

R909-DSP radio (Arduino+Si4732+Si5351a+TA2003+LM386)

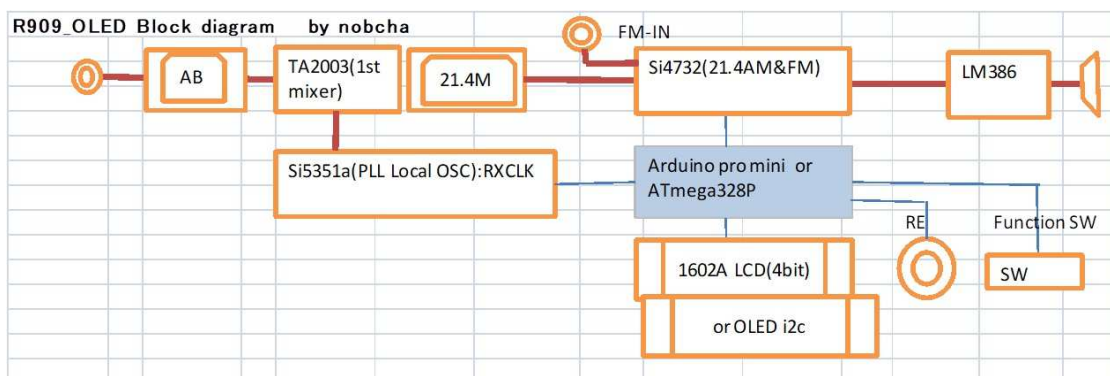
2025. 01. 19 tentative by nobcha

1. PREFACE



-The front view of this radio.

R909-4732(DSP) is a radio for the air band and the FM broadcasting. It is assembled with Si5351a, Si4732, and TA2003. TA2003 and Si5351a are sharing the first mixer and the local oscillator. Si4732 is acting as a mother 21.4MHz receiver for the air band and the FM radio itself. I adopted PU2CLR Si4735/32 library for this sketch. There are some kinds of display versions, as OLED and WE1602A. I will introduce OLED version mainly.



-Block diagram

To operate the radio, you shall use the rotary encoder, encoder push switch, and function switches.

There are two parts of PCBs as Panel and RF. They are connecting by pin header connector. The ATmega328P with the Arduino boot loader, the switches, and the display are locating on the Panel PCB.



-Inside of R909-DSP radio

2. The details of R909-DSP(4732)

2.1 Specification

.Band coverage Air band AM: 118-136MHz, FM: 76-109MHz

.Sensitivity about -110dBm

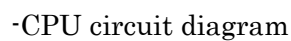
.Power supply DC+12V about 110 mA

.Audio output 1W max, 2.5 jack

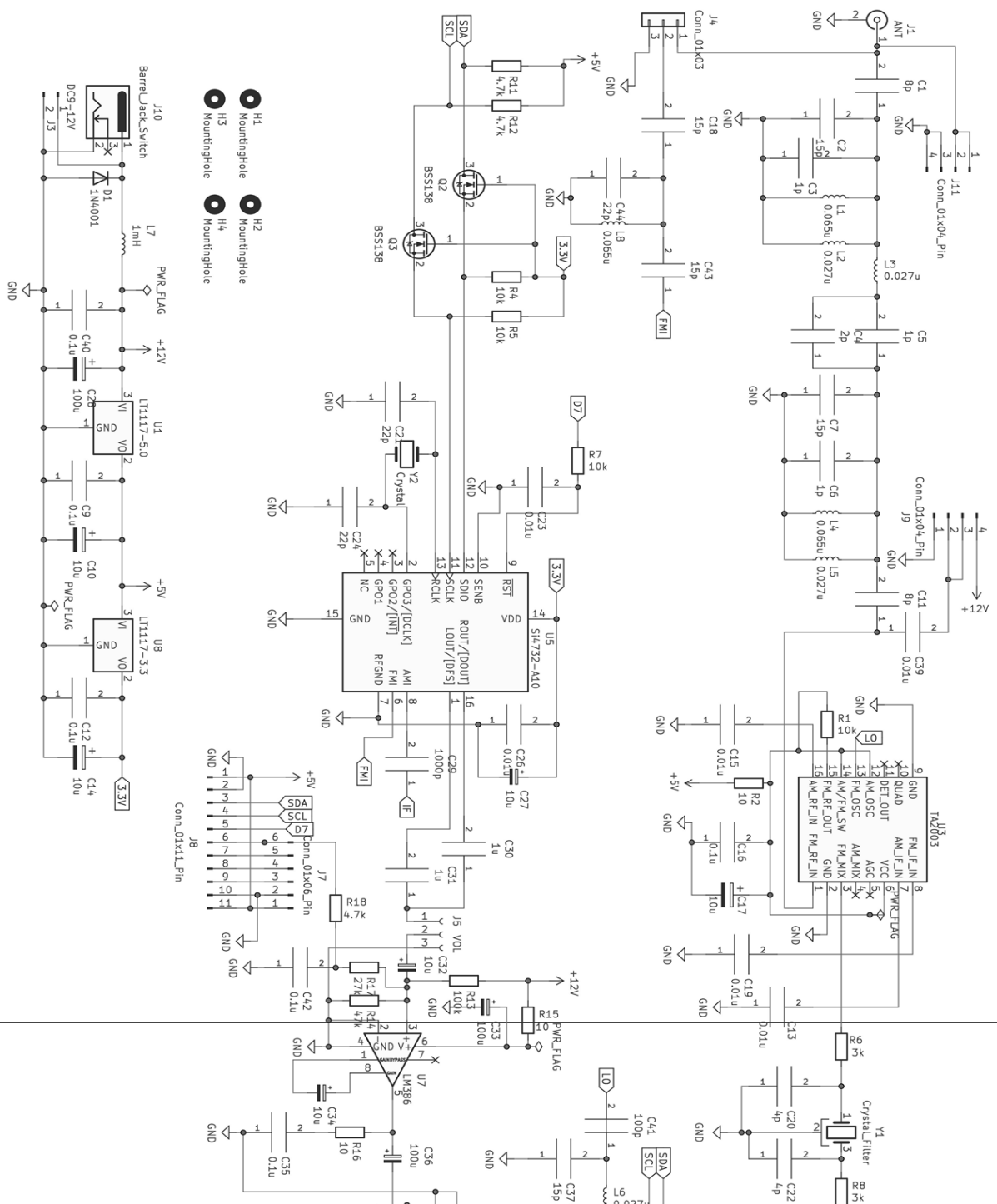
.Case size 38h x 88w x 100d, weight: about 250gm

2.2 Circuit and PCBs

There are 2 PCBs of RF and CPU. RF PCB is containing the front end filter, TA2003 mixer, Si4732 radio, Si5351a frequency module, LM386 audio AMP, and the power circuit. Panel PCB of CPU circuit is holding ATmega328P with boot loader, OLED display module, and the switches.



-RF circuit diagram



2.3 Operation

Operation is depending on the rotary encoder and the rotary encoder's push switch. There are 3

modes, to select a function (FUNC), to change parameter at every function mode, and to memory the parameter into EEPROM. FUNC mode is to select every function. You shall select the function by rotating and determine the one by single pushing. In every function mode you can change the parameter by rotating and store the parameter on to EEPROM by double pushing. To escape out from every function mode to push rotary encoder switch single. Rotating, one pushing, and two pushing is the identical operation for this sketch.

There are 10 major functions in this radio machine control.

.Func: To select every function

.FRQ: To determine the frequency stepped by the step frequency

.STP: To select the step frequency from 10Hz, 1kHz, 10kHz, 100kHz, 1MHz, and 25kHz

.MEM: To set the memory channel number for EEPROM 50channels

.SCN: To scan the memory channel number for EEPROM 50channels

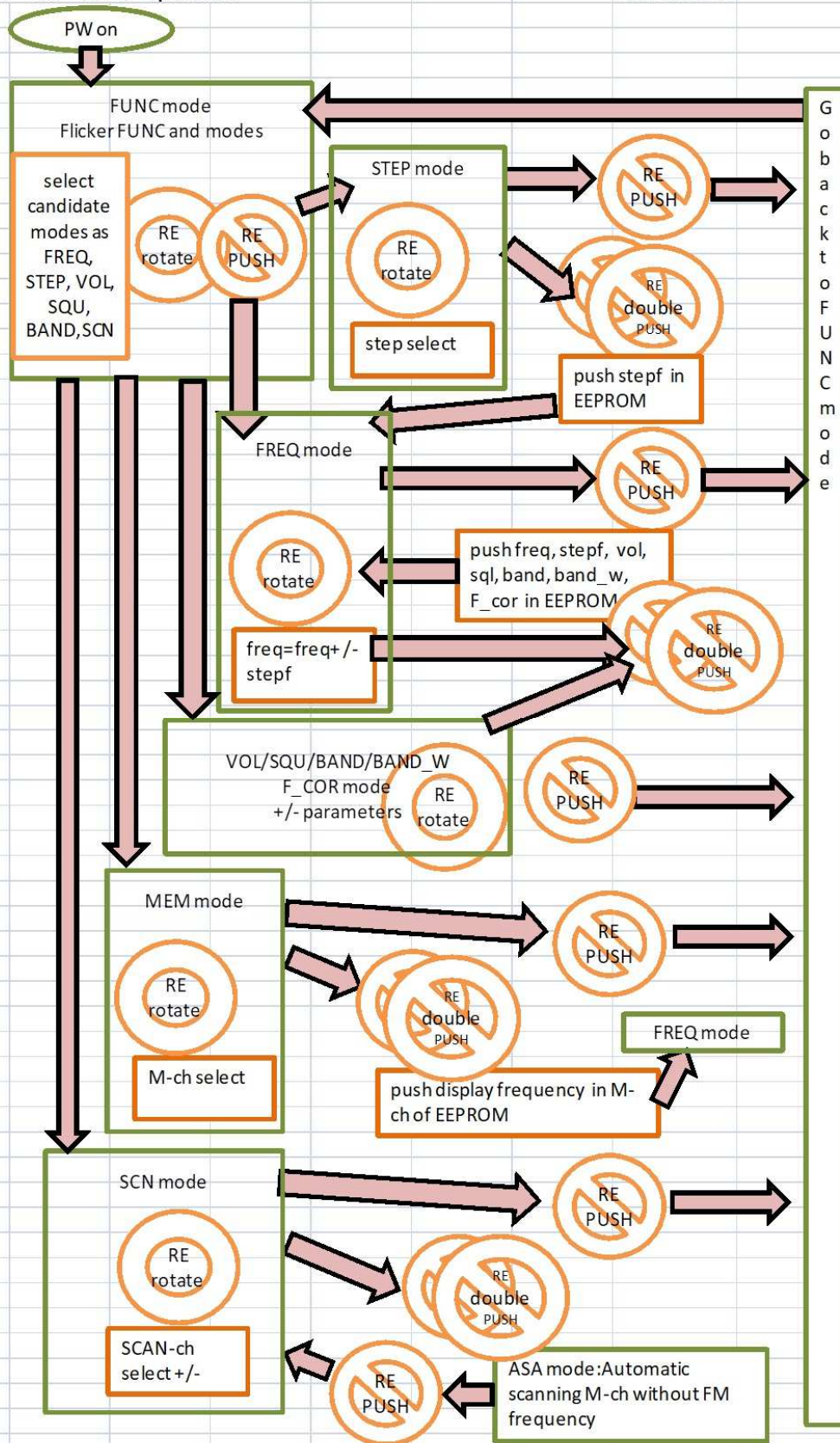
.VOL: To control volume level

.SQU: To control squelch level

.BAND: To alternate AM or FM

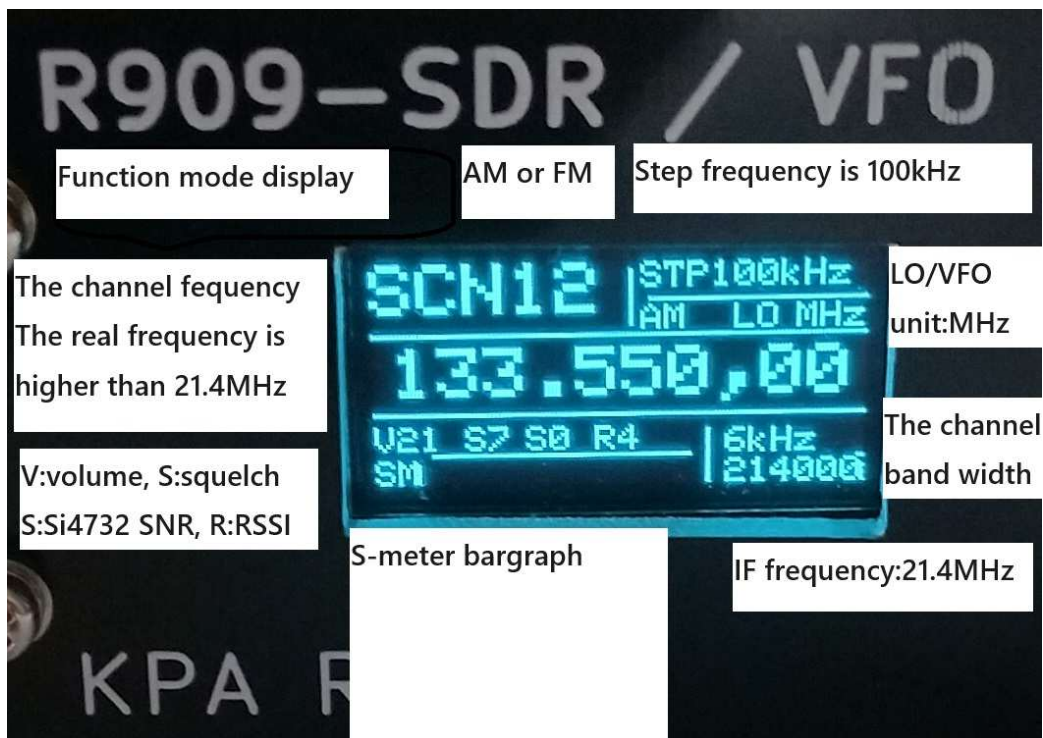
.BAND_W: To select the band width frequency from 1Hz, 1.5kHz, 2kHz, 4kHz, and 6kHz

.F_COR: To correct the basic crystal 25MHz frequency error



- Operation flow

Display contents on OLED is below.



[-Youtube video](#)

- First setting

To initialize EEPROM contents, you shall turn on with pushing RE-SW at same time.

2.4 About sketches

Some libraries and common sketches are included. Many thanks for providing those materials. They are PU2CLR's 4735 library, Adafruits OLED libraries, TJ lab's Si5351a sketch, and Ben Buxton's rotary encoder library.

xxxxx https://github.com/Nobcha/R909-SDR/R909-SDR-OLED_test3.ino

There are the diagnostic sketches for testing the hardware, as i2c scanner and USB serial controlling Si4732.

Xxxx https://github.com/Nobcha/R909-SDR/i2c_scanner_R909PANEL.zip

Xx https://github.com/Nobcha/R909-SDR/SI4735_01_POC_5351.ino

3. How to assemble the PCB and to combine PCBs with module.

3.1 CPU PCB

You shall gather the parts on the list. There are some optional parts. Please judge depending on your

plan.

There are used the surface mounting CRs on this PCB. You shall solder the surface mounting CRs at first. Please take care of the parts which must be soldered on B side.

https://github.com/Nobcha/R909-SDR/R909-SDR-Panel_OLED_bom.pdf

Next the crystal and the aluminum capacitors are soldered. ATmega328P should be mounted with the IC socket to be replaced as needed. J and J are used on demanded. The switches and LEDs are mounted to take care of combining with the front panel PCB.

The assembled PCB could be tested by i2c scanning sketch. When the OLED shows its own i2c address of 0x3c on it, testing result is OK.



-Photo of assembled PANEL PCB

3.2 RF PCB

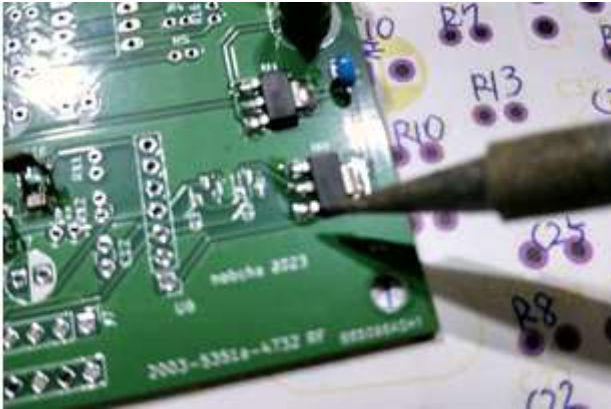
You shall gather the parts on the list. There are some optional parts. Please judge depending on your plan.

https://github.com/Nobcha/R909-SDR/R909-SDR-Panel_OLED_bom.pdf

Prior to solder the parts you shall wind the coils. You should wire 4 air core coils and 1 troidul coil as below.

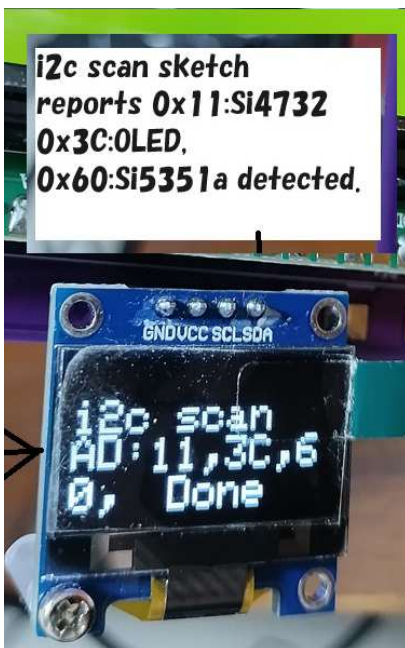
https://github.com/Nobcha/R909-SDR/coils_R909-SDR.pdf

At first you shall solder the surface mounting parts as Si4732, SGA2751 and some LCs.



After then you solder the DIP type LCR and pin header connectors.

If you would like to check digital connection between PANEL and RF PCB, you can use i2c scanner program. When you find Si4732 address of 0x11, it works well. And USB serial controlling Si4732 sketch is useful to tune RF coils.



3.3 To tune

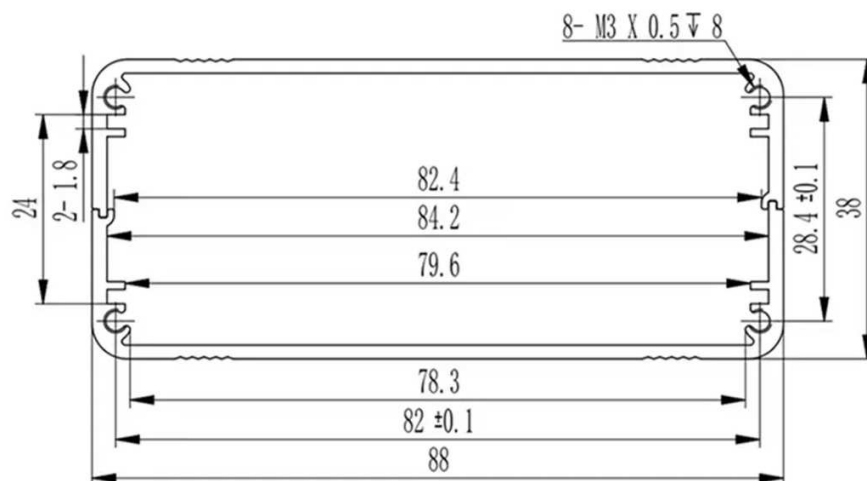
To tune the coils, you shall use nano VNA. Please refer coils_R909-SDR.pdf.

You may use the signal generator or some other RF signal source of about 120MHz or so.

If you hold tiny SA ultra, please set it as a RF generator mode.

3.4 To install the PCBs in the case

The size of PCBs is intended to be installed into 38x88x120 aluminum case.



RF PCB shall be loaded into 84.5mm spacing graves

I have designed the front and back panel PCB as below. The panel control PCB is holding by 15mm stud with M2.6 screws on to the front panel PCB.



4. Errata

R909 SDR Radio PCB errata			2025.01.19
#	Problem	PCB	To make change
1	No power	25mm Panel PCB	On panel PCB: To connect VCC of P1(COM) with any +5V
2	Irregal 5V power current	Debug Panel PCB	On debug panel PCB: To cut the trace between Vin and +12V input
3	Si4732 was not active	RF PCB	To connect Si4732#15(GND) with B plane GND pattern thorough PCB (Si4732 was floating)
4	Si4732 was not active	RF PCB	To pull up A3 of J8's#5 with 10k ohm (Si4732 reset inactive)
5	Low gain of Si4732	RF PCB	To change R1 of 10kohm into 1k ohm
6	Low gain of Si4732	RF PCB	To cut the trace between C41both pins
7	Low gain of Si4732	RF PCB	To short 3k ohm of R6 and R8
8	Mute logic	RF PCB	To remove 100k ohm of R13
9	Low gain of Si4732	RF PCB	To change R1 of resister into 400nH coil (ie:T37-2 10t)
10	To reduce noise	25mm Panel PCB	To change capacitors value for C6 as 47uF and to jump C6 +node with 5V (J7#10) (circuit mistaken)
11	To reduce noise	Debug Panel PCB	To change capacitors value for C4 and C6 as 47uF
12	To reduce noise	RF PCB	To add 470uF capacitor on +5V line (To use J7's #1 and #2)
13	Low gain of 2SC3356	RF PCB	To twist the lead wire of 2SC3356(1:B, 2:E, 3:C) for the PCB pattern being wrong(1:E, 2:C, 3:B).
14	Parts value	25mm Panel PCB	R2:390 (330/390 both OK)
15	Parts value	25mm Panel PCB	C22,23:0.15u (0.22/0.15 both OK)
16	Parts name	RF PCB	Y1:21.4MHz crysyal filter (ie:21M07A, 21M15A etc)
17	Parts name	RF PCB	Y2:32.768kHz crystal
18	Parts value	RF PCB	C21,C24:12pF
19	To reduce noise	RF PCB	To add SMD 0.1uF capacitor on LT1117-5,3.3 output line (#1 and #2)

5.References and thanks

I'm much thanking Mr.Jason,9H5BM to give me the idea of this project, PU2CLR and JF3HZB to show me sketch examples, Cesar Sound to give me display layout example, and many people.

Jason kits,9H5BM:<https://www.facebook.com/profile.php?id=100012257914763>

Ricardo Lima Caratti,pu2clr:<https://github.com/pu2clr>

上保 徹志 (Tetsuji Uebo),JF3HZB:<https://tj-lab.org/2017/03/13/si5351/>

CesarSound:<https://www.hackster.io/CesarSound/10khz-to-225mhz-vfo-rf-generator-with-si5351-version-2-bfa619>

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