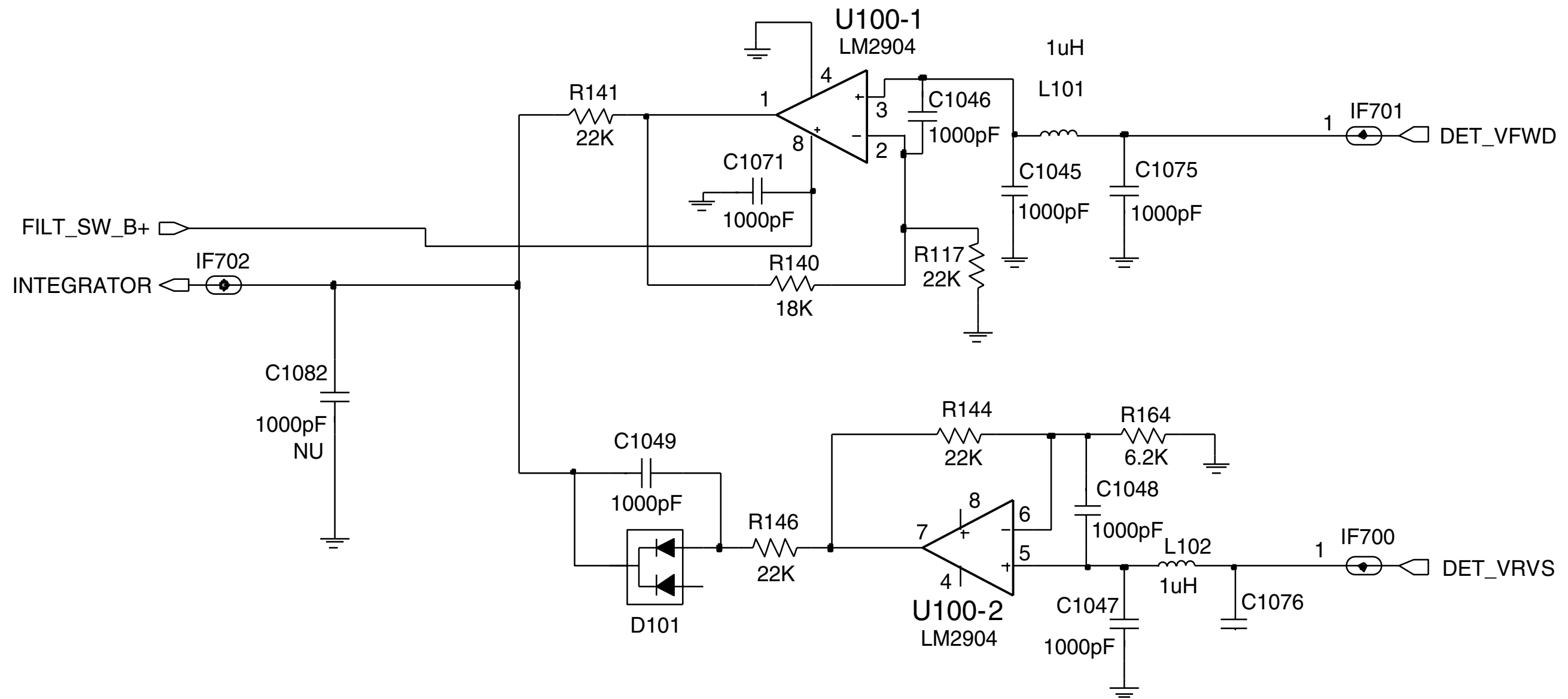
VHF 2 (146-174 MHz) 25-45 W DC and Audio Circuits (Sht 2 of 2)



VHF 2 (146-174 MHz) 25-45 W Microprocessor and Controller Circuits (Sht 1 of 2)



VHF 2 (146-174 MHz) 25-45 W Microprocessor and Controller Circuits (Sht 2 of 2)



VHF 2 (146-174 MHz) 25-45 W Power Control Circuit

2.1 VHF 2 PCB 8486487Z03-B Parts List 25–45 W

Circuit Ref.	Motorola Part No.	Description
C300	2113740F44	CAP, 51pF
C301	2311049A57	CAP, 10uF
C302	2113740F54	CAP, 130pF
C303	2113743K15	CAP, 0.1uF
C304	2113743E20	CAP, 0.1uF
C305	2113743E20	CAP, 0.1uF
C306	2113743E20	CAP, 0.1uF
C307	2113743E20	CAP, 0.1uF
C308	2113743E20	CAP, 0.1uF
C309	2113743E20	CAP, 0.1uF
C310	2113743E20	CAP, 0.1uF
C311	2113743E20	CAP, 0.1uF
C312	2113743E20	CAP, 0.1uF
C313	2113743E20	CAP, 0.1uF
C314	2113743E20	CAP, 0.1uF
C315	2113743E20	CAP, 0.1uF
C316	2113743E20	CAP, 0.1uF
C317	2113743E20	CAP, 0.1uF
C318	2113743E20	CAP, 0.1uF
C319	2113743E20	CAP, 0.1uF
C320	2113743E20	CAP, 0.1uF
C321	2113741F49	CAP, .01uF
C322	2113741F41	CAP, 4700pF
C323	2113741F25	CAP, 1000pF
C324	2113741F25	CAP, 1000pF
C325	2113741F25	CAP, 1000pF
C326	2113741F25	CAP, 1000pF
C327	2113741F25	CAP, 1000pF
C328	2113740F67	CAP, 470pF
C329	2113740F67	CAP, 470pF

Circuit Ref.	Motorola Part No.	Description
C330	2113740F67	CAP, 470pF
C331	2113740F67	CAP, 470pF
C332	2113741F13	CAP, 330pF
C333	2113740L41	CAP, 91pF
C334	2113740L41	CAP, 91pF
C335	2113740L17	CAP, 9.1pF
C336	2113740L14	CAP, 6.8pF
C337	2113740F57	CAP, 180pF
C338	2113740F53	CAP, 120pF
C339	2113740F51	CAP, 100pF
C340	2113740F49	CAP, 82pF
C341	2113740F49	CAP, 82pF
C342	2113740F49	CAP, 82pF
C343	2113740F49	CAP, 82pF
C344	NOT PLACED	CAP, 82pF
C345	NOT PLACED	CAP, 82pF
C346	2113740F45	CAP, 56pF
C347	2113740F41	CAP, 39pF
C348	2113740F41	CAP, 39pF
C349	NOT PLACED	CAP, 36pF
C350	2113740F40	CAP, 36pF
C351	2113740F40	CAP, 36pF
C352	2113740F39	CAP, 33pF
C353	2113740F38	CAP, 30pF
C354	2113740F38	CAP, 30pF
C355	2113740F38	CAP, 30pF
C356	NOT PLACED	CAP, 30pF
C357	2113740F35	CAP, 22pF
C359	NOT PLACED	CAP, 22pF
C360	NOT PLACED	CAP, 22pF
C361	2113740F33	CAP, 18pF

Circuit Ref.	Motorola Part No.	Description
C362	2113740F33	CAP, 18pF
C363	NOT PLACED	CAP, 12pF
C364	2113740F25	CAP, 8.2pF
C365	2113740F21	CAP, 5.6pF
C366	NOT PLACED	CAP, 3.3pF
C367	NOT PLACED	CAP, 2.7pF
C400	2113741F25	CAP, 1000pF
C401	2113743K15	CAP, 0.1uF
C402	2113743K15	CAP, 0.1uF
C403	2113743K15	CAP, 0.1uF
C404	2113743K15	CAP, 0.1uF
C405	2113743K15	CAP, 0.1uF
C406	2113743K15	CAP, 0.1uF
C407	2113743K15	CAP, 0.1uF
C408	2113743K15	CAP, 0.1uF
C410	2113743K15	CAP, 0.1uF
C411	2113741F25	CAP, 1000pF
C412	2113741F25	CAP, 1000pF
C413	2113741F25	CAP, 1000pF
C414	2113741F25	CAP, 1000pF
C415	2113741F25	CAP, 1000pF
C416	2113741F25	CAP, 1000pF
C417	2113741F25	CAP, 1000pF
C418	2113741F25	CAP, 1000pF
C421	2113743E07	CAP, .022uF
C422	2113741F25	CAP, 1000pF
C423	2113743K15	CAP, 0.1uF
C490	NOT PLACED	CAP, 1uF
C602	2113741F25	CAP, 1000pF
C603	2113741F25	CAP, 1000pF
C604	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C605	2113741F25	CAP, 1000pF
C606	2113741F25	CAP, 1000pF
C607	2113741F25	CAP, 1000pF
C608	NOT PLACED	CAP, 1000pF
C609	NOT PLACED	CAP, 1000pF
C610	2113741F25	CAP, 1000pF
C611	2113741F25	CAP, 1000pF
C612	2113741F25	CAP, 1000pF
C613	2113741F25	CAP, 1000pF
C614	2113741F25	CAP, 1000pF
C615	2113741F25	CAP, 1000pF
C616	2113741F25	CAP, 1000pF
C617	2113741F25	CAP, 1000pF
C618	2113741F25	CAP, 1000pF
C619	NOT PLACED	CAP, 1000pF
C620	2113741F25	CAP, 1000pF
C621	2113741F25	CAP, 1000pF
C622	2113741F25	CAP, 1000pF
C623	2113741F25	CAP, 1000pF
C624	2113741F25	CAP, 1000pF
C625	2113741F25	CAP, 1000pF
C626	2113741F25	CAP, 1000pF
C627	2113741F25	CAP, 1000pF
C628	2113741F25	CAP, 1000pF
C629	2113741F25	CAP, 1000pF
C630	2113741F25	CAP, 1000pF
C631	2113741F25	CAP, 1000pF
C632	2113741F25	CAP, 1000pF
C633	2113741F25	CAP, 1000pF
C662	2113741F25	CAP, 1000pF
C678	2113741M69	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C1000	2113740F59	CAP, 220pF
C1001	2311049A08	CAPP, 1uF
C1002	2113741W01	CAP, 1uF
C1003	NOT PLACED	CAP, 470pF
C1004	2111078B42	CAP, 100pF
C1005	2111078B42	CAP, 100pF
C1006	2111078B48	CAP, 160pF
C1007	2111078B40	CAP, 82pF
C1008	2111078B10	CAP, 7.5pF
C1009	2111078B37	CAP, 62pF
C1010	NOT PLACED	CAP, 100pF
C1011	NOT PLACED	CAP, 82pF
C1012	2111078B36	CAP, 56pF
C1013	2111078B08	CAP, 6.2pF
C1014	NOT PLACED	CAP, 56pF
C1015	2111078B43	CAP, 110pF
C1017	2111078B18	CAP, 15pF
C1018	2111078B32	CAP, 39pF
C1019	2111078B28	CAP, 32pF
C1020	2111078B32	CAP, 39pF
C1021	NOT PLACED	CAP, 6.2pF
C1022	2111078B26	CAP, 28pF
C1026	2113740A79	CAP, 1000pF
C1027	2311049A45	CAPP, 10uF
C1028	2113743K15	CAP, 0.1uF
C1029	2113743K15	CAP, 0.1uF
C1030	2113740F37	CAP, 27pF
C1031	2113743E07	CAP, .022uF
C1032	2113743E07	CAP, .022uF
C1033	2113743E07	CAP, .022uF
C1034	2113740F59	CAP, 220pF

Circuit Ref.	Motorola Part No.	Description
C1035	2113743E07	CAP, .022uF
C1036	2113743E07	CAP, .022uF
C1037	2113743E07	CAP, .022uF
C1038	NOT PLACED	CAP, .022uF
C1039	2113743E07	CAP, .022uF
C1040	NOT PLACED	CAP, 2200pF
C1041	2113741F17	CAP, 470pF
C1042	2113740F52	CAP, 110pF
C1043	2113740F52	CAP, 110pF
C1044	2113741F13	CAP, 330pF
C1045	2113741F25	CAP, 1000pF
C1046	2113741F25	CAP, 1000pF
C1047	2113741F25	CAP, 1000pF
C1048	2113741F25	CAP, 1000pF
C1049	2113741F25	CAP, 1000pF
C1050	2113741F25	CAP, 1000pF
C1051	2113741F25	CAP, 1000pF
C1052	2113741F25	CAP, 1000pF
C1053	2113741F25	CAP, 1000pF
C1054	2113741F25	CAP, 1000pF
C1055	NOT PLACED	CAP, 1000pF
C1056	NOT PLACED	CAP, 1000pF
C1057	2113741F25	CAP, 1000pF
C1058	NOT PLACED	CAP, 1000pF
C1059	2113741F25	CAP, 1000pF
C1060	2113741F25	CAP, 1000pF
C1061	NOT PLACED	CAP, 1000pF
C1062	2113741F25	CAP, 1000pF
C1063	2113740F63	CAP, 330pF
C1064	2113741F25	CAP, 1000pF
C1065	2113740F63	CAP, 330pF

Circuit Ref.	Motorola Part No.	Description
C1066	2113741F25	CAP, 1000pF
C1067	2113741F25	CAP, 1000pF
C1068	2113741F13	CAP, 330pF
C1069	NOT PLACED	CAP, 330pF
C1070	2113741F25	CAP, 1000pF
C1071	2113741F25	CAP, 1000pF
C1072	2113741F25	CAP, 1000pF
C1073	NOT PLACED	CAP, 1000pF
C1074	2113741F25	CAP, 1000pF
C1075	2113741F25	CAP, 1000pF
C1076	2113741F25	CAP, 1000pF
C1077	2113741F25	CAP, 1000pF
C1078	2113740F59	CAP, 220pF
C1079	2113741F25	CAP, 1000pF
C1080	2113741F25	CAP, 1000pF
C1081	2113741F25	CAP, 1000pF
C1082	NOT PLACED	CAP, 1000pF
C1083	2113741F25	CAP, 1000pF
C1084	2113740F59	CAP, 220pF
C1085	2113741F25	CAP, 1000pF
C1086	2113741F25	CAP, 1000pF
C1087	2113741F25	CAP, 1000pF
C1088	2113741F25	CAP, 1000pF
C1089	2113741F25	CAP, 1000pF
C1090	NOT PLACED	CAP, 220pF
C1091	2113741F25	CAP, 1000pF
C1092	2113741F25	CAP, 1000pF
C1093	NOT PLACED	CAP, 220pF
C1094	NOT PLACED	CAP, 1000pF
C1095	2113740F59	CAP, 220pF
C1096	2111078B40	CAP, 82pF

Circuit Ref.	Motorola Part No.	Description
C1097	2113741F25	CAP, 1000pF
C1098	2113741F25	CAP, 1000pF
C1099	2113741F25	CAP, 1000pF
C1100	2113741F25	CAP, 1000pF
C1101	2113741F01	CAP, 100pF
C1102	2113741F01	CAP, 100pF
C1103	2113741A57	CAP, .033uF
C1104	2113741A45	CAP, .01uF
C1105	2113740F67	CAP, 470pF
C1106	2113740F67	CAP, 470pF
C1107	2113740F67	CAP, 470pF
C1108	2113740F47	CAP, 68pF
C1109	2113740F59	CAP, 220pF
C1110	2113740F59	CAP, 220pF
C1111	2111078B59	CAP, 470pF
C1112	2113740F59	CAP, 220pF
C1113	2113740F59	CAP, 220pF
C1114	2113740F59	CAP, 220pF
C1115	2113740F59	CAP, 220pF
C1116	2113740F59	CAP, 220pF
C1117	2113740F40	CAP, 36pF
C1118	2113740F39	CAP, 33pF
C1119	2113740F36	CAP, 24pF
C1120	2113740F39	CAP, 33pF
C1121	NOT PLACED	CAP, 6.8pF
C1122	2113740F59	CAP, 220pF
C1123	2113740F59	CAP, 220pF
C1124	2113740F59	CAP, 220pF
C1125	2113740F59	CAP, 220pF
C1126	2113740F59	CAP, 220pF
C1127	2360567A03	CAPP, 100uF

Circuit Ref.	Motorola Part No.	Description
C1128	2113740F59	CAP, 220pF
C1129	2113740F59	CAP, 220pF
C1130	2113740F59	CAP, 220pF
C1131	NOT PLACED	CAP, 220pF
C1132	2111078B40	CAP, 82pF
C1133	2113740A41	CAP, 33pF
C1134	2113740A38	CAP, 24pF
C1136	2113740F19	CAP, 4.7pF
C1137	2111078B33	CAP, 43pF
C1199	NOT PLACED	CAP, 16pF
C2000	2113743F18	CAP, 2.2uF
C2001	2311049J11	CAPP, 4.7uF
C2002	2311049A72	CAPP, 10uF
C2003	2113743K15	CAP, 0.1uF
C2004	2113743F18	CAP, 2.2uF
C2005	2113743F18	CAP, 2.2uF
C2006	2113743F18	CAP, 2.2uF
C2007	2113743E20	CAP, 0.1uF
C2008	2113743E20	CAP, 0.1uF
C2009	2113743E20	CAP, 0.1uF
C2010	2113743E20	CAP, 0.1uF
C2011	2113743E20	CAP, 0.1uF
C2012	NOT PLACED	CAP, 0.1uF
C2013	2113743E20	CAP, 0.1uF
C2014	2113743E20	CAP, 0.1uF
C2015	2113743E20	CAP, 0.1uF
C2016	2113743E20	CAP, 0.1uF
C2017	2113743E20	CAP, 0.1uF
C2018	2113743E20	CAP, 0.1uF
C2019	2113743E20	CAP, 0.1uF
C2020	2113743E20	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C2021	2113741F49	CAP, .01uF
C2022	2113741F49	CAP, .01uF
C2023	2113741F49	CAP, .01uF
C2024	2113741F49	CAP, .01uF
C2025	2113741F49	CAP, .01uF
C2026	2113741F49	CAP, .01uF
C2027	2113741F49	CAP, .01uF
C2028	2113741F33	CAP, 2200pF
C2029	2113741F25	CAP, 1000pF
C2030	2113741F39	CAP, 3900pF
C2031	NOT PLACED	CAP, 1000pF
C2032	2113741F25	CAP, 1000pF
C2033	2113741F25	CAP, 1000pF
C2034	2113741F25	CAP, 1000pF
C2035	2113741F25	CAP, 1000pF
C2036	2113741F25	CAP, 1000pF
C2037	2113741F25	CAP, 1000pF
C2038	2113741F25	CAP, 1000pF
C2039	2113741F25	CAP, 1000pF
C2040	2113741F25	CAP, 1000pF
C2041	2113741F25	CAP, 1000pF
C2042	2113741F25	CAP, 1000pF
C2043	2113740L14	CAP, 6.8pF
C2044	2113740L06	CAP, 3.3pF
C2045	2113740F67	CAP, 470pF
C2046	2113740F67	CAP, 470pF
C2047	2113740F67	CAP, 470pF
C2048	2113740F67	CAP, 470pF
C2049	NOT PLACED	CAP, 470pF
C2050	2113740F67	CAP, 470pF
C2051	2113740F59	CAP, 220pF

Circuit Ref.	Motorola Part No.	Description
C2052	2113740F67	CAP, 470pF
C2053	NOT PLACED	CAP, 100pF
C2054	2113740L37	CAP, 62pF
C2055	2113740F35	CAP, 22pF
C2056	2113740F33	CAP, 18pF
C2057	2113740F33	CAP, 18pF
C2058	2113740F33	CAP, 18pF
C2059	2113740F33	CAP, 18pF
C2060	2113740F31	CAP, 15pF
C2061	2113740F29	CAP, 12pF
C2062	2113740F29	CAP, 12pF
C2063	2113740L22	CAP, 15pF
C2064	2113740F32	CAP, 16pF
C2065	2113740F27	CAP, 10pF
C2066	2113740L16	CAP, 8.2pF
C2067	2113740F25	CAP, 8.2pF
C2068	2113740F23	CAP, 6.8pF
C2069	2113740L12	CAP, 5.6pF
C2070	2113740F41	CAP, 39pF
C2071	2113740F41	CAP, 39pF
C2072	2113740L04	CAP, 2.7pF
C2073	2113740F03	CAP, 1pF
C2074	2109720D14	CAP, 0.1uF
C2075	2109720D14	CAP, 0.1uF
C2076	NOT PLACED	CAP, 0.1uF
C2077	2109720D14	CAP, 0.1uF
C2078	2109720D14	CAP, 0.1uF
C2079	2109720D14	CAP, 0.1uF
C2080	2109720D14	CAP, 0.1uF
C2081	2113740F67	CAP, 470pF
C5000	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C5001	2389289U01	CAPP, 10uF
C5002	2311049A99	CAPP, 47uF
C5003	2311049A99	CAPP, 47uF
C5005	2360567A03	CAPP, 100uF
C5006	2311049A57	CAPP, 10uF
C5007	2311049A99	CAPP, 47uF
C5008	2311049A57	CAPP, 10uF
C5009	2311049A57	CAPP, 10uF
C5010	2311049A57	CAPP, 10uF
C5011	2311049A57	CAPP, 10uF
C5012	2311049A56	CAPP, 4.7uF
C5013	2113928P04	CAP, 1.0uF
C5014	NOT PLACED	CAP, 2.2uF
C5015	2113743K15	CAP, 0.1uF
C5016	2113743K15	CAP, 0.1uF
C5017	2113743K15	CAP, 0.1uF
C5018	2113743K15	CAP, 0.1uF
C5019	2113743K15	CAP, 0.1uF
C5020	2113743K15	CAP, 0.1uF
C5021	2113741M69	CAP, 0.1uF
C5022	2113743K15	CAP, 0.1uF
C5023	2113743K15	CAP, 0.1uF
C5024	2113743K15	CAP, 0.1uF
C5025	2113743K15	CAP, 0.1uF
C5026	2113743K15	CAP, 0.1uF
C5027	2113743K15	CAP, 0.1uF
C5028	2113743K15	CAP, 0.1uF
C5029	2113743K15	CAP, 0.1uF
C5030	2113743K15	CAP, 0.1uF
C5031	2113743K15	CAP, 0.1uF
C5032	2113743K15	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C5033	2113743K15	CAP, 0.1uF
C5034	2113743K15	CAP, 0.1uF
C5035	2113743K15	CAP, 0.1uF
C5036	2113743K15	CAP, 0.1uF
C5037	2113743K15	CAP, 0.1uF
C5038	2113743K15	CAP, 0.1uF
C5039	NOT PLACED	CAP, 0.1uF
C5040	NOT PLACED	CAP, 0.1uF
C5041	2113743F18	CAP, 2.2uF
C5042	2113743F16	CAP, 1uF
C5043	2113743F16	CAP, 1uF
C5044	2113928C04	CAP, 4.7uF
C5045	2113743F16	CAP, 1uF
C5046	2113743E20	CAP, 0.1uF
C5047	2113743E20	CAP, 0.1uF
C5048	2113743E20	CAP, 0.1uF
C5049	2113743E20	CAP, 0.1uF
C5050	2113743E20	CAP, 0.1uF
C5051	NOT PLACED	CAP, 0.1uF
C5052	2113743E20	CAP, 0.1uF
C5053	NOT PLACED	CAP, 0.1uF
C5054	NOT PLACED	CAP, 0.1uF
C5055	2113928C04	CAP, 4.7uF
C5056	2113928C04	CAP, 4.7uF
C5057	2113928C04	CAP, 4.7uF
C5058	NOT PLACED	CAP, 0.1uF
C5059	2113743E07	CAP, .022uF
C5060	2113741M69	CAP, 0.1uF
C5061	2113741M69	CAP, 0.1uF
C5062	2113741M69	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C5063	2113741M69	CAP, 0.1uF
C5064	2113741F25	CAP, 1000pF
C5065	2113741F25	CAP, 1000pF
C5066	2113741F25	CAP, 1000pF
C5067	2113741F25	CAP, 1000pF
C5068	2113741F25	CAP, 1000pF
C5069	2113741F25	CAP, 1000pF
C5070	2113741F25	CAP, 1000pF
C5071	2113741F25	CAP, 1000pF
C5072	2113741F25	CAP, 1000pF
C5073	2113741F25	CAP, 1000pF
C5074	2113741F25	CAP, 1000pF
C5075	NOT PLACED	CAP, 1000pF
C5076	2113741F25	CAP, 1000pF
C5077	2113741F25	CAP, 1000pF
C5078	2113741F25	CAP, 1000pF
C5079	2113741F25	CAP, 1000pF
C5080	2113741F25	CAP, 1000pF
C5081	2113741F25	CAP, 1000pF
C5082	2113741F25	CAP, 1000pF
C5083	2113740F51	CAP, 100pF
C5084	2113740F51	CAP, 100pF
C5085	2113741A53	CAP, .022uF
C5086	2113741A53	CAP, .022uF
C5087	2113740F53	CAP, 120pF
C5088	2113740F49	CAP, 82pF
C5089	2113740F49	CAP, 82pF
C5090	2113740F49	CAP, 82pF
C5091	2113740F49	CAP, 82pF
C5092	2113740F59	CAP, 220pF

Circuit Ref.	Motorola Part No.	Description
C5094	2113740F59	CAP, 220pF
C5095	2113740F59	CAP, 220pF
C5096	2113740F59	CAP, 220pF
C5097	2113740F59	CAP, 220pF
C5098	2113740F59	CAP, 220pF
C5099	2113740F59	CAP, 220pF
C5100	2113740F59	CAP, 220pF
C5101	NOT PLACED	CAP, 1000pF
C5102	NOT PLACED	CAP, 0.1uF
C5103	NOT PLACED	CAP, 0.1uF
C5104	NOT PLACED	CAP, 10uF
C5110	2113741F25	CAP, 1000pF
C5111	2113741F25	CAP, 1000pF
C5112	NOT PLACED	CAP, 16pF
C5113	NOT PLACED	CAP, 220pF
C5114	2113743F16	CAP, 1uF
C5115	NOT PLACED	CAP, 6.8pF
C5116	NOT PLACED	CAP, 220pF
C5117	NOT PLACED	CAP, 16pF
C5118	2113743E20	CAP, 0.1uF
C5119	2113743H14	CAP, 10uF
C5120	NOT PLACED	CAPP, 47uF
CR300	4880154K03	MMBD353, SCHOTTKY COMM AK
CR301	4880154K03	MMBD353, SCHOTTKY COMM AK
D100	NOT PLACED	MMBD6100, DUAL COMM CATH
D101	4813833C02	MMBD6100, DUAL COMM CATH
D102	4813833C02	MMBD6100, DUAL COMM CATH

Circuit Ref.	Motorola Part No.	Description
D103	4802482J02	MA4P959, PIN
D104	4802482J02	MA4P959, PIN
D105	4805218N57	RB715F, DUAL COMM CATH
D106	4805218N57	RB715F, DUAL COMM CATH
D107	4805218N57	RB715F, DUAL COMM CATH
D108	4805218N57	RB715F, DUAL COMM CATH
D200	4802233J09	IMN10, 3 DIODE ARRAY
D201	4802233J09	IMN10, 3 DIODE ARRAY
D202	4862824C03	1SV232, VARACTOR
D203	4805649Q13	1SV228, VARACTOR
D204	4805649Q13	1SV228, VARACTOR
D205	4862824C01	1SV229, VARACTOR
D301	4802245J97	DAN235ETL, DUAL COMM CATH
D302	4802245J97	DAN235ETL, DUAL COMM CATH
D303	4802245J97	DAN235ETL, DUAL COMM CATH
D304	4802245J97	DAN235ETL, DUAL COMM CATH
D305	4880142L01	MMBV3401LT, PIN
D400	4813833C07	MMBD7000, DUAL COMM AK
D401	4813833C02	MMBD6100, DUAL COMM CATH
D402	4809948D42	RB751V40, SCHOTTKY
D500	4813833C02	MMBD6100, DUAL COMM CATH
D501	NOT PLACED	MMBD6100, DUAL COMM CATH
D502	4813825A23	MMSD301T1, SCHOTTKY

Circuit Ref.	Motorola Part No.	Description
D511	4813833C02	MMBD6100, DUAL COMM CATH
D513	4813833C02	MMBD6100, DUAL COMM CATH
FL300	9180022M11	MXF45, 44.85MHz BPF
FL301	9180468V06	FLTR, 455kHz, BW 25KHZ
FL302	9180468V04	FLTR, 455kHz, BW 12.5KHZ
FL303	9180469V03	FLTR, 455kHz, BW 12.5KHZ
FL304	9180469V06	FLTR, 455kHz, BW 25KHZ
J2	0989241U02	CONNECTOR 22 PIN
J3	NOT PLACED	CONNECTOR 32 PIN
J11	2889309U01	ANTENNA CONNECTOR
L100	7686135U02	FERRITE BEAD
L101	2462587T30	IDCTR, 1uH
L102	2462587T30	IDCTR, 1uH
L103	2462587T30	IDCTR, 1uH
L104	2462587T38	IND CHIP 22NH 5% LOW PRO
L105	2462587T13	IDCTR, 68nH
L106	2460591A11	IDCTR, 7.66nH
L107	2460591A01	IDCTR, 4.22nH
L108	2462587X69	IDCTR, 1.2uH
L109	NOT PLACED	IDCTR, 11.03nH
L110	2462587N42	IDCTR, 12nH
L111	2460592B01	IDCTR, 51nH
L112	2460592B01	IDCTR, 51nH
L113	2460592B01	IDCTR, 51nH
L114	2460592B01	IDCTR, 51nH
L115	2460592A01	IDCTR, 17nH
L116	2460592A01	IDCTR, 17nH

Circuit Ref.	Motorola Part No.	Description
L117	7686135U02	FERRITE BEAD
L118	7686135U02	FERRITE BEAD
L119	7686135U02	FERRITE BEAD
L120	7686135U02	FERRITE BEAD
L121	7686135U02	FERRITE BEAD
L122	2460591C23	IDCTR, 13.85nH
L123	2462587X69	IDCTR, 1.2uH
L124	2485873L05	IDCTR, 48nH
L131	NOT PLACED	IDCTR, 120nH
L132	2462587N15	IDCTR, 100nH
L200	2462587Q42	IDCTR, 390nH
L201	2462587V44	IDCTR, 680nH
L202	2462587V44	IDCTR, 680nH
L203	2462587V44	IDCTR, 680nH
L204	2462587V44	IDCTR, 680nH
L205	2462587Q47	IDCTR, 1uH
L206	2413923C05	IDCTR, 33nH
L207	2413923C07	IDCTR, 47nH
L208	2413926N24	IDCTR, 100nH
L209	2413926N24	IDCTR, 100nH
L210	2413926N24	IDCTR, 100nH
L211	2413926N24	IDCTR, 100nH
L212	2413926N24	IDCTR, 100nH
L213	2413926N24	IDCTR, 100nH
L214	2413926H20	IDCTR, 47nH
L215	2413926H20	IDCTR, 47nH
L216	2413926H20	IDCTR, 47nH
L217	2462587Q42	IDCTR, 390nH
L300	2460591G24	IDCTR, 33.47nH
L301	2462587X69	IDCTR, 1.2uH
L302	2462587X69	IDCTR, 1.2uH

Circuit Ref.	Motorola Part No.	Description
L303	2462587N69	IDCTR, 1.2uH
L304	2483411T74	IDCTR, 1.2uH
L305	2413926K31	IDCTR, 470nH
L306	2462587N55	IDCTR, 150nH
L307	2460591G24	IDCTR, 33.47nH
L308	2460591G24	IDCTR, 33.47nH
L309	2460591G24	IDCTR, 33.47nH
L310	2460591G24	IDCTR, 33.47nH
L311	2460591G24	IDCTR, 33.47nH
L312	2460591G24	IDCTR, 33.47nH
L313	2460591G24	IDCTR, 33.47nH
L314	2460591G24	IDCTR, 33.47nH
L315	NOT PLACED	IDCTR, 27nH
L500	7686135U02	FERRITE BEAD
L501	7686135U02	FERRITE BEAD
L502	7686135U02	FERRITE BEAD
M6	4387454V01	SPACER
M9	0289511U01	NUT
M100	2680499Z01	HEATSINK
M105	7588823L03	CONTACT, METAL
M106	7588823L03	CONTACT, METAL
M107	7588823L03	CONTACT, METAL
M108	7588823L04	CONTACT, METAL
M109	7588823L04	CONTACT, METAL
M110	7588823L04	CONTACT, METAL
M111	NOT PLACED	CONTACT, METAL
M112	NOT PLACED	CONTACT, METAL
M113	NOT PLACED	CONTACT, METAL
M114	NOT PLACED	CONTACT, METAL
P1	2804503J01	CONNECTOR, 16 PIN
P2	NOT PLACED	CONNECTOR, 2 PIN DC

Circuit Ref.	Motorola Part No.	Description
Q100	4886136B01	MRF1550, LDMOS RF
Q101	4813824A10	MMBT3904, BIPOLAR NPN
Q102	NOT PLACED	MMBT3904, BIPOLAR NPN
Q103	4813824A06	MMBTA13, DARLINGTON, NPN
Q105	4886212B01	MRF1518, LDMOS RF
Q106	4805128M27	BSR33, BIPOLAR, PNP
Q200	4802245J95	BFS540, NPN
Q300	4809940E02	DTC114YE, NPN
Q301	4813824A17	MMBT3906, BIPOLAR PNP
Q302	4813824A10	MMBT3904, BIPOLAR NPN
Q303	4802245J95	BFS540, NPN
Q304	4809939C04	UMC3
Q305	4802197J95	PBR941, NPN
Q306	4813824A17	MMBT3906, BIPOLAR PNP
Q400	4809940E02	DTC114YE, NPN
Q401	4880141L03	BCW68G, BIPOLAR PNP
Q403	4809940E02	DTC114YE, NPN
Q404	4809940E02	DTC114YE, NPN
Q405	4809940E02	DTC114YE, NPN
Q407	4809940E02	DTC114YE, NPN
Q408	4880048M01	DTC144EKA, BIPOLAR
Q409	4880048M01	DTC144EKA, BIPOLAR
Q410	4880048M01	DTC144EKA, BIPOLAR
Q411	4880048M01	DTC144EKA, BIPOLAR
Q412	4880048M01	DTC144EKA, BIPOLAR
Q413	4809940E02	DTC114YE, NPN
Q414	4809940E02	DTC114YE, NPN

Circuit Ref.	Motorola Part No.	Description
Q415	NOT PLACED	MMBT3904
Q416	4809940E02	DTC114YE, NPN
Q417	4813824A10	MMBT3904, BIPOLAR NPN
Q500	4813824A10	MMBT3904, BIPOLAR NPN
Q501	4809940E02	DTC114YE, NPN
Q502	4809940E02	DTC114YE, NPN
Q503	4813824A10	MMBT3904, BIPOLAR NPN
Q504	4880048M01	DTC144EKA, BIPOLAR
Q505	4813824A10	MMBT3904, BIPOLAR NPN
Q506	4813824A10	MMBT3904, BIPOLAR NPN
R101	1705603W01	SHUNT, 1.639m
R102	0680194M18	RES, 51
R103	0683994M18	RES, 51
R104	0680194M18	RES, 51
R105	0680194M18	RES, 51
R106	0680194M18	RES, 51
R107	0680194M18	RES, 51
R108	0680194M18	RES, 51
R109	0662057A12	RES, 30
R110	NOT PLACED	RES, 1K
R111	NOT PLACED	RES, 1K
R112	NOT PLACED	RES, 62K
R113	NOT PLACED	RES, 10K
R114	NOT PLACED	RES, 10K
R115	NOT PLACED	RES, 10K
R116	NOT PLACED	RES, 10K
R117	0662057A81	RES, 22K

Circuit Ref.	Motorola Part No.	Description
R118	0662057C55	RES, 150
R120	0662057C51	RES, 100
R121	NOT PLACED	RES, 100
R122	0662057C19	RES, 4.7
R123	0662057C13	RES, 2.7
R124	0662057C13	RES, 2.7
R125	0662057C13	RES, 2.7
R126	0662057C03	RES, 1
R127	0662057C03	RES, 1
R130	0662057B47	RES, 0
R131	0662057A97	RES, 100K
R132	NOT PLACED	RES, 100K
R134	0662057A89	RES, 47K
R135	0662057A82	RES, 24K
R136	0662057A87	RES, 39K
R137	0662057A87	RES, 39K
R138	NOT PLACED	RES, 39K
R139	NOT PLACED	RES, 39K
R140	0662057A79	RES, 718K
R141	0662057A81	RES, 22K
R142	0662057A81	RES, 22K
R143	0662057A81	RES, 22K
R144	0662057A75	RES, 12K
R145	0662057A81	RES, 22K
R146	0662057A81	RES, 22K
R147	0662057A81	RES, 22K
R148	0662057A81	RES, 22K
R149	0662057A81	RES, 22K
R150	0662057A89	RES, 47K
R151	0662057A70	RES, 7.5K

Circuit Ref.	Motorola Part No.	Description
R153	0662057A73	RES, 10K
R155	NOT PLACED	RES, 10K
R156	0662057A73	RES, 10K
R157	0662057A91	RES, 56K
R158	0662057A67	RES, 5.6K
R159	NOT PLACED	RES, 5.6K
R160	0662057A61	RES, 3.3K
R161	0662057A61	RES, 3.3K
R162	0662057A61	RES, 3.3K
R163	0662057A61	RES, 3.3K
R164	0662057A68	RES, 6.2K
R165	0662057A58	RES, 2.4K
R166	NOT PLACED	RES, 2.4K
R167	0662057A57	RES, 2.2K
R168	0662057A57	RES, 2.2K
R169	NOT PLACED	RES, 2.2K
R170	0662057A42	RES, 510
R171	0662057A33	RES, 220
R172	0662057A41	RES, 470
R173	0662057A29	RES, 150
R174	0662057A29	RES, 150
R175	NOT PLACED	RES, 220
R176	2413926N25	IDCTR, 120nH
R177	NOT PLACED	RES, 100
R178	0662057A14	RES, 36
R179	0662057A14	RES, 36
R180	0660082A89	RES, 47K
R181	0660082A89	RES, 47K
R182	0662057A73	RES, 10K
R185	0662057A73	RES, 10K

Circuit Ref.	Motorola Part No.	Description
R186	0662057C20	RES, 5.1
R188	NOT PLACED	RES, 0
R189	NOT PLACED	RES, 0
R190	0662057G64	RES, 1MEG
R191	0662057G64	RES, 1MEG
R195	0662057C01	RES, 0
R196	NOT PLACED	RES, 0
R197	0662057C19	RES, 4.7
R198	0662057C01	RES, 0
R199	0662057B47	RES, 0
R200	0662057A99	RES, 120K
R201	0662057B47	RES, 0
R202	NOT PLACED	RES, 0
R203	0662057B47	RES, 0
R204	NOT PLACED	RES, 0
R205	NOT PLACED	RES, 0
R206	0662057B02	RES, 150K
R207	0662057B02	RES, 150K
R208	0662057A18	RES, 51
R209	0662057A97	RES, 100K
R210	NOT PLACED	RES, 100K
R211	0662057A89	RES, 47K
R212	0662057A84	RES, 30K
R213	0662057A65	RES, 4.7K
R214	0662057A65	RES, 4.7K
R215	0662057A65	RES, 4.7K
R216	0662057A63	RES, 3.9K
R217	0662057A52	RES, 1.3K
R218	0662057A49	RES, 1K
R219	NOT PLACED	RES, 820

Circuit Ref.	Motorola Part No.	Description
R220	0662057A42	RES, 510
R221	0662057A33	RES, 220
R222	0662057A33	RES, 220
R223	0662057A33	RES, 220
R224	0662057A53	RES, 1.5K
R225	0662057A29	RES, 150
R226	0662057A29	RES, 150
R227	0662057A25	RES, 100
R228	0662057A25	RES, 100
R229	0662057A25	RES, 100
R230	0662057A25	RES, 100
R231	0662057A18	RES, 51
R232	0662057A17	RES, 47
R233	0662057A17	RES, 47
R234	0662057A15	RES, 39
R235	0662057A07	RES, 18
R300	0662057A73	RES, 10K
R301	0662057A41	RES, 470
R302	0662057B47	RES, 0
R303	0662057B47	RES, 0
R304	0662057A85	RES, 33K
R305	0662057A80	RES, 20K
R306	0662057A80	RES, 20K
R307	0662057A80	RES, 20K
R308	0662057A80	RES, 20K
R309	0662057A77	RES, 15K
R310	0662057A77	RES, 15K
R311	NOT PLACED	RES, 15K
R312	0662057A76	RES, 13K
R313	0662057A75	RES, 12K

Circuit Ref.	Motorola Part No.	Description
R314	0662057A75	RES, 12K
R315	0662057A75	RES, 12K
R316	0662057A75	RES, 12K
R317	0662057A75	RES, 12K
R318	0662057A75	RES, 12K
R319	0662057A75	RES, 12K
R320	0662057A73	RES, 10K
R321	0662057A71	RES, 8.2K
R322	0662057A65	RES, 4.7K
R323	0662057A65	RES, 4.7K
R324	0662057A61	RES, 3.3K
R325	0662057A61	RES, 3.3K
R326	0662057A58	RES, 2.4K
R327	0662057A58	RES, 2.4K
R328	0662057A55	RES, 1.8K
R329	0662057A51	RES, 1.2K
R330	0662057A49	RES, 1K
R331	0662057A45	RES, 680
R332	0662057A43	RES, 560
R333	0662057A40	RES, 430
R334	0662057A39	RES, 390
R335	0662057A33	RES, 220
R336	0662057A25	RES, 100
R337	0662057A25	RES, 100
R338	0662057A18	RES, 51
R339	0662057A18	RES, 51
R340	0662057A18	RES, 51
R341	0662057A01	RES, 10
R342	0662057A01	RES, 10
R343	0662057A01	RES, 10

Circuit Ref.	Motorola Part No.	Description
R344	0662057A01	RES, 10
R345	0662057A73	RES, 10K
R346	0662057A73	RES, 10K
R401	0662057C85	RES, 2.7K
R402	0662057B47	RES, 0
R403	0662057B47	RES, 0
R404	0662057B47	RES, 0
R405	0662057B47	RES, 0
R406	0662057B47	RES, 0
R407	0662057B47	RES, 0
R414	0662057B47	RES, 0
R415	NOT PLACED	RES, 0
R421	0662057A33	RES, 220
R422	0662057A73	RES, 10K
R423	NOT PLACED	RES, 100K
R424	NOT PLACED	RES, 100K
R425	0662057A97	RES, 100K
R426	0662057A97	RES, 100K
R427	NOT PLACED	RES, 100K
R428	0662057A97	RES, 100K
R429	0662057A97	RES, 100K
R430	0662057A87	RES, 39K
R431	NOT PLACED	RES, 10K
R432	0662057A85	RES, 33K
R433	0662057A85	RES, 33K
R434	0662057A85	RES, 33K
R435	0662057A85	RES, 33K
R436	0662057A85	RES, 33K
R438	0662057A73	RES, 10K
R439	0662057A73	RES, 10K

Circuit Ref.	Motorola Part No.	Description
R440	0662057A73	RES, 10K
R441	0662057A73	RES, 10K
R442	0662057A73	RES, 10K
R443	0662057A61	RES, 3.3K
R444	0662057A73	RES, 10K
R445	0662057A73	RES, 10K
R450	0662057A73	RES, 10K
R451	0662057A73	RES, 10K
R453	0662057A61	RES, 3.3K
R454	0662057A61	RES, 3.3K
R455	0662057A61	RES, 3.3K
R456	0662057A61	RES, 3.3K
R457	0662057A61	RES, 3.3K
R458	0662057A61	RES, 3.3K
R459	NOT PLACED	RES, 47K
R460	0662057A53	RES, 1.5K
R461	0662057A33	RES, 220
R462	0662057A18	RES, 51
R463	0662057A73	RES, 10K
R466	NOT PLACED	RES, 0
R467	NOT PLACED	RES, 0
R468	NOT PLACED	RES, 0
R469	NOT PLACED	RES, 0
R470	NOT PLACED	RES, 10K
R471	0662057A01	RES, 10
R472	NOT PLACED	RES, 100K
R473	NOT PLACED	RES, 100K
R600	0662057C01	RES, 0
R601	0611077A62	RES, 330
R602	0662057B47	RES, 0

Circuit Ref.	Motorola Part No.	Description
R610	0662057C59	RES, 220
R615	0662057A25	RES, 100
R5000	0662057B47	RES, 0
R5001	0662057T68	RES, 1K
R5002	NOT PLACED	RES, 0
R5008	0662057B47	RES, 0
R5009	0662057B47	RES, 0
R5010	0662057B47	RES, 0
R5011	NOT PLACED	RES, 0
R5013	NOT PLACED	RES, 0
R5014	0662057B47	RES, 0
R5016	NOT PLACED	RES, 1MEG
R5019	0662057B05	RES, 200K
R5020	0662057B02	RES, 150K
R5021	0662057A97	RES, 100K
R5022	0662057A97	RES, 100K
R5023	0662057A97	RES, 100K
R5024	NOT PLACED	RES, 100K
R5025	0662057A97	RES, 100K
R5026	0662057A85	RES, 33K
R5027	0662057B08	RES, 270K
R5028	0662057A97	RES, 100K
R5029	0662057A97	RES, 100K
R5030	0662057A85	RES, 33K
R5031	0662057A92	RES, 62K
R5032	0662057A89	RES, 47K
R5033	0662057A89	RES, 47K
R5034	0662057A86	RES, 36K
R5035	0662057A89	RES, 47K
R5036	0662057A89	RES, 47K

Circuit Ref.	Motorola Part No.	Description
R5037	0662057A73	RES, 10K
R5038	0662057A85	RES, 33K
R5039	0662057A97	RES, 100K
R5040	0662057A84	RES, 30K
R5041	0662057A82	RES, 24K
R5042	0662057A82	RES, 24K
R5043	0662057A82	RES, 24K
R5044	0662057A82	RES, 24K
R5045	0662057A85	RES, 33K
R5046	0662057A82	RES, 24K
R5047	0662057B47	RES, 0
R5048	0662057A82	RES, 24K
R5049	0662057A77	RES, 15K
R5050	0662057A76	RES, 13K
R5051	0662057A75	RES, 12K
R5052	0662057A73	RES, 10K
R5053	0662057A73	RES, 10K
R5054	0662057A73	RES, 10K
R5055	0662057A73	RES, 10K
R5056	0662057A73	RES, 10K
R5057	0662057A73	RES, 10K
R5058	NOT PLACED	RES, 10K
R5059	NOT PLACED	RES, 10K
R5060	0662057A73	RES, 10K
R5061	0662057A73	RES, 10K
R5062	0662057A73	RES, 10K
R5063	NOT PLACED	RES, 8.2K
R5064	NOT PLACED	RES, 8.2K
R5065	0662057A68	RES, 6.2K
R5066	0662057A49	RES, 1K

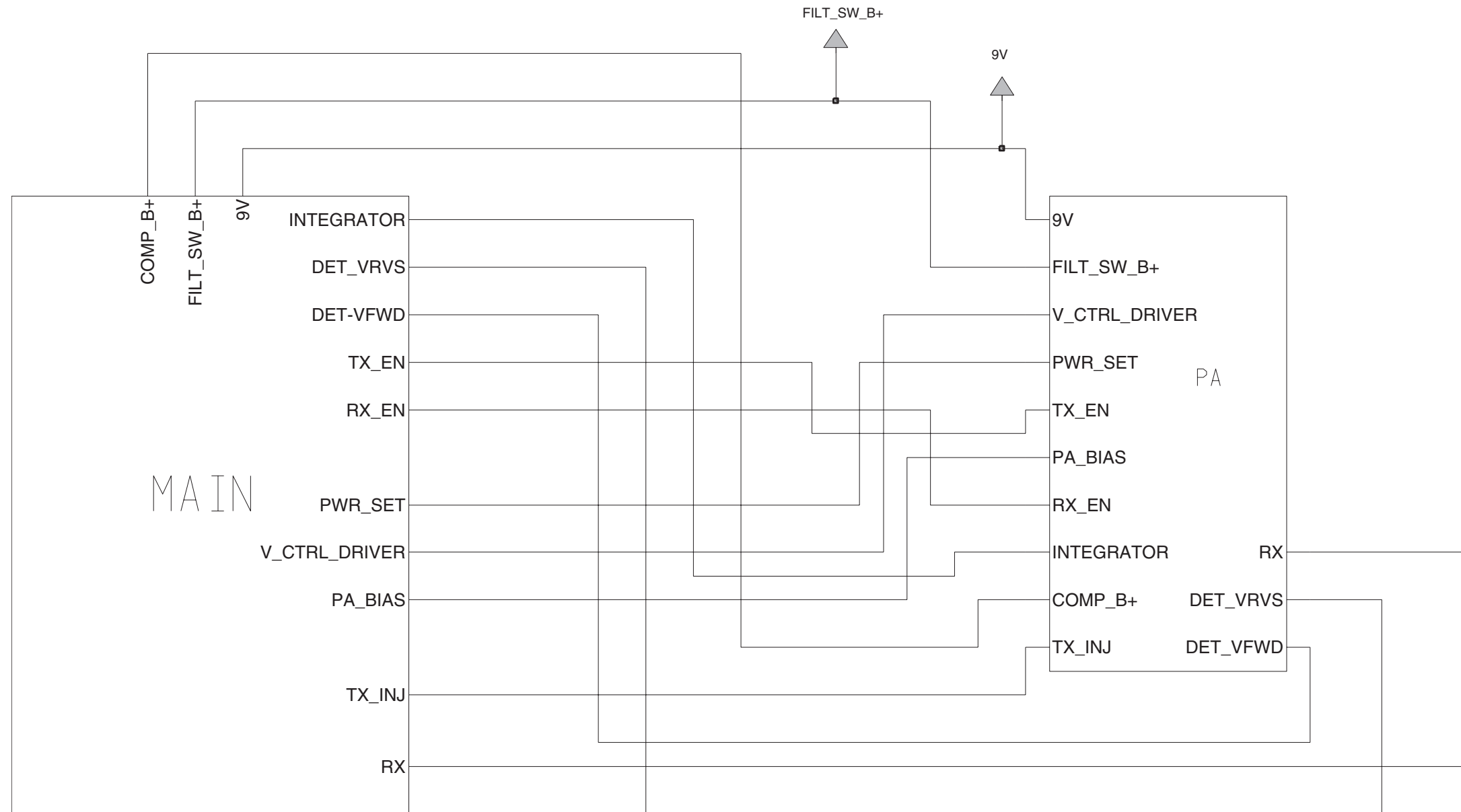
Circuit Ref.	Motorola Part No.	Description
R5067	NOT PLACED	RES, 6.2K
R5068	NOT PLACED	RES, 6.2K
R5069	0662057A73	RES, 10K
R5070	0662057A57	RES, 2.2K
R5071	0662057A57	RES, 2.2K
R5072	0662057A65	RES, 4.7K
R5073	0662057A49	RES, 1K
R5074	0662057A49	RES, 1K
R5075	0662057A42	RES, 510
R5076	0662057A42	RES, 510
R5077	0662057A36	RES, 300
R5078	0662057A25	RES, 100
R5079	0662057A25	RES, 100
R5080	0662057A01	RES, 10
R5081	0613952D78	RES, 6.34K
R5082	0662057A90	RES, 51K
R5083	0662057B08	RES, 270K
R5084	NOT PLACED	RES, 0
R5085	NOT PLACED	RES, 1MEG
R5086	0662057A43	RES, 560
R5087	0662057A97	RES, 100K
R5088	0662057B47	RES, 0
R5089	NOT PLACED	RES, 1MEG
R5092	0662057A73	RES, 10K
R5093	0662057A73	RES, 10K
R5094	NOT PLACED	RES, 1MEG
R5095	0662057A82	RES, 24K
R5096	0662057A73	RES, 10K
R5097	NOT PLACED	RES, 0
R5098	0662057B47	RES, 0

Circuit Ref.	Motorola Part No.	Description
R5099	NOT PLACED	RES, 100K
R5100	NOT PLACED	RES, 1MEG
R5103	NOT PLACED	RES, 24K
R5290	0662057A25	RES, 100
R5291	0662057A25	RES, 100
R6000	NOT PLACED	RES, 0
R6001	NOT PLACED	RES, 0
RT100	0680361L01	THERM, 47K
S5010	1889288U01	SWITCH, 50.K
SH200	2689590U01	SHIELD
SH201	2689589U01	SHIELD
SH202	2689589U01	SHIELD
SH300	2689591U01	SHIELD
SH301	2689593U01	SHIELD
SH302	2689591U01	SHIELD
T300	2580541Z01	XFMR
T301	2580541Z01	XFMR
U100	5180932W01	LM2904
U101	5185130C65	30C65, RF PREDRIVER
U102	NOT PLACED	LM2904, OPAMP
U103	5113819A04	MC3303
U200	5185963A27	63A27, LVFRACN
U201	5105750U54	50U54, VCOBIC
U300	5186144B01	SA616, IFIC
U301	5109522E10	TC7W04F, INVERTER
U302	4808612Y05	SMS3928_023, MIXER
U400	5102463J64	X25128-2.7, EEPROM
U402	5102463J36	SRM2B256, SRAM
U403	5102226J56	MC68HC11FL0, MICRO PROC
U404	5115037H01	4M FLASH ROM IC

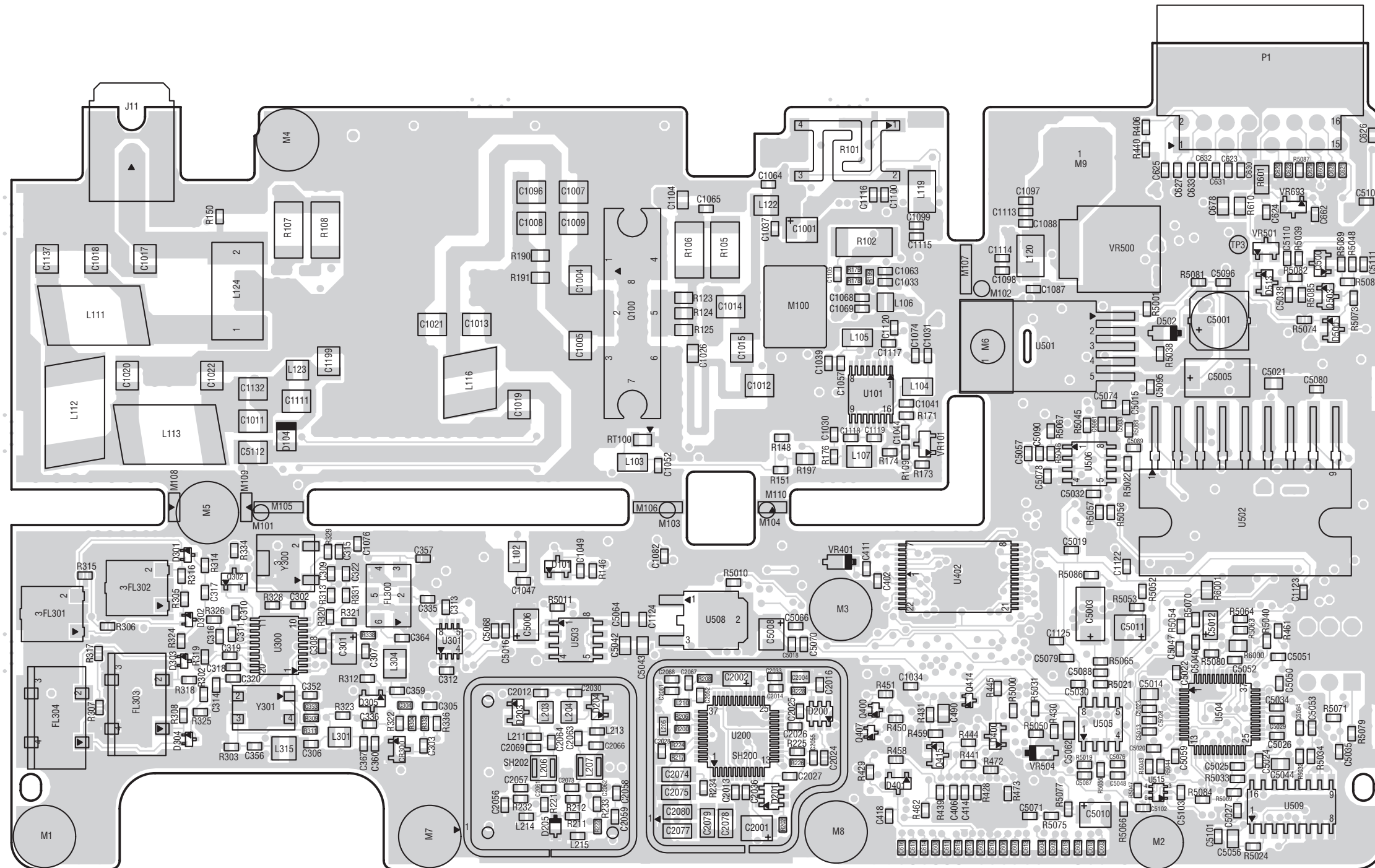
Circuit Ref.	Motorola Part No.	Description
U405	5113805A75	MC74HC595A, SHIFT REG
U500	5180932W01	LM2904, OPAMP
U501	5102190C33	LM2941T, 9.3V REGULATOR
U502	5102463J95	TDA1519C, AUDIO PA
U503	5105469E65	LP2951C, 5V REGULATOR
U504	5185130C53	30C53, ASFIC CMP
U505	5180932W01	LM2904, OPAMP
U506	5180932W01	LM2904, OPAMP
U507	5180932W01	LM2904, OPAMP
U508	5113816A30	MC33269D, 3.3V REGULATOR
U509	5113806A20	MC14053B, MUX
U510	5104187K94	LP2986ILDX, 3.3V REGULATOR
U514	4802393L66	SI3455ADV, 12V P-Ch FET
U515	NOT PLACED	MAX4599EXT, SWITCH
VR101	4813830A15	MMBZ5232B, 5.6V ZENER
VR102	4813830A15	MMBZ5232B, 5.6V ZENER
VR105	4813830A15	MMBZ5232B, 5.6V ZENER
VR400	NOT PLACED	MMBZ5232B, 5.6V ZENER
VR401	4813830G12	MMSZ4687T1, 4.3V ZENER
VR402	4813830A09	MMBZ5226B, 3.3V ZENER
VR500	4813832C77	MR2835S, 24V ZENER
VR501	4813830A14	MMBZ5231B, 5.1V ZENER

Circuit Ref.	Motorola Part No.	Description
VR502	NOT PLACED	MMSZ4686T1, 3.9V ZENER
VR503	4813830G09	MMSZ4684, 3.3V ZENER
VR504	4813830G09	MMSZ4684, 3.3V ZENER
VR692	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR693	4813830A77	MMBZ33VAL, 33V DUAL ZENER
VR694	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR695	4813830A77	MMBZ33VAL, 33V DUAL ZENER
VR696	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR697	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR698	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR699	4813830A75	MMBZ20VAL, 20V DUAL ZENER
Y200	NOT PLACED	45J68, TCXO
Y201	4880114R06	14R06, 16.8MHZ XTAL OSC
Y300	9186145B02	45B02, 455KHZ XTAL
Y301	4880606B09	06B09, 44.395MHZ XTAL OSC

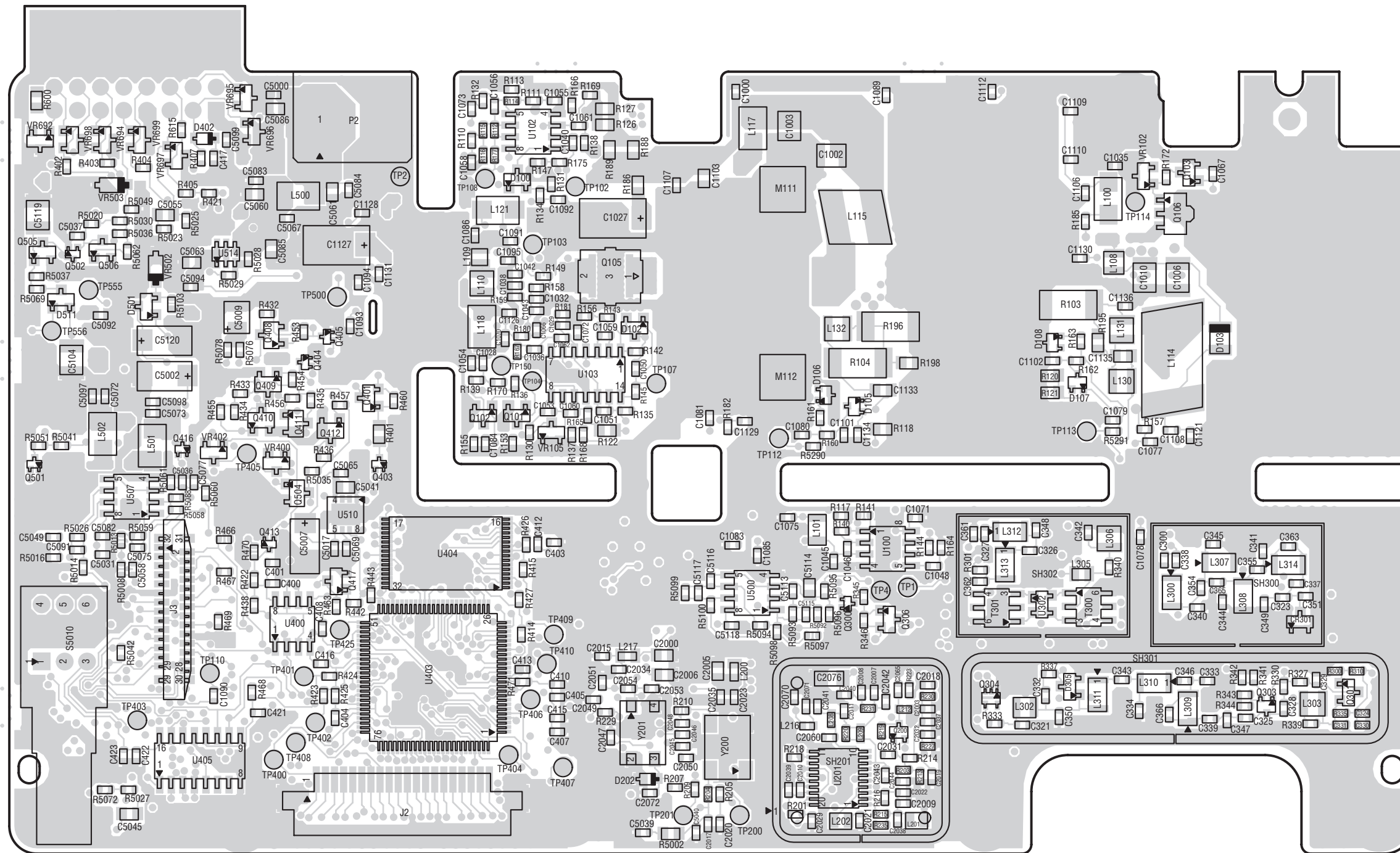
3.0 VHF 25–45 W Band 2 PCB 8486487Z04 / Schematics



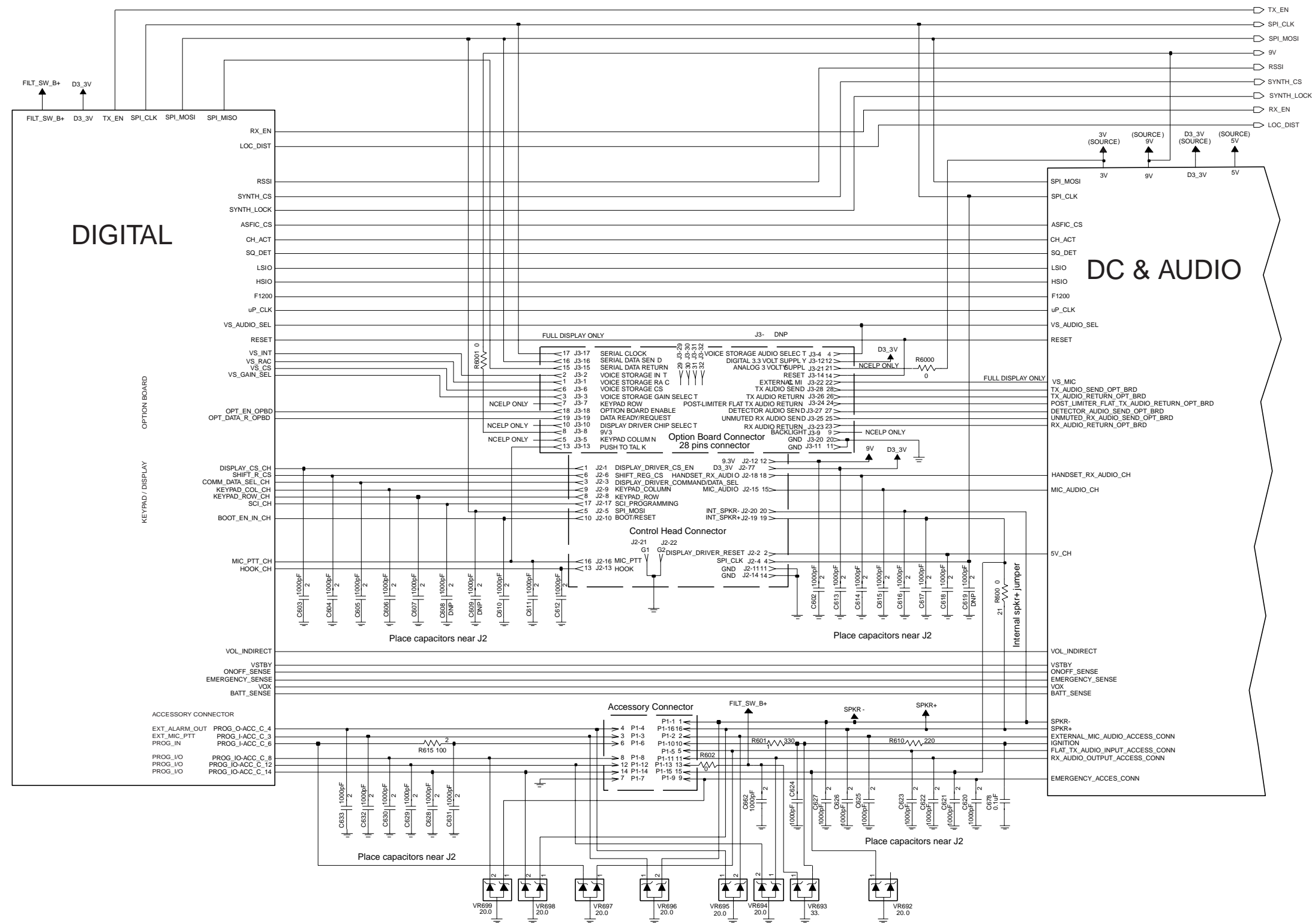
VHF 2 (146–174 MHz) 25–45 W Interconnection between Main Board and Power Amplifier Compartment



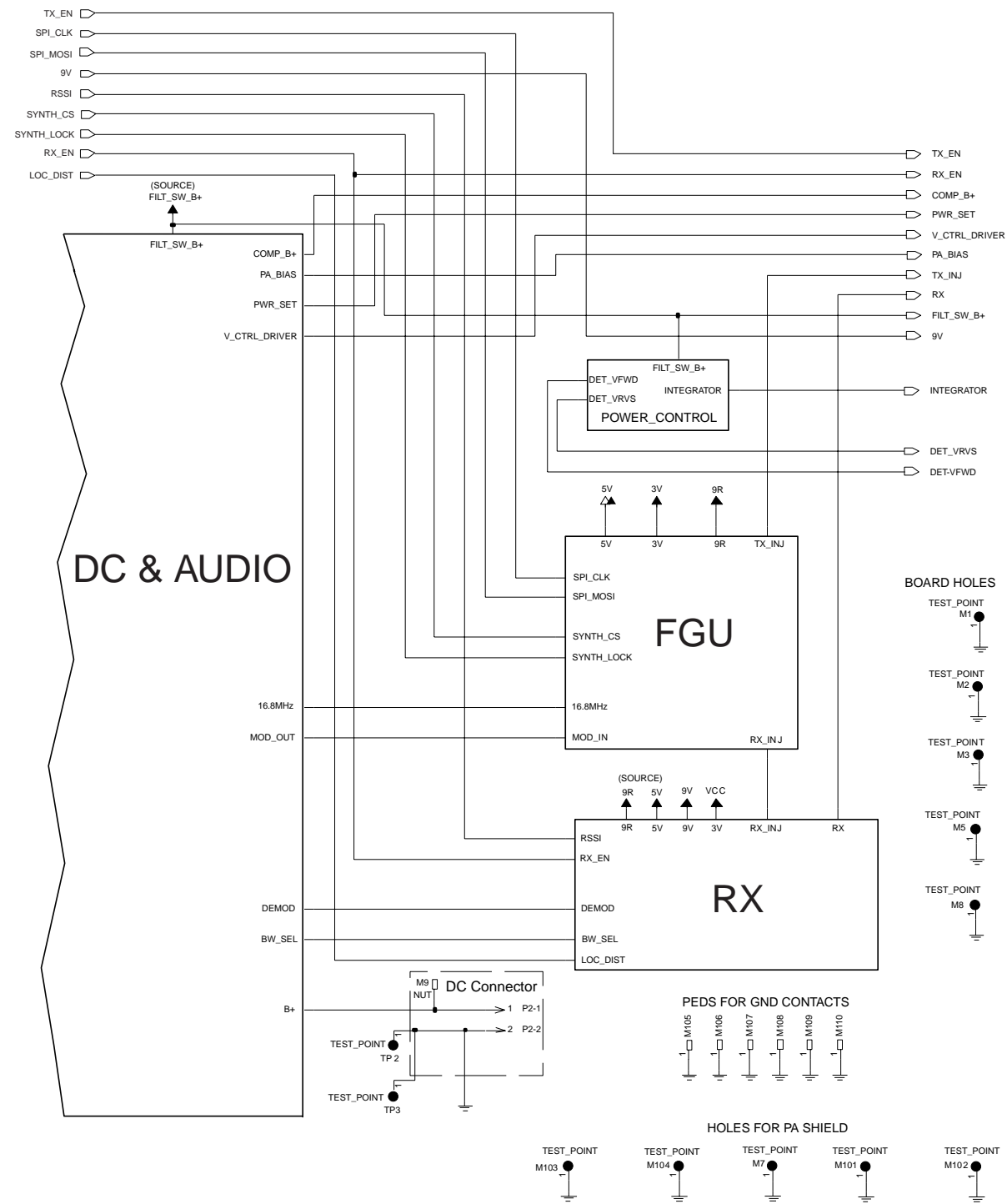
VHF 2 (146-174 MHz) 25-45 W 8486487Z04, Top Side View



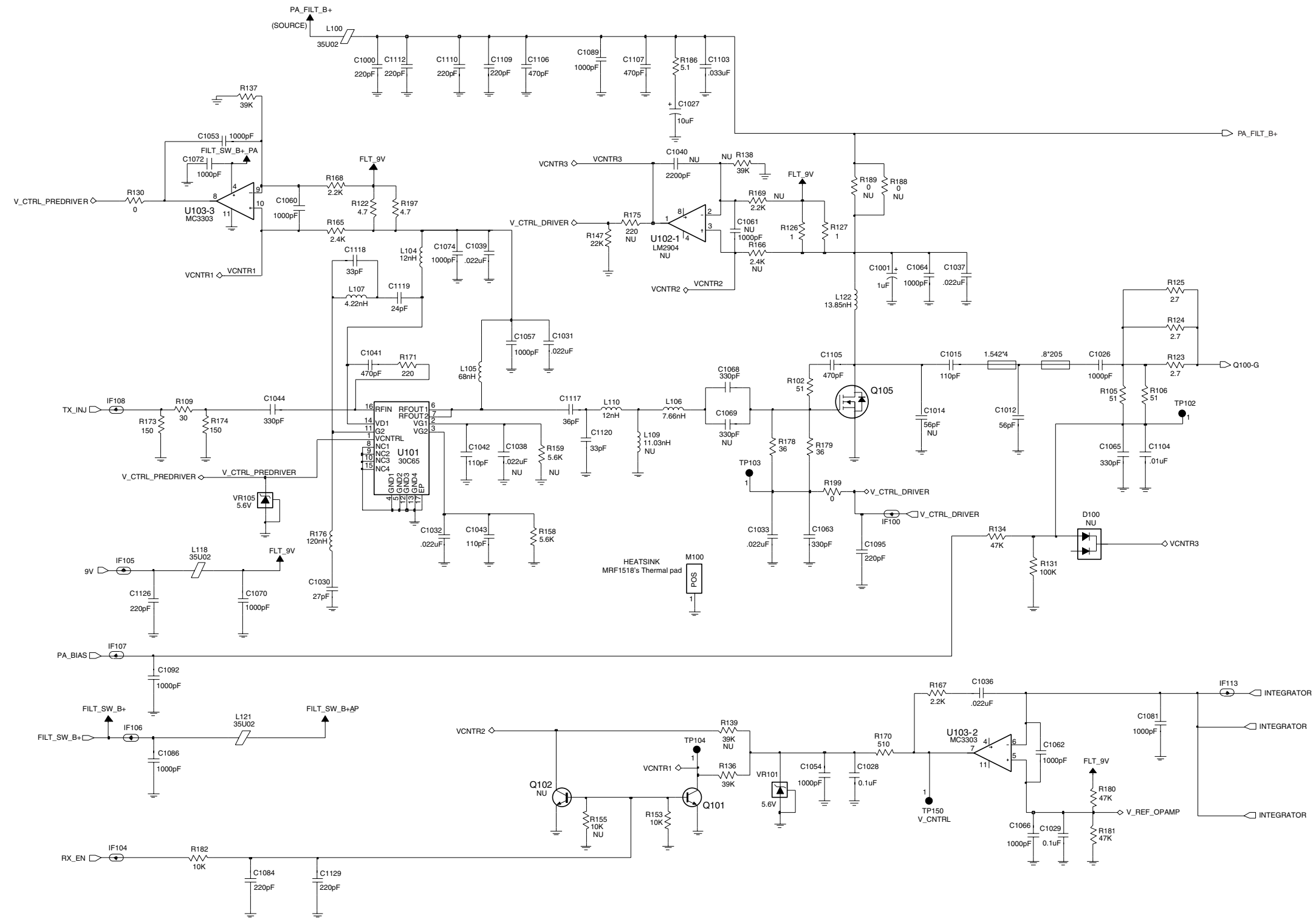
VHF 2 (146–174 MHz) 25–45 W 8486487Z04, Bottom Side View

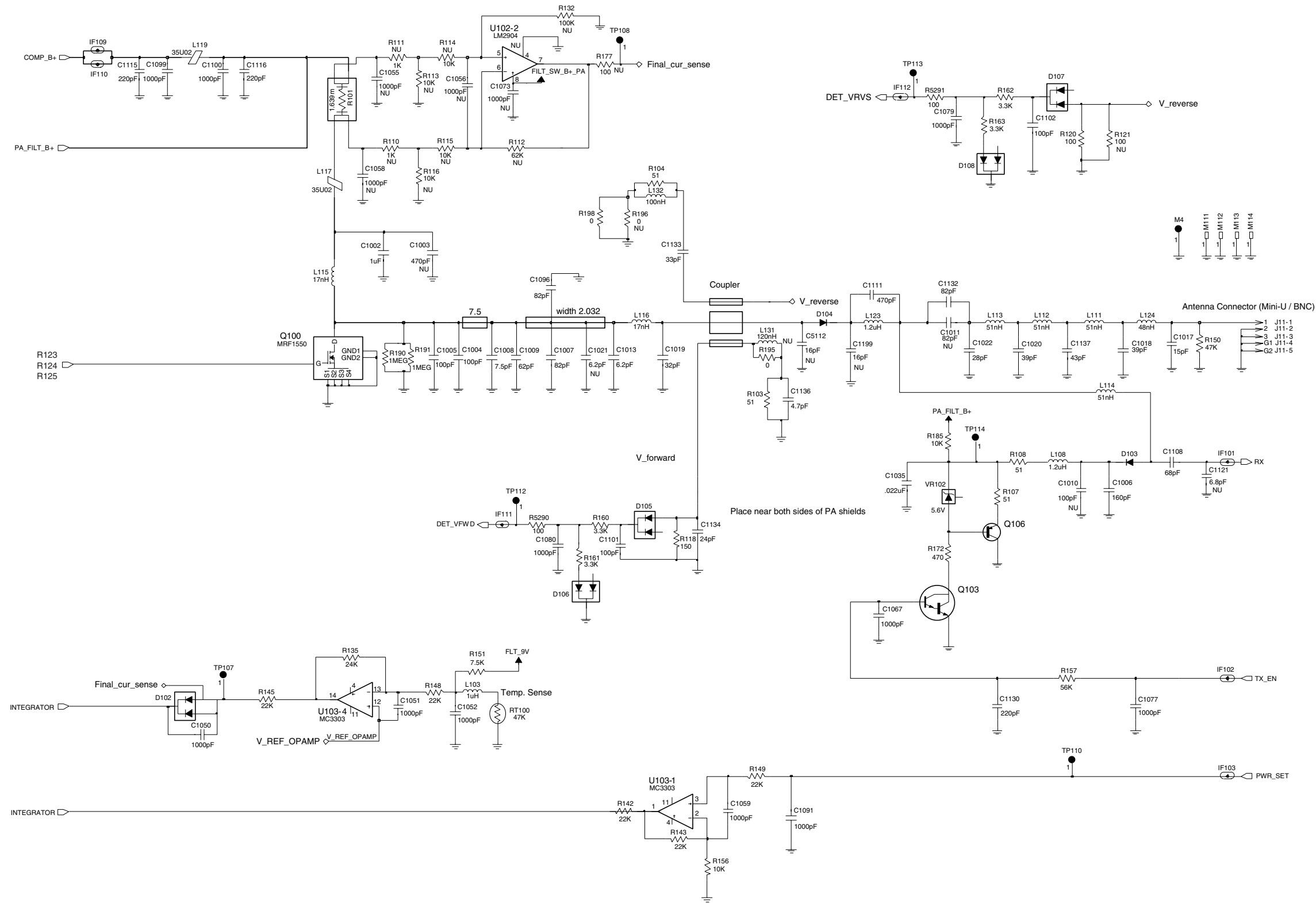


VHF 2 (146-174 MHz) 25-45 W Main Circuit (Sht 1 of 2)

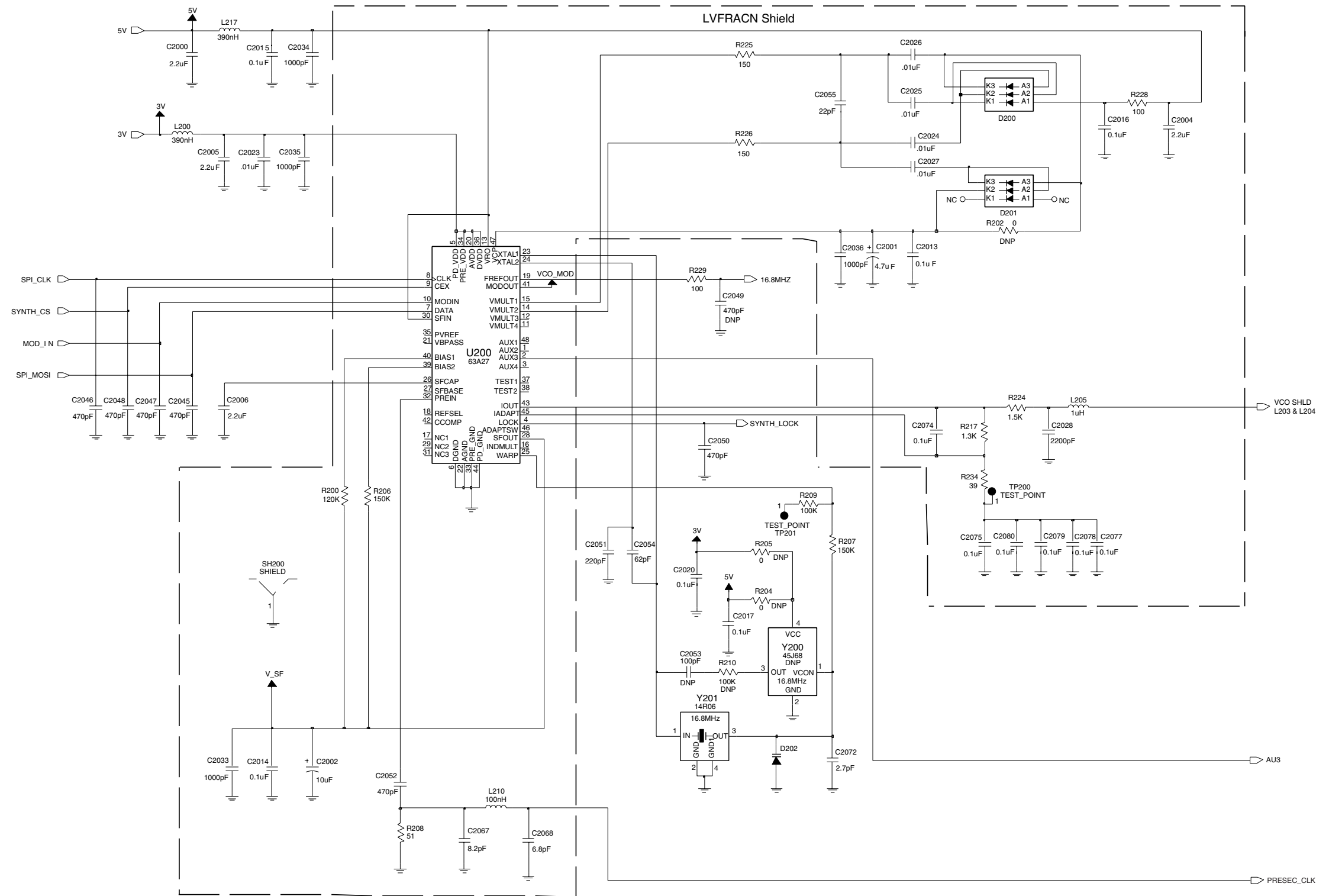


VHF 2 (146-174 MHz) 25-45 W Main Circuit (Sht 2 of 2)

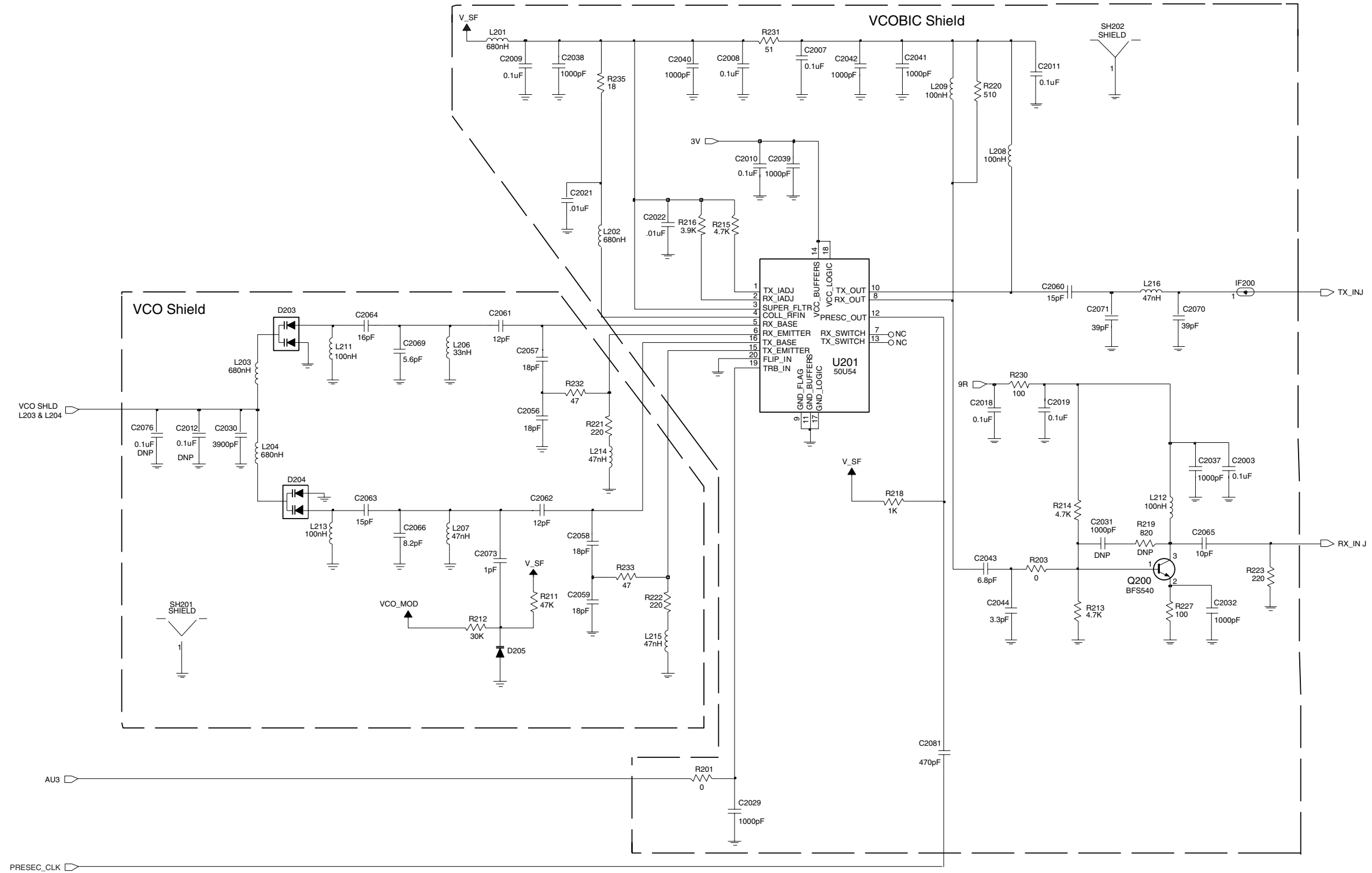




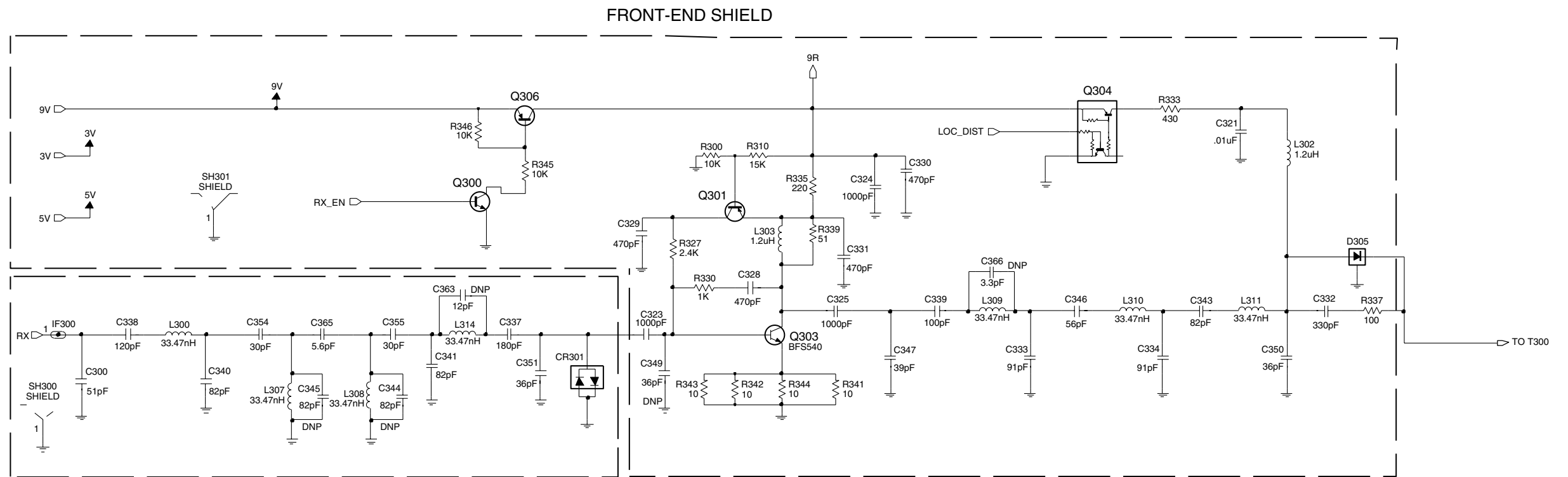
VHF 2 (146-174 MHz) 25-45 W Transmitter (Sht 2 of 2)



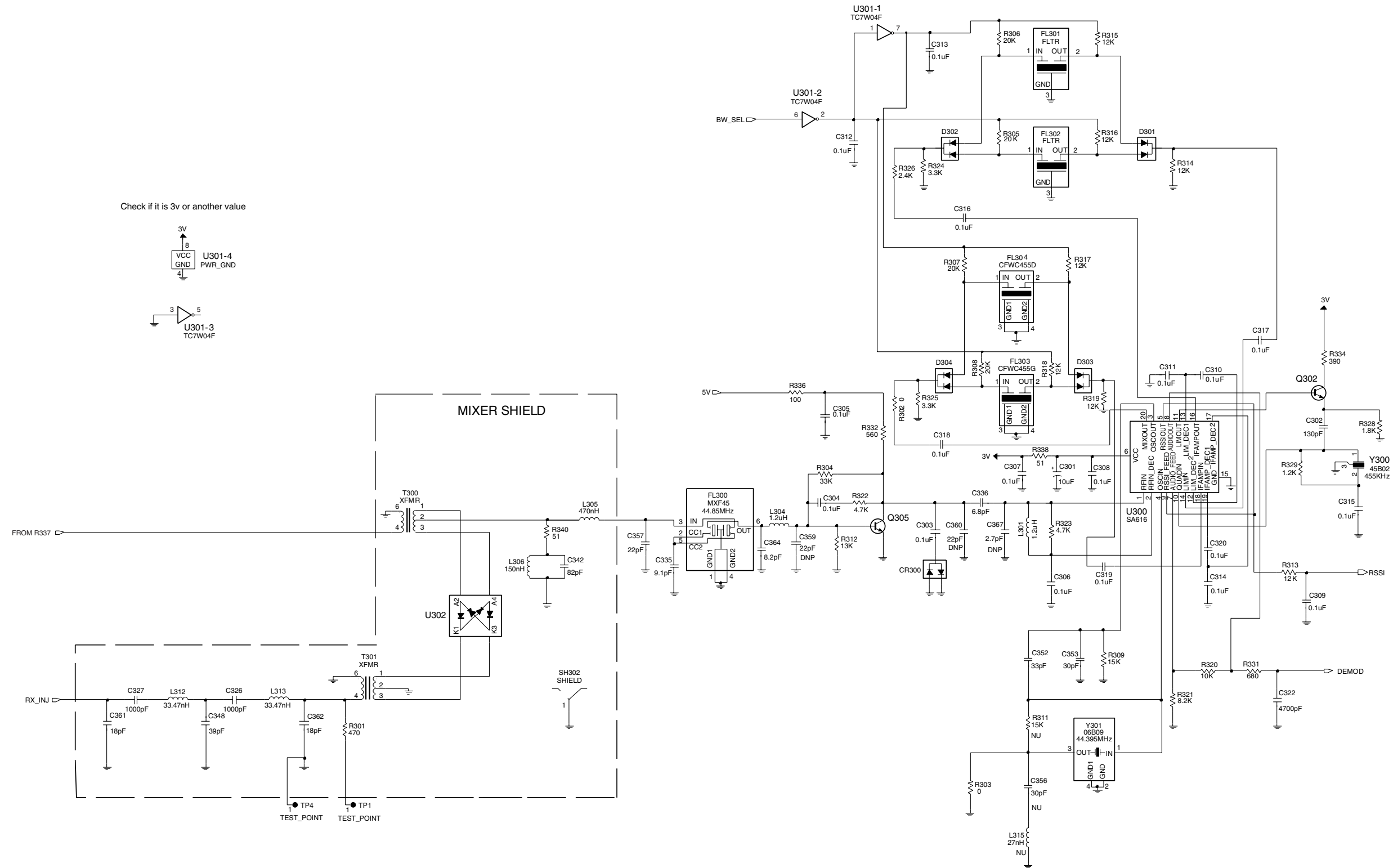
VHF 2 (146-174 MHz) 25-45 W Synthesiser and VCO (Sht 1 of 2)



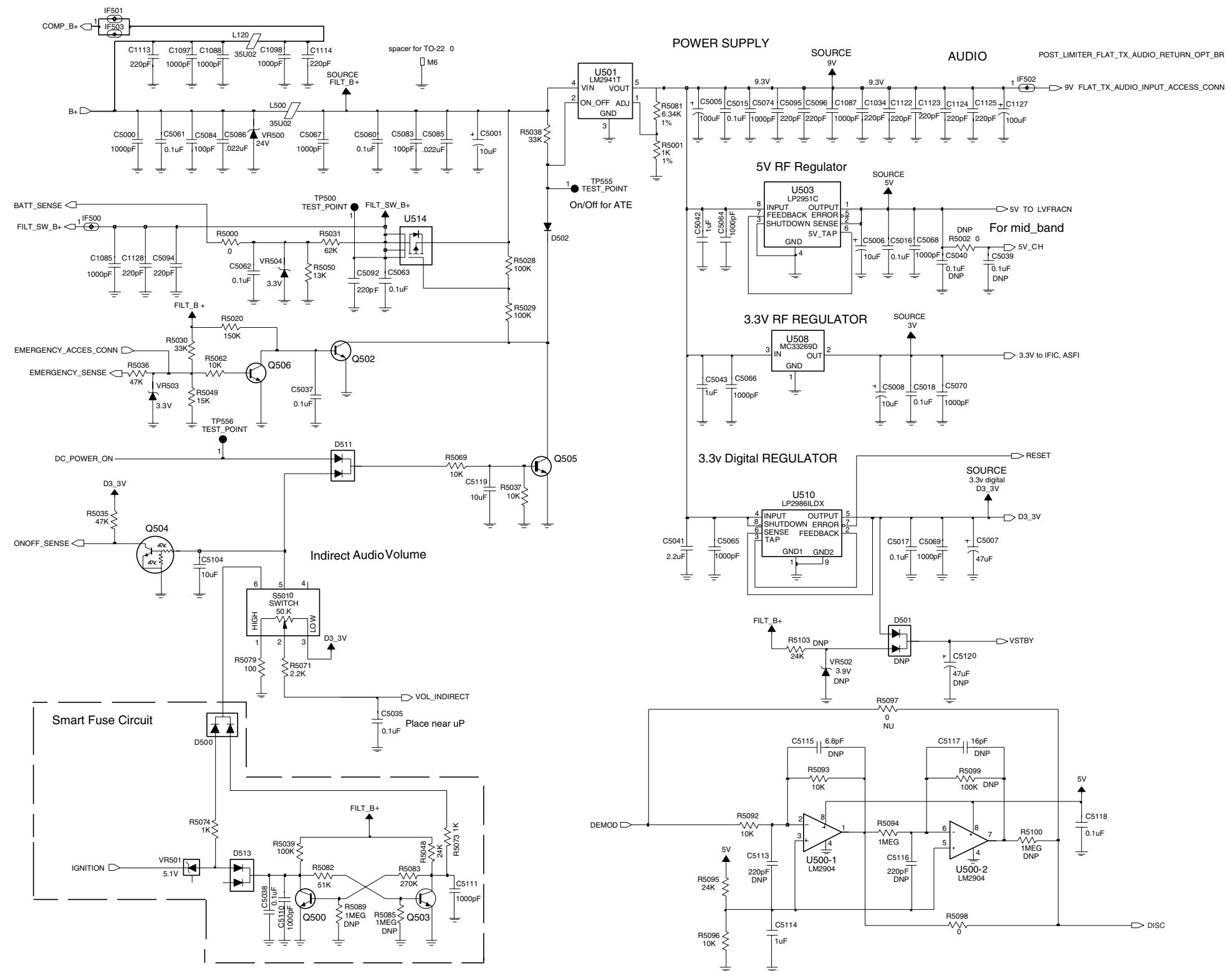
VHF 2 (146-174 MHz) 25-45 W Synthesiser and VCO (Sht 2 of 2)



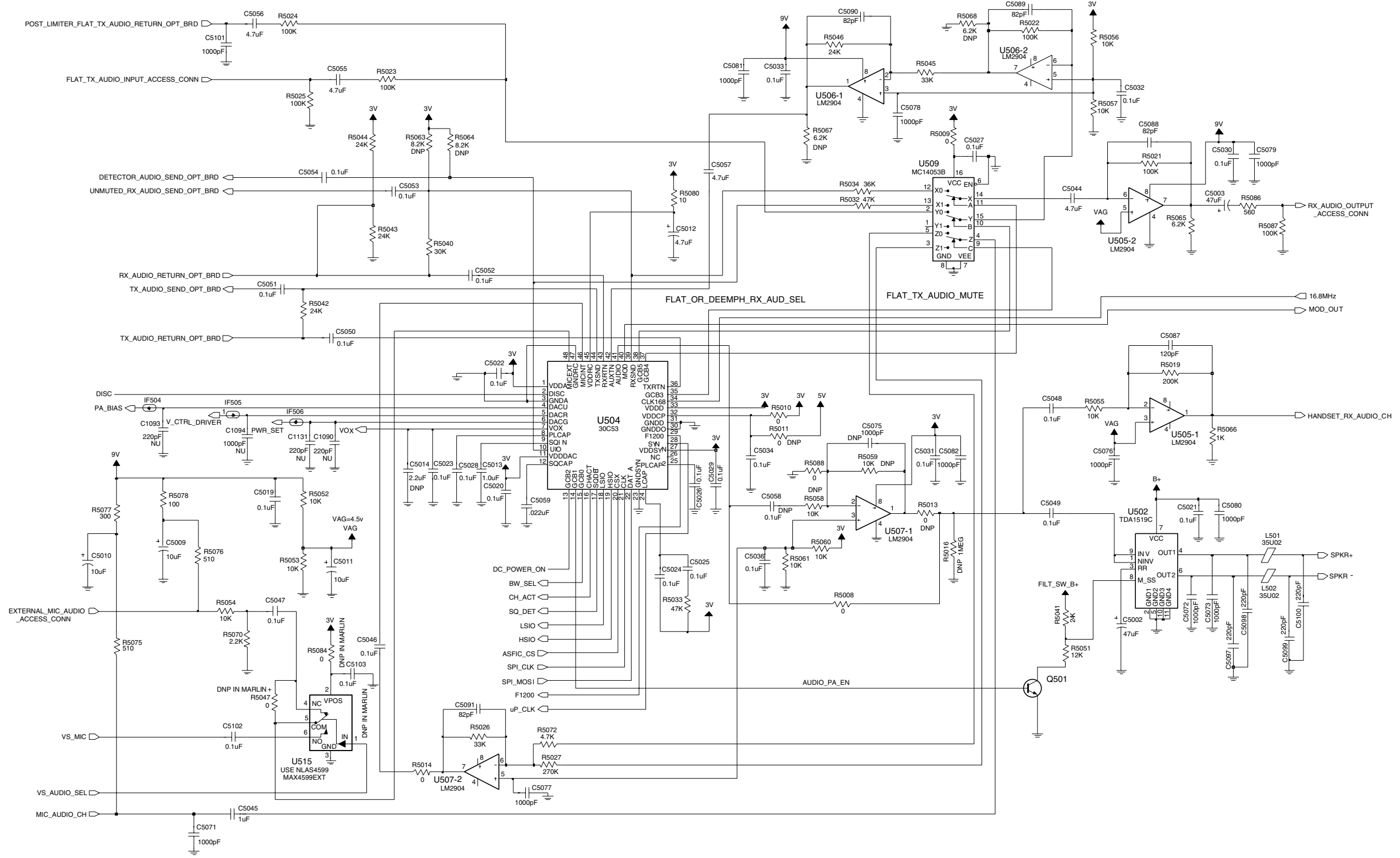
VHF 2 (146-174 MHz) 25-45 W Receiver Front and Back End (Sht 1 of 2)



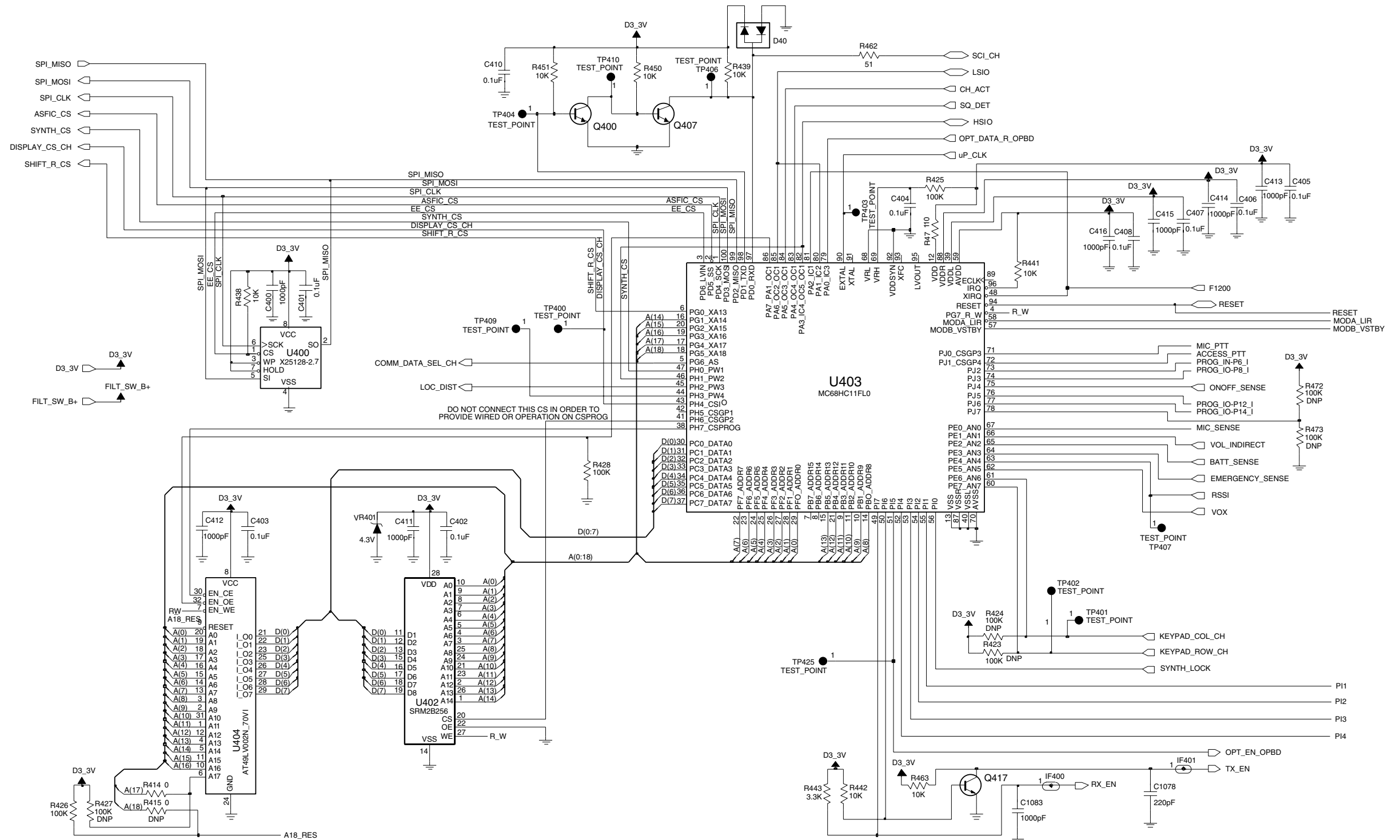
VHF 2 (146-174 MHz) 25-45 W Receiver Front and Back End (Sht 2 of 2)



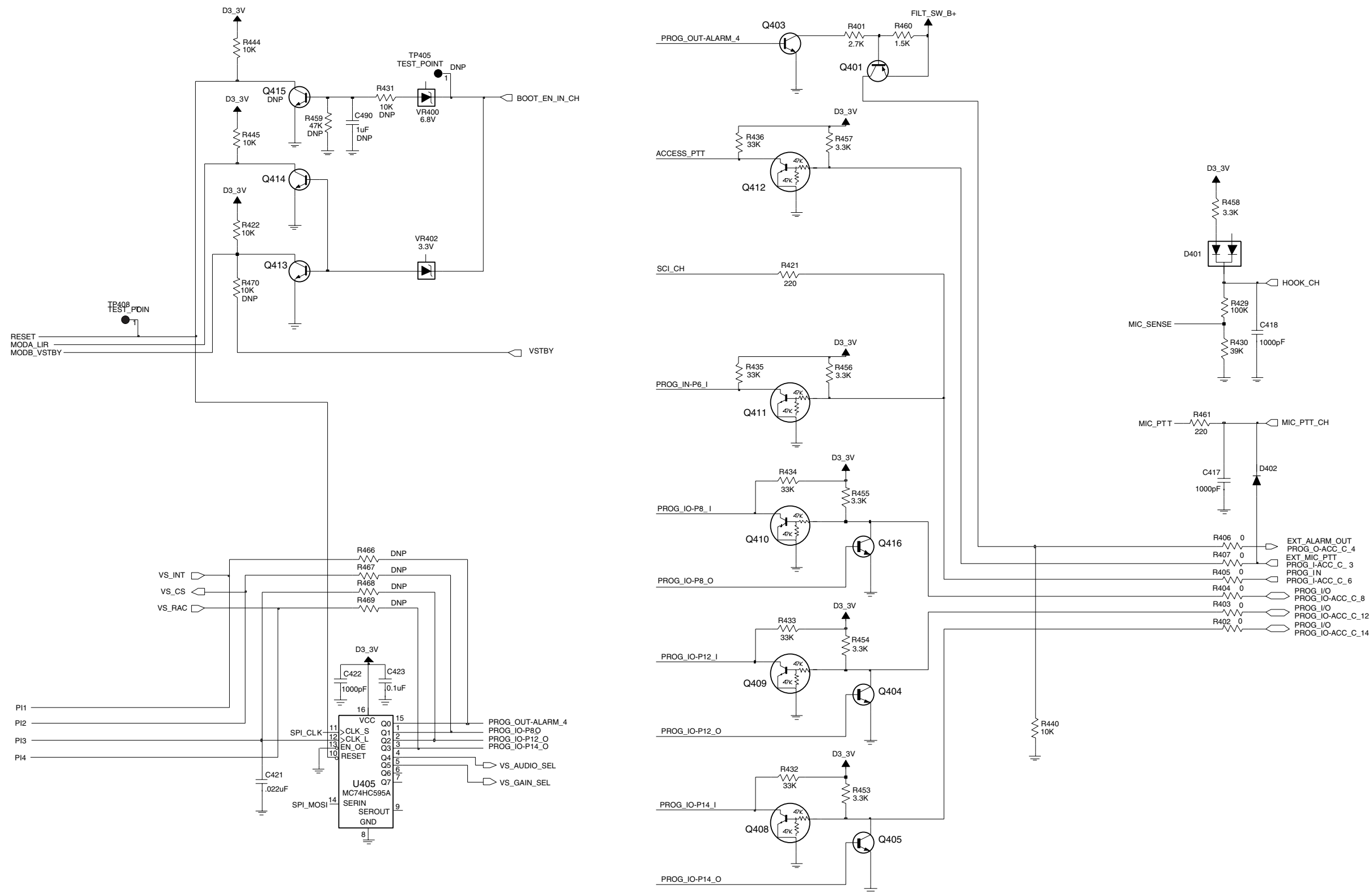
VHF 2 (146-174 MHz) 25-45 W DC and Audio Circuits (Sht 1 of 2)



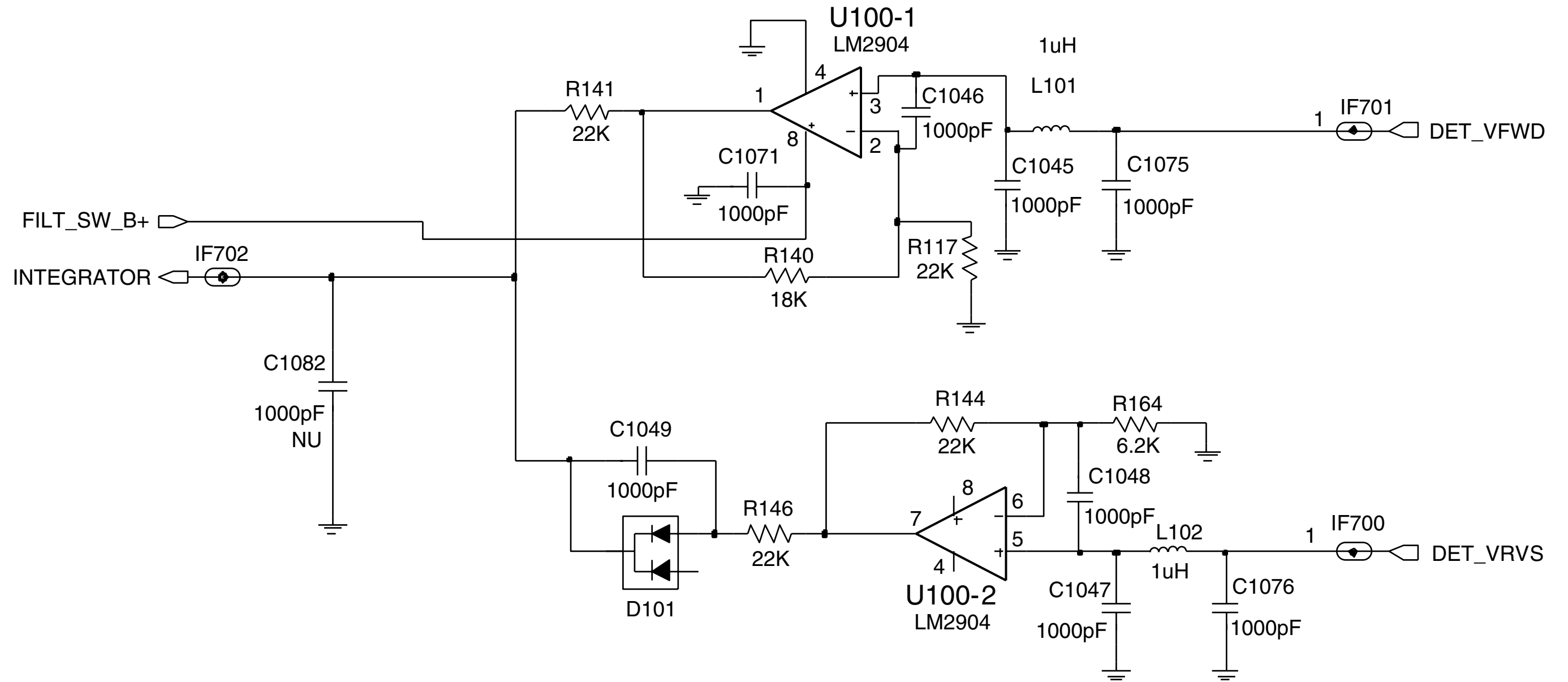
VHF 2 (146-174 MHz) 25-45 W DC and Audio Circuits (Sht 2 of 2)



VHF 2 (146–174 MHz) 25–45 W Microprocessor and Controller Circuits (Sht 1 of 2)



VHF 2 (146-174 MHz) 25-45 W Microprocessor and Controller Circuits (Sht 2 of 2)



VHF 2 (146-174 MHz) 25-45 W Power Control Circuit

**3.1 VHF 2 PCB 8486487Z04
Parts List 25-45 W**

Circuit Ref.	Motorola Part No.	Description
C300	2113740F44	CAP, 51pF
C301	2311049A57	CAP, 10uF
C302	2113740F54	CAP, 130pF
C303	2113743K15	CAP, 0.1uF
C304	2113743E20	CAP, 0.1uF
C305	2113743E20	CAP, 0.1uF
C306	2113743E20	CAP, 0.1uF
C307	2113743E20	CAP, 0.1uF
C308	2113743E20	CAP, 0.1uF
C309	2113743E20	CAP, 0.1uF
C310	2113743E20	CAP, 0.1uF
C311	2113743E20	CAP, 0.1uF
C312	2113743E20	CAP, 0.1uF
C313	2113743E20	CAP, 0.1uF
C314	2113743E20	CAP, 0.1uF
C315	2113743E20	CAP, 0.1uF
C316	2113743E20	CAP, 0.1uF
C317	2113743E20	CAP, 0.1uF
C318	2113743E20	CAP, 0.1uF
C319	2113743E20	CAP, 0.1uF
C320	2113743E20	CAP, 0.1uF
C321	2113741F49	CAP, .01uF
C322	2113741F41	CAP, 4700pF
C323	2113741F25	CAP, 1000pF
C324	2113741F25	CAP, 1000pF
C325	2113741F25	CAP, 1000pF
C326	2113741F25	CAP, 1000pF
C327	2113741F25	CAP, 1000pF
C328	2113740F67	CAP, 470pF

Circuit Ref.	Motorola Part No.	Description
C329	2113740F67	CAP, 470pF
C330	2113740F67	CAP, 470pF
C331	2113740F67	CAP, 470pF
C332	2113741F13	CAP, 330pF
C333	2113740L41	CAP, 91pF
C334	2113740L41	CAP, 91pF
C335	2113740L17	CAP, 9.1pF
C336	2113740L14	CAP, 6.8pF
C337	2113740F57	CAP, 180pF
C338	2113740F53	CAP, 120pF
C339	2113740F51	CAP, 100pF
C340	2113740F49	CAP, 82pF
C341	2113740F49	CAP, 82pF
C342	2113740F49	CAP, 82pF
C343	2113740F49	CAP, 82pF
C344	NOT PLACED	CAP, 82pF
C345	NOT PLACED	CAP, 82pF
C346	2113740F45	CAP, 56pF
C347	2113740F41	CAP, 39pF
C348	2113740F41	CAP, 39pF
C349	NOT PLACED	CAP, 36pF
C350	2113740F40	CAP, 36pF
C351	2113740F40	CAP, 36pF
C352	2113740F39	CAP, 33pF
C353	2113740F38	CAP, 30pF
C354	2113740F38	CAP, 30pF
C355	2113740F38	CAP, 30pF
C356	NOT PLACED	CAP, 30pF
C357	2113740F35	CAP, 22pF
C359	NOT PLACED	CAP, 22pF
C360	NOT PLACED	CAP, 22pF

Circuit Ref.	Motorola Part No.	Description
C361	2113740F33	CAP, 18pF
C362	2113740F33	CAP, 18pF
C363	NOT PLACED	CAP, 12pF
C364	2113740F25	CAP, 8.2pF
C365	2113740F21	CAP, 5.6pF
C366	NOT PLACED	CAP, 3.3pF
C367	NOT PLACED	CAP, 2.7pF
C400	2113741F25	CAP, 1000pF
C401	2113743K15	CAP, 0.1uF
C402	2113743K15	CAP, 0.1uF
C403	2113743K15	CAP, 0.1uF
C404	2113743K15	CAP, 0.1uF
C405	2113743K15	CAP, 0.1uF
C406	2113743K15	CAP, 0.1uF
C407	2113743K15	CAP, 0.1uF
C408	2113743K15	CAP, 0.1uF
C410	2113743K15	CAP, 0.1uF
C411	2113741F25	CAP, 1000pF
C412	2113741F25	CAP, 1000pF
C413	2113741F25	CAP, 1000pF
C414	2113741F25	CAP, 1000pF
C415	2113741F25	CAP, 1000pF
C416	2113741F25	CAP, 1000pF
C417	2113741F25	CAP, 1000pF
C418	2113741F25	CAP, 1000pF
C421	2113743E07	CAP, .022uF
C422	2113741F25	CAP, 1000pF
C423	2113743K15	CAP, 0.1uF
C490	NOT PLACED	CAP, 1uF
C602	2113741F25	CAP, 1000pF
C603	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C604	2113741F25	CAP, 1000pF
C605	2113741F25	CAP, 1000pF
C606	2113741F25	CAP, 1000pF
C607	2113741F25	CAP, 1000pF
C608	NOT PLACED	CAP, 1000pF
C609	NOT PLACED	CAP, 1000pF
C610	2113741F25	CAP, 1000pF
C611	2113741F25	CAP, 1000pF
C612	2113741F25	CAP, 1000pF
C613	2113741F25	CAP, 1000pF
C614	2113741F25	CAP, 1000pF
C615	2113741F25	CAP, 1000pF
C616	2113741F25	CAP, 1000pF
C617	2113741F25	CAP, 1000pF
C618	2113741F25	CAP, 1000pF
C619	NOT PLACED	CAP, 1000pF
C620	2113741F25	CAP, 1000pF
C621	2113741F25	CAP, 1000pF
C622	2113741F25	CAP, 1000pF
C623	2113741F25	CAP, 1000pF
C624	2113741F25	CAP, 1000pF
C625	2113741F25	CAP, 1000pF
C626	2113741F25	CAP, 1000pF
C627	2113741F25	CAP, 1000pF
C628	2113741F25	CAP, 1000pF
C629	2113741F25	CAP, 1000pF
C630	2113741F25	CAP, 1000pF
C631	2113741F25	CAP, 1000pF
C632	2113741F25	CAP, 1000pF
C633	2113741F25	CAP, 1000pF
C662	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C678	2113741M69	CAP, 0.1uF
C1000	2113740F59	CAP, 220pF
C1001	2311049A08	CAPP, 1uF
C1002	2113741W01	CAP, 1uF
C1003	NOT PLACED	CAP, 470pF
C1004	2111078B42	CAP, 100pF
C1005	2111078B42	CAP, 100pF
C1006	2111078B48	CAP, 160pF
C1007	2111078B40	CAP, 82pF
C1008	2111078B10	CAP, 7.5pF
C1009	2111078B37	CAP, 62pF
C1010	NOT PLACED	CAP, 100pF
C1011	2111078B40	CAP, 82pF
C1012	2111078B36	CAP, 56pF
C1013	2111078B08	CAP, 6.2pF
C1014	NOT PLACED	CAP, 56pF
C1015	2111078B43	CAP, 110pF
C1017	2111078B18	CAP, 15pF
C1018	2111078B32	CAP, 39pF
C1019	2111078B28	CAP, 32pF
C1020	2111078B32	CAP, 39pF
C1021	NOT PLACED	CAP, 6.2pF
C1022	2111078B26	CAP, 28pF
C1026	2113740A79	CAP, 1000pF
C1027	2311049A45	CAPP, 10uF
C1028	2113743K15	CAP, 0.1uF
C1029	2113743K15	CAP, 0.1uF
C1030	2113740F37	CAP, 27pF
C1031	2113743E07	CAP, .022uF
C1032	2113743E07	CAP, .022uF

Circuit Ref.	Motorola Part No.	Description
C1033	2113743E07	CAP, .022uF
C1034	2113740F59	CAP, 220pF
C1035	2113743E07	CAP, .022uF
C1036	2113743E07	CAP, .022uF
C1037	2113743E07	CAP, .022uF
C1038	NOT PLACED	CAP, .022uF
C1039	2113743E07	CAP, .022uF
C1040	NOT PLACED	CAP, 2200pF
C1041	2113741F17	CAP, 470pF
C1042	2113740F52	CAP, 110pF
C1043	2113740F52	CAP, 110pF
C1044	2113741F13	CAP, 330pF
C1045	2113741F25	CAP, 1000pF
C1046	2113741F25	CAP, 1000pF
C1047	2113741F25	CAP, 1000pF
C1048	2113741F25	CAP, 1000pF
C1049	2113741F25	CAP, 1000pF
C1050	2113741F25	CAP, 1000pF
C1051	2113741F25	CAP, 1000pF
C1052	2113741F25	CAP, 1000pF
C1053	2113741F25	CAP, 1000pF
C1054	2113741F25	CAP, 1000pF
C1055	NOT PLACED	CAP, 1000pF
C1056	NOT PLACED	CAP, 1000pF
C1057	2113741F25	CAP, 1000pF
C1058	NOT PLACED	CAP, 1000pF
C1059	2113741F25	CAP, 1000pF
C1060	2113741F25	CAP, 1000pF
C1061	NOT PLACED	CAP, 1000pF
C1062	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C1063	2113740F63	CAP, 330pF
C1064	2113741F25	CAP, 1000pF
C1065	2113740F63	CAP, 330pF
C1066	2113741F25	CAP, 1000pF
C1067	2113741F25	CAP, 1000pF
C1068	2113741F13	CAP, 330pF
C1069	NOT PLACED	CAP, 330pF
C1070	2113741F25	CAP, 1000pF
C1071	2113741F25	CAP, 1000pF
C1072	2113741F25	CAP, 1000pF
C1073	NOT PLACED	CAP, 1000pF
C1074	2113741F25	CAP, 1000pF
C1075	2113741F25	CAP, 1000pF
C1076	2113741F25	CAP, 1000pF
C1077	2113741F25	CAP, 1000pF
C1078	2113740F59	CAP, 220pF
C1079	2113741F25	CAP, 1000pF
C1080	2113741F25	CAP, 1000pF
C1081	2113741F25	CAP, 1000pF
C1082	NOT PLACED	CAP, 1000pF
C1083	2113741F25	CAP, 1000pF
C1084	2113740F59	CAP, 220pF
C1085	2113741F25	CAP, 1000pF
C1086	2113741F25	CAP, 1000pF
C1087	2113741F25	CAP, 1000pF
C1088	2113741F25	CAP, 1000pF
C1089	2113741F25	CAP, 1000pF
C1090	NOT PLACED	CAP, 220pF
C1091	2113741F25	CAP, 1000pF
C1092	2113741F25	CAP, 1000pF

Circuit Ref.	Motorola Part No.	Description
C1093	NOT PLACED	CAP, 220pF
C1094	NOT PLACED	CAP, 1000pF
C1095	2113740F59	CAP, 220pF
C1096	2111078B40	CAP, 82pF
C1097	2113741F25	CAP, 1000pF
C1098	2113741F25	CAP, 1000pF
C1099	2113741F25	CAP, 1000pF
C1100	2113741F25	CAP, 1000pF
C1101	2113741F01	CAP, 100pF
C1102	2113741F01	CAP, 100pF
C1103	2113741A57	CAP, .033uF
C1104	2113741A45	CAP, .01uF
C1105	2113740F67	CAP, 470pF
C1106	2113740F67	CAP, 470pF
C1107	2113740F67	CAP, 470pF
C1108	2113740F47	CAP, 68pF
C1109	2113740F59	CAP, 220pF
C1110	2113740F59	CAP, 220pF
C1111	2111078B59	CAP, 470pF
C1112	2113740F59	CAP, 220pF
C1113	2113740F59	CAP, 220pF
C1114	2113740F59	CAP, 220pF
C1115	2113740F59	CAP, 220pF
C1116	2113740F59	CAP, 220pF
C1117	2113740F40	CAP, 36pF
C1118	2113740F39	CAP, 33pF
C1119	2113740F36	CAP, 24pF
C1120	2113740F39	CAP, 33pF
C1121	NOT PLACED	CAP, 6.8pF
C1122	2113740F59	CAP, 220pF

Circuit Ref.	Motorola Part No.	Description
C1123	2113740F59	CAP, 220pF
C1124	2113740F59	CAP, 220pF
C1125	2113740F59	CAP, 220pF
C1126	2113740F59	CAP, 220pF
C1127	2360567A03	CAPP, 100uF
C1128	2113740F59	CAP, 220pF
C1129	2113740F59	CAP, 220pF
C1130	2113740F59	CAP, 220pF
C1131	NOT PLACED	CAP, 220pF
C1132	2111078B40	CAP, 82pF
C1133	0662057C01	RES, 0
C1134	NOT PLACED	RES, 100
C1135	0662057C01	RES, 0
C1136	NOT PLACED	CAP, 4.7pF
C1137	2111078B33	CAP, 43pF
C1199	NOT PLACED	CAP, 16pF
C2000	2113743F18	CAP, 2.2uF
C2001	2311049J11	CAPP, 4.7uF
C2002	2311049A72	CAPP, 10uF
C2003	2113743K15	CAP, 0.1uF
C2004	2113743F18	CAP, 2.2uF
C2005	2113743F18	CAP, 2.2uF
C2006	2113743F18	CAP, 2.2uF
C2007	2113743E20	CAP, 0.1uF
C2008	2113743E20	CAP, 0.1uF
C2009	2113743E20	CAP, 0.1uF
C2010	2113743E20	CAP, 0.1uF
C2011	2113743E20	CAP, 0.1uF
C2012	NOT PLACED	CAP, 0.1uF
C2013	2113743E20	CAP, 0.1uF
C2014	2113743E20	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C2015	2113743E20	CAP, 0.1uF
C2016	2113743E20	CAP, 0.1uF
C2017	2113743E20	CAP, 0.1uF
C2018	2113743E20	CAP, 0.1uF
C2019	2113743E20	CAP, 0.1uF
C2020	2113743E20	CAP, 0.1uF
C2021	2113741F49	CAP, .01uF
C2022	2113741F49	CAP, .01uF
C2023	2113741F49	CAP, .01uF
C2024	2113741F49	CAP, .01uF
C2025	2113741F49	CAP, .01uF
C2026	2113741F49	CAP, .01uF
C2027	2113741F49	CAP, .01uF
C2028	2113741F33	CAP, 2200pF
C2029	2113741F25	CAP, 1000pF
C2030	2113741F39	CAP, 3900pF
C2031	NOT PLACED	CAP, 1000pF
C2032	2113741F25	CAP, 1000pF
C2033	2113741F25	CAP, 1000pF
C2034	2113741F25	CAP, 1000pF
C2035	2113741F25	CAP, 1000pF
C2036	2113741F25	CAP, 1000pF
C2037	2113741F25	CAP, 1000pF
C2038	2113741F25	CAP, 1000pF
C2039	2113741F25	CAP, 1000pF
C2040	2113741F25	CAP, 1000pF
C2041	2113741F25	CAP, 1000pF
C2042	2113741F25	CAP, 1000pF
C2043	2113740L14	CAP, 6.8pF
C2044	2113740L06	CAP, 3.3pF
C2045	2113740F67	CAP, 470pF

Circuit Ref.	Motorola Part No.	Description
C2046	2113740F67	CAP, 470pF
C2047	2113740F67	CAP, 470pF
C2048	2113740F67	CAP, 470pF
C2049	NOT PLACED	CAP, 470pF
C2050	2113740F67	CAP, 470pF
C2051	2113740F59	CAP, 220pF
C2052	2113740F67	CAP, 100pF
C2053	NOT PLACED	CAP, 100pF
C2054	2113740L37	CAP, 62pF
C2055	2113740F35	CAP, 22pF
C2056	2113740F33	CAP, 18pF
C2057	2113740F33	CAP, 18pF
C2058	2113740F33	CAP, 18pF
C2059	2113740F33	CAP, 18pF
C2060	2113740F31	CAP, 15pF
C2061	2113740F29	CAP, 12pF
C2062	2113740F29	CAP, 12pF
C2063	2113740L22	CAP, 15pF
C2064	2113740F32	CAP, 16pF
C2065	2113740F27	CAP, 10pF
C2066	2113740L16	CAP, 8.2pF
C2067	2113740F25	CAP, 8.2pF
C2068	2113740F23	CAP, 6.8pF
C2069	2113740L12	CAP, 5.6pF
C2070	2113740F41	CAP, 39pF
C2071	2113740F41	CAP, 39pF
C2072	2113740L04	CAP, 2.7pF
C2073	2113740F03	CAP, 1pF
C2074	2109720D14	CAP, 0.1uF
C2075	2109720D14	CAP, 0.1uF
C2076	NOT PLACED	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C2077	2109720D14	CAP, 0.1uF
C2078	2109720D14	CAP, 0.1uF
C2079	2109720D14	CAP, 0.1uF
C2080	2109720D14	CAP, 0.1uF
C2081	2113740F67	CAP, 470pF
C5000	2113741F25	CAP, 1000pF
C5001	2389289U01	CAPP, 10uF
C5002	2311049A99	CAPP, 47uF
C5003	2311049A99	CAPP, 47uF
C5005	2360567A03	CAPP, 100uF
C5006	2311049A57	CAPP, 10uF
C5007	2311049A99	CAPP, 47uF
C5008	2311049A57	CAPP, 10uF
C5009	2311049A57	CAPP, 10uF
C5010	2311049A57	CAPP, 10uF
C5011	2311049A57	CAPP, 10uF
C5012	2311049A56	CAPP, 4.7uF
C5013	2113928P04	CAP, 1.0uF
C5014	NOT PLACED	CAP, 2.2uF
C5015	2113743K15	CAP, 0.1uF
C5016	2113743K15	CAP, 0.1uF
C5017	2113743K15	CAP, 0.1uF
C5018	2113743K15	CAP, 0.1uF
C5019	2113743K15	CAP, 0.1uF
C5020	2113743K15	CAP, 0.1uF
C5021	2113741M69	CAP, 0.1uF
C5022	2113743K15	CAP, 0.1uF
C5023	2113743K15	CAP, 0.1uF
C5024	2113743K15	CAP, 0.1uF
C5025	2113743K15	CAP, 0.1uF
C5026	2113743K15	CAP, 0.1uF

Circuit Ref.	Motorola Part No.	Description
C5027	2113743K15	CAP, 0.1uF
C5028	2113743K15	CAP, 0.1uF
C5029	2113743K15	CAP, 0.1uF
C5030	2113743K15	CAP, 0.1uF
C5031	2113743K15	CAP, 0.1uF
C5032	2113743K15	CAP, 0.1uF
C5033	2113743K15	CAP, 0.1uF
C5034	2113743K15	CAP, 0.1uF
C5035	2113743K15	CAP, 0.1uF
C5036	2113743K15	CAP, 0.1uF
C5037	2113743K15	CAP, 0.1uF
C5038	2113743K15	CAP, 0.1uF
C5039	NOT PLACED	CAP, 0.1uF
C5040	NOT PLACED	CAP, 0.1uF
C5041	2113743F18	CAP, 2.2uF
C5042	2113743F16	CAP, 1uF
C5043	2113743F16	CAP, 1uF
C5044	2113928C04	CAP, 1uF
C5045	2113743F16	CAP, 1uF
C5046	2113743E20	CAP, 0.1uF
C5047	2113743E20	CAP, 0.1uF
C5048	2113743E20	CAP, 0.1uF
C5049	2113743E20	CAP, 0.1uF
C5050	2113743E20	CAP, 0.1uF
C5051	NOT PLACED	CAP, 0.1uF
C5052	2113743E20	CAP, 0.1uF
C5053	NOT PLACED	CAP, 0.1uF
C5054	NOT PLACED	CAP, 0.1uF
C5055	2113928C04	CAP, 4.7uF
C5056	2113928C04	CAP, 4.7uF

Circuit Ref.	Motorola Part No.	Description
C5057	2113928C04	CAP, 4.7uF
C5058	NOT PLACED	CAP, 0.1uF
C5059	2113743E07	CAP, .022uF
C5060	2113741M69	CAP, 0.1uF
C5061	2113741M69	CAP, 0.1uF
C5062	2113741M69	CAP, 0.1uF
C5063	2113741M69	CAP, 0.1uF
C5064	2113741F25	CAP, 1000pF
C5065	2113741F25	CAP, 1000pF
C5066	2113741F25	CAP, 1000pF
C5067	2113741F25	CAP, 1000pF
C5068	2113741F25	CAP, 1000pF
C5069	2113741F25	CAP, 1000pF
C5070	2113741F25	CAP, 1000pF
C5071	2113741F25	CAP, 1000pF
C5072	2113741F25	CAP, 1000pF
C5073	2113741F25	CAP, 1000pF
C5074	2113741F25	CAP, 1000pF
C5075	NOT PLACED	CAP, 1000pF
C5076	2113741F25	CAP, 1000pF
C5077	2113741F25	CAP, 1000pF
C5078	2113741F25	CAP, 1000pF
C5079	2113741F25	CAP, 1000pF
C5080	2113741F25	CAP, 1000pF
C5081	2113741F25	CAP, 1000pF
C5082	2113741F25	CAP, 1000pF
C5083	2113740F51	CAP, 100pF
C5084	2113740F51	CAP, 100pF
C5085	2113741A53	CAP, .022uF
C5086	2113741A53	CAP, .022uF

Circuit Ref.	Motorola Part No.	Description
C5087	2113740F53	CAP, 120pF
C5088	2113740F49	CAP, 82pF
C5089	2113740F49	CAP, 82pF
C5090	2113740F49	CAP, 82pF
C5091	2113740F49	CAP, 82pF
C5092	2113740F59	CAP, 220pF
C5094	2113740F59	CAP, 220pF
C5095	2113740F59	CAP, 220pF
C5096	2113740F59	CAP, 220pF
C5097	2113740F59	CAP, 220pF
C5098	2113740F59	CAP, 220pF
C5099	2113740F59	CAP, 220pF
C5100	2113740F59	CAP, 220pF
C5101	NOT PLACED	CAP, 1000pF
C5102	NOT PLACED	CAP, 0.1uF
C5103	NOT PLACED	CAP, 0.1uF
C5104	NOT PLACED	CAP, 10uF
C5110	2113741F25	CAP, 1000pF
C5111	2113741F25	CAP, 1000pF
C5112	NOT PLACED	CAP, 16pF
C5113	NOT PLACED	CAP, 220pF
C5114	2113743F16	CAP, 1uF
C5115	NOT PLACED	CAP, 6.8pF
L502	7686135U02	FERRITE BEAD
M6	4387454V01	SPACER
M9	0289511U01	NUT
M100	2680499Z01	HEATSINK
M105	7588823L03	CONTACT, METAL
M106	7588823L03	CONTACT, METAL
M107	7588823L03	CONTACT, METAL

Circuit Ref.	Motorola Part No.	Description
M108	7588823L04	CONTACT, METAL
M109	7588823L04	CONTACT, METAL
M110	7588823L04	CONTACT, METAL
M111	NOT PLACED	CONTACT, METAL
M112	NOT PLACED	CONTACT, METAL
P1	2804503J01	CONNECTOR, 16 PIN
P2	NOT PLACED	CONNECTOR, 2 PIN DC
Q100	4886136B01	MRF1550, LD MOS RF
Q101	4813824A10	MMBT3904, BIPOLAR NPN
Q102	4813824A10	MMBT3904, BIPOLAR NPN
Q103	4813824A06	MMBTA13, DARLINGTON, NPN
Q105	4886212B01	MRF1518, LD MOS RF
Q106	4805128M27	BSR33, BIPOLAR, PNP
Q200	4802245J95	BFS540, NPN
Q300	4809940E02	DTC114YE, NPN
Q301	4813824A17	MMBT3906, BIPOLAR PNP
Q302	4813824A10	MMBT3904, BIPOLAR NPN
Q303	4802245J95	BFS540, NPN
Q304	4809939C04	UMC3
Q305	4802197J95	PBR941, NPN
Q306	4813824A17	MMBT3906, BIPOLAR
Q400	4809940E02	DTC114YE, NPN
Q401	4880141L03	BCW68G, BIPOLAR PNP
Q403	4809940E02	DTC114YE, NPN
Q404	4809940E02	DTC114YE, NPN
Q405	4809940E02	DTC114YE, NPN
Q407	4809940E02	DTC114YE, NPN

Circuit Ref.	Motorola Part No.	Description
Q408	4880048M01	DTC144EKA, BIPOLAR
Q409	4880048M01	DTC144EKA, BIPOLAR
Q410	4880048M01	DTC144EKA, BIPOLAR
Q411	4880048M01	DTC144EKA, BIPOLAR
Q412	4880048M01	DTC144EKA, BIPOLAR
Q413	4809940E02	DTC114YE, NPN
Q414	4809940E02	DTC114YE, NPN
Q415	NOT PLACED	MMBT3904
Q416	4809940E02	DTC114YE, NPN
Q417	4813824A10	MMBT3904, BIPOLAR NPN
Q500	4813824A10	MMBT3904, BIPOLAR NPN
Q501	4809940E02	DTC114YE, NPN
Q502	4809940E02	DTC114YE, NPN
Q503	4813824A10	MMBT3904, BIPOLAR NPN
Q504	4880048M01	DTC144EKA, BIPOLAR
Q505	4813824A10	MMBT3904, BIPOLAR NPN
Q506	4813824A10	MMBT3904, BIPOLAR NPN
R101	1705603W01	SHUNT, 1.639m
R102	0680194M18	RES, 51
R103	0683962T51	RES, 120
R104	0680194M18	RES, 51
R105	0680194M18	RES, 51
R106	0680194M18	RES, 51
R107	0680194M18	RES, 51
R108	0680194M18	RES, 51
R109	0662057A12	RES, 30
R110	NOT PLACED	RES, 1K

Circuit Ref.	Motorola Part No.	Description
R111	NOT PLACED	RES, 1K
R112	NOT PLACED	RES, 62K
R113	NOT PLACED	RES, 10K
R114	NOT PLACED	RES, 10K
R115	NOT PLACED	RES, 10K
R116	NOT PLACED	RES, 10K
R117	0662057A77	RES, 15K
R118	0662057C51	RES, 100
R120	0662057C51	RES, 100
R121	NOT PLACED	RES, 100
R122	0662057C19	RES, 4.7
R123	0662057C13	RES, 2.7
R124	0662057C13	RES, 2.7
R125	0662057C13	RES, 2.7
R126	0662057C03	RES, 1
R127	0662057C03	RES, 1
R130	0662057B47	RES, 0
R131	0662057A97	RES, 100K
R132	NOT PLACED	RES, 100K
R134	0662057A89	RES, 47K
R135	0662057A88	RES, 43K
R136	0662057A87	RES, 39K
R137	0662057A87	RES, 39K
R138	NOT PLACED	RES, 39K
R139	NOT PLACED	RES, 39K
R140	0662057A70	RES, 7.5K
R141	0662057A81	RES, 22K
R142	0662057A81	RES, 22K
R143	0662057A81	RES, 22K
R144	0662057A75	RES, 12K

Circuit Ref.	Motorola Part No.	Description
R145	0662057A81	RES, 22K
R146	0662057A81	RES, 22K
R147	0662057A81	RES, 22K
R148	0662057A81	RES, 22K
R149	0662057A81	RES, 22K
R150	0662057A89	RES, 47K
R151	0662057A67	RES, 5.6K
R153	0662057A73	RES, 10K
R155	0662057A73	RES, 10K
R156	0662057A73	RES, 10K
R157	0662057A91	RES, 56K
R158	0662057A67	RES, 5.6K
R159	NOT PLACED	RES, 5.6K
R160	0662057A61	RES, 3.3K
R161	0662057A61	RES, 3.3K
R162	0662057A61	RES, 3.3K
R163	0662057A61	RES, 3.3K
R164	0662057A63	RES, 3.9K
R165	0662057A58	RES, 2.4K
R166	NOT PLACED	RES, 2.4K
R167	0662057A57	RES, 2.2K
R168	0662057A57	RES, 2.2K
R169	NOT PLACED	RES, 2.2K
R170	0662057A42	RES, 510
R171	0662057A33	RES, 220
R172	0662057A41	RES, 470
R173	0662057A29	RES, 150
R174	0662057A29	RES, 150
R175	NOT PLACED	RES, 220
R176	2413926N25	IDCTR, 120nH

Circuit Ref.	Motorola Part No.	Description
R177	NOT PLACED	RES, 100
R178	0662057A14	RES, 36
R179	0662057A14	RES, 36
R180	0660082A89	RES, 47K
R181	0660082A89	RES, 47K
R182	0662057A73	RES, 10K
R185	0662057A73	RES, 10K
R186	0662057C20	RES, 5.1
R188	NOT PLACED	RES, 0
R189	NOT PLACED	RES, 0
R190	0662057G64	RES, 1MEG
R191	0662057G64	RES, 1MEG
R195	0662057C01	RES, 0
R196	NOT PLACED	RES, 0
R197	0662057C19	RES, 4.7
R198	0662057C01	RES, 0
R199	0662057B47	RES, 0
R200	0662057A99	RES, 200K
R201	0662057B47	RES, 0
R202	NOT PLACED	RES, 0
R203	0662057B47	RES, 0
R204	NOT PLACED	RES, 0
R205	NOT PLACED	RES, 0
R206	0662057B02	RES, 150K
R207	0662057B02	RES, 150K
R208	0662057A18	RES, 390
R209	0662057A97	RES, 100K
R210	NOT PLACED	RES, 100K
R211	0662057A89	RES, 47K
R212	0662057A84	RES, 30K

Circuit Ref.	Motorola Part No.	Description
R213	0662057A65	RES, 4.7K
R214	0662057A65	RES, 4.7K
R215	0662057A65	RES, 4.7K
R216	0662057A63	RES, 3.9K
R217	0662057A52	RES, 1.3K
R218	0662057A49	RES, 1K
R219	NOT PLACED	RES, 820
R220	0662057A42	RES, 510
R221	0662057A33	RES, 220
R222	0662057A33	RES, 220
R223	0662057A33	RES, 220
R224	0662057A53	RES, 1.5K
R225	0662057A29	RES, 150
R226	0662057A29	RES, 150
R227	0662057A25	RES, 100
R228	0662057A25	RES, 100
R229	0662057A25	RES, 100
R230	0662057A25	RES, 100
R231	0662057A18	RES, 51
R232	0662057A17	RES, 47
R233	0662057A17	RES, 47
R234	0662057A15	RES, 39
R235	0662057A07	RES, 18
R300	0662057A73	RES, 10K
R301	0662057A41	RES, 470
R302	0662057B47	RES, 0
R303	0662057B47	RES, 0
R304	0662057A85	RES, 33K
R305	0662057A80	RES, 20K
R306	0662057A80	RES, 20K

Circuit Ref.	Motorola Part No.	Description
R307	0662057A80	RES, 20K
R308	0662057A80	RES, 20K
R309	0662057A77	RES, 15K
R310	0662057A77	RES, 15K
R311	NOT PLACED	RES, 15K
R312	0662057A76	RES, 13K
R313	0662057A75	RES, 12K
R314	0662057A75	RES, 12K
R315	0662057A75	RES, 12K
R316	0662057A75	RES, 12K
R317	0662057A75	RES, 12K
R318	0662057A75	RES, 12K
R319	0662057A75	RES, 12K
R320	0662057A73	RES, 10K
R321	0662057A71	RES, 8.2K
R322	0662057A65	RES, 4.7K
R323	0662057A65	RES, 4.7K
R324	0662057A61	RES, 3.3K
R325	0662057A61	RES, 3.3K
R326	0662057A58	RES, 2.4K
R327	0662057A58	RES, 2.4K
R328	0662057A55	RES, 1.8K
R329	0662057A51	RES, 1.2K
R330	0662057A49	RES, 1K
R331	0662057A45	RES, 680
R332	0662057A43	RES, 560
R333	0662057A40	RES, 430
R334	0662057A39	RES, 390
R335	0662057A33	RES, 220
R336	0662057A25	RES, 100

Circuit Ref.	Motorola Part No.	Description
R337	0662057A25	RES, 100
R338	0662057A18	RES, 51
R339	0662057A18	RES, 51
R340	0662057A18	RES, 51
R341	0662057A01	RES, 10
R342	0662057A01	RES, 10
R343	0662057A01	RES, 10
R344	0662057A01	RES, 10
R345	0662057A73	RES, 10K
R346	0662057A73	RES, 10K
R401	0662057C85	RES, 2.7K
R402	0662057B47	RES, 0
R403	0662057B47	RES, 0
R404	0662057B47	RES, 0
R405	0662057B47	RES, 0
R406	0662057B47	RES, 0
R407	0662057B47	RES, 0
R414	0662057B47	RES, 0
R415	NOT PLACED	RES, 0
R421	0662057A33	RES, 220
R422	0662057A73	RES, 10K
R423	NOT PLACED	RES, 100K
R424	NOT PLACED	RES, 100K
R425	0662057A97	RES, 100K
R426	0662057A97	RES, 100K
R427	NOT PLACED	RES, 100K
R428	0662057A97	RES, 100K
R429	0662057A97	RES, 100K
R430	0662057A87	RES, 39K
R431	NOT PLACED	RES, 10K

Circuit Ref.	Motorola Part No.	Description
R432	0662057A85	RES, 33K
R433	0662057A85	RES, 33K
R434	0662057A85	RES, 33K
R435	0662057A85	RES, 33K
R436	0662057A85	RES, 33K
R438	0662057A73	RES, 10K
R439	0662057A73	RES, 10K
R440	0662057A73	RES, 10K
R441	0662057A73	RES, 10K
R442	0662057A73	RES, 10K
R443	0662057A61	RES, 3.3K
R444	0662057A73	RES, 10K
R445	0662057A73	RES, 10K
R450	0662057A73	RES, 10K
R451	0662057A73	RES, 10K
R453	0662057A61	RES, 3.3K
R454	0662057A61	RES, 3.3K
R455	0662057A61	RES, 3.3K
R456	0662057A61	RES, 3.3K
R457	0662057A61	RES, 3.3K
R458	0662057A61	RES, 3.3K
R459	NOT PLACED	RES, 47K
R460	0662057A53	RES, 1.5K
R461	0662057A33	RES, 220
R462	0662057A18	RES, 51
R463	0662057A73	RES, 10K
R466	NOT PLACED	RES, 0
R467	NOT PLACED	RES, 0
R468	NOT PLACED	RES, 0
R469	NOT PLACED	RES, 0

Circuit Ref.	Motorola Part No.	Description
R470	NOT PLACED	RES, 10K
R471	0662057A01	RES, 10
R472	NOT PLACED	RES, 100K
R473	NOT PLACED	RES, 100K
R600	0662057C01	RES, 0
R601	0611077A62	RES, 330
R602	0662057B47	RES, 0
R610	0662057C59	RES, 220
R615	0662057A25	RES, 100
R5000	0662057B47	RES, 0
R5001	0662057T68	RES, 1K
R5002	NOT PLACED	RES, 0
R5008	0662057B47	RES, 0
R5009	0662057B47	RES, 0
R5010	0662057B47	RES, 0
R5011	NOT PLACED	RES, 0
R5013	NOT PLACED	RES, 0
R5014	0662057B47	RES, 0
R5016	NOT PLACED	RES, 1MEG
R5019	0662057B05	RES, 200K
R5020	0662057B02	RES, 150K
R5021	0662057A97	RES, 100K
R5022	0662057A97	RES, 100K
R5023	0662057A97	RES, 100K
R5024	NOT PLACED	RES, 100K
R5025	0662057A97	RES, 100K
R5026	0662057A85	RES, 33K
R5027	0662057B08	RES, 270K
R5028	0662057A97	RES, 100K
R5029	0662057A97	RES, 100K

Circuit Ref.	Motorola Part No.	Description
R5030	0662057A85	RES, 33K
R5031	0662057A92	RES, 62K
R5032	0662057A89	RES, 47K
R5033	0662057A89	RES, 47K
R5034	0662057A86	RES, 36K
R5035	0662057A89	RES, 47K
R5036	0662057A89	RES, 47K
R5037	0662057A73	RES, 10K
R5038	0662057A85	RES, 33K
R5039	0662057A97	RES, 100K
R5040	0662057A84	RES, 30K
R5041	0662057A82	RES, 24K
R5042	0662057A82	RES, 24K
R5043	0662057A82	RES, 24K
R5044	0662057A82	RES, 24K
R5045	0662057A85	RES, 33K
R5046	0662057A82	RES, 24K
R5047	0662057B47	RES, 0
R5048	0662057A82	RES, 24K
R5049	0662057A77	RES, 15K
R5050	0662057A76	RES, 13K
R5051	0662057A75	RES, 12K
R5052	0662057A73	RES, 10K
R5053	0662057A73	RES, 10K
R5054	0662057A73	RES, 10K
R5055	0662057A73	RES, 10K
R5056	0662057A73	RES, 10K
R5057	0662057A73	RES, 10K
R5058	NOT PLACED	RES, 10K
R5059	NOT PLACED	RES, 10K

Circuit Ref.	Motorola Part No.	Description
R5060	0662057A73	RES, 10K
R5061	0662057A73	RES, 10K
R5062	0662057A73	RES, 10K
R5063	NOT PLACED	RES, 8.2K
R5064	NOT PLACED	RES, 8.2K
R5065	0662057A68	RES, 6.2K
R5066	0662057A49	RES, 1K
R5067	NOT PLACED	RES, 6.2K
R5068	NOT PLACED	RES, 6.2K
R5069	0662057A73	RES, 10K
R5070	0662057A57	RES, 2.2K
R5071	0662057A57	RES, 2.2K
R5072	0662057A65	RES, 4.7K
R5073	0662057A49	RES, 1K
R5074	0662057A49	RES, 1K
R5075	0662057A42	RES, 510
R5076	0662057A42	RES, 510
R5077	0662057A36	RES, 300
R5078	0662057A25	RES, 100
R5079	0662057A25	RES, 100
R5080	0662057A01	RES, 10
R5081	0613952D78	RES, 6.34K
R5082	0662057A90	RES, 51K
R5083	0662057B08	RES, 270K
R5084	NOT PLACED	RES, 0
R5085	NOT PLACED	RES, 1MEG
R5086	0662057A43	RES, 560
R5087	0662057A97	RES, 100K
R5088	0662057B47	RES, 0
R5089	NOT PLACED	RES, 1MEG

Circuit Ref.	Motorola Part No.	Description
R5092	0662057A73	RES, 10K
R5093	0662057A73	RES, 10K
R5094	NOT PLACED	RES, 1MEG
R5095	0662057A82	RES, 24K
R5096	0662057A73	RES, 10K
R5097	NOT PLACED	RES, 0
R5098	0662057B47	RES, 0
R5099	NOT PLACED	RES, 100K
R5100	NOT PLACED	RES, 1MEG
R5103	NOT PLACED	RES, 24K
R5290	0662057A25	RES, 100
R5291	0662057A25	RES, 100
R6000	NOT PLACED	RES, 0
R6001	NOT PLACED	RES, 0
RT100	0680361L01	THERM, 47K
S5010	1889288U01	SWITCH, 50.K
SH200	2689590U01	SHIELD
SH201	2689589U01	SHIELD
SH202	2689589U01	SHIELD
SH300	2689591U01	SHIELD
SH301	2689593U01	SHIELD
SH302	2689591U01	SHIELD
T300	2580541Z01	XFMR
T301	2580541Z01	XFMR
U100	5180932W01	LM2904
U101	5185130C65	30C65, RF PREDRIVER
U102	NOT PLACED	LM2904, OPAMP
U103	5113819A04	MC3303
U200	5185963A27	63A27, LVFRACN
U201	5105750U54	50U54, VCOBIC

Circuit Ref.	Motorola Part No.	Description
U300	5186144B01	SA616, IFIC
U301	5109522E10	TC7W04F, INVERTER
U302	4808612Y05	SMS3928_023, MIXER
U400	5102463J64	X25128-2.7, EEPROM
U402	5102463J36	SRM2B256, SRAM
U403	5102226J56	MC68HC11FL0, MICRO PROC
U404	5115037H01	4M FLASH ROM IC
U405	5113805A75	MC74HC595A, SHIFT REG
U500	5180932W01	LM2904, OPAMP
U501	5102190C33	LM2941T, 9.3V REGULATOR
U502	5102463J95	TDA1519C, AUDIO PA
U503	5105469E65	LP2951C, 5V REGULATOR
U504	5185130C53	30C53, ASFIC CMP
U505	5180932W01	LM2904, OPAMP
U506	5180932W01	LM2904, OPAMP
U507	5180932W01	LM2904, OPAMP
U508	5113816A30	MC33269D, 3.3V REGULATOR
U509	5113806A20	MC14053B, MUX
U510	5104187K94	LP2986ILD, 3.3V REGULATOR
U514	4802393L66	SI3455ADV, 12V P-Ch FET
U515	NOT PLACED	MAX4599EXT, SWITCH
VR101	4813830A15	MMBZ5232B, 5.6V ZENER
VR102	4813830A15	MMBZ5232B, 5.6V ZENER
VR105	4813830A15	MMBZ5232B, 5.6V ZENER

Circuit Ref.	Motorola Part No.	Description
VR400	NOT PLACED	MMBZ5232B, 5.6V ZENER
VR401	4813830G12	MMSZ4687T1, 4.3V ZENER
VR402	4813830A09	MMBZ5226B, 3.3V ZENER
VR500	4813832C77	MR2835S, 24V ZENER
VR501	4813830A14	MMBZ5231B, 5.1V ZENER
VR502	NOT PLACED	MMSZ4686T1, 3.9V ZENER
VR503	4813830G09	MMSZ4684, 3.3V ZENER
VR504	4813830G09	MMSZ4684, 3.3V ZENER
VR692	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR693	4813830A77	MMBZ33VAL, 33V DUAL ZENER
VR694	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR695	4813830A77	MMBZ33VAL, 33V DUAL ZENER
VR696	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR697	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR698	4813830A75	MMBZ20VAL, 20V DUAL ZENER
VR699	4813830A75	MMBZ20VAL, 20V DUAL ZENER
Y200	NOT PLACED	45J68, TCXO
Y201	4880114R06	14R06, 16.8MHZ XTAL OSC
Y300	9186145B02	45B02, 455KHZ XTAL
Y301	4880606B09	06B09, 44.395MHZ XTAL OSC

Notes



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