MOTOROLA

Professional Radio
GP Series

VHF (136-174MHz)

Service Information

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Chapter 1

MODEL CHART AND TECHNICAL SPECIFICATIONS

1.0 GP320/GP340/GP360/GP380 Model Chart

Professional GP300 Series (VHF)						
Model						Description
MDH25KDC9AN0_E						GP320 VHF 136-174MHz 5W 1-Ch
	MDH25KDC9AN3_E					GP340 VHF 136-174MHz 5W 16-Ch
		MDH25KDF9AN5_E				GP360 VHF 136-174MHz 5W 255-Ch
			MDH25KDH9AN6_E			GP380 VHF 136-174MHz 5W 255-Ch
					Item	Description
X					PMLD4121_	GP320 VHF Back Cover Kit
	X				PMLD4117_	GP340 VHF Back Cover Kit
		X			PMLD4119_	GP360 VHF Back Cover Kit
			X		PMLD4118_	GP380 VHF Back Cover Kit
X					6864110B12	GP320 Basic User Guide
	X				6864110B13	GP340 Basic User Guide
		X			6864110B16	GP360 Basic User Guide
			X		6864110B18	GP380 Basic User Guide
X	X	X	X		PMAD4023_	VHF 14cm (150-161 MHz) Antenna
X	X	X	X		HNN9008_	Battery, NiMH Standard

2.0 GP140 Model Chart

Professional GP140 (VHF)			
Model			**Description**
MDH25KDC9AA3_E			GP140 VHF 136-174 MHz 5W 16 Ch
		Item	**Description**
X		PMLE4109_	GP140 UHF Back Cover Kit
X		6864110B25	GP140 Basic User Guide
X		PMAD4023_	VHF 14cm (150-161 MHz) Antenna
X		HNN9008_	Battery, NiMH Standard

x = Indicates one of each is required.

3.0 GP640/GP680 Model Chart

Professional GP600 Series (VHF)				
Model				**Description**
MDH25KDC9ACK3_E				GP640 VHF 136-174 MHz 5W
	MDH25KDH9CK6_E			GP680 VHF 136-174 MHz 5W
			Item	**Description**
X			PMLD4113_	GP640 VHF Back Cover Kit
	X		PMLD4114_	GP680 VHF Back Cover Kit
X			6864110B14	GP640 Basic User Guide
	X		6864110B19	GP680 Basic User Guide
X	X		PMAD4023_	VHF 14cm (150-161 MHz) Antenna
X	X		HNN9008_	Battery, NiMH Standard

x = Indicates one of each is required.

4.0 GP1280 Model Chart

Professional GP1280 (VHF)			
Model			**Description**
MDH25KDN9CK8_E			GP1280 VHF 136-174 MHz 5W
		Item	**Description**
X		PMLD4120_	GP1280 VHF Back Cover Kit
X		6864110B20	GP1280 Basic User Guide
X		PMAD4023_	VHF 14cm (150-161 MHz) Antenna
X		HNN9008_	Battery, NiMH Standard

x = Indicates one of each is required.

5.0 Technical Specifications

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

General Specifications		
Channel Capacity		
GP140	16	
GP320	1	
GP340	16	
GP360	255	
GP380	255	
GP640	16 (Conventional)	
GP680	16 (Conventional)	
GP1280	16 (Conventional)	
Power Supply	Rechargeable battery 7.5v	
Dimensions: H x W x D (mm) Height excluding knobs	**GP140/320/340/360/380/640/680**	
With standard high capacity NiMH battery	137 x 57.5 x 37.5	
With ultra high capacity NiMH battery	137 x 57.5 x 40.0	
With NiCD battery	137 x 57.5 x 40.0	
With LiIon battery	137 x 57.5 x 33.0	
	GP1280	
With standard high capacity NiMH battery	152 x 57.5 x 37.5	
With ultra high capacity NiMH battery	152 x 57.5 x 37.5	
With NiCD battery	152 x 57.5 x 37.5	
With LiIon battery	152 x 57.5 x 37.5	
Weight: (gm)	**GP140/GP320 GP340/GP640**	**GP360/GP380 GP680**
With Standard high capacity NiMH battery	420	428
With Ultra high capacity NiMH battery	500	508
With NiCD battery	450	458
With LiIon battery	350	358
	GP1280	
With Standard high capacity NiMH battery	460	
With Ultra high capacity NiMH battery	535	
With NiCD battery	485	
With LiIon battery	390	
Average Battery Life @5/5/90 Cycle:	Low Power	High Power
With Standard high capacity NiMH battery	11 hours	8 hours
With Ultra high capacity NiMH battery	14 hours	11 hours
With NiCD battery	12 hours	9 hours
With LiIon battery	11 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	VHF
*Frequencies - Full Bandsplit	VHF 136-174 MHz
Channel Spacing	12.5/20/25 kHz
Frequency Stability (-25°C to +55°C, +25° Ref.)	±2.5 ppm @ 12.5kHz ±5ppm @ 25 kHz
Power	136 - 174 MHz:1-5W
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	VHF
*Frequencies - Full Bandsplit	VHF 136-174 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 VHF circuits in the radio. For details of the theory of operation and trouble shooting for the the associated Controller circuits refer to the Controller Section of this manual.

2.0 VHF Transmitter

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

The VHF transmitter consists of the following basic circuits:

1. Power amplifier (PA).
2. Antenna switch/harmonic filter.
3. Antenna matching network.
4. Power Control Integrated Circuit (PCIC).

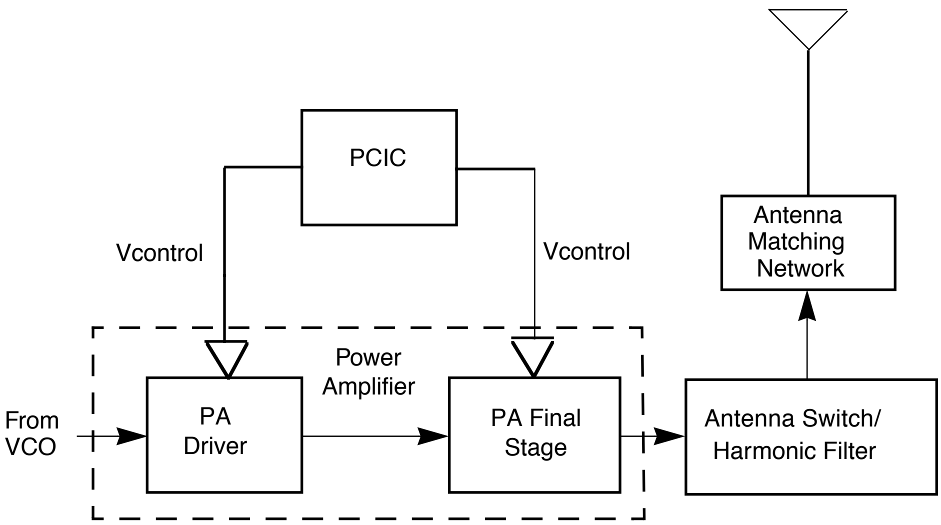


Figure 2-1 VHF Transmitter Block Diagram.

2.1 Power Amplifier

The power amplifier consists of two devices:

1. LDMOS driver IC (U3501)
2. LDMOS PA (Q3501)

The LDMOS driver IC contains two stages of amplification with a supply voltage of 7.3V.

This RF power amplifier is capable of supplying an output power of 0.3W (pin 6 and 7) with an input signal of 2mW (3dBm) (pin16). The current drain is typically around 130mA while operating in the frequency range of 136-174MHz.

The LDMOS PA is capable of supplying an output power of 7W with an input signal of 0.3W. The current drain is typically around 1800mA while operating in the frequency range of 136-174MHz. The power output is varied by changing the bias voltage.

2.2 Antenna Switch

The antenna switch circuit consists of two pin diodes, D3521 and D3551, a pi network (C3531, L3551 and C3550), and three current limiting resistors (R3571, R3572, R3573). In the transmit mode, B+ at PCIC (U3502) pin 23 goes low to turn on Q3561 where a B+ bias is applied to the antenna switch circuit to bias the diodes "on". The shunt diode (D3551) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, creating a low attenuation path between the antenna and receiver ports.

2.3 Harmonic Filter

The harmonic filter consists of C3532 to C3536, L3531 and L3532. This network forms a low-pass filter to attenuate harmonic energy of the transmitter to specifications level. The harmonic filter insertion loss is typically less than 1.2dB.

2.4 Antenna Matching Network

A matching network made up of L3538 and C3537/C3539 is used to match the antenna impedance to the harmonic filter. This optimizes the performance of the transmitter and receiver into the antenna.

2.5 Power Control Integrated Circuit (PCIC)

The transmitter uses the PCIC, U3502 to control the power output of the radio by maintaining the radio current drain. The current to the final stage of the power module is supplied through R3519, which provides a voltage proportional to the current drain. This voltage is then fedback to the Automatic Level Control (ALC) within the PCIC to provide loop stability.

The PCIC also contains internal digital to analog converters (DACs) that provide the reference voltage of the control loop. The voltage level is controlled by the microprocessor through the data line of the PCIC.

The resistors and integrators within the PCIC, and external capacitors (C3562, C3563 and C3565) control the transmitter rise and fall times. These are necessary to reduce the power splatter into adjacent channels.

U3503 and its associated components act as a temperature cut back circuit. This provides the necessary voltage to the PCIC to cut the transmitter power if the radio temperature gets too high.

3.0 VHF Receiver

The VHF receiver consists of a front end, back end, and automatic gain control circuits. A block diagram of the VHF receiver is shown in Figure 2-2. Detailed descriptions of these features are contained in the paragraphs that follow.

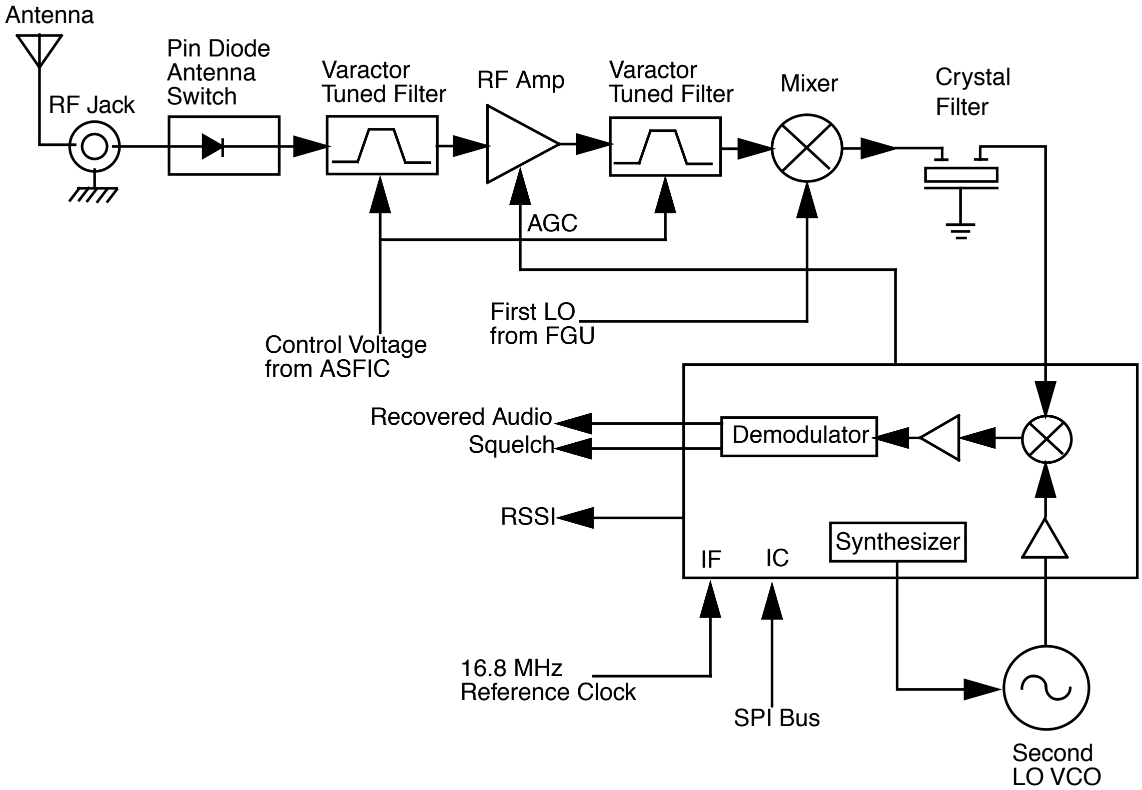


Figure 2-2 VHF Receiver Block Diagram.

3.1 Receiver Front-End

(Refer to Figure 2-2 and the VHF Receiver Front End schematic diagram)

The RF signal is received by the antenna and applied to a low-pass filter consisting of L3531, L3532, C3532 to C3563. The filtered RF signal is passed through the antenna switch. The antenna switch circuit consists of two pin diodes (D3521 and D3551) and a pi network (C3531, L3551, and C3550).The RF signal is then applied to a varactor tuned bandpass filter which consists of L3301, L3303, C3301 to C3304, and D3301. The filter is tuned by applying a control voltage to the varactor diode (D3301) in the filter.

The bandpass filter is electronically tuned by the DACRx from IC 404 which is controlled by the microprocessor. Depending on the carrier frequency, the DACRx supplies the tuned voltage to the varactor diodes in the filter. Wideband operation of the filter is achieved by shifting the bandpass filter across the band.

The output of the bandpass filter is coupled to the RF amplifier transistor Q3302 via C3306. After being amplified by the RF amplifier, the RF signal is further filtered by a second varactor tuned bandpass filter, consisting of L3305, L3306, C3311 to C3314 and D3302.

Both the pre and post-RF amplifier varactor tuned filters have similar responses. The 3 dB bandwidth of the filter is about 12 MHz. This enables the filters to be electronically controlled by using a single control voltage which is DACRx.

The output of the post-RF amplifier filter is connected to the passive double balanced mixer which consists of T3301, T3302, and CR3301. Matching of the filter to the mixer is provided by C3317, C3318 and L3308. After mixing with the first LO signal from the voltage controlled oscillator (VCO) using high side injection, the RF signal is down-converted to the 45.1 MHz IF signal.

The IF signal coming out of the mixer is transferred to the crystal filter (Y3200) through a resistor pad (R3321 - R3323) and a diplexer (C3320 and L3309). Matching to the input of the crystal filter is provided by C3200 and L3200. The crystal filter provides the necessary selectivity and intermodulation protection.

3.2 Receiver Back-End

(Refer to Figure 2-2 and the VHF Receiver Back End schematic diagram)

The output of crystal filter FL3200 is matched to the input of IF amplifier transistor Q3200 by capacitor C3203. Voltage supply to the IF amplifier is taken from the receive 5 volts (R5). The gain controlled IF amplifier provides a maximum gain of about 10dB. The amplified IF signal is then coupled into U3220 pin 3 via L3202, C3207, and C3230 which provides impedance matching for the IF amplifier and U3220.

The IF signal applied to pin 3 of U3220 is amplified, down-converted, filtered, then demodulated to produce the recovered audio at pin 27 of U3220. 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 the IF module (U3220).

The IF IC uses a type of direct conversion process, whereby the externally generated second LO frequency is divided by two in U3220 so that it is very close to the first IF frequency. The IF IC (U3220) 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 will lock onto the IF signal. The second LO/VCO is a Colpitts oscillator built around transistor Q3270. The VCO has a varactor diode, D3270, to adjust the VCO frequency. The control signal for the varactor is derived from a loop filter consisting of C3278 to C3280, R3274 and R3275.

The IF IC (U3220) also provides a received signal-strength indicator (RSSI) and a squelch output. The RSSI is a dc voltage monitored by the microprocessor and is used as a peak indicator during the bench tuning of the receiver front-end varactor filter. The RSSI voltage is also used to control the automatic gain control (AGC) circuit at the front-end.

The demodulated signal on pin 27 of U3220 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 front end automatic gain control circuit provides automatic reduction of gain of the front end RF amplifier via feedback. This prevents overloading of backend circuits and is achieved by drawing some of the output power from the RF amplifier output. At high radio frequencies, capacitor C3327 provides the low impedance path to ground for this purpose. CR3302 is a pin diode used for switching the path on or off. A certain amount of forward biasing current is needed to turn the pin diode on. Transistor Q3301 provides this current.

Radio signal strength indicator, RSSI, a voltage signal, is used to drive Q3301 to saturation i.e. turned on. RSSI is produced by U3220 and is proportional to the gain of the RF amplifier and the input power to the radio.

Resistors R3304 and R3305 are voltage dividers designed to turn on Q3301 at certain RSSI levels. To turn on Q3301 the voltage across R3305 must be greater or equal to the voltage across R3324 + Vbe. Capacitor C3209 is used to dampen any instability while the AGC is turning on. The current flowing into the collector of Q3301, a high current gain NPN transistor, is drawn through the pin diode to turn it on. Maximum current flowing through the pin is limited by resistors R3316, R3313, R3306 and R3324. Feedback capacitor C3326 used to provide some stability to this high gain stage.

An additional gain control circuit is formed by Q3201 and associated components. Resistors R3206 and R3207 are voltage dividers designed to turn on Q3201 at a significantly higher RSSI level than the level required to turn on pin diode control transistor Q3301. In order to turn on Q3201 the voltage across R3207 must be greater or equal to the voltage across R3208 + Vbe. As current starts flowing into the collector of Q3201, it reduces the bias voltage at the base of IF amplifier transistor Q3200 and in turn, the gain of the IF amplifier. The gain is then controlled in a range of -30dB up to +10dB.

4.0 Frequency Generation Circuit

(Refer to Figure 2-3 and the VHF Frequency Synthesizer schematic diagram)

The Frequency Generation Circuit, shown in Figure 2-3, is composed of two main ICs, the Fractional-N synthesizer (U3701), and the VCO/Buffer IC (U3801). Designed in conjunction to maximize compatibility, the two ICs provide many of the functions that normally would require additional circuits. The synthesizer block diagram illustrates the interconnect and support circuit used in the region. Refer to the schematic for the reference designator.

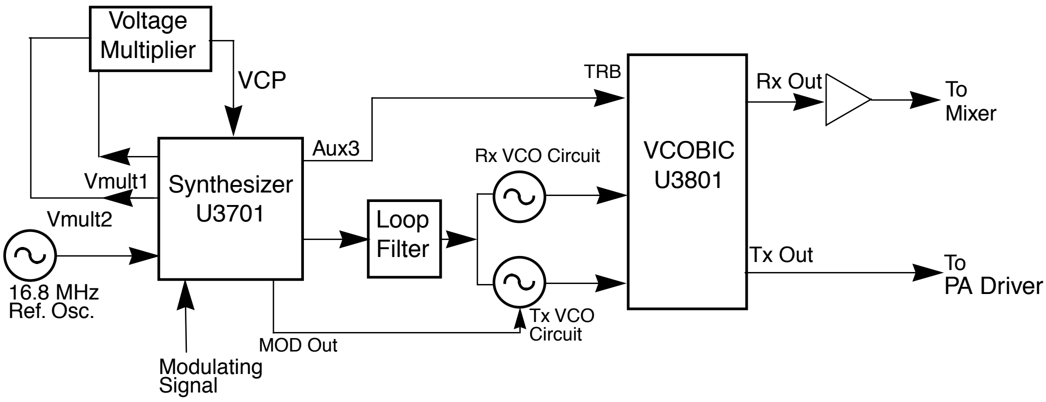


Figure 2-3 VHF Frequency Generation Unit Block Diagram

The synthesizer is powered by regulated 5V and 3.3V which is provided from ICs U3711 and U3201 respectively. The 5V signal is supplied to pins 13 and 30 and the 3.3V signal is applied to pins 5, 20, 34 and 36 of U3701. The synthesizer in turn generates a superfiltered 5V which powers U3801.

In addition to the VCO, the synthesizer must interface 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 pin10 of U3701. Internally the audio is digitized by the Fractional-N and applied to the loop divider to provide low-port modulation. The audio runs through an internal attenuator for modulation balancing purposes before going out at pin 41 to the VCO.

4.1 Synthesizer

The Fractional-N Synthesizer, shown in Figure 2-4, uses a 16.8MHz crystal (Y3761) to provide a reference for the system. The LVFractN IC (U3701) further divides this to 2.1MHz, 2.225MHz, and 2.4MHz as reference frequencies. Together with C3761, C3762, C3763, R3761, and D3761, they build up the reference oscillator that is capable of 2.5 ppm stability over temperatures of -30 to 85°C. A 16.8MHz signal at pin 19 of U3701 is also provided for use by ASFIC and LVZIF.

The loop filter which consist of C3721, C3722, R3721, R3722 and R3723 provides the necessary dc steering voltage for the VCO and determines the amount of noise and spur passing through.

In achieving fast locking for the synthesizer, an internal adapt charge pump provides higher current at pin 45 of U3701 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 capacitive voltage multiplier made up of C3701 to C3704 and triple diodes D3701, D3702. Two 3.3V square waves (180 degrees out of phase) are first multiplied by four and then shifted, along with regulated 5V, to build up 13.5V at pin 47 of U3701.

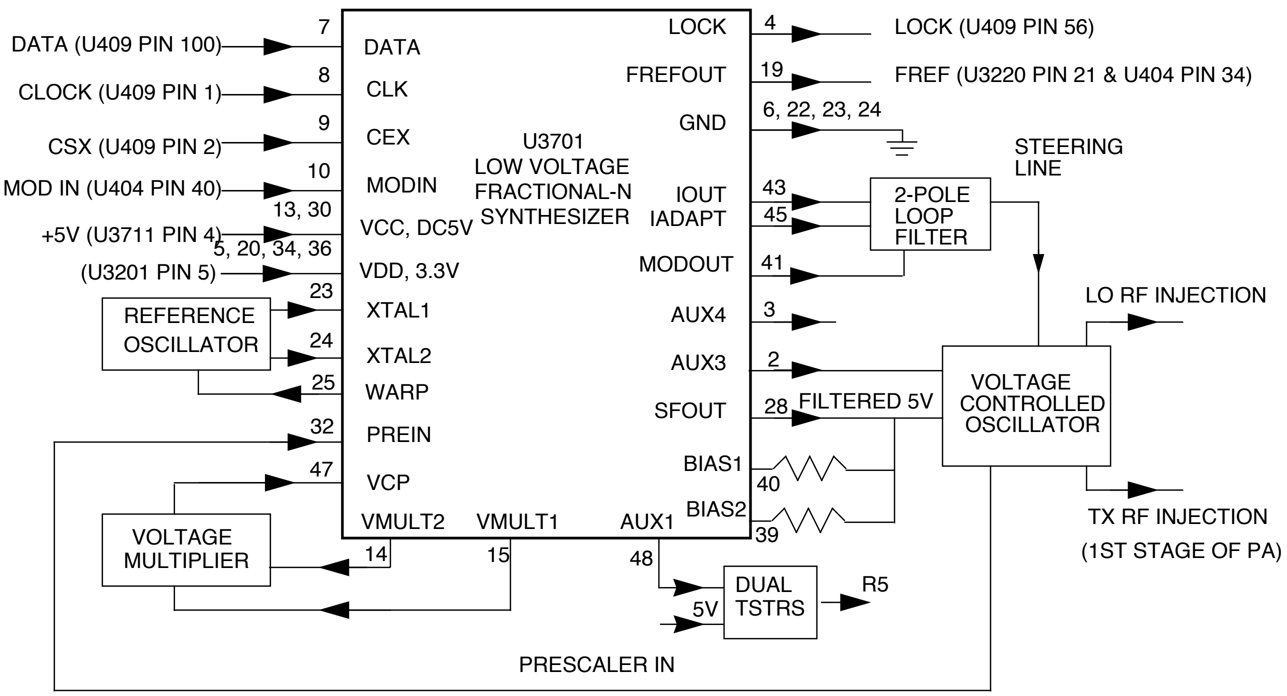


Figure 2-4 VHF Synthesizer Block Diagram.

4.2 Voltage Controlled Oscillator (VCO)

(Refer to Figure 2-4 and the VHF Voltage Controlled Oscillator schematic diagram)

The VCOB IC (U3801), shown in Figure 2-5, in conjunction with the Fractional-N synthesizer (U3701) generates RF in both the receive and the transmit modes of operation. The TRB line (U3801 pin 19) determines which oscillator and buffer are enabled. A sample of the RF signal from the enabled oscillator is routed from U3801 pin 12, through a low pass filter, to the prescaler input (U3701 pin 32). After frequency comparison in the synthesizer, a resultant CONTROL VOLTAGE is received at the VCO. This voltage is a DC voltage typically between 3.5V and 9.5V when the PLL is locked on frequency.

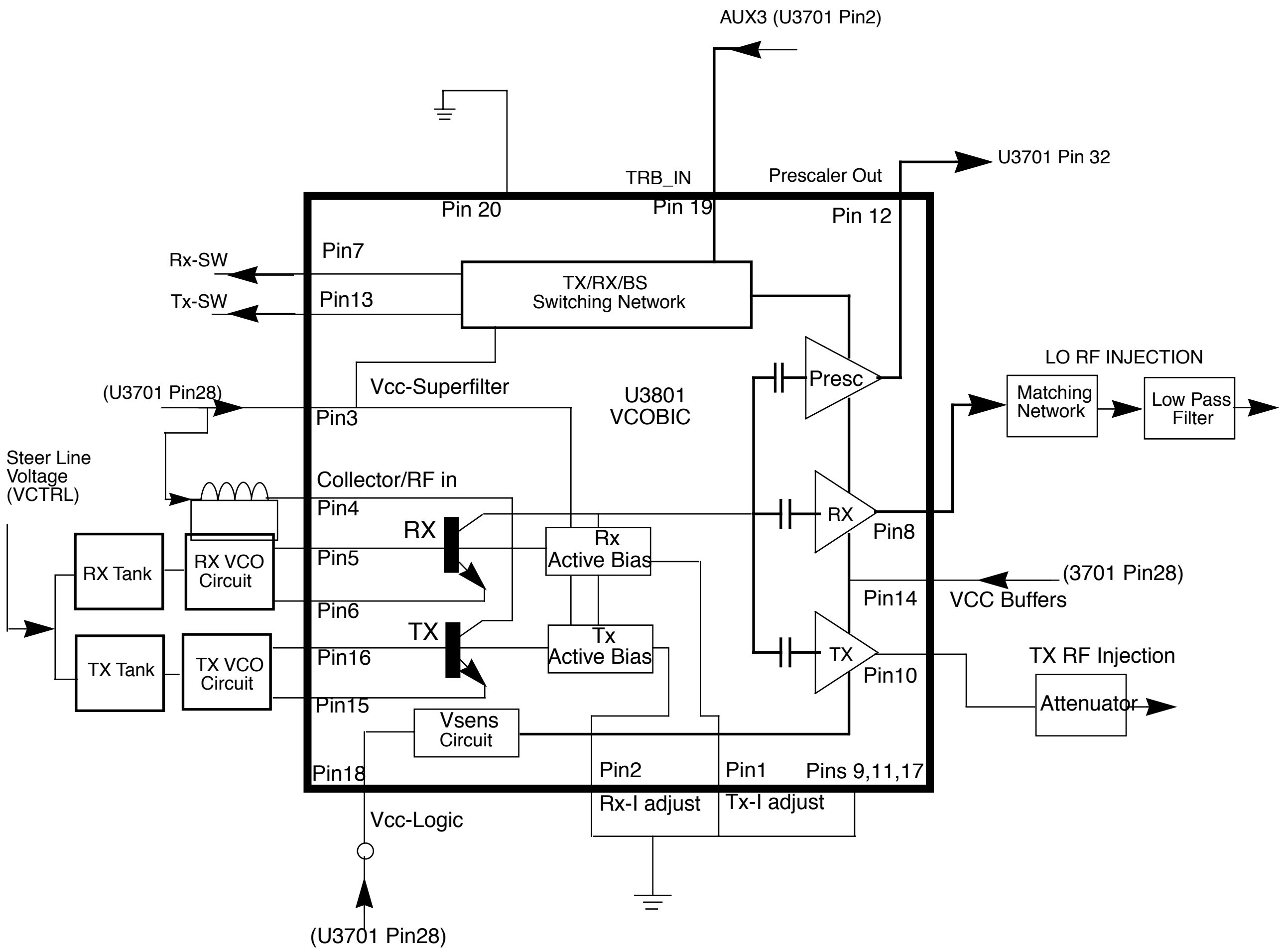


Figure 2-5 VHF VCO Block Diagram

Table 2-1 Level Shifter Logic

Desired Mode	AUX 4	AUX 3	TRB
Tx	n.u.	High (@3.2V)	High (@3.2V)
Rx	n.u.	Low	Low
Battery Saver	n.u.	Hi-Z/Float (@1.6V)	Hi-Z/Float (@1.6V)

In the receive mode, U3801 pin 19 is low or grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U3801. The RF signal at U3801 pin 8 is routed through a matching network. The resulting LO RF INJECTION signal is applied to the mixer at T3302.

During the transmit condition, when PTT is pressed, 3.2 volts is applied to U3801 pin 19. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U3801. The RF signal at U3801 pin 10 is injected into the input of the PA module (U3501 pin16). This RF signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received through U3701, pin 41.

When a high impedance is applied to U3801 pin19, the VCO is operating in battery saver mode. In this case, both the receive and transmit oscillators as well as the receive, transmit and prescaler buffer are turned off.

5.0 Voice Storage (GP1280)

(Refer to Figure 2-6 and the VHF Voice Storage schematic diagram)

The Voice Storage feature is offered as standard in the GP1280 and as an Option board for GP340/GP360/GP380 and GP640/GP680.

The Voice Storage feature enables users to:

- ❑ Record and Playback Personal Memo (Reminders, Notes, etc.).
- ❑ Send over-the-air an “Out-Of-Office” message when an incoming call is received but is not available to take up call.
- ❑ Over-the-air recording of important voice message being received.

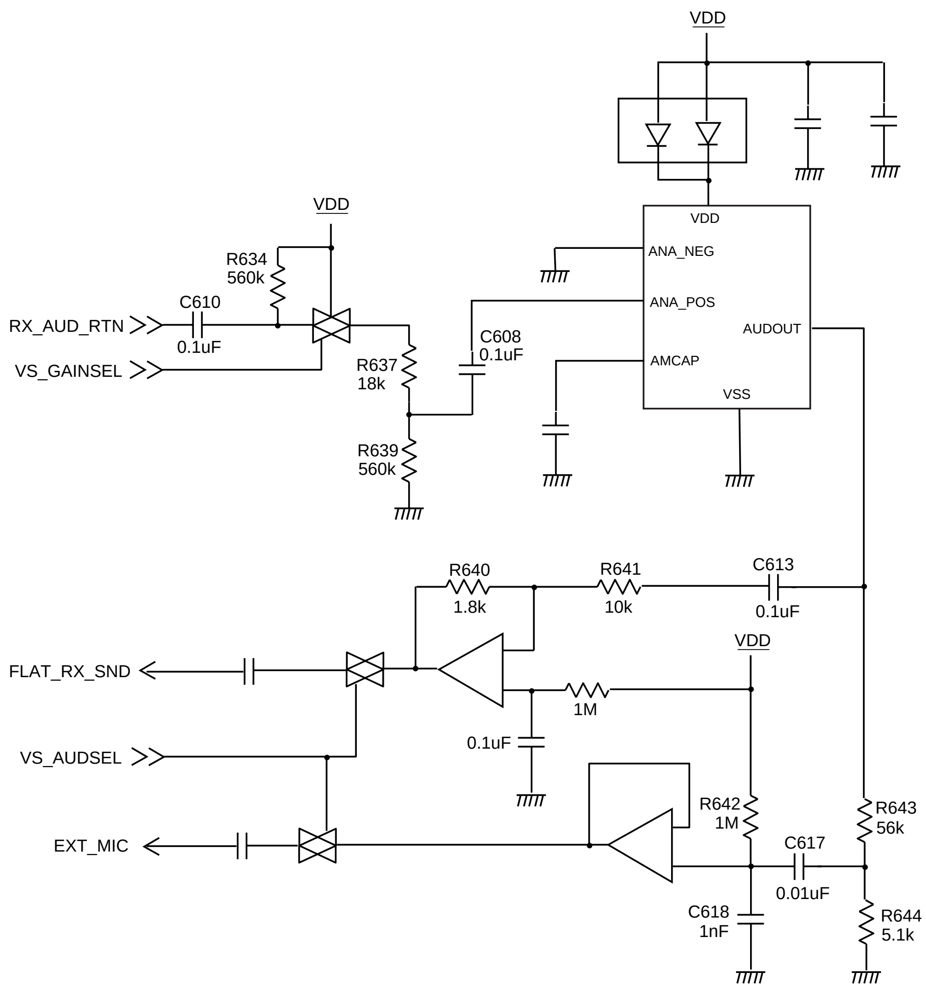


Figure 2-6 Audio path for voice storage connection to interface connector

Audio routing to the Voice Storage circuitry during receive message recording, message playback, personal memo recording and voice prompt transmit over the air are as follows:

Received Message Recording

The receive audio is tapped from the Rx_Aud_Rtn pin of the ASFIC_CMP during receive mode.

Message Playback

Message playback is via the FLAT_RX_SND pin of ASFIC_CMP. In the ASFIC_CMP, the signal is routed via the Side-Tone path to the Receive path where playback audio is routed to the speaker.

Personal Memo Recording

In this mode, voice is pick-up at the Mic. and via the Side-Tone path will be directed to the Rx_Aud_Rtn pin, which is then routed to the voice recording chip.

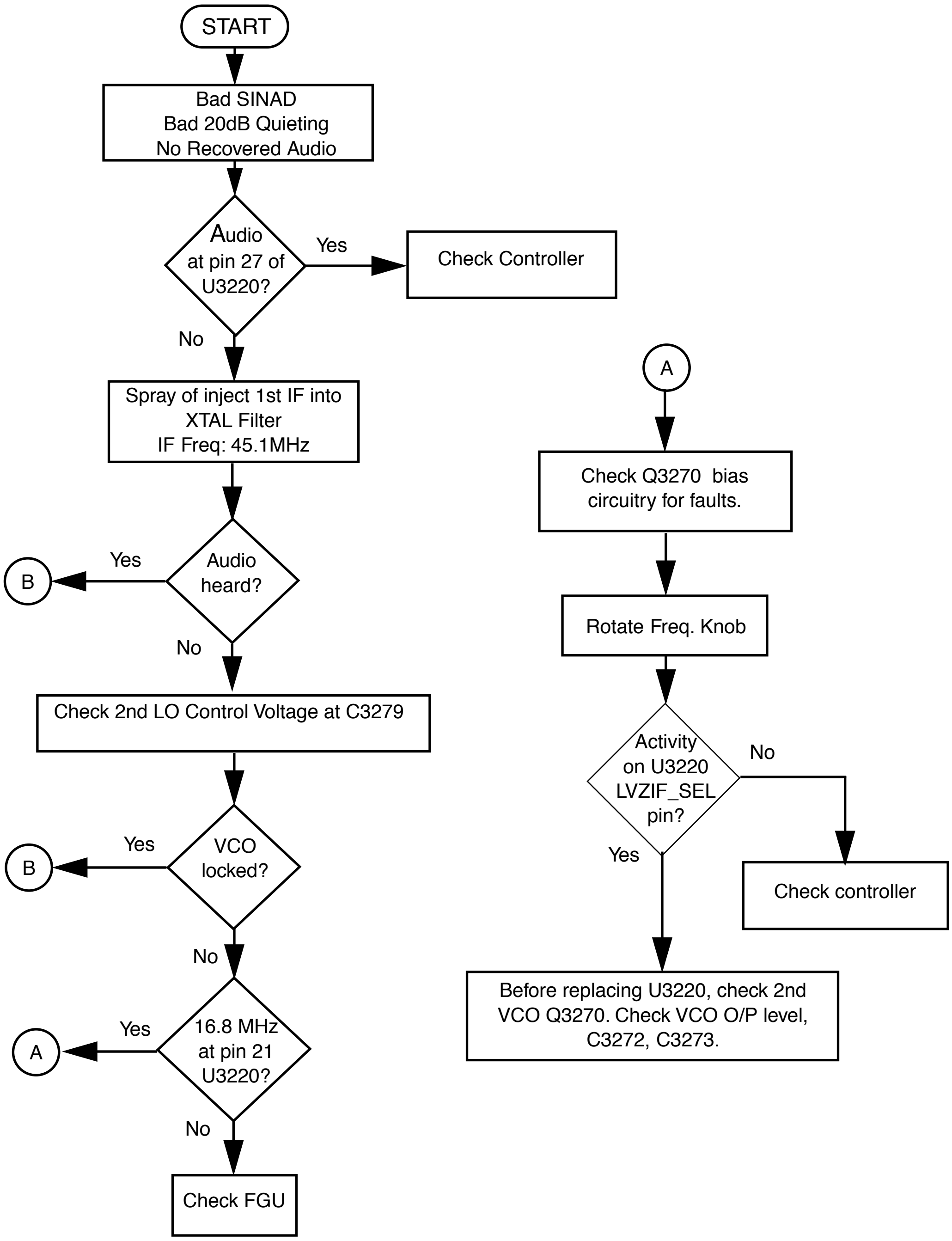
Voice Prompt transmit over the air

A personal voice prompt or Out-Of-Office Message which is stored in the IC can be transmitted over the air through mic path in the ASFIC_CMP to the calling party. This feature is similar to the Telephone Answering Machine feature when the person called is not available to attend the call.

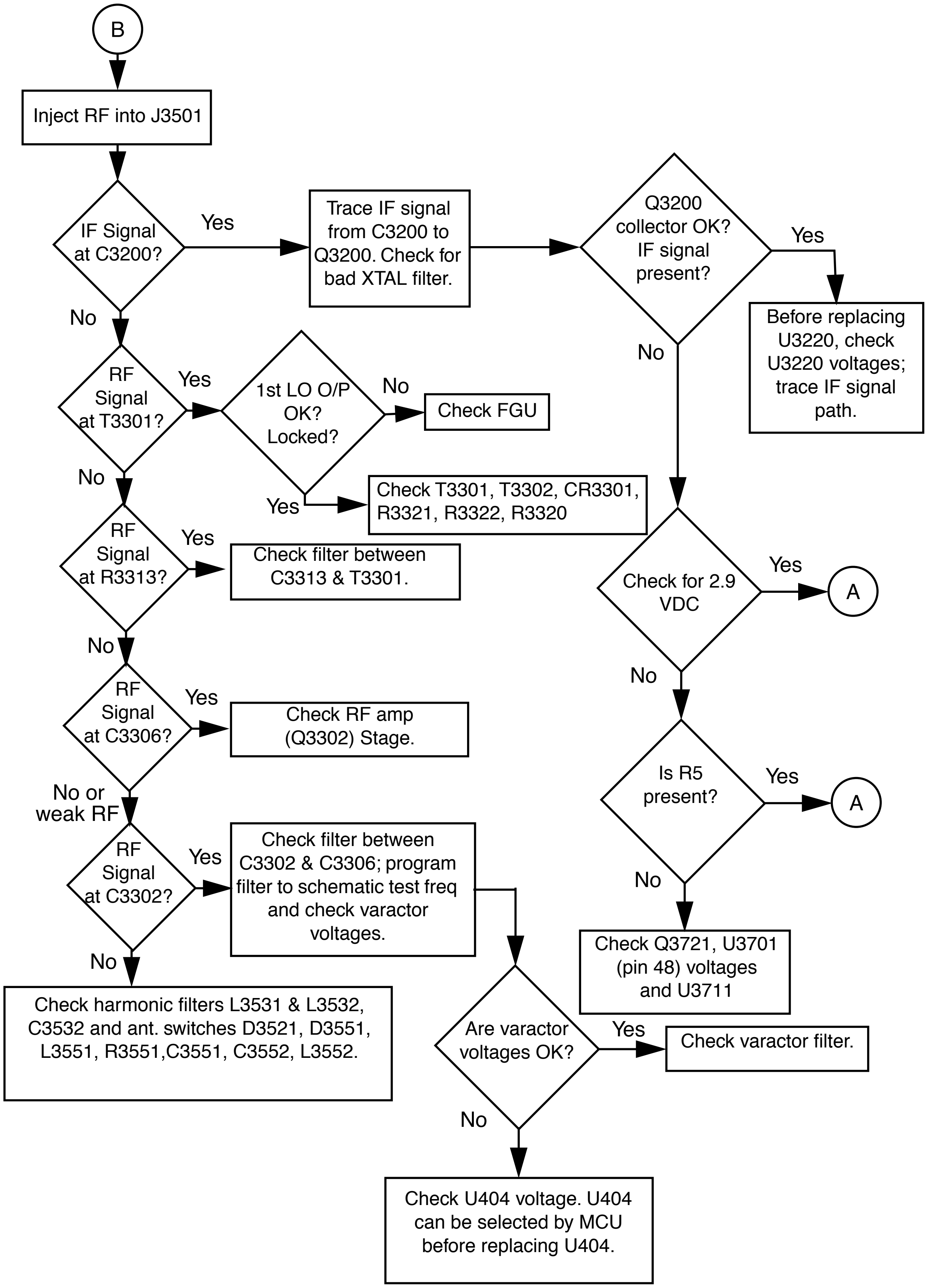
Chapter 3

TROUBLESHOOTING CHARTS

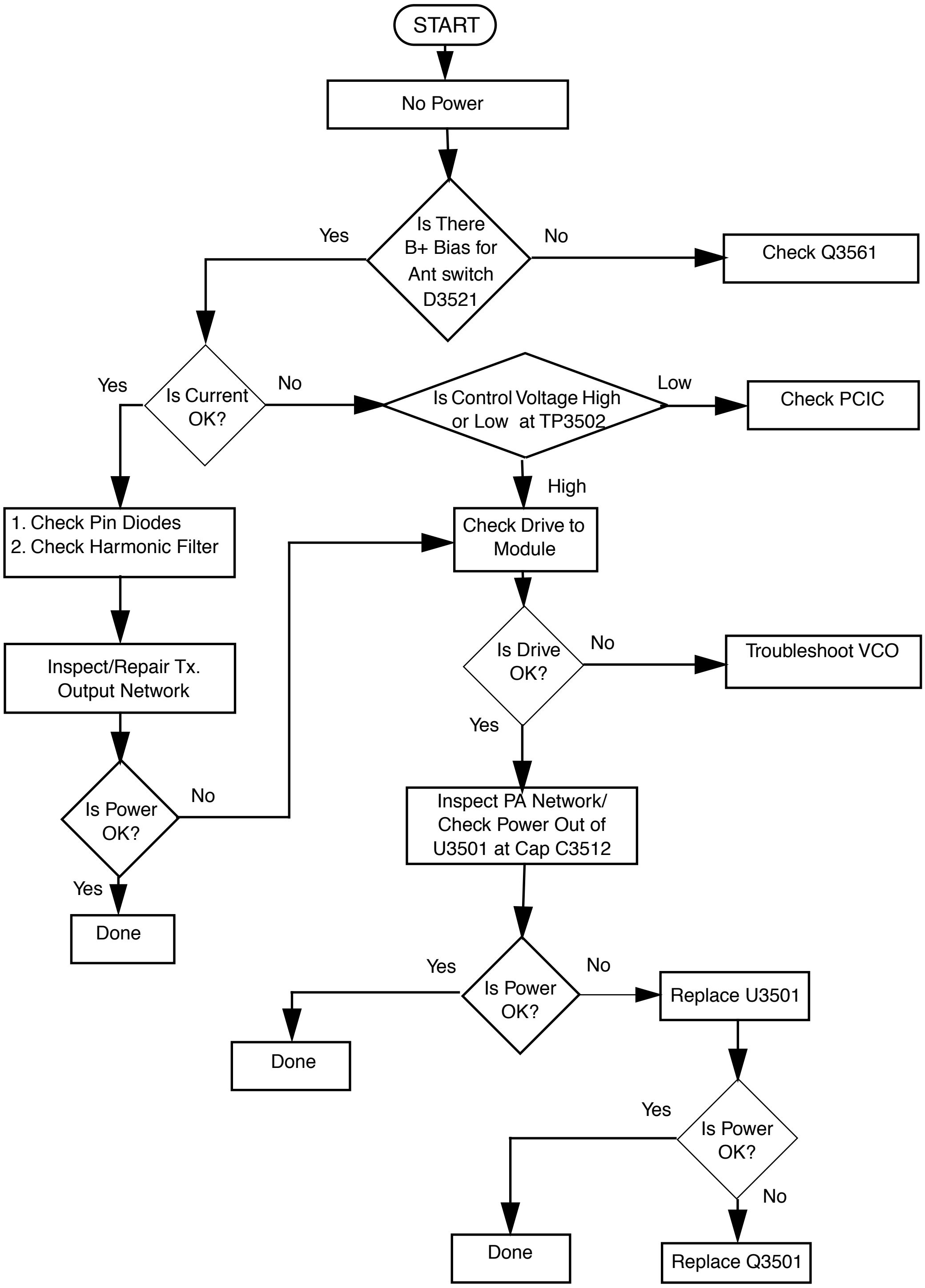
1.0 Troubleshooting Flow Chart for Receiver (Sheet 1 of 2)



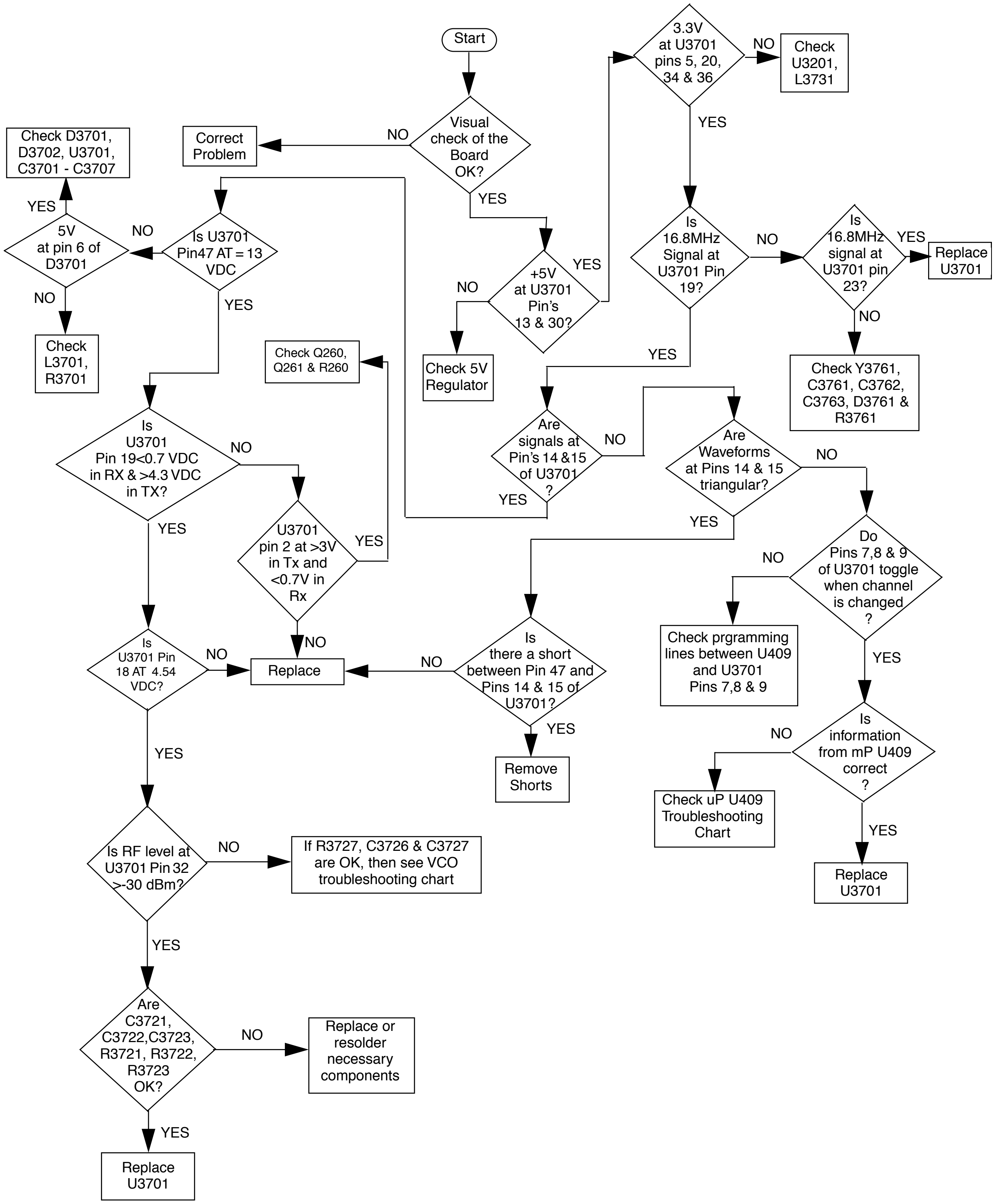
2.0 Troubleshooting Flow Chart for Receiver (Sheet 2 of 2)



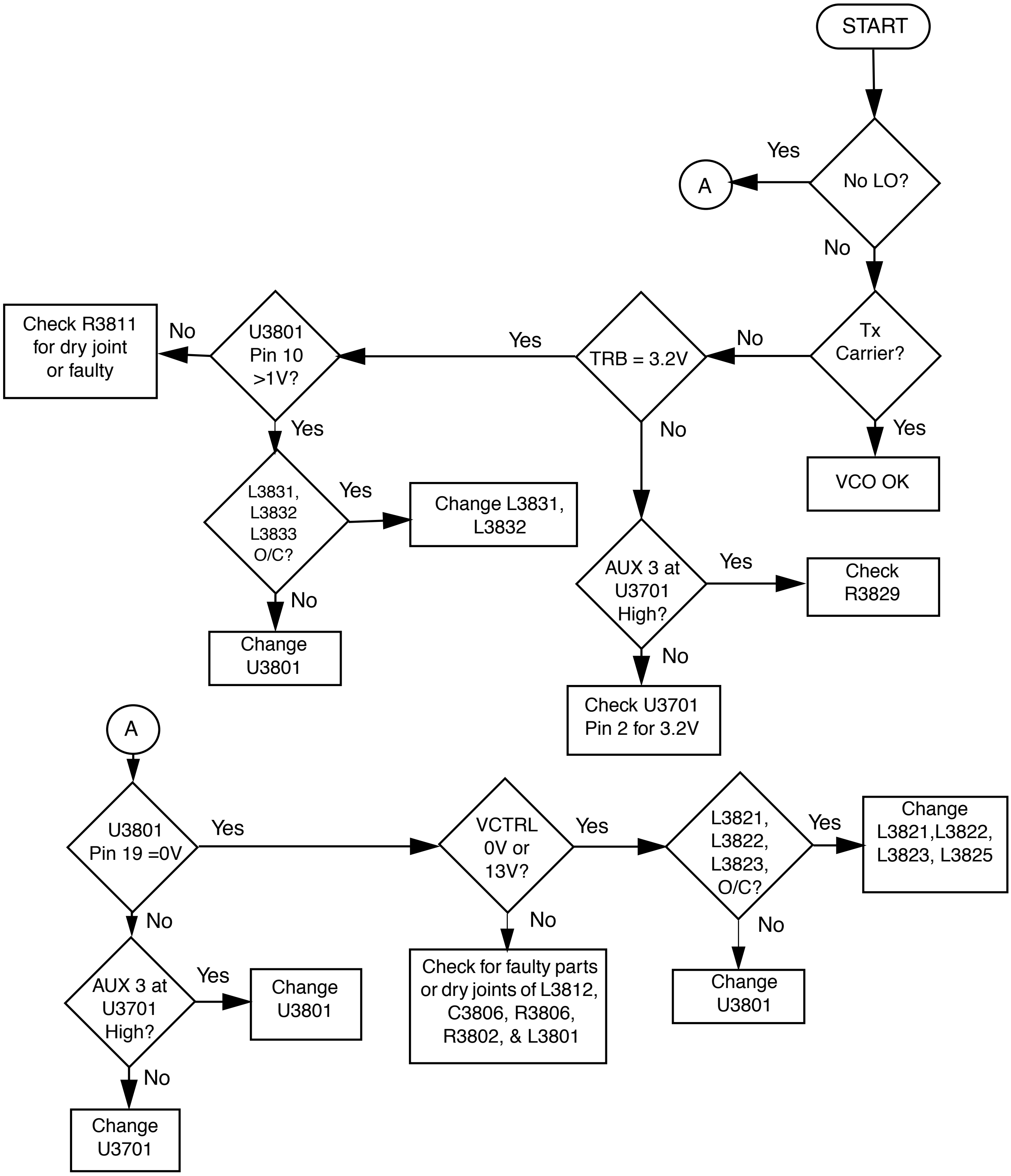
3.0 Troubleshooting Flow Chart for Transmitter



4.0 Troubleshooting Flow Chart for Synthesizer



5.0 Troubleshooting Flow Chart for VCO



Chapter 4

VHF PCB/SCHEMATICS/PARTS LISTS

1.0 Allocation of Schematics and Circuit Boards

1.1 Controller Circuits

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

1.2 Voice Storage Facility

The Voice Storage facility is fitted to the GP1280 radio as standard and the schematics, component layout and parts list for these circuits are shown in this Chapter. The Voice Storage facility may be fitted to other radios in the GP Series as an option board; reference must be made to the Option Board manual in this case. The Voice Storage schematic and the related PCB is shown in Table 4-2 below.

Table 4-1 VHF Diagrams and Parts Lists

PCB :	
8486062B12 Main Board Top Side	Page 4-3
8486062B12 Main Board Bottom Side	Page 4-4
8486062B14 Main Board Top Side	Page 4-23
8486062B14 Main Board Bottom Side	Page 4-24
SCHEMATICS	
Controls and Switches	Page 4-5
Receiver Front End	Page 4-6
Receiver Back End	Page 4-7
Synthesizer	Page 4-8
Voltage Controlled Oscillator	Page 4-9
Transmitter	Page 4-10
Parts List	
8486062B12	Page 4-11
8486062B14	Page 4-25

Table 4-2 VHF GP1280 Diagrams and Parts Lists

PCB :	
8486101B09 Main Board Top Side	Page 4-15
8486101B09 Main Board Bottom Side	Page 4-16
8486101B10 Main Board Top Side	Page 4-29
8486101B10 Main Board Bottom Side	Page 4-30
SCHEMATICS	
Controls and Switches	Page 4-5
Receiver Front End	Page 4-6
Receiver Back End	Page 4-7
Synthesizer	Page 4-8
Voltage Controlled Oscillator	Page 4-9
Transmitter	Page 4-10
Voice Storage Circuits	Page 4-17
Parts List	
8486101B09	Page 4-19
8486101B10	Page 4-31

Table 4-3 VHF Diagrams and Parts Lists

PCB :	
8486062B16 Main Board Top Side	Page 4-35
8486062B16 Main Board Bottom Side	Page 4-36
SCHEMATICS	
Controls and Switches	Page 4-37
Receiver Front End	Page 4-38
Receiver Back End	Page 4-39
Synthesizer	Page 4-40
Voltage Controlled Oscillator	Page 4-41
Transmitter	Page 4-42
Parts List	
8486062B16	Page 4-43