Professional Radio
GP Series

Lowband (29.7-42MHz and 35-50MHz)

Service Information

Issue: June 2002

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Chapter 1

MODEL CHART AND TECHNICAL SPECIFICATIONS

1.0 GP340 / GP380 Model Chart

Professional GP300 Series (LB)						
Model						Description
MDH25BEC9AN3_E						GP340 LB1 29.7-42 MHz 6W 16-Ch
	MDH25BEH9AN6_E					GP380 LB1 29.7-42 MHz 6W 255-Ch
		MDH25CEC9AN3_E				GP340 LB2 35-50 MHz 6W 16-Ch
			MDH25CEH9AN6_E			GP380 LB2 35-50 MHz 6W 255-Ch
					Item	Description
X					PMLB4006_	GP340 LB1 Back Cover Kit
	X				PMLB4016_	GP380 LB1 Back Cover Kit
		X			PMLB4012_	GP340 LB2 Back Cover Kit
			X		PMLB4017_	GP380 LB2 Back Cover Kit
X		X			6864110B13	GP340 Basic User Guide
	X		X		6864110B18	GP380 Basic User Guide
X	X	X	X		NAB6064_	Low/Mid Band (29-50MHz) Heliflex, Trimmable Antenna
X	X	X	X		HNN9008_	Battery, NiMH Standard

x = Indicates one of each is required.

2.0 Technical Specifications

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

General Specifications		
Channel Capacity **GP340** **GP380**	 16 255	
Power Supply	Rechargeable battery 7.5v	
Dimensions: H x W x D (mm) With standard high capacity NiMH battery With ultra high capacity NiMH battery With NiCD battery With Lilon battery	Height excluding knobs 137 x 57.5 x 37.5 137 x 57.5 x 40.0 137 x 57.5 x 40.0 137 x 57.5 x 33.0	
Weight: (gm) With Standard high capacity NiMH battery With Ultra high capacity NiMH battery With NiCD battery With Lilon battery	**GP340** 420 500 450 350	**GP380** 428 508 458 358
Average Battery Life @5/5/90 Cycle: With Standard high capacity NiMH battery With Ultra high capacity NiMH battery With NiCD battery With Lilon battery	Low Power 11 hours 14 hours 12 hours 11 hours	High Power 8 hours 11 hours 9 hours 8 hours
Sealing:	Withstands rain testing per MIL STD 810 C/D /E and IP54	
Shock and Vibration:	Protection provided via impact resistant housing exceeding MIL STD 810-C/D /E and TIA/EIA 603	
Dust and Humidity:	Protection provided via environment resistant housing exceeding MIL STD 810 C/D /E and TIA/EIA 603	

Transmitter	LB
*Frequencies - Full Bandsplit	LB1 29.7-42 MHz LB2 35-50 MHz
Channel Spacing	12.5/20/25 kHz
Frequency Stability (-25°C to +55°C, +25° Ref.)	±10ppm
Power	1-6W
Modulation Limiting	±2.5 @ 12.5 kHz ±4.0 @ 20 kHz ±5.0 @ 25 kHz
FM Hum & Noise	-40 dB typical
Conducted/Radiated Emission	-36 dBm <1 GHz -30 dBm >1 GHz
Adjacent Channel Power	-60 dB @ 12.5 kHz -70 dB @ 25 kHz
Audio Response (300 - 3000 Hz)	+1 to -3 dB
Audio Distortion	<3% typical

Receiver	LB
*Frequencies - Full Bandsplit	LB1 29.7-42 MHz LB2 35-50 MHz
Channel Spacing	12.5/20/25 kHz
Sensitivity (12 dB SINAD) EIA Sensitivity (20 dB SINAD) ETS	0.25 µV typical 0.50 µV typical
Intermodulation EIA	65 dB
Adjacent Channel Selectivity	60 dB @ 12.5 kHz 70 dB @ 25 kHz
Spurious Rejection	>70 dB
Rated Audio	0.5W
Audio Distortion @ Rated Audio	<3% typical
Hum & Noise	-45 dB @ 12.5 kHz -50 dB @ 20/25 kHz
Audio Response (300 - 3000 Hz)	+1 to -3 dB
Conducted Spurious Emission	-57 dBm <1 GHz -47 dBm >1 GHz ETS 300 086

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

Chapter 2

THEORY OF OPERATION

1.0 Introduction

This chapter provides a detailed theory of operation for the radio RF circuits. Refer to the relevant section of this manual for details of the operation of the Controller Circuits.

2.0 Lowband Transmitter

(*Refer to Figure 2-1 and the Lowband Transmitter schematic diagram*)

The Lowband transmitter consists of the following basic circuits :

- Power amplifier (PA).
- Antenna switch/harmonic filter.
- Antenna matching network.
- Power Control Integrated Circuit (PCIC).

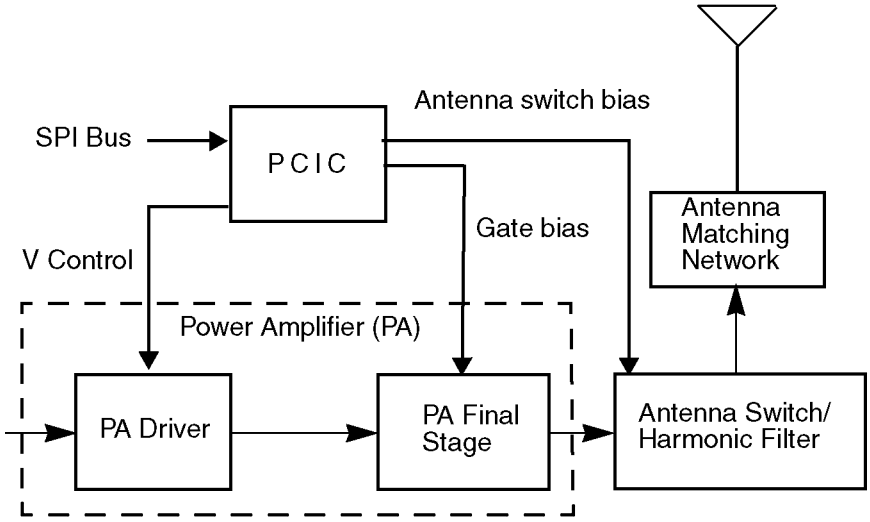


Figure 2-1 Lowband Transmitter Block Diagram.

2.1 Power Amplifier (PA)

The power amplifier (PA) consists of two LDMOS devices:

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

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

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

2.2 Antenna Switch

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

2.3 Harmonic Filter

The harmonic filter consists of components C103, C106, C107, C110, C111, C114, C115 and inductors L100, L101 and L102, which are a part of the SH100 assembly. The harmonic filter for lowband is pole zero design which gives greater attenuation in low frequencies where the harmonic energy of the transmitter is the greatest and less attenuation in high frequencies where there is less harmonic energy. The harmonic filter insertion loss is typically less than 0.8 dB.

2.4 Antenna Matching Network

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

2.5 Power Control Integrated Circuit (PCIC)

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

2.6 Temperature Cut Back Circuit

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

3.0 Lowband Receiver

(*Refer to Figure 2-2 and the Receiver Front End and Receiver Back End schematic diagrams)*

The Lowband receiver consists of a front end, back end, and automatic gain control circuits. Detailed descriptions of these stages are contained in the paragraphs that follow.

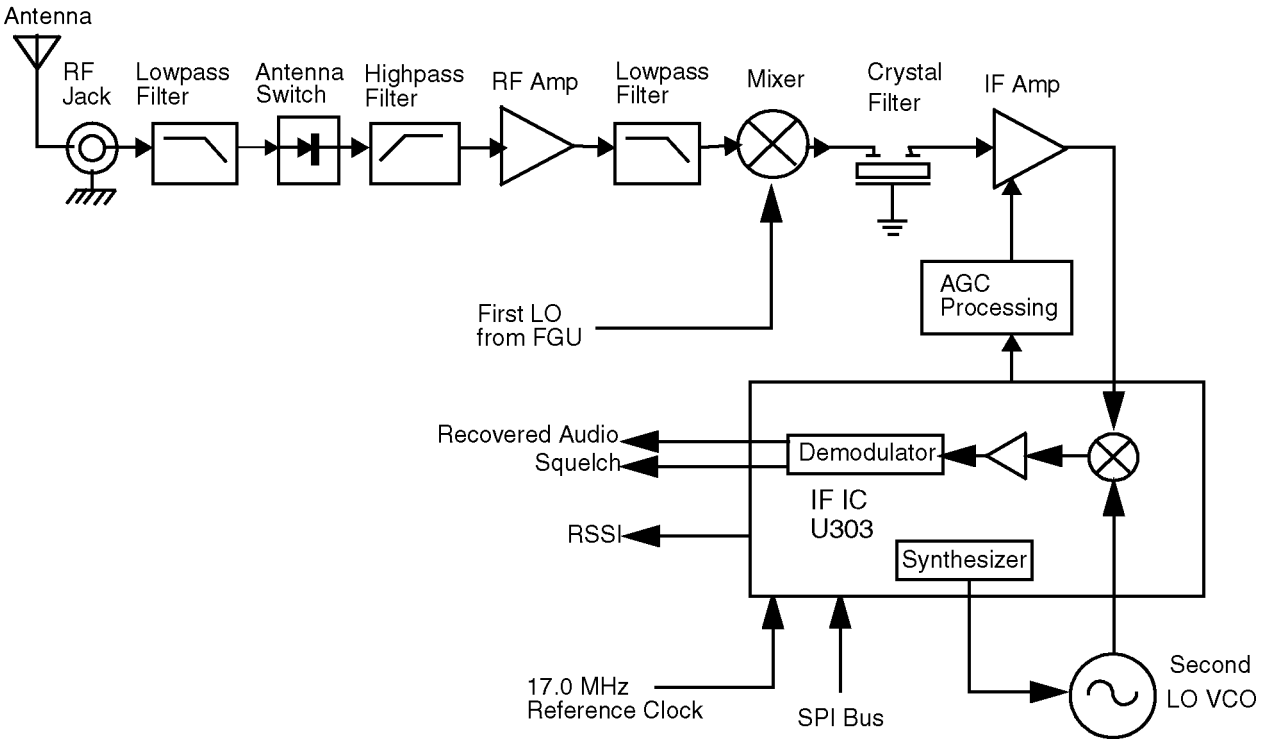


Figure 2-2 Lowband Receiver Block Diagram.

3.1 Receiver Front-End

(*Refer to the Receiver Front End, Receiver Back end and Transmitter schematic diagrams*)

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

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

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

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

3.2 Receiver Back-End

(*Refer to the Receiver Back End schematic diagram*)

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

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

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

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

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

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

3.3 Automatic Gain Control (AGC)

(Refer to the Receiver Front End and Receiver Back End schematic diagrams)

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

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

4.0 Frequency Generation Circuit

(*Refer to Figure 2-3, the Synthesizer and Voltage controlled Oscillator schematic diagrams*)

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

The synthesizer is powered by regulated 5V and 3.3V. The 5 volt signal to the synthesizer as well as the rest of the radio is provided by U204. The 3.3 v signal is provided from U200 in the controller. The 5V signal goes to pins 13 and 30 while the 3.3V signal goes to pins 5, 20, 34 and 36 of U201. The synthesizer in turn generates a superfiltered 4.3V which powers the VCOs and buffers.

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

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

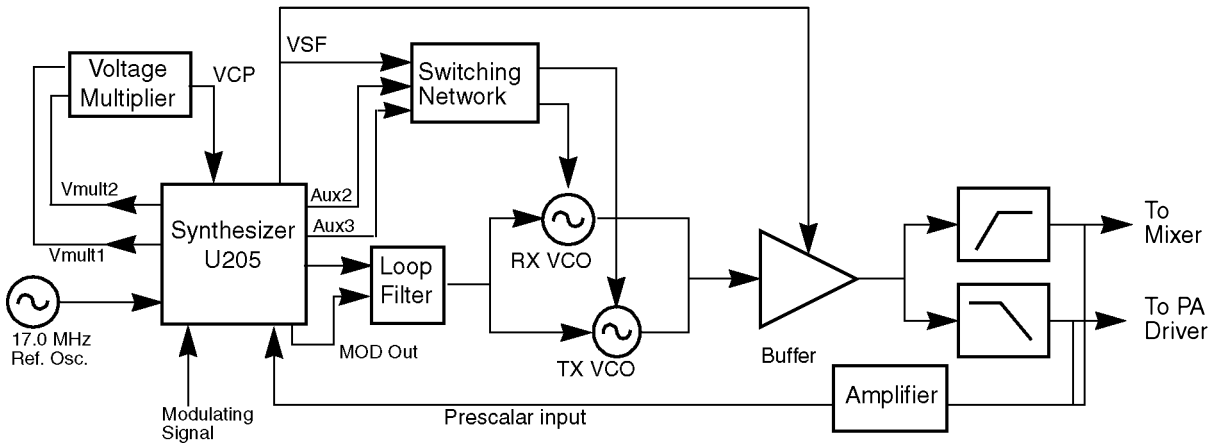


Figure 2-3 Lowband Frequency Generation Unit Block Diagram

4.1 Synthesizer

(Refer to Figure 2-4 and the Synthesizer schematic diagram)

The Fractional-N synthesizer, shown in Figure 2-4, uses a 17.0 MHz crystal (Y201) to provide a reference for the system. Along with being used in the LVFracN, the 17.0 MHz signal is provided at pin 19 of U205 for use by the ASFIC and LVZIF.

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

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

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

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

Both the normal and adapt charge pumps get their supply from the inductive voltage multiplier made up of C247, C249, C283-C286, D210, D211, R285 and R286.
This circuit provides 13.3V at U205, pin 47.

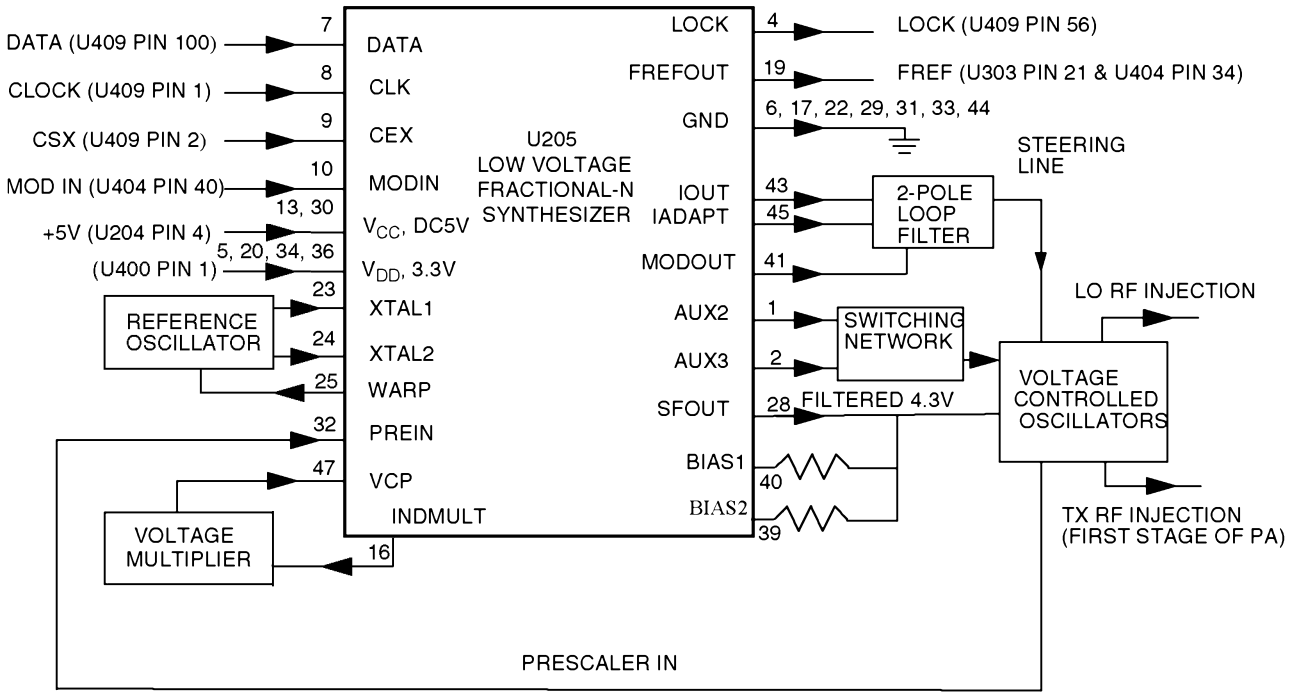


Figure 2-4 Lowband Synthesizer Block Diagram.

4.2 Voltage Controlled Oscillator (VCO)

(*Refer to the Voltage Controlled Oscillator schematic diagram*)

4.2.1 Receive VCO

The receive VCO is a Colpitts type design and using two active devices in parallel, Q202 and Q204. The oscillator is powered off of the 4.3 volt super filter supply when the AUX3 line goes low. The oscillator operates from 139 to 152 MHz for range 1 and 145 to 160 MHz for range 2. The frequency is tuned by varactor diodes CR201 and CR202.

4.2.2 Transmit VCO

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

4.2.3 Buffer

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

4.2.4 Diplexer and Output Filters

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

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

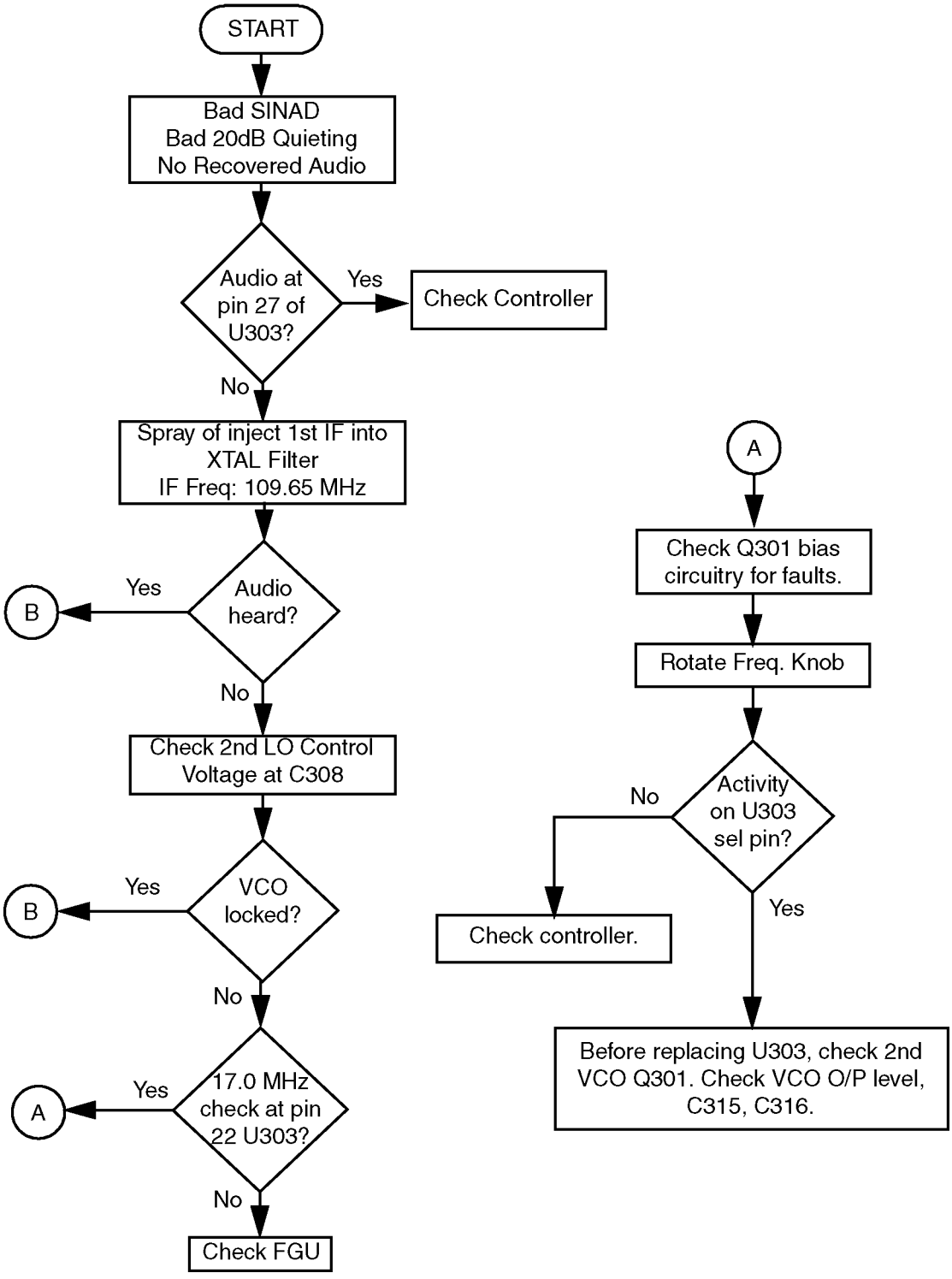
4.2.5 Prescaler Feedback

The prescaler input signal for receive and transmit is tapped off the outputs of each filter by resistors R234 and R238. This signal is routed to the buffer amplifier consisting of components C287, Q288, R287, R288 and R289. The output of this buffer feeds U205 pin 32. After frequency comparison in the synthesizer, current is transferred in the loop filter and a control voltage is generated at the output of the loop filter to adjust the frequency of the VCO. This voltage is a DC voltage between 3.5V and 9.5V when the PLL is locked on frequency.

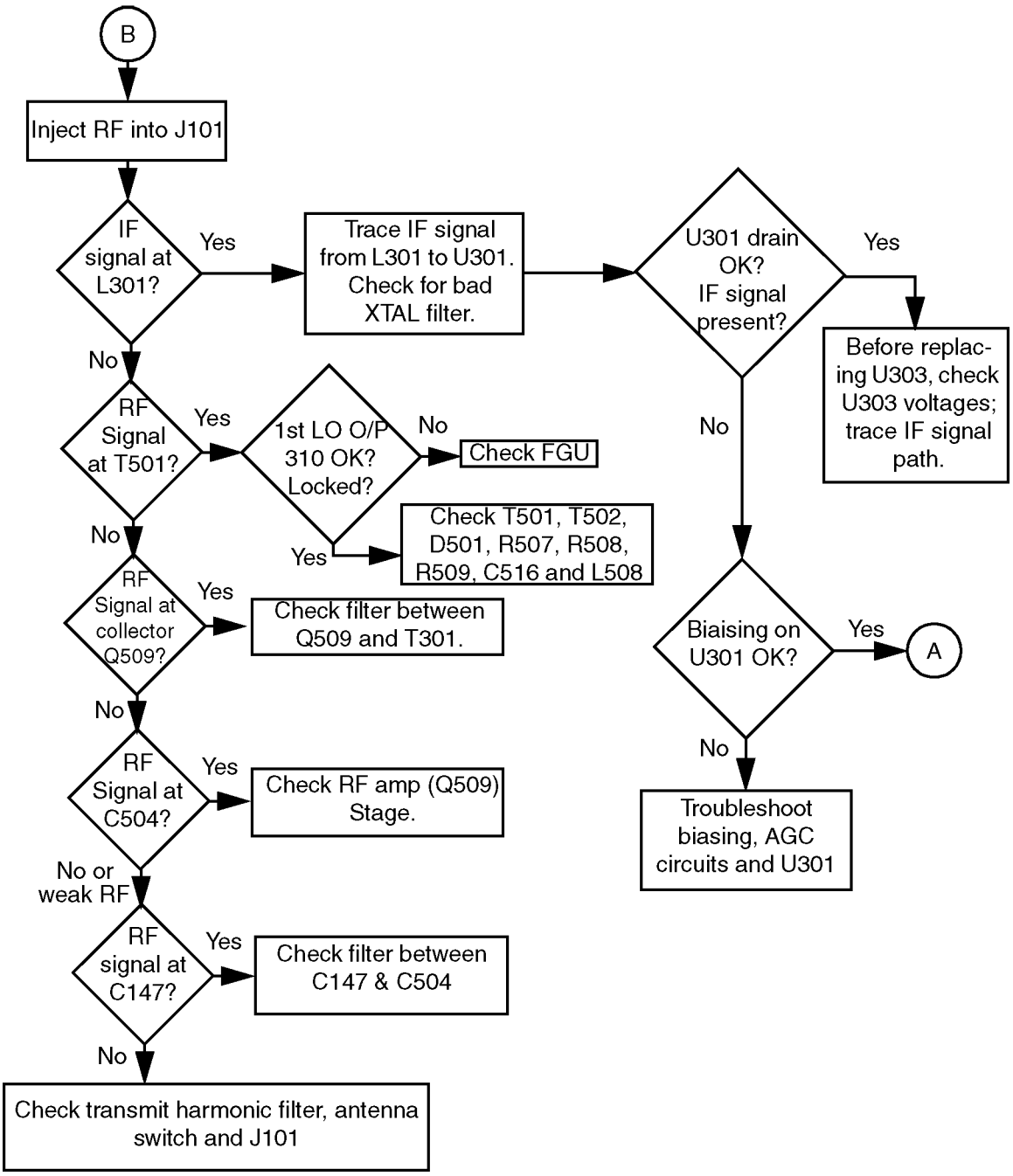
Chapter 3

TROUBLESHOOTING CHARTS

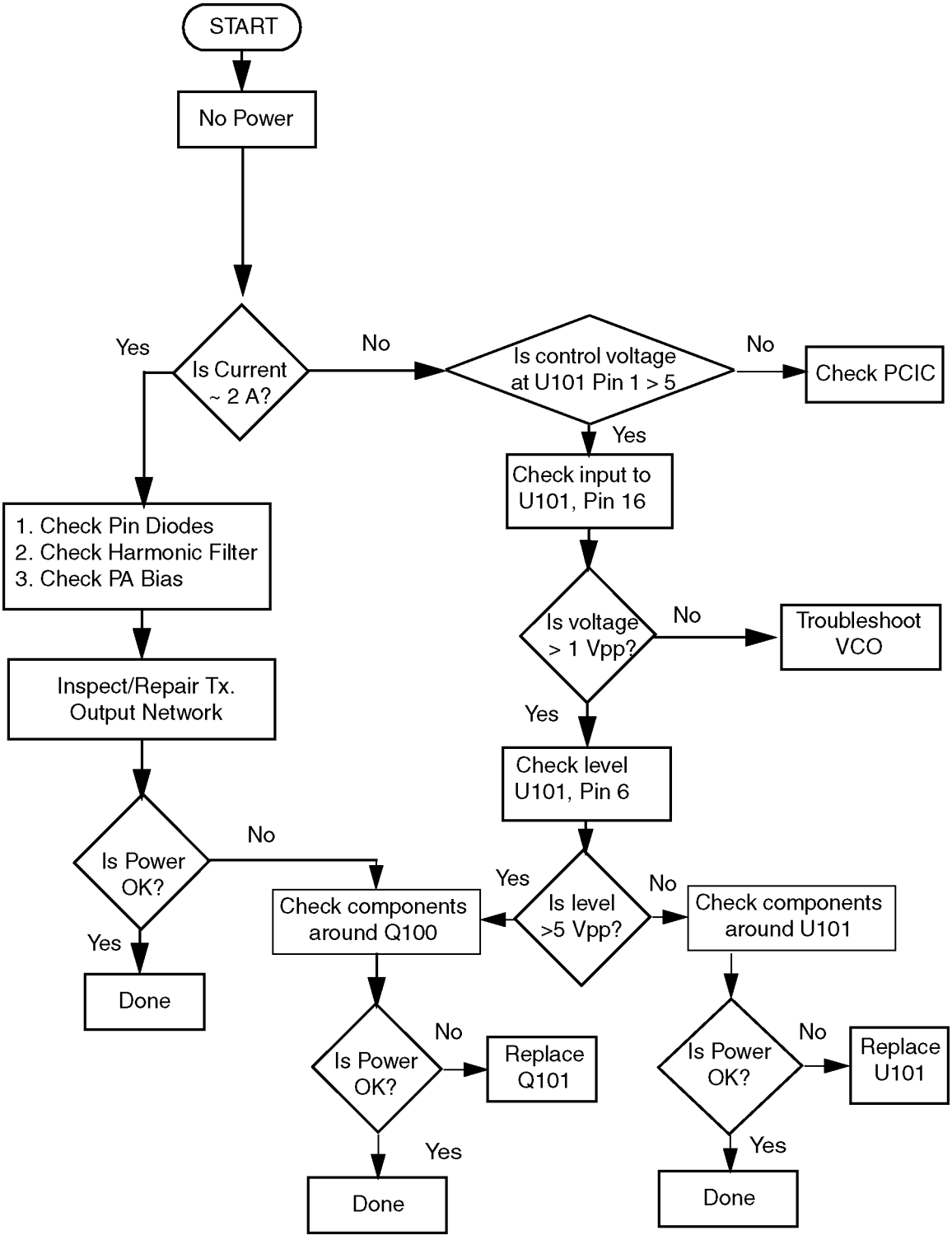
1.0 Receiver (Sheet 1 of 2)



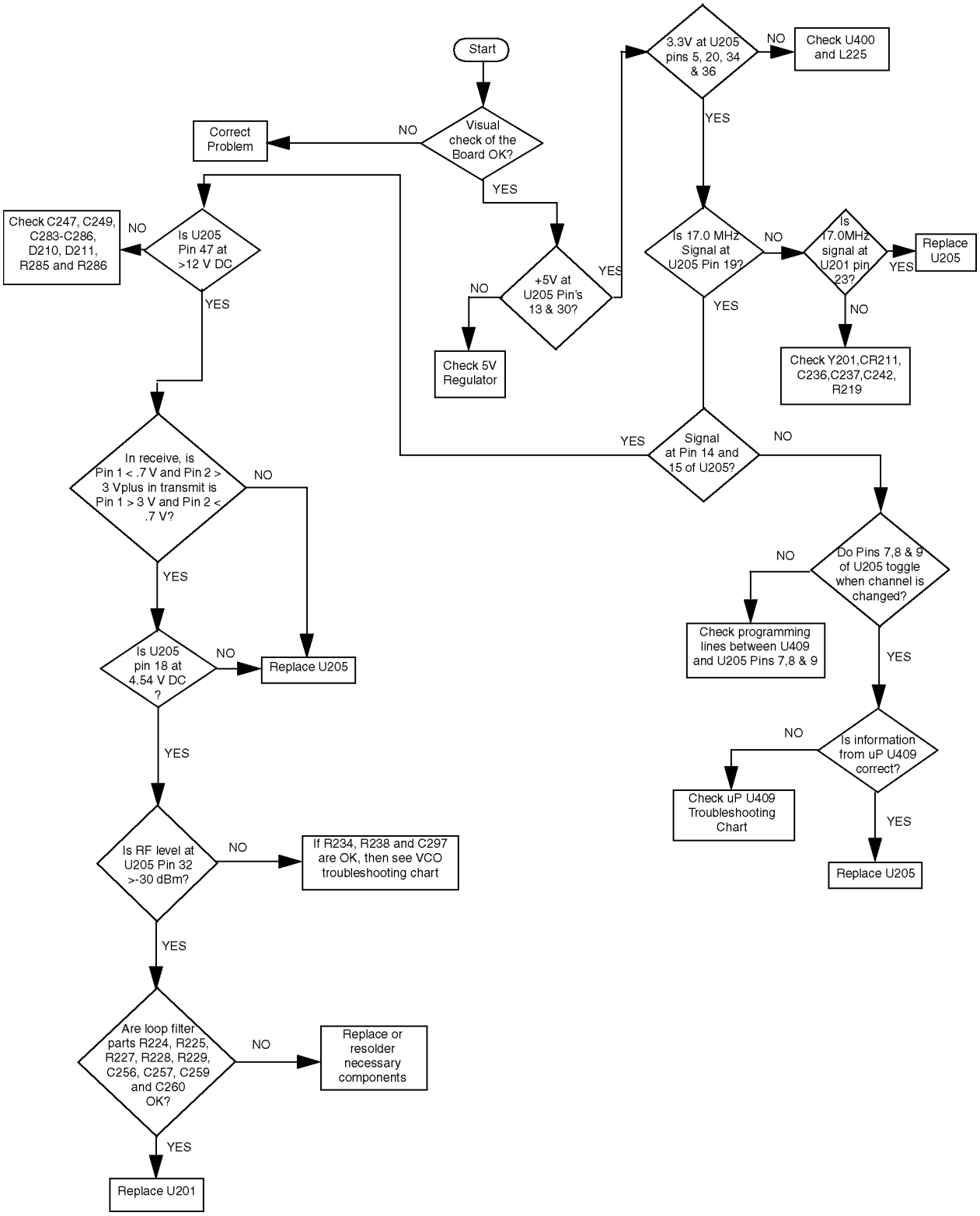
2.0 Receiver (Sheet 2 of 2)



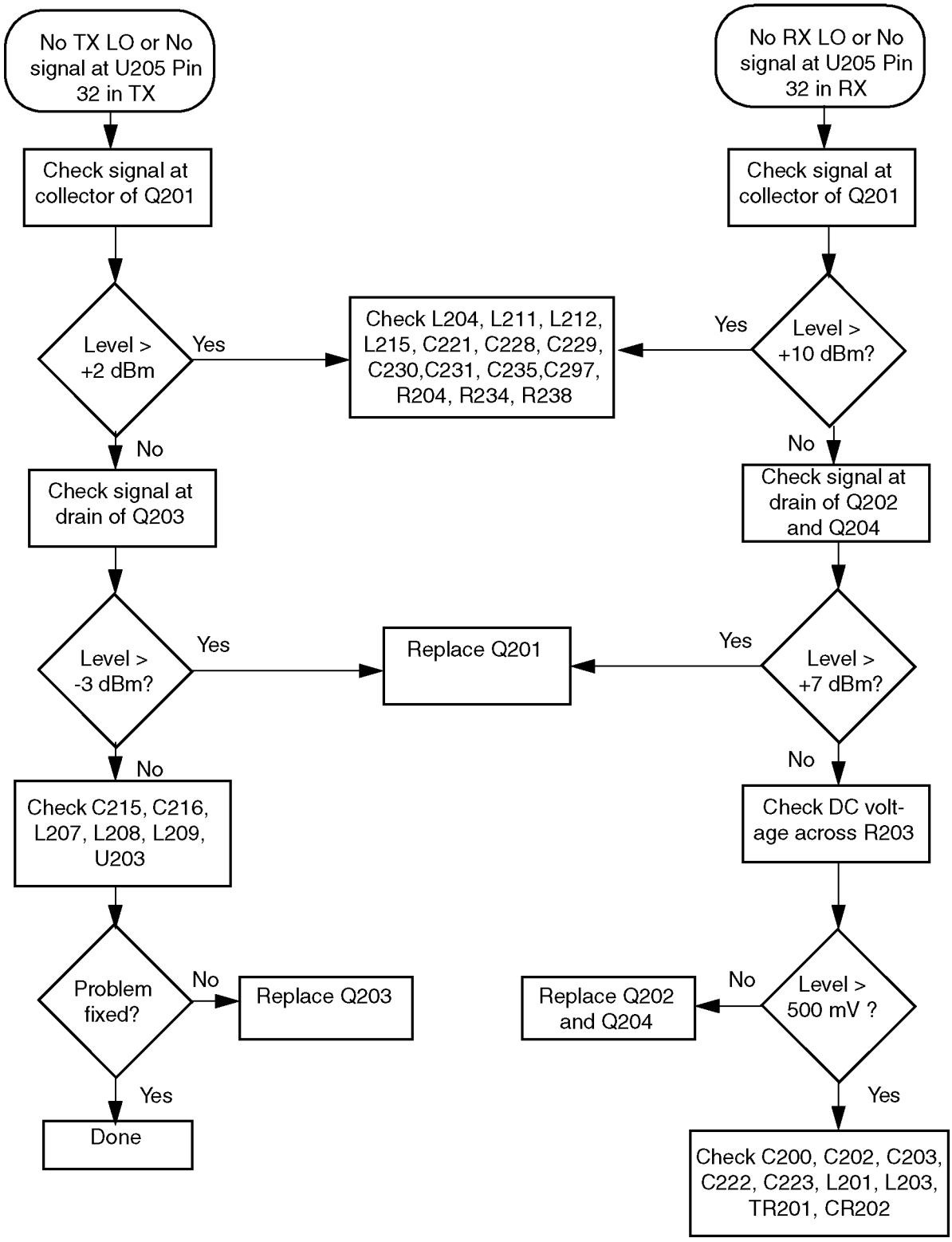
3.0 Transmitter



4.0 Synthesizer



5.0 Voltage Controlled Oscillator



Chapter 4

LOWBAND PCB/SCHEMATICS/PARTS LIST

1.0 Allocation of Schematics and Circuit Boards

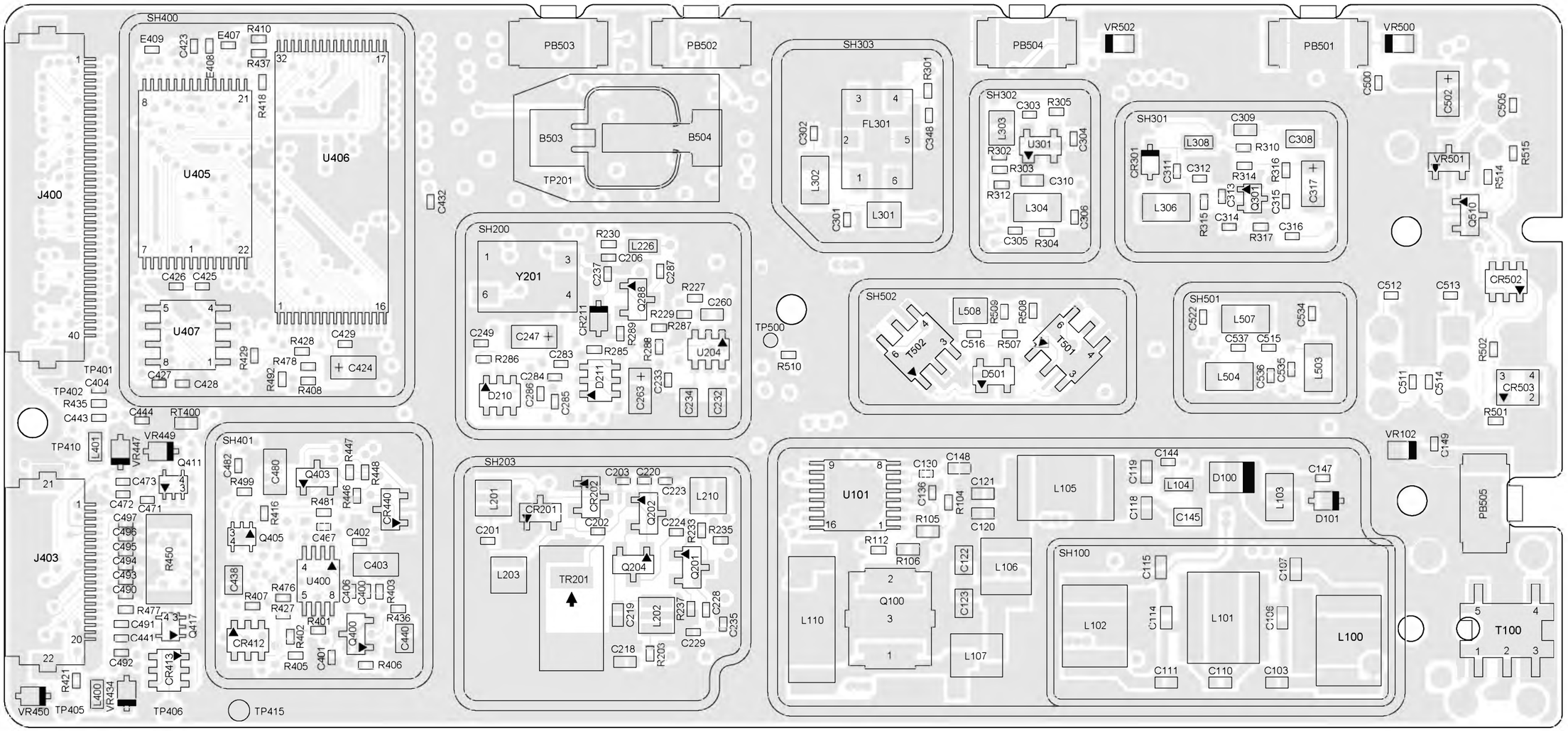
1.1 Controller Circuits

The Lowband circuits are contained on the printed circuit board (PCB) which also contains the Controller circuits. This chapter shows the schematics for the Lowband circuits only, refer to the Controller section for details of the related Controller circuits. The PCB component layouts and the Parts Lists in this chapter show both the Controller and Lowband circuit components. The Lowband schematics and the related PCB and parts list are shown in the Table below.

Table 4-1 Lowband Diagrams and Parts

2.0 Lowband PCB 8485658Z03 / Schematics

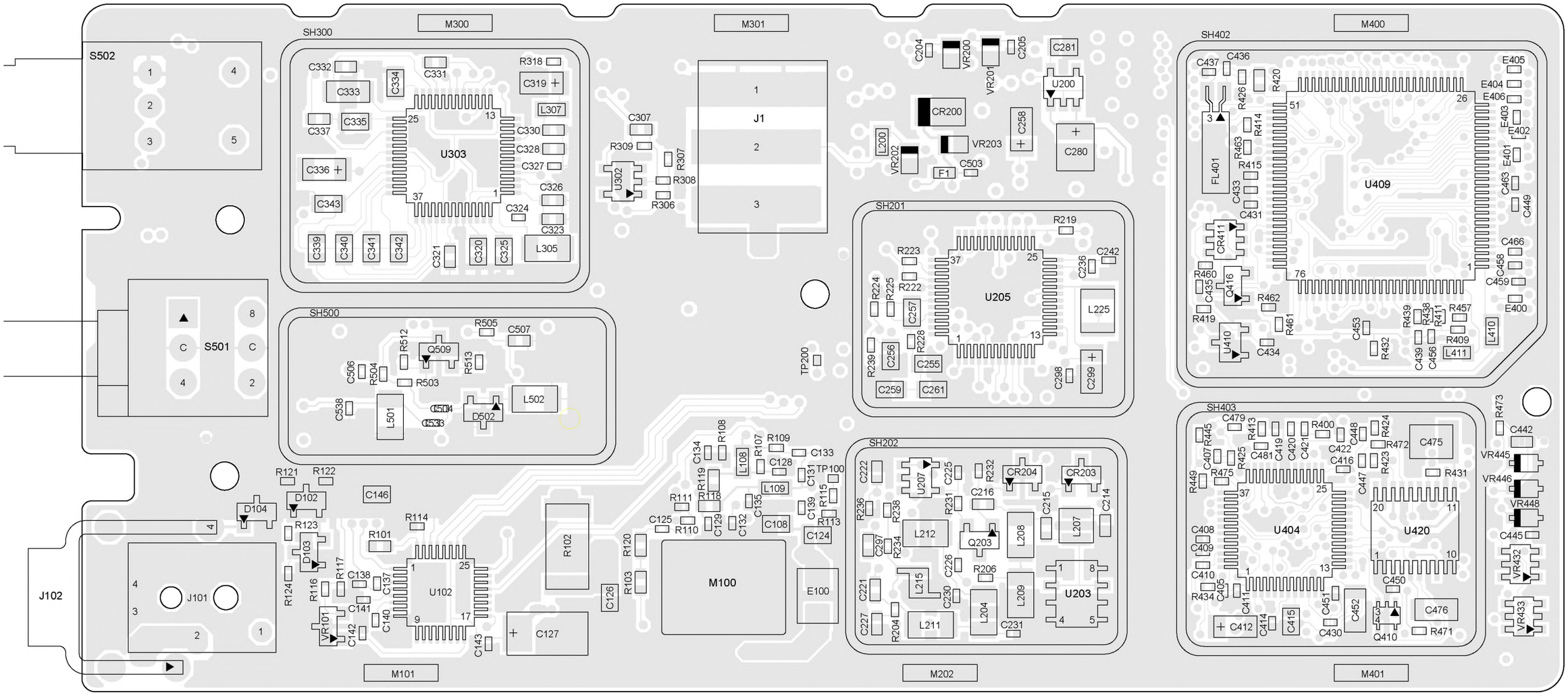
VIEWED FROM SIDE 1



FL0830829-O

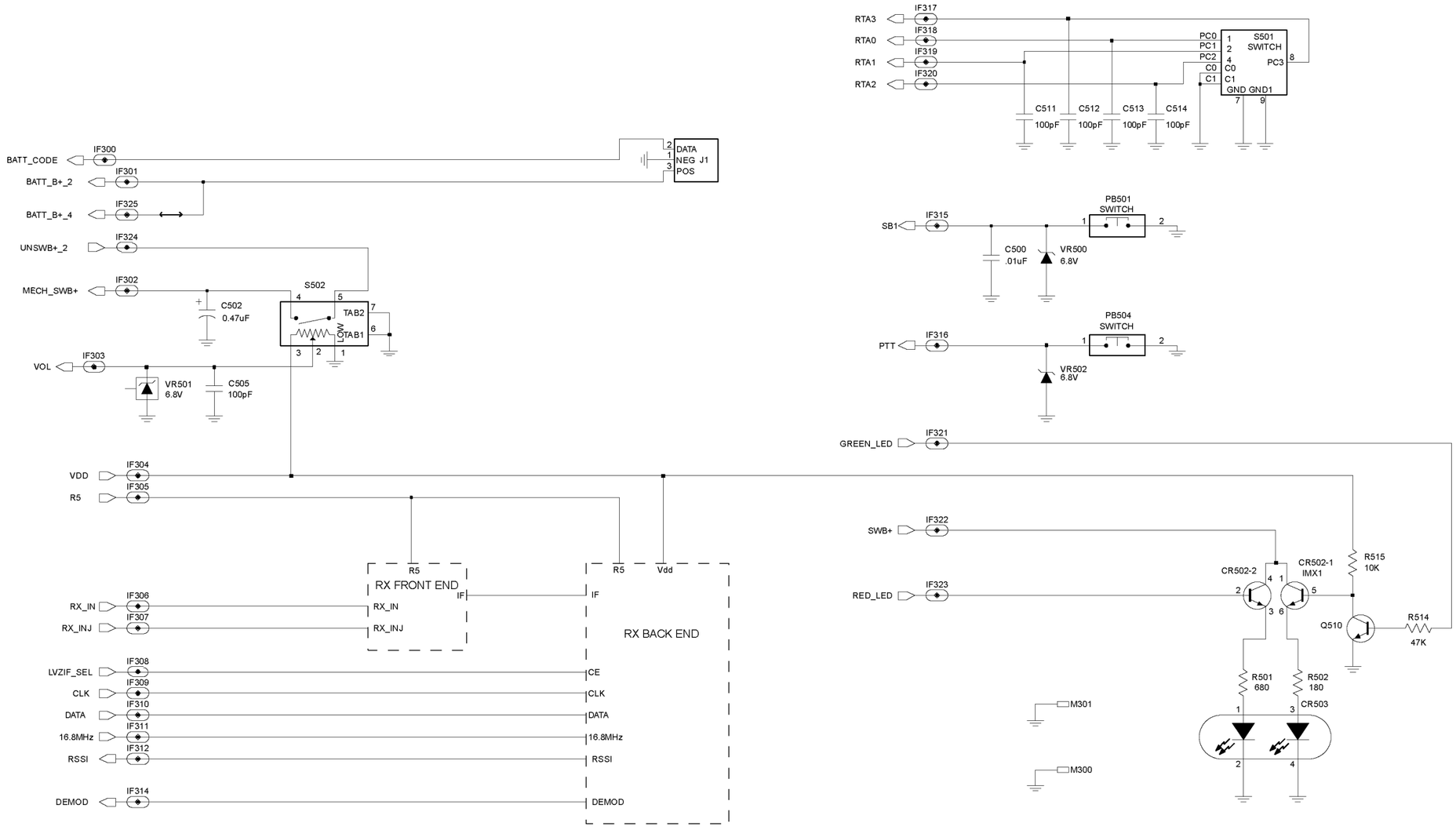
Lowband (30-50 MHz) Main Board Top Side

VIEWED FROM SIDE 2



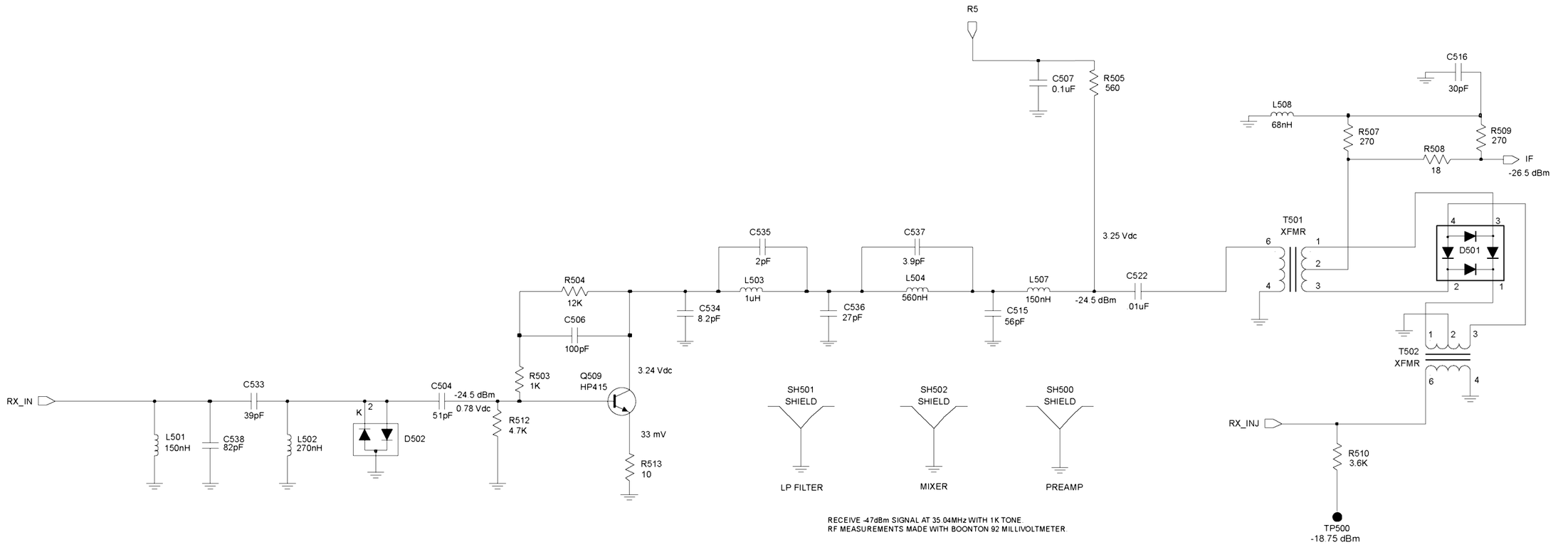
FL0830830-O

Lowband (30-50 MHz) Main Board Bottom Side



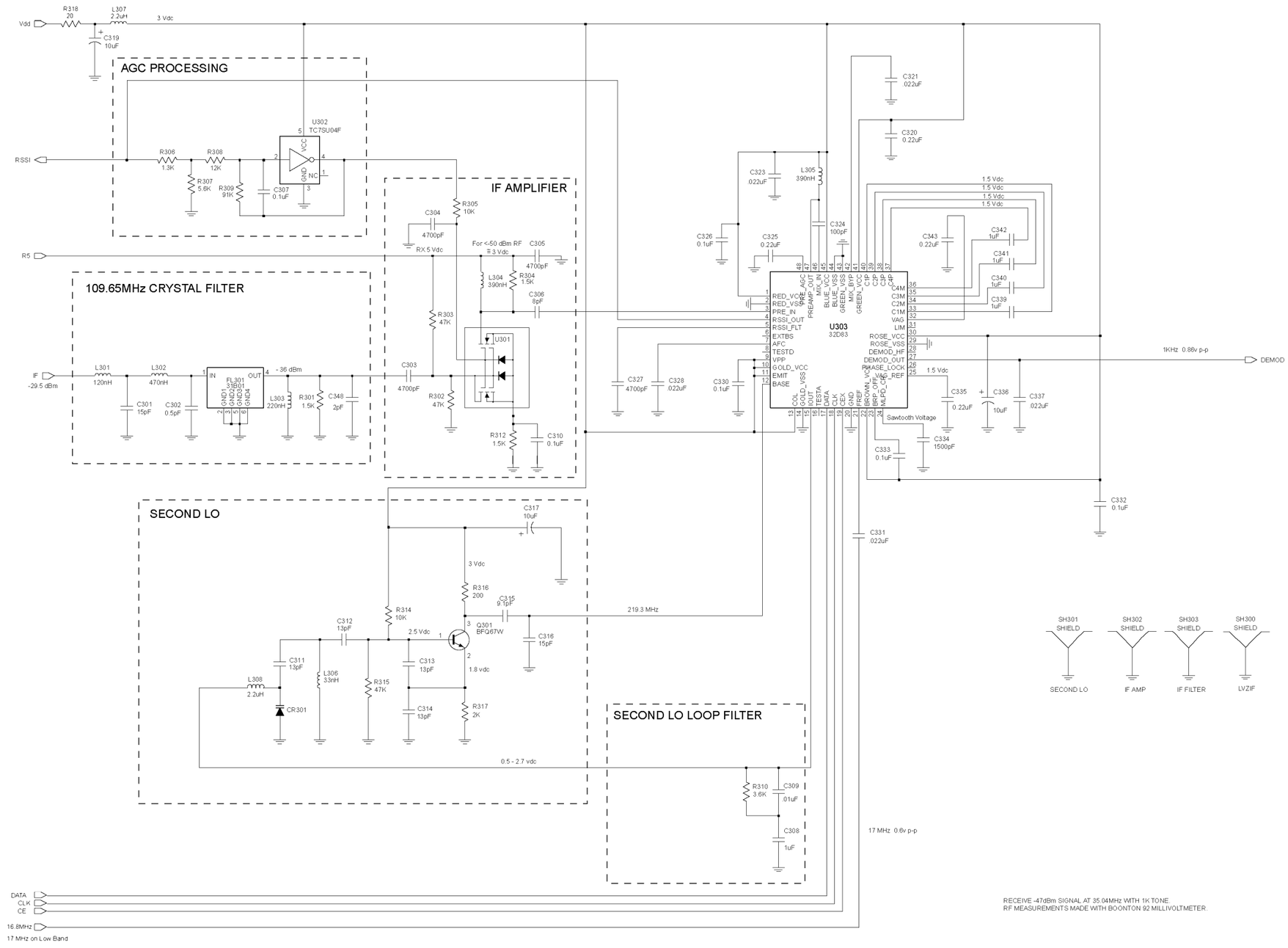
FL0830470-O

Lowband (30-50 MHz) Receiver Overall Schematic



FL0830471-O

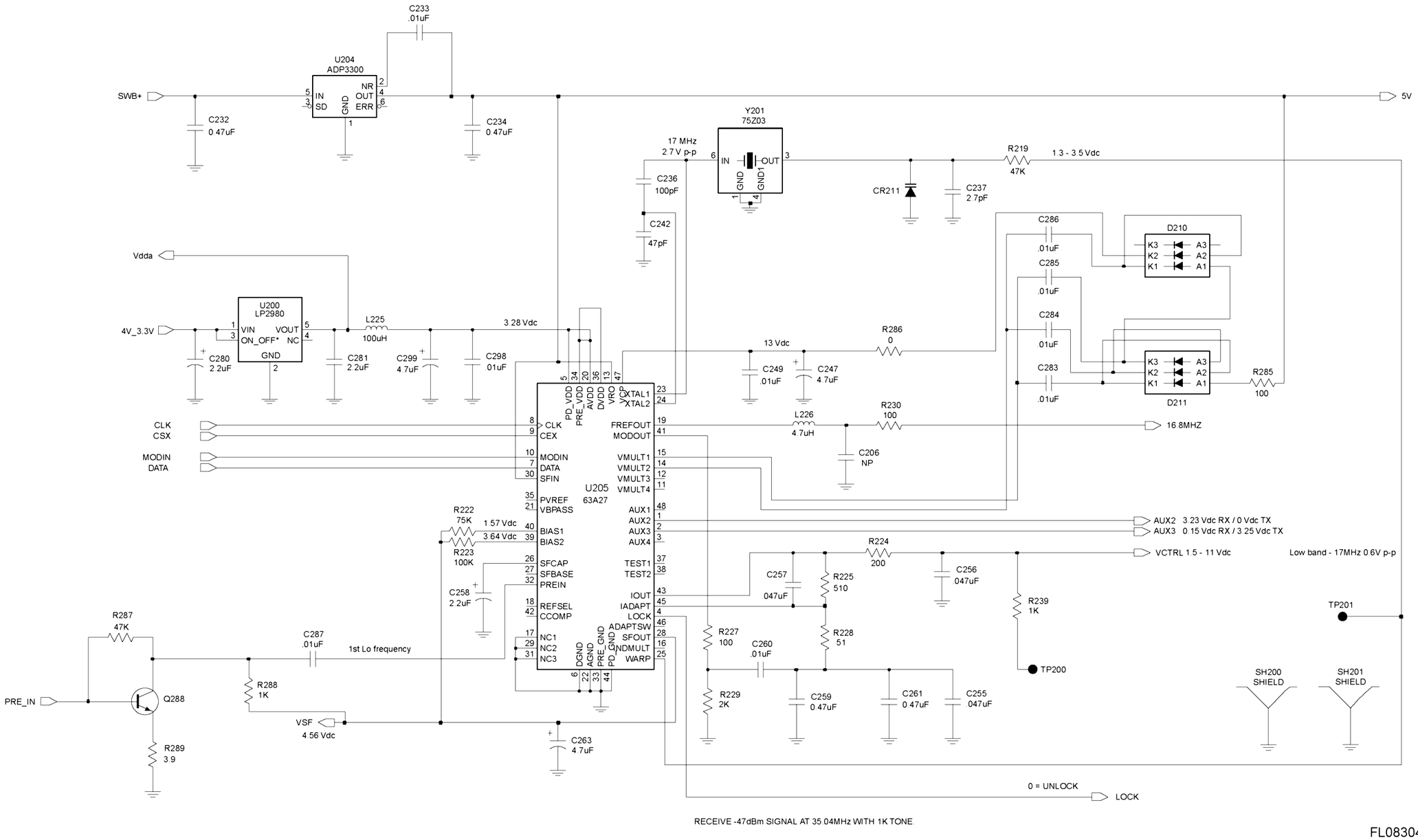
Lowband (30-50 MHz) Receiver Front End



RECEIVE -47dBm SIGNAL AT 35.04MHz WITH 1K TONE.
RF MEASUREMENTS MADE WITH BOONTON 92 MILLIVOLTMETER.

FL0830472-O

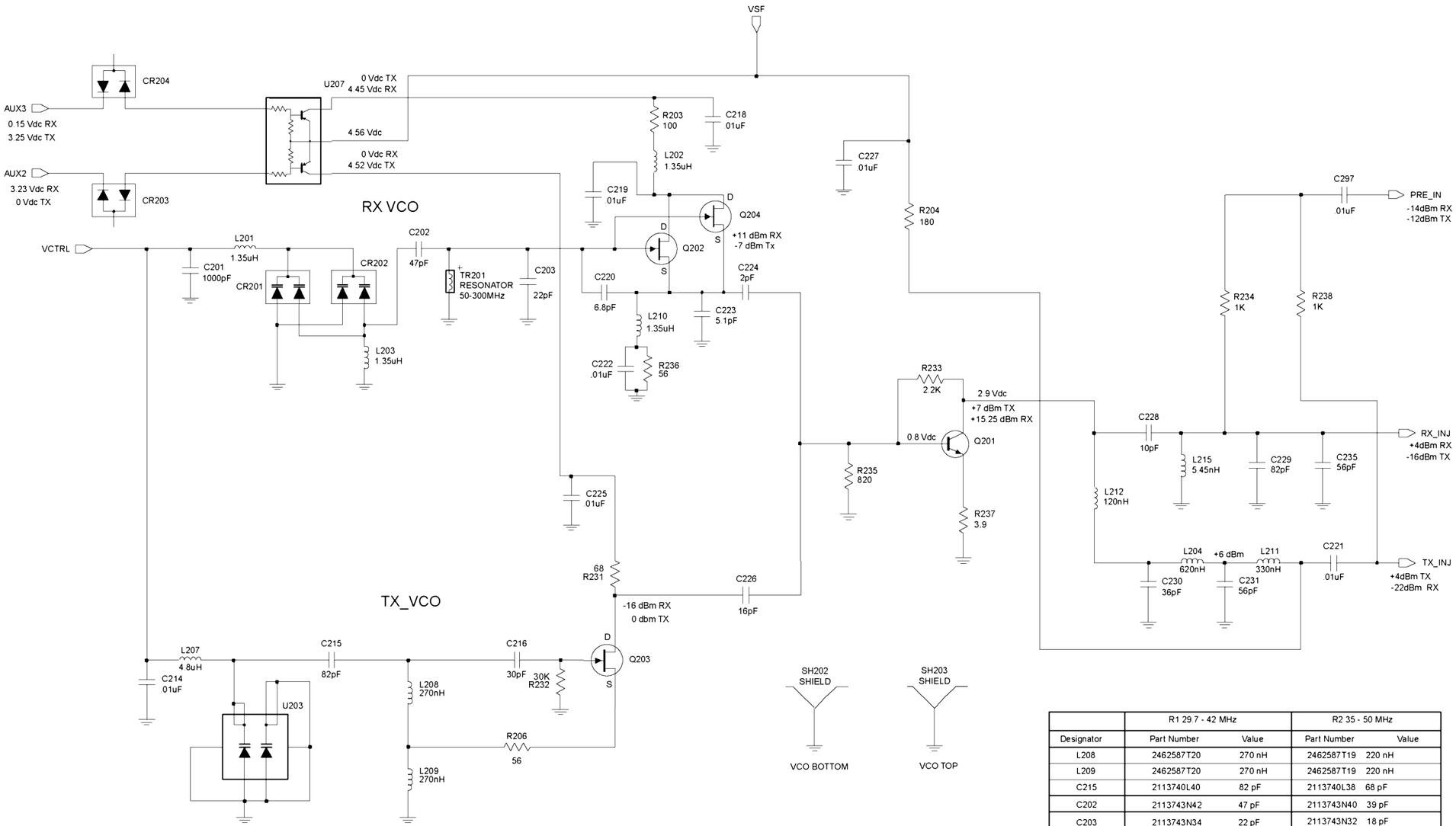
Lowband (30-50 MHz) Receiver Back End



RECEIVE -47dBm SIGNAL AT 35.04MHz WITH 1K TONE.

FL0830468-O

Lowband (30-50 MHz) Synthesizer

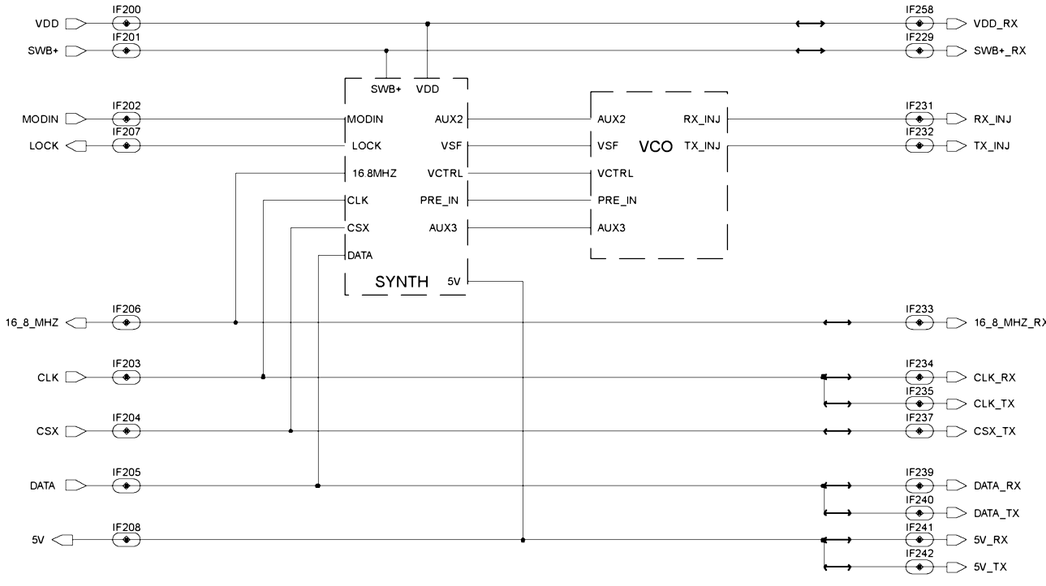


RECEIVE -47dBm SIGNAL AT 35.04MHz WITH 1KHz TONE.
RF MEASUREMENTS MADE WITH BOONTON 92 MILLIVOLTMETER.

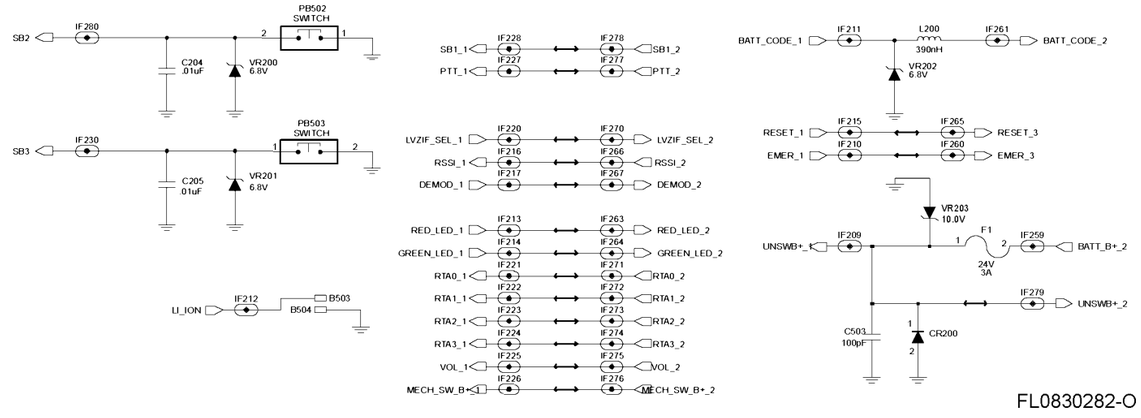
	R1 29.7 - 42 MHz		R2 35 - 50 MHz	
Designator	Part Number	Value	Part Number	Value
L208	2462587T20	270 nH	2462587T19	220 nH
L209	2462587T20	270 nH	2462587T19	220 nH
C215	2113740L40	82 pF	2113740L38	68 pF
C202	2113743N42	47 pF	2113743N40	39 pF
C203	2113743N34	22 pF	2113743N32	18 pF
L207	2405452C27	4.8 uH	2405452C63	1.35 uH

FL0830469-O

Lowband (30-50 MHz) Voltage Controlled Oscillator



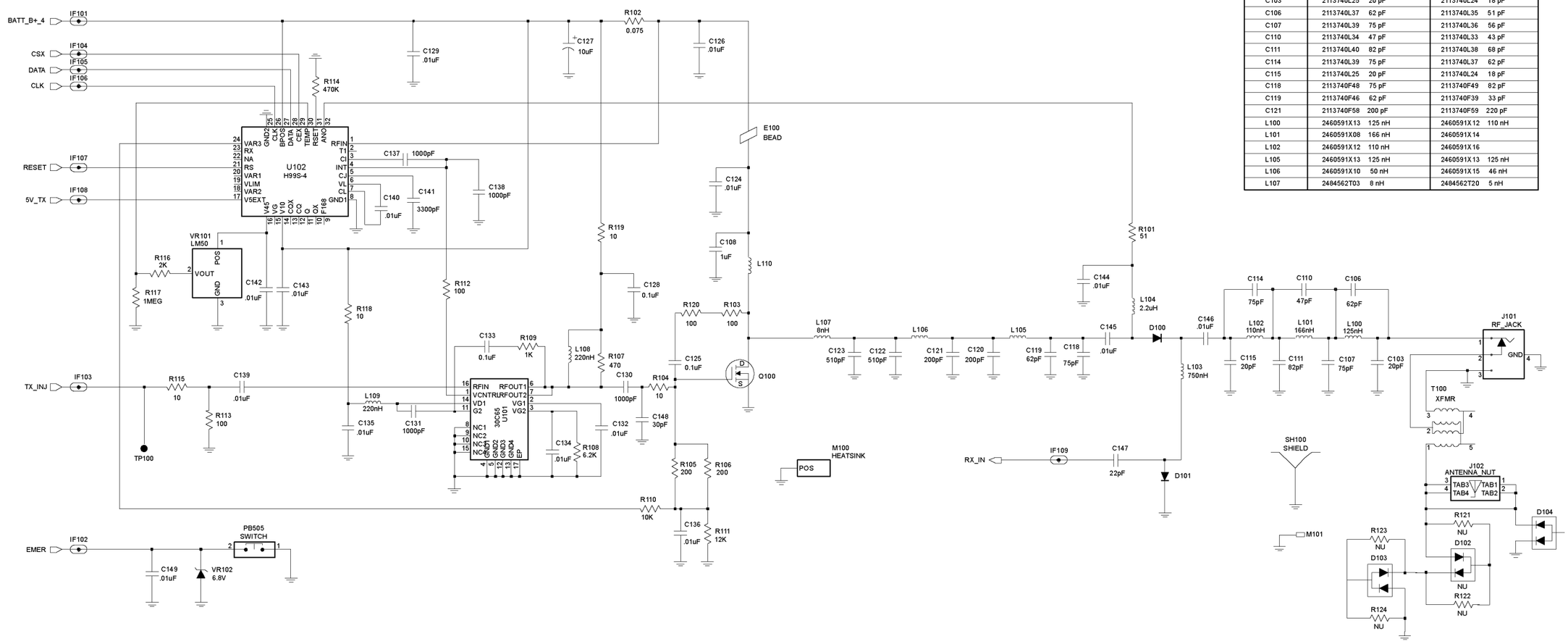
FL0830281-O



FL0830282-O

Lowband (30-50 MHz) Overall Synthesizer Schematic

	R1 29.7 - 42 MHz		R2 35 - 50 MHz	
Designator	Part Number	Value	Part Number	Value
C103	2113740L25	20 pF	2113740L24	18 pF
C106	2113740L37	62 pF	2113740L35	51 pF
C107	2113740L39	75 pF	2113740L36	56 pF
C110	2113740L34	47 pF	2113740L33	43 pF
C111	2113740L40	82 pF	2113740L38	68 pF
C114	2113740L39	75 pF	2113740L37	62 pF
C115	2113740L25	20 pF	2113740L24	18 pF
C118	2113740F48	75 pF	2113740F49	82 pF
C119	2113740F46	62 pF	2113740F39	33 pF
C121	2113740F58	200 pF	2113740F59	220 pF
L100	2460591X13	125 nH	2460591X12	110 nH
L101	2460591X08	166 nH	2460591X14	
L102	2460591X12	110 nH	2460591X16	
L105	2460591X13	125 nH	2460591X13	125 nH
L106	2460591X10	50 nH	2460591X15	46 nH
L107	2484562T03	8 nH	2484562T20	5 nH



FL0830473-A

Lowband (30-50 MHz) Transmitter

3.0 Lowband PCB 8485658Z03 Parts List

Circuit Ref	Motorola Part No.	Description
C103	2113740L25	20pF
C103*	2113740L24	18pF
C106	2113740L37	62pF
C106*	2113740L35	51pF
C107	2113740L39	75pF
C107*	2113740L36	56pF
C108	2113743F16	1.0uF
C110	2113740L34	47pF
C110*	2113740L33	43pF
C111	2113740L40	82pF
C111*	2113740L38	68pF
C114	2113740L39	75pF
C114*	2113740L37	62pF
C115	2113740L25	20pF
C115*	2113740L24	18pF
C118	2113740F48	47pF
C118*	2113740F49	82pF
C119	2113740F46	62pF
C119	2113740F39	33pF
C120	2113740F58	200pF
C121	2113740F58	200pF
C121*	2113740F59	220pF
C122	2113740A72	510pF
C123	2113740A72	510pF
C124	2113741A45	56pF
C125	2113743M24	0.01uF
C126	2113741A45	56pF
C127	2311049A18	10uF
C128	2113743M24	0.01uF
C129	2113743L41	0.01uF
C130	2113743L17	1000pF
C131‘	2113743L17	1000pF
C132	2113743L41	0.01uF
C133	2113743M24	0.01uF
C134	2113743L41	0.01uF
C135	2113743L41	0.01uF
C136	2113743L41	0.01uF
C137	2113743L17	1000pF
C138	2113743L17	1000pF
C139	2113743L41	0.01uF
C140	2113743L41	0.01uF
C141	2113743L29	3300pF
C142	2113743L41	0.01uF
C143	2113743L41	0.01uF
C144	2113743L41	0.01uF
C145	2113741A45	56pF
C146	2113741A45	56pF
C147	2113743N34	22pF
C148	2113740F38	30pF
C149	2113743L41	0.01uF
C201	2113743L17	1000pF
C202	2113743N42	47pF
C203	2113743N34	18pF
C204	2113743L41	0.01uF
C205	2113743L41	0.01uF
C206	2113743N42	47pF
C214	2113741F49	0.1uF
C215	2113740L40	82pF
C216	2113740F38	30pF
C218	2113741F49	0.1uF
C219	2113741F49	0.1uF
C220	2113743N22	15pF
C221	2113741F49	0.1uF
C222	2113741F49	0.1uF
C223	2113743N19	5.1pF
C224	2113743N09	2pF
C225	2113743L41	0.1uF
C226	2113743N31	16pF
C227	2113741F49	0.1uF
C228	2113743N26	10pF
C229	2113743N48	82pF
C230	2113743N39	36pF
C231	2113743N44	56pF
C232	2113743A27	0.47uF
C233	2113743L41	0.01uF
C234	2113743A27	0.47uF
C235	2113932N44	56pF
C236	2113743N50	100pF
C237	2113743N12	2.7pF
C242	2113743N42	47pF
C247	2311049A56	4.7uF
C249	2113743L41	0.01uF
C255	2113741A61	0.047uF
C256	2113741A61	0.047uF
C257	2113741A61	0.047uF
C258	2311049F16	2.2uF
C259	2113743A27	0.47uF
C260	2113743F49	0.01uF
C261	2113741A27	0.47uF
C263	2311049A56	4.7uF
C280	2311049A09	2.2uF
C281	2104993J02	2.2uF
C283	2113743L41	0.01uF
C284	2113743L41	0.01uF
C285	2113743L41	0.01uF
C286	2113743L41	0.01uF
C287	2113743L41	0.01uF
C297	2113741F49	0.1uF
C298	2113743L41	0.01uF
C299	2311049A56	4.7uF
C301	2113743N30	15pF
C302	Not Placed	
C303	2113743R33	4700pF
C304	2113743R33	4700pF
C305	2113743R33	4700pF
C306	2113743N65	8pF
C307	2113743E20	0.1uF
C308	2180478Z20	1uF
C309	2113741F49	0.1uF
C310	2113743E20	0.1uF
C311	2113743N29	13pF
C312	2113743N29	13pF
C313	2113743N29	13pF
C314	2113743N29	13pF
C315	2113743N25	9.1pF
C316	2113743N30	15pF
C317	2311049A59	10uF
C319	2311049A59	10uF
C320	2113743A23	0.22uF
C321	2113743E07	0.022uF
C323	2113743E07	0.022uF
C324	2113743N50	100pF
C325	2113743A23	0.22uF
C326	2113743E20	0.1uF
C327	2113743R33	4700pF
C328	2113743E07	0.022uF
C330	2113743E20	0.1uF
C331	2113743E07	0.022uF
C332	2113743E20	0.1uF
C333	2109720D14	0.1uF
C334	2113740A82	1500pF
C335	2113743A23	0.22uF
C336	2311049A59	10uF
C337	2113743E07	0.022uF
C339	2113743F16	1uF
C340	2113743F16	1uF
C341	2113743F16	1uF
C342	2113743F16	1uF
C343	2113743A23	0.22uF
C348	2113743N09	2pF
C400	2113743L41	.01uF
C401	2113743M24	0.1uF
C402	2113743M24	0.1uF
C403	2113928D08	10uF
C404	Not Placed	
C405	Not Placed	
C406	Not Placed	
C407	2113928N01	0.1uF
C408	2113743N50	100pF
C409	2113743M24	0.1uF
C410	2113928N01	0.1uF
C411	2113743M24	0.1uF
C412	2311049A59	10uF
C414	2113743M24	0.1uF
C415	2109720D01	0.1uF
C416	2113928N01	0.1uF
C419	Not Placed	
C420	2113743L41	.01uF
C421	2113928N01	0.1uF
C422	2113743M24	0.1uF
C423	2113743N50	100pF
C424	2311049A59	10uF
C425	2113743M24	0.1uF
C426	2113743N50	100pF
C427	2113743N50	100pF
C428	2113743M24	0.1uF
C429	2113743M24	0.1uF
C430	2113928N01	0.1uF
C431	2113743N50	100pF
C432	Not Placed	
C433	2113743L41	.01uF
C434	2113743M24	0.1uF
C435	2113743M24	0.1uF
C436	2113743N34	22pF
C437	2113743N34	22pF
C438	2113743F18	2.2pF
C440	2113743F18	2.2pF
C441	2113743N50	100pF
C442	2113743E20	0.1uF
C443	2113928N01	0.1uF
C444	2113743N50	100pF
C445	2113743N50	100pF
C447	2113743M08	0.022uF
C448	2113928N01	0.1uF
C449	2113743N50	100pF
C450	Not Placed	
C451	2113743M08	0.022uF
C452	2113743G26	4.7uF
C453	2113743N50	100pF
C456	2113743N50	100pF
C458	2113743N50	100pF
C459	2113743N50	100pF
C463	2113743N50	100pF
C466	2113743N50	100pF
C467	2113928N01	0.1uF
C471	2113743N50	100pF
C472	2113743N50	100pF
C473	2113743N50	100pF
C475	2113743H14	10uF
C476	2113928D08	10uF
C479	2113928N01	0.1uF

Circuit Ref	Motorola Part No.	Description
C480	2113743G24	0.1uF
C481	2113928N01	0.1uF
C482	2113928N01	0.1uF
C490	2113743N50	100pF
C491	2113743N50	100pF
C492	2113743N50	100pF
C493	2113743N50	100pF
C494	2113743N50	100pF
C495	2113743N50	100pF
C496	2113743N50	100pF
C497	2113743N50	100pF
C500	2113743L41	0.01uF
C502	2311049A05	0.47uF
C503	2113743N50	100pF
C504	2113743N43	51pF
C505	2113743N50	100pF
C506	2113743N50	100pF
C507	2113743K15	0.1uF
C511	2113743N50	100pF
C512	2113743N50	100pF
C513	2113743N50	100pF
C514	2113743N50	100pF
C515	2113743N44	56pF
C516	2113928N37	30pF
C522	2113743L41	0.01uF
C533	2113743N40	100pF
C534	2113743N24	8.2pF
C535	2113743N09	2pF
C536	2113743N36	27pF
C537	2113743N16	3.9pF
C538	2113743N48	82pF
CR200	4880107R01	Varactor
CR201	4805648Q13	Dual Varactor
CR202	4805648Q13	Dual Varactor
CR203	4813833C07	Varactor
CR204	4813833C07	Varactor
CR211	4813833C03	Varactor
CR301	4813833C01	Varactor
CR411	4802245J62	Schottky Diode
CR412	4802245J62	Schottky Diode
CR413	4802245J62	Schottky Diode
CR440	4813833C02	Dual Diode Common Cathode
CR502	4880107R01	Rectifier
CR503	4805729G49	LED Red/Yellow
D100	4802482J02	Pin Diode
D101	4809948D23	Pin Diode
D102	NOT PLACED	
D103	NOT PLACED	
D104	4813833C06	Dual Shottky Diode
D210	4802233J09	Triple Diode
D211	4802233J09	Triple Diode

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

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

Circuit Ref	Motorola Part No.	Description
R110	0662057M98	10K
R111	0662057N01	12K
R112	0662057M50	100
R113	0662057M50	100
R114	0662057N39	470K
R115	0662057M26	10
R116	0662057M81	2K
R117	0662057N47	1M
R118	0662057A01	10
R119	0662057A01	10
R120	0662057A25	100
R203	0662057M50	100
R204	0662057M56	180
R206	0662057U45	56
R219	0662057N15	47K
R222	0662057N20	75K
R223	0662057N23	100K
R224	0662057M57	200
R225	0662057M67	510
R227	0662057M50	100
R228	0662057M43	51
R229	0662057M81	2K
R230	0662057M50	100
R231	0662057M46	68
R232	0662057N10	30K
R233	0662057M82	2.2K
R234	0662057A41	470
R235	0662057M72	820
R236	0662057M44	56
R237	0662057M16	3.9
R238	0662057M74	1K
R239	0662057M74	1K
R285	0662057M50	100
R286	0662057M01	0
R287	0662057N15	47K
R288	0662057M74	1K
R289	0662057M16	3.9
R301	0662057M78	1.5K
R302	0662057N15	47K
R303	0662057N15	47K
R304	0662057M78	1.5K
R305	0662057M98	10K
R306	0662057M77	1.3K
R307	0662057M92	5.6K
R308	0662057N01	12K
R309	0662057N22	91K
R310	0662057M87	3.6K
R312	0662057M78	1.5K
R314	0662057M98	10K
R315	0662057N15	47K
R316	0662057M57	200

Circuit Ref	Motorola Part No.	Description
R317	0662057M81	2K
R318	0662057M33	20
R400	0662057N15	47K
R401	0662057M01	0
R402	Not Placed	
R403	Not Placed	
R405	0662057M01	0
R406	0662057N20	75K
R407	0662057N19	68K
R408	Not Placed	
R409	0662057M98	10K
R410	0662057N23	100K
R411	0662057M98	10K
R413	0662057M01	0
R414	0662057V34	180K
R415	0662057V26	91K
R416	0662057N13	39K
R418	Not Placed	
R419	0662057M67	510
R420	0662057B46	10M
R421	0662057M81	2K
R423	0662057N21	82K
R424	0662057N12	36K
R425	0662057N10	30K
R426	0662057M35	330
R427	0662057M84	2.7K
R428	0662057M10	2.2
R429	0662057M98	10K
R431	0662057N39	470K
R432	0662057N16	51K
R434	0662057M62	330
R435	0662057M81	2K
R436	0662057M74	1K
R437	0662057M01	0
R445	0662057N08	24K
R446	0662057N30	220K
R447	0662057N52	1.6M
R448	0662057N33	270K
R449	0662057N08	24K
R450	0662057T45	68
R457	0662057M98	10K
R460	0662057M90	4.7K
R461	0662057M56	180
R462	0662057M98	10K
R463	0662057M61	300
R471	0662057M92	5.6K
R472	0662057M93	6.2K
R473	0662057M26	10
R475	0662057M01	0
R476	0662057N08	24K
R477	0662057M74	1K

Circuit Ref	Motorola Part No.	Description
R478	0662057M98	10K
R481	0662057N08	24K
R492	0662057M01	0
R499	Not Placed	
R501	0662057M70	680
R502	0662057M56	180
R503	0662057M74	1K
R504	0662057N01	12K
R505	0662057M68	10K
R507	0662057M60	270
R508	0662057M32	18
R509	0662057M60	270
R510	0662057M87	3.6K
R512	0662057M90	4.7K
R513	0662057M26	10
R514	0662057N15	47K
R515	0662057M98	10K
RT400	0680590Z01	Thermistor 33K
S501	4080710Z01	Channel Switch
S502	1880619Z01	Volume Switch
SH100	2686076A01	Shield
SH200	2685709B02	Shield
SH201	2680511Z01	Shield
SH202	2680511Z01	Shield
SH203	2686079A01	Shield
SH300	2680516Z01	Shield
SH301	2680508Z01	Shield
SH302	2680697Z01	Shield
SH303	2680553Z01	Shield
SH400	2680505Z01	Controller Memory Shield
SH401	2680506Z01	Controller On/Off Shield
SH402	2680515Z01	Controller Microprocessor Shield
SH403	2680516Z01	Controller ASFIC Cmp/Audi PA Shield
SH500	2680555Z01	Shield
SH501	2680697Z01	Shield
SH502	2680696Z01	Shield
T100	2505515V03	Transformer Coil
T501	2580541Z01	Transformer Coil
T502	2580541Z01	Transformer Coil
TR201	2460593D01	Resonator, 50-300MHz
U101	5105109Z67	LDMOS Driver
U102	5185765B01	Power Control
U200	5102463J58	3.3V Regulator
U203	4805649Q14	Varactor Diode
U204	5105739X05	Linear Regulator
U205	5185963A27	LV Fractional N Synthesizer
U207	4805921T06	Dual PNP
U301	4885622B01	Dual Gate MOSFET
U302	5185623B01	3.3V Regulator

Circuit Ref	Motorola Part No.	Description
U303	5109632D83	Low Voltage ZIF
U400	5102463J40	3.3V Regulator
U404	5185963A53	ASFIC
U405	Not Placed	
U406**	5102463J59	ROM 256K
U407**	5102463J64	EEPROM 16Kx8
U409	5102226J56	Microcontroller
U410	5102463J57	3.3V Regulator
U420	5102463J44	Audio PA
VR101	5185963A15	Temperature Sense
VR102	4802245J51	6.8V Zener
VR200	4802245J51	6.8V Zener
VR201	4802245J51	6.8V Zener
VR202	4802245J51	6.8V Zener
VR203	4802245J53	6.8V Zener
VR432	4805656W08	5.6V Zener
VR433	4805656W08	5.6V Zener
VR434	4802245J51	6.8V Zener
VR445	4802245J53	10V Zener
VR446	4802245J53	10V Zener
VR447	4802245J53	10V Zener
VR448	4802245J53	10V Zener
VR449	4802245J53	10V Zener
VR450	4802245J53	10V Zener
VR500	4800245J51	6.8V Zener
VR501	4813830A18	6.8V Zener
VR502	4802245J51	6.8V Zener
Y201	4805875Z03	Crystal Oscillator

** Motorola Depot Servicing only.

* Range 2 Only.