



**MOTOROLA**  
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# **CDM Series™**

# **PRO Series™**

**Professional Series**  
**Two-Way Mobile Radios**

## **Detailed Service Manual**





**CDM Series™ and  
PRO Series™  
Two-Way Mobile Radios**

Detailed Service Manual

6881091C63-B

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## 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 6881095C99) to ensure compliance with RF energy exposure limits.**

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

### Foreword

The information contained in this manual relates to all CDM Series and PRO Series models of Professional Series two-way mobile radios. This manual provides sufficient information to enable qualified service technicians to troubleshoot and repair a Professional Series two-way mobile radio to the component level.

### Manual Revisions

Changes which occur after this manual is printed are described in FMRs (Florida Manual Revisions). These FMRs provide complete replacement pages for all added, changed, and deleted items, including pertinent parts list data, schematics, and board overlays. To obtain FMRs, please contact the Customer Care and Services Division (CCSD). (Refer to the Appendix in the back of this manual for contact information.)

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# **CDM Series™ and PRO Series™**

## **Two-Way Mobile Radios**

### **Detailed Service Manual**

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## Notes



# Section 1

## INTRODUCTION

### 1.0 About this Manual

#### 1.1 Scope

This manual is intended for use by service technicians familiar with mobile two-way radio 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 booklet (Motorola publication part number 6881095C99) enclosed with your radio.

#### 1.2 Organization

This manual is organized such that the first three chapters contain non-band-specific information, and the remaining chapters cover band-specific information (for example, VHF low power, UHF Band 1 high power, etc.).

All data on control heads—including board overlays, schematics, and parts lists—is contained in Chapter 2, and all data on controllers is in Chapter 3.

The band-specific chapters (Chapters 4–13) each contain their own sections on:

- model charts and technical specifications (Section 1)
- theory of operation (Section 2)
- troubleshooting charts (Section 3)
- board overlays, schematics, and parts lists (Section 4)

Every chapter includes its own table of contents. In addition, the introductory page for each schematics section in the manual has allocation charts, indicating the page numbers for each board overlay, schematic and parts list in the section.

#### 1.3 Conventions

“Microprocessor” is abbreviated as “ $\mu$ P”.

### 2.0 Warranty and Service Support

Motorola offers support which includes full exchange and/or repair of the product during the warranty period (available only in certain countries), and service/repair or spare parts support out of warranty. Any “return for exchange” or “return for repair” to an authorized Motorola Dealer must be accompanied by a Warranty Claim Form. Contact an authorized Motorola dealer for Warranty Claim Forms.

## 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 subsections are for guidance purposes only.

In instances where the product is covered under a “return for replacement” or “return for repair” warranty, follow the steps outlined below before shipping the unit back to the appropriate Motorola warranty depot:

1. Check the product to make sure it is correctly programmed or has not been subjected to damage outside the terms of the warranty.
2. Contact Customer Resources to report the problem.
3. Fill out a Warranty Claim Form. (Forms are available from your Customer Resources representative or authorized Motorola dealer.)
4. Ship the product(s) back in the original packaging (or otherwise securely packaged) to ensure it is not damaged in transit. Enclose the Warranty Claim Form in the package.

## 2.2 After Warranty Period

Motorola continues to support its products in two ways after the Warranty period:

- Motorola's Customer Care and Services Division (CCSD) (formerly AAD) offers a repair service to both end-users and dealers at competitive prices.
- CCSD supplies individual parts and modules that can be purchased by dealers who are technically capable of performing fault analysis and repair.

## 2.3 Piece Parts Availability

Some replacement parts, spare parts, and/or product information can be ordered directly.

If...	It means that...
The part has a complete Motorola part number assigned to it	The part can be ordered from Motorola's Customer Care and Services Division.
The part does not have a part number assigned to it	The part is not normally available from Motorola.
The part number is appended with an asterisk	The part is serviceable only by a Motorola Depot.
A parts list is not included	No user-serviceable parts are available for that kit or assembly.

## 2.4 Replacement Parts Ordering

When ordering replacement parts and information, be sure to specify the complete Motorola identification number in your order. Direct all part orders to your local Customer Care and Services Division (CCSD) office. Refer to the Appendix in the back of this manual for contact information.

## 2.5 Technical Support

Motorola provides technical support to assist dealers, distributors and self-maintained customers in resolving problems, if any, with their unit. When contacting Motorola Technical Support, keep the radio's **model number** and the unit's **serial number** handy. Technical support contact information is listed below.

United States and Puerto Rico: 1-800-927-2744

Mexico, Caribbean, South and Central America: Go to <https://www.motorola.com/businessonline>. Log in and click on [Contact Us](#).

## 3.0 Radio Model Information

The radio's model number and serial number are located on a label attached to the back of the unit. The radio's model number indicates the unit's RF output power, frequency band, protocols, and physical packages. The example below shows a mobile radio model number and its characteristics.

**Table 1-1** Radio Model Number (Example: AAM25KHC9AA1AN)

Motorola Internal Use Only	Type of Unit	Model Series	Freq. Band	Power Level	Physical Packages	Channel Spacing	Protocol	Feature Level	Model Revision	Model Package
AA or LA	M (for Mobile)	25	K VHF (136-174MHz)	H 1-25W	C No Display, Basic Keypad	9 Program-mable	AA Conventional	1 4F	A	N
			B Low Band, R1 (29.7-36.0MHz)	K 25-40W	A No Display No Keypad		DU LTR	2 64F		
			C Low Band, R2 (36.0-42.0MHz)		D 1-Line Display, Limited Keypad		DP PassPort and LTR	5 128F		
			D Low Band, R3 (42.0-50.0MHz)		F 1-Line Display, Standard Keypad		PW 1.5ppm	6 160F LTR		
			R UHF1 (403-470MHz)					8 160F		
			S UHF2 (CDM: 450-512MHz, PRO, 1-25W: 450-527MHz, PRO, 25-40W: 450-520MHz)							

## Notes

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## Section 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. We recommend **against** inspecting 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.

**CAUTION** The effects of certain chemicals and their vapors can have harmful results on certain plastics. Do not use aerosol sprays, tuner cleaners, and other chemicals to clean the radio.

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

##### 2.2.1 Cleaning External Plastic Surfaces

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent in water. Apply this solution sparingly on the surface with a stiff, non-metallic, short-bristled brush to work all loose dirt out. Use a soft, absorbent, lintless cloth or tissue to remove the solution. Then dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

### 2.2.2 Cleaning Internal Circuit Boards and Components

The only factory-recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume). Apply Isopropyl alcohol 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, take special precautions to prevent device damage during disassembly, troubleshooting, and repair.

**CAUTION** DO NOT attempt to disassemble the radio without first referring to the disassembly and reassembly sections in the Basic Service Manual (Motorola Publication part number 6881091C62 [CDM Series models] or 6881092C71 [PRO Series models]).

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

## 4.0 General Repair Procedures and Techniques

### 4.1 Parts Replacement and Substitution

When replacing damaged parts, use identical part replacements. If an 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 parts center (see the Appendix at the back of this manual).

### 4.2 Rigid Circuit Boards

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

When soldering near the 18-pin and 40-pin connectors:

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

### 4.3 Chip Components

Use either the RLN4062 Hot-Air Repair Station or the Motorola 0180381B45 Repair Station for chip component replacement. When using the 0180381B45 Repair Station, select the TJ-65 mini-thermojet hand piece. On either unit, adjust the temperature control to 370°C (700°F), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

**To remove a chip component:**

1. Use a hot-air hand piece and position the nozzle of the hand piece approximately 0.3 cm (1/8") above the component to be removed.
2. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers.
3. Using a solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.

**To replace a chip component using a soldering iron:**

1. Select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads.
2. Using a pair of tweezers, position the new chip component in place while heating the fresh solder.
3. Once solder wicks onto the new component, remove the heat from the solder.
4. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.

**To replace a chip component using hot air:**

1. Use the hot-air hand piece and reflow the solder on the solder pads to smooth it.
2. Apply a drop of solder paste flux to each pad.
3. Using a pair of tweezers, position the new component in place.
4. Position the hot-air hand piece approximately 0.3 cm (1/8") above the component and begin applying heat.
5. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

### 4.4 Shields

Remove and replace shields using the R1070 station with the temperature control set to approximately 215°C (415°F) [230°C (445°F) maximum].

**To remove the shield:**

1. Place the circuit board in the R1070 circuit board holder.
2. Select the proper heat focus head and attach it to the heater chimney.
3. Add solder paste flux around the base of the shield.
4. Position the shield under the heat-focus head.
5. Lower the vacuum tip and attach it to the shield by turning on the vacuum pump.
6. Lower the focus head until it is approximately 0.3 cm (1/8") above the shield.
7. Turn on the heater and wait until the shield lifts off the circuit board.
8. Once the shield is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump.
9. Remove the circuit board from the R1070 circuit-board holder.

**To replace the shield:**

1. Add solder to the shield, if necessary, using a micro-tipped soldering iron.
2. 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 R1070 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 and lower it to approximately 0.3 cm (1/8") above 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.

- Unless otherwise stated, resistances are in Ohms (K = 1000, M = 1,000,000), and capacitances are in picofarads (pF), nanofarads (nF), or microfarads ( $\mu$ F).
- DC voltages are measured from point indicated to chassis ground using a Motorola DC multimeter or equivalent. Transmitter measurements should be made with a 1.2  $\mu$ H (microHenry) choke in series with the voltage probe to prevent circuit loading.
- Interconnect Tie Point Legend:

16_8MHz	16.8MHz Reference Frequency
3V3	Regulated 3.3V Supply Voltage for Voice Storage
5V	Regulated 5V Supply Voltage for RF Circuitry
5V	Regulated 5V Supply Voltage (Control Head)
5V RF	Regulated 5V Supply Voltage for RF Circuitry
5V SOURCE	5V Signal to Switch On Control Head
5VD	Regulated 5V Supply Voltage for Digital Circuitry
9V3	Regulated 9.3V Supply Voltage
9V3FLT	Filtered 9.3V Supply Voltage
A+	13.2V Supply Voltage
ADDR	Microprocessor ( $\mu$ P) Address Lines
AN	Analog Lines to Analog-to-Digital Converter
ANALOG INPUT 2	External Keypad Matrix Column Signal
ANALOG INPUT 3	External Keypad Matrix Row Signal
BATTERY VOLTAGE	Battery Voltage Sense Line
BL A GREEN	Back Light Anode Green
BL A RED	Back Light Anode Red
BL GREEN	Green Back Light Control



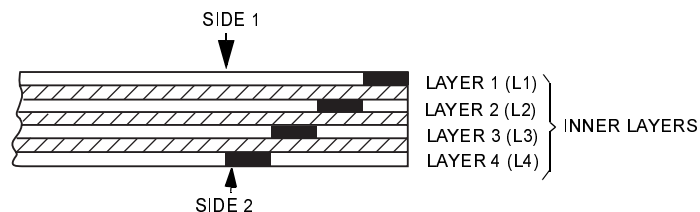
BL K GREEN	Back Light Cathode Green
BL K RED	Back Light Cathode Red
BL KP Green	Green Keypad Back Light Control
BL KP RED	Red Keypad Back Light Control
BL LCD GREEN	Green Display Back Light Control
BL LCD RED	Red Display Back Light Control
BL RED	Red Back Light Control
BOOT CNTRL	Bootstrap Mode Enable Signal
BOOT MODE	Boot Mode Select
BOOT PWR ON	Control Head Switch On Signal
BOOT SCI RX	Serial Communication Interface Receive Line
BOOT SCI TX	Serial Communication Interface Transmit Line
BOOT VPP	Boot Mode Select
BUS+	Bi-directional Serial Communication Line
BWSELECT	Signal to select between the Ceramic Filter Pairs
CEX	Chip Enable Line
CH ACT	Channel Activity Indicator Signal (Fast Squelch)
CH KP ID	Control Head Keypad ID (Data) Lines
CH REQUEST	Control Head Request from Control Head $\mu$ P
CLK	Clock Signal
CNTLVLTG	PA Power Control Voltage
CNTR AUDIO	Audio Lines of the Controller
COL x	Keypad Matrix Column x
CSX	Chip Enable Line
DATA	Data Signal
DC POWER ON	Electronic Switching On or Off of the Radio's Voltage Regulators
DISCAUDIO	Audio Output Signal from the Receiver IC
ECLK	Clock (not used)
EE CS	EEPROM Chip Select
EMERGENCY CONTROL	Emergency Line to switch on the Radio's Voltage Regulators
EXP BD REQ	Service Request Line from Expansion Board
EXP1 CS	Expansion Board Chip Select 1
EXP2 CS	Expansion Board Chip Select 2
EXT KP COL	External Keypad Matrix Column Signal
EXT KP ROW	External Keypad Matrix Row Signal
EXT MIC	External (from Accessory Connector) Microphone Input
EXT SWB+	External Switched 13.2V Supply Voltage
F1200	Interrupt Line from ASFIC CMP

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FECTRL 1	Control Voltage for Front-End Filter
FECTRL 2	Control Voltage for Front-End Attenuator Switch
FLASH CS	Flash Chip Select
FLASH OE	Flash Output Enable
FLAT RX SND	Option Board Audio Output Signal
FLAT TX RTN	Flat TX Input from Option Board and Accessory Connector
FLT A+	Filtered 13.2 V Supply Voltage
GP x IN	General Purpose Input x
GP x IN ACC y	General Purpose Input x from Accessory Connector Pin y
GP x IN OUT ACC y	General Purpose Input/Output x from Accessory Connector Pin y
GP x OUT	General Purpose Output x
GP x OUT ACC y	General Purpose Input x from Accessory Connector Pin y
GPIO	General Purpose Input Output Lines
HANDSET AUDIO	Handset Audio Output
HOOK	Hang-up Switch Input
HSIO	High Speed Clock In / Data Out
IF	First Intermediate Frequency Signal
IGNITION CONTROL	Ignition Line to switch on the Radio's Voltage Regulators
IN 5V RF REG	Supply Voltage for 5V Regulator in RF Section
INT KP COL	Internal Keypad Matrix Column Signal
INT KP ROW	Internal Keypad Matrix Row Signal
INT MIC	Internal (from Control Head) Microphone Input
INT SWB	Internal Switched 13.2V Supply Voltage
INT SWB+	Internal Switched 13.2V Supply Voltage
IRQ	Interrupt Request from Control Head
K9V1	9.1V in Transmit Mode
KEYPAD ID	Keypad Identification Line
LCD A0	LCD Control / Display Data Select
LCD CS	LCD Chip Select
LCD DATA	LCD Data Lines
LCD E RD	LCD Enable Read
LCD RW WR	LCD Read Write Control
LED CNTRL	LED Control Lines
LED GREEN	Green LED Control
LED RED	Red LED Control
LED YELLOW	Yellow LED Control

LOCK	Lock Detect Signal from Synthesizer
LSIO	Low Speed Clock In / Data Out
LVZIF CS	LVZIF Chip Select (not used)
MIC	Microphone Input
MISO	Serial Peripheral Interface Receive Line
MODIN	Modulation Signal into the Synthesizer
MOSBIAS 2	PA Bias Voltage for Second Stage
MOSBIAS 3	PA Bias Voltage for Third Stage
NOISE BLNKR	Noise Blanker Enable (Low Band only)
ON OFF CONTROL	Service Request Line from Control Head / Manual Switching On of the Radio's Voltage Regulators
ON OFF SENSE (Control Head)	On/Off Sense Line to Control Head $\mu$ P
ON OFF SENSE (Controller)	Service Request Line from Control Head
OPT CS	Option Board Chip Select
OPT PTT	PTT from Option Board
PA PWR SET	ASFIC Output Voltage to set the Transmitter Power
PA SWB	Switches Supply Voltage for PA Current Control Circuitry
PA SUPVLTG	13.2 V Supply Voltage of the Transmitter PA
PCIC MOSBIAS 1	PA Bias Voltage for First Stage
PRESC	Prescaler Signal from VCO to Synthesizer
PTT IRDEC	Microphone PTT Input
PTT IRDECODER	Microphone PTT Input
R W	Read Write Signal for RAM / Flash
RAM CS	RAM Chip Select
RDY	Service Request Line from Option Board
REF CS	Reference Chip Select (not used)
RESET	Reset Line
ROW x	Keypad Matrix Row x
RSSI	Received Signal Strength Indicator
RX ADAPT	Flat TX Path Disable during Transmitter Key-up
RX AUD RTN	Option Board Input / Output of Receiver Audio Path
RX FLAT FILTERED AUDIO	Flat or Filtered Audio to Accessory Connector
RXIN	RF Signal from Antenna Switch into the Receiver
RXINJ	RF Signal from the VCO into the Mixer
SCI RX	Serial Communication Interface Receive Line
SCI TX	Serial Communication Interface Transmit Line
SPI	Serial Peripheral Interface Bus
SPKR-	Negative Audio PA Speaker Output

SPKR+	Positive Audio PA Speaker Output
SQ DET	Squelch Detect Signal
SYN	$\mu$ P Clock Signal
TEMP SENSE	Temperature Sense Line for LCD
TEMPSENSE	Temperature Sense Line from PA to $\mu$ P
TRB	TX/RX VCO Switch Signal
TX AUD RTN	Option Board Output to Transmit Audio Path
TX AUD SND	Microphone Audio to Option Board
TXINJ	RF Signal from the VCO into the Transmitter PA
U DRIVER	Supply Voltage for PA Driver
U PREDRIVER	Supply Voltage for PA Pre-driver
UNSW 5V	Permanent 5V Supply
URX SND	Filtered Audio Signal to Option Board
VAG	2.5V Reference Voltage for Analog Circuitry
VCBIAS 1	Switch Signal from Synthesizer
VCBIAS 2	Switch Signal from Synthesizer
VCOMOD	Modulation Signal into VCO
VCTRL	VCO Frequency Control Voltage
VDDA	Regulated 5V for Digital Circuitry in RF Section
VOLTAGE SENSE	Voltage Sense Line from LCD
VOLUME	Volume Pot Output
VOX	Voice Operated Transmit Level
VPP	Boot Mode Select
VS AUDIOSEL	Switch Signal to Enable Option Board Audio Output Signal
VS GAINSEL	Voice Storage Gain Select Line
VS INT	Voice Storage Interrupt Line
VS MIC	Voice Storage Audio Signal into Microphone Path
VS RAC	Voice Storage Row Address Clock Signal
VSF	Voltage Super Filtered (5V)
VSTBY	5V Supply for $\mu$ P when the Radio is switched off



**Four-layer circuit board detail, viewing copper steps in proper layer sequence**

## Section 3

# SERVICE AIDS

### 1.0 Recommended Service Tools

Table 3-1 lists the service tools 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** Recommended Service Tools

Motorola Part No.	Description	Application
0180302E51	Master lens system	Illumination and magnification of components
0180386A78	Illuminated magnifying glass with lens attachment	
0180303E45	SMD tool kit (included with R1319_)	
0180357A57	Wall-Mounted Power Supply	Used to supply power to the RIB (120 VAC)
0180358A56	Wall-Mounted Power Supply	Used to supply power to the RIB (220 VAC)
0180386A82	Anti-static Grounding Kit	Used during all radio assembly and disassembly procedures
1010041A86	Solder (RMA type), 63/67, 0.5mm diameter, 1lb. spool	
3080070N01	Programming Cable	Connects RIB to radio microphone input
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)
6680309B53	Rework equipment catalog	Contains application notes, procedures, and technical references used to rework equipment
6680384A98	Brush	
6684253C72	Straight prober	
6686119B01	Removal Tool	Assists in the removal of radio control head
8180384J59	Housing Eliminator (short)	Test fixture used to bench test the radio PCB
8180384J60	Housing Eliminator (medium)	Test fixture used to bench test the radio PCB
8180384J61	Housing Eliminator (long)	Test fixture used to bench test the radio PCB
8180384L95	Housing Eliminator (short + top)	Test fixture used to bench test the radio PCB (radio uses pressure pads to retain PCB)

Motorola Part No.	Description	Application
AARKN4081_	Programming Cable with Internal RIB	Programming cable with internal RIB that provides direct connection from computer to radio microphone connector
AARKN4083_	Mobile Programming/Test Cable	Connects radio to RIB (RLN4008_)
HLN8027_	Mini UHF to BNC Adaptor	Adapts radio antenna port to BNC cabling of test equipment
R1319_	ChipMaster (110V)	Surface-mount removal and assembly of surface-mounted integrated circuits and/or rework station shields. Includes 5 nozzles.
R1321_	ChipMaster (220V)	
ChipMaster options:		
6680370B54	0.710" × 0.710"	Heat-focus heads for R1319_ workstation
6680370B57	0.245" × 0.245"	
6680370B58	0.340" × 0.340"	
6680371B15	0.460" × 0.560"	
ChipMaster nozzles:		
6680332E82	PLCC-44* nozzle	
6680332E83	PLCC-28* nozzle	
6680332E84	SOIC-20 nozzle	
6680332E86	SOIC-14/SOL-16J nozzle	
6680332E87	SOL-20J nozzle	
6680332E88	SOL-28J nozzle	
6680332E89	QFP-80 nozzle	
6680332E90	QFP-100* nozzle	
6680332E91	QFP-132* nozzle	
6680332E93	PLCC-32 nozzle	
6680332E94	PLCC-52 nozzle	
6680332E95	PLCC-68* nozzle	
6680332E96	PLCC-84 nozzle	
6680333E28	PA nozzle	
6680333E45	SOL-24 nozzle	
6680333E46	SOL-18 nozzle	
6680333E54	TSOP-32 nozzle	
6680333E55	TSOP-64 nozzle	
6680334E67	QFP-160 nozzle	
R1364_	Digital heated tweezer system	Chip component removal

Motorola Part No.	Description	Application
R1427_	Board preheater	Reduces heatsink on multi-level boards
R1453_	Digital readout solder station	Digitally controlled soldering iron
RLN4008_	Radio Interface Box	Enables communications between radio and computer's serial communications adapter
RLN4062_	Hot air workstation, 120V	Tool for hot air soldering/desoldering of surface-mounted integrated circuits
RLN4460_	Portable Test Set	Enables connection to audio/accessory jack. Allows switching for radio testing.
RLN4853_	10 to 20 Pin Adapter	Connects RKN4081_ to the radio accessory connector
RSX4043_	TORX screwdriver	Tighten and remove chassis screws
6680387A72	T-8 TORX bit	Removable TORX screwdriver bit
6680387A76	T-20 TORX bit	Removable TORX screwdriver bit

\* Included with ChipMaster packages.

## 2.0 Recommended Test Equipment

Table 3-2 lists test equipment required to service the mobile radios described in this manual as well as other two-way radios.

**Table 3-2** Recommended Test Equipment

Motorola Part Number	Description	Characteristics	Application
*R1013_ or *R1370_	SINAD meter or SINAD meter with RMS	Without RMS audio voltmeter or with RMS audio voltmeter	Receiver sensitivity measurements
*R1074_	Fluke 87 digital multimeter	True RMS metering, 200 kHz frequency counter, 32-segment bar graph with backlit display	Digital voltmeter is recommended for AC/ DC voltage and current measurements
*R1377_	AC voltmeter	100 $\mu$ V to 300V, 5Hz - 1MHz, 10Megohm input impedance	Audio voltage measurements
R1439_ or R1440_ (See Table 3-3)	BIRD wattmeter	Power range: 100mW - 100W, 2MHz - 1GHz, UHF-F connector Power range: 100mW - 100W, 2MHz - 1GHz, N-female connector	Transmitter power output measurements
R1611_	Dual channel 100MHz oscilloscope (Agilent)	Two-channel, 100MHz bandwidth, 200M sample rate/sec, 2Mb memory/ channel	Waveform measurements
R2600_NT	Comms System Analyzer (non MPT)	This monitor will substitute for items with an asterisk*	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment

Motorola Part Number	Description	Characteristics	Application
S1339_	RF millivoltmeter	100mV to 3 VRF. 10kHz to 1.2GHz	RF level measurements
S1348_	Programmable DC power supply	0–20V DC, 0–5 amps, current limited	Bench supply for 7.5V DC

Table 3-3 Wattmeter Plug-In Elements

Power	25-60MHz	50-125MHz	100-250MHzx	200-500MHz	400-1000MHz
5W	—	01-80305F21	01-80305F29	01-80305F38	01-80305F46
10W	—	01-80305F22	01-80305F30	01-80305F39	01-80305F47
25W	01-80305F15	01-80305F23	01-80305F31	01-80305F40	01-80305F48
50W	01-80305F16	01-80305F24	01-80305F32	01-80305F41	01-80305F49
100W	01-80305F17	01-80305F25	01-80305F33	01-80305F42	01-80305F50
250W	01-80305F18	01-80305F26	01-80305F34	01-80305F43	01-80305F51
500W	01-80305F19	01-80305F27	01-80305F35	01-80305F44	01-80305F52
1000W	01-80305F20	01-80305F28	01-80305F36	01-80305F45	01-80305F53



## Chapter 2: Control Head Service Information

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## Section 1

# OVERVIEW

### 1.0 CDM750 / PRO3100 Model (GCN6112\_)

This control head (Model A) contains the internal speaker, the On/Off/Volume knob, the microphone connector, buttons to operate the radio, and indicator Light Emitting Diodes (LEDs) to indicate radio status. The radio uses a Motorola 68HC11E9 microprocessor to control the LEDs and communicate with the host radio.



Model A Control Head (GCN6112\_) for CDM750 / PRO3100

### 2.0 CDM1250 / PRO5100 Model (GCN6113\_)

This control head (Model B) contains the internal speaker, the On/Off/Volume knob, the microphone connector, buttons to operate the radio, LEDs to indicate radio status, and a 14-character Liquid Crystal Display (LCD) that displays alphanumerical information (for example, channel number or call address name). The radio uses a Motorola 68HC11E9 microprocessor to control the LEDs and LCD, and communicate with the host radio.



Model B Control Head (GCN6113\_) for CDM1250 / PRO5100

### 3.0 CDM1550 Series / PRO7100 Model (GCN6114\_)

This control head (Model C) contains the internal speaker, the On/Off/Volume knob, the microphone connector, buttons to operate the radio, LEDs to indicate radio status, and a 14-character LCD that displays alphanumerical information (for example, channel number or call address name). The radio uses a Motorola 68HC11E9 microprocessor to control the LEDs and the LCD, and communicate with the host radio.



**Model C Control Head (GCN6114\_) for CDM1550 Series / PRO7100**

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## Section 2

# THEORY OF OPERATION

### 1.0 Introduction

This chapter provides a detailed theory of operation for the control head circuits. For troubleshooting information, refer to the related section of this manual.

**NOTE** From this point on the microprocessor is referred to as “ $\mu$ P”.

### 2.0 Control Head (CDM750 / PRO3100)

#### 2.1 Power Supplies

The power supply to the control head is taken from the host radio's FLT A+ voltage via connector J0801, pin 3 and the regulated 5V via connector J0801 pin 7. The voltage FLT A+ is at battery level and is used for the LEDs, the back light and to power up the radio using the On/Off/Volume knob. The stabilized 5V is used for the  $\mu$ P and the keypad buttons. The voltage USW 5V derived from the FLT A+ voltage and stabilized by the series combination of R0822, VR0822 is used to buffer the internal RAM of the  $\mu$ P (U0831). C0822 allows the battery voltage to be disconnected for a couple of seconds without losing RAM parameters. Dual diode D0822 prevents radio circuits from discharging this capacitor. When the supply voltage is applied to the radio, C0822 is charged via R0822 and D0822. To avoid the  $\mu$ P entering the wrong mode if the radio is switched on while the voltage across C0822 is still too low, the regulated 5V supply charges C0822 via diode D0822.

#### 2.2 Power On/Off

The On/Off/Volume knob, when pressed, switches the radio's voltage regulators on by connecting line ON OFF CONTROL to line UNSW 5V via D0821. Additionally, 5V at the base of digital transistor Q0822 informs the control head's  $\mu$ P about the pressed knob. The  $\mu$ P asserts pin 62 and line CH REQUEST low to hold the line ON OFF CONTROL at 5V via Q0823 and D0821. The high line ON OFF CONTROL also informs the host radio that the control head's  $\mu$ P wants to send data via the SBEP bus. When the radio returns a data request message, the  $\mu$ P informs the radio about the pressed knob. If the radio is switched off, the radio's  $\mu$ P switches it on and vice versa. If the On/Off/Volume knob is pressed while the radio is on, the software detects a low state on line ON OFF SENSE, the radio is alerted via line ON OFF CONTROL and sends a data request message. The control head  $\mu$ P informs the radio about the pressed knob and the radio's  $\mu$ P switches the radio off.

#### 2.3 Microprocessor Circuit

The control head uses the Motorola 68HC11E9  $\mu$ P (U0831) to control the LEDs and to communicate with the host radio. RAM and ROM are contained within the  $\mu$ P.

The  $\mu$ P generates its clock using the oscillator inside the  $\mu$ P along with a 8 MHz ceramic resonator (U0833) and R0920.

The  $\mu$ P's RAM is always powered up to maintain parameters such as the last operating mode. This is achieved by maintaining 5V at  $\mu$ P, pin 25. Under normal conditions, when the radio is off, USW 5V is formed by FLT A+ running to D0822. Capacitor C0822 allows the battery voltage to be disconnected

for a couple of seconds without losing RAM parameters. Diode D0822 prevents radio circuits from discharging this capacitor.

There are eight analog-to-digital converter ports (A/D) on the  $\mu$ P. They are labeled within the device block as PE0-PE7. These lines sense the voltage level ranging from 0 to 5V of the input line and convert that level to a number ranging from 0 to 255 which can be read by the software to take appropriate action.

Pin VRH is the high reference voltage for the A/D ports on the  $\mu$ P. If this voltage is lower than 5V the A/D reading is incorrect. The VRL signal is the low reference for the A/D ports. This line is normally tied to ground. If this line is not connected to ground, the A/D readings could be incorrect.

The  $\mu$ P determines the used keypad type and the control head ID by reading the levels at ports PC0 – PC7. Connections JU0852/3/4 are provided by the individual keypads.

The MODB / MODA input of the  $\mu$ P must be at a logic “1” to start executing correctly. The XIRQ and the IRQ pins should also be at a logic “1”.

Voltage sense device U0832 provides a reset output that goes to 0V if the regulated 5V goes below 4.5 V. This is used to reset the controller to prevent improper operation.

## 2.4 SBEP Serial Interface

The host radio (master) communicates to the control head  $\mu$ P (slave) through its SBEP bus. This bus uses only line BUS+ for data transfer. The line is bi-directional, that is, either the radio or the control head  $\mu$ P can drive the line. The  $\mu$ P sends serial data via pin 50 and D0831 and it reads serial data via pin 47. Whenever the  $\mu$ P detects activity on the BUS+ line, it starts communication.

When the host radio needs to communicate to the control head  $\mu$ P, it sends data via line BUS+. Any transition on this line generates an interrupt and the  $\mu$ P starts communication. The host radio may send data (for example, LED and back light status) or it may request the control head ID or the keypad ID.

When the control head  $\mu$ P wants to communicate to the host radio, the  $\mu$ P brings the request line CH REQUEST to a logic “0” via  $\mu$ P pin 62. This switches Q0823 on, which pulls line ON OFF CONTROL high through diode D0821. A low-to-high transition on this line informs the radio that the control head requires service. The host radio then sends a data request message via BUS+ and the control head  $\mu$ P replies with the data it wants to send (for example, which key has been pressed or that the volume knob has been rotated).

The control head  $\mu$ P monitors all messages sent via BUS+, but ignores any data communication between the host radio and the CPS or the universal tuner.

## 2.5 Keypad Keys

The control head keypad is a six-key design. All keys are configured as two analog lines read by  $\mu$ P pins 13 and 15. The voltage on the analog lines varies between 0V and 5V depending on which key is pressed. If no key is pressed, the voltage at both lines is 5V. 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 5V. 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  $\mu$ P (ports PE 0 - 1) and specify the pressed button. To determine which key is pressed, the voltage of both lines must be considered.

An additional pair of analog lines and A/D  $\mu$ P ports (PE 3 – 2) are available to support a keypad microphone, connected to the microphone connector J0811. Any microphone key press is processed the same way as a key press on a control head.

## 2.6 Status LED 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 via SBEP bus to the control head  $\mu\text{P}$ . The control head  $\mu\text{P}$  determines the LED status from the received message and switches the LEDs on or off via port PB 7 – 0 and port PA4. The LED status is stored in the  $\mu\text{P}$ 's memory. The LED current is determined by the resistor at the emitter of the respective current source transistor.

The back light for the keypad is controlled by the host radio the same way as the indicator LEDs using  $\mu\text{P}$  port PA 5. The  $\mu\text{P}$  can switch the back light on and off under software control. The back light current for the keypad is drawn from the FLT A+ source and controlled by two current sources. The LED current is determined by the resistor at the emitter of the respective current source transistor.

## 2.7 Microphone Connector Signals

Signals BUS+, PTT IRDEC, HOOK, MIC, HANDSET AUDIO, FLT A+, 5V, and two A/D converter inputs are available at the microphone connector J0811. Signal BUS+ (J0811-7) connects to the SBEP bus for communication with the CPS or the Universal Tuner. Line MIC (J0811-5) feeds the audio from the microphone to the radio's controller via connector J0801-4. The Line HANDSET AUDIO (J0811-8) feeds the receiver audio from the controller (J0801-6) to a connected handset. FLT A+, which is at supply voltage level, and 5V are used to supply any connected accessory like a microphone or a handset.

The two A/D converter inputs (J0811-9/10) are used for a microphone with keypad. A pressed key changes the DC voltage on both lines. The voltages depend on which key is pressed. The  $\mu\text{P}$  determines from the voltage on these lines which key is pressed and sends the information to the host radio.

Line PTT IRDEC (J0811-6) is used to key up the radio's transmitter. While the PTT button on a connected microphone is released, line PTT IRDEC is pulled to 5V level by R0843. Transistor Q0843 is switched on and causes a low at  $\mu\text{P}$  port PA2. When the PTT button is pressed, signal PTT IRDEC is pulled to ground level. This switches Q0843 off and the resulting high level at  $\mu\text{P}$  port PA2 signals the  $\mu\text{P}$  about the pressed PTT button. The  $\mu\text{P}$  signals the host radio about any status change on the PTT IRDEC line via SBEP bus.

When the line PTT IRDEC is connected to FLT A+ level, transistor Q0821 is switched on through diode VR0821 and thereby pulls the level on line ON OFF CONTROL to FLT A+ level. This switches on the radio and puts the radio's  $\mu\text{P}$  in bootstrap mode. Bootstrap mode loads the firmware into the radio's flash memory.

When the microphone's hang-up switch is engaged, the HOOK input (J0811-3) signals the  $\mu\text{P}$ . Depending on how the radio is programmed using the Customer Programming Software (CPS), the  $\mu\text{P}$  may take actions such as turning the audio PA on or off. While the hang-up switch is open, R0841 pulls the line HOOK to a 5V level. Transistor Q0841 is switched on and causes a low at  $\mu\text{P}$  port PA1. When the HOOK switch is closed, the HOOK signal is pulled to ground level. This switches R0841 off and the resulting high level at  $\mu\text{P}$  port PA1 signals the  $\mu\text{P}$  about the closed hang-up switch. The  $\mu\text{P}$  signals the host radio about any status change on the HOOK line via the SBEP bus.

## 2.8 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 J0801-10, 11 to the speaker connector P0801, pins 1 and 2. The speaker is connected to the

speaker connector P0801. The control head speaker can be disconnected only if an external speaker (connected through the accessory connector) is used.

## 2.9 Electrostatic Transient Protection

Electrostatic transient protection is provided for the sensitive components in the control head by diodes VR0811, VR0812, and VR0816 - VR0817. The diodes limit any transient voltages. The associated capacitors provide radio frequency interference (RFI) protection.

## 3.0 Control Head (CDM1250 / PRO5100 / CDM1550 Series / PRO7100)

### 3.1 Power Supplies

The power supply to the control head is taken from the host radio's FLT A+ voltage via connector J0801 pin 3 and the regulated 5V via connector J0801 pin 7. The voltage FLT A+ is at battery level and is used for the LEDs, the back light and to power up the radio using the On/Off/Volume knob. The stabilized 5V is used for the  $\mu$ P, the display, the display driver and the keypad buttons. The voltage USW 5V derived from the FLT A+ voltage and stabilized by the series combination of R0822, VR0822 is used to buffer the internal RAM of the  $\mu$ P (U0831). C0822 allows the battery voltage to be disconnected for a couple of seconds without losing RAM parameters. Dual diode D0822 prevents radio circuitry from discharging this capacitor. When the supply voltage is applied to the radio, C0822 is charged via R0822 and D0822. To avoid the  $\mu$ P entering the wrong mode when the radio is switched on while the voltage across C0822 is still too low, the regulated 5V supply charges C0822 via diode D0822.

### 3.2 Power On/Off

The On/Off/Volume knob, when pressed, switches the radio's voltage regulators on by connecting line ON OFF CONTROL to line UNSW 5V via D0821. Additionally, 5V at the base of digital transistor Q0822 signals the control head's  $\mu$ P about the pressed knob. The  $\mu$ P asserts pin 62 and line CH REQUEST low to hold line ON OFF CONTROL at 5V via Q0823 and D0821. The high line ON OFF CONTROL also informs the host radio that the control head's  $\mu$ P wants to send data via SBEP bus. When the radio returns a data request message, the  $\mu$ P will inform the radio about the pressed knob. If the radio was switched off, the radio's  $\mu$ P will switch it on and vice versa. If the On/Off/Volume knob is pressed while the radio is on, the software detects a low state on line ON OFF SENSE, the radio is alerted via line ON OFF CONTROL, and sends a data request message. The control head  $\mu$ P will inform the radio about the pressed knob and the radio's  $\mu$ P will switch the radio off.

### 3.3 Microprocessor Circuit

The control head uses the Motorola 68HC11E9  $\mu$ P (U0831) to control the LEDs and the LCD and to communicate with the host radio. RAM and ROM are contained within the  $\mu$ P itself.

The  $\mu$ P generates its clock using the oscillator inside the  $\mu$ P along with a 8 MHz ceramic resonator (U0833) and R0920.

The  $\mu$ P's RAM is always powered to maintain parameters such as the last operating mode. This is achieved by maintaining 5V at  $\mu$ P pin 25. Under normal conditions, when the radio is off, USW 5V is formed by FLT A+ running to D0822. C0822 allows the battery voltage to be disconnected for a couple of seconds without losing RAM parameters. Diode D0822 prevents radio circuitry from discharging this capacitor.

There are eight analog-to-digital converter ports (A/D) on the  $\mu$ P. They are labeled within the device block as PE0-PE7. These lines sense the voltage level ranging from 0 to 5V of the input line and



convert that level to a number ranging from 0 to 255 which can be read by the software to take appropriate action.

Pin VRH is the high-reference voltage for the A/D ports on the  $\mu$ P. If this voltage is lower than 5V, the A/D readings will be incorrect. Likewise pin VRL is the low reference for the A/D ports. This line is normally tied to ground. If this line is not connected to ground, the A/D readings will be incorrect.

The  $\mu$ P can determine the keypad type and the control head ID by reading the levels at ports PC0 – PC7. Connections JU0852/3/4 are provided by individual keypads.

The MODB / MODA input of the  $\mu$ P must be at a logic “1” for it to start executing correctly. The XIRQ and the IRQ pins should also be at a logic “1”.

Voltage sense device U0832 provides a reset output that goes to 0V if the regulated 5V goes below 4.5 V. This is used to reset the controller to prevent improper operation.

### 3.4 SBEP Serial Interface

The host radio (master) communicates to the control head  $\mu$ P (slave) through its SBEP bus. This bus uses only line BUS+ for data transfer. The line is bi-directional, that is, either the radio or the control head  $\mu$ P can drive the line. The  $\mu$ P sends serial data via pin 50 and D0831 and it reads serial data via pin 47. Whenever the  $\mu$ P detects activity on the BUS+ line, it starts communication.

When the host radio needs to communicate to the control head  $\mu$ P, it sends data via line BUS+. Any transition on this line generates an interrupt and the  $\mu$ P starts communication. The host radio may send data (for example, display information, LED status, or back light status), or it may request the control head or keypad ID.

When the control head  $\mu$ P wants to communicate to the host radio, the  $\mu$ P brings request line CH REQUEST to a logic “0” via  $\mu$ P pin 62. This switches on Q0823, which pulls line ON OFF CONTROL high through diode D0821. A low-to-high transition on this line informs the radio that the control head requires service. The host radio then sends a data request message via BUS+ and the control head  $\mu$ P replies with the data it wants to send (for example, which key has been pressed or that the volume knob has been rotated).

The control head  $\mu$ P monitors all messages sent via BUS+, but ignores any data communication between host radio and CPS or Universal Tuner.

### 3.5 Keypad Keys

The control head keypad is a six-key keypad (Model B) or a 10-key keypad (Model C). All keys are configured as two analog lines read by  $\mu$ P pins 13 and 15. The voltage on the analog lines varies between 0V and 5V depending on the key that has been pressed. If no key is pressed, the voltage at both lines will be 5V. 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 5V. 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  $\mu$ P (ports PE 0 - 1) and specify the pressed button. The voltage of both lines must be considered in order to determine which key is pressed.

An additional pair of analog lines and A/D  $\mu$ P ports (PE 3 – 2) is available to support a keypad microphone, connected to the microphone connector J0811. Any microphone key press is processed in the same way as a key press on the control head.

### 3.6 Status LED 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 via SBEP bus to the control head  $\mu\text{P}$ . The control head  $\mu\text{P}$  determines the LED status based the received message and switches the LEDs on or off via port PB 7 – 0 and port PA4. The LED status is stored in the  $\mu\text{P}$ 's memory. The LED current is determined by the resistor at the emitter of the respective current source transistor.

The back light for the LCD and the keypad is controlled by the host radio the same way as the indicator LEDs using  $\mu\text{P}$  port PA 5. This port is a Pulse Width Modulator (PWM) output. The output signal charges capacitor C0843 through R0847. By changing the pulse width under software control, the DC voltage of C0843 and, therefore, the brightness of the back light can be changed in four steps. The keypad back light current is drawn from the FLT A+ source and controlled by transistor Q0933. The current flowing through the LEDs causes a proportional voltage drop across the parallel resistors R0947 and R0948. This voltage drop is amplified by the op-amp U0931-2. U0931-2 and Q0934 form a differential amplifier. The voltage difference between the base of Q0934 and the output of U0931-2 determines the current from the base of the LED control transistor Q0933 and in turn the brightness of the LEDs. The  $\mu\text{P}$  can control the LEDs by changing the DC level at the base of Q0934. If the base of Q0934 is at ground level, Q0934 is switched off and no current flows through Q0933 and the LEDs. If the base voltage of Q0934 rises, a current flows through Q0934 and in turn through Q0933, causing the LEDs to turn on and a rising voltage drop across R0947 and R0948. The rising voltage causes the output of the op-amp to rise and to reduce the base to emitter voltage of Q0934. This decreases the current of Q0933 until the loop has settled.

### 3.7 Liquid Crystal Display (LCD)

The LCD H0971 uses the display driver U0971. The display is a single-layer super-twist nematic (STN) LCD display. It has 14 characters and a 5x8 dot matrix to display alphanumeric information and a line with 21 pre-defined icons above the dot matrix.

The driver contains a data interface to the  $\mu\text{P}$ , an LCD segment driver, an LCD power circuit, an oscillator, data RAM and control logic. At power up, the driver's control logic is reset by a logic "0" at input SR2 (U0971-15). The driver's internal oscillator is set to about 20 kHz and can be measured at pin 22. The driver's  $\mu\text{P}$  interface is configured to accept 8-bit parallel data input (U0971-D0-D7) from the control head  $\mu\text{P}$  (U0831 port PC0-PC7).

To write data to the driver's RAM, the  $\mu\text{P}$  sets chip select (U0971-20) to logic "0" via U0831-11, RD (U0971-18) to logic "1" via (U0831-10) and WR (U0971-17) to logic "0" via U0831-9. With input A0 (U0971-21) set to logic "0" via U0831-12, the  $\mu\text{P}$  writes control data to the driver. Control data includes the RAM start address for the display data. With input A0 set to logic "1", the  $\mu\text{P}$  then writes the display data to the display RAM. When data transfer is complete, the  $\mu\text{P}$  terminates the chip select, RD and WD activities.

The display driver's power circuit provides the voltage supply for the display. This circuit consists of a voltage multiplier, voltage regulator and a voltage follower. The external capacitors C0971 - C0973 configure the multiplier to double the supply voltage. In this configuration, the multiplier output VOUT (U0971-8) supplies a voltage of  $-5\text{V}$  ( $2 \times -5\text{V}$  below VDD). The multiplied voltage VOUT is sent to the internal voltage regulator. To set the voltage level of the regulator output V5 (U0971-5), this voltage is divided by the resistors R0973 and R0974 and then fed back to the reference input VR (U0971-6). In addition, the regulator output voltage V5 can be controlled electronically by a control command sent to the driver. With the used configuration, the voltage V5 is about  $-2\text{V}$ . The voltage V5 is resistively divided by the driver's voltage follower to provide the voltages V1 - V4. These voltages are required to drive the liquid crystals. The level of V5 can be measured by one of the  $\mu\text{P}$ 's analog-to-digital converters (U0831-20) via resistive divider R0975, R0976. To stabilize the display brightness over a large temperature range, the  $\mu\text{P}$  measures the temperature via analog-to-digital

converter (U0831-18) using temperature sensor U0834. Based on the measured temperature, the  $\mu$ P adjusts the driver output voltage V5, and in turn the display brightness, via a parallel interface.

### 3.8 Microphone Connector Signals

Signals BUS+, PTT IRDEC, HOOK, MIC, HANDSET AUDIO, FLT A+, 5V and 2 A/D converter inputs are available at the microphone connector J0811. Signal BUS+ (J0811-7) connects to the SBEP bus for communication with the CPS or the Universal Tuner. Line MIC (J0811-5) feeds the audio from the microphone to the radio's controller via connector J0801-4. Line HANDSET AUDIO (J0811-8) feeds the receiver audio from the controller (J0801-6) to a connected handset. FLT A+, which is at supply voltage level, and 5V are used to supply accessories connected to the radio, if any (for example, a microphone or a handset).

The two A/D converter inputs (J0811-9/10) are used for a microphone with a keypad. When a key is pressed, the DC voltage changes on both lines. The voltages depend on which key is pressed. The  $\mu$ P determines which key is pressed based on the voltage on these lines. It then sends the information to the host radio.

Line PTT IRDEC (J0811-6) is used to key up the radio's transmitter. When the PTT button on a connected microphone is released, line PTT IRDEC is pulled to 5V level by R0843. Transistor Q0843 is switched on and causes a low at  $\mu$ P port PA2. When the PTT button is pressed, signal PTT IRDEC is pulled to ground level. This switches Q0843 off and the resulting high level at  $\mu$ P port PA2 signals the  $\mu$ P about the pressed PTT button. The  $\mu$ P informs the host radio about any change of status on the PTT IRDEC line via SBEP bus.

When line PTT IRDEC is connected to FLT A+ level, transistor Q0821 is switched on through diode VR0821 and thereby pulls the level on line ON OFF CONTROL to FLT A+ level. This switches the radio on and puts the radio's  $\mu$ P in bootstrap mode. Bootstrap mode is the mode used to load the firmware into the radio's flash memory (see the Controller chapter for more details).

The HOOK input (J0811-3) is used to signal the  $\mu$ P when the microphone's hang-up switch is engaged. Depending on the CPS programming the  $\mu$ P may take actions like turning the audio PA on or off. While the hang-up switch is open, line HOOK is pulled to 5V level by R0841. Transistor Q0841 is switched on and causes a low at  $\mu$ P port PA1. When the HOOK switch is closed, signal HOOK is pulled to ground level. This switches off R0841 and the resulting high level at  $\mu$ P port PA1 informs the  $\mu$ P about the closed hang-up switch. The  $\mu$ P will inform the host radio about any status change on the HOOK line via SBEP bus.

### 3.9 Speaker

The control head contains a speaker for 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 J0801-10, 11 to the speaker connector P0801 pin 1 and pin 2. The speaker is connected to the speaker connector P0801. The control head speaker can be disconnected if an external speaker (connected through the accessory connector) is used.

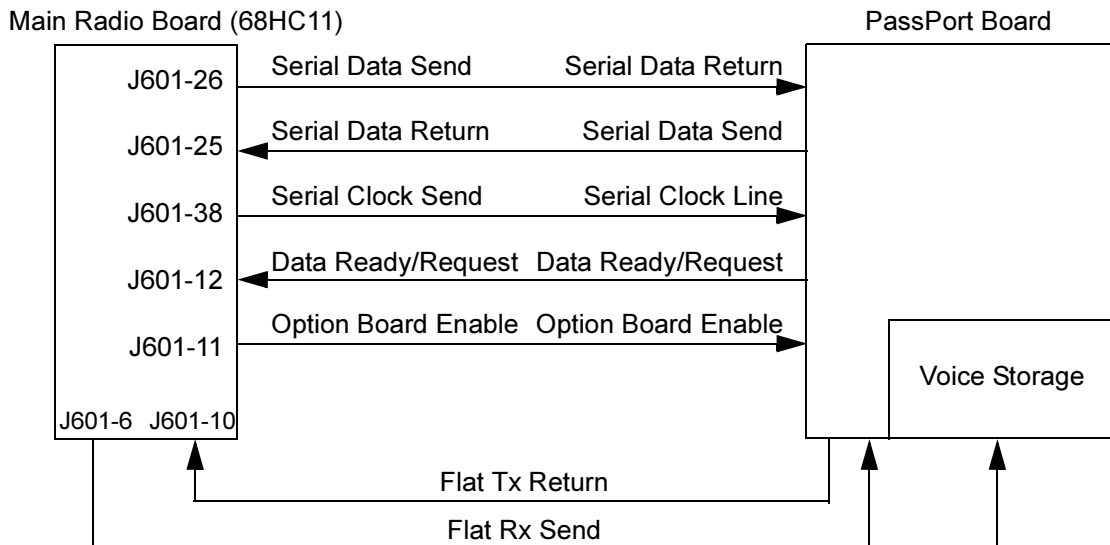
### 3.10 Electrostatic Transient Protection

Electrostatic transient protection is provided for the sensitive components in the control head by diodes VR0811, VR0812, and VR0816 - VR0817. The diodes limit any transient voltages to tolerable levels. The associated capacitors provide Radio Frequency Interference (RFI) protection.

### 3.11 PassPort Trunking Controller Board (PTCB)

PassPort is an enhanced trunking protocol developed by Trident Microsystems that supports wide-area dispatch networking. A network is formed by linking several trunked sites together to form a single system. This offers users an extended communication coverage area. Additionally, users with PassPort can seamlessly roam among all sites within the network. Seamless roaming means that the radio user does not have to manually change the position on the radio when roaming from site to site.

For models which feature PassPort Trunking operation, the PassPort Trunking Controller Board (PTCB) is added to the top cover of the radio. This board also provides advanced voice storage features. Refer to Figure 2-1 for connector and signal routing from and to the radio and PTCB.



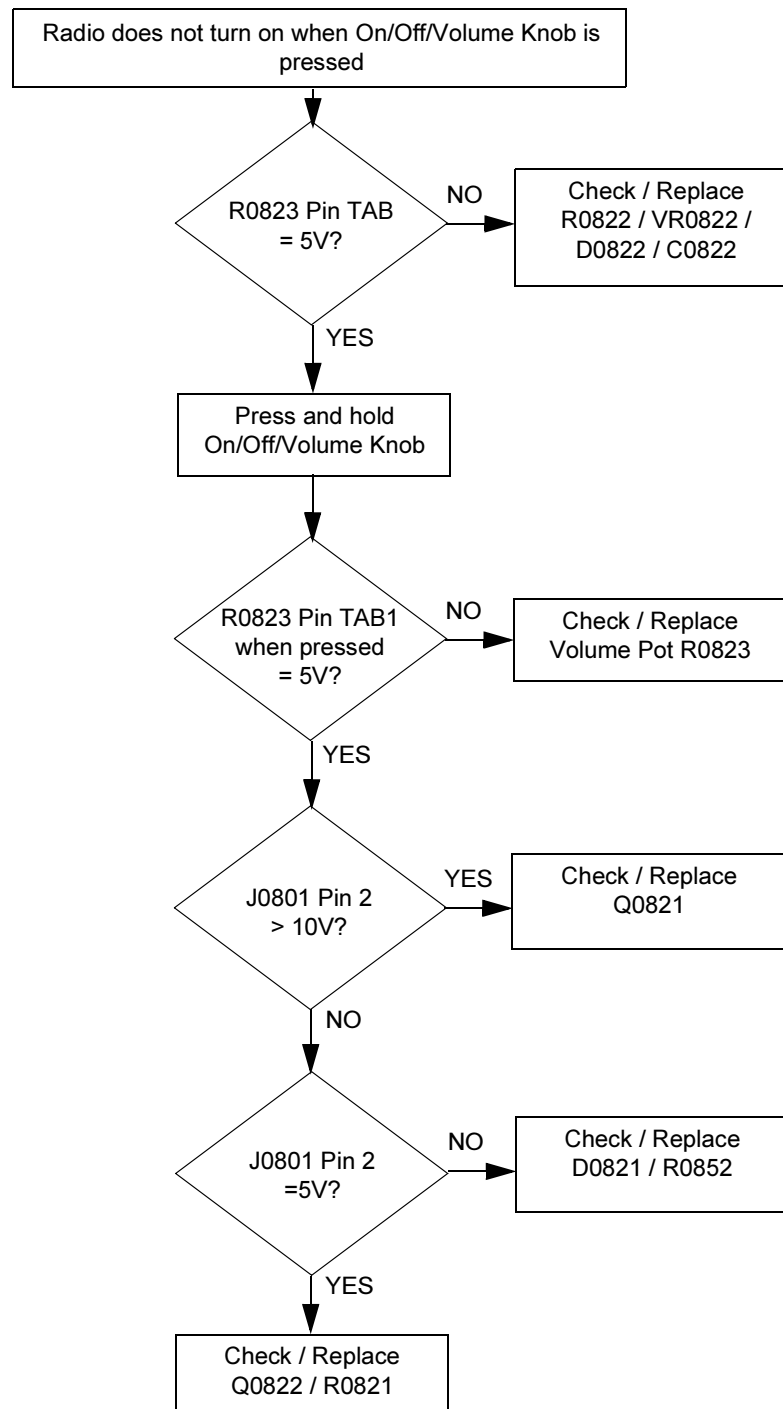
**Figure 2-1** Full Serial Interface Lines for PassPort Trunking Controller Board

## Section 3

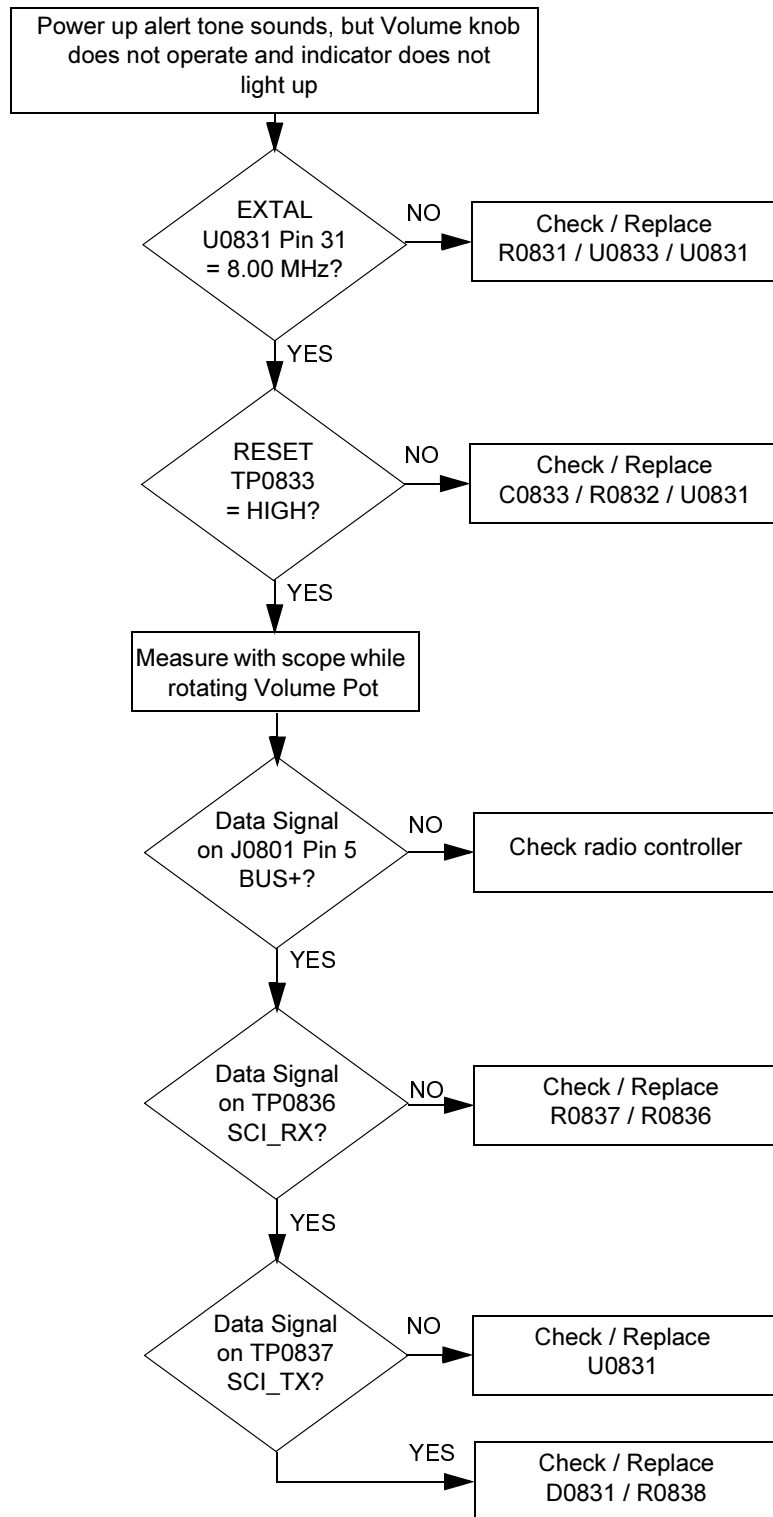
# TROUBLESHOOTING CHARTS

## 1.0 Control Head CDM750 / PRO3100 Troubleshooting Flow Charts

### 1.1 Troubleshooting Flow Chart for On/Off

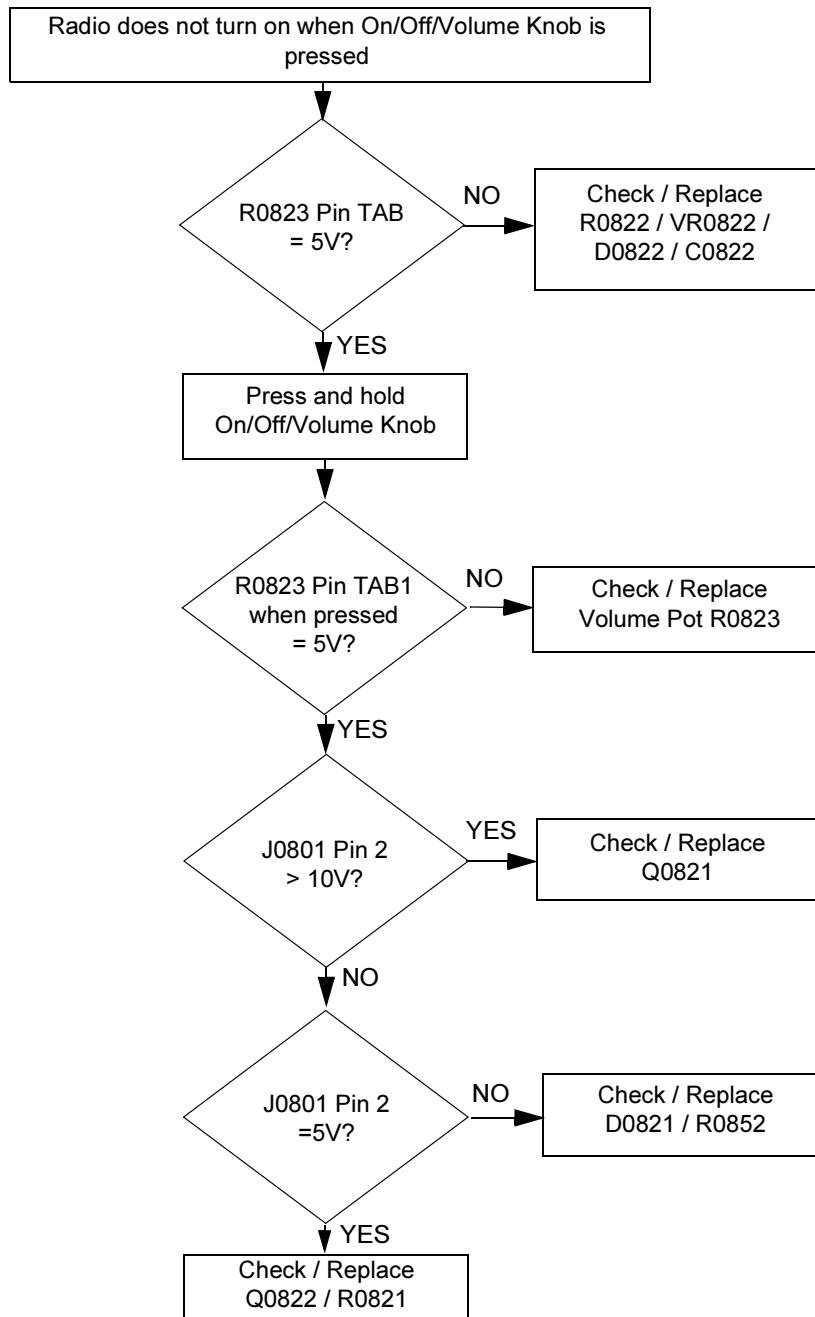


## 1.2 Troubleshooting Flow Chart for Microprocessor

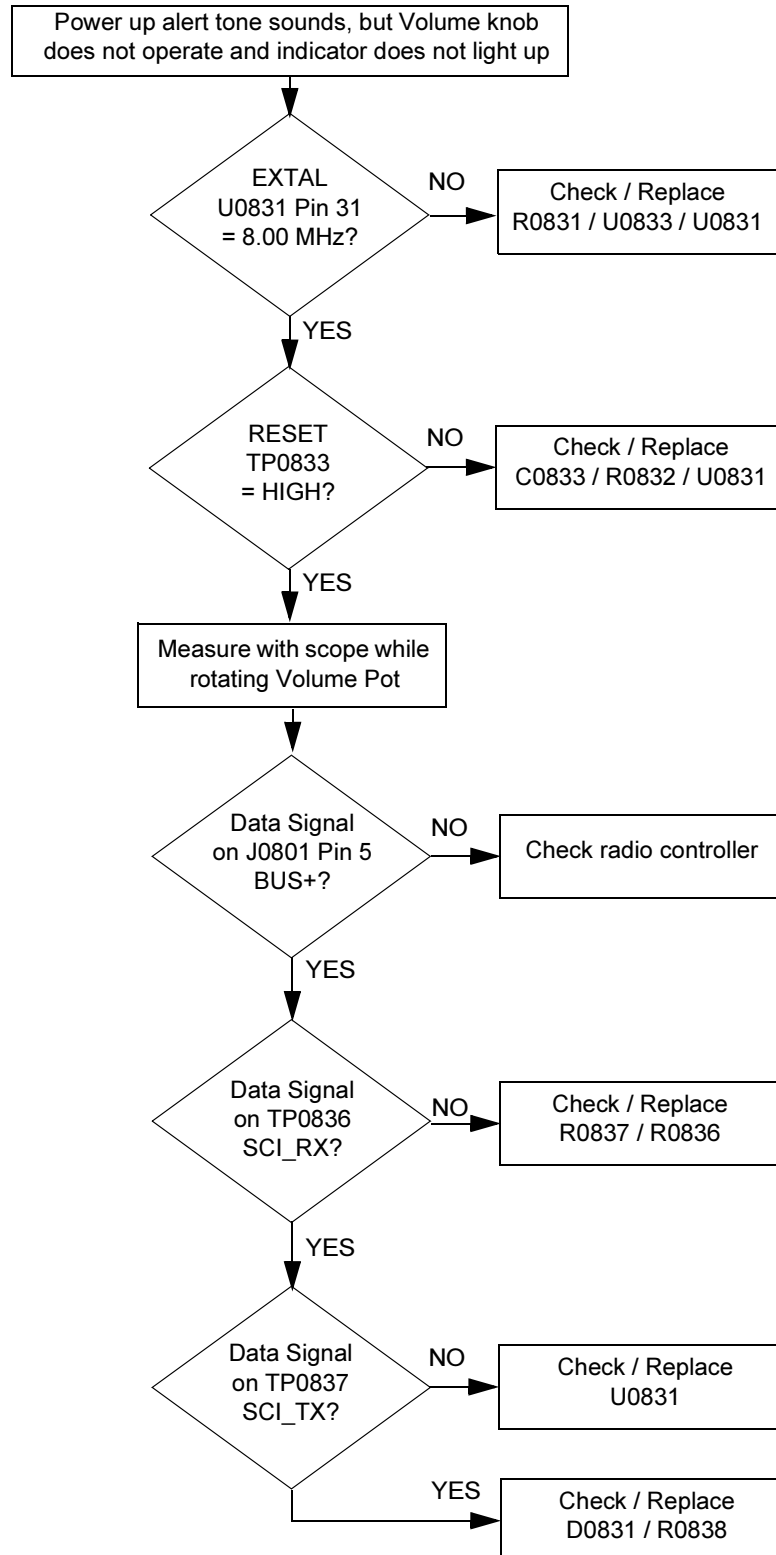


## 2.0 Control Head CDM1250 / PRO5100 / CDM1550 Series / PRO7100 Troubleshooting Flow Charts

### 2.1 Troubleshooting Flow Chart for On/Off

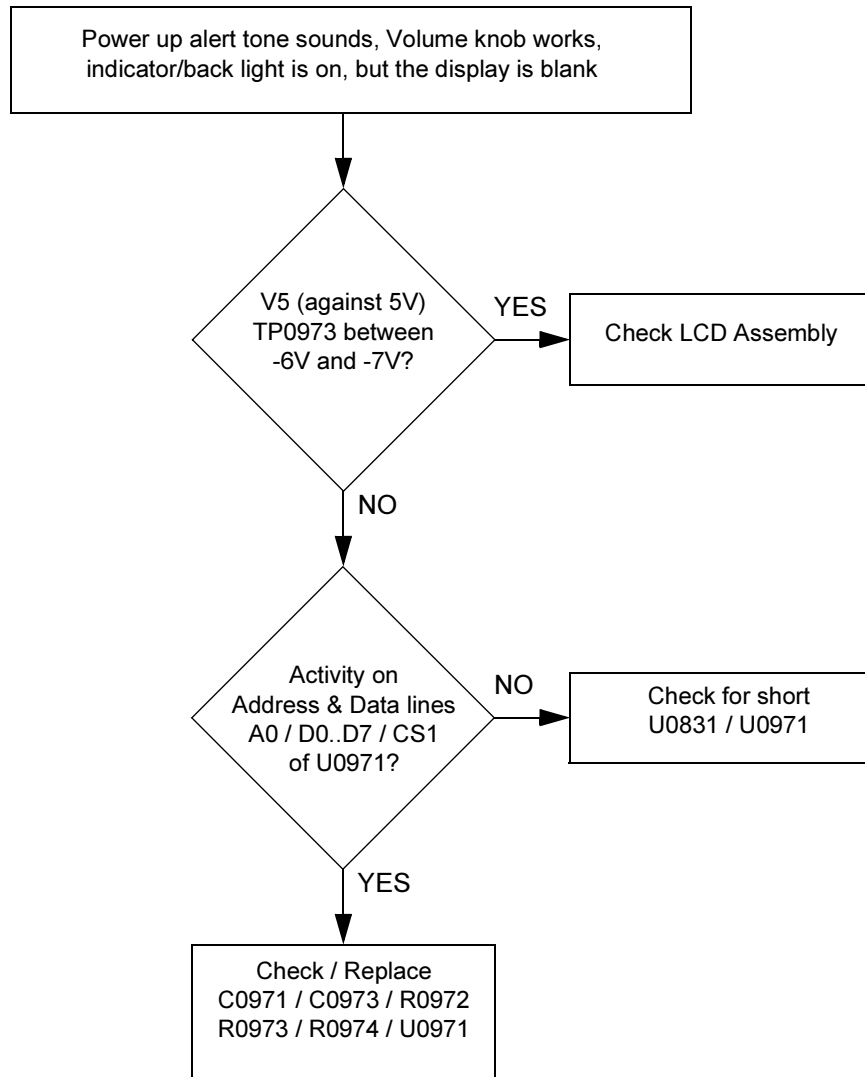


## 2.2 Troubleshooting Flow Chart for Microprocessor

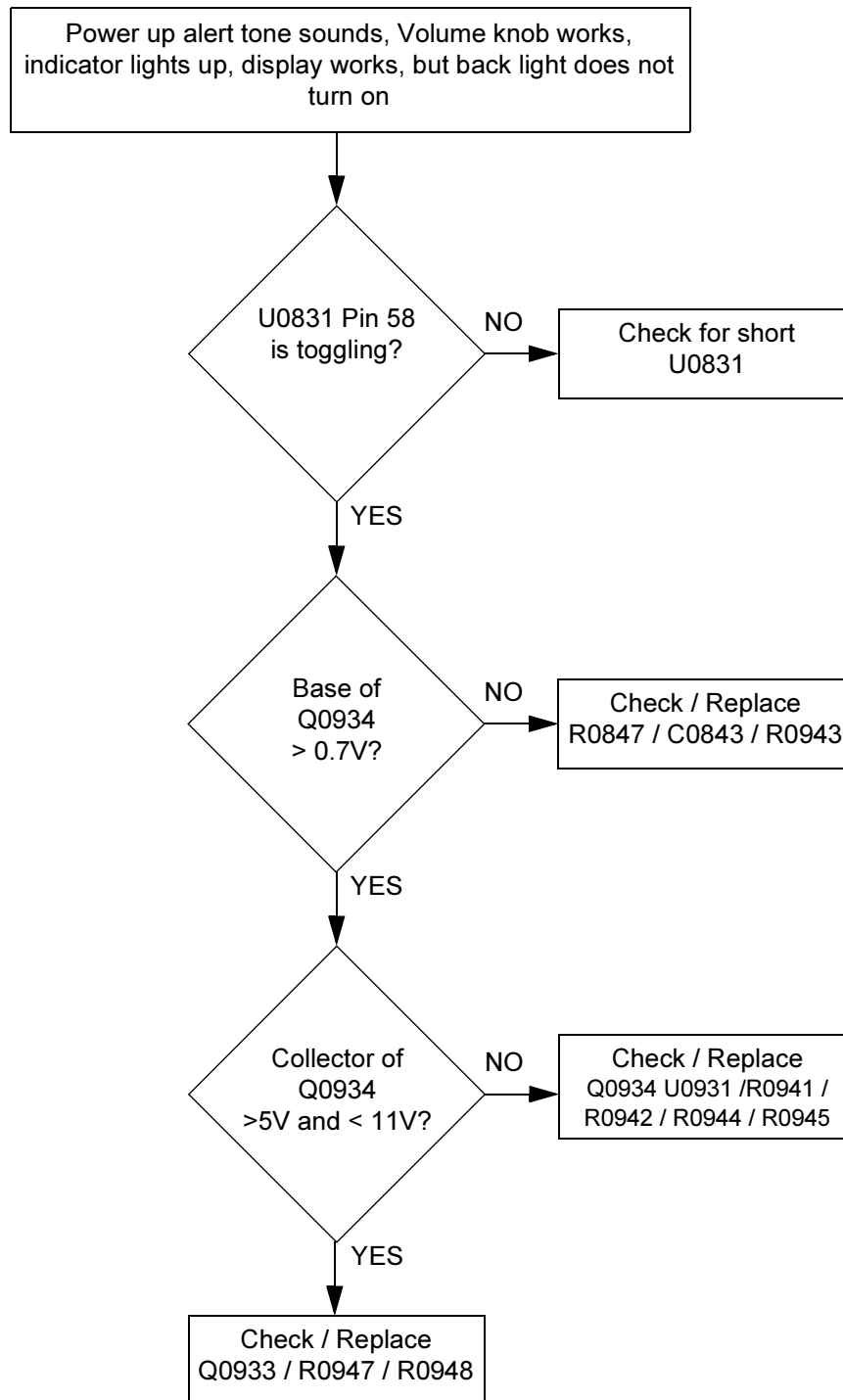




## 2.3 Troubleshooting Flow Chart for Display



## 2.4 Troubleshooting Flow Chart for Back Light



## Section 4

# CONTROL HEAD PCBS, SCHEMATICS, AND PARTS LISTS

### 1.0 Allocation of Schematics and Circuit Boards

**Table 2-1** Control Head CDM750 / PRO3100 Diagrams and Parts Lists

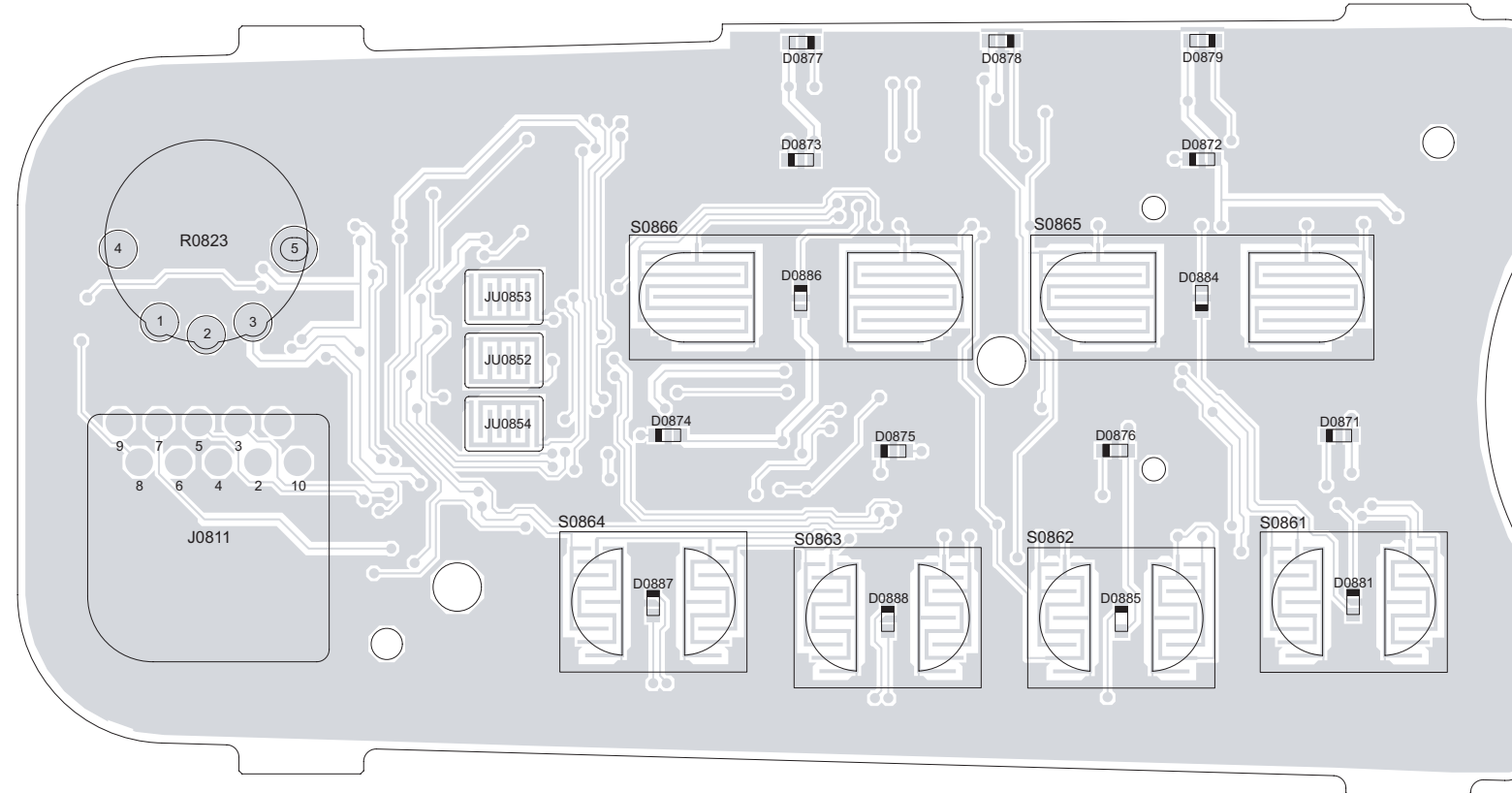
<b>PCB 8486146B07:</b> Main Board Top Side Main Board Bottom Side	<b>Page:</b> 2: 4-3 2: 4-3
<b>SCHEMATICS:</b> Sheet 1 of 2 Sheet 2 of 2	2: 4-4 2: 4-5
<b>Parts List</b>	2: 4-6

**Table 2-2** Control Head CDM1250 / PRO5100 / CDM1550 Series / PRO7100 Diagrams and Parts Lists

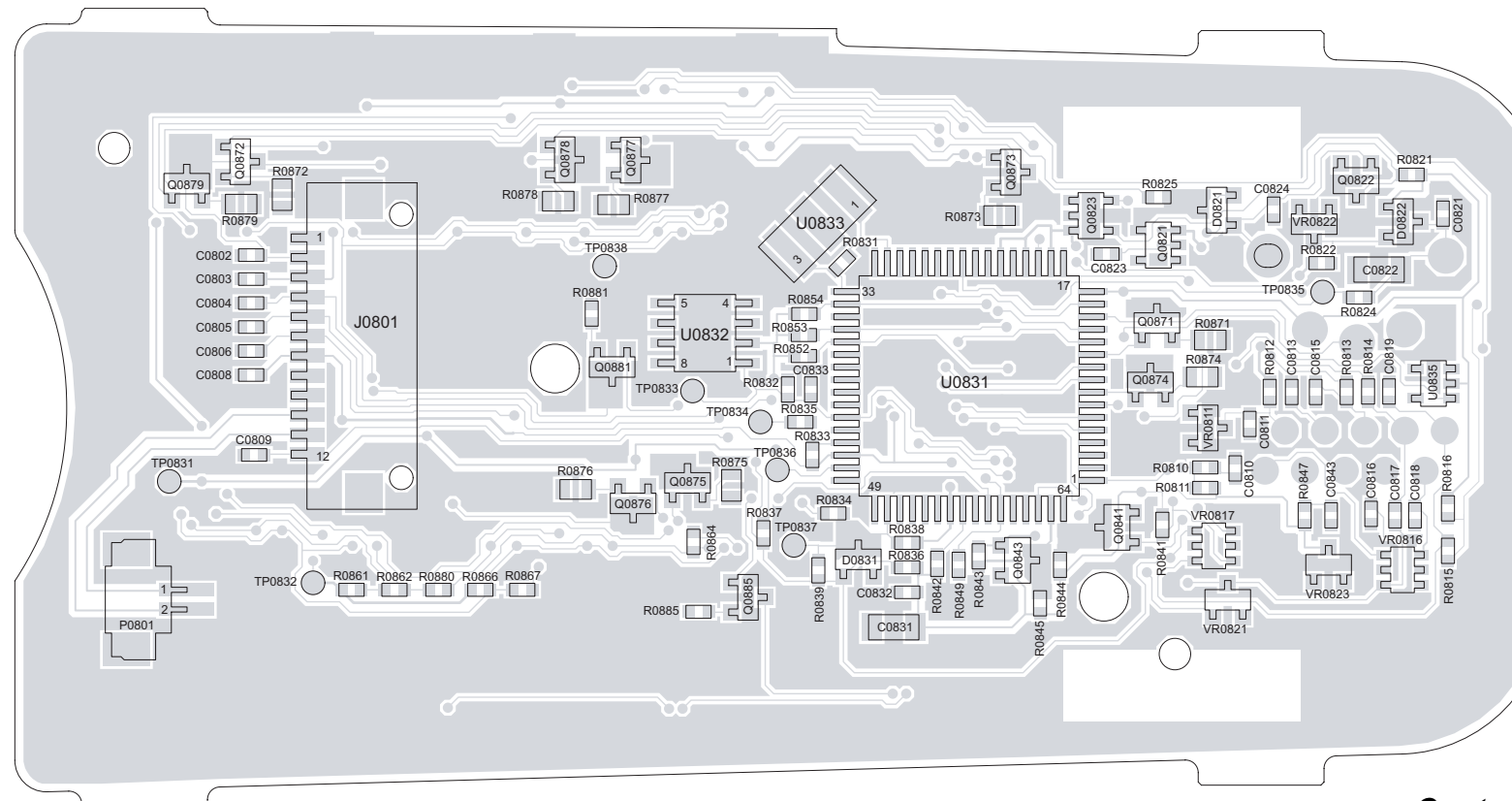
<b>PCB 8486155B06:</b> Main Board Top Side Main Board Bottom Side	<b>Page:</b> 2: 4-7 2: 4-7
<b>SCHEMATICS:</b> Sheet 1 of 4 Sheet 2 of 4 Sheet 3 of 4 Sheet 4 of 4	2: 4-8 2: 4-9 2: 4-10 2: 4-11
<b>Parts List</b>	2: 4-12

## Notes

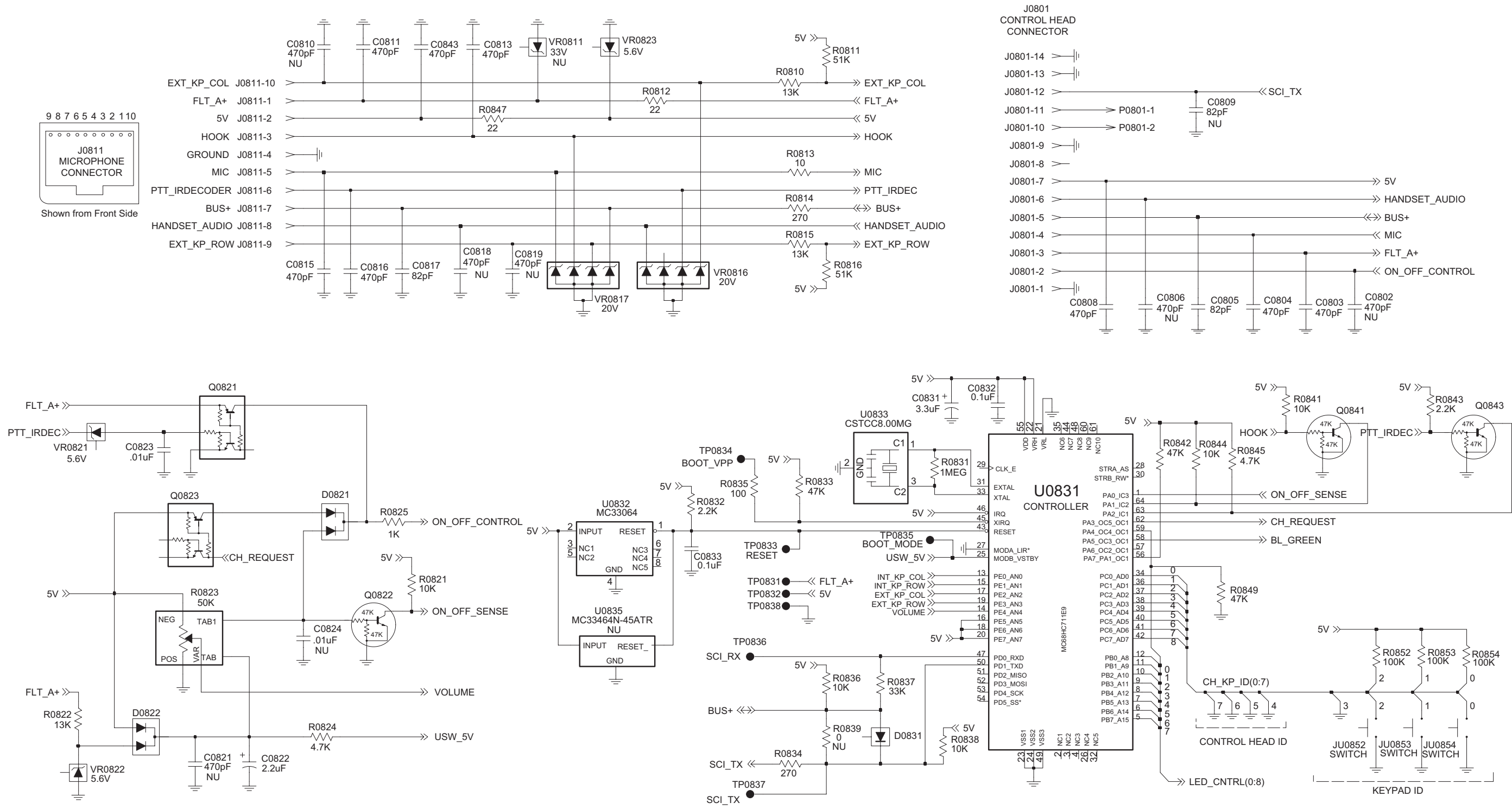
## 2.0 Control Head CDM750 / PRO3100 PCB 8486146B07, Schematics, and Parts Lists



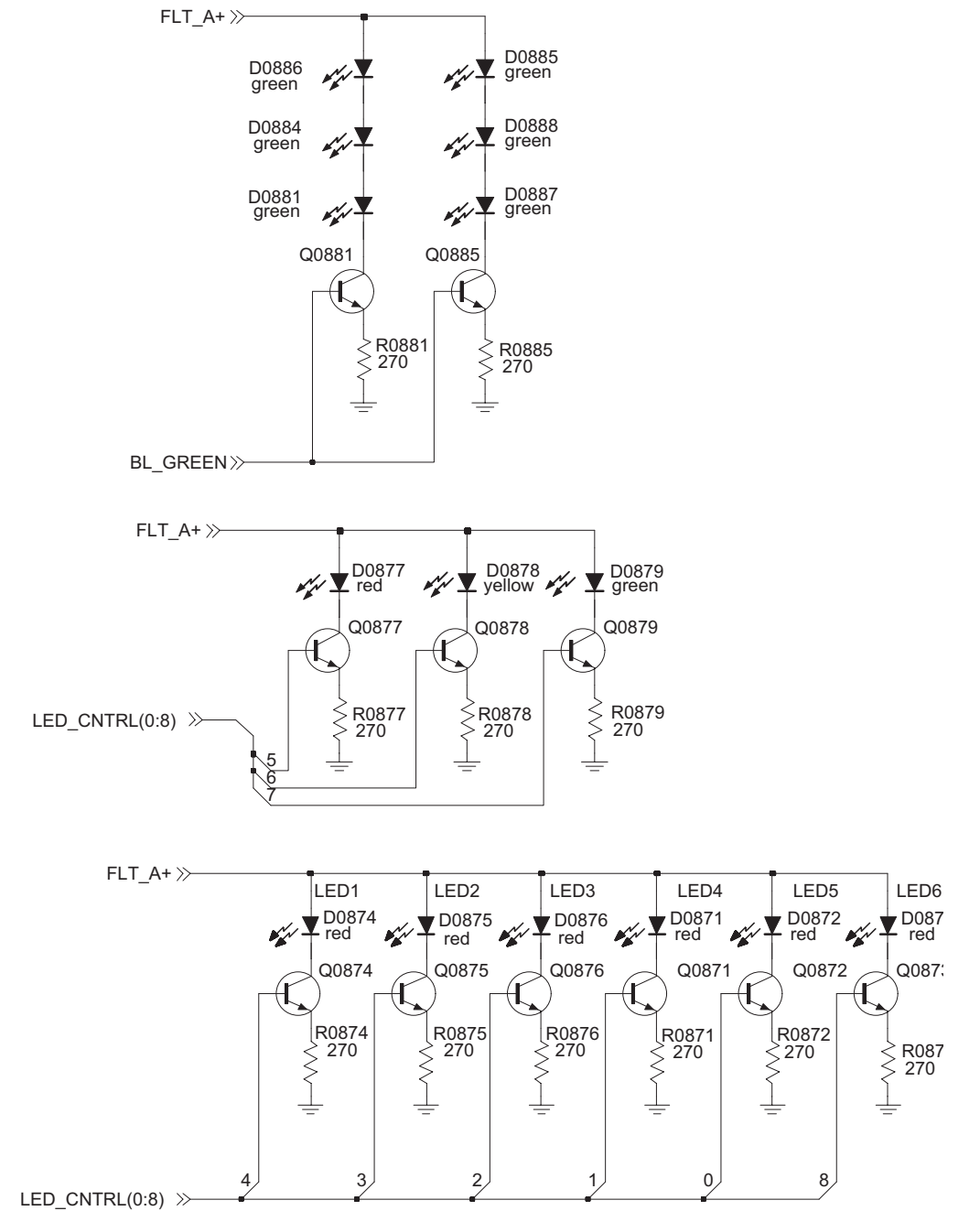
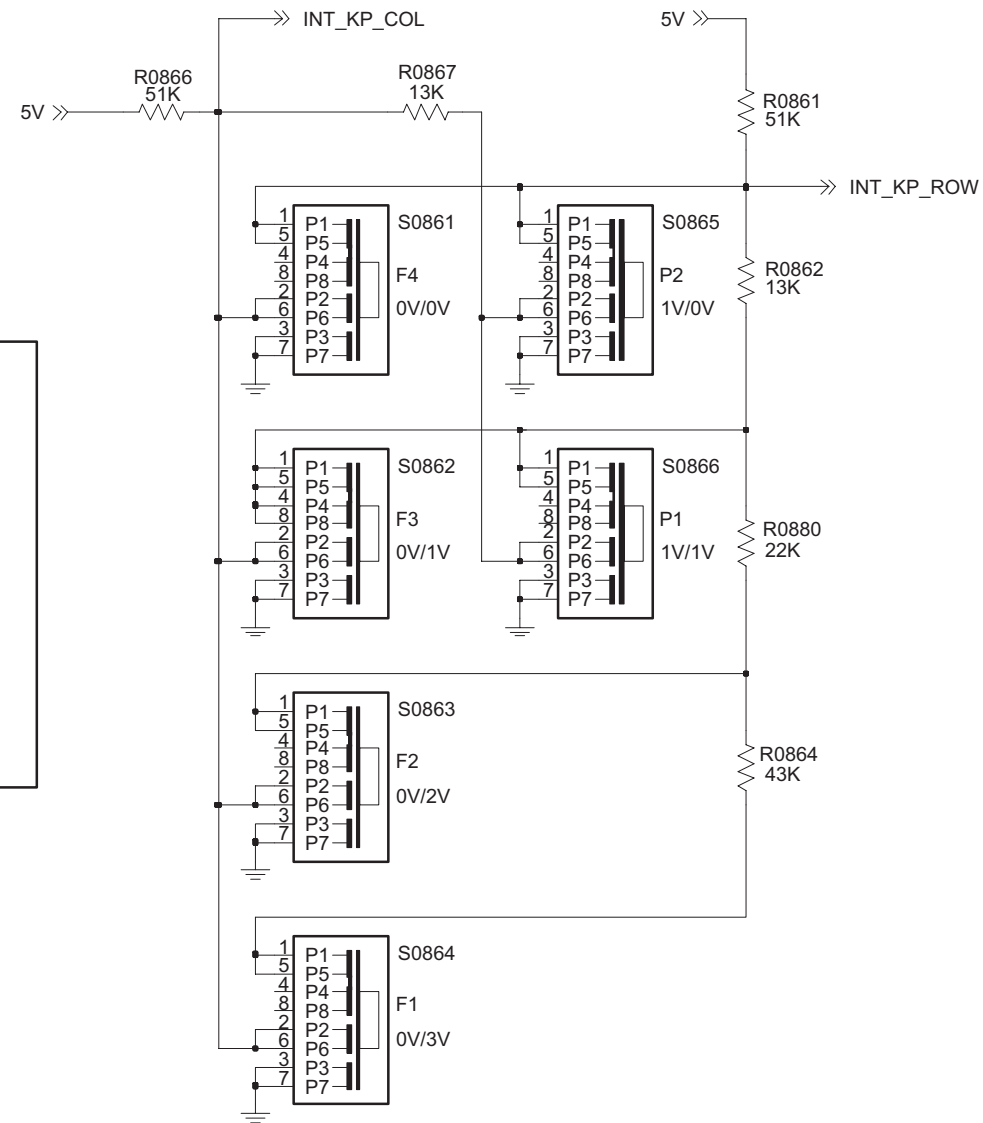
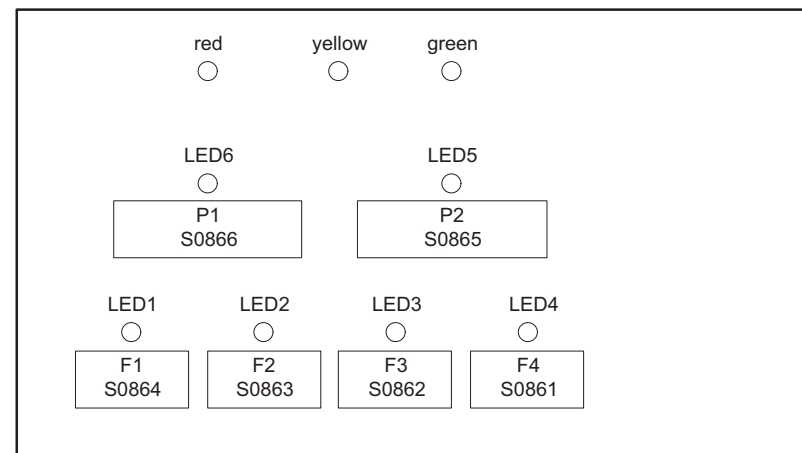
ZWG0130114-A  
Top Side



ZWG0130113-B  
Bottom Side



### KEYPAD A LAYOUT



ZWG0130240-A

## Control Head PCB 8486146B07 Parts List†

Circuit Ref	Motorola Part No.	Description
C0802	2113741F17	470pF 50V
C0803	2113741F17	470pF 50V
C0804	2113741F17	470pF 50V
C0805	2113740F49	82pF 5% 50V
C0806	2113741F17	470pF 50V
C0808	2113741F17	470pF 50V
C0810	2113741F17	470pF 50V
C0811	2113741F17	470pF 50V
C0813	2113741F17	470pF 50V
C0815	2113741F17	470pF 50V
C0816	2113741F17	470pF 50V
C0817	2113740F49	82pF 5% 50V
C0818	2113741F17	470pF 50V
C0821	2113741F17	470pF 50V
C0822	2311049A40	TANT CP 2.2uF 10% 10V
C0823	2113741F49	10nF 50V
C0824	2113741F49	10nF 50V
C0831	2311049A42	TANT CP 3.3uF 10% 6V
C0832	2113743E20	100nF 16V
C0833	2113743E20	100nF 16V
C0843	2113741F17	470pF 50V
D0821	4813833C02	DUAL SOT MMBD6100
D0822	4813833C02	DUAL SOT MMBD6100
D0831	4880236E05	DIODE CHIP SCHOTTKY
D0871	4886171B01	LED RED
D0872	4886171B01	LED RED
D0873	4886171B01	LED RED
D0874	4886171B01	LED RED
D0875	4886171B01	LED RED
D0876	4886171B01	LED RED
D0877	4886171B01	LED RED
D0878	4886171B03	LED YELLOW
D0879	4886171B04	LED GREEN
D0881	4886171B04	LED GREEN
D0884	4886171B04	LED GREEN
D0885	4886171B04	LED GREEN
D0886	4886171B04	LED GREEN
D0887	4886171B04	LED GREEN
D0888	4886171B04	LED GREEN
J0801	0902636Y02	CONNECTOR FLEX 12 PIN
J0811	2864287B01	CONN TELCO 10 PIN JACK
P0801	2809926G01	CONN 1.25MM 2PIN SURMT
Q0821	4805921T02	TSTR DUAL ROHM FMC2 RH
Q0822	4880048M01	TSTR NPN DIG 47k/47k
Q0823	4805921T02	TSTR DUAL ROHM FMC2 RH
Q0841	4880048M01	TSTR NPN DIG 47k/47k
Q0843	4880048M01	TSTR NPN DIG 47k/47k

Circuit Ref	Motorola Part No.	Description
Q0871	4813824A10	TSTR NPN 40V .2A B=50-150
Q0872	4813824A10	TSTR NPN 40V .2A B=50-150
Q0873	4813824A10	TSTR NPN 40V .2A B=50-150
Q0874	4813824A10	TSTR NPN 40V .2A B=50-150
Q0875	4813824A10	TSTR NPN 40V .2A B=50-150
Q0876	4813824A10	TSTR NPN 40V .2A B=50-150
Q0877	4813824A10	TSTR NPN 40V .2A B=50-150
Q0878	4813824A10	TSTR NPN 40V .2A B=50-150
Q0879	4813824A10	TSTR NPN 40V .2A B=50-150
Q0881	4813824A10	TSTR NPN 40V .2A B=50-150
Q0885	4813824A10	TSTR NPN 40V .2A B=50-150
R0810	0662057A76	13k 1/16W 5%
R0811	0662057A90	51k 1/16W 5%
R0812	0662057A09	22 1/16W 5%
R0813	0662057A01	10 1/16W 5%
R0814	0662057A35	270 1/16W 5%
R0815	0662057A76	13k 1/16W 5%
R0816	0662057A90	51k 1/16W 5%
R0821	0662057A73	10k 1/16W 5%
R0822	0662057A76	13K 1/16W 5%
R0823	1805911V02	POT VOL
R0824	0662057A65	4700 1/16W 5%
R0825	0662057A49	1k 1/16W 5%
R0831	0662057B22	1M 1/16W 5%
R0832	0662057A57	2k2 1/16W 5%
R0833	0662057A89	47k 1/16W 5%
R0834	0662057A35	270 1/16W 5%
R0835	0662057A25	100 1/16W 5%
R0836	0662057A73	10k 1/16W 5%
R0837	0662057A85	33k 1/16W 5%
R0838	0662057A73	10k 1/16W 5%
R0841	0662057A73	10k 1/16W 5%
R0842	0662057A89	47k 1/16W 5%
R0843	0662057A57	2.2k 1/16W 5%
R0844	0662057A73	10k 1/16W 5%
R0845	0662057A65	4700 1/16W 5%
R0847	0662057A09	22 1/16W 5%
R0849	0662057A89	47k 1/16W 5%
R0852	0662057A97	100k 1/16W
R0853	0662057A97	100k 1/16W
R0854	0662057A97	100k 1/16W
R0861	0662057A90	51k 1/16W 5%
R0862	0662057A76	13k 1/16W 5%
R0864	0662057A88	43k 1/16W 5%
R0866	0662057A90	51k 1/16W 5%
R0867	0662057A76	13k 1/16W 5%
R0873	0660076A35	270 5 1/8
R0874	0660076A35	270 5 1/8
R0875	0660076A35	270 5 1/8
R0876	0660076A35	270 5 1/8
R0877	0660076A35	270 5 1/8

Circuit Ref	Motorola Part No.	Description
R0878	0660076A35	270 5 1/8
R0879	0660076A35	270 5 1/8
R0880	0662057A81	22k 1/16W 5%
R0881	0662057A35	270 1/16W 5%
R0885	0662057A35	270 1/16W 5%
*U0831	5113802A24	IC 68HC11 W/SCI,SPI,A/D
U0832	5113815A02	IC
U0833	4886061B01	CER RESONATOR 8MHZ CSTCC8.00MG
VR0816	4805656W09	DIODE ZENER QUAD MMQA20VT1
VR0817	4805656W09	DIODE ZENER QUAD MMQA20VT1
VR0821	4813830A15	DIODE 5.6V 5% 225mW
VR0822	4813830A15	DIODE 5.6V 5% 225mW
VR0823	4813830A15	DIODE 5.6V 5% 225mW

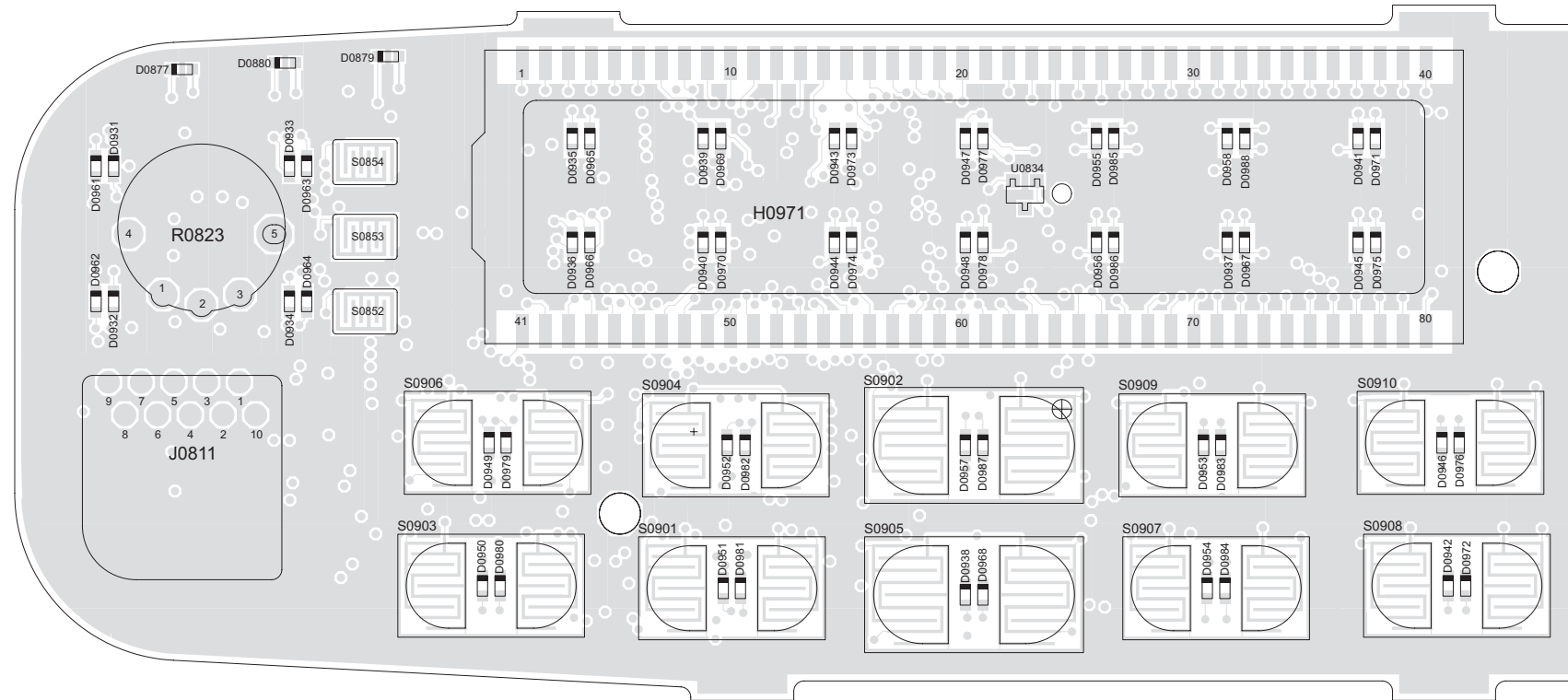
\* Motorola Depot Servicing only

Reference designators with an asterisk indicate components that are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

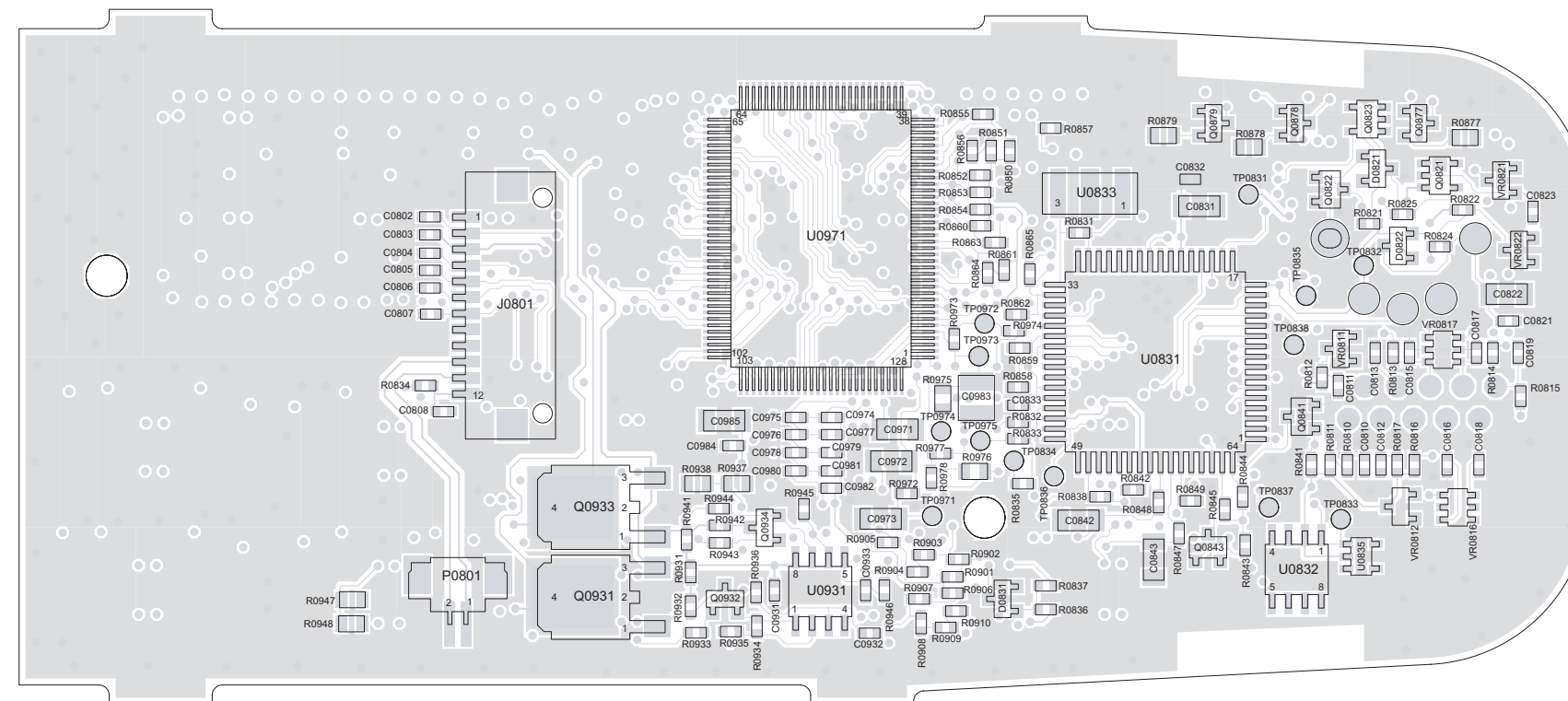
† Replacement boards must be ordered from CCSD (formerly AAD) using the number shown in the model charts in Chapters 4 - 13. Boards are not orderable using the 84-prefixed number.



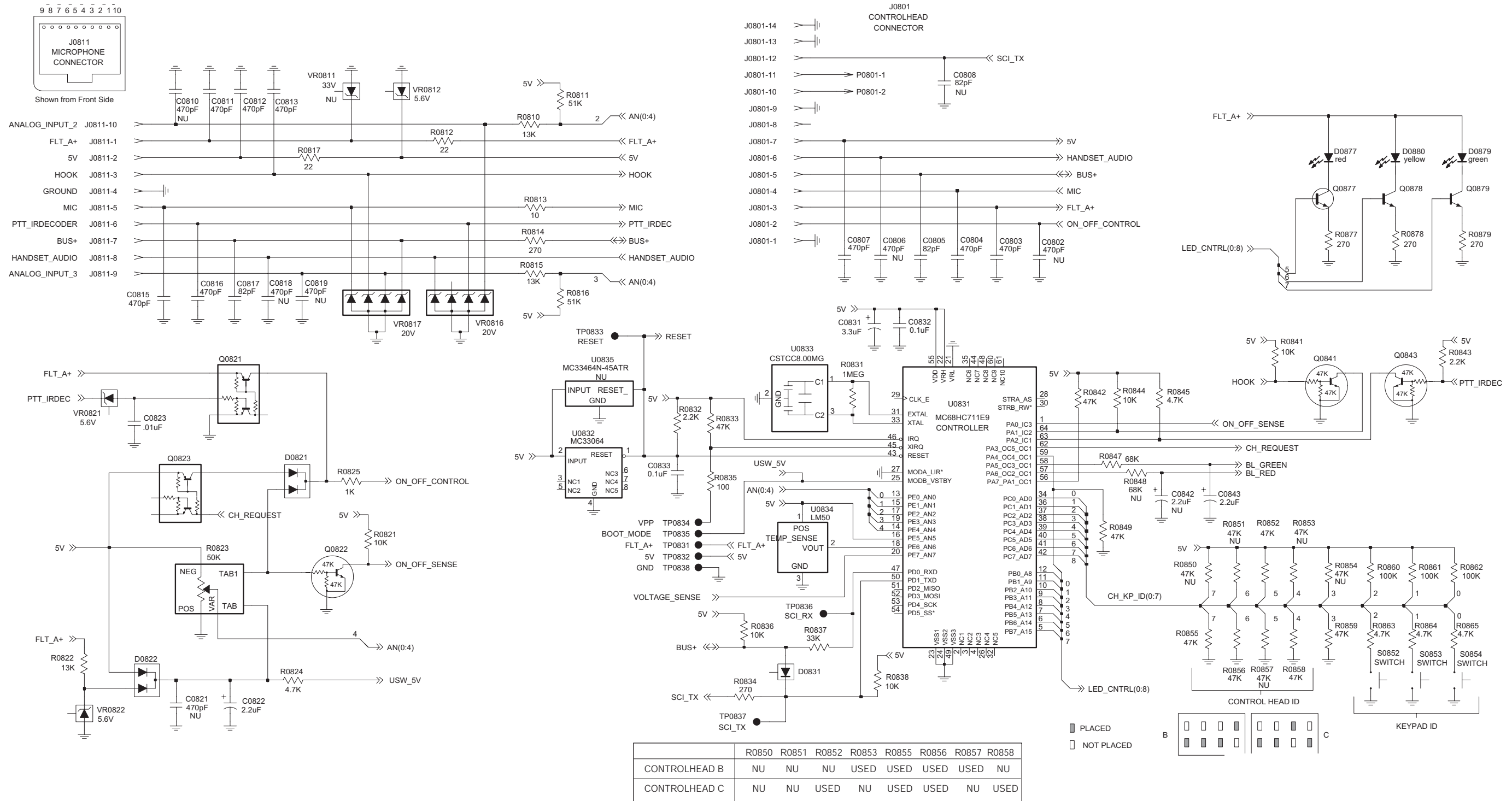
### 3.0 Control Head CDM1250 / PRO5100 / CDM1550 Series / PRO7100 PCB 8486155B06, Schematics, and Parts Lists



ZWG0130136-A Top Side

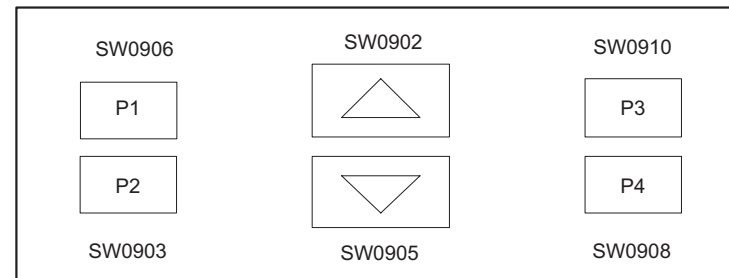


ZWG0130137-B Bottom Side

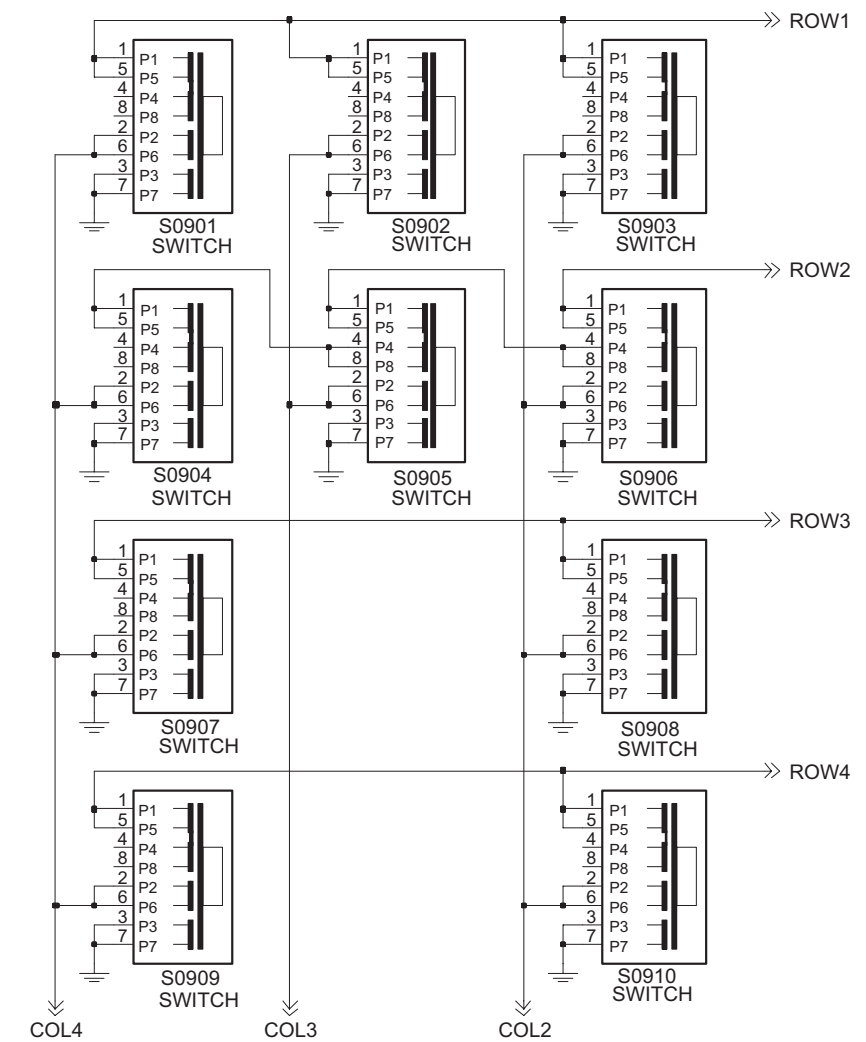
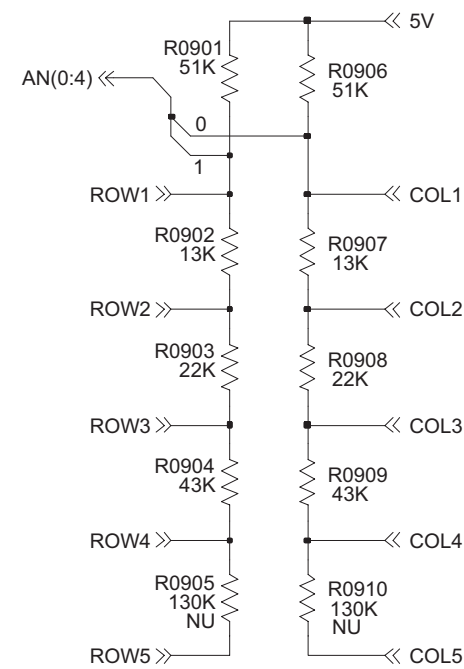
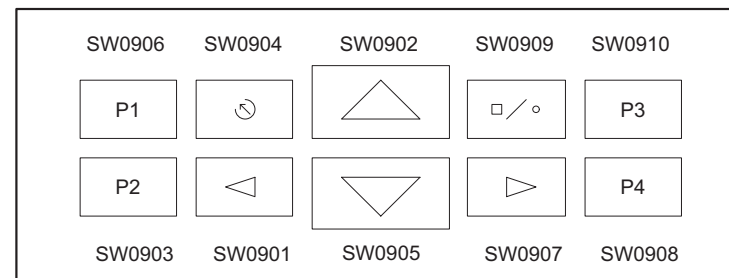


ZWG0130241-B

### KEYPAD B LAYOUT

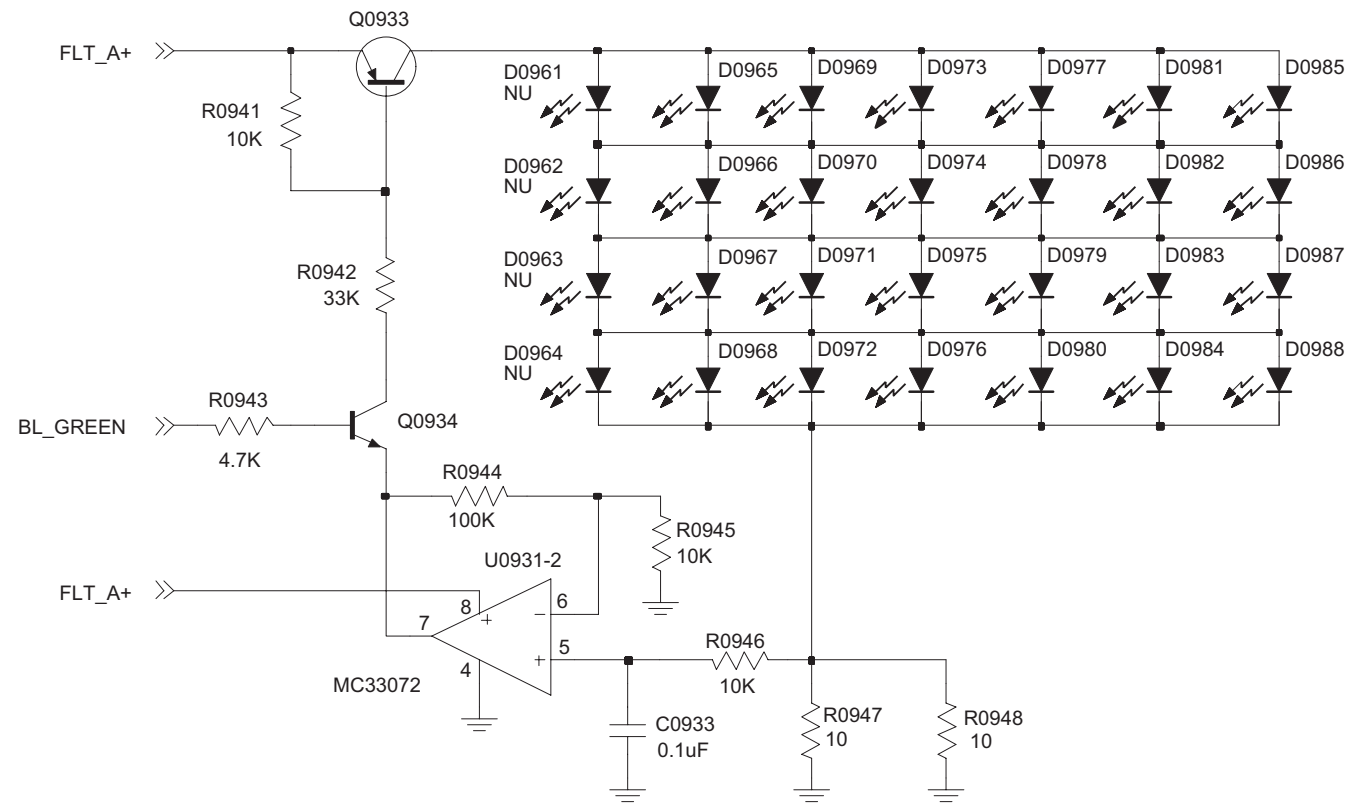


### KEYPAD C LAYOUT

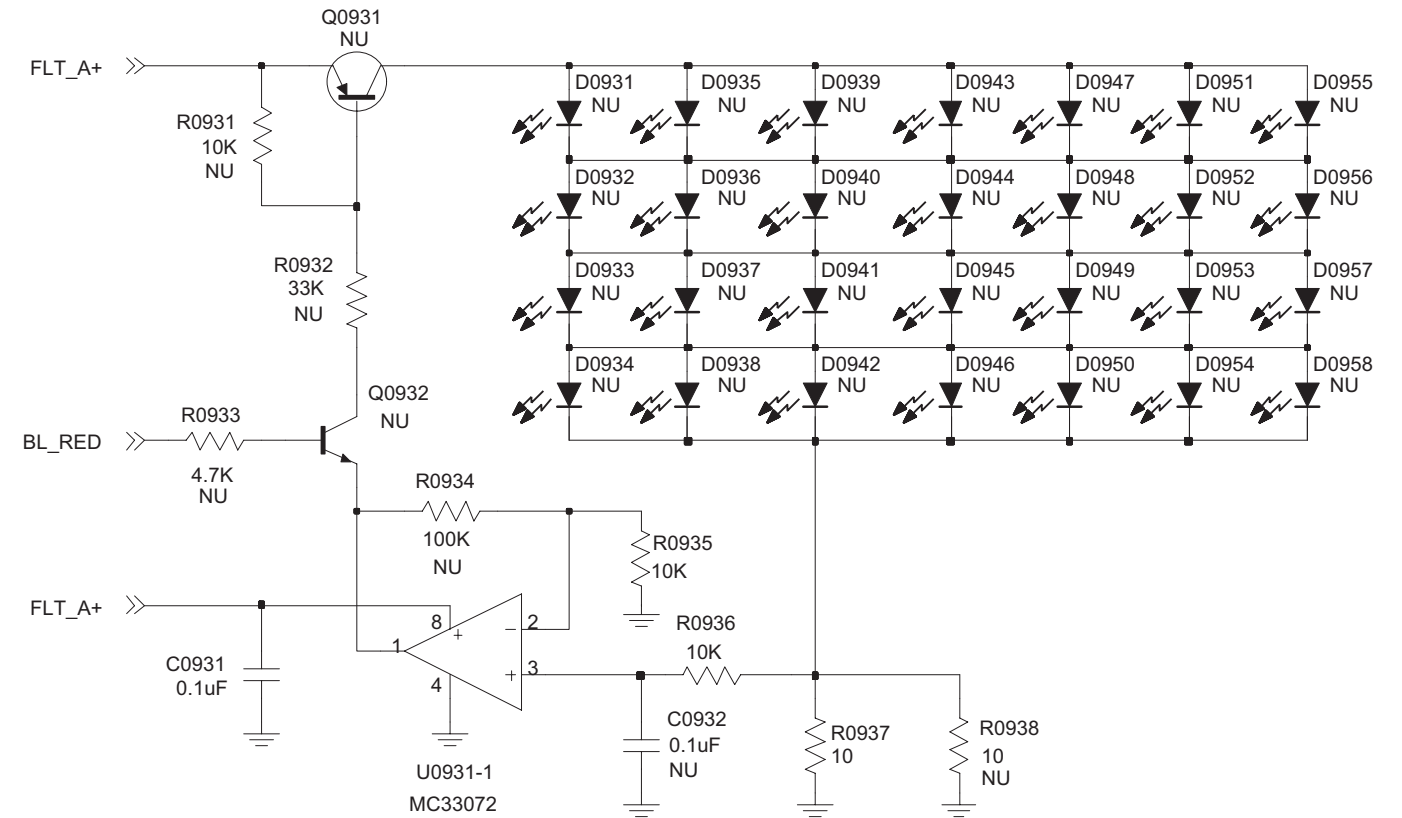


ZWG0130242-A

BACKLIGHT GREEN

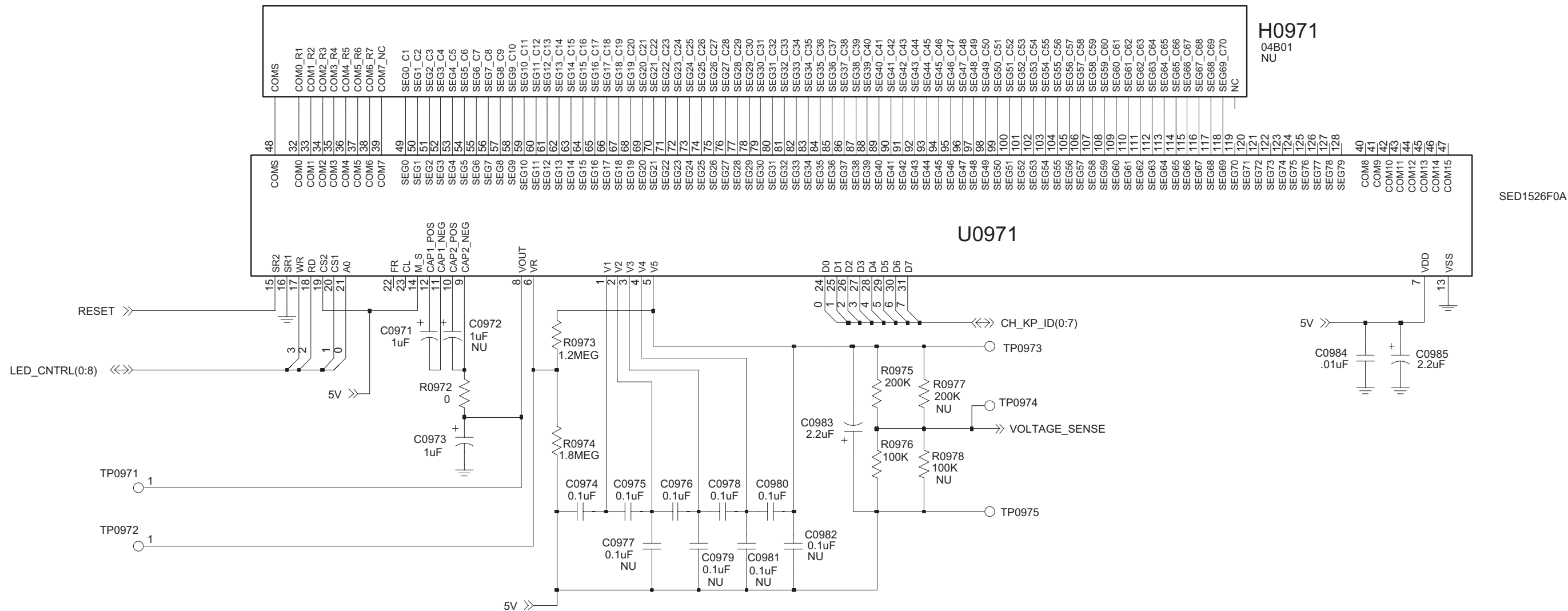


BACKLIGHT RED



# DISPLAY

THE LCD IS PART OF HARDWARE KITS GLN7358A (EUR) AND GLN7359A (US)



ZWG0130244-A

## Control Head PCB 8486155B06 Parts List†

Circuit Ref	Motorola Part No.	Description
C0803	2113741F17	470pF 50V
C0804	2113741F17	470pF 50V
C0805	2113740F49	82pF 5% 50V NPO
C0807	2113741F17	470pF 50V
C0811	2113741F17	470pF 50V
C0812	2113741F17	470pF 50V
C0813	2113741F17	470pF 50V
C0815	2113741F17	470pF 50V
C0816	2113741F17	470pF 50V
C0817	2113740F49	82pF 5% 50V
C0822	2311049A40	TANT CP 2.2uF 10% 10V
C0823	2113741F49	10nF 50V
C0831	2311049A42	TANT CP 3.3uF 10% 6V
C0832	2113743E20	100nF 16V
C0833	2113743E20	100nF 16V
C0843	2311049A40	TANT CP 2.2uF 10% 10V
C0931	2113743E20	100nF 16V
C0933	2113743E20	100nF 16V
C0971	2311049A07	TANT CP 1uF 10% 16V
C0973	2311049A07	TANT CP 1uF 10% 16V
C0974	2113743E20	100nF 16V
C0975	2113743E20	100nF 16V
C0976	2113743E20	100nF 16V
C0978	2113743E20	100nF 16V
C0980	2113743E20	100nF 16V
C0983	2311049A09	TANT CP 2.2uF 10% 20V
C0984	2113741F49	10nF 50V
C0985	2311049A40	TANT CP 2.2uF 10% 10V
D0821	4813833C02	DIODE DUAL SOT MMBD6100
D0822	4813833C02	DIODE DUAL SOT MMBD6100
D0831	4880236E05	DIODE CHIP SCHOTTKY
D0877	4886171B01	LED RED
D0879	4886171B04	LED GREEN
D0880	4886171B03	LED YELLOW
D0951	4886171B02	LED ORANGE Not used in Control Head B
D0952	4886171B02	LED ORANGE Not used in Control Head B
D0953	4886171B02	LED ORANGE Not used in Control Head B
D0954	4886171B02	LED ORANGE Not used in Control Head B
D0965	4886171B04	LED GREEN
D0966	4886171B04	LED GREEN
D0967	4886171B04	LED GREEN
D0968	4886171B04	LED GREEN
D0969	4886171B04	LED GREEN

Circuit Ref	Motorola Part No.	Description
D0970	4886171B04	LED GREEN
D0971	4886171B04	LED GREEN
D0972	4886171B04	LED GREEN
D0973	4886171B04	LED GREEN
D0974	4886171B04	LED GREEN
D0975	4886171B04	LED GREEN
D0976	4886171B04	LED GREEN
D0977	4886171B04	LED GREEN
D0978	4886171B04	LED GREEN
D0979	4886171B04	LED GREEN
D0980	4886171B04	LED GREEN
D0981	4886171B04	LED GREEN Not used in Control Head B
D0982	4886171B04	LED GREEN Not used in Control Head B
D0983	4886171B04	LED GREEN Not used in Control Head B
D0984	4886171B04	LED GREEN Not used in Control Head B
D0985	4886171B04	LED GREEN
D0986	4886171B04	LED GREEN
D0987	4886171B04	LED GREEN
D0988	4886171B04	LED GREEN
J0801	0902636Y02	CONNECTOR FLEX 12 PIN
J0811	2864287B01	CONN TELCO 10 PIN JACK
P0801	2809926G01	CONN 1.25MM 2PIN SUR MT
Q0821	4805921T02	TSTR DUAL ROHM FMC2 RH
Q0822	4880048M01	TSTR NPN DIG 47k/47k
Q0823	4805921T02	TSTR DUAL ROHM FMC2 RH
Q0841	4880048M01	TSTR NPN DIG 47k/47k
Q0843	4880048M01	TSTR NPN DIG 47k/47k
Q0877	4813824A10	TSTR NPN 40V .2A B=50-150
Q0878	4813824A10	TSTR NPN 40V .2A B=50-150
Q0879	4813824A10	TSTR NPN 40V .2A B=50-150
Q0933	4813822A08	TSTR PNP 25V 5AMJD210T4
Q0934	4813824A10	TSTR NPN 40V .2A B=50-150
R0810	0662057A76	13k 1/16W 5%
R0811	0662057A90	51k 1/16W 5%
R0812	0662057A09	22 1/16W 5%
R0813	0662057A01	10 1/16W 5%
R0814	0662057A35	270 1/16W 5%
R0815	0662057A76	13k 1/16W 5%
R0816	0662057A90	51k 1/16W 5%
R0817	0662057A09	22 1/16W 5%
R0821	0662057A73	10k 1/16W 5%
R0822	0662057A76	13k 1/16W 5%
R0823	1805911V02	POT VOL
R0824	0662057A65	4700 1/16W 5%
R0825	0662057A49	1k 1/16W 5%
R0831	0662057B22	1M 1/16W 5%
R0832	0662057A57	2200 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R0833	0662057A89	47k 1/16W 5%
R0834	0662057A35	270 1/16W 5%
R0835	0662057A25	100 1/16W 5%
R0836	0662057A73	10k 1/16W 5%
R0837	0662057A85	33k 1/16W 5%
R0838	0662057A73	10k 1/16W 5%
R0841	0662057A73	10k 1/16W 5%
R0842	0662057A89	47k 1/16W 5%
R0843	0662057A57	2.2k 1/16W 5%
R0844	0662057A73	10k 1/16W 5%
R0845	0662057A65	4700 1/16W 5%
R0847	0662057A93	68k 1/16W 5%
R0849	0662057A89	47k 1/16W 5%
R0852	0662057A89	47k 1/16W 5% Not used in Control Head B
R0853	0662057A89	47k 1/16W 5% Not used in Control Head C
R0855	0662057A89	47k 1/16W 5%
R0856	0662057A89	47k 1/16W 5%
R0857	0662057A89	47k 1/16W 5% Not used in Control Head C
R0858	0662057A89	47k 1/16W 5% Not used in Control Head B
R0859	0662057A89	47k 1/16W 5%
R0860	0662057A97	100k 1/16W
R0861	0662057A97	100k 1/16W
R0862	0662057A97	100k 1/16W
R0863	0662057A65	4700 1/16W 5%
R0864	0662057A65	4700 1/16W 5%
R0865	0662057A65	4700 1/16W 5%
R0877	0660076A35	270 5 1/8
R0878	0660076A35	270 5 1/8
R0879	0660076A35	270 5 1/8
R0901	0662057A90	51k 1/16W 5%
R0902	0662057A76	13k 1/16W 5%
R0903	0662057A81	22k 1/16W 5%
R0904	0662057A88	43k 1/16W 5%
R0906	0662057A90	51k 1/16W 5%
R0907	0662057A76	13k 1/16W 5%
R0908	0662057A81	22k 1/16W 5%
R0909	0662057A88	43k 1/16W 5% Not used in Control Head B
R0935	0662057A73	10k 1/16W 5%
R0936	0662057A73	10k 1/16W 5%
R0937	0660076A01	10 5 1/8
R0941	0662057A73	10k 1/16W 5%
R0942	0662057A85	33k 1/16W 5%
R0943	0662057A65	4700 1/16W 5%
R0944	0662057A97	100k 1/16W
R0945	0662057A73	10k 1/16W 5%
R0946	0662057A73	10k 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R0947	0660076A01	10 5 1/8
R0948	0660076A01	10 5 1/8
R0972	0662057B47	0 1/16W
R0973	0662057B24	1.2M 1/16W 5%
R0974	0662057B28	1.8M 1/16W 5%
R0975	0662057G29	200k 0.1W 1%
R0976	0662057G13	100k 0.1W 1%
*U0831	5113802A24	IC 68HC11 W/SCI,SPI,A/D
U0832	5113815A02	MC33064 UNDER VLTG SENSING
U0833	4886061B01	CER RESONATOR 8MHZ CSTCC8.00MG
U0834	5185963A15	TEMP SENSOR 1M5
U0931	5113818A03	IC HIGH PERFORMANCE SI
U0971	5186158B01	LCD DRIVER SED1526F0A
VR0812	4813830A15	DIODE 5.6V 5% 225mW
VR0816	4805656W09	DIODE ZENER QUAD MMQA20VT1
VR0817	4805656W09	DIODE ZENER QUAD MMQA20VT1
VR0821	4813830A15	DIODE 5.6V 5% 225mW
VR0822	4813830A15	DIODE 5.6V 5% 225mW

\* Motorola Depot Servicing only

Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

† Replacement boards must be ordered from CCSD (formerly AAD) using the number shown in the model charts in Chapters 4 - 13. Boards are not orderable using the 84-prefixed number.

# Chapter 3: Controller Service Maintainability

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## Section 1

# THEORY OF OPERATION

## 1.0 Controller Circuits

### 1.1 Overview

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. The main board is designed to accept one option board. The option board may provide functions such as secure voice/data, voice storage, or signaling decoder.

A control head is either mounted directly or connected by an extension cable. The control head contains LED indicators, a microphone connector, buttons, and—depending on the radio type—a display and a speaker. These provide the user with interface control over the various features of the radio.

If no control head is mounted directly on the front of the radio, an expansion board containing circuitry for special applications can be mounted on the front of the radio. An additional control head can be connected by an extension cable.

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.

### 1.2 General

The radio controller consists of three main subsections:

- digital control
- audio processing
- voltage regulation

The digital control section of the radio is based upon an open architecture controller configuration. It consists of a microprocessor, support memory, support logic, signal MUX ICs, the On/Off circuit, and general purpose Input/Output circuitry.

The controller uses the Motorola 68HC11FL0 microprocessor (U0101). The controller also has three external memory devices. These devices consist of a 32KByte SRAM (U0122), a 512KByte FLASH EEPROM (U0121), and a 16KByte EEPROM (U0111).

**NOTE** From this point on, the 68HC11FL0 microprocessor is referred to as “ $\mu$ P”. References to a control head indicate the control heads with display.

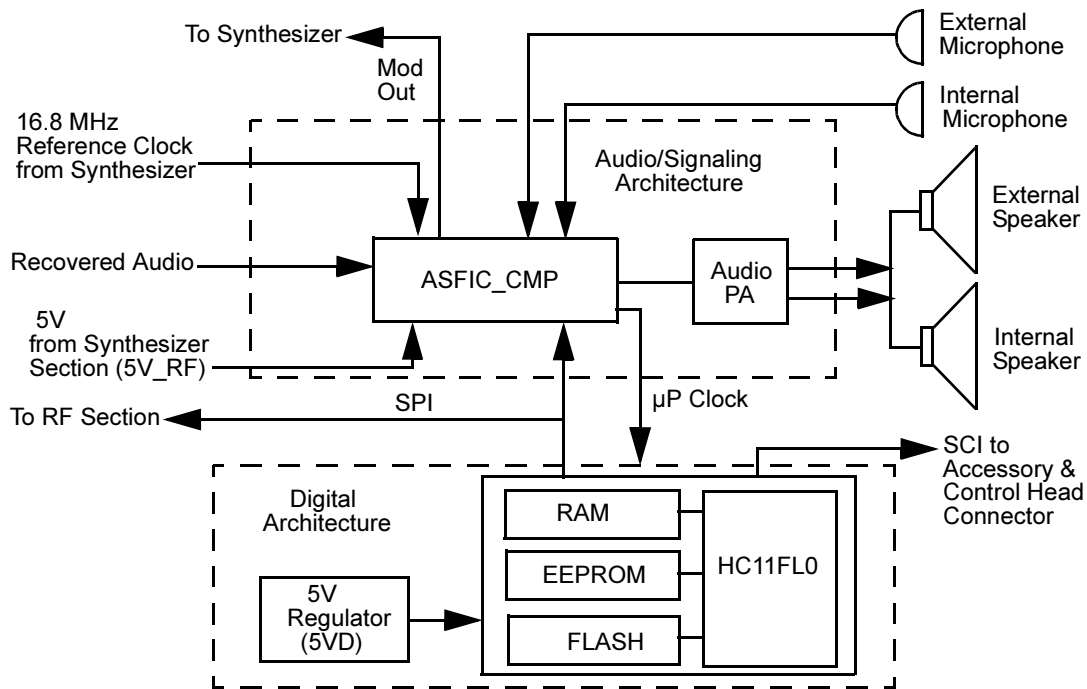


Figure 3-1 Controller Block Diagram

### 1.3 Radio Power Distribution

The DC power distribution throughout the radio board is shown in Figure 3-2. Voltage regulation for the controller is provided by 4 separate devices; U0651 (MC78M05) 5V, U0641 (LM2941) 9.3V, U0611 (LM2941) SWB+ limited to 16.5V and VSTBY 5V (a combination of R0621 and VR0621). An additional 5V regulator is located on the RF section.

The DC voltage applied to connector J0601 supplies power directly to the electronic on/off control, RF power amplifier, 16.5V limiter, 9.3V regulator, Audio PA and 5.6V stabilization circuit. The 9.3V regulator (U0641) supplies power to the 5V regulator (U0651) and the 6V voltage divider Q0681.

Regulator U0641 is used to generate the 9.3 volts required by some audio circuits, the RF circuitry and power control circuitry. Input and output capacitors (C0641 and C0644 / C0645) are used to reduce high frequency noise. R0642 / R0643 set the output voltage of the regulator. If the voltage at pin 1 is greater than 1.3 volts the regulator output decreases and if the voltage is less than 1.3 volts the regulator output increases. This regulator output is electronically enabled by a 0 volt signal on pin 2. Q0661, Q0641 and R0641 are used to disable the regulator when the radio is turned off.

Voltage regulation providing 5V for the digital circuitry is done by U0651. Operating voltage is from the regulated 9.3V supply. Input and output capacitors (C0651 / C0652 and C0654 / C0655) are used to reduce high frequency noise and provide proper operation during battery transients. Voltage sense device U0652 or alternatively U0653 provides a reset output that goes to 0 volts if the regulator output goes below 4.5 volts. This is used to reset the controller to prevent improper operation. Diode D0651 prevents discharge of C0652 by negative spikes on the 9.3V voltage.

Transistor Q0681 and resistors R0681 / R0682 divide the regulated 9.3V down to about 6 volts. This voltage supplies the 5V regulator, located on the RF section. By reducing the supply voltage of the regulator, the power dissipation is divided between the RF section and the controller section.

The voltage VSTBY, which is derived directly from the supply voltage by components R0621 and VR0621, is used to buffer the internal RAM. C0622 allows the battery voltage to be disconnected for a couple of seconds without losing RAM parameters. Dual diode D0621 prevents radio circuitry from discharging this capacitor. When the supply voltage is applied to the radio, C0622 is charged via R0621 and D0621. To avoid the μP entering the wrong mode when the radio is switched on while the voltage across C0622 is still too low, the regulated 5V supply charges C0622 via diode D0621.

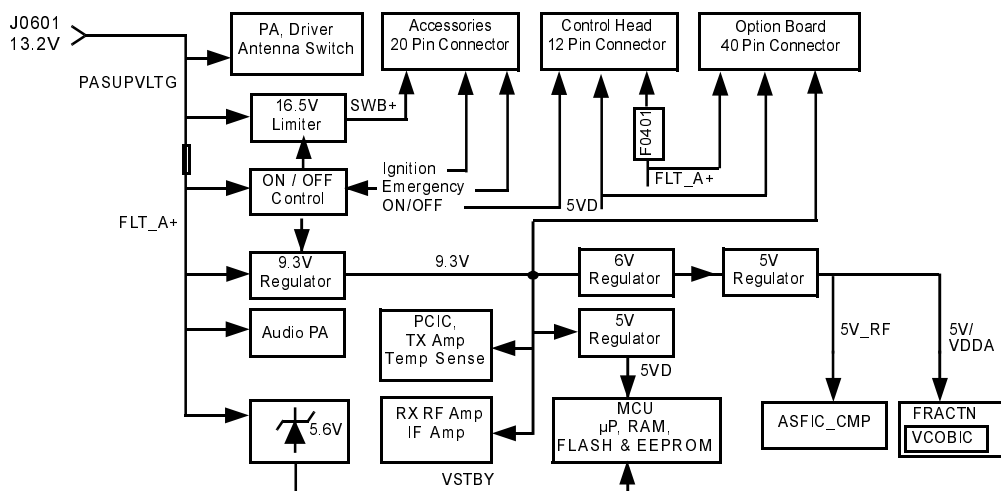


Figure 3-2 DC Power Distribution Block Diagram

The voltage INT SW B+ from switching transistor Q0661 provides power to the circuit controlling the audio PA output. The voltage INT SW B+ voltage is monitored by the μP through voltage divider R0671 / R0672 and line BATTERY VOLTAGE. Diode VR0671 limits the divided voltage to 5.6V to protect the μP.

Regulator U0611 is used to generate the voltage for the switched supply voltage output (SWB+) at the accessory connector J0501 pin 13. U0611 is configured to operate as a switch with voltage and current limit. R0611 / R0612 set the maximum output voltage to 16.5 volts. This limitation is only active at high supply voltage levels. The regulator output is electronically enabled by a 0 volt signal on pin 2. Q0661, Q0641 and R0641 are used to disable the regulator when the radio is turned off. Input and output capacitors (C0603 and C0611 / C0612) are used to reduce high frequency noise.

Diode VR0601 acts as protection against transients and wrong polarity of the supply voltage.

Fuse F0401 prevents damage of the board in case the FLT A+ line is shorted at the control head connector.

## 1.4 Electronic ON/OFF

The radio has circuitry which allows radio software and/or external triggers to turn the radio on or off without direct user action (for example, automatic turn on when ignition is sensed and off when ignition is off).

Q0661 is used to provide INT SW B+ to the various radio circuits and to enable the voltage regulators via transistor Q0641. Q0661 contains an pnp and an npn transistor and acts as an electronic on/off switch. The switch is on when the collector of the npn transistor within Q0661 is low. When the radio is off the collector is at supply voltage level. This effectively prevents current flow from emitter to collector of the pnp transistor. When the radio is turned on the voltage at the base of the npn transistor is pulled high and the pnp transistor switches on (saturation). With voltage INT SWB+ now at supply voltage level, transistor Q0641 pulls pin 2 of the voltage regulators U0611 and U0641 to ground level and thereby enables their outputs.

The electronic on/off circuitry can be enabled by the  $\mu$ P (through ASFIC CMP port GCB2, line DC POWER ON), the emergency switch (line EMERGENCY CONTROL), the mechanical On/Off/Volume knob on the control head (line ON OFF CONTROL), or the ignition sense circuitry (line IGNITION CONTROL). If any of the 4 paths cause a low at the collector of the npn transistor within Q0661, the electronic "ON" is engaged.

## 1.5 Emergency

The emergency switch (J0501 pin 9), when engaged, grounds the base of Q0662 via line EMERGENCY CONTROL. This switches Q0662 off and resistor R0662 pulls the collector of Q0662 and the base of Q0663 to levels above 2 volts. Transistor Q0663 switches on and pulls the collector of the npn transistor within Q0661 to ground level and thereby enables the voltage regulators via Q0641. When the emergency switch is released R0541 pulls the base of Q0662 up to 0.6 volts. This causes the collector of transistor Q0662 to go low (0.2V), thereby switching Q0663 off.

While the radio is switched on, the  $\mu$ P monitors the voltage at the emergency input on the accessory connector via pin 60 and line GP5 IN ACC9. Three different conditions are distinguished: no emergency, emergency, and open connection to the emergency switch. If no emergency switch is connected or the connection to the emergency switch is broken, the resistive divider R0541 / R0512 will set the voltage to about 4.7 volts. If an emergency switch is connected, a resistor to ground within the emergency switch will reduce the voltage on line GP5 IN ACC9 to inform the  $\mu$ P that the emergency switch is operational. An engaged emergency switch pulls line GP5 IN ACC9 to ground level. Diode D0179 limits the voltage to protect the  $\mu$ P input.

While EMERGENCY CONTROL is low, INT SW B+ is on, the  $\mu$ P starts execution, reads that the emergency input is active through the voltage level of line GP5 IN ACC9, and sets the DC POWER ON output of the ASFIC CMP pin 13 to a logic high. This high will keep Q0661 and Q0641 switched on. This operation allows a momentary press of the emergency switch to power up the radio. When the  $\mu$ P has finished processing the emergency press, it sets the DC POWER ON line to a logic "0". This turns off Q0661 and the radio turns off. Notice that the  $\mu$ P is alerted to the emergency condition via line GP5 IN ACC9. If the radio was already on when emergency was triggered then DC POWER ON would already be high.

## 1.6 Mechanical ON/OFF

This refers to the typical On/Off/Volume knob, located on the control head, and which turns the radio on and off.

If the radio is turned off and the On/Off/Volume knob is pressed, line ON OFF CONTROL (J0401 pin 11) goes high and switches the radio's voltage regulators on as long as the button is pressed. The  $\mu$ P is alerted through line ON OFF SENSE (U0101 pin 6) which is pulled to low by Q0110 while the On/Off/Volume knob is pressed. In addition, an interrupt is generated at  $\mu$ P pin 96. The  $\mu$ P asserts line DC POWER ON via ASFIC CMP, pin 13 high which keeps Q0661 and Q0641, and in turn the radio, switched on. When the On/Off/Volume knob is released again the control head informs the  $\mu$ P via SBEP bus about the knob release. (See SBEP Serial Interface subsection for more details.) This informs the  $\mu$ P to keep the radio switched on and continue with normal operation.

If the On/Off/Volume knob is pressed while the radio is on, the control head informs the  $\mu$ P via SBEP bus about the knob status. (See SBEP Serial Interface subsection for more details.) After a short delay time the  $\mu$ P switches the radio off by setting DC POWER ON to low via ASFIC CMP pin 13.

## 1.7 Ignition

Ignition sense is used to prevent the radio from draining the vehicle's battery because the engine is not running.

When the IGNITION input (J0501 pin 10) goes above 5 volts Q0661 is turned on via line IGNITION CONTROL. Q0661 turns on INT SW B+ and the voltage regulators by turning on Q0641 and the  $\mu$ P starts execution. The  $\mu$ P is alerted through line GP6 IN ACC10. The voltage at the IGNITION input turns Q0181 on, which pulls  $\mu$ P pin 74 to low. If the software detects a low state it asserts DC POWER ON via ASFIC pin 13 high which keeps Q0661 and Q0641 on, and in turn the radio switched on.

When the IGNITION input goes below 3 volts, Q0181 switches off and R0181 pulls  $\mu$ P pin 74 to high. This alerts the software to switch off the radio by setting DC POWER ON to low. The next time the IGNITION input goes above 5 volts the above process will be repeated.

## 1.8 Microprocessor Clock Synthesizer

The clock source for the  $\mu$ P system is generated by the ASFIC CMP (U0221). 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 1200Hz to 32.769MHz in 1200Hz steps.

When power is first applied, the ASFIC CMP will generate its default 3.6864MHz CMOS square wave UP CLK (on U0221 pin 28) and this is routed to the  $\mu$ P (U0101 pin 90). After the  $\mu$ P 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 C0245, C0246 and R0241 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 3.6864MHz output.

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

The  $\mu$ P uses XTAL Y0131 and associated components to form a Real Time Clock (RTC). It may be used to display the time on control heads with display or as time stamp for incoming calls or messages. The real time clock is powered from the voltage VSTBY to keep it running while the radio is switched off. When the radio is disconnected from its supply voltage, the time must be set again.

## 1.9 Serial Peripheral Interface (SPI)

The  $\mu$ P communicates to many of the ICs through its SPI port. This port consists of SPI TRANSMIT DATA (MOSI) (U0101-100), SPI RECEIVE DATA (MISO) (U0101-99), SPI CLK (U0101-1) and chip select lines going to the various ICs, 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  $\mu$ P to a device, and SPI RECEIVE DATA is used to send data from a device to a  $\mu$ P.

On the controller there are two ICs on the SPI BUS, ASFIC CMP (U0221-22), and EEPROM (U0111-5). In the RF sections there are 2 ICs on the SPI BUS, the FRAC-N Synthesizer, and the Power Control IC (PCIC). The SPI TRANSMIT DATA and CLK lines going to the RF section are filtered by L0481 / R0481 and L0482 / R0482 to minimize noise. The chip select line CSX from U0101 pin 2 is shared by the ASFIC CMP, FRAC-N Synthesizer and PCIC. Each of these ICs check the SPI data and when the sent address information matches the IC's address, the following data is processed. The chip select lines for the EEPROM (EE CS), Voice Storage (VS CS), expansion board (EXP1 CS, EXP2 CS) and option board (OPT CS) are decoded by the address decoder U0141.

When the  $\mu$ P needs to program any of these ICs 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 ICs are different; e.g., the ASFIC CMP can receive up to 19 bytes (152 bits) while the PCIC can receive up to 6 bytes (48 bits). After the data has been sent the chip select line is returned to logic "1".

The option board interfaces are different in that the  $\mu$ P can also read data back from devices connected. The timing and operation of this interface is specific to the option connected, but generally follows the pattern:

1. an option board device generates a service request via J0551-29, line RDY and  $\mu$ P pin 79,
2. the main board asserts a chip select for that option board device via U0141-14, line OPT CS, J0551-30,
3. the main board  $\mu$ P generates the CLK (J0551-3),
4. the main board  $\mu$ P writes serial data via J0551-15 and reads serial data via J0551-16 and,
5. when data transfer is complete the main board terminates the chip select and CLK activity.

## 1.10 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 microphone connector via control head connector (J0401-8) and to the accessory connector J0501-17 and comprises BUS+. The line is bi-directional, meaning that either the radio or the RIB can drive the line. The  $\mu\text{P}$  sends serial data via pin 98 and D0101 and it reads serial data via pin 97. Whenever the  $\mu\text{P}$  detects activity on the BUS+ line, it starts communication.

In addition, the SBEP serial interface is used to communicate with a connected control head. When a control head key is pressed or the volume knob is rotated, the line ON OFF CONTROL goes high. This turns on transistor Q0110 which pulls line ON OFF SENSE and  $\mu\text{P}$  pin 6 to ground level. In addition, an interrupt is generated at  $\mu\text{P}$  pin 96. This indicates that the control head wants to start SBEP communication. The  $\mu\text{P}$  then requests the data from the control head. The control head starts sending and after all data has been sent, the ON OFF CONTROL line goes low. The control head ignores any data on BUS+ during SBEP communication with the CPS or Universal Tuner.

## 1.11 General Purpose Input/Output

The controller provides eight general purpose lines (DIG1 through DIG8) available on the accessory connector J0501 to interface to external options. Lines DIG IN 1, 3, 5, 6 are inputs, DIG OUT 2 is an output and DIG IN OUT 4, 7, 8 are bi-directional. The software and the hardware configuration of the radio model define the function of each port.

- DIG IN 1 can be used as external PTT input, DATA PTT input or others, set by the CPS. The  $\mu\text{P}$  reads this port via pin 77 and Q0171.
- DIG OUT 2 can be used as normal output or external alarm output, set by the CPS. Transistor Q0173 is controlled by the  $\mu\text{P}$  via ASFIC CMP pin 14.
- DIG IN 3 is read by  $\mu\text{P}$  pin 61 via resistor R0176
- DIG IN 5 can be used as normal input or emergency input, set by the CPS. The  $\mu\text{P}$  reads this port via R0179 and  $\mu\text{P}$  pin 60. Diode D0179 limits the voltage to protect the  $\mu\text{P}$  input.
- DIG IN 6 can be used as normal input, set by the CPS. The  $\mu\text{P}$  reads this port via pin 74 and Q0181.
- DIG IN OUT 4,7,8 are bi-directional and use the same circuit configuration. Each port uses an output transistor Q0177, Q0183, Q0185 controlled by  $\mu\text{P}$  pins 46, 47, 53. The ports are read by  $\mu\text{P}$  pins 75, 54, 76. To use one of the ports as input the  $\mu\text{P}$  must turn off the corresponding output transistor.

In addition the signals from DIG IN 1, DIG IN OUT 4 are fed to the option board connector J0551 and the expansion board connector J0451.

## 1.12 Normal Microprocessor Operation

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

In expanded mode on this radio, the  $\mu\text{P}$  (U0101) has access to 3 external memory devices; U0121 (FLASH EEPROM), U0122 (SRAM), U0111 (EEPROM). Also, within the  $\mu\text{P}$  there are 3 KBytes of internal RAM, as well as logic to select external memory devices.

The external EEPROM (U0111) 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. (See the particular device subsection for more details.)

The external SRAM (U0122) as well as the  $\mu\text{P}$ '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. (See the particular device subsection for more details.)

The FLASH EEPROM contains the actual Radio Operating Software. This software is common to all open architecture radios within a given model type. For example, trunking radios may have a different version of software in the FLASH EEPROM than non-trunking radios. (See the particular device subsection for more details.)

The  $\mu\text{P}$  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 (U0101-38) to chip select U0121-30 (FLASH EEPROM), CSgp2 (U0101-41) to chip select U0122-20 (SRAM) and PG7 R W (U0101-4) to select whether to read or to write. The external EEPROM (U0111-1), the OPTION BOARD and EXPANSION BOARD are selected by 3 lines of the  $\mu\text{P}$  using address decoder U0141. The chips ASFIC CMP / FRAC-N / PCIC are selected by line CSX (U0101-2).

When the  $\mu\text{P}$  is functioning normally, the address and data lines should be toggling at CMOS logic levels. Specifically, the logic high levels should be between 4.8 and 5.0V, and the logic low levels should be between 0 and 0.2V. 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  $\mu\text{P}$  control lines.

On the  $\mu\text{P}$  the lines XIRQ (U0101-48), MODA LIR (U0101-58), MODB VSTPY (U0101-57) and RESET (U0101-94) 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 2.5V when 2 shorted lines attempt to drive to opposite rails.

The MODA LIR (U0101-58) and MODB VSTPY (U0101-57) inputs to the  $\mu\text{P}$  must be at a logic "1" for it to start executing correctly. After the  $\mu\text{P}$  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  $\mu\text{P}$  begins a new instruction (an instruction typically requires 2-4 external bus cycles, or memory fetches). However, since it is an open-drain output, the waveform rise assumes an exponential shape similar to an RC circuit.



There are 8 analog-to-digital converter ports (A/D) on U0101. They are labeled within the device block as PE0-PE7. These lines sense the voltage level ranging from 0 to 5V of the input line and convert that level to a number ranging from 0 to 255 which can be read by the software to take appropriate action.

For example U0101-67 is the battery voltage detect line. R0671 and R0672 form a resistor divider on INT SWB+. With 30K and 10K and a voltage range of 11V to 17V, that A/D port would see 2.74V to 4.24V which would then be converted to ~140 to 217 respectively.

U0101-69 is the high reference voltage for the A/D ports on the  $\mu$ P. Capacitor C0101 filters the 5V reference. If this voltage is lower than 5V the A/D readings will be incorrect. Likewise U0101-68 is the low reference for the A/D ports. This line is normally tied to ground. If this line is not connected to ground, the A/D readings will be incorrect.

### 1.13 FLASH Electronically Erasable Programmable Memory (FLASH EEPROM)

The 512K Byte FLASH EEPROM (U0121) contains the radio's operating software. This software is common to all open architecture radios within a given model type. For example, trunking radios may have a different version of software in the FLASH EEPROM than non-trunking radios. This is, as opposed to the codeplug information stored in EEPROM (U0111) which could be different from one user to another in the same company.

In normal operating mode, this memory is read-only; it cannot be written to. The memory access signals (CE, OE and WE) are generated by the  $\mu$ P.

To upgrade/reprogram the FLASH software, the  $\mu$ P must be set in bootstrap operating mode. This is done by pulling  $\mu$ P pins MODA LIR (U0101-58) and MODB VSTBY (U0101-57) to low during power up. When accessory connector pin 18 is at ground level, diode D0151 will pull both  $\mu$ P pins to low. The same can be done by a level of 12 volts on line ON OFF CONTROL from the control head. Q0151 pulls diode D0151 and in turn both  $\mu$ P pins to low. Diode VR0151 prevents entering bootstrap operating mode during normal power up.

In bootstrap operating mode the  $\mu$ P controls the FLASH EN OE (U0121-32) input by  $\mu$ P pin 86. Chip select (U0121-30) and read or write operation (U0121-7) are controlled by  $\mu$ P pins 38 and 4.

The FLASH device may be reprogrammed 1,000 times without issue. It is not recommended to reprogram the FLASH device at a temperature below 0°C.

Capacitor C0121 serves to filter out any AC noise which may ride on 5V at U0121.

### 1.14 Electrically Erasable Programmable Memory (EEPROM)

The external 16 KByte EEPROM (U0111) contains additional radio operating parameters such as operating frequency and signaling features, commonly know as the codeplug. It is also used to store radio operating state parameters such as current mode and volume. This memory can be written to in excess of 100,000 times and will retain the data when power is removed from the radio. The memory access signals (SI, SO and SCK) are generated by the  $\mu$ P and chip select (CS) is generated by address decoder U0141-15.

## 1.15 Static Random Access Memory (SRAM)

The SRAM (U0121) 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 U0122-20 (which comes from U0101-CSGP2) going low. U0122 is commonly referred to as the external RAM as opposed to the internal RAM which is the 3 KBytes 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 C0122 serves to filter out any AC noise which may ride on 5V at U0122.

## 2.0 Controller Board Audio and Signaling Circuits

### 2.1 Audio Signaling Filter IC with Compander (ASFIC CMP)

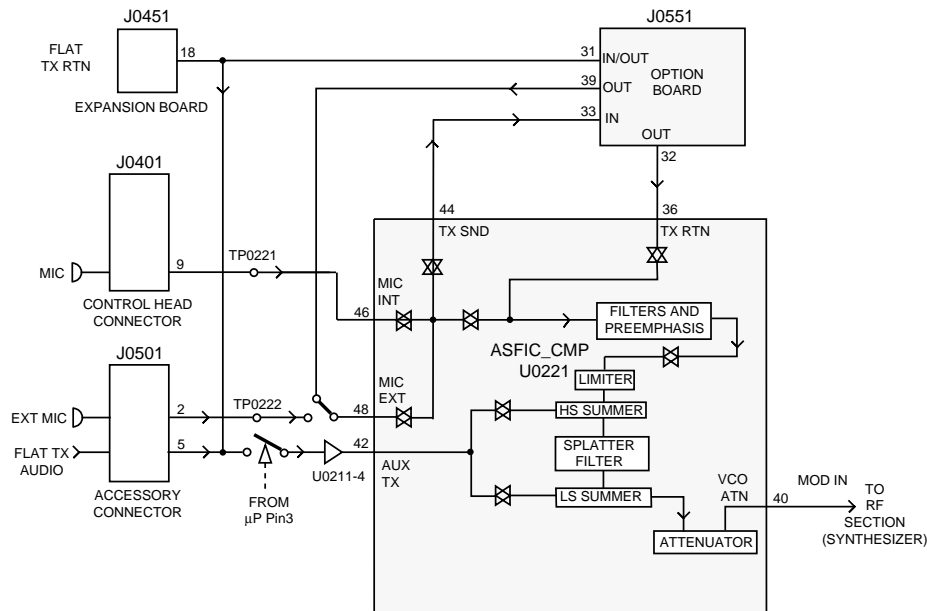
The ASFIC CMP (U0221) used in the controller has 4 functions:

1. RX/TX audio shaping, i.e. filtering, amplification, attenuation
2. RX/TX signaling, PL/DPL/HST/MDC
3. Squelch detection
4.  $\mu$ P clock signal generation (see Section 1.8: Microprocessor Clock Synthesizer)

The ASFIC CMP is programmable through the SPI BUS (U0221-20/21/22), 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 NOISE BLANKER (GCB0) in Low Band radios, EXTERNAL ALARM (GCB1) and DC POWER ON (GCB2) to switch the voltage regulators (and the radio) on and off. GCB3 controls U0251 pin 11 to output either RX FLAT AUDIO or RX FILTERED AUDIO on the accessory connector pin 11. GCB4 controls U0251 pin 10 to use either the external microphone input or the voice storage playback signal. GCB5 is used to switch the audio PA on and off.

## 2.2 Transmit Audio Circuits

Refer to Figure 3-3 for reference for the following sections.



**Figure 3-3** Transmit Audio Paths

### 2.2.1 Mic/Data Input Path

The radio supports 2 distinct microphone paths known as internal (from control head) and external mic (from accessory connector J0501-2) and an auxiliary path (FLAT TX AUDIO, from accessory connector J0501-5). The microphones used for the radio require a DC biasing voltage provided by a resistive network.

These two microphone audio input paths enter the ASFIC CMP at U0221-48 (external mic) and U0221-46 (internal mic). Following the internal mic path; the microphone is plugged into the radio control head and is connected to the controller board via J0401-9.

From here the signal is routed via R0409 and line INT MIC to R0205. R0201 and R0202 provide the 9.3VDC bias. Resistive divider R0205 / R0207 divide the input signal by 5.5 and provide input protection for the CMOS amplifier input. R0202 and C0201 provide a 560 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.

C0204 serves as a DC blocking capacitor. The audio signal at U0221-46 (TP0221) should be approximately 14mV for 1.5kHz or 3kHz of deviation with 12.5kHz or 25kHz channel spacing.

The external microphone signal enters the radio on accessory connector J0501 pin 2 and is routed via line EXT MIC to R0206. R0203 and R0204 provide the 9.3VDC bias. Resistive divider R0206 / R0208 divide the input signal by 5.5 and provide input protection for the CMOS amplifier input.

R0204 and C0202 provide a 560 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.

C0254 serves as a DC blocking capacitor. Multi switch U0251 controlled by ASFIC CMP port GCB4 selects either the external microphone input signal or the voice storage playback signal for entering the ASFIC CMP at pin 48. The audio signal at U0221-48 (TP0222) should be approximately 14mV for 1.5kHz or 3kHz of deviation with 12.5kHz or 25kHz channel spacing.

The FLAT TX AUDIO path is used for transmitting data signals and has therefore no limiter or filters enabled inside the ASFIC CMP. When this path is enabled via CPS and DATA PTT is asserted, any signal on this path is directly fed to the modulator. Signals applied to this path either via accessory connector J0501, expansion board connector J0451 or option board connector J0551 must be filtered and set to the correct level externally or on the option board in order not to exceed the maximum specified transmit deviation and transmitted power in the adjacent channels. The attenuator inside the ASFIC CMP changes the FM deviation of the data signal according to the channel spacing of the active transmit channel.

The FLAT TX AUDIO signal from accessory connector J0501-5 is fed to the ASFIC CMP (U0221) pin 42 through C0541 and line FLAT TX RTN, switch U0251 and buffer U0211-4. When the radio switches from receive to transmit mode the  $\mu$ P opens switch U0251 for a short period to prevent that any applied signal can cause a transmit frequency offset. Buffer U0211-4 sets the correct DC level and ensures a short settle period when the radio is switched on. Inside the ASFIC CMP the signal is routed directly to the attenuator, which sets the FM deviation according to the channel spacing of the active transmit channel and emerges from the ASFIC CMP at U0221-40, at which point it is routed to the RF section.

The ASFIC has an internal AGC that can control the gain in the mic audio path. The AGC can be disabled / enabled by the  $\mu$ P. Another feature that can be enabled or disabled in the ASFIC is the VOX. This circuit, along with the capacitor at U0221-7, provides a DC voltage that can allow the  $\mu$ P to detect microphone audio. The ASFIC can also be programmed to route the microphone audio to the speaker for public address operation.

### 2.2.2 PTT Sensing and TX Audio Processing

Microphone PTT coming from the control head is sent via SBEP bus to the  $\mu$ P. An external PTT can be generated by grounding pin 3 on the accessory connector if this input is programmed for PTT by the CPS. When microphone PTT is sensed, the  $\mu$ P will always configure the ASFIC CMP for the "internal" mic audio path, and external PTT will result in the external mic audio path being selected.

Inside the ASFIC CMP, the mic audio is filtered to eliminate frequency components outside the 300-3000Hz 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 U0221-40 MOD IN, at which point it is routed to the RF section.

Dependent on the radio model, input pin 3 on the accessory connector can be programmed for DATA PTT by the CPS. When DATA PTT is sensed, the  $\mu$ P will always configure the ASFIC CMP for the flat TX audio path. Limiter and any filtering will be disabled. The signal is routed directly to the attenuator, which sets the FM deviation according to the channel spacing of the active transmit

channel and emerges from the ASFIC CMP at U0221-40, at which point it is routed to the RF section.

### 2.2.3 TX Secure Audio (Optional)

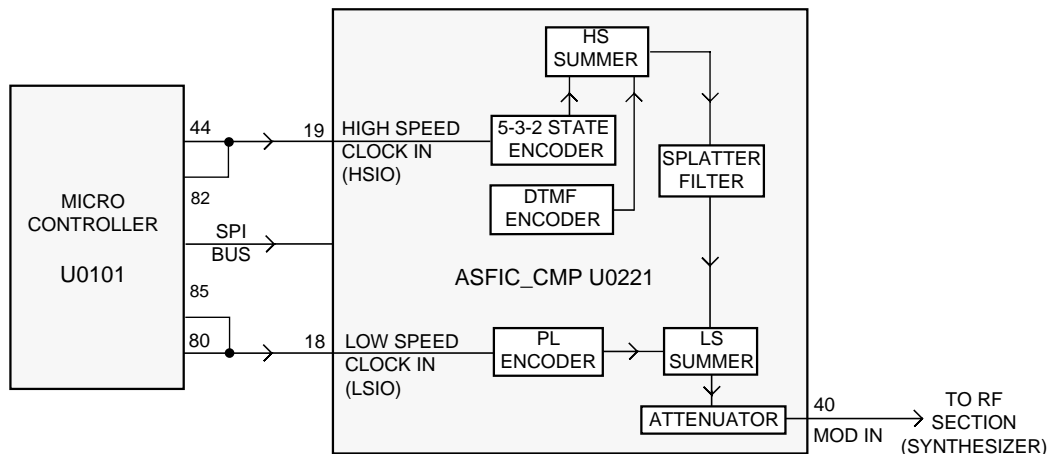
The audio follows the normal transmit audio processing until it emerges from the ASFIC CMP TX SND pin (U0221-44), which is fed to the Secure board residing at option connector J0551-33. The Secure board contains circuitry to amplify, encrypt, and filter the audio. The encrypted signal is then fed back from J0551-32 to the ASFIC CMP TX RTN input (U0221-36). The signal level at this pin should be about 65mVrms. The signal is then routed through the TX path in the ASFIC CMP and emerges at MOD IN pin 40.

### 2.2.4 Option Board Transmit Audio

The audio follows the normal transmit audio processing until it emerges from the ASFIC CMP TX SND pin (U0221-44), which is fed to the option board residing at option connector J0551-33. The option board contains circuitry to process the audio. The processed signal is then fed back from J0551-32 to the ASFIC CMP TX RTN input (U0221-36). The signal level at this pin should be about 65mVrms. The signal is then routed through the TX path in the ASFIC CMP and emerges at MOD IN pin 40.

## 2.3 Transmit Signaling Circuits

Refer to Figure 3-4 for reference for the following sections.



**Figure 3-4** Transmit Signaling Paths

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.

### 2.3.1 Sub-audible Data (PL/DPL)

Sub-audible data implies signaling whose bandwidth is below 300Hz. 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 300Hz, so these tones are never heard in the actual system.

Only one type of sub-audible data can be generated by U0221 (ASFIC CMP) at any one time. The process is as follows, using the SPI BUS, the  $\mu$ P programs the ASFIC CMP to set up the proper low-speed data deviation and select the PL or DPL filters. The  $\mu$ P then generates a square wave which strobes the ASFIC PL / DPL encode input LSIO U0221-18 at twelve times the desired data rate. For example, for a PL frequency of 103Hz, the frequency of the square wave would be 1236Hz.

This drives a tone generator inside U0221 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 U0221-40 (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.

### 2.3.2 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  $\mu$ P first programs the ASFIC CMP (U0221) to the proper filter and gain settings. It then begins strobing U0221-19 (HSIO) with a pulse when the data is supposed to change states. U0221'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 attenuators 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.

### 2.3.3 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, 941Hz) and three in the high group (1209, 1336, 1477Hz).

The high-group tone is generated by the  $\mu$ P (U0101-44) strobing U0221-19 at six times the tone frequency for tones less than 1440Hz or twice the frequency for tones greater than 1440Hz. The low group tone is generated by the ASFIC CMP, controlled by the  $\mu$ P via SPI bus. Inside U0221 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.

## 2.4 Receive Audio Circuits

Refer to Figure 3-5 for reference for the following sections.

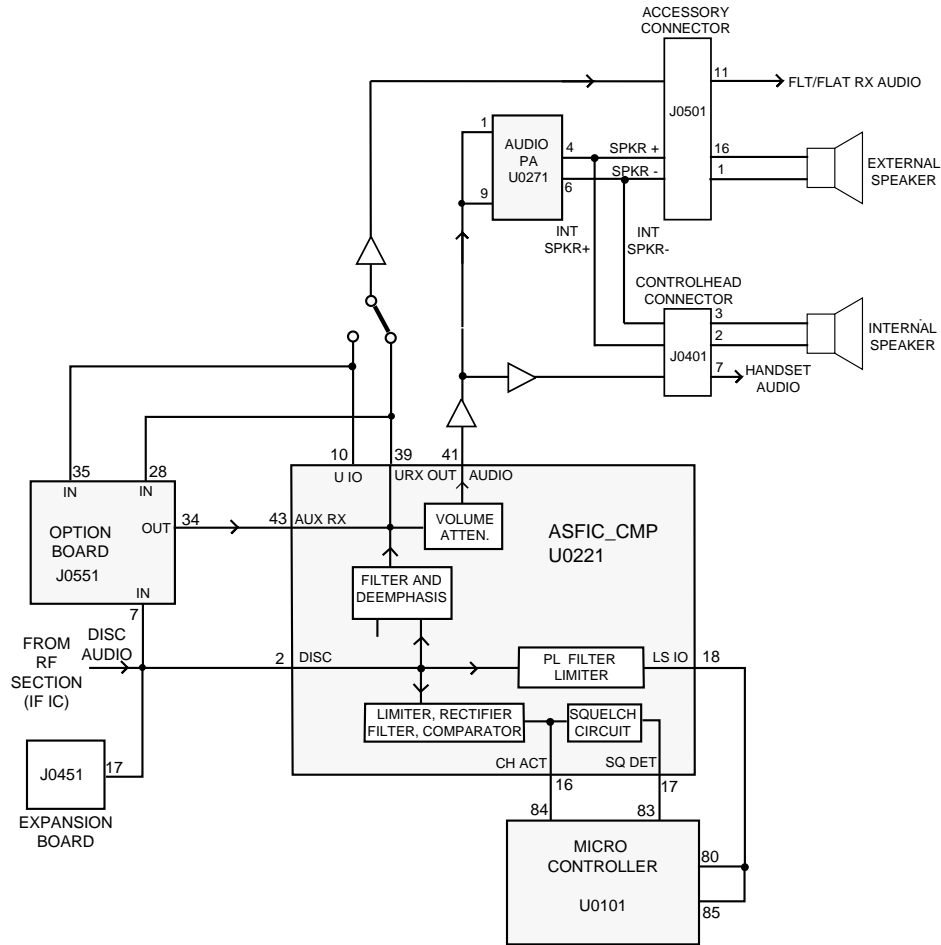


Figure 3-5 Receive Audio Paths

### 2.4.1 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 (U0221-2). 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 (U0221-16) and SQ DET (U0221-17).

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 (U0221-17) 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  $\mu$ P pin 84 while SQ DET is routed to the  $\mu$ 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.

### 2.4.2 Audio Processing and Digital Volume Control

The receiver audio signal enters the controller section from the IF IC on DISC AUDIO. The signal is DC coupled by R0228 and enters the ASFIC CMP via the DISC pin U0221-2.

Inside the ASFIC CMP, the signal goes through 2 paths in parallel, the audio path and the PL/DPL path.

The audio path has a programmable amplifier, whose setting is based on the channel bandwidth being received, then a LPF filter to remove any frequency components above 3000Hz and then an HPF to strip off any sub-audible data below 300Hz. 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 pin AUDIO (U0221-41).

The  $\mu$ 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 U0221-2. Once inside it goes through the PL/DPL path. The signal first passes through one of 2 low-pass filters, either PL low-pass filter or DPL/LST low-pass filter. Either signal is then filtered and goes through a limiter and exits the ASFIC CMP at LSIO (U0221-18). At this point the signal will appear as a square wave version of the sub-audible signal which the radio received. The  $\mu$ P U0101-80 will decode the signal directly to determine if it is the tone / code which is currently active on that mode.

### 2.4.3 Audio Amplification Speaker (+) Speaker (-)

The output of the ASFIC CMP's digital volume pot, U0221-41 is routed through DC blocking capacitor C0265 to a buffer formed by U0211-1. Resistors R0265 and R0268 set the correct input level to the audio PA (U0271). This is necessary because the gain of the audio PA is 46 dB, and the ASFIC CMP output is capable of overdriving the PA unless the maximum volume is limited. Resistor R0267 and capacitor C0267 increase frequency components below 350Hz.

The audio then passes through R0269 and C0272 which provides AC coupling and low frequency roll-off. C0273 provides high frequency roll-off as the audio signal is routed to pins 1 and 9 of the audio power amplifier U0271.

The audio power amplifier has one inverted and one non-inverted output that produces the differential audio output SPK+ / SPK- (U0271-4/6). The inputs for each of these amplifiers are pins 1 and 9 respectively; these inputs are both tied to the received audio. The audio PA's DC biases are not activated until the audio PA is enabled at pin 8.

The audio PA is enabled via the ASFIC CMP (U0221-38). When the base of Q0271 is low, the transistor is off and U0271-8 is high, using pull up resistor R0273, and the audio PA is ON. The voltage at U0273-8 must be above 8.5VDC to properly enable the device.



If the voltage is between 3.3 and 6.4V, the device will be active but has its input (U0273-1/9) 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 FLT A+ (U0271-7). FLT A+ of 11V yields a DC offset of 5V, and FLT A+ of 17V yields a DC offset of 8.5V. 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 (J0501-16 and 1) and to the control head (connector J0401-2 and 3).

#### 2.4.4 Handset Audio

Certain handheld accessories have a speaker within them which require a different voltage level than that provided by U0271. For those devices HANDSET AUDIO is available at control head connector J0401-7.

The received audio from the output of the ASFIC CMP's digital volume attenuator and buffered by U0211-1 is also routed to U0211-3 pin 9 where it is amplified 20 dB; this is set by the 10k/100k combination of R0261 and R0262. This signal is routed from the output of the op-amp U0211-3 pin 8 to J0401-7. The control head sends this signal directly out to the microphone jack. The maximum value of this output is 6.6Vp-p.

#### 2.4.5 Filtered Audio and Flat Audio

The ASFIC CMP has an audio whose output at U0221-39 has been filtered and de-emphasized, but has not gone through the digital volume attenuator. From ASFIC CMP U0221-39 the signal is routed via R0251 through gate U0251-12 and AC coupled to U0211-2. The gate controlled by ASFIC CMP port GCB3 (U0221-35) 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). R0251 and R0253 determine the gain of op-amp U0211-2 for the filtered audio while R0252 and R0253 determine the gain for the flat Audio. The output of U0253-7 is then routed to J0501-11 via DC blocking capacitor C0542 and R0531. Note that any volume adjustment of the signal on this path must be done by the accessory.

#### 2.4.6 RX Secure Audio (Optional)

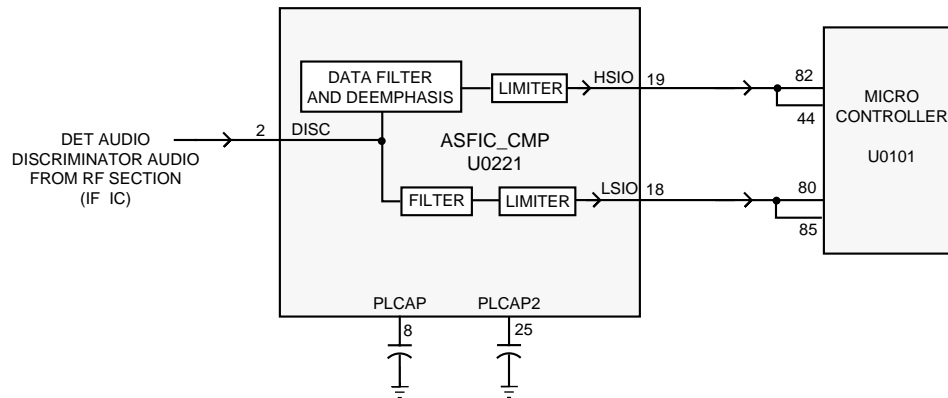
Discriminator audio, which is now encrypted audio, follows the normal receive audio processing until it emerges from the ASFIC CMP UIO pin (U0221-10), which is fed to the Secure board residing at option connector J0551-35. On the Secure board, the encrypted signal is converted back to normal audio format, and then fed back through (J0551-34) to AUX RX of the ASFIC CMP (U0221-43). From then on it follows a path identical to conventional receive audio, where it is filtered (0.3 - 3kHz) and de-emphasized. The signal URX SND from the ASFIC CMP (U0221-39), also routed to option connector J0551-28, is not used for the Secure board but for other option boards.

#### 2.4.7 Option Board Receive Audio

Unfiltered audio from the ASFIC CMP pin UIO (U0221-10) enters the option board at connector J0551-35. Filtered audio from the ASFIC CMP pin URXOUT (U0221-39) enters the option board at connector J0551-28. On the option board, the signal may be processed, and then fed back through J0551-34 to AUX RX of the ASFIC CMP (U0221-43). From then on it follows a path identical to conventional receive audio, where it may be filtered (0.3 - 3kHz) and de-emphasized.

## 2.5 Receive Signaling Circuits

Refer to Figure 3-6 for reference for the following sections.



**Figure 3-6** Receive Signaling Paths

### 2.5.1 Sub-audible (PL/DPL) and High Speed Data Decoder

The ASFIC CMP (U0221) is used to filter and limit all received data. The data enters the ASFIC CMP at input DISC (U0221-2). Inside U0221 the data is filtered according to data type (HS or LS), then it is limited to a 0-5V digital level. The MDC and trunking high speed data appear at U0221-19, where it connects to the  $\mu$ P U0101-82

The low speed limited data output (PL, DPL, and trunking LS) appears at U0221-18, where it connects to the  $\mu$ P U0101-80.

The low speed data is read by the  $\mu$ 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 C0236, and C0244 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.

### 2.5.2 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 U0221 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  $\mu$ P and the ASFIC CMP.

The allowable internal alert tones are 304, 608, 911, and 1823Hz. 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  $\mu$ P can generate any tone within the 100-3000Hz audio band. This is accomplished by the  $\mu$ P generating a square wave which enters the ASFIC CMP at U0221-19. 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 U0221 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 U0221-41 and is routed to the audio PA like receive audio

## 2.6 Voice Storage (Optional)

The Voice Storage (VS) option can be used to store audio signals coming from the receiver or from the microphone. Any stored audio signal can be played back over the radio's speaker or sent out via the radio's transmitter.

The Voice Storage option can be placed on the controller section or on an additional board which resides on option board connector J0551. Voice Storage is included on the PassPort board. Voice Storage IC U0301 provides all required functionality and is powered from 3.3 volts regulator U0351 which, is powered from the regulated 5 volts. Dual shottky diode D0301 reduces the supply voltage for U0301 to 3 volts. The  $\mu$ P controls U0301 via SPI bus lines CLK (U0301-8), DATA (U0301-10) and MISO (U0301-11). To transfer data, the  $\mu$ P first selects the U0301 via address decoder U0141, line VS CS and U0301 pin 9. Then the  $\mu$ P sends data through line DATA and receives data through line MISO. Pin 2 (RAC) of U0301 indicates the end of a message row by a low state for 12.5 ms and connects to  $\mu$ P pin 52. A low at pin 5 (INT), which is connected to  $\mu$ P pin 55 indicates that the Voice Storage IC requires service from the  $\mu$ P.

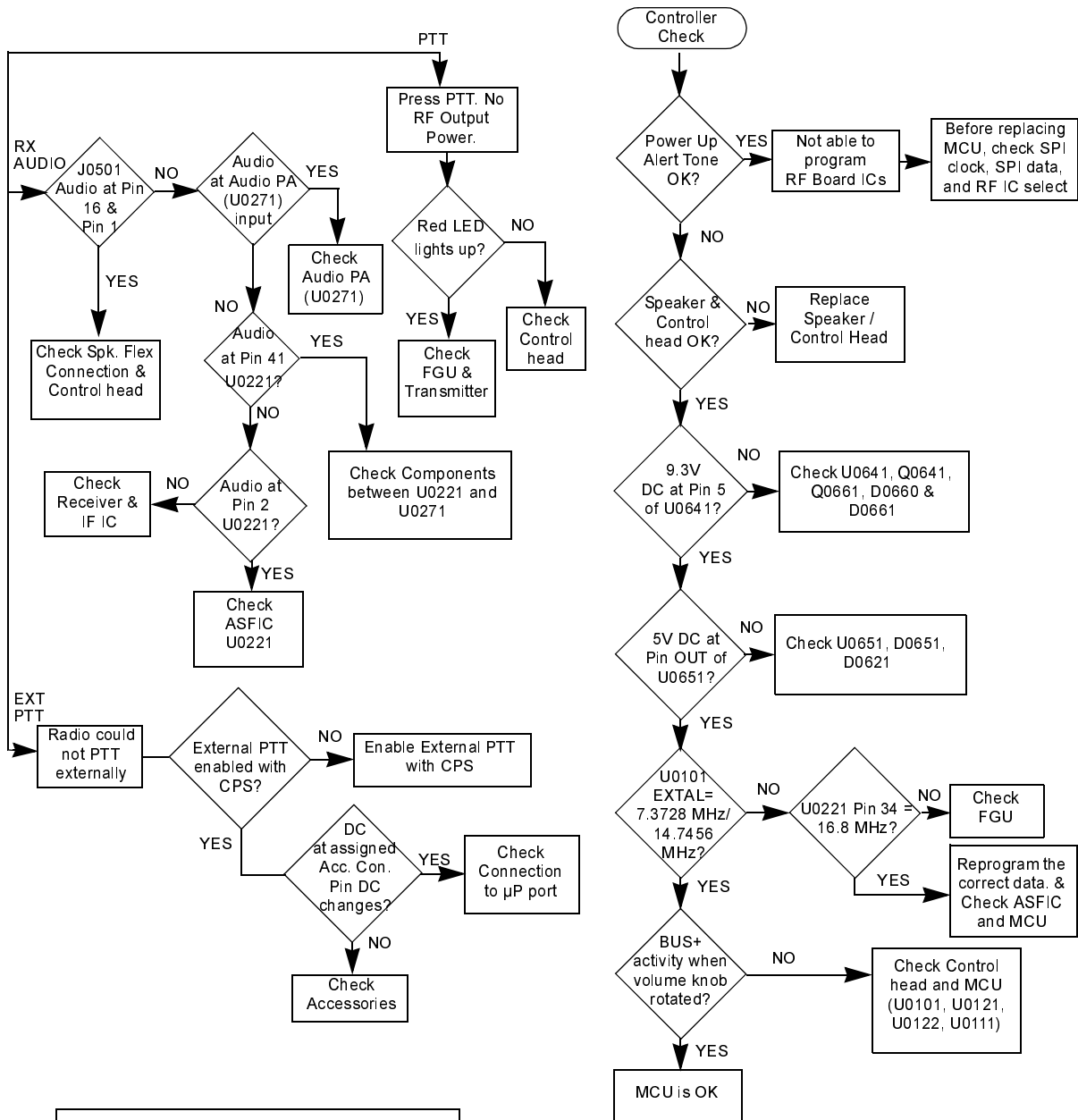
Audio, either from the radio's receiver or from one of the microphone inputs, emerges the ASFIC CMP (U0221) at pin 39, is buffered by op-amp U0341-1 and enters the Voice Storage IC U0301 at pin 25. During playback, the stored audio emerges U0301 at pin 20. To transmit the audio signal it is fed through resistive divider R0344 / R0345 and line VS MIC to input selector IC U0251. When this path is selected by the  $\mu$ P via ASFIC CMP port GCB 4, the audio signal enters the ASFIC CMP at pin 48 and is processed like normal transmit audio. To play the stored audio over the radio's speaker, the audio from U0301 pin 20 is buffered by op-amp U0341-2 and fed via switch U0342 and line FLAT RX SND to ASFIC CMP pin 10 (UIO). In this case, this ASFIC CMP pin is programmed as input and feeds the audio signal through the normal receiver audio path to the speaker or handset. Switch U0342 is controlled by the  $\mu$ P via ASFIC CMP port GCB 4 and feeds the stored audio only to the ASFIC CMP port UIO when it is programmed as input.

## Notes

## Section 2

# TROUBLESHOOTING CHARTS

### 1.0 Troubleshooting Flow Chart for Controller



Before troubleshooting the controller section according to this chart please check the following:

1. Check tuning and CPS settings
2. Check if Alert Tones are enabled
3. Check if Control Head is OK
4. Check board visually

## Notes

## Section 3

# CONTROLLER SCHEMATICS AND PARTS LISTS

### 1.0 Allocation of Schematics and Circuit Boards

#### 1.1 Controller Circuits

This chapter shows the schematics and the parts lists for the controller circuits.

#### 1.2 Voice Storage Facility

The Voice Storage facility is an orderable option on all CDM and PRO models except the PassPort model (CDM1550•LS+), on which Voice Storage is a standard feature.

The schematics (including the Voice Storage schematic, where applicable), boards and parts lists for these circuits are shown in this chapter.

**Table 3-1** Controller T2 Diagrams and Parts Lists

<b>Controller T2 used on PCB: 8486172B04 VHF, 1-25W</b>	
<b>SCHEMATICS</b>	<b>Page:</b>
Controller Overall	3: 3-3
Supply Voltage	3: 3-4
Audio	3: 3-5
I/O	3: 3-6
Microprocessor	3: 3-7
<b>Parts List</b>	<b>3: 3-8</b>

**Table 3-2** Controller T5 Diagrams and Parts Lists

<b>Controller T5 used on PCB: 8486172B06 VHF, 1-25W</b>	
<b>SCHEMATICS</b>	<b>Page:</b>
Controller Overall	3: 3-10
Supply Voltage	3: 3-11
Audio	3: 3-12
I/O	3: 3-13
Microprocessor	3: 3-14
Voice Storage (if fitted)	3: 3-15
<b>Parts List</b>	<b>3: 3-16</b>

**Table 3-3** Controller T6/T7/T9 Diagrams and Parts Lists

<b>Controller T6/T7/T9 used on PCB:</b> T6/7 on <b>8486206B06</b> LB1, 40-60W T6/7 on <b>8486207B05</b> LB2, 40-60W T6/7 on <b>8486140B12</b> VHF, 25-45W T6/7 on <b>8480643Z06</b> UHF B1, 25-40W T6/7 on <b>8480645Z04</b> UHF B2, 25-40W T7 on <b>8486172B07</b> VHF, 1-25W T7 on <b>8485670Z02</b> UHF B1, 1-25W T9 on <b>8486172B08</b> VHF, 1-25W T9 on <b>8486140B13</b> VHF, 25-45W T9 on <b>8485670Z03</b> UHF B1, 1-25W T9 on <b>8485671Z03</b> UHF B2, 1-25W T9 on <b>8485908Z02</b> LB3, 40-60W	
<b>SCHEMATICS</b> T6/7/9/11 Controller Overall T6/7/9 Supply Voltage T6/7/9 Audio T6 I/O T7 I/O T9 I/O T6/7 Microprocessor T9 Microprocessor T6/7/9 Voice Storage (if fitted)	<b>Page:</b> <b>3: 3-18</b> <b>3: 3-19</b> <b>3: 3-20</b> <b>3: 3-21</b> <b>3: 3-22</b> <b>3: 3-23</b> <b>3: 3-24</b> <b>3: 3-25</b> <b>3: 3-26</b>
T6/7 Parts List T9 Parts List	<b>3: 3-27</b> <b>3: 3-29</b>

**Table 3-4** Controller T11 Diagrams and Parts Lists

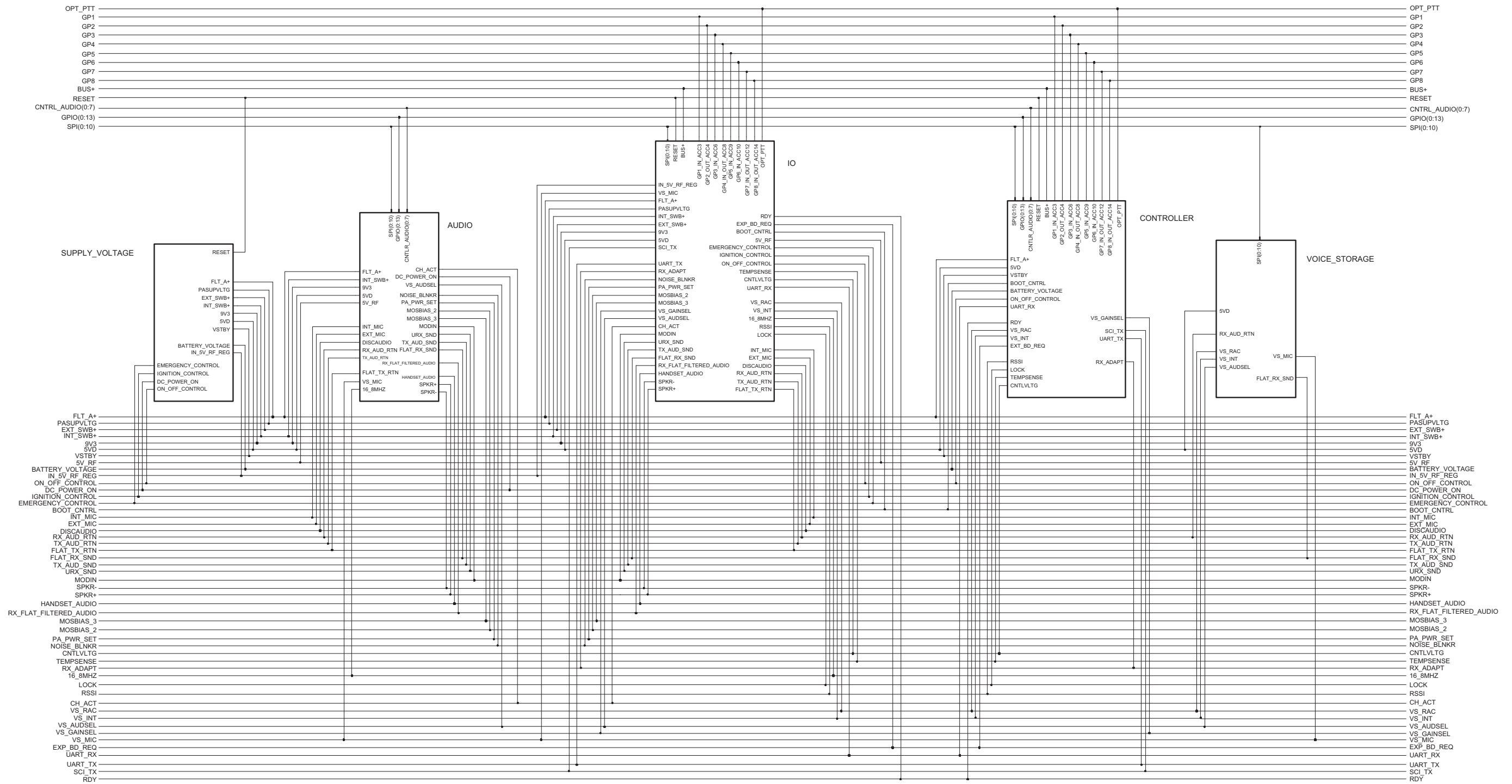
<b>Controller T11 used on PCB:</b> <b>8486206B08</b> LB1, 40-60W <b>8486207B07</b> LB2, 40-60W <b>8485908Z04</b> LB3, 40-60W	
<b>SCHEMATICS</b> Controller Overall Supply Voltage Audio I/O Microprocessor	<b>Page:</b> <b>3: 3-18</b> <b>3: 3-31</b> <b>3: 3-32</b> <b>3: 3-33</b> <b>3: 3-34</b>
<b>Parts List</b>	<b>3: 3-35</b>

**Table 3-5** Controller T12 Diagrams and Parts Lists

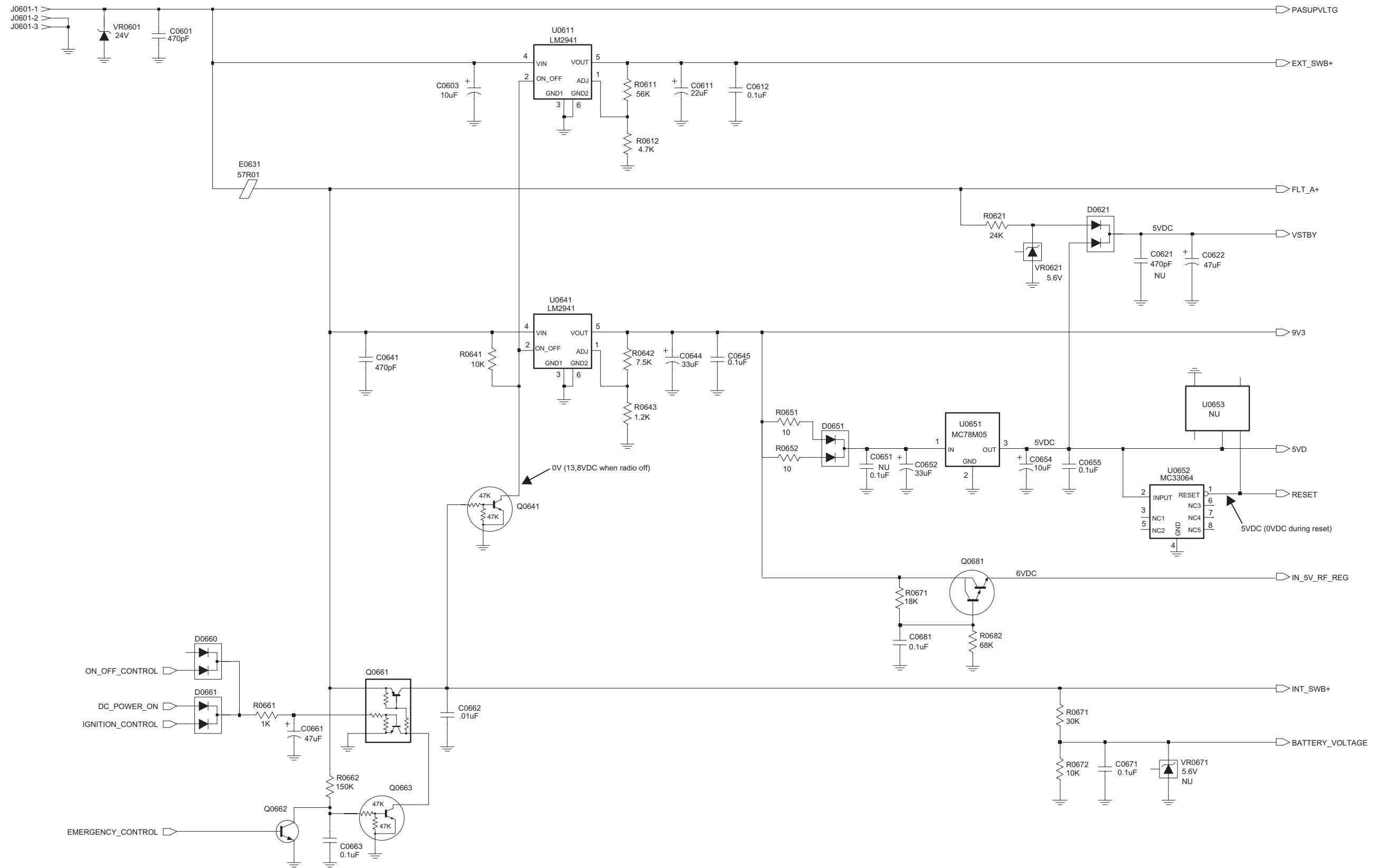
<b>Controller T12 used on PCB:</b> <b>8486140B15</b> VHF, 25-45W LDMOS <b>8486127Z01</b> UHF B1, 25-40W LDMOS <b>8486250Z02</b> UHF B2, 25-40W LDMOS	
<b>SCHEMATICS</b> Controller Overall Supply Voltage Audio I/O Microprocessor	<b>Page:</b> <b>3: 3-37</b> <b>3: 3-38</b> <b>3: 3-39</b> <b>3: 3-40</b> <b>3: 3-41</b>
<b>Parts List</b>	<b>3: 3-42</b>



## 2.0 Controller T2 Schematics and Parts Lists

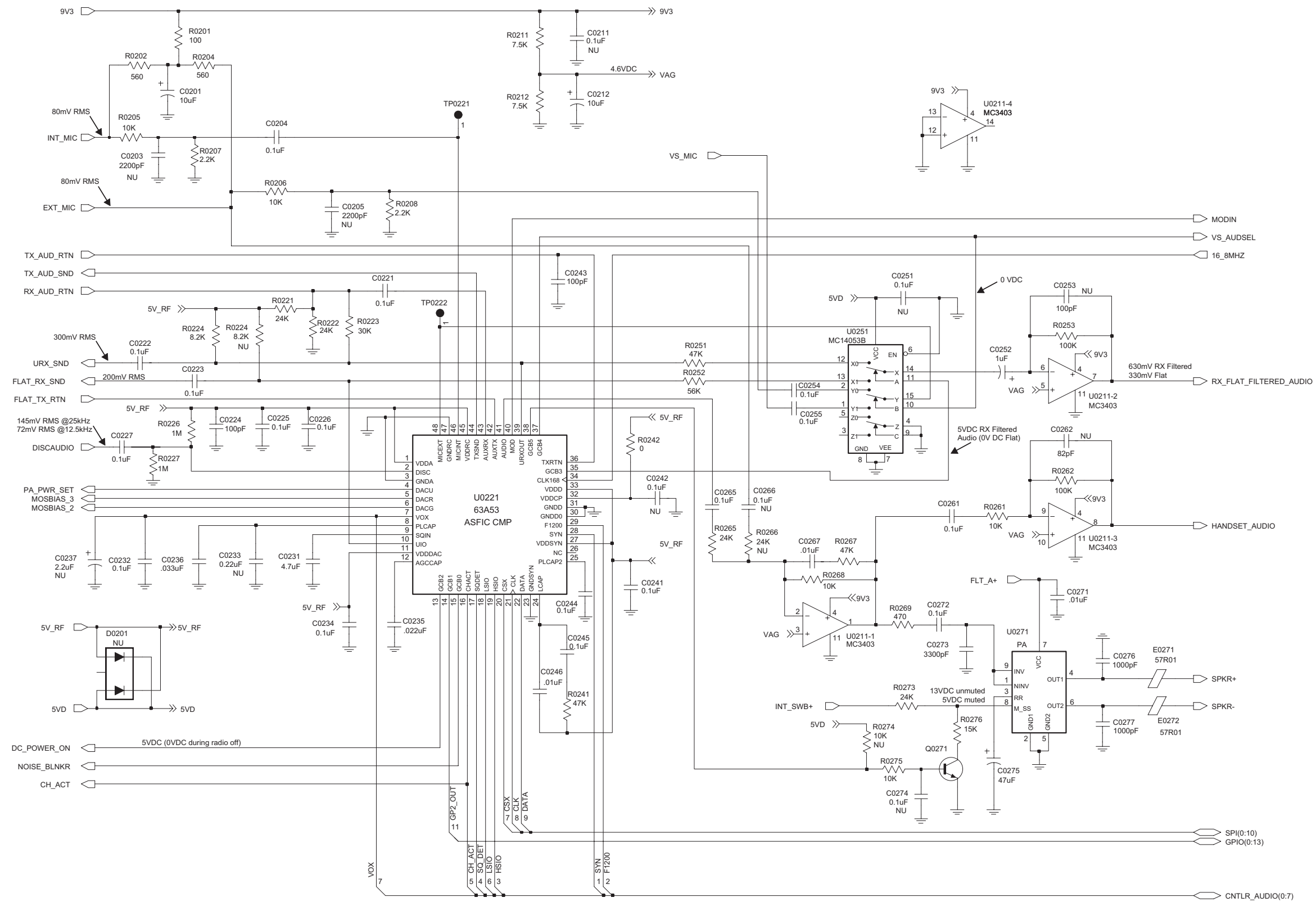


**Controller T2 Schematic Diagram - Controller Overall**

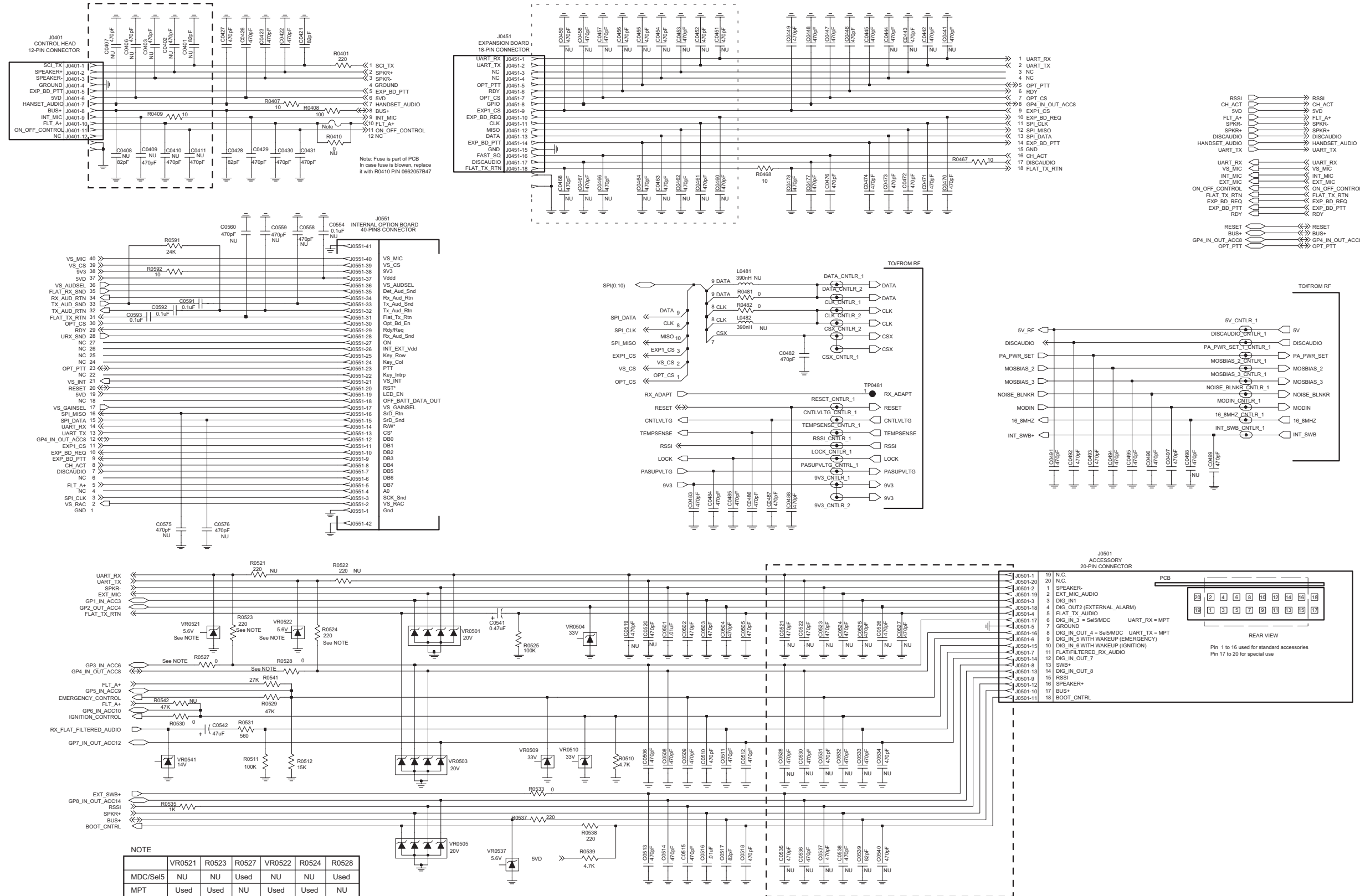


Controller T2 Schematic Diagram - Supply Voltage

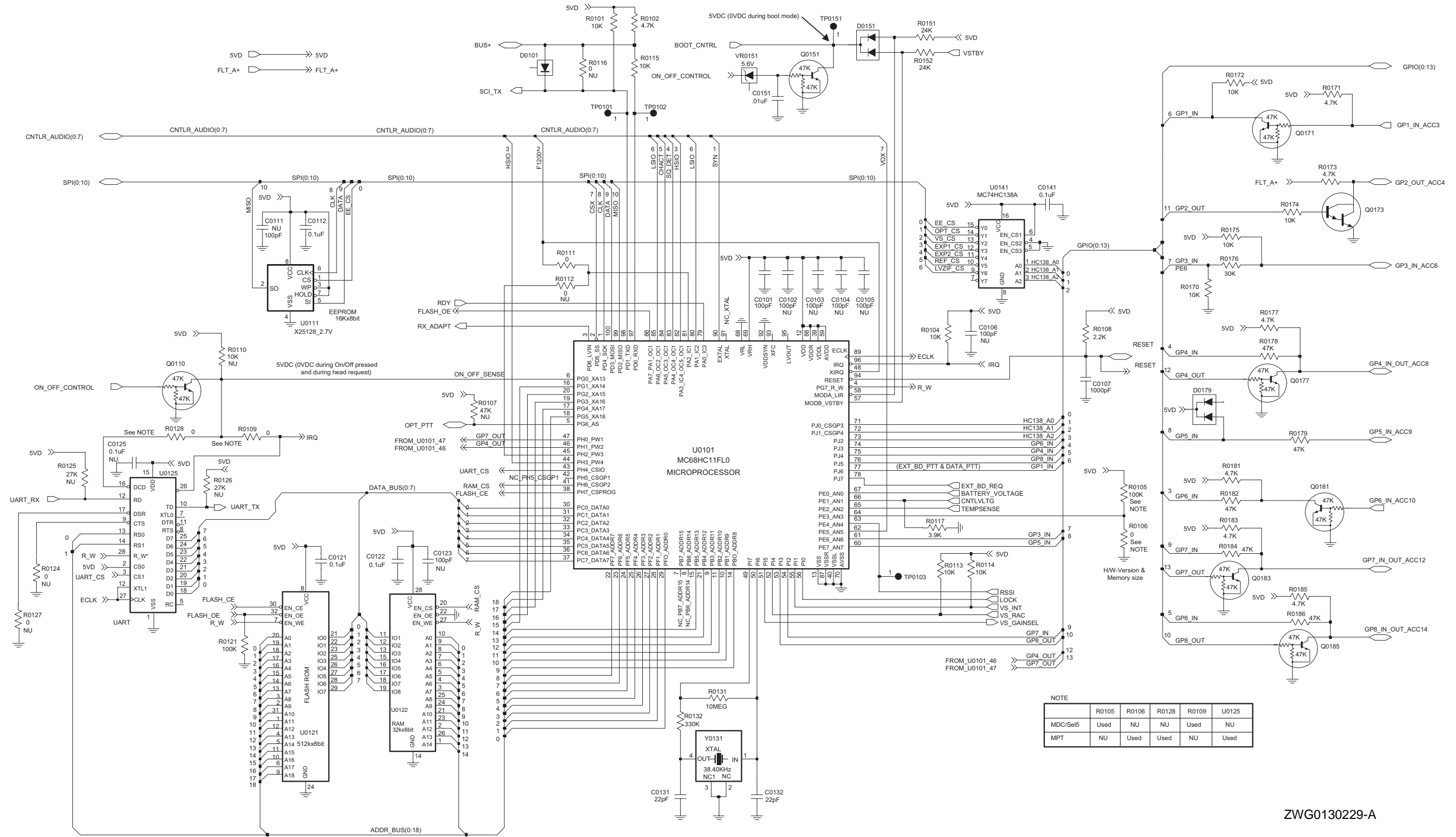
ZWG0130232-A



Controller T2 Schematic Diagram - Audio



Controller T2 Schematic Diagram - I/O



ZWG0130229-A

Controller T2 Schematic Diagram - Microprocessor

## Controller T2 Parts List

Circuit Ref	Motorola Part No.	Description
C0101	2113740F51	100pF
C0107	2113741F25	1000pF
C0112	2113743E20	0.1uF
C0121	2113743E20	0.1uF
C0122	2113743E20	0.1uF
C0125	2113743E20	0.1uF
C0131	2113740F35	22pF
C0132	2113740F35	22pF
C0141	2113743E20	0.1uF
C0151	2113741F49	.01uF
C0201	2311049A57	10uF
C0204	2113743E20	0.1uF
C0212	2311049A57	10uF
C0221	2113743E20	0.1uF
C0222	2113743E20	0.1uF
C0223	2113743E20	0.1uF
C0224	2113740F51	100pF
C0225	2113743E20	0.1uF
C0226	2113743E20	0.1uF
C0227	2113743E20	0.1uF
C0231	2113743G24	2.2uF
C0232	2113743E20	0.1uF
C0234	2113743E20	0.1uF
C0235	2113743E07	.022uF
C0236	2113743E10	.033uF
C0241	2113743E20	0.1uF
C0243	2113740F51	100pF
C0244	2113743E20	0.1uF
C0245	2113743E20	0.1uF
C0246	2113741F49	.01uF
C0252	2311049A07	1uF
C0254	2113743E20	0.1uF
C0255	2113743E20	0.1uF
C0261	2113743E20	0.1uF
C0262	2113740F49	82pF
C0265	2113743E20	0.1uF
C0267	2113741F49	.01uF

Circuit Ref	Motorola Part No.	Description
C0271	2113741F49	.01uF
C0272	2113743E20	0.1uF
C0273	2113741F37	3300pF
C0275	2311049A99	47uF
C0276	2113741F25	1000pF
C0277	2113741F25	1000pF
C0421	2113743N48	82pF
C0422	2113741F17	470pF
C0423	2113741F17	470pF
C0426	2113743L09	470pF
C0427	2113743L09	470pF
C0428	2113743N48	82pF
C0429	2113743L09	470pF
C0430	2113741F17	470pF
C0431	2113741F17	470pF
C0441	2113743L09	470pF
C0442	2113743L09	470pF
C0445	2113743L09	470pF
C0446	2113743L09	470pF
C0447	2113743L09	470pF
C0448	2113743L09	470pF
C0449	2113743L09	470pF
C0470	2113743L09	470pF
C0471	2113743L09	470pF
C0472	2113743L09	470pF
C0473	2113743L09	470pF
C0474	2113743L09	470pF
C0476	2113743L09	470pF
C0477	2113743L09	470pF
C0478	2113743L09	470pF
C0482	2113743L09	470pF
C0483	2113743L09	470pF
C0484	2113741F17	470pF
C0485	2113743L09	470pF
C0486	2113743L09	470pF
C0487	2113743L09	470pF
C0488	2113743L09	470pF
C0490	2113743L09	470pF

Circuit Ref	Motorola Part No.	Description
C0491	2113743L09	470pF
C0492	2113743L09	470pF
C0493	2113743L09	470pF
C0494	2113743L09	470pF
C0495	2113743L09	470pF
C0496	2113743L09	470pF
C0497	2113743L09	470pF
C0499	2113743L09	470pF
C0501	2113741F49	.01uF
C0502	2113743L09	470pF
C0503	2113743L09	470pF
C0504	2113743L09	470pF
C0505	2113743L09	470pF
C0506	2113743L09	470pF
C0508	2113743L09	470pF
C0509	2113743L09	470pF
C0510	2113741F17	470pF
C0511	2113743L09	470pF
C0512	2113743L09	470pF
C0513	2113741F17	470pF
C0514	2113743L09	470pF
C0515	2113743L09	470pF
C0516	2113741F49	.01uF
C0517	2113743N48	82pF
C0518	2113743L09	470pF
C0541	2311049A05	0.47uF
C0542	2311049A99	47uF
C0591	2113743E20	0.1uF
C0592	2113743E20	0.1uF
C0593	2113743E20	0.1uF
C0601	2113741F17	470pF
C0603	2380090M24	10uF
C0611	2311049C06	22uF
C0612	2113743E20	0.1uF
C0622	2311049A99	47uF
C0641	2113741F17	470pF
C0644	2311049A97	33uF
C0645	2113743E20	0.1uF

Circuit Ref	Motorola Part No.	Description
C0652	2311049A97	33uF
C0654	2311049A57	10uF
C0655	2113743E20	0.1uF
C0661	2311049C05	47uF
C0662	2113741F49	.01uF
C0663	2113743E20	0.1uF
C0671	2113743E20	0.1uF
C0681	2113743E20	0.1uF
D0101	4880236E05	Chip Schottky
D0151	4813833C02	DUAL SOT MMBD6100
D0179	4813833C02	DUAL SOT MMBD6100
D0621	4813833C02	DUAL SOT MMBD6100
D0651	4813833C02	DUAL SOT MMBD6100
D0660	4813833C02	DUAL SOT MMBD6100
D0661	4813833C02	DUAL SOT MMBD6100
E0271	2484657R01	Ferrite Bead
E0272	2484657R01	Ferrite Bead
E0631	2484657R01	Ferrite Bead
J0401	0902636Y02	CONN FLEX 12 PIN
J0451	0902636Y01	CONN FLEX SIDE ENTRY
J0501	0986105B01	CONN SMD 20 PIN
J0551	0905505Y04	CONN ZIF HORIZONTAL
J0601	0986165B01	DC PWR CONN
Q0110	4880048M01	NPN DIG 47k/47k
Q0151	4880048M01	NPN DIG 47k/47k
Q0171	4880048M01	NPN DIG 47k/47k
Q0173	4880052M01	NPN DRLNGTN MXTA
Q0177	4880048M01	NPN DIG 47k/47k
Q0181	4880048M01	NPN DIG 47k/47k
Q0183	4880048M01	NPN DIG 47k/47k
Q0185	4880048M01	NPN DIG 47k/47k
Q0271	4813824A10	NPN 40V .2A
Q0641	4880048M01	NPN DIG 47k/47k
Q0661	4805921T02	DUAL ROHM FMC2 RH
Q0662	4813824A10	NPN 40V .2A B=50-150
Q0663	4880048M01	NPN DIG 47k/47k
Q0681	4880052M01	NPN DRLNGTN MXTA
R0101	0662057A73	10K 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R0102	0662057A65	4.7K
R0104	0662057A73	10K
R0105	0662057A97	100K
R0108	0662057A57	2.2K
R0111	0662057B47	0
R0113	0662057A73	10K
R0114	0662057A73	10K
R0115	0662057A73	10K
R0117	0662057A63	3.9K
R0121	0662057A97	100K
R0124	0662057B47	0
R0125	0662057A83	27K
R0126	0662057A83	27K
R0127	0662057B47	0
R0128	0662057B47	0
R0131	0662057B46	10MEG
R0132	0662057B10	330K
R0151	0662057A82	24K
R0152	0662057A82	24K
R0170	0662057A73	10K
R0171	0662057A65	4.7K
R0172	0662057A73	10K
R0173	0662057A65	4.7K
R0174	0662057A73	10K
R0175	0662057A73	10K
R0176	0662057A84	30K
R0177	0662057A65	4.7K
R0178	0662057A89	47K
R0179	0662057A89	47K
R0181	0662057A65	4.7K
R0182	0662057A89	47K
R0183	0662057A65	4.7K
R0184	0662057A89	47K
R0185	0662057A65	4.7K
R0186	0662057A89	47K
R0201	0662057A25	100
R0202	0662057A43	560
R0204	0662057A43	560

Circuit Ref	Motorola Part No.	Description
R0205	0662057A73	10K
R0206	0662057A73	10K
R0207	0662057A57	2.2K
R0208	0662057A57	2.2K
R0211	0660076E70	7.5K
R0212	0660076E70	7.5K
R0221	0662057A82	24K
R0222	0662057A82	24K
R0223	0662057A84	30K
R0224	0662057A71	8.2K
R0226	0662057B22	1MEG
R0227	0662057B22	1MEG
R0241	0662057A89	47K
R0242	0662057B47	0
R0251	0662057A89	47K
R0252	0662057A91	56K
R0253	0662057A97	100K
R0261	0662057A73	10K
R0262	0662057A97	100K
R0265	0662057A82	24K
R0267	0662057A89	47K
R0268	0662057A73	10K
R0269	0662057A41	470
R0273	0662057A82	24K
R0275	0662057A73	10K
R0276	0662057A77	15K
R0401	0662057A33	220
R0407	0662057M26	10
R0408	0662057A25	100
R0409	0662057M26	10
R0467	0662057M26	10
R0468	0662057M26	10
R0481	0662057B47	0
R0482	0662057B47	0
R0510	0662057A65	4.7K
R0511	0662057A97	100K
R0512	0662057A77	15K
R0523	0662057A33	220

Circuit Ref	Motorola Part No.	Description
R0524	0662057A33	220
R0525	0662057A97	100K
R0529	0662057A89	47K
R0530	0662057B47	0
R0531	0662057A43	560
R0533	0662057B47	0
R0535	0662057A49	1K
R0537	0662057A33	220
R0538	0662057A33	220
R0539	0662057A65	4.7K
R0541	0662057A83	27K
R0591	0662057A82	24K
R0592	0662057A01	10
R0611	0662057A91	56K
R0612	0662057A65	4.7K
R0621	0662057A82	24K
R0641	0662057A73	10K
R0642	0660076E70	7.5K
R0643	0660076E51	1.2K
R0651	0662057A01	10
R0652	0662057A01	10
R0661	0662057A49	1K
R0662	0662057B02	150K
R0671	0662057A84	30K
R0672	0662057A73	10K
R0681	0662057A79	18K
R0682	0662057A93	68K
U0101	5102226J56	MC68HC11FL0 100 PIN
* U0111	5102463J64	16KX8 SPI SERIAL EEPROM
* U0121	5186137B01	512KX8 IC 120NS
U0122	5185963A21	32KX8 SRAM
U0125	5105625U34	IC CMOS ACIA SSOP
U0141	5113805A30	MC74HC138A DCDR/DEMUX
U0211	5183222M49	MC3403 IC AMP
U0221	5185963A53	IC ASFIC CMP 48 PIN
U0251	5113806A20	MC14053B MUX/DEMUX, TRIPLE 2CH

Circuit Ref	Motorola Part No.	Description
U0271	5109699X01	TDA1519C AUDIO PA
U0611	5183308X01	LM2941 TO DRPOUT RGTR
U0641	5183308X01	LM2941 TO DRPOUT RGTR
U0651	5113816A07	MC78M05BDTRK REG 5V POS 500 MA
U0652	5113815A02	MC33064 UNDERVOLT SENSING
U0653	4805921T02	NU
VR0151	4813830A15	5.6V
VR0501	4805656W09	20V
VR0503	4805656W09	20V
VR0504	4813830A40	33V
VR0505	4805656W09	20V
VR0509	4813830A40	33V
VR0510	4813830A40	33V
VR0521	4813830A15	5.6V
VR0522	4813830A15	5.6V
VR0537	4813830A15	5.6V
VR0541	4813830A27	14V
VR0601	4813832C77	24V
VR0621	4813830A15	5.6V
Y0131	4880113R19	XTAL

\* Motorola Depot Servicing only  
 Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

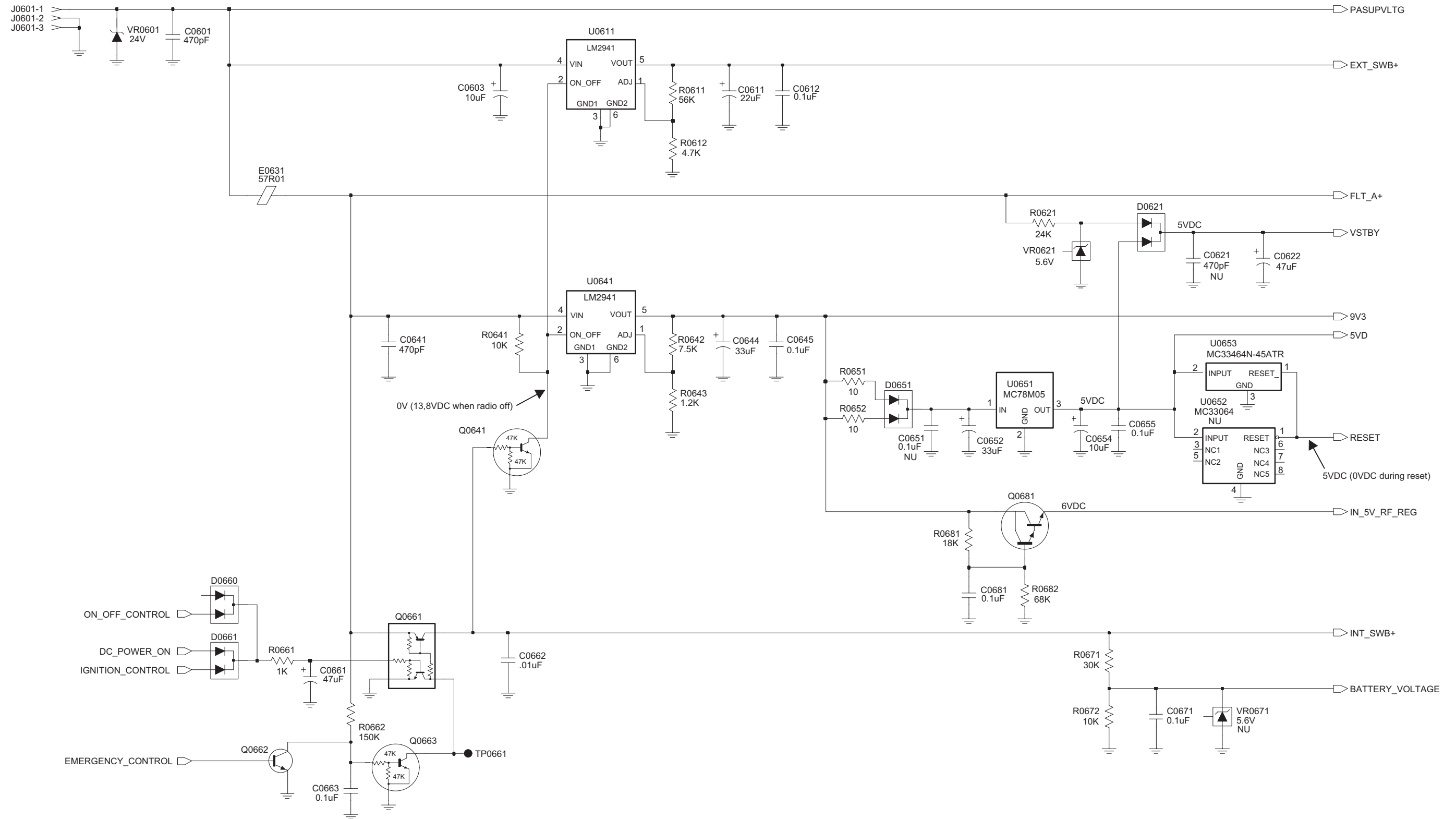
### 3.0 Controller T5 Schematics and Parts Lists

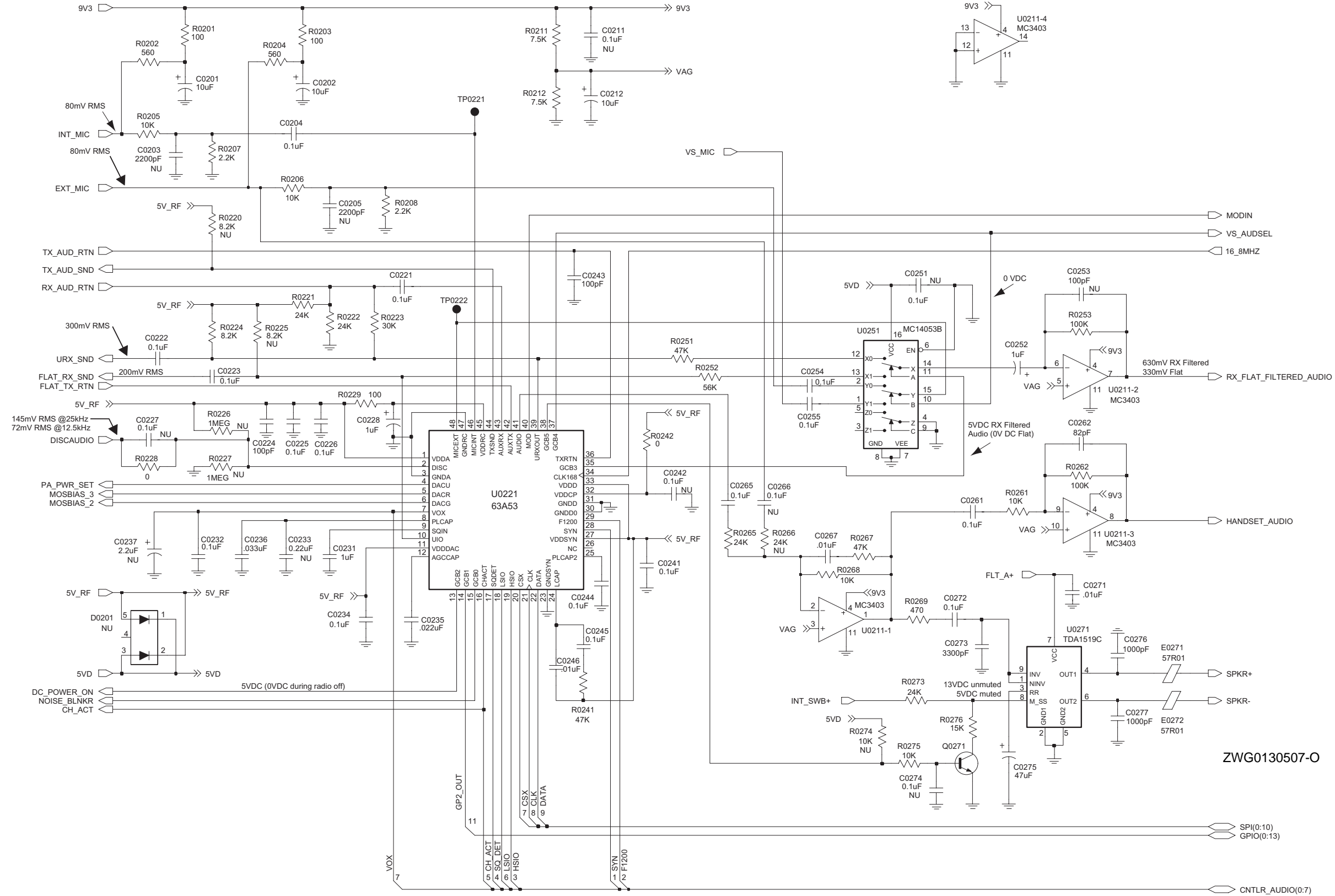


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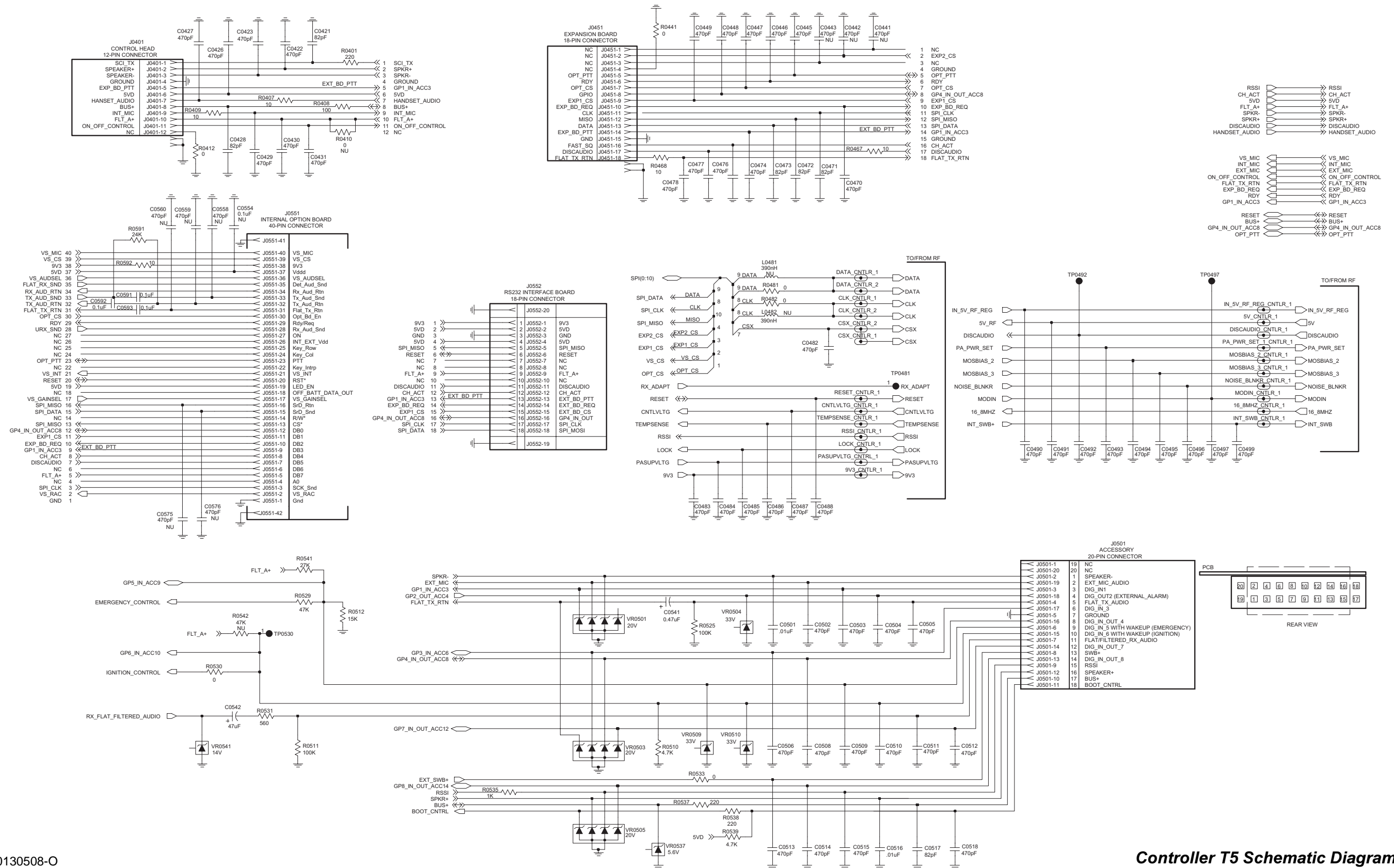
### Controller T5 Schematic Diagram - Overall

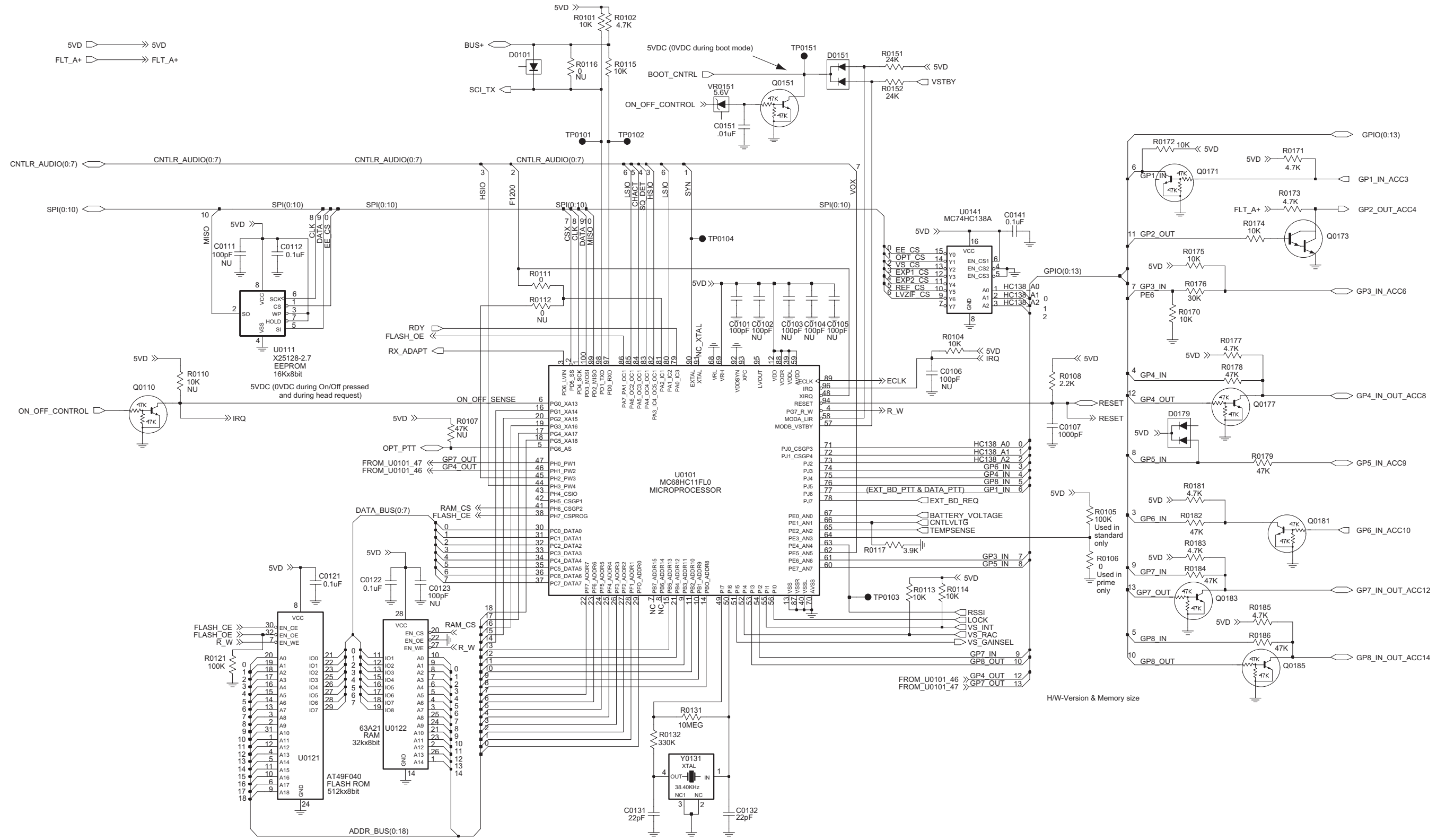






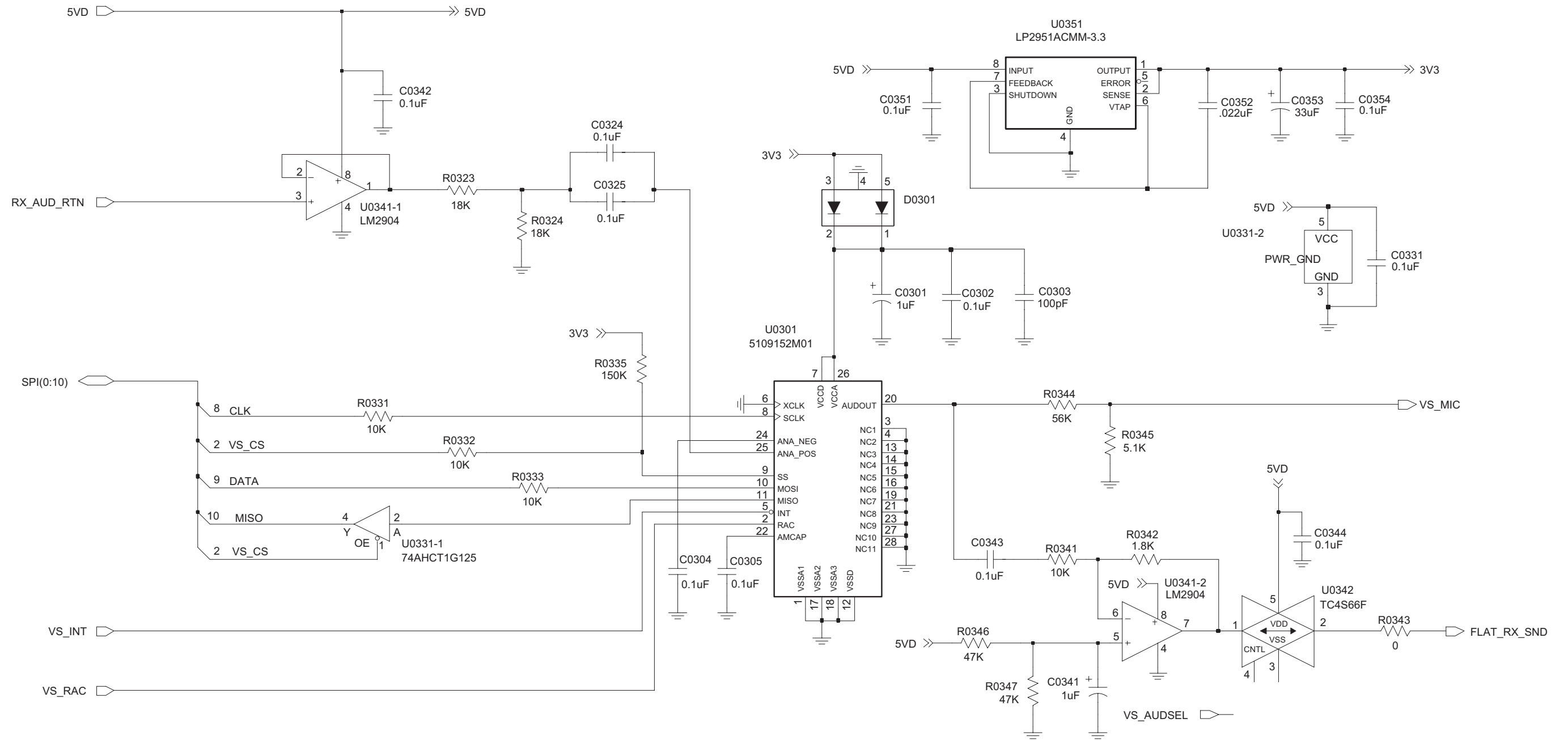
Controller T5 Schematic Diagram - Audio





Controller T5 Schematic Diagram - Microprocessor

ZWG0130509-A



ZWG0130505-O

Controller T5 Schematic Diagram - Voice Storage

## Controller T5 Parts List

Circuit Ref	Motorola Part No.	Description
C0101	2113740F51	100pF 5% 50V
C0107	2113741F25	1nF 50V
C0112	2113743E20	100nF 16V
C0121	2113743E20	100nF 16V
C0122	2113743E20	100nF 16V
C0131	2113740F35	22pF 5% 50V
C0132	2113740F35	22pF 5% 50V
C0141	2113743E20	100nF 16V
C0151	2113741F49	10nF 50V
C0201	2311049A57	TANT CP 10uF 10% 16V
C0202	2311049A57	TANT CP 10uF 10% 16V
C0204	2113743E20	100nF 16V
C0212	2311049A57	TANT CP 10uF 10% 16V
C0221	2113743E20	100nF 16V
C0222	2113743E20	100nF 16V
C0223	2113743E20	100nF 16V
C0224	2113740F51	100pF 5% 50V NP0
C0225	2113743E20	100nF 16V
C0226	2113743E20	100nF 16V
C0228	2311049A07	TANT CP 1uF 10% 16V
C0231	2113743B29	1 uF 10% 16V
C0232	2113743E20	100nF 16V
C0234	2113743E20	100nF 16V
C0235	2113743E07	22nF 16V
C0236	2113743E10	.033uF 10%
C0241	2113743E20	100nF 16V
C0243	2113740F51	100pF 5% 50V
C0244	2113743E20	100nF 16V
C0245	2113743E20	100nF 16V
C0246	2113741F49	10nF 50V
C0252	2311049A07	TANT CP 1uF 10%
C0254	2113743E20	100nF 16V
C0255	2113743E20	100nF 16V
C0261	2113743E20	100nF 16V
C0262	2113740F49	82pF 5% 50V
C0265	2113743E20	100nF 16V
C0267	2113741F49	10nF 50V
C0271	2113741F49	10nF 50V
C0272	2113743E20	100nF 16V
C0273	2113741F37	3.3nF 50V
C0275	2311049A99	TANT CP 47uF 20% 10V
C0276	2113741F25	1nF 50V
C0277	2113741F25	1nF 50V
C0301	2311049A07	1uF 10% 16V Voice storage only

Circuit Ref	Motorola Part No.	Description
C0302	2113743E20	100nF 16V Voice storage only
C0303	2113740F51	100pF 5% 50V Voice storage only
C0304	2113743E20	100nF 16V Voice storage only
C0305	2113743E20	100nF 16V Voice storage only
C0324	2113743E20	100nF 16V Voice storage only
C0331	2113743E20	100nF 16V Voice storage only
C0341	2311049A07	TANT CP 1uF 10% 16V Voice storage only
C0342	2113743E20	100nF 16V Voice storage only
C0343	2113743E20	100nF 16V Voice storage only
C0344	2113743E20	100nF 16V Voice storage only
C0351	2113743E20	100nF 16V Voice storage only
C0352	2113743E07	22nF 16V Voice storage only
C0353	2311049A97	TANT CHIP 33 uF 16 Voice storage only
C0354	2113743E20	100nF 16V Voice storage only
C0421	2113743N48	82.0 pF 5%
C0422	2113741F17	470pF 50V
C0423	2113741F17	470pF 50V
C0426	2113743L09	470 pF 10%
C0427	2113743L09	470 pF 10%
C0428	2113743N48	82.0 pF 5%
C0429	2113743L09	470 pF 10%
C0430	2113741F17	470pF 50V
C0431	2113741F17	470pF 50V
C0445	2113743L09	470 pF 10%
C0446	2113743L09	470 pF 10%
C0447	2113743L09	470 pF 10%
C0448	2113743L09	470 pF 10%
C0449	2113743L09	470 pF 10%
C0470	2113743L09	470 pF 10%
C0471	2113743N48	82.0 pF 5%
C0472	2113743N48	82.0 pF 5%
C0473	2113743N48	82.0 pF 5%
C0474	2113743L09	470 pF 10%
C0476	2113743L09	470 pF 10%
C0477	2113743L09	470 pF 10%

Circuit Ref	Motorola Part No.	Description
C0478	2113743L09	470 pF 10%
C0482	2113743L09	470 pF 10%
C0483	2113743L09	470 pF 10%
C0484	2113741F17	470 pF 50V
C0485	2113743L09	470 pF 10%
C0486	2113743L09	470 pF 10%
C0487	2113743L09	470 pF 10%
C0488	2113743L09	470 pF 10%
C0490	2113743L09	470 pF 10%
C0491	2113743L09	470 pF 10%
C0492	2113743L09	470 pF 10%
C0493	2113743L09	470 pF 10%
C0494	2113743L09	470 pF 10%
C0495	2113743L09	470 pF 10%
C0496	2113743L09	470 pF 10%
C0497	2113743L09	470 pF 10%
C0499	2113743L09	470 pF 10%
C0501	2113741F49	10nF 50V
C0502	2113743L09	470 pF 10%
C0503	2113743L09	470 pF 10%
C0504	2113743L09	470 pF 10%
C0505	2113743L09	470 pF 10%
C0506	2113743L09	470 pF 10%
C0508	2113743L09	470 pF 10%
C0509	2113743L09	470 pF 10%
C0510	2113741F17	470 pF 50V
C0511	2113743L09	470 pF 10%
C0512	2113743L09	470 pF 10%
C0513	2113741F17	470 pF 50V
C0514	2113743L09	470 pF 10%
C0515	2113743L09	470 pF 10%
C0516	2113741F49	10nF 50V
C0517	2113743N48	82.0 pF 5%
C0518	2113743L09	470 pF 10%
C0541	2311049A05	TANT CP 470nF 10% 25V
C0542	2311049A99	TANT CP 47uF 20% 10V
C0591	2113743E20	100nF 16V
C0592	2113743E20	100nF 16V
C0593	2113741B69	100nF 50V
C0601	2113741F17	470pF 50V
C0603	2380090M24	LYT 10uF 50V 20%
C0611	2311049C06	TANT CP 22uF 20% 35V
C0612	2113743E20	100nF 16V
C0622	2311049A99	TANT CP 47uF 20% 10V
C0641	2113741F17	470pF 50V
C0644	2311049A97	TANT CHIP 33 uF 16
C0645	2113743E20	100nF 16V

Circuit Ref	Motorola Part No.	Description
C0652	2311049A97	TANT CHIP 33 uF 16
C0654	2311049A57	TANT CP 10uF 10% 16V
C0655	2113743E20	100nF 16V
C0661	2311049C05	TANT CP 47uF 10% 16V
C0662	2113741F49	10nF 50V
C0663	2113743E20	100nF 16V
C0671	2113743E20	100nF 16V
C0681	2113743E20	100nF 16V
D0101	4880236E05	CHIP SCHOTTKY
D0151	4813833C02	DUAL SOT MMBD6100
D0179	4813833C02	DUAL SOT MMBD6100
D0301	4802245J47	SCHOTTKY BARRIER (RB471E) Voice storage only
D0621	4813833C02	DUAL SOT MMBD6100
D0651	4813833C02	DUAL SOT MMBD6100
D0660	4813833C02	DUAL SOT MMBD6100
D0661	4813833C02	DUAL SOT MMBD6100
E0271	2484657R01	Ferrite Bead
E0272	2484657R01	Ferrite Bead
E0631	2484657R01	Ferrite Bead
J0401	0902636Y02	CONN FLEX 12 PIN
J0451	0902636Y01	CONN FLEX SIDE ENTRY
J0501	0986105B01	CONN SMD 20 PIN
J0551	0905505Y04	CONN ZIF HORIZONTAL
J0552	0905505Y03	CONN ZIF 18PIN
J0601	0986165B01	DC PWR CONN
Q0110	4880048M01	NPN DIG 47k/47k
Q0151	4880048M01	NPN DIG 47k/47k
Q0171	4880048M01	NPN DIG 47k/47k
Q0173	4880052M01	NPN DRLNGTN MXTA
Q0177	4880048M01	NPN DIG 47k/47k
Q0181	4880048M01	NPN DIG 47k/47k
Q0183	4880048M01	NPN DIG 47k/47k
Q0185	4880048M01	NPN DIG 47k/47k
Q0271	4813824A10	NPN 40V .2A
Q0641	4880048M01	NPN DIG 47k/47k
Q0661	4805921T02	DUAL ROHM FMC2 RH
Q0662	4813824A10	NPN 40V .2A B=50-150
Q0663	4880048M01	NPN DIG 47k/47k
Q0681	4880052M01	NPN DRLNGTN MXTA
R0101	0662057A73	10k 1/16W 5%
R0102	0662057A65	4700 1/16W 5%
R0104	0662057A73	10k 1/16W 5%
R0105	0662057A97	100k 1/16W Voice storage only
R0106	0662057B47	0 1/16W Voice storage only

Circuit Ref	Motorola Part No.	Description
R0108	0662057A57	2200 1/16W 5%
R0111	0662057B47	0 1/16W
R0113	0662057A73	10k 1/16W 5%
R0114	0662057A73	10k 1/16W 5%
R0115	0662057A73	10k 1/16W 5%
R0117	0662057A63	3900 1/16W 5%
R0121	0662057A97	100k 1/16W
R0131	0662057B46	10.0 MEG OHMS 5%
R0132	0662057B10	330k 1/16W 5%
R0151	0662057A82	24K 1/16W 5%
R0152	0662057A82	24K 1/16W 5%
R0170	0662057A73	10k 1/16W 5%
R0171	0662057A65	4700 1/16W 5%
R0172	0662057A73	10k 1/16W 5%
R0173	0662057A65	4700 1/16W 5%
R0174	0662057A73	10k 1/16W 5%
R0175	0662057A73	10k 1/16W 5%
R0176	0662057A84	30k 1/16W 5%
R0177	0662057A65	4700 1/16W 5%
R0178	0662057A89	47k 1/16W 5%
R0179	0662057A89	47k 1/16W 5%
R0181	0662057A65	4700 1/16W 5%
R0182	0662057A89	47k 1/16W 5%
R0183	0662057A65	4700 1/16W 5%
R0184	0662057A89	47k 1/16W 5%
R0185	0662057A65	4700 1/16W 5%
R0186	0662057A89	47k 1/16W 5%
R0201	0662057A25	100 1/16W 5%
R0202	0662057A43	560 1/16W 5%
R0203	0662057A25	100 1/16W 5%
R0204	0662057A43	560 1/16W 5%
R0205	0662057A73	10k 1/16W 5%
R0206	0662057A73	10k 1/16W 5%
R0207	0662057A57	2200 1/16W 5%
R0208	0662057A57	2200 1/16W 5%
R0211	0660076E70	FILM 7500
R0212	0660076E70	FILM 7500
R0221	0662057A82	24K 1/16W 5%
R0222	0662057A82	24K 1/16W 5%
R0223	0662057A84	30k 1/16W 5%
R0224	0662057A71	8200 1/16W 5%
R0228	0662057B47	0 1/16W
R0229	0662057A25	100 1/16W 5%
R0241	0662057A89	47k 1/16W 5%
R0242	0662057B47	0 1/16W
R0251	0662057A89	47k 1/16W 5%
R0252	0662057A91	56K 1/16W 5%

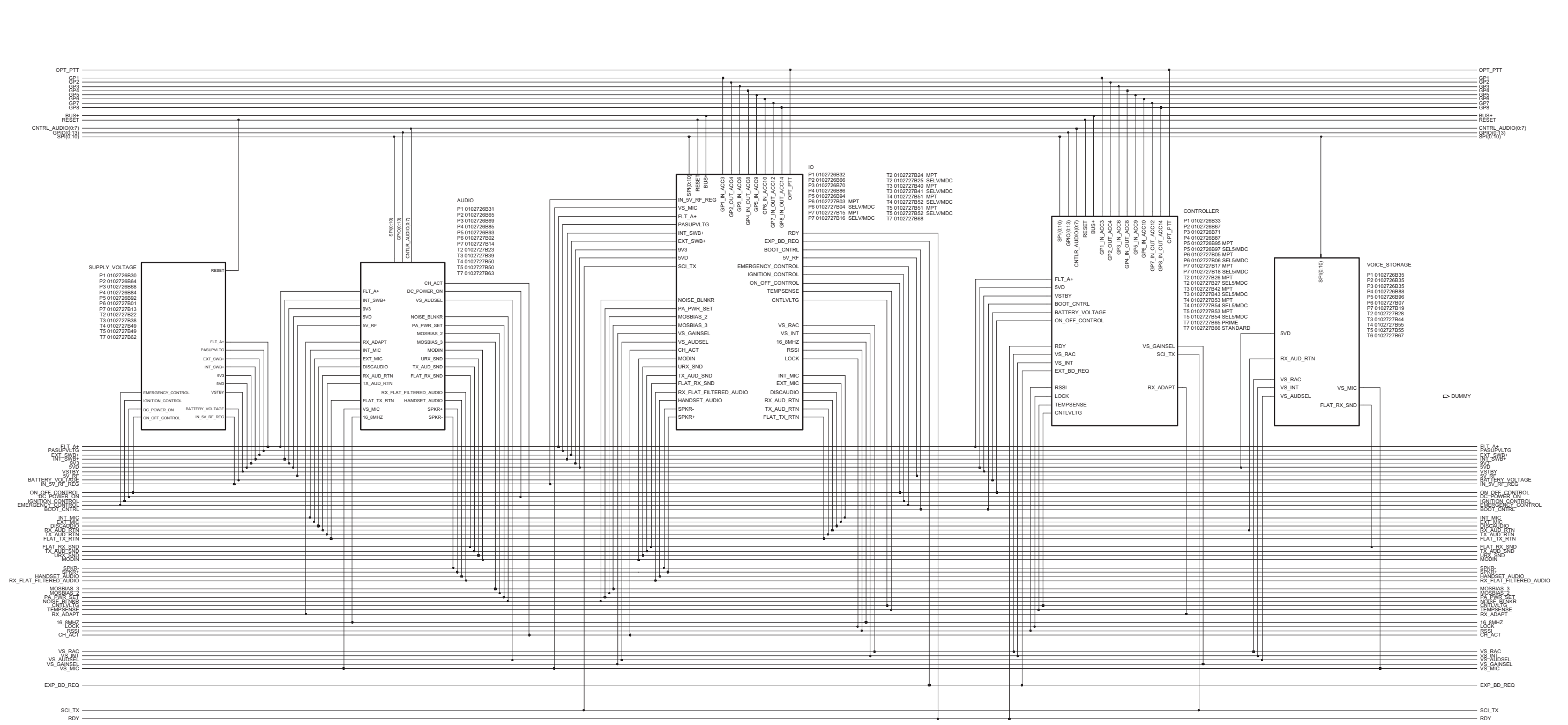
Circuit Ref	Motorola Part No.	Description
R0253	0662057A97	100k 1/16W
R0261	0662057A73	10k 1/16W 5%
R0262	0662057A97	100k 1/16W
R0265	0662057A82	24K 1/16W 5%
R0267	0662057A89	47k 1/16W 5%
R0268	0662057A73	10k 1/16W 5%
R0269	0662057A41	470 1/16W 5%
R0273	0662057A82	24K 1/16W 5%
R0275	0662057A73	10k 1/16W 5%
R0276	0662057A77	15k 1/16W 5%
R0323	0662057A79	18k 1/16W 5% Voice storage only
R0324	0662057A79	18k 1/16W 5% Voice storage only
R0331	0662057A73	10k 1/16W 5% Voice storage only
R0332	0662057A73	10k 1/16W 5% Voice storage only
R0333	0662057A73	10k 1/16W 5% Voice storage only
R0335	0662057B02	150k 1/16W Voice storage only
R0341	0662057A73	10k 1/16W 5% Voice storage only
R0342	0662057A55	1800 1/16W 5% Voice storage only
R0343	0662057B47	0 1/16W Voice storage only
R0344	0662057A91	56K 1/16W 5% Voice storage only
R0345	0662057A66	5100 1/16W 5% Voice storage only
R0346	0662057A89	47k 1/16W 5% Voice storage only
R0347	0662057A89	47k 1/16W 5% Voice storage only
R0401	0662057A33	220 1/16W 5%
R0407	0662057M26	10 5%
R0408	0662057A25	100 1/16W 5%
R0409	0662057M26	10 5%
R0412	0662057B47	0 1/16W
R0441	0662057B47	0 1/16W
R0467	0662057M26	10 5%
R0468	0662057M26	10 5%
R0481	0662057B47	0 1/16W
R0482	0662057B47	0 1/16W
R0510	0662057A65	4700 1/16W 5%
R0511	0662057A97	100k 1/16W
R0512	0662057A77	15k 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R0525	0662057A97	100k 1/16W
R0529	0662057A89	47k 1/16W 5%
R0530	0662057B47	0 1/16W
R0531	0662057A43	560 1/16W 5%
R0533	0662057B47	0 1/16W
R0535	0662057A49	1k 1/16W
R0537	0662057A33	220 1/16W 5%
R0538	0662057A33	220 1/16W 5%
R0539	0662057A65	4700 1/16W 5%
R0541	0662057A83	27k 1/16W 5%
R0591	0662057A82	24K 1/16W 5%
R0592	0662057A01	10 1/16W 5%
R0611	0662057A91	56K 1/16W 5%
R0612	0662057A65	4700 1/16W 5%
R0621	0662057A82	24K 1/16W 5%
R0641	0662057A73	10k 1/16W 5%
R0642	0660076E70	FILM 7500 1 1
R0643	0660076E51	FILM 1200 1 1
R0651	0662057A01	10 1/16W 5%
R0652	0662057A01	10 1/16W 5%
R0661	0662057A49	1k 1/16W 5%
R0662	0662057B02	150k 1/16W
R0671	0662057A84	30k 1/16W 5%
R0672	0662057A73	10k 1/16W 5%
R0681	0662057A79	18k 1/16W 5%
R0682	0662057A93	68k 1/16W 5%
U0101	5102226J56	MICRO PROCESSOR MC68HC1
* U0111	5102463J64	EEPROM X25128-2.7 SO8
* U0121	5186137B01	IC 512KX8 FLASH ROM (AT49BV020)
U0122	5185963A21	IC 32K x 8 SRAM
U0141	5113805A30	IC 10F8 DCDR/REMUX 74HC138
U0211	5183222M49	IC QUAD OPAMP __3403
U0221	5185963A53	ASFICOMP 0.5MM TQFP
U0251	5113806A20	MUX/DEMUX, TRIPLE 2-
U0271	5109699X01	AUDIO PA TDA1519C
U0301	5109152M01	EEPROM ANALOG ISD33120EI Voice storage only
U0331	5186204B01	BUFFER/DRIVER 74AHCT1G125 Voice storage only
U0341	5180932W01	LINEAR IC OP AMP Voice storage only
U0342	5105750U28	SNGL ANALOG SWITCH Voice storage only

Circuit Ref	Motorola Part No.	Description
U0351	5102463J40	REGULATOR, 3.3V Voice storage only
U0611	5183308X01	ADJ VLTG REG LM2941 TO263
U0641	5183308X01	ADJ VLTG REG LM2941 TO263
U0651	5113816A07	REG 5V POS 500MA MC78M05
U0653	5186205B01	MC33464N-45ATR SOT23- 5-RB
VR0151	4813830A15	5.6V 5% 225mW
VR0501	4805656W09	ZENER QUAD MMQA20VT1
VR0503	4805656W09	ZENER QUAD MMQA20VT1
VR0504	4813830A40	SOC23 AUTO SDN
VR0505	4805656W09	ZENER QUAD MMQA20VT1
VR0509	4813830A40	SOC23 AUTO SDN
VR0510	4813830A40	SOC23 AUTO SDN
VR0537	4813830A15	5.6V 5% 225mW
VR0541	4813830A27	14V 5% 225MW
VR0601	4813832C77	TRANS SUP. 24V HIGPWR
VR0621	4813830A15	DIODE 5.6V 5% 225mW
Y0131	4880113R19	CRYSTAL 38.4KHZ

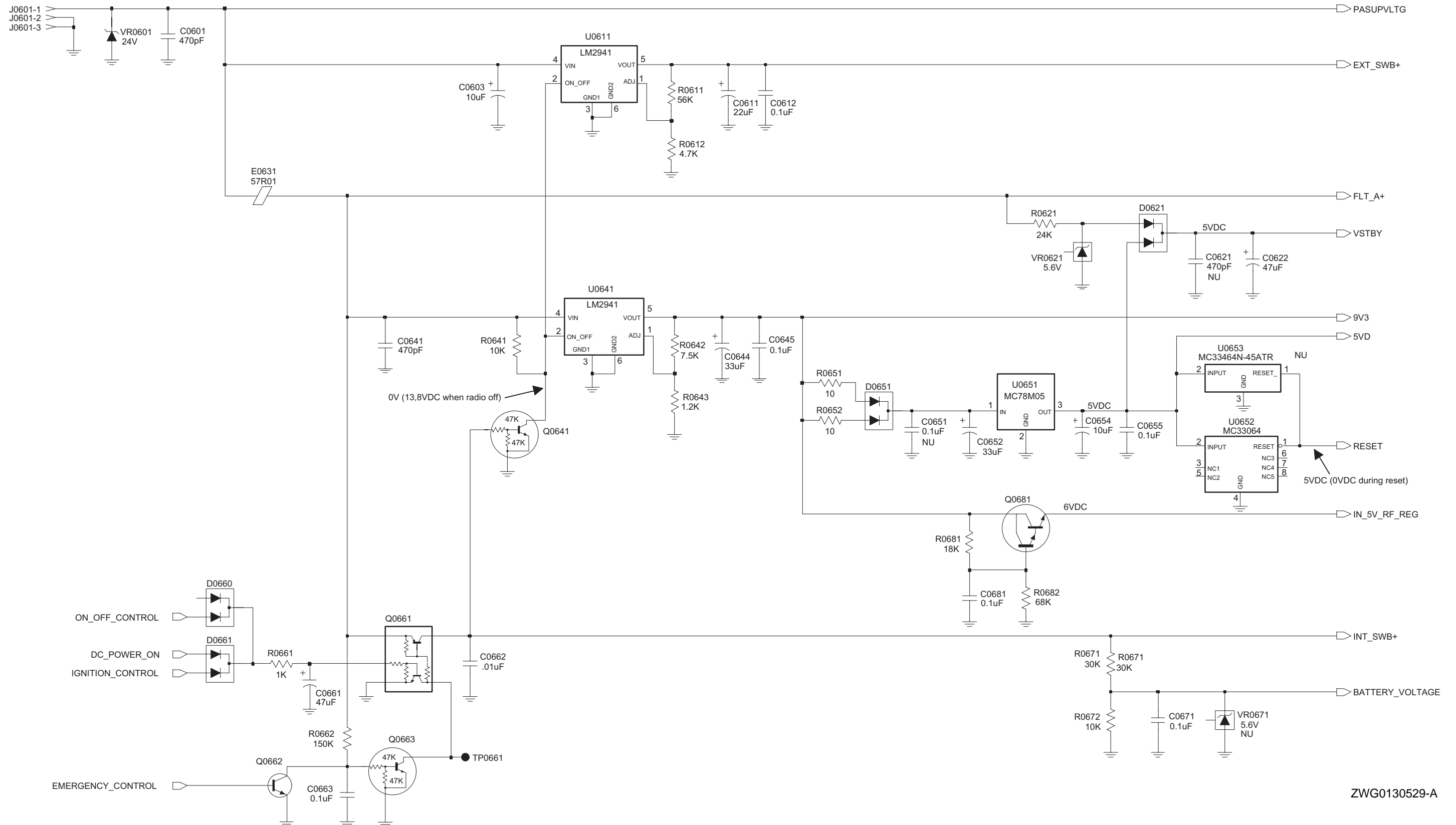
\* Motorola Depot Servicing only  
Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

### 4.0 Controller T6/T7/T9 Schematics and Parts Lists



Controller T6/T7/T9/T11 Schematic Diagram - Overall

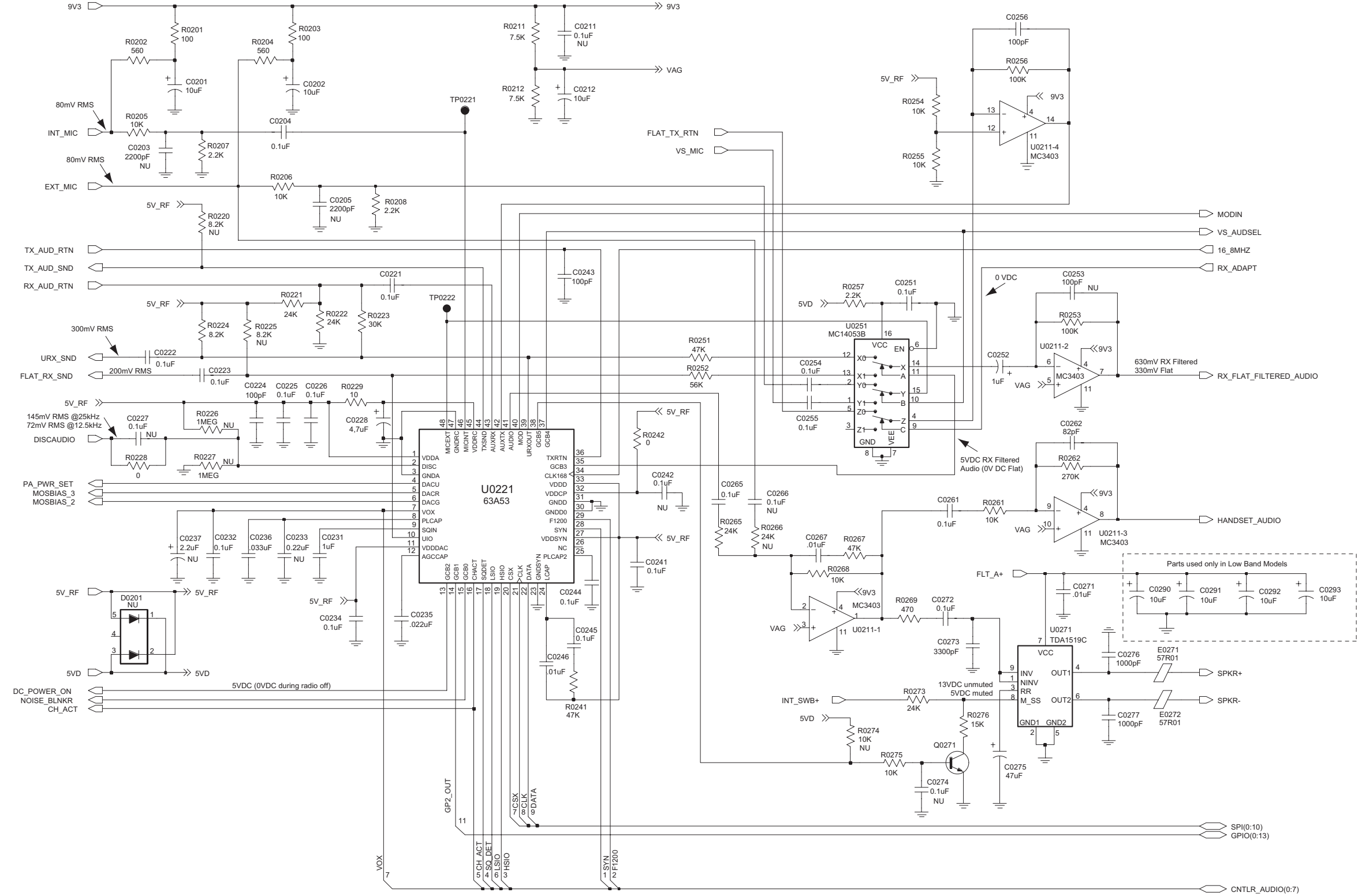




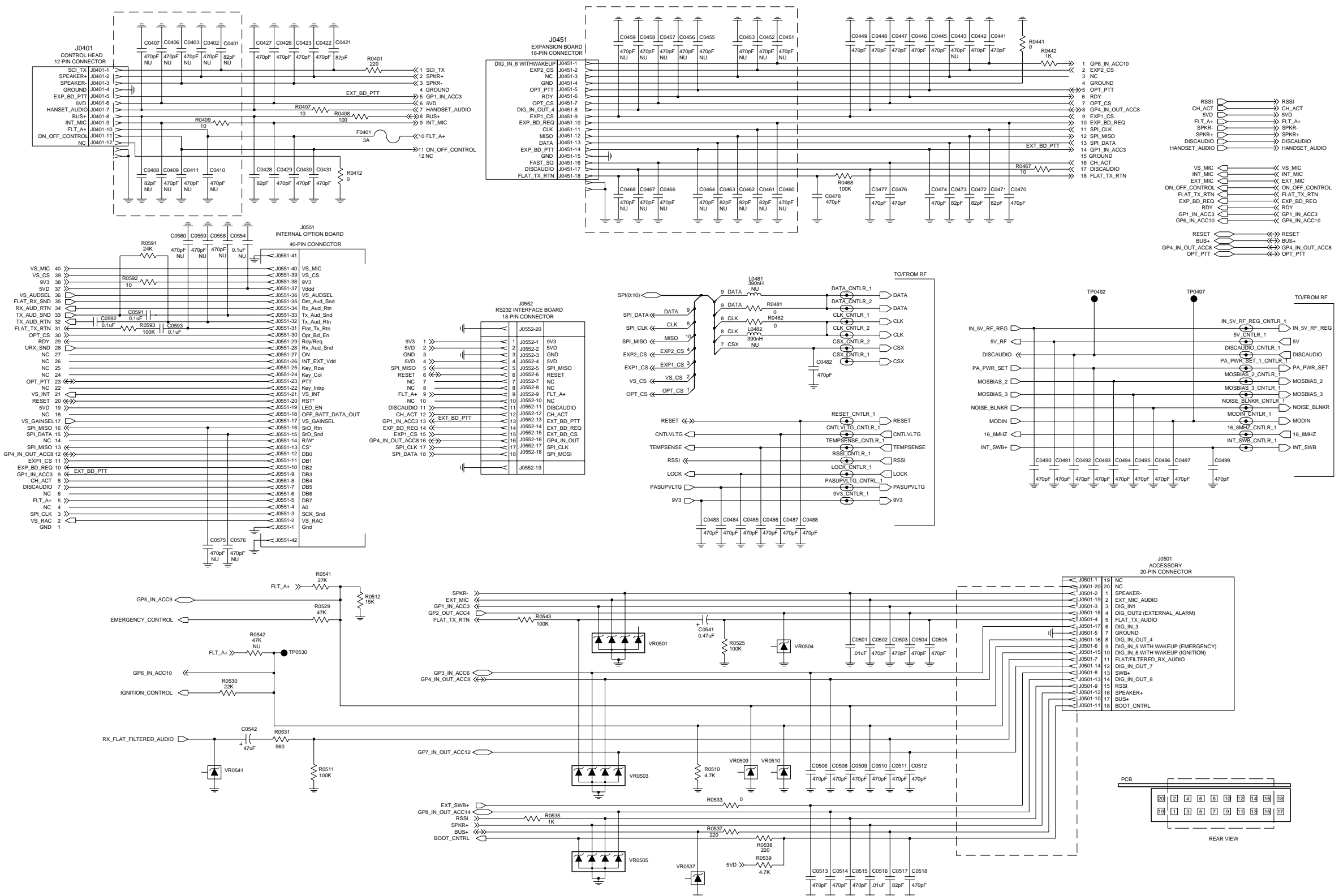
ZWG0130529-A

**Controller T6/T7/T9 Schematic Diagram - Supply Voltage**

6881091C63-B

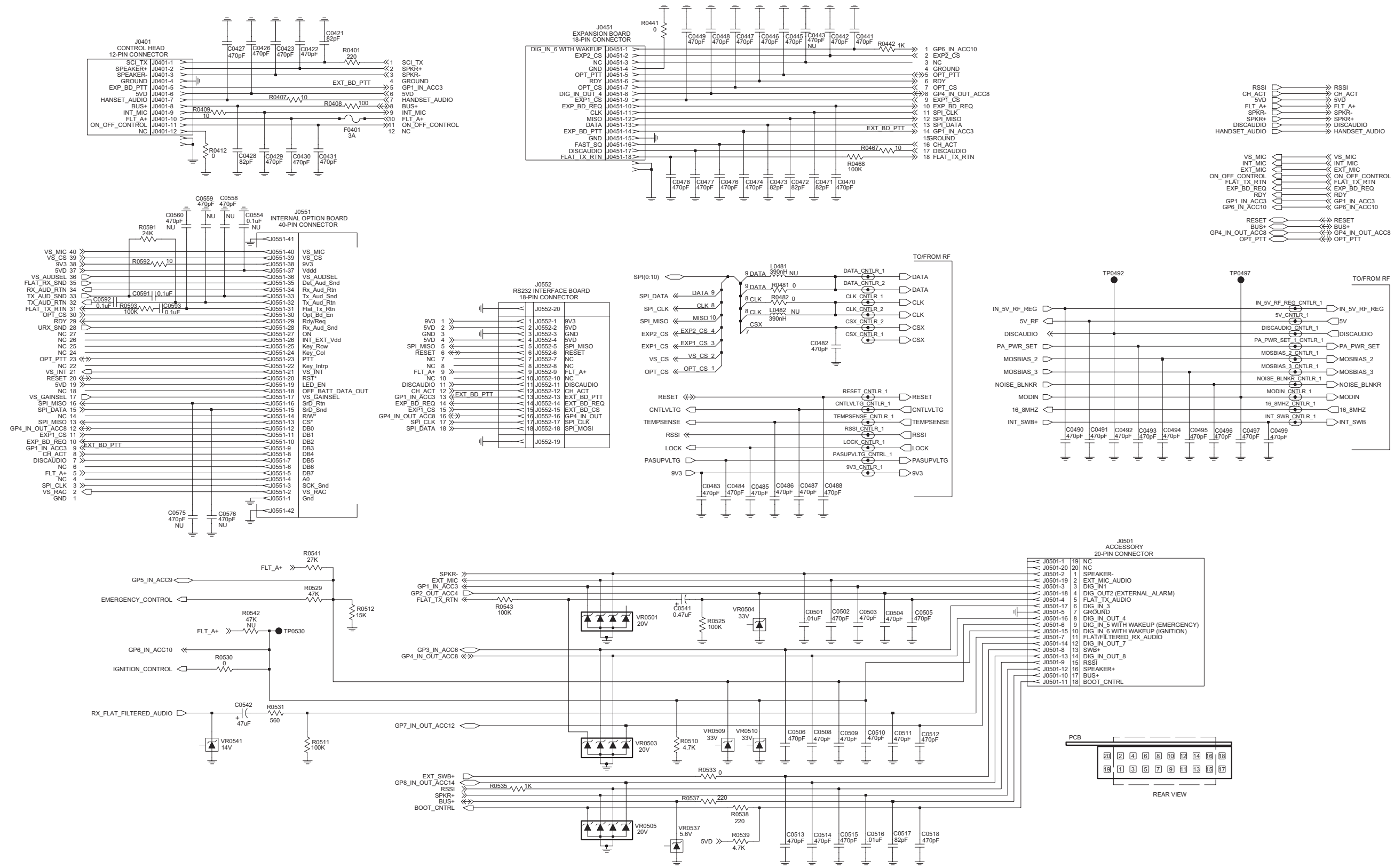


Controller T6/T7/T9 Schematic Diagram - Audio

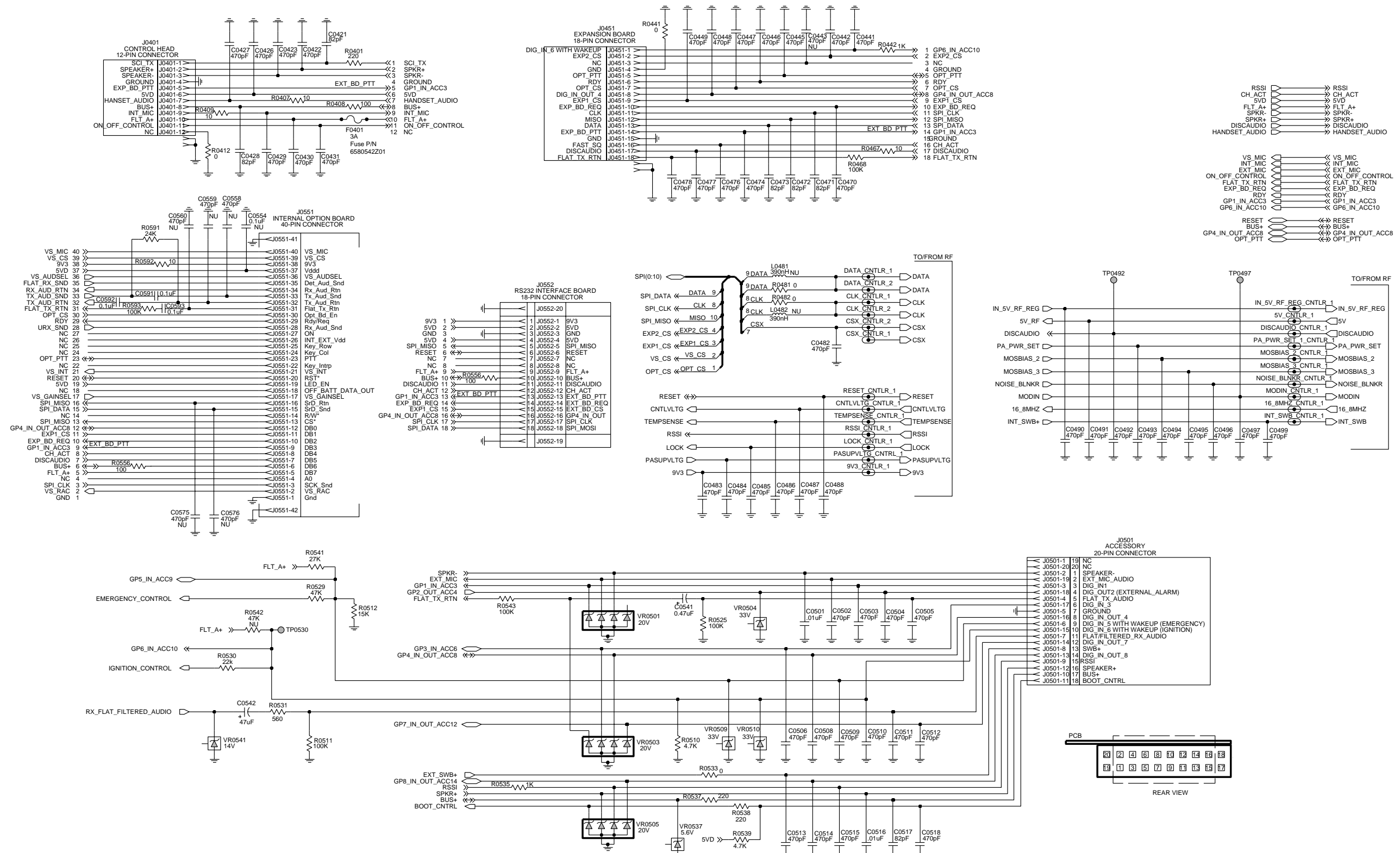


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Controller T6 Only Schematic Diagram - I/O

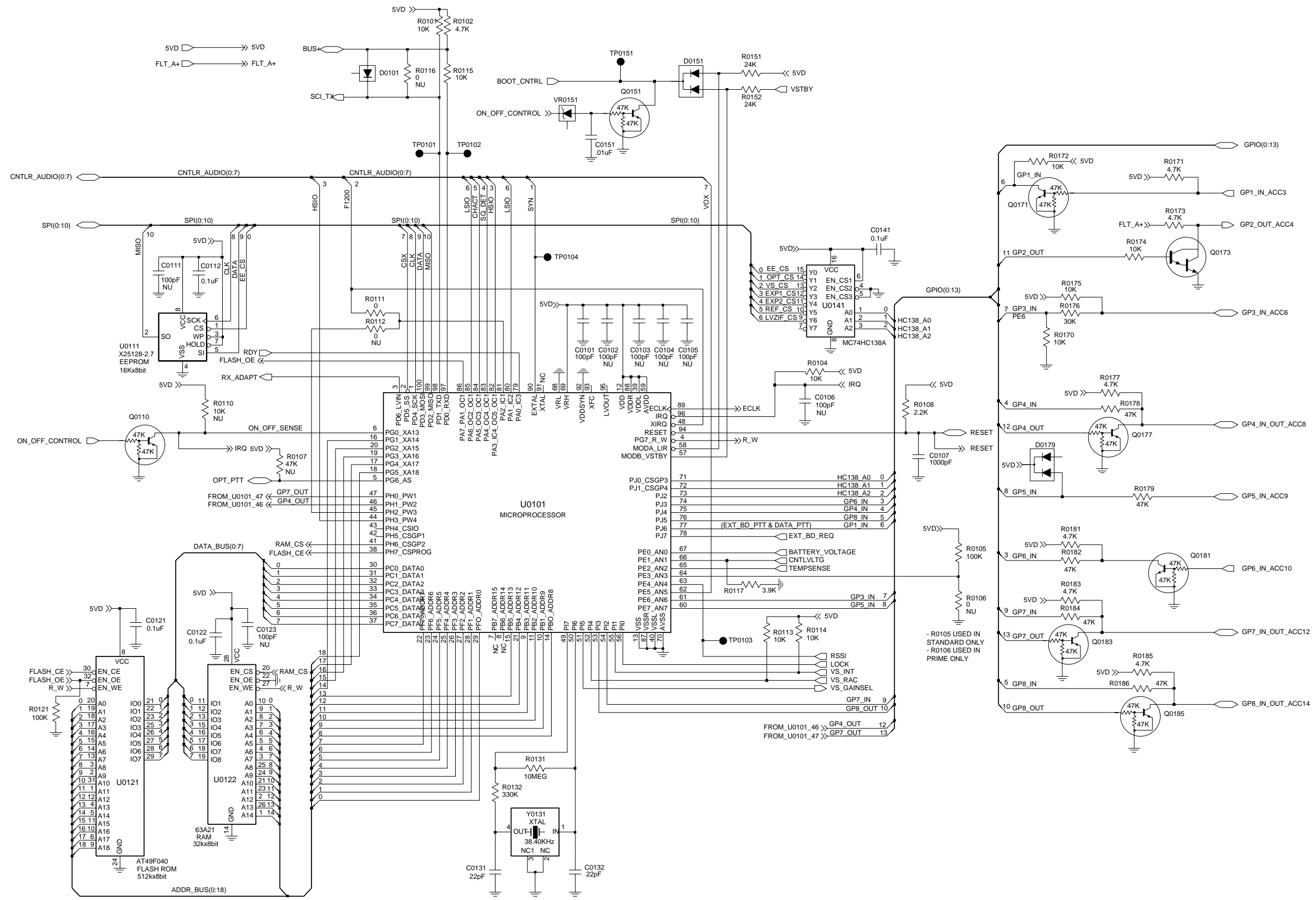


Controller T7 Only Schematic Diagram - I/O

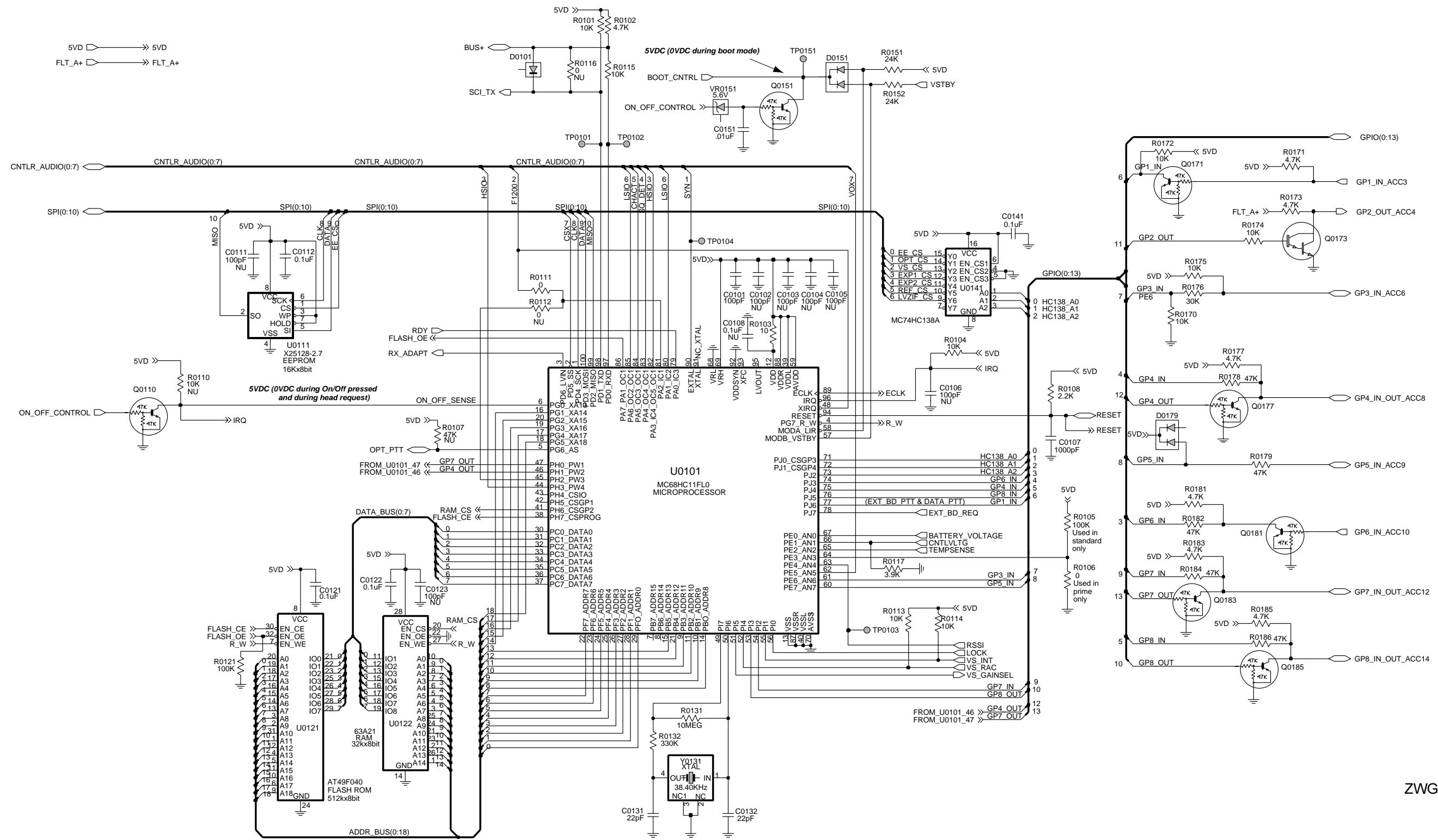


ZWG0130586-A

Controller T9 Only Schematic Diagram - I/O

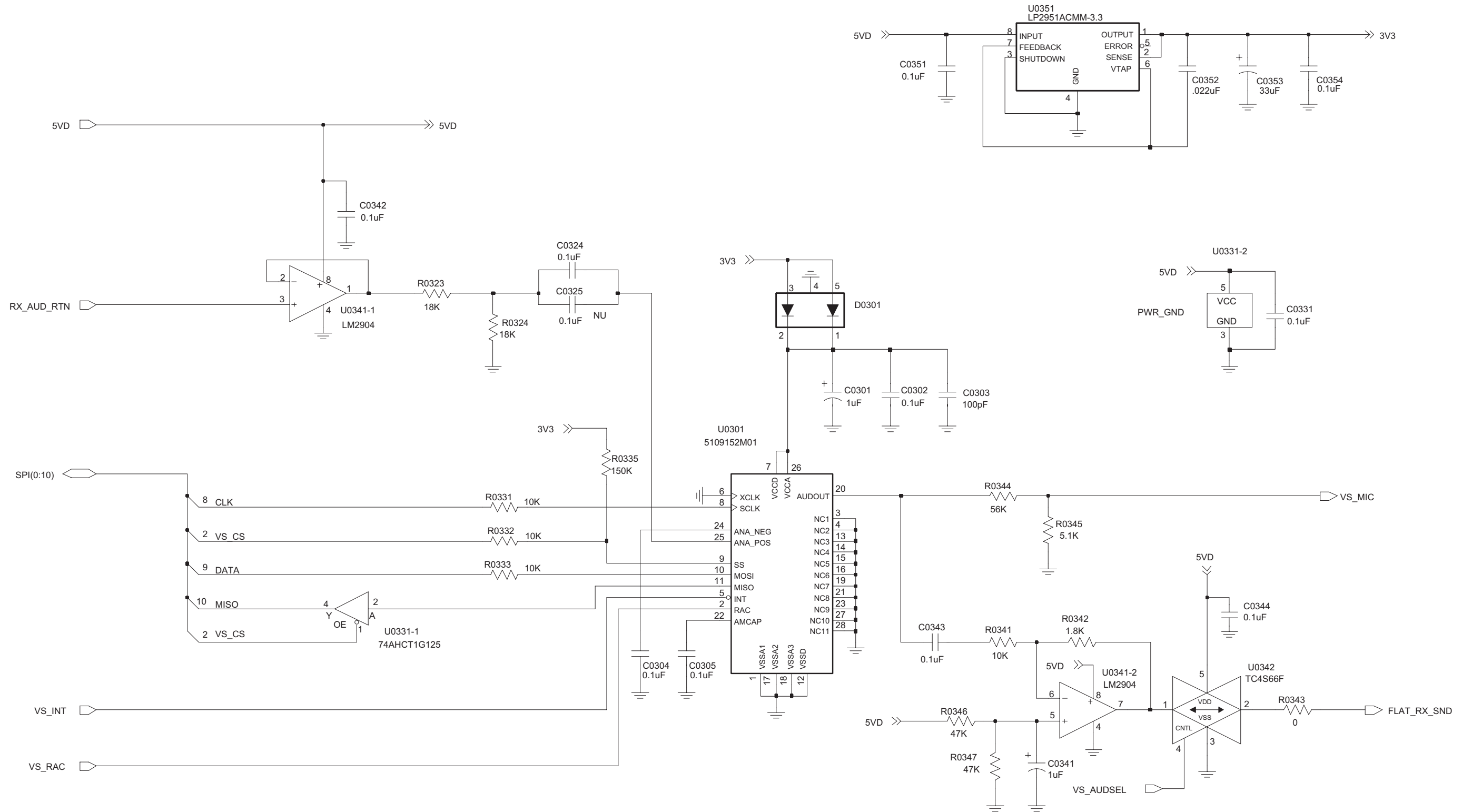


Controller T6/T7 Schematic Diagram - Microprocessor



ZWG0130585-A

Controller T9 Only Schematic Diagram - Microprocessor



Controller T6/T7/T9 Schematic Diagram - Voice Storage

ZWG0130530-O



**Controller T6/7 Parts List**

Circuit Ref	Motorola Part No.	Description
C0101	2113740F51	100pF 5% 50V
C0107	2113741F25	1nF 50V
C0112	2113743E20	100nF 16V
C0121	2113743E20	100nF 16V
C0122	2113743E20	100nF 16V
C0131	2113740F35	22pF 5% 50V
C0132	2113740F35	22pF 5% 50V
C0141	2113743E20	100nF 16V
C0151	2113741F49	10nF 50V
C0201	2311049A57	10uF 10% 16V
C0202	2311049A57	10uF 10% 16V
C0204	2113743E20	100nF 16V
C0212	2311049A57	10uF 10% 16V
C0221	2113743E20	100nF 16V
C0222	2113743E20	100nF 16V
C0223	2113743E20	0.1uF, 0662057B47, 0 Kohm resistor for LS+ models
C0224	2113740F51	100pF 5% 50V
C0225	2113743E20	100nF 16V
C0226	2113743E20	100nF 16V
C0228	2311049A56	4.7uF 10% 16V
C0231	2113743B29	1 uF 10% 16V
C0232	2113743E20	100nF 16V
C0234	2113743E20	100nF 16V
C0235	2113743E07	22nF 16V
C0236	2113743E10	.033uF 10%
C0241	2113743E20	100nF 16V
C0243	2113740F51	100pF 5% 50V
C0244	2113743E20	100nF 16V
C0245	2113743E20	100nF 16V
C0246	2113741F49	10nF 50V
C0251	2113743E20	100nF 16V
Used in		CNTRL T7 only
C0252	2311049A07	1uF 10% 16V
C0254	2113743E20	100nF 16V
C0255	2113743E20	100nF 16V
C0256	2113740F51	100pF 5% 50V
C0261	2113743E20	100nF 16V
C0262	2113740F49	82pF 5% 50V NPO
C0265	2113743E20	100nF 16V
C0267	2113741F49	10nF 50V
C0271	2113741F49	10nF 50V
C0272	2113743E20	100nF 16V
C0273	2113741F37	3.3nF 50V
C0275	2311049A99	47uF 20% 10V
C0276	2113741F25	1nF 50V X7R
C0277	2113741F25	1nF 50V X7R
C0290	2311049C01	10uF (only Low Band)
C0291	2311049C01	10uF (only Low Band)
C0292	2311049C01	10uF (only Low Band)

Circuit Ref	Motorola Part No.	Description
C0293	2311049C01	10uF (only Low Band)
C0301	2311049A07	1uF 10% 16V Voice storage only
C0302	2113743E20	100nF 16V Voice storage only
C0303	2113740F51	100pF 5% 50V Voice storage only
C0304	2113743E20	100nF 16V Voice storage only
C0305	2113743E20	100nF 16V Voice storage only
C0324	2113743E20	100nF 16V Voice storage only
C0331	2113743E20	100nF 16V Voice storage only
C0341	2311049A07	TANT CP 1uF 10% 16V Voice storage only
C0342	2113743E20	100nF 16V Voice storage only
C0343	2113743E20	100nF 16V Voice storage only
C0344	2113743E20	100nF 16V Voice storage only
C0351	2113743E20	100nF 16V Voice storage only
C0352	2113743E07	22nF 16V Voice storage only
C0353	2311049A97	TANT CHIP 33 uF 16 Voice storage only
C0354	2113743E20	100nF 16V Voice storage only
C0421	2113743N48	82.0 pF 5%
C0422	2113741F17	470pF 50V
C0423	2113741F17	470pF 50V
C0426	2113743L09	470 pF 10%
C0427	2113743L09	470 pF 10%
C0428	2113743N48	82.0 pF 5%
C0429	2113743L09	470 pF 10%
C0430	2113741F17	470pF 50V
C0431	2113741F17	470pF 50V
C0441	2113743L09	470 pF 10%
C0442	2113743L09	470 pF 10%
C0445	2113743L09	470 pF 10%
C0446	2113743L09	470 pF 10%
C0447	2113743L09	470 pF 10%
C0448	2113743L09	470 pF 10%
C0449	2113743L09	470 pF 10%
C0470	2113743L09	470 pF 10%
C0471	2113743N48	82.0 pF 5%
C0472	2113743N48	82.0 pF 5%
C0473	2113743N48	82.0 pF 5%
C0474	2113743L09	470 pF 10%
C0476	2113743L09	470 pF 10%

Circuit Ref	Motorola Part No.	Description
C0477	2113743L09	470 pF 10%
C0478	2113743L09	470 pF 10%
C0482	2113743L09	470 pF 10%
C0483	2113743L09	470 pF 10%
C0484	2113741F17	470pF 50V
C0485	2113743L09	470 pF 10%
C0486	2113743L09	470 pF 10%
C0487	2113743L09	470 pF 10%
C0488	2113743L09	470 pF 10%
C0490	2113743L09	470 pF 10%
C0491	2113743L09	470 pF 10%
C0492	2113743L09	470 pF 10%
C0493	2113743L09	470 pF 10%
C0494	2113743L09	470 pF 10%
C0495	2113743L09	470 pF 10%
C0496	2113743L09	470 pF 10%
C0497	2113743L09	470 pF 10%
C0499	2113743L09	470 pF 10%
C0501	2113741F49	10nF 50V
C0502	2113743L09	470pF 10% (CNTRL T6)
C0502	2113741F17	470pF 50V (CNTRL T7)
C0503	2113743L09	470pF 10% (CNTRL T6)
C0503	2113741F17	470pF 50V (CNTRL T7)
C0504	2113741F17	470pF 50V
C0505	2113743L09	470pF 10% (CNTRL T6)
C0505	2113741F17	470pF 50V (CNTRL T7)
C0506	2113743L09	470pF 10% (CNTRL T6)
C0506	2113741F17	470pF 50V (CNTRL T7)
C0508	2113743L09	470pF 10% (CNTRL T6)
C0508	2113741F17	470pF 50V (CNTRL T7)
C0509	2113743L09	470pF 10% (CNTRL T6)
C0509	2113741F17	470pF 50V (CNTRL T7)
C0510	2113741F17	470pF 50V
C0511	2113743L09	470pF 10% (CNTRL T6)
C0511	2113741F17	470pF 50V (CNTRL T7)
C0512	2113743L09	470pF 10% (CNTRL T6)
C0512	2113741F17	470pF 50V (CNTRL T7)
C0513	2113741F17	470pF 50V
C0514	2113743L09	470pF 10% (CNTRL T6)
C0514	2113741F17	470pF 50V (CNTRL T7)
C0515	2113743L09	470pF 10% (CNTRL T6)
C0515	2113741F17	470pF 50V (CNTRL T7)
C0516	2113741F49	10nF 50V
C0517	2113743N48	82.0 pF 5%
C0518	2113743L09	470pF 10% (CNTRL T6)
C0518	2113741F17	470pF 50V (CNTRL T7)
C0541	2311049A05	470nF 10% 25V
C0542	2311049A99	47uF 20% 10V
C0591	2113743E20	100nF 16V
C0592	2113743E20	100nF 16V
C0593	2113743E20	0.1uF, 0662057B47, 0 Kohm resistor for LS+ models

Circuit Ref	Motorola Part No.	Description
C0601	2113741F17	470pF 50V
C0603	2380090M24	LYT 10uF 50V 20%
C0611	2311049C06	CP 22uF 20% 35V
C0612	2113743E20	100nF 16V
C0622	2311049A99	CP 47uF 20%
C0641	2113741F17	470pF 50V
C0644	2311049A97	CHIP 33 uF
C0645	2113743E20	100nF 16VD
C0652	2311049A97	CHIP 33 uF 16
C0654	2311049A57	CP 10uF 10% 16V
C0655	2113743E20	100nF 16V
C0661	2311049C05	CP 47uF 10% 16V
C0662	2113741F49	10nF 50V
C0663	2113743E20	100nF 16V
C0671	2113743E20	100nF 16V
C0681	2113743E20	100nF 16V
D0101	4880236E05	CHIP SCHOTTKY
D0151	4813833C02	DUAL SOT MMBD6100
D0179	4813833C02	DUAL SOT MMBD6100
D0301	4802245J47	SCHOTTKY BARRIER (RB471E) Voice storage only
D0621	4813833C02	DUAL SOT MMBD6100
D0651	4813833C02	DUAL SOT MMBD6100
D0660	4813833C02	DUAL SOT MMBD6100
D0661	4813833C02	DUAL SOT MMBD6100
E0271	2484657R01	Ferrite Bead
E0272	2484657R01	Ferrite Bead
E0631	2484657R01	Ferrite Bead
F0401	6580542Z01	3A 24V
J0401	0902636Y02	CONN FLEX 12 PIN
J0451	0902636Y01	CONN FLEX SIDE ENTRY
J0501	0986105B01	CONN SMD 20 PIN
J0551	0905505Y04	CONN ZIF HORIZONTAL
J0552	0905505Y03	CONN ZIF 18PIN
J0601	0986165B01	DC PWR CONN
Q0110	4880048M01	NPN DIG 47k/47k
Q0151	4880048M01	NPN DIG 47k/47k
Q0171	4880048M01	NPN DIG 47k/47k
Q0173	4880052M01	NPN DRLNGTN MXTA
Q0177	4880048M01	NPN DIG 47k/47k
Q0181	4880048M01	NPN DIG 47k/47k
Q0183	4880048M01	NPN DIG 47k/47k
Q0185	4880048M01	NPN DIG 47k/47k
Q0271	4813824A10	NPN 40V .2A
Q0641	4880048M01	NPN DIG 47k/47k
Q0661	4805921T02	DUAL ROHM FMC2 RH
Q0662	4813824A10	NPN 40V .2A B=50-150
Q0663	4880048M01	NPN DIG 47k/47k
Q0681	4880052M01	NPN DRLNGTN MXTA
R0101	0662057A73	10k 1/16W 5%
R0102	0662057A65	4700 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R0104	0662057A73	10k 1/16W 5%
R0105	0662057A97	100k 1/16W
R0106	0662057B47	0 1/16W Voice storage only
R0108	0662057A57	2200 1/16W 5%
R0111	0662057B47	0 1/16W 0306
R0113	0662057A73	10k 1/16W 5%
R0114	0662057A73	10k 1/16W 5%
R0115	0662057A73	10k 1/16W 5%
R0117	0662057A63	3900 1/16W 5%
R0121	0662057A97	100k 1/16W
R0131	0662057B46	10.0 MEG OHMS 5%
R0132	0662057B10	330k 1/16W 5%
R0151	0662057A82	24k 1/16W 5%
R0152	0662057A82	24k 1/16W 5%
R0170	0662057A73	10k 1/16W 5%
R0171	0662057A65	4700 1/16W 5%
R0172	0662057A73	10k 1/16W 5%
R0173	0662057A65	4700 1/16W 5%
R0174	0662057A73	10k 1/16W 5%
R0175	0662057A73	10k 1/16W 5%
R0176	0662057A84	30k 1/16W 5%
R0177	0662057A65	4700 1/16W 5%
R0178	0662057A89	47k 1/16W 5%
R0179	0662057A89	47k 1/16W 5%
R0181	0662057A65	4700 1/16W 5%
R0182	0662057A89	47k 1/16W 5%
R0183	0662057A65	4700 1/16W 5%
R0184	0662057A89	47k 1/16W 5%
R0185	0662057A65	4700 1/16W 5%
R0186	0662057A89	47k 1/16W 5%
R0201	0662057A25	100 1/16W 5%
R0202	0662057A43	560 1/16W 5%
R0203	0662057A25	100 1/16W 5%
R0204	0662057A43	560 1/16W 5%
R0205	0662057A73	10k 1/16W 5%
R0206	0662057A73	10k 1/16W 5%
R0207	0662057A57	2200 1/16W 5%
R0208	0662057A57	2200 1/16W 5%
R0211	0660076E70	FILM 7500
R0212	0660076E70	FILM 7500
R0221	0662057A82	24k 1/16W 5%
R0222	0662057A82	24k 1/16W 5%
R0223	0662057A84	30k 1/16W 5%
R0224	0662057A71	8200 1/16W 5%
R0228	0662057B47	0 1/16W
R0229	0662057A01	10 1/16W 5%
R0241	0662057A89	47k 1/16W 5%
R0242	0662057B47	0 1/16W
R0251	0662057A89	47k 1/16W 5%
R0252	0662057A91	56K 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R0253	0662057A97	100k 1/16W
R0254	0662057A73	10k 1/16W 5% (CNTRL T7 only)
R0255	0662057A73	10k 1/16W 5% (CNTRL T7 only)
R0256	0662057A97	100k 1/16W (CNTRL T7 only)
R0257	0662057A57	2200 1/16W 5% (CNTRL T7 only)
R0261	0662057A73	10k 1/16W 5%
R0262	0662057A97	100k 1/16W
R0265	0662057A82	24k 1/16W 5%
R0267	0662057A89	47k 1/16W 5%
R0268	0662057A73	10k 1/16W 5%
R0269	0662057A41	470 1/16W 5%
R0273	0662057A82	24k 1/16W 5%
R0275	0662057A73	10k 1/16W 5%
R0276	0662057A77	15k 1/16W 5%
R0323	0662057A79	18k 1/16W 5% Voice storage only
R0324	0662057A79	18k 1/16W 5% Voice storage only
R0331	0662057A73	10k 1/16W 5% Voice storage only
R0332	0662057A73	10k 1/16W 5% Voice storage only
R0333	0662057A73	10k 1/16W 5% Voice storage only
R0335	0662057B02	150k 1/16W Voice storage only
R0341	0662057A73	10k 1/16W 5% Voice storage only
R0342	0662057A55	1800 1/16W 5% Voice storage only
R0343	0662057B47	0 1/16W Voice storage only
R0344	0662057A91	56K 1/16W 5% Voice storage only
R0345	0662057A66	5100 1/16W 5% Voice storage only
R0346	0662057A89	47k 1/16W 5% Voice storage only
R0347	0662057A89	47k 1/16W 5% Voice storage only
R0401	0662057A33	220 1/16W
R0407	0662057M26	10 5% 20X40
R0408	0662057A25	100 1/16W 5%
R0409	0662057M26	10 5% 20X40
R0412	0662057B47	0 1/16W
R0441	0662057B47	0 1/16W
R0442	0662057A49	1k 1/16W 5%
Used in		CNTRL T7 only

Circuit Ref	Motorola Part No.	Description
R0467	0662057M26	10 5% 20X40
R0468	0662057M26	10 5% 20X40 (CNTRL T6)
R0468	0662057A97	100k 1/16W (CNTRL T7)
R0481	0662057B47	0 1/16W
R0482	0662057B47	0 1/16W
R0510	0662057A65	4700 1/16W 5%
R0511	0662057A97	100k 1/16W
R0512	0662057A77	15k 1/16W 5%
R0525	0662057A97	100k 1/16W
R0529	0662057A89	47k 1/16W 5%
R0530	0662057B47	0 1/16W
R0531	0662057A43	560 1/16W 5%
R0533	0662057B47	0 1/16W
R0535	0662057A49	1k 1/16W 5%
R0537	0662057A33	220 1/16W 5%
R0538	0662057A33	220 1/16W 5%
R0539	0662057A65	4700 1/16W 5%
R0541	0662057A83	27k 1/16W 5%
R0543	0662057A97	100k 1/16W (CNTRL T7 only)
R0591	0662057A82	24k 1/16W 5%
R0592	0662057A01	10 1/16W 5%
R0593	0662057A97	100k 1/16W (CNTRL T7 only)
R0611	0662057A91	56K 1/16W
R0612	0662057A65	4700 1/16W
R0621	0662057A82	24k 1/16W
R0641	0662057A73	10k 1/16W
R0642	0660076E70	FILM 7500
R0643	0660076E51	FILM 1200
R0651	0662057A01	10 1/16W 5%
R0652	0662057A01	10 1/16W 5%
R0661	0662057A49	1k 1/16W 5%
R0662	0662057B02	150k 1/16W
R0671	0662057A84	30k 1/16W 5%
R0672	0662057A73	10k 1/16W 5%
R0681	0662057A79	18k 1/16W 5%
R0682	0662057A93	68k 1/16W 5%
U0101	5102226J56	MICRO PROCESSOR MC68HC1 1FLO
* U0111	5102463J64	EEPROM X25128-2.7 SO8
* U0121	5186137B01	512KX8 FLASH ROM (AT49BV020)
U0122	5185963A21	32K x 8 SRAM
U0141	5113805A30	10F8 DCDR/REMUX 74HC138
U0211	5183222M49	QUAD OPAMP __3403
U0221	5185130C53	ASFICCMP 0.5MM TQFP
U0251	5113806A20	MUX/DEMUX, TRIPLE 2-CH
U0271	5109699X01	AUDIO PA TDA1519C

Circuit Ref	Motorola Part No.	Description
U0301	5109152M01	EEPROM ANALOG ISD33120EI Voice storage only
U0331	5186204B01	BUFFER/DRIVER 74AHCT1G125 Voice storage only
U0341	5180932W01	LINEAR IC OP AMP Voice storage only
U0342	5105750U28	SNGL ANALOG SWITCH Voice storage only
U0351	5102463J40	REGULATOR, 3.3V Voice storage only
U0611	5183308X01	ADJ VLTG REG LM2941 TO263
U0641	5183308X01	ADJ VLTG REG LM2941 TO263
U0651	5113816A07	REG 5V POS 500MA MC78M05
U0652	5113815A02	MC33064
VR0151	4813830A15	5.6V 5% 225mW
VR0501	4805656W09	ZENER QUAD MMQA20VT1
VR0503	4805656W09	ZENER QUAD MMQA20VT1
VR0504	4813830A40	SOC23 AUTO SDN
VR0505	4805656W09	ZENER QUAD MMQA20VT1
VR0509	4813830A40	SOC23 AUTO SDN
VR0510	4813830A40	SOC23 AUTO SDN
VR0537	4813830A15	5.6V 5% 225mW
VR0541	4813830A27	14V 5% 225MW
VR0601	4813832C77	TRANS SUP. 24V HIGH POWER
VR0621	4813830A15	5.6V 5% 225mW
Y0131	4880113R19	CRYSTAL 38.4KHz

\* Motorola Depot Servicing only

Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

**Controller T9 Parts List**

Circuit Ref	Motorola Part No.	Description
C0101	2113740F51	100pF 5% 50V
C0107	2113741F25	1nF 50V
C0112	2113743E20	100nF 16V
C0121	2113743E20	100nF 16V
C0122	2113743E20	100nF 16V
C0131	2113740F35	22pF 5% 50V
C0132	2113740F35	22pF 5% 50V
C0141	2113743E20	100nF 16V
C0151	2113741F49	10nF 50V
C0201	2311049A57	10uF 10% 16V
C0202	2311049A57	10uF 10% 16V
C0204	2113743E20	100nF 16V
C0212	2311049A57	10uF 10% 16V
C0221	2113743E20	100nF 16V
C0222	2113743E20	100nF 16V
C0223	2113743E20	0.1uF, 0662057B47, 0 Kohm resistor for LS+ models
C0224	2113740F51	100pF 5% 50V
C0225	2113743E20	100nF 16V
C0226	2113743E20	100nF 16V
C0228	2311049A56	4.7uF 10% 16V
C0231	2113743B29	1 uF 10% 16V
C0232	2113743E20	100nF 16V
C0234	2113743E20	100nF 16V
C0235	2113743E07	22nF 16V
C0236	2113743E10	.033uF 10%
C0241	2113743E20	100nF 16V
C0243	2113740F51	100pF 5% 50V
C0244	2113743E20	100nF 16V
C0245	2113743E20	100nF 16V
C0246	2113741F49	10nF 50V
C0251	2113743E20	100nF 16V
C0252	2311049A07	1uF 10% 16V
C0254	2113743E20	100nF 16V
C0255	2113743E20	100nF 16V
C0256	2113740F51	100pF 5% 50V
C0261	2113743E20	100nF 16V
C0262	2113740F49	82pF 5% 50V NPO
C0265	2113743E20	100nF 16V
C0267	2113741F49	10nF 50V
C0271	2113741F49	10nF 50V
C0272	2113743E20	100nF 16V
C0273	2113741F37	3.3nF 50V
C0275	2311049A99	47uF 20% 10V
C0276	2113741F25	1nF 50V X7R
C0277	2113741F25	1nF 50V X7R

Circuit Ref	Motorola Part No.	Description
C0290	2311049C01	10uF (only Low Band)
C0291	2311049C01	10uF (only Low Band)
C0292	2311049C01	10uF (only Low Band)
C0293	2311049C01	10uF (only Low Band)
C0301	2311049A07	1uF 10% 16V Voice storage only
C0302	2113743E20	100nF 16V Voice storage only
C0303	2113740F51	100pF 5% 50V Voice storage only
C0304	2113743E20	100nF 16V Voice storage only
C0305	2113743E20	100nF 16V Voice storage only
C0324	2113743E20	100nF 16V Voice storage only
C0331	2113743E20	100nF 16V Voice storage only
C0341	2311049A07	TANT CP 1uF 10% 16V Voice storage only
C0342	2113743E20	100nF 16V Voice storage only
C0343	2113743E20	100nF 16V Voice storage only
C0344	2113743E20	100nF 16V Voice storage only
C0351	2113743E20	100nF 16V Voice storage only
C0352	2113743E07	22nF 16V Voice storage only
C0353	2311049A97	TANT CHIP 33 uF 16 Voice storage only
C0354	2113743E20	100nF 16V Voice storage only
C0421	2113743N48	82.0 pF 5%
C0422	2113741F17	470pF 50V
C0423	2113741F17	470pF 50V
C0426	2113743L09	470 pF 10%
C0427	2113743L09	470 pF 10%
C0428	2113743N48	82.0 pF 5%
C0429	2113743L09	470 pF 10%
C0430	2113741F17	470pF 50V
C0431	2113741F17	470pF 50V
C0441	2113743L09	470 pF 10%
C0442	2113743L09	470 pF 10%
C0445	2113743L09	470 pF 10%
C0446	2113743L09	470 pF 10%
C0447	2113743L09	470 pF 10%
C0448	2113743L09	470 pF 10%
C0449	2113743L09	470 pF 10%

Circuit Ref	Motorola Part No.	Description
C0470	2113743L09	470 pF 10%
C0471	2113743N48	82.0 pF 5%
C0472	2113743N48	82.0 pF 5%
C0473	2113743N48	82.0 pF 5%
C0474	2113743L09	470 pF 10%
C0476	2113743L09	470 pF 10%
C0477	2113743L09	470 pF 10%
C0478	2113743L09	470 pF 10%
C0482	2113743L09	470 pF 10%
C0483	2113743L09	470 pF 10%
C0484	2113741F17	470pF 50V
C0485	2113743L09	470 pF 10%
C0486	2113743L09	470 pF 10%
C0487	2113743L09	470 pF 10%
C0488	2113743L09	470 pF 10%
C0490	2113743L09	470 pF 10%
C0491	2113743L09	470 pF 10%
C0492	2113743L09	470 pF 10%
C0493	2113743L09	470 pF 10%
C0494	2113743L09	470 pF 10%
C0495	2113743L09	470 pF 10%
C0496	2113743L09	470 pF 10%
C0497	2113743L09	470 pF 10%
C0499	2113743L09	470 pF 10%
C0501	2113741F49	10nF 50V
C0502	2113741F17	470pF 50V
C0503	2113741F17	470pF 50V
C0504	2113741F17	470pF 50V
C0505	2113741F17	470pF 50V
C0506	2113741F17	470pF 50V
C0508	2113741F17	470pF 50V
C0509	2113741F17	470pF 50V
C0510	2113741F17	470pF 50V
C0511	2113741F17	470pF 50V
C0512	2113741F17	470pF 50V
C0513	2113741F17	470pF 50V
C0514	2113741F17	470pF 50V
C0515	2113741F17	470pF 50V
C0516	2113741F49	10nF 50V
C0517	2113743N48	82.0 pF 5%
C0518	2113741F17	470pF 50V
C0541	2311049A05	470nF 10% 25V
C0542	2311049A99	47uF 20% 10V
C0560	2113743L17	1nF 10%
C0591	2113743E20	100nF 16V
C0592	2113743E20	100nF 16V
C0593	2113743E20	0.1uF, 0662057B47, 0 Kohm resistor for LS+ models

Circuit Ref	Motorola Part No.	Description
C0601	2113741F17	470pF 50V
C0603	2380090M24	LYT 10uF 50V 20%
C0611	2311049C06	CP 22uF 20% 35V
C0612	2113743E20	100nF 16V
C0622	2311049A99	CP 47uF 20%
C0641	2113741F17	470pF 50V
C0644	2311049A97	CHIP 33 uF
C0645	2113743E20	100nF 16VD
C0652	2311049A97	CHIP 33 uF 16
C0654	2311049A57	CP 10uF 10% 16V
C0655	2113743E20	100nF 16V
C0661	2311049C05	CP 47uF 10% 16V
C0662	2113741F49	10nF 50V
C0663	2113743E20	100nF 16V
C0671	2113743E20	100nF 16V
C0681	2113743E20	100nF 16V
D0101	4813825A05	CHIP SCHOTTKY
D0151	4813833C02	DUAL SOT MMBD6100
D0179	4813833C02	DUAL SOT MMBD6100
D0301	4802245J47	SCHOTTKY BARRIER (RB471E) Voice storage only
D0621	4813833C02	DUAL SOT MMBD6100
D0651	4813833C02	DUAL SOT MMBD6100
D0660	4813833C02	DUAL SOT MMBD6100
D0661	4813833C02	DUAL SOT MMBD6100
E0271	2484657R01	Ferrite Bead
E0272	2484657R01	Ferrite Bead
E0631	2484657R01	Ferrite Bead
F0401	6580542Z01	3A 24V
J0401	0902636Y02	CONN FLEX 12 PIN
J0451	0902636Y01	CONN FLEX SIDE ENTRY
J0501	0986105B01	CONN SMD 20 PIN
J0551	0905505Y04	CONN ZIF HORIZONTAL
J0552	0905505Y03	CONN ZIF 18PIN
J0601	0986165B01	DC PWR CONN
Q0110	4880048M01	NPN DIG 47k/47k
Q0151	4880048M01	NPN DIG 47k/47k
Q0171	4880048M01	NPN DIG 47k/47k
Q0173	4880052M01	NPN DRLNGTN MXTA
Q0177	4880048M01	NPN DIG 47k/47k
Q0181	4880048M01	NPN DIG 47k/47k
Q0183	4880048M01	NPN DIG 47k/47k
Q0185	4880048M01	NPN DIG 47k/47k
Q0271	4880214G02	NPN 40V .2A
Q0641	4880048M01	NPN DIG 47k/47k
Q0661	4805921T02	DUAL ROHM FMC2 RH
Q0662	4880214G02	NPN 40V .2A

Circuit Ref	Motorola Part No.	Description
Q0663	4880048M01	NPN DIG 47k/47k
Q0681	4880052M01	NPN DRLNGTN MXTA
R0101	0662057A73	10k 1/16W 5%
R0102	0662057A65	4700 1/16W 5%
R0103	0662057A01	10 1/16W 5%
R0104	0662057A73	10k 1/16W 5%
R0105	0662057A97	100k 1/16W
R0106	0662057B47	0 1/16W Voice storage only
R0108	0662057A57	2200 1/16W 5%
R0111	0662057B47	0 1/16W 0306
R0113	0662057A73	10k 1/16W 5%
R0114	0662057A73	10k 1/16W 5%
R0115	0662057A73	10k 1/16W 5%
R0117	0662057A63	3900 1/16W 5%
R0121	0662057A97	100k 1/16W
R0131	0662057B46	10.0 MEG OHMS 5%
R0132	0662057B10	330k 1/16W 5%
R0151	0662057A82	24k 1/16W 5%
R0152	0662057A82	24k 1/16W 5%
R0170	0662057A73	10k 1/16W 5%
R0171	0662057A65	4700 1/16W 5%
R0172	0662057A73	10k 1/16W 5%
R0173	0662057A65	4700 1/16W 5%
R0174	0662057A73	10k 1/16W 5%
R0175	0662057A73	10k 1/16W 5%
R0176	0662057A84	30k 1/16W 5%
R0177	0662057A65	4700 1/16W 5%
R0178	0662057A89	47k 1/16W 5%
R0179	0662057A89	47k 1/16W 5%
R0181	0662057A65	4700 1/16W 5%
R0182	0662057A89	47k 1/16W 5%
R0183	0662057A65	4700 1/16W 5%
R0184	0662057A89	47k 1/16W 5%
R0185	0662057A65	4700 1/16W 5%
R0186	0662057A89	47k 1/16W 5%
R0201	0662057A25	100 1/16W 5%
R0202	0662057A43	560 1/16W 5%
R0203	0662057A25	100 1/16W 5%
R0204	0662057A43	560 1/16W 5%
R0205	0662057A73	10k 1/16W 5%
R0206	0662057A73	10k 1/16W 5%
R0207	0662057A57	2200 1/16W 5%
R0208	0662057A57	2200 1/16W 5%
R0211	0660076E70	FILM 7500
R0212	0660076E70	FILM 7500
R0221	0662057A82	24k 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R0222	0662057A82	24k 1/16W 5%
R0223	0662057A84	30k 1/16W 5%
R0224	0662057A71	8200 1/16W 5%
R0228	0662057B47	0 1/16W
R0229	0662057A01	10 1/16W 5%
R0241	0662057A89	47k 1/16W 5%
R0242	0662057B47	0 1/16W
R0251	0662057A89	47k 1/16W 5%
R0252	0662057A91	56K 1/16W 5%
R0253	0662057A97	100k 1/16W
R0254	0662057A73	10k 1/16W 5%
R0255	0662057A73	10k 1/16W 5%
R0256	0662057A97	100k 1/16W
R0257	0662057A57	2200 1/16W 5%
R0261	0662057A73	10k 1/16W 5%
R0262	0662057B08	270k 1/16W
R0265	0662057A82	24k 1/16W 5%
R0267	0662057A89	47k 1/16W 5%
R0268	0662057A73	10k 1/16W 5%
R0269	0662057A41	470 1/16W 5%
R0273	0662057A82	24k 1/16W 5%
R0275	0662057A73	10k 1/16W 5%
R0276	0662057A77	15k 1/16W 5%
R0323	0662057A79	18k 1/16W 5% Voice storage only
R0324	0662057A79	18k 1/16W 5% Voice storage only
R0331	0662057A73	10k 1/16W 5% Voice storage only
R0332	0662057A73	10k 1/16W 5% Voice storage only
R0333	0662057A73	10k 1/16W 5% Voice storage only
R0335	0662057B02	150k 1/16W Voice storage only
R0341	0662057A73	10k 1/16W 5% Voice storage only
R0342	0662057A55	1800 1/16W 5% Voice storage only
R0343	0662057B47	0 1/16W Voice storage only
R0344	0662057A91	56K 1/16W 5% Voice storage only
R0345	0662057A66	5100 1/16W 5% Voice storage only
R0346	0662057A89	47k 1/16W 5% Voice storage only
R0347	0662057A89	47k 1/16W 5% Voice storage only

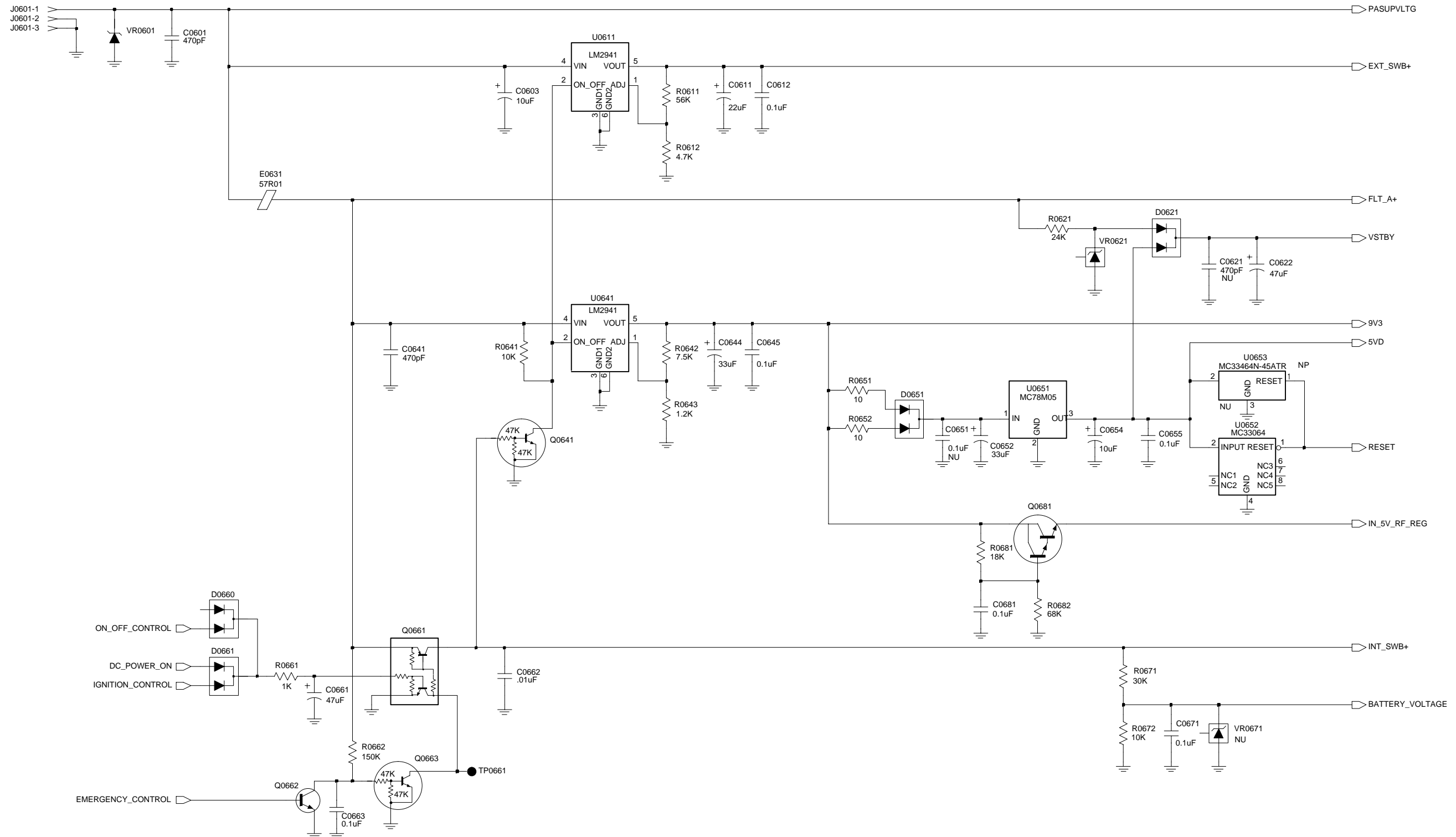
Circuit Ref	Motorola Part No.	Description
R0401	0662057A33	220 1/16W
R0407	0662057M26	10 5% 20X40
R0408	0662057A25	100 1/16W 5%
R0409	0662057M26	10 5% 20X40
R0412	0662057B47	0 1/16W
R0441	0662057B47	0 1/16W
R0442	0662057A49	1k 1/16W 5%
R0467	0662057M26	10 5% 20X40
R0468	0662057A97	100k 1/16W
R0481	0662057B47	0 1/16W
R0482	0662057B47	0 1/16W
R0510	0662057A65	4700 1/16W 5%
R0511	0662057A97	100k 1/16W
R0512	0662057A77	15k 1/16W 5%
R0525	0662057A97	100k 1/16W
R0529	0662057A89	47k 1/16W 5%
R0530	0662057A81	22k 1/16W 5%
R0531	0662057A43	560 1/16W 5%
R0533	0662057B47	0 1/16W
R0535	0662057A49	1k 1/16W 5%
R0537	0662057A33	220 1/16W 5%
R0538	0662057A33	220 1/16W 5%
R0539	0662057A65	4700 1/16W 5%
R0541	0662057A83	27k 1/16W 5%
R0543	0662057A97	100k 1/16W
R0555	0662057A25	100 1/16W 5%
R0556	0662057A25	100 1/16W 5%
R0591	0662057A82	24k 1/16W 5%
R0592	0662057A01	10 1/16W 5%
R0593	0662057A97	100k 1/16W
R0611	0662057A91	56k 1/16W
R0612	0662057A65	4700 1/16W
R0621	0662057A82	24k 1/16W
R0641	0662057A73	10k 1/16W
R0642	0660076E70	FILM 7500
R0643	0660076E51	FILM 1200
R0651	0662057A01	10 1/16W 5%
R0652	0662057A01	10 1/16W 5%
R0661	0662057A49	1k 1/16W 5%
R0662	0662057B02	150k 1/16W
R0671	0662057A84	30k 1/16W 5%
R0672	0662057A73	10k 1/16W 5%
R0681	0662057A79	18k 1/16W 5%
R0682	0662057A93	68k 1/16W 5%
U0101	5102226J56	MICRO PROCESSOR MC68HC1 1FLO
* U0111	5102463J64	EEPROM X25128-2.7 SO8

Circuit Ref	Motorola Part No.	Description
* U0121	5186137B01	512KX8 FLASH ROM (AT49BV020)
U0122	5185748L01	32K x 8 SRAM
U0141	5113805A30	10F8 DCDR/REMUX 74HC138
U0211	5183222M49	QUAD OPAMP __3403
U0221	5185130C53	ASFICOMP 0.5MM TQFP
U0251	5184704M60	MUX/DEMUX, TRIPLE 2-CH
U0271	5109699X01	AUDIO PA TDA1519C
U0301	5109152M01	EEPROM ANALOG ISD33120EI Voice storage only
U0331	5186204B01	BUFFER/DRIVER 74AHCT1G125 Voice storage only
U0341	5180932W01	LINEAR IC OP AMP Voice storage only
U0342	5105750U28	SNGL ANALOG SWITCH Voice storage only
U0351	5102463J40	REGULATOR, 3.3V Voice storage only
U0611	5183308X01	ADJ VLTG REG LM2941 TO263
U0641	5183308X01	ADJ VLTG REG LM2941 TO263
U0651	5113816A07	REG 5V POS 500MA MC78M05
U0652	5113815A02	MC33064
VR0151	4813830A15	5.6V 5% 225mW
VR0501	4805656W09	ZENER QUAD MMQA20VT1
VR0503	4805656W09	ZENER QUAD MMQA20VT1
VR0504	4813830A40	SOC23 AUTO SDN
VR0505	4805656W09	ZENER QUAD MMQA20VT1
VR0509	4813830A40	SOC23 AUTO SDN
VR0510	4813830A40	SOC23 AUTO SDN
VR0537	4813830A15	5.6V 5% 225mW
VR0541	4813830A27	14V 5% 225MW
VR0601	4813832C77	TRANS SUP. 24V HIGH POWER
VR0621	4813830A15	5.6V 5% 225mW
Y0131	4880113R19	CRYSTAL 38.4KHz

\* Motorola Depot Servicing only

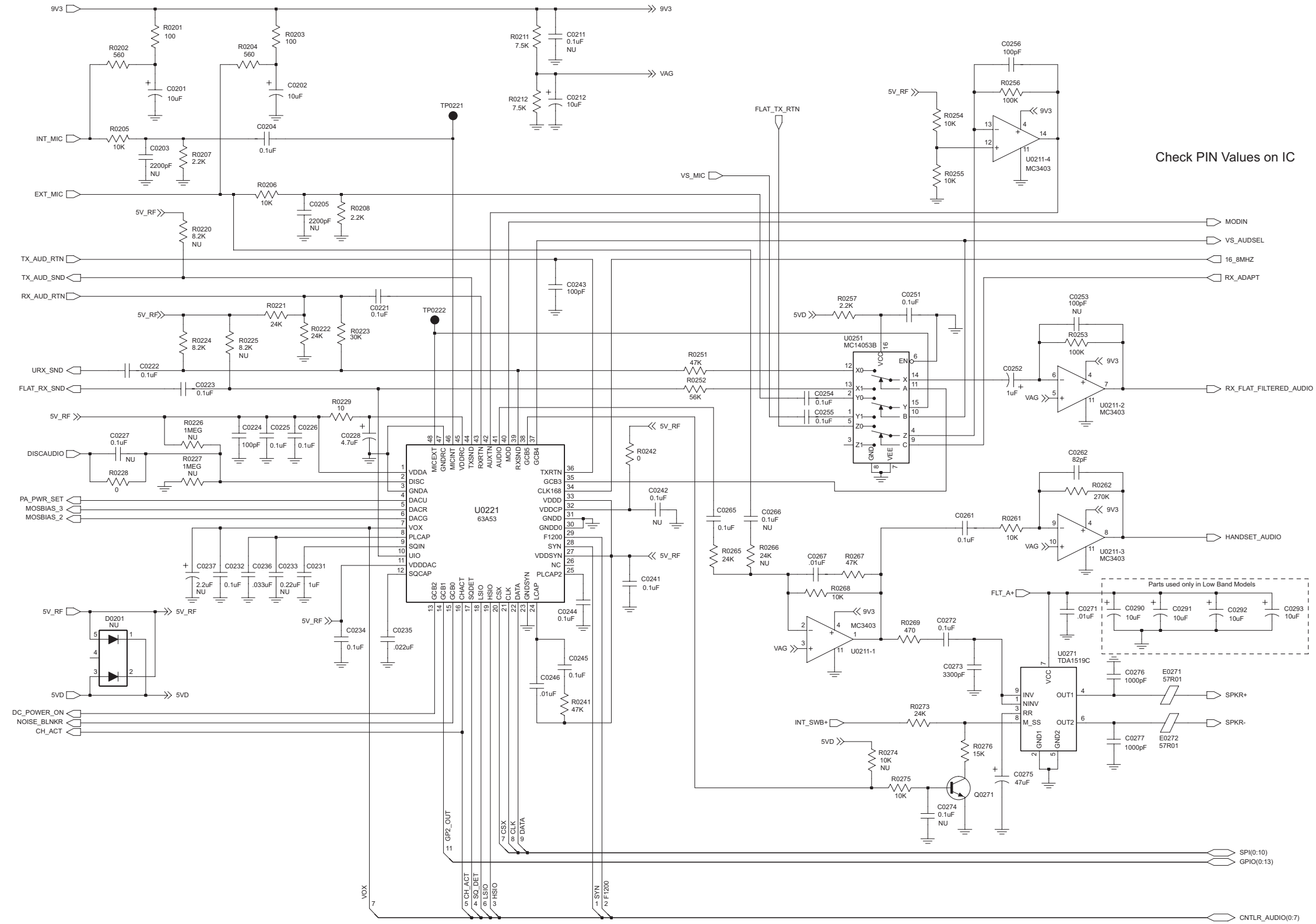
Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

### 5.0 Controller T11 Schematics and Parts Lists



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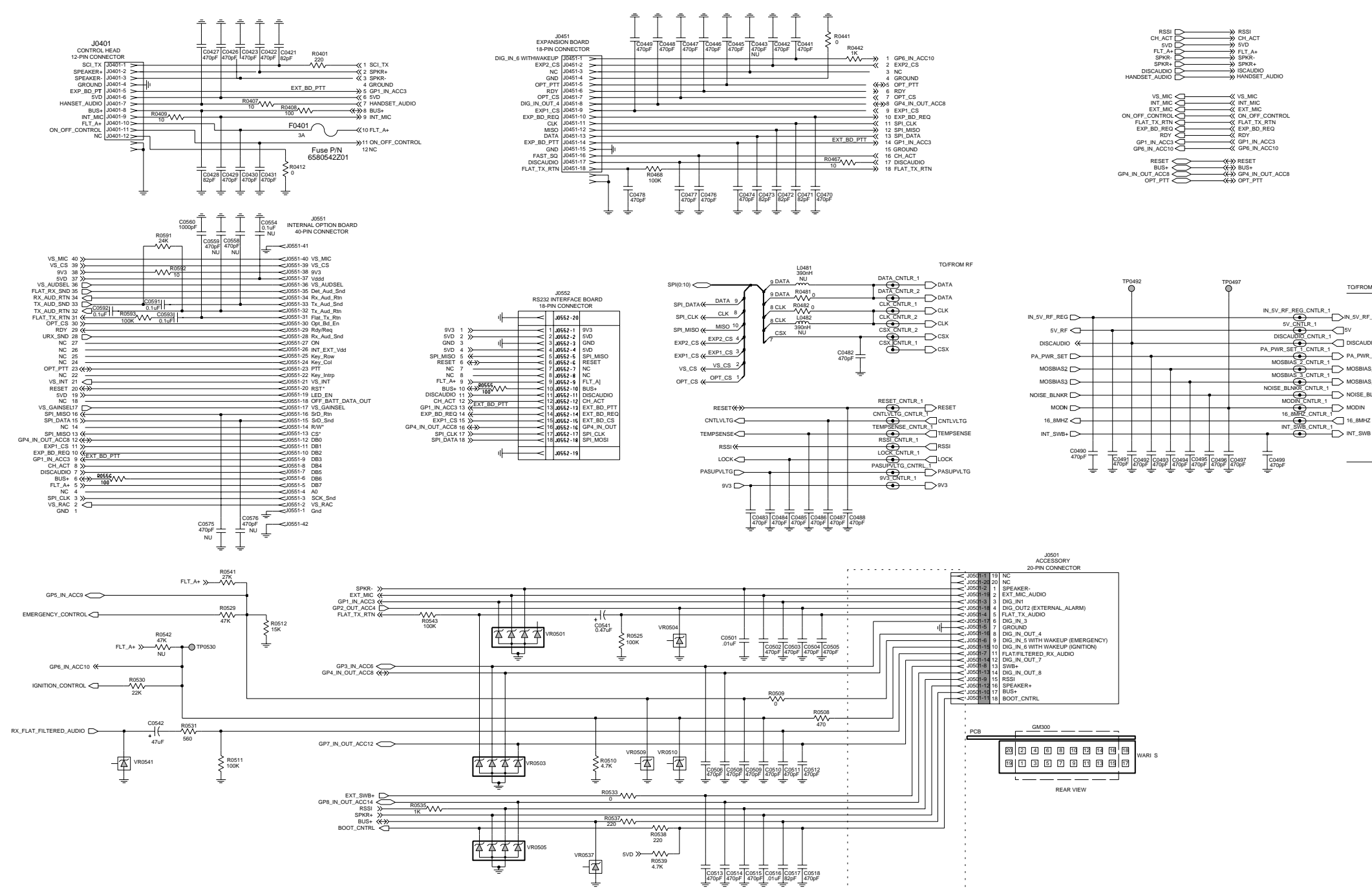
**Controller T11 Schematic Diagram - Supply Voltage**



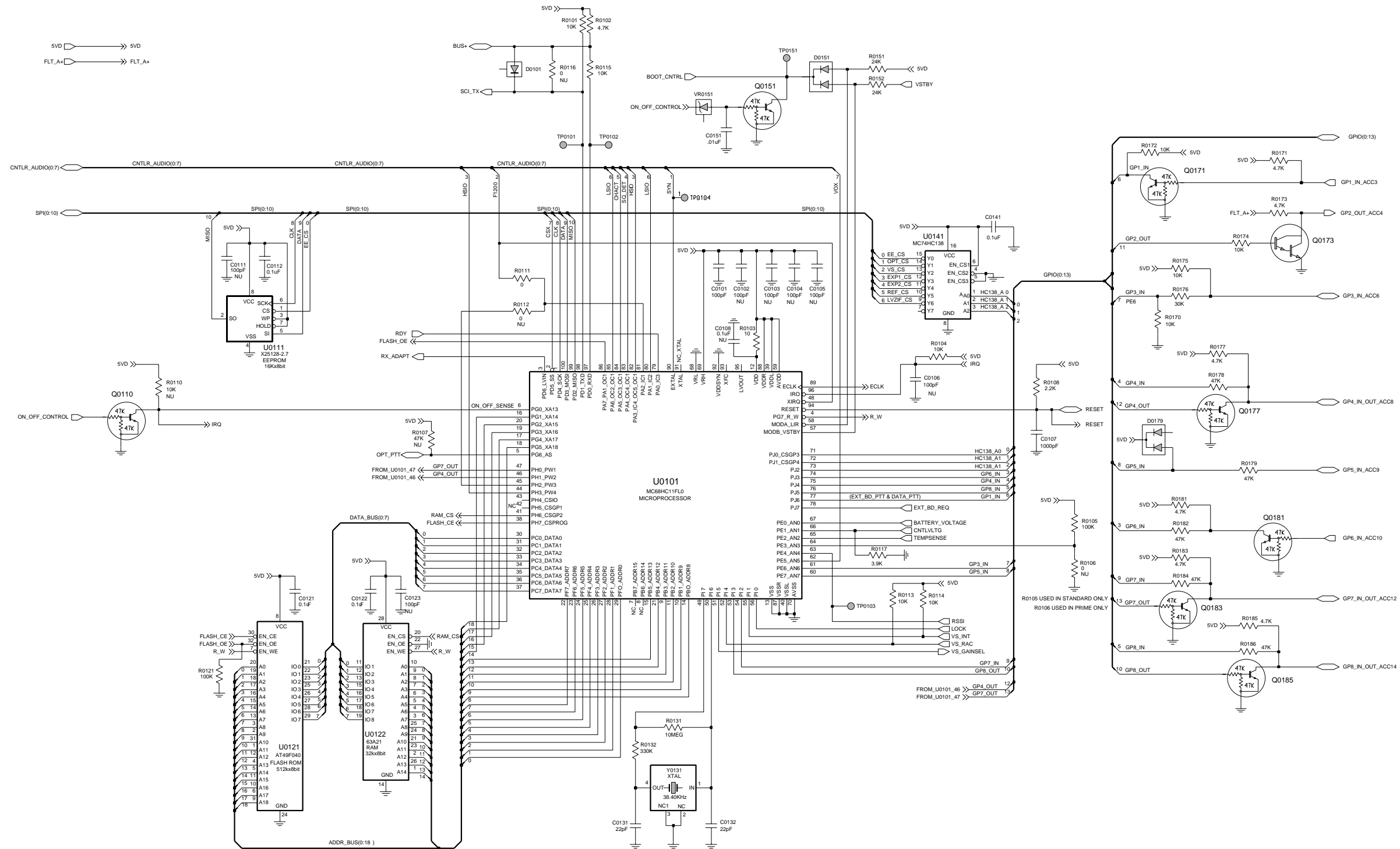
Check PIN Values on IC

Parts used only in Low Band Models

**Controller T11 Schematic Diagram - Audio**



ZWG0131050-O



Controller T11 Schematic Diagram - Microprocessor

ZWG0131049-O



**Controller T11 Parts List**

Circuit Ref	Motorola Part No.	Description
C0101	2113740F51	CAP, 100pF
C0107	2113741F25	CAP, 1000pF
C0112	2113743E20	CAP, 0.1uF
C0121	2113743E20	CAP, 0.1uF
C0122	2113743E20	CAP, 0.1uF
C0131	2113740F35	CAP, 22pF
C0132	2113740F35	CAP, 22pF
C0141	2113743E20	CAP, 0.1uF
C0151	2113741F49	CAP, .01uF
C0201	2311049A57	CAP, 10uF
C0202	2311049A57	CAP, 10uF
C0204	2113743E20	CAP, 0.1uF
C0212	2311049A57	CAP, 10uF
C0221	2113743E20	CAP, 0.1uF
C0222	2113743E20	CAP, 0.1uF
C0223	2113743E20	CAP, 0.1uF
C0224	2113740F51	CAP, 100pF
C0225	2113743E20	CAP, 0.1uF
C0226	2113743E20	CAP, 0.1uF
C0228	2311049A56	CAP, 4.7uF
C0231	2113743B29	CAP, 1uF
C0232	2113743E20	CAP, 0.1uF
C0234	2113743E20	CAP, 0.1uF
C0235	2113743E07	CAP, .022uF
C0236	2113743E10	CAP, .033uF
C0241	2113743E20	CAP, 0.1uF
C0243	2113740F51	CAP, 100pF
C0244	2113743E20	CAP, 0.1uF
C0245	2113743E20	CAP, 0.1uF
C0246	2113741F49	CAP, .01uF
C0251	2113743E20	CAP, 0.1uF
C0252	2311049A07	CAP, 1uF
C0254	2113743E20	CAP, 0.1uF
C0255	2113743E20	CAP, 0.1uF
C0256	2113740F51	CAP, 100pF
C0261	2113743E20	CAP, 0.1uF
C0262	2113740F49	CAP, 82pF
C0265	2113743E20	CAP, 0.1uF
C0267	2113741F49	CAP, .01uF
C0271	2113741F49	CAP, .01uF
C0272	2113743E20	CAP, 0.1uF
C0273	2113741F37	CAP, 3300pF

Circuit Ref	Motorola Part No.	Description
C0275	2311049A99	CAP, 47uF
C0276	2113741F25	CAP, 1000pF
C0277	2113741F25	CAP, 1000pF
C0290	2311049C01	CAP, 10uF (only Low Band)
C0291	2311049C01	CAP, 10uF (only Low Band)
C0292	2311049C01	CAP, 10uF (only Low Band)
C0293	2311049C01	CAP, 10uF (only Low Band)
C0421	2113743N48	CAP, 82pF
C0422	2113741F17	CAP, 470pF
C0423	2113741F17	CAP, 470pF
C0426	2113743L09	CAP, 470pF
C0427	2113743L09	CAP, 470pF
C0428	2113743N48	CAP, 82pF
C0429	2113743L09	CAP, 470pF
C0430	2113741F17	CAP, 470pF
C0431	2113741F17	CAP, 470pF
C0441	2113743L09	CAP, 470pF
C0442	2113743L09	CAP, 470pF
C0445	2113743L09	CAP, 470pF
C0446	2113743L09	CAP, 470pF
C0447	2113743L09	CAP, 470pF
C0448	2113743L09	CAP, 470pF
C0449	2113743L09	CAP, 470pF
C0470	2113743L09	CAP, 470pF
C0471	2113743N48	CAP, 82pF
C0472	2113743N48	CAP, 82pF
C0473	2113743N48	CAP, 82pF
C0474	2113743L09	CAP, 470pF
C0476	2113743L09	CAP, 470pF
C0477	2113743L09	CAP, 470pF
C0478	2113743L09	CAP, 470pF
C0482	2113743L09	CAP, 470pF
C0483	2113743L09	CAP, 470pF
C0484	2113741F17	CAP, 470pF
C0485	2113743L09	CAP, 470pF
C0486	2113743L09	CAP, 470pF
C0487	2113743L09	CAP, 470pF
C0488	2113743L09	CAP, 470pF
C0490	2113743L09	CAP, 470pF
C0491	2113743L09	CAP, 470pF
C0492	2113743L09	CAP, 470pF
C0493	2113743L09	CAP, 470pF
C0494	2113743L09	CAP, 470pF
C0495	2113743L09	CAP, 470pF

Circuit Ref	Motorola Part No.	Description
C0496	2113743L09	CAP, 470pF
C0497	2113743L09	CAP, 470pF
C0499	2113743L09	CAP, 470pF
C0501	2113741F49	CAP, .01uF
C0502	2113741F17	CAP, 470pF
C0503	2113741F17	CAP, 470pF
C0504	2113741F17	CAP, 470pF
C0505	2113741F17	CAP, 470pF
C0506	2113741F17	CAP, 470pF
C0508	2113741F17	CAP, 470pF
C0509	2113741F17	CAP, 470pF
C0510	2113741F17	CAP, 470pF
C0511	2113741F17	CAP, 470pF
C0512	2113741F17	CAP, 470pF
C0513	2113741F17	CAP, 470pF
C0514	2113741F17	CAP, 470pF
C0515	2113741F17	CAP, 470pF
C0516	2113741F49	CAP, .01uF
C0517	2113743N48	CAP, 82pF
C0518	2113741F17	CAP, 470pF
C0541	2311049A05	CAP, 0.47uF
C0542	2311049A99	CAP, 47uF
C0560	2113741F25	CAP, 1000pF
C0591	2113743E20	CAP, 0.1uF
C0592	2113743E20	CAP, 0.1uF
C0593	2113741B69	CAP, 0.1uF
C0601	2113741F17	CAP, 470pF
C0603	2380090M24	CAP, 10uF
C0611	2311049C06	CAP, 22uF
C0612	2113743E20	CAP, 0.1uF
C0622	2311049A99	CAP, 47uF
C0641	2113741F17	CAP, 470pF
C0644	2311049A97	CAP, 33uF
C0645	2113743E20	CAP, 0.1uF
C0652	2311049A97	CAP, 33uF
C0654	2311049A57	CAP, 10uF
C0655	2113743E20	CAP, 0.1uF
C0661	2311049C05	CAP, 47uF
C0662	2113741F49	CAP, .01uF
C0663	2113743E20	CAP, 0.1uF
C0671	2113743E20	CAP, 0.1uF
C0681	2113743E20	CAP, 0.1uF
D0101	4813825A05	MMBD301
D0151	4813833C02	MMBD6100

Circuit Ref	Motorola Part No.	Description
D0179	4813833C02	MMBD6100
D0621	4813833C02	MMBD6100
D0651	4813833C02	MMBD6100
D0660	4813833C02	MMBD6100
D0661	4813833C02	MMBD6100
E0271	2484657R01	FERRITE BEAD
E0272	2484657R01	FERRITE BEAD
E0631	2484657R01	FERRITE BEAD
F0401	6580542Z01	FUSE
J0401	0902636Y02	CONN, 12-PIN, CONTROL HEAD
J0451	0902636Y01	CONN, 18-PIN, EXPANSION BOARD
J0501	0986105B01	CONN, 20-PIN, ACCESSORY
J0551	0905505Y04	CONN, 40-PIN, INTERNAL OPTION
J0552	0905505Y03	CONN, 18-PIN, RS232
J0601	0986165B01	DC POWER CONNECTOR
Q0110	4880048M01	DTC144EKA
Q0151	4880048M01	DTC144EKA
Q0171	4880048M01	DTC144EKA
Q0173	4880052M01	RXT-A28
Q0177	4880048M01	DTC144EKA
Q0181	4880048M01	DTC144EKA
Q0183	4880048M01	DTC144EKA
Q0185	4880048M01	DTC144EKA
Q0271	4880214G02	MMBT3904
Q0641	4880048M01	DTC144EKA
Q0661	4805921T02	FMC2A
Q0662	4880214G02	MMBT3904
Q0663	4880048M01	DTC144EKA
Q0681	4880052M01	RXT-A28
R0101	0662057A73	RES, 10K
R0102	0662057A65	RES, 4.7K
R0103	0662057A01	RES, 10
R0104	0662057A73	RES, 10K
R0105	0662057A97	RES, 100K
R0108	0662057A57	RES, 2.2K
R0111	0662057B47	RES, 0
R0113	0662057A73	RES, 10K
R0114	0662057A73	RES, 10K
R0115	0662057A73	RES, 10K

Circuit Ref	Motorola Part No.	Description
R0117	0662057A63	RES, 3.9K
R0121	0662057A97	RES, 100K
R0131	0662057B46	RES, 10MEG
R0132	0662057B10	RES, 330K
R0151	0662057A82	RES, 24K
R0152	0662057A82	RES, 24K
R0170	0662057A73	RES, 10K
R0171	0662057A65	RES, 4.7K
R0172	0662057A73	RES, 10K
R0173	0662057A65	RES, 4.7K
R0174	0662057A73	RES, 10K
R0175	0662057A73	RES, 10K
R0176	0662057A84	RES, 30K
R0177	0662057A65	RES, 4.7K
R0178	0662057A89	RES, 47K
R0179	0662057A89	RES, 47K
R0181	0662057A65	RES, 4.7K
R0182	0662057A89	RES, 47K
R0183	0662057A65	RES, 4.7K
R0184	0662057A89	RES, 47K
R0185	0662057A65	RES, 4.7K
R0186	0662057A89	RES, 47K
R0201	0662057A25	RES, 100
R0202	0662057A43	RES, 560
R0203	0662057A25	RES, 100
R0204	0662057A43	RES, 560
R0205	0662057A73	RES, 10K
R0206	0662057A73	RES, 10K
R0207	0662057A57	RES, 2.2K
R0208	0662057A57	RES, 2.2K
R0211	0660076E70	RES, 7.5K
R0212	0660076E70	RES, 7.5K
R0221	0662057A82	RES, 24K
R0222	0662057A82	RES, 24K
R0223	0662057A84	RES, 30K
R0224	0662057A71	RES, 8.2K
R0228	0662057B47	RES, 0
R0229	0662057A01	RES, 10
R0241	0662057A89	RES, 47K
R0242	0662057B47	RES, 0
R0251	0662057A89	RES, 47K
R0252	0662057A91	RES, 56K
R0253	0662057A97	RES, 100K
R0254	0662057A73	RES, 10K

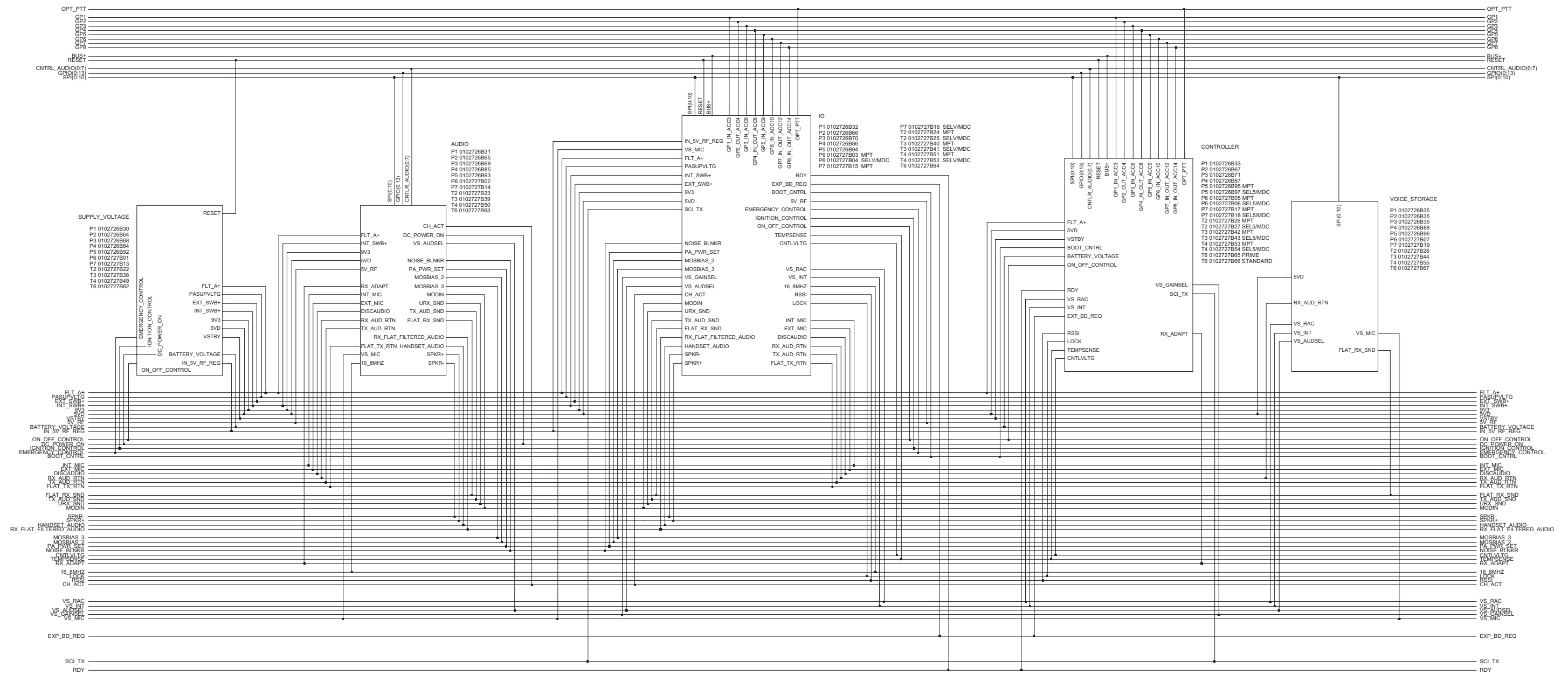
Circuit Ref	Motorola Part No.	Description
R0255	0662057A73	RES, 10K
R0256	0662057A97	RES, 100K
R0257	0662057A57	RES, 2.2K
R0261	0662057A73	RES, 10K
R0262	0662057B08	RES, 270K
R0265	0662057A82	RES, 24K
R0267	0662057A89	RES, 47K
R0268	0662057A73	RES, 10K
R0269	0662057A41	RES, 470
R0273	0662057A82	RES, 24K
R0275	0662057A73	RES, 10K
R0276	0662057A77	RES, 15K
R0401	0662057A33	RES, 220
R0407	0662057M26	RES, 10
R0408	0662057A25	RES, 100
R0409	0662057M26	RES, 10
R0412	0662057B47	RES, 0
R0441	0662057B47	RES, 0
R0442	0662057A49	RES, 1K
R0467	0662057M26	RES, 10
R0468	0662057A97	RES, 100K
R0481	0662057B47	RES, 0
R0482	0662057B47	RES, 0
R0508	0662057A41	RES, 470
R0509	0662057B47	RES, 0
R0510	0662057A65	RES, 4.7K
R0511	0662057A97	RES, 100K
R0512	0662057A77	RES, 15K
R0525	0662057A97	RES, 100K
R0529	0662057A89	RES, 47K
R0530	0662057A81	RES, 22K
R0531	0662057A43	RES, 560
R0533	0662057B47	RES, 0
R0535	0662057A49	RES, 1K
R0537	0662057A33	RES, 220
R0538	0662057A33	RES, 220
R0539	0662057A65	RES, 4.7K
R0541	0662057A83	RES, 27K
R0543	0662057A97	RES, 100K
R0555	0662057A25	RES, 100
R0556	0662057A25	RES, 100
R0591	0662057A82	RES, 24K
R0592	0662057A01	RES, 10
R0593	0662057A97	RES, 100K

Circuit Ref	Motorola Part No.	Description
R0611	0662057A91	RES, 56K
R0612	0662057A65	RES, 4.7K
R0621	0662057A82	RES, 24K
R0641	0662057A73	RES, 10K
R0642	0660076E70	RES, 7.5K
R0643	0660076E51	RES, 1.2K
R0651	0662057A01	RES, 10
R0652	0662057A01	RES, 10
R0661	0662057A49	RES, 1K
R0662	0662057B02	RES, 150K
R0671	0662057A84	RES, 30K
R0672	0662057A73	RES, 10K
R0681	0662057A79	RES, 18K
R0682	0662057A93	RES, 68K
U0101	5102226J56	MC68HC11FL0
U0111	5102463J64	EEPROM
U0121	5186137B01	FLASH ROM
U0122	5185748L01	SRAM
U0141	5113805A30	REMUX
U0211	5183222M49	MC3403
U0221	5185130C53	ASFIC COMPANDER IC
U0251	5184704M60	MUX/DEMUX
U0271	5109699X01	AUDIO PA
U0611	5183308X01	LM2941
U0641	5183308X01	LM2941
U0651	5113816A07	MC78M05
U0652	5113815A02	MC33064
VR0151	4813830A15	MMBZ5232B
VR0501	4805656W09	MMQA20VT1
VR0503	4805656W09	MMQA20VT1
VR0504	4813830A40	MMBZ5257B
VR0505	4805656W09	MMQA20VT1
VR0509	4813830A40	MMBZ5257B
VR0510	4813830A40	MMBZ5257B
VR0537	4813830A15	MMBZ5232B
VR0541	4813830A27	MMBZ5244B
VR0601	4813832C77	TRANSIENT SUPPRESSOR
VR0621	4813830A15	MMBZ5232B
Y0131	4880113R19	CRYSTAL, 38.4 KHZ

\* Motorola Depot Servicing only

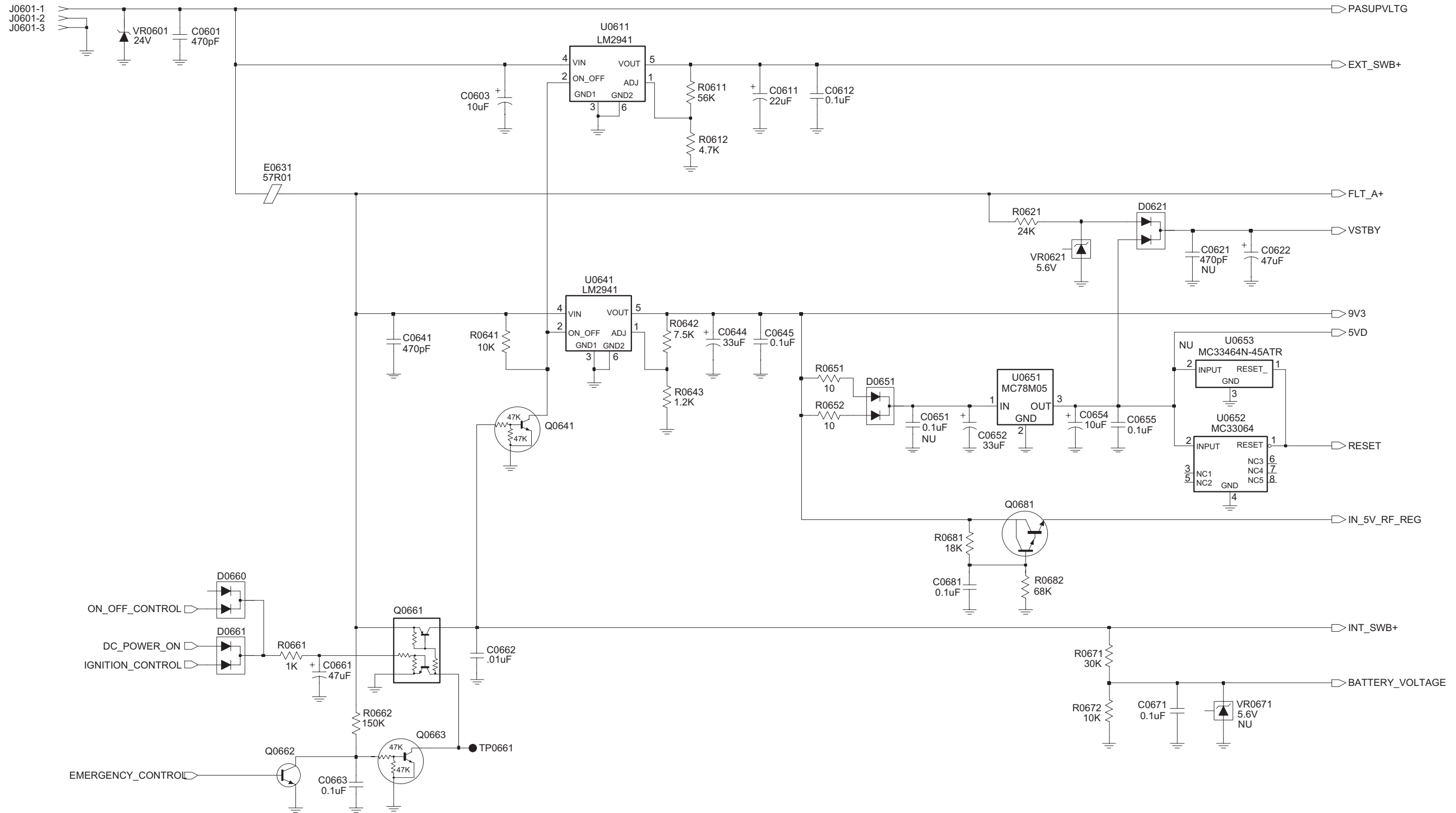
Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

### 6.0 Controller T12 Schematics and Parts Lists

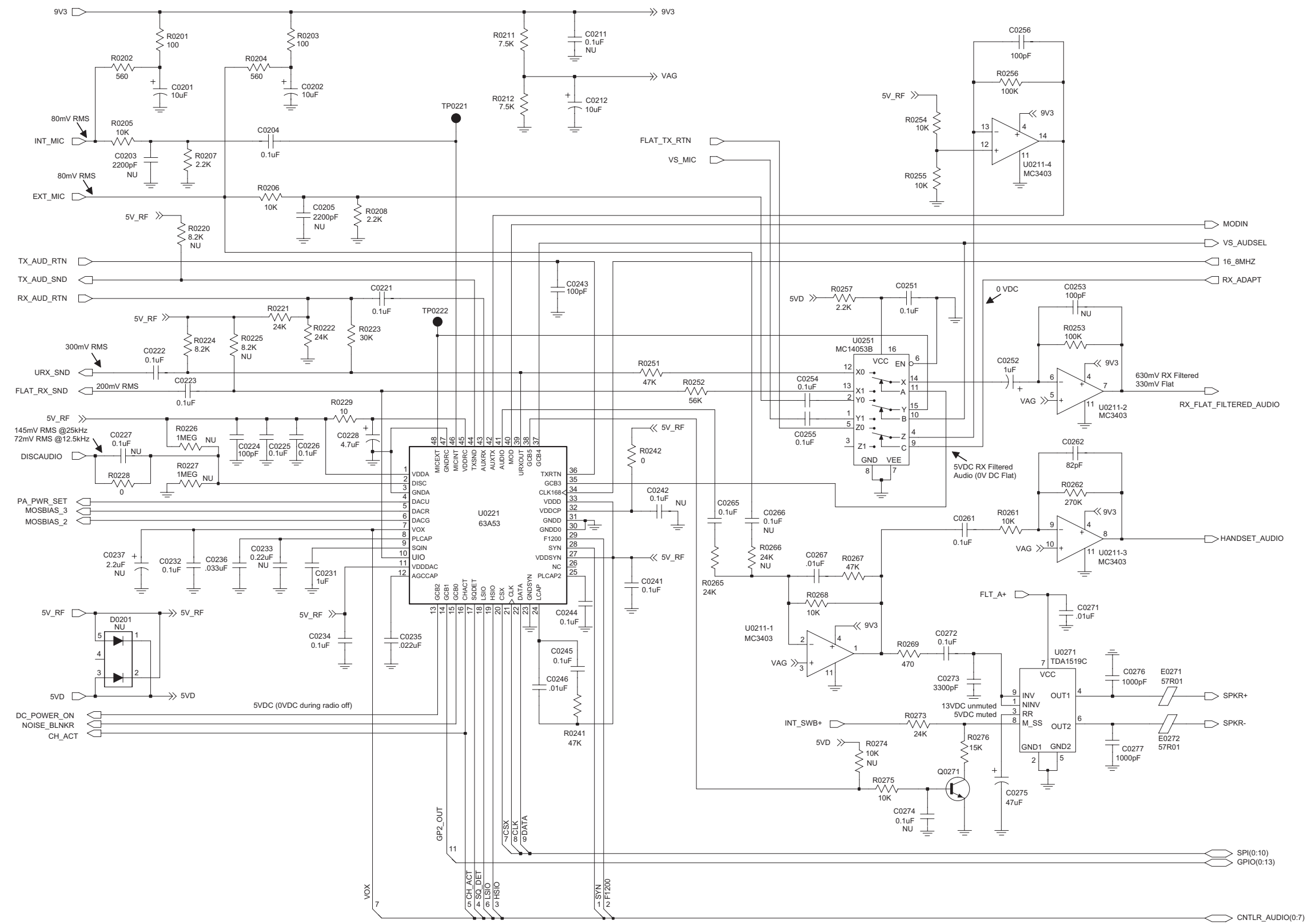


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Controller T12 Schematic Diagram - Overall

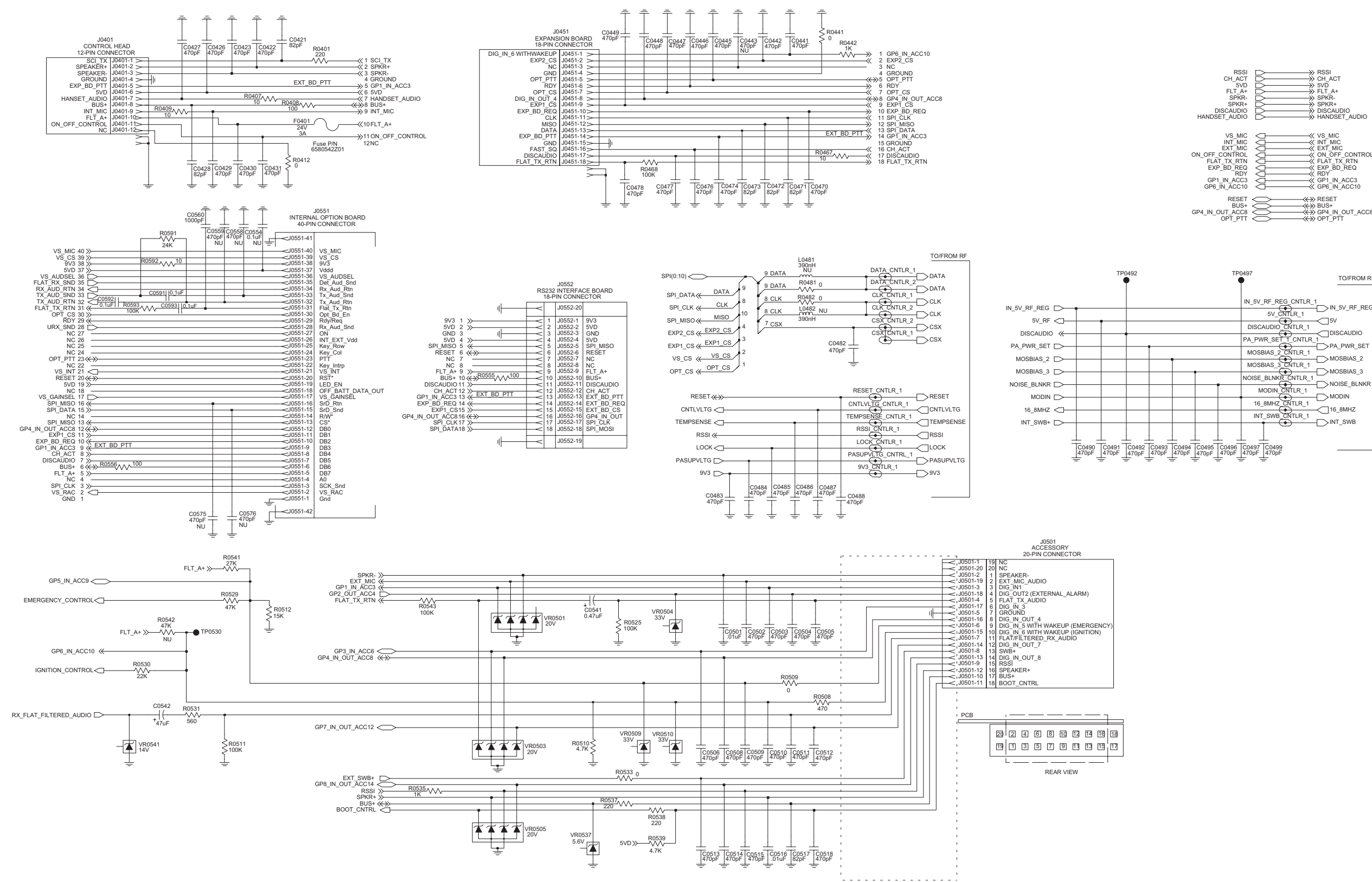


**Controller T12 Schematic Diagram - Supply Voltage**



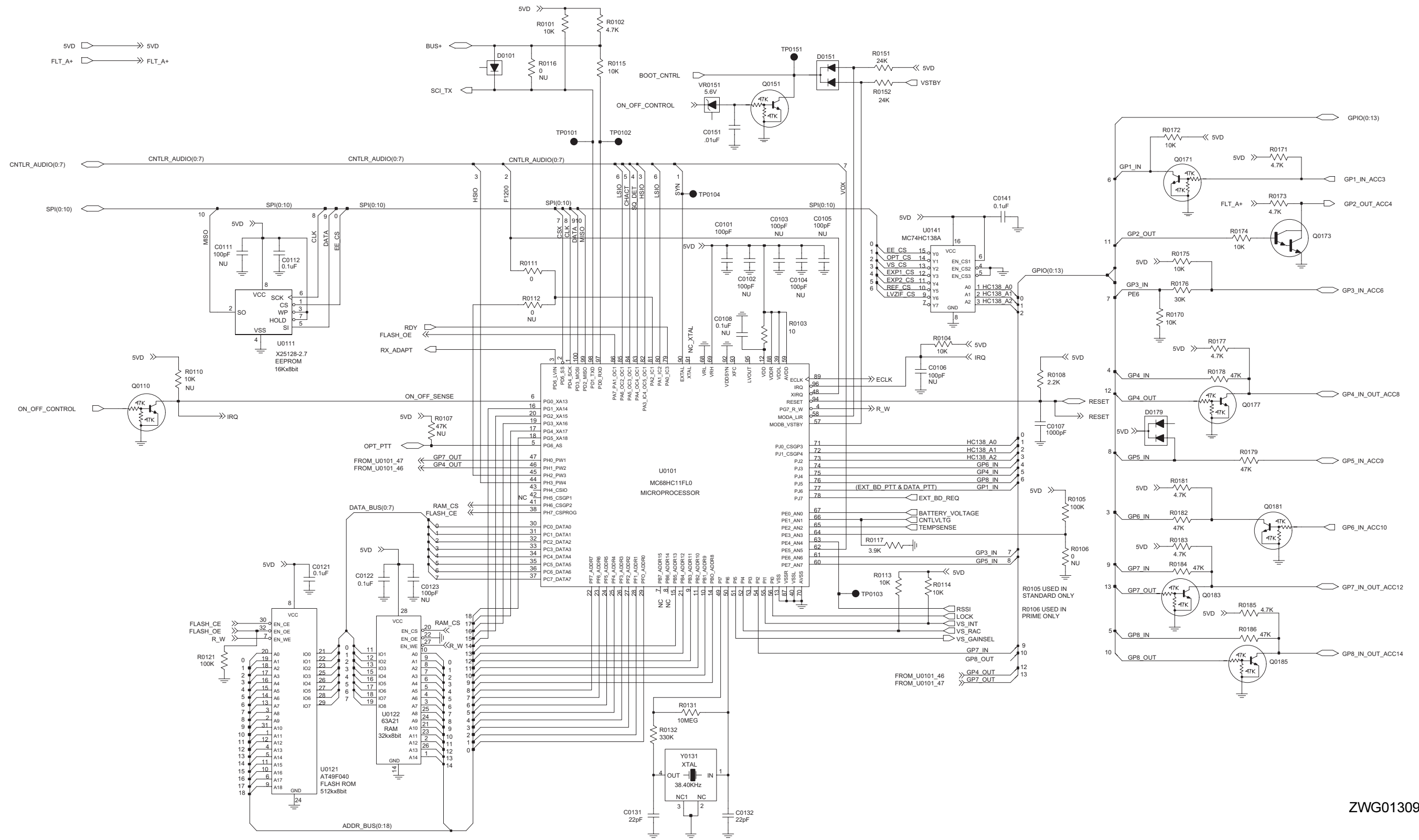
ZWG0131030-O

Controller T12 Schematic Diagram - Audio



Controller T12 Schematic Diagram - I/O

ZWG0131029-O



ZWG0130935-O

Controller T12 Schematic Diagram - Microprocessor

## Controller T12 Parts List

Circuit Ref	Motorola Part No.	Description
C0101	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0107	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0112	2113743E20	CAP CHIP. 10 uF 10%
C0121	2113743E20	CAP CHIP. 10 uF 10%
C0122	2113743E20	CAP CHIP. 10 uF 10%
C0131	2113740F35	CAP CHIP REEL CL1 +/-30 22
C0132	2113740F35	CAP CHIP REEL CL1 +/-30 22
C0141	2113743E20	CAP CHIP. 10 uF 10%
C0151	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0201	2311049A57	CAP TANT CHIP A/P 10uF 10% 16V
C0202	2311049A57	CAP TANT CHIP A/P 10uF 10% 16V
C0204	2113743E20	CAP CHIP. 10 uF 10%
C0212	2311049A57	CAP TANT CHIP A/P 10uF 10% 16V
C0221	2113743E20	CAP CHIP. 10 uF 10%
C0222	2113743E20	CAP CHIP. 10 uF 10%
C0223	2113743E20	CAP CHIP. 10 uF 10%, 0662057B47 0 (SUB on LS+ Models Only)
C0224	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0225	2113743E20	CAP CHIP. 10 uF 10%
C0226	2113743E20	CAP CHIP. 10 uF 10%
C0228	2311049A56	CAP TAN CHIP A/P 4.7 20 10
C0231	2113743B29	CAP CHIP 1.00 uF 10% 16V
C0232	2113743E20	CAP CHIP. 10 uF 10%
C0234	2113743E20	CAP CHIP. 10 uF 10%
C0235	2113743E07	CER CHIP CAP .022uF
C0236	2113743E10	CAP CHIP .033 uF 10% X 7R
C0241	2113743E20	CAP CHIP. 10 uF 10%
C0243	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0244	2113743E20	CAP CHIP. 10 uF 10%
C0245	2113743E20	CAP CHIP. 10 uF 10%
C0246	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0251	2113743E20	CAP CHIP. 10 uF 10%
C0252	2311049A07	CAP TANT 10% 1.0uF
C0254	2113743E20	CAP CHIP. 10 uF 10%
C0255	2113743E20	CAP CHIP. 10 uF 10%
C0256	2113740F51	CAP CHIP REEL CL1 +/-30 100
C0261	2113743E20	CAP CHIP. 10 uF 10%
C0262	2113740F49	CAP CHIP REEL CL1 +/-30 82
C0265	2113743E20	CAP CHIP. 10 uF 10%
C0267	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0271	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0272	2113743E20	CAP CHIP. 10 uF 10%
C0273	2113741F37	CAP CHIP CL2 X7R REEL 3300
C0275	2311049A99	CAP TANT CHIP 47 uF 10V 20%
C0276	2113741F25	CAP CHIP CL2 X7R REEL 1000
C0277	2113741F25	CAP CHIP CL2 X7R REEL 1000

Circuit Ref	Motorola Part No.	Description
C0301	2311049A07	1uF 10% 16V Voice storage only
C0302	2113743E20	100nF 16V Voice storage only
C0303	2113740F51	100pF 5% 50V Voice storage only
C0304	2113743E20	100nF 16V Voice storage only
C0305	2113743E20	100nF 16V Voice storage only
C0324	2113743E20	100nF 16V Voice storage only
C0331	2113743E20	100nF 16V Voice storage only
C0341	2311049A07	TANT CP 1uF 10% 16V Voice storage only
C0342	2113743E20	100nF 16V Voice storage only
C0343	2113743E20	100nF 16V Voice storage only
C0344	2113743E20	100nF 16V Voice storage only
C0351	2113743E20	100nF 16V Voice storage only
C0352	2113743E07	22nF 16V Voice storage only
C0353	2311049A97	TANT CHIP 33 uF 16 Voice storage only
C0354	2113743E20	100nF 16V Voice storage only
C0421	2113743N48	CAP CHIP 82.0 pF 5% COG
C0422	2113741F17	CAP CHIP CL2 X7R REEL 470
C0423	2113741F17	CAP CHIP CL2 X7R REEL 470
C0426	2113743L09	CAP CHIP 470 pF 10% X7R
C0427	2113743L09	CAP CHIP 470 pF 10% X7R
C0428	2113743N48	CAP CHIP 82.0 pF 5% COG
C0429	2113743L09	CAP CHIP 470 pF 10% X7R
C0430	2113741F17	CAP CHIP CL2 X7R REEL 470
C0431	2113741F17	CAP CHIP CL2 X7R REEL 470
C0441	2113743L09	CAP CHIP 470 pF 10% X7R
C0442	2113743L09	CAP CHIP 470 pF 10% X7R
C0445	2113743L09	CAP CHIP 470 pF 10% X7R
C0446	2113743L09	CAP CHIP 470 pF 10% X7R
C0447	2113743L09	CAP CHIP 470 pF 10% X7R
C0448	2113743L09	CAP CHIP 470 pF 10% X7R
C0449	2113743L09	CAP CHIP 470 pF 10% X7R
C0470	2113743L09	CAP CHIP 470 pF 10% X7R
C0471	2113743N48	CAP CHIP 82.0 pF 5% COG
C0472	2113743N48	CAP CHIP 82.0 pF 5% COG
C0473	2113743N48	CAP CHIP 82.0 pF 5% COG
C0474	2113743L09	CAP CHIP 470 pF 10% X7R
C0476	2113743L09	CAP CHIP 470 pF 10% X7R
C0477	2113743L09	CAP CHIP 470 pF 10% X7R
C0478	2113743L09	CAP CHIP 470 pF 10% X7R
C0482	2113743L09	CAP CHIP 470 pF 10% X7R
C0483	2113743L09	CAP CHIP 470 pF 10% X7R

Circuit Ref	Motorola Part No.	Description
C0484	2113741F17	CAP CHIP CL2 X7R REEL 470
C0485	2113743L09	CAP CHIP 470 pF 10% X7R
C0486	2113743L09	CAP CHIP 470 pF 10% X7R
C0487	2113743L09	CAP CHIP 470 pF 10% X7R
C0488	2113743L09	CAP CHIP 470 pF 10% X7R
C0490	2113743L09	CAP CHIP 470 pF 10% X7R
C0491	2113743L09	CAP CHIP 470 pF 10% X7R
C0492	2113743L09	CAP CHIP 470 pF 10% X7R
C0493	2113743L09	CAP CHIP 470 pF 10% X7R
C0494	2113743L09	CAP CHIP 470 pF 10% X7R
C0495	2113743L09	CAP CHIP 470 pF 10% X7R
C0496	2113743L09	CAP CHIP 470 pF 10% X7R
C0497	2113743L09	CAP CHIP 470 pF 10% X7R
C0499	2113743L09	CAP CHIP 470 pF 10% X7R
C0501	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0502	2113741F17	CAP CHIP CL2 X7R REEL 470
C0503	2113741F17	CAP CHIP CL2 X7R REEL 470
C0504	2113741F17	CAP CHIP CL2 X7R REEL 470
C0505	2113741F17	CAP CHIP CL2 X7R REEL 470
C0506	2113741F17	CAP CHIP CL2 X7R REEL 470
C0508	2113741F17	CAP CHIP CL2 X7R REEL 470
C0509	2113741F17	CAP CHIP CL2 X7R REEL 470
C0510	2113741F17	CAP CHIP CL2 X7R REEL 470
C0511	2113741F17	CAP CHIP CL2 X7R REEL 470
C0512	2113741F17	CAP CHIP CL2 X7R REEL 470
C0513	2113741F17	CAP CHIP CL2 X7R REEL 470
C0514	2113741F17	CAP CHIP CL2 X7R REEL 470
C0515	2113741F17	CAP CHIP CL2 X7R REEL 470
C0516	2113741F49	CAP CHIP CL2 X7R REEL 10000
C0517	2113743N48	CAP CHIP 82.0 pF 5% COG
C0518	2113741F17	CAP CHIP CL2 X7R REEL 470
C0541	2311049A05	CAP TANT 10% 0.47uF
C0542	2311049A99	CAP TANT CHIP 47 uF 10V 20%
C0560	2113743L17	CAP CHIP 1000 pF 10% X7R
C0591	2113743E20	CAP CHIP. 10 uF 10%
C0592	2113743E20	CAP CHIP. 10 uF 10%
C0593	2113741B69	CAP CHIP 0.1uF, 10%, 0611077A01 0 (SUB on LS+ Models Only)
C0601	2113741F17	CAP CHIP CL2 X7R REEL 470
C0603	2380090M24	"ALU CAP SOT 10,50V"
C0611	2311049C06	CAP TANT CHIP 22 uF 35V 20%
C0612	2113743E20	CAP CHIP. 10 uF 10%
C0622	2311049A99	CAP TANT CHIP 47 uF 10V 20%
C0641	2113741F17	CAP CHIP CL2 X7R REEL 470
C0644	2311049A97	CAP TANT CHIP 33 uF 16V 20%
C0645	2113743E20	CAP CHIP. 10 uF 10%
C0652	2311049A97	CAP TANT CHIP 33 uF 16V 20%
C0654	2311049A57	CAP TANT CHIP A/P 10uF 10% 16V
C0655	2113743E20	CAP CHIP. 10 uF 10%
C0661	2311049C05	CAP TANT CHIP 47uF 16V 10%
C0662	2113741F49	CAP CHIP CL2 X7R REEL 10000

Circuit Ref	Motorola Part No.	Description
C0663	2113743E20	CAP CHIP. 10 uF 10%
C0671	2113743E20	CAP CHIP. 10 uF 10%
C0681	2113743E20	CAP CHIP. 10 uF 10%
D0101	4813825A05	DIODE 30V HOT CARRIER MMBD301L
D0151	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0179	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0301	4802245J47	SCHOTTKY BARRIER (RB471E) Voice storage only
D0621	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0651	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0660	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0661	4813833C02	DIODE DUAL 70V '5B' COMM CATH
E0271	2484657R01	INDUCTOR BEAD CHIP
E0272	2484657R01	INDUCTOR BEAD CHIP
E0631	2484657R01	INDUCTOR BEAD CHIP
F0401	6580542Z01	FUSE CHIP SMT TR/1608FF 3A
J0401	0902636Y02	12 POS. FLEX CONNECTOR
J0451	0902636Y01	"CONNECTOR, FLEX, SIDE ENTRY"
J0501	0986105B01	"20 POS. 0.64 SQ CONNec- TOR"
J0551	0905505Y04	CONN ZIF HORIZONTAL
J0552	0905505Y03	CONN ZIF HORIZONTAL
J0601	0986165B01	MOBILE DC POWER CONNec- TOR
Q0110	4880048M01	TSTR NPN DIG 47K/47K
Q0151	4880048M01	TSTR NPN DIG 47K/47K
Q0171	4880048M01	TSTR NPN DIG 47K/47K
Q0173	4880052M01	TSTR NPN DRLNGTN MXTA27
Q0177	4880048M01	TSTR NPN DIG 47K/47K
Q0181	4880048M01	TSTR NPN DIG 47K/47K
Q0183	4880048M01	TSTR NPN DIG 47K/47K
Q0185	4880048M01	TSTR NPN DIG 47K/47K
Q0271	4880214G02	TSTR MMBT3904
Q0641	4880048M01	TSTR NPN DIG 47K/47K
Q0661	4805921T02	XISTOR FMC2 RH
Q0662	4880214G02	TSTR MMBT3904
Q0663	4880048M01	TSTR NPN DIG 47K/47K
Q0681	4880052M01	TSTR NPN DRLNGTN MXTA27
R0101	0662057A73	CHIP RES 10K OHMS 5%
R0102	0662057A65	CHIP RES 4700 OHMS 5%
R0103	0662057A01	CHIP RES 10 OHMS 5%
R0104	0662057A73	CHIP RES 10K OHMS 5%
R0105	0662057A97	100k 1/16W
R0106	0662057B47	0 1/16W Voice storage only
R0108	0662057A57	CHIP RES 2200 OHMS 5%



Circuit Ref	Motorola Part No.	Description
R0111	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0113	0662057A73	CHIP RES 10K OHMS 5%
R0114	0662057A73	CHIP RES 10K OHMS 5%
R0115	0662057A73	CHIP RES 10K OHMS 5%
R0117	0662057A63	CHIP RES 3900 OHMS 5%
R0121	0662057A97	CHIPRES 100K OHM 5%
R0131	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R0132	0662057B10	CHIP RES 330K OHMS 5%
R0151	0662057A82	CHIP RES 24K OHMS 5%
R0152	0662057A82	CHIP RES 24K OHMS 5%
R0170	0662057A73	CHIP RES 10K OHMS 5%
R0171	0662057A65	CHIP RES 4700 OHMS 5%
R0172	0662057A73	CHIP RES 10K OHMS 5%
R0173	0662057A65	CHIP RES 4700 OHMS 5%
R0174	0662057A73	CHIP RES 10K OHMS 5%
R0175	0662057A73	CHIP RES 10K OHMS 5%
R0176	0662057A84	CHIP RES 30K OHMS 5%
R0177	0662057A65	CHIP RES 4700 OHMS 5%
R0178	0662057A89	CHIP RES 47K OHMS 5%
R0179	0662057A89	CHIP RES 47K OHMS 5%
R0181	0662057A65	CHIP RES 4700 OHMS 5%
R0182	0662057A89	CHIP RES 47K OHMS 5%
R0183	0662057A65	CHIP RES 4700 OHMS 5%
R0184	0662057A89	CHIP RES 47K OHMS 5%
R0185	0662057A65	CHIP RES 4700 OHMS 5%
R0186	0662057A89	CHIP RES 47K OHMS 5%
R0201	0662057A25	CHIP RES 100 OHMS 5%
R0202	0662057A43	CHIP RES 560 OHMS 5%
R0203	0662057A25	CHIP RES 100 OHMS 5%
R0204	0662057A43	CHIP RES 560 OHMS 5%
R0205	0662057A73	CHIP RES 10K OHMS 5%
R0206	0662057A73	CHIP RES 10K OHMS 5%
R0207	0662057A57	CHIP RES 2200 OHMS 5%
R0208	0662057A57	CHIP RES 2200 OHMS 5%
R0211	0660076E70	RES CHIP FILM 7500 1 1/8
R0212	0660076E70	RES CHIP FILM 7500 1 1/8
R0221	0662057A82	CHIP RES 24K OHMS 5%
R0222	0662057A82	CHIP RES 24K OHMS 5%
R0223	0662057A84	CHIP RES 30K OHMS 5%
R0224	0662057A71	CHIP RES 8200 OHMS 5%
R0228	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0229	0662057A01	CHIP RES 10 OHMS 5%
R0241	0662057A89	CHIP RES 47K OHMS 5%
R0242	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0251	0662057A89	CHIP RES 47K OHMS 5%
R0252	0662057A91	CHIP RES 56K OHMS 5%
R0253	0662057A97	CHIPRES 100K OHM 5%
R0254	0662057A73	CHIP RES 10K OHMS 5%
R0255	0662057A73	CHIP RES 10K OHMS 5%
R0256	0662057A97	CHIPRES 100K OHM 5%
R0257	0662057A57	CHIP RES 2200 OHMS 5%
R0261	0662057A73	CHIP RES 10K OHMS 5%
R0262	0662057B08	CHIP RES 270K OHMS 5%

Circuit Ref	Motorola Part No.	Description
R0265	0662057A82	CHIP RES 24K OHMS 5%
R0267	0662057A89	CHIP RES 47K OHMS 5%
R0268	0662057A73	CHIP RES 10K OHMS 5%
R0269	0662057A41	CHIP RES 470 OHMS 5%
R0273	0662057A82	CHIP RES 24K OHMS 5%
R0275	0662057A73	CHIP RES 10K OHMS 5%
R0276	0662057A77	CHIP RES 15K OHMS 5%
R0323	0662057A79	18k 1/16W 5% Voice storage only
R0324	0662057A79	18k 1/16W 5% Voice storage only
R0331	0662057A73	10k 1/16W 5% Voice storage only
R0332	0662057A73	10k 1/16W 5% Voice storage only
R0333	0662057A73	10k 1/16W 5% Voice storage only
R0335	0662057B02	150k 1/16W Voice storage only
R0341	0662057A73	10k 1/16W 5% Voice storage only
R0342	0662057A55	1800 1/16W 5% Voice storage only
R0343	0662057B47	0 1/16W Voice storage only
R0344	0662057A91	56K 1/16W 5% Voice storage only
R0345	0662057A66	5100 1/16W 5% Voice storage only
R0346	0662057A89	47k 1/16W 5% Voice storage only
R0347	0662057A89	47k 1/16W 5% Voice storage only
R0401	0662057A33	CHIP RES 220 OHMS 5%
R0407	0662057M26	RES. CHIP 10 5% 20X40
R0408	0662057A25	CHIP RES 100 OHMS 5%
R0409	0662057M26	RES. CHIP 10 5% 20X40
R0412	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0441	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0442	0662057A49	CHIP RES 1000 OHMS 5%
R0467	0662057M26	RES. CHIP 10 5% 20X40
R0468	0662057A97	CHIPRES 100K OHM 5%
R0481	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0482	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0508	0662057A41	CHIP RES 470 OHMS 5%
R0509	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0510	0662057A65	CHIP RES 4700 OHMS 5%
R0511	0662057A97	CHIPRES 100K OHM 5%
R0512	0662057A77	CHIP RES 15K OHMS 5%
R0525	0662057A97	CHIPRES 100K OHM 5%
R0529	0662057A89	CHIP RES 47K OHMS 5%

Circuit Ref	Motorola Part No.	Description
R0530	0662057A81	CHIP RES 22K OHMS 5%
R0531	0662057A43	CHIP RES 560 OHMS 5%
R0533	0662057B47	CHIP RES 0 OHMS +/-0.050 OHMS
R0535	0662057A49	CHIP RES 1000 OHMS 5%
R0537	0662057A33	CHIP RES 220 OHMS 5%
R0538	0662057A33	CHIP RES 220 OHMS 5%
R0539	0662057A65	CHIP RES 4700 OHMS 5%
R0541	0662057A83	CHIP RES 27K OHMS 5%
R0543	0662057A97	CHIPRES 100K OHM 5%
R0555	0662057A25	CHIP RES 100 OHMS 5%
R0591	0662057A82	CHIP RES 24K OHMS 5%
R0592	0662057A01	CHIP RES 10 OHMS 5%
R0593	0662057A97	CHIPRES 100K OHM 5%
R0611	0662057A91	CHIP RES 56K OHMS 5%
R0612	0662057A65	CHIP RES 4700 OHMS 5%
R0621	0662057A82	CHIP RES 24K OHMS 5%
R0641	0662057A73	CHIP RES 10K OHMS 5%
R0642	0660076E70	RES CHIP FILM 7500 1 1/8
R0643	0660076E51	RES CHIP 1200 1 1/8
R0651	0662057A01	CHIP RES 10 OHMS 5%
R0652	0662057A01	CHIP RES 10 OHMS 5%
R0661	0662057A49	CHIP RES 1000 OHMS 5%
R0662	0662057B02	CHIP RES 150K OHMS 5%
R0671	0662057A84	CHIP RES 30K OHMS 5%
R0672	0662057A73	CHIP RES 10K OHMS 5%
R0681	0662057A79	CHIP RES 18K OHMS 5%
R0682	0662057A93	CHIP RES 68K OHMS 5%
U0101	5102226J56	68HC11FLO_PASS5 100P IN TQFP
U0111	5102463J64	16KX8 SPI SERIAL EEPROM
U0121	5186137B01	IC FLASH 4MBIT (512KX8) 120NS
U0122	5185748L01	32K X 8 SRAM 28PIN TSOP
U0141	5113805A30	IC 10F8 DCDR/REMUX 74HC138
U0211	5183222M49	IC AMP_3403_
U0221	5185130C53	IC ASFIC_CMP_R1
U0251	5184704M60	IC-CMOS 04M60 ANALOG
U0271	5102463J95	AUDIO PA TDA1519C
U0301	5109152M01	EEPROM ANALOG ISD33120EI Voice storage only
U0331	5186204B01	BuFFER/DRIVER 74AHCT1G125 Voice storage only
U0341	5180932W01	LINEAR IC OP AMP Voice storage only
U0342	5105750U28	SNGL ANALOG SWITCH Voice storage only
U0351	5102463J40	REGULATOR, 3.3V Voice storage only
U0611	5183308X01	"IC, LM2941, TO DRPOUT RGTR"
U0641	5183308X01	"IC, LM2941, TO DRPOUT RGTR"

Circuit Ref	Motorola Part No.	Description
U0651	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0652	5113815A02	IC UNDERVOLT SENSING CKT
VR0151	4813830A15	TSTR 5.6V 5% 20MA 225MW
VR0501	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0503	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0504	4813830A40	SOC23 AUTO SDN
VR0505	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0509	4813830A40	SOC23 AUTO SDN
VR0510	4813830A40	SOC23 AUTO SDN
VR0537	4813830A15	TSTR 5.6V 5% 20MA 225MW
VR0541	4813830A27	DIODE 14V 5% 225MW MMBZ5244B_
VR0601	4813832C77	TRANS SUP. 24V HIGH PWR
VR0621	4813830A15	TSTR 5.6V 5% 20MA 225MW
Y0131	4880113R19	CRYSTAL 38.4KHZ

\* Motorola Depot Servicing only  
Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

## Notes

# Chapter 4: VHF (136-174 MHz) 1-25W Service Information

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## Section 1

# MODEL CHARTS AND TECHNICAL SPECIFICATIONS

## 1.0 VHF (136-174 MHz) 1-25W Model Charts

### 1.1 CDM Series Model Chart

<b>CDM Series, VHF (136-174 MHz) 1-25W</b>					
<b>Model</b>					<b>Description</b>
AAM25KHC9AA1AN					CDM750, 136-174 MHz, 1-25W, 12.5/20/25 kHz
AAM25KHD9AA2AN					CDM1250, 136-174 MHz, 1-25W, 12.5/20/25 kHz
AAM25KHF9AA5AN					CDM1550, 136-174 MHz, 1-25W, 12.5/20/25 kHz
AAM25KHF9DP5AN					CDM1550 LS <sup>+</sup> , 136-174 MHz, 25W, 16CH
AAM25KHF9DP6AN					CDM1550 LS <sup>+</sup> , 136-174 MHz, 25W, 160CH w/MDC
<b>Item</b>					<b>Description</b>
X				GCN6112	Control Head, CDM750
	X			GCN6113	Control Head, CDM1250
		X	X	GCN6114	Control Head, CDM1550
X	X	X		IMUD6014	Tanapa, VHF 136-174 MHz, 1-25W, 12.5/20/25 kHz
X	X	X		IMUD6014_S	Replacement Board, VHF 136-174 MHz, 1-25W, 12.5/20/25 kHz
			X	PMUD 2076A	Tanapa, VHF 136-174 MHz, 25W 16CH
			X	PMUD 2077A	Tanapa, VHF 136-174 MHz, 25W 160CH w/MDC
X	X	X	X	HAD4006	Antenna, 136-144 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	HAD4007	Antenna, 146-150.8 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	HAD4008	Antenna, 150.8-162 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	HAD4009	Antenna, 162-174 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X	X	HAD4014	Antenna, 146-172 MHz, 3dB Gain Roof Mount (Mini U)
X			X	6881091C54	User Guide, CDM750
	X		X	6881091C55	User Guide, CDM1250
		X		6881091C56	User Guide, CDM1550
		X	X	6881094C79	User Guide, CDM1550 LS <sup>+</sup>

## 1.2 PRO Series Model Chart

<b>PRO Series, VHF (136-174 MHz) 1-25W</b>			
<b>Model</b>		<b>Description</b>	
	LAM25KHC9AA1AN	PRO3100, 136-174 MHz, 1-25W, 12.5/20/25 kHz Ch Sp	
	LAM25KHD9AA2AN	PRO5100, 136-174 MHz, 1-25W, 12.5/20/25 kHz Ch Sp	
	LAM25KHF9AA5AN	PRO7100, 136-174 MHz, 1-25W, 12.5/20/25 kHz Ch Sp	
		<b>Item</b>	<b>Description</b>
X		GCN6112	Control Head, PRO3100
	X	GCN6113	Control Head, PRO5100
		X GCN6114	Control Head, PRO7100
X	X	X IMUD6014	Tanapa, VHF 136-174 MHz, 1-25W, 12.5/20/25 kHz
X	X	X IMUD6014_S	Replacement Board, VHF 136-174 MHz, 1-25W, 12.5/20/25 kHz
X	X	X HAD4006	Antenna, 136-144 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X HAD4007	Antenna, 146-150.8 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X HAD4008	Antenna, 150.8-162 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X HAD4009	Antenna, 162-174 MHz, 1/4 Wave Roof Mount (Mini U)
X	X	X HAD4014	Antenna, 146-172 MHz, 3dB Gain Roof Mount (Mini U)
X		6881091C57	User Guide, PRO3100
	X	6881091C58	User Guide, PRO5100
		X 6881091C59	User Guide, PRO7100

## 2.0 Technical Specifications

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

<b>General Specifications</b>	
Channel Capacity <b>CDM750/PRO3100</b> <b>CDM1250/PRO5100</b> <b>CDM1550/PRO7100</b>	4 64 128
Power Supply	13.2Vdc (10.8 - 15.6Vdc)
Dimensions: H x W x D (in./mm) <b>CDM750/PRO3100</b> <b>CDM1250/PRO5100 and</b> <b>CDM1550/PRO7100</b> Depth excludes knobs	<b>1 - 25W:</b> 2.2 in. x 6.93 in. x 6.97 in. (56 mm x 176 mm x 177 mm) 2.34 in. x 7.05 in. x 7.32 in. (59 mm x 179 mm x 186 mm) Add 0.35 in. (9mm) for Volume Knob
Weight (All CDM and PRO models)	3.15 lb. (1430 g)
Sealing:	Withstands rain testing per MIL STD 810 C/D /E and IP54
Shock and Vibration:	Protection provided via impact resistant housing exceeding MIL STD 810-C/D /E
Dust, Salt & Fog	Protection provided via environment resistant housing exceeding MIL STD 810 C/D /E

Transmitter	VHF
*Frequencies - Full Bandsplit	VHF 136-174 MHz
Channel Spacing	12.5/20/25 kHz
Frequency Stability (-30°C to +60°C, +25° Ref.)	±2.0 ppm
Power	1-25W
Modulation Limiting	±2.5 @ 12.5 kHz ±4.0 @ 20 kHz ±5.0 @ 25 kHz
FM Hum & Noise	-40 dB @ 12.5 kHz -45 dB @ 20/25 kHz
Conducted/Radiated Emission	-36 dBm <1 GHz -30 dBm >1 GHz
Adjacent Channel Power	-60 dB @ 12.5 kHz -70 dB @ 25 kHz
Audio Response (300 - 3000Hz @ 20/25 kHz) (300 - 2550Hz @12.5 kHz)	+1 to -3 dB TIA/EIA box
Audio Distortion @1000Hz, 60% Rated Maximum Deviation	<3% typical

Receiver	VHF
*Frequencies - Full Bandsplit	VHF 136-174 MHz
Channel Spacing	12.5/20/25 kHz
Sensitivity (12 dB SINAD)	0.30 µV (0.22 µV typical)
Intermodulation	>65 dB (ETS) 75 dB @ 12.5 kHz (TIA) 78 dB @ 25 kHz (TIA) Base Mode: >70dB (1-25W model only)
Adjacent Channel Selectivity	65 dB @ 12.5 kHz 75 dB @ 20 kHz 80 dB @ 25 kHz
Spurious Rejection	75 dB @ 12.5 kHz 80 dB @ 20/25 kHz
Rated Audio	3W Internal 7.5W External 13W External
Audio Distortion @ Rated Audio	<3% typical
Hum & Noise	-40 dB @ 12.5 kHz -45 dB @ 20/25 kHz
Audio Response (300 - 3000Hz @ 20/25 kHz) (300 - 2550Hz @12.5 kHz)	+1 to -3 dB TIA/EIA box
Conducted Spurious Emission	-57 dBm <1 GHz -47 dBm >1 GHz

\*Availability subject to the laws and regulations of individual countries.

## Notes



## Section 2

# THEORY OF OPERATION

## 1.0 Introduction

This chapter provides a detailed theory of operation for the VHF circuits in the radio. For details of the theory of operation and troubleshooting for the associated controller circuits refer to the controller section of this manual.

## 2.0 VHF (136-174 MHz) 1-25W Receiver Front-End

### 2.1 Receiver Front-End

The receiver is able to cover the VHF range from 136 to 174 MHz. It consists of four major blocks: front-end bandpass filters and pre-amplifier, first mixer, high-IF, low-IF and receiver back-end. Two varactor-tuned bandpass filters perform antenna signal pre-selection. A passive double-balanced mixer converts the signal to the first IF of 44.85 MHz. High-side first injection is used.

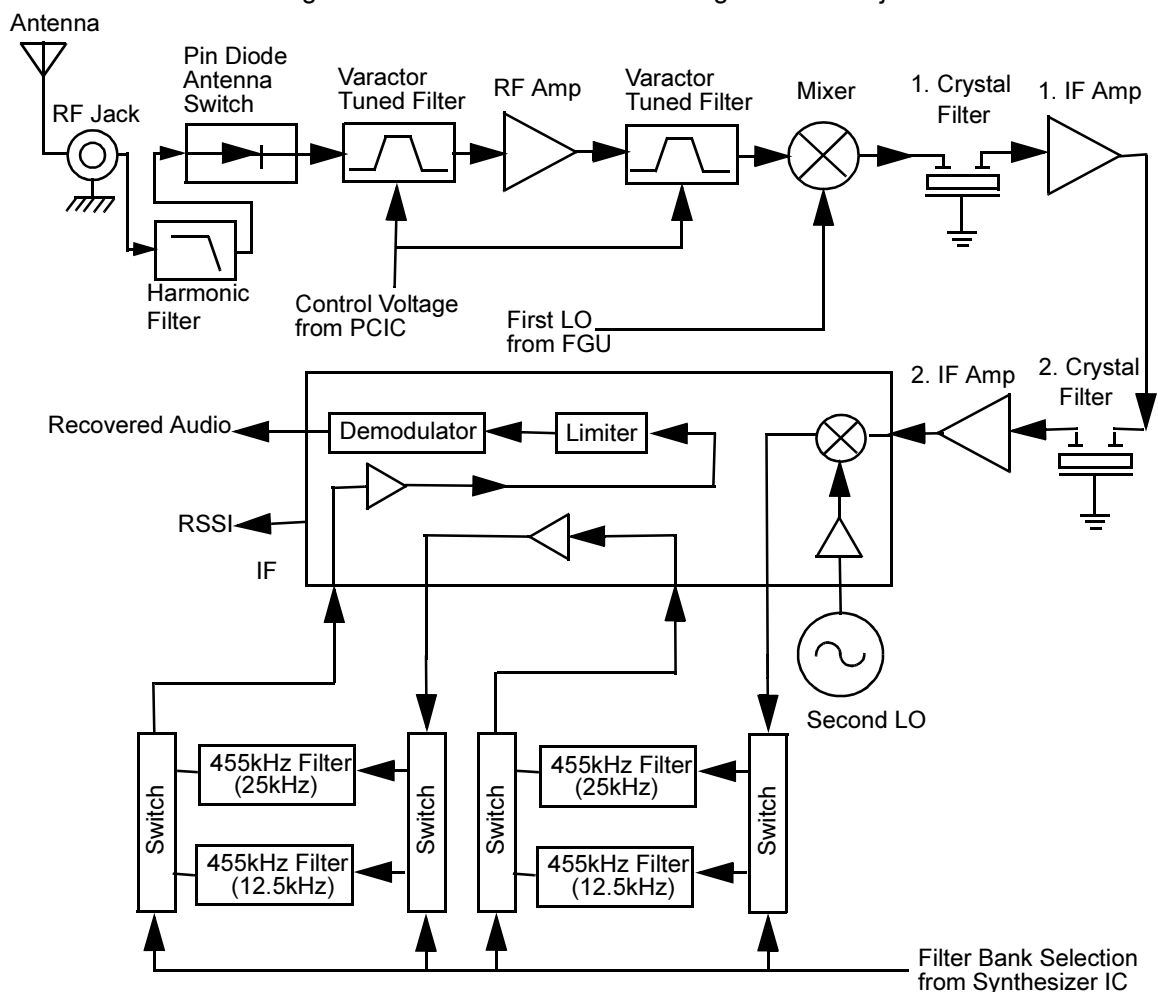


Figure 4-1 VHF Receiver Block Diagram

There are two 2-pole 44.85 MHz crystal filters in the high-IF section and 2 pairs of 455 kHz ceramic filters in the low-IF section to provide the required adjacent channel selectivity. The correct pair of ceramic filters for 12.5 or 25kHz channel spacing is selected via control line BWSELECT. The second IF at 455 kHz is mixed, amplified and demodulated in the IF IC. The processing of the demodulated audio signal is performed by an audio processing IC located in the controller section.

## 2.2 Front-End Bandpass Filters and Pre-Amplifier

The received signal from the radio's antenna connector is first routed through the harmonic filter and antenna switch, which are part of the RF power amplifier circuitry, before being applied to the receiver pre-selector filter (C3001, C3002, D3001 and associated components). The 2-pole pre-selector filter tuned by the dual varactor diode D3001 pre-selects the incoming signal (RXIN) from the antenna switch to reduce spurious effects to following stages. The tuning voltage (FECNTL\_1) ranging from 2 volts to 8 volts is controlled by pin 20 of PCIC (U3501) in the Transmitter section. A dual hot carrier diode (D3003) limits any inband signal to 0 dBm to prevent damage to the pre-amplifier.

The RF pre-amplifier is an SMD device (Q3001) with collector-base feedback to stabilize gain, impedance, and intermodulation. Transistor Q3002 compares the voltage drop across resistor R3002 with a fixed base voltage from divider R3011, R3000 and R3012, and adjusts the base current of Q3001 as necessary to maintain its collector current constant at approximately 15-20 mA. Operating voltage is from the regulated 9.3V supply (9V3). During transmit, 9.1 volts (K9V1) turns off both transistors Q3002 and Q3001. This protects the RF pre-amplifier from excessive dissipation during transmit mode. A switchable 3dB pad (R3022, R3024, R3016 and R3018) controlled via Line FECNTL\_2 and Q3021 stabilizes the output impedance and intermodulation performance.

A second 2-pole varactor tuned bandpass filter provides additional filtering of the amplified signal. The dual varactor diode D3004 is controlled by the same signal FECNTL\_1, which controls the pre-selector filter.

## 2.3 First Mixer and High Intermediate Frequency (IF)

The signal coming from the front-end is converted to the high-IF frequency of 44.85 MHz using a passive double-balanced mixer (D3031). Its ports are matched for incoming RF signal conversion to the 44.85 MHz IF using high side injection. The high-side injection signal (RXINJ) from the frequency synthesizer circuitry has a level of approximately 13 dBm and is injected via matching transformer T3002.

The mixer IF output signal (IF) from transformer T3001 pin 2 is fed to the first two pole crystal filter FL3101. The filter output in turn is matched to the following IF amplifier.

The IF amplifier Q3101 is actively biased by a collector base feedback (R3101, R3106) to a current drain of approximately 5 mA drawn from the voltage 5V. Its output impedance is matched to the second two pole crystal filter FL3102. The signal is further amplified by a pre-amplifier (Q3102) before going into pin 1 of IFIC (U3101).

A dual hot carrier diode (D3101) limits the filter output voltage swing to reduce overdrive effects at RF input levels above -27 dBm.

## 2.4 Low Intermediate Frequency (IF) and Receiver Back-End

The 44.85 MHz high-IF signal from the second IF amplifier feeds the IF IC (U3101) at pin 1. Within the IF IC, the 44.85 MHz high IF signal mixes with the 44.395 MHz second local oscillator (2nd LO) to produce the low-IF signal at 455 kHz. The 2nd LO frequency is determined by crystal Y3101. The low IF signal is amplified and filtered by an external pair of 455 kHz ceramic filters FL3112, FL3114

for 20/25 kHz channel spacing or FL3111, FL3113/F3115 for 12.5 kHz channel spacing. These pairs are selectable via BWSELECT. The filtered output from the ceramic filters is applied to the limiter input pin of the IF IC (pin 14).

The IF IC contains a quadrature detector using a ceramic phase-shift element (Y3102) to provide audio detection. Internal amplification provides an audio output level of 120 mVrms (at 60% deviation) from U3101 pin 8 (DISCAUDIO) which is fed to the ASFIC\_CMP (U0221) pin 2 (part of the Controller circuitry).

A Receive Signal Strength Indicator (RSSI) signal is available at U3101 pin 5, having a dynamic range of 70 dB. The RSSI signal is interpreted by the  $\mu$ P (U0101 pin 63) and in addition is available at accessory connector J0501-15.

### 3.0 VHF (136-174 MHz) 1-25W Transmitter Power Amplifier (PA) 25W

The radio's 25W PA is a three-stage amplifier used to amplify the output from the VCOBIC to the radio transmit level. All three stages utilize LDMOS technology. The gain of the first stage (U3401) and the second stage (Q3421) is adjustable, controlled by pin 4 of PCIC (U3501) via U3402-1 and U3402-2. It is followed by an LDMOS final stage (Q3441).

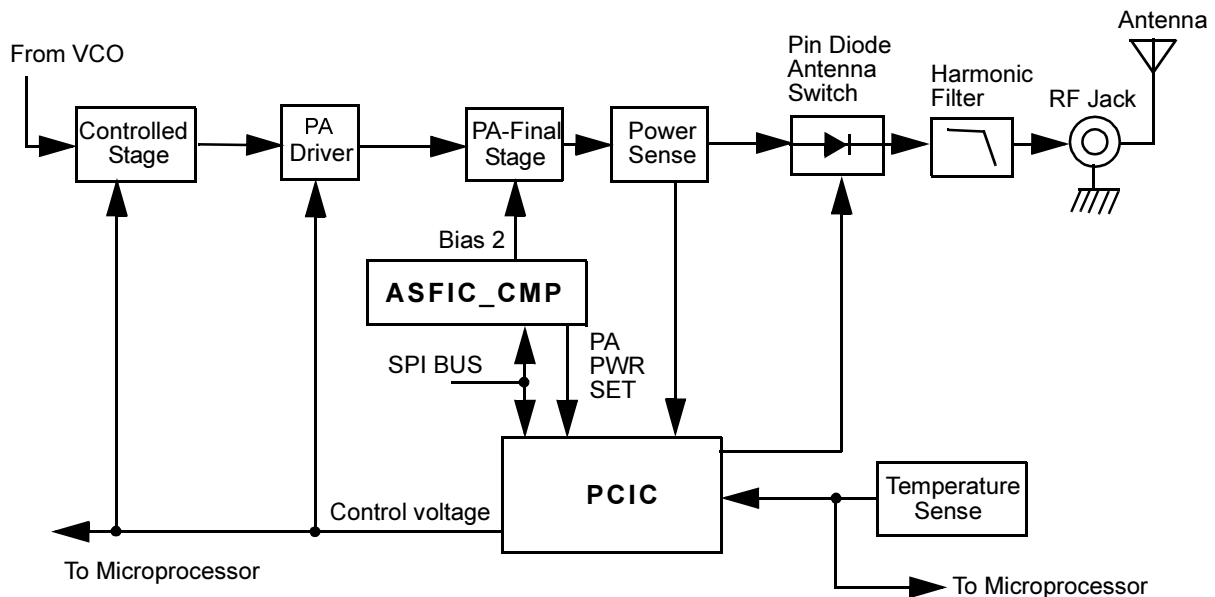


Figure 4-2 VHF Transmitter Block Diagram

Devices U3401, Q3421 and Q3441 are surface mounted. A pressure pad between the board and the radio's cover provides good thermal contact between the devices and the chassis.

#### 3.1 First Power Controlled Stage

The first stage (U3401) is a 20dB gain integrated circuit containing two LDMOS FET amplifier stages. It amplifies the RF signal from the VCO (TXINJ). The output power of stage U3401 is controlled by a DC voltage applied to pin 1 from the op-amp U3402-1, pin 1. The control voltage simultaneously varies the bias of two FET stages within U3401. This biasing point determines the

overall gain of U3401 and therefore its output drive level to Q3421, which in turn controls the output power of the PA.

Op-amp U3402-1 monitors the drain current of U3401 via resistor R3444 and adjusts the bias voltage of U3401 so that the current remains constant. The PCIC (U3501) provides a DC output voltage at pin 4 (INT) which sets the reference voltage of the current control loop. A rising power output causes the DC voltage from the PCIC to fall, and U3402-1 adjusts the bias voltage for a lower drain current to lower the gain of the stage.

In receive mode the DC voltage from PCIC pin 23 (RX) turns on Q3442, which in turn switches off the biasing voltage to U3401.

Switch S3440 is a pressure pad with a conductive strip which connects two conductive areas on the board when the radio's cover is properly screwed to the chassis. When the cover is removed, S3440 opens and the resulting high voltage level at the inverting inputs of the current control op-amps U3402-1 & 2 switches off the biasing of U3401 and Q3421. This prevents transmitter key up while the devices do not have proper thermal contact to the chassis.

### 3.2 Power Controlled Driver Stage

The next stage is an LDMOS device (Q3421) providing 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 the drain current control op-amp U3402-2, and fed to the gate of Q3421 via the resistive network R3429, R3418, R3415 and R3416.

Op-amp U3402-2 monitors the drain current of U3421 via resistors R3424-27 and adjusts the bias voltage of Q3421 so that the current remains constant. The PCIC (U3501) provides a DC output voltage at pin 4 (INT) which sets the reference voltage of the current control loop. A rising power output causes the DC voltage from the PCIC to fall, and U3402-2 adjusts the bias voltage for a lower drain current to lower the gain of the stage.

In receive mode the DC voltage from PCIC pin 23 (RX) turns on Q3422, which in turn switches off the biasing voltage to Q3421.

### 3.3 Final Stage

The final stage is an LDMOS device (Q3441) 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 MOSBIAS\_2 is set in transmit mode by the ASFIC and fed to the gate of Q3441 via the resistive network R3404, R3406, and R3431-5. This bias voltage is tuned in the factory. If the transistor is replaced, the bias voltage must be tuned using the Customer Programming Software (CPS). Care must be taken not to damage the device by exceeding the maximum allowed bias voltage. In receive mode U3402-2 pulls the bias voltage to low via D3401. The device's drain current is drawn directly from the radio's DC supply voltage input, PASUPVLTG, via L3436 and L3437.

A matching network consisting of C3441-49, L3443, and two striplines, transforms the impedance to 50 ohms and feeds the directional coupler.

### 3.4 Directional Coupler

The directional coupler is a microstrip printed circuit, which couples a small amount of the forward power delivered by Q3441. The coupled signal is rectified by D3451. The DC voltage is proportional to the RF output power and feeds the RFIN port of the PCIC (U3501 pin 1). The PCIC controls the gain of stage U3401 and Q3421 as necessary to hold this voltage constant, thus ensuring the forward power out of the radio to be held to a constant value.

### 3.5 Antenna Switch

The antenna switch consists of two PIN diodes, D3471 and D3472. In the receive mode, both diodes are off. Signals applied at the antenna jack J3401 are routed, via the harmonic filter, through network L3472, C3474 and C3475, to the receiver input. In the transmit mode, K9V1 turns on Q3471 which enables current sink Q3472, set to 96 mA by R3473 and VR3471. This completes a DC path from PASUPVLTG, through L3437, D3471, L3472, D3472, L3471, R3474 and the current sink, to ground. Both diodes are forward biased into conduction. The transmitter RF from the directional coupler is routed via D3471 to the harmonic filter and antenna jack. D3472 also conducts, shunting RF power and preventing it from reaching the receiver port (RXIN). L3472 is selected to appear as a  $\lambda / 4$  wave transmission line, making the short circuit presented by D3472 appear as an open circuit at the junction of D3472 and the receiver path.

### 3.6 Harmonic Filter

Components L3491-L3493 and L3472, C3491-C3499 form a Chebychev low-pass filter to attenuate harmonic energy of the transmitter to specifications level. R3491 is used to drain electrostatic charge 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, improving spurious response rejection.

### 3.7 Power Control

The transmitter uses the Power Control IC (PCIC, U3501) to control the power output of the radio. A portion of the forward RF power from the transmitter is sampled by the directional coupler and rectified, to provide a DC voltage to the RFIN port of the PCIC (pin 1) which is proportional to the sampled RF power.

The ASFIC (U0221) has internal digital-to-analog converters (DACs) which provide a reference voltage of the control loop to the PCIC via R3505. The reference voltage level is programmable through the SPI line of the PCIC. This reference voltage is proportional to the desired power setting of the transmitter, and is factory programmed at several points across the frequency range of the transmitter to offset frequency response variations of the transmitter's power detector circuit. The PCIC provides a DC output voltage at pin 4 (INT) which sets the drain current of the first (U3401) and second (Q3421) transmitter stage via current control op-amps U3402-1 and U3402-2. This adjusts the transmitter power output to the intended value. Variations in forward transmitter power cause the DC voltage at pin 1 to change, and the PCIC adjusts the control voltage above or below its nominal value to raise or lower output power. Capacitors C3502-4, in conjunction with resistors and integrators within the PCIC, control the transmitter power-rise (key-up) and power-decay (de-key) characteristic to minimize splatter into adjacent channels. U3502 is a temperature-sensing device, which monitors the circuit board temperature in the vicinity of the transmitter driver and final devices, and provides a DC voltage to the PCIC (TEMP, pin 30) proportional to temperature. If the DC voltage produced exceeds the set threshold in the PCIC, the transmitter output power will be reduced so as to reduce the transmitter temperature.

## 4.0 VHF (136-174 MHz) 1-25W Frequency Synthesis

The frequency synthesizer subsystem consists of the reference oscillator (Y3261 or Y3263), the Low Voltage Fractional-N synthesizer (LVFRAC-N, U3201), and the voltage-controlled oscillators and buffer amplifiers (U3301, Q3301-2 and associated circuitry).

## 4.1 Reference Oscillator

The reference oscillator (Y3263) contains a temperature compensated crystal oscillator with a frequency of 16.8 MHz. An analog-to-digital (A/D) converter internal to U3201 (LVFRAC-N) and controlled by the  $\mu$ P via serial interface (SRL) sets the voltage at the warp output of U3201 (pin 25) to set the frequency of the oscillator. The output of the oscillator (U3263 pin 3) is applied to pin 23 (XTAL1) of U3201 via R3263 and C3235.

In applications where less frequency stability is required, the oscillator inside U3201 is used along with an external crystal Y3261, varactor diode D3261, C3261, C3262 and R3262. In this case, Y3263, R3263, C3235 and C3251 are not used. When Y3263 is used, Y3261, D3261, C3261, C3262 and R3262 are not used, and C3263 is increased to 0.1  $\mu$ F.

## 4.2 Fractional-N Synthesizer

The LVFRAC-N synthesizer IC (U3201) consists of a pre-scaler, a programmable loop divider, control divider logic, a phase detector, a charge pump, an A/D converter for low frequency digital modulation, a balance attenuator to balance high frequency analog modulation and low frequency digital modulation, a 13V positive voltage multiplier, a serial interface for control, and finally a super filter for the regulated 5 volts.

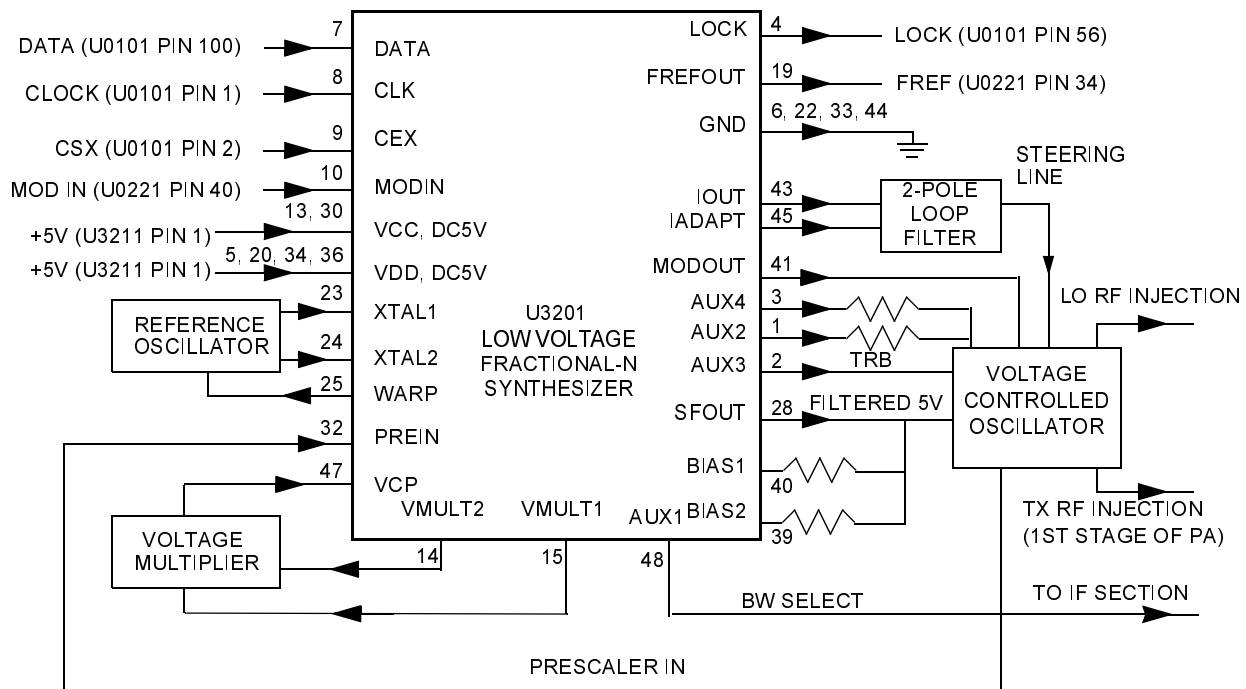


Figure 4-3 VHF Synthesizer Block Diagram

A voltage of 5V applied to the super filter input (U3201 pin 30) supplies an output voltage of 4.5 VDC (VSF) at pin 28. It supplies the VCO, VCO modulation bias circuit (via R3363) and the synthesizer charge pump resistor network (R3251, R3252). The synthesizer supply voltage is provided by the 5V regulator U3211.

In order to generate a high voltage to supply the phase detector (charge pump) output stage at pin 47 VCP (U3201-47), a voltage of 13 VDC is being generated by the positive voltage multiplier

circuitry (D3201, C3202, C3203). This voltage multiplier is basically a diode capacitor network driven by two (1.05MHz) 180 degrees out of phase signals (U3201-14 and -15).

Output LOCK (U3201-4) provides information about the lock status of the synthesizer loop. A high level at this output indicates a stable loop. IC U3201 provides the 16.8 MHz reference frequency at pin 19.

The serial interface (SRL) is connected to the  $\mu$ P via the data line DATA (U3201-7), clock line CLK (U3201-8), and chip enable line CSX (U3201-9).

### 4.3 Voltage Controlled Oscillator (VCO)

The Voltage Controlled Oscillator (VCO) consists of the VCO/Buffer IC (VCOBIC, U3301), the TX and RX tank circuits, the external RX buffer stages, and the modulation circuitry.

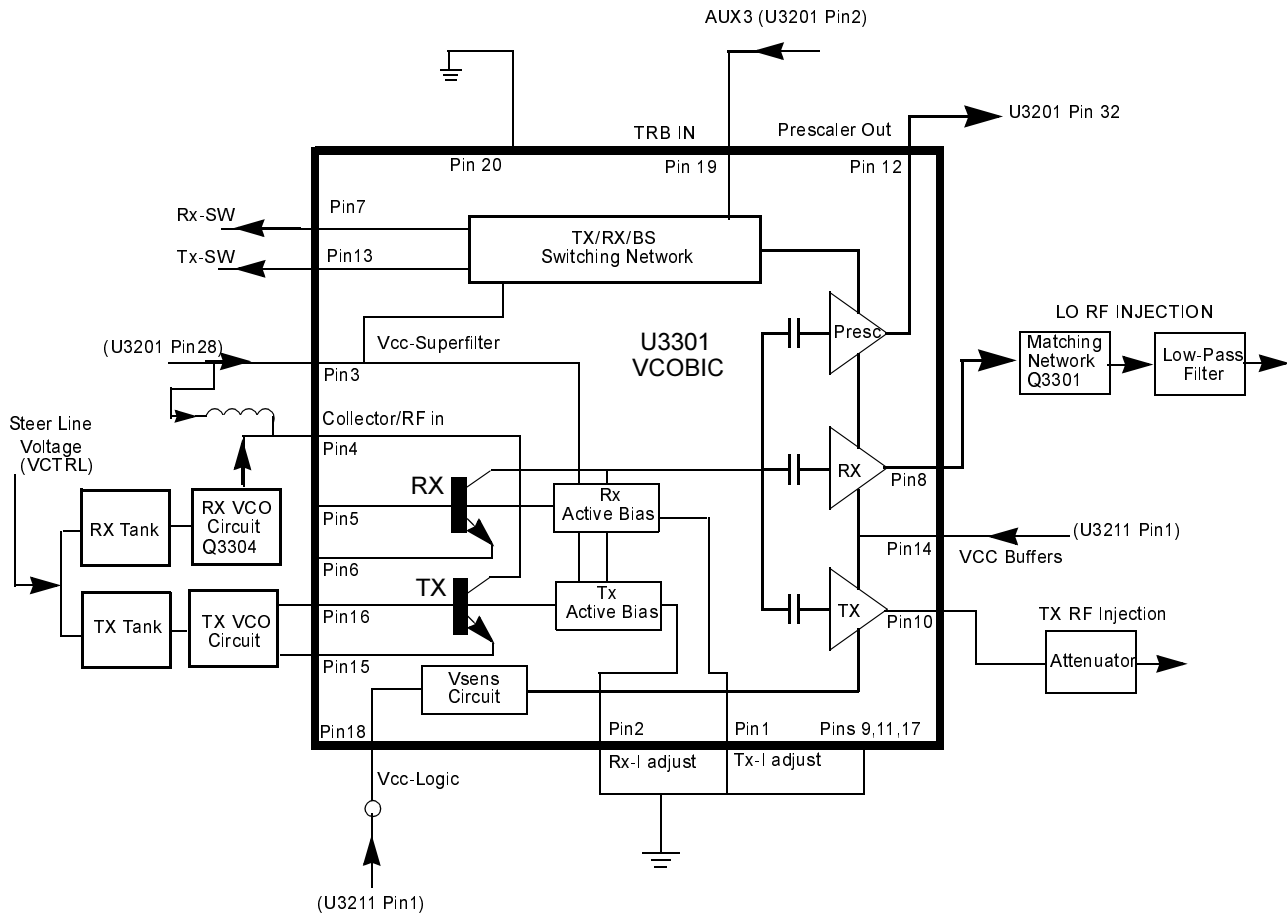


Figure 4-4 VHF VCO Block Diagram

The VCOBIC together with the Fractional-N synthesizer (U3201) generates the required frequencies in both the transmit and receive modes. The TRB line (U3301 pin 19) determines which tank circuits and internal buffers are to be enabled. A high level on TRB enables the TX tank and TX output (pin 10), and a low enables the RX tank and RX output (pin 8). A sample of the signal from the enabled RF output is routed from U3301 pin 12 (PRESC\_OUT), via a low-pass filter, to pin 32 of U3201 (PREIN).

A steering line voltage (VCTRL) between 2.5V and 11V at varactor diode D3361 will tune the full TX frequency range (TXINJ) from 136 MHz to 174 MHz, and at varactor diode D3341 will tune the full RX frequency range (RXINJ) from 181 MHz to 219 MHz. The RX tank circuit uses a Hartley configuration for wider bandwidth. For the RX tank circuit, an external transistor Q3304 is used for better side-band noise.

The external RX buffers (Q3301 and Q3302) are enabled by a high at U3301 pin 7 (RX\_SWITCH) via transistor switch Q3303. In the TX mode, the modulation signal (VCOMOD) from the LVFRAC-N synthesizer IC (U3201 pin 41) is applied to varactor diode D3362, which modulates the TX VCO frequency via capacitor C3362. Varactor D3362 is biased for linearity from VSF.

## 4.4 Synthesizer Operation

The complete synthesizer subsystem consists of the low voltage FRAC-N (LVFRACN), the reference oscillator (a crystal oscillator with temperature compensation), charge pump circuitry, loop filter circuitry and a DC supply. The output signal PRESC from the VCOBIC (U3301 pin 12) is fed to U3201 pin 32 (PREIN) via a low-pass filter (C3318, L3318 and C3226) which attenuates harmonics and provides the correct level to close the synthesizer loop.

The pre-scaler in the synthesizer (U3201) is a dual modulus type 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 SRL. 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 (Y3261 or Y3263).

The output signal of the phase detector is a pulsed DC signal which is routed to the charge pump. The charge pump outputs a current at U3201 pin 43 (IOUT). The loop filter (which consists of R3221-R3223 and C3221-C3224) transforms this current into a voltage that is applied to the varactor diodes (D3361 for transmit, D3341 for receive) to alter the output frequency of the appropriate VCO. The current can be set to a value fixed within the LVFRAC-N IC, or to a value determined by the currents flowing into BIAS 1 (U3201-40) or BIAS 2 (U3201-39). The currents are set by the value of R3251 and R3252 respectively. The selection of the three different bias sources is done by software programming.

To reduce synthesizer lock time when new frequency data has been loaded into the synthesizer, the magnitude of the loop current is increased by enabling the IADAPT pin (U3201-45) for a certain software programmable time (adapt mode). The adapt mode timer is started by a low to high transition of the CSX line. When the synthesizer is within the lock range, the current is determined only by the resistors connected to BIAS 1 and BIAS 2, or by the internal current source. A settled synthesizer loop is indicated by a high level signal at U3201-4 (LOCK).

The LOCK signal is routed to one of the  $\mu$ P's ADC inputs (U0101-56). From the measured voltage, the  $\mu$ P determines whether LOCK is active.

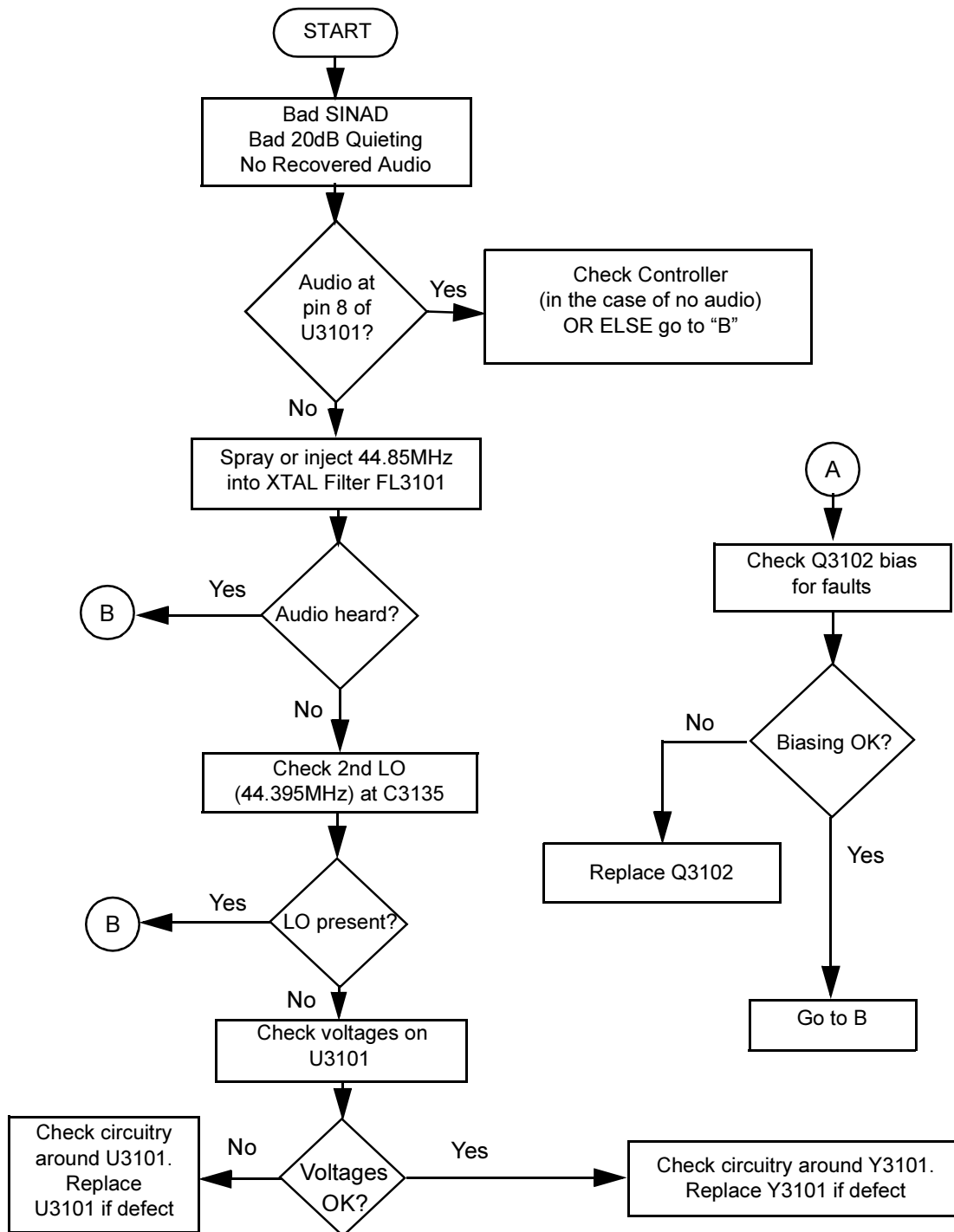
In order to modulate the PLL, the two spot modulation method is utilized. Via U3201 pin 10 (MODIN), the audio signal is applied to both the A/D converter (low frequency path) as well as the balance attenuator (high frequency path). The A/D converter changes the low frequency analog modulating signal into a digital code that 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 present at the MODOUT port (U3201-41) and connected to the VCO modulation diode D3362 via R3364.



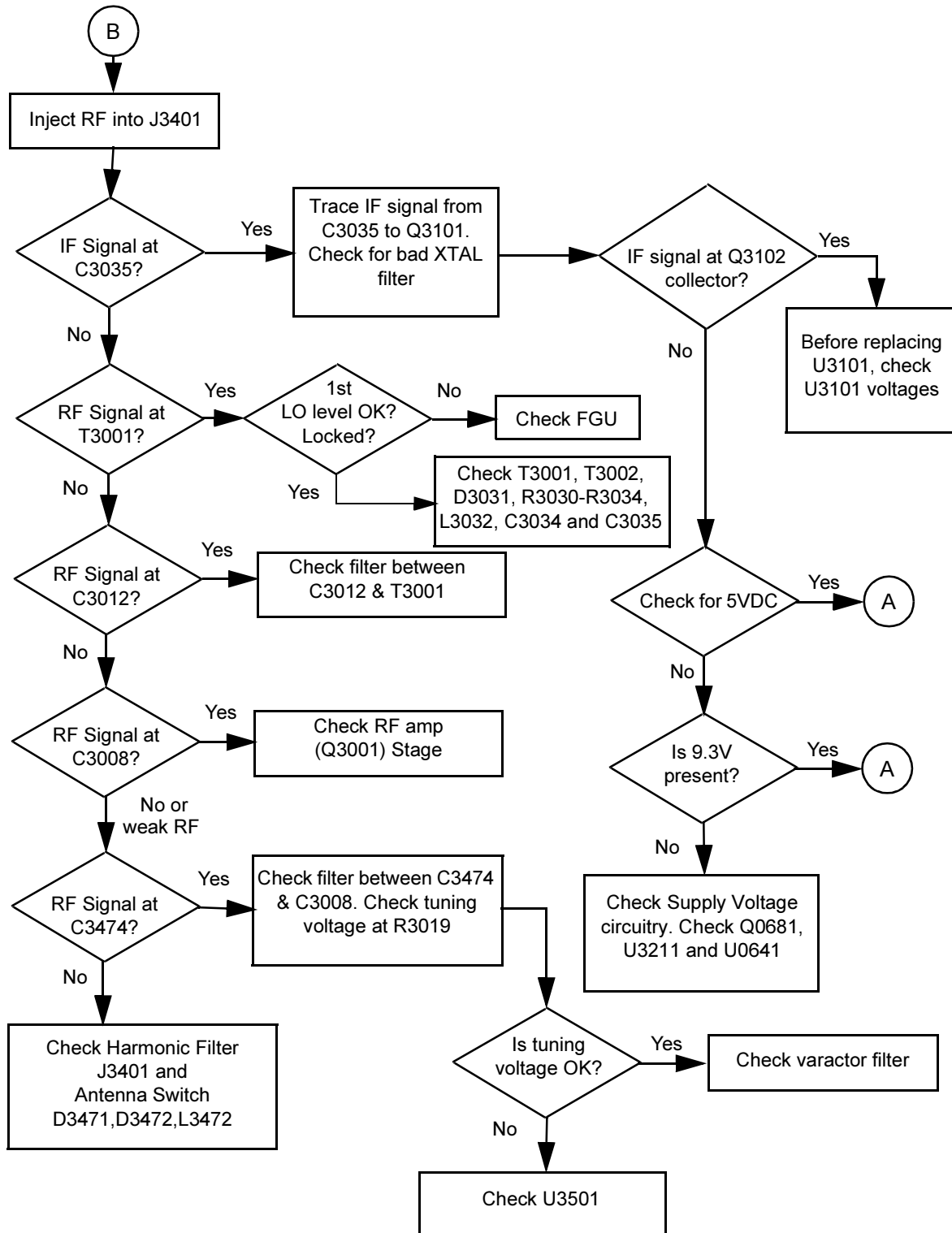
## Section 3

# TROUBLESHOOTING CHARTS

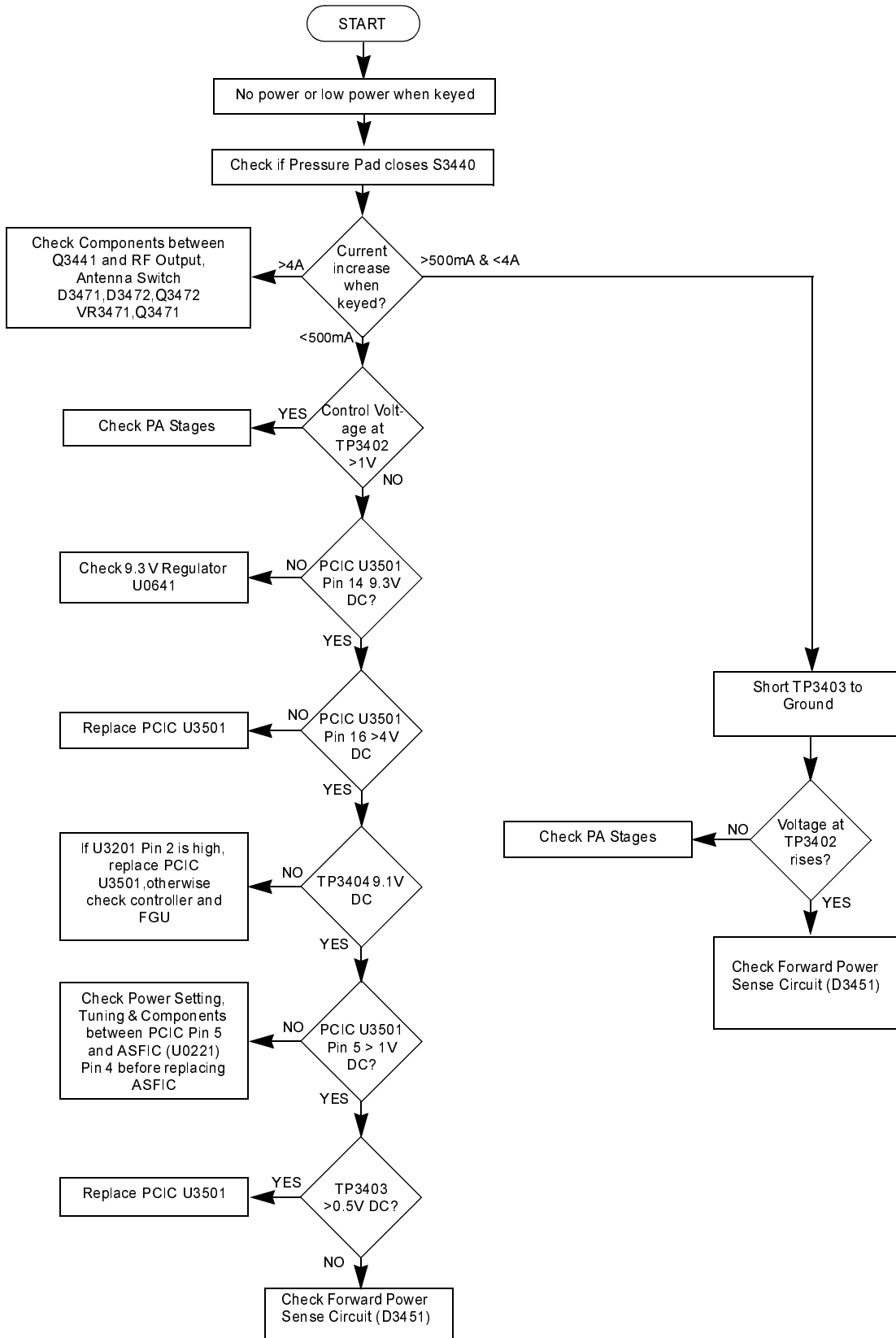
## 1.0 Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)



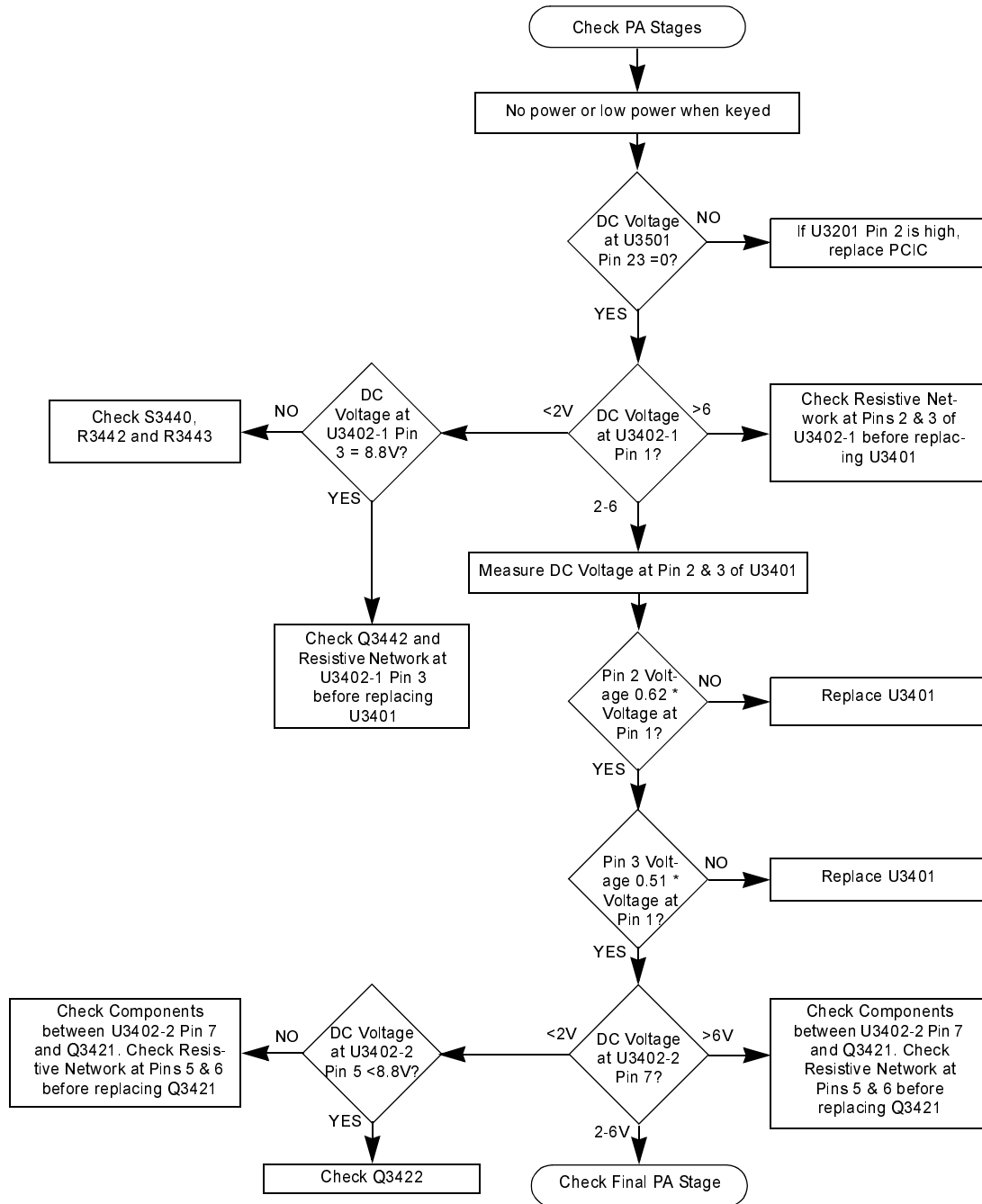
### 1.1 Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



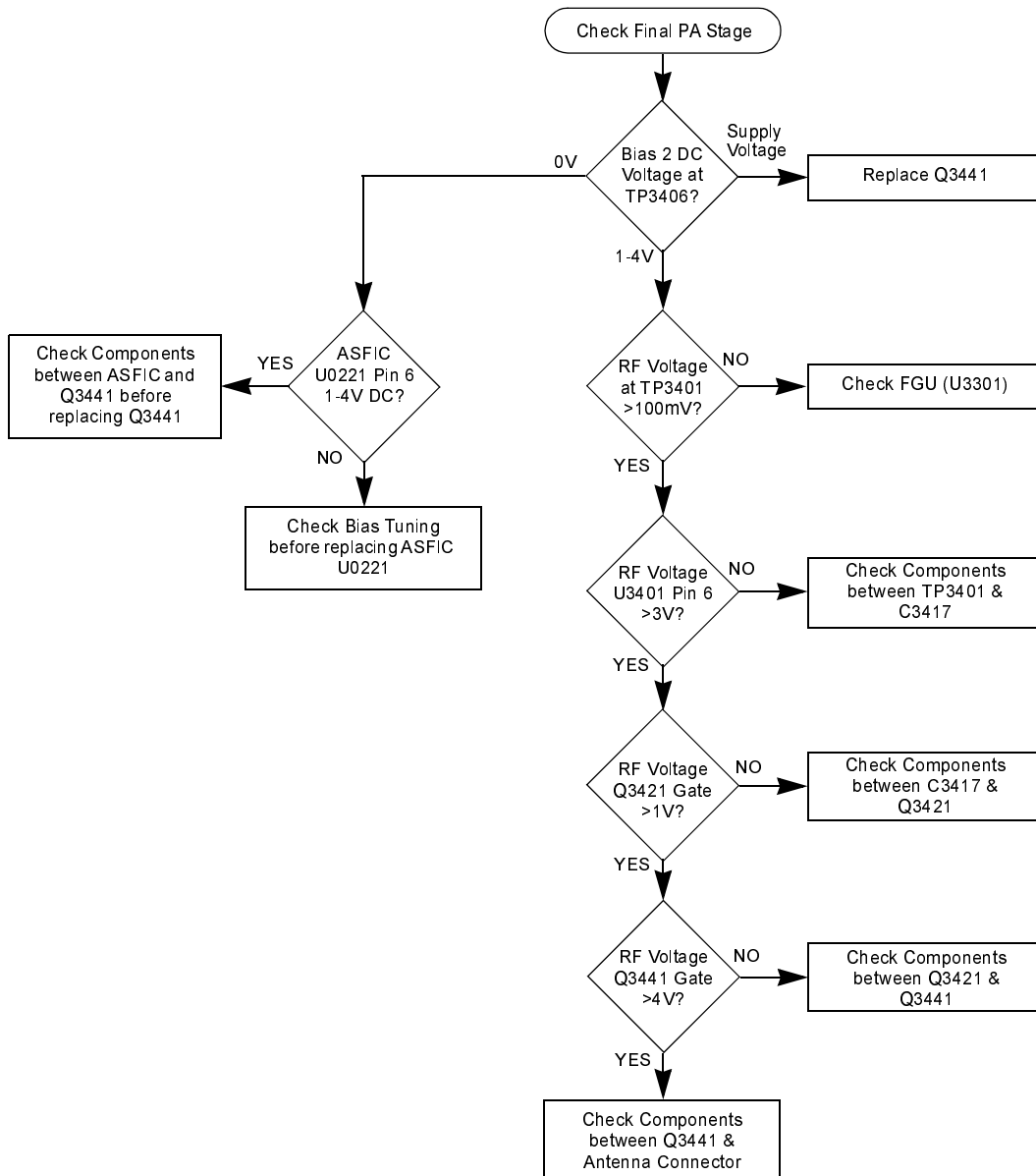
## 2.0 Troubleshooting Flow Chart for 25W Transmitter (Sheet 1 of 3)



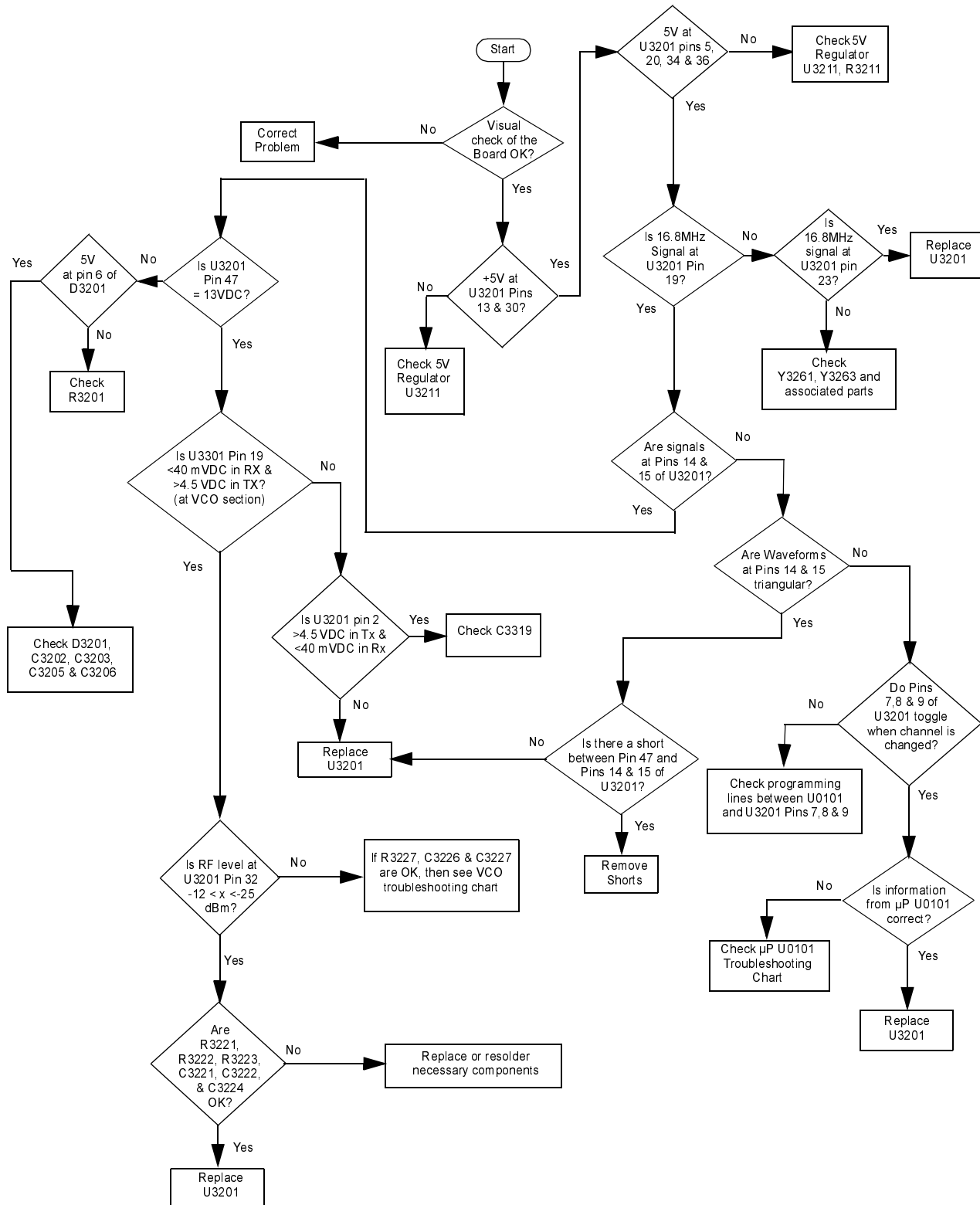
## 2.1 Troubleshooting Flow Chart for 25W Transmitter (Sheet 2 of 3)



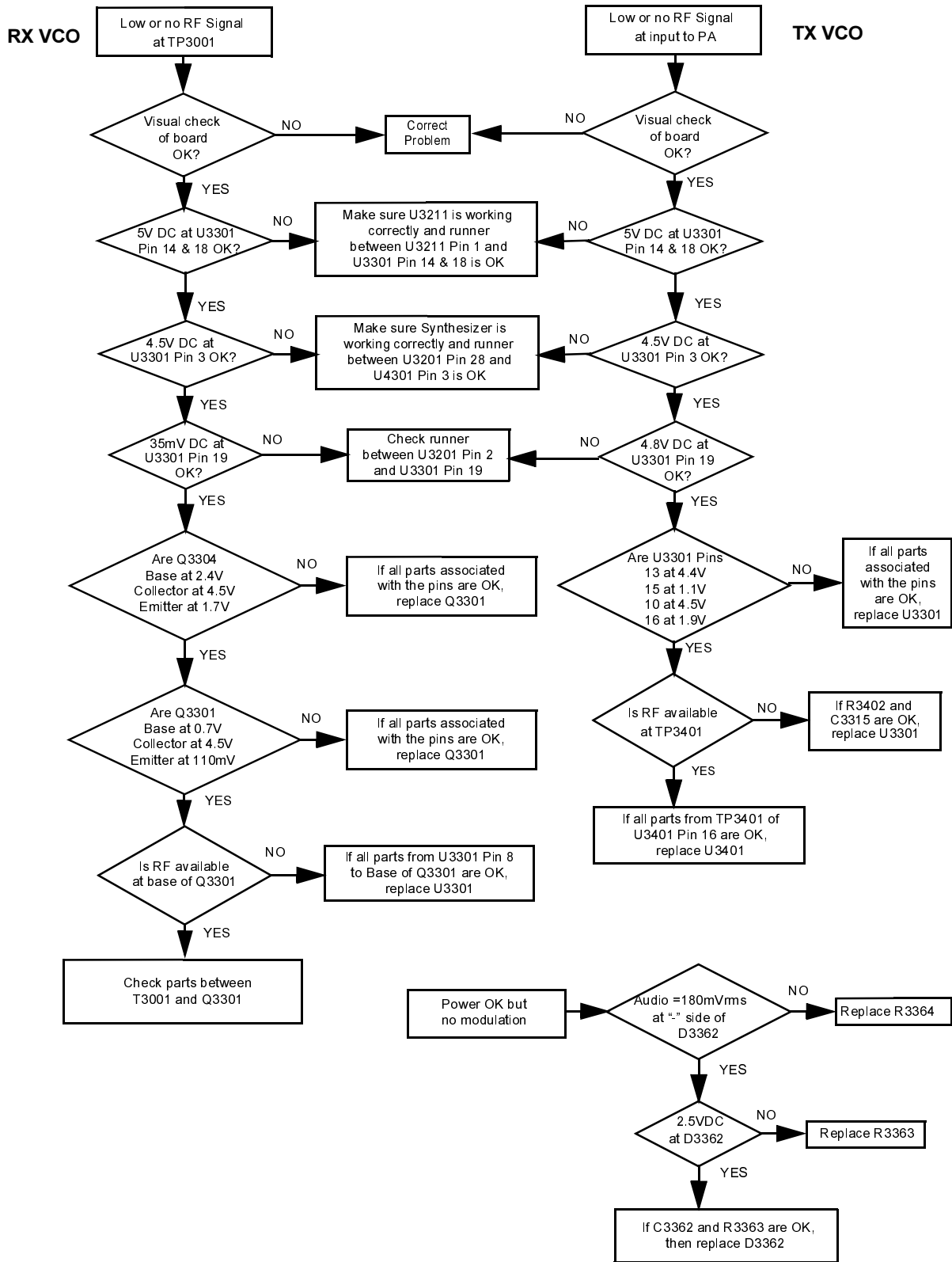
## 2.2 Troubleshooting Flow Chart for 25W Transmitter (Sheet 3 of 3)



### 3.0 Troubleshooting Flow Chart for Synthesizer



### 4.0 Troubleshooting Flow Chart for VCO



## Notes



## Section 4

# VHF (136-174 MHZ) 1-25W PCBS, SCHEMATICS, AND PARTS LISTS

## 1.0 Allocation of Schematics and Circuit Boards

### 1.1 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 the VHF circuits only. Refer to the controller section for details of the related controller circuits. The PCB component layouts and the parts lists in this chapter show both the controller and VHF circuit components. The VHF schematics and the related PCB and parts list are shown in the tables below.

**Table 4-1** VHF 1-25W PCB 8486172B04 Diagrams and Parts Lists

<b>PCB 8486172B04:</b> <b>Main Board Top Side</b> <b>Main Board Bottom Side</b>	<b>Page:</b> <b>4: 4-3</b> <b>4: 4-4</b>
<b>SCHEMATICS</b> <b>Power Amplifier 1 - 25W</b> <b>FRACN Synthesizer</b> <b>Voltage Controlled Oscillator</b> <b>Receiver Front-End</b> <b>IF</b>	<b>4: 4-5</b> <b>4: 4-6</b> <b>4: 4-7</b> <b>4: 4-8</b> <b>4: 4-9</b>
<b>Parts List</b>	<b>4: 4-10</b>
<b>Controller version is T2</b>	

**Table 4-2** VHF 1-25W PCB 8486172B06 Diagrams and Parts Lists

<b>PCB 8486172B06:</b> <b>Main Board Top Side</b> <b>Main Board Bottom Side</b>	<b>Page:</b> <b>4: 4-13</b> <b>4: 4-14</b>
<b>SCHEMATICS</b> <b>Power Amplifier 1 - 25W</b> <b>FRACN Synthesizer</b> <b>Voltage Controlled Oscillator</b> <b>Receiver Front-End</b> <b>IF</b>	<b>4: 4-15</b> <b>4: 4-16</b> <b>4: 4-17</b> <b>4: 4-18</b> <b>4: 4-19</b>
<b>Parts List</b>	<b>4: 4-20</b>
<b>Controller version is T5</b>	

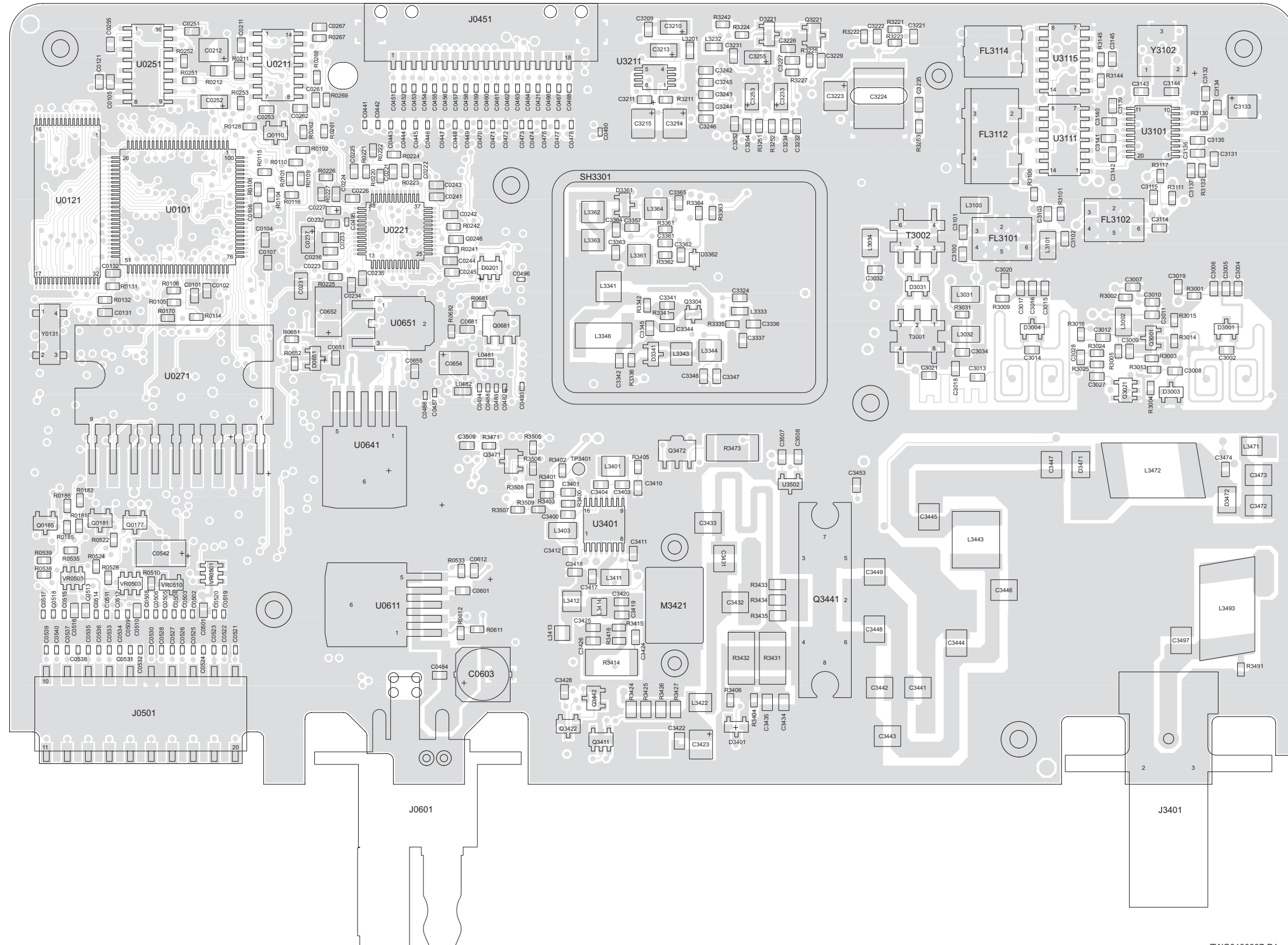
**Table 4-3** VHF 1-25W PCB 8486172B07 Diagrams and Parts Lists

<b>PCB 8486172B07:</b>	<b>Page:</b>
<b>Main Board Top Side</b>	<b>4: 4-23</b>
<b>Main Board Bottom Side</b>	<b>4: 4-24</b>
<b>SCHEMATICS</b>	
<b>Power Amplifier 1 - 25W</b>	<b>4: 4-15</b>
<b>FRACN Synthesizer</b>	<b>4: 4-25</b>
<b>Voltage Controlled Oscillator</b>	<b>4: 4-17</b>
<b>Receiver Front-End</b>	<b>4: 4-18</b>
<b>IF</b>	<b>4: 4-26</b>
<b>Parts List</b>	<b>4: 4-27</b>
<b>Controller version is T7</b>	

**Table 4-4** VHF 1-25W PCB 8486172B08 Diagrams and Parts Lists

<b>PCB 8486172B08:</b>	<b>Page:</b>
<b>Main Board Top Side</b>	<b>4: 4-30</b>
<b>Main Board Bottom Side</b>	<b>4: 4-31</b>
<b>SCHEMATICS</b>	
<b>Power Amplifier 1 - 25W</b>	<b>4: 4-32</b>
<b>FRACN Synthesizer</b>	<b>4: 4-25</b>
<b>Voltage Controlled Oscillator</b>	<b>4: 4-17</b>
<b>Receiver Front-End</b>	<b>4: 4-18</b>
<b>IF</b>	<b>4: 4-33</b>
<b>Parts List</b>	<b>4: 4-34</b>
<b>Controller version is T9</b>	

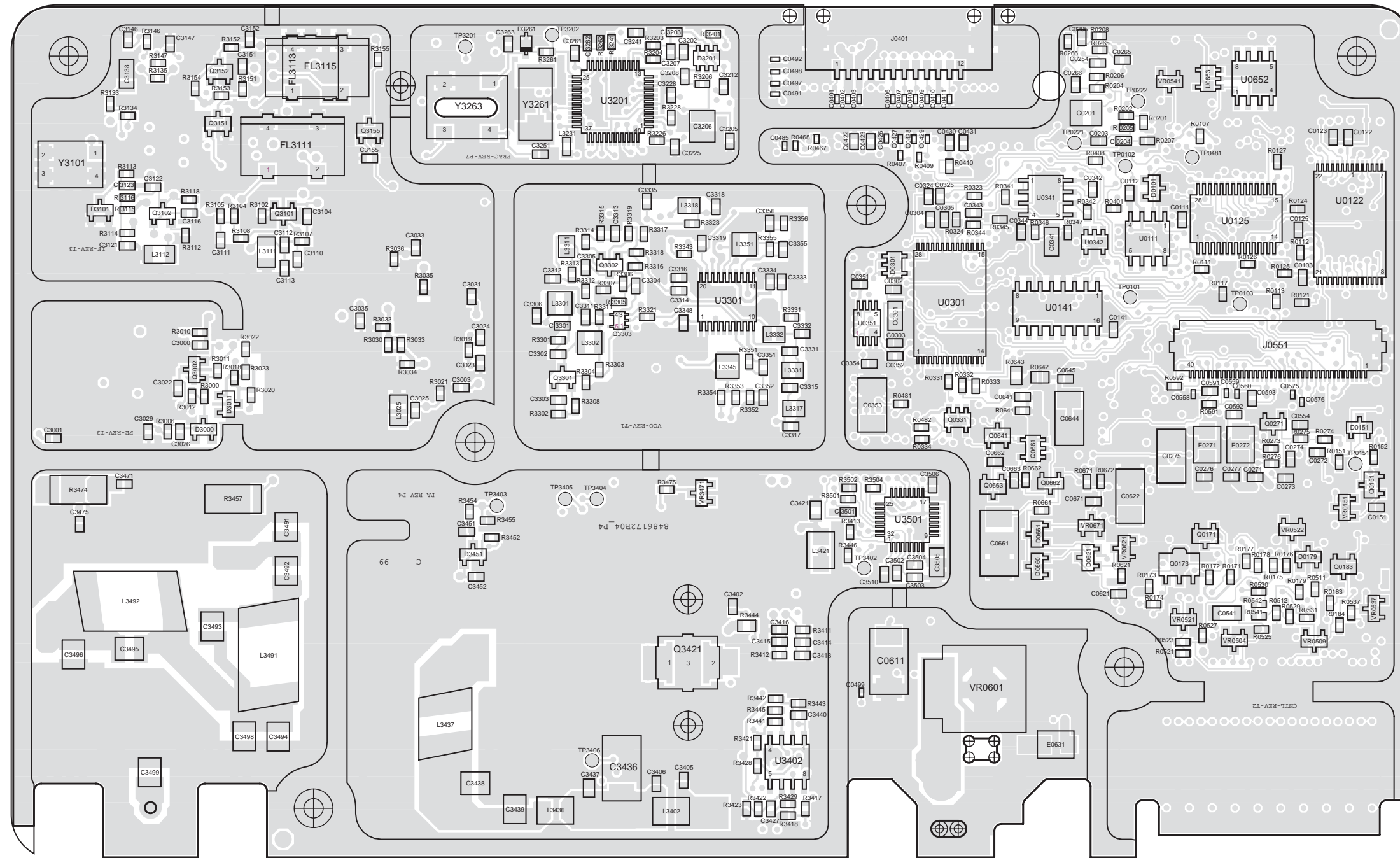
## 2.0 VHF (136-174 MHz) 1-25W PCB 8486172B04, Schematics, and Parts Lists



ZWG0130397-P4

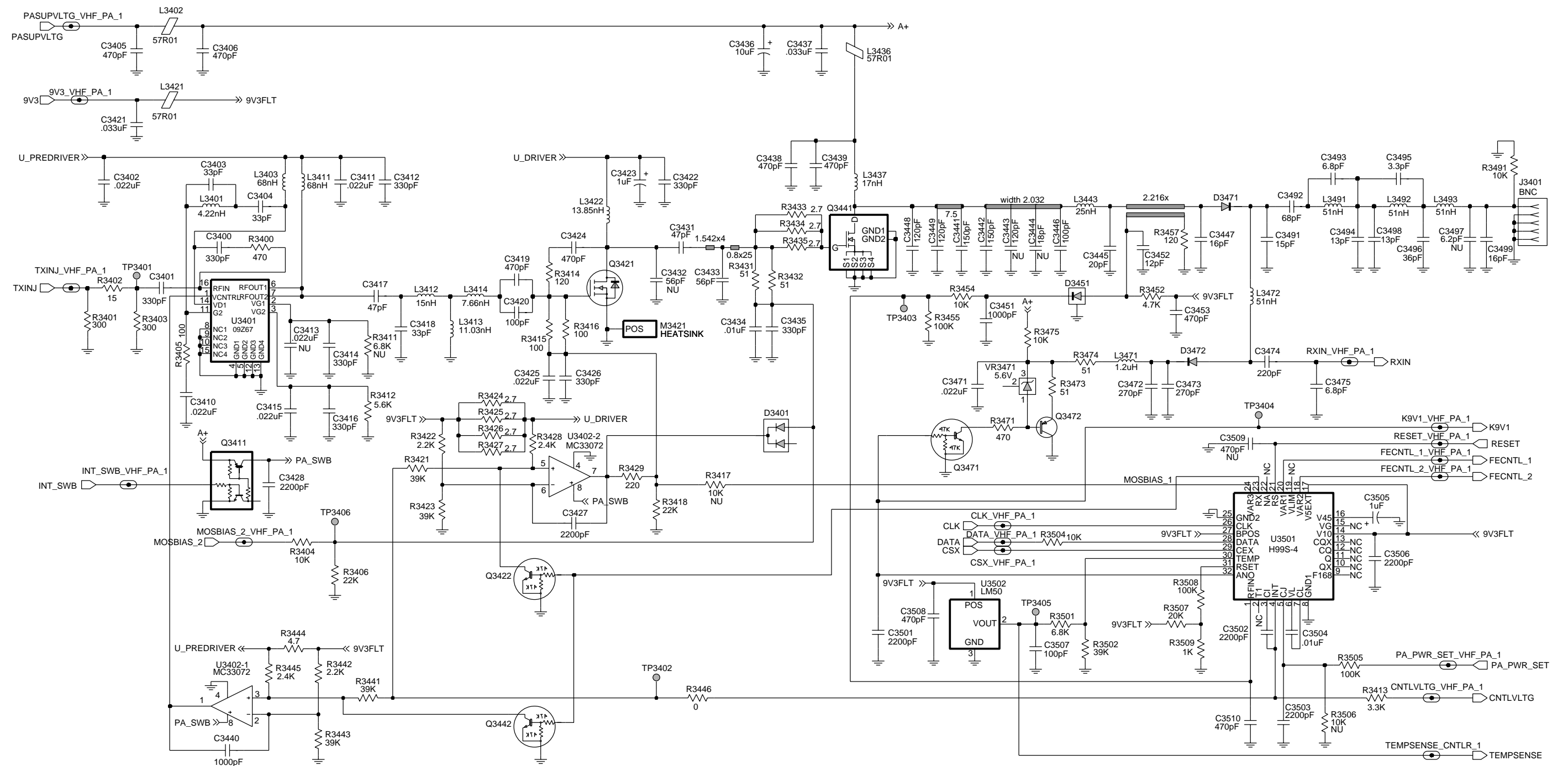
VHF (136-174 MHz) 1-25W PCB 8486172B04 Top Side

6881091C63-B



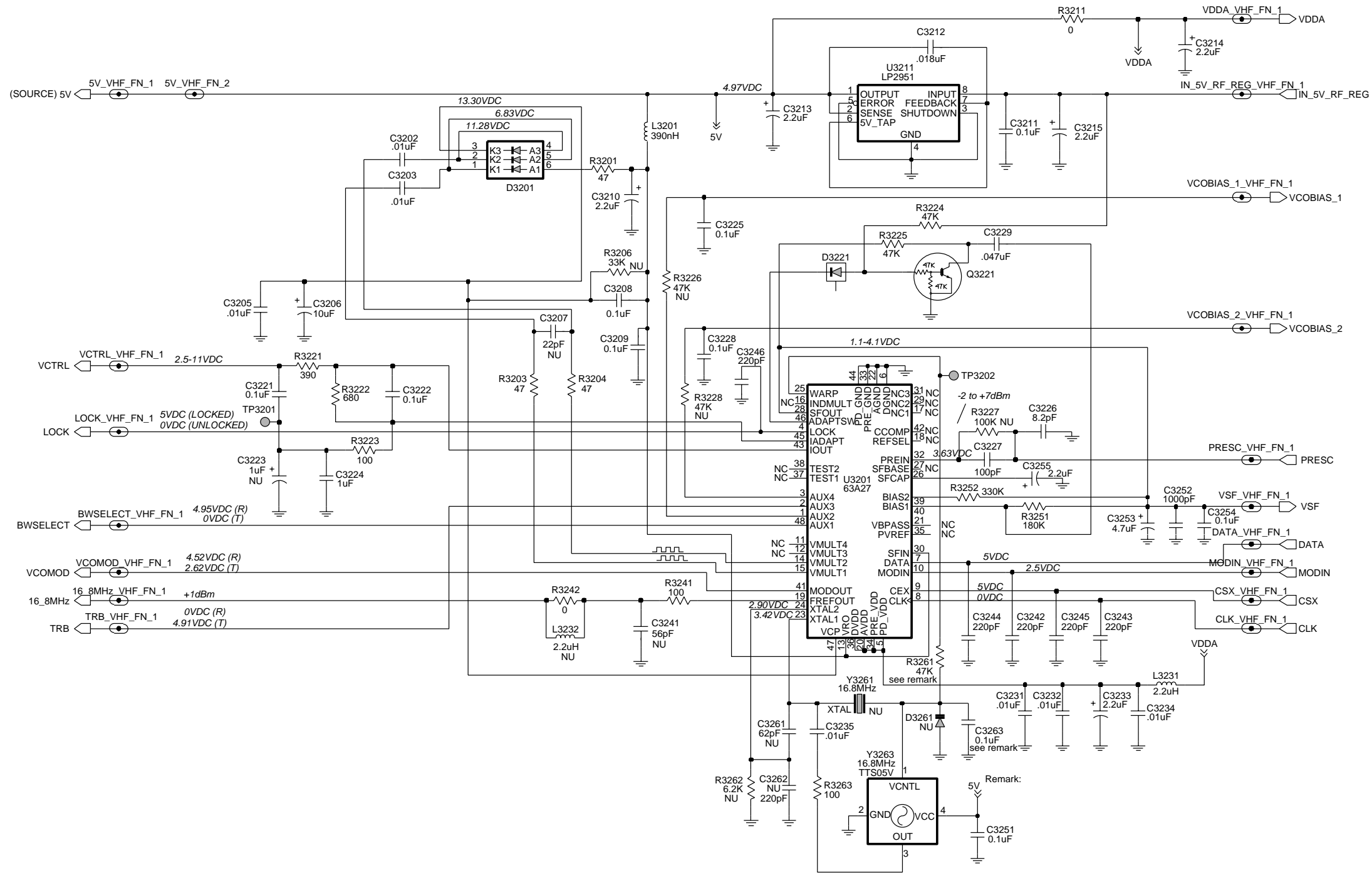
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VHF (136-174 MHz) 1-25W PCB 8486172B04 Bottom Side

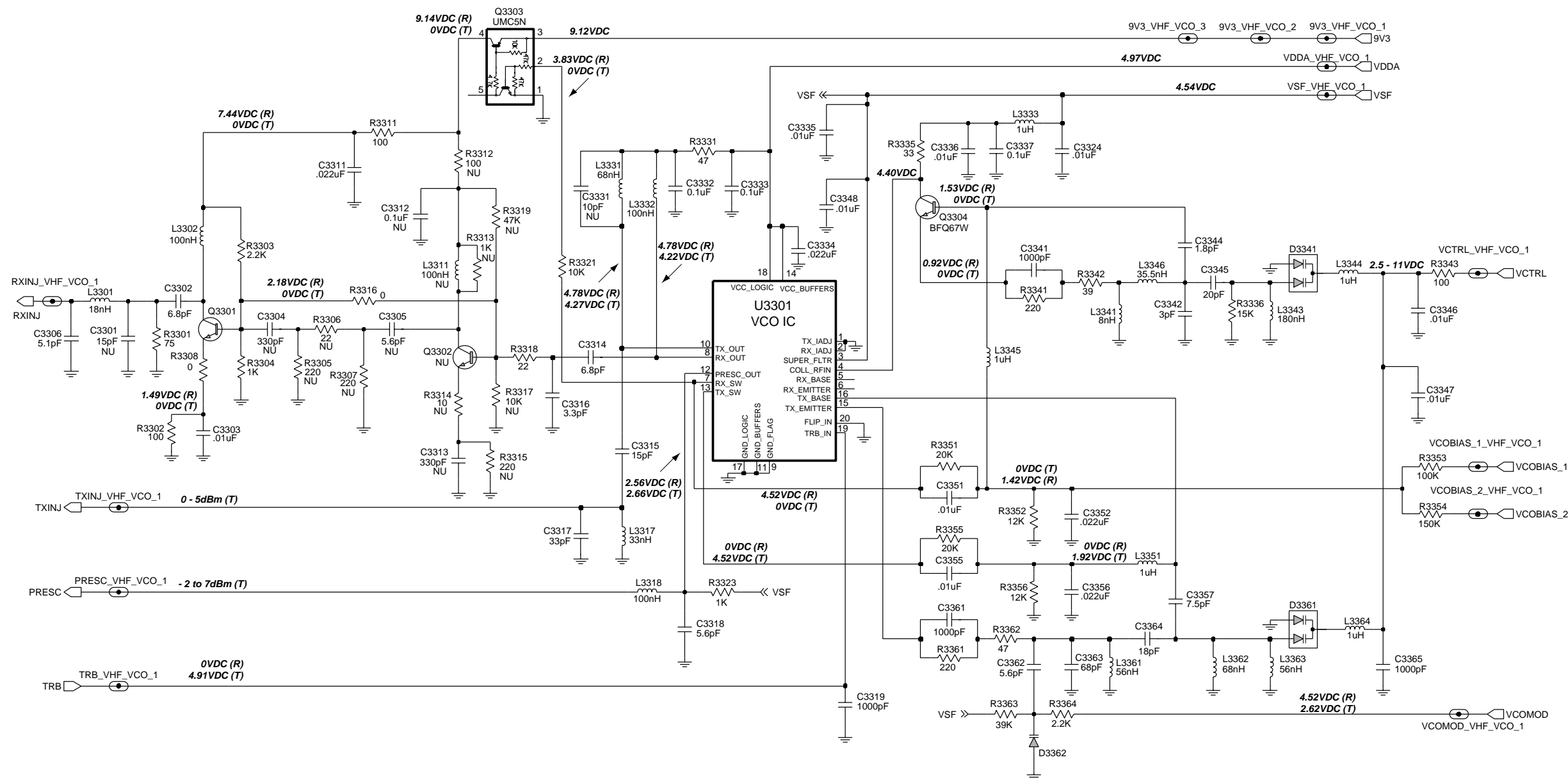


ZWG0130392-P4

**VHF (136-174 MHz) 1-25W Power Amplifier**

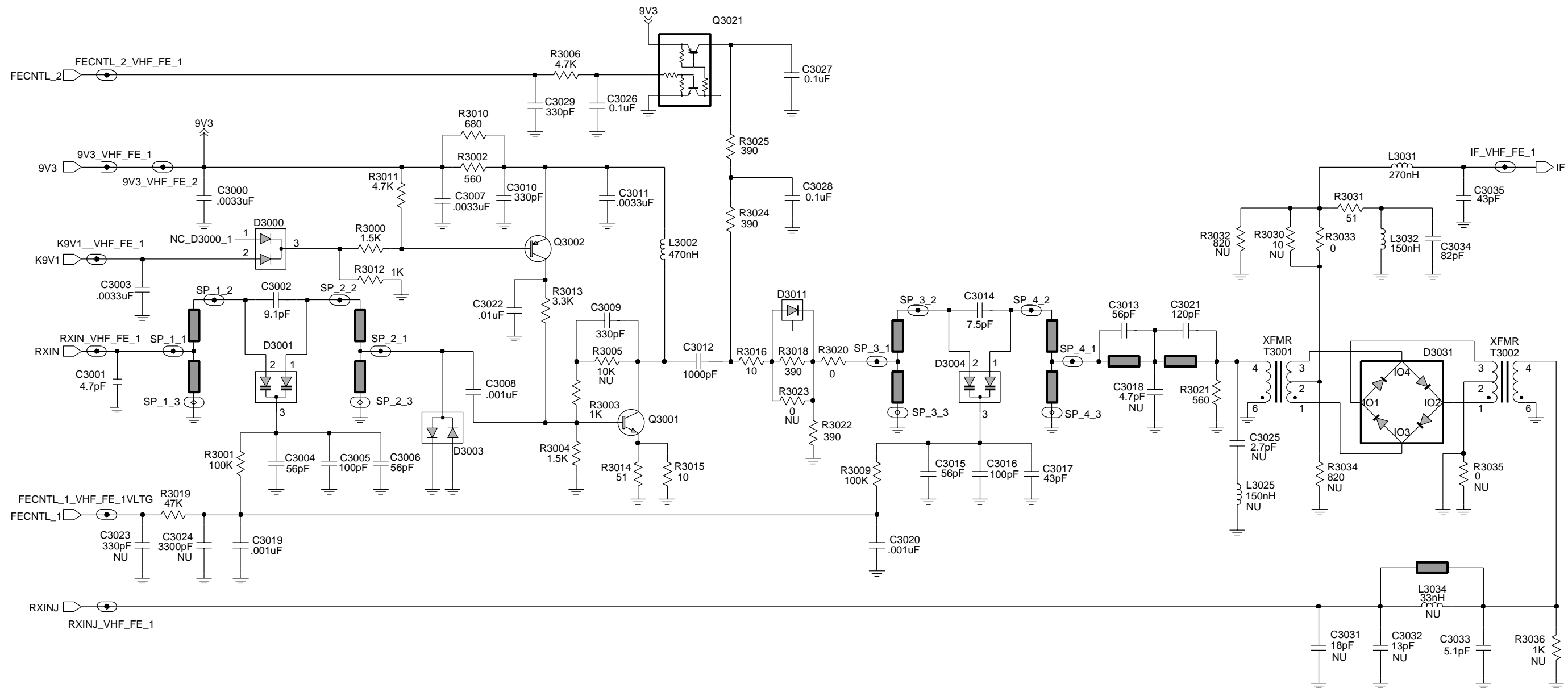


VHF (136-174 MHz) 1-25W FRACN Synthesizer



ZWG0130394-P4

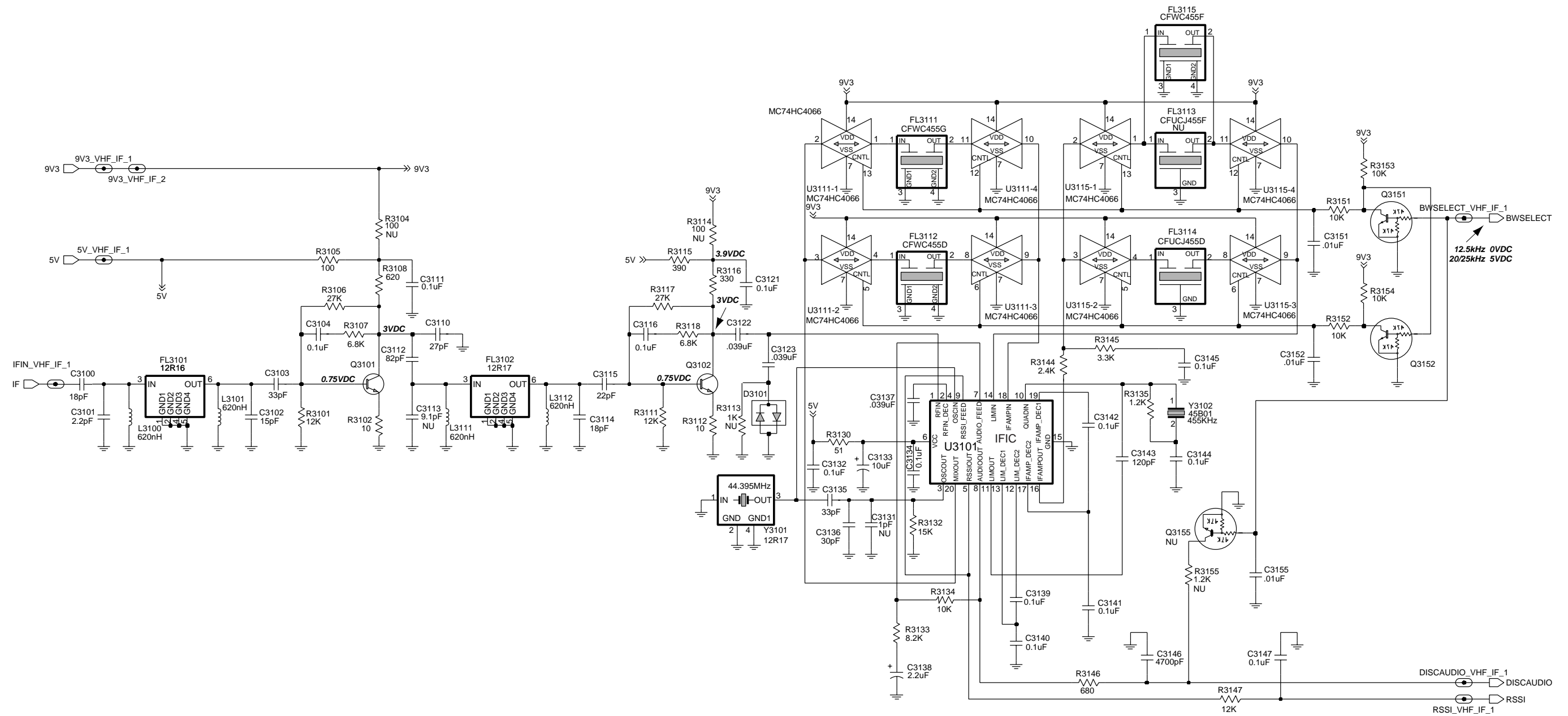
VHF (136-174 MHz) 1-25W Voltage Controlled Oscillator



ZWG0130395-P4

VHF (136-174 MHz) 1-25W Receiver Front-End





ZWG0130396-P4

**VHF (136-174 MHz) 1-25W IF**

## VHF 1-25W PCB 8486172B04 Parts List†

Circuit Ref	Motorola Part No.	Description
C3000	2113741F37	3.3nF 50V
C3001	2113740F19	4.7pF 5% 50V
C3002	2113740F26	9.1pF 5% 50V
C3003	2113741F37	3.3nF 50V
C3004	2113740F45	56pF 5% 50V
C3005	2113740F51	100pF 5% 50V
C3006	2113740F45	56pF 5% 50V
C3007	2113741F37	3.3nF 50V
C3008	2113741F25	1nF 50V
C3009	2113741F13	330pF 50V
C3010	2113741F13	330pF 50V
C3011	2113741F37	3.3nF 50V
C3012	2113741F25	1nF 50V
C3013	2113740F45	56pF 5% 50V
C3014	2113740F24	7.5pF 5% 50V
C3015	2113740F45	56pF 5% 50V
C3016	2113740F51	100pF 5% 50V
C3017	2113740F42	43pF 5% 50V
C3019	2113741F25	1nF 50V
C3020	2113741F25	1nF 50V
C3021	2113740F53	120pF 5% 50V
C3022	2113741F49	10nF 50V
C3026	2113741F25	1nF 50V
C3027	2113741F25	1nF 50V
C3033	2113740F20	5.1pF 5% 50V
C3034	2113740F49	82pF 5% 50V
C3035	2113740F42	43pF 5% 50V
C3100	2113740F33	18pF 5% 50V
C3101	2113740F11	2.2pF 5% 50V
C3102	2113740F31	15pF 5% 50V
C3103	2113740F39	33pF 5% 50V
C3104	2113743E20	100nF
C3110	2113740F37	27pF 5% 50V
C3111	2113743E20	100nF
C3112	2113740F49	82pF 5% 50V
C3114	2113740F33	18pF 5% 50V
C3115	2113740F35	22pF 5% 50V
C3116	2113743E20	100nF
C3121	2113743E20	100nF
C3122	2113743E11	39nF 10%
C3123	2113743E11	39nF 10%
C3132	2113743E20	100nF
C3133	2311049A57	TANT CP 10uF 10% 16V
C3134	2113743E20	100nF
C3135	2113740L30	33pF 2%
C3136	2113740L29	30pF 2%
C3137	2113743E11	39nF 10%
C3138	2311049A40	TANT CP 2.2uF 10% 10V
C3139	2113743E20	100nF

Circuit Ref	Motorola Part No.	Description
C3140	2113743E20	100nF
C3141	2113743E20	100nF
C3142	2113743E20	100nF
C3143	2113740F53	120pF 5% 50V
C3144	2113743E20	100nF
C3145	2113743E20	100nF
C3146	2113741F41	4.7nF 50V
C3147	2113743E20	100nF
C3151	2113741F49	10nF 50V
C3152	2113741F49	10nF 50V
C3155	2113741F49	10nF 50V
C3202	2113741F49	10nF 50V
C3203	2113741F49	10nF 50V
C3205	2113741F49	10nF 50V
C3206	2311049A57	TANT CP 10uF 10% 16V
C3208	2113743E20	100nF
C3209	2113743E20	100nF
C3210	2311049A40	TANT CP 2.2uF 10% 10V
C3211	2113743E20	100nF
C3212	2113743E05	18nF
C3213	2311049A40	TANT CP 2.2uF 10% 10V
C3214	2311049A09	TANT CP 2.2uF 10% 20V
C3215	2311049A09	TANT CP 2.2uF 10% 20V
C3221	2113743E20	100nF
C3222	2113743E20	100nF
C3224	0882422W23	FILM SM 1.0uF 15V 5%
C3225	2113743E20	100nF
C3226	2113740F25	8.2pF 5% 50V
C3227	2113740F51	100pF 5% 50V
C3228	2113743E20	100nF
C3229	2113743E12	47nF 10%
C3231	2113741F49	10nF 50V
C3232	2113741F49	10nF 50V
C3233	2311049A40	TANT CP 2.2uF 10% 10V
C3234	2113741F49	10nF 50V
C3235	2113741F49	10nF 50V
C3242	2113740F59	220pF 5% 50V
C3243	2113740F59	220pF 5% 50V
C3244	2113740F59	220pF 5% 50V
C3245	2113740F59	220pF 5% 50V
C3246	2113740F59	220pF 5% 50V
C3251	2113743E20	100nF
C3252	2113741F25	1nF 50V
C3253	2311049A56	TANT CP 4.7uF 20% 10V
C3254	2113743E20	100nF
C3255	2311049A40	TANT CP 2.2uF 10% 10V
C3263	2113743E20	100nF
C3302	2113740F23	6.8pF 5% 50V
C3303	2113741F49	10nF 50V
C3306	2113740F20	5.1pF 5% 50V
C3311	2113743E07	22nF

Circuit Ref	Motorola Part No.	Description
C3314	2113740F23	6.8pF 5% 50V
C3315	2113740F31	15pF 5% 50V
C3316	2113740F15	3.3pF 5% 50V
C3317	2113740F39	33pF 5% 50V
C3318	2113740F21	5.6pF 5% 50V
C3319	2113741F25	1nF 50V
C3324	2113741F49	10nF 50V
C3332	2113743E20	100nF
C3333	2113743E20	100nF
C3334	2113743E07	22nF
C3335	2113741F49	10nF 50V
C3336	2113741F49	10nF 50V
C3337	2113743E20	100nF
C3341	2113741F25	1nF 50V
C3342	2113740L05	3.0pF +/-0.1pF
C3344	2113740F09	1.8pF 5% 50V
C3345	2113740L25	20pF +/-0.25pF
C3346	2113741F49	10nF 50V
C3347	2113741F49	10nF 50V
C3348	2113741F49	10nF 50V
C3351	2113741F49	10nF 50V
C3352	2113743E07	22nF
C3355	2113741F49	10nF 50V
C3356	2113743E07	22nF
C3357	2113740F24	7.5pF 5% 50V
C3361	2113741F25	1nF 50V
C3362	2113740F21	5.6pF 5% 50V
C3363	2113740F47	68pF 5% 50V
C3364	2113740F33	18pF 5% 50V
C3365	2113741F25	1nF 50V
C3400	2113740F63	330pF 5% 50V
C3401	2113740F63	330pF 5% 50V
C3402	2113743E07	22nF
C3403	2113740F39	33pF 5% 50V
C3404	2113740F39	33pF 5% 50V
C3405	2113740F67	470pF 5% 50V
C3406	2113740F67	470pF 5% 50V
C3410	2113743E07	22nF
C3411	2113743E07	22nF
C3412	2113740F63	330pF 5% 50V
C3414	2113740F63	330pF 5% 50V
C3415	2113743E07	22nF
C3416	2113740F63	330pF 5% 50V
C3417	2113740F43	47pF 5% 50V
C3418	2113740F39	33pF 5% 50V
C3419	2113741F17	470pF 50V
C3420	2113740F51	100pF 5% 50V
C3421	2113741A57	33nF 50V
C3422	2113740A67	330pF 5% 50V
C3423	2311049A08	TANT CP 1uF 10% 35V
C3424	2113740F67	470pF 5% 50V

Circuit Ref	Motorola Part No.	Description
C3425	2113743E07	22nF
C3426	2113740F63	330pF 5% 50V
C3427	2113741F33	2.2nF 50V
C3428	2113741F33	2.2nF 50V
C3431	2111078B34	HQ 47pF 5%
C3433	2111078B36	HQ 56pF 5%
C3434	2113741A45	10nF 50V
C3435	2113740A67	330pF 5% 50V
C3436	2311049A45	TANT CP 10uF 10% 35V
C3437	2113741A57	33nF 50V
C3438	2111078B59	HQ 470pF 5%
C3439	2111078B59	HQ 470pF 5%
C3440	2113741F25	1nF 50V
C3441	2111078B47	HQ 150pF 5%
C3442	2111078B47	HQ 150pF 5%
C3445	2111078B21	HQ 20pF 5%
C3446	2111078B42	HQ 100pF 5%
C3447	2111078B19	HQ 16pF 5%
C3448	2111078B44	HQ 120pF 5%
C3449	2111078B44	HQ 120pF 5%
C3451	2113741F25	1nF 50V
C3452	2113740F29	12pF 5% 50V
C3453	2113740F67	470pF 5% 50V
C3471	2113743E07	22nF
C3472	2111078B53	HQ 270pF 5%
C3473	2111078B53	HQ 270pF 5%
C3474	2113740F59	220pF 5% 50V
C3475	2113740F23	6.8pF 5% 50V
C3491	2111078B18	HQ 15pF 5%
C3492	2111078B38	HQ 68pF 5%
C3493	2111078B09	HQ 6.8pF 5%
C3494	2111078B16	HQ 13pF 5%
C3495	2111078B01	HQ 3.3pF 5%
C3496	2111078B31	HQ 36pF 5%
C3498	2111078B16	HQ 13pF 5%
C3499	2111078B19	HQ 16pF 5%
C3501	2113741F33	2.2nF 50V
C3502	2113741F33	2.2nF 50V
C3503	2113741F33	2.2nF 50V
C3504	2113741F49	10nF 50V
C3505	2311049A07	TANT CP 1uF 10% 16V
C3506	2113741F33	2.2nF 50V
C3507	2113740F51	100pF 5% 50V
C3508	2113740F67	470pF 5% 50V
C3510	2113740F67	470pF 5% 50V
D3000	4813833C02	DUAL SOT MMBD6100
D3001	4805649Q13	VCTR 1SV228 SOT23
D3003	4880154K03	DUAL SCHOTTKY SOT23
D3004	4805649Q13	VCTR 1SV228 SOT23
D3011	4880142L01	PIN
D3031	4886143B01	MIXER DIODE CROSSOVER

Circuit Ref	Motorola Part No.	Description
D3101	4880154K03	DUAL SCHOTTKY SOT23
D3201	4802233J09	TRIPLE SOT143-RH
D3221	4880236E05	CHIP SCHOTTKY
D3341	4805649Q13	VCTR 1SV228 SOT23
D3361	4805649Q13	VCTR 1SV228 SOT23
D3362	4862824C01	VARACTOR CHIP
D3401	4813833C02	DUAL SOT MMBD6100
D3451	4880236E05	CHIP SCHOTTKY
D3471	4802482J02	PIN MA/COM
D3472	4802482J02	PIN MA/COM
FL3101	9180112R16	44.85 MHZ XSTAL FLTR 80dB
FL3102	9180112R16	44.85 MHZ XSTAL FLTR 80dB
FL3111	9180469V03	CER FLTR 6EL 455 KHZ SMD
FL3112	9180469V06	CER FLTR 6EL 455 KHZ SMD
FL3114	9180468V06	CER FLTR 4EL 455 KHZ SMD
FL3115	9180469V04	CER FLTR 6EL 455 KHZ SMD
J0401	0902636Y02	FLEX CONNECTOR
J0451	0902636Y01	FLEX CONNECTOR
J0501	0986105B01	ACCESSORY CONNECTOR
J0551	0905505Y04	FLEX CONNECTOR
J0552	0905505Y03	FLEX CONNECTOR
J0601	0986165B01	DC POWER CONNECTOR
J3401	0986166B02	RF CONNECTOR (MINI UHF)
L3002	2462587T23	COIL CHIP 470nH
L3021	2462587T30	COIL CHIP 1uH
L3031	2462587T20	COIL CHIP 270nH
L3032	2462587T17	COIL CHIP 150nH
L3100	2462587T25	COIL CHIP 620nH
L3101	2462587T25	COIL CHIP 620nH
L3111	2462587T25	COIL CHIP 620nH
L3112	2462587T25	COIL CHIP 620nH
L3201	2462587Q42	IND CHIP 390nH 10%
L3231	2462587Q20	IND CHIP 2.2uH 20%
L3301	2462587N44	CHIP IND 18 NH 5%
L3302	2462587N53	CHIP IND 100 nH 5%
L3317	2462587V28	CHIP IND 33 NH 5%
L3318	2462587V34	IND CHIP 100nH 5%
L3331	2462587V32	CHIP IND 68NH 5%
L3332	2462587V15	IND CHIP 100nH 10%
L3333	2462587Q47	IND CHIP 1uH 10%
L3341	2484562T13	MINISPRING AW IND 8NH2%
L3343	2462587N56	COIL CHIP 180nH 5%
L3344	2462587N68	CHIP IND 1 uH 5%
L3345	2462587N68	CHIP IND 1 uH 5%
L3346	2484562T18	MINI-SPRING AW IND 35.5NH 2%
L3351	2462587N68	CHIP IND 1 uH 5%
L3361	2462587N50	CHIP IND 56 nH 5%
L3362	2462587N51	CHIP IND 68 nH 5%

Circuit Ref	Motorola Part No.	Description
L3363	2462587N50	CHIP IND 56 nH 5%
L3364	2462587N68	CHIP IND 1 uH 5%
L3401	2460591A01	SQUARE COIL 4.22nH 3T
L3402	2484657R01	Ferrite Bead
L3403	2462587T13	COIL CHIP 68nH
L3411	2462587T13	COIL CHIP 68nH
L3412	2462587X43	IND CHIP LO-PRO 15.0 N
L3413	2460591B04	SQUARE COIL 11.03nH 4T
L3414	2460591A11	SQUARE COIL 7.66nH 3T
L3421	2484657R01	Ferrite Bead
L3422	2460591C23	SQUARE COIL 16nH 3T
L3436	2484657R01	Ferrite Bead
L3437	2460592A01	COIL AW 17nH 2T
L3443	2460591X02	COIL SQUARE 25nH
L3471	2462587X69	IND CHIP 1.2uH 5%
L3472	2460592B01	COIL AW 51nH 4T
L3491	2460592B01	COIL AW 51nH 4T
L3492	2460592B01	COIL AW 51nH 4T
L3493	2460592B01	COIL AW 51nH 4T
M3421	2680499Z01	HEAT SPREADER
Q3001	4813827A07	NPN SML SIG MMBR9
Q3002	4813824A17	PNP 40V .2A B=100-
Q3021	4805921T02	DUAL ROHM FMC2 RH
Q3101	4813827A07	NPN SML SIG MMBR9
Q3102	4813827A07	NPN SML SIG MMBR9
Q3151	4880048M01	NPN DIG 47k/47k
Q3152	4880048M01	NPN DIG 47k/47k
Q3221	4880048M01	NPN DIG 47k/47k
Q3301	4813827A07	NPN SML SIG MMBR9
Q3303	4802245J50	DUAL NPN/PNP UMC5N
Q3304	4805218N63	RF TRANS SOT 323 Bfq67W
Q3411	4805921T02	DUAL ROHM FMC2 RH
Q3421	4802245J55	MRF1507
Q3422	4880048M01	NPN DIG 47k/47k
Q3441	4886136B01	LDMOS PWR MRF1565
Q3442	4880048M01	NPN DIG 47k/47k
Q3471	4880048M01	NPN DIG 47k/47k
Q3472	4805128M27	PNP SOT89 BSR33 LH
R3000	0662057A53	1500 1/16W 5%
R3001	0662057A97	100k 1/16W
R3002	0662057A43	560 1/16W 5%
R3003	0662057A49	1k 1/16W 5%
R3004	0662057A53	1500 1/16W 5%
R3006	0662057A39	390 1/16W 5%
R3009	0662057A97	100k 1/16W
R3010	0662057A45	680 OHMS 5%
R3011	0662057A65	4700 1/16W 5%
R3012	0662057A49	1k 1/16W 5%
R3013	0662057A61	3300 1/16W 5%
R3014	0662057A18	51 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3015	0662057A01	10 1/16W 5%
R3016	0662057A01	10 1/16W 5%
R3018	0662057A39	390 1/16W 5%
R3019	0662057A89	47k 1/16W 5%
R3020	0662057B47	0 1/16W
R3021	0662057A43	560 1/16W 5%
R3022	0662057A39	390 1/16W 5%
R3024	0662057A47	820 1/16W 5%
R3031	0662057A18	51 1/16W 5%
R3033	0662057B47	0 1/16W
R3101	0662057A75	12k 1/16W 5%
R3102	0662057A01	10 1/16W 5%
R3105	0662057A25	100 1/16W 5%
R3106	0662057A83	27k 1/16W 5%
R3107	0662057A69	6800 1/16W 5%
R3108	0662057A44	620 OHMS 5%
R3111	0662057A75	12k 1/16W 5%
R3112	0662057A01	10 1/16W 5%
R3115	0662057A39	390 1/16W 5%
R3116	0662057A37	330 1/16W 5%
R3117	0662057A83	27k 1/16W 5%
R3118	0662057A69	6800 1/16W 5%
R3130	0662057A18	51 1/16W 5%
R3132	0662057A77	15k 1/16W 5%
R3133	0662057A71	8200 1/16W 5%
R3134	0662057A73	10k 1/16W 5%
R3135	0662057A51	1200 1/16W 5%
R3144	0662057A58	2400 1/16W 5%
R3145	0662057A61	3300 1/16W 5%
R3146	0662057A45	680 OHMS 5%
R3147	0662057A75	12k 1/16W 5%
R3151	0662057A73	10k 1/16W 5%
R3152	0662057A73	10k 1/16W 5%
R3153	0662057A73	10k 1/16W 5%
R3154	0662057A73	10k 1/16W 5%
R3201	0662057A17	47 1/16W 5%
R3203	0662057A17	47 1/16W 5%
R3204	0662057A17	47 1/16W 5%
R3211	0662057B47	0 1/16W
R3221	0662057A39	390 1/16W 5%
R3222	0662057A45	680 OHMS 5%
R3223	0662057A25	100 1/16W 5%
R3224	0662057A89	47k 1/16W 5%
R3225	0662057A89	47k 1/16W 5%
R3241	0662057A25	100 1/16W 5%
R3242	0662057B47	0 1/16W
R3251	0662057B04	180k 1/16W 5%
R3252	0662057B10	330k 1/16W 5%
R3261	0662057B02	150k 1/16W
R3263	0662057A25	100 1/16W 5%
R3301	0662057A22	75 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3302	0662057A25	100 1/16W 5%
R3303	0662057A57	2200 1/16W 5%
R3304	0662057A49	1k 1/16W 5%
R3308	0662057B47	0 1/16W
R3311	0662057A25	100 1/16W 5%
R3316	0662057B47	0 1/16W
R3318	0662057A09	22 1/16W 5%
R3321	0662057A73	10k 1/16W 5%
R3323	0662057A49	1k 1/16W 5%
R3331	0662057A17	47 1/16W 5%
R3335	0662057A13	33 1/16W 5%
R3336	0662057A77	15k 1/16W 5%
R3341	0662057A33	220 1/16W 5%
R3342	0662057A15	39 1/16W 5%
R3343	0662057A25	100 1/16W 5%
R3351	0662057A80	20k 1/16W 5%
R3352	0662057A75	12k 1/16W 5%
R3353	0662057A97	100k 1/16W
R3354	0662057B02	150k 1/16W
R3355	0662057A80	20k 1/16W 5%
R3356	0662057A75	12k 1/16W 5%
R3361	0662057A33	220 1/16W 5%
R3362	0662057A17	47 1/16W 5%
R3363	0662057A87	39k 1/16W 5%
R3364	0662057A57	2200 1/16W 5%
R3400	0662057A41	470 1/16W 5%
R3401	0662057A36	300 1/16W 5%
R3402	0662057A05	15 1/16W 5%
R3403	0662057A36	300 1/16W 5%
R3404	0662057A73	10k 1/16W 5%
R3405	0662057A25	100 1/16W 5%
R3406	0662057A81	22k 1/16W 5%
R3412	0662057A67	5600 1/16W 5%
R3413	0662057A61	3300 1/16W 5%
R3414	0683962T51	120 1W 5%
R3415	0662057A25	100 1/16W 5%
R3416	0662057A25	100 1/16W 5%
R3418	0662057A81	22k 1/16W 5%
R3421	0662057A87	39k 1/16W 5%
R3422	0662057A57	2200 1/16W 5%
R3423	0662057A87	39k 1/16W 5%
R3424	0662057C13	2.7 1/10W 5%
R3425	0662057C13	2.7 1/10W 5%
R3426	0662057C13	2.7 1/10W 5%
R3427	0662057C13	2.7 1/10W 5%
R3428	0662057A58	2400 1/16W 5%
R3429	0662057A33	220 1/16W 5%
R3431	0680194M18	51 1W 5%
R3432	0680194M18	51 1W 5%
R3433	0662057C13	2.7 1/10W 5%
R3434	0662057C13	2.7 1/10W 5%

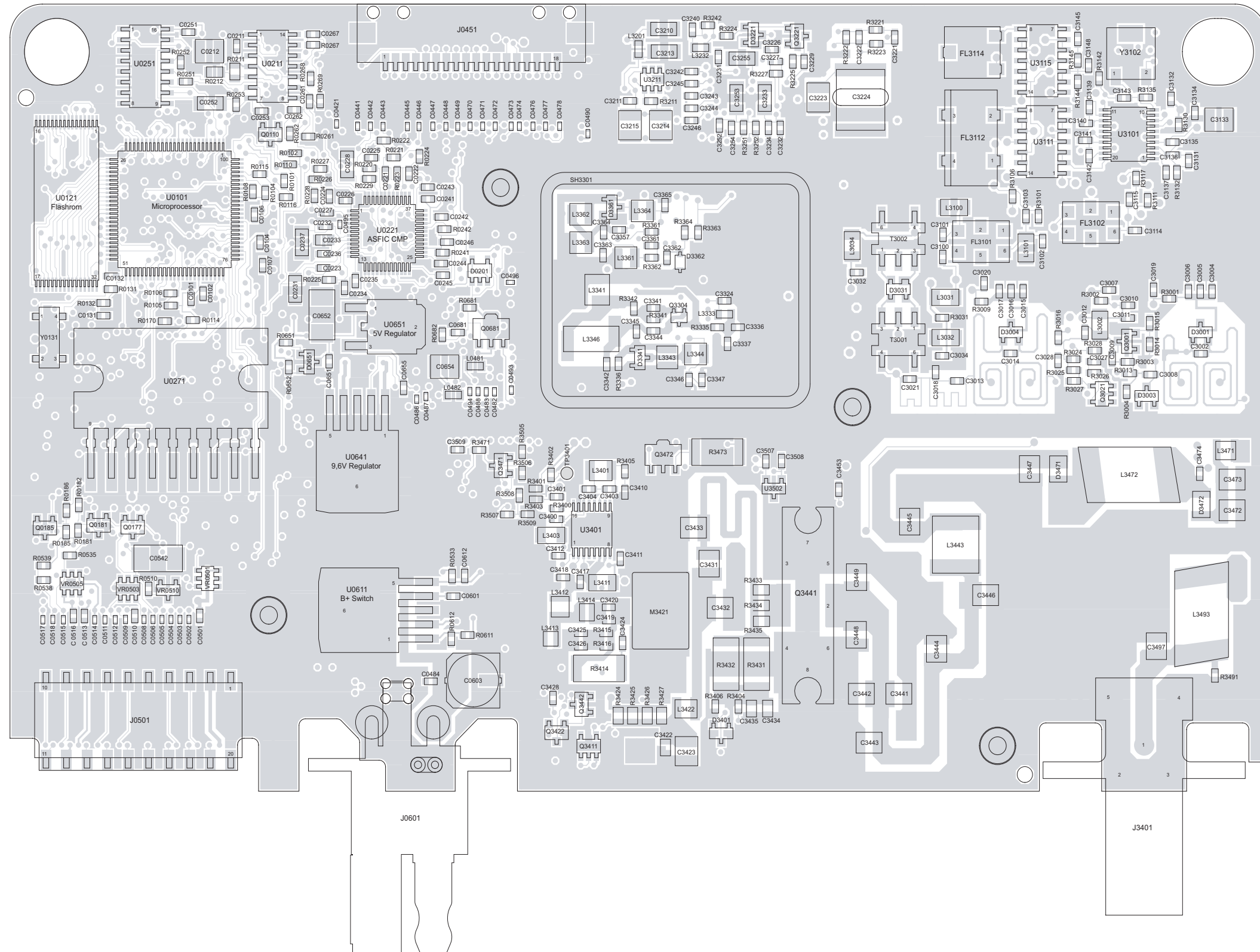
Circuit Ref	Motorola Part No.	Description
R3435	0662057C13	2.7 1/10W 5%
R3441	0662057A87	39k 1/16W 5%
R3442	0662057A57	2200 1/16W 5%
R3443	0662057A87	39k 1/16W 5%
R3444	0662057C19	4.7 1/10W 5%
R3445	0662057A58	2400 1/16W 5%
R3446	0662057B47	0 1/16W
R3452	0662057A65	4700 1/16W 5%
R3454	0662057A73	10k 1/16W 5%
R3455	0662057A97	100k 1/16W
R3457	0683962T51	120 1W 5%
R3471	0662057A41	470 1/16W 5%
R3473	0680194M18	51 1W 5%
R3474	0680194M18	51 1W 5%
R3475	0662057A73	10k 1/16W 5%
R3491	0662057A73	10k 1/16W 5%
R3501	0662057A69	6800 1/16W 5%
R3502	0662057A87	39k 1/16W 5%
R3504	0662057A73	10k 1/16W 5%
R3505	0662057A97	100k 1/16W
R3507	0662057A80	20k 1/16W 5%
R3508	0662057A97	100k 1/16W
R3509	0662057A49	1k 1/16W 5%
T3001	2508396X02	TRANSFORMER
T3002	2508397X02	TRANSFORMER
U3101	5186144B01	FM IF IC SA616
U3111	5113805A86	IC QUAD ANALOG MUX/ DEMUX
U3115	5113805A86	IC QUAD ANALOG MUX/ DEMUX
U3201	5185963A27	IC TESTED AT25016 48 PIN GFP
U3211	5185963A33	VLTG REG LP2951 SO8
U3301	5105750U54	VCO BUFFER PKG DIE
U3401	5105109Z67	LD MOS DRIVER VHF/UHF
U3402	5113818A03	IC HIGH PERFORMANCE SI
U3501	5185765B01	IC POWER CONTROL
U3502	5185963A15	TEMP SENSOR 1M5
Y3101	4880606B09	CRYSTAL 44.395 MHZ
Y3102	9186145B02	44.85 MHZ XSTAL FLTR 60dB
Y3263	4886182B01	VCTCXO 16.8MHz 2ppm TTSO5V
* Y3261	Not Used	16.8MHz 75Z04

\* Motorola Depot Servicing only

Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

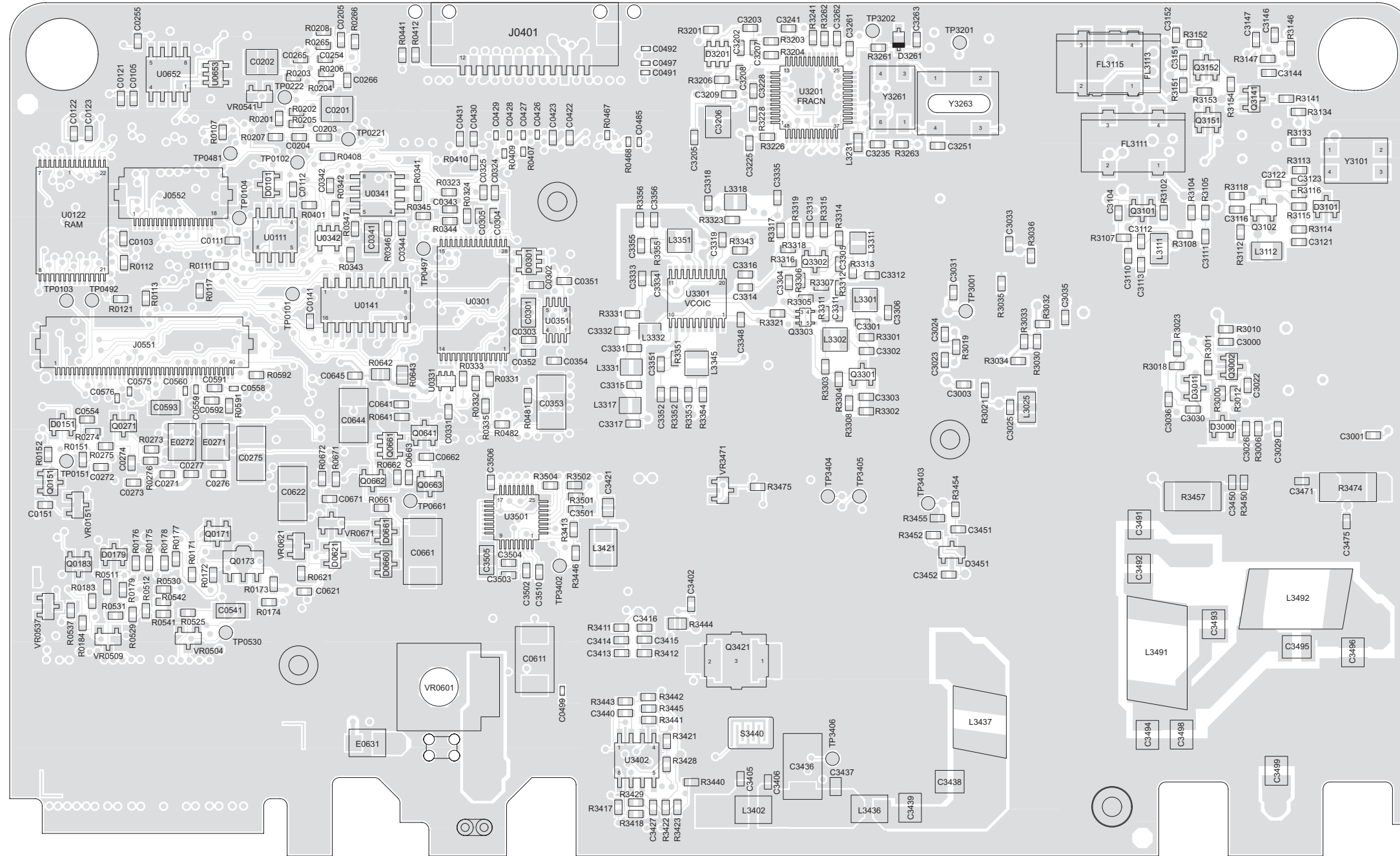
† Replacement boards must be ordered from CCSD (formerly AAD) using the number shown in the model charts in Section 1. Boards are not orderable using the 84-prefixed number.

### 3.0 VHF (136-174 MHz) 1-25W PCB 8486172B06, Schematics, and Parts Lists

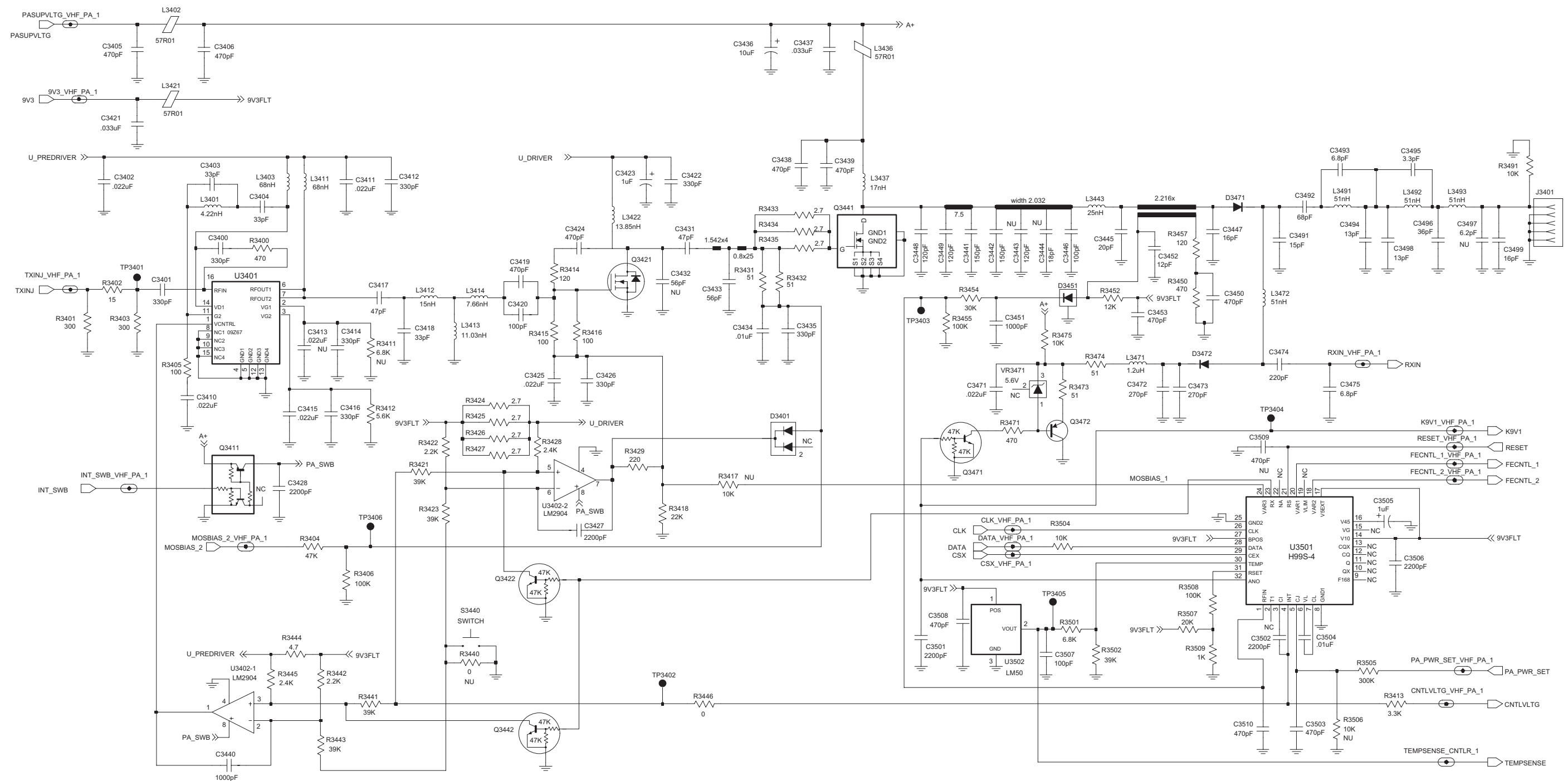


ZWG0130397-O

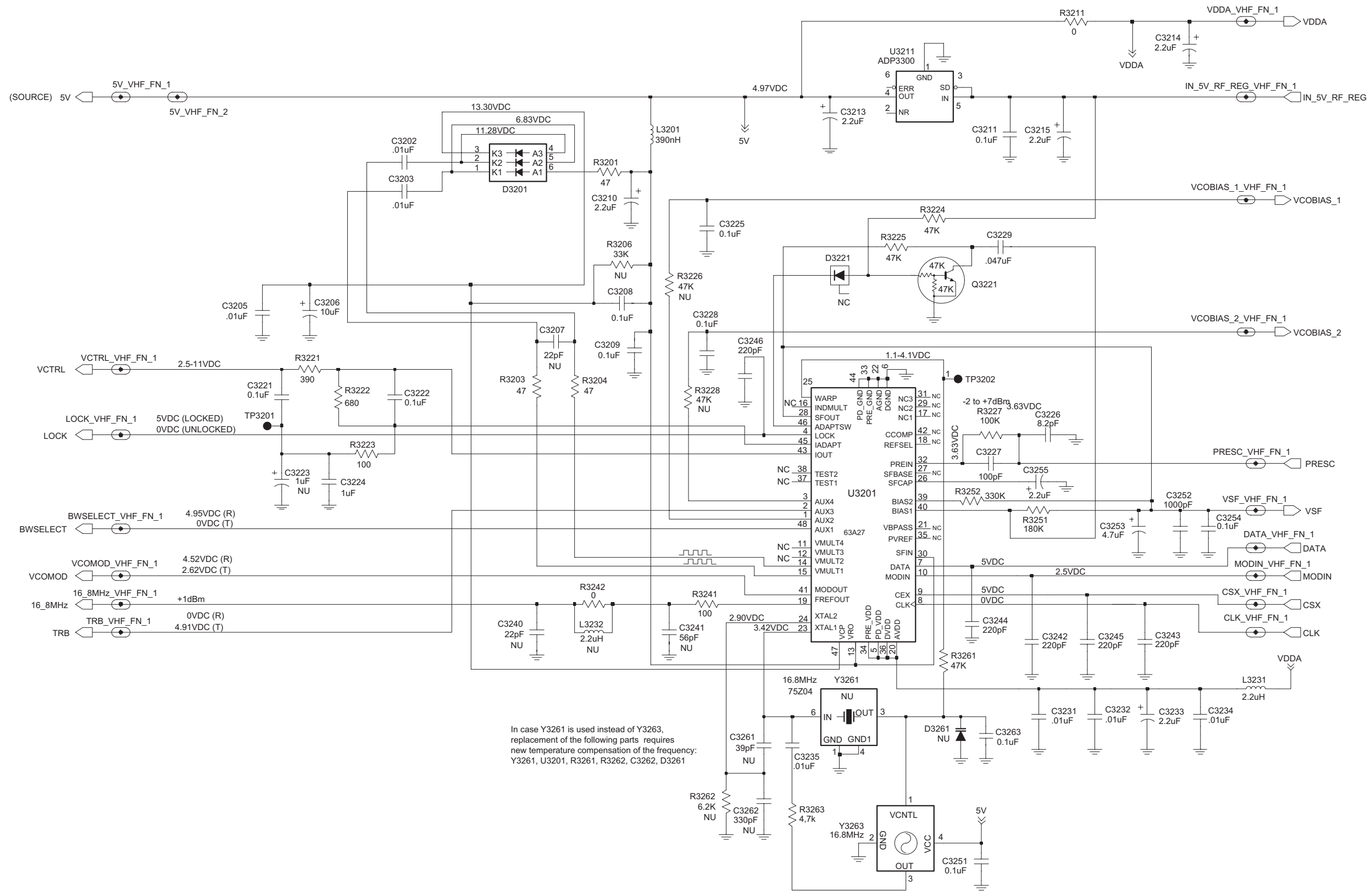
VHF (136-174 MHz) 1-25W PCB 8486172B06 Top Side



VHF (136-174 MHz) 1-25W PCB 8486172B06 Bottom Side

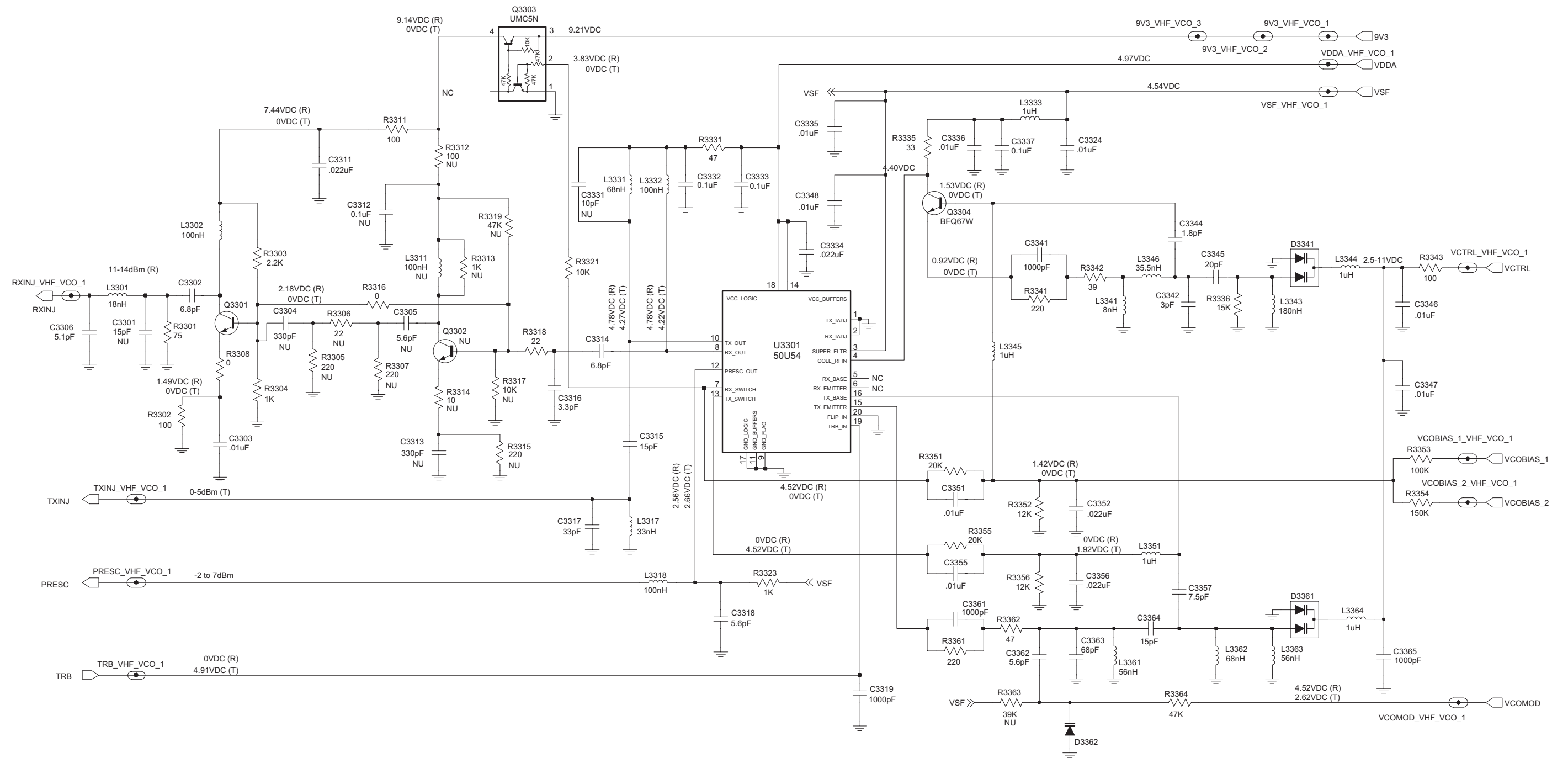


VHF (136-174 MHz) 1-25W Power Amplifier for PCBs 8486172B06 and 8486172B07



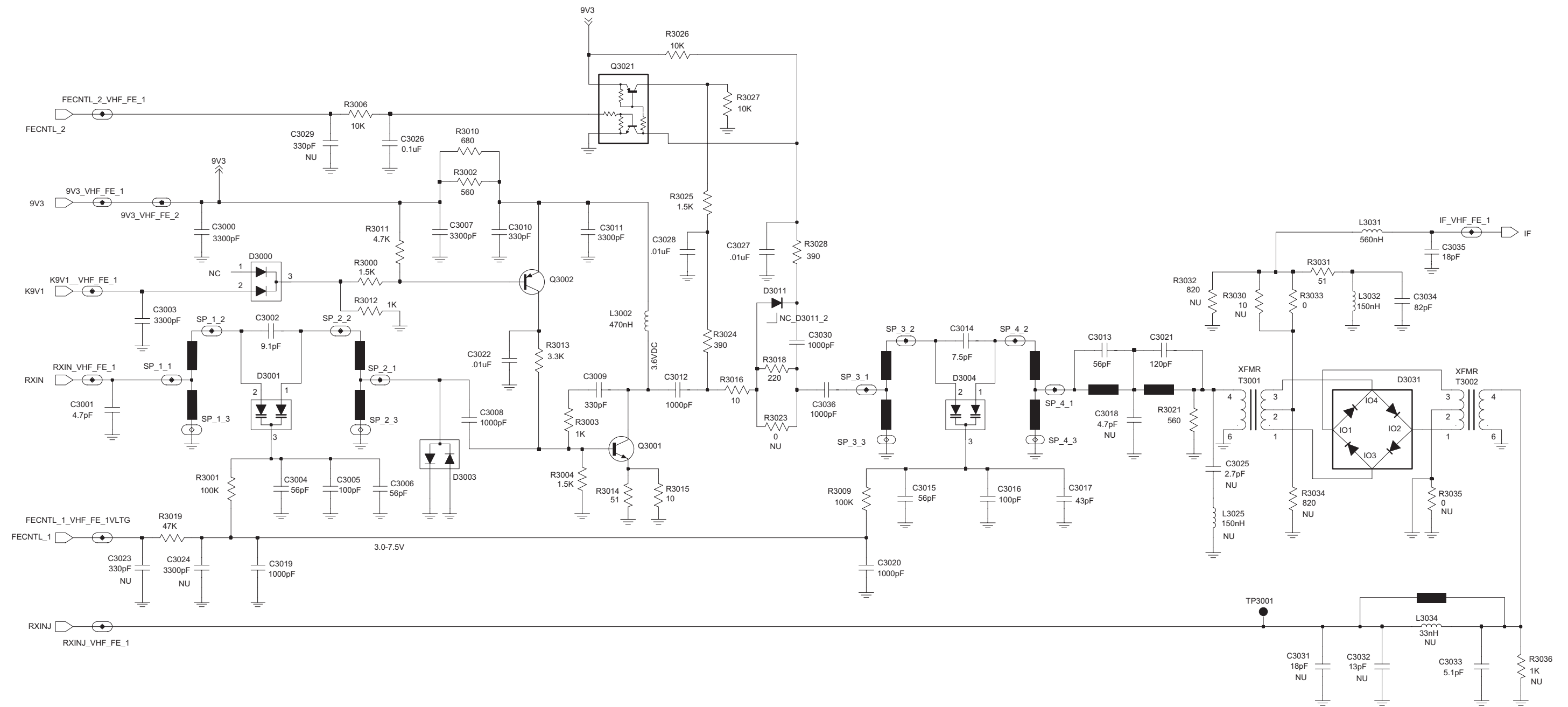
VHF (136-174 MHz) 1-25W FRACN Synthesizer





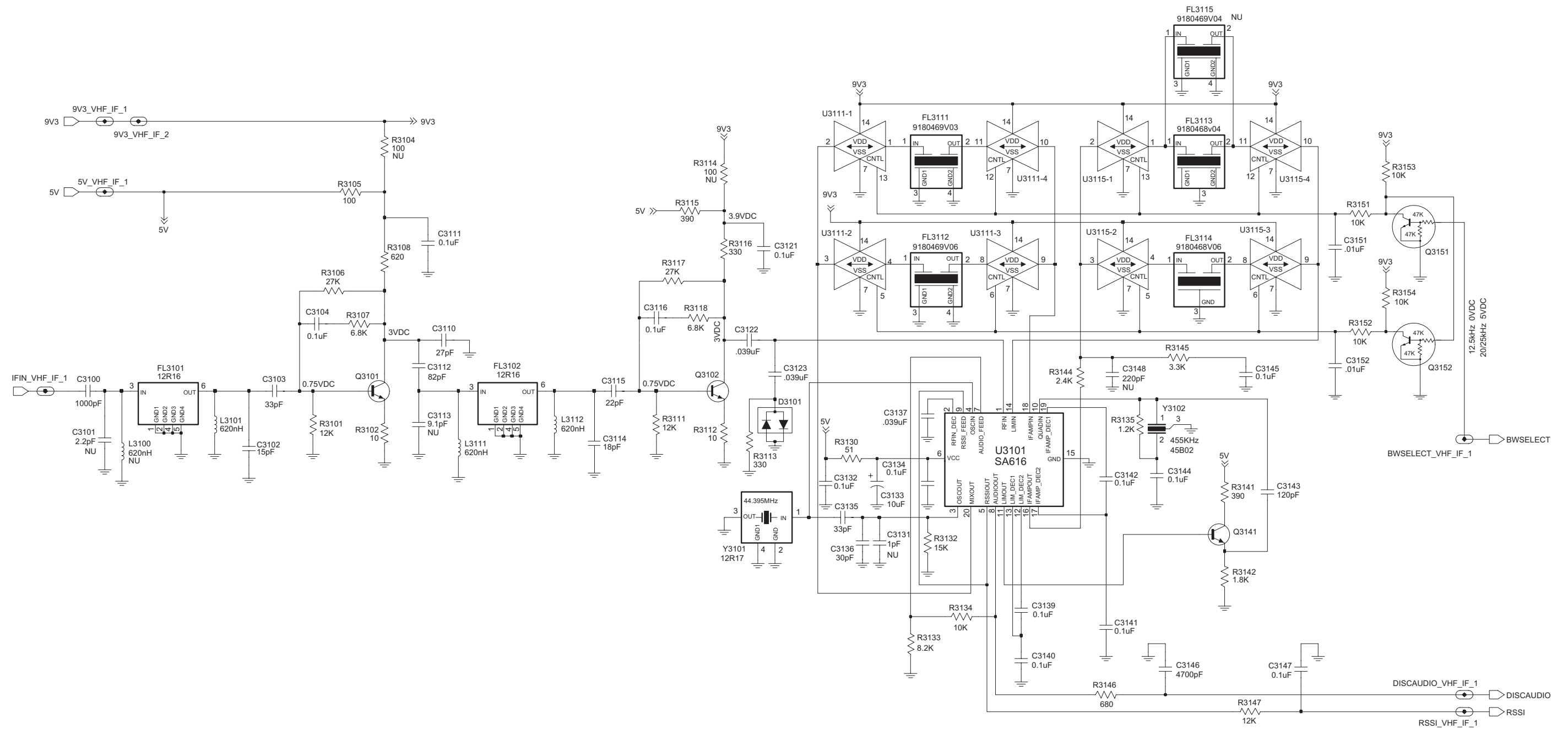
ZWG0130394-O

VHF (136-174 MHz) 1-25W Voltage Controlled Oscillator for PCBs 8486172B06, 8486172B07 and 8486172B08



ZWG0130395-A

**VHF (136-174 MHz) 1-25W Receiver Front-End for PCBs 8486172B06, 8486172B07 and 8486172B08**



VHF (136-174 MHz) 1-25W IF

## VHF 1-25W PCB 8486172B06 Parts List†

Circuit Ref	Motorola Part No.	Description
C3000	2113741F37	3.3nF 50V
C3001	2113740F19	4.7pF 5%
C3002	2113740F26	9.1pF 5%
C3003	2113741F37	3.3nF 50V
C3004	2113740F45	56pF 5%
C3005	2113740F51	100pF 5%
C3006	2113740F45	56pF 5%
C3007	2113741F37	3.3nF 50V
C3008	2113741F25	1nF 50V
C3009	2113741F13	330pF 50V
C3010	2113741F13	330pF 50V
C3011	2113741F37	3.3nF 50V
C3012	2113741F25	1nF 50V
C3013	2113740F45	56pF 5%
C3014	2113740F24	7.5pF 5%
C3015	2113740F45	56pF 5%
C3016	2113740F51	100pF 5% 50V
C3017	2113740F42	43pF 5% 50V
C3019	2113741F25	1nF 50V
C3020	2113741F25	1nF 50V
C3021	2113740F53	120pF 5% 50V
C3022	2113741F49	10nF 50V
C3026	2113743E20	100nF 16V
C3027	2113741F49	10nF 50V
C3028	2113741F49	10nF 50V
C3030	2113741F25	1nF 50V
C3033	2113740F20	5.1pF 5% 50V
C3034	2113740F49	82pF 5% 50V
C3035	2113740F33	18pF 5% 50V
C3036	2113741F25	1nF 50V
C3100	2113741F25	1nF 50V
C3102	2113740F31	15pF 5% 50V
C3103	2113740F39	33pF 5% 50V
C3104	2113743E20	100nF 16V
C3110	2113740F37	27pF 5% 50V
C3111	2113743E20	100nF 16V
C3112	2113740F49	82pF 5% 50V
C3114	2113740F33	18pF 5% 50V
C3115	2113740F35	22pF 5% 50V
C3116	2113743E20	100nF 16V
C3121	2113743E20	100nF 16V
C3122	2113743E11	39nF 10%
C3123	2113743E11	39nF 10%
C3132	2113743E20	100nF 16V
C3133	2311049A57	TANT CP 10uF 10% 16V
C3134	2113743E20	100nF 16V
C3135	2113740L30	33pF 2%
C3136	2113740L29	30pF 2%
C3137	2113743E11	39nF 10%

Circuit Ref	Motorola Part No.	Description
C3139	2113743E20	100nF 16V
C3140	2113743E20	100nF 16V
C3141	2113743E20	100nF 16V
C3142	2113743E20	100nF 16V
C3143	2113740F53	120pF 5% 50V
C3144	2113743E20	100nF 16V
C3145	2113743E20	100nF 16V
C3146	2113741F41	4.7nF 50V
C3147	2113743E20	100nF 16V
C3151	2113741F49	10nF 50V
C3152	2113741F49	10nF 50V
C3202	2113741F49	10nF 50V
C3203	2113741F49	10nF 50V
C3205	2113741F49	10nF 50V
C3206	2311049A57	TANT CP 10uF 10% 16V
C3208	2113743E20	100nF 16V
C3209	2113743E20	100nF 16V
C3210	2311049A40	TANT CP 2.2uF 10% 10V
C3211	2113743E20	100nF 16V
C3213	2311049A40	TANT CP 2.2uF 10% 10V
C3214	2311049A09	TANT CP 2.2uF 10% 20V
C3215	2311049A09	TANT CP 2.2uF 10% 20V
C3221	2113743E20	100nF 16V
C3222	2113743E20	100nF 16V
C3224	0882422W23	FILM SM 1.0uF 15V 5%
C3225	2113743E20	100nF 16V
C3226	2113740F25	8.2pF 5% 50V
C3227	2113740F51	100pF 5% 50V
C3228	2113743E20	100nF 16V
C3229	2113743E12	47nF 10%
C3231	2113741F49	10nF 50V
C3232	2113741F49	10nF 50V
C3233	2311049A40	TANT CP 2.2uF 10%
C3234	2113741F49	10nF 50V
C3235	2113741F49	10nF 50V
C3242	2113740F59	220pF 5% 50V
C3243	2113740F59	220pF 5% 50V
C3244	2113740F59	220pF 5% 50V
C3245	2113740F59	220pF 5% 50V
C3246	2113740F59	220pF 5% 50V
C3251	2113743E20	100nF 16V
C3252	2113741F25	1nF 50V
C3253	2311049A56	TANT CP 4.7uF 20% 10V
C3254	2113743E20	100nF 16V
C3255	2311049A40	TANT CP 2.2uF 10% 10V
C3263	2113743E20	100nF 16V
C3302	2113740F23	6.8pF 5% 50V
C3303	2113741F49	10nF 50V
C3306	2113740F20	5.1pF 5% 50V
C3311	2113743E07	22nF 16V
C3314	2113740F23	6.8pF 5% 50V

Circuit Ref	Motorola Part No.	Description
C3315	2113740F31	15pF 5% 50V
C3316	2113740F15	3.3pF 5% 50V
C3317	2113740F39	33pF 5% 50V
C3318	2113740F21	5.6pF 5% 50V
C3319	2113741F25	1nF 50V
C3324	2113741F49	10nF 50V
C3332	2113743E20	100nF 16V
C3333	2113743E20	100nF 16V
C3334	2113743E07	22nF 16V
C3335	2113741F49	10nF 50V
C3336	2113741F49	10nF 50V
C3337	2113743E20	100nF 16V
C3341	2113741F25	1nF 50V
C3342	2113740L05	3.0pF +/-0.1pF
C3344	2113740F09	1.8pF 5% 50V
C3345	2113740L25	20pF +/-0.25pF
C3346	2113741F49	10nF 50V
C3347	2113741F49	10nF 50V
C3348	2113741F49	10nF 50V
C3351	2113741F49	10nF 50V
C3352	2113743E07	22nF 16V
C3355	2113741F49	10nF 50V
C3356	2113743E07	22nF 16V
C3357	2113740F24	7.5pF 5% 50V
C3361	2113741F25	1nF 50V
C3362	2113740F21	5.6pF 5% 50V
C3363	2113740F47	68pF 5% 50V
C3364	2113740F31	15pF 5% 50V
C3365	2113741F25	1nF 50V
C3400	2113740F63	330pF 5% 50V
C3401	2113740F63	330pF 5% 50V
C3402	2113743E07	22nF 16V
C3403	2113740F39	33pF 5% 50V
C3404	2113740F39	33pF 5% 50V
C3405	2113740F67	470pF 5% 50V
C3406	2113740F67	470pF 5% 50V
C3410	2113743E07	22nF 16V
C3411	2113743E07	22nF 16V
C3412	2113740F63	330pF 5% 50V
C3414	2113740F63	330pF 5% 50V
C3415	2113743E07	22nF 16V
C3416	2113740F63	330pF 5% 50V
C3417	2113740F43	47pF 5% 50V
C3418	2113740F39	33pF 5% 50V
C3419	2113740F57	180pF 5% 50V
C3420	2113740F57	180pF 5% 50V
C3421	2113741A57	33nF 50V
C3422	2113740A67	330pF 5% 50V
C3423	2311049A08	TANT CP 1uF 10% 35V
C3424	2113740F67	470pF 5% 50V
C3425	2113743E07	22nF 16V

Circuit Ref	Motorola Part No.	Description
C3426	2113740F63	330pF 5% 50V
C3427	2113741F33	2.2nF 50V
C3428	2113741F33	2.2nF 50V
C3431	2111078B34	HQ 47pF 5%
C3433	2111078B36	HQ 56pF 5%
C3434	2113741A45	10nF 50V
C3435	2113740A67	330pF 5% 50V
C3436	2311049A45	TANT CP 10uF 10% 35V
C3437	2113741A57	33nF 50V
C3438	2111078B59	HQ 470pF 5%
C3439	2111078B59	HQ 470pF 5%
C3440	2113741F25	1nF 50V
C3441	2111078B47	HQ 150pF 5%
C3442	2111078B47	HQ 150pF 5%
C3445	2111078B21	HQ 20pF 5%
C3446	2111078B42	HQ 100pF 5%
C3447	2111078B19	HQ 16pF 5%
C3448	2111078B44	HQ 120pF 5%
C3449	2111078B44	HQ 120pF 5%
C3450	2113740F67	470pF 5% 50V
C3451	2113741F25	1nF 50V
C3452	2113740F29	12pF 5% 50V
C3453	2113740F67	470pF 5% 50V
C3471	2113743E07	22nF 16V
C3472	2111078B53	HQ 270pF 5%
C3473	2111078B53	HQ 270pF 5%
C3474	2113740F59	220pF 5% 50V
C3475	2113740F23	6.8pF 5% 50V
C3491	2111078B18	HQ 15pF 5%
C3492	2111078B38	HQ 68pF 5%
C3493	2111078B09	HQ 6.8pF 5%
C3494	2111078B16	HQ 13pF 5%
C3495	2111078B01	HQ 3.3pF 5%
C3496	2111078B31	HQ 36pF 5%
C3498	2111078B16	HQ 13pF 5%
C3499	2111078B19	HQ 16pF 5%
C3501	2113741F33	2.2nF 50V
C3502	2113741F33	2.2nF 50V
C3503	2113740F67	470pF 5% 50V
C3504	2113741F49	10nF 50V
C3505	2311049A07	TANT CP 1uF 10% 16V
C3506	2113741F33	2.2nF 50V X7R
C3507	2113740F51	100pF 5% 50V
C3508	2113740F67	470pF 5% 50V
C3510	2113740F67	470pF 5% 50V
D3000	4813833C02	DUAL SOT MMBD6100
D3001	4805649Q13	VCTR 1SV228 SOT23
D3003	4880154K03	DUAL SCHOTTKY SOT23
D3004	4805649Q13	VCTR 1SV228 SOT23
D3011	4880142L01	PIN
D3031	4886143B01	MIXER DIODE CROSSOVER

Circuit Ref	Motorola Part No.	Description
D3101	4880154K03	DIODE DUAL SCHOTTKY
D3201	4802233J09	TRIPLE SOT143-RH
D3221	4880236E05	CHIP SCHOTTKY
D3341	4805649Q13	VCTR 1SV228 SOT23
D3361	4805649Q13	VCTR 1SV228 SOT23
D3362	4862824C01	VARACTOR CHIP
D3401	4813833C02	DUAL SOT MMBD6100
D3451	4880236E05	CHIP SCHOTTKY
D3471	4802482J02	PIN MA/COM
D3472	4802482J02	PIN MA/COM
FL3101	9180112R16	44.85 MHZ XTAL FLTR 80dB
FL3102	9180112R16	44.85 MHZ XTAL FLTR 80dB
FL3111	9180469V03	CER FLTR 6EL 455 KHZ SMD
FL3112	9180469V06	CER FLTR 6EL 455 KHZ SMD
FL3113	9180468V04	CER FLTR 4EL 455 KHZ SMD
FL3114	9180468V06	CER FLTR 4EL 455 KHZ SMD
J0401	0902636Y02	FLEX CONNECTOR
J0451	0902636Y01	FLEX CONNECTOR
J0501	0986105B01	ACCESSORY CONNECTOR
J0551	0905505Y04	FLEX CONNECTOR
J0552	0905505Y03	FLEX CONNECTOR
J0601	0986165B01	DC POWER CONNECTOR
J3401	0986166B02	RF CONN MINI UHF
L3002	2462587T23	COIL CHIP 470nH
L3031	2462587T24	COIL CHIP 560nH
L3032	2462587T17	COIL CHIP 150nH
L3101	2462587T25	COIL CHIP 620nH
L3111	2462587T25	COIL CHIP 620nH
L3112	2462587T25	COIL CHIP 620nH
L3201	2462587Q42	IND CHIP 390nH 10%
L3231	2462587Q20	IND CHIP 2.2uH 20%
L3301	2462587N44	CHIP IND 18 NH 5%
L3302	2462587N53	CHIP IND 100 nH 5%
L3317	2462587V28	CHIP IND 33 NH 5%
L3318	2462587V34	IND CHIP 100nH 5%
L3331	2462587V32	CHIP IND 68NH 5%
L3332	2462587V15	IND CHIP 100nH 10%
L3333	2462587Q47	IND CHIP 1uH 10%
L3341	2484562T13	MINI-SPRING AW IND 8NH 2%
L3343	2462587N56	COIL CHIP 180nH 5%
L3344	2462587N68	CHIP IND 1 uH 5%
L3345	2462587N68	CHIP IND 1 uH 5%
L3346	2484562T18	MINI-SPRING AW IND 35.5NH 2%
L3351	2462587N68	CHIP IND 1 uH 5%
L3361	2462587N50	CHIP IND 56 nH 5%
L3362	2462587N51	CHIP IND 68 nH 5%
L3363	2462587N50	CHIP IND 56 nH 5%
L3364	2462587N68	CHIP IND 1 uH 5%
L3401	2460591A01	SQUARE COIL 4.22nH 3T

Circuit Ref	Motorola Part No.	Description
L3402	2484657R01	Ferrite Bead
L3403	2462587T13	COIL CHIP 68nH
L3411	2462587T13	COIL CHIP 68nH
L3412	2462587X43	IND CHIP LO-PRO 15.0
L3413	2460591B04	SQUARE COIL 11.03nH 4T
L3414	2460591A11	SQUARE COIL 7.66nH 3T
L3421	2484657R01	Ferrite Bead
L3422	2460591C23	SQUARE COIL 16nH 3T
L3436	2484657R01	Ferrite Bead
L3437	2460592A01	COIL AW 17nH 2T
L3443	2460591X02	COIL SQUARE 25nH
L3471	2462587X69	IND CHIP 1.2uH 5%
L3472	2460592B01	COIL AW 51nH 4T
L3491	2460592B01	COIL AW 51nH 4T
L3492	2460592B01	COIL AW 51nH 4T
L3493	2460592B01	COIL AW 51nH 4T
M3421	2686201B01	HEAT SPREADER
Q3001	4813827A07	TSTR NPN SML SIG MMBR9
Q3002	4813824A17	TSTR PNP 40V .2A B=100-
Q3021	4805921T02	TSTR DUAL ROHM FMC2
Q3101	4813827A07	TSTR NPN SML SIG MMBR9
Q3102	4813827A07	TSTR NPN SML SIG MMBR9
Q3141	4813824A10	TSTR NPN 40V .2A B=50-150
Q3151	4880048M01	TSTR NPN DIG 47k/47k
Q3152	4880048M01	TSTR NPN DIG 47k/47k
Q3221	4880048M01	TSTR NPN DIG 47k/47k
Q3301	4813827A07	TSTR NPN SML SIG MMBR9
Q3303	4802245J50	TSTR DUAL NPN/PNP UMC5N
Q3304	4805218N63	RF TRANS SOT 323 Bfq67W
Q3411	4805921T02	DUAL ROHM FMC2 RH
Q3421	4802245J55	MRF1507
Q3422	4880048M01	NPN DIG 47k/47k
Q3441	4886136B01	LDMOS PWR TSTR MRF1565 MRF1550
Q3442	4880048M01	NPN DIG 47k/47k
Q3471	4880048M01	NPN DIG 47k/47k
Q3472	4805128M27	PNP SOT89 BSR33 LH
R3000	0662057A53	1500 1/16W 5%
R3001	0662057A97	100k 1/16W
R3002	0662057A43	560 1/16W 5%
R3003	0662057A49	1k 1/16W 5%
R3004	0662057A53	1500 1/16W 5%
R3006	0662057A73	10k 1/16W 5%
R3009	0662057A97	100k 1/16W
R3010	0662057A45	680 OHMS 5%
R3011	0662057A65	4700 1/16W 5%
R3012	0662057A49	1k 1/16W 5%
R3013	0662057A61	3300 1/16W 5%
R3014	0662057A18	51 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3015	0662057A01	10 1/16W 5%
R3016	0662057A01	10 1/16W 5%
R3018	0662057A33	220 1/16W 5%
R3019	0662057A89	47k 1/16W 5%
R3021	0662057A43	560 1/16W 5%
R3024	0662057A39	390 1/16W 5%
R3025	0662057A53	1500 1/16W 5%
R3026	0662057A73	10k 1/16W 5%
R3027	0662057A73	10k 1/16W 5%
R3028	0662057A39	390 1/16W 5%
R3031	0662057A18	51 1/16W 5%
R3033	0662057B47	0 1/16W
R3101	0662057A75	12k 1/16W 5%
R3102	0662057A01	10 1/16W 5%
R3105	0662057A25	100 1/16W 5%
R3106	0662057A83	27k 1/16W 5%
R3107	0662057A69	6800 1/16W 5%
R3108	0662057A44	620 OHMS 5%
R3111	0662057A75	12k 1/16W 5%
R3112	0662057A01	10 1/16W 5%
R3113	0662057A37	30 1/16W 5%
R3115	0662057A39	390 1/16W 5%
R3116	0662057A37	330 1/16W 5%
R3117	0662057A83	27k 1/16W 5%
R3118	0662057A69	6800 1/16W 5%
R3130	0662057A18	51 1/16W 5%
R3132	0662057A77	15k 1/16W 5%
R3133	0662057A71	8200 1/16W 5%
R3134	0662057A73	10k 1/16W 5%
R3135	0662057A51	1200 1/16W 5%
R3141	0662057A39	390 1/16W 5%
R3142	0662057A55	1800 1/16W 5%
R3144	0662057A58	2400 1/16W 5%
R3145	0662057A61	3300 1/16W 5%
R3146	0662057A45	680 OHMS 5%
R3147	0662057A75	12k 1/16W 5%
R3151	0662057A73	10k 1/16W 5%
R3152	0662057A73	10k 1/16W 5%
R3153	0662057A73	10k 1/16W 5%
R3154	0662057A73	10k 1/16W 5%
R3201	0662057A17	47 1/16W 5%
R3203	0662057A17	47 1/16W 5%
R3204	0662057A17	47 1/16W 5%
R3211	0662057B47	0 1/16W
R3221	0662057A39	390 1/16W 5%
R3222	0662057A45	CHIP RES 680 OHMS 5%
R3223	0662057A25	100 1/16W 5%
R3224	0662057A89	47k 1/16W 5%
R3225	0662057A89	47k 1/16W 5%
R3227	0662057A97	100k 1/16W
R3241	0662057A25	100 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3242	0662057B47	0 1/16W
R3251	0662057B04	180k 1/16W 5%
R3252	0662057B10	330k 1/16W 5%
R3261	0662057A89	47k 1/16W 5%
R3263	0662057A65	4700 1/16W 5%
R3301	0662057A22	75 1/16W 5%
R3302	0662057A25	100 1/16W 5%
R3303	0662057A57	2200 1/16W 5%
R3304	0662057A49	1k 1/16W 5%
R3308	0662057B47	0 1/16W
R3311	0662057A25	100 1/16W 5%
R3316	0662057B47	0 1/16W
R3318	0662057A09	22 1/16W 5%
R3321	0662057A73	10k 1/16W 5%
R3323	0662057A49	1k 1/16W 5%
R3331	0662057A17	47 1/16W 5%
R3335	0662057A13	33 1/16W 5%
R3336	0662057A77	15k 1/16W 5%
R3341	0662057A33	220 1/16W 5%
R3342	0662057A15	39 1/16W 5%
R3343	0662057A25	100 1/16W 5%
R3351	0662057A80	20k 1/16W 5%
R3352	0662057A75	12k 1/16W 5%
R3353	0662057A97	100k 1/16W
R3354	0662057B02	150k 1/16W
R3355	0662057A80	20k 1/16W 5%
R3356	0662057A75	12k 1/16W 5%
R3361	0662057A33	220 1/16W 5%
R3362	0662057A17	47 1/16W 5%
R3364	0662057A89	47k 1/16W 5%
R3400	0662057A41	470 1/16W 5%
R3401	0662057A36	300 1/16W 5%
R3402	0662057A05	15 1/16W 5%
R3403	0662057A36	300 1/16W 5%
R3404	0662057A89	47k 1/16W 5%
R3405	0662057A25	100 1/16W 5%
R3406	0662057A97	100k 1/16W
R3412	0662057A67	5600 1/16W 5%
R3413	0662057A61	3300 1/16W 5%
R3414	0683962T51	120 1W 5%
R3415	0662057A25	100 1/16W 5%
R3416	0662057A25	100 1/16W 5%
R3418	0662057A81	22k 1/16W 5%
R3421	0662057A87	39k 1/16W 5%
R3422	0662057A57	2200 1/16W 5%
R3423	0662057A87	39k 1/16W 5%
R3424	0662057C13	2.7 1/10W 5%
R3425	0662057C13	2.7 1/10W 5%
R3426	0662057C13	2.7 1/10W 5%
R3427	0662057C13	2.7 1/10W 5%
R3428	0662057A58	2400 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3429	0662057A33	220 1/16W 5%
R3431	0680194M18	51 1W 5%
R3432	0680194M18	51 1W 5%
R3433	0662057C13	2.7 1/10W 5%
R3434	0662057C13	2.7 1/10W 5%
R3435	0662057C13	2.7 1/10W 5%
R3441	0662057A87	39k 1/16W 5%
R3442	0662057A57	2200 1/16W 5%
R3443	0662057A87	39k 1/16W 5%
R3444	0662057C19	4.7 1/10W 5%
R3445	0662057A58	2400 1/16W 5%
R3446	0662057B47	0 1/16W
R3450	0662057A41	470 1/16W 5%
R3452	0662057A75	12k 1/16W 5%
R3454	0662057A84	30k 1/16W 5%
R3455	0662057A97	100k 1/16W
R3457	0683962T51	120 1W 5%
R3471	0662057A41	470 1/16W 5%
R3473	0680194M18	51 1W 5%
R3474	0680194M18	51 1W 5%
R3475	0662057A73	10k 1/16W 5%
R3491	0662057A73	10k 1/16W 5%
R3501	0662057A69	6800 1/16W 5%
R3502	0662057A87	39k 1/16W 5%
R3504	0662057A73	10k 1/16W 5%
R3505	0662057B09	300k 1/16W 5%
R3507	0662057A80	20k 1/16W 5%
R3508	0662057A97	100k 1/16W
R3509	0662057A49	1k 1/16W 5%
T3001	2508396X02	TRANSFORMER
T3002	2508397X02	TRANSFORMER
U3101	5186144B01	FM IF IC SA616
U3111	5113805A86	IC QUAD ANALOG MUX/ DEMUX
U3115	5113805A86	IC QUAD ANALOG MUX/ DEMUX
U3201	5185963A27	IC TESTED AT25016 48PIN GFP
U3211	5105739X05	IC SOT 5V HI-PRECISION REGULAT
U3301	5105750U54	VCO BUFFER PKG DIE
U3401	5105109Z67	LDMOS DRIVER VHF/UHF
U3402	5180932W01	LINEAR IC OP-AMP
U3501	5185765B01	IC POWER CONTROL
U3502	5185963A15	TEMP SENSOR 1M5
VR3471	4813830A15	5.6V 5% 225mW
Y3101	4880606B09	CRYSTAL 44.395 MHZ
Y3102	9186145B02	CERAMIC DISCRIMINATOR 455kHz

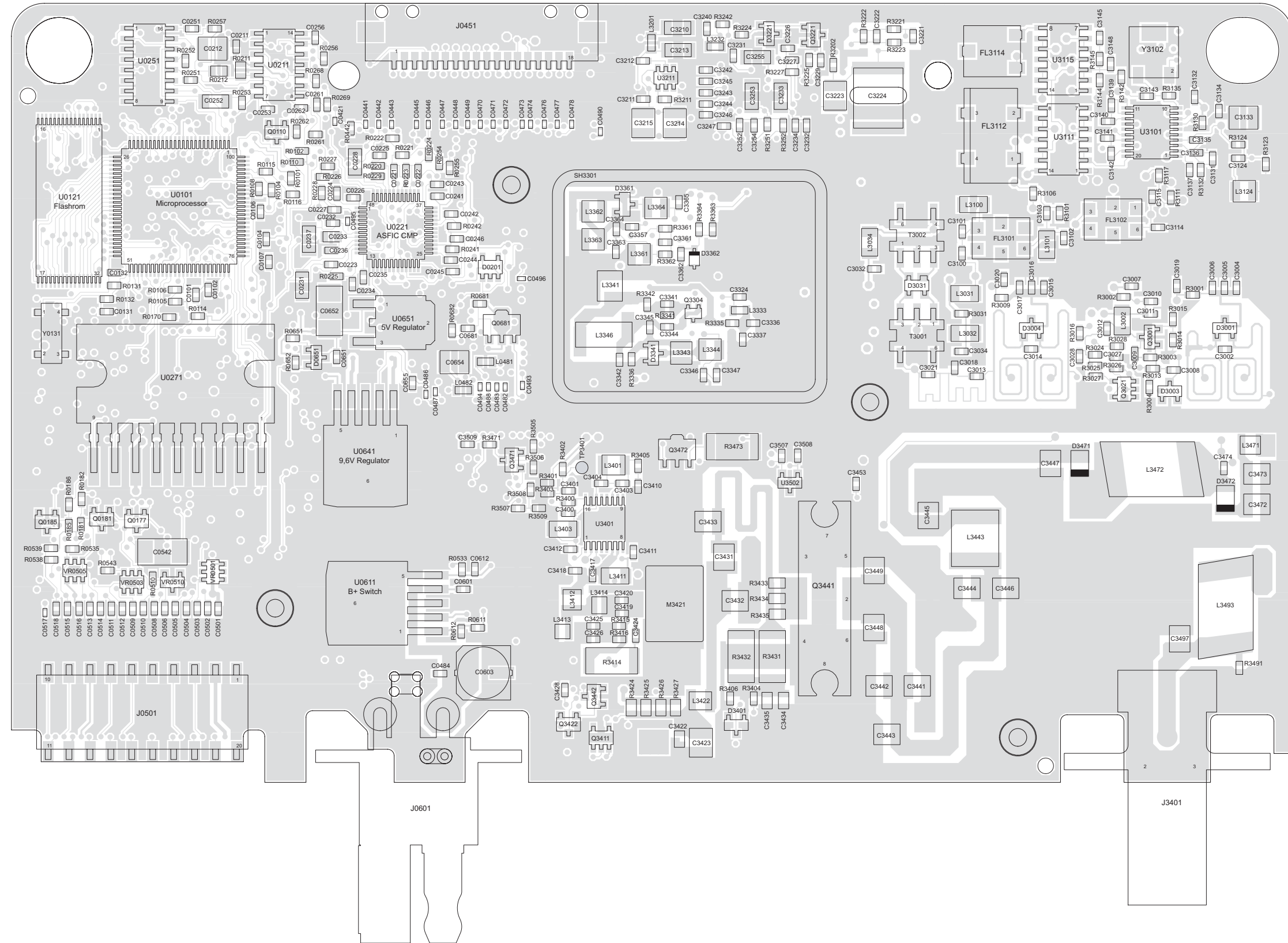
Circuit Ref	Motorola Part No.	Description
Y3263	4886182B01	VCTCXO 16.8MHz 2ppm TTSO5V
* Y3261	Not Used	16.8MHz 75Z04

\* Motorola Depot Servicing only

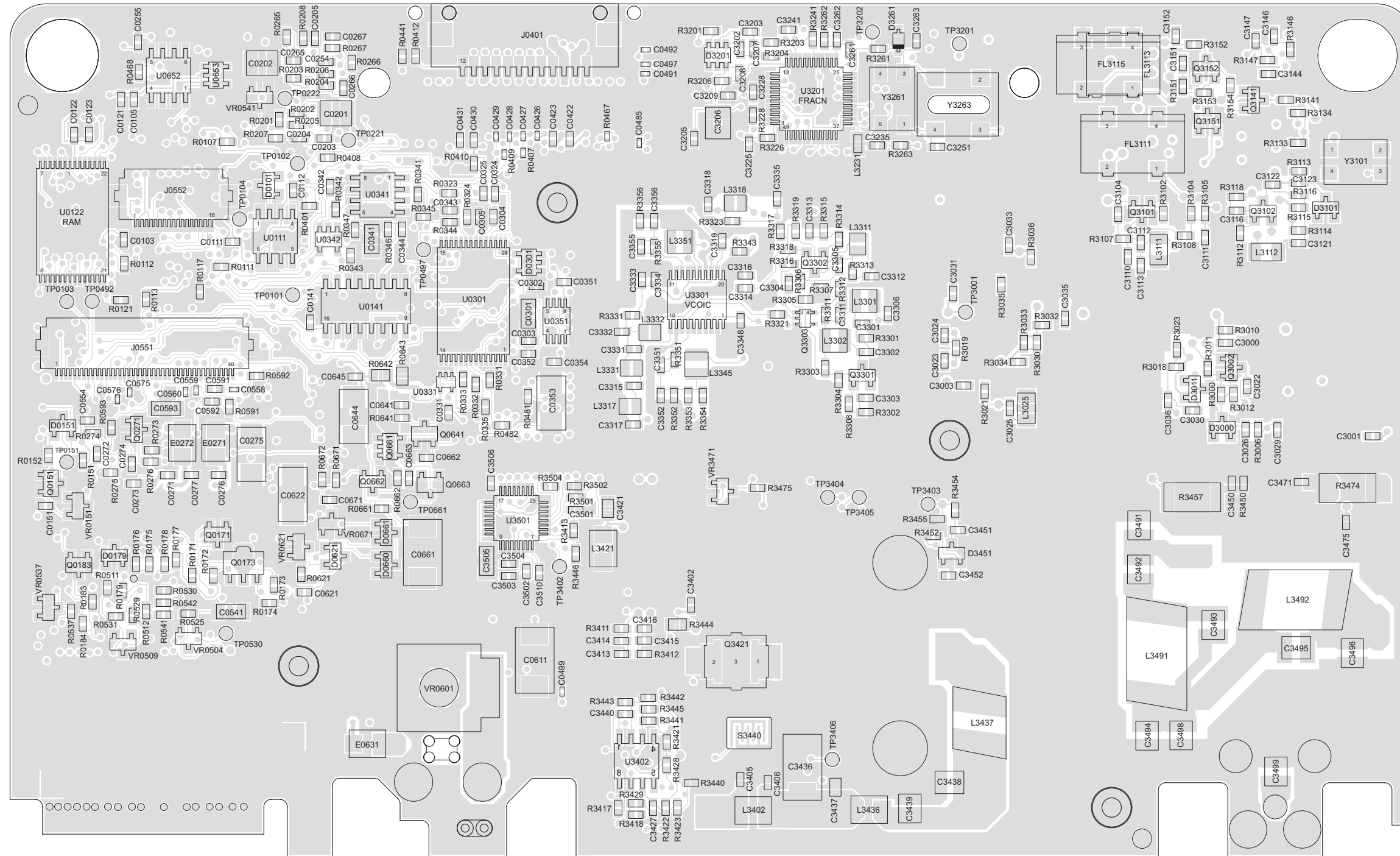
Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

† Replacement boards must be ordered from CCSD (formerly AAD) using the number shown in the model charts in Section 1. Boards are not orderable using the 84-prefixed number.

### 4.0 VHF (136-174 MHz) 1-25W PCB 8486172B07, Schematics, and Parts Lists



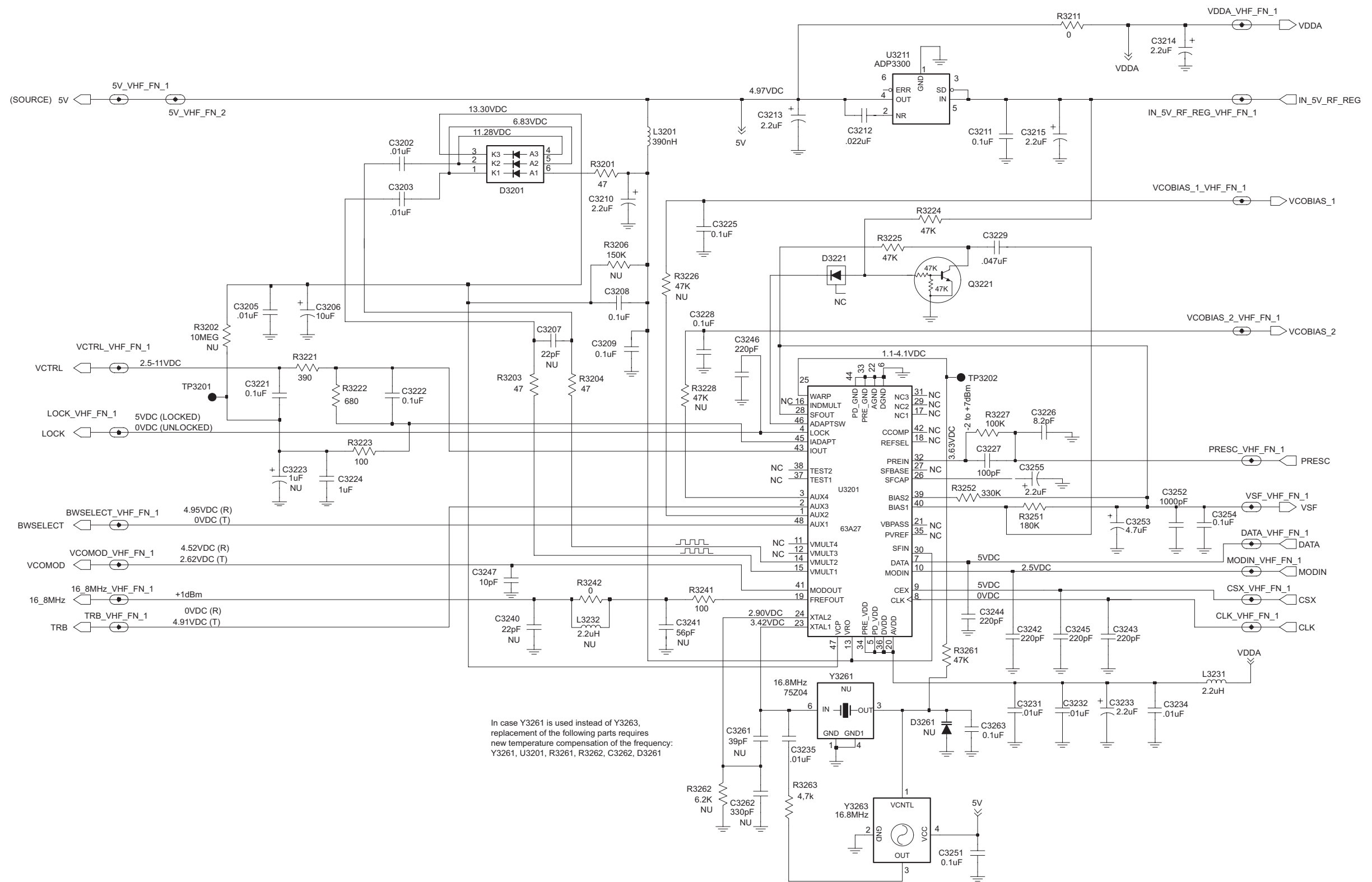
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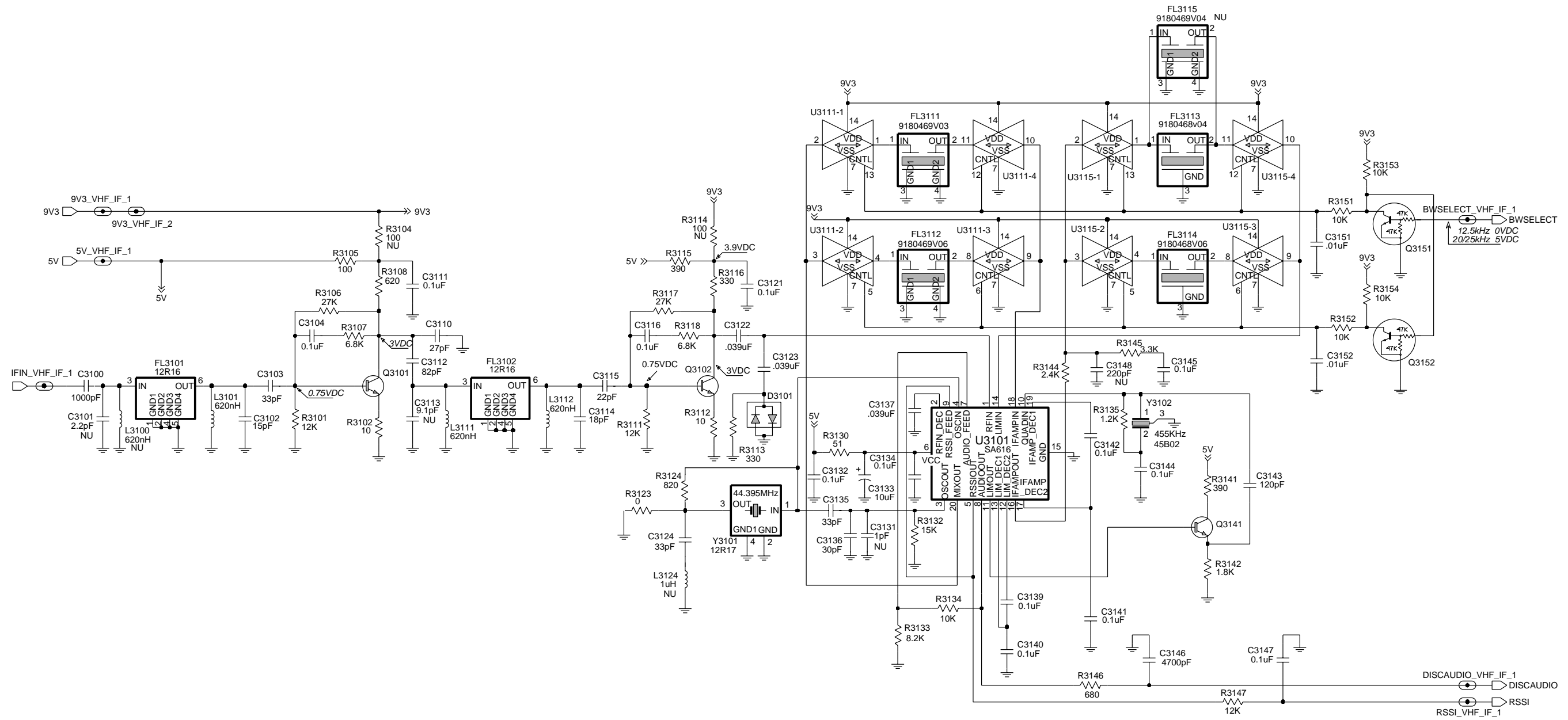
VHF (136-174 MHz) 1-25W PCB 8486172B07 Bottom Side

ZWG0130398-A





ZWG0130564-O



## VHF 1-25W PCB 8486172B07 Parts List†

Circuit Ref	Motorola Part No.	Description
C3000	2113741F37	3.3nF 50V
C3001	2113740F19	4.7pF 5%
C3002	2113740F26	9.1pF 5%
C3003	2113741F37	3.3nF 50V
C3004	2113740F45	56pF 5%
C3005	2113740F51	100pF 5%
C3006	2113740F45	56pF 5%
C3007	2113741F37	3.3nF 50V
C3008	2113741F25	1nF 50V
C3009	2113741F13	330pF 50V
C3010	2113741F13	330pF 50V
C3011	2113741F37	3.3nF 50V
C3012	2113741F25	1nF 50V
C3013	2113740F45	56pF 5%
C3014	2113740F24	7.5pF 5%
C3015	2113740F45	56pF 5%
C3016	2113740F51	100pF 5% 50V
C3017	2113740F42	43pF 5% 50V
C3019	2113741F25	1nF 50V
C3020	2113741F25	1nF 50V
C3021	2113740F53	120pF 5% 50V
C3022	2113741F49	10nF 50V
C3026	2113743E20	100nF 16V
C3027	2113741F49	10nF 50V
C3028	2113741F49	10nF 50V
C3030	2113741F25	1nF 50V
C3033	2113740F20	5.1pF 5% 50V
C3034	2113740F49	82pF 5% 50V
C3035	2113740F33	18pF 5% 50V
C3036	2113741F25	1nF 50V
C3100	2113741F25	1nF 50V
C3102	2113740F31	15pF 5% 50V
C3103	2113740F39	33pF 5% 50V
C3104	2113743E20	100nF 16V
C3110	2113740F37	27pF 5% 50V
C3111	2113743E20	100nF 16V
C3112	2113740F49	82pF 5% 50V
C3114	2113740F33	18pF 5% 50V
C3115	2113740F35	22pF 5% 50V
C3116	2113743E20	100nF 16V
C3121	2113743E20	100nF 16V
C3122	2113743E11	39nF 10%
C3123	2113743E11	39nF 10%
C3124	2113740L30	33pF 2%
C3132	2113743E20	100nF 16V
C3133	2311049A57	TANT CP 10uF 10% 16V
C3134	2113743E20	100nF 16V
C3135	2113740L30	33pF 2%
C3136	2113740L29	30pF 2%

Circuit Ref	Motorola Part No.	Description
C3137	2113743E11	39nF 10%
C3139	2113743E20	100nF 16V
C3140	2113743E20	100nF 16V
C3141	2113743E20	100nF 16V
C3142	2113743E20	100nF 16V
C3143	2113740F53	120pF 5% 50V
C3144	2113743E20	100nF 16V
C3145	2113743E20	100nF 16V
C3146	2113741F41	4.7nF 50V
C3147	2113743E20	100nF 16V
C3151	2113741F49	10nF 50V
C3152	2113741F49	10nF 50V
C3202	2113741F49	10nF 50V
C3203	2113741F49	10nF 50V
C3205	2113741F49	10nF 50V
C3206	2311049A57	TANT CP 10uF 10% 16V
C3208	2113743E20	100nF 16V
C3209	2113743E20	100nF 16V
C3210	2311049A40	TANT CP 2.2uF 10% 10V
C3211	2113743E20	100nF 16V
C3212	2113743E07	22nF 16V
C3312	2113743E07	22nF 16V
C3213	2311049A40	TANT CP 2.2uF 10% 10V
C3214	2311049A09	TANT CP 2.2uF 10% 20V
C3215	2311049A09	TANT CP 2.2uF 10% 20V
C3221	2113743E20	100nF 16V
C3222	2113743E20	100nF 16V
C3224	0882422W23	FILM SM 1.0uF 15V 5%
C3225	2113743E20	100nF 16V
C3226	2113740F25	8.2pF 5% 50V
C3227	2113740F51	100pF 5% 50V
C3228	2113743E20	100nF 16V
C3229	2113743E12	47nF 10%
C3231	2113741F49	10nF 50V
C3232	2113741F49	10nF 50V
C3233	2311049A40	TANT CP 2.2uF 10%
C3234	2113741F49	10nF 50V
C3235	2113741F49	10nF 50V
C3242	2113740F59	220pF 5% 50V
C3243	2113740F59	220pF 5% 50V
C3244	2113740F59	220pF 5% 50V
C3245	2113740F59	220pF 5% 50V
C3246	2113740F59	220pF 5% 50V
C3247	2113740F27	10pF 5% 50V
C3251	2113743E20	100nF 16V
C3252	2113741F25	1nF 50V
C3253	2311049A56	TANT CP 4.7uF 20% 10V
C3254	2113743E20	100nF 16V
C3255	2311049A40	TANT CP 2.2uF 10% 10V
C3263	2113743E20	100nF 16V
C3302	2113740F23	6.8pF 5% 50V

Circuit Ref	Motorola Part No.	Description
C3303	2113741F49	10nF 50V
C3306	2113740F20	5.1pF 5% 50V
C3311	2113743E07	22nF 16V
C3314	2113740F23	6.8pF 5% 50V
C3315	2113740F31	15pF 5% 50V
C3316	2113740F15	3.3pF 5% 50V
C3317	2113740F39	33pF 5% 50V
C3318	2113740F21	5.6pF 5% 50V
C3319	2113741F25	1nF 50V
C3324	2113741F49	10nF 50V
C3332	2113743E20	100nF 16V
C3333	2113743E20	100nF 16V
C3334	2113743E07	22nF 16V
C3335	2113741F49	10nF 50V
C3336	2113741F49	10nF 50V
C3337	2113743E20	100nF 16V
C3341	2113741F25	1nF 50V
C3342	2113740L05	3.0pF +-0.1pF
C3344	2113740F09	1.8pF 5% 50V
C3345	2113740L25	20pF +-0.25pF
C3346	2113741F49	10nF 50V
C3347	2113741F49	10nF 50V
C3348	2113741F49	10nF 50V
C3351	2113741F49	10nF 50V
C3352	2113743E07	22nF 16V
C3355	2113741F49	10nF 50V
C3356	2113743E07	22nF 16V
C3357	2113740F24	7.5pF 5% 50V
C3361	2113741F25	1nF 50V
C3362	2113740F21	5.6pF 5% 50V
C3363	2113740F47	68pF 5% 50V
C3364	2113740F31	15pF 5% 50V
C3365	2113741F25	1nF 50V
C3400	2113740F63	330pF 5% 50V
C3401	2113740F63	330pF 5% 50V
C3402	2113743E07	22nF 16V
C3403	2113740F39	33pF 5% 50V
C3404	2113740F39	33pF 5% 50V
C3405	2113740F67	470pF 5% 50V
C3406	2113740F67	470pF 5% 50V
C3410	2113743E07	22nF 16V
C3411	2113743E07	22nF 16V
C3412	2113740F63	330pF 5% 50V
C3414	2113740F63	330pF 5% 50V
C3415	2113743E07	22nF 16V
C3416	2113740F63	330pF 5% 50V
C3417	2113740F43	47pF 5% 50V
C3418	2113740F39	33pF 5% 50V
C3419	2113740F57	180pF 5% 50V
C3420	2113740F57	180pF 5% 50V
C3421	2113741A57	33nF 50V

Circuit Ref	Motorola Part No.	Description
C3422	2113740A67	330pF 5% 50V
C3423	2311049A08	TANT CP 1uF 10% 35V
C3424	2113740F67	470pF 5% 50V
C3425	2113743E07	22nF 16V
C3426	2113740F63	330pF 5% 50V
C3427	2113741F33	2.2nF 50V
C3428	2113741F33	2.2nF 50V
C3431	2111078B34	HQ 47pF 5%
C3433	2111078B36	HQ 56pF 5%
C3434	2113741A45	10nF 50V
C3435	2113740A67	330pF 5% 50V
C3436	2311049A45	TANT CP 10uF 10% 35V
C3437	2113741A57	33nF 50V
C3438	2111078B59	HQ 470pF 5%
C3439	2111078B59	HQ 470pF 5%
C3440	2113741F25	1nF 50V
C3441	2111078B47	HQ 150pF 5%
C3442	2111078B47	HQ 150pF 5%
C3445	2111078B21	HQ 20pF 5%
C3446	2111078B42	HQ 100pF 5%
C3447	2111078B19	HQ 16pF 5%
C3448	2111078B44	HQ 120pF 5%
C3449	2111078B44	HQ 120pF 5%
C3450	2113740F67	470pF 5% 50V
C3451	2113741F25	1nF 50V
C3452	2113740F29	12pF 5% 50V
C3453	2113740F67	470pF 5% 50V
C3471	2113743E07	22nF 16V
C3472	2111078B53	HQ 270pF 5%
C3473	2111078B53	HQ 270pF 5%
C3474	2113740F59	220pF 5% 50V
C3475	2113740F23	6.8pF 5% 50V
C3491	2111078B18	HQ 15pF 5%
C3492	2111078B38	HQ 68pF 5%
C3493	2111078B09	HQ 6.8pF 5%
C3494	2111078B16	HQ 13pF 5%
C3495	2111078B01	HQ 3.3pF 5%
C3496	2111078B31	HQ 36pF 5%
C3498	2111078B16	HQ 13pF 5%
C3499	2111078B19	HQ 16pF 5%
C3501	2113741F33	2.2nF 50V
C3502	2113741F33	2.2nF 50V
C3503	2113740F67	470pF 5% 50V
C3504	2113741F49	10nF 50V
C3505	2311049A07	TANT CP 1uF 10% 16V
C3506	2113741F33	2.2nF 50V X7R
C3507	2113740F51	100pF 5% 50V
C3508	2113740F67	470pF 5% 50V
C3510	2113740F67	470pF 5% 50V
D3000	4813833C02	DUAL SOT MMBD6100
D3001	4805649Q13	VCTR 1SV228 SOT23

Circuit Ref	Motorola Part No.	Description
D3003	4880154K03	DUAL SCHOTTKY SOT23
D3004	4805649Q13	VCTR 1SV228 SOT23
D3011	4880142L01	PIN
D3031	4886143B01	MIXER DIODE CROSSOVER
D3101	4880154K03	DIODE DUAL SCHOTTKY
D3201	4802233J09	TRIPLE SOT143-RH
D3221	4880236E05	CHIP SCHOTTKY
D3341	4805649Q13	VCTR 1SV228 SOT23
D3361	4805649Q13	VCTR 1SV228 SOT23
D3362	4862824C01	VARACTOR CHIP
D3401	4813833C02	DUAL SOT MMBD6100
D3451	4880236E05	CHIP SCHOTTKY
D3471	4802482J02	PIN MA/COM
D3472	4802482J02	PIN MA/COM
FL3101	9180112R16	44.85MHZ CRYSTAL FLTR 80dB
FL3102	9180112R16	44.85 MHZ CRYSTAL FLTR 80dB
FL3111	9180469V03	CER FLTR 6EL 455 KHZ SMD
FL3112	9180469V06	CER FLTR 6EL 455 KHZ SMD
FL3113	9180468V04	CER FLTR 4EL 455 KHZ SMD
FL3114	9180468V06	CER FLTR 4EL 455 KHZ SMD
J0401	0902636Y02	FLEX CONNECTOR
J0451	0902636Y01	FLEX CONNECTOR
J0501	0986105B01	ACCESSORY CONNECTOR
J0551	0905505Y04	FLEX CONNECTOR
J0552	0905505Y03	FLEX CONNECTOR
J0601	0986165B01	DC POWER CONNECTOR
J3401	0986166B02	RF CONN MINI UHF
L3002	2462587T23	COIL CHIP 470nH
L3031	2462587T24	COIL CHIP 560nH
L3032	2462587T17	COIL CHIP 150nH
L3101	2462587T25	COIL CHIP 620nH
L3111	2462587T25	COIL CHIP 620nH
L3112	2462587T25	COIL CHIP 620nH
L3124	2462587N68	1uH
L3201	2462587Q42	IND CHIP 390nH 10%
L3231	2462587Q20	IND CHIP 2.2uH 20%
L3301	2462587N44	CHIP IND 18 NH 5%
L3302	2462587N53	CHIP IND 100 nH 5%
L3317	2462587V28	CHIP IND 33 NH 5%
L3318	2462587V34	IND CHIP 100nH 5%
L3331	2462587V32	CHIP IND 68NH 5%
L3332	2462587V15	IND CHIP 100nH 10%
L3333	2462587Q47	IND CHIP 1uH 10%
L3341	2484562T13	MINI-SPRING AW IND 8NH 2%
L3343	2462587N56	COIL CHIP 180nH 5%
L3344	2462587N68	CHIP IND 1 uH 5%
L3345	2462587N68	CHIP IND 1 uH 5%

Circuit Ref	Motorola Part No.	Description
L3346	2484562T18	MINI-SPRING AW IND 35.5NH 2%
L3351	2462587N68	CHIP IND 1 uH 5%
L3361	2462587N50	CHIP IND 56 nH 5%
L3362	2462587N51	CHIP IND 68 nH 5%
L3363	2462587N50	CHIP IND 56 nH 5%
L3364	2462587N68	CHIP IND 1 uH 5%
L3401	2460591A01	SQUARE COIL 4.22nH 3T
L3402	2484657R01	Ferrite Bead
L3403	2462587T13	COIL CHIP 68nH
L3411	2462587T13	COIL CHIP 68nH
L3412	2462587X43	IND CHIP LO-PRO 15.0
L3413	2460591B04	SQUARE COIL 11.03nH 4T
L3414	2460591A11	SQUARE COIL 7.66nH 3T
L3421	2484657R01	Ferrite Bead
L3422	2460591C23	SQUARE COIL 16nH 3T
L3436	2484657R01	Ferrite Bead
L3437	2460592A01	COIL AW 17nH 2T
L3443	2460591X02	COIL SQUARE 25nH
L3471	2462587X69	IND CHIP 1.2uH 5%
L3472	2460592B01	COIL AW 51nH 4T
L3491	2460592B01	COIL AW 51nH 4T
L3492	2460592B01	COIL AW 51nH 4T
L3493	2460592B01	COIL AW 51nH 4T
M3421	2686201B01	HEAT SPREADER
Q3001	4813827A07	TSTR NPN SML SIG MMBR9
Q3002	4813824A17	TSTR PNP 40V .2A B=100-
Q3021	4805921T02	TSTR DUAL ROHM FMC2
Q3101	4813827A07	TSTR NPN SML SIG MMBR9
Q3102	4813827A07	TSTR NPN SML SIG MMBR9
Q3141	4813824A10	TSTR NPN 40V .2A B=50-150
Q3151	4880048M01	TSTR NPN DIG 47k/47k
Q3152	4880048M01	TSTR NPN DIG 47k/47k
Q3221	4880048M01	TSTR NPN DIG 47k/47k
Q3301	4813827A07	TSTR NPN SML SIG MMBR9
Q3303	4802245J50	TSTR DUAL NPN/PNP UMC5N
Q3304	4805218N63	RF TRANS SOT 323 Bfq67W
Q3411	4805921T02	DUAL ROHM FMC2 RH
Q3421	4802245J55	MRF1507
Q3422	4880048M01	NPN DIG 47k/47k
Q3441	4886136B01	LD MOS PWR TSTR MRF1565 MRF1550
Q3442	4880048M01	NPN DIG 47k/47k
Q3471	4880048M01	NPN DIG 47k/47k
Q3472	4805128M27	PNP SOT89 BSR33 LH
R3000	0662057A53	1500 1/16W 5%
R3001	0662057A97	100k 1/16W
R3002	0662057A43	560 1/16W 5%
R3003	0662057A49	1k 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3004	0662057A53	1500 1/16W 5%
R3006	0662057A73	10k 1/16W 5%
R3009	0662057A97	100k 1/16W
R3010	0662057A45	680 OHMS 5%
R3011	0662057A65	4700 1/16W 5%
R3012	0662057A49	1k 1/16W 5%
R3013	0662057A61	3300 1/16W 5%
R3014	0662057A18	51 1/16W 5%
R3015	0662057A01	10 1/16W 5%
R3016	0662057A01	10 1/16W 5%
R3018	0662057A33	220 1/16W 5%
R3019	0662057A89	47k 1/16W 5%
R3021	0662057A43	560 1/16W 5%
R3024	0662057A39	390 1/16W 5%
R3025	0662057A53	1500 1/16W 5%
R3026	0662057A73	10k 1/16W 5%
R3027	0662057A73	10k 1/16W 5%
R3028	0662057A39	390 1/16W 5%
R3031	0662057A18	51 1/16W 5%
R3033	0662057B47	0 1/16W
R3101	0662057A75	12k 1/16W 5%
R3102	0662057A01	10 1/16W 5%
R3105	0662057A25	100 1/16W 5%
R3106	0662057A83	27k 1/16W 5%
R3107	0662057A69	6800 1/16W 5%
R3108	0662057A44	620 OHMS 5%
R3111	0662057A75	12k 1/16W 5%
R3112	0662057A01	10 1/16W 5%
R3113	0662057A37	330 1/16W 5%
R3115	0662057A39	390 1/16W 5%
R3116	0662057A37	330 1/16W 5%
R3117	0662057A83	27k 1/16W 5%
R3118	0662057A69	6800 1/16W 5%
R3123	0662057B47	0 1/16W
R3124	0662057A47	820 1/16W
R3130	0662057A18	51 1/16W 5%
R3132	0662057A77	15k 1/16W 5%
R3133	0662057A71	8200 1/16W 5%
R3134	0662057A73	10k 1/16W 5%
R3135	0662057A51	1200 1/16W 5%
R3141	0662057A39	390 1/16W 5%
R3142	0662057A55	1800 1/16W 5%
R3144	0662057A58	2400 1/16W 5%
R3145	0662057A61	3300 1/16W 5%
R3146	0662057A45	680 OHMS 5%
R3147	0662057A75	12k 1/16W 5%
R3151	0662057A73	10k 1/16W 5%
R3152	0662057A73	10k 1/16W 5%
R3153	0662057A73	10k 1/16W 5%
R3154	0662057A73	10k 1/16W 5%
R3201	0662057A17	47 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3202	0662057B46	10MEG
R3203	0662057A17	47 1/16W 5%
R3204	0662057A17	47 1/16W 5%
R3206	0662057B02	150k 1/16W
R3211	0662057B47	0 1/16W
R3221	0662057A39	390 1/16W 5%
R3222	0662057A45	680 OHMS 5%
R3223	0662057A25	100 1/16W 5%
R3224	0662057A89	47k 1/16W 5%
R3225	0662057A89	47k 1/16W 5%
R3227	0662057A97	100k 1/16W
R3241	0662057A25	100 1/16W 5%
R3242	0662057B47	0 1/16W
R3251	0662057B04	180k 1/16W 5%
R3252	0662057B10	330k 1/16W 5%
R3261	0662057A89	47k 1/16W 5%
R3263	0662057A65	4700 1/16W 5%
R3301	0662057A22	75 1/16W 5%
R3302	0662057A25	100 1/16W 5%
R3303	0662057A57	2200 1/16W 5%
R3304	0662057A49	1k 1/16W 5%
R3308	0662057B47	0 1/16W
R3311	0662057A25	100 1/16W 5%
R3316	0662057B47	0 1/16W
R3318	0662057A09	22 1/16W 5%
R3321	0662057A73	10k 1/16W 5%
R3323	0662057A49	1k 1/16W 5%
R3331	0662057A17	47 1/16W 5%
R3335	0662057A13	33 1/16W 5%
R3336	0662057A77	15k 1/16W 5%
R3341	0662057A33	220 1/16W 5%
R3342	0662057A15	39 1/16W 5%
R3343	0662057A25	100 1/16W 5%
R3351	0662057A80	20k 1/16W 5%
R3352	0662057A75	12k 1/16W 5%
R3353	0662057A97	100k 1/16W
R3354	0662057B02	150k 1/16W
R3355	0662057A80	20k 1/16W 5%
R3356	0662057A75	12k 1/16W 5%
R3361	0662057A33	220 1/16W 5%
R3362	0662057A17	47 1/16W 5%
R3364	0662057A89	47k 1/16W 5%
R3400	0662057A41	470 1/16W 5%
R3401	0662057A36	300 1/16W 5%
R3402	0662057A05	15 1/16W 5%
R3403	0662057A36	300 1/16W 5%
R3404	0662057A89	47k 1/16W 5%
R3405	0662057A25	100 1/16W 5%
R3406	0662057A97	100k 1/16W
R3412	0662057A67	5600 1/16W 5%
R3413	0662057A61	3300 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3414	0683962T51	120 1W 5%
R3415	0662057A25	100 1/16W 5%
R3416	0662057A25	100 1/16W 5%
R3418	0662057A81	22k 1/16W 5%
R3421	0662057A87	39k 1/16W 5%
R3422	0662057A57	2200 1/16W 5%
R3423	0662057A87	39k 1/16W 5%
R3424	0662057C13	2.7 1/10W 5%
R3425	0662057C13	2.7 1/10W 5%
R3426	0662057C13	2.7 1/10W 5%
R3427	0662057C13	2.7 1/10W 5%
R3428	0662057A58	2400 1/16W 5%
R3429	0662057A33	220 1/16W 5%
R3431	0680194M18	51 1W 5%
R3432	0680194M18	51 1W 5%
R3433	0662057C13	2.7 1/10W 5%
R3434	0662057C13	2.7 1/10W 5%
R3435	0662057C13	2.7 1/10W 5%
R3441	0662057A87	39k 1/16W 5%
R3442	0662057A57	2200 1/16W 5%
R3443	0662057A87	39k 1/16W 5%
R3444	0662057C19	4.7 1/10W 5%
R3445	0662057A58	2400 1/16W 5%
R3446	0662057B47	0 1/16W
R3450	0662057A41	470 1/16W 5%
R3452	0662057A75	12k 1/16W 5%
R3454	0662057A84	30k 1/16W 5%
R3455	0662057A97	100k 1/16W
R3457	0683962T51	120 1W 5%
R3471	0662057A41	470 1/16W 5%
R3473	0680194M18	51 1W 5%
R3474	0680194M18	51 1W 5%
R3475	0662057A73	10k 1/16W 5%
R3491	0662057A73	10k 1/16W 5%
R3501	0662057A69	6800 1/16W 5%
R3502	0662057A87	39k 1/16W 5%
R3504	0662057A73	10k 1/16W 5%
R3505	0662057B09	300k 1/16W 5%
R3507	0662057A80	20k 1/16W 5%
R3508	0662057A97	100k 1/16W
R3509	0662057A49	1k 1/16W 5%
T3001	2508396X02	TRANSFORMER
T3002	2508397X02	TRANSFORMER
U3101	5186144B01	FM IF IC SA616
U3111	5113805A86	IC QUAD ANALOG MUX/ DEMUX
U3115	5113805A86	IC QUAD ANALOG MUX/ DEMUX
U3201	5185963A27	IC TESTED AT25016 48 PIN GFP

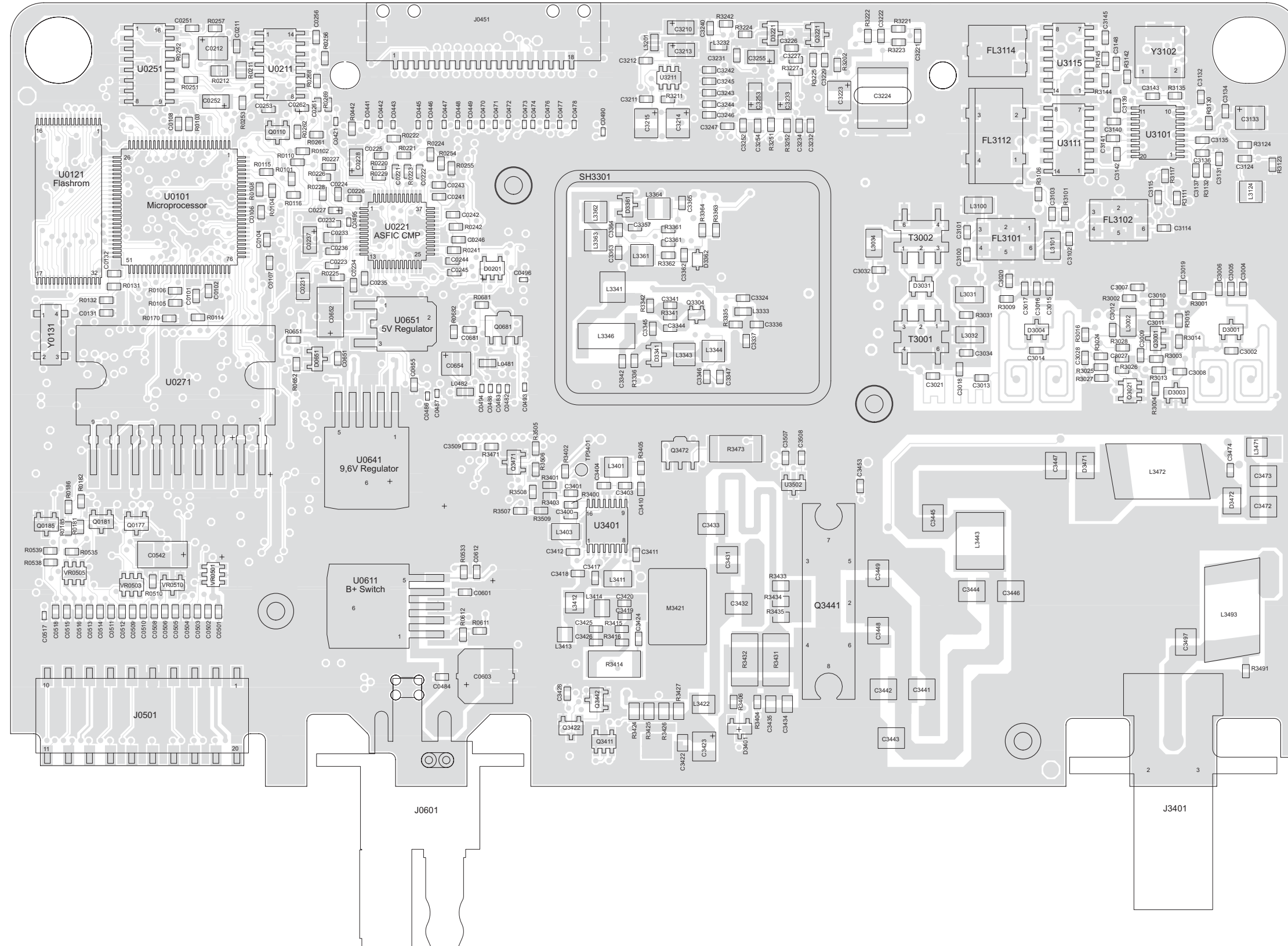
Circuit Ref	Motorola Part No.	Description
U3211	5105739X05	IC SOT 5V HI-PRECISION REGULAT
U3301	5105750U54	VCO BUFFER PKG DIE
U3401	5105109Z67	LD MOS DRIVER VHF/UHF
U3402	5180932W01	LINEAR IC OP-AMP
U3501	5185765B01	IC POWER CONTROL
U3502	5185963A15	TEMP SENSOR 1M5
VR3471	4813830A15	5.6V 5% 225mW
Y3101	4880606B09	CRYSTAL 44.395 MHZ
Y3102	9186145B02	CERAMIC DISCRIMINATOR 455kHz
Y3263	4886182B01	VCTCXO 16.8MHz 2ppm TTSO5V
* Y3261	Not Used	16.8MHz 75Z04

\* Motorola Depot Servicing only

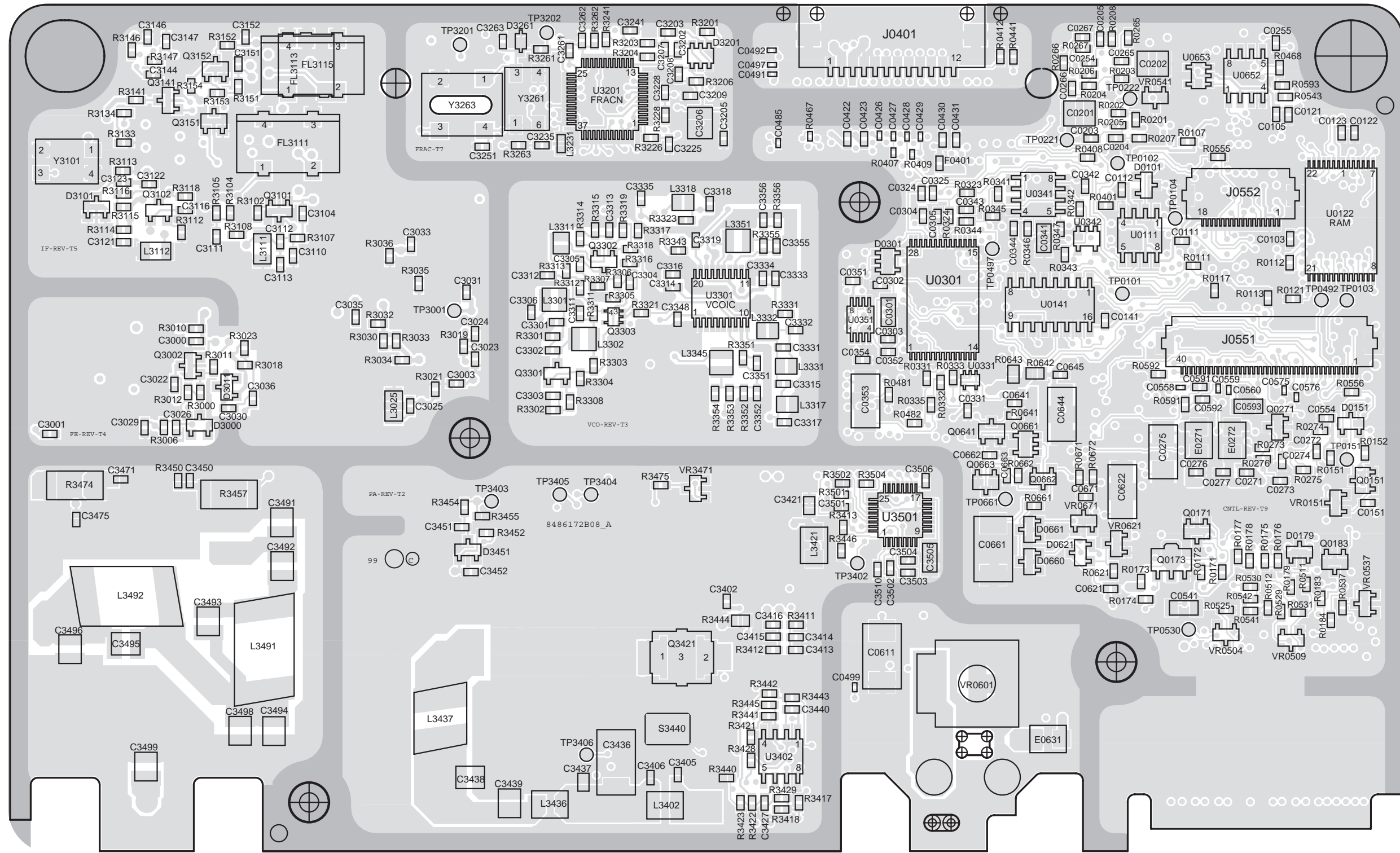
Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

† Replacement boards must be ordered from CCSD (formerly AAD) using the number shown in the model charts in Section 1. Boards are not orderable using the 84-prefixed number.

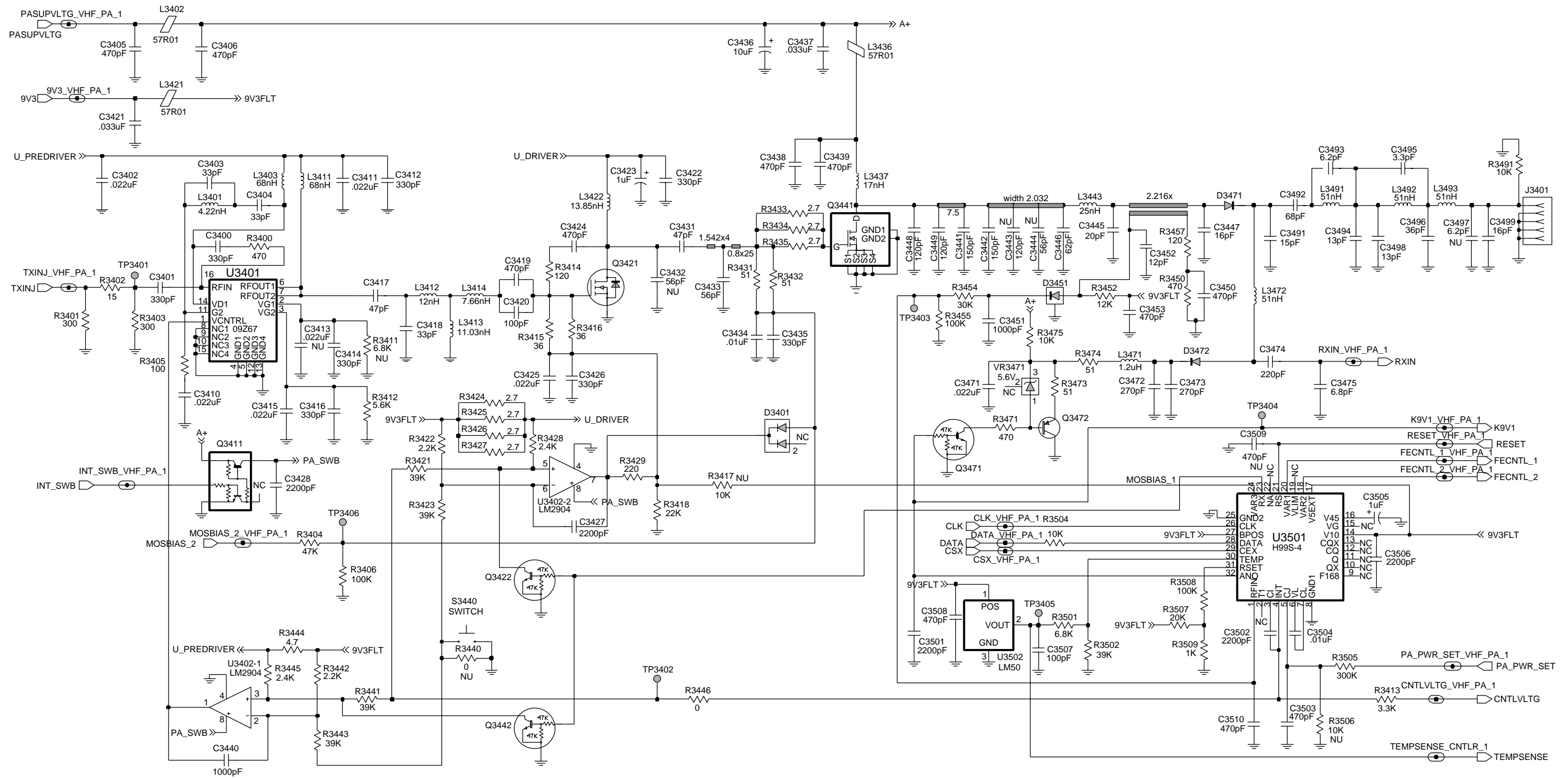
### 5.0 VHF (136-174 MHz) 1-25W PCB 8486172B08, Schematics, and Parts Lists



VHF (136-174 MHz) 1-25W PCB 8486172B08 Top Side



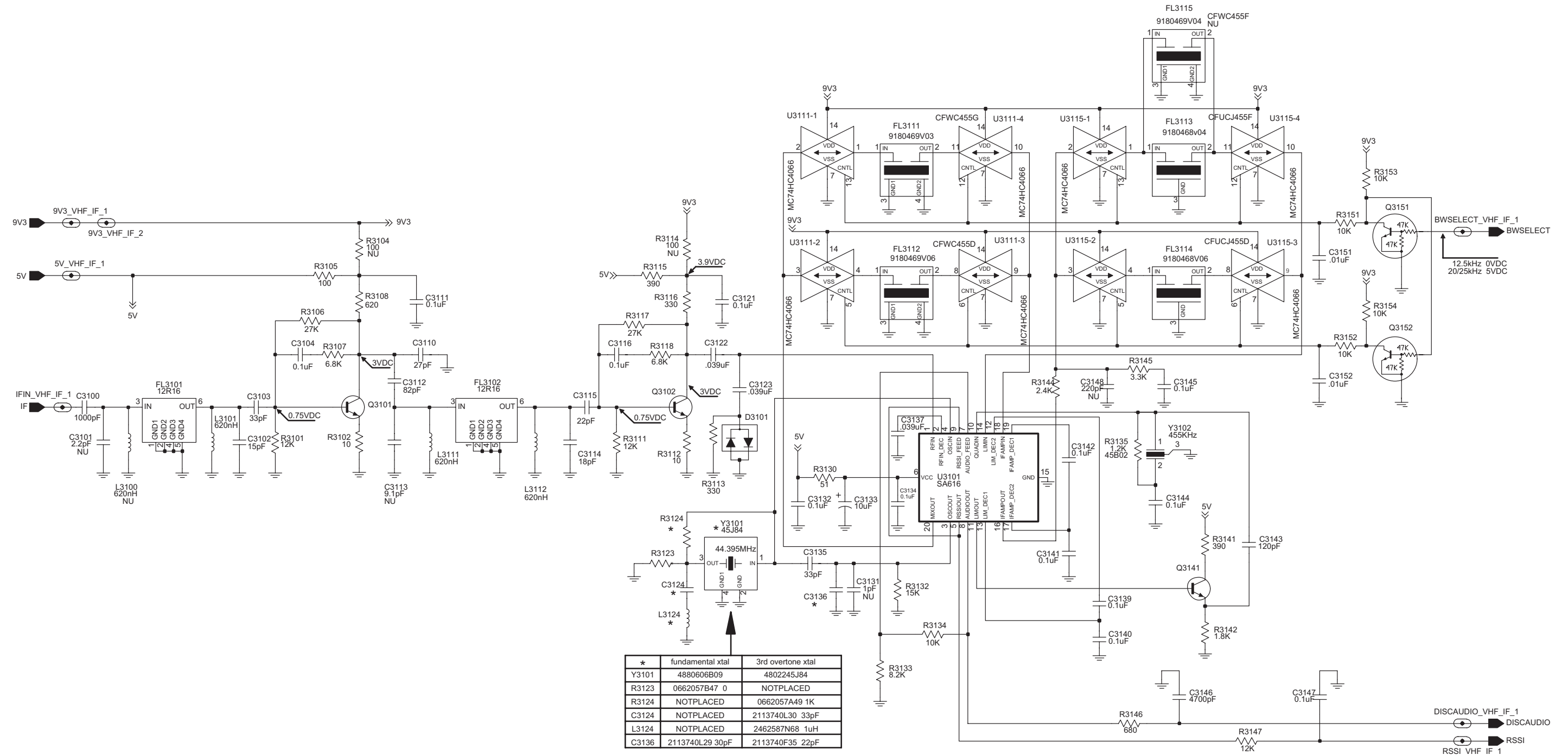
ZWG01300592-O



ZWG0130628-O

**VHF (136-174 MHz) 1-25W Power Amplifier**





ZWG0130565-B

VHF (136-174 MHz) 1-25W IF

6881091C63-B

## VHF 1-25W PCB 8486172B08 Parts List†

Circuit Ref	Motorola Part No.	Description
C3000	2113741F37	3.3nF 50V
C3001	2113740F19	4.7pF 5%
C3002	2113740F26	9.1pF 5%
C3003	2113741F37	3.3nF 50V
C3004	2113740F45	56pF 5%
C3005	2113740F51	100pF 5%
C3006	2113740F45	56pF 5%
C3007	2113741F37	3.3nF 50V
C3008	2113741F25	1nF 50V
C3009	2113741F13	330pF 50V
C3010	2113741F13	330pF 50V
C3011	2113741F37	3.3nF 50V
C3012	2113741F25	1nF 50V
C3013	2113740F45	56pF 5%
C3014	2113740F24	7.5pF 5%
C3015	2113740F45	56pF 5%
C3016	2113740F51	100pF 5% 50V
C3017	2113740F42	43pF 5% 50V
C3019	2113741F25	1nF 50V
C3020	2113741F25	1nF 50V
C3021	2113740F53	120pF 5% 50V
C3022	2113741F49	10nF 50V
C3026	2113743E20	100nF 16V
C3027	2113741F49	10nF 50V
C3028	2113741F49	10nF 50V
C3030	2113741F25	1nF 50V
C3033	2113740F20	5.1pF 5% 50V
C3034	2113740F49	82pF 5% 50V
C3035	2113740F33	18pF 5% 50V
C3036	2113741F25	1nF 50V
C3100	2113741F25	1nF 50V
C3102	2113740F31	15pF 5% 50V
C3103	2113740F39	33pF 5% 50V
C3104	2113743E20	100nF 16V
C3110	2113740F37	27pF 5% 50V
C3111	2113743E20	100nF 16V
C3112	2113740F49	82pF 5% 50V
C3114	2113740F33	18pF 5% 50V
C3115	2113740F35	22pF 5% 50V
C3116	2113743E20	100nF 16V
C3121	2113743E20	100nF 16V
C3122	2113743E11	39nF 10%
C3123	2113743E11	39nF 10%
C3124	2113740L30	33pF 2% 3rd overtone crystal fundamental crystal
C3132	2113743E20	100nF 16V
C3133	2311049A57	TANT CP 10uF 10% 16V
C3134	2113743E20	100nF 16V
C3135	2113740L30	33pF 2%
C3136	2113740F35	22pF 3rd overtone crystal fundamental crystal
C3137	2113743E11	39nF 10%
C3139	2113743E20	100nF 16V
C3140	2113743E20	100nF 16V

Circuit Ref	Motorola Part No.	Description
C3141	2113743E20	100nF 16V
C3142	2113743E20	100nF 16V
C3143	2113740F53	120pF 5% 50V
C3144	2113743E20	100nF 16V
C3145	2113743E20	100nF 16V
C3146	2113741F41	4.7nF 50V
C3147	2113743E20	100nF 16V
C3151	2113741F49	10nF 50V
C3152	2113741F49	10nF 50V
C3202	2113741F49	10nF 50V
C3203	2113741F49	10nF 50V
C3205	2113741F49	10nF 50V
C3206	2311049A57	TANT CP 10uF 10% 16V
C3208	2113743E20	100nF 16V
C3209	2113743E20	100nF 16V
C3210	2311049A40	TANT CP 2.2uF 10% 10V
C3211	2113743E20	100nF 16V
C3212	2113743E07	22nF 16V
C3312	2113743E07	22nF 16V
C3213	2311049A40	TANT CP 2.2uF 10% 10V
C3214	2311049A09	TANT CP 2.2uF 10% 20V
C3215	2311049A09	TANT CP 2.2uF 10% 20V
C3221	2113743E20	100nF 16V
C3222	2113743E20	100nF 16V
C3224	0882422W23	FILM SM 1.0uF 15V 5%
C3225	2113743E20	100nF 16V
C3226	2113740F25	8.2pF 5% 50V
C3227	2113740F51	100pF 5% 50V
C3228	2113743E20	100nF 16V
C3229	2113743E12	47nF 10%
C3231	2113741F49	10nF 50V
C3232	2113741F49	10nF 50V
C3233	2311049A40	TANT CP 2.2uF 10%
C3234	2113741F49	10nF 50V
C3235	2113741F49	10nF 50V
C3242	2113740F59	220pF 5% 50V
C3243	2113740F59	220pF 5% 50V
C3244	2113740F59	220pF 5% 50V
C3245	2113740F59	220pF 5% 50V
C3246	2113740F59	220pF 5% 50V
C3247	2113740F27	10pF 5% 50V
C3251	2113743E20	100nF 16V
C3252	2113741F25	1nF 50V
C3253	2311049A56	TANT CP 4.7uF 20% 10V
C3254	2113743E20	100nF 16V
C3255	2311049A40	TANT CP 2.2uF 10% 10V
C3263	2113743E20	100nF 16V
C3302	2113740F23	6.8pF 5% 50V
C3303	2113741F49	10nF 50V
C3306	2113740F20	5.1pF 5% 50V
C3311	2113743E07	22nF 16V
C3314	2113740F23	6.8pF 5% 50V
C3315	2113740F31	15pF 5% 50V
C3316	2113740F15	3.3pF 5% 50V
C3317	2113740F39	33pF 5% 50V
C3318	2113740F21	5.6pF 5% 50V

Circuit Ref	Motorola Part No.	Description
C3319	2113741F25	1nF 50V
C3324	2113741F49	10nF 50V
C3332	2113743E20	100nF 16V
C3333	2113743E20	100nF 16V
C3334	2113743E07	22nF 16V
C3335	2113741F49	10nF 50V
C3336	2113741F49	10nF 50V
C3337	2113743E20	100nF 16V
C3341	2113741F25	1nF 50V
C3342	2113740L05	3.0pF +-0.1pF
C3344	2113740F09	1.8pF 5% 50V
C3345	2113740L25	20pF +-0.25pF
C3346	2113741F49	10nF 50V
C3347	2113741F49	10nF 50V
C3348	2113741F49	10nF 50V
C3351	2113741F49	10nF 50V
C3352	2113743E07	22nF 16V
C3355	2113741F49	10nF 50V
C3356	2113743E07	22nF 16V
C3357	2113740F24	7.5pF 5% 50V
C3361	2113741F25	1nF 50V
C3362	2113740F21	5.6pF 5% 50V
C3363	2113740F47	68pF 5% 50V
C3364	2113740F31	15pF 5% 50V
C3365	2113741F25	1nF 50V
C3400	2113740F63	330pF 5% 50V
C3401	2113740F63	330pF 5% 50V
C3402	2113743E07	22nF 16V
C3403	2113740F39	33pF 5% 50V
C3404	2113740F39	33pF 5% 50V
C3405	2113740F67	470pF 5% 50V
C3406	2113740F67	470pF 5% 50V
C3410	2113743E07	22nF 16V
C3411	2113743E07	22nF 16V
C3412	2113740F63	330pF 5% 50V
C3414	2113740F63	330pF 5% 50V
C3415	2113743E07	22nF 16V
C3416	2113740F63	330pF 5% 50V
C3417	2113740F43	47pF 5% 50V
C3418	2113740F39	33pF 5% 50V
C3419	2113740F63	330pF 5% 50V
C3420	2113740F63	330pF 5% 50V
C3421	2113741A57	33nF 50V
C3422	2113740A67	330pF 5% 50V
C3423	2311049A08	TANT CP 1uF 10% 35V
C3424	2113740F67	470pF 5% 50V
C3425	2113743E07	22nF 16V
C3426	2113740F63	330pF 5% 50V
C3427	2113741F33	2.2nF 50V
C3428	2113741F33	2.2nF 50V
C3431	2111078B34	HQ 47pF 5%
C3433	2111078B36	HQ 56pF 5%
C3434	2113741A45	10nF 50V
C3435	2113740A67	330pF 5% 50V
C3436	2311049A45	TANT CP 10uF 10% 35V
C3437	2113741A57	33nF 50V

Circuit Ref	Motorola Part No.	Description
C3438	2111078B59	HQ 470pF 5%
C3439	2111078B59	HQ 470pF 5%
C3440	2113741F25	1nF 50V
C3441	2111078B47	HQ 150pF 5%
C3442	2111078B47	HQ 150pF 5%
C3444	2111078B36	HQ 56pF 5%
C3445	2111078B23	HQ 24pF 5%
C3446	2111078B37	HQ 62pF 5%
C3447	2111078B19	HQ 16pF 5%
C3450	2113740F67	470pF 5% 50V
C3451	2113741F25	1nF 50V
C3452	2113740F29	12pF 5% 50V
C3453	2113740F67	470pF 5% 50V
C3471	2113743E07	22nF 16V
C3472	2111078B53	HQ 270pF 5%
C3473	2111078B53	HQ 270pF 5%
C3474	2113740F59	220pF 5% 50V
C3475	2113740F23	6.8pF 5% 50V
C3491	2111078B18	HQ 15pF 5%
C3492	2111078B38	HQ 68pF 5%
C3493	2111078B08	HQ 6.2pF 5%
C3494	2111078B16	HQ 13pF 5%
C3495	2111078B01	HQ 3.3pF 5%
C3496	2111078B31	HQ 36pF 5%
C3498	2111078B16	HQ 13pF 5%
C3499	2111078B19	HQ 16pF 5%
C3501	2113741F33	2.2nF 50V
C3502	2113741F33	2.2nF 50V
C3503	2113740F67	470pF 5% 50V
C3504	2113741F49	10nF 50V
C3505	2311049A07	TANT CP 1uF 10% 16V
C3506	2113741F33	2.2nF 50V X7R
C3507	2113740F51	100pF 5% 50V
C3508	2113740F67	470pF 5% 50V
C3510	2113740F67	470pF 5% 50V
D3000	4813833C02	DUAL SOT MMBD6100
D3001	4805649Q13	VCTR 1SV228 SOT23
D3003	4880154K03	DUAL SCHOTTKY SOT23
D3004	4805649Q13	VCTR 1SV228 SOT23
D3011	4880142L01	PIN
D3031	4886143B01	MIXER DIODE CROSSOVER
D3101	4880154K03	DIODE DUAL SCHOTTKY
D3201	4802233J09	TRIPLE SOT143-RH
D3221	4880236E05	CHIP SCHOTTKY
D3341	4805649Q13	VCTR 1SV228 SOT23
D3361	4805649Q13	VCTR 1SV228 SOT23
D3362	4862824C01	VARACTOR CHIP
D3401	4813833C02	DUAL SOT MMBD6100
D3451	4880236E05	CHIP SCHOTTKY
D3471	4802482J02	PIN MA/COM
D3472	4802482J02	PIN MA/COM
FL3101	9180112R16	44.85 MHZ CRYSTAL FLTR 80dB
FL3102	9180112R16	44.85 MHZ CRYSTAL FLTR 80dB
FL3111	9180469V03	CER FLTR 6EL 455 KHZ SMD
FL3112	9180469V06	CER FLTR 6EL 455 KHZ SMD
FL3113	9180468V04	CER FLTR 4EL 455 KHZ SMD

Circuit Ref	Motorola Part No.	Description
FL3114	9180468V06	CER FLTR 4EL 455 KHZ SMD
J0401	0902636Y02	FLEX CONNECTOR
J0451	0902636Y01	FLEX CONNECTOR
J0501	0986105B01	ACCESSORY CONNECTOR
J0551	0905505Y04	FLEX CONNECTOR
J0552	0905505Y03	FLEX CONNECTOR
J0601	0986165B01	DC POWER CONNECTOR
J3401	0986166B02	RF CONN MINI UHF
L3002	2462587T23	COIL CHIP 470nH
L3031	2462587T24	COIL CHIP 560nH
L3032	2462587T17	COIL CHIP 150nH
L3101	2462587T25	COIL CHIP 620nH
L3111	2462587T25	COIL CHIP 620nH
L3112	2462587T25	COIL CHIP 620nH
L3124	2462587N68	1uH 3rd overtone crystal fundamental crystal
L3201	2462587Q42	IND CHIP 390nH 10%
L3231	2462587Q20	IND CHIP 2.2uH 20%
L3301	2462587N44	CHIP IND 18 NH 5%
L3302	2462587N53	CHIP IND 100 nH 5%
L3317	2462587V28	CHIP IND 33 NH 5%
L3318	2462587V34	IND CHIP 100nH 5%
L3331	2462587V32	CHIP IND 68NH 5%
L3332	2462587V15	IND CHIP 100nH 10%
L3333	2462587Q47	IND CHIP 1uH 10%
L3341	2484562T13	MINI-SPRING AW IND 8NH 2%
L3343	2462587N56	COIL CHIP 180nH 5%
L3344	2462587N68	CHIP IND 1 uH 5%
L3345	2462587N68	CHIP IND 1 uH 5%
L3346	2484562T18	MINI-SPRING AW IND 35.5NH 2%
L3351	2462587N68	CHIP IND 1 uH 5%
L3361	2462587N50	CHIP IND 56 nH 5%
L3362	2462587N51	CHIP IND 68 nH 5%
L3363	2462587N50	CHIP IND 56 nH 5%
L3364	2462587N68	CHIP IND 1 uH 5%
L3401	2460591A01	SQUARE COIL 4.22nH 3T
L3402	2484657R01	Ferrite Bead
L3403	2462587T13	COIL CHIP 68nH
L3411	2462587T13	COIL CHIP 68nH
L3412	2462587X42	IND CHIP LO-PRO 12nH 5%
L3414	2460591A11	SQUARE COIL 7.66nH 3T
L3421	2484657R01	Ferrite Bead
L3422	2460591C23	SQUARE COIL 16nH 3T
L3436	2484657R01	Ferrite Bead
L3437	2460592A01	COIL AW 17nH 2T
L3443	2460591X02	COIL SQUARE 25nH
L3471	2462587X69	IND CHIP 1.2uH 5%
L3472	2460592B01	COIL AW 51nH 4T
L3491	2460592B01	COIL AW 51nH 4T
L3492	2460592B01	COIL AW 51nH 4T
L3493	2460592B01	COIL AW 51nH 4T
M3421	2686201B01	HEAT SPREADER
Q3001	4813827A07	TSTR NPN SML SIG MMBR9
Q3002	4813824A17	TSTR PNP 40V .2A B=100-

Circuit Ref	Motorola Part No.	Description
Q3021	4805921T02	TSTR DUAL ROHM FMC2
Q3101	4813827A07	TSTR NPN SML SIG MMBR9
Q3102	4813827A07	TSTR NPN SML SIG MMBR9
Q3141	4813824A10	TSTR NPN 40V .2A B=50-150
Q3151	4880048M01	TSTR NPN DIG 47k/47k
Q3152	4880048M01	TSTR NPN DIG 47k/47k
Q3221	4880048M01	TSTR NPN DIG 47k/47k
Q3301	4813827A07	TSTR NPN SML SIG MMBR9
Q3303	4802245J50	TSTR DUAL NPN/PNP UMC5N
Q3304	4805218N63	RF TRANS SOT 323 BFOQ67W
Q3411	4805921T02	DUAL ROHM FMC2 RH
Q3421	4886212B01	LDMOS PWRTSTR MRF1518
Q3422	4880048M01	NPN DIG 47k/47k
Q3441	4886136B01	LDMOS PWR TSTR MRF1565 MRF1550
Q3442	4880048M01	NPN DIG 47k/47k
Q3471	4880048M01	NPN DIG 47k/47k
Q3472	4805128M27	PNP SOT89 BSR33 LH
R3000	0662057A53	1500 1/16W 5%
R3001	0662057A97	100k 1/16W
R3002	0662057A43	560 1/16W 5%
R3003	0662057A49	1k 1/16W 5%
R3004	0662057A53	1500 1/16W 5%
R3006	0662057A73	10k 1/16W 5%
R3009	0662057A97	100k 1/16W
R3010	0662057A45	680 OHMS 5%
R3011	0662057A65	4700 1/16W 5%
R3012	0662057A49	1k 1/16W 5%
R3013	0662057A61	3300 1/16W 5%
R3014	0662057A18	51 1/16W 5%
R3015	0662057A01	10 1/16W 5%
R3016	0662057A01	10 1/16W 5%
R3018	0662057A33	220 1/16W 5%
R3019	0662057A89	47k 1/16W 5%
R3021	0662057A43	560 1/16W 5%
R3024	0662057A39	390 1/16W 5%
R3025	0662057A53	1500 1/16W 5%
R3026	0662057A73	10k 1/16W 5%
R3027	0662057A73	10k 1/16W 5%
R3028	0662057A39	390 1/16W 5%
R3031	0662057A18	51 1/16W 5%
R3033	0662057B47	0 1/16W
R3101	0662057A75	12k 1/16W 5%
R3102	0662057A01	10 1/16W 5%
R3105	0662057A25	100 1/16W 5%
R3106	0662057A83	27k 1/16W 5%
R3107	0662057A69	6800 1/16W 5%
R3108	0662057A44	620 OHMS 5%
R3111	0662057A75	12k 1/16W 5%
R3112	0662057A01	10 1/16W 5%
R3113	0662057A37	330 1/16W 5%
R3115	0662057A39	390 1/16W 5%
R3116	0662057A37	330 1/16W 5%
R3117	0662057A83	27k 1/16W 5%
R3118	0662057A69	6800 1/16W 5%

Circuit Ref	Motorola Part No.	Description
R3123	NU	3rd overtone crystal
R3124	0662057B47	0 fundamental crystal
R3124	0662057A49	1K 3rd overtone crystal
R3124	NU	fundamental crystal
R3130	0662057A18	51 1/16W 5%
R3132	0662057A77	15k 1/16W 5%
R3133	0662057A71	8200 1/16W 5%
R3134	0662057A73	10k 1/16W 5%
R3135	0662057A51	1200 1/16W 5%
R3141	0662057A39	390 1/16W 5%
R3142	0662057A55	1800 1/16W 5%
R3144	0662057A58	2400 1/16W 5%
R3145	0662057A61	3300 1/16W 5%
R3146	0662057A45	680 OHMS 5%
R3147	0662057A75	12k 1/16W 5%
R3151	0662057A73	10k 1/16W 5%
R3152	0662057A73	10k 1/16W 5%
R3153	0662057A73	10k 1/16W 5%
R3154	0662057A73	10k 1/16W 5%
R3201	0662057A17	47 1/16W 5%
R3202	0662057B46	10MEG
R3203	0662057A17	47 1/16W 5%
R3204	0662057A17	47 1/16W 5%
R3206	0662057B02	150k 1/16W
R3211	0662057B47	0 1/16W
R3221	0662057A39	390 1/16W 5%
R3222	0662057A45	680 OHMS 5%
R3223	0662057A25	100 1/16W 5%
R3224	0662057A89	47k 1/16W 5%
R3225	0662057A89	47k 1/16W 5%
R3227	0662057A97	100k 1/16W
R3241	0662057A25	100 1/16W 5%
R3242	0662057B47	0 1/16W
R3251	0662057B04	180k 1/16W 5%
R3252	0662057B10	330k 1/16W 5%
R3261	0662057A89	47k 1/16W 5%
R3263	0662057A65	4700 1/16W 5%
R3301	0662057A22	75 1/16W 5%
R3302	0662057A25	100 1/16W 5%
R3303	0662057A57	2200 1/16W 5%
R3304	0662057A49	1k 1/16W 5%
R3308	0662057B47	0 1/16W
R3311	0662057A25	100 1/16W 5%
R3316	0662057B47	0 1/16W
R3318	0662057A09	22 1/16W 5%
R3321	0662057A73	10k 1/16W 5%
R3323	0662057A49	1k 1/16W 5%
R3331	0662057A17	47 1/16W 5%
R3335	0662057A13	33 1/16W 5%
R3336	0662057A77	15k 1/16W 5%
R3341	0662057A33	220 1/16W 5%
R3342	0662057A15	39 1/16W 5%
R3343	0662057A25	100 1/16W 5%
R3351	0662057A80	20k 1/16W 5%
R3352	0662057A75	12k 1/16W 5%
R3353	0662057A97	100k 1/16W

Circuit Ref	Motorola Part No.	Description
R3354	0662057B02	150k 1/16W
R3355	0662057A80	20k 1/16W 5%
R3356	0662057A75	12k 1/16W 5%
R3361	0662057A33	220 1/16W 5%
R3362	0662057A17	47 1/16W 5%
R3364	0662057A89	47k 1/16W 5%
R3400	0662057A41	470 1/16W 5%
R3401	0662057A36	300 1/16W 5%
R3402	0662057A05	15 1/16W 5%
R3403	0662057A36	300 1/16W 5%
R3404	0662057A89	47k 1/16W 5%
R3405	0662057A25	100 1/16W 5%
R3406	0662057A97	100k 1/16W
R3412	0662057A67	5600 1/16W 5%
R3413	0662057A61	3300 1/16W 5%
R3414	0683962T51	120 1W 5%
R3415	0662057A14	36 1/16W 5%
R3416	0662057A14	36 1/16W 5%
R3418	0662057A81	22k 1/16W 5%
R3421	0662057A87	39k 1/16W 5%
R3422	0662057A57	2200 1/16W 5%
R3423	0662057A87	39k 1/16W 5%
R3424	0662057C13	2.7 1/10W 5%
R3425	0662057C13	2.7 1/10W 5%
R3426	0662057C13	2.7 1/10W 5%
R3427	0662057C13	2.7 1/10W 5%
R3428	0662057A58	2400 1/16W 5%
R3429	0662057A33	220 1/16W 5%
R3431	0680194M18	51 1W 5%
R3432	0680194M18	51 1W 5%
R3433	0662057C13	2.7 1/10W 5%
R3434	0662057C13	2.7 1/10W 5%
R3435	0662057C13	2.7 1/10W 5%
R3441	0662057A87	39k 1/16W 5%
R3442	0662057A57	2200 1/16W 5%
R3443	0662057A87	39k 1/16W 5%
R3444	0662057C19	4.7 1/10W 5%
R3445	0662057A58	2400 1/16W 5%
R3446	0662057B47	0 1/16W
R3450	0662057A41	470 1/16W 5%
R3452	0662057A75	12k 1/16W 5%
R3454	0662057A84	30k 1/16W 5%
R3455	0662057A97	100k 1/16W
R3457	0683962T51	120 1W 5%
R3471	0662057A41	470 1/16W 5%
R3473	0680194M18	51 1W 5%
R3474	0680194M18	51 1W 5%
R3475	0662057A73	10k 1/16W 5%
R3491	0662057A73	10k 1/16W 5%
R3501	0662057A69	6800 1/16W 5%
R3502	0662057A87	39k 1/16W 5%
R3504	0662057A73	10k 1/16W 5%
R3505	0662057B09	300k 1/16W 5%
R3507	0662057A80	20k 1/16W 5%
R3508	0662057A97	100k 1/16W
R3509	0662057A49	1k 1/16W 5%

Circuit Ref	Motorola Part No.	Description
T3001	2508396X02	TRANSFORMER
T3002	2508397X02	TRANSFORMER
U3101	5186144B01	FM IF IC SA616
U3111	5113805A86	IC QUAD ANALOG MUX/DEMUX
U3115	5113805A86	IC QUAD ANALOG MUX/DEMUX
U3201	5185963A27	IC TESTED AT25016 48 PIN GFP
U3211	5105739X05	IC SOT 5V HI-PRECISION REG- ULAT
U3301	5105750U54	VCO BUFFER PKG DIE
U3401	5185130C65	LDMOS DRIVER VHF/UHF/ 800MHz
U3402	5180932W01	LINEAR IC OP-AMP
U3501	5185765B01	IC POWER CONTROL
U3502	5185963A15	TEMP SENSOR 1M5
VR3471	4813830A15	5.6V 5% 225mW
Y3101	4802245J84	2ND OSC XTAL 44.395 MHZ 3rd overtone crystal
	4880606B09	fundamental crystal
Y3102	9186145B02	CERAMIC DISCRIMINATOR 455kHz
Y3263	4886182B01	VCTCXO 16.8MHz 2ppm TTSO5V
* Y3261	Not Used	16.8MHz 75Z04

\* Motorola Depot Servicing only

Reference designators with an asterisk indicate components which are not field-replaceable because they need to be calibrated with specialized factory equipment after installation. Radios in which these parts have been replaced in the field will be off frequency at temperature extremes.

† Replacement boards must be ordered from CCSD (formerly AAD) using the number shown in the model charts in Section 1. Boards are not orderable using the 84-prefixed number.