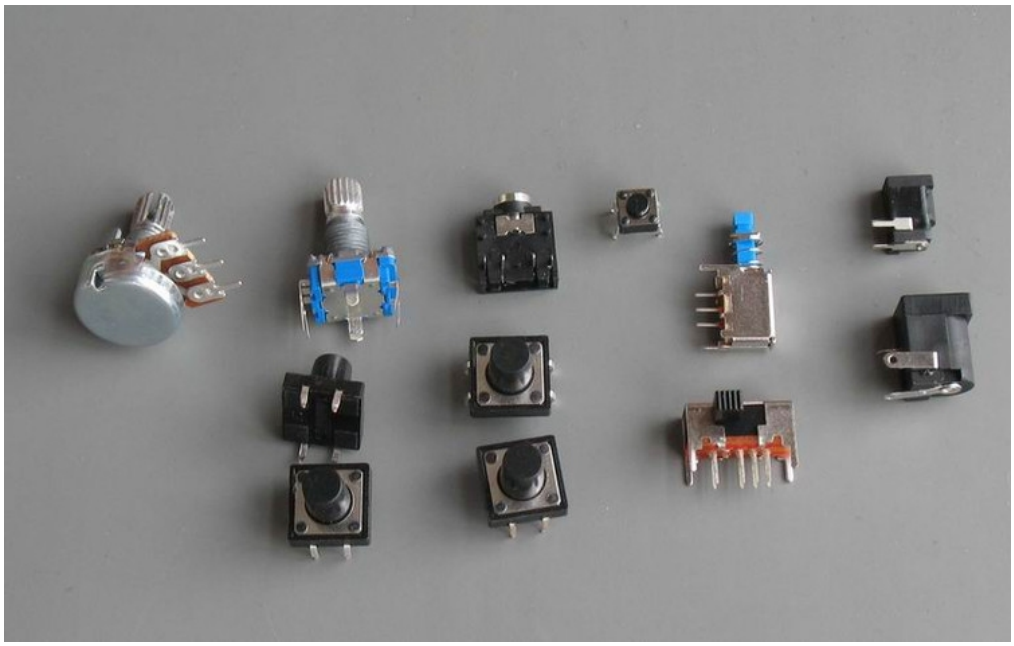
CONSTRUCTION OF TJ2B HANDHELD SSB TRANSCEIVER

The TJ2B is a high-performance QRP portable multi-band SSB transceiver using DDS as the LO, and offering wide frequency coverage and fine tuning rate. The Doubly Balanced Diode Ring Mixer makes strong signal handling capability possible. The TJ2B is a pre-assembled kit. You need only assemble a few parts and connect some cables to be qrv.

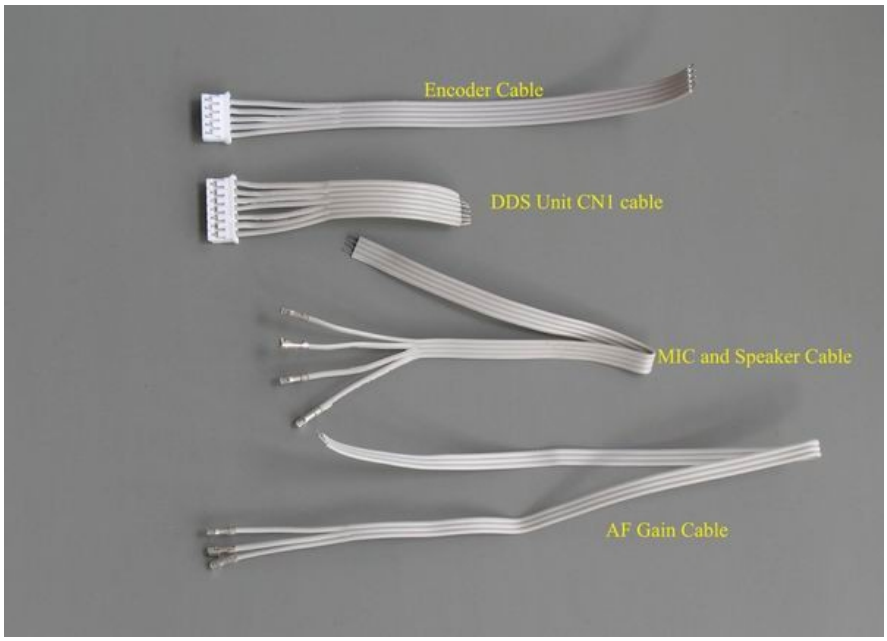
Operating Frequency: 3 - 18.2 MHz (Kit A)
Mode: LSB, USB, CW (RX)
Tuning Rate: 1Hz, 10Hz, 100Hz, 1KHz, 10KHz, 100KHz
IF: 9 MHz
Sensitivity: 0.3uV
Current Drain: 260 mA (RX)
Operating Power: 10 - 13.6V
Output Power: 5W
40 Memories
Dual VFO

Memory-VFO Transfer

Tuning steps of 1 Hz are available. Pressing the TUNE knob selects the tuning rate.

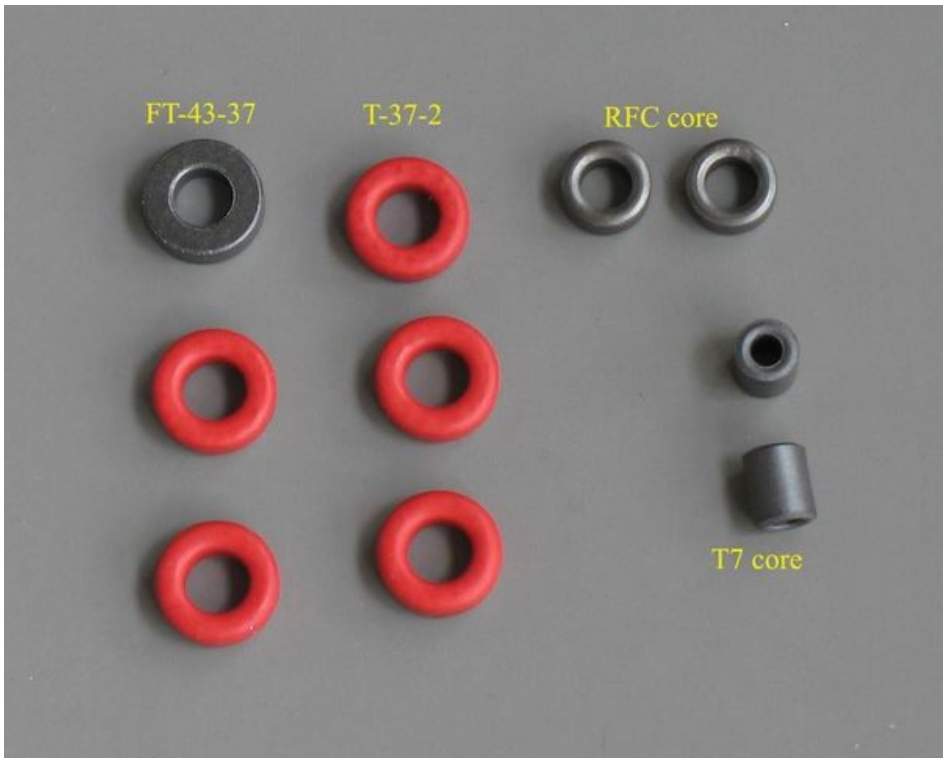


Included Hardware: Buttons, switches, DC sockets, earphone socket, pot, and encoder. A miniature speaker is packed in the bottom cover of the enclosure.

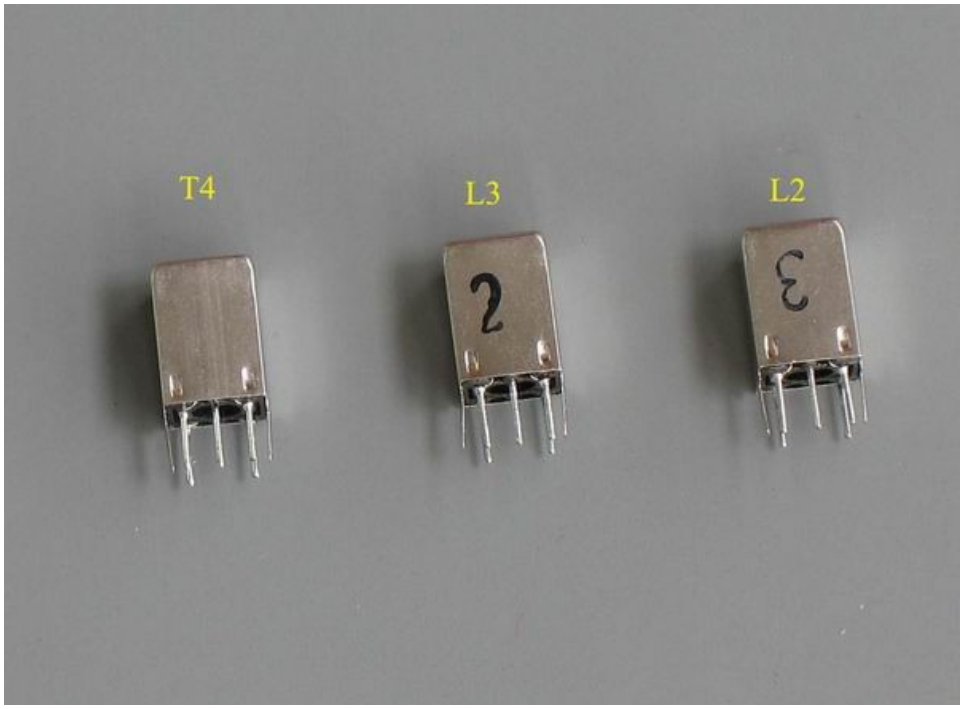


Cables for internal connections

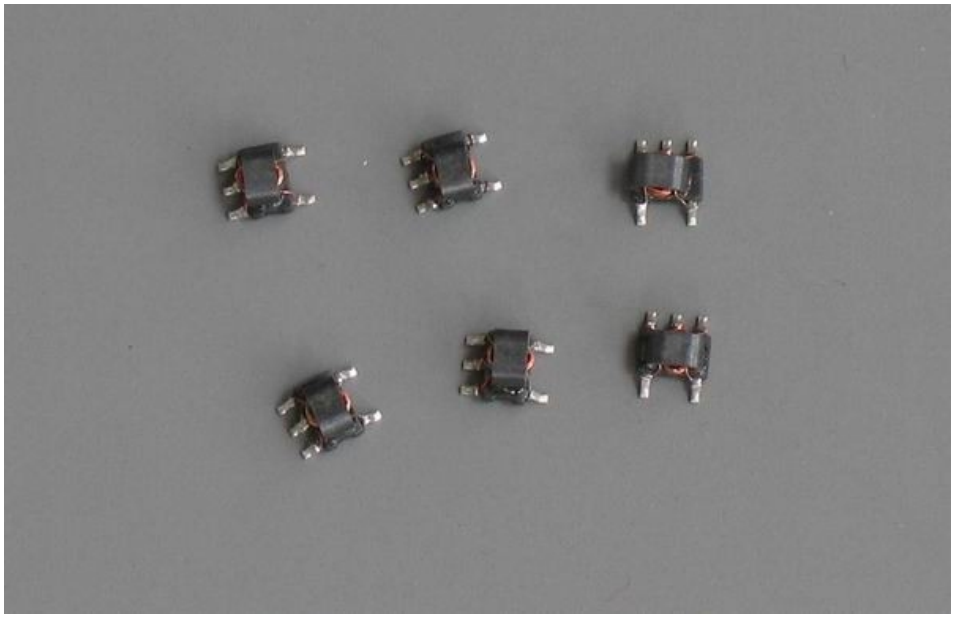
Components package



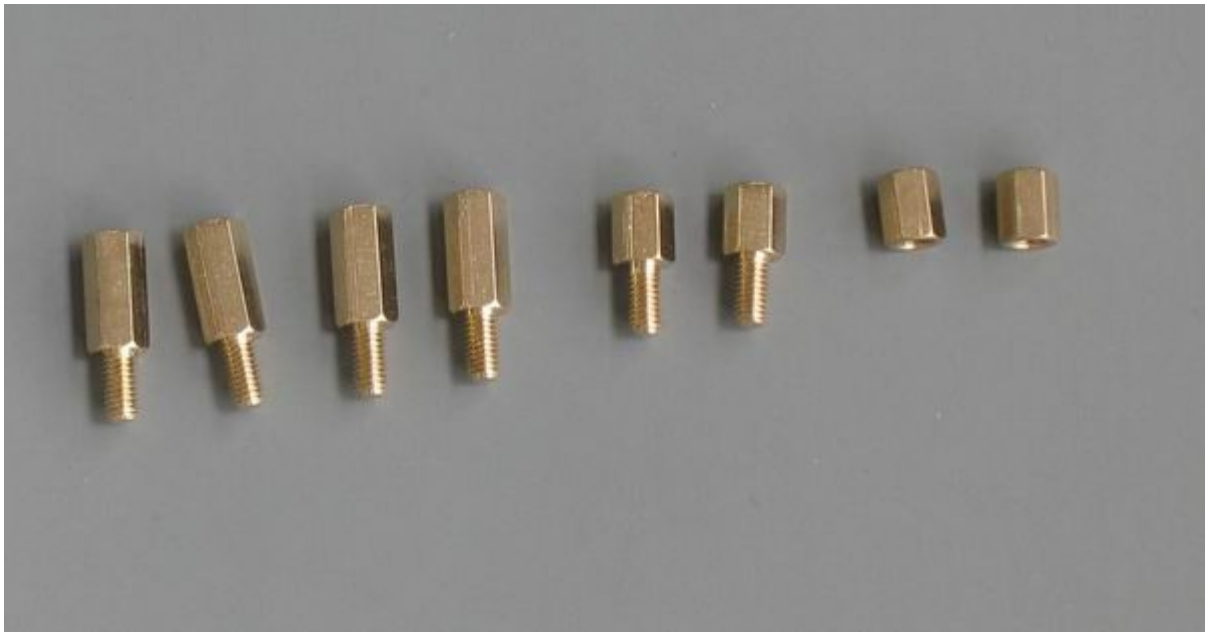
Toroids Note: FB-43-2401 may be supplied in the kit. This core is larger than FT-43-37.



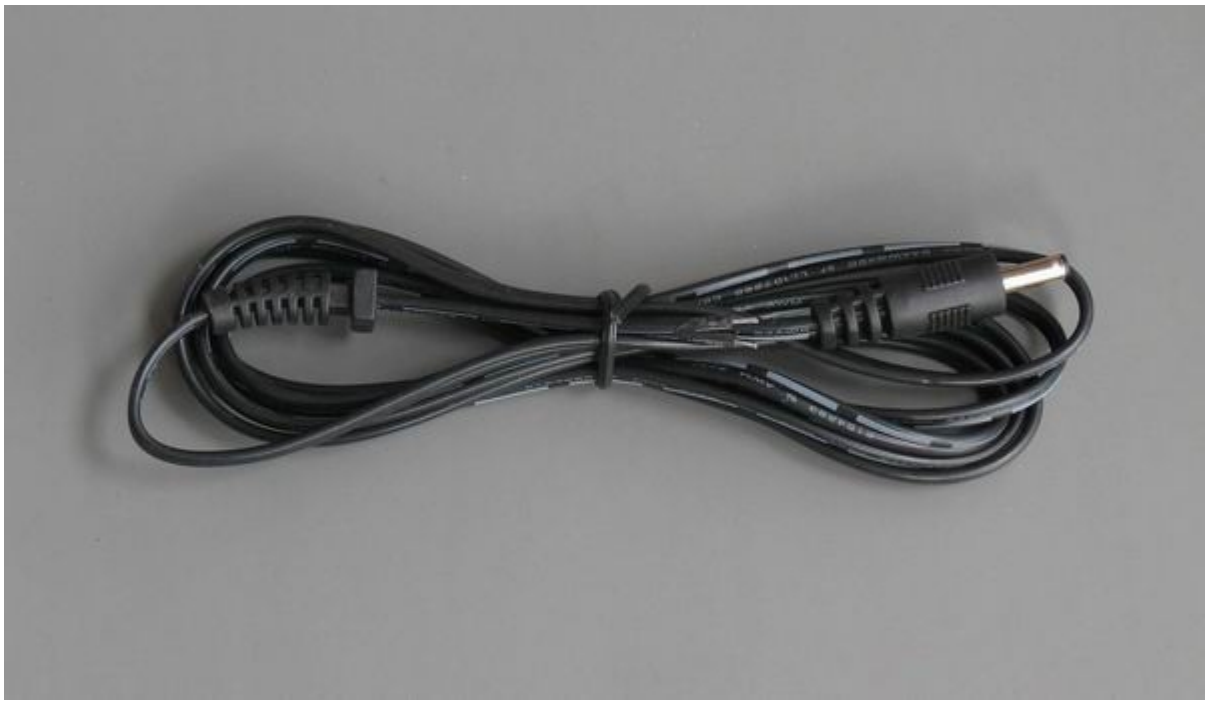
Can Inductors



Pre-assembled Miniature Transformers (Packed in a separate plastic bag)



Brass Stand-Off Parts



Included DC cable as a free gift.

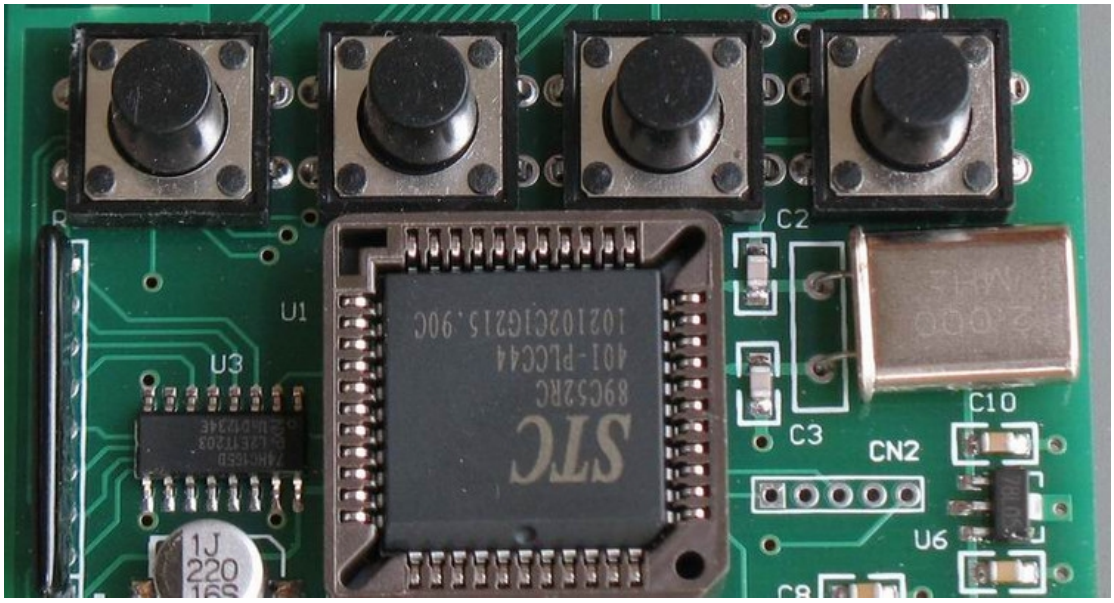
All the SMD have been assembled in the factory. However, some bulkier components, such as the buttons,switches, can transformers, toroids, electro caps., have not been assembled. Thess components prone to damage in transpiration if they were pre-assembled. The users are required to solder them onto the PCB.

Let's start step by step.

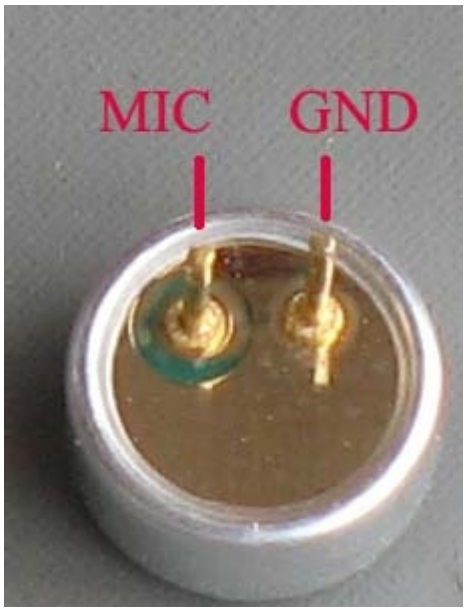
1. DDS Unit

Assemble the following components: (C34 has no component)

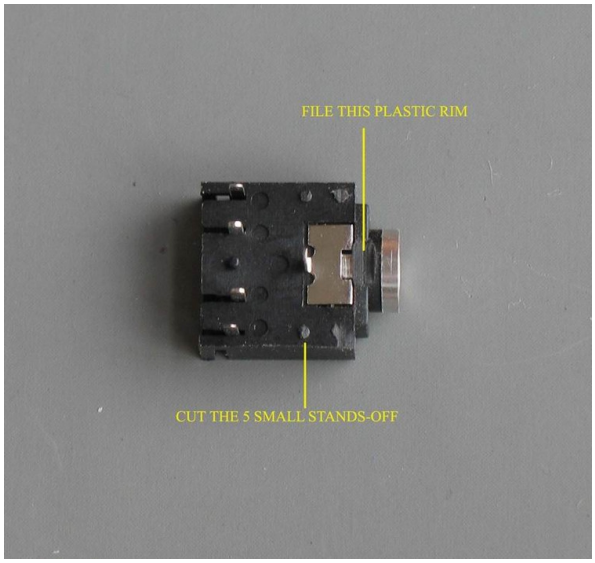
1) Assemble Y1, the 2MHz crystal. Bend the leads before soldering. Otherwise it will be too high.



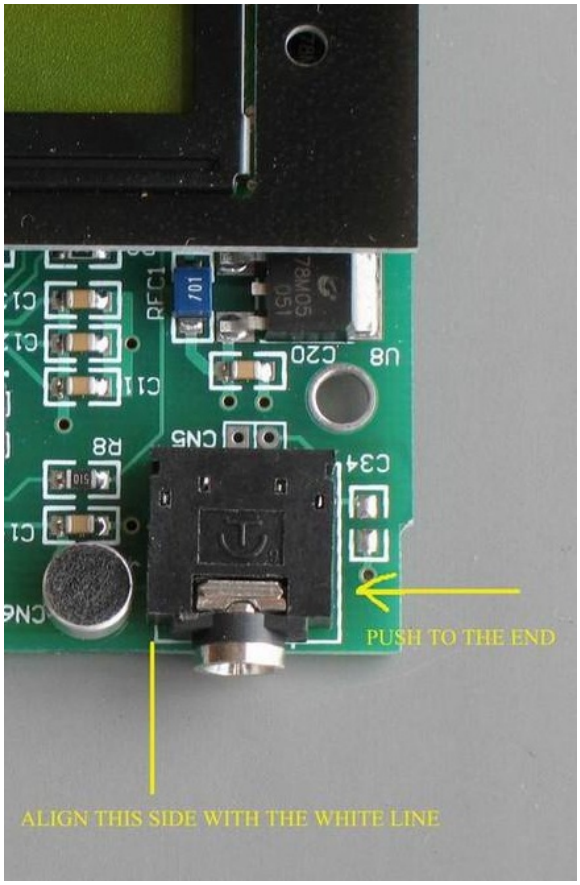
2) Assemble MIC. Notice the Ground pin (the pin connected to the casing). Solder the GND pin of the MIC to the GND pad of CN6 (the square pad on the left), and solder the MIC pin to the MIC pad (the round pad). It is suggested to extend the leads so that the MIC is closer to the MIC hole on the case. See illustration.



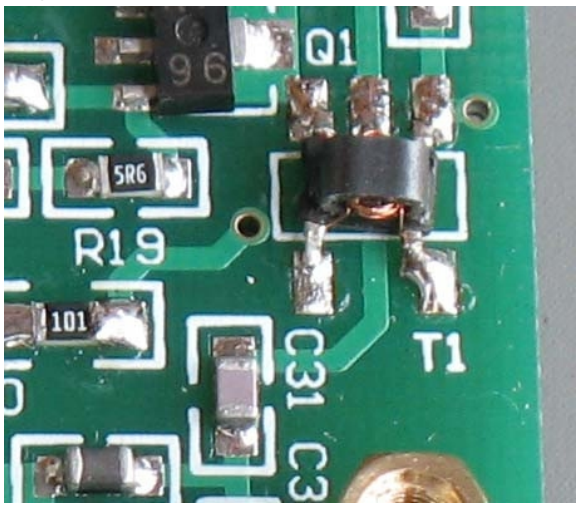
3) Assemble the 3.5mm stereo socket to J1. This is the external MIC and PTT socket. Because of the manufacturing process, the top cover opening for J1 cannot be lower. It is suggested to modify the socket a little so as to align with the opening better. It takes only 2 or 3 minutes. First, cut off the 5 tiny plastic stands-off on the socket. Second, flatten the plastic rim with a file. See the illustration below.



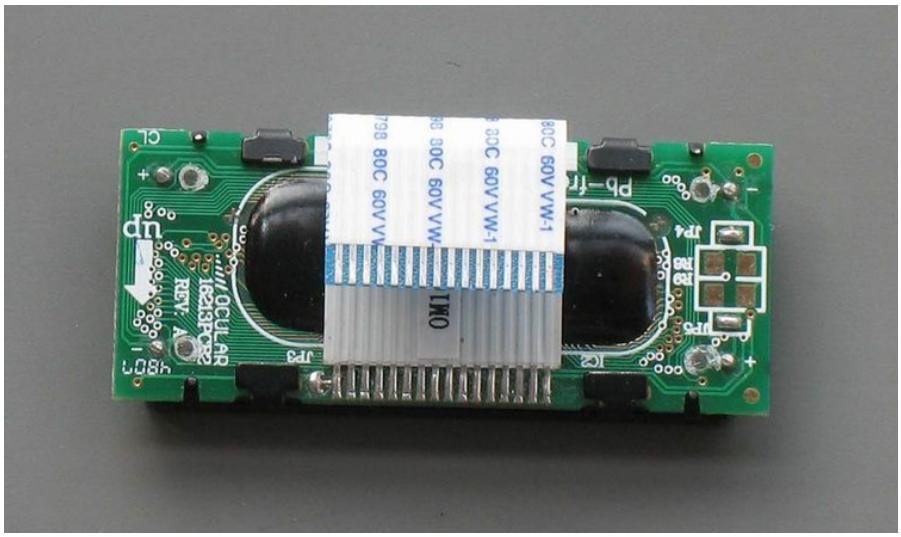
Assemble the modified socket to J1. Push the socket to the MIC side as much as possible until the side aligns with the silk line before soldering. See the illustration below.



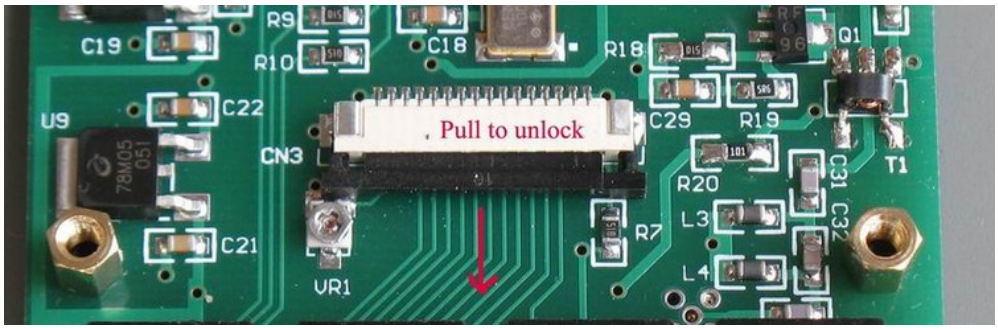
4) Solder a 220uF electrolytic capacitor to C7 pads. (C7 may have been assembled).
5) Solder a miniature transformer to T1 pads. Six such transformers are supplied in the bag. Use one of them here.



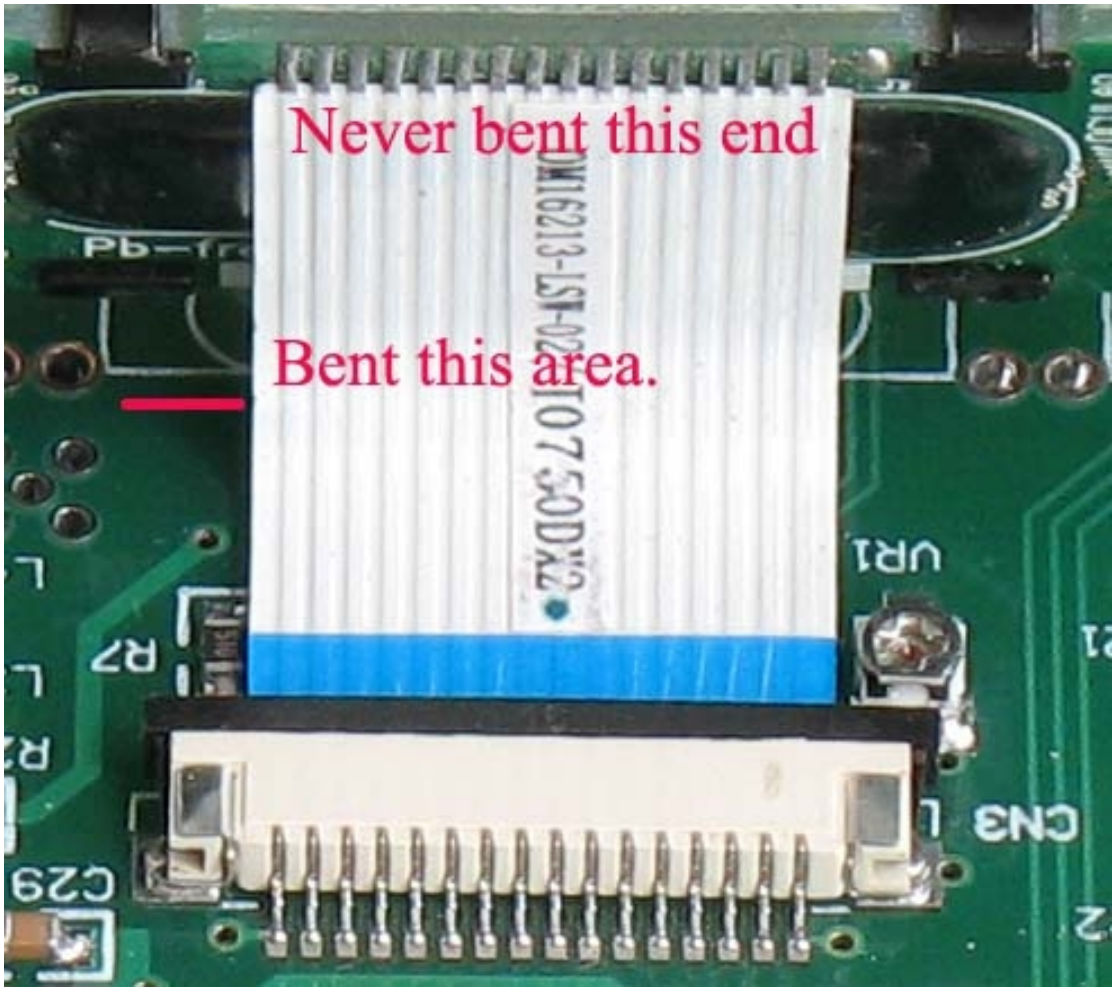
6) Insert the LCD cable to the FFC socket (CN3). Do not assemble the buttons until the LCD is assembled. Bend the flexible cable before inserting it into the socket.



Pull the lock bar to release the lock of CN3.



How to insert the LCD Cable



Never bend the cable end soldered to the LCD!

Now carefully insert the flat cable into the socket. When the cable is inserted into position, press the lock bar down to lock the cable. Never bend the cable end which is soldered to the LCD PCB. This will break the cable at the end, because the thin tracks have no protecting plastic at the end. Always push the bent part (the "U" part) to insert.

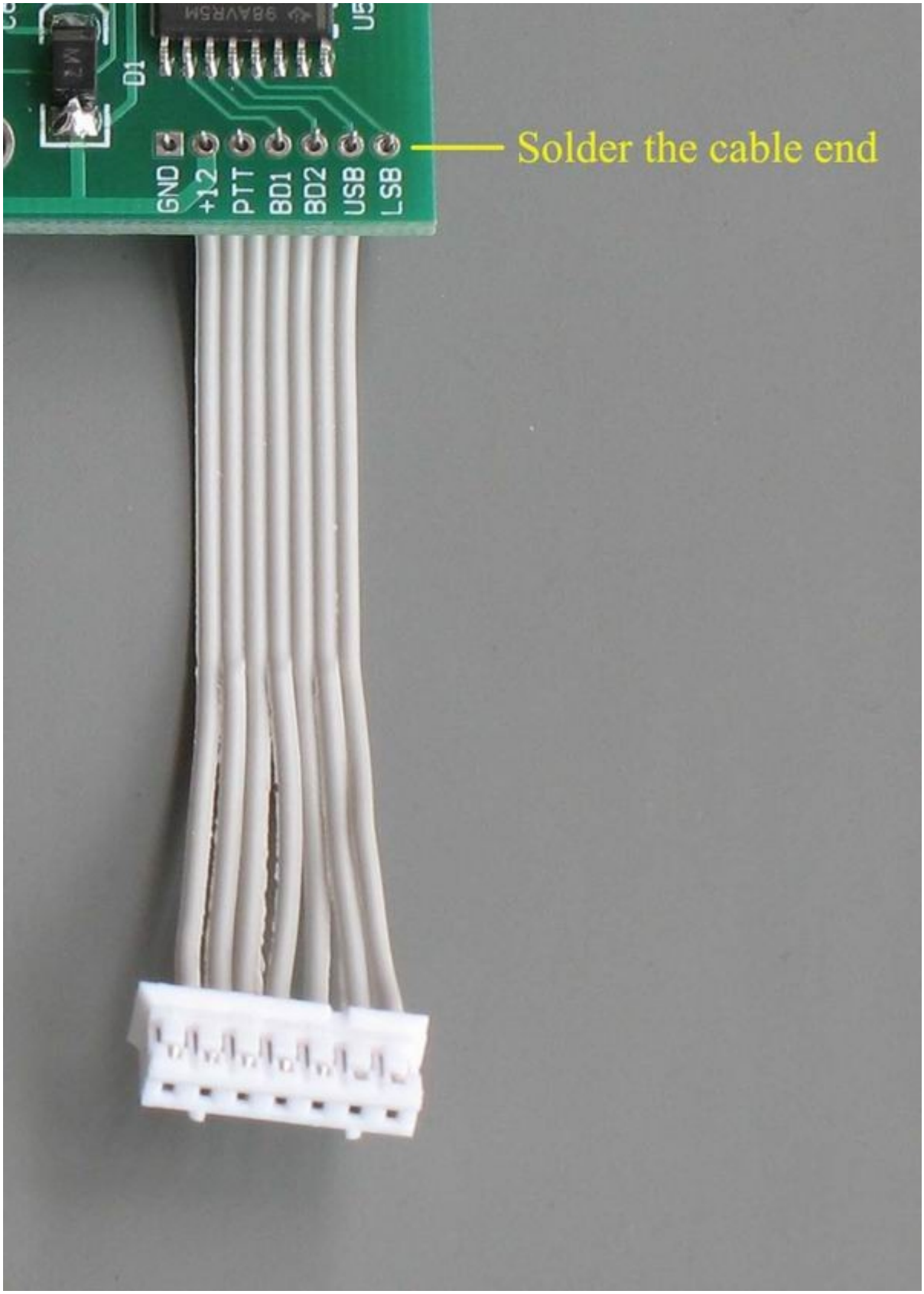
Another method of inserting the LCD is to insert the LCD with a slanted angle.

Fasten two 6mm-brass stands-off (the two brass stand-offs without a tail) to the mounting holes with 2 flat-head screws.

Solder the four function buttons onto the DDS board.

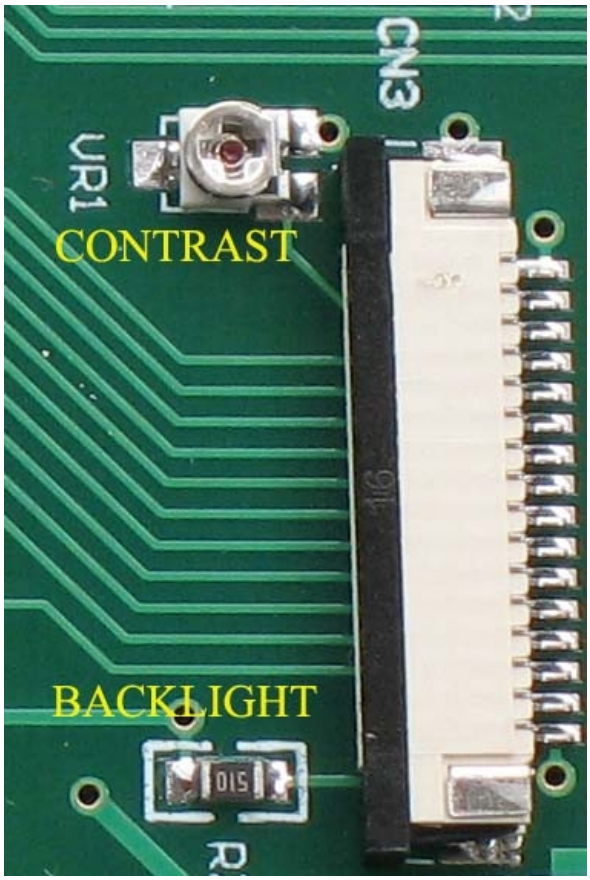
7) Solder the 7-wire cable to CN1.

First, split the end leads to fit CN1.

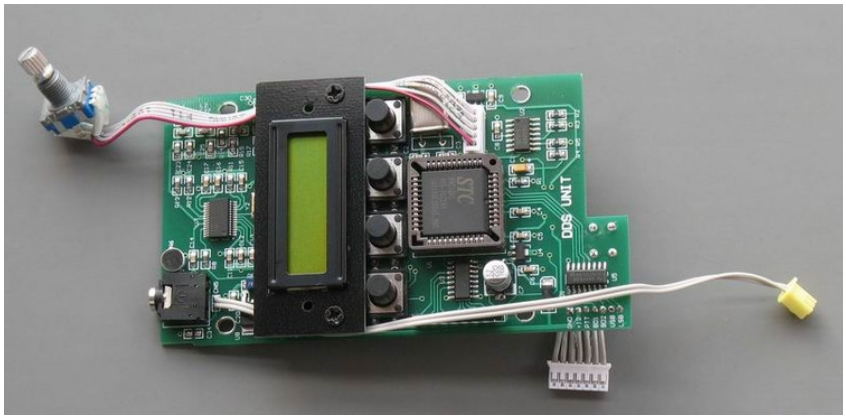


Now, solder the 7-wire cable.

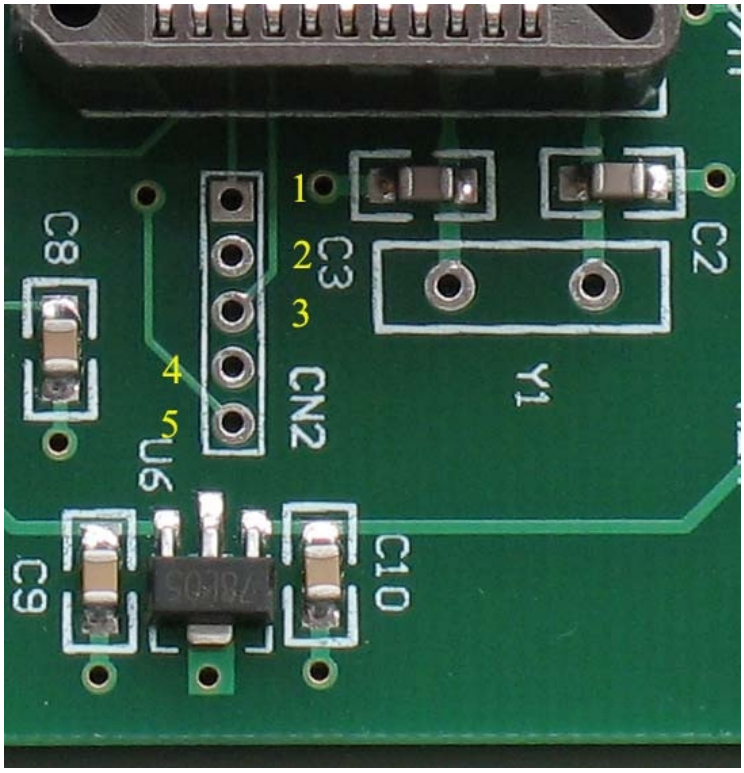
Supply 12V from the 7-pin cable, negative to "GND", positive to “+12V". Voltage ranging from 10.5 - 13.8V works. Never connect the wrong polarity! When the power is connected, the backlight is on. There may be nothing seen on the LCD screen at first. Don't worry. Adjust the contrast control VR1, until the display appears. The 51 ohm resister controls backlight brightness.



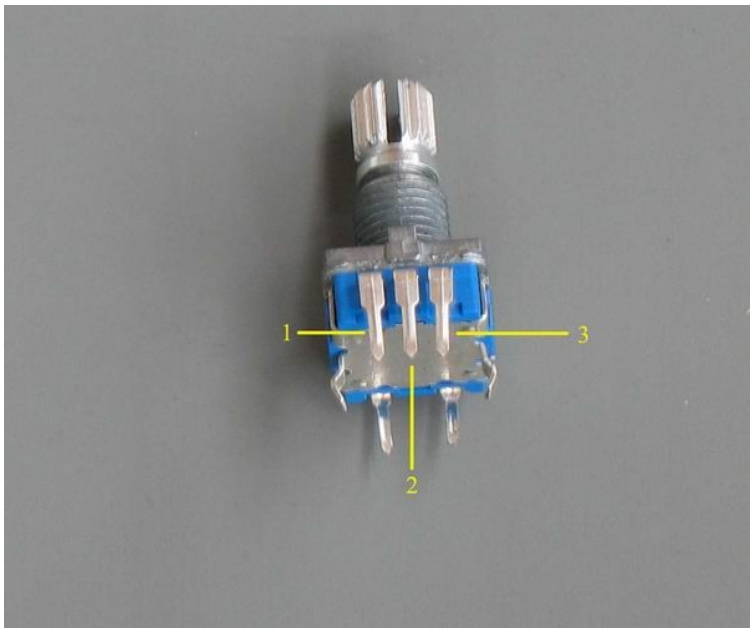
Now push the LCD window through the LCD frame. Fasten the frame with 2 flat head screws. A little glue can be applied along the contacting edges of the LCD PCB and the frame. However, even without the glue, the LCD assembly will work fine, because the LCD is backed by connector CN3, and there is only around 1mm clearance between CN3 and the back of the LCD.



8) Solder the 5-pin socket to CN2. This is the encoder and tuning rate port. Assemble CN2 at the other side of the PCB, making it easier to run the cable.



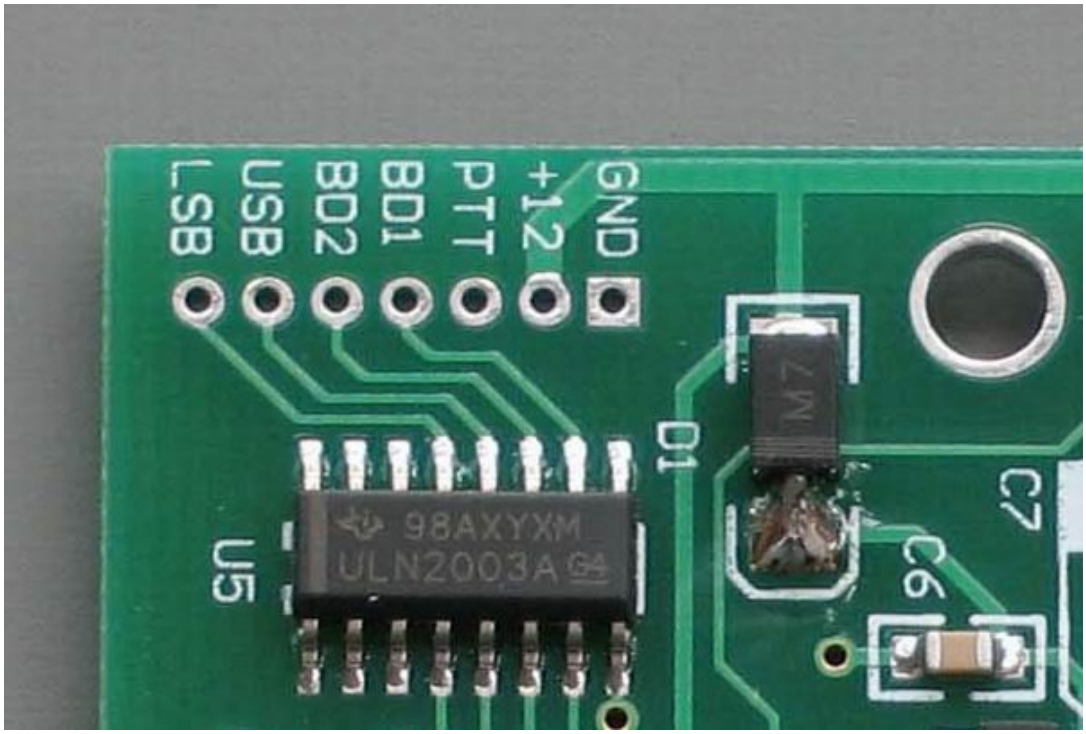
Pins 1 - 3 are soldered to encoder pins 1 - 3 respectively. Pins 4 - 5 are soldered to the two encoder switch pins.



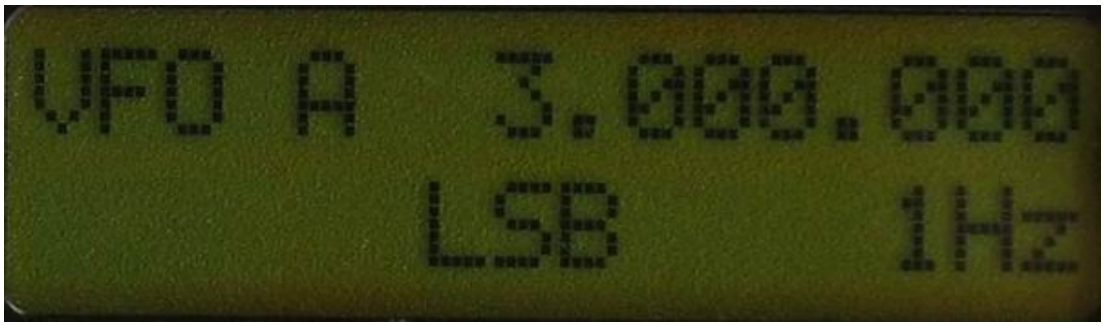
The encoder pins are numbered as shown above. The center pin (Pin2) is GND. The lower two pins are switch pins used as tuning rate selection.

9) Solder the MIC cable to CN5. Use the yellow connector. Note: The square pad (on the right) is GND, the round pad is the MIC pad. They are routed to the MIC pad and the GND pad of Main board CN4 respectively.

10) Assemble the SETUP switch which is on the PCB back.
Now, the DDS Unit is ready. You may test this assembly separately.
Apply 12V to CN1 to test the DDS Unit.



Supply 12V DC to +12V and GND. Connect + to +12V pin, - to GND. Never connect the wrong polarity! Power supply range is 10.5 - 13.6V.
If there isn't any display after adjusting VR1, please check the LCD cable. The cable may only be half way into the connector. Insert the cable properly. For the first test the DDS works best at the lowest frequency of BAND 1 (3.000.000), LSB, VFO A.



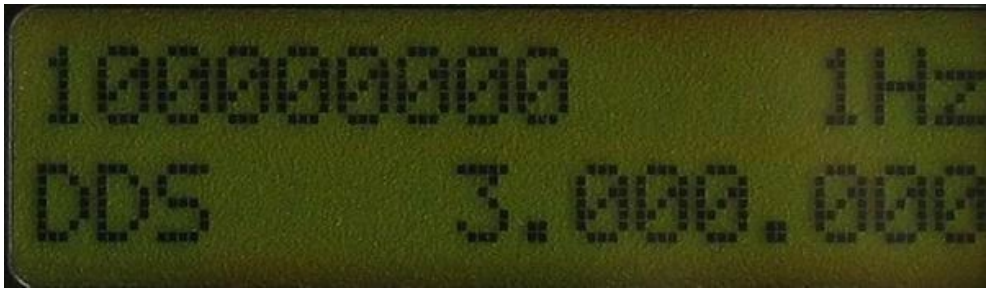
Press MOD, the mode changes, press A/B, the VFOs switch, press V/M, VFO mode is switched to the memory, press MEM, the frequency is ready to save to the memory. Turn TUNE, the frequency changes. Press the TUNE knob, the tuning rate changes. All the functions work! Let's check the DDS output.
Check the DDS output with a frequency meter. Connect the frequency probe to CN4, the

GND clip to GND of DDS Unit. The reading should be 12.000.000. This is the display frequency + IF (9.000.000). If there is no reading, check T1 for a cold solder joint.
The reading may be not accurate, around 12 MHz, because of the 100 MHz crystal tolerance. If the measured frequency is not accurate, please calibrate the clock value through SETUP.

If you don't have a frequency counter, ignore the clock calibration. You may calibrate the clock later with the aid of beacon signal at 5 MHz, 10 MHz, or 15 MHz.

Let’s setup the DDS unit.
Press the SETUP button, IFS appears on the screen. Setup IFS later

Press again, DDS information appears.



The top line indicates the clock value. The default clock value is 100000000 (100 MHz). Use the TUNE knob to alter the value. If the 1 Hz tuning rate is too slow, use a faster rate. Tune while watching the frequency meter, until 12.000.000 (or 11.999.999) is measured on the frequency meter. Press the MEM button to save this value. You can ignore this step if you don’t have a frequency counter.

Press SETUP again, USB appears on the screen.

The default value is 3000, indicating USB and LSB are 3 kHz apart, i.e., both the LSB and USB is 1.5 kHz from the XTL filter center frequency. Turn TUNE knob counter-clockwise to

alter the value to 2800, so that LSB and USB are 1.4 kHz from the center frequency. Press the MEM button to save the modified data. Press SETUP to exit.

Monitor the frequency meter. Tune from 3 - 18.199999 MHz using LSB mode, the reading is always 9 MHz higher than the DDS LCD displays. If the frequency is not very accurate at higher band frequencies, re-calibrate the clock. Press MOD to enter USB mode, the measured frequency is 2.4kHz higher. Now, let's calibrate the IF.

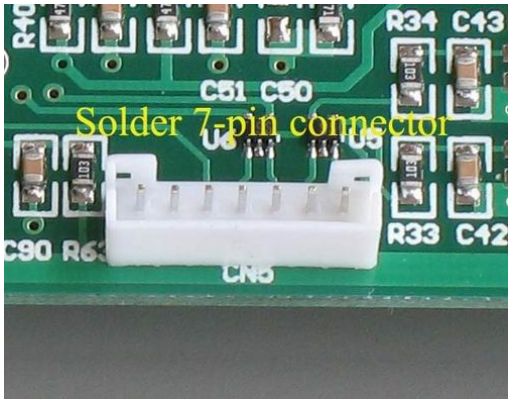
Press the SETUP button, IFS information appears on the screen. "0" indicates the default IF value which is 9 MHz. In this kit, the BFO frequency at LSB mode is 8.998400 MHz, not 9.00000 MHz.

(900000 – 8998400) = 1600, i.e., 1.6 kHz. The DDS should be 1.6kHz lower to match the LCD display. Please turn the TUNE control counter-clockwise until -1600 appears on the LCD screen. Press MEM to save this modified data. Press SETUP or other function keys to exit SETUP.

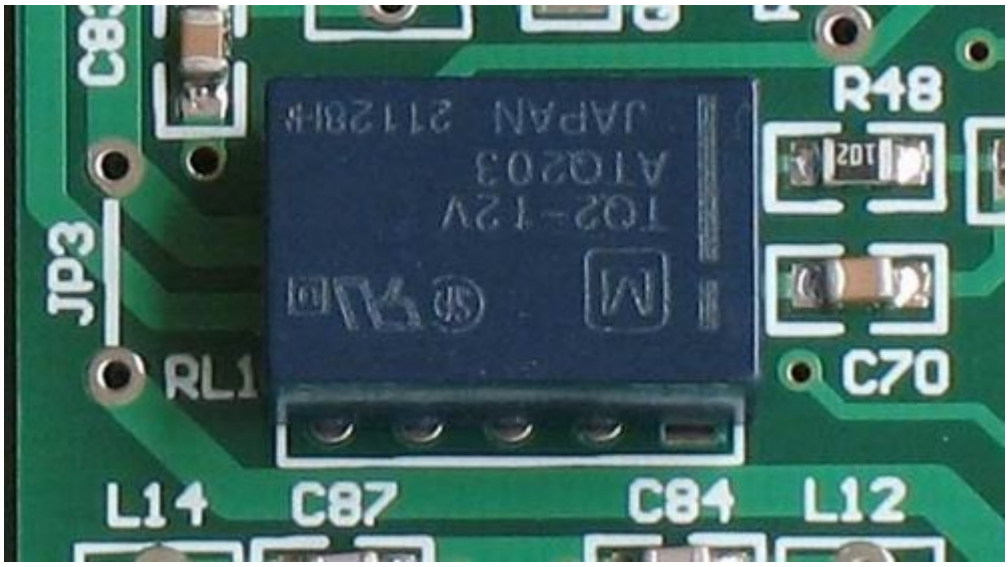
Now let's move up to the main board.

2. Main Board

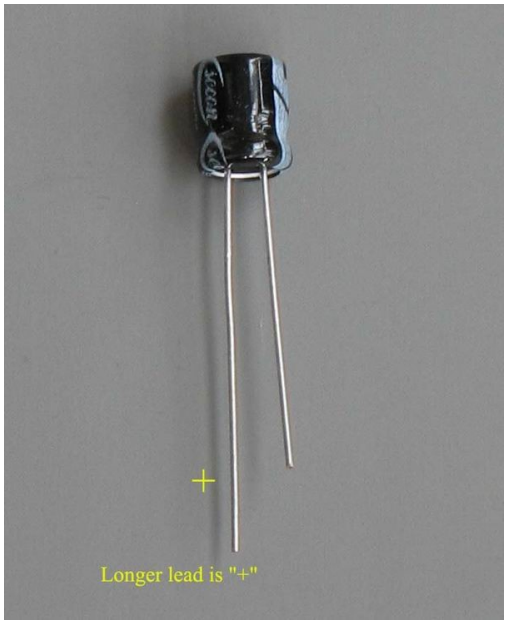
Note – there are no components at C21
A few bulkier components should be assembled:
1) Two DC input sockets
2) Power switch
3) PTT switch (Do not put on the push button until the whole kit is completed.)
4) Phone socket (3.5mm stereo socket. **Do not** cut the stand-off and file the rim like J1 of DDS board.)
5) Connectors: CN3, CN4, CN5, CN6, CN7 (Note: CN7 is assembled on the back to shorten the leads from the battery pack.)

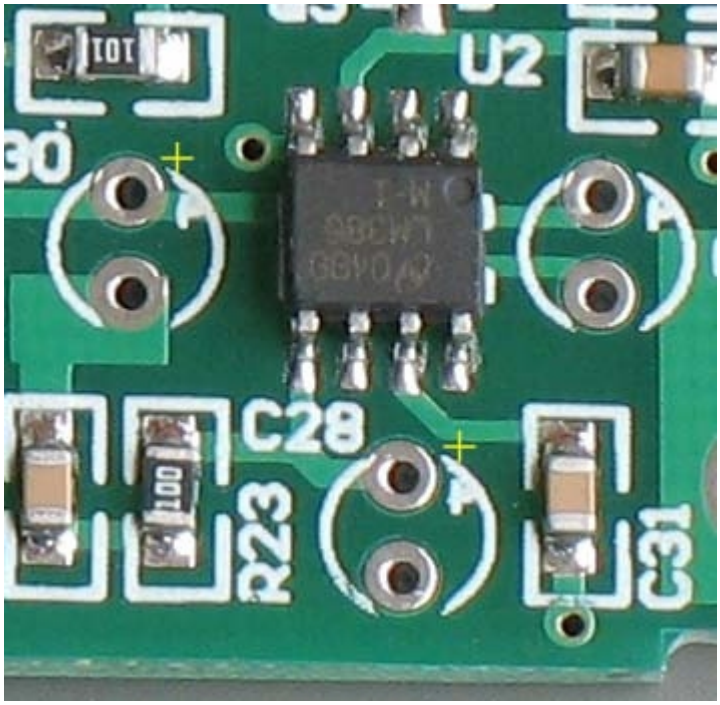


6) Two TQ2 relays (Notice the bar printed on the relay. There is also a bar printed on the PCB.)

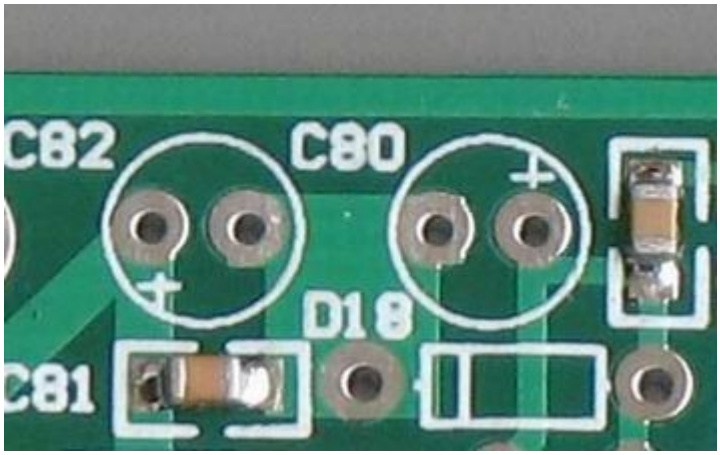


7) 220uF electrolyte caps. Note: The longer lead is "+". Solder them to C28, C30,C80,C82 pad. Find ‘‘+’’ on the PCB. Never mistake the polarity.



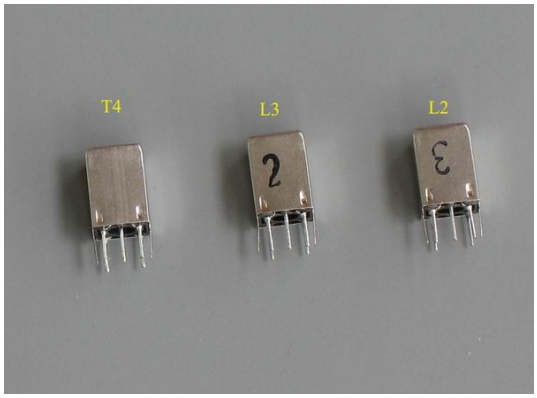


Notice "+" symbol.

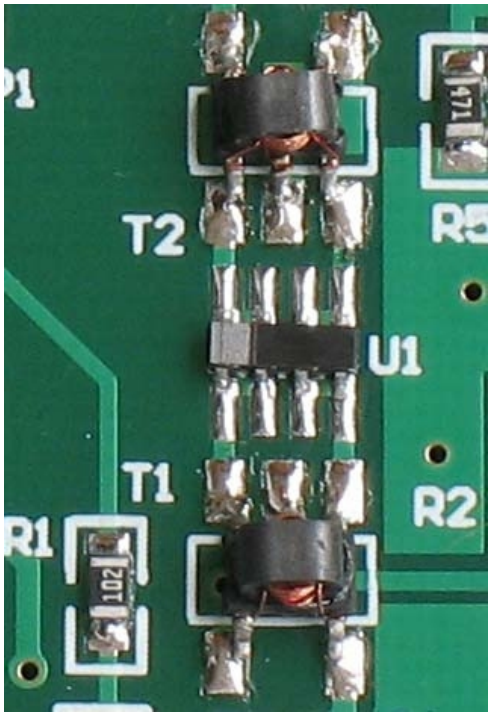


8) Solder the 9 MHz crystals on main board Y1 - Y5 pads.

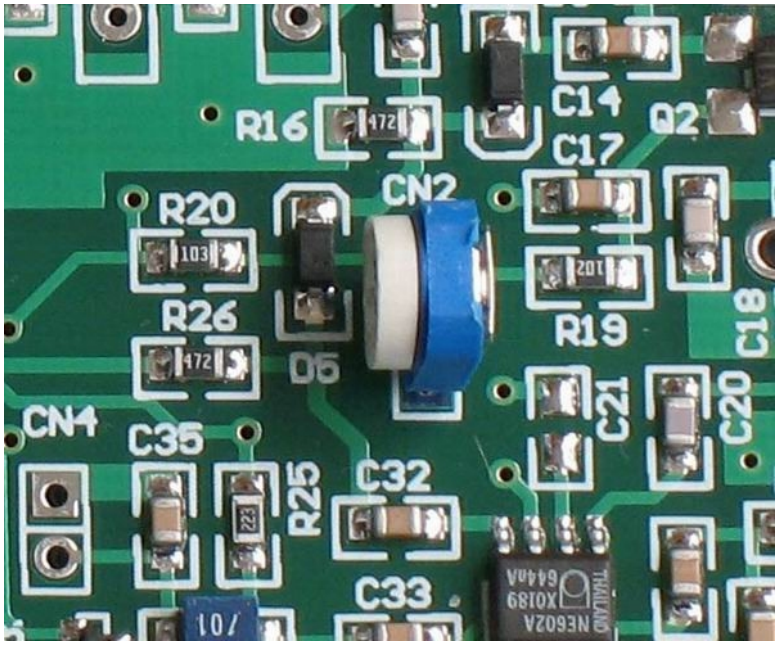
9) Solder the can inductors to the main board. The can without any number is for T4; the can labeled (3) is for L2; and the can labeled (2) is for L3.



10) Solder T1, T2, T3, T5, T6. These are miniature transformers. One of them is used on the DDS Unit.

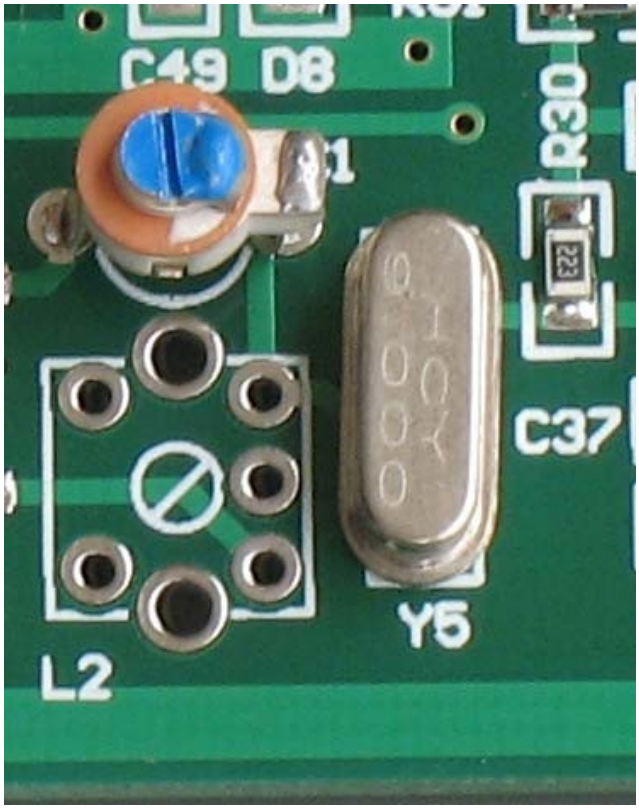


11) Assemble the 10k trimmer on the CN2 pads. Adjust the leads so that they fit the pads.

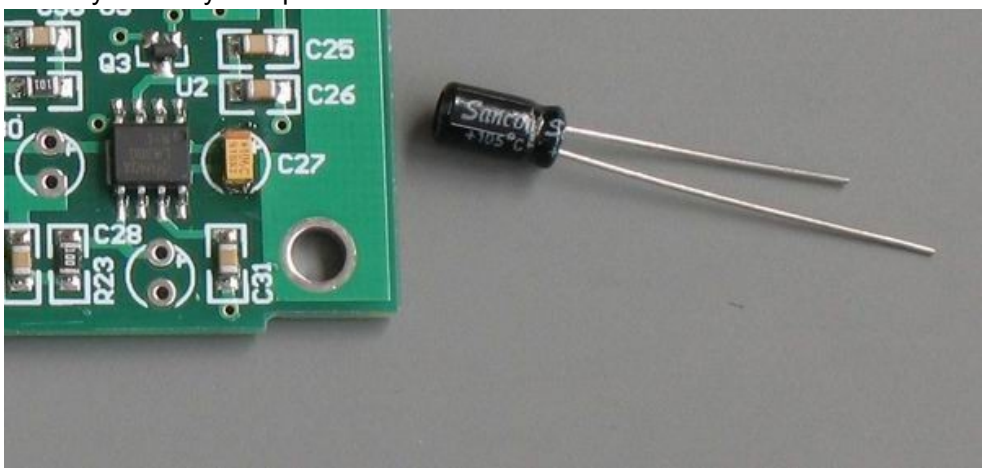


12) Assemble VC1

Notice the mounting direction of this variable cap.

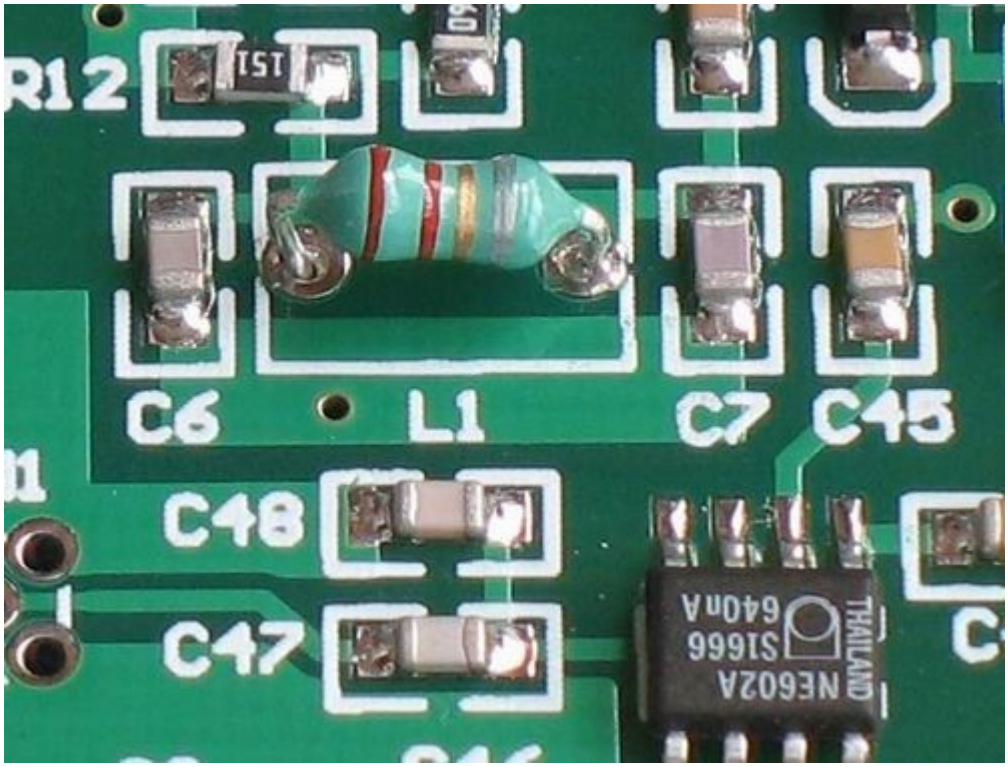


13) Solder the 10uF chip at C27 if a capacitor is not already present. Notice the polarity. The brown bar is "+". If the SMT chip is too small for you to handle, you can use an ordinary electrolytic cap here instead.



14) Assemble L1, L12, L13, L14, L15.

L1 - Colour code inductor

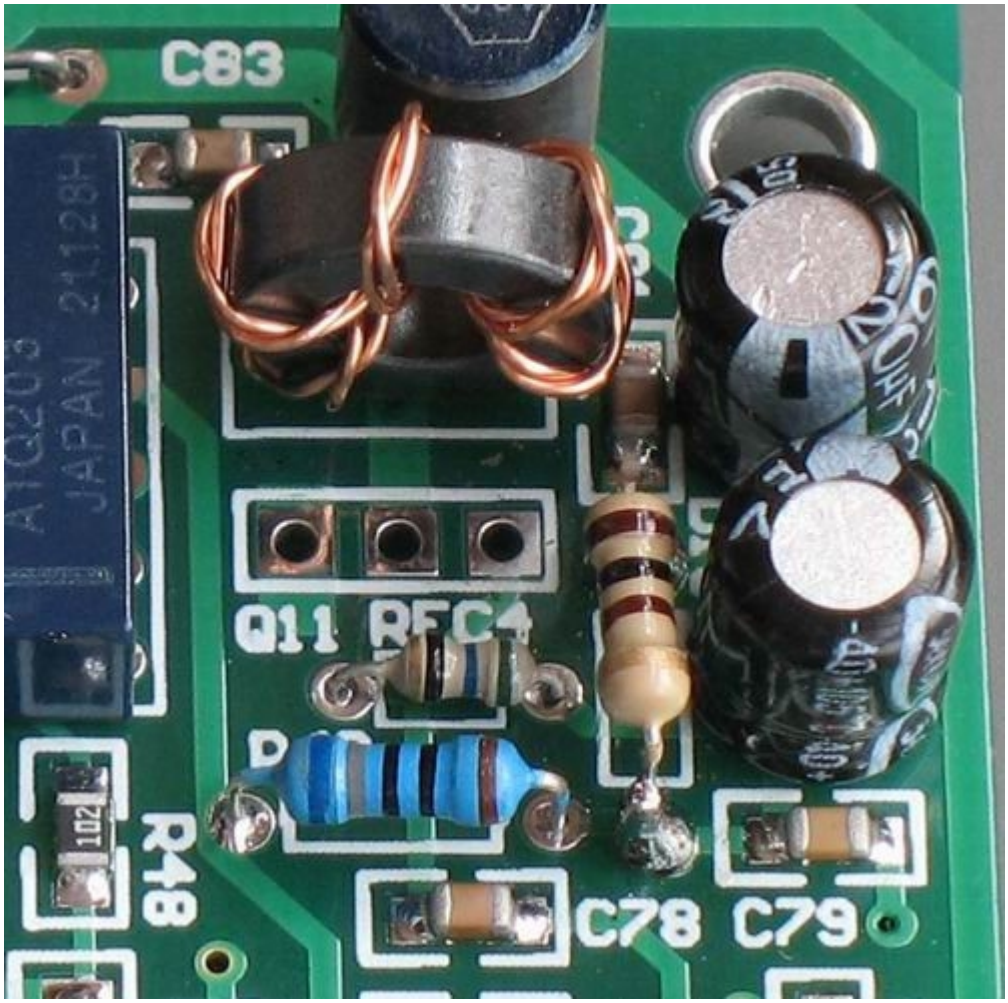


Now, wind the coils :
Use 0.42 emaneled wire supplied in the kit. The emanel of 0.42 wire is a kind of solder aid. You don't have to scrape the emanel. Tin the leads directly. The emanel melts when heated. However, if the temperature is not high enough, the emanel does not melt. It is more reliable to remove the emanel with a knife and then tin. Never use fire to "burn" the wire to remove the emanel.

L12, L13 - 40m LPF inductors. 17 turns, 0.42 wire on T37-2 core, leaving 1 cm for the leads. A length of 22cm is enogh. Tin the leads, and then solder them to the related pads.

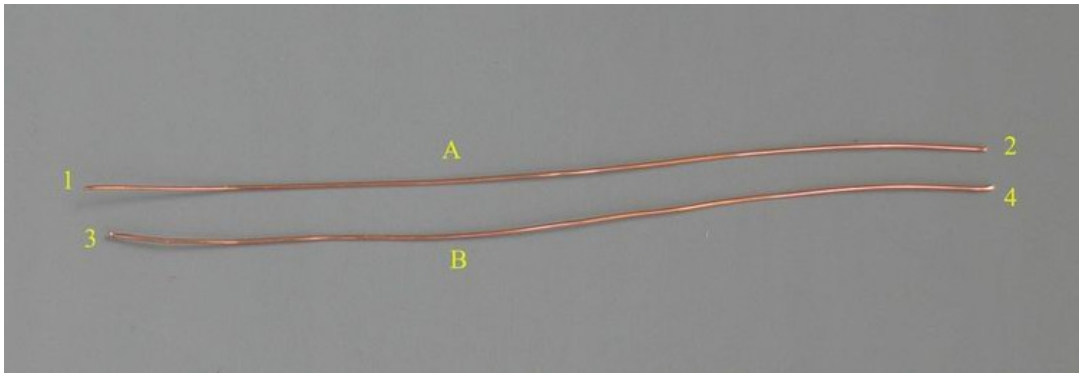
L14, L15 - 20m LPF inductors. 12 turns, 0.42 wire on T37-2 core, leaving 1 cm for the leads. A length of 16cm is enogh. Tin the leads, and then solder them to the related pads.

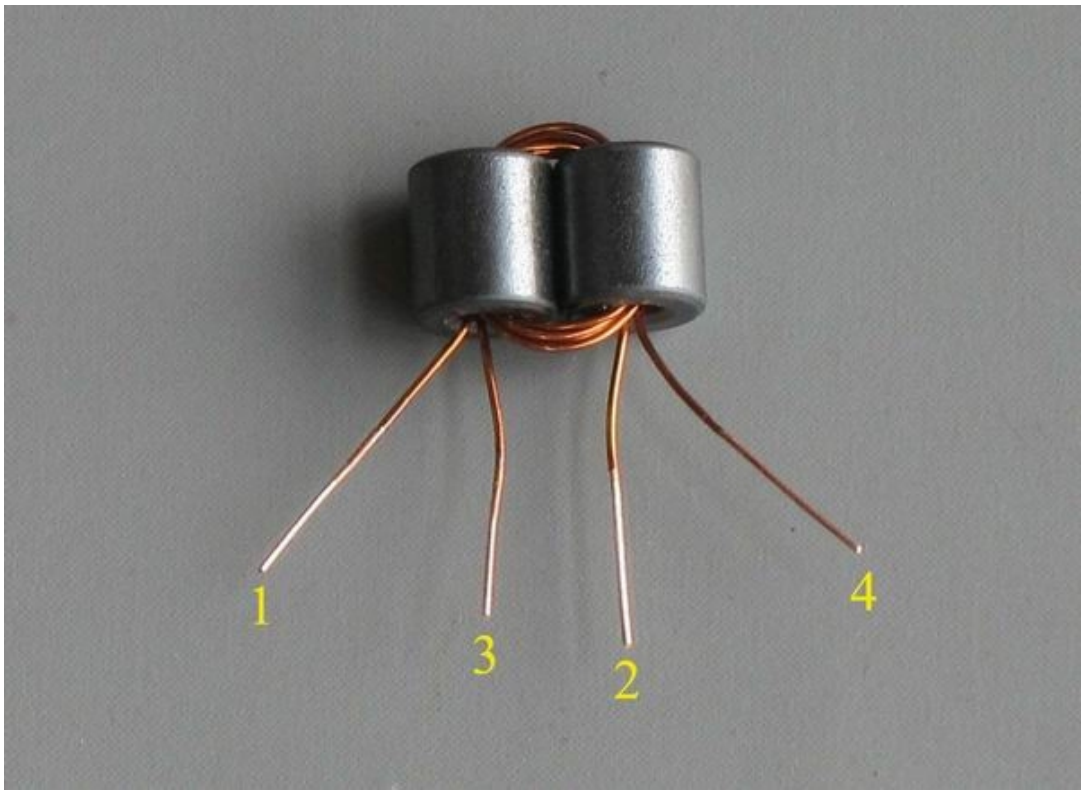
15) Assemble RFC4 and RFC5 (the RFC ring cores are not supplied).
RFC 4 - 56 ohm resistor.
RFC 5 - TDK miniature inductor.

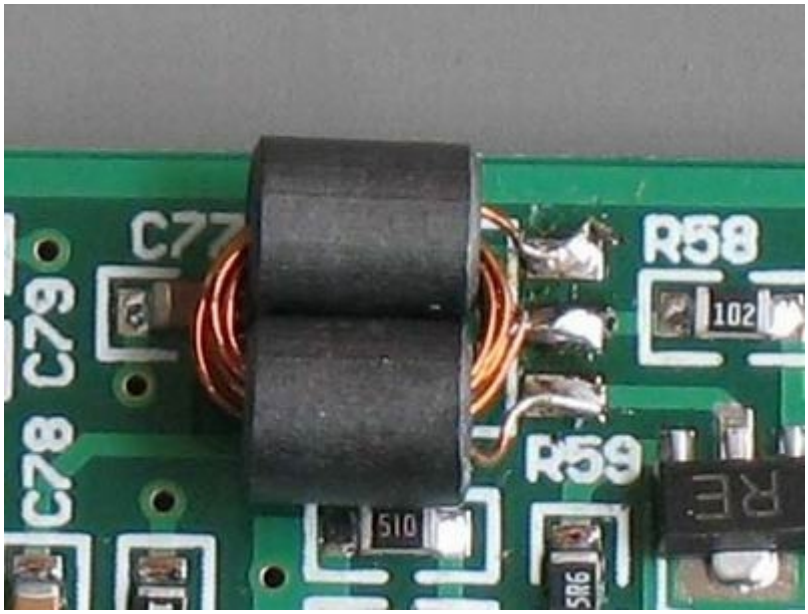


16) Assemble T7.

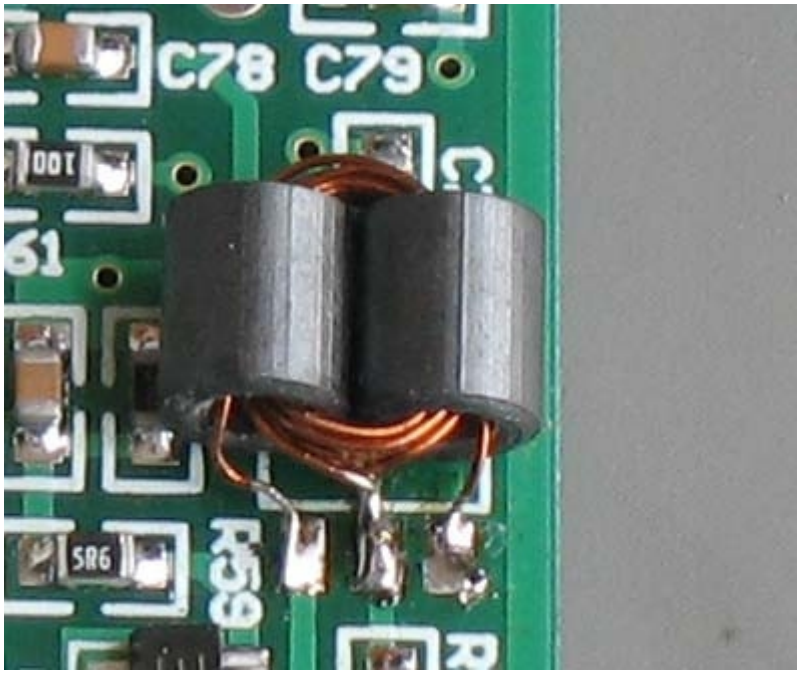
Broadband transformer, 5 bifilar turns 0.31 enameled wire on the binocular core made up of 2 small sleeves. Cut a pair of 12 cm long enameled wires, and thread through the core. 1 - 2 is wire A; 3 - 4 is wire B. Connect 2 (the finish of wire A) with 3 (the start of wire B) as the tap (Use Ohm meter to identify each wire). You don't have to twist the wire. Leave about 1 cm for each lead. Remove about 5 mm enamel from the leads, and tin. The tap goes to the center hole. **Note:** 0.31 wire is different from 0.42 wire. The enamel is not a solder aid with 0.31 wire, you have to scrape the wire ends and tin them with solder.







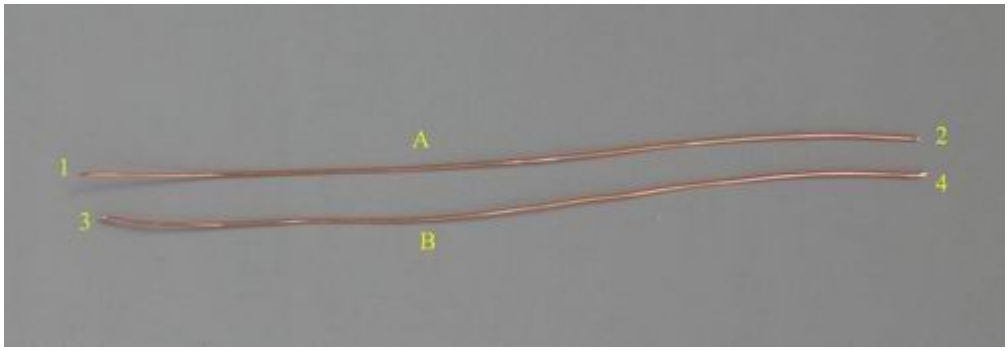
T7 is soldered on the 3-lead pads, with the tap in then middle pad. No connection on the 2-pin lpads.

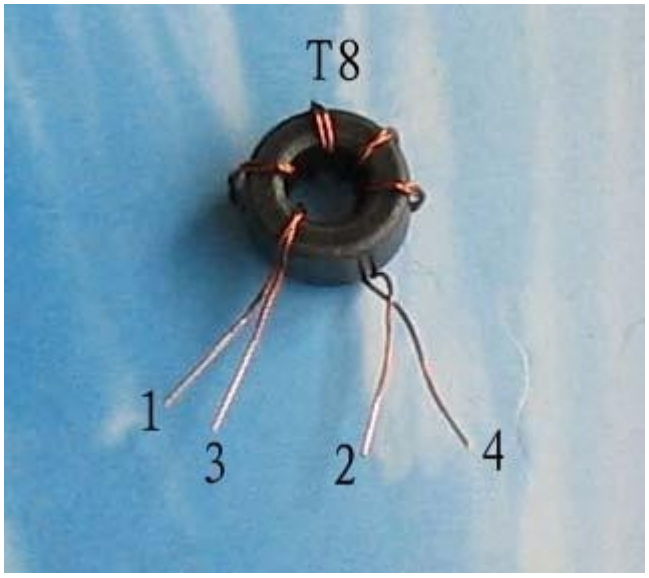


Another picture of T7

17) Assemble T8.

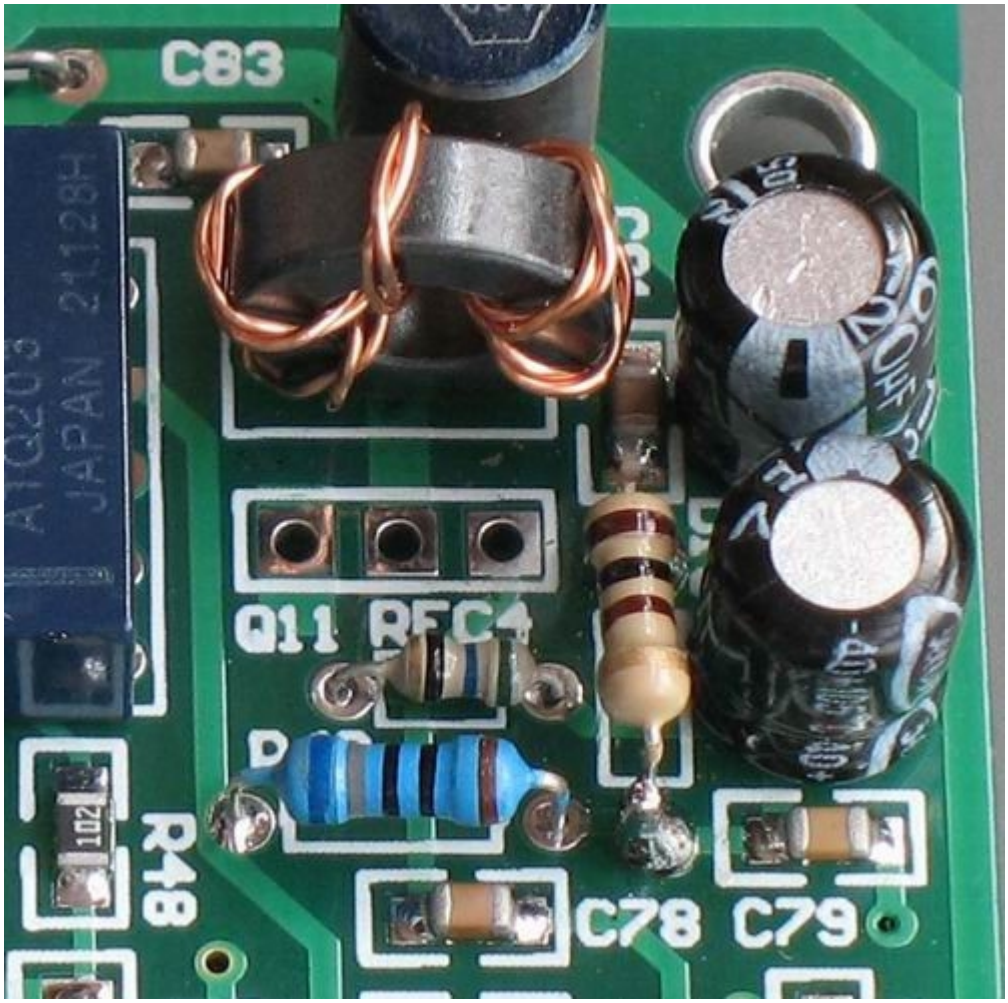
Broadband transformer, 5 bifilar turns on FT37-43 core, 0.42 wire. Cut 2 pieces of 15 cm long enameled wires, wire A and wire B. Twist the 2 wires before winding. Connect 2 (the finish of wire A) with 3 (the start of wire B) as the tap (Use an Ohm meter to identify). Leave about 1 cm for each lead. Remove about 5 mm enamel from the leads, and tin. The tap goes to the center hole.





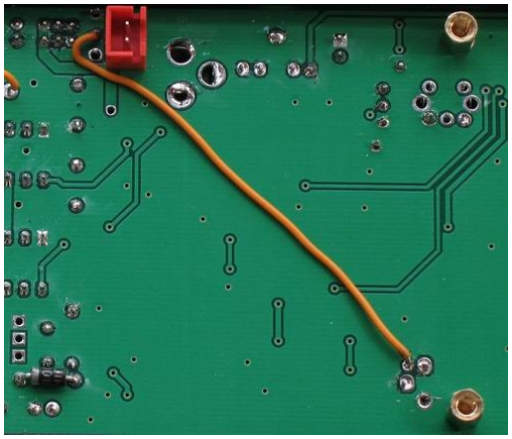
18) Assemble the bias resistor of the power transistor R62.

19) Assemble D18 on then PCB back. Solder a 100 ohm resistor on the leads of D18, i.e., the resistor is paralleled with D18.

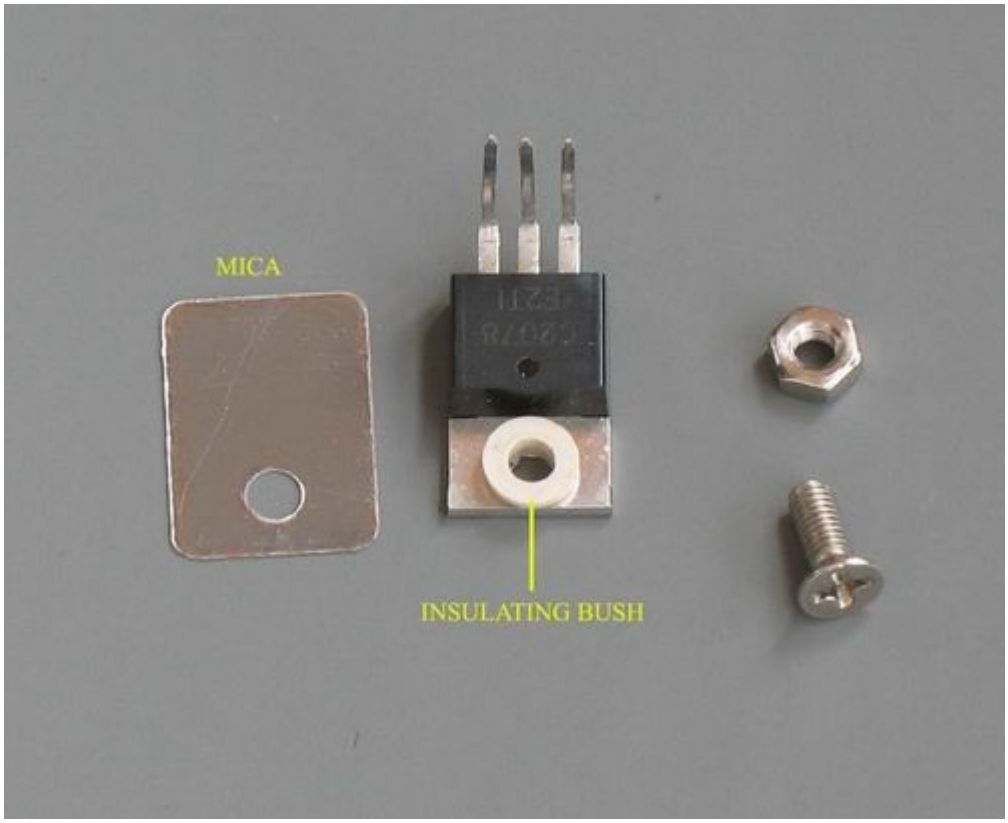


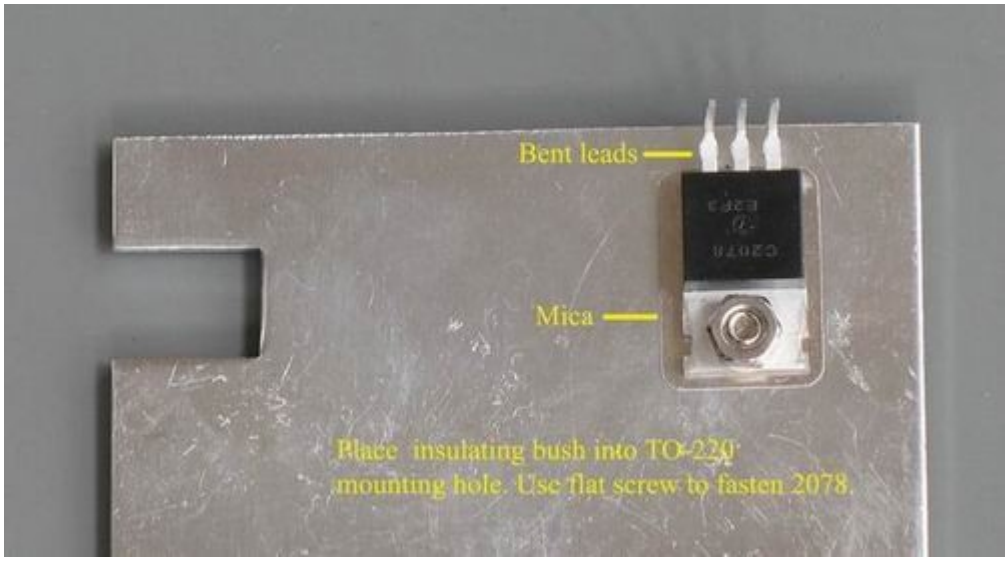
20) Put a jump wire in JP3.

21) Jump JP1 and JP2 with a hookup wire (JP1 is near J3. JP2 is near J2). Jump these two points on the PCB back.



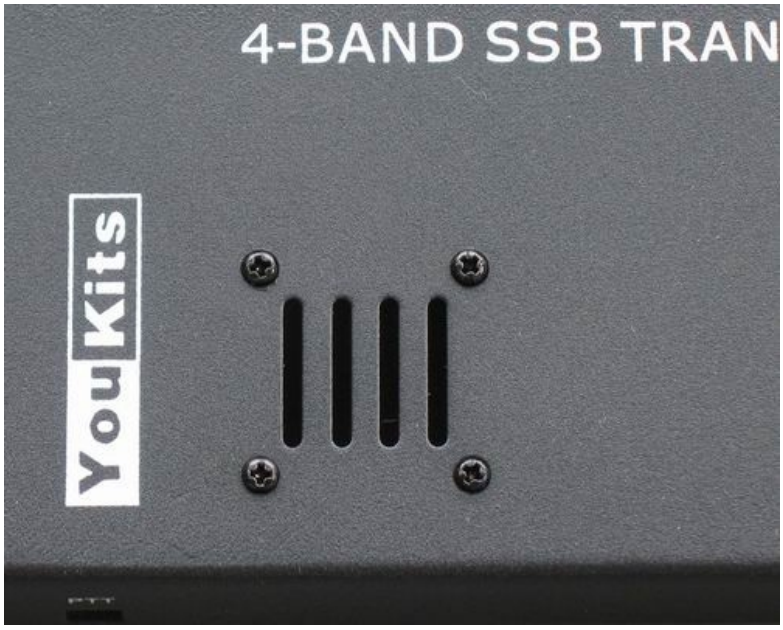
22) Next construct the power transistor assembly.
First bent the transistor leads. Put the insulating bush into the transistor heat sink mounting hole. Place the mica insulator sheet between the transistor and the aluminum plate. Thread a flat head screw through the mounting hole. Tighten the screw.

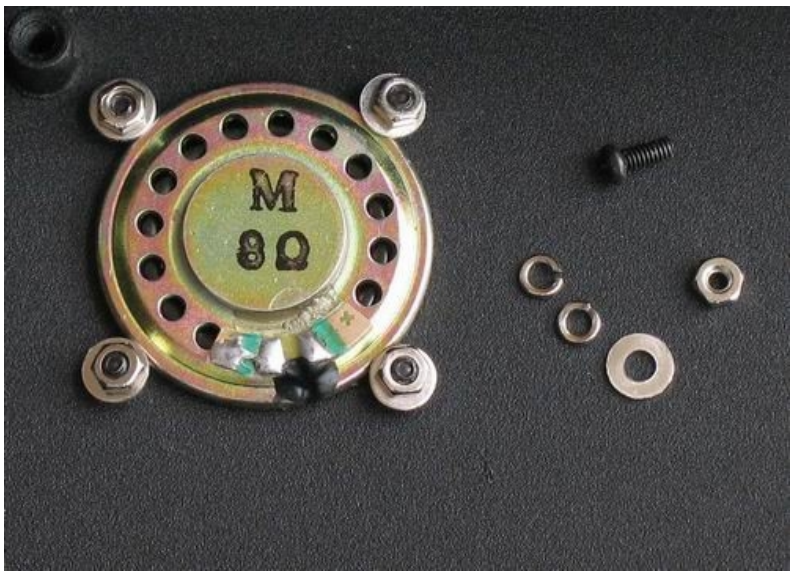




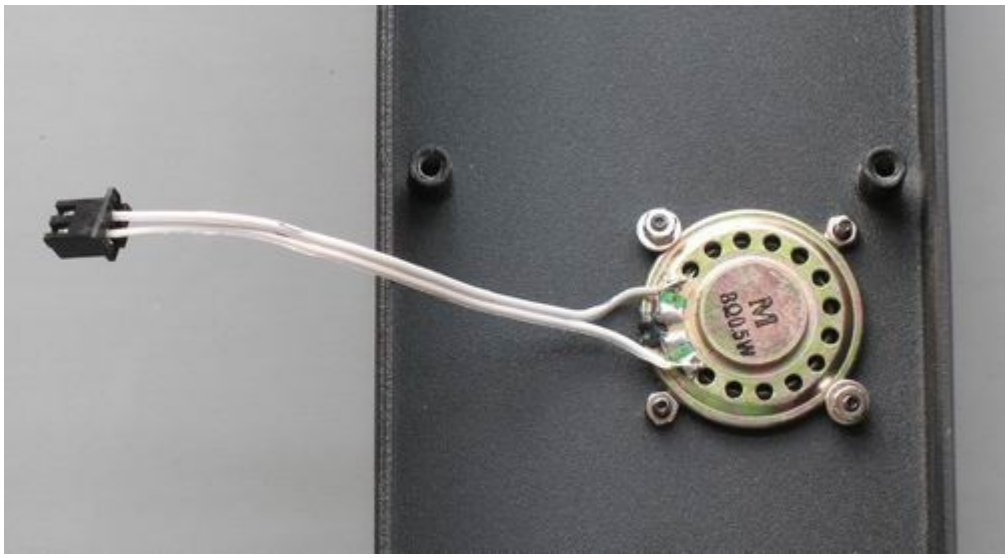
Use an Ohm meter to check the resistance between the aluminum and the power transistor heat sink (collector). There should be no reading. If the reading is 0 ohms, this indicates a short circuit between the transistor and the aluminum plate. Check the insulating bush. You may have placed it in the wrong direction. Attach this assembly to the PCB later.

Now, let's assemble the speaker. Use M2 screws.





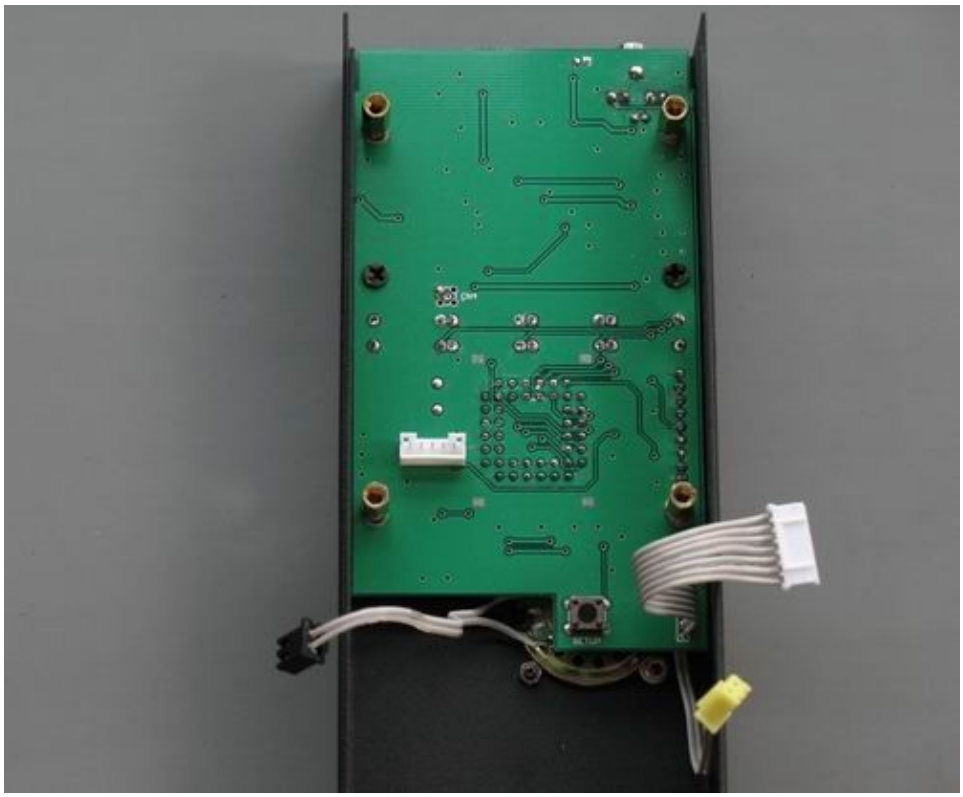
Use two 2 mm spring washers for each screw. The thickness of the 2 stacked springs is almost that of the speaker rim. Place 2 spring washers, and then a shim. Lock with the nut.



Cut the 2-wire ribbon cable in appropriate length (a length of 90 mm is enough) and solder the 2-wire cable to the speaker pads. Assemble the black connector to the cable.

Assemble the DDS Unit to the enclosure. The stands-off are pre-made inside the enclosure.

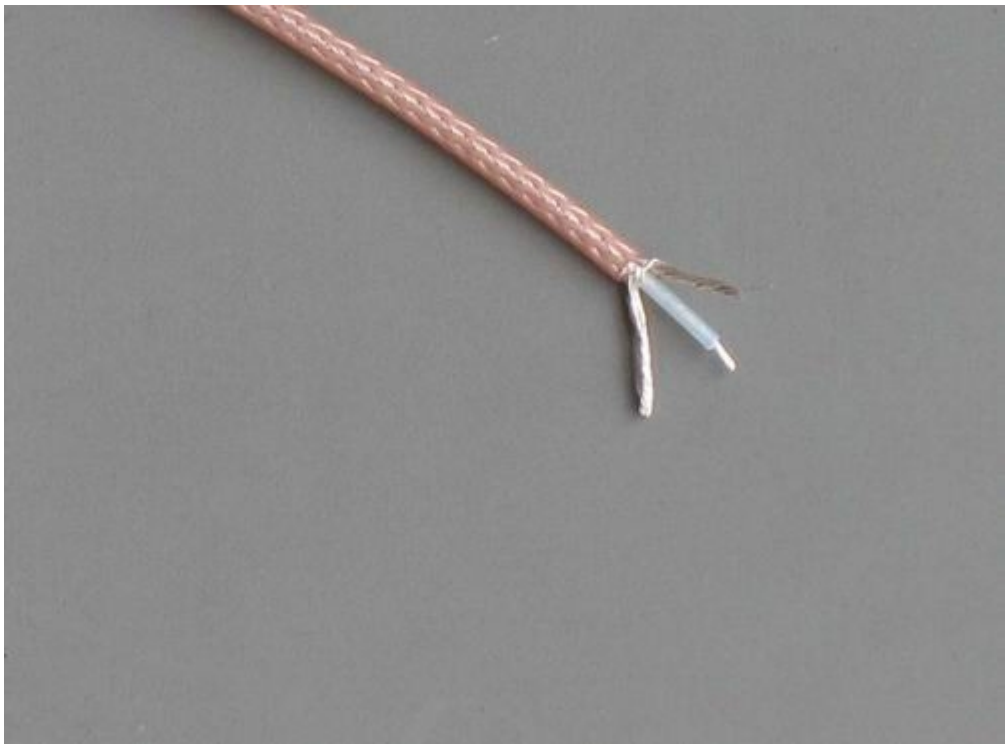
Place the DDS Unit in position. The screen and the buttons fit the openings. Press the buttons. They should be running-fit. Tighten the assembly with 4 10mm stands-off. Use 1 washer and 1 spring washer, so that the stand-off is raised 1mm.

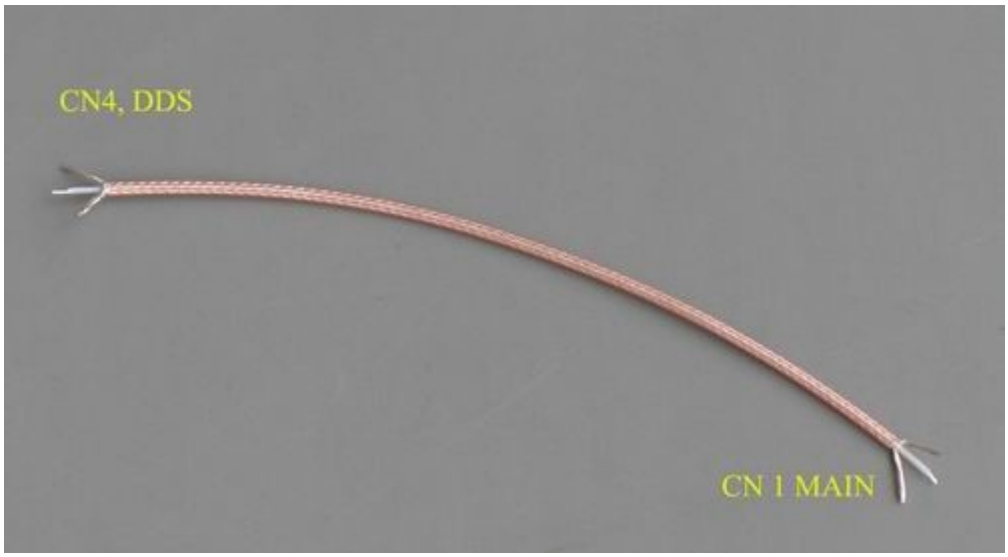


Tighten the stand-off.

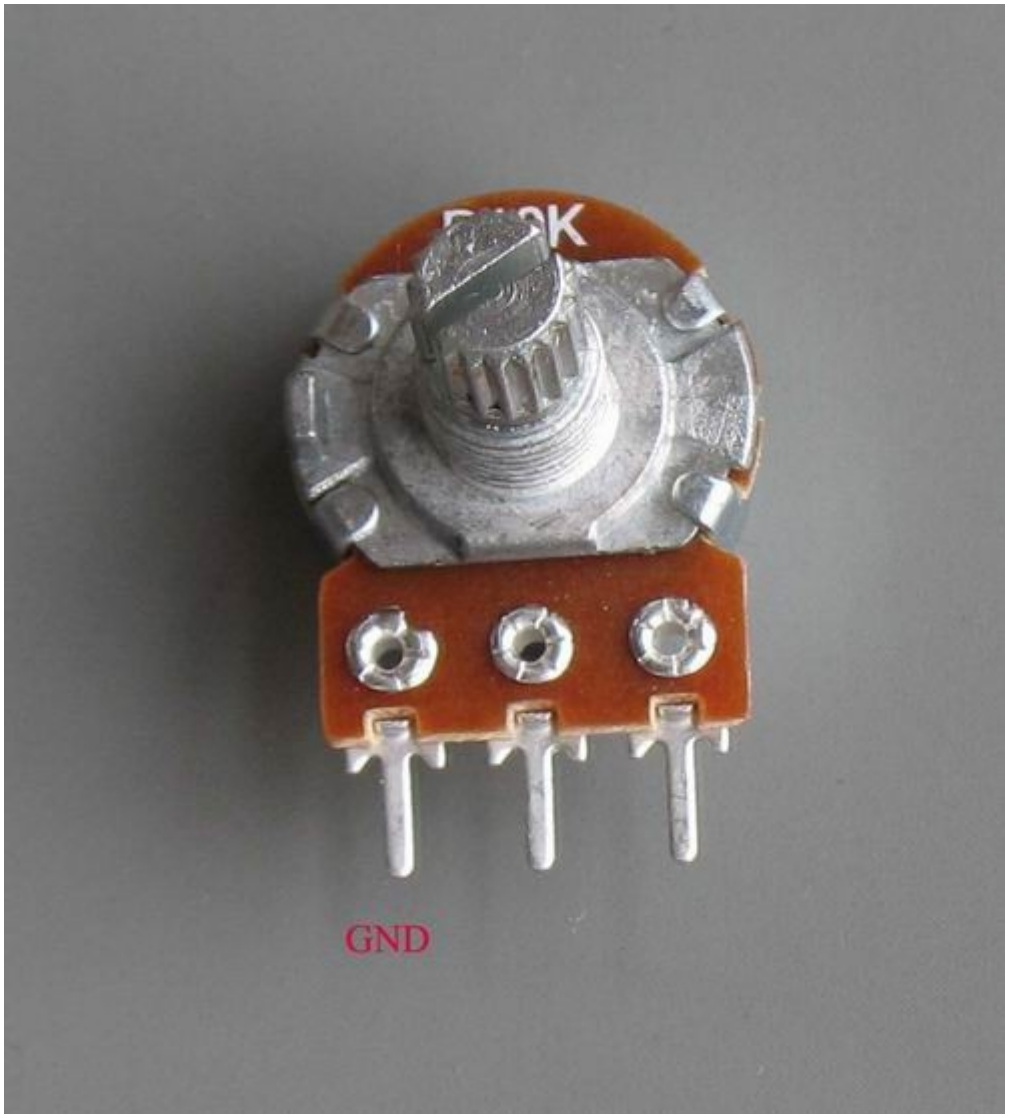
Split the sreen braid of the 50-ohm cable into 2 parts. You may twist the screen braid

togather as one tail, but the screen would be too hard to handle. tin the leads and solder to DDS CN4 and MAIN CN1, center inductor to the center hole, screen to the any 2 holes of the the 4 holes.





Solder the 3-wire cable to the AF GAIN 10k pot. Notice the GND pin. Cut the 3-wire cable in appropriate length (a length of 210 mm is enough).

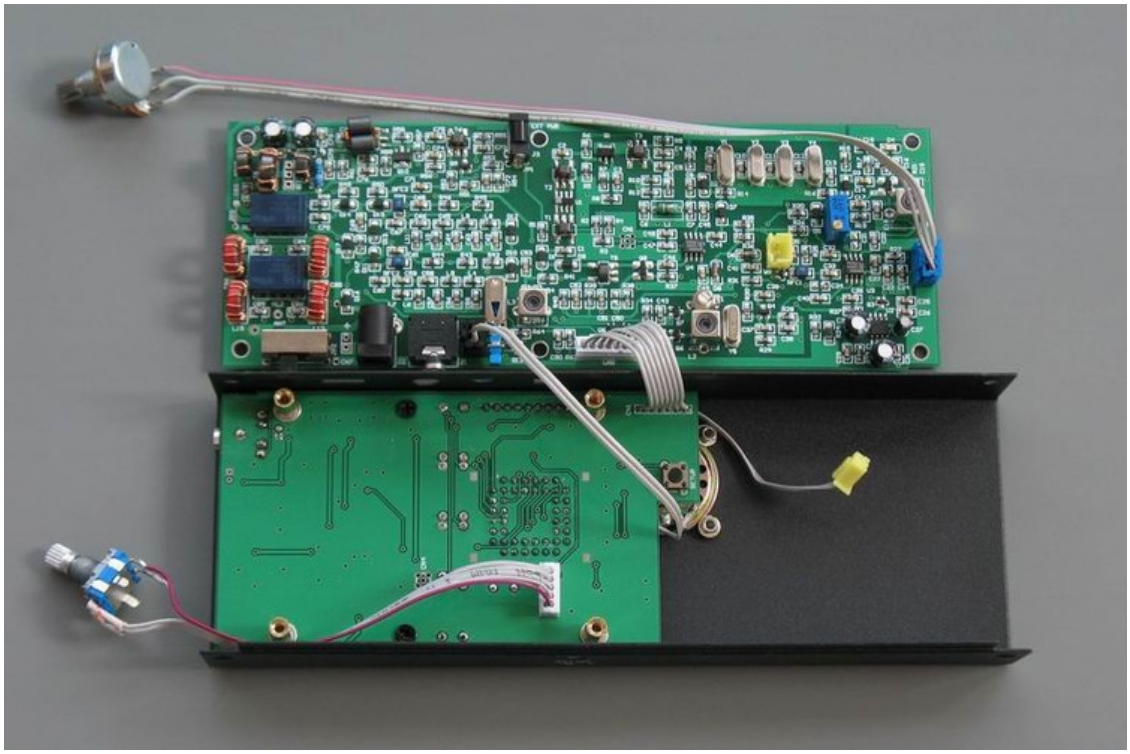


The GND pin goes to the GND pad (square pad). Assemble the blue connector, and plug the cable to CN3.

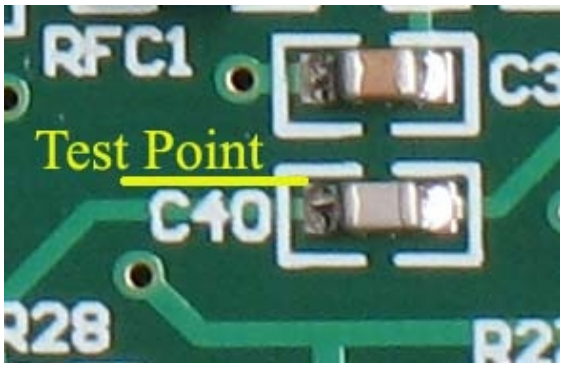
3. Testing the Rig

Five components need adjusting. They are T4, L2, VC1, 10k variable on CN2, and L3. Pug the 7-pin ribbon cable to CN5, speaker cable to CN6. Plug in the encoder. The MIC cable is not very long. Connect it later. BFO frequency can be measured in this stage.

Do not assemble the power transistor assembly to the main board now.

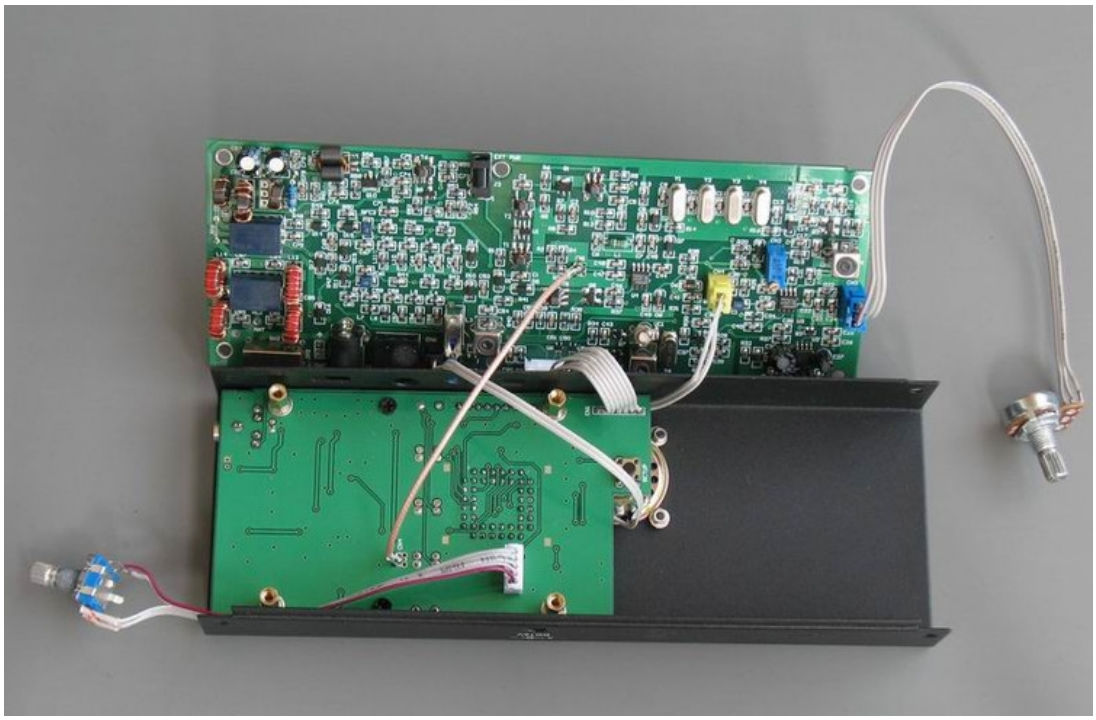


2) Connect 12V DC to J3, or to J2. Never plug in the wrong polarity! The center pin is "+". Move the power switch to EXT position (external power). If you use J2 as input , move to BATT position (battery).
3) Measure the BFO frequency.
Measure BFO at left side of C40. insert a 470-ohm resistor between the test point and the probe to minimize the pulling. This resistor value is not very critical, any value from 220 ohm - 1k.

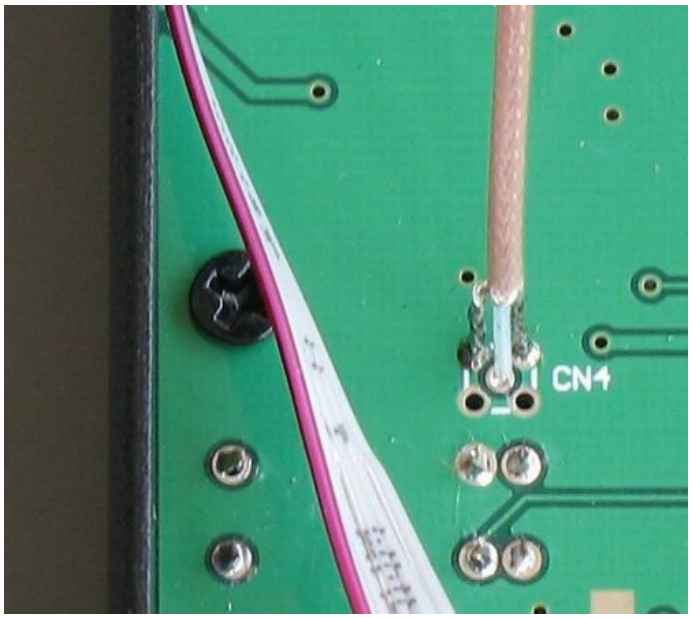


Press MOD to select LSB. Adjust L2 until the frequency is 8.99840 MHz. Select USB, adjust VC1 until the reading is 2.8kHz higher than that of LSB, i.e., 9.0012MHz.
Adjust the 10k trimmer on CN2 to the end, so that D4, the LED, lights the brightest.

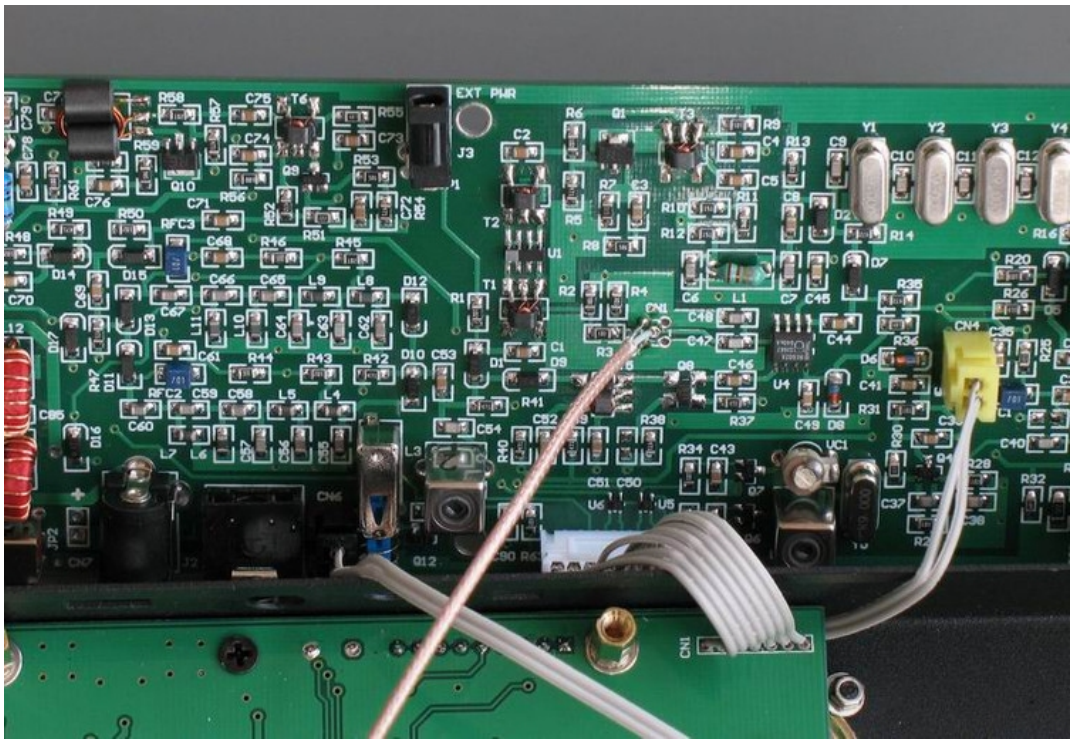
Now, solder the 50 ohm cable. Connect the MIC cable.



50 ohm cable and MIC cable are connected.



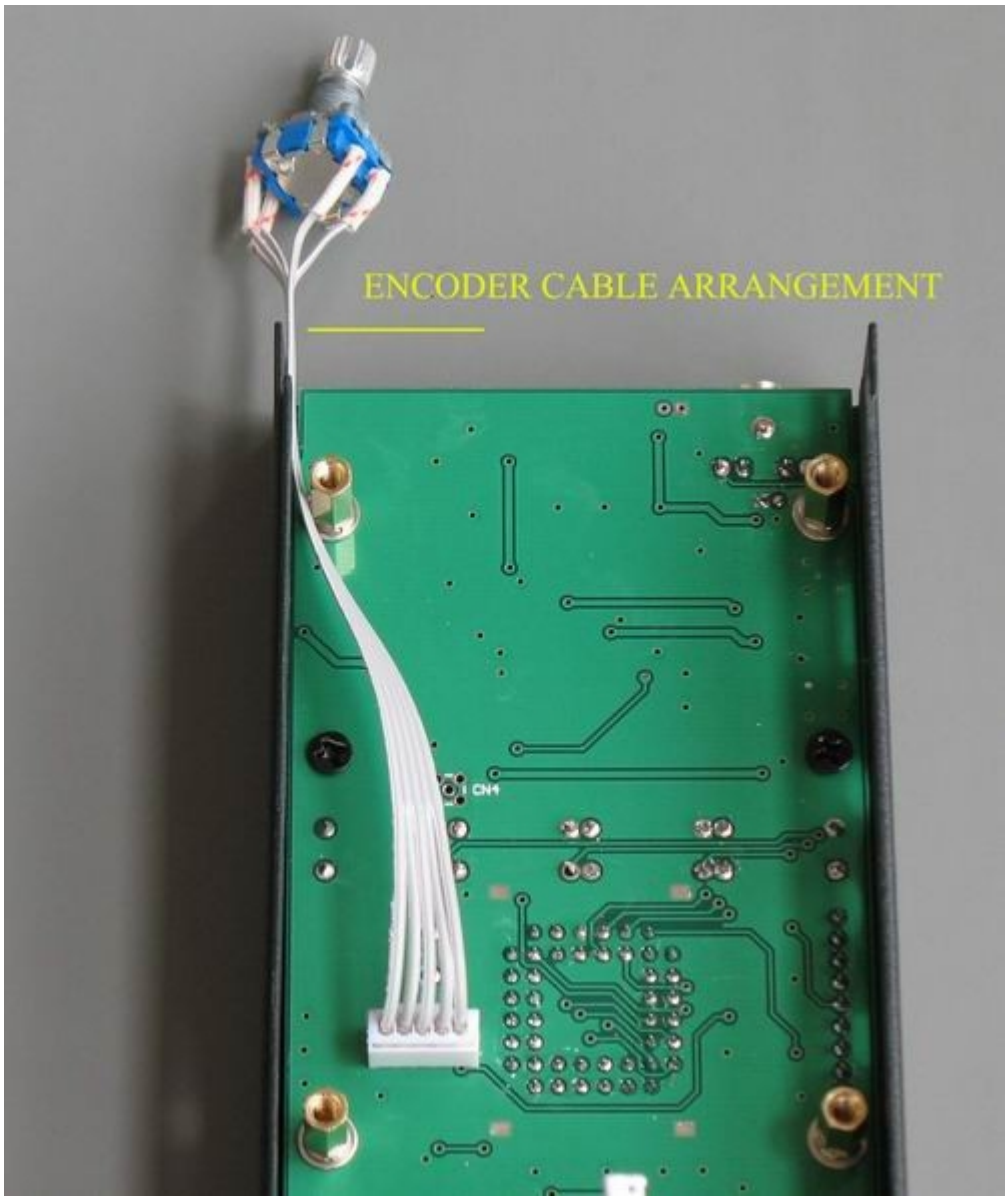
How the cable is soldered.



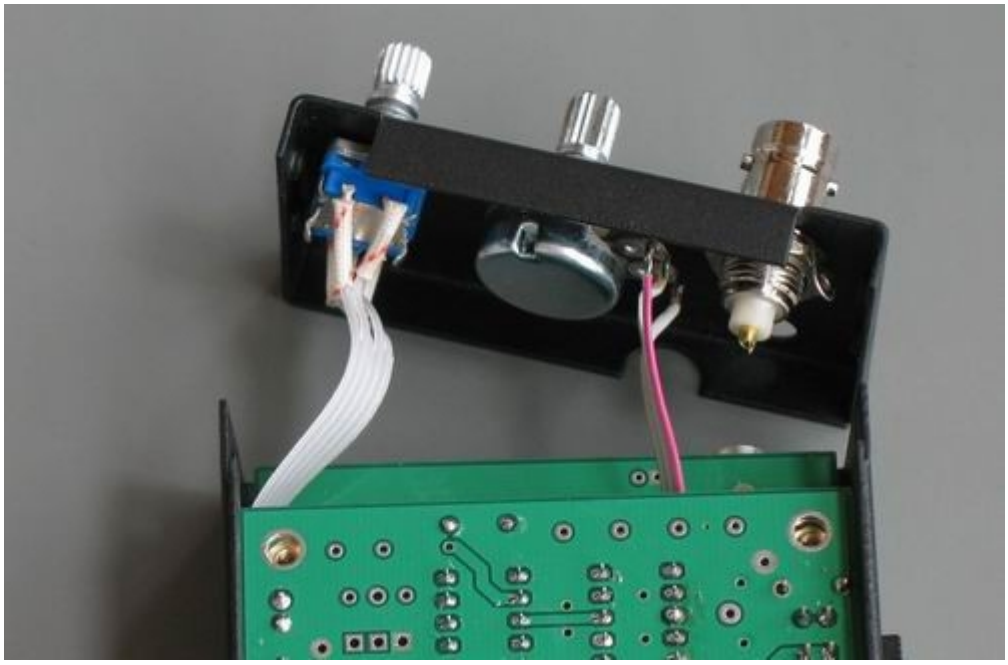
Now connect the antenna. Set AF GAIN to 1/3 or 1/4 level. Tune to 7MHz, adjust T4 to peak the recieved signal. Rotate the TUNE knob, you can hear ham signals, and other radio stations. If you are testing the rig in the evening, at 5MHz, you can pick up the beacon signal. In the day time, you can pick up the beacon signal at 10MHz, and 15MHz.

4) Align the IF trap. L3 is a trap coil which eliminates the 9MHz leakage. When the slug is at the same level with the metal case, it is almost in the position to trap the IF. However, it needs trimming to achieve the best result. Rotate TUNE knob to reach 8.9900MHz. Adjust L3 until the received noise is lowest, i.e. to **suppress**the signal, not to **peak** the signal.

With all the calibration work finished, the main board can be placed into the enclosure.

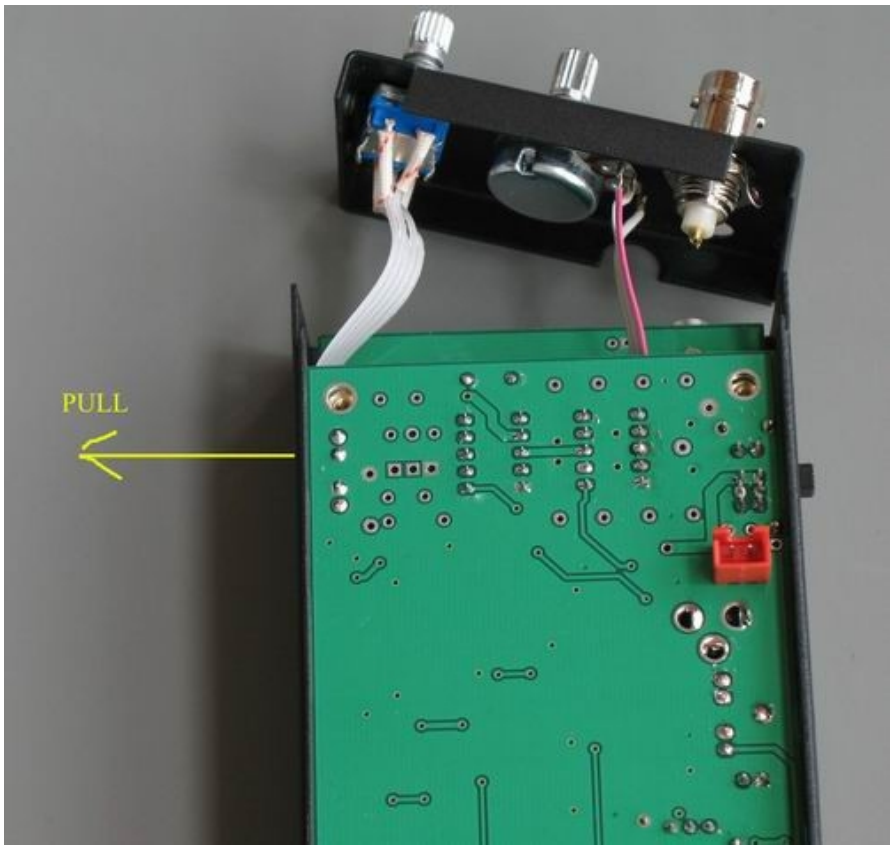


See how to arrange the 5-wire ribbon cable.



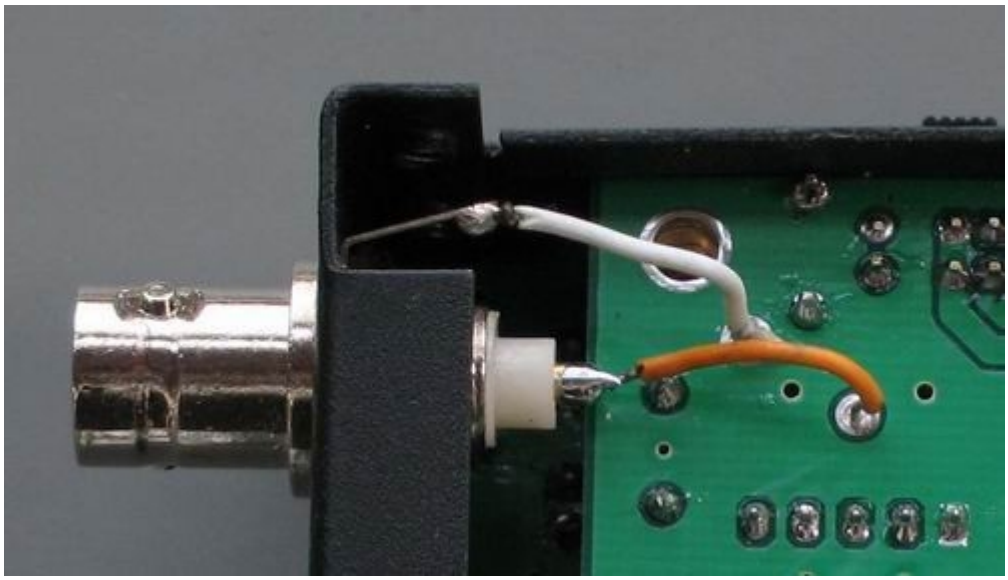
Fasten the encoder, AF GAIN POT, ANT socket to the top cover, but do not assemble the cover to the enclosure.

Slantly slide in the main board, with the power switch handle aligned with the opening on the side.

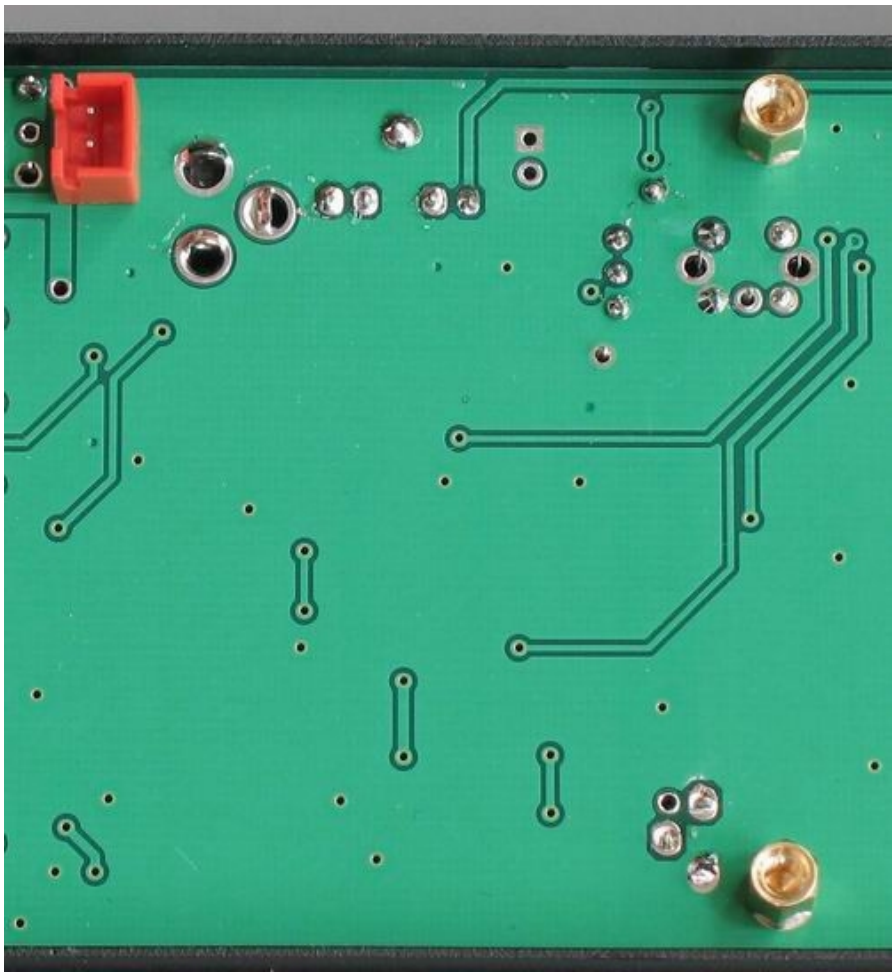


The enclosuer side wall blocks the main board a little, because of the DC12V socket. Pull the enclosure edge, and press the main board at the same time, so that the main board goes into the enclosure.

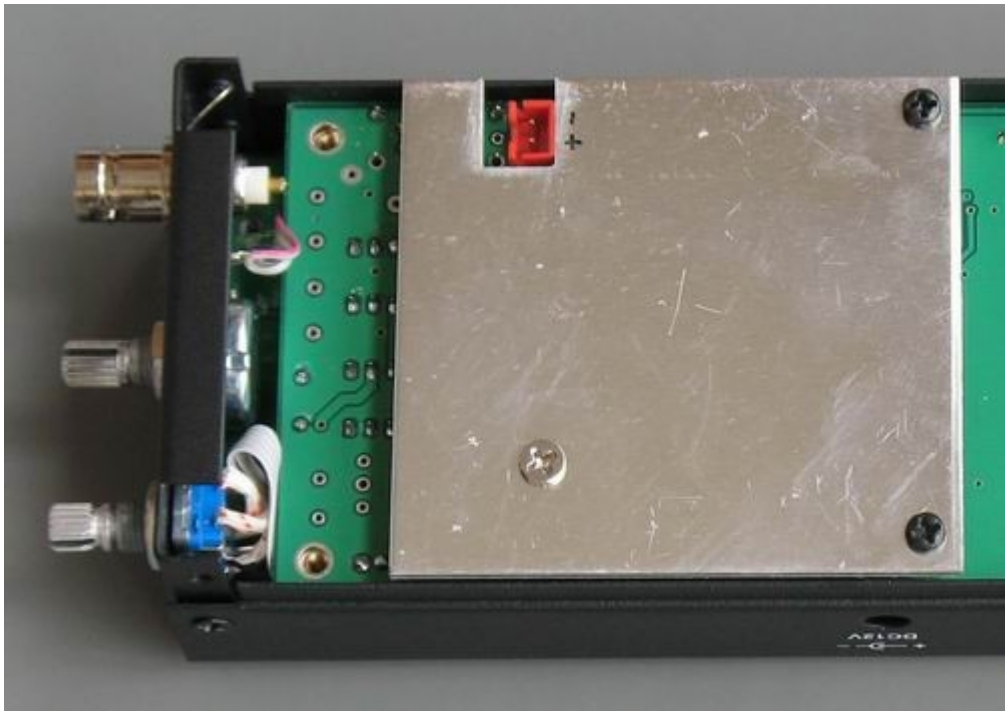
The ANT socket tail may be a little longer. Cut the tail to fit the space. Fasten the cover to the enclosure walls.



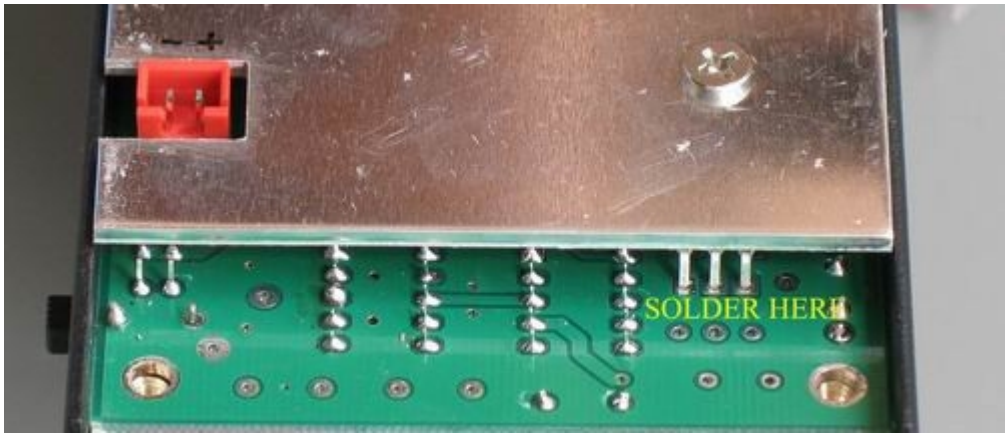
Don't forget to solder ANT leads.



Assemble the two brass stands-off with a tai to the mounting holes.



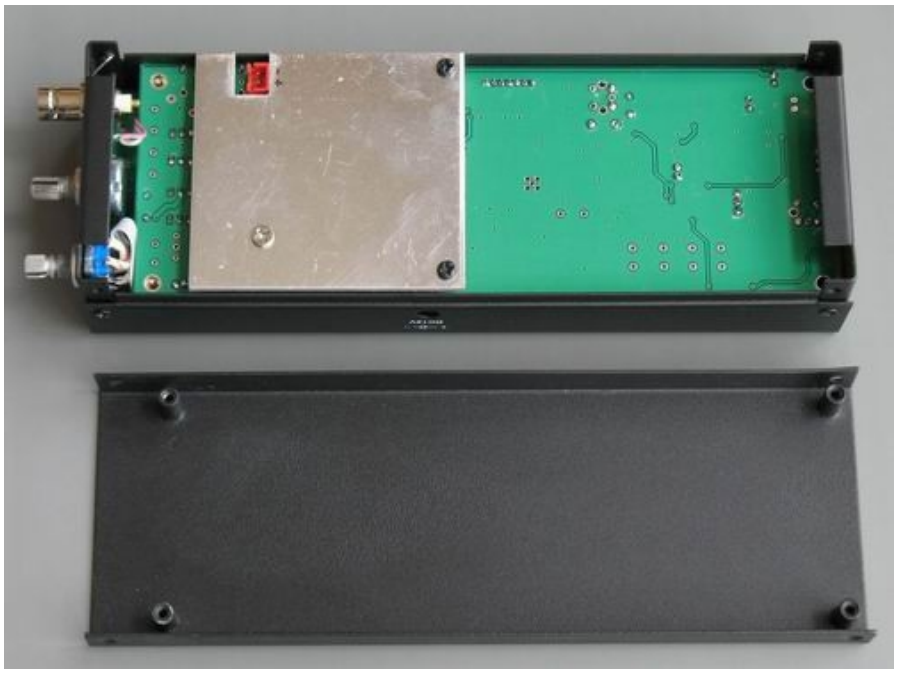
Assemble the power transistor assembly to the main board , with the power transistor leads in the pads. Fasten the aluminium to the stands-off.



You can solder the 3 leads easily. No screws are needed in the 2 top mounting holes.

Now, put on the PTT button. Plug in the DC cord, and connect the antenna. Switch on the power.
Does the rig work? Yes. OK. Press PTT and talk to the MIC. Output power can be observed on the power meter. The MIC opening is very small, so the internal MIC is not very sensitive. For better performance, please use an external MIC.

Now you can close the bottom and back covers.



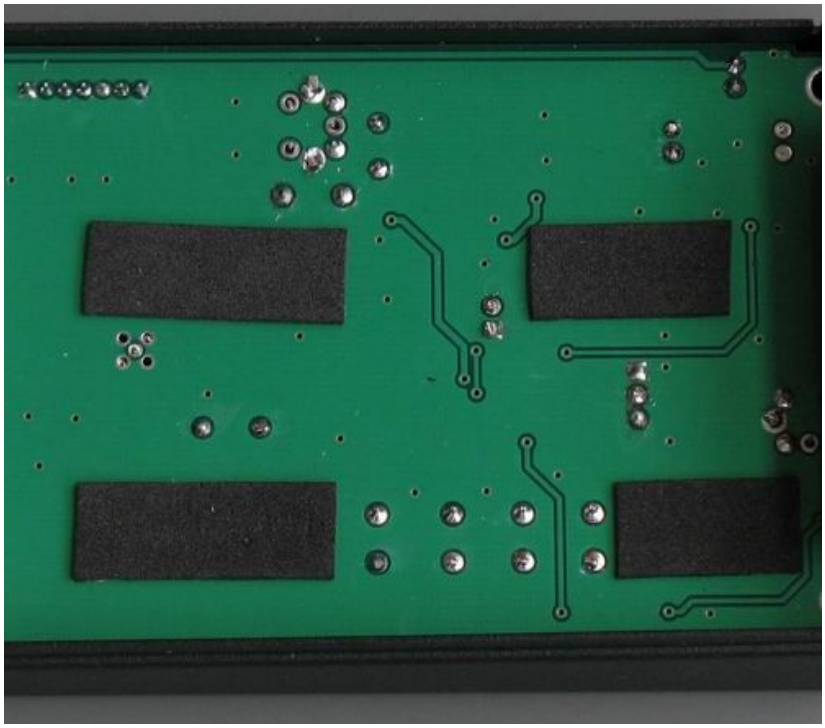
Assemble the bottom cover.

The last step.
How to place the battery?

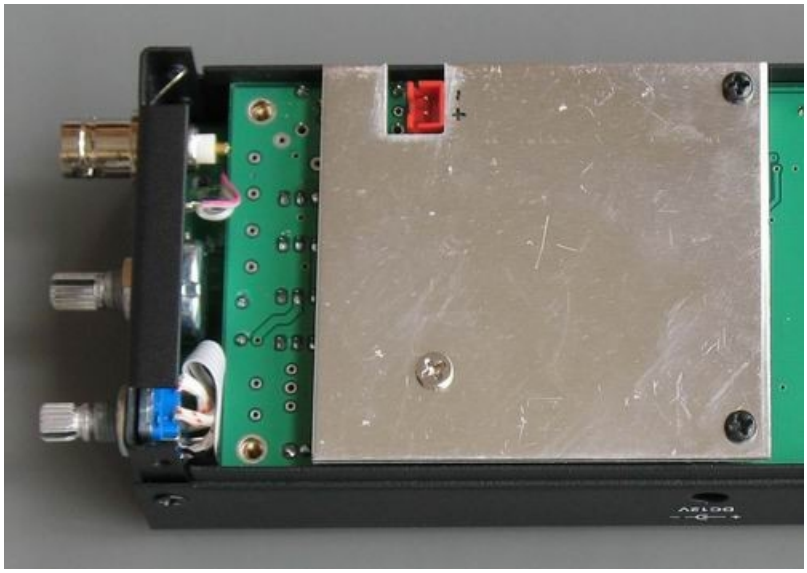
The battery pack (optional) is placed on the back cover, with 2 pieces of adhesive tape. It

is also a good practice to placea piece of tape near the connector.

Cut the leads short if they are too high above the main board back, such as the can inductor leads, CN4 leads. Stick 3 or 4 pieces of thicker tape on the main board. Place a piece of thin hard card between the tape and the battery to prevent it from touching the main board.



Never connect the wrong battery polarity! The pin near the enclouser side wall is "-".



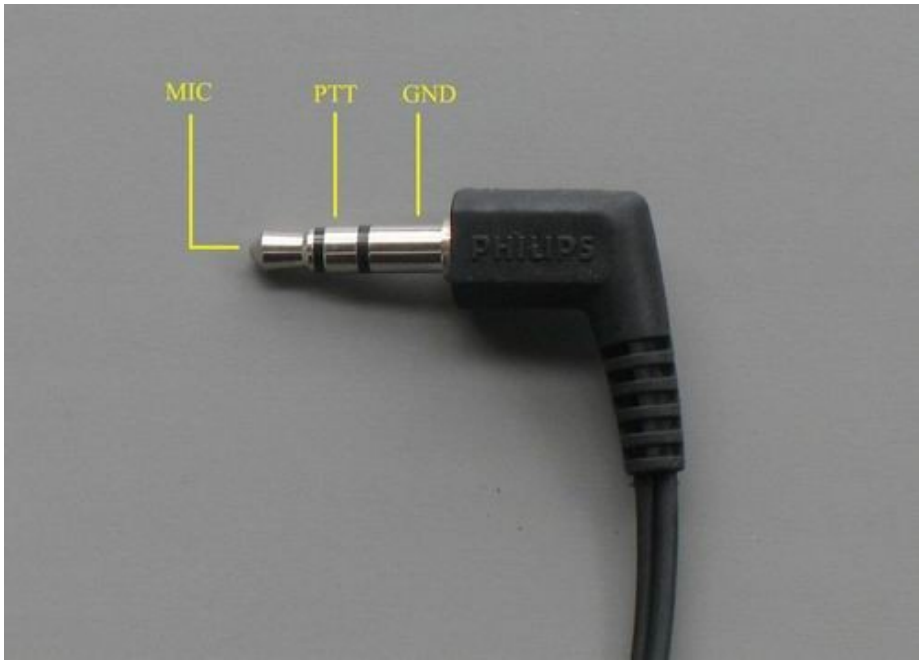
4. Operation

1) Controls and connectors on the top cover

BNC- Antenna socket

MIC- External microphone and PTT. For better performance, use an external MIC.

Note: Always turn off the power before plugging in the external MIC.



The tip is MIC, the narrow ring is PTT, and the inner conductor is GND.

AF GAIN- Volume control. Turn clockwise to increase volume.

TUNE- Frequency tuning knob/Tuning rate selector. Turning clockwise is frequency up, turning counter-clockwise is frequency down. Press the knob to select the tuning rate. The

sequence is 1Hz, 10Hz, 100Hz, 1kHz, 10kHz, and 100kHz.

2) Buttons:

MOD- Mode switch. Press to select LSB, USB and CW (RX)

A / B- VFO Selection /Memory clearing. Press to select VFO A or VFO B. In MEM state, hold the button until all of the memories are cleared.

V / M- VFO/MEM switching. Press to switch between VFO and MEM. Turn TUNE to select the memory number.

MEM- Frequency saving/MEM to VFO transfer. Press to save the frequency to the memory. Press MEM, the memory number appears. The dashes indicate the blank state of the memory. Turn TUNE to select the MEM position you want to store the frequency into. MEM00 - MEM39 can be used to store the frequency.

In MEM state, press MEM, VFO appears on the left corner. For example, VFO A may appear on the left corner (Press A/B to select the VFO you want to transfer the memory to). Press MEM, the frequency in the memory will be transferred to VFO A. Press V/M to enter VFO A, and now you can see the transferred frequency.

3) Switches and sockets on the side

BATT- When the switch is set at this position, the internal battery is switched on, and the rig works if the battery pack is installed.

OFF- When the switch is set at this position, the power is off. The rig stops working.

EXT- When the switch is set at this position, external power is on, and the rig works if 12V DC is plugged in the 2.5mm DC socket.

CHG- Battery charging socket. The battery is charged no matter what position the switch is set.

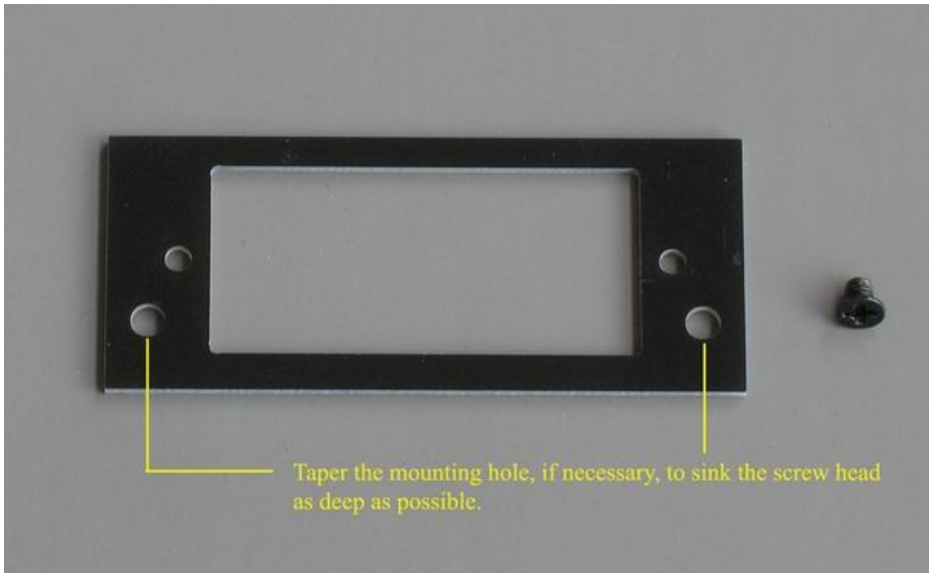
PH- Earphone/speaker socket. Either earphones or speaker can be used.

PTT- Push to talk. Press to transmit.
DC12V- External power socket

5. Miscellaneous

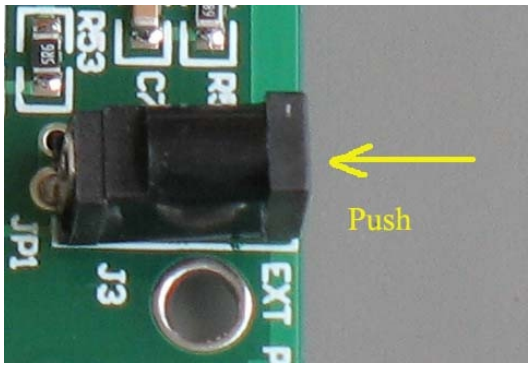
Bias resistor R62- This resistor depends on the specific power transistor and D18. The supplied resistor is 680 ohms.

LCD Holder - Sink the 2 mounting screws (screen side) as deep as possible. Otherwise the LCD could not reach the position. If necessary, taper the 2 mounting holes a little so that the screw heads sink a little. Use a knife or a drill bead to taper, i.e., to tim the eadge of the mounting hole.The material is rather soft.



BFO calibration- There is the possibility that the BFO frequency cannot be adjusted to 8.99840MHz. The highest is 8.9980MHz. Never mind. Use 8.9980MHz as LSB. In this case, USB frequency should be 400Hz lower, i.e., 9.0008MHz (USB is 2.8kHz apart from LSB), not 9.0012MHz. Also, the alteration should be made in IFS in the DDS calibration procedure. IFS should be set to "-2000", instead of "-1600".

EXT PWR Socket- This socket makes pushing-in-the-main board a little difficult, not the two 220uF caps. However, if correct procedure is followed, pushing in the main board would be very easy. Try to push the socket inwards when soldering it to the PCB so that it moves back a little instead of projecting.

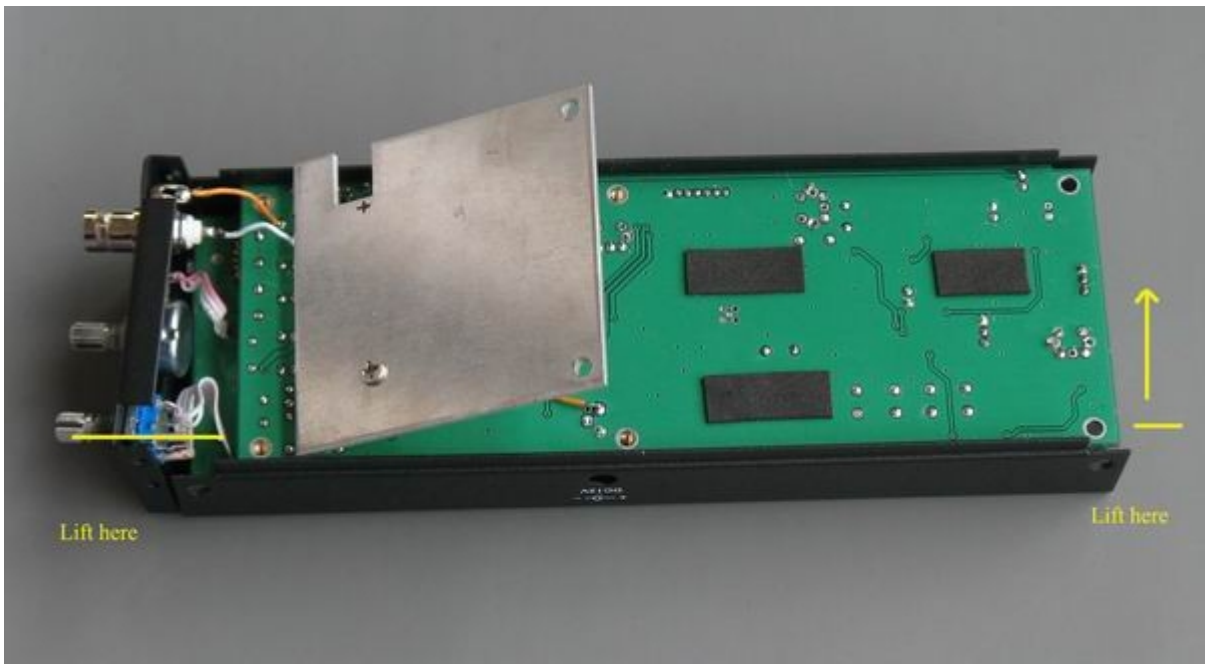


6. Dis-assemble the rig

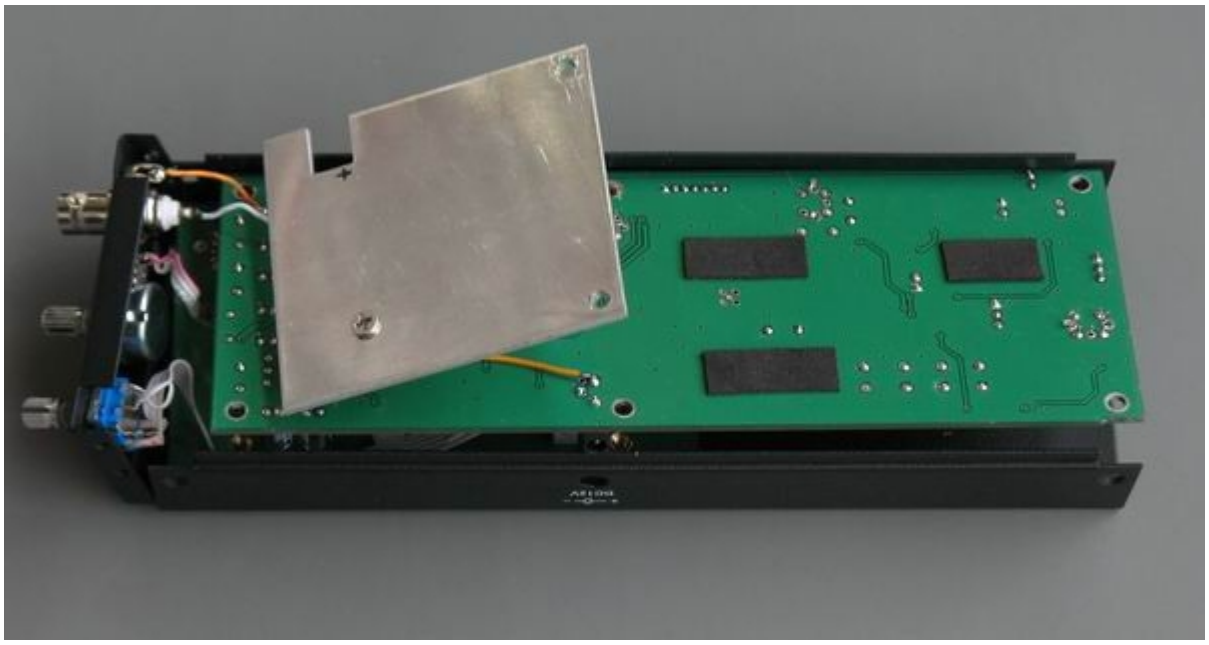
You may want to improve the kit, or the kit needs repair some day. You have to open the enclosure and take out the main board. Dis-assemble the kit reverse operation.

1) Pull out the PTT button. Remove the screws and open the back cover.

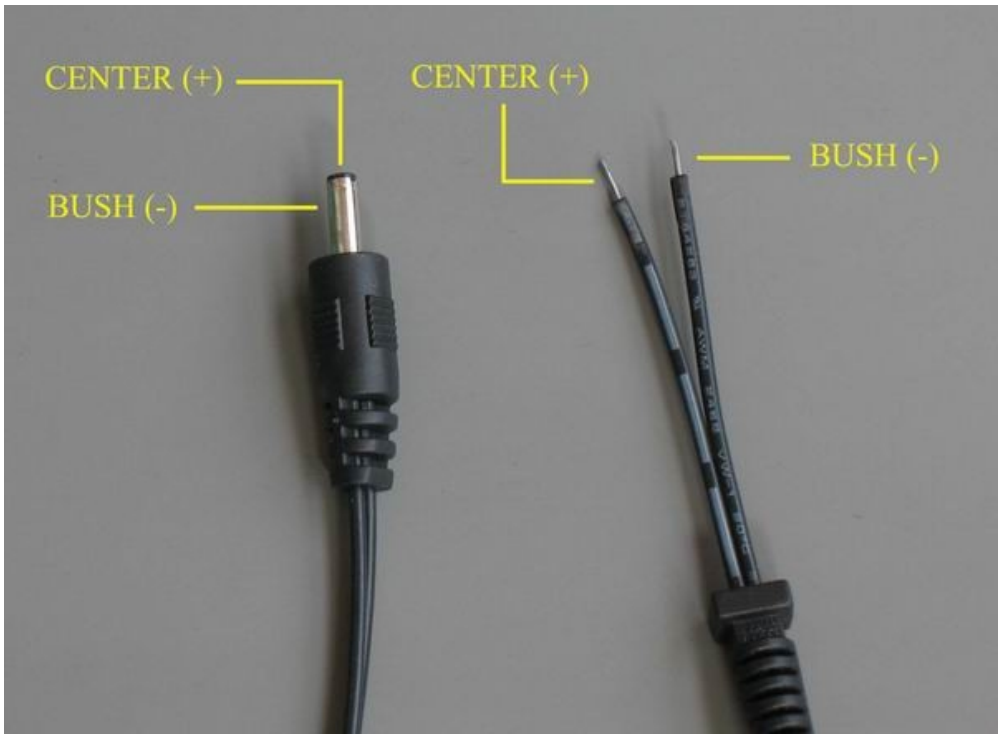
2) Remove the two screws to fasten the aluminum plate. Lift the aluminum plate a little until you can reach the two brass stands-off, and remove the stands-off. Remove the screws that fasten the top cover and the bottom cover. Take away the bottom cover. You may need to unsolder the two wires connected to ANT so that you have more room to lift the left corner. Lift the main board with two of your fingers as indicated.



Now, the main board is up from one side, ready to be pulled out.



7. DC cable- The wire labled white dash is the center, i.e., "+"; the other "-". However, please use the ohm meter to confirm. The bush should be connected to "-", the center to "+", never use the wrong polarity!

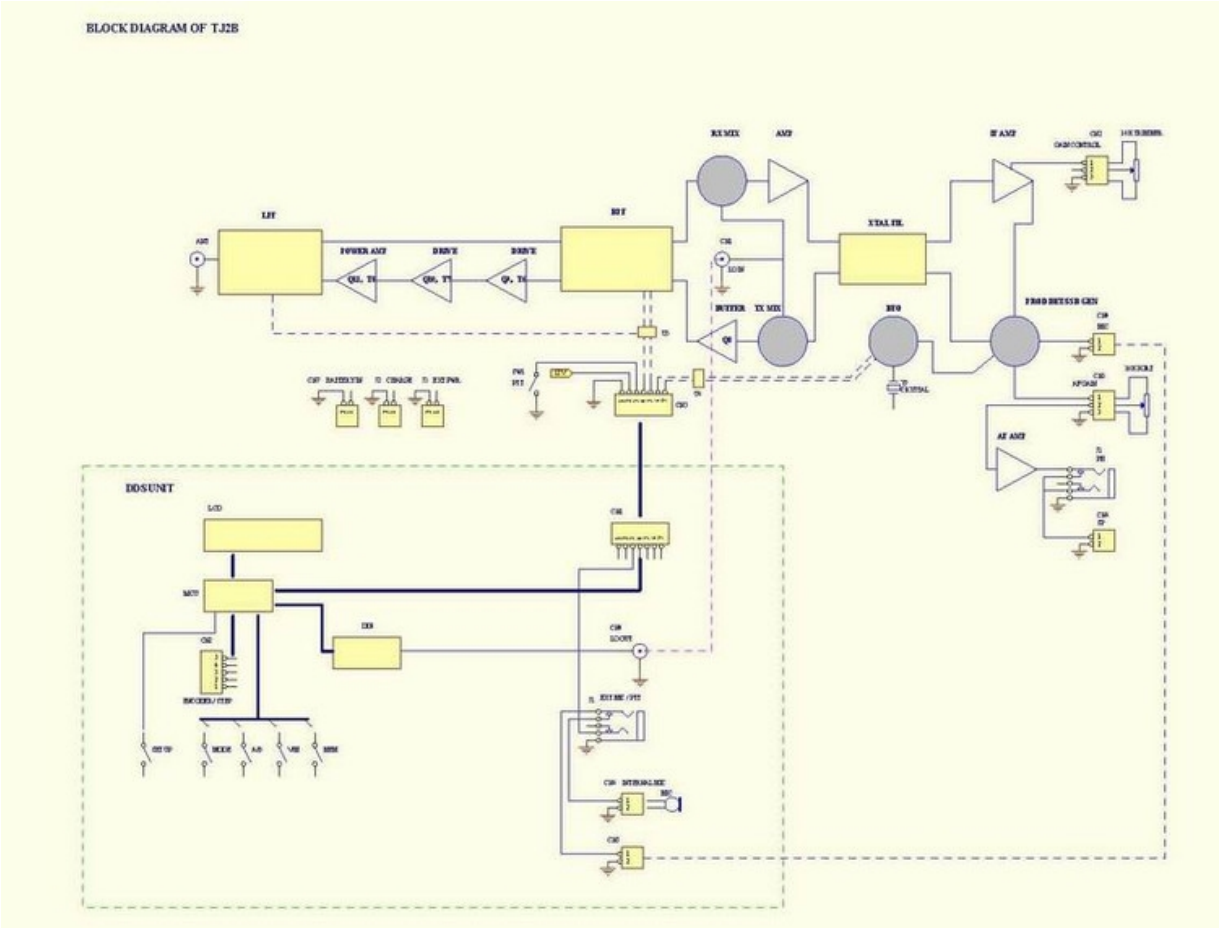


8. KIT B Notes

Construction of KIT B is the same, except the following:

1) L3 is not necessary. No. 2 can inductor is not supplied in the kit;
2) C50 is a pre-assembled cap;
3) T8 - Broadband transformer, 4 turns;
4) L12, L13 - 15m LPF inductor, 10 turns;
5) L14, L15 - 10m LPF inductor, 8 turns.

9. Block Diagram



10. Simple Way to Calibrate L3

A much easier way to calibrate L3 is to tune the frequency to 8.998000MHz with antenna connected, and adjust L3 until the received noise weakest, i.e., to suppress the received signal. Use 100 KHz tuning rate to get to that frequency faster.

While you tune from 3 MHz - 8.998000 MHz, you may notice a sudden mute (received noise level drops suddenly), this silence is where the trap works. It may be around 8 MHz with the supplied can coil (The slug is about half way into the can). Move this "silence" to 8.998000MHz. i.e., turn the slug out a little, about the same height as the metal can.

11. **Troubleshooting and Repair**

“I noticing that the TJ2B receive sound is not as loud. So I took the back cover off and when I touch the board and depress, it becomes loud again.”

This is caused by two possible reseasons on the main board:

1) Cold solder of T1, T2, T3. Please check the pads with the amplifying glass. Solder the miniature transformers with the help of the amplifying glass. Use thick books as the holder to adjust the distance between the PCB and amplifying glass.

2) A broken coupling SMD cap (The cap cracks between the body and the metal part). The SMD cap might be broken by bending or twisting force in transportation or in the process of assembling the main board into the enclosure. There will be a thin crack between the cap body and the metal part. They are C1, C2, C5, C14. C2 is the most possible because it is close to the mounding hole. Try to locate the broken cap with an antenna. Use the antenna center conductor in series with a 0.01 cap (alternatively use a long wire) to touch C14. First right side pad and then left side. A loud noise or broadcast will be heard, indicating IF AMP module and C14 are working. Move the antenna to C13, the same level will be heard. Move to C9, the sound should be much smaller, because of the XTL filter. Move to C5, the sound level should be the same as C9. Move to collector of Q1(the heat sink), same level as C5. The above tests indicate all the coupling caps are good. Now move to the right pad of C2 (base of Q1),sound should be louder than the collector due to the amplification of Q1. Move to the left side of C2, should be the same level; otherwise the cap is broken. Now move to the right side of C1. Noise or signal will be heard. Now the left side of C1. The same level as the right side of C1; otherwise the cap is broken. The crack might be found with the amplifying glass to save the above process.

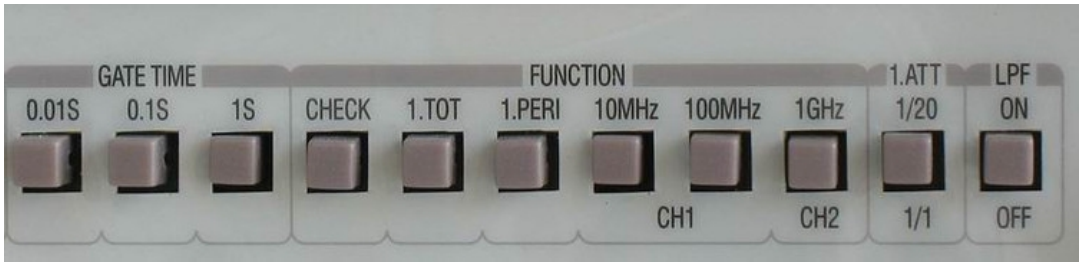
12. Calibrating DDS unit and BFO with your frequency counter

1) Select proper channel

Usually the frequence counter has two channels: Channel 1 for measuring frequency ranging from 10Hz - 100MHz. This channel is sub-divided into two ranges: 10Hz - 10MHz, the reading not scaled. 10MHz - 100MHz, the reading scaled; Channel 2 for measuring frequency ranging from 100MHz - 1000MHz, the reading usually scaled. For our purpose 10Hz - 10MHz in CH1 is suggested, because the reading is not scaled (More precise and in reality it handles frequencies up to 15MHz) and reading in "Hz" can be observed.

2) Select proper gate time

Several gate time buttons appear on the panel: 0.01s, 0.1s, 1s, etc. Which button should be used? In our case, "1s" button is to be used to obtain the reading in "Hz". 10MHz and 100MHz buttons are for CH1. Use 10MHz button since the DDS output frequency is 12.000000MHz. However, different frequency counter may have different divisions. Use the division with which the reading in "Hz" is available.



Calibrating DDS Unit

(Note: This frequency count displays in "kHz". 12000.000kHz = 12.000000MHz)

Now turn on the frequency counter, and warm-up the frequency counter for 20 minutes (Different frequency counter has different warming-up time. Consult the instruction for the correct warming-up time). Turn on TJ2B.Let it run for 10 - 20 minutes for the clock to stabilize.

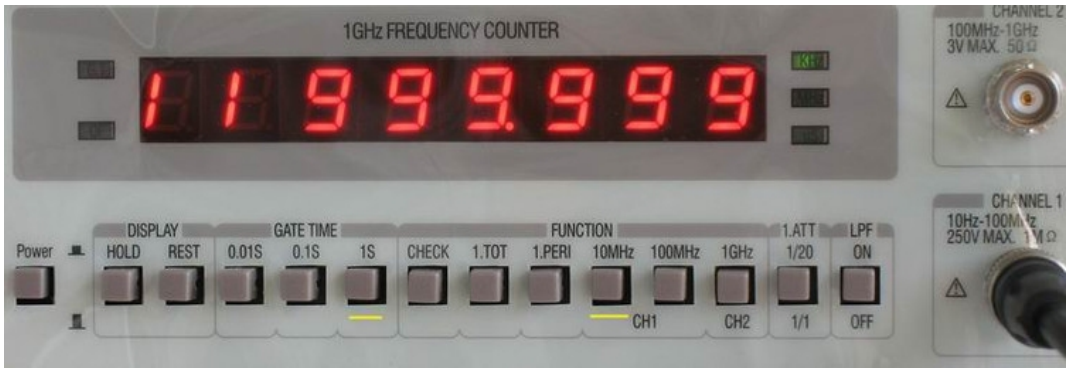
Connect the red alligater clip to the center of the DDS output cable, the black alligater clip to the ground (the cable bread). Press SETUP to enter DDS setup interface. For the convenience of reading, IFS should be at the default value, i.e., "0". For KIT A the frequency reading is the starting frequency of Band 1, i.e., 12000.000 (9000.000 + 3000.000). However, due to the tolerance of the 100MHz clock, the reading might not be 12000.000. It might be a liittle lower than that. When you move to higher bands, the situation might be much worse. It is necessary to calibrate the clock so as to have a more accurate DDS frequency output.

If you calibrate DDS clock with IFS "-1600", you have to substract "1.600kHz" from

12000.000. The reading is 11998.400 in this case

In this example, the reading is "11999.976", 24Hz lower than the required frequency (the reading might be greater at higher band.), indicating the 100MHz crystal is around 200Hz lower that the labeled frequency. Press TUNE to select 100Hz tuning rate, and rotate TUNE counter-clockwise to decrease the clock value until the reading is 11999.996.Now let's handle the 4 Hz error.

Press TUNE to select 10Hz tuning rate, and rotate TUNE counter-clockwise to decrease the clock value until the reading is 11999.999 or 12000.000.

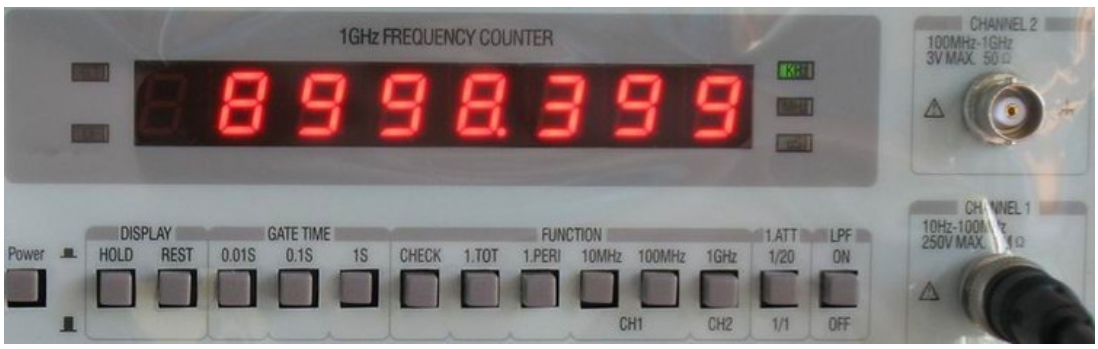


Press MEM to save the calibration. Exit SETUP.Now you can setup the IFS and USB compensation.

Some users may say, my frequency counter reading is 12000.002, some may 11999.997. This result is good enough, because the room temperature, the accuracy of the frequency counter contribute to the result. Tolerance ranging from 5 - 10Hz is acceptable.

Calibrating BFO

Connect the red alligate clip to the test point of BFO. DO NOT forget to insert a resistor between the clip and the test point to reduce the effect from the frequency counter input. The resistor value ranges from 470 ohms - 2.2k, depending on your frequency counter input sensitivity. Try to use a larger value possible. Connect the black alligate clip to the ground (the main board mounting hole). Press MOD to select LSB. Adjust L2 until the reading is 8998.399 or 8998.400. Maybe your reading is 8998.398, or 8998.401, or 8998.403.The result is good enough. Try to be as precise as possible, but never go to the extreme. 5 - 10Hz tolerance is just fine.



Press MOD to select USB. Adjust VC1 until the reading is 9001.199 or 9001.200, 2.8kHz apart from LSB. Maybe your reading is 9001.998, or 9001.201. The result is good enough.

Select LSB. If the frequency is changed a little, trim L2 again to meet the requirement.

Questions from the users:

Question 1-- I adjusted VC1 but I cannot reach 9001.200MHz. How to solve this problem?

Two reasons to cause this problem:

(1) The red clip is connected to the test point without a resistor. The input of the frequency counter might affect the BFO frequency. Or the resistor value is too small. Try to use a greater value, say 1k or 2.2k, even 4.7k if you can take a stable reading.

(2) The crystal group is different. Try to use 8998.000 as LSB, 9000.800 as USB. In this case the IF setting of DDS Unit is -2000, not -1600.

Question 2-- I had calibrated the BFO frequency to 8998.400 at LSB mode. However, when I turned the rig on next time, the frequency was not 8998.400; it was 8998.700 - 8998.900. Anything wrong with my kit?

Do not worry. About 10 - 20 minutes the frequency will be 8998.400 again. According to the experiment, it takes about 15 minutes for the BFO to stablize at the ambient temperature of 30° C. The BFO crystal needs warming-up time. Let TJ2B work for 15 - 20 minutes before Calibrating the BFO frequency.

Question 3-- I have calibrated the DDS unit and BFO, but the kit still has 30 Hz error.

Tj2B is used with the advanced DDS as LO, the frequency is accurate, rock-stable; the signal pure and clean, the tuning fast and smooth. However, the the accuracy of the DDS depends on the precise calibration of the DDS clock. A good frequency counter is required for this process.

After the clock calibration is saved, tune the frequency to the highest frequency of band 2 to see if the the frequency is still accurate. For Kit A the highest frequency is 18.199999. The frequency counter reading should be 27.199999. If it is lower than this, you have to calibrate the clock again: decrease the clock 10 or 100Hz for a try. Repeat the process until both the lowest and highest frequencies are 12.000000 and 27.199999 respectively. With 8-digit frequency counter it is not easy to find the small frequency error at the calibration stage. The frequency counter displays 11.999999. It seems that an increase or decrease of 10Hz in clock does not affect the "Hz" reading. In reality does. The small error becomes bigger as the frequency increases.

After the DDS calibration, please calibrate the BFO. Refer to **"Calibrating BFO"**for details.

Important: The accuracy of the DDS and BFO depends heavily on the accuracy of your frequency counter. If your frequency counter is not accurate, your TJ2B's frequency will not be very accurate, but this would not degrade the performance of the kit except for the 50 - 100Hz display error.