

SRM 9000 Series

FM VHF/UHF Mobile Radio Transceiver

SERVICE MANUAL



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Draft D



Revision History

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List of Associated Publications

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TNM-I-E-0005	SRM9000 Series Installation Instructions	Simoco Europe
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TNM-U-E-0014	SRM9025 PMR Operating Instructions	Simoco Europe
TNM-U-E-0015	SRM9025 Trunk Operating Instructions	Simoco Europe
TNM-U-E-0003	SRM9030 PMR Operating Instructions	Simoco Europe
TNM-U-E-0004	SRM9030 Trunk Operating Instructions	Simoco Europe

Table of Contents

1. INTRODUCTION	1
1.1 GENERAL.....	1
1.2 SCOPE	1
1.3 DESCRIPTION.....	1
1.4 PRODUCT VARIANTS AND FACILITIES	2
1.5 GLOSSARY.....	5
2. SERVICE PHILOSOPHY	6
2.1 SERVICE CONCEPT	6
2.2 WARRANTY.....	6
2.2.1 Service within and out of warranty	6
2.2.2 Ancillary Items.....	6
2.3 SOFTWARE POLICY	6
2.4 ADJUSTMENT AND ALIGNMENT	7
2.5 TECHNICAL SPECIFICATION.....	8
2.5.1 General	8
2.5.2 Transmitter.....	9
2.5.3 Receiver.....	10
2.5.4 Signalling.....	11
2.5.5 Environmental	12
3. TECHNICAL DESCRIPTION	13
3.1 RECEIVER.....	13
3.1.1 Front End Filters and RF Amplifier.....	13
3.1.2 First Mixer and IF Section	13
3.1.3 Quadrature Demodulator	15
3.1.4 Receiver Audio Processing.....	15
3.2 TRANSMITTER	15
3.2.1 Drivers and PA Stages.....	15
3.2.2 Power Control	17
3.2.3 Antenna Changeover and Harmonic Filter.....	17
3.2.4 Transmitter Audio Processing.....	17
3.3 FREQUENCY SYNTHESISER.....	19
3.3.1 General	19
3.3.2 PLL.....	19
3.3.3 VCO	19
3.3.4 Negative Bias Generator and Loop Filter	19
3.3.5 Phase Modulator	19
3.3.6 Reference Oscillator	20
3.4 CONTROL	20
3.4.1 DSP and FPGA.....	20
3.4.2 DSP Clock Oscillator.....	22
3.5 MEMORY	22
3.5.1 Multiplexer.....	22
3.6 POWER SUPPLIES	22
3.6.1 Power On Function	22
3.6.2 Power Supplies	23
4. ALIGNMENT	25
4.1 TEST EQUIPMENT	25
4.2 TEST SET UP	27
4.2.1 COMMS Set up.....	28
4.2.2 Radio Preparation	29

4.2.3 ALIGNMENT PROCEDURE	30
5. REPLACEABLE PARTS	39
6. CIRCUIT DIAGRAMS AND PARTS LIST	41
6.1 LIST OF ILLUSTRATIONS	41

List of Figures

<i>Figure 3-1 VHF/UHF Receiver Block Diagram</i>	<i>14</i>
<i>Figure 3-2 VHF/UHF Transmitter Block Diagram</i>	<i>16</i>
<i>Figure 3-3 VHF/UHF Synthesiser, Block Diagram</i>	<i>18</i>
<i>Figure 3-4 VHF/UHF Control Block Diagram</i>	<i>21</i>
<i>Figure 4-1 SRM9000 Programming & Alignment Breakout Box</i>	<i>26</i>
<i>Figure 4-2 SRM9000 Speaker Output Breakout Box</i>	<i>26</i>
<i>Figure 4-3 Test Set up</i>	<i>27</i>
<i>Figure 5-1 Replaceable Parts</i>	<i>39</i>
<i>Figure 5-2 Band-Specific Parts</i>	<i>40</i>
<i>Figure 6-1 SRM9000 Block Diagram</i>	<i>42</i>
<i>Figure 6-2 DSP and FGPA Schematic</i>	<i>43</i>
<i>Figure 6-3 Power Supply Schematic</i>	<i>44</i>
<i>Figure 6-4E0 Receiver Circuit Schematic</i>	<i>45</i>
<i>Figure 6-5E0 Transmitter Circuit Schematic</i>	<i>49</i>
<i>Figure 6-6E0 Synthesiser - VCO Schematic</i>	<i>53</i>
<i>Figure 6-7E0 Synthesiser - PLL Schematic</i>	<i>57</i>
<i>Figure 6-8 A/D Converter Schematic</i>	<i>61</i>
<i>Figure 6-9 D/A Multiplexer Schematic</i>	<i>62</i>
<i>Figure 6-10 I/O Connections Schematic</i>	<i>63</i>
<i>Figure 6-11 SRM9000 PCB Layout, Top (1/2)</i>	<i>64</i>
<i>Figure 6-12 SRM9000 PCB Layout, Top (2/2)</i>	<i>65</i>
<i>Figure 6-13 SRM9000 PCB Layout, Bottom (1/2)</i>	<i>66</i>
<i>Figure 6-14 SRM9000 PCB Layout, Bottom (2/2)</i>	<i>67</i>

List of Tables

<i>Table 1-1 Common Features for All Variants</i>	<i>2</i>
<i>Table 1-2 Conventional-PMR Variants</i>	<i>3</i>
<i>Table 1-3 Trunked Variants</i>	<i>4</i>

1. INTRODUCTION

1.1 General

The SRM9000 series of FM mobile radio transceivers is designed for conventional PMR and Trunked operation in VHF and UHF radio systems.

The system is available in a number of functional variants. Each variant uses the standard SRM9000 mobile transceiver, which is software configured for different control ancillaries. The software configuration together with the type of controller (Basic or Enhanced microphone, Handset, or Alphanumeric Control Head) determines the radio features for the different variants as follows.

	PMR/Trunked
Basic Telemetry Transceiver No Display or Control Head	SRM9005
Low Range Version with Basic Control Microphone	SRM9010
Mid Range Version with Enhanced Control Microphone	SRM9020
Handset Version with Alpha Display Handset	SRM9025
System Level Remote Version with Alpha Display Handset	SRM9030

1.2 Scope

This manual provides technical specifications, description and servicing details for the SRM9000 series of mobile radio transceivers together with the related microphones and control heads.

Unless specifically stated otherwise, the text and illustrations refer to all versions in the series.

1.3 Description

The design concept utilises wide band analogue techniques for RF transmit and receive circuitry with digital signal processing for narrow and wideband modulation and demodulation. Electronic tuning is used throughout the mobile to eliminate manual tuning and level adjustment.

A Digital Signal Processor (DSP) and a Field Programmable Gate Array (FPGA) are used with other dedicated devices in the SRM9000 to perform the following functions under software control:

- Frequency Synthesis of all operating frequencies.
- Modulation and demodulation of 12.5/20/25kHz FM signals on a per channel basis.
- Modem functionality for specified data modulation schemes.
- Filtering, pre-emphasis, de-emphasis, limiting, compression, muting, CTCSS, Selcall or any other frequency or level dependent signal modification.
- Serial communications with the Control Ancillaries and Alignment Tool.
- Tuning Control data for TX and RX.

The SRM9000 Transceiver comprises a rugged extruded aluminium sleeve which houses a single printed circuit board assembly and provides all heatsinking requirements. The sleeve housing is closed at each end by high-impact plastic end caps; all cable ports and mechanical interfaces are sealed against moisture and dust ingress.

The PCB assembly comprises a single, multi-layer PCB containing all the RF and control circuitry. The PCB seats on an extruded aluminium tray that slides into the outer aluminium sleeve where it is secured with screws accessed from the outside of the case. Provision is made under the main PCB tray assembly for additional hardware options.

There are two installation options available for the SRM9000. The outer aluminium extrusion has side flanges which allow the mobile to be bolted directly to any flat surface in the vehicle. A quick release cradle is also available.

1.4 Product Variants And Facilities

Product variants and facilities are detailed in Table 1-1, Table 1-2 and Table 1-3

Table 1-1 Common Features for All Variants

Feature:	Model:	9005	9010	9020	9025	9030
Control		None or Serial or Parallel if Option Brd	Display Microphone	Display Microphone	Display Handset	Control Unit with Microphone
Display		-	1 digit LED	6 digit LCD	2x12 char LCD	8x14 char graphic LCD
Adjustable Display Illumination		-	Yes	Yes	-	Yes
Buttons and Keys		-	Vol Up/Down Select 1 Function	Vol Up/Down 4 Function	Vol Up/Down 6 Function 12 Keypad Send/End Menu + Scroll	6 Function
Speaker		-	Yes	Yes	Yes	Yes
Frequency Bands		66-88MHz, 136-174MHz, 174-235MHz, 335-400MHz, 400-450MHz, 440-500MHz, 470-530MHz				
Channel Spacing		12.5/20/25kHz				
Menu driven		-	-	-	Yes	Yes
Customisable Menus		-	-	-	Yes	Yes

Table 1-2 Conventional-PMR Variants

Feature: Model	9005	9010	9020	9025	9030
Channels	10	10	100	1000	1000
Signalling	CTCSS / DCS	CTCSS / DCS ANI	CTCSS / DCS Selcall	CTCSS / DCS Selcall + Phonebook	CTCSS / DCS Selcall + Phonebook
Attack Operation	-	Yes	Yes	Yes	Yes
DTMF Encode	-	-	-	Yes	Yes
PTT Limit Timer with warning beeps	Yes				
PTT Inhibit on Busy	Yes				
Voting	Yes				
Scanning	8 fixed groups	8 fixed groups	7 fixed, 1 user	4 fixed, 4 user	4 fixed, 4 user
Priority Scanning	Yes				
Nuisance Delete	-	-	-	Yes	Yes
Multi-ax	Yes				
Mod/Demod Fctn	Option	-	-	-	-
Ignition Sense Input	Yes				
VOX Handsfree	Option	Option	Option	Yes	Option
General External IO	Option	Option	Option	Option	Option
600 Ohm Interface	Option	Option	Option	Option	Option
Internal GPS	Option	Option	Option	Option	Option

Table 1-3 Trunked Variants

Feature: Model:	9005	9010	9020	9025	9030
Channels	1024 channels in 50 sub-bands				
Frequency Bands	Specifically : 136-174MHz, 400-450MHz (and possible in all other bands)				
Background Hunt and Vote-Now	Yes	Yes	Yes	Yes	Yes
MPT1343 dialstrings	Yes	Yes	Yes	Yes	Yes
ANN Numbering	-	Yes	Yes	Yes	Yes
Memories	10	10	100	250	250
User Phonebook	-	-	-	Yes	Yes
Alpha Status List	-	-	-	Yes	Yes
SDM/EDMs	Yes	-	-	Yes	Yes
NPDs	Yes	-	-	Yes	Yes
Mod/Demod Fctn	Option	-	-	-	-
Attack Operation	-	Yes	Yes	Yes	Yes
Ignition Sense Input	Yes	Yes	Yes	Yes	Yes
VOX Handsfree	Option	Option	Option	Yes	Option
General External IO	Option	Option	Option	Option	Option
600 Ohm Interface	Option	Option	Option	Option	Option

1.5 Glossary

The following specific abbreviations are used in this handbook:

ADC	Analog to Digital Converter
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
CODEC	COde (Analog to Digital Converter) / DECode (Digital to Analog Converter) integrated circuit.
CTCS	Continuous Tone Controlled Squelch System
DAC	Digital to Analog Converter
DSP	Digital Signal Processor
FPGA	Field Programmable Gate Array
I	The In phase baseband signal produced by the internal "I" mixer of demodulator U401.
PLL	Phase Locked Loop
PSD	Peak System Deviation
PMR	Private Mobile Radio
Q	The Quadrature baseband signal produced by the internal "Q" mixer of demodulator U401. This signal is 90° out of phase with the I signal.
RSSI	Receiver Signal Strength Indicator
TCXO	Temperature Compensated Crystal Oscillator

2. SERVICE PHILOSOPHY

2.1 Service Concept

The SRM9000 series has been designed to provide low cost trunked and non-trunked analogue, mobile transceivers, using common core electronics, software and interfacing. It is a requirement that once the customer has purchased equipment, Simoco can follow this by providing an ongoing, high level of customer support together with a competitive and professional servicing activity.

There are three levels of service available:

LEVEL	ACTIVITY	RECOMMENDED SPARES	RECOMMENDED TEST EQUIPMENT
1	Replacement of complete transceiver/antenna/fuses Reprogramming	Antennas, Fuses Ancillaries	Multimeter P.C. Radio software Programmer
2	Replacement of PCB or mechanical component replacement, Cosmetic repair	Listed in Level 2 Spares Schedule	As above + service aids and test equipment
3	Repair by PCB or mechanical component replacement, Cosmetic repair. Repair of Radio PCB to component level in CRU.	Listed in Level 2 Spares Schedule Radio PCB components only available to CRU.	As above + service aids and test equipment

2.2 Warranty

Initially, the normal 12-month warranty will apply to all radios and ancillaries.

2.2.1 Service within and out of warranty

The field Service Level for the SRM9000 mobile is LEVEL 2, PCB replacement.

LEVEL 2 service, PCB (only) and case part replacement, will be carried out in field repair workshops, or the Central Repair Unit (CRU) if required.

LEVEL 3 Service (Radio PCB component level repair) will ONLY be carried out in the Central Repair Unit. For this, the complete radio must be returned to the CRU.

A PCB replacement program may be offered by the CRU in some countries.

2.2.2 Ancillary Items

All ancillary items (except remote alphanumeric control head) are Level 1 service.

These items should be replaced if faulty; they are non-repairable, and non-returnable to the CRU.

2.3 Software Policy

Software provided by Simoco Europe shall remain the Company's property, or that of its licensors and the customer recognises the confidential nature of the rights owned by the Company.

The customer is granted a personal, non-exclusive, non-transferable limited right of use of such software in machine-readable form in direct connection with the equipment for which it was supplied only. In certain circumstances the customer may be required to enter into a separate licence agreement and pay a licence fee, which will be negotiated at the time of the contract.

The customer undertakes not to disclose any part of the software to third parties without the Company's written consent, nor to copy or modify any software. The Company may, at its discretion, carry out minor modifications to software. Major modifications may be undertaken under a separate agreement, and will be charged separately.

All software is covered by a warranty of 3 months from delivery, and within this warranty period the Company will correct errors or defects, or at its option, arrange free-of-charge replacement against return of defective material.

Other than in clause above, the Company makes no representations or warranties, expressed or implied such, by way of example, but not of limitation regarding merchantable quality or fitness for any particular purpose, or that the software is error free, the Company does not accept liability with respect to any claims for loss of profits or of contracts, or of any other loss of any kind whatsoever on account of use of software and copies thereof.

2.4 Adjustment and Alignment

There are no internal adjustments in the SRM9000. Re-programming and alignment is done with the unit installed using software tools. For servicing, the radio PCB can be operated as a stand alone unit provided a temporary heatsink is fitted under the transmitter PA module for transmitter servicing and that the receiver audio output be kept below 100mW for receiver servicing. Radio performance is not adversely affected by operating without the outer sleeve but there will be some change to performance when the metal cans are removed from the RF sections of the board.

2.5 Technical Specification

2.5.1 General

Operation

Single or two frequency simplex

Modulation

Frequency modulation (phase) F3E

Supply Voltage Requirements

10.8 to 16.2V DC negative earth (13.8V nom.)

Current Consumption

	Mobile With Control Mic	Mobile With Alpha Mic	Mobile With Alpha Head
Radio off	≤ 5mA	≤ 5mA	≤ 5mA
Standby(squelched):	≤ 200mA	≤ 210mA	≤ 210mA*
RX Audio O/P:			
300mW (not bridged)	≤ 450mA	≤ 470mA	≤ 500mA *
4.0W	≤ 1200mA	≤ 1220mA	≤ 1250mA*
Transmit:			
	VHF	UHF	
25W	≤ 6.5A	≤ 7.5A	
1W	≤ 2.0A	≤ 2.5A	

*Add 250mA to current consumption for Alpha Head with backlight on.

Frequency Bands

Band	Frequency Range	Band	Frequency Range
E0	66 - 88 MHz	R1	335 - 375MHz
AC	136 - 174MHz	R2	370 - 400MHz
K1	174 - 208MHz	TK	400 - 450MHz
KM	208 -245MHz	UW	440 - 500MHz
		WR	470 - 530MHz

Switching Bandwidth

Radio covers the complete band without retuning

Channel Spacing

12.5 / 20 / 25kHz

Frequency Stability

Better than ± 2.5 ppm

Operating Temperature

-30°C to +60°C ambient

Dimensions (mm)	Height	Width	Depth
Transceiver	56	170	165
9030 Alpha Control Head	65	188	45
9025 Alpha Display Handset	165	52	30
9020 Alpha Mic	96	68	44
9010/30 Microphone	82	57	38

Weight

Transceiver 1.8kg

2.5.2 Transmitter

Power Output

High Power: 25W Adjustable down to 1W

Low Power: 1W Adjustable up to 25W

Transmitter Rise Time

Less than 40 ms

Duty Cycle

1 minute transmit : 4 minutes receive

Spurious Emissions

< 0.25uW (9kHz to 1GHz)

< 1.0uW (1GHz to 4GHz))

Residual Noise

60% deviation. CCITT Weighted

25kHz Channel Spacing >45dB

12.5kHz Channel Spacing >40dB

Audio Frequency Distortion

≤ 3% (at 60% deviation)

Audio Frequency Response

300 to 3000Hz* +1dB -3dB

Figures apply for a flat audio signal or a 6dB/octave pre-emphasis curve

(*2550Hz 12.5kHz channel spacing)

2.5.3 Receiver

Sensitivity

$\leq 0.3\mu\text{V}$ PD (-117.5dBm) for 12dB SINAD

$\leq 0.4\mu\text{V}$ PD for 20 dB Quieting.

Adjacent Channel Selectivity

25kHz Channel Spacing >73dB

12.5kHz Channel Spacing > 65dB

Intermodulation Rejection

ETS Method > 65dB

AS4295 Method > 70dB

Spurious Response Rejection

> 75dB

Blocking

> 95dB ($\pm 1\text{MHz}$)

Conducted Spurious Emissions

< 2nW (-57dBm) 9kHz to 4GHz

FM Residual Noise (CCITT weighted)

25kHz : > 45dB

12.5kHz : > 40dB

Mute Range

Typically 6 to 25dB SINAD

Typical setting 10 to 12dB SINAD

Mute Response Time

<30mS (no CTCSS)

add 200mS for CTCSS

Voting Response Time

tba

Audio Distortion

< 3% (1W / 4ohm, 60% modulation)

<5% (4W / 4ohm, 60% modulation)

Audio Frequency Response

350 to 3000Hz*, +1dB to -3dB (no CTCSS)

360 to 3000Hz*, +1dB to -3dB (with CTCSS)

Figures apply for a flat audio response or a 6dB/octave de-emphasis curve

(*2550Hz for 12.5kHz channel spacing)

2.5.4 Signalling

CTCSS

38 standard CTCSS tones are supported plus any non prescribed tones in the range 67 to 241.8Hz.

Frequency (Hz)	Frequency (Hz)	Frequency (Hz)
67.0 Hz	107.2 Hz	162.2 Hz
71.9 Hz	110.9 Hz	167.9 Hz
74.4 Hz	114.8 Hz	173.8 Hz
77.0 Hz	118.8 Hz	179.9 Hz
79.7 Hz	123.0 Hz	186.2 Hz
82.5 Hz	127.3 Hz	192.8 Hz
85.4 Hz	131.8 Hz	203.5 Hz
88.5 Hz	136.5 Hz	210.7 Hz
91.5 Hz	141.3 Hz	218.1 Hz
94.8 Hz	146.2 Hz	225.7 Hz
97.4 Hz	151.4 Hz	233.6 Hz
100.0 Hz	156.7 Hz	241.8 Hz
103.5 Hz	250.3 Hz	

CTCSS Encoder Tone Deviation

Channel Spacing	Deviation
25 kHz	500 to 750 Hz
20 kHz	400 to 600 Hz
12.5 kHz	250 to 375 Hz

SELCALL

The following tone sets are supported:

ST-500: CCIR, EEA, ZVEI, DZVEI, EIA

ST500/CML: ZVEI_3, DZVEI

CML: CCIR, EEA, ZVEI

SIGTEC: CCIR, CCIRH, EEA, ZVEI_1, XVEI_2, ZVEI_3, NATEL, EIA

SEPAC: CCIR, EEA, ZVEI_1, ZVEI_2, ZVEI_3, EIA

Tone period: 20mS, 33mS 40mS, then 10mS steps to 2.55S.

Selcall Tone Deviation

6dB/octave pre-emphasis response, relative to 70% PSD at 2.4 kHz

DTMF Tone Frequencies

Tones 0-9, *, #.

Tones	1209 Hz	1336 Hz	1477 Hz
697 Hz	1	2	3
770 Hz	4	5	6
852 Hz	7	8	9
941 Hz	*	0	#

2.5.5 Environmental

Operational Temperature

-30°C to +60°C

Storage Temperature

-40°C to +80°C

Vibration Specification

IEC 68-2-6 with additional frequency acceleration from 60 – 150 Hz

Cold

IEC 68-2-1 Test 5 hours at -10°C

Dry Heat

IEC 68-2-2 Test 5 hours at +55°C

Damp Heat Cycle

IEC 68-2-30 Test 2 cycles at +40°C

Product Sealing

Main Radio Unit: IEC529 rating IP54

Microphones: IEC529 rating IP54

Remote Control Head IEC529 rating IP54

3. Technical Description

3.1 Receiver

Refer Figure 3-1

3.1.1 Front End Filters and RF Amplifier

The receiver input signal from the antenna passes through the antenna filter comprising L10, L11, L12 and associated tuning capacitors. With the mobile in receive mode, diodes D3, D4 and D5 in the antenna switch are reverse biased allowing the receiver input signal to be coupled through to the front end with minimal loss. The overall insertion loss of the antenna filter and switch is approximately 0.8dB. Front end selectivity is provided by varactor tuned bandpass filters at the input and output of the RF amplifier.

Front end tuning voltages are derived from the alignment data stored in the radio. The DSP processes this data to optimise front end tuning relative to the programmed channel frequencies which may be changed at any time without re-aligning the radio.

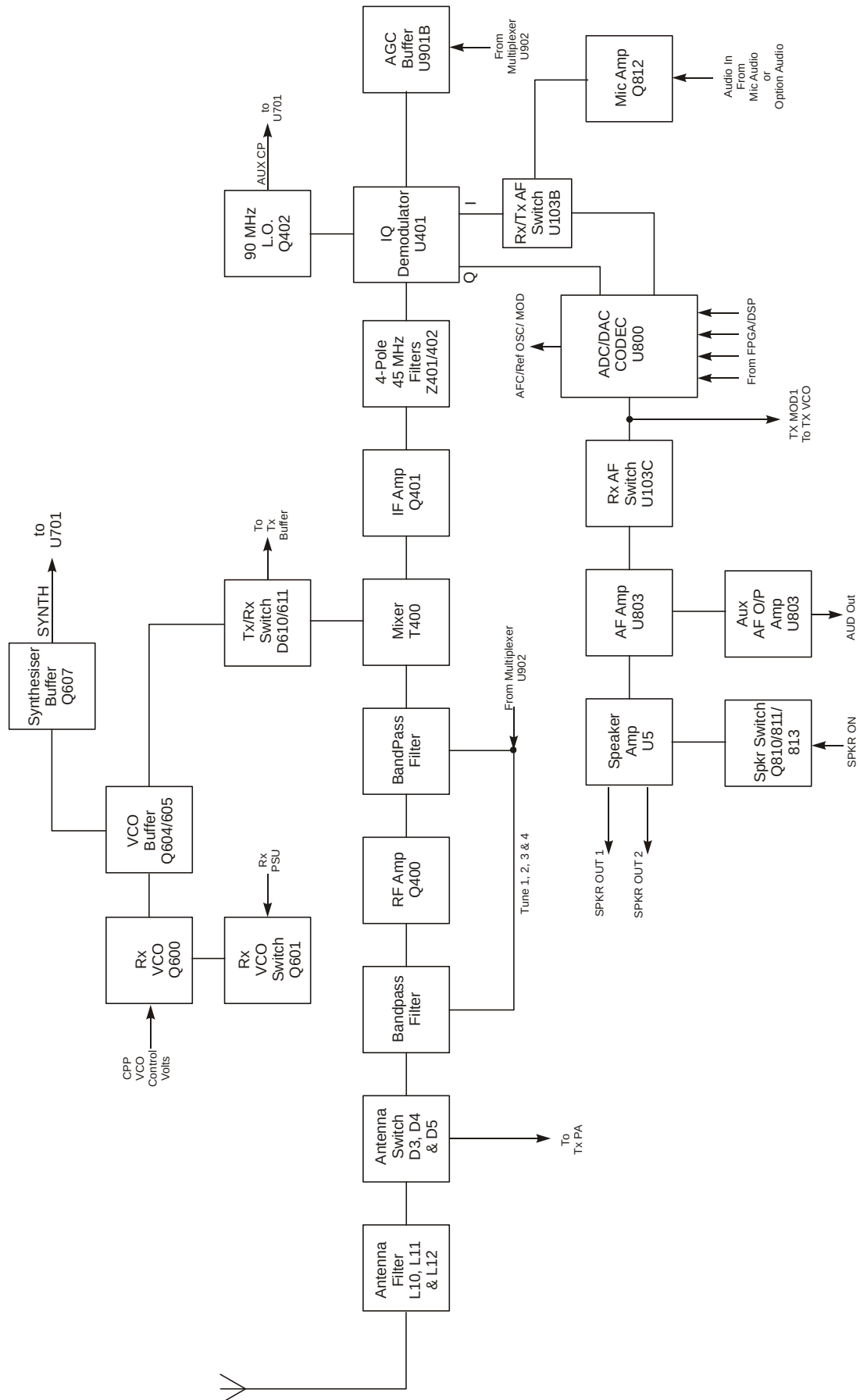
To achieve the required varactor tuning range an arrangement of positive and negative bias power supplies is used to provide a total bias across the varactors of up to 14.0VDC. A fixed 2.5V positive bias derived from the 5.0V supply and voltage divider R425/426 is applied to the cathodes of the varactor diodes. The negative bias supply originates at the DSP/FPGA as a composite digital tuning signal (FE TUNE) containing the data for the four front end tuning values TUNE 1 to 4 for the particular channel frequency selected. The level is dependent on channel frequency and tuning and varies between +0.1 and +3.0V. This signal then passes through buffer U901A and level translator Q900 to Q903 where it is converted to a high level (-0.5 to -11.5V) negative equivalent of the original signal. The -12.0V rail of the level translator is generated by U300B/C with D304 to D306 providing the required voltage multiplier effect. The high level negative signal is then split into the four individual front end negative DC values under software control by multiplexer U902 and associated storage capacitors C904 to C907 before being applied to the anodes of the front end tuning varactors.

The RF amplifier stage comprises a low noise transistor amplifier (Q400) which is compensated to maintain good linearity across the required frequency bands and temperature range. This provides excellent intermodulation and blocking performance across the full operating range. The gain of this stage is typically 17dB for both UHF and VHF versions.

3.1.2 First Mixer and IF Section

The output of the last front end bandpass filter is coupled into single balanced mixer T400/D413 which converts the RF signal to an IF frequency of 45MHz. The local oscillator injection level is typically +8dBm at T400 pin 1 with low side injection used for UHF and high side for VHF.

Following the mixer is IF amplifier Q401 which provides approximately 15dB of gain and in association with its output circuitry presents the required load conditions to the 4 pole 45MHz crystal filter Z401/402.



3.1.3 Quadrature Demodulator

Additional IF gain of approximately 30dB occurs at U401 which is a dedicated IF AGC amplifier/Quadrature Demodulator configured for single ended input and output operation. The AGC voltage for U401 is derived from the RSSI function of the DSP via AUX CTL and multiplexer U902. The onset of AGC operation occurs when RF input signal levels at the antenna exceed -90dBm.

Conversion of the 45MHz IF signal to I and Q baseband signals is carried out by the demodulator section of U401. The 90MHz local oscillator signal is generated by VCO Q402 which is phase locked by the auxiliary PLL output of U701 via feedback signal AUX LO2.

3.1.4 Receiver Audio Processing

All receiver audio processing and filtering functions are performed by the CODEC U800 under the control of the DSP. The receiver I and Q analog baseband signals are converted to digital signals by the CODEC ADC before being applied to a series of digital filters which provide the final stage of adjacent channel filtering, high pass and low pass filtering and mute noise processing for narrow and wideband operation. The processed signals are then converted to analog audio signals by the CODEC DAC and are applied to conventional audio amplifiers U803A/B and the speaker amplifier U5.

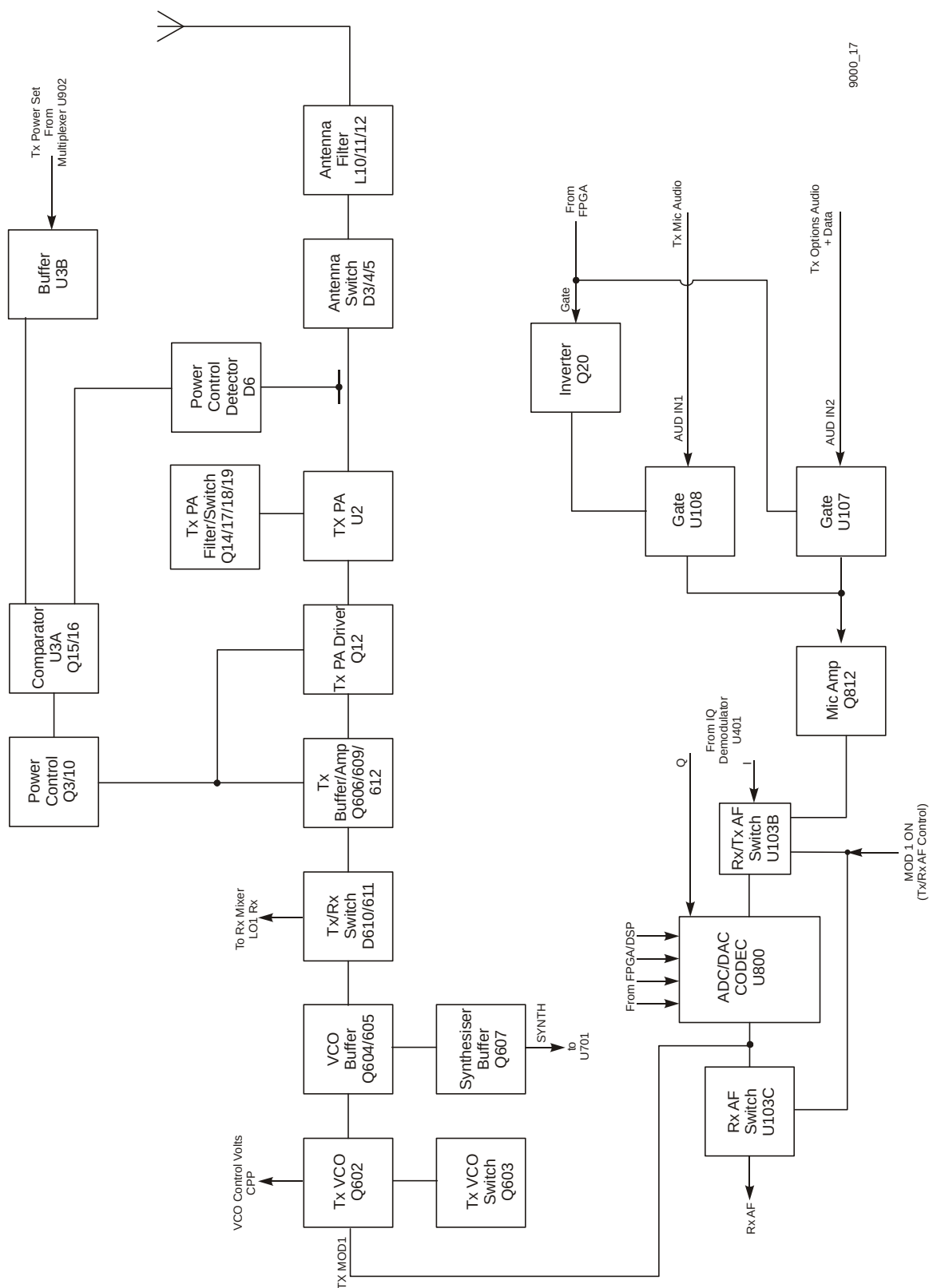
There are two speaker options available. A half bridged configuration using a speaker across balanced output SPKR OUT1 and 2 which provides an audio output level of up to 4 watts into 4 ohms. The other option is a full bridge configuration using a high power speaker across SPKR OUT1 and 2 and providing an audio output level of up to 10 watts into 8 ohms. The carrier and signalling mute functions are performed by Q810/811/813 under DSP control with additional receiver muting to U803B being applied by U103C when the mobile is in transmit mode. De-emphasis to the audio PA U5 is performed by R43 and capacitors C42 to C58. Flat audio is provided to S1-6 via amplifier U803A.

3.2 Transmitter

Refer Figure 3-2.

3.2.1 Drivers and PA Stages

The RF output level from the VCO buffer Q604 is typically +5dBm (UHF) and +8dBm (VHF). TX buffer Q606 increases this level by approximately 3dB (UHF) and 11dB (VHF) and also provides additional VCO isolation. The following section of the TX buffer Q612 is controlled by the transmitter power control loop and Q609. Q609 is normally saturated in transmit mode so there is no minimum gain control applied to this stage. The gain of Q612 is typically 10dB (UHF) and 15dB (VHF) but the output level is reduced by input and output resistive attenuators to limit the PA driver input level to typically +20dBm. The gain of PA driver Q12 is controlled by the power control loop to ensure that transmitter output power remains within defined limits. The PA driver output level is typically +25dBm. PA module U2 utilises three stages (UHF) and two stages (VHF) to achieve the required final RF output power level of +44dBm (25 watts). Power output settings are derived from alignment data stored in flash memory during the initial factory alignment. The DSP processes this data to optimise the power output level relative to the programmed channel frequencies which may be changed at any time without retuning the radio.



3.2.2 Power Control

Output power is stabilised by a power control feedback loop. L1, R54, a printed circuit transmission line, D6 and associated components comprise the power detector with Q3/Q10, U3 and associated components providing the power setting and control sections. Forward and reverse power is sampled by the power detector and applied as a DC voltage to the inverting input of comparator U3A. The TX PWR SET voltage which is a DC voltage proportional to the programmed TX power setting is applied to the non-inverting input of the comparator. PA module output level changes due to supply voltage, load or temperature variations are detected and applied to the comparator which proportionally adjusts the PA driver (Q12) supply, and therefore the PA drive level, via Q10/Q3. High temperature protection is provided by thermistor R452 which progressively reduces the power level if the PA module temperature becomes excessive. Q15 and Q16 provide for dual power control time constants necessary for good power ramp and decay characteristics.

3.2.3 Antenna Changeover and Harmonic Filter

The antenna changeover circuit consisting of pin diodes D3/D4/D5 is switched by Q4/Q8/Q11 and associated circuitry allowing the transmitter output to be coupled to the antenna while providing isolation for the receiver input. With the transmitter switched on, the diodes are forward biased allowing power to be coupled through to the antenna and isolating the receiver by grounding its input at C28. The short circuit at the receiver input is transformed to an effective open circuit at D3 by L13, which minimises transmitter loading. With the transmitter switched off the diodes are reverse biased allowing the receiver input signal to reach the receiver front end with minimal loading and loss.

The harmonic rejection low pass filter comprises L10/11/12 and associated capacitors.

3.2.4 Transmitter Audio Processing

Microphone audio input signals of 40mV RMS with a source impedance of 470 ohms are provided at the microphone input (AUD IN1) by an external microphone unit comprising an electret microphone insert and a preamplifier with a gain of 18dB. U108 is a control gate for the microphone audio signals.

AUD IN2 is the external audio options and data input which is controlled by gate U107. Inverter Q20 ensures that the data or audio options signals are muted when the mic. audio gate is active. The AUD IN2 input level and source impedance is the same as the microphone input.

Q812 is a unity gain amplifier which provides buffering of the audio and data signals. U103B provides CODEC input switching which selects either the receiver I signal or transmitter audio/data signals depending on the TX/RX mode. All pre-emphasis, filtering, compression and limiting processes for narrow and wideband operation are carried out in the CODEC (U800) under the control of the DSP. The processed transmitter audio/data from the CODEC output at VOUTL is applied to the VCO as a modulation signal with a level of approximately 200mV P/P.

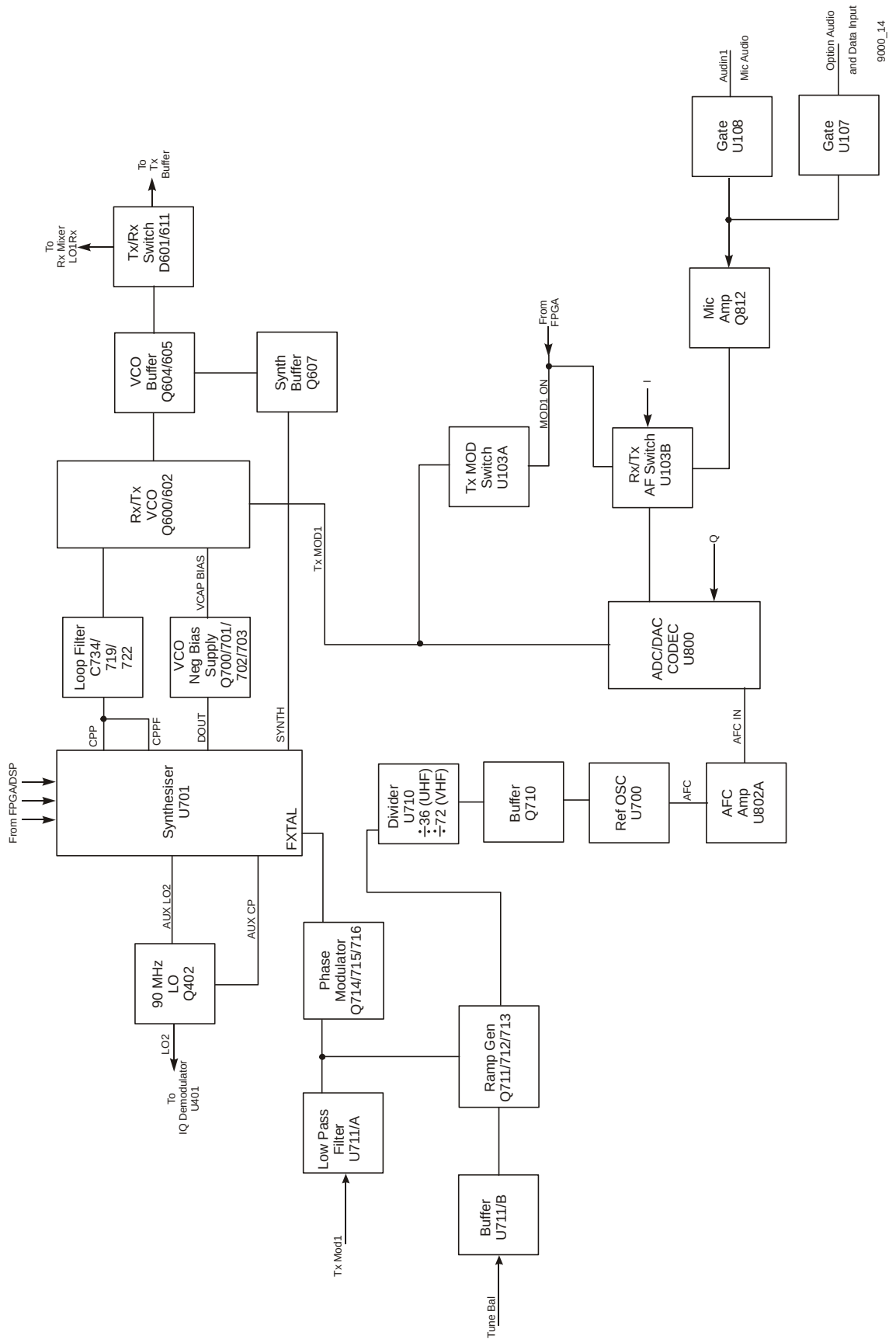


Figure 3-3 VHF/UHF Synthesiser, Block Diagram

3.3 Frequency Synthesiser

3.3.1 General

Refer Figure 3-3

The SRM9000 frequency synthesiser consists of individual transmitter and receiver (local oscillator) voltage controlled oscillators, loop filter, varactor negative bias generator, reference oscillator and an integrated, dual phase locked loop device U701.

3.3.2 PLL

The PLL device contains two prescalers, programmable dividers and phase comparators to provide a main and auxiliary PLL. The main PLL of U701 controls the frequency of the TX/RX VCOs via Control Voltage outputs at pins 2 and 3 and VCO Feedback to pin 6. The auxiliary PLL is used to control the receiver 90MHz second local oscillator via the Control Voltage output at pin 17 and VCO Feedback to pin 15. The PLL operation involves the division of the 14.4MHz reference oscillator frequency by divider U710 and the internal divider of U701 down to a lower frequency which corresponds to a sub-multiple of the radio channel spacing ie. 6.25kHz for 12.5/25kHz channel spacing or 5kHz for 20kHz channel spacing. The VCO frequency is sampled and divided down to the same frequency after which it is phase compared to the reference. Any error produces an offset to the Control Voltage output which is used to correct the VCO frequency. A valid lock detect output is derived from pin 20 and is sampled by the FPGA during transmit. If an unlocked signal is detected the radio will switch back to receive mode.

3.3.3 VCO

The transmitter and receiver VCOs use low noise JFET transistors (Q600 RX, Q602 TX) and inductors L602 (RX), L608 (TX) to generate the signals for the required band coverage. Electronic tuning is provided by varactor diodes D600 to D608 with their control voltages derived from the Loop Filter, PLL and Negative Bias Generator.

VCO selection and timing is controlled by the DSP via the RX and TX power supplies and applied through switches Q601 (RX) and Q603 (TX). VCO buffer Q604/605 isolates the VCO from load variations and active power supply filter Q615 minimises supply related noise. A PLL feedback signal is sampled from the VCO buffer output via buffer Q607.

3.3.4 Negative Bias Generator and Loop Filter

A positive and negative varactor bias supply similar to the front-end varactor arrangement has been used to achieve the required broadband tuning range of the VCOs. PLL device U701 is programmed to deliver a fixed nominal +2.5V output from phase detector/charge pump CPPF or CPP (selection depends on radio setup) regardless of the channel frequency selected. This voltage is filtered to remove synthesiser noise and reference products by loop filter C719/722/734 and R721/724/734. The resulting low noise voltage is applied to the cathode side of the VCO varactor tuning diodes as a positive bias voltage. The negative bias supply originates as a positive DC voltage (0.1V to 3.0V) at the DAC output of U701 (DOUT) with a level relative to the programmed state of the radio (eg. channel frequency, TX/RX state). The voltage is converted to a high level negative supply by VCO Varicap Negative Supply Q700 to Q703. The -17V rail of this supply is generated by U300B/C with D304 to D307 providing the voltage multiplying effect needed to achieve -17V. The output of the negative supply is applied directly to the VCO varactor anodes as the negative tuning voltage VCAP BIAS.

3.3.5 Phase Modulator

The modulation path for audio, data and higher frequency CTCSS signals is via D609 and its associated components in the TX VCO. The reference input to the PLL (FXTAL) provides the low frequency modulation path in conjunction with phase modulator Q714 to Q716. U711A is a low pass filter which provides 6dB per octave attenuation to frequencies above approximately 180Hz. Modulation balance adjustment is carried out using a CODEC generated 100Hz square wave applied to TX MOD1. A DAC output from the Alignment Tool is applied to buffer U711B and ramp generator Q711 to Q713 via the TUNE BAL line to adjust the low frequency modulation level.

3.3.6 Reference Oscillator

TCXO U700 determines the overall frequency stability and frequency setting of the radio. The frequency setting is achieved by adjusting its ADJ voltage with the Alignment Tool. In addition, the ADJ input is used in a frequency control loop with the receiver I and Q signals to provide receiver AFC. U700 operates at 14.4MHz and is specified at ± 2.5 ppm frequency stability over the temperature range -25° to $+75^{\circ}\text{C}$.

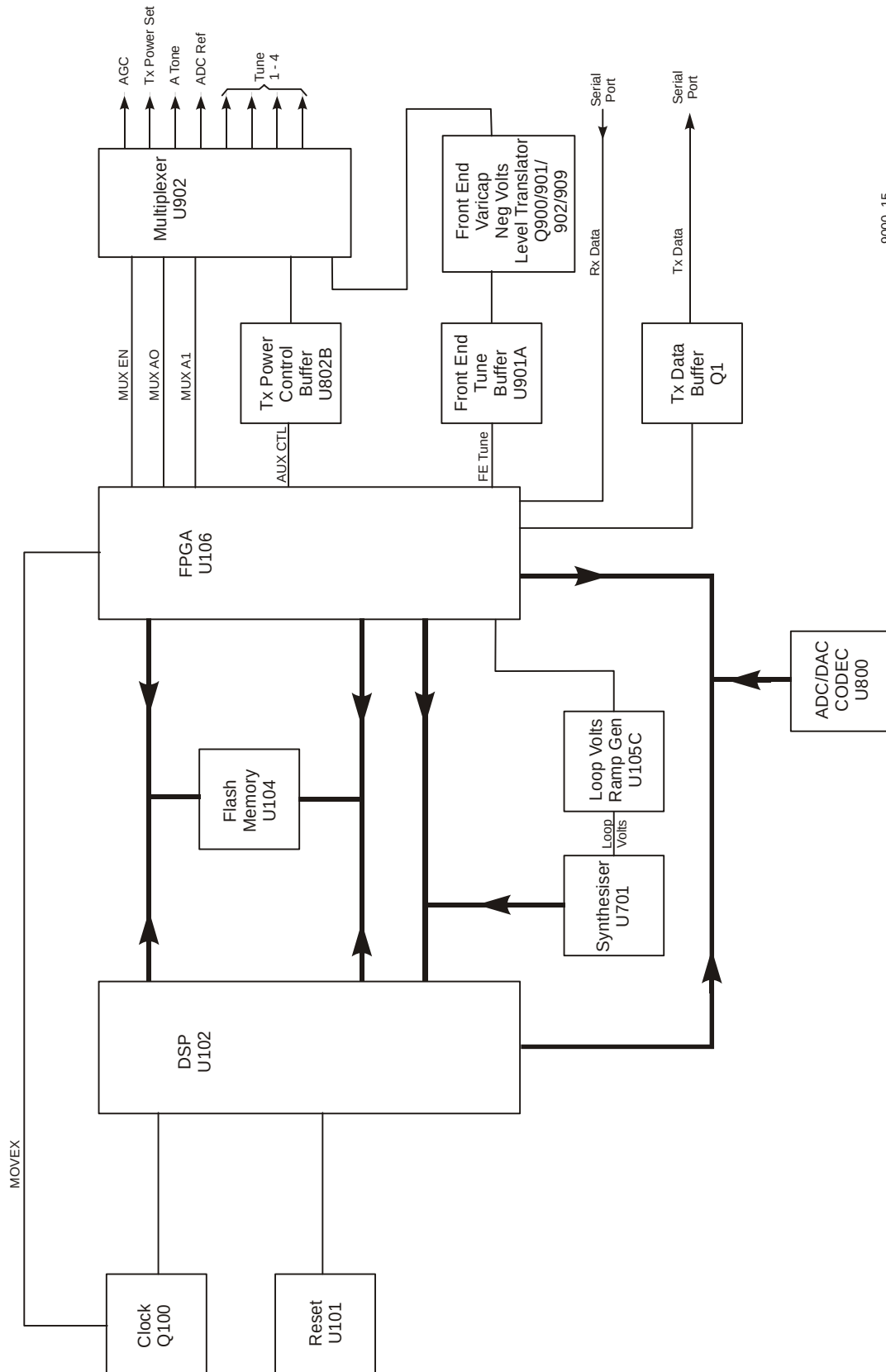
3.4 Control

Refer Figure 3-4

3.4.1 DSP and FPGA

The SRM9000 transceiver operates under the control of a DSP (U102) and FPGA (U106) combination which together with a number of other dedicated devices perform all the operational and processing functions required by the radio. The FPGA is configured by the DSP under software control to provide the following functions:

- Channel set-up of all operating frequencies
- Modulation processing and filtering
- De-modulation processing and filtering
- TX power output reference
- Receiver front end tuning
- Serial communications with alignment tool, microphone and control head
- Modem functionality for data modulation
- All signalling / CTCSS generation and decoding
- CO control
- Receiver muting control
- TX / RX switching
- PLL detect



9000_15

Figure 3-4 VHF/UHF Control Block Diagram

3.4.2 DSP Clock Oscillator

The DSP is clocked by a 15.360MHz oscillator which consists of crystal X100 and an internal DSP oscillator. Q100 forms a crystal switching circuit with C117 which when activated by a command from the FPGA steers the oscillator away from potential interfering frequencies.

3.5 Memory

Memory consists of the internal DSP memory and an external 4MB non-volatile Flash Memory U104. When power is off, program and data is retained in Flash Memory. At power-on, a boot program downloads the DSP's program from Flash Memory to its internal RAM for faster program execution and access to data.

3.5.1 Multiplexer

U902 contains 2 separate 4-channel multiplexers providing a total of 8 independently controlled analog switches. Under software control, the multiplexers produce tuning voltages from supplied data for the receiver front end (TUNE 1 to 4), TX power setting (TX PWR SET), receiver AGC (AGC-1), alert tone (A TONE) and FPGA ramp generator (ADC REF).

Buffer U802B is fed with a composite digital tuning signal (AUX CTL) from the DSP/FPGA containing the data for AGC, A TONE, ADC REF and TX PWR SET settings. The level is dependent on channel frequency and tuning and varies between 0.1 to 3.0V. This signal is applied to one group of 4 analog switches in U902 via a common input connected to pin 13. The second group of 4 switches is fed with the receiver front end tuning signal FE TUNE (to provide outputs for TUNE 1 to 4) via the second common input at pin 3 as described in the receiver front end section.

The 2 groups of analog switches are independently controlled by FPGA binary signals MUX A0 and A1 and enable line MUXEN to output the required tuning voltages as a series of pulses. These pulses are converted to steady state voltages by integration capacitors C904 to 911 and C921 to 925.

3.6 Power Supplies

3.6.1 Power On Function

The unregulated 13.8V DC input is routed directly to high current devices and is also switched via FET Q350. The output from Q350 feeds three, low drop out series regulators and associated switched and auxiliary supplies which along with a negative voltage generator provide all the switched power requirements of the transceiver.

Q315/316/317 and U313 form a power on/off latch circuit which is activated by a pulse from the control unit or microphone/handset via PWR ON or PWR OFF and controls the FET power switch Q350. A PWR OFF operation requires the button to be held down for more than 2 seconds. This is then sensed by the FPGA via the PWR SENSE line which turns the radio off by placing a positive pulse on the PWR OFF line thereby resetting U313B.

3.6.2 Power Supplies

The following is a list of the SRM9000 power supplies and some of the devices and circuits they supply.

3.6.2.1 +8V Regulator U310

Regulated +8.0V supply (8V0 and +8V)

- TX buffer Q612
- VCOs and VCO buffers via active filter Q615
- RX second local oscillator via Q403

Regulated +8.0V switched supply (RX PSU)

- RX front end
- IF Amplifier
- Various switching functions

3.6.2.2 +5V Regulator U311

Regulated +5.0V supply (5V0 and +5V)

- RX front end varactor positive bias
- Synth. buffer Q607
- VCO varactor negative supply Q700 to Q703
- TCXO U700
- RX audio amplifiers U803A/B
- RX mute switch Q810/813
- Multiplexer U902
- FE TUNE level translator and buffer U901A, Q900/901

Regulated +5.0V switched supply (TX PSU and TX PSU+)

- TX power control U3
- TX buffer Q606
- Microphone amplifier Q812
- Various switching functions

3.6.2.3+3.3V Regulator U312

Regulated +3.3V supply (3N3)

- Digital supply for CODEC U800
- DSP U102
- FPGA U106

Regulated +3.3V supply (3Q3)

- I Q demodulator U401

Regulated +3.3V supply (3C3)

- Analog supply for CODEC U800

Regulated +3.3V supply (3P3)

- PLL U701
- TCXO divider U702

Unregulated 13.8V (13V8 UNSW)

- TX PA module U2
- TX PA power control circuit Q3
- Active filter Q14/17/18/19
- Antenna changeover switch Q4/8/11
- RX mute switch Q811
- RX speaker amplifier U5

3.6.2.4Negative Power Supply U300B/C

Provides -17.0V output (-17V0)

- Negative rail for VCO Varicap Negative Supply Q700, 701, 702 and Q703

-12.0V Output (-12V0)

- Negative rail for FE TUNE level translator Q900, 901, 902, 903 and multiplexer U902

4. Alignment

This procedure is applicable to all versions of **SRM9000** mobile transceivers.

Caution

Preparing the radio will erase from the radio all customer PMR and Trunking configuration data (channel, signalling information etc). The only data retained by the Alignment Tool is the alignment data from the radio (DAC settings for TX power, front-end tuning etc).

If the radio contains customer configuration data that must be retained, you **must first** use the SRM9000 Configuration Programmer (FPP) software to read the radio and store the data on an FPP file **before** commencing with the alignment procedure.

When the Alignment is completed, use the SRM9000 Configuration Programmer (FPP) software to retrieve this stored data from the FPP file and write it back to the radio.

It is preferred that the radio remain installed in its aluminium extruded case throughout this alignment procedure. If the radio is to be aligned when removed from the case, a temporary heat sink must be fitted under the Transmitter PA module and the receiver output must be kept below 100 mW.

4.1 TEST EQUIPMENT

- | | |
|---|---|
| 1. Radio transceiver test set | CMT, 52/82 or similar. |
| 2. Variable DC power supply | 10.8V to 16.2V at 10 amps |
| 3. Oscilloscope | 20 MHz bandwidth minimum |
| 4. SRM9000 Programming & Alignment Breakout Box | As detailed in Figure 4-1 |
| 5. SRM9000 Speaker O/P Breakout Box | As detailed in Figure 4-2 |
| 6. Personal Computer | 486 DX 66 or better.
Operating system Windows 95 or later.
Minimum RAM - 16MB.
5MB free hard disk space.
Floppy drive - 1.44MB.
Mouse and serial port required |
| 7. SRM9000 Alignment Tool | Computer Software file |
| 8. SRM9000 Configuration Programmer (FPP) | Computer Software file |

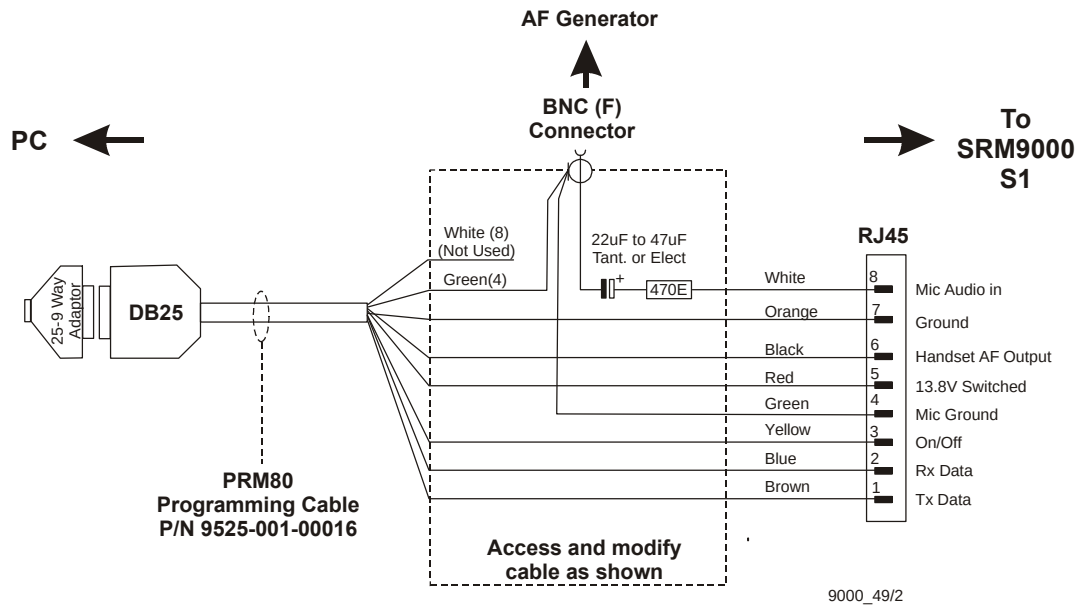


Figure 4-1 SRM9000 Programming & Alignment Breakout Box

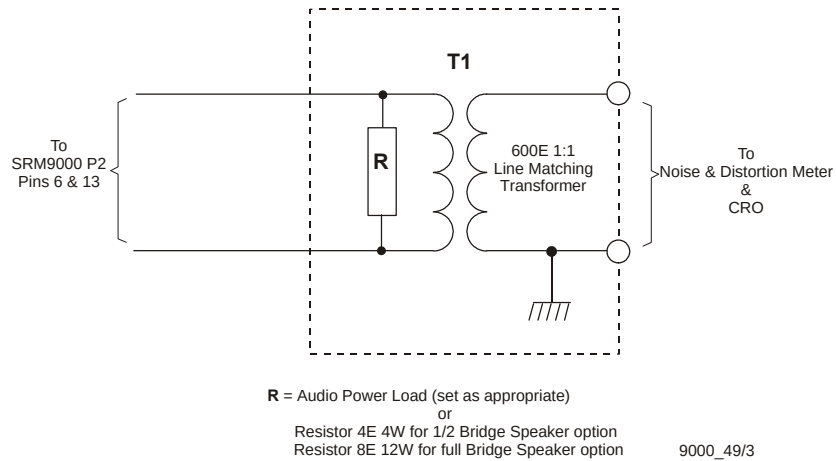
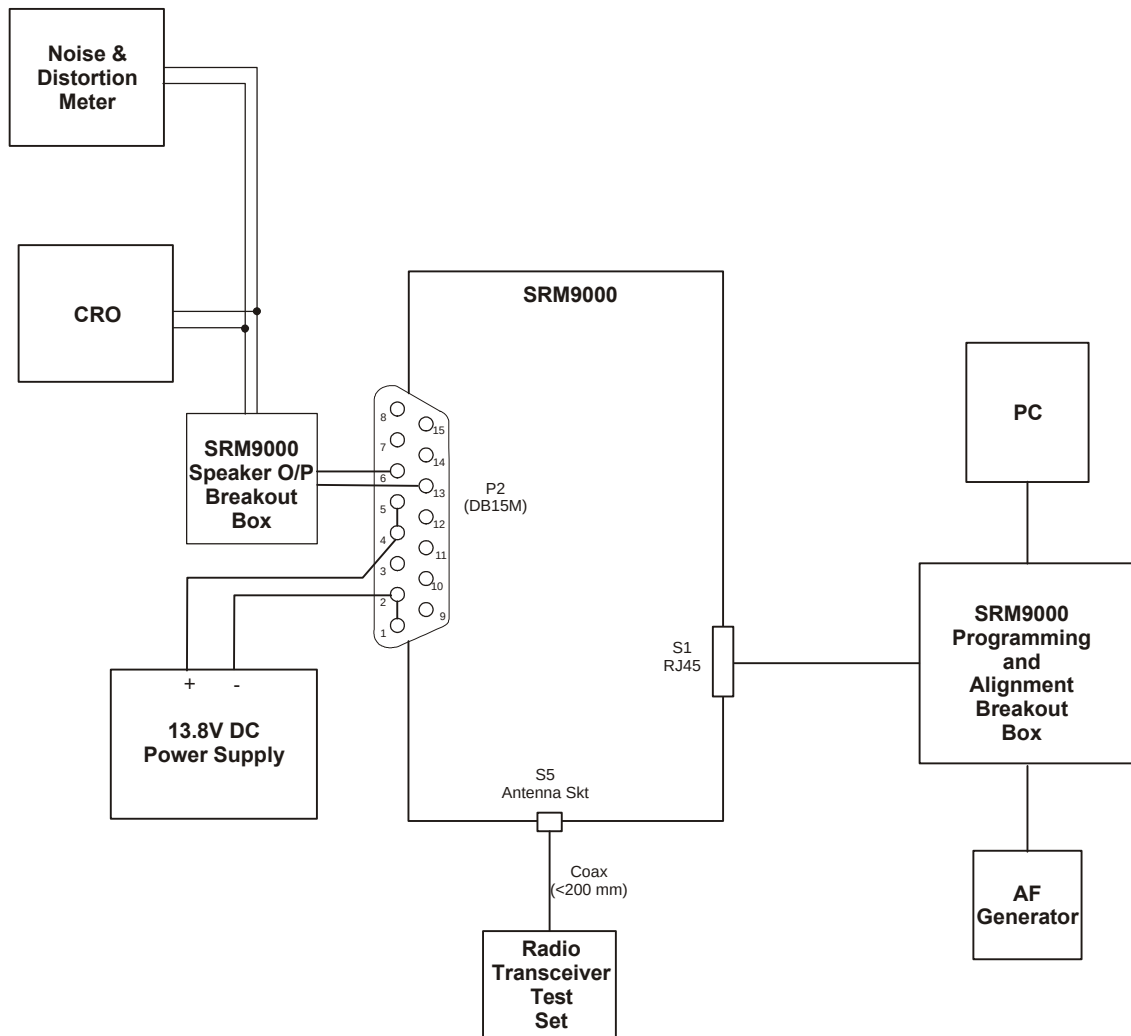


Figure 4-2 SRM9000 Speaker Output Breakout Box

4.2 test set up



9000_49

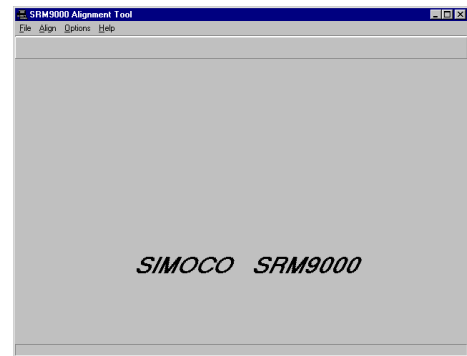
Figure 4-3 Test Set up

1. Connect the radio to the test equipment as shown in Figure 4-3.
2. Switch on the DC Power Supply.

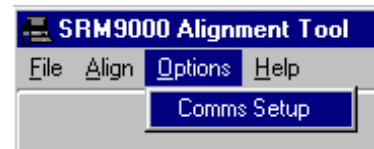
4.2.1 COMMS Set up

1. Copy the SRM9000 Alignment Tool Computer Software file to the PC hard drive and run the program

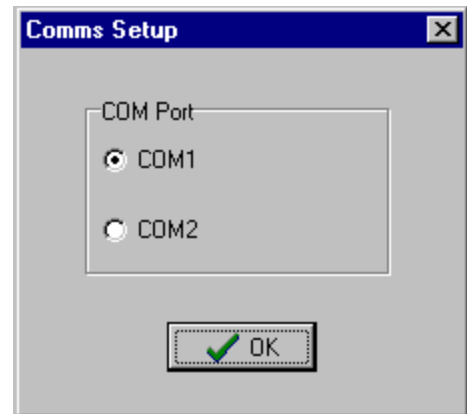
The Alignment Tool Opening Menu is displayed.



2. Go to the **Options** menu and choose **Comms Setup**.



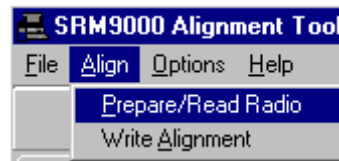
3. The **Comms Setup** dialogue box is displayed.
Select the Comms Port setting appropriate to the configuration of your PC and choose ✓OK.
(Usually COM1)



4.2.2 Radio Preparation

Radio parameters are to be aligned sequentially as detailed in this procedure.

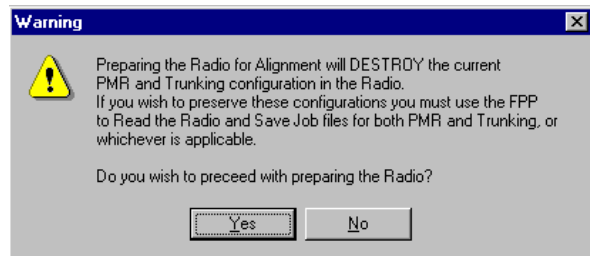
1. At the Opening Menu, select the **Align Menu** and choose **Prepare/Read Radio**.



2. The **WARNING** is displayed.

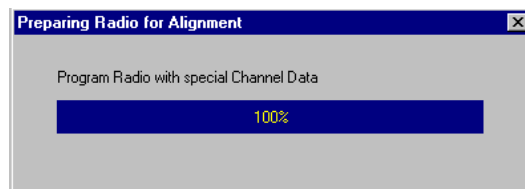
Choose **No** if you want to save the configuration and use the FPP software to read and save the data to a file.

Choose **Yes** if you want to proceed and go to step 3.



3. The radio alignment data is read (indicated by percentage bar) and stored.

The test alignment data is downloaded into the radio.

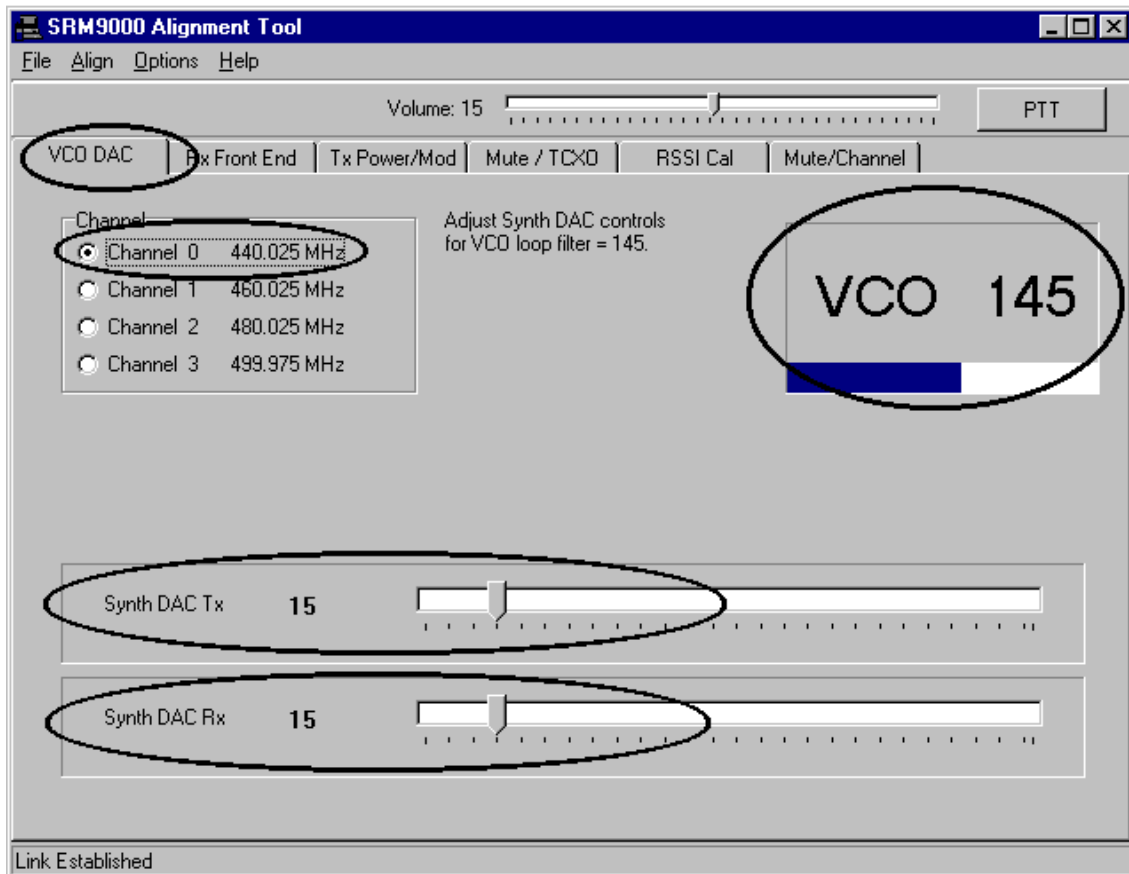


Note: *In test alignment mode the radio is configured only for 12.5 kHz channel spacing, therefore all alignment is carried out at 12.5 kHz levels. When the radio is configured with the FPP for other channel spacings, the deviation related levels are calculated on a per channel basis by the radio software.*

4.2.3 ALIGNMENT PROCEDURE

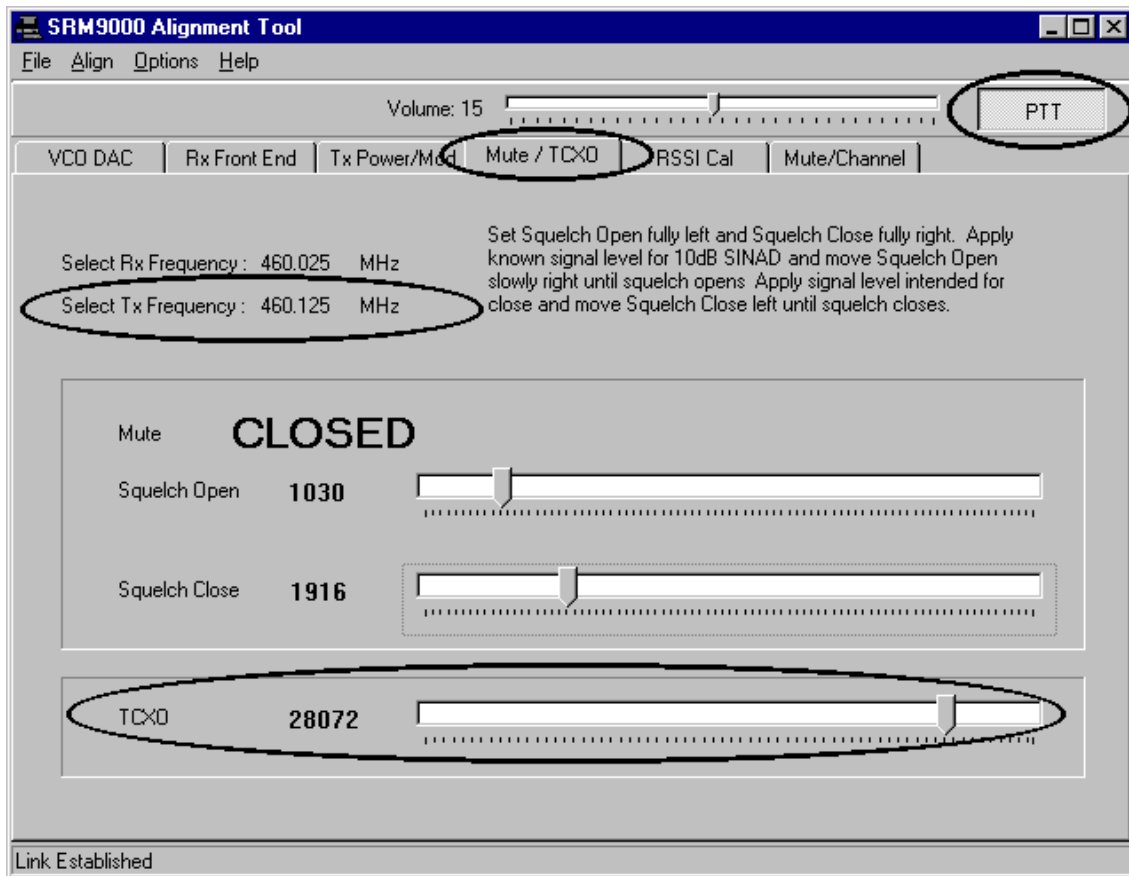
Radio alignment must be done in the sequence detailed in the following paragraphs. This alignment assumes that the radio is functioning normally.

4.2.3.1 VCO DAC Alignment



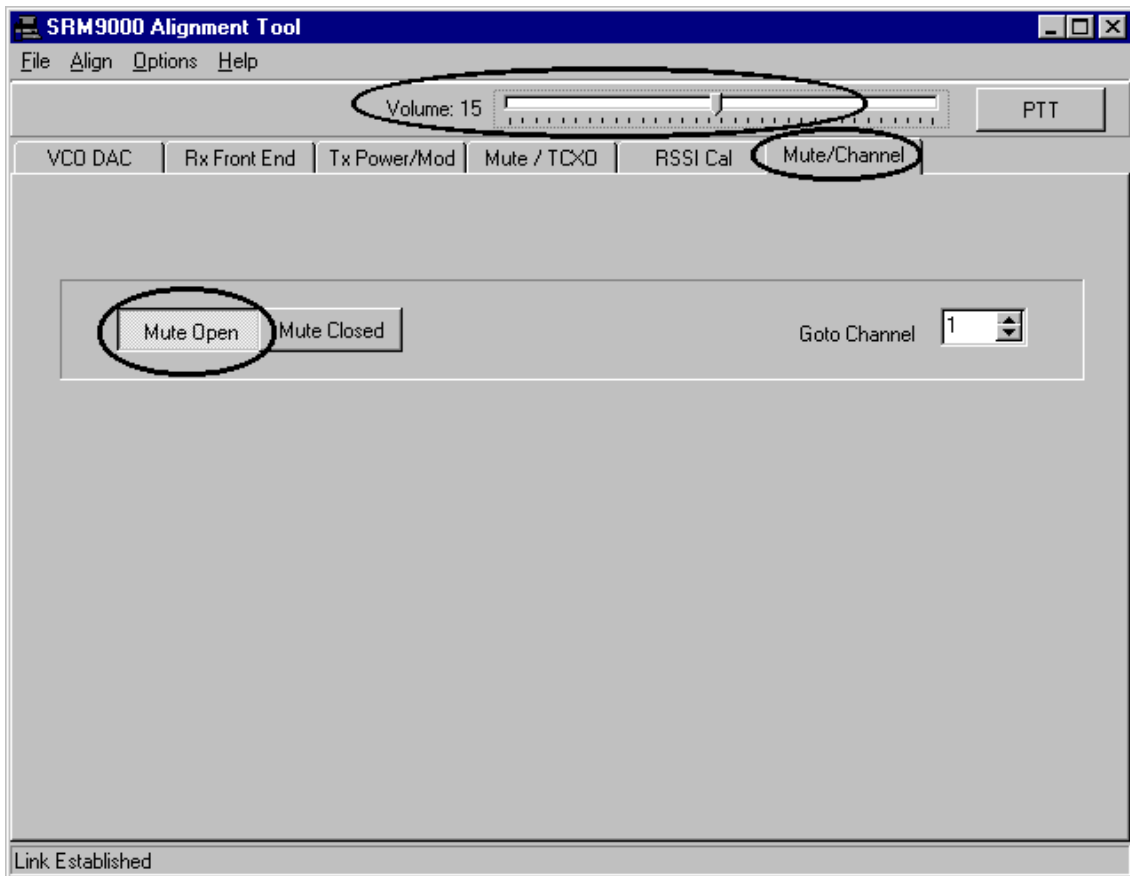
1. Select the *VCO DAC* page and choose Channel 0.
The channel number and frequency will be highlighted.
2. Select the **Synth DAC Rx** slider (slider will be highlighted) and (using the left/right arrow keys or the mouse) adjust for a VCO reading as close to 145 as possible (must be between 140 and 150).
3. Repeat Step 2 for the remaining 3 Channels (1, 2, & 3, in turn)
4. Select Channel 0.
5. Select **PTT** and adjust the **Synth DAC Tx** slider for a VCO reading as close to 145 as possible (must be between 140 and 150).
6. Repeat Step 5 for the remaining 3 Channels (1, 2, & 3).
7. Release the **PTT**.

4.2.3.2 TCXO (Radio Netting Adjustment)



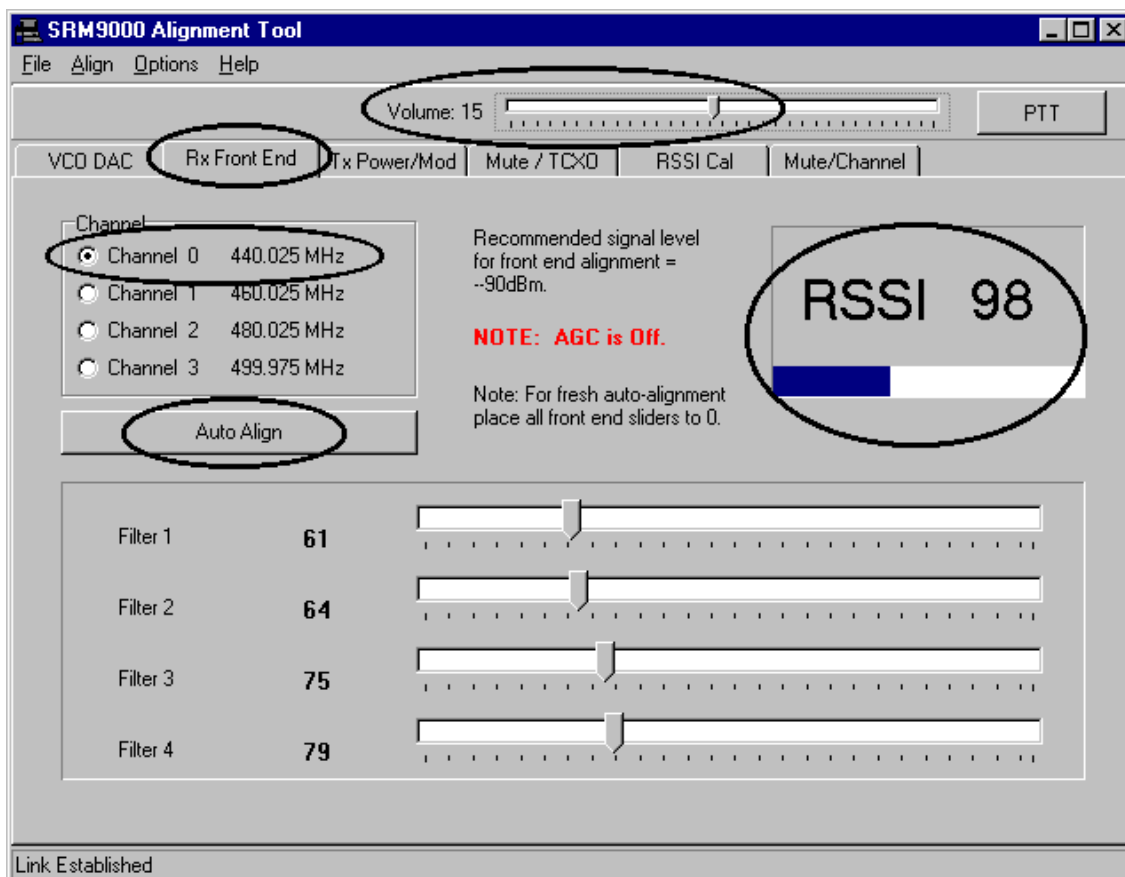
1. Select the **Mute/TCXO** page.
2. Select **PTT**.
3. Adjust the **TCXO** slider to ensure that the transmit frequency error is within normal tolerance for the selected channel (to be measured on the RF Test Set frequency counter).

4.2.3.3 RX FRONT END



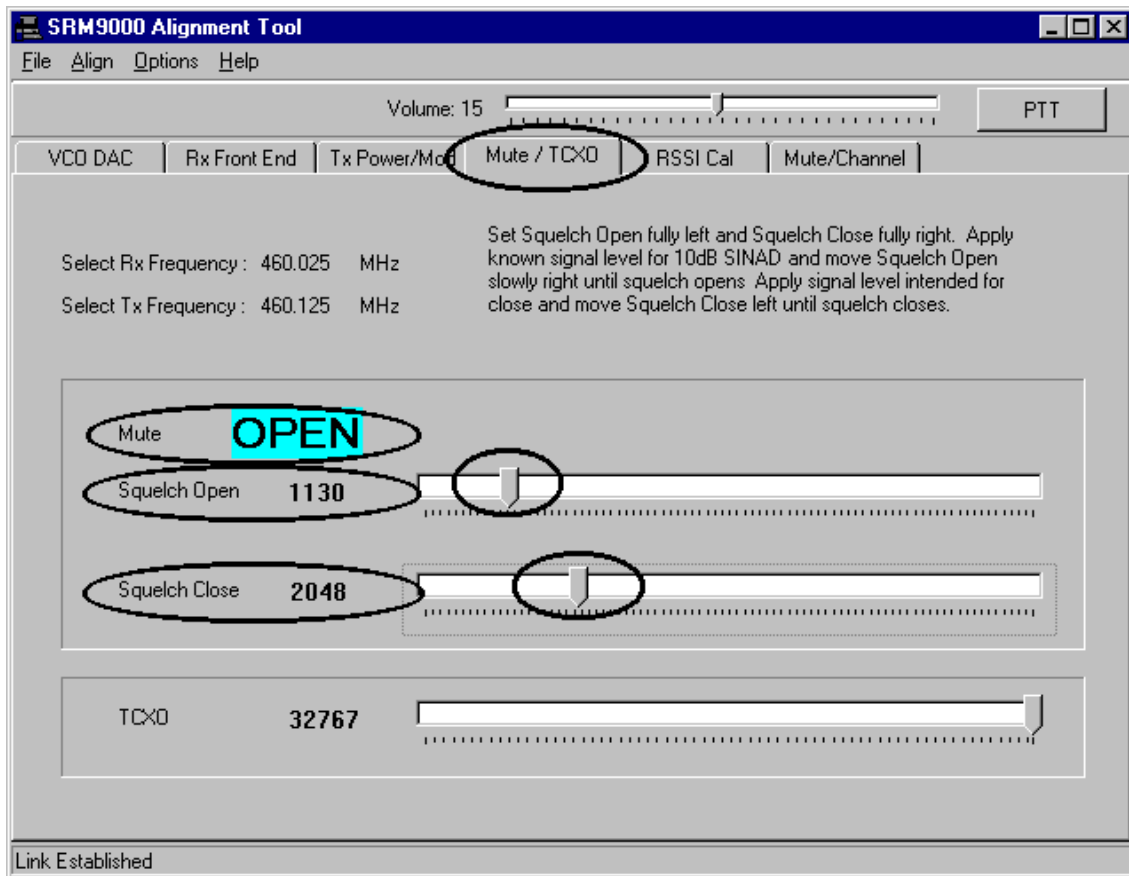
1. Ensure that the TCX0 Alignment has been done before proceeding with this section.
2. Select the **Mute/Channel** page
3. Select **Mute Open**.
4. Set the **Volume** slider to 15.

Speaker audio should now be visible on the CRO, if required readjust the **Volume** slider to a suitable level.



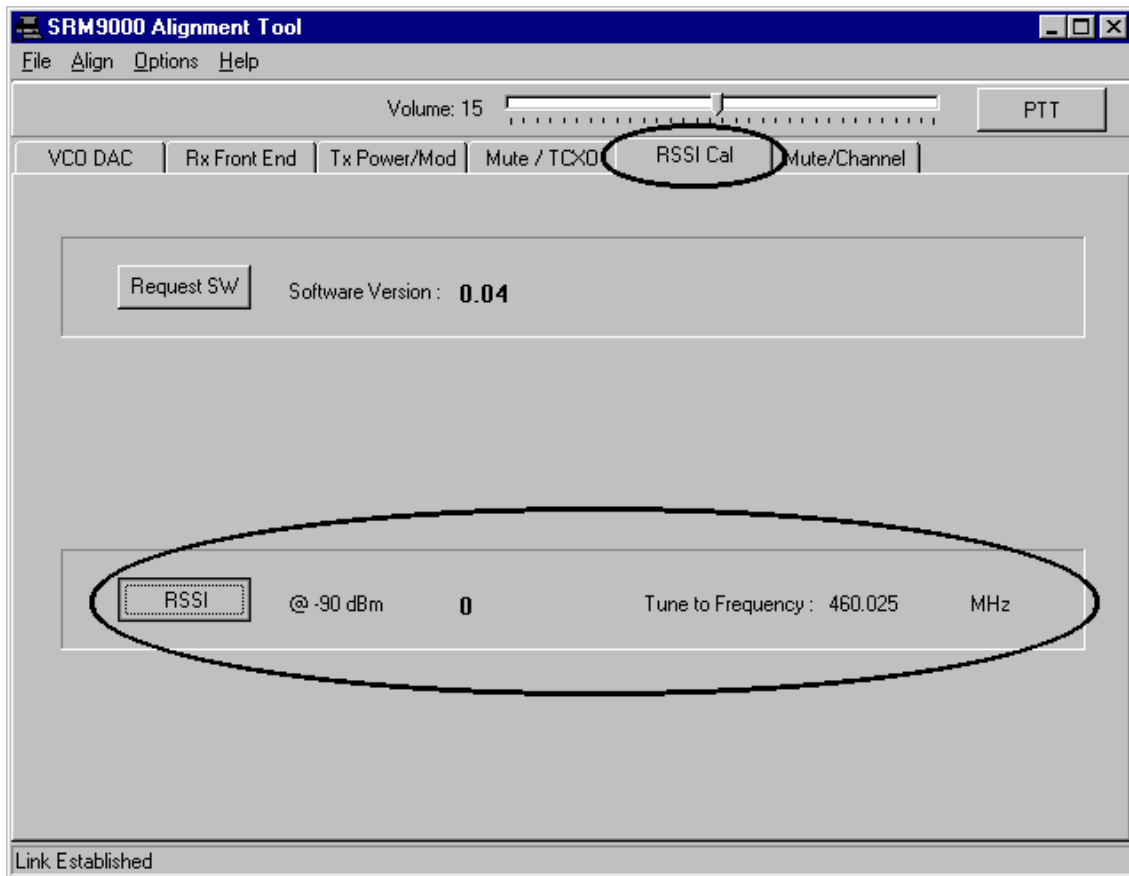
5. Select the **Rx Front End** Page
6. Select **Channel 0**
7. Set the Signal Generator to the Channel 0 carrier frequency, with a 1000Hz modulation signal, a deviation of ± 1.5 kHz and a RF level of -90dBm.
The RSSI bargraph display should now be (typically) well above a reading of 20 - if so, jump to step 9.
8. If the RSSI is not visible or is very low, Manual Tuning may be required. To do this, adjust the four Filter sliders (1-4) in combination for the maximum RSSI reading or for the best sinad reading. Proceed to step 9 when an RSSI of better than 20 is achieved.
Note: For optimum results, the sliders should be adjusted to be approximately in line.
9. Select **Auto Align**.
The front end will be tuned automatically.
1. Verify that the receiver sensitivity is better than -117.5dBm for 12dB sinad. (Sensitivity is typically -120dBm).
0. typically -120dBm).
1. Repeat Steps 7 to 10 for the remaining 3 Channels (1, 2, & 3).
- 1.

4.2.3.4 MUTE ADJUSTMENT



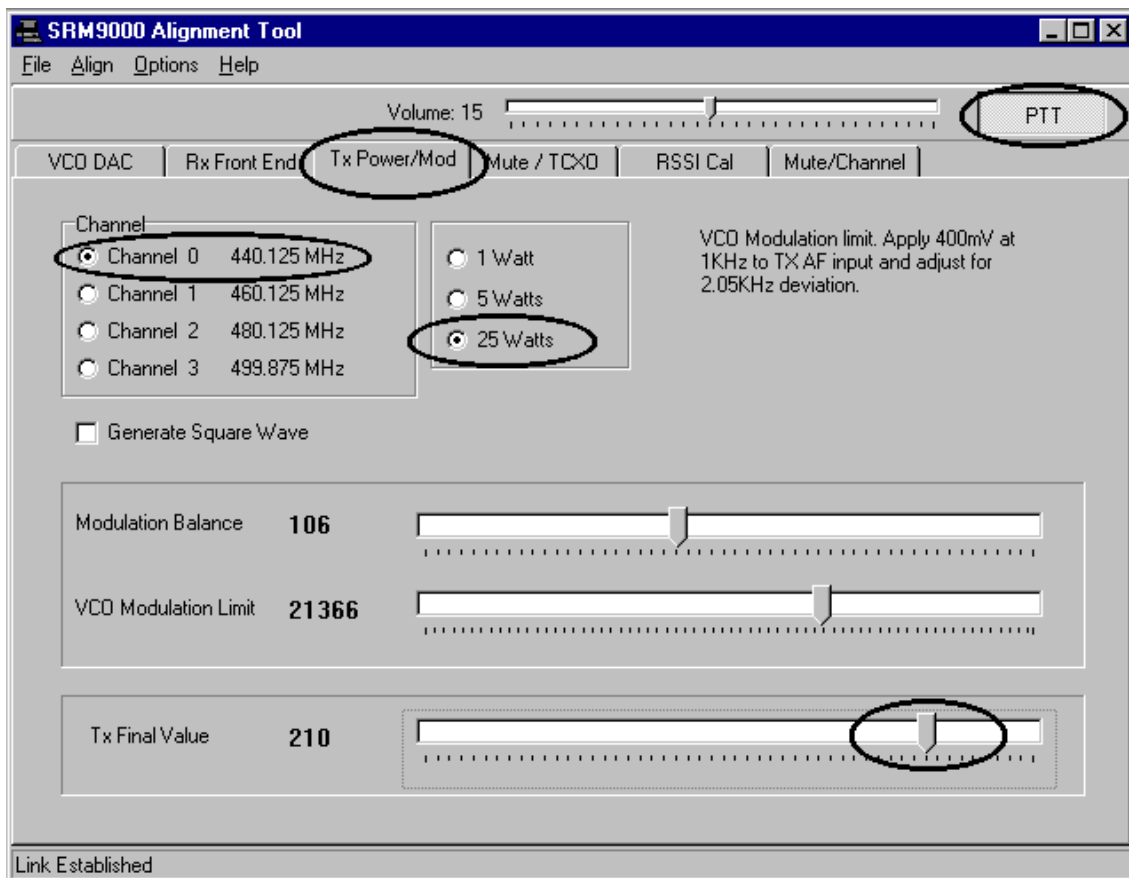
1. Select the **Mute/Channel** page, and ensure that the **Mute Open** option is selected.
2. Set the RF signal generator to the receiver alignment frequency, and adjust the RF level such that the desired mute opening sinad (typically 10dB sinad) is achieved.
3. Select **Mute Closed** and remove the RF input from the radio.
4. Select the **Mute/TCXO** page
5. Set the **Squelch Open** and **Squelch Close** sliders to the fully left position. This ensures the receiver will be muted.
6. Set the **Squelch Close** slider to the fully right position.
7. Reconnect the RF input to the radio.
8. Adjust the **Squelch Open** slider to the right until the mute opens.
9. Reduce the Signal Generator output level by approximately 2dB (or by an amount equal to the desired mute hysteresis level).
10. Adjust the **Squelch Close** slider to the left until the mute closes.
11. The mute should now open and closes at the desired RF levels.

4.2.3.5 RSSI



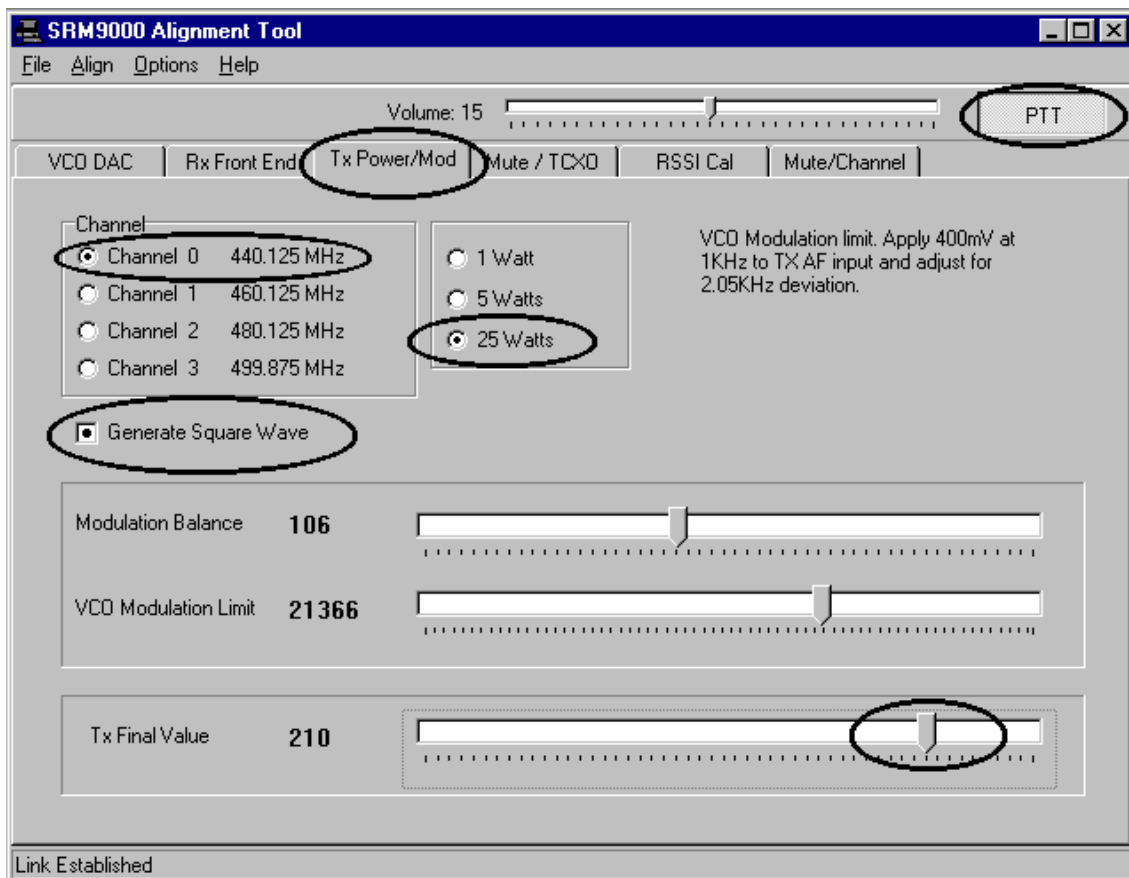
1. Select the ***RSSI Cal*** page.
2. Set the Signal Generator for a RF output level of -90dBm at the specified frequency.
3. Activate the ***RSSI*** button.
The receiver RSSI threshold setting is calibrated.

4.2.3.6 TX POWER



1. Select **Tx Power/Mod** page.
2. Select **Channel 0**.
3. Select the **25W**-power level.
4. Press the **PTT** button.
5. Adjust the **Tx Final Value** slider for a power output of 25W.
The supply current shall be less than 7.5A (UHF) and 6.5A (VHF).
6. Select the **5W**-power level.
7. Adjust the **Tx Final Value** slider for a power output of 5W.
8. Select the **1W** power level.
9. Adjust the **Tx Final Value** slider for a power output of 1W.
10. Release the **PTT** button.
11. Repeat steps 2 to 10 inclusive for the remaining 3 Channels (1, 2, & 3).

4.2.3.7 MODULATION



1. Select ***Tx Power/Mod*** page.
2. Select ***Channel 0***.
3. Select the ***1W*** power level.
4. Set the microphone input signal from the Audio Generator to 1000Hz at 400 mV RMS.
5. Adjust the ***VCO Modulation Limit*** slider for a deviation of $\pm 2.05\text{kHz}$
6. Reduce the microphone input level to 40mV RMS and check that the deviation is within the range $\pm 1.25\text{ kHz}$ to $\pm 1.75\text{ kHz}$.
7. Repeat steps 2 to 7 inclusive for the remaining 3 Channels (1, 2, & 3).
8. Remove the microphone audio input signal
9. Select the ***Generate Square Wave*** function.
10. Select ***PTT*** and, while viewing the de-modulated signal on the transceiver test set oscilloscope, adjust the ***Modulation Balance*** slider for the best square wave symmetry.
11. Repeat steps 8 to 11 inclusive for the remaining 3 Channels (1, 2, & 3).

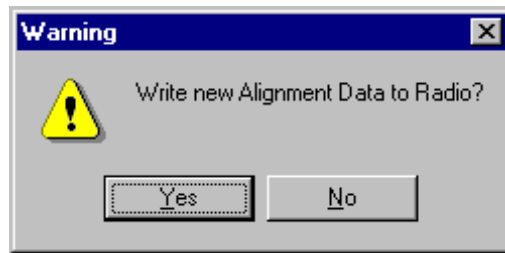
4.2.3.8 PROGRAMMING

When all channels have been aligned the radio is programmed with the new alignment data:

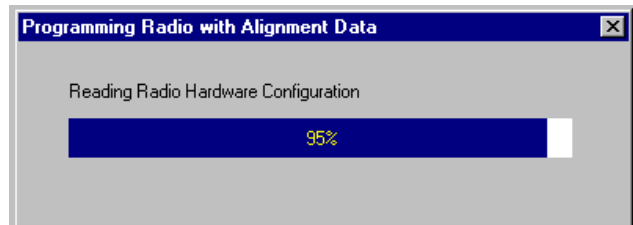
1. Select **Align** and choose **Write Alignment**.



2. A warning message is displayed.



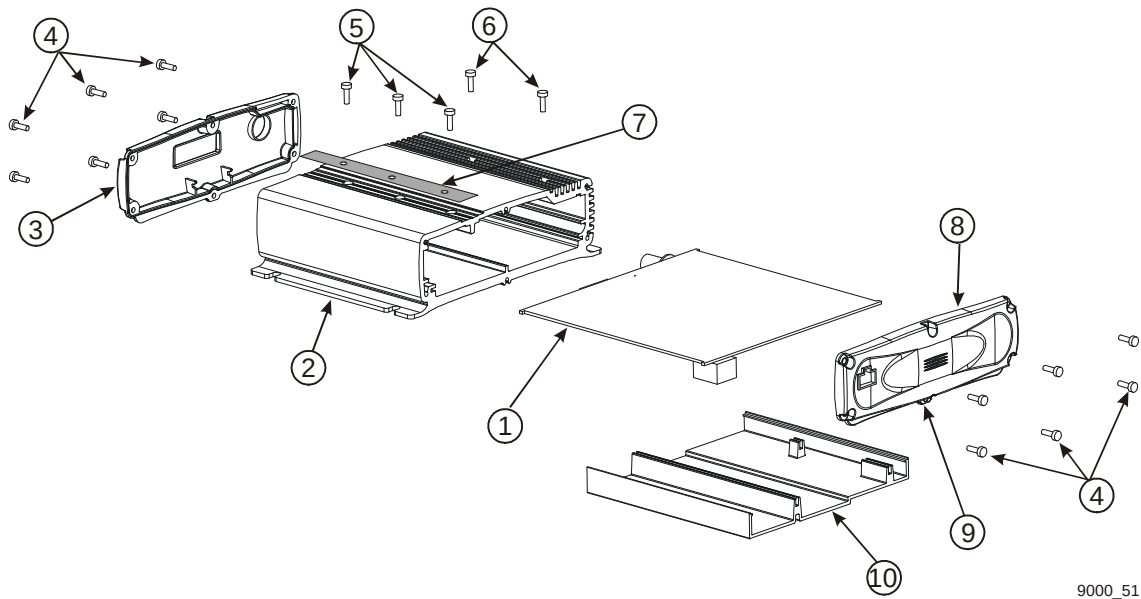
3. Choose **Yes**.
New alignment data is written to the radio.



4.2.3.9 Customers Radio Configuration Data

If the Customers Radio Configuration Data was stored in an FPP file, use the SRM9000 Configuration Programmer to write this data to the radio.

5. Replaceable Parts



9000_51

Figure 5-1 Replaceable Parts

Ident	Description	Quantity per Assembly	Part Number
1	PCB E0-Band Transceiver	1	3513-570-13371
1	PCB AC-Band Transceiver	1	3513-570-13361
1	PCB KM-Band Transceiver	1	3513-570-13381
1	PCB TK-Band Transceiver	1	3513-570-13391
1	PCB UW-Band Transceiver	1	3513-570-13401
1	PCB WR-Band Transceiver	1	tba
2	Case	1	3513-901-70071
3	End Cap, Rear	1	3513-903-91081
4	Screw End Cap	12	PT Type DG
5	Screw Tray Retention	3	M3 x 16
6	Screw Tray Retention	2	M3 x 12
7	Label Transceiver Top	1	3513-903-8219A
8	End Cap, Front	1	3513-903-91071
9	Label Front End Cap	1	3513-903-8220A
10	Inner Tray	1	3502-310-63310
11	LT Lead - 5m	1	3502-350-11251
12	BNC Connector, Crimp	1	3513-505-05991
13	Fuse Holder	1	2422-088-00185
14	Fuse 10A Quickblow	1	2422-086-10096
15	TX PA Shield cover		3502-310-63221
16	RJ45 Connector	1	3513-999-99331
17	DB15 Connector	1	3513-999-02063
18	Antenna BNC connector	1	3513-505-05991
19	Audio PA Module U5	1	3513-999-52036
20	Voltage Regulator 8V, U310	1	3513-999-52031
21	Voltage Regulator U311 & U312	1	3513-999-52032
22	Temperature Controlled Crystal Oscillator U700	1	3513-999-99200
23	Transient Suppressor Diode D1	1	3513-999-24014
24	ALC Regulator Q3	1	3513-999-05031

DRAFT D

Ident	Description	Quantity per Assembly	Part Number
25	Transmit Receive Switch Q4	1	3513-999-00006
26	Supply Regulator Switch Q14	1	3513-999-05032
27	Option Switch Q105	1	3513-999-00006
28	Output 0 Driver Q320	1	9336-630-70115
29	ON/OFF FET Q350	1	9336-630-05032

Figure 5-2 Band-Specific Parts

Ident	Description	Quantity per Assembly	Part Number
1	Tx PA Module U2 (E0 Band)	1	tba
1	Tx PA Module U2 (AC Band)	1	tba
1	Tx PA Module U2 (KM Band)	1	tba
1	Tx PA Module U2 (TK Band)	1	tba
1	Tx PA Module U2 (UW Band)	1	3513-999-52033
1	Tx PA Module U2 (WR Band)	1	tba

6. Circuit Diagrams and Parts List

This section contains circuit schematics and printed circuit board details.

6.1 List of Illustrations

Diagram Reference	Sheet Code	Description	Comment
Figure 6.1	1	SRM9000 Block Diagram	Illustration showing all sub-section interconnections
Figure 6.2	2	DSP and FGPA Schematic	
Figure 6.3	3	Power Supply Schematic	
Figure 6.4E0	4	Receiver Circuit Schematic	E0 Band (66 - 88MHz)
Figure 6.4AC	4	Receiver Circuit Schematic	AC Band (136 - 174MHz)
Figure 6.4TK	4	Receiver Circuit Schematic	TK Band (400-450MHz)
Figure 6.4UW	4	Receiver Circuit Schematic	UW Band (440- 500MHz)
Figure 6.5E0	5	Transmitter Circuit Schematic	E0 Band (66 - 88MHz)
Figure 6.5AC	5	Transmitter Circuit Schematic	AC Band (136 - 174MHz)
Figure 6.5TK	5	Transmitter Circuit Schematic	TK Band (400-450MHz)
Figure 6.5UW	5	Transmitter Circuit Schematic	UW Band (440- 500MHz)
Figure 6.6E0	6	Synthesiser - VCO Schematic	E0 Band (66 - 88MHz)
Figure 6.6AC	6	Synthesiser - VCO Schematic	AC Band (136 - 174MHz)
Figure 6.6TK	6	Synthesiser - VCO Schematic	TK Band (400-450MHz)
Figure 6.6UW	6	Synthesiser - VCO Schematic	UW Band (440- 500MHz)
Figure 6.7E0	7	Synthesiser - PLL Schematic	E0 Band (66 - 88MHz)
Figure 6.7AC	7	Synthesiser - PLL Schematic	AC Band (136 - 174MHz)
Figure 6.7TK	7	Synthesiser - PLL Schematic	TK Band (400-450MHz)
Figure 6.7UW	7	Synthesiser - PLL Schematic	UW Band (440- 500MHz)
Figure 6.8	8	A/D Converter Schematic	
Figure 6.9	9	D/A Multiplexer Schematic	
Figure 6.10	10	I/O Connections Schematic	
Figure 6.11	-	SRM9000 PCB layout, Top	1 of 2
Figure 6.12	-	SRM9000 PCB layout, Top	2 of 2
Figure 6.13	-	SRM9000 PCB layout, Bottom	1 of 2
Figure 6.14		SRM9000 PCB layout, Bottom	2 of 2



Figure 6-1 SRM9000 Block Diagram

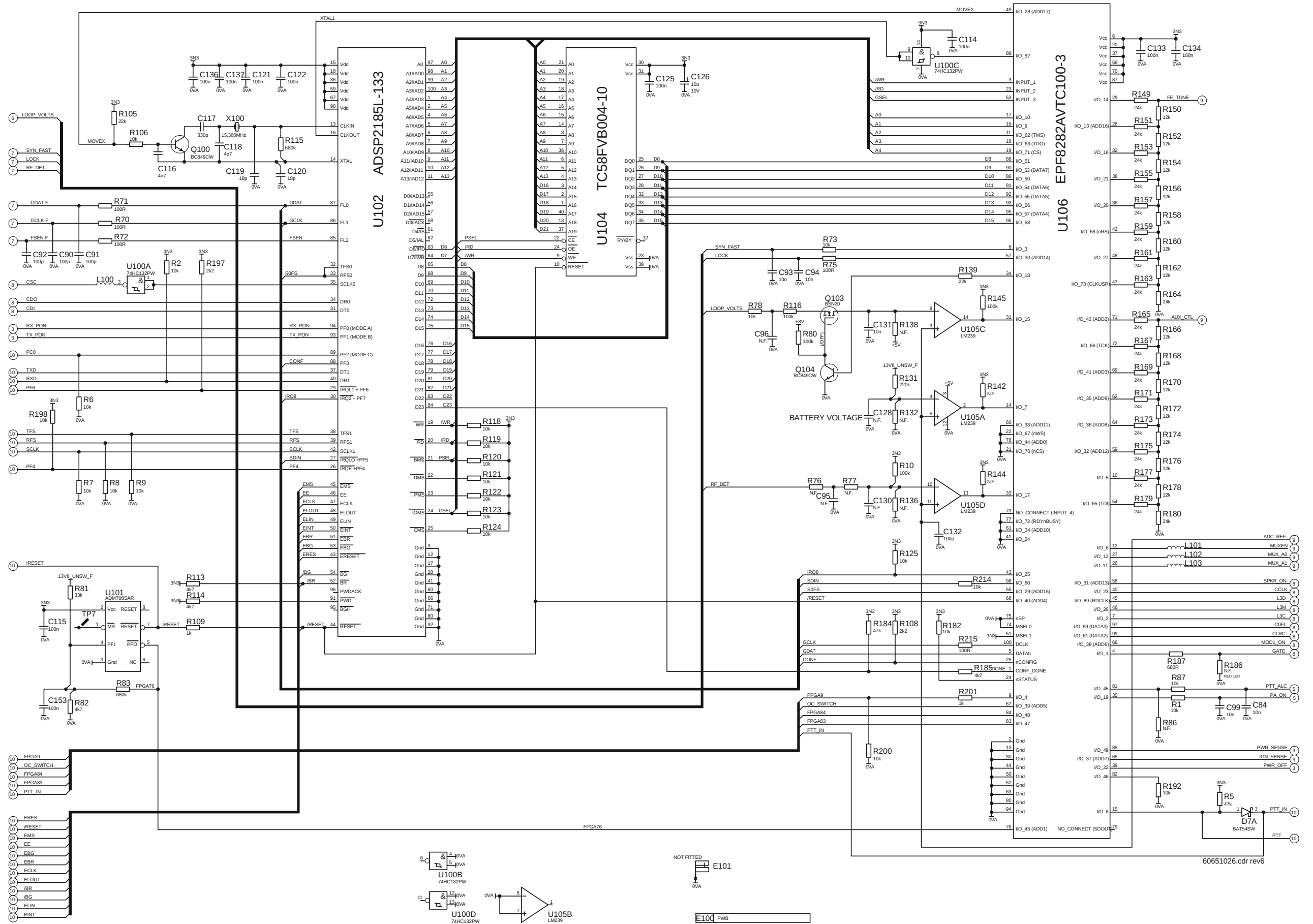
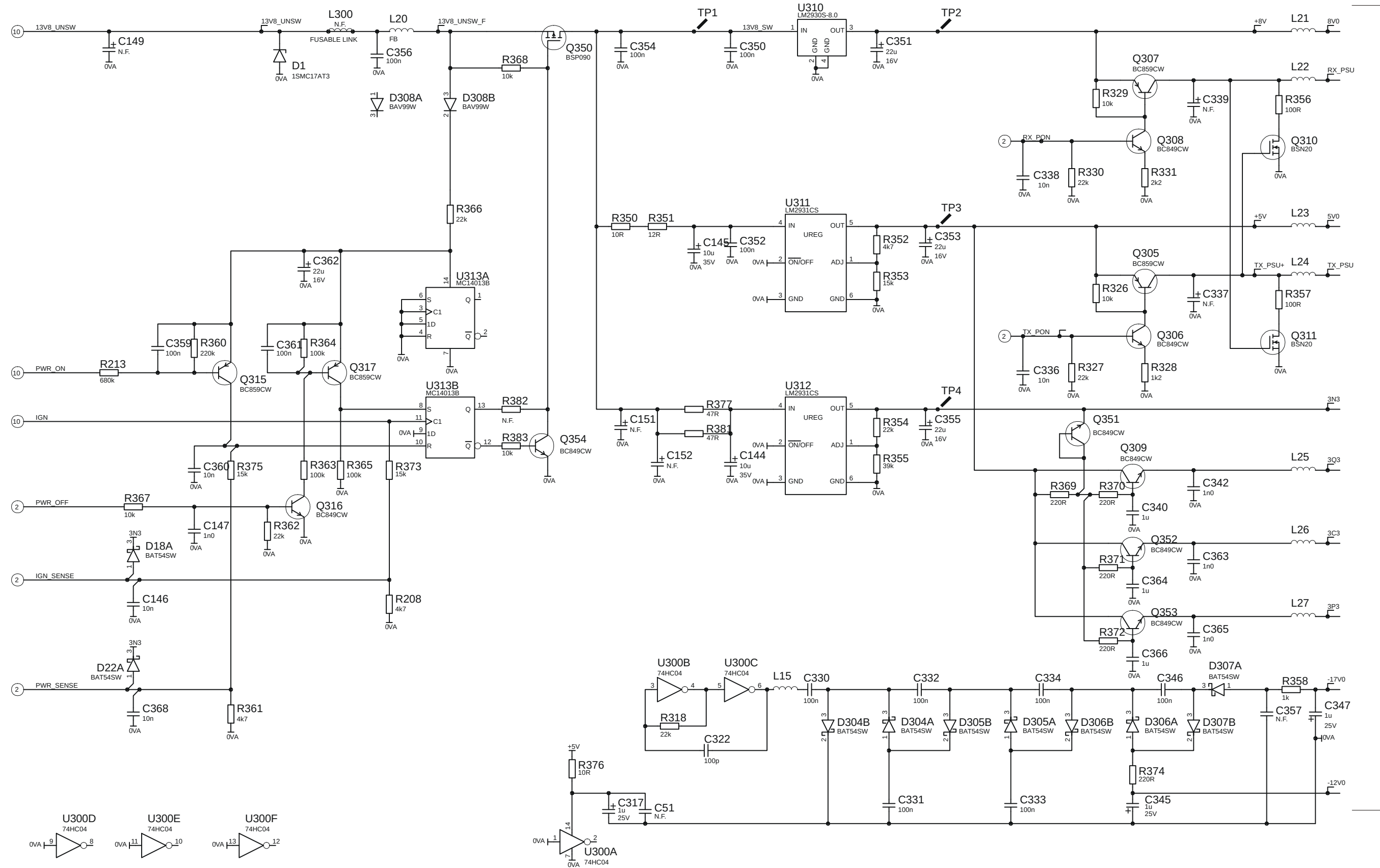


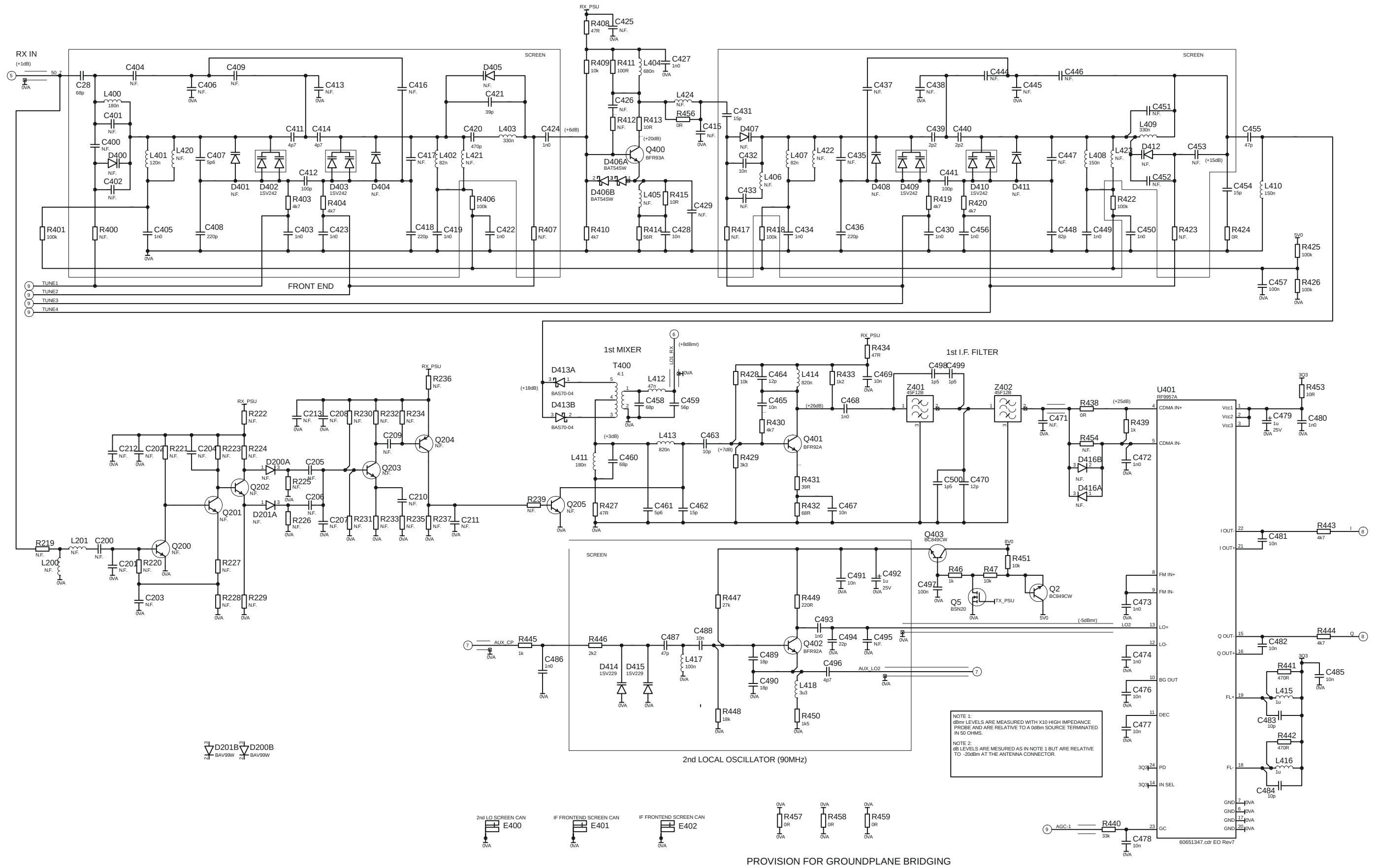
Figure 6-2 DSP and FPGA Schematic

DRAFT D



DC supply is distributed to all other schematics

Figure 6-3 Power Supply Schematic



DRAFT D

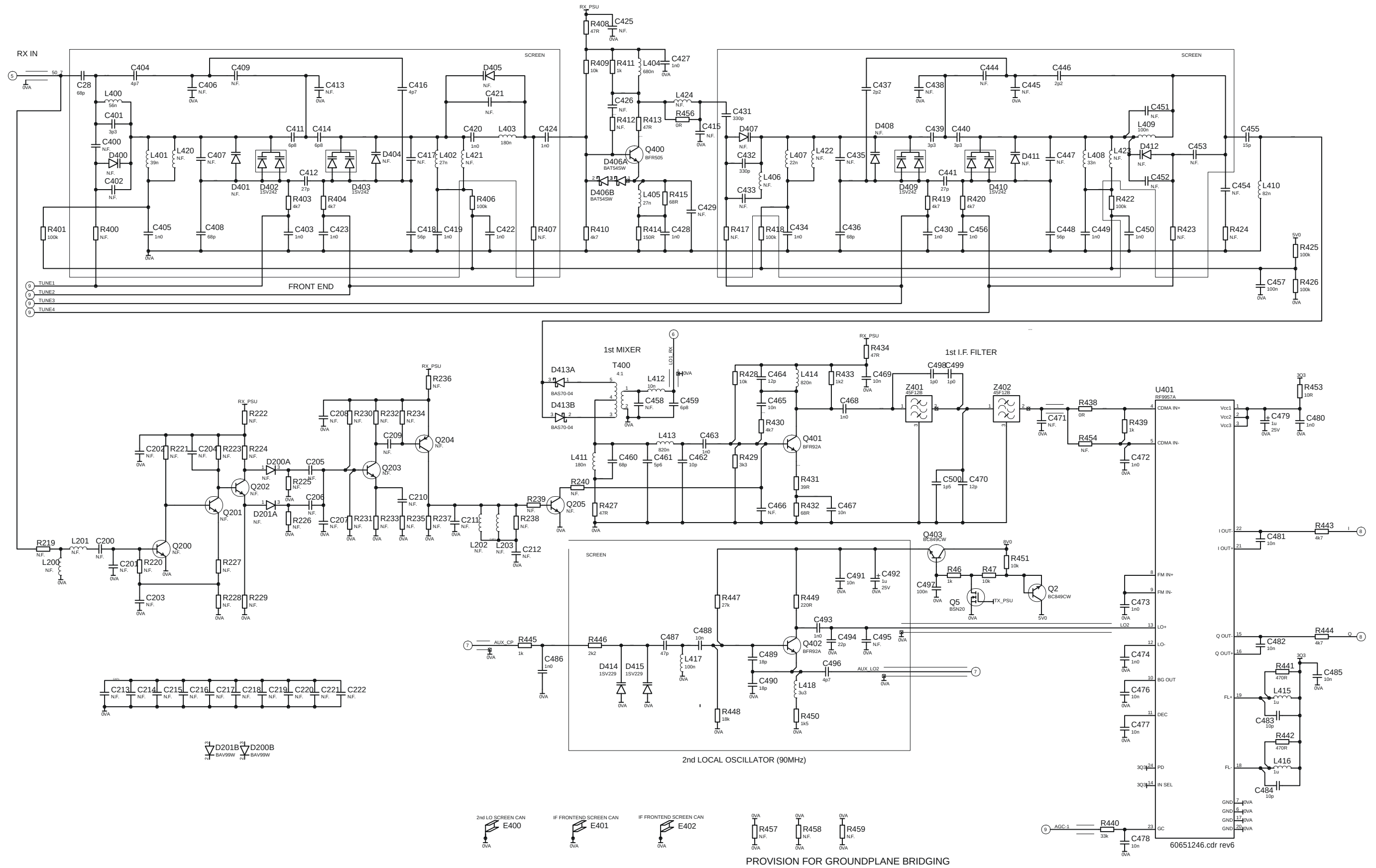


Figure 6-4AC Receiver Circuit Schematic
AC Band (136 - 174MHz)

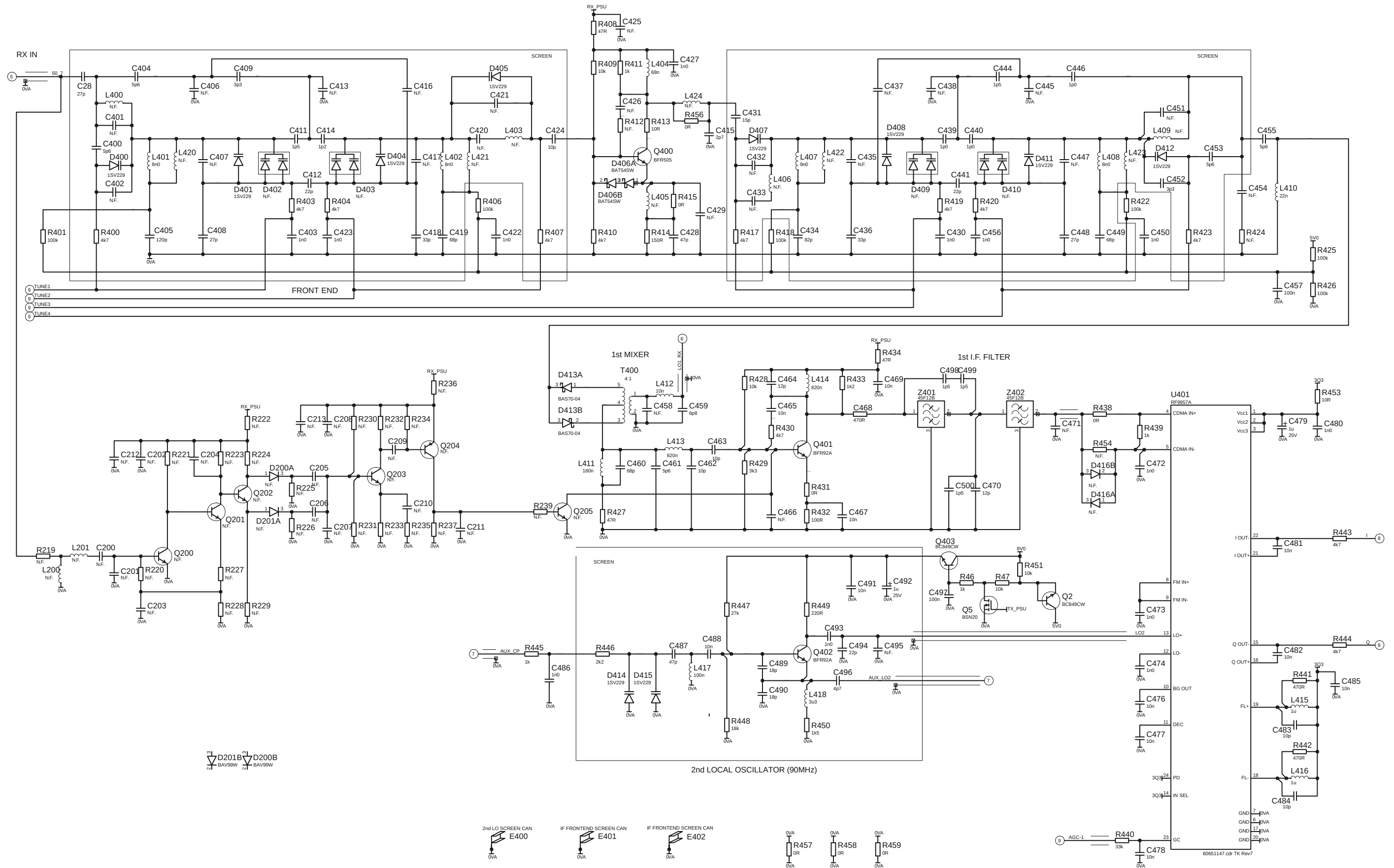


Figure 6-4TK Receiver Circuit Schematic

TK Band (400- 450MHz)

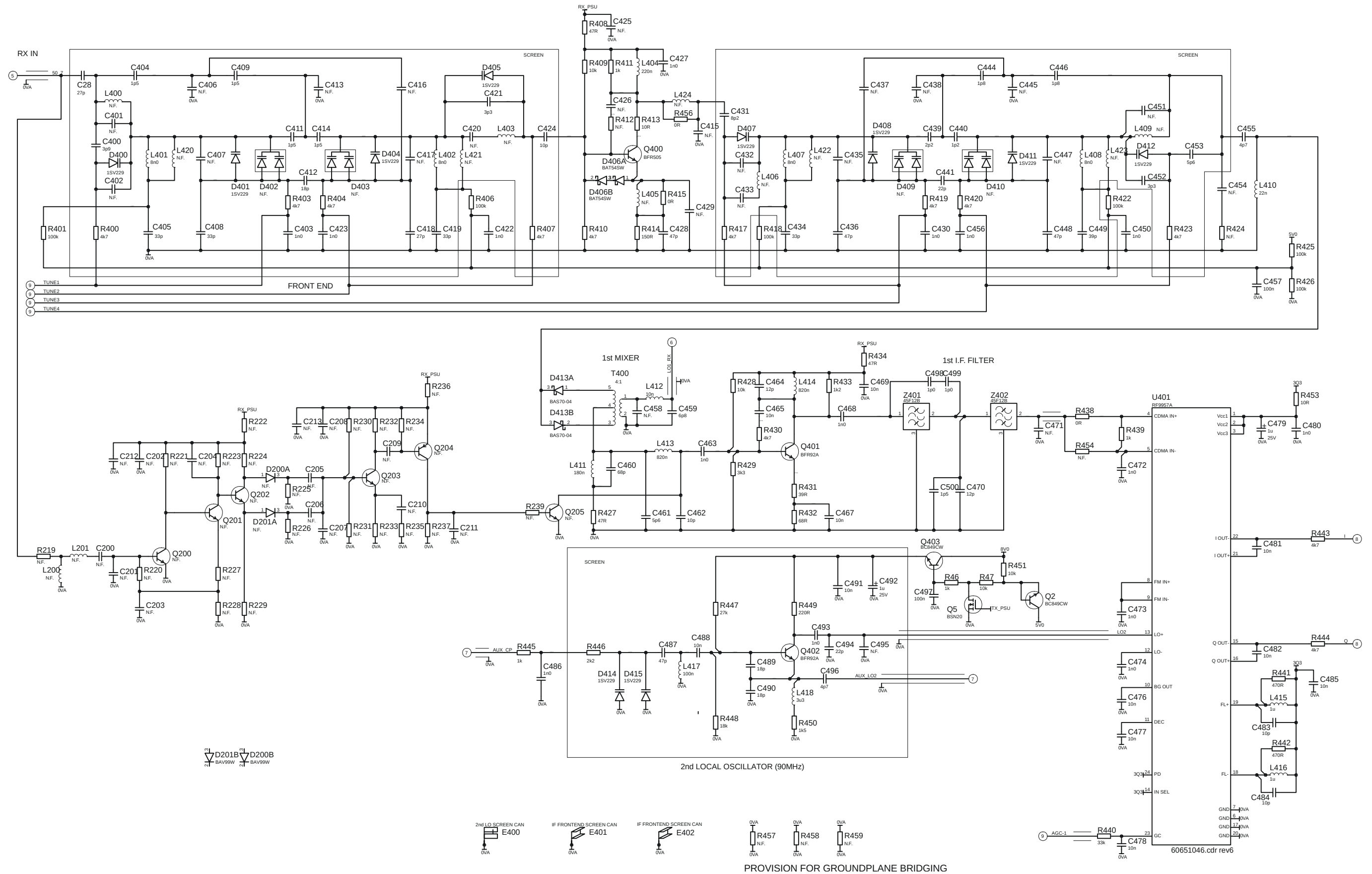


Figure 6-4UW Receiver Circuit Schematic

UW Band (440- 500MHz)

DRAFT D

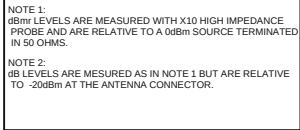


Figure 6-5E0 Transmitter Circuit Schematic

E0 Band (66-88MHz)

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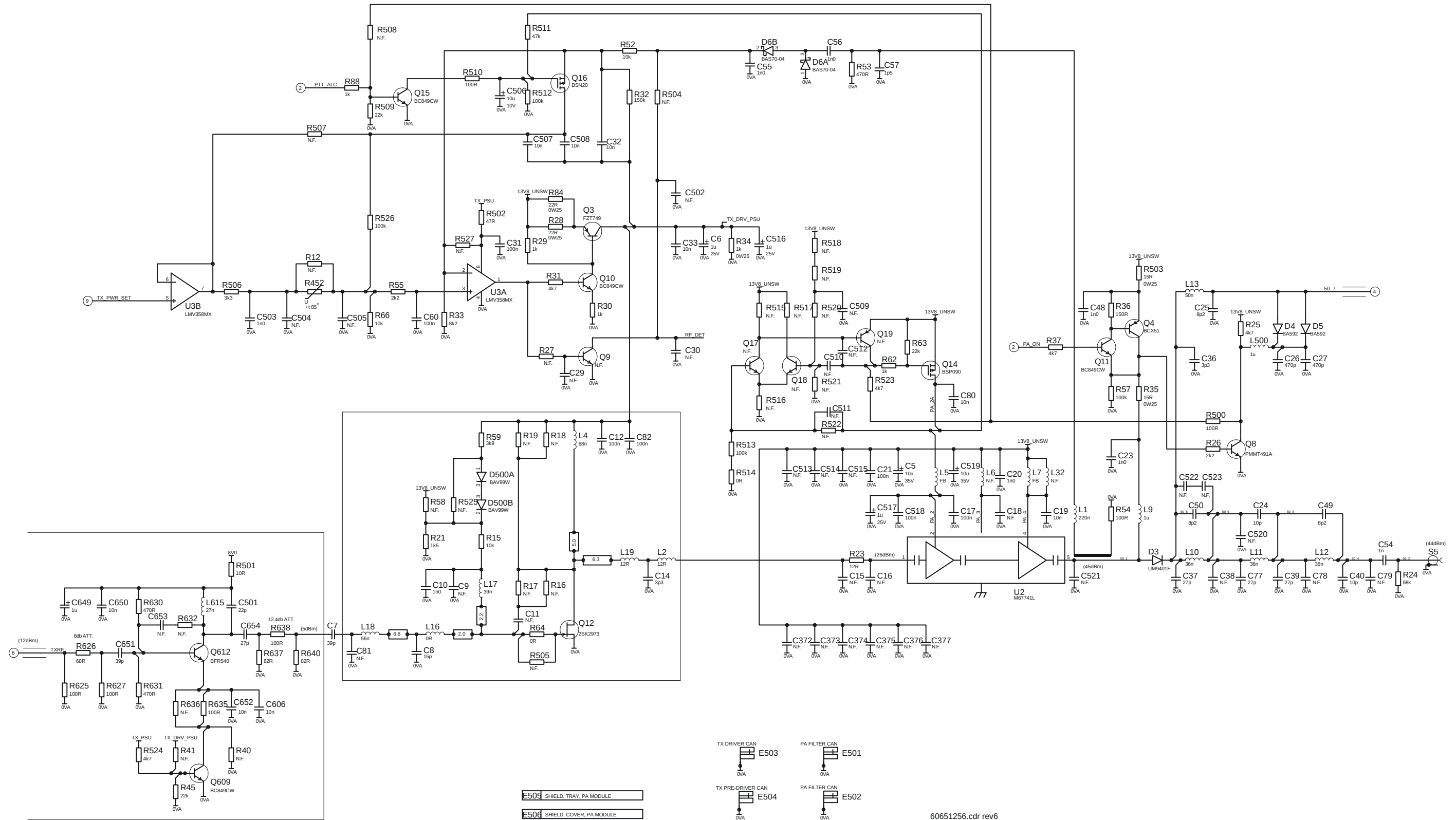


Figure 6-5AC Transmitter Circuit Schematic
AC Band (136 - 174MHz)

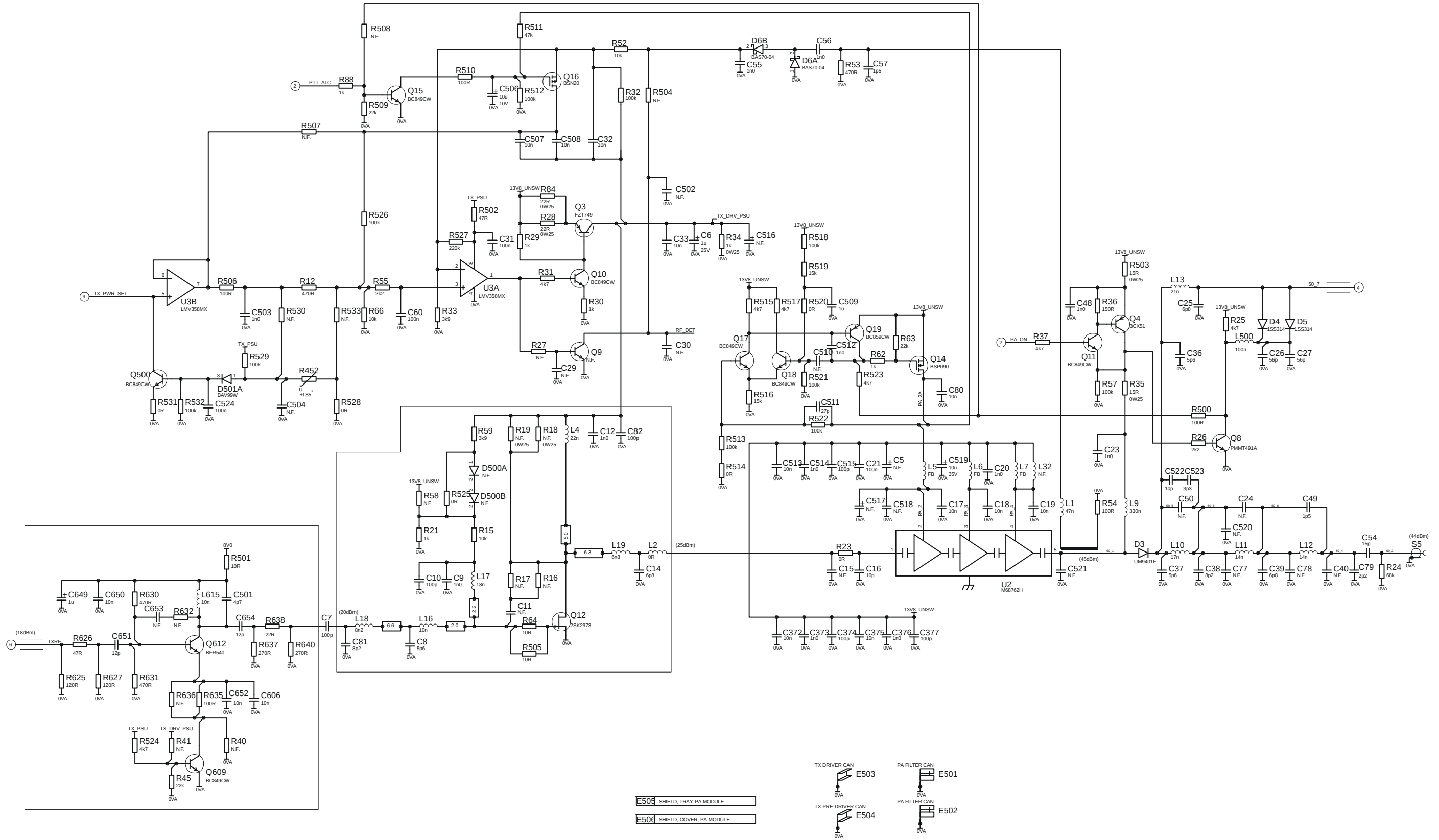


Figure 6-5TK Transmitter Circuit Schematic
TK Band (400- 450MHz)

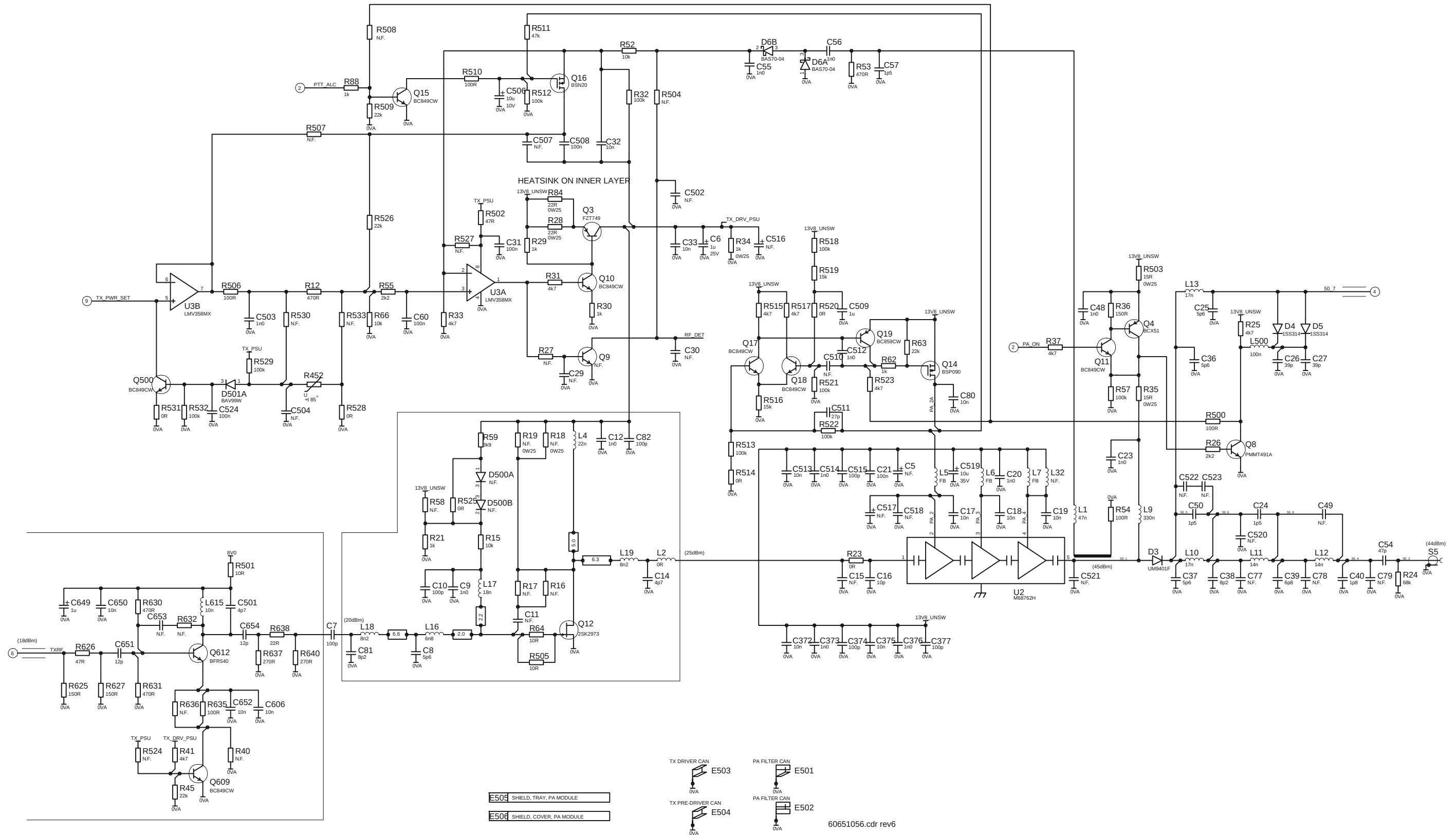


Figure 6-5UW Transmitter Circuit Schematic
UW Band (440- 500MHz)

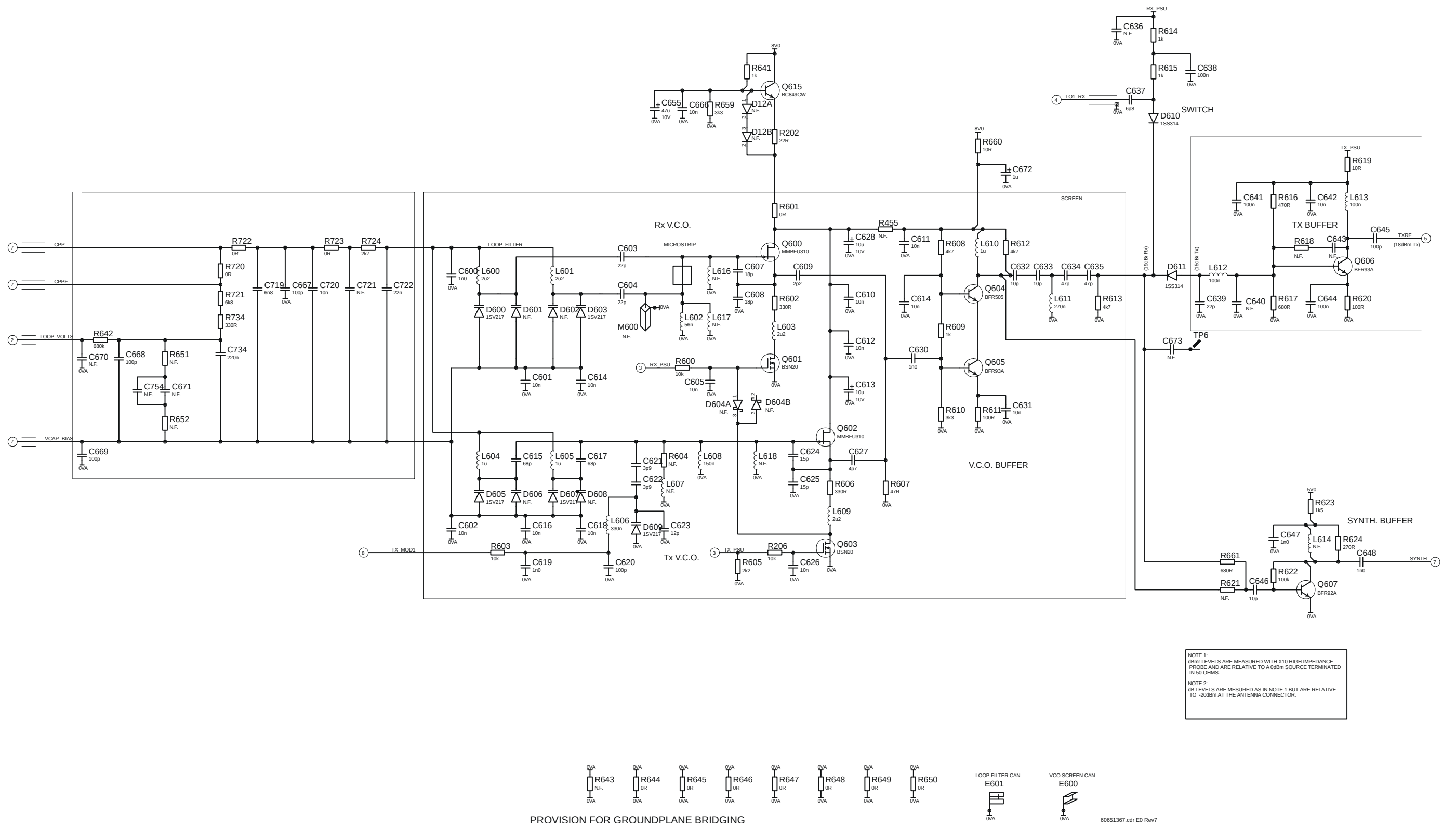


Figure 6-E0 Synthesiser - VCO Schematic

E0 Band (66-88MHz)

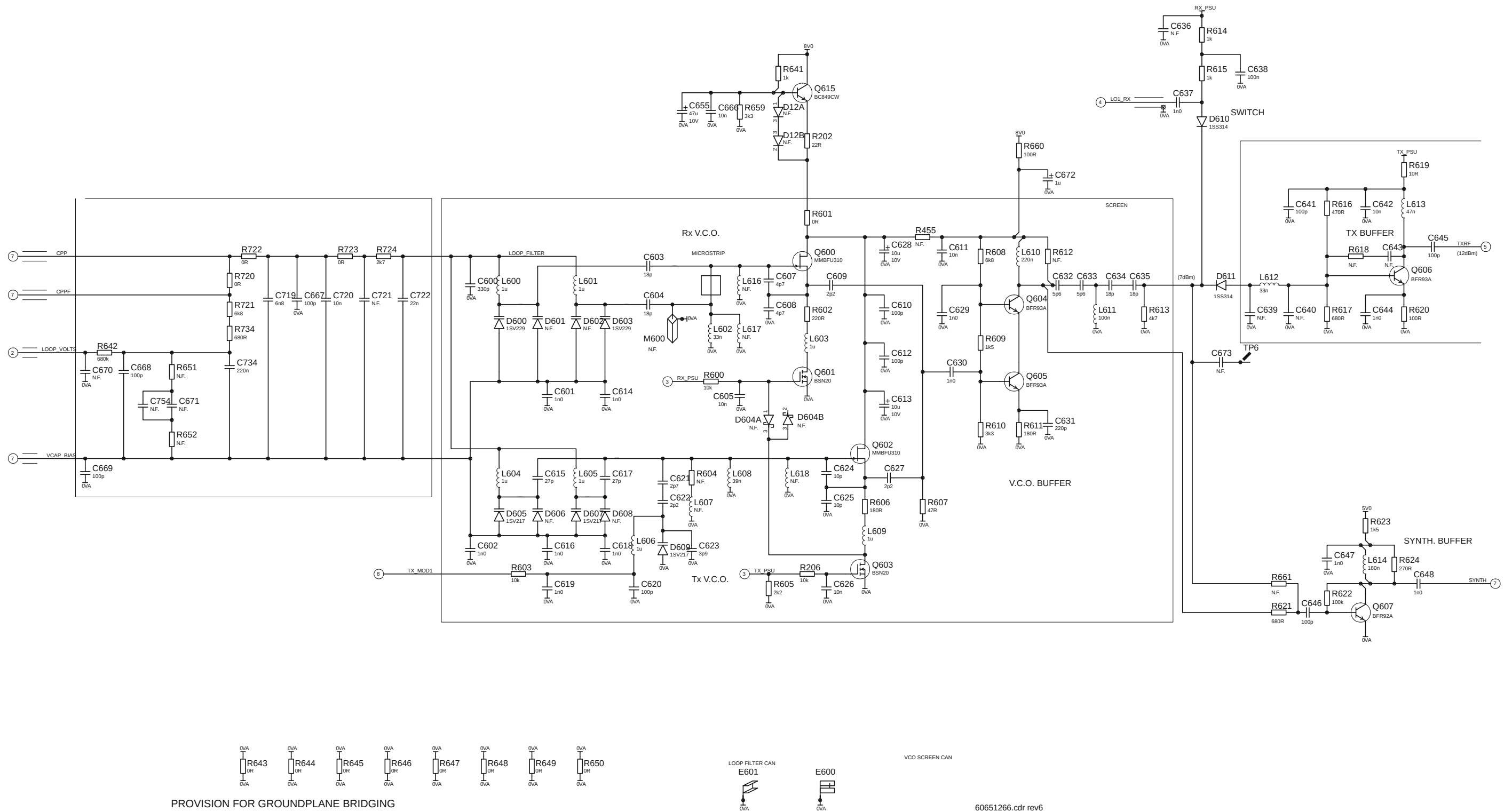


Figure 6-6AC Synthesiser - VCO Schematic
AC Band (136 - 174MHz)

DRAFT D

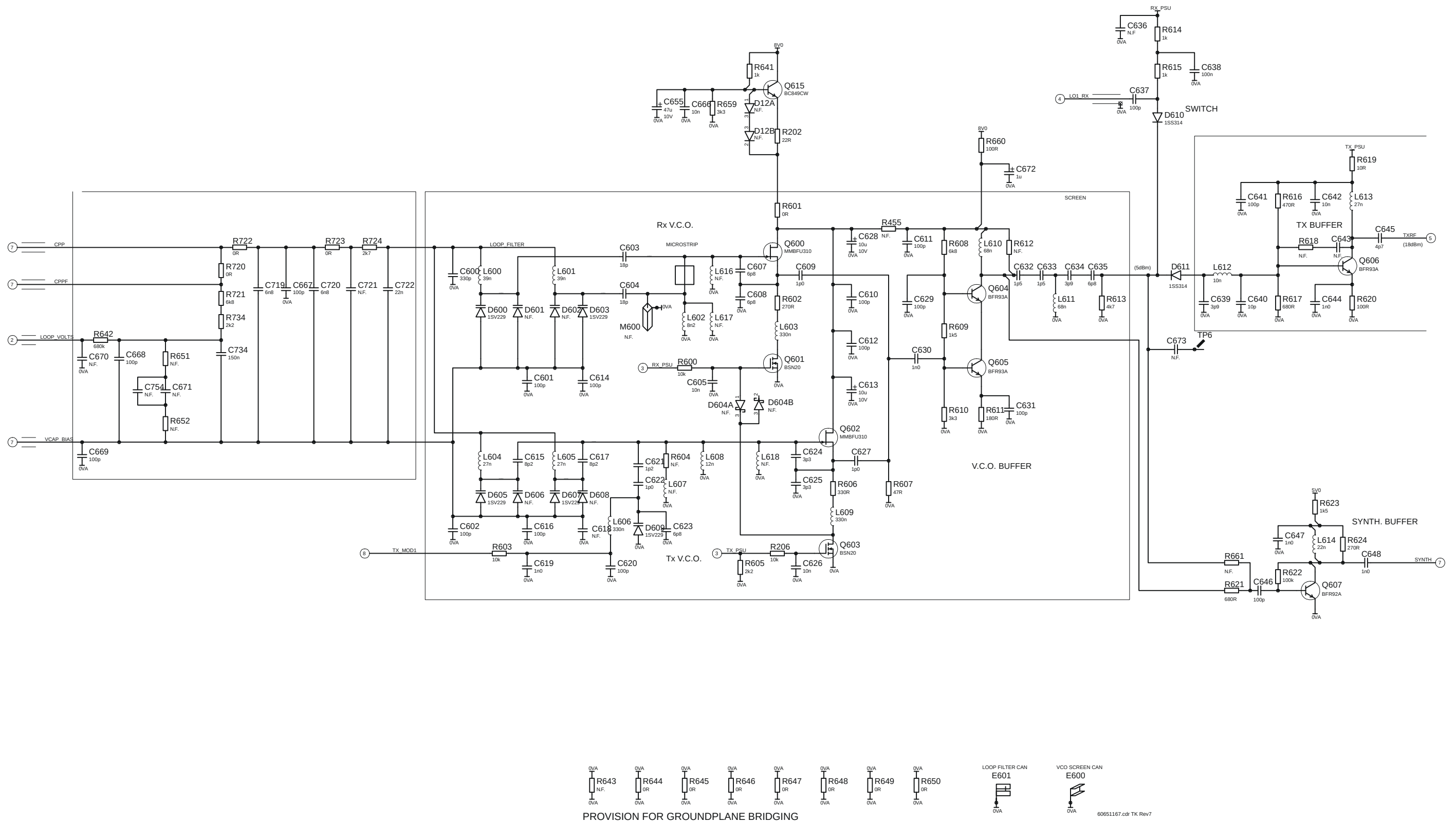


Figure 6-6TK Synthesiser – VCO Schematic
TK Band (400- 450MHz)

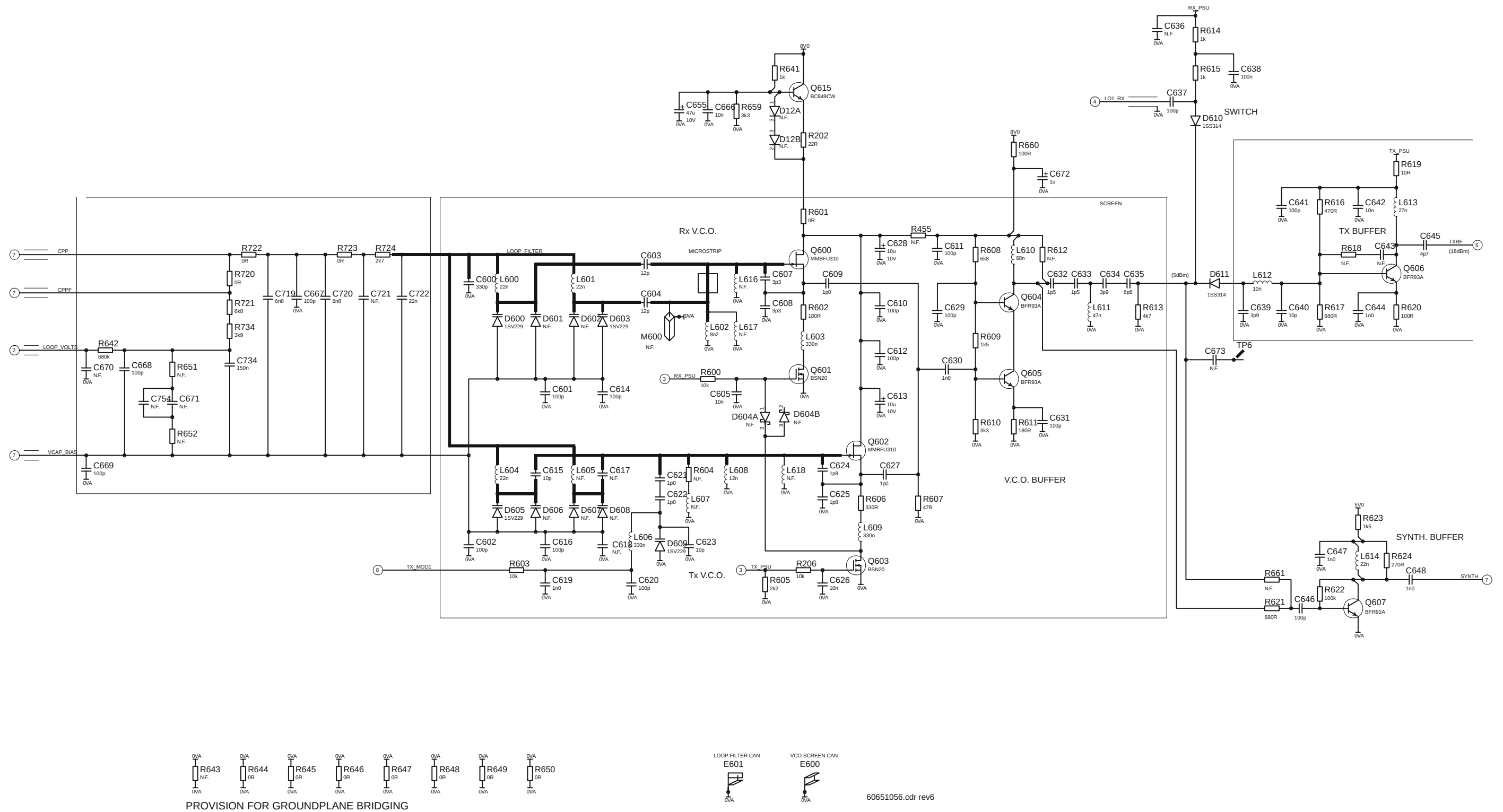
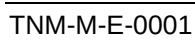
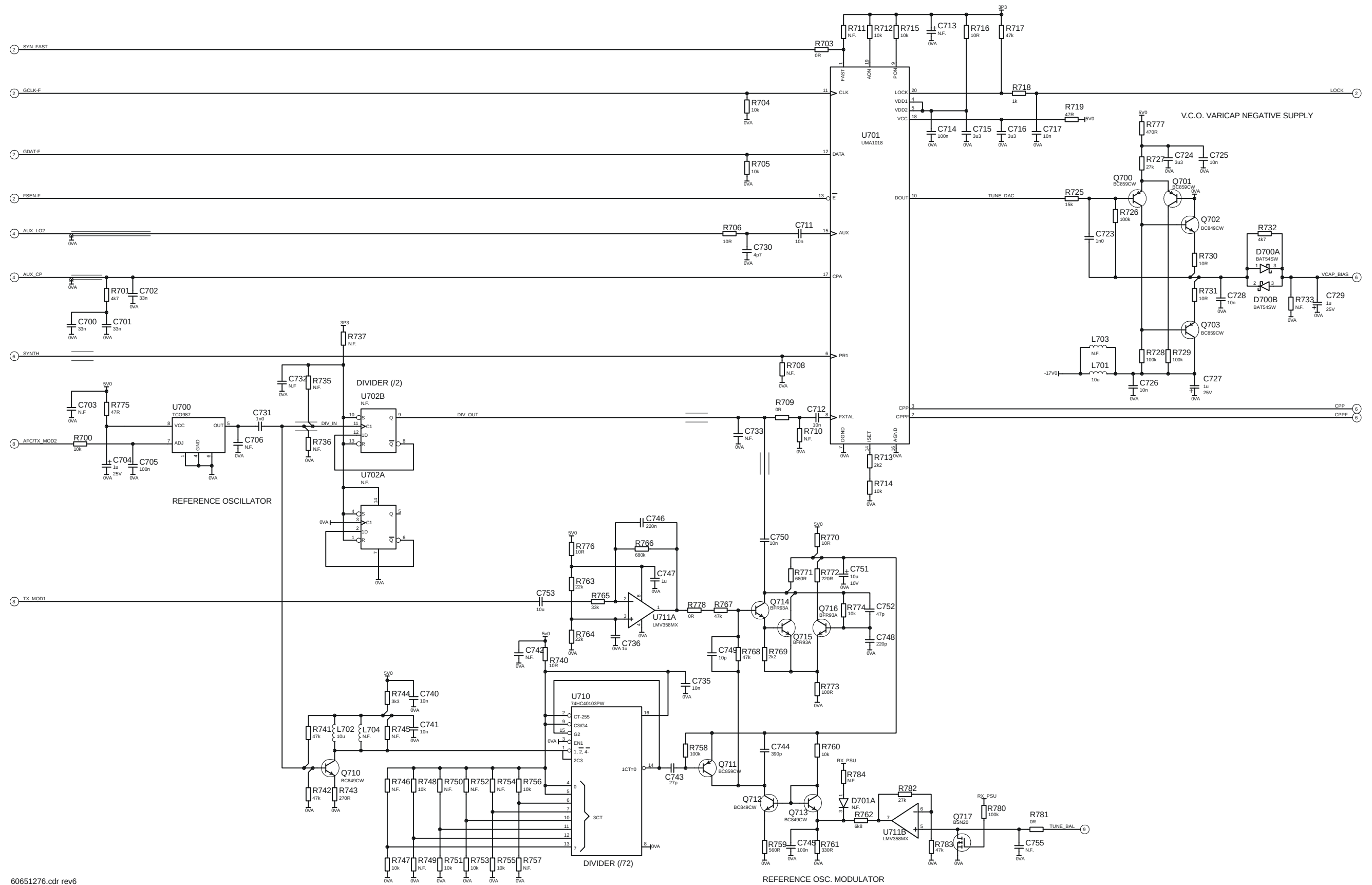


Figure 6-6UW Synthesiser – VCO Schematic
UW Band (440- 500MHz)



TNM-M-E-0001

TNM-M-E-0001



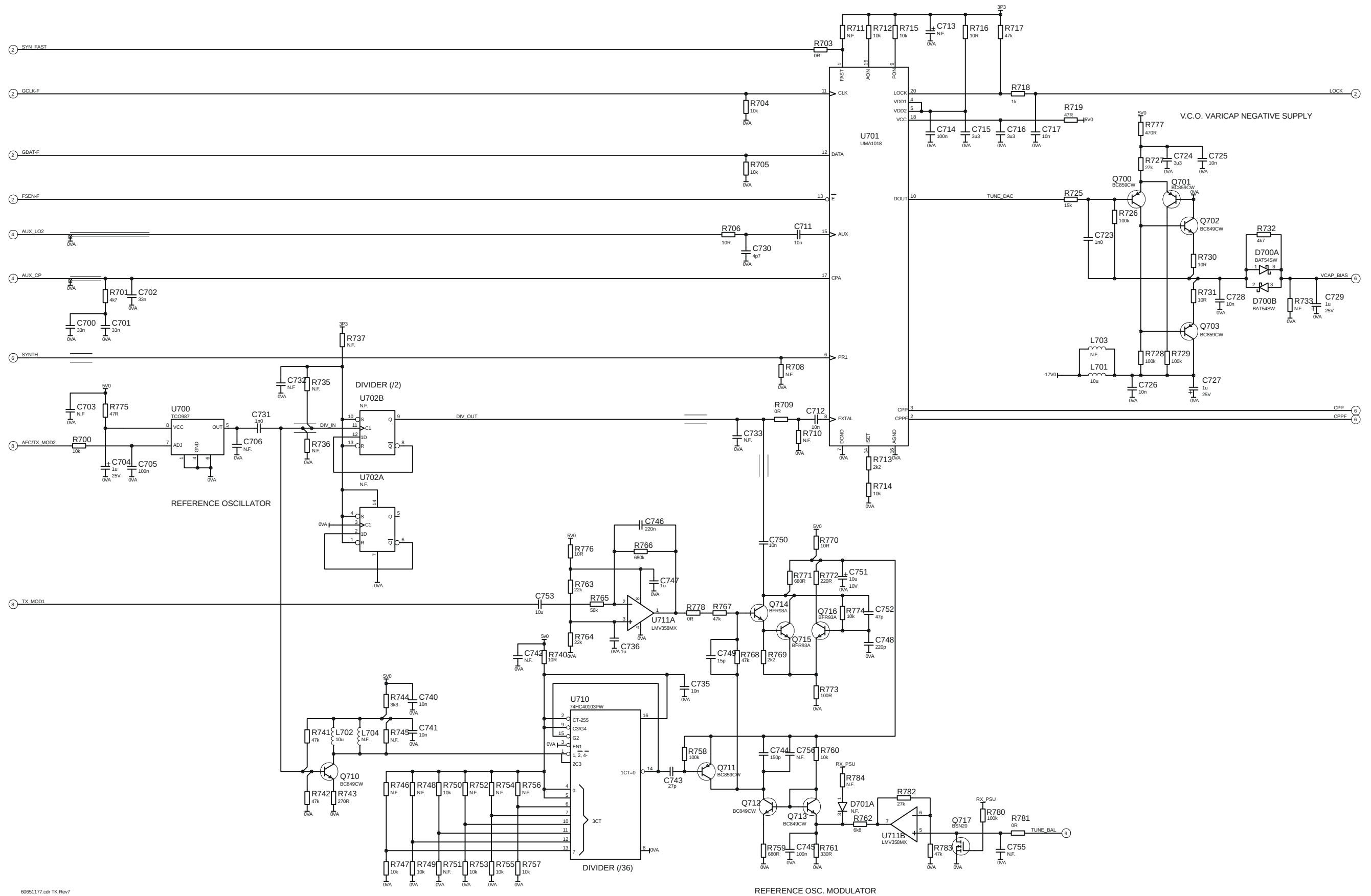


Figure 6-7TK Synthesiser – PLL Schematic
TK Band (400- 450MHz)

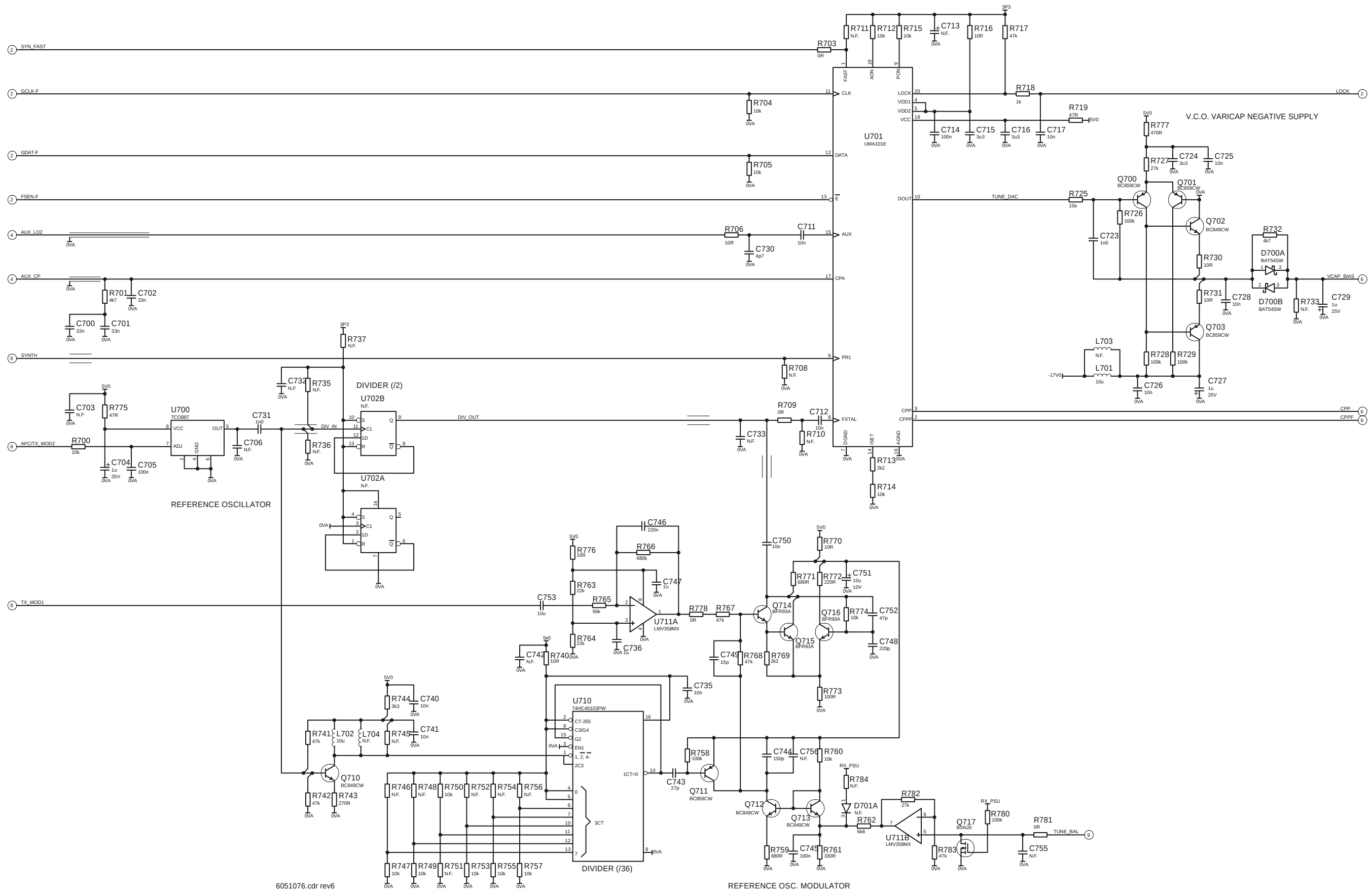
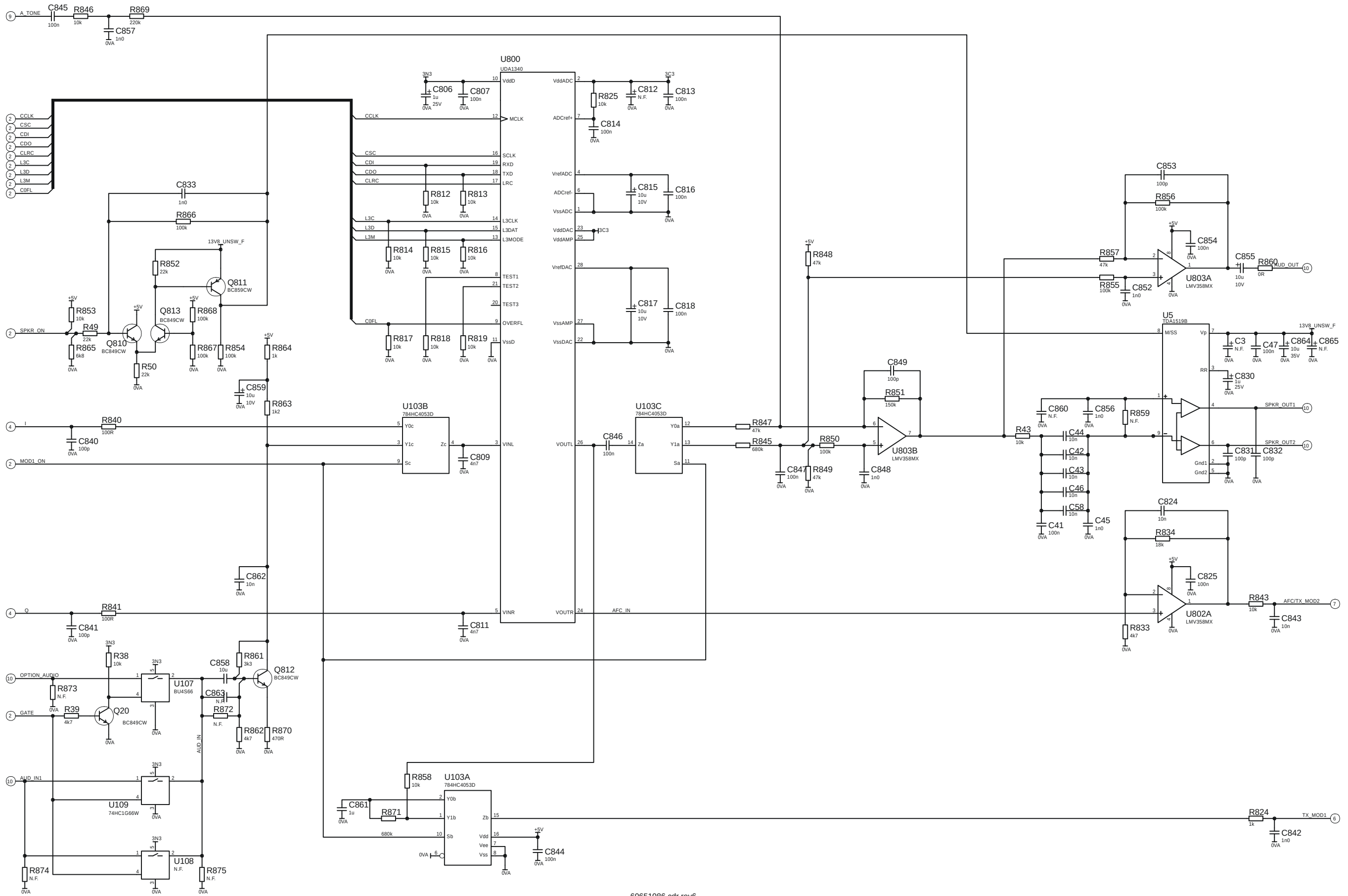


Figure 6-7UW Synthesiser – PLL Schematic

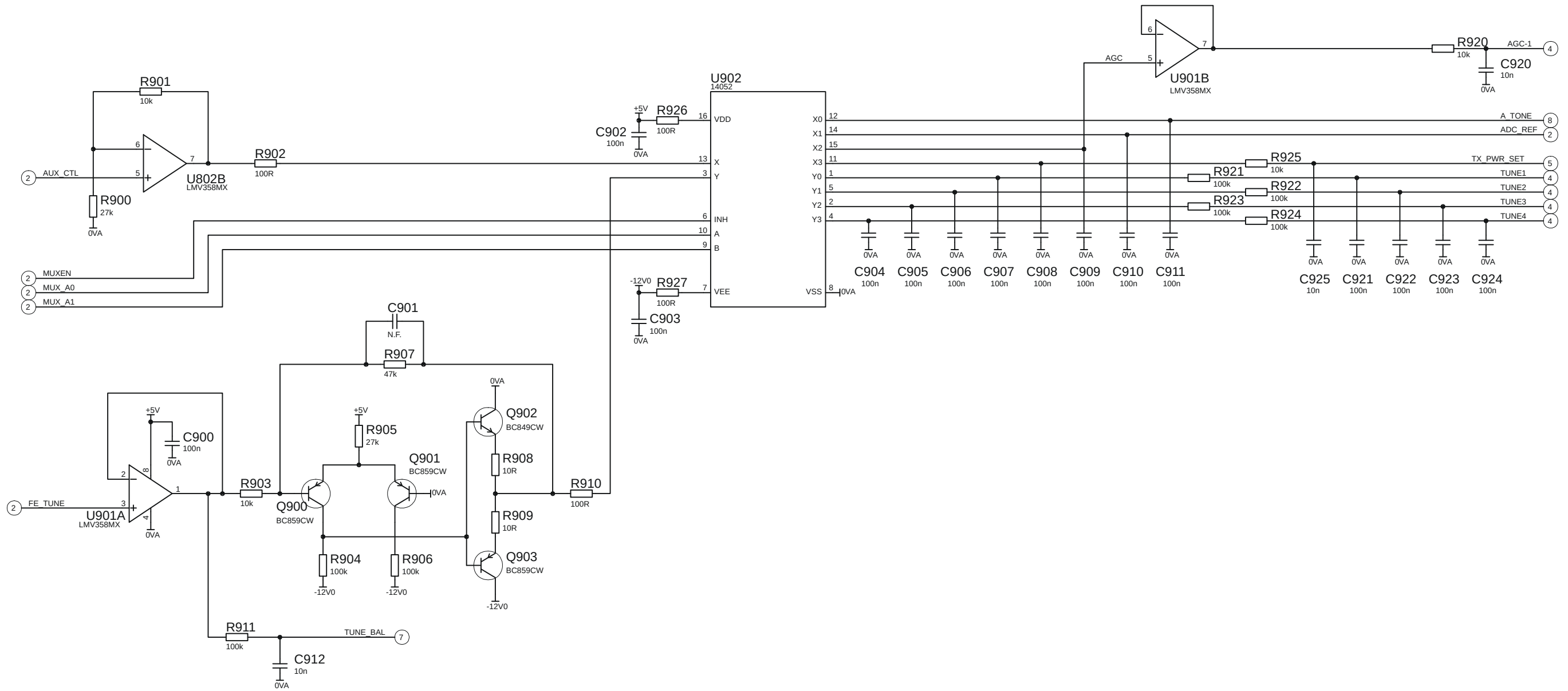
UW Band (440- 500MHz)

DRAFT D



60651086.cdr rev6

Figure 6-8 A/D Converter Schematic



60651096.cdr rev6

Figure 6-9 D/A Multiplexer Schematic

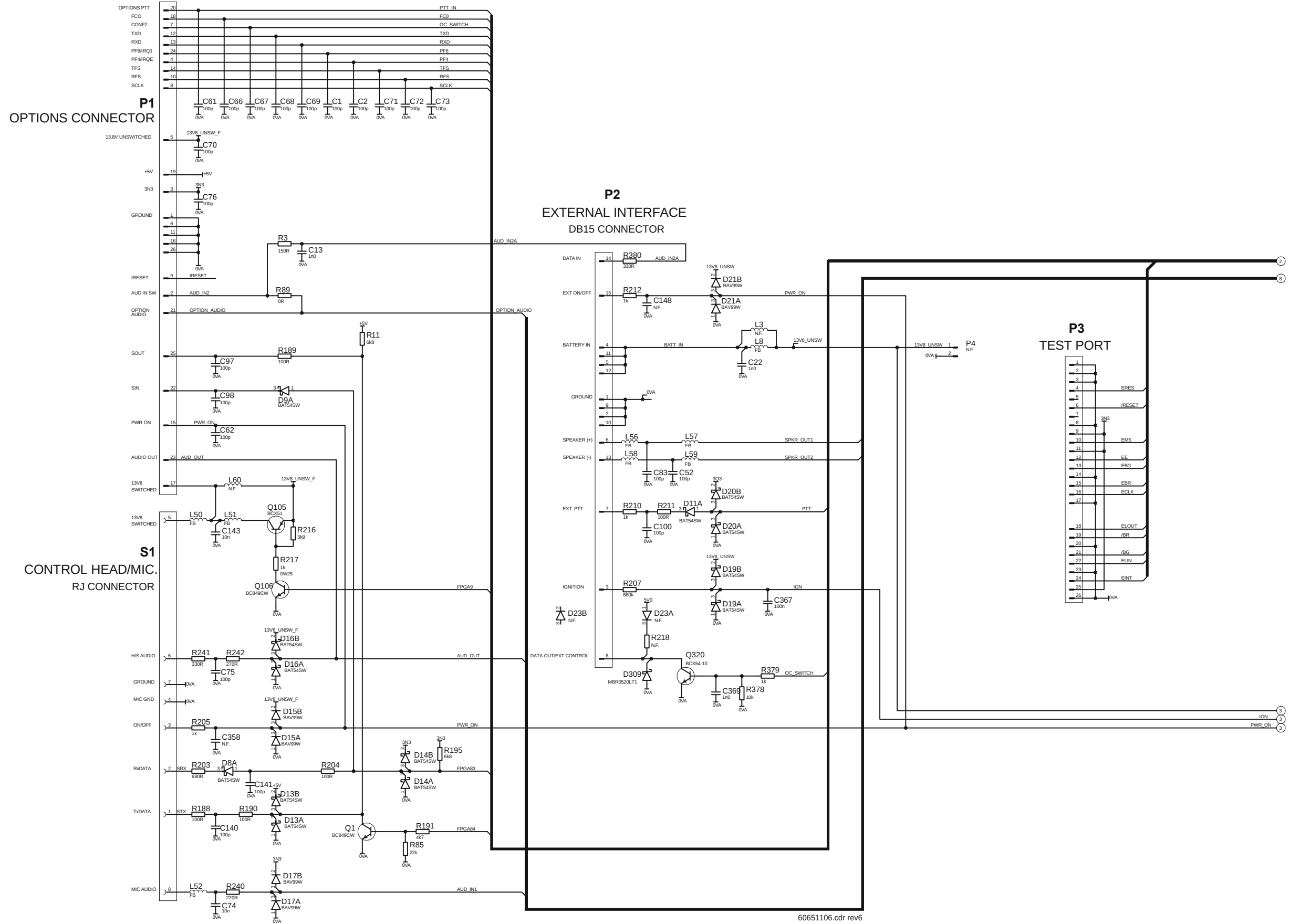


Figure 6-10 I/O Connections Schematic

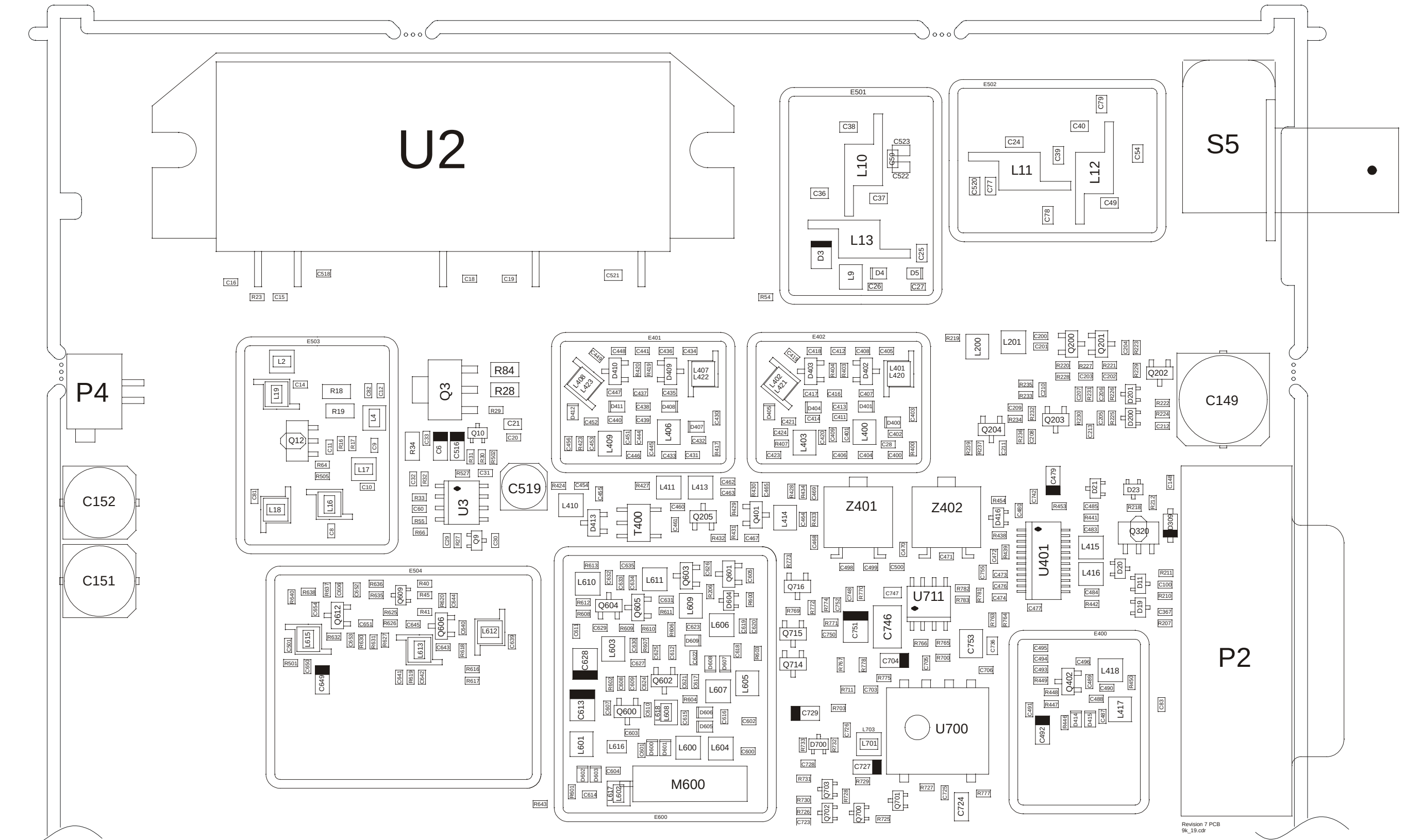


Figure 6-11 SRM9000 PCB Layout, Top (1/2)

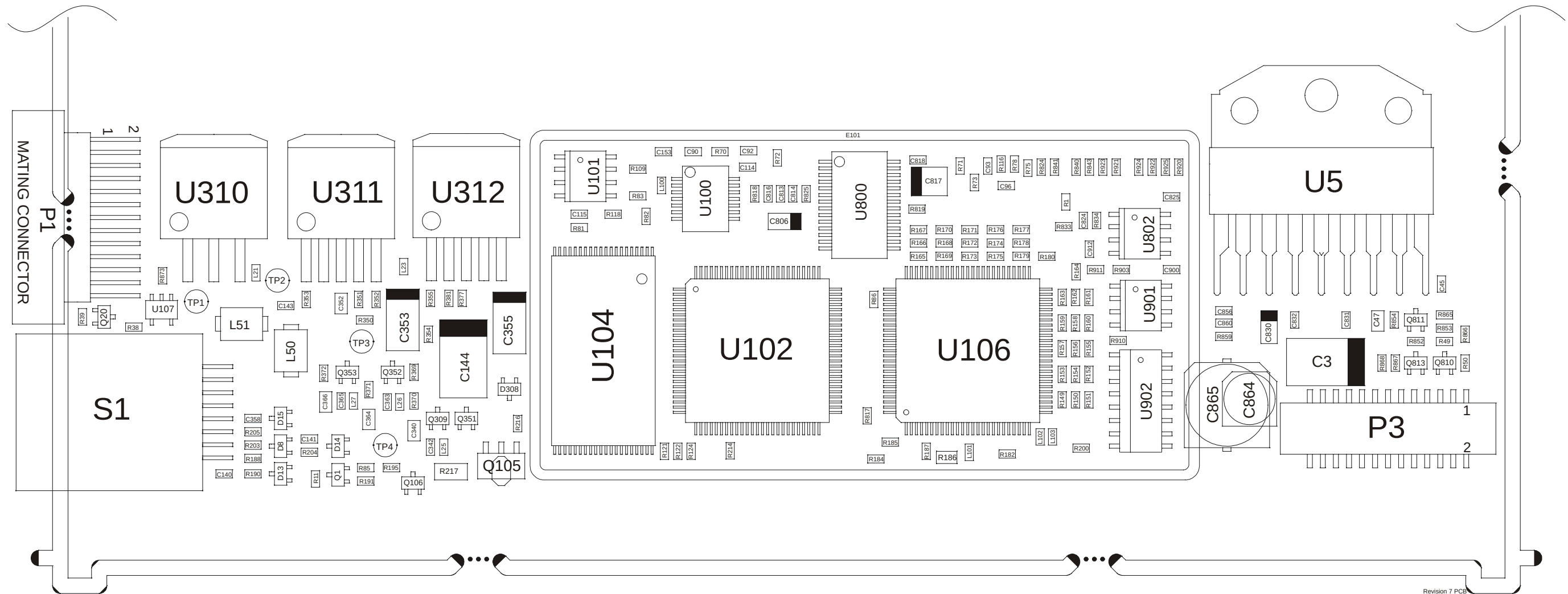
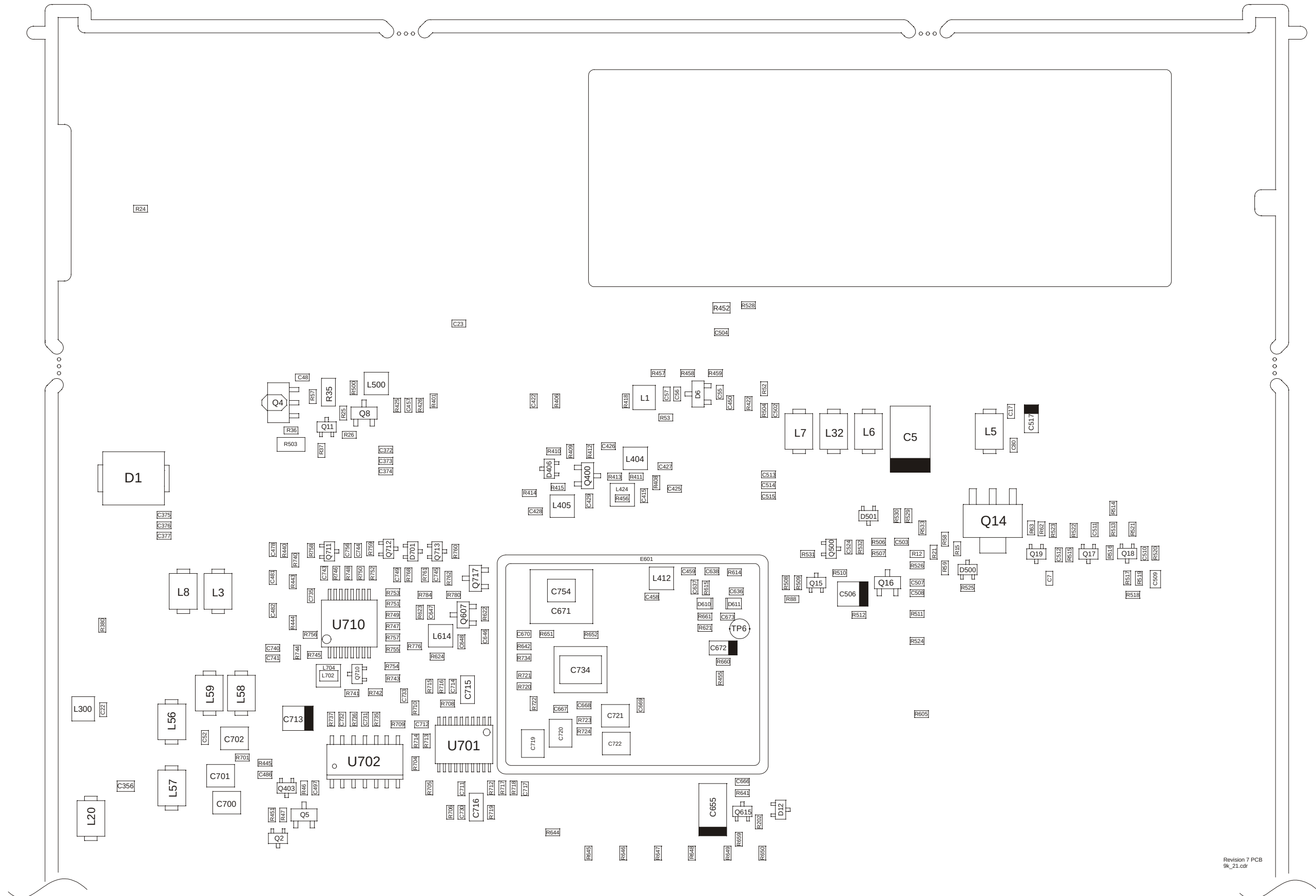
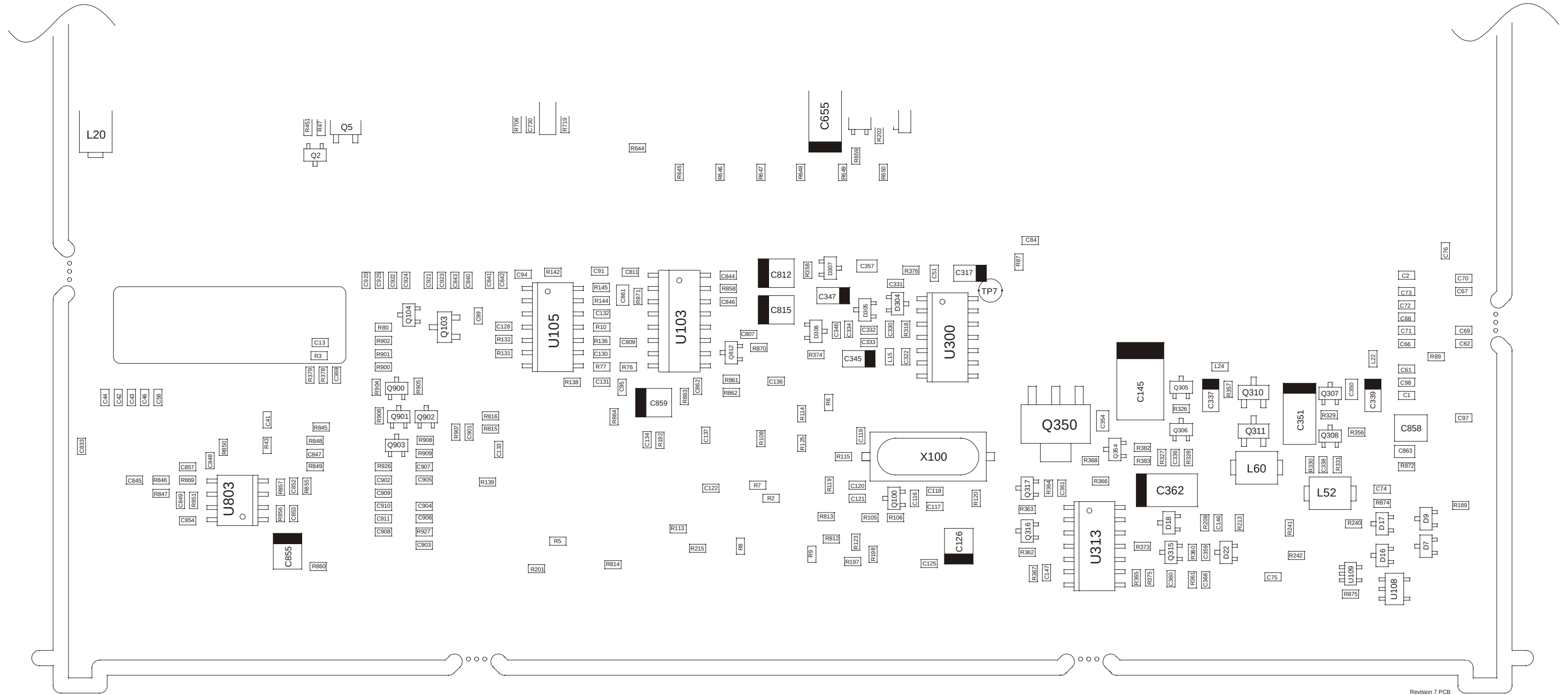
Revision 7 PCB
9K_20.cdr

Figure 6-12 SRM9000 PCB Layout, Top (2/2)



Revision 7 PCB
9k_21.cdr

Figure 6-13 SRM9000 PCB Layout, Bottom (1/2)



Revision 7 PCB
9k_22.cdr

Figure 6-14 SRM9000 PCB Layout, Bottom (2/2)

APPENDIX A - TRANSCEIVER CONNECTIONS

A.1. MICROPHONE / HANDSET CONNECTOR

The Transceiver front end-cap has a 8 pin RJ45 Microphone / Control Unit / Serial Control / Programming connector:



Figure A.1 SRM9000 RJ45 Pinout (S1)

Name	Pin Number	Comment
Tx-Data (0,5V)	1	Output. Low = 50mA sink to GROUND, High = 6k8 Ohm pull-up to 5V 200 Ohm series Impedance Diode Clamped to 0 & +5V
Rx-Data (0,5V)	2	Input. Low < 0.5V, High > 2.5V Internal 6k8 Ohm Pull-up to 3.3V 780 Ohm series Impedance Diode Clamped to 0 & +3.3V
On/Off input	3	Input. Low < 5V, High > (Supply Volts – 1.5V) or O/C Internal 220kM Ohm Pull-up to Supply Voltage 680k Ohm series Impedance Diode Clamped to 0 & Supply Voltage
Mic Ground	4	Connected internally to GROUND (see below)
+13.8V (Switched OP)	5	Switched + Supply Voltage 250mA max source current
Handset Audio OP (Flat)	6	Output: * Note-1 AC coupled (10uF) to 0/5V OpAmp Output 245mVrms (nominal) for 60% RF deviation of 1000Hz tone. 600 Ohm series Impedance Diode Clamped to 0 & Supply Voltage
GROUND	7	Internally connected to Transceiver –VE Supply Input.
Mic Audio IP	8	Input : * Note-2 40mVrms at 1kHz = 60% RF Deviation >1k Ohm series Impedance Diode Clamped to 0 & Supply Voltage

Note 1: *The Handset Audio Output is same as passed to Loudspeaker, except that audio response is always flat (no de-emphasis).*

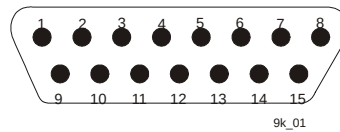
The Audio level on this pin is determined as follows:

- *When Loudspeaker Muted: level is set by Data Volume setting (see Programmer parameters)*
- *When Received Audio is present at Loudspeaker: level is determined by User Volume setting.*
- *When an Alert is sounding: level is determined by Alert setting. The Alert Tone will also be present on this line.*

Note 2: *The Mic Audio Input may be either Pre-emphasised, or passed flat to the Transmitter. This is determined by the type of PTT command that keys the Transmitter.*

A.2. EXTERNAL INTERFACE CONNECTOR

The Transceiver rear end-cap is fitted with a male DB15 connector:



DB15(M) Plug
(view looking into transceiver)

Figure A.2 SRM9000 External Interface Pinout (P2)

Name	DB15 Pin numbers
-VE (Gnd)	1, 2, 9, 10
+VE (+13.8V)	4, 5, 11, 12
Speaker	6, 13
General Input-0 (PTT/RTS)	7
General Output-0 (CD/CTS)	8
Ignition_Sense Input	3
On/Off input	15

APPENDIX B - SRM9010 MICROPHONE

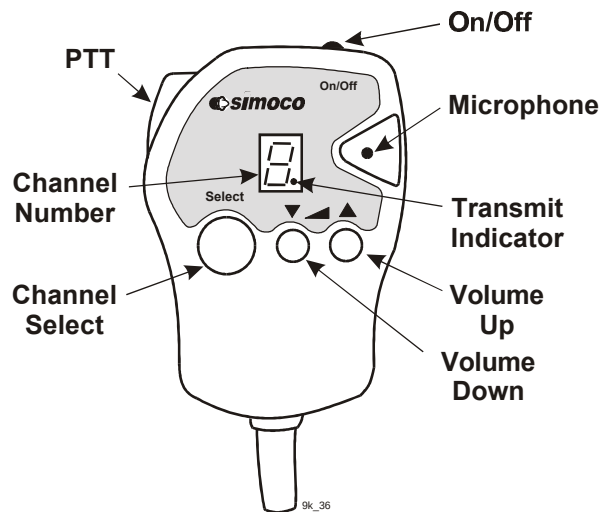


Figure B.1 SRM9010 Microphone

The microphone is arranged for connection to the RJ45 connector on the front of the SRM9000 Transceiver, either directly or via the extension lead accessory.

There are no repairable electronic components in the Microphone. Only those items listed in Paragraph B1 are replaceable. If the Microphone PCB fails, the Microphone must be replaced in its entirety.

B.1 Replaceable Parts

Item	Part Number
On/Off Switch	3502-445-00020
Volume Up/Down Switch	3502-445-00030
Channel Select Switch	3502-445-00030
PTT Switch	3502-445-00010
Curly cord	3502-310-63400
Mic Element	3502-310-63420

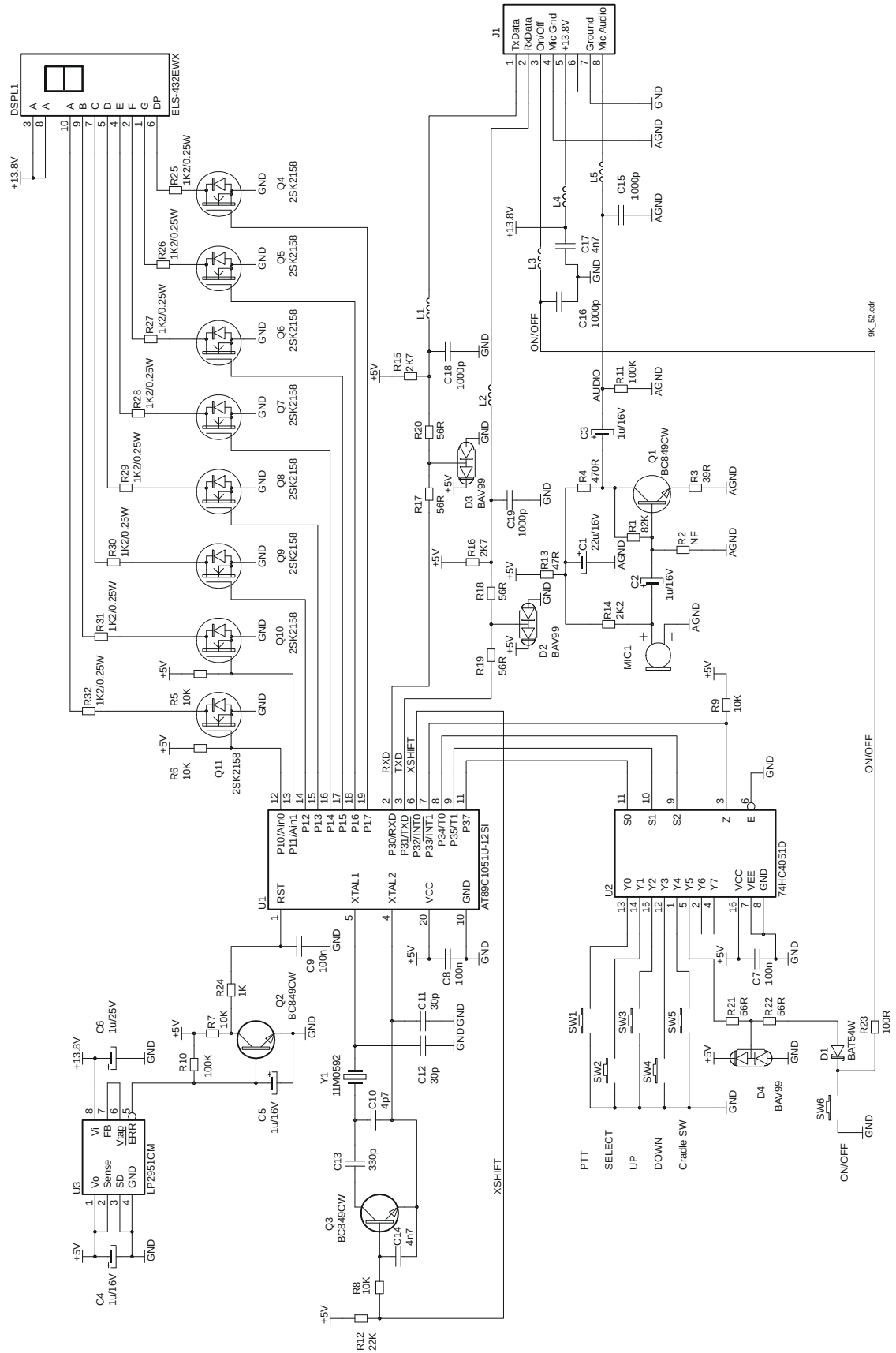
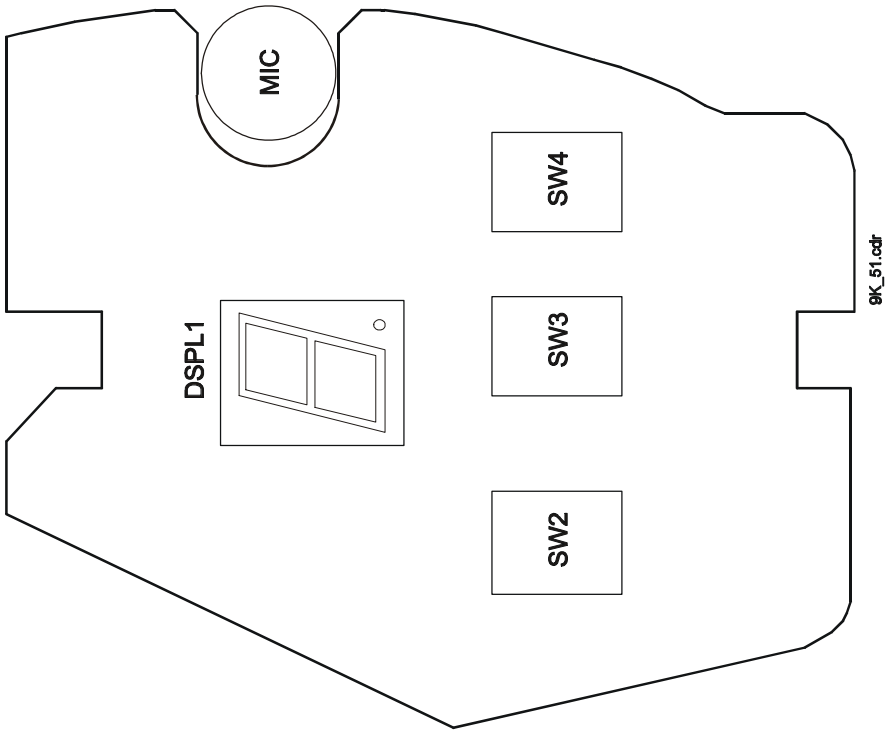


Figure B.2 SRM9010 Microphone Schematic

SRM9010 Microphone PCB - Bottom Layout



SRM9010 Microphone PCB - Top Layout

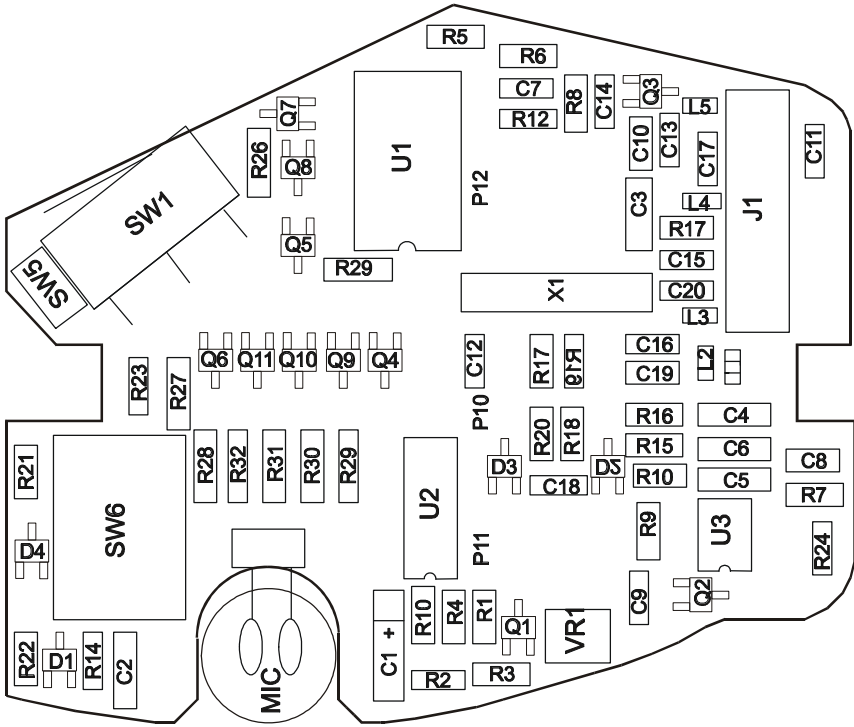


Figure B.3 SRM9010 Microphone PCB Layout

APPENDIX C - SRM9020 MICROPHONE

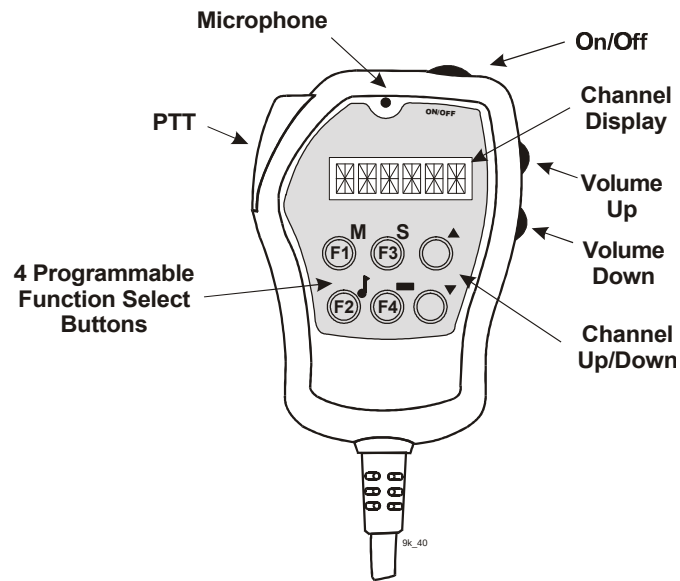


Figure C.1 SRM9020 Microphone

The microphone is arranged for connection to the RJ45 connector on the front of the SRM9000 Transceiver, either directly or via the extension lead accessory.

There are no repairable electronic components in the Microphone. Only those items listed in Paragraph C1 are replaceable. If the Microphone PCB fails, the Microphone must be replaced in its entirety.

C.1 REPLACEABLE PARTS

Item	Part Number
On/Off Switch	3502-445-00020
Volume Switch	tba
Front Face Switches	3502-445-00030
PTT Switch	3502-445-00010
Curly cord	3502-310-63400
Mic Element	3502-310-63420

APPENDIX D - SRM9025 HANDSET



Figure D.1 SRM9025 Handset

The Handset is arranged for connection to the RJ45 connector on the front of the SRM9000 Transceiver, either directly or via the extension lead accessory.

There are no repairable electronic components in the Handset. Only those items listed in Paragraph D1 are replaceable. If the Handset PCB fails, the Handset must be replaced in its entirety.

D.1 REPLACEABLE PARTS

Item	Part Number
On/Off Switch	tba
Volume Switch	tba
Front Face Switches	tba
PTT Switch	tba
Curly cord	tba

APPENDIX E - SRM9030 CONTROL HEAD



Figure E.1 SRM9030 Control Head

The Control Head is arranged for connection to the RJ45 connector on the front of the SRM9000 Transceiver, either directly or via the extension lead accessory.

There are no repairable electronic components in the Microphone. Only those items listed in Paragraph E1 are replaceable. If the Control Head PCB fails, the Control Head must be replaced in its entirety.

E.1 REPLACEABLE PARTS

Item	Part Number
Volume potentiometer	tba
RJ45 connector	tba

APPENDIX F - SRM9030 MICROPHONE

F.1 Replaceable Parts

Item	Part Number
Curly Cord	3502-310-63410
Function Switch	3502-445-00020
PTT Switch	3502-445-00010
Mic Element	3502-310-63420

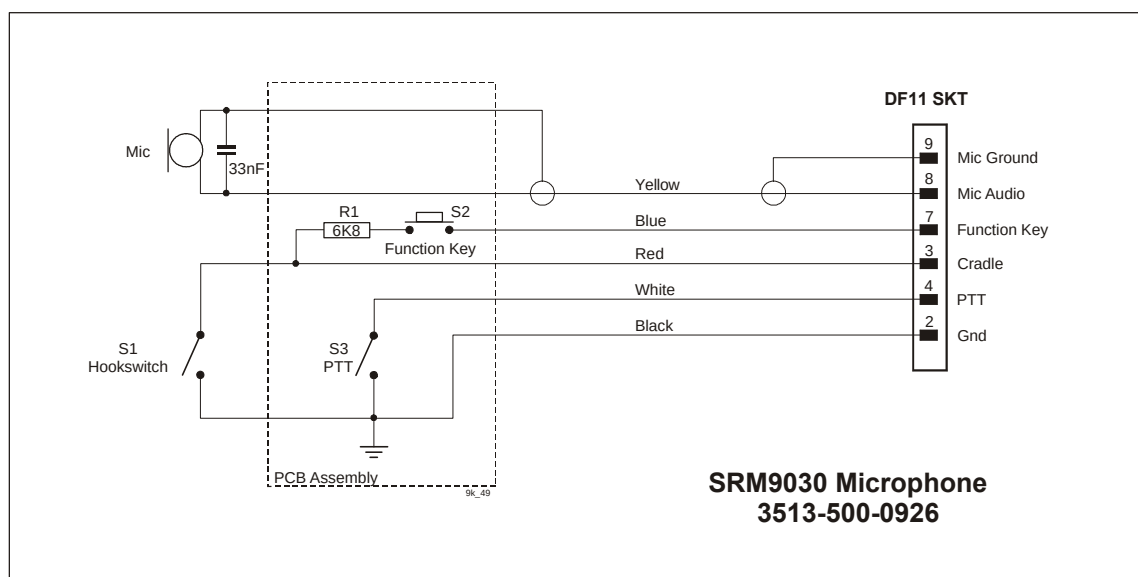


Figure F.1 SRM9030 Microphone Schematic