

CS-Series

Single Band SSB Transceiver Kit Assembly Manual

Rev. A
CRKITS.COM
May 2, 2017



Written by Adam Rong, BD6CR/4

Email: rongxh@gmail.com

<http://www.crkits.com>

Thanks to the following people for their editing and help.

Shi Ke, BA6BF

Jon Iza, EA2SN

Junichi Nakajima, JL1KRA

Mark McNabb, N7EKU

Qin Ling, BD4AHS

Ed Durrant, VK2ARE

Larry Lovell, N7RGW

Revision History

May 2, 2017: Rev. A, first formal release, after review from worldwide distributors

THANK YOU!

Thank you for purchasing your CS-SERIES Single Band SSB Transceiver Kit. The kit is the upgraded version from KN-Q7A which was designed by BA6BF and supplied by CRKITS.COM and its worldwide distributors. The CS-SERIES kit is an ideal candidate for field operation, back pack and emergency use.

Specifications

- Dimension: 153 mm x 97 mm x 40 mm, not including protruding features
- Weight: approximately 500 grams or 1.1 lbs
- Power Supply: 11~13.8 V, 3 A
- Current consumption: about 70 mA in RX and about 2 A in TX @ 13.8 V
- RF output: about 10 W PEP @ 13.8 V (5 W PEP for the 20m version)
- Spur suppression: better than -43 dBc
- Sensitivity: better than 0.5 μ V at 10 dB SNR
- IF filter: 6 pole crystal ladder filter + 1 pole post IF amplifier crystal filter
- IF bandwidth: about 2.0 kHz
- IF frequency: 8.467 MHz
- Frequency tuning range: 7.000~7.200 or 7.300 MHz (depending on ITU region) or 14.000~14.350 MHz
- Frequency stability: crystal controlled PLL
- Frequency display: a dual color LED
- Connectors:
 - Speaker output: 3.5 mm connector, mono output
 - Microphone input: 8-pin, can be configured to be compatible with electret microphones or speaker microphones
 - DC IN connector: Type 2.1 mm center positive
 - Antenna connector: BNC type
- Controls:
 - IF Gain Control: act as volume control
 - Tune Control with button: act as digital VFO tuning and control

Disclaimer

We offer the kit as is and do not guarantee the assembled kit by yourself can meet your local regulatory requirements, including safety, RF, environmental or others. As some parts used in the kit are obsolete, we cannot guarantee that all the components in the kit are brand new, but we bear the responsibility of providing them working properly.

Tools Preparation

The tools needed for the kit building are solder iron, solder sucker, clipper, tweezers, pliers, screw drivers including Philips and slotted, and a multimeter of digital or analog type. Besides, you will need an electric drill and a 3 mm drill bit, a 50 Ω , 20 W or higher power dummy load, an HF band SWR/Power meter, a 13.8 V/ 3 A power supply, a personal computer running Windows, an amateur radio transceiver with a general coverage receiver and calibrated frequency display, and other ancillary instruments. It will be nice if you have access to a frequency counter, an audio signal generator, a RF signal generator, an oscilloscope and a spectrum analyzer, but they are not absolutely required.

Parts Inventory

Open the package and read the one-page quick guide thoroughly. Also, some volunteers have translated some manuals for you. To download your local language documents, you can search the CHINA_QRP group file section on Yahoo or go to the document archive section of <http://crkits.com>. There you will find a list of all documents.

You need to download the complete part list and do the parts inventory carefully. 40 m and 20 m versions are in: <http://crkits.com/csmanual.zip>

We have put resistors, trimmers, potentiometers, rotary encoders and 104 capacitors into one plastic bag so it will make your work much easier. You may find some extra parts, and it is fine to keep them as backup.

It is okay to discard the original metal front panel, rear panel and the original 8x panel screws now, because they have replacements in the kit. If you find problems or missing parts, please contact your seller directly.

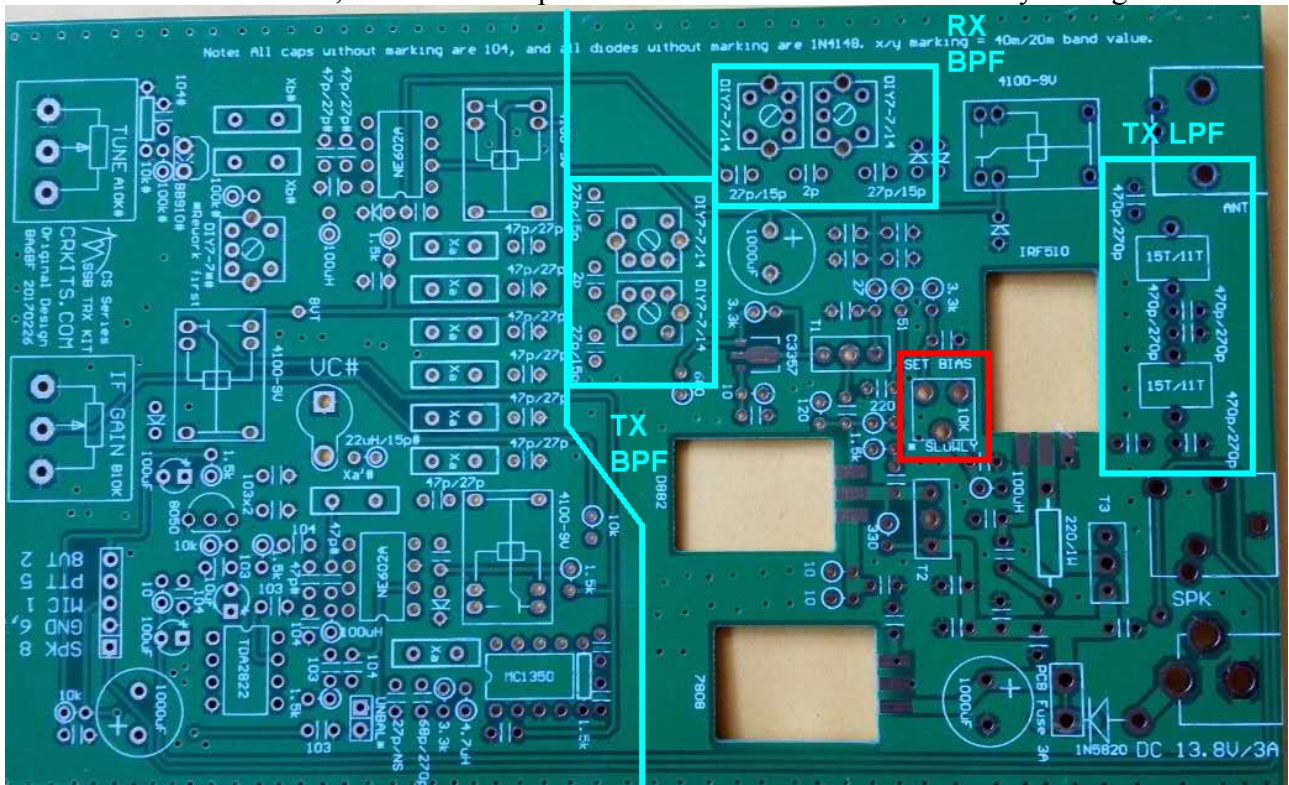
Board Assembly

We will do it step by step, finishing one part of assembly at a time, and testing it to ensure final success. We will provide partial schematic in each step to help you understand the theory of operation, and make sure you install all the parts required to do the final testing of the block.

However, the partial schematic might not contain all the parts you should install in each step, so don't get confused when you are told to install a part not shown on the schematic. Note that PCB version is subject to change without prior notice and it may look slightly different from yours.

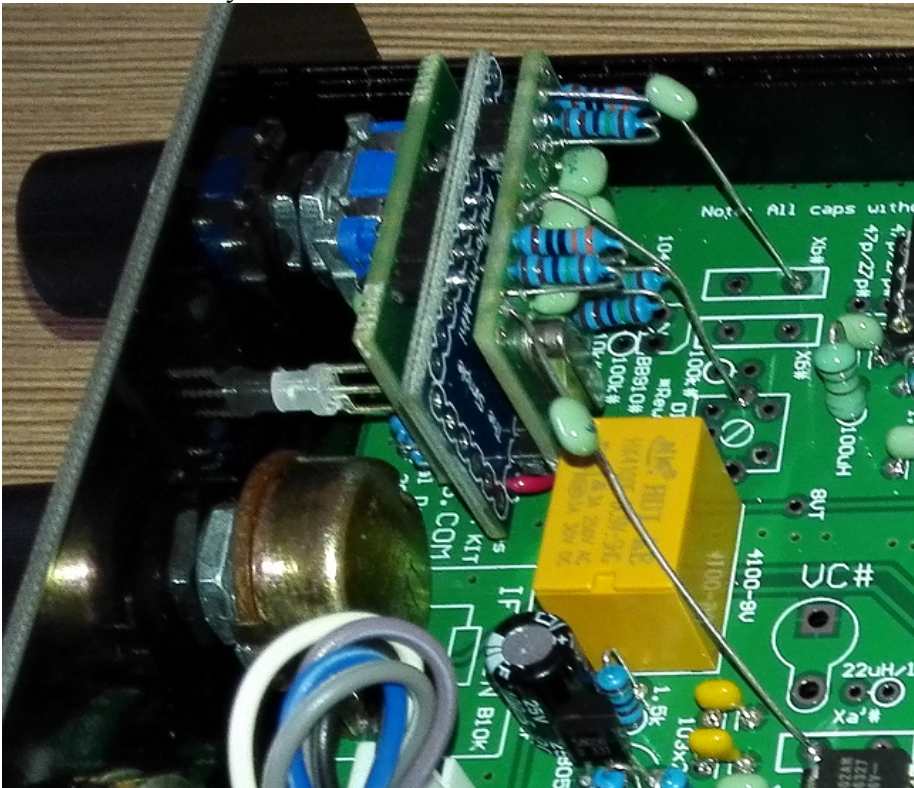
Get to Know the Main PCB

See the photo. You will see a line of words on the top. It tells you the default marking of 104 capacitors and 1N4148 diodes. In order to keep backward compatibility, for band dependent parts, x/y marking is for 40m/20m value. However, in CS-series, the IF frequency is always 8.467 MHz, so it follows the original KN-Q7A 40m value. To understand it easily, the photo has a line in the middle. On the left part, please always follow the value for 40m band (x portion of x/y marking), while on the right part, please follow the value for your band. The only trimmer near IRF510 hole is very sensitive while adjusting the bias for the IRF510 final amplifier. You must preset this trimmer fully counter-clockwise before you apply power supply. When you adjust the bias, turn it clockwise **VERY VERY SLOWLY**, or the final amplifier MOSFET IRF510 will be easily damaged.



Step 0: Sandwich Digital VFO

Let's start with the Sandwich Digital VFO. It is an Arduino and Silicon-Labs si5351a based open-source design by CRKITS.COM to offer stable and wider range frequency coverage. A dual-color LED offers frequency reading capability. It has three outputs: One for VFO, another for BFO and the last one for crystal calibration.



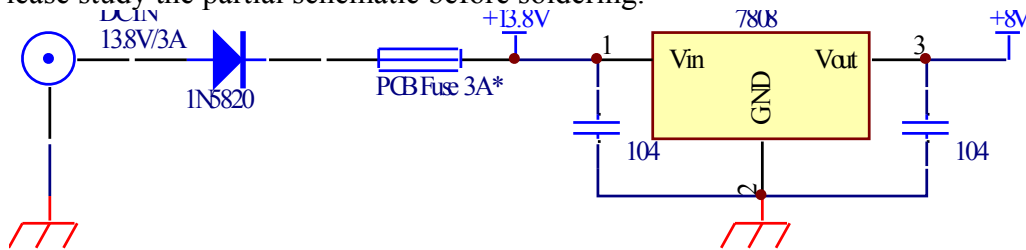
Unlike KN-Q7A, CS-series uses common 8.467 MHz IF, so the IF settings will be different. The table below shows the CS-series setting based on the sketches for CS-40, CS-20 and later on available bands.

JP10	80-meter	40-meter	20-meter
OPEN	band high limit = 3800 kHz default frequency = 3700 kHz BFO = around 8467.2 kHz	band high limit = 7200 kHz default frequency = 7100 kHz BFO = around 8467.2 kHz	band high limit = 14350 kHz default frequency = 14300 kHz BFO = around 8467.2 kHz
SHORT	band high limit = 3900 kHz default frequency = 3700 kHz BFO = around 8467.2kHz	band high limit = 7300 kHz default frequency = 7200 kHz BFO = around 8467.2 kHz	band high limit = 14350 kHz default frequency = 14200 kHz BFO = around 8467.2 kHz

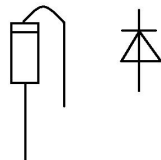
Other than the above setting difference, for CS-series kit building, please refer to the kit building manual at <http://crkits.com/sandwichkitassemblymanual.pdf>. **Once the building is completed, don't put in front panel or connect to main board yet. You will do so in step 3, step 6 and final assembly.**

Step 1: Power Supply Circuit

Let's go ahead to the power supply circuit. Should you want to study the whole schematic prior to the building to have better understanding, you may find a copy of the circuit at the end of this manual. Please study the partial schematic before soldering.

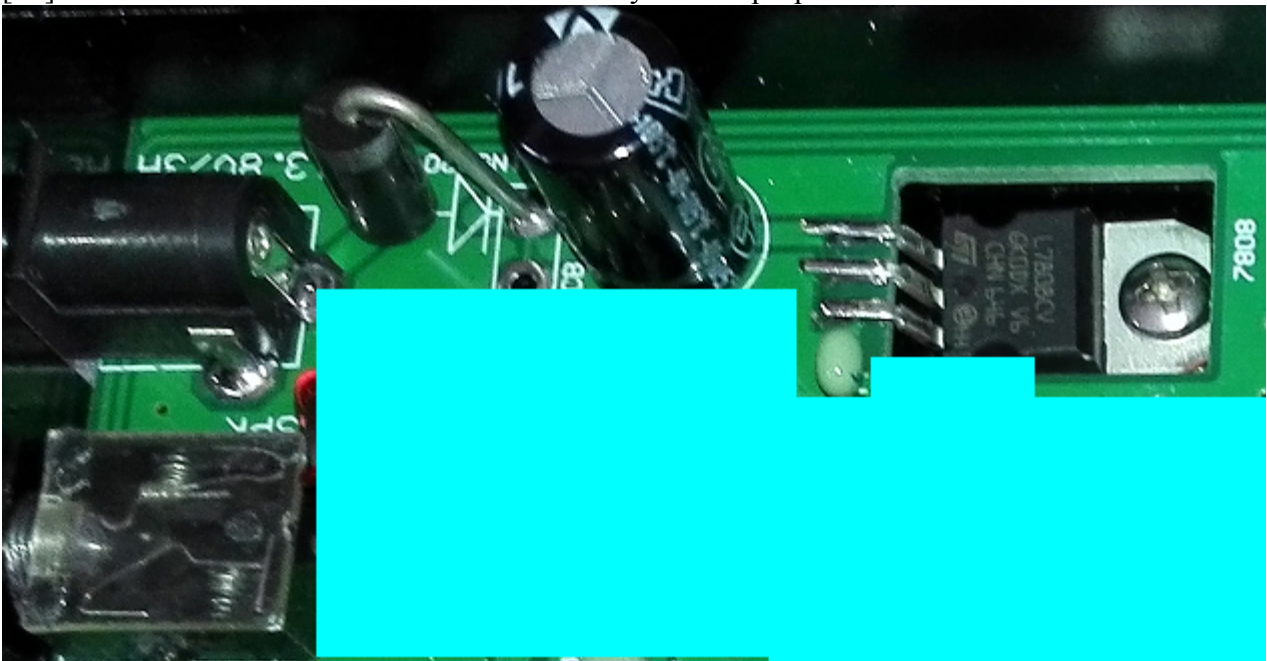


- [] Solder 1x DC IN socket, and trim the pins flush to avoid shorts with chassis foot screws
- [] Solder 1x speaker connector near the DC IN power connector; make sure you install it in place
- [] Bend the pins of 1x 1N5820 diodes as shown, and solder. For other diodes, always bend the



pins like this.

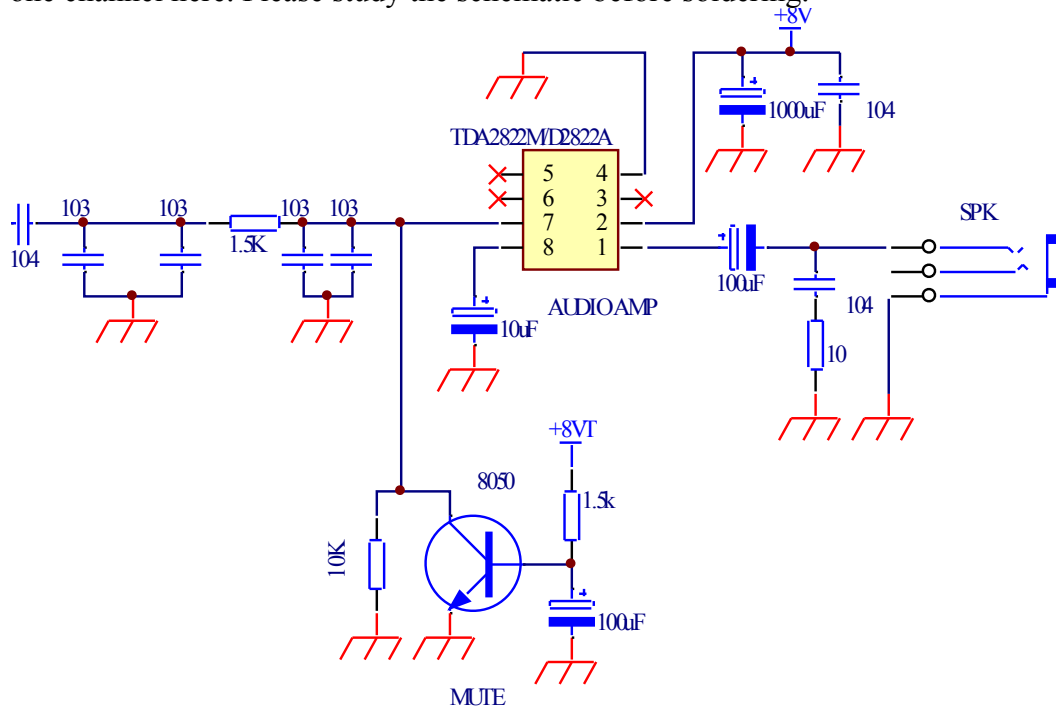
- [] Solder 1x 1000 μF capacitor; check polarity
- [] Solder 1x 0.1 μF (104) monolithic capacitor near 7808. Remember that all capacitors without marking are 104 ones.
- [] Solder 1x 7808 but don't trim leads now only for test purposes.



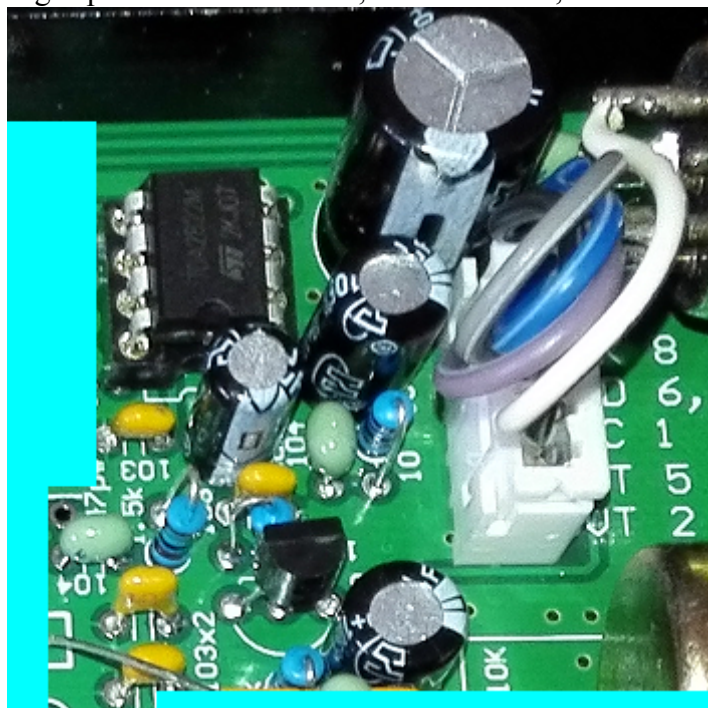
- [] Plug in an 11~13.8 V power supply to the DC IN connector (center positive) and measure the voltage on pin 3 of 7808 near to the 104 capacitor to see if it is within +/-5 % of 8 V; if not, check power supply polarity and your soldering
- [] Disconnect the power supply and proceed to the next step.

Step 2: Audio Amplifier

The core component of the audio amplifier is a TDA2822M. It is a dual channel amplifier but we only use one channel here. Please study the schematic before soldering.



- [] Place 1x 8 pin IC socket, paying close attention to the notch, and solder, then insert a TDA2822M with correct orientation as shown on the photo
- [] Solder 1x 1000 μ F capacitor; check polarity
- [] Solder 2x 100 μ F electrolytic capacitors; check polarity
- [] Solder 1x 10 μ F electrolytic capacitor; check polarity
- [] Solder 1x 8050 transistor; check PCB outline
- [] Solder the remaining capacitors and resistors; when finished, it will look like the photo below



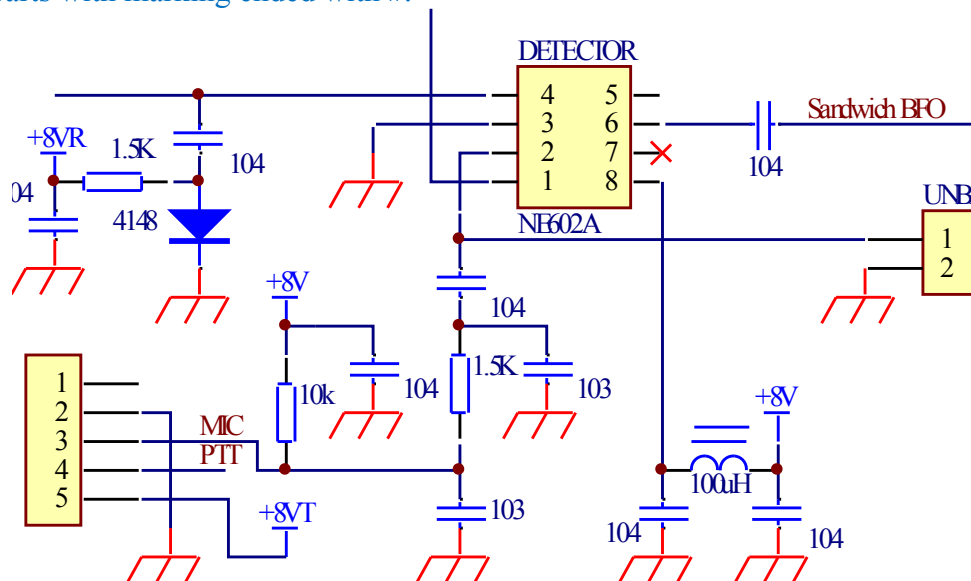
- [] Plug in an 11~13.8 V power supply and connect an external speaker of 8 Ω or higher impedance to the speaker connector. Touch pin 5 of the nearby NE602A using tweezers to inject

some noise, and note if the audio amplifier works. If not, please check your soldering, and check the pin 2 of the TDA2822M for the presence of 8V. If all is okay, disconnect the power supply and the external speaker to proceed to the next step.

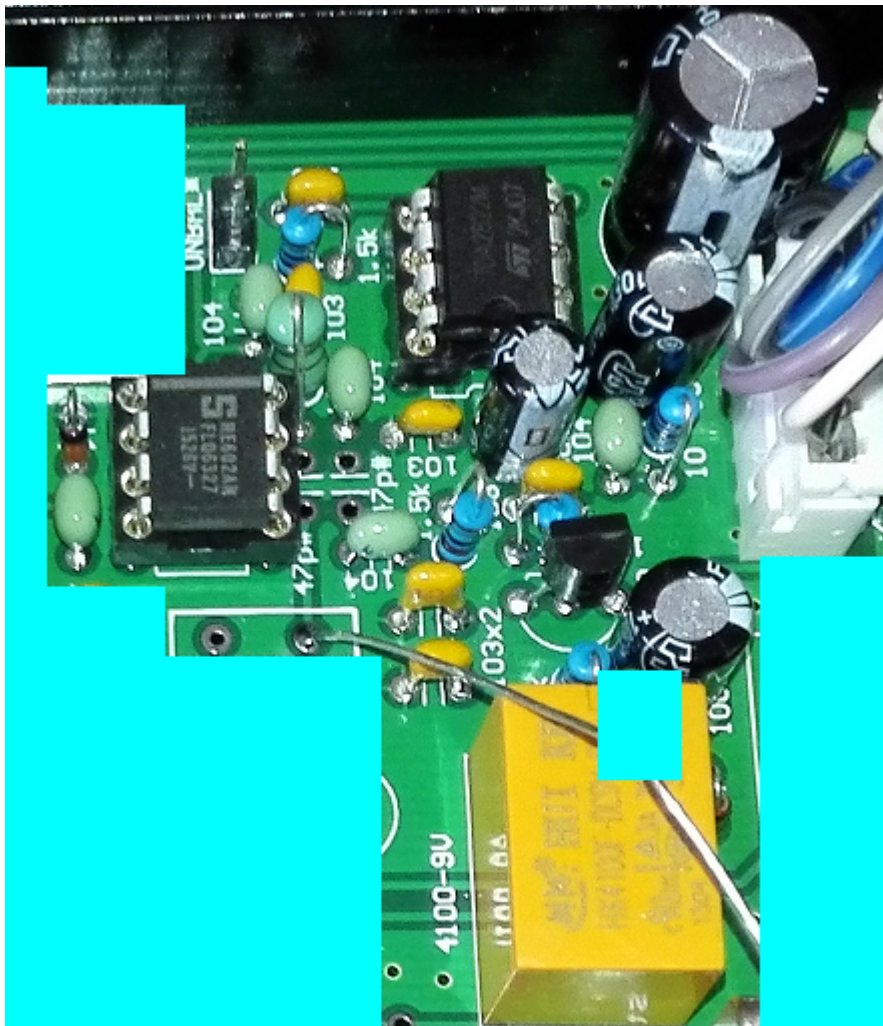
WARNING: It is not a good choice to plug in a headphone to the speaker connector, as the radio does not have an AGC circuit and an abrupt strong signal or noise may cause hearing impairment.

Step 3: Detector/ Double Sided Band Modulator

The core component is a double-balanced mixer and oscillator NE602A. It acts as the detector in the RX path and also as a DSB modulator in TX. Please study the schematic before soldering. Do not install parts with marking ended with #.



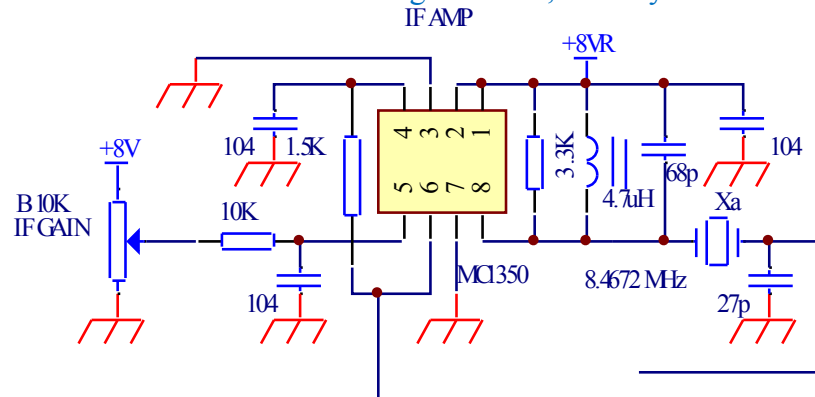
- [] Place 1x 8 pin IC socket, paying close attention to the notch, and solder, then insert a NE602A with correct orientation as shown on the photo
- [] Solder 1x SIP5 socket as on-board microphone connector as shown on the photo
- [] Solder 1x relay. This relay is controlled by the PTT and switches 8 V RX/ TX power
- [] Solder 1x 104 monolithic capacitor near 1000 μ F capacitor. Remember that all capacitors without marking are 104
- [] Solder 1x 1N4148 near the relay. Remember that all diodes without marking are 1N4148 and bend the pin near the bar marking on the body
- [] Solder the remaining inductors, resistors, diodes and capacitors. When finished, it will look like the photo below. Note that you will connect Sandwich BFO pin by a 104 capacitor. The Sandwich digital VFO will be powered by the regulated 8V at A10K TUNE control pins. See the Sandwich digital VFO manual for the detail.



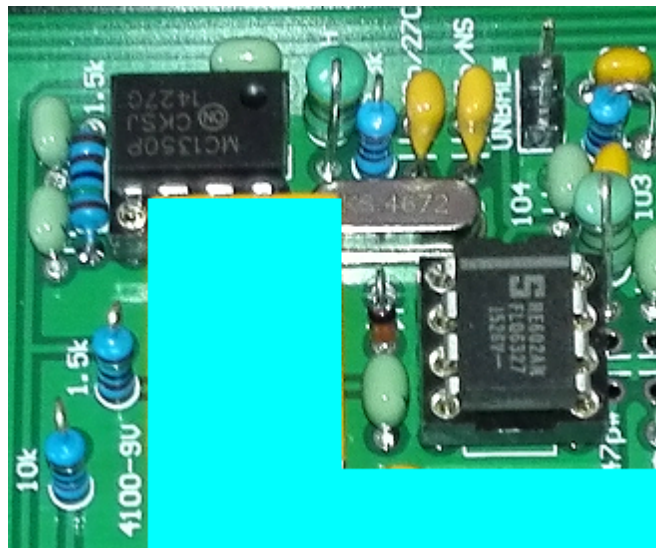
[] Plug in an 11~13.8 V power supply. Short the PTT pin to GND to see if the relay works. Use a nearby general coverage SSB/CW receiver to hear the leakage of the BFO within +/-2 kHz range of the marked frequency. Connect an external speaker to the speaker connector and touch pin 1 of the NE602A using tweezers to note if the noise coming out of the speaker increases. Check your soldering and the presence of 8 V on pin 8 of NE602A if it is not normal. If all is okay, disconnect the power supply and the external speaker to proceed to the next step.

Step 4: RX IF Amplifier

The core component is an MC1350. There is no AGC circuit designed, and the IF gain is controlled by a potentiometer (IF GAIN) and also used as volume control. A crystal filter is added after the output network of the MC1350. Please study the schematic before soldering. Xa is a marking for IF crystals. Although there are 40/20m value markings on PCB, we only use 40m value here.



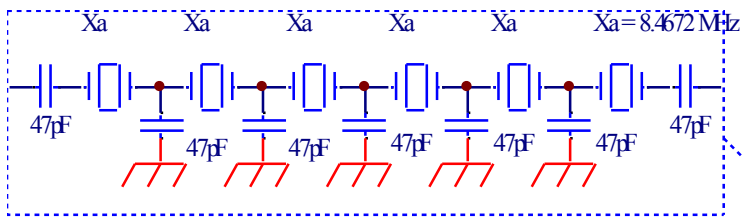
- [] Place 1x 8 pin IC socket, paying close attention to the notch, and solder, then insert a MC1350 with correct orientation as shown on the photo
- [] Pick 1x IF crystal and solder. You don't have to place an insulator under the crystal or ground the crystal case
- [] Pick the potentiometer marked B10K and solder it as IF GAIN control, making sure that the shaft is vertical to the PCB side
- [] Solder the remaining inductors, resistors and capacitors. When finished, it will look like the photo below.



- [] Plug in an 11~13.8 V power supply and connect an external speaker to the speaker connector. Turn the potentiometer to fully clockwise, touch pin 6 of MC1350 using tweezers and note if the noise coming out of the speaker increases. Turn the potentiometer counter clockwise to note if the noise decreases. If it is not normal, please check your soldering, and check the pin 1, 2 and 8 of the MC1350 for the presence of 8 V. If all is okay, turn the potentiometer fully clockwise again, and disconnect the power supply and the external speaker to proceed to the next step.

Step 5: IF Crystal Filter

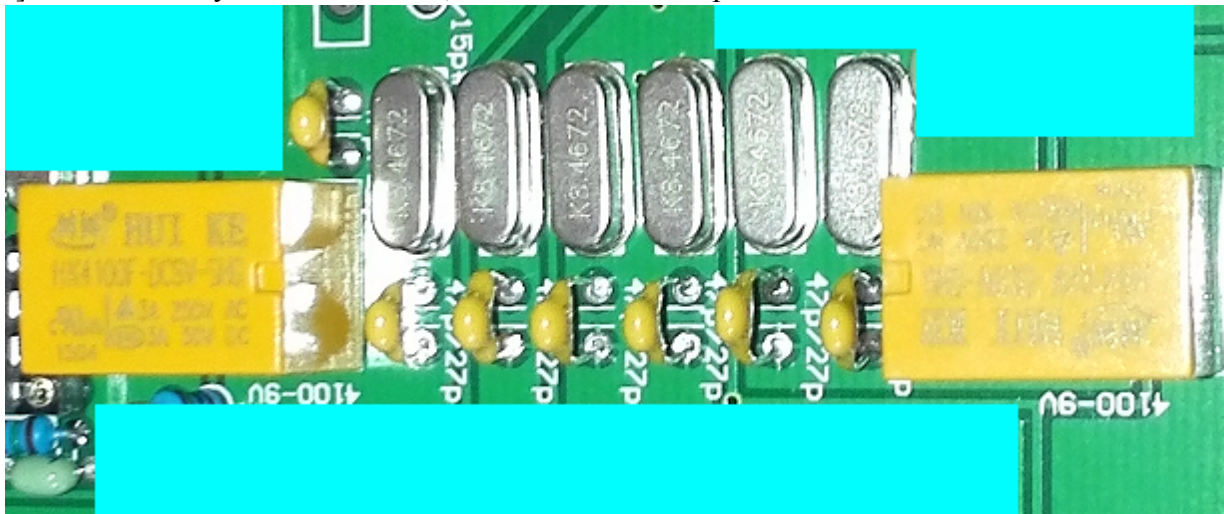
This part includes 6x IF crystals, 7x capacitors and 2x relays. Please study the schematic before soldering. Xa is a marking for IF crystals. Although there are 40/20m value markings on PCB, we only use 40m value here.



[] Pick 6x IF crystals and solder. You don't need to place insulators under the crystals or ground the crystal cases

[] Solder 7x 47 pF capacitors

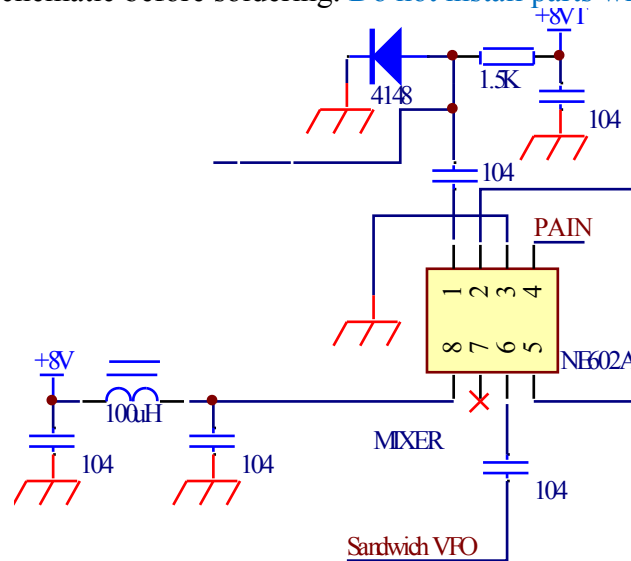
[] Solder 2x relays. When finished, it will look like the photo below



[] Plug in an 11~13.8 V power supply and connect an external speaker to the speaker connector. Touch pin 5 of the uninstalled NE602A using tweezers to note a little noise from the speaker. If it is not normal, please check your soldering. If it is okay, disconnect the power supply and the external speaker to proceed to the next step.

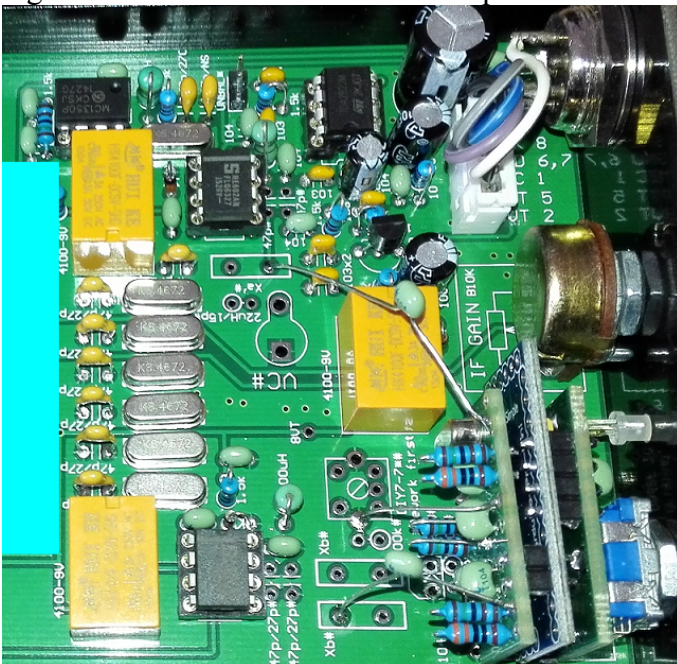
Step 6: Mixer

The core component is another double-balanced mixer and oscillator NE602A. It acts as the RX/TX mixer. Please study the schematic before soldering. **Do not install parts with marking ended with #.**



[] Place 1x 8 pin IC socket, paying close attention to the notch, and solder, then insert a NE602A with correct orientation as shown on the photo

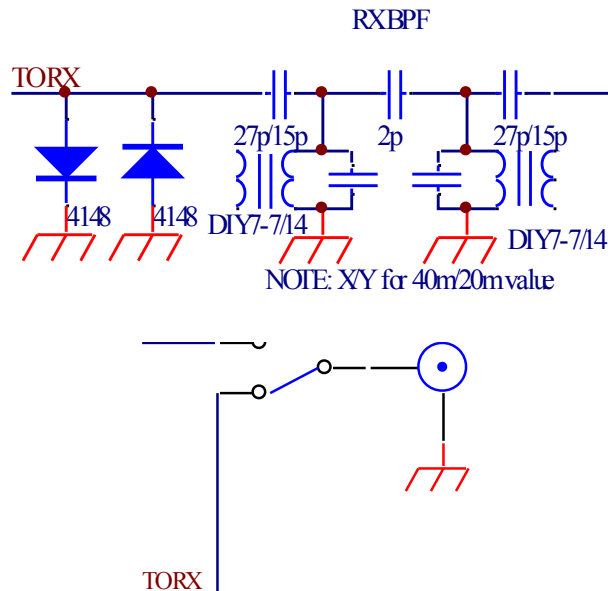
[] Solder the remaining parts. When finished, it will look like the photo below. Note that you will connect Sandwich VFO pin by a 104 capacitor. The Sandwich digital VFO will be powered by the regulated 8V at A10K TUNE control pins. See the Sandwich digital VFO manual for the detail.



[] Plug in an 11~13.8 V power supply and connect an external speaker to the speaker connector. Touch pin 1 of the NE602A using tweezers or even with an antenna cable tip to note if strong band noise comes out of the speaker. Turn the TUNE control to check if the digital VFO frequency changes thus the noise tone changes. The digital VFO frequency change can be detected by a general coverage SSB/CW receiver nearby. Check soldering and the presence of 8 V on pin 8 of the NE602A if it is not normal. If all is okay, disconnect the power supply and the external speaker to proceed to the next step.

Step 7: RX Front End

This part of circuit includes an antenna connector, a relay, two 1N4148 diodes as a level limiter for protection purposes and two DIY7-xx IFT's as RX band-pass filters (BPF). By completing this step, you will have a fully working receiver, so you will be able to align it and hear some signals. Please study the schematic before soldering. [Always check PCB marking for the difference between 20m and 40m versions.](#) If you modify to other bands, you will need to change these band dependent parts.



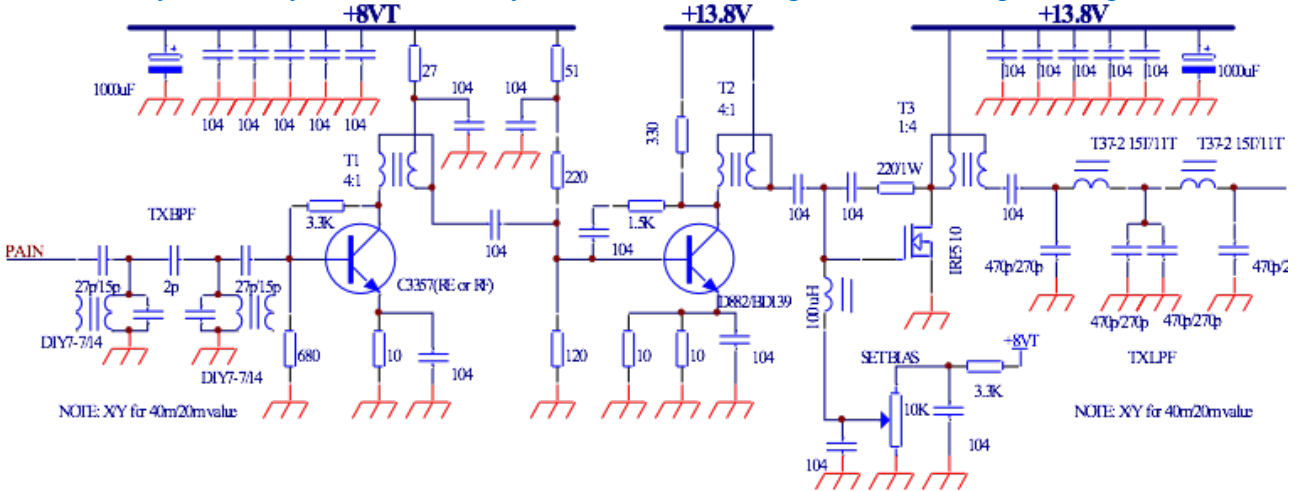
- [] Solder 2x IFT's DIY7-xx; no rework is required
- [] Solder 3x 1N4148 diodes; check polarity
- [] Solder 1x relay
- [] Solder the remaining capacitors. When finished, it will look like the photo below. And it also completes the RX part



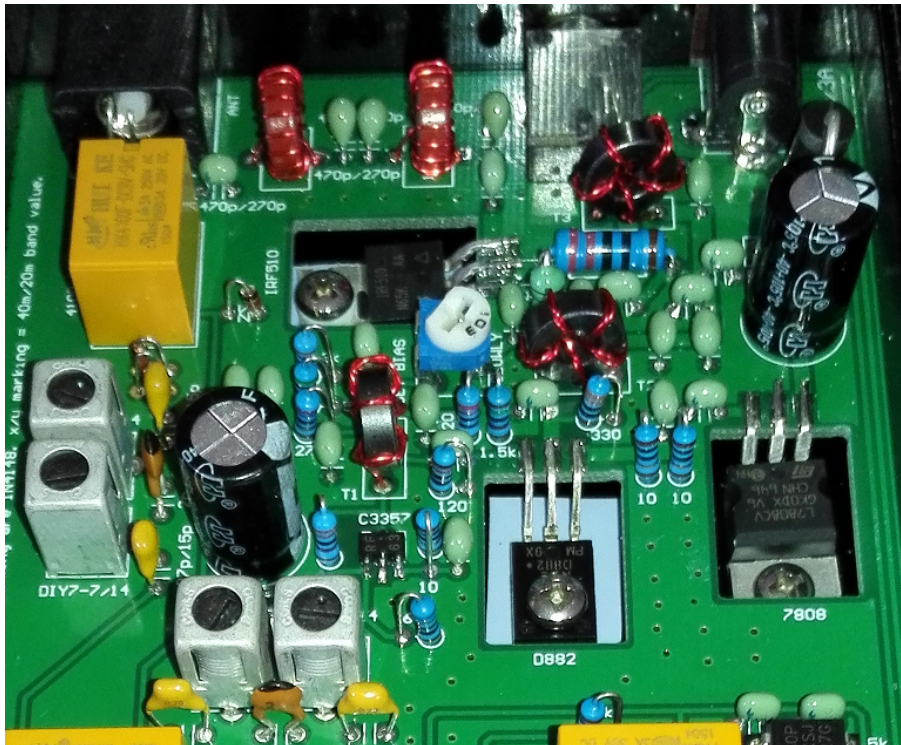
[] Now let's do a brief alignment and enjoy receiving on-air signals. Plug in an 11~13.8V power supply and connect an external speaker to the speaker connector. Touch ANT pin using an antenna cable tip to note strong band noises or signals coming out of the speaker. Turn the TUNE control slowly to see if you can hear any on-going QSO. While hearing the band noise or a QSO signal, peak the RX BPF by turning the cores of the two IFT's. Fine tune the signal by slowly turning TUNE control in 100 Hz step and if you feel the audio spectrum is not normal and you can only hear vague voices, you may need to calibrate the BFO frequency a little bit until you can hear loud and clear signals from the speaker. Check your soldering if it is not normal. If all is okay, disconnect the power supply and the external speaker to proceed to the next step.

Step 8: TX Amplifiers and Low-Pass Filters (LPF)

This part of the circuit includes a BPF composed of two DIY7-xx IFT's, three amplifier stages using a C3357, a D882/BD139 and an IRF510 respectively, and a two stage LPF. Please study the schematic before soldering. Always check PCB marking for the difference between 20m and 40m versions. If you modify to other bands, you will need to change these band dependant parts.

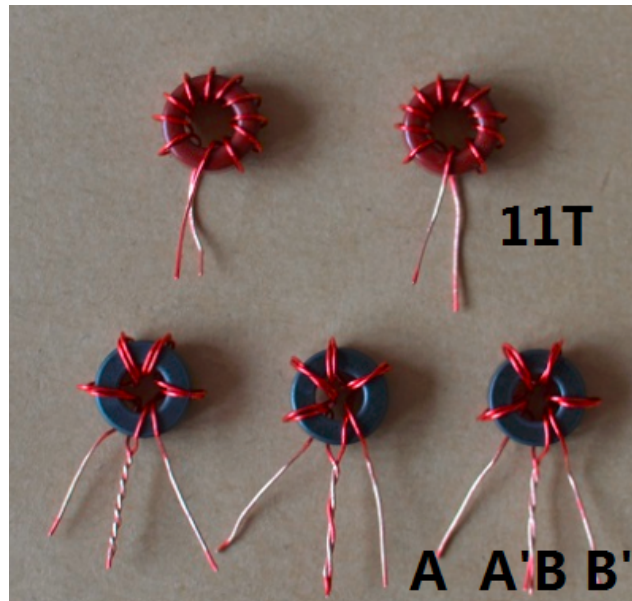


- [] Solder the SMD transistor C3357 first. It comes with an RE or RF marking on the body
- [] Solder 2x DIY7-xx IFT's
- [] Solder 1x 10 k Ω trimmer, and preset it to fully counter clockwise to preset 0 V to the gate of IRF510
- [] Install the big size 220 Ω 1 W resistor horizontally and solder
- [] Solder the remaining parts, with the exception of all toroid coils, and the D882/BD139 and IRF510 transistors, which will be installed later in final assembly stages. When finished, it will look like the photo below.



- [] Desolder the 7808 voltage regulator, and clean the solder from the pads and pins
- [] We will use two kinds of toroid coils as shown. LPF coils (2x) are on the top. They require 11 turns (15 turns for the 40m version) windings on the toroids T37-2 (red) using about 25 cm of

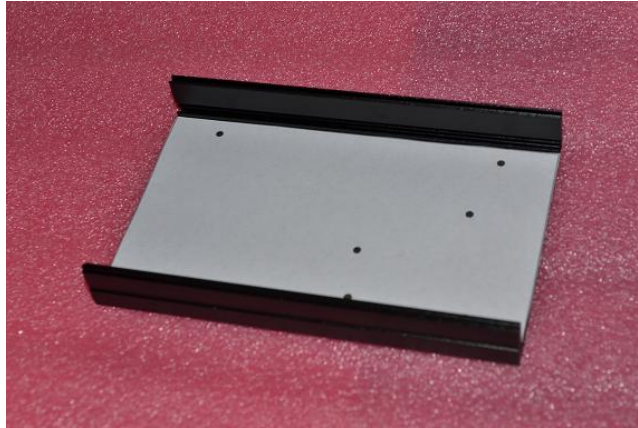
enamel wire. The wide-band transformers (3x) are on the bottom. They require 5 turns of a bifilar winding on the toroids FT37-43 (black) using about 20 cm of bifilar enamel wire, and connecting different windings in the middle. Make the bifilar wire about 4 twists per inch (25 mm). Once twisted, you should wind 5 turns, and prepare the central tap by connecting two ends from **different windings**. If the winding start wires are A and B, and the end wires are A' and B', you should join B with A' for the central tap. You will find continuity between A and the central tap, between the central tap and B', and between A and B'. In all cases, you should scrape carefully the enamel from the wire, and tin it prior to use. It is very important to effectively clean the enamel to get good soldered connections. Follow the same procedure to prepare the second LPF coil and the other two wide-band transformers, and solder in place. That ends the board assembly. Let's move on to the final assembly.



Final Assembly

Now you have the completed board ready to start the final assembly.

[] You will need to drill 7x M3 holes on any one of the two chassis pieces, since they are identical, but only on one, please :-). Download the drilling template from <http://crkits.com/knq7atemplate.pdf>. Print it on a piece of A4 size paper with 100% scale (the default scale is not necessarily 100%). Cut off the outline and fit it into the chassis bottom.



[] Drill 7x M3 holes. The locations for the 4x chassis feet holes are not very important, but you have to be very careful with the locations of the holes for the three semiconductors. Please pay close attention while you are drilling. After you are done with the drilling, please make sure you remove the blurs from the holes.



[] Install the 4x rubber feet with 4 pairs of M3x10 screws and M3 nuts. The nuts should be placed in the holes of the rubber feet, otherwise the screws will be too long to interfere with the PCB. You can press the rubber feet by your fingers so you can drive screws easily to the nuts and tighten them.

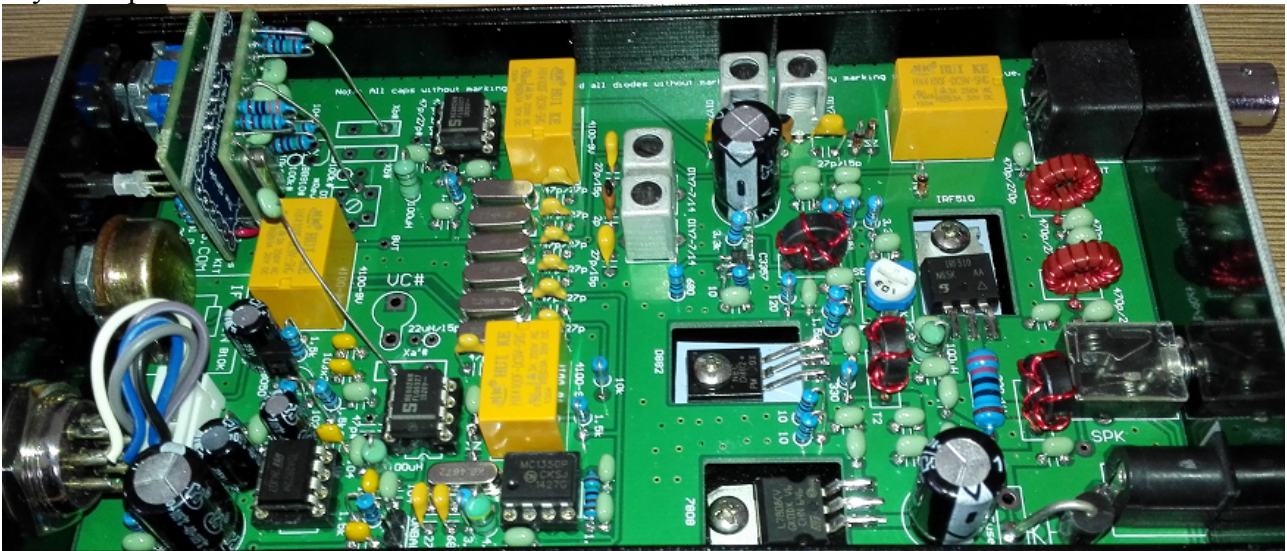


[] Slide in the board through the slot, make sure that you may see the three holes from the rectangular holes on the PCB, and also **observe that there are no short circuit or interference** whatsoever between the board and the chassis. Review carefully the screw head areas.

[] Bend the pins of the 7808, IRF510, and D882/BD139 semiconductors as shown. Please note that the IRF510 is an electrostatic sensitive part, so handle it with care.



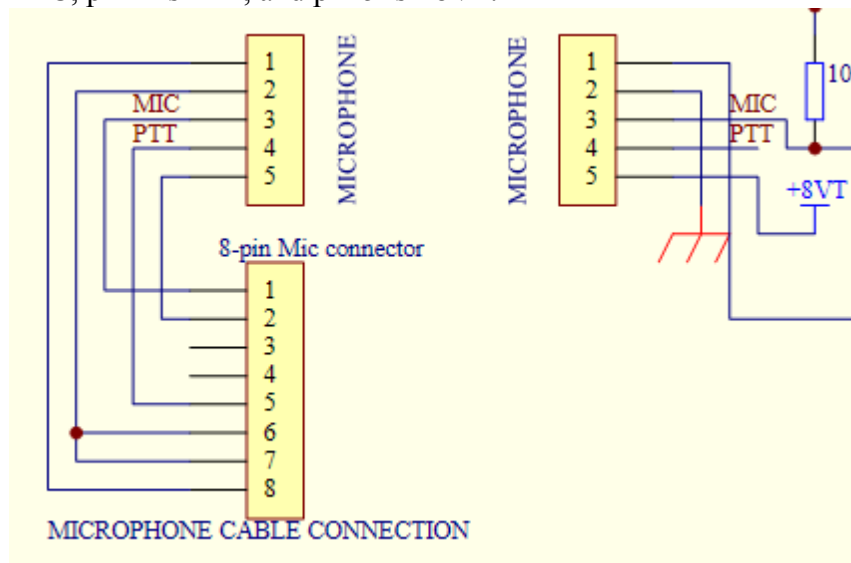
[] Place insulator pads on the places where the body of the D882/BD139 and IRF510 transistors will lie. Place the semiconductors on each position and insert M3x10 screws from the bottom. The 7808 may be secured directly with a M3 nut, as well as the D882/BD139 (which already has an insulator pad below). The IRF510 needs also a small white insulator washer to isolate the metal tab from the chassis. (You may check with a tester that there is no continuity between the screw -or chassis- and the tab). Once all three semiconductors are in position and secured, bend the pins, trim any extra portions and solder.



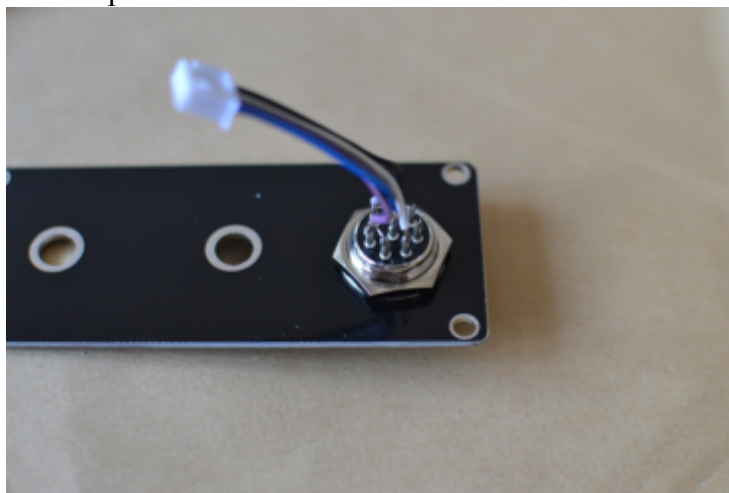
[] Prepare the front panel by installing the 8-pin microphone connector.



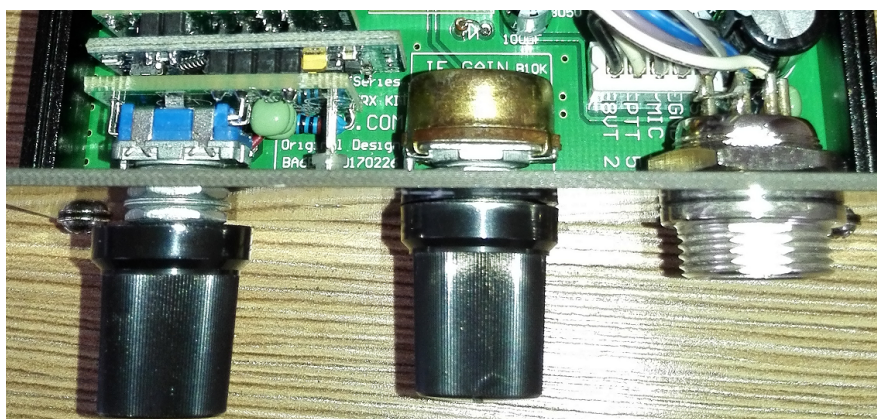
[] Solder the microphone cable, based on the schematic below. This connection is compatible with ICOM HM-series and the supplied optional microphone. To use a different brand microphone, please identify the pinout and wire it accordingly. On the SIP5 connector pin 1 is SPEAKER, pin 2 is GND, pin 3 is MIC, pin 4 is PTT, and pin 5 is +8VT.



After you are done, the front panel will look like this one.



[] Make sure both controls have a nut on first. Plug in the microphone cable into the SIP5 socket on board, install the front panel using two black chassis screws, **protrude the LED and two controls from front panel holes**, then put a washer and another nut on each control, and finally install the knobs.



[] Preset the IF GAIN control to mid-way and you are ready to start alignment. After alignment, remember to install the top chassis using another 4x black chassis screws.

Alignment

RX Alignment

In previous steps we have done most of the RX alignment. Now we are going to use an audio spectrum analyzer software (on a PC running Windows) to fine tune the BFO frequency, so the RX voice can be very clear, and more importantly, the carrier and the opposite sideband are well suppressed.

In the one-page quick guide, we mentioned briefly that we should tune the audio spectrum to lie between 350 Hz and 2200 Hz. Here we provide some details on how to do it easily.

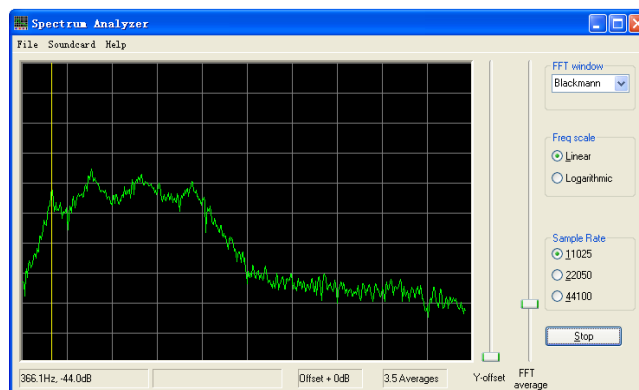
There are many audio spectrum analyzer programs available. Here we recommend for our purpose the free software by Con, ZL2AFP. You may download it from <http://www.qsl.net/zl1an/Software/Spectrum3.zip>. Unzip and double click the spectrum2.exe file to run.

The photo below shows the hardware setup. You will need to connect the speaker out to the microphone input of the sound card on PC, as the white audio cable does. You will also need to connect a noise generator or simply an antenna to the antenna connector, and apply a power supply of 11~13.8 V.



Follow the setup on the screen capture below, and click start, you will see a similar audio spectrum. If not, you may need to turn clockwise or counter clockwise the IF GAIN control.

In BFO calibration mode of the Sandwich digital VFO, tune encoder to move the pass-band to the left or to the right. You can use the cursor to read the frequency and level of the signal (on the left bottom corner) to identify the low and high end of the pass-band, so you can get about 350 Hz~2200 Hz range.



If you have wider or narrower range, please make sure you still set the lower end of 350 Hz. Please note that, if you are using an antenna to do this, you should tune away from any signal to use the band noise as a random noise source, or the spectrum will jump up and down making the measurement very difficult.

Please also note, both LSB and USB will be possible since the BFO calibration range is wider now. If you can see correct audio spectrum range, but cannot receive clear voice signal of the intended side band, you might need to tune encoder again to use the correct side band. Normally, the default value should be very close to the intended mode. Just a few steps tuning should be okay. Once it is done, press the button to memorize the setting to EEPROM.

Remove the audio cable and connect an external speaker. Use band noise or a signal to peak again the RX BPF.

Then, tune the Sandwich digital VFO to check the frequency coverage and accuracy. You can use a calibrated radio to receive the same signal and know where you are on the band, or you can use a signal generator to inject a specific frequency so you can get the range that you want quickly.

If you see problems at the high limit of the band, please double check JP10 setting of the Sandwich digital VFO. If you see problems of the frequency accuracy, please double check the crystal calibration of the Sandwich digital VFO.

By the way, you may want to measure the overall current in RX, and it should be about 70 mA. If not, please check your soldering.

TX Alignment

PTT Test:

Connect a dummy load to the antenna connector, the power supply of 11~13.8 V/ 3 A to DC IN connector, and a microphone to the front panel connector. Press PTT to see if it causes relay clicks. If not, you should check the wiring of the microphone connector.



Setting bias voltage for the final amplifier IRF510:

Make sure that the SET BIAS trimmer is preset to fully counter clockwise first. Connect an ampere meter in series with the power cable (set to measure 1A or more), press PTT but **do not talk to the microphone**, the current will likely be 0.50 A. Then turn SET BIAS trimmer clockwise **VERY VERY SLOWLY** until the current increases 60mA to about 0.56 A. Note that, if you turn the trimmer too quickly, or the preset position is not in the middle, the IRF510 might conduct

completely and it may cause an over current failure. A PCB fuse is designed on PCB near 1N5820 diode. Over current failure will most likely blow the PCB fuse, and you can short it with a wire.

Peaking the TX BPF and measuring the RF power output:

Connect a power meter between the antenna connector and the dummy load, press PTT while speaking into the microphone loudly, turn the cores of the TX BPF IFT's up a few turns and the RF power output will increase rapidly from about 1 W to about 10 W (5 W for the 20m version). If you are serious into getting as much power as possible, you can generate a stable RF power by intentionally breaking the balance of BFO NE602A. Now you can simply short the UNBAL jumper by a jumper cap while PTT is pressed. You may need to adjust BFO frequency in Sandwich BFO calibration mode for TX BPF peaking, but after it, you should not click button before power off, or the BFO setting will be stored in EEPROM and the receiver audio will be bad. See the YouTube video to know more about how to use the UNBAL jumper:

<https://youtu.be/D2RQtk1blUA>

Theory of Operation

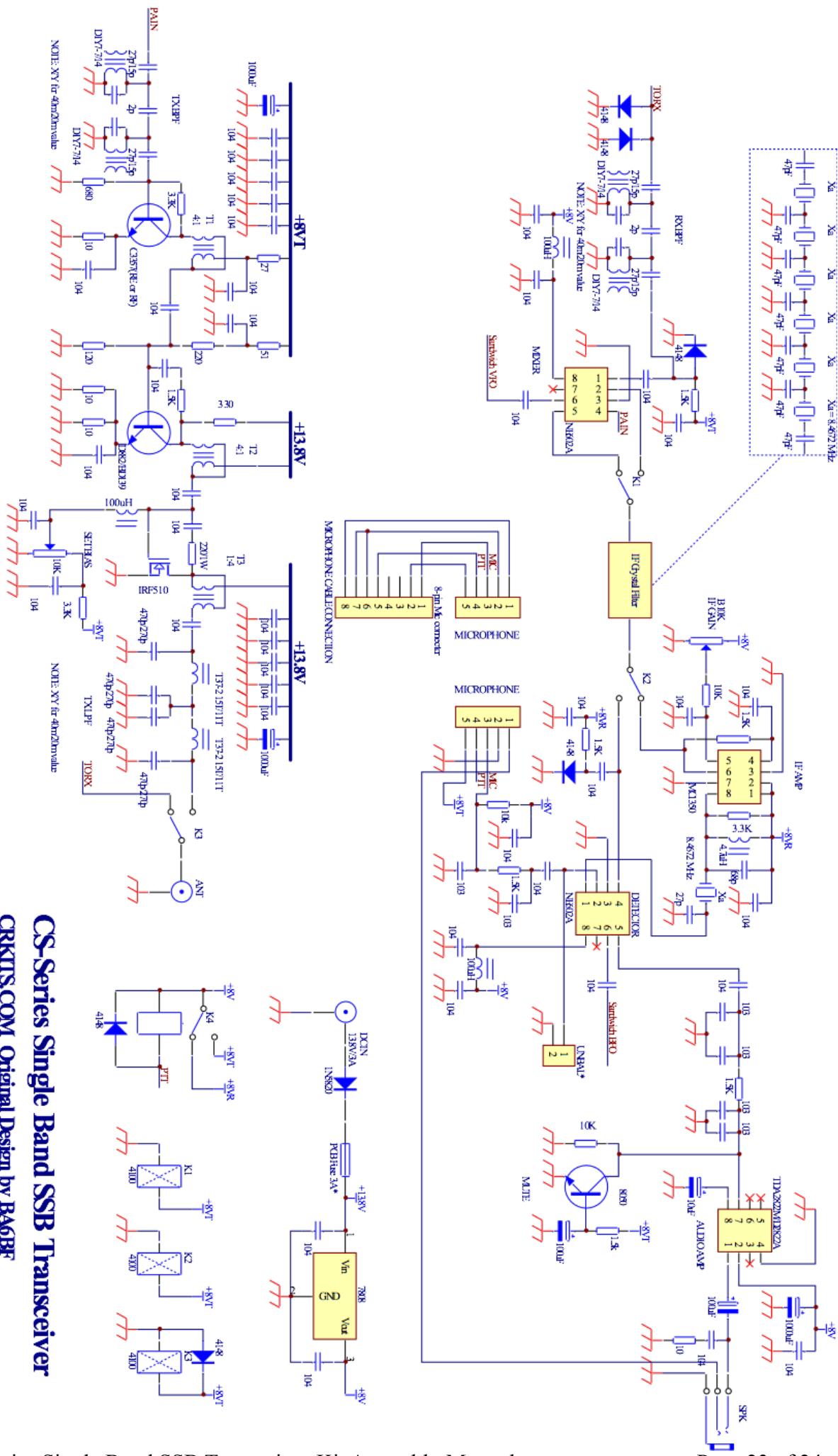
We have explained the theory of operation in each functional block. Here it may be beneficial to go through the signal flow so it will help to understand the whole schematic diagram on the last page.

The CS-series is a simple design with two NE602A chips which are used both for RX and TX. When in RX, one NE602A works as first mixer plus VFO input to convert the received RF signal to IF, and the other works as detector plus BFO input to convert the IF signal to AF. When in TX, the detector NE602A now works as a DSB modulator to modulate BFO signal with voice and convert it to an IF signal, and the first mixer NE602A still works as a mixer to convert the IF signal to the RF. Some signal switch diodes and relays are used here to multiplex the use of the NE602A chips.

RX signal flow: The RF signal from the antenna is switched by an antenna switch relay, and goes into the RX BPF to filter out the unwanted interference and signals, goes into the mixer NE602A to convert it to IF signal, then passes through an IF crystal filter, a manually-controlled variable-gain IF amplifier composed of a MC1350, fitted with a post-IF-amplifier crystal filter, and later feeds to the detector NE602A to convert the signal to audio, and finally is amplified by a TDA2822M to drive a speaker.

TX signal flow: The voice picked up by the microphone goes directly into a NE602A to modulate the BFO signal to produce the dual sided-band (DSB) IF signal, then goes through the IF crystal filter to become a single sided-band (SSB) IF signal. It is mixed with the VFO to produce the RF signal at the operating frequency, and after filtering out unwanted mixer products and other signals with the TX BPF, goes into a three-stage TX amplifiers and the LPF which will filter out spurs and harmonics. The antenna selector relay gets the amplified signal to the antenna for transmission.

The Sandwich digital VFO module acts as both BFO and VFO generators. The VFO frequency follows BFO frequency by adding the intended operation frequency.



CS-Series Single Band SSB Transceiver
 CRKTS.COM Original Design by BA6BF
 May 1, 2017

Troubleshooting

If you follow the manual step by step, the success rate of the kit should be very high. Should you have any trouble, the #1 rule of thumb you should remember is that you probably have soldering problems, either cold soldering, solder bridges or misplaced components. A careful double check will be always helpful.

Here, we list the voltage on each pin of the key semiconductors in RX and TX. It will help you to identify the problems. For example, if you find that the RF power output is too low, by checking IRF510 pin G, if you measure a voltage lower than 2 V, the problem could be that you forgot to adjust the bias voltage.

Note: Please be careful not to cause any accidental short circuit between pins during your test.

Voltages in RX @ 13.8 V, “var” means variable, * is for detector IC near BFO, and ** is for mixer IC near VFO

NE602A*		MC1350		NE602A**		TDA2822		C3357		D882/BD139		IRF510		8050	
1	1.4	1	7.9	1	1.4	1	3.6	E	0	E	0	S	0	E	0
2	1.4	2	7.9	2	1.4	2	7.9	B	0	B	0	G	0	B	0
3	0	3	0	3	0	3	7.2	C	0	C	13.4	D	13.4	C	0
4	6.7	4	2.4	4	6.7	4	0								
5	6.7	5	var	5	6.7	5	4.2								
6	7.8	6	2.4	6	7.8	6	0.3								
7	7.3	7	0	7	7.1	7	0								
8	7.9	8	7.9	8	7.9	8	0.6								

Voltages in TX with PTT on but no modulation @ 13.8 V, “var” means variable, * is for detector IC near BFO, and ** is for mixer IC near VFO

NE602A*		MC1350		NE602A**		TDA2822		C3357		D882/BD139		IRF510		8050	
1	1.4	1	0.5	1	1.4	1	3.6	E	0.3	E	1.7	S	0	E	0
2	1.4	2	0.5	2	1.4	2	7.9	B	1	B	2.3	G	2-4. 3V	B	0.7
3	0	3	0	3	0	3	7.2	C	7.1	C	13.0	D	13.0	C	0
4	6.7	4	0	4	6.7	4	0								
5	6.7	5	var	5	6.7	5	4.2								
6	7.8	6	0	6	7.8	6	0.3								
7	7.3	7	0	7	7.1	7	0								
8	7.9	8	0	8	7.9	8	0.6								

CS-series SSB Transceiver Kit Part List 20170604

Part	Qty	Comments
Band Independent Common Parts		
<u>Resistors</u>		
10 Ω	4	BRN-BLK-BLK-GLD-BRN
27 Ω	1	RED-VIO-BLK-GLD-BRN
51 Ω	1	GRN-BRN-BLK-GLD-BRN
120 Ω	1	BRN-RED-BLK-BLK-BRN
220 Ω	1	RED-RED-BLK-BLK-BRN
220 Ω 1W	1	RED-RED-BLK-BLK-BRN, Big Size
330 Ω	4	ORG-ORG-BLK-BLK-BRN, 3 for Sandwich
680 Ω	1	BLU-GRY-BLK-BLK-BRN
1 k Ω	5	BRN-BLK-BLK-BRN-BRN, for Sandwich
1.5 k Ω	7	BRN-GRN-BLK-BRN-BRN
3.3 k Ω	3	ORG-ORG-BLK-BRN-BRN
10 k Ω	3	BRN-BLK-BLK-RED-BRN
10 k Ω trimmer	1	103. Blue and White. 3-pin
10 k Ω potentiometer	1	B10K marking for GAIN, A10K is not installed
<u>Capacitors</u>		
2 pF NPO	2	2. Ceramic or monolithic.
27 pF NPO	1	27 or 270. Ceramic or monolithic.
47 pF NPO	7	47 or 470. Ceramic or monolithic.
68 pF NPO	1	68 or 680. Ceramic or monolithic.
0.01 μ F	6	103. Ceramic or monolithic.
0.1 μ F	42	104. Ceramic or monolithic, 9 for Sandwich
10 μ F 16 V or higher	1	Electrolytic capacitor
100 μ F 16 V or higher	2	Electrolytic capacitor
1000 μ F 25 V or higher	3	Electrolytic capacitor
<u>Diodes, Transistors and IC's</u>		
1N4148	6	Glass body. Band is cathode.
1N5820	1	Black body. Band is cathode.

Part	Qty	Comments
Dual color LED	1	3mm dual color, for Sandwich D1
C8050 or S8050	1	TO-92 transistor. 3-pin. RX muting.
C3357	1	RE or RF marking. SMD 3-pin. First TX amplifier.
D882 or BD139	1	TO-126 transistor. 3-pin. TX driver amplifier.
IRF510	1	TO-220 MOSFET. 3-pin. Final TX amplifier.
7808	1	TO-220 IC. 3-pin. 8V voltage regulator.
NE602A	2	DIP-8 IC. Balanced mixer.
MC1350	1	DIP-8 IC. IF amplifier.
TDA2822M or D2822A	1	DIP-8 IC. Audio amplifier.
IC Socket	4	DIP-8.
<u>Inductors and Transformers</u>		
4.7 μ H Solenoidal	1	YEL-VIO-GLD-SLV
100 μ H Solenoidal	3	BRN-BLK-BRN-SLV
FT37-43 Toroid	3	Black, for RF wide-band transformers
T37-2 Toroid	2	Red, for low-pass filters
Magnet Wire	2m	For toroid winding instruction, see band dependent sections below
<u>Others</u>		
IF Crystals	7	8.4672 MHz, HC-49S
Sandwich Crystal	1	27 MHz, HC-49S, for Sandwich X1
Rotary encoder w/ button	1	20 pulses per rev., for Sandwich SW1
Black chassis screw	8	For front and rear panels.
Chassis Feet	4	14 mm tall.
TO-220 thermal insulator	2	For IRF510 and D882, as insulator between chassis and plate
TO-220 washer	1	Small and white, for IRF510, as insulator between plate and nut
Silver M3x10 Screw	7	For chassis feet and semiconductors.
Silver M3 Nut	7	For chassis feet and semiconductors.
Phone Jack	1	3.5mm, for speaker output
DC IN Connector	1	2.1mm type. Center positive.

Part	Qty	Comments
Mic Connector	1	8-pin type socket.
SIP5 Connector	1	One pair with cable, for mic connector to PCB connection.
Black plastic knob	2	For both TUNE and GAIN controls
9V Relay	4	HK4100F-DC9V-SHG. Yellow body
Antenna Connector	1	BNC type, PCB mount.
Chassis	1	Black, aluminum alloy material
PCB/PCBA set of 5 pcs	1	Including main board, black front panel and rear panel, Sandwich control board, Sandwich OSC board with SI5351a pre-mounted
Jumper cables	1	10 wires F/F, for Sandwich programming, power wiring and other potential use like UNBAL jumper wiring to panel mount switch
Jumper cap	1	For UNBAL jumper short
Quick Guide	1	Printed one-page guide.
75/80-meter Band Dependent Parts		
27 pF NPO	4	27 or 270. Ceramic or monolithic.
820 pF NPO	4	821. Ceramic or monolithic.
3.8M IFT/ shielded coil	4	DIY7-3.8
Arduino Pro Mini 3.3V	1	75/80-meter code pre-programmed, for Sandwich
Toroids winding: 8 bi-filar turns on 3 pcs of FT37-43 black toroids, and 22 turns on 2 pcs T37-2 red toroids.		
40-meter Band Dependent Parts		
27 pF NPO	4	27 or 270. Ceramic or monolithic.
470 pF NPO	4	471. Ceramic or monolithic.
7M IFT/ shielded coil	4	DIY7-7
Arduino Pro Mini 3.3V	1	40-meter code pre-programmed, for Sandwich
Toroids winding: 5 bi-filar turns on 3 pcs of FT37-43 black toroids, and 15 turns on 2 pcs T37-2 red toroids.		
20-meter Band Dependent Parts		
15 pF NPO	4	15 or 150. Ceramic or monolithic.

Part	Qty	Comments
270 pF NPO	4	271. Ceramic or monolithic.
14M IFT/ shielded coil	4	DIY7-14
Arduino Pro Mini 3.3V	1	20-meter code pre-programmed, for Sandwich
Toroids winding: 5 bi-filar turns on 3 pcs of FT37-43 black toroids, and 11 turns on 2 pcs T37-2 red toroids.		
15-meter or 17-meter Band Dependent Parts		
15 pF NPO	4	15 or 150. Ceramic or monolithic.
150 pF NPO	4	151. Ceramic or monolithic.
21M IFT/ shielded coil	4	DIY7-21
Arduino Pro Mini 3.3V	1	15-meter and 17-meter code pre-programmed, for Sandwich
Toroids winding: 5 bi-filar turns on 3 pcs of FT37-43 black toroids, and 8 turns on 2 pcs T37-2 red toroids.		