

ASTRO® XTL™ 1500

Digital Mobile Radio

Detailed Service Manual



MOTOROLA





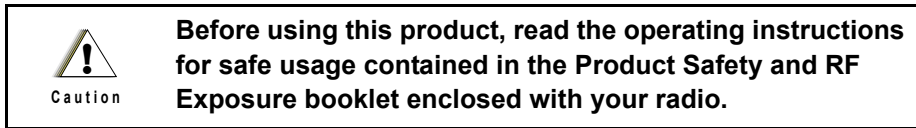
ASTRO® Digital XTL™ 1500
**VHF/UHF Range 1/UHF Range 2/
700–800 MHz**
Mobile Radio
Detailed Service Manual

Foreword

The information contained in this manual relates to all ASTRO® Digital XTL™ 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz mobile radios equipped with XTL 1500 control heads, unless otherwise specified. This manual provides sufficient information to enable qualified service technicians to troubleshoot and repair XTL 1500 radios to the component level.

For details on radio operation or basic troubleshooting, refer to the applicable manuals available separately. A list of related publications is provided in the section, “Related Publications,” on page xx.

Product Safety and RF Exposure Compliance



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>.

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 component layout diagrams. To obtain FMRs, contact the Radio Products and Services Division (refer to “Appendix A Replacement Parts Ordering”).

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Document History

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Related Publications

ASTRO Digital XTL 1500 Mobile Radio Installation Manual.....	6815851H01
ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700-800 MHz Mobile Radio Basic Service Manual.....	6815853H01
CPS Programming Installation Guide.....	6881095C44
System 9000 Direct Entry Keyboard Instruction Manual	68P80101W22-B

Commercial Warranty

Limited Warranty

MOTOROLA COMMUNICATION PRODUCTS

I. What This Warranty Covers And For How Long

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

ASTRO Digital XTL 1500 Mobile Radio Units	One (1) Year
Product Accessories	One (1) Year

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

This express limited warranty is extended by MOTOROLA to the original end user purchaser only and is not assignable or transferable to any other party. This is the complete warranty for the Product manufactured by MOTOROLA. MOTOROLA assumes no obligations or liability for additions or modifications to this warranty unless made in writing and signed by an officer of MOTOROLA. Unless made in a separate agreement between MOTOROLA and the original end user purchaser, MOTOROLA does not warrant the installation, maintenance or service of the Product.

MOTOROLA cannot be responsible in any way for any ancillary equipment not furnished by MOTOROLA which is attached to or used in connection with the Product, or for operation of the Product with any ancillary equipment, and all such equipment is expressly excluded from this warranty. Because each system which may use the Product is unique, MOTOROLA disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

II. General Provisions

This warranty sets forth the full extent of MOTOROLA's responsibilities regarding the Product. Repair, replacement or refund of the purchase price, at MOTOROLA's option, is the exclusive remedy. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER EXPRESS WARRANTIES. IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY. IN NO EVENT SHALL MOTOROLA BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE SUCH PRODUCT, TO THE FULL EXTENT SUCH MAY BE DISCLAIMED BY LAW.

III. State Law Rights

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION OR EXCLUSIONS MAY NOT APPLY.

This warranty gives specific legal rights, and there may be other rights which may vary from state to state.

IV. How To Get Warranty Service

You must provide proof of purchase (bearing the date of purchase and Product item serial number) in order to receive warranty service and, also, deliver or send the Product item, transportation and insurance prepaid, to an authorized warranty service location. Warranty service will be provided by Motorola through one of its authorized warranty service locations. If you first contact the company which sold you the Product, it can facilitate your obtaining warranty service. You can also call Motorola at 1-888-567-7347 US/Canada.

V. What This Warranty Does Not Cover

- A. Defects or damage resulting from use of the Product in other than its normal and customary manner.
- B. Defects or damage from misuse, accident, water, or neglect.
- C. Defects or damage from improper testing, operation, maintenance, installation, alteration, modification, or adjustment.
- D. Breakage or damage to antennas unless caused directly by defects in material workmanship.
- E. A Product subjected to unauthorized Product modifications, disassemblies or repairs (including, without limitation, the addition to the Product of non-Motorola supplied equipment) which adversely affect performance of the Product or interfere with Motorola's normal warranty inspection and testing of the Product to verify any warranty claim.
- F. Product which has had the serial number removed or made illegible.
- G. Rechargeable batteries if:
 - any of the seals on the battery enclosure of cells are broken or show evidence of tampering.
 - the damage or defect is caused by charging or using the battery in equipment or service other than the Product for which it is specified.
- H. Freight costs to the repair depot.
- I. A Product which, due to illegal or unauthorized alteration of the software/firmware in the Product, does not function in accordance with MOTOROLA's published specifications or the FCC type acceptance labeling in effect for the Product at the time the Product was initially distributed from MOTOROLA.
- J. Scratches or other cosmetic damage to Product surfaces that does not affect the operation of the Product.
- K. Normal and customary wear and tear.

VI. Patent And Software Provisions

MOTOROLA will defend, at its own expense, any suit brought against the end user purchaser to the extent that it is based on a claim that the Product or parts infringe a United States patent, and MOTOROLA will pay those costs and damages finally awarded against the end user purchaser in any such suit which are attributable to any such claim, but such defense and payments are conditioned on the following:

- A. that MOTOROLA will be notified promptly in writing by such purchaser of any notice of such claim;
- B. that MOTOROLA will have sole control of the defense of such suit and all negotiations for its settlement or compromise; and
- C. should the Product or parts become, or in MOTOROLA's opinion be likely to become, the subject of a claim of infringement of a United States patent, that such purchaser will permit MOTOROLA, at its option and expense, either to procure for such purchaser the right to continue using the Product or parts or to replace or modify the same so that it becomes noninfringing or to grant such purchaser a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by MOTOROLA.

MOTOROLA will have no liability with respect to any claim of patent infringement which is based upon the combination of the Product or parts furnished hereunder with software, apparatus or devices not furnished by MOTOROLA, nor will MOTOROLA have any liability for the use of ancillary equipment or software not furnished by MOTOROLA which is attached to or used in connection with the Product. The foregoing states the entire liability of MOTOROLA with respect to infringement of patents by the Product or any parts thereof.

Laws in the United States and other countries preserve for MOTOROLA certain exclusive rights for copyrighted MOTOROLA software such as the exclusive rights to reproduce in copies and distribute copies of such Motorola software. MOTOROLA software may be used in only the Product in which the software was originally embodied and such software in such Product may not be replaced, copied, distributed, modified in any way, or used to produce any derivative thereof. No other use including, without limitation, alteration, modification, reproduction, distribution, or reverse engineering of such MOTOROLA software or exercise of rights in such MOTOROLA software is permitted. No license is granted by implication, estoppel or otherwise under MOTOROLA patent rights or copyrights.

VII. Governing Law

This Warranty is governed by the laws of the State of Illinois, USA.

Notes

Model Numbering, Charts, and Specifications

Mobile Radio Model Numbering Scheme

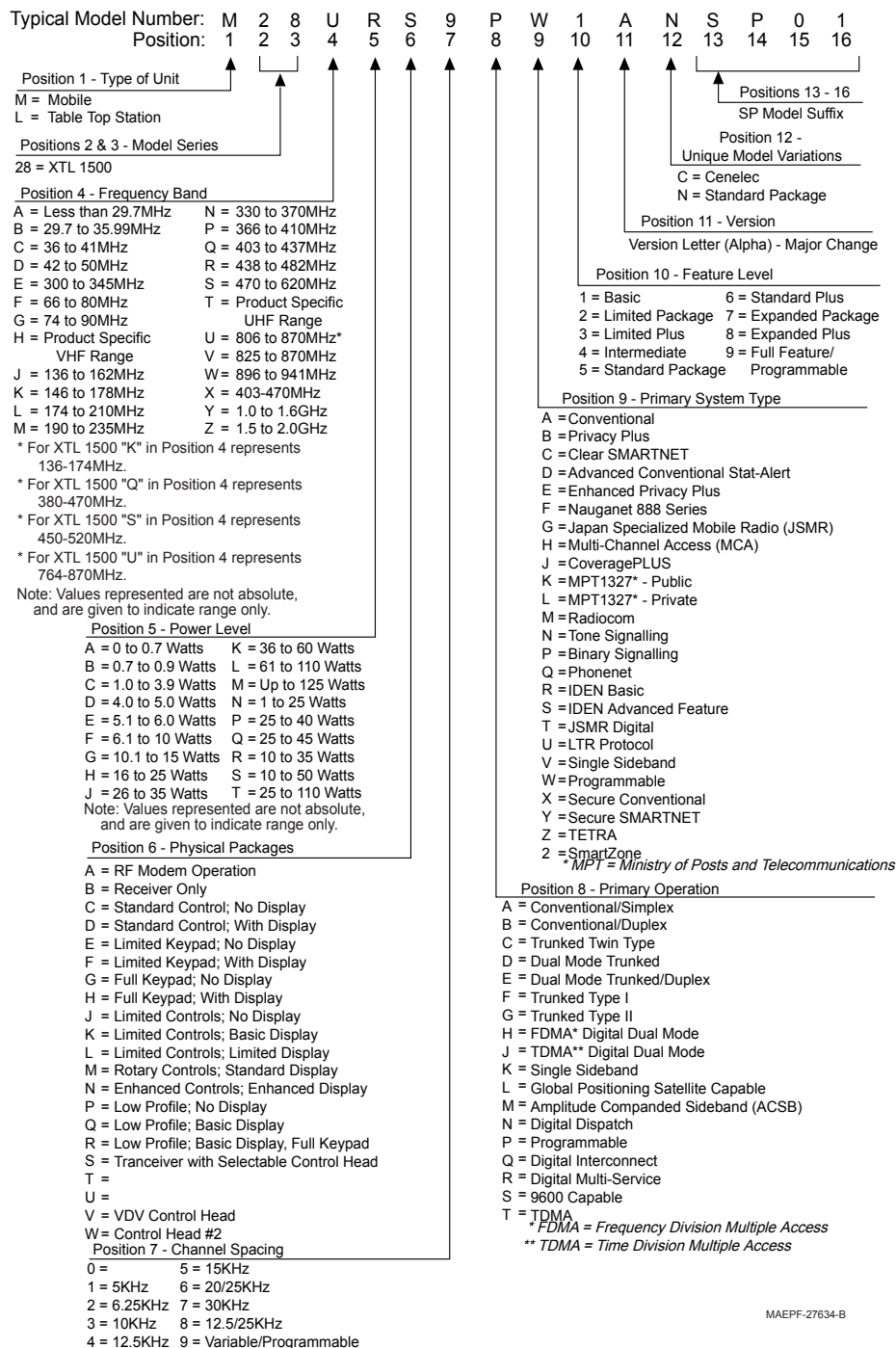


Figure 1. Mobile Radio Model Numbering Scheme

ASTRO XTL 1500 VHF 10-50 Watt Model Chart

M28KSS9PW1AN																
Option									Description							
									W20BX	ALT: Keypad Microphone						
									W382AH	ALT: Control Station Palm Microphone						
									G798AA	ADD: Control Station Base Mount						
									G91AA	ADD: Control Station Power Supply						
									W470AR	ADD: External Emergency Footswitch						
									W688AP	ADD: External Emergency Pushbutton						
									W81AL	ADD: Key Lock Mount						
									W116AN	ADD: External Alarm and Relay Cable						
									B18CL	ADD: Auxiliary Speaker Spectra 5 Watt						
									G296AA	ADD: Antenna 1/4 Wave Whip Roof Top 136-144 MHz						
									G297AA	ADD: Antenna 1/4 Wave Roof Top VHF 144-150.8 MHz						
									G299AA	ADD: Antenna 1/4 Wave Roof Top VHF 150.8-162 MHz						
									G300AA	ADD: Antenna 1/4 Wave Roof Top VHF 162-174 MHz						
									G301AA	ADD: Antenna 3 dB Roof Top VHF 136-174 MHz						
									Item No.	Description						
X										HMN4079_	Keypad Microphone					
	X									HMN1088_	Control Station Desk Microphone					
		X								HLN6925_	Control Station Mount					
			X							HPN4001_	Power Supply					
				X						HLN5113_	Emergency Footswitch					
					X					HLN5131_	Emergency Pushbutton					
						X				HLN6372_	Keylock Mount					
							X			TLN4533_	Relays					
								X		HKN4258_	Cable Relay					
									X	HSN4031_	External 7.5 Watt Speaker					
										X	HAD4006_	1/4 Wave Whip Antenna Roof Top				
											X	HAD4007_	1/4 Wave Roof Top VHF			
												X	HAD4008_	1/4 Wave Roof Top		
													X	HAD4009_	1/4 Wave Roof Top	
														X	RAD4010_RB	3 dB Antenna 136-174 MHz

X = Item Included

_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

ASTRO XTL 1500 UHF Range 1 10-40 Watt Model Chart

M28QSS9PW1AN 380–470 MHz											
Option									Description		
									W20BX	ALT: Keypad Microphone	
									W382AH	ALT: Control Station Palm Microphone	
									G798AA	ADD: Control Station Base Mount	
									G91AA	ADD: Control Station Power Supply	
									W470AR	ADD: External Emergency Footswitch	
									W688AP	ADD: External Emergency Pushbutton	
									W81AL	ADD: Key Lock Mount	
									W116AN	ADD: External Alarm and Relay	
									B18CL	ADD: Auxiliary Speaker Spectra 5 Watt	
									G425AA	ADD: Antenna 1/4 Wave Whip 380-420 MHz	
									G426AA	ADD: Antenna 1/4 Wave Whip 450-470 MHz	
									G427AA	ADD: Antenna 3.5 dB 380-420 MHz	
									G428AA	ADD: Antenna 3.5 dB 450-470 MHz	
									G429AA	ADD: Antenna 5.0 dB 380-420 MHz	
									G430AA	ADD: Antenna 5.0 dB 450-470 MHz	
									G431AA	ADD: Antenna Wideband 380-470 MHz	
									Item No.	Description	
X										HMN4079_	Keypad Microphone
	X									HMN1088_	Control Station Desk Microphone
		X								HLN6925_	Control Station Mount
			X							HPN4001_	Power Supply
				X						HLN5113_	Emergency Footswitch
					X					HLN5131_	Emergency Pushbutton
						X				HLN6372_	Key Lock Mount
							X			TLN4533_	Relays
								X		HKN4258_	Cable Relay
									X	HSN4031_	External 7.5 Watt Speaker
								X		HAE4003_	Antenna, 1/4 Wave Whip, 450-470 MHz
									X	HAE4011_	Antenna, 3.5 dB, 450-470 MHz
									X	HAE6010_	Antenna, 3.5 dB, 380-433 MHz
									X	HAE6011_	Antenna, 5.0 dB, 380-433 MHz
						X				HAE6012_	Antenna, 1/4 Wave Whip, 380-433 MHz
									X	HAE6013_	Antenna, 2.0 dB Wideband, 380-470 MHz
									X	RAE4014_RB	Antenna, 5.0 dB, 450-470 MHz

X = Item Included

_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

ASTRO XTL 1500 UHF Range 2 10-45 Watt Model Chart

M28SSS9PW1AN 450–520 MHz													
Option										Description			
										W20BX	ALT: Keypad Microphone		
										W382AH	ALT: Control Station Palm Microphone		
										G798AA	ADD: Control Station Base Mount		
										G91AA	ADD: Control Station Power Supply		
										W470AR	ADD: External Emergency Footswitch		
										W688AP	ADD: External Emergency Pushbutton		
										W81AL	ADD: Key Lock Mount		
										W116AN	ADD: External Alarm and Relay		
										B18CL	ADD: Auxiliary Speaker Spectra 5 Watt		
										G426AA	ADD: Antenna 1/4 Wave Whip 450-470 MHz		
										G428AA	ADD: Antenna 3.5 dB 450-470 MHz		
										G430AA	ADD: Antenna 5.0 dB 450-470 MHz		
										G486AA	ADD: Antenna 5.0 dB 494-512 MHz		
										G490AB	ADD: Antenna 1/4 Wave 470-512 MHz		
										G493AB	ADD: Antenna 3.0 dB Roof Top 470-495 MHz		
										G494AB	ADD: Antenna 3.0 dB Roof Top 494-512 MHz		
										Item No.		Description	
X											HMN4079_	Keypad Microphone	
	X										HMN1088_	Control Station Desk Microphone	
		X									HLN6925_	Control Station Mount	
			X								HPN4001_	Power Supply	
				X							HLN5113_	Emergency Footswitch	
					X						HLN5131_	Emergency Pushbutton	
						X					HLN6372_	Key Lock Mount	
							X				TLN4533_	Relays	
								X			HKN4258_	Cable Relay	
									X		HSN4031_	External 7.5 Watt Speaker	
										X	HAE4003_	Antenna, 1/4 Wave Whip, 450-470 MHz	
											X	HAE4004_	Antenna, 1/4 Wave, 470-512 MHz
									X		HAE4011_	Antenna, 3.5 dB, 450-470 MHz	
										X	HAE4012_	Antenna, 3.0 dB, Roof Top 470-495 MHz	
										X	HAE4013_	Antenna, 3.0 dB, Roof Top 494-512 MHz	
								X			RAE4014_RB	Antenna, 5.0 dB, 450-470 MHz	
									X		RAE4016_RB	Antenna, 5.0 dB Gain, 494-512 MHz	

X = Item Included

_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

ASTRO XTL 1500 700-800 MHz 10-35 Watt Model Chart

M28URS9PW1AN 764–870 MHz										
Option								Description		
								W20BX	ALT: Keypad Microphone	
								W382AH	ALT: Control Station Palm Microphone	
								G798AA	ADD: Control Station Base Mount	
								G91AA	ADD: Control Station Power Supply	
								W470AR	ADD: External Emergency Footswitch	
								W688AP	ADD: External Emergency Pushbutton	
								W81AL	ADD: Key Lock Mount	
								W116AN	ADD: External Alarm and Relay Cable	
								B18CL	ADD: Auxiliary Speaker Spectra 5 Watt	
								W484AD	ALT: Antenna 3 dB Gain 762-870 MHz	
								G335AT	ADD: Antenna 1/4 Wave 762-870 MHz	
								G174AA	ADD: Antenna 3 dB Low-Profile 762-870 MHz	
								G175AA	ADD: Antenna 3 dB Elevat Feed 762-870 MHz	
								Item No.	Description	
X									HMN4079_	Keypad Microphone
	X								HMN1088_	Control Station Desk Microphone
		X							HLN6925_	Control Station Mount
			X						HPN4001_	Power Supply
				X					HLN5113_	Emergency Footswitch
					X				HLN5131_	Emergency Pushbutton
						X			HLN6372_	Keylock Mount
							X		TLN4533_	Relays
								X	HKN4258_	Cable Relay
								X	HSN4031_	External 7.5 Watt Speaker
								X	HAF4013_	Antenna, 3 dB Low Profile 762-870 MHz
								X	HAF4014_	Antenna, 3 dB Elevat Feed 762-870 MHz
								X	HAF4016_	Antenna, 1/4 Wave 762-870 MHz
							X		HAF4017_	Antenna, 3 dB Collinear, 762-870 MHz

X = Item Included

_ = the latest version kit. When ordering a kit, refer to your specific kit for the suffix number.

VHF Radio Specifications

GENERAL		RECEIVER	TRANSMITTER
FCC Designations:	AZ492FT3806	Frequency Range: Range 1: 136–174 MHz	Frequency Range: Range 1: 136–174 MHz
Temperature Range: Operating: –30°C to +60°C Storage: –55°C to +85°C		Channel Spacing: 12.5 kHz/30 kHz	Rated Output Power: Low-Power Radio: 25 Watt Mid-Power Radio: 50 Watt
Power Supply: 12 Vdc Negative Ground Only		Input Impedance: 50 Ohm	
Battery Drain: (Maximum) 50 Watt: Standby @ 13.8 V: 0.8 A Receive at Rated Audio @ 13.6 V: 3.0 A Transmit @ Rated Power: 10 W 8.0 A 50 W 13.0 A		Frequency Separation: Full Bandsplit	Channel Spacing: 12.5 kHz or 30 kHz
Dimensions (H x W x D) Dash-Mount Radio: 2.5" x 7.3" x 9.8" (65 mm x 185 mm x 248 mm)		Sensitivity: (per EIA spec. RS204C) With pre-amplifier 20 dB Quieting: (25 kHz Channel Spacing): 0.25 µV 12 dB SINAD: (25 kHz Channel Spacing): 0.20 µV Without pre-amplifier 20 dB Quieting: (25 kHz Channel Spacing): 0.4 µV 12 dB SINAD: (25 kHz Channel Spacing): 0.3 µV	Output Impedance: 50 Ohm Frequency Separation: Range 1: 30 MHz Frequency Stability: (–30° to +60°C; 25°C Ref.): 2.5 ppm
Speaker: (excluding mounting bracket) 5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)		Intermodulation: (per EIA Specifications) With pre-amplifier (Measured in the Analog Mode): –80 dB Without pre-amplifier (Measured in the Analog Mode): –85 dB	Modulation Limiting: 25 kHz Channel Spacing: ±5.0 kHz 12.5 kHz Channel Spacing: ±2.5 kHz Modulation Fidelity (C4FM): 12.5 kHz Digital Channel: ±2.8 kHz
Mid Power Weight: Radio: 5.1 lbs (2.3 kg) Speaker: 1.5 lbs (0.7 kg)		Digital Sensitivity: With pre-amplifier 1% BER (12.5 kHz channel): 0.25 µV 5% BER (12.5 kHz channel): 0.20 µV Without pre-amplifier 1% BER (12.5 kHz channel): 0.4 µV 5% BER (12.5 kHz channel): 0.3 µV	FM Hum and Noise: 25 kHz Channel Spacing: –50 dB 12.5 kHz Channel Spacing: –40 dB Emission (Conduct/Radiated): –85 dBc/-20dBm
		Selectivity: (per EIA Specifications) (Measured in the Analog Mode) 25 kHz Channel Spacing: –90 dB 12.5 kHz Channel Spacing: –70 dB	Audio Sensitivity: (For 60% Max. Deviation at 1 kHz): 0.08V ±3 dB
		Intermodulation: (per EIA Specifications) (Measured in the Analog Mode): –80 dB	Audio Response: (Measured in the Analog Mode) (6 dB/Octave Pre-Emphasis 300 to 3000Hz): +1, –3 dB
		Spurious Rejection: –90 dB	Audio Distortion: (For 60% Max. Deviation at 1 kHz): 2% per EIA
		Frequency Stability: (–30° to +60°C; 25°C Reference): 2.5 ppm	Emissions Designators: 8K10F1E, 11K0F3E, 15K0F2D, 16K0F3E, 20K0F1E, 15K0F1D, 11K0F1D, and 11K0F2D
		Audio Output: (per EIA Specifications) (Measured in the Analog Mode at Less than 3% Distortion): 7.5W (External Speaker) 3W (Internal Speaker)	

Specifications subject to change without notice.
All measurements are taken in the test mode at 25 kHz channel spacing except where indicated.

UHF Range 1 Radio Specifications

GENERAL		RECEIVER	TRANSMITTER
FCC Designations:	AZ492FT4862	Frequency Range: Range 1: 380–470 MHz	Frequency Range: Range 1: 380–470 MHz
Temperature Range: Operating: –30°C to +60°C Storage: –51°C to +85°C		Channel Spacing: 12.5 kHz/20 kHz/25 kHz	Rated Output Power: Low-Power Radio: 25 Watt Mid-Power Radio: 50 Watt
Power Supply: 12 Vdc Negative Ground Only		Input Impedance: 50 Ohm	Channel Spacing: 12.5 kHz or 25 kHz
Battery Drain: (Maximum) Standby @ 13.8 V: 0.85 A Receive at Rated Audio @ 13.8 V: 3.2 A Transmit @ Rated Power: 10 W 8.0 A 40 W 11.0 A		Frequency Separation: Full Bandsplit	Output Impedance: 50 Ohm
Dimensions (H x W x D) Dash-Mount Radio: 2.5" x 7.3" x 9.8" (65 mm x 185 mm x 248 mm)		Sensitivity: (per EIA spec. RS204C) With pre-amplifier 20 dB Quieting: (25 kHz Channel Spacing): 0.25 µV 12 dB SINAD: (25 kHz Channel Spacing): 0.20 µV Without pre-amplifier 20 dB Quieting: (25 kHz Channel Spacing): 0.4 µV 12 dB SINAD: (25 kHz Channel Spacing): 0.3 µV	Frequency Separation: Full Bandsplit Frequency Stability: (–30° to +60°C; 25°C Ref.): 2 ppm
Speaker: (excluding mounting bracket) 5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)		Intermodulation: (per EIA Specifications) With pre-amplifier (Measured in the Analog Mode): –80 dB Without pre-amplifier (Measured in the Analog Mode): –85 dB	Modulation Limiting: 25 kHz Channel Spacing: ±5.0 kHz 12.5 kHz Channel Spacing: ±2.5 kHz
Mid Power Weight: Radio: 5.1 lbs (2.3 kg) Speaker: 1.5 lbs (0.7 kg)		Digital Sensitivity: With pre-amplifier 1% BER (12.5 kHz channel): 0.25 µV 5% BER (12.5 kHz channel): 0.20 µV Without pre-amplifier 1% BER (12.5 kHz channel): 0.4 µV 5% BER (12.5 kHz channel): 0.3 µV	Modulation Fidelity (C4FM): 12.5 kHz Digital Channel: ±2.8 kHz
		Selectivity: (per EIA Specifications) (Measured in the Analog Mode) 25 kHz Channel Spacing: –82 dB 12.5 kHz Channel Spacing: –75 dB	FM Hum and Noise: 25 kHz Channel Spacing: –45 dB 12.5 kHz Channel Spacing: –40 dB
		Spurious Rejection: –90 dB	Emission (Conduct/Radiated): –85 dBc/-20dBm
		Frequency Stability: (–30° to +60°C; 25°C Reference): 2 ppm	Audio Sensitivity: (For 60% Max. Deviation at 1 kHz): 0.08V ±3 dB
		Audio Output: (per EIA Specifications) (Measured in the Analog Mode at Less than 3% Distortion): 7.5 W (External Speaker) 3W (Internal Speaker)	Audio Response: (Measured in the Analog Mode) (6 dB/Octave Pre-Emphasis 300 to 3000Hz): +1, –3 dB
			Audio Distortion: (For 60% Max. Deviation at 1 kHz): 2% per EIA
			Emissions Designators: 8K10F1E, 11K0F3E, 15K0F2D, 16K0F3E, 20K0F1E, 15K0F1D, 11K0F1D, and 11K0F2D

Specifications subject to change without notice.

All measurements are taken in the test mode at 25 kHz channel spacing except where indicated.

UHF Range 2 Radio Specifications

GENERAL		RECEIVER	TRANSMITTER
FCC Designations:	AZ492FT4867	Frequency Range: Range 2: 450–520 MHz	Frequency Range: Range 2: 450–520 MHz
Temperature Range: Operating: –30°C to +60°C Storage: –51°C to +85°C		Channel Spacing: 12.5 kHz/20 kHz/25 kHz	Rated Output Power: Mid-Power Radio: 45 Watt 450–500 MHz 40 Watt 500–512 MHz 25 Watt 512–520 MHz
Power Supply: 12 Vdc Negative Ground Only		Input Impedance: 50 Ohm	Channel Spacing: 12.5 kHz or 25 kHz
Battery Drain: (Maximum) Standby @ 13.8 V: 0.85 A Receive at Rated Audio @ 13.8 V: 3.2 A Transmit @ Rated Power: 10 W 5.7 A 45 W 13.0 A		Frequency Separation: Full Bandsplit	Output Impedance: 50 Ohm
Dimensions (H x W x D) Dash-Mount Radio: 2.5" x 7.3" x 9.8" (65 mm x 185 mm x 248 mm)		Sensitivity: (per EIA spec. RS204C) With pre-amplifier 20 dB Quieting: (25 kHz Channel Spacing): 0.25 µV 12 dB SINAD: (25 kHz Channel Spacing): 0.20 µV Without pre-amplifier 20 dB Quieting: (25 kHz Channel Spacing): 0.4 µV 12 dB SINAD: (25 kHz Channel Spacing): 0.3 µV	Frequency Separation: Full Bandsplit Frequency Stability: (–30° to +60°C; 25°C Ref.): 2 ppm Modulation Limiting: 25 kHz Channel Spacing: ±5.0 kHz 12.5 kHz Channel Spacing: ±2.5 kHz
Speaker: (excluding mounting bracket) 5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)		Intermodulation: (per EIA Specifications) With pre-amplifier (Measured in the Analog Mode): –80 dB Without pre-amplifier (Measured in the Analog Mode): –85 dB	Modulation Fidelity (C4FM): 12.5 kHz Digital Channel: ±2.8 kHz
Weight: Radio: 5.1 lbs (2.3 kg) Speaker: 1.5 lbs (0.7 kg)		Digital Sensitivity: With pre-amplifier 1% BER (12.5 kHz channel): 0.25 µV 5% BER (12.5 kHz channel): 0.20 µV Without pre-amplifier 1% BER (12.5 kHz channel): 0.4 µV 5% BER (12.5 kHz channel): 0.3 µV	FM Hum and Noise: 25 kHz Channel Spacing: –45 dB 12.5 kHz Channel Spacing: –40 dB
		Selectivity: (per EIA Specifications) (Measured in the Analog Mode) 25 kHz Channel Spacing: –82 dB 12.5 kHz Channel Spacing: –75 dB	Emission (Conducted and Radiated): –85 dBc Audio Sensitivity: (For 60% Max. Deviation at 1 kHz): 0.08V ±3 dB
		Spurious Rejection: –90 dB	Audio Response: (Measured in the Analog Mode) (6 dB/Octave Pre-Emphasis 300 to 3000Hz): +1, –3 dB
		Frequency Stability: (–30° to +60°C; 25°C Reference): 2 ppm	Audio Distortion: (For 60% Max. Deviation at 1 kHz): 2% per EIA
		Audio Output: (per EIA Specifications) (Measured in the Analog Mode at Less than 3% Distortion): 7.5 W (External Speaker) 3W (Internal Speaker)	Emissions Designators: 8K10F1E, 11K0F3E, 15K0F2D, 16K0F3E, 20K0F1E, 15K0F1D, 11K0F1D, and 11K0F2D

Specifications subject to change without notice.

All measurements are taken in the test mode at 25 kHz channel spacing except where indicated.

700–800 MHz Radio Specifications

GENERAL		RECEIVER		TRANSMITTER	
FCC Designations:	AZ492FT5823	Frequency Range:		Frequency Range:	
Temperature Range:		700 MHz Band:	764–776 MHz	700 MHz Band:	
Operating:	–30° C to +60° C	800 MHz Band:	851–870 MHz	Repeater Mode:	794–806 MHz
Storage:	–40° C to +85° C	Channel Spacing:	12.5 kHz/20 kHz/25 kHz	Talkaround Mode:	764–776 MHz
Power Supply:	12 Vdc Negative Ground Only	Input Impedance:	50 ohm	800 MHz Band:	
Battery Drain: (Maximum)		Frequency Separation:	Full Bandsplit	Repeater Mode:	806–825 MHz
35 W:		Sensitivity:		Talkaround Mode:	851–870 MHz
Standby @ 13.8 V:	0.7 A	20 dB Quieting:		Rated Output Power:	
Receive at Rated Audio @ 13.8 V:	3.0 A	25 kHz Channel Spacing:	0.30 µV	764–806 MHz Band:	2***/30 W
Transmit @ Rated Power:		12 dB SINAD:		806–870 MHz Band:	35 W
35 W	3.0 A	25 kHz Channel Spacing:	0.25 µV	Channel Spacing:	12.5 kHz/20 kHz/25 kHz
Dimensions (H x W x D)		Digital Sensitivity**:		Output Impedance:	50 ohm
Dash-Mount Radio:	2.5" x 7.3" x 9.8" (65 mm x 185 mm x 248 mm)	1% BER (12.5 kHz channel):	0.30 µV	Frequency Separation:	Full Bandsplit
Speaker: (excluding mounting bracket)	5.5" x 5.5" x 2.5" (139.7 mm x 139.7 mm x 63.5 mm)	5% BER (12.5 kHz channel):	0.25 µV	Frequency Stability*:	
Weight:		Adjacent Channel Selectivity*:		(–30° to +60° C; 25° C Ref.):	1.5 ppm
Radio:	6.1 lbs (2.8 kg)	25 kHz Channel:	80 dB	Modulation Limiting*:	
Speaker:	1.5 lbs (0.7 kg)	12.5 kHz Channel:	65 dB	25 kHz Channel Spacing:	±5.0 kHz
		Intermodulation*:	80 dB	12.5 kHz Channel Spacing:	±2.5 kHz
		Spurious Rejection*:	90 dB	Modulation Fidelity (C4FM)**:	
		Frequency Stability*:		12.5 kHz Digital Channel:	±2.8 kHz
		(–30° to +60° C; 25° C Ref.):	1.5 ppm	FM Hum and Noise*:	
		Audio Output at 3% Distortion*:		20/25 kHz Channel:	–40 dB
		7.5 W (External Speaker)		12.5 kHz Channel:	–34 dB
		3 W (Internal Speaker)		Emission (Conducted and Radiated):	
					–70 dBc/–85 dBc (GNSS)
				Audio Sensitivity*:	
				(For 60% Max. Deviation at 1 kHz):	
					0.08 V ±3 dB
				Audio Response*:	
				(6 dB/Octave Pre-Emphasis 300 to 3000 Hz):	
					+1, –3 dB
				Audio Distortion*:	2%
				Emissions Designators:	
					8K10F1D, 8K10F1E, 11K0F3E, 16K0F3E, and 20K0F1E

Specifications subject to change without notice.

* Measured in analog mode per TIA/EIA 603 under nominal conditions.

** Measured in digital mode per TIA/EIA IS 102.CAAB.

*** 2 W. itinerant frequencies.

Notes

Chapter 1 Introduction

1.1 Notations Used in This Manual

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

NOTE: The Note notation indicates an operational procedure, practice, or condition that is essential to emphasize.



Caution

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



WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.



DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or injury.

1.2 General

This manual includes all the information necessary to maintain peak product performance and maximum working time. This detailed level of service (component-level) is typical of some service centers, self-maintained customers, and distributors.

Use this manual in conjunction with the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual* (Motorola part number 6815854H01), which helps in troubleshooting a problem to a particular board.

Conduct the basic performance checks first to verify the need to analyze the radio and help pinpoint the functional problem area. In addition, you will become familiar with the radio test mode of operation which is a helpful tool. If any basic receiver or transmitter parameters fail to be met, the radio should be aligned using the radio alignment procedure described in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual*.

Included in other areas of this manual are functional block diagrams, detailed theory of operation, troubleshooting charts and waveforms, schematics, and parts list. You should be familiar with these sections to aid in deducing the problem circuit. Also included are component location diagrams to aid in locating individual circuit components, as well as IC diagrams, which identify some convenient probe points.

The Theory of Operation section of this manual contains detailed descriptions of operations of many circuits. Once you locate the problem area, review the Troubleshooting Chart for that circuit to fix the problem.

Chapter 2 Product Overview

2.1 Introduction

The ASTRO Digital XTL 1500 radio is a dual-mode (trunked/conventional), microcontroller-based transceiver incorporating a Digital Signal Processor (DSP). The microcontroller handles the general radio control, monitors status, and processes commands input from the keypad or other user controls. The DSP processes the typical analog signals and generates the standard signaling digitally to provide compatibility with existing analog systems. In addition it provides for digital modulation techniques utilizing voice encoding techniques with error correction schemes to provide the user with enhanced range and audio quality all in a reduced bandwidth channel requirement. It allows embedded signaling which can mix system information and data with digital voice to add the capability of supporting a multitude of system features.

The XTL 1500 radios are wideband, synthesized, fixed-tuned radios and are available in the VHF (136–174 MHz), UHF Range 1 (380–470 MHz), UHF Range 2 (450–520 MHz), 700 MHz, and 800 MHz bands. All XTL 1500 radios are capable of both analog operation (12.5 kHz, 20 kHz, and 25 kHz bandwidths) and ASTRO mode operation (12.5 kHz bandwidth).

NOTE: The UHF radio does not support 20 kHz bandwidth.

2.2 Functional Blocks

The XTL 1500 radios contain the following functional blocks:

- Control-Head Assembly (Dash)—is connected directly to the front of the transceiver. This assembly is divided into three main sections, the controller (applications processor, RAM and Flash), power management (Power Control Processor, and Voltage Regulators) and user interface (GCAI Accessory Connector, Keypad, STN Display, Volume and Frequency Knob) section.
 - Radio Power Distribution—contains voltage-regulation circuitry for power distribution throughout the radio.
 - Receiver Front-End section—contains the preselector, low-noise amplifier (LNA), and mixer.
 - Receiver Back-End section—contains the receiver intermediate-frequency (IF) amplifier/filter and the digital receiver back-end integrated circuit (IC).
 - Transmitter section—contains the antenna switch, directional coupler/ detector, and power amplifier circuitry.
 - Frequency Generation section—contains the synthesizer, voltage controlled oscillators (VCOs), reference oscillator, and receive and transmit buffers.
 - Controller section—combines a vocoder and a controller into a single section containing the following elements:
-

2.3 Control-Head Assembly

This section discusses the basic operation and components of the control-head assembly.

2.3.1 Controller

The controller consists of three main components, namely the OMAP Applications Processor, Flash and SDRAM. The Applications Processor is the main controller of the control head. Its main function is to receive inputs from the user and relays the command to the transceiver microprocessor for processing via Serial Synchronous Interface (SSI) link. The Applications Processor will relay back any information from the transceiver microprocessor to the user through the Liquid Crystal Display (LCD). The control head is equipped with an 8MB SDRAM and a 2MB Flash memory for storing and executing commands.

2.3.2 Power Management (Power Control Microcontroller and Voltage Regulators)

2.3.2.1 Power Control Microcontroller

ATTiny 13 microcontroller is employed to control the power state of the radio. The power state of the radio will always follow the VOLUME/ON/OFF knob selection. Using the Customer Programming Software (CPS), the radio can be set to optionally disable or enable the radio via sensing the ignition, provided the ON/OFF knob is at the ON position. Moreover, the CPS can also allow emergency footswitch to power up the radio into emergency mode without the VOLUME/ON/OFF having turned to ON position.

2.3.2.2 Voltage Regulators

The control head utilizes seven different voltage levels to operate correctly, namely 13.8V, 5V, 3.3V, 3.0V, 2.8V, 1.88V and 1.55V. There are a total of three main regulator ICs to provide the needed voltages.

13.8V on the main A+ line is fed through to a low power linear regulator to obtain 3.0V. This regulator will remain powered at all times to power the ATTiny 13 microcontroller and other logic ICs of the power control circuitry.

When the radio is in the ON state, the A+ is stepped down to 5V through a switching regulator, being the main power source supplying the standard USB 5V and power management IC for the applications processor. The power management IC provides the necessary reset and voltage sequencing to start the processor correctly. The power management IC supplies the rest of the circuits with 1.55V, 1.88V, 2.8V and 3.3V.

Moreover, 13.8V (A+) is fed to a MOSFET to supply 13.8V back to the transceiver power circuitry as a sense line to turn ON or OFF the transceiver.

2.3.3 User Interface (Keypad, STN Display, Volume and Frequency Knob) section

2.3.3.1 Display

The control head assembly utilizes a Super Twisted Nematic (STN) Liquid Crystal Display (LCD) with a dot-matrix resolution of 131x 53 pixels. The LCD is configured to display a row of eight alphanumeric characters, eight soft icons and four soft menu keys. The LCD is controlled by the applications processor through eight parallel LCD interface lines and operates off a 2.8V supply.

The trans reflective module comes with four yellow LEDs for backlighting and is capable of three steps dimming together with the backlight LEDs, namely OFF, Low and High, driven by SW_B+ at 13.8V.

2.3.3.2 Keypad, Volume and Frequency Knob

The control head assembly processes all menu button inputs and visual indicators through the application processor. The buttons are programmable to allow different modes of operation through the CPS. All buttons are backlit to allow operation in low light.

The volume knob allows a linear step of the volume and integrates the on/off function.

2.3.3.3 Status LEDs

Three LEDs (Green, Yellow, Red) are driven by the applications processor through the toggling of three transistors. The biasing voltage level is 2.8Vdc while the LEDs are driven by SW_B+ at 13.8V.

2.3.3.4 Backlight LEDs

The applications processor operates the backlight LEDs via two transistors controlling all the backlight LEDs, providing two different brightness levels by way of toggling the base of the transistors. The biasing voltage level is also 2.8Vdc while the LEDs are driven by SW_B+ at 13.8V. The dim feature can be activated via CPS.

2.3.4 Vehicle Interface Ports

The Vehicle Interface Ports (VIPs) allow the control head to activate external circuits and receive inputs from the outside world. In general, VIP outputs are used for relay control. See the cable kit section for typical connections of VIP output relays.

In the XTL 1500 dash-mount configuration (Figure 2-1), only two VIP output pins are available, and they are located at the 26-pin accessory connector, J2-18 and J2-19. There are two VIP outputs for the XTL 1500 control head. The VIP outputs are normally at SWB+ levels and are driven low by logic within the control head. Field programming of the radio can define the functions of these pins. The output MOSFETs that drive the VIP outputs can sink 300 mA of current and are primarily used to control external relays. These relays should be connected between the respective VIP output pin and switched B+. The relay can be normally ON or normally OFF depending on the configuration of the VIP outputs. The CPS can be used to program the function of these VIP outputs in the radio.

The following are typical applications currently supported with ASTRO products:

- Horn relay
- Light relay
- Siren horn transfer

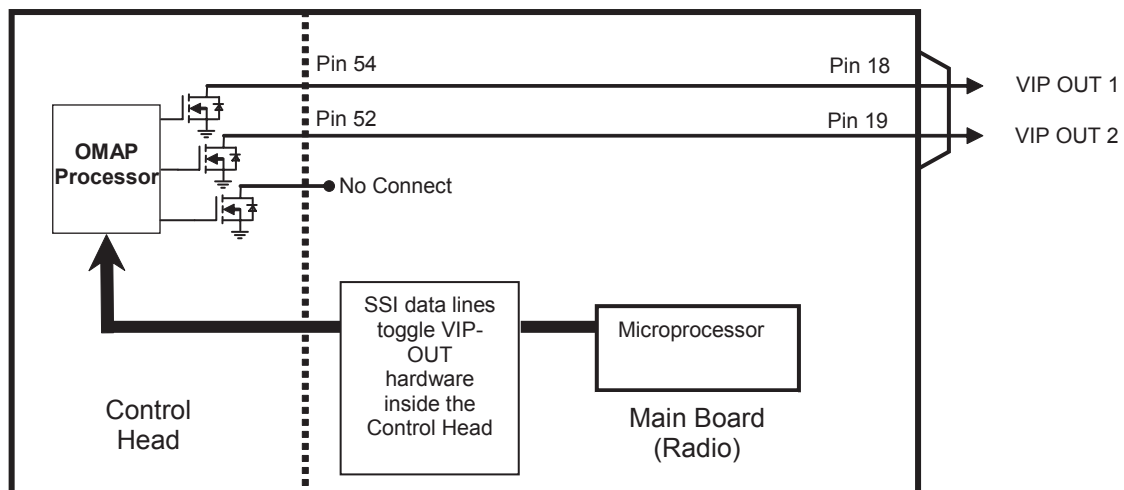


Figure 2-1. VIP Dash-Mount Configuration

2.4 Receiver Section

This section discusses the receiver section components and basic operation for each band.

2.4.1 VHF Band Radios

The VHF (136–174 MHz) receiver consists of a front-end and a back-end sections.

2.4.1.1 Front-End Section

The primary function of the receiver front-end is to optimize image rejection and selectivity while providing the first conversion. The front-end uses discreet filters and LNAs. The first filter reduces the IF spur, image frequency response and limits some of the out-of-band interference. The second filter following the second low-noise amplifier (LNA) provides additional image rejection and half IF spur.

The receiver front-end signal is fed to the monolithic mixer IC where it is down converted to an IF of 109.65 MHz. The mixer is driven by the receiver injection buffer that provides 20 dBm to the mixer. The VCO performs high side injection for the VHF band. The design maintains temperature stability, low insertion loss, and high out-of-band rejection.

2.4.1.2 Back-End Section

The crystal filters provide IF selectivity and out-of-band signal protection to the back-end IC. Two 2-pole crystal filters centered at 109.65 MHz that are isolated from one another by a stable, high-gain low noise amplifier are used to meet the receiver specifications for gain, close-in intermodulation rejection, adjacent-channel selectivity, and second-image rejection.

The output of the IF circuit is fed directly to the Abacus III digital back-end IC. The ABACUS III is an IC with a variable-bandwidth bandpass Sigma-Delta architecture. It is capable of down-converting analog, as well as digital, RF protocols into a baseband signal transmitted on the Synchronous Serial Interface (SSI) bus. The ABACUS III IC converts the 109.65 MHz signal from the IF section down to 2.25 MHz using a second LO frequency of 107.4 MHz or 111.9 MHz. The second LO VCO is tuned to 107.4 MHz (low side), but can be modified to 75.6 MHz (high side injection) depends on known spurious interference related to the programmed received frequency.

2.4.2 UHF Range 1/UHF Range 2 Band Radios

The UHF Range 1 (380–470 MHz)/UHF Range 2 (450–520 MHz) receiver consists of a front-end section and a back-end section.

2.4.2.1 Front-End Section

The receiver front-end consists of a switchable high pass filter and LNA, a preselector, a switchable attenuator, a second switchable low noise amplifier (always in for UHF Range 2), image filter, mixer, and injection amplifier. The preselector filter is varactor-tuned and is aligned at the factory. The radio tuner software can also be used to check and re-align the preselector. The switchable stage provides AGC capability.

The signal from the preselector is amplified by the low noise amplifier, then filtered by the image filter before it is sent to the mixer. The mixer uses the LO signal, amplified by the injection amplifier, to convert the RF signal to IF frequency of 109.65 MHz. This signal is then sent to the IF and back-end circuits.

2.4.2.2 Intermediate Frequency and Back-End

The Intermediate Frequency (IF) consists of a crystal filter, amplifier, a second crystal filter, and a switchable attenuator. This provides selectivity at the IF while attenuating out-of-band signals and protecting the back-end (BE) IC.

The back-end is primarily the ABACUS III digital IC. The ABACUS III IC uses a variable-bandwidth bandpass sigma-delta architecture. It is capable of down-converting analog as well as digital RF protocols into a baseband signal, which is then transmitted over the Synchronous Serial Interface (SSI) bus to the DSP and microprocessor.

2.4.3 700–800 MHz Band Radios

The 700–800 MHz receiver consists of a front-end section and a back-end section.

2.4.3.1 Front-End Section

The primary function of the receiver front-end is to optimize image rejection and selectivity while providing the first conversion. The front-end uses ceramic-filter technology and includes a wideband, monolithic amplifier. The first filter is a dual-switched filter that reduces the image frequency response and limits some of the out-of-band interference. The second filter following the monolithic low-noise amplifier (LNA) provides additional image rejection.

The receiver front-end signal is fed to the monolithic mixer IC where it is down converted to an IF of 73.35 MHz. The mixer is designed to provide low conversion loss and high intermodulation performance. The mixer is driven by the receiver injection buffer, a two-stage discrete IC design used with the receiver VCO to efficiently drive the mixer over a wide temperature range with minimum power variation. The injection buffer provides 15 dBm to the mixer. The VCO performs low-side injection for the 800 MHz band and high-side Injection for the 700 MHz band. The design maintains temperature stability, low insertion loss, and high out-of-band rejection.

2.4.3.2 Back-End Section

The crystal filters provide IF selectivity and out-of-band signal protection to the back-end IC. Two 2-pole crystal filters centered at 73.35 MHz that are isolated from one another by a stable, moderate-gain amplifier are used to meet the receiver specifications for gain, close-in intermodulation rejection, adjacent-channel selectivity, and second-image rejection.

The output of the IF circuit is fed directly to the ABACUS III digital back-end IC. The ABACUS III is an IC with a variable-bandwidth bandpass Sigma-Delta architecture. It is capable of down-converting analog, as well as digital, RF protocols into a baseband signal transmitted on the Synchronous Serial Interface (SSI) bus. The ABACUS III IC converts the 73.35 MHz signal from the IF section down to 2.25 MHz using a second LO frequency of 71.1 MHz or 75.6 MHz. The second LO VCO is tuned to 71.1 MHz (low side) or 75.6 MHz (high side injection). The choice of frequency depends on known spurious interference related to the programmed received frequency.

2.5 Transmitter Section

This section discusses the transmitter section components and basic operation for each band.

2.5.1 VHF Radios

The VHF (136–174 MHz) transmitter consists of an RF power amplifier (RFPA), output network (ON), and power control. See 2.5.3 700–800 MHz Radios below for an overview of the transmitter sections.

2.5.2 UHF Range 1/UHF Range 2 Radios

The UHF Range 1 (380–470 MHz)/UHF Range 2 (450–520 MHz) transmitter consists of an RF power amplifier (RFPA), output network (ON), and power control. See 2.5.3 700–800 MHz Radios below for an overview of the transmitter sections.

2.5.3 700–800 MHz Radios

The 700–800 MHz transmitter consists of an RF power amplifier (RFPA), output network (ON), and power control.

2.5.3.1 RFPA

The RFPA is a three-stage, discrete-LDMOS transistor amplifier consisting of the following stages: first, driver, and final.

The first stage acts as a variable-gain amplifier and feeds the driver stage, which, in turn, feeds the final stage. All of the stages are matched using transmission lines, capacitors, and inductors. Stage drain biases are supplied via A+ or K9.1V and DRV_9.3V (DRV_9.3V is present for UHF Range 1 and UHF Range 2 only). Stage gate biases are supplied via a digital-to-analog converter (DAC) or the RFPA control voltage.

2.5.3.2 Output Network

The output network (ON) consists on the antenna switch, harmonic filter, and power detector. The antenna switch operates in two modes: RX and TX.

In TX mode, the RFPA final stage is connected to the antenna through the harmonic filter and power detector and is isolated from the RX path.

In RX mode, the antenna is connected to the RX front-end through the power detector and the harmonic filter and is isolated from the TX path. The harmonic filter attenuates harmonics generated by the RFPA when the antenna switch is in TX mode and provides extra selectivity in RX mode.

The power detector senses forward and reverse power and generates a detected voltage proportional to each.

2.5.3.3 Power Control

The forward-power and reverse-power detected voltage is fed back to the power control section where it is added to a DAC voltage determined via power tuning and compared to a reference voltage. A control loop corrects the control voltage adjusting the first stage gain to maintain the reference.

2.5.3.4 Circuit Protection

Final-stage current and temperature as well as radio A+ voltage and RFPA control voltage are sensed. If a fault condition is determined, power is cut back to a level that is safe for the particular conditions.

2.6 Frequency Generation Unit

This section discusses the frequency generation unit (FGU) components and basic operation for each band.

2.6.1 VHF MHz Radios

The VHF (136-174 MHz) frequency generation unit consists of the following:

- Low-voltage fractional-N synthesizer IC
- 16.8 MHz reference oscillator IC
- Two receiver (RX) voltage-controlled oscillators (VCOs)
- Two transmitter (TX) voltage-controlled oscillators (VCOs)
- VCO buffer/amplifier circuits

- Associated circuitry

The reference oscillator IC provides a frequency standard to the Fractional-N synthesizer IC, the ABACUS III digital back-end IC, and the controller section. The synthesizer turns on one of the four VCOs (determined by mode and band of operation) and tunes it to the receiver (RX) local oscillator (LO) or transmitter (TX) carrier frequency.

All four voltage-controlled oscillators (VCOs) employ a discrete Colpitts configuration with a N-channel J-FET transistor. The VCOs tank consists of a varactor diode, coupling capacitor, and a resonator. The varactor changes the oscillator frequency when the DC voltage of the steering line changes. The output of the VCOs is coupled to the second transistor for impedance buffering, and its output is coupled to respective TX/RX buffer amplifiers.

In TX mode, the transmitter VCO output is coupled to a three-stage buffer before being injected into the power amplifier. In RX mode, the receiver VCO output is buffered and amplified with a two-stages. The output of the second-stage transistor is split into two paths. One path feeds back to the synthesizer prescaler; the other path is injected into the third-stage. The output of the third-stage provides the proper signal level for the LO port of the RX front-end mixer.

The superfilter supplies the voltage to the first two stages of the TX buffer and to the first two stages transistor of the RX buffer/amplifier. The voltage for the third stage of the TX buffer is supplied by a keyed 9.1 V source to conserve current drain while the radio is receiving. The third-stage of the RX buffer/amplifier is supplied by a 9.3 V regulator.

2.6.2 UHF Range 1/UHF Range 2 Radios

The UHF Range 1 (380–470 MHz)/UHF Range 2 (450–520 MHz) frequency generation unit consists of the following:

- Low-voltage fractional-N synthesizer IC
- 16.8 MHz reference oscillator IC
- Three receive voltage-controlled oscillators (VCO)
- Two transmit VCOs
- VCO buffer/amplifier circuits
- Associated circuitry

See 2.6.3 700–800 MHz Radios below for an overview of the FGU sections.

2.6.3 700–800 MHz Radios

The 700–800 MHz frequency generation unit consists of the following:

- Low-voltage fractional-N synthesizer IC
- 16.8 MHz reference oscillator IC
- Two voltage-controlled oscillator (VCO) modules (receive and transmit, containing two VCOs each)
- VCO buffer/amplifier circuits
- Associated circuitry

The reference oscillator IC provides a frequency standard to the fractional-N synthesizer IC, the ABACUS III digital back-end IC, and the controller section. The synthesizer turns on one of the four VCOs (determined by mode and band of operation) and tunes it to the receiver (RX) local oscillator (LO) or transmitter (TX) carrier frequency.

The voltage-controlled oscillator (VCO) module employs a Colpitts configuration with two bipolar stages in a common-base, common-collector configuration. The LC tank circuit's capacitive portion consists of a varactor diode, coupling capacitor, and a laser-trimmed capacitor for frequency adjustment. The inductive portion consists of microstrip transmission line resonators for TX VCO and coaxial resonators for RX VCO. Tuning is performed by the module manufacturer and is not field adjustable. The varactor changes the oscillator frequency when the DC voltage of the steering line changes. The output of the common base is coupled to the second transistor for impedance buffering, and its output is coupled to respective TX/RX buffer amplifiers.

In TX mode, the transmitter VCO output is coupled to a three-stage buffer before being injected into the power amplifier. In RX mode, the receiver VCO output is buffered and amplified with a two-stage transistor/microwave monolithic IC (MMIC) circuit. The output of the first-stage transistor is split into two paths. One path feeds back to the synthesizer prescaler; the other path is injected into the second-stage MMIC. The output of the MMIC provides the proper signal level for the LO port of the RX front-end mixer.

The superfilter supplies the voltage to the first two stages of the TX buffer and to the first-stage transistor of the RX buffer/amplifier. The voltage for the third stage of the TX buffer is supplied by a keyed 9.1 V source to conserve current drain while the radio is receiving. The second-stage MMIC of the RX buffer/amplifier is supplied by a 9.3 V regulator.

2.7 Controller Section

This section provides an explanation of radio operating modes and an overview of the controller section components and circuits.

2.7.1 Analog Mode of Operation

When the radio is receiving, the signal comes from the antenna/antenna-switch to the front-end receiver. The signal is then filtered, amplified, and mixed with the first local-oscillator signal generated by the voltage-controlled oscillator (VCO). The resulting intermediate frequency (IF) signal is fed to the IF circuitry, where it is again filtered and amplified. This amplified signal is passed to the digital back-end IC, where it is mixed with the second local oscillator to create the second IF at 2.25 MHz. The analog IF is processed by an analog-to-digital (A/D) converter inside the digital back-end IC where it is converted to a digital bit stream and divided down to a baseband signal, producing digital samples. These samples are converted to TTL logic signals and sent to the DSP. The DSP digitally filters and discriminates the signal, decodes the information in the signal, and identifies the appropriate destination for it. For a voice signal, the DSP will route the digital voice data to the coder/decoder (CODEC) for conversion to an analog signal. The CODEC will then present the signal to the audio power amplifier, which drives the speaker. For signalling information, the DSP will decode the message and pass it to the microcomputer.

When the radio is transmitting, microphone audio is passed to an adjustable gain circuit, then to the CODEC where the signal is digitized. The CODEC passes digital data to the DSP where pre-emphasis and low-pass (splatter) filtering are done. The DSP sends this signal to the modulation digital-to-analog (D/A) converter where it is reconverted into an analog signal and scaled for application to the voltage-controlled oscillator as a modulation signal. Transmitted signalling information is accepted by the DSP from the microcomputer, coded appropriately, and passed to the modulation D/A converter, which handles it the same as a voice signal. Modulation information is passed to the synthesizer along the modulation line. A modulated carrier is provided to the power amplifier (PA), which transmits the signal under dynamic power control.

2.7.2 Digital (ASTRO) Mode of Operation

In the ASTRO mode (digital mode) of operation, the transmitted or received signal is limited to a discrete set of deviation levels, instead of continuously varying. The receiver handles an ASTRO-mode signal identically to an analog-mode signal up to the point where the DSP decodes the received data. In the ASTRO receive mode, the DSP uses a specifically defined algorithm to recover information. In the ASTRO transmit mode, microphone audio is processed identically to an analog mode with the exception of the algorithm the DSP uses to encode the information. This algorithm will result in deviation levels that are limited to discrete levels.

2.7.3 Controller Section Circuitry

The controller section consists of the following:

- Voltage regulators
- Data connectivity circuitry (RS-232, USB, and SB9600)
- Daughtercard module, which contains the:
 - Patriot microprocessor IC
 - 64-Mbit (8MB) FLASH IC
 - 8-Mbit (1MB) SRAM IC
- Modulation D/A conversion circuitry
- CODEC audio circuitry
- TX power-control circuitry
- Emergency circuitry
- V.I.P input/output paths
- Front connector interface for control heads
- Rear connector for additional accessories
- DC power-in plug

The controller section controls receive/transmit frequencies, the display, and various radio functions using either direct logic control or serial communication to external devices. The connector J0701 provides interface between the encryption module and the controller for encrypting voice messages.

Connector J0402 provides the accessory interface to the outside rear connector while connector J0401 provides the control-head interface.

The controller section executes a stored program located in the FLASH ROM. Data is transferred to and from memory via an RS-232 interface on the microprocessor. The memory location from which data is read, or to which data is written, is selected by the address lines. Besides the host and DSP code, the customer-specific programming features (codeplug) and tuning parameters also are stored in the FLASH ROM. The SRAM is used as scratchpad memory for the microprocessor.

The controller section is powered by SW_B+ coming from the control head, which is regulated down to a 5 V supply. This supply powers the entire controller section and its regulators. The SW_B+ supply is removed from the board when the radio is turned off by the control-head switch.

The microprocessor is powered by a 1.55-V regulator for the microprocessor core and a 2.85-V regulator for the I/O and control lines, while the memory is powered by a 1.85-V regulator. The 2.85-V regulator also supplies almost all of the discrete controller circuitry. These three regulators are all supplied by a switched 5-V regulator, which also provides power for the SB9600 data bus and for interface to certain legacy data and control signals.

The DSP section of microprocessor performs signaling, voice encoding/decoding, audio filtering, microphone gain and tuning, Private-Line/Digital Private Line (PL/DPL) encode, and alert-tone generation. It processes all baseband audio signals, providing pre-emphasis and signaling/filtering of the digital microphone audio data, as well as other transmitted signals. It also performs de-emphasis and decoding of received digital speaker audio and other received signals. The DSP clock frequency is derived from the 16.8 MHz reference oscillator clock input using a phase-locked loop (PLL) inside the Patriot IC. The digital audio bus on the Patriot IC uses an 8 kHz clock, which provides the sampling rate, and a 512 kHz clock, which provides the data rate.

The CODEC performs analog-to-digital and digital-to-analog conversions on audio signals. The DSP controls squelch, deviation, and compensation, and it executes receiver filtering and discrimination.

The interface to the RX back-end IC (ABACUS III IC) consists of a single logic-level data line, a 1.2 MHz clock line (the discriminator data bit rate) and a 20 kHz frame-sync line (the discriminator data sample rate). These clocks are generated by the ABACUS III IC and provided to the Patriot IC.

The interface to the TX modulation/DAC consists of a single logic-level data line, a 2.4 MHz clock line (the modulation data bit rate), and a 48 kHz clock line (the modulation data sample rate). These clocks are generated by the Urchin IC and provided to the Patriot IC.

Other functions provided by the controller include SB9600 communication, IC programming, and TX power control. The SB9600 bus is used to communicate to legacy control heads and accessories. IC programming is performed via the SPI bus for ICs including the ABACUS III, LV Frac-N, A/D, D/A, and volume attenuator. The power-control circuitry receives power set and limit inputs from the D/A IC and feedback from the RF power amplifier (RFPA). Based on these inputs, the circuit produces a control voltage to maintain a fixed RF power level to the antenna.

The controller also provides detection of the On/Off and reset inputs. The reset circuits consist of the regulator power-on reset circuit, low SW_B+ voltage-detector circuit, an ignition detection circuit, an emergency detection circuit, and the external-bus system reset. The reset circuits allow the microcomputer to recover from an unstable situation; for example, no battery on the radio, battery voltage too high or too low, and remote devices on the external bus not communicating. Communication using RS-232 protocol is provided to the rear accessory connector (J2).

Notes

Chapter 3 Theory of Operation

3.1 Control Head Board

This section provides a detailed circuit description of the XTL 1500 radio control head board for VHF/UHF Range 1/UHF Range 2/700–800 MHz models. The control head board contains the following major sections:

- Controller (page 3-2)
- Power Management (page 3-3)
- User Interface (page 3-7)
- GCAI Accessory Interface (page 3-7)

When reading the theory of operation, refer to your appropriate schematic and component location diagrams located in “Chapter 7. Schematics, Component Location Diagrams, and Parts Lists”. This detailed Theory of Operation will help isolate the problem. However, first use the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual* (6815853H01) to troubleshoot the problem to a particular board.

3.2 Control Head Board Major Sections

This section contains the control head board layouts for XTL 1500.

The illustrations (Figure 3-1 on page 3-1 to Figure 3-2 on page 3-2) identify the location of the major sections of the control head board.

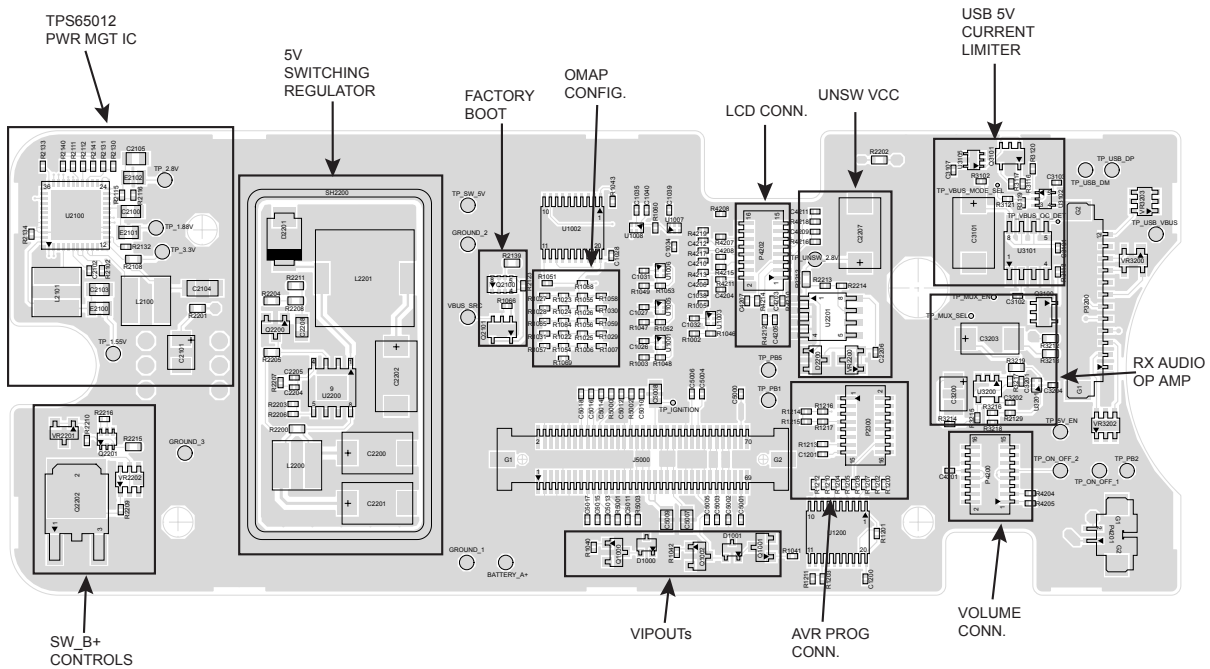


Figure 3-1. XTL 1500 Control Head Board Sections — Side 1

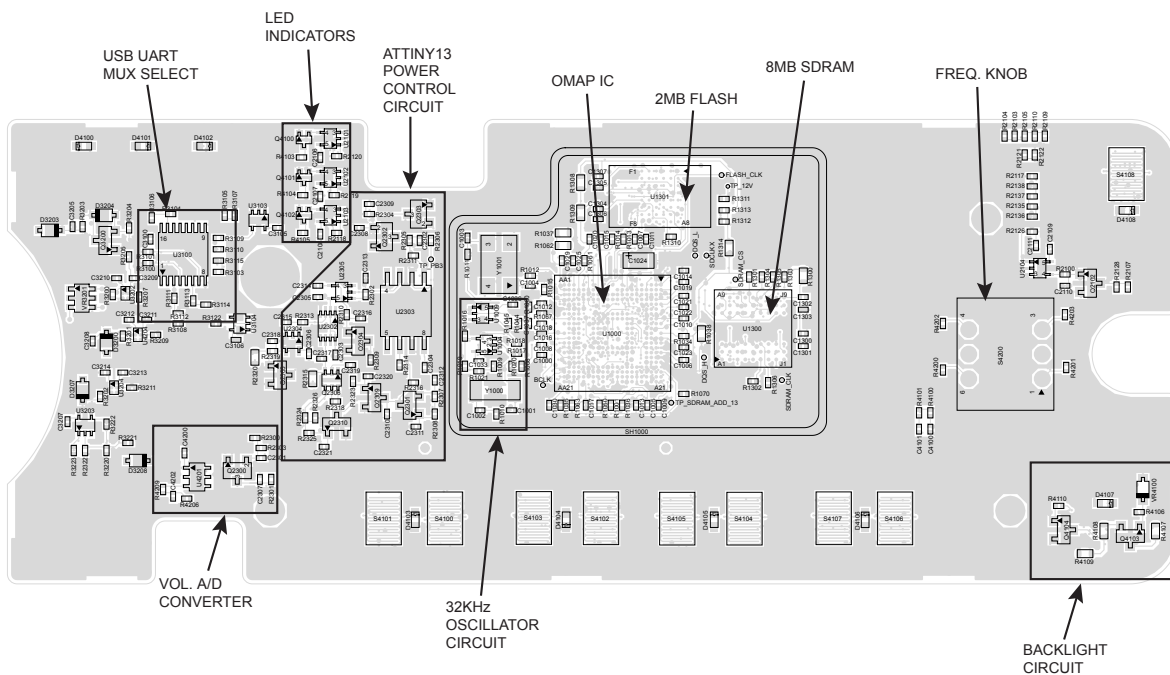


Figure 3-2. XTL 1500 Control Head Board Sections — Side 2

3.3 Controller Section

The controller consists of a digital logic comprising of an applications processor, the OMAP330 IC, (U1000) and memory consisting of a 4M x 16 SDRAM (U1300) and a 1M x 16 Flash ROM (U1301). The applications processor runs on the ARM 9 technology and is capable of processing speeds up to 200 MHz. The Flash ROM contains the programs the OMAP processor executes and is used to store error logs as well for smooth operation of the radio. The programs allows the both the software in the control head and firmware in the transceiver to be reprogrammed for future software upgrades or feature enhancements. The SDRAM is used for scratchpad memory during program execution.

The OMAP processor interacts with all the peripherals in the control head as well as maintaining constant communications with the transceiver microprocessor using Serial Synchronous Interface (SSI). Linkage between all the peripherals in the control head is done through the use of Serial Peripheral Interface (SPI), I2C, Special optimiSed Screen Interface (SoSSi) for LCD Driver, and General Purpose Input-Output (GPIO). Devices that interfaces with OMAP through these lines includes the Frequency Pot, A/D converter for volume control, ATMEEL ATTiny13 for power control functions, TPS65012 (U2100) for OMAP Power Management Control and the Solomon SSD LCD Driver.

Input from the user through the GCAI Accessory Interface, Keypad presses; Volume and Frequency knobs are received by the OMAP processor and sent back to the transceiver PATRIOT microprocessor for the processing. The information would be relayed back to the user through the LCD Display.

The ARM core of the processor requires two clocks for proper operation. A 12 MHz crystal (Y1001) is provided at pin Y2 and pin W3 of OMAP IC. The processor has the capability of running at higher clock rates, which are programmable and based on the 12 MHz reference.

The OMAP IC also requires a 32.768 kHz square-wave clock, provided at the P13 pin. This clock is generated by a 32.768 kHz crystal (Y1000), with supporting circuitry for oscillation. This clock is utilized only for the OMAP IC, and is used for reset capability and other OMAP IC functions. Note that the rise/fall time of this clock is optimum at 20ns or less.

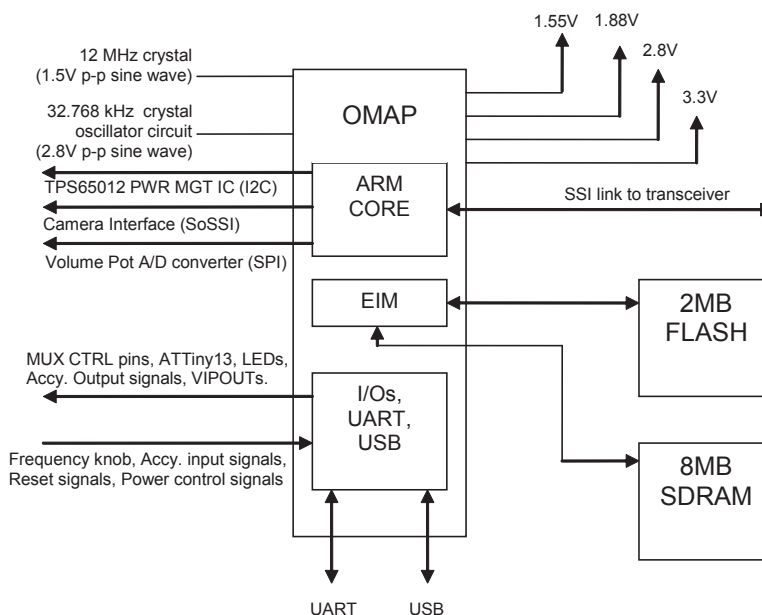


Figure 3-3. Control Head Controller Block

NOTE: The controller section (OMAP, Flash and SDRAM) are highly susceptible to ESD and moisture damage. Extreme care is advised when handling or servicing the control head board.

3.4 Power Management

XTL1500 utilizes a smart power control system in which the 8-bit ATTiny13 microcontroller (U2303) processes all the power up, power down, and resets of the radio. A series of commands is issued from the Patriot IC to the ATTiny13 through BUS_PWR_OUT while the OMAP IC does that through B+_CTRL. All resets and radio power up/down is then outputted from the ATTiny13 through 5V_EN.

The sub-sections to follow will describe in detail the power management design of the radio.

3.4.1 Power Distribution

The control head houses 7 different power levels for smooth operation of the complex system of XTL1500. They are A+ & SW_B+ at 13.8V (nominal battery terminal voltage), UNSW_VCC (3.0V), SW_5V (5.0V), 1.55V, 1.88V, 2.8V and 3.3V.

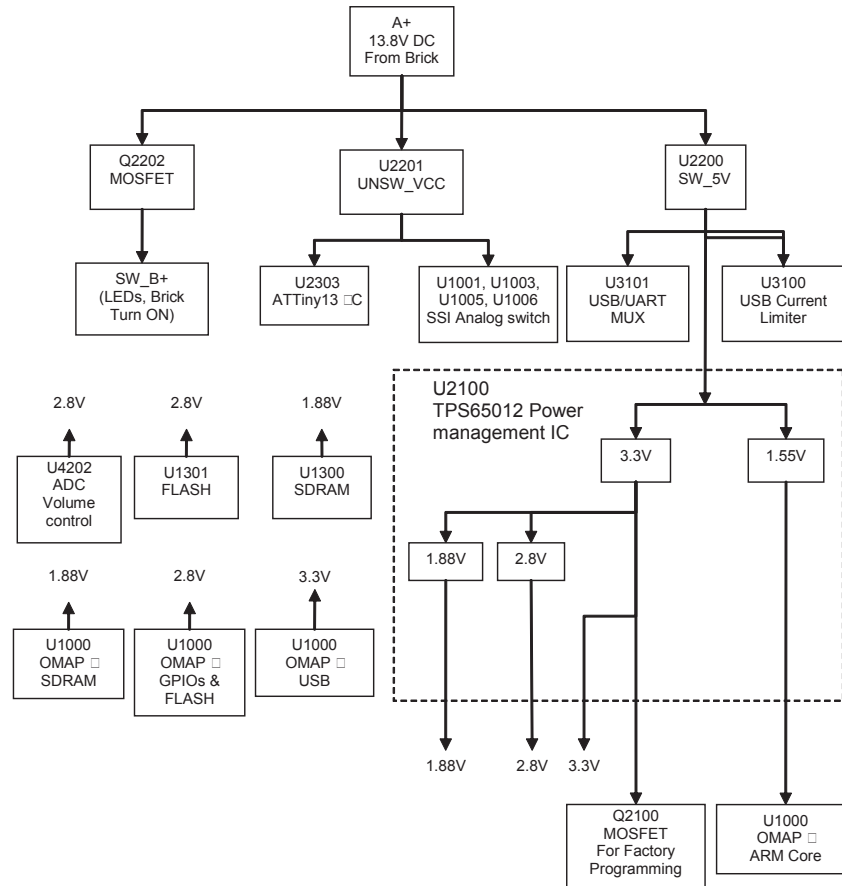


Figure 3-4. Control Head Power Distribution

The control head receives the main supply from A+ that comes from the brick, which is generally about 13.8V (nominal battery terminal voltage). A+ is stepped down to UNSW_VCC through a low power linear regulator IC (U2201). UNSW_VCC remains ON all the time even when the radio is in the OFF state, mainly supplying to U2303 microcontroller and other logic gates that are essential to the overall power control when the radio is OFF.

When the radio powers ON, A+ will be stepped down to 5V through the Switching Regulator IC (U2200). Both USB host and TPS65012 Power Management IC (U2100) utilize the 5V supply.

U2100 is a specific IC made for OMAP IC, consisting of two switching regulators with hardware selectable default output of 1.55V and 3.3V, and two linear regulators with default output voltage of 1.88V and one adjustable output configured to 2.8V. Input for the internal linear regulators is taken from the 3.3V supply. Furthermore, U2100 also contains GPIOs that is controllable via I2C communication with OMAP IC.

The 1.55V ensures smooth operation of OMAP's ARM core. 3.3V supplies OMAP's internal USB module and its supporting circuitry. The 1.88V supplies the 8MB SDRAM (U1300) and OMAP's SDRAM associated data, address and control lines. 2.8V is the most widely used voltage in the control head and it supplies to OMAP's GPIOs, configuration resistors and all other parts of the control head.

Please refer to “Chapter 7. Schematics, Component Location Diagrams, and Parts Lists”, for detailed circuitry and power distribution information and the various voltages used by the ICs on the main board are shown in Table 3-1.

Table 3-1. Integrated Circuits Voltages

Integrated Circuit	A+	UNSW_VCC (3.0V)	SW_5V	1.55 V	3.3 V	2.8 V	1.88 V
OMAP IC				U1000	U1000	U1000	U1000
Unbuffered inverter for 32 kHz clock						U1004	
Schmidt trigger for 32 kHz clock						U1009	
Buffer array for isolation from Unswitched supplies to OMAP						U1002	
SSI line analog switches		U1001 U1003 U1005 U1007					
8MB SDRAM							U1300
2MB Flash						U1301	
TPS65012 PWR MGT IC			U2100				
Indicator LEDs NAND Gates						U2101 U2102 U2103	
USB Enable MOSFET					Q2100		
UNSW_VCC Linear Voltage Regulator	U2201						
SW_5V Switching Voltage Regulator	U2200						
ATTiny13 Microcontroller		U2302					
Flip Flop to control SW_B+		U2302					
USB / UART MUX IC			U3100				
USB Current Limiter IC			U3101				
Volume Knob ADC IC						U4201	
All LEDs	D4100 D4101 D4102 D4103 D4104 D4105 D4106 D4107 D4108						

3.4.2 Power Up / Power Down Sequence

Powering up the radio can be initiated by turning the ON/OFF knob to ON position or an ON command from the Patriot IC through BUS_PWR_OUT line. These actions will trigger the ATTiny13 microcontroller to start the power up sequence by asserting the 5V_EN. Once 5V_EN is high, the U2200 will turn ON and MOSFET Q2202 that will turn ON the transceiver via SW_B+.

Supply from 5V will power up Power Management IC U2100 which has its own defined sequencing for its 4 output voltages. The 1.55V supply will start to ramp and once the peak is reached the other voltages (3.3V, 1.88V and 2.8V) will start. The reset lines, POR and MPU_RESET from the U2200 will remain low for 1 second to hold OMAP in the reset mode the moment 5V is applied to U2100. Once the Reset lines are asserted high, the OMAP IC will start and software will commence. The OMAP will send a 1ms low true signal to the ATTiny13 through line B+_CTRL to indicate OMAP's software has started so as to cancel a reset pulse from ATTiny13. The assumption is that if OMAP IC failed to start within 8 seconds from the assertion of 5V_EN, ATTiny13 will force a reset on the system.

For powering down, the trigger would begin by turning the ON/OFF knob to OFF position or an OFF command from Patriot IC through BUS_PWR_OUT. ATTiny13 microcontroller and OMAP IC's ON_OFF_SENSE will be triggered to initiate the shutdown sequence. ATTiny13 microcontroller would de-assert 5V_EN which would turn OFF the 5V Regulator IC (U2200) and turns OFF MOSFET Q2202 in which SW_B+ will drop and initiate a shutdown of the transceiver section.

3.4.3 Reset Circuits

A reset will occur when OMAP IC or Patriot IC sends a reset command to the ATTiny13 microcontroller through B+_CTRL or BUS_PWR_OUT respectively. To reset, ATTiny13 microcontroller will drop 5V_EN low for 2 seconds, in which the whole radio system will reset.

When 5V_EN is dropped, POR will be high, 5V switching regulator (U2200) will go off and SW_B+ will be low. Brick_5V will reset the flip-flop (U2302) and ensure that the brick did turn off. When 5V_EN is back to high after 2 seconds, the whole system will power up again.

3.4.4 ATTiny13 Microcontroller Programming

As with all microcontrollers, software resides in the ATTiny13 microcontroller. If upgrade is necessary, programming can be accomplished through the use of a specially made ATTiny13 Flex cable.

The flex is to be connected to P2300 and at ALL TIMES the volume knob must be in the OFF position. ATMEL's AVRISP programming kit is to be attached on the other end of the flex. A+ must be supplied to the control head for UNSW_VCC in order to power the AVRISP and ATTiny13 microcontroller.

For a list of programming kits needed, please refer to Table 3-2.

Table 3-2. ATTiny13 Programming Kit

Part Number	Description	Application
8416228H01 (Motorola Part Number)	AVR ATTiny13 Programming Flex	To be used with XTL 1500 control head to reprogram the ATTiny13.
ATAVRISP (ATMEL Part Number)	AVR ISP Programmer	Device used to program ATMEL range of ATTiny Microcontrollers.

3.5 User Interface

The User Interface consists of 2 main sections, the LCD display as well as user activated menu buttons and frequency and volume knob.

3.5.1 LCD Display

The LCD of XTL1500 provides 1 line / 8 alphanumeric characters with 1 upper row of 8 soft icons and 4 programmable soft menus on the bottom. The LCD is backlit with 4 LEDs. Solomon SSD1805 Driver is used to drive the LCD and interfaces to the OMAP processor through 8 parallel SoSSI lines. The LCD operates off 2.8V while the LEDs are powered by SW_B+.

3.5.2 Keypad, Volume and Frequency Knob

Five keypad buttons configured as column/row matrix is used in XTL1500. One button is default programmed as emergency while the other four activates the user programmed soft menus.

The volume knob provides a linear increase in volume and is converted to digital signals through the A/D converter (U4202) which connects through SPI to OMAP IC.

The frequency knob is configured to provide a standard 48 frequency channel selection with a maximum of 256 channel selection (software dependent) and uses 4 GPIOs for frequency selection.

3.6 GCAI Accessory Interface

GCAI or Global Core Accessory Interface is the new Motorola accessory interface standard that provides the user the ability of retaining GCAI compatible accessories when migrating to new radio platforms. XTL1500 is one of the first Motorola products to implement this standard and is GCAI Class 0 compliant. The accessory interface port (J7000) incorporates USB Host and Client, 2-wire RS232 UART transmission, GPIOs and One Wire device detect capability.

Note that the GCAI accessory connector, J7000 resides on a small GCAI board (“Chapter 7. Schematics, Component Location Diagrams, and Parts Lists”) due to limited space on the main control head board. They are connected together via a 12- wire bridge cable.

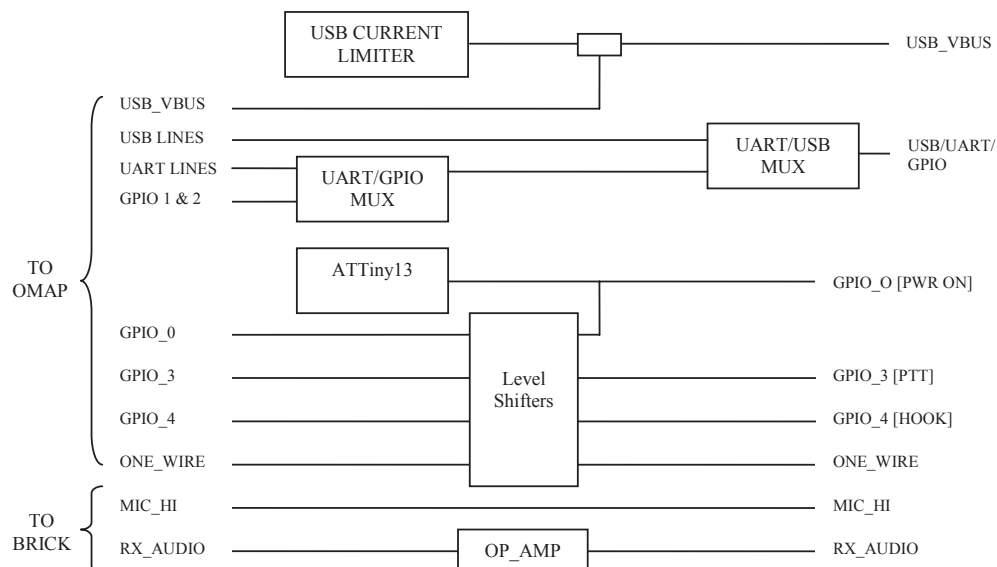


Figure 3-5. GCAI Block Diagram

All GCAI Outputs are configured to be at nominal 3.3V High with 15K Ω pull-ups on GPIO lines and 2.2K Ω pullup on ONE_WIRE line while UART is pullup with 100K Ω . USB is configured to comply with international USB standard.

The one-wire detection will provide the radio with information on what accessory has been plugged in and will configure the radio correctly to allow smooth operation of smart accessories such as the keypad microphone and the RS232 programming cable.

Please refer to section 3.14.11, "Flash Programming," on page 3-75 for details on Flash programming using GCAI's RS232 UART.

3.7 Main Board

This section provides a detailed circuit description of the XTL 1500 radio main board for VHF/UHF Range 1/UHF Range 2/700–800 MHz models. The main board contains the following major sections:

- Radio Power (page 3-15)
- Receiver Front-End (page 3-16)
- Receiver Back-End (page 3-23)
- Transmitter (page 3-29)
- Frequency Generation Unit (page 3-45)
- Controller (page 3-62)

When reading the theory of operation, refer to your appropriate schematic and component location diagrams located in "Chapter 7. Schematics, Component Location Diagrams, and Parts Lists". This detailed Theory of Operation will help isolate the problem. However, first use the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual* (6815853H01) to troubleshoot the problem to a particular board.

3.8 Main Board Major Sections

This section contains the main board layouts for each radio frequency band.

3.8.1 VHF (136–174 MHz) Band

The illustrations (Figure 3-6 on page 3-9 to Figure 3-7 on page 3-10) and their accompanying tables (Table 3-3 on page 3-9 to Table 3-4 on page 3-10) identify the location of the major sections of the main board.

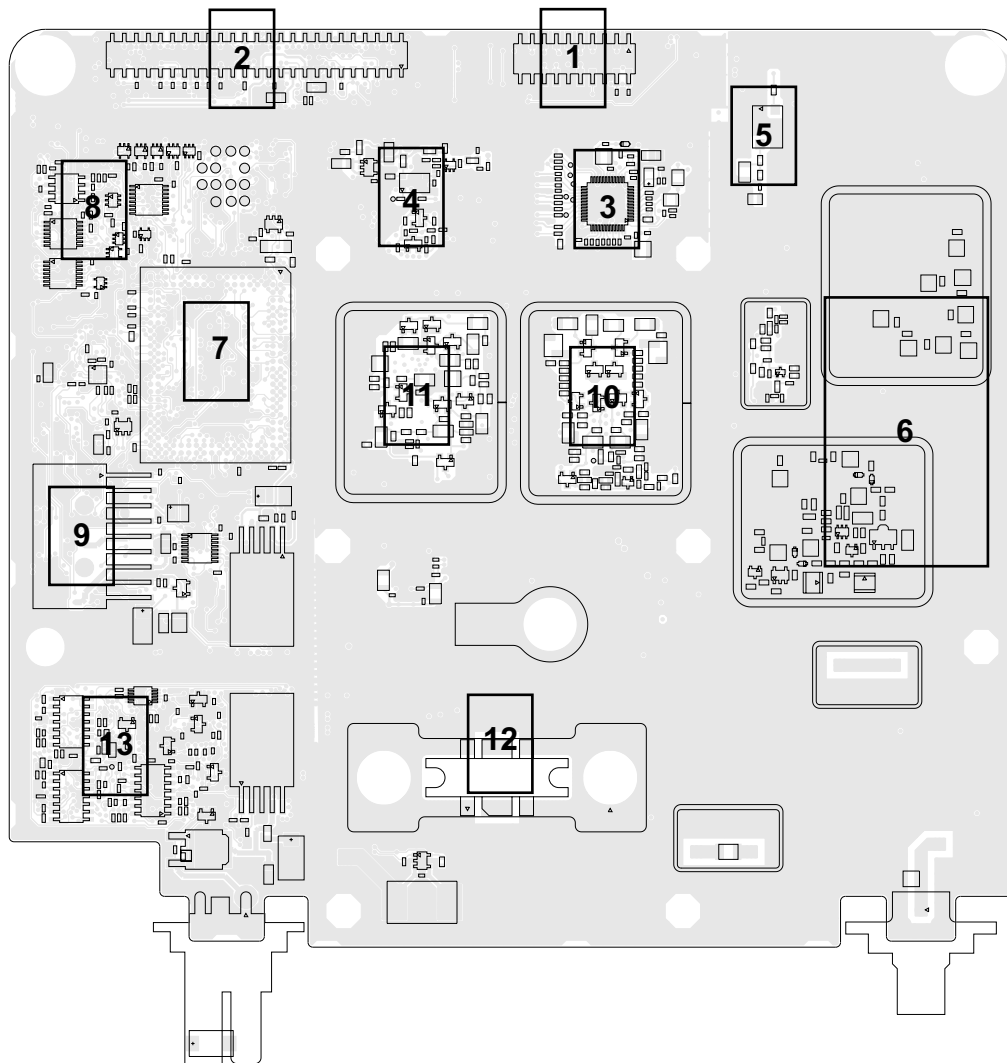


Figure 3-6. XTL 1500 Main Board Sections (VHF Mid Power)—Side 1

Table 3-3. XTL 1500 Main Board Sections (VHF Mid Power)—Side 1

1	Secure Connector (J0501)	8	Controller Section
2	Front Connector (J0401)	9	Audio Power Amplifier (PA)
3	RX Back-End (ABACUS III)	10	RX VCO
4	16.8 MHz Reference Oscillator	11	TX VCO
5	IF Filter	12	TX PA
6	RX Front-End	13	TX Power Control
7	Daughtercard		

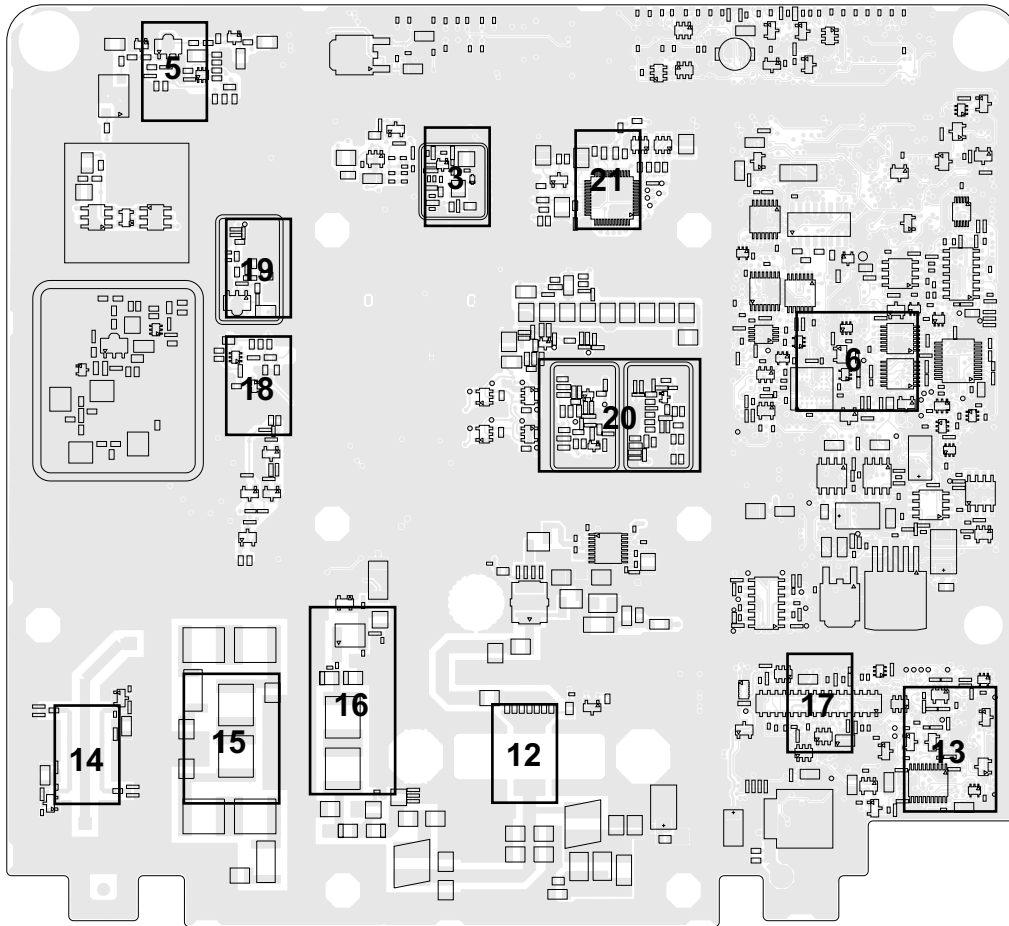


Figure 3-7. XTL 1500 Main Board Sections (VHF Mid Power)—Side 2

Table 3-4. XTL 1500 Main Board Sections (VHF Mid Power)—Side 2

3	RX Back-End	16	Antenna Switch
5	IF Filter	17	Rear Connector (J0402)
6	Controller Section	18	RX Front-End Biasing
12	TX PA	19	RX VCO Injection Stage
13	TX Power Control	20	TX VCO Injection Stage
14	Power Detector	21	FGU (Synthesizer)
15	Harmonic Filter		

3.8.2 UHF Range 1 (380-470 MHz) and UHF Range 2 (450-520 MHz) Band

The illustrations (Figure 3-8 on page 3-11 to Figure 3-9 on page 3-12) and their accompanying tables (Table 3-5 on page 3-11 and Table 3-6 on page 3-12) identify the location of the major sections of the main board.

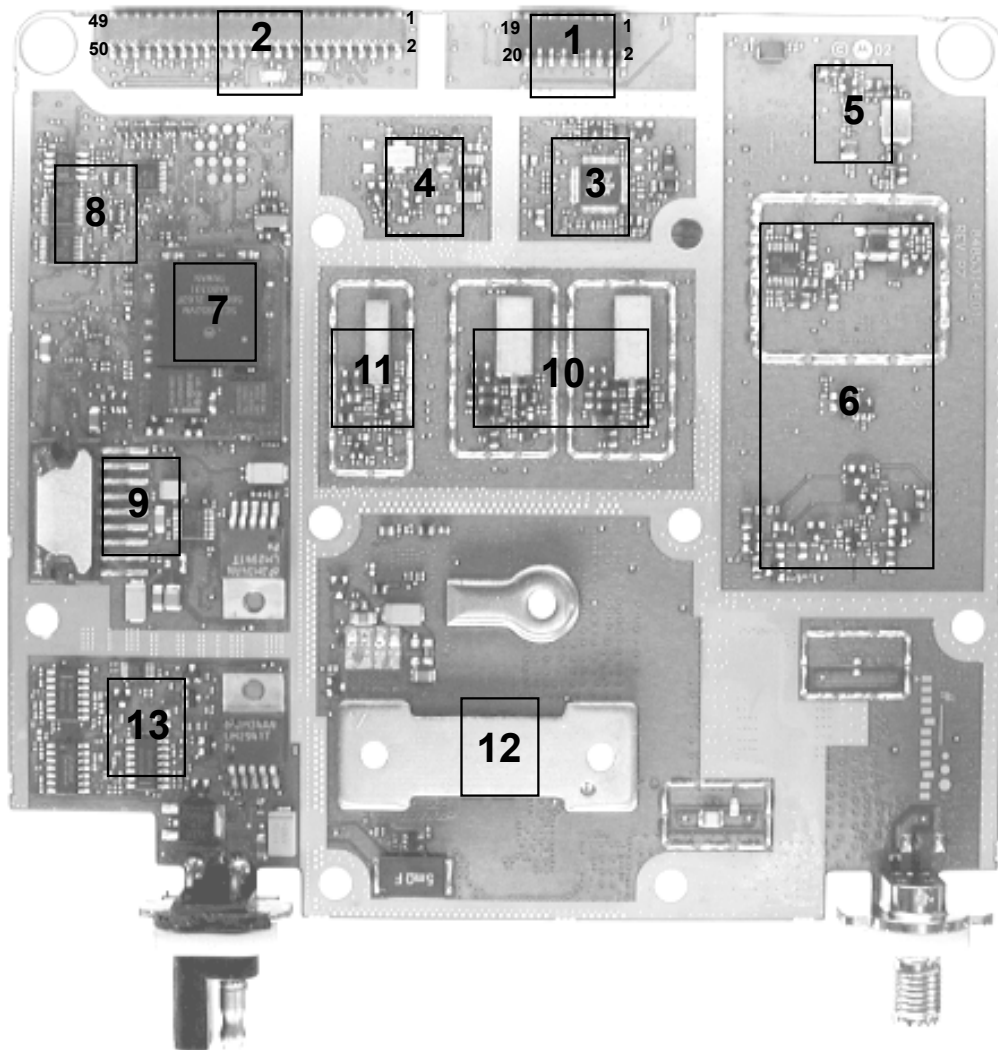


Figure 3-8. XTL 1500 Main Board Sections (UHF Range 1 Mid Power and UHF Range 2)—Side 1

Table 3-5. XTL 1500 Main Board Sections (UHF Range 1 Mid Power and UHF Range 2)—Side 1

1	Secure Connector (J0501)	8	Controller Section
2	Front Connector (J0401)	9	Audio Power Amplifier (PA)
3	RX Back-End (ABACUS III)	10	RX VCO
4	16.8 MHz Reference Oscillator	11	TX VCO
5	IF Filter	12	TX PA
6	RX Front-End	13	TX Power Control
7	Daughtercard		

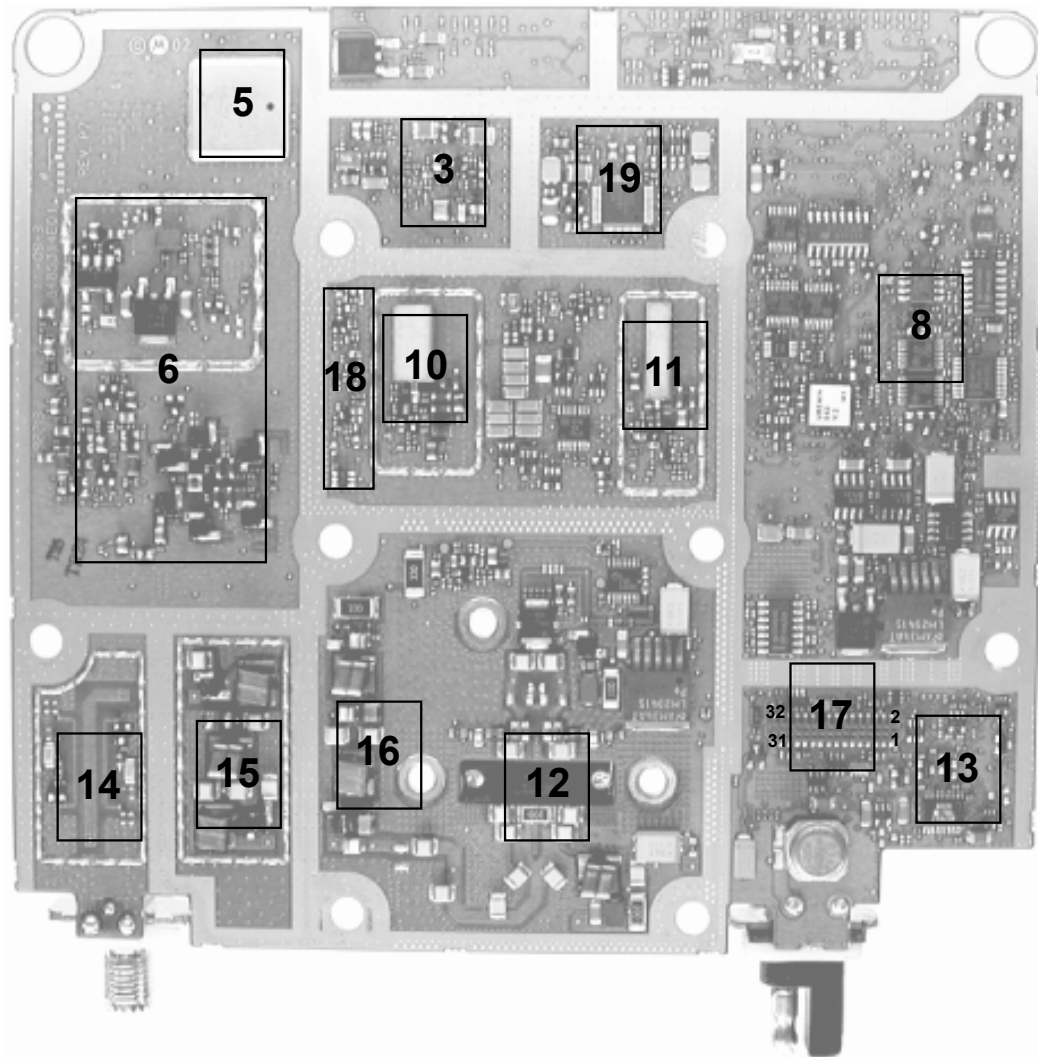


Figure 3-9. XTL 1500 Main Board Sections (UHF Range 1 Mid Power and UHF Range 2)—Side 2

Table 3-6. XTL 1500 Main Board Sections (UHF Range 1 Mid Power and UHF Range 2)—Side 2

3	RX Back-End	13	TX Power Control
5	IF Filter	14	Power Detector
6	RX Front-End	15	Harmonic Filter
8	Controller Section	16	Antenna Switch
10	RX VCO	17	Rear Connector (J0402)
11	TX VCO	18	RX VCO Injection Stage
12	TX PA	19	FGU (Synthesizer)

3.8.3 700–800 MHz Band

The illustrations (Figure 3-10 and Figure 3-11 on page 3-14) and their accompanying tables (Table 3-7 and Table 3-8 on page 3-14) identify the location of the major sections of the main board.

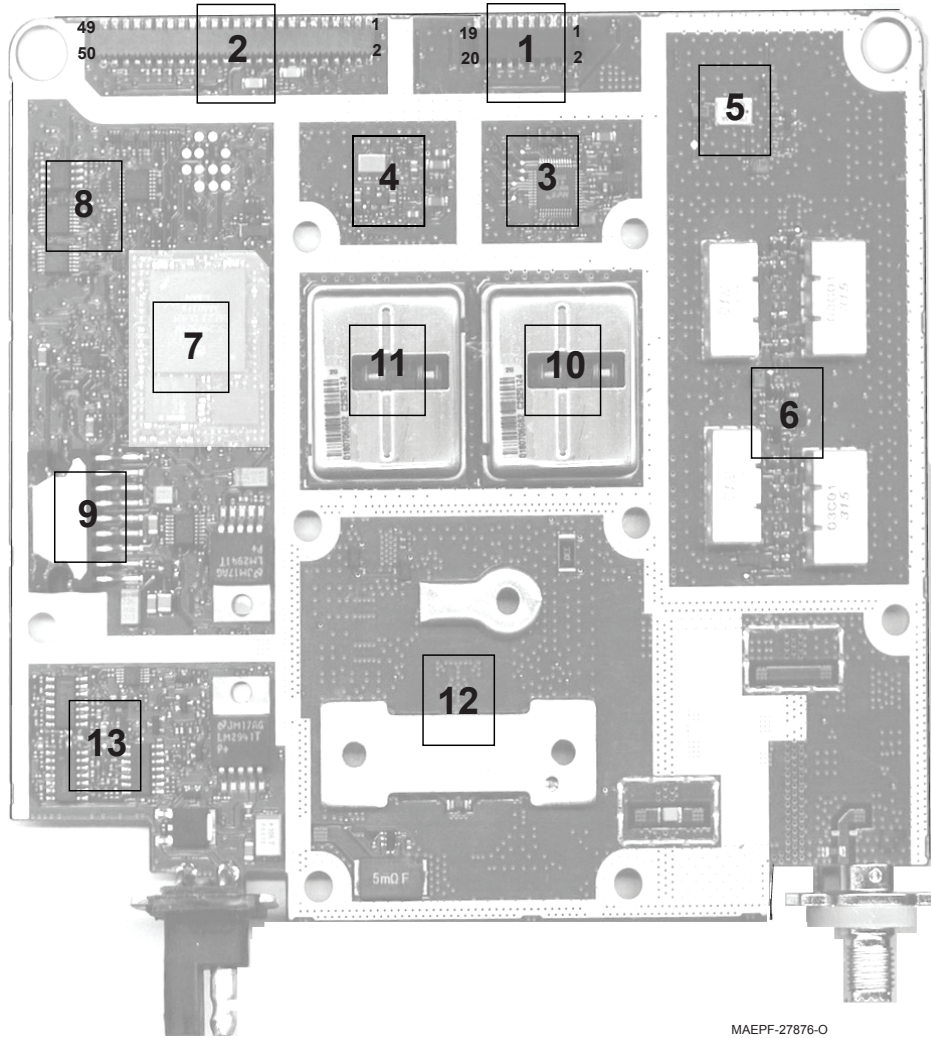


Figure 3-10. XTL 1500 Main Board Sections (700–800 MHz)—Side 1

Table 3-7. XTL 1500 Main Board Sections (700–800 MHz)—Side 1

1	Secure Connector (J0501)	8	Controller Section
2	Front Connector (J0401)	9	Audio Power Amplifier (PA)
3	RX Back-End (ABACUS III)	10	RX VCO
4	16.8 MHz Reference Oscillator	11	TX VCO
5	IF Filter	12	TX PA
6	RX Front-End	13	TX Power Control
7	Daughtercard		

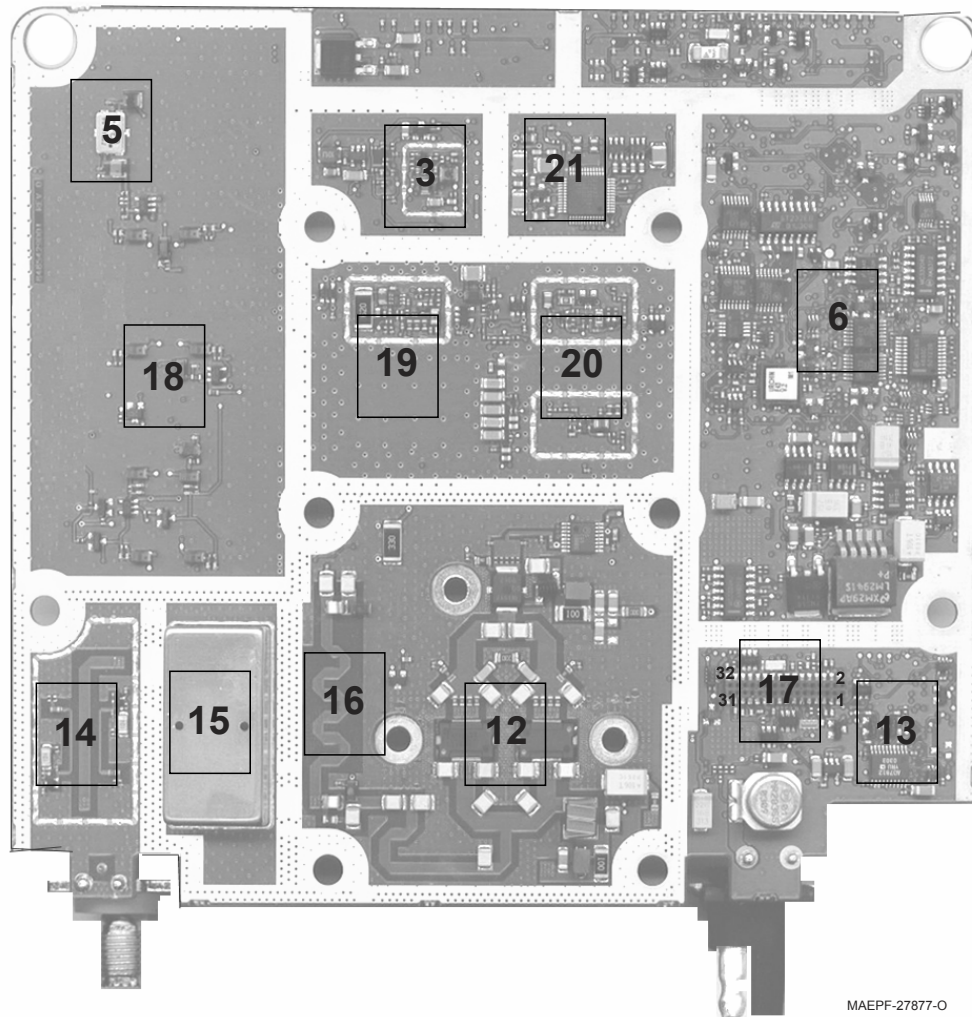


Figure 3-11. XTL 1500 Main Board Sections (700–800 MHz)—Side 2

Table 3-8. XTL 1500 Main Board Sections (700–800 MHz)—Side 2

3	RX Back-End	16	Antenna Switch
5	IF Filter	17	Rear Connector (J0402)
6	Controller Section	18	RX Front-End Biasing
12	TX PA	19	RX VCO Injection Stage
13	TX Power Control	20	TX VCO Injection Stage
14	Power Detector	21	FGU (Synthesizer)
15	Harmonic Filter		

3.9 Radio Power Distribution

This section provides information on DC power distribution in XTL 1500 radios. In the XTL 1500 radio, power is distributed to two boards: the main board and control head.

Power for the radio is supplied by the vehicle's 12-V battery. When using a desktop adapter unit, an external DC power supply can be connected to replace the vehicle's battery source.

A+ (referred to as incoming unswitched battery voltage) enters the radio through the rear RF power amplifier connector (J0950) and is the main entry for DC power. The second path, through J2, pin 25, provides ignition sense to optionally inhibit radio turn-on when the ignition switch is off. This feature is programmable through the CPS.

When the control-head On/Off knob is turned on, the three 9.3-V regulators power on the controller section, the RX/frequency generation unit (FGU) section, and the TX section. See Figure 3-12 for the UHF Range 1 and UHF Range 2 bands or Figure 3-13 on page 3-16 for the VHF and 700-800 MHz bands.

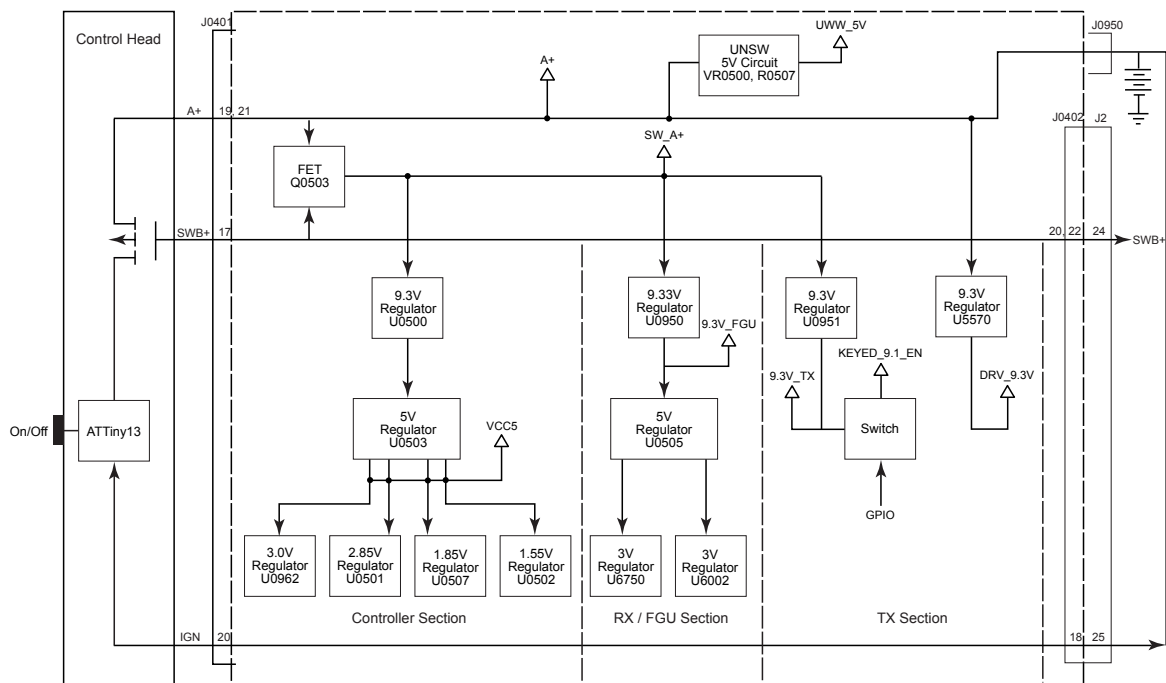


Figure 3-12. DC Voltage Routing Block Diagram (UHF Range 1 and UHF Range 2)

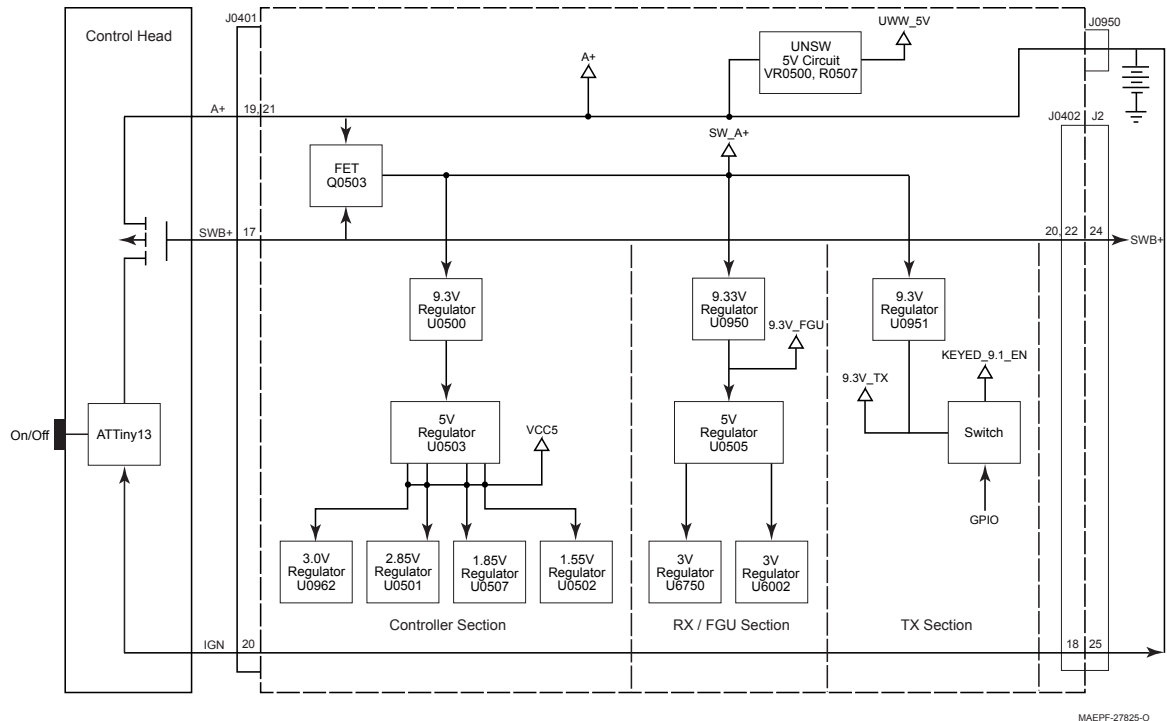


Figure 3-13. DC Voltage Routing Block Diagram (VHF and 700–800 MHz)

The 9.3 V and the A+ voltage are the main DC power for the RF section. The 9.1 V (referred to as “keyed 9.1 V”) is controlled by the VOCON board through P501, pin 45. This DC voltage enables the transmitter’s RF power amplifier when the VOCON board senses a lock detect from the synthesizer.

3.10 Receiver Front-End

This section provides a detailed circuit description of receiver front-end (RXFE). When reading the Theory of Operation, refer to your appropriate schematic and component location diagrams located in “Chapter 7. Schematics, Component Location Diagrams, and Parts Lists”. This detailed theory of operation will help isolate the problem to a particular component.

3.10.1 VHF (136–174 MHz) Band

The receiver circuits primary duties are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals. The receiver is broken down into the following blocks (Figure 3-14 on page 3-17):

- Front-end, which includes:
 - 15 dB step attenuator
 - PIN diode switches
 - Three discrete filters
 - Two low-noise amplifiers
 - Mixer
- Back-end, which includes:
 - Two crystal filters

- Low-noise IF amplifier
- ABACUS III digital back-end IC

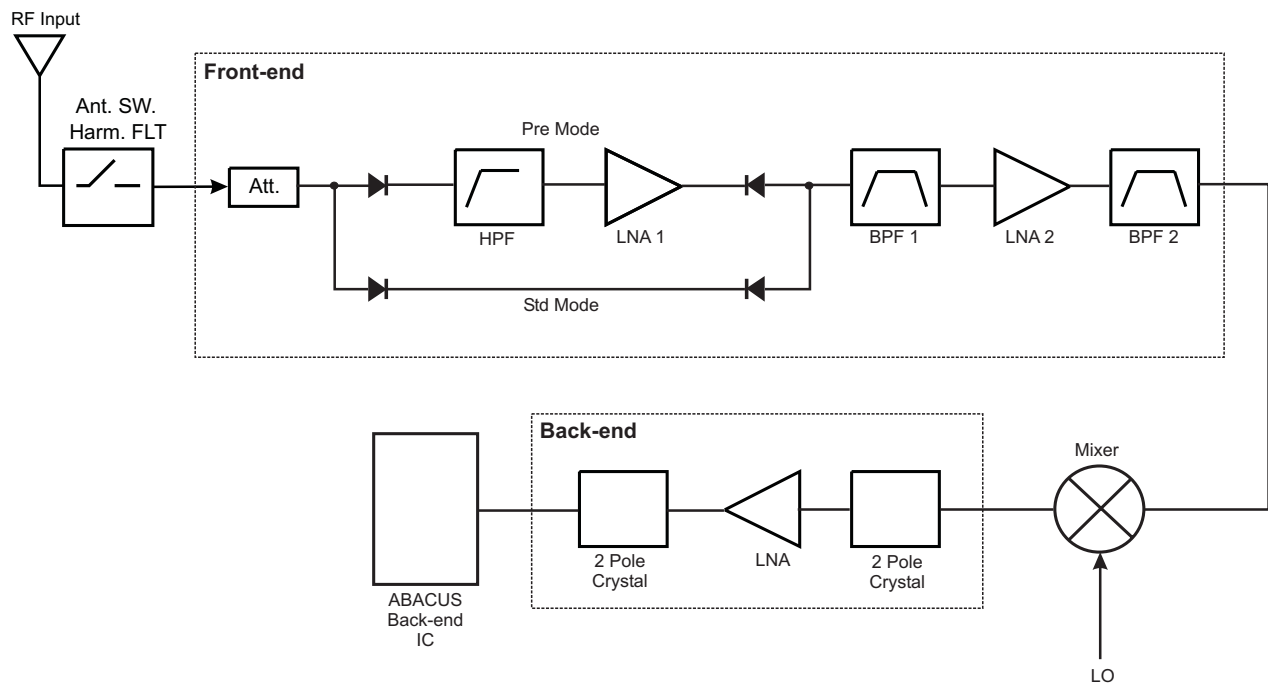


Figure 3-14. Receiver Block Diagram (VHF)

3.10.1.1 15 dB Step Attenuator (U3250)

The 15 dB step attenuator provides protection from strong on-channel signals and interferences.

3.10.1.2 PIN Diode Switches

The VHF front end operates in two modes: Standard mode and Preamp mode. The PIN diode switches select between the two modes. In standard mode the intermodulation performance is improved by bypassing the first HPF and LNA. Preamp mode is characterized by higher sensitivity.

3.10.1.3 Preselector Filters

The front-end operates in the 136-174 MHz band. The front-end filters primary function is to provide protection against out-of-band spurious responses such as image, IF, half-IF, etc. while providing flat, low-loss response in the receive band. The front-end uses discrete LC filter technology. The first filter is a high-pass filter that protects the first LNA from strong out-of-band signals at frequencies which are below the receive band and is used in preamp mode only. The second and third filters are band-pass filters that provide additional out-of-band spurious rejection.

3.10.1.4 Low-Noise Amplifiers (Q3255, Q3252)

The function of the Low-Noise Amplifiers (LNA) is to amplify the received signal with minimal noise contribution. The first LNA (Q3255) has 10 dB of gain and is activated in Preamp mode only. A clamping diode pair (D3256) located after the High Pass and before the first LNA protects the receiver from strong RF signals by limiting the signal amplitude going into the amplifier. The second LNA (Q3252) has 15 dB of gain. Both LNAs are biased with 9.3V.

3.10.1.5 Mixer (D3258)

The received signal is down-converted by a double-balanced mixer to an Intermediate Frequency (IF) of 109.65 MHz. The mixer is designed to provide low conversion loss and high intermodulation performance. The injection buffer provides a 20 dBm LO signal to the mixer. High-side injection is used.

3.10.2 UHF Range 1 (380–470 MHz) Band

The receiver circuits primary duties are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals. The receiver (see Figure 3-15) is broken down into the following blocks:

- Front-end, which includes:
 - High pass filter and first low-noise amplifier (LNA)
 - Preselector filter
 - Switchable 15 dB attenuator
 - Second LNA
 - Image Filter
 - First mixer
- Back-end, which includes:
 - Intermediate Frequency (IF)
 - ABACUS III IC

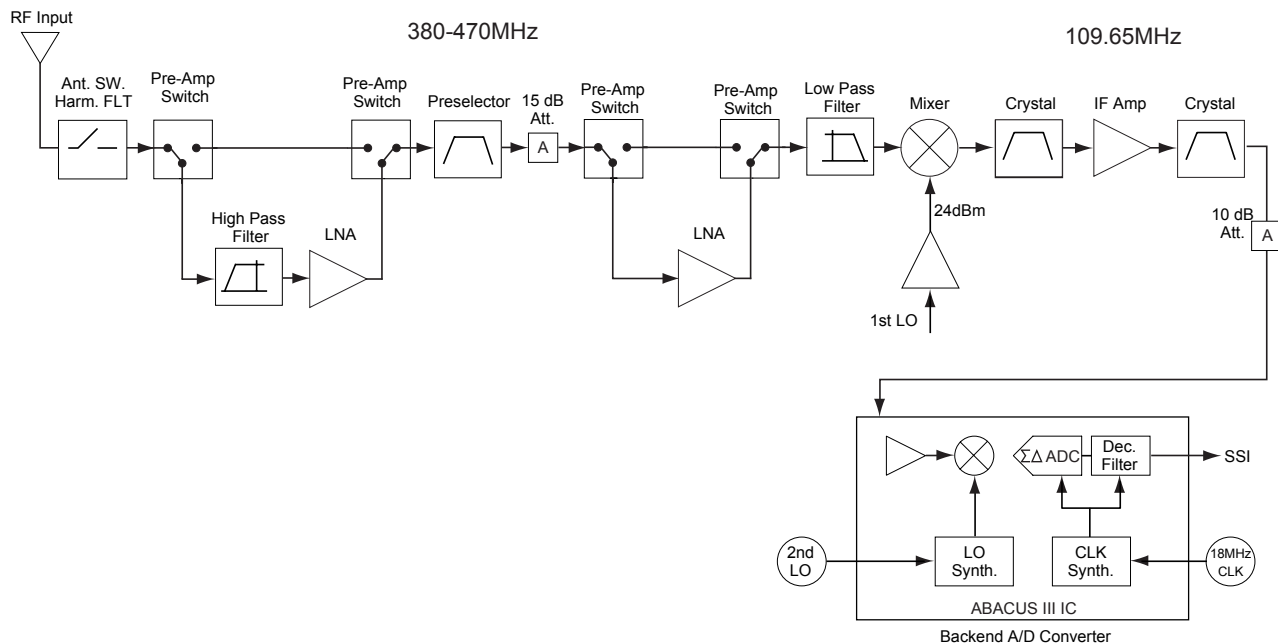


Figure 3-15. Receiver Front-End and Back-End (UHF Range 1)

3.10.2.1 Highpass Filter and First Low-Noise Amplifier

The highpass filter and first low-noise amplifier (LNA) (11 dB gain) can be switched in and out of the signal path by diode switches. When switched into the signal path, the sensitivity of the radio is improved at the cost of degraded intermodulation performance. This can be necessary in fringe areas when strong interference that can lead to intermodulation problems are not present and the desired signal is weak.

The preamplifier version of the radio must be purchased to be able to control this option. If it has not been purchased, the direct path created by the diode switches is the only one available, giving the radio standard model performance with enhanced intermodulation rejection. Purchasing the preamplifier option allows the user to select either mode with the CPS.

3.10.2.2 Preselector Filter

The front-end operates in the 380 to 470 MHz band. The front-end's primary function is to optimize half IF rejection, image rejection, and selectivity while providing the first conversion. The front-end uses a varactor-tuned filter that is tuned by the controller. The tuning signal is a DC control voltage between 0 and 9V that come from the PA power control section. Low voltages are for lower frequencies and higher voltages correspond to the higher frequencies. This filter is aligned in the factory and can also be aligned using the Tuner software.

3.10.2.3 Switchable 15 dB Attenuator

This circuit block can provide 0 dB or 15 dB of attenuation in the signal path. Normally, it is set for 0 dB and does not affect the received signal. When strong signals are detected, the radio controller can choose to activate this attenuator to provide protection to the back end circuits, and to enhance high level intermodulation performance. Proprietary algorithms are used to control the switching.

3.10.2.4 Low-Noise Amplifier (LNA, U5302)

A diode (D5281) located after the varactor preselector and before the LNA protects the receiver from strong RF signals by limiting the signal amplitude going into the amplifier. The LNA is a low-noise monolithic IC providing ~ 15 dB of gain to the receiver. It is biased with 5 V and can be bypassed by the radio software under very strong signal conditions.

The UHF receiver also has a second LNA based on Q5252 that can be activated or bypassed by the radio software. This amplifier is protected by D5280 and provides 11 dB of gain. This is available only if the preamplifier option has been purchased.

3.10.2.5 Image Filter

Following the LNA (U5302), the signal goes through a bandpass filter before it is sent to the mixer. The passband is from 380 to 470 MHz with an insertion loss of about 2 dB, while the image rejection is 55 dB. There is a trap on the input side of this filter to attenuate the 109.65 MHz IF.

3.10.2.6 Mixer

A passive double-balanced diode ring mixer is used to down-convert the received signal to an Intermediate Frequency (IF) of 109.65 MHz. The mixer is designed to provide low conversion loss (< 7.0 dBm) and high intermodulation performance and requires a strong injection signal. The mixer is driven by the receiver injection buffer, a two-stage LDMOS IC design, that amplifies the +3 dBm high-side injection signal from the Frequency Generation Unit (FGU) to +24 dBm.

3.10.3 UHF Range 2 (450–520 MHz) Band

The receiver circuits primary duties are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals. The receiver (see Figure 3-16) is broken down into the following blocks:

- Front-end, which includes:
 - High pass filter and first low-noise amplifier (LNA)
 - Preselector filter
 - Switchable 15 dB attenuator
 - Second LNA
 - Image Filter
 - First mixer
- Back-end, which includes:
 - Intermediate Frequency (IF)
 - ABACUS III IC

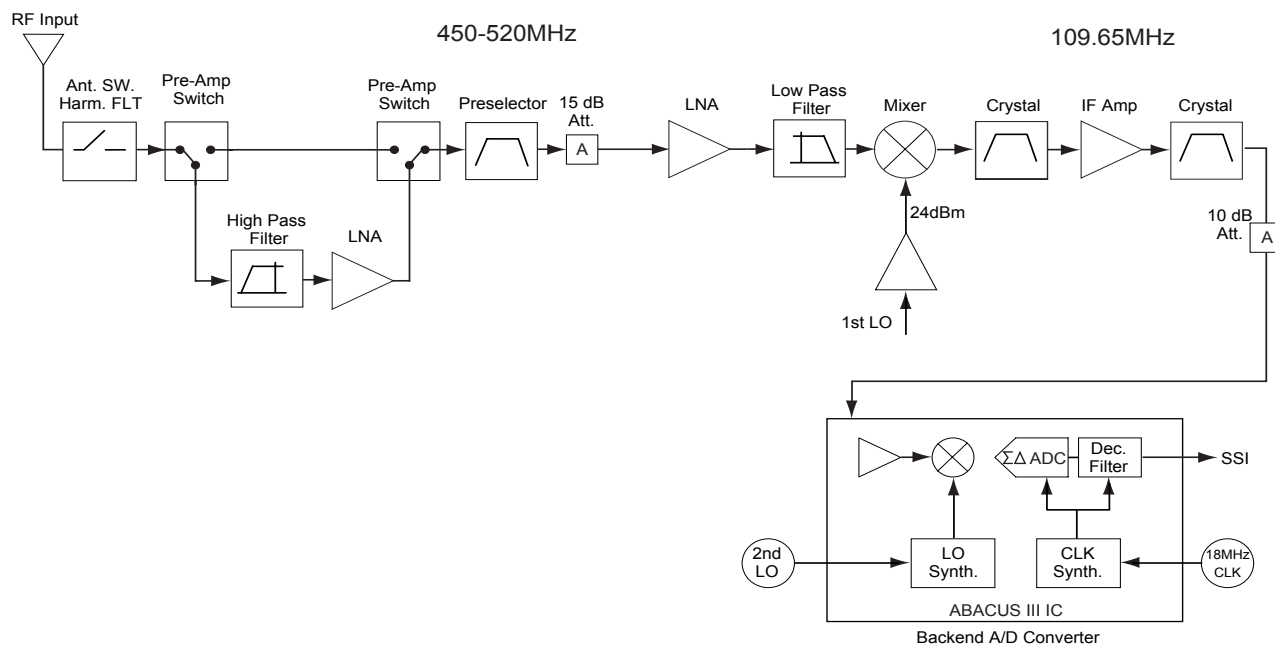


Figure 3-16. Receiver Front-End and Back-End (UHF Range 2)

3.10.3.1 Highpass Filter and First Low-Noise Amplifier

The highpass filter and first low-noise amplifier (LNA) (11 dB gain) can be switched in and out of the signal path by diode switches. When switched into the signal path, the sensitivity of the radio is improved at the cost of degraded intermodulation performance. This can be necessary in fringe areas when strong interference that can lead to intermodulation problems are not present and the desired signal is weak.

The preamplifier version of the radio must be purchased to be able to control this option. If it has not been purchased, the direct path created by the diode switches is the only one available, giving the radio standard model performance with enhanced intermodulation rejection. Purchasing the preamplifier option allows the user to select either mode with the CPS.

3.10.3.2 Preselector Filter

The front-end operates in the 450 to 520 MHz band. The front-end's primary function is to optimize half IF rejection, image rejection, and selectivity while providing the first conversion. The front-end uses a varactor-tuned filter that is tuned by the controller. The tuning signal is a DC control voltage between 0 and 9V that come from the PA power control section. Low voltages are for lower frequencies and higher voltages correspond to the higher frequencies. This filter is aligned in the factory and can also be aligned using the Tuner software.

3.10.3.3 Switchable 15 dB Attenuator

This circuit block can provide 0 dB or 15 dB of attenuation in the signal path. Normally, it is set for 0 dB and does not affect the received signal. When strong signals are detected, the radio controller can choose to activate this attenuator to provide protection to the back end circuits, and to enhance high level intermodulation performance. Proprietary algorithms are used to control the switching.

3.10.3.4 Low-Noise Amplifier (LNA, U5302)

A diode (D5281) located after the varactor preselector and before the LNA protects the receiver from strong RF signals by limiting the signal amplitude going into the amplifier. The LNA is a low-noise monolithic IC providing ~ 15 dB of gain to the receiver. It is biased with 5 V.

The UHF receiver also has a second LNA based on Q5252 that can be activated or bypassed by the radio software. This amplifier is protected by D5280 and provides 11 dB of gain.

3.10.3.5 Image Filter

Following the LNA (U5302), the signal goes through a bandpass filter before it is sent to the mixer. The passband is from 450 to 520 MHz with an insertion loss of about 2 dB, while the image rejection is 55 dB. There is a trap on the input side of this filter to attenuate the 109.65 MHz IF.

3.10.3.6 Mixer

A passive double-balanced diode ring mixer is used to down-convert the received signal to an Intermediate Frequency (IF) of 109.65 MHz. The mixer is designed to provide low conversion loss (< 7.0 dBm) and high intermodulation performance and requires a strong injection signal. The mixer is driven by the receiver injection buffer, a two-stage LDMOS IC design, that amplifies the +3 dBm high-side injection signal from the Frequency Generation Unit (FGU) to +24 dBm.

3.10.4 700–800 MHz Band

The receiver circuits primary duties are to detect, filter, amplify, and demodulate RF signals in the presence of strong interfering noise and unintended signals. The receiver (see Figure 3-17) is broken down into the following blocks:

- Front-end, which includes:
 - Preselector filters
 - Low-noise amplifier (LNA)
 - First mixer
- IF
- Back-end

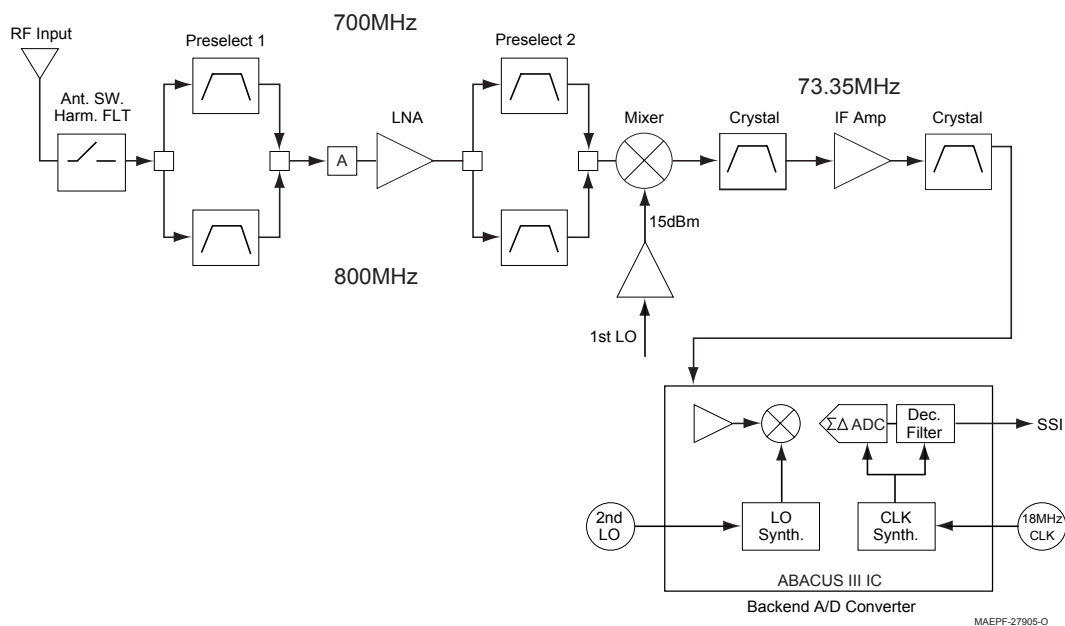


Figure 3-17. Receiver Front-End and Back-End (700–800 MHz)

3.10.4.1 Preselector Filters

The front-end operates in the 700 MHz and 800 MHz bands. The front-end's primary function is to optimize image rejection and selectivity while providing the first conversion. The front-end uses fixed ceramic-filter technology. There are two sets of filters: (B6250 and B6252) for the 800 MHz band and (B6251 and B6253) for the 700 MHz band. These filters are switched between bands by a network of diode switches (D6251 thru D6257) biased by RLC networks (C6254, C6260, R6254, and L6254) that also act as RF chokes. The first filter is a dual-switched filter that reduces the image-frequency response and limits some of the out-of-band interferers. The second filter following the monolithic low-noise amplifier (LNA) provides additional image rejection.

3.10.4.2 Low-Noise Amplifier (LNA, U6250)

A diode (D6258) located after the first preselector and before the LNA protects the receiver from strong RF signals by limiting the signal amplitude going into the amplifier. The LNA is a low-noise monolithic IC providing ~ 16 dB of gain to the receiver. It is biased with 5 V at pins 1 and 6. The input matching consists of an LC network (C6288, L6258) for optimal gain.

3.10.4.3 Mixer (U6251)

The monolithic, passive mixer IC down-converts the received signal to an Intermediate Frequency (IF) of 73.35 MHz. The mixer is designed to provide low conversion loss (< 7.0) and high intermodulation performance. To improve the performance of the mixer in both bands, a shunt 9.1 pF capacitor (C6297) along with a resistive PI network (R6278, R6280, R6281) is designed at the IF port (pin 5) of the mixer. The mixer is driven by the receiver injection buffer, a two-stage discrete/IC design used with the VCO to efficiently drive the mixer over temperature with minimum power variation. The injection buffer provides 15 dBm to the mixer. The VCO does high-side injection for the 800 MHz band and low-side injection for the 700 MHz band.

3.11 Receiver Back-End

This section discusses the receiver back-end (RXBE) components and detailed theory of operation. The receiver back-end processes the down-converted, filtered IF signal to produce digital data for final processing by the Patriot microcontroller IC.

3.11.1 VHF (136-174 MHz) Band

The receiver back-end contains the following major components:

- Intermediate frequency (IF) section.
- ABACUS III IC

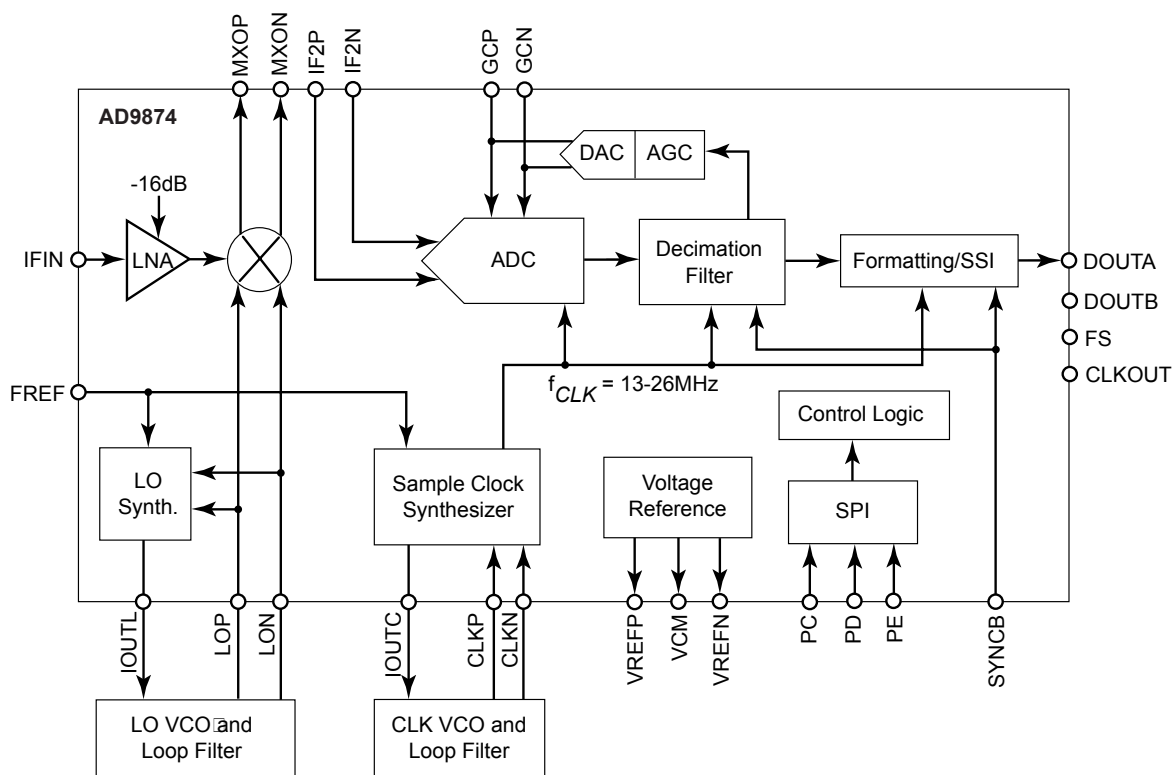
3.11.1.1 Intermediate Frequency (IF) Section

The XTL 1500 radio uses two leadless, surface-mount, two-pole, third-overtone, quartz crystal filters (Y3400, Y3401) separated by a 21 dB gain IF amplifier. The filters are centered at 109.65 MHz. This narrowband bandpass filter contributes to the radio's adjacent-channel and alternate-channel rejection performance. Components L3401, L3403, L3404, L3405, C3421, C3414, C3409, C3416, C3420, C3418 and C3415 are used as impedance-matching networks. Components Q3400, R3409, R3401, R3402, R3405, R3407, and R3413 are used for biasing and stabilizing the transistor Q3400. Components C3424, C3404 bypass the DC supply. L3400 is RF choke. Diode D3400 and Inductor L3408 protect the Abacus and the second IF filter from strong In-band signals.

3.11.1.2 ABACUS III IC

The receiver back-end is designed around the ABACUS III (AD9874 IF digitizing subsystem) IC and its associated circuitry. The AD9874 (Figure 3-18 on page 3-24) is a general-purpose, IF subsystem that digitizes a low-level, 10–300 MHz IF input with a bandwidth up to 270 kHz. The signal chain of the AD9874 consists of a variable gain, low-noise amplifier, a mixer; a bandpass, sigma-delta, A/D converter; and a decimation filter with programmable decimation factor. An automatic gain control (AGC) circuit provides the AD9874 with 12 dB of continuous gain adjustment. The high dynamic range and inherent anti-aliasing provided by the bandpass, sigma-delta converter allow the AD9874 to cope with blocking signals 80 dB stronger than the desired signal. Auxiliary blocks include clock and LO synthesizers, as well as an SPI port. Input signal RXIF is the 109.65 MHz IF from the IF section in the receiver front-end.

Components C3000, C3038, and L3002 match the input impedance from 50 ohms (IF Filter terminating impedance) to the ABACUS III IC input IFIN. Formatted SSI data is output to the Patriot microcontroller IC for DSP processing on ports FS, DOUTA, and CLKOUT. Control logic is sent to the ABACUS III IC from the Patriot microcontroller via the SPI lines (PC, PD, PE).



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Figure 3-18. ABACUS III (AD9874) IC Functional Block Diagram from Data Sheet (VHF)

3.11.1.2.1 Second Local Oscillator

The ABACUS III IC local oscillator (LO) synthesizer controls the second LO. Signal FREF is the 16.8 MHz reference from the frequency generation unit (FGU). The second LO frequency is 107.4 MHz by default, or 111.9 MHz in special cases as necessary to avoid radio self-quieters. The second LO signal mixes with IFIN to produce a 109.65 MHz final IF. The external VCO consists of transistor Q3000, together with its bias and instability network and tank elements. Darlington transistor Q3001 along with C3035 and C3017 form an active DC filter. The second-order loop filter is comprised of C3044, C3005, and R3009.

3.11.1.2.2 Sampling Clock Oscillator

The ABACUS III IC sampling clock synthesizer, at $F_{clk}=18$ MHz ($IF_2=F_{clk}/8$, where F_{clk} is the clock rate), utilizes a negative-resistance core that is internal to the ABACUS III IC which, when used in conjunction with an external LC tank (made up of L3003 and C3039) and a varactor (D3001), serves as the VCO.

3.11.2 UHF Range 1 (380-470 MHz) Band

The receiver back-end (see Figure 3-15 on page 3-18) contains the following major components:

- Intermediate frequency (IF) filter
- ABACUS III IC

3.11.2.1 Intermediate Frequency (IF) Filter

The XTL 1500 radio uses two leadless, surface-mount, two-pole, third-overtone, quartz crystal filters (Y5400, Y5401) separated by a 20 dB gain IF amplifier. The filter is centered at 109.65 MHz. This narrow-bandpass filter gives the radio part of its adjacent-channel and alternate-channel rejection performance. Impedance-matching networks are located at the input and output of each crystal. The IF amplifier is made with Q5401. The 10 dB attenuator (U5400) located after the second crystal filter is controlled by the software to limit the signal gain in front of the ABACUS III IC.

3.11.2.2 ABACUS III IC (U5002)

The receiver back-end is designed around the ABACUS III (AD9874 IF digitizing subsystem) IC and its associated circuitry. The AD9874 (Figure 3-19) is a general-purpose, IF subsystem that digitizes a low-level, 10-300 MHz IF input with a bandwidth up to 270 kHz. The signal chain of the AD9874 consists of a variable gain, low-noise amplifier, a mixer; a bandpass, sigma-delta, A/D converter; and a decimation filter with programmable decimation factor. An automatic gain control (AGC) circuit provides the AD9874 with 12 dB of continuous gain adjustment. The high dynamic range and inherent anti-aliasing provided by the bandpass, sigma-delta converter allow the AD9874 to cope with blocking signals 80 dB stronger than the desired signal. Auxiliary blocks include clock and LO synthesizers, as well as an SPI port. Input signal RXIF is the 109.65 MHz IF from the IF filter.

Components C5002, C5007, and L5002 match the input impedance from 50 ohms (IF Filter terminating impedance) to the ABACUS III IC input IFIN. Formatted SSI (synchronous serial interface) data is output to the Patriot microcontroller IC for DSP processing on ports FS, DOUTA, and CLKOUT. Control logic is sent to the ABACUS III IC from the Patriot microcontroller via the SPI lines (PC, PD, PE).

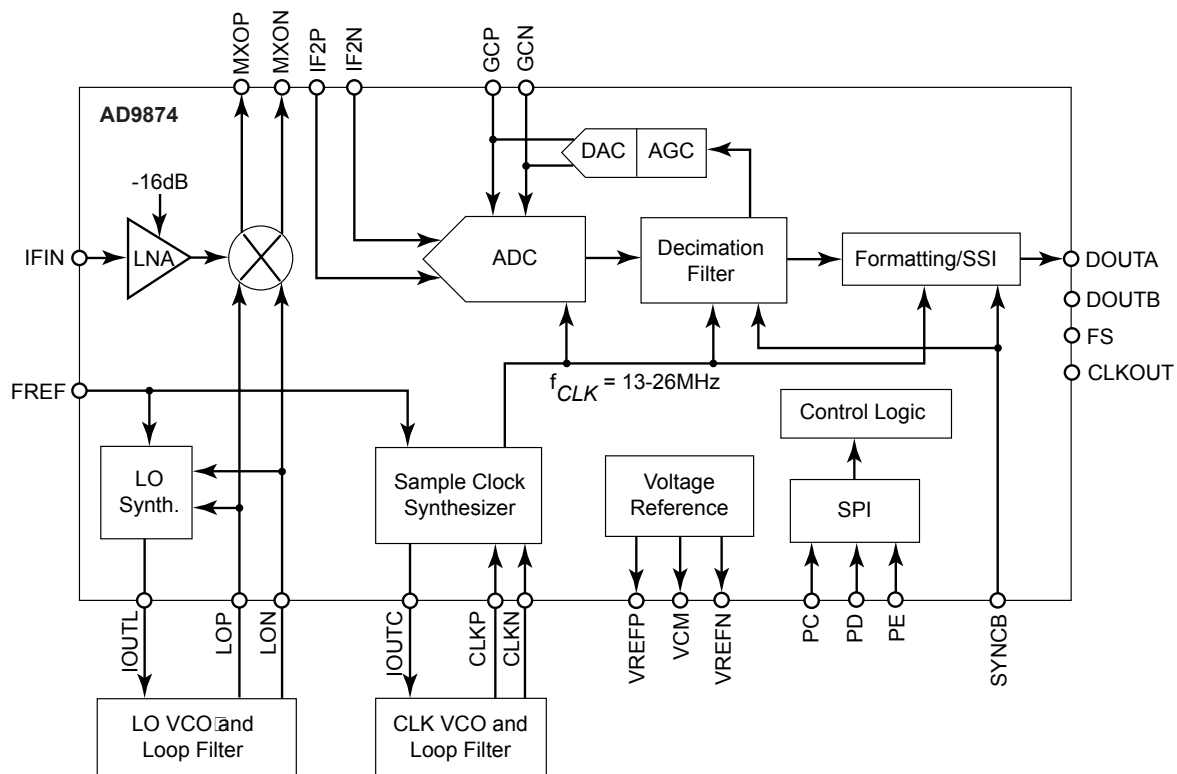


Figure 3-19. ABACUS III (AD9874) IC Functional Block Diagram from Data Sheet (UHF Range 1)

3.11.2.2.1 Second Local Oscillator (LO)

The ABACUS III IC local oscillator (LO) synthesizer controls the second LO. Signal FREF is the 16.8 MHz reference from the frequency generation unit (FGU). The second LO frequency is 107.4 MHz by default, or 111.9 MHz in special cases as necessary to avoid radio self-quieters. The second LO signal mixes with IFIN to produce a 2.25 MHz final IF. The external VCO consists of transistor Q5002, together with its bias and instability network and tank elements. Darlington transistor Q5001 along with C5018 and C5050 form an active DC filter. The 2nd order loop filter is comprised of C5044, C5045, and R5013.

3.11.2.2.2 Sampling Clock Oscillator

The ABACUS III IC sampling clock synthesizer, at $F_{clk}=18$ MHz ($IF2=F_{clk}/8$, where F_{clk} is the clock rate), utilizes the clock VCO built around Q5003.

3.11.3 UHF Range 2 (450-520 MHz) Band

The receiver back-end (see Figure 3-16 on page 3-20) contains the following major components:

- Intermediate frequency (IF) filter
- ABACUS III IC

3.11.3.1 Intermediate Frequency (IF) Filter

The XTL 1500 radio uses two leadless, surface-mount, two-pole, third-overtone, quartz crystal filters (Y5400, Y5401) separated by a 20 dB gain IF amplifier. The filter is centered at 109.65 MHz. This narrow-bandpass filter gives the radio part of its adjacent-channel and alternate-channel rejection performance. Impedance-matching networks are located at the input and output of each crystal. The IF amplifier is made with Q5401. The 10 dB attenuator (U5400) located after the second crystal filter is controlled by the software to limit the signal gain in front of the ABACUS III IC.

3.11.3.2 ABACUS III IC (U5002)

The receiver back-end is designed around the ABACUS III (AD9874 IF digitizing subsystem) IC and its associated circuitry. The AD9874 (Figure 3-20 on page 3-27) is a general-purpose, IF subsystem that digitizes a low-level, 10-300 MHz IF input with a bandwidth up to 270 kHz. The signal chain of the AD9874 consists of a variable gain, low-noise amplifier, a mixer; a bandpass, sigma-delta, A/D converter; and a decimation filter with programmable decimation factor. An automatic gain control (AGC) circuit provides the AD9874 with 12 dB of continuous gain adjustment. The high dynamic range and inherent anti-aliasing provided by the bandpass, sigma-delta converter allow the AD9874 to cope with blocking signals 80 dB stronger than the desired signal. Auxiliary blocks include clock and LO synthesizers, as well as an SPI port. Input signal RXIF is the 109.65 MHz IF from the IF filter.

Components C5002, C5007, and L5002 match the input impedance from 50 ohms (IF Filter terminating impedance) to the ABACUS III IC input IFIN. Formatted SSI (synchronous serial interface) data is output to the Patriot microcontroller IC for DSP processing on ports FS, DOUTA, and CLKOUT. Control logic is sent to the ABACUS III IC from the Patriot microcontroller via the SPI lines (PC, PD, PE).

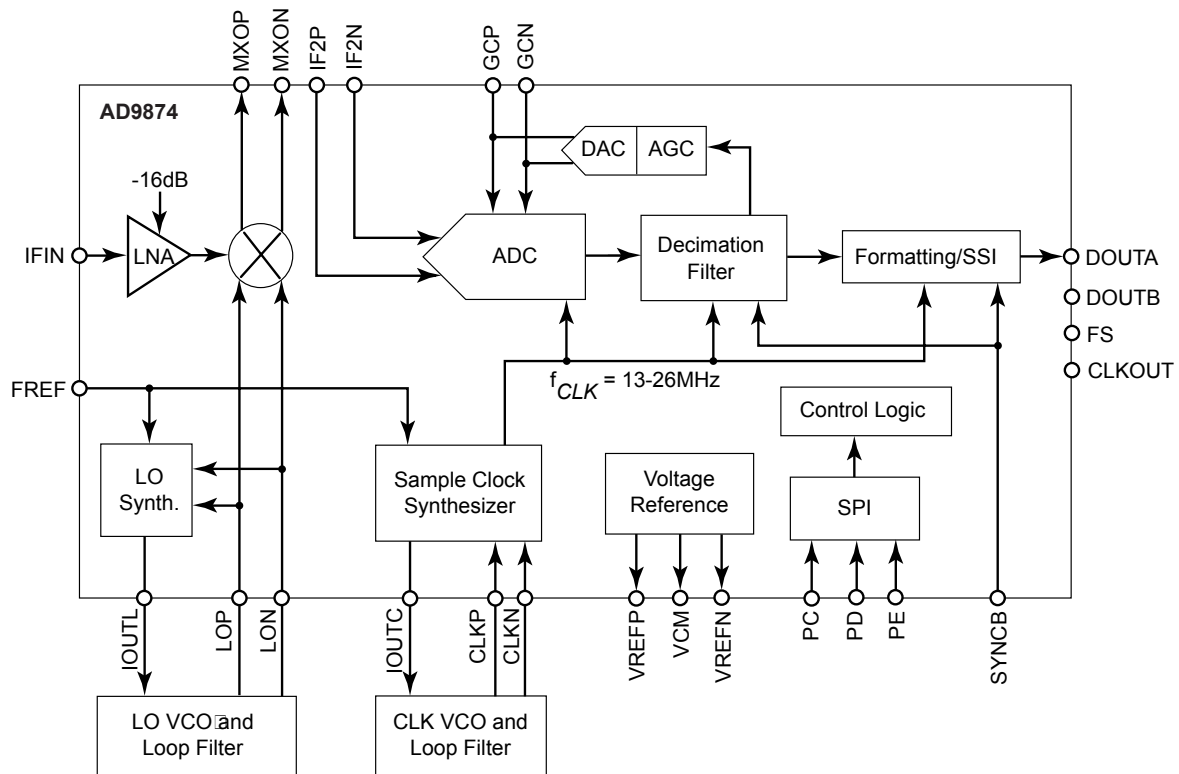


Figure 3-20. ABACUS III (AD9874) IC Functional Block Diagram from Data Sheet (UHF Range 2)

3.11.3.2.1 Second Local Oscillator (LO)

The ABACUS III IC local oscillator (LO) synthesizer controls the second LO. Signal FREF is the 16.8 MHz reference from the frequency generation unit (FGU). The second LO frequency is 107.4 MHz by default, or 111.9 MHz in special cases as necessary to avoid radio self-quieters. The second LO signal mixes with IFIN to produce a 2.25 MHz final IF. The external VCO consists of transistor Q5002, together with its bias and instability network and tank elements. Darlington transistor Q5001 along with C5018 and C5050 form an active DC filter. The 2nd order loop filter is comprised of C5044, C5045, and R5013.

3.11.3.2.2 Sampling Clock Oscillator

The ABACUS III IC sampling clock synthesizer, at $F_{clk}=18$ MHz ($IF2=F_{clk}/8$, where F_{clk} is the clock rate), utilizes the clock VCO built around Q5003.

3.11.4 700–800 MHz Band

The receiver back-end (see Figure 3-17 on page 3-22) contains the following major components:

- Intermediate frequency (IF) filter
- ABACUS III IC

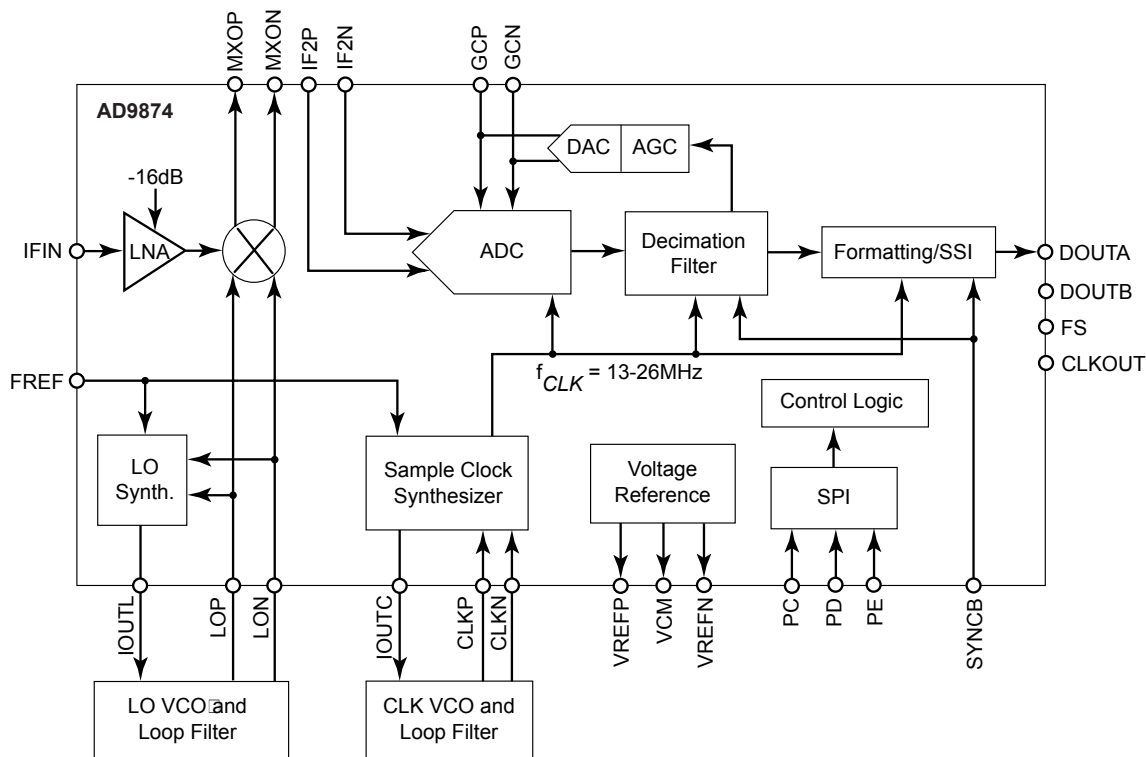
3.11.4.1 Intermediate Frequency (IF) Filter

The XTL 1500 radio uses two leadless, surface-mount, two-pole, third-overtone, quartz crystal filters (B6350, B6351) separated by a 20 dB gain IF amplifier. The filter is centered at 73.35 MHz. This narrow-bandpass filter gives the radio its adjacent-channel and alternate-channel rejection performance. Components L6350, L6351, L6352, L6353, C6351, C6352, C6353, C6355, C6356, and C6357 are used as impedance-matching networks. Components L6355, R6354, R6352, R6353, C6354, and R6350 are used for biasing and stabilizing the transistor Q6350. Component C6358 bypasses the DC supply. L6355 is an RF choke.

3.11.4.2 ABACUS III IC (U6000)

The receiver back-end is designed around the ABACUS III (AD9874 IF digitizing subsystem) IC and its associated circuitry. The AD9874 (Figure 3-21) is a general-purpose, IF subsystem that digitizes a low-level, 10–300 MHz IF input with a bandwidth up to 270 kHz. The signal chain of the AD9874 consists of a variable gain, low-noise amplifier, a mixer; a bandpass, sigma-delta, A/D converter; and a decimation filter with programmable decimation factor. An automatic gain control (AGC) circuit provides the AD9874 with 12 dB of continuous gain adjustment. The high dynamic range and inherent anti-aliasing provided by the bandpass, sigma-delta converter allow the AD9874 to cope with blocking signals 80 dB stronger than the desired signal. Auxiliary blocks include clock and LO synthesizers, as well as an SPI port. Input signal RXIF is the 73.35 MHz IF from the IF filter in the receiver front-end.

Components C6000, C6001, and L6000 match the input impedance from 50 ohms (IF Filter terminating impedance) to the ABACUS III IC input IFIN. Formatted SSI (synchronous serial interface) data is output to the Patriot microcontroller IC for DSP processing on ports FS, DOUTA, and CLKOUT. Control logic is sent to the ABACUS III IC from the Patriot microcontroller via the SPI lines (PC, PD, PE).



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Figure 3-21. ABACUS III (AD9874) IC Functional Block Diagram from Data Sheet (700–800 MHz)

3.11.4.2.1 Second Local Oscillator (LO)

The ABACUS III IC local oscillator (LO) synthesizer controls the second LO. Signal FREF is the 16.8 MHz reference from the frequency generation unit (FGU). The second LO frequency is 75.6 MHz by default, or 71.1 MHz in special cases as necessary to avoid radio self-quieters. The second LO signal mixes with IFIN to produce a 2.25 MHz final IF. The external VCO consists of transistor Q6000, together with its bias and instability network and tank elements. Darlington transistor Q6001 along with C6024 and C6025 form an active DC filter. The 2nd order loop filter is comprised of C6056, C6057, and R6019.

3.11.4.2.2 Sampling Clock Oscillator

The ABACUS III IC sampling clock synthesizer, at $F_{clk}=18$ MHz ($IF2=F_{clk}/8$, where F_{clk} is the clock rate), utilizes a negative-resistance core that is internal to the ABACUS III IC which, when used in conjunction with an external LC tank (made up of L6003 and C6031) and a varactor (D6030), serves as the VCO.

3.12 Transmitter

This section of the theory of operation provides a detailed circuit description of the transmitter, which includes the RF power amplifier (RFPA), output network (ON), and power control.

When reading the theory of operation, refer to the appropriate schematic and component location diagrams located in “Chapter 7. Schematics, Component Location Diagrams, and Parts Lists”. This detailed theory of operation will help isolate the problem to a particular component. However, first use the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual* to troubleshoot the problem to a particular section.

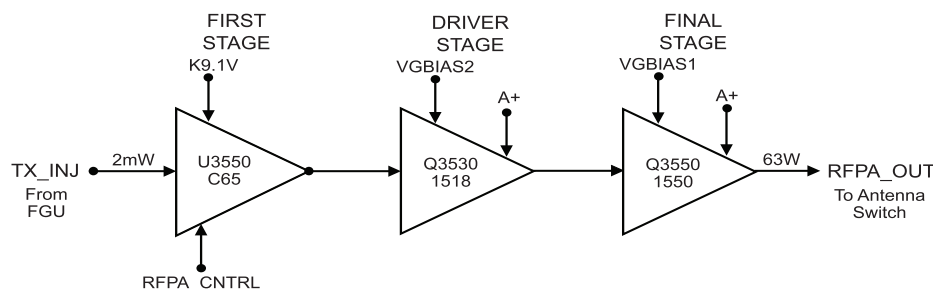
3.12.1 VHF (136-174 MHz) Band

3.12.1.1 50-Watt Transmitter

The following text discusses the 50-W transmitter.

3.12.1.1.1 RF Power Amplifier (RFPA)

The RFPA consists of three gain stages, which are shown in Figure 3-22.



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Figure 3-22. 50-Watt RF Power Amplifier (RFPA) Gain Stages (VHF)

First Stage

The RFPA first stage provides gain that is determined by the control voltage, RFPA_CNTRL. This control voltage is generated in the power control section and is a function of the final-stage output power, temperature, and current, as well as the control and A+ voltage levels. See “3.12.1.3. Power Control” on page 3-31 for a detailed explanation of the power control section.

The 2 mW TX_INJ signal is routed to the U3550 first-stage device (Pin 16, RFIN) via C3500 to an integrated, wide-band input match. U3550 is a two-stage LDMOS device with a bandpass interstage match consisting of C3503, L3502, C3504, R3501 and C3505 routed between VD1 (pin 14) and G2 (pin 11). L3501 and L3503 provide the K9.1V drain bias voltage for the first and second stages to VD1 (pin 14) and RFOUT1/2 (pins 6 and 7), respectively. The RFPA_CNTRL gate bias is provided to both stages internally via VCNTRL (pin 1). Both U3550 stages are operated Class A.

Driver Stage

C3521, L3520, C3520, and a transmission line form a low-pass, interstage match that transfers power to the Q3530 LDMOS transistor. R3520-3 provide device stability, and R3524 and C3522 supply the VGBIAS2 gate bias. L3530-1, R3530-1, C3530, C3531, C3536 and C3537 form the A+ drain bias circuit. Q3530 is operated Class AB.

Final Stage

C3532-4, and transmission lines form a bandpass. R3532-8 provide stability for Q3550. R3540 and C3535 supply the VGBIAS1 gate bias to Q3550. L3549-51, C3548-51, and R3551 form the A+ drain bias circuit.

C3552-9 and transmission lines form a low-pass. Q3550 operate Class AB.

R3550, R3560, C3563, and U3561 comprise the final-stage, current-sense circuit that generates the VCURRENT voltage proportional to the final stage current. R3560 sets the circuit gain. U3560 generates the VTEMP voltage, which is proportional to the final-stage temperature.

3.12.1.2 Output Network (ON)

The ON consists of the antenna switch, harmonic filter, and power detector (see Figure 3-23).

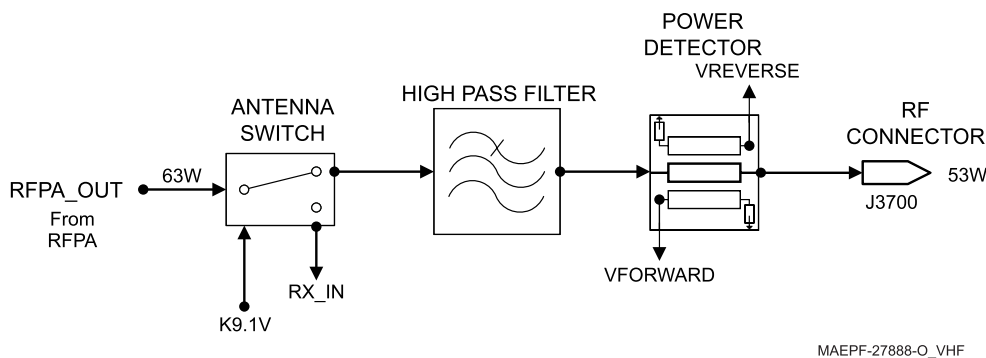


Figure 3-23. Output Network Components (VHF)

Antenna Switch

The antenna switch functions in two modes, which are determined by the presence of K9.1V. The K9.1V switch bias is applied via L3700, L3731-2, and C3702. When K9.1V is present, the switch is in TX mode. D3701-2 and D3704 are forward biased forming a low-loss path from the RFPA final stage to the harmonic filter and a 60 dB isolation path between the RFPA final stage and the RX front-end. Isolation is achieved via a quarter-wave transmission line between D3701 and D3702. D3701-4 serves as an ESD protection circuit against ESD discharge on the antenna connector.

When K9.1V is absent, the switch is in RX mode. D3701 and D3702 are reverse biased forming a low-loss path from the harmonic filter to the RX front-end and a 60 dB isolation path from the harmonic filter to the RFPA final stage. Isolation is achieved via the D3701 off resistance.

Harmonic Filter

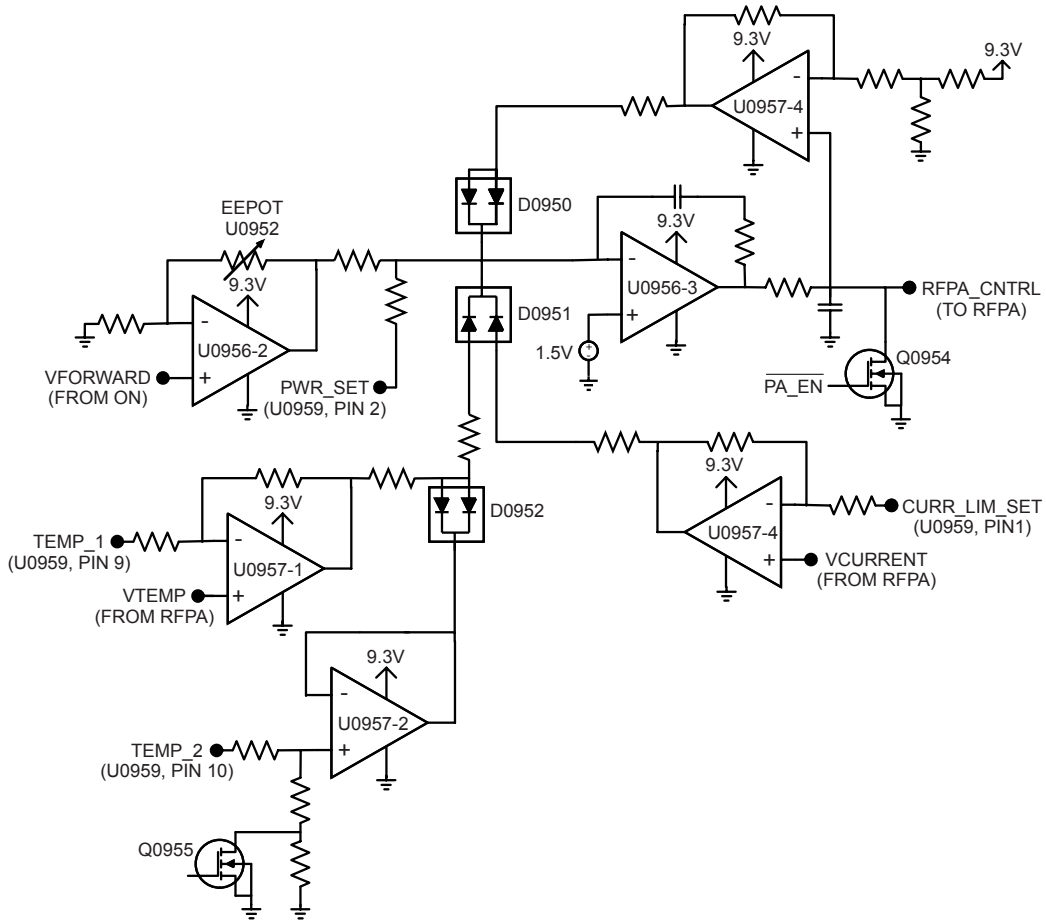
L3720-7, C3720-3, form the twelve-element, low-pass harmonic filter. The filter attenuates harmonics generated by the RFPA when the antenna switch is in TX mode and provides extra selectivity when the antenna switch is in RX mode.

Power Detector

The power detector consists of two asymmetric, coupled transmission lines and detection circuitry that detects forward and reverse power. C3730-1, D3730, L3730, R3730-3, and R3735-6 form the forward-power detector (VFORWARD), which is used for power leveling. C3732-3, D3731, L3731, R3737-9, and R3733-4 form the reverse-power detector (VREVERSE). L3737 provides an electrostatic discharge path to protect the RFPA final stage device.

3.12.1.3 Power Control

The power control section is comprised of a control loop to level forward power and protection mechanisms to reduce power to a safe level for the given environmental conditions (see Figure 3-24).



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Figure 3-24. Power Control Components (VHF)

Power Control Loop

VFORWARD from the ON is buffered via the non-inverting, variable-gain stage U0956-2 whose gain is set by EPOT U0952. The proper gain is determined during power-detection calibration tuning. Buffered VFORWARD (U0956-2, Pin 7) is added to PWR_SET via R0971, R0972, and R0947 and then compared to a reference determined by R0974 and R0975. PWR_SET is supplied by the digital-to-analog converter (DAC) U0959, Pin 2. Comparator stage U0956-3 increases or decreases RFPA_CNTRL so that the voltage at U0956-3, Pin 9 in the same at the reference voltage at U0956-3, Pin 10. When the PWR_SET voltage is decreased, U0956-3 increases RFPA_CNTRL to increase VFORWARD which is proportional to forward power thus increasing the power level. When the PWR_SET voltage is increased, U0956-3 decreases RFPA_CNTRL to decrease VFORWARD, thus decreasing the power level. The microprocessor initiates the loop through U0958-1 and Q0954. Loop timing is set via software together with R0977, and C0973.

Protection Mechanisms

Final-stage temperature is sensed in the RFPA resulting in VTEMP, which is proportional to temperature. VTEMP is compared against a reference voltage TEMP_1 (U0959, pin 9) via U0957-1. When VTEMP exceeds TEMP_1, the U0957-1, pin 1, voltage increases and forward biases one of the D0951 diodes, which cuts back power. Power continues to cut back with rising temperature until the voltage level at the junction of R0978 and R0983 is high enough to forward bias D0952, thus clamping the cut back so that the radio meets its duty cycle specification while providing protection against high-temperature conditions. The clamping level is set via TEMP_2 (U0959, pin 10) and U0957-2. U0957-3 is used to sense if a high A+ battery voltage condition exists and, if it does, the Q0955 gate is biased on, which increases the clamp voltage allowing for additional power cutback for a high A+, high temperature condition.

Final-stage current is also monitored via VCURRENT, which is proportional to current. VCURRENT is compared against a reference CURR_LIM_SET (U0959, pin 1) which is tuned after power characterization. If VCURRENT exceeds CURR_LIM_SET, then U0957-4, pin 14, voltage rises and forward biases one of the D0951 diodes, which limits power.

Finally, control voltage is limited by U0956-4 and D0950. RFPA_CNTRL can rise to the control voltage limit set by R0942-4.

3.12.2 UHF Range 1 (380-470 MHz) Band

3.12.2.1 40-Watt Transmitter

The following text discusses the 40-W transmitter.

3.12.2.1.1 RF Power Amplifier (RFPA)

The RFPA consists of three gain stages, which are shown in Figure 3-25.

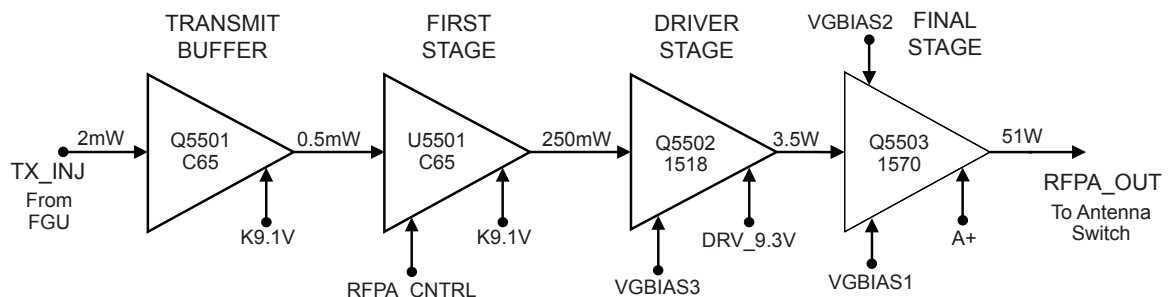


Figure 3-25. 40-Watt RF Power Amplifier (RFPA) Gain Stages (UHF Range 1)

First Stage

The RFPA first stage provides gain that is determined by the control voltage, RFPA_CNTRL. This control voltage is generated in the power control section and is a function of the final-stage output power, temperature, and current, as well as the control and A+ voltage levels. See “3.12.2.3. Power Control” on page 3-35 for a detailed explanation of the power control section.

The 0.5 mW TX_INJ signal is routed to the U5501 first stage device (Pin 16, RFIN) via C5508 to an integrated, wide-band input match. U5501 is a two-stage LDMOS device with a bandpass interstage match consisting of L5503, C5507, and C5509 routed between VD1 (pin 14) and G2 (pin 11). L5502 and L5505 provide the K9.1V drain bias voltage for the first and second stages to VD1 (pin 14) and RFOUT1/2 (pins 6 and 7), respectively. The RFPA_CNTRL gate bias is provided to both stages internally via VCNTRL (pin 1). Both U5501 stages are operated Class A and the second-stage output power is approximately 250 mW.

Driver Stage

C5566, C5516, C5518 and a transmission line form a low-pass, interstage match that transfers power to the Q5502 LDMOS transistor. R5511-R5515 provide device stability, and R5527, C5556, C5525 and R5516 supply the VGBIAS3 gate bias. L5508, C5527, R5517, E5501 and C5526 form the 9.3 V drain bias circuit. The 9.3 V drain voltage is supplied from regulator U5570 via R5574. The 9.3 V supply to the driver is only present during transmit and is disabled during receive via the K9.1V signal and Q5570. Q5502 is operated Class AB and its output power is approximately 3.5 W.

Final Stage

C5559, C5560, C5535, C5538, and transmission lines form a low pass, splitter match that transfers power to the LDMOS final-stage transistor Q5503. Q5503 contains two transistors in a single package, each with its own gate and drain lead. R5530, R5533, R5534 and R5536 provide stability for Q5503. R5525, C5557, C5539 and R5520 supply the VGBIAS1 gate bias to Q5503-7. R5526, C5558, C5540 and R5521 supply the VGBIAS2 gate bias to Q5503-6. L5510, C5549, R5523, E5502 and C5550 form the A+ drain bias circuit to Q5503-2 and Q5503-3. C5542-43, C5545-46, C5547-48, C5551-53 and transmission lines form a low-pass combiner match that transfers approximately 51 W to the antenna switch. R5535 provides stability for Q5503. Q5503 operates Class AB.

R5522 and U5503 comprise the final-stage, current-sense circuit that generates the VCURRENT voltage proportional to the final stage current. R5519 sets the circuit gain. U5502 generates the VTEMP voltage, which is proportional to the final-stage temperature.

3.12.2.2 Output Network (ON)

The ON consists of the antenna switch, harmonic filter, and power detector (see Figure 3-26).

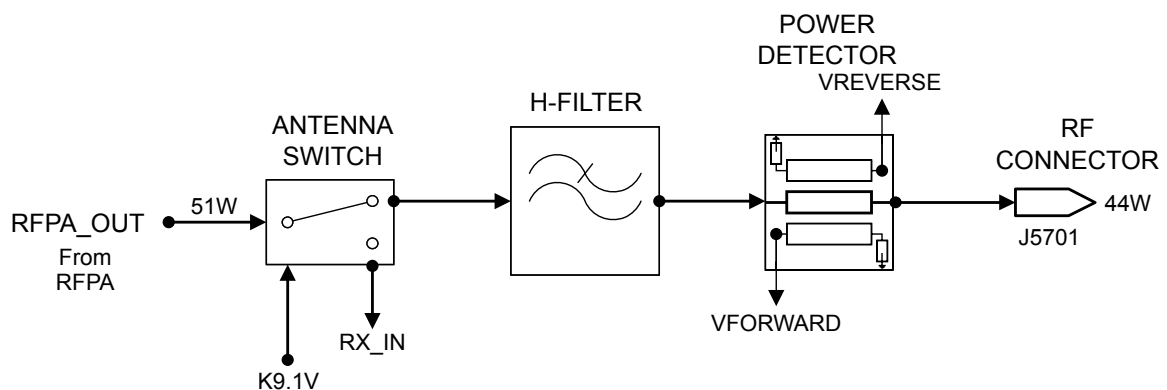


Figure 3-26. Output Network Components (UHF Range 1)

Antenna Switch

The antenna switch functions in two modes determined by the presence of K9.1V. The K9.1V switch bias is applied via L5701 and C5702. When K9.1V is present, the switch is in TX mode. D5701, D5702 and D5703 are forward biased forming a low-loss path from the RFPA final stage to the harmonic filter and a 20 dB isolation path between the RFPA final stage and the RX front-end. Isolation is achieved via a quarter-wave transmission lines between D5701 - D5702 and between D5702 - D5703. C5709-10 resonates out the D5702-3 on inductance improving the isolation. When K9.1V is absent, the switch is in RX mode. D5701, D5702 and D5703 are reverse biased forming a low-loss path from the harmonic filter to the RX front-end and a 20 dB isolation path from the harmonic filter to the RFPA final stage. Isolation is achieved via the D5701 off resistance. L5702 resonates out the D5701 off capacitance improving the isolation.

Harmonic Filter

The harmonic filter is a 7-element, equal-L Zolotarev quasi-lowpass filter consisting of C5712 and C5713, C5719 thru C5721 and L5706 thru L5708. L5712, C5711 and L5713, C5714 form two shunt zeros for extra attenuation at the second harmonic. C5708 acts as a DC block between the filter and the antenna switch. The filter provides approximately 60 dB of harmonic rejection. The harmonic filter together with the antenna switch provides approximately 0.7 dB insertion loss between the transmitter power amplifier and the antenna.

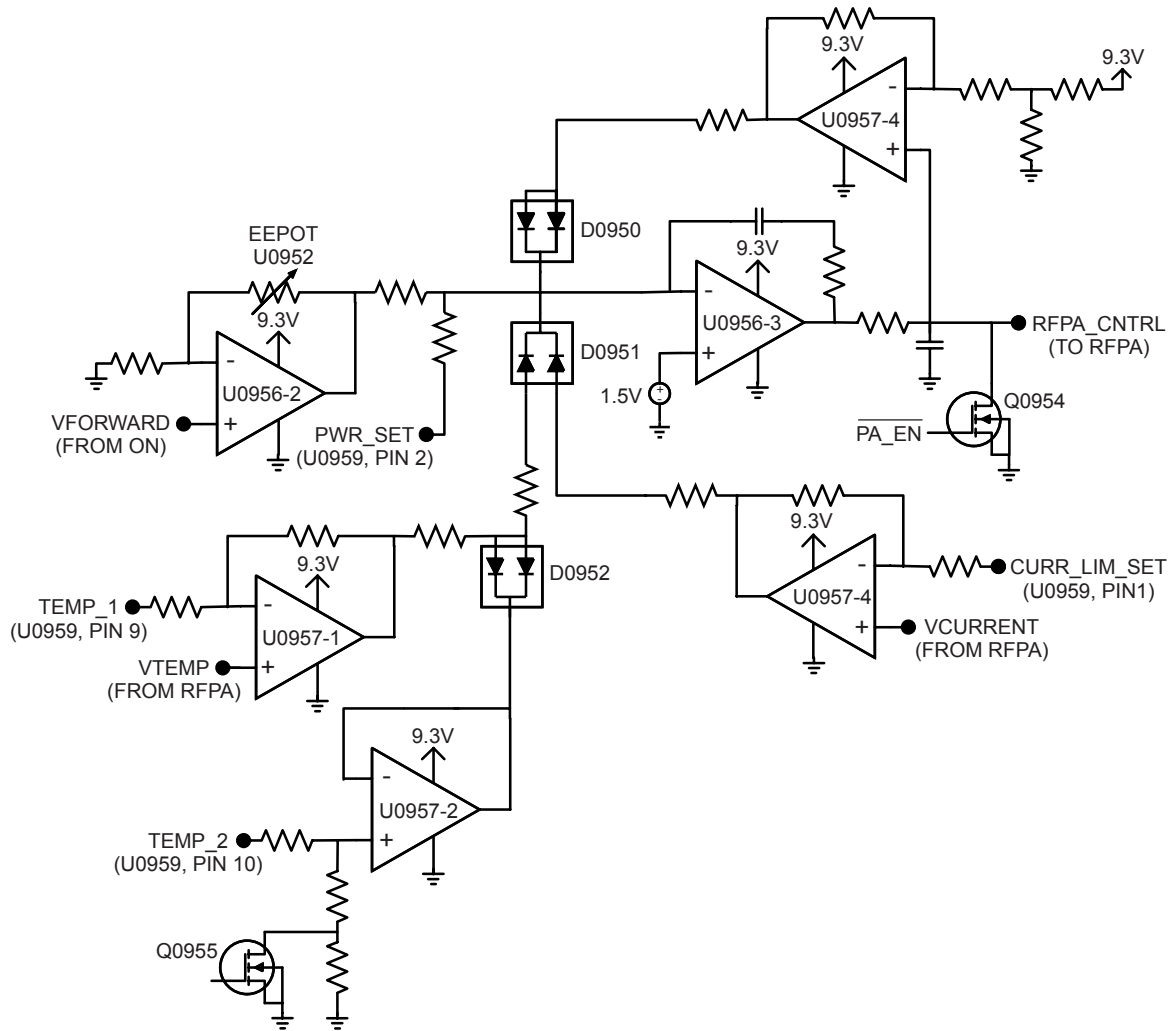
Power Detector

The power detector consists of a main microstrip transmission line that transfers power from the harmonic filter to the antenna and two parallel lines that are used to detect the forward and reverse power. The forward power detection line is terminated via R5707 and R5708. RF energy coupled onto this line is rectified and filtered via D5704 and C5715 to provide a DC voltage to the power control circuitry that is proportional to the forward transmitted power level. The detected forward voltage is approximately 1.5 Vdc when the radio is putting out 44 watts. Thermister R5704 compensates for temperature changes in D5704 to maintain constant DC voltage versus detected forward power over temperature.

The reverse power detection line is terminated via R5705-06. RF energy coupled onto this line is rectified and filtered via D5705 and C5718 to provide a DC voltage to the power control circuitry that is proportional to the reverse power level reflected back from the antenna. Thermister R5712 compensates for temperature changes in D5705 to maintain constant DC voltage versus detected reverse power over temperature.

3.12.2.3 Power Control

The power control section is comprised of a control loop to level forward power, and protection mechanisms to reduce power to a safe level for the given environmental conditions (see Figure 3-27 on page 3-36).



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Figure 3-27. Power Control Components (UHF Range 1)

Power Control Loop

VFORWARD from the ON is buffered via the non-inverting, variable-gain stage U0956-2 whose gain is set by EPOT U0952. The proper gain is determined during power-detection calibration tuning. Buffered VFORWARD (U0956-2, Pin 7) is added to PWR_SET via R0971 and R0972 and then compared to a reference determined by R0974 and R0975. PWR_SET is supplied by the digital-to-analog converter (DAC) U0959, Pin 2. Comparator stage U0956-3 increases or decreases RFFPA_CNTRL so that the voltage at U0956-3, Pin 9 in the same at the reference voltage at U0956-3, Pin 10. When the PWR_SET voltage is decreased, U0956-3 increases RFFPA_CNTRL to increase VFORWARD which is proportional to forward power thus increasing the power level. When the PWR_SET voltage is increased, U0956-3 decreases RFFPA_CNTRL to decrease VFORWARD, thus decreasing the power level. The microprocessor initiates the loop through U0958-1 and Q0954. Loop timing is set via software together with R0977 and C0973.

Protection Mechanisms

Final-stage temperature is sensed in the RFPA resulting in VTEMP, which is proportional to temperature. VTEMP is compared against a reference voltage TEMP_1 (U0959, pin 9) via U0957-1. When VTEMP exceeds TEMP_1, the U0957-1, pin 1, voltage increases and forward biases one of the D0951 diodes, which cuts back power. Power continues to cut back with rising temperature until the voltage level at the junction of R0978 and R0983 is high enough to forward bias D0952, thus clamping the cut back so that the radio meets its duty cycle specification while providing protection against high-temperature conditions. The clamping level is set via TEMP_2 (U0959, pin 10) and U0957-2. U0957-3 is used to sense if a high A+ battery voltage condition exists and, if it does, the Q0955 gate is biased on, which increases the clamp voltage allowing for additional power cutback for a high A+, high temperature condition.

Final-stage current is also monitored via VCURRENT, which is proportional to current. VCURRENT is compared against a reference CURR_LIM_SET (U0959, pin 1) which is tuned after power characterization. If VCURRENT exceeds CURR_LIM_SET, then U0957-4, pin 14, voltage rises and forward biases one of the D0951 diodes, which limits power.

Finally, control voltage is limited by U0956-4 and D0950. RFPA_CNTRL can rise to the control voltage limit set by R0942-4. U0965 provides protection against supply voltage transients. When transients on the A+ voltage exceed 24 volts U0965 pin 1 is pulled high thus turning on Q0954 via TX_DISABLE, R0932, U0958 disabling the control voltage to the PA first stage and momentarily turning off the transmitter. In addition, Q0900 is turned on, forward biasing one of the D0950 diodes and thus reducing the control voltage. When the voltage transient drops back below 20 volts, U0965 pin 1 goes low thus enabling the control loop and turning the transmitter on again.

3.12.3 UHF Range 2 (450-520 MHz) Band

3.12.3.1 45-Watt Transmitter

The following text discusses the 45-W transmitter.

3.12.3.1.1 RF Power Amplifier (RFPA)

The RFPA consists of three gain stages, which are shown in Figure 3-28.

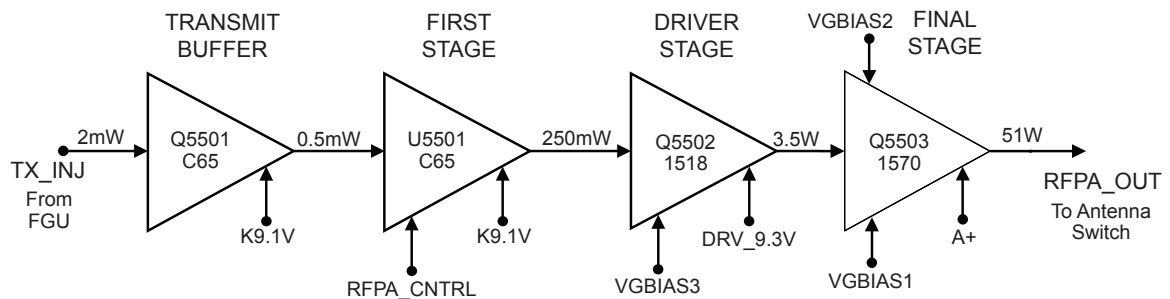


Figure 3-28. 45-Watt RF Power Amplifier (RFPA) Gain Stages (UHF Range 2)

First Stage

The RFPA first stage provides gain that is determined by the control voltage, RFPA_CNTRL. This control voltage is generated in the power control section and is a function of the final-stage output power, temperature, and current, as well as the control and A+ voltage levels. See “3.12.3.1.3. Power Control” on page 3-39 for a detailed explanation of the power control section.

The 0.5 mW TX_INJ signal is routed to the U5501 first stage device (Pin 16, RFIN) via C5508 to an integrated, wide-band input match. U5501 is a two-stage LDMOS device with a bandpass interstage match consisting of L5503, C5507, and C5509 routed between VD1 (pin 14) and G2 (pin 11). L5502 and L5505 provide the K9.1V drain bias voltage for the first and second stages to VD1 (pin 14) and RFOUT1/2 (pins 6 and 7), respectively. The RFPA_CNTRL gate bias is provided to both stages internally via VCNTRL (pin 1). Both U5501 stages are operated Class A and the second-stage output power is approximately 250 mW.

Driver Stage

C5566, C5516, C5518 and a transmission line form a low-pass, interstage match that transfers power to the Q5502 LDMOS transistor. R5511-R5515 provide device stability, and R5527, C5556, C5525 and R5516 supply the VGBIAS3 gate bias. L5508, C5527, R5517, E5501 and C5526 form the 9.3 V drain bias circuit. The 9.3 V drain voltage is supplied from regulator U5570. The 9.3 V supply to the driver is only present during transmit and is disabled during receive via the K9.1V signal and Q5570. Q5502 is operated Class AB and its output power is approximately 3.5 W.

Final Stage

C5559, C5560, C5535, C5538, and transmission lines form a low pass, splitter match that transfers power to the LDMOS final-stage transistor Q5503. Q5503 contains two transistors in a single package, each with it's own gate and drain lead. R5530, R5533, R5534, R5536, R5538-R5545 provide stability for Q5503. R5525, C5557, C5539 and R5520 supply the VGBIAS1 gate bias to Q5503-7 via U5504-2 pin7. R5526, C5558, C5540 and R5521 supply the VGBIAS2 gate bias to Q5503-6 via U5504-1 pin 1. Gate bias voltage to the final is adjusted dependant on the temperature of Q5503. The output voltage from the temperature sensing IC, U5502-2, is summed via R5550 and R5555 respectively with the gate bias voltage VGBIAS1 and VGBIAS2, via R5549 and R5554 respectively. As the temperature of the final device decreases the bias voltage applied to the gates of U5503 is reduced. L5510, C5549, R5523, E5502 and C5550 form the A+ drain bias circuit to Q5503-2 and Q5503-3. C5542-43, C5545-46, C5548, C5551-53 and transmission lines form a low -pass combiner match that transfers approximately 51 W to the antenna switch. R5535 provides stability for Q5503. Q5503 operates Class AB.

R5522 and U5503 comprise the final-stage, current-sense circuit that generates the VCURRENT voltage proportional to the final stage current. R5519 sets the circuit gain. U5502 generates the VTEMP voltage, which is proportional to the final-stage temperature.

3.12.3.1.2 Output Network (ON)

The ON consists of the antenna switch, harmonic filter, and power detector (see Figure 3-29).

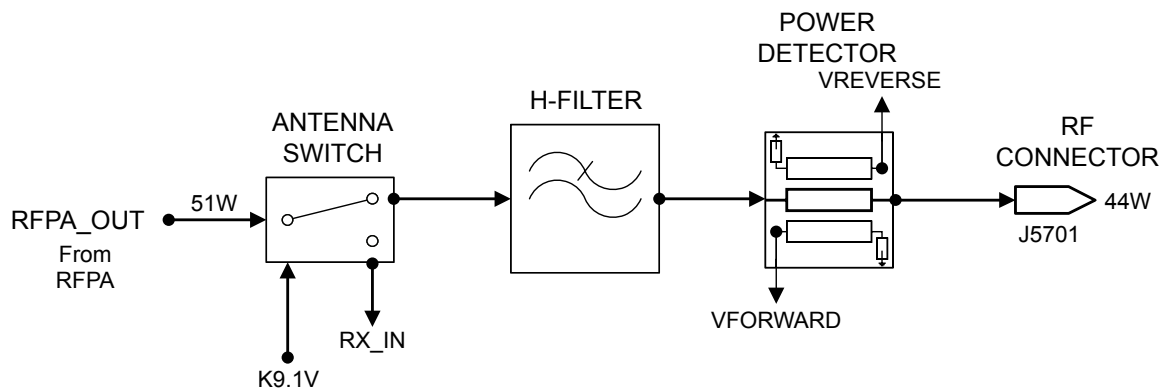


Figure 3-29. Output Network Components (UHF Range 2)

Antenna Switch

The antenna switch functions in two modes determined by the presence of K9.1V. The K9.1V switch bias is applied via L5701 and C5702. When K9.1V is present, the switch is in TX mode. D5701, D5702 and D5703 are forward biased forming a low-loss path from the RFPA final stage to the harmonic filter and a 20 dB isolation path between the RFPA final stage and the RX front-end. Isolation is achieved via a quarter-wave transmission lines between D5701 - D5702 and between D5702 - D5703. C5709-10 resonates out the D5702-3 on inductance improving the isolation. When K9.1V is absent, the switch is in RX mode. D5701, D5702 and D5703 are reverse biased forming a low-loss path from the harmonic filter to the RX front-end and a 20 dB isolation path from the harmonic filter to the RFPA final stage. Isolation is achieved via the D5701 off resistance. L5702 resonates out the D5701 off capacitance improving the isolation.

Harmonic Filter

The harmonic filter is a 7-element, equal-L Zolotarev quasi-lowpass filter consisting of C5712 and C5713, C5719 thru C5721 and L5706 thru L5708. L5712, C5711 and L5713, C5714 form two shunt zeros for extra attenuation at the second harmonic. C5708 acts as a DC block between the filter and the antenna switch. The filter provides approximately 60 dB of harmonic rejection. The harmonic filter together with the antenna switch provides approximately 0.7 dB insertion loss between the transmitter power amplifier and the antenna.

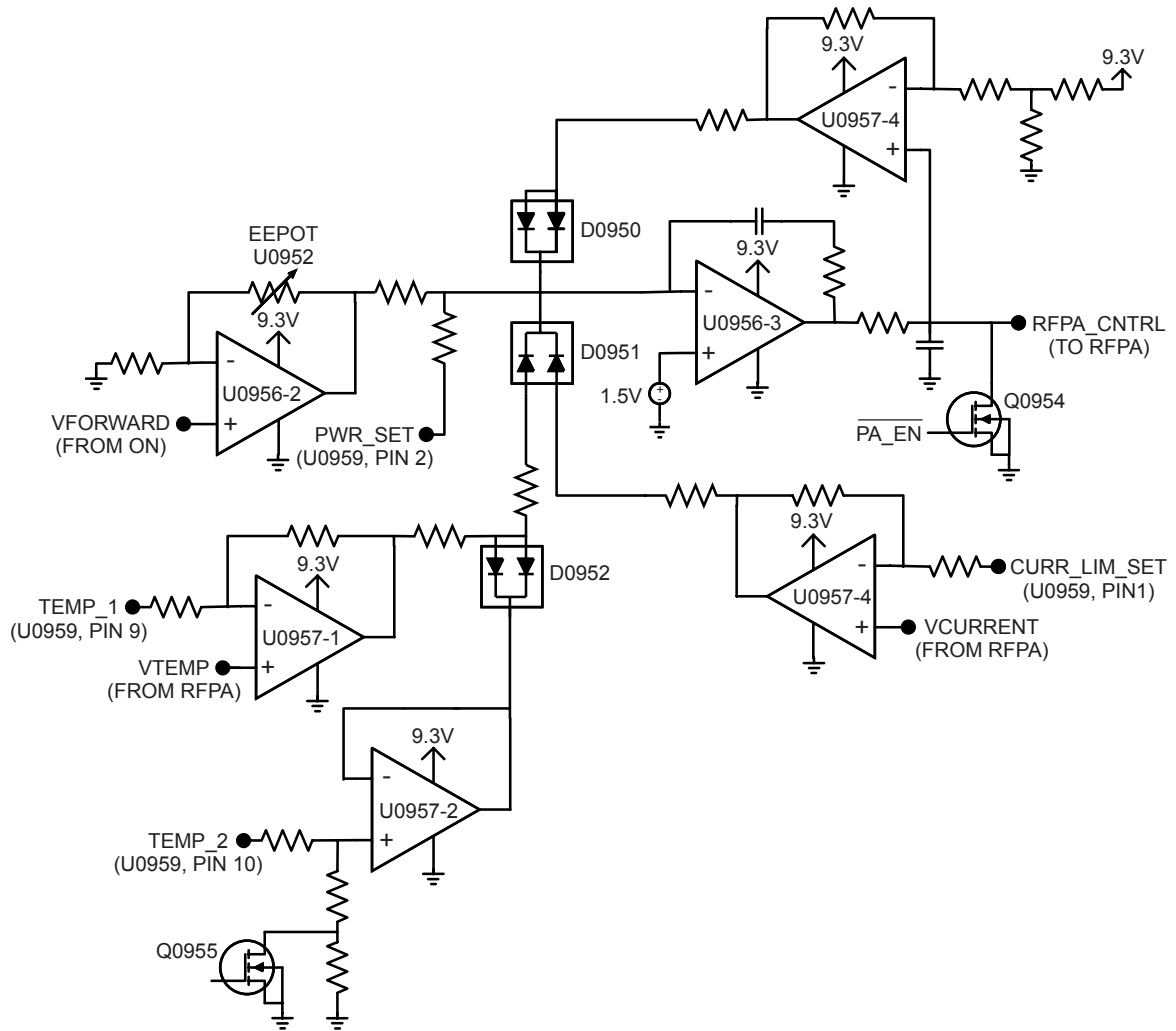
Power Detector

The power detector consists of a main microstrip transmission line that transfers power from the harmonic filter to the antenna and two parallel lines that are used to detect the forward and reverse power. The forward power detection line is terminated via R5707 and R5708. RF energy coupled onto this line is rectified and filtered via D5704 and C5715 to provide a DC voltage to the power control circuitry that is proportional to the forward transmitted power level. The detected forward voltage is approximately 1.5 Vdc when the radio is putting out 44 watts. Thermister R5704 compensates for temperature changes in D5704 to maintain constant DC voltage versus detected forward power over temperature.

The reverse power detection line is terminated via R5705-06. RF energy coupled onto this line is rectified and filtered via D5705 and C5718 to provide a DC voltage to the power control circuitry that is proportional to the reverse power level reflected back from the antenna. Thermister R5712 compensates for temperature changes in D5705 to maintain constant DC voltage versus detected reverse power over temperature.

3.12.3.1.3 Power Control

The power control section is comprised of a control loop to level forward power, and protection mechanisms to reduce power to a safe level for the given environmental conditions (see Figure 3-30 on page 3-40).



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Figure 3-30. Power Control Components (UHF Range 2)

Power Control Loop

VFORWARD from the ON is buffered via the non-inverting, variable-gain stage U0956-2 whose gain is set by EPOT U0952. The proper gain is determined during power-detection calibration tuning. Buffered VFORWARD (U0956-2, Pin 7) is added to PWR_SET via R0971 and R0972 and then compared to a reference determined by R0974 and R0975. PWR_SET is supplied by the digital-to-analog converter (DAC) U0959, Pin 2. Comparator stage U0956-3 increases or decreases RFFPA_CNTRL so that the voltage at U0956-3, Pin 9 in the same at the reference voltage at U0956-3, Pin 10. When the PWR_SET voltage is decreased, U0956-3 increases RFFPA_CNTRL to increase VFORWARD which is proportional to forward power thus increasing the power level. When the PWR_SET voltage is increased, U0956-3 decreases RFFPA_CNTRL to decrease VFORWARD, thus decreasing the power level. The microprocessor initiates the loop through U0958-1 and Q0954. Loop timing is set via software together with R0977 and C0973.

Protection Mechanisms

Final-stage temperature is sensed in the RFPA resulting in VTEMP, which is proportional to temperature. VTEMP is compared against a reference voltage TEMP_1 (U0959, pin 9) via U0957-1. When VTEMP exceeds TEMP_1, the U0957-1, pin 1, voltage increases and forward biases one of the D0951 diodes, which cuts back power. Power continues to cut back with rising temperature until the voltage level at the junction of R0978 and R0983 is high enough to forward bias D0952, thus clamping the cut back so that the radio meets its duty cycle specification while providing protection against high-temperature conditions. The clamping level is set via TEMP_2 (U0959, pin 10) and U0957-2. U0957-3 is used to sense if a high A+ battery voltage condition exists and, if it does, the Q0955 gate is biased on, which increases the clamp voltage allowing for additional power cutback for a high A+, high temperature condition.

Final-stage current is also monitored via VCURRENT, which is proportional to current. VCURRENT is compared against a reference CURR_LIM_SET (U0959, pin 1) which is tuned after power characterization. If VCURRENT exceeds CURR_LIM_SET, then U0957-4, pin 14, voltage rises and forward biases one of the D0951 diodes, which limits power.

Finally, control voltage is limited by U0956-4 and D0950. RFPA_CNTRL can rise to the control voltage limit set by R0942-4. U0965 provides protection against supply voltage transients. When transients on the A+ voltage exceed 24 volts U0965 pin 1 is pulled high thus turning on Q0954 via TX_DISABLE, R0932, U0958 disabling the control voltage to the PA first stage and momentarily turning off the transmitter. In addition, Q0900 is turned on, forward biasing one of the D0950 diodes and thus reducing the control voltage. When the voltage transient drops back below 20 volts, U0965 pin 1 goes low thus enabling the control loop and turning the transmitter on again.

3.12.4 700–800 MHz Band

3.12.4.1 35-Watt Transmitter

The following text discusses the 35-W transmitter.

3.12.4.1.1 RF Power Amplifier (RFPA)

The RFPA consists of three gain stages, which are shown in Figure 3-31.

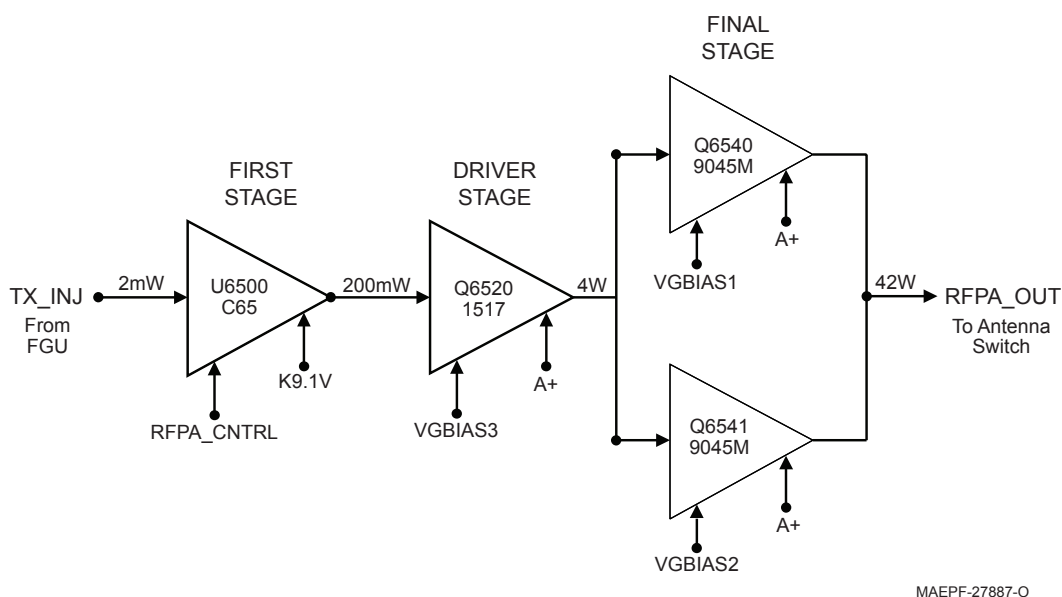


Figure 3-31. 35-Watt RF Power Amplifier (RFPA) Gain Stages (700–800 MHz)

First Stage

The RFPA first stage provides gain that is determined by the control voltage, RFPA_CNTRL. This control voltage is generated in the power control section and is a function of the final-stage output power, temperature, and current, as well as the control and A+ voltage levels. See “3.12.4.1.3. Power Control” on page 3-43 for a detailed explanation of the power control section.

The 2 mW TX_INJ signal is routed to the U6500 first-stage device (Pin 16, RFIN) via C6501 to an integrated, wide-band input match. U6500 is a two-stage LDMOS device with a bandpass interstage match consisting of L6502, C6506, and C6503 routed between VD1 (pin 14) and G2 (pin 11). L6501 and L6500 provide the K9.1V drain bias voltage for the first and second stages to VD1 (pin 14) and RFOUT1/2 (pins 6 and 7), respectively. The RFPA_CNTRL gate bias is provided to both stages internally via VCNTRL (pin 1). Both U6500 stages are operated Class A, and the second-stage output power is approximately 200 mW.

Driver Stage

C6502, C6509, C6510, C6511, and a transmission line form a low-pass, interstage match that transfers power to the Q6520 LDMOS transistor. R6521-5 provide device stability, and R6520 and C6500 supply the VGBIAS1 gate bias. L6521-2, R6526-7, and C6521-5 form the A+ drain bias circuit. Q6520 is operated Class AB, and its output power is approximately 4 W.

Final Stage

C6541-2, C6544-5, C6547-8, and transmission lines form a bandpass, splitter match that transfers power to the LDMOS final-stage transistors Q6540 and Q6541. R6550-3, R6554-7, C6565-6, and R6559-60 provide stability for Q6540 and Q6541, respectively. R6540 and C6540 supply the VGBIAS1 gate bias to Q6540. R6543 and C6558 supply the VGBIAS2 gate bias to Q6541. L6542-3, C6559-60, and R6544 form the A+ drain bias circuit.

C6549-57 and transmission lines form a low-pass, combiner match that transfers approximately 42 W to the antenna switch. Both Q6540 and Q6541 operate Class AB.

R6545-6, C6564, and U6541 comprise the final-stage, current-sense circuit that generates the VCURRENT voltage proportional to the final stage current. R6546 sets the circuit gain. U6540 generates the VTEMP voltage, which is proportional to the final-stage temperature.

3.12.4.1.2 Output Network (ON)

The ON consists of the antenna switch, harmonic filter, and power detector (see Figure 3-32).

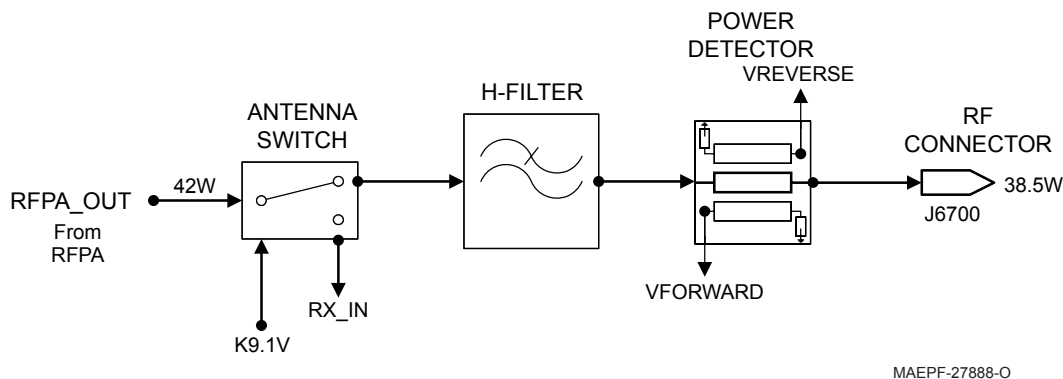


Figure 3-32. Output Network Components (700–800 MHz)

Antenna Switch

The antenna switch functions in two modes, which are determined by the presence of K9.1V. The K9.1V switch bias is applied via L6700, L6702, and C6700. When K9.1V is present, the switch is in TX mode. D6701 and D6702 are forward biased forming a low-loss path from the RFPA final stage to the harmonic filter and a 20 dB isolation path between the RFPA final stage and the RX front-end. Isolation is achieved via a quarter-wave transmission line between D6701 and D6702. C6703 resonates out the D6702 on inductance improving the isolation.

When K9.1V is absent, the switch is in RX mode. D6701 and D6702 are reverse biased forming a low-loss path from the harmonic filter to the RX front-end and a 20 dB isolation path from the harmonic filter to the RFPA final stage. Isolation is achieved via the D6701 off resistance. L6703 resonates out the D6701 off capacitance improving the isolation.

Harmonic Filter

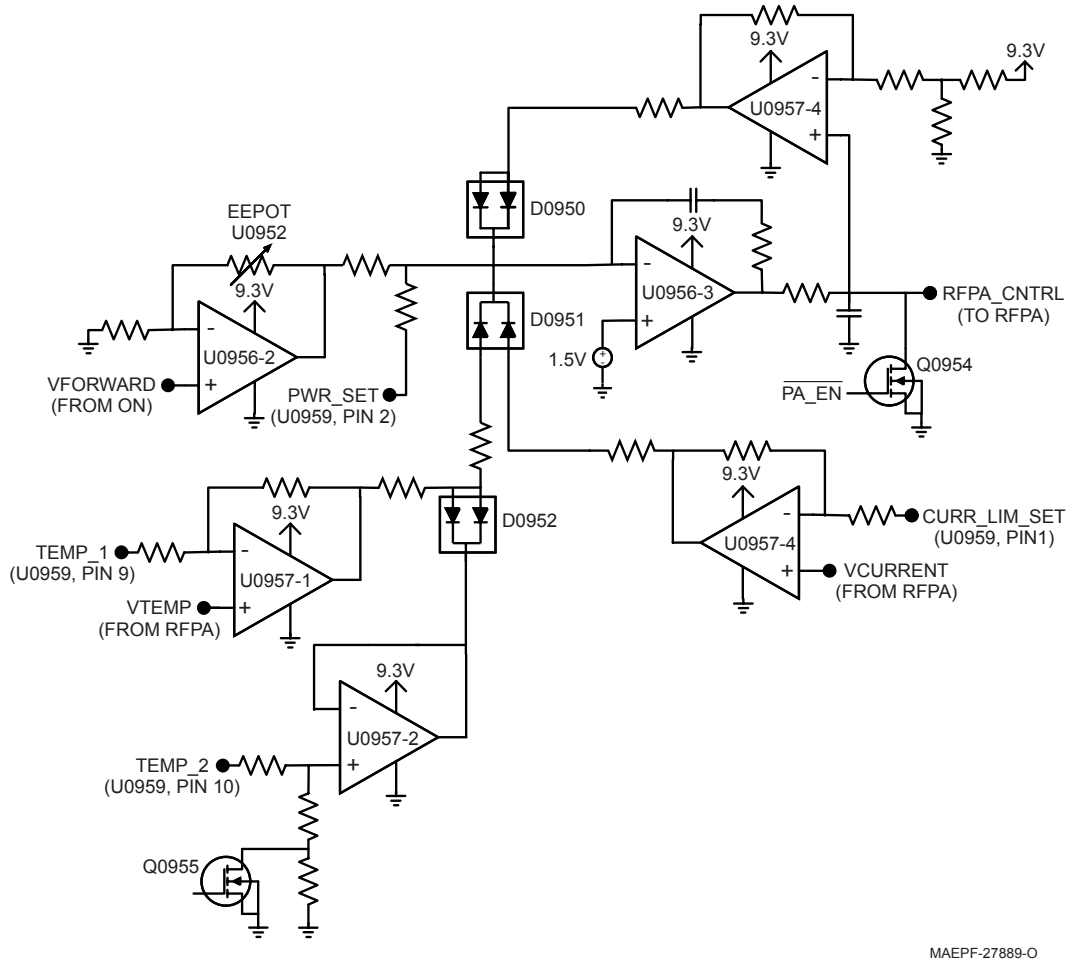
L6720-2, C6720-1, and two open-stub transmission lines form the seven-element, low-pass harmonic filter. The filter attenuates harmonics generated by the RFPA when the antenna switch is in TX mode and provides extra selectivity when the antenna switch is in RX mode.

Power Detector

The power detector consists of two asymmetric, coupled transmission lines and detection circuitry that detects forward and reverse power. C6730-1, D6730, L6730, R6730-3, and R6735-6 form the forward-power detector (VFORWARD), which is used for power leveling. C6732-3, D6731, L6731, R6737-9, and R6733-4 form the reverse-power detector (VREVERSE). C6734-5 provides additional harmonic attenuation. R6740 provides an electrostatic discharge path to protect the RFPA final stage device.

3.12.4.1.3 Power Control

The power control section is comprised of a control loop to level forward power, and protection mechanisms to reduce power to a safe level for the given environmental conditions (see Figure 3-33 on page 3-44).



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Figure 3-33. Power Control Components (700–800 MHz)

Power Control Loop

VFORWARD from the ON is buffered via the non-inverting, variable-gain stage U0956-2 whose gain is set by EPOT U0952. The proper gain is determined during power-detection calibration tuning. Buffered VFORWARD (U0956-2, Pin 7) is added to PWR_SET via R0971 and R0972 and then compared to a reference determined by R0974 and R0975. PWR_SET is supplied by the digital-to-analog converter (DAC) U0959, Pin 2. Comparator stage U0956-3 increases or decreases RFPA_CNTRL so that the voltage at U0956-3, Pin 9 in the same at the reference voltage at U0956-3, Pin 10. When the PWR_SET voltage is decreased, U0956-3 increases RFPA_CNTRL to increase VFORWARD which is proportional to forward power thus increasing the power level. When the PWR_SET voltage is increased, U0956-3 decreases RFPA_CNTRL to decrease VFORWARD, thus decreasing the power level. The microprocessor initiates the loop through U0958-1 and Q0954. Loop timing is set via software together with R0977 and C0973.

Protection Mechanisms

Final-stage temperature is sensed in the RFPA resulting in VTEMP, which is proportional to temperature. VTEMP is compared against a reference voltage TEMP_1 (U0959, pin 9) via U0957-1. When VTEMP exceeds TEMP_1, the U0957-1, pin 1, voltage increases and forward biases one of the D0951 diodes, which cuts back power. Power continues to cut back with rising temperature until the voltage level at the junction of R0978 and R0983 is high enough to forward bias D0952, thus clamping the cut back so that the radio meets its duty cycle specification while providing protection against high-temperature conditions. The clamping level is set via TEMP_2 (U0959, pin 10) and U0957-2. U0957-3 is used to sense if a high A+ battery voltage condition exists and, if it does, the Q0955 gate is biased on, which increases the clamp voltage allowing for additional power cutback for a high A+, high temperature condition.

Final-stage current is also monitored via VCURRENT, which is proportional to current. VCURRENT is compared against a reference CURR_LIM_SET (U0959, pin 1) which is tuned after power characterization. If VCURRENT exceeds CURR_LIM_SET, then U0957-4, pin 14, voltage rises and forward biases one of the D0951 diodes, which limits power.

Finally, control voltage is limited by U0956-4 and D0950. RFPA_CNTRL can rise to the control voltage limit set by R0942-4.

3.13 Frequency Generation Unit (FGU)

This section of the theory of operation provides a detailed circuit description of the frequency generation unit (FGU).

3.13.1 VHF (136-174 MHz) Band

The FGU (Figure 3-34 on page 3-46) provides the XTL 1500 radio with a 16.8 MHz reference frequency, receiver 1st local oscillator, and a modulated transmitter RF carrier that is further amplified by the power amplifier section of the radio.

The FGU consists of the following:

- Reference oscillator (Y3750)
- Low-voltage Fractional-N (LV Frac-N) synthesizer (U3751)
- Two transmitter VCOs
- Three transmitter buffer/amplifier stages
- Two Receiver VCOs
- Three receiver buffer/amplifier stages

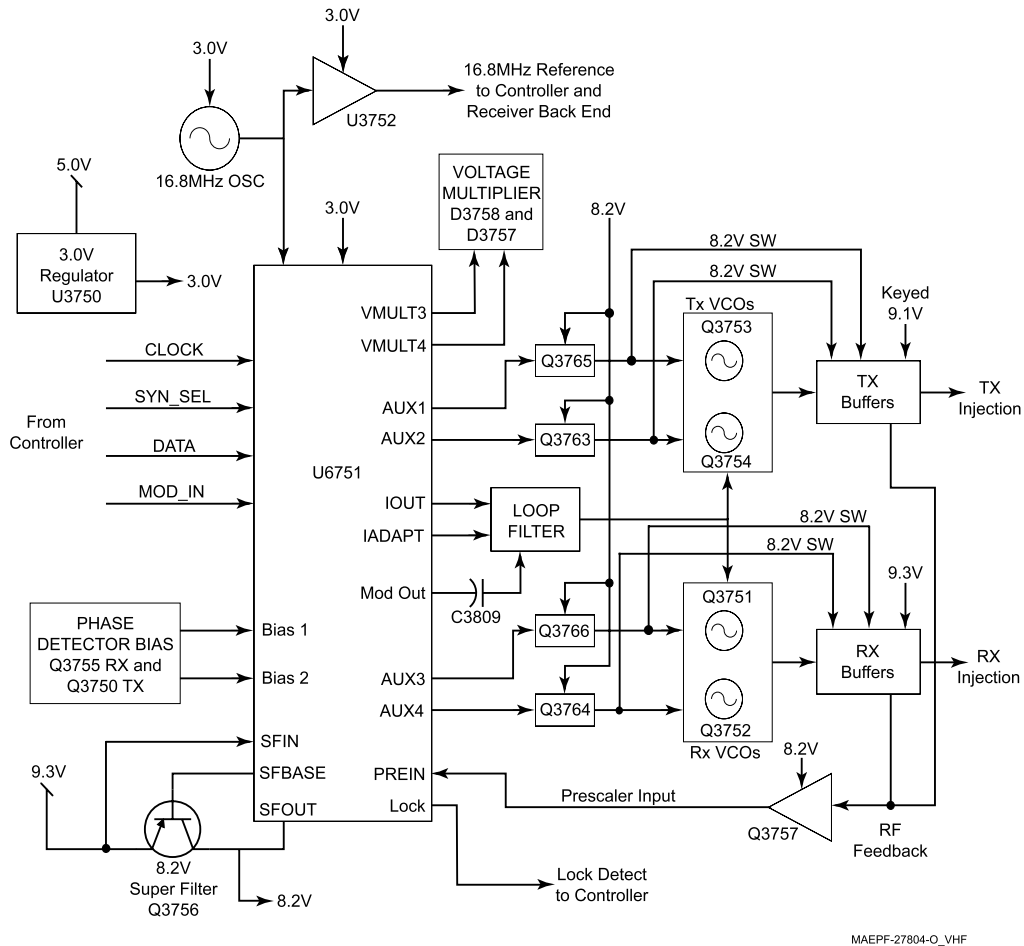


Figure 3-34. Frequency Generation Unit Block Diagram (VHF)

3.13.1.1 Reference Oscillator

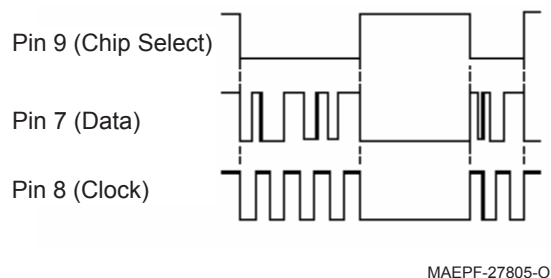
The radio's frequency stability and accuracy is derived from the 16.8 MHz reference oscillator (Y3750). The 16.8 MHz reference oscillator circuitry provides a 16.8 MHz reference to the LV Frac-N (U3751), receiver backend IC (U3000), and the controller section of the XTL 1500 radio. The reference oscillator circuitry consists of the reference oscillator Y3750 and the inverter/buffer circuitry containing the active device U3752. Y3750 is a voltage-controlled, temperature-compensated crystal oscillator (VCTCXO). Circuitry internal to Y3750 compensates for frequency error over temperature. Warping of the oscillator on frequency is accomplished via a programmable DAC in the LV Frac-N. The warp voltage is present at pin 25 (WARP) of U3751 and is applied to pin 1 of Y3750. The 16.8 MHz output frequency of Y3750 is capacitor-coupled to pin 23 of the LV Frac-N (U3751) and also to the inverter/buffer stage U3752. L3754 and C3824 at the output of U3752 filter the 16.8 MHz signal, and R3768 along with C3830 set the appropriate amplitude of the signal for the receiver backend and controller sections.

3.13.1.2 LV Frac-N Synthesizer IC

The LV Frac-N IC (U3751) functions include frequency synthesis, modulation control, voltage multiplication and filtering, and auxiliary logic outputs for VCO selection.

U3751 is a mixed-mode IC containing digital and analog circuits. Separate power supply inputs are used for the various functional blocks on the IC. Inductors L3757 and L3756 provide isolation between supply pin 20 (AVDD - analog supply input) and pin 36 (DVDD - digital supply input) connected to F3.0v. This 3.0 V DC supply is provided by U3750, a 3-V regulator IC.

All programmable variables on the synthesizer IC, such as the synthesizer frequency; reference-oscillator warping; adapt-timer duration; modulation-attenuator setting; and auxiliary-control outputs, which select one of four voltage-controlled oscillators, can be programmed through a serial peripheral interface (SPI). The SPI is connected to the controller microcomputer via three programming lines, namely the data (pin 7), clock (pin 8), and the chip enable (pin 9) of U3751 (Figure 3-35).



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Figure 3-35. Waveform Representation During Programming of the LV Frac-N IC (VHF)

3.13.1.3 Voltage Multiplier

Pin 12 (VMULT3) and pin 11 (VMULT4) of U3751, together with diode arrays D3757 and D3758 and their associated capacitors C3763, C3764, C3765 and C3767, form the voltage multiplier. The voltage multiplier generates 12.0 Vdc from the 3.0-V supply to supply the phase detector and charge-pump output stage at pin 47 (VCP) of U3751. This voltage multiplier is basically a stacked, multiple-diode capacitor network driven by two 1.05 MHz, 180 degrees out of phase signals from pins 12 and 11 of U3751.

3.13.1.4 Superfilter

The superfilter is an active filter that provides a low-noise supply for the VCOs, receiver and transmitter injection amplifiers. Regulator U0950, located in the controller section, supplies 9.3 Vdc to the FGU section thru the filtering network consisting of L3752, C3811, C3751, and C3820. This voltage is applied to pin 30 (SFIN) of U3751 and the emitter of Q3756. The output is a superfiltered 8.2 Vdc at the junction of pin 28 (SFOUT) of U3751 and the collector of Q3756. Filtering is accomplished with capacitors C3821, C3753, and C3752 at the output of this circuit and C3823 at pin 26 of U3751.

3.13.1.5 Modulation

To support many voice, data, and signaling protocols, XTL 1500 radios must modulate the transmitter carrier frequency over a wide audio-frequency range, from less than 10 Hz up to more than 6 kHz. The LV Frac-N IC supports audio frequencies down to zero Hz by using dual-port modulation. The audio signal at pin 10 (MODIN) is internally divided into high- and low-frequency components, which modulate both the synthesizer dividers and the external VCOs through signal MODOUT (pin 41). The IC is adjusted to achieve flat modulation frequency response during transmitter modulation balance calibration using a built-in modulation attenuator.

The Digital-to-Analog Converter (DAC) IC (U0900), and switched-capacitor filter (SCF) IC (FL0900) form the interface between the radio's DSP and the analog input of the LV Frac-N IC.

3.13.1.6 Charge Pump Bias

External circuitry connected to pin 39 (Bias 2) and pin 40 (Bias 1) of U3751 determine the current that is applied to the charge-pump circuitry. During receive mode, resistors R3778, R3763, and R3758 set the current supplied to pin 40 (Bias 1). Transistor Q3755 and resistors R3779, R3756, and capacitor C3808 form a circuit that momentarily increases the current to pin 40 (Bias 1) during receiver programming of U3751. This circuit is activated by pin 46 (ADAPTSW) of U3751 during the transition of programming U3751 to frequency and effectively decreases the length of time for the synthesizer to lock on frequency. Similarly, during transmitter mode, resistors R3778, R3763, and R3776 set the current supplied to pin 39 (Bias 2). Transistor Q3750 and resistors R3759, R3776, and capacitor C3825 form a circuit that momentarily increases the current to pin 39 (Bias 2) during transmitter programming of U3751.

3.13.1.7 Loop Filter

The loop filter operates in synchronization with the phase detector of U3751 in two modes, normal and adapt. In normal mode, the loop filter forms a third-order loop filter consisting of components R3765, R3773, R3770, C3833, C3810, C3834, C3855 to C3861 and C3881 to C3883.

Pin 43 (IOUT) of U3751 provides the charge-pump current for steering of the control voltage line to the VCOs. During normal mode, pin 45 (IADAPT) is set to a high impedance and has no effect on the loop filter. When U3751 is programmed to a new frequency, the IC is initially operated in adapt mode. In this mode the loop filter is reconfigured for a wider bandwidth allowing the synthesizer to lock faster. The charge-pump output is supplied through pin 45 (IADAPT) in this mode, and this reconfigures the loop filter to behave like a second-order filter.

3.13.1.8 Lock Detect

Lock status of the synthesizer loop is provided to the microprocessor by pin 4 (LOCK) of U3751. A high level (3.0 Vdc) indicates that the loop is stable. A low voltage indicates that the loop is not locked and will result in a Fail 001 to be displayed on the control head display.

3.13.1.9 Transmitter Injection

The transmit (TX) injection string consists of three amplifier stages (Q3760, Q3759, and Q3758) whose main purpose is to maintain a constant output to drive the RF power amplifier and supply the TX feedback signal to the FGU synthesizer loop. The first two stages are powered by the superfiltered 8.2 Vdc, which is decreased by 0.7 Vdc via the dual diode D3750, resulting in a 7.5 Vdc supply. The third stage is powered by the keyed 9.1 Vdc and the TX injection string is on only with keyed 9.1 Vdc activated during transmit mode. The TX VCO output is attenuated 3 dB via resistors R3840, R3833, and R3839. This output is coupled to the first-stage amplifier Q3760, further attenuated 3 dB via resistors R3803, R3809, and R3803, and then coupled to the second-stage amplifier Q3759. This output is tapped to supply the TX feedback signal to the synthesizer prescaler, and the balance is further attenuated 5 dB via resistors R3818, R3823, and R3824. This output is coupled to the third-stage amplifier Q3758, further attenuated 3 dB via resistors R3858, R3863, and R3859, routed to the 7-pole Cow Chebychev low-pass filter C3917 through C3921, L3785, and L3787 in order to attenuate harmonics. The output is, again, attenuated 3 dB via resistors R3842, R3834, and R3841 and coupled to the input of the RF power amplifier section. The five sets of resistive attenuators provide increased isolation between the TX VCO and RF power amplifier.

3.13.1.10 Receiver Injection

The receiver (RX) injection string is a three-stage amplifier that supplies the RX feedback signal to the FGU synthesizer loop and supplies the first local oscillator (LO) signal to the RX front-end mixer. The RX VCO output is attenuated 3 dB via resistors R3825 through R3827 to increase isolation. This buffered signal is amplified by the first-stage amplifier Q3761, which is supplied by the 8.2-V superfilter for a gain of approximately 6 dB. Resistors R3790, R3798, R3800, and R3801 bias Q3761. L3774 serves as a choke inductor; C3779 and C3868 are added for filtering. The output of Q3761 is attenuated 9.5 dB via resistors R3854, R3865, and R3855. This output is coupled to Q3769 which gain of approximately 3 dB. The output of Q3769 is split into two paths. The first path feeds back to the synthesizer prescaler through blocking capacitor C3913. The second path, which supplies the LO signal to the RX front-end mixer, is attenuated 3 dB via resistors R3857, R3864, and R3856 to increase isolation. This buffered signal is amplified by the second-stage amplifier Q3762, which is supplied by the 9.3-V regulator for a gain of approximately 15 dB. Resistors R3843, R3851, and R3852 biases Q3762. L3783 serves as a choke inductor; C3873, C3870, and C3925 are added for filtering. The output of Q3762 is passed through blocking capacitor C3759, then, routed to C3804, L3781, C3786, and L3782 which form a low pass filter and attenuated 1 dB via resistors R3821, R3794, and R3802 to increase isolation and supply approximately 20 dBm to the LO port of the mixer.

3.13.1.11 Transmitter VCOs

Transmitter frequencies are generated from two external, discrete, Colpits VCOs, low band (136-155 MHz) and high band (155-174 MHz), based on Q3753 and Q3754 respectively. The VCOs are switched On and Off by transistors Q3765 and Q3763, which are controlled by the Frac-N outputs AUX1 and AUX2 respectively when turned high.

3.13.1.12 Receiver VCOs

The receiver first local oscillator frequencies are generated from two external, discrete, Colpits VCOs, low band (245.65-264.65) and high band (264.65-283.65), based on Q3751 and Q3752 respectively. The VCOs are switched On and Off by transistors Q3766 and Q3764, which are controlled by the Frac-N outputs AUX3 and AUX4 respectively when turned high.

3.13.1.13 Prescaler Feedback

RF feedback for the synthesizer loop is provided by prescaler amplifier Q3757. Feedback from both the transmitter and receiver injection strings are coupled to this amplifier through resistor networks that both balance and attenuate the levels prior to amplification by Q3757. The output of Q3757 is coupled to U3751 at pin 32 (PREIN), which is the prescaler input for the synthesizer.

3.13.2 UHF Range 1 (380–470 MHz) Band

The FGU (Figure 3-36 on page 3-50) provides the XTL 1500 radio with a 16.8 MHz reference frequency, receiver 1st local oscillator, and a modulated transmitter RF carrier that is further amplified by the power amplifier section of the radio.

The FGU consists of the following:

- Reference oscillator (Y5750)
- Low-voltage Fractional-N (LV Frac-N) synthesizer (U5752)
- Three receiver voltage-controlled oscillators (VCOs)
- Two transmitter VCOs
- Three receiver LO amplifiers (Q5904, Q5902 and Q5906)
- Two transmitter injection amplifiers (Q5828, and Q5829)

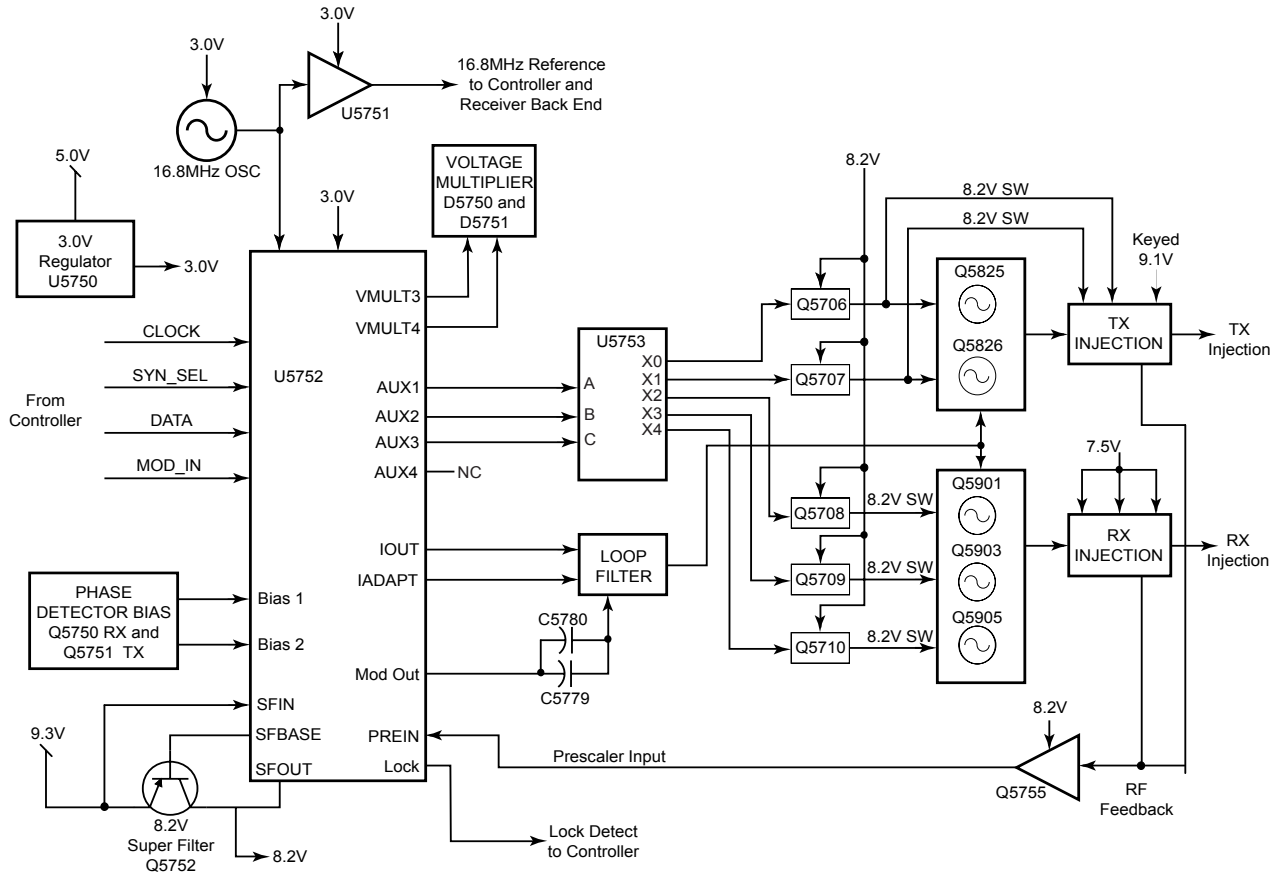


Figure 3-36. Frequency Generation Unit Block Diagram (UHF Range 1)

3.13.2.1 Reference Oscillator

The radio's frequency stability and accuracy is derived from the 16.8 MHz reference oscillator (Y5750). The 16.8 MHz reference oscillator circuitry provides a 16.8 MHz reference to the LV Frac-N (U5752), receiver back-end IC (U5002), and the controller section of the XTL 1500 radio. The reference oscillator circuitry consists of the reference oscillator Y5750 and the inverter/buffer circuitry containing the active device U5751. Y5750 is a voltage-controlled, temperature-compensated crystal oscillator (VCTCXO). Circuitry internal to Y5750 compensates for frequency error over temperature. Warping of the oscillator on frequency is accomplished via a programmable DAC in the LV Frac-N. The warp voltage is present at pin 25 (WARP) of U5752 and is applied to pin 1 of Y5750. The 16.8 MHz output frequency of Y5750 is capacitor-coupled to pin 23 of the LV Frac-N (U5752) and also to the inverter/buffer stage U5751. L5753 and C5768 at the output of U5751 filter the 16.8 MHz signal, and R5768 along with C5763 set the appropriate amplitude of the signal for the receiver back-end and controller sections.

3.13.2.2 LV Frac-N Synthesizer IC

The LV Frac-N IC (U5752) functions include frequency synthesis, modulation control, voltage multiplication and filtering, and auxiliary logic outputs for VCO selection.

U5752 is a mixed-mode IC containing digital and analog circuits. Separate power supply inputs are used for the various functional blocks on the IC. Inductors L5755 and L5756 provide isolation between supply pin 20 (AVDD - analog supply input) and pin 36 (DVDD - digital supply input) connected to F3.0v. This 3.0 V DC supply is provided by U5750, a 3-V regulator IC.

All programmable variables on the synthesizer IC, such as the synthesizer frequency; reference-oscillator warping; adapt-timer duration; modulation-attenuator setting; and auxiliary-control outputs, which select one of five voltage-controlled oscillators, can be programmed through a serial peripheral interface (SPI). The SPI is connected to the controller microcomputer via three programming lines, namely the data (pin 7), clock (pin 8), and the chip enable (pin 9) of U5752 (Figure 3-37).

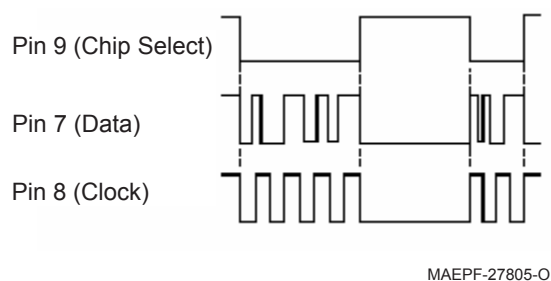


Figure 3-37. Waveform Representation During Programming of the LV Frac-N IC (UHF Range 1)

3.13.2.3 Voltage Multiplier

Pin 12 (VMULT3) and pin 11 (VMULT4) of U5752, together with diode arrays D5750 and D5751 and their associated capacitors C5775, C5776, C5777 and C5778, form the voltage multiplier. The voltage multiplier generates 13.4 Vdc from the 5.0-V supply to supply the phase detector and charge-pump output stage at pin 47 (VCP) of U5752. This voltage multiplier is basically a stacked, multiple-diode capacitor network driven by two 1.05 MHz, 180 degrees out of phase signals from pins 12 and 11 of U5752.

3.13.2.4 Superfilter

The superfilter is an active filter that provides a low-noise supply for the VCOs, receiver and transmitter injection amplifiers. Regulator U0950, located in the controller section, supplies 9.3 Vdc to the FGU section thru the filtering network consisting of L5750, C5751, C5753, and C5755. This voltage is applied to pin 30 (SFIN) of U5752 and the emitter of Q5752. The output is a superfiltered 8.2 Vdc at the junction of pin 28 (SFOUT) of U5752 and the collector of Q5752. Filtering is accomplished with capacitors C5766, C5769, and C5772 at the output of this circuit and C5770 at pin 26 of U5752.

3.13.2.5 Modulation

To support many voice, data, and signaling protocols, XTL 1500 radios must modulate the transmitter carrier frequency over a wide audio-frequency range, from less than 10 Hz up to more than 6 kHz. The LV Frac-N IC supports audio frequencies down to zero Hz by using dual-port modulation. The audio signal at pin 10 (MODIN) is internally divided into high- and low-frequency components, which modulate both the synthesizer dividers and the external VCOs through signal MODOUT (pin 41). The IC is adjusted to achieve flat modulation frequency response during transmitter modulation balance calibration using a built-in modulation attenuator.

The Digital-to-Analog Converter (DAC) IC (U0900), and switched-capacitor filter (SCF) IC (FL0900) form the interface between the radio's DSP and the analog input of the LV Frac-N IC.

3.13.2.6 Charge Pump Bias

External circuitry connected to pin 39 (Bias 2) and pin 40 (Bias 1) of U5752 determine the current that is applied to the charge-pump circuitry. During receive mode, resistors R5754, R5759, and R5765 set the current supplied to pin 40 (Bias 1). Transistor Q5750 and resistors R5752, R5753, and capacitor C5759 form a circuit that momentarily increases the current to pin 40 (Bias 1) during receiver programming of U5752. This circuit is activated by pin 46 (ADAPTSW) of U5752 during the transition of programming U5752 to frequency and effectively decreases the length of time for the synthesizer to lock on frequency. Similarly, during transmitter mode, resistors R5764, R5759, and R5753 set the current supplied to pin 39 (Bias 2). Transistor Q5752 and resistors R5767, R5764, and capacitor C5762 form a circuit that momentarily increases the current to pin 39 (Bias 2) during transmitter programming of U5752.

3.13.2.7 Loop Filter

The loop filter operates in synchronization with the phase detector of U5752 in two modes, normal and adapt. In normal mode, the loop filter forms a third-order loop filter consisting of components R5772, R5774, R5775, C5781 to C5787, C5790 to C5792, and C5809 to C5812.

Pin 43 (IOUT) of U5752 provides the charge-pump current for steering of the control voltage line to the VCOs. During normal mode, pin 45 (IADAPT) is set to a high impedance and has no effect on the loop filter. When U5752 is programmed to a new frequency, the IC is initially operated in adapt mode. In this mode the loop filter is reconfigured for a wider bandwidth allowing the synthesizer to lock faster. The charge-pump output is supplied through pin 45 (IADAPT) in this mode, and this reconfigures the loop filter to behave like a second-order filter.

3.13.2.8 Lock Detect

Lock status of the synthesizer loop is provided to the microprocessor by pin 4 (LOCK) of U5752. A high level (3.0 Vdc) indicates that the loop is stable. A low voltage indicates that the loop is not locked and will result in a Fail 001 to be displayed on the control head display.

3.13.2.9 Transmitter Injection

The transmit (TX) injection string consists of three amplifier stages (Q5828, Q5829, and Q5501) whose main purpose is to maintain a constant output to drive the RF power amplifier chain and supply the TX feedback signal to the FGU synthesizer loop. The first two stages are powered by the superfiltered 8.2 Vdc, which is decreased by 0.7 Vdc via the dual diode D5833, resulting in a 7.5 Vdc supply. The third stage is powered by the keyed 9.1 Vdc and the TX injection string is on only with keyed 9.1 Vdc activated during transmit mode.

The output of the second stage amplifier Q5829 is tapped via capacitor C5863 to supply the TX feedback signal to the synthesizer prescaler via the amplifier Q5755.

3.13.2.10 Receiver Injection

The receiver (RX) injection string is a four-stage amplifier that supplies the RX feedback signal to the FGU synthesizer loop and supplies the first local oscillator (LO) signal to the RX front-end mixer. Each RX VCO output is attenuated via resistive pads to increase isolation. The VCO signals are buffered by the RX injection amplifier string Q5904, Q5902 and Q5906. The output of Q5906 is tapped via C5957 and fed back to the synthesizer prescaler through amplifier Q5755. The main path at the output of Q5906 is amplified by U5303 to a level of 24 dBm to provide the first LO signal to the RX front end mixer in the receiver chain.

3.13.2.11 Transmitter VCOs

Transmitter frequencies are generated from two VCOs, Q5825 and Q5826.

- Q5825 supplies frequencies in the range 380 MHz up to (but not including) 425 MHz.
- Q5826 supplies frequencies in the range from 425 MHz to 470 MHz.

3.13.2.12 Receiver VCOs

Receiver first local-oscillator frequencies are generated from three VCOs, Q5901, Q5903 and Q5905.

- Q5901 supplies frequencies in the range 489.65 MHz up to (but not including) 519.65 MHz.
- Q5903 supplies frequencies in the range 519.65 MHz up to (but not including) 549.65 MHz.
- Q5905 supplies frequencies in the range 549.65 MHz up to 579.65 MHz.

The RX VCOs operate at frequencies which are 109.65 MHz higher than the radio channel selected frequency since the receiver is high side injected, and the first IF frequency is 109.65 MHz.

The five VCOs are selected by the following pattern of logic levels on the AUX pins from the synthesizer chip U5752 (Table 3-9):

Table 3-9. VCO AUX Pin Logic UHF Range 1

VCO	AUX1	AUX2	AUX3
RX VCO Q5901	0	1	0
RX VCO Q5903	1	1	0
RX VCO Q5905	0	0	1
TX VCO Q5825	0	0	0
TX VCO Q5826	1	0	0

3.13.2.13 Prescaler Feedback

RF feedback for the synthesizer loop is provided by prescaler amplifier Q5755. Feedback from both the transmitter and receiver injection strings are coupled to this amplifier through capacitors C5863 and C5957. The output of Q5755 is coupled to U5752 at pin 32 (PREIN), which is the prescaler input for the synthesizer.

3.13.3 UHF Range 2 (450–520 MHz) Band

The FGU (Figure 3-38) provides the XTL 1500 radio with a 16.8 MHz reference frequency, receiver 1st local oscillator, and a modulated transmitter RF carrier that is further amplified by the power amplifier section of the radio.

The FGU consists of the following:

- Reference oscillator (Y5750)
- Low-voltage Fractional-N (LV Frac-N) synthesizer (U5752)
- Three receiver voltage-controlled oscillators (VCOs)
- Two transmitter VCOs
- Three receiver LO amplifiers (Q5904, Q5902 and Q5906)
- Two transmitter injection amplifiers (Q5828, and Q5829)

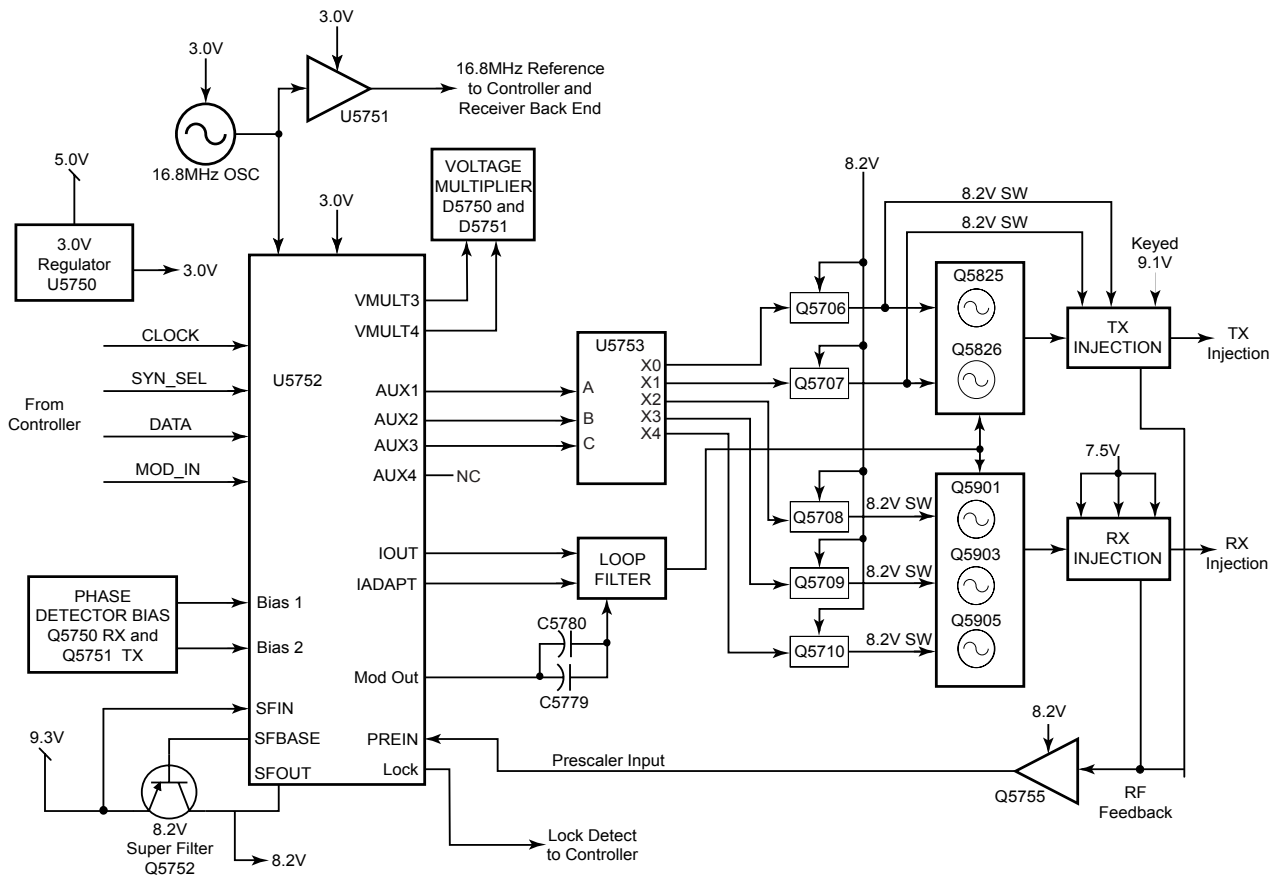


Figure 3-38. Frequency Generation Unit Block Diagram (UHF Range 2)

3.13.3.1 Reference Oscillator

The radio's frequency stability and accuracy is derived from the 16.8 MHz reference oscillator (Y5750). The 16.8 MHz reference oscillator circuitry provides a 16.8 MHz reference to the LV Frac-N (U5752), receiver back-end IC (U5002), and the controller section of the XTL 1500 radio. The reference oscillator circuitry consists of the reference oscillator Y5750 and the inverter/buffer circuitry containing the active device U5751. Y5750 is a voltage-controlled, temperature-compensated crystal oscillator (VCTCXO). Circuitry internal to Y5750 compensates for frequency error over temperature. Warping of the oscillator on frequency is accomplished via a programmable DAC in the LV Frac-N. The warp voltage is present at pin 25 (WARP) of U5752 and is applied to pin 1 of Y5750. The 16.8 MHz output frequency of Y5750 is capacitor-coupled to pin 23 of the LV Frac-N (U5752) and also to the inverter/buffer stage U5751. L5753 and C5768 at the output of U5751 filter the 16.8 MHz signal, and R5768 along with C5763 set the appropriate amplitude of the signal for the receiver back-end and controller sections.

3.13.3.2 LV Frac-N Synthesizer IC

The LV Frac-N IC (U5752) functions include frequency synthesis, modulation control, voltage multiplication and filtering, and auxiliary logic outputs for VCO selection.

U5752 is a mixed-mode IC containing digital and analog circuits. Separate power supply inputs are used for the various functional blocks on the IC. Inductors L5755 and L5756 provide isolation between supply pin 20 (AVDD - analog supply input) and pin 36 (DVDD - digital supply input) connected to F3.0v. This 3.0 V DC supply is provided by U5750, a 3-V regulator IC.

All programmable variables on the synthesizer IC, such as the synthesizer frequency; reference-oscillator warping; adapt-timer duration; modulation-attenuator setting; and auxiliary-control outputs, which select one of five voltage-controlled oscillators, can be programmed through a serial peripheral interface (SPI). The SPI is connected to the controller microcomputer via three programming lines, namely the data (pin 7), clock (pin 8), and the chip enable (pin 9) of U5752 (Figure 3-39).

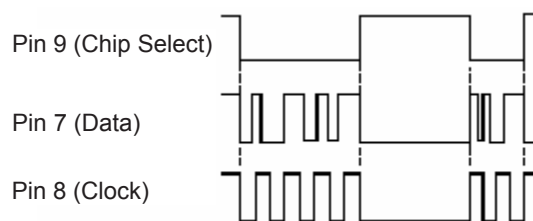


Figure 3-39. Waveform Representation During Programming of the LV Frac-N IC (UHF Range 2)

3.13.3.3 Voltage Multiplier

Pin 12 (VMULT3) and pin 11 (VMULT4) of U5752, together with diode arrays D5750 and D5751 and their associated capacitors C5775, C5776, C5777 and C5778, form the voltage multiplier. The voltage multiplier generates 13.4 Vdc from the 5.0-V supply to supply the phase detector and charge-pump output stage at pin 47 (VCP) of U5752. This voltage multiplier is basically a stacked, multiple-diode capacitor network driven by two 1.05 MHz, 180 degrees out of phase signals from pins 12 and 11 of U5752.

3.13.3.4 Superfilter

The superfilter is an active filter that provides a low-noise supply for the VCOs, receiver and transmitter injection amplifiers. Regulator U0950, located in the controller section, supplies 9.3 Vdc to the FGU section thru the filtering network consisting of L5750, C5751, C5753, and C5755. This voltage is applied to pin 30 (SFIN) of U5752 and the emitter of Q5752. The output is a superfiltered 8.2 Vdc at the junction of pin 28 (SFOUT) of U5752 and the collector of Q5752. Filtering is accomplished with capacitors C5766, C5769, and C5772 at the output of this circuit and C5770 at pin 26 of U5752.

3.13.3.5 Modulation

To support many voice, data, and signaling protocols, XTL 1500 radios must modulate the transmitter carrier frequency over a wide audio-frequency range, from less than 10 Hz up to more than 6 kHz. The LV Frac-N IC supports audio frequencies down to zero Hz by using dual-port modulation. The audio signal at pin 10 (MODIN) is internally divided into high- and low-frequency components, which modulate both the synthesizer dividers and the external VCOs through signal MODOUT (pin 41). The IC is adjusted to achieve flat modulation frequency response during transmitter modulation balance calibration using a built-in modulation attenuator.

The Digital-to-Analog Converter (DAC) IC (U0900), and switched-capacitor filter (SCF) IC (FL0900) form the interface between the radio's DSP and the analog input of the LV Frac-N IC.

3.13.3.6 Charge Pump Bias

External circuitry connected to pin 39 (Bias 2) and pin 40 (Bias 1) of U5752 determine the current that is applied to the charge-pump circuitry. During receive mode, resistors R5754, R5759, and R5765 set the current supplied to pin 40 (Bias 1). Transistor Q5750 and resistors R5752, R5753, and capacitor C5759 form a circuit that momentarily increases the current to pin 40 (Bias 1) during receiver programming of U5752. This circuit is activated by pin 46 (ADAPTSW) of U5752 during the transition of programming U5752 to frequency and effectively decreases the length of time for the synthesizer to lock on frequency. Similarly, during transmitter mode, resistors R5764, R5759, and R5753 set the current supplied to pin 39 (Bias 2). Transistor Q5752 and resistors R5767, R5764, and capacitor C5762 form a circuit that momentarily increases the current to pin 39 (Bias 2) during transmitter programming of U5752.

3.13.3.7 Loop Filter

The loop filter operates in synchronization with the phase detector of U5752 in two modes, normal and adapt. In normal mode, the loop filter forms a third-order loop filter consisting of components R5772, R5774, R5775, C5781 to C5787, C5790 to C5792, and C5809 to C5812.

Pin 43 (IOUT) of U5752 provides the charge-pump current for steering of the control voltage line to the VCOs. During normal mode, pin 45 (IADAPT) is set to a high impedance and has no effect on the loop filter. When U5752 is programmed to a new frequency, the IC is initially operated in adapt mode. In this mode the loop filter is reconfigured for a wider bandwidth allowing the synthesizer to lock faster. The charge-pump output is supplied through pin 45 (IADAPT) in this mode, and this reconfigures the loop filter to behave like a second-order filter.

3.13.3.8 Lock Detect

Lock status of the synthesizer loop is provided to the microprocessor by pin 4 (LOCK) of U5752. A high level (3.0 Vdc) indicates that the loop is stable. A low voltage indicates that the loop is not locked and will result in a Fail 001 to be displayed on the control head display.

3.13.3.9 Transmitter Injection

The transmit (TX) injection string consists of three amplifier stages (Q5828, Q5829, and Q5501) whose main purpose is to maintain a constant output to drive the RF power amplifier chain and supply the TX feedback signal to the FGU synthesizer loop. The first two stages are powered by the superfiltered 8.2 Vdc, which is decreased by 0.7 Vdc via the dual diode D5833, resulting in a 7.5 Vdc supply. The third stage is powered by the keyed 9.1 Vdc and the TX injection string is on only with keyed 9.1 Vdc activated during transmit mode.

The output of the second stage amplifier Q5829 is tapped via capacitor C5863 to supply the TX feedback signal to the synthesizer prescaler via the amplifier Q5755.

3.13.3.10 Receiver Injection

The receiver (RX) injection string is a four-stage amplifier that supplies the RX feedback signal to the FGU synthesizer loop and supplies the first local oscillator (LO) signal to the RX front-end mixer. Each RX VCO output is attenuated via resistive pads to increase isolation. The VCO signals are buffered by the RX injection amplifier string Q5904, Q5902 and Q5906. The output of Q5906 is tapped via C5957 and fed back to the synthesizer prescaler through amplifier Q5755. The main path at the output of Q5906 is amplified by U5303 to a level of 24 dBm to provide the first LO signal to the RX front end mixer in the receiver chain.

3.13.3.11 Transmitter VCOs

Transmitter frequencies are generated from two VCOs, Q5825 and Q5826.

- Q5826 supplies frequencies in the range 450 MHz up to (but not including) 485 MHz.
- Q5825 supplies frequencies in the range from 485 MHz to 520 MHz.

3.13.3.12 Receiver VCOs

Receiver first local-oscillator frequencies are generated from three VCOs, Q5901, Q5903 and Q5905.

- Q5905 supplies frequencies in the range 559.65 MHz up to (but not including) 582.65 MHz.
- Q5903 supplies frequencies in the range 582.65 MHz up to (but not including) 605.65 MHz.
- Q5901 supplies frequencies in the range 605.65 MHz up to 629.65 MHz.

The RX VCOs operate at frequencies which are 109.65 MHz higher than the radio channel selected frequency since the receiver is high side injected, and the first IF frequency is 109.65 MHz.

The five VCOs are selected by the following pattern of logic levels on the AUX pins from the synthesizer chip U5752 (Table 3-10):

Table 3-10. VCO AUX Pin Logic UHF Range 2

VCO	AUX1	AUX2	AUX3
RX VCO Q5905	0	0	1
RX VCO Q5903	1	1	0
RX VCO Q5901	0	1	0
TX VCO Q5826	1	0	0
TX VCO Q5825	0	0	0

3.13.3.13 Prescaler Feedback

RF feedback for the synthesizer loop is provided by prescaler amplifier Q6761. Feedback from both the transmitter and receiver injection strings are coupled to this amplifier through capacitors C5863 and C5957. The output of Q6761 is coupled to U6752 at pin 32 (PREIN), which is the prescaler input for the synthesizer.

3.13.4 700–800 MHz Band

The FGU (Figure 3-40) provides the XTL 1500 radio with a 16.8 MHz reference frequency, receiver 1st local oscillator, and a modulated transmitter RF carrier that is further amplified by the power amplifier section of the radio.

The FGU consists of the following:

- Reference oscillator (Y6750)
- Low-voltage Fractional-N (LV Frac-N) synthesizer (U6751)
- Two receiver voltage-controlled oscillators (VCOs) contained in U6755
- Two transmitter VCOs contained in U6754
- Two receiver LO amplifiers (Q6762 and Q6763)
- Three transmitter injection amplifiers (Q6764, Q6765 and Q6766)

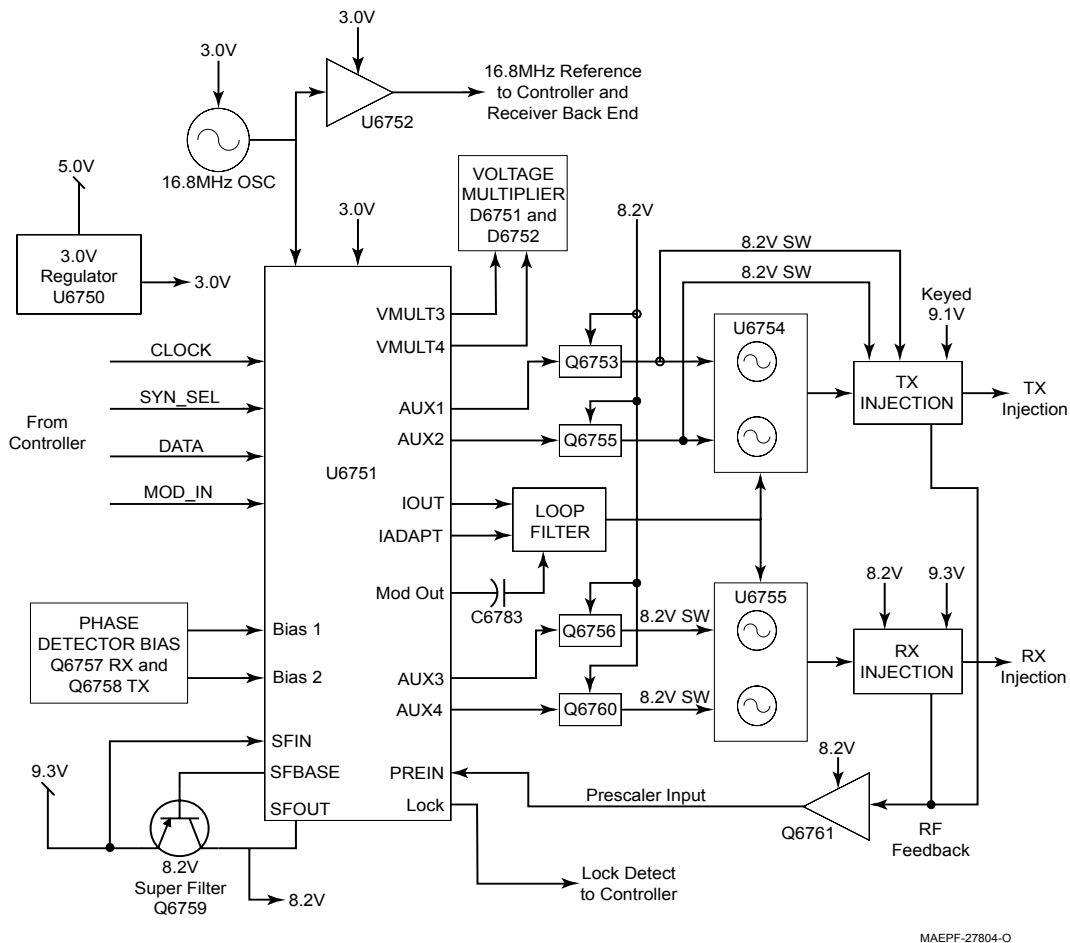


Figure 3-40. Frequency Generation Unit Block Diagram (700–800 MHz)

3.13.4.1 Reference Oscillator

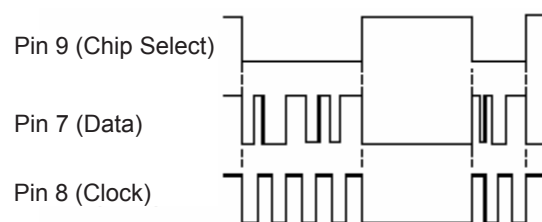
The radio's frequency stability and accuracy is derived from the 16.8 MHz reference oscillator (Y6750). The 16.8 MHz reference oscillator circuitry provides a 16.8 MHz reference to the LV Frac-N (U6751), receiver back-end IC (U6000), and the controller section of the XTL 1500 radio. The reference oscillator circuitry consists of the reference oscillator Y6750 and the inverter/buffer circuitry containing the active device U6752. Y6750 is a voltage-controlled, temperature-compensated crystal oscillator (VCTCXO). Circuitry internal to Y6750 compensates for frequency error over temperature. Warping of the oscillator on frequency is accomplished via a programmable DAC in the LV Frac-N. The warp voltage is present at pin 25 (WARP) of U6751 and is applied to pin 4 of Y6750. The 16.8 MHz output frequency of Y6750 is capacitor-coupled to pin 24 of the LV Frac-N (U6751) and also to the inverter/buffer stage U6752. L6756 and C6755 at the output of U6752 filter the 16.8 MHz signal, and R6757 along with C6759 set the appropriate amplitude of the signal for the receiver back-end and controller sections.

3.13.4.2 LV Frac-N Synthesizer IC

The LV Frac-N IC (U6751) functions include frequency synthesis, modulation control, voltage multiplication and filtering, and auxiliary logic outputs for VCO selection.

U6751 is a mixed-mode IC containing digital and analog circuits. Separate power supply inputs are used for the various functional blocks on the IC. Inductors L6752 and L6753 provide isolation between supply pin 20 (AVDD - analog supply input) and pin 36 (DVDD - digital supply input) connected to F3.0v. This 3.0 V DC supply is provided by U6750, a 3-V regulator IC.

All programmable variables on the synthesizer IC, such as the synthesizer frequency; reference-oscillator warping; adapt-timer duration; modulation-attenuator setting; and auxiliary-control outputs, which select one of four voltage-controlled oscillators, can be programmed through a serial peripheral interface (SPI). The SPI is connected to the controller microcomputer via three programming lines, namely the data (pin 7), clock (pin 8), and the chip enable (pin 9) of U6751 (Figure 3-41).



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Figure 3-41. Waveform Representation During Programming of the LV Frac-N IC

3.13.4.3 Voltage Multiplier

Pin 12 (VMULT3) and pin 11 (VMULT4) of U6751, together with diode arrays D6751 and D6752 and their associated capacitors C6763, C6766, C6769 and C6771, form the voltage multiplier. The voltage multiplier generates 12.0 Vdc from the 3.0-V supply to supply the phase detector and charge-pump output stage at pin 47 (VCP) of U6751. This voltage multiplier is basically a stacked, multiple-diode capacitor network driven by two 1.05 MHz, 180 degrees out of phase signals from pins 12 and 11 of U6751.

3.13.4.4 Superfilter

The superfilter is an active filter that provides a low-noise supply for the VCOs, receiver and transmitter injection amplifiers. Regulator U0950, located in the controller section, supplies 9.3 Vdc to the FGU section thru the filtering network consisting of L6755, C6806, C6807, and C6818. This voltage is applied to pin 30 (SFIN) of U6751 and the emitter of Q6759. The output is a superfiltered 8.2 Vdc at the junction of pin 28 (SFOUT) of U6751 and the collector of Q6759. Filtering is accomplished with capacitors C6808, C6790, and C6791 at the output of this circuit and C6775 at pin 26 of U6751.

3.13.4.5 Modulation

To support many voice, data, and signaling protocols, XTL 1500 radios must modulate the transmitter carrier frequency over a wide audio-frequency range, from less than 10 Hz up to more than 6 kHz. The LV Frac-N IC supports audio frequencies down to zero Hz by using dual-port modulation. The audio signal at pin 10 (MODIN) is internally divided into high- and low-frequency components, which modulate both the synthesizer dividers and the external VCOs through signal MODOUT (pin 41). The IC is adjusted to achieve flat modulation frequency response during transmitter modulation balance calibration using a built-in modulation attenuator.

The Digital-to-Analog Converter (DAC) IC (U0900), and switched-capacitor filter (SCF) IC (FL0900) form the interface between the radio's DSP and the analog input of the LV Frac-N IC.

3.13.4.6 Charge Pump Bias

External circuitry connected to pin 39 (Bias 2) and pin 40 (Bias 1) of U6751 determine the current that is applied to the charge-pump circuitry. During receive mode, resistors R6768, R6769, and R6766 set the current supplied to pin 40 (Bias 1). Transistor Q6757 and resistors R6763, R6762, and capacitor C6795 form a circuit that momentarily increases the current to pin 40 (Bias 1) during receiver programming of U6751. This circuit is activated by pin 46 (ADAPTSW) of U6751 during the transition of programming U6751 to frequency and effectively decreases the length of time for the synthesizer to lock on frequency. Similarly, during transmitter mode, resistors R6768, R6769, and R6768 set the current supplied to pin 39 (Bias 2). Transistor Q6758 and resistors R6770, R6767, and capacitor C6794 form a circuit that momentarily increases the current to pin 39 (Bias 2) during transmitter programming of U6751.

3.13.4.7 Loop Filter

The loop filter operates in synchronization with the phase detector of U6751 in two modes, normal and adapt. In normal mode, the loop filter forms a third-order loop filter consisting of components R6764, R6765, R6761, C6776 to C6779, and C6785 to C6789.

Pin 43 (IOUT) of U6751 provides the charge-pump current for steering of the control voltage line to the VCOs. During normal mode, pin 45 (IADAPT) is set to a high impedance and has no effect on the loop filter. When U6751 is programmed to a new frequency, the IC is initially operated in adapt mode. In this mode the loop filter is reconfigured for a wider bandwidth allowing the synthesizer to lock faster. The charge-pump output is supplied through pin 45 (IADAPT) in this mode, and this reconfigures the loop filter to behave like a second-order filter.

3.13.4.8 Lock Detect

Lock status of the synthesizer loop is provided to the microprocessor by pin 4 (LOCK) of U6751. A high level (3.0 Vdc) indicates that the loop is stable. A low voltage indicates that the loop is not locked and will result in a Fail 001 to be displayed on the control head display.

3.13.4.9 Transmitter Injection

The transmit (TX) injection string consists of three amplifier stages (Q6764, Q6765, and Q6766) whose main purpose is to maintain a constant output to drive the RF power amplifier and supply the TX feedback signal to the FGU synthesizer loop. The first two stages are powered by the superfiltered 8.2 Vdc, which is decreased by 0.7 Vdc via the dual diode D6750, resulting in a 7.5 Vdc supply. The third stage is powered by the keyed 9.1 Vdc and the TX injection string is on only with keyed 9.1 Vdc activated during transmit mode. The TX VCO output is attenuated 3 dB via resistors R6829 through R6831. This output is coupled to the first-stage amplifier Q6764, further attenuated 3 dB via resistors R6809 through R6811, and then coupled to the second-stage amplifier Q6765. This output is tapped to supply the TX feedback signal to the synthesizer prescaler, and the balance is further attenuated 3 dB via resistors R6816 through R6818. This output is coupled to the third-stage amplifier Q6766, further attenuated 3 dB via resistors R6825 through R6827, and coupled to the input of the RF power amplifier section. The four sets of resistive attenuators provide increased isolation between the TX VCO and RF power amplifier.

3.13.4.10 Receiver Injection

The receiver (RX) injection string is a two-stage amplifier that supplies the RX feedback signal to the FGU synthesizer loop and supplies the first local oscillator (LO) signal to the RX front-end mixer. The RX VCO output is attenuated 6 dB via resistors R6793 through R6795 to increase isolation. This buffered signal is amplified by the first-stage amplifier Q6762, which is supplied by the 8.2-V superfilter for a gain of approximately 10 dB. Resistors R6789, R6790, and R6796 through R6798 bias Q6762 to approximately 5 V and 35 mA. L6757 serves as a choke inductor; C6819 and C821 are added for filtering. The output of Q6762 is split into two paths. The first path feeds back to the synthesizer prescaler through blocking capacitor C6822. The second path, which supplies the LO signal to the RX front-end mixer, is attenuated 3 dB via resistors R6799, R6800, and R6824 to increase isolation. This buffered signal is amplified by the second-stage amplifier Q6763, which is supplied by the 9.3-V regulator for a gain of approximately 15 dB. Resistor R6801 biases Q6763 to approximately 4.5 V (± 1 V, due to possible part variations). L6758 serves as a choke inductor; C6823, C6824, and C6826 are added for filtering. The output of Q6763 is passed through blocking capacitor C6825 and attenuated 3 dB via resistors R6802 through R6804 to increase isolation and supply approximately 15.5 dBm to the LO port of the mixer.

3.13.4.11 Transmitter VCOs

Transmitter frequencies are generated from two VCOs contained in U6754. U6754 is not serviceable and should be replaced if it is determined to be non-functional. Transmitter frequencies in the range of 764 to 776 MHz (repeater talkaround) and 794 to <806 MHz (trunking or repeater mode) can be generated when Aux1 (pin 48) of U6751 is active high (3.0 Vdc). This 3.0 volts is applied to transistor switch Q6753 allowing the superfiltered 8.2 Vdc supply to be connected to pin 2 (SWBPOSC1), bias for the first VCO of U6754. Likewise, transmitter frequencies in the range of 806 to 825 MHz (trunking or repeater mode) and 851 to 870 MHz (repeater talkaround) can be generated when Aux2 (pin 1) of U6751 is active high (3.0 Vdc). This 3.0 volts is applied to transistor switch Q6755 allowing the superfiltered 8.2 Vdc supply to be connected to pin 17 (SWBPOSC2), bias for the second VCO of U6754. Pin 20 (RFOUT) of U6754 is common to both oscillators and couples the oscillator's output signal to the first stage of the transmitter injection string. Modulation and frequency steering is accomplished through pin 8 (Cont_V) of U6754.

3.13.4.12 Receiver VCOs

Receiver first local-oscillator frequencies are generated from two VCOs in U6755. U6755 is not serviceable and should be replaced if determined to be non-functional. For receiver frequencies in the range of 764 to 776 MHz, high-side, first local-oscillator injection of 837.35 to 849.35 MHz ($F_c + 73.35$ MHz) is generated when Aux3 (pin 2) of U6751 is active high (3.0 Vdc). This 3.0 volts is applied to transistor switch Q6756 allowing the superfiltered 8.2-V supply to be connected to pin 2 (SWBPOSC1), bias for the first VCO of U6755. For receiver frequencies in the range of 851 to 870 MHz, low-side, first LO injection of 777.65 to 796.65 MHz ($F_c - 73.35$ MHz) is generated when Aux4 (pin 3) of U6751 is active high (3.0 Vdc). This 3.0 volts is applied to transistor switch Q6760 allowing the superfiltered 8.2-V supply to be connected to pin 17 (SWBPOSC2), bias of the second VCO of U6755. Pin 20 (RFOUT) of U6755 is common to both oscillators and couples the oscillator's output signal to the first stage of the receiver injection string. Frequency steering is accomplished through pin 8 (CONT_V) of U6755.

3.13.4.13 Prescaler Feedback

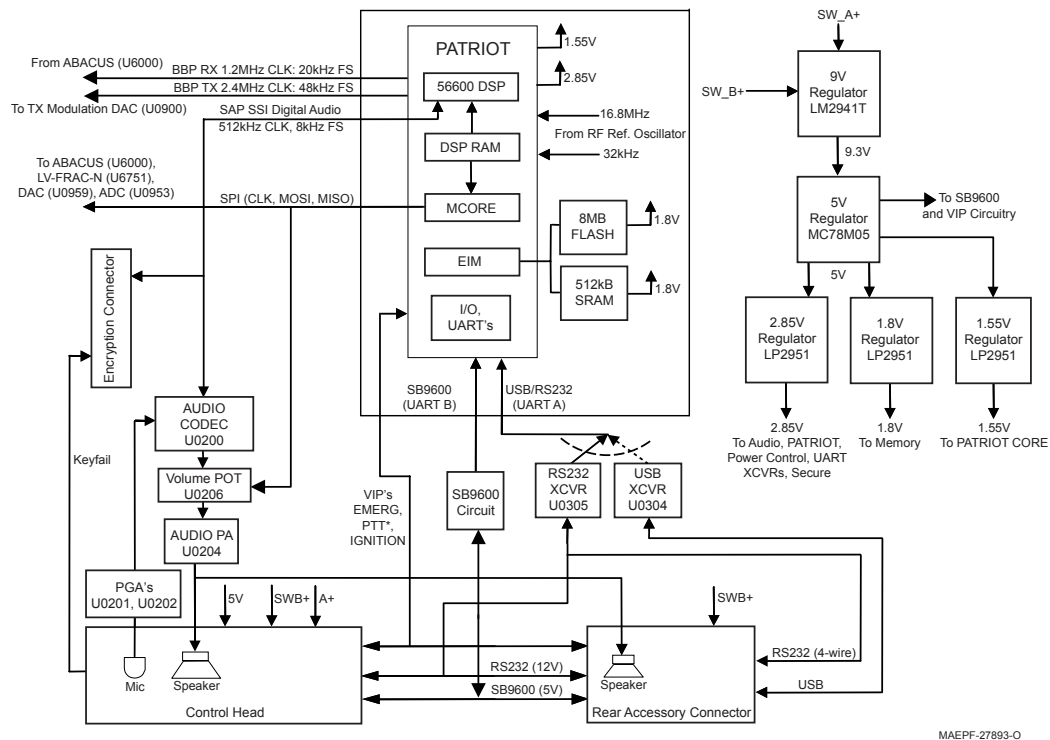
RF feedback for the synthesizer loop is provided by prescaler amplifier Q6761. Feedback from both the transmitter and receiver injection strings are coupled to this amplifier through resistor networks that both balance and attenuate the levels prior to amplification by Q6761. The output of Q6761 is coupled to U6751 at pin 32 (PREIN), which is the prescaler input for the synthesizer.

3.14 Controller Section

The controller section consists of a daughtercard module and associated circuitry to which it interfaces. It is the central interface between the various subsystems of the radio. Its main task is to interpret user input, provide user feedback, and schedule events in the radio operation, which include programming ICs, performing digital signal processing (DSP) on baseband audio and data, and sending messages to the control head display. Figure 3-42 on page 3-63 illustrates the components of the controller section.

The DSP section of the microprocessor performs digital vocoder (voice coder-decoder) functions previously performed by analog circuitry. This includes all tone signaling, trunking signaling, and conventional analog voice processing.

All analog signal processing is accomplished digitally using the Patriot IC microprocessor (U100). This microprocessor consists of a microcontroller, as well as a DSP. In addition, it provides a digital voice plus data capability utilizing IMBE voice-compression algorithms. *Vocoder* is the general term used to refer to these DSP-based systems.



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Figure 3-42. XTL 1500 Controller Section

The controller consists of digital logic comprised of a microprocessor (the Patriot IC, U100) and memory consisting of a 512K x 16 SRAM (U103) and a 4M x 16 FLASH ROM (U102). The microprocessor is a dual-core processor that contains a DSP56600 core and an MCORE microcontroller with custom peripherals. The term, *MCU*, refers to the MCORE controller section of the Patriot IC. The FLASH ROM contains the programs that the Patriot microprocessor executes and is used to store customer-specific information and radio-personality features that, together, constitute the *codeplug*. It allows the controller firmware to be reprogrammed for future software upgrades or feature enhancements. The SRAM is used for scratchpad memory during program execution.

The controller performs the programming of all peripheral ICs. This is done via a serial peripheral interface (SPI) bus and through General-Purpose Input/Outputs (GPIO) from the Patriot IC. ICs programmed through this interface include the LV Frac-N synthesizer, ABACUS III IC, D/A converter (DAC), A/-D converter (ADC), and volume digital potentiometer.

In addition to the SPI bus, the controller also maintains two asynchronous serial busses: the SB9600 bus and an RS-232/USB serial bus. The SB9600 bus interfaces the controller section to different hardware accessories, some of which may be external to the radio, including the control head. The RS-232/USB bus is used as a common data interface for external devices and for programming/flashing the radio.

User input is from the control head and is sent to the controller through the SB9600 bus. Feedback to the user is provided by the control-head display.

The controller schedules the activities of the DSP, including setting operational modes and parameters. The DSP section of the processor contains an 84K x 24 program RAM, 2K x 24 program ROM, and 62K x 16 data RAM, which are all integrated into the Patriot IC. The vocoder subsystem consists of this DSP core, the modulation DAC (U0900), and the voice CODEC (U0200).

In receive mode, the ABACUS III IC provides data samples directly to the DSP for processing. In transmit mode, the DAC provides a serial D/A converter. The data generated by the DSP is filtered and reconstructed as an analog signal to present a modulation signal to the VCO (voltage-controlled oscillator) at the LV Frac-N synthesizer. Both the transmit and receive digital data paths between the DSP and the CODEC are through the Patriot IC BBP (Baseband Interface Port) SSI port.

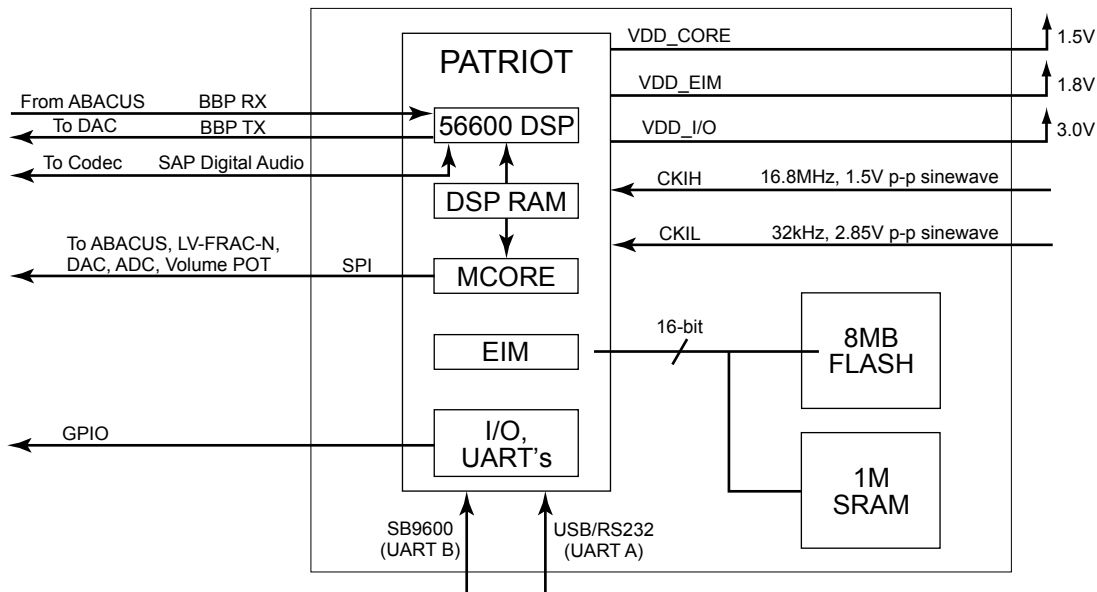
The CODEC provides A/D conversion of the analog microphone signal and D/A conversion of the analog speaker output. During transmit, the microphone audio is passed through the gain/filtering analog circuitry to the CODEC, which translates the analog waveform to serial SSI data. This data is made available to the DSP through the Serial Audio Port (SAP) of the Patriot IC. Conversely, the DSP writes speaker data samples to the D/A in the CODEC through the SAP port. The CODEC provides an analog speaker output audio signal to the audio power amplifier, U0204.

3.14.1 Daughtercard Module

The daughtercard module (Figure 3-43) contains the central processing unit (CPU) of the radio. This module interfaces with other parts of the main board. This module primarily contains three sections:

- Microprocessor (Patriot IC: U100): consists of a controller and a DSP whose functions are described above in “3.14. Controller Section” on page 3-62.
- FLASH IC (U102): the firmware storage IC
- SRAM IC (U103): used by the microprocessor to perform its memory operations

NOTE: The three sections of the daughtercard module are highly susceptible to ESD and moisture damage. Extreme care is advised when handling or servicing the main board.



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Figure 3-43. XTL 1500 Daughtercard Module

3.14.2 Controller DC Power Distribution

Figure 3-44 illustrates the controller DC power distribution circuitry.

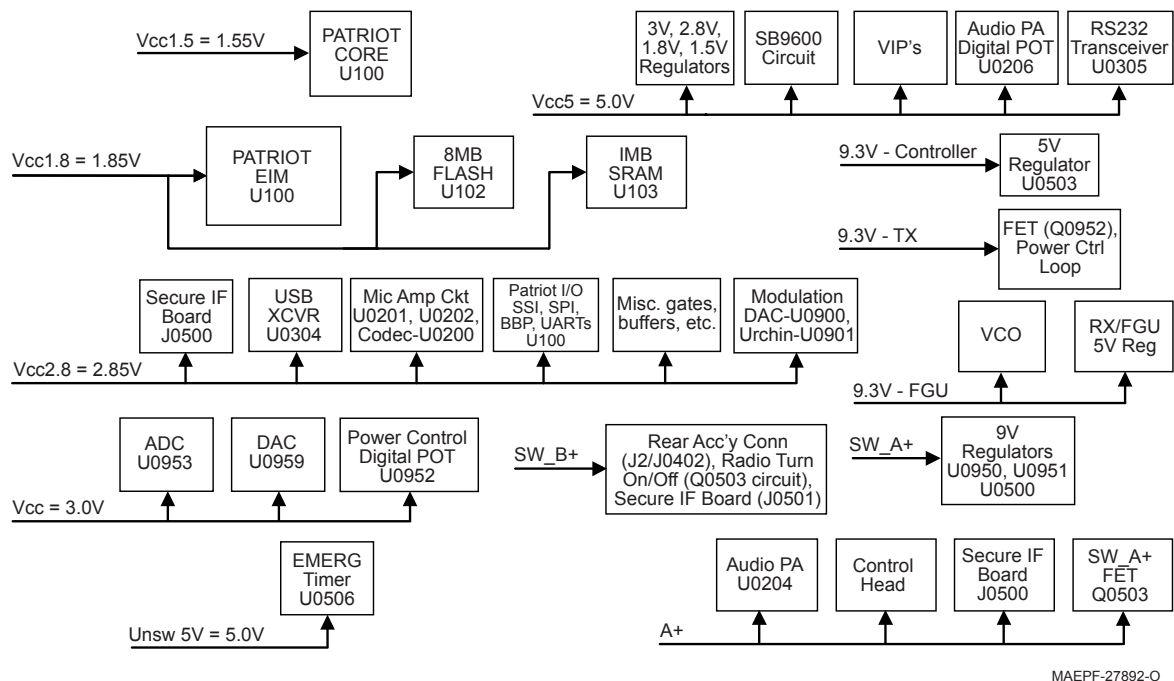
The A+ power for the radio is derived from the 12-V battery, which is applied to the main board through connector J0950. This A+ voltage is routed to the control-head connector, J0401, pins 19 and 21, to the control head.

A power FET (Q51) provides the means of controlling the main power source (SWB+) by the on/off switch. SWB+ is routed back to the main board through connector J0401-17 and out the rear connector, J2-24.

SW_B+ turns on controller FET switch Q0503, which supplies SW_A+ to regulator U0500. This 9.3-V regulator powers up the main 5-V controller regulator U0503. The 5-V supply powers on all four controller regulators:

- U0962 (3.0 V) for the power control section
- U0503 (2.85 V) for the controller and daughtercard I/O
- U0507 (1.85 V) for the memory
- U0502 (1.55 V) for the microprocessor core.

The SW+5-V regulator is the main power source for the controller.



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Figure 3-44. B+ Routing for Controller Section

On the secure interface board, U800, Q802, and Q803 provide SWB+ to the encryption module (if equipped). The SWB+ and UNSWB+ encryption voltages both originate from the secure interface board and are fed to the encryption module via J0701 and J0501.

It should also be noted that a system reset is provided by the undervoltage detector, U0504. This device brings the system out of reset on power-up, and provides a system reset to the microcomputer on power-down.

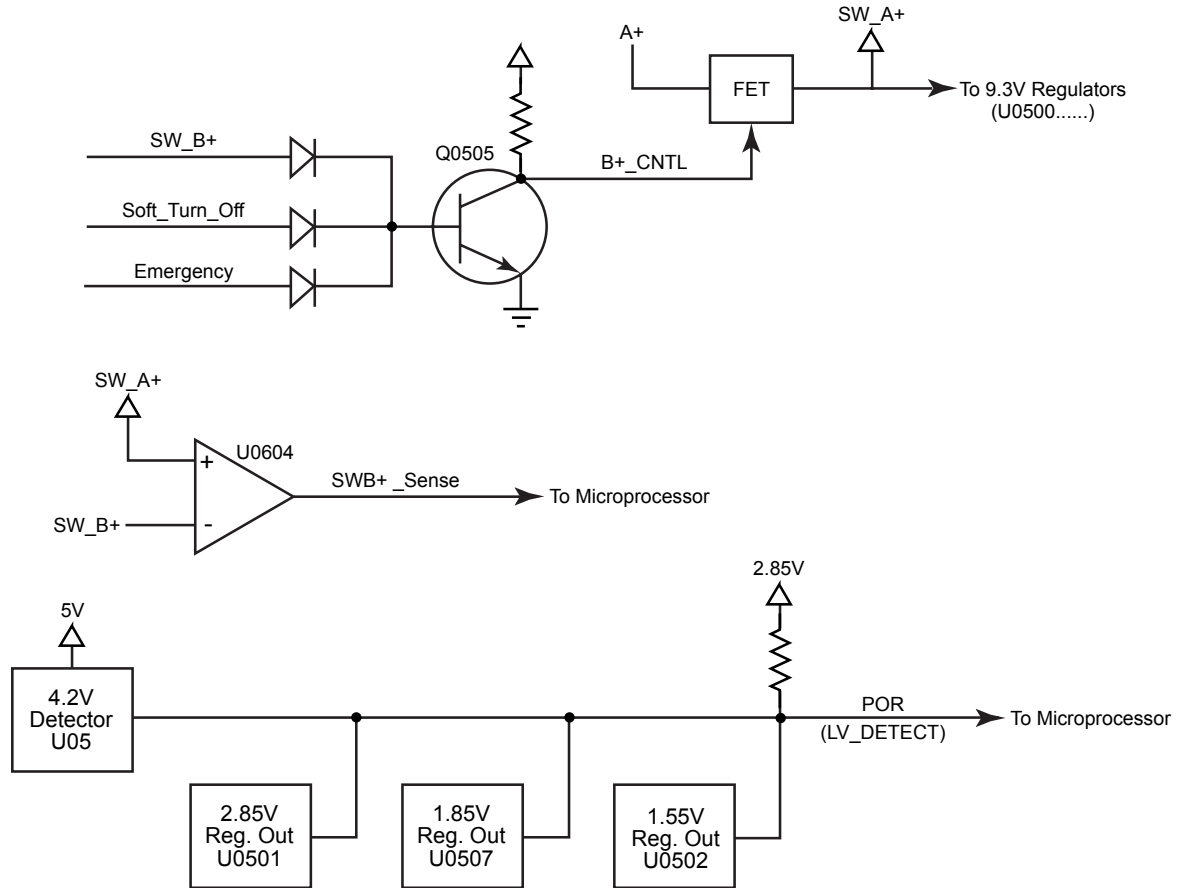
The various voltages used by the ICs on the main board are shown in Table 3-11.

Table 3-11. Integrated Circuits Voltages

Integrated Circuit	UNSW5V	SW 5V	A+	3.0 V	2.85 V	9.3 V _T X	1.85 V	1.55 V
Patriot Microprocessor					U100		U100	U100
Flash							U102	
SRAM							U103	
A/D				U0953-28				
D/A				U0959-4				
Modulation D/A					U0900-3 FL0900-4			
Urchin					U0901			
RS-232 XCVR		U0305-16						
USB XCVR					U0304-7			
Audio PA			U0204-7					
CODEC					U200-6			
Amplifiers, EPOTs					U0201-4 U0202-3			
555 Timer	U0506-4							
SB9600 MUX		U606-16						
Volume Pot		U0206-7						
32K Crystal					Y0100-5			
Modulation MUX					U0902-16			
Power Control						U0956-4 U0957-4 U0960-4		
Keyed 9.1 V Switch						Q0952		

3.14.3 Reset Circuits

The reset circuits consist of the power-on reset (POR*) circuit (Figure 3-45), SW_B+ sense circuit, and SB9600 bus reset circuit. These circuits allow the microprocessor to recover from an unstable condition, such as removing battery A+ from the radio while it is on, battery voltage too low, and miscommunication to remote devices on the SB9600 bus, as well as generally monitoring the power on/off condition.



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Figure 3-45. Power-On Reset Circuit

The SW_B+ and A+ voltage levels are sensed by the comparator circuit consisting of U0604, Q0505, and R0505, R0506, R0508, and R0509. When SW_B+ goes below 8.5 V or SW_A+ goes below 10 V, U0604-7, SW B+ Sense, goes low. When this occurs, the radio completes its soft power-down and eventually drives the Soft_Turn_Off line low, which turns off Q0502 and FET Q0503. This turns off SW_A+ and eventually turns off the 9-V, 5-V, 3-V, 2.85-V, 1.85-V, and 1.55-V regulators.

The POR* circuit consists of a wired-OR circuit of the error output lines from the 2.85-V, 1.85-V, and 1.55-V regulators, which indicates a failure of either of these regulators; and a reset output from a 4.2-V detector IC U0504. When either of the regulators fails or the 5-V supply begins to drop below 4.2 V, POR* is asserted low, resetting the microprocessor U100 at U001, LV_DETECT.

When the radio is operating correctly ($A+ > 10\text{ V}$ and $SW_B+ > 8.5\text{ V}$), SW_A+ and VOCON regulators U0501, U0502, and U05007 are at normal voltage. The POR* line and SW_B+_Sense are high (2.85 V).

The other signal that can cause a processor/radio reset is the SB9600 RESET line. The RESET line is driven high (5 V) by a remote device that is having problems communicating with the processor.

3.14.4 Power-Up/Power-Down Sequence

The XTL 1500 radio power is cycled via SW_B+ (battery voltage level). This voltage is supplied by the control head via J0401, pin 17, when the On/Off knob is cycled. SW_B+ is derived from the battery A+ voltage via a power FET in the control head.

3.14.4.1 Power Turn-On

When SW_B+ is active at turn-on time, the voltage turns on Q0501, Q0504, and Q0505, which then turns on SW_A+ via the power FET Q0503. SW_A+ then supplies all radio power (9.3-V regulators and controller regulators). SW_A+ is derived the same way SW_B+ is at the control head.

SW_B+ is also sent to the comparator circuit, U0604, which allows the processor to monitor its level via SW_B+_Sense (active high). When SW_B+ is sensed “on” by the processor, it asserts high an output line, Soft_Turn_Off, to the wired-OR turn-on circuit at Q0502. This active-high processor output is required for performing a soft power-down.

3.14.4.2 Power Turn-Off

At turn-off, SW_B+ becomes inactive at the control heads. As this voltage falls below 8.5 V, the U0604 comparator circuit drives SW_B+_Sense low, telling the processor to power down the radio. The processor eventually de-asserts low the SOFT_TURN_OFF signal after keeping the wired-OR turn-on circuit, and thus SW_A+ and all radio power, on long enough to perform a soft power-down, which includes deaffiliating on a trunked system, saving radio status parameters, etc. Once the SW_B+ and SOFT_TURN_ON lines are both low, Q0502 and Q0504 turn off, which provides a low at power FET Q0503. This turns off SW_A+, which removes all radio power.

3.14.4.3 Emergency Power-Up/-Down Sequence

The emergency input is provided to enable the radio transceiver to be activated, regardless of the state of the control head's On/Off switch. The emergency input is activated by opening the normally grounded footswitch connected to J0402, pin 28, of the controller. This input is routed to Q0501 and to the same wired or turn-on circuit and SW_A+ FET.

Under normal configurations, the output of Q0501 goes low to trigger pin 2 of a monostable vibrator U0506 causing the output pin 3 to go high. This enables the regulators through D0501 and Q0502. It also enables the EMERG_SENSE line to the MCU through U0508-1. The monostable vibrator is a timeout timer that holds the regulators on for 300 ms. This delay is required to allow the MCU to initiate its start-up vectors and poll the EMERG_SENSE line J17 of U0001. The MCU takes control of the regulators through D0501 and Q0502 by holding SOFT_TURN_OFF high.

The emergency active state depends on the emergency polarity into the timer. Normally with Q0501 present, emergency is active with the footswitch open. Removing Q0501 and adding R0527 causes the emergency to go active with the switch closed.

3.14.5 MCU and DSP System Clocks

The MCU within the Patriot IC (U100) needs two clocks for proper operation. A 16.8 MHz sine-wave reference is provided at the CKIH (A6) pin of the Patriot IC. The source of this clock is a 16.8 MHz oscillator and its associated filtering circuitry. This clock is also provided to the Urchin IC (U0901). The MCU has the capability of running at higher clock rates, which are programmable and based on this 16.8 MHz reference. The DSP within the Patriot IC also uses the 16.8 MHz provided at the CKIH (A6) pin as a reference.

The Patriot IC also requires a 32 kHz square-wave clock, provided at the CKIL (J7) pin. This clock is generated by a 32 kHz crystal (Y0100), with supporting circuitry for oscillation. This clock is utilized only for the Patriot IC, and is used for reset capability and other Patriot IC functions.

Four additional clocks are also supplied to the daughtercard: a 20 kHz RX frame-sync clock, a 48 kHz TX frame-sync clock, a 1.2 MHz RX data clock, and a 2.4 MHz TX data clock. The microprocessor also generates the digital audio bus clocks: a 512 kHz data clock and an 8 kHz frame-sync clock.

3.14.6 RS-232 USB Bus

The XTL 1500 microcontroller in the Patriot IC (U100) has two internal UARTS that can be configured for RS-232 data communication: UARTA and UARTB (Figure 3-46).

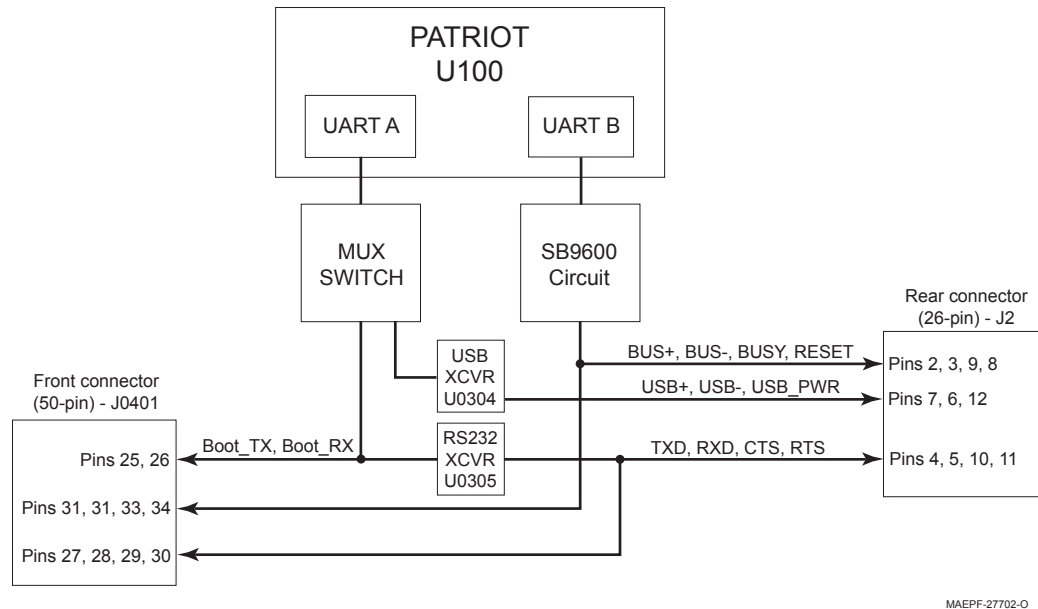


Figure 3-46. Patriot IC (U100) UART Configuration

UARTA is configured for RS-232 data transmission by default, and its data transmission is routed through an on-board RS-232 transceiver (U0305) to bring the data voltage levels up to EIA RS-232 standards before the data exits the front and rear of the radio. The U0305 is a two-driver, two-receiver device, protected against ± 15 kV electrostatic discharges.

For data output, UARTA transmits data from the microcontroller at 0-V and 2.85-V levels. This data is sent on an asynchronous serial bus, which is routed to an on-board RS-232 transceiver (U0305) that converts these low-voltage levels to -9 V and +9 V signal levels. This RS-232-formatted data is routed out the front of the radio (J0401-27, J0401-28, J0401-29, J0401-30) and to the rear of the radio (J0402-7, J0402-8, J0402-9, J0402-10).

For data input, U0305 can accept up to ± 30 -V signal levels. These high levels are converted inside the U0305 down to 0-V and 5-V levels. Next these data levels are routed thru a buffer stage (U0303) which lowers the data to 0-V and 2.85-V levels. This is the required voltage levels for the input into the microcontroller.

This radio meets EIA compatibility with external data accessory devices. The naming scheme (see Table 3-12) used for the microcontroller's RS-232 lines sometimes conflict with EIA RS-232 naming schemes. This is due to the microcontroller's pin names versus I/O direction, compared to the EIA pin names versus I/O direction. Therefore, a matching naming scheme has been developed. If the pin is coming from the UART, the pin name has UART in the name. However, if you want to know how the EIA standard identifies the pin, a chart exists that provides the naming conversion. The shipping rear data cable automatically routes the pins according to the EIA standard, so interfacing to external data devices, such as computers, is done correctly. The naming scheme information is only needed when the rear connector is opened and the wires need to be identified for connection to a custom device. Note that the correct interfacing of RS-232 lines is "output line" to "input line". For example, the TX pin of one device connects to the RX pin of the other device, and the RTS pin of one device connects to the CTS pin of the other device. Never connect TX to TX, RX to RX, and so on.

Table 3-12. Rear Connector Naming Scheme

Radio Pin Direction	J2 Pin No.	J2 Pin Name	Pin Alternate Name	EIA-Compatible Name at Rear Conn. J2	P2 Rear Accessory Cable DB9 (Female) = DCE Interface		DB9 (Male) Serial Port Connector = DTE Interface	Data Device Pin Direction
Output	4	UARTA_TX	No Change	TX_DCE	TX_DCE = pin 2	<-->	pin 2 = RX_DTE	Input
Input	5	UARTA_RX	No Change	RX_DCE	RX_DCE = pin 3	<-->	pin 3 = TX_DTE	Output
Output	10	UARTA_CTS	Becomes RTS	RTS_DCE	RTS_DCE = pin 8	<-->	pin 8 = CTS_DTE	Input
Input	11	UARTA_RTS	Becomes CTS	CTS_DCE	CTS_DCE = pin 7	<-->	pin 7 = RTS_DTE	Output

Note: Connecting to a computer = DTE device
TX to RX and RTS to CTS

3.14.7 Serial Communications on the External Bus (SB9600)

The SB9600 bus is an asynchronous serial communication bus using a Motorola-proprietary protocol. It provides a means for the microcontroller within the Patriot IC (U100) to communicate with other hardware devices. In the radio, it communicates with hardware accessories connected to the accessory connector. Serial communications on this external bus uses three of the four SB9600 lines: BUS+ (J0402-3), BUS- (J0402-5), and BUSY (J0402-6) data lines originating from the microcontroller's secondary UART.

These three lines are bidirectional; therefore, numerous devices can be in parallel on the bus. All devices monitor the bus while data is being transmitted at a 9600-baud rate.

The microcontroller sends the data transmission from UARTB, onto the bus at 0-V and 2.85-V levels. Next, the software sets microcontroller SB96_RS232_EN to a logic HIGH. Buffers (U0602 and U0603) are now powered and the data is changed to the SB9600 format via pull-up and pull-down logic circuitry. SB96_RS232_EN also sets the data MUX (U0606) to route the new SB9600-formatted data to the correct lines at the rear of the radio (J0402-3, J0402-4, J0402-5, and J0402-6). Since SB96_RS232_EN is kept HIGH as the default state, the UARTB default function is for SB9600 data traffic only.

When the microcontroller sends data onto the bus, the microcontroller monitors the transmitted data as a collision-detection measure. If a collision is detected as a result of receiving a different data pattern, the microcontroller will stop transmission and try again; that is, when the RESET line (J0402-4) is used.

Data bus drivers for the BUS+ and BUS- lines are differentially driven, having BUS- inverted from the state of BUS+. The drivers are so designed that any of the devices on the bus can drive these lines to their non-idle state without loading problems.

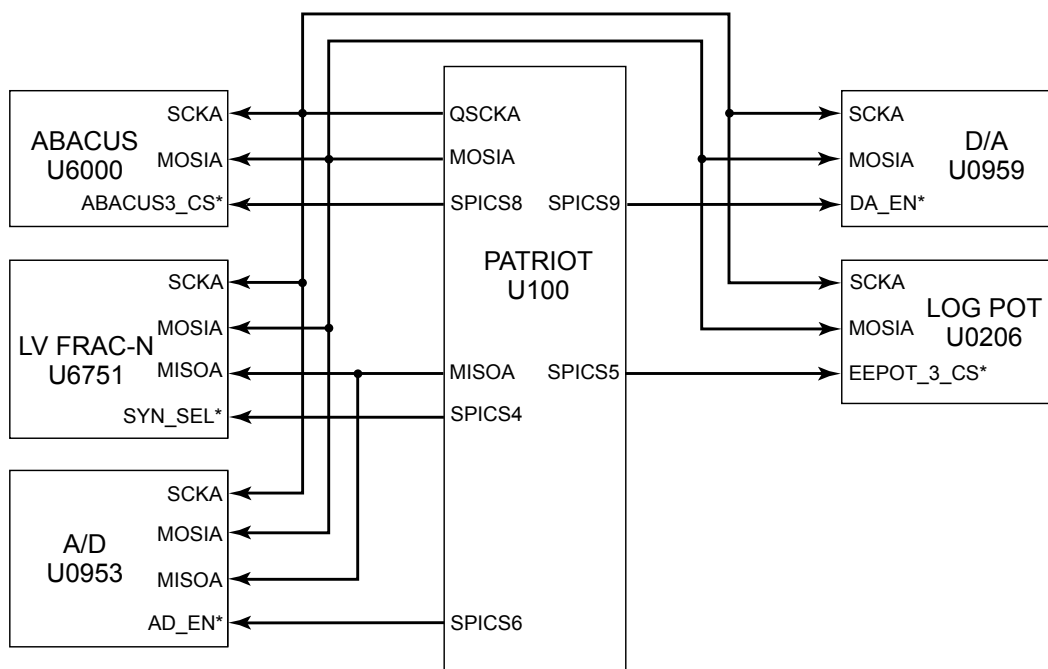
In a typical data transmission, the microcontroller examines the BUSY line. If the BUSY line is in the idle state, the microcontroller sets the BUSY line HIGH, and then it transmits using BUS+ and BUS-. At the end of the transmission, the microcontroller returns the BUSY line to idle.

The idle states for the SB9600 lines are: BUS+ = logic HIGH, BUS- = logic LOW, BUSY = logic LOW, and RESET = logic LOW.

3.14.8 Serial Peripheral Interface (SPI) Bus

The microcontroller (U100) utilizes an SPI bus for configuring and operating specific ICs in the controller and RF sections of the radio. The SPI bus is a synchronous serial bus made up of four lines (see Figure 3-47 on page 3-71). The CLK line is used to control the speed of the data to/from the IC and the microcontroller. If necessary, this clock speed can be adjusted to a different value for each IC.

The Data-OUT pin receives a data string from the microcontroller. The Data-IN pin sends a serial data string to the microcontroller, usually to indicate what the current programmed values are of the IC. The Chip Select pin is used to select which single IC is currently being programmed. Each ICs Chip Select pin is hardwired to a specific SPI bus and can only be controlled by that bus. The microcontroller pulls the ICs chip-select line LOW to enable the IC for receiving configuration data, for programming, or for sending out its existing configuration state. Additional SPI buses allow chip selecting to occur in parallel. Therefore, the operations on each SPI bus do not add any delay to the activities occurring on another SPI bus.



MAEPF-27820-O

Figure 3-47. Serial Peripheral Interface (SPI) Block Diagram

The following ICs are controlled and programmed by SPI_A:

- ABACUS III (U6000): Sigma Delta A/D converter and 2nd LO frequency adjust. The ABACUS III IC has a single pin for both input and output. Therefore, additional circuitry (U0103 and U0105) handles the SPI_MISO or the SPI_MOSI data lines from the microcontroller and allows a read or write operation to occur with the ABACUS III IC via a single bidirectional data line.
- A/D (U0953): monitors temperature, source voltage, PA current, feedback-voltage loop, forward-detected voltage, and reverse-detected voltage
- D/A (U0959) (microcontroller only writes to IC): controls bias stages 1-4, sets current limit, monitor thermistors, tuner overall RF power, and adjusts RX filter

- LV Frac-N (U6751) (microcontroller only writes to IC): scales the frequency from the VCO, control RX, and TX feedback loops
- EPOT (U0206) (microcontroller only writes to IC): controls the 32 steps of audio volume (vol=0: low to 15: high) that is routed to audio PA

3.14.9 Receive Audio

The controller processes all received signals digitally. This requires a unique back-end from a standard analog radio. This unique functionality is provided by the ABACUS III IC as the interface to the DSP. The ABACUS III IC (in the receive back-end section of the transceiver) provides a digital back-end for the receiver. It provides digital output data words at a 20 kHz sampling rate (refer to section “3.11. Receiver Back-End” for more details on ABACUS III IC operation). This data is passed to the DSP through the RX Baseband Interface Port (BBP). The SPI bus is used to configure the operation of the ABACUS III IC and is driven by the Patriot IC. ABACUS_DIN is the data line on which the RX data words are transferred from ABACUS III IC to the Patriot IC (refer to Figure 3-48 on page 3-72).

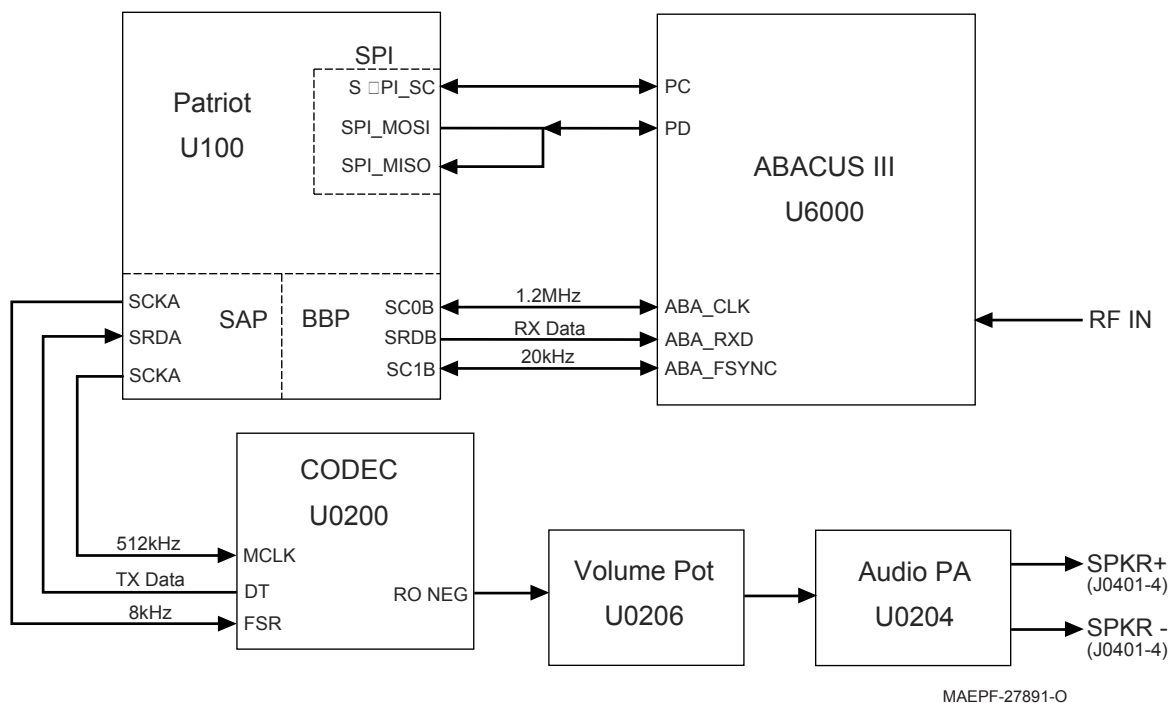


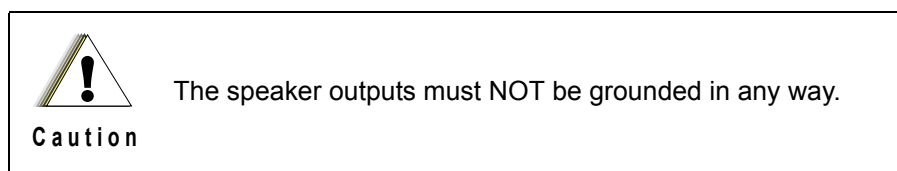
Figure 3-48. XTL 1500 RX Signal Path

The ABACUS III data is transferred to the Patriot IC at a 1.2 MHz bit rate, which is a synchronous clock provided by the ABACUS III IC. The 20 kHz interrupt clock, also provided by the ABACUS III IC, signals the arrival of a data packet and represents the sampling rate of the received data.

The DSP then processes this data to extract audio and signaling, perform filtering, alert-tone generation, etc. The DSP performs de-emphasis and discrimination before sending the discriminator data to the audio CODEC (U0200) via the SAP SSI bus. This bus is the digital audio bus consisting of the 512 kHz master bit clock (SAP_DCLK), and the 8 kHz frame sync (SAP_FSYNC). These clocks represent the data bit rate and sampling rate, respectively, for both the transmit and receive digital audio. For secure messages, the digital signal data must be passed to the secure module for decryption prior to DSP processing of the speaker data. The DSP transfers the data to and from the secure module through the SAP SSI port TXD and RXD signals. Configuration and mode control of the secure module is performed by the MCU through this bus.

The CODEC D/A analog output signal is routed to the RX_FILT_AUDIO line at both J0401 and J0402/J2 for legacy accessories and special applications products at an amplitude of 100 mV per kHz of deviation. The signal amplitude is independent of volume setting. This output is also routed to a multiplex switch, U0210, which is one source of audio to the audio PA speaker output. The alternate PA source, AUX_RX, is an input from J0401 and is used with vehicular repeater systems (VRS). The multiplexer output, normally received speaker audio, is routed to a volume control digital programmable potentiometer, U0206, and then to the audio PA (U0204) input. The audio PA output then drives the external speaker.

The audio power amplifier (U0204), is a DC-coupled-output, bridge-type amplifier. The gain is internally fixed at 40 dB. Speaker audio leaves U0204 on pins 4 and 6. For dash-mount radios, the audio is routed to the speaker via J0402, pins 19, 21, 23, and 25, and then to J2, pins 20 and 26. The amplifier is biased to one-half of the A+ voltage. An audio isolation transformer must be used if grounded test equipment, such as an audio analyzer or service monitor, is to be connected to the speaker outputs.



Normally, R0220 pulls up U0204, pin 8, to SW_B+ to enable the audio PA. When the radio is squelched, the audio PA is muted by the microprocessor. Q0200 is enabled to provide approximately 4.5 V through a voltage divider (Q0200 and R0222) to U0204, pin 8, which mutes the audio PA. When SW_B+ is turned off, the voltage from SW_A+ on U0204 falls below 2 V, placing the audio PA in standby, which turns off the U0204 output transistors to the speaker. Table 3-13 shows the voltages present at U0204, pin 8, during its various conditions.

Table 3-13. PA Condition Voltages at U0204, Pin 8

Power Amplifier Condition	U0204 Pin 8 (Vdc)
Standby	0-2
Mute	3.3-6.4
Enabled	8.5-17

3.14.10 Transmit Audio

The mobile microphone connects to the front of the control head through connector P104. Microphone audio (MIC_HI) enters the main board via J0401, pin 4, and is routed to multiplexer U0209 (refer to Figure 3-49 on page 3-74). Resistors R0200 and R0204 provide 9.6 Vdc bias voltage for the microphone's internal circuitry.

The multiplexer allows TX modulation audio to be routed from one of 3 possible sources: mobile microphone (MIC_HI), AUX_MIC (audio sourced from the J2 rear accessory connector in motorcycle configuration), or AUX_TX (audio from a VRS). The resulting audio source is then sent to a two-stage, programmable gain/attenuation circuit comprised of U0201 and U0202. The gain is accomplished via a programmable digital potentiometer in the amplifier circuit. This gain is adjustable via CPS and is programmed in ± 3 dB steps. After passing through an anti-aliasing filter, audio is sent to the input of the CODEC (U0200) where it is digitized via its internal A/D converter. The digital audio data is then sent via the SAP SSI bus to the DSP at the Patriot IC. As with speaker data samples, the DSP reads the microphone audio samples and processes, pre-emphasizes, filters, and adds signaling information to this data. As with the received trunking data, low-speed transmit data is processed by the MCU and returned to the DSP. For secure messages, the digital signal data can be passed to the secure module prior to DSP processing and modulation. The DSP transfers the data to and from the secure module through the SAP SSI transmit (TXD) and receive (RXD) lines.

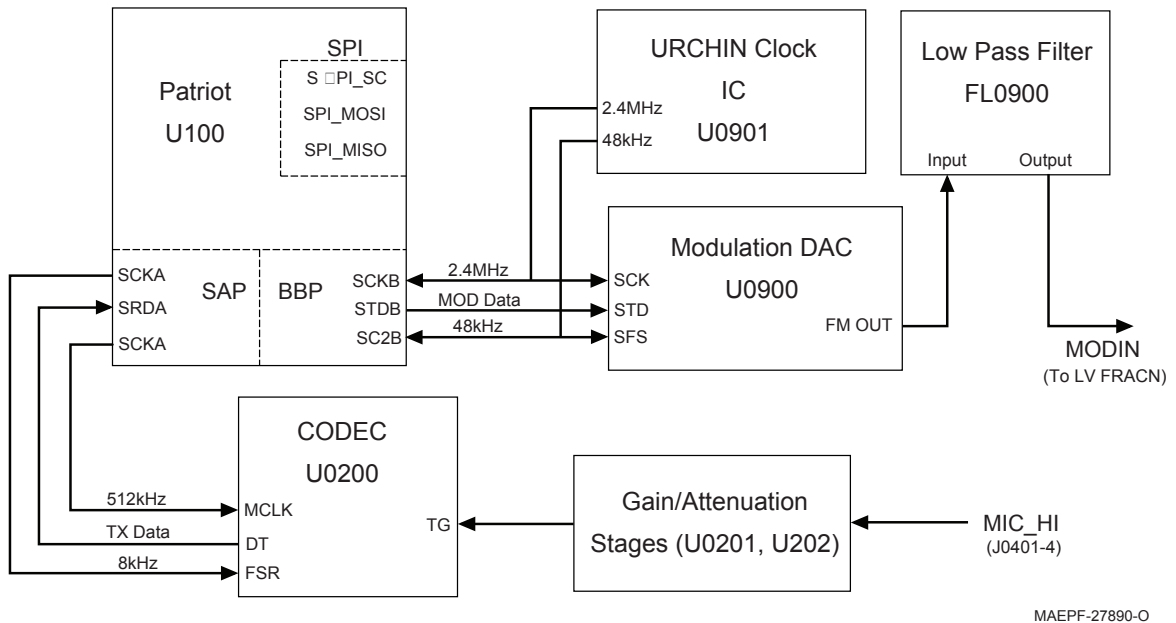


Figure 3-49. XTL 1500 TX Signal Path

After the DSP has finished its processing, filtering, and signaling on the audio data samples, it then sends this data to the modulation DAC (U0900) on the BBP SSI port, where it is converted to the analog modulation signal. The data is clocked over to the modulation DAC at a 2.4 MHz bit rate, with a frame sync (representing the transmit data sample rate) of 48 kHz. Both of these clocks are generated by the Urchin IC (U0901).

The modulation DAC audio output signal is sent to a switched capacitor low-pass filter (FL0900) that performs anti-aliasing filtering. The filter output is sent through a multiplexer switch, U0902, and finally on to the FGU/LV Frac-N synthesizer for modulation of the RF carrier signal.

3.14.11 Flash Programming

When the radio needs new program code, this can often be done by reflashing the FLASH ROM (U102) located on the daughtercard and the FLASH ROM (U1300) located on the control head. Reflashing is accomplished by using a programming cable (HKN6183) and the Motorola Customer Programming Software (CPS) FLASHport tool. The technique to flash the radio is the same as when using CPS or the TUNER software to change features on your radio. The software will first flash the codes into the U102 FLASH ROM and then proceed to U1300 FLASH ROM.

Two data lines are utilized on the programming cable to allow the computer to communicate with the microcontroller. These two lines are called USB_DP_UART_TX (J7000-8) and USB_DM_UART_RX (J7000-4) on the control head GCAI connector (see [Figure 3-50](#)).

The standard method of upgrading a radio's software and communicating between a computer and the radio microcontroller involves the use of the UART path via the programming cable. The UART lines from the GCAI connector connects to the OMAP applications processor in the control head in which the data will be routed to the transceiver patriot IC via SSI link.

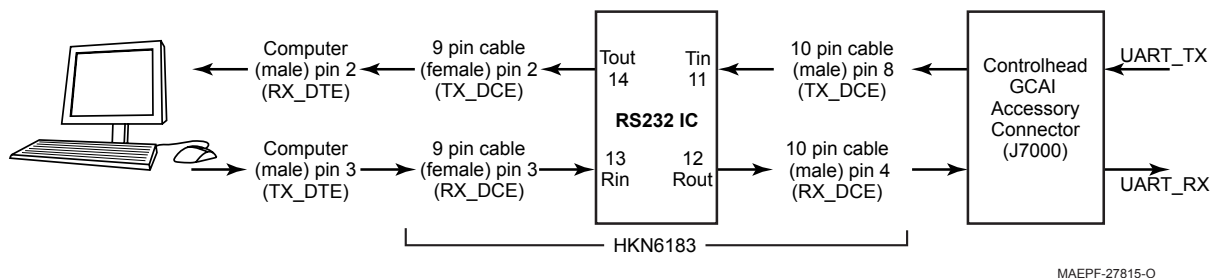


Figure 3-50. Boot RX and Boot TX Data Lines

The programming cable is detected by grounding GP10_0 on the GCAI connector and in turn the processor reads the one-wire memory in the same attached cable. If it determines from one-wire that a two-wire RS232 cable is attached, RS232 on GCAI is enabled. This would enable the computer to communicate with the OMAP applications processor and via SSI link allows the programming of the transceiver radio.

3.14.12 Reflashing/Upgrading Firmware

The FLASH IC is the firmware storage IC. Programming this IC is accomplished using one of the following input paths:

- Two-wire RS-232 directly from a computer's serial port to the radio's rear connector data cable HKN6160
- Two-wire RS-232 through an HKN6183 programming cable at the control head's 10-pin accessory port

For a list of all available programming cables, refer to the table below.

Table 3-14. Programming Cables

Motorola Part Number	Description	Application
HKN6183	Programming Flash Cable	Used with Tuner software, Customer Programming Software (CPS), and FLASHport
RVN4185	Customer Programming Software and Tuner Software	Programming and radio alignment software on CD
HKN6160	Cable Kit 6' Dash Mount Data (RS232)	Used for programming XTL 1500



Caution

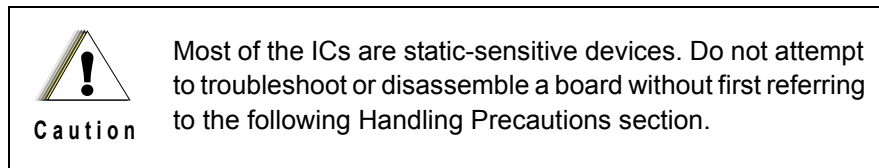
If you choose to reflash the radio (reflash the IC), DO NOT interrupt the process; otherwise, you might corrupt the FLASH IC and need advanced technical support to revive your radio.

NOTE: FLASH IC replacement is not supported as a field repair option. If the FLASH IC is removed, the radio cannot be reflashed by a customer or radio depot. This is because the FLASH IC must be hard-boot loaded at the factory to allow the programming of a unique file.

Chapter 4 Troubleshooting Procedures

4.1 Introduction

This section will aid you in troubleshooting a malfunctioning XTL 1500 radio. It is intended to be detailed enough to localize the malfunctioning circuit and isolate the defective component.



4.2 Handling Precautions

Complementary metal-oxide semiconductor (CMOS) devices and other high-technology devices, are used in the XTL 1500 radio. While the attributes of these devices are many, their characteristics make them susceptible to damage by electrostatic discharge (ESD) or high-voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair. Handling precautions are mandatory for this radio, and are especially important in low-humidity conditions. DO NOT attempt to disassemble the radio without observing the following handling precautions.

1. Eliminate static generators (plastics, Styrofoam, etc.) in the work area.
2. Remove nylon or double-knit polyester jackets, roll up long sleeves, and remove or tie back loose hanging neckties.
3. Store and transport all static-sensitive devices in ESD-protective containers.
4. Disconnect all power from the unit before ESD-sensitive components are removed or inserted unless otherwise noted.
5. Use a static-safeguarded workstation, which can be accomplished through the use of an anti-static kit (Motorola part number 01-80386A82). This kit includes a wrist strap, two ground cords, a static-control table mat and a static-control floor mat.
6. Always wear a conductive wrist strap when servicing this equipment. The Motorola part number for a replacement wrist strap that connects to the table mat is 42-80385A59.

4.2.1 Parts Replacement and Substitution

Special care should be taken to ensure that a suspected component is actually the one at fault. This special care will eliminate unnecessary unsoldering and removal of parts, which could damage or weaken other components or the printed circuit board (PCB) itself.

When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the component from the nearest Motorola Communications Parts facility.

4.2.2 Rigid Circuit Boards

The XTL 1500 radio uses bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, special considerations are required when soldering and unsoldering components. The printed-through holes might interconnect multiple layers of the printed circuit. Therefore, care should be exercised to avoid pulling the plated circuit out of the hole.

When soldering near module socket pins, be careful to avoid accidentally getting solder in the socket. Also, be careful not to form solder bridges between module socket pins. Closely examine your work for shorts caused by solder bridges. When removing modules with metal enclosures, be sure to unsolder the enclosure ground tabs as well as the module parts.

4.2.3 Heat-Related Precautions

During all repair procedures, heating neighboring components can be minimized by:

- Using upper heat only
- Using the correct size of heat-focus head, which should be approximately the same size as the carrier being replaced
- Keeping the heat-focus head approximately 1/8 in. (3-6 mm) above the printed circuit board when removing or replacing the device



Caution

Moisture-sensitive devices (MSD) are subject to die-bond (or other interface) delamination if heated above 185°C. To ensure that delamination does not occur, the PCB should be baked for eight hours at 125°C prior to repair if an adjacent MSD could potentially be exposed to 185°C or greater temperature during repair. Use 0.250 in. as the determining distance between the component being repaired and the MSD.

4.2.4 Daughtercard Module

The daughtercard module can be removed by desoldering. However, this only should be done as a last resort since the module cannot be reliably reattached to the main board, except with a new module, and contains extremely small parts that can be easily lost. Therefore, it is recommended that when troubleshooting an XTL 1500 radio, avoid removing and replacing large sections for an expected quick fix.

4.2.4.1 SRAM

Each of the daughtercard module's three sections are attached to the module using BGA (Ball Grid Array) solder-attachment technology, and once removed, cannot be reliably reattached. Also, because of the dense grouping of the solder balls, heating of the part and doing a slight tap to fix presumed cold-solder joints usually only results in smearing the solder and shorting the solder balls.

4.2.4.2 Testing


The daughtercard module is tested prior to placement on the main board. However, this is done with proprietary software that is not available outside Motorola. Also, because of the high density of the solder balls, the pins of the three ICs are not exposed to the outside world for test probing.

4.3 Voltage Measurement and Signal Tracing

In most situations, the problem circuit may be identified using a DC voltmeter, RF millivoltmeter, and oscilloscope (preferably with 100 MHz bandwidth or more). The “Recommended Test Equipment, Service Aids, and Tools” section in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/ 700–800 MHz Mobile Radio Basic Service Manual (6815853H01)* outlines the recommended tools and service aids which would be useful. Of special note are:

- 30-80370E06 Extender Cable which provides an extension cable for VOCON board connector J501 and command board connector P501
- RPX-4725C Command and Control Service Cable Kit which provides extension cables for servicing digital and analog circuits
- RPX-4724B RF Service Cable Kit which provides interface cables needed to service the RF boards

In some cases DC voltages at probe points are shown in red on the schematics. In other areas diagrams are included to show time-varying signals, which should be present under the indicated circumstances. It is recommended that a thorough check be made prior to replacement of any IC or part. If the probe point does not have a signal reasonably close to the indicated one, a check of the surrounding components should be made prior to replacing any parts.

 <p>Caution</p>	<p>When checking a transistor or module, either in or out of circuit, do not use an ohmmeter having more than 1.5 Vdc appearing across test leads or use an ohms scale of less than x100.</p>
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4.4 Power-Up Self-Check Errors

When the radio is turned on (power-up), the radio performs cursory tests to determine if its basic electronics and software are in working order. Problems detected during these tests are presented as error codes on the radio’s display. The presence of an error should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors inhibit user operation; non-fatal errors do not. Table 4-1 will aid in understanding particular power-up error code displays.

Table 4-1. Power-Up Self-Check Error Codes

Error Code	Description	Error Type	Corrective Action
ERROR 01/02	FLASH ROM Codeplug Checksum	NON-FATAL	Re-flash the entire codeplug.
ERROR 01/12	Security Partition Checksum	NON-FATAL	Re-flash the codeplug sections.
ERROR 01/20	ABACUS Tune Failure	NON_FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Re-flash tuning (codeplug). • Replace ABACUS IC / resolder.
ERROR 01/22	Tuning Codeplug Checksum	NON-FATAL	<ul style="list-style-type: none"> • Re-flash tuning (codeplug). • Retune the radio using CPS.
FAIL 01/81	FLASH ROM Checksum	FATAL	Re-flash the firmware.
FAIL 01/82	FLASH ROM Codeplug Checksum	FATAL	Re-flash the codeplug or firmware.

Table 4-1. Power-Up Self-Check Error Codes (Continued)

Error Code	Description	Error Type	Corrective Action
FAIL 01/88	External RAM Error	FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Hard bootstrap and flash the firmware. • Replace the daughtercard.
FAIL 01/90	General Hardware	FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Replace the control head or flex.
FAIL 01/92	Security Partition Checksum	FATAL	Re-flash the codeplug sections.
FAIL 01/93	FlashPORT AUTHENT CODE Failure	FATAL	Re-flash the appropriate base codeplug to match the radio feature set.
FAIL 01/98	Internal RAM Failure	FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Hard bootstrap and flash the firmware. • Replace the daughtercard.
FAIL 01/A0	ABACUS IC Failure/Wrong ABACUS IC Version	FATAL	<ul style="list-style-type: none"> • Re-flash tuning (codeplug). • Retune the radio using CPS.
FAIL 01/A2	Tuning Codeplug Checksum	FATAL	<ul style="list-style-type: none"> • Re-flash tuning (codeplug). • Retune the radio using CPS.
FAIL 02/81	DSP ROM Checksum	FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Re-flash the DSP firmware (DSP is processor-dependent).
FAIL 02/88	DSP RAM Error	FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Re-flash the DSP firmware (DSP is processor-dependent).
FAIL 02/90	General DSP Hardware Failure	FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Re-flash the DSP firmware (DSP is processor-dependent). • Replace daughtercard.
FAIL 02/CO	Wrong Microprocessor Version	FATAL	<ul style="list-style-type: none"> • Re-flash the firmware. • Hard bootstrap and flash the firmware. • Replace the daughtercard.
ERROR 05/10	Control Head Hardware Error	NON-FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Replace the control head or flex.
FAIL 05/81	Control Head ROM Checksum Error	FATAL	Replace the control head.
ERROR 06/10	Aux Control Head Hardware Error	NON-FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Replace the control head or flex.
FAIL 06/81	Aux Control Head ROM Checksum Error	FATAL	Replace the auxiliary control head.
ERROR 08/10	Siren Hardware Error	NON-FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Check the siren cable connection.
FAIL 08/81	Siren ROM Checksum Error	FATAL	Replace the siren.
ERROR 09/10	Secure Hardware Error	NON-FATAL	Replace the secure module.

Table 4-1. Power-Up Self-Check Error Codes (Continued)

Error Code	Description	Error Type	Corrective Action
FAIL 09/90	Secure Hardware Fatal Error	FATAL	Replace the secure module.
ERROR 12/10	VRS Hardware Error	NON-FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Check the VRS cable connection.
FAIL 12/81	VRS ROM Checksum Error	FATAL	Replace the VRS.
ERROR 1C/10	Tone Remote Control (TRC) Hardware Error	NON-FATAL	<ul style="list-style-type: none"> • Turn the radio off, then on. • Check the TRC cable connection.
FAIL 1C/81	TRC ROM Checksum Error	FATAL	Replace the TRC.
Note: <ul style="list-style-type: none"> • Firmware=Radio HOST and DSP software files • Codeplug=Radio configuration software files. 			

4.5 Operational Error Codes

During radio operation, the radio performs dynamic tests to determine if the radio is working properly. Problems detected during these tests are presented as error codes on the radio's display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Table 4-2 will aid in understanding particular operational error codes.

Table 4-2. Operational Error Codes

Error Code	Description	Error Type	Corrective Action
FAIL 001	Synthesizer Out of Lock/ Radio band mismatch	NON-FATAL	<ul style="list-style-type: none"> • Re-flash the tuning (codeplug) • Re-flash the entire codeplug. • Replace the daughtercard.
FAIL 002	Personality Checksum or System Block Error	NON-FATAL	Re-flash the entire codeplug.

4.6 VHF (136–174 MHz) Band Main Board Troubleshooting

This information will help you troubleshoot the RF section of the VHF (136–174 MHz) band XTL 1500 radio. Use this information, along with the theory of operation and troubleshooting charts, to diagnose and isolate the cause of failures.

Prior to troubleshooting, it is important to review the theory of operation, including specific precautions and troubleshooting methods. Because much of the radio's circuitry operates at high frequencies, measurements must be taken very carefully. Notes and cautions are added to the text to alert you to this need in areas of greatest sensitivity. However, the need for extreme care does exist in all measurements and tests.

4.6.1 Display Flashes "FAIL 001"

This display indicates a synthesizer "out-of-lock" condition. The following information will help to trouble shoot the frequency generation unit to the component level. Perform the following checks to determine the mode of the Fail 001:

1. Determine if the "out-of-lock" condition occurs in either receive mode, transmit mode, or both. Also, check other frequencies programmed in the unit if available.

2. To determine if the "out-of-lock" is frequency or VCO dependant, place the unit into RF TEST Mode, as described in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual* (6815853H01) and step through each test channel. Table 4-3 indicates the frequency and Aux logic level for each test mode channel. In addition, Table 4-4 provides information about the frequency of operation for each VCO.

Table 4-3. Test Mode Channels

Test MODE	LV Frac-N TX Logic	TX Freq MHz	LV Frac-N RX Logic	RX Freq MHz
CHAN 1	AUX 2	136.0125	AUX 3	245.7125
CHAN 2	AUX 2	140.7625	AUX 3	250.4625
CHAN 3	AUX 2	145.5125	AUX 3	255.2125
CHAN 4	AUX 2	150.2625	AUX 3	259.9625
CHAN 5	AUX 2	154.9875	AUX 3	264.5875
CHAN 6	AUX 1	155.0125	AUX 4	264.7125
CHAN 7	AUX 1	159.7625	AUX 4	269.4625
CHAN 8	AUX 1	164.5125	AUX 4	274.2125
CHAN 9	AUX 1	169.2625	AUX 4	278.9625
CHAN 10	AUX 1	173.9875	AUX 4	283.5875

Table 4-4. VCO Frequency and Switching Logic

MODE	Frequency (MHz)	AUX1	AUX2	AUX3	AUX4
RX	245.65–264.65	LOW	LOW	HIGH	LOW
RX	264.65–283.65	LOW	LOW	LOW	HIGH
TX	155–174	HIGH	LOW	LOW	LOW
TX	136–155	LOW	HIGH	LOW	LOW

3. Continue troubleshooting by using the Fail 001 troubleshooting chart in Chapter 5.

4.6.2 VCO Hybrid Assembly

The VCO hybrid substrate is glued to the carrier board. The hybrid is not a field-repairable assembly. If a failure is indicated in this assembly, replace the entire carrier board.

4.6.3 Out-of-Lock Condition

The probable cause of an out-of-lock condition is a failure in the synthesizer circuit. If the voltages on the AUX 1*, AUX 2*, AUX3*, and AUX4* lines do not conform to required output frequency in Table 4-5, troubleshoot the synthesizer.

If the AUX 1* to AUX 4* voltages are correct but the synthesizer feedback level is not within the range indicated, troubleshoot the feedback path.

If the AUX 1* to AUX 4* voltages are correct and the synthesizer feedback level is correct but an out-of-lock condition persists, troubleshoot the synthesizer.

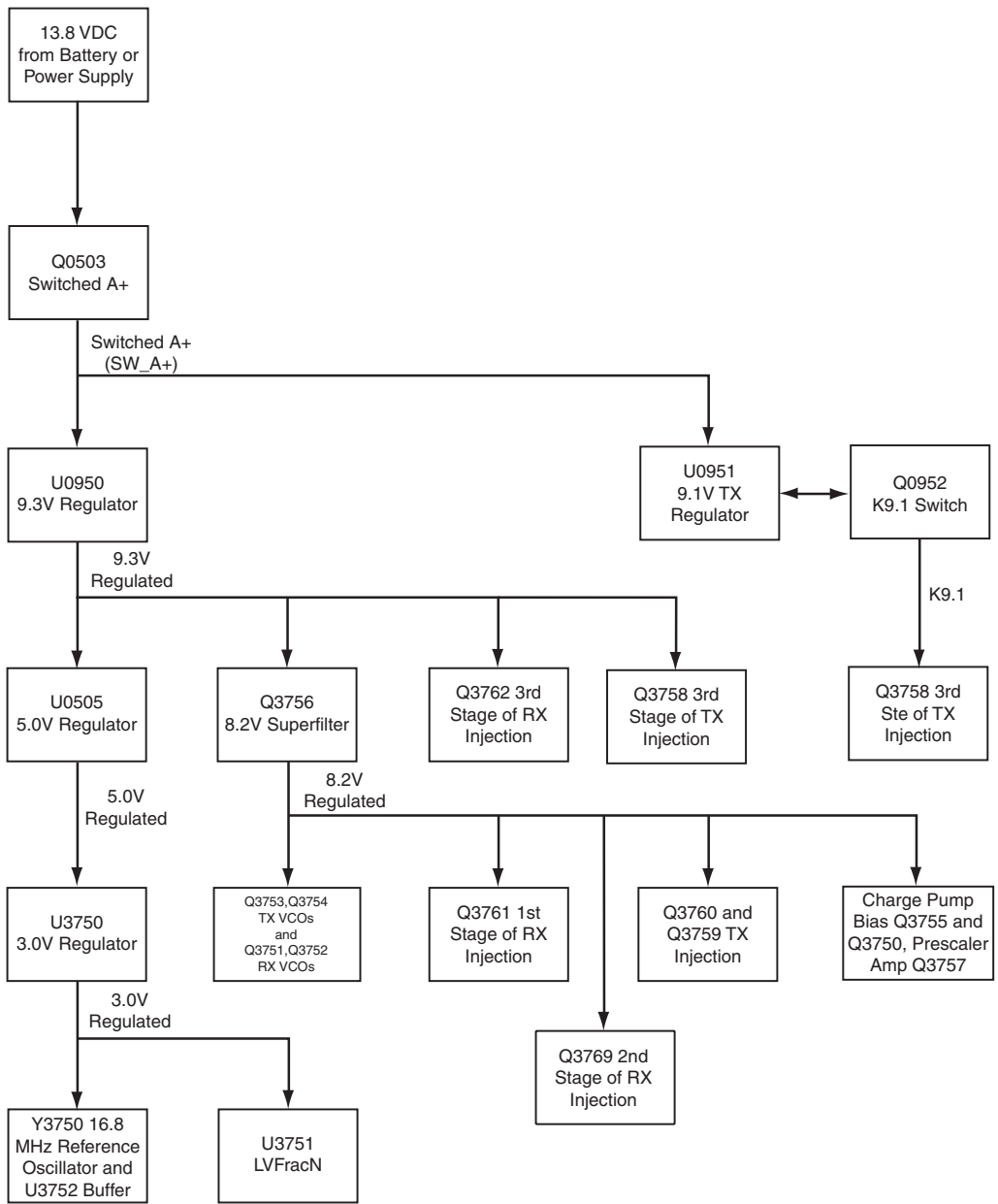
Table 4-5. AUX Output Frequency Requirements

Frequency Range	AUX 1	AUX 2	AUX 3	AUX 4	Output Frequency
	HI	LOW	LOW	LOW	136–155 MHz
	LOW	HI	LOW	LOW	155–174 MHz
	LOW	LOW	HI	LOW	245.65–264.65 MHz
	LOW	LOW	LOW	HIGH	264.65–283.65 MHz

4.6.4 FGU Troubleshooting Aids

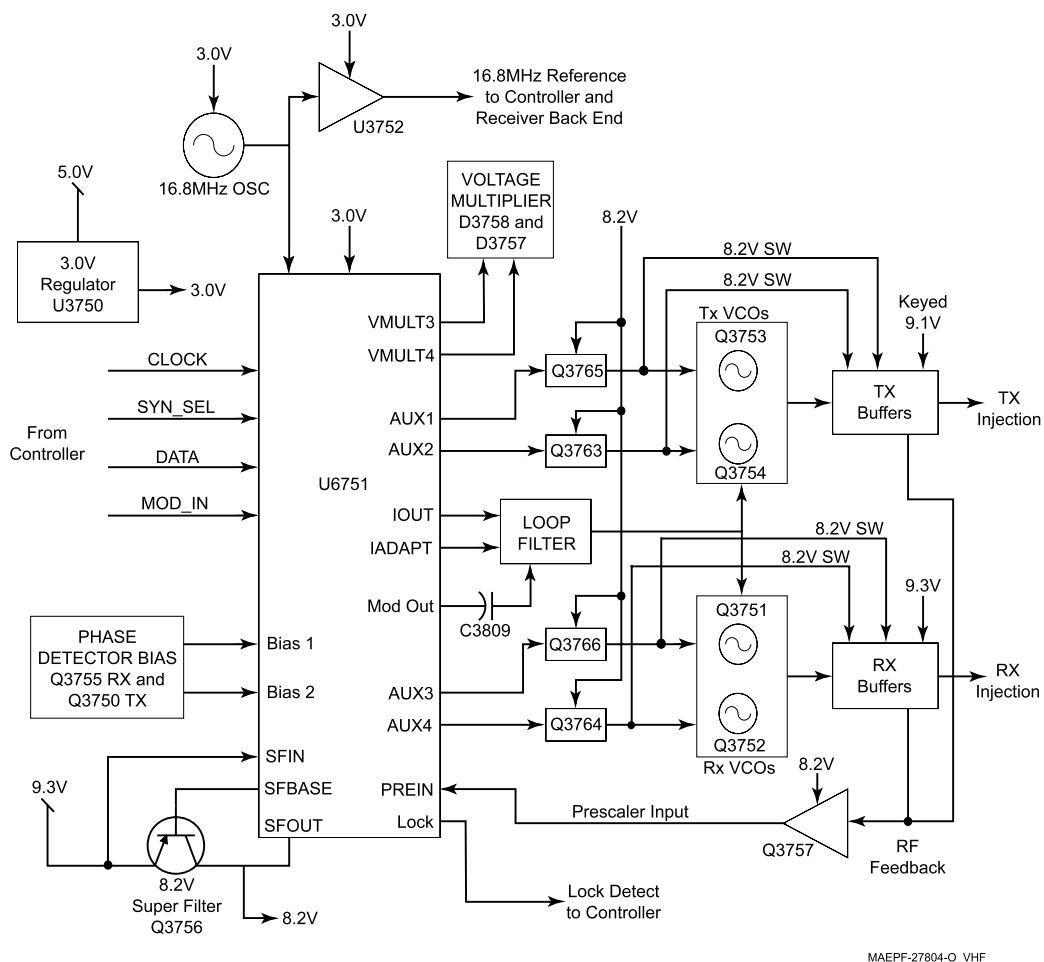
The following illustrations are additional service aids for troubleshooting the frequency generation unit.

- Figure 4-1 on page 4-8 is a block diagram of the DC distribution for the frequency generation unit.
- Figure 4-2 on page 4-9 is a block diagram of the frequency generation unit.
- Table 4-6 on page 4-9 describes the function of pins on the LV Frac-N IC U3751.
- Figure 4-3 on page 4-11 is a waveform representation during programming of the LV Frac-N IC U3751.



MAEPF-27803-O_VHF

Figure 4-1. Frequency Generator Unit DC Power Supply Distribution (VHF)



MAEPF-27804-O_VHF

Figure 4-2. Frequency Generation Unit Block Diagram (VHF)

Table 4-6. LV Frac-N U3751 Pin Descriptions (VHF)

Pin No.	Pin Name	Description
1	AUX2	Auxiliary logic output, high selects Low TX VCO
2	AUX3	Auxiliary logic output, high selects Low RX VCO
3	AUX4	Auxiliary logic output, high selects High RX VCO
4	LOCK	Lock detect—logic high indicates in-lock condition
5	PD_VDD	3.0-V supply (phase detector)
6	GROUND	Ground (digital)
7	DATA	SPI data I/O
8	CLK	SPI clock
9	CEX	SPI enable line—active low
10	MODIN	Modulation input from controller
11	VMULT4	Multiplier clock output
12	VMULT3	Multiplier clock output

Table 4-6. LV Frac-N U3751 Pin Descriptions (VHF) (Continued)

Pin No.	Pin Name	Description
13	VRO	3.0-V supply for reference oscillator warp circuitry
14	VMULT2	Not used
15	VMULT1	Not used
16	INDMULT	Not used
17	—	No connection
18	REFSEL	Not used
19	FREFOUT	Not used
20	AVDD	3.0-V supply (analog)
21	VBPASS	Not used
22	GND	Ground (analog)
23	XTAL1	16.8 MHz reference oscillator input
24	XTAL2	Not used
25	WARP	Reference oscillator warp output
26	SFCAP	Superfilter bypass node
27	SFBASE	Superfilter control node for Q6759
28	SFOUT	Superfilter output
29	—	No connection
30	SFIN	Superfilter supply input
31	—	No connection
32	PREIN	Prescalar input
33	GROUND	Ground (prescalar)
34	PRE_VDD	3.0-V supply
35	PVREF	Not used
36	DVDD	3.0-V supply (digital)
37	TEST1	Not used
38	TEST2	Not used
39	CPB2	Phase detector bias input
40	CPB1	Phase detector bias input
41	MODOUT	Modulation output
42	CCOMP	Not used
43	IOUT	Phase detector normal mode output
44	GND	Ground (phase detector)
45	IADAPT	Phase detector adapt mode output
46	ADAPTSW	Phase detector adapt switch
47	VCP	High-voltage supply for phase detector
48	AUX1	Auxiliary logic output, high selects Low TX VCO

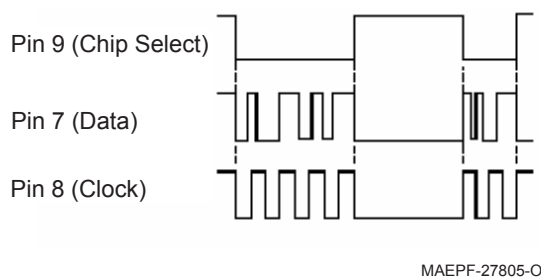


Figure 4-3. Waveform Representation During Programming of the LV Frac-N IC (U3751)

NOTE: The above waveforms are representations only.

4.6.5 No or Low Output Power (TX or RX Injection)

In addition to the schematic and theory of operation, refer to the transmitter injection troubleshooting flowchart and the receiver injection trouble shooting flowchart in Chapter 5. The charts will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter or receiver injection strings.

4.6.6 No or Low Modulation

In addition to the schematic and theory of operation, refer to the transmitter no TX Audio troubleshooting flowchart in Chapter 5. The chart will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter Audio section of the FGU.

4.6.7 Troubleshooting the Back-End

Refer to “5.6.4 RX Back-End—Poor SINAD or No Audio (136–174 MHz)—Part 1 of 3” on page 5-15.

4.7 UHF Range 1 (380–470 MHz) Band Main Board Troubleshooting

This information will help you troubleshoot the RF section of the UHF Range 1 (380–470 MHz) band XTL 1500 radio. Use this information, along with the theory of operation and troubleshooting charts, to diagnose and isolate the cause of failures.

Prior to troubleshooting, it is important to review the theory of operation, including specific precautions and troubleshooting methods. Because much of the radio’s circuitry operates at high frequencies, measurements must be taken very carefully. Notes and cautions are added to the text to alert you to this need in areas of greatest sensitivity. However, the need for extreme care does exist in all measurements and tests.

4.7.1 Display Flashes “FAIL 001”

This display indicates a synthesizer “out-of-lock” condition. The following information will help to trouble shoot the frequency generation unit to the component level. Perform the following checks to determine the mode of the Fail 001:

1. Determine if the “out-of-lock” condition occurs in either receive mode, transmit mode, or both. Also, check other frequencies programmed in the unit if available.
2. To determine if the “out-of-lock” is frequency or VCO dependant, place the unit into RF TEST Mode, as described in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual* (6815853H01) and step through each test channel. Table 4-7 on page 4-12 indicates the frequency and Aux logic level for each test mode channel. In addition, Table 4-8 on page 4-12 provides information about the frequency of operation for each VCO.

Table 4-7. Test Mode Channels UHF Range 1 (AUX 4 is not used for VCO selection in UHF)

Test Mode	AUX (TX Logic)			TX VCO	TX Freq (MHz)	AUX (RX Logic)			RX VCO	RX Freq (MHz)	RX VCO Freq (MHz)
	1	2	3			1	2	3			
Chan 1	0	0	0	Q5825	380.0250	0	1	0	Q5901	380.0750	489.7250
Chan 2	0	0	0	Q5825	391.4750	0	1	0	Q5901	391.4250	501.0750
Chan 3	0	0	0	Q5825	408.9750	0	1	0	Q5901	408.9250	518.5750
Chan 4	0	0	0	Q5825	424.9375	1	1	0	Q5903	424.9875	534.6375
Chan 5	1	0	0	Q5826	425.0250	1	1	0	Q5903	425.0750	534.7250
Chan 6	1	0	0	Q5826	436.0250	1	1	0	Q5903	436.0750	545.7250
Chan 7	1	0	0	Q5826	455.8750	0	0	1	Q5905	455.8250	565.4750
Chan 8	1	0	0	Q5826	469.9375	0	0	1	Q5905	469.9875	579.5750

NOTE: The UHF band radios use high-side injection with an IF frequency of 109.65 MHz; therefore, the receive VCO frequencies are 109.65 MHz higher than the selected radio channel frequencies.

Table 4-8. VCO Frequency Calculation and Switching Logic (UHF Range 1)

VCO	AUX1	AUX2	AUX3	VCO Frequency
RX VCO Q5901	0	1	0	489.65 ≤ f < 519.65
RX VCO Q5903	1	1	0	519.65 ≤ f < 549.65
RX VCO Q5905	0	0	1	549.65 ≤ f < 579.65
TX VCO Q5825	0	0	0	380 ≤ f < 425
TX VCO Q5826	1	0	0	425 ≤ f ≤ 470

NOTE: If a failure is indicated in any of the VCOs, whose operation is defined in the table above, then the respective circuit should be checked to ensure proper bias is being applied to the transistor. Specifically, the transistor collector pin should be at 8.2 V and base-emitter voltage should be on the order of 0.8 V. The steering line voltage should be in the range of 2 V for the lower frequency end of operation, and on the order of 11V at the upper frequency end of operation. There could be typically +/- 1 V deviation from the above quoted numbers, which allow for tolerances in the components. A clean, steady, frequency spike should be observed on a spectrum analyzer of typically -18 dBm at the end of the resistive pad in the collector circuitry of a properly working VCO.

3. Continue troubleshooting by using the Fail 001 troubleshooting chart in Chapter 5.

4.7.2 FGU Troubleshooting Aids

The following illustrations are additional service aids for troubleshooting the frequency generation unit.

- Figure 4-4 is a block diagram of the DC distribution for the frequency generation unit.
- Figure 4-5 on page 4-14 is a block diagram of the frequency generation unit.
- Table 4-9 on page 4-14 describes the function of pins on the LV Frac-N IC U5752.
- Figure 4-6 on page 4-16 is a waveform representation during programming of the LV Frac-N IC U5752.

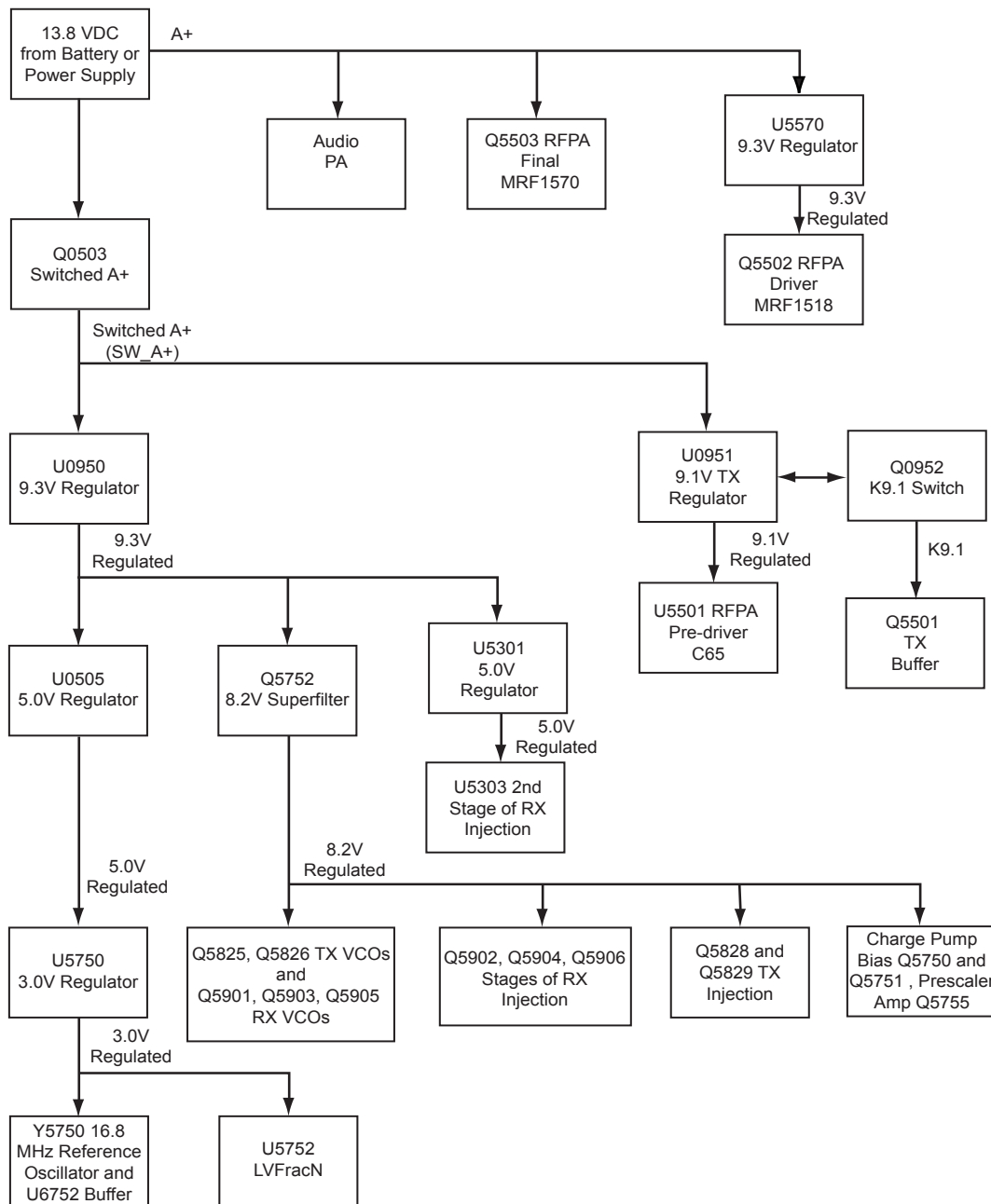


Figure 4-4. Frequency Generation Unit DC Power Supply Distribution (UHF Range 1)

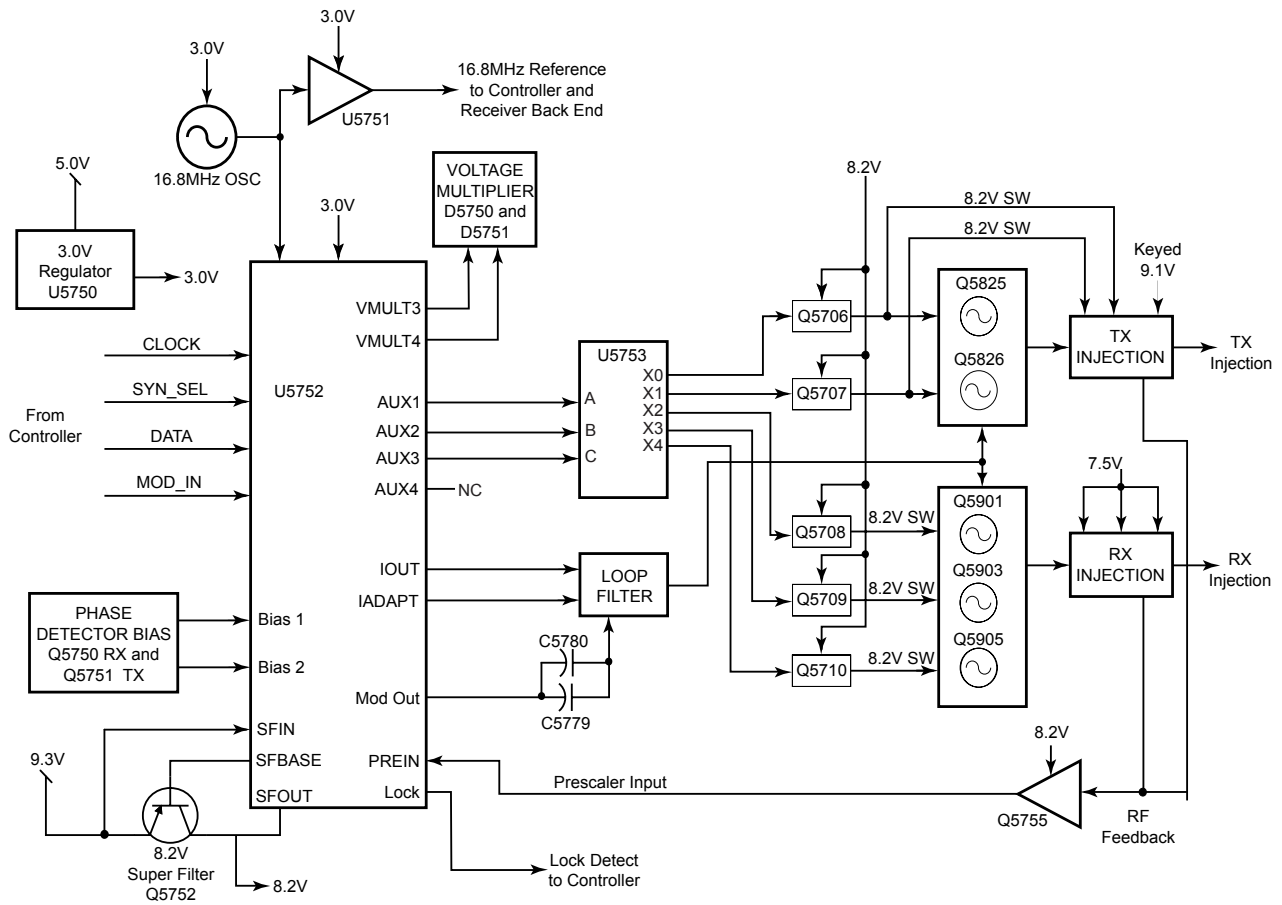


Figure 4-5. Frequency Generation Unit Block Diagram (UHF Range 1)

Table 4-9. LV Frac-N U6751 Pin Descriptions (UHF Range 1)

Pin No.	Pin Name	Description
1	AUX2	Auxiliary logic output
2	AUX3	Auxiliary logic output
3	AUX4	Auxiliary logic output
4	LOCK	Lock detect—logic high indicates in-lock condition
5	PD_VDD	3.0-V supply (phase detector)
6	GROUND	Ground (digital)
7	DATA	SPI data I/O
8	CLK	SPI clock
9	CEX	SPI enable line—active low
10	MODIN	Modulation input from controller
11	VMULT4	Multiplier clock output
12	VMULT3	Multiplier clock output
13	VRO	3.0-V supply for reference oscillator warp circuitry
14	VMULT2	Not used

Table 4-9. LV Frac-N U6751 Pin Descriptions (UHF Range 1) (Continued)

Pin No.	Pin Name	Description
15	VMULT1	Not used
16	INDMULT	Not used
17	—	No connection
18	REFSEL	Not used
19	FREFOUT	Not used
20	AVDD	3.0-V supply (analog)
21	VBPASS	Not used
22	GND	Ground (analog)
23	XTAL1	16.8 MHz reference oscillator input
24	XTAL2	Not used
25	WARP	Reference oscillator warp output
26	SFCAP	Superfilter bypass node
27	SFBASE	Superfilter control node for Q5752
28	SFOUT	Superfilter output
29	—	No connection
30	SFIN	Superfilter supply input
31	—	No connection
32	PREIN	Prescaler input
33	GROUND	Ground (prescaler)
34	PRE_VDD	3.0-V supply
35	PVREF	Not used
36	DVDD	3.0-V supply (digital)
37	TEST1	Not used
38	TEST2	Not used
39	CPB2	Phase detector bias input
40	CPB1	Phase detector bias input
41	MODOUT	Modulation output
42	CCOMP	Not used
43	IOUT	Phase detector normal mode output
44	GND	Ground (phase detector)
45	IADAPT	Phase detector adapt mode output
46	ADAPTSW	Phase detector adapt switch
47	VCP	High-voltage supply for phase detector
48	AUX1	Auxiliary logic output

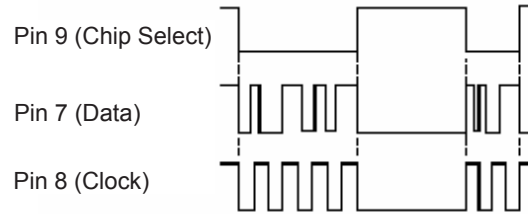


Figure 4-6. Waveform Representation During Programming of the LV Frac-N IC (U5752)

NOTE: The above waveforms are representations only.

4.7.3 Out-of-Lock Condition

The probable cause of an out-of-lock condition is a failure in the synthesizer circuit. If the voltages on the AUX lines do not conform to Table 4-8 on page 4-12, troubleshoot the synthesizer. If the AUX pins are correct, but the supply switch (Q5706, Q5707, Q5708, Q5709 or Q5710) to the in question VCO is not active with 8.2V at the VCO end, then troubleshoot the 3 to 8 multiplexer U5753 or the switch transistor packages.

If the AUX voltages are correct but the synthesizer feedback level is not within the range indicated at TP5783 (-6 to -11dBm), troubleshoot the buffer stages after the VCO. If the AUX voltages are correct and the synthesizer feedback level is correct but an out-of-lock condition persists, troubleshoot the synthesizer.

4.7.4 No or Low Output Power (TX or RX Injection)

In addition to the schematic and theory of operation, refer to the transmitter injection troubleshooting flowchart and the receiver injection trouble shooting flowchart in Chapter 5. The charts will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter or receiver injection strings.

4.7.5 No or Low Modulation

In addition to the schematic and theory of operation, refer to the transmitter no TX Audio troubleshooting flowchart in Chapter 5. The chart will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter Audio section of the FGU.

4.7.6 Troubleshooting the Back-End

Refer to “5.6.18 RX Back-End—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 1 of 3” on page 5-29.

4.8 UHF Range 2 (450–520 MHz) Band Main Board Troubleshooting

This information will help you troubleshoot the RF section of the UHF Range 2 (450–520 MHz) band XTL 1500 radio. Use this information, along with the theory of operation and troubleshooting charts, to diagnose and isolate the cause of failures.

Prior to troubleshooting, it is important to review the theory of operation, including specific precautions and troubleshooting methods. Because much of the radio's circuitry operates at high frequencies, measurements must be taken very carefully. Notes and cautions are added to the text to alert you to this need in areas of greatest sensitivity. However, the need for extreme care does exist in all measurements and tests.

4.8.1 Display Flashes “FAIL 001”

This display indicates a synthesizer “out-of-lock” condition. The following information will help to trouble shoot the frequency generation unit to the component level. Perform the following checks to determine the mode of the Fail 001:

1. Determine if the “out-of-lock” condition occurs in either receive mode, transmit mode, or both. Also, check other frequencies programmed in the unit if available.
2. To determine if the “out-of-lock” is frequency or VCO dependant, place the unit into RF TEST Mode, as described in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual* (6815853H01) and step through each test channel. Table 4-10 indicates the frequency and Aux logic level for each test mode channel. In addition, Table 4-11 on page 4-18 provides information about the frequency of operation for each VCO.

Table 4-10. Test Mode Channels UHF Range 2 (AUX 4 is not used for VCO selection in UHF)

Test Mode	AUX (TX Logic)			TX VCO	TX Freq (MHz)	AUX (RX Logic)			RX VCO	RX Freq (MHz)	RX VCO Freq (MHz)
	1	2	3			1	2	3			
Chan 1	1	0	0	Q5826	450.025	0	0	1	Q5905	450.075	559.725
Chan 2	1	0	0	Q5826	455.825	0	0	1	Q5905	455.625	565.275
Chan 3	1	0	0	Q5826	463.675	0	0	1	Q5905	463.625	573.275
Chan 4	1	0	0	Q5826	473.375	1	1	0	Q5903	473.325	582.975
Chan 5	1	0	0	Q5826	484.975	1	1	0	Q5903	484.925	594.575
Chan 6	0	0	0	Q5825	485.025	1	1	0	Q5903	485.075	594.725
Chan 7	0	0	0	Q5825	490.825	1	1	0	Q5903	490.875	600.525
Chan 8	0	0	0	Q5825	496.625	0	1	0	Q5901	496.675	606.325
Chan 9	0	0	0	Q5825	508.375	0	1	0	Q5901	508.325	617.975
Chan 10	0	0	0	Q5825	519.975	0	1	0	Q5901	519.925	629.575

NOTE: The UHF band radios use high-side injection with an IF frequency of 109.65 MHz; therefore, the receive VCO frequencies are 109.65 MHz higher than the selected radio channel frequencies.

Table 4-11. VCO Frequency Calculation and Switching Logic (UHF Range 2)

VCO	AUX1	AUX2	AUX3	VCO Frequency
RX VCO Q5905	0	0	1	559.65 ≤ f < 582.65
RX VCO Q5903	1	1	0	582.65 ≤ f < 605.65
RX VCO Q5901	0	1	0	605.65 ≤ f < 629.65
TX VCO Q5826	1	0	0	450 ≤ f < 485
TX VCO Q5825	0	0	0	485 ≤ f ≤ 520

NOTE: If a failure is indicated in any of the VCOs, whose operation is defined in the table above, then the respective circuit should be checked to ensure proper bias is being applied to the transistor. Specifically, the transistor collector pin should be at 8.2 V and base-emitter voltage should be on the order of 0.8 V. The steering line voltage should be in the range of 2 V for the lower frequency end of operation, and on the order of 11V at the upper frequency end of operation. There could be typically +/- 1 V deviation from the above quoted numbers, which allow for tolerances in the components. A clean, steady, frequency spike should be observed on a spectrum analyzer of typically -18 dBm at the end of the resistive pad in the collector circuitry of a properly working VCO.

3. Continue troubleshooting by using the Fail 001 troubleshooting chart in Chapter 5.

4.8.2 FGU Troubleshooting Aids

The following illustrations are additional service aids for troubleshooting the frequency generation unit.

- Figure 4-7 is a block diagram of the DC distribution for the frequency generation unit.
- Figure 4-8 on page 4-20 is a block diagram of the frequency generation unit.
- Table 4-12 on page 4-20 describes the function of pins on the LV Frac-N IC U5752.
- Figure 4-9 on page 4-22 is a waveform representation during programming of the LV Frac-N IC U5752.

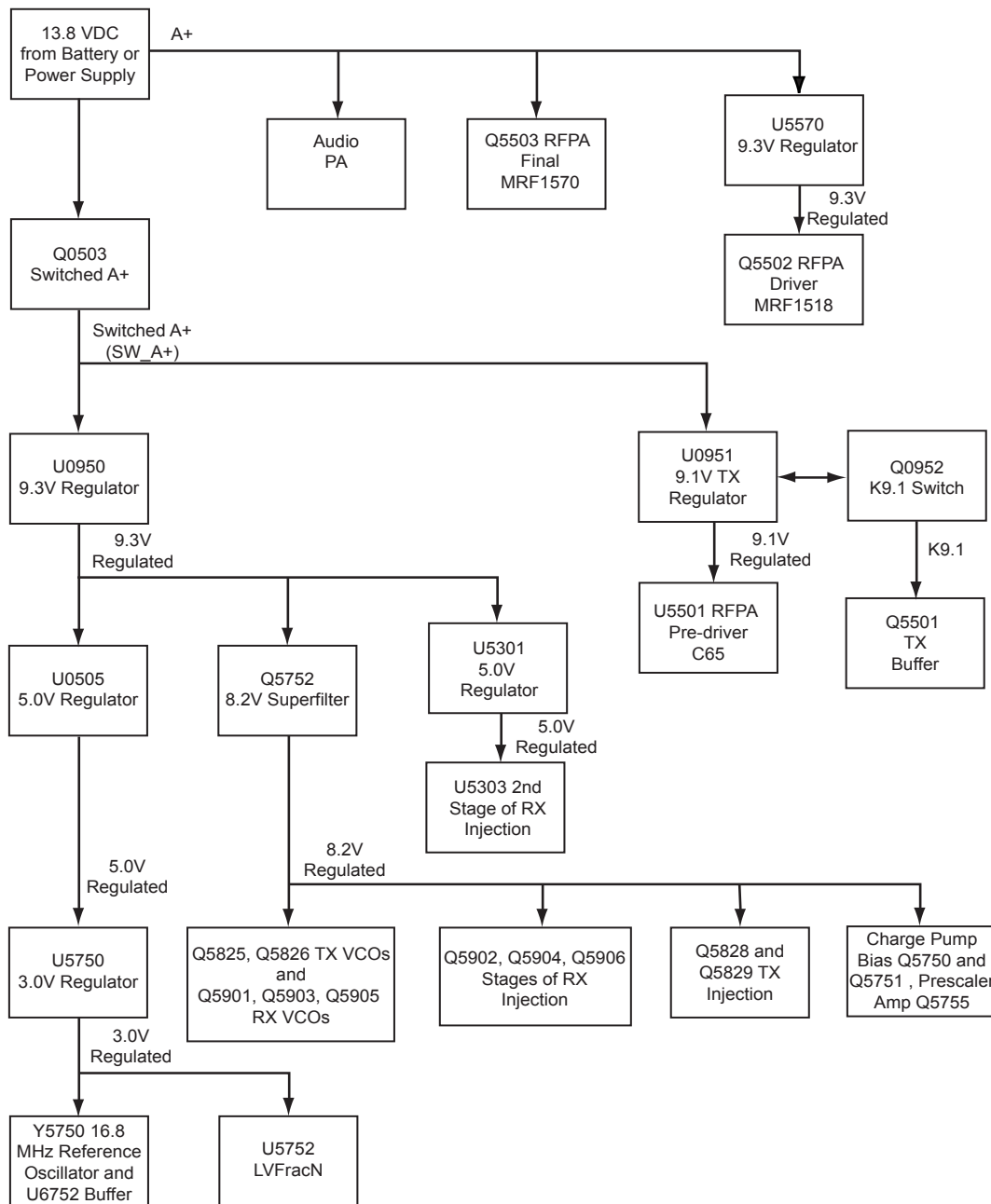


Figure 4-7. Frequency Generation Unit DC Power Supply Distribution (UHF Range 2)

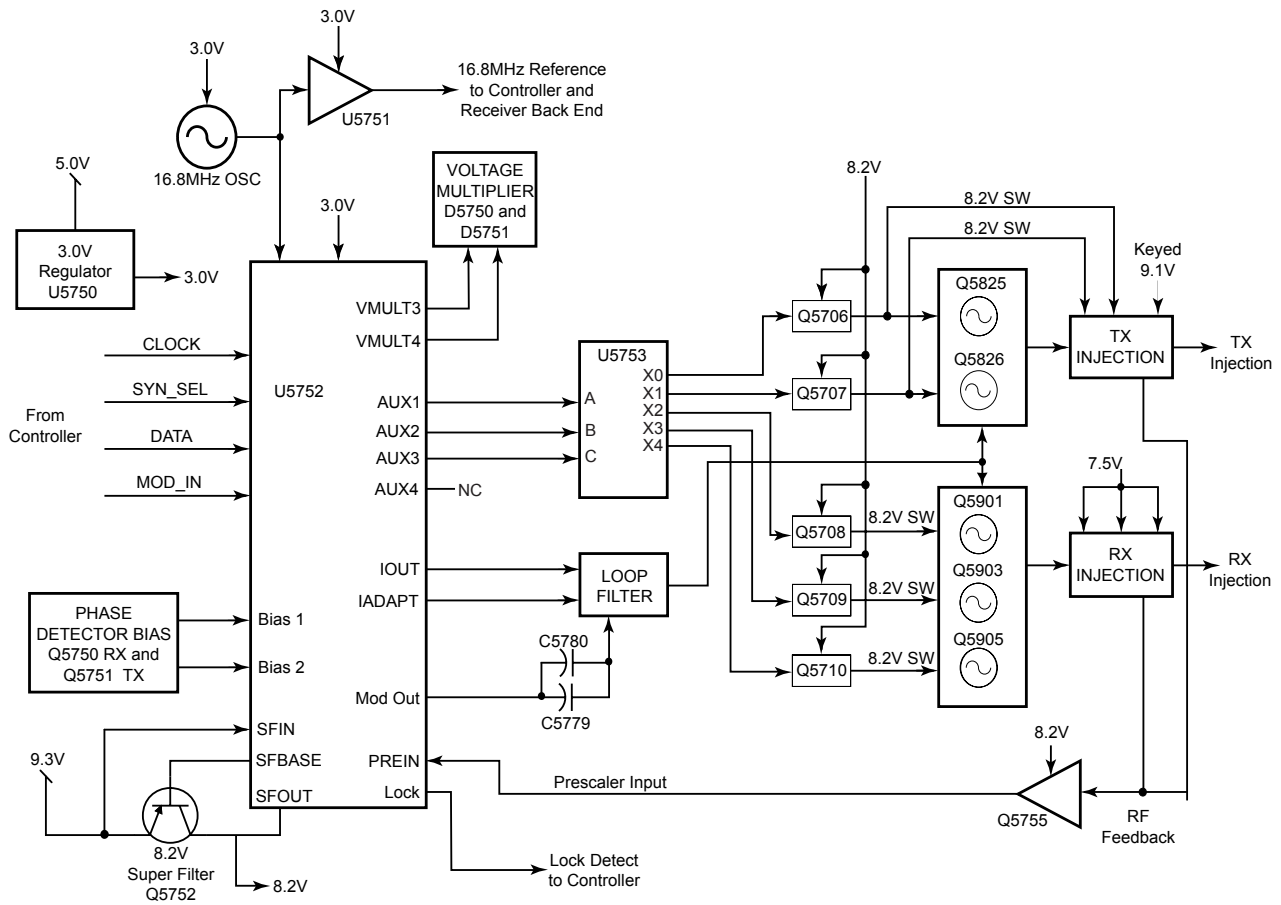


Figure 4-8. Frequency Generation Unit Block Diagram (UHF Range 2)

Table 4-12. LV Frac-N U6751 Pin Descriptions (UHF Range 2)

Pin No.	Pin Name	Description
1	AUX2	Auxiliary logic output
2	AUX3	Auxiliary logic output
3	AUX4	Auxiliary logic output
4	LOCK	Lock detect—logic high indicates in-lock condition
5	PD_VDD	3.0-V supply (phase detector)
6	GROUND	Ground (digital)
7	DATA	SPI data I/O
8	CLK	SPI clock
9	CEX	SPI enable line—active low
10	MODIN	Modulation input from controller
11	VMULT4	Multiplier clock output
12	VMULT3	Multiplier clock output
13	VRO	3.0-V supply for reference oscillator warp circuitry
14	VMULT2	Not used

Table 4-12. LV Frac-N U6751 Pin Descriptions (UHF Range 2) (Continued)

Pin No.	Pin Name	Description
15	VMULT1	Not used
16	INDMULT	Not used
17	—	No connection
18	REFSEL	Not used
19	FREFOUT	Not used
20	AVDD	3.0-V supply (analog)
21	VBPASS	Not used
22	GND	Ground (analog)
23	XTAL1	16.8 MHz reference oscillator input
24	XTAL2	Not used
25	WARP	Reference oscillator warp output
26	SFCAP	Superfilter bypass node
27	SFBASE	Superfilter control node for Q5752
28	SFOUT	Superfilter output
29	—	No connection
30	SFIN	Superfilter supply input
31	—	No connection
32	PREIN	Prescaler input
33	GROUND	Ground (prescaler)
34	PRE_VDD	3.0-V supply
35	PVREF	Not used
36	DVDD	3.0-V supply (digital)
37	TEST1	Not used
38	TEST2	Not used
39	CPB2	Phase detector bias input
40	CPB1	Phase detector bias input
41	MODOUT	Modulation output
42	CCOMP	Not used
43	IOUT	Phase detector normal mode output
44	GND	Ground (phase detector)
45	IADAPT	Phase detector adapt mode output
46	ADAPTSW	Phase detector adapt switch
47	VCP	High-voltage supply for phase detector
48	AUX1	Auxiliary logic output

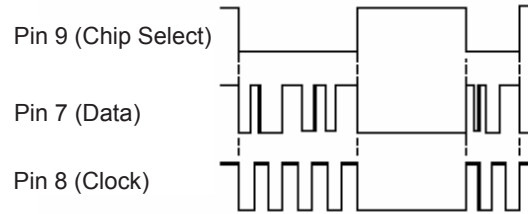


Figure 4-9. Waveform Representation During Programming of the LV Frac-N IC (U5752)

NOTE: The above waveforms are representations only.

4.8.3 Out-of-Lock Condition

The probable cause of an out-of-lock condition is a failure in the synthesizer circuit. If the voltages on the AUX lines do not conform to Table 4-11 on page 4-18, troubleshoot the synthesizer. If the AUX pins are correct, but the supply switch (Q5706, Q5707, Q5708, Q5709 or Q5710) to the in question VCO is not active with 8.2V at the VCO end, then troubleshoot the 3 to 8 multiplexer U5753 or the switch transistor packages.

If the AUX voltages are correct but the synthesizer feedback level is not within the range indicated at TP5783 (-6 to -11dBm), troubleshoot the buffer stages after the VCO. If the AUX voltages are correct and the synthesizer feedback level is correct but an out-of-lock condition persists, troubleshoot the synthesizer.

4.8.4 No or Low Output Power (TX or RX Injection)

In addition to the schematic and theory of operation, refer to the transmitter injection troubleshooting flowchart and the receiver injection trouble shooting flowchart in Chapter 5. The charts will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter or receiver injection strings.

4.8.5 No or Low Modulation

In addition to the schematic and theory of operation, refer to the transmitter no TX Audio troubleshooting flowchart in Chapter 5. The chart will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter Audio section of the FGU.

4.8.6 Troubleshooting the Back-End

Refer to “5.6.18 RX Back-End—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 1 of 3” on page 5-29.

4.9 700–800 MHz Main Board Troubleshooting

This information will help you troubleshoot the RF section of the 700–800 MHz XTL 1500 radio. Use this information, along with the theory of operation and troubleshooting charts, to diagnose and isolate the cause of failures.

Prior to troubleshooting, it is important to review the theory of operation, including specific precautions and troubleshooting methods. Because much of the radio's circuitry operates at high frequencies, measurements must be taken very carefully. Notes and cautions are added to the text to alert you to this need in areas of greatest sensitivity. However, the need for extreme care does exist in all measurements and tests.

4.9.1 Display Flashes “FAIL 001”

This display indicates a synthesizer "out-of-lock" condition. The following information will help to trouble shoot the frequency generation unit to the component level. Perform the following checks to determine the mode of the Fail 001:

1. Determine if the "out-of-lock" condition occurs in either receive mode, transmit mode, or both. Also, check other frequencies programmed in the unit if available.
2. To determine if the "out-of-lock" is frequency or VCO dependant, place the unit into RF TEST Mode, as described in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UF Range 2/700–800 MHz Mobile Radio Basic Service Manual* (6815853H01) and step through each test channel. Table 4-13 indicates the frequency and Aux logic level for each test mode channel. In addition, Table 4-14 provides information about the frequency of operation for each VCO.

Table 4-13. Test Mode Channels (700–800 MHz)

Test MODE	LV Frac-N TX Logic	TX Oscillator	TX Freq MHz	LV Frac-N RX Logic	RX Oscillator	RX Freq MHz
CHAN 1	AUX 1	U6754 osc1	762.0125	AUX 3	U6755 osc1	762.0625
CHAN 2	AUX 1	U6754 osc1	769.0125	AUX 3	U6755 osc1	769.0625
CHAN 3	AUX 1	U6754 osc1	775.9875	AUX 3	U6755 osc1	775.9375
CHAN 4	AUX 1	U6754 osc1	794.0125	AUX 4	U6755 osc2	851.0625
CHAN 5	AUX 1	U6754 osc1	805.9875	AUX 4	U6755 osc2	860.0625
CHAN 6	AUX 2	U6754 osc2	806.0125	AUX 4	U6755 osc2	860.0625
CHAN 7	AUX 2	U6754 osc2	823.9875	AUX 4	U6755 osc2	869.9375
CHAN 8	AUX 2	U6754 osc2	851.0125	AUX 4	U6755 osc2	851.0625
CHAN 9	AUX 2	U6754 osc2	860.0125	AUX 4	U6755 osc2	860.0625
CHAN 10	AUX 2	U6754 osc2	869.8875	AUX 4	U6755 osc2	869.9375

Table 4-14. VCO Frequency Calculation and Switching Logic (700–800 MHz)

MODE	Radio Frequency (MHz)	VCO Frequency Formula	VCO Frequency (MHz)	AUX 1	AUX 2	AUX 3	AUX 4
Rx	764.0125 - 775.9875	$F(U6755\ osc1) = F_c + 73.35\ MHz$	837.3625 - 849.3375	Low	Low	Hlgh	Low
Rx	851.0125 - 868.9875	$F(U6755\ osc2) = F_c - 73.35\ MHz$	777.6625 - 795.6375	Low	Low	Low	Hlgh
Tx (TA)	764.0125 - 775.9875	$F(U6754\ osc1) = F_c$	764.0125 - 775.9875	Hlgh	Low	Low	Low
Tx(RPTR)	794.0125 - 805.9875	$F(U6754\ osc1) = F_c$	794.0125 - 805.9875	Hlgh	Low	Low	Low
Tx(RPTR)	806.0125 - 823.9875	$F(U6754\ osc2) = F_c$	806.0125 - 823.9875	Low	Hlgh	Low	Low

Table 4-14. VCO Frequency Calculation and Switching Logic (700–800 MHz) (Continued)

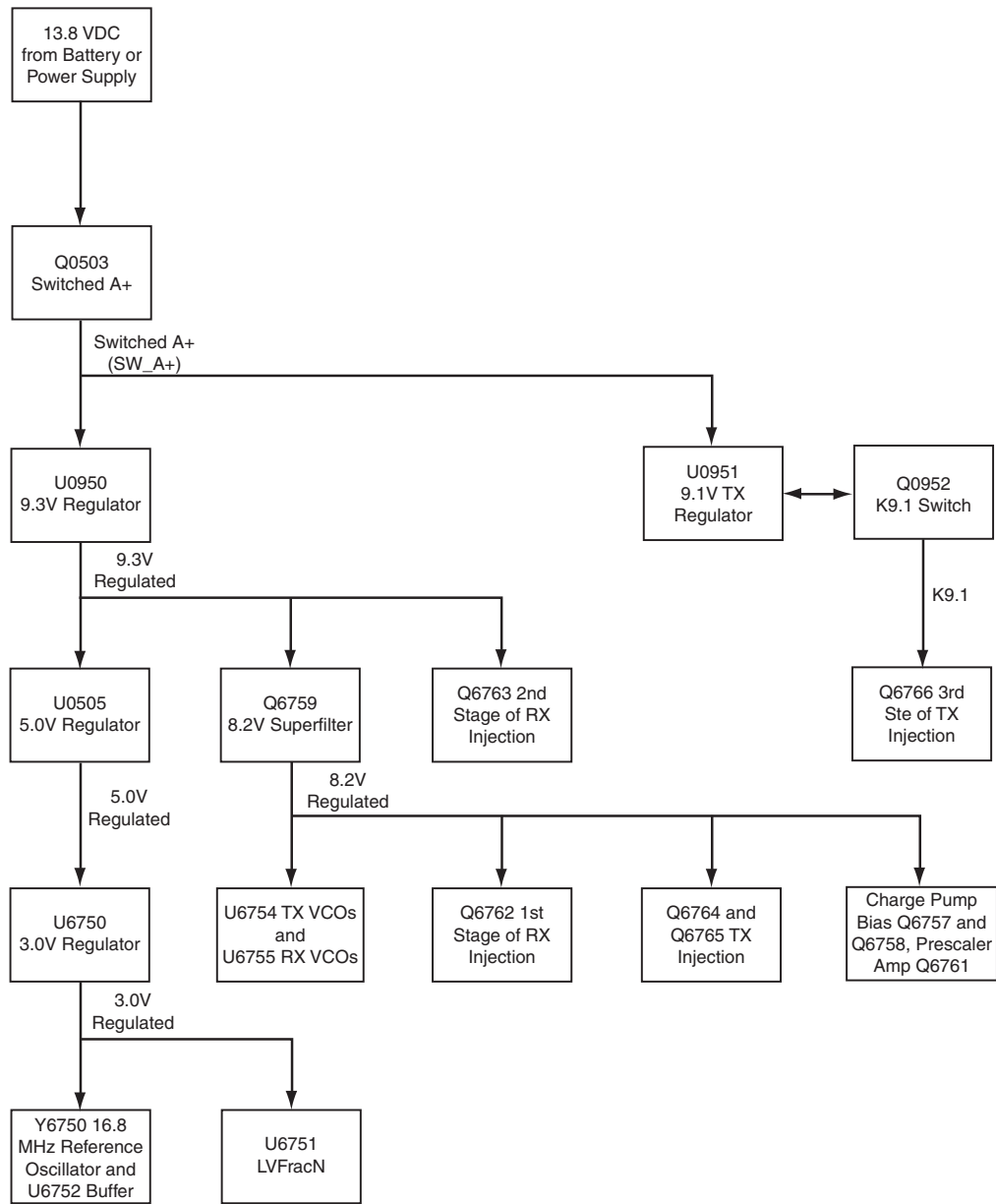
MODE	Radio Frequency (MHz)	VCO Frequency Formula	VCO Frequency (MHz)	AUX 1	AUX 2	AUX 3	AUX 4
Tx (TA)	851.0125 - 868.9875	$F(U6754 \text{ osc}2) = F_c$	851.0125 - 868.9875	Low	High	Low	Low
Tx (TA) = Talkaround Mode Tx(RPTR) = Repeater or trunked							

- Continue troubleshooting by using the Fail 001 troubleshooting chart in Chapter 5.

4.9.2 FGU Troubleshooting Aids

The following illustrations are additional service aids for troubleshooting the frequency generation unit.

- Figure 4-10 on page 4-25 is a block diagram of the DC distribution for the frequency generation unit.
- Figure 4-11 on page 4-26 is a block diagram of the frequency generation unit.
- Table 4-15 on page 4-26 describes the function of pins on the LV Frac-N IC U6751.
- Figure 4-12 on page 4-28 is a waveform representation during programming of the LV Frac-N IC U6751.



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Figure 4-10. Frequency Generation Unit DC Power Supply Distribution (700–800 MHz)

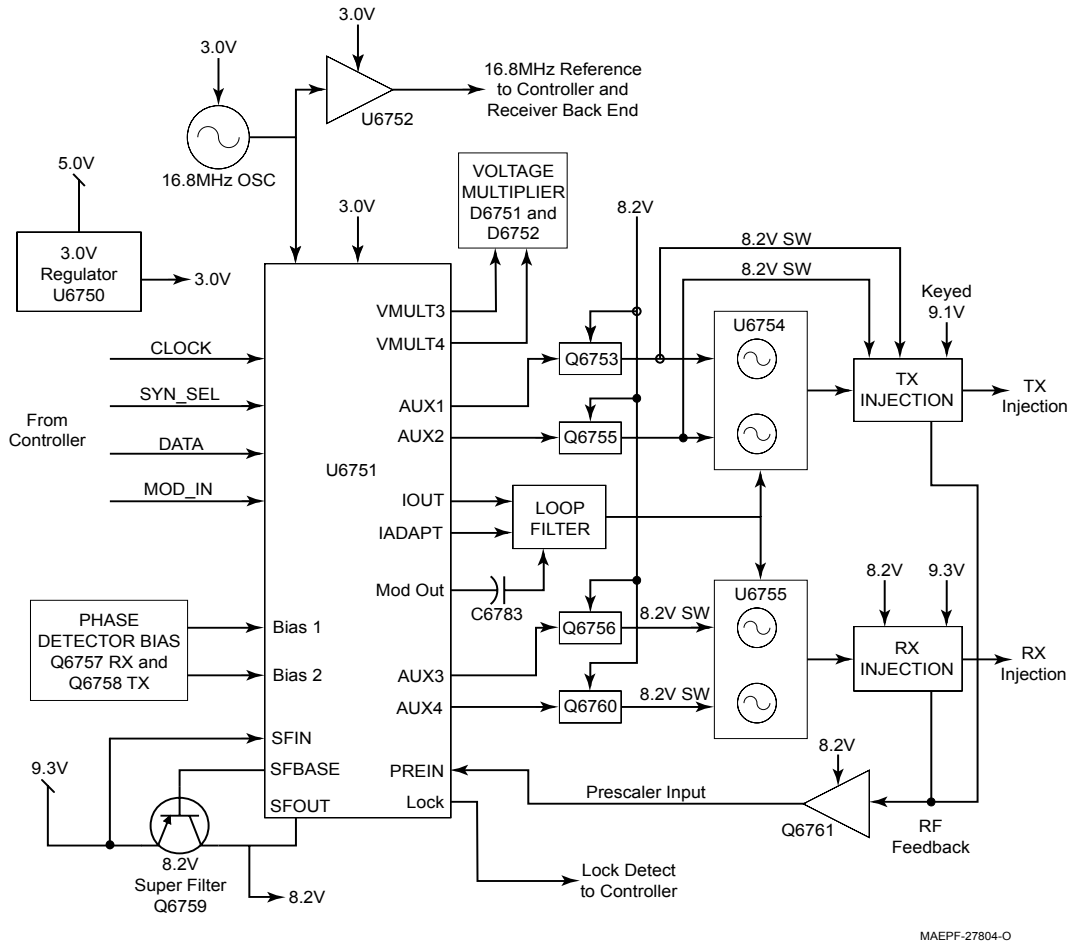


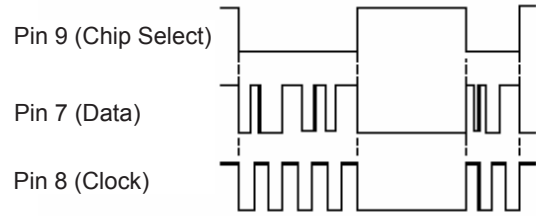
Figure 4-11. Frequency Generation Unit Block Diagram (700–800 MHz)

Table 4-15. LV Frac-N U6751 Pin Descriptions (700–800 MHz)

Pin No.	Pin Name	Description
1	AUX2	Auxiliary logic output, high selects U6754 OSC2
2	AUX3	Auxiliary logic output, high selects U6755 OSC1
3	AUX4	Auxiliary logic output, high selects U6755 OSC2
4	LOCK	Lock detect—logic high indicates in-lock condition
5	PD_VDD	3.0-V supply (phase detector)
6	GROUND	Ground (digital)
7	DATA	SPI data I/O
8	CLK	SPI clock
9	CEX	SPI enable line—active low
10	MODIN	Modulation input from controller
11	VMULT4	Multiplier clock output
12	VMULT3	Multiplier clock output

Table 4-15. LV Frac-N U6751 Pin Descriptions (700–800 MHz) (Continued)

Pin No.	Pin Name	Description
13	VRO	3.0-V supply for reference oscillator warp circuitry
14	VMULT2	Not used
15	VMULT1	Not used
16	INDMULT	Not used
17	—	No connection
18	REFSEL	Not used
19	FREFOUT	Not used
20	AVDD	3.0-V supply (analog)
21	VBPASS	Not used
22	GND	Ground (analog)
23	XTAL1	16.8 MHz reference oscillator input
24	XTAL2	Not used
25	WARP	Reference oscillator warp output
26	SFCAP	Superfilter bypass node
27	SFBASE	Superfilter control node for Q6759
28	SFOUT	Superfilter output
29	—	No connection
30	SFIN	Superfilter supply input
31	—	No connection
32	PREIN	Prescalar input
33	GROUND	Ground (prescalar)
34	PRE_VDD	3.0-V supply
35	PVREF	Not used
36	DVDD	3.0-V supply (digital)
37	TEST1	Not used
38	TEST2	Not used
39	CPB2	Phase detector bias input
40	CPB1	Phase detector bias input
41	MODOUT	Modulation output
42	CCOMP	Not used
43	IOUT	Phase detector normal mode output
44	GND	Ground (phase detector)
45	IADAPT	Phase detector adapt mode output
46	ADAPTSW	Phase detector adapt switch
47	VCP	High-voltage supply for phase detector
48	AUX1	Auxiliary logic output, high selects U6754 OSC1



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Figure 4-12. Waveform Representation During Programming of the LV Frac-N IC (U6751)

NOTE: The above waveforms are representations only.

4.9.3 No or Low Output Power (TX or RX Injection)

In addition to the schematic and theory of operation, refer to the transmitter injection troubleshooting flowchart and the receiver injection troubleshooting flowchart in Chapter 5. The charts will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter or receiver injection strings.

4.9.4 No or Low Modulation

In addition to the schematic and theory of operation, refer to the transmitter no TX Audio troubleshooting flowchart in Chapter 5. The chart will guide you through a sequence of tests and checks designed to isolate problems in the Transmitter Audio section of the FGU.

4.9.5 Troubleshooting the Back-End

Refer to “5.6.36 RX Back-End—Poor SINAD or No Audio (700–800 MHz)—Part 1 of 3” on page 5-47.

4.10 Standard Bias Tables

Table 4-16, below, outlines some standard supply voltages and system clocks that should be present during normal operation. These should be checked as a first step to any troubleshooting procedure.

Table 4-16. Standard Operating Bias: Power Lines

Nominal Value	Signal Name	Range/State	Probe Locations
13.8 V	A+ (at DC connector)	11.0 to 16.6 V	J0401-20, TP0414
13.8 V	IGNITION	11.0 to 16.6 V	J0401-19, J0401-21
13.8 V	SW_A+ (on board only)	11.0 to 16.6 V	U0500-4, Q0503
13.8 V	SW_B+ (from C.H.)	11.0 to 16.6 V	TP0413, J0401-17
2.83 V	SW_B+_SENSE	No change	U0604-7
2.5 V	SW_B+_ON_OFF (on board only)	2 to 3 V	Q0505-1, Q0504-1
9.1 V	9.3V_ABACUS	No change	U0505-1
9.1 V	9.3V	No change	TP0951, TP0950

Table 4-16. Standard Operating Bias: Power Lines (Continued)

Nominal Value	Signal Name	Range/State	Probe Locations
9.18 V	9V	No change	U0500-5
5 V	5V_ABACUS	No change	U0505-3
5 V	VCC_5	No change	J0401-23, U0507-8, U0503-3, U0502-8, U0501-8
3 V	VCC_3	No change	U0962-5
2.85 V	LV_DETECT	When A+ drops too far below 9 V, this line goes to 0 V	U0504-1
2.85 V	STO (at microprocessor)	No change	TP0500
2.85 V	VCC_2.85	No change	U0501-1
1.86 V	Vpp	No change	TP0400
1.85 V	VCC_1.8	1.84 to 1.87 V	U0507-1
1.55 V	VCC_1.55	No change	U0502-1
1.42 V	VAG	No change	U0206-1, U0201-3

Note: Do not KEY UP unless the board is inside a chassis.

Table 4-17. Standard Operating Bias: Clock and Control Lines

Nominal Value	Signal Name	Range/State	Probe Locations
(See "Chapter 6 Troubleshooting Waveforms" on page 6-1)	SB9600__BUS +	Idle=High (4 V to 5 V)	J0402-3, J2-2
	SB9600__BUS -	Idle=Low (0 V)	J0402-5, J2-3
	SB9600__BUSY	Idle=Low (0 V)	J0402-4, J2-9
	SB9600__RESET	Idle=Low (0 V)	J0402-6, J2-8
Note: Use chassis as GND when measuring on an oscilloscope.			
(See "Chapter 6 Troubleshooting Waveforms" on page 6-1)	USB_PWR	5.1 V	J0402-12, J2-12
	USB_DATA +		J0402-11, J2-7
	USB_DATA -		J402-13, J2-6
Note: Use chassis as GND when measuring on an oscilloscope.			
(See "Chapter 6 Troubleshooting Waveforms" on page 6-1)	RS232__UARTA_TX	Output voltage level is the same as BOOT TX	TP0407, J2-7
	RS232__UARTA_RX	Input level depends on inputting device's levels	TP0408, J2-9
	RS232__UARTA_CTS	Flow control line—not used always	TP0409, J2-8

Table 4-17. Standard Operating Bias: Clock and Control Lines (Continued)

Nominal Value	Signal Name	Range/State	Probe Locations
	RS232__UARTA_RTS	Flow control line—not used always	TP0410, J2-10
Note: Use chassis as GND when measuring on an oscilloscope.			
Approx. 0 V	Emergency	Idle = deactivated = grounded	J2-15, J0402-28, TP0403
1.88 V	Emergency	Activated = ungrounded	J2-15, J0402-28, TP0403
Approx. 0 V	Emergency_sense	Deactivated	U508-4
2.85 V	Emergency_sense	Activated	U508-4
(See “Chapter 6 Troubleshooting Waveforms” on page 6-1)	SAP_TX	Idle = Radio ON	J0401-35
	SAP_RX	Idle = Radio ON	J0401-36
2.85 V	SAP_DCLK	Idle = Radio ON	U0401-37
0 V	SAP_FSYNC	Idle = Radio ON	U0401-38
(See “6.2.5 32 kHz Clock Waveform” on page 6-4)	32 kHz		U0102-4
(See “6.2.4 16.8 MHz Clock Waveform” on page 6-3)	16.8 Mhz		C0911 near U0903

Note: Do not KEY UP unless the board is inside a chassis.

Table 4-18. Standard Operating Bias: Audio Lines

Nominal Value	Signal Name	Range/State	Probe Locations
9.2 V	Mic_Hi	When microphone connected (expects 80 mV input) (line has microphone bias)	TP0402, J0401-4
9.2 V	Mic_Hi	When microphone disconnected	TP0402, J0401-4
13 V to 16 V	Mic_Hi	When programming cable inserted	TP0402, J0401-4
Note: Do not press the PTT unless the PCB is inside a chassis even for a moment to check a line. Permanent RF hardware damage can occur to the board due to no heatsinking.			

Table 4-18. Standard Operating Bias: Audio Lines (Continued)

Nominal Value	Signal Name	Range/State	Probe Locations
9.2 V	Aux_Mic = [A(tx)] (transmit audio)	Expects 300 mV input (APCO default) Expects 80 mV input (motorcycle use)	J0401-6, J2-23
2.84 V	Aux_PTT = [PTT]	Idle = High Active = Low Hard-wired PTT, which will mute or unmute Aux_Mic line	J0402-24, J2-16
1.4 Vdc to 25 Vdc (needs ext. cap)	Aux_TX (audio input)	300 mV line-level (no mic bias)	J0401-7
0 V	Aux_RX (audio input)	300 mV line-level (Audio PA In)	J0401-8
Note: The Mic_Hi audio overrides Aux_TX/Aux_Mic audio, and the speaker is always muted.			
0 V	Speaker +	Muted (output)	J2-21, U204-4
	Speaker -	Muted (output)	J2-20, U204-6
26v peak-to-peak @volume= 15+	Speaker +	Unmuted (output)	J2-21, U204-4
	Speaker -	Unmuted (output)	J2-20, U204-6
Note: Never ground speaker lines. They are differential, not single-sided. Use an oscilloscope probe on "Spk+" and oscilloscope-probe GND on "Spk-".			
2.85 V	Monitor	Idle = High Activate = Low	J2-22
2.84 V	Audio_PA_Enable		Q0200-1
1.3 V	RX_Filt_Audio = [A(rx)] (receive audio/audio output)	300 mV line-level output	J2-21, TP0204
0 V or 5 V	Chan_Act = [A(p)] (qualified audio presence)	Idle = Low (0v) Active = High (5 V)	J2-13
	HUB	This pin causes the control head to send SB9600 message to the radio, indicating when HUB is attached	P502-3

Note: Do not KEY UP unless the board is inside a chassis.

Table 4-19. Standard Operating Bias: VIP Lines (Dash Configuration)

Nominal Value	Signal Name	Range/State	Probe Locations
NA	VIP_OUT_1_5v	Not accessible	J0401-13
NA	VIP_OUT_2_5v	Not accessible	J0401-14
NA	VIP_IN_1_5v	Not accessible	J0401-15
NA	VIP_IN_2_5v	Not accessible	J0401-16
SW_B+ level	VIP_OUT_1_12v	Deactivate = relay closed	J0401-11, J2-18
0.3 V to 0.5 V		Activate = relay open	
SW_B+ level	VIP_OUT_2_12v	Deactivate = relay closed	J0401-12, J2-19
0.3 V to 0.5 V		Activate = relay open	

Note: The voltage levels on the microprocessor side are at 2.85 V levels. The microprocessor is not designed to drive the relay, but instead, is intended to drive the transistors inside the control head or on the interconnect board. Be careful when changing jumpers.

Note: The impedance of the relay is why the SW_B+ does not damage the VIP line. Never connect SW_B+ directly to a VIP line.

4.11 Receiver Front-End (RXFE)

This section provides band-specific troubleshooting procedures for the receiver front-end.

4.11.1 VHF (136–174 MHz) Band

Use this information, along with the theory of operation, to diagnose and isolate the cause of failures. The principle tools needed to troubleshoot a circuit to the component level are the schematic and the theory of operation.

In addition to the schematic and theory, you can use the troubleshooting flowcharts in "Chapter 5. Troubleshooting Charts" that will guide you through a sequence of tests and checks designed to isolate problems.

Prior to troubleshooting, it is important to review the theory of operation including specific precautions and troubleshooting methods. Because much of the radio's circuitry operates at a high frequency, measurements must be taken carefully.

4.11.2 UHF Range 1 (380–470 MHz) Band

Use this information, along with the theory of operation, to diagnose and isolate the cause of failures. The principle tools needed to troubleshoot a circuit to the component level are the schematic and the theory of operation.

In addition to the schematic and theory, you can use the troubleshooting flowcharts in "Chapter 5. Troubleshooting Charts" that will guide you through a sequence of tests and checks designed to isolate problems.

Prior to troubleshooting, it is important to review the theory of operation including specific precautions and troubleshooting methods. Because much of the radio's circuitry operates at 400 MHz, measurements must be taken carefully.

4.11.3 UHF Range 2 (450–520 MHz) Band

Use this information, along with the theory of operation, to diagnose and isolate the cause of failures. The principle tools needed to troubleshoot a circuit to the component level are the schematic and the theory of operation.

In addition to the schematic and theory, you can use the troubleshooting flowcharts in "Chapter 5. Troubleshooting Charts" that will guide you through a sequence of tests and checks designed to isolate problems.

Prior to troubleshooting, it is important to review the theory of operation including specific precautions and troubleshooting methods. Because much of the radio's circuitry operates at 400 MHz, measurements must be taken carefully.

4.11.4 700–800 MHz Band

Use this information, along with the theory of operation, to diagnose and isolate the cause of failures. The principle tools needed to troubleshoot a circuit to the component level are the schematic and the theory of operation.

In addition to the schematic and theory, you can use the troubleshooting flowchart in "Chapter 5. Troubleshooting Charts" that will guide you through a sequence of tests and checks designed to isolate problems.

Prior to troubleshooting, it is important to review the theory of operation including specific precautions and troubleshooting methods. Because much of the radio's circuitry operates at 800 MHz, measurements must be taken carefully.

4.12 Power Amplifier Procedures

This section provides band-specific troubleshooting procedures for the RF power amplifier (RFPA).

4.12.1 VHF (136–174 MHz) Band

Use this information, along with the theory of operation, to diagnose and isolate the cause of failures. The principle tools needed to troubleshoot a circuit to the component level are the schematic and the theory of operation.

Prior to troubleshooting, be sure to review the theory of operation including any precautions and troubleshooting methods.

4.12.1.1 50-Watt Power Amplifiers

In addition to the schematic and theory, this section includes troubleshooting information that will help you test and check the circuits to localize and isolate problems.

4.12.1.2 General Troubleshooting and Repair Notes

Most of the common transmitter symptoms are caused by either failure of the power amplifier or a failure in the control circuitry. The initial troubleshooting effort should be toward isolating the problem to one of those two areas. If either the control voltage or keyed 9.4 V are zero, then the problem is likely to be in the control circuit. If those voltages are present, then the problem is more likely in the power amplifier circuit.

If for diagnostic reasons, a chip component needs to be removed to facilitate testing, such as a series capacitor removed to allow for signal insertion, then the component(s) returned to the circuit should be new parts. The application of a soldering iron to many chip components will tend to cause leaching which could lead to failure.

After a PA board is replaced, or if any power control circuitry components are replaced, readjust the power according to instructions in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/ 700–800 MHz Mobile Radio Basic Service Manual*.

NOTE: Due to the high frequency of operation, it is imperative that you use specified Motorola parts when component replacement is necessary. At these frequencies, second and third order properties of the components are very important and are part of the circuit's design. Substitute components may not work. It is also critical that you use great care when replacing parts. Excessive solder or flux, longer than original leads on coax connectors, misorientation of parts, and other commonly benign imperfections may cause the radio's performance to degrade.

4.12.2 UHF Range 1 (380–470 MHz) Band

In addition to the schematic ("7.4 HUE4039A (UHF Range 1) Main Board" on page 7-65) and theory of operation ("3.12.2 UHF Range 1 (380-470 MHz) Band" on page 3-33), refer to the RFPA troubleshooting flowcharts in "5.6.23 No TX Audio (380–470 MHz and 450–520 MHz)" on page 5-34. These flowcharts will guide you through a sequence of tests and checks designed to isolate problems in the RFPA stages.

See section "4.12.4 700–800 MHz Band" on page 4-34, for more information on troubleshooting the RF power amplifier circuitry.

4.12.3 UHF Range 2 (450–520 MHz) Band

In addition to the schematic ("7.5 HUE4040A (UHF Range 2) Main Board" on page 7-106) and theory of operation ("3.12.3 UHF Range 2 (450-520 MHz) Band" on page 3-37), refer to the RFPA troubleshooting flowcharts in "5.6.23 No TX Audio (380–470 MHz and 450–520 MHz)" on page 5-34. These flowcharts will guide you through a sequence of tests and checks designed to isolate problems in the RFPA stages.

See section "4.12.4 700–800 MHz Band" on page 4-34, for more information on troubleshooting the RF power amplifier circuitry.

4.12.4 700–800 MHz Band

In addition to the schematic ("Chapter 7. Schematics, Component Location Diagrams, and Parts Lists") and theory of operation ("Chapter 3. Theory of Operation"), refer to the RFPA troubleshooting flowcharts in "Chapter 5. Troubleshooting Charts". These flowcharts will guide you through a sequence of tests and checks designed to isolate problems in the RFPA stages.

Use the following information as a guide for troubleshooting the RF power amplifier circuitry:

- Read the theory of operation before troubleshooting.
- To avoid damage to the RFPA, only key the transmitter with the main board installed in the chassis and the internal screws completely installed and secured with the proper torque setting.
- The chassis eliminator, which allows access to both sides of the main board is useful for transmitter troubleshooting. Keying the transmitter for an extended period of time while using the chassis eliminator can cause damage to the radio. Therefore, be sure to cool the radio by forcing air through the chassis eliminator cooling fins.
- To avoid personal injury from high RF voltages and currents, exercise extreme care while troubleshooting the transmitter power amplifier.
- Set the A+ supply to 13.6 V with the current limit set to 15 A.
- Calibrate the power meter regularly using the manufacturer's suggested calibration method.

- If a component is removed for troubleshooting, replace the removed part, regardless of its condition, with a new part.
- To reinstall the main board into the chassis, follow the reassembly instruction in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual*.
- Apply new thermal pads if the current thermal pad are damaged. Follow the instructions in the *ASTRO Digital XTL 1500 VHF/UHF Range 1/UHF Range 2/700–800 MHz Mobile Radio Basic Service Manual*.
- Use Motorola-specified parts when component replacement is required.
- When instructed to inspect parts, look for any package damage and/or solder defects.

Notes

Chapter 5 Troubleshooting Charts

5.1 Introduction

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

5.2 List of Troubleshooting Charts

Most troubleshooting flowcharts (see Table 5-1) end by pointing to an IC to replace. Before replacing any IC, it is good practice to verify power supplies and grounds to the affected IC and trace continuity to the malfunctioning signal and related circuitry. For example, if a clock signal is not available at a destination IC, continuity from the source IC should be checked before replacing the source IC.

Table 5-1. List of Troubleshooting Charts

Description	Page
VHF (136–174 MHz)	
Poor RX Sensitivity or No RX Audio	5-12
RX IF—Poor SINAD or No Audio	5-14
RX Back-End—Poor SINAD or No Audio	5-15
Low or No RX Injection Signal	5-18
Low or No TX Injection Signal	5-19
TX or RX VCO Unlock (Fail 001)	5-20
No Output Power at TX Mode	5-22
No Output Power and IDC < 2A at TX Mode	5-23
UHF Range 1 (380–470 MHz) and UHF Range 2 (450–520 MHz)	
No 16.8 MHz Reference Oscillator Frequency	5-24
Poor RX Sensitivity or No RX Audio	5-25
RX IF—Poor SINAD or No Audio	5-27
RX Back-End—Poor SINAD or No Audio	5-29
Low or No RX Injection Signal	5-32
Low or No TX Injection Signal	5-33
No TX Audio	5-34
TX or RX VCO Unlock (Fail 001)	5-35
RF Power Amplifier (RPFA)—No or Low TX Power Output	5-37

Table 5-1. List of Troubleshooting Charts (Continued)

Description	Page
RFPA Power Control—No VGBIAS	5-42
700–800 MHz	
No 16.8 MHz Reference Oscillator Frequency	5-43
Poor RX Sensitivity or No RX Audio	5-44
RX IF—Poor SINAD or No Audio	5-46
RX Back-End—Poor SINAD or No Audio	5-47
Low or No RX Injection Signal	5-50
Low or No TX Injection Signal	5-51
No TX Audio	5-52
TX or RX VCO Unlock (Fail 001)	5-53
RF Power Amplifier (RFPA)—No or Low TX Power Output	5-55
RFPA Power Control—No K9.1V	5-60
RFPA Power Control—No VGBIAS	5-61
RFPA Power Control—No or Low TX RFPA_CNTRL	5-62

NOTE: The term μC might be used in some of the following troubleshooting charts;
 μC = MCU or microprocessor.

5.3 Troubleshooting Tables

5.3.1 For VHF, UHF R1 and 700-800 MHz models

This section contains troubleshooting tables that can help you isolate a problem in your radio.

Table 5-2. XTL 1500 Troubleshooting Table (700–800 MHz, 380-470 MHz and 136-174 MHz)

Symptom	Check Section	Troubleshooting Procedure	Component
No TX Modulation	Controller Block	<p>With 80 mV rms, 1 kHz injected to the MIC_HI line and CPS mic gain level set to 0 (default), check the following levels.</p> <ul style="list-style-type: none"> • 80 mVrms at TP0200, U0209-4, J0401-4. • 36 mV rms at TP0201. • 20 mV rms at U0201-1, TP0202. • 36 mV rms at U0201-7, TP0203. • 36 mV rms at U0200-17. • > 150 mV rms at U0900-1. • > 150 mV rms at FL0900-5. • > 150 mV rms at U0902-14 • > 150 mV rms at R6782 	<ul style="list-style-type: none"> • Absence of signal may indicate failure with U0209 (MUX), or U0201 (Op-Amp) • Absence of signal may indicate failure with U0209 (MUX), or U0201 (Op-Amp) • Absence of signal may indicate failure with U0202 (EPOT), or U0201 (Op-Amp) • Absence of signal may indicate failure with U0202 (EPOT), or U0201 (Op-Amp) • Absence of signal may indicate failure with U0200 (Codec) • Absence of signal may indicate failure with U0901 (Urchin), U0900 (Modulation DAC), or U0001 (Microprocessor Board) • Absence of signal may indicate failure with U0901 (Urchin), or FL0900 (Filter) • Absence of signal may indicate failure with U0902 (MUX) • Presence of signal may indicate a problem in RF section
	Flex/Control Head	<p>Check that MIC_HI is getting to controller at VR0412, VR0421, C0438, C0207, C0234, or R0204</p>	<p>Absence of signal may indicate failure with flex, control head, VR0412, or VR0421</p>
Radio Dead, No Display, No LED Backlighting	Blown Fuse	<p>Check fuse in red lead of power cable (or green lead if used)</p>	<p>Absence of signal may indicate failure with J0401, J0402, VR0412, or VR0402</p>
	Controller Section	<ul style="list-style-type: none"> • Check for IGNITION (if enabled as required in CPS) at J0401-20, J0402-18, VR0402, VR0412 • Check for A+ at Q0503, VR0950, J0401-19,21, or TP0414 	<ul style="list-style-type: none"> • Absence of signal may indicate failure with J0401, J0402 • Absence of signal may indicate failure with J0950, J0401

Table 5-2. XTL 1500 Troubleshooting Table (700–800 MHz, 380-470 MHz and 136-174 MHz) (Continued)

Symptom	Check Section	Troubleshooting Procedure	Component
Radio Dead, No Display, No LED Backlighting (cont.)	Flex/Control Head	<p>Check for SW_B+_CH at J0401-17, TP0413.</p> <p>Check for all voltages in CH; 1.55V, 1.88V, 2.8V, 3.3V, 5V and UNSW_VCC (3.0V).</p> <p>Check for Board ID resistors on CH. Should match schematics.</p>	<p>Absence of signal may indicate failure with flex, control head</p> <p>Absence/mismatch warrants replacement to correct location.</p>
	Clocks	<p>Check for 32 kHz clock at U0102-4, and 16.8 MHz clock at C0106, C0911</p>	<p>Presence of signals may indicate failure with U0001 (Microprocessor Board). Absence of signals may indicate failure with U0102 (Inverter) or with FGU reference oscillator circuit</p>
	A+	<p>Check A+ to the Control Head J0401-19, 21</p>	<ul style="list-style-type: none"> • Absence of voltage F0400 may be blown.
No RX Audio/Receive Does not Unsquench	Controller Block	<p>(Inject 1 kHz tone, 3 kHz deviation into radio antenna, set volume to rated audio.</p> <ul style="list-style-type: none"> • Check for speaker leads shorted to ground, or at U0204-4, 6. • Check for > 30 mV rms audio at audio PA input, U0204-1,9. • Check for > 30 mV rms audio at U0206-8 or TP0205. • Check for > 30 mV rms audio at U0210-6 or U0200-2. <p>• Check that U0204-8 is >10 V</p>	<ul style="list-style-type: none"> • Short may indicate failure with VR0400, VR0412, or U0204 • Presence of signal may indicate failure with U0204 (Audio PA) • Presence of signal may indicate failure with U0206 (Log-POT) • Presence of signal may indicate failure with U0210 (MUX); Absence of signal may indicate failure with U0200 (CODEC), or U0001 (Microprocessor Board) • Absence of >10V may indicate failure with Q0200 or U0001
	Regulators	<p>See description for <i>No VOCON Powerup</i></p>	

Table 5-2. XTL 1500 Troubleshooting Table (700–800 MHz, 380-470 MHz and 136-174 MHz) (Continued)

Symptom	Check Section	Troubleshooting Procedure	Component
No RX Audio/ Receive Does not Unsquench (cont.)	ABACUS Circuit (380-470 MHz, 450-520 MHz)	<ul style="list-style-type: none"> • Check for 20 kHz Frame Sync pulse signal at testpoint FS (U5002-31) • Check for 1.2 MHz Clock square wave at testpoint CLKOUT (U5002-28) • Check for random data pattern at testpoint DOUTA (U5002-29) • Check for Clock Oscillator at R5025 (18 MHz) • Check for Local Oscillator at C5058 (71.1 MHz or 75.6 MHz) 	<ul style="list-style-type: none"> • Absence of signal causes no receive. Possible U5002 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U5002 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U5002 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of Clock signal causes no receive. Possible U5002 (ABACUS), Clock VCO, or U0001 (Microprocessor Board) failure • Absence of LO signal causes no receive. Possible U5002 (ABACUS), or LO VCO
	ABACUS Circuit (700-800 MHz)	<ul style="list-style-type: none"> • Check for 20 kHz Frame Sync pulse signal at testpoint FS (U6000-31) • Check for 1.2 MHz Clock square wave at testpoint CLKOUT (U6000-28) • Check for random data pattern at testpoint DOUTA (U6000-29) • Check for Clock Oscillator at R6003 (18 MHz) • Check for Local Oscillator at C6026 (71.1 MHz or 75.6 MHz) 	<ul style="list-style-type: none"> • Absence of signal causes no receive. Possible U6000 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U6000 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U6000 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of Clock signal causes no receive. Possible U6000 (ABACUS), Clock VCO, or U0001 (Microprocessor Board) failure • Absence of LO signal causes no receive. Possible U6000 (ABACUS), or LO VCO
Radio Will Not Turn Off	On/Off Switch (Control Head)	Check for SW_B+_CH at 0 V at J0401-17, TP0413	A high voltage may indicate failure with the control head
	Emergency Circuit	Check for 0 V at Timer U0506-3, U0508-2,4	A high voltage may indicate failure with U0506, or that the EMERGENCY line is not grounded by the rear accessory cable
	SW_B+ Sense Circuit	Check that U0604-7 is low (0 V) and that SOFT TURN OFF is low (0 V) at D0501	Absence of this voltage may indicate failure with U0604 (Op-Amp) or with U0001 (Microprocessor Board)

5.3.2 For UHF R2 Models

This section contains troubleshooting tables that can help you isolate a problem in your radio.

Table 5-3. XTL 1500 Troubleshooting Table (450-520 MHz)

Symptom	Check Section	Troubleshooting Procedure	Component
No TX Modulation	Controller Block	<p>With 80 mV rms, 1 kHz injected to the MIC_HI line and CPS mic gain level set to 0 (default), check the following levels.</p> <ul style="list-style-type: none"> • 80 mVrms at TP0200, U0209-4, J0401-57. • 80 mV rms at TP0201. • 2.5 Vdc at U0201-8. • 80 mV rms at U0201-7, U0201-7, TP0203. • 36 mV rms at U0200-17. • > 150 mV rms at U0900-1. • > 150 mV rms at FL0900-5. • > 150 mV rms at U0902-14 • > 150 mV rms at R6782 	<ul style="list-style-type: none"> • Absence of signal may indicate failure with U0209 (MUX), or U0201 (Op-Amp) • Absence of signal may indicate failure with U0209 (MUX), or U0201 (Op-Amp) • Absence of DC bias may indicate failure with U0201 (Op-Amp) • Absence of signal may indicate failure with U0202 (EPOT), or U0201 (Op-Amp) • Absence of signal may indicate failure with U0200 (Codec) • Absence of signal may indicate failure with U0901 (Urchin), U0900 (Modulation DAC), or U0001 (Microprocessor Board) • Absence of signal may indicate failure with U0901 (Urchin), or FL0900 (Filter) • Absence of signal may indicate failure with U0902 (MUX) • Presence of signal may indicate a problem in RF section
	Flex/Control Head	Check that MIC_HI is getting to controller at VR0412, VR0421, C0438, C0207, C0234, or R0204	Absence of signal may indicate failure with flex, control head, VR0412
Radio Dead, No Display, No LED Backlighting	Blown Fuse	Check fuse in red lead of power cable (or green lead if used)	Absence of signal may indicate failure with J0401, J0402, VR0412, or VR0402
	Controller Section	<ul style="list-style-type: none"> • Check for IGNITION (if enabled as required in CPS) at J0401-27, 28 • Check for A+ at Q0503, VR0950, J0401-19,21, or TP0414 	<ul style="list-style-type: none"> • Absence of signal may indicate failure with J0401 • Absence of signal may indicate failure with J0950, J0401 or VR0950
	Flex/Control Head	<p>Check for SW_B+ at J0401-33,34, TP0413.</p> <p>Check for all voltages in CH; 1.55V, 1.88V, 2.8V, 3.3V, 5V and UNSW_VCC (3.0V).</p>	Absence of signal may indicate failure with flex, control head

Table 5-3. XTL 1500 Troubleshooting Table (450-520 MHz) (Continued)

Symptom	Check Section	Troubleshooting Procedure	Component
Radio Dead, Display Lights Up with FL 01/90	Regulators	<ul style="list-style-type: none"> • Check for SW_B+ at Q0503, U0500-4, U0950-4, U0951-4 • Check for 9.3 V at U0500-5, U0950-5, U0951-5. • Check for 5 V at U0503-5, 3 V at U0962-3, 2.85 V at U0501-1, 1.85 V at U0507-1, 1.55 V at U0502-1 	<ul style="list-style-type: none"> • Absence of signal may indicate failure with Q0503 • Absence of signal may indicate failure with U0500, U0950, or U0951 (9 V Regulators) • Absence of signal may indicate failure with U0503, U0962, U0501, U0507, or U0502 (5 V, 3 V, 2.85 V, 1.85 V, and 1.55 V Regulators)
	Flex/Control Head	Check for SW_B+_CH at J0401-33,34, TP0413, or pin 21 of P502 (on control head)	Absence of signal may indicate failure with flex, control head
	Clocks	Check for 32 kHz clock at U0102-4, and 16.8 MHz clock at C0106, C0911	Presence of signals may indicate failure with U0001 (Microprocessor Board). Absence of signals may indicate failure with U0102 (Inverter) or with FGU reference oscillator circuit
	Flex, Control Head	Check for SSI signal on CH.	No signal indicate missing/failure of SSI components (MUXes, jumper resistors) on CH board, flex contamination or failure. Needs rework or changing of flex.
No RX Audio/ Receive Does not Unsquench	Controller Block	<p>(Inject 1 kHz tone, 3 kHz deviation into radio antenna, set volume to rated audio.</p> <ul style="list-style-type: none"> • Check for speaker leads shorted to ground, or at U0204-4, 6. • Check for > 30 mV rms audio at audio PA input, U0204-1,9. • Check for > 30 mV rms audio at U0206-8 or TP0205. • Check for > 30 mV rms audio at U0210-6 or U0200-2. • Check that U0204-8 is >10 V 	<ul style="list-style-type: none"> • Short may indicate failure with VR0400, VR0412, or U0204 • Presence of signal may indicate failure with U0204 (Audio PA) • Presence of signal may indicate failure with U0206 (Log-POT) • Presence of signal may indicate failure with U0210 (MUX); Absence of signal may indicate failure with U0200 (CODEC), or U0001 (Microprocessor Board) • Absence of >10V may indicate failure with Q0200 or U0001
	Regulators	See description for <i>No VOCON Powerup</i>	

Table 5-3. XTL 1500 Troubleshooting Table (450-520 MHz) (Continued)

Symptom	Check Section	Troubleshooting Procedure	Component
No RX Audio/ Receive Does not Unsquench (cont.)	ABACUS Circuit (380-470 MHz, 450-520 MHz)	<ul style="list-style-type: none"> • Check for 20 kHz Frame Sync pulse signal at testpoint FS (U5002-31) • Check for 1.2 MHz Clock square wave at testpoint CLKOUT (U5002-28) • Check for random data pattern at testpoint DOUTA (U5002-29) • Check for Clock Oscillator at R5025 (18 MHz) • Check for Local Oscillator at C5058 (71.1 MHz or 75.6 MHz) 	<ul style="list-style-type: none"> • Absence of signal causes no receive. Possible U5002 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U5002 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U5002 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of Clock signal causes no receive. Possible U5002 (ABACUS), Clock VCO, or U0001 (Microprocessor Board) failure • Absence of LO signal causes no receive. Possible U5002 (ABACUS), or LO VCO
	ABACUS Circuit (700-800 MHz)	<ul style="list-style-type: none"> • Check for 20 kHz Frame Sync pulse signal at testpoint FS (U6000-31) • Check for 1.2 MHz Clock square wave at testpoint CLKOUT (U6000-28) • Check for random data pattern at testpoint DOUTA (U6000-29) • Check for Clock Oscillator at R6003 (18 MHz) • Check for Local Oscillator at C6026 (71.1 MHz or 75.6 MHz) 	<ul style="list-style-type: none"> • Absence of signal causes no receive. Possible U6000 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U6000 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of signal causes no receive. Possible U6000 (ABACUS) failure or U0001 (Microprocessor Board) failure • Absence of Clock signal causes no receive. Possible U6000 (ABACUS), Clock VCO, or U0001 (Microprocessor Board) failure • Absence of LO signal causes no receive. Possible U6000 (ABACUS), or LO VCO
Radio Will Not Turn Off	On/Off Switch (Control Head)	Check for SW_B+_CH at 0 V at J0401-17, TP0413	A high voltage may indicate failure with the control head
	Emergency Circuit	Check for 0 V at Timer U0506-3, U0508-2,4	A high voltage may indicate failure with U0506, or that the EMERGENCY line is not grounded by the rear accessory cable
	SW_B+ Sense Circuit	Check that U0604-7 is low (0 V) and that SOFT TURN OFF is low (0 V) at D0501	Absence of this voltage may indicate failure with U0604 (Op-Amp) or with U0001 (Microprocessor Board)

Table 5-4. XTL 1500 Receiver Troubleshooting Table (VHF Band)

Symptom	Check Section	Troubleshooting Procedure	Component
Poor Sensitivity	Front-end	<ul style="list-style-type: none"> • Check 2.85 V on pin 4 and 0 V on pin 5 of U3250 • Check transistors Q3250, Q3252 VCE levels. Levels should be ~ 5 V • Using a RF probe, check for 20 dBm on TP6771 • Verify that all Front-end components are well soldered 	<ul style="list-style-type: none"> • U3250. • Q3250, Q3252 (only Q3252 in STD mode). • FGU section. • Visual inspection of soldering.
	Back-end	<ul style="list-style-type: none"> • Check for VCE level of 8 V at IF amplifier • Verify that ABACUS is well soldered <p>Check ABACUS for:</p> <ul style="list-style-type: none"> • Reference clock 16.8 MHz • Synthesizer frequency 107.4 MHz or 111.9 MHz 	<ul style="list-style-type: none"> • Q3401. • Visual inspection of U3000 leads soldering. • R3822. • C3846.
Poor Reception	Back-end	<p>Check ABACUS DC voltages:</p> <ul style="list-style-type: none"> • 2.7-3 V on pins 1, 2, 6, 9, 14, 17, 40 • 5 V at on 39 • Check Second Local Oscillator for voltage of 0.5-4.7 V • Check second IF for 2.25 MHz 	<ul style="list-style-type: none"> • U3000. • U3000 pin 38. • C3047.

5.4 Troubleshooting Test Points

The following figures show the location of the main board test points for measuring voltages and viewing waveforms.

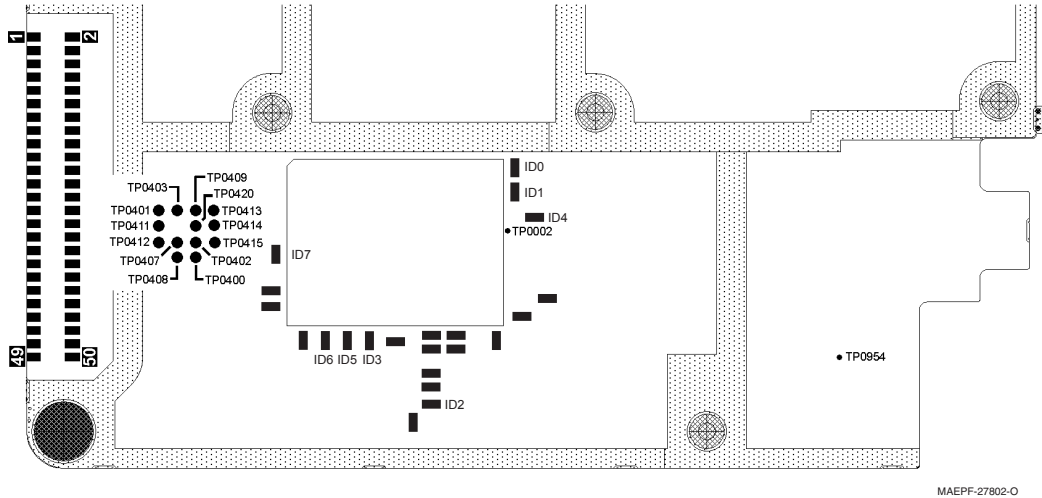


Figure 5-1. Main Board Test Points—Top Side

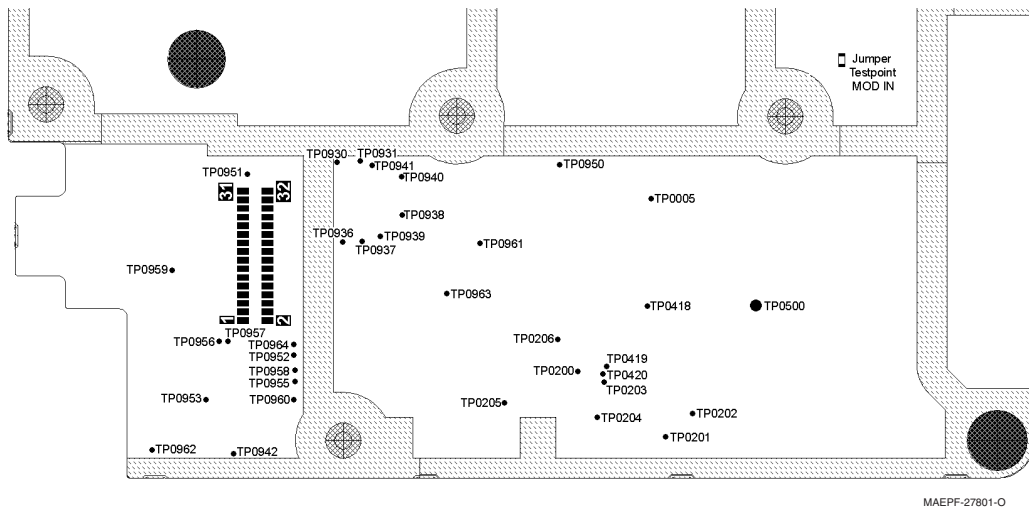


Figure 5-2. Main Board Test Points—Bottom Side

5.5 Board ID Jumper Configuration

The following jumper table (Table 5-5 on page 5-11) is provided for troubleshooting and determining what board revision you have. This can be helpful in the event a jumper was placed incorrectly or was removed during a repair and the radio is not functioning correctly.

This table provides two types of information:

- RF band of the radio
- Overall revision of the main board and controller section

The table indicates what the logic levels are, as well as how they correlate to the placement or removal of a jumper to accomplish the logic level. This is because some of the board ID resistors are on Pull-Up I/O pins and some are on Pull-Down I/O pins. Therefore, the placement or removal of a resistor for a Pull-Up I/O is the opposite of what must be done for the placement or removal of a resistor for a Pull-Down I/O.

Refer to the troubleshooting testpoints chapter for a general idea of where the board ID pins are located. Refer to the board layout for the exact location with respect to all nearby components before attempting to place or remove any jumpers.

Table 5-5. Board ID Jumper Configuration

Board ID2 R0103 Pull-Up	Board ID1 R0102 Pull-Up	Board ID0 R0101 Pull-Up		Band
0 = NP	0 = NP	0 = NP	<-->	700 / 800_35W
0 = NP	0 = NP	1 = Place	<-->	VHF_50W
0 = NP	1 = Place	0 = NP	<-->	UHF_40W
0 = NP	1 = Place	1 = Place	<-->	UHF_R2_45W
1 = Place	0 = NP	0 = NP	<-->	UHF_R1_100W
1 = Place	0 = NP	1 = Place	<-->	VHF_R1_100W

Board ID7 R0125 Pull-Down	Board ID6 R0110 Pull-Down	Board ID5 R0111 Pull-Down	Board ID4 R0123 Pull-Down	Board ID3 R0104 Pull-Up	
0 = Place	0 = Place	0 = Place	0 = Place	0 = Place	<-->
0 = Place	0 = Place	0 = Place	0 = Place	1 = NP	<-->
0 = Place	0 = Place	0 = Place	1 = NP	0 = Place	<-->
0 = Place	0 = Place	0 = Place	1 = NP	1 = NP	<-->
0 = Place	0 = Place	1 = NP	0 = Place	0 = Place	<-->
0 = Place	0 = Place	1 = NP	0 = Place	1 = NP	<-->
0 = Place	0 = Place	1 = NP	1 = NP	0 = Place	<-->
0 = Place	0 = Place	1 = NP	1 = NP	1 = NP	<-->
0 = Place	1 = NP	0 = Place	0 = Place	0 = Place	<-->

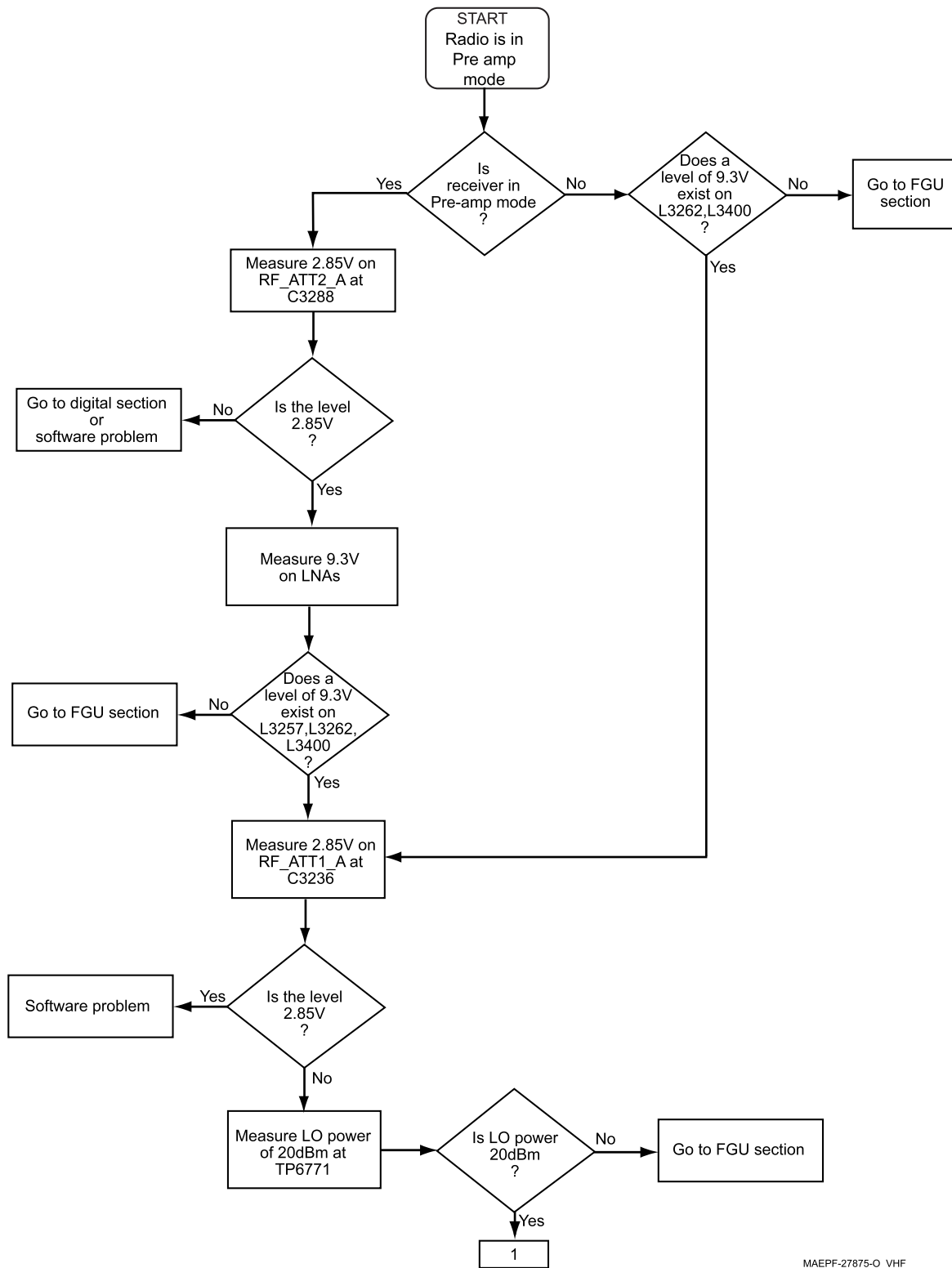
Con-troller	700-800 MHz	VHF1 50W	UHF1 40W	UHF2 45W
Reserved				
Reserved				
Reserved				REV0/ REVA
Reserved				
Reserved	Reserved	Reserved	Reserved	Reserved
REV0	REV0	Reserved	Reserved	Reserved
REVA	NA	Reserved	Reserved	Reserved
REVA	NA	NA	REV0	
REVB	REVA	REV0	REVA	

Note: NP = Not Placed

5.6 Flowcharts

This section contains the troubleshooting flowcharts that can help you isolate a problem in your radio.

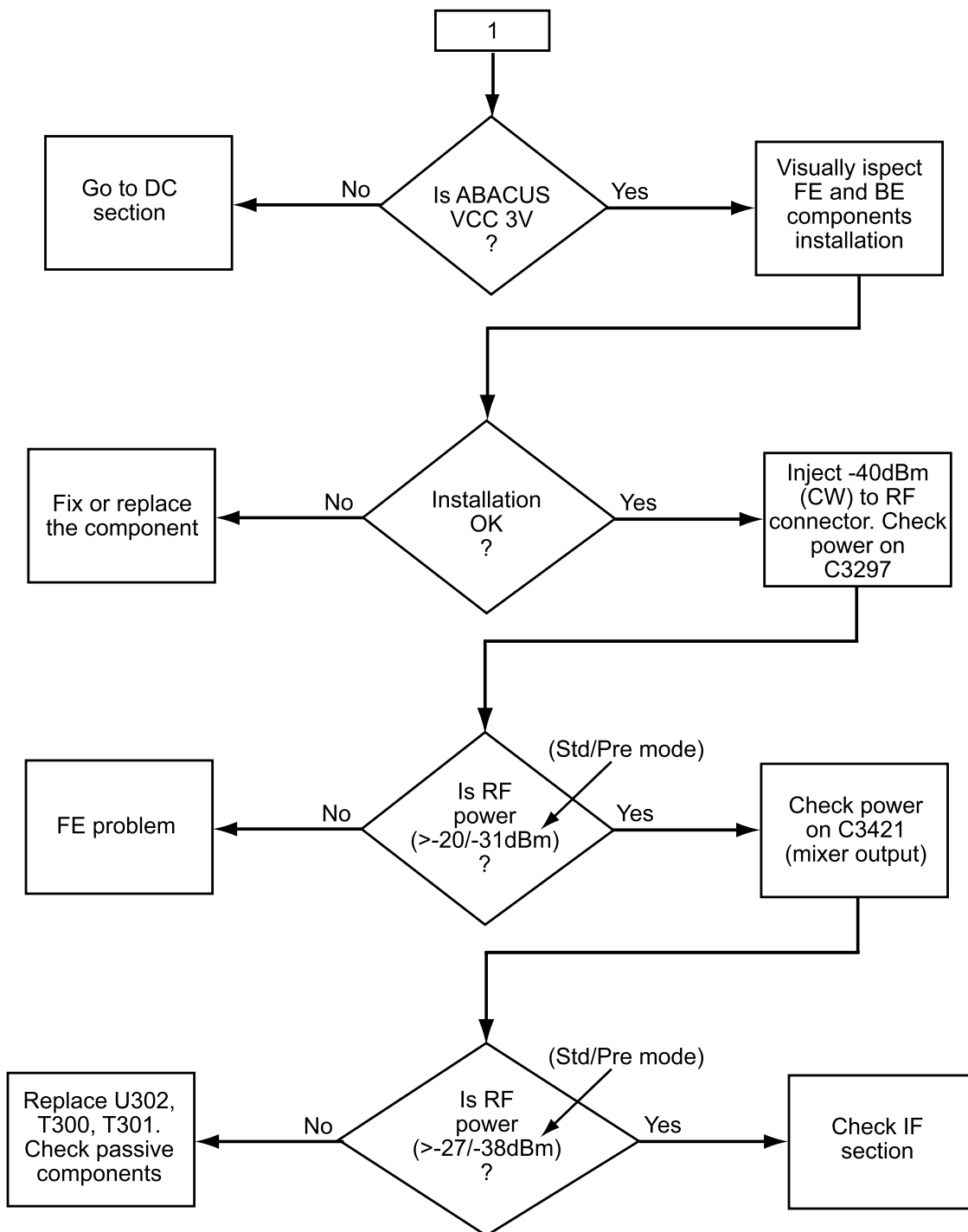
5.6.1 Poor RX Sensitivity or No RX Audio (136–174 MHz)—Part 1 of 2



MAEPF-27875-O_VHF

Figure 5-3. Poor RX Sensitivity or No RX Audio (136–174 MHz)—Part 1 of 2

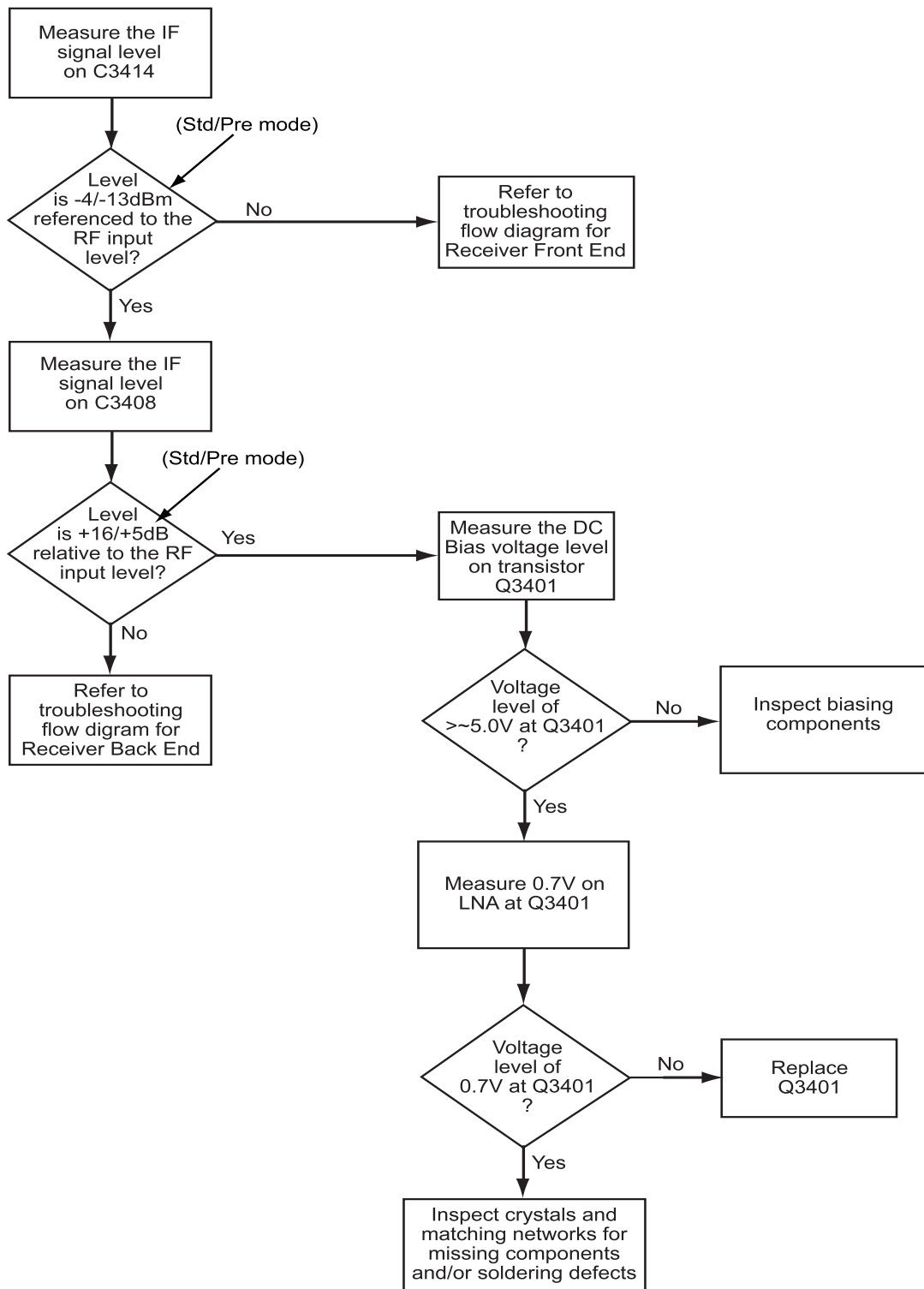
5.6.2 Poor RX Sensitivity or No RX Audio (136–174 MHz)—Part 2 of 2



MAEPF-27874-O_VHF

Figure 5-4. Poor RX Sensitivity or No RX Audio (136–174 MHz)—Part 2 of 2

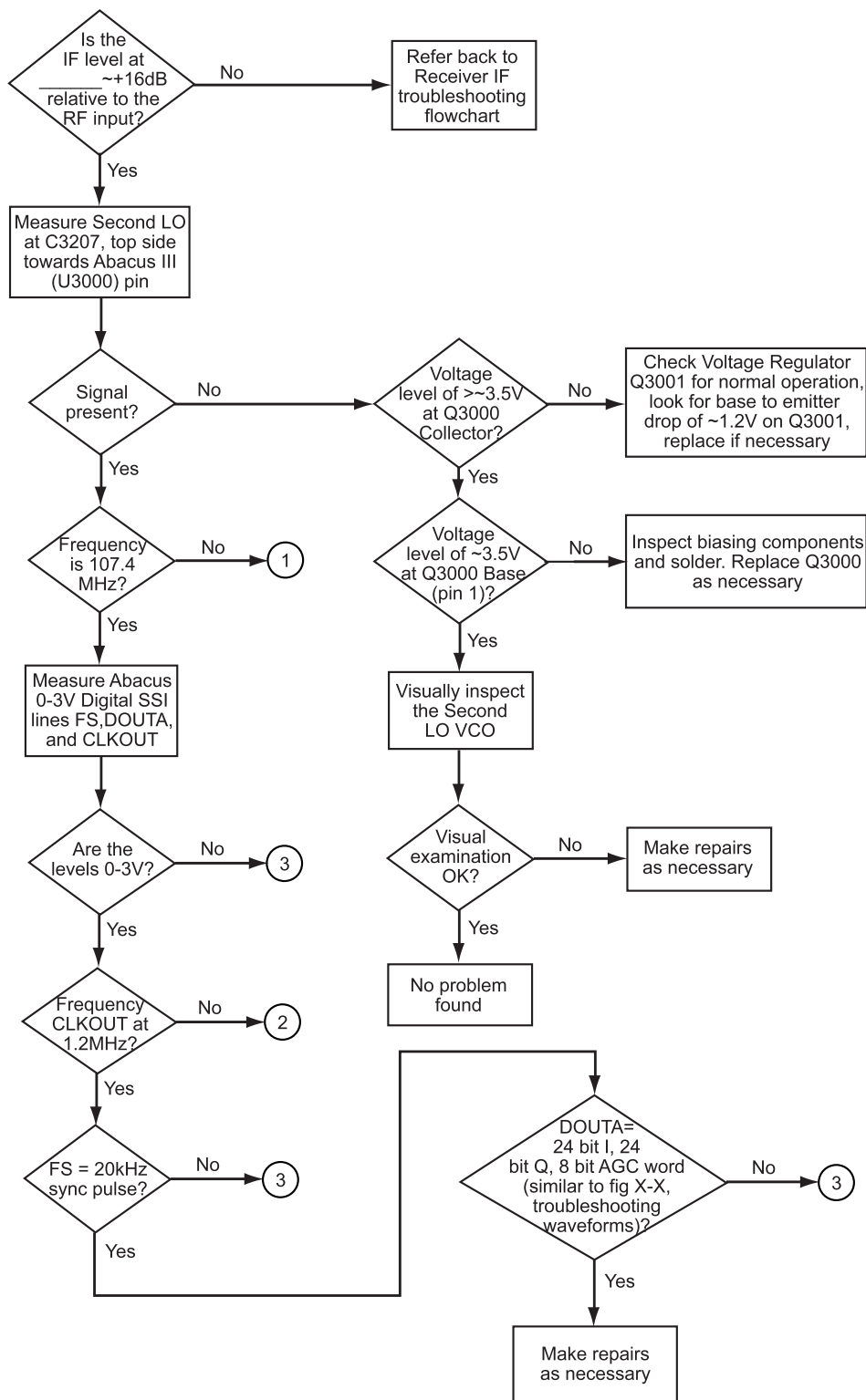
5.6.3 RX IF—Poor SINAD or No Audio (136–174 MHz)



MAEPF-27809-O_VHF

Figure 5-5. RX IF—Poor SINAD or No Audio (136–174 MHz)

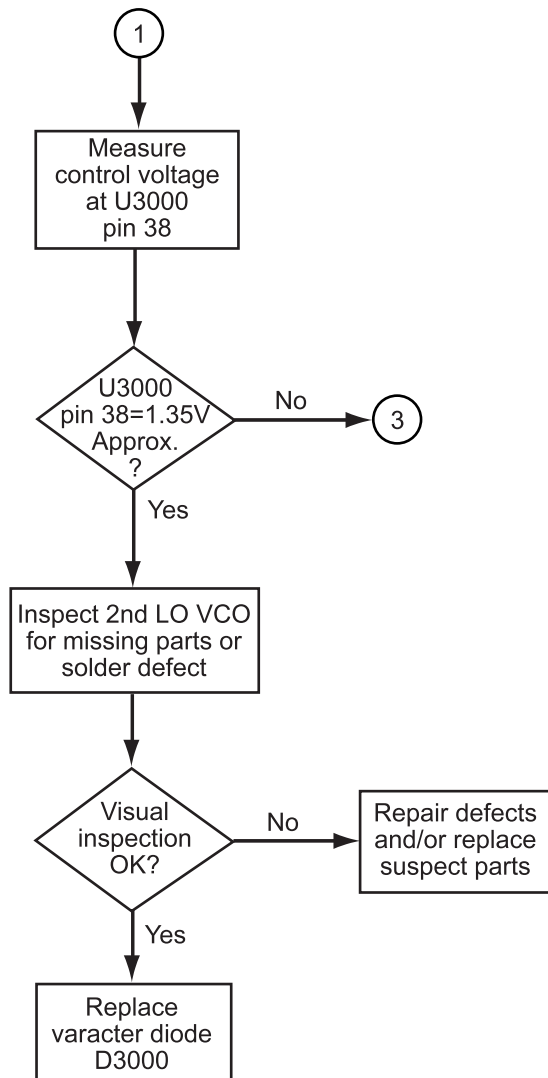
5.6.4 RX Back-End—Poor SINAD or No Audio (136–174 MHz)—Part 1 of 3



MAEPF-27806-O_VHF

Figure 5-6. RX Back-End—Poor SINAD or No Audio (136–174 MHz)—Part 1 of 3

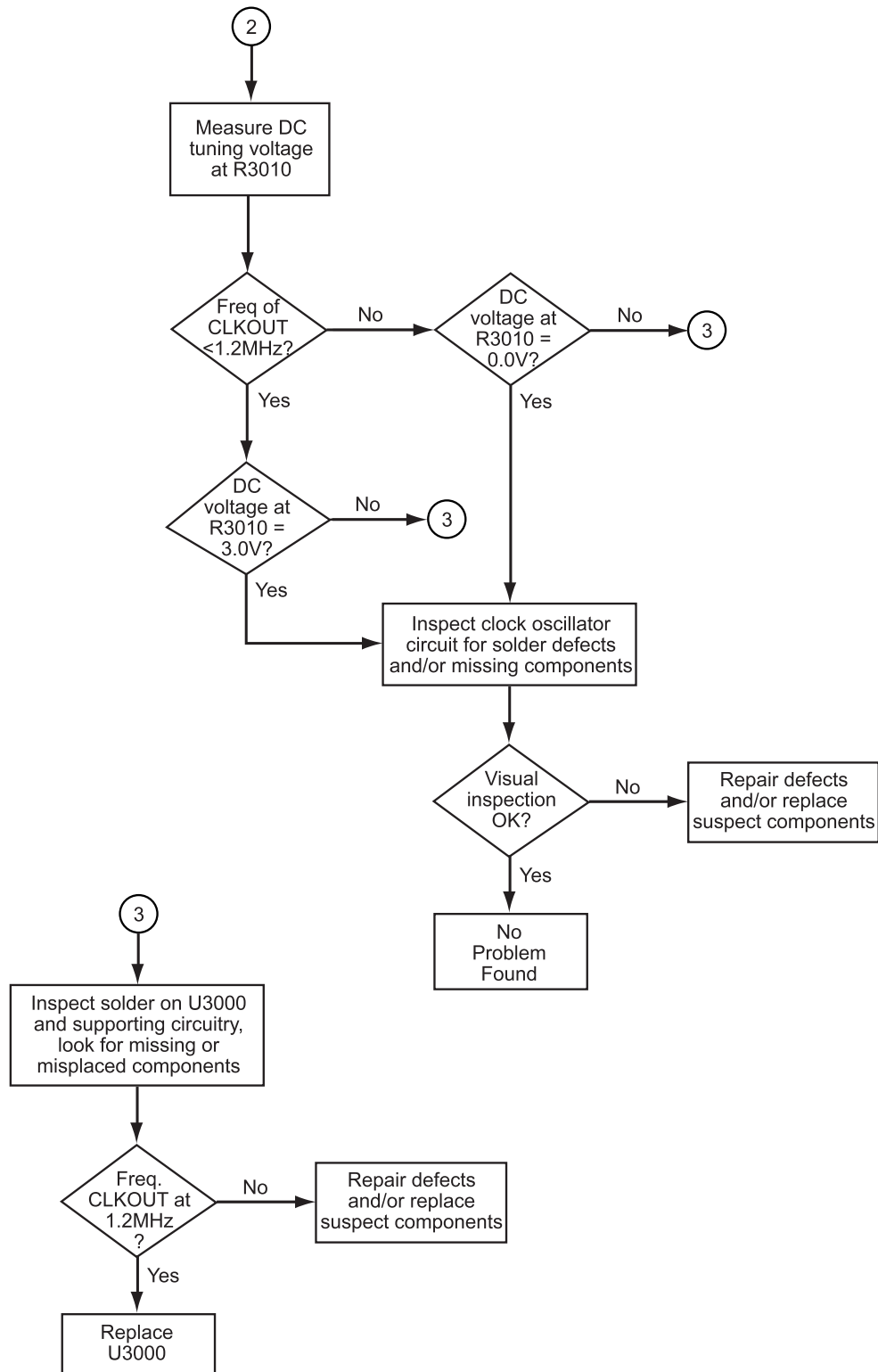
5.6.5 RX Back-End—Poor SINAD or No Audio (136–174 MHz)—Part 2 of 3



MAEPF-27807_VHF-O

Figure 5-7. RX Back-End—Poor SINAD or No Audio (136–174 MHz)—Part 2 of 3

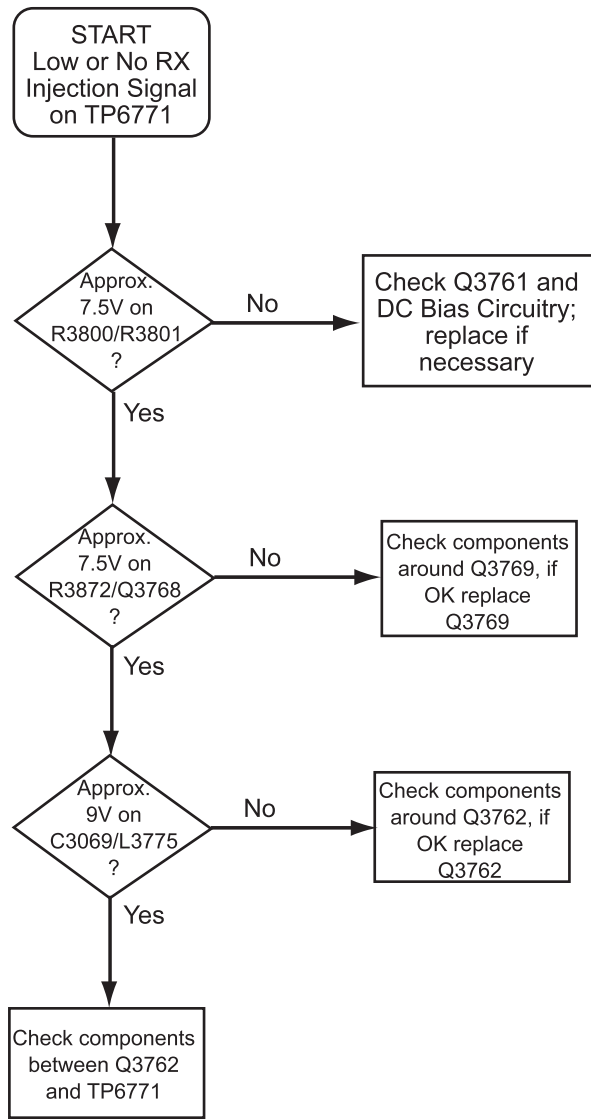
5.6.6 RX Back-End—Poor SINAD or No Audio (136–174 MHz)—Part 3 of 3



MAEPF-27808-O_VHF

Figure 5-8. RX Back-End—Poor SINAD or No Audio (136–174 MHz)—Part 3 of 3

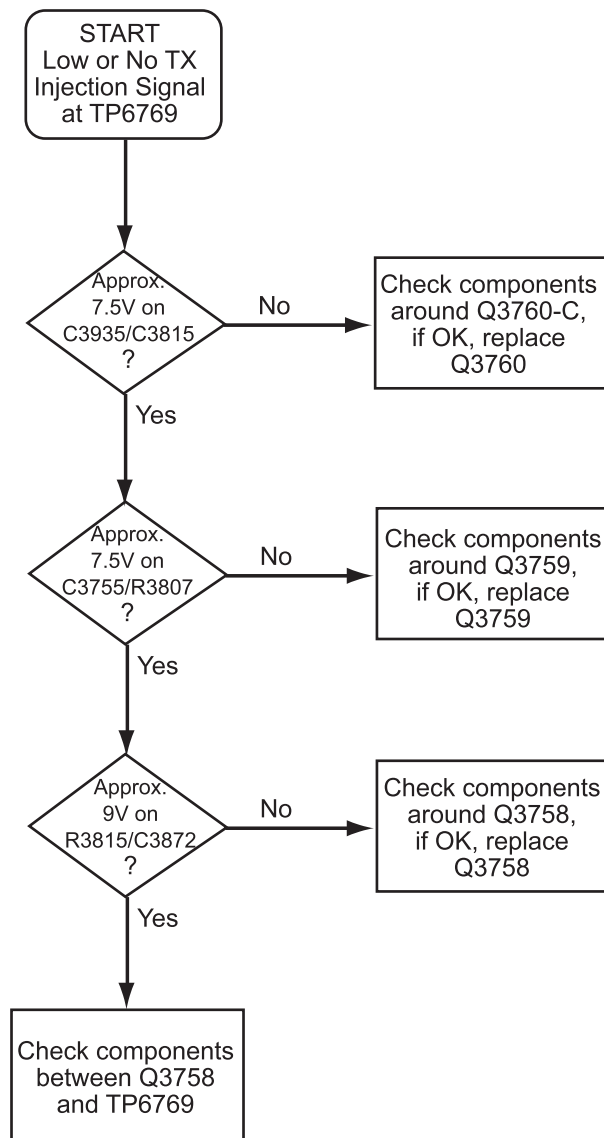
5.6.7 Low or No RX Injection Signal (136–174 MHz)



MAEPF-27810-O_VHF

Figure 5-9. Low or No RX Injection Signal (136–174 MHz)

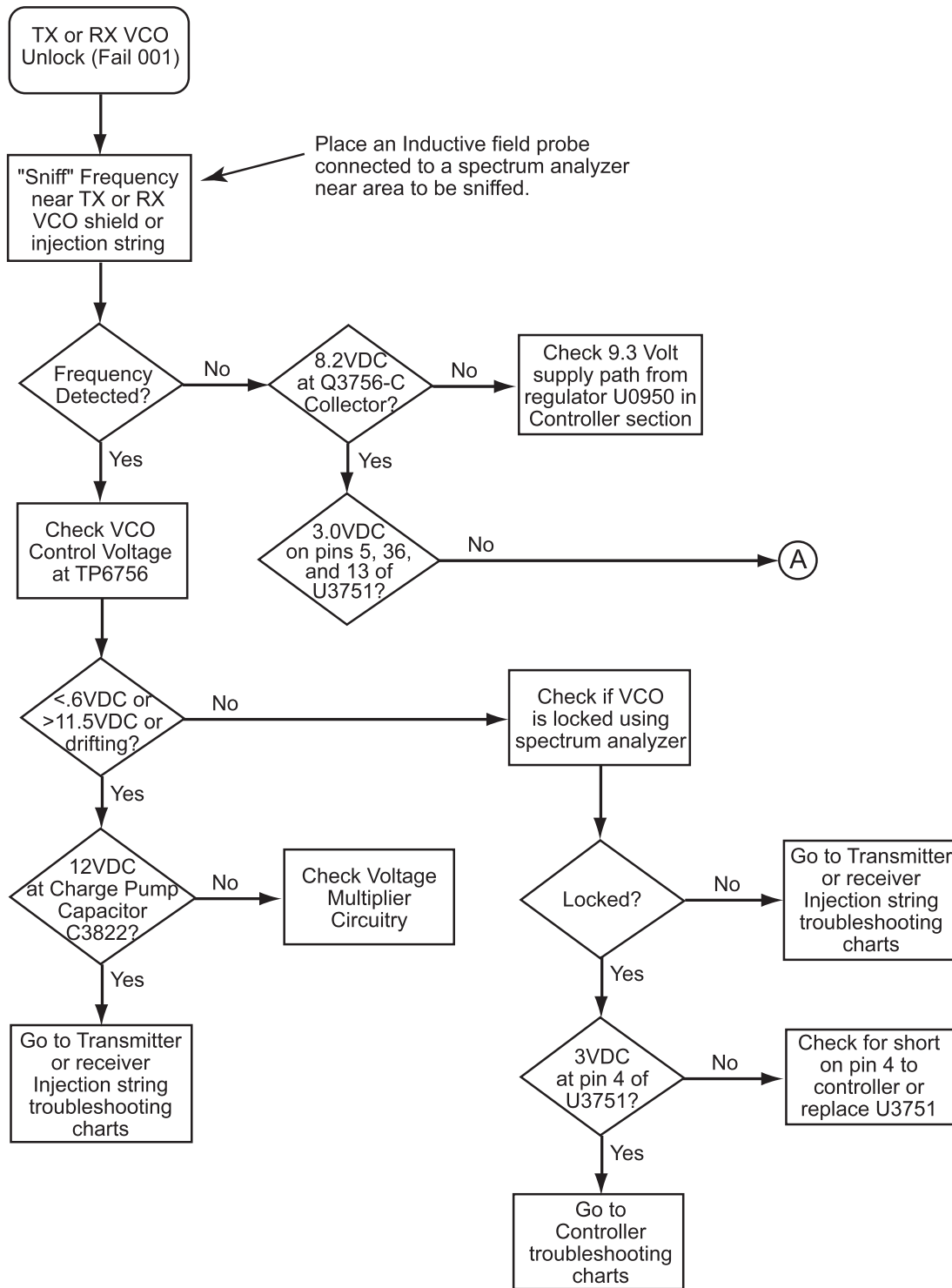
5.6.8 Low or No TX Injection Signal (136–174 MHz)



MAEPF-27811-O_VHF

Figure 5-10. Low or No TX Injection Signal (136–174 MHz)

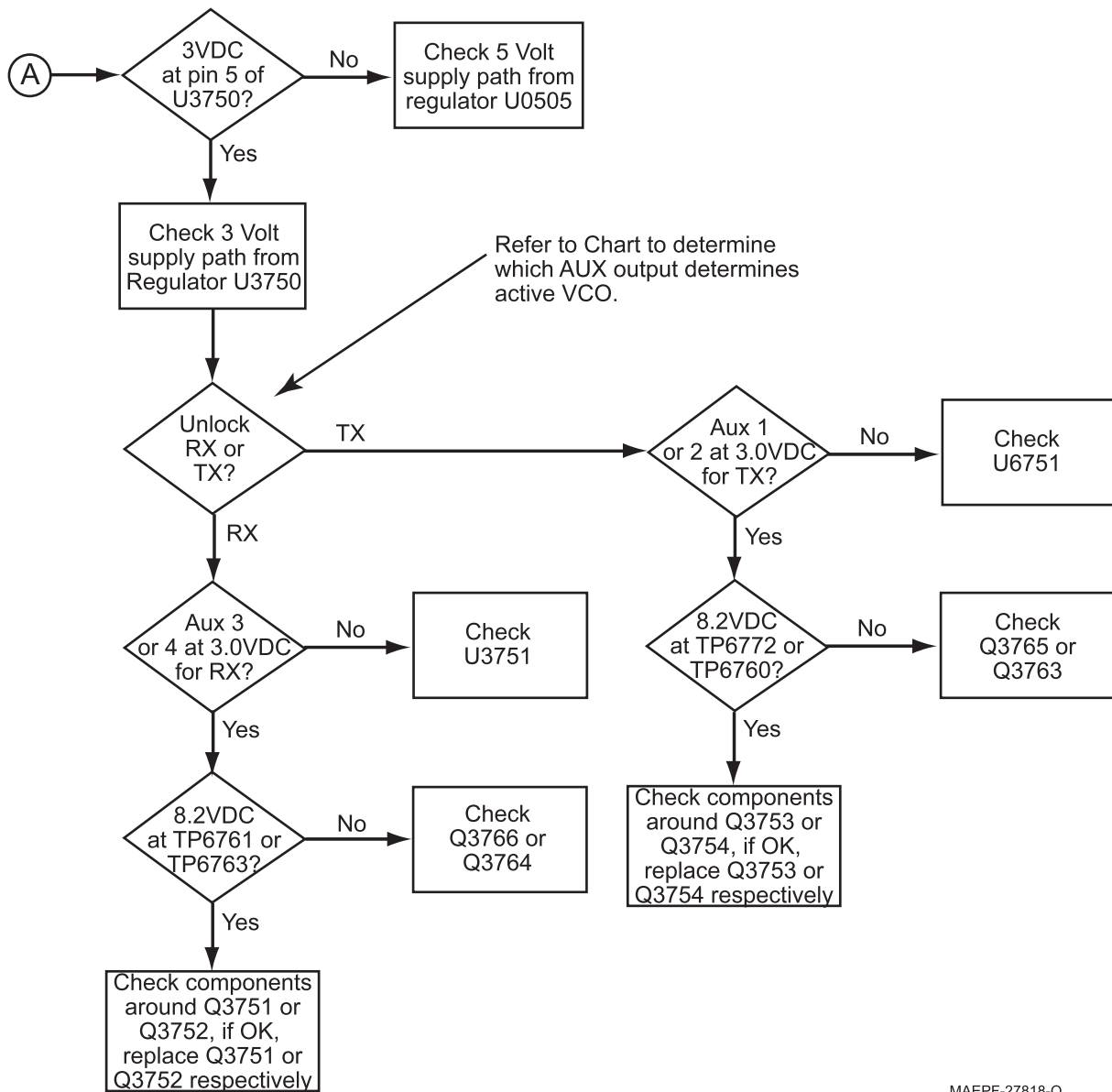
5.6.9 TX or RX VCO Unlock (Fail 001) (136–174 MHz)—Part 1 of 2



MAEPF-27812-O_VHF

Figure 5-11. TX or RX VCO Unlock (Fail 001) (136–174 MHz)—Part 1 of 2

5.6.10 TX or RX VCO Unlock (Fail 001) (136–174 MHz)—Part 2 of 2



MAEPF-27818-O

Figure 5-12. TX or RX VCO Unlock (Fail 001) (136–174 MHz)—Part 2 of 2

5.6.11 No Output Power at TX Mode (136–174 MHz)

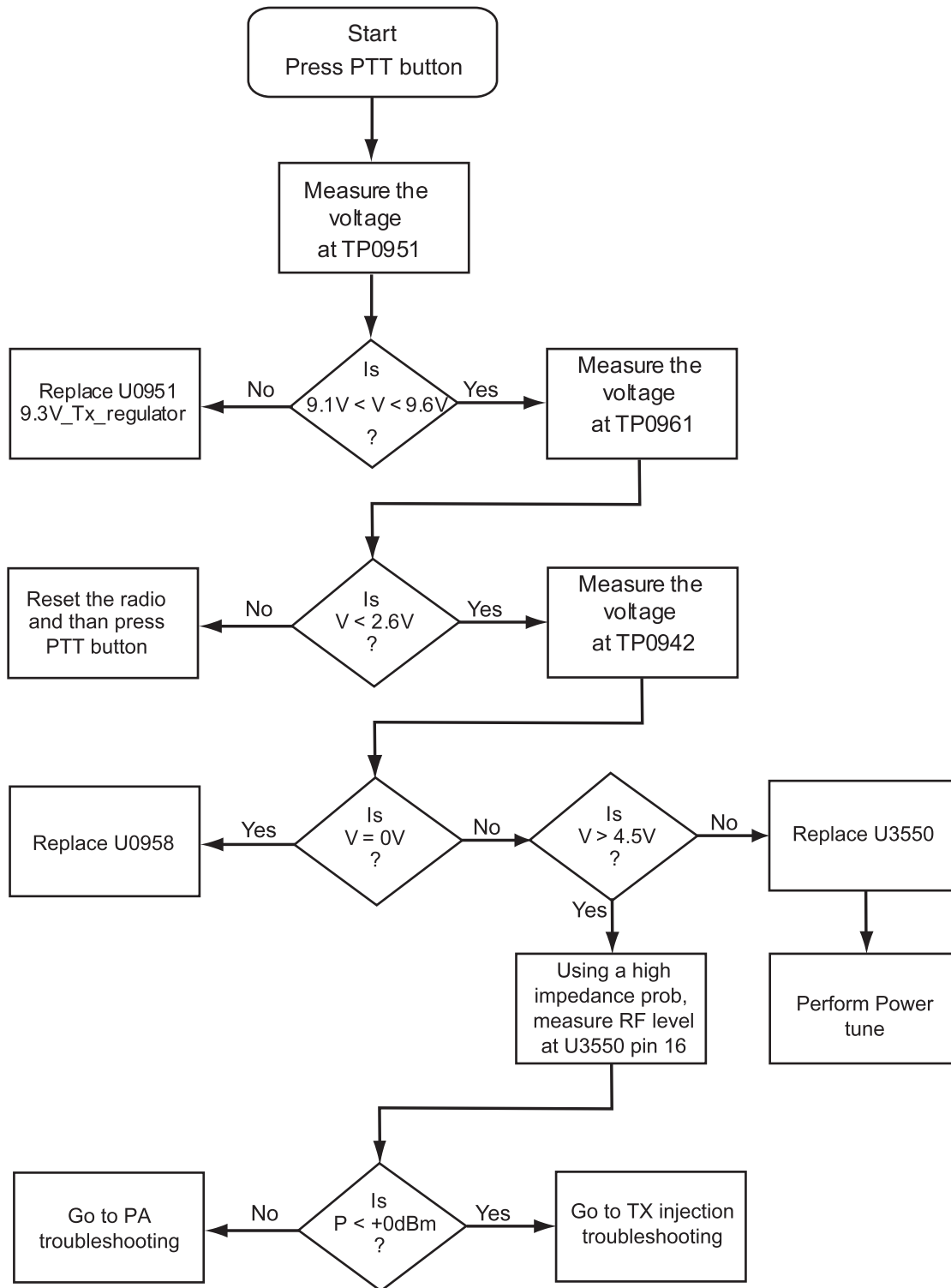


Figure 5-13. No Output Power at TX Mode (136–174 MHz)

5.6.12 No Output Power and IDC < 2A at TX Mode (136–174 MHz)

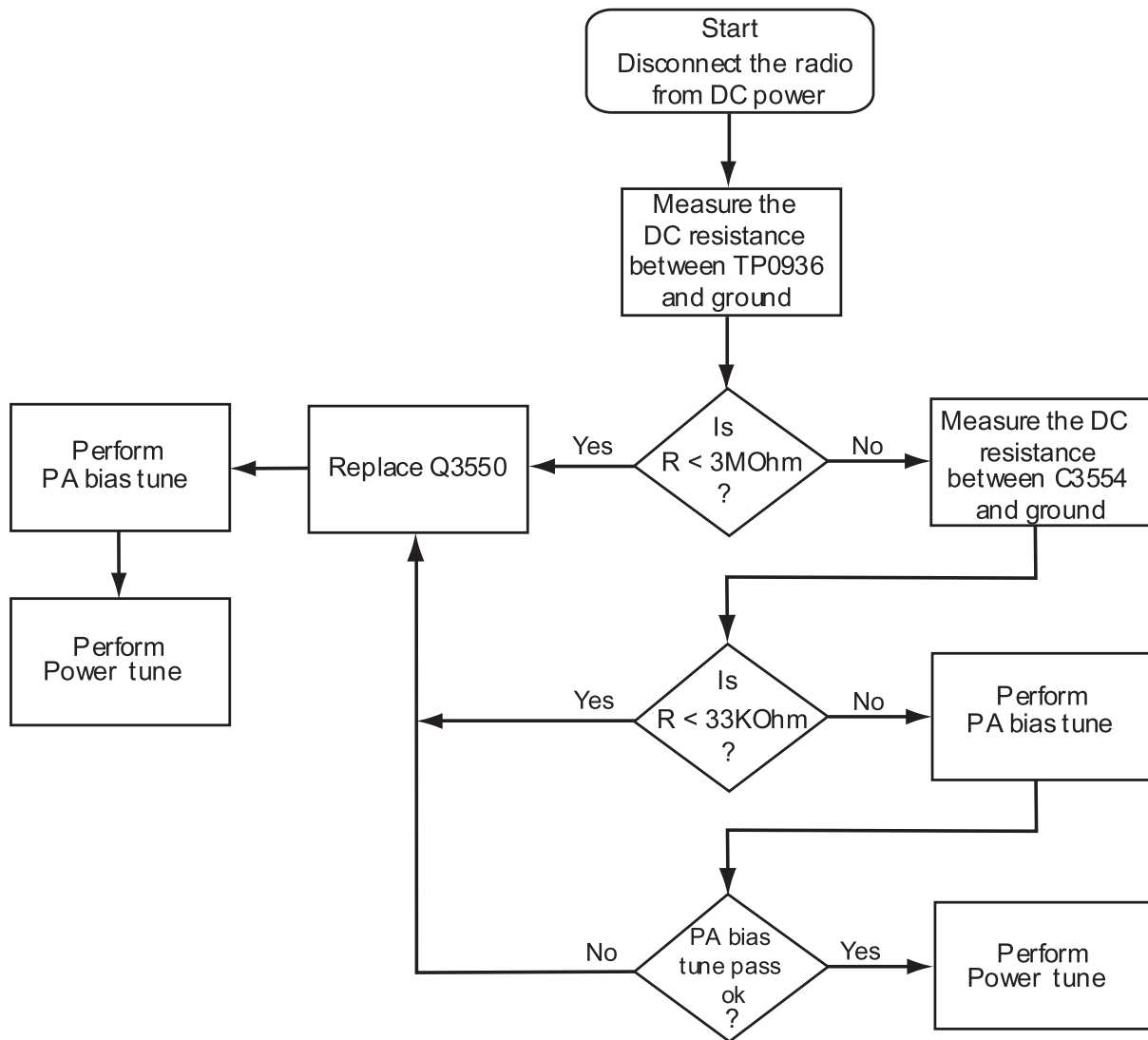


Figure 5-14. No Output Power and IDC < 2A at TX Mode (136–174 MHz)

5.6.13 No 16.8 MHz Reference Oscillator Frequency (380–470 MHz and 450–520 MHz)

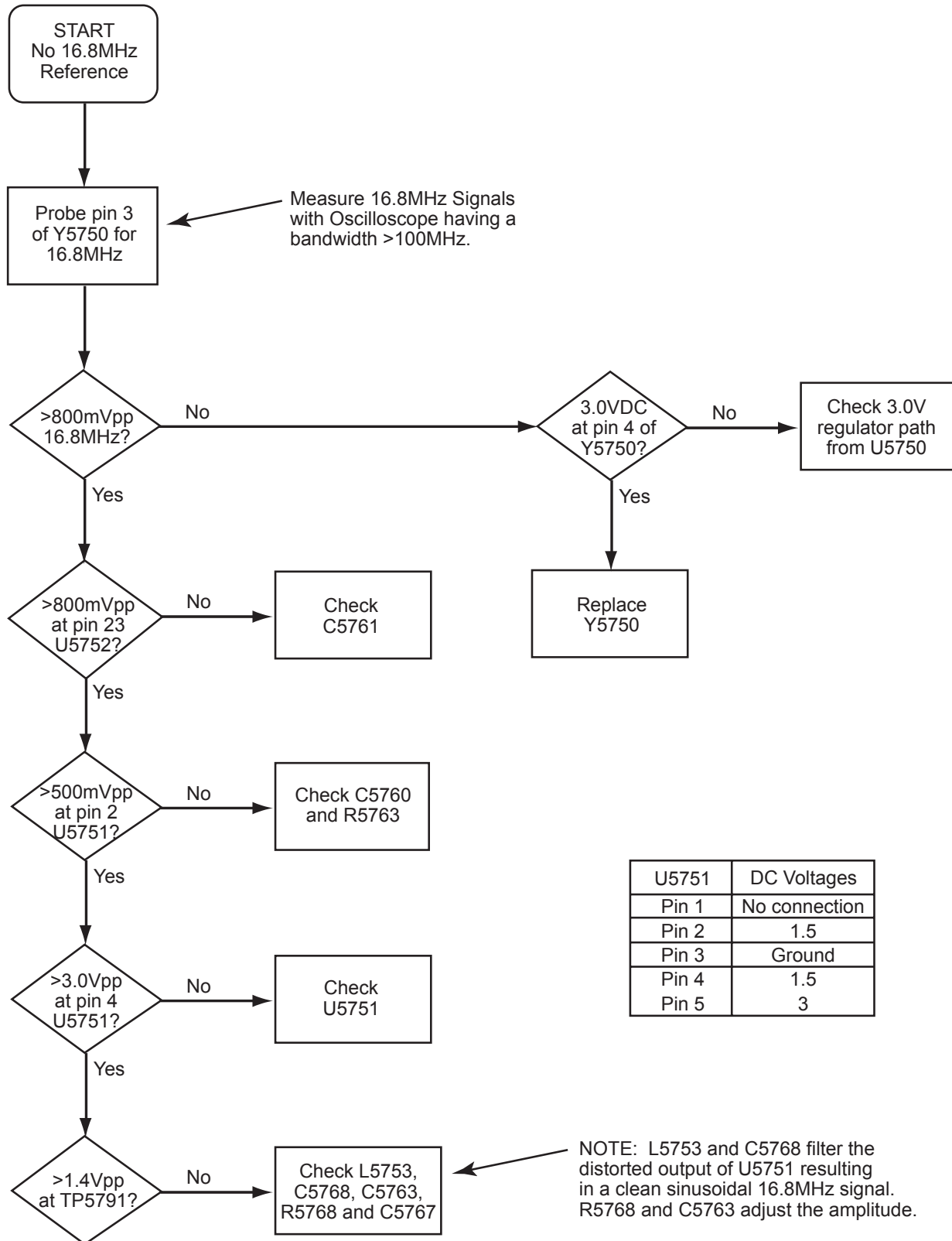


Figure 5-15. No 16.8 MHz Reference Oscillator Frequency (380–470 MHz and 450–520 MHz)

5.6.14 Poor RX Sensitivity or No RX Audio (380–470 MHz and 450–520 MHz)—Part 1 of 2

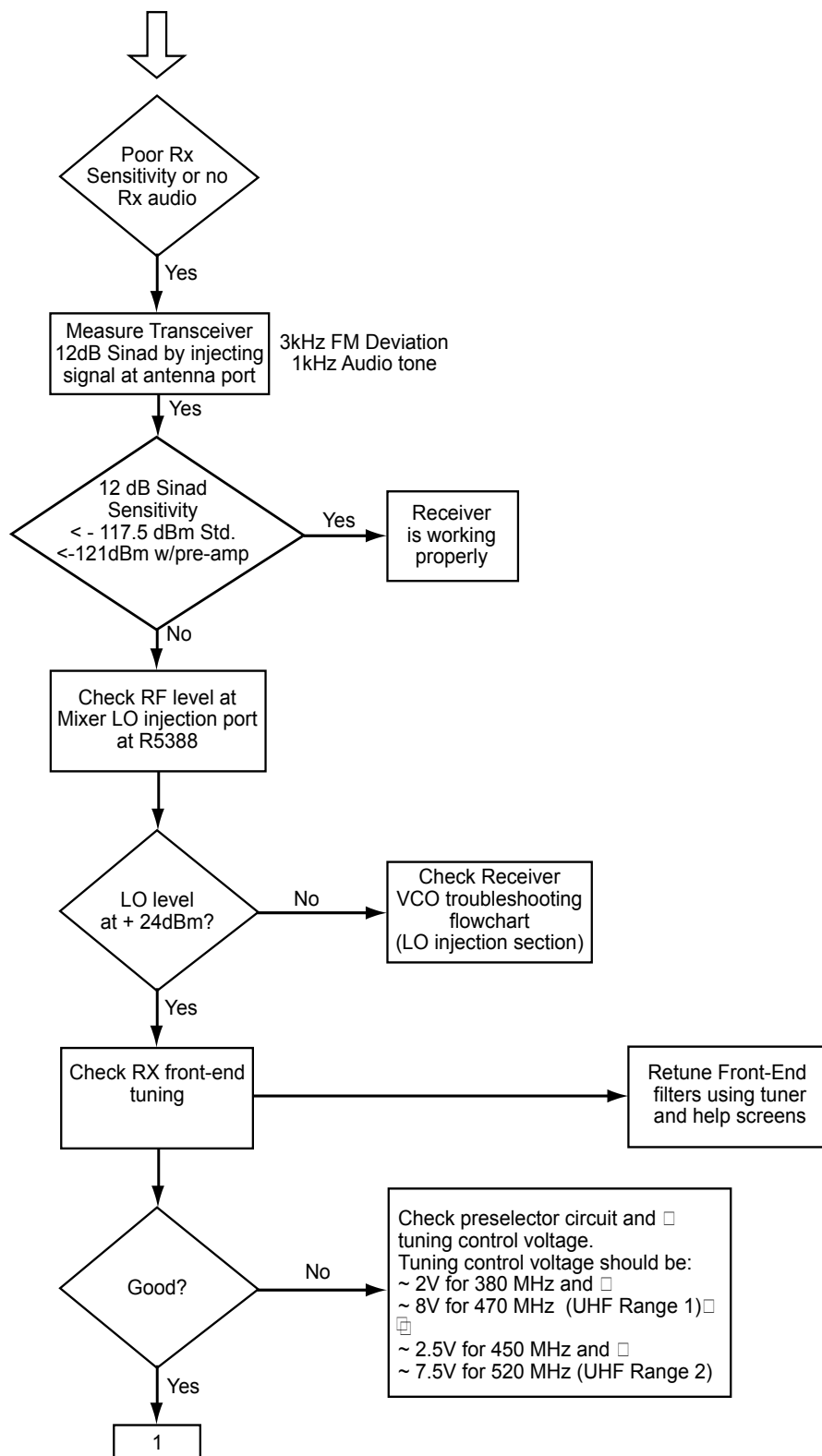


Figure 5-16. Poor RX Sensitivity or No RX Audio (380–470 MHz and 450–520 MHz)—Part 1 of 2

5.6.15 Poor RX Sensitivity or No RX Audio (380–470 MHz and 450–520 MHz)—Part 2 of 2

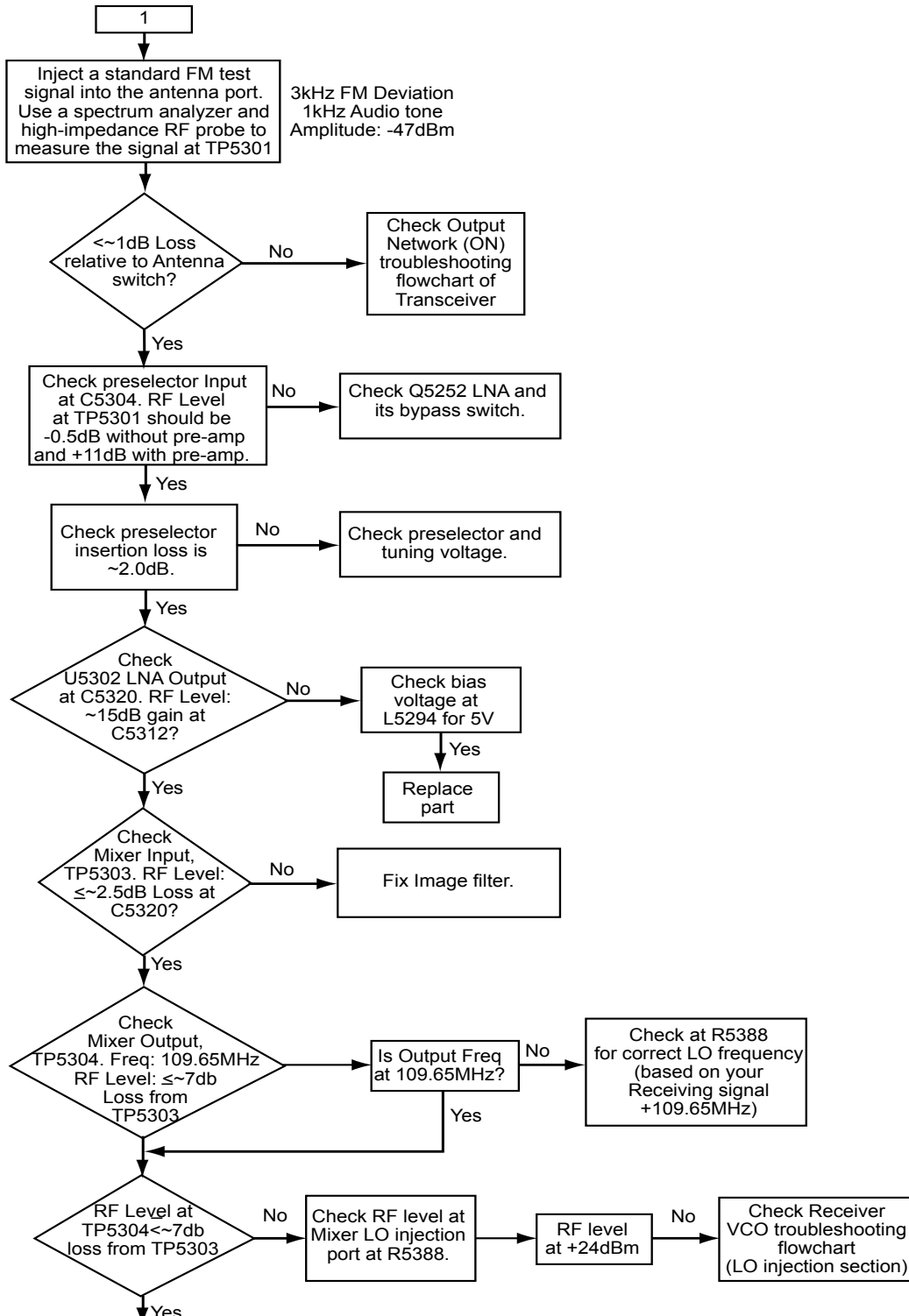


Figure 5-17. Poor RX Sensitivity or No RX Audio (380–470 MHz and 450–520 MHz)—Part 2 of 2

5.6.16 RX IF—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 1 of 2

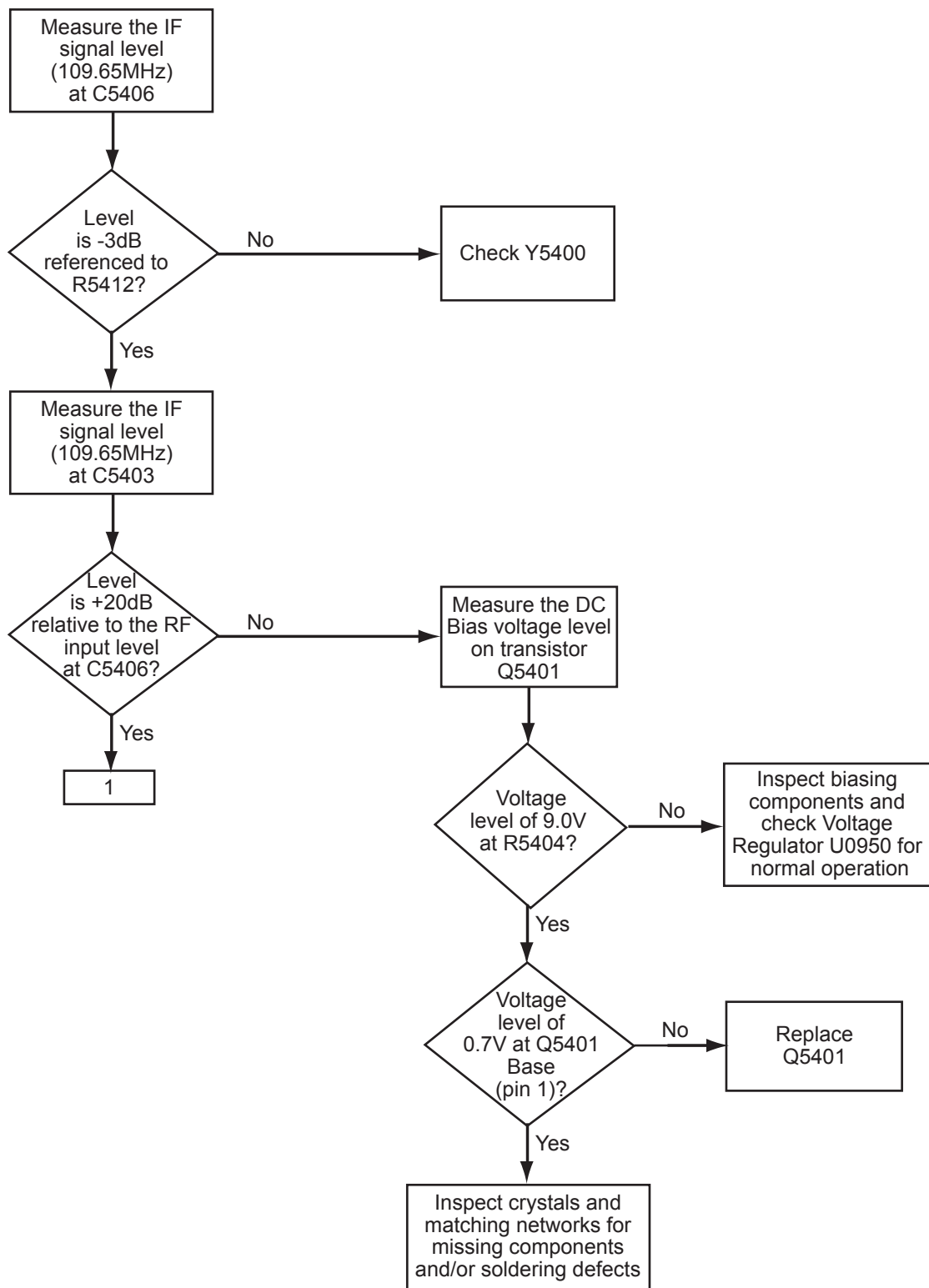


Figure 5-18. RX IF—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 1 of 2

5.6.17 RX IF—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 2 of 2

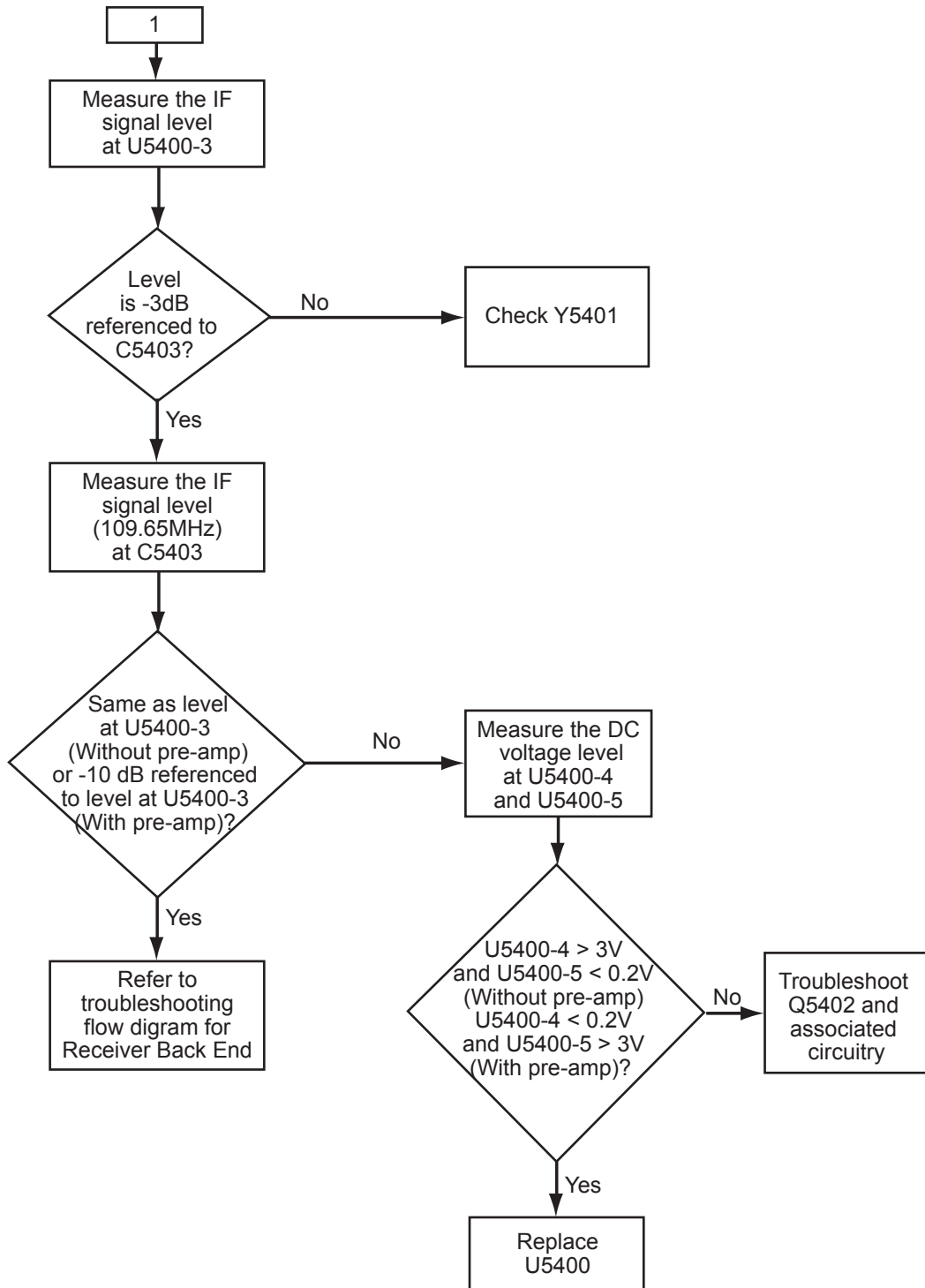


Figure 5-19. RX IF—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 2 of 2

5.6.18 RX Back-End—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 1 of 3

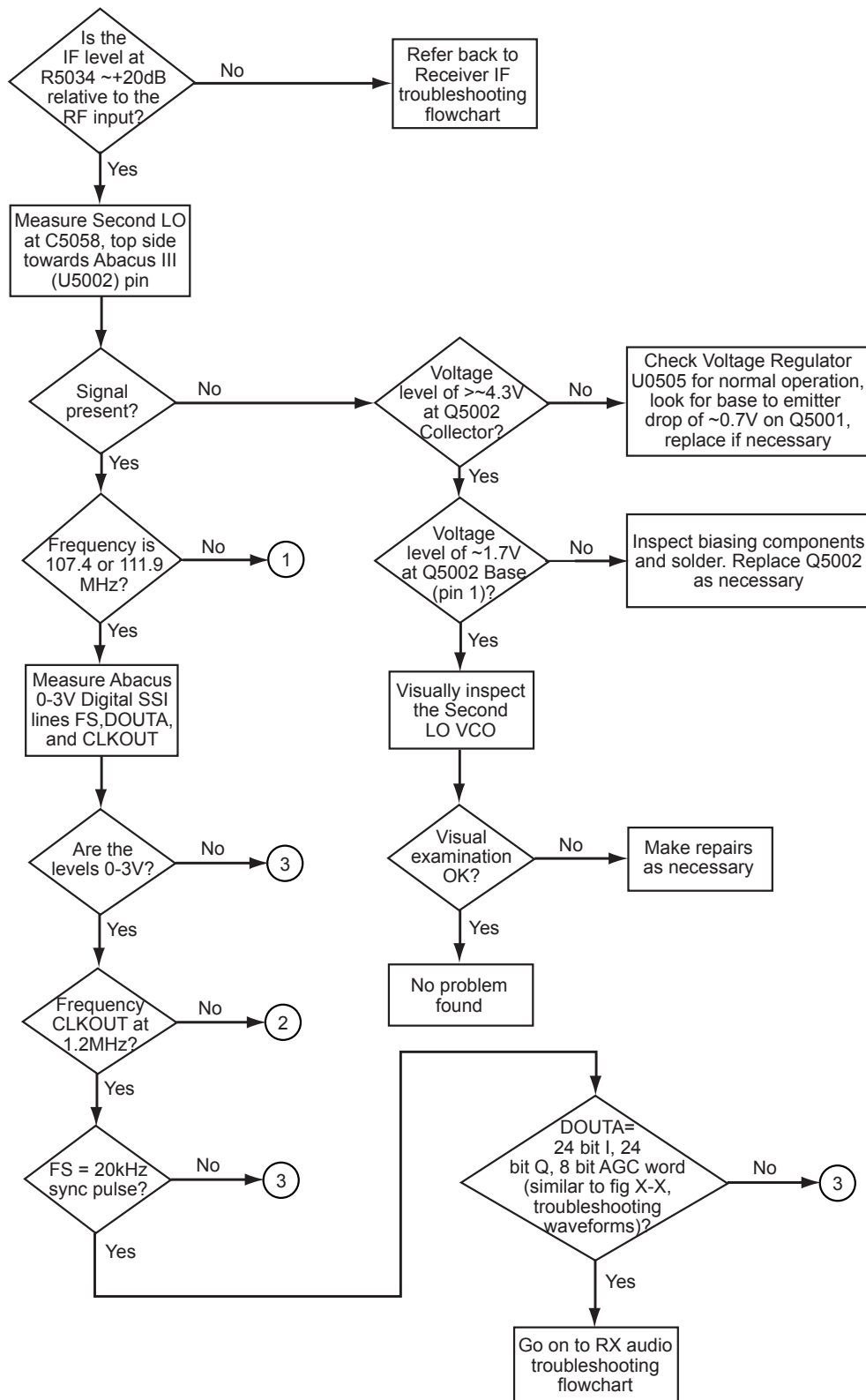


Figure 5-20. RX Back-End—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 1 of 3

**5.6.19 RX Back-End—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—
Part 2 of 3**

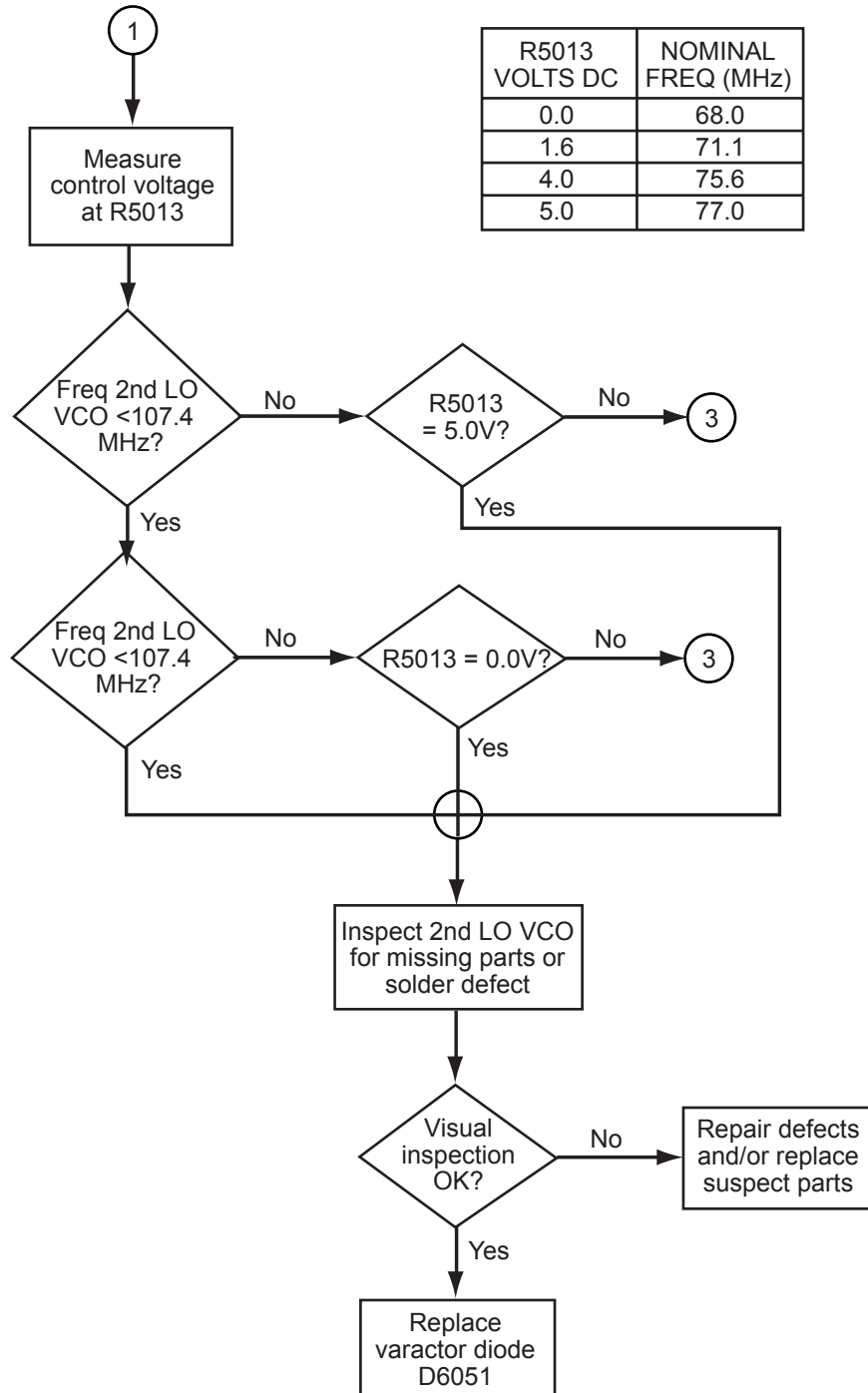


Figure 5-21. RX Back-End—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 2 of 3

**5.6.20 RX Back-End — Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—
Part 3 of 3**

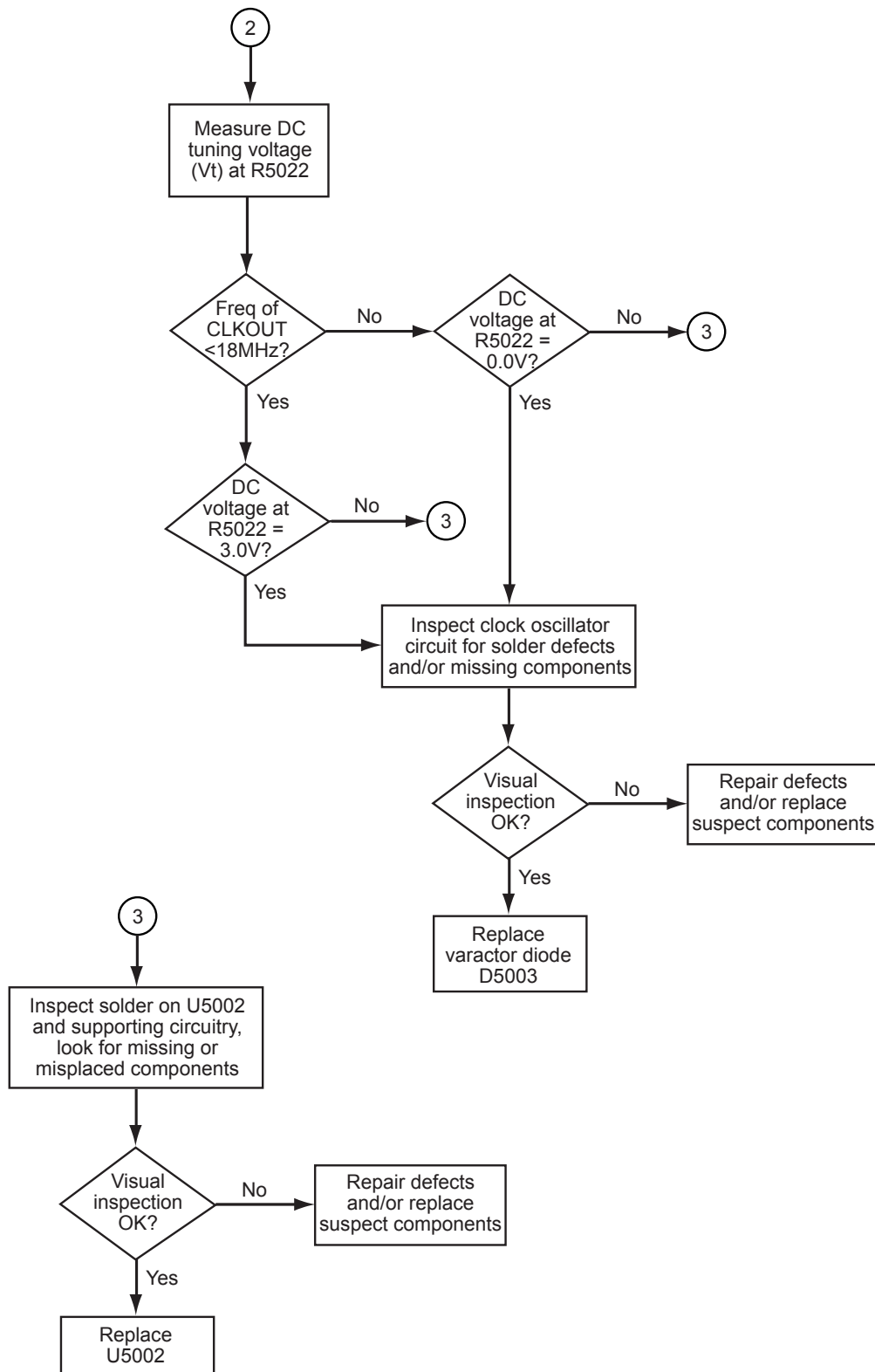


Figure 5-22. RX Back-End—Poor SINAD or No Audio (380–470 MHz and 450–520 MHz)—Part 3 of 3

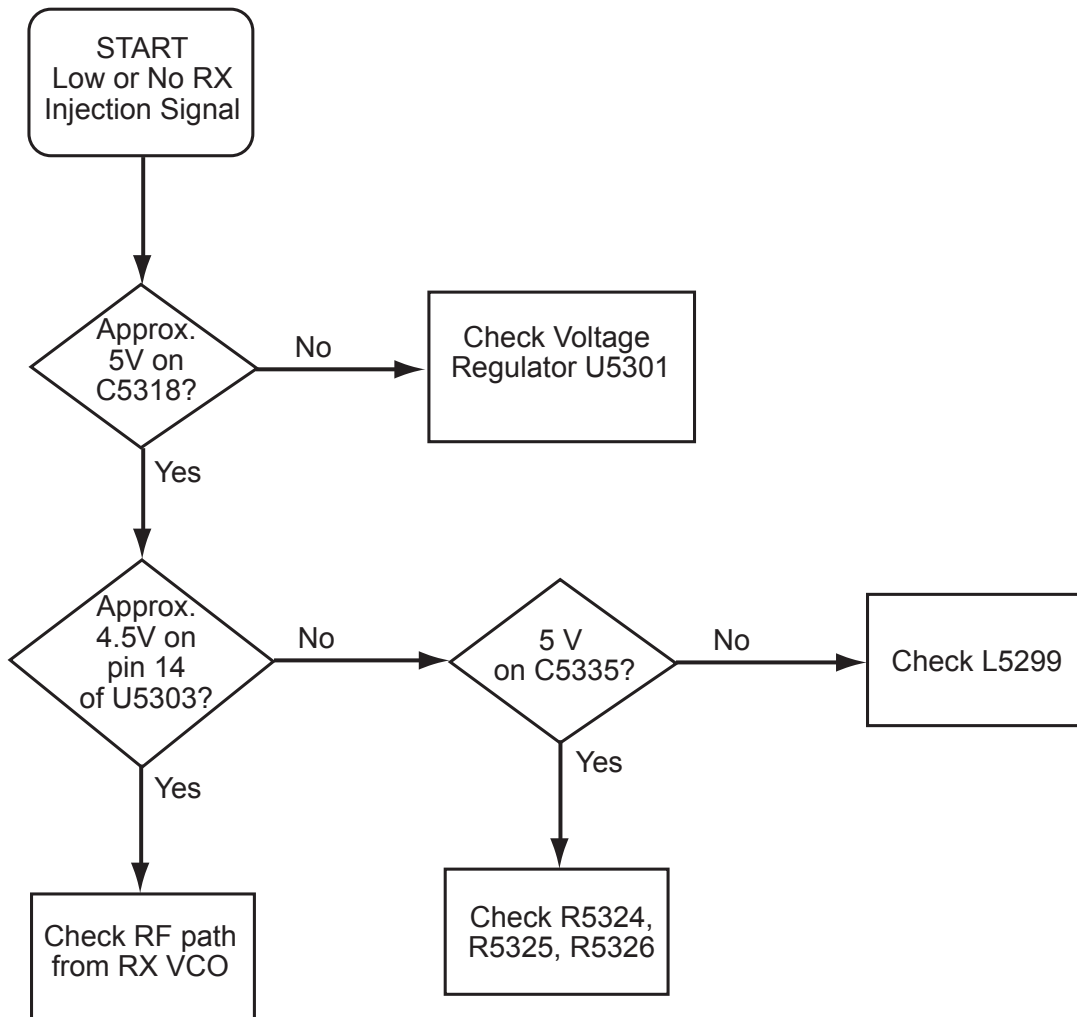
5.6.21 Low or No RX Injection Signal (380–470 MHz and 450–520 MHz)

Figure 5-23. Low or No RX Injection Signal (380–470 MHz and 450–520 MHz)

5.6.22 Low or No TX Injection Signal (380–470 MHz and 450–520 MHz)

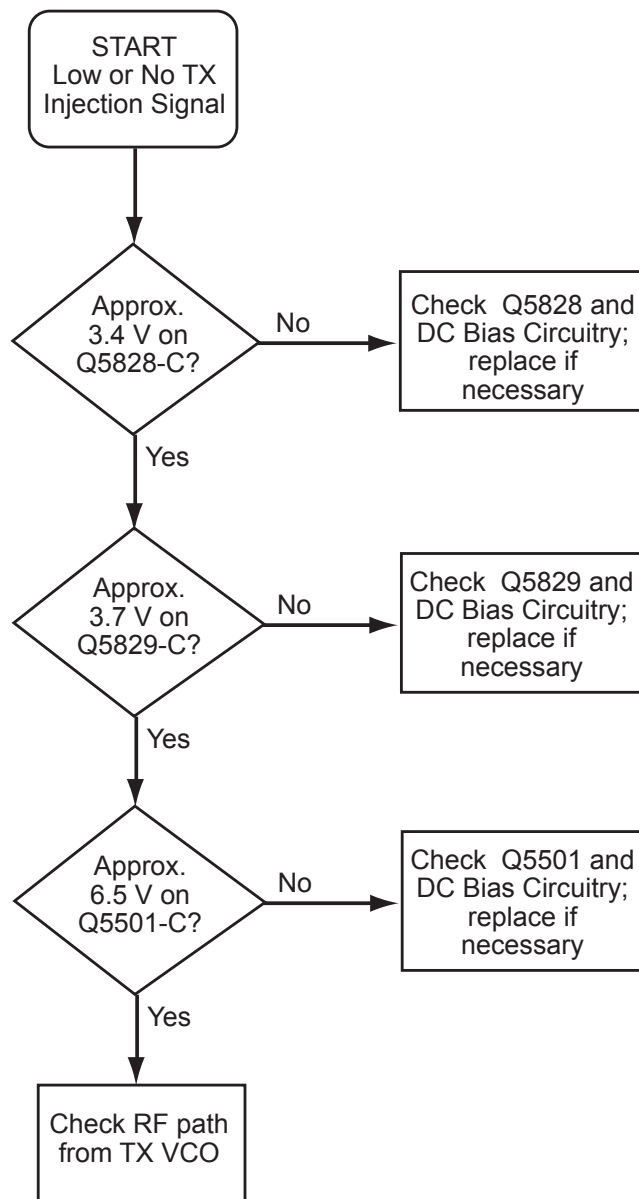


Figure 5-24. Low or No TX Injection Signal (380–470 MHz and 450–520 MHz)

5.6.23 No TX Audio (380–470 MHz and 450–520 MHz)

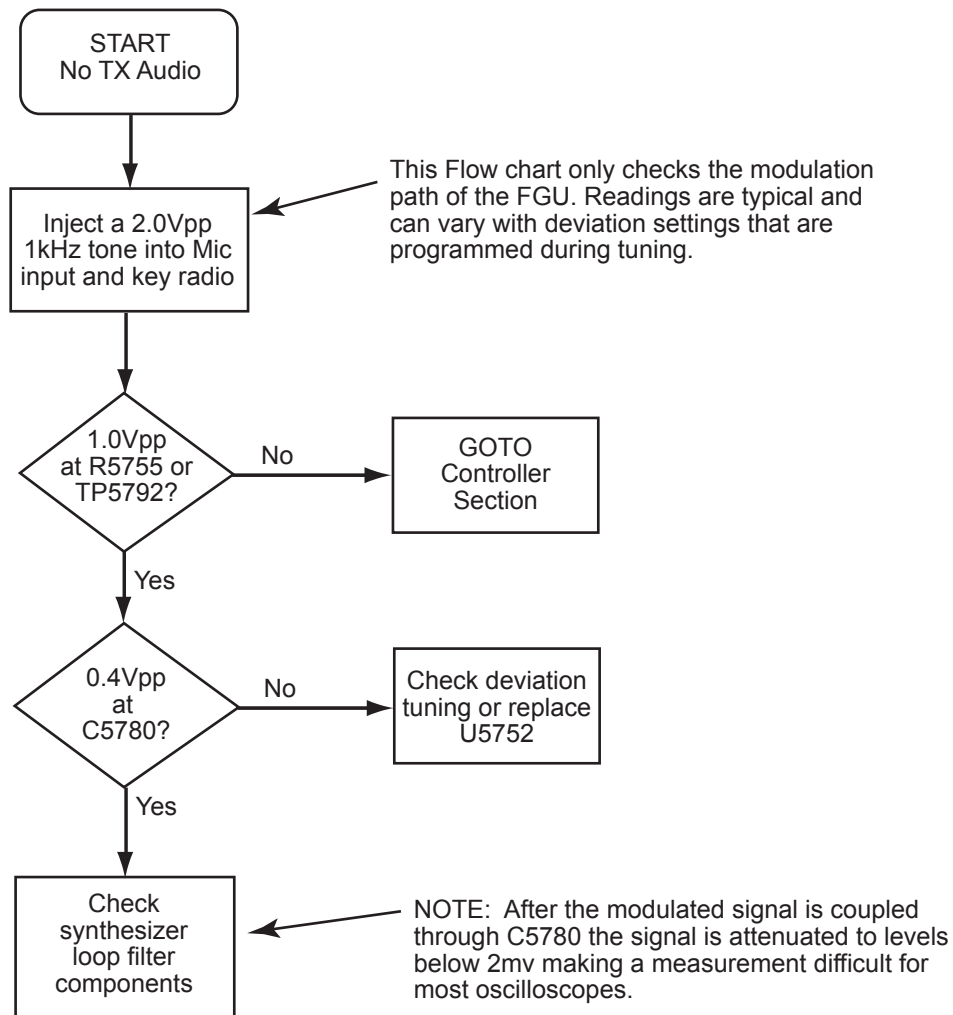


Figure 5-25. No TX Audio (380–470 MHz and 450–520 MHz)

5.6.24 TX or RX VCO Unlock (Fail 001) (380–470 MHz and 450–520 MHz)—Part 1 of 2

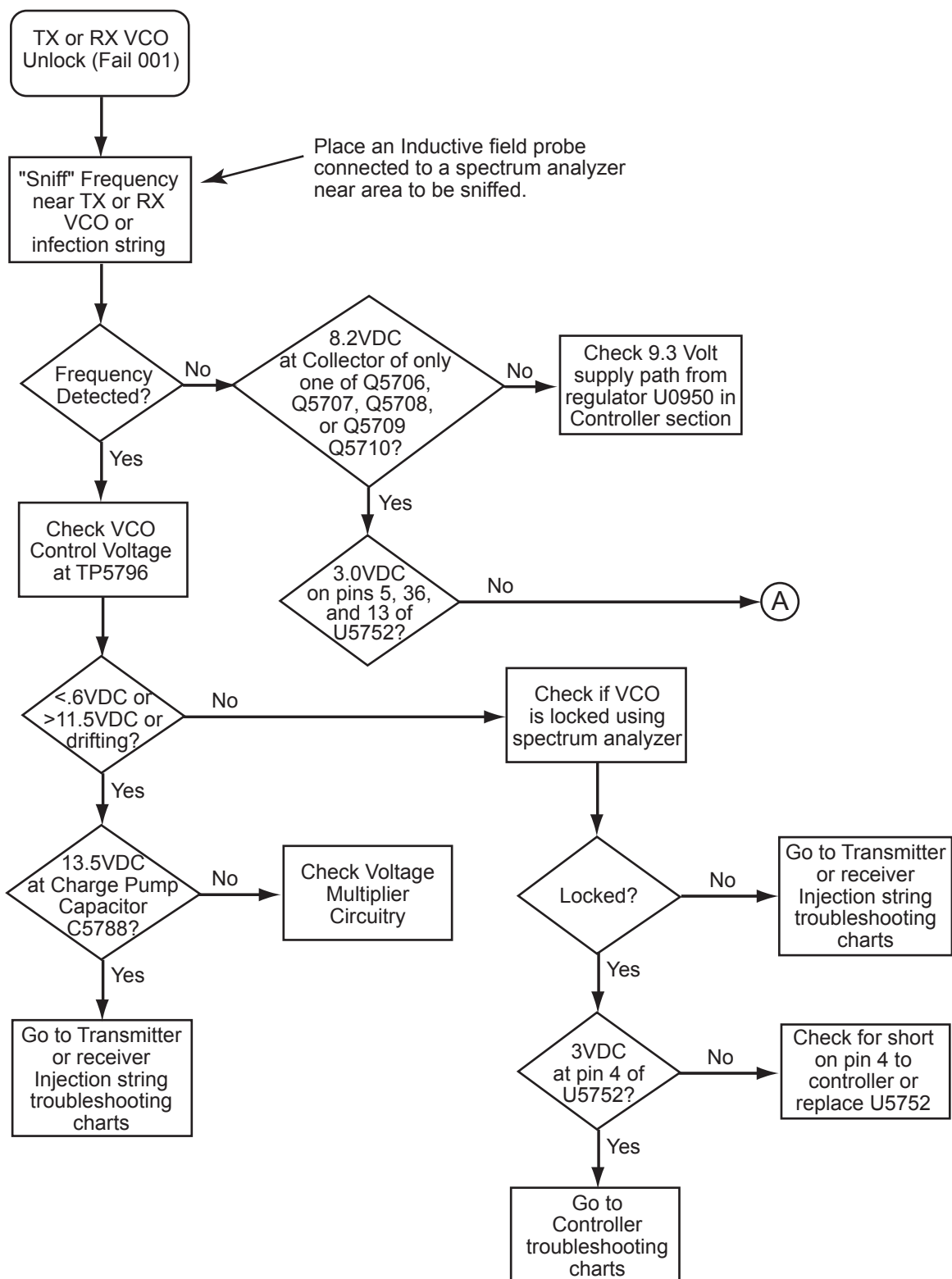


Figure 5-26. TX or RX VCO Unlock (Fail 001) (380–470 MHz and 450–520 MHz)—Part 1 of 2

5.6.25 TX or RX VCO Unlock (Fail 001) (380–470 MHz and 450–520 MHz)—Part 2 of 2

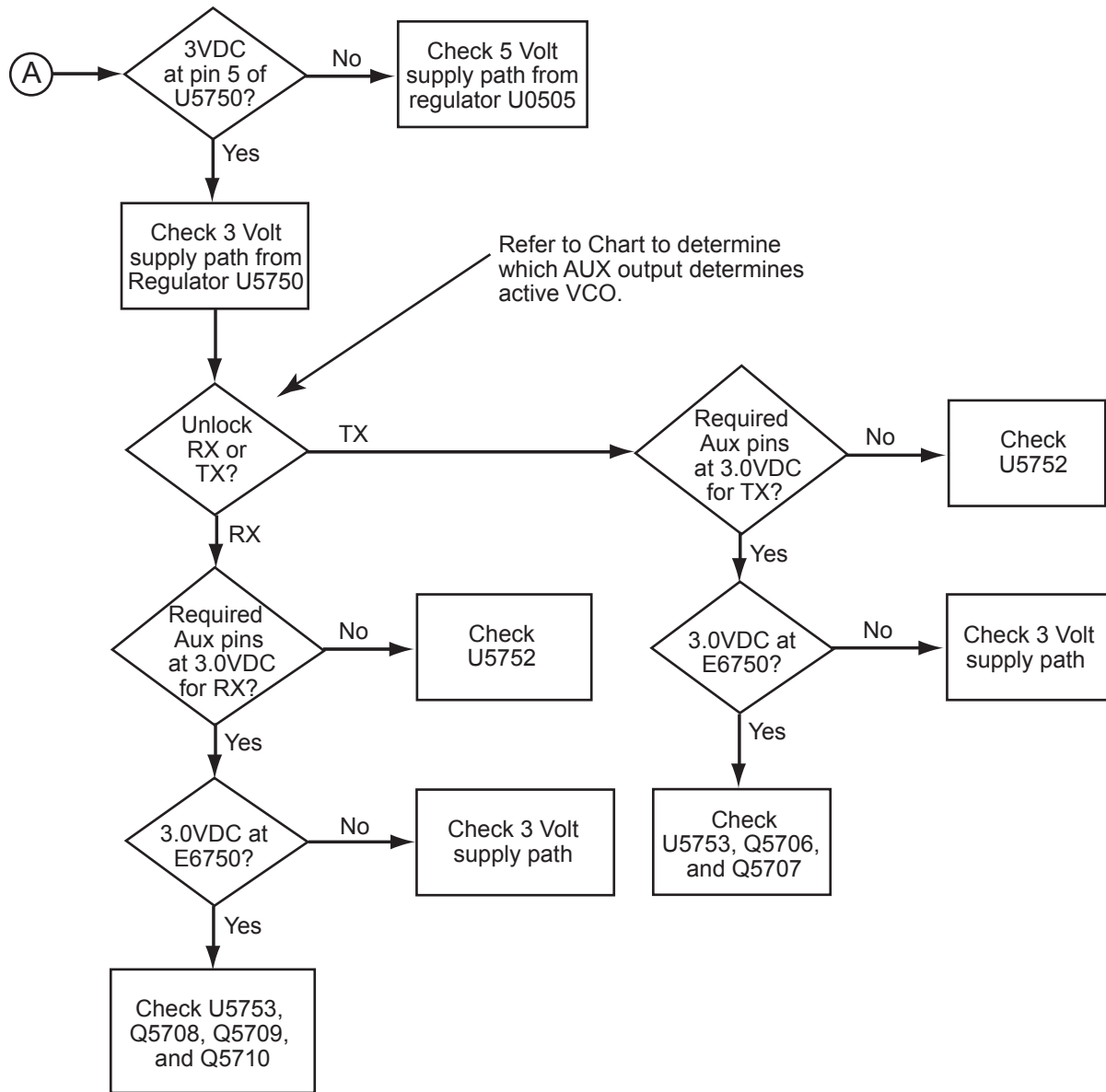


Figure 5-27. TX or RX VCO Unlock (Fail 001) (380–470 MHz and 450–520 MHz)—Part 2 of 2

5.6.26 RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 1 of 5

NOTE: For each flowchart step in which reference is made to a note, be sure to refer to that specific note (located on page 58 of this flowchart) for guidance in performing the actual troubleshooting procedure. Also, RFPA DC voltages are shown in Table 5-6 on page 5-41.

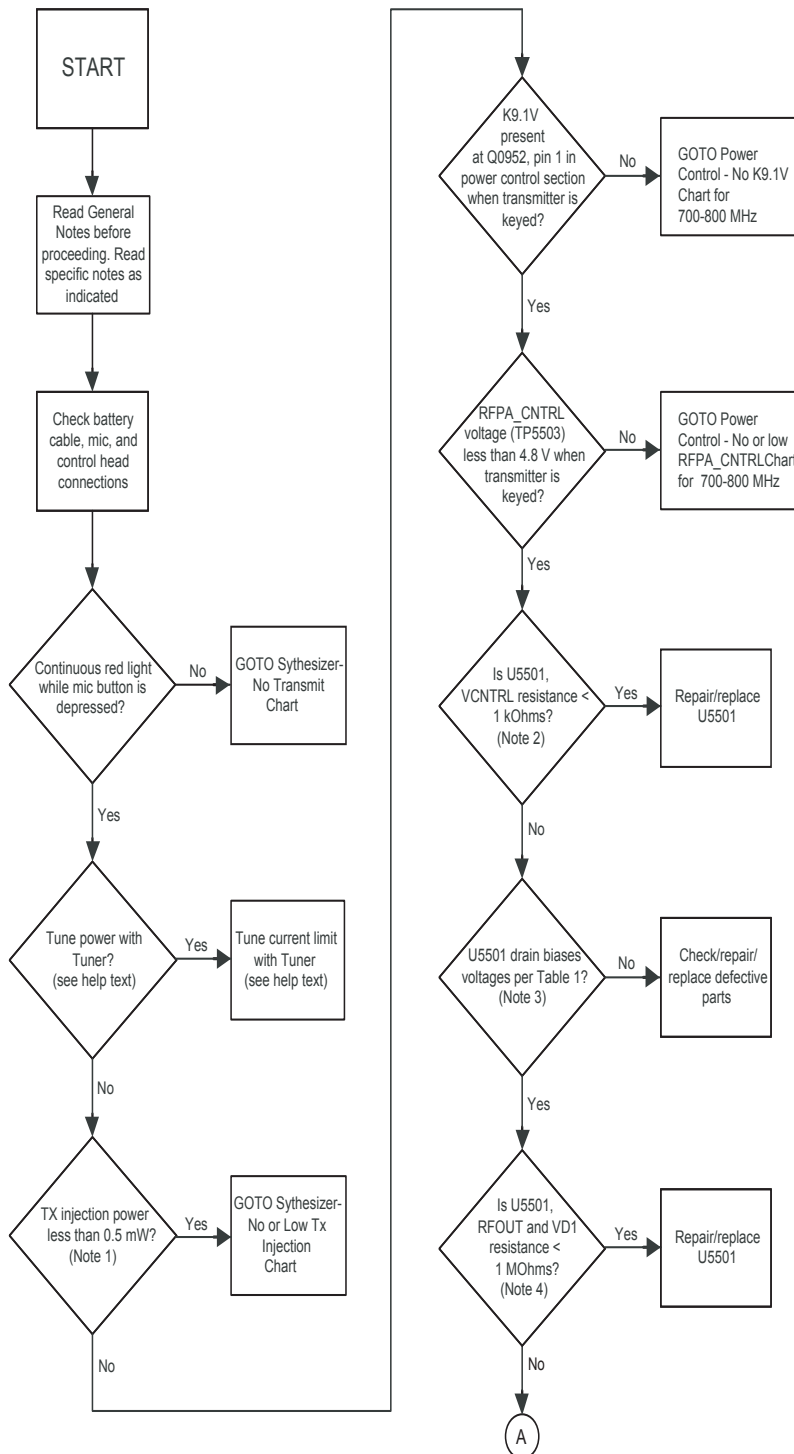


Figure 5-28. RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 1 of 5

5.6.27 RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 2 of 5

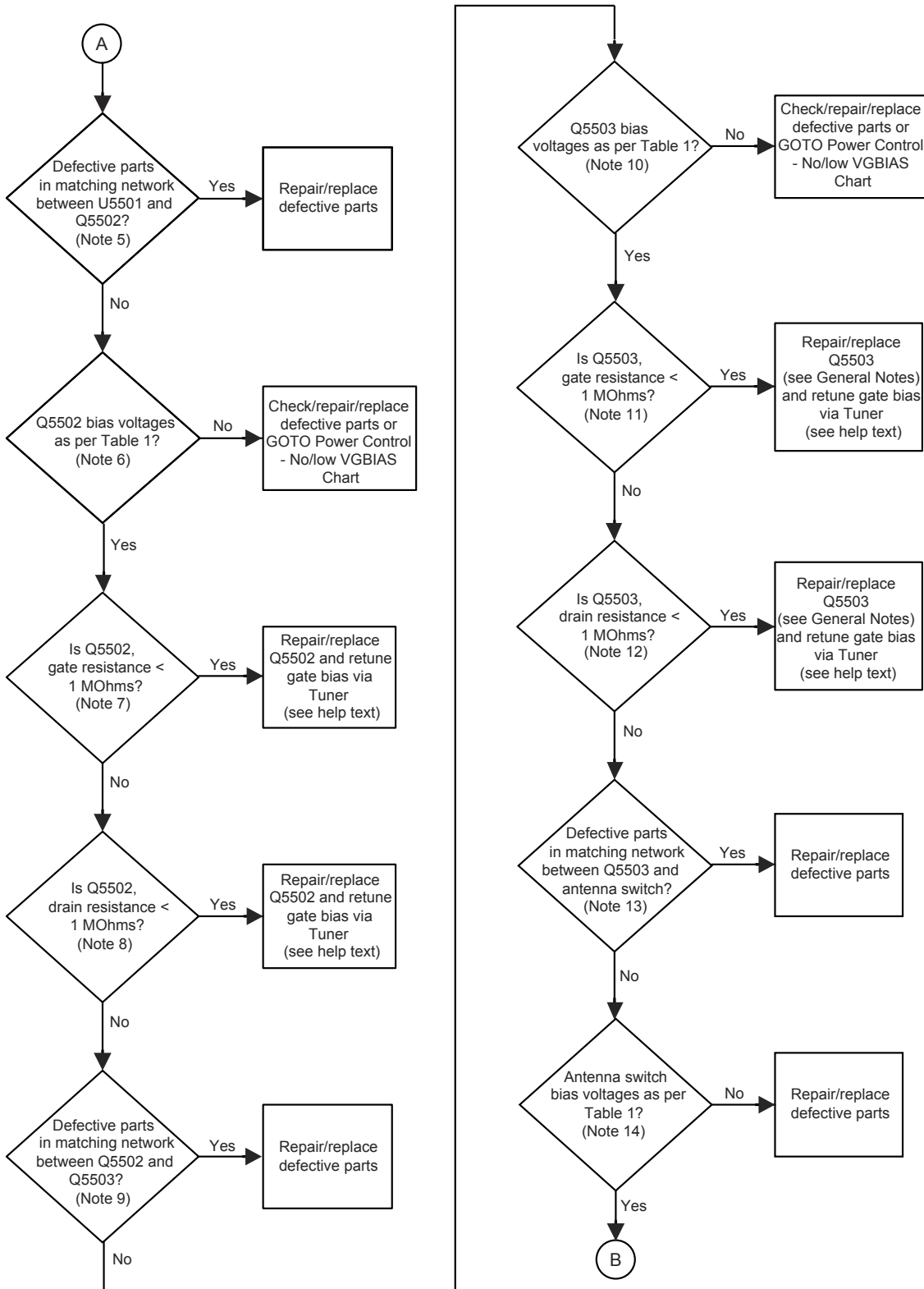


Figure 5-29. RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 2 of 5

5.6.28 RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 3 of 5

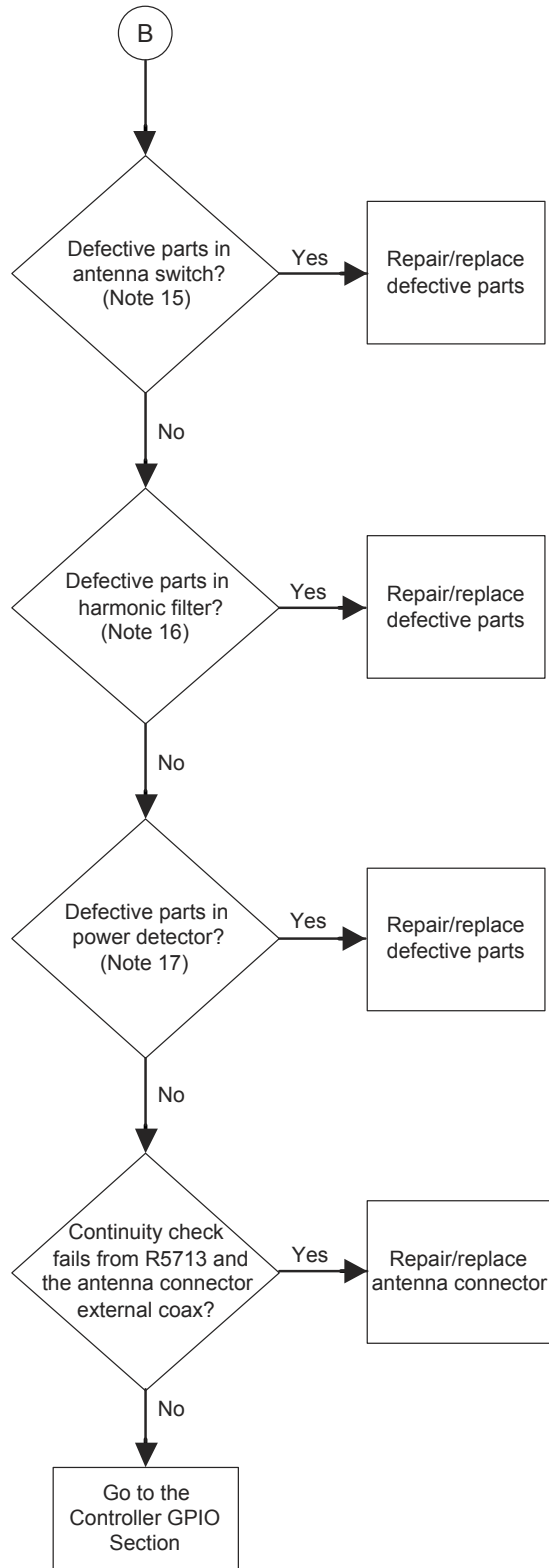


Figure 5-30. RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 3 of 5

5.6.29 RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 4 of 5

Specific Notes:

1. Remove C5508 and solder the center conductor of a small 50-ohm, coaxial cable to TP5502. Solder ground to the gold shield track adjacent to TP5502. Attach an RF milliwatt meter, key the transmitter, and measure TX_INJ power. Then, remove the coaxial cable and replace C5508. Remove the solder added to shield track.
2. Remove R0977 in the power control section, and measure the resistance between VCNTRL (TP5503) and ground. Replace R0977.
3. If U5501, VD1, is incorrect, inspect the bias feed circuitry (L5502 and C5505) and interstage match components (L5503, C5509, and C5507). If U5501, RFOUT, is incorrect, inspect the bias feed circuitry (L5505 and C5517).
4. Remove L5502 and measure the resistance between VD1 (U5501 pin 14) and ground. Replace L5502. Remove L5505 and measure the resistance between RFOUT (U5501 pin 6) and ground. Replace L5505.
5. Inspect C5566, C5516, C5518, and R5511-15.
6. If the Q5502 gate bias is incorrect, inspect the bias feed circuitry (R5516, L5525, C5556, and R5527). If the bias feed circuitry is functional, then go to the Power Control—No or low VGBIAS flowchart. If the Q5502 drain bias is incorrect, inspect the bias feed circuitry (L5508, C5526-27, R5517, E5501, and R5574). Check U5570, Q5770, and associated circuitry.
7. Remove R5516 and measure the resistance between Q5502 gate and ground. Replace R5516.
8. Remove L5508 and measure the resistance between Q5502 drain and ground. Replace L5508.
9. Inspect C5559-60, C5535, C5538, R5530, R5533-34, and R5536.
10. If the Q5503 pin 7 gate bias is incorrect, inspect the bias feed circuitry (R5520, C5539, C5557, and R5525). If the gate bias feed circuitry is functional, then go to the Power Control—No or low VGBIAS flowchart. If the Q5503 pin 6 gate bias is incorrect, inspect the bias feed circuitry (R5521, C5540, C5558, and R5526). If the bias feed circuitry is functional, then go to the Power Control—No or low VGBIAS flowchart. If the Q5503 pins 2 and 3 common drain bias is incorrect, inspect the bias feed circuitry (L5510, C5549-50, R5522-23, and E5502).
11. Remove R5520 and measure the resistance between Q5503 pin 7 gate and ground. Replace R5520. Remove R5521 and measure the resistance between Q5503 pin 6 gate and ground. Replace R5521.
12. Remove L5510 and measure the resistance between Q5503 pins 2 and 3 drain and ground. Replace L5510.
13. Inspect R5535, C5542-43, C5545-48, and C5551-53.
14. If the antenna switch bias voltages are incorrect, inspect R5524, L5701-4, and R5701, as well as perform diode checks on D5701-3.
15. Inspect the remaining antenna switch parts (C5701-10).
16. Inspect L5706-8, L5712-13, C5708, C5711-14, C5719-20, R5713, and R5718.
17. Inspect D5704, R5707-8, R5702-4, and C5715-16.

5.6.30 RF Power Amplifier (RFPA)—No or Low TX Power Output (380–470 MHz and 450–520 MHz)—Part 5 of 5

Table 5-6. RFPA DC Voltages

Description	Location	Voltage (Vdc) (380–470 MHz)	Voltage (Vdc) (450–520 MHz)
A+ = 13.6 Vdc			
U5501, VD1	U5501 pin 14	9.0–9.3	9.0–9.3
U5501, RFOUT	U5501 pins 6 and 7	9.0–9.3	9.0–9.3
Q5502 Gate Bias	R5516/C5525 node	1.8–2.0	1.8–2.1
Q5502 Drain Bias	L5508/R5517 Node	9.0–9.3	9.0–9.3
Q5503 Gate Bias 1	R5520/C5539 node	2.0–2.2	1.4–1.9
Q5503 Gate Bias 2	R5521/C5540 node	2.0–2.2	1.4–1.9
Q5503 Drain Bias	L5510/R5523 Node	13.0–13.6	13.0–13.6
Antenna Switch Bias Voltage 1	L5701/C5702 node	~4.7	~5.95
Antenna Switch Bias Voltage 2	D5701/D5702 node	~4.0	~5.0
Antenna Switch Bias Voltage 3	D5703/R5701 node	~3.3	~3.3

5.6.31 RFPA Power Control—No VGBIAS (380–470 MHz and 450–520 MHz)

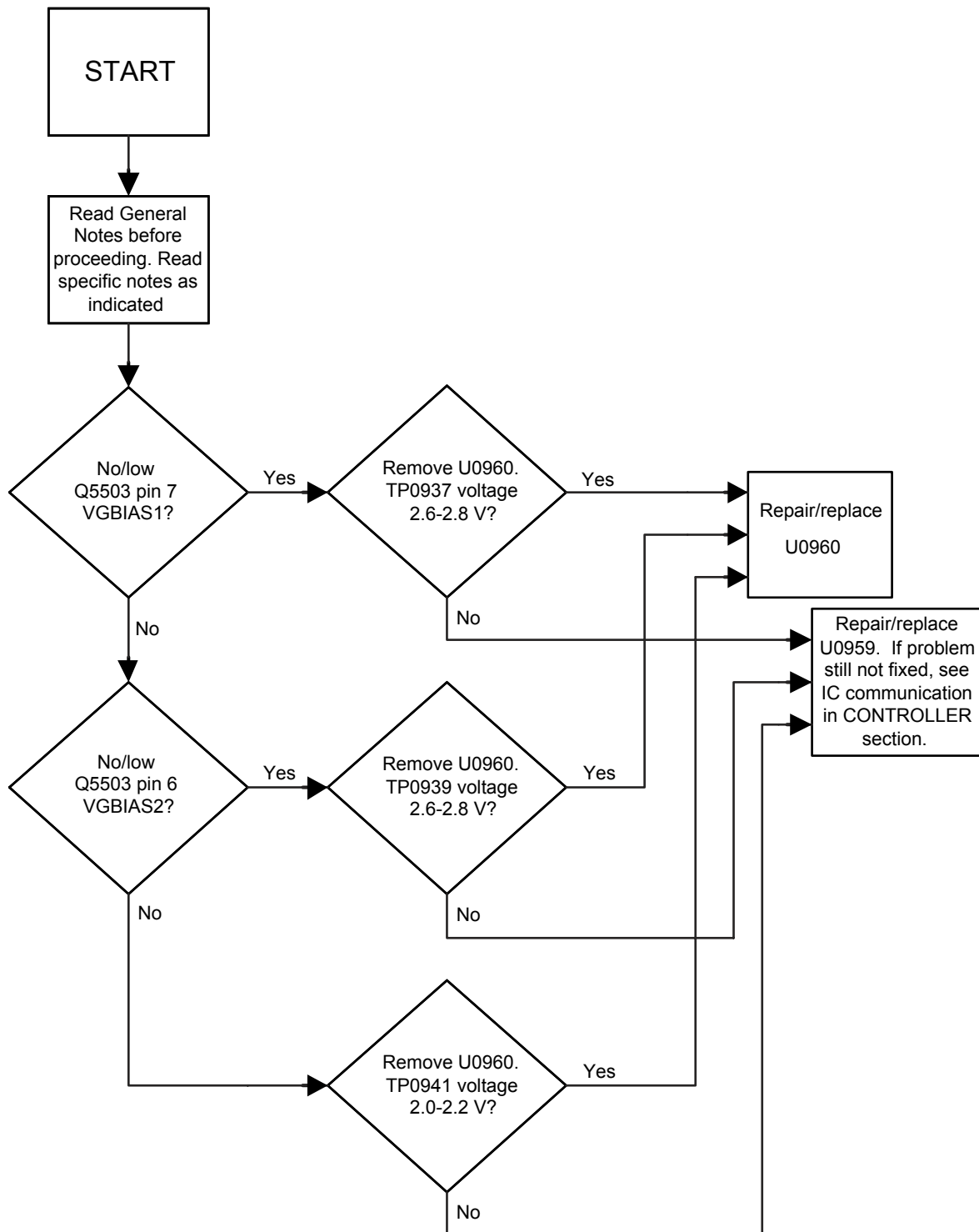


Figure 5-31. RFPA Power Control—No VGBIAS (380–470 MHz and 450–520 MHz)

5.6.32 No 16.8 MHz Reference Oscillator Frequency (700–800 MHz)

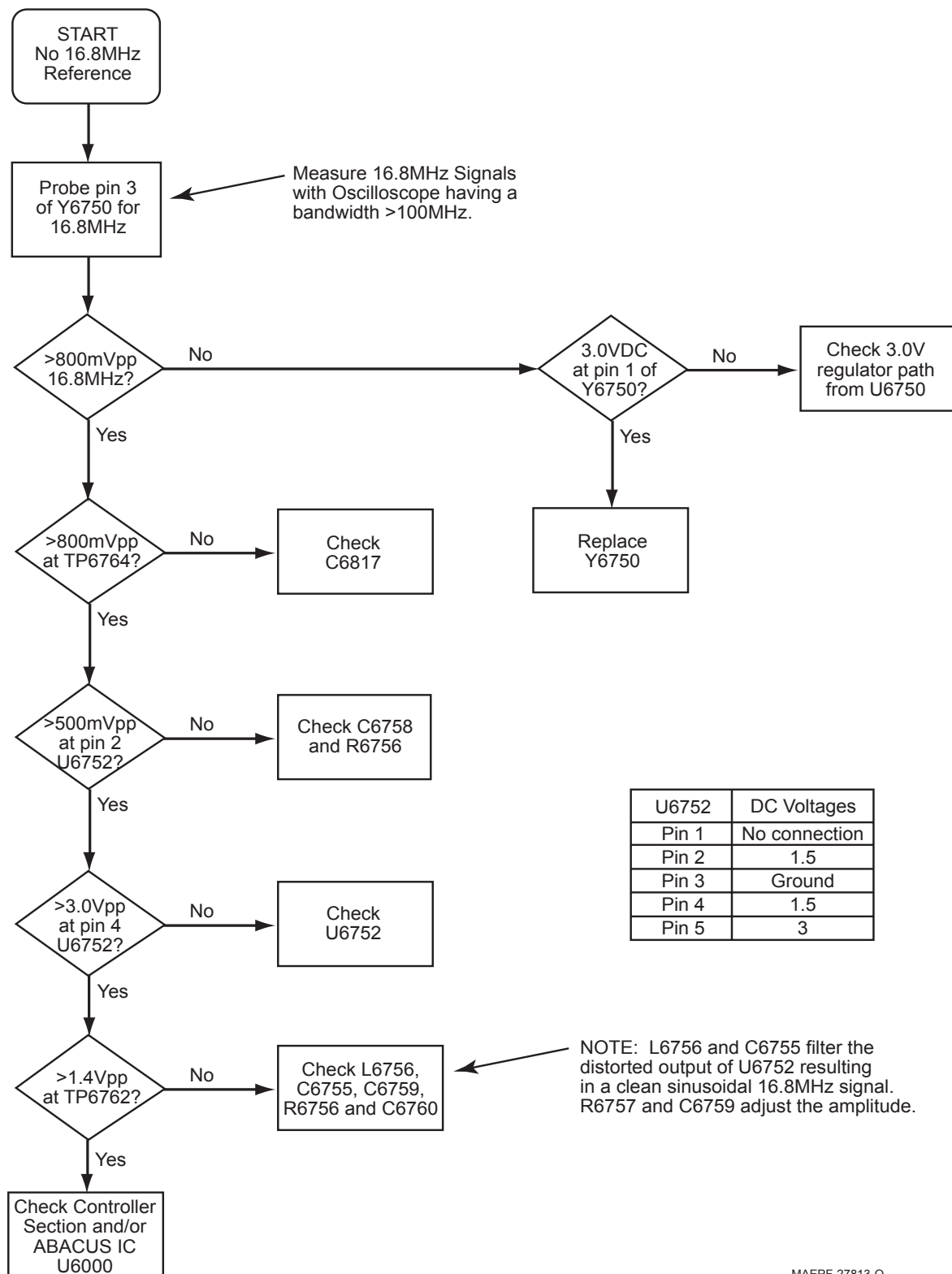
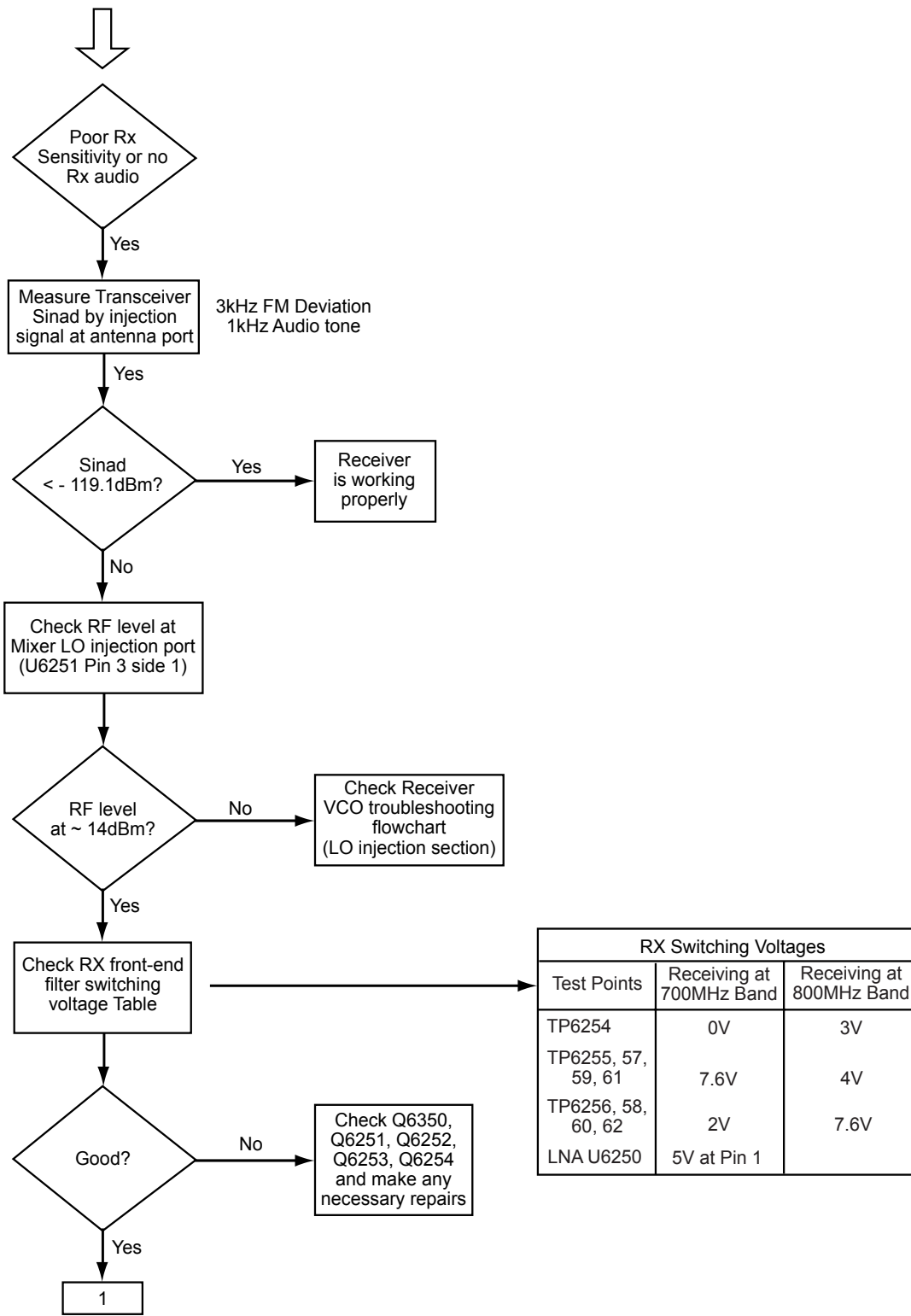


Figure 5-32. No 16.8 MHz Reference Oscillator Frequency (700–800 MHz)

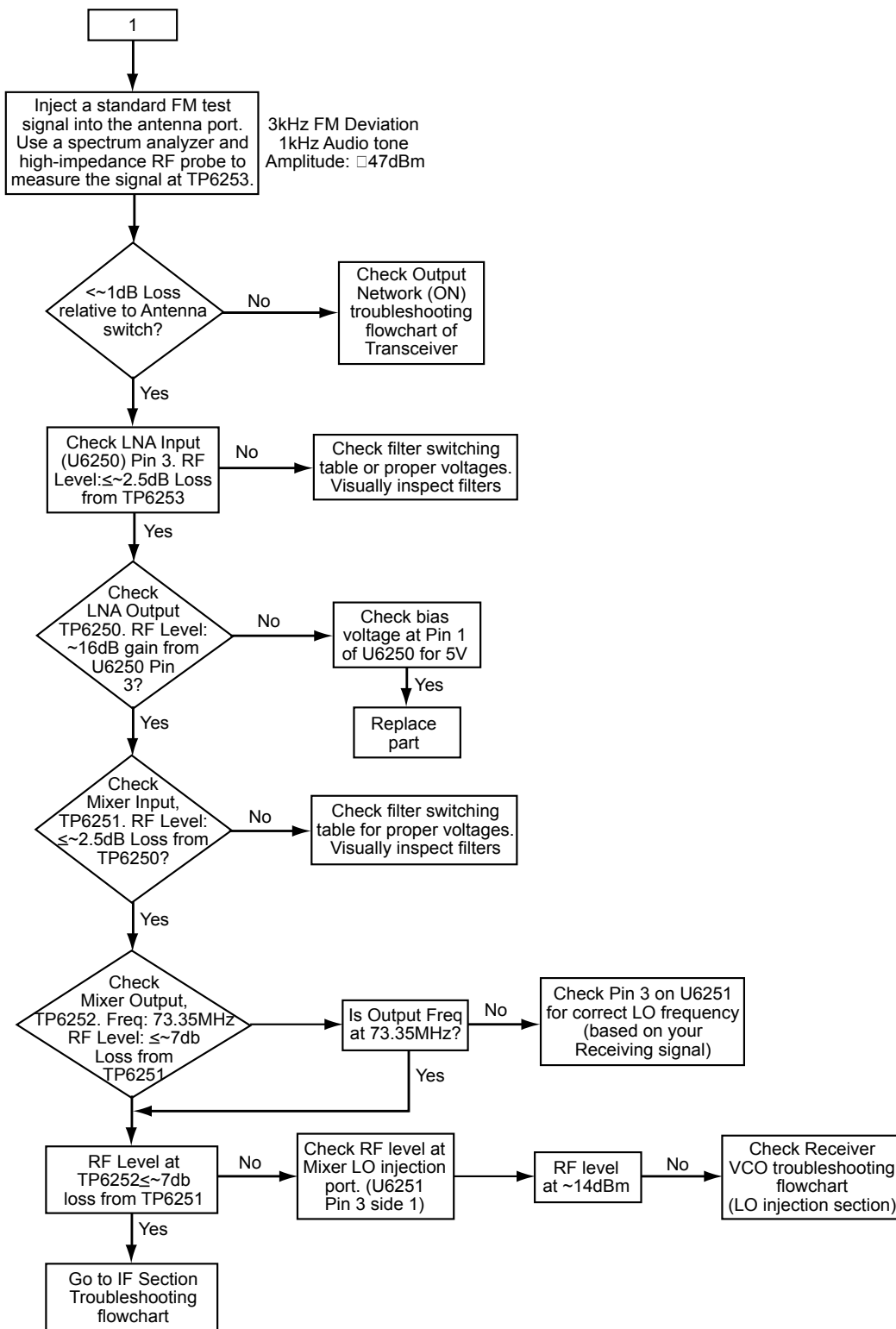
5.6.33 Poor RX Sensitivity or No RX Audio (700–800 MHz)—Part 1 of 2



MAEPF-27875-0

Figure 5-33. Poor RX Sensitivity or No RX Audio (700–800 MHz)—Part 1 of 2

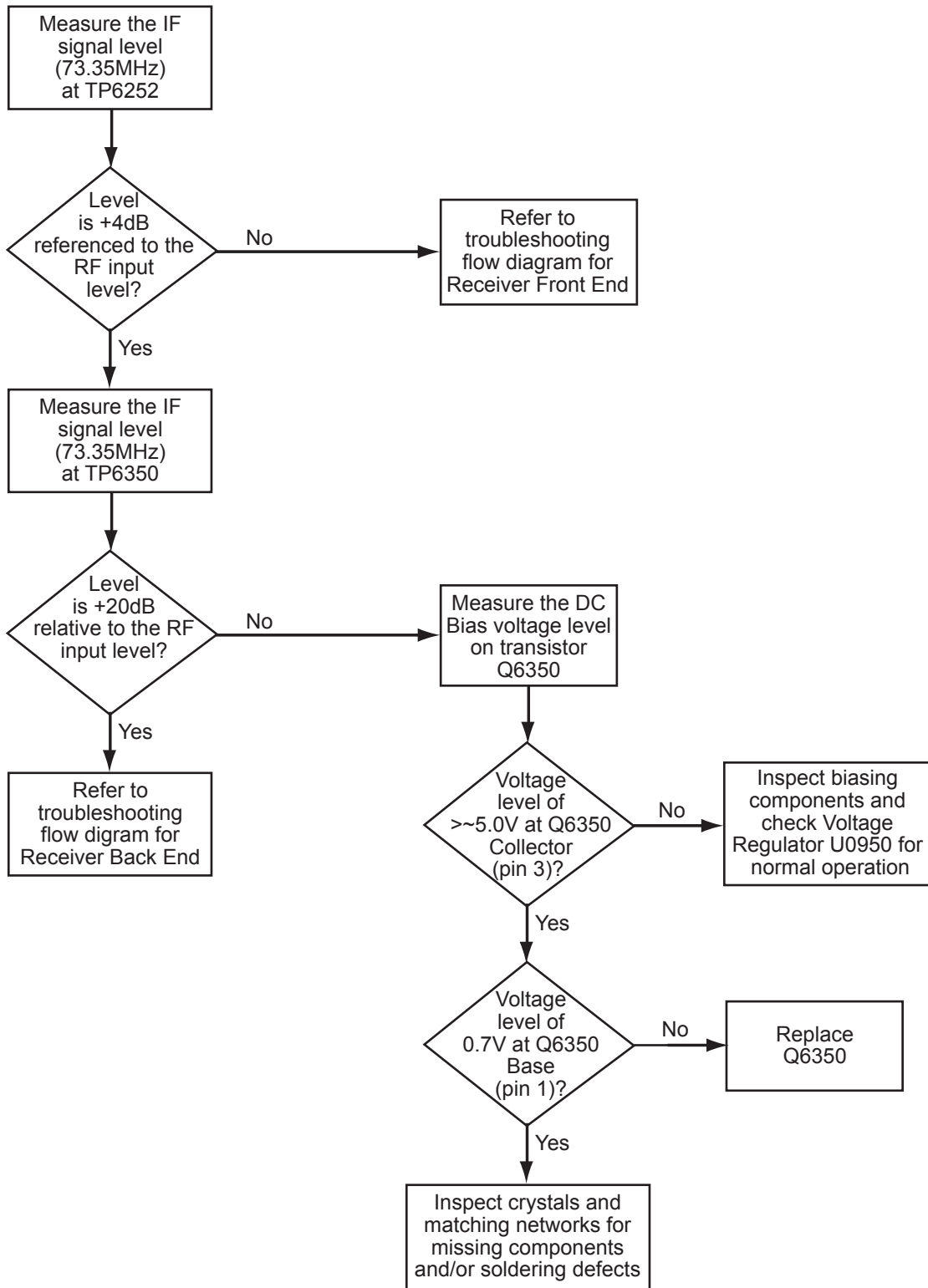
5.6.34 Poor RX Sensitivity or No RX Audio (700–800 MHz)—Part 2 of 2



MAEPF-27874-O

Figure 5-34. Poor RX Sensitivity or No RX Audio (700–800 MHz)—Part 2 of 2

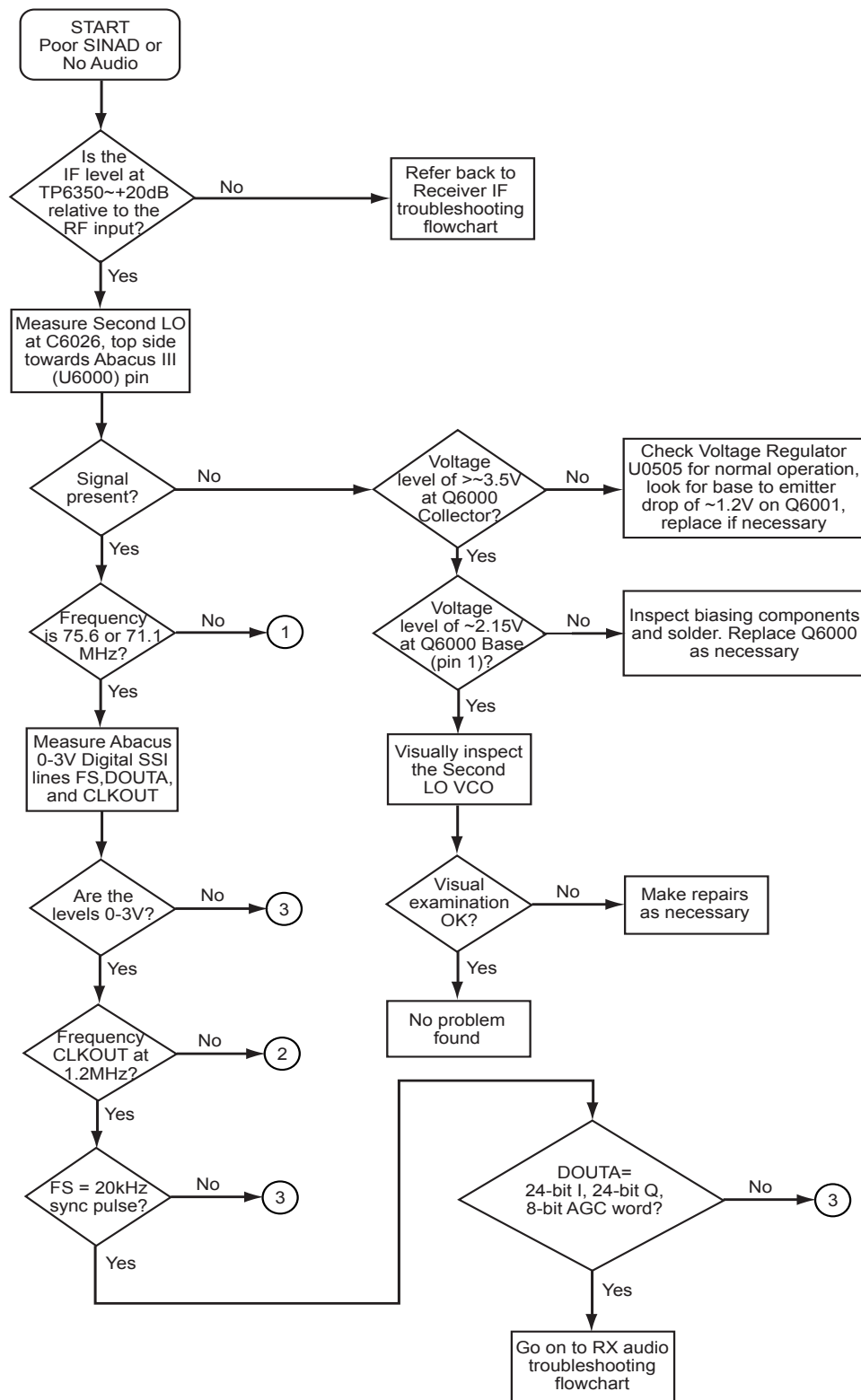
5.6.35 RX IF—Poor SINAD or No Audio (700–800 MHz)



MAEPF-27809-O

Figure 5-35. RX IF—Poor SINAD or No Audio (700–800 MHz)

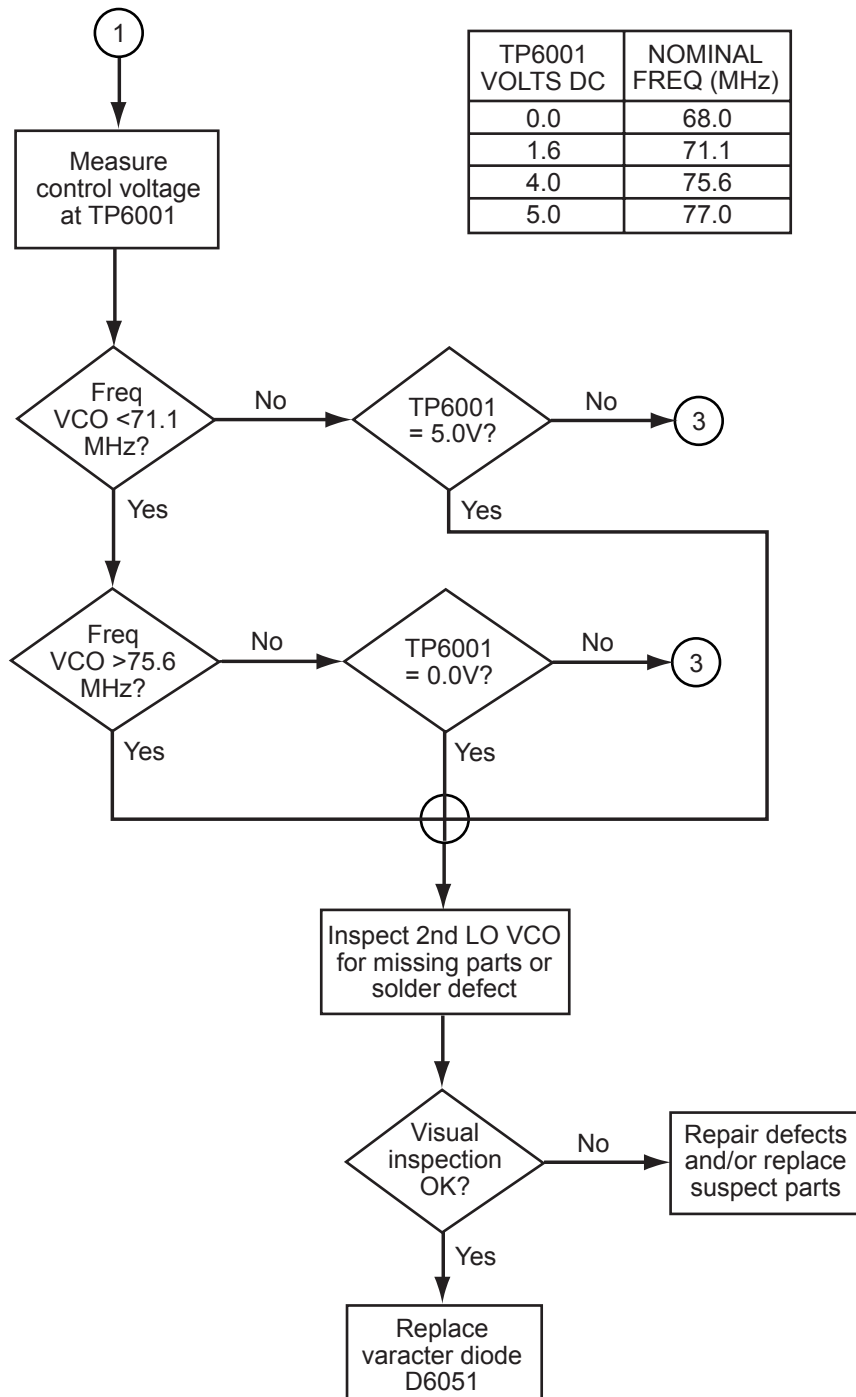
5.6.36 RX Back-End—Poor SINAD or No Audio (700–800 MHz)—Part 1 of 3



MAEPF-27806-O

Figure 5-36. RX Back-End—Poor SINAD or No Audio (700–800 MHz)—Part 1 of 3

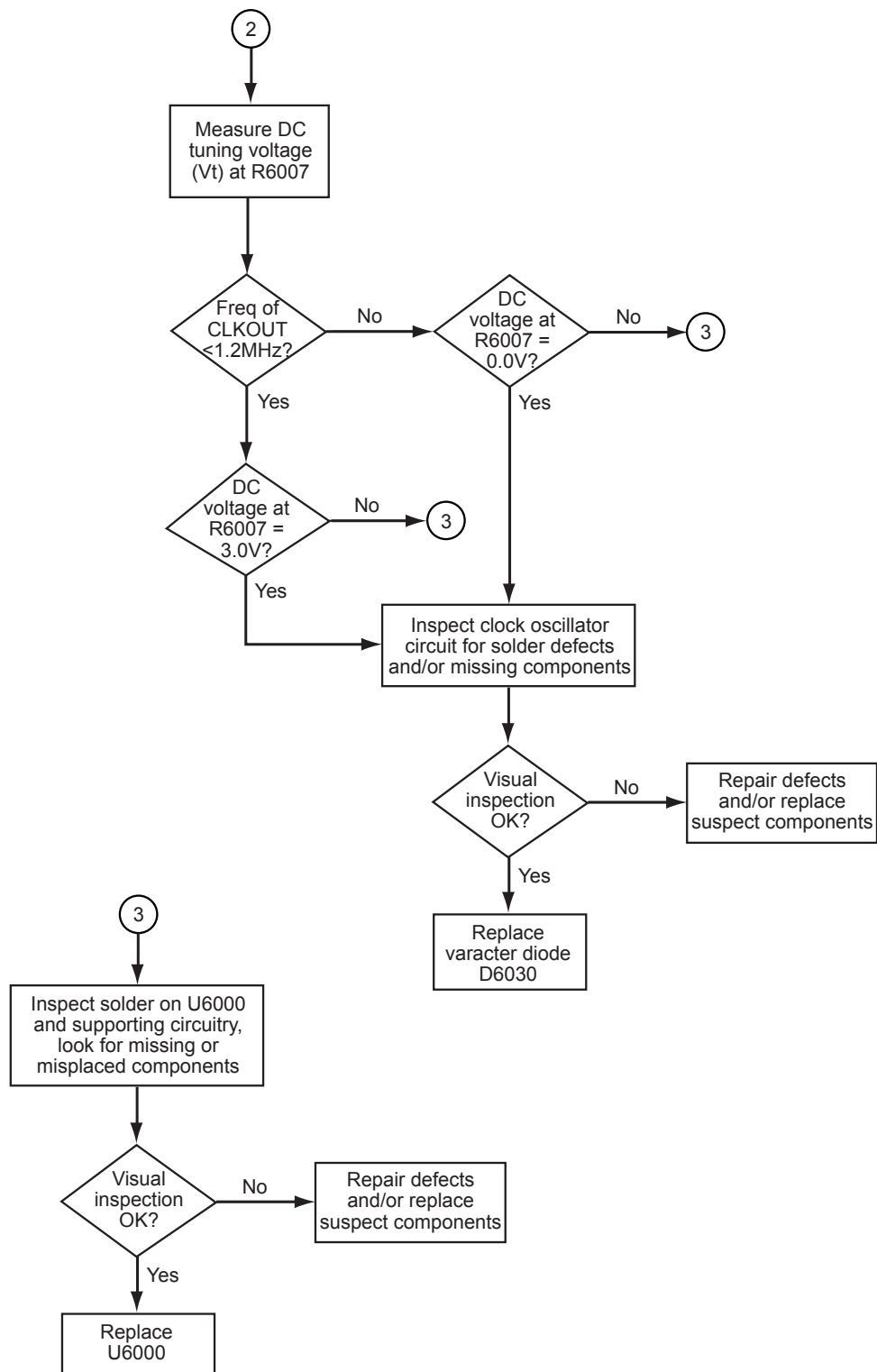
5.6.37 RX Back-End—Poor SINAD or No Audio (700–800 MHz)—Part 2 of 3



MAEPF-27807-O

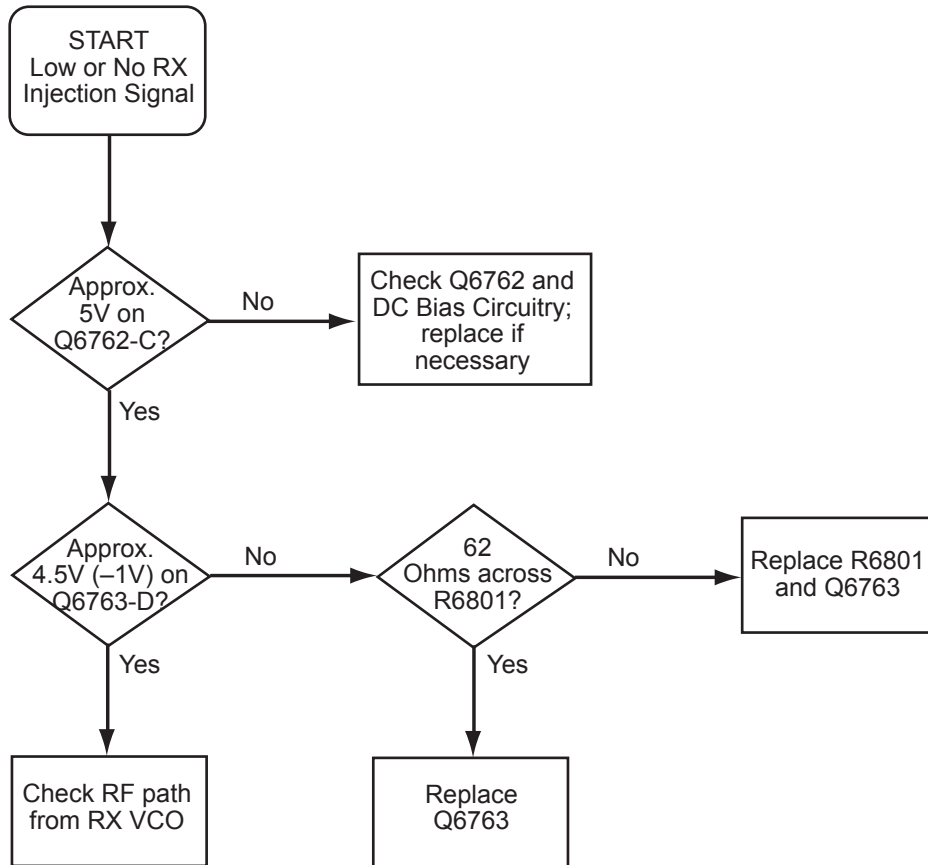
Figure 5-37. RX Back-End—Poor SINAD or No Audio (700–800 MHz)—Part 2 of 3

5.6.38 RX Back-End—Poor SINAD or No Audio (700–800 MHz)—Part 3 of 3



MAEPF-27808-O

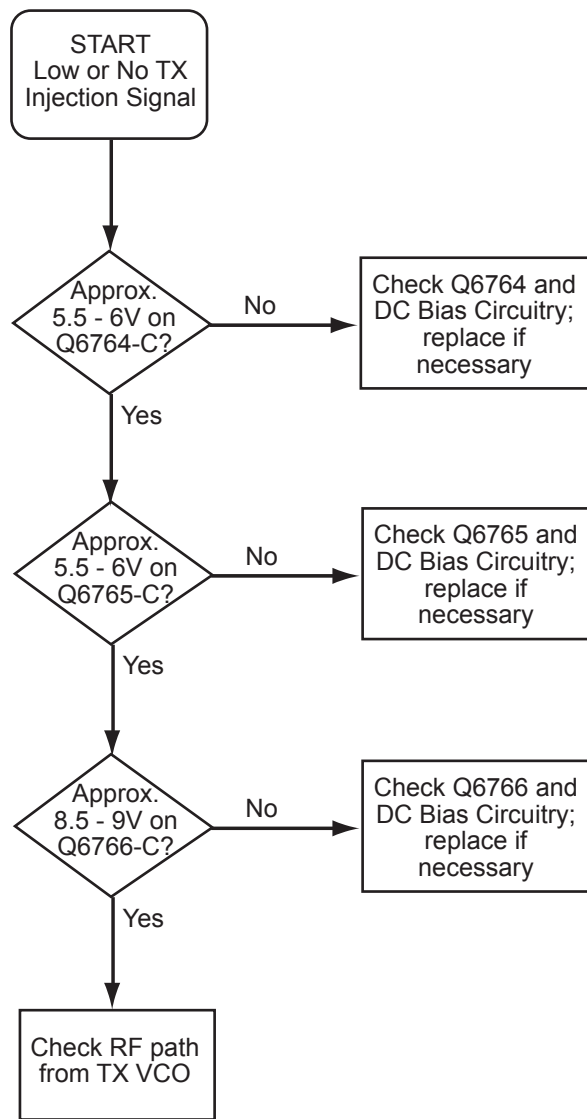
Figure 5-38. RX Back-End—Poor SINAD or No Audio (700–800 MHz)—Part 3 of 3

5.6.39 Low or No RX Injection Signal (700–800 MHz)

MAEPF-27810-0

Figure 5-39. Low or No RX Injection Signal (700–800 MHz)

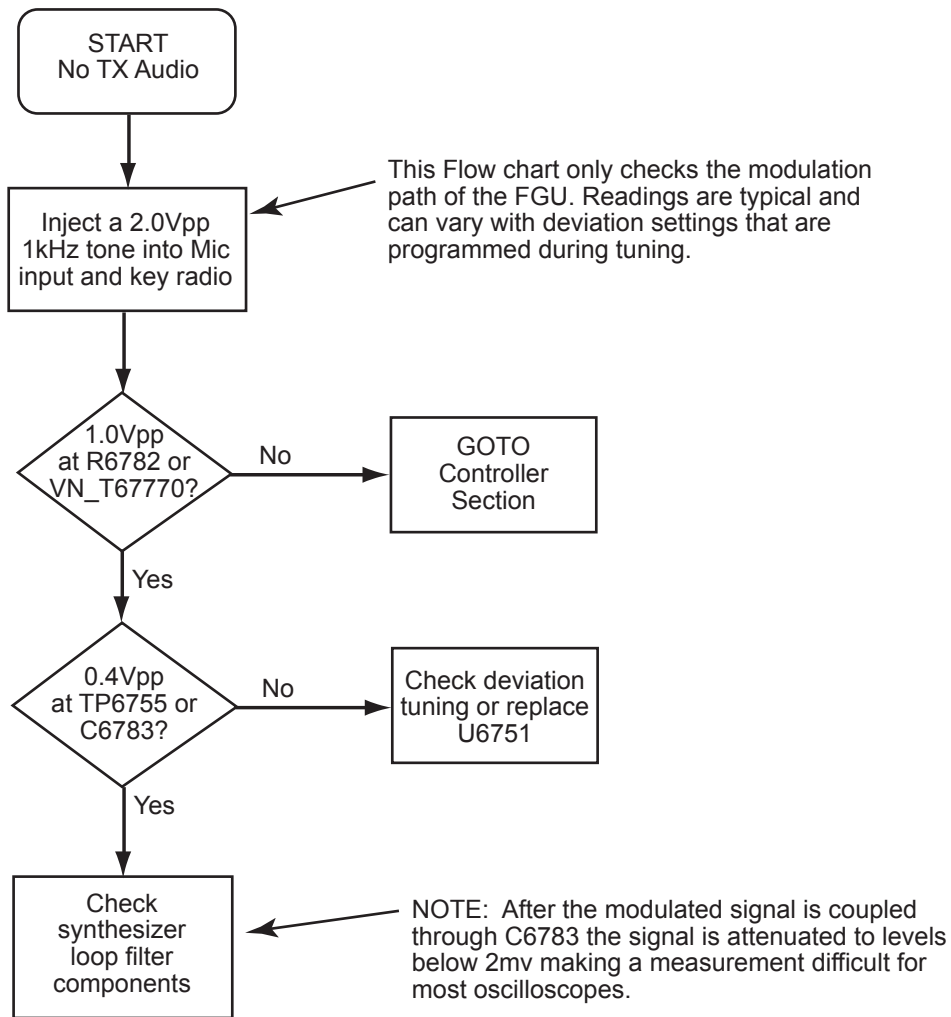
5.6.40 Low or No TX Injection Signal (700–800 MHz)



MAEPF-27811-O

Figure 5-40. Low or No TX Injection Signal (700–800 MHz)

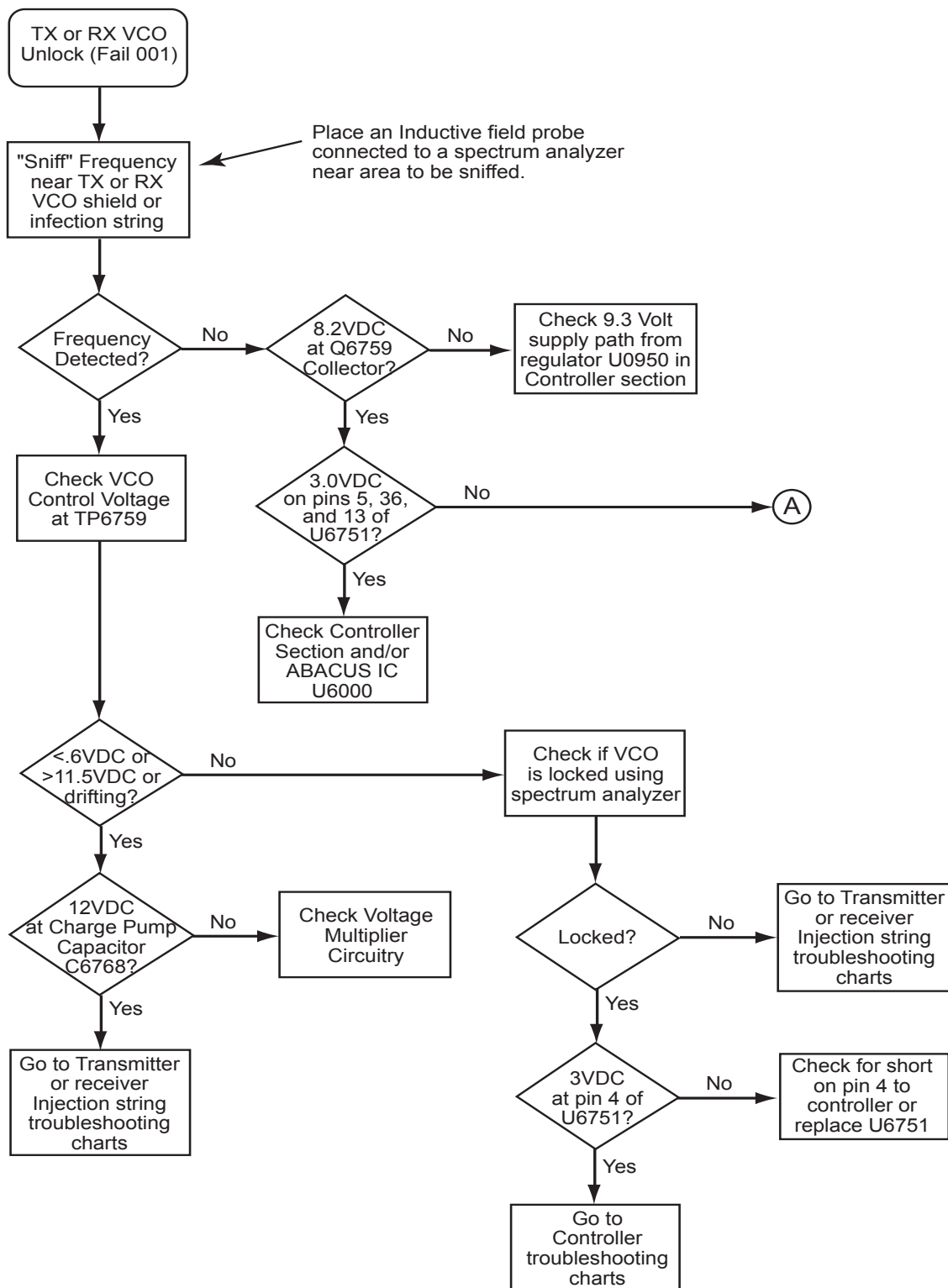
5.6.41 No TX Audio (700–800 MHz)



MAEPF-27814-O

Figure 5-41. No TX Audio (700–800 MHz)

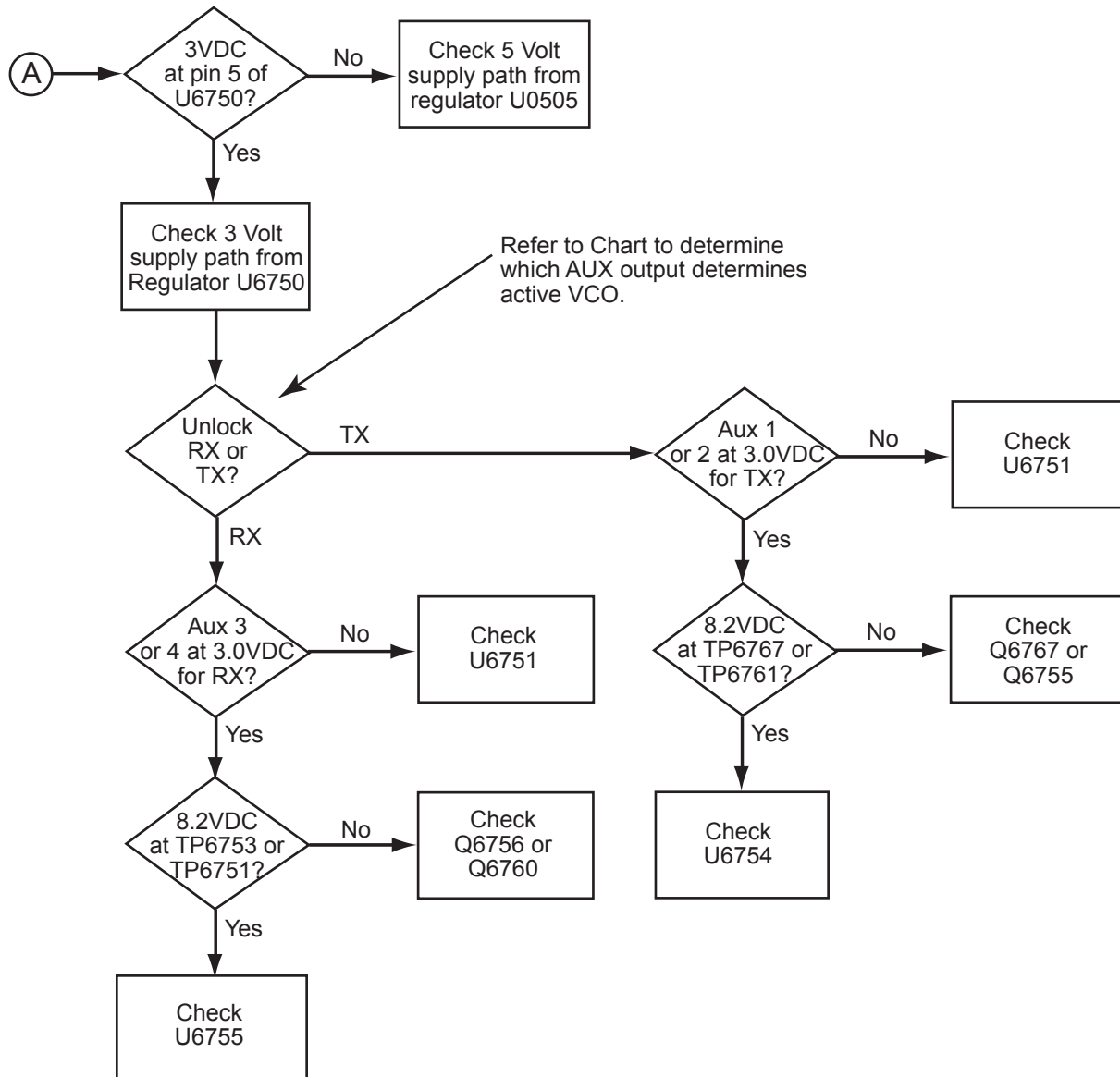
5.6.42 TX or RX VCO Unlock (Fail 001) (700–800 MHz)—Part 1 of 2



MAEPF-27812-O

Figure 5-42. TX or RX VCO Unlock (Fail 001) (700–800 MHz)—Part 1 of 2

5.6.43 TX or RX VCO Unlock (Fail 001) (700–800 MHz)—Part 2 of 2

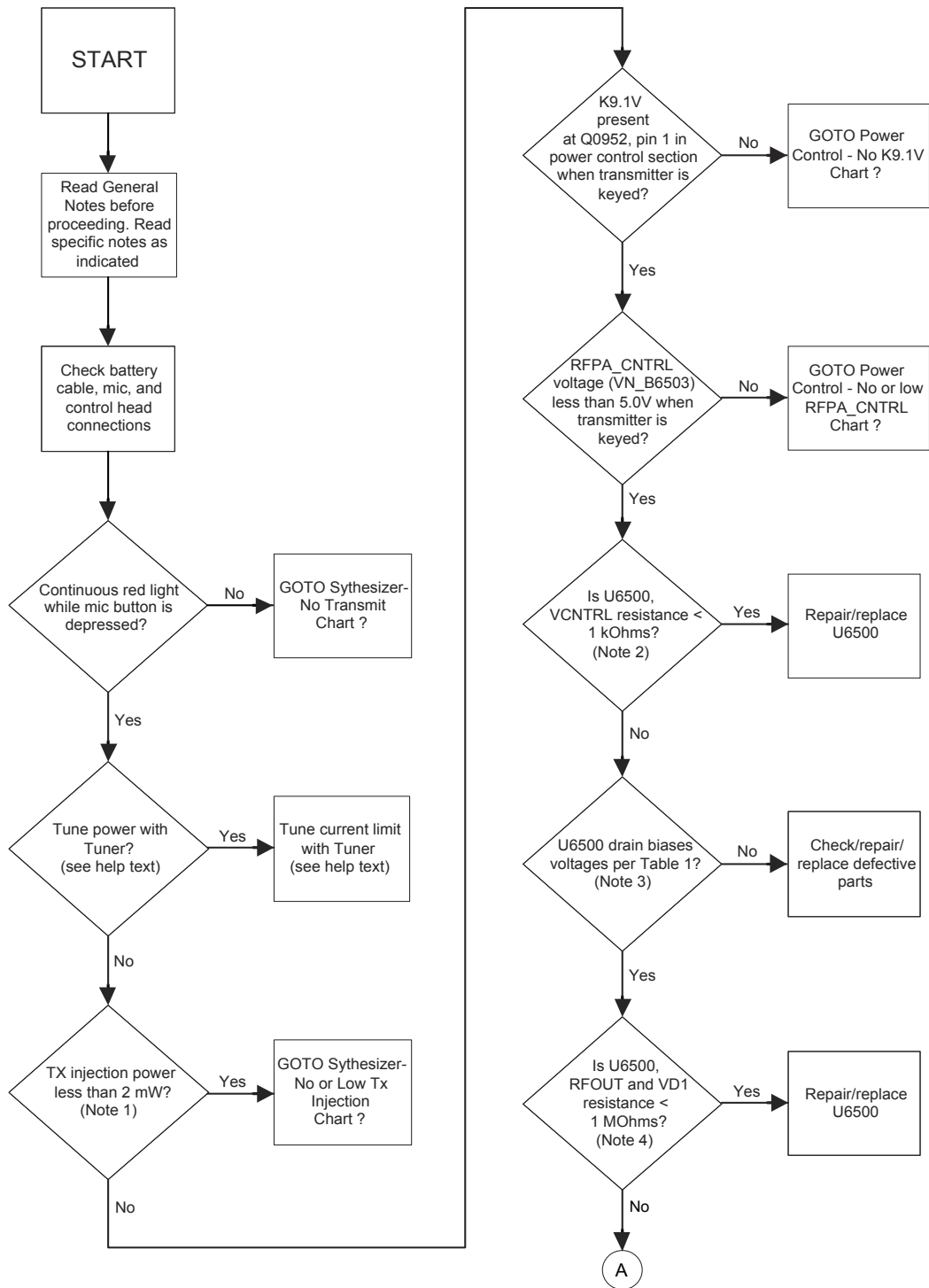


MAEPF-27818-O

Figure 5-43. TX or RX VCO Unlock (Fail 001) (700–800 MHz)—Part 2 of 2

5.6.44 RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)—Part 1 of 5

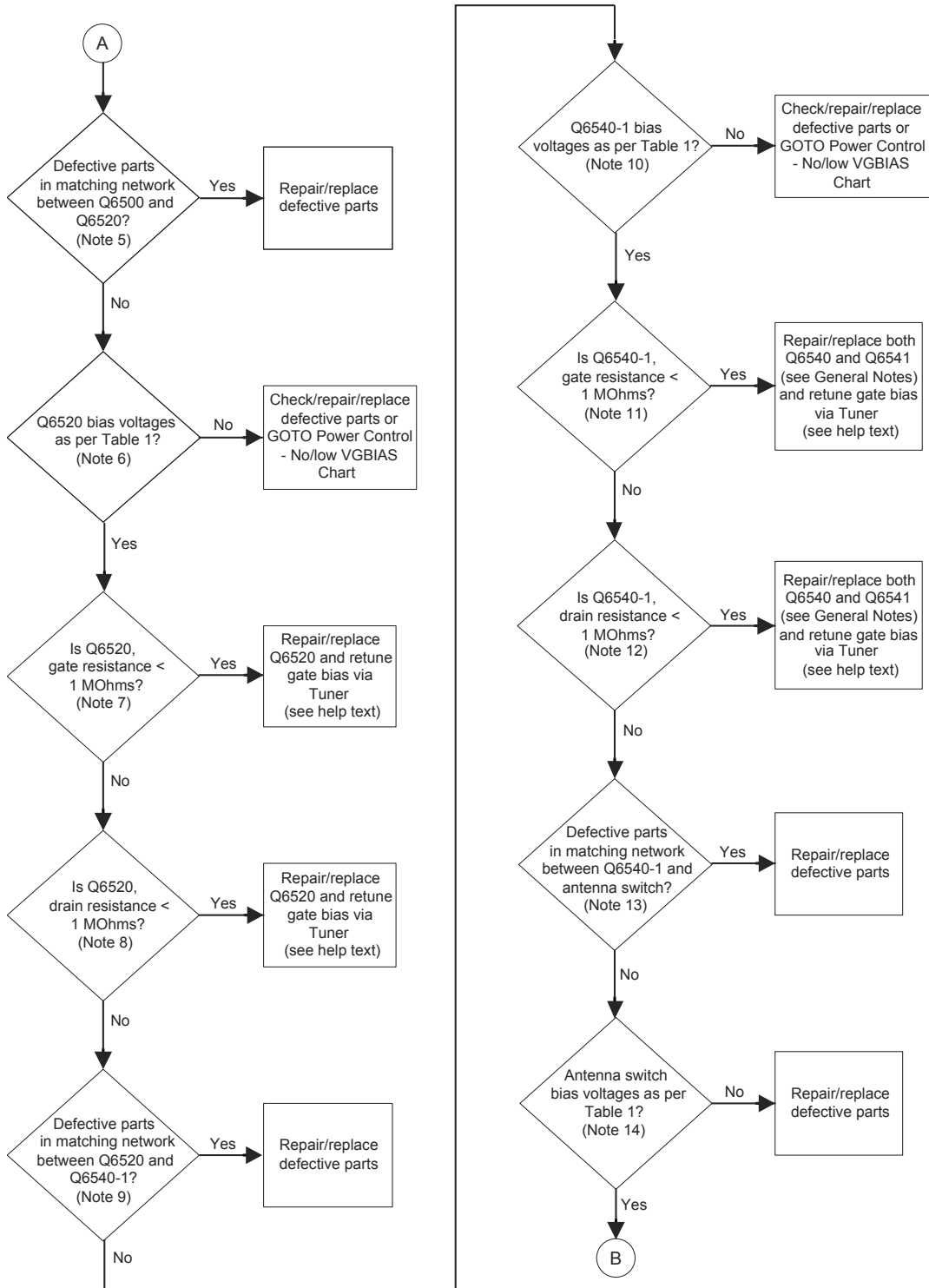
NOTE: For each flowchart step in which reference is made to a note, be sure to refer to that specific note (located on page 58 of this flowchart) for guidance in performing the actual troubleshooting procedure. Also, RFPA DC voltages are shown in Table 5-7 on page 5-59.



MAEPF-27929-O

Figure 5-44. RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)—Part 1 of 5

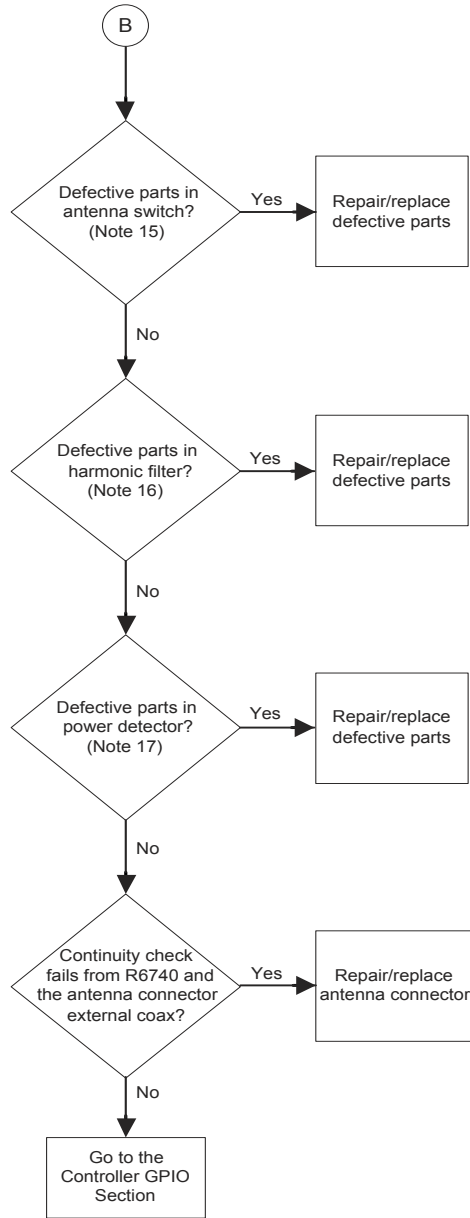
5.6.45 RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)—Part 2 of 5



MAEPF-27930-O

Figure 5-45. RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)—Part 2 of 5

5.6.46 RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)—Part 3 of 5



MAEPF-27931-O

Figure 5-46. RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)—Part 3 of 5

5.6.47 RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)— Part 4 of 5

Specific Notes:

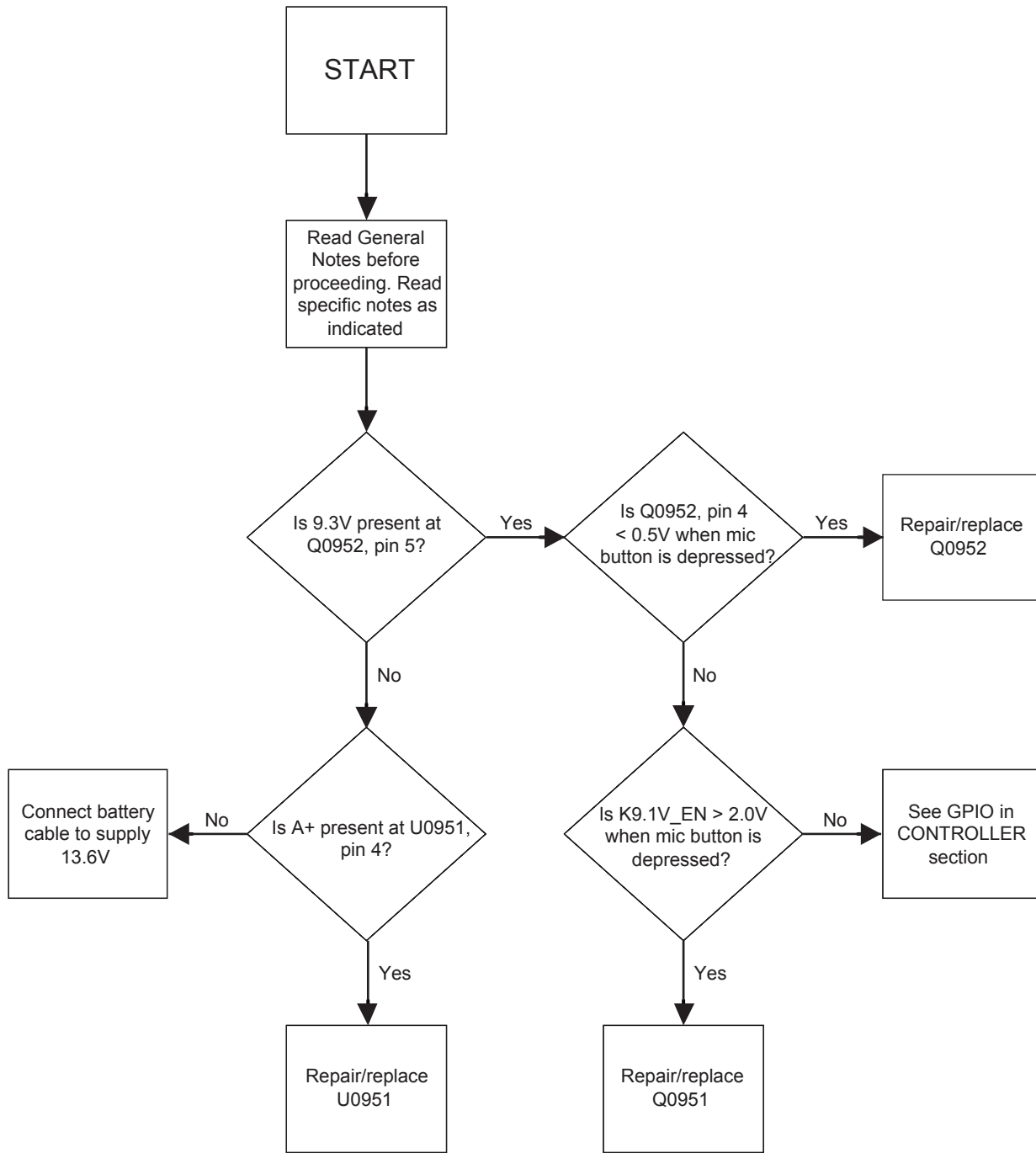
1. Remove C6501 and solder the center conductor of a small 50-ohm, coaxial cable to VN_B6500. Solder ground to the gold shield track adjacent to VN_B6500. Attach an RF milliwatt meter, key the transmitter, and measure TX_INJ power. Then, remove the coaxial cable and replace C6501. Remove the solder added to shield track.
2. Remove R0977 in the power control section, and measure the resistance between VCNTRL (VN_B6503) and ground. Replace R0977.
3. If U6500, VD1, is incorrect, inspect the bias feed circuitry (L6501 and C6504) and interstage match components (L6502, C6506, and C6503). If U6500, RFOUT, is incorrect, inspect the bias feed circuitry (L6500 and C6500).
4. Remove L6501 and measure the resistance between VD1 (VN_B6501) and ground. Replace L6501. Remove L6500 and measure the resistance between RFOUT (VN_B6504) and ground. Replace L6500.
5. Inspect C6502, C6509-11, and R6521-5.
6. If the Q6520 gate bias is incorrect, inspect the bias feed circuitry (R6520 and C6520). If the bias feed circuitry is functional, then go to the Power Control—No or low VGBIAS flowchart. If the Q6520 drain bias is incorrect, inspect the bias feed circuitry (L6521, C6521-2, R6526-7, and L6521-5).
7. Remove R6520 and measure the resistance between Q6520 gate and ground. Replace R6520.
8. Remove L6521 and measure the resistance between Q6520 drain and ground. Replace L6521.
9. Inspect C6541-2, C6544-5, C6547-8, C6565-6, R6550-7, and R6559.
10. If the Q6540 gate bias is incorrect, inspect the bias feed circuitry (R6540 and C6540). If the gate bias feed circuitry is functional, then go to the Power Control—No or low VGBIAS flowchart. If the Q6540 gate bias is incorrect, inspect the bias feed circuitry (R6543 and C6558). If the bias feed circuitry is functional, then go to the Power Control—No or low VGBIAS flowchart. If the Q6540-1 common drain bias is incorrect, inspect the bias feed circuitry (L6542-3, C6559-60, R6544-5, and L6521-5).
11. Remove R6540 and measure the resistance between Q6540 gate and ground. Replace R6540. Remove R6543 and measure the resistance between Q6541 gate and ground. Replace R6541.
12. Remove L6542 and measure the resistance between Q6540-1 drain and ground. Replace L6542.
13. Inspect R6560 and C6549-57.
14. If the antenna switch bias voltages are incorrect, inspect R6547-8, L6700, and L6702-3, as well as perform diode checks on D6701-2.
15. Inspect the remaining antenna switch parts (C6700-5).
16. Inspect L6720-2 and C6720-1.
17. Inspect D6730, R6730-2, R6735-6, L6730, and C6730-1.

**5.6.48 RF Power Amplifier (RFPA)—No or Low TX Power Output (700–800 MHz)—
Part 5 of 5**

Table 5-7. RFPA DC Voltages

Description	Location	Voltage (Vdc)
A+ = 13.6 Vdc		
U5501, VD1	VN_B6503	9.0–9.3
U5501, RFOUT	VN_B6504	9.0–9.3
Q6520 Gate Bias	VN_B6520	2.0–2.2
Q6520 Drain Bias	L6521/R6526 Node	13.0–13.6
Q6540 Gate Bias	VN_B6540	3.5–3.7
Q6541 Gate Bias	VN_B6541	3.5–3.7
Q6540/Q6541 Drain Bias	L6542/R6544 Node	13.0–13.6
Antenna Switch Bias Voltage 1	VN_B6563	~5.3
Antenna Switch Bias Voltage 2	VN_T6701	~1.6
Antenna Switch Bias Voltage 3	D6701/D6702 Node	~0.8

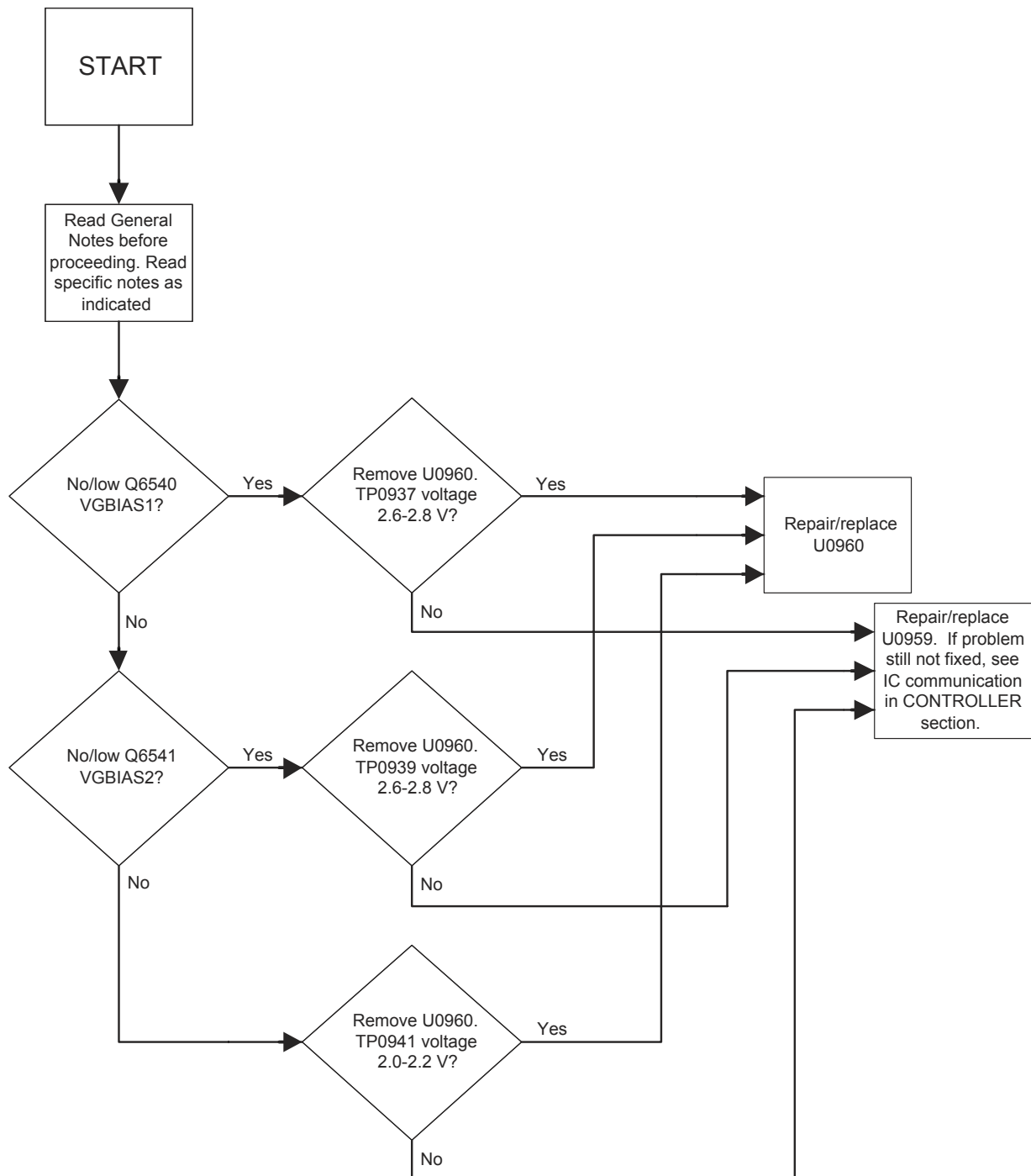
5.6.49 RFPA Power Control—No K9.1V (700–800 MHz)



MAEPF-27926-O

Figure 5-47. RFPA Power Control—No K9.1V (700–800 MHz)

5.6.50 RFPA Power Control—No VGBIAS (700–800 MHz)

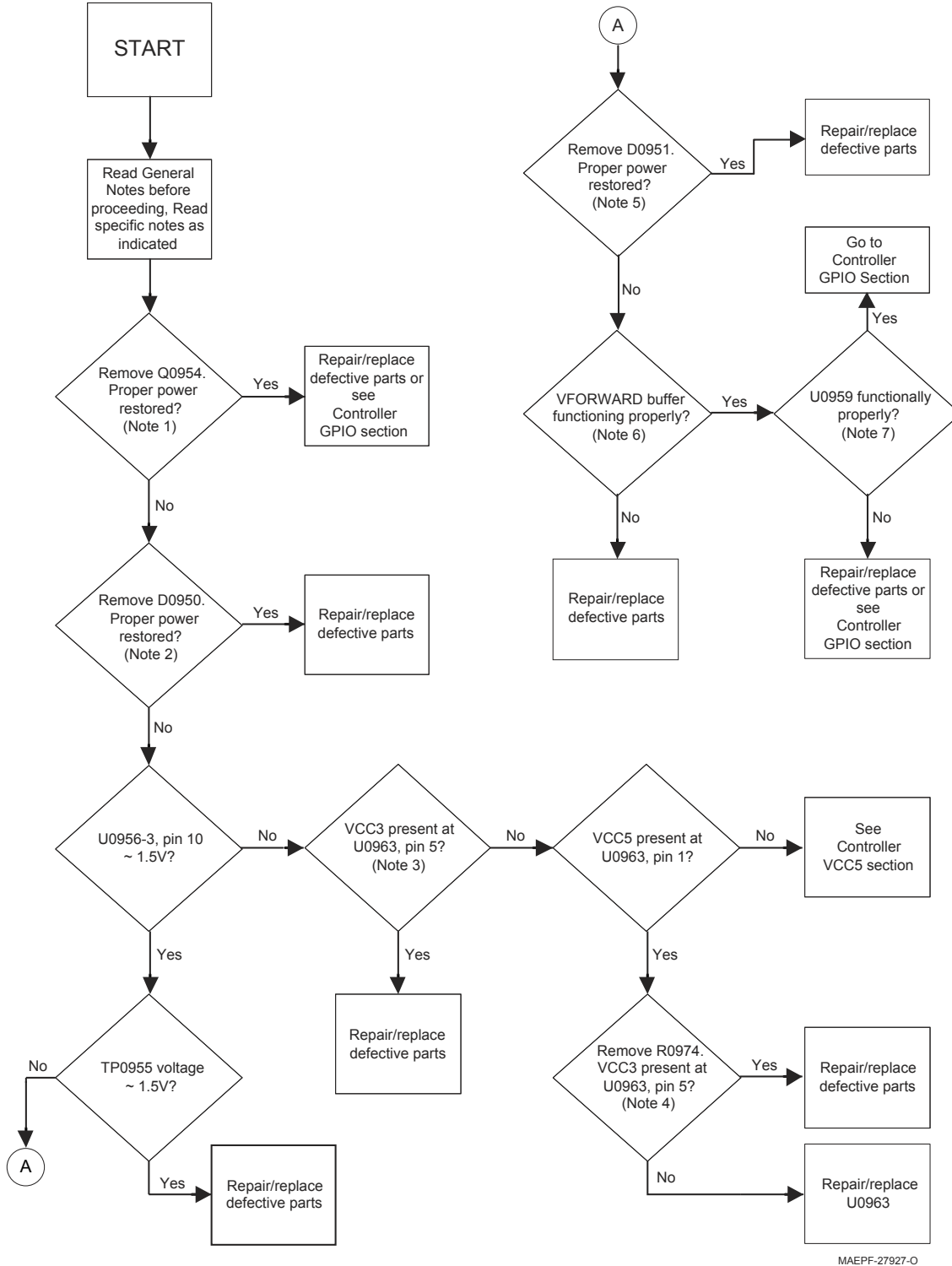


MAEPF-27928-O

Figure 5-48. RFPA Power Control—No VGBIAS (700–800 MHz)

5.6.51 RFPA Power Control—No or Low TX RFPA_CNTRL (700–800 MHz)—Part 1 of 2

For each flowchart step in which reference is made to a note, be sure to refer to that specific note (located on page 63 of this flowchart) for guidance in performing the actual troubleshooting procedure.



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Figure 5-49. RFPA Power Control—No or Low TX RFPA_CNTRL (700–800 MHz)—Part 1 of 2

5.6.52 RFPA Power Control—No or Low TX RFPA_CNTRL (700–800 MHz)—Part 2 of 2**Specific Notes:**

1. Remove Q0954. If proper power is restored, repair/replace Q0954. If the problem still persists, check for proper operation of U0958-1, and replace U0958 if not functioning properly. If U0958-1 operation is correct, refer the controller section in the theory of operation chapter.
2. Remove D0950. If proper power is restored, inspect R0942-5, R0991, and U0956-4. Replace D0958.
3. Inspect R0974-5.
4. Remove R0974. Measure U0963, pin 5 voltage. Replace R0974.
5. Inspect the current limit and temperature cutback circuitry (refer to the power control section in the theory of operation chapter).
6. Adjust the Power Detector Calibration via the Tuner software (see the tuner Help text) and monitor the output power while the transmitter is keyed. If the circuit is functioning properly, output power will decrease if the softpot is increased, and output power will increase if the softpot is decreased. If the circuitry is not functioning properly, then inspect U0952, U0956-2, R0971-3. If the problem persists, refer to the controller section in the theory of operation chapter.
7. Retune the Power Detector Calibration if any circuitry is repaired/replaced.
8. Adjust the power via CPS (see the Help text) and monitor output power. If the softpot is decreased, power will increase; if the softpot is increased, power will decrease. If the circuitry is not functioning properly, replace U0959 and retune the power via CPS (see the Help text for complete procedures). If the problem persists, refer to the controller section in the theory of operation chapter.

Notes

Chapter 6 Troubleshooting Waveforms

6.1 Introduction

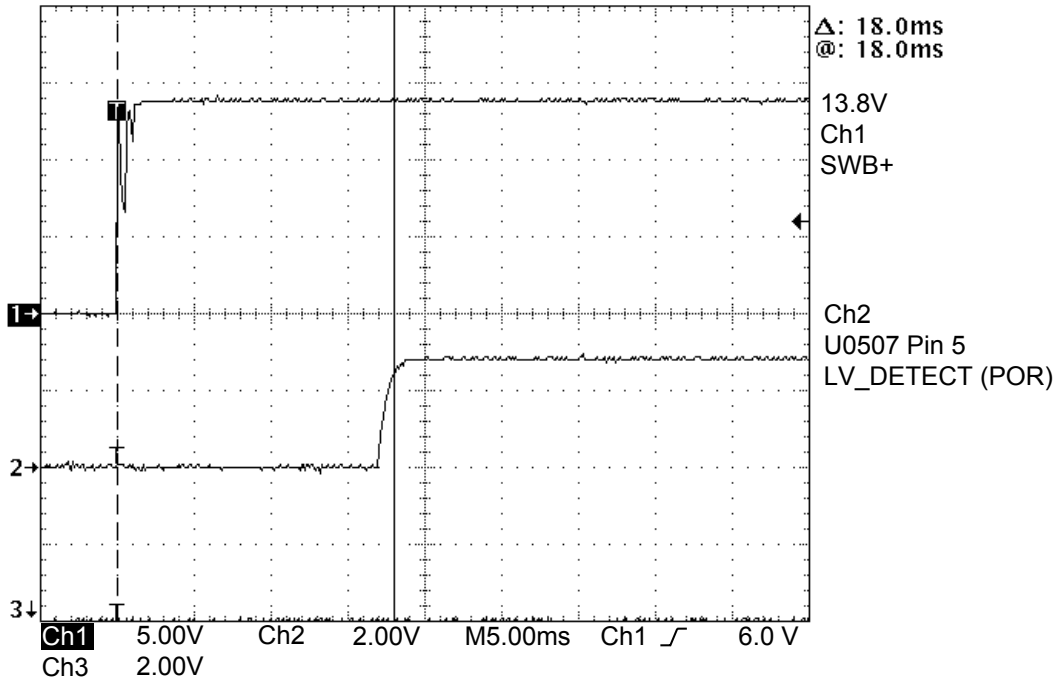
This chapter contains images of waveforms that might be useful in verifying operation of certain parts of the circuitry. These waveforms are for reference only; the actual data depicted will vary depending upon the operating conditions.

Table 6-1. List of Troubleshooting Waveforms

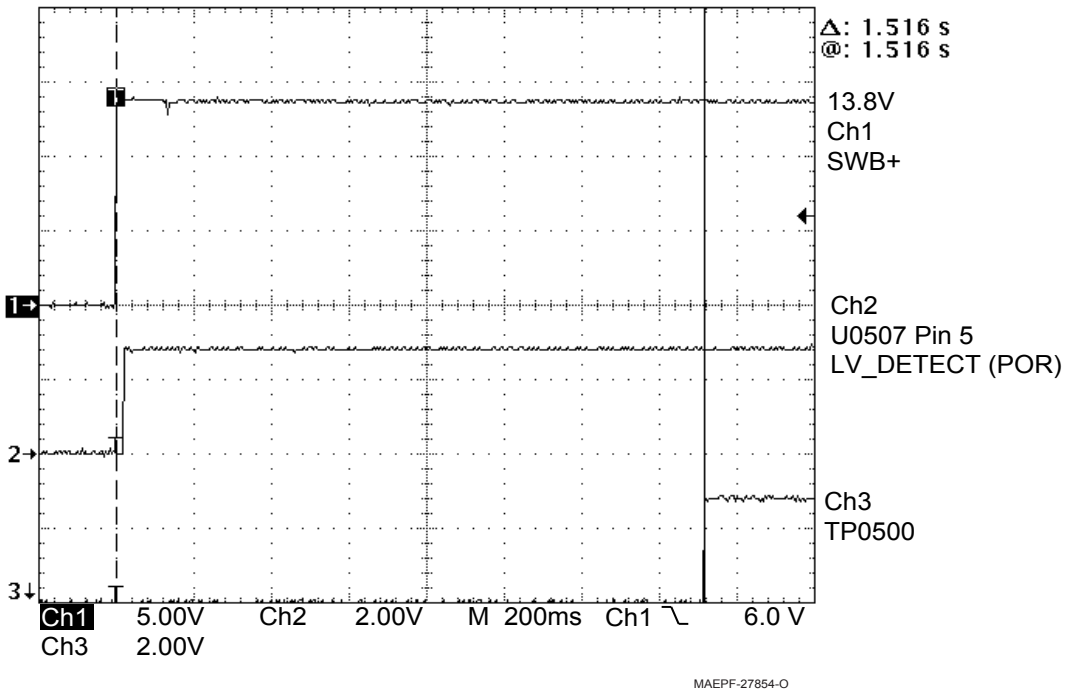
Waveform	Page
Power-On Reset Timing	6-2
Power-On to Soft Turn-On Timing	6-2
Power-Down Reset	6-3
16.8 MHz Clock Waveform	6-3
32 kHz Clock Waveform	6-4
DSP SSI Port RX Mode	6-4
DSP SSI Port TX Mode CSQ	6-5
SPI Bus Waveform	6-5
SB9600 Waveform	6-6
SB9600 BUS+ and BUS- Waveforms	6-6
SB9600 BUS+ and RESET Waveforms	6-7
SB9600 BUSY and BUS- Waveforms	6-7
RS-232 RX Waveforms	6-8
RS-232 TX Waveforms	6-8
RS-232 RX/TX Waveforms	6-9
USB Waveforms	6-9
Serial Audio Port Waveforms	6-10
Secure Interface Waveforms	6-10
8 kHz Frame Sync Waveform	6-11
RX Audio Waveforms	6-11
TX Audio Waveforms	6-12
TX and RX 1 kHz Audio Path Sinewave and Chart	6-12

6.2 XTL 1500 Waveforms

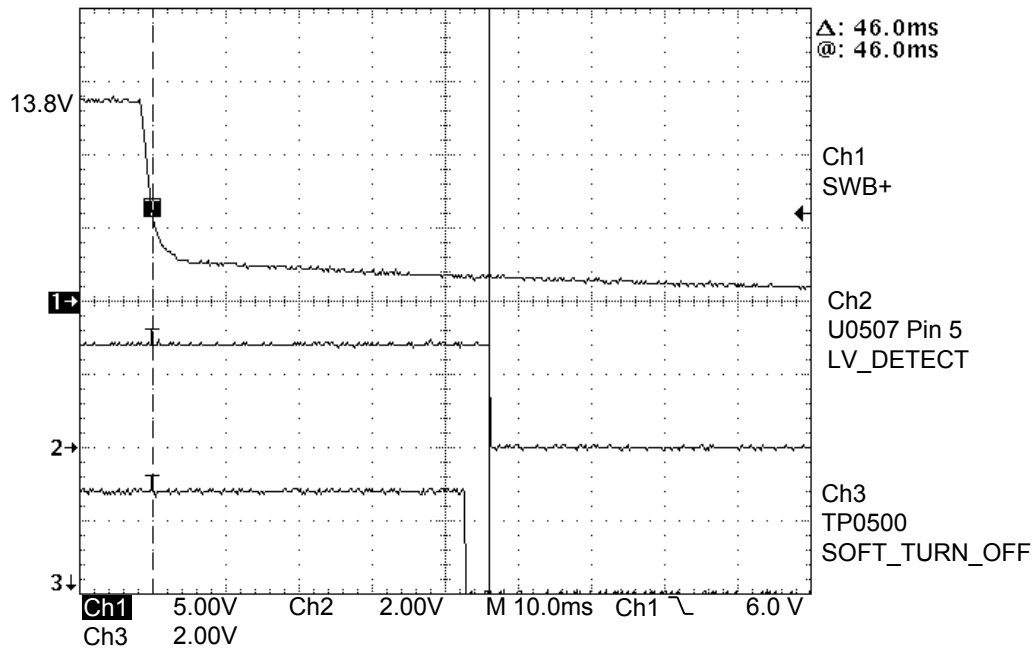
6.2.1 Power-On Reset Timing



6.2.2 Power-On to Soft Turn-On Timing



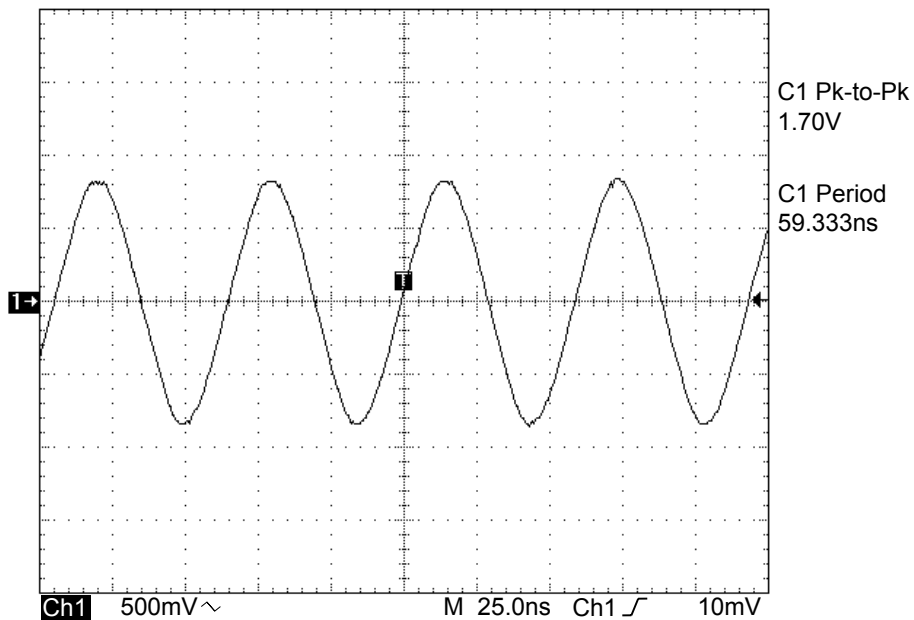
6.2.3 Power-Down Reset



Power-Down Reset
 Trace 1 — SWB+
 Trace 2 — LV_DETECT — U0507 Pin 5
 Trace 3 — SOFT_TURN_OFF — TP0500

MAEPF-27855-O

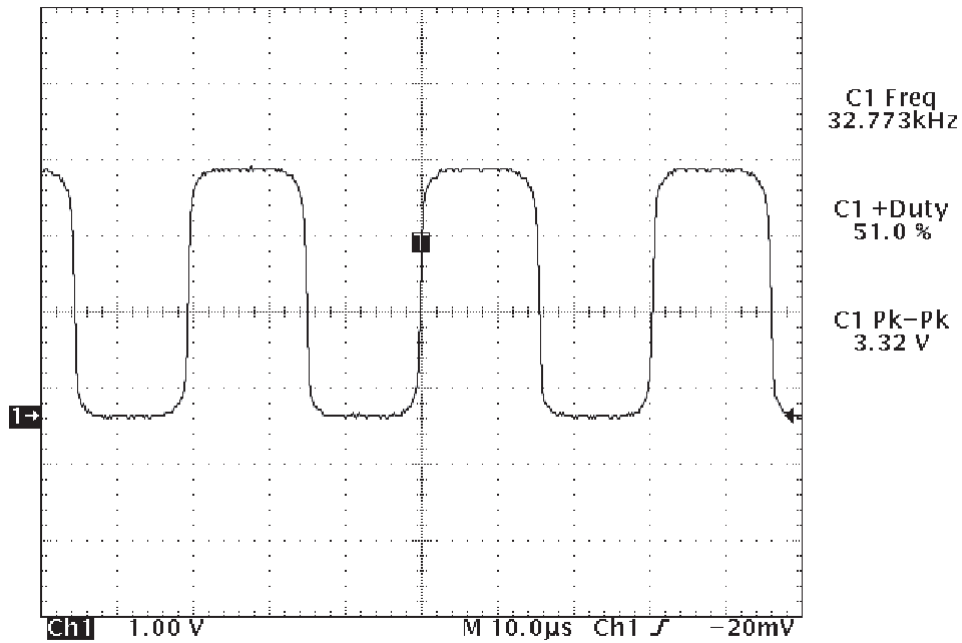
6.2.4 16.8 MHz Clock Waveform



Trace 1 — U0903 Pin 3 — 16.8 MHz Clock

MAEPF-27856-O

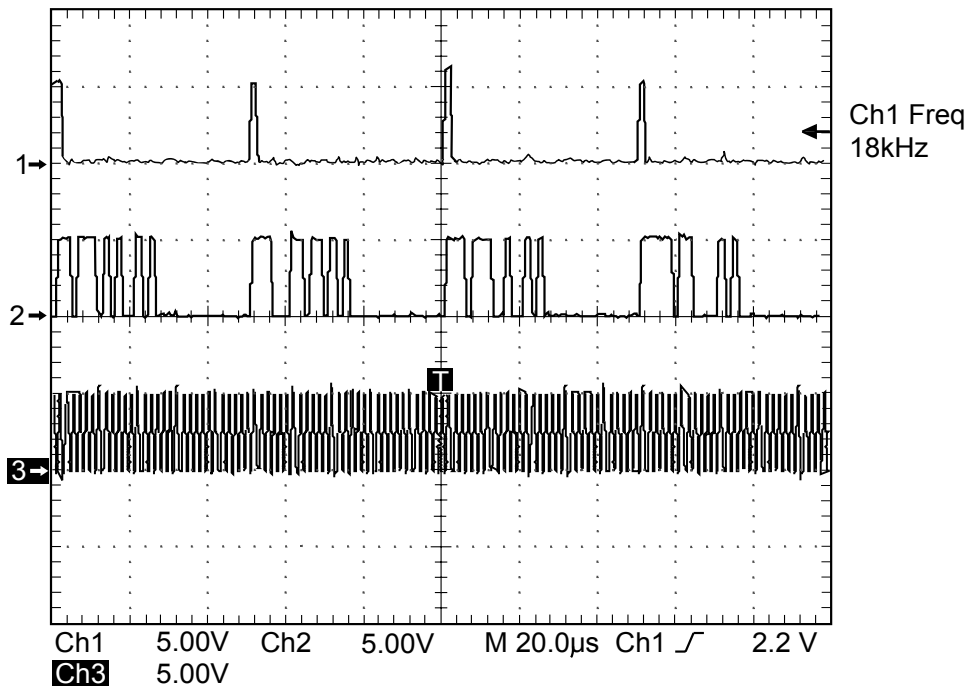
6.2.5 32 kHz Clock Waveform



Trace 1 — R428 — 32 kHz Clock

MAEPF-27857-0

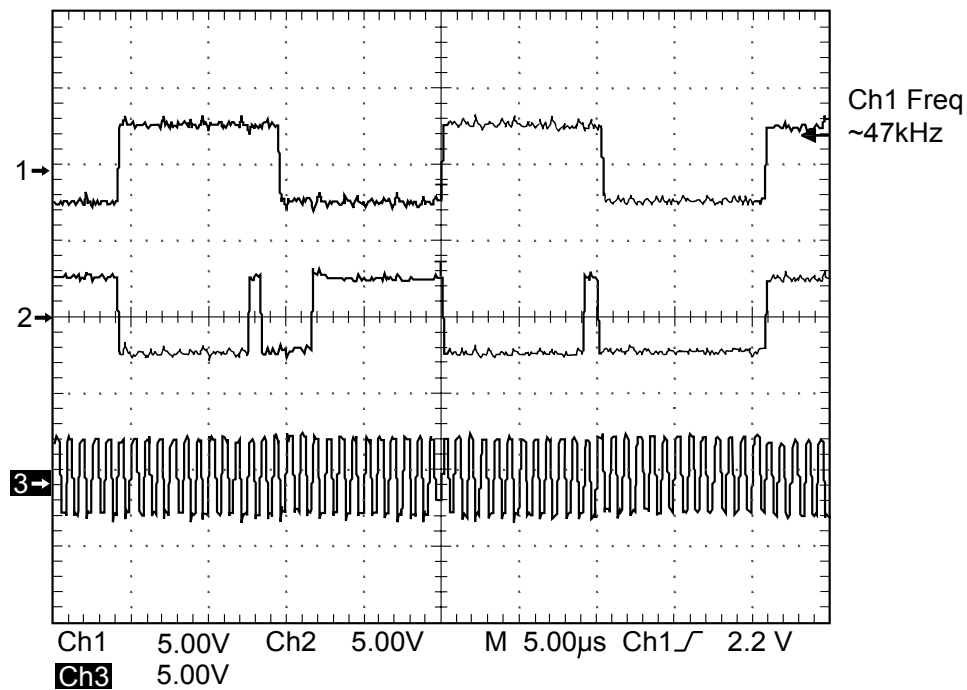
6.2.6 DSP SSI Port RX Mode



DSP SSI Port RX Mode CSQ
Trace 1 — ABACUS_SSI_FSYNC
Trace 2 — ABACUS_SSI_RXD
Trace 3 — ABACUS_SSI_CLK (1.2 MHz)

MAEPF-27858-0

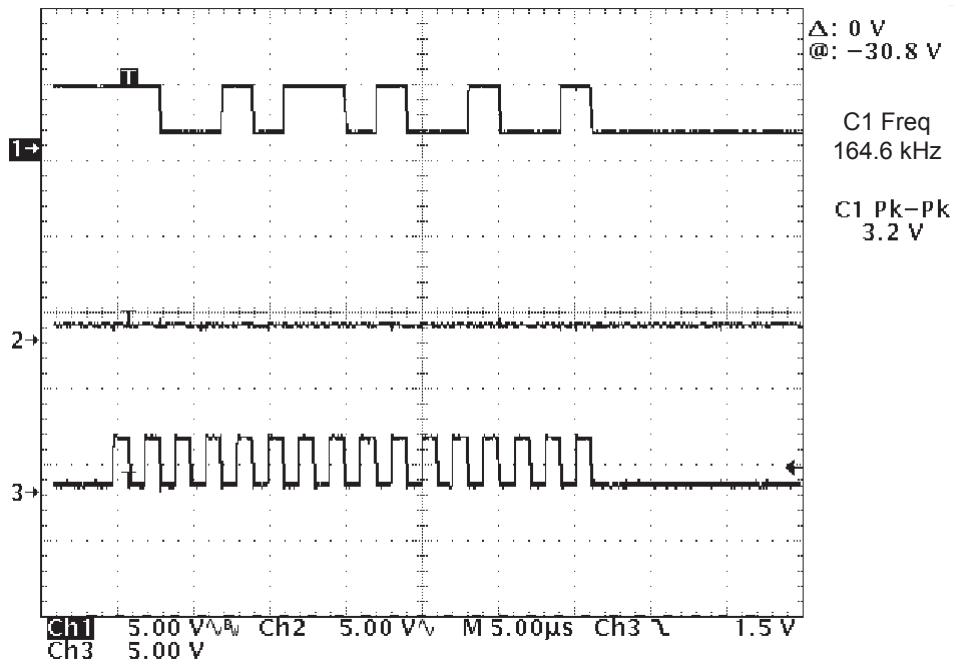
6.2.7 DSP SSI Port TX Mode CSQ



DSP SSI Port TX Mode CSQ
 Trace 1 — DAC_SSI_FSYNC
 Trace 2 — DAC_SSI_TXD
 Trace 3 — DAC_SSI_CLK (2.4 MHz)

MAEPF-27859-O

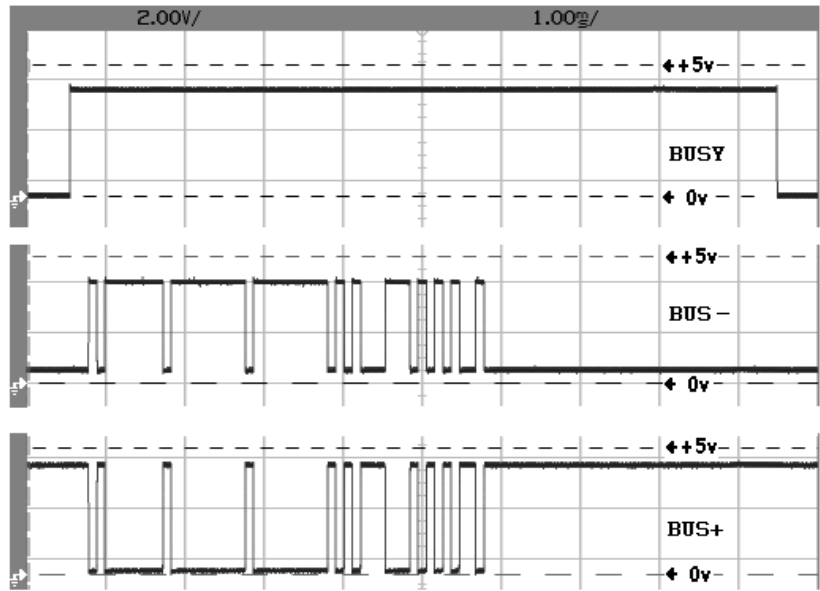
6.2.8 SPI Bus Waveform



Radio Power-Up
 Trace 1 — Data
 Trace 2 — Chip Select
 Trace 3 — Clock

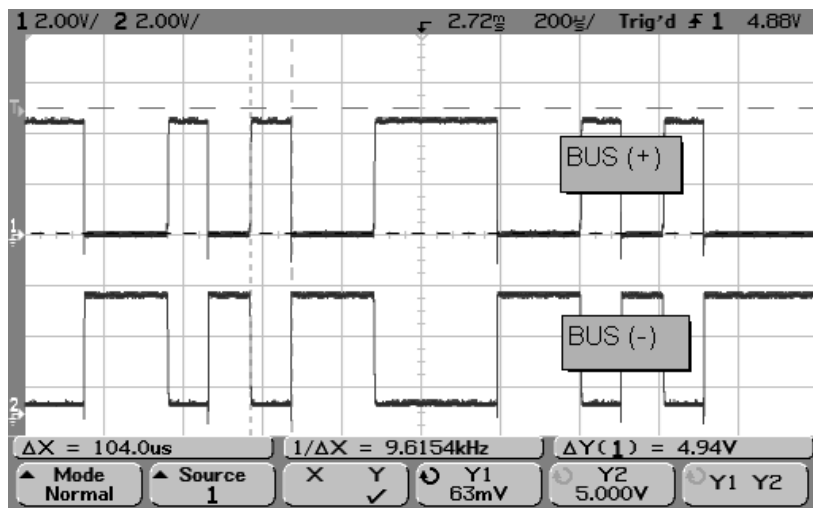
MAEPF-27860-O

6.2.9 SB9600 Waveforms



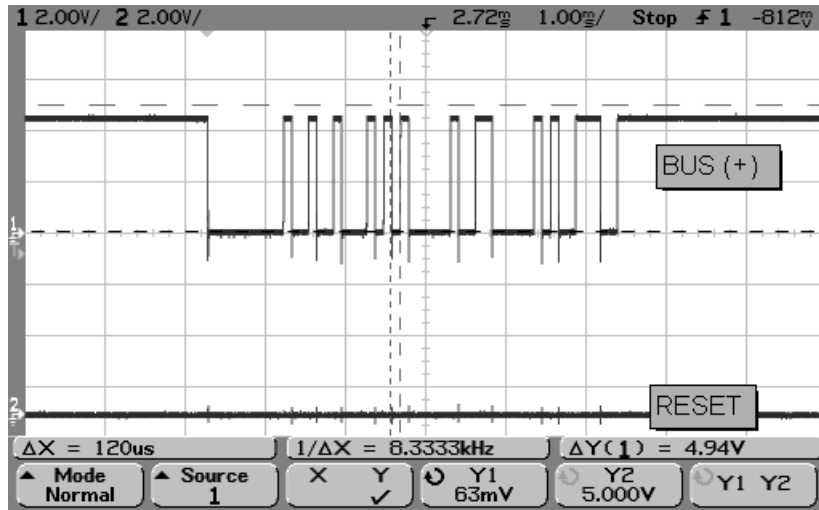
MAEPF-27781-O

6.2.10 SB9600 BUS+ and BUS- Waveforms



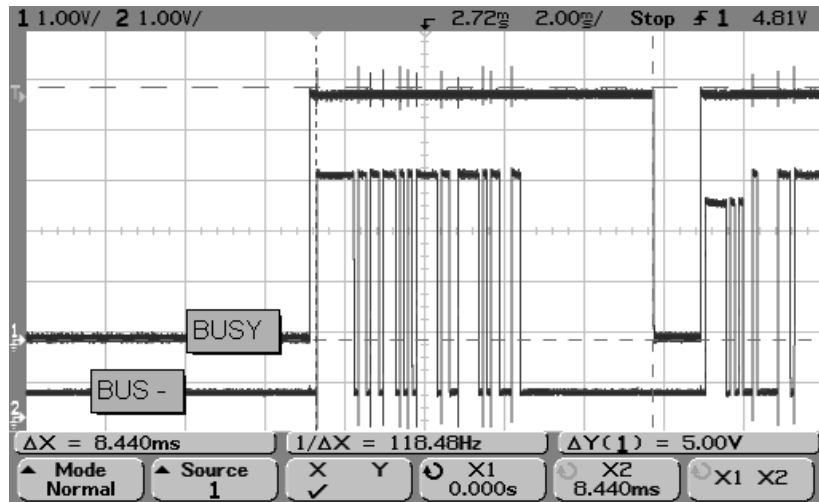
MAEPF-27871-O

6.2.11 SB9600 BUS+ and RESET Waveforms



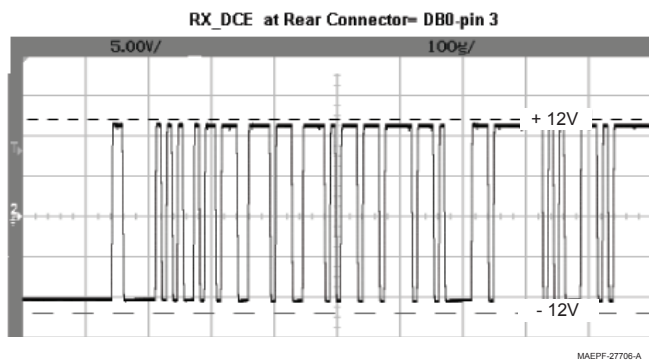
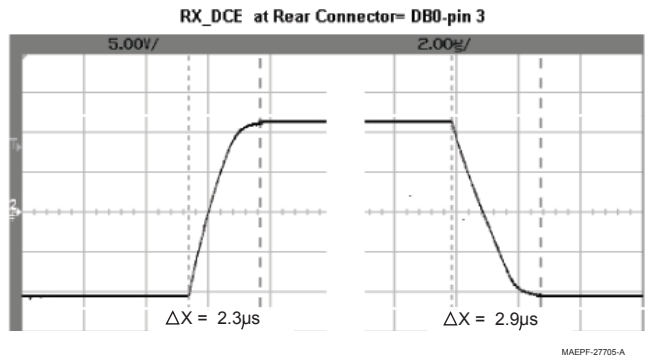
MAEPF-27872-O

6.2.12 SB9600 BUSY and BUS- Waveforms

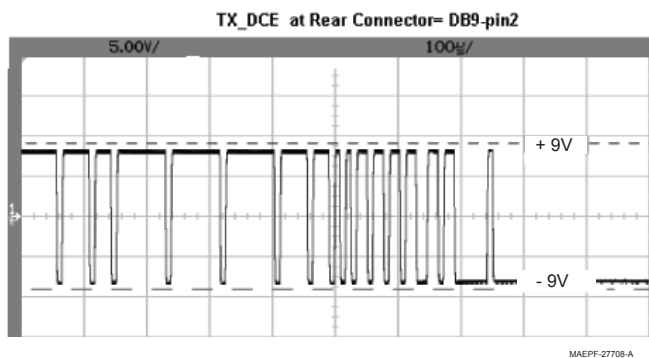
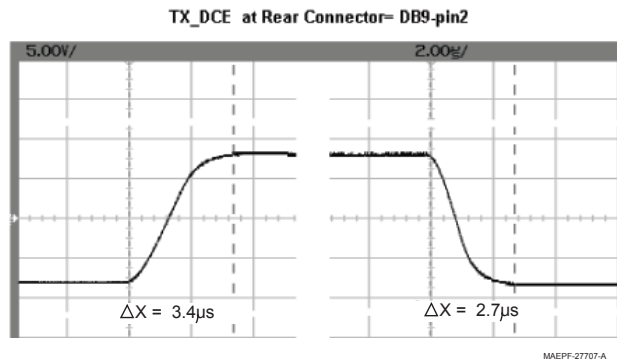


MAEPF-27873-O

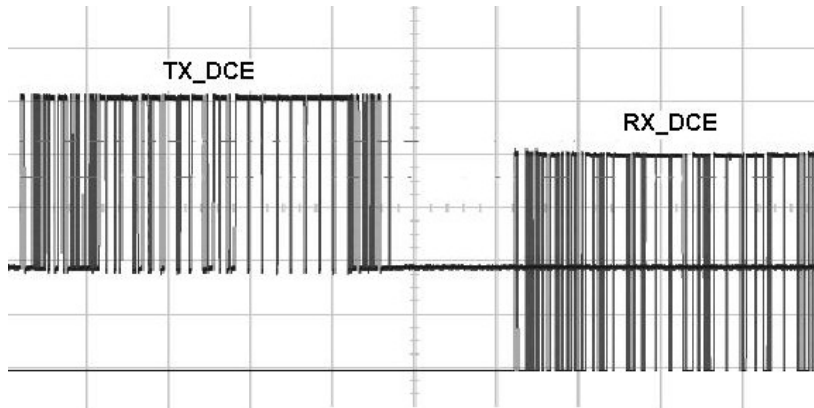
6.2.13 RS-232 RX Waveforms



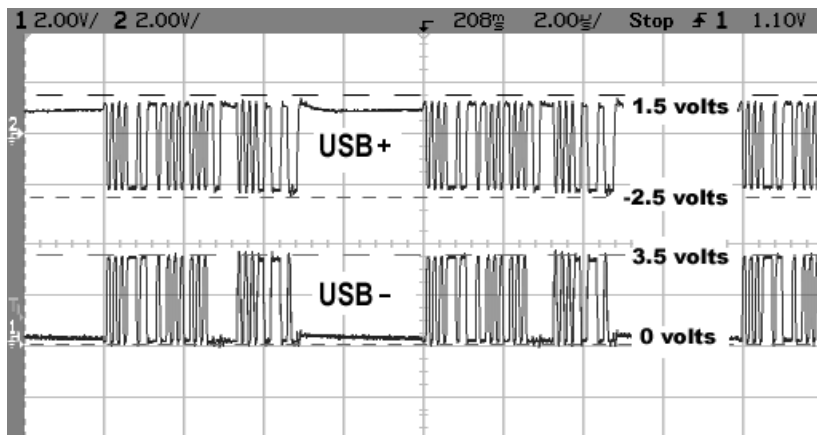
6.2.14 RS-232 TX Waveforms



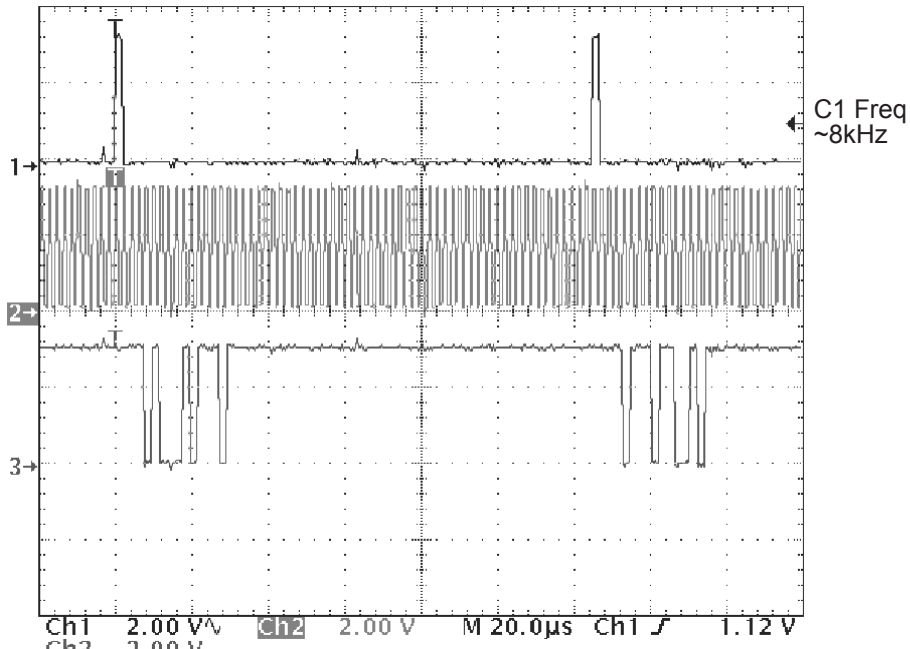
6.2.15 RS-232 RX/TX Waveforms



6.2.16 USB Waveforms



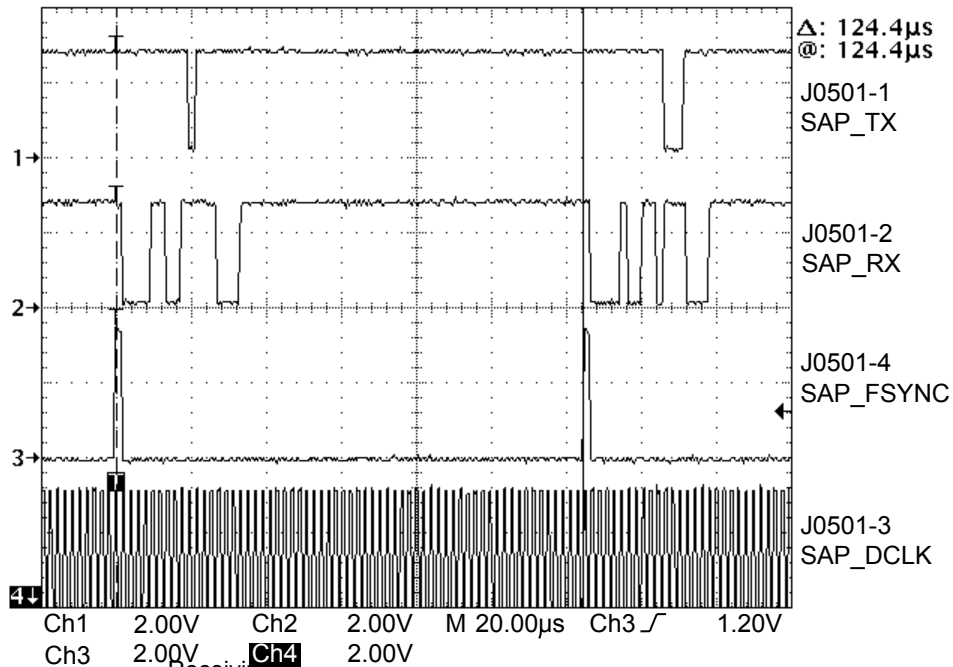
6.2.17 Serial Audio Port Waveforms



Transmitting
 1 kHz tone at 85mVrms into microphone
 Trace 1 — Frame Sync — SAP_FSYNC
 Trace 2 — Clock — SAP_DCLK
 Trace 3 — Data — SAP_TX

MAEPF-27864-O

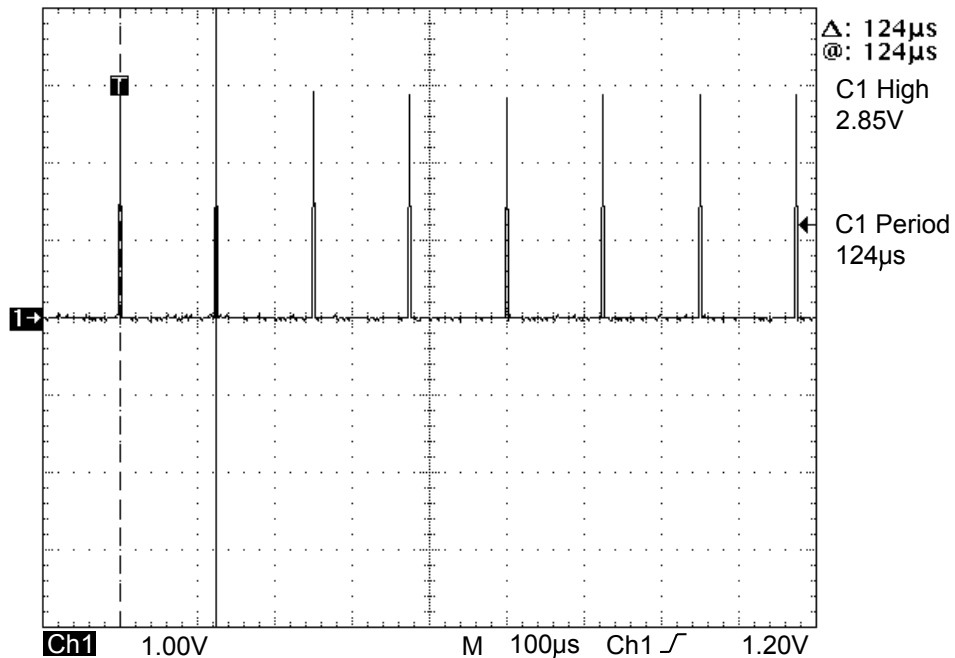
6.2.18 Secure Interface Waveforms



Receiving
 1 kHz tone at 3 kHz Dev, -47dBm Secure Mode
 Trace 1 — J0501 — 1 - SAP TX
 Trace 2 — J0501 — 2 - SAP RX
 Trace 3 — J0501 — 3 - SAP DCLK

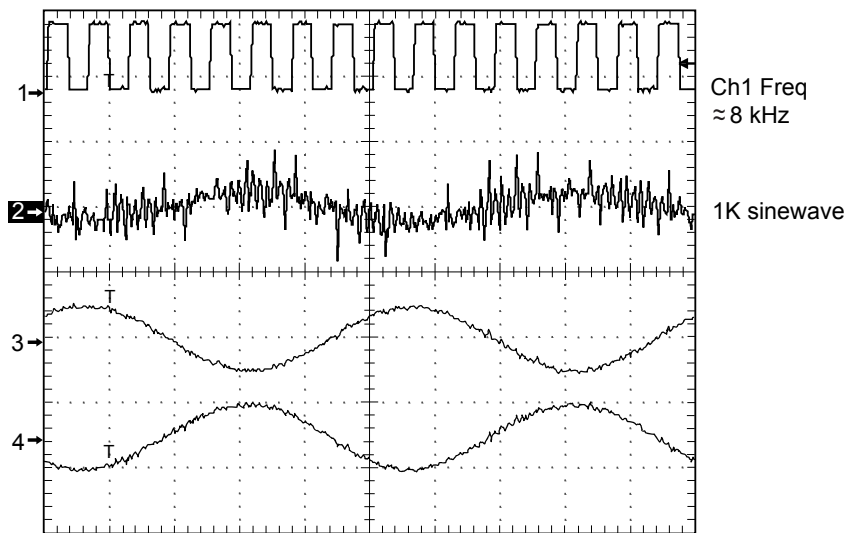
MAEPF-27865-O

6.2.19 8 kHz Frame Sync Waveform



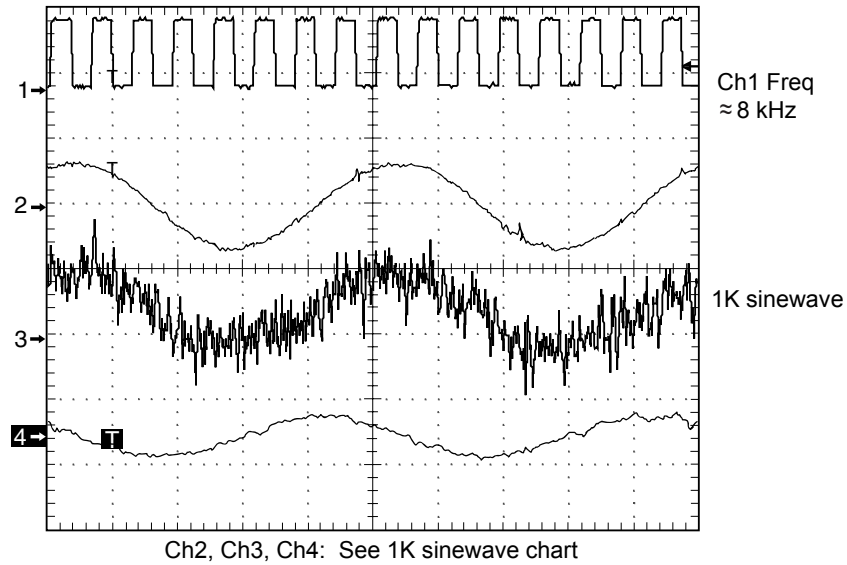
Receiving
 1 kHz tone at 3 kHz Dev, -47dBm Secure Mode
 Trace 1 — J0501 — 4
 MAEPF-27866-O

6.2.20 RX Audio Waveforms



Receiving
 1 kHz tone @ 3 kHz deviation, -60 dBm. Volume set to rated audio.
 Trace 1 — SAP_DCLK (8 kHz)
 Trace 2 — TP0205
 Trace 3 — SPKR_LOW out of U0204
 Trace 4 — SPKR_HI out of U0204
 Note 3: Actual level is dependent upon volume setting.
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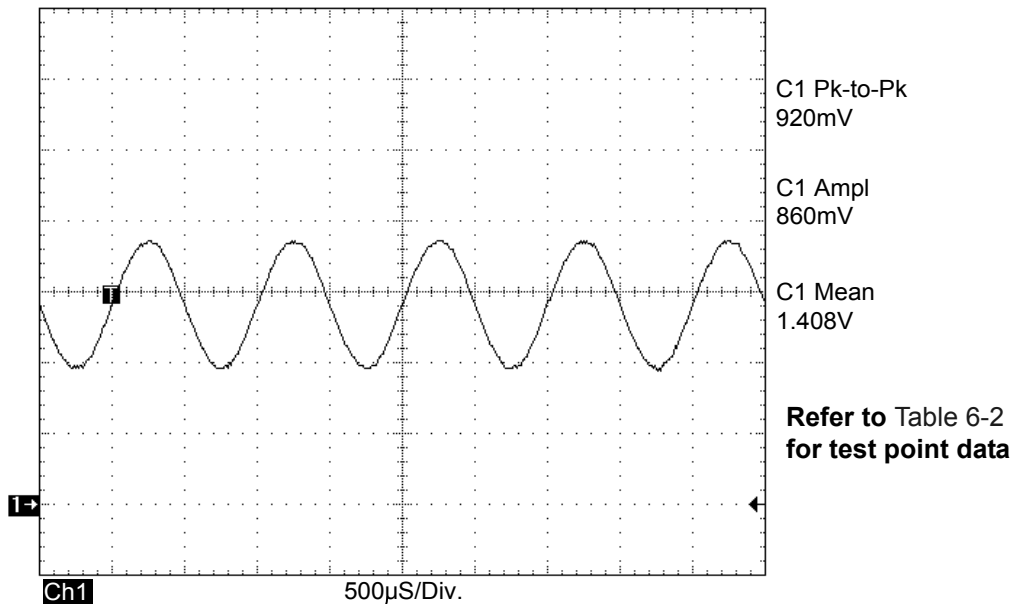
6.2.21 TX Audio Waveforms



MAEPF-27868-O

Transmit Audio
 1 kHz tone which provides 3 kHz deviation
 Trace 1 — SAP_DCLK (8 kHz)
 Trace 2 — MODIN R6782
 Trace 3 — MIC TP0200
 Trace 4 — TP0203
 Note 3: Actual level is dependent upon volume setting.

6.2.22 TX and RX 1 kHz Audio Path Sinewave and Chart



MAEPF-27869-O

Table 6-2. TX and RX Audio Path Test Points for 1 kHz Sine Wave
(for VHF, UHF R1 and 700/800 MHz)

Test Point	Description	Typical	O-Scope	Measured mV p-p		Volts
		mV RMS	mV/div	LL ¹	UL ²	DC Bias
TX Audio Path						
MIC_HI	80 mV RMS input	80 mV	20	226	227	3 to 9
TP0200	MIC_PREAMP_IN	80 mV	20	220	227	1.42
TP0201	Preamp in, attn.-out	43 mV	10	100	122	1.42
U0201-1	1st op amp out ³	42 mV	10	97	121	1.42
TP0202	2nd op amp in ³	41 mV	10	97	121	1.42
U0201-7	2nd op amp out	41 mV	10	94	120	1.42
U0201-8	3rd op amp and filter out	40 mV	10	91	119	1.42
U0201-14	4th op amp and filter out	39 mV	10	88	118	1.42
TP0203	CODEC op amp in	38 mV	10	85	117	1.42
U0200-17	Buffered CODEC in	36 mV	10	82	116	1.42
C0904	5 CF Out	150 mV	50	400	700	1.42
R6782	MOD_IN at 3 kHz dev. ³	150 mV	50	400	700	1.5
RX Audio Path ⁴						
TP0204	RX_FILT_AUDIO	318	500	849	953	1.42
TP0205	RX_AUDIO_IN	318	500	849	953	1.42
TP0206	AUDIO_PA_IN	39	10	92	130	1/2 A+
SPKR+	NON INVERTED PA out	7.74 VbtI ⁵	2 V	9.5 Vpp	12.4 Vpp	1/2 A+
SPKR-	INVERTED PA out	7.74 VbtI ⁵	2 V	9.5 Vpp	12.4 Vpp	1/2 A+

¹ LL = lower limit

² UL = upper limit

³ Measurement depends on tuning parameters

⁴ 1 kHz tone at 3 kHz deviation, -47 dBm

⁵ "btI" = bridge to load

Table 6-3. TX and RX Audio Path Test Points for 1 kHz Sine Wave
(for UHF R2)

Test Point	Description	Typical	O-Scope	Measured mV p-p		Volts
		mV RMS	mV/div	LL ¹	UL ²	DC Bias
TX Audio Path						
MIC_HI	80 mV RMS input	80 mV	20	226	227	3 to 9
TP0200	MIC_PREAMP_IN	80 mV	20	220	227	2.5
U0201-8	1st op amp out ³	0 mV	10	0	10	2.5
U0201-7	2nd op amp out	80 mV	10	210	227	2.5
U0201-1	3rd op amp and filter out	80 mV	10	210	227	2.5
U0201-14	4th op amp and filter out	80 mV	10	210	227	2.5
TP0203	CODEC op amp in	36 mV	10	85	117	1.42
U0200-17	Buffered CODEC in	36 mV	10	82	116	1.42
C0904	5 CF Out	150 mV	50	400	700	1.42
R6782	MOD_IN at 3 kHz dev. ³	150 mV	50	400	700	1.5
RX Audio Path⁴						
TP0204	RX_FILTER_AUDIO	318	500	849	953	1.42
TP0205	RX_AUDIO_IN	318	500	849	953	1.42
TP0206	AUDIO_PA_IN	39	10	92	130	1/2 A+
SPKR+	NON INVERTED PA out	7.74 Vbtl ⁵	2 V	9.5 Vpp	12.4 Vpp	1/2 A+
SPKR-	INVERTED PA out	7.74 Vbtl ⁵	2 V	9.5 Vpp	12.4 Vpp	1/2 A+

¹ LL = lower limit

² UL = upper limit

³ Measurement depends on tuning parameters

⁴ 1 kHz tone at 3 kHz deviation, -47 dBm

⁵ "btl" = bridge to load

Chapter 7 Schematics, Component Location Diagrams, and Parts Lists

7.1 List of Schematics, Component Location Diagrams, and Parts Lists

The following table lists the schematics, component location diagrams, and parts lists contained in this chapter.

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7.2 Control Head Main Board

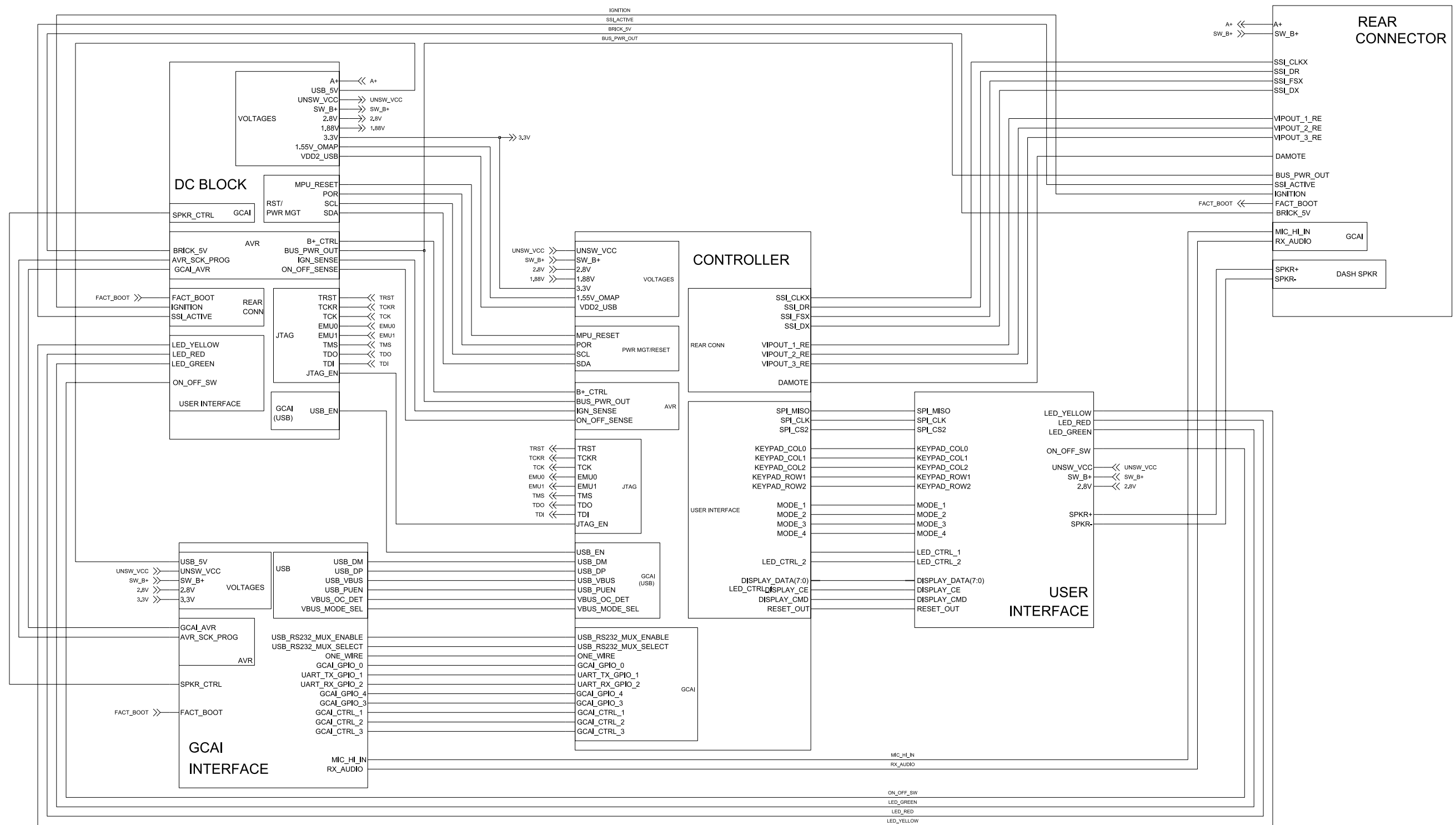


Figure 7-1. Control Head Board Overall Block Diagram

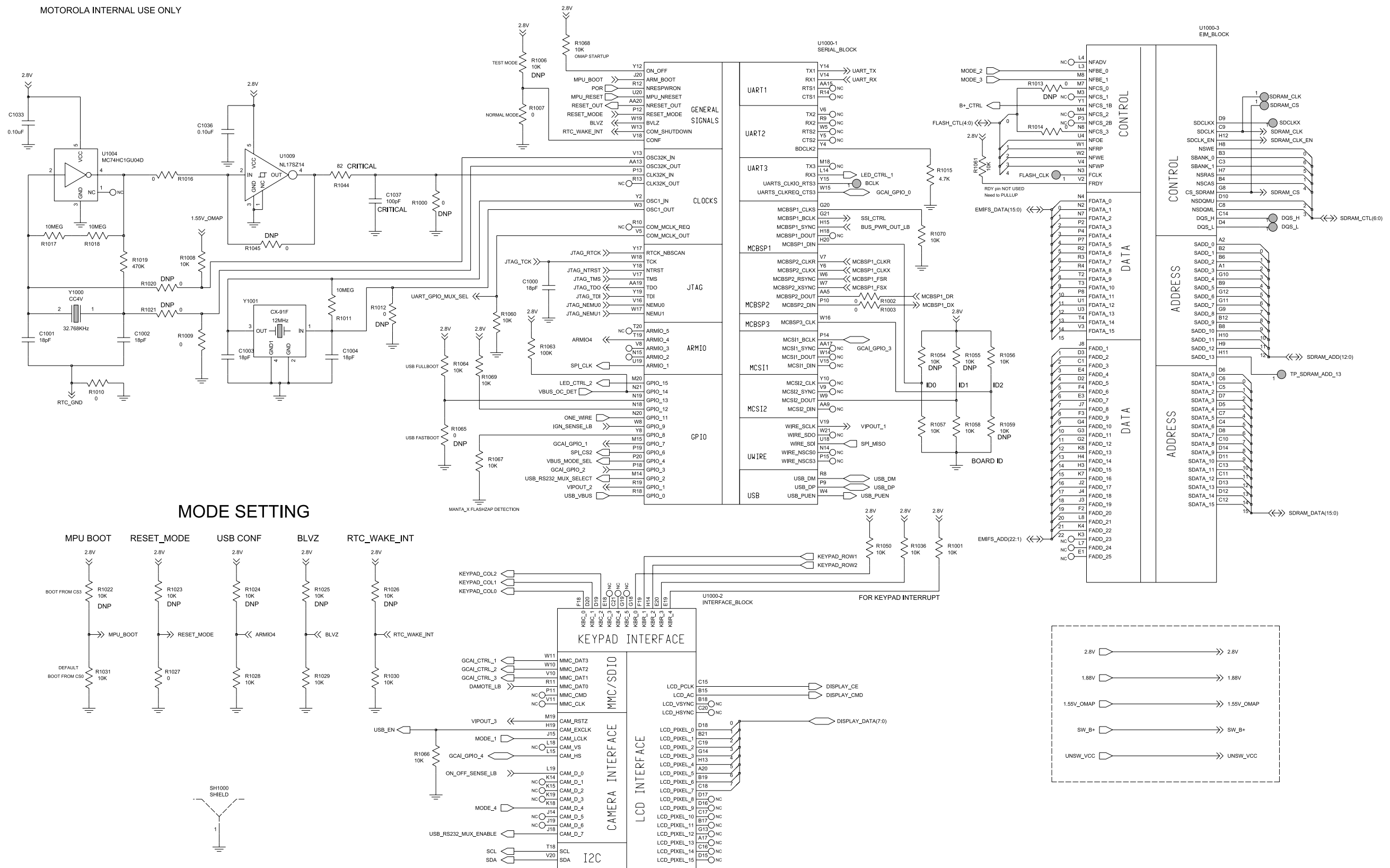


Figure 7-2. Control Head Controller (OMAP Processor) Sheet 1 of 2

OMAP POWER DISTRIBUTION

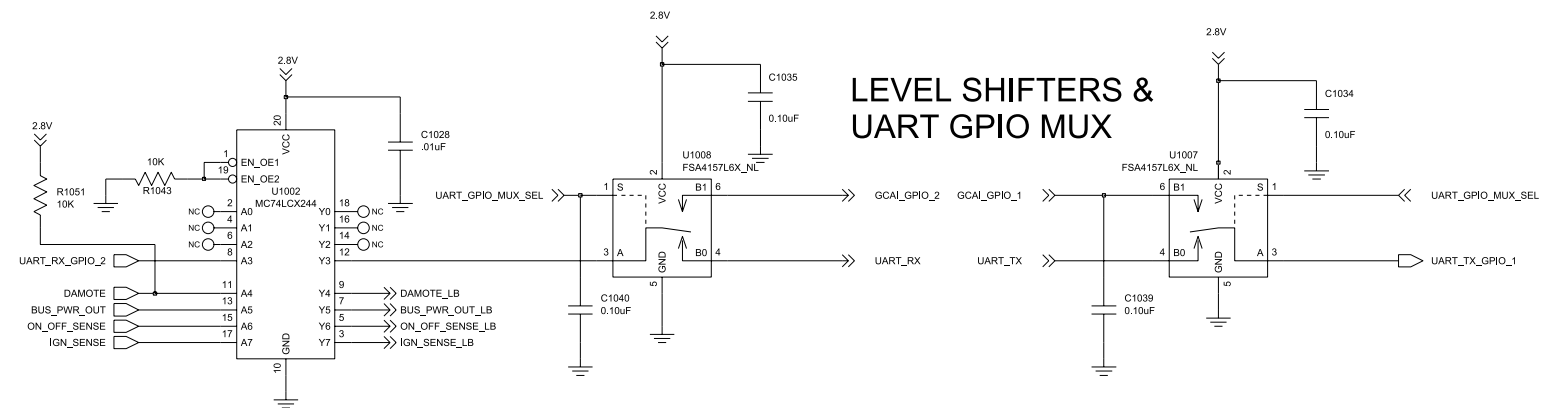
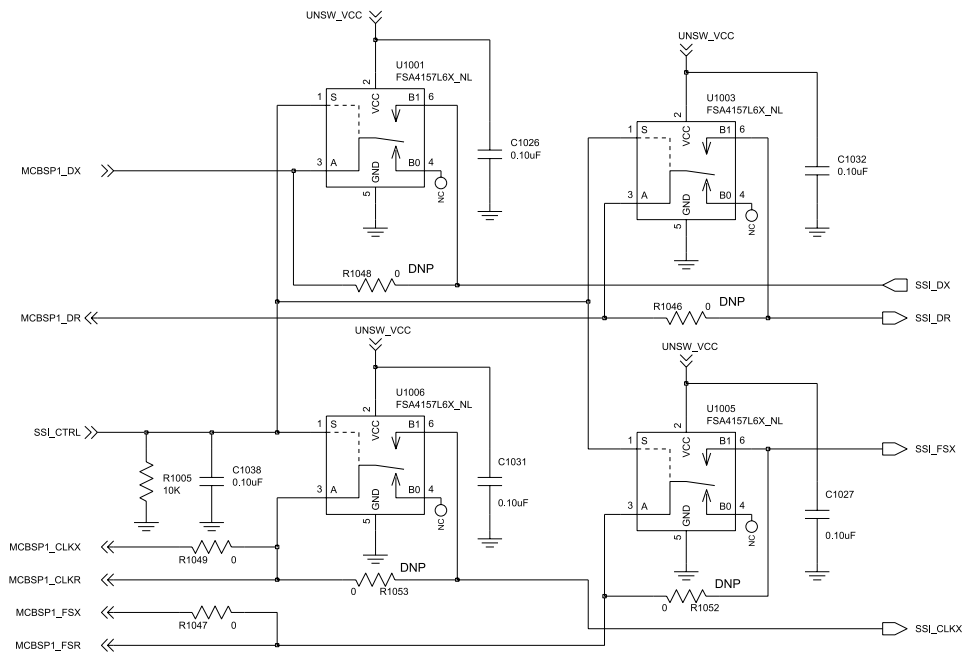
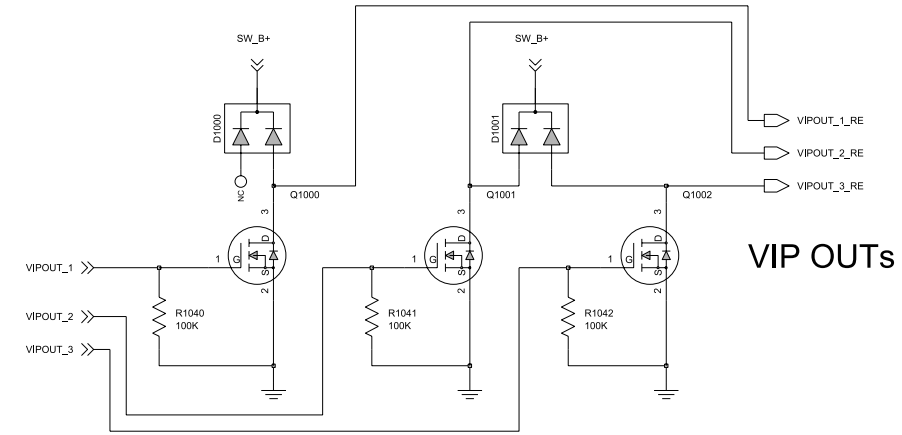
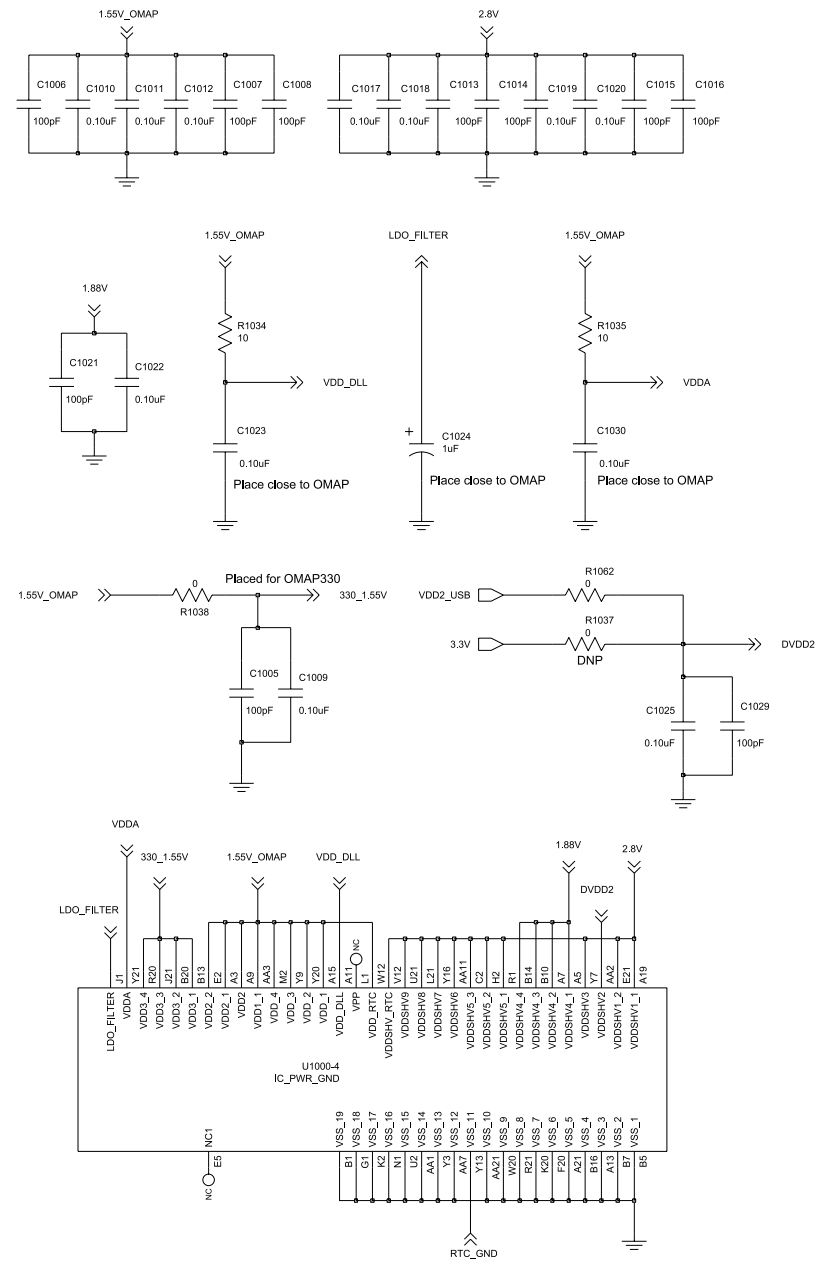


Figure 7-3. Control Head Controller (OMAP Processor) Sheet 2 of 2

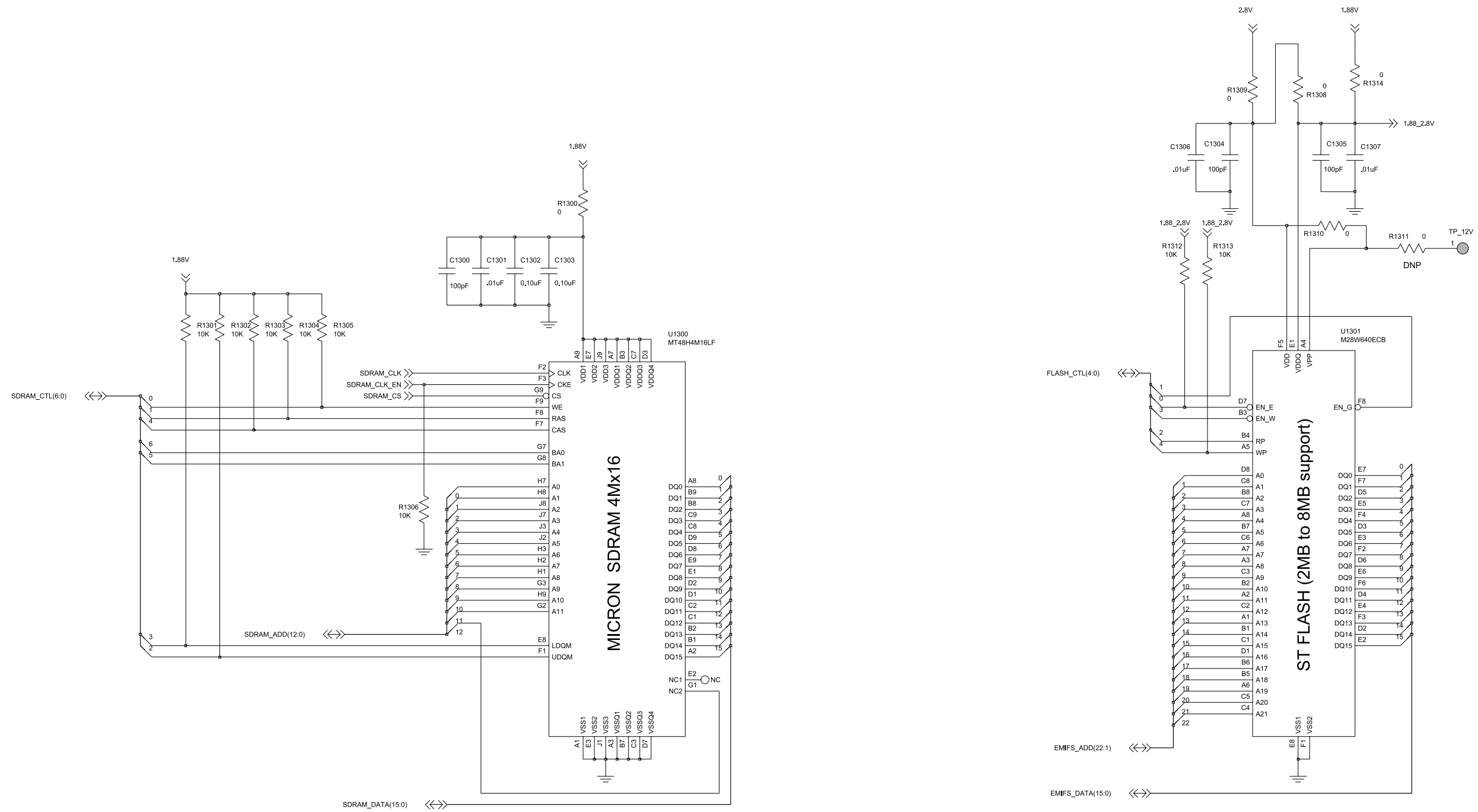


Figure 7-4. Control Head Controller (SDRAM and Flash Memory)

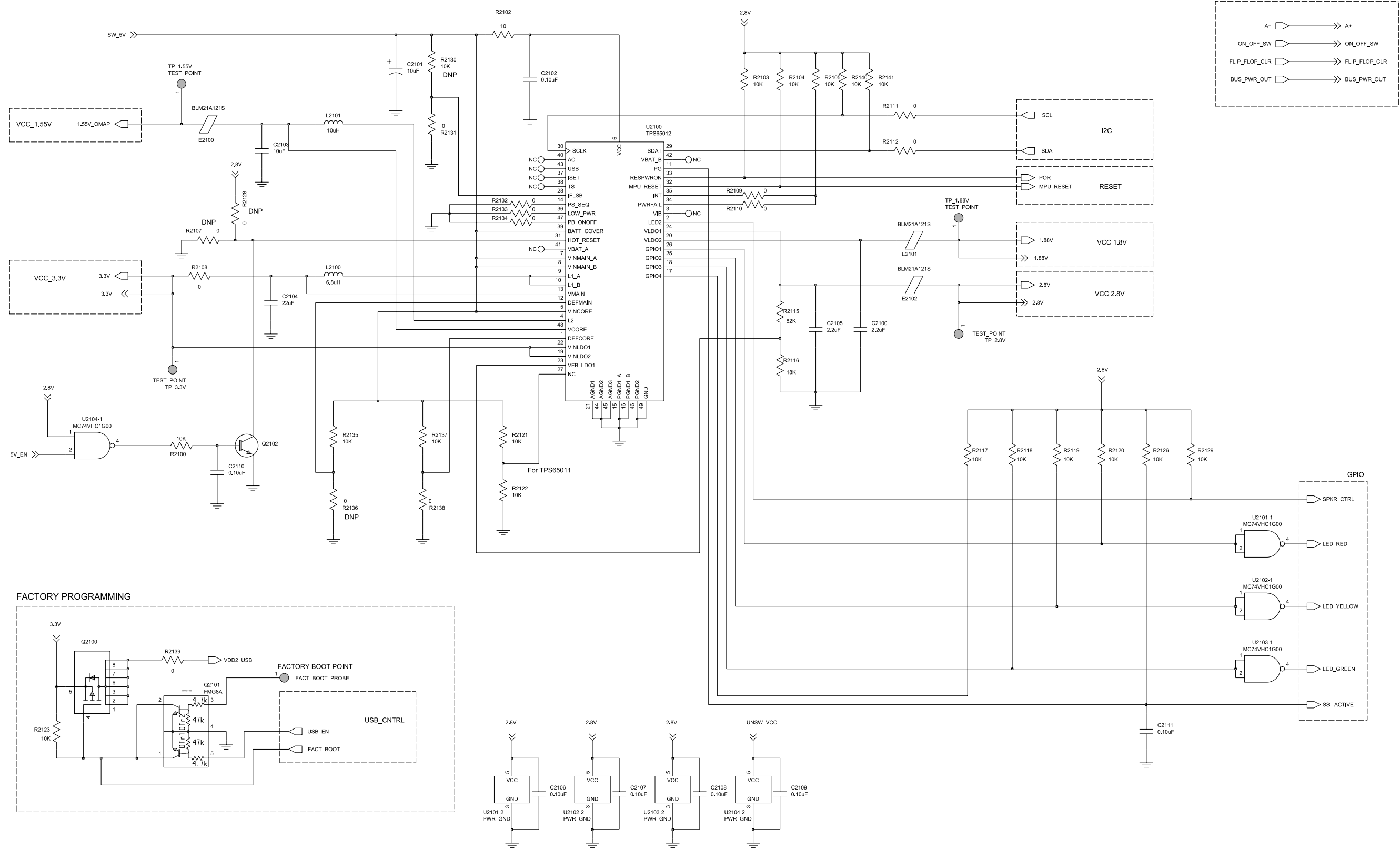
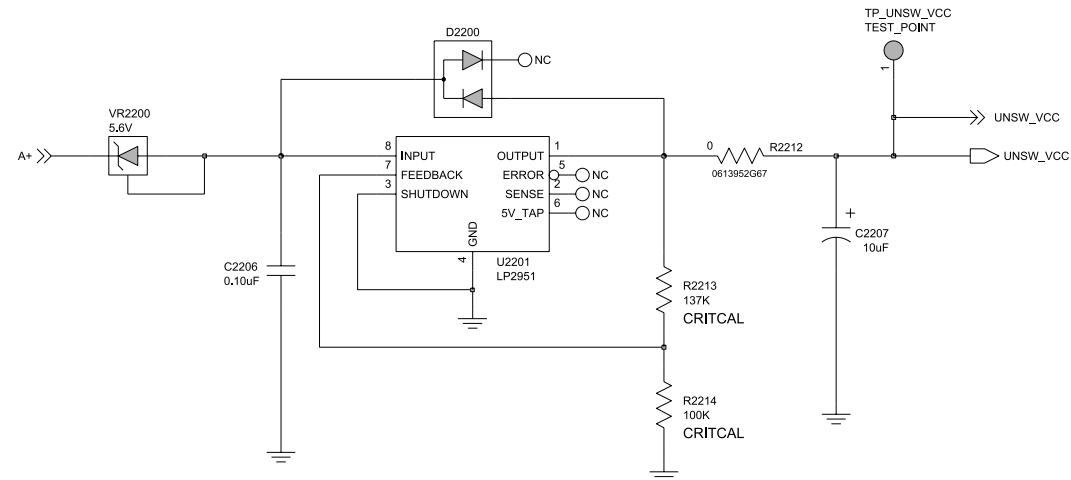
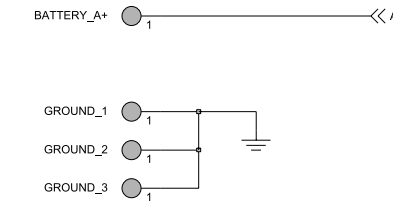


Figure 7-5. TPS65012 Power Management IC, Factory Programming

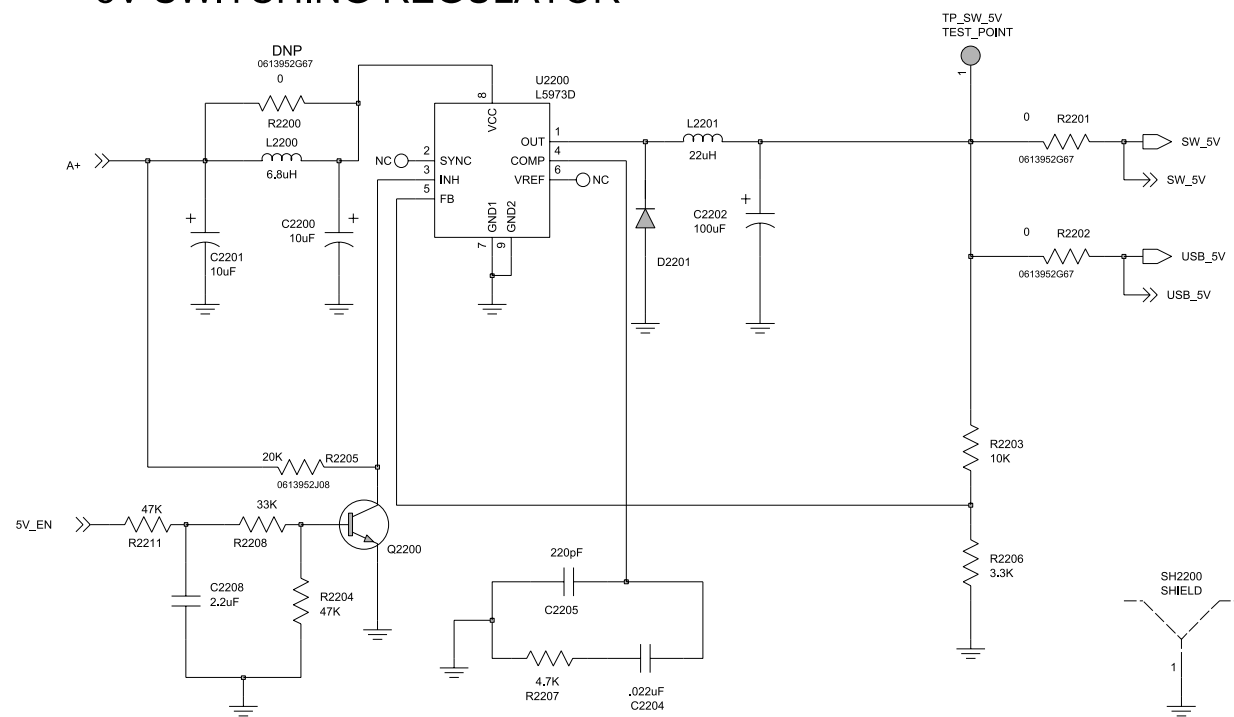
UNSW_VCC LINEAR REGULATOR



FACTORY PROBE POINTS



5V SWITCHING REGULATOR



SW_B+ CONTROL

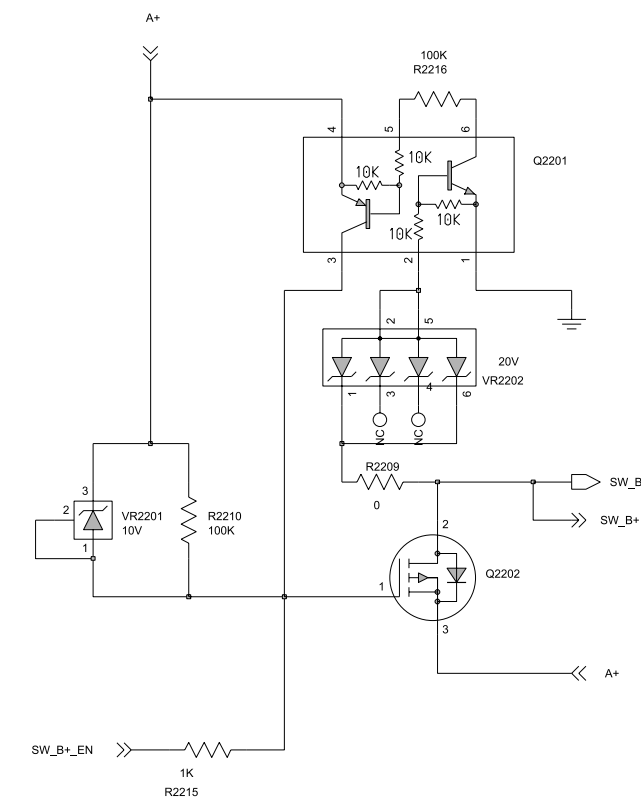


Figure 7-6. Voltage Regulators

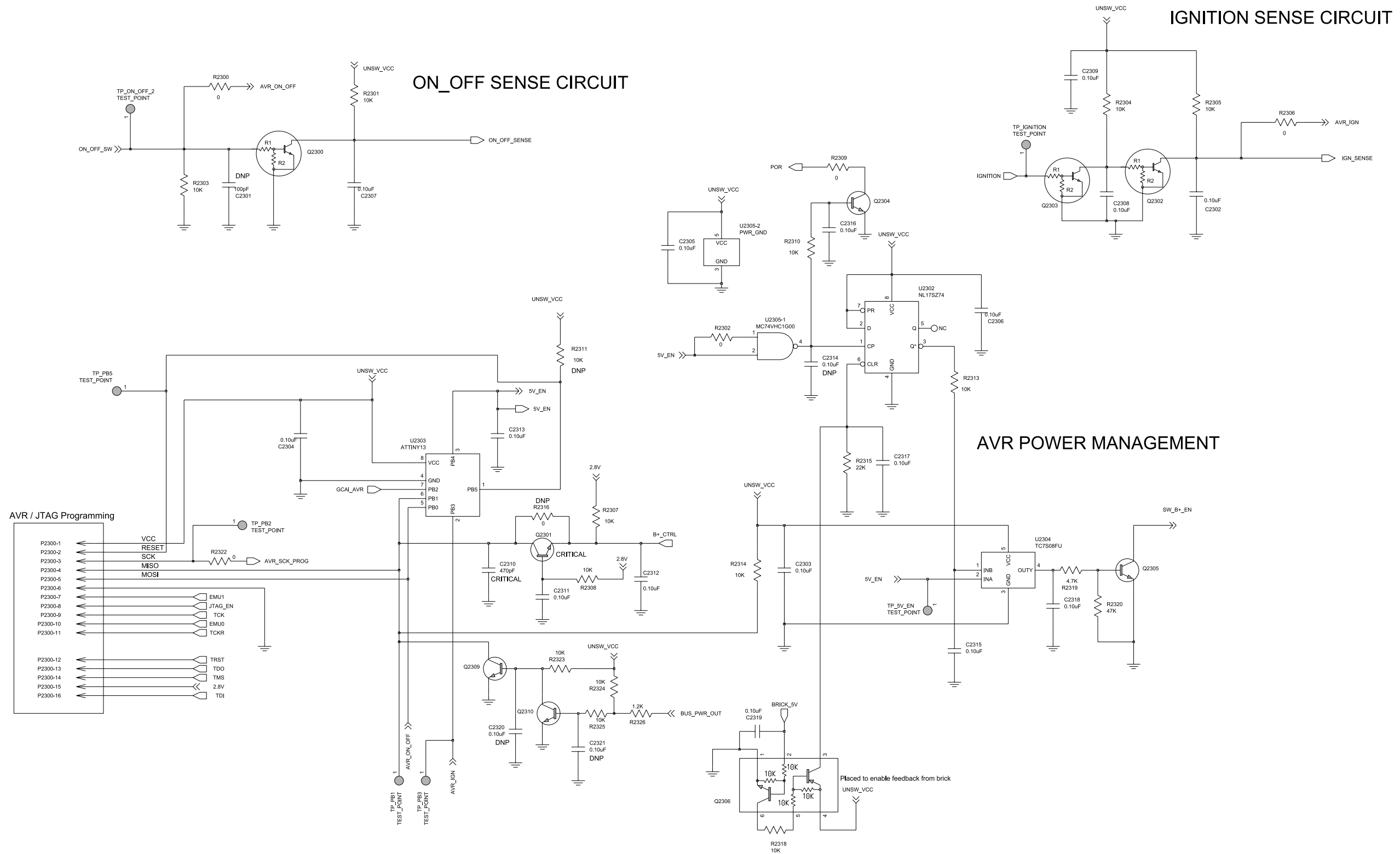


Figure 7-7. AVR Power Management Control

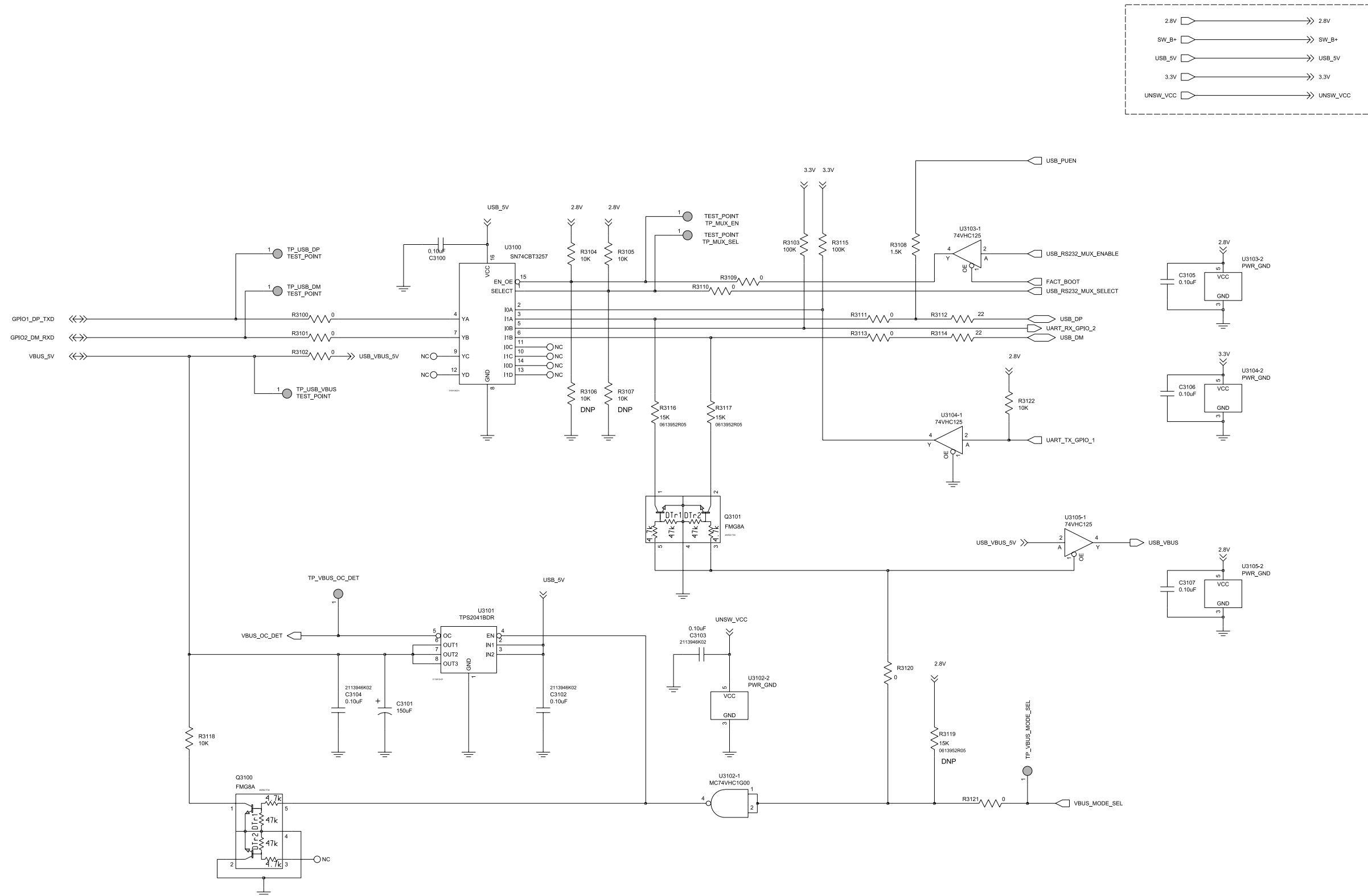


Figure 7-8. GCAI Accessory Interface (Sheet 1 of 2)

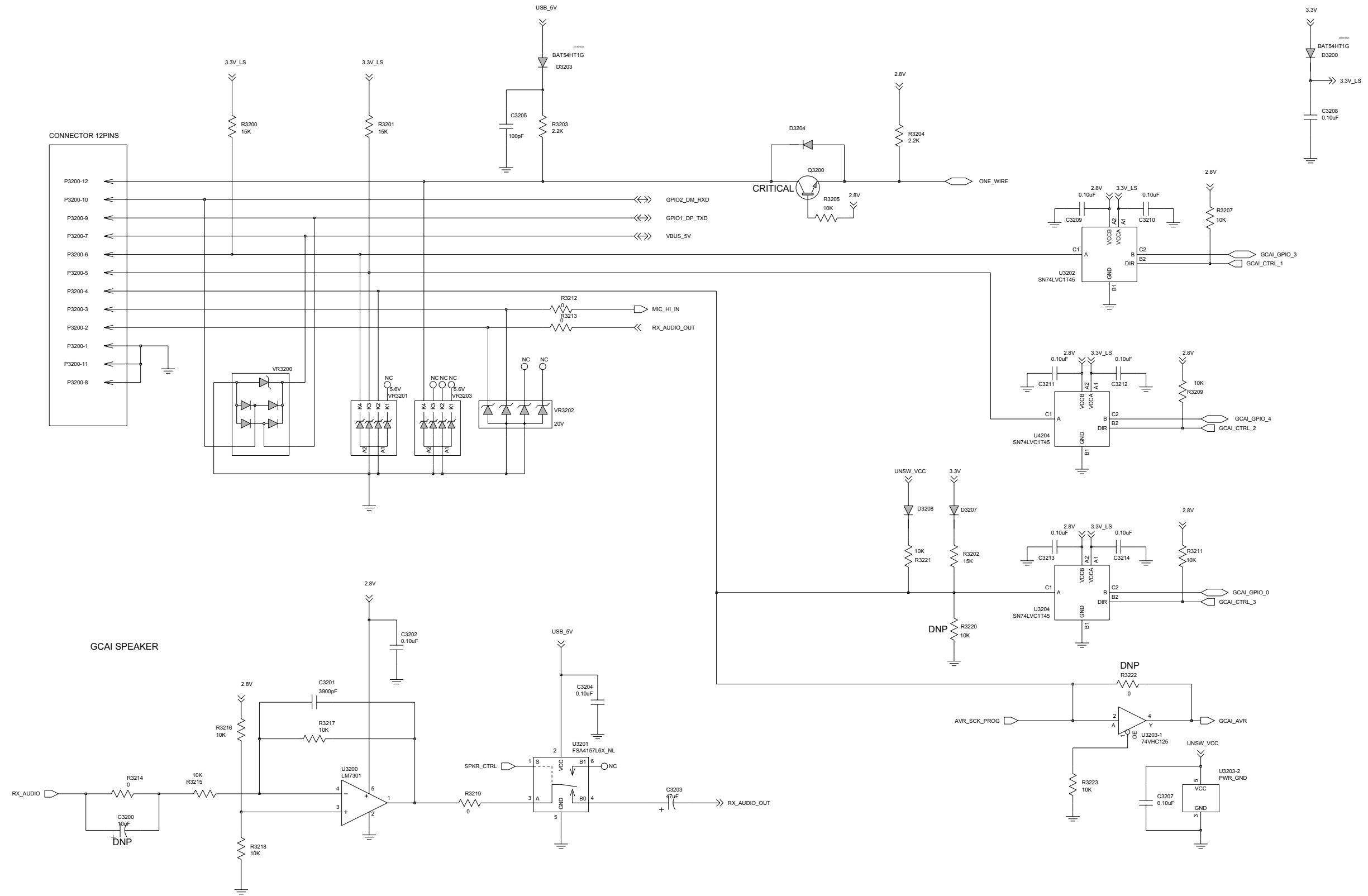


Figure 7-9. GCAI Accessory Interface (Sheet 2 of 2)

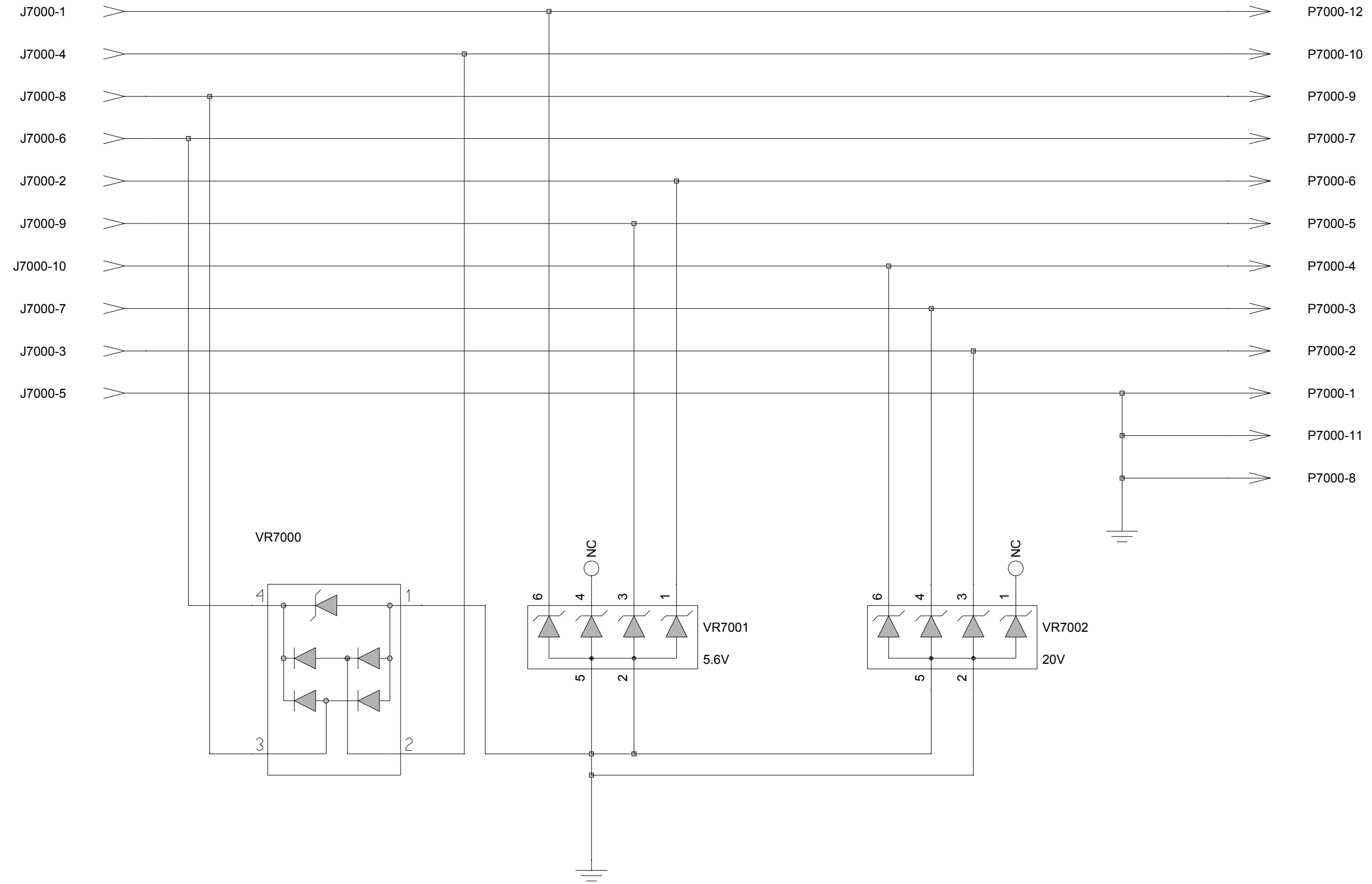
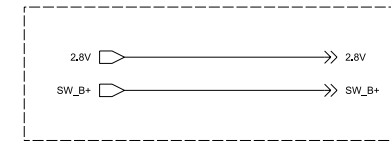
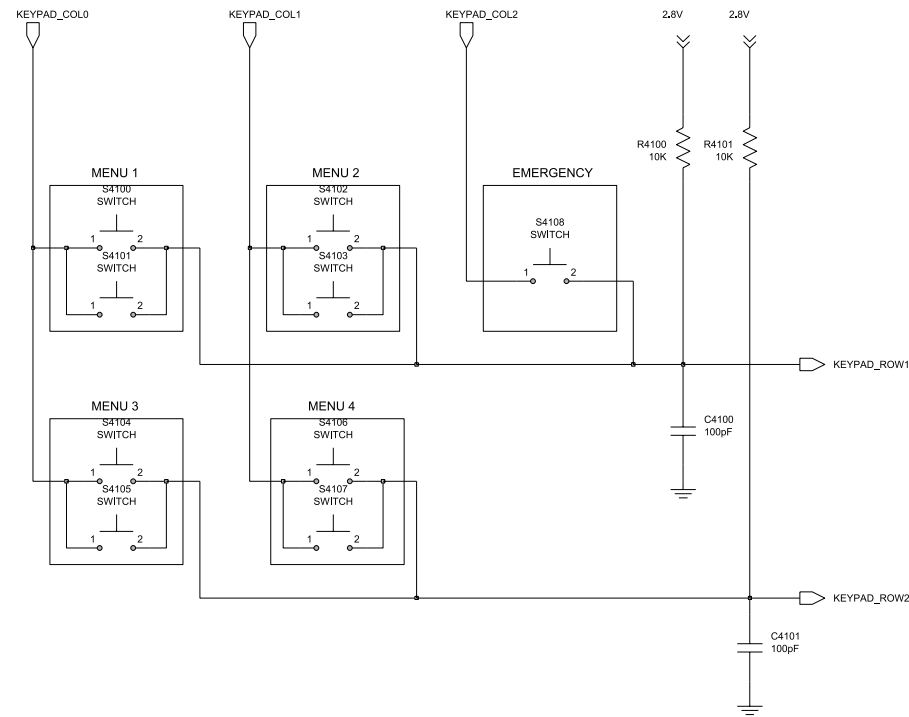
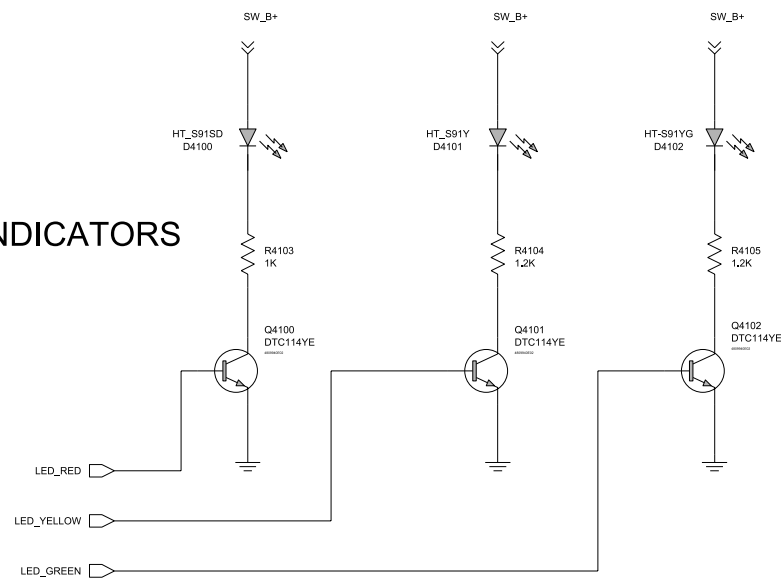


Figure 7-10. GCAI Connector Schematic

PROGAMMABLE BUTTONS



LED INDICATORS



KEYPAD BACKLIGHT

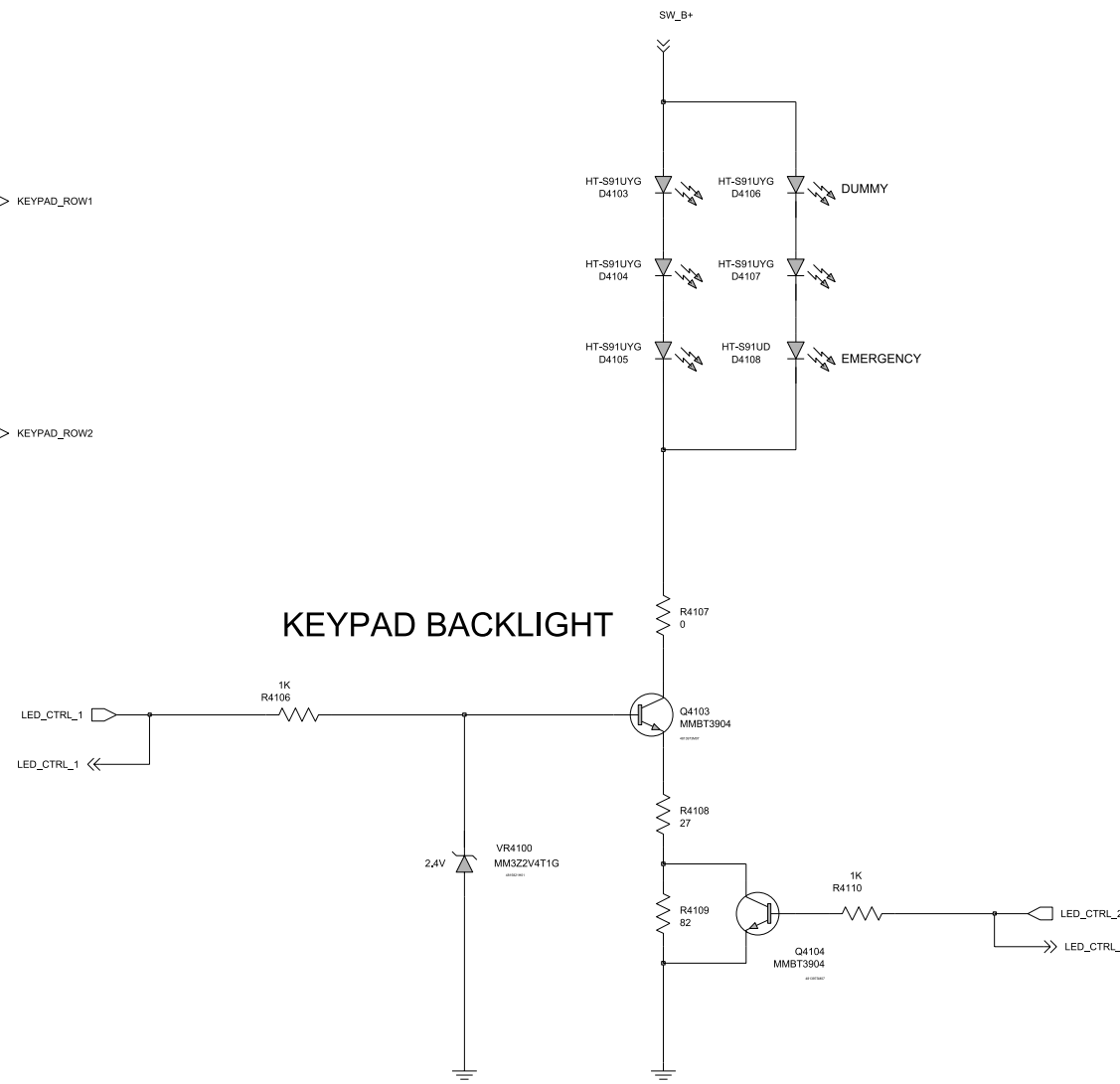


Figure 7-11. User Interface (Sheet 1 of 2)

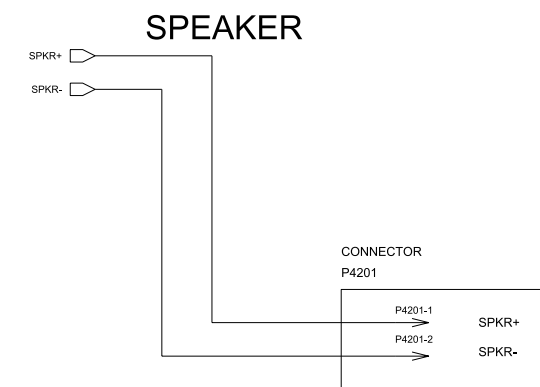
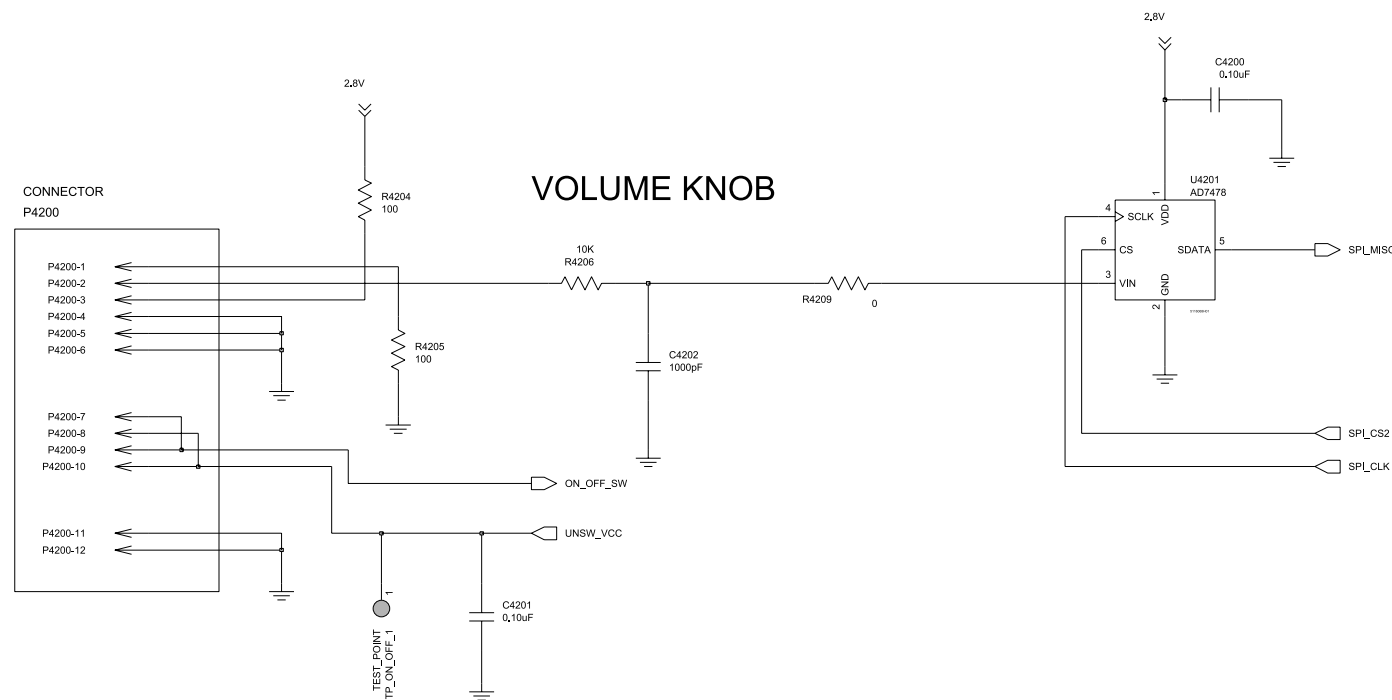
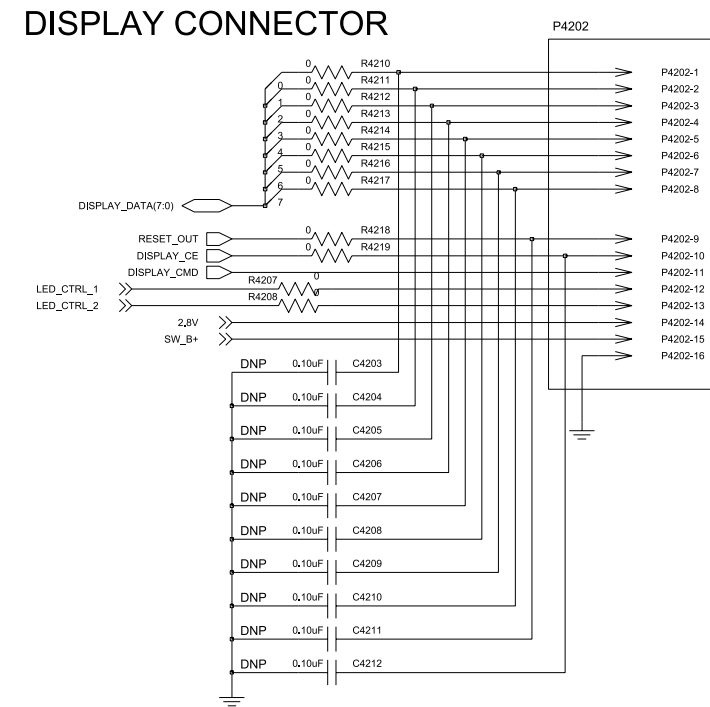
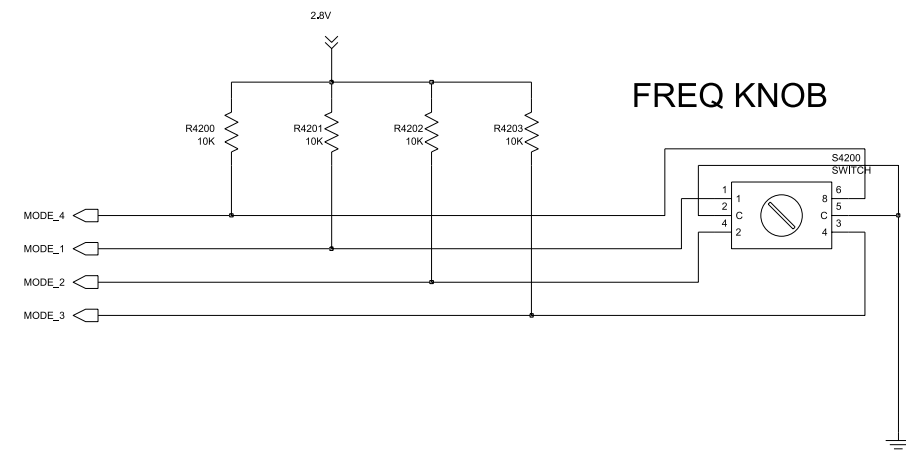


Figure 7-12. User Interface (Sheet 2 of 2)

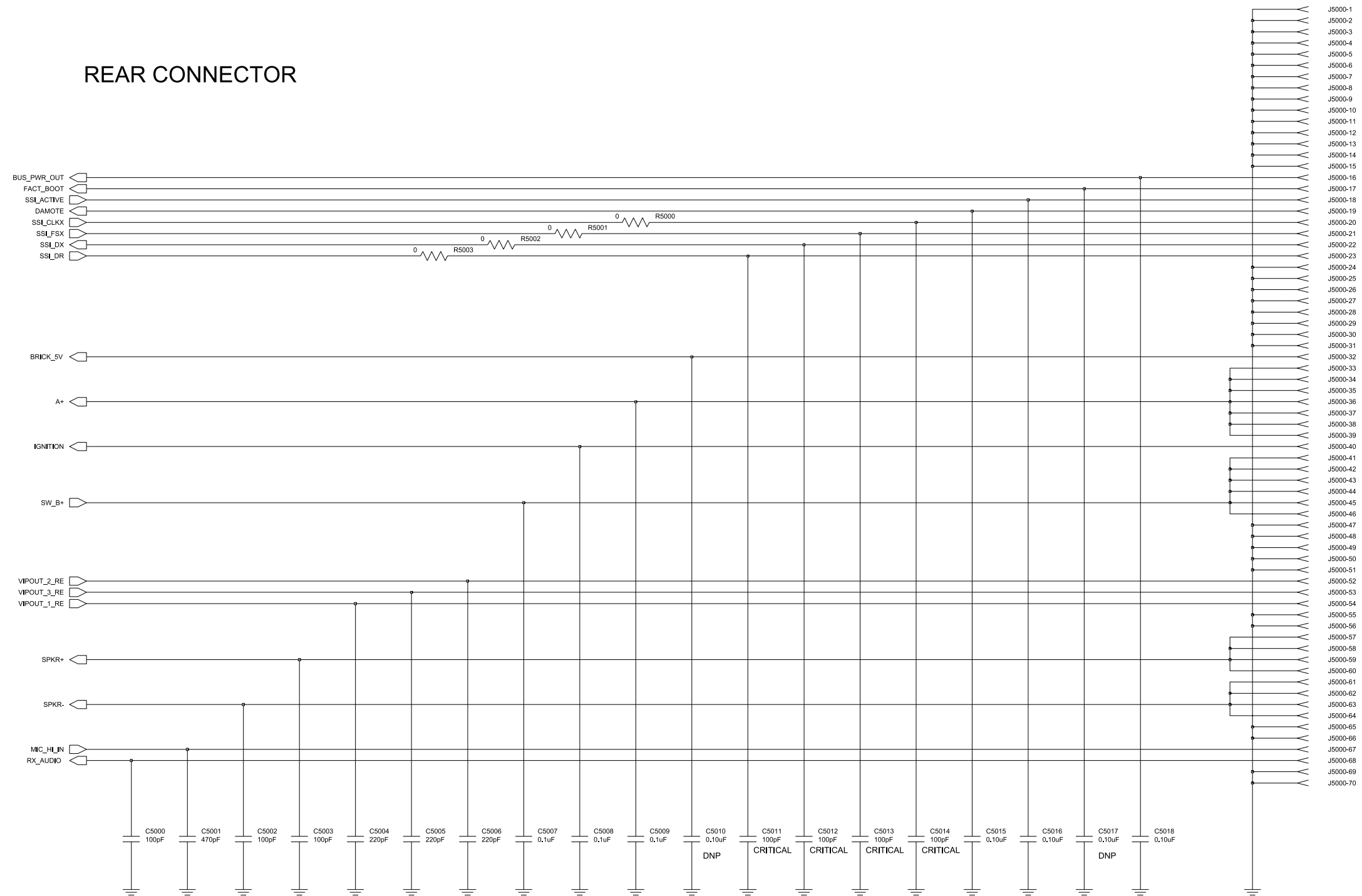


Figure 7-13. Rear Connector

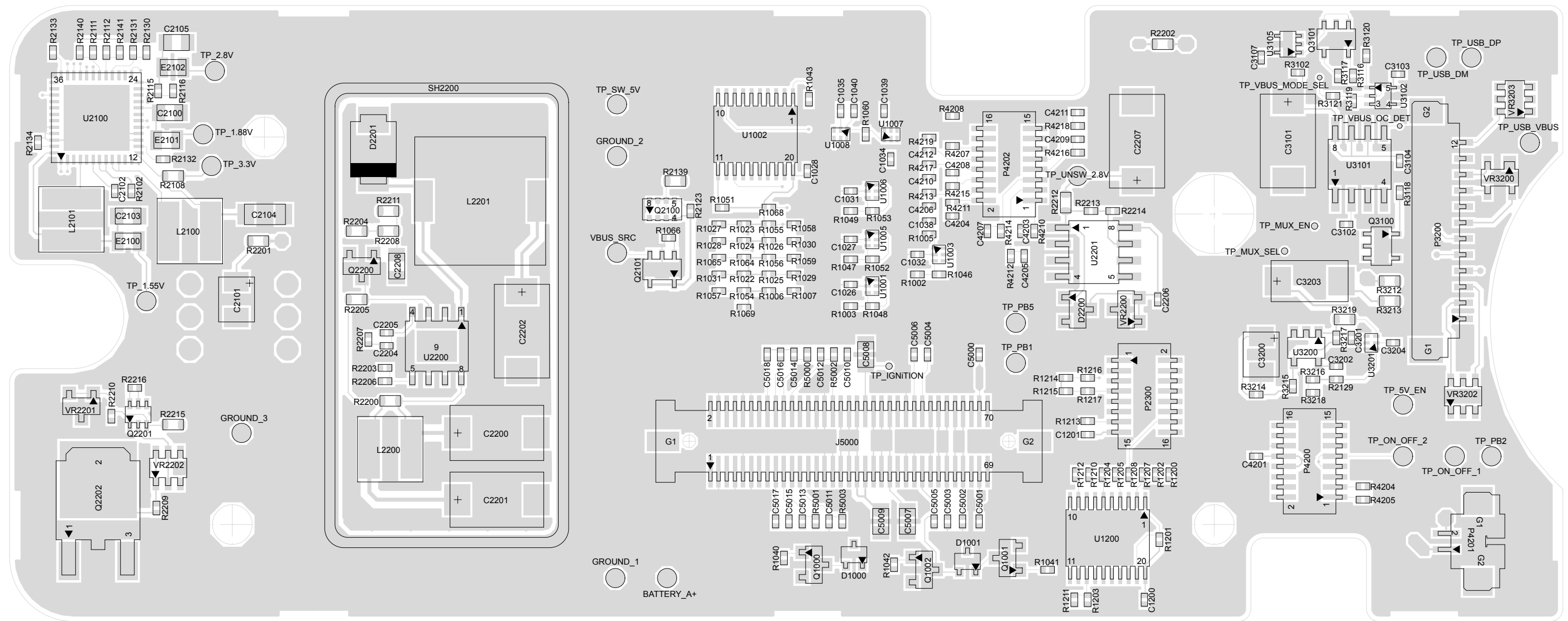


Figure 7-14. Control Head Main Board Layout—Side 1 Top

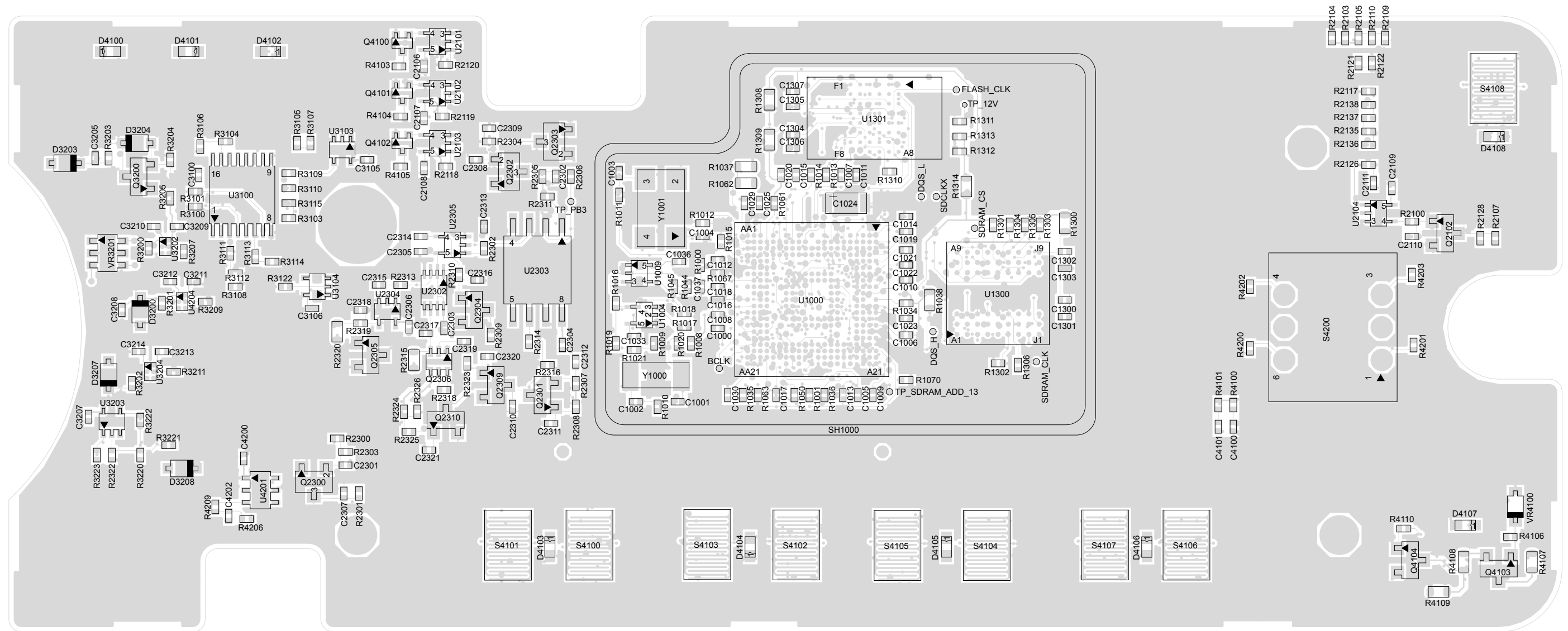


Figure 7-15. Control Head Main Board Layout—Side 2 Bottom

Control Head Main Board Parts Lists

Reference Designator	Motorola Part Number	Description
C0001	2311049A78	CAP TANT CHIP 10.0 UF
C1000	2113944A28	CAP CHIP 18pF 5% 50V COG
C1001	2113944A28	CAP CHIP 18pF 5% 50V COG
C1002	2113944A28	CAP CHIP 18pF 5% 50V COG
C1003	2113944A28	CAP CHIP 18pF 5% 50V COG
C1004	2113944A28	CAP CHIP 18pF 5% 50V COG
C1005	2113944A40	CAP CHIP 100pF 5% 50V COG
C1006	2113944A40	CAP CHIP 100pF 5% 50V COG
C1007	2113944A40	CAP CHIP 100pF 5% 50V COG
C1008	2113944A40	CAP CHIP 100pF 5% 50V COG
C1009	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1010	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1011	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1012	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1013	2113944A40	CAP CHIP 100pF 5% 50V COG
C1014	2113944A40	CAP CHIP 100pF 5% 50V COG
C1015	2113944A40	CAP CHIP 100pF 5% 50V COG
C1016	2113944A40	CAP CHIP 100pF 5% 50V COG
C1017	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1018	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1019	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1020	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1021	2113944A40	CAP CHIP 100pF 5% 50V COG

Reference Designator	Motorola Part Number	Description
C1022	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1023	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1024	2313960B01	CAP TANT 1.0uF 10% 16V
C1025	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1026	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1027	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1028	2113945B02	CAP CHIP 10000pF 10% 25V X7R
C1029	2113944A40	CAP CHIP 100pF 5% 50V COG
C1030	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1031	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1032	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1033	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1034	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1035	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1036	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1037	2113944A40	CAP CHIP 100pF 5% 50V COG
C1038	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1039	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1040	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1200	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1201	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1300	2113944A40	CAP CHIP 100pF 5% 50V COG
C1301	2113945B02	CAP CHIP 10000pF 10% 25V X7R
C1302	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V

Reference Designator	Motorola Part Number	Description
C1303	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C1304	2113944A40	CAP CHIP 100pF 5% 50V COG
C1305	2113944A40	CAP CHIP 100pF 5% 50V COG
C1306	2113945B02	CAP CHIP 10000pF 10% 25V X7R
C1307	2113945B02	CAP CHIP 10000pF 10% 25V X7R
C2100	2113946N03	CAP CHIP 2.2uF +80%/-20% 16V Y5V
C2101	2313960D07	CAP TANT 10.0uF 10% 16V
C2102	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2103	2113946F05	CAP CHIP 10uF 10% 6.3V X5R
C2104	2188155V02	CAP CHIP 22uF 10% 10V
C2105	2113946N03	CAP CHIP 2.2uF +80%/-20% 16V Y5V
C2106	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2107	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2108	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2109	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2110	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2111	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2200	2313960G32	CAP TANT 10.0uF 10% 35V
C2201	2313960G32	CAP TANT 10.0uF 10% 35V
C2202	2311049C49	CAP TANT 100uF 10% 16V
C2204	2113945B04	CAP CHIP 22000pF 10% 25V X7R
C2205	2113945A01	CAP CHIP 220pF 10% 50V X7R
C2206	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2207	2313960G32	CAP TANT 10.0uF 10% 35V

Reference Designator	Motorola Part Number	Description
C2208	2113946N03	CAP CHIP 2.2uF +80%/-20% 16V Y5V
C2301	2113944A40	CAP CHIP 100pF 5% 50V COG
C2302	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2303	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2304	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2305	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2306	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2307	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2308	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2309	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2310	2113945A05	CAP CHIP 470pF 10% 50V X7R
C2311	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2312	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2313	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2314	NOTPLACED	GCAM DUMMY PART NUMBER
C2315	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2316	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2317	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2318	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2319	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C2320	NOTPLACED	GCAM DUMMY PART NUMBER
C2321	NOTPLACED	GCAM DUMMY PART NUMBER
C3100	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3101	2360567A07	CAP TANT 150uF

Reference Designator	Motorola Part Number	Description
C3102	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3103	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3104	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3105	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3106	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3107	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3200	NOTPLACED	GCAM DUMMY PART NUMBER
C3201	2113945A69	CAP CHIP 3900pF 10% 50V X7R
C3202	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3203	2313960F30	CAP TANT 47.0uF 10% 10V
C3204	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3205	2113944A40	CAP CHIP 100pF 5% 50V COG
C3207	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3208	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3209	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3210	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3211	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3212	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3213	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C3214	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C4100	2113944A40	CAP CHIP 100pF 5% 50V COG
C4101	2113944A40	CAP CHIP 100pF 5% 50V COG
C4200	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V

Reference Designator	Motorola Part Number	Description
C4201	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C4202	2113945A09	CAP CHIP 1000pF 10% 50V X7R
C4203	NOTPLACED	GCAM DUMMY PART NUMBER
C4204	NOTPLACED	GCAM DUMMY PART NUMBER
C4205	NOTPLACED	GCAM DUMMY PART NUMBER
C4206	NOTPLACED	GCAM DUMMY PART NUMBER
C4207	NOTPLACED	GCAM DUMMY PART NUMBER
C4208	NOTPLACED	GCAM DUMMY PART NUMBER
C4209	NOTPLACED	GCAM DUMMY PART NUMBER
C4210	NOTPLACED	GCAM DUMMY PART NUMBER
C4211	NOTPLACED	GCAM DUMMY PART NUMBER
C4212	NOTPLACED	GCAM DUMMY PART NUMBER
C5000	2113944A40	CAP CHIP 100pF 5% 50V COG
C5001	2113945A05	CAP CHIP 470pF 10% 50V X7R
C5002	2113944A40	CAP CHIP 100pF 5% 50V COG
C5003	2113944A40	CAP CHIP 100pF 5% 50V COG
C5004	2113945A01	CAP CHIP 220pF 10% 50V X7R
C5005	2113945A01	CAP CHIP 220pF 10% 50V X7R
C5006	2113945A01	CAP CHIP 220pF 10% 50V X7R
C5007	2113945G91	CAP CHIP 100000pF 10% 50V X7R
C5008	2113945G91	CAP CHIP 100000pF 10% 50V X7R
C5009	2113945G91	CAP CHIP 100000pF 10% 50V X7R
C5010	NOTPLACED	GCAM DUMMY PART NUMBER

Reference Designator	Motorola Part Number	Description
C5011	2113944A40	CAP CHIP 100pF 5% 50V COG
C5012	2113944A40	CAP CHIP 100pF 5% 50V COG
C5013	2113944A40	CAP CHIP 100pF 5% 50V COG
C5014	2113944A40	CAP CHIP 100pF 5% 50V COG
C5015	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C5016	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
C5017	NOTPLACED	GCAM DUMMY PART NUMBER
C5018	2113946K02	CAP CHIP 0.1uF +80%/-20% 16V Y5V
D1000	4888722V03	DIODE SCHOTTKY RB715F
D1001	4888722V03	DIODE SCHOTTKY RB715F
D2200	4813978P07	DIODE DUAL MMBD7000
D2201	4813978B17	DIODE SCHOTTKY 30V 2.0A
D3200	4813978A25	DIODE SCHOTTKY 30V
D3203	4813978A25	DIODE SCHOTTKY 30V
D3204	4813978A25	DIODE SCHOTTKY 30V
D3207	4813978A25	DIODE SCHOTTKY 30V
D3208	4813978A25	DIODE SCHOTTKY 30V
D4100	4815813H01	LED CHIP HT-S91SD
D4101	4815816H01	LED CHIP HT-S91Y
D4102	4815817H01	LED CHIP HT-S91YG
D4103	4815809H01	LED CHIP HT-S91UYG
D4104	4815809H01	LED CHIP HT-S91UYG
D4105	4815809H01	LED CHIP HT-S91UYG
D4106	4815809H01	LED CHIP HT-S91UYG
D4107	4815809H01	LED CHIP HT-S91UYG
D4108	4815814H02	LED CHIP HT-S91D
E2100	2480067M02	CHK RF CHIP BEAD IND BLM21A
E2101	2480067M02	CHK RF CHIP BEAD IND BLM21A
E2102	2480067M02	CHK RF CHIP BEAD IND BLM21A
J5000	0915213H01	CONN 70-PINS REAR

Reference Designator	Motorola Part Number	Description
L2100	2416090H01	POWER IND 6.8uH 20%
L2101	2416089H01	POWER IND 10uH 20%
L2200	2416090H01	POWER IND 6.8uH 20%
L2201	2416086H01	POWER IND 22uH 30%
P2300	2815146H01	CONN 16-PINS AVR
P3200	2815159H01	CONN 12-PINS GCAI
P4200	2815146H01	CONN 16-PINS VOL POT
P4201	2815162H01	CONN 2-PINS SPKR
P4202	2815146H01	CONN 16-PINS DISPLAY
PCB	8415212H01	MAIN PCB
Q1000	4813972A17	TSTR MOSFET N-CHAN MGSF1N02
Q1001	4813972A17	TSTR MOSFET N-CHAN MGSF1N02
Q1002	4813972A17	TSTR MOSFET N-CHAN MGSF1N02
Q2100	4813970A62	TSTR MOSFET P-CHAN NTH5441T1
Q2101	4805921T09	TSTR DUAL ROHM FMG8A
Q2102	4813973M07	TSTR NPN 40V .2A MMBT3904
Q2200	4813973M07	TSTR NPN 40V .2A MMBT3904
Q2201	4813973A81	TSTR DUAL NPN-PNP MUN5311
Q2202	4815332H01	TSTR MOSFET P-CHAN NTD2955
Q2300	4813973A42	TSTR NPN DIG 47K/47K MUN2213
Q2301	4813973M07	TSTR NPN 40V .2A MMBT3904
Q2302	4813973A42	TSTR NPN DIG 47K/47K MUN2213
Q2303	4813973A42	TSTR NPN DIG 47K/47K MUN2213
Q2304	4813973M07	TSTR NPN 40V .2A MMBT3904
Q2305	4813973M07	TSTR NPN 40V .2A MMBT3904
Q2306	4813973A81	TSTR DUAL NPN-PNP MUN5311
Q2309	4813973M07	TSTR NPN 40V .2A MMBT3904
Q2310	4813973M07	TSTR NPN 40V .2A MMBT3904

Reference Designator	Motorola Part Number	Description
Q3100	4805921T09	TSTR DUAL ROHM FMG8A
Q3101	4805921T09	TSTR DUAL ROHM FMG8A
Q3200	4813973M07	TSTR NPN 40V .2A MMBT3904
Q4100	4809940E02	DTC114YE TSTR DIG NPN
Q4101	4809940E02	DTC114YE TSTR DIG NPN
Q4102	4809940E02	DTC114YE TSTR DIG NPN
Q4103	4813973M07	TSTR NPN 40V .2A MMBT3904
Q4104	4813973M07	TSTR NPN 40V .2A MMBT3904
R1000	NOTPLACED	GCAM DUMMY PART NUMBER
R1001	0613952R01	RES CHIP 10K 5% 0402
R1002	0613952R66	RES CHIP 0 5% 0402
R1003	0613952R66	RES CHIP 0 5% 0402
R1005	0613952R01	RES CHIP 10K 5% 0402
R1006	NOTPLACED	GCAM DUMMY PART NUMBER
R1007	0613952R66	RES CHIP 0 5% 0402
R1008	0613952R01	RES CHIP 10K 5% 0402
R1009	0613952R66	RES CHIP 0 5% 0402
R1010	0613952R66	RES CHIP 0 5% 0402
R1011	0613952R74	RES CHIP 10M 5% 0402
R1012	NOTPLACED	GCAM DUMMY PART NUMBER
R1013	NOTPLACED	GCAM DUMMY PART NUMBER
R1014	0613952R66	RES CHIP 0 5% 0402
R1015	0613952Q89	RES CHIP 4K7 5% 0402
R1016	0613952R66	RES CHIP 0 5% 0402
R1017	0613952R74	RES CHIP 10M 5% 0402
R1018	0613952R74	RES CHIP 10M 5% 0402
R1019	0613952R41	RES CHIP 470K 5% 0402
R1020	NOTPLACED	GCAM DUMMY PART NUMBER
R1021	NOTPLACED	GCAM DUMMY PART NUMBER
R1022	NOTPLACED	GCAM DUMMY PART NUMBER
R1023	NOTPLACED	GCAM DUMMY PART NUMBER

Reference Designator	Motorola Part Number	Description
R1024	NOTPLACED	GCAM DUMMY PART NUMBER
R1025	NOTPLACED	GCAM DUMMY PART NUMBER
R1026	NOTPLACED	GCAM DUMMY PART NUMBER
R1027	0613952R66	RES CHIP 0 5% 0402
R1028	0613952R01	RES CHIP 10K 5% 0402
R1029	0613952R01	RES CHIP 10K 5% 0402
R1030	0613952R01	RES CHIP 10K 5% 0402
R1031	0613952R01	RES CHIP 10K 5% 0402
R1034	0613952Q25	RES CHIP 10 5% 0402
R1035	0613952Q25	RES CHIP 10 5% 0402
R1036	0613952R01	RES CHIP 10K 5% 0402
R1037	NOTPLACED	GCAM DUMMY PART NUMBER
R1038	0613952G67	RES CHIP 0 1% 0603
R1040	0613952R25	RES CHIP 100K 5% 0402
R1041	0613952R25	RES CHIP 100K 5% 0402
R1042	0613952R25	RES CHIP 100K 5% 0402
R1043	0613952R01	RES CHIP 10K 5% 0402
R1044	0613952Q47	RES CHIP 82 5% 0402
R1045	NOTPLACED	GCAM DUMMY PART NUMBER
R1046	NOTPLACED	GCAM DUMMY PART NUMBER
R1047	0613952R66	RES CHIP 0 5% 0402
R1048	NOTPLACED	GCAM DUMMY PART NUMBER
R1049	0613952R66	RES CHIP 0 5% 0402
R1050	0613952R01	RES CHIP 10K 5% 0402
R1051	0613952R01	RES CHIP 10K 5% 0402
R1052	NOTPLACED	GCAM DUMMY PART NUMBER
R1053	NOTPLACED	GCAM DUMMY PART NUMBER
R1054	NOTPLACED	GCAM DUMMY PART NUMBER
R1055	NOTPLACED	GCAM DUMMY PART NUMBER
R1056	0613952R01	RES CHIP 10K 5% 0402
R1057	0613952R01	RES CHIP 10K 5% 0402
R1058	0613952R01	RES CHIP 10K 5% 0402

Reference Designator	Motorola Part Number	Description
R1059	NOTPLACED	GCAM DUMMY PART NUMBER
R1060	0613952R01	RES CHIP 10K 5% 0402
R1061	0613952R01	RES CHIP 10K 5% 0402
R1062	0613952G67	RES CHIP 0 1% 0603
R1063	0613952R25	RES CHIP 100K 5% 0402
R1064	0613952R01	RES CHIP 10K 5% 0402
R1065	NOTPLACED	GCAM DUMMY PART NUMBER
R1066	0613952R01	RES CHIP 10K 5% 0402
R1067	0613952R01	RES CHIP 10K 5% 0402
R1068	0613952R01	RES CHIP 10K 5% 0402
R1069	0613952R01	RES CHIP 10K 5% 0402
R1070	0613952R01	RES CHIP 10K 5% 0402
R1200	0613952R01	RES CHIP 10K 5% 0402
R1201	0613952R01	RES CHIP 10K 5% 0402
R1202	NOTPLACED	GCAM DUMMY PART NUMBER
R1203	0613952R25	RES CHIP 100K 5% 0402
R1204	0613952R25	RES CHIP 100K 5% 0402
R1205	0613952R25	RES CHIP 100K 5% 0402
R1207	0613952Q37	RES CHIP 33 5% 0402
R1208	0613952Q37	RES CHIP 33 5% 0402
R1210	0613952Q37	RES CHIP 33 5% 0402
R1211	0613952Q37	RES CHIP 33 5% 0402
R1212	0613952Q37	RES CHIP 33 5% 0402
R1213	0613952Q37	RES CHIP 33 5% 0402
R1214	0613952Q89	RES CHIP 4K7 5% 0402
R1215	0613952Q89	RES CHIP 4K7 5% 0402
R1216	0613952Q37	RES CHIP 33 5% 0402
R1217	0613952Q37	RES CHIP 33 5% 0402
R1300	0613952G67	RES CHIP 0 1% 0603
R1301	0613952R01	RES CHIP 10K 5% 0402
R1302	0613952R01	RES CHIP 10K 5% 0402
R1303	0613952R01	RES CHIP 10K 5% 0402
R1304	0613952R01	RES CHIP 10K 5% 0402
R1305	0613952R01	RES CHIP 10K 5% 0402
R1306	0613952R01	RES CHIP 10K 5% 0402
R1308	0613952G67	RES CHIP 0 1% 0603
R1309	0613952G67	RES CHIP 0 1% 0603
R1310	0613952R66	RES CHIP 0 5% 0402

Reference Designator	Motorola Part Number	Description
R1311	NOTPLACED	GCAM DUMMY PART NUMBER
R1312	0613952R01	RES CHIP 10K 5% 0402
R1313	0613952R01	RES CHIP 10K 5% 0402
R1314	NOTPLACED	GCAM DUMMY PART NUMBER
R2100	0613952R01	RES CHIP 10K 5% 0402
R2102	0613952Q25	RES CHIP 10 5% 0402
R2103	0613952R01	RES CHIP 10K 5% 0402
R2104	0613952R01	RES CHIP 10K 5% 0402
R2105	0613952R01	RES CHIP 10K 5% 0402
R2107	NOTPLACED	GCAM DUMMY PART NUMBER
R2108	0613952G67	RES CHIP 0 1% 0603
R2109	0613952R66	RES CHIP 0 5% 0402
R2110	0613952R66	RES CHIP 0 5% 0402
R2111	0613952R66	RES CHIP 0 5% 0402
R2112	0613952R66	RES CHIP 0 5% 0402
R2115	0613952R23	RES CHIP 82K 5% 0402
R2116	0613952R07	RES CHIP 18K 5% 0402
R2117	0613952R01	RES CHIP 10K 5% 0402
R2118	0613952R01	RES CHIP 10K 5% 0402
R2119	0613952R01	RES CHIP 10K 5% 0402
R2120	0613952R01	RES CHIP 10K 5% 0402
R2121	0613952R01	RES CHIP 10K 5% 0402
R2122	0613952R01	RES CHIP 10K 5% 0402
R2123	0613952R01	RES CHIP 10K 5% 0402
R2126	0613952R01	RES CHIP 10K 5% 0402
R2128	NOTPLACED	GCAM DUMMY PART NUMBER
R2129	0613952R01	RES CHIP 10K 5% 0402
R2130	NOTPLACED	GCAM DUMMY PART NUMBER
R2131	0613952R66	RES CHIP 0 5% 0402
R2132	0613952R66	RES CHIP 0 5% 0402
R2133	0613952R66	RES CHIP 0 5% 0402
R2134	0613952R66	RES CHIP 0 5% 0402
R2135	0613952R01	RES CHIP 10K 5% 0402
R2136	NOTPLACED	GCAM DUMMY PART NUMBER
R2137	0613952R01	RES CHIP 10K 5% 0402
R2138	0613952R66	RES CHIP 0 5% 0402

Reference Designator	Motorola Part Number	Description
R2139	0613952G67	RES CHIP 0 1% 0603
R2140	0613952R01	RES CHIP 10K 5% 0402
R2141	0613952R01	RES CHIP 10K 5% 0402
R2200	NOTPLACED	GCAM DUMMY PART NUMBER
R2201	0613952G67	RES CHIP 0 1% 0603
R2202	0613952G67	RES CHIP 0 1% 0603
R2203	0613952R01	RES CHIP 10K 5% 0402
R2204	0613952J17	RES CHIP 47K 5% 0603
R2205	0613952J08	RES CHIP 20K 5% 0603
R2206	0613952Z44	RES CHIP 3K3 1% 0402
R2207	0613952Q89	RES CHIP 4K7 5% 0402
R2208	0613952J13	RES CHIP 33K 5% 0603
R2209	0613952R66	RES CHIP 0 5% 0402
R2210	0613952R25	RES CHIP 100K 5% 0402
R2211	0613952J17	RES CHIP 47K 5% 0603
R2212	0613952G67	RES CHIP 0 1% 0603
R2213	0613952P14	RES CHIP 137K 1% 0402
R2214	0613952R25	RES CHIP 100K 5% 0402
R2215	0613952H73	RES CHIP 1K 5% 0603
R2216	0613952R25	RES CHIP 100K 5% 0402
R2300	0613952R66	RES CHIP 0 5% 0402
R2301	0613952R01	RES CHIP 10K 5% 0402
R2302	0613952R66	RES CHIP 0 5% 0402
R2303	0613952R01	RES CHIP 10K 5% 0402
R2304	0613952R01	RES CHIP 10K 5% 0402
R2305	0613952R01	RES CHIP 10K 5% 0402
R2306	0613952R66	RES CHIP 0 5% 0402
R2307	0613952R01	RES CHIP 10K 5% 0402
R2308	0613952R01	RES CHIP 10K 5% 0402
R2309	0613952R66	RES CHIP 0 5% 0402
R2310	0613952R01	RES CHIP 10K 5% 0402
R2311	0613952R01	RES CHIP 10K 5% 0402
R2313	0613952R01	RES CHIP 10K 5% 0402
R2314	0613952R01	RES CHIP 10K 5% 0402
R2315	0613952J09	RES CHIP 22K 5% 0603
R2316	NOTPLACED	GCAM DUMMY PART NUMBER
R2318	0613952R01	RES CHIP 10K 5% 0402
R2319	0613952Q89	RES CHIP 4K7 5% 0402
R2320	0613952J17	RES CHIP 47K 5% 0603

Reference Designator	Motorola Part Number	Description
R2322	0613952R66	RES CHIP 0 5% 0402
R2323	0613952R01	RES CHIP 10K 5% 0402
R2324	0613952R01	RES CHIP 10K 5% 0402
R2325	0613952R01	RES CHIP 10K 5% 0402
R2326	0613952Q75	RES CHIP 1K2 5% 0402
R3100	0613952R66	RES CHIP 0 5% 0402
R3101	0613952R66	RES CHIP 0 5% 0402
R3102	0613952R66	RES CHIP 0 5% 0402
R3103	0613952R25	RES CHIP 100K 5% 0402
R3104	0613952R01	RES CHIP 10K 5% 0402
R3105	0613952R01	RES CHIP 10K 5% 0402
R3106	NOTPLACED	GCAM DUMMY PART NUMBER
R3107	NOTPLACED	GCAM DUMMY PART NUMBER
R3108	0613952Q77	RES CHIP 1K5 5% 0402
R3109	0613952R66	RES CHIP 0 5% 0402
R3110	0613952R66	RES CHIP 0 5% 0402
R3111	0613952R66	RES CHIP 0 5% 0402
R3112	0613952Q33	RES CHIP 22 5% 0402
R3113	0613952R66	RES CHIP 0 5% 0402
R3114	0613952Q33	RES CHIP 22 5% 0402
R3115	0613952R25	RES CHIP 100K 5% 0402
R3116	0613952R05	RES CHIP 15K 5% 0402
R3117	0613952R05	RES CHIP 15K 5% 0402
R3118	0613952R01	RES CHIP 10K 5% 0402
R3119	NOTPLACED	GCAM DUMMY PART NUMBER
R3120	0613952R66	RES CHIP 0 5% 0402
R3121	0613952R66	RES CHIP 0 5% 0402
R3122	0613952R01	RES CHIP 10K 5% 0402
R3200	0613952R05	RES CHIP 15K 5% 0402
R3201	0613952R05	RES CHIP 15K 5% 0402
R3202	0613952R05	RES CHIP 15K 5% 0402
R3203	0613952Q81	RES CHIP 2K2 5% 0402
R3204	0613952Q81	RES CHIP 2K2 5% 0402
R3205	0613952R01	RES CHIP 10K 5% 0402
R3207	0613952R01	RES CHIP 10K 5% 0402
R3209	0613952R01	RES CHIP 10K 5% 0402
R3211	0613952R01	RES CHIP 10K 5% 0402
R3212	0613952G67	RES CHIP 0 1% 0603
R3213	0613952G67	RES CHIP 0 1% 0603

Reference Designator	Motorola Part Number	Description
R3214	0613952R66	RES CHIP 0 5% 0402
R3215	0613952R01	RES CHIP 10K 5% 0402
R3216	0613952R01	RES CHIP 10K 5% 0402
R3217	0613952R01	RES CHIP 10K 5% 0402
R3218	0613952R01	RES CHIP 10K 5% 0402
R3219	0613952G67	RES CHIP 0 1% 0603
R3220	NOTPLACED	GCAM DUMMY PART NUMBER
R3221	0613952R25	RES CHIP 100K 5% 0402
R3222	NOTPLACED	GCAM DUMMY PART NUMBER
R3223	0613952R01	RES CHIP 10K 5% 0402
R4100	0613952R01	RES CHIP 10K 5% 0402
R4101	0613952R01	RES CHIP 10K 5% 0402
R4103	0613952Q73	RES CHIP 1K 5% 0402
R4104	0613952Q75	RES CHIP 1K2 5% 0402
R4105	0613952Q75	RES CHIP 1K2 5% 0402
R4106	0613952Q73	RES CHIP 1K 5% 0402
R4107	0613952G67	RES CHIP 0 1% 0603
R4108	0613952H35	RES CHIP 27 5% 0603
R4109	0613952H47	RES CHIP 82 5% 0603
R4110	0613952Q73	RES CHIP 1K 5% 0402
R4200	0613952R01	RES CHIP 10K 5% 0402
R4201	0613952R01	RES CHIP 10K 5% 0402
R4202	0613952R01	RES CHIP 10K 5% 0402
R4203	0613952R01	RES CHIP 10K 5% 0402
R4204	0613952Q49	RES CHIP 100 5% 0402
R4205	0613952Q49	RES CHIP 100 5% 0402
R4206	0613952R01	RES CHIP 10K 5% 0402
R4207	0613952R66	RES CHIP 0 5% 0402
R4208	0613952R66	RES CHIP 0 5% 0402
R4209	0613952R66	RES CHIP 0 5% 0402
R4210	0613952R66	RES CHIP 0 5% 0402
R4211	0613952R66	RES CHIP 0 5% 0402
R4212	0613952R66	RES CHIP 0 5% 0402
R4213	0613952R66	RES CHIP 0 5% 0402
R4214	0613952R66	RES CHIP 0 5% 0402
R4215	0613952R66	RES CHIP 0 5% 0402
R4216	0613952R66	RES CHIP 0 5% 0402
R4217	0613952R66	RES CHIP 0 5% 0402
R4218	0613952R66	RES CHIP 0 5% 0402

Reference Designator	Motorola Part Number	Description
R4219	0613952R66	RES CHIP 0 5% 0402
R5000	0613952R66	RES CHIP 0 5% 0402
R5001	0613952R66	RES CHIP 0 5% 0402
R5002	0613952R66	RES CHIP 0 5% 0402
R5003	0613952R66	RES CHIP 0 5% 0402
S4200	4015133H01	SW ENDLESS ROTARY
SH1000	2615260H01	MICROPROCESSOR SHIELD
SH2200	2615259H01	SWITCHING REGULATOR SHIELD
U1000	5185941F53	IC OMAP330 MICROPROCESSOR
U1001	5102836C11	IC ANLG SW FSA4157
U1002	5114007A07	IC QUAD NON-INVTR BUFFER
U1003	5102836C11	IC ANLG SW FSA4157
U1004	5114000A48	IC SNGL INVTR 1GU04
U1005	5102836C11	IC ANLG SW FSA4157
U1006	5102836C11	IC ANLG SW FSA4157
U1007	5102836C11	IC ANLG SW FSA4157
U1008	5102836C11	IC ANLG SW FSA4157
U1009	5114007A43	IC SCHMITT INVTER NL17SZ14
U1200	5114007A07	IC QUAD NON-INVTR BUFFER
U1300	5115004H02	IC 8MB SDRAM
U1301	5115836H01	IC 2MB FLASH
U2100	5115331H01	IC PWR MGT TPS65012
U2101	5114000B34	IC SNGL 2-INPUT NAND GATE
U2102	5114000B34	IC SNGL 2-INPUT NAND GATE
U2103	5114000B34	IC SNGL 2-INPUT NAND GATE
U2104	5114000B34	IC SNGL 2-INPUT NAND GATE
U2200	5115808H01	IC SWITCHING REGULATOR 2.5A
U2201	5116021H01	IC VOLTAGE REGULATOR
U2302	5114007M28	IC SNGL D FLIP-FLOP NL17SZ74
U2303	5116018H01	IC ATTINY13 MICROCONTROLLER

Reference Designator	Motorola Part Number	Description
U2304	5109522E99	IC SNGL 2-INPUT AND GATE
U2305	5114000B34	IC SNGL 2-INPUT NAND GATE
U3100	5105109Z31	IC QUAD 2:1 MUX/DEMUX
U3101	5115810H01	IC ANLG CURRENT LIMITED SW
U3102	5114000B34	IC SNGL 2-INPUT NAND GATE
U3103	5114000B39	IC SNGL NON-INVTR BUFFER
U3104	5114000B39	IC SNGL NON-INVTR BUFFER
U3105	5114000B39	IC SNGL NON-INVTR BUFFER
U3200	5185941F22	IC SNGL OPAMP LM7301
U3201	5102836C11	IC ANLG SW FSA4157
U3202	5115007H01	IC XCVR SNGL-BIT TRANSLATOR
U3203	5114000B39	IC SNGL NON-INVTR BUFFER
U3204	5115007H01	IC XCVR SNGL-BIT TRANSLATOR
U4201	5116068H01	IC ADC AD7478
U4204	5115007H01	IC XCVR SNGL-BIT TRANSLATOR
VR2200	4813977M11	DIODE 5.6V ZENER MMBZ5232
VR2201	4813977M19	DIODE 10V ZENER MMBZ5240
VR2202	4813979C11	DIODE QUAD ZENER 20V
VR3200	4866544A01	DIODE ARRAY SR05 ZENER
VR3201	4813979P10	DIODE QUAD ZENER 5.6V
VR3202	4813979C11	DIODE QUAD ZENER 20V
VR3203	4813979P10	DIODE QUAD ZENER 5.6V
VR4100	4815821H01	DIODE ZENER 2.4V 200mW
Y1000	4809995L05	XTAL CC4V QUARTZ
Y1001	4809612J45	XTAL FLTR CX-91F

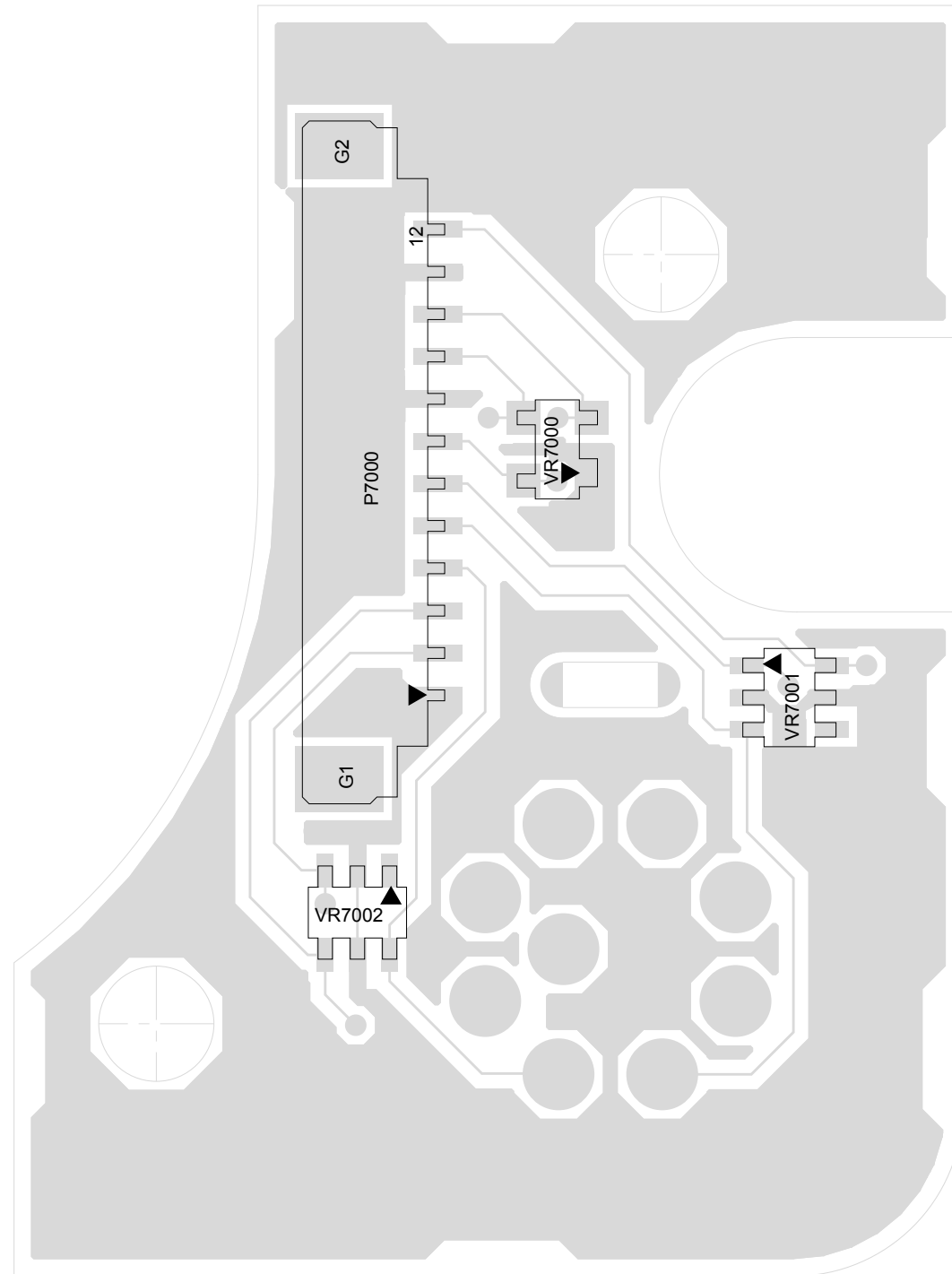


Figure 7-16. GCAI Connector Board Layout—Side 1 Top

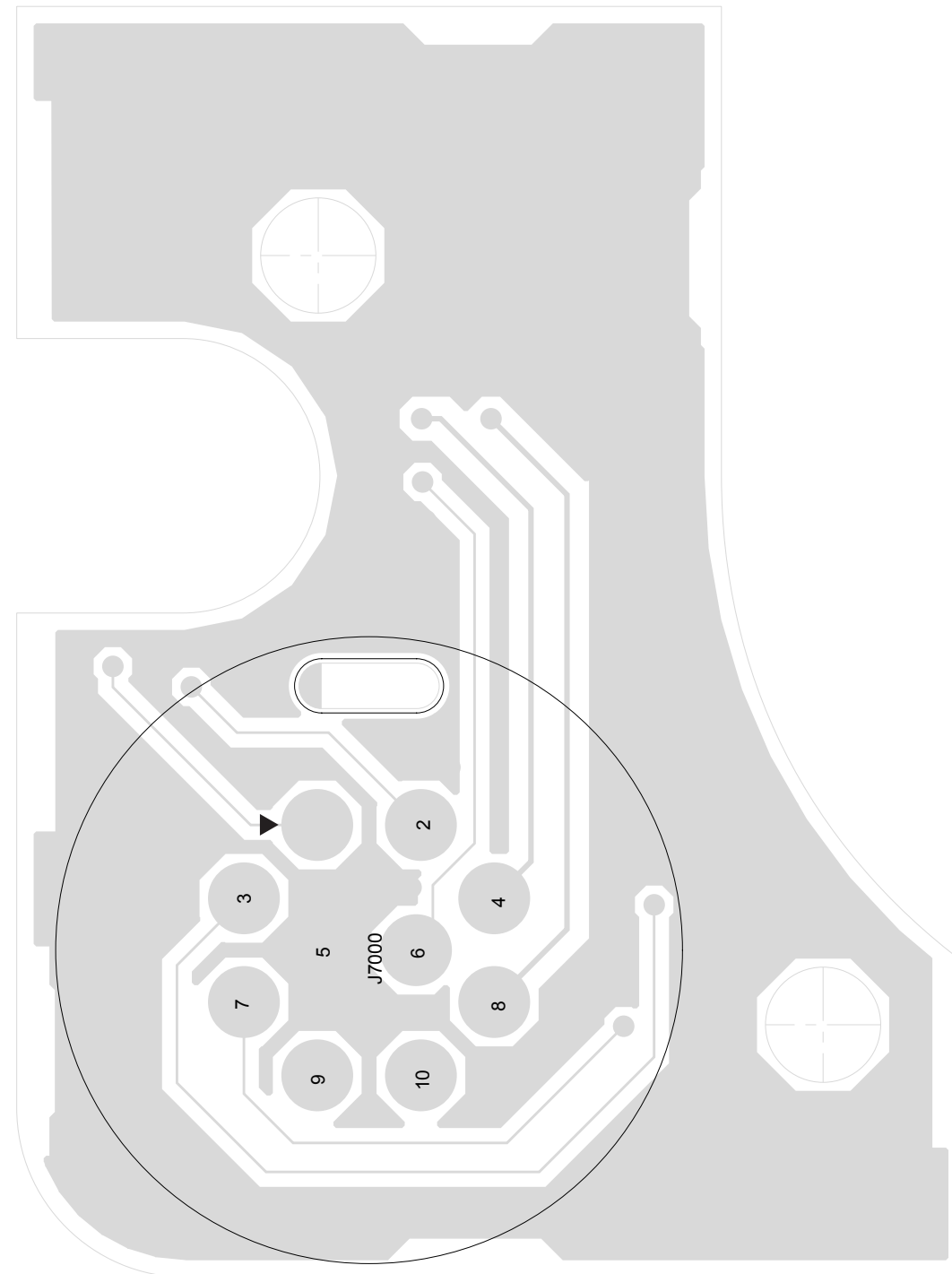


Figure 7-17. GCAI Connector Board Layout—Side 2 Bottom

GCAI Connector Board Parts List

Reference Designator	Motorola Part Number	Description
J7000	0964501H02	CONN 10-PINS ACCY GCAI
P7000	2815159H01	CONN 12-PINS GCAI
PCB	8415256H01	GCAI CONN PCB
VR7000	4866544A01	DIODE ARRAY SR05 ZENER
VR7001	4813979P10	DIODE QUAD ZENER 5.6V
VR7002	4813979C11	DIODE QUAD ZENER 20V

7.3 HUD4022A (VHF) Main Board

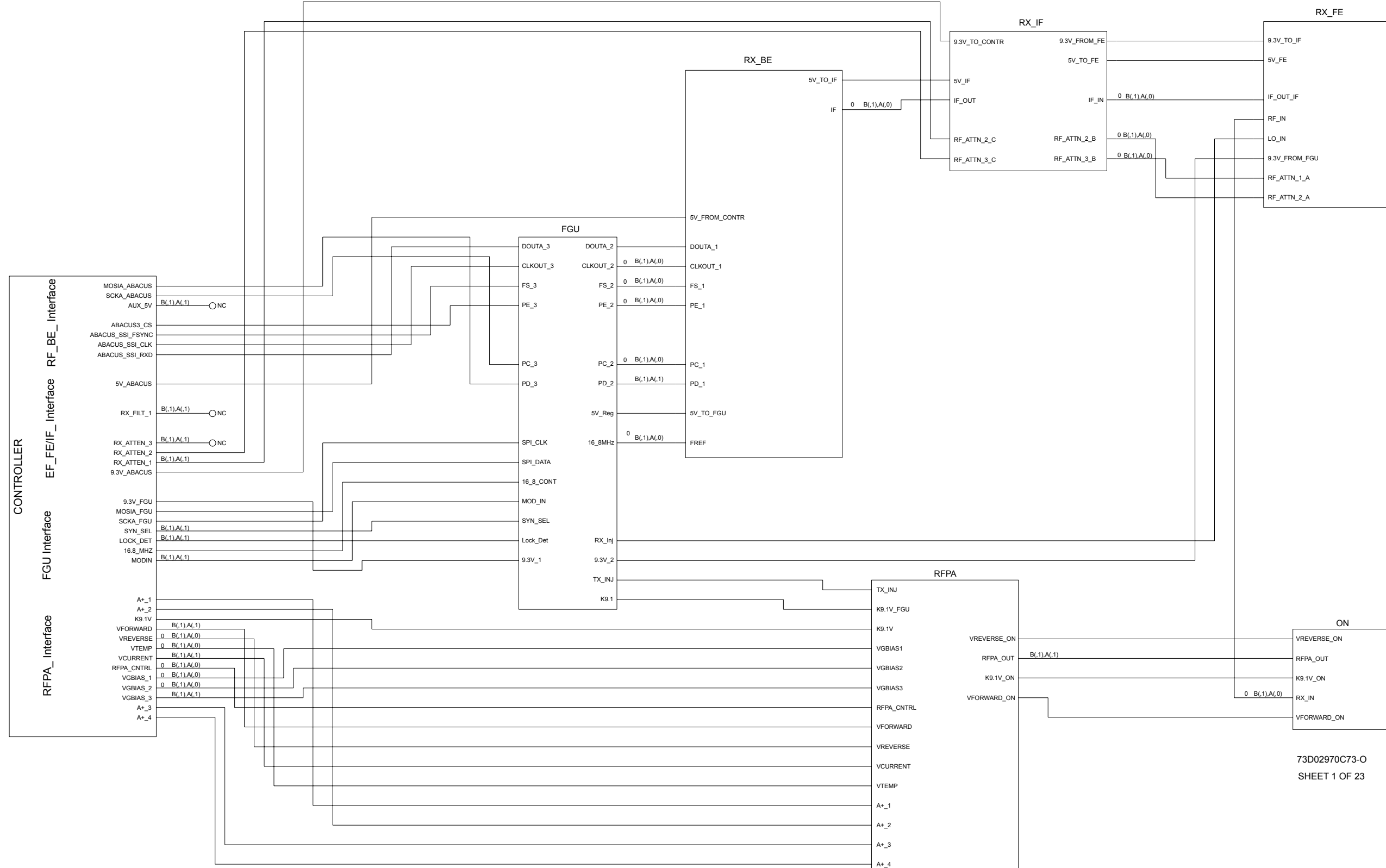


Figure 7-18. HUD4022A Main Board Overall Block Diagram and Interconnections

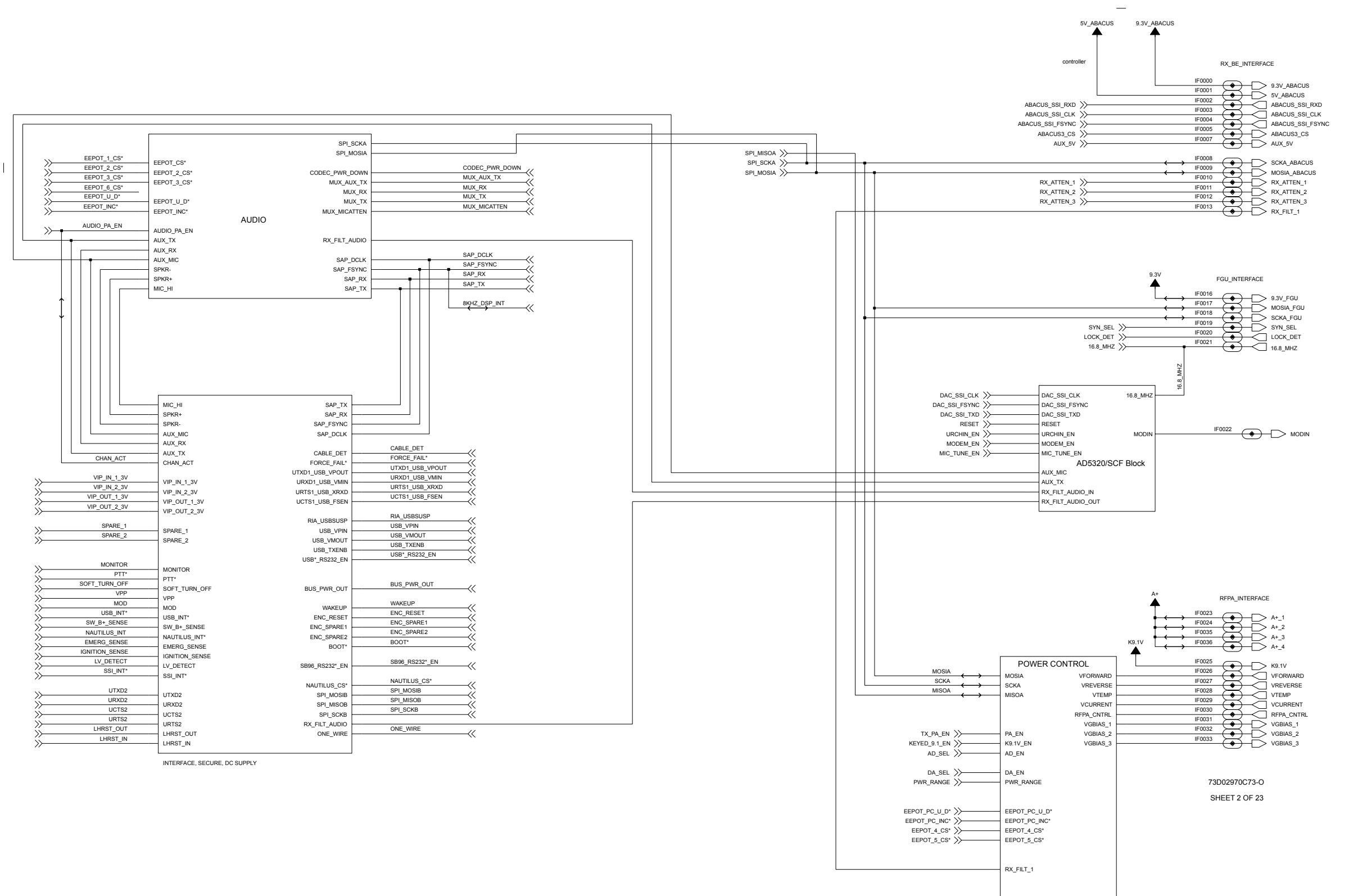


Figure 7-19. HUD4022A Controller Block Diagram and Interconnections (Sheet 1 of 2)

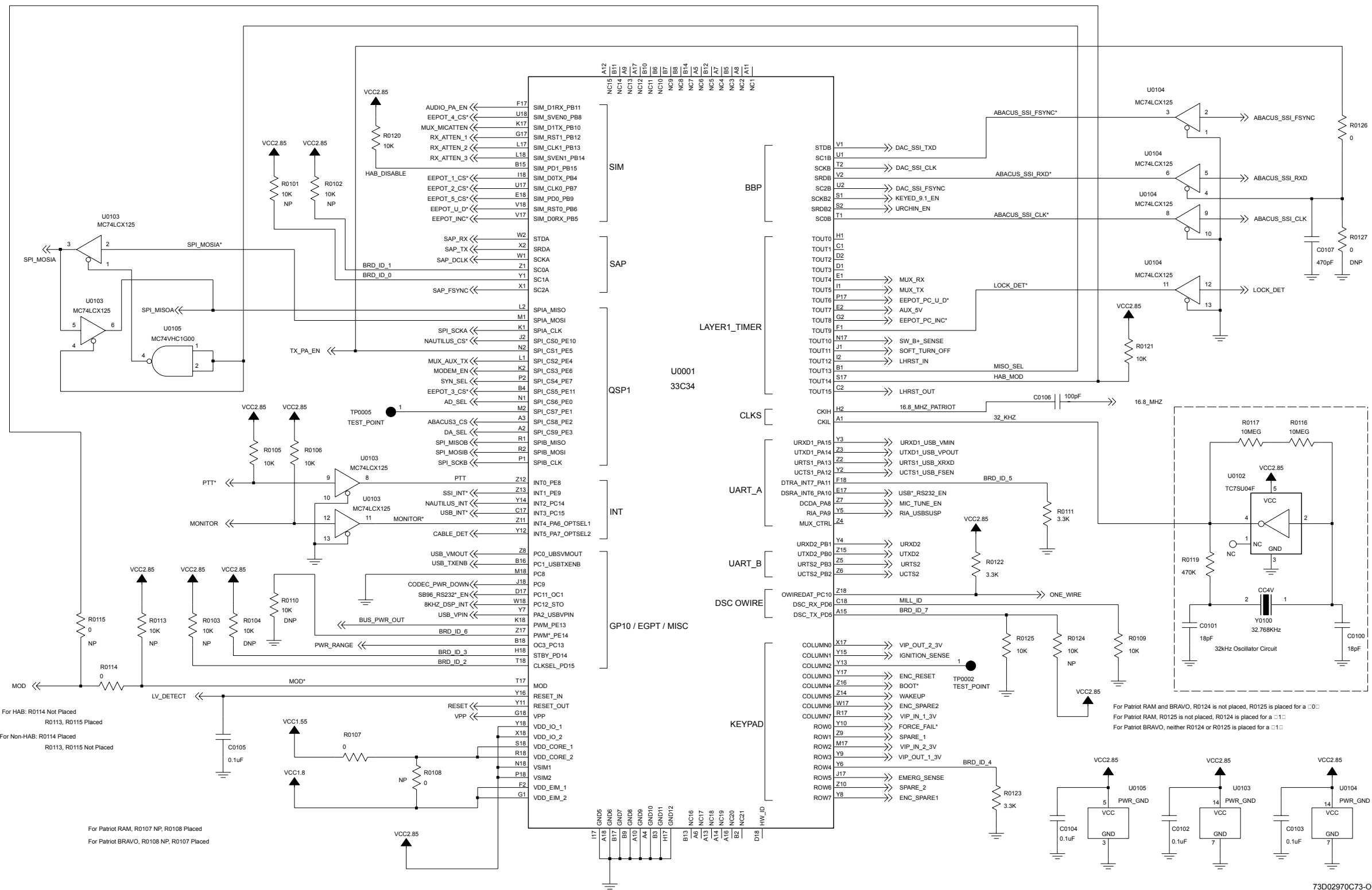


Figure 7-20. HUD4022A Controller Block Diagram and Interconnections (Sheet 2 of 2)

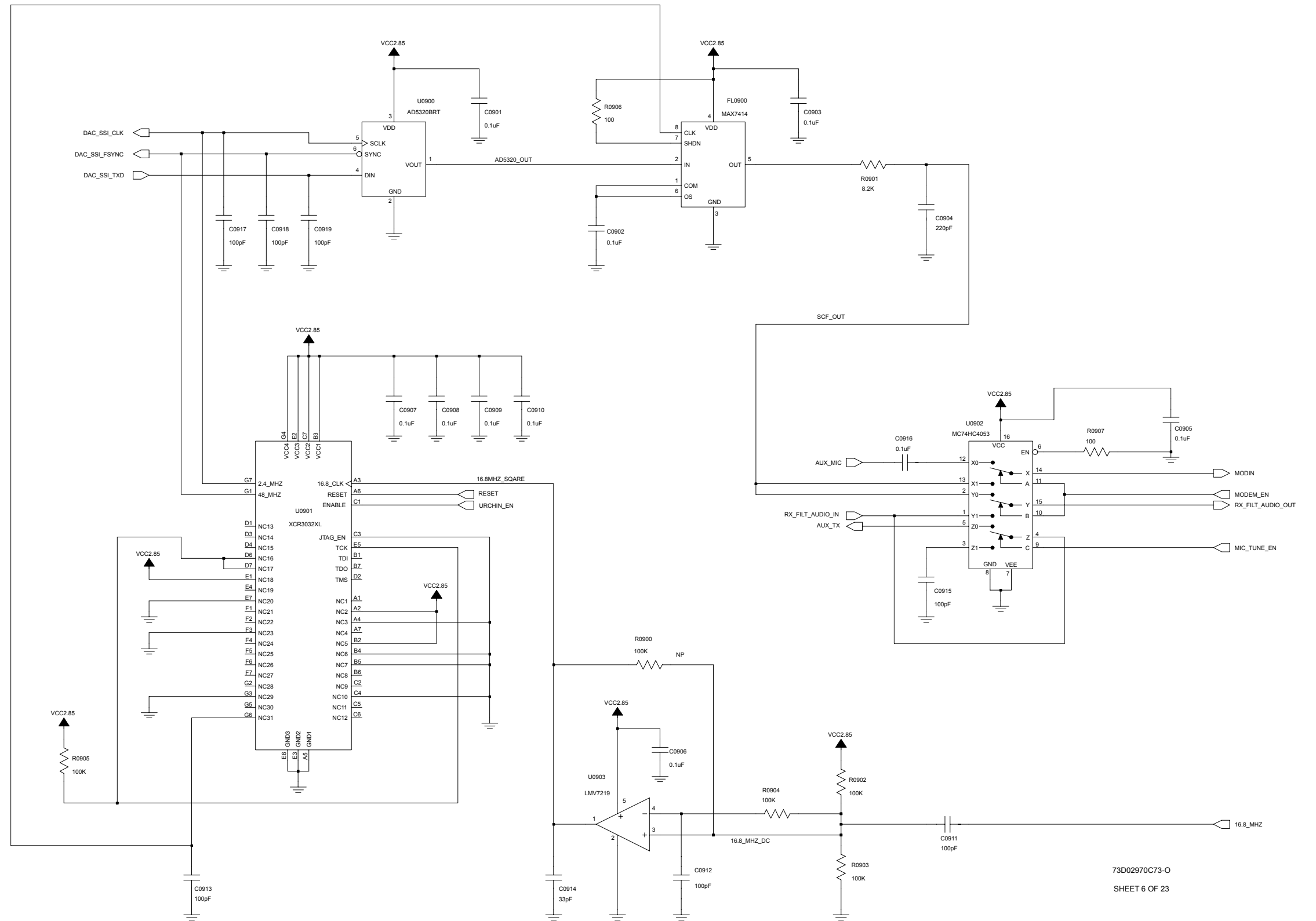


Figure 7-21. HUD4022A Controller Urchin IC, MUX, and AD5320 DAC Schematic

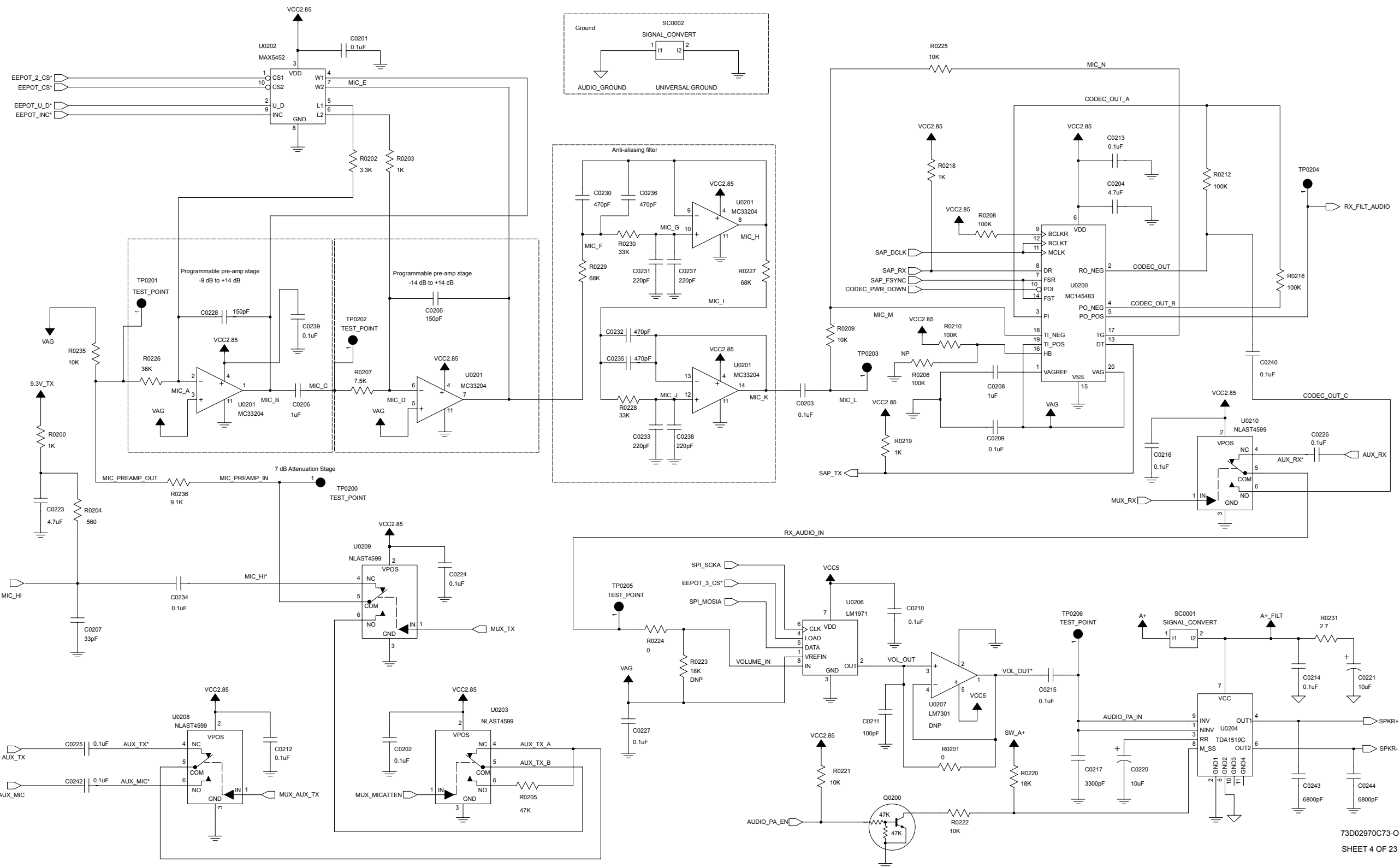


Figure 7-22. HUD4022A Controller Audio Schematic

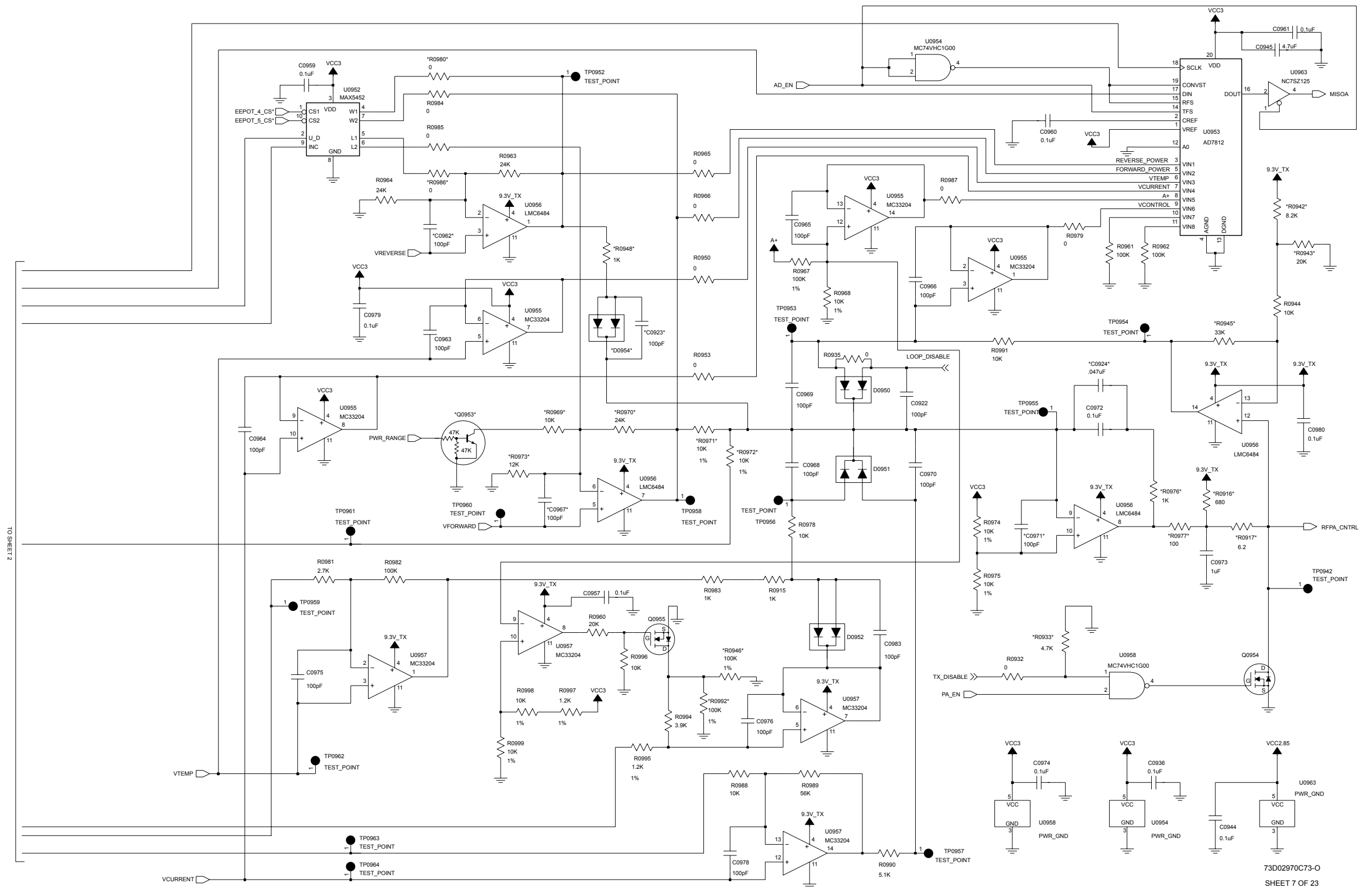


Figure 7-23. HUD4022A Controller Power Control (Sheet 1 of 2)

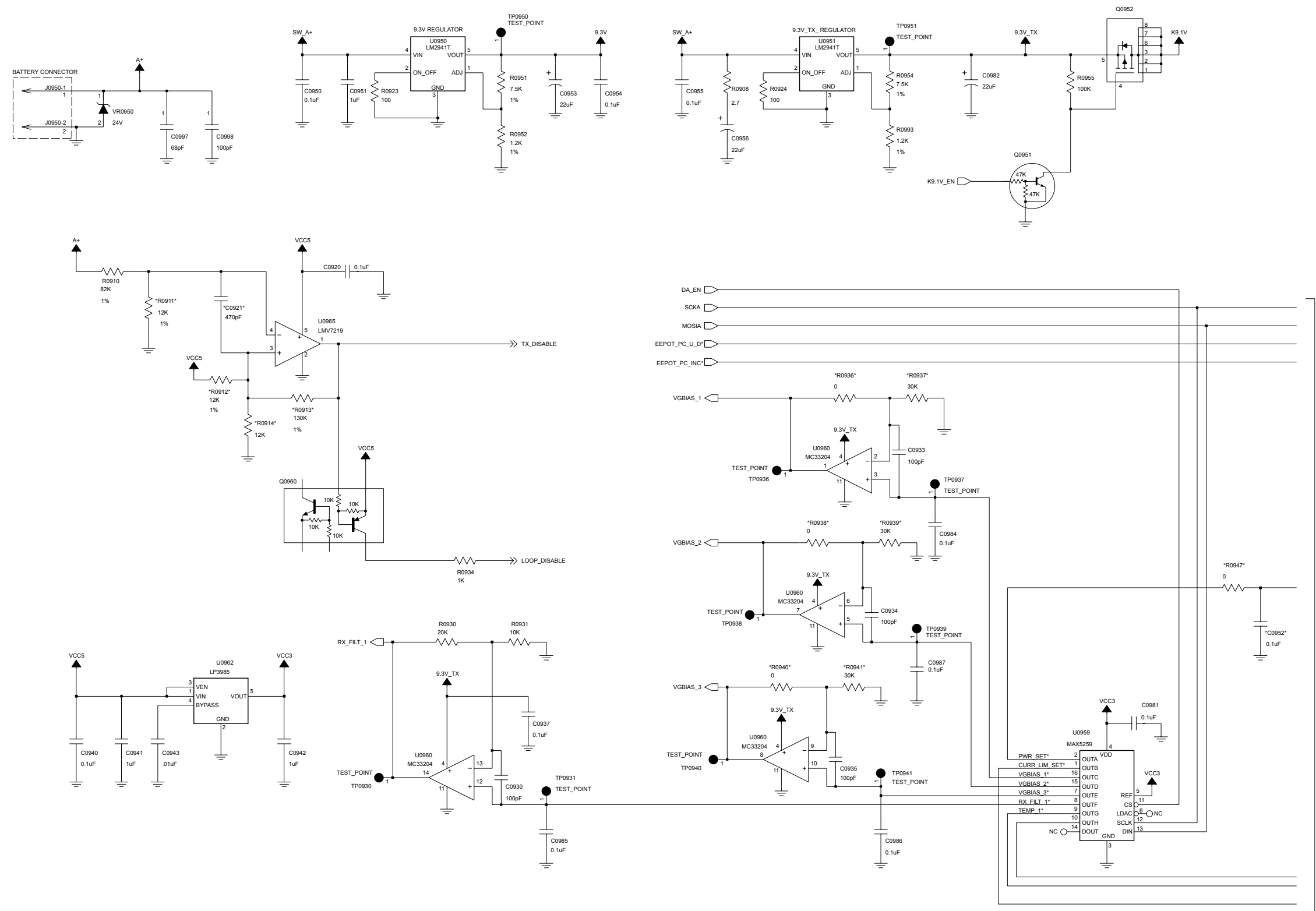


Figure 7-24. HUD4022A Controller Power Control (Sheet 2 of 2)

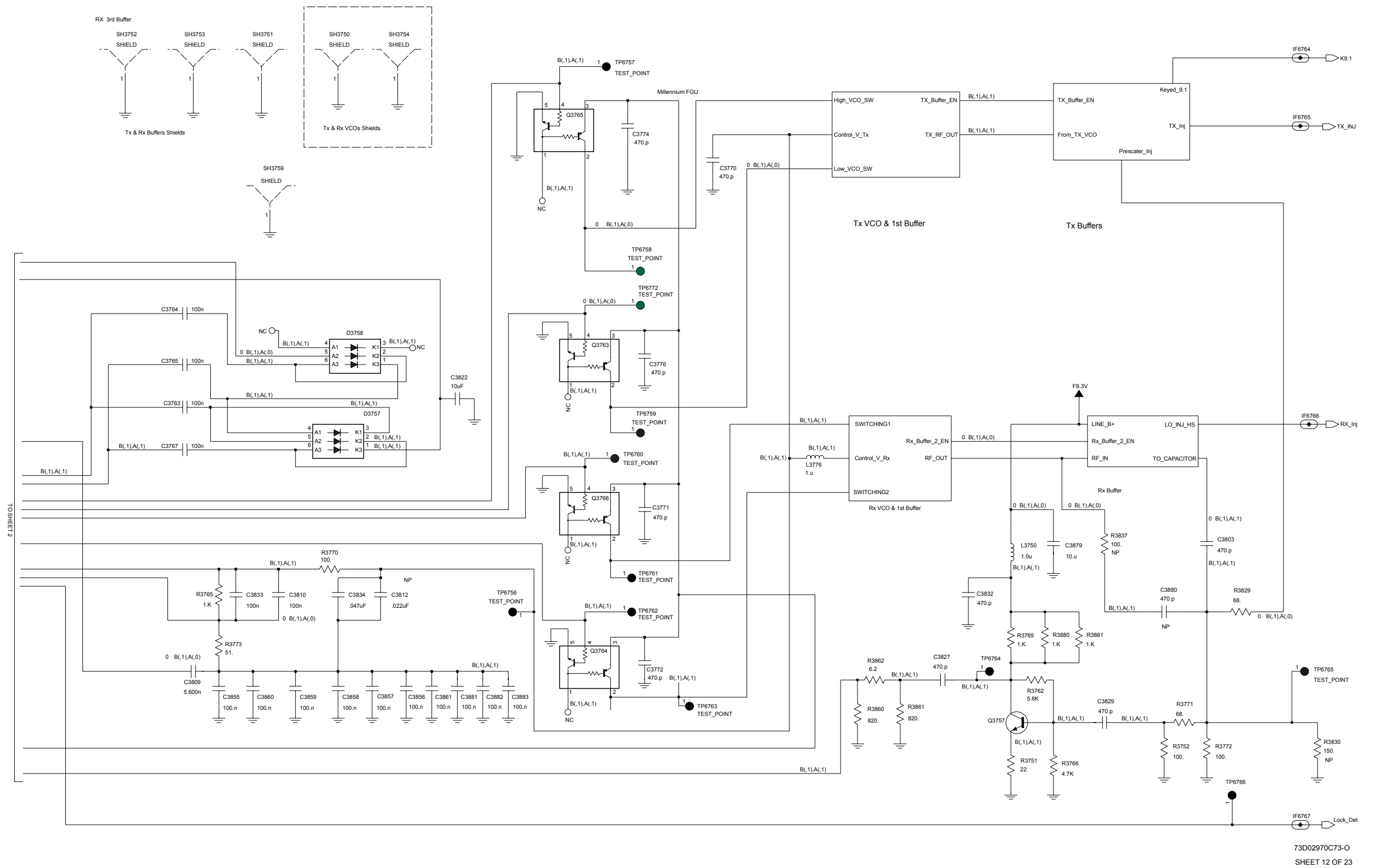


Figure 7-25. HUD4022A Frequency Generation Unit Overall Schematic (Sheet 1 of 2)

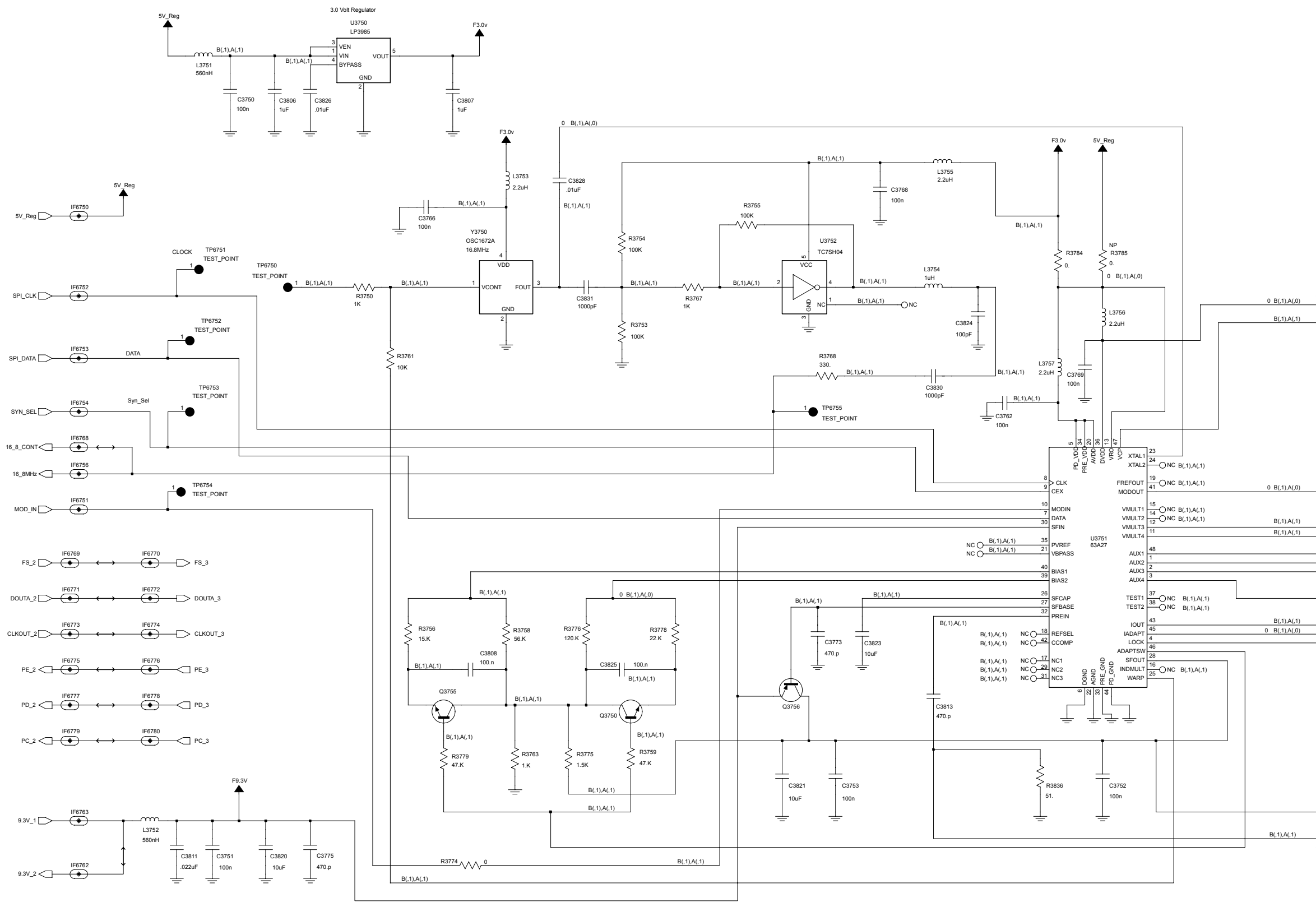


Figure 7-26. HUD4022A Frequency Generation Unit Overall Schematic (Sheet 2 of 2)

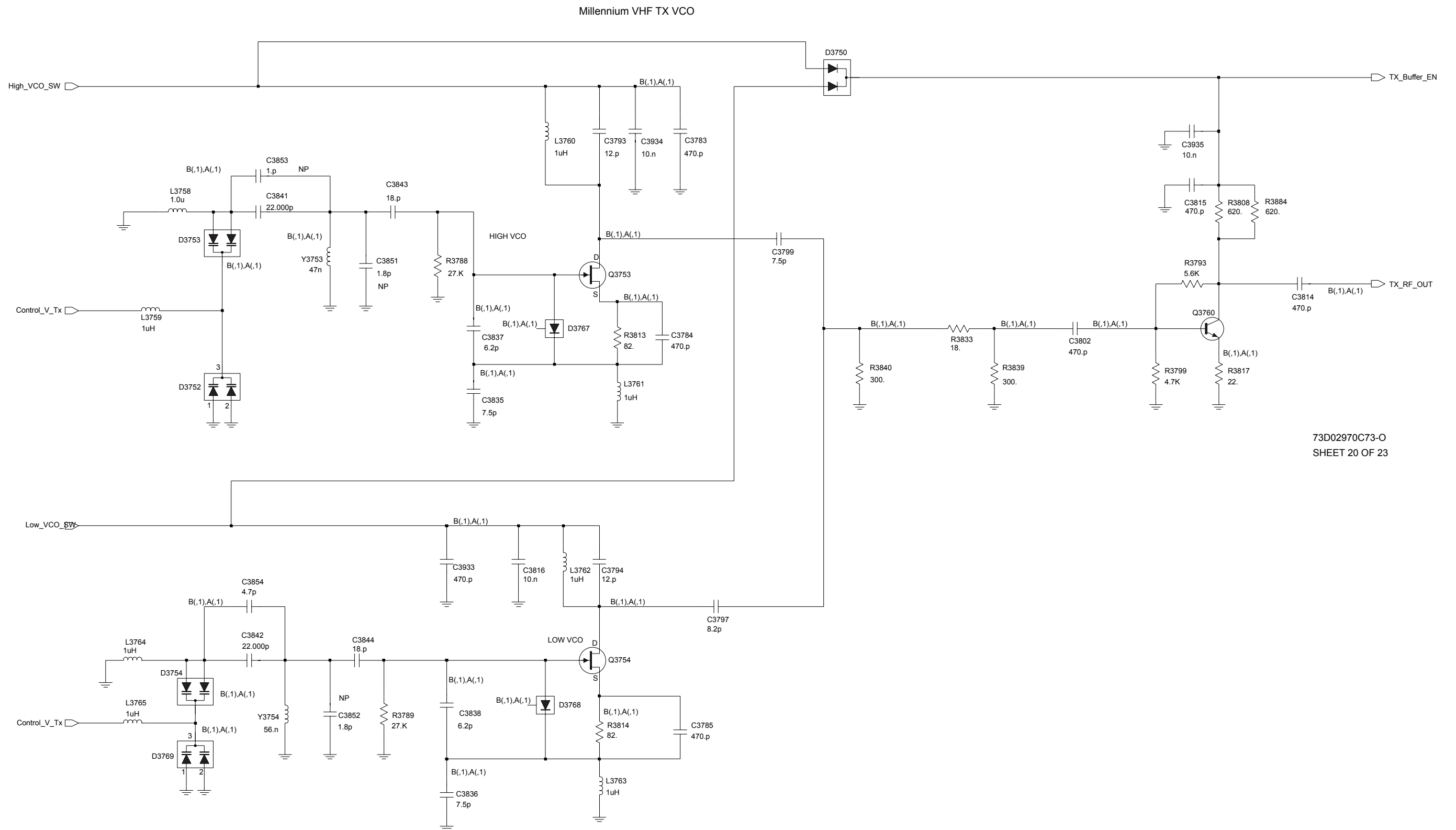


Figure 7-27. HUD4022A VHF Transmitter VCO Schematic

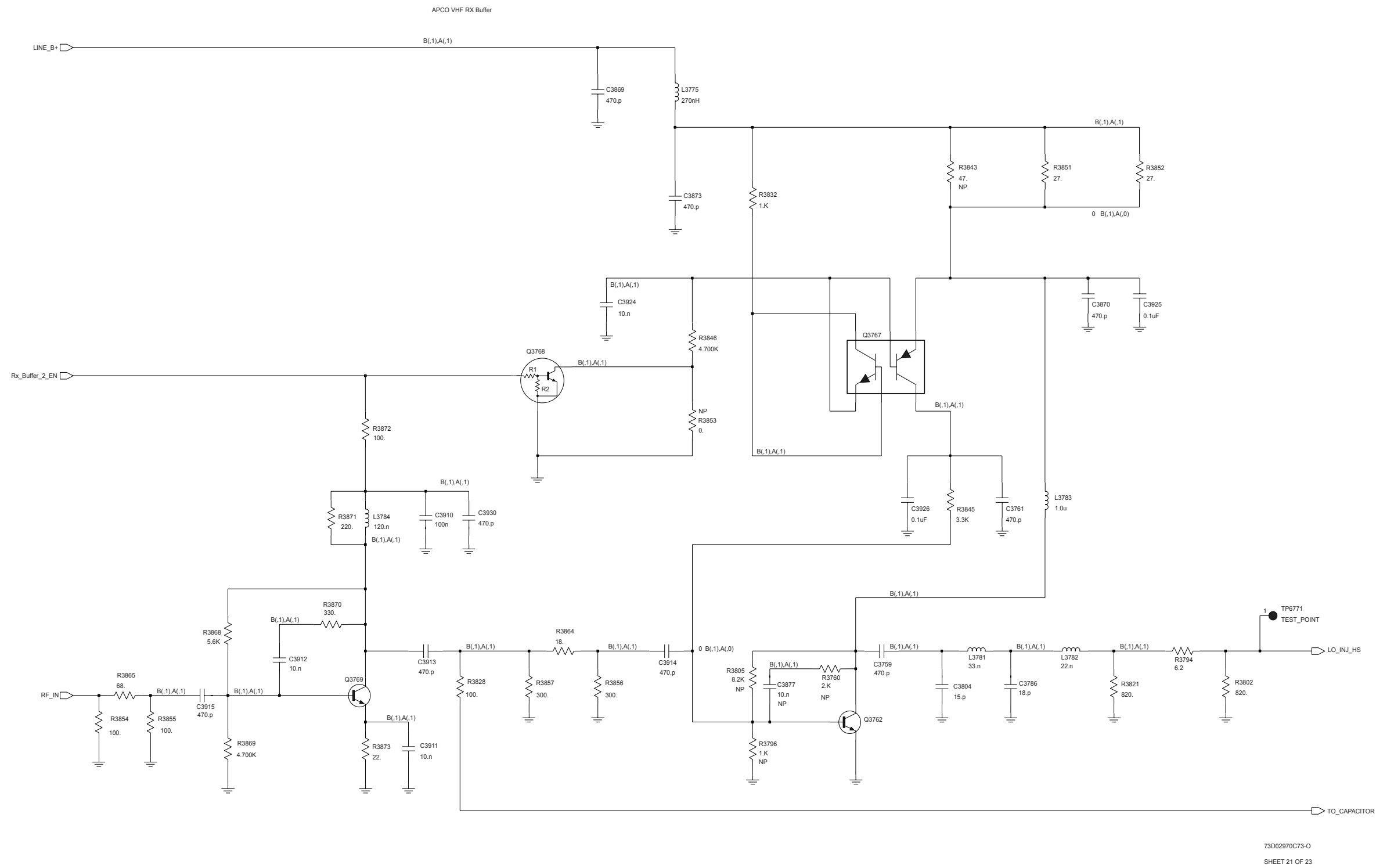
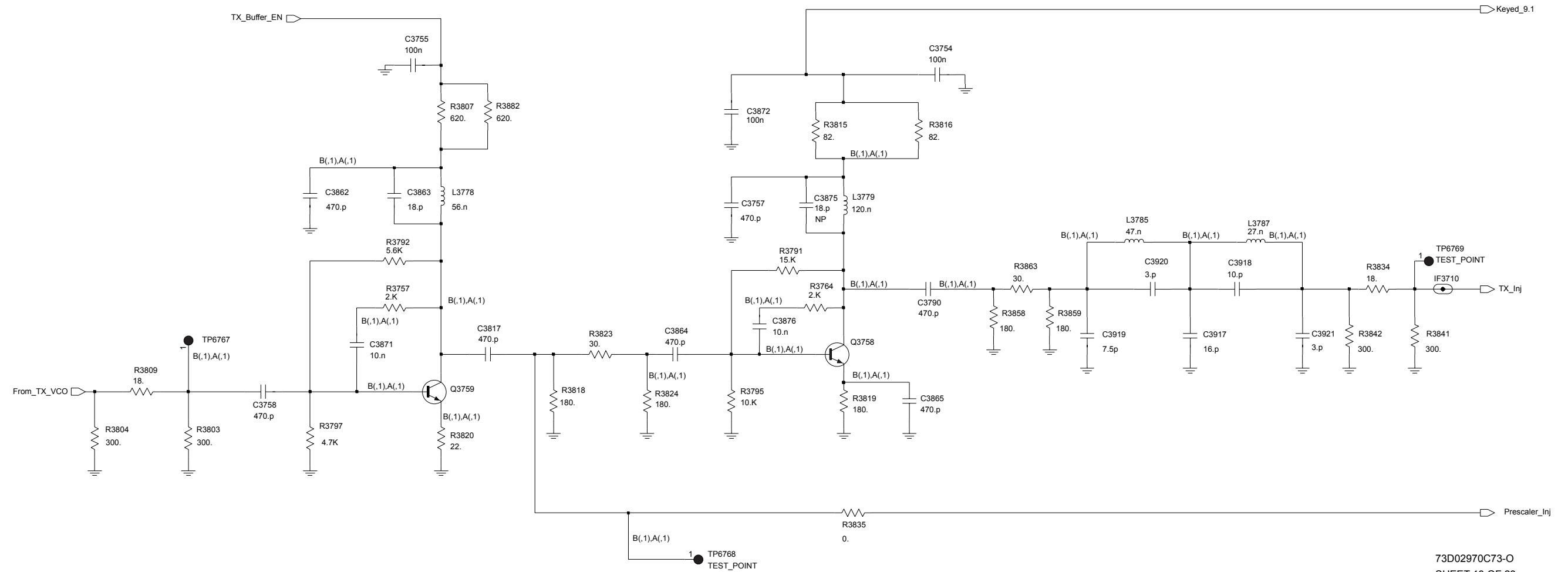


Figure 7-28. HUD4022A Frequency Generation Unit VHF Receive Injection Schematic

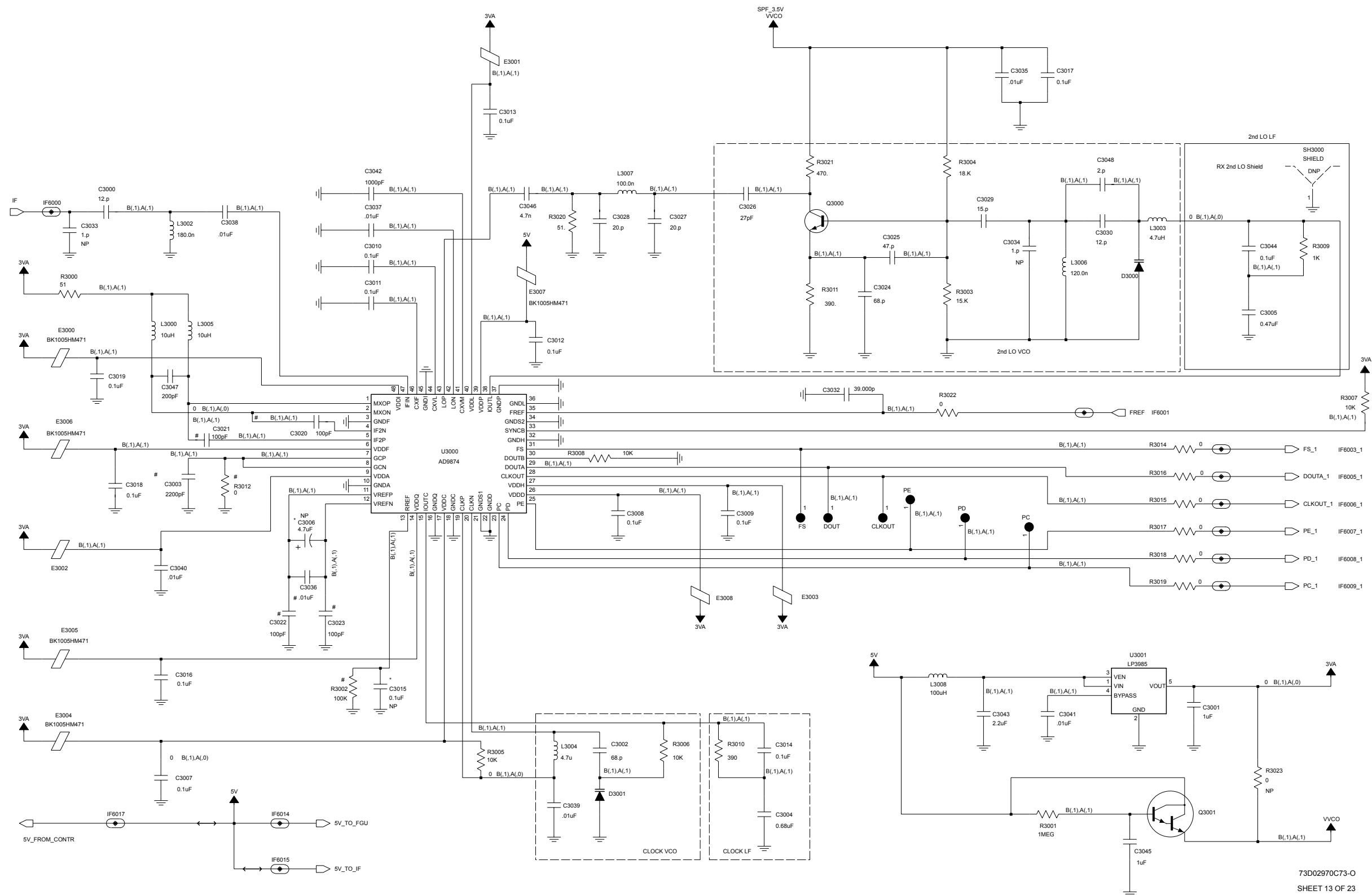
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APCO VHF TX Buffers



73D02970C73-O
SHEET 18 OF 23

Figure 7-29. HUD4022A Frequency Generation Unit VHF Transmit Injection Schematic



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Figure 7-30. HUD4022A Receiver Back-End Schematic

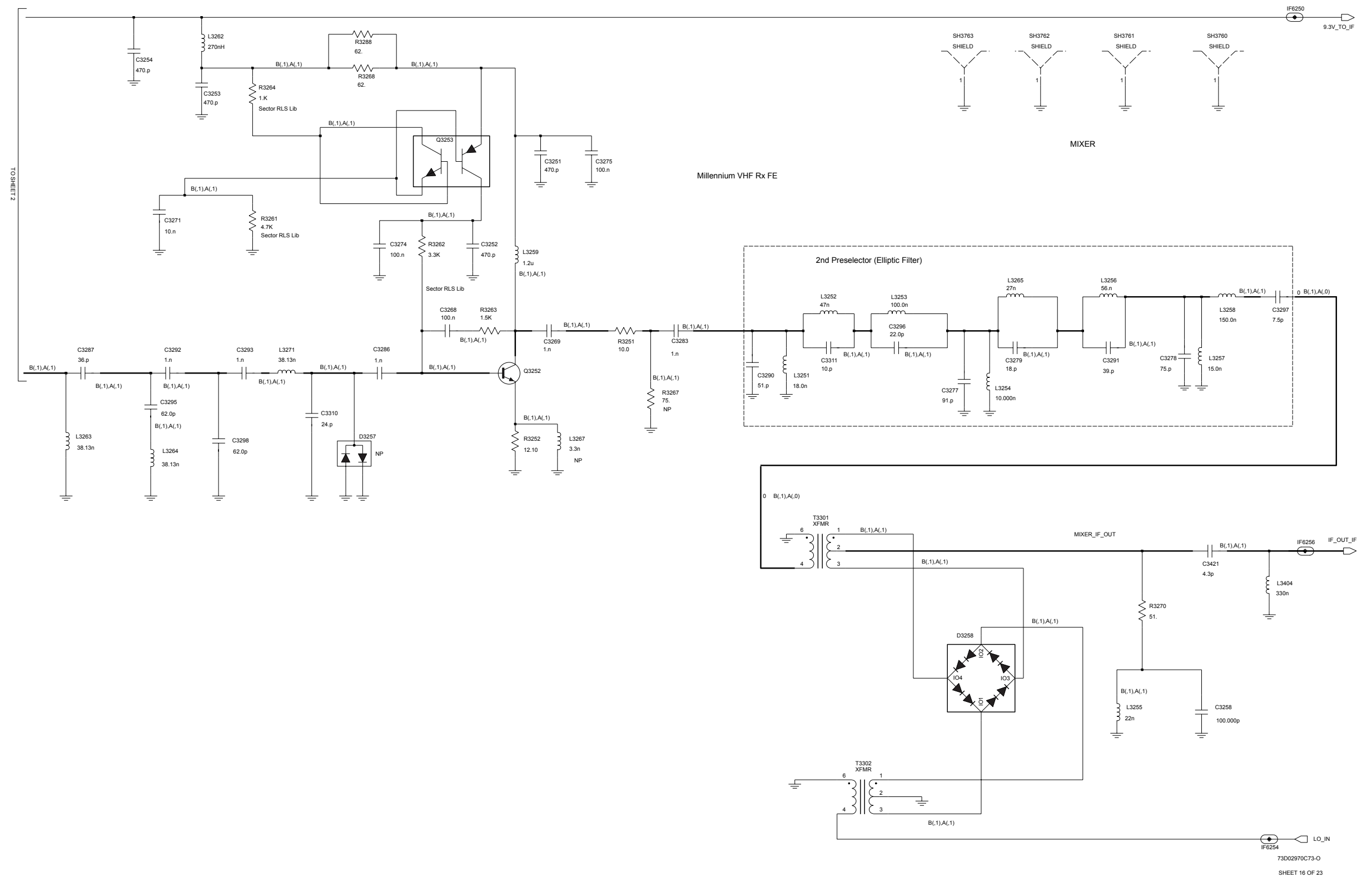


Figure 7-31. HUD4022A Receiver Front-End Schematic (Sheet 1 of 2)

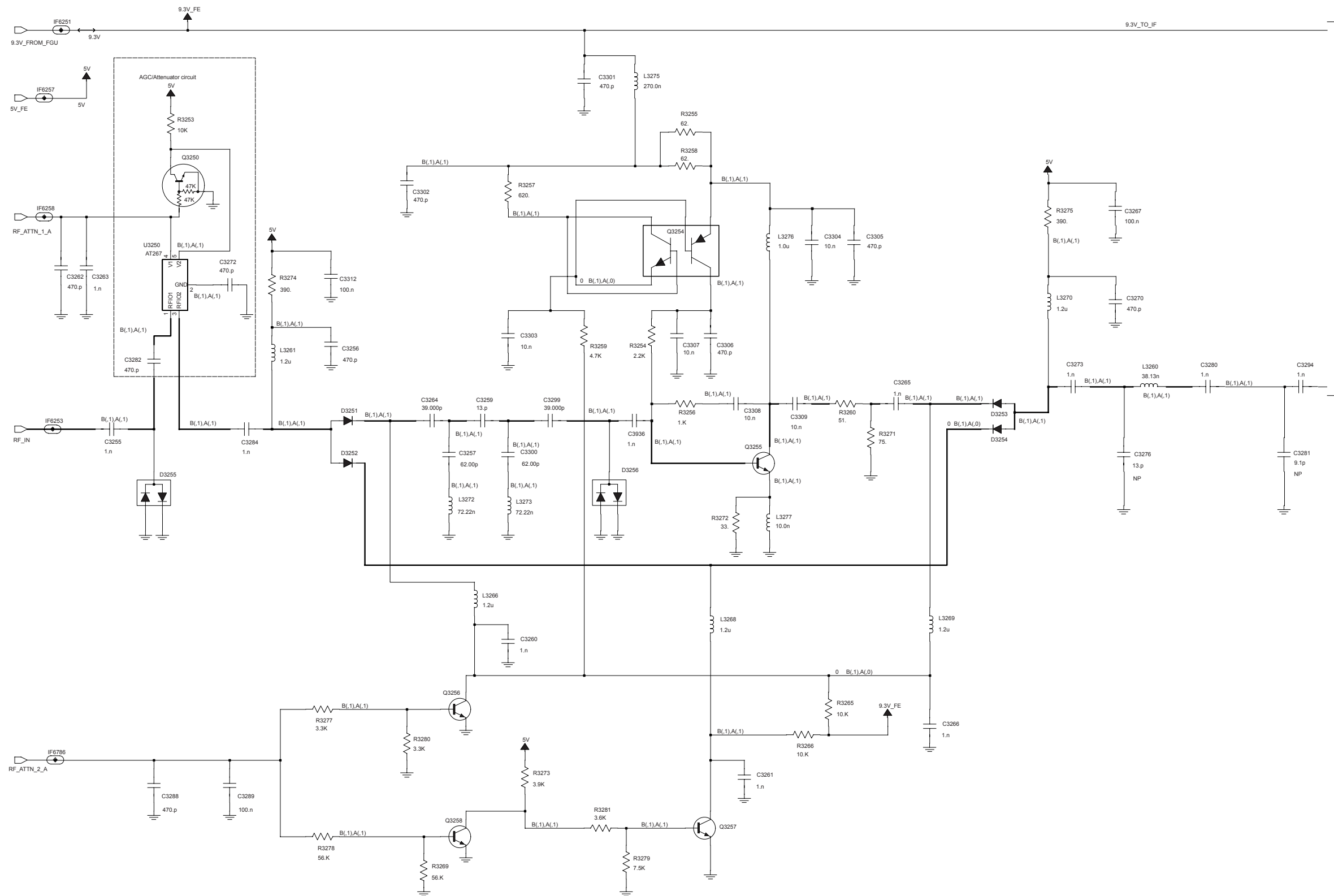


Figure 7-32. HUD4022A Receiver Front-End Schematic (Sheet 2 of 2)

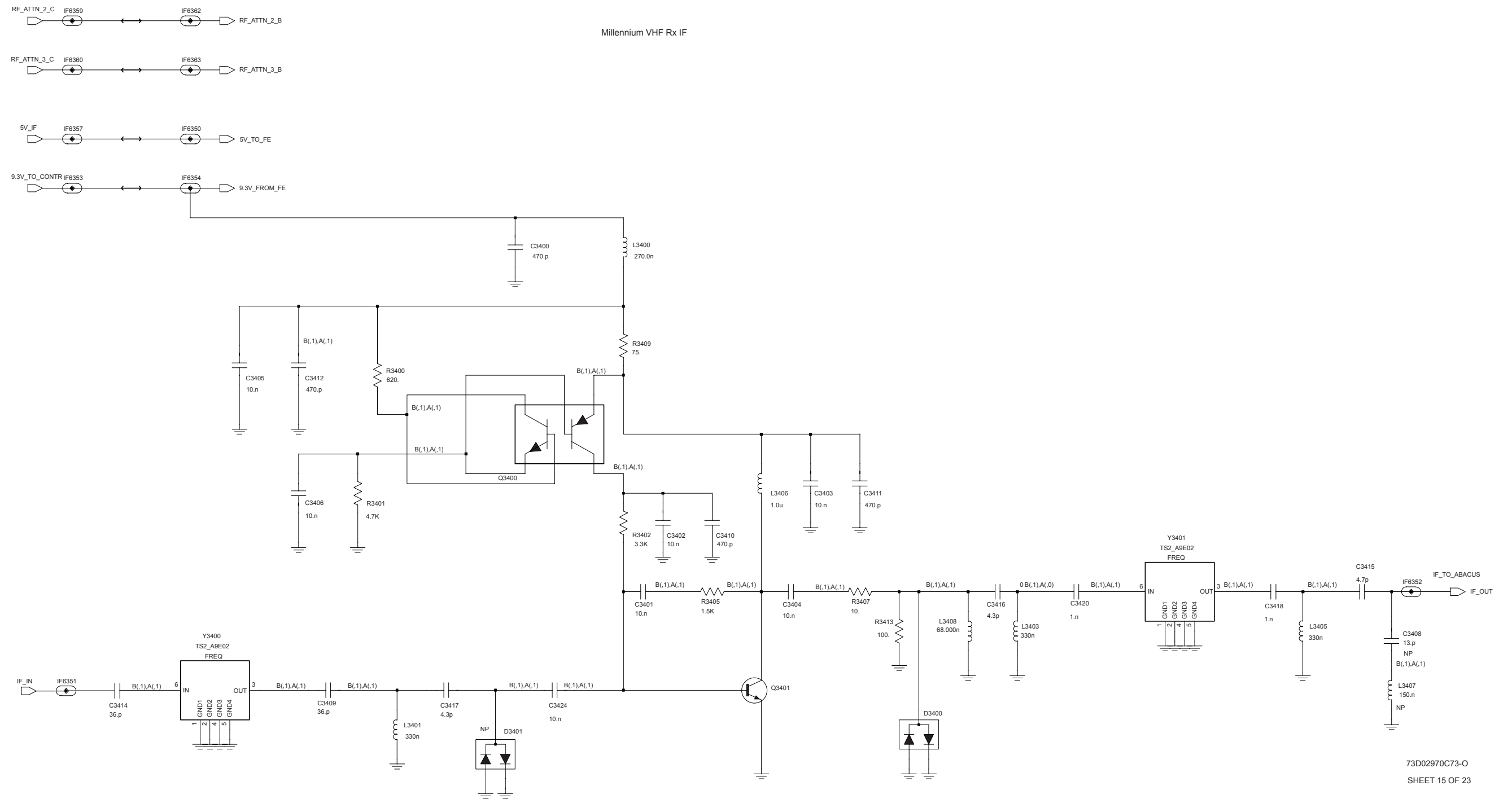
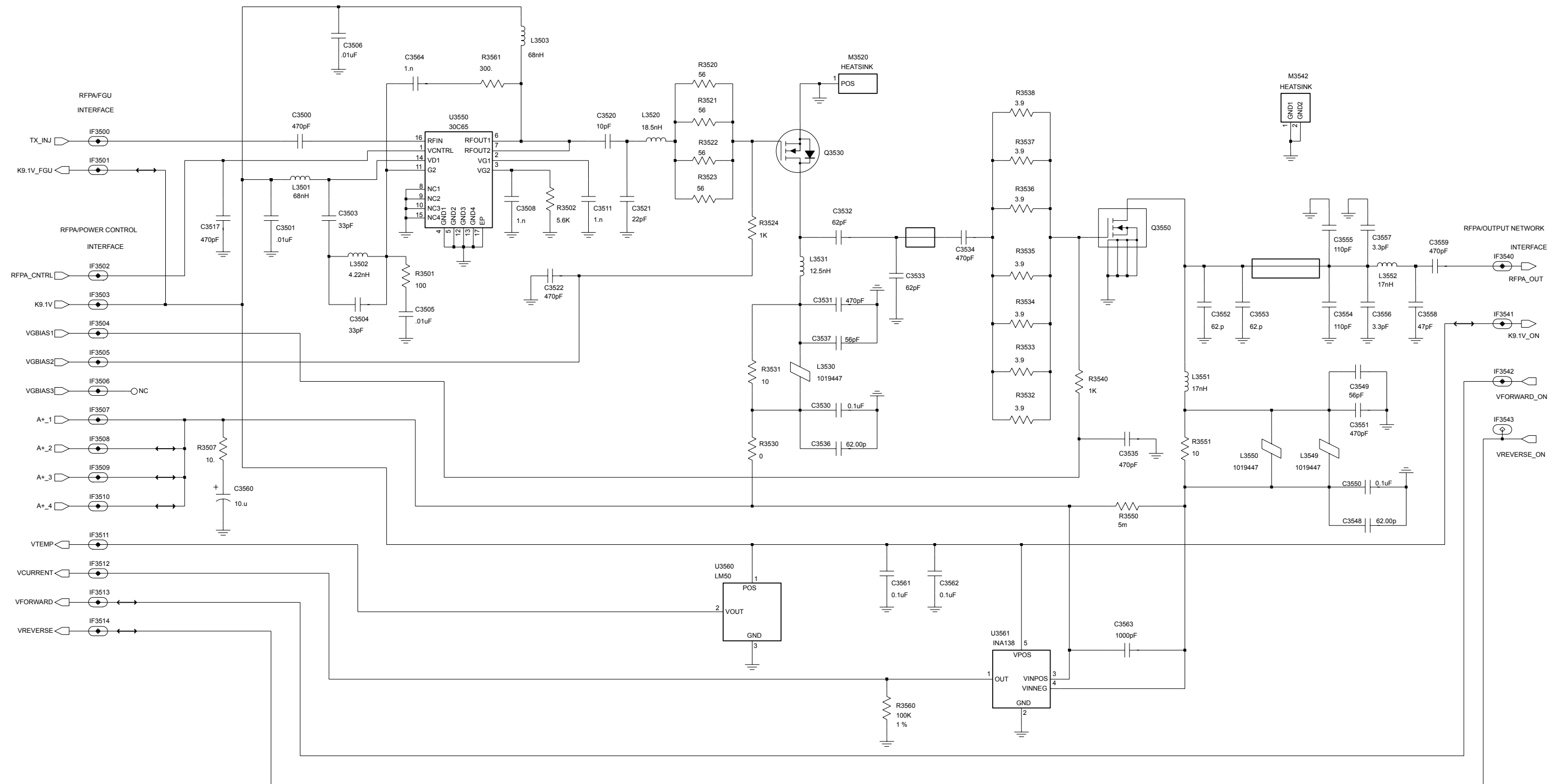


Figure 7-33. HUD4022A Receiver IF Schematic



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SHEET 14 OF 23

Figure 7-34. HUD4022A RF Power Amplifier (RF PA) Schematic (Sheet 1 of 2)

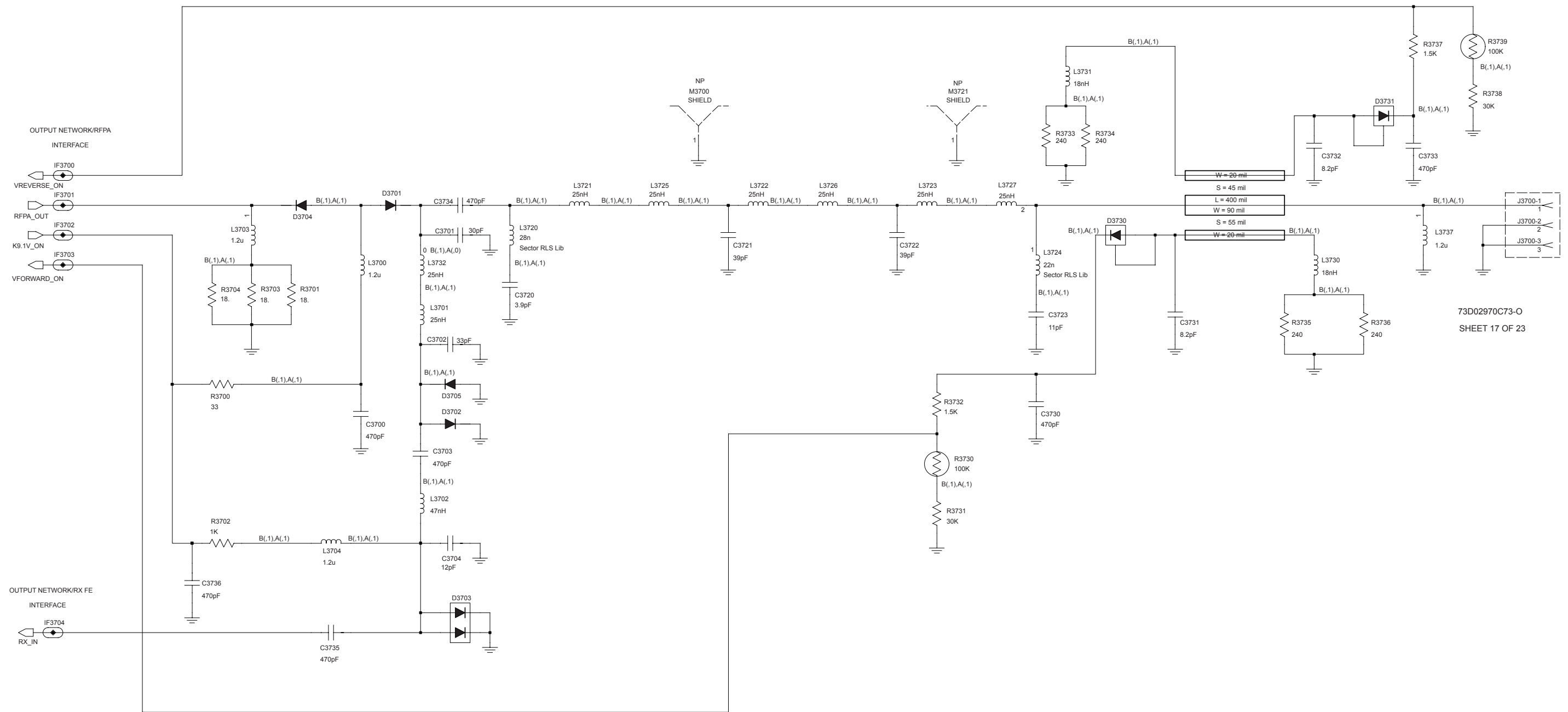
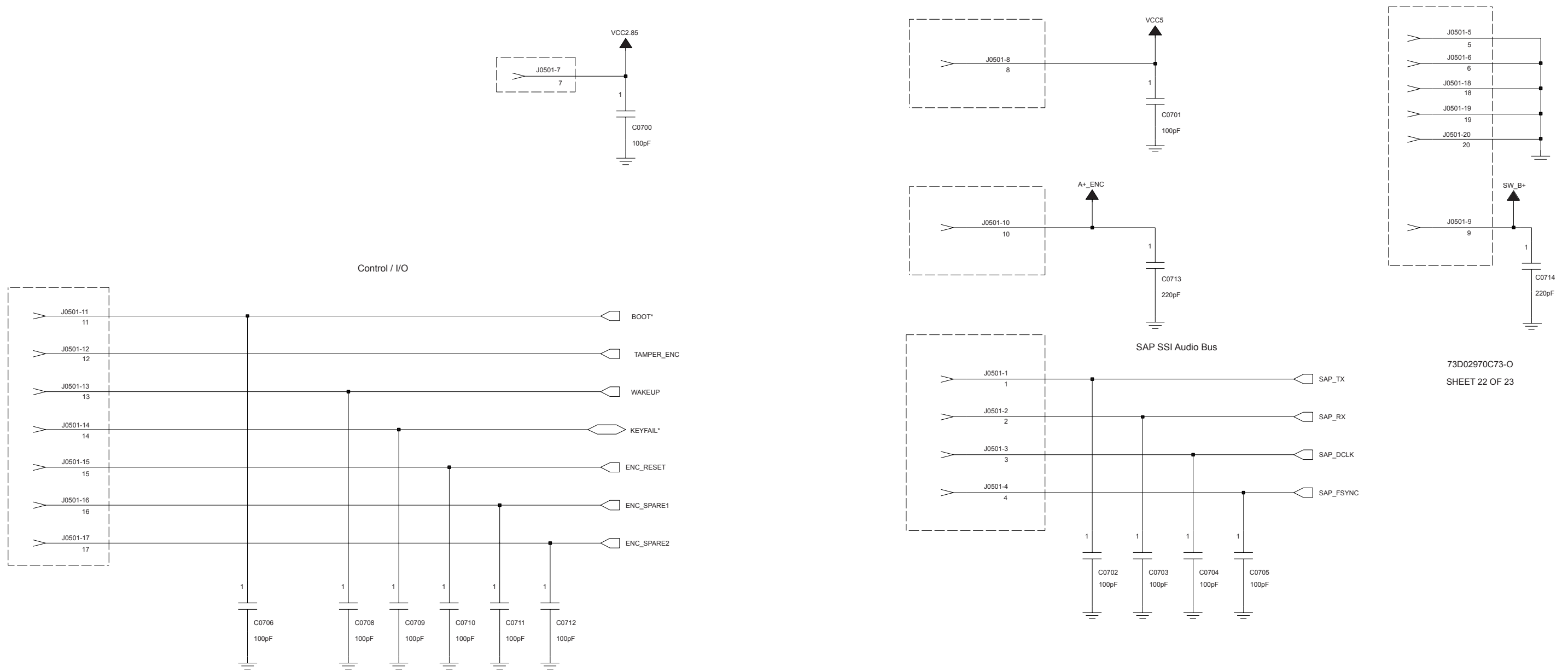
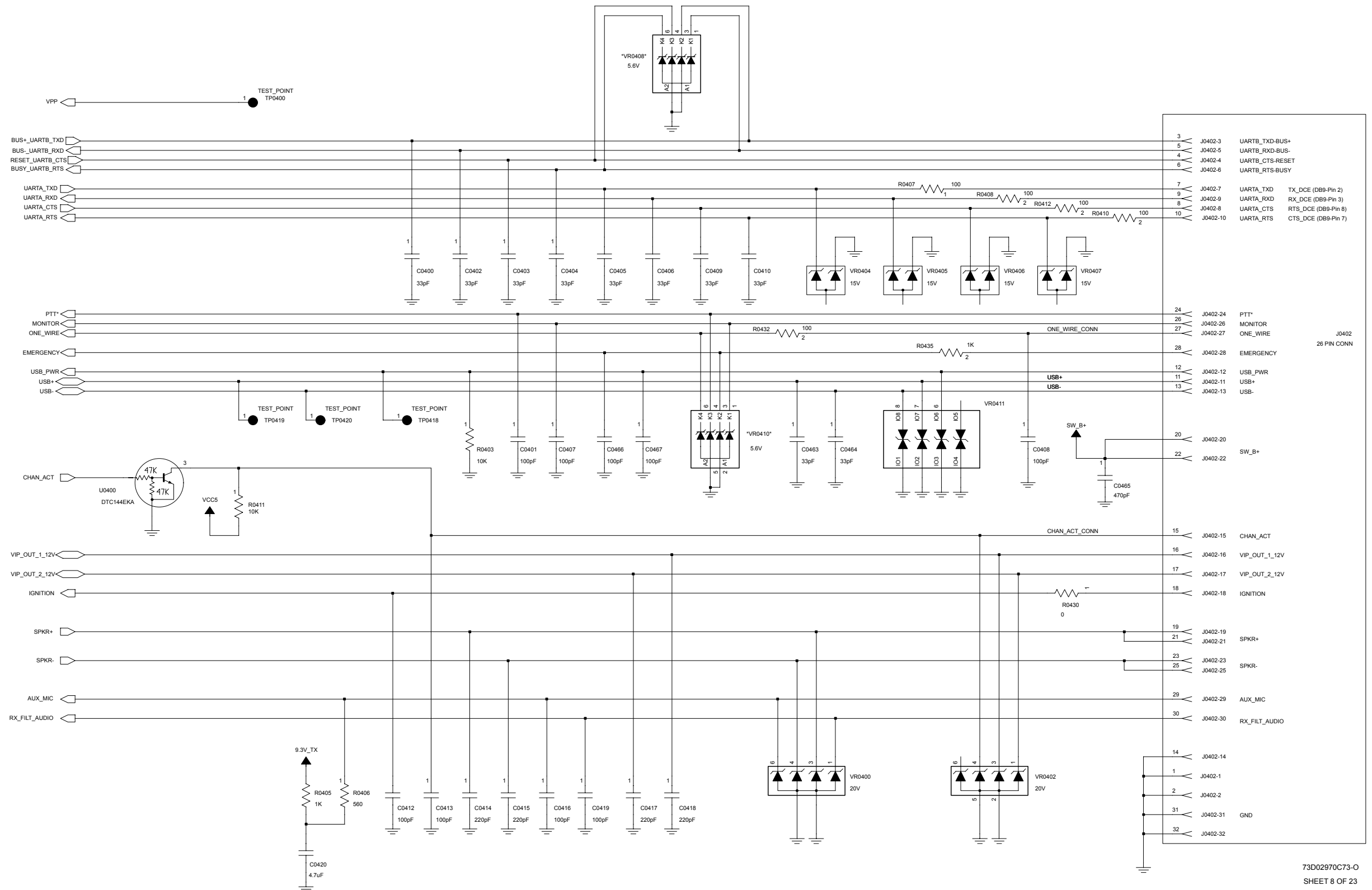


Figure 7-35. HUD4022A RF Power Amplifier (RF PA) Schematic (Sheet 2 of 2)



73D02970C73-O
SHEET 22 OF 23

Figure 7-36. HUD4022A Secure Block Diagram and Interconnections



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Figure 7-37. HUD4022A Accessory Connector Schematic

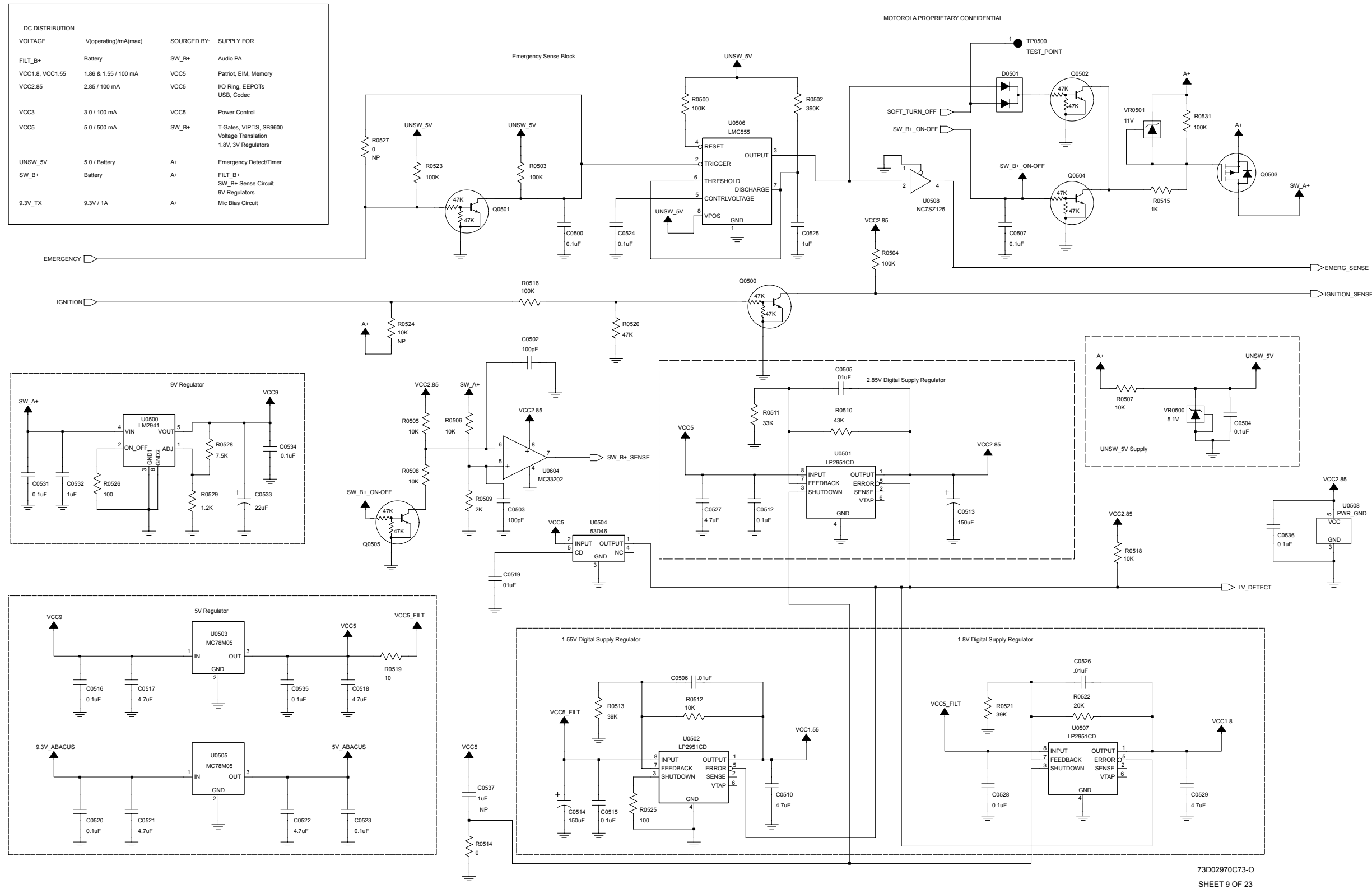
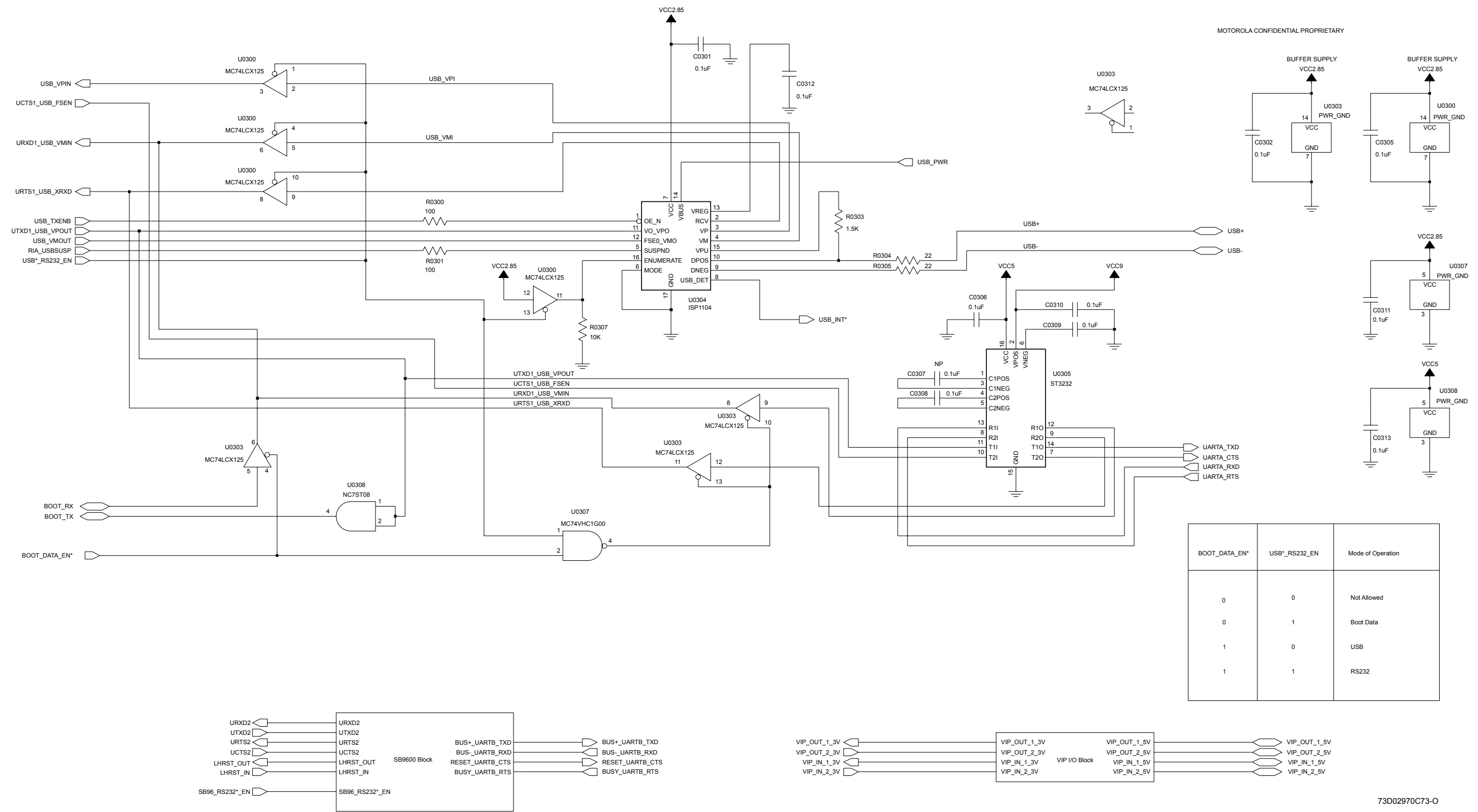


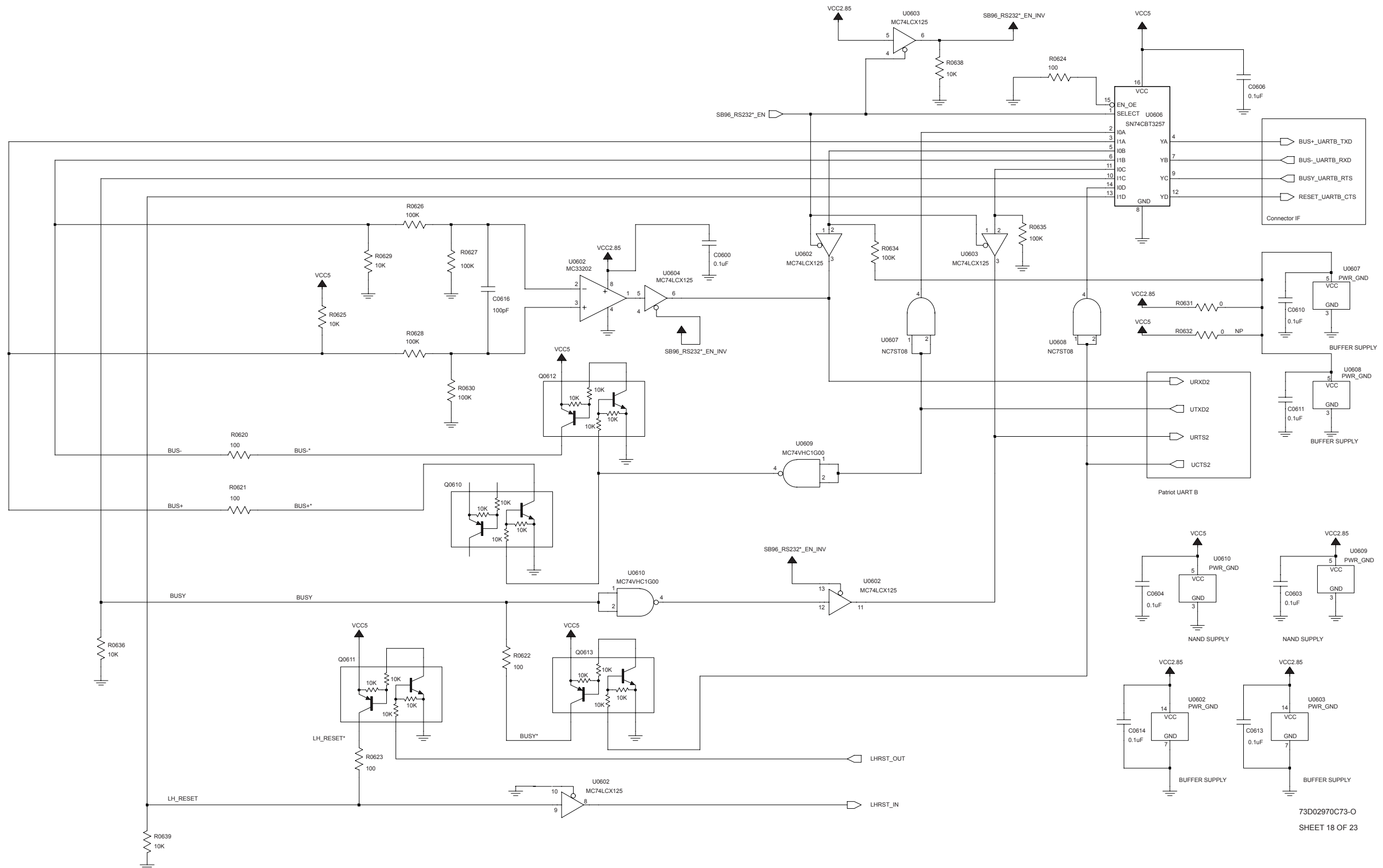
Figure 7-38. HUD4022A Power Supply Schematic



73D02970C73-O

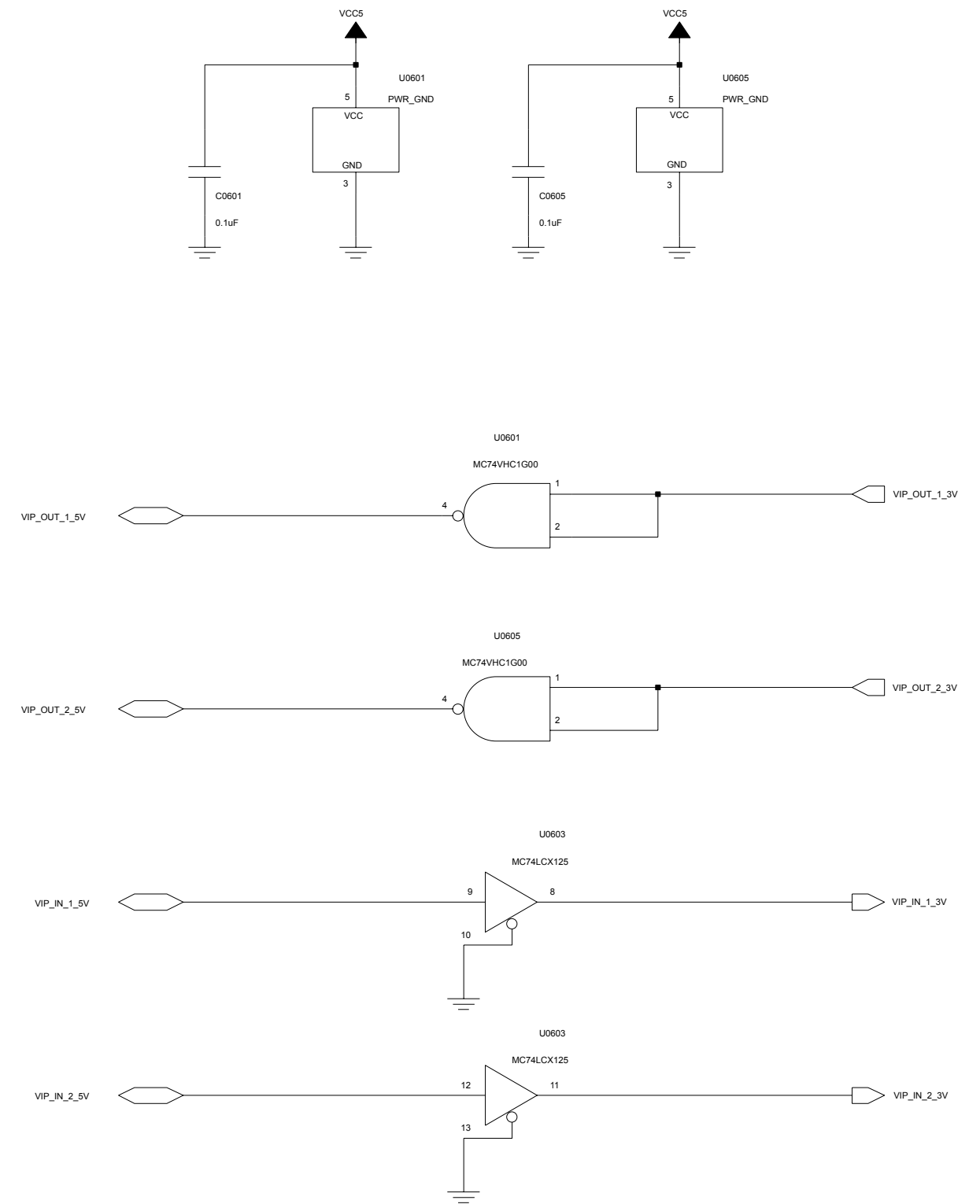
SHEET 10 OF 23

Figure 7-39. HUD4022A USB/RS232/SB9600 Schematic



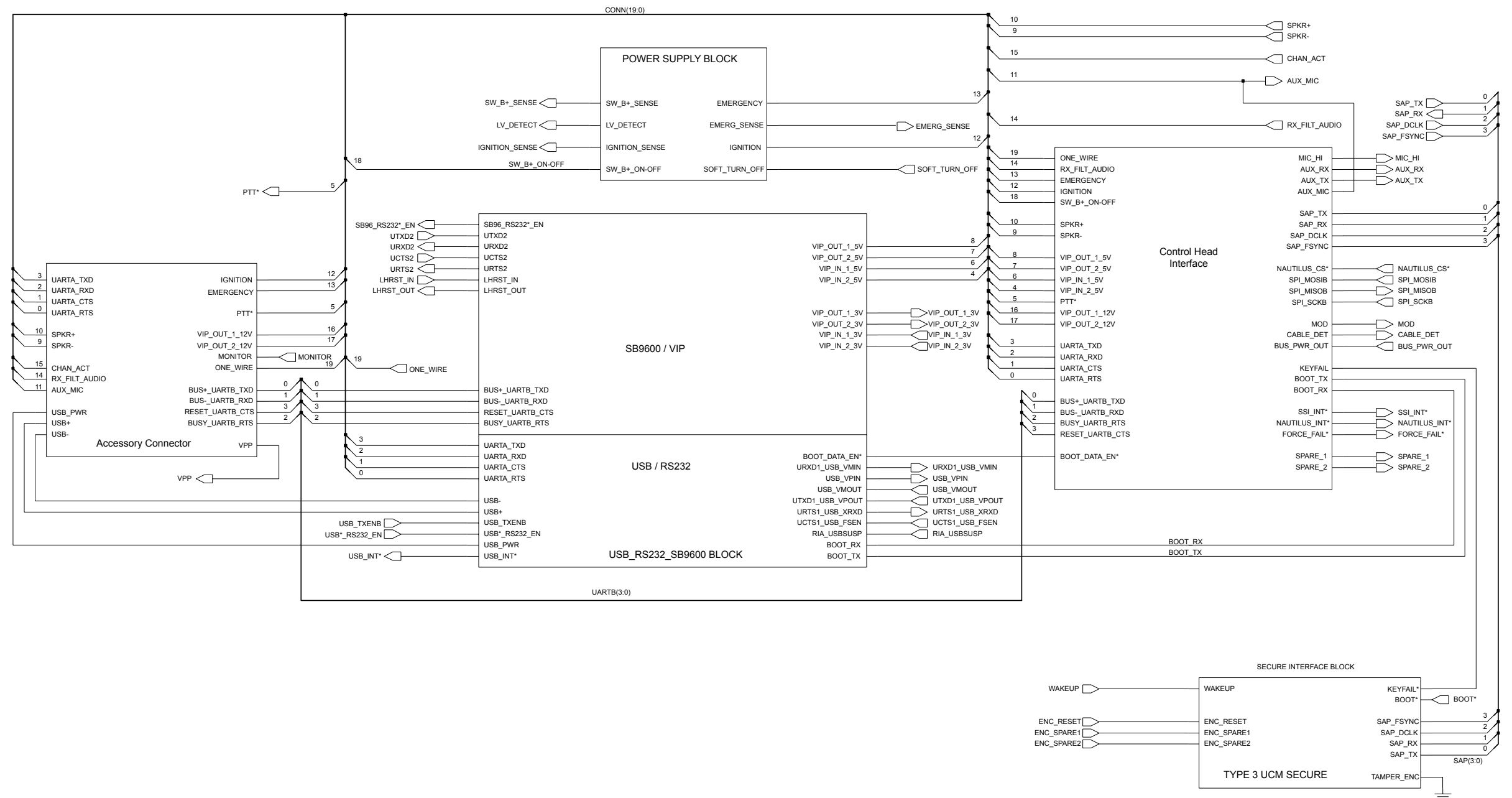
73D02970C73-O
SHEET 18 OF 23

Figure 7-40. HUD4022A SB9600 Schematic



73D02970C73-O
SHEET 23 OF 23

Figure 7-41. HUD4022A USB/RS232/SB9600 VIP Input/Output Schematic



73D02970C73-0
SHEET 5 OF 23

Figure 7-43. HUD4022A Interface Connector Schematic

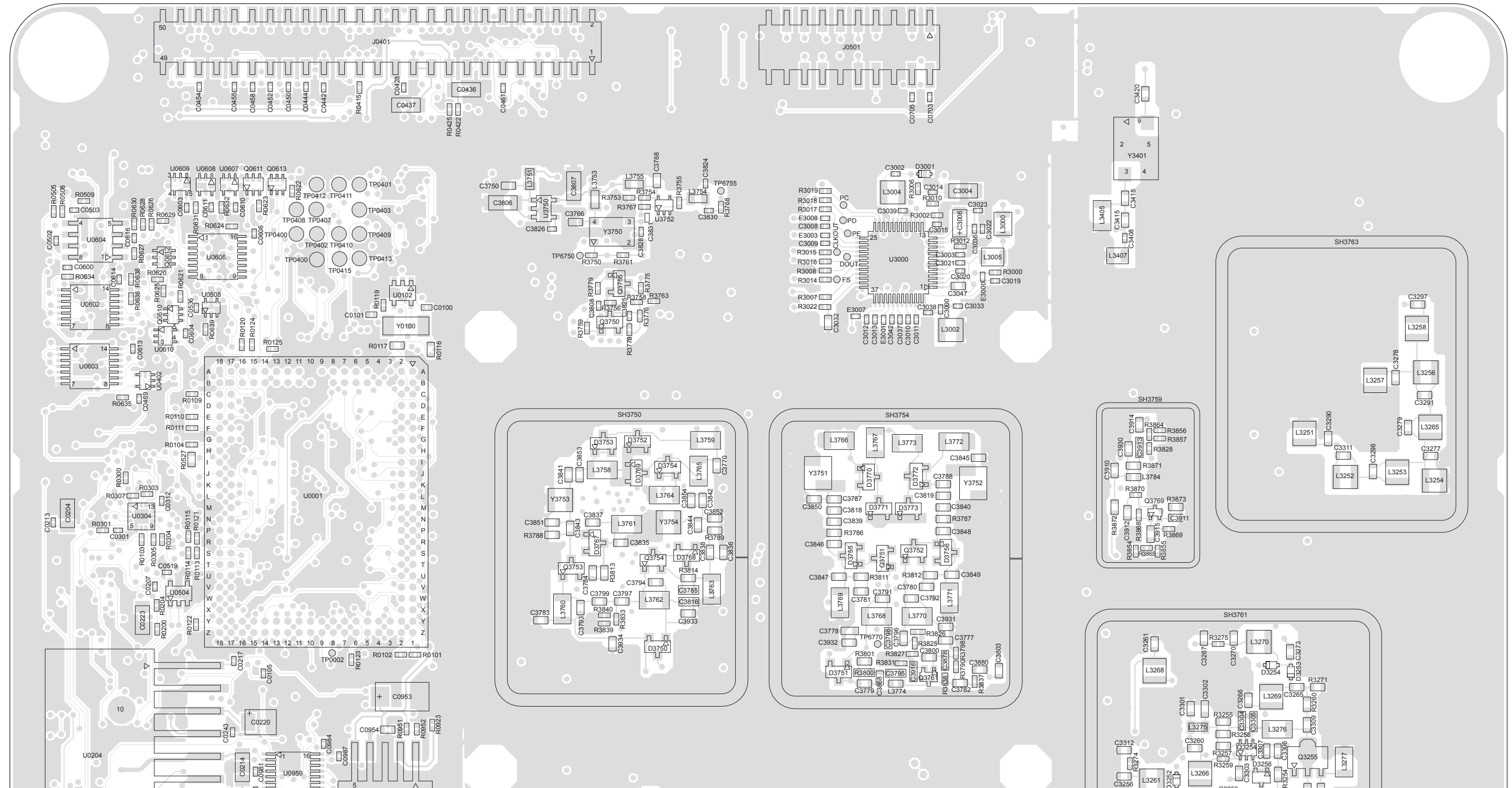


Figure 7-44. HUD4022A Main Board Layout—Side 1 Top

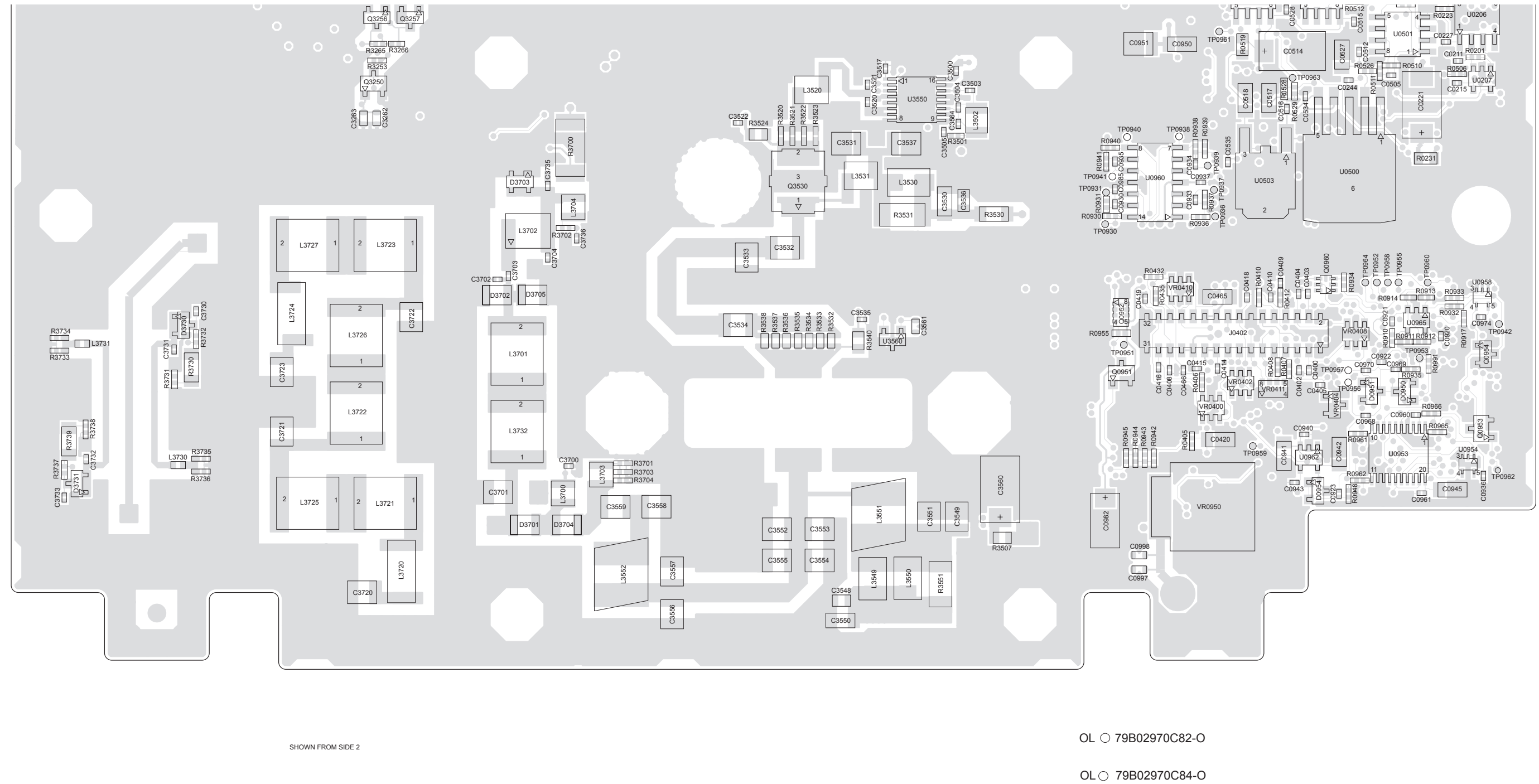


Figure 7-47. HUD4022A Main Board Layout—Side 2 Bottom

HUD4022A (VHF) Main Board Parts List

Reference Designator	Motorola Part Number	Description
C0001	2311049A78	CAP TANT CHIP 10.0 UF
C0100	2113743N32	CAP CHIP 18.0 PF 5% CO
C0101	2113743N32	CAP CHIP 18.0 PF 5% CO
C0102	2113743M24	CAP CHIP 100000 PF +80
C0103	2113743M24	CAP CHIP 100000 PF +80
C0104	2113743M24	CAP CHIP 100000 PF +80
C0105	2113743M24	CAP CHIP 100000 PF +80
C0106	2113743N50	CAP CHIP 100 PF 5% COG
C0107	2113743L09	CAP CHIP 470 PF 10% X7
C0201	2113743M24	CAP CHIP 100000 PF +80
C0202	2113743M24	CAP CHIP 100000 PF +80
C0203	2113928S04	CAP CER CHIP 0.100UF 1
C0204	2185802B01	CAP 10V 4.7UF
C0205	2113743N54	CAP CHIP 150 PF 5% COG
C0206	2113928E01	CAP CER CHIP 1.0 UF 10
C0001	2311049A78	CAP TANT CHIP 10.0 UF
C0100	2113743N32	CAP CHIP 18.0 PF 5% CO
C0101	2113743N32	CAP CHIP 18.0 PF 5% CO
C0102	2113743M24	CAP CHIP 100000 PF +80
C0103	2113743M24	CAP CHIP 100000 PF +80
C0104	2113743M24	CAP CHIP 100000 PF +80
C0105	2113743M24	CAP CHIP 100000 PF +80
C0106	2113743N50	CAP CHIP 100 PF 5% COG
C0107	2113743L09	CAP CHIP 470 PF 10% X7
C0201	2113743M24	CAP CHIP 100000 PF +80
C0202	2113743M24	CAP CHIP 100000 PF +80
C0203	2113928S04	CAP CER CHIP 0.100UF 1
C0204	2185802B01	CAP 10V 4.7UF
C0205	2113743N54	CAP CHIP 150 PF 5% COG
C0206	2113928E01	CAP CER CHIP 1.0 UF 10
C0207	2113743N38	CAP CHIP 33.0 PF 5% CO
C0208	2113928E01	CAP CER CHIP 1.0 UF 10
C0209	2113743M24	CAP CHIP 100000 PF +80
C0210	2113743M24	CAP CHIP 100000 PF +80
C0211	2113743N50	CAP CHIP 100 PF 5% COG
C0212	2113743M24	CAP CHIP 100000 PF +80
C0213	2113743M24	CAP CHIP 100000 PF +80
C0214	2113741N69	CAP CHIP CL2 X7R 10% 1
C0215	2113928S04	CAP CER CHIP 0.100UF 1

Reference Designator	Motorola Part Number	Description
C0216	2113743M24	CAP CHIP 100000 PF +80
C0217	2113743L29	CAP CHIP 3300 PF 10% X
C0220	2311049A57	CAP TANT CHIP A/P 10UF
C0221	2311049C06	CAP TANT CHIP 22 UF 35
C0223	2185802B01	CAP 10V 4.7UF
C0224	2113743M24	CAP CHIP 100000 PF +80
C0225	2113928S04	CAP CER CHIP 0.100UF 1
C0226	2113928S04	CAP CER CHIP 0.100UF 1
C0227	2113743M24	CAP CHIP 100000 PF +80
C0228	2113743N54	CAP CHIP 150 PF 5% COG
C0230	2113743L09	CAP CHIP 470 PF 10% X7
C0231	2113743L01	CAP CHIP 220 PF 10% X7
C0232	2113743L09	CAP CHIP 470 PF 10% X7
C0233	2113743L01	CAP CHIP 220 PF 10% X7
C0234	2113928S04	CAP CER CHIP 0.100UF 1
C0235	2113743L09	CAP CHIP 470 PF 10% X7
C0236	2113743L09	CAP CHIP 470 PF 10% X7
C0237	2113743L01	CAP CHIP 220 PF 10% X7
C0238	2113743L01	CAP CHIP 220 PF 10% X7
C0239	2113743M24	CAP CHIP 100000 PF +80
C0240	2113928S04	CAP CER CHIP 0.100UF 1
C0242	2113928S04	CAP CER CHIP 0.100UF 1
C0243	2113945B01	CAP CER CHP 6800PF 25V
C0244	2113945B01	CAP CER CHP 6800PF 25V
C0301	2113743M24	CAP CHIP 100000 PF +80
C0302	2113743M24	CAP CHIP 100000 PF +80
C0305	2113743M24	CAP CHIP 100000 PF +80
C0306	2113743M24	CAP CHIP 100000 PF +80
C0308	2113743E20	CAP CHIP .10 UF 10%
C0309	2113743E20	CAP CHIP .10 UF 10%
C0310	2113743E20	CAP CHIP .10 UF 10%
C0311	2113743M24	CAP CHIP 100000 PF +80
C0312	2113743M24	CAP CHIP 100000 PF +80
C0313	2113743M24	CAP CHIP 100000 PF +80
C0400	2113743N38	CAP CHIP 33.0 PF 5% CO
C0401	2113743N50	CAP CHIP 100 PF 5% COG
C0402	2113743N38	CAP CHIP 33.0 PF 5% CO
C0403	2113743N38	CAP CHIP 33.0 PF 5% CO
C0404	2113743N38	CAP CHIP 33.0 PF 5% CO

Reference Designator	Motorola Part Number	Description
C0405	2113743N38	CAP CHIP 33.0 PF 5% CO
C0406	2113743N38	CAP CHIP 33.0 PF 5% CO
C0407	2113743N50	CAP CHIP 100 PF 5% COG
C0408	2113743N50	CAP CHIP 100 PF 5% COG
C0409	2113743N38	CAP CHIP 33.0 PF 5% CO
C0410	2113743N38	CAP CHIP 33.0 PF 5% CO
C0412	2113743N50	CAP CHIP 100 PF 5% COG
C0413	2113743N50	CAP CHIP 100 PF 5% COG
C0414	2113743L01	CAP CHIP 220 PF 10% X7
C0415	2113743L01	CAP CHIP 220 PF 10% X7
C0416	2113743N50	CAP CHIP 100 PF 5% COG
C0417	2113743L01	CAP CHIP 220 PF 10% X7
C0418	2113743L01	CAP CHIP 220 PF 10% X7
C0419	2113743N50	CAP CHIP 100 PF 5% COG
C0420	2185802B01	CAP 10V 4.7UF
C0421	2113741B13	CAP CHIP CL2 X7R REEL
C0422	2113743N38	CAP CHIP 33.0 PF 5% CO
C0423	2113743N38	CAP CHIP 33.0 PF 5% CO
C0424	2113743N38	CAP CHIP 33.0 PF 5% CO
C0425	2113743N50	CAP CHIP 100 PF 5% COG
C0426	2113741B13	CAP CHIP CL2 X7R REEL
C0427	2113743N50	CAP CHIP 100 PF 5% COG
C0428	2113743N50	CAP CHIP 100 PF 5% COG
C0429	2113743N50	CAP CHIP 100 PF 5% COG
C0430	2113743N50	CAP CHIP 100 PF 5% COG
C0431	2113743N50	CAP CHIP 100 PF 5% COG
C0432	2113743N50	CAP CHIP 100 PF 5% COG
C0433	2113743N50	CAP CHIP 100 PF 5% COG
C0434	2113743N50	CAP CHIP 100 PF 5% COG
C0435	2113743L09	CAP CHIP 470 PF 10% X7
C0436	2113741B13	CAP CHIP CL2 X7R REEL
C0437	2113741B13	CAP CHIP CL2 X7R REEL
C0438	2113743L09	CAP CHIP 470 PF 10% X7
C0439	2113743N50	CAP CHIP 100 PF 5% COG
C0440	2113743N50	CAP CHIP 100 PF 5% COG
C0441	2113743M24	CAP CHIP 100000 PF +80
C0442	2113743N38	CAP CHIP 33.0 PF 5% CO
C0443	2113743N38	CAP CHIP 33.0 PF 5% CO
C0444	2113743N38	CAP CHIP 33.0 PF 5% CO
C0445	2113743N38	CAP CHIP 33.0 PF 5% CO
C0446	2113743N50	CAP CHIP 100 PF 5% COG

Reference Designator	Motorola Part Number	Description
C0447	2113743N50	CAP CHIP 100 PF 5% COG
C0448	2113743N50	CAP CHIP 100 PF 5% COG
C0449	2113743N50	CAP CHIP 100 PF 5% COG
C0450	2113743N38	CAP CHIP 33.0 PF 5% CO
C0451	2113743N38	CAP CHIP 33.0 PF 5% CO
C0452	2113743N38	CAP CHIP 33.0 PF 5% CO
C0453	2113743N38	CAP CHIP 33.0 PF 5% CO
C0454	2113743N38	CAP CHIP 33.0 PF 5% CO
C0455	2113743N38	CAP CHIP 33.0 PF 5% CO
C0456	2113743N38	CAP CHIP 33.0 PF 5% CO
C0457	2113743N38	CAP CHIP 33.0 PF 5% CO
C0458	2113743N38	CAP CHIP 33.0 PF 5% CO
C0459	2113743N38	CAP CHIP 33.0 PF 5% CO
C0460	2113743N50	CAP CHIP 100 PF 5% COG
C0461	2113743L01	CAP CHIP 220 PF 10% X7
C0462	2113743L01	CAP CHIP 220 PF 10% X7
C0463	2113743N38	CAP CHIP 33.0 PF 5% CO
C0464	2113743N38	CAP CHIP 33.0 PF 5% CO
C0465	2113741B13	CAP CHIP CL2 X7R REEL
C0466	2113743N50	CAP CHIP 100 PF 5% COG
C0467	2113743N50	CAP CHIP 100 PF 5% COG
C0469	2113743M24	CAP CHIP 100000 PF +80
C0470	2113743N38	CAP CHIP 33.0 PF 5% CO
C0475	2113743N50	CAP CHIP 100 PF 5% COG
C0476	2113743N50	CAP CHIP 100 PF 5% COG
C0477	2113743N50	CAP CHIP 100 PF 5% COG
C0478	2113743N50	CAP CHIP 100 PF 5% COG
C0500	2113743M24	CAP CHIP 100000 PF +80
C0502	2113743N50	CAP CHIP 100 PF 5% COG
C0503	2113743N50	CAP CHIP 100 PF 5% COG
C0504	2113741N69	CAP CHIP CL2 X7R 10% 1
C0505	2113743L41	CAP CHIP 10000 PF 10%
C0506	2113743L41	CAP CHIP 10000 PF 10%
C0507	2113743M24	CAP CHIP 100000 PF +80
C0510	2185802B01	CAP 10V 4.7UF
C0512	2113743M24	CAP CHIP 100000 PF +80
C0513	2311049A43	CAP TANT CHIP 150 10 6
C0514	2311049A43	CAP TANT CHIP 150 10 6
C0515	2113743M24	CAP CHIP 100000 PF +80
C0516	2113743M24	CAP CHIP 100000 PF +80
C0517	2185802B01	CAP 10V 4.7UF

Reference Designator	Motorola Part Number	Description
C0518	2185802B01	CAP 10V 4.7UF
C0519	2113743L41	CAP CHIP 10000 PF 10%
C0520	2113743M24	CAP CHIP 100000 PF +80
C0521	2185802B01	CAP 10V 4.7UF
C0522	2185802B01	CAP 10V 4.7UF
C0523	2113743M24	CAP CHIP 100000 PF +80
C0524	2113743M24	CAP CHIP 100000 PF +80
C0525	2113928E01	CAP CER CHIP 1.0 UF 10
C0526	2113743L41	CAP CHIP 10000 PF 10%
C0527	2185802B01	CAP 10V 4.7UF
C0528	2113743M24	CAP CHIP 100000 PF +80
C0529	2185802B01	CAP 10V 4.7UF
C0531	2113741N69	CAP CHIP CL2 X7R 10% 1
C0532	2113741Y32	CAP CER 1,000,000 10%"
C0533	2311049C47	CAP TANT CHIP 22.0UF 1
C0534	2113743M24	CAP CHIP 100000 PF +80
C0535	2113743M24	CAP CHIP 100000 PF +80
C0536	2113743M24	CAP CHIP 100000 PF +80
C0600	2113743M24	CAP CHIP 100000 PF +80
C0601	2113743M24	CAP CHIP 100000 PF +80
C0603	2113743M24	CAP CHIP 100000 PF +80
C0604	2113743M24	CAP CHIP 100000 PF +80
C0605	2113743M24	CAP CHIP 100000 PF +80
C0606	2113743M24	CAP CHIP 100000 PF +80
C0610	2113743M24	CAP CHIP 100000 PF +80
C0611	2113743M24	CAP CHIP 100000 PF +80
C0613	2113743M24	CAP CHIP 100000 PF +80
C0614	2113743M24	CAP CHIP 100000 PF +80
C0616	2113743N50	CAP CHIP 100 PF 5% COG
C0700	2113743N50	CAP CHIP 100 PF 5% COG
C0701	2113743N50	CAP CHIP 100 PF 5% COG
C0702	2113743N50	CAP CHIP 100 PF 5% COG
C0703	2113743N50	CAP CHIP 100 PF 5% COG
C0704	2113743N50	CAP CHIP 100 PF 5% COG
C0705	2113743N50	CAP CHIP 100 PF 5% COG
C0706	2113743N50	CAP CHIP 100 PF 5% COG
C0708	2113743N50	CAP CHIP 100 PF 5% COG
C0709	2113743N50	CAP CHIP 100 PF 5% COG
C0710	2113743N50	CAP CHIP 100 PF 5% COG
C0711	2113743N50	CAP CHIP 100 PF 5% COG
C0712	2113743N50	CAP CHIP 100 PF 5% COG

Reference Designator	Motorola Part Number	Description
C0713	2113743L01	CAP CHIP 220 PF 10% X7
C0714	2113743L01	CAP CHIP 220 PF 10% X7
C0901	2113743M24	CAP CHIP 100000 PF +80
C0902	2113743M24	CAP CHIP 100000 PF +80
C0903	2113743M24	CAP CHIP 100000 PF +80
C0904	2113743L01	CAP CHIP 220 PF 10% X7
C0905	2113743M24	CAP CHIP 100000 PF +80
C0906	2113743M24	CAP CHIP 100000 PF +80
C0907	2113743M24	CAP CHIP 100000 PF +80
C0908	2113743M24	CAP CHIP 100000 PF +80
C0909	2113743M24	CAP CHIP 100000 PF +80
C0910	2113743M24	CAP CHIP 100000 PF +80
C0911	2113743N50	CAP CHIP 100 PF 5% COG
C0912	2113743N50	CAP CHIP 100 PF 5% COG
C0913	2113743N50	CAP CHIP 100 PF 5% COG
C0914	2113743N38	CAP CHIP 33.0 PF 5% CO
C0915	2113743N50	CAP CHIP 100 PF 5% COG
C0916	2113743M24	CAP CHIP 100000 PF +80
C0917	2113743N50	CAP CHIP 100 PF 5% COG
C0918	2113743N50	CAP CHIP 100 PF 5% COG
C0919	2113743N50	CAP CHIP 100 PF 5% COG
C0920	2113743M24	CAP CHIP 100000 PF +80
C0922	2113743N50	CAP CHIP 100 PF 5% COG
C0923	2113743N50	CAP CHIP 100 PF 5% COG
C0924	2113743E12	CAP CHIP .047 UF 10% X
C0930	2113743N50	CAP CHIP 100 PF 5% COG
C0933	2113743N50	CAP CHIP 100 PF 5% COG
C0934	2113743N50	CAP CHIP 100 PF 5% COG
C0935	2113743N50	CAP CHIP 100 PF 5% COG
C0936	2113743M24	CAP CHIP 100000 PF +80
C0937	2113743M24	CAP CHIP 100000 PF +80
C0940	2113743M24	CAP CHIP 100000 PF +80
C0941	2113743S01	CAP CER CHIP 1.0 UF 10
C0942	2113743S01	CAP CER CHIP 1.0 UF 10
C0943	2113743L41	CAP CHIP 10000 PF 10%
C0944	2113743M24	CAP CHIP 100000 PF +80
C0945	2185802B01	CAP 10V 4.7UF
C0950	2113741N69	CAP CHIP CL2 X7R 10% 1
C0951	2113741Y32	CAP CER 1,000,000 10%"
C0952	2113743E20	CAP CHIP .10 UF 10%
C0953	2311049C47	CAP TANT CHIP 22.0UF 1

Reference Designator	Motorola Part Number	Description
C0954	2113743E20	CAP CHIP .10 UF 10%
C0955	2113741N69	CAP CHIP CL2 X7R 10% 1
C0956	2311049C06	CAP TANT CHIP 22 UF 35
C0957	2113743M24	CAP CHIP 100000 PF +80
C0959	2113743M24	CAP CHIP 100000 PF +80
C0960	2113743M24	CAP CHIP 100000 PF +80
C0961	2113743M24	CAP CHIP 100000 PF +80
C0963	2113743N50	CAP CHIP 100 PF 5% COG
C0964	2113743N50	CAP CHIP 100 PF 5% COG
C0965	2113743N50	CAP CHIP 100 PF 5% COG
C0966	2113743N50	CAP CHIP 100 PF 5% COG
C0968	2113743N50	CAP CHIP 100 PF 5% COG
C0969	2113743N50	CAP CHIP 100 PF 5% COG
C0970	2113743N50	CAP CHIP 100 PF 5% COG
C0972	2113743E07	CER CHIP CAP .022UF
C0973	2113928E01	CAP CER CHIP 1.0 UF 10
C0974	2113743M24	CAP CHIP 100000 PF +80
C0975	2113743N50	CAP CHIP 100 PF 5% COG
C0976	2113743N50	CAP CHIP 100 PF 5% COG
C0978	2113743N50	CAP CHIP 100 PF 5% COG
C0979	2113743M24	CAP CHIP 100000 PF +80
C0980	2113743M24	CAP CHIP 100000 PF +80
C0981	2113743M24	CAP CHIP 100000 PF +80
C0982	2311049C47	CAP TANT CHIP 22.0UF 1
C0983	2113743N50	CAP CHIP 100 PF 5% COG
C0984	2113743M24	CAP CHIP 100000 PF +80
C0985	2113743M24	CAP CHIP 100000 PF +80
C0986	2113743M24	CAP CHIP 100000 PF +80
C0987	2113743M24	CAP CHIP 100000 PF +80
C0997	2113740F47	CAP CHIP REEL CL1 +/-3
C0998	2113741F01	CAP CHIP CL2 X7R REEL
C3000	2113743N28	CAP CHIP 12.0 PF 5% CO
C3001	2113743S01	CAP CER CHIP 1.0 UF 10
C3002	2113743N46	CAP CHIP 68.0 PF 5% CO
C3003	2113743L25	CAP CHIP 2200 PF 10% X
C3004	2113743B27	CAP CHIP .680 UF 10% X
C3005	2113743A27	CAP CHIP .470 UF 10% 1
C3007	2113928N01	CAP CER CHIP 0.1UF 10%
C3008	2113928N01	CAP CER CHIP 0.1UF 10%
C3009	2113928N01	CAP CER CHIP 0.1UF 10%
C3010	2113928N01	CAP CER CHIP 0.1UF 10%

Reference Designator	Motorola Part Number	Description
C3011	2113928N01	CAP CER CHIP 0.1UF 10%
C3012	2113928N01	CAP CER CHIP 0.1UF 10%
C3013	2113928N01	CAP CER CHIP 0.1UF 10%
C3014	2113928N01	CAP CER CHIP 0.1UF 10%
C3016	2113928N01	CAP CER CHIP 0.1UF 10%
C3017	2113928N01	CAP CER CHIP 0.1UF 10%
C3018	2113928N01	CAP CER CHIP 0.1UF 10%
C3019	2113928N01	CAP CER CHIP 0.1UF 10%
C3020	2113743N50	CAP CHIP 100 PF 5% COG
C3021	2113743N50	CAP CHIP 100 PF 5% COG
C3022	2113743N50	CAP CHIP 100 PF 5% COG
C3023	2113743N50	CAP CHIP 100 PF 5% COG
C3024	2113743N46	CAP CHIP 68.0 PF 5% CO
C3025	2113743N42	CAP CHIP 47.0 PF 5% CO
C3026	2113743N36	CAP CHIP 27.0 PF 5% CO
C3027	2113743N33	CAP CHIP 20.0 PF 5% CO
C3028	2113743N33	CAP CHIP 20.0 PF 5% CO
C3029	2113743N30	CAP CHIP 15.0 PF 5% CO
C3030	2113743N28	CAP CHIP 12.0 PF 5% CO
C3032	2113740L32	CAP 39.0 PF 50V 2.0 %
C3035	2113743L41	CAP CHIP 10000 PF 10%
C3036	2113743L41	CAP CHIP 10000 PF 10%
C3037	2113743L41	CAP CHIP 10000 PF 10%
C3038	2113743L41	CAP CHIP 10000 PF 10%
C3039	2113743L41	CAP CHIP 10000 PF 10%
C3040	2113743L41	CAP CHIP 10000 PF 10%
C3041	2113743L41	CAP CHIP 10000 PF 10%
C3042	2113743L17	CAP CHIP 1000 PF 10% X
C3043	2113743F18	CAP CHIP 2.2 UF 16V +8
C3044	2113743E20	CAP CHIP .10 UF 10%
C3045	2113743A31	CAP CHIP 1.0 UF 10% X7
C3046	2113743L33	CAP CHIP 4700 PF 10% X
C3047	2113740F58	CAP CHIP REEL CL1 +/-3
C3048	2113743N09	CAP CHIP 2.0 PF +/- .25P
C3251	2113740F67	CAP CHIP CL1 +/-30 470
C3252	2113740F67	CAP CHIP CL1 +/-30 470
C3253	2113740F67	CAP CHIP CL1 +/-30 470
C3254	2113740F67	CAP CHIP CL1 +/-30 470
C3255	2113741F25	CAP CHIP CL2 X7R REEL
C3256	2113740F67	CAP CHIP CL1 +/-30 470
C3257	2113740L37	CAP 62.0 PF 50V 2.0 %

Reference Designator	Motorola Part Number	Description
C3258	2113740L42	CAP 100.0 PF 50V 2.0 %
C3259	2113740L21	CAP 13.0 PF 50V 2.0 %
C3260	2113741F25	CAP CHIP CL2 X7R REEL
C3261	2113741F25	CAP CHIP CL2 X7R REEL
C3262	2113740F67	CAP CHIP CL1 +/-30 470
C3263	2113741F25	CAP CHIP CL2 X7R REEL
C3264	2113740L32	CAP 39.0 PF 50V 2.0 %
C3265	2113741F25	CAP CHIP CL2 X7R REEL
C3266	2113741F25	CAP CHIP CL2 X7R REEL
C3267	2113743K15	CER CHIP CAP .100UF
C3268	2113743K15	CER CHIP CAP .100UF
C3269	2113741F25	CAP CHIP CL2 X7R REEL
C3270	2113740F67	CAP CHIP CL1 +/-30 470
C3271	2113741F49	CAP CHIP CL2 X7R REEL
C3272	2113740F67	CAP CHIP CL1 +/-30 470
C3273	2113741F25	CAP CHIP CL2 X7R REEL
C3274	2113743K15	CER CHIP CAP .100UF
C3275	2113743K15	CER CHIP CAP .100UF
C3277	2113740L41	CAP 91.0 PF 50V 2.0 %
C3278	2113740L39	CAP 75.0 PF 50V 2.0 %
C3279	2113740L24	CAP 18.0 PF 50V 2.0 %
C3280	2113741F25	CAP CHIP CL2 X7R REEL
C3282	2113740F67	CAP CHIP CL1 +/-30 470
C3283	2113741F25	CAP CHIP CL2 X7R REEL
C3284	2113741F25	CAP CHIP CL2 X7R REEL
C3286	2113741F25	CAP CHIP CL2 X7R REEL
C3287	2113740L31	CAP 36.0 PF 50V 2.0 %
C3288	2113740F67	CAP CHIP CL1 +/-30 470
C3289	2113743K15	CER CHIP CAP .100UF
C3290	2113740L35	CAP 51.0 PF 50V 2.0 %
C3291	2113740F41	CAP CHIP REEL CL1 +/-3
C3292	2113741F25	CAP CHIP CL2 X7R REEL
C3293	2113741F25	CAP CHIP CL2 X7R REEL
C3294	2113741F25	CAP CHIP CL2 X7R REEL
C3295	2113740L37	CAP 62.0 PF 50V 2.0 %
C3296	2113740L26	CAP 22.0 PF 50V 2.0 %
C3297	2113740L15	CAP CER CHIP 7.5 PF +/-
C3298	2113740L37	CAP 62.0 PF 50V 2.0 %
C3299	2113740L32	CAP 39.0 PF 50V 2.0 %
C3300	2113740L37	CAP 62.0 PF 50V 2.0 %
C3301	2113740F67	CAP CHIP CL1 +/-30 470

Reference Designator	Motorola Part Number	Description
C3302	2113740F67	CAP CHIP CL1 +/-30 470
C3303	2113741F49	CAP CHIP CL2 X7R REEL
C3304	2113741F49	CAP CHIP CL2 X7R REEL
C3305	2113740F67	CAP CHIP CL1 +/-30 470
C3306	2113740F67	CAP CHIP CL1 +/-30 470
C3307	2113741F49	CAP CHIP CL2 X7R REEL
C3308	2113741F49	CAP CHIP CL2 X7R REEL
C3309	2113741F49	CAP CHIP CL2 X7R REEL
C3310	2113740L27	CAP 24.0 PF 50V 2.0 %
C3311	2113740L18	CAP CER CHIP 10.0 PF +
C3312	2113743K15	CER CHIP CAP .100UF
C3400	2113740F67	CAP CHIP CL1 +/-30 470
C3401	2113741F49	CAP CHIP CL2 X7R REEL
C3402	2113741F49	CAP CHIP CL2 X7R REEL
C3403	2113741F49	CAP CHIP CL2 X7R REEL
C3404	2113741F49	CAP CHIP CL2 X7R REEL
C3405	2113741F49	CAP CHIP CL2 X7R REEL
C3406	2113741F49	CAP CHIP CL2 X7R REEL
C3409	2113740L31	CAP 36.0 PF 50V 2.0 %
C3410	2113740F67	CAP CHIP CL1 +/-30 470
C3411	2113740F67	CAP CHIP CL1 +/-30 470
C3412	2113740F67	CAP CHIP CL1 +/-30 470
C3414	2113740L31	CAP 36.0 PF 50V 2.0 %
C3415	2113740F19	CAP CHIP REEL CL1 +/-3
C3416	2113740L09	CAP CER CHIP 4.3 PF +/-
C3417	2113740L09	CAP CER CHIP 4.3 PF +/-
C3418	2113741F25	CAP CHIP CL2 X7R REEL
C3420	2113741F25	CAP CHIP CL2 X7R REEL
C3421	2113740L09	CAP CER CHIP 4.3 PF +/-
C3424	2113741F49	CAP CHIP CL2 X7R REEL
C3500	2113743L09	CAP CHIP 470 PF 10% X7
C3501	2113743L41	CAP CHIP 10000 PF 10%
C3503	2113743N38	CAP CHIP 33.0 PF 5% CO
C3504	2113743N38	CAP CHIP 33.0 PF 5% CO
C3505	2113743L41	CAP CHIP 10000 PF 10%
C3506	2113743L41	CAP CHIP 10000 PF 10%
C3508	2113743L17	CAP CHIP 1000 PF 10% X
C3511	2113743L17	CAP CHIP 1000 PF 10% X
C3517	2113743L09	CAP CHIP 470 PF 10% X7
C3520	2113743N26	CAP CHIP 10.0 PF 5% CO
C3521	2113743N34	CAP CHIP 22.0 PF 5% CO

Reference Designator	Motorola Part Number	Description
C3522	2113743L09	CAP CHIP 470 PF 10% X7
C3530	2113741N69	CAP CHIP CL2 X7R 10% 1
C3531	2111078B59	CAP CHIP RF 470 5 NPO
C3532	2111078B37	CAP CHIP RF 62 5 NPO 1
C3533	2111078B37	CAP CHIP RF 62 5 NPO 1
C3534	2111078B59	CAP CHIP RF 470 5 NPO
C3535	2113743L09	CAP CHIP 470 PF 10% X7
C3536	2113740G50	CAP CERAMIC CHIP 62 PF
C3537	2111078B36	CAP CHIP RF 56 5 NPO 1
C3548	2113740G50	CAP CERAMIC CHIP 62 PF
C3549	2111078B36	CAP CHIP RF 56 5 NPO 1
C3550	2113741N69	CAP CHIP CL2 X7R 10% 1
C3551	2111078B59	CAP CHIP RF 470 5 NPO
C3552	2111078B40	CAP CHIP RF 82 5 NPO 1
C3553	2111078B40	CAP CHIP RF 82 5 NPO 1
C3554	2111078B40	CAP CHIP RF 82 5 NPO 1
C3555	2111078B40	CAP CHIP RF 82 5 NPO 1
C3556	2111078B01	CAP CHIP RF 3.3 .25 NP
C3557	2111078B01	CAP CHIP RF 3.3 .25 NP
C3558	2111078B34	CAP CHIP RF 47 5 NPO 1
C3559	2111078B59	CAP CHIP RF 470 5 NPO
C3560	2311049C06	CAP TANT CHIP 22 UF 35
C3561	2113932E20	CAP CER CHP .10 UF 10%
C3562	2113932E20	CAP CER CHP .10 UF 10%
C3563	2113743L17	CAP CHIP 1000 PF 10% X
C3564	2113743L17	CAP CHIP 1000 PF 10% X
C3700	2113743L09	CAP CHIP 470 PF 10% X7
C3701	2111078B27	CAP CHIP RF 30 5 NPO 1
C3702	2113743N38	CAP CHIP 33.0 PF 5% CO
C3703	2113743L09	CAP CHIP 470 PF 10% X7
C3704	2113743N28	CAP CHIP 12.0 PF 5% CO
C3720	2111078B03	CAP CHIP RF 3.9 .25 NP
C3721	2111078B32	CAP CHIP RF 39 5 NPO 1
C3722	2111078B32	CAP CHIP RF 39 5 NPO 1
C3723	2111078B14	CAP CHIP RF 11 5 NPO 1
C3730	2113743L09	CAP CHIP 470 PF 10% X7
C3731	2113743N24	CAP CHIP 8.2 PF + -.5P
C3732	2113743N24	CAP CHIP 8.2 PF + -.5P
C3733	2113743L09	CAP CHIP 470 PF 10% X7

Reference Designator	Motorola Part Number	Description
C3734	2111078B59	CAP CHIP RF 470 5 NPO
C3735	2113743L09	CAP CHIP 470 PF 10% X7
C3736	2113743L09	CAP CHIP 470 PF 10% X7
C3750	2113743E20	CAP CHIP .10 UF 10%
C3751	2113743E20	CAP CHIP .10 UF 10%
C3752	2113743E20	CAP CHIP .10 UF 10%
C3753	2113743E20	CAP CHIP .10 UF 10%
C3754	2113743E20	CAP CHIP .10 UF 10%
C3755	2113743E20	CAP CHIP .10 UF 10%
C3757	2113740F67	CAP CHIP CL1 +/-30 470
C3758	2113740F67	CAP CHIP CL1 +/-30 470
C3759	2113740F67	CAP CHIP CL1 +/-30 470
C3761	2113740F67	CAP CHIP CL1 +/-30 470
C3762	2113743E20	CAP CHIP .10 UF 10%
C3763	2113743E20	CAP CHIP .10 UF 10%
C3764	2113743E20	CAP CHIP .10 UF 10%
C3765	2113743E20	CAP CHIP .10 UF 10%
C3766	2113743E20	CAP CHIP .10 UF 10%
C3767	2113743E20	CAP CHIP .10 UF 10%
C3768	2113743E20	CAP CHIP .10 UF 10%
C3769	2113743E20	CAP CHIP .10 UF 10%
C3770	2113740F67	CAP CHIP CL1 +/-30 470
C3771	2113740F67	CAP CHIP CL1 +/-30 470
C3772	2113740F67	CAP CHIP CL1 +/-30 470
C3773	2113740F67	CAP CHIP CL1 +/-30 470
C3774	2113740F67	CAP CHIP CL1 +/-30 470
C3775	2113740F67	CAP CHIP CL1 +/-30 470
C3776	2113740F67	CAP CHIP CL1 +/-30 470
C3777	2113740F67	CAP CHIP CL1 +/-30 470
C3778	2113740F67	CAP CHIP CL1 +/-30 470
C3779	2113740F67	CAP CHIP CL1 +/-30 470
C3780	2113740F67	CAP CHIP CL1 +/-30 470
C3781	2113740F67	CAP CHIP CL1 +/-30 470
C3782	2113740F67	CAP CHIP CL1 +/-30 470
C3783	2113740F67	CAP CHIP CL1 +/-30 470
C3784	2113740F67	CAP CHIP CL1 +/-30 470
C3785	2113740F67	CAP CHIP CL1 +/-30 470
C3786	2113743N32	CAP CHIP 18.0 PF 5% CO
C3787	2113740F32	CAP CHIP REEL CL1 +/-3
C3788	2113740F31	CAP CHIP REEL CL1 +/-3
C3790	2113740F67	CAP CHIP CL1 +/-30 470

Reference Designator	Motorola Part Number	Description
C3791	2113740F29	CAP CHIP REEL CL1 +/-3
C3792	2113740F29	CAP CHIP REEL CL1 +/-3
C3793	2113740F29	CAP CHIP REEL CL1 +/-3
C3794	2113740F29	CAP CHIP REEL CL1 +/-3
C3796	2113740F25	CAP CHIP REEL CL1 +/-3
C3797	2113740F25	CAP CHIP REEL CL1 +/-3
C3798	2113740L15	CAP CER CHIP 7.5 PF +/-
C3799	2113740L15	CAP CER CHIP 7.5 PF +/-
C3800	2113740F67	CAP CHIP CL1 +/-30 470
C3802	2113740F67	CAP CHIP CL1 +/-30 470
C3803	2113740F67	CAP CHIP CL1 +/-30 470
C3804	2113743N30	CAP CHIP 15.0 PF 5% CO
C3806	2113743S01	CAP CER CHIP 1.0 UF 10
C3807	2113743S01	CAP CER CHIP 1.0 UF 10
C3808	2113928N01	CAP CER CHIP 0.1UF 10%
C3809	2113740B88	CAP CHIP 5600PF 5%
C3810	2113743E20	CAP CHIP .10 UF 10%
C3811	2113932E07	CAP CER CHP .022 UF 10
C3813	2113740F67	CAP CHIP CL1 +/-30 470
C3814	2113740F67	CAP CHIP CL1 +/-30 470
C3815	2113740F67	CAP CHIP CL1 +/-30 470
C3816	2113741F49	CAP CHIP CL2 X7R REEL
C3817	2113740F67	CAP CHIP CL1 +/-30 470
C3818	2113740L09	CAP CER CHIP 4.3 PF +/-
C3820	2113743T19	CAP 10UF 16V CER 3225
C3821	2113743T19	CAP 10UF 16V CER 3225
C3822	2113743T19	CAP 10UF 16V CER 3225
C3823	2113743T19	CAP 10UF 16V CER 3225
C3824	2113743N50	CAP CHIP 100 PF 5% COG
C3825	2113928N01	CAP CER CHIP 0.1UF 10%
C3826	2113743L41	CAP CHIP 10000 PF 10%
C3827	2113740F67	CAP CHIP CL1 +/-30 470
C3828	2113743L41	CAP CHIP 10000 PF 10%
C3829	2113740F67	CAP CHIP CL1 +/-30 470
C3830	2113743L17	CAP CHIP 1000 PF 10% X
C3831	2113743L17	CAP CHIP 1000 PF 10% X
C3832	2113740F67	CAP CHIP CL1 +/-30 470
C3833	2113743E20	CAP CHIP .10 UF 10%
C3834	2113743E12	CAP CHIP .047 UF 10% X
C3835	2113740L15	CAP CER CHIP 7.5 PF +/-
C3836	2113740L15	CAP CER CHIP 7.5 PF +/-

Reference Designator	Motorola Part Number	Description
C3837	2113740L13	CAP CER CHIP 6.2 PF +/-
C3838	2113740L13	CAP CER CHIP 6.2 PF +/-
C3839	2113740F33	CAP CHIP REEL CL1 +/-3
C3840	2113740F33	CAP CHIP REEL CL1 +/-3
C3841	2113740L26	CAP 22.0 PF 50V 2.0 %
C3842	2113740L26	CAP 22.0 PF 50V 2.0 %
C3843	2113740F33	CAP CHIP REEL CL1 +/-3
C3844	2113740F33	CAP CHIP REEL CL1 +/-3
C3845	2113740L13	CAP CER CHIP 6.2 PF +/-
C3846	2113740L13	CAP CER CHIP 6.2 PF +/-
C3847	2113740L13	CAP CER CHIP 6.2 PF +/-
C3848	2113740L13	CAP CER CHIP 6.2 PF +/-
C3849	2113740L13	CAP CER CHIP 6.2 PF +/-
C3850	2113740L14	CAP CER CHIP 6.8 PF +/-
C3854	2113740F19	CAP CHIP REEL CL1 +/-3
C3855	2104263L01	CAPACITOR 0.1UF FILM
C3856	2104263L01	CAPACITOR 0.1UF FILM
C3857	2104263L01	CAPACITOR 0.1UF FILM
C3858	2104263L01	CAPACITOR 0.1UF FILM
C3859	2104263L01	CAPACITOR 0.1UF FILM
C3860	2104263L01	CAPACITOR 0.1UF FILM
C3861	2104263L01	CAPACITOR 0.1UF FILM
C3862	2113740F67	CAP CHIP CL1 +/-30 470
C3863	2113740F33	CAP CHIP REEL CL1 +/-3
C3864	2113740F67	CAP CHIP CL1 +/-30 470
C3865	2113740F67	CAP CHIP CL1 +/-30 470
C3868	2113743E20	CAP CHIP .10 UF 10%
C3869	2113740F67	CAP CHIP CL1 +/-30 470
C3870	2113740F67	CAP CHIP CL1 +/-30 470
C3871	2113741F49	CAP CHIP CL2 X7R REEL
C3872	2113743E20	CAP CHIP .10 UF 10%
C3873	2113740F67	CAP CHIP CL1 +/-30 470
C3876	2113741F49	CAP CHIP CL2 X7R REEL
C3878	2113741F49	CAP CHIP CL2 X7R REEL
C3879	2113743T19	CAP 10UF 16V CER 3225
C3881	2104263L01	CAPACITOR 0.1UF FILM
C3882	2104263L01	CAPACITOR 0.1UF FILM
C3883	2104263L01	CAPACITOR 0.1UF FILM
C3910	2113743E20	CAP CHIP .10 UF 10%
C3911	2113741F49	CAP CHIP CL2 X7R REEL
C3912	2113741F49	CAP CHIP CL2 X7R REEL

Reference Designator	Motorola Part Number	Description
C3913	2113740F67	CAP CHIP CL1 +/-30 470
C3914	2113740F67	CAP CHIP CL1 +/-30 470
C3915	2113740F67	CAP CHIP CL1 +/-30 470
C3916	2113740F67	CAP CHIP CL1 +/-30 470
C3917	2113740F32	CAP CHIP REEL CL1 +/-3
C3918	2113740L18	CAP CER CHIP 10.0 PF +
C3919	2113740L15	CAP CER CHIP 7.5 PF +/-
C3920	2113740F14	CAP CHIP REEL CL1 +/-3
C3921	2113740F14	CAP CHIP REEL CL1 +/-3
C3924	2113741F49	CAP CHIP CL2 X7R REEL
C3925	2113743A19	CAP CHIP .100 UF 10% X
C3926	2113743A19	CAP CHIP .100 UF 10% X
C3930	2113740F67	CAP CHIP CL1 +/-30 470
C3931	2113741F49	CAP CHIP CL2 X7R REEL
C3932	2113741F49	CAP CHIP CL2 X7R REEL
C3933	2113740F67	CAP CHIP CL1 +/-30 470
C3934	2113741F49	CAP CHIP CL2 X7R REEL
C3935	2113741F49	CAP CHIP CL2 X7R REEL
C3936	2113741F25	CAP CHIP CL2 X7R REEL
D0501	4805218N57	DIODE DUAL
D0950	4813833C02	DIODE DUAL 70V '5B' CO
D0951	4813833C02	DIODE DUAL 70V '5B' CO
D0952	4813833C02	DIODE DUAL 70V '5B' CO
D0954	4813833C02	DIODE DUAL 70V '5B' CO
D3000	4809877C13	DIODE VARACTOR ISV305
D3001	4805656W28	DIODE VARACTOR 18PF@1V
D3251	4808115L23	DIODE,PIN,SMP1322,,,,1"
D3252	4808115L23	DIODE,PIN,SMP1322,,,,1"
D3253	4808115L23	DIODE,PIN,SMP1322,,,,1"
D3254	4808115L23	DIODE,PIN,SMP1322,,,,1"
D3255	4808115L17	PIN DIODE
D3256	4813825A19	DIODE SCHOTTKY BARRIER
D3258	4802245J92	QUAD CROSSOVER RING MI
D3400	4813833B24	DIODE SCHOTTKY DL SERI
D3701	4802482J02	PIN DIODE SMD
D3702	4802482J02	PIN DIODE SMD
D3703	4880154K06	DIODE PIN SCHOTTKY

Reference Designator	Motorola Part Number	Description
D3704	4802482J02	PIN DIODE SMD
D3705	4802482J02	PIN DIODE SMD
D3730	4813825A05	DIODE 30V HOT CARRIER
D3731	4813825A05	DIODE 30V HOT CARRIER
D3750	4813833C02	DIODE DUAL 70V '5B' CO
D3751	4813833C02	DIODE DUAL 70V '5B' CO
D3752	4805649Q13	DIODE VCTR ISV 228
D3753	4805649Q13	DIODE VCTR ISV 228
D3754	4805649Q13	DIODE VCTR ISV 228
D3755	4813825A08	DIODE 70V HOT CARRIER
D3756	4813825A08	DIODE 70V HOT CARRIER
D3757	4802233J09	DIODE TRIPLE SOT25-RH
D3758	4802233J09	DIODE TRIPLE SOT25-RH
D3767	4813825A08	DIODE 70V HOT CARRIER
D3768	4813825A08	DIODE 70V HOT CARRIER
D3769	4805649Q13	DIODE VCTR ISV 228
D3770	4805649Q13	DIODE VCTR ISV 228
D3771	4805649Q13	DIODE VCTR ISV 228
D3772	4805649Q13	DIODE VCTR ISV 228
D3773	4805649Q13	DIODE VCTR ISV 228
E3000	2480640Z01	SURFACE MOUNT FER- RITE
E3001	2480640Z01	SURFACE MOUNT FER- RITE
E3002	2480640Z01	SURFACE MOUNT FER- RITE
E3003	2480640Z01	SURFACE MOUNT FER- RITE
E3004	2480640Z01	SURFACE MOUNT FER- RITE
E3005	2480640Z01	SURFACE MOUNT FER- RITE
E3006	2480640Z01	SURFACE MOUNT FER- RITE
E3007	2480640Z01	SURFACE MOUNT FER- RITE
E3008	2480640Z01	SURFACE MOUNT FER- RITE
F0400	6583049X16	FUSE 5A FAST ACT
FL0900	9185130D01	FLTR SW CAP 3 POLE BUT
J0401	0985722E01	CONN 50 POS FM SMT RTA

Reference Designator	Motorola Part Number	Description
J0402	0985631E01	CONNECTOR FEMALE 32 PI
J0501	0985473E01	CONN SECURE 20 POS FM
J0950	0905902V07	CONNECTOR DC
J3700	0905901V11	RF CONNECTOR,RF,,F,,,"
L3000	2405769X05	COIL INDUCTOR
L3002	2462587N56	CHIP IND 180 NH 5%
L3003	2462587N76	CHIP IND 4700 NH 5%
L3004	2462587N76	CHIP IND 4700 NH 5%
L3005	2405769X05	COIL INDUCTOR
L3006	2413923A05	IND CHIP 120 NH 2%
L3007	2413926N24	IND CER CHIP 100.0 NH
L3008	2462587L50	CHIP IND 100000 NH 10%
L3251	2413923A32	IND CHIP 18 NH 2%
L3252	2413923A24	IND CHIP 47 NH 2%
L3253	2413923A04	IND CHIP 100 NH 2%
L3254	2413923A36	IND CHIP 10 NH 2%
L3255	2413923A20	IND CHIP 22 NH 2%
L3256	2413923A01	IND CHIP 56 NH 2%
L3257	2413923A35	IND CHIP 15 NH 2%
L3258	2413923A06	IND CHIP 150 NH 2%
L3259	2462587N69	CHIP IND 1200 NH 5%
L3260	2460591M77	COIL AIR WOUND INDUC 3
L3261	2462587N69	CHIP IND 1200 NH 5%
L3262	2462587Q40	IND CHIP 270 NH 10%
L3263	2460591M77	COIL AIR WOUND INDUC 3
L3264	2460591M77	COIL AIR WOUND INDUC 3
L3265	2413923A21	IND CHIP 27 NH 2%
L3266	2462587N69	CHIP IND 1200 NH 5%
L3268	2462587N69	CHIP IND 1200 NH 5%
L3269	2462587N69	CHIP IND 1200 NH 5%
L3270	2462587N69	CHIP IND 1200 NH 5%
L3271	2460591M77	COIL AIR WOUND INDUC 3
L3272	2460591P75	COIL AIR WOUND INDUC 7
L3273	2460591P75	COIL AIR WOUND INDUC 7
L3275	2462587Q40	IND CHIP 270 NH 10%

Reference Designator	Motorola Part Number	Description
L3276	2462587T30	IND CHIP 1000NH 5% LOW
L3277	2462587T03	IND CHIP 10NH 10% LOW
L3400	2462587Q40	IND CHIP 270 NH 10%
L3401	2462587T59	IND CHIP 330NH 2% LOW
L3403	2462587T59	IND CHIP 330NH 2% LOW
L3404	2462587T59	IND CHIP 330NH 2% LOW
L3405	2462587T59	IND CHIP 330NH 2% LOW
L3406	2462587T30	IND CHIP 1000NH 5% LOW
L3408	2462587T13	IND CHIP 68NH 5% LOW P
L3501	2462587T13	IND CHIP 68NH 5% LOW P
L3502	2460591A01	COIL AIR WOUND INDUC 4
L3503	2462587T13	IND CHIP 68NH 5% LOW P
L3520	2484562T05	COIL SURFACE MOUNT AIR
L3530	7686135U02	FLTR,EMI"
L3531	2484562T04	COIL SURFACE MOUNT AIR
L3549	7686135U02	FLTR,EMI"
L3550	7686135U02	FLTR,EMI"
L3551	2460592A01	COIL AW 2 TURN 17 NH
L3552	2460592A01	COIL AW 2 TURN 17 NH
L3700	2462587N69	CHIP IND 1200 NH 5%
L3701	2485873L02	ENCAPSULATED AIR WOUND
L3702	2408384A05	47NH 5% COILCRAFT 1812
L3703	2462587N69	CHIP IND 1200 NH 5%
L3704	2462587N69	CHIP IND 1200 NH 5%
L3720	2484562T17	COIL SURFACE MNT AIR W
L3721	2485873L02	ENCAPSULATED AIR WOUND
L3722	2485873L02	ENCAPSULATED AIR WOUND
L3723	2485873L02	ENCAPSULATED AIR WOUND
L3724	2484562T16	COIL SURFACE MNT AIR W
L3725	2485873L02	ENCAPSULATED AIR WOUND

Reference Designator	Motorola Part Number	Description
L3726	2485873L02	ENCAPSULATED AIR WOUND
L3727	2485873L02	ENCAPSULATED AIR WOUND
L3730	2488428L09	IDCTR,CHIP,18NH,5%,1.9"
L3731	2488428L09	IDCTR,CHIP,18NH,5%,1.9"
L3732	2485873L02	ENCAPSULATED AIR WOUND
L3737	2462587N69	CHIP IND 1200 NH 5%
L3750	2462587T30	IND CHIP 1000NH 5% LOW
L3751	2462587Q44	IND CHIP 560 NH 10%
L3752	2462587Q44	IND CHIP 560 NH 10%
L3753	2462587Q20	IND CHIP 2,200 NH 20%"
L3754	2462587Q47	IND CHIP 1,000 NH 10%"
L3755	2462587Q20	IND CHIP 2,200 NH 20%"
L3756	2462587Q20	IND CHIP 2,200 NH 20%"
L3757	2462587Q20	IND CHIP 2,200 NH 20%"
L3758	2462587T30	IND CHIP 1000NH 5% LOW
L3759	2462587T30	IND CHIP 1000NH 5% LOW
L3760	2462587T30	IND CHIP 1000NH 5% LOW
L3761	2462587T30	IND CHIP 1000NH 5% LOW
L3762	2462587T30	IND CHIP 1000NH 5% LOW
L3763	2462587T30	IND CHIP 1000NH 5% LOW
L3764	2462587T30	IND CHIP 1000NH 5% LOW
L3765	2462587T30	IND CHIP 1000NH 5% LOW
L3766	2462587T30	IND CHIP 1000NH 5% LOW
L3767	2462587T30	IND CHIP 1000NH 5% LOW
L3768	2462587T30	IND CHIP 1000NH 5% LOW
L3769	2462587T30	IND CHIP 1000NH 5% LOW
L3770	2462587T30	IND CHIP 1000NH 5% LOW
L3771	2462587T30	IND CHIP 1000NH 5% LOW

Reference Designator	Motorola Part Number	Description
L3772	2462587T30	IND CHIP 1000NH 5% LOW
L3773	2462587T30	IND CHIP 1000NH 5% LOW
L3774	2409377M13	IDCTR,CHIP,56NH,5%,600 "
L3775	2462587Q40	IND CHIP 270 NH 10%
L3776	2462587T30	IND CHIP 1000NH 5% LOW
L3778	2409377M13	IDCTR,CHIP,56NH,5%,600 "
L3779	2409377M19	IDCTR,CHIP,120NH,5%,30 "
L3781	2409377M10	IDCTR,CHIP,33NH,5%,600 "
L3782	2409377M08	IDCTR,CHIP,22NH,5%,700 "
L3783	2462587T30	IND CHIP 1000NH 5% LOW
L3784	2409377M19	IDCTR,CHIP,120NH,5%,30 "
L3785	2409377M12	IDCTR,CHIP,47NH,5%,600 "
L3787	2409377M09	IDCTR,CHIP,27NH,5%,600 "
L400	2485821C07	IDCTR,CHIP"
M3520	2685838C01	HEATSINK PLD1.5 TRANSI
M3542	2685837C04	HEATSINK TRANSISTOR CA
Q0200	4880048M01	TSTR NPN DIG 47K/47K
Q0402	4880048M01	TSTR NPN DIG 47K/47K
Q0403	4805723X03	TRANS DUAL NPN-PNP UMD
Q0404	4880048M01	TSTR NPN DIG 47K/47K
Q0500	4880048M01	TSTR NPN DIG 47K/47K
Q0501	4880048M01	TSTR NPN DIG 47K/47K
Q0502	4880048M01	TSTR NPN DIG 47K/47K
Q0503	4813821A09	TSTR P-CH 60V 12A _295
Q0504	4880048M01	TSTR NPN DIG 47K/47K
Q0505	4880048M01	TSTR NPN DIG 47K/47K
Q0610	4805723X03	TRANS DUAL NPN-PNP UMD
Q0611	4805723X03	TRANS DUAL NPN-PNP UMD

Reference Designator	Motorola Part Number	Description
Q0612	4805723X03	TRANS DUAL NPN-PNP UMD
Q0613	4805723X03	TRANS DUAL NPN-PNP UMD
Q0951	4880048M01	TSTR NPN DIG 47K/47K
Q0952	4885844C01	XSTR FET
Q0954	4809579E16	TSTR MOSFET N-CHAN TN0
Q0955	4809579E16	TSTR MOSFET N-CHAN TN0
Q0960	4805723X03	TRANS DUAL NPN-PNP UMD
Q3000	4805218N63	RF TRANS SOT 323 Bfq67
Q3001	4805128M19	TSTR SOT23 MMBTA13 RH
Q3250	4880048M01	TSTR NPN DIG 47K/47K
Q3252	4804188K01	TSTR NPN RF NE85634
Q3253	4805921T11	XSTR DUAL PNP
Q3254	4805921T11	XSTR DUAL PNP
Q3255	4804188K01	TSTR NPN RF NE85634
Q3256	4813824A10	TSTR NPN 40V .2A GEN P
Q3257	4813824A10	TSTR NPN 40V .2A GEN P
Q3258	4813824A10	TSTR NPN 40V .2A GEN P
Q3400	4805921T11	XSTR DUAL PNP
Q3401	4804188K01	TSTR NPN RF NE85634
Q3530	4886212B01	LD MOS PWR TSTR MRF1518
Q3550	4813828C45	TSTR VHF 50W 12.5 VOLT
Q3750	4813824A10	TSTR NPN 40V .2A GEN P
Q3751	4880141L06	TSTR NC MOS FET SOT23
Q3752	4880141L06	TSTR NC MOS FET SOT23
Q3753	4880141L06	TSTR NC MOS FET SOT23
Q3754	4880141L06	TSTR NC MOS FET SOT23
Q3755	4813824A10	TSTR NPN 40V .2A GEN P
Q3756	4813824A17	XSTR PNP40V .2A GENP B
Q3757	4809527E41	TRANSISTOR UHF PRF949
Q3758	4809527E41	TRANSISTOR UHF PRF949

Reference Designator	Motorola Part Number	Description
Q3759	4809527E41	TRANSISTOR UHF PRF949
Q3760	4809527E41	TRANSISTOR UHF PRF949
Q3761	4809527E41	TRANSISTOR UHF PRF949
Q3762	4804188K14	TSTR,RF POWER,SLCN,NPN"
Q3763	4805921T04	XISTOR FMC1 RH REELED
Q3764	4805921T04	XISTOR FMC1 RH REELED
Q3765	4805921T04	XISTOR FMC1 RH REELED
Q3766	4805921T04	XISTOR FMC1 RH REELED
Q3767	4805921T11	XSTR DUAL PNP
Q3768	4880048M03	TRST NPN DIG 47K/47K
Q3769	4809527E41	TRANSISTOR UHF PRF949
R0101	0662057M98	RES. CHIP 10K 5% 20X40
R0105	0662057M98	RES. CHIP 10K 5% 20X40
R0106	0662057M98	RES. CHIP 10K 5% 20X40
R0107	0662057M01	RES. CHIP 0 5% 20X40
R0109	0662057M98	RES. CHIP 10K 5% 20X40
R0111	0662057M86	RES. CHIP 3300 5% 20X4
R0114	0662057M01	RES. CHIP 0 5% 20X40
R0116	0662057B46	CHIP RES 10.0 MEG OHMS
R0117	0662057B46	CHIP RES 10.0 MEG OHMS
R0119	0662057N39	RES. CHIP 470K 5% 20X4
R0120	0662057M98	RES. CHIP 10K 5% 20X40
R0121	0662057M98	RES. CHIP 10K 5% 20X40
R0122	0662057M86	RES. CHIP 3300 5% 20X4
R0123	0662057M86	RES. CHIP 3300 5% 20X4
R0125	0662057M98	RES. CHIP 10K 5% 20X40
R0126	0662057M01	RES. CHIP 0 5% 20X40
R0200	0662057M74	RES. CHIP 1000 5% 20X4
R0201	0662057M01	RES. CHIP 0 5% 20X40
R0202	0662057M86	RES. CHIP 3300 5% 20X4
R0203	0662057M74	RES. CHIP 1000 5% 20X4
R0204	0662057M68	RES. CHIP 560 5% 20X40
R0205	0662057N15	RES. CHIP 47K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0207	0662057M95	RES. CHIP 7500 5% 20X4
R0208	0662057N23	RES. CHIP 100K 5% 20X4
R0209	0662057M98	RES. CHIP 10K 5% 20X40
R0210	0662057N23	RES. CHIP 100K 5% 20X4
R0212	0662057N23	RES. CHIP 100K 5% 20X4
R0216	0662057N23	RES. CHIP 100K 5% 20X4
R0218	0662057M74	RES. CHIP 1000 5% 20X4
R0219	0662057M74	RES. CHIP 1000 5% 20X4
R0220	0662057N05	RES. CHIP 18K 5% 20X40
R0221	0662057M98	RES. CHIP 10K 5% 20X40
R0222	0662057M98	RES. CHIP 10K 5% 20X40
R0224	0662057M01	RES. CHIP 0 5% 20X40
R0225	0662057M98	RES. CHIP 10K 5% 20X40
R0226	0662057N12	RES. CHIP 36K 5% 20X40
R0227	0662057N19	RES. CHIP 68K 5% 20X40
R0228	0662057N11	RES. CHIP 33K 5% 20X40
R0229	0662057N19	RES. CHIP 68K 5% 20X40
R0230	0662057N11	RES. CHIP 33K 5% 20X40
R0231	0662057C13	CHIP RES 2.7 OHMS 5%
R0235	0662057M98	RES. CHIP 10K 5% 20X40
R0236	0662057M97	RES. CHIP 9100 5% 20X4
R0300	0662057M50	RES. CHIP 100 5% 20X40
R0301	0662057M50	RES. CHIP 100 5% 20X40
R0303	0662057M78	RES. CHIP 1500 5% 20X4
R0304	0662057M34	RES. CHIP 22 5% 20X40
R0305	0662057M34	RES. CHIP 22 5% 20X40
R0307	0662057M98	RES. CHIP 10K 5% 20X40
R0403	0662057M98	RES. CHIP 10K 5% 20X40
R0404	0662057M74	RES. CHIP 1000 5% 20X4
R0405	0662057M74	RES. CHIP 1000 5% 20X4
R0406	0662057M68	RES. CHIP 560 5% 20X40
R0407	0662057M50	RES. CHIP 100 5% 20X40
R0408	0662057M50	RES. CHIP 100 5% 20X40
R0409	0662057M98	RES. CHIP 10K 5% 20X40
R0410	0662057M50	RES. CHIP 100 5% 20X40
R0411	0662057M98	RES. CHIP 10K 5% 20X40
R0412	0662057M50	RES. CHIP 100 5% 20X40
R0415	0662057M50	RES. CHIP 100 5% 20X40
R0416	0662057M50	RES. CHIP 100 5% 20X40
R0417	0662057M50	RES. CHIP 100 5% 20X40
R0418	0662057M50	RES. CHIP 100 5% 20X40

Reference Designator	Motorola Part Number	Description
R0419	0662057M90	RES. CHIP 4700 5% 20X4
R0420	0662057M98	RES. CHIP 10K 5% 20X40
R0421	0662057M01	RES. CHIP 0 5% 20X40
R0422	0662057V15	RES CHIP 33K 1% 1/16W
R0425	0662057M98	RES. CHIP 10K 5% 20X40
R0430	0662057M01	RES. CHIP 0 5% 20X40
R0431	0662057M98	RES. CHIP 10K 5% 20X40
R0432	0662057M50	RES. CHIP 100 5% 20X40
R0435	0662057M74	RES. CHIP 1000 5% 20X4
R0500	0662057N23	RES. CHIP 100K 5% 20X4
R0502	0662057N37	RES. CHIP 390K 5% 20X4
R0503	0662057N23	RES. CHIP 100K 5% 20X4
R0504	0662057N23	RES. CHIP 100K 5% 20X4
R0505	0662057M98	RES. CHIP 10K 5% 20X40
R0506	0662057M98	RES. CHIP 10K 5% 20X40
R0507	0662057M98	RES. CHIP 10K 5% 20X40
R0508	0662057M98	RES. CHIP 10K 5% 20X40
R0509	0662057M81	RES. CHIP 2000 5% 20X4
R0510	0662057V18	RES CHIP 43K 1% 1/16W
R0511	0662057V15	RES CHIP 33K 1% 1/16W
R0512	0662057V02	RES CHIP 10K 1% 1/16W
R0513	0662057V17	RES CHIP 39K 1% 1/16W
R0514	0662057M01	RES. CHIP 0 5% 20X40
R0515	0662057M74	RES. CHIP 1000 5% 20X4
R0516	0662057N23	RES. CHIP 100K 5% 20X4
R0517	0662057M90	RES. CHIP 4700 5% 20X4
R0518	0662057M98	RES. CHIP 10K 5% 20X40
R0519	0662057C27	CHIP RES 10 OHMS 5%
R0520	0662057N15	RES. CHIP 47K 5% 20X40
R0521	0662057V17	RES CHIP 39K 1% 1/16W
R0522	0662057V10	RES CHIP 20K 1% 1/16W
R0523	0662057N23	RES. CHIP 100K 5% 20X4
R0525	0662057M50	RES. CHIP 100 5% 20X40
R0526	0662057M50	RES. CHIP 100 5% 20X40
R0528	0662057M95	RES. CHIP 7500 5% 20X4
R0529	0662057M76	RES. CHIP 1200 5% 20X4
R0531	0662057N23	RES. CHIP 100K 5% 20X4
R0620	0662057M50	RES. CHIP 100 5% 20X40
R0621	0662057M50	RES. CHIP 100 5% 20X40
R0622	0662057M50	RES. CHIP 100 5% 20X40
R0623	0662057M50	RES. CHIP 100 5% 20X40

Reference Designator	Motorola Part Number	Description
R0624	0662057M50	RES. CHIP 100 5% 20X40
R0625	0662057M98	RES. CHIP 10K 5% 20X40
R0626	0662057N23	RES. CHIP 100K 5% 20X4
R0627	0662057N23	RES. CHIP 100K 5% 20X4
R0628	0662057N23	RES. CHIP 100K 5% 20X4
R0629	0662057M98	RES. CHIP 10K 5% 20X40
R0630	0662057N23	RES. CHIP 100K 5% 20X4
R0631	0662057M01	RES. CHIP 0 5% 20X40
R0634	0662057N23	RES. CHIP 100K 5% 20X4
R0635	0662057N23	RES. CHIP 100K 5% 20X4
R0636	0662057M98	RES. CHIP 10K 5% 20X40
R0638	0662057M98	RES. CHIP 10K 5% 20X40
R0639	0662057M98	RES. CHIP 10K 5% 20X40
R0901	0662057M96	RES. CHIP 8200 5% 20X4
R0902	0662057N23	RES. CHIP 100K 5% 20X4
R0903	0662057N23	RES. CHIP 100K 5% 20X4
R0904	0662057N23	RES. CHIP 100K 5% 20X4
R0905	0662057N23	RES. CHIP 100K 5% 20X4
R0906	0662057M50	RES. CHIP 100 5% 20X40
R0907	0662057M50	RES. CHIP 100 5% 20X40
R0908	0662057C13	CHIP RES 2.7 OHMS 5%
R0910	0662057V25	RES CHIP 82K 1% 1/16W
R0911	0662057V04	RES CHIP 12K 1% 1/16W
R0912	0662057V04	RES CHIP 12K 1% 1/16W
R0913	0662057V30	RES CHIP 130K 1% 1/16W
R0914	0662057V04	RES CHIP 12K 1% 1/16W
R0915	0662057M74	RES. CHIP 1000 5% 20X4
R0916	0662057M66	RES. CHIP 470 5% 20X40
R0917	0662057M21	RES. CHIP 6.2 5% 20X40
R0923	0662057M50	RES. CHIP 100 5% 20X40
R0924	0662057M50	RES. CHIP 100 5% 20X40
R0930	0662057N06	RES. CHIP 20K 5% 20X40
R0931	0662057M98	RES. CHIP 10K 5% 20X40
R0932	0662057M86	RES. CHIP 3300 5% 20X4
R0933	0662057M90	RES. CHIP 4700 5% 20X4
R0934	0662057M74	RES. CHIP 1000 5% 20X4
R0936	0662057M01	RES. CHIP 0 5% 20X40
R0938	0662057M01	RES. CHIP 0 5% 20X40
R0940	0662057M01	RES. CHIP 0 5% 20X40
R0942	0662057N05	RES. CHIP 18K 5% 20X40
R0943	0662057N06	RES. CHIP 20K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0944	0662057M98	RES. CHIP 10K 5% 20X40
R0945	0662057N37	RES. CHIP 390K 5% 20X4
R0947	0662057M87	RES. CHIP 3600 5% 20X4
R0948	0662057M74	RES. CHIP 1000 5% 20X4
R0950	0662057M01	RES. CHIP 0 5% 20X40
R0951	0662057U98	RES CHIP 7.5K 1% 1/16W
R0952	0662057U78	RES CHIP 1.2K 1% 1/16W
R0953	0662057M01	RES. CHIP 0 5% 20X40
R0954	0662057U98	RES CHIP 7.5K 1% 1/16W
R0955	0662057N23	RES. CHIP 100K 5% 20X4
R0960	0662057N06	RES. CHIP 20K 5% 20X40
R0961	0662057N23	RES. CHIP 100K 5% 20X4
R0962	0662057N23	RES. CHIP 100K 5% 20X4
R0963	0662057N05	RES. CHIP 18K 5% 20X40
R0964	0662057M86	RES. CHIP 3300 5% 20X4
R0965	0662057M01	RES. CHIP 0 5% 20X40
R0966	0662057M01	RES. CHIP 0 5% 20X40
R0967	0662057V27	RES CHIP 100K 1% 1/16W
R0968	0662057V02	RES CHIP 10K 1% 1/16W
R0971	0662057N03	RES. CHIP 15K 5% 20X40
R0972	0662057U93	RES CHIP 4.7K 1% 1/16W
R0973	0662057N05	RES. CHIP 18K 5% 20X40
R0974	0662057V02	RES CHIP 10K 1% 1/16W
R0975	0662057V02	RES CHIP 10K 1% 1/16W
R0976	0662057M78	RES. CHIP 1500 5% 20X4
R0977	0662057M54	RES. CHIP 150 5% 20X40
R0978	0662057M98	RES. CHIP 10K 5% 20X40
R0979	0662057M01	RES. CHIP 0 5% 20X40
R0981	0662057M84	RES. CHIP 2700 5% 20X4
R0982	0662057N23	RES. CHIP 100K 5% 20X4
R0983	0662057M74	RES. CHIP 1000 5% 20X4
R0984	0662057M01	RES. CHIP 0 5% 20X40
R0985	0662057M01	RES. CHIP 0 5% 20X40
R0987	0662057M01	RES. CHIP 0 5% 20X40
R0988	0662057M98	RES. CHIP 10K 5% 20X40
R0989	0662057N17	RES. CHIP 56K 5% 20X40
R0990	0662057M91	RES. CHIP 5100 5% 20X4
R0991	0662057M98	RES. CHIP 10K 5% 20X40
R0992	0662057N23	RES. CHIP 100K 5% 20X4
R0993	0662057U78	RES CHIP 1.2K 1% 1/16W
R0994	0662057M91	RES. CHIP 5100 5% 20X4

Reference Designator	Motorola Part Number	Description
R0995	0662057U78	RES CHIP 1.2K 1% 1/16W
R0996	0662057M98	RES. CHIP 10K 5% 20X40
R0997	0662057U78	RES CHIP 1.2K 1% 1/16W
R0998	0662057V02	RES CHIP 10K 1% 1/16W
R0999	0662057V02	RES CHIP 10K 1% 1/16W
R3000	0662057M43	RES. CHIP 51 5% 20X40
R3001	0662057N47	RES. CHIP 1.0 MEG 5% 2
R3002	0662057N23	RES. CHIP 100K 5% 20X4
R3003	0662057N03	RES. CHIP 15K 5% 20X40
R3004	0662057N05	RES. CHIP 18K 5% 20X40
R3005	0662057M98	RES. CHIP 10K 5% 20X40
R3006	0662057M98	RES. CHIP 10K 5% 20X40
R3007	0662057M98	RES. CHIP 10K 5% 20X40
R3008	0662057M98	RES. CHIP 10K 5% 20X40
R3009	0662057M74	RES. CHIP 1000 5% 20X4
R3010	0662057M64	RES. CHIP 390 5% 20X40
R3011	0662057M64	RES. CHIP 390 5% 20X40
R3012	0662057M01	RES. CHIP 0 5% 20X40
R3014	0662057M01	RES. CHIP 0 5% 20X40
R3015	0662057M01	RES. CHIP 0 5% 20X40
R3016	0662057M01	RES. CHIP 0 5% 20X40
R3017	0662057M01	RES. CHIP 0 5% 20X40
R3018	0662057M01	RES. CHIP 0 5% 20X40
R3019	0662057M01	RES. CHIP 0 5% 20X40
R3020	0662057M43	RES. CHIP 51 5% 20X40
R3021	0662057M66	RES. CHIP 470 5% 20X40
R3022	0662057M01	RES. CHIP 0 5% 20X40
R3251	0662057A01	CHIP RES 10 OHMS 5%
R3252	0662057R04	RES CHIP 12.1 .1W 1%
R3253	0662057M98	RES. CHIP 10K 5% 20X40
R3254	0662057A57	CHIP RES 2200 OHMS 5%
R3255	0662057A20	CHIP RES 62 OHMS 5%
R3256	0662057A49	CHIP RES 1000 OHMS 5%
R3257	0662057A44	CHIP RES 620 OHMS 5%
R3258	0662057A20	CHIP RES 62 OHMS 5%
R3259	0662057M90	RES. CHIP 4700 5% 20X4
R3260	0662057A18	CHIP RES 51 OHMS 5%
R3261	0662057M90	RES. CHIP 4700 5% 20X4
R3262	0662057M86	RES. CHIP 3300 5% 20X4
R3263	0662057M78	RES. CHIP 1500 5% 20X4
R3264	0662057M74	RES. CHIP 1000 5% 20X4

Reference Designator	Motorola Part Number	Description
R3265	0662057M98	RES. CHIP 10K 5% 20X40
R3266	0662057M98	RES. CHIP 10K 5% 20X40
R3268	0662057A20	CHIP RES 62 OHMS 5%
R3269	0662057N17	RES. CHIP 56K 5% 20X40
R3270	0662057A18	CHIP RES 51 OHMS 5%
R3271	0662057A22	CHIP RES 75 OHMS 5%
R3272	0662057A13	CHIP RES 33 OHMS 5%
R3273	0662057M88	RES. CHIP 3900 5% 20X4
R3274	0662057M64	RES. CHIP 390 5% 20X40
R3275	0662057M64	RES. CHIP 390 5% 20X40
R3277	0662057M86	RES. CHIP 3300 5% 20X4
R3278	0662057N17	RES. CHIP 56K 5% 20X40
R3279	0662057M95	RES. CHIP 7500 5% 20X4
R3280	0662057M86	RES. CHIP 3300 5% 20X4
R3281	0662057M87	RES. CHIP 3600 5% 20X4
R3288	0662057A20	CHIP RES 62 OHMS 5%
R3400	0662057A44	CHIP RES 620 OHMS 5%
R3401	0662057M90	RES. CHIP 4700 5% 20X4
R3402	0662057M86	RES. CHIP 3300 5% 20X4
R3405	0662057M78	RES. CHIP 1500 5% 20X4
R3407	0662057A01	CHIP RES 10 OHMS 5%
R3409	0662057A22	CHIP RES 75 OHMS 5%
R3413	0662057A25	CHIP RES 100 OHMS 5%
R3501	0662057M50	RES. CHIP 100 5% 20X40
R3502	0662057M92	RES. CHIP 5600 5% 20X4
R3507	0662057C13	CHIP RES 2.7 OHMS 5%
R3520	0662057M44	RES. CHIP 56 5% 20X40
R3521	0662057M44	RES. CHIP 56 5% 20X40
R3522	0662057M44	RES. CHIP 56 5% 20X40
R3523	0662057M44	RES. CHIP 56 5% 20X40
R3524	0662057C75	CHIP RES 1000 OHMS 5%
R3530	0611077A01	RES CHIP JUMPER
R3531	0680195M01	RES CHIP 10 OHMS 5% .5
R3532	0655087A24	3.9 OHM 5% 1/16W
R3533	0655087A24	3.9 OHM 5% 1/16W
R3534	0655087A24	3.9 OHM 5% 1/16W
R3535	0655087A24	3.9 OHM 5% 1/16W
R3536	0655087A24	3.9 OHM 5% 1/16W
R3537	0655087A24	3.9 OHM 5% 1/16W
R3538	0655087A24	3.9 OHM 5% 1/16W
R3540	0662057C75	CHIP RES 1000 OHMS 5%

Reference Designator	Motorola Part Number	Description
R3550	0685934D01	RES FIXED CHIP (CURRENT)
R3551	0680195M01	RES CHIP 10 OHMS 5% .5
R3560	0662057V27	RES CHIP 100K 1% 1/16W
R3561	0662057M61	RES. CHIP 300 5% 20X40
R3700	0680194M13	RES 33 OHMS 5% 1W
R3701	0662057M32	RES. CHIP 18 5% 20X40
R3702	0662057M74	RES. CHIP 1000 5% 20X4
R3703	0662057M32	RES. CHIP 18 5% 20X40
R3704	0662057M32	RES. CHIP 18 5% 20X40
R3730	0680149M02	THERMISTOR CHIP 100K O
R3731	0662057N10	RES. CHIP 30K 5% 20X40
R3732	0662057M78	RES. CHIP 1500 5% 20X4
R3733	0662057M59	RES. CHIP 240 5% 20X40
R3734	0662057M59	RES. CHIP 240 5% 20X40
R3735	0662057M59	RES. CHIP 240 5% 20X40
R3736	0662057M59	RES. CHIP 240 5% 20X40
R3737	0662057M78	RES. CHIP 1500 5% 20X4
R3738	0662057N10	RES. CHIP 30K 5% 20X40
R3739	0680149M02	THERMISTOR CHIP 100K O
R3750	0662057M74	RES. CHIP 1000 5% 20X4
R3751	0662057M34	RES. CHIP 22 5% 20X40
R3752	0662057M50	RES. CHIP 100 5% 20X40
R3753	0662057N23	RES. CHIP 100K 5% 20X4
R3754	0662057N23	RES. CHIP 100K 5% 20X4
R3755	0662057N23	RES. CHIP 100K 5% 20X4
R3756	0662057N03	RES. CHIP 15K 5% 20X40
R3757	0662057M81	RES. CHIP 2000 5% 20X4
R3758	0662057N17	RES. CHIP 56K 5% 20X40
R3759	0662057N15	RES. CHIP 47K 5% 20X40
R3761	0662057M98	RES. CHIP 10K 5% 20X40
R3762	0662057M92	RES. CHIP 5600 5% 20X4
R3763	0662057M74	RES. CHIP 1000 5% 20X4
R3793	0662057M92	RES. CHIP 5600 5% 20X4
R3794	0662057M21	RES. CHIP 6.2 5% 20X40
R3795	0662057M98	RES. CHIP 10K 5% 20X40
R3797	0662057M90	RES. CHIP 4700 5% 20X4
R3798	0662057M74	RES. CHIP 1000 5% 20X4
R3799	0662057M90	RES. CHIP 4700 5% 20X4
R3800	0662057A23	CHIP RES 82 OHMS 5%

Reference Designator	Motorola Part Number	Description
R3801	0662057A23	CHIP RES 82 OHMS 5%
R3802	0662057M72	RES. CHIP 820 5% 20X40
R3803	0662057M61	RES. CHIP 300 5% 20X40
R3804	0662057M61	RES. CHIP 300 5% 20X40
R3807	0662057A44	CHIP RES 620 OHMS 5%
R3808	0662057A44	CHIP RES 620 OHMS 5%
R3809	0662057M32	RES. CHIP 18 5% 20X40
R3811	0662057A21	CHIP RES 68 OHMS 5%
R3812	0662057A21	CHIP RES 68 OHMS 5%
R3813	0662057A23	CHIP RES 82 OHMS 5%
R3814	0662057A23	CHIP RES 82 OHMS 5%
R3815	0662057A23	CHIP RES 82 OHMS 5%
R3816	0662057A23	CHIP RES 82 OHMS 5%
R3817	0662057M34	RES. CHIP 22 5% 20X40
R3818	0662057M56	RES. CHIP 180 5% 20X40
R3819	0662057M56	RES. CHIP 180 5% 20X40
R3820	0662057M34	RES. CHIP 22 5% 20X40
R3821	0662057M72	RES. CHIP 820 5% 20X40
R3823	0662057M37	RES. CHIP 30 5% 20X40
R3824	0662057M56	RES. CHIP 180 5% 20X40
R3825	0662057M32	RES. CHIP 18 5% 20X40
R3826	0662057M61	RES. CHIP 300 5% 20X40
R3827	0662057M61	RES. CHIP 300 5% 20X40
R3828	0662057M50	RES. CHIP 100 5% 20X40
R3829	0662057M46	RES. CHIP 68 5% 20X40
R3831	0662057M21	RES. CHIP 6.2 5% 20X40
R3832	0662057M74	RES. CHIP 1000 5% 20X4
R3833	0662057M32	RES. CHIP 18 5% 20X40
R3834	0662057M32	RES. CHIP 18 5% 20X40
R3835	0662057M01	RES. CHIP 0 5% 20X40
R3836	0662057M43	RES. CHIP 51 5% 20X40
R3838	0662057M81	RES. CHIP 2000 5% 20X4
R3839	0662057M61	RES. CHIP 300 5% 20X40
R3840	0662057M61	RES. CHIP 300 5% 20X40
R3841	0662057M61	RES. CHIP 300 5% 20X40
R3842	0662057M61	RES. CHIP 300 5% 20X40
R3845	0662057M86	RES. CHIP 3300 5% 20X4
R3846	0662057M90	RES. CHIP 4700 5% 20X4
R3851	0662057A11	CHIP RES 27 OHMS 5%
R3852	0662057A11	CHIP RES 27 OHMS 5%
R3854	0662057M50	RES. CHIP 100 5% 20X40

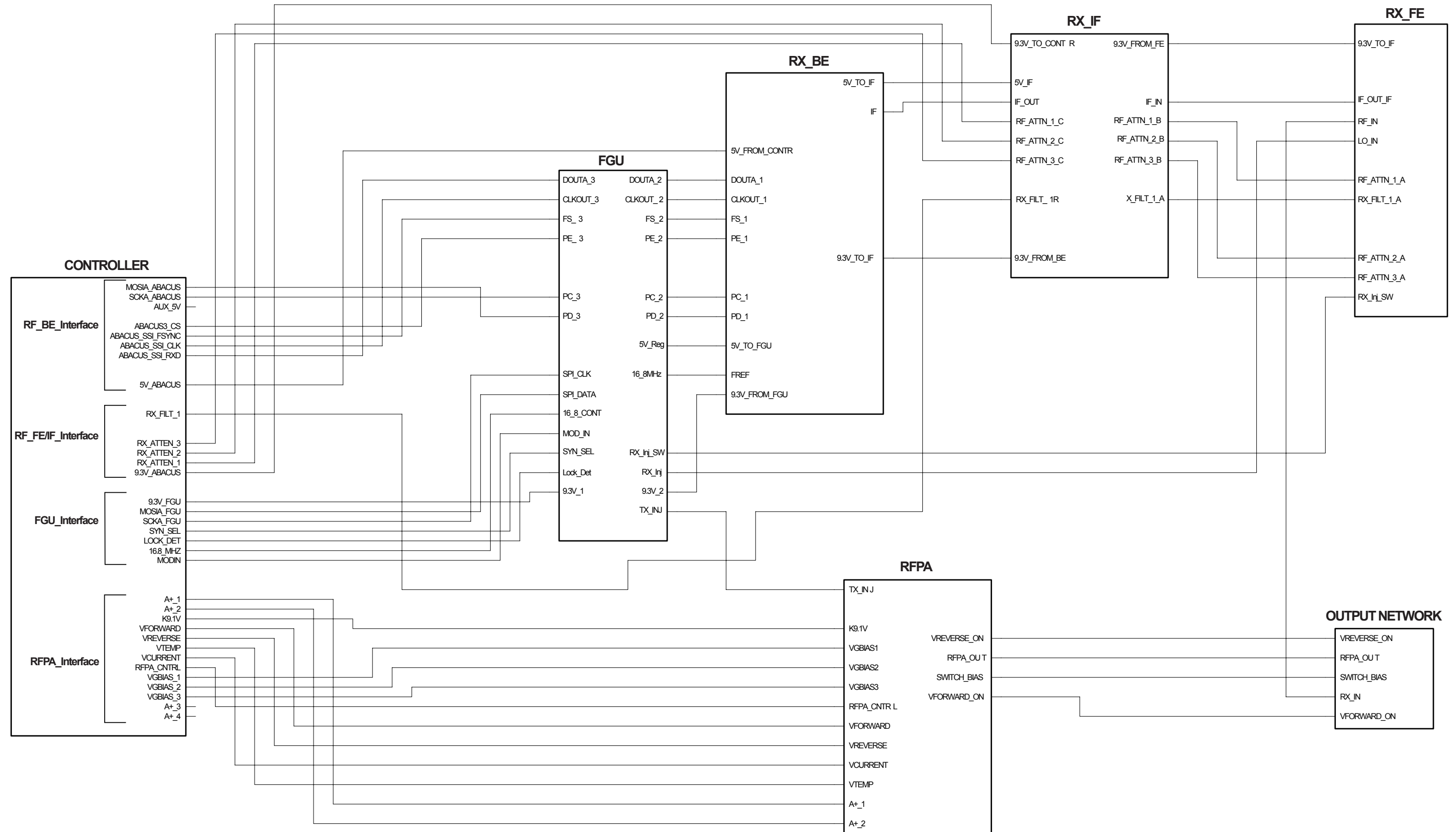
Reference Designator	Motorola Part Number	Description
R3855	0662057M50	RES. CHIP 100 5% 20X40
R3856	0662057M61	RES. CHIP 300 5% 20X40
R3857	0662057M61	RES. CHIP 300 5% 20X40
R3858	0662057M56	RES. CHIP 180 5% 20X40
R3859	0662057M56	RES. CHIP 180 5% 20X40
R3860	0662057M72	RES. CHIP 820 5% 20X40
R3861	0662057M72	RES. CHIP 820 5% 20X40
R3862	0662057M21	RES. CHIP 6.2 5% 20X40
R3863	0662057M37	RES. CHIP 30 5% 20X40
R3864	0662057M32	RES. CHIP 18 5% 20X40
R3865	0662057M46	RES. CHIP 68 5% 20X40
R3868	0662057M92	RES. CHIP 5600 5% 20X4
R3869	0662057M90	RES. CHIP 4700 5% 20X4
R3870	0662057M62	RES. CHIP 330 5% 20X40
R3871	0662057A33	CHIP RES 220 OHMS 5%
R3872	0662057A25	CHIP RES 100 OHMS 5%
R3873	0662057A09	CHIP RES 22 OHMS 5%
R3880	0662057A49	CHIP RES 1000 OHMS 5%
R3881	0662057A49	CHIP RES 1000 OHMS 5%
R3882	0662057A44	CHIP RES 620 OHMS 5%
R3884	0662057A44	CHIP RES 620 OHMS 5%
SH3750	2602641Y02	SHIELD,ARIANE VCO"
SH3751	2602660J02	SHLD 18.13 X 11.14
SH3752	2602660J02	SHLD 18.13 X 11.14
SH3753	2602660J02	SHLD 18.13 X 11.14
SH3754	2602641Y02	"SHIELD,ARIANE VCO"
SH3759	2602660J02	SHLD 18.13 X 11.14
SH3760	2689589U01	VCO SHIELD
SH3762	2605782V04	SHLD
SH3763	2605782V04	SHLD
T3301	2580541Z02	BALUN TRANSFORMER (NEW
T3302	2580541Z02	BALUN TRANSFORMER (NEW
U0001	5185633C34	MODULE RAM/MEMORY
U0102	5185623B01	HIGH SPEED CMOS INVERT
U0103	5113837A15	IC 3.3V QUAD BUFFER
U0104	5113837A15	IC 3.3V QUAD BUFFER
U0105	5109522E17	IC SNGL NAND TC7S00FU
U0200	5105109Z38	3 VOLT LINEAR PCM CODE

Reference Designator	Motorola Part Number	Description
U0201	5113819A14	IC QD OP AMP _33204_
U0202	5185353D35	IC DUAL EEPOT 256 TAP
U0203	5162852A79	IC MOS TTL SPDT ANALOG
U0204	5185794L01	AUDIO AMP TAPE AND REE
U0206	5185143E67	INTEGRATED CIRCUITS
U0208	5162852A79	IC MOS TTL SPDT ANALOG
U0209	5162852A79	IC MOS TTL SPDT ANALOG
U0210	5162852A79	IC MOS TTL SPDT ANALOG
U0300	5113837A15	IC 3.3V QUAD BUFFER
U0303	5113837A15	IC 3.3V QUAD BUFFER
U0304	5187970L15	IC USB TRANS FULL-SPEE
U0305	5185353D94	IC RS232 TRANSCEIVER
U0307	5113805B65	IC 2 INPUT NAND
U0308	5109522E74	IC 2INPUT AND GATE
U0400	4880048M01	TSTR NPN DIG 47K/47K
U0401	5162852A79	IC MOS TTL SPDT ANALOG
U0402	5109522E53	IC,BFR,1BITS,NC7SZ125P"
U0500	5183308X01	IC, LM2941, TO DRPOUT"
U0501	5185353D55	IC VOLTAGE REGULATOR 1
U0502	5185353D55	IC VOLTAGE REGULATOR 1
U0503	5113816A07	REG 5V POS 500MA MC78M
U0504	5185353D46	IF 4.3V VOLTAGE DETECT
U0505	5113816A07	REG 5V POS 500MA MC78M
U0506	5185143E57	CMOS TIMER-LMC555CM
U0507	5185353D55	IC VOLTAGE REGULATOR 1
U0508	5109522E53	IC,BFR,1BITS,NC7SZ125P"
U0601	5109522E17	IC SNGL NAND TC7S00FU
U0602	5113837A15	IC 3.3V QUAD BUFFER
U0603	5113837A15	IC 3.3V QUAD BUFFER
U0604	5113818A14	IC DL OP AMP RAIL TO R

Reference Designator	Motorola Part Number	Description
U0605	5109522E17	IC SNGL NAND TC7S00FU
U0606	5105109Z31	IC QUAD 2:1 MUX/DEMUX
U0607	5109522E74	IC 2INPUT AND GATE
U0608	5109522E74	IC 2INPUT AND GATE
U0609	5109522E17	IC SNGL NAND TC7S00FU
U0610	5109522E17	IC SNGL NAND TC7S00FU
U0900	5185368C83	IC 12 BIT DAC
U0901	5185143E43	IC 23 MACROCELL CPLD
U0902	5113805B39	IC MUX/DEMUX, TRIP 2-C"
U0903	5185143E68	INTEGRATED CIRCUITS
U0950	5105625U25	IC 9.3V REG 2941
U0951	5105625U25	IC 9.3V REG 2941
U0952	5185353D35	IC DUAL EEPOT 256 TAP
U0953	5185143E16	IC ANALOG TO DIGITAL C
U0954	5109522E17	IC SNGL NAND TC7S00FU
U0955	5113819A14	IC QD OP AMP _33204_
U0956	5185956E24	IC,OP AMP,2PER PKG,RAI"
U0957	5113819A14	IC QD OP AMP _33204_
U0958	5109522E17	IC SNGL NAND TC7S00FU
U0959	5185143E05	IC DAC OCTAL 8 BIT
U0960	5113819A14	IC QD OP AMP _33204_
U0962	5185353D14	IC SOT23-5 HI PRECISIO
U0963	5109522E53	IC,BFR,1BITS,NC7SZ125P"
U0965	5185143E68	INTEGRATED CIRCUITS
U3000	5185963A85	IC-ABACUS III-LP
U3001	5185353D14	IC SOT23-5 HI PRECISIO
U3250	5185130C83	IC 15DB DIGITAL ATTEUA
U3550	5185130C65	IC VHF/UHF/800 MHZ LDM
U3560	5185963A15	IC TEMPATURE SENSOR 1
U3561	5185353D92	IC CURRENT SHUNT MONIT
U3750	5185353D14	IC SOT23-5 HI PRECISIO
U3751	5185963A27	IC TESTED AT25016 48 P
U3752	5105492X03	IC SNG HI SPD L-MOS NO
VR0400	4805656W09	DIODE QUAD 20 VOLT ZEN
VR0402	4805656W09	DIODE QUAD 20 VOLT ZEN

Reference Designator	Motorola Part Number	Description
VR0404	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0405	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0406	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0407	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0408	4813832C75	TRANS SUP QUAD 6.8 V
VR0410	4813832C75	TRANS SUP QUAD 6.8 V
VR0411	4805656W39	QUAD ESD SUPPRES-SOR AR
VR0412	4805656W09	DIODE QUAD 20 VOLT ZEN
VR0414	4813832C75	TRANS SUP QUAD 6.8 V
VR0417	4813832C75	TRANS SUP QUAD 6.8 V
VR0418	4813832C75	TRANS SUP QUAD 6.8 V
VR0420	4813830A24	DIODE 11V 5% 225MW MMB
VR0421	4813830A24	DIODE 11V 5% 225MW MMB
VR0422	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0423	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0424	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0425	4805656W10	DIODE DUAL 15 VOLT ZEN
VR0500	4813830A14	DIODE 5.1V 5% 225MW MM
VR0501	4813830A24	DIODE 11V 5% 225MW MMB
VR0950	4813832C77	TRANS SUP. 24V HIGH PW
Y0100	4809995L05	XTAL QUARTZ 32.768KHZ
Y3400	4885230C01	109.65MHZ FILTER 3RD O
Y3401	4885230C01	109.65MHZ FILTER 3RD O
Y3750	5185143E07	IC 16.8 MHZ REF OSC .8
Y3751	2484562T11	COIL SURF MNT AIR WOUN
Y3752	2484562T11	COIL SURF MNT AIR WOUN
Y3753	2413923A24	IND CHIP 47 NH 2%
Y3754	2413923A01	IND CHIP 56 NH 2%

7.4 HUE4039A (UHF Range 1) Main Board



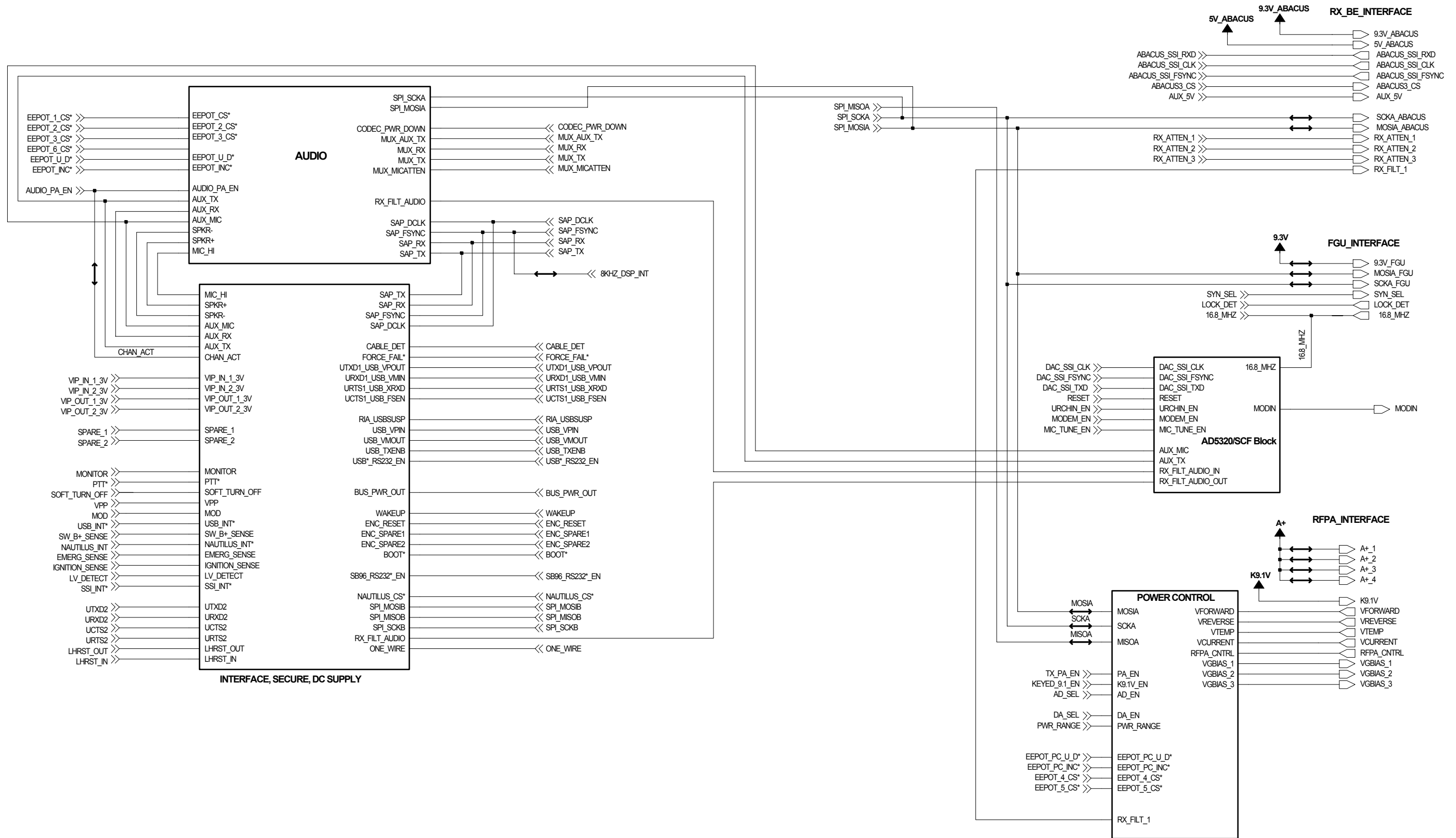


Figure 7-49. HUE4039A Controller Block Diagram and Interconnections (Sheet 1 of 2)

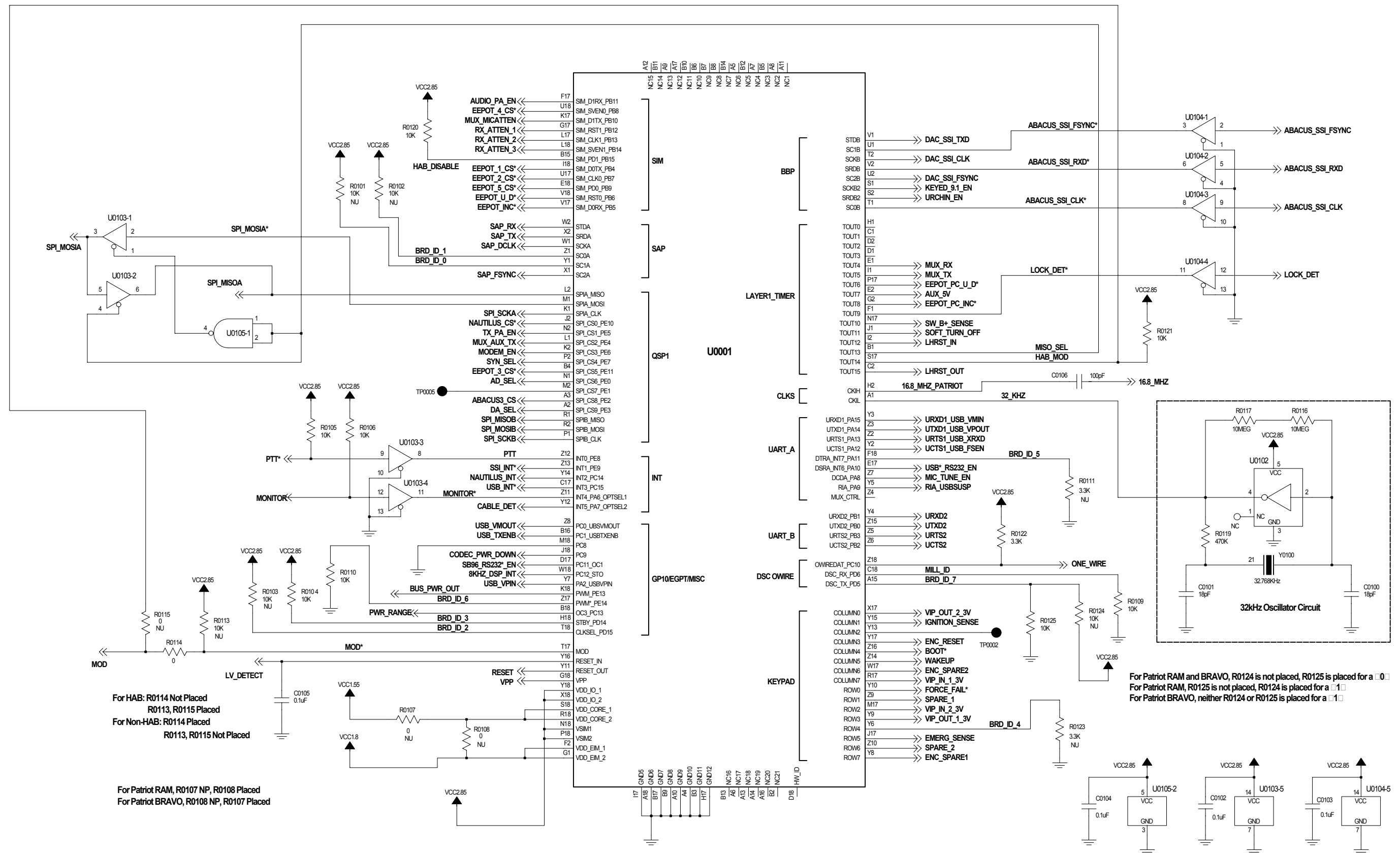


Figure 7-50. HUE4039A Controller Block Diagram and Interconnections (Sheet 2 of 2)

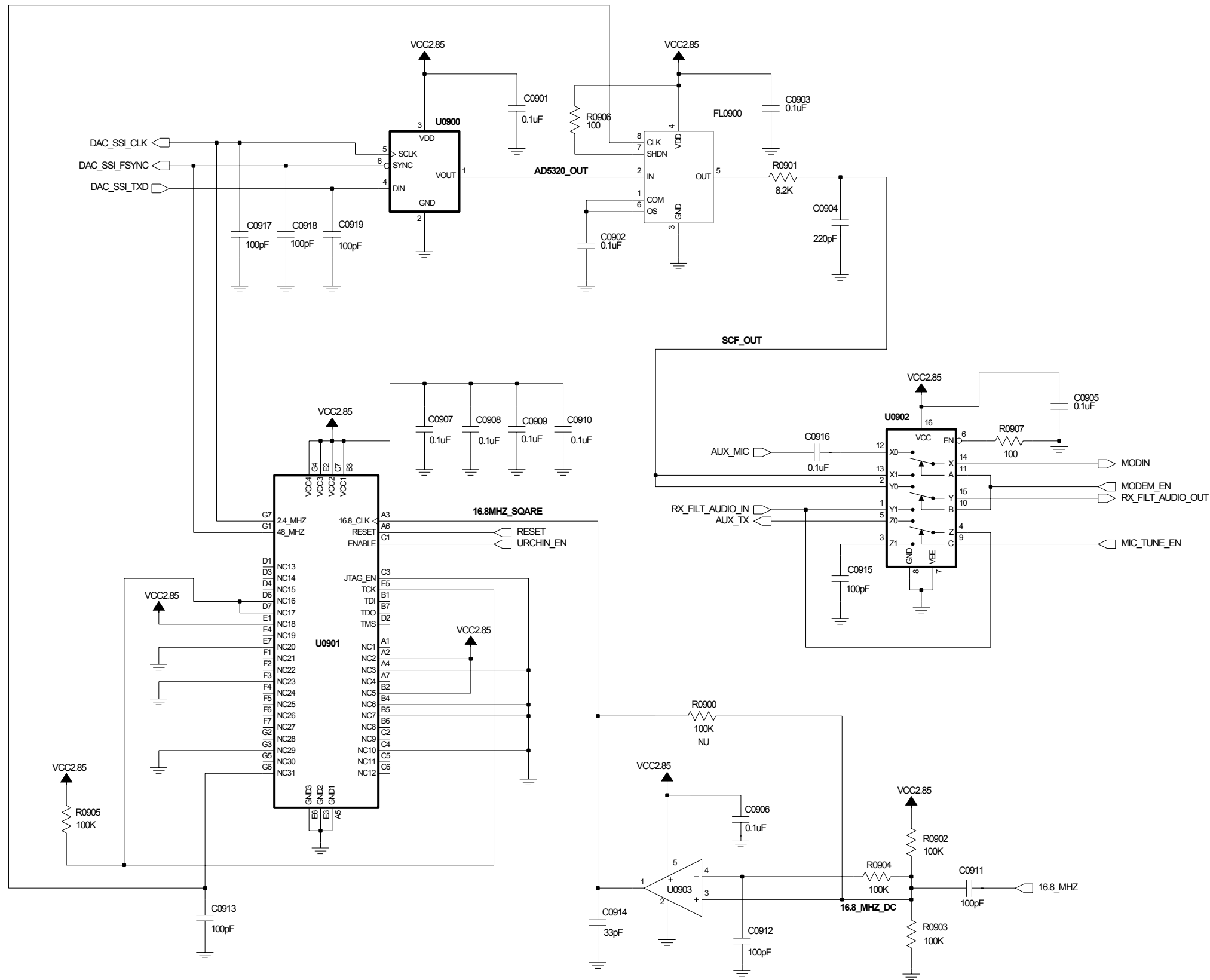


Figure 7-51. HUE4039A Controller Urchin IC, MUX, and AD5320 DAC Schematic

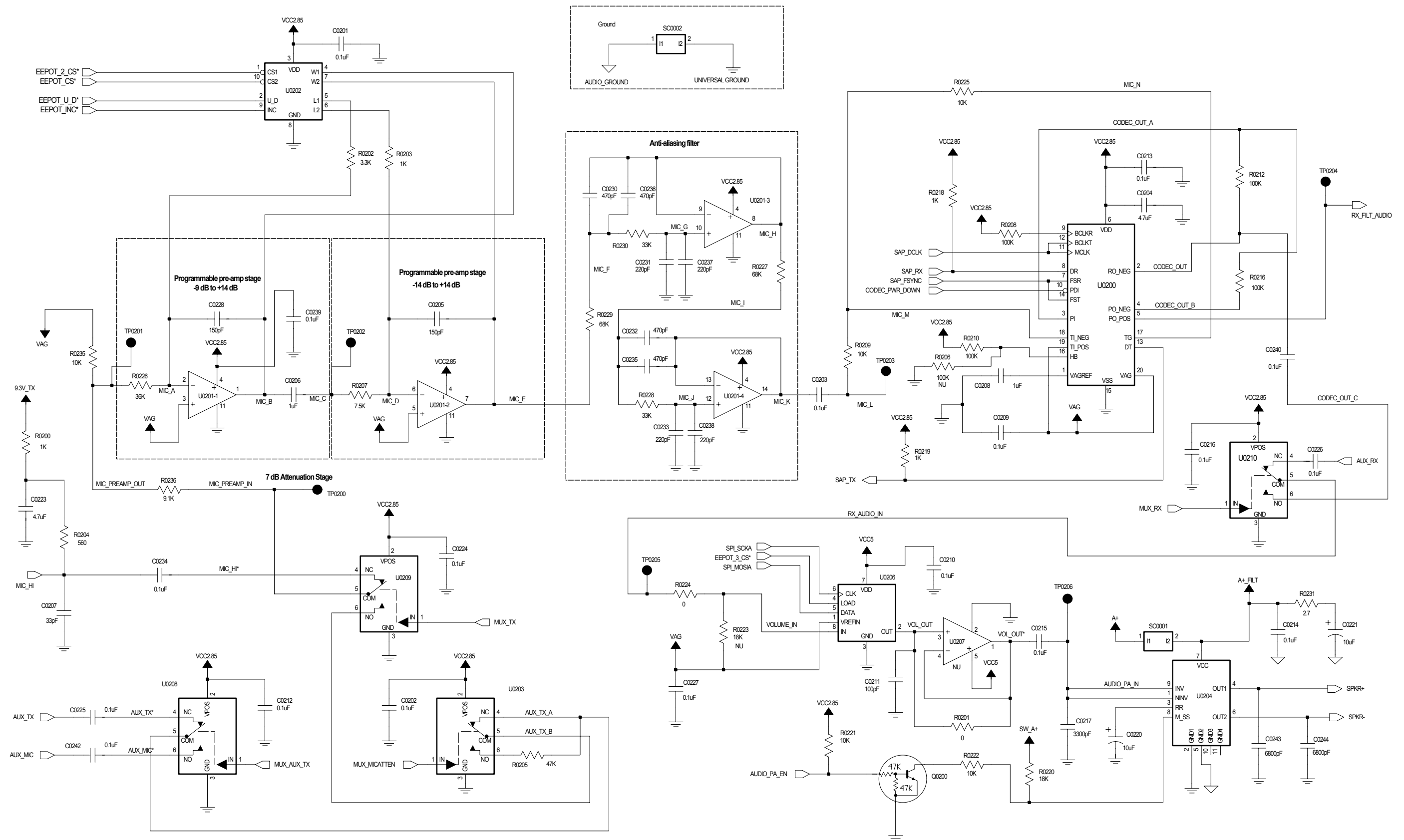


Figure 7-52. HUE4039A Controller Audio Schematic

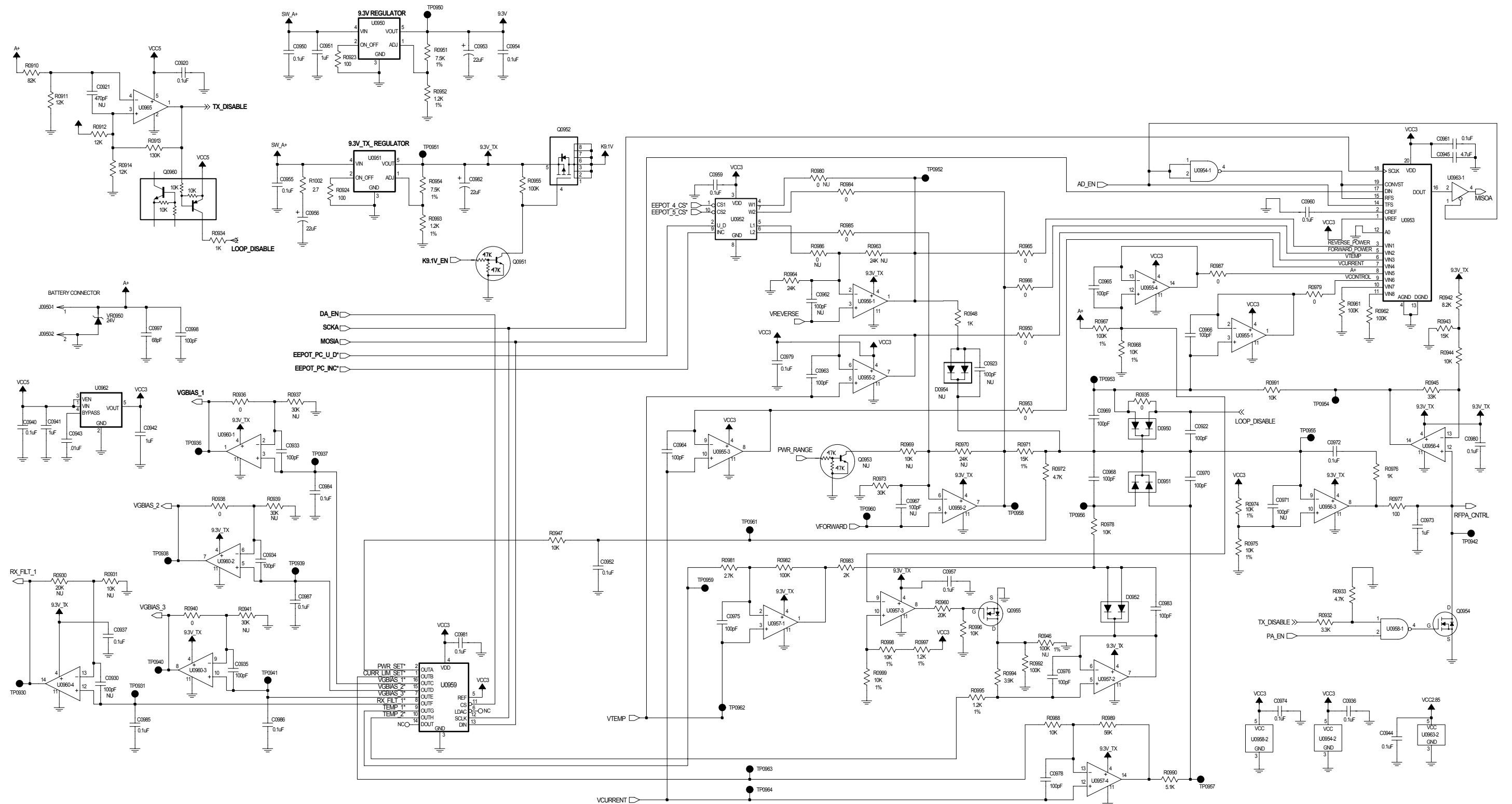


Figure 7-53. HUE4039A Controller Power Control Schematic

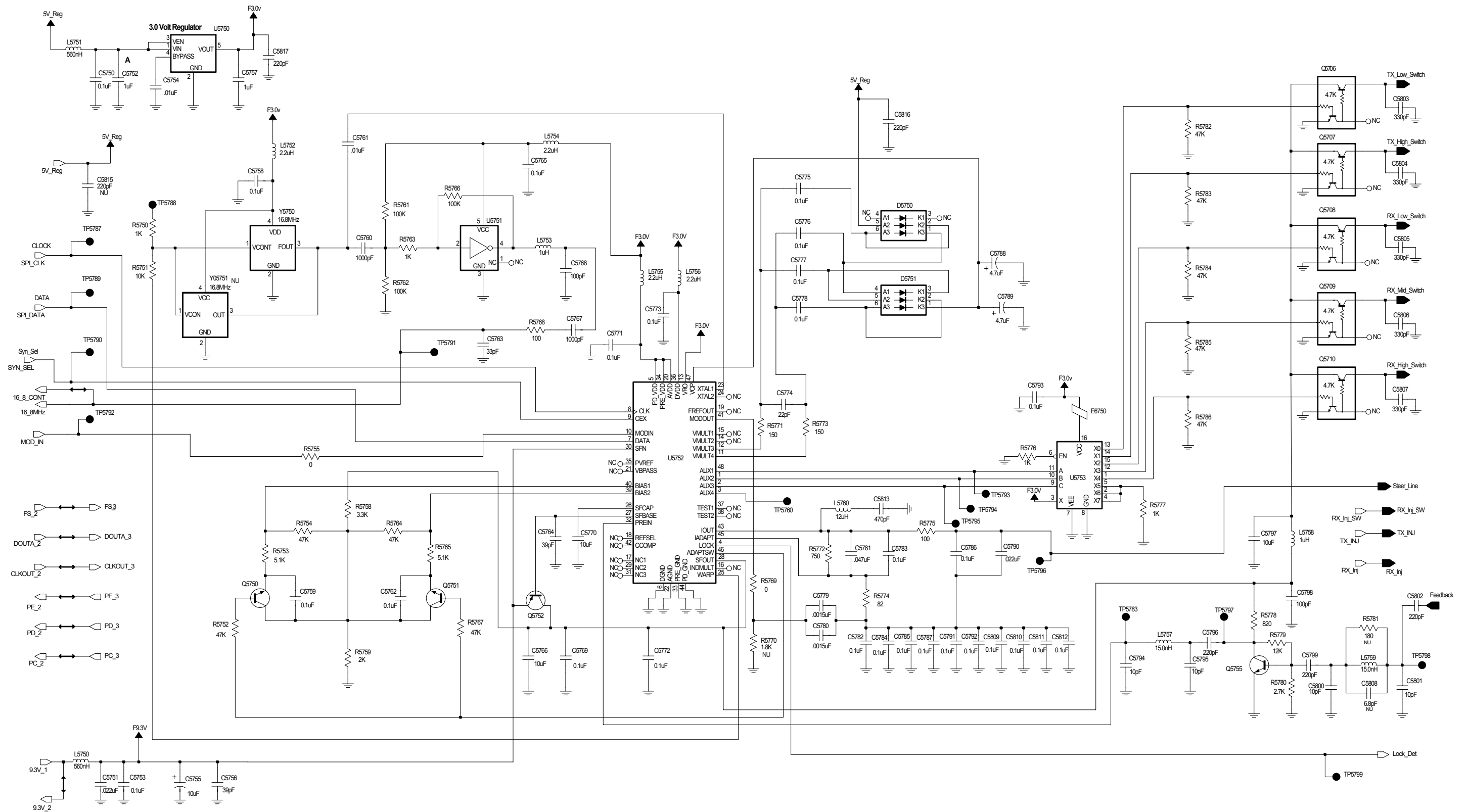


Figure 7-54. HUE4039A Frequency Generation Unit

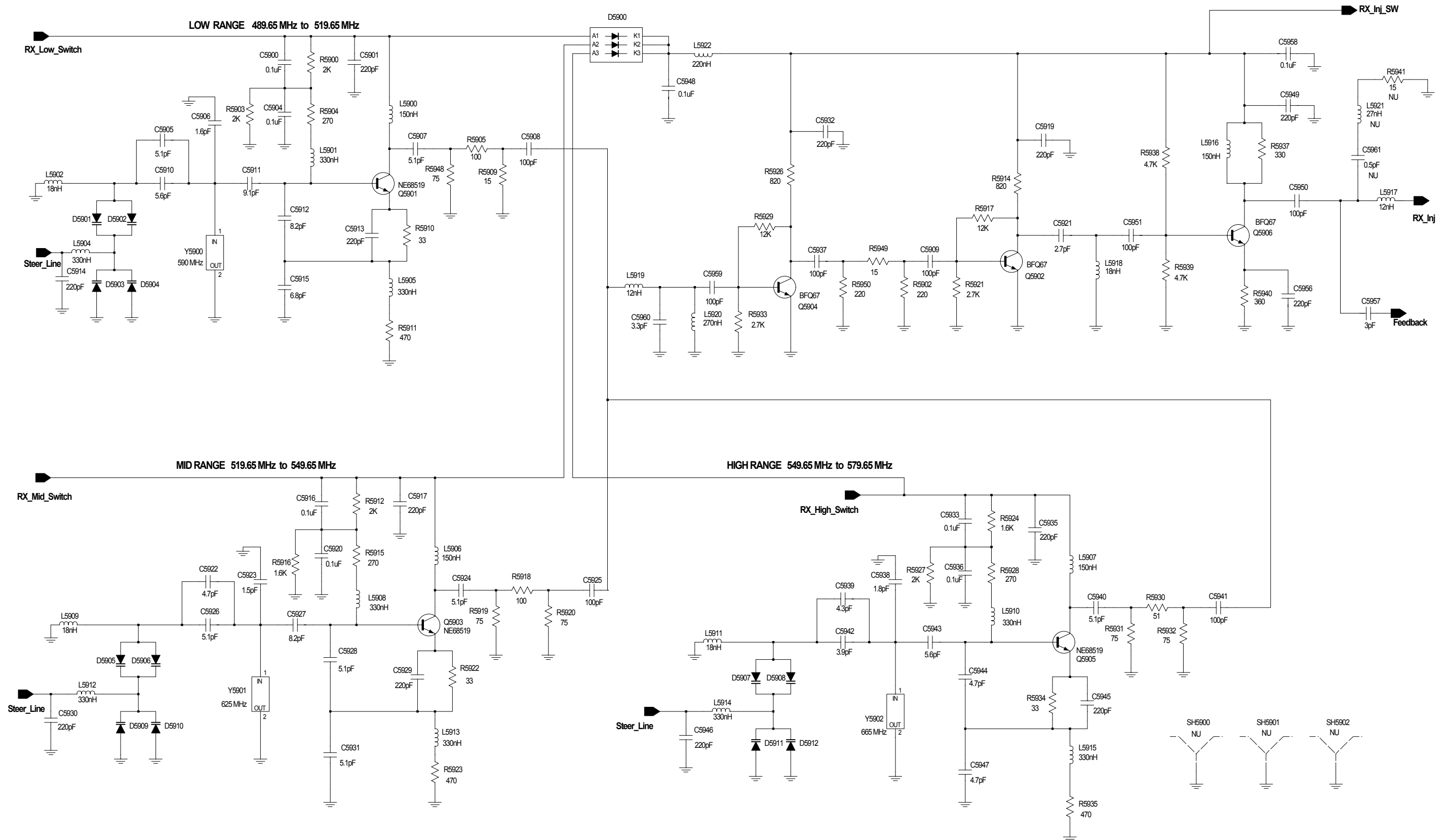


Figure 7-55. HUE4039A Receive VCO Schematic

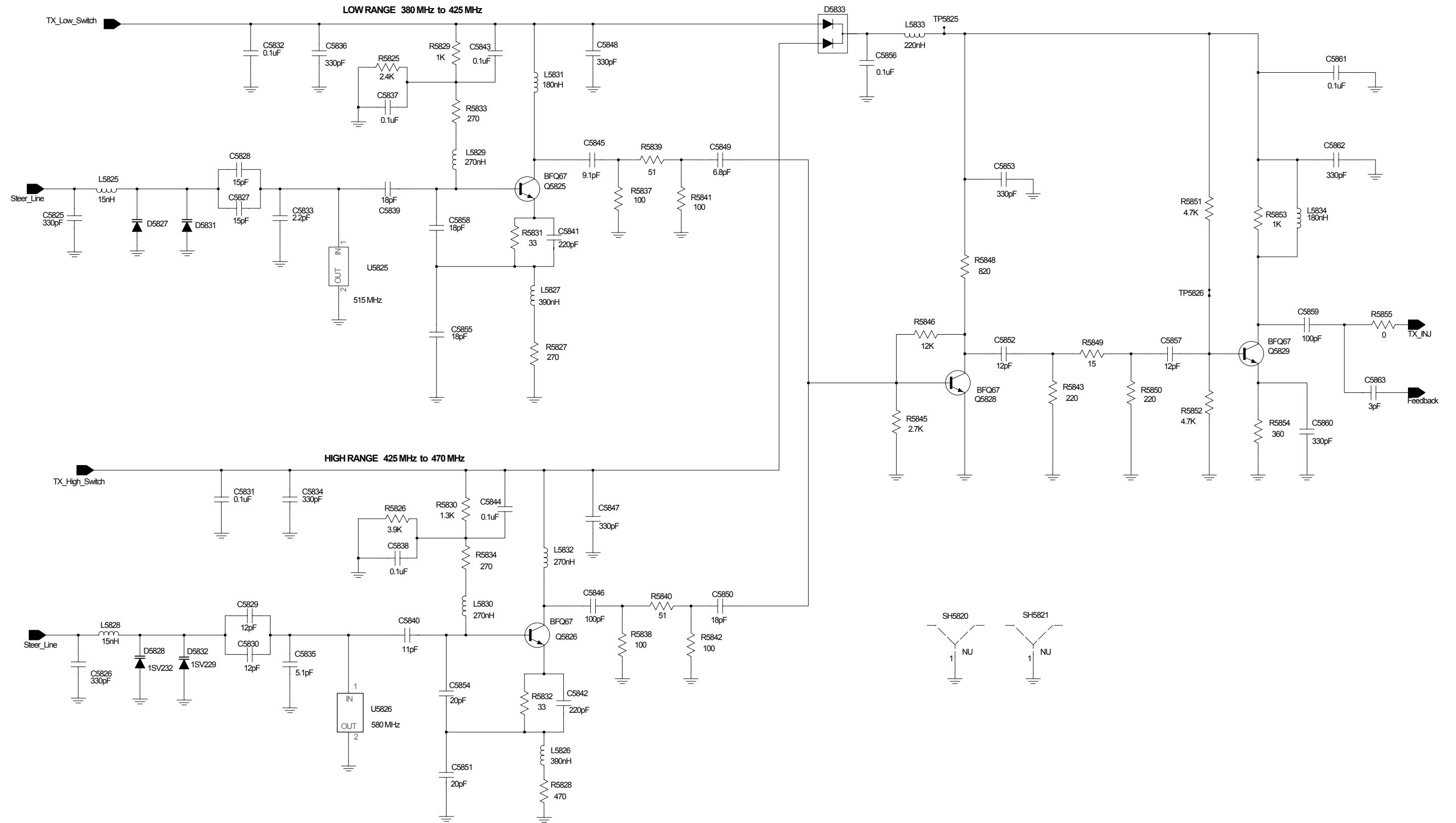


Figure 7-56. HUE4039A Transmit VCO Schematic

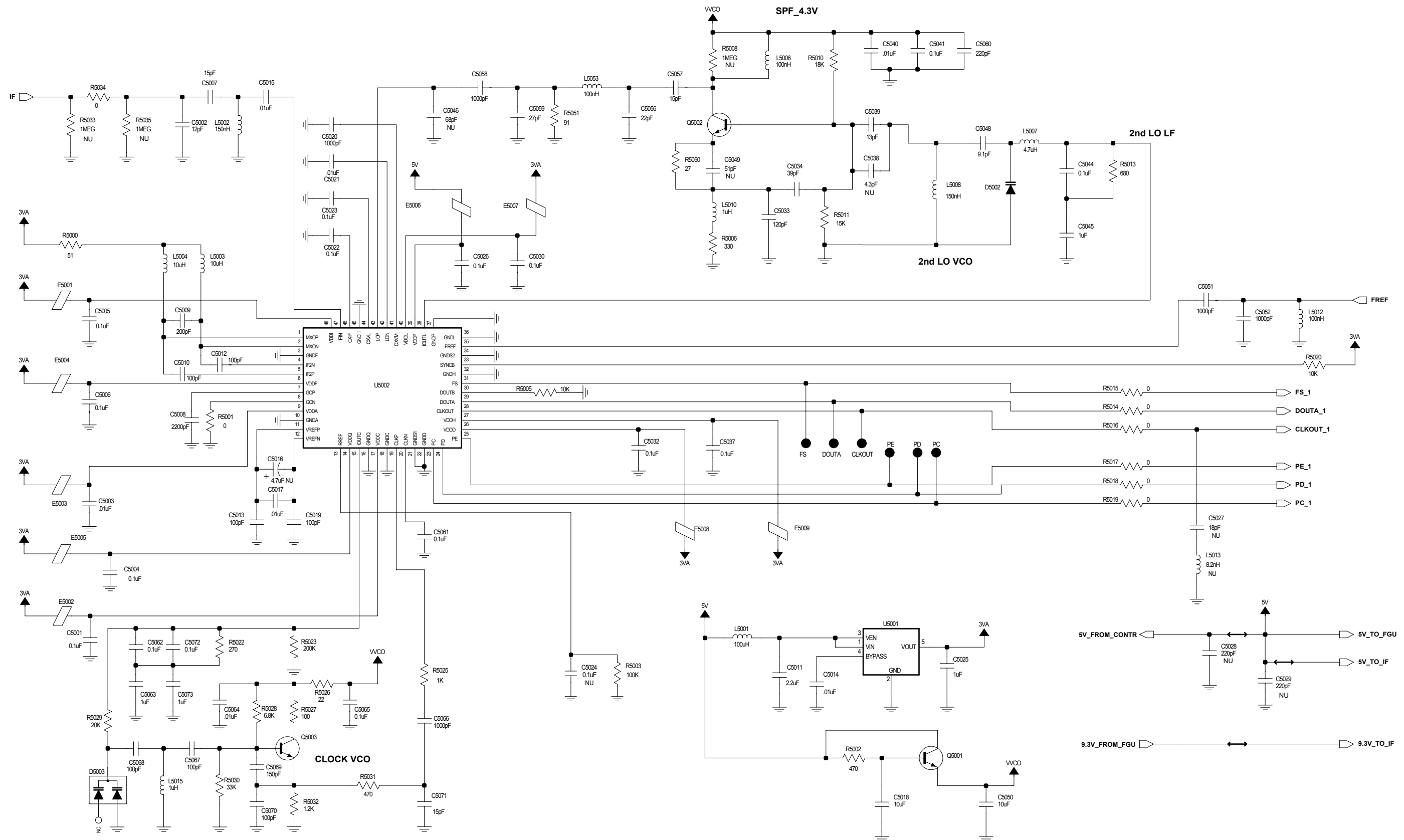
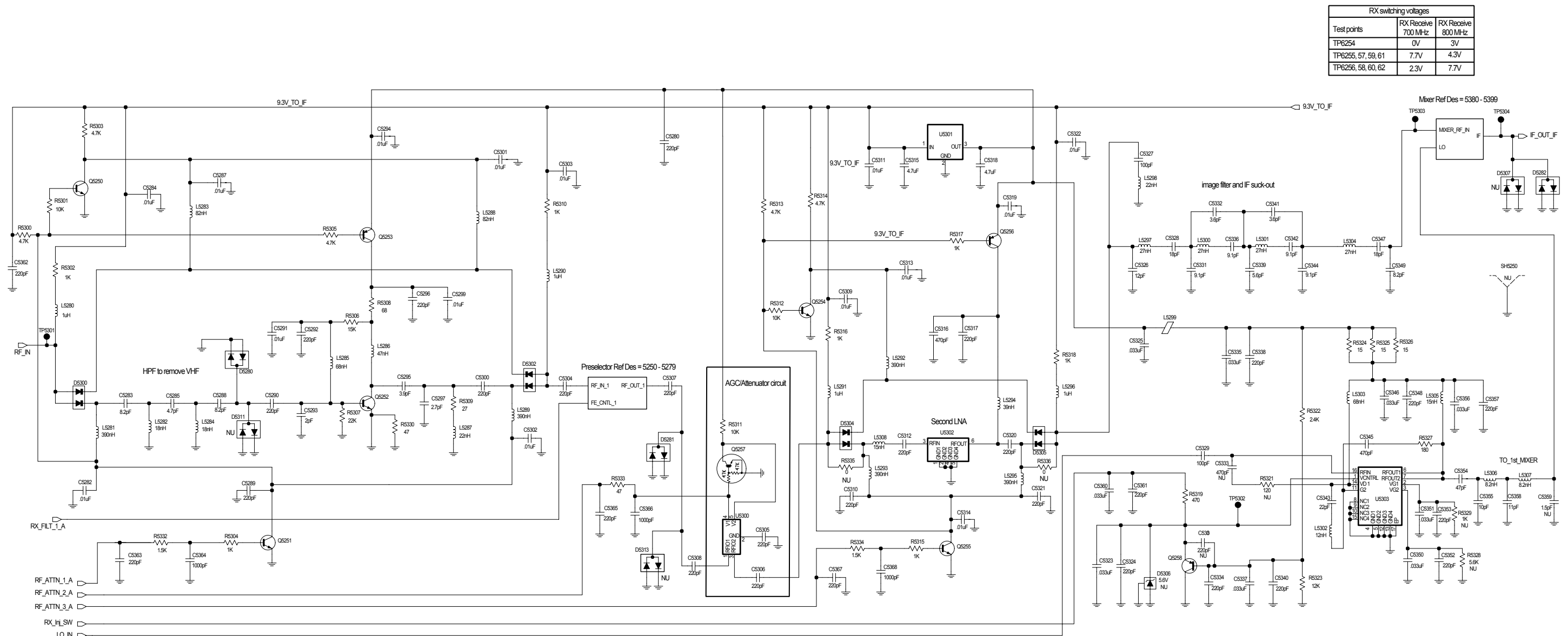


Figure 7-57. HUE4039A Receiver Back-End Schematic



RX switching voltages		
Test points	RX Receive 700 MHz	RX Receive 800 MHz
TP6254	0V	3V
TP6255, 57, 59, 61	7.7V	4.3V
TP6256, 58, 60, 62	2.3V	7.7V

Figure 7-58. HUE4039A Receiver Front-End Schematic

THE RECEIVER INPUT SIGNAL AND THE INJECTION SIGNAL GENERATED BY THE RECEIVER SYNTHESIZER ARE MIXED TO PROVIDE A 109.65 MHz I-F SIGNAL.

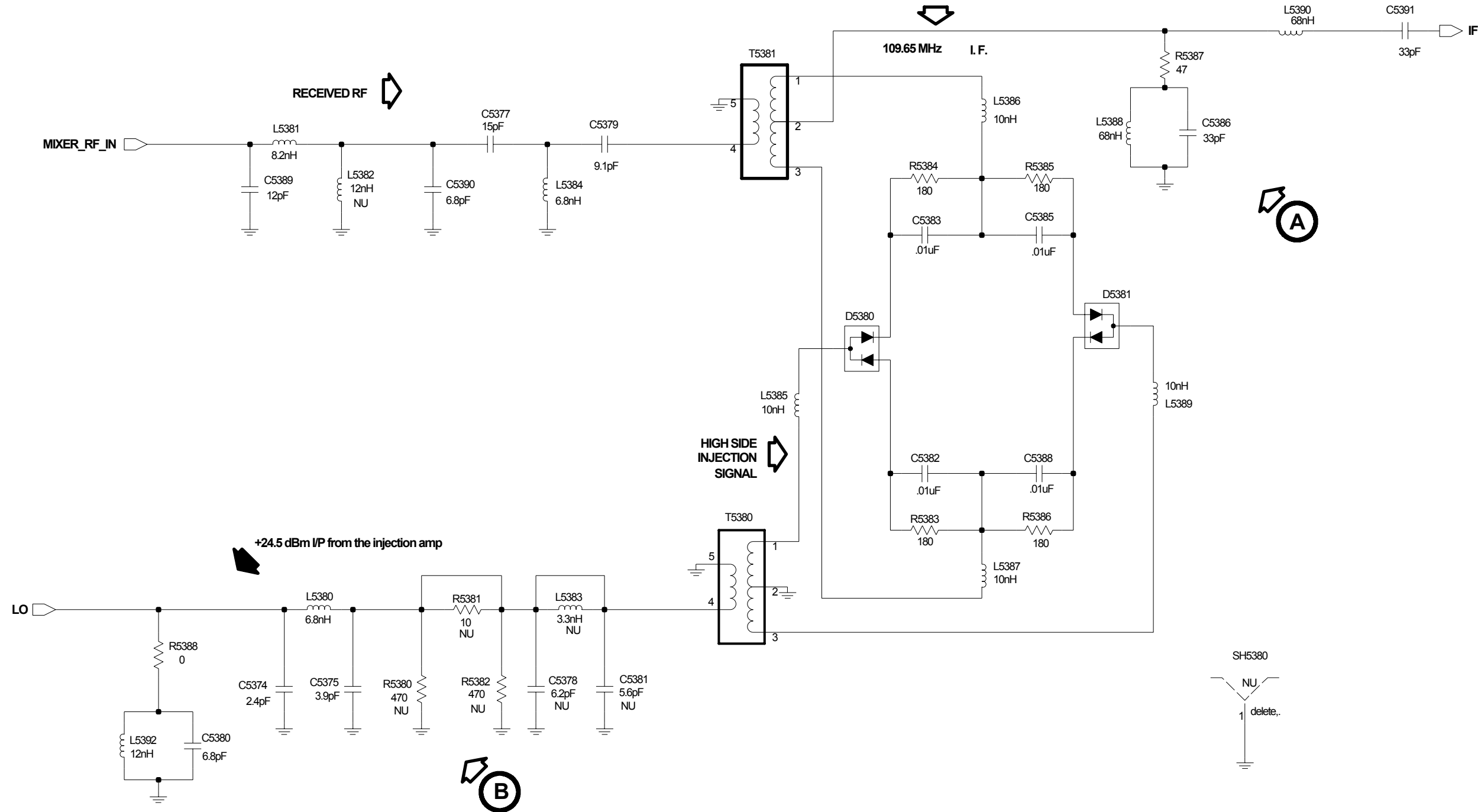


Figure 7-59. HUE4039A Receiver Mixer Schematic

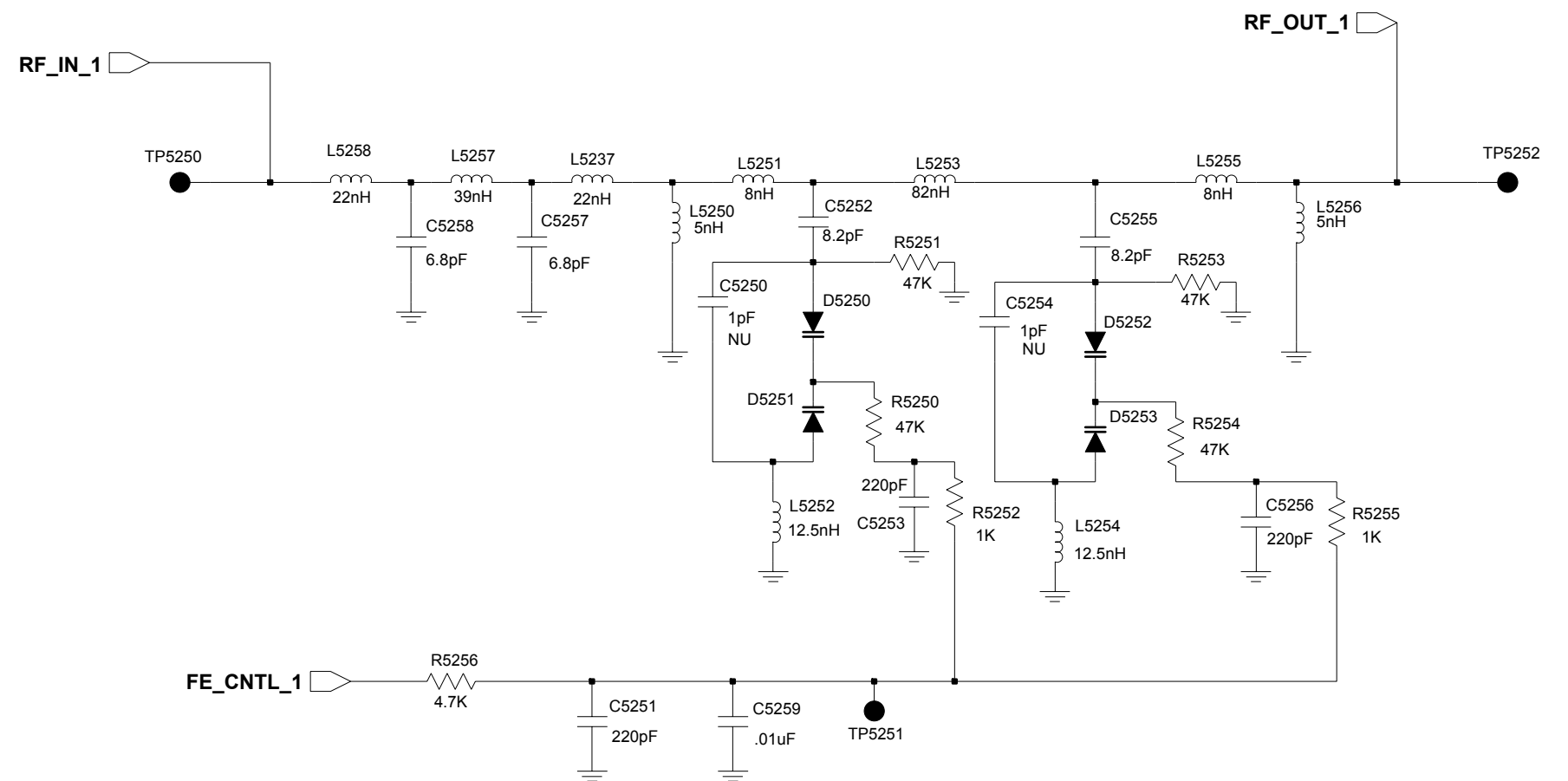


Figure 7-60. HUE4039A Receiver Preselector Schematic

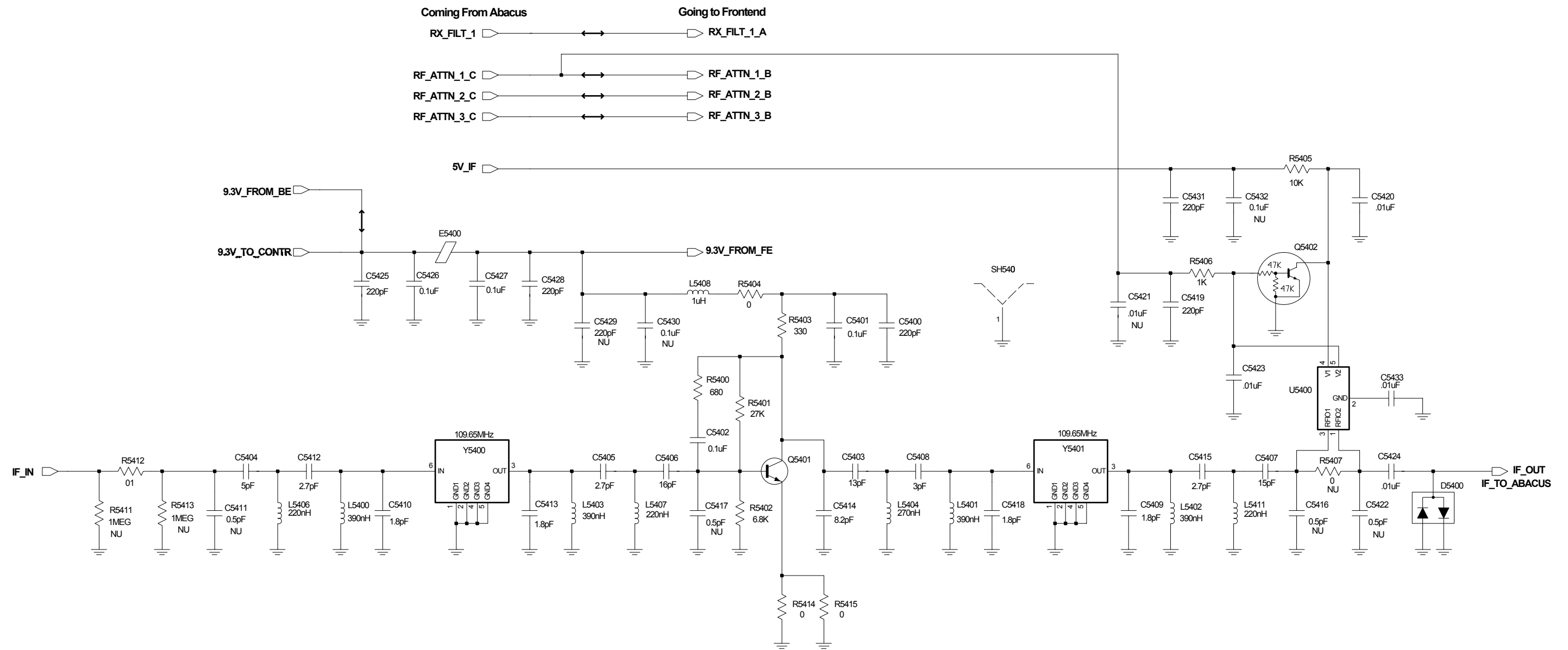


Figure 7-61. HUE4039A Receiver IF Schematic

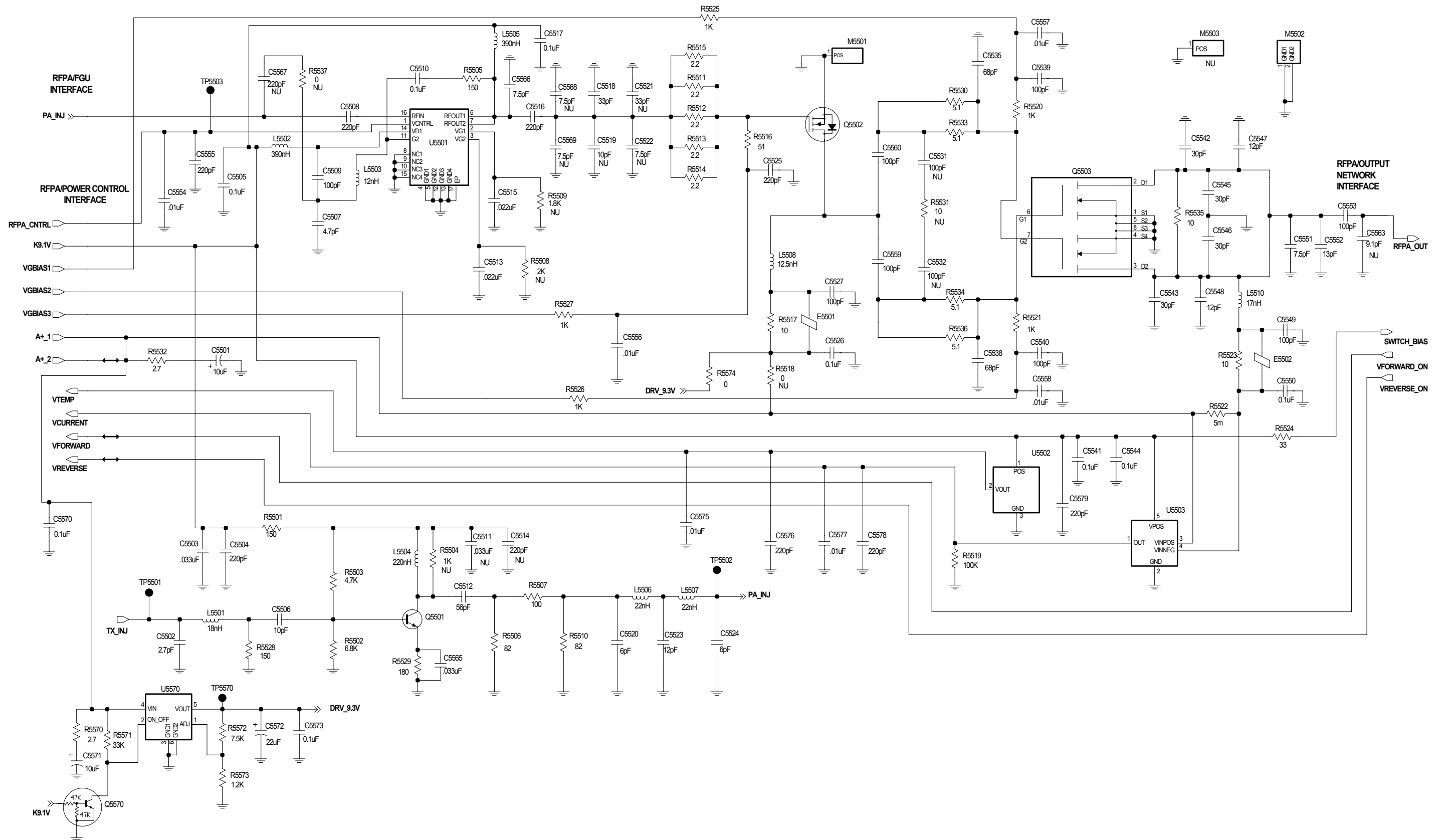


Figure 7-62. HUE4039A RF Power Amplifier (RF PA) Schematic

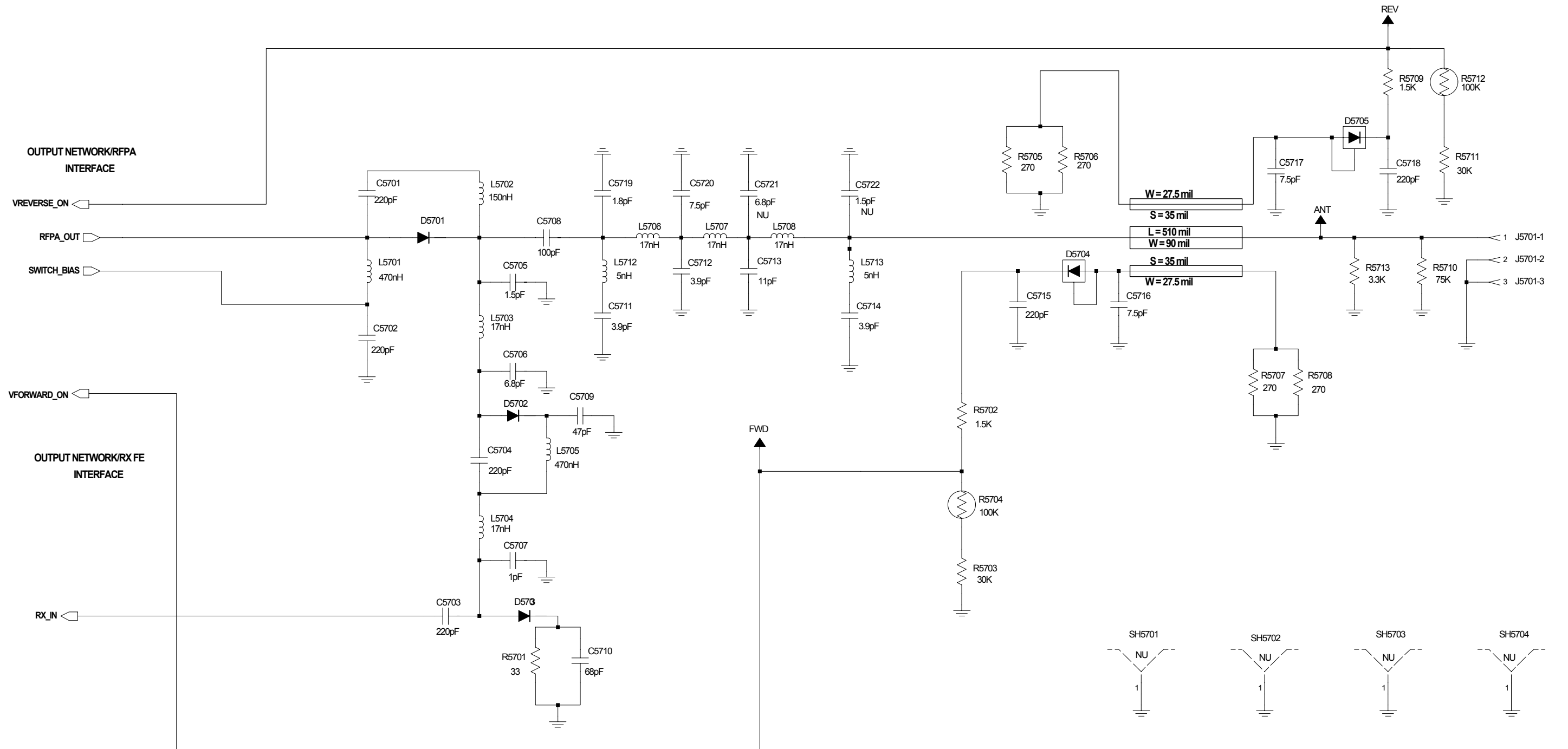


Figure 7-63. HUE4039A Output Network (ON) Schematic

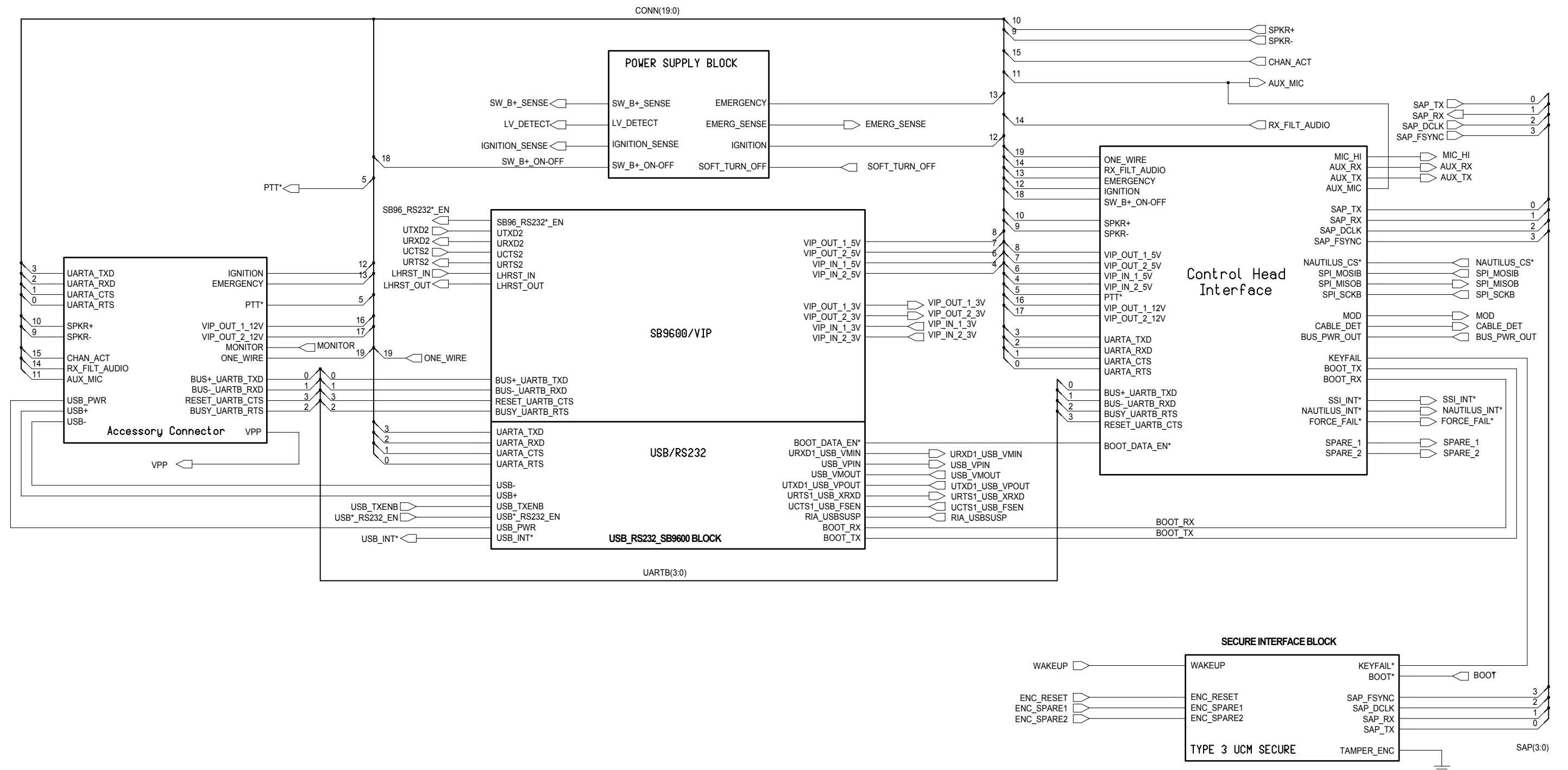


Figure 7-64. HUE4039A Secure Block Diagram and Interconnections

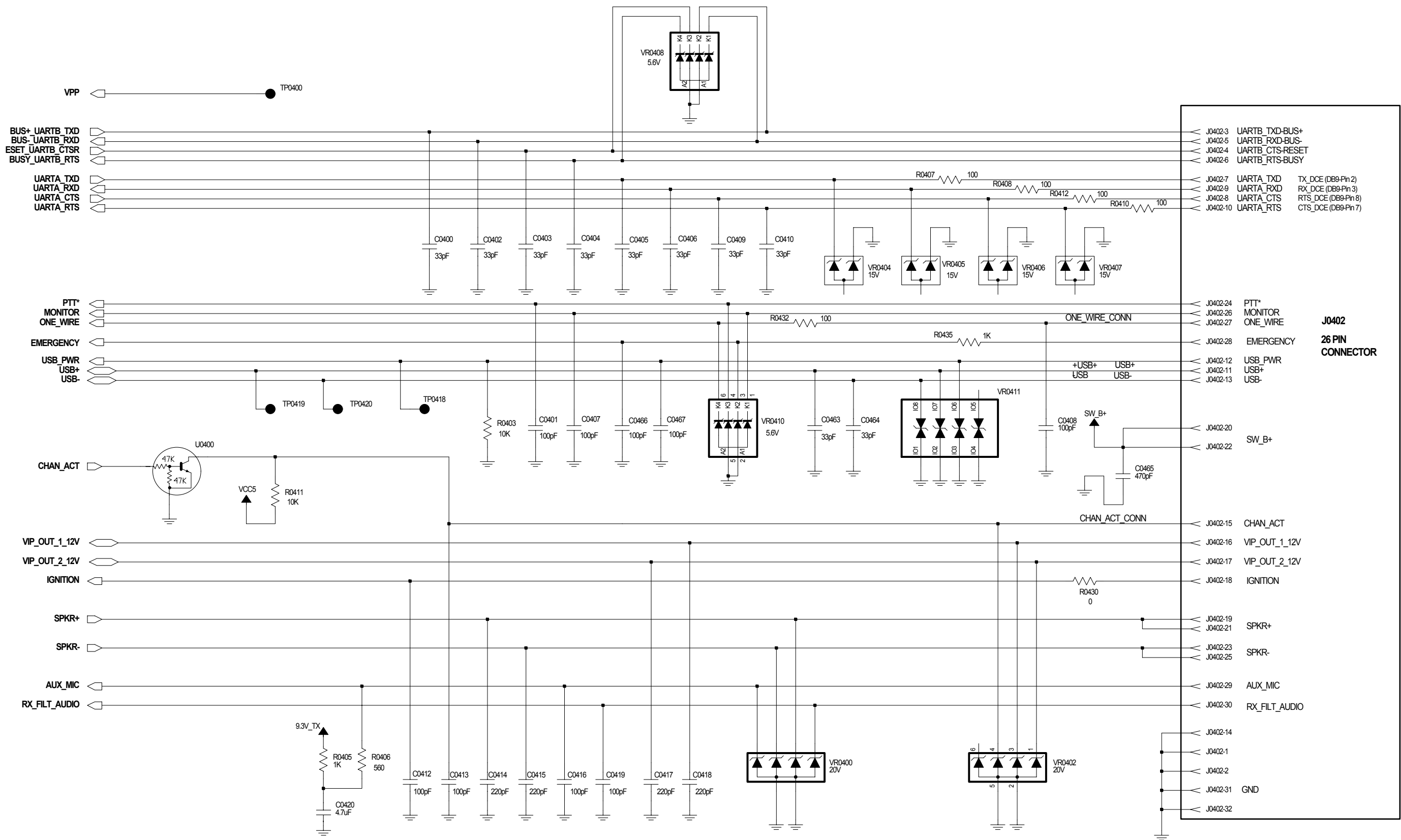


Figure 7-65. HUE4039A Rear Accessory Connector Schematic

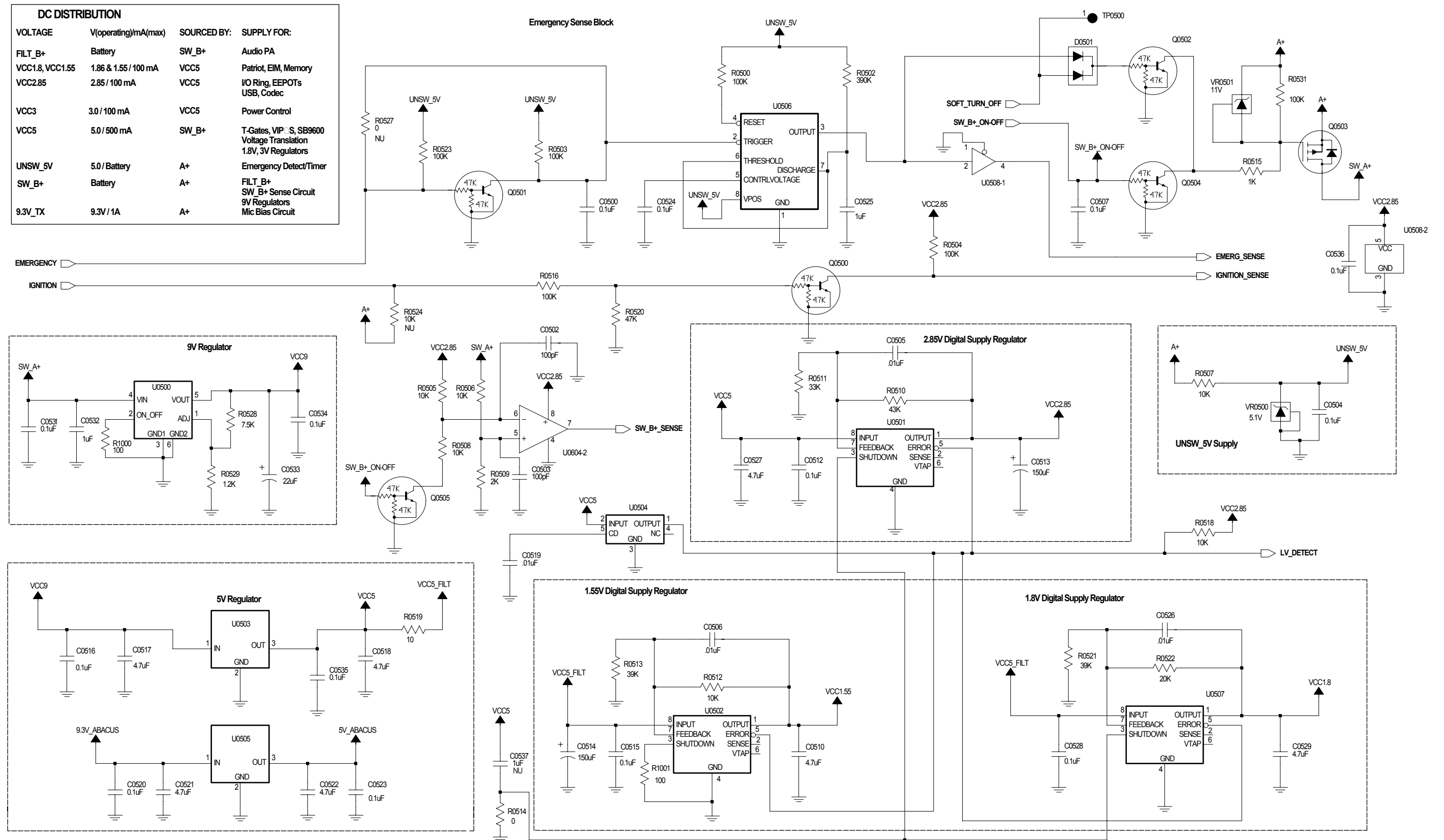
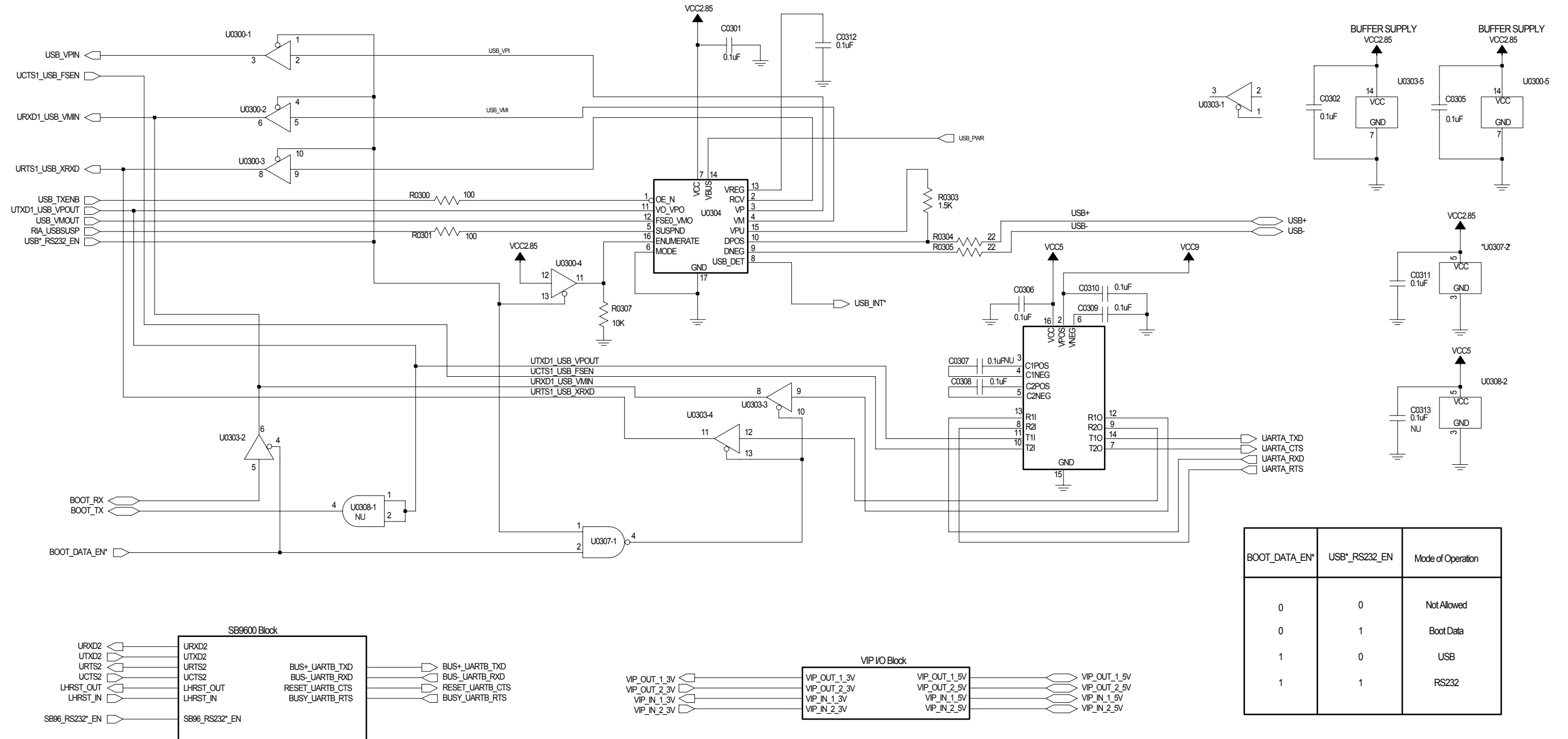


Figure 7-66. HUE4039A Secure Power Supply Schematic



BOOT_DATA_EN*	USB*_RS232_EN	Mode of Operation
0	0	Not Allowed
0	1	Boot Data
1	0	USB
1	1	RS232

Figure 7-67. HUE4039A Secure USB/RS232/SB9600 Schematic

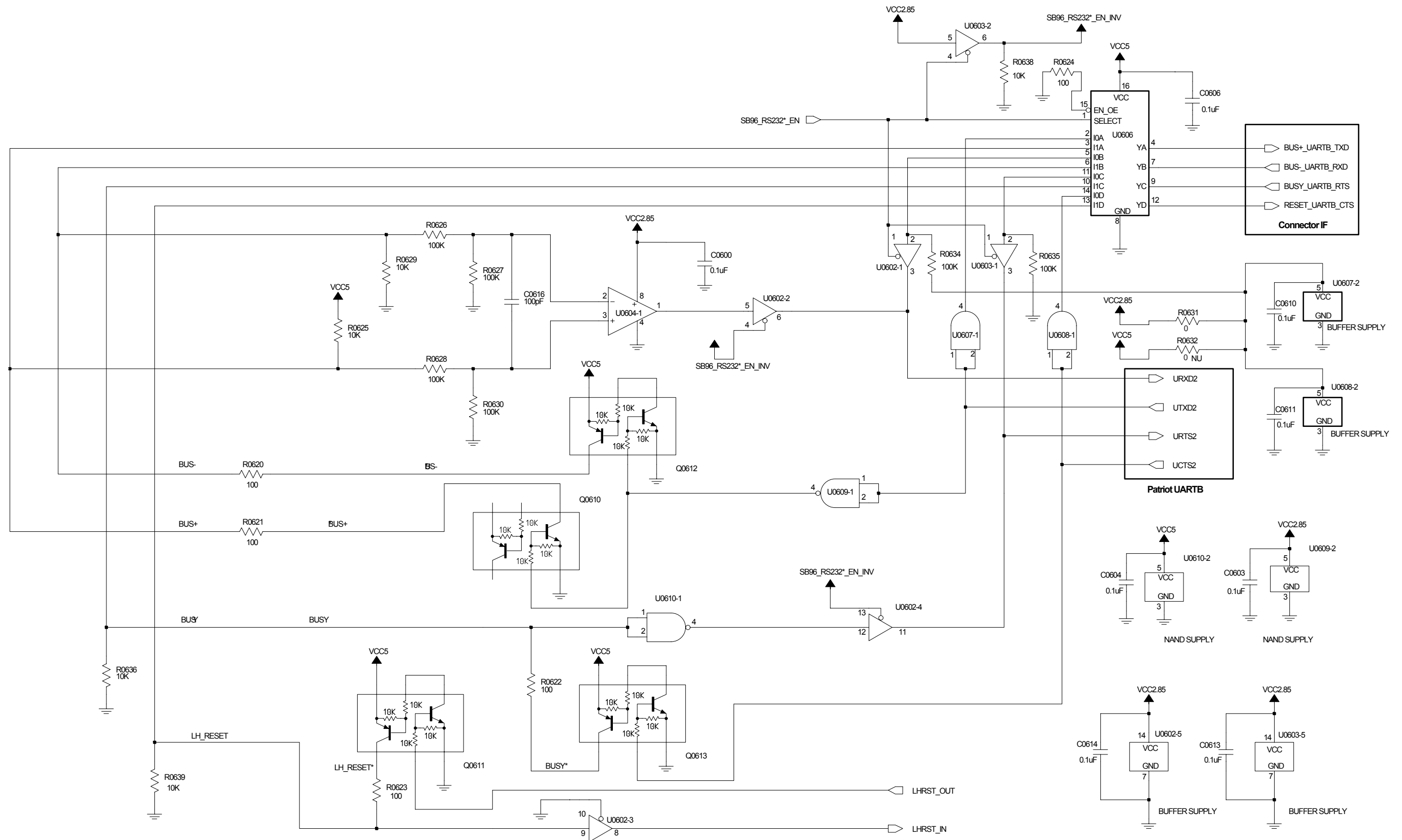


Figure 7-68. HUE4039A Secure SB9600 Schematic

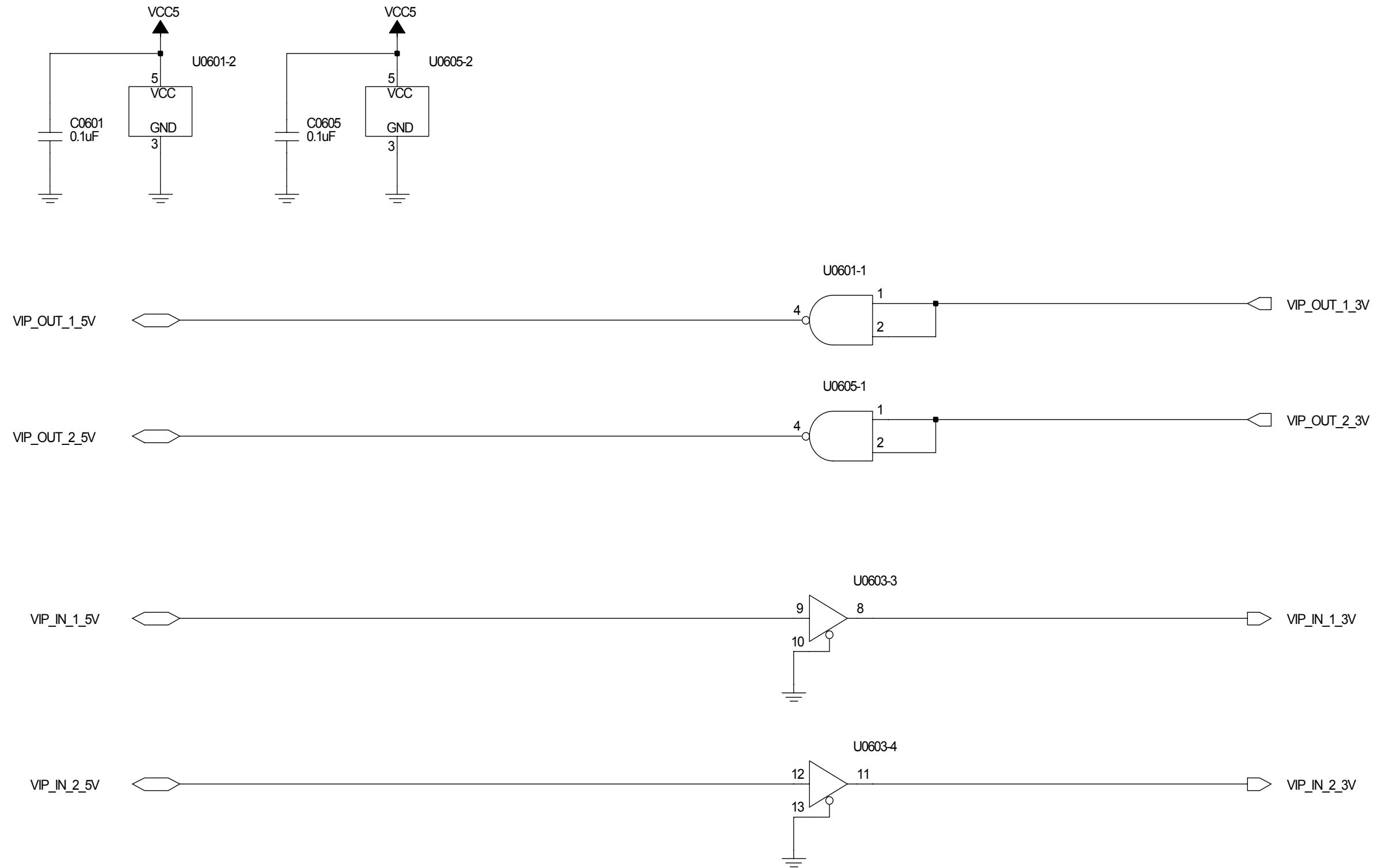


Figure 7-69. HUE4039A Secure USB/RS232/SB9600 VIP Input/Output Schematic

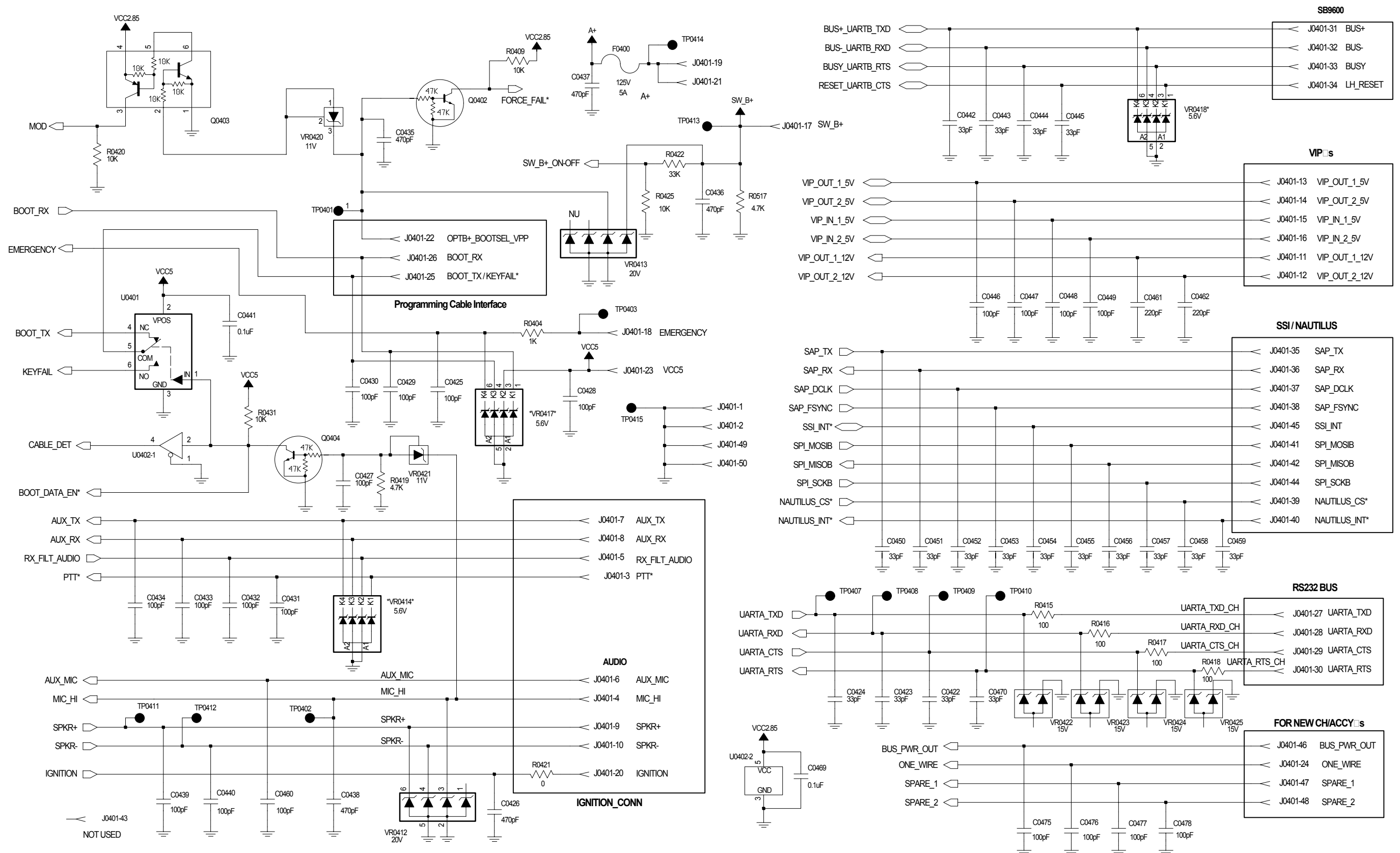


Figure 7-70. HUE4039A Secure Control-Head Connector Schematic

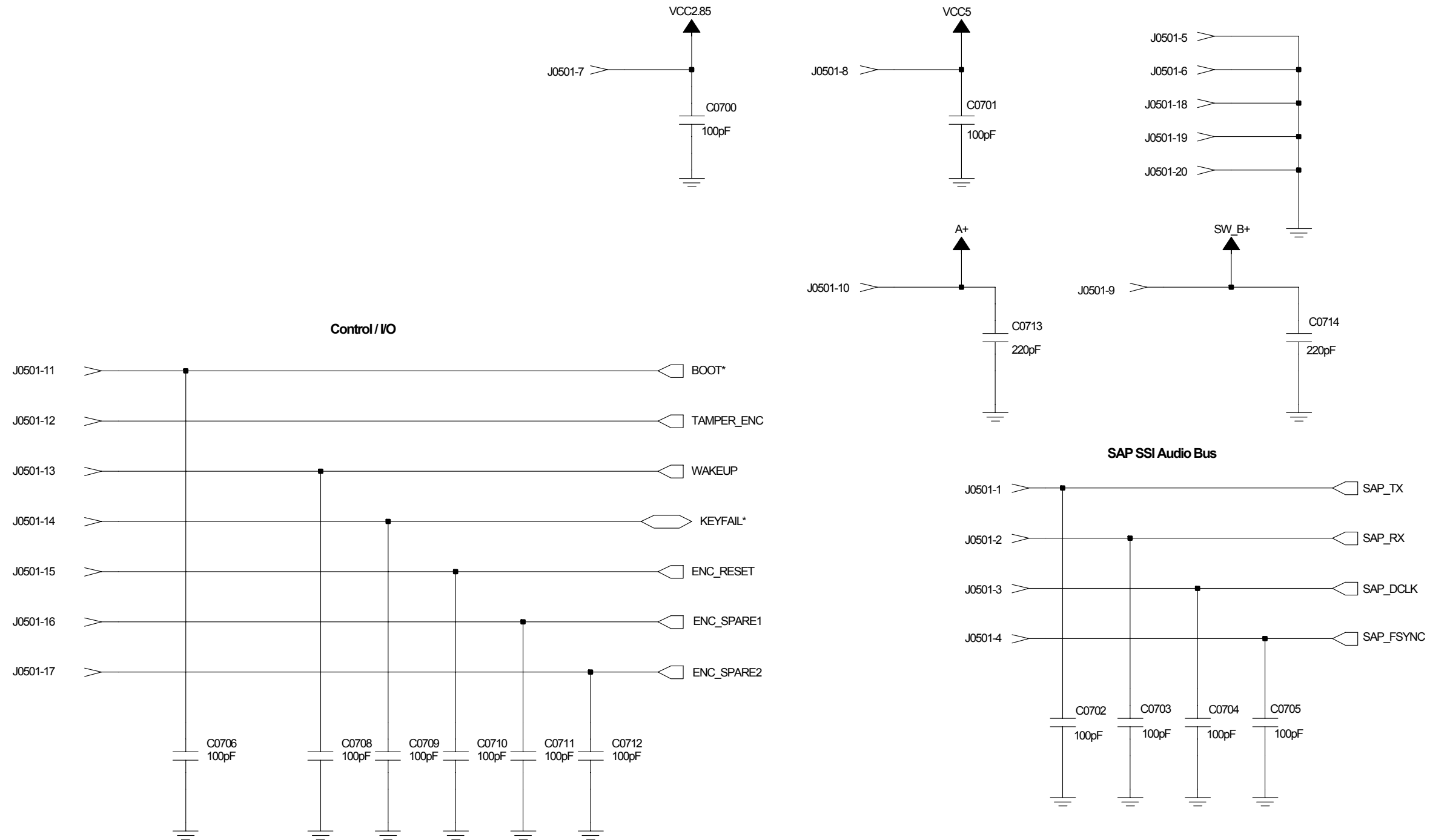


Figure 7-71. HUE4039A Secure Interface Connector Schematic

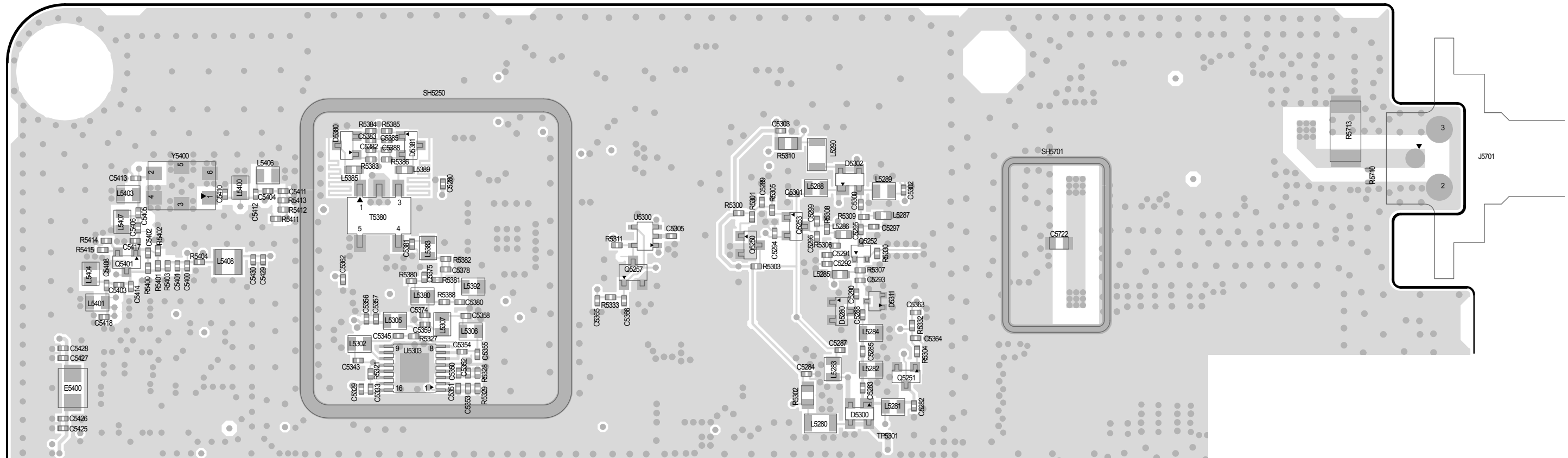


Figure 7-72. HUE4039A Main Board Layout—Side 1 Top

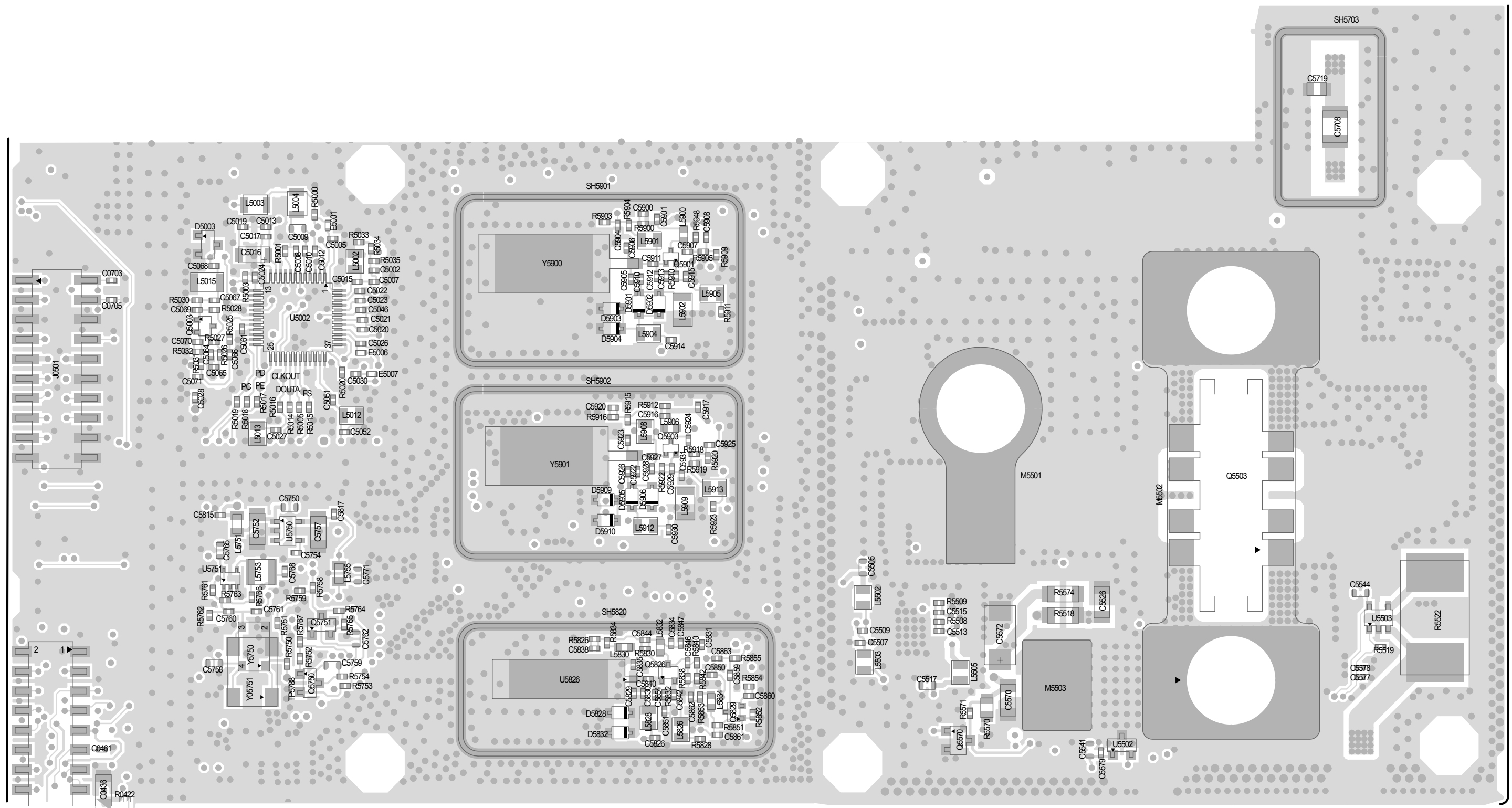


Figure 7-73. HUE4039A Main Board Layout—Side 1 Middle

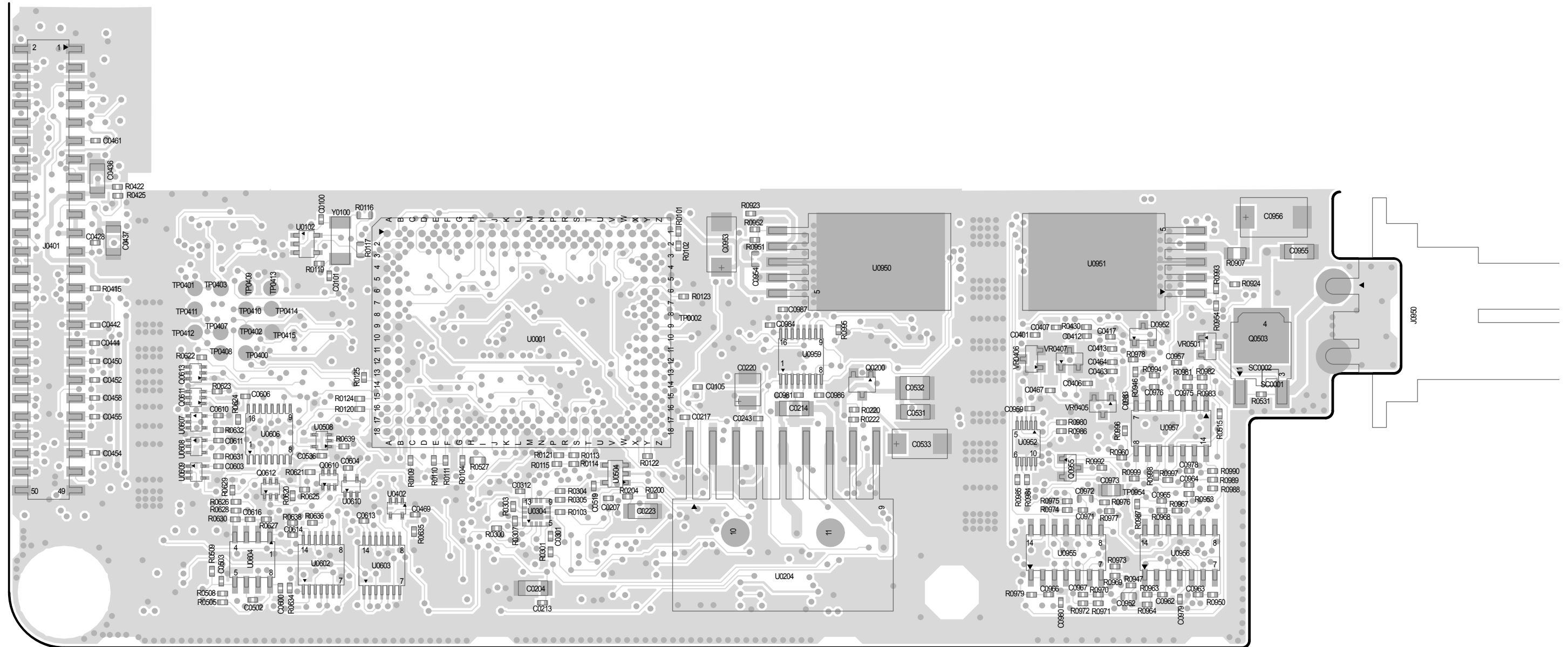


Figure 7-74. HUE4039A Main Board Layout—Side 1 Bottom

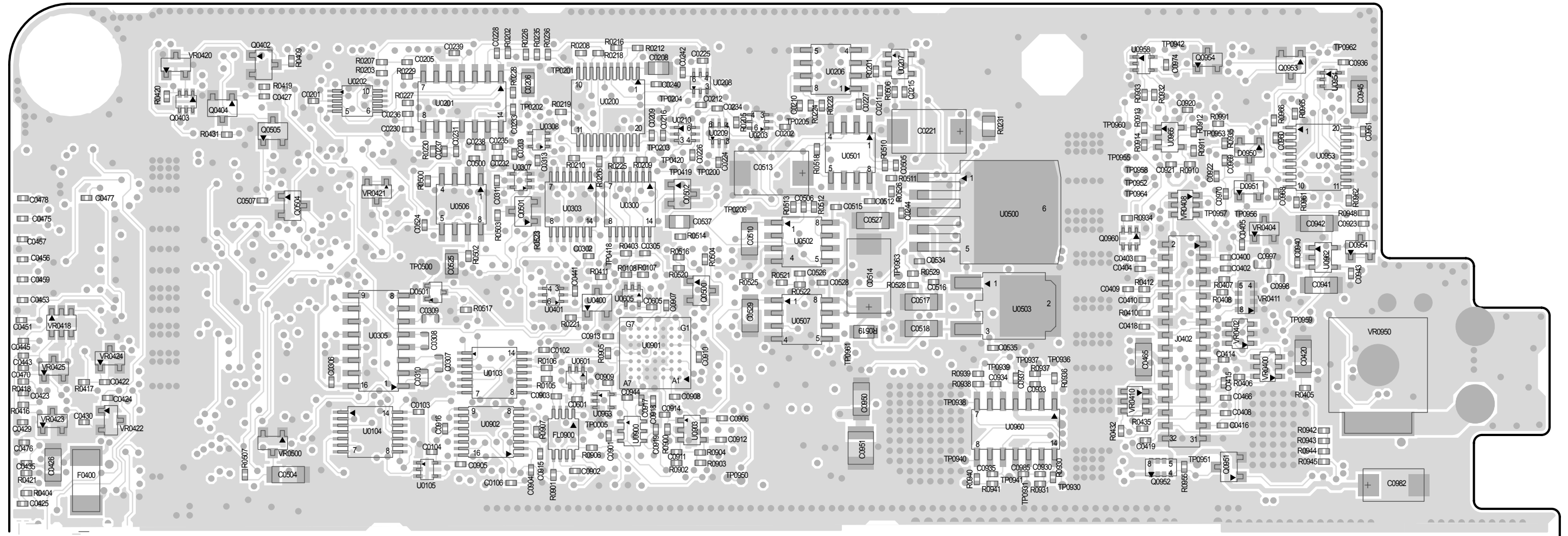


Figure 7-75. HUE4039A Main Board Layout—Side 2 Top

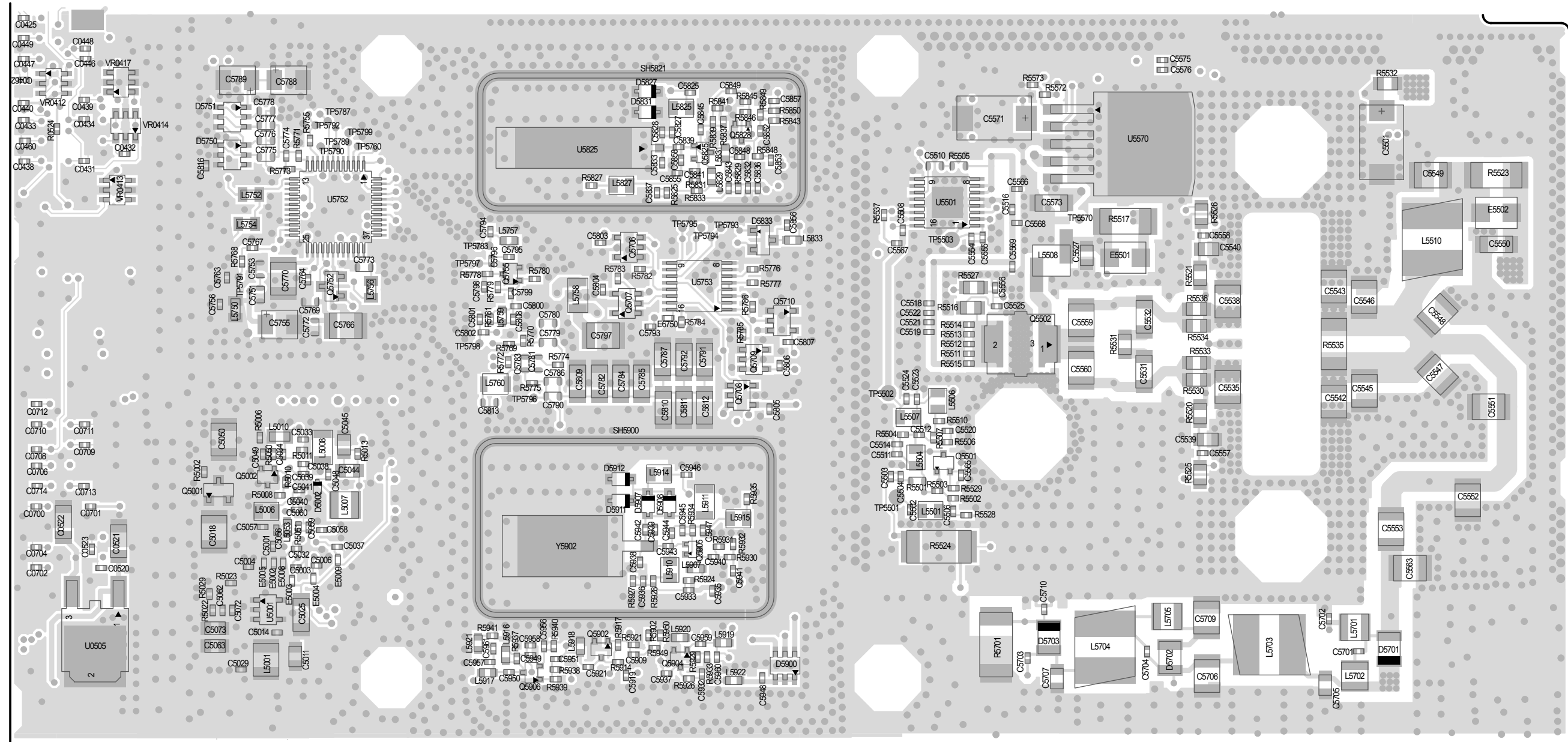


Figure 7-76. HUE4039A Main Board Layout—Side 2 Middle

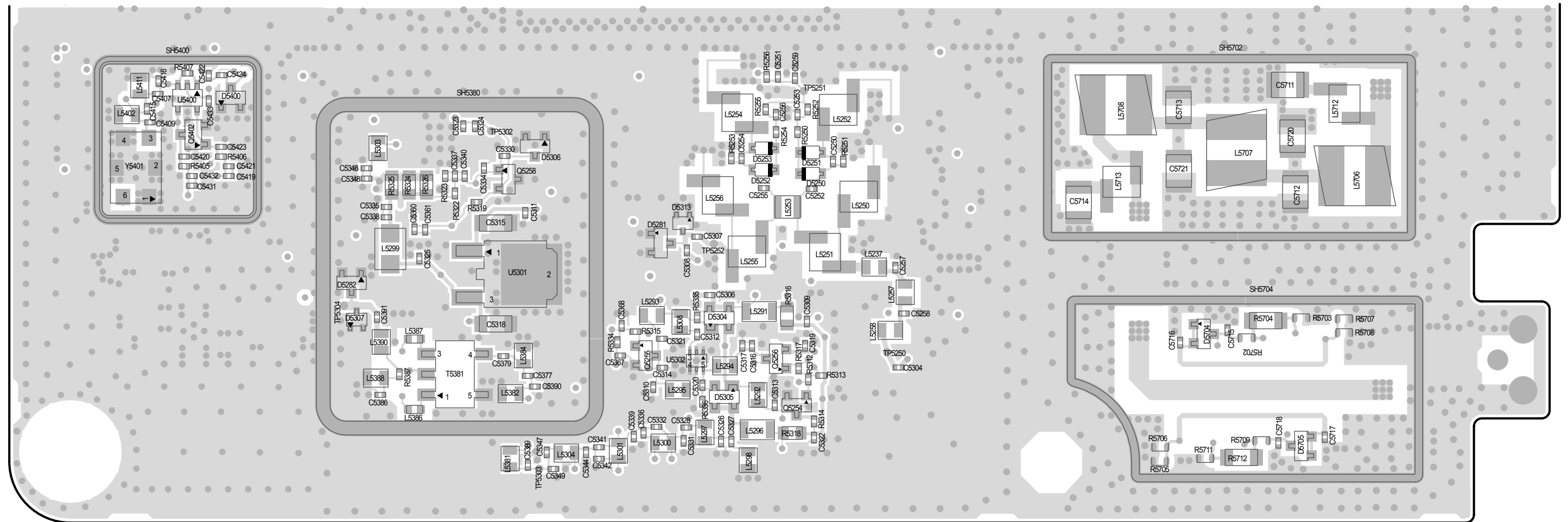


Figure 7-77. HUE4039A Main Board Layout—Side 2 Bottom

HUE4039A Main Board Parts List

Reference Designator	Motorola Part Number	Description
C0100	2113743N32	CAP CHIP 18.0 PF 5% COG
C0101	2113743N32	CAP CHIP 18.0 PF 5% COG
C0102	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0103	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0104	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0105	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0106	2113743N50	CAP CHIP 100 PF 5% COG
C0201	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0202	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0203	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0204	2185802B01	CAP 10V 4.7UF
C0205	2113743N54	CAP CHIP 150 PF 5% COG
C0206	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0207	2113743N38	CAP CHIP 33.0 PF 5% COG
C0208	2113928E01	CAP CER CHIP 1.0 UF 10% 10V
C0209	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0210	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0211	2113743N50	CAP CHIP 100 PF 5% COG
C0212	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0213	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0214	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0215	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0216	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0217	2113743L29	CAP CHIP 3300 PF 10% X7R
C0220	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V

Reference Designator	Motorola Part Number	Description
C0221	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C0223	2185802B01	CAP 10V 4.7UF
C0224	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0225	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0226	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0227	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0228	2113743N54	CAP CHIP 150 PF 5% COG
C0230	2113743L09	CAP CHIP 470 PF 10% X7R
C0231	2113743L01	CAP CHIP 220 PF 10% X7R
C0232	2113743L09	CAP CHIP 470 PF 10% X7R
C0233	2113743L01	CAP CHIP 220 PF 10% X7R
C0234	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0235	2113743L09	CAP CHIP 470 PF 10% X7R
C0236	2113743L09	CAP CHIP 470 PF 10% X7R
C0237	2113743L01	CAP CHIP 220 PF 10% X7R
C0238	2113743L01	CAP CHIP 220 PF 10% X7R
C0239	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0240	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0242	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0243	2113945B01	CAP CER CHIP 6800 PF 25V 10%
C0244	2113945B01	CAP CER CHIP 6800 PF 25V 10%
C0301	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0302	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0305	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0306	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0308	2113743E20	CAP CHIP .10 UF 10%
C0309	2113743E20	CAP CHIP .10 UF 10%
C0310	2113743E20	CAP CHIP .10 UF 10%
C0311	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0312	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0313	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0400	2113743N38	CAP CHIP 33.0 PF 5% COG
C0401	2113743N50	CAP CHIP 100 PF 5% COG
C0402	2113743N38	CAP CHIP 33.0 PF 5% COG
C0403	2113743N38	CAP CHIP 33.0 PF 5% COG
C0404	2113743N38	CAP CHIP 33.0 PF 5% COG
C0405	2113743N38	CAP CHIP 33.0 PF 5% COG
C0406	2113743N38	CAP CHIP 33.0 PF 5% COG
C0407	2113743N50	CAP CHIP 100 PF 5% COG
C0408	2113743N50	CAP CHIP 100 PF 5% COG
C0409	2113743N38	CAP CHIP 33.0 PF 5% COG
C0410	2113743N38	CAP CHIP 33.0 PF 5% COG
C0412	2113743N50	CAP CHIP 100 PF 5% COG
C0413	2113743N50	CAP CHIP 100 PF 5% COG
C0414	2113743L01	CAP CHIP 220 PF 10% X7R
C0415	2113743L01	CAP CHIP 220 PF 10% X7R
C0416	2113743N50	CAP CHIP 100 PF 5% COG
C0417	2113743L01	CAP CHIP 220 PF 10% X7R
C0418	2113743L01	CAP CHIP 220 PF 10% X7R
C0419	2113743N50	CAP CHIP 100 PF 5% COG
C0420	2185802B01	CAP 10V 4.7UF
C0422	2113743N38	CAP CHIP 33.0 PF 5% COG
C0423	2113743N38	CAP CHIP 33.0 PF 5% COG
C0424	2113743N38	CAP CHIP 33.0 PF 5% COG
C0425	2113743N50	CAP CHIP 100 PF 5% COG
C0426	2113741B13	CAP CHIP CL2 X7R REEL 470
C0427	2113743N50	CAP CHIP 100 PF 5% COG
C0428	2113743N50	CAP CHIP 100 PF 5% COG
C0429	2113743N50	CAP CHIP 100 PF 5% COG
C0430	2113743N50	CAP CHIP 100 PF 5% COG
C0431	2113743N50	CAP CHIP 100 PF 5% COG
C0432	2113743N50	CAP CHIP 100 PF 5% COG
C0433	2113743N50	CAP CHIP 100 PF 5% COG
C0434	2113743N50	CAP CHIP 100 PF 5% COG
C0435	2113743L09	CAP CHIP 470 PF 10% X7R
C0436	2113741B13	CAP CHIP CL2 X7R REEL 470
C0437	2113741B13	CAP CHIP CL2 X7R REEL 470
C0438	2113743L09	CAP CHIP 470 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C0439	2113743N50	CAP CHIP 100 PF 5% COG
C0440	2113743N50	CAP CHIP 100 PF 5% COG
C0441	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0442	2113743N38	CAP CHIP 33.0 PF 5% COG
C0443	2113743N38	CAP CHIP 33.0 PF 5% COG
C0444	2113743N38	CAP CHIP 33.0 PF 5% COG
C0445	2113743N38	CAP CHIP 33.0 PF 5% COG
C0446	2113743N50	CAP CHIP 100 PF 5% COG
C0447	2113743N50	CAP CHIP 100 PF 5% COG
C0448	2113743N50	CAP CHIP 100 PF 5% COG
C0449	2113743N50	CAP CHIP 100 PF 5% COG
C0450	2113743N38	CAP CHIP 33.0 PF 5% COG
C0451	2113743N38	CAP CHIP 33.0 PF 5% COG
C0452	2113743N38	CAP CHIP 33.0 PF 5% COG
C0453	2113743N38	CAP CHIP 33.0 PF 5% COG
C0454	2113743N38	CAP CHIP 33.0 PF 5% COG
C0455	2113743N38	CAP CHIP 33.0 PF 5% COG
C0456	2113743N38	CAP CHIP 33.0 PF 5% COG
C0457	2113743N38	CAP CHIP 33.0 PF 5% COG
C0458	2113743N38	CAP CHIP 33.0 PF 5% COG
C0459	2113743N38	CAP CHIP 33.0 PF 5% COG
C0460	2113743N50	CAP CHIP 100 PF 5% COG
C0461	2113743L01	CAP CHIP 220 PF 10% X7R
C0462	2113743L01	CAP CHIP 220 PF 10% X7R
C0463	2113743N38	CAP CHIP 33.0 PF 5% COG
C0464	2113743N38	CAP CHIP 33.0 PF 5% COG
C0465	2113741B13	CAP CHIP CL2 X7R REEL 470
C0466	2113743N50	CAP CHIP 100 PF 5% COG
C0467	2113743N50	CAP CHIP 100 PF 5% COG
C0469	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0470	2113743N38	CAP CHIP 33.0 PF 5% COG
C0475	2113743N50	CAP CHIP 100 PF 5% COG
C0476	2113743N50	CAP CHIP 100 PF 5% COG
C0477	2113743N50	CAP CHIP 100 PF 5% COG
C0478	2113743N50	CAP CHIP 100 PF 5% COG
C0500	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0502	2113743N50	CAP CHIP 100 PF 5% COG
C0503	2113743N50	CAP CHIP 100 PF 5% COG

Reference Designator	Motorola Part Number	Description
C0504	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0505	2113743L41	CAP CHIP 10000 PF 10% X7R
C0506	2113743L41	CAP CHIP 10000 PF 10% X7R
C0507	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0510	2185802B01	CAP 10V 4.7UF
C0512	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0513	2311049A43	CAP TANT CHIP 150 10 6
C0514	2311049A43	CAP TANT CHIP 150 10 6
C0515	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0516	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0517	2185802B01	CAP 10V 4.7UF
C0518	2185802B01	CAP 10V 4.7UF
C0519	2113743L41	CAP CHIP 10000 PF 10% X7R
C0520	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0521	2185802B01	CAP 10V 4.7UF
C0522	2185802B01	CAP 10V 4.7UF
C0523	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0524	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0525	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0526	2113743L41	CAP CHIP 10000 PF 10% X7R
C0527	2185802B01	CAP 10V 4.7UF
C0528	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0529	2185802B01	CAP 10V 4.7UF
C0531	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0532	2113741Y32	CAP CER 1,000,000 10% 50V
C0533	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0534	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0535	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0536	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0600	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0601	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0603	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0604	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0605	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0606	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0610	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0611	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0613	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0614	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0616	2113743N50	CAP CHIP 100 PF 5% COG
C0700	2113743N50	CAP CHIP 100 PF 5% COG
C0701	2113743N50	CAP CHIP 100 PF 5% COG
C0702	2113743N50	CAP CHIP 100 PF 5% COG
C0703	2113743N50	CAP CHIP 100 PF 5% COG
C0704	2113743N50	CAP CHIP 100 PF 5% COG
C0705	2113743N50	CAP CHIP 100 PF 5% COG
C0706	2113743N50	CAP CHIP 100 PF 5% COG
C0708	2113743N50	CAP CHIP 100 PF 5% COG
C0709	2113743N50	CAP CHIP 100 PF 5% COG
C0710	2113743N50	CAP CHIP 100 PF 5% COG
C0711	2113743N50	CAP CHIP 100 PF 5% COG
C0712	2113743N50	CAP CHIP 100 PF 5% COG
C0713	2113743L01	CAP CHIP 220 PF 10% X7R
C0714	2113743L01	CAP CHIP 220 PF 10% X7R
C0901	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0902	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0903	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0904	2113743L01	CAP CHIP 220 PF 10% X7R
C0905	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0906	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0907	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0908	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0909	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0910	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0911	2113743N50	CAP CHIP 100 PF 5% COG
C0912	2113743N50	CAP CHIP 100 PF 5% COG
C0913	2113743N50	CAP CHIP 100 PF 5% COG
C0914	2113743N38	CAP CHIP 33.0 PF 5% COG
C0915	2113743N50	CAP CHIP 100 PF 5% COG
C0916	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0917	2113743N50	CAP CHIP 100 PF 5% COG
C0918	2113743N50	CAP CHIP 100 PF 5% COG
C0919	2113743N50	CAP CHIP 100 PF 5% COG
C0920	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0922	2113743N50	CAP CHIP 100 PF 5% COG
C0930	2113743N50	CAP CHIP 100 PF 5% COG
C0933	2113743N50	CAP CHIP 100 PF 5% COG
C0934	2113743N50	CAP CHIP 100 PF 5% COG
C0935	2113743N50	CAP CHIP 100 PF 5% COG
C0936	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0937	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0940	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0941	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C0942	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C0943	2113743L41	CAP CHIP 10000 PF 10% X7R
C0944	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0945	2185802B01	CAP 10V 4.7UF
C0950	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0951	2113741Y32	CAP CER 1,000,000 10% 50V

Reference Designator	Motorola Part Number	Description
C0952	2113743E20	CAP CHIP .10 UF 10%
C0953	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0954	2113743E20	CAP CHIP .10 UF 10%
C0955	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0956	2311049C06	CAP TANT CHIP 22 UF 35V 20%
C0957	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0959	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0960	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0961	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0963	2113743N50	CAP CHIP 100 PF 5% COG
C0964	2113743N50	CAP CHIP 100 PF 5% COG
C0965	2113743N50	CAP CHIP 100 PF 5% COG
C0966	2113743N50	CAP CHIP 100 PF 5% COG
C0968	2113743N50	CAP CHIP 100 PF 5% COG
C0969	2113743N50	CAP CHIP 100 PF 5% COG
C0970	2113743N50	CAP CHIP 100 PF 5% COG
C0972	2113743E20	CAP CHIP .10 UF 10%
C0973	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0974	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0975	2113743N50	CAP CHIP 100 PF 5% COG
C0976	2113743N50	CAP CHIP 100 PF 5% COG
C0978	2113743N50	CAP CHIP 100 PF 5% COG
C0979	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0980	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0981	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0982	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0983	2113743N50	CAP CHIP 100 PF 5% COG
C0984	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0985	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0986	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0987	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0997	2113740F47	CAP CHIP REEL CL1 +/-30 68
C0998	2113741F01	CAP CHIP CL2 X7R REEL 100
C5001	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5002	2113743N28	CAP CHIP 12.0 PF 5% COG
C5003	2113743L41	CAP CHIP 10000 PF 10% X7R
C5004	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5005	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5006	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5007	2113743N30	CAP CHIP 15.0 PF 5% COG
C5008	2113743L25	CAP CHIP 2200 PF 10% X7R
C5009	2113740F58	CAP CHIP REEL CL1 +/-30 200
C5010	2113743N50	CAP CHIP 100 PF 5% COG
C5011	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C5012	2113743N50	CAP CHIP 100 PF 5% COG
C5013	2113743N50	CAP CHIP 100 PF 5% COG
C5014	2113743L41	CAP CHIP 10000 PF 10% X7R
C5015	2113743L41	CAP CHIP 10000 PF 10% X7R
C5017	2113743L41	CAP CHIP 10000 PF 10% X7R
C5018	2113743T19	CAP 10UF 16V CER 3225 X5R
C5019	2113743N50	CAP CHIP 100 PF 5% COG
C5020	2113743L17	CAP CHIP 1000 PF 10% X7R
C5021	2113743L41	CAP CHIP 10000 PF 10% X7R
C5022	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5023	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5025	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C5026	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5030	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5032	2113928N01	CAP CER CHIP 0.1UF 10% 6.3

Reference Designator	Motorola Part Number	Description
C5033	2113743N52	CAP CHIP 120 PF 5% COG
C5034	2113743N40	CAP CHIP 39.0 PF 5% COG
C5037	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5039	2113743N29	CAP 13PF 20X40
C5040	2113743L41	CAP CHIP 10000 PF 10% X7R
C5041	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5044	2113743A19	CAP CHIP .100 UF 10% X7R
C5045	2113743A31	CAP CHIP 1.0 UF 10% X7R
C5048	2113743N25	CAP CHIP 9.1 PF +-.5PF COG
C5050	2113743T19	CAP 10UF 16V CER 3225 X5R
C5051	2113743L17	CAP CHIP 1000 PF 10% X7R
C5052	2113743L17	CAP CHIP 1000 PF 10% X7R
C5056	2113743N34	CAP CHIP 22.0 PF 5% COG
C5057	2113743N30	CAP CHIP 15.0 PF 5% COG
C5058	2113743L17	CAP CHIP 1000 PF 10% X7R
C5059	2113743N36	CAP CHIP 27.0 PF 5% COG
C5060	2113743L01	CAP CHIP 220 PF 10% X7R
C5061	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5062	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5063	2113743A31	CAP CHIP 1.0 UF 10% X7R
C5064	2113743L41	CAP CHIP 10000 PF 10% X7R
C5065	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5066	2113743L17	CAP CHIP 1000 PF 10% X7R
C5067	2113743N50	CAP CHIP 100 PF 5% COG
C5068	2113743N50	CAP CHIP 100 PF 5% COG
C5069	2113743N54	CAP CHIP 150 PF 5% COG
C5070	2113743N50	CAP CHIP 100 PF 5% COG
C5071	2113743N30	CAP CHIP 15.0 PF 5% COG
C5072	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5073	2113743A31	CAP CHIP 1.0 UF 10% X7R
C5251	2113743L01	CAP CHIP 220 PF 10% X7R
C5252	2113743N24	CAP CHIP 8.2 PF +-.5PF COG
C5253	2113743L01	CAP CHIP 220 PF 10% X7R
C5255	2113743N24	CAP CHIP 8.2 PF +-.5PF COG

Reference Designator	Motorola Part Number	Description
C5256	2113743L01	CAP CHIP 220 PF 10% X7R
C5257	2113743N22	CAP CHIP 6.8 PF +-.5PF COG
C5258	2113743N22	CAP CHIP 6.8 PF +-.5PF COG
C5259	2113743L41	CAP CHIP 10000 PF 10% X7R
C5280	2113743L01	CAP CHIP 220 PF 10% X7R
C5282	2113743L41	CAP CHIP 10000 PF 10% X7R
C5283	2113743N24	CAP CHIP 8.2 PF +-.5PF COG
C5284	2113743L41	CAP CHIP 10000 PF 10% X7R
C5285	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C5287	2113743L41	CAP CHIP 10000 PF 10% X7R
C5288	2113743N24	CAP CHIP 8.2 PF +-.5PF COG
C5289	2113743L01	CAP CHIP 220 PF 10% X7R
C5290	2113743L01	CAP CHIP 220 PF 10% X7R
C5291	2113743L41	CAP CHIP 10000 PF 10% X7R
C5292	2113743L01	CAP CHIP 220 PF 10% X7R
C5293	2113743N09	CAP CHIP 2.0 PF +-.25PF COG
C5294	2113743L41	CAP CHIP 10000 PF 10% X7R
C5295	2113743N16	CAP CHIP 3.9 PF +-.25PF COG
C5296	2113743L01	CAP CHIP 220 PF 10% X7R
C5297	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C5299	2113743L41	CAP CHIP 10000 PF 10% X7R
C5300	2113743L01	CAP CHIP 220 PF 10% X7R
C5301	2113743L41	CAP CHIP 10000 PF 10% X7R
C5302	2113743L41	CAP CHIP 10000 PF 10% X7R
C5303	2113743L41	CAP CHIP 10000 PF 10% X7R
C5304	2113743L01	CAP CHIP 220 PF 10% X7R
C5305	2113743L01	CAP CHIP 220 PF 10% X7R
C5306	2113743L01	CAP CHIP 220 PF 10% X7R
C5307	2113743L01	CAP CHIP 220 PF 10% X7R
C5308	2113743L01	CAP CHIP 220 PF 10% X7R
C5309	2113743L41	CAP CHIP 10000 PF 10% X7R
C5310	2113743L01	CAP CHIP 220 PF 10% X7R
C5311	2113743L41	CAP CHIP 10000 PF 10% X7R
C5312	2113743L01	CAP CHIP 220 PF 10% X7R
C5313	2113743L41	CAP CHIP 10000 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C5314	2113743L41	CAP CHIP 10000 PF 10% X7R
C5315	2185802B01	CAP 10V 4.7UF
C5316	2113743L09	CAP CHIP 470 PF 10% X7R
C5317	2113743L01	CAP CHIP 220 PF 10% X7R
C5318	2185802B01	CAP 10V 4.7UF
C5319	2113743L41	CAP CHIP 10000 PF 10% X7R
C5320	2113743L01	CAP CHIP 220 PF 10% X7R
C5321	2113743L01	CAP CHIP 220 PF 10% X7R
C5322	2113743L41	CAP CHIP 10000 PF 10% X7R
C5323	2113743L50	CAP CHIP 33000 PF 10%
C5324	2113743L01	CAP CHIP 220 PF 10% X7R
C5325	2113743L50	CAP CHIP 33000 PF 10%
C5326	2113743N28	CAP CHIP 12.0 PF 5% COG
C5327	2113743N50	CAP CHIP 100 PF 5% COG
C5328	2113743N32	CAP CHIP 18.0 PF 5% COG
C5329	2113743N50	CAP CHIP 100 PF 5% COG
C5331	2113743N25	CAP CHIP 9.1 PF +-.5PF COG
C5332	2113743N15	CAP CHIP 3.6 PF +-.25PF COG
C5334	2113743L01	CAP CHIP 220 PF 10% X7R
C5335	2113743L50	CAP CHIP 33000 PF 10%
C5336	2113743N25	CAP CHIP 9.1 PF +-.5PF COG
C5337	2113743L50	CAP CHIP 33000 PF 10%
C5338	2113743L01	CAP CHIP 220 PF 10% X7R
C5339	2113743N20	CAP CHIP 5.6 PF +-.5PF COG
C5340	2113743L01	CAP CHIP 220 PF 10% X7R
C5341	2113743N15	CAP CHIP 3.6 PF +-.25PF COG
C5342	2113743N25	CAP CHIP 9.1 PF +-.5PF COG
C5343	2113743N34	CAP CHIP 22.0 PF 5% COG
C5344	2113743N25	CAP CHIP 9.1 PF +-.5PF COG
C5345	2113743L09	CAP CHIP 470 PF 10% X7R
C5346	2113743L50	CAP CHIP 33000 PF 10%
C5347	2113743N32	CAP CHIP 18.0 PF 5% COG
C5348	2113743L01	CAP CHIP 220 PF 10% X7R
C5349	2113743N24	CAP CHIP 8.2 PF +-.5PF COG
C5350	2113743L50	CAP CHIP 33000 PF 10%

Reference Designator	Motorola Part Number	Description
C5351	2113743L50	CAP CHIP 33000 PF 10%
C5352	2113743L01	CAP CHIP 220 PF 10% X7R
C5353	2113743L01	CAP CHIP 220 PF 10% X7R
C5354	2113743N42	CAP CHIP 47.0 PF 5% COG
C5355	2113743N26	CAP CHIP 10.0 PF 5% COG
C5356	2113743L50	CAP CHIP 33000 PF 10%
C5357	2113743L01	CAP CHIP 220 PF 10% X7R
C5358	2113743N27	CAP CHIP 11.0 PF 5% COG
C5360	2113743L50	CAP CHIP 33000 PF 10%
C5361	2113743L01	CAP CHIP 220 PF 10% X7R
C5362	2113743L01	CAP CHIP 220 PF 10% X7R
C5363	2113743L01	CAP CHIP 220 PF 10% X7R
C5364	2113743L17	CAP CHIP 1000 PF 10% X7R
C5365	2113743L01	CAP CHIP 220 PF 10% X7R
C5366	2113743L17	CAP CHIP 1000 PF 10% X7R
C5367	2113743L01	CAP CHIP 220 PF 10% X7R
C5368	2113743L17	CAP CHIP 1000 PF 10% X7R
C5374	2113743N11	CAP CHIP 2.4 PF +/- .25PF COG
C5375	2113743N16	CAP CHIP 3.9 PF +/- .25PF COG
C5377	2113743N30	CAP CHIP 15.0 PF 5% COG
C5379	2113743N25	CAP CHIP 9.1 PF + .5PF COG
C5380	2113743N22	CAP CHIP 6.8 PF + .5PF COG
C5382	2113743L41	CAP CHIP 10000 PF 10% X7R
C5383	2113743L41	CAP CHIP 10000 PF 10% X7R
C5385	2113743L41	CAP CHIP 10000 PF 10% X7R
C5386	2113743N38	CAP CHIP 33.0 PF 5% COG
C5388	2113743L41	CAP CHIP 10000 PF 10% X7R
C5389	2113743N28	CAP CHIP 12.0 PF 5% COG
C5390	2113743N22	CAP CHIP 6.8 PF + .5PF COG
C5391	2113743N38	CAP CHIP 33.0 PF 5% COG
C5400	2113743L01	CAP CHIP 220 PF 10% X7R
C5401	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C5402	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5403	2113743N29	CAP 13PF 20X40
C5404	2113743N30	CAP CHIP 15.0 PF 5% COG

Reference Designator	Motorola Part Number	Description
C5405	2113743N12	CAP CHIP 2.7 PF +/- .25PF COG
C5406	2113743N31	CAP 16PF 20X40
C5407	2113743N30	CAP CHIP 15.0 PF 5% COG
C5408	2113743N13	CAP CHIP 3.0 PF +/- .25PF COG
C5409	2113743N69	CAP CHIP 1.8PF 16V +/- .25PF
C5410	2113743N69	CAP CHIP 1.8PF 16V +/- .25PF
C5412	2113743N12	CAP CHIP 2.7 PF +/- .25PF COG
C5413	2113743N69	CAP CHIP 1.8PF 16V +/- .25PF
C5414	2113743N24	CAP CHIP 8.2 PF + .5PF COG
C5415	2113743N12	CAP CHIP 2.7 PF +/- .25PF COG
C5418	2113743N69	CAP CHIP 1.8PF 16V +/- .25PF
C5419	2113743L01	CAP CHIP 220 PF 10% X7R
C5420	2113743L41	CAP CHIP 10000 PF 10% X7R
C5423	2113743L41	CAP CHIP 10000 PF 10% X7R
C5424	2113743L41	CAP CHIP 10000 PF 10% X7R
C5425	2113743L01	CAP CHIP 220 PF 10% X7R
C5426	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C5427	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C5428	2113743L01	CAP CHIP 220 PF 10% X7R
C5431	2113743L01	CAP CHIP 220 PF 10% X7R
C5433	2113743L41	CAP CHIP 10000 PF 10% X7R
C5501	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C5502	2113743N12	CAP CHIP 2.7 PF +/- .25PF COG
C5503	2113743L50	CAP CHIP 33000 PF 10%
C5504	2113743L01	CAP CHIP 220 PF 10% X7R
C5505	2113743E20	CAP CHIP .10 UF 10%
C5506	2113743N26	CAP CHIP 10.0 PF 5% COG
C5507	2113743N18	CAP CHIP 4.7 PF +/- .25PF COG
C5508	2113743L01	CAP CHIP 220 PF 10% X7R
C5509	2113743N50	CAP CHIP 100 PF 5% COG
C5510	2113743E20	CAP CHIP .10 UF 10%
C5512	2113743N44	CAP CHIP 56.0 PF 5% COG
C5513	2113743L48	CAP CHIP 22,000 PF 10%

Reference Designator	Motorola Part Number	Description
C5515	2113743L48	CAP CHIP 22,000 PF 10%
C5516	2113743L01	CAP CHIP 220 PF 10% X7R
C5517	2113743E20	CAP CHIP .10 UF 10%
C5518	2113743N38	CAP CHIP 33.0 PF 5% COG
C5520	2113743N62	CAP CHIP 6.0PF 16V .5PF COG
C5523	2113743N28	CAP CHIP 12.0 PF 5% COG
C5524	2113743N62	CAP CHIP 6.0PF 16V .5PF COG
C5525	2113743L01	CAP CHIP 220 PF 10% X7R
C5526	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5527	2113740A55	CAP CHIP REEL CL1 +/-30 100
C5535	2111078B38	CAP CHIP RF 68 5 NPO 100V
C5538	2111078B38	CAP CHIP RF 68 5 NPO 100V
C5539	2113740A55	CAP CHIP REEL CL1 +/-30 100
C5540	2113740A55	CAP CHIP REEL CL1 +/-30 100
C5541	2113932E20	CAP CER CHP .10 UF 10% 16V
C5542	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5543	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5544	2113932E20	CAP CER CHP .10 UF 10% 16V
C5545	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5546	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5547	2111078B15	CAP CHIP RF 12 5 NPO 100V
C5548	2111078B15	CAP CHIP RF 12 5 NPO 100V
C5549	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5550	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5551	2111078B10	CAP CHIP RF 7.5 .25 NPO 100V
C5552	2111078B16	CAP CHIP RF 13 5 NPO 100V
C5553	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5554	2113743L41	CAP CHIP 10000 PF 10% X7R
C5555	2113743L01	CAP CHIP 220 PF 10% X7R
C5556	2113743L41	CAP CHIP 10000 PF 10% X7R
C5557	2113743L41	CAP CHIP 10000 PF 10% X7R
C5558	2113743L41	CAP CHIP 10000 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C5559	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5560	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5565	2113743L50	CAP CHIP 33000 PF 10%
C5566	2113743N23	CAP CHIP 7.5 PF + .5PF COG
C5570	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5571	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C5572	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C5573	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5575	2113743L41	CAP CHIP 10000 PF 10% X7R
C5576	2113743L01	CAP CHIP 220 PF 10% X7R
C5577	2113743L41	CAP CHIP 10000 PF 10% X7R
C5578	2113743L01	CAP CHIP 220 PF 10% X7R
C5579	2113743L01	CAP CHIP 220 PF 10% X7R
C5701	2113743L01	CAP CHIP 220 PF 10% X7R
C5702	2113743L01	CAP CHIP 220 PF 10% X7R
C5703	2113743L01	CAP CHIP 220 PF 10% X7R
C5704	2113743L01	CAP CHIP 220 PF 10% X7R
C5705	2111078A06	CAP CHIP RF 1.5 .25 NPO 100V
C5706	2111078B09	CAP CHIP RF 6.8 .25 NPO 100V
C5707	2111078A01	CAP CHIP RF 1 .25 NPO 100V
C5708	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5709	2111078B34	CAP CHIP RF 47 5 NPO 100V
C5710	2113743N46	QAP CHIP 68.0 PF 5% COG
C5711	2111078B03	CAP CHIP RF 3.9 .25 NPO 100V
C5712	2111078B03	CAP CHIP RF 3.9 .25 NPO 100V
C5713	2111078B14	CAP CHIP RF 11 5 NPO 100V
C5714	2111078B03	CAP CHIP RF 3.9 .25 NPO 100V
C5715	2113743L01	CAP CHIP 220 PF 10% X7R
C5716	2113743N23	CAP CHIP 7.5 PF + .5PF COG
C5717	2113743N23	CAP CHIP 7.5 PF + .5PF COG

Reference Designator	Motorola Part Number	Description
C5718	2113743L01	CAP CHIP 220 PF 10% X7R
C5719	2111078A09	CAP CHIP RF 1.8 .25 NPO 100V
C5720	2111078B10	CAP CHIP RF 7.5 .25 NPO 100V
C5750	2113932E20	CAP CER CHP .10 UF 10% 16V
C5751	2113932E07	CAP CER CHP .022 UF 10% 16V
C5752	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C5753	2113743K15	CER CHIP CAP .100UF
C5754	2113743L41	CAP CHIP 10000 PF 10% X7R
C5755	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5756	2113743N40	CAP CHIP 39.0 PF 5% COG
C5757	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C5758	2113932E20	CAP CER CHP .10 UF 10% 16V
C5759	2113743E20	CAP CHIP .10 UF 10%
C5760	2113743L17	CAP CHIP 1000 PF 10% X7R
C5761	2113743L41	CAP CHIP 10000 PF 10% X7R
C5762	2113743E20	CAP CHIP .10 UF 10%
C5763	2113743N38	CAP CHIP 33.0 PF 5% COG
C5764	2113743N40	CAP CHIP 39.0 PF 5% COG
C5765	2113932E20	CAP CER CHP .10 UF 10% 16V
C5766	2113743T19	CAP 10UF 16V CER 3225 X5R
C5767	2113743L17	CAP CHIP 1000 PF 10% X7R
C5768	2113743N50	CAP CHIP 100 PF 5% COG
C5769	2113743K15	CER CHIP CAP .100UF
C5770	2113743T19	CAP 10UF 16V CER 3225 X5R
C5771	2113932E20	CAP CER CHP .10 UF 10% 16V
C5772	2113743K15	CER CHIP CAP .100UF
C5773	2113932E20	CAP CER CHP .10 UF 10% 16V
C5774	2113743N34	CAP CHIP 22.0 PF 5% COG
C5775	2113932E20	CAP CER CHP .10 UF 10% 16V
C5776	2113932E20	CAP CER CHP .10 UF 10% 16V

Reference Designator	Motorola Part Number	Description
C5777	2113932E20	CAP CER CHP .10 UF 10% 16V
C5778	2113932E20	CAP CER CHP .10 UF 10% 16V
C5779	2185419D10	CAP CER SUPER L/D 0.0015UF
C5780	2185419D10	CAP CER SUPER L/D 0.0015UF
C5781	2113743E12	CAP CHIP .047 UF 10% X7R
C5782	2185419D06	CAP CER SUPER L/D 0.1UF
C5783	2113743E20	CAP CHIP .10 UF 10%
C5784	2185419D06	CAP CER SUPER L/D 0.1UF
C5785	2185419D06	CAP CER SUPER L/D 0.1UF
C5786	2113743E20	CAP CHIP .10 UF 10%
C5787	2185419D06	CAP CER SUPER L/D 0.1UF
C5788	2311049J11	CAP TANT CHIP 4.7 10 16
C5789	2311049J11	CAP TANT CHIP 4.7 10 16
C5790	2113932E07	CAP CER CHP .022 UF 10% 16V
C5791	2185419D06	CAP CER SUPER L/D 0.1UF
C5792	2185419D06	CAP CER SUPER L/D 0.1UF
C5793	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5794	2113743N26	CAP CHIP 10.0 PF 5% COG
C5795	2113743N26	CAP CHIP 10.0 PF 5% COG
C5796	2113743L01	CAP CHIP 220 PF 10% X7R
C5797	2113743T19	CAP 10UF 16V CER 3225 X5R
C5798	2113743N50	CAP CHIP 100 PF 5% COG
C5799	2113743L01	CAP CHIP 220 PF 10% X7R
C5800	2113743N26	CAP CHIP 10.0 PF 5% COG
C5801	2113743N26	CAP CHIP 10.0 PF 5% COG
C5802	2113743L01	CAP CHIP 220 PF 10% X7R
C5803	2113743L05	CAP CHIP 330 PF 10% X7R
C5804	2113743L05	CAP CHIP 330 PF 10% X7R
C5805	2113743L05	CAP CHIP 330 PF 10% X7R
C5806	2113743L05	CAP CHIP 330 PF 10% X7R
C5807	2113743L05	CAP CHIP 330 PF 10% X7R
C5809	2185419D06	CAP CER SUPER L/D 0.1UF
C5810	2185419D06	CAP CER SUPER L/D 0.1UF
C5811	2185419D06	CAP CER SUPER L/D 0.1UF
C5812	2185419D06	CAP CER SUPER L/D 0.1UF
C5813	2113741F17	CAP CHIP CL2 X7R REEL 470

Reference Designator	Motorola Part Number	Description
C5816	2113743L01	CAP CHIP 220 PF 10% X7R
C5817	2113743L01	CAP CHIP 220 PF 10% X7R
C5825	2113743L05	CAP CHIP 330 PF 10% X7R
C5826	2113743L05	CAP CHIP 330 PF 10% X7R
C5827	2113743N30	CAP CHIP 15.0 PF 5% COG
C5828	2113743N30	CAP CHIP 15.0 PF 5% COG
C5829	2113743N28	CAP CHIP 12.0 PF 5% COG
C5830	2113743N28	CAP CHIP 12.0 PF 5% COG
C5831	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5832	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5833	2113743N10	CAP CHIP 2.2 PF +/- .25PF COG
C5834	2113743L05	CAP CHIP 330 PF 10% X7R
C5835	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C5836	2113743L05	CAP CHIP 330 PF 10% X7R
C5837	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5838	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5839	2113743N32	CAP CHIP 18.0 PF 5% COG
C5840	2113743N27	CAP CHIP 11.0 PF 5% COG
C5841	2113743L01	CAP CHIP 220 PF 10% X7R
C5842	2113743L01	CAP CHIP 220 PF 10% X7R
C5843	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5844	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5845	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5846	2113743N50	CAP CHIP 100 PF 5% COG
C5847	2113743L05	CAP CHIP 330 PF 10% X7R
C5848	2113743L05	CAP CHIP 330 PF 10% X7R
C5849	2113743N22	CAP CHIP 6.8 PF + -.5PF COG
C5850	2113743N32	CAP CHIP 18.0 PF 5% COG
C5851	2113743N33	CAP CHIP 20.0 PF 5% COG
C5852	2113743N28	CAP CHIP 12.0 PF 5% COG
C5853	2113743L05	CAP CHIP 330 PF 10% X7R
C5854	2113743N33	CAP CHIP 20.0 PF 5% COG
C5855	2113743N32	CAP CHIP 18.0 PF 5% COG

Reference Designator	Motorola Part Number	Description
C5856	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5857	2113743N28	CAP CHIP 12.0 PF 5% COG
C5858	2113743N32	CAP CHIP 18.0 PF 5% COG
C5859	2113743N50	CAP CHIP 100 PF 5% COG
C5860	2113743L05	CAP CHIP 330 PF 10% X7R
C5861	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5862	2113743L05	CAP CHIP 330 PF 10% X7R
C5863	2113743N13	CAP CHIP 3.0 PF +/- .25PF COG
C5900	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5901	2113743L01	CAP CHIP 220 PF 10% X7R
C5904	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5905	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C5906	2113743N08	CAP CHIP 1.6 PF +/- .25PF COG
C5907	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C5908	2113743N50	CAP CHIP 100 PF 5% COG
C5909	2113743N50	CAP CHIP 100 PF 5% COG
C5910	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C5911	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5912	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C5913	2113743L01	CAP CHIP 220 PF 10% X7R
C5914	2113743L01	CAP CHIP 220 PF 10% X7R
C5915	2113743N22	CAP CHIP 6.8 PF + -.5PF COG
C5916	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5917	2113743L01	CAP CHIP 220 PF 10% X7R
C5919	2113743L01	CAP CHIP 220 PF 10% X7R
C5920	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5921	2113743N12	CAP CHIP 2.7 PF +/- .25PF COG
C5922	2113743N18	CAP CHIP 4.7 PF +/- .25PF COG

Reference Designator	Motorola Part Number	Description
C5923	2113743Q07	CAP CHIP 1.5 PF +/-1PF 20*40
C5924	2113743N19	CAP CHIP 5.1 PF + .5PF COG
C5925	2113743N50	CAP CHIP 100 PF 5% COG
C5926	2113743N19	CAP CHIP 5.1 PF + .5PF COG
C5927	2113743N24	CAP CHIP 8.2 PF + .5PF COG
C5928	2113743N19	CAP CHIP 5.1 PF + .5PF COG
C5929	2113743L01	CAP CHIP 220 PF 10% X7R
C5930	2113743L01	CAP CHIP 220 PF 10% X7R
C5931	2113743N19	CAP CHIP 5.1 PF + .5PF COG
C5932	2113743L01	CAP CHIP 220 PF 10% X7R
C5933	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5935	2113743L01	CAP CHIP 220 PF 10% X7R
C5936	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5937	2113743N50	CAP CHIP 100 PF 5% COG
C5938	2113743Q08	CAP CHIP 1.8PF +/-1PF 20*40
C5939	2113743N17	CAP CHIP 4.3 PF +/- .25PF COG
C5940	2113743N19	CAP CHIP 5.1 PF + .5PF COG
C5941	2113743N50	CAP CHIP 100 PF 5% COG
C5942	2113743N16	CAP CHIP 3.9 PF +/- .25PF COG
C5943	2113743N20	CAP CHIP 5.6 PF + .5PF COG
C5944	2113743N18	CAP CHIP 4.7 PF +/- .25PF COG
C5945	2113743L01	CAP CHIP 220 PF 10% X7R
C5946	2113743L01	CAP CHIP 220 PF 10% X7R
C5947	2113743N18	CAP CHIP 4.7 PF +/- .25PF COG
C5948	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5949	2113743L01	CAP CHIP 220 PF 10% X7R
C5950	2113743N50	CAP CHIP 100 PF 5% COG
C5951	2113743N50	CAP CHIP 100 PF 5% COG
C5956	2113743L01	CAP CHIP 220 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C5957	2113743N13	CAP CHIP 3.0 PF +/- .25PF COG
C5958	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5959	2113743N50	CAP CHIP 100 PF 5% COG
C5960	2113743N14	CAP CHIP 3.3 PF +/- .25PF COG
D0501	4805218N57	DIODE DUAL
D0950	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0951	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0952	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D5002	4809877C13	DIODE VARACTOR ISV305 SMD
D5003	4805649Q13	DIODE VCTR ISV 228
D5250	4862824C01	DIODE VARACTOR
D5251	4862824C01	DIODE VARACTOR
D5252	4862824C01	DIODE VARACTOR
D5253	4862824C01	DIODE VARACTOR
D5280	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5281	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5282	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5300	4880154K06	DIODE PIN SCHOTTKY
D5302	4880154K06	DIODE PIN SCHOTTKY
D5304	4880154K06	DIODE PIN SCHOTTKY
D5305	4880154K06	DIODE PIN SCHOTTKY
D5380	4882290T04	DIODE SI HOT CARRIER HSMS 2812
D5381	4882290T04	DIODE SI HOT CARRIER HSMS 2812
D5400	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5701	4802482J02	PIN DIODE SMD
D5702	4802482J02	PIN DIODE SMD
D5703	4802482J02	PIN DIODE SMD
D5704	4813825A05	DIODE 30V HOT CARRIER MMBD301L
D5705	4813825A05	DIODE 30V HOT CARRIER MMBD301L
D5750	4802233J09	DIODE TRIPLE SOT25-RH

Reference Designator	Motorola Part Number	Description
D5751	4802233J09	DIODE TRIPLE SOT25-RH
D5827	4862824C03	DIODE VARACTOR
D5828	4862824C03	DIODE VARACTOR
D5831	4862824C03	DIODE VARACTOR
D5832	4862824C01	DIODE VARACTOR
D5833	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D5900	4802233J09	DIODE TRIPLE SOT25-RH
D5901	4862824C01	DIODE VARACTOR
D5902	4862824C01	DIODE VARACTOR
D5903	4862824C01	DIODE VARACTOR
D5904	4862824C01	DIODE VARACTOR
D5905	4862824C01	DIODE VARACTOR
D5906	4862824C01	DIODE VARACTOR
D5907	4862824C01	DIODE VARACTOR
D5908	4862824C01	DIODE VARACTOR
D5909	4862824C01	DIODE VARACTOR
D5910	4862824C01	DIODE VARACTOR
D5911	4862824C01	DIODE VARACTOR
D5912	4862824C01	DIODE VARACTOR
E5001	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5002	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5003	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5004	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5005	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5006	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5007	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5008	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5009	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5400	2484657R01	INDUCTOR BEAD CHIP
E5501	2484657R01	INDUCTOR BEAD CHIP
E5502	2484657R01	INDUCTOR BEAD CHIP
E6750	2480640Z01	SURFACE MOUNT FERRITE BEAD

Reference Designator	Motorola Part Number	Description
F0400	6583049X16	FUSE 5A FAST ACT
FL0900	9185130D01	FLTR SW CAP 3 POLE BUTTERW
J0401	0985722E01	CONN 50 POS FM SMT RTANG
J0402	0985631E01	CONNECTOR FEMALE 32 PIN ACCY
J0501	0985473E01	CONN SECURE 20 POS FM SMT RT ANG
J0950	0905902V07	CONNECTOR DC
J5701	0905901V11	CONNECTOR RF
L5001	2462587L50	FERRITE INDUCTOR 100UH
L5002	2462587V36	CHIP IND 150 NH 5% 0805
L5003	2405769X05	COIL INDUCTOR
L5004	2405769X05	COIL INDUCTOR
L5006	2462587V34	CHIP IND 100 NH 5% 0805
L5007	2462587N76	CHIP IND 4700 NH 5%
L5008	2485209F02	INDUCTOR 150NH 2%
L5010	2462587Q47	IND CHIP 1,000 NH 10%
L5012	2462587V34	CHIP IND 100 NH 5% 0805
L5015	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5053	2413926G19	IND 100 NH 5%
L5237	2462587V26	CHIP IND 22 NH 5% 0805
L5250	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5251	2484562T03	COIL SURFACE MOUNT AIR WOUND
L5252	2484562T04	COIL SURFACE MOUNT AIR WOUND
L5253	2462587X52	IND CHIP LO-PRO 82.0 NH 5%
L5254	2484562T04	COIL SURFACE MOUNT AIR WOUND
L5255	2484562T03	COIL SURFACE MOUNT AIR WOUND
L5256	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5257	2462587V29	CHIP IND 39 NH 5% 0805
L5258	2462587V26	CHIP IND 22 NH 5% 0805
L5280	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5281	2462587V59	IND CHIP 390 NH 5%
L5282	2462587V25	CHIP IND 18 NH 5% 0805

Reference Designator	Motorola Part Number	Description
L5283	2462587V33	CHIP IND 82 NH 5% 0805
L5284	2462587V25	CHIP IND 18 NH 5% 0805
L5285	2413926N22	IND CER CHIP 68.0 NH 5%
L5286	2413926N20	IND CER CHIP 47.0 NH 5%
L5287	2413926N16	IND CER CHIP 22.0 NH 5%
L5288	2462587V33	CHIP IND 82 NH 5% 0805
L5289	2462587V59	IND CHIP 390 NH 5%
L5290	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5291	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5292	2462587V59	IND CHIP 390 NH 5%
L5293	2462587V59	IND CHIP 390 NH 5%
L5294	2462587V29	CHIP IND 39 NH 5% 0805
L5295	2462587V59	IND CHIP 390 NH 5%
L5296	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5297	2462587V27	CHIP IND 27 NH 5% 0805
L5298	2462587V26	CHIP IND 22 NH 5% 0805
L5299	2484657R01	INDUCTOR BEAD CHIP
L5300	2462587V27	CHIP IND 27 NH 5% 0805
L5301	2462587V27	CHIP IND 27 NH 5% 0805
L5302	2462587V23	CHIP IND 12 NH 5% 0805
L5303	2462587V32	CHIP IND 68 NH 5% 0805
L5304	2462587V27	CHIP IND 27 NH 5% 0805
L5305	2462587V24	CHIP IND 15 NH 5% 0805
L5306	2462587V22	CHIP IND 8.2 NH 5% 0805
L5307	2462587V22	CHIP IND 8.2 NH 5% 0805
L5308	2462587V24	CHIP IND 15 NH 5% 0805
L5380	2462587V21	CHIP IND 6.8 NH 5% 0805
L5381	2462587V22	CHIP IND 8.2 NH 5% 0805
L5384	2462587V21	CHIP IND 6.8 NH 5% 0805
L5385	2413926N12	IND CER CHIP 10.0 MH 5%
L5386	2413926N12	IND CER CHIP 10.0 MH 5%
L5387	2413926N12	IND CER CHIP 10.0 MH 5%
L5388	2462587V32	CHIP IND 68 NH 5% 0805
L5389	2413926N12	IND CER CHIP 10.0 MH 5%
L5390	2462587V32	CHIP IND 68 NH 5% 0805
L5392	2462587V23	CHIP IND 12 NH 5% 0805
L5400	2462587V59	IND CHIP 390 NH 5%
L5401	2462587V59	IND CHIP 390 NH 5%

Reference Designator	Motorola Part Number	Description
L5402	2462587V59	IND CHIP 390 NH 5%
L5403	2462587V59	IND CHIP 390 NH 5%
L5404	2462587V52	IND CHIP 270NH 5%
L5406	2462587V38	CHIP IND 220 NH 5% 0805
L5407	2462587V38	CHIP IND 220 NH 5% 0805
L5408	2462587N68	CHIP IND 1000 NH
L5411	2462587V38	CHIP IND 220 NH 5% 0805
L5501	2462587V25	CHIP IND 18 NH 5% 0805
L5502	2462587V59	IND CHIP 390 NH 5%
L5503	2462587V23	CHIP IND 12 NH 5% 0805
L5504	2462587V38	CHIP IND 220 NH 5% 0805
L5505	2462587V59	IND CHIP 390 NH 5%
L5506	2462587V26	CHIP IND 22 NH 5% 0805
L5507	2462587V26	CHIP IND 22 NH 5% 0805
L5508	2484562T04	COIL SURFACE MOUNT AIR WOUND
L5510	2460592A01	COIL AW 2 TURN 17 NH
L5701	2462587N61	CHIP IND 470 NH
L5702	2462587N55	CHIP IND 150 NH
L5703	2460592A01	COIL AW 2 TURN 17 NH
L5704	2460592A01	COIL AW 2 TURN 17 NH
L5705	2462587N61	CHIP IND 470 NH
L5706	2460592A01	COIL AW 2 TURN 17 NH
L5707	2460592A01	COIL AW 2 TURN 17 NH
L5708	2460592A01	COIL AW 2 TURN 17 NH
L5712	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5713	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5750	2462587Q44	IND CHIP 560 NH 10%
L5751	2462587Q44	IND CHIP 560 NH 10%
L5752	2462587Q20	IND CHIP 2,200 NH 20%
L5753	2462587N68	CHIP IND 1000 NH
L5754	2462587Q20	IND CHIP 2,200 NH 20%
L5755	2462587Q20	IND CHIP 2,200 NH 20%
L5756	2462587Q20	IND CHIP 2,200 NH 20%
L5757	2413926H14	IND CHIP 15.0 NH 5%
L5758	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5759	2413926H14	IND CHIP 15.0 NH 5%
L5760	2462587P25	CHIP IND 12000 NH 5%
L5825	2462587V24	CHIP IND 15 NH 5% 0805

Reference Designator	Motorola Part Number	Description
L5826	2462587V59	IND CHIP 390 NH 5%
L5827	2462587V59	IND CHIP 390 NH 5%
L5828	2462587V24	CHIP IND 15 NH 5% 0805
L5829	2413926N29	IND CER CHIP 270.0 NH 5%
L5830	2413926N29	IND CER CHIP 270.0 NH 5%
L5831	2413926N27	COIL 30X60 INDUCTOR 180.0 NH
L5832	2413926N29	IND CER CHIP 270.0 NH 5%
L5833	2413926N28	IND CER CHIP 220.0MH 5%
L5834	2413926N27	COIL 30X60 INDUCTOR 180.0 NH
L5900	2413926N26	COIL 30X60 INDUCTOR 150.0 NH
L5901	2462587V40	IND CHIP 330 NH 10%
L5902	2462587T37	IND CHIP 18NH 5% LOW PRO
L5904	2462587V40	IND CHIP 330 NH 10%
L5905	2462587V40	IND CHIP 330 NH 10%
L5906	2413926N26	COIL 30X60 INDUCTOR 150.0 NH
L5907	2413926N26	COIL 30X60 INDUCTOR 150.0 NH
L5908	2462587V40	IND CHIP 330 NH 10%
L5909	2462587T37	IND CHIP 18NH 5% LOW PRO
L5910	2462587V40	IND CHIP 330 NH 10%
L5911	2462587T37	IND CHIP 18NH 5% LOW PRO
L5912	2462587V40	IND CHIP 330 NH 10%
L5913	2462587V40	IND CHIP 330 NH 10%
L5914	2462587V40	IND CHIP 330 NH 10%
L5915	2462587V40	IND CHIP 330 NH 10%
L5916	2413926N26	COIL 30X60 INDUCTOR 150.0 NH
L5917	2413926N13	ND CER CHIP 12.0 NH 5%
L5918	2413926N15	IND CER CHIP 18.0 NH 5%
L5919	2413926N13	ND CER CHIP 12.0 NH 5%
L5922	2413926N28	IND CER CHIP 220.0MH 5%
M5501	2685838C01	HEATSINK PLD1.5 TRANSISTOR ASSY
M5502	2685837C04	HEATSINK TRANSISTOR CARRIER
PCB	8485314E01	PCB MILLENNIUM UHF
Q0200	4880048M01	TSTR NPN DIG 47K/47K
Q0402	4880048M01	TSTR NPN DIG 47K/47K

Reference Designator	Motorola Part Number	Description
Q0403	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0404	4880048M01	TSTR NPN DIG 47K/47K
Q0500	4880048M01	TSTR NPN DIG 47K/47K
Q0501	4880048M01	TSTR NPN DIG 47K/47K
Q0502	4880048M01	TSTR NPN DIG 47K/47K
Q0503	4813821A09	TSTR P-CH 60V 12A _2955_
Q0504	4880048M01	TSTR NPN DIG 47K/47K
Q0505	4880048M01	TSTR NPN DIG 47K/47K
Q0610	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0611	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0612	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0613	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0951	4880048M01	TSTR NPN DIG 47K/47K
Q0952	4885844C01	XSTR FET
Q0954	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q0955	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q0960	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q5001	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5002	4805218N63	RF TRANS SOT 323 BFQ67W
Q5003	4805218N63	RF TRANS SOT 323 BFQ67W
Q5250	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5251	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5252	4805218N63	RF TRANS SOT 323 BFQ67W
Q5253	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q5254	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5255	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5256	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q5257	4880048M01	TSTR NPN DIG 47K/47K
Q5258	4813824A17	XSTR PNP40V .2A GENP B=100-300

Reference Designator	Motorola Part Number	Description
Q5401	4805218N55	TRANSISTOR 3 LEAD BFQ67
Q5402	4880048M01	TSTR NPN DIG 47K/47K
Q5501	4805218N63	RF TRANS SOT 323 BFQ67W
Q5502	4886212B01	LD MOS PWR TSTR MRF 1518
Q5503	4813828C44	TSTR UHF 70W 12.5 VOLTS LD MOS
Q5570	4880048M01	TSTR NPN DIG 47K/47K
Q5706	4805921T04	XISTOR FMC1 RH REELED
Q5707	4805921T04	XISTOR FMC1 RH REELED
Q5708	4805921T04	XISTOR FMC1 RH REELED
Q5709	4805921T04	XISTOR FMC1 RH REELED
Q5710	4805921T04	XISTOR FMC1 RH REELED
Q5750	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5751	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5752	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q5755	4805218N63	RF TRANS SOT 323 BFQ67W
Q5825	4805218N63	RF TRANS SOT 323 BFQ67W
Q5826	4805218N63	RF TRANS SOT 323 BFQ67W
Q5828	4805218N63	RF TRANS SOT 323 BFQ67W
Q5829	4805218N63	RF TRANS SOT 323 BFQ67W
Q5901	4805793Y01	TRANS MINI SOT NPN LOW NOISE
Q5902	4805218N63	RF TRANS SOT 323 BFQ67W
Q5903	4805793Y01	TRANS MINI SOT NPN LOW NOISE
Q5904	4805218N63	RF TRANS SOT 323 BFQ67W
Q5905	4805793Y01	TRANS MINI SOT NPN LOW NOISE
Q5906	4805218N63	RF TRANS SOT 323 BFQ67W
R0102	0662057M98	RES. CHIP 10K 5% 20X40
R0104	0662057M98	RES. CHIP 10K 5% 20X40
R0105	0662057M98	RES. CHIP 10K 5% 20X40
R0106	0662057M98	RES. CHIP 10K 5% 20X40
R0107	0662057M01	RES. CHIP 0
R0109	0662057M98	RES. CHIP 10K 5% 20X40
R0110	0662057M98	RES. CHIP 10K 5% 20X40
R0114	0662057M01	RES. CHIP 0
R0116	0662057B46	CHIP RES 10.0 MEG OHMS 5%

Reference Designator	Motorola Part Number	Description
R0117	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R0119	0662057N39	RES. CHIP 470K 5% 20X40
R0120	0662057M98	RES. CHIP 10K 5% 20X40
R0121	0662057M98	RES. CHIP 10K 5% 20X40
R0122	0662057M86	RES CHIP 3300 5% 20X40
R0125	0662057M98	RES. CHIP 10K 5% 20X40
R0200	0662057M74	RES. CHIP 1000 5% 20X40
R0201	0662057M01	RES. CHIP 0
R0202	0662057M86	RES CHIP 3300 5% 20X40
R0203	0662057M74	RES. CHIP 1000 5% 20X40
R0204	0662057M68	RES CHIP 560 5% 20X40
R0205	0662057N15	RES. CHIP 47K 5% 20X40
R0207	0662057M95	RES. CHIP 7500 5% 20X40
R0208	0662057N23	RES. CHIP 100K 5% 20X40
R0209	0662057M98	RES. CHIP 10K 5% 20X40
R0210	0662057N23	RES. CHIP 100K 5% 20X40
R0212	0662057N23	RES. CHIP 100K 5% 20X40
R0216	0662057N23	RES. CHIP 100K 5% 20X40
R0218	0662057M74	RES. CHIP 1000 5% 20X40
R0219	0662057M74	RES. CHIP 1000 5% 20X40
R0220	0662057N05	RES. CHIP 18K 5% 20X40
R0221	0662057M98	RES. CHIP 10K 5% 20X40
R0222	0662057M98	RES. CHIP 10K 5% 20X40
R0224	0662057M01	RES. CHIP 0
R0225	0662057M98	RES. CHIP 10K 5% 20X40
R0226	0662057N12	RES. CHIP 36K 5% 20X40
R0227	0662057N19	RES. CHIP 68K 5% 20X40
R0228	0662057N11	RES. CHIP 33K 5% 20X40
R0229	0662057N19	RES. CHIP 68K 5% 20X40
R0230	0662057N11	RES. CHIP 33K 5% 20X40
R0231	0662057C13	CHIP RES 2.7 OHMS 5%
R0235	0662057M98	RES. CHIP 10K 5% 20X40
R0236	0662057M97	RES CHIP 9100 5% 20X40
R0300	0662057M50	RES. CHIP 100 5% 20X40
R0301	0662057M50	RES. CHIP 100 5% 20X40
R0303	0662057M78	RES. CHIP 1500 5% 20X40
R0304	0662057M34	RES. CHIP 22 5% 20X40
R0305	0662057M34	RES. CHIP 22 5% 20X40
R0307	0662057M98	RES. CHIP 10K 5% 20X40
R0403	0662057M98	RES. CHIP 10K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0404	0662057M74	RES. CHIP 1000 5% 20X40
R0405	0662057M74	RES. CHIP 1000 5% 20X40
R0406	0662057M68	RES CHIP 560 5% 20X40
R0407	0662057M50	RES. CHIP 100 5% 20X40
R0408	0662057M50	RES. CHIP 100 5% 20X40
R0409	0662057M98	RES. CHIP 10K 5% 20X40
R0410	0662057M50	RES. CHIP 100 5% 20X40
R0411	0662057M98	RES. CHIP 10K 5% 20X40
R0412	0662057M50	RES. CHIP 100 5% 20X40
R0415	0662057M50	RES. CHIP 100 5% 20X40
R0416	0662057M50	RES. CHIP 100 5% 20X40
R0417	0662057M50	RES. CHIP 100 5% 20X40
R0418	0662057M50	RES. CHIP 100 5% 20X40
R0419	0662057M90	RES. CHIP 4700 5% 20X40
R0420	0662057M98	RES. CHIP 10K 5% 20X40
R0421	0662057M01	RES. CHIP 0
R0422	0662057V15	RES CHIP 33K 1% 1/16W
R0425	0662057M98	RES. CHIP 10K 5% 20X40
R0430	0662057M01	RES. CHIP 0
R0431	0662057M98	RES. CHIP 10K 5% 20X40
R0432	0662057M50	RES. CHIP 100 5% 20X40
R0435	0662057M74	RES. CHIP 1000 5% 20X40
R0500	0662057N23	RES. CHIP 100K 5% 20X40
R0502	0662057N37	RES CHIP 390K 5% 20X40
R0503	0662057N23	RES. CHIP 100K 5% 20X40
R0504	0662057N23	RES. CHIP 100K 5% 20X40
R0505	0662057M98	RES. CHIP 10K 5% 20X40
R0506	0662057M98	RES. CHIP 10K 5% 20X40
R0507	0662057M98	RES. CHIP 10K 5% 20X40
R0508	0662057M98	RES. CHIP 10K 5% 20X40
R0509	0662057M81	RES. CHIP 2000 5% 20X40
R0510	0662057V18	RES CHIP 43K 1% 1/16W
R0511	0662057V15	RES CHIP 33K 1% 1/16W
R0512	0662057V02	RES CHIP 10K 1% 1/16W
R0513	0662057V17	RES CHIP 39K 1% 1/16W
R0514	0662057M01	RES. CHIP 0
R0515	0662057M74	RES. CHIP 1000 5% 20X40
R0516	0662057N23	RES. CHIP 100K 5% 20X40
R0517	0662057M90	RES. CHIP 4700 5% 20X40
R0518	0662057M98	RES. CHIP 10K 5% 20X40
R0519	0662057C27	CHIP RES 10 OHMS 5%

Reference Designator	Motorola Part Number	Description
R0520	0662057N15	RES. CHIP 47K 5% 20X40
R0521	0662057V17	RES CHIP 39K 1% 1/16W
R0522	0662057V10	RES CHIP 20K 1% 1/16W
R0523	0662057N23	RES. CHIP 100K 5% 20X40
R0528	0662057M95	RES. CHIP 7500 5% 20X40
R0529	0662057M76	RES. CHIP 1200 5% 20X40
R0531	0662057N23	RES. CHIP 100K 5% 20X40
R0620	0662057M50	RES. CHIP 100 5% 20X40
R0621	0662057M50	RES. CHIP 100 5% 20X40
R0622	0662057M50	RES. CHIP 100 5% 20X40
R0623	0662057M50	RES. CHIP 100 5% 20X40
R0624	0662057M50	RES. CHIP 100 5% 20X40
R0625	0662057M98	RES. CHIP 10K 5% 20X40
R0626	0662057N23	RES. CHIP 100K 5% 20X40
R0627	0662057N23	RES. CHIP 100K 5% 20X40
R0628	0662057N23	RES. CHIP 100K 5% 20X40
R0629	0662057M98	RES. CHIP 10K 5% 20X40
R0630	0662057N23	RES. CHIP 100K 5% 20X40
R0631	0662057M01	RES. CHIP 0
R0634	0662057N23	RES. CHIP 100K 5% 20X40
R0635	0662057N23	RES. CHIP 100K 5% 20X40
R0636	0662057M98	RES. CHIP 10K 5% 20X40
R0638	0662057M98	RES. CHIP 10K 5% 20X40
R0639	0662057M98	RES. CHIP 10K 5% 20X40
R0901	0662057M96	RES. CHIP 8200 5% 20X40
R0902	0662057N23	RES. CHIP 100K 5% 20X40
R0903	0662057N23	RES. CHIP 100K 5% 20X40
R0904	0662057N23	RES. CHIP 100K 5% 20X40
R0905	0662057N23	RES. CHIP 100K 5% 20X40
R0906	0662057M50	RES. CHIP 100 5% 20X40
R0907	0662057M50	RES. CHIP 100 5% 20X40
R0910	0662057V25	RES CHIP 82K 1% 1/16
R0911	0662057V04	RES CHIP 12K 1% 1/16W
R0912	0662057V04	RES CHIP 12K 1% 1/16W
R0913	0662057V30	RES CHIP 130K 1% 1/16W
R0914	0662057V04	RES CHIP 12K 1% 1/16W
R0923	0662057M50	RES. CHIP 100 5% 20X40
R0924	0662057M50	RES. CHIP 100 5% 20X40
R0930	0662057N06	RES. CHIP 20K 5% 20X40
R0931	0662057M98	RES. CHIP 10K 5% 20X40
R0932	0662057M86	RES CHIP 3300 5% 20X40

Reference Designator	Motorola Part Number	Description
R0933	0662057M90	RES. CHIP 4700 5% 20X40
R0934	0662057M74	RES. CHIP 1000 5% 20X40
R0935	0662057M01	RES. CHIP 0
R0936	0662057M01	RES. CHIP 0
R0938	0662057M01	RES. CHIP 0
R0940	0662057M01	RES. CHIP 0
R0942	0662057M96	RES. CHIP 8200 5% 20X40
R0943	0662057N03	RES. CHIP 15K 5% 20X40
R0944	0662057M98	RES. CHIP 10K 5% 20X40
R0945	0662057N11	RES. CHIP 33K 5% 20X40
R0947	0662057V02	RES CHIP 10K 1% 1/16W
R0950	0662057M01	RES. CHIP 0
R0951	0662057U98	RES CHIP 7.5K 1% 1/16W
R0952	0662057U78	RES CHIP 1.2K 1% 1/16W
R0953	0662057M01	RES. CHIP 0
R0954	0662057U98	RES CHIP 7.5K 1% 1/16W
R0955	0662057N23	RES. CHIP 100K 5% 20X40
R0960	0662057N06	RES. CHIP 20K 5% 20X40
R0961	0662057N23	RES. CHIP 100K 5% 20X40
R0962	0662057N23	RES. CHIP 100K 5% 20X40
R0963	0662057N08	RES CHIP 24K 5% 20X40
R0964	0662057N08	RES CHIP 24K 5% 20X40
R0965	0662057M01	RES. CHIP 0
R0966	0662057M01	RES. CHIP 0
R0967	0662057V27	RES CHIP 100K 1% 1/1 6W
R0968	0662057V02	RES CHIP 10K 1% 1/16W
R0971	0662057V07	RES CHIP 15K 1% 1/16W
R0972	0662057U93	RES CHIP 4.7K 1% 1/16W
R0973	0662057N17	RES. CHIP 56K 5% 20X40
R0974	0662057V02	RES CHIP 10K 1% 1/16W
R0975	0662057V02	RES CHIP 10K 1% 1/16W
R0976	0662057M74	RES. CHIP 1000 5% 20X40
R0977	0662057M50	RES. CHIP 100 5% 20X40
R0978	0662057M98	RES. CHIP 10K 5% 20X40
R0979	0662057M01	RES. CHIP 0
R0981	0662057M84	RES. CHIP 2700 5% 20X40
R0982	0662057N23	RES. CHIP 100K 5% 20X40
R0983	0662057M81	RES. CHIP 2000 5% 20X40
R0984	0662057M01	RES. CHIP 0
R0985	0662057M01	RES. CHIP 0
R0987	0662057M01	RES. CHIP 0

Reference Designator	Motorola Part Number	Description
R0988	0662057M98	RES. CHIP 10K 5% 20X40
R0989	0662057N17	RES. CHIP 56K 5% 20X40
R0990	0662057M91	RES CHIP 5100 5% 20X40
R0991	0662057M98	RES. CHIP 10K 5% 20X40
R0992	0662057V27	RES CHIP 100K 1% 1/1 6W
R0993	0662057U78	RES CHIP 1.2K 1% 1/16W
R0994	0662057M88	RES. CHIP 3900 5% 20X40
R0995	0662057U78	RES CHIP 1.2K 1% 1/16W
R0996	0662057M98	RES. CHIP 10K 5% 20X40
R0997	0662057U78	RES CHIP 1.2K 1% 1/16W
R0998	0662057V02	RES CHIP 10K 1% 1/16W
R0999	0662057V02	RES CHIP 10K 1% 1/16W
R1000	0662057M50	RES. CHIP 100 5% 20X40
R1001	0662057M50	RES. CHIP 100 5% 20X40
R1002	0662057C13	CHIP RES 2.7 OHMS 5%
R5000	0662057M43	RES. CHIP 51 5% 20X40
R5001	0662057M01	RES. CHIP 0
R5002	0662057M66	RES. CHIP 470 5% 20X40
R5003	0662057N23	RES. CHIP 100K 5% 20X40
R5005	0662057M98	RES. CHIP 10K 5% 20X40
R5006	0662057M62	RES. CHIP 330 5% 20X40
R5010	0662057N05	RES. CHIP 18K 5% 20X40
R5011	0662057N03	RES. CHIP 15K 5% 20X40
R5013	0662057M70	RES. CHIP 680 5% 20X40
R5014	0662057M01	RES. CHIP 0
R5015	0662057M01	RES. CHIP 0
R5016	0662057M01	RES. CHIP 0
R5017	0662057M01	RES. CHIP 0
R5018	0662057M01	RES. CHIP 0
R5019	0662057M01	RES. CHIP 0
R5020	0662057M98	RES. CHIP 10K 5% 20X40
R5022	0662057M60	RES. CHIP 270 5% 20X40
R5023	0662057N30	RES. CHIP 200K 5% 20X40
R5025	0662057M74	RES. CHIP 1000 5% 20X40
R5026	0662057M34	RES. CHIP 22 5% 20X40
R5027	0662057M50	RES. CHIP 100 5% 20X40
R5028	0662057M94	RES. CHIP 6800 5% 20X40
R5029	0662057N06	RES. CHIP 20K 5% 20X40
R5030	0662057N11	RES. CHIP 33K 5% 20X40
R5031	0662057M66	RES. CHIP 470 5% 20X40
R5032	0662057M76	RES. CHIP 1200 5% 20X40

Reference Designator	Motorola Part Number	Description
R5034	0662057M01	RES. CHIP 0
R5050	0662057M36	RES CHIP 27 5% 20X4
R5051	0662057M49	RES CHIP 91 5% 20X40
R5250	0662057N15	RES. CHIP 47K 5% 20X40
R5251	0662057N15	RES. CHIP 47K 5% 20X40
R5252	0662057M74	RES. CHIP 1000 5% 20X40
R5253	0662057N15	RES. CHIP 47K 5% 20X40
R5254	0662057N15	RES. CHIP 47K 5% 20X40
R5255	0662057M74	RES. CHIP 1000 5% 20X40
R5256	0662057M90	RES. CHIP 4700 5% 20X40
R5300	0662057M90	RES. CHIP 4700 5% 20X40
R5301	0662057M98	RES. CHIP 10K 5% 20X40
R5302	0662057C75	CHIP RES 1000 OHMS 5%
R5303	0662057M90	RES. CHIP 4700 5% 20X40
R5304	0662057M74	RES. CHIP 1000 5% 20X40
R5305	0662057M90	RES. CHIP 4700 5% 20X40
R5306	0662057N03	RES. CHIP 15K 5% 20X40
R5307	0662057N07	RES. CHIP 22K 5% 20X40
R5308	0662057M46	RES. CHIP 68 5% 20X40
R5309	0662057M36	RES CHIP 27 5% 20X4
R5310	0662057C75	CHIP RES 1000 OHMS 5%
R5311	0662057M98	RES. CHIP 10K 5% 20X40
R5312	0662057M98	RES. CHIP 10K 5% 20X40
R5313	0662057M90	RES. CHIP 4700 5% 20X40
R5314	0662057M90	RES. CHIP 4700 5% 20X40
R5315	0662057M74	RES. CHIP 1000 5% 20X40
R5316	0662057C75	CHIP RES 1000 OHMS 5%
R5317	0662057M74	RES. CHIP 1000 5% 20X40
R5318	0662057C75	CHIP RES 1000 OHMS 5%
R5319	0662057M66	RES. CHIP 470 5% 20X40
R5322	0662057M83	RES. CHIP 2400 5% 20X40
R5323	0662057N01	RES CHIP 12K 5% 20X40
R5324	0662057C31	CHIP RES 15 OHMS 5%
R5325	0662057C31	CHIP RES 15 OHMS 5%
R5326	0662057C31	CHIP RES 15 OHMS 5%
R5327	0662057M56	RES. CHIP 180 5% 20X40
R5330	0662057M42	RES. CHIP 47 5% 20X40
R5332	0662057M78	RES. CHIP 1500 5% 20X40
R5333	0662057M42	RES. CHIP 47 5% 20X40
R5334	0662057M78	RES. CHIP 1500 5% 20X40
R5383	0662057M56	RES. CHIP 180 5% 20X40

Reference Designator	Motorola Part Number	Description
R5384	0662057M56	RES. CHIP 180 5% 20X40
R5385	0662057M56	RES. CHIP 180 5% 20X40
R5386	0662057M56	RES. CHIP 180 5% 20X40
R5387	0662057M42	RES. CHIP 47 5% 20X40
R5388	0662057M01	RES. CHIP 0
R5400	0662057M70	RES. CHIP 680 5% 20X40
R5401	0662057N09	RES. CHIP 27K 5% 20X40
R5402	0662057M94	RES. CHIP 6800 5% 20X40
R5403	0662057M62	RES. CHIP 330 5% 20X40
R5404	0662057M01	RES. CHIP 0
R5405	0662057M98	RES. CHIP 10K 5% 20X40
R5406	0662057M74	RES. CHIP 1000 5% 20X40
R5412	0662057M01	RES. CHIP 0
R5414	0662057M01	RES. CHIP 0
R5415	0662057M01	RES. CHIP 0
R5501	0662057A29	CHIP RES 150 OHMS 5%
R5502	0662057M94	RES. CHIP 6800 5% 20X40
R5503	0662057M90	RES. CHIP 4700 5% 20X40
R5505	0662057A29	CHIP RES 150 OHMS 5%
R5506	0662057M48	RES. CHIP 82 5% 20X40
R5507	0662057M50	RES. CHIP 100 5% 20X40
R5510	0662057M48	RES. CHIP 82 5% 20X40
R5511	0662057M10	RES CHIP 2.2 5% 20X40
R5512	0662057M10	RES CHIP 2.2 5% 20X40
R5513	0662057M10	RES CHIP 2.2 5% 20X40
R5514	0662057M10	RES CHIP 2.2 5% 20X40
R5515	0662057M10	RES CHIP 2.2 5% 20X40
R5516	0662057C44	CHIP RES 51 OHMS 5%
R5517	0680195M01	RES CHIP 10 OHMS 5% .5W
R5519	0662057N23	RES. CHIP 100K 5% 20X40
R5520	0662057C75	CHIP RES 1000 OHMS 5%
R5521	0662057C75	CHIP RES 1000 OHMS 5%
R5522	0685934D01	RES FIXED CHIP (CURRENT SENSOR)
R5523	0680195M01	RES CHIP 10 OHMS 5% .5W
R5524	0680194M13	RES 33 OHMS 5% 1W
R5525	0662057C75	CHIP RES 1000 OHMS 5%
R5526	0662057C75	CHIP RES 1000 OHMS 5%
R5527	0662057C75	CHIP RES 1000 OHMS 5%
R5528	0662057M54	RES. CHIP 150 5% 20X40
R5529	0662057M56	RES. CHIP 180 5% 20X40

Reference Designator	Motorola Part Number	Description
R5530	0662057C20	CHIP RES 5.1 OHMS 5%
R5532	0662057C13	CHIP RES 2.7 OHMS 5%
R5533	0662057C20	CHIP RES 5.1 OHMS 5%
R5534	0662057C20	CHIP RES 5.1 OHMS 5%
R5535	0680195M01	RES CHIP 10 OHMS 5% .5W
R5536	0662057C20	CHIP RES 5.1 OHMS 5%
R5570	0662057C13	CHIP RES 2.7 OHMS 5%
R5571	0662057N11	RES. CHIP 33K 5% 20X40
R5572	0662057U98	RES CHIP 7.5K 1% 1/16W
R5573	0662057U78	RES CHIP 1.2K 1% 1/16W
R5574	0611077A01	RES CHIP JUMPER
R5701	0680194M13	RES 33 OHMS 5% 1W
R5702	0662057A53	CHIP RES 1500 OHMS 5%
R5703	0662057A84	CHIP RES 30K OHMS 5%
R5704	0680149M02	THERMISTOR CHIP 100K OHM
R5705	0662057A35	CHIP RES 270 OHMS 5%
R5706	0662057A35	CHIP RES 270 OHMS 5%
R5707	0662057A35	CHIP RES 270 OHMS 5%
R5708	0662057A35	CHIP RES 270 OHMS 5%
R5709	0662057A53	CHIP RES 1500 OHMS 5%
R5710	0662057A94	CHIP RES 75K OHMS 5%
R5711	0662057A84	CHIP RES 30K OHMS 5%
R5712	0680149M02	THERMISTOR CHIP 100K OHM
R5750	0662057M74	RES. CHIP 1000 5% 20X40
R5751	0662057M98	RES. CHIP 10K 5% 20X40
R5752	0662057N15	RES. CHIP 47K 5% 20X40
R5753	0662057M91	RES CHIP 5100 5% 20X40
R5754	0662057N15	RES. CHIP 47K 5% 20X40
R5755	0662057M01	RES. CHIP 0
R5758	0662057M86	RES CHIP 3300 5% 20X40
R5759	0662057M81	RES. CHIP 2000 5% 20X40
R5761	0662057N23	RES. CHIP 100K 5% 20X40
R5762	0662057N23	RES. CHIP 100K 5% 20X40
R5763	0662057M74	RES. CHIP 1000 5% 20X40
R5764	0662057N15	RES. CHIP 47K 5% 20X40
R5765	0662057M91	RES CHIP 5100 5% 20X40
R5766	0662057N23	RES. CHIP 100K 5% 20X40
R5767	0662057N15	RES. CHIP 47K 5% 20X40
R5768	0662057M50	RES. CHIP 100 5% 20X40

Reference Designator	Motorola Part Number	Description
R5769	0662057M01	RES. CHIP 0
R5771	0662057M54	RES. CHIP 150 5% 20X40
R5772	0662057M71	RES CHIP 750 5% 20X40
R5773	0662057M54	RES. CHIP 150 5% 20X40
R5774	0662057M48	RES. CHIP 82 5% 20X40
R5775	0662057M50	RES. CHIP 100 5% 20X40
R5776	0662057M74	RES. CHIP 1000 5% 20X40
R5777	0662057M74	RES. CHIP 1000 5% 20X40
R5778	0662057M72	RES. CHIP 820 5% 20X40
R5779	0662057N01	RES CHIP 12K 5% 20X40
R5780	0662057M84	RES. CHIP 2700 5% 20X40
R5782	0662057N15	RES. CHIP 47K 5% 20X40
R5783	0662057N15	RES. CHIP 47K 5% 20X40
R5784	0662057N15	RES. CHIP 47K 5% 20X40
R5785	0662057N15	RES. CHIP 47K 5% 20X40
R5786	0662057N15	RES. CHIP 47K 5% 20X40
R5825	0662057M83	RES. CHIP 2400 5% 20X40
R5826	0662057M88	RES. CHIP 3900 5% 20X40
R5827	0662057M60	RES. CHIP 270 5% 20X40
R5828	0662057M66	RES. CHIP 470 5% 20X40
R5829	0662057M74	RES. CHIP 1000 5% 20X40
R5830	0662057M77	RES. CHIP 1300 5% 20X40
R5831	0662057M38	RES. CHIP 33 5% 20X40
R5832	0662057M38	RES. CHIP 33 5% 20X40
R5833	0662057M60	RES. CHIP 270 5% 20X40
R5834	0662057M60	RES. CHIP 270 5% 20X40
R5837	0662057M50	RES. CHIP 100 5% 20X40
R5838	0662057M50	RES. CHIP 100 5% 20X40
R5839	0662057M43	RES. CHIP 51 5% 20X40
R5840	0662057M43	RES. CHIP 51 5% 20X40
R5841	0662057M50	RES. CHIP 100 5% 20X40
R5842	0662057M50	RES. CHIP 100 5% 20X40
R5843	0662057M58	RES. CHIP 220 5% 20X40
R5845	0662057M84	RES. CHIP 2700 5% 20X40
R5846	0662057N01	RES CHIP 12K 5% 20X40
R5848	0662057M72	RES. CHIP 820 5% 20X40
R5849	0662057M30	RES. CHIP 15 5% 20X40
R5850	0662057M58	RES. CHIP 220 5% 20X40
R5851	0662057M90	RES. CHIP 4700 5% 20X40
R5852	0662057M90	RES. CHIP 4700 5% 20X40
R5853	0662057M74	RES. CHIP 1000 5% 20X40

Reference Designator	Motorola Part Number	Description
R5854	0662057M63	RES CHIP 360 5% 20X40
R5855	0662057M01	RES. CHIP 0
R5900	0662057M81	RES. CHIP 2000 5% 20X40
R5902	0662057M58	RES. CHIP 220 5% 20X40
R5903	0662057M81	RES. CHIP 2000 5% 20X40
R5904	0662057M60	RES. CHIP 270 5% 20X40
R5905	0662057M50	RES. CHIP 100 5% 20X40
R5909	0662057M30	RES. CHIP 15 5% 20X40
R5910	0662057M38	RES. CHIP 33 5% 20X40
R5911	0662057M66	RES. CHIP 470 5% 20X40
R5912	0662057M81	RES. CHIP 2000 5% 20X40
R5914	0662057M72	RES. CHIP 820 5% 20X40
R5915	0662057M60	RES. CHIP 270 5% 20X40
R5916	0662057M79	RES CHIP 1600 5% 20X40
R5917	0662057N01	RES CHIP 12K 5% 20X40
R5918	0662057M50	RES. CHIP 100 5% 20X40
R5919	0662057M47	RES CHIP 75 5% 20X40
R5921	0662057M84	RES. CHIP 2700 5% 20X40
R5922	0662057M38	RES. CHIP 33 5% 20X40
R5923	0662057M66	RES. CHIP 470 5% 20X40
R5924	0662057M79	RES CHIP 1600 5% 20X40
R5926	0662057M72	RES. CHIP 820 5% 20X40
R5927	0662057M81	RES. CHIP 2000 5% 20X40
R5928	0662057M60	RES. CHIP 270 5% 20X40
R5929	0662057N01	RES CHIP 12K 5% 20X40
R5930	0662057M43	RES. CHIP 51 5% 20X40
R5931	0662057M47	RES CHIP 75 5% 20X40
R5932	0662057M47	RES CHIP 75 5% 20X40
R5933	0662057M84	RES. CHIP 2700 5% 20X40
R5934	0662057M38	RES. CHIP 33 5% 20X40
R5935	0662057M66	RES. CHIP 470 5% 20X40
R5937	0662057M62	RES. CHIP 330 5% 20X40
R5938	0662057M90	RES. CHIP 4700 5% 20X40
R5939	0662057M90	RES. CHIP 4700 5% 20X40
R5940	0662057M63	RES CHIP 360 5% 20X40
R5948	0662057M47	RES CHIP 75 5% 20X40
R5949	0662057M30	RES. CHIP 15 5% 20X40
R5950	0662057M58	RES. CHIP 220 5% 20X40
SH5400	2685882A01	SHLD VCO TANK
T5380	2584600T01	BALUN RF
T5381	2584600T01	BALUN RF

Reference Designator	Motorola Part Number	Description
U0001	5185633C34	MODULE RAM/MEMORY
U0102	5185623B01	HIGH SPEED CMOS INVERTER
U0103	5113837A15	IC 3.3V QUAD BUFFER
U0104	5113837A15	IC 3.3V QUAD BUFFER
U0105	5109522E17	IC SNGL NAND TC7S00FU
U0200	5105109Z38	3 VOLT LINEAR PCM CODEC FILTER
U0201	5113819A14	IC QD OP AMP _33204_
U0202	5185353D35	IC DUAL EEPOT 256 TAP
U0203	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0204	5185794L01	AUDIO AMP TAPE AND REEL
U0206	5185143E67	IC LM1971-62 DB LOG POT
U0208	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0209	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0210	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0300	5113837A15	IC 3.3V QUAD BUFFER
U0303	5113837A15	IC 3.3V QUAD BUFFER
U0304	5187970L15	IC USB TRANS FULL-SPEED
U0305	5185353D94	IC RS232 TRANSCEIVER
U0307	5113805B65	IC 2 INPUT NAND
U0308	5109522E74	IC 2-INPUT AND GATE
U0400	4880048M01	TSTR NPN DIG 47K/47K
U0401	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0402	5109522E53	IC SNGL BUF NC7S125P5X SC70
U0500	5183308X01	IC, LM2941, TO DRPOUT RGTR
U0501	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0502	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0503	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0504	5185353D46	IF 4.3V VOLTAGE DETECTOR
U0505	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0506	5185143E57	CMOS TIMER-LMC555CM

Reference Designator	Motorola Part Number	Description
U0507	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0508	5109522E53	IC SNGL BUF NC7S125P5X SC70
U0601	5109522E17	IC SNGL NAND TC7S00FU
U0602	5113837A15	IC 3.3V QUAD BUFFER
U0603	5113837A15	IC 3.3V QUAD BUFFER
U0604	5113818A14	IC DL OP AMP RAIL TO RAIL
U0605	5109522E17	IC SNGL NAND TC7S00FU
U0606	5105109Z31	IC QUAD 2:1 MUX/DEMUX
U0607	5109522E74	IC 2-INPUT AND GATE
U0608	5109522E74	IC 2-INPUT AND GATE
U0609	5109522E17	IC SNGL NAND TC7S00FU
U0610	5109522E17	IC SNGL NAND TC7S00FU
U0900	5185368C83	IC 12 BIT DAC
U0901	5185143E43	IC 23 MACROCELL CPLD
U0902	5113805B39	IC MUX/DEMUX, TRIP 2-CH ANALOG
U0903	5185143E68	IC LM7219 HIGH SPEED COMPARATOR
U0950	5105625U25	IC 9.3V REG 2941
U0951	5105625U25	IC 9.3V REG 2941
U0952	5185353D35	IC DUAL EEPOT 256 TAP
U0953	5185143E16	IC ANALOG TO DIGITAL CONVERTER
U0954	5109522E17	IC SNGL NAND TC7S00FU
U0955	5113819A14	IC QD OP AMP _33204_
U0956	5185956E24	QUAD OP AMP RAIL TO RAIL 14
U0957	5113819A14	IC QD OP AMP _33204_
U0958	5109522E17	IC SNGL NAND TC7S00FU
U0959	5185143E05	IC DAC OCTAL 8 BIT
U0960	5113819A14	IC QD OP AMP _33204_
U0962	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U0963	5109522E53	IC SNGL BUF NC7S125P5X SC70
U0965	5185143E68	IC LM7219 HIGH SPEED COMPARATOR
U5001	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U5002	5185963A85	IC-ABACUS III-LP

Reference Designator	Motorola Part Number	Description
U5300	5185130C83	IC 15DB DIGITAL ATTEUATOR SOT25 PKG
U5301	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U5302	5186258W01	IC GAAS RF GAIN STAGE
U5303	5185130C65	IC VHF/UHF/800 MHZ LDMOS DRIVER
U5400	5185963A87	IC ATTENUATOR
U5501	5185130C65	IC VHF/UHF/800 MHZ LDMOS DRIVER
U5502	5185963A15	IC TEMPATURE SENSOR 1M50C
U5503	5185353D92	IC CURRENT SHUNT MONITOR
U5570	5183308X01	IC, LM2941, TO DRPOUT RGTR
U5750	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U5751	5105492X03	IC SNG HI SPD L-MOS NOT GATE
U5752	5185963A27	IC TESTED AT25016 48 PIN GFP
U5753	5113805B87	IC MUX/DEMUX DUAL 4 CHAN ANALOG
U5825	4885757E03	RESONATOR 4MMX4MM COPPER DIELECTRIC COAXIAL
U5826	4885757E02	RESONATOR 4MM X 4MM COPPER DIELECTRIC
VR0400	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0402	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0404	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0405	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0406	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0407	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0408	4813832C75	DIODE ZENER QU O
VR0410	4813832C75	DIODE ZENER QU O
VR0411	4805656W39	QUAD ESD SUPPRESSOR ARRAY -41206ESD

Reference Designator	Motorola Part Number	Description
VR0412	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0414	4813832C75	DIODE ZENER QU O
VR0417	4813832C75	DIODE ZENER QU O
VR0418	4813832C75	DIODE ZENER QU O
VR0420	4813830A24	DIODE 11V 5% 225MW MMBZ5241B_
VR0421	4813830A24	DIODE 11V 5% 225MW MMBZ5241B_
VR0422	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0423	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0424	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0425	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0500	4813830A14	DIODE 5.1V 5% 225MW MMBZ5231B_
VR0501	4813830A24	DIODE 11V 5% 225MW MMBZ5241B_
VR0950	4813832C77	TRANS SUP .24V HIGH PWR
Y0100	4809995L05	XTAL QUARTZ 32.768KHZ CC4V-T1
Y5400	4885230C01	109.65MHZ FILTER 3RD OVERTONE
Y5401	4885230C01	109.65MHZ FILTER 3RD OVERTONE
Y5750	5185143E07	IC 16.8 MHZ REF OSC .8 PPM
Y5900	4885593E04	RESONATOR 6MMX6MM COPPER DIELECTRIC COAXIAL
Y5901	4885593E05	RESONATOR 6MMX6MM COPPER DIELECTRIC COAXIAL
Y5902	4885593E06	RESONATOR 6MMX6MM COPPER DIELECTRIC COAXIAL

Note: For optimum performance, diodes, transistors and integrated circuits must be ordered by MOTOROLA part numbers.

7.5 HUE4040A (UHF Range 2) Main Board

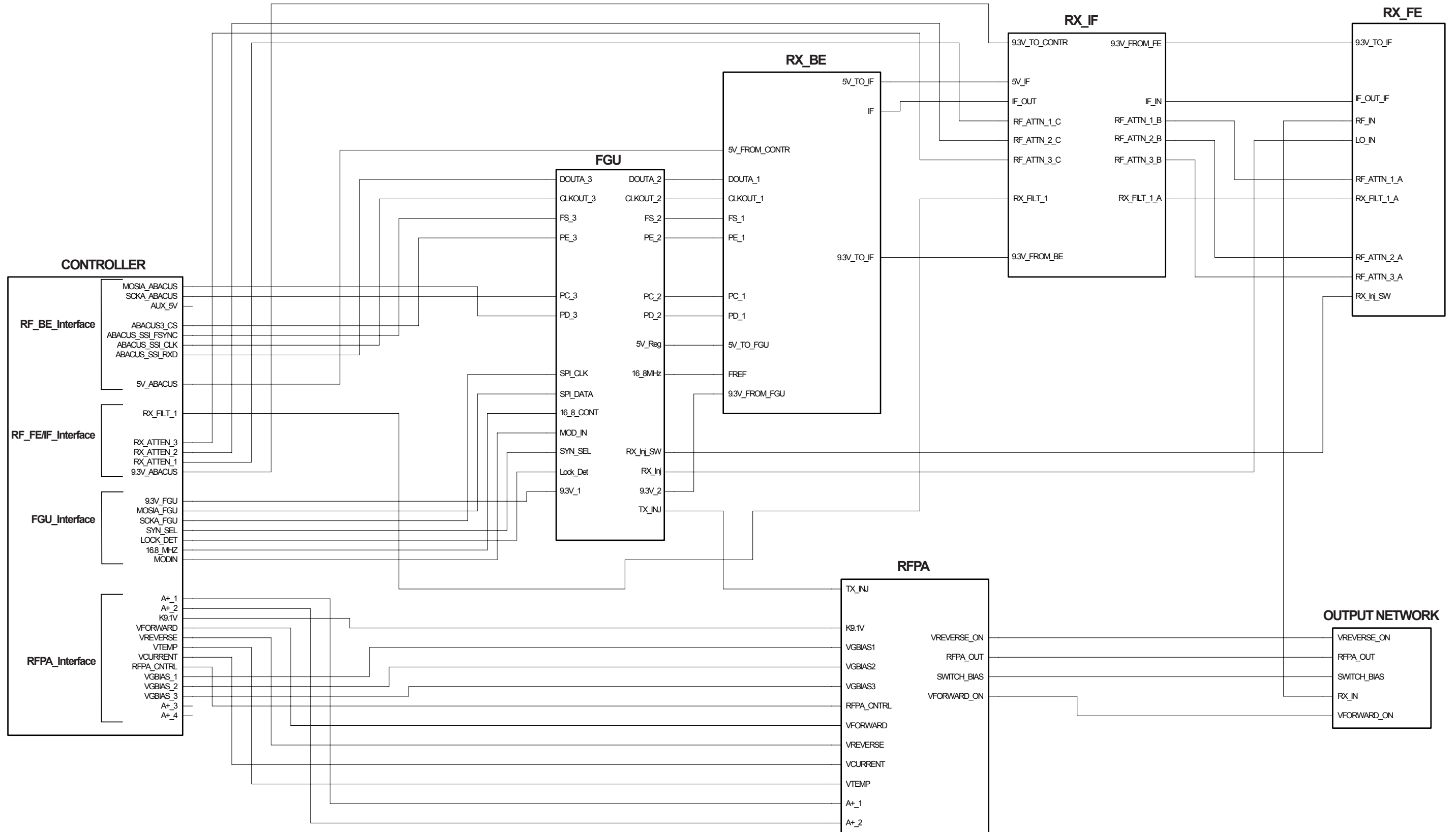


Figure 7-78. HUE4040 Main Board Overall Block Diagram and Interconnections

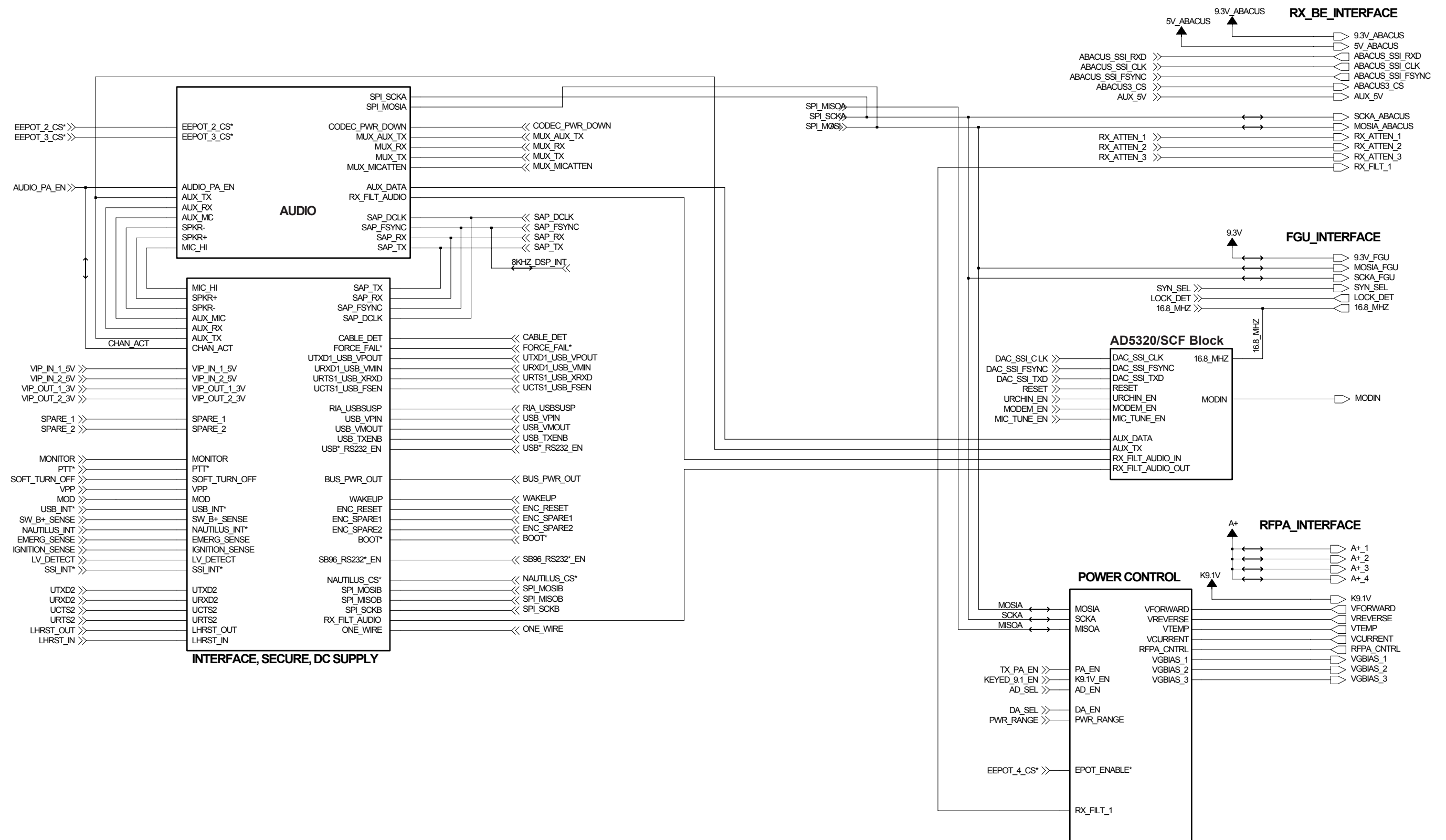


Figure 7-79. HUE4040A Controller Block Diagram and Interconnections (Sheet 1 of 2)

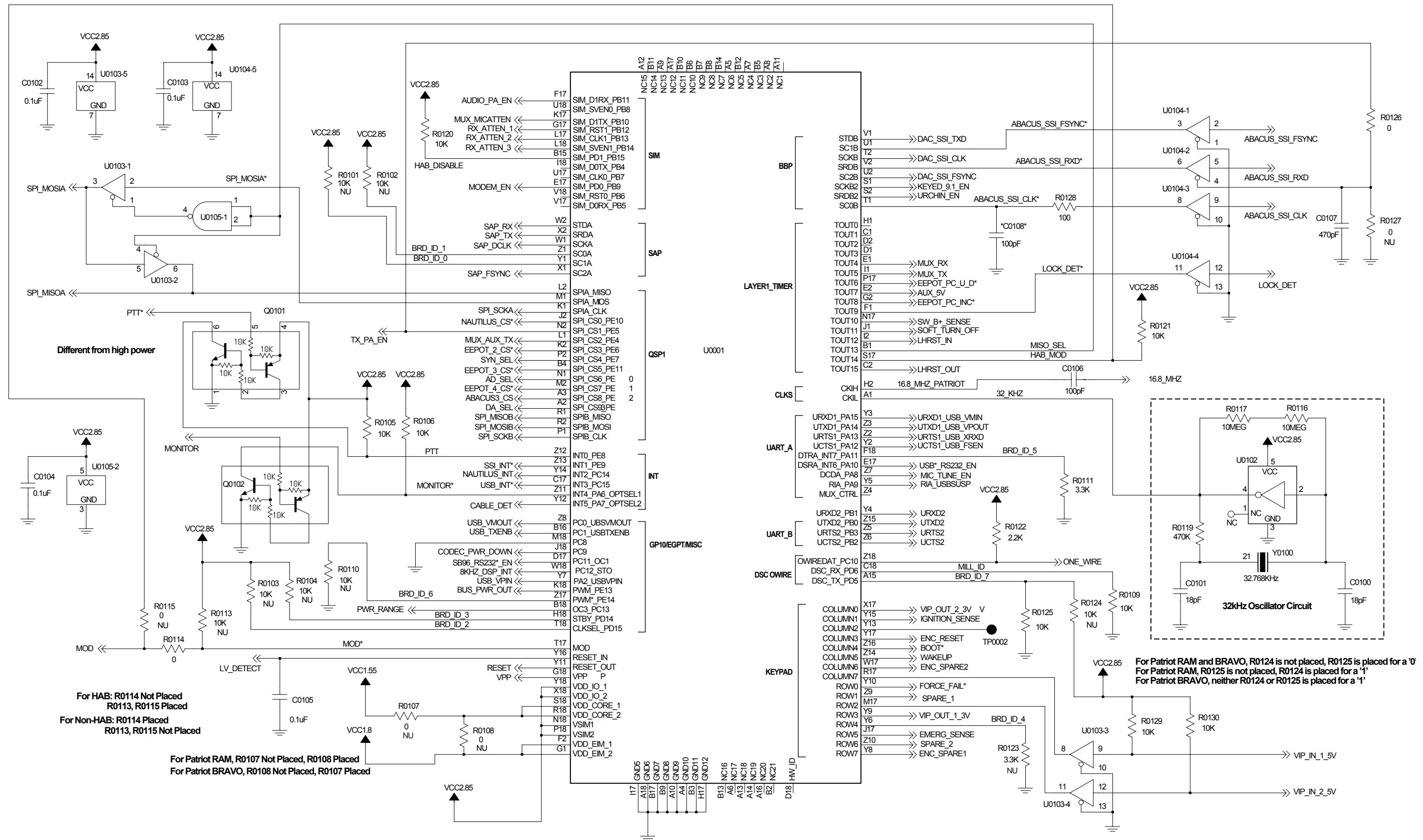


Figure 7-80. HUE4040A Controller Block Diagram and Interconnections (Sheet 2 of 2)

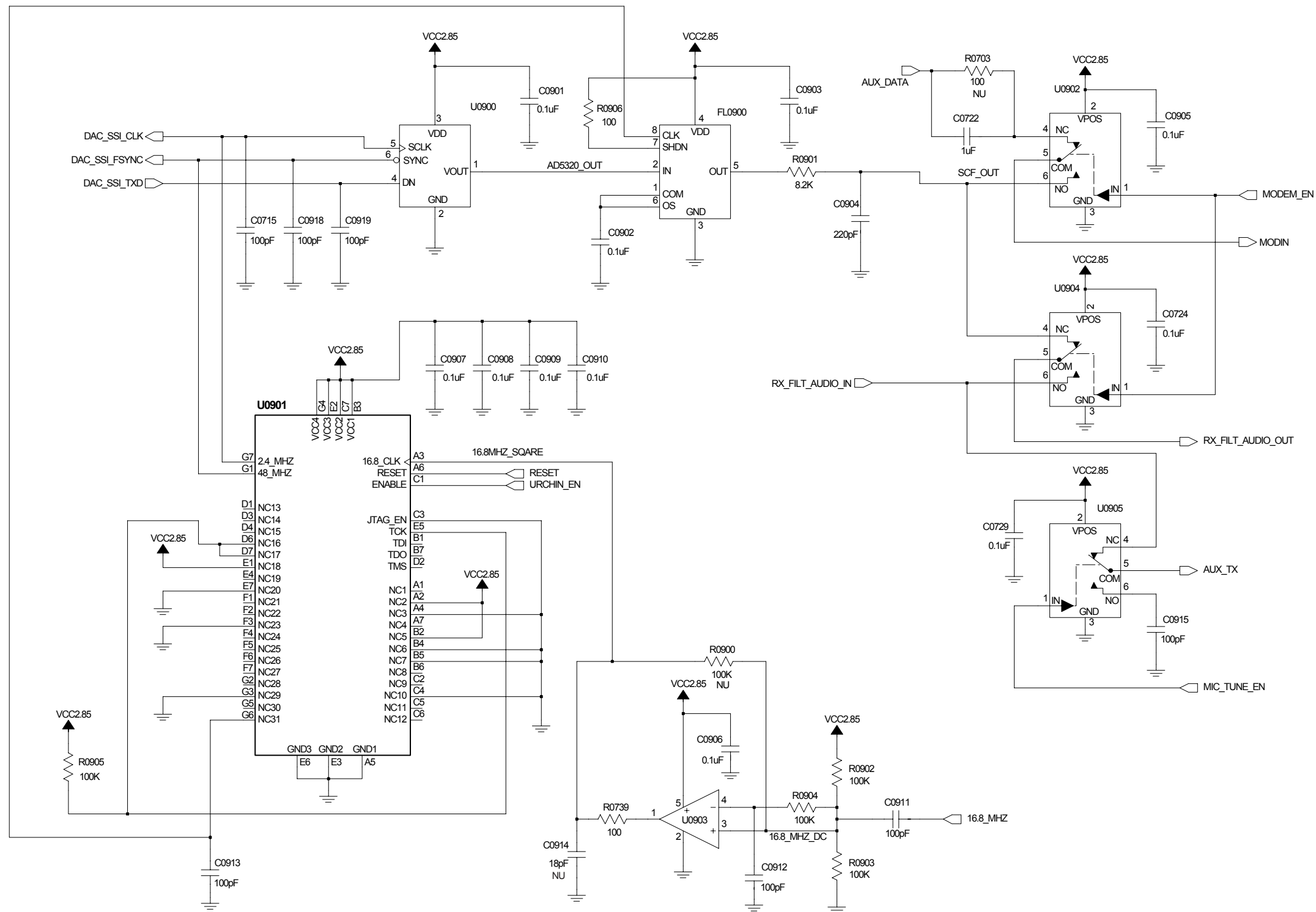


Figure 7-81. HUE4040A Controller Urchin IC, MUX, and AD5320 DAC Schematic

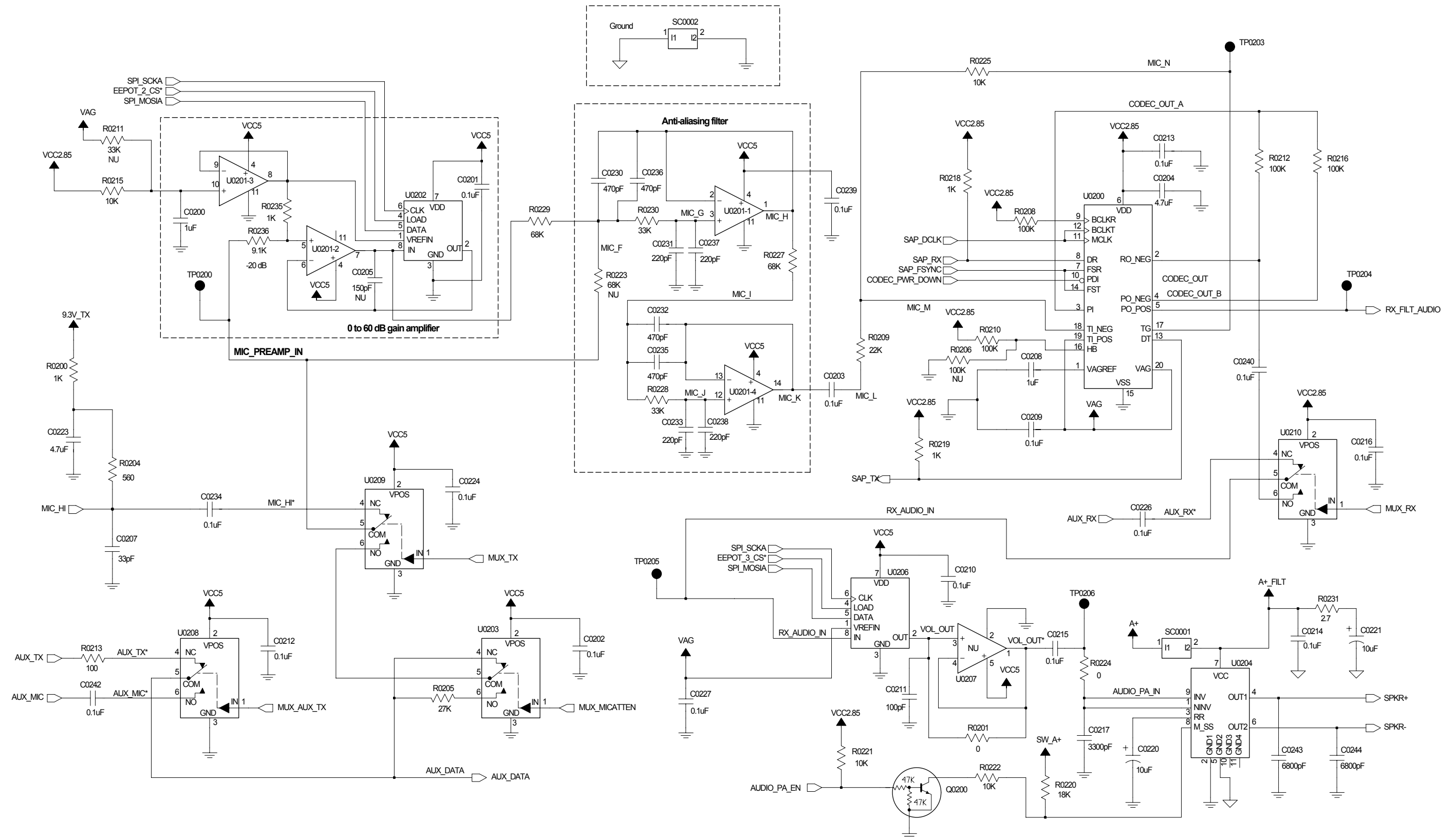


Figure 7-82. HUE4040A Controller Audio Schematic

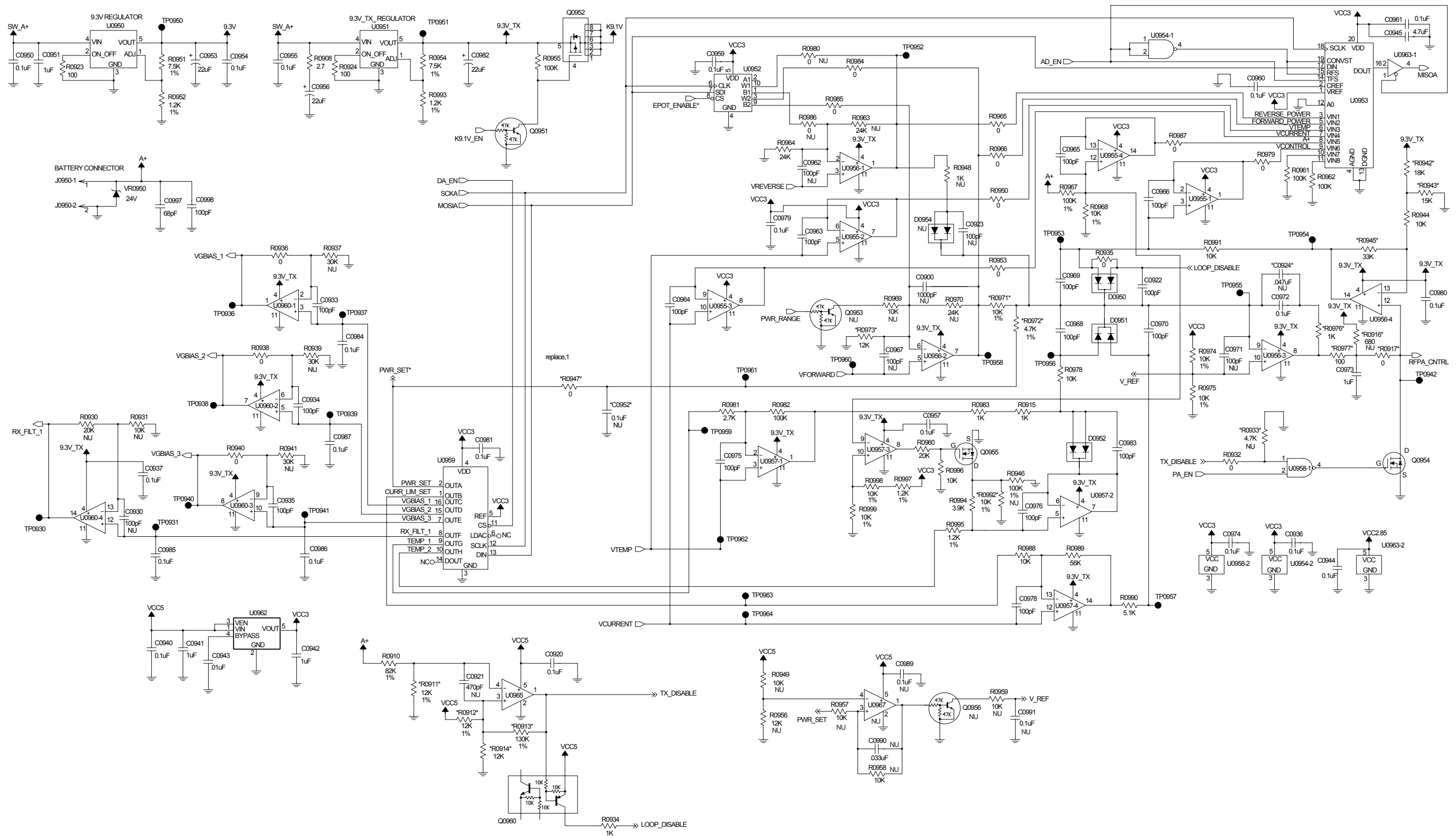


Figure 7-83. HUE4040A Controller Power Control Schematic

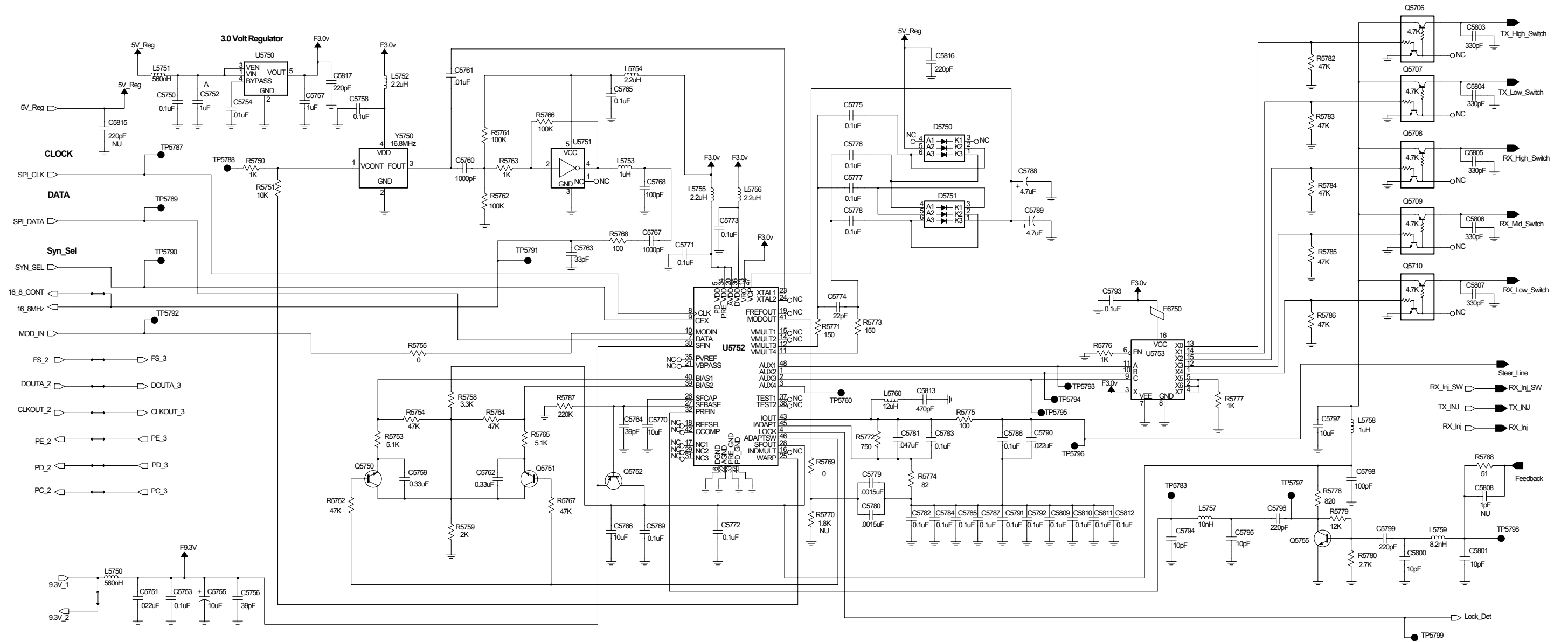


Figure 7-84. HUE4040A Frequency Generation Unit

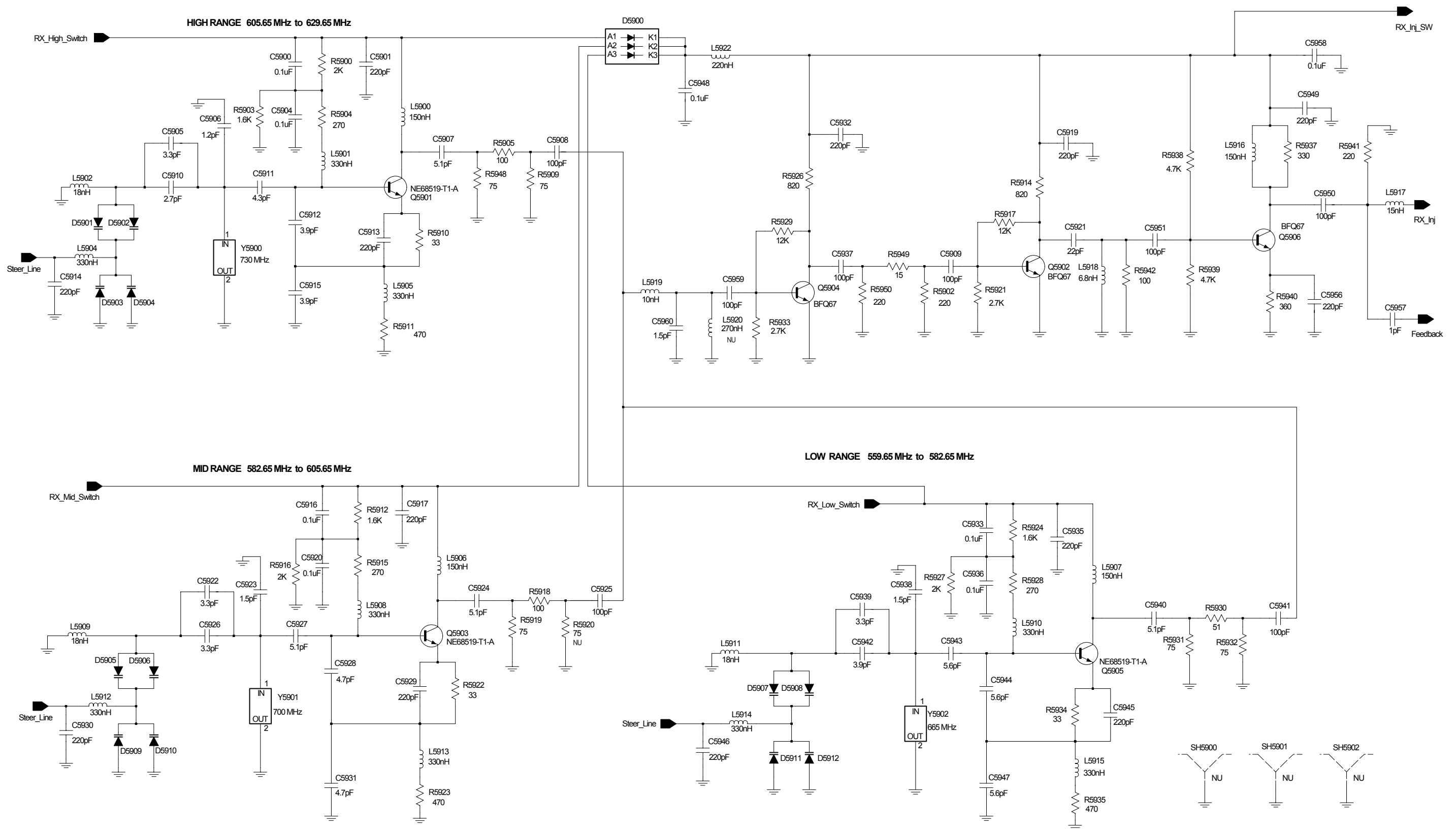


Figure 7-85. HUE4040A Receive VCO Schematic

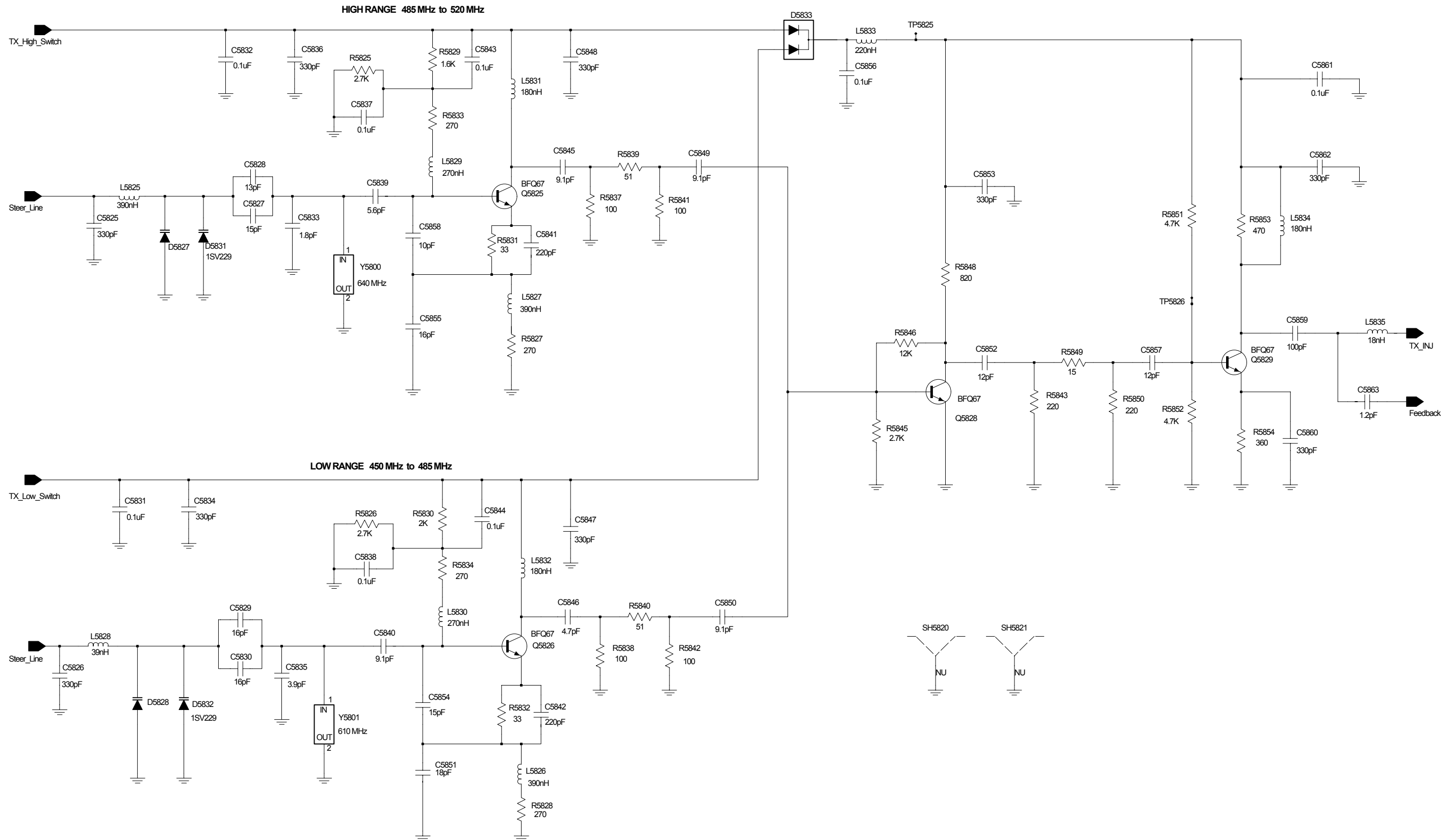


Figure 7-86. HUE4040A Transmit VCO Schematic

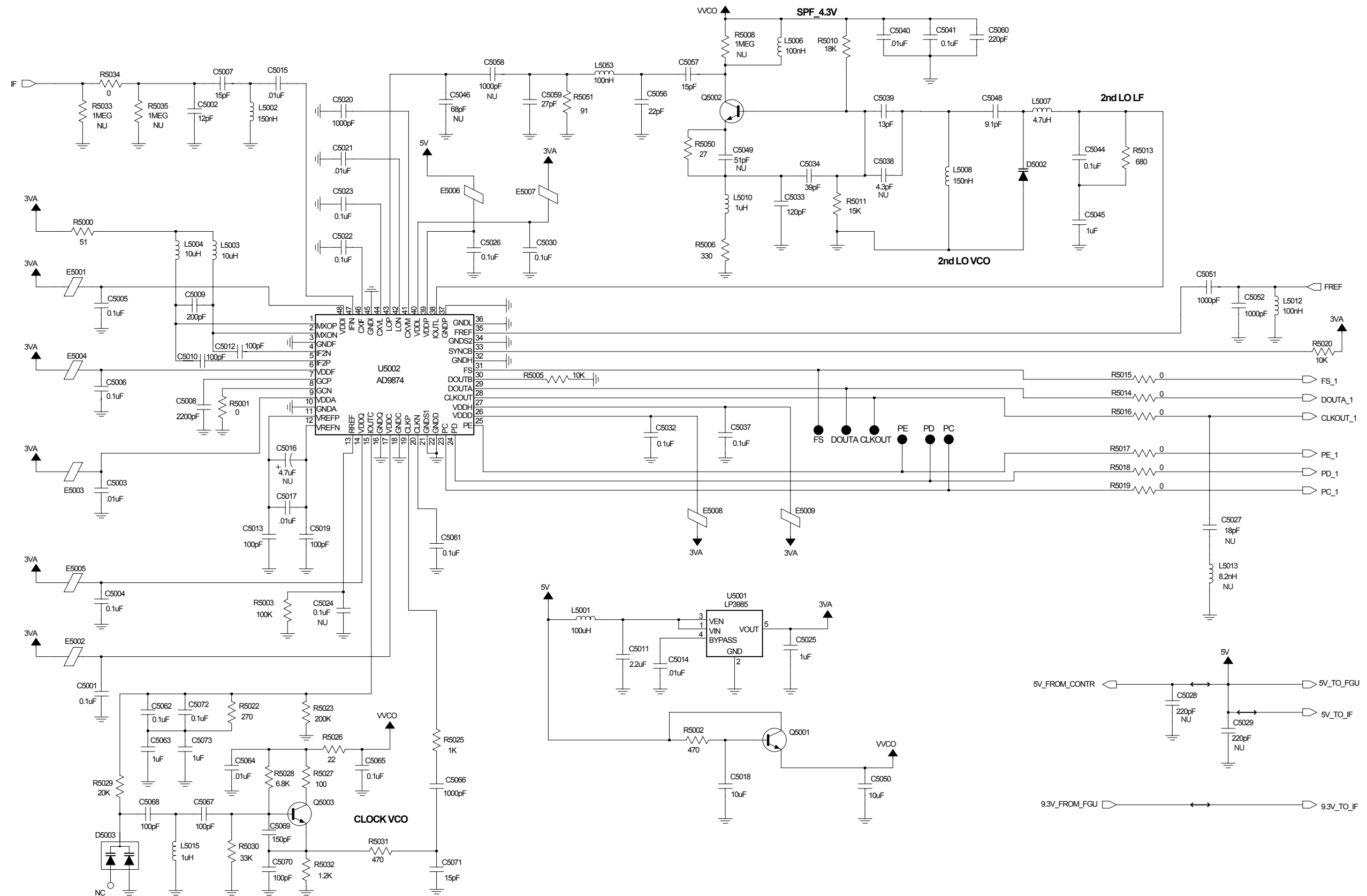


Figure 7-87. HUE4040A Receiver Back-End Schematic

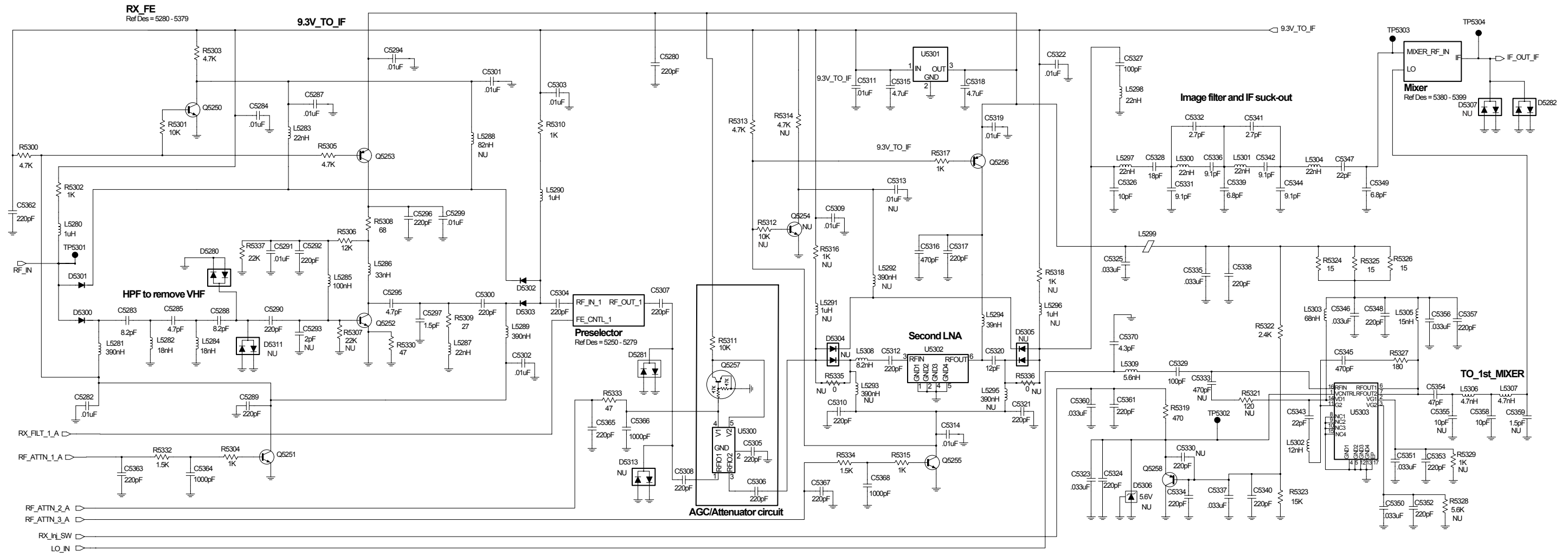


Figure 7-88. HUE4040A Receiver Front-End Schematic

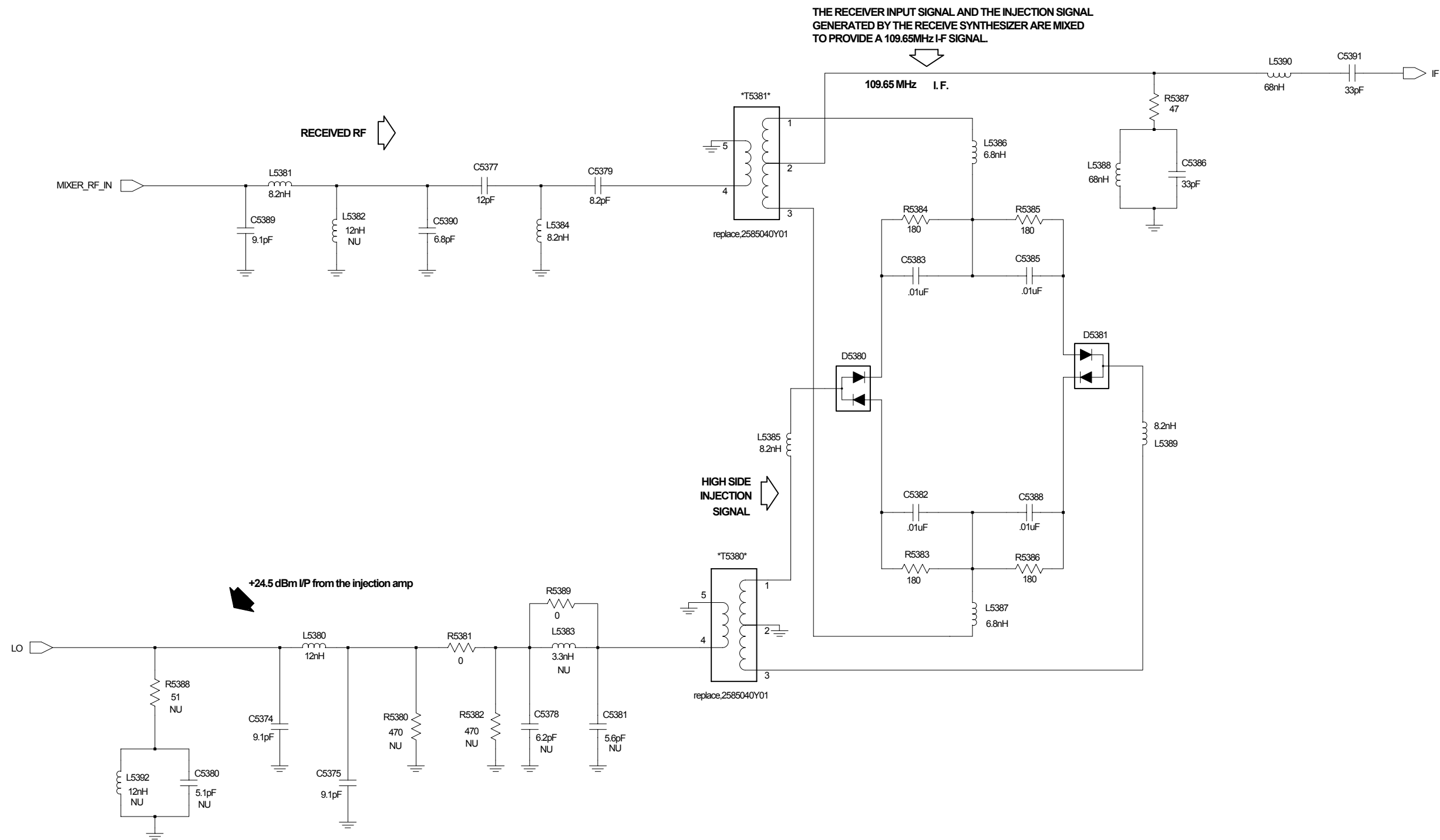


Figure 7-89. HUE4040A Receiver Mixer Schematic

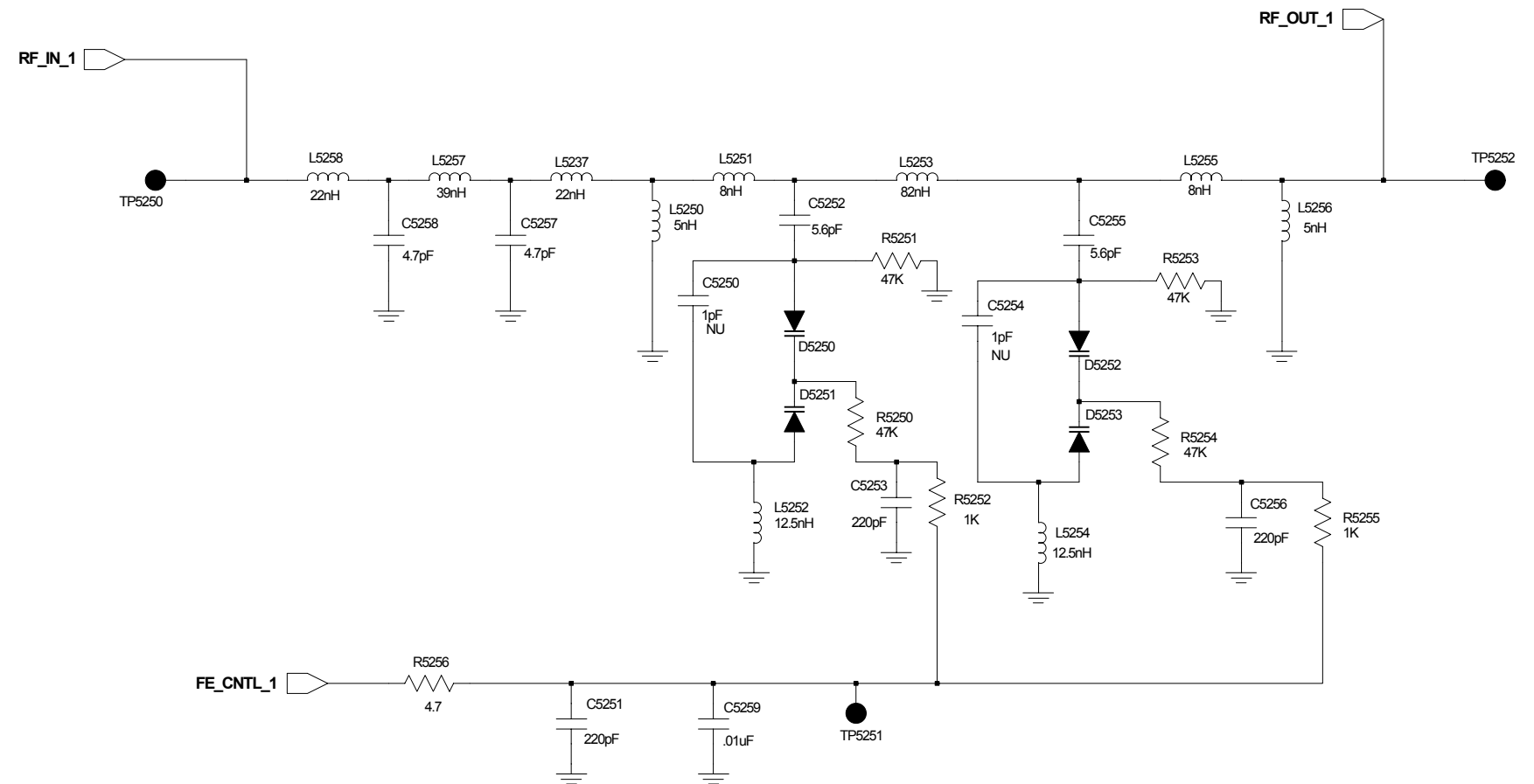


Figure 7-90. HUE4040A Receiver Preselector Schematic

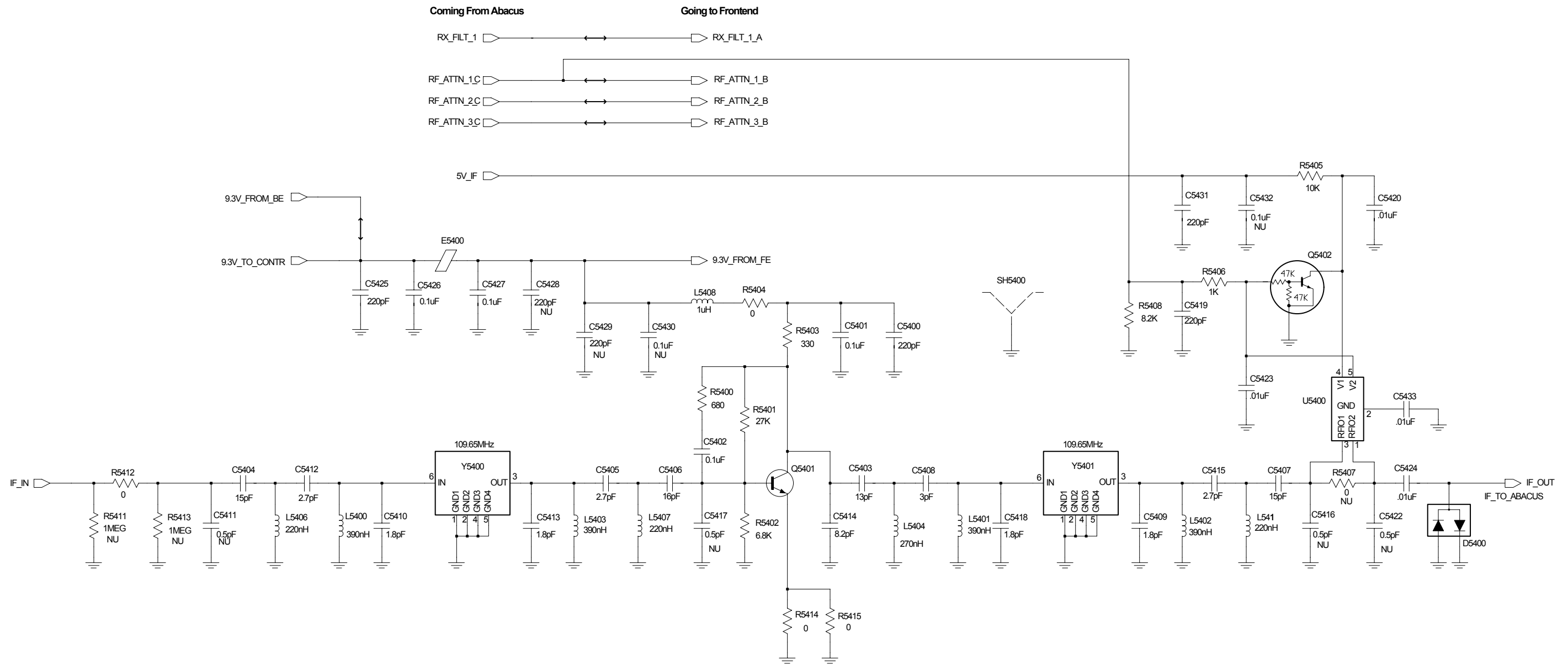


Figure 7-91. HUE4040A Receiver IF Schematic

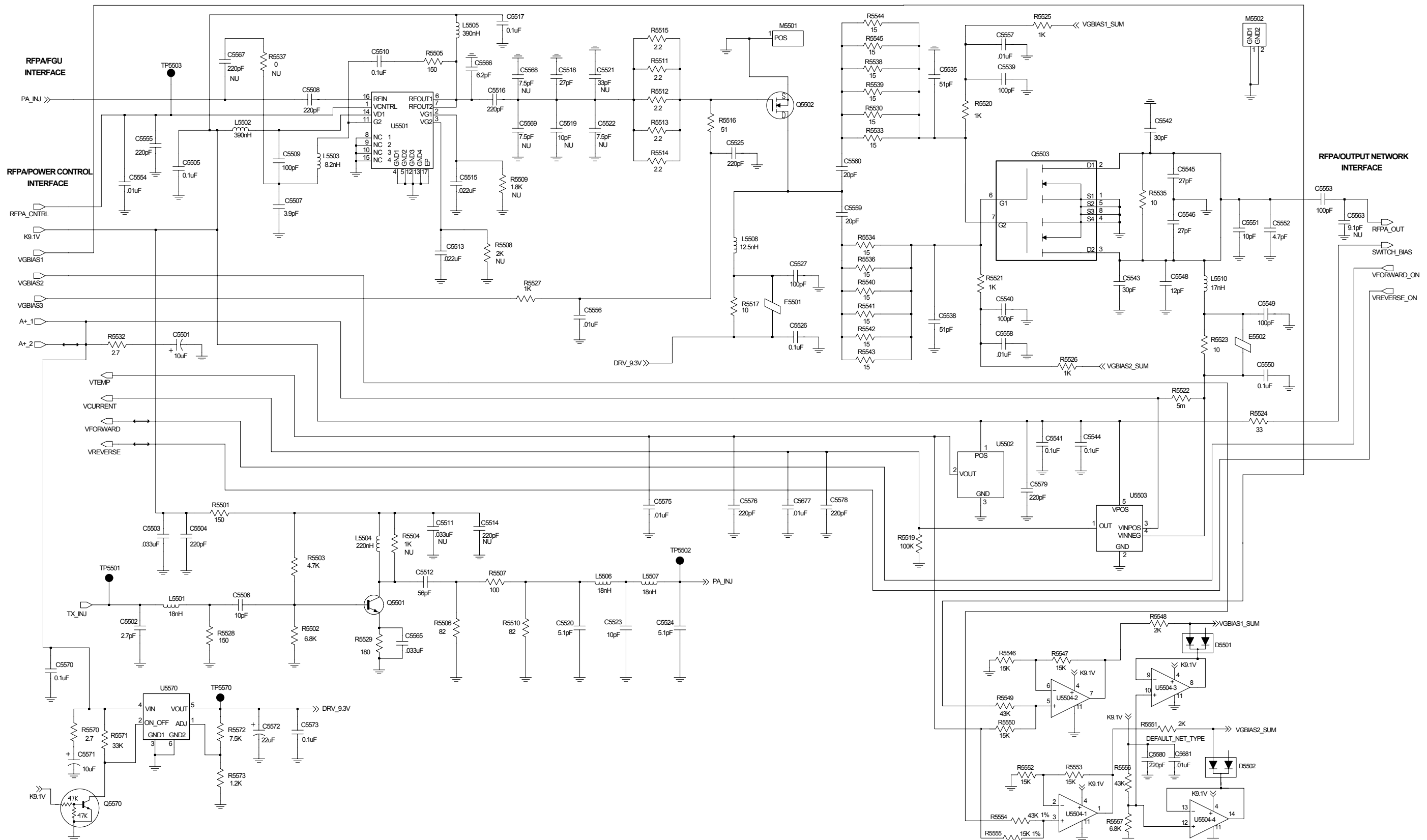


Figure 7-92. HUE4040A RF Power Amplifier (RF PA) Schematic

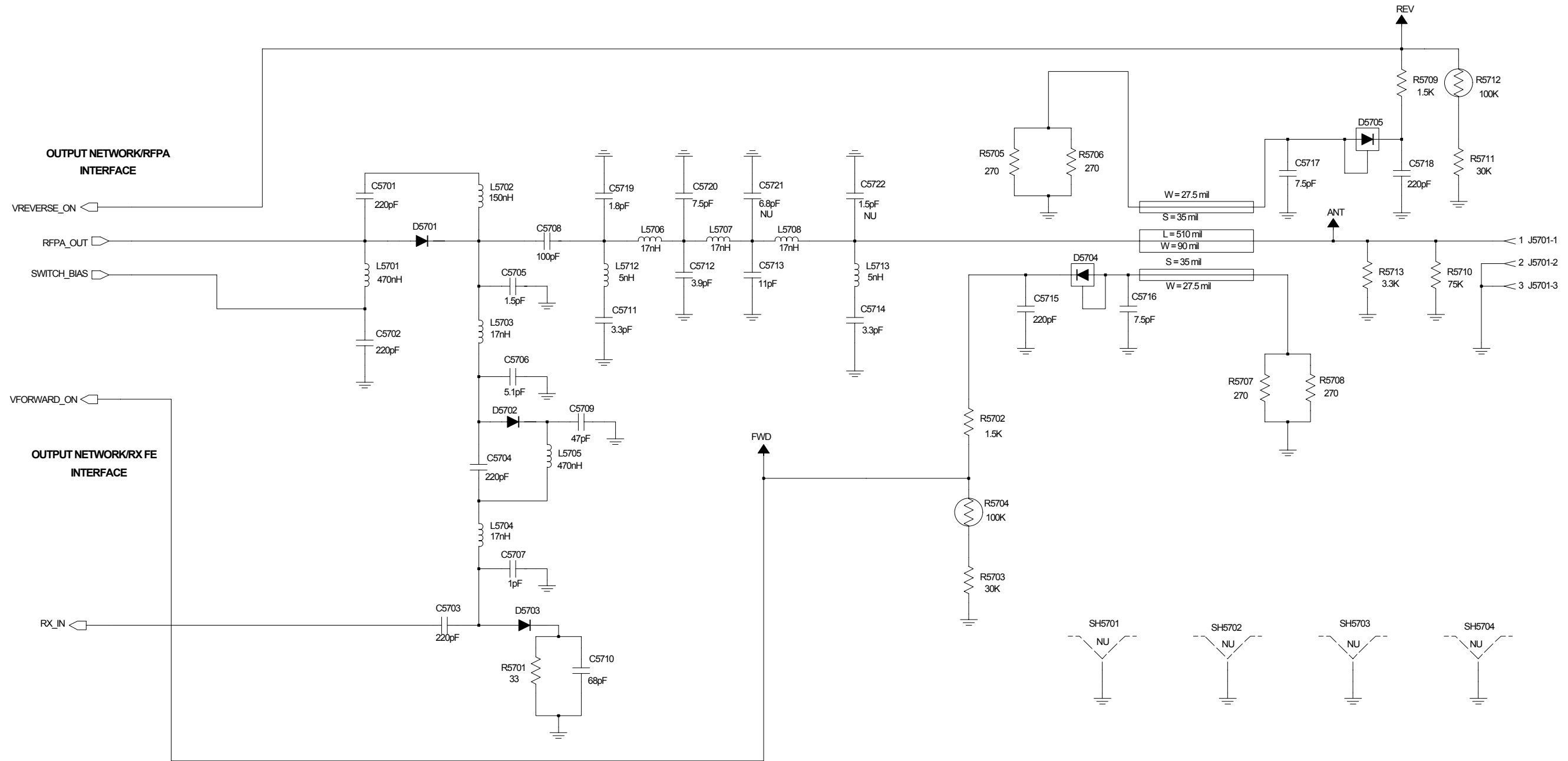


Figure 7-93. HUE4040A Output Network (ON) Schematic

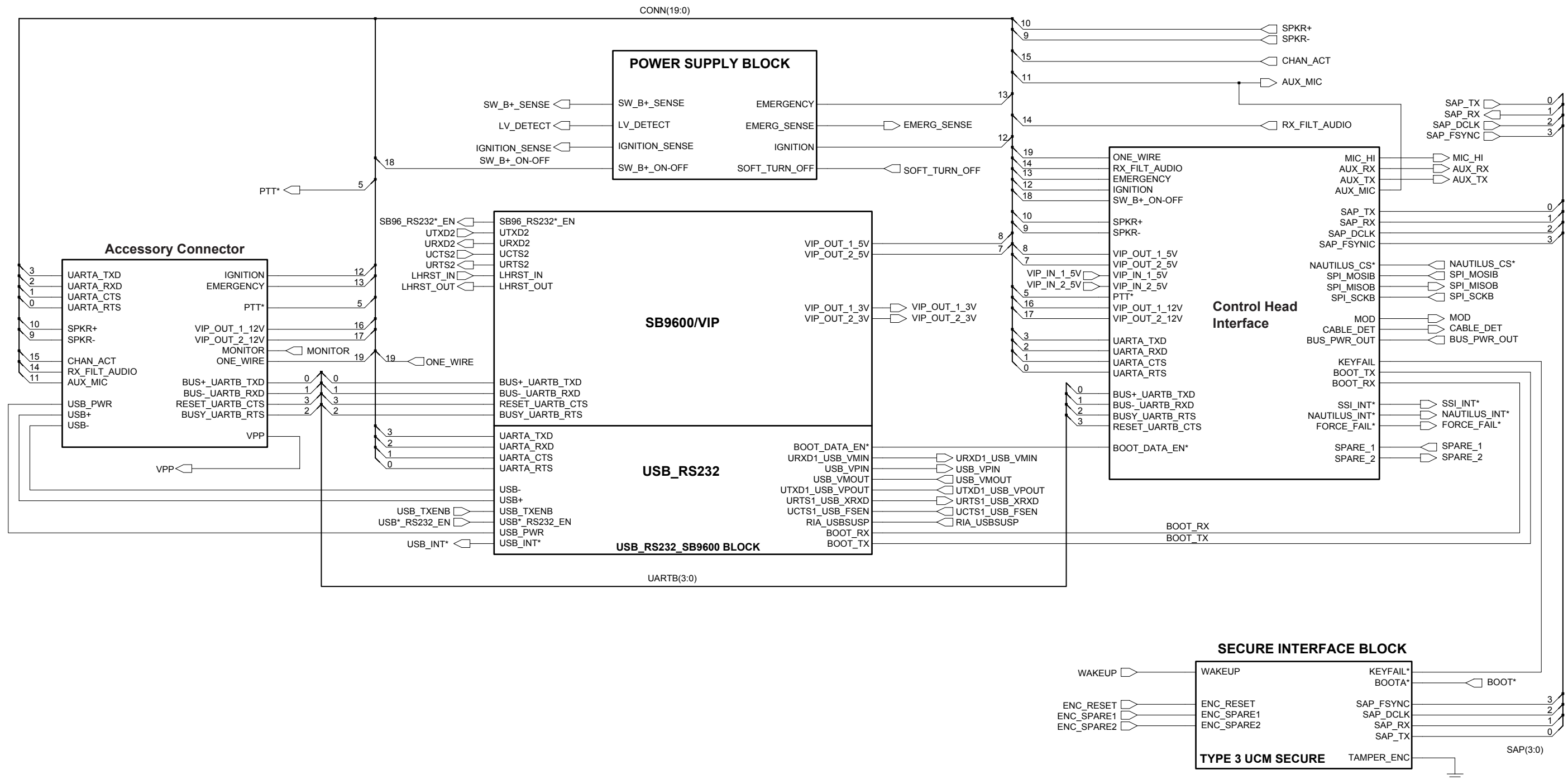


Figure 7-94. HUE4040A Secure Block Diagram and Interconnections

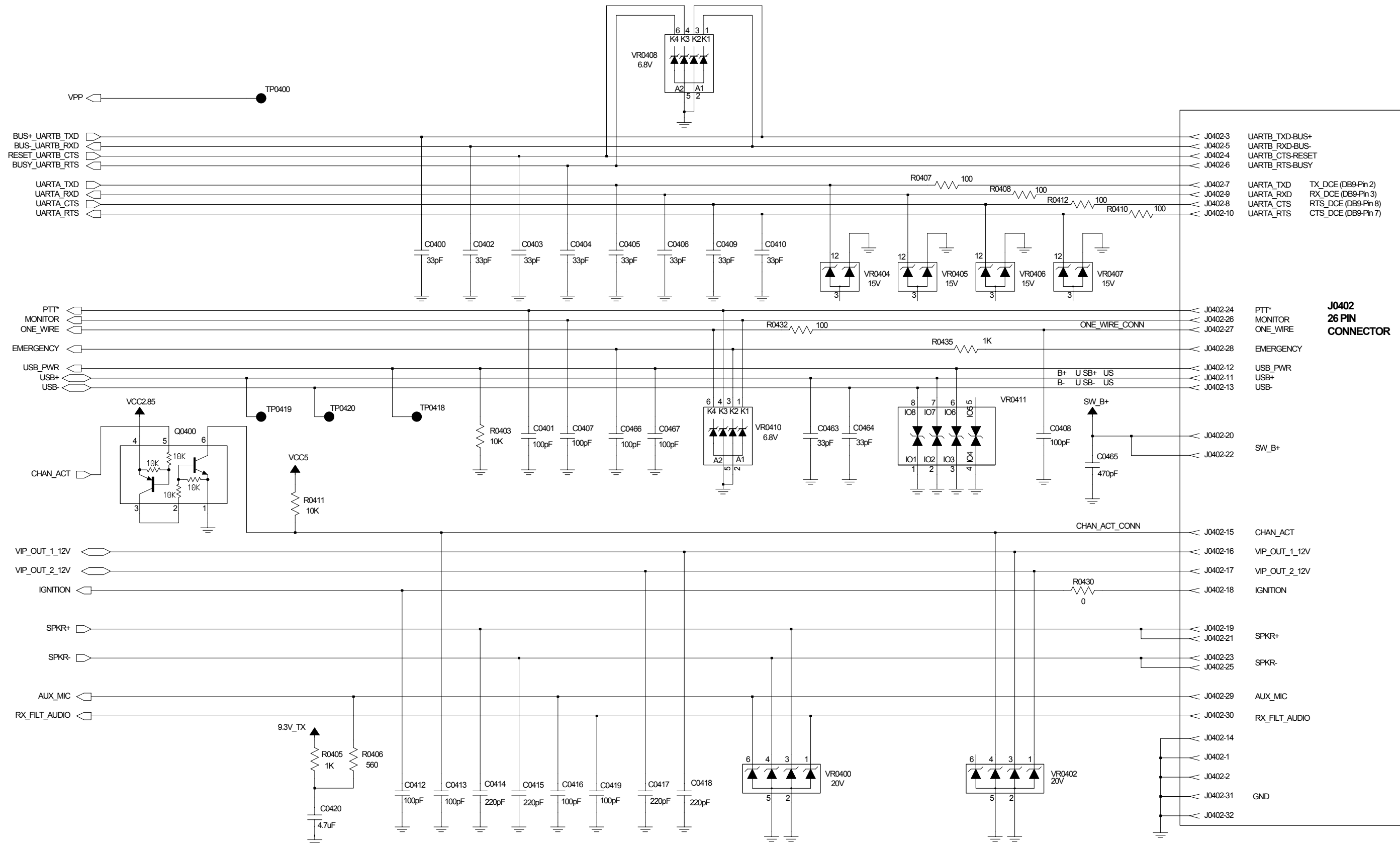


Figure 7-95. HUE4040A Rear Accessory Connector Schematic

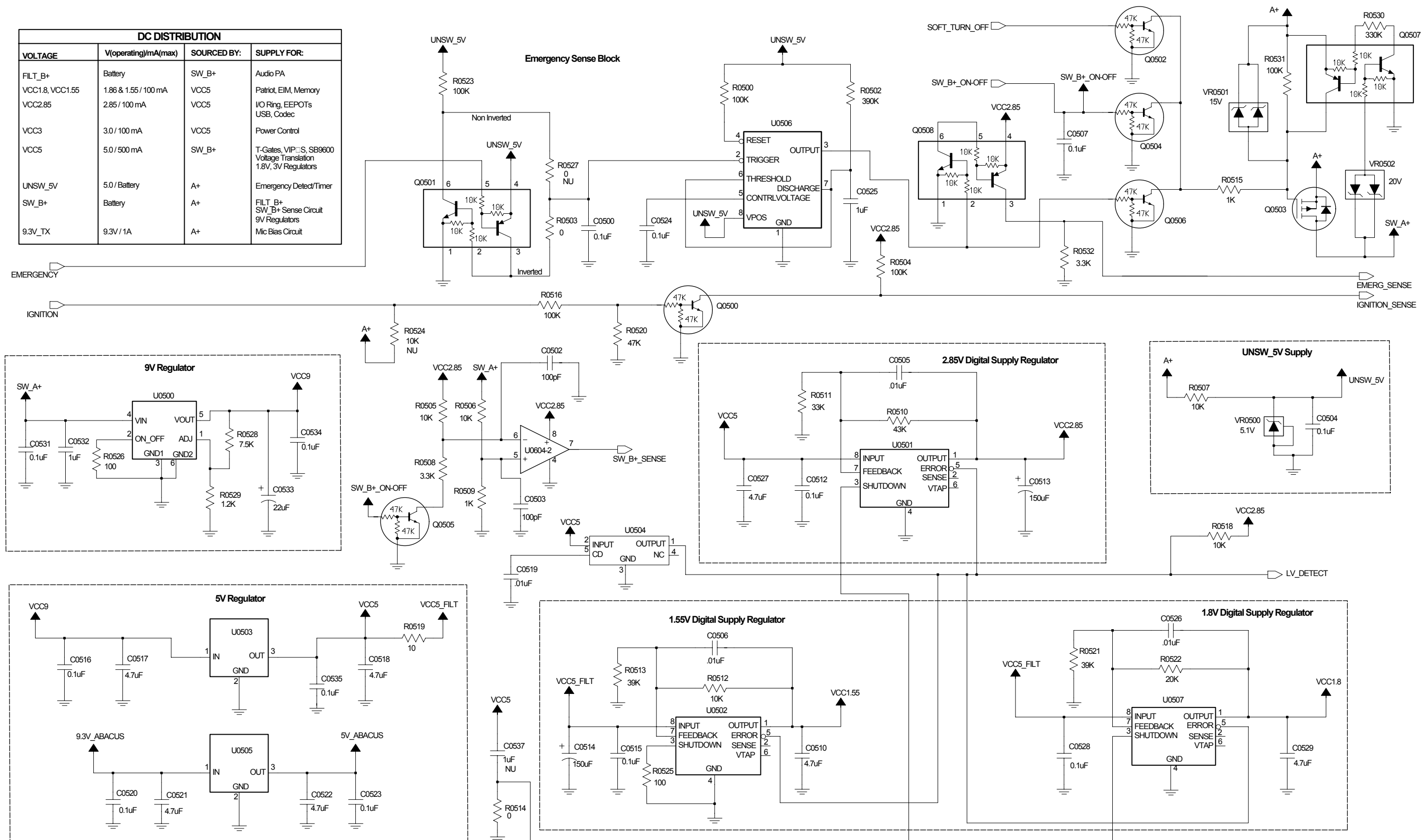
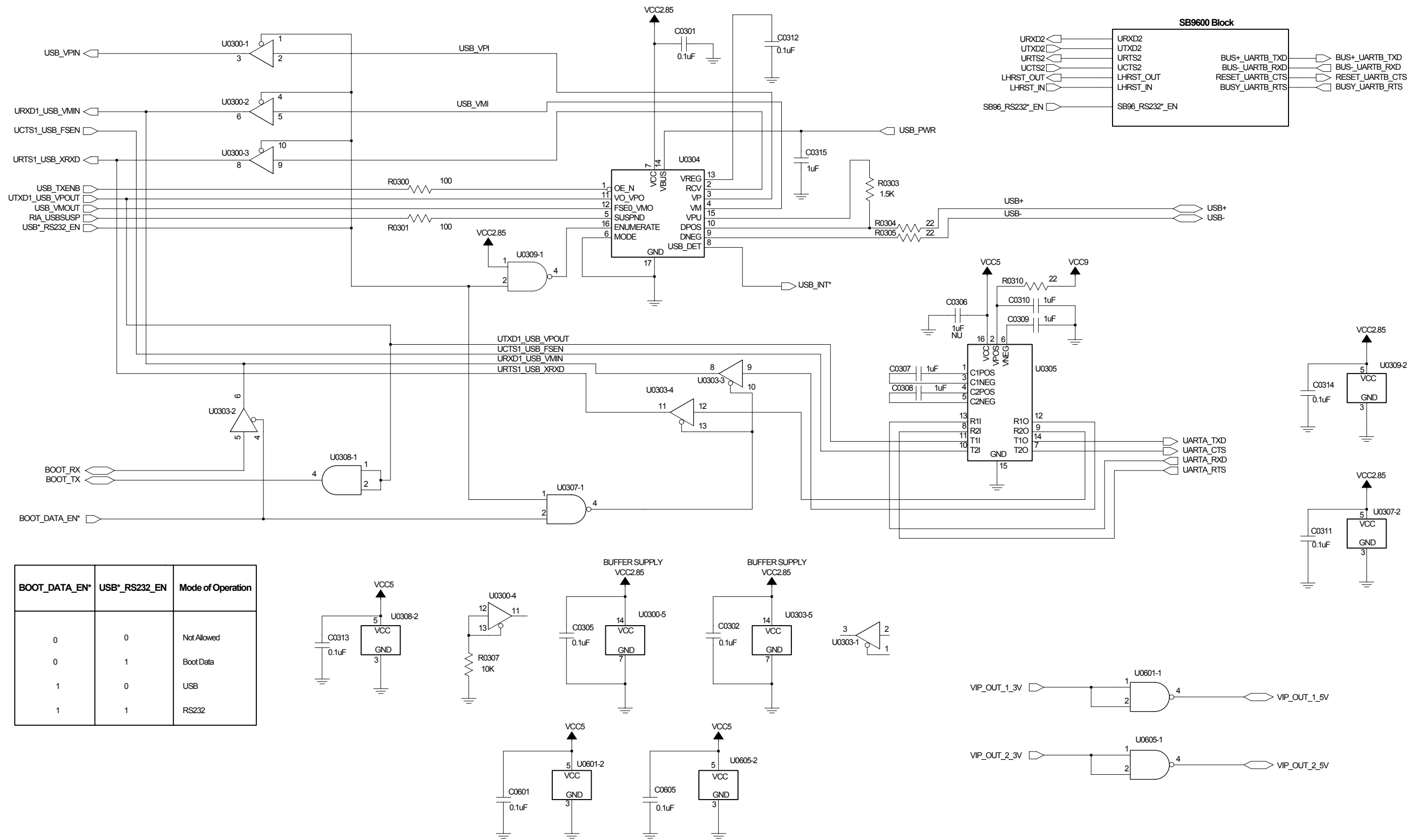


Figure 7-96. HUE4040A Secure Power Supply Schematic



BOOT_DATA_EN*	USB*_RS232_EN	Mode of Operation
0	0	Not Allowed
0	1	Boot Data
1	0	USB
1	1	RS232

Figure 7-97. HUE4040A Secure USB/RS232/SB9600 Schematic

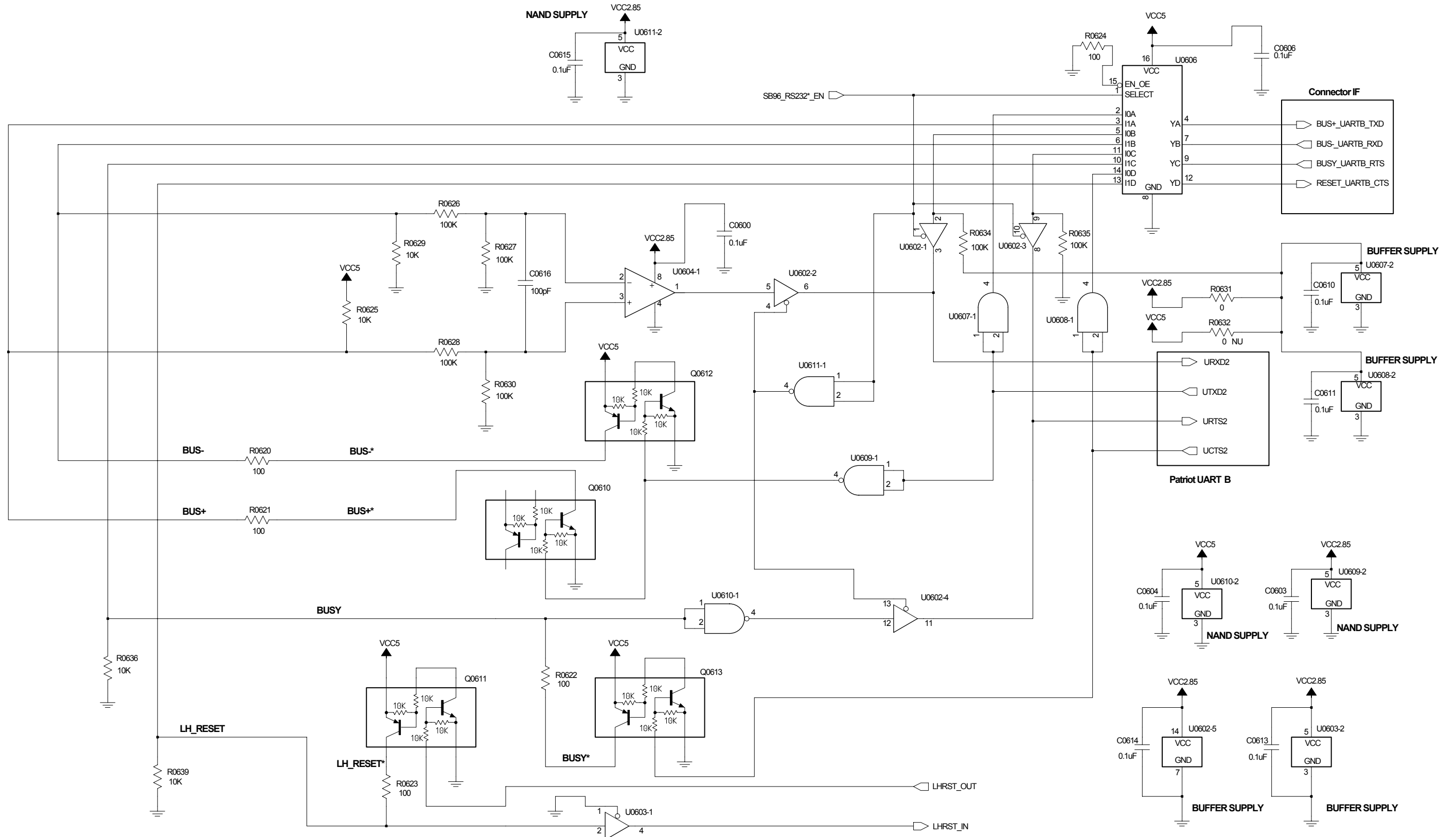


Figure 7-98. HUE4040A Secure SB9600 Schematic

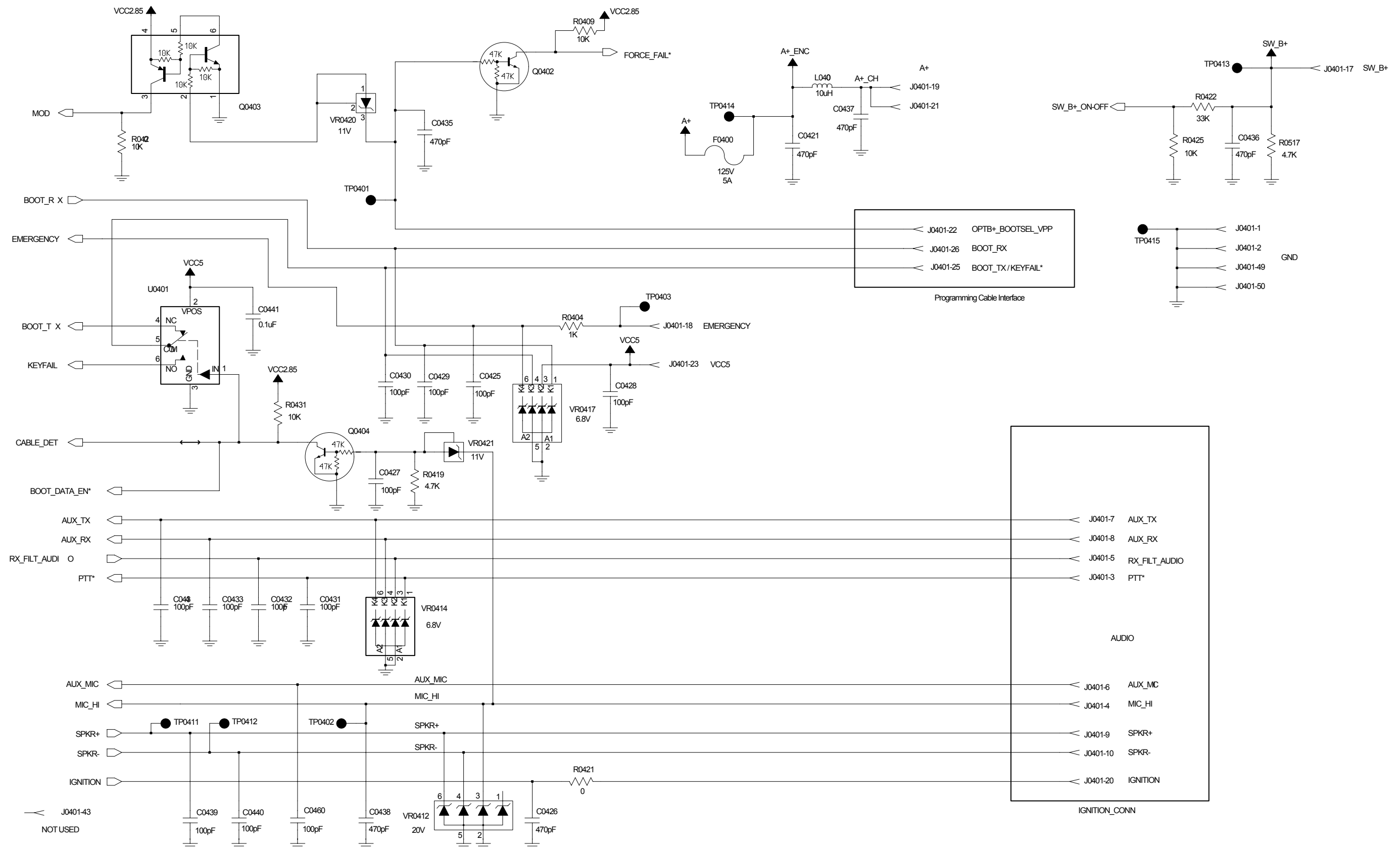


Figure 7-99. HUE4040A Secure Control-Head Connector Schematic (Sheet 1 of 2)

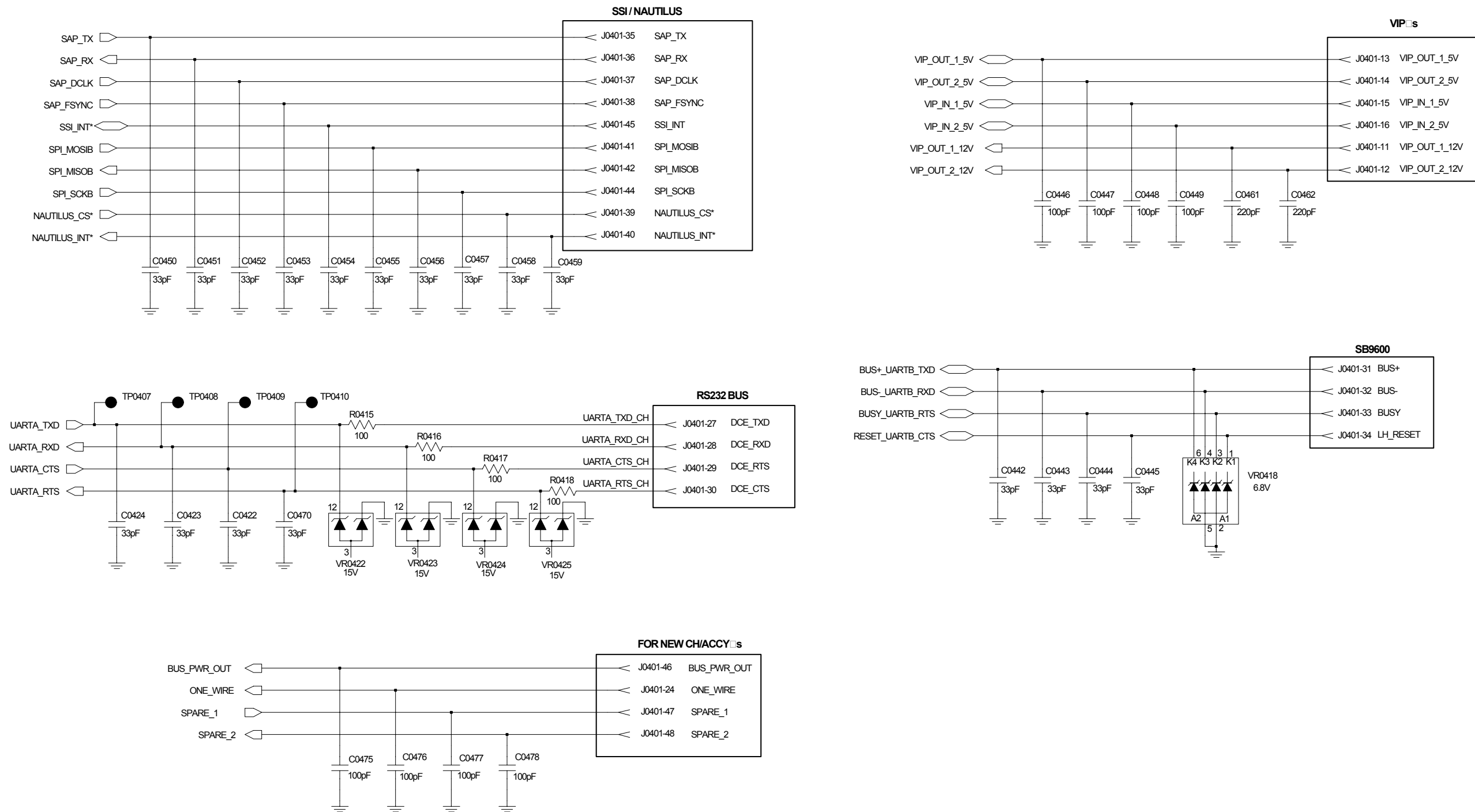


Figure 7-100. HUE4040A Secure Control-Head Connector Schematic (Sheet 2 of 2)

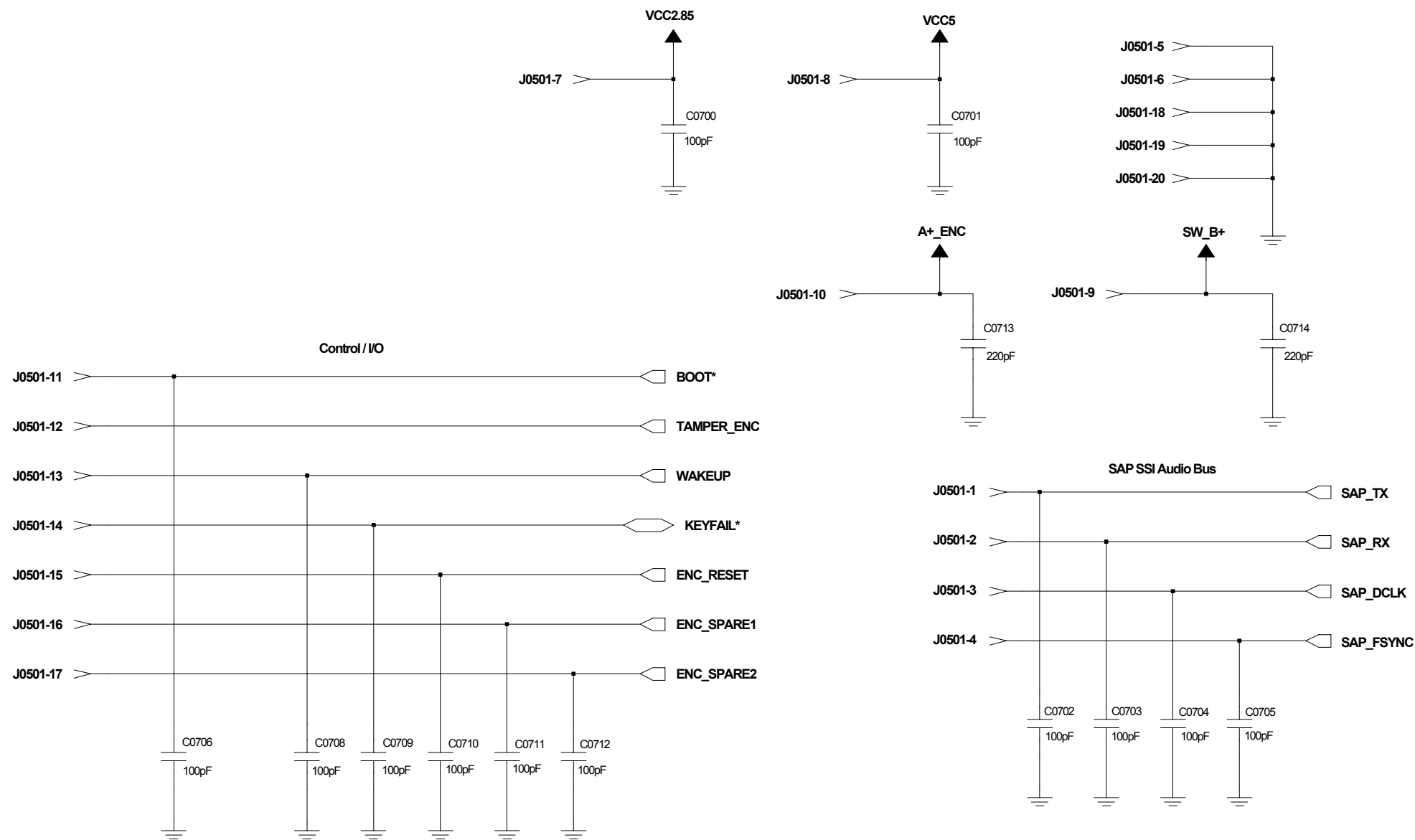


Figure 7-101. HUE4040A Secure Interface Connector Schematic

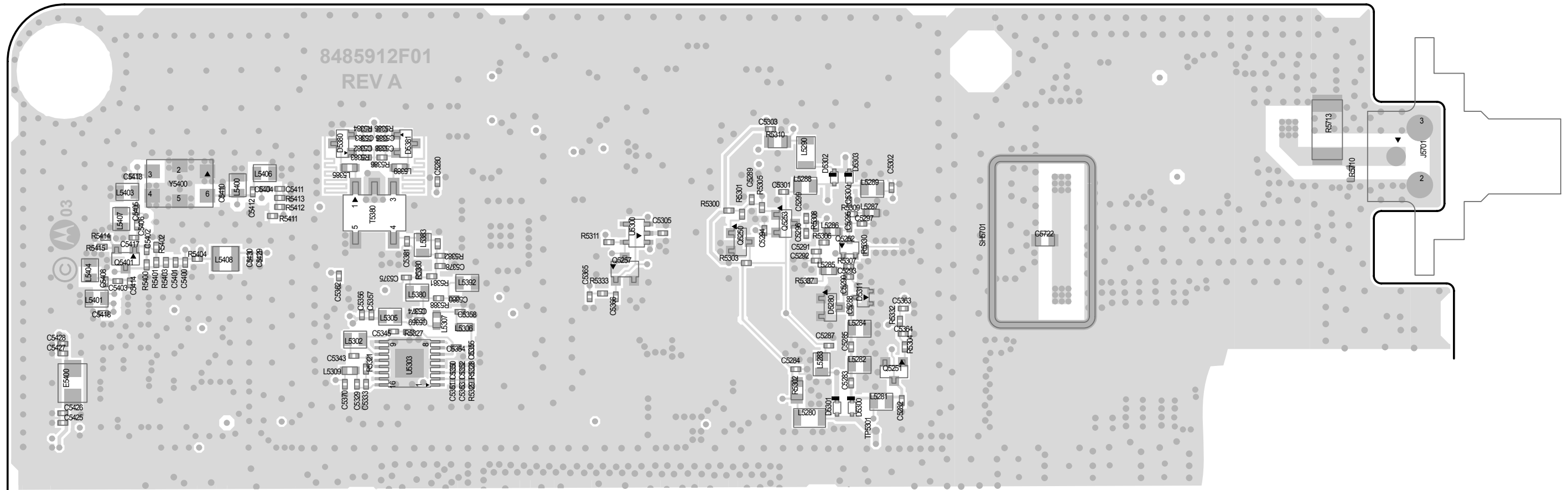


Figure 7-102. HUE4040A Main Board Layout—Side 1 Top

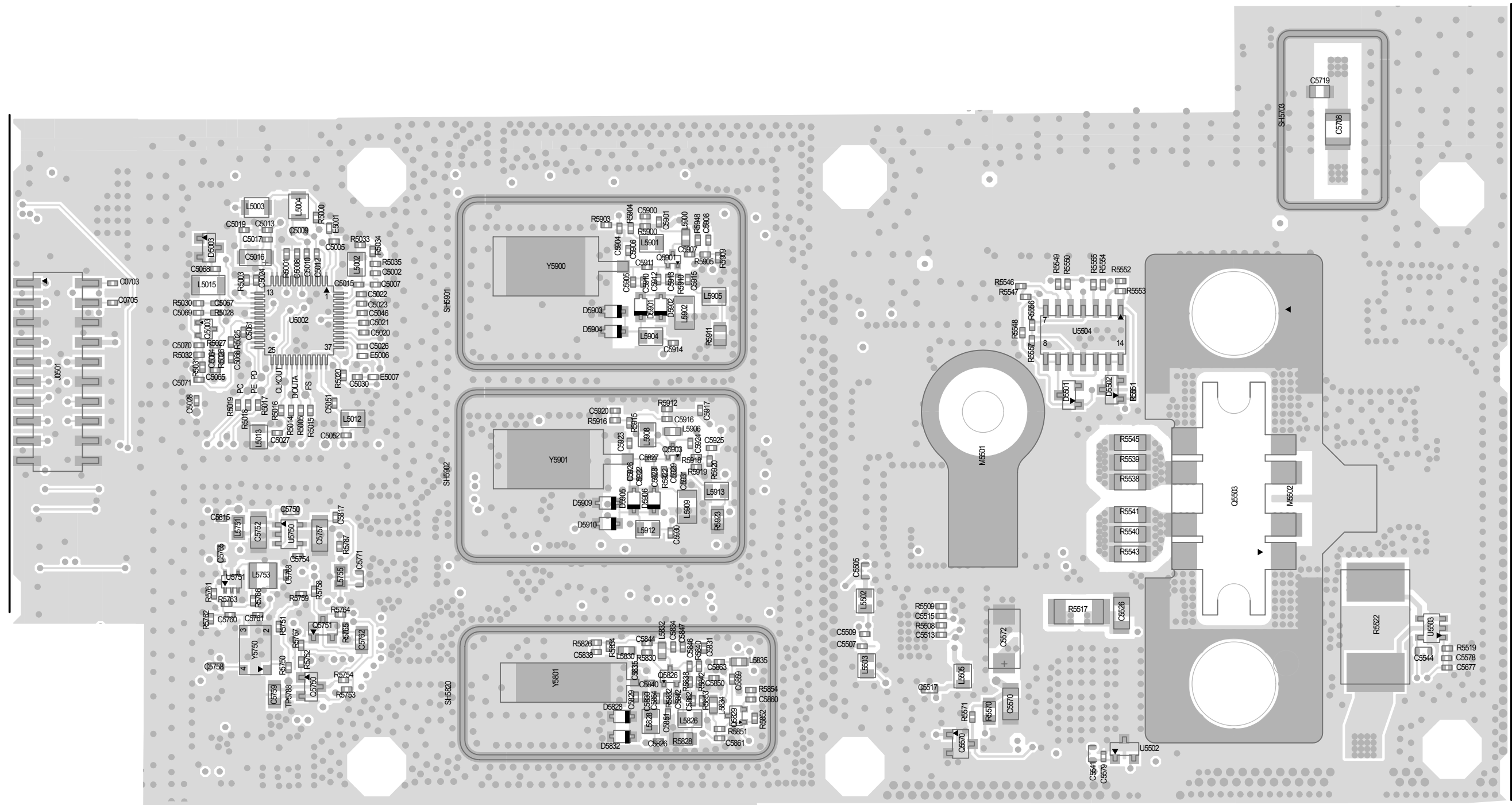


Figure 7-103. HUE4040A Main Board Layout—Side 1 Middle

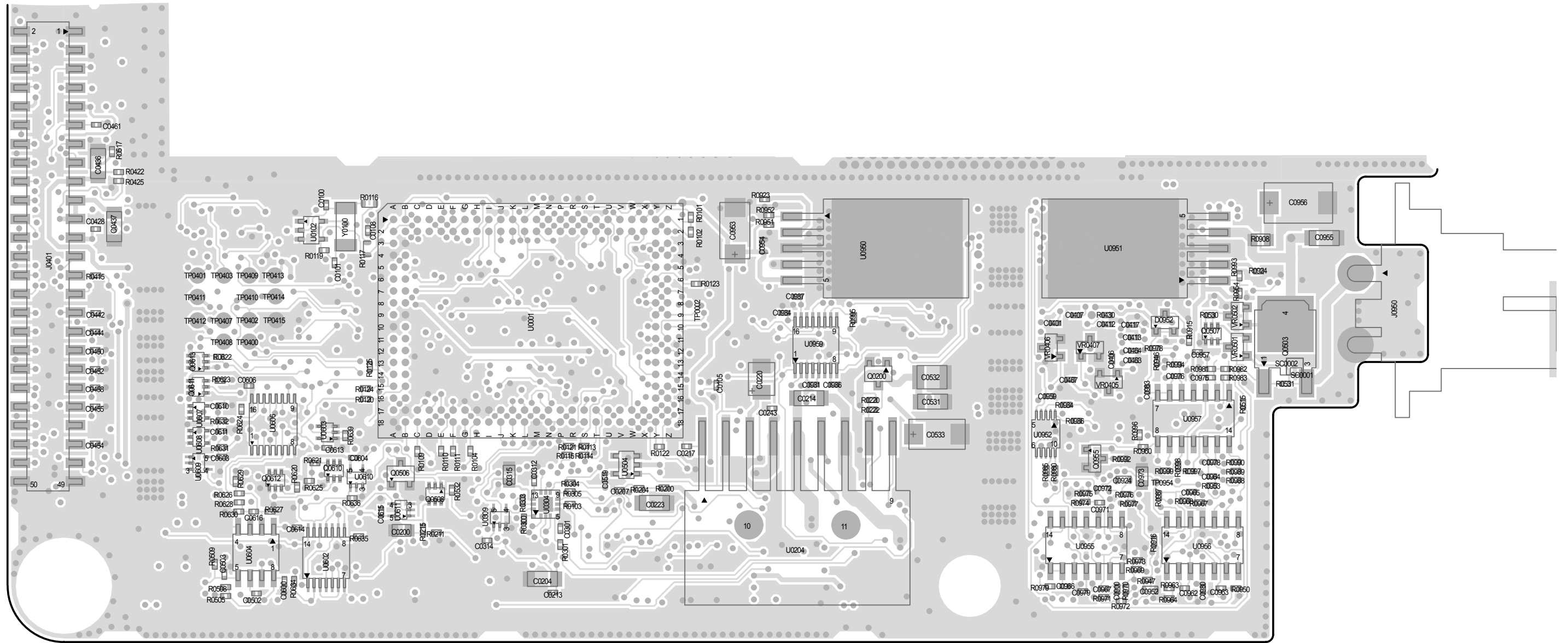


Figure 7-104. HUE4040A Main Board Layout—Side 1 Bottom

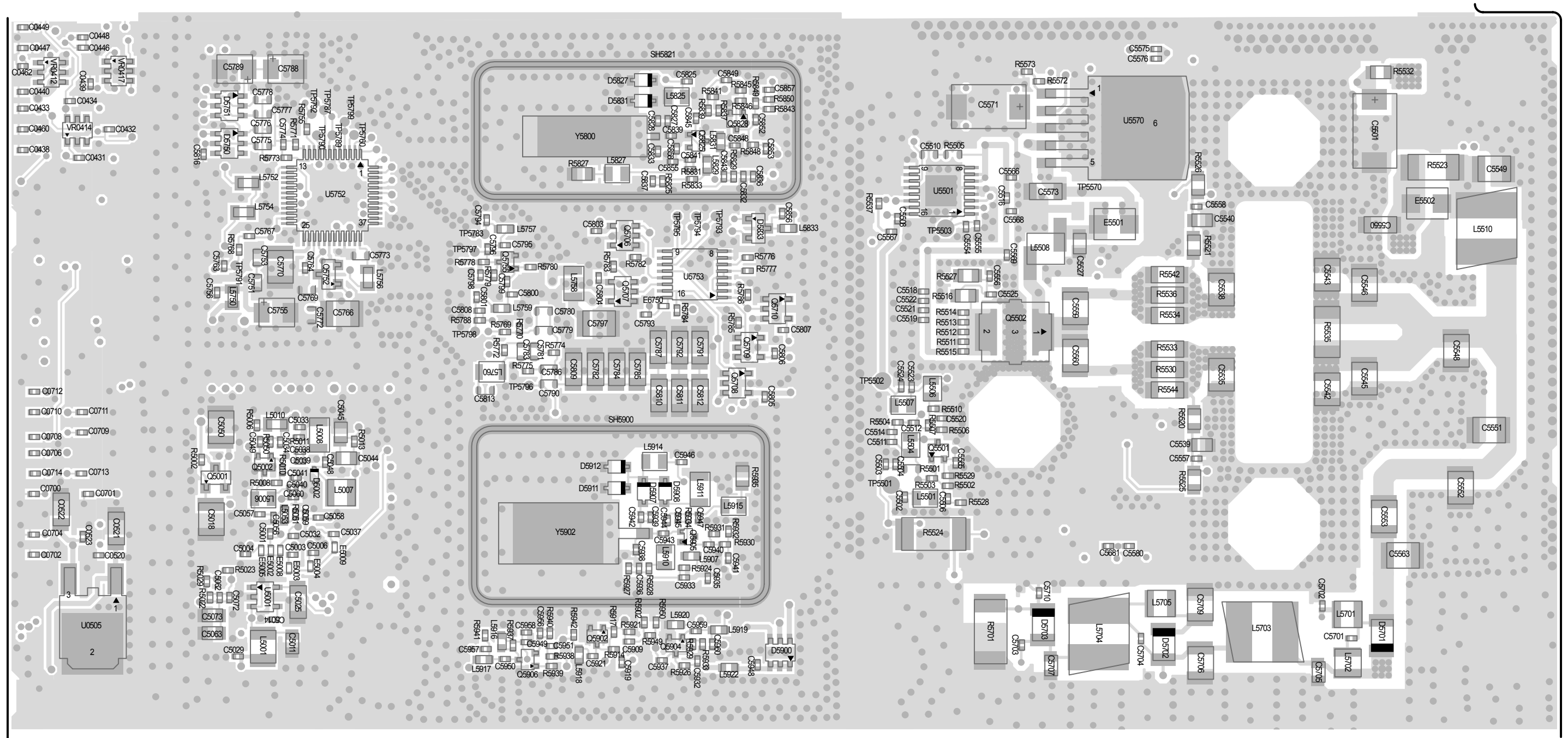


Figure 7-106. HUE4040A Main Board Layout—Side 2 Middle



Figure 7-107. HUE4040A Main Board Layout—Side 2 Bottom

HUE4040A Main Board Parts List

Reference Designator	Motorola Part Number	Description
C0001	2380090M24	CAP ALU 10 20 50V SURF MT
C0100	2113743N32	CAP CHIP 18.0 PF 5% COG
C0101	2113743N32	CAP CHIP 18.0 PF 5% COG
C0102	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0103	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0104	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0105	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0106	2113743N50	CAP CHIP 100 PF 5% COG
C0107	2113743L09	CAP CHIP 470 PF 10% X7R
C0108	2113743N50	CAP CHIP 100 PF 5% COG
C0200	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0201	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0202	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0203	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0204	2185802B01	CAP 10V 4.7UF
C0207	2113743N38	CAP CHIP 33.0 PF 5% COG
C0208	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0209	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0210	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0211	2113743N50	CAP CHIP 100 PF 5% COG
C0212	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0213	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0214	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0215	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0216	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0217	2113743L29	CAP CHIP 3300 PF 10% X7R
C0220	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V

Reference Designator	Motorola Part Number	Description
C0221	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C0223	2185802B01	CAP 10V 4.7UF
C0224	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0226	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0227	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0230	2113743L09	CAP CHIP 470 PF 10% X7R
C0231	2113743L01	CAP CHIP 220 PF 10% X7R
C0232	2113743L09	CAP CHIP 470 PF 10% X7R
C0233	2113743L01	CAP CHIP 220 PF 10% X7R
C0234	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0235	2113743L09	CAP CHIP 470 PF 10% X7R
C0236	2113743L09	CAP CHIP 470 PF 10% X7R
C0237	2113743L01	CAP CHIP 220 PF 10% X7R
C0238	2113743L01	CAP CHIP 220 PF 10% X7R
C0239	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0240	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0242	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C0243	2113945B01	CAP CER CHP 6800PF 25V 10%
C0244	2113945B01	CAP CER CHP 6800PF 25V 10%
C0301	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0302	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0305	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0306	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0308	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0309	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0310	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0311	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0312	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0313	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0314	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0315	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0400	2113743N38	CAP CHIP 33.0 PF 5% COG
C0401	2113743N50	CAP CHIP 100 PF 5% COG
C0402	2113743N38	CAP CHIP 33.0 PF 5% COG
C0403	2113743N38	CAP CHIP 33.0 PF 5% COG
C0404	2113743N38	CAP CHIP 33.0 PF 5% COG
C0405	2113743N38	CAP CHIP 33.0 PF 5% COG
C0406	2113743N38	CAP CHIP 33.0 PF 5% COG
C0407	2113743N50	CAP CHIP 100 PF 5% COG
C0408	2113743N50	CAP CHIP 100 PF 5% COG
C0409	2113743N38	CAP CHIP 33.0 PF 5% COG
C0410	2113743N38	CAP CHIP 33.0 PF 5% COG
C0412	2113743N50	CAP CHIP 100 PF 5% COG
C0413	2113743N50	CAP CHIP 100 PF 5% COG
C0414	2113743L01	CAP CHIP 220 PF 10% X7R
C0415	2113743L01	CAP CHIP 220 PF 10% X7R
C0416	2113743N50	CAP CHIP 100 PF 5% COG
C0417	2113743L01	CAP CHIP 220 PF 10% X7R
C0418	2113743L01	CAP CHIP 220 PF 10% X7R
C0419	2113743N50	CAP CHIP 100 PF 5% COG
C0420	2185802B01	CAP 10V 4.7UF
C0421	2113741B13	CAP CHIP CL2 X7R REEL 470
C0422	2113743N38	CAP CHIP 33.0 PF 5% COG
C0423	2113743N38	CAP CHIP 33.0 PF 5% COG
C0424	2113743N38	CAP CHIP 33.0 PF 5% COG
C0425	2113743N50	CAP CHIP 100 PF 5% COG
C0426	2113741B13	CAP CHIP CL2 X7R REEL 470
C0427	2113743N50	CAP CHIP 100 PF 5% COG
C0428	2113743N50	CAP CHIP 100 PF 5% COG
C0429	2113743N50	CAP CHIP 100 PF 5% COG
C0430	2113743N50	CAP CHIP 100 PF 5% COG
C0431	2113743N50	CAP CHIP 100 PF 5% COG
C0432	2113743N50	CAP CHIP 100 PF 5% COG
C0433	2113743N50	CAP CHIP 100 PF 5% COG
C0434	2113743N50	CAP CHIP 100 PF 5% COG
C0435	2113743L09	CAP CHIP 470 PF 10% X7R
C0436	2113741B13	CAP CHIP CL2 X7R REEL 470
C0437	2113741B13	CAP CHIP CL2 X7R REEL 470
C0438	2113743L09	CAP CHIP 470 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C0439	2113743N50	CAP CHIP 100 PF 5% COG
C0440	2113743N50	CAP CHIP 100 PF 5% COG
C0441	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0442	2113743N38	CAP CHIP 33.0 PF 5% COG
C0443	2113743N38	CAP CHIP 33.0 PF 5% COG
C0444	2113743N38	CAP CHIP 33.0 PF 5% COG
C0445	2113743N38	CAP CHIP 33.0 PF 5% COG
C0446	2113743N50	CAP CHIP 100 PF 5% COG
C0447	2113743N50	CAP CHIP 100 PF 5% COG
C0448	2113743N50	CAP CHIP 100 PF 5% COG
C0449	2113743N50	CAP CHIP 100 PF 5% COG
C0450	2113743N38	CAP CHIP 33.0 PF 5% COG
C0451	2113743N38	CAP CHIP 33.0 PF 5% COG
C0452	2113743N38	CAP CHIP 33.0 PF 5% COG
C0453	2113743N38	CAP CHIP 33.0 PF 5% COG
C0454	2113743N38	CAP CHIP 33.0 PF 5% COG
C0455	2113743N38	CAP CHIP 33.0 PF 5% COG
C0456	2113743N38	CAP CHIP 33.0 PF 5% COG
C0457	2113743N38	CAP CHIP 33.0 PF 5% COG
C0458	2113743N38	CAP CHIP 33.0 PF 5% COG
C0459	2113743N38	CAP CHIP 33.0 PF 5% COG
C0460	2113743N50	CAP CHIP 100 PF 5% COG
C0461	2113743L01	CAP CHIP 220 PF 10% X7R
C0462	2113743L01	CAP CHIP 220 PF 10% X7R
C0463	2113743N38	CAP CHIP 33.0 PF 5% COG
C0464	2113743N38	CAP CHIP 33.0 PF 5% COG
C0465	2113741B13	CAP CHIP CL2 X7R REEL 470
C0466	2113743N50	CAP CHIP 100 PF 5% COG
C0467	2113743N50	CAP CHIP 100 PF 5% COG
C0470	2113743N38	CAP CHIP 33.0 PF 5% COG
C0475	2113743N50	CAP CHIP 100 PF 5% COG
C0476	2113743N50	CAP CHIP 100 PF 5% COG
C0477	2113743N50	CAP CHIP 100 PF 5% COG
C0478	2113743N50	CAP CHIP 100 PF 5% COG
C0500	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0502	2113743N50	CAP CHIP 100 PF 5% COG
C0503	2113743N50	CAP CHIP 100 PF 5% COG
C0504	2113741N69	CAP CHIP CL2 X7R 10% 100000

Reference Designator	Motorola Part Number	Description
C0505	2113743L41	CAP CHIP 10000 PF 10% X7R
C0506	2113743L41	CAP CHIP 10000 PF 10% X7R
C0507	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0510	2185802B01	CAP 10V 4.7UF
C0512	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0513	2311049A43	CAP TANT CHIP 150 10 6
C0514	2311049A43	CAP TANT CHIP 150 10 6
C0515	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0516	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0517	2185802B01	CAP 10V 4.7UF
C0518	2185802B01	CAP 10V 4.7UF
C0519	2113743L41	CAP CHIP 10000 PF 10% X7R
C0520	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0521	2185802B01	CAP 10V 4.7UF
C0522	2185802B01	CAP 10V 4.7UF
C0523	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0524	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0525	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0526	2113743L41	CAP CHIP 10000 PF 10% X7R
C0527	2185802B01	CAP 10V 4.7UF
C0528	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0529	2185802B01	CAP 10V 4.7UF
C0531	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0532	2113741Y32	CAP CER 1,000,000 10% 50V
C0533	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0534	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0535	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0600	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0601	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0603	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0604	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0605	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0606	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0610	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0611	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0613	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0614	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0615	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0616	2113743N50	CAP CHIP 100 PF 5% COG
C0700	2113743N50	CAP CHIP 100 PF 5% COG
C0701	2113743N50	CAP CHIP 100 PF 5% COG
C0702	2113743N50	CAP CHIP 100 PF 5% COG
C0703	2113743N50	CAP CHIP 100 PF 5% COG
C0704	2113743N50	CAP CHIP 100 PF 5% COG
C0705	2113743N50	CAP CHIP 100 PF 5% COG
C0706	2113743N50	CAP CHIP 100 PF 5% COG
C0708	2113743N50	CAP CHIP 100 PF 5% COG
C0709	2113743N50	CAP CHIP 100 PF 5% COG
C0710	2113743N50	CAP CHIP 100 PF 5% COG
C0711	2113743N50	CAP CHIP 100 PF 5% COG
C0712	2113743N50	CAP CHIP 100 PF 5% COG
C0713	2113743L01	CAP CHIP 220 PF 10% X7R
C0714	2113743L01	CAP CHIP 220 PF 10% X7R
C0715	2113743N50	CAP CHIP 100 PF 5% COG
C0722	2113743A31	CAP CHIP 1.0 UF 10% X7R
C0724	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0729	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0900	2113743L17	CAP CHIP 1000 PF 10% X7R
C0901	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0902	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0903	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0904	2113743L01	CAP CHIP 220 PF 10% X7R
C0905	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0906	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0907	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0908	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0909	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0910	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0911	2113743N50	CAP CHIP 100 PF 5% COG
C0912	2113743N50	CAP CHIP 100 PF 5% COG
C0913	2113743N50	CAP CHIP 100 PF 5% COG
C0915	2113743N50	CAP CHIP 100 PF 5% COG
C0918	2113743N50	CAP CHIP 100 PF 5% COG
C0919	2113743N50	CAP CHIP 100 PF 5% COG
C0920	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0922	2113743N50	CAP CHIP 100 PF 5% COG
C0930	2113743N50	CAP CHIP 100 PF 5% COG
C0933	2113743N50	CAP CHIP 100 PF 5% COG
C0934	2113743N50	CAP CHIP 100 PF 5% COG
C0935	2113743N50	CAP CHIP 100 PF 5% COG
C0936	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0937	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0940	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0941	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C0942	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C0943	2113743L41	CAP CHIP 10000 PF 10% X7R
C0944	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0945	2185802B01	CAP 10V 4.7UF
C0950	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0951	2113741Y32	CAP CER 1,000,000 10% 50V

Reference Designator	Motorola Part Number	Description
C0952	2113743E20	CAP CHIP .10 UF 10%
C0953	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0954	2113743E20	CAP CHIP .10 UF 10%
C0955	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0956	2311049C06	CAP TANT CHIP 22 UF 35V 20%
C0957	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0959	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0960	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0961	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0963	2113743N50	CAP CHIP 100 PF 5% COG
C0964	2113743N50	CAP CHIP 100 PF 5% COG
C0965	2113743N50	CAP CHIP 100 PF 5% COG
C0966	2113743N50	CAP CHIP 100 PF 5% COG
C0968	2113743N50	CAP CHIP 100 PF 5% COG
C0969	2113743N50	CAP CHIP 100 PF 5% COG
C0970	2113743N50	CAP CHIP 100 PF 5% COG
C0972	2113743E20	CAP CHIP .10 UF 10%
C0973	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0974	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0975	2113743N50	CAP CHIP 100 PF 5% COG
C0976	2113743N50	CAP CHIP 100 PF 5% COG
C0978	2113743N50	CAP CHIP 100 PF 5% COG
C0979	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0980	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0981	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0982	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0983	2113743N50	CAP CHIP 100 PF 5% COG
C0984	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0985	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0986	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0987	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0989	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0990	2113743L50	CAP CHIP 33000 PF 10%
C0991	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0997	2113740F47	CAP CHIP REEL CL1 +/-30 68
C0998	2113741F01	CAP CHIP CL2 X7R REEL 100
C5001	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5002	2113743N28	CAP CHIP 12.0 PF 5% COG
C5003	2113743L41	CAP CHIP 10000 PF 10% X7R
C5004	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5005	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5006	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5007	2113743N30	CAP CHIP 15.0 PF 5% COG
C5008	2113743L25	CAP CHIP 2200 PF 10% X7R
C5009	2113740F58	CAP CHIP REEL CL1 +/-30 200
C5010	2113743N50	CAP CHIP 100 PF 5% COG
C5011	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C5012	2113743N50	CAP CHIP 100 PF 5% COG
C5013	2113743N50	CAP CHIP 100 PF 5% COG
C5014	2113743L41	CAP CHIP 10000 PF 10% X7R
C5015	2113743L41	CAP CHIP 10000 PF 10% X7R
C5017	2113743L41	CAP CHIP 10000 PF 10% X7R
C5018	2113743T19	CAP 10UF 16V CER 3225 X5R
C5019	2113743N50	CAP CHIP 100 PF 5% COG
C5020	2113743L17	CAP CHIP 1000 PF 10% X7R
C5021	2113743L41	CAP CHIP 10000 PF 10% X7R
C5022	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5023	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5025	2113743S01	CAP CER CHIP 1.0 UF 10% 16V

Reference Designator	Motorola Part Number	Description
C5026	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5030	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5032	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5033	2113743N52	CAP CHIP 120 PF 5% COG
C5034	2113743N40	CAP CHIP 39.0 PF 5% COG
C5037	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5039	2113743N29	CAP CHIP 13.0 PF 5% COG
C5040	2113743L41	CAP CHIP 10000 PF 10% X7R
C5041	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5044	2113743A19	CAP CHIP .100 UF 10% X7R
C5045	2113743A31	CAP CHIP 1.0 UF 10% X7R
C5048	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5050	2113743T19	CAP 10UF 16V CER 3225 X5R
C5051	2113743L17	CAP CHIP 1000 PF 10% X7R
C5052	2113743L17	CAP CHIP 1000 PF 10% X7R
C5056	2113743N34	CAP CHIP 22.0 PF 5% COG
C5057	2113743N30	CAP CHIP 15.0 PF 5% COG
C5058	2113743L17	CAP CHIP 1000 PF 10% X7R
C5059	2113743N36	CAP CHIP 27.0 PF 5% COG
C5060	2113743L01	CAP CHIP 220 PF 10% X7R
C5061	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5062	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5063	2113743A31	CAP CHIP 1.0 UF 10% X7R
C5064	2113743L41	CAP CHIP 10000 PF 10% X7R
C5065	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5066	2113743L17	CAP CHIP 1000 PF 10% X7R
C5067	2113743N50	CAP CHIP 100 PF 5% COG
C5068	2113743N50	CAP CHIP 100 PF 5% COG
C5069	2113743N54	CAP CHIP 150 PF 5% COG
C5070	2113743N50	CAP CHIP 100 PF 5% COG
C5071	2113743N30	CAP CHIP 15.0 PF 5% COG
C5072	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5073	2113743A31	CAP CHIP 1.0 UF 10% X7R

Reference Designator	Motorola Part Number	Description
C5251	2113743L01	CAP CHIP 220 PF 10% X7R
C5252	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C5253	2113743L01	CAP CHIP 220 PF 10% X7R
C5255	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C5256	2113743L01	CAP CHIP 220 PF 10% X7R
C5257	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C5258	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C5259	2113743L41	CAP CHIP 10000 PF 10% X7R
C5280	2113743L01	CAP CHIP 220 PF 10% X7R
C5282	2113743L41	CAP CHIP 10000 PF 10% X7R
C5283	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C5284	2113743L41	CAP CHIP 10000 PF 10% X7R
C5285	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C5287	2113743L41	CAP CHIP 10000 PF 10% X7R
C5288	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C5289	2113743L01	CAP CHIP 220 PF 10% X7R
C5290	2113743L01	CAP CHIP 220 PF 10% X7R
C5291	2113743L41	CAP CHIP 10000 PF 10% X7R
C5292	2113743L01	CAP CHIP 220 PF 10% X7R
C5294	2113743L41	CAP CHIP 10000 PF 10% X7R
C5295	2113743N18	CAP CHIP 4.7 PF +-.25PF COG
C5296	2113743L01	CAP CHIP 220 PF 10% X7R
C5297	2113743N07	CAP CHIP 1.5 PF +-.25PF COG
C5299	2113743L41	CAP CHIP 10000 PF 10% X7R
C5300	2113743L01	CAP CHIP 220 PF 10% X7R
C5301	2113743L41	CAP CHIP 10000 PF 10% X7R
C5302	2113743L41	CAP CHIP 10000 PF 10% X7R
C5303	2113743L41	CAP CHIP 10000 PF 10% X7R
C5304	2113743L01	CAP CHIP 220 PF 10% X7R
C5305	2113743L01	CAP CHIP 220 PF 10% X7R
C5306	2113743L01	CAP CHIP 220 PF 10% X7R
C5307	2113743L01	CAP CHIP 220 PF 10% X7R
C5308	2113743L01	CAP CHIP 220 PF 10% X7R
C5309	2113743L41	CAP CHIP 10000 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C5310	2113743L01	CAP CHIP 220 PF 10% X7R
C5311	2113743L41	CAP CHIP 10000 PF 10% X7R
C5312	2113743L01	CAP CHIP 220 PF 10% X7R
C5314	2113743L41	CAP CHIP 10000 PF 10% X7R
C5315	2185802B01	CAP 10V 4.7UF
C5316	2113743L09	CAP CHIP 470 PF 10% X7R
C5317	2113743L01	CAP CHIP 220 PF 10% X7R
C5318	2185802B01	CAP 10V 4.7UF
C5319	2113743L41	CAP CHIP 10000 PF 10% X7R
C5320	2113743N28	CAP CHIP 12.0 PF 5% COG
C5321	2113743L01	CAP CHIP 220 PF 10% X7R
C5322	2113743L41	CAP CHIP 10000 PF 10% X7R
C5323	2113743L50	CAP CHIP 33000 PF 10%
C5324	2113743L01	CAP CHIP 220 PF 10% X7R
C5325	2113743L50	CAP CHIP 33000 PF 10%
C5326	2113743N26	CAP CHIP 10.0 PF 5% COG
C5327	2113743N50	CAP CHIP 100 PF 5% COG
C5328	2113743N32	CAP CHIP 18.0 PF 5% COG
C5329	2113743N50	CAP CHIP 100 PF 5% COG
C5331	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5332	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C5334	2113743L01	CAP CHIP 220 PF 10% X7R
C5335	2113743L50	CAP CHIP 33000 PF 10%
C5336	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5337	2113743L50	CAP CHIP 33000 PF 10%
C5338	2113743L01	CAP CHIP 220 PF 10% X7R
C5339	2113743N22	CAP CHIP 6.8 PF + -.5PF COG
C5340	2113743L01	CAP CHIP 220 PF 10% X7R
C5341	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C5342	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5343	2113743N34	CAP CHIP 22.0 PF 5% COG
C5344	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5345	2113743L09	CAP CHIP 470 PF 10% X7R
C5346	2113743L50	CAP CHIP 33000 PF 10%
C5347	2113743N34	CAP CHIP 22.0 PF 5% COG

Reference Designator	Motorola Part Number	Description
C5348	2113743L01	CAP CHIP 220 PF 10% X7R
C5349	2113743N22	CAP CHIP 6.8 PF + .5PF COG
C5350	2113743L50	CAP CHIP 33000 PF 10%
C5351	2113743L50	CAP CHIP 33000 PF 10%
C5352	2113743L01	CAP CHIP 220 PF 10% X7R
C5353	2113743L01	CAP CHIP 220 PF 10% X7R
C5354	2113743N42	CAP CHIP 47.0 PF 5% COG
C5356	2113743L50	CAP CHIP 33000 PF 10%
C5357	2113743L01	CAP CHIP 220 PF 10% X7R
C5358	2113743N26	CAP CHIP 10.0 PF 5% COG
C5360	2113743L50	CAP CHIP 33000 PF 10%
C5361	2113743L01	CAP CHIP 220 PF 10% X7R
C5362	2113743L01	CAP CHIP 220 PF 10% X7R
C5363	2113743L01	CAP CHIP 220 PF 10% X7R
C5364	2113743L17	CAP CHIP 1000 PF 10% X7R
C5365	2113743L01	CAP CHIP 220 PF 10% X7R
C5366	2113743L17	CAP CHIP 1000 PF 10% X7R
C5367	2113743L01	CAP CHIP 220 PF 10% X7R
C5368	2113743L17	CAP CHIP 1000 PF 10% X7R
C5370	2113743N17	CAP CHIP 4.3 PF +-.25PF COG
C5374	2113743N25	CAP CHIP 9.1 PF + .5PF COG
C5375	2113743N25	CAP CHIP 9.1 PF + .5PF COG
C5377	2113743N28	CAP CHIP 12.0 PF 5% COG
C5379	2113743N24	CAP CHIP 8.2 PF + .5PF COG
C5382	2113743L41	CAP CHIP 10000 PF 10% X7R
C5383	2113743L41	CAP CHIP 10000 PF 10% X7R
C5385	2113743L41	CAP CHIP 10000 PF 10% X7R
C5386	2113743N38	CAP CHIP 33.0 PF 5% COG
C5388	2113743L41	CAP CHIP 10000 PF 10% X7R
C5389	2113743N25	CAP CHIP 9.1 PF + .5PF COG
C5390	2113743N22	CAP CHIP 6.8 PF + .5PF COG
C5391	2113743N38	CAP CHIP 33.0 PF 5% COG
C5400	2113743L01	CAP CHIP 220 PF 10% X7R
C5401	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C5402	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5403	2113743N29	CAP CHIP 13.0 PF 5% COG
C5404	2113743N30	CAP CHIP 15.0 PF 5% COG
C5405	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C5406	2113743N31	CAP CHIP 16.0 PF 5% COG
C5407	2113743N30	CAP CHIP 15.0 PF 5% COG
C5408	2113743N13	CAP CHIP 3.0 PF +-.25PF COG
C5409	2104801Z12	CAP CER NPO 1.8PF 16V 1005 SMD
C5410	2104801Z12	CAP CER NPO 1.8PF 16V 1005 SMD
C5412	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C5413	2104801Z12	CAP CER NPO 1.8PF 16V 1005 SMD
C5414	2113743N24	CAP CHIP 8.2 PF + .5PF COG
C5415	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C5418	2104801Z12	CAP CER NPO 1.8PF 16V 1005 SMD
C5419	2113743L01	CAP CHIP 220 PF 10% X7R
C5420	2113743L41	CAP CHIP 10000 PF 10% X7R
C5423	2113743L41	CAP CHIP 10000 PF 10% X7R
C5424	2113743L41	CAP CHIP 10000 PF 10% X7R
C5425	2113743L01	CAP CHIP 220 PF 10% X7R
C5426	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C5427	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C5428	2113743L01	CAP CHIP 220 PF 10% X7R
C5431	2113743L01	CAP CHIP 220 PF 10% X7R
C5433	2113743L41	CAP CHIP 10000 PF 10% X7R
C5501	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C5502	2113743N12	CAP CHIP 2.7 PF +-.25PF COG
C5503	2113743L50	CAP CHIP 33000 PF 10%
C5504	2113743L01	CAP CHIP 220 PF 10% X7R
C5505	2113743E20	CAP CHIP .10 UF 10%
C5506	2113743N26	CAP CHIP 10.0 PF 5% COG

Reference Designator	Motorola Part Number	Description
C5507	2113743N16	CAP CHIP 3.9 PF +-.25PF COG
C5508	2113743L01	CAP CHIP 220 PF 10% X7R
C5509	2113743N50	CAP CHIP 100 PF 5% COG
C5510	2113743E20	CAP CHIP .10 UF 10%
C5512	2113743N44	CAP CHIP 56.0 PF 5% COG
C5513	2113743L48	CAP CHIP 22,000 PF 10%
C5515	2113743L48	CAP CHIP 22,000 PF 10%
C5516	2113743L01	CAP CHIP 220 PF 10% X7R
C5517	2113743E20	CAP CHIP .10 UF 10%
C5518	2113743N36	CAP CHIP 27.0 PF 5% COG
C5520	2113743N19	CAP CHIP 5.1 PF + .5PF COG
C5523	2113743N26	CAP CHIP 10.0 PF 5% COG
C5524	2113743N19	CAP CHIP 5.1 PF + .5PF COG
C5525	2113743L01	CAP CHIP 220 PF 10% X7R
C5526	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5527	2113740A55	CAP CHIP 100PF, +5%, -5%, 50V-DC, 0805
C5535	2111078B35	CAP CHIP RF 51 5 NPO 100V
C5538	2111078B35	CAP CHIP RF 51 5 NPO 100V
C5539	2113740A55	CAP CHIP 100PF, +5%, -5%, 50V-DC, 0805
C5540	2113740A55	CAP CHIP 100PF, +5%, -5%, 50V-DC, 0805
C5541	2113743E20	CAP CHIP .10 UF 10%
C5542	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5543	2111078B27	CAP CHIP RF 30 5 NPO 100V
C5544	2113743E20	CAP CHIP .10 UF 10%
C5545	2111078B25	CAP CHIP RF 27 5 NPO 100V
C5546	2111078B25	CAP CHIP RF 27 5 NPO 100V
C5548	2111078B15	CAP CHIP RF 12 5 NPO 100V
C5549	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5550	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5551	2111078B13	CAP CHIP RF 10 .5 NPO 100V
C5552	2111078B05	CAP CHIP RF 4.7 .25 NPO 100V
C5553	2111078B42	CAP CHIP RF 100 5 NPO 100V

Reference Designator	Motorola Part Number	Description
C5554	2113743L41	CAP CHIP 10000 PF 10% X7R
C5555	2113743L01	CAP CHIP 220 PF 10% X7R
C5556	2113743L41	CAP CHIP 10000 PF 10% X7R
C5557	2113743L41	CAP CHIP 10000 PF 10% X7R
C5558	2113743L41	CAP CHIP 10000 PF 10% X7R
C5559	2111078B21	CAP CHIP RF 20 5 NPO 100V
C5560	2111078B21	CAP CHIP RF 20 5 NPO 100V
C5565	2113743L50	CAP CHIP 33000 PF 10%
C5566	2113743N21	CAP CHIP 6.2 PF + .5PF COG
C5570	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5571	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C5572	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C5573	2113741N69	CAP CHIP CL2 X7R 10% 100000
C5575	2113743L41	CAP CHIP 10000 PF 10% X7R
C5576	2113743L01	CAP CHIP 220 PF 10% X7R
C5578	2113743L01	CAP CHIP 220 PF 10% X7R
C5579	2113743L01	CAP CHIP 220 PF 10% X7R
C5580	2113743L01	CAP CHIP 220 PF 10% X7R
C5677	2113743L41	CAP CHIP 10000 PF 10% X7R
C5681	2113743L41	CAP CHIP 10000 PF 10% X7R
C5701	2113743L01	CAP CHIP 220 PF 10% X7R
C5702	2113743L01	CAP CHIP 220 PF 10% X7R
C5703	2113743L01	CAP CHIP 220 PF 10% X7R
C5704	2113743L01	CAP CHIP 220 PF 10% X7R
C5705	2111078A06	CAP CHIP RF 1.5 .25 NPO 100V
C5706	2111078B06	CAP CHIP RF 5.1 .25 NPO 100V
C5707	2111078A01	CAP CHIP RF 1 .25 NPO 100V
C5708	2111078B42	CAP CHIP RF 100 5 NPO 100V
C5709	2111078B34	CAP CHIP RF 47 5 NPO 100V
C5710	2113743N46	CAP CHIP 68.0 PF 5% COG
C5711	2111078B01	CAP CHIP RF 3.3 .25 NPO 100V
C5712	2111078B03	CAP CHIP RF 3.9 .25 NPO 100V
C5713	2111078B14	CAP CHIP RF 11 5 NPO 100V

Reference Designator	Motorola Part Number	Description
C5714	2111078B01	CAP CHIP RF 3.3 .25 NPO 100V
C5715	2113743L01	CAP CHIP 220 PF 10% X7R
C5716	2113743N23	CAP CHIP 7.5 PF + -.5PF COG
C5717	2113743N23	CAP CHIP 7.5 PF + -.5PF COG
C5718	2113743L01	CAP CHIP 220 PF 10% X7R
C5719	2111078A09	CAP CHIP RF 1.8 .25 NPO 100V
C5720	2111078B10	CAP CHIP RF 7.5 .25 NPO 100V
C5750	2113743E20	CAP CHIP .10 UF 10%
C5751	2113743E07	CER CHIP CAP .022UF
C5752	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C5753	2113743K15	CER CHIP CAP .100UF
C5754	2113743L41	CAP CHIP 10000 PF 10% X7R
C5755	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C5756	2113743N40	CAP CHIP 39.0 PF 5% COG
C5757	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C5758	2113743E20	CAP CHIP .10 UF 10%
C5759	2113743A24	CAP CHIP .330 UF 10% 16V
C5760	2113743L17	CAP CHIP 1000 PF 10% X7R
C5761	2113743L41	CAP CHIP 10000 PF 10% X7R
C5762	2113743A24	CAP CHIP .330 UF 10% 16V
C5763	2113743N38	CAP CHIP 33.0 PF 5% COG
C5764	2113743N40	CAP CHIP 39.0 PF 5% COG
C5765	2113743E20	CAP CHIP .10 UF 10%
C5766	2113743T19	CAP 10UF 16V CER 3225 X5R
C5767	2113743L17	CAP CHIP 1000 PF 10% X7R
C5768	2113743N50	CAP CHIP 100 PF 5% COG
C5769	2113743K15	CER CHIP CAP .100UF
C5770	2113743T19	CAP 10UF 16V CER 3225 X5R
C5771	2113743E20	CAP CHIP .10 UF 10%
C5772	2113743K15	CER CHIP CAP .100UF
C5773	2113743E20	CAP CHIP .10 UF 10%
C5774	2113743N34	CAP CHIP 22.0 PF 5% COG
C5775	2113743E20	CAP CHIP .10 UF 10%
C5776	2113743E20	CAP CHIP .10 UF 10%
C5777	2113743E20	CAP CHIP .10 UF 10%

Reference Designator	Motorola Part Number	Description
C5778	2113743E20	CAP CHIP .10 UF 10%
C5779	2185419D10	CAP CER SUPER L/D 0.0015UF
C5780	2185419D10	CAP CER SUPER L/D 0.0015UF
C5781	2113743E12	CAP CHIP .047 UF 10% X7R
C5782	2185419D06	CAP CER SUPER L/D 0.1UF
C5783	2113743E20	CAP CHIP .10 UF 10%
C5784	2185419D06	CAP CER SUPER L/D 0.1UF
C5785	2185419D06	CAP CER SUPER L/D 0.1UF
C5786	2113743E20	CAP CHIP .10 UF 10%
C5787	2185419D06	CAP CER SUPER L/D 0.1UF
C5788	2311049J11	CAP TANT CHIP 4.7 10 16
C5789	2311049J11	CAP TANT CHIP 4.7 10 16
C5790	2113743E07	CER CHIP CAP .022UF
C5791	2185419D06	CAP CER SUPER L/D 0.1UF
C5792	2185419D06	CAP CER SUPER L/D 0.1UF
C5793	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C5794	2113743N26	CAP CHIP 10.0 PF 5% COG
C5795	2113743N26	CAP CHIP 10.0 PF 5% COG
C5796	2113743L01	CAP CHIP 220 PF 10% X7R
C5797	2113743T19	CAP 10UF 16V CER 3225 X5R
C5798	2113743N50	CAP CHIP 100 PF 5% COG
C5799	2113743L01	CAP CHIP 220 PF 10% X7R
C5800	2113743N26	CAP CHIP 10.0 PF 5% COG
C5801	2113743N26	CAP CHIP 10.0 PF 5% COG
C5803	2113743L05	CAP CHIP 330 PF 10% X7R
C5804	2113743L05	CAP CHIP 330 PF 10% X7R
C5805	2113743L05	CAP CHIP 330 PF 10% X7R
C5806	2113743L05	CAP CHIP 330 PF 10% X7R
C5807	2113743L05	CAP CHIP 330 PF 10% X7R
C5809	2185419D06	CAP CER SUPER L/D 0.1UF
C5810	2185419D06	CAP CER SUPER L/D 0.1UF
C5811	2185419D06	CAP CER SUPER L/D 0.1UF
C5812	2185419D06	CAP CER SUPER L/D 0.1UF
C5813	2113741F17	CAP CHIP CL2 X7R REEL 470
C5816	2113743L01	CAP CHIP 220 PF 10% X7R
C5817	2113743L01	CAP CHIP 220 PF 10% X7R
C5825	2113743L05	CAP CHIP 330 PF 10% X7R
C5826	2113743L05	CAP CHIP 330 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C5827	2113743N30	CAP CHIP 15.0 PF 5% COG
C5828	2113743N29	CAP CHIP 13.0 PF 5% COG
C5829	2113743N31	CAP CHIP 16.0 PF 5% COG
C5830	2113743N31	CAP CHIP 16.0 PF 5% COG
C5831	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5832	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5833	2113743Q08	CAP CHIP 1.8 PF +/- .1PF 20*40
C5834	2113743L05	CAP CHIP 330 PF 10% X7R
C5835	2113743N16	CAP CHIP 3.9 PF +/- .25PF COG
C5836	2113743L05	CAP CHIP 330 PF 10% X7R
C5837	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5838	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5839	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C5840	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5841	2113743L01	CAP CHIP 220 PF 10% X7R
C5842	2113743L01	CAP CHIP 220 PF 10% X7R
C5843	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5844	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5845	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5846	2113743N18	CAP CHIP 4.7 PF +/- .25PF COG
C5847	2113743L05	CAP CHIP 330 PF 10% X7R
C5848	2113743L05	CAP CHIP 330 PF 10% X7R
C5849	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5850	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C5851	2113743N32	CAP CHIP 18.0 PF 5% COG
C5852	2113743N28	CAP CHIP 12.0 PF 5% COG
C5853	2113743L05	CAP CHIP 330 PF 10% X7R
C5854	2113743N30	CAP CHIP 15.0 PF 5% COG
C5855	2113743N31	CAP CHIP 16.0 PF 5% COG
C5856	2113928S04	CAP CER CHIP 0.100UF 10V 0402

Reference Designator	Motorola Part Number	Description
C5857	2113743N28	CAP CHIP 12.0 PF 5% COG
C5858	2113743N26	CAP CHIP 10.0 PF 5% COG
C5859	2113743N50	CAP CHIP 100 PF 5% COG
C5860	2113743L05	CAP CHIP 330 PF 10% X7R
C5861	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5862	2113743L05	CAP CHIP 330 PF 10% X7R
C5863	2113743N05	CAP CHIP 1.2 PF +/- .25PF COG
C5900	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5901	2113743L01	CAP CHIP 220 PF 10% X7R
C5904	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5905	2113743N14	CAP CHIP 3.3 PF +/- .25PF COG
C5906	2113743Q05	CAP CHIP 1.2 PF +/- .1PF 20*40
C5907	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C5908	2113743N50	CAP CHIP 100 PF 5% COG
C5909	2113743N50	CAP CHIP 100 PF 5% COG
C5910	2113743N12	CAP CHIP 2.7 PF +/- .25PF COG
C5911	2113743N17	CAP CHIP 4.3 PF +/- .25PF COG
C5912	2113743N16	CAP CHIP 3.9 PF +/- .25PF COG
C5913	2113743L01	CAP CHIP 220 PF 10% X7R
C5914	2113743L01	CAP CHIP 220 PF 10% X7R
C5915	2113743N16	CAP CHIP 3.9 PF +/- .25PF COG
C5916	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5917	2113743L01	CAP CHIP 220 PF 10% X7R
C5919	2113743L01	CAP CHIP 220 PF 10% X7R
C5920	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5921	2113743N34	CAP CHIP 22.0 PF 5% COG
C5922	2113743N14	CAP CHIP 3.3 PF +/- .25PF COG
C5923	2113743Q07	CAP CHIP 1.5 PF +/- .1PF 20*40
C5924	2113743N19	CAP CHIP 5.1 PF + -.5PF COG

Reference Designator	Motorola Part Number	Description
C5925	2113743N50	CAP CHIP 100 PF 5% COG
C5926	2113743N14	CAP CHIP 3.3 PF +/- .25PF COG
C5927	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C5928	2113743N18	CAP CHIP 4.7 PF +/- .25PF COG
C5929	2113743L01	CAP CHIP 220 PF 10% X7R
C5930	2113743L01	CAP CHIP 220 PF 10% X7R
C5931	2113743N18	CAP CHIP 4.7 PF +/- .25PF COG
C5932	2113743L01	CAP CHIP 220 PF 10% X7R
C5933	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5935	2113743L01	CAP CHIP 220 PF 10% X7R
C5936	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5937	2113743N50	CAP CHIP 100 PF 5% COG
C5938	2113743Q07	CAP CHIP 1.5 PF +/- .1PF 20*40
C5939	2113743N14	CAP CHIP 3.3 PF +/- .25PF COG
C5940	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C5941	2113743N50	CAP CHIP 100 PF 5% COG
C5942	2113743N16	CAP CHIP 3.9 PF +/- .25PF COG
C5943	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C5944	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C5945	2113743L01	CAP CHIP 220 PF 10% X7R
C5946	2113743L01	CAP CHIP 220 PF 10% X7R
C5947	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C5948	2113928S04	CAP CER CHIP 0.100UF 10V 0402
C5949	2113743L01	CAP CHIP 220 PF 10% X7R
C5950	2113743N50	CAP CHIP 100 PF 5% COG
C5951	2113743N50	CAP CHIP 100 PF 5% COG
C5956	2113743L01	CAP CHIP 220 PF 10% X7R
C5957	2113743Q03	CAP CHIP 1.0 PF +/- .1PF 20*40
C5958	2113928S04	CAP CER CHIP 0.100UF 10V 0402

Reference Designator	Motorola Part Number	Description
C5959	2113743N50	CAP CHIP 100 PF 5% COG
C5960	2113743Q07	CAP CHIP 1.5 PF +/- .1PF 20*40
D0950	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0951	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0952	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D5002	4809877C13	DIODE VARACTOR ISV305 SMD
D5003	4805649Q13	DIODE VCTR ISV 228
D5250	4862824C01	DIODE VARACTOR
D5251	4862824C01	DIODE VARACTOR
D5252	4862824C01	DIODE VARACTOR
D5253	4862824C01	DIODE VARACTOR
D5280	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5281	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5282	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5300	4808115L23	DIODE,PIN,SMP1322,,,,,100M A,1V,.25W,
D5301	4808115L23	DIODE,PIN,SMP1322,,,,,100M A,1V,.25W,
D5302	4808115L23	DIODE,PIN,SMP1322,,,,,100M A,1V,.25W,
D5303	4808115L23	DIODE,PIN,SMP1322,,,,,100M A,1V,.25W,
D5380	4882290T04	DIODE SI HOT CARRIER HSMS 2812
D5381	4882290T04	DIODE SI HOT CARRIER HSMS 2812
D5400	4880154K03	DIODE DUAL SCHOTTKY MIXER
D5501	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D5502	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D5701	4802482J02	PIN DIODE SMD
D5702	4802482J02	PIN DIODE SMD
D5703	4802482J02	PIN DIODE SMD
D5704	4813825A05	DIODE 30V HOT CARRIER MMBD301L

Reference Designator	Motorola Part Number	Description
D5705	4813825A05	DIODE 30V HOT CARRIER MMBD301L
D5750	4802233J09	DIODE TRIPLE SOT25-RH
D5751	4802233J09	DIODE TRIPLE SOT25-RH
D5827	4862824C01	DIODE VARACTOR
D5828	4862824C01	DIODE VARACTOR
D5831	4862824C01	DIODE VARACTOR
D5832	4862824C01	DIODE VARACTOR
D5833	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D5900	4802233J09	DIODE TRIPLE SOT25-RH
D5901	4862824C01	DIODE VARACTOR
D5902	4862824C01	DIODE VARACTOR
D5903	4862824C01	DIODE VARACTOR
D5904	4862824C01	DIODE VARACTOR
D5905	4862824C01	DIODE VARACTOR
D5906	4862824C01	DIODE VARACTOR
D5907	4862824C01	DIODE VARACTOR
D5908	4862824C01	DIODE VARACTOR
D5909	4862824C01	DIODE VARACTOR
D5910	4862824C01	DIODE VARACTOR
D5911	4862824C01	DIODE VARACTOR
D5912	4862824C01	DIODE VARACTOR
E5001	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5002	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5003	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5004	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5005	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5006	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5007	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5008	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5009	2480640Z01	SURFACE MOUNT FERRITE BEAD
E5400	2484657R01	INDUCTOR BEAD CHIP
E5501	2484657R01	INDUCTOR BEAD CHIP

Reference Designator	Motorola Part Number	Description
E5502	2484657R01	INDUCTOR BEAD CHIP
E6750	2480640Z01	SURFACE MOUNT FERRITE BEAD
F0400	6583049X16	FUSE 5A FAST ACT
FL0900	9185130D01	FLTR SW CAP 3 POLE BUTTERW
J0401	0985722E01	CONN 50 POS FM SMT RTANG
J0402	0985631E01	CONNECTOR FEMALE 32 PIN ACCY
J0501	0985473E01	CONN SECURE 20 POS FM SMT RT ANG
J0950	0905902V07	CONNECTOR DC
J5701	0905901V11	RF CONNECTOR,RF,,F,,,,,CON N RF
L0400	2485821C07	IND RF 10UH
L5001	2462587L50	CHIP IND 100000 NH 10%
L5002	2462587V36	CHIP IND 150 NH 5% 0805
L5003	2405769X05	COIL INDUCTOR
L5004	2405769X05	COIL INDUCTOR
L5006	2462587V34	CHIP IND 100 NH 5% 0805
L5007	2462587N76	CHIP IND 4700 NH 5%
L5008	2485209F02	IDCTR,COIL,,150UH,2%,,,,,,ID CTR 150N
L5010	2462587Q47	IDCTR,CHIP,1UH,10%,50MA,, FERR,,,,45
L5012	2462587V34	CHIP IND 100 NH 5% 0805
L5015	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5053	2413926G19	IND 100 NH 5%
L5237	2462587V26	CHIP IND 22 NH 5% 0805
L5250	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5251	2484562T03	COIL SURFACE MOUNT AIR WOUND
L5252	2484562T04	COIL SURFACE MOUNT AIR WOUND
L5253	2462587X52	IND CHIP LO-PRO 82.0 NH 5%
L5254	2484562T04	COIL SURFACE MOUNT AIR WOUND
L5255	2484562T03	COIL SURFACE MOUNT AIR WOUND

Reference Designator	Motorola Part Number	Description
L5256	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5257	2462587V29	CHIP IND 39 NH 5% 0805
L5258	2462587V26	CHIP IND 22 NH 5% 0805
L5280	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5281	2462587V59	IND CHIP 390 NH 5%
L5282	2462587V25	CHIP IND 18 NH 5% 0805
L5283	2462587V26	CHIP IND 22 NH 5% 0805
L5284	2462587V25	CHIP IND 18 NH 5% 0805
L5285	2413926N24	IND CER CHIP 100.0 NH 5%
L5286	2413926N18	IND CER CHIP 33.0 NH 5%
L5287	2413926N16	IND CER CHIP 22.0 NH 5%
L5289	2462587V59	IND CHIP 390 NH 5%
L5290	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5294	2462587V29	CHIP IND 39 NH 5% 0805
L5297	2462587V26	CHIP IND 22 NH 5% 0805
L5298	2462587V26	CHIP IND 22 NH 5% 0805
L5299	2484657R01	INDUCTOR BEAD CHIP
L5300	2462587V26	CHIP IND 22 NH 5% 0805
L5301	2462587V26	CHIP IND 22 NH 5% 0805
L5302	2462587V23	CHIP IND 12 NH 5% 0805
L5303	2462587V32	CHIP IND 68 NH 5% 0805
L5304	2462587V26	CHIP IND 22 NH 5% 0805
L5305	2462587V24	CHIP IND 15 NH 5% 0805
L5306	2413926N08	IND CER CHIP 4.7 NH +/- 0.3 NH
L5307	2413926N08	IND CER CHIP 4.7 NH +/- 0.3 NH
L5308	2462587V22	CHIP IND 8.2 NH 5% 0805
L5309	2413926N09	IND CER CHIP 5.6 NH +/- 0.3 NH
L5380	2462587V23	CHIP IND 12 NH 5% 0805
L5381	2462587V22	CHIP IND 8.2 NH 5% 0805
L5384	2462587V22	CHIP IND 8.2 NH 5% 0805
L5385	2413926N11	IND CER CHIP 8.2 NH 5%
L5386	2413926N10	IND CER CHIP 6.8 NH 5%
L5387	2413926N10	IND CER CHIP 6.8 NH 5%
L5388	2462587V32	CHIP IND 68 NH 5% 0805
L5389	2413926N11	IND CER CHIP 8.2 NH 5%
L5390	2462587V32	CHIP IND 68 NH 5% 0805

Reference Designator	Motorola Part Number	Description
L5400	2462587V59	IND CHIP 390 NH 5%
L5401	2462587V59	IND CHIP 390 NH 5%
L5402	2462587V59	IND CHIP 390 NH 5%
L5403	2462587V59	IND CHIP 390 NH 5%
L5404	2462587V52	IND CHIP 270NH 5 %
L5406	2462587V38	CHIP IND 220 NH 5% 0805
L5407	2462587V38	CHIP IND 220 NH 5% 0805
L5408	2462587N68	CHIP IND 1000 NH 5%
L5411	2462587V38	CHIP IND 220 NH 5% 0805
L5501	2462587V25	CHIP IND 18 NH 5% 0805
L5502	2462587V59	IND CHIP 390 NH 5%
L5503	2462587V22	CHIP IND 8.2 NH 5% 0805
L5504	2462587V38	CHIP IND 220 NH 5% 0805
L5505	2462587V59	IND CHIP 390 NH 5%
L5506	2462587V25	CHIP IND 18 NH 5% 0805
L5507	2462587V25	CHIP IND 18 NH 5% 0805
L5508	2484562T04	COIL SURFACE MOUNT AIR WOUND
L5510	2460592A01	COIL AW 2 TURN 17 NH
L5701	2462587N61	CHIP IND 470 NH 5%
L5702	2462587N55	CHIP IND 150 NH 5%
L5703	2460592A01	COIL AW 2 TURN 17 NH
L5704	2460592A01	COIL AW 2 TURN 17 NH
L5705	2462587N61	CHIP IND 470 NH 5%
L5706	2460592A01	COIL AW 2 TURN 17 NH
L5707	2460592A01	COIL AW 2 TURN 17 NH
L5708	2460592A01	COIL AW 2 TURN 17 NH
L5712	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5713	2484562T02	COIL SURFACE MOUNT AIR WOUND
L5750	2462587Q44	IND CHIP 560 NH 10%
L5751	2462587Q44	IND CHIP 560 NH 10%
L5752	2462587Q20	IND CHIP 2,200 NH 20%
L5753	2462587N68	CHIP IND 1000 NH 5%
L5754	2462587Q20	IND CHIP 2,200 NH 20%
L5755	2462587Q20	IND CHIP 2,200 NH 20%
L5756	2462587Q20	IND CHIP 2,200 NH 20%
L5757	2413926H12	IND CHIP 10.0 NH 5%
L5758	2462587T30	IND CHIP 1000NH 5% LOW PRO
L5759	2413926H11	IND CHIP 8.2 NH 5%

Reference Designator	Motorola Part Number	Description
L5760	2462587P25	CHIP IND 12000 NH 5%
L5825	2462587V41	IND CHIP 390 NH 10%
L5826	2462587V59	IND CHIP 390 NH 5%
L5827	2462587V59	IND CHIP 390 NH 5%
L5828	2462587V29	CHIP IND 39 NH 5% 0805
L5829	2413926N29	IND CER CHIP 270.0 NH 5%
L5830	2413926N29	IND CER CHIP 270.0 NH 5%
L5831	2413926N27	IND CER CHIP 180.0 NH 5%
L5832	2413926N27	IND CER CHIP 180.0 NH 5%
L5833	2413926N28	IND CER CHIP 220.0 NH 5%
L5834	2413926N27	IND CER CHIP 180.0 NH 5%
L5835	2413926N15	IND CER CHIP 18.0 NH 5%
L5900	2413926N26	IND CER CHIP 150.0 NH 5%
L5901	2462587V40	IND CHIP 330 NH 10%
L5902	2462587T37	IND CHIP 18NH 5% LOW PRO
L5904	2462587V40	IND CHIP 330 NH 10%
L5905	2462587V40	IND CHIP 330 NH 10%
L5906	2413926N26	IND CER CHIP 150.0 NH 5%
L5907	2413926N26	IND CER CHIP 150.0 NH 5%
L5908	2462587V40	IND CHIP 330 NH 10%
L5909	2462587T37	IND CHIP 18NH 5% LOW PRO
L5910	2462587V40	IND CHIP 330 NH 10%
L5911	2462587T37	IND CHIP 18NH 5% LOW PRO
L5912	2462587V40	IND CHIP 330 NH 10%
L5913	2462587V40	IND CHIP 330 NH 10%
L5914	2462587V40	IND CHIP 330 NH 10%
L5915	2462587V40	IND CHIP 330 NH 10%
L5916	2413926N26	IND CER CHIP 150.0 NH 5%
L5917	2413926N14	IND CER CHIP 15.0 NH 5%
L5918	2413926N10	IND CER CHIP 6.8 NH 5%
L5919	2413926N12	IND CER CHIP 10.0 NH 5%
L5922	2413926N28	IND CER CHIP 220.0 NH 5%
M5501	2685838C01	HEATSINK PLD1.5 TRANSISTOR ASSY
M5502	2664487H01	ASSY,HEATSINK/ TRANSISTOR,,,HT SINK
PCB	8485912F01	PCB MILL UHF R2
Q0101	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0102	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0200	4880048M01	TSTR NPN DIG 47K/47K

Reference Designator	Motorola Part Number	Description
Q0400	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0402	4880048M01	TSTR NPN DIG 47K/47K
Q0403	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0404	4880048M01	TSTR NPN DIG 47K/47K
Q0500	4880048M01	TSTR NPN DIG 47K/47K
Q0501	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0502	4880048M01	TSTR NPN DIG 47K/47K
Q0503	4813821A09	TSTR P-CH 60V 12A _2955_
Q0504	4880048M01	TSTR NPN DIG 47K/47K
Q0505	4880048M01	TSTR NPN DIG 47K/47K
Q0506	4880048M01	TSTR NPN DIG 47K/47K
Q0507	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0508	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0610	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0611	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0612	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0613	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0951	4880048M01	TSTR NPN DIG 47K/47K
Q0952	4885844C01	XSTR FET
Q0954	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q0955	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q0956	4880048M01	TSTR NPN DIG 47K/47K
Q0960	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q5001	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5002	4805218N63	RF TRANS SOT 323 Bfq67W
Q5003	4805218N63	RF TRANS SOT 323 Bfq67W
Q5250	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5251	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5252	4805218N63	RF TRANS SOT 323 Bfq67W

Reference Designator	Motorola Part Number	Description
Q5253	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q5255	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5256	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q5257	4880048M01	TSTR NPN DIG 47K/47K
Q5258	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q5401	4805218N55	TRANSISTOR 3 LEAD BFQ67
Q5402	4880048M01	TSTR NPN DIG 47K/47K
Q5501	4805218N63	RF TRANS SOT 323 BFQ67W
Q5502	4813976A03	TSTR, 450 MHZ, 8W, 7.5V, PLD 1.5
Q5503	4813976A06	TSTR, UHF 70 W, 12.5 V LD MOS
Q5570	4880048M01	TSTR NPN DIG 47K/47K
Q5706	4805921T04	XISTOR FMC1 RH REELED
Q5707	4805921T04	XISTOR FMC1 RH REELED
Q5708	4805921T04	XISTOR FMC1 RH REELED
Q5709	4805921T04	XISTOR FMC1 RH REELED
Q5710	4805921T04	XISTOR FMC1 RH REELED
Q5750	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5751	4813824A10	TSTR NPN 40V .2A GEN PURP
Q5752	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q5755	4805218N63	RF TRANS SOT 323 BFQ67W
Q5825	4805218N63	RF TRANS SOT 323 BFQ67W
Q5826	4805218N63	RF TRANS SOT 323 BFQ67W
Q5828	4805218N63	RF TRANS SOT 323 BFQ67W
Q5829	4805218N63	RF TRANS SOT 323 BFQ67W
Q5901	4805793Y10	XSTR,BIP RF SMALL SIGNAL,SLCN,NPN,N
Q5902	4805218N63	RF TRANS SOT 323 BFQ67W
Q5903	4805793Y10	XSTR,BIP RF SMALL SIGNAL,SLCN,NPN,N
Q5904	4805218N63	RF TRANS SOT 323 BFQ67W
Q5905	4805793Y10	XSTR,BIP RF SMALL SIGNAL,SLCN,NPN,N
Q5906	4805218N63	RF TRANS SOT 323 BFQ67W
R0101	0662057M98	RES. CHIP 10K 5% 20X40
R0102	0662057M98	RES. CHIP 10K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0104	0662057M98	RES. CHIP 10K 5% 20X40
R0105	0662057M98	RES. CHIP 10K 5% 20X40
R0106	0662057M98	RES. CHIP 10K 5% 20X40
R0107	0662057M01	RES. CHIP 0 5% 20X40
R0109	0662057M98	RES. CHIP 10K 5% 20X40
R0110	0662057M98	RES. CHIP 10K 5% 20X40
R0111	0662057M86	RES. CHIP 3300 5% 20X40
R0114	0662057M01	RES. CHIP 0 5% 20X40
R0116	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R0117	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R0119	0662057N39	RES. CHIP 470K 5% 20X40
R0120	0662057M98	RES. CHIP 10K 5% 20X40
R0121	0662057M98	RES. CHIP 10K 5% 20X40
R0122	0662057M82	RES. CHIP 2200 5% 20X40
R0125	0662057M98	RES. CHIP 10K 5% 20X40
R0126	0662057M01	RES. CHIP 0 5% 20X40
R0128	0662057M50	RES. CHIP 100 5% 20X40
R0129	0662057M98	RES. CHIP 10K 5% 20X40
R0130	0662057M98	RES. CHIP 10K 5% 20X40
R0200	0662057M74	RES. CHIP 1000 5% 20X40
R0201	0662057M01	RES. CHIP 0 5% 20X40
R0204	0662057M68	RES. CHIP 560 5% 20X40
R0205	0662057N09	RES. CHIP 27K 5% 20X40
R0208	0662057N23	RES. CHIP 100K 5% 20X40
R0209	0662057N07	RES. CHIP 22K 5% 20X40
R0210	0662057N23	RES. CHIP 100K 5% 20X40
R0212	0662057N23	RES. CHIP 100K 5% 20X40
R0213	0662057M50	RES. CHIP 100 5% 20X40
R0215	0662057M98	RES. CHIP 10K 5% 20X40
R0216	0662057N23	RES. CHIP 100K 5% 20X40
R0218	0662057M74	RES. CHIP 1000 5% 20X40
R0219	0662057M74	RES. CHIP 1000 5% 20X40
R0220	0662057N05	RES. CHIP 18K 5% 20X40
R0221	0662057M98	RES. CHIP 10K 5% 20X40
R0222	0662057M98	RES. CHIP 10K 5% 20X40
R0224	0662057M01	RES. CHIP 0 5% 20X40
R0225	0662057M98	RES. CHIP 10K 5% 20X40
R0227	0662057N19	RES. CHIP 68K 5% 20X40
R0228	0662057N11	RES. CHIP 33K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0229	0662057N19	RES. CHIP 68K 5% 20X40
R0230	0662057N11	RES. CHIP 33K 5% 20X40
R0231	0662057C13	CHIP RES 2.7 OHMS 5%
R0235	0662057M74	RES. CHIP 1000 5% 20X40
R0236	0662057M97	RES. CHIP 9100 5% 20X40
R0300	0662057M50	RES. CHIP 100 5% 20X40
R0301	0662057M50	RES. CHIP 100 5% 20X40
R0303	0662057M78	RES. CHIP 1500 5% 20X40
R0304	0662057M34	RES. CHIP 22 5% 20X40
R0305	0662057M34	RES. CHIP 22 5% 20X40
R0307	0662057M98	RES. CHIP 10K 5% 20X40
R0310	0662057M34	RES. CHIP 22 5% 20X40
R0403	0662057M98	RES. CHIP 10K 5% 20X40
R0404	0662057M74	RES. CHIP 1000 5% 20X40
R0405	0662057M74	RES. CHIP 1000 5% 20X40
R0406	0662057M68	RES. CHIP 560 5% 20X40
R0407	0662057M50	RES. CHIP 100 5% 20X40
R0408	0662057M50	RES. CHIP 100 5% 20X40
R0409	0662057M98	RES. CHIP 10K 5% 20X40
R0410	0662057M50	RES. CHIP 100 5% 20X40
R0411	0662057M98	RES. CHIP 10K 5% 20X40
R0412	0662057M50	RES. CHIP 100 5% 20X40
R0415	0662057M50	RES. CHIP 100 5% 20X40
R0416	0662057M50	RES. CHIP 100 5% 20X40
R0417	0662057M50	RES. CHIP 100 5% 20X40
R0418	0662057M50	RES. CHIP 100 5% 20X40
R0419	0662057M90	RES. CHIP 4700 5% 20X40
R0420	0662057M98	RES. CHIP 10K 5% 20X40
R0421	0662057M01	RES. CHIP 0 5% 20X40
R0422	0662057V15	RES CHIP 33K 1% 1/16W
R0425	0662057M98	RES. CHIP 10K 5% 20X40
R0430	0662057M01	RES. CHIP 0 5% 20X40
R0431	0662057M98	RES. CHIP 10K 5% 20X40
R0432	0662057M50	RES. CHIP 100 5% 20X40
R0435	0662057M74	RES. CHIP 1000 5% 20X40
R0500	0662057N23	RES. CHIP 100K 5% 20X40
R0502	0662057N37	RES. CHIP 390K 5% 20X40
R0503	0662057B47	CHIP RES 0 OHMS +-.050 OHMS
R0504	0662057N23	RES. CHIP 100K 5% 20X40
R0505	0662057M98	RES. CHIP 10K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0506	0662057M98	RES. CHIP 10K 5% 20X40
R0507	0662057M98	RES. CHIP 10K 5% 20X40
R0508	0662057M86	RES. CHIP 3300 5% 20X40
R0509	0662057M74	RES. CHIP 1000 5% 20X40
R0510	0662057V18	RES CHIP 43K 1% 1/16W
R0511	0662057V15	RES CHIP 33K 1% 1/16W
R0512	0662057V02	RES CHIP 10K 1% 1/16W
R0513	0662057V17	RES CHIP 39K 1% 1/16W
R0514	0662057M01	RES. CHIP 0 5% 20X40
R0515	0662057M74	RES. CHIP 1000 5% 20X40
R0516	0662057N23	RES. CHIP 100K 5% 20X40
R0517	0662057M90	RES. CHIP 4700 5% 20X40
R0518	0662057M98	RES. CHIP 10K 5% 20X40
R0519	0662057C27	CHIP RES 10 OHMS 5%
R0520	0662057N15	RES. CHIP 47K 5% 20X40
R0521	0662057V17	RES CHIP 39K 1% 1/16W
R0522	0662057V10	RES CHIP 20K 1% 1/16W
R0523	0662057N23	RES. CHIP 100K 5% 20X40
R0525	0662057M50	RES. CHIP 100 5% 20X40
R0526	0662057M50	RES. CHIP 100 5% 20X40
R0528	0662057M95	RES. CHIP 7500 5% 20X40
R0529	0662057M76	RES. CHIP 1200 5% 20X40
R0530	0662057N35	RES. CHIP 330K 5% 20X40
R0531	0662057N23	RES. CHIP 100K 5% 20X40
R0532	0662057M86	RES. CHIP 3300 5% 20X40
R0620	0662057M50	RES. CHIP 100 5% 20X40
R0621	0662057M50	RES. CHIP 100 5% 20X40
R0622	0662057M50	RES. CHIP 100 5% 20X40
R0623	0662057M50	RES. CHIP 100 5% 20X40
R0624	0662057M50	RES. CHIP 100 5% 20X40
R0625	0662057M98	RES. CHIP 10K 5% 20X40
R0626	0662057N23	RES. CHIP 100K 5% 20X40
R0627	0662057N23	RES. CHIP 100K 5% 20X40
R0628	0662057N23	RES. CHIP 100K 5% 20X40
R0629	0662057M98	RES. CHIP 10K 5% 20X40
R0630	0662057N23	RES. CHIP 100K 5% 20X40
R0631	0662057M01	RES. CHIP 0 5% 20X40
R0634	0662057N23	RES. CHIP 100K 5% 20X40
R0635	0662057N23	RES. CHIP 100K 5% 20X40
R0636	0662057M98	RES. CHIP 10K 5% 20X40
R0639	0662057M98	RES. CHIP 10K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0739	0662057M50	RES. CHIP 100 5% 20X40
R0901	0662057M96	RES. CHIP 8200 5% 20X40
R0902	0662057N23	RES. CHIP 100K 5% 20X40
R0903	0662057N23	RES. CHIP 100K 5% 20X40
R0904	0662057N23	RES. CHIP 100K 5% 20X40
R0905	0662057N23	RES. CHIP 100K 5% 20X40
R0906	0662057M50	RES. CHIP 100 5% 20X40
R0908	0662057C13	CHIP RES 2.7 OHMS 5%
R0910	0662057V25	RES CHIP 82K 1% 1/16W
R0911	0662057V04	RES CHIP 12K 1% 1/16W
R0912	0662057V04	RES CHIP 12K 1% 1/16W
R0913	0662057V30	RES CHIP 130K 1% 1/16W
R0914	0662057V04	RES CHIP 12K 1% 1/16W
R0915	0662057M74	RES. CHIP 1000 5% 20X40
R0917	0662057M01	RES. CHIP 0 5% 20X40
R0923	0662057M50	RES. CHIP 100 5% 20X40
R0924	0662057M50	RES. CHIP 100 5% 20X40
R0930	0662057N06	RES. CHIP 20K 5% 20X40
R0931	0662057M98	RES. CHIP 10K 5% 20X40
R0932	0662057M01	RES. CHIP 0 5% 20X40
R0934	0662057M74	RES. CHIP 1000 5% 20X40
R0935	0662057M01	RES. CHIP 0 5% 20X40
R0936	0662057M01	RES. CHIP 0 5% 20X40
R0938	0662057M01	RES. CHIP 0 5% 20X40
R0940	0662057M01	RES. CHIP 0 5% 20X40
R0942	0662057M96	RES. CHIP 8200 5% 20X40
R0943	0662057N03	RES. CHIP 15K 5% 20X40
R0944	0662057M98	RES. CHIP 10K 5% 20X40
R0945	0662057N11	RES. CHIP 33K 5% 20X40
R0947	0662057V02	RES CHIP 10K 1% 1/16W
R0949	0662057V02	RES CHIP 10K 1% 1/16W
R0950	0662057M01	RES. CHIP 0 5% 20X40
R0951	0662057U98	RES CHIP 7.5K 1% 1/16W
R0952	0662057U78	RES CHIP 1.2K 1% 1/16W
R0953	0662057M01	RES. CHIP 0 5% 20X40
R0954	0662057U98	RES CHIP 7.5K 1% 1/16W
R0955	0662057N23	RES. CHIP 100K 5% 20X40
R0956	0662057V04	RES CHIP 12K 1% 1/16W
R0957	0662057V02	RES CHIP 10K 1% 1/16W
R0959	0662057V02	RES CHIP 10K 1% 1/16W
R0960	0662057N06	RES. CHIP 20K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0961	0662057N23	RES. CHIP 100K 5% 20X40
R0962	0662057N23	RES. CHIP 100K 5% 20X40
R0963	0662057N08	RES. CHIP 24K 5% 20X40
R0964	0662057N08	RES. CHIP 24K 5% 20X40
R0965	0662057M01	RES. CHIP 0 5% 20X40
R0966	0662057M01	RES. CHIP 0 5% 20X40
R0967	0662057V27	RES CHIP 100K 1% 1/16W
R0968	0662057V02	RES CHIP 10K 1% 1/16W
R0971	0662057V07	RES CHIP 15K 1% 1/16W
R0972	0662057U93	RES CHIP 4.7K 1% 1/16W
R0973	0662057N17	RES. CHIP 56K 5% 20X40
R0974	0662057V02	RES CHIP 10K 1% 1/16W
R0975	0662057V02	RES CHIP 10K 1% 1/16W
R0976	0662057M74	RES. CHIP 1000 5% 20X40
R0977	0662057M50	RES. CHIP 100 5% 20X40
R0978	0662057M98	RES. CHIP 10K 5% 20X40
R0979	0662057M01	RES. CHIP 0 5% 20X40
R0981	0662057M84	RES. CHIP 2700 5% 20X40
R0982	0662057N23	RES. CHIP 100K 5% 20X40
R0983	0662057M74	RES. CHIP 1000 5% 20X40
R0984	0662057M01	RES. CHIP 0 5% 20X40
R0985	0662057M01	RES. CHIP 0 5% 20X40
R0987	0662057M01	RES. CHIP 0 5% 20X40
R0988	0662057M98	RES. CHIP 10K 5% 20X40
R0989	0662057N17	RES. CHIP 56K 5% 20X40
R0990	0662057M91	RES. CHIP 5100 5% 20X40
R0991	0662057M98	RES. CHIP 10K 5% 20X40
R0992	0662057V27	RES CHIP 100K 1% 1/16W
R0993	0662057U78	RES CHIP 1.2K 1% 1/16W
R0994	0662057M88	RES. CHIP 3900 5% 20X40
R0995	0662057U78	RES CHIP 1.2K 1% 1/16W
R0996	0662057M98	RES. CHIP 10K 5% 20X40
R0997	0662057U78	RES CHIP 1.2K 1% 1/16W
R0998	0662057V02	RES CHIP 10K 1% 1/16W
R0999	0662057V02	RES CHIP 10K 1% 1/16W
R5000	0662057M43	RES CHIP 51 5 20X40
R5001	0662057M01	RES. CHIP 0 5% 20X40
R5002	0662057M66	RES. CHIP 470 5% 20X40
R5003	0662057N23	RES. CHIP 100K 5% 20X40
R5005	0662057M98	RES. CHIP 10K 5% 20X40
R5006	0662057M62	RES. CHIP 330 5% 20X40

Reference Designator	Motorola Part Number	Description
R5010	0662057N05	RES. CHIP 18K 5% 20X40
R5011	0662057N03	RES. CHIP 15K 5% 20X40
R5013	0662057M70	RES. CHIP 680 5% 20X40
R5014	0662057M01	RES. CHIP 0 5% 20X40
R5015	0662057M01	RES. CHIP 0 5% 20X40
R5016	0662057M01	RES. CHIP 0 5% 20X40
R5017	0662057M01	RES. CHIP 0 5% 20X40
R5018	0662057M01	RES. CHIP 0 5% 20X40
R5019	0662057M01	RES. CHIP 0 5% 20X40
R5020	0662057M98	RES. CHIP 10K 5% 20X40
R5022	0662057M60	RES. CHIP 270 5% 20X40
R5023	0662057N30	RES. CHIP 200K 5% 20X40
R5025	0662057M74	RES. CHIP 1000 5% 20X40
R5026	0662057M34	RES. CHIP 22 5% 20X40
R5027	0662057M50	RES. CHIP 100 5% 20X40
R5028	0662057M94	RES. CHIP 6800 5% 20X40
R5029	0662057N06	RES. CHIP 20K 5% 20X40
R5030	0662057N11	RES. CHIP 33K 5% 20X40
R5031	0662057M66	RES. CHIP 470 5% 20X40
R5032	0662057M76	RES. CHIP 1200 5% 20X40
R5034	0662057M01	RES. CHIP 0 5% 20X40
R5050	0662057M36	RES. CHIP 27 5% 20X40
R5051	0662057M49	RES. CHIP 91 5% 20X40
R5250	0662057N15	RES. CHIP 47K 5% 20X40
R5251	0662057N15	RES. CHIP 47K 5% 20X40
R5252	0662057M74	RES. CHIP 1000 5% 20X40
R5253	0662057N15	RES. CHIP 47K 5% 20X40
R5254	0662057N15	RES. CHIP 47K 5% 20X40
R5255	0662057M74	RES. CHIP 1000 5% 20X40
R5256	0662057M90	RES. CHIP 4700 5% 20X40
R5300	0662057M90	RES. CHIP 4700 5% 20X40
R5301	0662057M98	RES. CHIP 10K 5% 20X40
R5302	0662057C75	CHIP RES 1000 OHMS 5%
R5303	0662057M90	RES. CHIP 4700 5% 20X40
R5304	0662057M74	RES. CHIP 1000 5% 20X40
R5305	0662057M90	RES. CHIP 4700 5% 20X40
R5306	0662057N01	RES CHIP 12K 5% 20X40
R5308	0662057M46	RES. CHIP 68 5% 20X40
R5309	0662057M36	RES. CHIP 27 5% 20X40
R5310	0662057C75	CHIP RES 1000 OHMS 5%
R5311	0662057M98	RES. CHIP 10K 5% 20X40

Reference Designator	Motorola Part Number	Description
R5313	0662057M90	RES. CHIP 4700 5% 20X40
R5315	0662057M74	RES. CHIP 1000 5% 20X40
R5317	0662057M74	RES. CHIP 1000 5% 20X40
R5319	0662057M66	RES. CHIP 470 5% 20X40
R5322	0662057M83	RES. CHIP 2400 5% 20X40
R5323	0662057N03	RES. CHIP 15K 5% 20X40
R5324	0662057C31	CHIP RES 15 OHMS 5%
R5325	0662057C31	CHIP RES 15 OHMS 5%
R5326	0662057C31	CHIP RES 15 OHMS 5%
R5327	0662057M56	RES. CHIP 180 5% 20X40
R5330	0662057M42	RES. CHIP 47 5% 20X40
R5332	0662057M78	RES. CHIP 1500 5% 20X40
R5333	0662057M42	RES. CHIP 47 5% 20X40
R5334	0662057M78	RES. CHIP 1500 5% 20X40
R5337	0662057N07	RES. CHIP 22K 5% 20X40
R5381	0662057M01	RES. CHIP 0 5% 20X40
R5383	0662057M56	RES. CHIP 180 5% 20X40
R5384	0662057M56	RES. CHIP 180 5% 20X40
R5385	0662057M56	RES. CHIP 180 5% 20X40
R5386	0662057M56	RES. CHIP 180 5% 20X40
R5387	0662057M42	RES. CHIP 47 5% 20X40
R5389	0662057M01	RES. CHIP 0 5% 20X40
R5400	0662057M70	RES. CHIP 680 5% 20X40
R5401	0662057N09	RES. CHIP 27K 5% 20X40
R5402	0662057M94	RES. CHIP 6800 5% 20X40
R5403	0662057M62	RES. CHIP 330 5% 20X40
R5404	0662057M01	RES. CHIP 0 5% 20X40
R5405	0662057M98	RES. CHIP 10K 5% 20X40
R5406	0662057M74	RES. CHIP 1000 5% 20X40
R5408	0662057M96	RES. CHIP 8200 5% 20X40
R5412	0662057M01	RES. CHIP 0 5% 20X40
R5414	0662057M01	RES. CHIP 0 5% 20X40
R5415	0662057M01	RES. CHIP 0 5% 20X40
R5501	0662057A29	CHIP RES 150 OHMS 5%
R5502	0662057M94	RES. CHIP 6800 5% 20X40
R5503	0662057M90	RES. CHIP 4700 5% 20X40
R5505	0662057A29	CHIP RES 150 OHMS 5%
R5506	0662057M48	RES. CHIP 82 5% 20X40
R5507	0662057M50	RES. CHIP 100 5% 20X40
R5510	0662057M48	RES. CHIP 82 5% 20X40
R5511	0662057M10	RES. CHIP 2.2 5% 20X40

Reference Designator	Motorola Part Number	Description
R5512	0662057M10	RES. CHIP 2.2 5% 20X40
R5513	0662057M10	RES. CHIP 2.2 5% 20X40
R5514	0662057M10	RES. CHIP 2.2 5% 20X40
R5515	0662057M10	RES. CHIP 2.2 5% 20X40
R5516	0662057C44	CHIP RES 51 OHMS 5%
R5517	0680195M01	RES CHIP 10 OHMS 5% .5W
R5519	0662057N23	RES. CHIP 100K 5% 20X40
R5520	0662057C75	CHIP RES 1000 OHMS 5%
R5521	0662057C75	CHIP RES 1000 OHMS 5%
R5522	0685934D01	RES FIXED CHIP (CURRENT SENOR)
R5523	0680195M01	RES CHIP 10 OHMS 5% .5W
R5524	0680194M13	RES 33 OHMS 5% 1W
R5525	0662057C75	CHIP RES 1000 OHMS 5%
R5526	0662057C75	CHIP RES 1000 OHMS 5%
R5527	0662057C75	CHIP RES 1000 OHMS 5%
R5528	0662057M54	RES. CHIP 150 5% 20X40
R5529	0662057M56	RES. CHIP 180 5% 20X40
R5530	0611077A30	RES CHIP 15 5 1/8W
R5532	0662057C13	CHIP RES 2.7 OHMS 5%
R5533	0611077A30	RES CHIP 15 5 1/8W
R5534	0611077A30	RES CHIP 15 5 1/8W
R5535	0680195M01	RES CHIP 10 OHMS 5% .5W
R5536	0611077A30	RES CHIP 15 5 1/8W
R5538	0611077A30	RES CHIP 15 5 1/8W
R5539	0611077A30	RES CHIP 15 5 1/8W
R5540	0611077A30	RES CHIP 15 5 1/8W
R5541	0611077A30	RES CHIP 15 5 1/8W
R5542	0611077A30	RES CHIP 15 5 1/8W
R5543	0611077A30	RES CHIP 15 5 1/8W
R5544	0611077A30	RES CHIP 15 5 1/8W
R5545	0611077A30	RES CHIP 15 5 1/8W
R5546	0662057N03	RES. CHIP 15K 5% 20X40
R5547	0662057N03	RES. CHIP 15K 5% 20X40
R5548	0662057M81	RES. CHIP 2000 5% 20X40
R5549	0662057N14	RES. CHIP 43K 5% 20X40
R5550	0662057N03	RES. CHIP 15K 5% 20X40
R5551	0662057M81	RES. CHIP 2000 5% 20X40
R5552	0662057N03	RES. CHIP 15K 5% 20X40
R5553	0662057N03	RES. CHIP 15K 5% 20X40
R5554	0662057N14	RES. CHIP 43K 5% 20X40

Reference Designator	Motorola Part Number	Description
R5555	0662057N03	RES. CHIP 15K 5% 20X40
R5556	0662057V18	RES CHIP 43K 1% 1/16W
R5557	0662057M94	RES. CHIP 6800 5% 20X40
R5570	0662057C13	CHIP RES 2.7 OHMS 5%
R5571	0662057N11	RES. CHIP 33K 5% 20X40
R5572	0662057U98	RES CHIP 7.5K 1% 1/16W
R5573	0662057U78	RES CHIP 1.2K 1% 1/16W
R5701	0680194M13	RES 33 OHMS 5% 1W
R5702	0662057A53	CHIP RES 1500 OHMS 5%
R5703	0662057A84	CHIP RES 30K OHMS 5%
R5704	0680149M02	THERMISTOR CHIP 100K OHM
R5705	0662057A35	CHIP RES 270 OHMS 5%
R5706	0662057A35	CHIP RES 270 OHMS 5%
R5707	0662057A35	CHIP RES 270 OHMS 5%
R5708	0662057A35	CHIP RES 270 OHMS 5%
R5709	0662057A53	CHIP RES 1500 OHMS 5%
R5710	0662057A94	CHIP RES 75K OHMS 5%
R5711	0662057A84	CHIP RES 30K OHMS 5%
R5712	0680149M02	THERMISTOR CHIP 100K OHM
R5750	0662057M74	RES. CHIP 1000 5% 20X40
R5751	0662057M98	RES. CHIP 10K 5% 20X40
R5752	0662057N15	RES. CHIP 47K 5% 20X40
R5753	0662057M91	RES. CHIP 5100 5% 20X40
R5754	0662057N15	RES. CHIP 47K 5% 20X40
R5755	0662057M01	RES. CHIP 0 5% 20X40
R5758	0662057M86	RES. CHIP 3300 5% 20X40
R5759	0662057M81	RES. CHIP 2000 5% 20X40
R5761	0662057N23	RES. CHIP 100K 5% 20X40
R5762	0662057N23	RES. CHIP 100K 5% 20X40
R5763	0662057M74	RES. CHIP 1000 5% 20X40
R5764	0662057N15	RES. CHIP 47K 5% 20X40
R5765	0662057M91	RES. CHIP 5100 5% 20X40
R5766	0662057N23	RES. CHIP 100K 5% 20X40
R5767	0662057N15	RES. CHIP 47K 5% 20X40
R5768	0662057M50	RES. CHIP 100 5% 20X40
R5769	0662057M01	RES. CHIP 0 5% 20X40
R5771	0662057M54	RES. CHIP 150 5% 20X40
R5772	0662057M71	RES. CHIP 750 5% 20X40
R5773	0662057M54	RES. CHIP 150 5% 20X40

Reference Designator	Motorola Part Number	Description
R5774	0662057M48	RES. CHIP 82 5% 20X40
R5775	0662057M50	RES. CHIP 100 5% 20X40
R5776	0662057M74	RES. CHIP 1000 5% 20X40
R5777	0662057M74	RES. CHIP 1000 5% 20X40
R5778	0662057M72	RES. CHIP 820 5% 20X40
R5779	0662057N01	RES CHIP 12K 5% 20X40
R5780	0662057M84	RES. CHIP 2700 5% 20X40
R5782	0662057N15	RES. CHIP 47K 5% 20X40
R5783	0662057N15	RES. CHIP 47K 5% 20X40
R5784	0662057N15	RES. CHIP 47K 5% 20X40
R5785	0662057N15	RES. CHIP 47K 5% 20X40
R5786	0662057N15	RES. CHIP 47K 5% 20X40
R5787	0662057N31	RES. CHIP 220K 5% 20X40
R5788	0662057M43	RES CHIP 51 5 20X40
R5825	0662057M84	RES. CHIP 2700 5% 20X40
R5826	0662057M84	RES. CHIP 2700 5% 20X40
R5827	0662057C61	CHIP RES 270 OHMS 5%
R5828	0662057C61	CHIP RES 270 OHMS 5%
R5829	0662057M79	RES. CHIP 1600 5% 20X40
R5830	0662057M81	RES. CHIP 2000 5% 20X40
R5831	0662057M38	RES. CHIP 33 5% 20X40
R5832	0662057M38	RES. CHIP 33 5% 20X40
R5833	0662057M60	RES. CHIP 270 5% 20X40
R5834	0662057M60	RES. CHIP 270 5% 20X40
R5837	0662057M50	RES. CHIP 100 5% 20X40
R5838	0662057M50	RES. CHIP 100 5% 20X40
R5839	0662057M43	RES CHIP 51 5 20X40
R5840	0662057M43	RES CHIP 51 5 20X40
R5841	0662057M50	RES. CHIP 100 5% 20X40
R5842	0662057M50	RES. CHIP 100 5% 20X40
R5843	0662057M58	RES. CHIP 220 5% 20X40
R5845	0662057M84	RES. CHIP 2700 5% 20X40
R5846	0662057N01	RES CHIP 12K 5% 20X40
R5848	0662057M72	RES. CHIP 820 5% 20X40
R5849	0662057M30	RES. CHIP 15 5% 20X40
R5850	0662057M58	RES. CHIP 220 5% 20X40
R5851	0662057M90	RES. CHIP 4700 5% 20X40
R5852	0662057M90	RES. CHIP 4700 5% 20X40
R5853	0662057M66	RES. CHIP 470 5% 20X40
R5854	0662057M63	RES. CHIP 360 5% 20X40
R5900	0662057M81	RES. CHIP 2000 5% 20X40

Reference Designator	Motorola Part Number	Description
R5902	0662057M58	RES. CHIP 220 5% 20X40
R5903	0662057M79	RES. CHIP 1600 5% 20X40
R5904	0662057M60	RES. CHIP 270 5% 20X40
R5905	0662057M50	RES. CHIP 100 5% 20X40
R5909	0662057M47	RES. CHIP 75 5% 20X40
R5910	0662057M38	RES. CHIP 33 5% 20X40
R5911	0662057C67	CHIP RES 470 OHMS 5%
R5912	0662057M79	RES. CHIP 1600 5% 20X40
R5914	0662057M72	RES. CHIP 820 5% 20X40
R5915	0662057M60	RES. CHIP 270 5% 20X40
R5916	0662057M81	RES. CHIP 2000 5% 20X40
R5917	0662057N01	RES CHIP 12K 5% 20X40
R5918	0662057M50	RES. CHIP 100 5% 20X40
R5919	0662057M47	RES. CHIP 75 5% 20X40
R5921	0662057M84	RES. CHIP 2700 5% 20X40
R5922	0662057M38	RES. CHIP 33 5% 20X40
R5923	0662057C67	CHIP RES 470 OHMS 5%
R5924	0662057M79	RES. CHIP 1600 5% 20X40
R5926	0662057M72	RES. CHIP 820 5% 20X40
R5927	0662057M81	RES. CHIP 2000 5% 20X40
R5928	0662057M60	RES. CHIP 270 5% 20X40
R5929	0662057N01	RES CHIP 12K 5% 20X40
R5930	0662057M43	RES CHIP 51 5 20X40
R5931	0662057M47	RES. CHIP 75 5% 20X40
R5932	0662057M47	RES. CHIP 75 5% 20X40
R5933	0662057M84	RES. CHIP 2700 5% 20X40
R5934	0662057M38	RES. CHIP 33 5% 20X40
R5935	0662057C67	CHIP RES 470 OHMS 5%
R5937	0662057M62	RES. CHIP 330 5% 20X40
R5938	0662057M90	RES. CHIP 4700 5% 20X40
R5939	0662057M90	RES. CHIP 4700 5% 20X40
R5940	0662057M63	RES. CHIP 360 5% 20X40
R5941	0662057M58	RES. CHIP 220 5% 20X40
R5942	0662057M50	RES. CHIP 100 5% 20X40
R5948	0662057M47	RES. CHIP 75 5% 20X40
R5949	0662057M30	RES. CHIP 15 5% 20X40
R5950	0662057M58	RES. CHIP 220 5% 20X40
SH5400	2685882A01	SHIELD VCO TANK
T5380	2584600T01	BALUN RF
T5381	2584600T01	BALUN RF

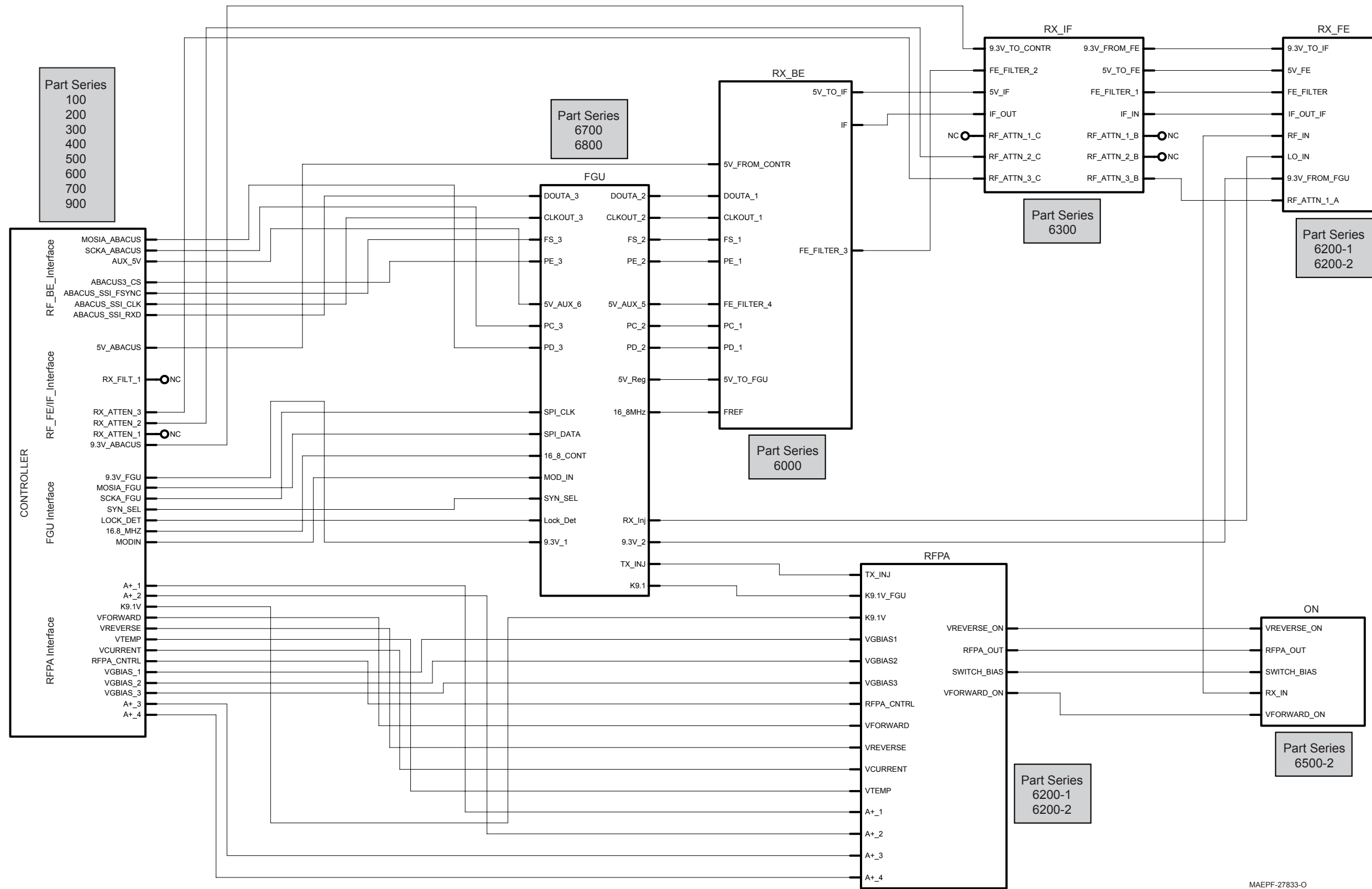
Reference Designator	Motorola Part Number	Description
U0001	0105958T50	XTL5000 DAUGHTER BD W/ BRAVO
U0102	5185623B01	HIGH SPEED CMOS INVERTER
U0103	5113837A15	IC 3.3V QUAD BUFFER
U0104	5113837A15	IC 3.3V QUAD BUFFER
U0105	5113805B78	IC 1 GATE 2 INPUT NAND
U0200	5105109Z38	3 VOLT LINEAR PCM CODEC FILTER
U0201	5113819A14	IC QD OP AMP _33204_
U0202	5185143E67	INTEGRATED CIRCUITS
U0203	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0204	5185794L01	AUDIO AMP TAPE AND REEL
U0206	5185143E67	INTEGRATED CIRCUITS
U0208	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0209	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0210	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0300	5113837A15	IC 3.3V QUAD BUFFER
U0303	5113837A15	IC 3.3V QUAD BUFFER
U0304	5187970L15	IC USB TRANS FULL-SPEED
U0305	5185353D94	IC RS232 TRANSCEIVER
U0307	5113805B78	IC 1 GATE 2 INPUT NAND
U0308	5109522E74	IC 2INPUT AND GATE
U0309	5113805B78	IC 1 GATE 2 INPUT NAND
U0401	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0500	5183308X01	IC, LM2941, TO DRPOUT RGTR
U0501	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0502	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0503	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0504	5185353D46	IF 4.3V VOLTAGE DETECTOR
U0505	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0506	5185143E57	CMOS TIMER-LMC555CM
U0507	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ

Reference Designator	Motorola Part Number	Description
U0601	5113805B78	IC 1 GATE 2 INPUT NAND
U0602	5113837A15	IC 3.3V QUAD BUFFER
U0603	5109522E53	IC,BFR,1BITS,NC7SZ125P5X, ,3 STATE O
U0604	5113818A14	IC DL OP AMP RAIL TO RAIL
U0605	5113805B78	IC 1 GATE 2 INPUT NAND
U0606	5105109Z31	IC QUAD 2:1 MUX/DEMUX
U0607	5109522E74	IC 2INPUT AND GATE
U0608	5109522E74	IC 2INPUT AND GATE
U0609	5113805B78	IC 1 GATE 2 INPUT NAND
U0610	5113805B78	IC 1 GATE 2 INPUT NAND
U0611	5113805B78	IC 1 GATE 2 INPUT NAND
U0900	5185368C83	IC 12 BIT DAC
U0901	5164015H66	IC,CPLD,EEPROM,,,SM,BGA 48,64MC,1500
U0902	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0903	5185143E68	INTEGRATED CIRCUITS
U0904	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0905	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0950	5105625U25	IC 9.3V REG 2941
U0951	5105625U25	IC 9.3V REG 2941
U0952	5185956E99	IC,POT,DUAL 256 TAP DIGITAL 50K SP
U0953	5185143E16	IC ANALOG TO DIGITAL CONVERTER
U0954	5113805B78	IC 1 GATE 2 INPUT NAND
U0955	5113819A14	IC QD OP AMP _33204_
U0956	5185956E24	IC,OP AMP,2PER PKG,RAIL-RAIL,DIFF,,
U0957	5113819A14	IC QD OP AMP _33204_
U0958	5113805B78	IC 1 GATE 2 INPUT NAND
U0959	5185143E05	IC DAC OCTAL 8 BIT
U0960	5113819A14	IC QD OP AMP _33204_
U0962	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U0963	5109522E53	IC,BFR,1BITS,NC7SZ125P5X, ,3 STATE O
U0965	5185143E68	INTEGRATED CIRCUITS
U0967	5185143E68	INTEGRATED CIRCUITS

Reference Designator	Motorola Part Number	Description
U5001	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U5002	5185963A85	IC-ABACUS III-LP
U5300	5185130C83	IC 15DB DIGITAL ATTEUATOR SOT25 PKG
U5301	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U5302	5186258W01	IC GAAS RF GAIN STAGE
U5303	5185130C65	IC VHF/UHF/800 MHZ LDMOS DRIVER

Note: For optimum performance, diodes, transistors and integrated circuits must be ordered by MOTOROLA part numbers.

7.6 HUF4017A (700-800 MHz) Main Board



MAEPF-27833-0

Figure 7-108. HUF4017A Main Board Overall Block Diagram and Interconnections

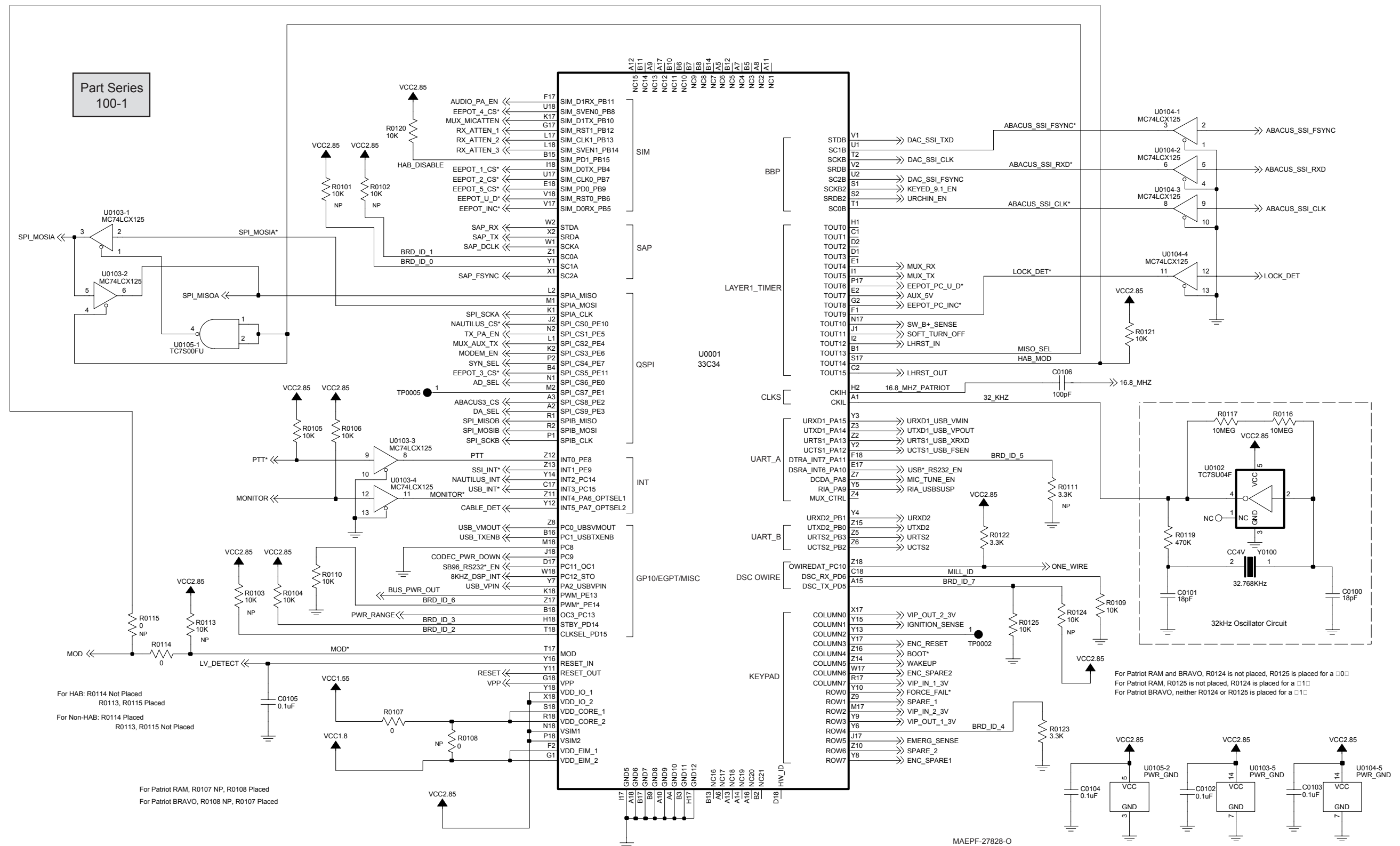


Figure 7-109. HUF4017A Controller Block Diagram and Interconnections (Sheet 1 of 3)

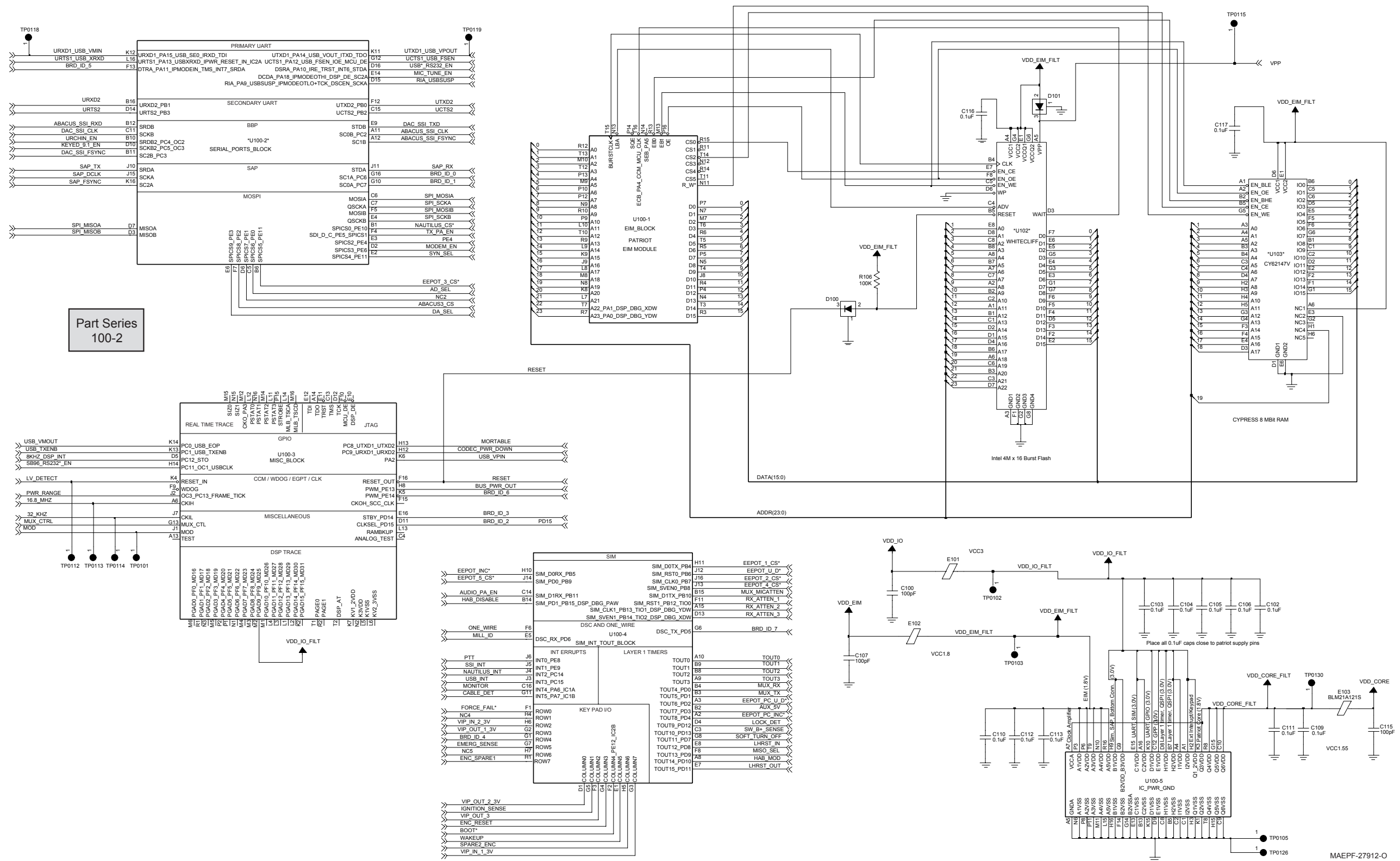
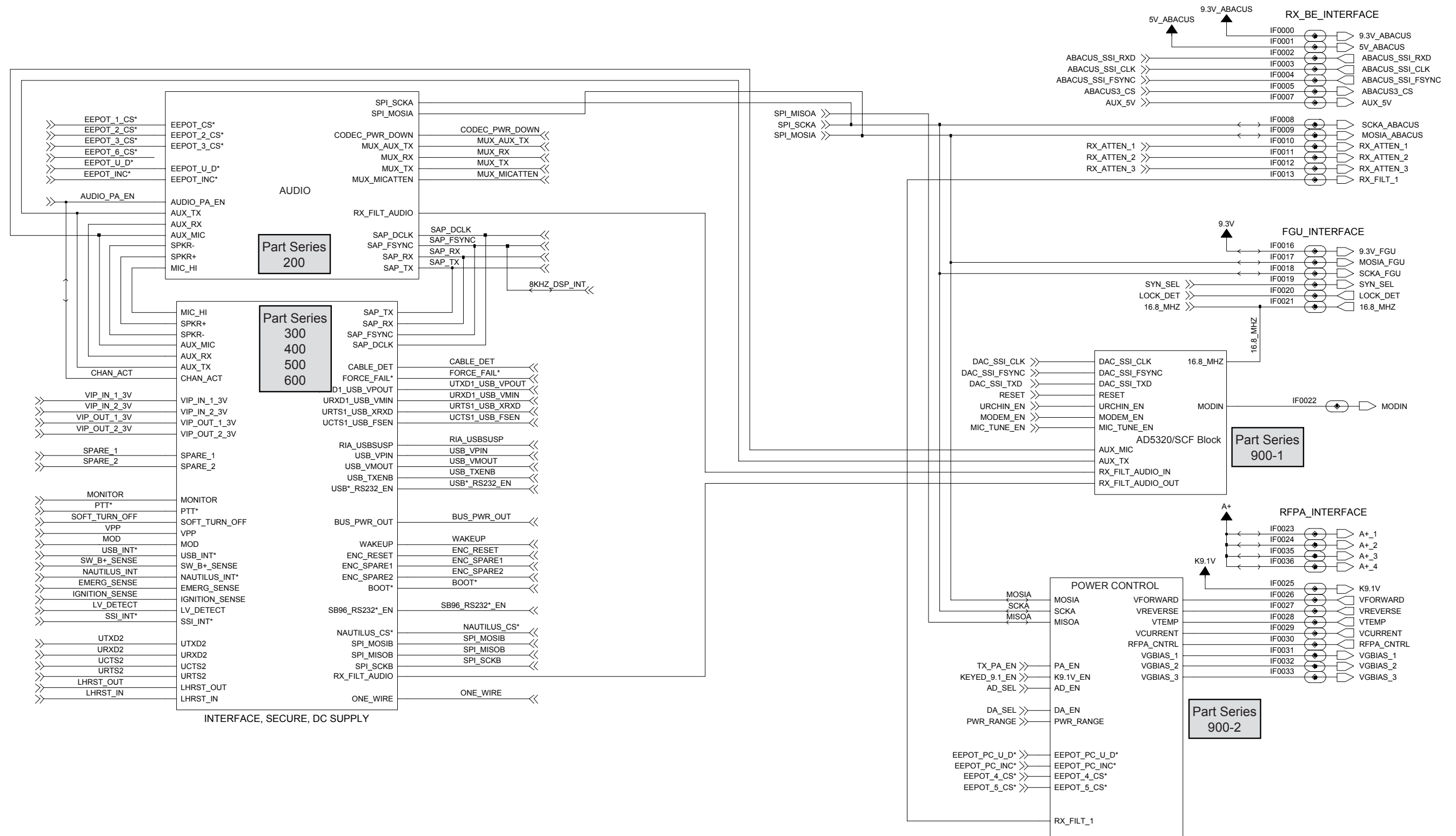
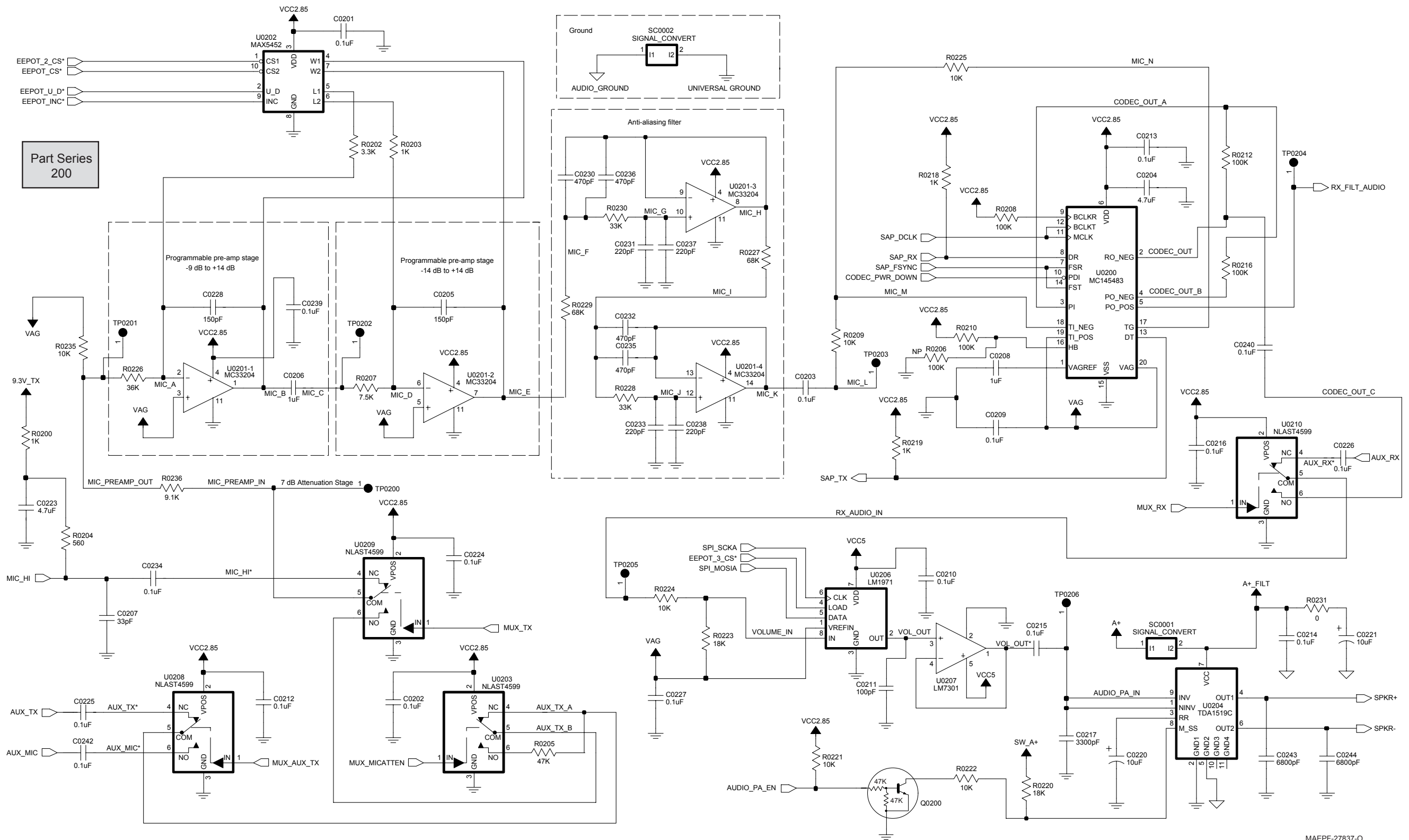


Figure 7-110. HUF4017A Controller Block Diagram and Interconnections (Sheet 2 of 3)



MAEPF-27827-O

Figure 7-111. HUF4017A Controller Block Diagram and Interconnections (Sheet 3 of 3)



MAEPF-27837-O

Figure 7-112. HUF4017A Controller Audio Schematic

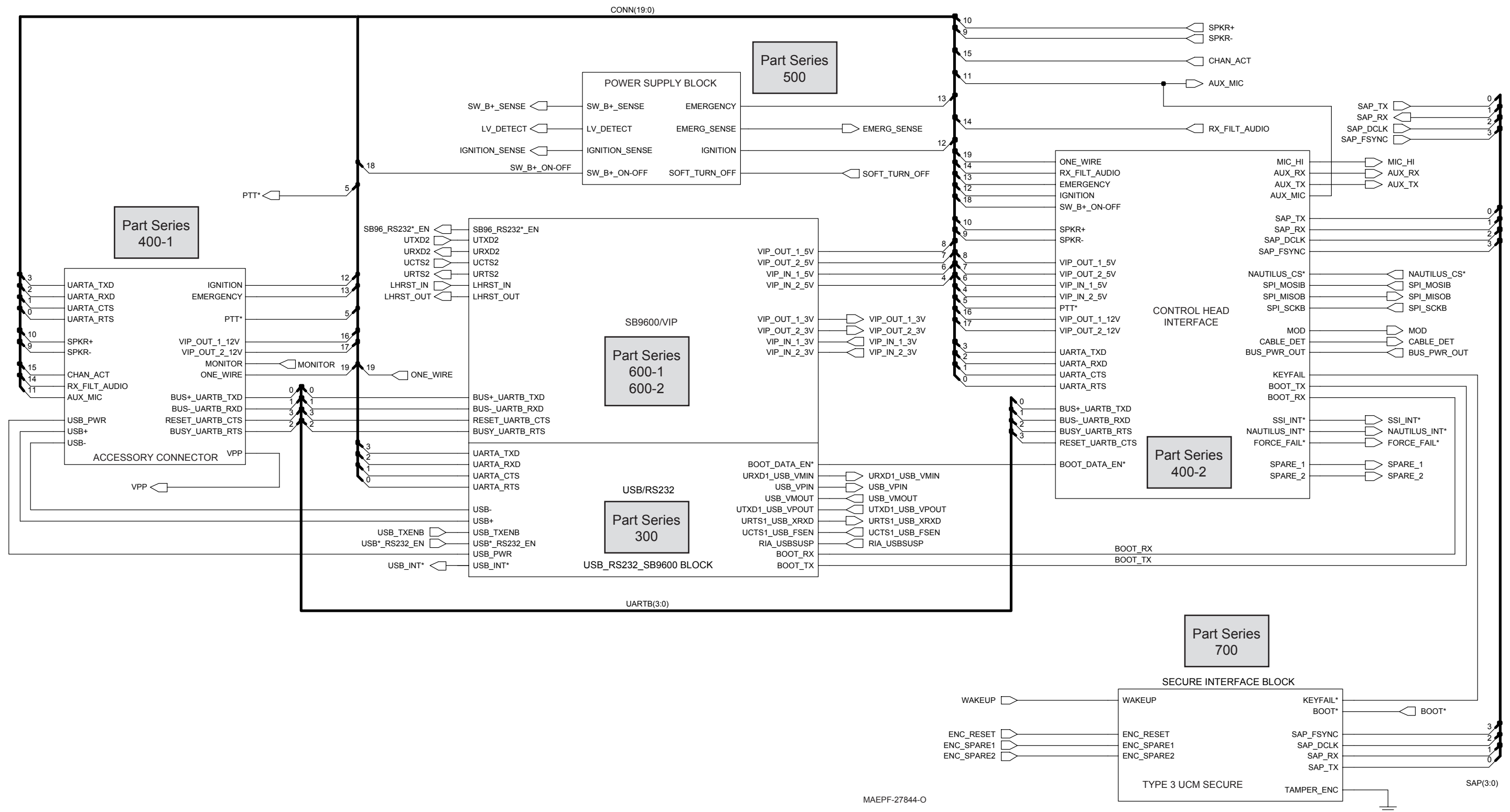


Figure 7-113. HUF4017A Power, Data, Secure, and Front/Rear Connector Block Diagrams

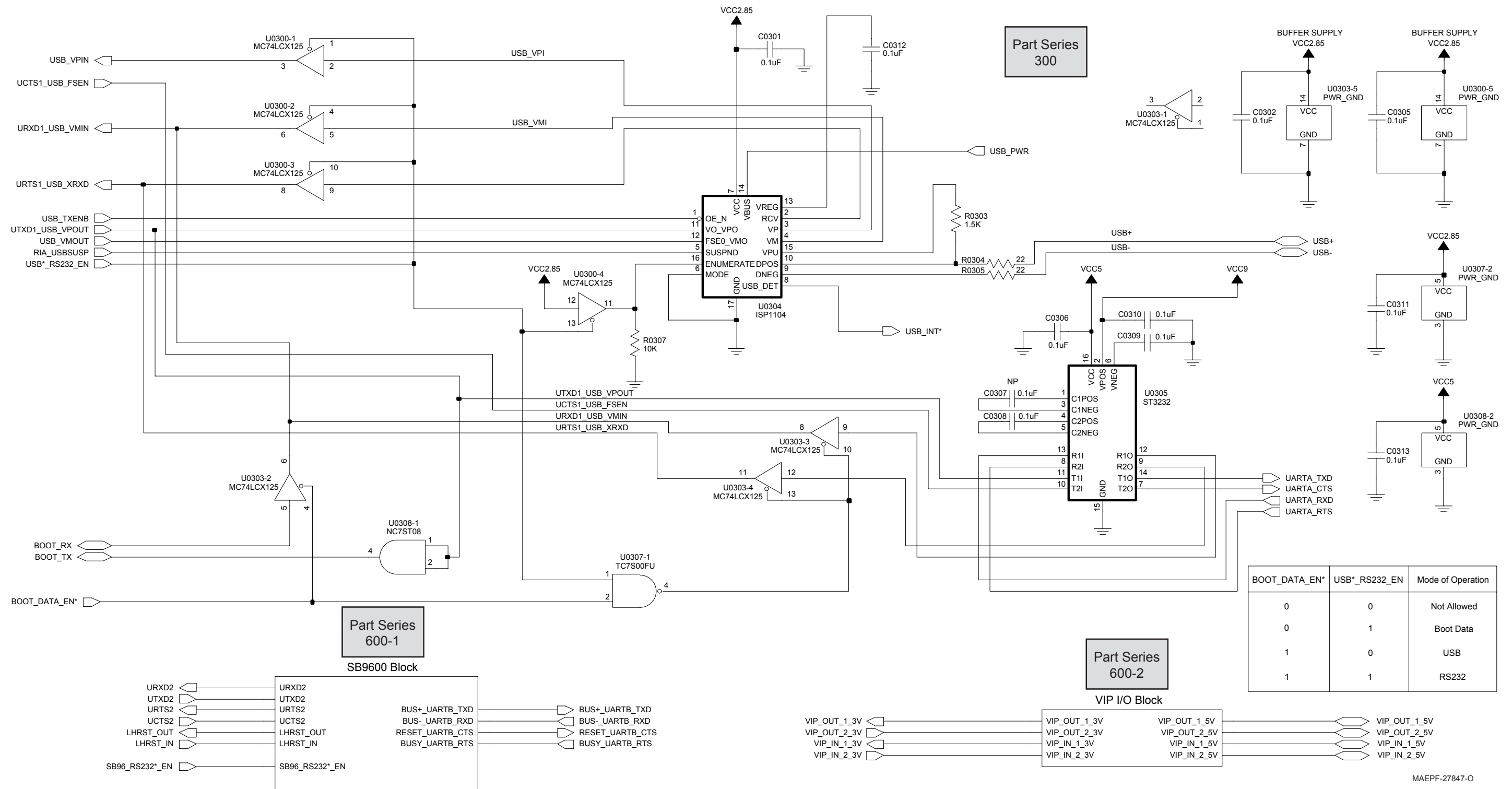
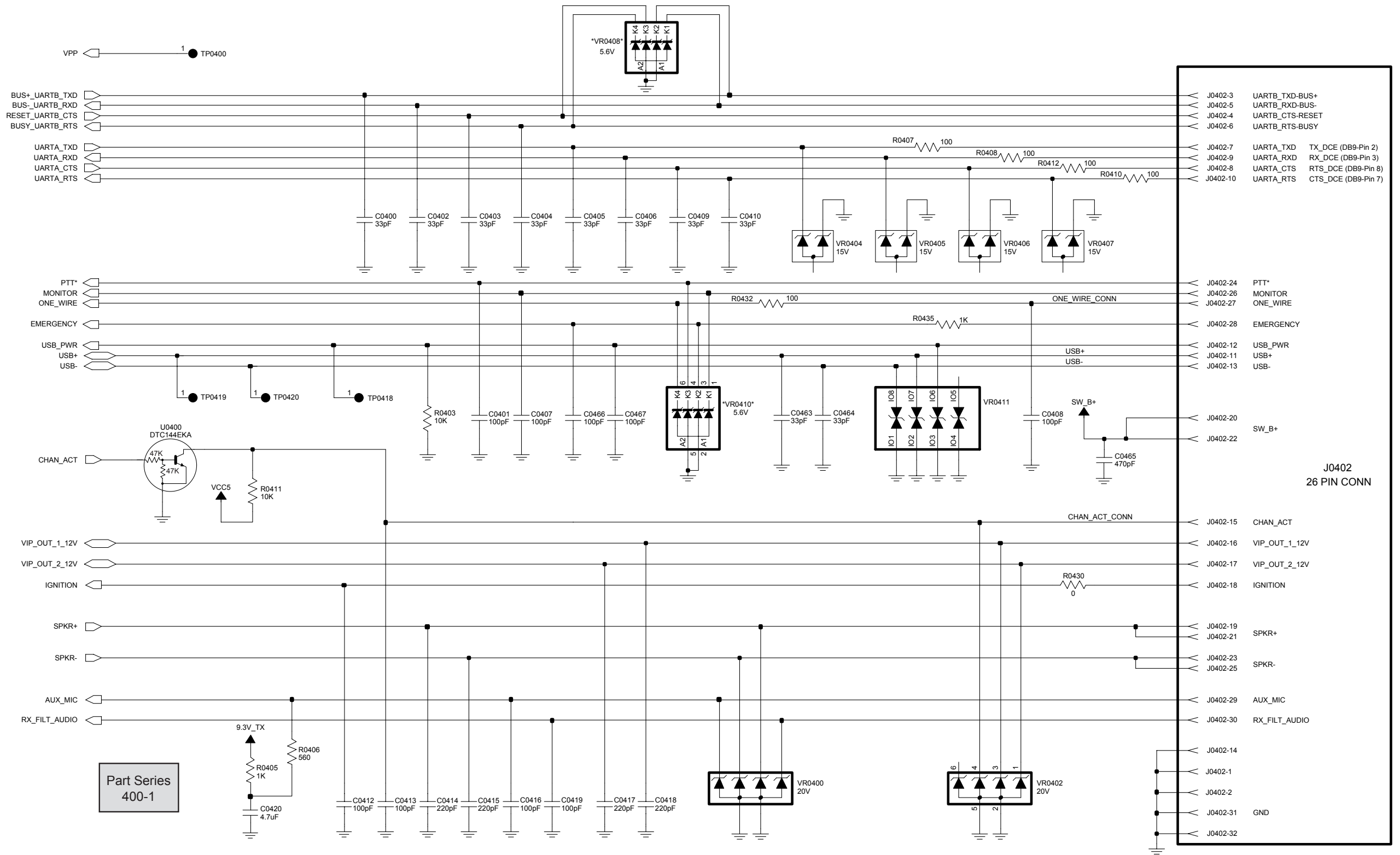


Figure 7-114. HUF4017A USB/RS232/SB9600 Schematic



MAEPF-27842-O

Figure 7-115. Rear Accessory Connector (J0402) Schematic

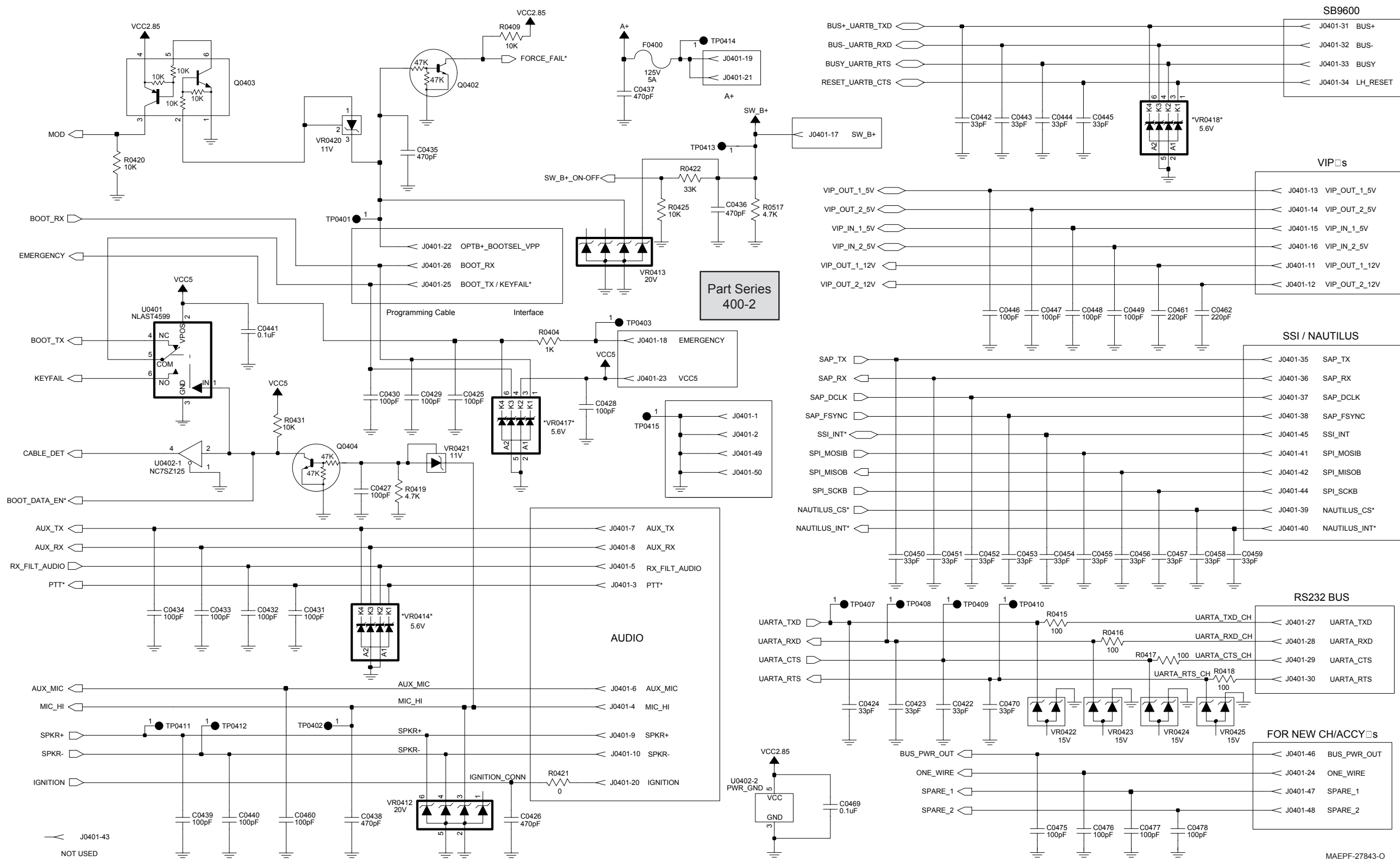


Figure 7-116. Control-Head Front Connector Schematic

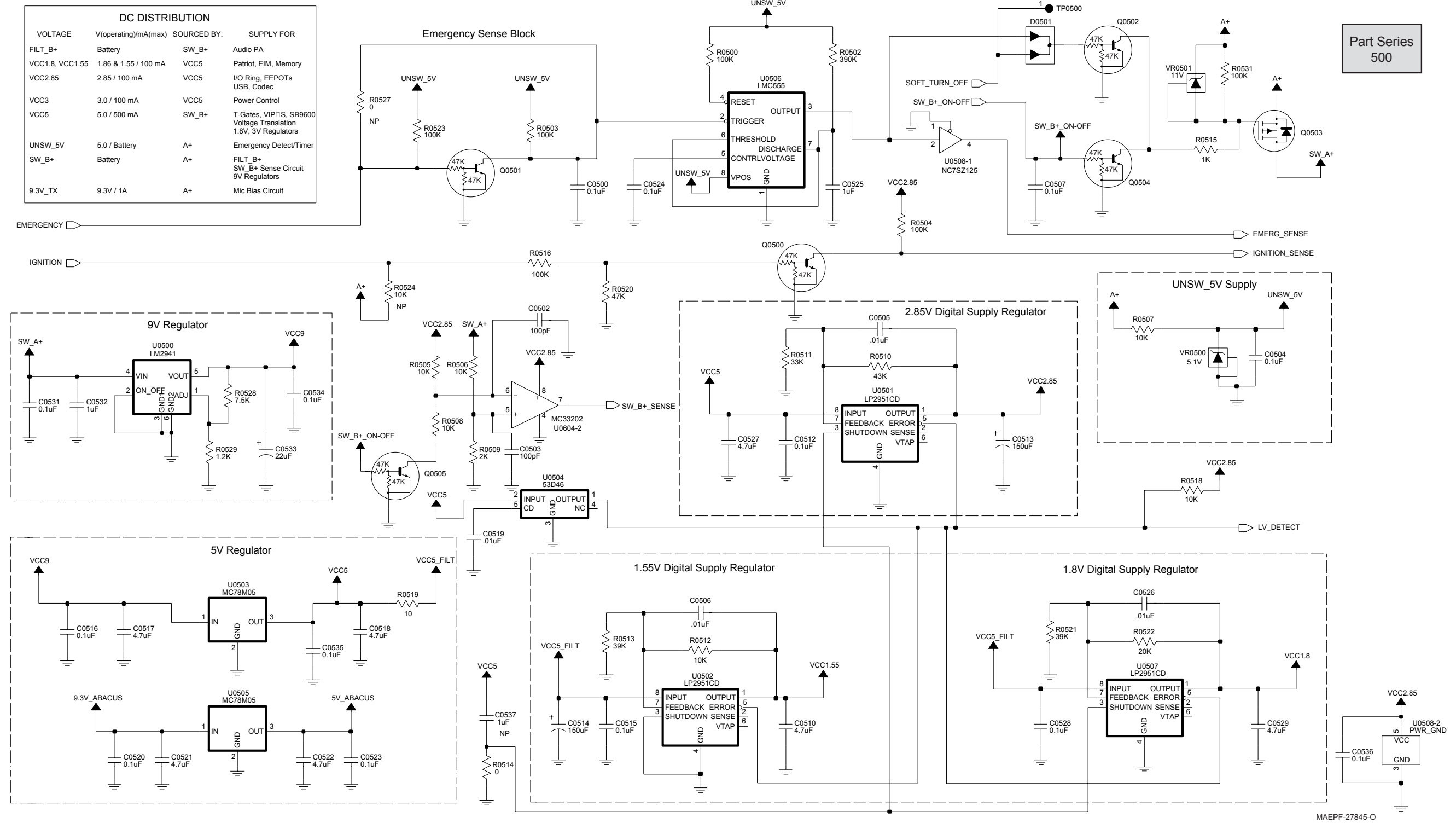


Figure 7-117. Controller Power Supply and Emergency Schematic

Part Series
600-1

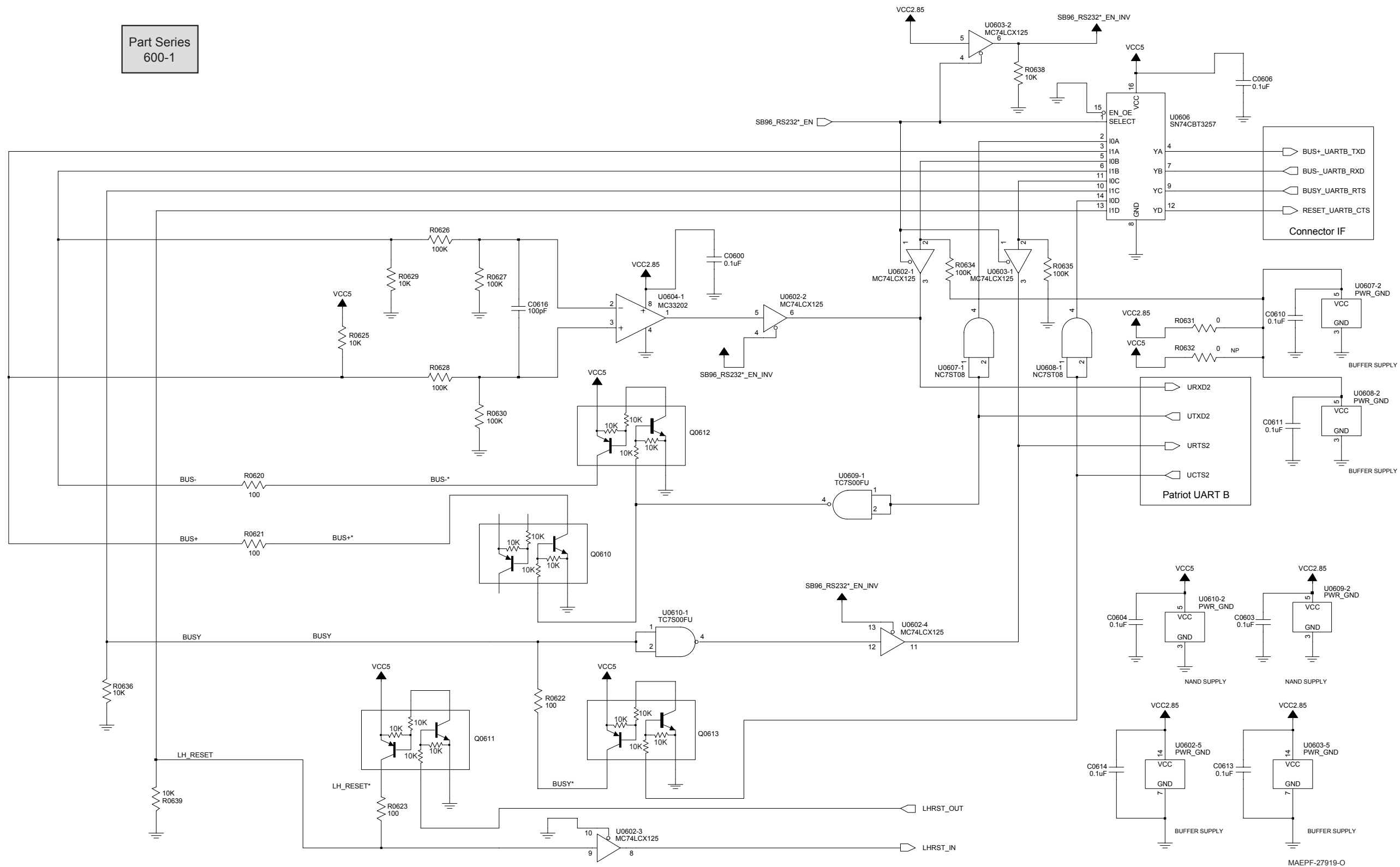


Figure 7-118. Controller RS232/SB9600 Schematic

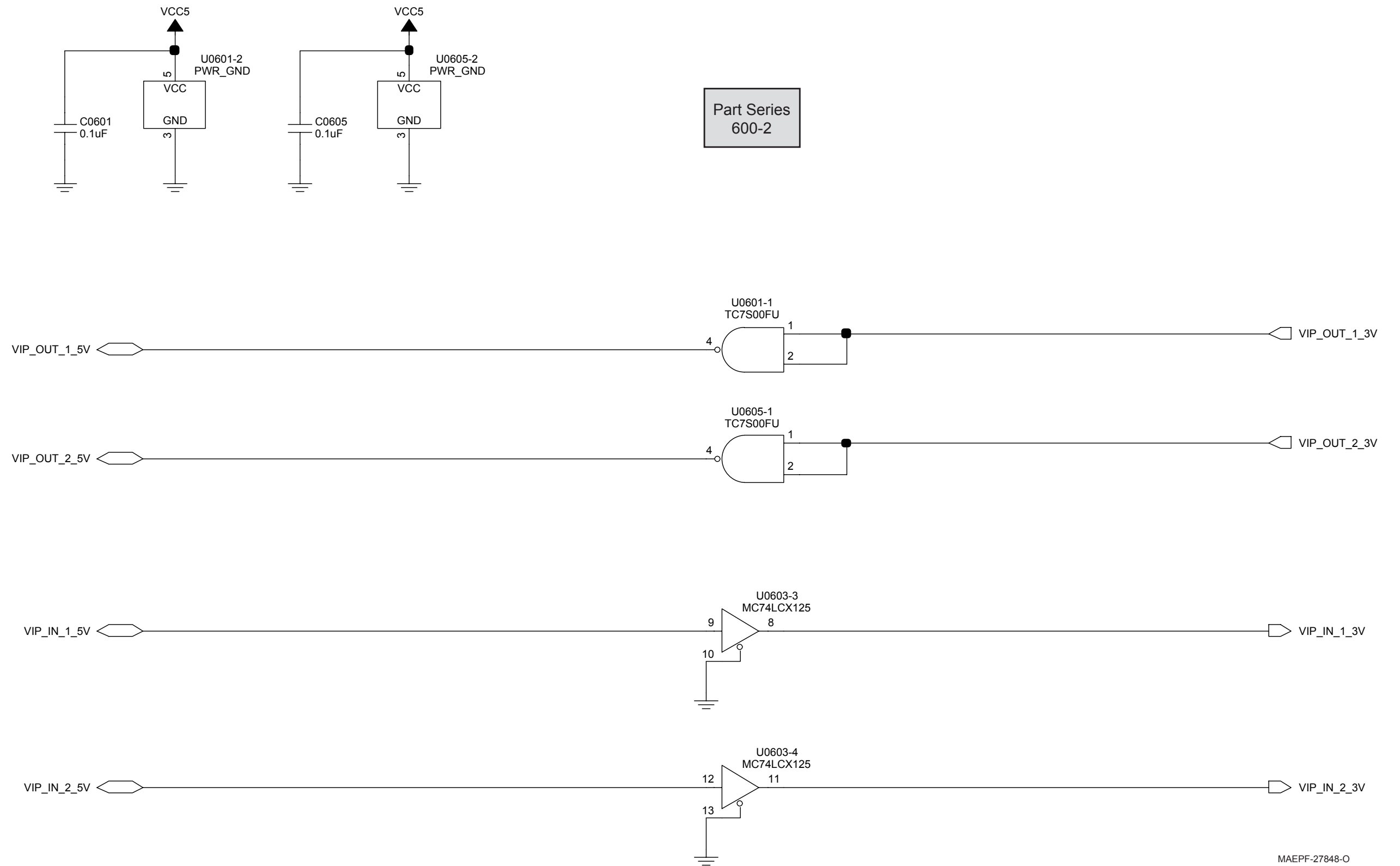
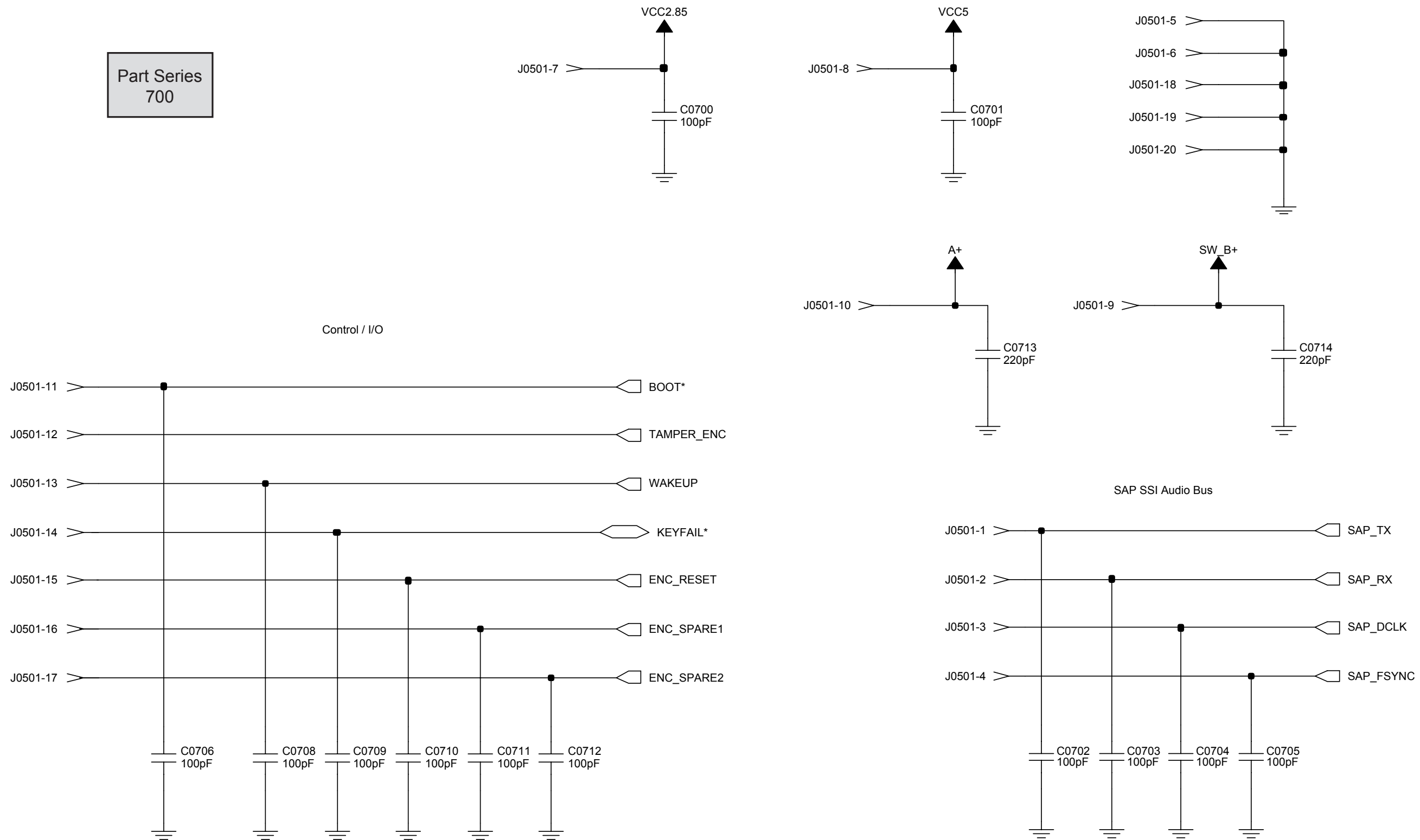


Figure 7-119. Controller VIP Input/Output Schematic

MAEPF-27848-O



MAEPF-27846-O

Figure 7-120. Controller Secure Interface Connector Schematic

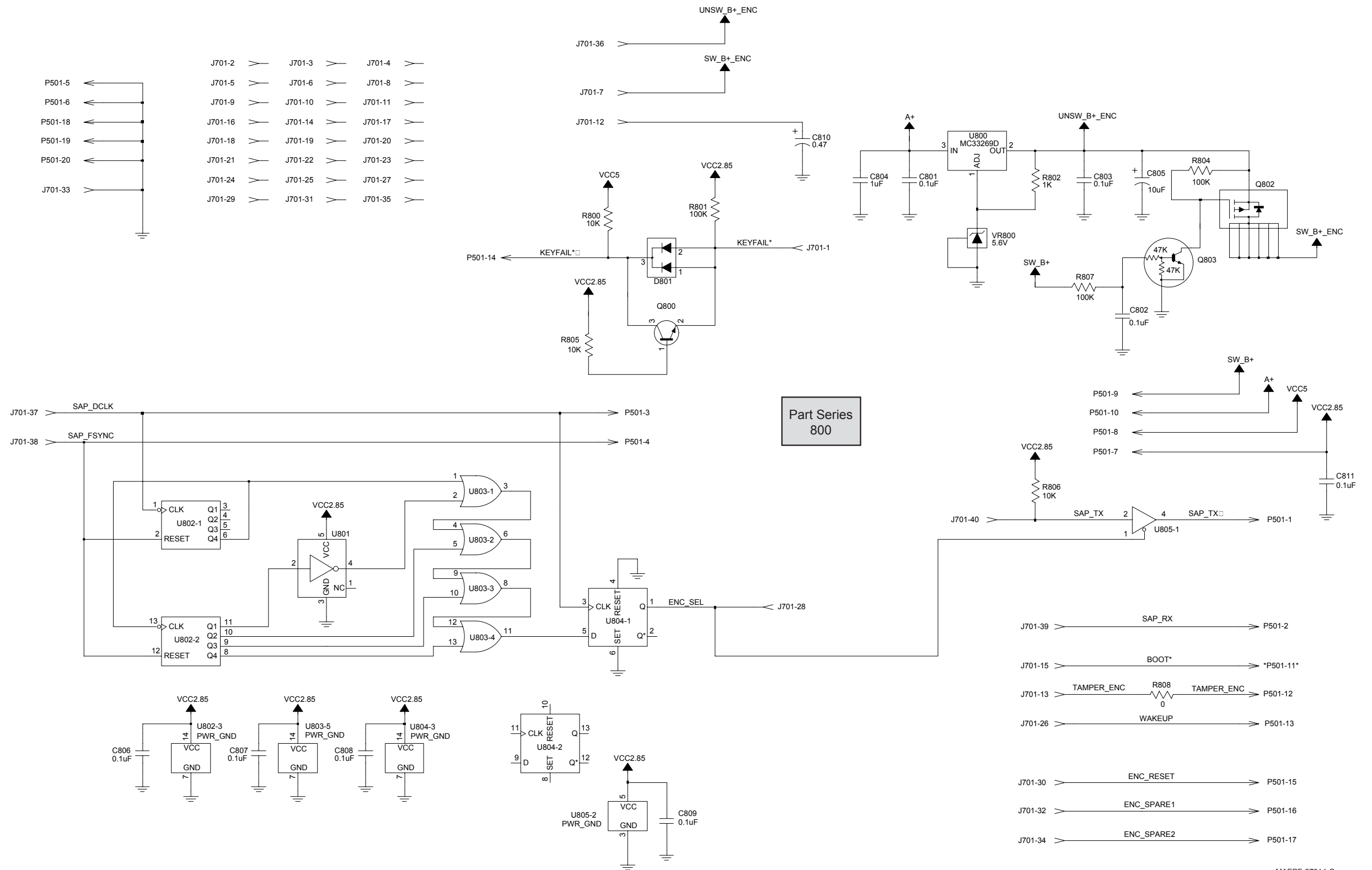
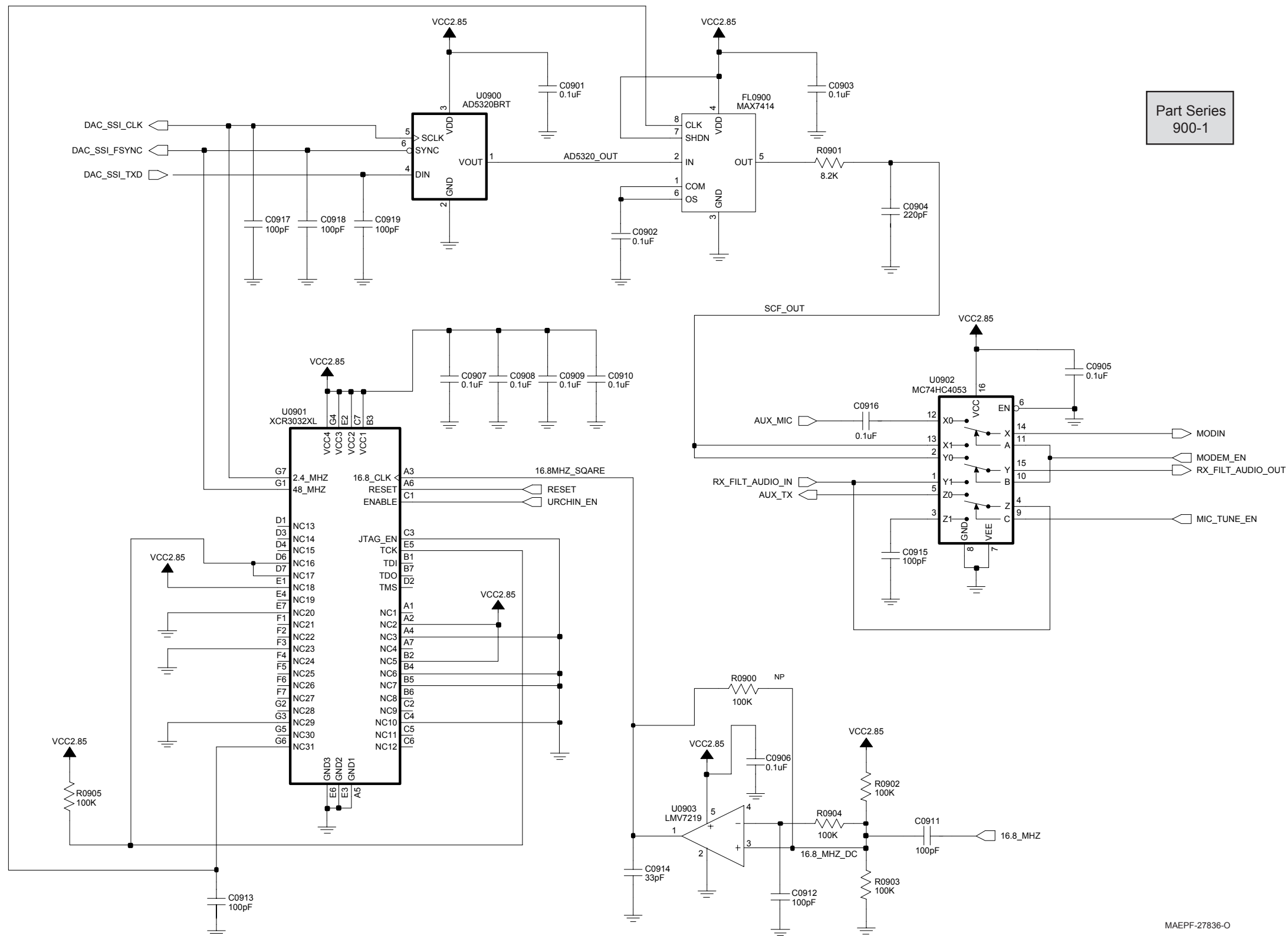


Figure 7-121. Secure Interface Board Schematic



Part Series
900-1

MAEPF-27836-O

Figure 7-122. HUF4017A Controller Urchin IC, MUX, and AD5320 DAC Schematic

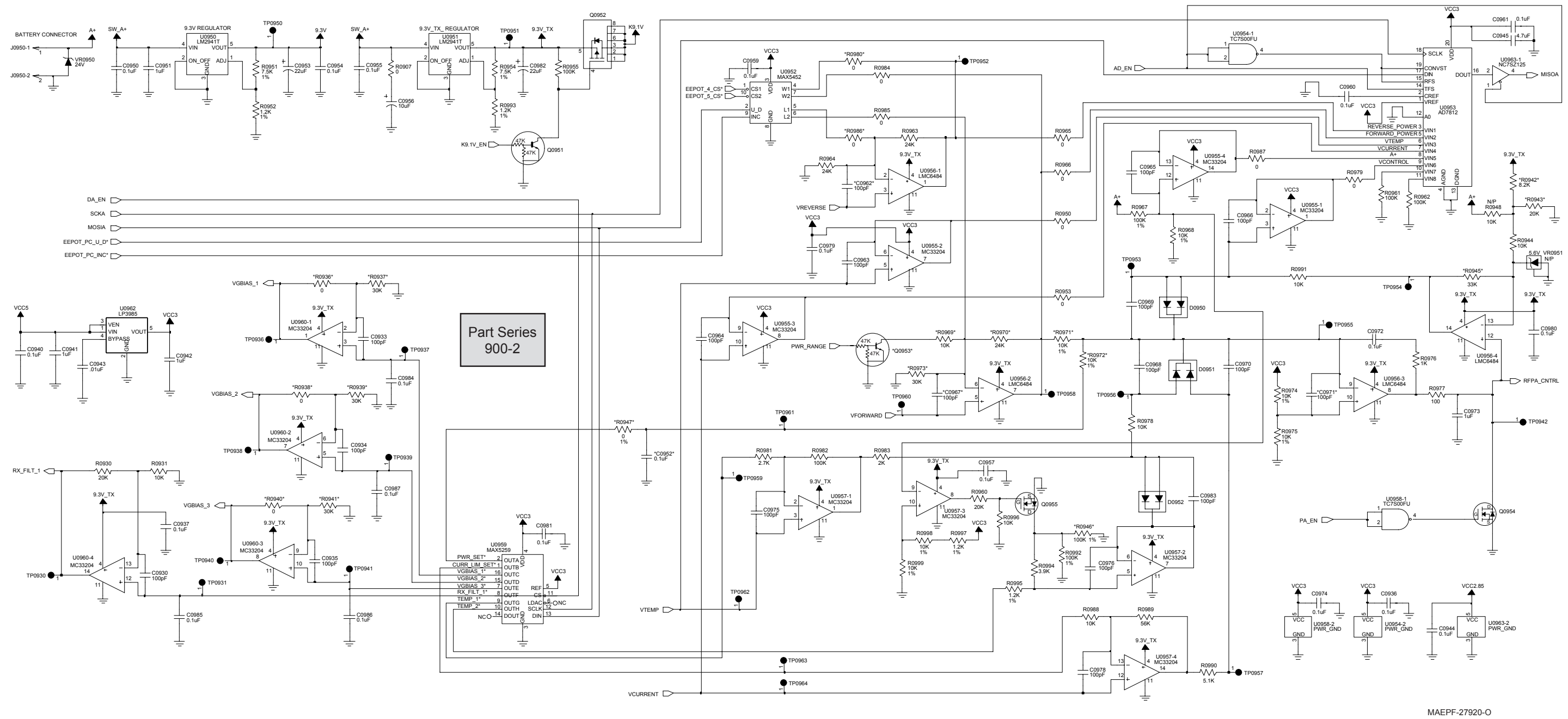
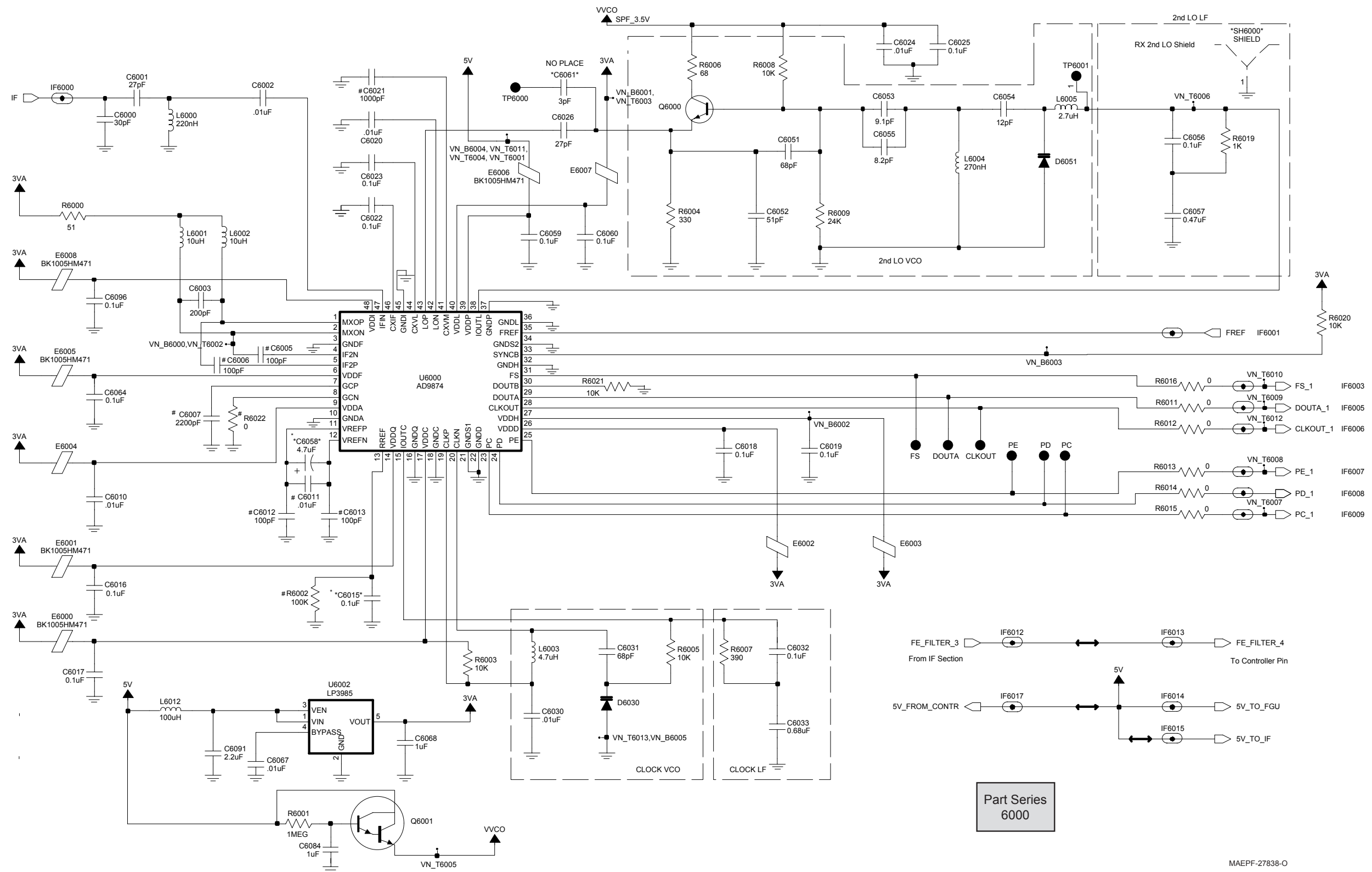
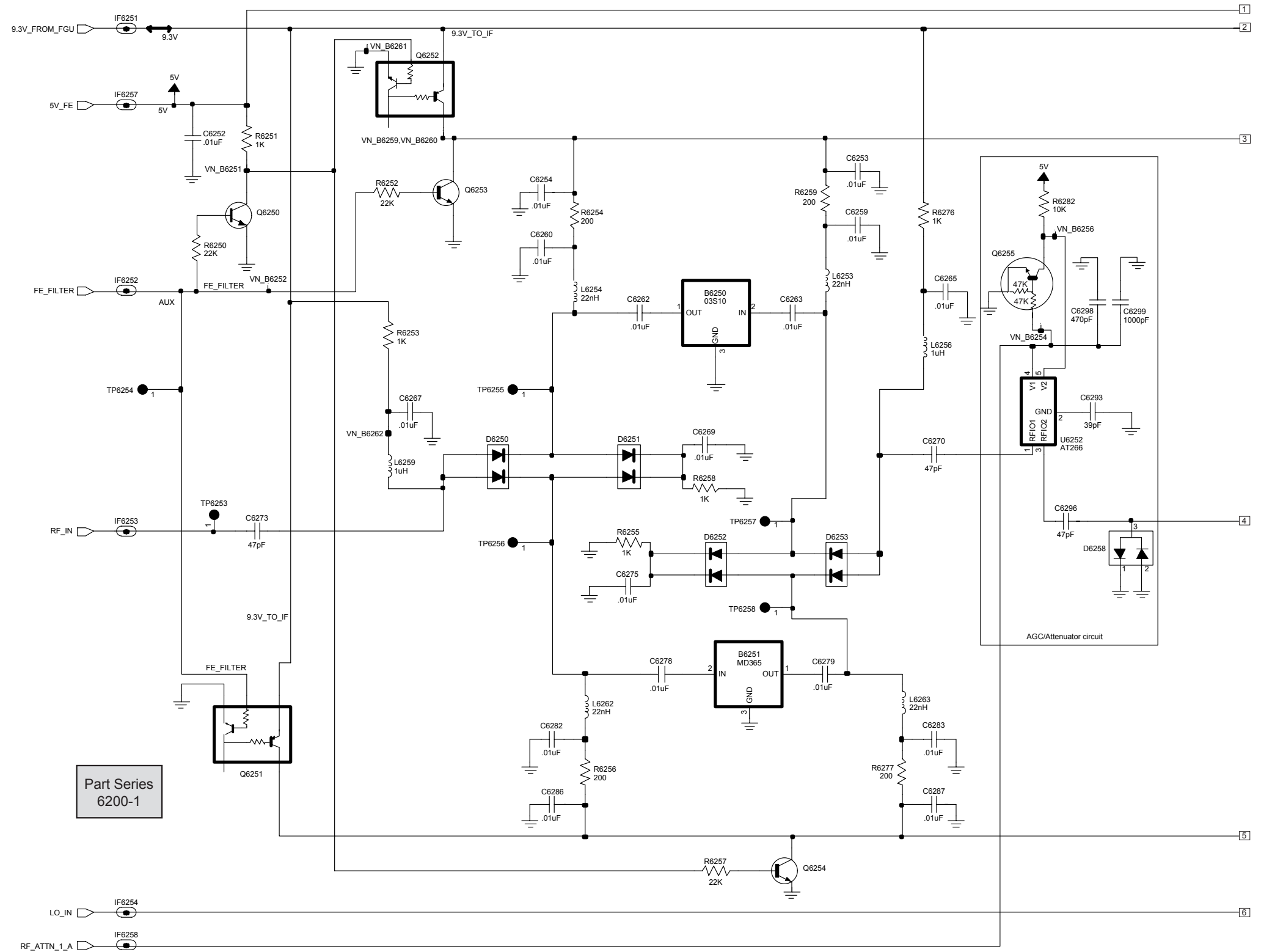


Figure 7-123. HUF4017A Controller Power Supply Schematic



MAEPF-27838-O
Figure 7-124. HUF4017A Receiver Back-End Schematic



MAEPF-27839-O

Figure 7-125. HUF4017A Receiver Front-End Schematic (Sheet 1 of 2)

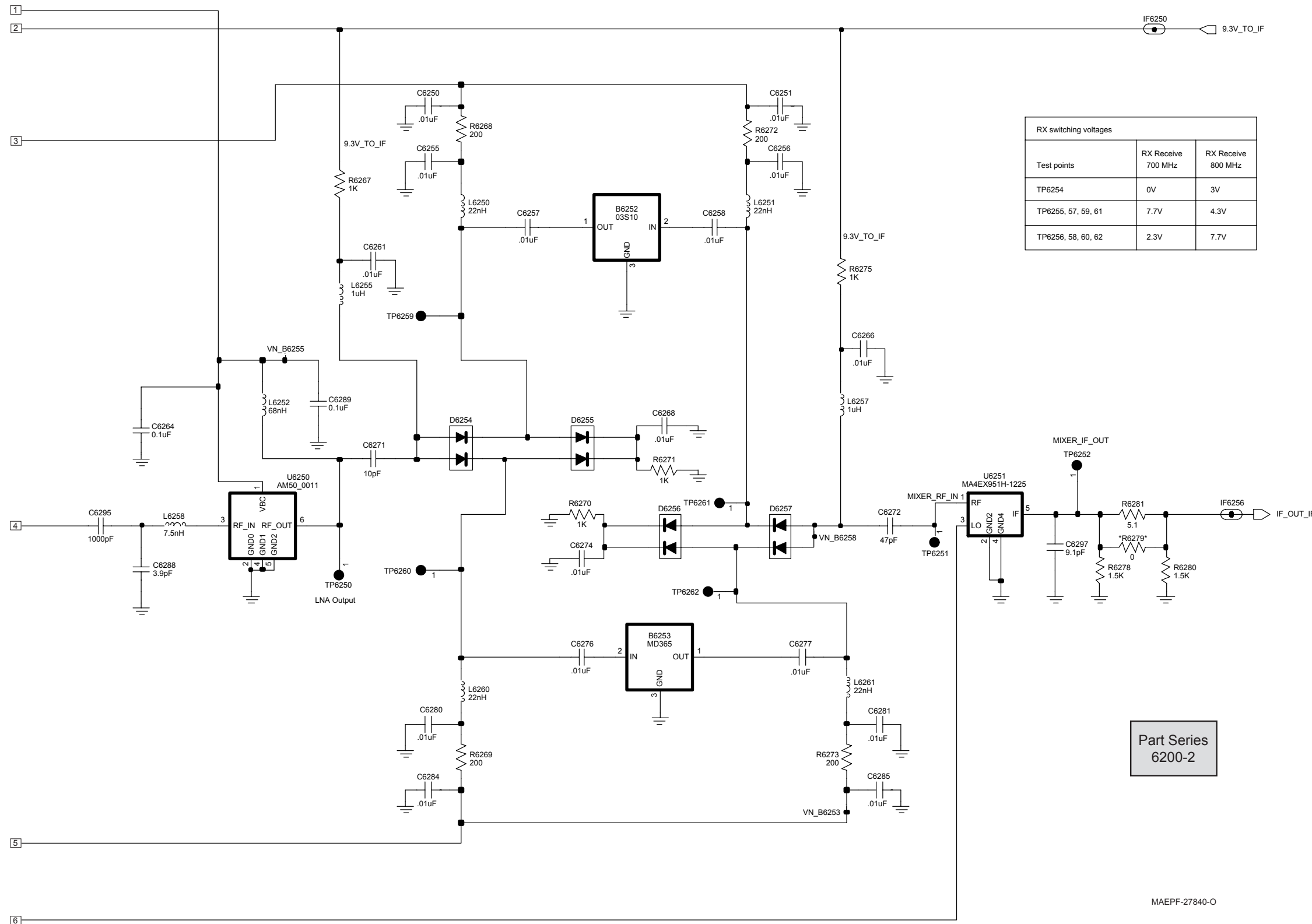


Figure 7-126. HUF4017A Receiver Front-End Schematic (Sheet 2 of 2)

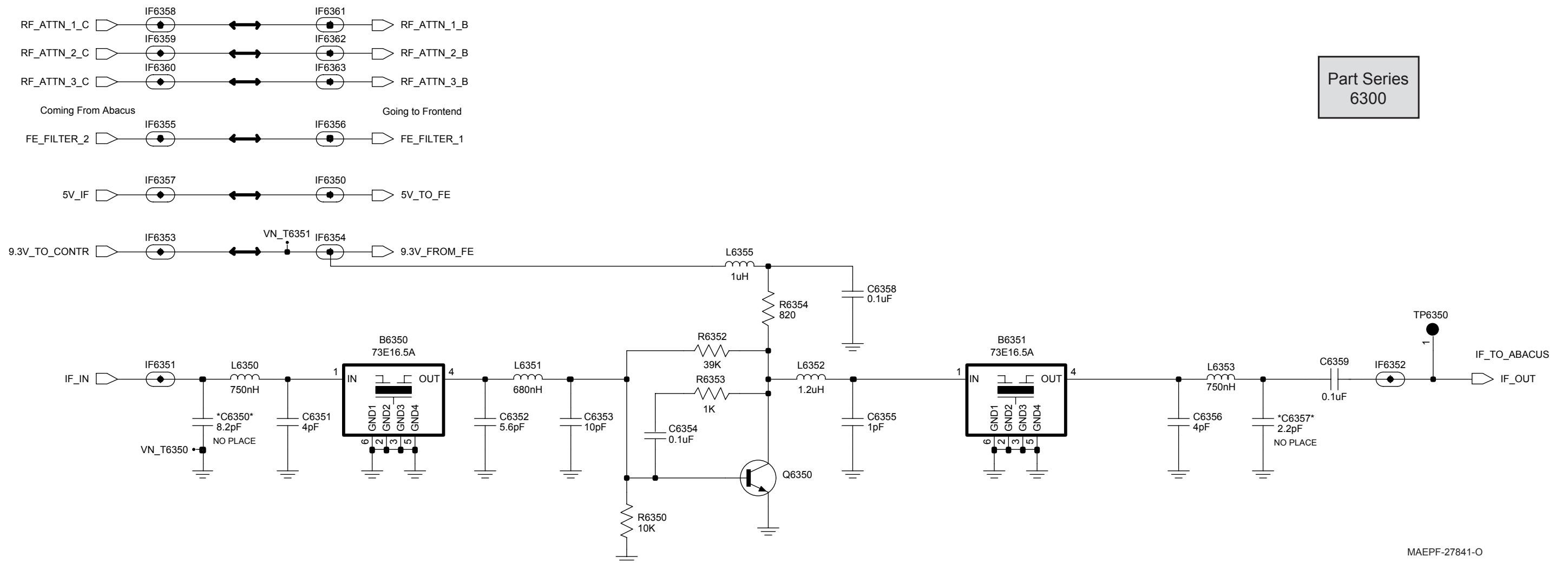
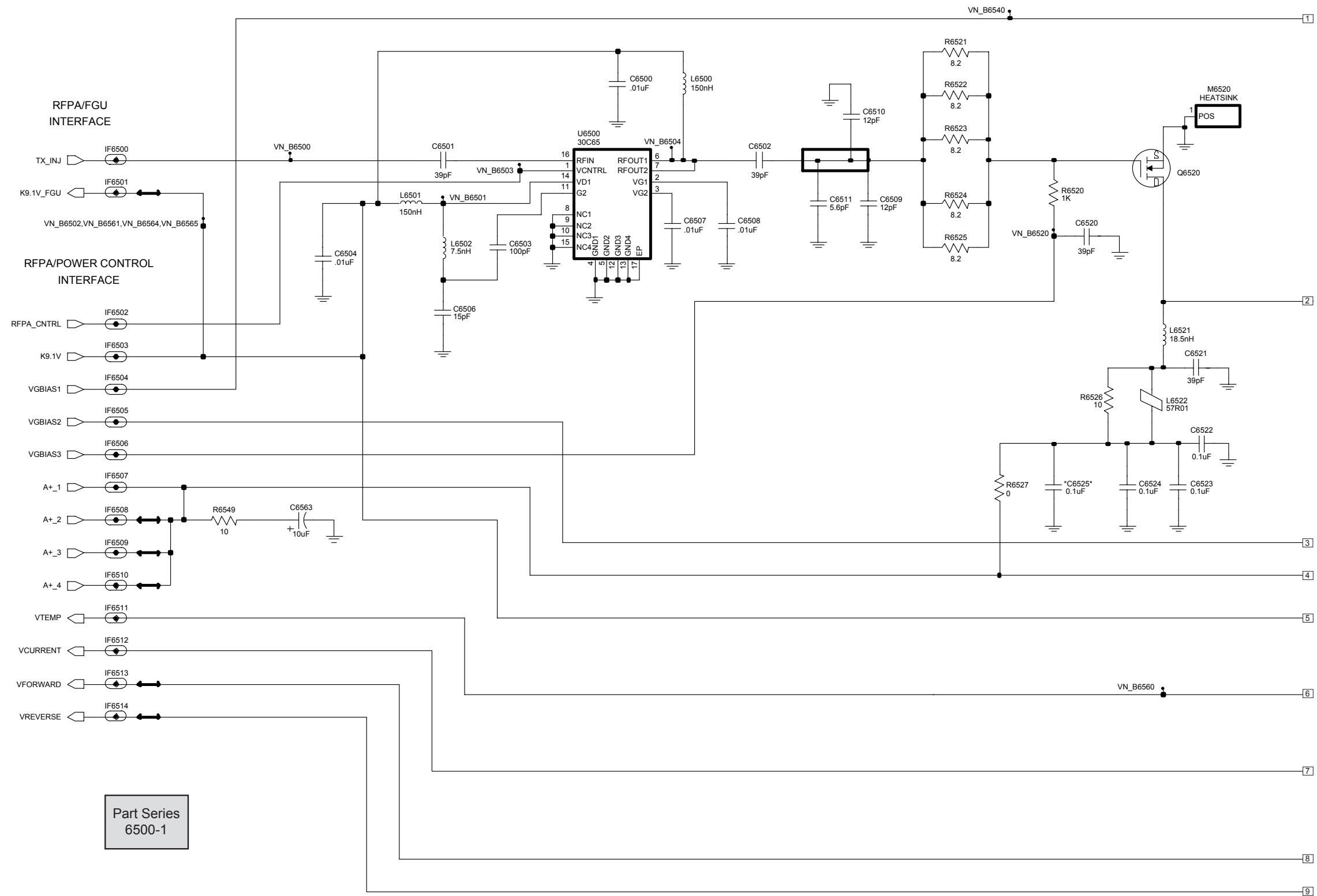


Figure 7-127. HUF4017A Receiver Intermediate Frequency (IF) Schematic



MAEPF-27834-0

Figure 7-128. HUF4017A RF Power Amplifier (PA) Schematic (Sheet 1 of 2)

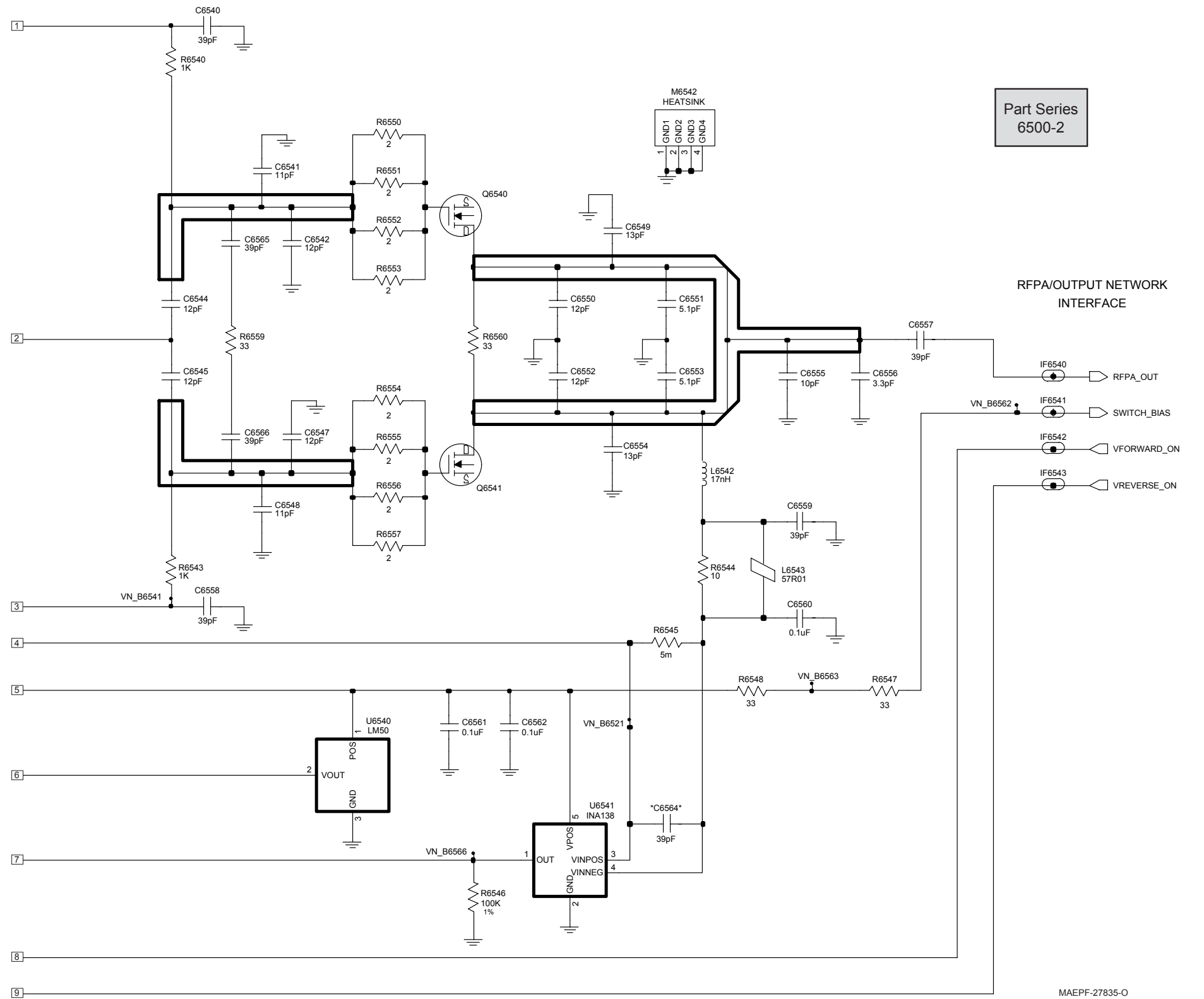


Figure 7-129. HUF4017A RF Power Amplifier (PA) Schematic (Sheet 2 of 2)

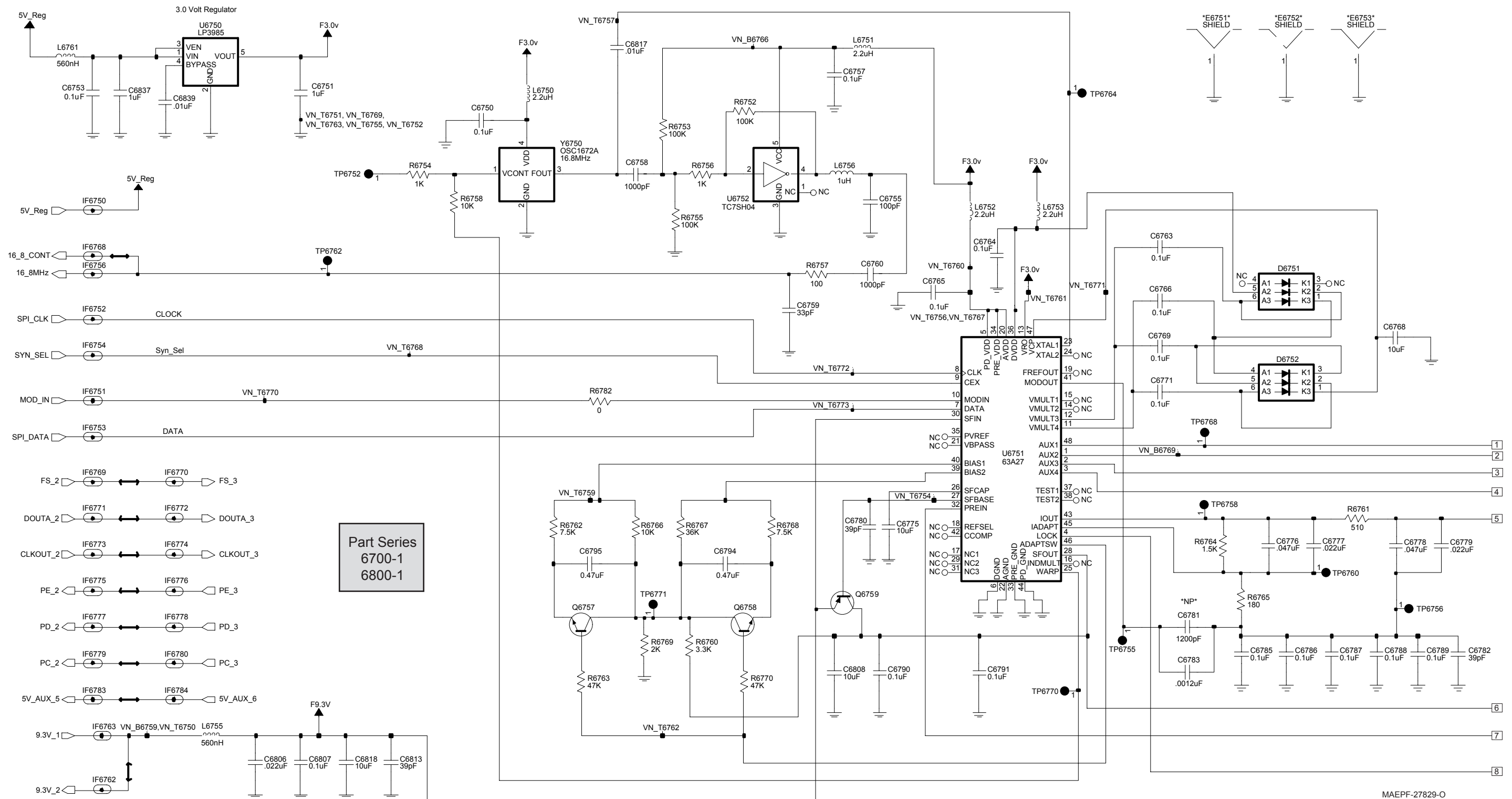


Figure 7-130. HUF4017A Frequency Generation Unit Overall Schematic (Sheet 1 of 2)

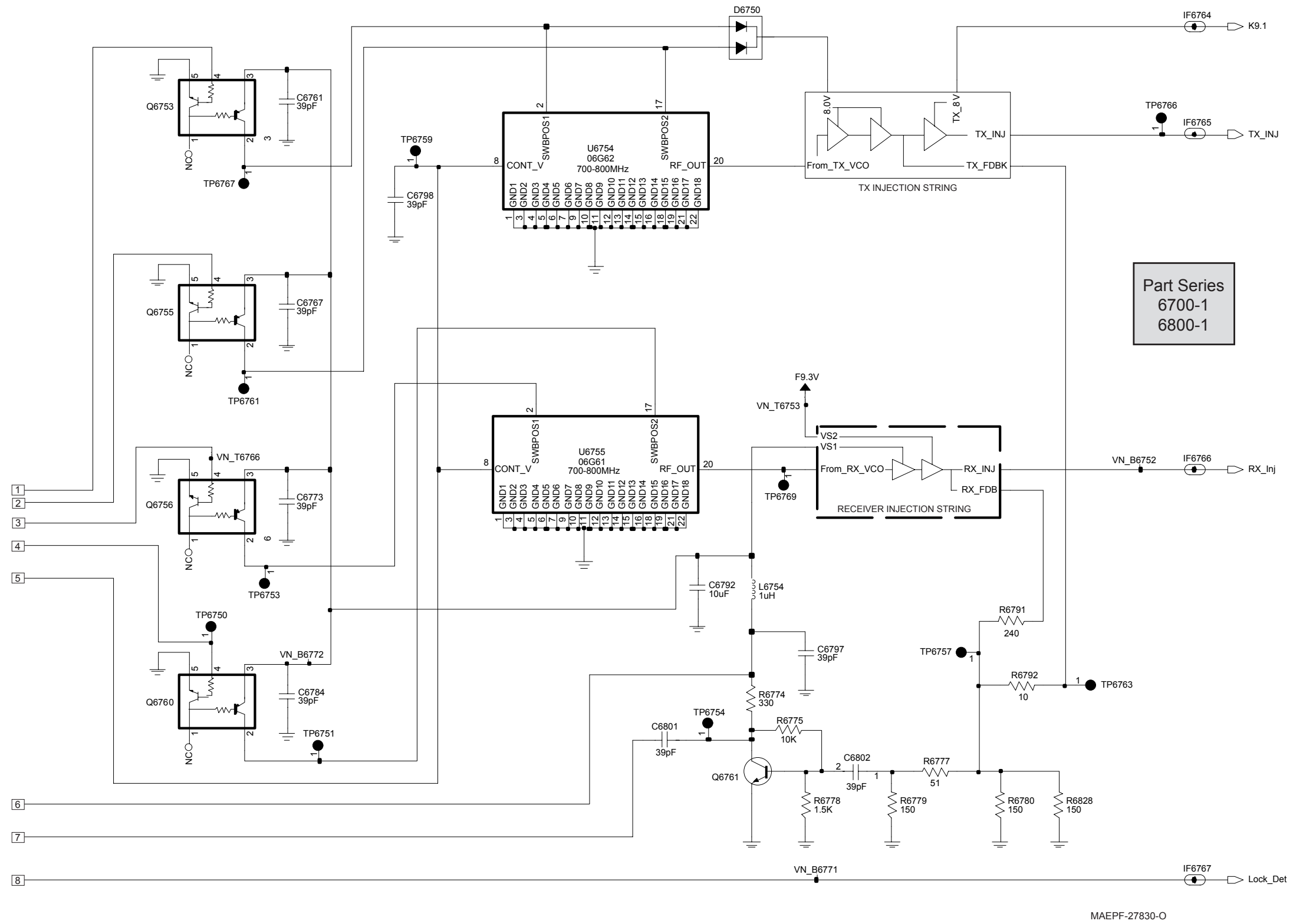
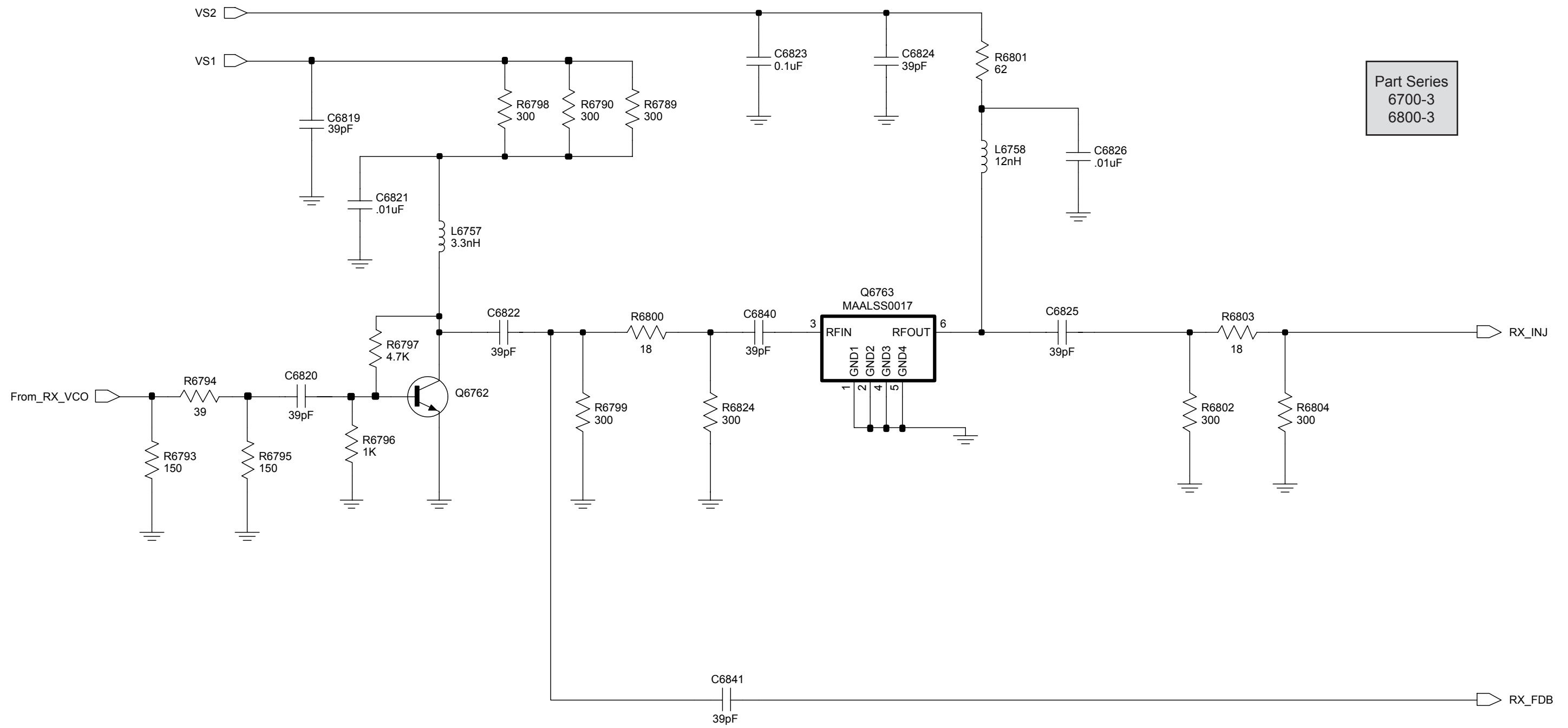


Figure 7-131. HUF4017A Frequency Generation Unit Overall Schematic (Sheet 2 of 2)



MAEPF-27831-O

Figure 7-132. HUF4017A Frequency Generation Unit 800 MHz Receive Injection Schematic

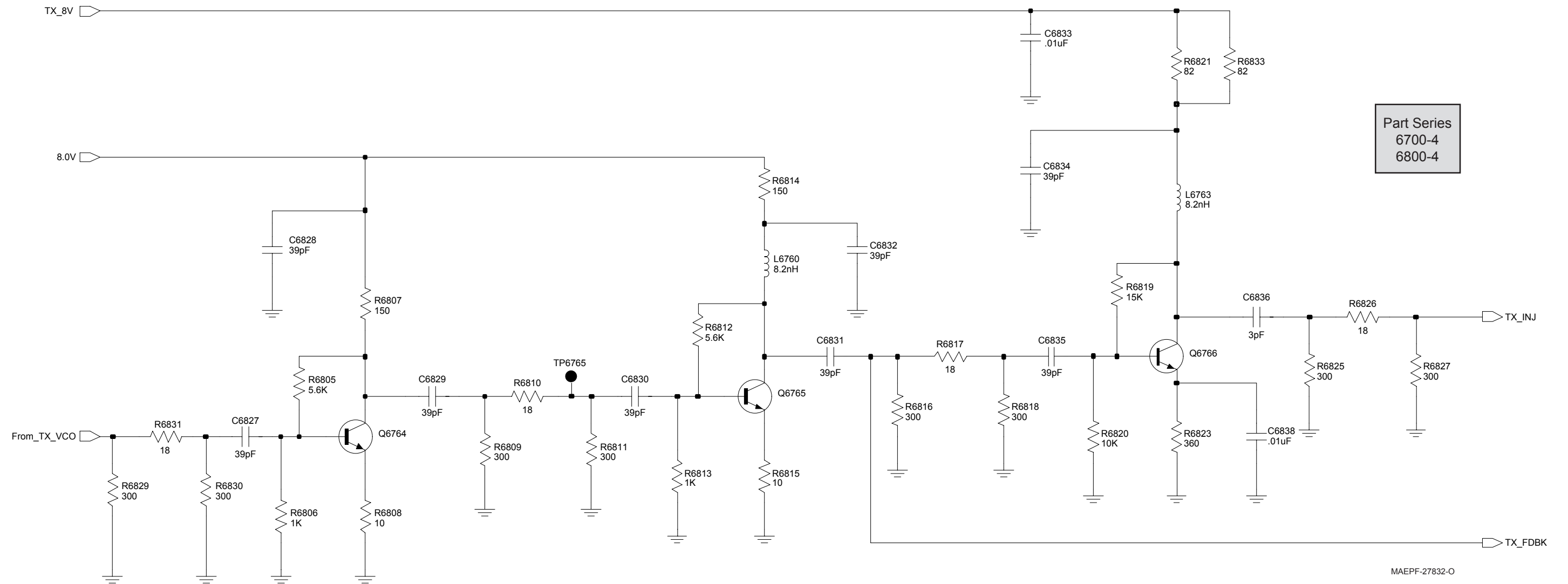


Figure 7-133. HUF4017A Frequency Generation Unit 800 MHz Transmit Injection Schematic

SIDE 1 - TOP PORTION OF CIRCUIT BOARD

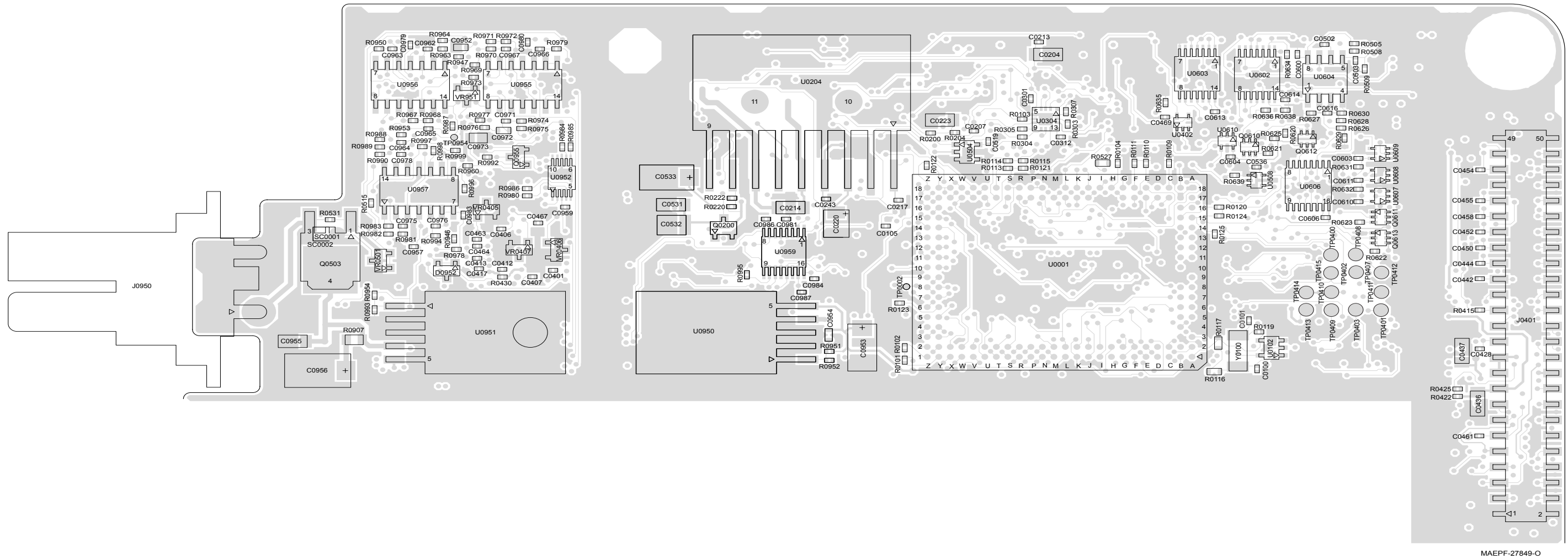
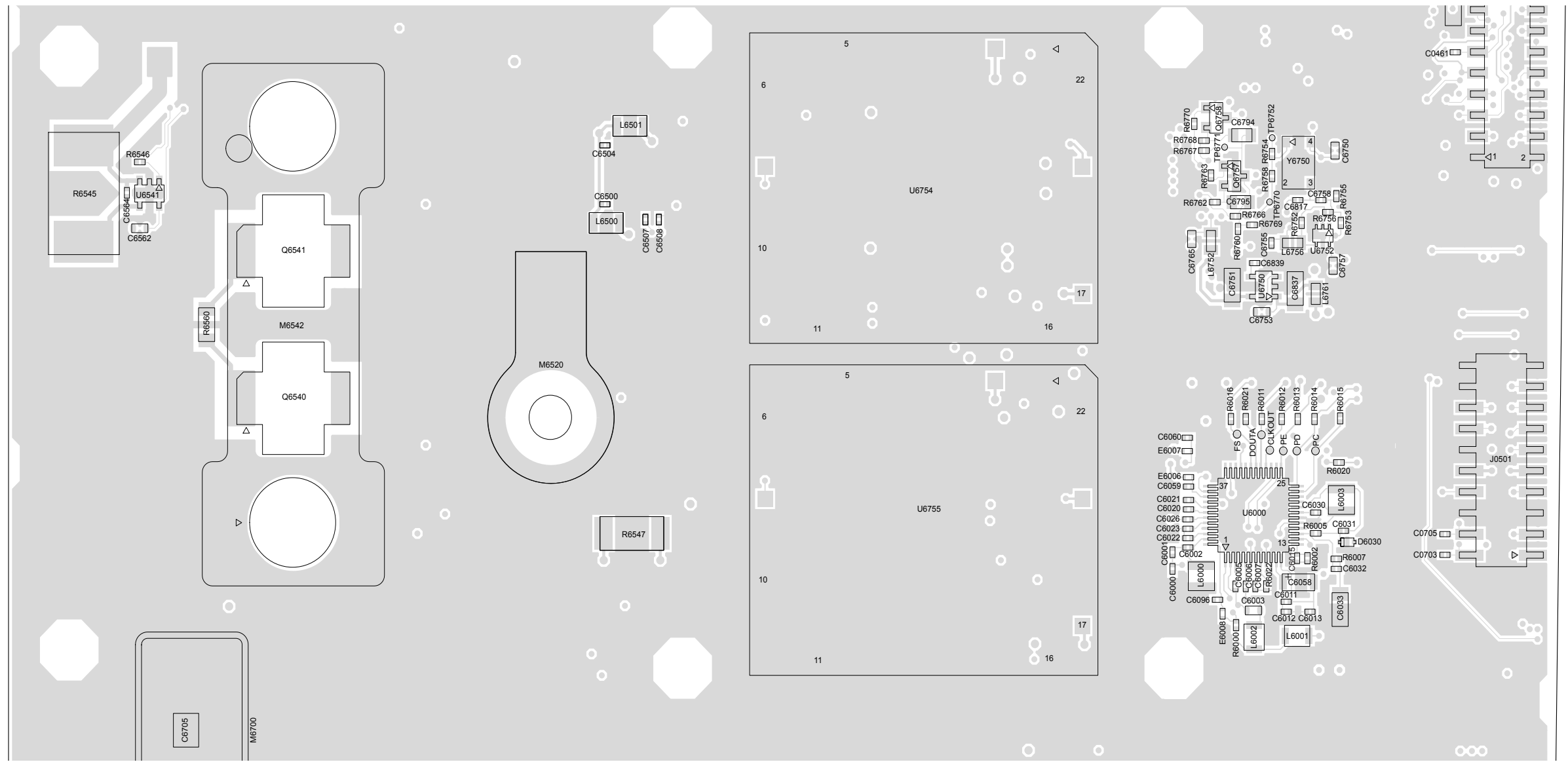


Figure 7-134. HUF4017A Main Board Layout—Side 1 Top

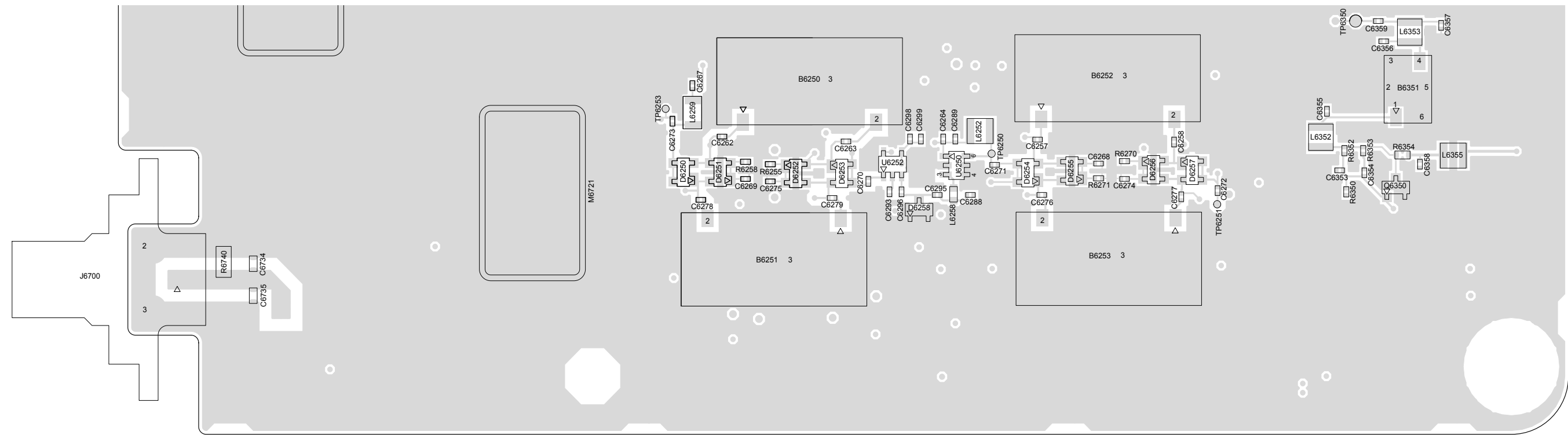
SIDE 1 - MIDDLE PORTION OF CIRCUIT BOARD



MAEPF-27850-O

Figure 7-135. HUF4017A Main Board Layout—Side 1 Middle

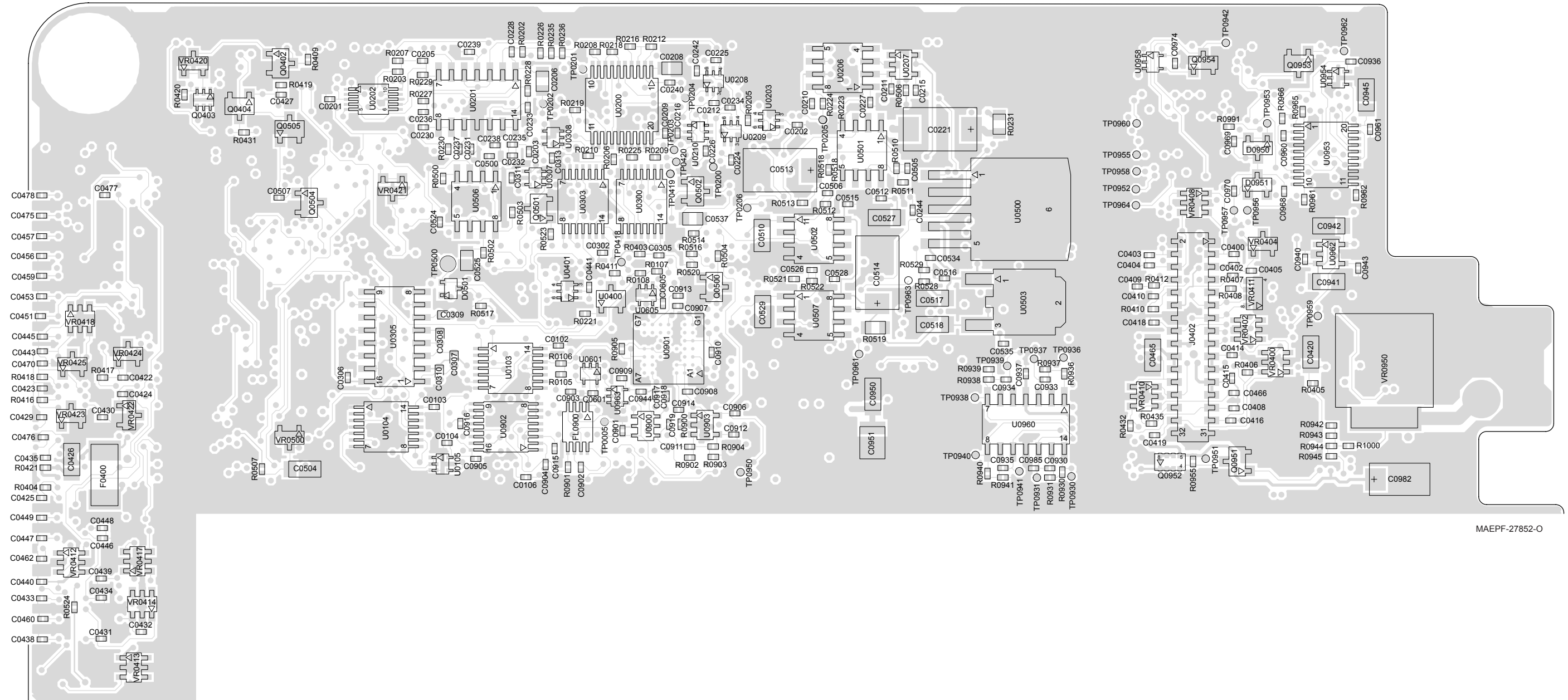
SIDE 1 - BOTTOM PORTION OF CIRCUIT BOARD



MAEPF-27851-O

Figure 7-136. HUF4017A Main Board Layout—Side 1 Bottom

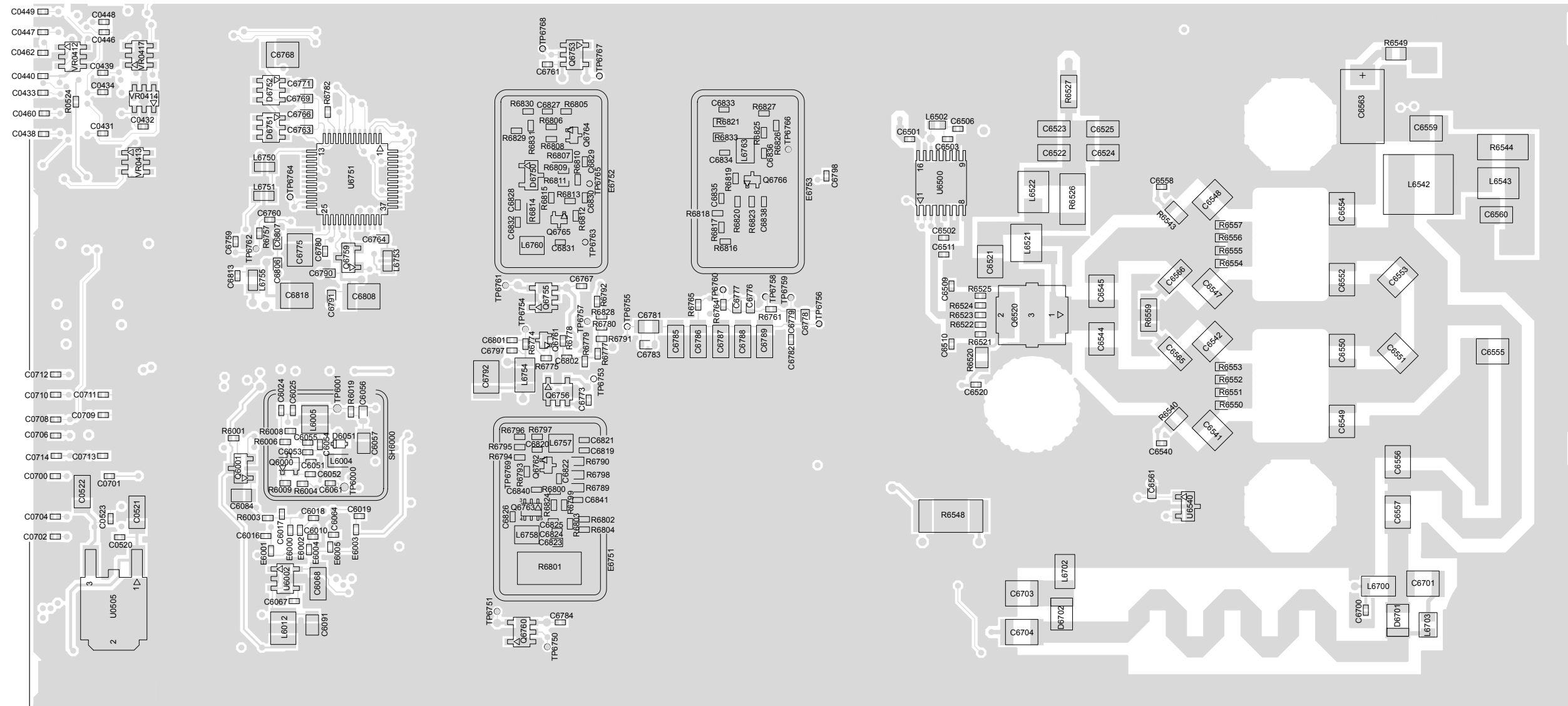
SIDE 2 - TOP PORTION OF CIRCUIT BOARD



MAEPF-27852-0

Figure 7-137. HUF4017A Main Board Layout—Side 2 Top

SIDE 2 - MIDDLE PORTION OF CIRCUIT BOARD



MAEPF-27909-O

Figure 7-138. HUF4017A Main Board Layout—Side 2 Middle

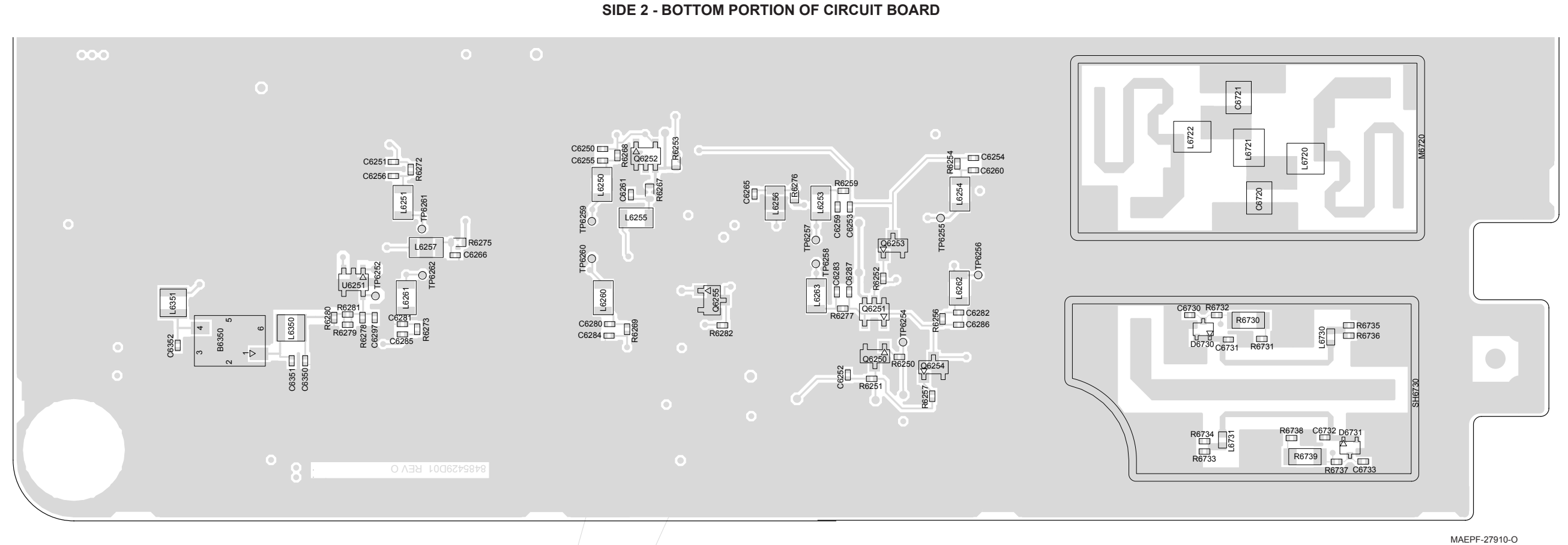
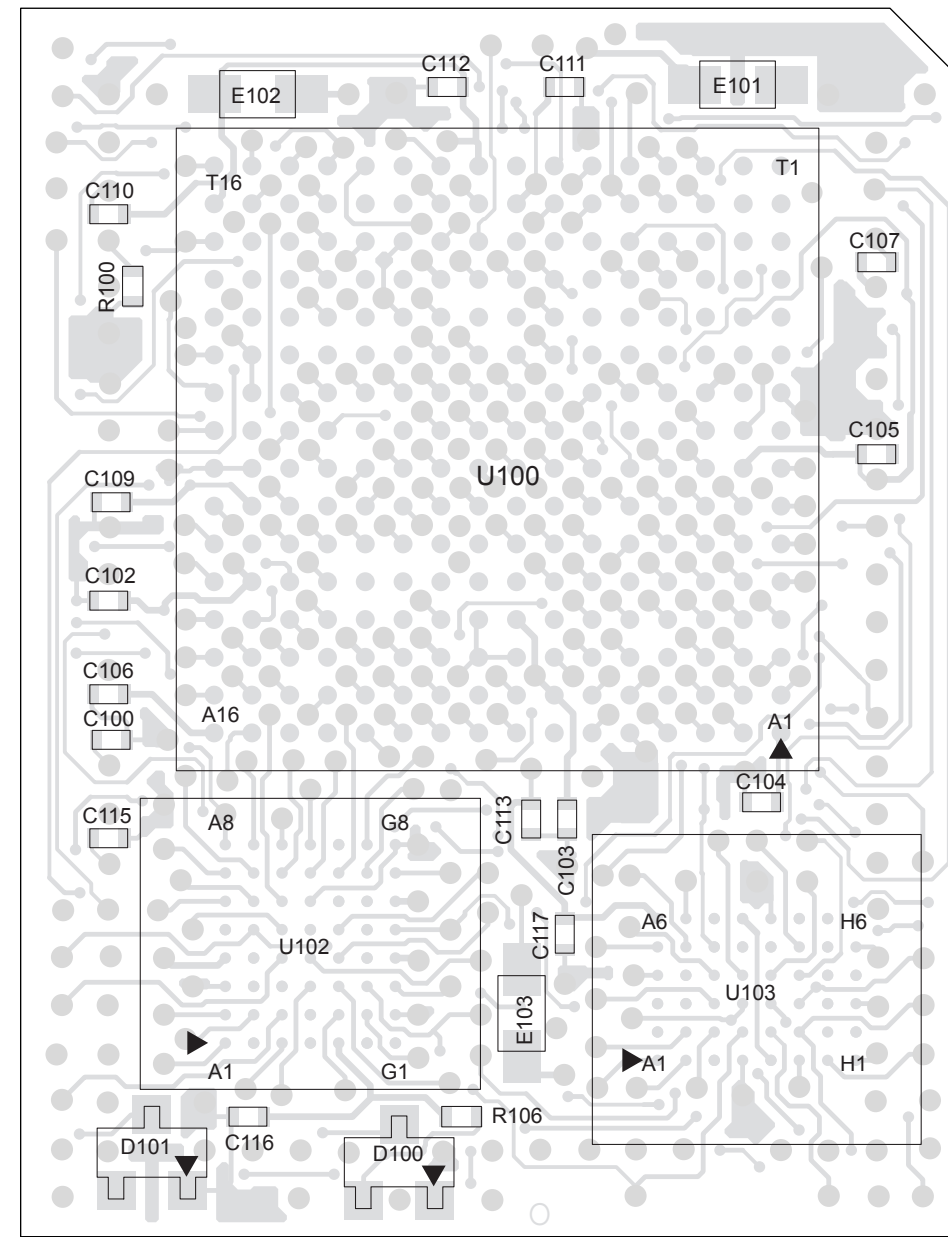


Figure 7-139. HUF4017A Main Board Layout—Side 2 Bottom



MAEPF-27911-O

Figure 7-140. HUF4017A Daughtercard Module Board Layout

HUF4017A Main Board Parts List

Reference Designator	Motorola Part Number	Description
B6250	9102603S10	FILTER 860.5 MHZ
B6251	9185503C01	FILTER CERAMIC 770 MHZ
B6252	9102603S10	FILTER 860.5 MHZ
B6253	9185503C01	FILTER CERAMIC 770 MHZ
B6350	9185116C01	FILTER CRYSTAL
B6351	9185116C01	FILTER CRYSTAL
C0001	2380090M24	CAP ALU 10 20 50V SURF MT
C0100	2113743N32	CAP CHIP 18.0 PF 5% COG
C0101	2113743N32	CAP CHIP 18.0 PF 5% COG
C0102	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0103	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0104	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0105	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0106	2113743N50	CAP CHIP 100 PF 5% COG
C0201	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0202	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0203	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0204	2185802B01	CAP 10V 4.7UF
C0205	2113743N54	CAP CHIP 150 PF 5% COG
C0206	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0207	2113743N38	CAP CHIP 33.0 PF 5% COG
C0208	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0209	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0210	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0211	2113743N50	CAP CHIP 100 PF 5% COG
C0212	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0213	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0214	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0215	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0216	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0217	2113743L29	CAP CHIP 3300 PF 10% X7R
C0220	2311049A57	CAP TANT CHIP A/P 10UF 10% 16V
C0221	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C0223	2185802B01	CAP 10V 4.7UF
C0224	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0225	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0226	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0227	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0228	2113743N54	CAP CHIP 150 PF 5% COG
C0230	2113743L09	CAP CHIP 470 PF 10% X7R
C0231	2113743L01	CAP CHIP 220 PF 10% X7R
C0232	2113743L09	CAP CHIP 470 PF 10% X7R
C0233	2113743L01	CAP CHIP 220 PF 10% X7R
C0234	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0235	2113743L09	CAP CHIP 470 PF 10% X7R
C0236	2113743L09	CAP CHIP 470 PF 10% X7R
C0237	2113743L01	CAP CHIP 220 PF 10% X7R
C0238	2113743L01	CAP CHIP 220 PF 10% X7R
C0239	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0240	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0242	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0243	2113945B01	CAP CER CHIP 6800 PF 25V 10%
C0244	2113945B01	CAP CER CHIP 6800 PF 25V 10%
C0301	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0302	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0305	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0306	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0307	NOTPLACED	64AM DUMMY PART NUMBER
C0308	2113743E20	CAP CHIP .10 UF 10%
C0309	2113743E20	CAP CHIP .10 UF 10%
C0310	2113743E20	CAP CHIP .10 UF 10%
C0311	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0312	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0313	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0400	2113743N38	CAP CHIP 33.0 PF 5% COG
C0401	2113743N50	CAP CHIP 100 PF 5% COG
C0402	2113743N38	CAP CHIP 33.0 PF 5% COG
C0403	2113743N38	CAP CHIP 33.0 PF 5% COG
C0404	2113743N38	CAP CHIP 33.0 PF 5% COG
C0405	2113743N38	CAP CHIP 33.0 PF 5% COG
C0406	2113743N38	CAP CHIP 33.0 PF 5% COG
C0407	2113743N50	CAP CHIP 100 PF 5% COG
C0408	2113743N50	CAP CHIP 100 PF 5% COG
C0409	2113743N38	CAP CHIP 33.0 PF 5% COG
C0410	2113743N38	CAP CHIP 33.0 PF 5% COG
C0412	2113743N50	CAP CHIP 100 PF 5% COG
C0413	2113743N50	CAP CHIP 100 PF 5% COG
C0414	2113743L01	CAP CHIP 220 PF 10% X7R
C0415	2113743L01	CAP CHIP 220 PF 10% X7R
C0416	2113743N50	CAP CHIP 100 PF 5% COG
C0417	2113743L01	CAP CHIP 220 PF 10% X7R
C0418	2113743L01	CAP CHIP 220 PF 10% X7R
C0419	2113743N50	CAP CHIP 100 PF 5% COG
C0420	2185802B01	CAP 10V 4.7UF
C0422	2113743N38	CAP CHIP 33.0 PF 5% COG
C0423	2113743N38	CAP CHIP 33.0 PF 5% COG
C0424	2113743N38	CAP CHIP 33.0 PF 5% COG
C0425	2113743N50	CAP CHIP 100 PF 5% COG

Reference Designator	Motorola Part Number	Description
C0426	2113741B13	CAP CHIP CL2 X7R REEL 470
C0427	2113743N50	CAP CHIP 100 PF 5% COG
C0428	2113743N50	CAP CHIP 100 PF 5% COG
C0429	2113743N50	CAP CHIP 100 PF 5% COG
C0430	2113743N50	CAP CHIP 100 PF 5% COG
C0431	2113743N50	CAP CHIP 100 PF 5% COG
C0432	2113743N50	CAP CHIP 100 PF 5% COG
C0433	2113743N50	CAP CHIP 100 PF 5% COG
C0434	2113743N50	CAP CHIP 100 PF 5% COG
C0435	2113743L09	CAP CHIP 470 PF 10% X7R
C0436	2113741B13	CAP CHIP CL2 X7R REEL 470
C0437	2113741B13	CAP CHIP CL2 X7R REEL 470
C0438	2113743L09	CAP CHIP 470 PF 10% X7R
C0439	2113743N50	CAP CHIP 100 PF 5% COG
C0440	2113743N50	CAP CHIP 100 PF 5% COG
C0441	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0442	2113743N38	CAP CHIP 33.0 PF 5% COG
C0443	2113743N38	CAP CHIP 33.0 PF 5% COG
C0444	2113743N38	CAP CHIP 33.0 PF 5% COG
C0445	2113743N38	CAP CHIP 33.0 PF 5% COG
C0446	2113743N50	CAP CHIP 100 PF 5% COG
C0447	2113743N50	CAP CHIP 100 PF 5% COG
C0448	2113743N50	CAP CHIP 100 PF 5% COG
C0449	2113743N50	CAP CHIP 100 PF 5% COG
C0450	2113743N38	CAP CHIP 33.0 PF 5% COG
C0451	2113743N38	CAP CHIP 33.0 PF 5% COG
C0452	2113743N38	CAP CHIP 33.0 PF 5% COG
C0453	2113743N38	CAP CHIP 33.0 PF 5% COG
C0454	2113743N38	CAP CHIP 33.0 PF 5% COG
C0455	2113743N38	CAP CHIP 33.0 PF 5% COG
C0456	2113743N38	CAP CHIP 33.0 PF 5% COG
C0457	2113743N38	CAP CHIP 33.0 PF 5% COG
C0458	2113743N38	CAP CHIP 33.0 PF 5% COG

Reference Designator	Motorola Part Number	Description
C0459	2113743N38	CAP CHIP 33.0 PF 5% COG
C0460	2113743N50	CAP CHIP 100 PF 5% COG
C0461	2113743L01	CAP CHIP 220 PF 10% X7R
C0462	2113743L01	CAP CHIP 220 PF 10% X7R
C0463	2113743N38	CAP CHIP 33.0 PF 5% COG
C0464	2113743N38	CAP CHIP 33.0 PF 5% COG
C0465	2113741B13	CAP CHIP CL2 X7R REEL 470
C0466	2113743N50	CAP CHIP 100 PF 5% COG
C0467	2113743N50	CAP CHIP 100 PF 5% COG
C0469	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0470	2113743N38	CAP CHIP 33.0 PF 5% COG
C0475	2113743N50	CAP CHIP 100 PF 5% COG
C0476	2113743N50	CAP CHIP 100 PF 5% COG
C0477	2113743N50	CAP CHIP 100 PF 5% COG
C0478	2113743N50	CAP CHIP 100 PF 5% COG
C0500	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0502	2113743N50	CAP CHIP 100 PF 5% COG
C0503	2113743N50	CAP CHIP 100 PF 5% COG
C0504	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0505	2113743L41	CAP CHIP 10000 PF 10% X7R
C0506	2113743L41	CAP CHIP 10000 PF 10% X7R
C0507	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0510	2185802B01	CAP 10V 4.7UF
C0512	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0513	2311049A43	CAP TANT CHIP 150 10 6
C0514	2311049A43	CAP TANT CHIP 150 10 6
C0515	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0516	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0517	2185802B01	CAP 10V 4.7UF
C0518	2185802B01	CAP 10V 4.7UF
C0519	2113743L41	CAP CHIP 10000 PF 10% X7R
C0520	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0521	2185802B01	CAP 10V 4.7UF
C0522	2185802B01	CAP 10V 4.7UF

Reference Designator	Motorola Part Number	Description
C0523	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0524	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0525	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0526	2113743L41	CAP CHIP 10000 PF 10% X7R
C0527	2185802B01	CAP 10V 4.7UF
C0528	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0529	2185802B01	CAP 10V 4.7UF
C0531	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0532	2113741Y32	CAP CER 1,000,000 10% 50V
C0533	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0534	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0535	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0536	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0537	NOTPLACED	64AM DUMMY PART NUMBER
C0600	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0601	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0603	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0604	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0605	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0606	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0610	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0611	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0613	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0614	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0616	2113743N50	CAP CHIP 100 PF 5% COG
C0700	2113743N50	CAP CHIP 100 PF 5% COG
C0701	2113743N50	CAP CHIP 100 PF 5% COG
C0702	2113743N50	CAP CHIP 100 PF 5% COG
C0703	2113743N50	CAP CHIP 100 PF 5% COG
C0704	2113743N50	CAP CHIP 100 PF 5% COG
C0705	2113743N50	CAP CHIP 100 PF 5% COG

Reference Designator	Motorola Part Number	Description
C0706	2113743N50	CAP CHIP 100 PF 5% COG
C0708	2113743N50	CAP CHIP 100 PF 5% COG
C0709	2113743N50	CAP CHIP 100 PF 5% COG
C0710	2113743N50	CAP CHIP 100 PF 5% COG
C0711	2113743N50	CAP CHIP 100 PF 5% COG
C0712	2113743N50	CAP CHIP 100 PF 5% COG
C0713	2113743L01	CAP CHIP 220 PF 10% X7R
C0714	2113743L01	CAP CHIP 220 PF 10% X7R
C0901	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0902	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0903	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0904	2113743L01	CAP CHIP 220 PF 10% X7R
C0905	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0906	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0907	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0908	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0909	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0910	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0911	2113743N50	CAP CHIP 100 PF 5% COG
C0912	2113743N50	CAP CHIP 100 PF 5% COG
C0913	2113743N50	CAP CHIP 100 PF 5% COG
C0914	2113743N38	CAP CHIP 33.0 PF 5% COG
C0915	2113743N50	CAP CHIP 100 PF 5% COG
C0916	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0917	2113743N50	CAP CHIP 100 PF 5% COG
C0918	2113743N50	CAP CHIP 100 PF 5% COG
C0919	2113743N50	CAP CHIP 100 PF 5% COG
C0930	2113743N50	CAP CHIP 100 PF 5% COG
C0933	2113743N50	CAP CHIP 100 PF 5% COG
C0934	2113743N50	CAP CHIP 100 PF 5% COG
C0935	2113743N50	CAP CHIP 100 PF 5% COG
C0936	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0937	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0940	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0941	2113743S01	CAP CER CHIP 1.0 UF 10% 16V

Reference Designator	Motorola Part Number	Description
C0942	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C0943	2113743L41	CAP CHIP 10000 PF 10% X7R
C0944	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0945	2185802B01	CAP 10V 4.7UF
C0950	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0951	2113741Y32	CAP CER 1,000,000 10% 50V
C0952	NOTPLACED	64AM DUMMY PART NUMBER
C0953	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0954	2113743E20	CAP CHIP .10 UF 10%
C0955	2113741N69	CAP CHIP CL2 X7R 10% 100000
C0956	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C0957	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0959	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0960	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0961	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0962	NOTPLACED	64AM DUMMY PART NUMBER
C0963	2113743N50	CAP CHIP 100 PF 5% COG
C0964	2113743N50	CAP CHIP 100 PF 5% COG
C0965	2113743N50	CAP CHIP 100 PF 5% COG
C0966	2113743N50	CAP CHIP 100 PF 5% COG
C0967	NOTPLACED	64AM DUMMY PART NUMBER
C0968	2113743N50	CAP CHIP 100 PF 5% COG
C0969	2113743N50	CAP CHIP 100 PF 5% COG
C0970	2113743N50	CAP CHIP 100 PF 5% COG
C0971	NOTPLACED	64AM DUMMY PART NUMBER
C0972	2113743E20	CAP CHIP .10 UF 10%
C0973	2113928E01	CAP CER CHIP 1.0 UF 10 % 10V
C0974	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0975	2113743N50	CAP CHIP 100 PF 5% COG
C0976	2113743N50	CAP CHIP 100 PF 5% COG
C0978	2113743N50	CAP CHIP 100 PF 5% COG
C0979	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0980	2113743M24	CAP CHIP 100000 PF +80-20% Y5V

Reference Designator	Motorola Part Number	Description
C0981	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0982	2311049C47	CAP TANT CHIP 22.0UF 10% 16V
C0983	2113743N50	CAP CHIP 100 PF 5% COG
C0984	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0985	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0986	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C0987	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C6000	2113743N37	CAP CHIP 30.0 PF 5% COG
C6001	2113743N36	CAP CHIP 27.0 PF 5% COG
C6002	2113743L41	CAP CHIP 10000 PF 10% X7R
C6003	2113740F58	CAP CHIP REEL CL1 +/-30 200
C6005	2113743N50	CAP CHIP 100 PF 5% COG
C6006	2113743N50	CAP CHIP 100 PF 5% COG
C6007	2113743L25	CAP CHIP 2200 PF 10% X7R
C6010	2113743L41	CAP CHIP 10000 PF 10% X7R
C6011	2113743L41	CAP CHIP 10000 PF 10% X7R
C6012	2113743N50	CAP CHIP 100 PF 5% COG
C6013	2113743N50	CAP CHIP 100 PF 5% COG
C6015	NOTPLACED	64AM DUMMY PART NUMBER
C6016	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6017	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6018	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6019	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6020	2113743L41	CAP CHIP 10000 PF 10% X7R
C6021	2113743L17	CAP CHIP 1000 PF 10% X7R
C6022	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6023	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6024	2113743L41	CAP CHIP 10000 PF 10% X7R
C6025	2113928N01	CAP CER CHIP 0.1UF 10% 6.3

Reference Designator	Motorola Part Number	Description
C6026	2113743N36	CAP CHIP 27.0 PF 5% COG
C6030	2113743L41	CAP CHIP 10000 PF 10% X7R
C6031	2113743N46	QAP CHIP 68.0 PF 5% COG
C6032	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6033	2113743B27	CAP CHIP .680 UF 10% X7R
C6051	2113743N46	QAP CHIP 68.0 PF 5% COG
C6052	2113743N43	CAP CHIP 51.0 PF 5% COG
C6053	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C6054	2113743N28	CAP CHIP 12.0 PF 5% COG
C6055	2113743N24	CAP CHIP 8.2 PF + -.5PF COG
C6056	2113743E20	CAP CHIP .10 UF 10%
C6057	2113743A27	CAP CHIP .470 UF 10% 16V
C6058	NOTPLACED	64AM DUMMY PART NUMBER
C6059	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6060	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6061	NOTPLACED	64AM DUMMY PART NUMBER
C6064	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6067	2113743L41	CAP CHIP 10000 PF 10% X7R
C6068	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C6084	2113743A31	CAP CHIP 1.0 UF 10% X7R
C6091	2113743F18	CAP CHIP 2.2 UF 16V +80-20%
C6096	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6250	2113743L41	CAP CHIP 10000 PF 10% X7R
C6251	2113743L41	CAP CHIP 10000 PF 10% X7R
C6252	2113743L41	CAP CHIP 10000 PF 10% X7R
C6253	2113743L41	CAP CHIP 10000 PF 10% X7R
C6254	2113743L41	CAP CHIP 10000 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C6255	2113743L41	CAP CHIP 10000 PF 10% X7R
C6256	2113743L41	CAP CHIP 10000 PF 10% X7R
C6257	2113743L41	CAP CHIP 10000 PF 10% X7R
C6258	2113743L41	CAP CHIP 10000 PF 10% X7R
C6259	2113743L41	CAP CHIP 10000 PF 10% X7R
C6260	2113743L41	CAP CHIP 10000 PF 10% X7R
C6261	2113743L41	CAP CHIP 10000 PF 10% X7R
C6262	2113743L41	CAP CHIP 10000 PF 10% X7R
C6263	2113743L41	CAP CHIP 10000 PF 10% X7R
C6264	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C6265	2113743L41	CAP CHIP 10000 PF 10% X7R
C6266	2113743L41	CAP CHIP 10000 PF 10% X7R
C6267	2113743L41	CAP CHIP 10000 PF 10% X7R
C6268	2113743L41	CAP CHIP 10000 PF 10% X7R
C6269	2113743L41	CAP CHIP 10000 PF 10% X7R
C6270	2113743N42	CAP CHIP 47.0 PF 5% COG
C6271	2113743N26	CAP CHIP 10.0 PF 5% COG
C6272	2113743N42	CAP CHIP 47.0 PF 5% COG
C6273	2113743N42	CAP CHIP 47.0 PF 5% COG
C6274	2113743L41	CAP CHIP 10000 PF 10% X7R
C6275	2113743L41	CAP CHIP 10000 PF 10% X7R
C6276	2113743L41	CAP CHIP 10000 PF 10% X7R
C6277	2113743L41	CAP CHIP 10000 PF 10% X7R
C6278	2113743L41	CAP CHIP 10000 PF 10% X7R
C6279	2113743L41	CAP CHIP 10000 PF 10% X7R
C6280	2113743L41	CAP CHIP 10000 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C6281	2113743L41	CAP CHIP 10000 PF 10% X7R
C6282	2113743L41	CAP CHIP 10000 PF 10% X7R
C6283	2113743L41	CAP CHIP 10000 PF 10% X7R
C6284	2113743L41	CAP CHIP 10000 PF 10% X7R
C6285	2113743L41	CAP CHIP 10000 PF 10% X7R
C6286	2113743L41	CAP CHIP 10000 PF 10% X7R
C6287	2113743L41	CAP CHIP 10000 PF 10% X7R
C6288	2113743N16	CAP CHIP 3.9 PF +-.25PF COG
C6289	2113743M24	CAP CHIP 100000 PF +80-20% Y5V
C6293	2113743N40	CAP CHIP 39.0 PF 5% COG
C6295	2113743L17	CAP CHIP 1000 PF 10% X7R
C6296	2113743N42	CAP CHIP 47.0 PF 5% COG
C6297	2113743N25	CAP CHIP 9.1 PF + -.5PF COG
C6298	2113743L09	CAP CHIP 470 PF 10% X7R
C6299	2113743L17	CAP CHIP 1000 PF 10% X7R
C6350	NOTPLACED	64AM DUMMY PART NUMBER
C6351	2113743N58	CAP CHIP 4.0PF 16V .25PF COG
C6352	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C6353	2113743N26	CAP CHIP 10.0 PF 5% COG
C6354	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6355	2113743Q03	CAP CHIP 1.0 PF +/- .1PF 20*40
C6356	2113743N58	CAP CHIP 4.0PF 16V .25PF COG
C6357	NOTPLACED	64AM DUMMY PART NUMBER
C6358	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6359	2113928N01	CAP CER CHIP 0.1UF 10% 6.3
C6500	2113743L41	CAP CHIP 10000 PF 10% X7R

Reference Designator	Motorola Part Number	Description
C6501	2113743N40	CAP CHIP 39.0 PF 5% COG
C6502	2113743N40	CAP CHIP 39.0 PF 5% COG
C6503	2113743N50	CAP CHIP 100 PF 5% COG
C6504	2113743L41	CAP CHIP 10000 PF 10% X7R
C6506	2113743N30	CAP CHIP 15.0 PF 5% COG
C6507	2113743L41	CAP CHIP 10000 PF 10% X7R
C6508	2113743L41	CAP CHIP 10000 PF 10% X7R
C6509	2113743N28	CAP CHIP 12.0 PF 5% COG
C6510	2113743N28	CAP CHIP 12.0 PF 5% COG
C6511	2113743N20	CAP CHIP 5.6 PF + -.5PF COG
C6520	2113743N40	CAP CHIP 39.0 PF 5% COG
C6521	2111078B32	CAP CHIP RF 39 5 NPO 100V
C6522	2113741N69	CAP CHIP CL2 X7R 10% 100000
C6523	2113741N69	CAP CHIP CL2 X7R 10% 100000
C6524	2113741N69	CAP CHIP CL2 X7R 10% 100000
C6525	NOTPLACED	64AM DUMMY PART NUMBER
C6540	2113743N40	CAP CHIP 39.0 PF 5% COG
C6541	2111078B14	CAP CHIP RF 11 5 NPO 100V
C6542	2111078B15	CAP CHIP RF 12 5 NPO 100V
C6544	2111078B15	CAP CHIP RF 12 5 NPO 100V
C6545	2111078B15	CAP CHIP RF 12 5 NPO 100V
C6547	2111078B15	CAP CHIP RF 12 5 NPO 100V
C6548	2111078B14	CAP CHIP RF 11 5 NPO 100V
C6549	2111078B16	CAP CHIP RF 13 5 NPO 100V
C6550	2111078B15	CAP CHIP RF 12 5 NPO 100V
C6551	2111078B06	CAP CHIP RF 5.1 .25 NPO 100V
C6552	2111078B15	CAP CHIP RF 12 5 NPO 100V

Reference Designator	Motorola Part Number	Description
C6553	2111078B06	CAP CHIP RF 5.1 .25 NPO 100V
C6554	2111078B16	CAP CHIP RF 13 5 NPO 100V
C6555	2111078B13	CAP CHIP RF 10 .5 NPO 100V
C6556	2111078B01	CAP CHIP RF 3.3 .25 NPO 100V
C6557	2111078B32	CAP CHIP RF 39 5 NPO 100V
C6558	2113743N40	CAP CHIP 39.0 PF 5% COG
C6559	2111078B32	CAP CHIP RF 39 5 NPO 100V
C6560	2113741N69	CAP CHIP CL2 X7R 10% 100000
C6561	2113743E20	CAP CHIP .10 UF 10%
C6562	2113743E20	CAP CHIP .10 UF 10%
C6563	2311049A78	CAP TANT CHIP 10.0 UF 10% 50V
C6564	NOTPLACED	64AM DUMMY PART NUMBER
C6565	2113740B39	CAP CHIP REEL CL1 +/-30 39
C6566	2113740B39	CAP CHIP REEL CL1 +/-30 39
C6700	2113743N40	CAP CHIP 39.0 PF 5% COG
C6701	2111078B32	CAP CHIP RF 39 5 NPO 100V
C6703	2111078B20	CAP CHIP RF 18 5 NPO 100V
C6704	2111078B32	CAP CHIP RF 39 5 NPO 100V
C6705	2111078B32	CAP CHIP RF 39 5 NPO 100V
C6720	2111078B05	CAP CHIP RF 4.7 .25 NPO 100V
C6721	2111078B05	CAP CHIP RF 4.7 .25 NPO 100V
C6730	2113743N40	CAP CHIP 39.0 PF 5% COG
C6731	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C6732	2113743N19	CAP CHIP 5.1 PF + -.5PF COG
C6733	2113743N40	CAP CHIP 39.0 PF 5% COG
C6734	2113951A07	CAP NPO 0.70PF +/- .1PF 250V HI FREQ
C6735	2113951A07	CAP NPO 0.70PF +/- .1PF 250V HI FREQ
C6750	2113743E20	CAP CHIP .10 UF 10%

Reference Designator	Motorola Part Number	Description
C6751	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C6753	2113743E20	CAP CHIP .10 UF 10%
C6755	2113743N50	CAP CHIP 100 PF 5% COG
C6757	2113743E20	CAP CHIP .10 UF 10%
C6758	2113743L17	CAP CHIP 1000 PF 10% X7R
C6759	2113743N38	CAP CHIP 33.0 PF 5% COG
C6760	2113743L17	CAP CHIP 1000 PF 10% X7R
C6761	2113743N40	CAP CHIP 39.0 PF 5% COG
C6763	2113743E20	CAP CHIP .10 UF 10%
C6764	2113743E20	CAP CHIP .10 UF 10%
C6765	2113743E20	CAP CHIP .10 UF 10%
C6766	2113743E20	CAP CHIP .10 UF 10%
C6767	2113743N40	CAP CHIP 39.0 PF 5% COG
C6768	2113743T19	CAP 10UF 16V CER 3225 X5R
C6769	2113743E20	CAP CHIP .10 UF 10%
C6771	2113743E20	CAP CHIP .10 UF 10%
C6773	2113743N40	CAP CHIP 39.0 PF 5% COG
C6775	2113743T19	CAP 10UF 16V CER 3225 X5R
C6776	2113743E12	CAP CHIP .047 UF 10% X7R
C6777	2113743E07	CER CHIP CAP .022UF
C6778	2113743E12	CAP CHIP .047 UF 10% X7R
C6779	2113743E07	CER CHIP CAP .022UF
C6780	2113743N40	CAP CHIP 39.0 PF 5% COG
C6781	NOTPLACED	64AM DUMMY PART NUMBER
C6782	2113743N40	CAP CHIP 39.0 PF 5% COG
C6783	2185419D08	CAP CER SUPER L/D 0.0012UF
C6784	2113743N40	CAP CHIP 39.0 PF 5% COG
C6785	2185419D06	CAP CER SUPER L/D 0.1UF
C6786	2185419D06	CAP CER SUPER L/D 0.1UF
C6787	2185419D06	CAP CER SUPER L/D 0.1UF
C6788	2185419D06	CAP CER SUPER L/D 0.1UF
C6789	2185419D06	CAP CER SUPER L/D 0.1UF

Reference Designator	Motorola Part Number	Description
C6790	2113743K15	CER CHIP CAP .100UF
C6791	2113743K15	CER CHIP CAP .100UF
C6792	2113743T19	CAP 10UF 16V CER 3225 X5R
C6794	2113743A27	CAP CHIP .470 UF 10% 16V
C6795	2113743A27	CAP CHIP .470 UF 10% 16V
C6797	2113743N40	CAP CHIP 39.0 PF 5% COG
C6798	2113743N40	CAP CHIP 39.0 PF 5% COG
C6801	2113743N40	CAP CHIP 39.0 PF 5% COG
C6802	2113743N40	CAP CHIP 39.0 PF 5% COG
C6806	2113743E07	CER CHIP CAP .022UF
C6807	2113743K15	CER CHIP CAP .100UF
C6808	2113743T19	CAP 10UF 16V CER 3225 X5R
C6813	2113743N40	CAP CHIP 39.0 PF 5% COG
C6817	2113743L41	CAP CHIP 10000 PF 10% X7R
C6818	2113743T19	CAP 10UF 16V CER 3225 X5R
C6819	2113743N40	CAP CHIP 39.0 PF 5% COG
C6820	2113743N40	CAP CHIP 39.0 PF 5% COG
C6821	2113743L41	CAP CHIP 10000 PF 10% X7R
C6822	2113743N40	CAP CHIP 39.0 PF 5% COG
C6823	2113743E20	CAP CHIP .10 UF 10%
C6824	2113743N40	CAP CHIP 39.0 PF 5% COG
C6825	2113743N40	CAP CHIP 39.0 PF 5% COG
C6826	2113743L41	CAP CHIP 10000 PF 10% X7R
C6827	2113743N40	CAP CHIP 39.0 PF 5% COG
C6828	2113743N40	CAP CHIP 39.0 PF 5% COG
C6829	2113743N40	CAP CHIP 39.0 PF 5% COG
C6830	2113743N40	CAP CHIP 39.0 PF 5% COG
C6831	2113743N40	CAP CHIP 39.0 PF 5% COG
C6832	2113743N40	CAP CHIP 39.0 PF 5% COG

Reference Designator	Motorola Part Number	Description
C6833	2113743L41	CAP CHIP 10000 PF 10% X7R
C6834	2113743N40	CAP CHIP 39.0 PF 5% COG
C6835	2113743N40	CAP CHIP 39.0 PF 5% COG
C6836	2113743N13	CAP CHIP 3.0 PF +/-25PF COG
C6837	2113743S01	CAP CER CHIP 1.0 UF 10% 16V
C6838	2113743L41	CAP CHIP 10000 PF 10% X7R
C6839	2113743L41	CAP CHIP 10000 PF 10% X7R
C6840	2113743N40	CAP CHIP 39.0 PF 5% COG
C6841	2113743N40	CAP CHIP 39.0 PF 5% COG
D0501	4805218N57	DIODE DUAL
D0950	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0951	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D0952	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D6030	4805656W28	DIODE VARACTOR 18PF@1V +6PF@4V
D6051	4809877C13	DIODE VARACTOR ISV305 SMD
D6250	4880154K06	DIODE PIN SCHOTTKY
D6251	4880154K06	DIODE PIN SCHOTTKY
D6252	4880154K06	DIODE PIN SCHOTTKY
D6253	4880154K06	DIODE PIN SCHOTTKY
D6254	4880154K06	DIODE PIN SCHOTTKY
D6255	4880154K06	DIODE PIN SCHOTTKY
D6256	4880154K06	DIODE PIN SCHOTTKY
D6257	4880154K06	DIODE PIN SCHOTTKY
D6258	4880154K03	DIODE DUAL SCHOTTKY MIXER
D6701	4802482J02	PIN DIODE SMD
D6702	4802482J02	PIN DIODE SMD
D6730	4805218N57	DIODE DUAL
D6731	4805218N57	DIODE DUAL
D6750	4813833C02	DIODE DUAL 70V '5B' COMM CATH
D6751	4802233J09	DIODE TRIPLE SOT25-RH
D6752	4802233J09	DIODE TRIPLE SOT25-RH
E6000	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6001	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6002	2480640Z01	SURFACE MOUNT FERRITE BEAD

Reference Designator	Motorola Part Number	Description
E6003	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6004	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6005	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6006	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6007	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6008	2480640Z01	SURFACE MOUNT FERRITE BEAD
E6751	NOTPLACED	64AM DUMMY PART NUMBER
E6752	NOTPLACED	64AM DUMMY PART NUMBER
E6753	NOTPLACED	64AM DUMMY PART NUMBER
F0400	6583049X16	FUSE 5A FAST ACT
FL0900	9185130D01	FLTR SW CAP 3 POLE BUTTERW
J0401	0985722E01	CONN 50 POS FM SMT RTANG
J0402	0985631E01	CONNECTOR FEMALE 32 PIN ACCY
J0501	0985473E01	CONN SECURE 20 POS FM SMT RT ANG
J0950	0905902V07	CONNECTOR DC
J6700	0905901V11	CONNECTOR RF
L6000	2462587N57	CHIP IND 220 NH 5%
L6001	2405769X05	COIL INDUCTOR
L6002	2405769X05	COIL INDUCTOR
L6003	2462587N76	CHIP IND 4700 NH 5%
L6004	2404574Z34	INDUCTOR 270 NH 2% 0805 WIREWOUND
L6005	2462587N73	WIREWOUND INDUCTOR 2700 NH 5% 1008
L6012	2462587L50	FERRITE INDUCTOR 100UH
L6250	2462587T38	IND CHIP 22NH 5% LOW PRO
L6251	2462587T38	IND CHIP 22NH 5% LOW PRO
L6252	2462587N51	CHIP IND 68 NH 5%
L6253	2462587T38	IND CHIP 22NH 5% LOW PRO
L6254	2462587T38	IND CHIP 22NH 5% LOW PRO
L6255	2462587T30	IND CHIP 1000NH 5% LOW PRO
L6256	2462587T30	IND CHIP 1000NH 5% LOW PRO

Reference Designator	Motorola Part Number	Description
L6257	2462587T30	IND CHIP 1000NH 5% LOW PRO
L6258	2488428L05	IND CHIP WW 7.5NH 5% 2.1A 1608
L6259	2462587T30	IND CHIP 1000NH 5% LOW PRO
L6260	2462587T38	IND CHIP 22NH 5% LOW PRO
L6261	2462587T38	IND CHIP 22NH 5% LOW PRO
L6262	2462587T38	IND CHIP 22NH 5% LOW PRO
L6263	2462587T38	IND CHIP 22NH 5% LOW PRO
L6350	2462587N65	CHIP IND 750 NH 5%
L6351	2462587N64	CHIP IND 680 NH 5%
L6352	2462587N69	CHIP IND 1200 NH 5%
L6353	2462587N65	CHIP IND 750 NH 5%
L6355	2462587N68	CHIP IND 1000 NH 5%
L6500	2462587T17	IND CHIP 150NH 5% LOW PRO
L6501	2462587T17	IND CHIP 150NH 5% LOW PRO
L6502	2488428L05	IND CHIP WW 7.5NH 5% 2.1A 1608
L6521	2484562T04	COIL SURFACE MOUNT AIR WOUND
L6522	2484657R01	INDUCTOR BEAD CHIP
L6542	2460592A01	COIL AW 2 TURN 17 NH
L6543	2484657R01	INDUCTOR BEAD CHIP
L6700	2462587T17	IND CHIP 150NH 5% LOW PRO
L6702	2462587T17	IND CHIP 150NH 5% LOW PRO
L6703	2462587V60	IND CHIP 43 NH 5%
L6720	2484562T21	COIL AIR WOUND ENCAP SPRING AUTO INSERT
L6721	2484562T21	COIL AIR WOUND ENCAP SPRING AUTO INSERT
L6722	2484562T21	COIL AIR WOUND ENCAP SPRING AUTO INSERT
L6730	2488428L09	IND CHIP WW 18 NH 5% 1.9A 1608
L6731	2488428L06	COILCRAFT 0603HC
L6750	2462587Q20	IND CHIP 2,200 NH 20%
L6751	2462587Q20	IND CHIP 2,200 NH 20%
L6752	2462587Q20	IND CHIP 2,200 NH 20%
L6753	2462587Q20	IND CHIP 2,200 NH 20%
L6754	2462587T30	IND CHIP 1000NH 5% LOW PRO
L6755	2462587Q44	IND CHIP 560 NH 10%
L6756	2462587Q47	IND CHIP 1,000 NH 10%
L6757	2462587V20	CHIP IND 3.3 NH 5% 0805

Reference Designator	Motorola Part Number	Description
L6758	2462587V23	CHIP IND 12 NH 5% 0805
L6760	2462587V22	CHIP IND 8.2 NH 5% 0805
L6761	2462587Q44	IND CHIP 560 NH 10%
L6763	2462587V22	CHIP IND 8.2 NH 5% 0805
M6520	2685838C01	HEATSINK PLD1.5 TRANSISTOR ASSY
M6542	2685837C03	HEATSINK TRANSISTOR CARRIER
M6700	NOTPLACED	64AM DUMMY PART NUMBER
M6720	2685059F01	SHIELD,FLTR,,,,,,SHIELD HAR FLTR
M6721	NOTPLACED	64AM DUMMY PART NUMBER
PCB	8485429D01	MAIN BOARD
Q0200	4880048M01	TSTR NPN DIG 47K/47K
Q0402	4880048M01	TSTR NPN DIG 47K/47K
Q0403	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0404	4880048M01	TSTR NPN DIG 47K/47K
Q0500	4880048M01	TSTR NPN DIG 47K/47K
Q0501	4880048M01	TSTR NPN DIG 47K/47K
Q0502	4880048M01	TSTR NPN DIG 47K/47K
Q0503	4813821A09	TSTR P-CH 60V 12A 2955
Q0504	4880048M01	TSTR NPN DIG 47K/47K
Q0505	4880048M01	TSTR NPN DIG 47K/47K
Q0610	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0611	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0612	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0613	4805723X03	TRANS DUAL NPN-PNP UMD3N ROHM
Q0951	4880048M01	TSTR NPN DIG 47K/47K
Q0952	4885844C01	XSTR FET
Q0953	NOTPLACED	64AM DUMMY PART NUMBER
Q0954	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q0955	4809579E16	TSTR MOSFET N-CHAN TN0200T
Q6000	4805218N63	RF TRANS SOT 323 Bfq67w
Q6001	4805128M19	TSTR SOT23 MMBTA13 RH
Q6250	4813824A10	TSTR NPN 40V .2A GEN PURP
Q6251	4805921T04	XISTOR FMC1 RH REELED
Q6252	4805921T04	XISTOR FMC1 RH REELED

Reference Designator	Motorola Part Number	Description
Q6253	4813824A10	TSTR NPN 40V .2A GEN PURP
Q6254	4813824A10	TSTR NPN 40V .2A GEN PURP
Q6255	4880048M01	TSTR NPN DIG 47K/47K
Q6350	4805218N55	TRANSISTOR 3 LEAD BFQ67
Q6520	4813828A09	TSTR 8W 450MHZ 7.5V
Q6540	4813828C46	TSTR 1 GHZ 45W TO270 T&R
Q6541	4813828C46	TSTR 1 GHZ 45W TO270 T&R
Q6753	4805921T04	XISTOR FMC1 RH REELED
Q6755	4805921T04	XISTOR FMC1 RH REELED
Q6756	4805921T04	XISTOR FMC1 RH REELED
Q6757	4813824A10	TSTR NPN 40V .2A GEN PURP
Q6758	4813824A10	TSTR NPN 40V .2A GEN PURP
Q6759	4813824A17	XSTR PNP40V .2A GENP B=100-300
Q6760	4805921T04	XISTOR FMC1 RH REELED
Q6761	4809527E41	TRANSISTOR UHF PRF949 SC75
Q6762	4809527E41	TRANSISTOR UHF PRF949 SC75
Q6763	5186258W01	IC GAAS RF GAIN STAGE
Q6764	4809527E41	TRANSISTOR UHF PRF949 SC75
Q6765	4809527E41	TRANSISTOR UHF PRF949 SC75
Q6766	4809527E41	TRANSISTOR UHF PRF949 SC75
R0101	NOTPLACED	64AM DUMMY PART NUMBER
R0102	NOTPLACED	64AM DUMMY PART NUMBER
R0103	NOTPLACED	64AM DUMMY PART NUMBER
R0104	0662057M98	RES. CHIP 10K 5% 20X40
R0105	0662057M98	RES. CHIP 10K 5% 20X40
R0106	0662057M98	RES. CHIP 10K 5% 20X40
R0107	0662057M01	RES. CHIP 0 5% 20X40
R0108	NOTPLACED	64AM DUMMY PART NUMBER
R0109	0662057M98	RES. CHIP 10K 5% 20X40
R0110	0662057M98	RES. CHIP 10K 5% 20X40
R0111	NOTPLACED	64AM DUMMY PART NUMBER

Reference Designator	Motorola Part Number	Description
R0113	NOTPLACED	64AM DUMMY PART NUMBER
R0114	0662057M01	RES. CHIP 0 5% 20X40
R0115	NOTPLACED	64AM DUMMY PART NUMBER
R0116	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R0117	0662057B46	CHIP RES 10.0 MEG OHMS 5%
R0119	0662057N39	RES. CHIP 470K 5% 20X40
R0120	0662057M98	RES. CHIP 10K 5% 20X40
R0121	0662057M98	RES. CHIP 10K 5% 20X40
R0122	0662057M86	RES CHIP 3300 5% 20X40
R0123	0662057M86	RES CHIP 3300 5% 20X40
R0124	NOTPLACED	64AM DUMMY PART NUMBER
R0125	0662057M98	RES. CHIP 10K 5% 20X40
R0200	0662057M74	RES. CHIP 1000 5% 20X40
R0202	0662057M86	RES CHIP 3300 5% 20X40
R0203	0662057M74	RES. CHIP 1000 5% 20X40
R0204	0662057M68	RES CHIP 560 5% 20X40
R0205	0662057N15	RES. CHIP 47K 5% 20X40
R0206	NOTPLACED	64AM DUMMY PART NUMBER
R0207	0662057M95	RES. CHIP 7500 5% 20X40
R0208	0662057N23	RES. CHIP 100K 5% 20X40
R0209	0662057M98	RES. CHIP 10K 5% 20X40
R0210	0662057N23	RES. CHIP 100K 5% 20X40
R0212	0662057N23	RES. CHIP 100K 5% 20X40
R0216	0662057N23	RES. CHIP 100K 5% 20X40
R0218	0662057M74	RES. CHIP 1000 5% 20X40
R0219	0662057M74	RES. CHIP 1000 5% 20X40
R0220	0662057N05	RES. CHIP 18K 5% 20X40
R0221	0662057M98	RES. CHIP 10K 5% 20X40
R0222	0662057M98	RES. CHIP 10K 5% 20X40
R0223	0662057N05	RES. CHIP 18K 5% 20X40
R0224	0662057M98	RES. CHIP 10K 5% 20X40
R0225	0662057M98	RES. CHIP 10K 5% 20X40
R0226	0662057N12	RES. CHIP 36K 5% 20X40
R0227	0662057N19	RES. CHIP 68K 5% 20X40
R0228	0662057N11	RES. CHIP 33K 5% 20X40
R0229	0662057N19	RES. CHIP 68K 5% 20X40

Reference Designator	Motorola Part Number	Description
R0230	0662057N11	RES. CHIP 33K 5% 20X40
R0231	0662057C01	CHIP RES 0 OHMS +.050 OHMS
R0235	0662057M98	RES. CHIP 10K 5% 20X40
R0236	0662057M97	RES CHIP 9100 5% 20X40
R0303	0662057M78	RES. CHIP 1500 5% 20X40
R0304	0662057M34	RES. CHIP 22 5% 20X40
R0305	0662057M34	RES. CHIP 22 5% 20X40
R0307	0662057M98	RES. CHIP 10K 5% 20X40
R0403	0662057M98	RES. CHIP 10K 5% 20X40
R0404	0662057M74	RES. CHIP 1000 5% 20X40
R0405	0662057M74	RES. CHIP 1000 5% 20X40
R0406	0662057M68	RES CHIP 560 5% 20X40
R0407	0662057M50	RES. CHIP 100 5% 20X40
R0408	0662057M50	RES. CHIP 100 5% 20X40
R0409	0662057M98	RES. CHIP 10K 5% 20X40
R0410	0662057M50	RES. CHIP 100 5% 20X40
R0411	0662057M98	RES. CHIP 10K 5% 20X40
R0412	0662057M50	RES. CHIP 100 5% 20X40
R0415	0662057M50	RES. CHIP 100 5% 20X40
R0416	0662057M50	RES. CHIP 100 5% 20X40
R0417	0662057M50	RES. CHIP 100 5% 20X40
R0418	0662057M50	RES. CHIP 100 5% 20X40
R0419	0662057M90	RES. CHIP 4700 5% 20X40
R0420	0662057M98	RES. CHIP 10K 5% 20X40
R0421	0662057M01	RES. CHIP 0 5% 20X40
R0422	0662057V15	RES CHIP 33K 1% 1/16W
R0425	0662057M98	RES. CHIP 10K 5% 20X40
R0430	0662057M01	RES. CHIP 0 5% 20X40
R0431	0662057M98	RES. CHIP 10K 5% 20X40
R0432	0662057M50	RES. CHIP 100 5% 20X40
R0435	0662057M74	RES. CHIP 1000 5% 20X40
R0500	0662057N23	RES. CHIP 100K 5% 20X40
R0502	0662057N37	RES CHIP 390K 5% 20X40
R0503	0662057N23	RES. CHIP 100K 5% 20X40
R0504	0662057N23	RES. CHIP 100K 5% 20X40
R0505	0662057M98	RES. CHIP 10K 5% 20X40
R0506	0662057M98	RES. CHIP 10K 5% 20X40
R0507	0662057M98	RES. CHIP 10K 5% 20X40
R0508	0662057M98	RES. CHIP 10K 5% 20X40
R0509	0662057M81	RES. CHIP 2000 5% 20X40
R0510	0662057V18	RES CHIP 43K 1% 1/16W
R0511	0662057V15	RES CHIP 33K 1% 1/16W

Reference Designator	Motorola Part Number	Description
R0512	0662057V02	RES CHIP 10K 1% 1/16W
R0513	0662057V17	RES CHIP 39K 1% 1/16W
R0514	0662057M01	RES. CHIP 0 5% 20X40
R0515	0662057M74	RES. CHIP 1000 5% 20X40
R0516	0662057N23	RES. CHIP 100K 5% 20X40
R0517	0662057M90	RES. CHIP 4700 5% 20X40
R0518	0662057M98	RES. CHIP 10K 5% 20X40
R0519	0662057C27	CHIP RES 10 OHMS 5%
R0520	0662057N15	RES. CHIP 47K 5% 20X40
R0521	0662057V17	RES CHIP 39K 1% 1/16W
R0522	0662057V10	RES CHIP 20K 1% 1/16W
R0523	0662057N23	RES. CHIP 100K 5% 20X40
R0524	NOTPLACED	64AM DUMMY PART NUMBER
R0527	NOTPLACED	64AM DUMMY PART NUMBER
R0528	0662057M95	RES. CHIP 7500 5% 20X40
R0529	0662057M76	RES. CHIP 1200 5% 20X40
R0531	0662057N23	RES. CHIP 100K 5% 20X40
R0620	0662057M50	RES. CHIP 100 5% 20X40
R0621	0662057M50	RES. CHIP 100 5% 20X40
R0622	0662057M50	RES. CHIP 100 5% 20X40
R0623	0662057M50	RES. CHIP 100 5% 20X40
R0625	0662057M98	RES. CHIP 10K 5% 20X40
R0626	0662057N23	RES. CHIP 100K 5% 20X40
R0627	0662057N23	RES. CHIP 100K 5% 20X40
R0628	0662057N23	RES. CHIP 100K 5% 20X40
R0629	0662057M98	RES. CHIP 10K 5% 20X40
R0630	0662057N23	RES. CHIP 100K 5% 20X40
R0631	0662057M01	RES. CHIP 0 5% 20X40
R0632	NOTPLACED	64AM DUMMY PART NUMBER
R0634	0662057N23	RES. CHIP 100K 5% 20X40
R0635	0662057N23	RES. CHIP 100K 5% 20X40
R0636	0662057M98	RES. CHIP 10K 5% 20X40
R0638	0662057M98	RES. CHIP 10K 5% 20X40
R0639	0662057M98	RES. CHIP 10K 5% 20X40
R0900	NOTPLACED	64AM DUMMY PART NUMBER

Reference Designator	Motorola Part Number	Description
R0901	0662057M96	RES. CHIP 8200 5% 20X40
R0902	0662057N23	RES. CHIP 100K 5% 20X40
R0903	0662057N23	RES. CHIP 100K 5% 20X40
R0904	0662057N23	RES. CHIP 100K 5% 20X40
R0905	0662057N23	RES. CHIP 100K 5% 20X40
R0907	0662057C01	CHIP RES 0 OHMS +.050 OHMS
R0930	0662057N06	RES. CHIP 20K 5% 20X40
R0931	0662057M98	RES. CHIP 10K 5% 20X40
R0936	0662057M98	RES. CHIP 10K 5% 20X40
R0937	0662057N10	RES. CHIP 30K 5% 20X40
R0938	0662057M98	RES. CHIP 10K 5% 20X40
R0939	0662057N10	RES. CHIP 30K 5% 20X40
R0940	0662057M01	RES. CHIP 0 5% 20X40
R0941	NOTPLACED	64AM DUMMY PART NUMBER
R0942	0662057M96	RES. CHIP 8200 5% 20X40
R0943	0662057N06	RES. CHIP 20K 5% 20X40
R0944	0662057M98	RES. CHIP 10K 5% 20X40
R0945	0662057N11	RES. CHIP 33K 5% 20X40
R0946	NOTPLACED	64AM DUMMY PART NUMBER
R0947	0662057M01	RES. CHIP 0 5% 20X40
R0948	NOTPLACED	64AM DUMMY PART NUMBER
R0950	0662057M01	RES. CHIP 0 5% 20X40
R0951	0662057U98	RES CHIP 7.5K 1% 1/16W
R0952	0662057U78	RES CHIP 1.2K 1% 1/16W
R0953	0662057M01	RES. CHIP 0 5% 20X40
R0954	0662057U98	RES CHIP 7.5K 1% 1/16W
R0955	0662057N23	RES. CHIP 100K 5% 20X40
R0960	0662057N06	RES. CHIP 20K 5% 20X40
R0961	0662057N23	RES. CHIP 100K 5% 20X40
R0962	0662057N23	RES. CHIP 100K 5% 20X40
R0963	0662057N08	RES CHIP 24K 5% 20X40
R0964	0662057N08	RES CHIP 24K 5% 20X40
R0965	0662057M01	RES. CHIP 0 5% 20X40
R0966	0662057M01	RES. CHIP 0 5% 20X40
R0967	0662057V27	RES CHIP 100K 1% 1/1 6W
R0968	0662057V02	RES CHIP 10K 1% 1/16W
R0969	NOTPLACED	64AM DUMMY PART NUMBER

Reference Designator	Motorola Part Number	Description
R0970	NOTPLACED	64AM DUMMY PART NUMBER
R0971	0662057V02	RES CHIP 10K 1% 1/16W
R0972	0662057V02	RES CHIP 10K 1% 1/16W
R0973	0662057N01	RES CHIP 12K 5% 20X40
R0974	0662057V02	RES CHIP 10K 1% 1/16W
R0975	0662057V02	RES CHIP 10K 1% 1/16W
R0976	0662057M74	RES. CHIP 1000 5% 20X40
R0977	0662057M50	RES. CHIP 100 5% 20X40
R0978	0662057M98	RES. CHIP 10K 5% 20X40
R0979	0662057M01	RES. CHIP 0 5% 20X40
R0980	NOTPLACED	64AM DUMMY PART NUMBER
R0981	0662057M84	RES. CHIP 2700 5% 20X40
R0982	0662057N23	RES. CHIP 100K 5% 20X40
R0983	0662057M81	RES. CHIP 2000 5% 20X40
R0984	0662057M01	RES. CHIP 0 5% 20X40
R0985	0662057M01	RES. CHIP 0 5% 20X40
R0986	NOTPLACED	64AM DUMMY PART NUMBER
R0987	0662057M01	RES. CHIP 0 5% 20X40
R0988	0662057M98	RES. CHIP 10K 5% 20X40
R0989	0662057N17	RES. CHIP 56K 5% 20X40
R0990	0662057M91	RES CHIP 5100 5% 20X40
R0991	0662057M98	RES. CHIP 10K 5% 20X40
R0992	0662057V27	RES CHIP 100K 1% 1/1 6W
R0993	0662057U78	RES CHIP 1.2K 1% 1/16W
R0994	0662057M88	RES. CHIP 3900 5% 20X40
R0995	0662057U78	RES CHIP 1.2K 1% 1/16W
R0996	0662057M98	RES. CHIP 10K 5% 20X40
R0997	0662057U78	RES CHIP 1.2K 1% 1/16W
R0998	0662057V02	RES CHIP 10K 1% 1/16W
R0999	0662057V02	RES CHIP 10K 1% 1/16W
R6000	0662057M43	RES. CHIP 51 5% 20X40
R6001	0662057N47	RES. CHIP 1.0 MEG 5% 20X40
R6002	0662057N23	RES. CHIP 100K 5% 20X40
R6003	0662057M98	RES. CHIP 10K 5% 20X40
R6004	0662057M62	RES. CHIP 330 5% 20X40
R6005	0662057M98	RES. CHIP 10K 5% 20X40
R6006	0662057M46	RES. CHIP 68 5% 20X40
R6007	0662057M64	RES. CHIP 390 5% 20X40
R6008	0662057M98	RES. CHIP 10K 5% 20X40
R6009	0662057N08	RES CHIP 24K 5% 20X40
R6011	0662057M01	RES. CHIP 0 5% 20X40
R6012	0662057M01	RES. CHIP 0 5% 20X40

Reference Designator	Motorola Part Number	Description
R6013	0662057M01	RES. CHIP 0 5% 20X40
R6014	0662057M01	RES. CHIP 0 5% 20X40
R6015	0662057M01	RES. CHIP 0 5% 20X40
R6016	0662057M01	RES. CHIP 0 5% 20X40
R6019	0662057M74	RES. CHIP 1000 5% 20X40
R6020	0662057M98	RES. CHIP 10K 5% 20X40
R6021	0662057M98	RES. CHIP 10K 5% 20X40
R6022	0662057M01	RES. CHIP 0 5% 20X40
R6250	0662057N07	RES. CHIP 22K 5% 20X40
R6251	0662057M74	RES. CHIP 1000 5% 20X40
R6252	0662057N07	RES. CHIP 22K 5% 20X40
R6253	0662057A49	CHIP RES 1000 OHMS 5%
R6254	0662057M57	RES CHIP 200 5% 20X40
R6255	0662057M74	RES. CHIP 1000 5% 20X40
R6256	0662057M57	RES CHIP 200 5% 20X40
R6257	0662057N07	RES. CHIP 22K 5% 20X40
R6258	0662057M74	RES. CHIP 1000 5% 20X40
R6259	0662057M57	RES CHIP 200 5% 20X40
R6267	0662057A49	CHIP RES 1000 OHMS 5%
R6268	0662057M57	RES CHIP 200 5% 20X40
R6269	0662057M57	RES CHIP 200 5% 20X40
R6270	0662057M74	RES. CHIP 1000 5% 20X40
R6271	0662057M74	RES. CHIP 1000 5% 20X40
R6272	0662057M57	RES CHIP 200 5% 20X40
R6273	0662057M57	RES CHIP 200 5% 20X40
R6275	0662057A49	CHIP RES 1000 OHMS 5%
R6276	0662057A49	CHIP RES 1000 OHMS 5%
R6277	0662057M57	RES CHIP 200 5% 20X40
R6278	0662057M78	RES. CHIP 1500 5% 20X40
R6279	NOTPLACED	64AM DUMMY PART NUMBER
R6280	0662057M78	RES. CHIP 1500 5% 20X40
R6281	0662057M19	RES. CHIP 5.1 5% 20X40
R6282	0662057M98	RES. CHIP 10K 5% 20X40
R6350	0662057M98	RES. CHIP 10K 5% 20X40
R6352	0662057N13	RES. CHIP 39K 5% 20X40
R6353	0662057M74	RES. CHIP 1000 5% 20X40
R6354	0662057A47	CHIP RES 820 OHMS 5%
R6520	0662057C75	CHIP RES 1000 OHMS 5%
R6521	0662057M24	RES CHIP 8.2 5% 20X40
R6522	0662057M24	RES CHIP 8.2 5% 20X40
R6523	0662057M24	RES CHIP 8.2 5% 20X40
R6524	0662057M24	RES CHIP 8.2 5% 20X40

Reference Designator	Motorola Part Number	Description
R6525	0662057M24	RES CHIP 8.2 5% 20X40
R6526	0680195M01	RES CHIP 10 OHMS 5% .5W
R6527	0611077A01	RES CHIP JUMPER
R6540	0662057C75	CHIP RES 1000 OHMS 5%
R6543	0662057C75	CHIP RES 1000 OHMS 5%
R6544	0680195M01	RES CHIP 10 OHMS 5% .5W
R6545	0685934D01	RES FIXED CHIP (CURRENT SENOR)
R6546	0662057V27	RES CHIP 100K 1% 1/1 6W
R6547	0680194M13	RES 33 OHMS 5% 1W
R6548	0680194M13	RES 33 OHMS 5% 1W
R6549	0662057C27	CHIP RES 10 OHMS 5%
R6550	0662057B55	CHIP RES 2.0 OHMS 5%
R6551	0662057B55	CHIP RES 2.0 OHMS 5%
R6552	0662057B55	CHIP RES 2.0 OHMS 5%
R6553	0662057B55	CHIP RES 2.0 OHMS 5%
R6554	0662057B55	CHIP RES 2.0 OHMS 5%
R6555	0662057B55	CHIP RES 2.0 OHMS 5%
R6556	0662057B55	CHIP RES 2.0 OHMS 5%
R6557	0662057B55	CHIP RES 2.0 OHMS 5%
R6559	0611077A38	RES CHIP 33 5 1/8W
R6560	0611077A38	RES CHIP 33 5 1/8W
R6730	0680149M02	THERMISTOR CHIP 100K OHM
R6731	0662057M98	RES. CHIP 10K 5% 20X40
R6732	0662057M78	RES. CHIP 1500 5% 20X40
R6733	0662057M55	RES CHIP 160 OHM 5%
R6734	0662057M55	RES CHIP 160 OHM 5%
R6735	0662057M56	RES. CHIP 180 5% 20X40
R6736	0662057M56	RES. CHIP 180 5% 20X40
R6737	0662057M78	RES. CHIP 1500 5% 20X40
R6738	0662057M98	RES. CHIP 10K 5% 20X40
R6739	0680149M02	THERMISTOR CHIP 100K OHM
R6740	0611077A98	RES CHIP 10K 5 1/8W
R6752	0662057N23	RES. CHIP 100K 5% 20X40
R6753	0662057N23	RES. CHIP 100K 5% 20X40
R6754	0662057M74	RES. CHIP 1000 5% 20X40
R6755	0662057N23	RES. CHIP 100K 5% 20X40
R6756	0662057M74	RES. CHIP 1000 5% 20X40
R6757	0662057M50	RES. CHIP 100 5% 20X40
R6758	0662057M98	RES. CHIP 10K 5% 20X40
R6760	0662057M86	RES CHIP 3300 5% 20X40

Reference Designator	Motorola Part Number	Description
R6761	0662057M67	RES. CHIP 510 5% 20X40
R6762	0662057M95	RES. CHIP 7500 5% 20X40
R6763	0662057N15	RES. CHIP 47K 5% 20X40
R6764	0662057M78	RES. CHIP 1500 5% 20X40
R6765	0662057M56	RES. CHIP 180 5% 20X40
R6766	0662057M98	RES. CHIP 10K 5% 20X40
R6767	0662057N12	RES. CHIP 36K 5% 20X40
R6768	0662057M95	RES. CHIP 7500 5% 20X40
R6769	0662057M81	RES. CHIP 2000 5% 20X40
R6770	0662057N15	RES. CHIP 47K 5% 20X40
R6774	0662057M62	RES. CHIP 330 5% 20X40
R6775	0662057M98	RES. CHIP 10K 5% 20X40
R6777	0662057M43	RES. CHIP 51 5% 20X40
R6778	0662057M78	RES. CHIP 1500 5% 20X40
R6779	0662057M54	RES. CHIP 150 5% 20X40
R6780	0662057M54	RES. CHIP 150 5% 20X40
R6782	0662057M01	RES. CHIP 0 5% 20X40
R6789	0662057A36	CHIP RES 300 OHMS 5%
R6790	0662057A36	CHIP RES 300 OHMS 5%
R6791	0662057M59	RES CHIP 240 5% 20X40
R6792	0662057M26	RES. CHIP 10 5% 20X40
R6793	0662057M54	RES. CHIP 150 5% 20X40
R6794	0662057M40	RES. CHIP 39 5% 20X40
R6795	0662057M54	RES. CHIP 150 5% 20X40
R6796	0662057M74	RES. CHIP 1000 5% 20X40
R6797	0662057M90	RES. CHIP 4700 5% 20X40
R6798	0662057A36	CHIP RES 300 OHMS 5%
R6799	0662057M61	RES. CHIP 300 5% 20X40
R6800	0662057M32	RES. CHIP 18 5% 20X40
R6801	0683962T44	RES CHIP 62 5-1
R6802	0662057M61	RES. CHIP 300 5% 20X40
R6803	0662057M32	RES. CHIP 18 5% 20X40
R6804	0662057M61	RES. CHIP 300 5% 20X40
R6805	0662057M92	RES. CHIP 5600 5% 20X40
R6806	0662057M74	RES. CHIP 1000 5% 20X40
R6807	0662057C55	CHIP RES 150 OHMS 5%
R6808	0662057M26	RES. CHIP 10 5% 20X40
R6809	0662057M61	RES. CHIP 300 5% 20X40
R6810	0662057M32	RES. CHIP 18 5% 20X40
R6811	0662057M61	RES. CHIP 300 5% 20X40
R6812	0662057M92	RES. CHIP 5600 5% 20X40

Reference Designator	Motorola Part Number	Description
R6813	0662057M74	RES. CHIP 1000 5% 20X40
R6814	0662057C55	CHIP RES 150 OHMS 5%
R6815	0662057M26	RES. CHIP 10 5% 20X40
R6816	0662057M61	RES. CHIP 300 5% 20X40
R6817	0662057M32	RES. CHIP 18 5% 20X40
R6818	0662057M61	RES. CHIP 300 5% 20X40
R6819	0662057N03	RES. CHIP 15K 5% 20X40
R6820	0662057M98	RES. CHIP 10K 5% 20X40
R6821	0662057A23	CHIP RES 82 OHMS 5%
R6823	0662057M63	RES CHIP 360 5% 20X40
R6824	0662057M61	RES. CHIP 300 5% 20X40
R6825	0662057M61	RES. CHIP 300 5% 20X40
R6826	0662057M32	RES. CHIP 18 5% 20X40
R6827	0662057M61	RES. CHIP 300 5% 20X40
R6828	0662057M54	RES. CHIP 150 5% 20X40
R6829	0662057M61	RES. CHIP 300 5% 20X40
R6830	0662057M61	RES. CHIP 300 5% 20X40
R6831	0662057M32	RES. CHIP 18 5% 20X40
R6833	0662057A23	CHIP RES 82 OHMS 5%
SH6000	NOTPLACED	64AM DUMMY PART NUMBER
SH6730	NOTPLACED	64AM DUMMY PART NUMBER
U0001	5185633C34	MODULE RAM/MEMORY
U0102	5185623B01	HIGH SPEED CMOS INVERTER
U0103	5113837A15	IC 3.3V QUAD BUFFER
U0104	5113837A15	IC 3.3V QUAD BUFFER
U0105	5109522E17	IC SNGL NAND TC7S00FU
U0200	5105109Z38	3 VOLT LINEAR PCM CODEC FILTER
U0201	5113819A14	IC QD OP AMP _33204_
U0202	5185353D35	IC DUAL EEPOT 256 TAP
U0203	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0204	5185794L01	AUDIO AMP TAPE AND REEL
U0206	5185143E67	IC LM1971-62 DB LOG POT
U0207	5109731C15	IC OP AMP SNGL OPA237 SOT23
U0208	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0209	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0210	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0300	5113837A15	IC 3.3V QUAD BUFFER
U0303	5113837A15	IC 3.3V QUAD BUFFER
U0304	5187970L15	IC USB TRANS FULL-SPEED

Reference Designator	Motorola Part Number	Description
U0305	5185353D94	IC RS232 TRANSCEIVER
U0307	5109522E17	IC SNGL NAND TC7S00FU
U0308	5109522E74	IC 2-INPUT AND GATE
U0400	4880048M01	TSTR NPN DIG 47K/47K
U0401	5162852A79	IC MOS TTL SPDT ANALOG SC70
U0402	5109522E53	IC SNGL BUF NC7S125P5X SC70
U0500	5183308X01	IC, LM2941, TO DRPOUT RGTR
U0501	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0502	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0503	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0504	5185353D46	IF 4.3V VOLTAGE DETECTOR
U0505	5113816A07	REG 5V POS 500MA MC78M05BDTRK
U0506	5185143E57	CMOS TIMER-LMC555CM
U0507	5185353D55	IC VOLTAGE REGULATOR 100MZ ADJ
U0508	5109522E53	IC SNGL BUF NC7S125P5X SC70
U0601	5109522E17	IC SNGL NAND TC7S00FU
U0602	5113837A15	IC 3.3V QUAD BUFFER
U0603	5113837A15	IC 3.3V QUAD BUFFER
U0604	5113818A14	IC DL OP AMP RAIL TO RAIL
U0605	5109522E17	IC SNGL NAND TC7S00FU
U0606	5105109Z31	IC QUAD 2:1 MUX/DEMUX
U0607	5109522E74	IC 2-INPUT AND GATE
U0608	5109522E74	IC 2-INPUT AND GATE
U0609	5109522E17	IC SNGL NAND TC7S00FU
U0610	5109522E17	IC SNGL NAND TC7S00FU
U0900	5185368C83	IC 12 BIT DAC
U0901	5185143E43	IC 23 MACROCELL CPLD
U0902	5113805B39	IC MUX/DEMUX, TRIP 2-CH ANALOG
U0903	5185143E68	IC LM7219 HIGH SPEED COMPARATOR
U0950	5105625U25	IC 9.3V REG 2941
U0951	5105625U25	IC 9.3V REG 2941
U0952	5185353D35	IC DUAL EEPOT 256 TAP
U0953	5185143E16	IC ANALOG TO DIGITAL CONVERTER
U0954	5109522E17	IC SNGL NAND TC7S00FU
U0955	5113819A14	IC QD OP AMP _33204_
U0956	5185956E24	QUAD OP AMP RAIL TO RAIL 14
U0957	5113819A14	IC QD OP AMP _33204_

Reference Designator	Motorola Part Number	Description
U0958	5109522E17	IC SNGL NAND TC7S00FU
U0959	5185143E05	IC DAC OCTAL 8 BIT
U0960	5113819A14	IC QD OP AMP _33204_
U0962	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U0963	5109522E53	IC SNGL BUF NC7S125P5X SC70
U6000	5185963A85	IC-ABACUS III-LP
U6002	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U6250	5186377E03	MMIC LNA 700-1000 MHZ
U6251	5185353D39	IC DOUBLE BALANCED MIXER 700/800MHZ
U6252	5185963A87	IC ATTENUATOR
U6500	5185130C65	IC VHF/UHF/800 MHZ LD MOS DRIVER
U6540	5185963A15	IC TEMPERATURE SENSOR 1M50C
U6541	5185353D92	IC CURRENT SHUNT MONITOR
U6750	5185353D14	IC SOT23-5 HI PRECISION REG 3V
U6751	5185963A27	IC TESTED AT25016 48 PIN GFP
U6752	5105492X03	IC SNGL HI SPD L-MOS NOT GATE
U6754	0180706G62	MILLENNIUM TRANSMIT VCO 700/800 MHZ
U6755	0180706G61	MILLENNIUM RECEIVER VCO 700/800 MHZ
VR0400	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0402	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0404	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0405	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0406	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0407	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0408	4813832C75	DIODE ZENER QU O
VR0410	4813832C75	DIODE ZENER QU O
VR0411	4805656W39	QUAD ESD SUPPRESSOR ARRAY - 41206ESD
VR0412	4805656W09	DIODE QUAD 20 VOLT ZENER
VR0413	NOTPLACED	64AM DUMMY PART NUMBER
VR0414	4813832C75	DIODE ZENER QU O
VR0417	4813832C75	DIODE ZENER QU O

Reference Designator	Motorola Part Number	Description
VR0418	4813832C75	DIODE ZENER QU O
VR0420	4813830A24	DIODE 11V 5% 225MW MMBZ5241B_
VR0421	4813830A24	DIODE 11V 5% 225MW MMBZ5241B_
VR0422	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0423	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0424	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0425	4805656W10	DIODE DUAL 15 VOLT ZENER
VR0500	4813830A14	DIODE 5.1V 5% 225MW MMBZ5231B_
VR0501	4813830A24	DIODE 11V 5% 225MW MMBZ5241B_
VR0950	4813832C77	TRANS SUP .24V HIGH PWR
VR0951	NOTPLACED	64AM DUMMY PART NUMBER
Y0100	4809995L05	XTAL QUARTZ 32.768KHZ CC4V-T1
Y6750	5185143E07	IC 16.8 MHZ REF OSC .8 PPM
*	1085674C03	PASTE/NC-SMQ230
*	5405569Y02	LBL BARCODE APC
*	5405569Y03	LABEL BARCODE
*	1105033S02	RIBBON LABEL LT. PACK LABEL
*	1105033S13	RIBBON LBL

Chapter 8 Flex Cable Pin-Out Lists

8.1 List of Flex Cables

This chapter lists the pin-out assignments for the following flex cables:

- Dash (Table 8-1 on page 8-1)
- Rear Accessory (Table 8-2 on page 8-1)

8.2 Flex Cables

Table 8-1. Dash Flex Cable J5000 to P0401 Pin-Out List

Signal	J5000 70-Pin (Female)		P0401 50-Pin (Male)
BUS_PWR_OUT	16	<-->	46
SW B+	41-46	<-->	17
A+	33-39	<-->	19, 21
SPKR+	57-60	<-->	9
SPKR-	61-64	<-->	10
MIC_HI	67	<-->	4
RX_AUDIO	68	<-->	5
IGNITION	40	<-->	20
VIP OUT 1_12v	54	<-->	11
VIP OUT 2_12v	52	<-->	12
BRICK_5V	32	<-->	23
SSI_CLKX	20	<-->	31
SSI_DX	22	<-->	34
SSI_RX	23	<-->	33
SSI_FSX	21	<-->	4
FACT BOOT	17	<-->	-
DAMOTE	19	<-->	-
VIP OUT 3_12v	53	<-->	-
GND	Remaining pins	<-->	1, 2, 49, 50

Table 8-2. Rear Accessory Flex Cable J2 to P0402 Pin-Out List

Signal	J2 26-Pin (Female)		P0402 32-Pin (Female)
GND	1, 14	<-->	1, 2, 14, 31, 32
BUS+	2	<-->	3
BUS-	3	<-->	5
TX_DCE	4	<-->	7
RX_DCE	5	<-->	9
USB -	6	<-->	13
USB +	7	<-->	11
RESET	8	<-->	4
BUSY	9	<-->	6
RTS_DCE	10	<-->	8
CTS_DCE	11	<-->	10
USB PWR	12	<-->	12
CHAN ACTIVITY	13	<-->	15
Emergency	15	<-->	28
PTT*= AUX PTT	16	<-->	24
ONE WIRE	17	<-->	27
VIP OUT 1	18	<-->	16
VIP OUT 2	19	<-->	17
Spkr +	20	<-->	19, 21
RX_filt_audio	21	<-->	30
MONITOR / HUB	22	<-->	26
Aux_Mic	23	<-->	29
SW B+	24	<-->	20, 22
IGN	25	<-->	18
Spkr -	26	<-->	23, 25

Notes

Appendix A Replacement Parts Ordering

A.1 Basic Ordering Information

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

Crystal orders should specify the crystal type number, crystal and carrier frequency, and the model number in which the part is used.

A.2 Motorola Online

Motorola Online users can access our online catalog at

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

To register for online access, please call 800-814-0601 (for U.S. and Canada Service Centers only). International customers can obtain assistance at <https://businessonline.motorola.com>.

A.3 Mail Orders

Send written orders to the following addresses:

**Replacement Parts/
Test Equipment/Manuals/
Crystal Service Items:**

Motorola Inc.
Radio Products and Services
Division*
Attention: Order Processing
2200 Galvin Drive
Elgin, IL 60123
U.S.A.

Federal Government Orders:

Motorola Inc.
U.S. Federal Government
Markets Division
Attention: Order Processing
7230 Parkway Drive
Landover, MD 21076
U.S.A.

International Orders:

Motorola Inc.
Radio Products and Services
Division*
Attention: Order Processing
2200 Galvin Drive
Elgin, IL 60123
U.S.A.

* The Radio Products and Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) and/or the Accessories and Aftermarket Division (AAD).

A.4 Telephone Orders

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

U.S. Federal Government Markets Division (USFGMD)
1-800-826-1913 Federal Government Parts - Credit Cards Only
8:30 AM to 5:00 PM (Eastern Standard Time)

A.5 Fax Orders

Radio Products and Services Division*
(United States and Canada)
1-800-622-6210
847-576-3023 (International)

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

A.6 Parts Identification

Radio Products and Services Division*
(United States and Canada)
1-800-422-4210, menu 3

A.7 Product Customer Service

Customer Response Center
(Non-technical Issues)
1-800-247-2346
FAX:1-800-247-2347

* The Radio Products and Services Division (RPSD) was formerly known as the Customer Care and Services Division (CCSD) and/or the Accessories and Aftermarket Division (AAD).

Glossary

This glossary contains an alphabetical listing of terms and their definitions that are applicable to ASTRO portable and mobile subscriber radio products.

Term	Definition
A/D	<i>See analog-to-digital conversion.</i>
ABACUS IC	A custom integrated circuit providing a digital receiver intermediate frequency (IF) backend.
ADC	<i>See analog-to-digital converter.</i>
ADDAG	<i>See Analog-to-Digital, Digital-to-Analog and Glue.</i>
ALC	<i>See automatic level control.</i>
analog	Refers to a continuously variable signal or a circuit or device designed to handle such signals. <i>See also digital.</i>
Analog-to-Digital, Digital-to-Analog and Glue	An integrated circuit designed to be an interface between the radio's DSP, which is digital, and the analog transmitter and receiver ICs.
analog-to-digital conversion	Conversion of an instantaneous dc voltage level to a corresponding digital value. <i>See also D/A.</i>
analog-to-digital converter	A device that converts analog signals into digital data. <i>See also DAC.</i>
automatic level control	A circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR.
band	Frequencies allowed for a specific purpose.
BBP	<i>See baseband interface port.</i>
baseband interface port	Synchronous serial interface to the transceiver board used to transfer transmit and receive audio data.
BGA	<i>See ball grid array.</i>
ball grid array	A type of IC package characterized by solder balls arranged in a grid that are located on the underside of the package.
CODEC	<i>See coder/decoder.</i>
codeplug	A memory chip inside a device that contains various programmable parameters, including frequencies, time-out timer, and so on.

Term	Definition
coder/decoder	A device that encodes or decodes a signal.
CPS	<i>See Customer Programming Software.</i>
Customer Programming Software	Software with a graphical user interface containing the feature set of an ASTRO radio. <i>See also RSS.</i>
D/A	<i>See digital-to-analog conversion.</i>
DAC	<i>See digital-to-analog converter.</i>
default	A pre-defined set of parameters.
digital	Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals. <i>See also analog.</i>
digital-to-analog conversion	Conversion of a digital signal to a voltage that is proportional to the input value. <i>See also A/D.</i>
digital-to-analog converter	A device that converts digital data into analog signals. <i>See also ADC.</i>
Digital Private Line	A type of digital communications that utilizes privacy call, as well as memory channel and busy channel lock out to enhance communication efficiency.
digital signal processor	A microcontroller specifically designed for performing the mathematics involved in manipulating analog information, such as sound, that has been converted into a digital form. DSP also implies the use of a data compression technique.
digital signal processor code	Object code executed by the Digital Signal Processor in an ASTRO subscriber radio. The DSP is responsible for computation-intensive tasks, such as decoding ASTRO signaling.
DPL	<i>See Digital Private Line. See also PL.</i>
DSP	<i>See digital signal processor.</i>
DSP code	<i>See digital signal processor code.</i>
DTMF	<i>See dual tone multi-frequency.</i>
dual tone multi-frequency	The system used by touch-tone telephones. DTMF assigns a specific frequency, or tone, to each key so that it can easily be identified by a microprocessor.
EPOT	Electrically Programmable Digital Potentiometer.
EEPROM	<i>See Electrically Erasable Programmable Read-Only Memory.</i>

Term	Definition
Electrically Erasable Programmable Read-Only Memory	A special type of PROM that can be erased by exposing it to an electrical charge. An EEPROM retains its contents even when the power is turned off.
EME	Electromagnetic Emissions.
ESD	Electrostatic Discharge.
FCC	Federal Communications Commission.
FET	Field-Effect Transistor.
firmware	Code executed by an embedded processor such as the Host or DSP in a subscriber radio. This type of code is typically resident in non-volatile memory and as such is more difficult to change than code executed from RAM.
FGU	<i>See frequency generation unit.</i>
flash	A non-volatile memory device similar to an EEPROM. Flash memory can be erased and reprogrammed in blocks instead of one byte at a time.
FLASHcode	A 13-digit code which uniquely identifies the System Software Package and Software Revenue Options that are enabled in a particular subscriber radio. FLASHcodes are only applicable for radios which are upgradeable through the FLASHport process.
FLASHport®	A Motorola term that describes the ability of a radio to change memory. Every FLASHport radio contains a FLASHport EEPROM memory chip that can be software written and rewritten to, again and again.
FMR	<i>See Florida Manual Revision.</i>
Florida Manual Revision	A publication that provides supplemental information for its parent publication before it is revised and reissued.
frequency	Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).
frequency generation unit	This unit generates ultra-stable, low-phase noise master clock and other derived synchronization clocks that are distributed throughout the communication network.
General-Purpose Input/Output	Pins whose function is programmable.
GPIO	<i>See General-Purpose Input/Output.</i>
host code	Object code executed by the host processor in an ASTRO subscriber radio. The host is responsible for control-oriented tasks such as decoding and responding to user inputs.
IC	<i>See integrated circuit.</i>

Term	Definition
IF	Intermediate Frequency.
IMBE	A sub-band, voice-encoding algorithm used in ASTRO digital voice.
inbound signaling word	Data transmitted on the control channel from a subscriber unit to the central control unit.
integrated circuit	An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.
ISW	<i>See inbound signaling word.</i>
key-variable loader	A device used to load encryption keys into a radio.
kHz	<i>See kilohertz.</i>
kilohertz	One thousand cycles per second. Used especially as a radio-frequency unit.
KVL	<i>See key-variable loader.</i>
LCD	<i>See liquid-crystal display.</i>
LED	<i>See light emitting diode.</i>
light emitting diode	An electronic device that lights up when electricity is passed through it.
liquid-crystal display	An LCD uses two sheets of polarizing material with a liquid-crystal solution between them. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them.
LO	Local oscillator.
low-speed handshake	150-baud digital data sent to the radio during trunked operation while receiving audio.
LSH	<i>See low-speed handshake.</i>
Master In Slave Out	SPI data line from a peripheral to the MCU.
Master Out Slave In	SPI data line from the MCU to a peripheral.
MCU	<i>See microcontroller unit.</i>
MDC	Motorola Digital Communications.
MDI	MCU/DSP Interface internal to the Patriot IC.
MHz	<i>See Megahertz.</i>
Megahertz	One million cycles per second. Used especially as a radio-frequency unit.

Term	Definition
microcontroller unit	Also written as μC . A microprocessor that contains RAM and ROM components, as well as communications and programming components and peripherals.
microprocessor core	The central processing unit of the microprocessor and DSP IC and powered by a lower voltage supply than the logic I/O section.
MISO	<i>See Master In Slave Out.</i>
MOSI	<i>See Master Out Slave In.</i>
multiplexer	An electronic device that combines several signals for transmission on some shared medium (e.g., a telephone wire).
MUX	<i>See multiplexer.</i>
NiCd	Nickel-cadmium.
NiMH	Nickel-metal-hydride.
OMPAC	<i>See over-molded pad-array carrier.</i>
open architecture	A controller configuration that utilizes a microprocessor with extended ROM, RAM, and EEPROM.
oscillator	An electronic device that produces alternating electric current and commonly employs tuned circuits and amplifying components.
OSW	<i>See outbound signaling word.</i>
OTAR	<i>See over-the-air rekeying.</i>
outbound signaling word	Data transmitted on the control channel from the central controller to the subscriber unit.
over-molded pad-array carrier	A Motorola custom IC package, distinguished by the presence of solder balls on the bottom pads.
over-the-air rekeying	Allows the dispatcher to remotely reprogram the encryption keys in the radio.
PA	Power amplifier.
paging	One-way communication that alerts the receiver to retrieve a message.
Patriot IC	A dual-core processor that contains an MCU and a DSP in one IC package.
PC Board	Printed Circuit Board. Also referred to as a PCB.
phase-locked loop	A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.
PL	<i>See private-line tone squelch.</i>

Term	Definition
PLL	<i>See phase-locked loop.</i>
private-line tone squelch	A continuous sub-audible tone that is transmitted along with the carrier. <i>See also DPL.</i>
Programmable Read-Only Memory	A memory chip on which data can be written only once. Once data has been written onto a PROM, it remains there forever.
PROM	<i>See Programmable Read-Only Memory.</i>
PTT	<i>See Push-to-Talk.</i>
Push-to-Talk	The switch or button usually located on the left side of the radio which, when pressed, causes the radio to transmit. When the PTT is released, the unit returns to receive operation.
radio frequency	The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).
radio frequency power amplifier	Amplifier having one or more active devices to amplify radio signals.
Radio Interface Box	A service aid used to enable communications between a radio and the programming software.
Radio Service Software	DOS-based software containing the feature set of an ASTRO radio. <i>See also CPS.</i>
random access memory	A type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes.
RAM	<i>See random access memory.</i>
read-only memory	A type of computer memory on which data has been prerecorded. Once data has been written onto a ROM chip, it cannot be removed and can only be read.
real-time clock	A module that keeps track of elapsed time even when a computer is turned off.
receiver	Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.
registers	Short-term data-storage circuits within the microcontroller unit or programmable logic IC.
repeater	Remote transmit/receive facility that re-transmits received signals in order to improve communications range and coverage (conventional operation).
repeater/talkaround	A conventional radio feature that permits communication through a receive/transmit facility, which re-transmits received signals in order to improve communication range and coverage.

Term	Definition
RESET	Reset line: an input to the microcontroller that restarts execution.
RF	<i>See radio frequency.</i>
RF PA	<i>See radio frequency power amplifier.</i>
RIB	<i>See Radio Interface Box.</i>
ROM	<i>See read-only memory.</i>
RPCIC	Regulator/power control IC.
RPT/TA	<i>See repeater/talkaround.</i>
RSS	<i>See Radio Service Software.</i>
RTC	<i>See real-time clock.</i>
RX	Receive.
RX DATA	Recovered digital data line.
SAP	<i>See Serial Audio CODEC Port.</i>
Serial Audio CODEC Port	SSI to and from the GCAP II IC CODEC used to transfer transmit and receive audio data.
Serial Communication Interface Input Line	A full-duplex (receiver/transmitter) asynchronous serial interface.
SCI IN	<i>See Serial Communication Interface Input Line.</i>
Serial Peripheral Interface	How the microcontroller communicates to modules and ICs through the CLOCK and DATA lines.
signal	An electrically transmitted electromagnetic wave.
Signal Qualifier mode	An operating mode in which the radio is muted, but still continues to analyze receive data to determine RX signal type.
softpot	<i>See software potentiometer.</i>
software	Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.
software potentiometer	A computer-adjustable electronic attenuator.
spectrum	Frequency range within which radiation has specific characteristics.
SPI	<i>See Serial Peripheral Interface.</i>
squelch	Muting of audio circuits when received signal levels fall below a pre-determined value. With carrier squelch, all channel activity that exceeds the radio's preset squelch level can be heard.

Term	Definition
SRAM	<i>See static RAM.</i>
SRIB	Smart Radio Interface Box. <i>See RIB.</i>
SSI	<i>See Synchronous Serial Interface.</i>
Standby mode	An operating mode in which the radio is muted but still continues to monitor data.
static RAM	A type of memory used for volatile, program/data memory that does not need to be refreshed.
Synchronous Serial Interface	DSP interface to peripherals that consists of a clock signal line, a frame synchronization signal line, and a data line.
system central controllers	Main control unit of the trunked dispatch system; handles ISW and OSW messages to and from subscriber units (<i>See ISW and OSW.</i>)
system select	The act of selecting the desired operating system with the system-select switch (also, the name given to this switch).
thin small-outline package	A type of dynamic random-access memory (DRAM) package that is commonly used in memory applications.
time-out timer	A timer that limits the length of a transmission.
TOT	<i>See time-out timer.</i>
transceiver	Transmitter-receiver. A device that both transmits and receives analog or digital signals. Also abbreviated as XCVR.
transmitter	Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.
TSOP	<i>See thin small-outline package.</i>
TX	Transmit.
UART	<i>See also Universal Asynchronous Receiver Transmitter.</i>
UCM	Universal Crypto Module.
UHF	Ultra-High Frequency.
Universal Asynchronous Receiver Transmitter	A microchip with programming that controls a computer's interface to its attached serial devices.
Universal Serial Bus	An external bus standard that supports data transfer rates of 12 Mbps.
Urchin IC	A programmable logic device configured to supply a 2.8 V, 48 kHz square wave at 2% duty cycle and a 2.8 V, 2.4 MHz square wave at 50% duty cycle to the TX modulation DAC using a 16.8 MHz reference input. These clock signals are used by the DAC to convert the digital SSI audio into an analog modulation waveform.

Term	Definition
USB	<i>See Universal Serial Bus.</i>
VCO	<i>See voltage-controlled oscillator.</i>
vector sum excited linear predictive coding	A voice-encoding technique used in ASTRO digital voice.
VHF	Very-High Frequency.
VIP	Vehicle Interface Port.
VOCON	<i>See vocoder/controller.</i>
vocoder	An electronic device for synthesizing speech by implementing a compression algorithm particular to voice. <i>See also voice encoder.</i>
vocoder/controller	A PC board that contains an ASTRO radio's microcontroller, DSP, memory, audio and power functions, and interface support circuitry.
voice encoder	The DSP-based system for digitally processing analog signals, and includes the capabilities of performing voice compression algorithms or voice encoding. <i>See also vocoder.</i>
voltage-controlled oscillator	An oscillator in which the frequency of oscillation can be varied by changing a control voltage.

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