

TJ6A pro High-Performance SSB/CW QRP Transceiver

Construction Guide (2011.01.30)

With the SMD doubly-balanced diode ring mixer as the receiving mixer and HSB88WS as the product detector, **TJ6A** offers excellent low-noise reception and strong signal handling ability. **TJ6A** is used with DDS (AD9850) as LO, offering wider frequency coverage.

Operating Power:

12 – 13.8 V

Output Power:

8 W (15 m: 5W)

Frequency Coverage:

BAND 1: 3.100000 – 4.099999 MHz

BAND 2: 4.100000 – 7.799999 MHz

BAND 3: 9.950000 – 15.099999 MHz (Covers 30m and 20m)

BAND 4: 17.950000 – 21.999999 MHz (Covers 17m and 15m)

Operating Mode:

LSB, USB, CW

IF:

9 MHz

Tuning Rate:

1Hz

10 Hz

100 Hz

1 KHz

10 KHz

100 KHz

Memories with VFO features:

Eight memories with features of VFO's, each memorizing the last operated frequency and mode

Dual System:

Two separate operating interfaces, covering different frequency range

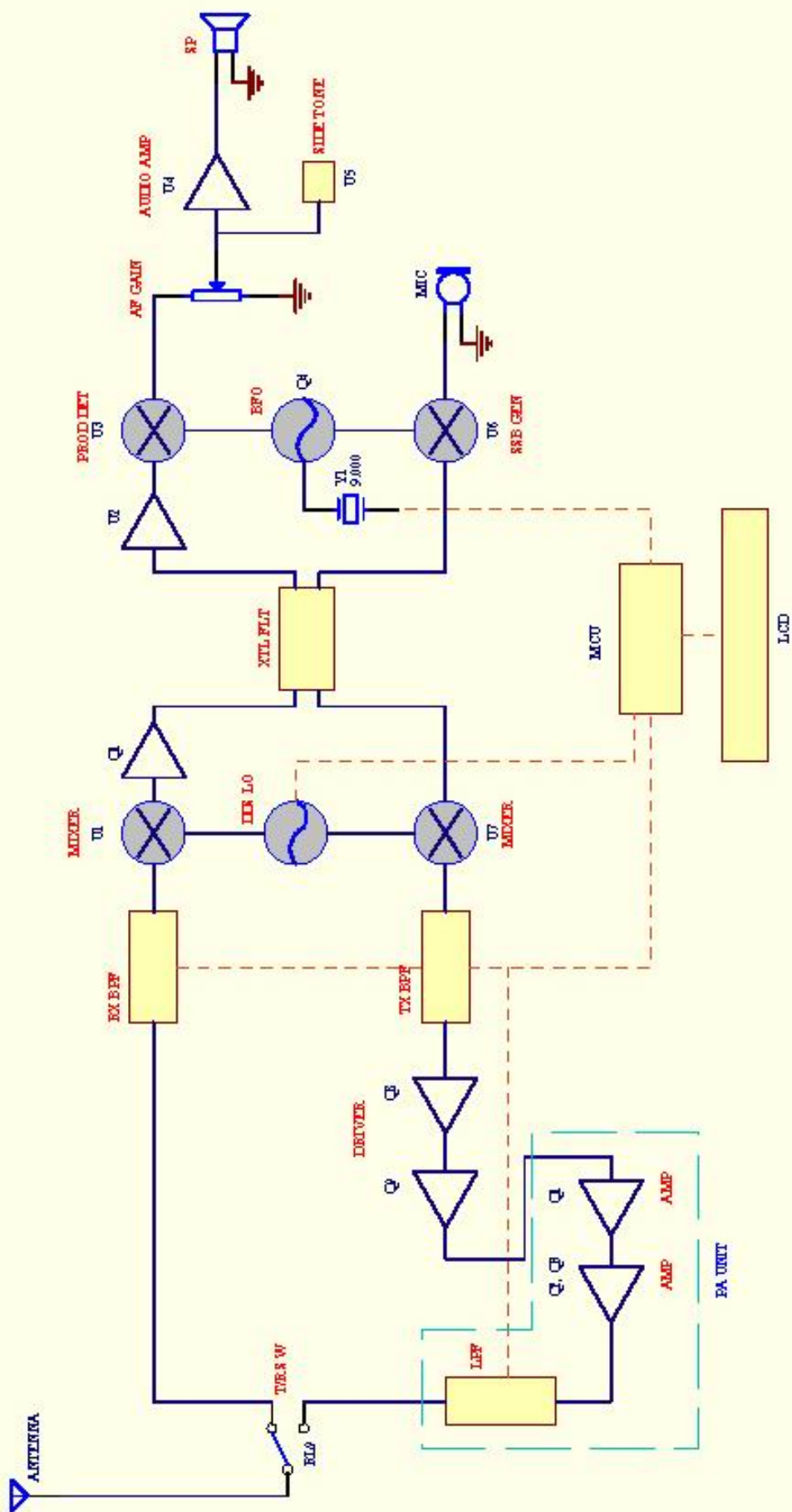
LED S Meter:

10-LED S meter offers a logarithmic 3dB/step analog display. Each 2 LEDS stands for 1 S.

Other New Features:

Plug-in RX and TX BPF modules and Plug-in IF XTL filter module

BLOCK DIAGRAM



1. Circuit Description

For better performance, an HSB88WS is employed as the first mixer, and another HSB88WS as the product detector. The signal is first routed through the BPF and then the doubly-balanced diode ring mixer (made up of U1, T1 and T2) which mixes the signal with LO. Q1 compensates the conversion loss. The amplified signal is fed into XTL FLT to remove the unwanted side band, and the amplified by IF amplifier U2. Output from the IF amplifier is fed into product detector U3 (HSB88WS), and mixed with BFO energy to produce audio signal. U4 amplifies the signal to drive the louder speaker.

The input impedance of Q1 is 50 ohms, matching that of the mixer. The 6-dB pad made up of R11, R12, and R13 preserves the input and output match of the stage. The amplifier gain is about 16dB. The loss of the mixer is about 6dB. The net gain of this circuit is about 10dB. The pi net work consisting of C7, C8 and L1 converts the 50-ohm impedance of the amplifier to the impedance required by the XTL filter.

U2 (LA1201), the IF amplifier, provides a gain of 55dB. This IC offers good AGC function and low noise feature.

The detector used here is HSB88WS, the output of which is applied to a net work formed by C23, C24 and R27. This network reduces the RF contents.

U4 (LM386) is the audio amplifier. C26 removes the hiss sound.

Separate BPF units are used in TJ6A: two for receiving purpose, and two for transmitting purpose. The RX BPF modules cover 3.1 – 22MHz, offering a wide receiving range with good selectivity. The TX BPF modules are identical with the RX BPF modules for the purpose of simplicity. However, for the best performance, different optional modules could be plugged in.

U6 functions as the modulator, mixing the signal from MIC with the BFO energy. Again, the XTL FLT removes the unwanted side band, and the signal is fed into the TX mixer U7 which mixes the signal with that from LO to produce the TX signal. The Signal is fed into the BPF unit to select the wanted signal and remove the harmonics. The selected signal is fed into Q8 and Q9, and then fed into PA board. The amplified signal is filtered by the LPF to eliminate the harmonics, and fed into the antenna.

RL1 operated by Q10, serves as RX and TX power switch. When PTT is pressed, Q10 conducts and RL1 functions. Q11 serves as CW power switch. When KEY is pressed, Q11 conducts, and 12V operates Q12 which makes Q10 conduct. D13, R69, C72, and R70 form relay holding circuit to extend some hold time after the last character and space, in order to limit the fast back and forth TX-RX cycles. When KEY is pressed, 12 V charges C72 through D13 and R69. During the very short intervals of key up, C72 discharges through R70 to the base of Q12, so that Q10 keeps conducting, avoiding the unnecessary frequent relay operation to save relay service life and avoid the contact noise. Increasing the value of R70 or C72 increases the relay hold time. Reducing the value shortens the hold time.

Q4 forms the BFO circuit. L2 pulls the frequency down to the desired BFO frequency for LSB. Mode control signal from DDS Board conducts Q5, switching in L2. Q6 is the USB switch. In USB mode, the control signal from the DDS unit makes

Q6 conduct, switching in VC2, which increases the frequency to the desired BFO frequency for USB. Q6 is also the CW mode switch. In CW mode, Q6 conducts, switching in VC2. However, in CW transmission, the keyed voltage from Q11 makes Q7 conduct, switching in VC3, lowers the frequency to change the frequency to the desired BFO frequency for CW transmission.

Q3 is the mute circuit, muting U4 during transmission.

U5 functions as the side tone circuit. When KEY is pressed, the keyed voltage is supplied to U4 via R34 and U4 starts working. The 1 KHz-tone is fed into U4 via C33, VR3, R32 and C35. VR3 sets the volume of the side tone. The keyed voltage is also fed into Pin 2 of U6 via D11 and R44, making the IC unbalanced and CW carrier is produced. The value of R44 controls the level of CW signal.

The optional VR1, R16, R17, R18, Q2, and C11 form the automatic bandwidth control circuit. In CW mode, with optional XTL filter unit, this circuit narrows the XTL filter bandwidth for better CW reception. In transmission or SSB mode, the control circuit is disabled.

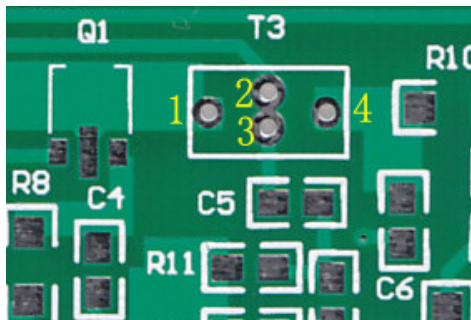
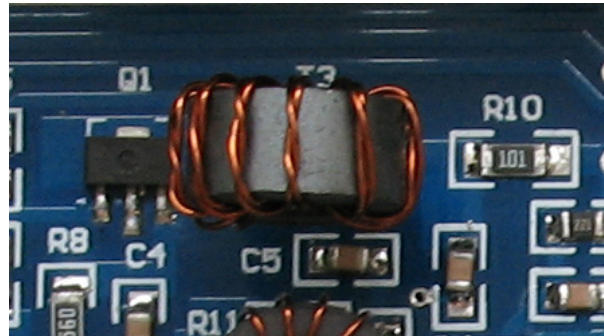
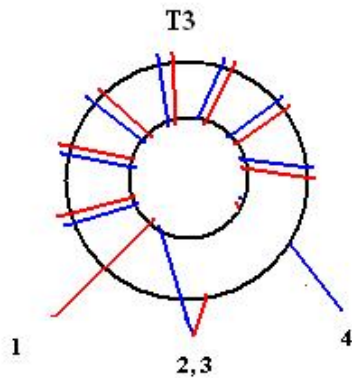
Q14 functions as the key control. When Q14 conducts, the driver Q8 works, and the signal is transmitted. Q13, D14, and D15 disable KEY function in SSB transmission, and disables MIC in CW transmission.

2. Construction

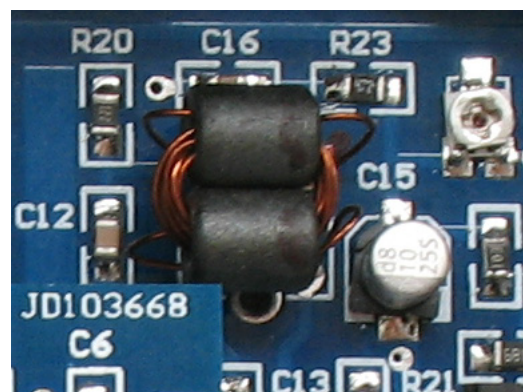
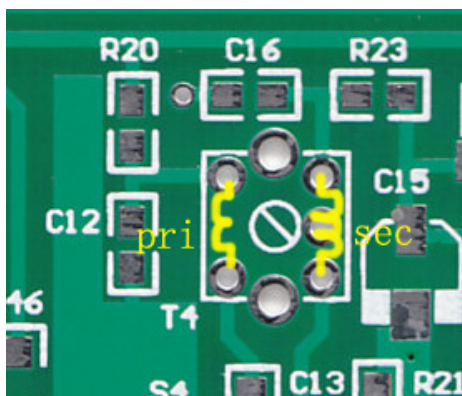
2.1 Winding Transformers and Coils

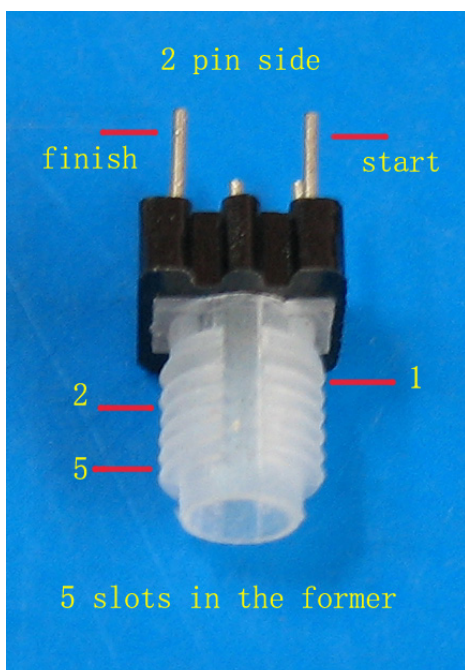
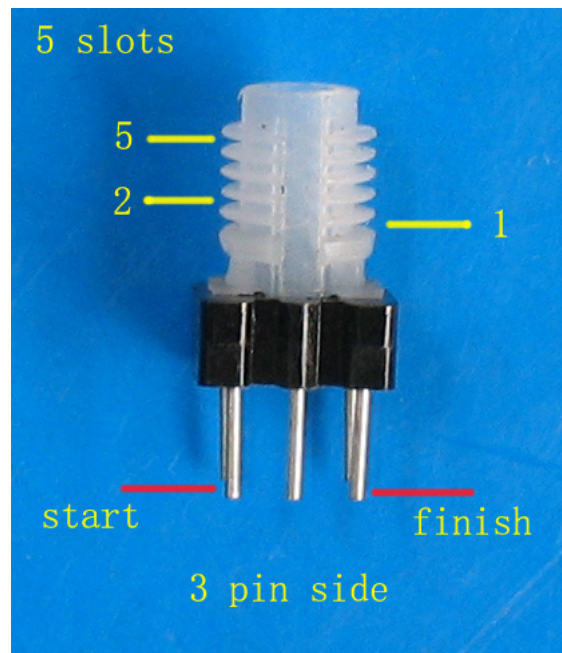
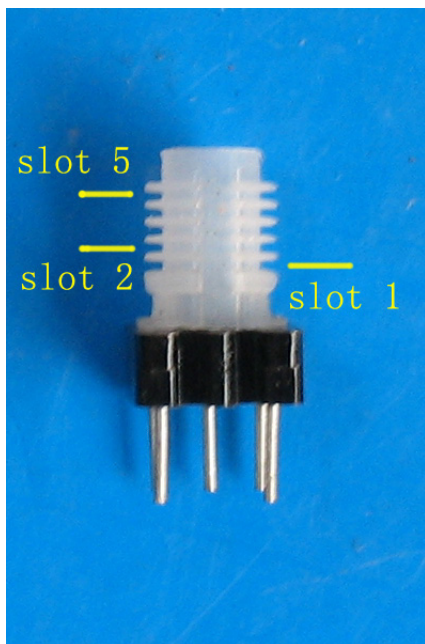
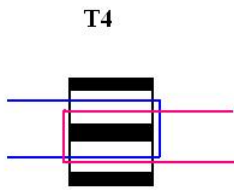
2.1.1 Main Board

T3: Broad-band ferrite transformer, 8 bifilar turns, 0.31 wire, on the broadband core. Cut 2 wires of 18 cm long, and twist them. See photo. Pay attention to the phase. As shown in the picture, red wire is Wire A; black wire is Wire B. The end of Wire A (2) is connected with the start of Wire B (3) as the tap.



T4: IF transformer. Use 2 sleeves to form a binocular core. 0.31 wire, primary (C12 side) 3 turns, secondary (C15 side) 9 turns. Cut 14 cm of wire for primary; 23 cm for secondary. Mark primary and secondary before winding the transformer, so that you can identify the primary and secondary easily.

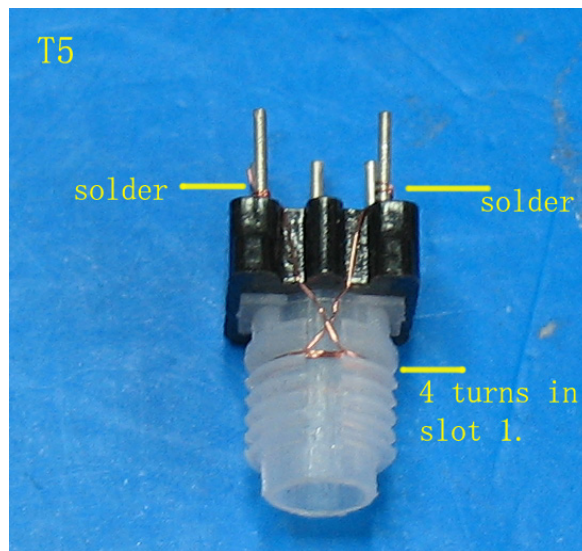
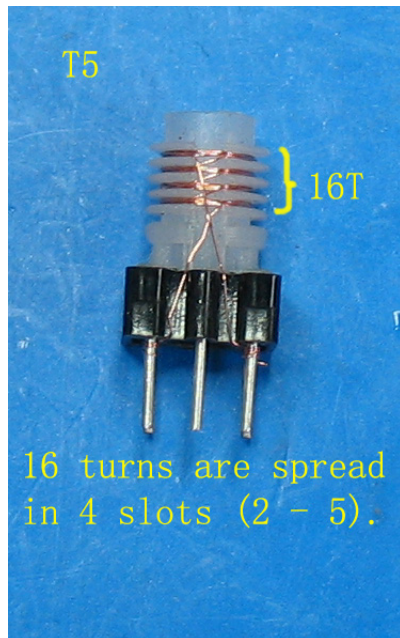


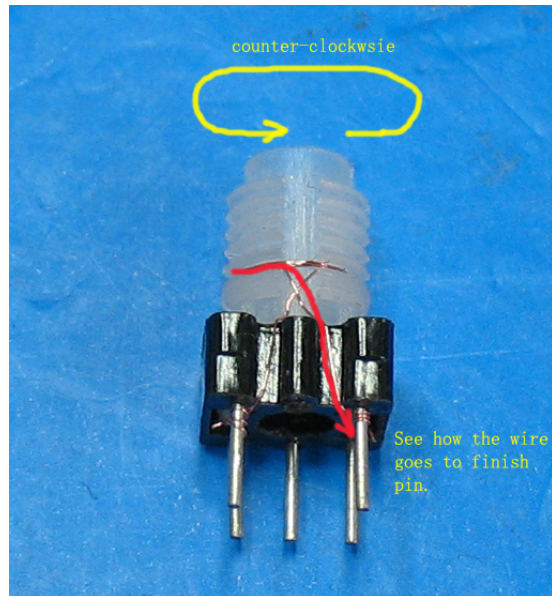
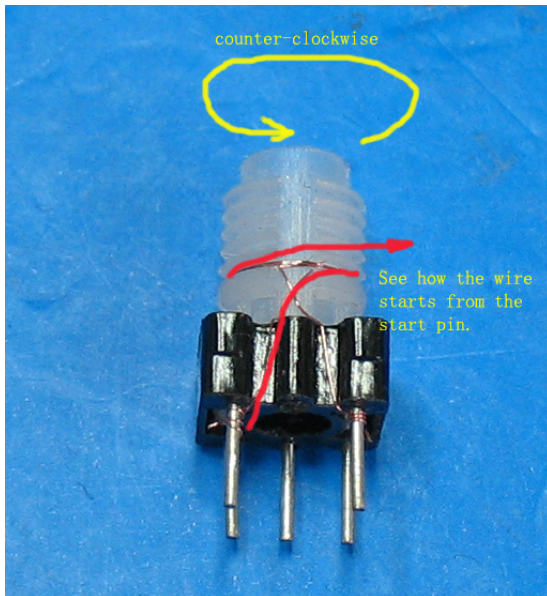
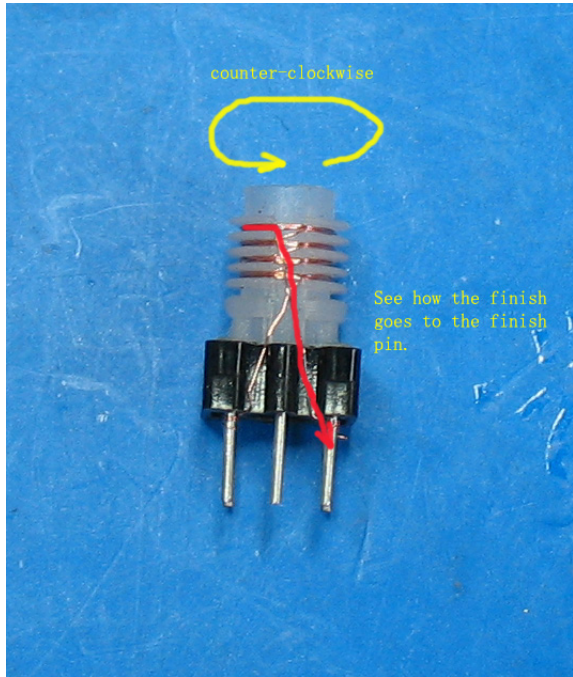
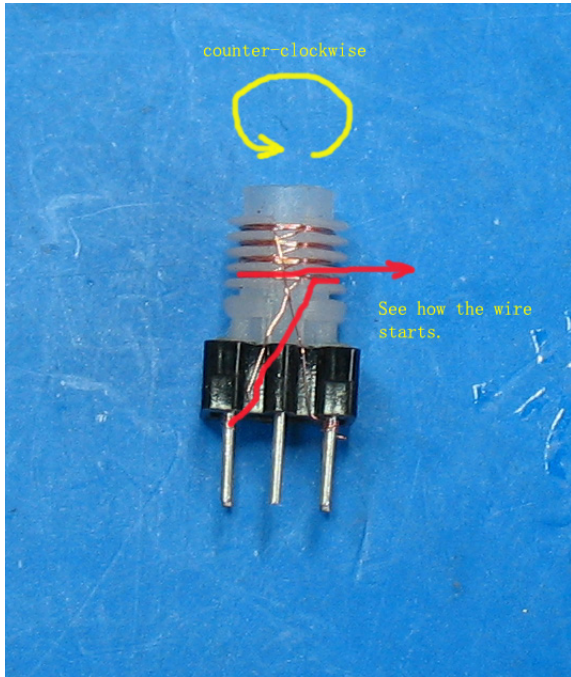


There are 5 slots in the can former. For T5 and L4, 16 turns are spread in slots 2 – 5. You may spread 16 turns evenly in 4 slots. However, it is not important whether the turns are spread in 3 or 4 slots. The important thing is the number of turns – 16 turns! If the slot were wide enough, you could wind 16 turns in one slot, no matter in slot 2, slot 3, slot 4, or slot 5. Unfortunately, one slot space is not wide enough to accommodate 16 turns, only enough to accommodate 6 - 8 turns each. The turns have to be spread in several slots.

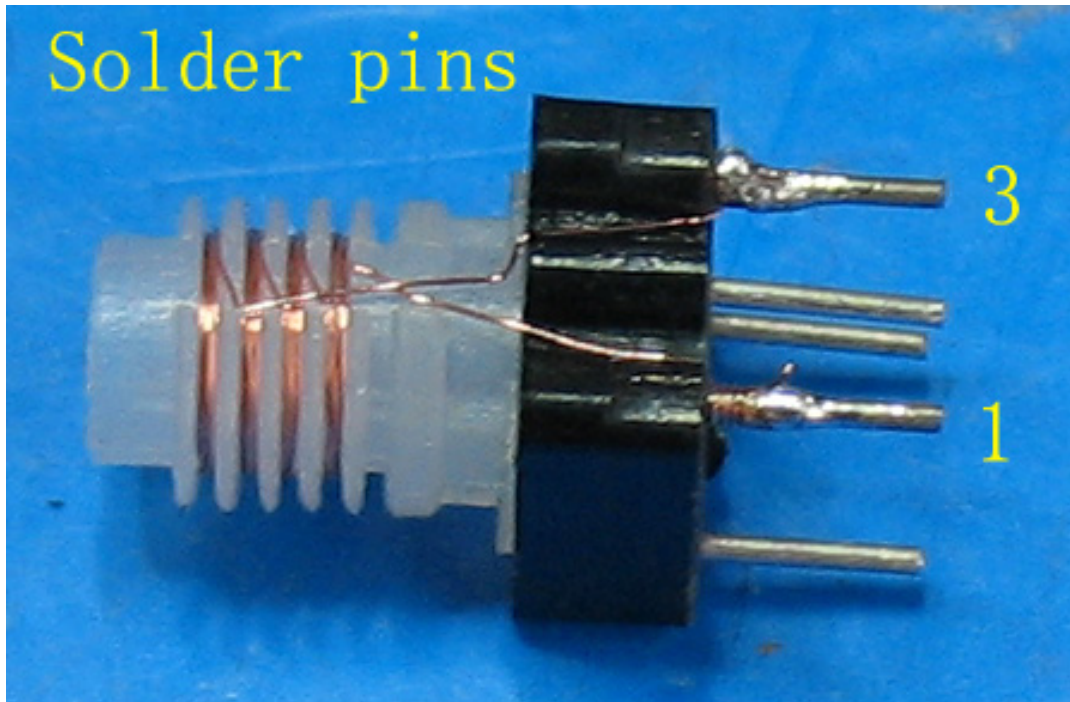
For L2, 26 turns are spread in 4 slots (2 – 5), or in 5 slots (1 -5). Again, the important thing is the number of turns.

T5: Use the can former (See picture). 0.1 wire, primary (the 3-pin side) 16 turns, counter clockwise, the turns spread in 4 slots (2 - 5). Secondary (2-pin side), 4 turns in slot 1, counter clockwise. Wind the secondary first. Pay attention to the start and finish. **See pictures below.** Anchor the wire lead on the star pin, and then start wind. When enough turns are completed, anchor the wire end lead to the finish pin.

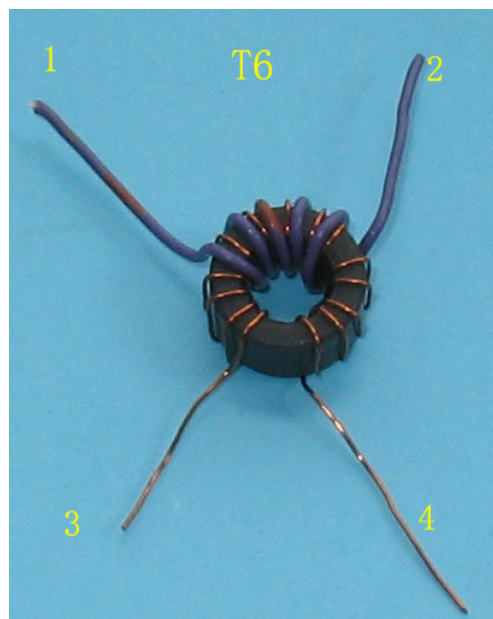
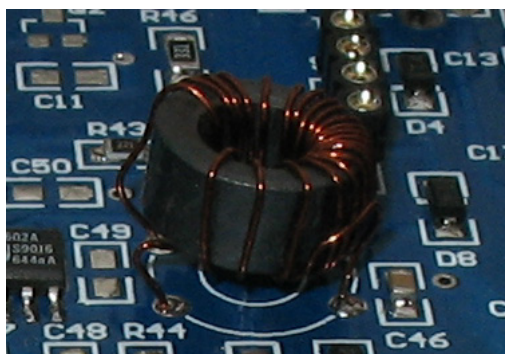


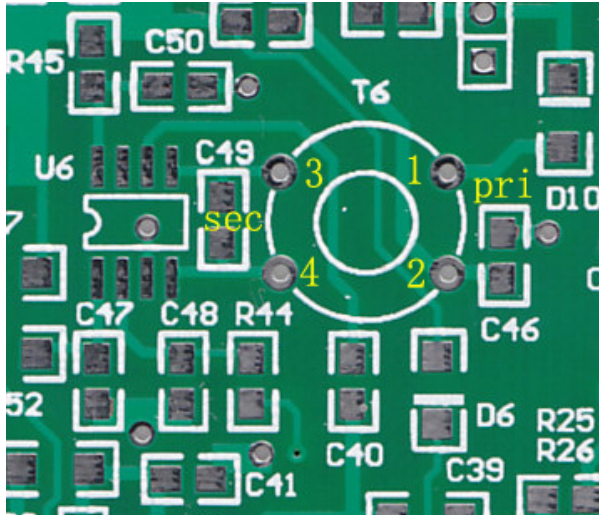


When you solder the wire start and end leads to the former pins, do not leave unsoldered turns on the leads (See the picture below.) Pin 1 is wrong: it has unsoldered turns, causing RF losses. Please solder all the turns on the pins. Pin 3 is correct: all the lead turns are soldered.

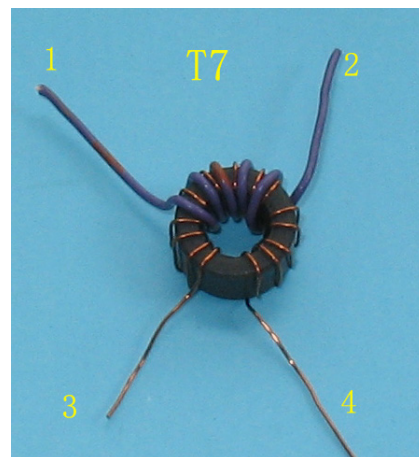
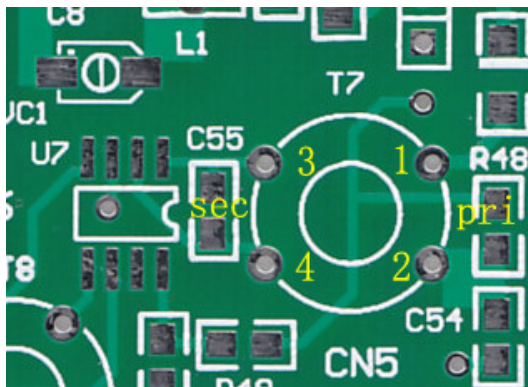


T6: Broad band transformer. 0.31 wire, primary 6 turns, secondary 15 turns on broadband toroid. Wind secondary first. Spread 15 turns evenly on the core. Do not overlap. Place the primary on the middle part of the secondary, see photo. For convenience of illustration, a purple wire is used for the primary.

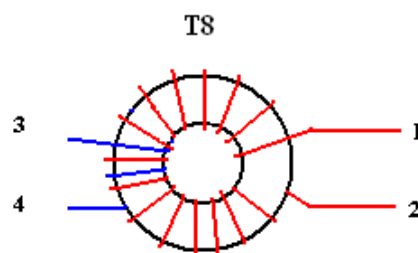
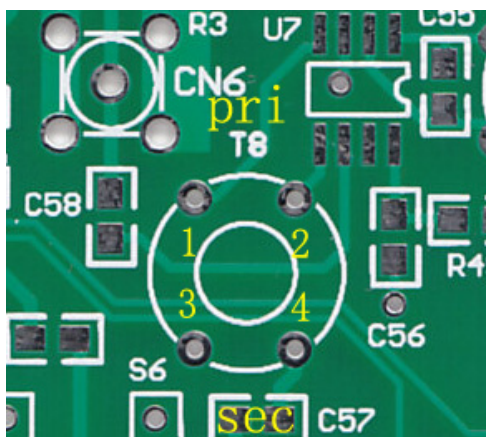




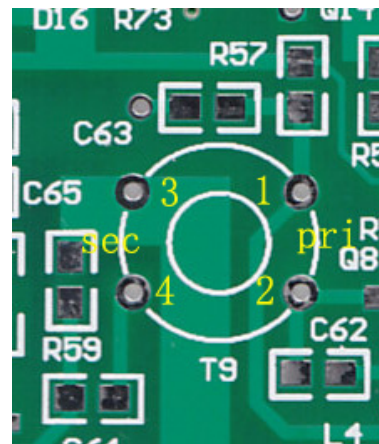
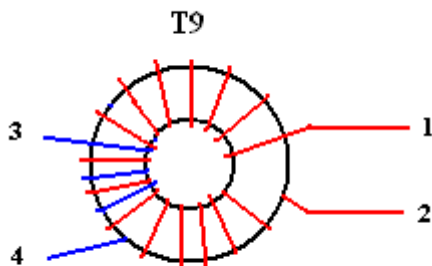
T7: IF transformer. 0.31 wire, primary 8 turns, secondary 22 turns on NXO-10 toroid. Wind secondary first. Spread 22 turns evenly on the core. Do not overlap. Place the primary on the middle part of the secondary.



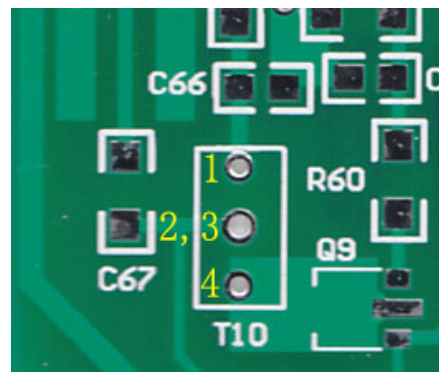
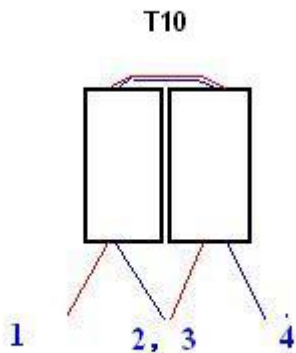
T8: Broad band transformer. 0.31 wire, primary 15 turns, secondary 2 turns on broadband toroid. Wind primary first. Spread 15 turns evenly on the core. Do not overlap. Place the secondary on the middle part of the primary.



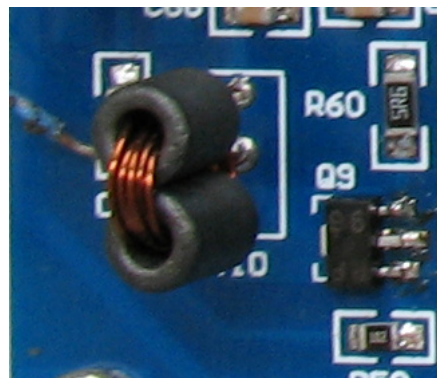
T9: Broad band transformer. 0.31 wire, primary 5 turns, secondary 3 turns on broadband toroid. Wind primary first. Spread 5 turns evenly on the core. Do not overlap.



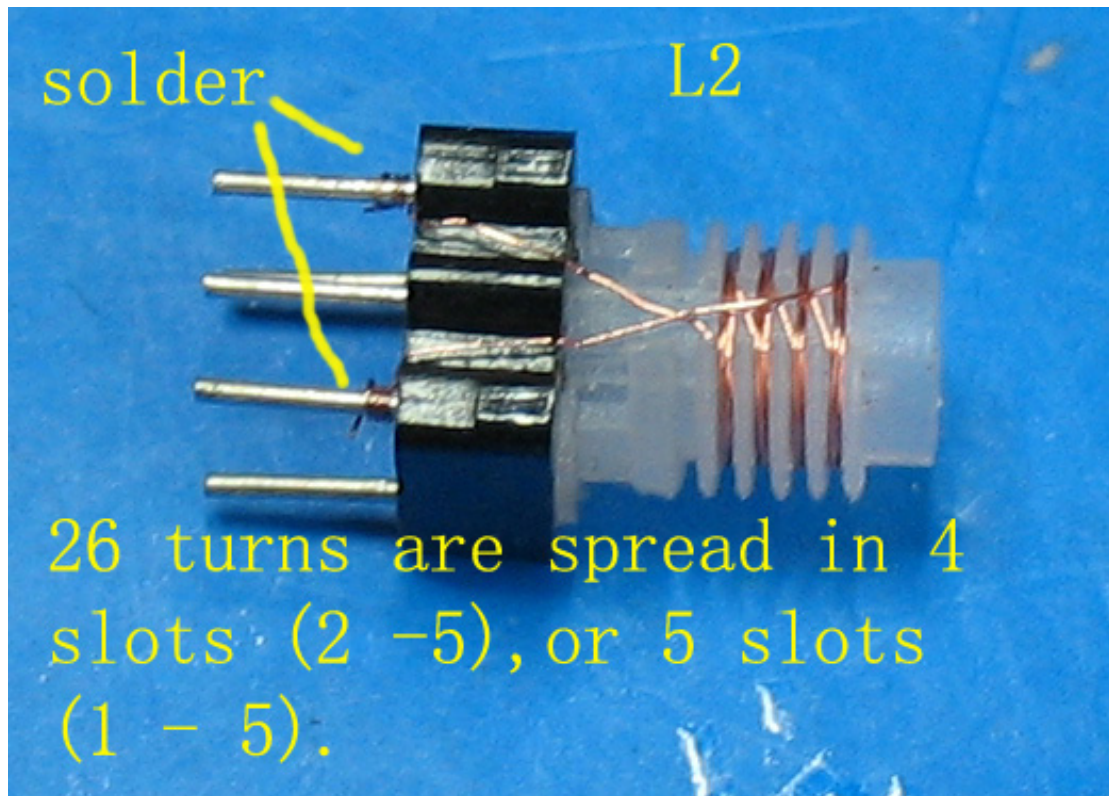
T10: Broad band transformer. 5 bifilar turns, 0.31 wire, on the binocular core formed by 2 sleeves. See photo. Pay attention to the phase. As shown in the picture, red wire is Wire A; black wire is Wire B. End of wire A (2) and start of Wire B (3) are connected as the tap.



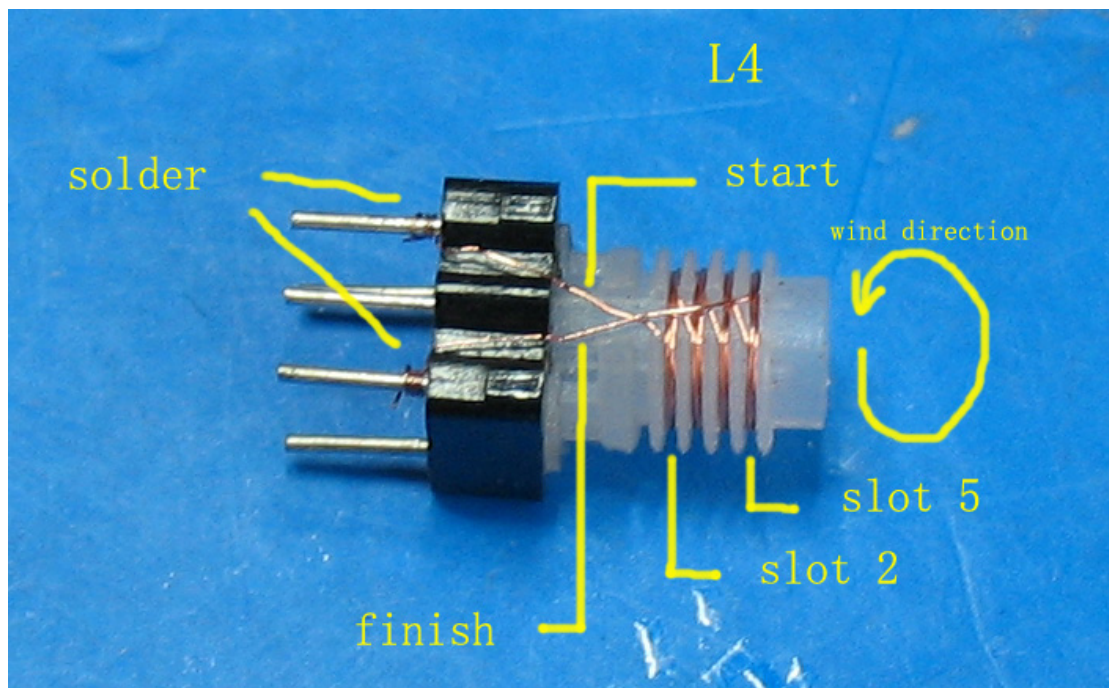
L1: 21 turns, 0.31 wire, on NXO-10 toroid core.

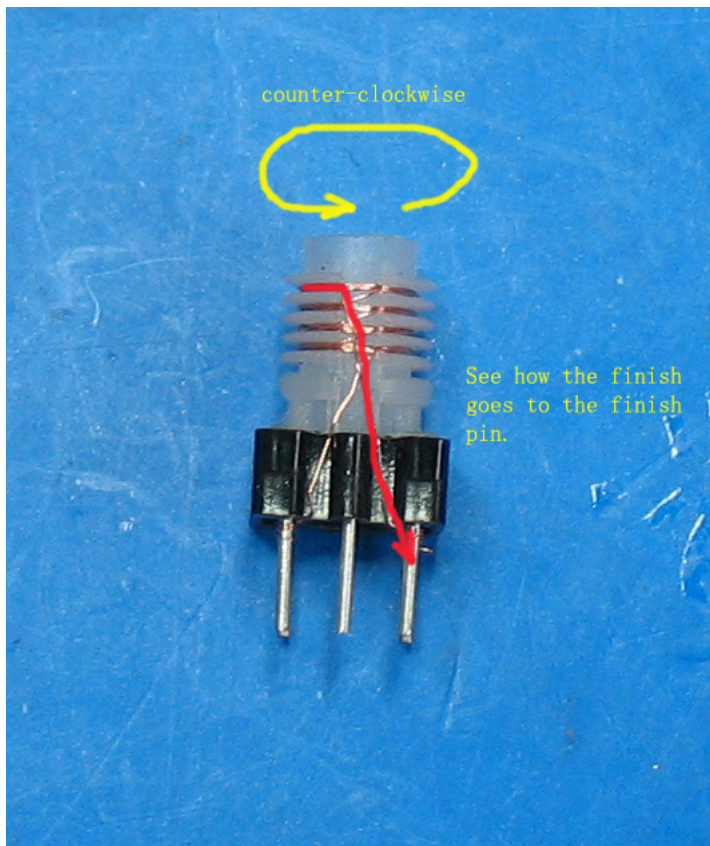
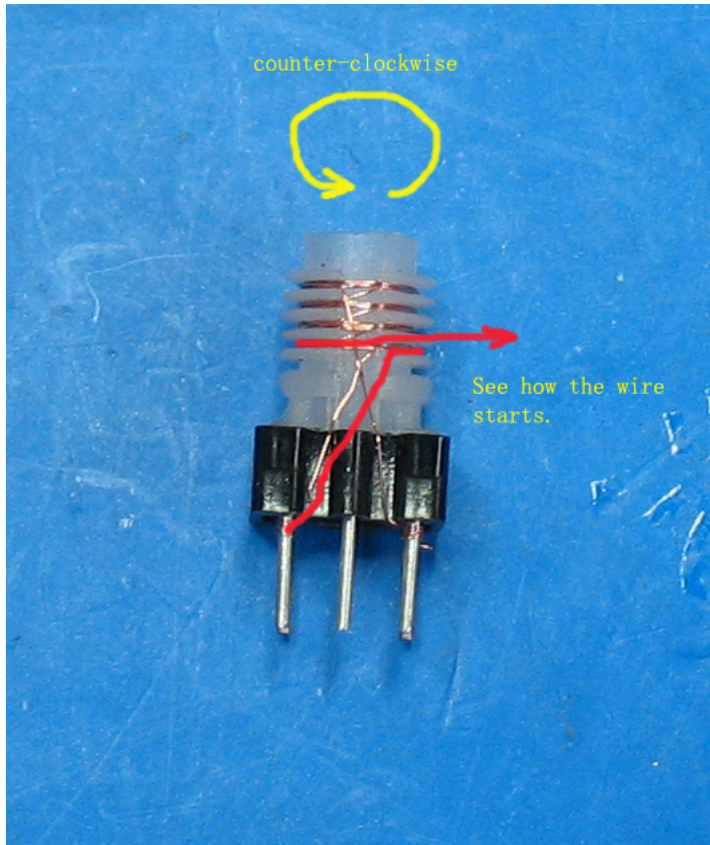


L2: 26 turns, 0.1 wire on can former, spread in 4 or 5 slots. If the turns are spread in 4 slots, then you could wind in slots 2 – 5. If in 5 slot, you could use slots 1 – 5.



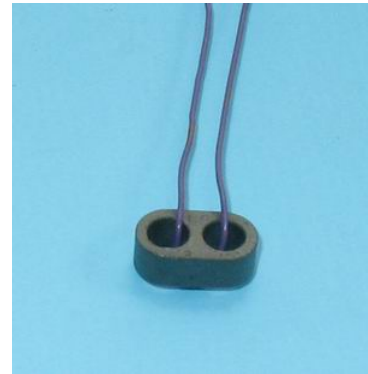
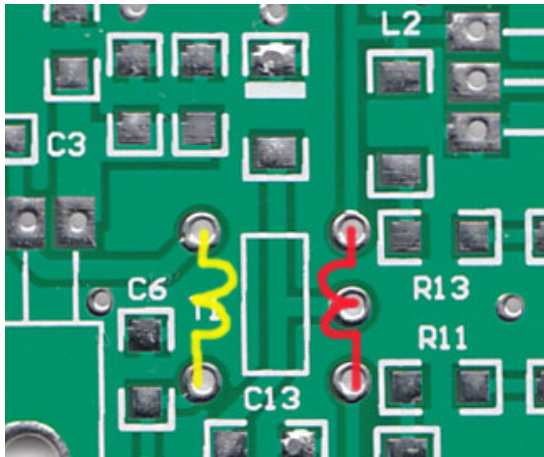
L4: Use the can former. 0.1 wire, 16 turns, (the 3-pin side), spread in 4 slots.





2.1.2 PA Board

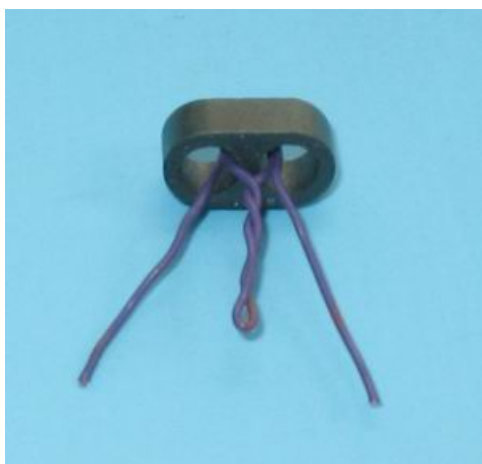
T1: Primary (yellow) 4 turns 0.38 wire or insulated wire on the binocular core; secondary (red) 2 turns, center tapped. See photo. The picture at right shows 1 turn. **Before winding T1, please use the sharpening stone (oilstone) to hone the sharp edges of the core, because the sharp edges would damage the enamel and cause short circuit between the windings and the core.** Insulated wires are suggested for T1.



The picture below shows 2 turns.



The picture below shows how to tap.

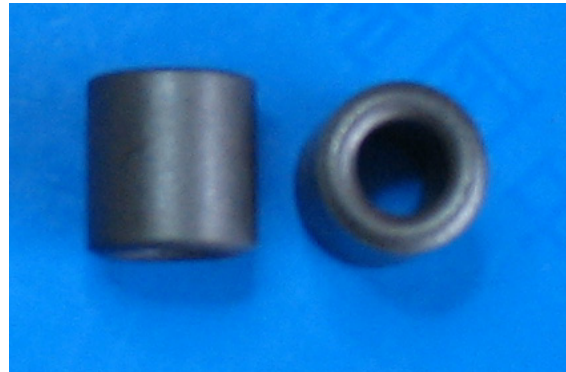
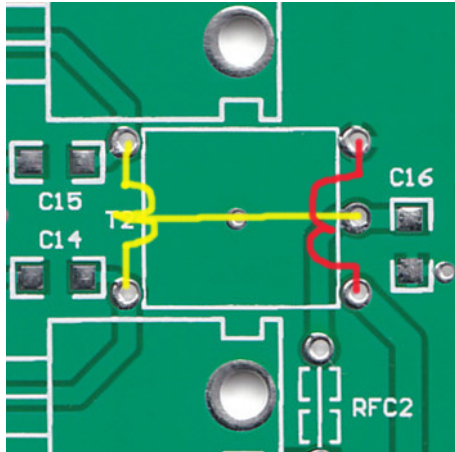


Finished transformer



NOTE: Two sleeves may be supplied instead of the binocular core in some kits. Use the sleeves to form the binocular core. The turns are the same.

T2: Use two sleeves to form 1 binocular core. Primary (yellow) 2 turns 0.38 - 0.47 wire or insulated wire, center tapped; secondary (red) 3 turns. See photo.



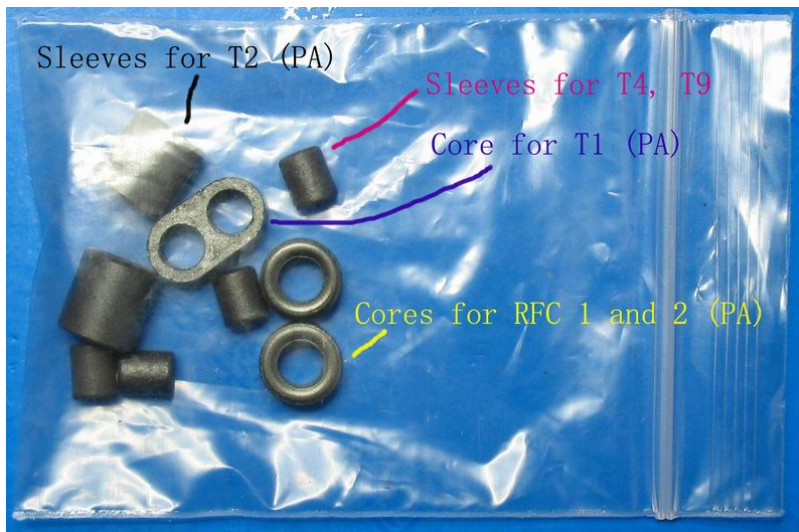
RFC1, RFC2: 3 turns, 0.47 wire, on the small toroid.

L3, L4: 9 turns, 0.47 wire, on T50-2 toroid.

L5, L6: 11 turns, 0.47 wire, on T50-2 toroid.

L7, L8: 15 turns, 0.47 wire, on T50-2 toroid.

L9, L10: 21 turns, 0.31 wire, on T50-2 toroid.



How to count turns on the toroid?

The pictures below show how to count turns. When the wire start and wire end meet, it is called ONE turn. Count turns according to the pictures.



See more pictures. Check if you are right.



Note: Wire size is not very critical. If there is sufficient space, larger wire size is preferred. You do not need to check the wire size of the wires of 0.1 mm, 0.31mm and 0.47mm supplied with the kit. They are good for the windings.

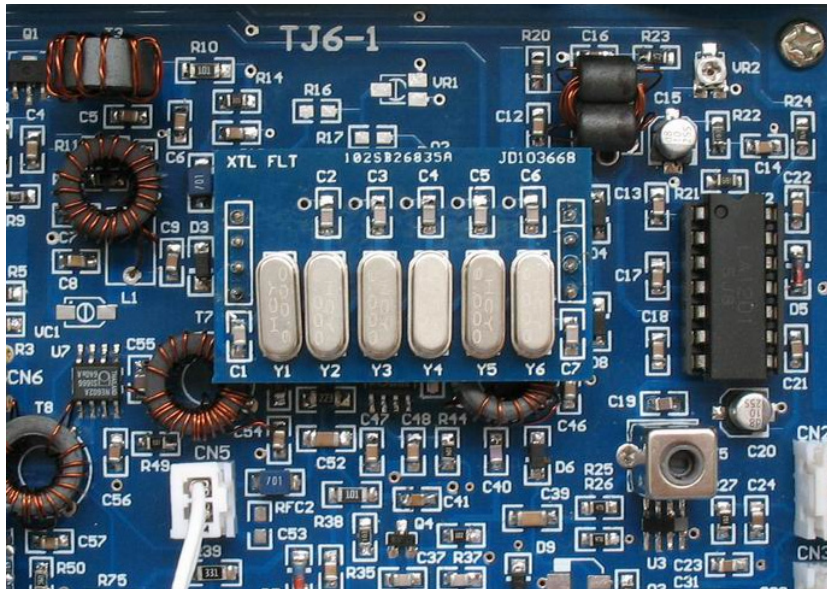
2.2 Soldering Components

2.2.1 Main Board

Before install other components, check all the FFC connectors with the ohm meter, or use tweezers to shake the pins of FFC, to make sure they are well soldered. Check the pre-installed resistors with the amplifying glass to see if they are well soldered.

Band control voltage is sent to CN4 of the main board from DDS board. CN1 of the main board is in parallel with CN4. Make point-to-point check to see if CN4 and CN1 are well soldered.

Install RL1. VC2 is ceramic variable capacitors. Solder the rotator pin to the left pad. **VC1 and VC3 are not needed. Q7 is not needed either.** However, leaving Q7 on the PCB would not affect the function.



On the main board it seems several parts are “missing”. In fact they are not necessary:

VC1, VC2 – No Component

VR1 - No Component

C32 - No Component

C49 - No Component

C76 - No Component

R16 – 18 - No Component

C11 - No Component

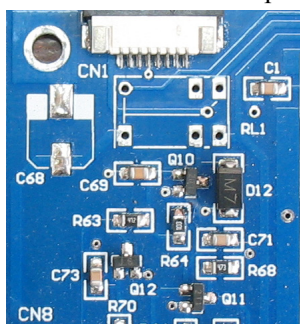
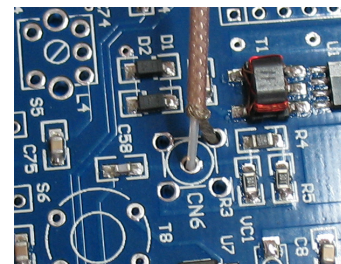
Q2 - No Component

Q7 - No Component (Installed, but does not affect)

R42 - No Component (Installed, but does not affect)

C45 - No Component (Installed, but does not affect)

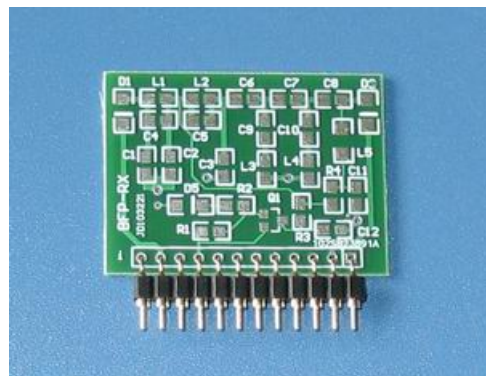
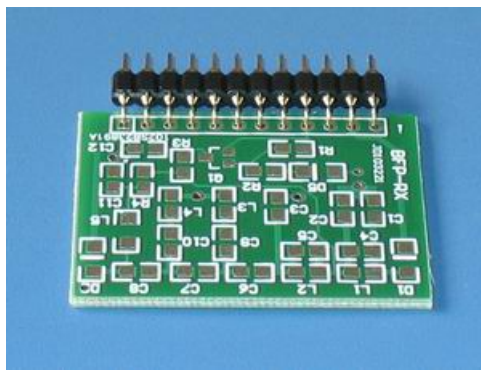
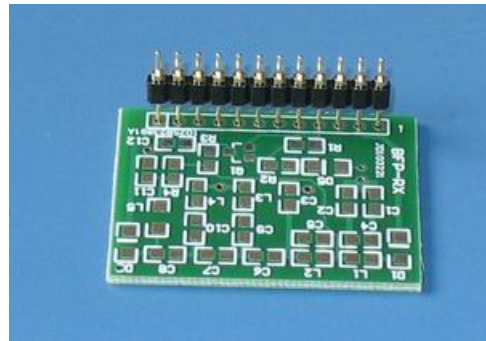
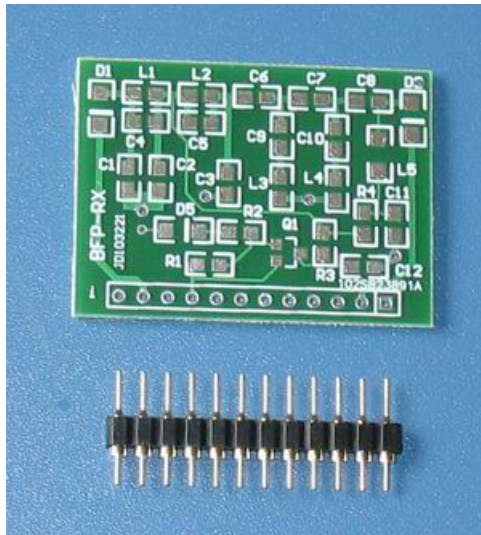
Solder a 470uF capacitor on the pads of C68.



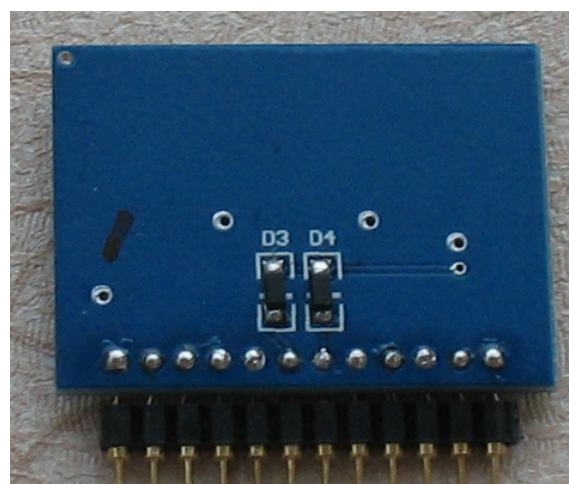
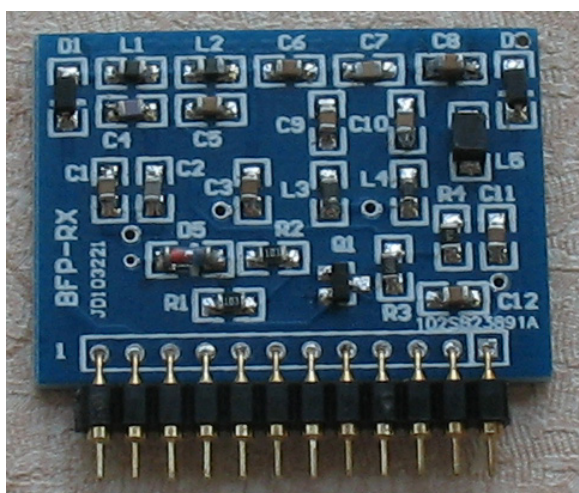
CN6 and CN7 do not need SMA connectors. Solder the coaxial directly to the pads, with coaxial center connector to the center hole, braid in any one hole (See picture). SMA connectors are not supplied for CN6 and CN7.

Module Construction

Bend the headers to make the BPF module legs, see pictures. Place the PCB on a flat surface; put in the headers; push the header plastic bar; the module legs are done. Solder the headers. Do not put the headers on the wrong side. Solder the header sockets to S1, S2, S5, and S6 on the PCB.

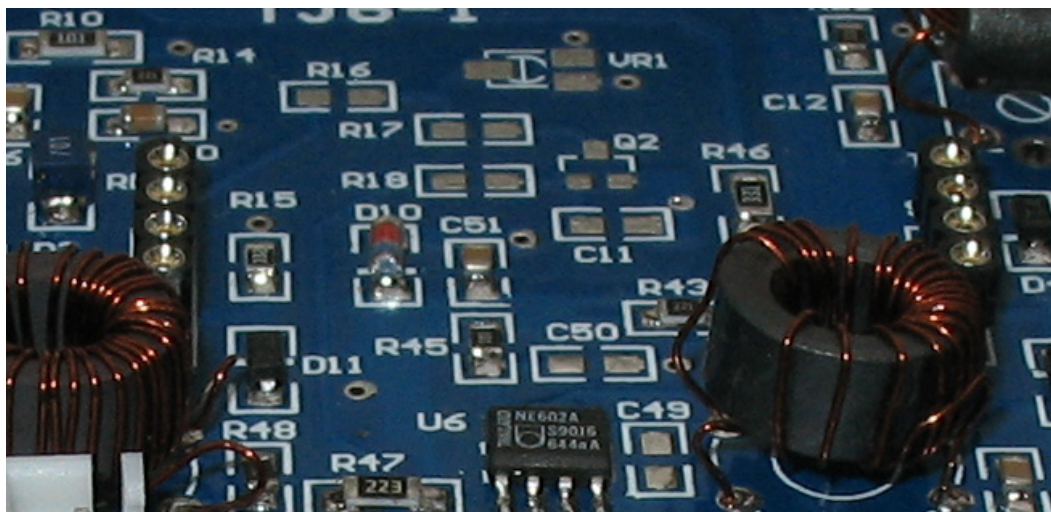
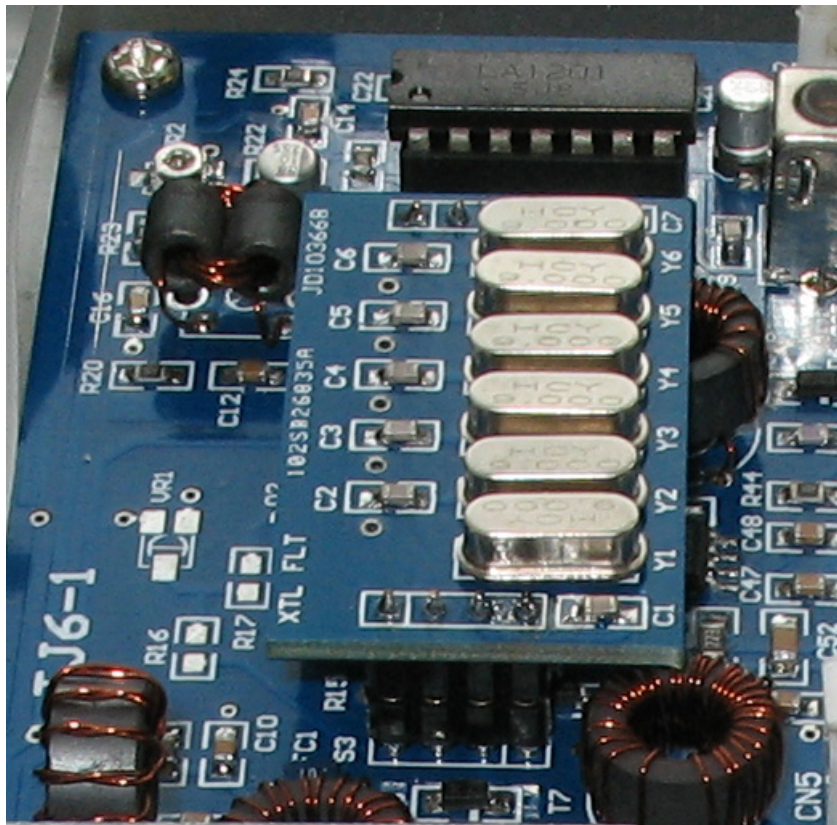


There are 5 modules in the kit, four of them BPF's: 2 for receiving, 2 for transmitting. The modules for S1 and S5 (3.5 – 7.5MHz) are identical, and the modules for S2 and S6 (10 – 21.5MHz) are identical.



The narrow module is XTL filter. Y1 through Y6 are 9.000MHz crystals. C1 through C7 are 47p capacitors. Solder 4-pin headers to the module. Solder header sockets to S3 and S4 on the PCB.

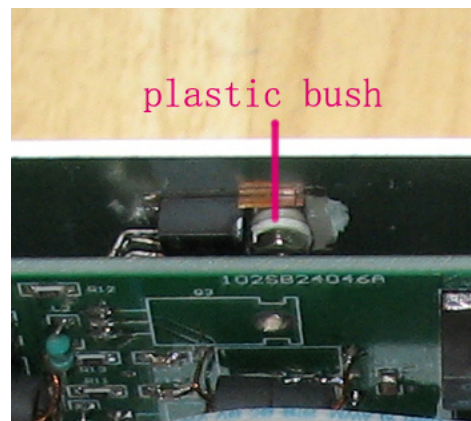
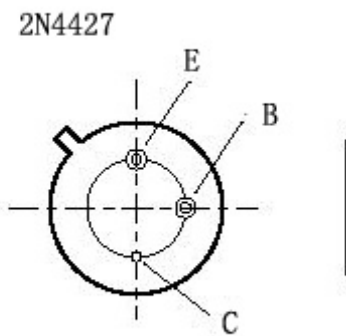
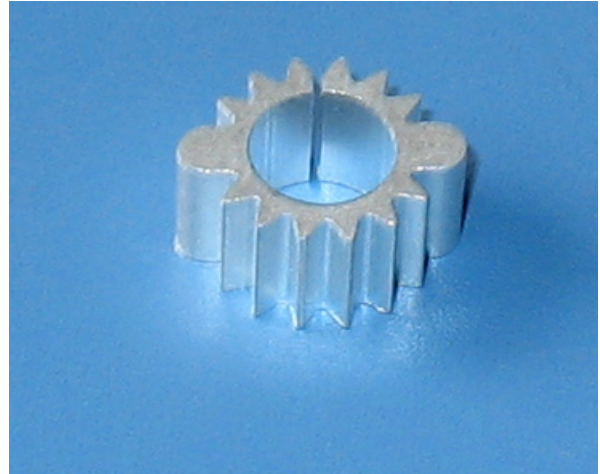
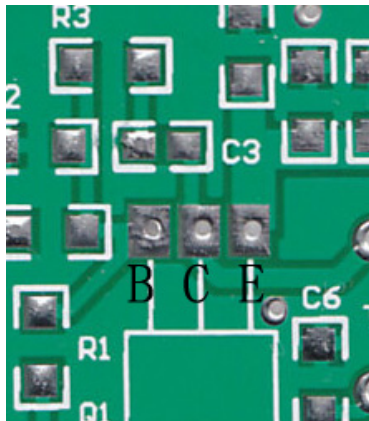
After all the components are soldered, plug in the RX modules into S1 and S2. S1 is for Band 1 and Band 2; S2 for Band 3 and Band 4. Plug XTL Filter module into S3 and S4. Do not plug into the wrong direction. For the BPF modules, the black plastic bar is on the left side. For the XTL filter module, the label “XTL FIL” on the XTL filter PCB is to the upper side of the main PCB.



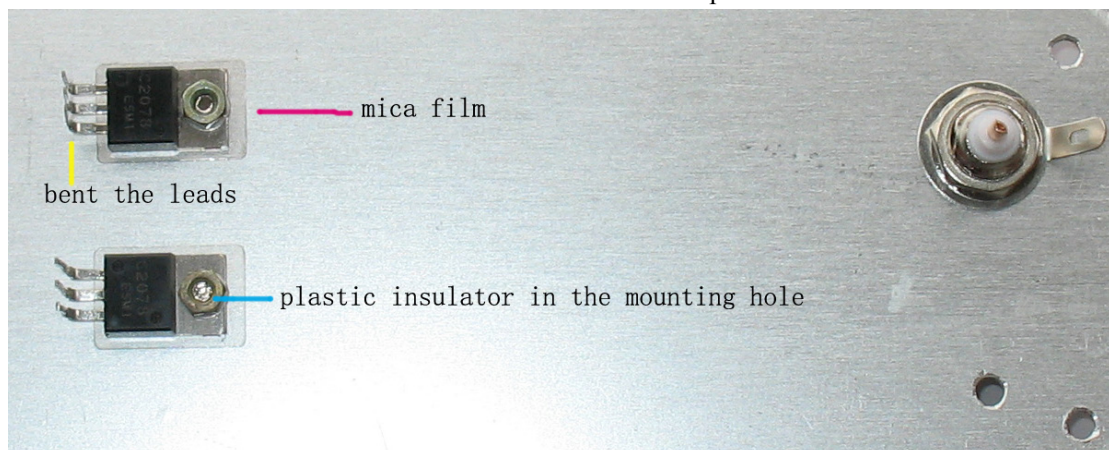
Solder the header sockets for XTL FLT.

2.2.2 PA BOARD

Q1 is 2N4427. Please bend the leads to suit the PCB (See photo). Before soldering 2N4427, press it into the heat sink. If it is very difficult to press it in, please widen the sink slot a little on the side, so that the transistor slides in tightly.



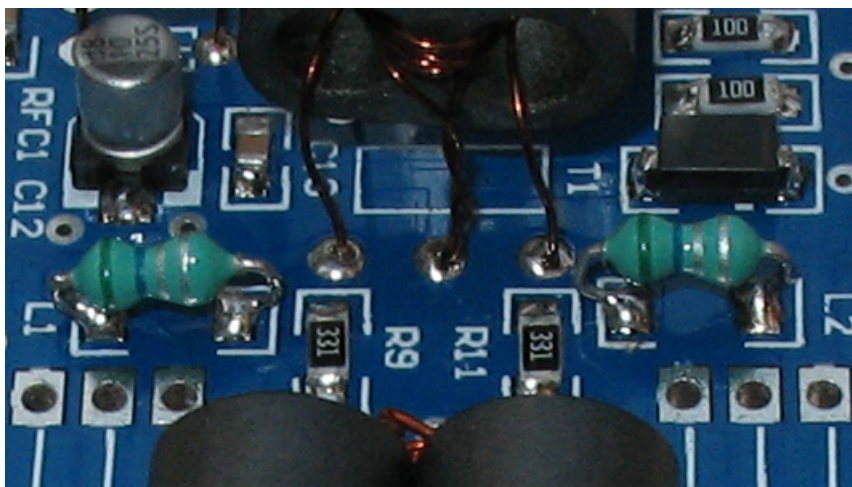
Band control voltage is sent to PA board CN4 via main board CN1. Diodes 6 – 9 are band switching devices. The top diode is Diode 6, Band 1 diode. The bottom one is Diode 9, Band 4 diode. Use the ohm meter to check their connection with CN4 pins.



Do not solder Q2 and Q3 until all the components have been soldered. First chamfer the mounting holes of 2078's. The burs projecting around the hole edges affect the heat transfer. Bend the transistor leads, so that they can go through the pad holes on the PCB. Use the mica film between the transistor sink and the aluminum back cover. Insert the white plastic bush into the mounting hole of the transistor sink before applying the screw nut. Mount the BNC socket. Remove the white plastic of the BNC a little so that the base is as high as 8 mm. Mount four 8mm-brass spacers on the 4 corners of the back cover. Place the PA PCB onto the back cover. Align the leads of the transistors and the BNC. Use 4 screws to mount the PCB. Solder the leads of Q2, Q3 and BNC.

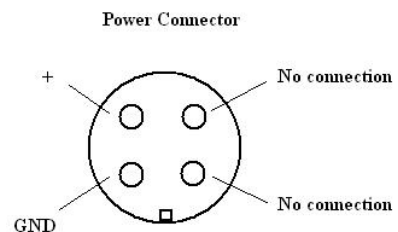
Use ohm meter to check the insulation between the 2078 collector and GND.

C5 – No Component



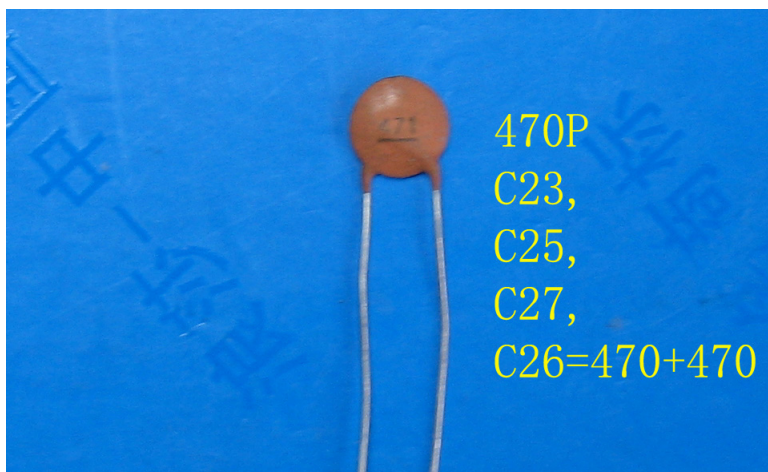
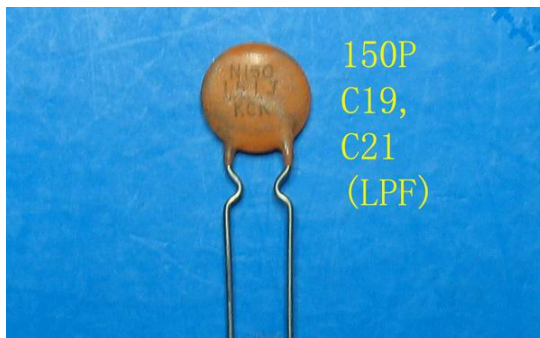
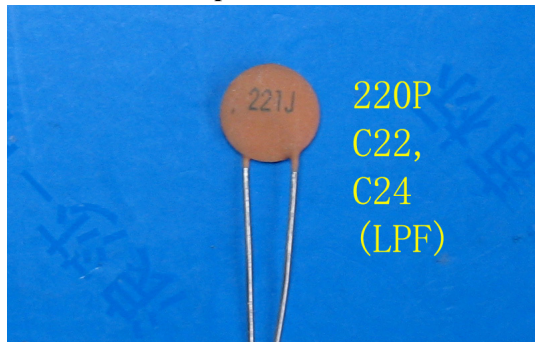
See how L1 and L2 are soldered to the pads. Cut the leads short, and bend the leads to suit the pads.

Use the 4-pin connector as the power connector. Connect the power connector to CN3 with 2 thick wires. Use the left upper pin for POSITIVE (+) power pin and left lower pin for GND (-). The rest two pins are left disconnected (See picture below).

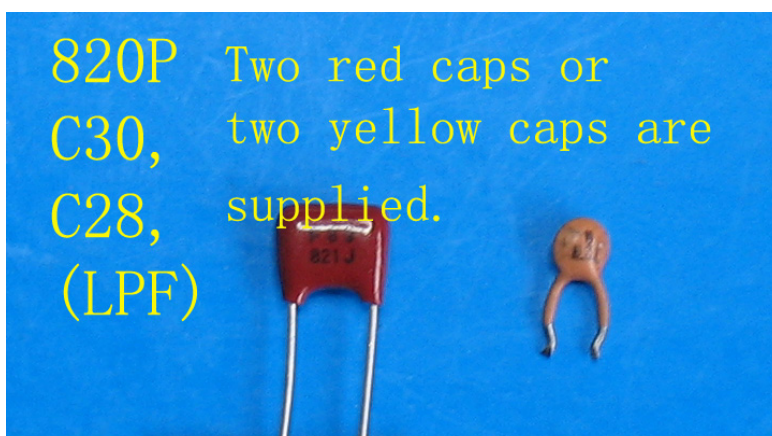


The bias resistor R7 is made up of ONE 10-ohm resistor and ONE 68-ohm resistor in series.

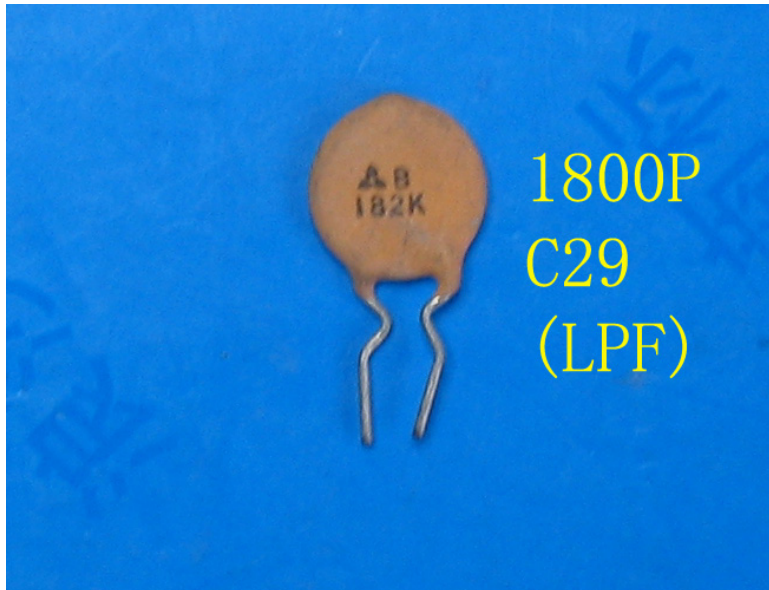
Pictures of LPF caps



C26 consists of TWO 470P caps in parallel.



Some kits are supplied with the red 820p caps. Some kits yellow.



2.2.3 DDS Board

Solder the LCD pins. Use the 5 mm long brass spacers to connect LCD and PCB.

It is suggested the encoder be mounted on the front cover. In this case the encoder leads have to be extended.

The MIC socket leads have to be extended since they are not long enough.

Bridge LIGHT connector with a wire.

Use the 15mm long brass spacer and screws to connect the front face and DDS Unit.

This part is further discussed in pp 24 -33.

2.3 Connecting the Assemblies

The assemblies are connected by FFC. The FFC connector has locking device (brown plastic). Pull out the lock before inserting the FFC. After inserting the FFC, push in the lock. The blue side of the FFC is always up.

Lock is pulled out



FFC is locked



The 12-pin FFC is used to connect DDS and CN4 of Main Board.

The 16 cm long 8-pin FFC is used to connect CN8 of Main Board to CN2 of PA Board.

The 20 cm long 8-pin FFC is used to connect CN1 of Main Board to CN4 of PA Board.

CN3 of DDS Board is connected through the coaxial cable to CN6 of Main Board. The coaxial cable is soldered to the Main Board CN6.

CN7 of Main Board is connected through the coaxial cable to CN1 of PA Board. The coaxial cable is soldered to the Main Board CN7.

CN2 of Main Board is connected to AF GAIN port. The thick white square indicates GND.

CN3 of Main Board is connected to Speaker. The speaker is mounted on the casing. The thick white square indicates GND. Please use a piece of card board to make a speaker gasket and place the gasket between the speaker and the casing to prevent the friction occurs between the speaker cone and the casing; see details on p.30.

CN5 of Main Board is connected to MIC socket of the DDS Unit. The thick white square indicates GND.



3. Setup and Alignment

3.1 DDS Unit

Turn on the power. LCD lights up. Display appears in about 2 seconds. For the first time to turn on the power, DDS Unit works at Band 1. If there is no display, adjust the contrast control VR1.

Connect a frequency counter to CN3 of DDS Unit. The measured frequency is 9 MHz higher than that of the DDS LCD. For example: LCD displays 3.100.00, the measured frequency is 12.1MHz.

Press TUNE knob to change tuning rate (1Hz, 10Hz, 100Hz, 1KHz, 10KHz, 100KHz). This feature allows the operator to move to different parts of the band quickly.

Press BAND to change the band.

Press MODE to change the operation mode (USB, LSB, CW).

Press MEM to call the memorized frequencies (MEM 0 – MEM 7). The default frequencies of the 8 MEM's are the starting frequency of Band 1 (3.1MHz). The operator can use any of them to operate. The operator may use MEM 0 to operate 80m,, use MEM 1 to operate 40m, etc. Press MEM, until MEM 0 appears on the screen.

Turn the tuning knob to tune the frequency.

In USB mode, DDS frequency is 3 KHz higher than that displayed in LCD. In CW mode, DDS frequency is 1 KHz higher.

The center frequency f_c of the DIY crystal filter is not that accurate, and calibration should be made to have correct frequency display. The rule of finding the compensation value is 9 – BFO frequency in LSB Mode. This will be discussed in 3.2.1.

Press the blue button IF SET until IFS (IF setup) appears on the lower left corner of the LCD. DDS Unit is ready to be calibrated. In this mode, DDS Unit works at Band 1. The frequency displayed on the lower right corner indicates Band 1 frequency. The 0 in the middle refers to the IF default setting. Press MEM to save the setting and exit.

3.2 Main Board

3.2.1 BFO

Set the mode to LSB. Connect a frequency counter to C39 or C40. Turn the slug of L2, until the reading is around 8.9981 MHz.

Set the mode to USB. Adjust VC2 until the reading is around 9.001, i.e. 3 KHz higher than that of LSB.

Now switch to LSB, see if the BFO frequency is correct. If the frequency is change, repeat the adjustment.

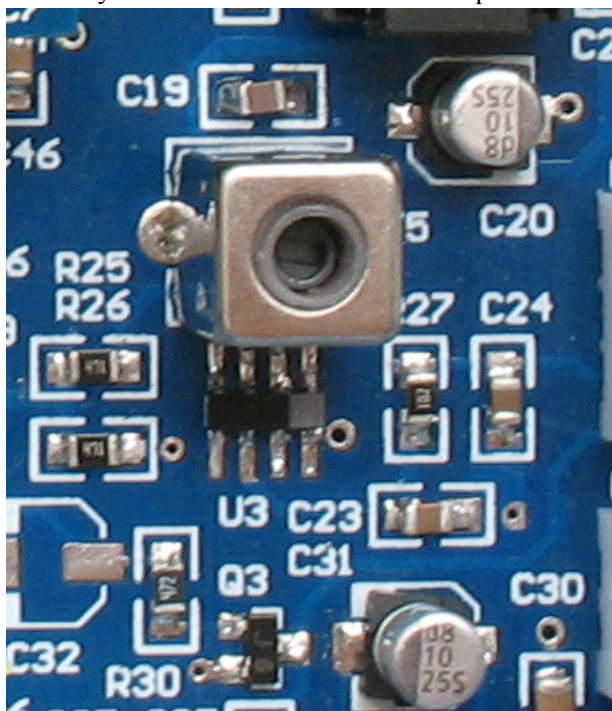
With the BFO frequency decided, IF frequency can be calibrated now. Press IF Set button on DDS board, until IFS appears on the lower left corner of the LCD. The 0 in the middle refers to the IF default setting. Subtract 8998.1 KHz from 9000 KHz. The result is 1.9 KHz. The compensation value is -1900Hz. Change the tuning rate to 100Hz. Turn TUNE counter-clockwise, until -1900 displays on LCD. Press MEM to save and exit. Now IF Set is done.

3.2.2 IF Amplifier U2

Do not connect the antenna. Use a digital meter to measure the voltage of pins 4 and 6 of U2. Adjust VR2 until voltage of pin 4 is around 1.19V, pin 6 around 0.65, or $V_4 - V_6 = 0.5V$. Now AGC works at the best condition. **Never short-circuit pins 2 and 3.** This would damage the IC.

Another simple way to adjust U2 is to wear earphones, adjust VR2, until you hear a relatively louder hiss sound.

Adjust T5. Listen carefully. Turn the slug, peak the weak hiss sound until you hear a relatively louder hiss sound. Notice the position of the slug of T5. The slug is about half way



inside the shielding case.

Connect the antenna. Select Band 2, select faster tuning rate (for example: 10KHz or 100KHz) tune the frequency to 7.000 – 7.060 and try to get a signal. Or use a signal generator to generate a 7.000MHz signal. Adjust T5 to peak the received signals.

The BPF's are of broadband, and no adjustment is needed. If no signal is received, connect the antenna to C1 of the Main Board. If the kit receives the signal with antenna connected in this position, check the connection of CN1 of Main Board to CN4 of PA Board. If no signal is received, move the antenna to C2. If no signal is received, check if

the XTL FIL module is plugged in the wrong direction. If the kit receives the signal, please check the BPF module. Forgot to solder some component? Check the band voltage:

At Band 1, Pin 7 of S1 is 0V. At other bands, 3.8 – 4.5V.

At Band 2, Pin 6 of S1 is 0V. At other bands, 3.8 – 4.5V.

At Band 3, Pin 7 of S2 is 0V. At other bands, 3.8 – 4.5V.

At Band 4, Pin 6 of S2 is 0V. At other bands, 3.8 – 4.5V.

The band control voltage is from MCU via FFC of CN1 of DDS Unit and CN4 of the Main Board.

The kit's background noise is very low. Receiving sensitivity is around 0.5 - 0.3uV, with good selectivity.

Plug in TX BPF modules in S5 and S6. Disconnect CN7. Connect a 47 - 51 ohm resistor between CN7 and GND as the load. Press KEY (short KEY to GND). Side tone can be heard. Side tone is not controlled by AF GAIN. Adjust VR3 to get comfortable volume.

Set the mode to CW. Set the frequency to 7010. Connect frequency counter to CN7. Press KEY (short KEY to GND), and frequency reading should be around 7010. If the reading is not stable, adjust the 9MHz trap L3 (If you have installed L4 instead of L3, trim L4. If the trap works at 7MHz instead of 9MHz, then 7MHz signal is suppressed.), until a stable frequency reading is measured (with the slug around 2 mm higher than the shielding case). This frequency is around 7010 (possibly 1 or 2 KHz

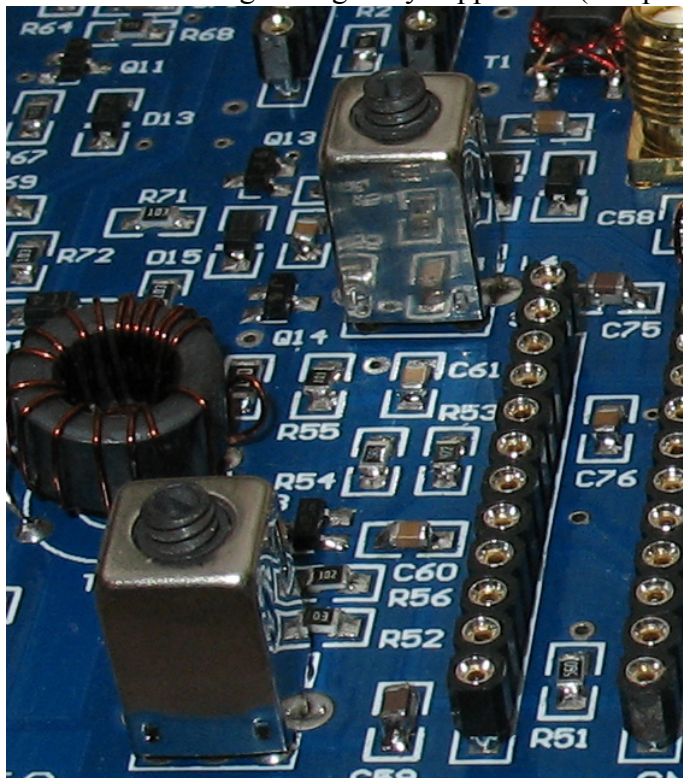
lower than 7010, but very stable). 9MHz trap adjustment is discussed in 3.2.3 in detail.

If no frequency is detected at CN7, trim L2, until the required signal appears.

T7 and C55 (120P) are resonant at 9MHz roughly. For better resonance, trim the capacitance of C55. One extra 20P - 33P cap can be soldered on the pads in parallel to achieve better resonance. C55 might range from 100P – 150P. With an oscilloscope, an RF voltage around 30 – 50mV p-p can be measured at upper pad of C55 when the CW key is down.

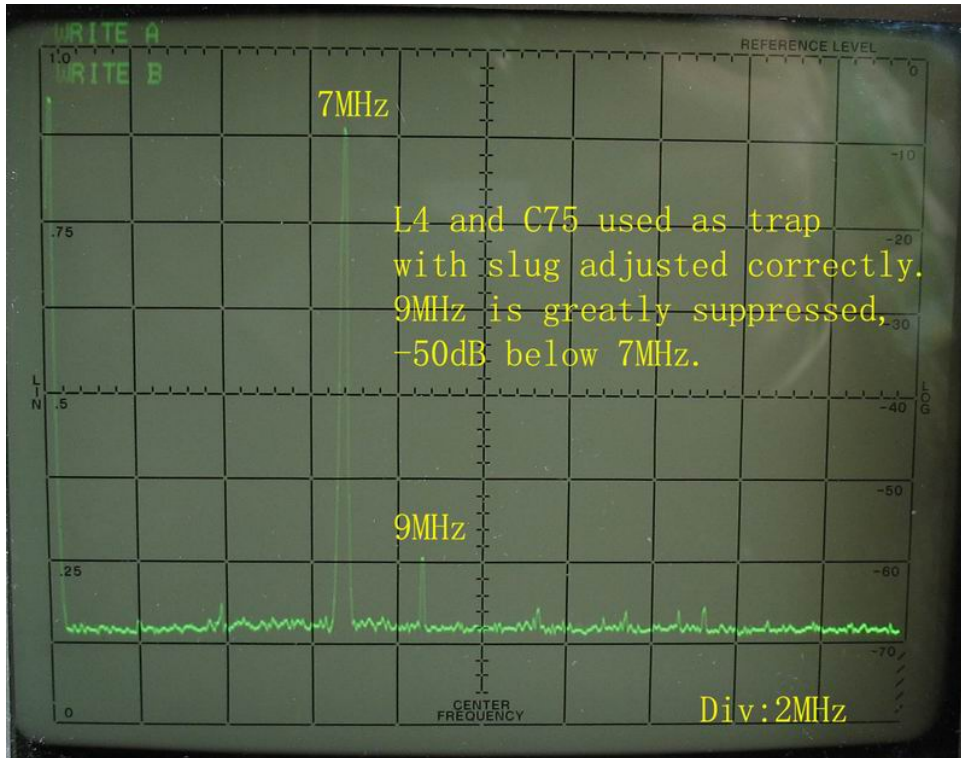
3.2.3 9 MHz Trap

L3 and C59 work as a 9MHz trap to remove the possibly leaked 9MHz IF signal. L4 and C75 also work as a 9MHz trap. Two places for the 9MHz trap. In fact one trap removes enough leakage. Which is the best place to install one trap? We suggest the trap made up of **L4 and C75** be installed. In this case **one trap is sufficient. One trap former is supplied with the kit. L3 is a spare trap place.** Follow the following step to adjust the trap. With power off, S5 and S6 removed, apply a 9MHz signal to the signal input pin hole (the second pin from top) of S5 or S6. Connect a RF volt meter or oscilloscope also to that point. Adjust L4 slug, until the level is the lowest. Now the 9MHz signal is greatly suppressed (See pictures on page 24).

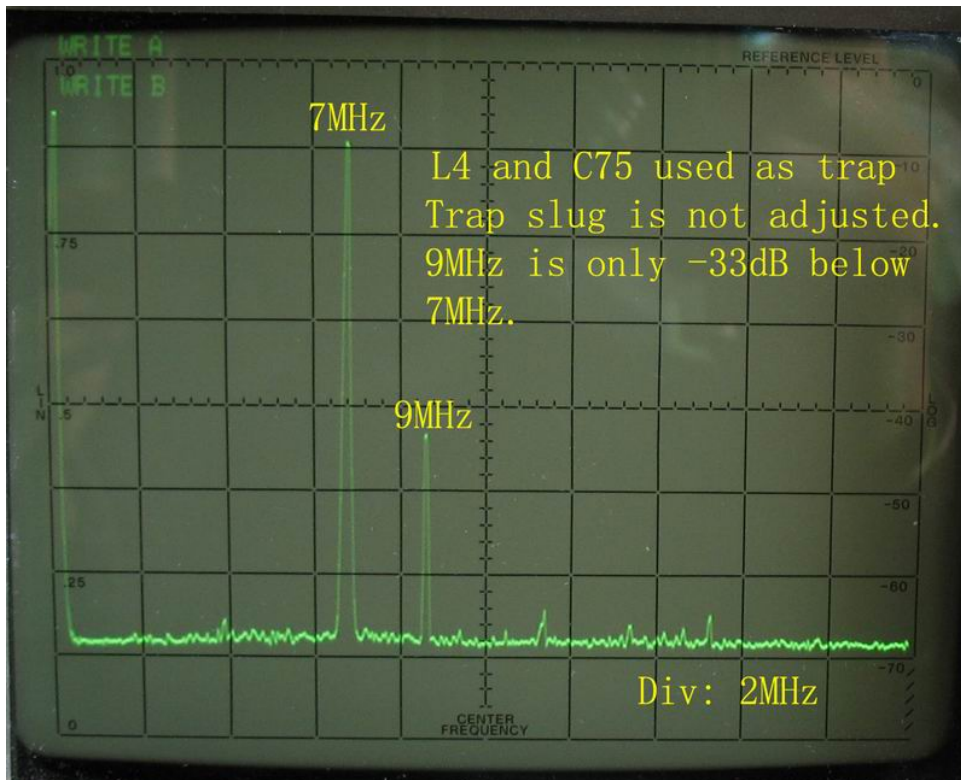


If you do not have an RF volt meter or oscilloscope, adjust the slug of L3 or L4 to the position as the following picture indicates: the slug is about 2 mm higher than the shielding case. This position is about to trap the 9MHz signal.

For the best suppression another trap could be installed in L3 and C59. Follow the instruction of adjusting L4 to adjust L3. However, connect the signal and RF volt meter in the signal out pin hole (the second pin from bottom) of S5 or S6.



L4 and C75 are used as the 9MHz trap. The slug of L4 is not adjusted to the right position. 9MHz leakage is not suppressed effectively, only -33dB below 7MHz.



L4 and C75 are used as the 9MHz trap, with L4 slug adjusted to the correct position. 9MHz leakage is greatly suppressed, -50dB below 7MHz.

3.2.4 Increasing Output Power

Power output is not the same at all bands. At 80m and 40m, the power output is around 8 – 9w. At 20m the output is close to 7 – 8W. At 15m the output is around 3 – 5W.

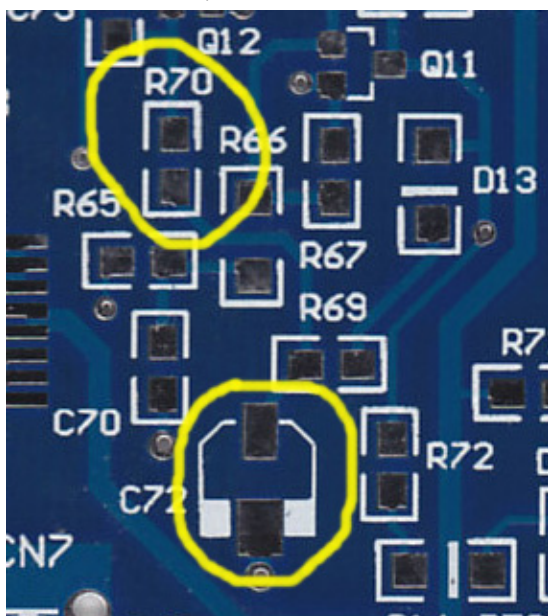
To increase output power, R60 (5.6ohms) could be reduced slightly, say, use a 2.2- ohm resistor. However, do not short-circuit R60 to squeeze out more power.

R44 (1M ohms) controls the CW drive power. Reduce the value of R44 could increase CW output power. However, too much drive causes unwanted harmonics. 1 - 2M ohm resistor develops better transmission, but the output power is lower. The value of R44 could be between 680k ohms – 2.2 M ohms.

Trimming L2, you will find that the CW output is increased. However in this case LSB performance might be affected – you might suffer carrier leakage – because CW and LSB share L2 for the circuitry and CW transmission calibration simplicity. Trimming L2 to increase the CW output should be on the condition that LSB performance (such as carrier leakage, speech clarity) is not affected. With LSB performance not affected, L2 can be trimmed to adjust CW output power. Besides, decreasing the value of R44 can also increase CW output power as discussed in the previous paragraph.

3.2.5 Adjusting Hold Time in CW Mode

The relay hold time after the last character and space can be extended by increasing either the value of R70 (100K) or C72 (1uF). However, changing the value of R70 is easier. The hold time can be shortened by reducing either the value of R70 or C72. Reducing the value of the resistor is more convenient. Solder a 100K resistor in parallel with R70, the hold time will be shortened.



3.3 PA Board

3.3.1 Adjusting 2078's Bias

Disconnect CN7 of the main board from PA CN1. Connect a 47 – 68 ohm resistor to CN7 as the load. Connect a 50-ohm dummy load to ANT.

Remove one lead of RFC 2 from the pad, and connect the multi-meter (500mA range) between the pad and RFC 2 lead to measure the quiescent current of 2078's. In SSB mode, press PTT, about 25 – 50mA should be measured. If the current is too low (less than 5mA), remove the 10 ohm resistor from the bias resistor R7 (68+10 ohm). The experiment shows that the quiescent current is around 25mA using a 68 ohm resistor as R7; the quiescent current is around 50mA using a 64 ohm resistor as R7 (18 + 47 ohm). In reality, most 2078's work nicely with 78 ohm resistor (68+10) as R7. The resistor value is not standard. However, you could obtain what you need by the methods of series parallel. For example: 64 ohm could be obtained by 68 ohm and 270 ohm in parallel, or by 47 ohm and 18 ohm in series, etc.

You could ignore this bias-adjusting step and do it later when it is necessary.

Remove the multi-meter, and solder back RFC 2 lead to the pad. Remove the load resistor from CN7, and connect it to PA CN1.

Connect a RF volt meter or oscilloscope to ANT. At CW mode, and press KEY, 50 - 60V p-p could be read at 80m, 40m and 20m. 30 - 40 V p-p could be read at 15m. Switch to SSB mode; talk to the microphone, and almost the same level could be measured.

3.3.2 Monitoring Your Own Signal

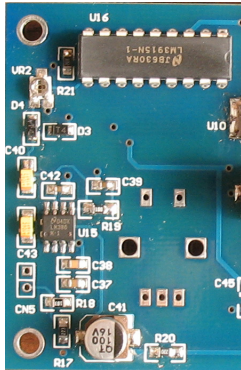
Do not remove the dummy load from TJ6A. If you have a receiver, tune it to, say 7050, LSB mode. Tune TN6A to 7050, LSB, too. Connect a short hookup wire to the receiver as the antenna. Plug in the earphone to the receiver. Adjust the volume to the appropriate level. Press PTT of TJ6A. Now you can hear your own voice. Fine tune your receiver's frequency, until you hear a clear voice, crystal clear. If you cannot tune in a clear voice, then you need adjust the bias of 2078's (This is discussed in 3.3.1). Some 2078's need 25 – 50mA to produce a clear voice; some 5mA.

Do not use high PA quiescent current. Always try to use the lowest quiescent current possible if the speech quality is good. The high quiescent current would make 2078's hot.

If you do not have a receiver, then you need help from someone else. You could get the speech clarity information from other's report.

4. DDS Unit Construction Guide of TJ6A pro

The main board, PA and the DDS function of TJ6A pro is the same with TJ6A. The different part is the DDS unit in which the S meter unit (SM unit) is add (see picture below).



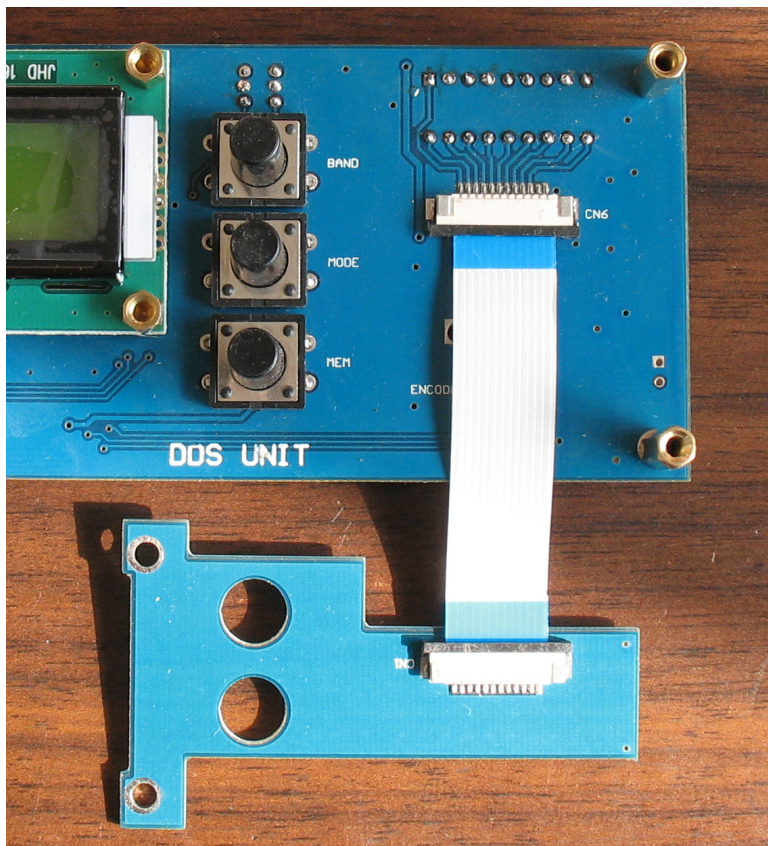
The DDS output filter circuitry is modified in the “pro” version to remove “birdies” caused by DDS unit.

Besides, the phone connector is added on the front panel. This guide only discusses the construction of the “pro” DDS unit and calibration of the S meter.

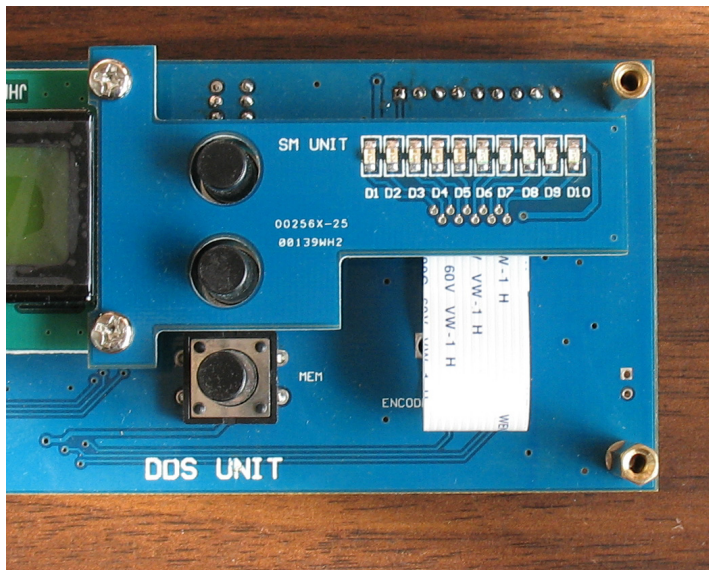
Assembling and Wiring

The assembling of the LED SM is illustrated in the following pictures.

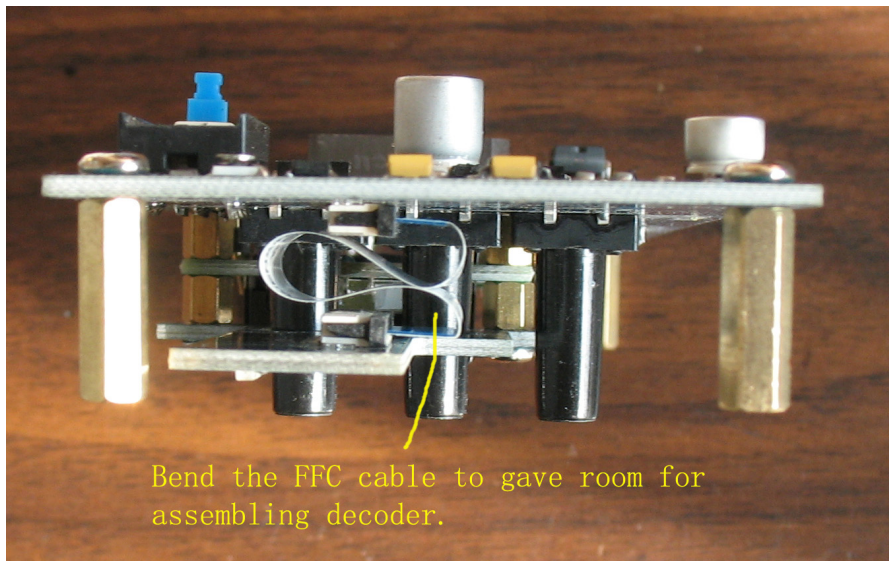
1. Insert the FFC cable, with blue plastic part up.



2. Position the LED unit and fasten with 2 screws. **Be sure to tighten the 2 screws.**

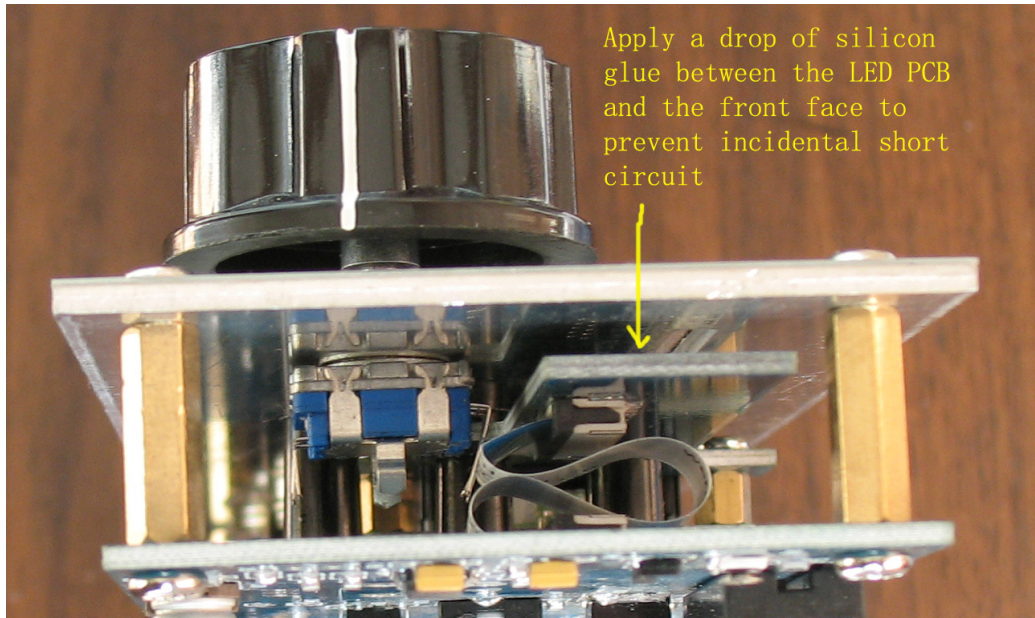


3. Bend the FFC cable, so that it does not block the connecting pads of the decoder.

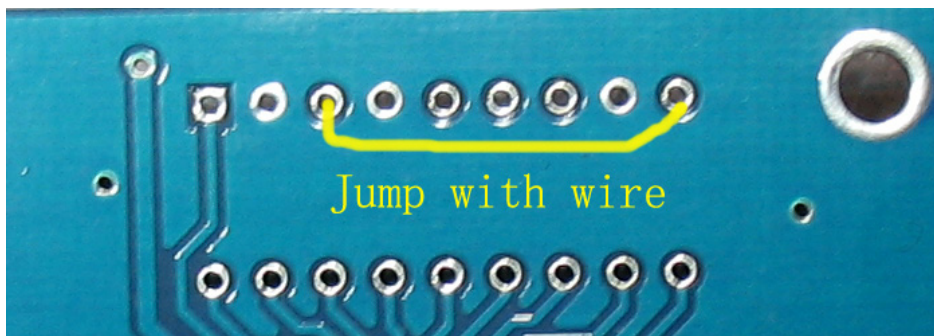


Mount the decoder on the front panel. Extend the decoder leads and solder them to the PCB pads respectively.

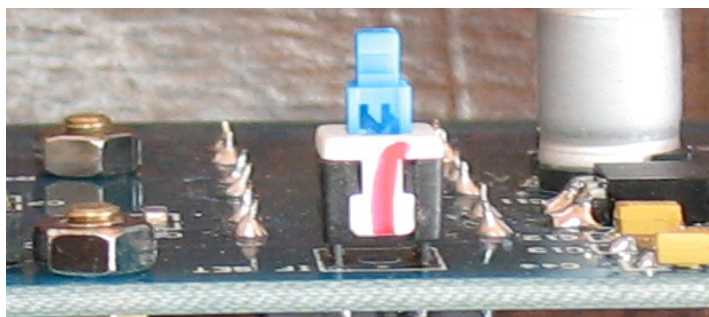
4. When the whole DDS assembly has been finished, it is suggested to apply a drop of silicon glue between the LED PCB edge and the front face to prevent incidental short circuit. The clearance between the LED and the front face is wide enough, but if the 2 screws become loose, the LED's metallic part might contact the front which is connected to GND, damaging the LED's and the FFC cable.



5. Install U16 (LM3915). TJ6A pro uses the dot display mode to save power. The S meter displays the signal peak. For bar display mode, connect Pin 3 to Pin 9 of U16 with a resistor between 10 – 100ohms, or with a hookup wire or.

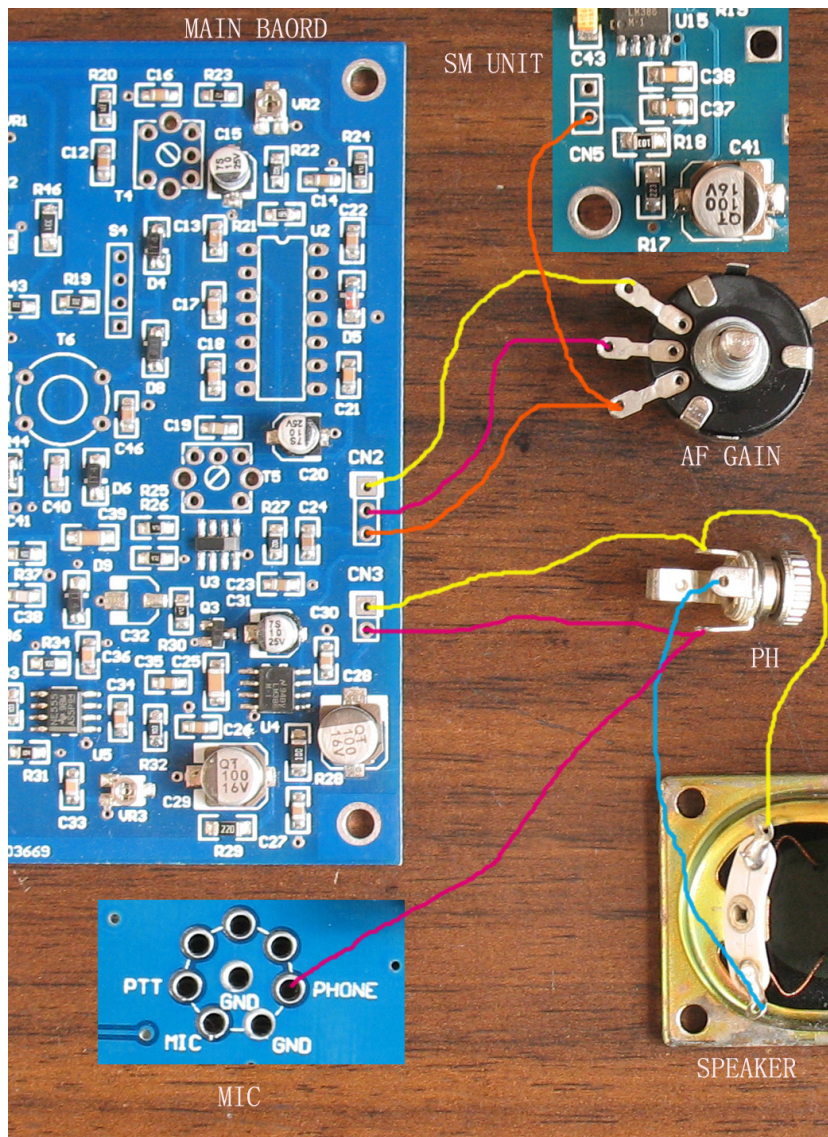


6. Install U2 socket, and plug in U2 (8-pin, 24C16A).



7. Install the IF SET button, with the red mark up, and solder.

8. Wiring DDS Unit and Main Board



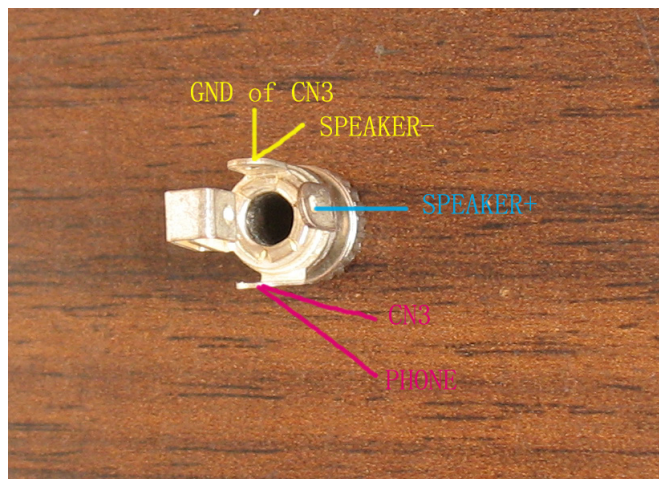
The wiring of the Pro DDS board to the main board is illustrated as the following picture. After the AF GAIN control, and PH, KEY, and MIC connectors are mounted on the front panel, wire them as shown.

Connect speaker's "+" lead to output lead of the PH connector (red line); connect speaker's "-" pin to the GND lead of the PH connector (yellow line).

The speaker is disconnected when the earphone is plugged in.

From the wiring you can see that "PHONE" of

MIC connector is directly connected to audio output of CN3. "PHONE" signal is not disconnected when the earphone is plugged in. "PHONE" of the MIC connector can be used as DATA OUT for PSK31 service.

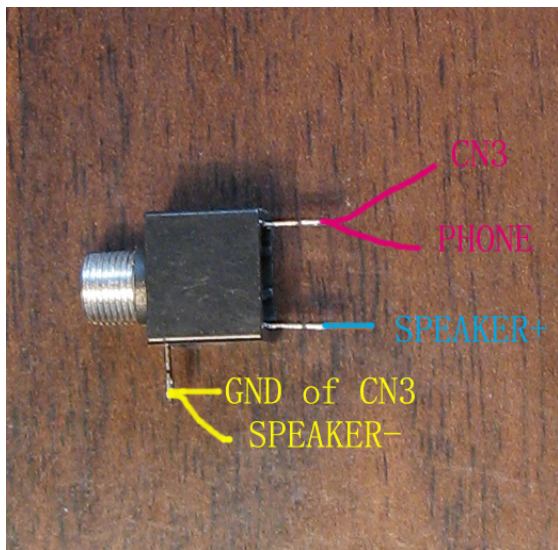


Connect AF GAIN control to CN2 of the main board as shown above.

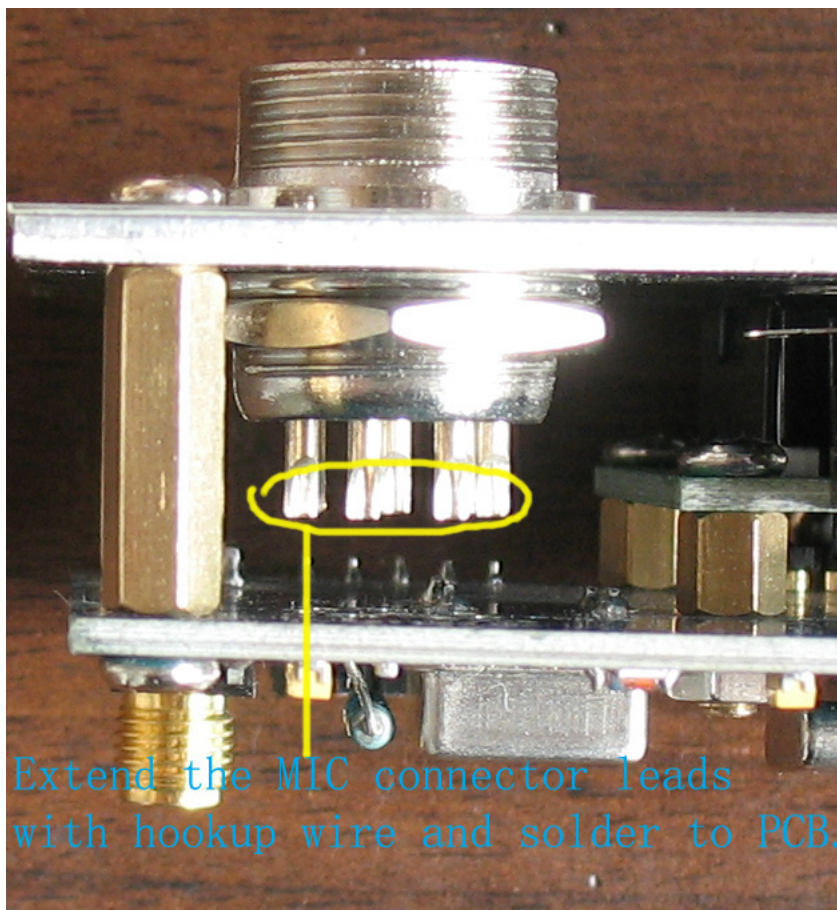
The S meter picks up signal from CN2. Connect CN5 of DDS Board to the signal arm of AF GAIN control (see above picture).

Different type PH connector may be supplied. If the black plastic **PH connector** is supplied in the kit, please connect as shown below.

Solder all the connections.



The connection of the MIC connector is illustrated below.



Extend the MIC connector leads with hookup wire and solder to PCB.

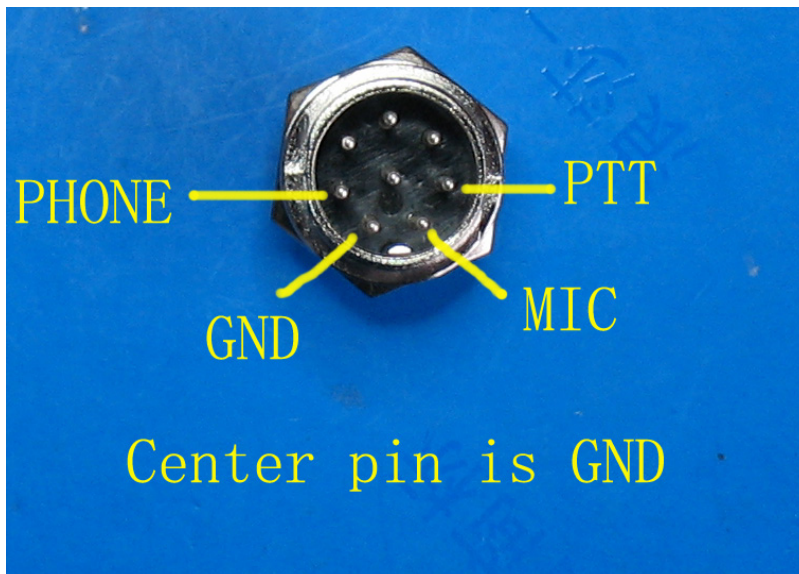
The definition of the MIC connecting pads on PCB is shown below (Viewed from front of radio). Unlabeled pads have no connections. Extend the connector leads to the PCB pads respectively.

After the MIC connector leads are connected to the respective PCB pads, connect

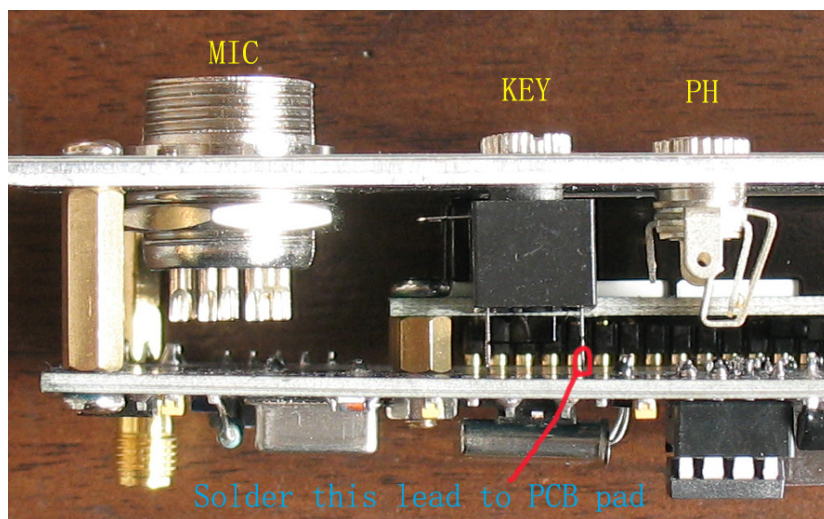
“MIC” pad and adjacent “GND” pad to CN5 of the main board. Connect “PHONE” pad to PH connector as shown in the previous picture. “MIC” of the MIC connector can also be used as DATA IN for PSK31 service.



However, you may wish to define the connector wiring as that of SG-2020 so as to suit the NUE-PSK Digital Modem connector. Then wire the 8-pin connector leads with hookup wires to the PCB pads according to the connector wiring as shown below.



The connection of the KEY connector is illustrated as the following picture. Solder the indicated lead (the tip lead) to the KEY pad on PCB. Since the front face is GND, it is not necessary to solder the GND lead of the KEY connector to the PCB.



Phone Connector

PH connector is the mono phone connector. When the earphone is connected, the louder speaker is disconnected.

IF SET Button

The “IF SET” feature has been discussed in the Instruction Guide of TJ6A. TJ6A pro has a button to access IF SET mode. Press IF SET button of the DDS unit, the DDS unit enters IF set up mode. Press MEM to exit this mode.

Calibration of S meter

The S meter circuit is used with LM3915 which drives 10 LEDs, providing a logarithmic 3dB/step analog display. Each 2 LEDs stands for 1 S. For example, LEDs 1 – 2 stands for S6 (6.3uV), LEDs 3 – 4 for S7 (13uV), LEDs 5 – 6 for S8 (25uV), LEDs 7 – 8 for S9 (50uV), LEDs 9 – 10 for S9+.

After checking, apply power. Try to find a strong signal (S9+) of either SSB or CW to calibrate the S meter. Trim VR2 of the DDS board (VR2 is beside U16) until all the LED's are lit. If you have a standard signal generator, input a 50uV signal into ANT of TJ6A pro. Trim VR2 until the 8th LED is lit, which stands for S9.

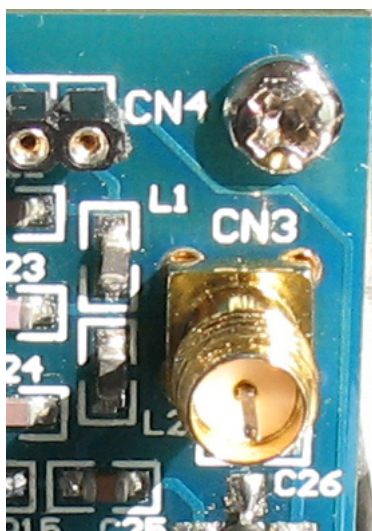
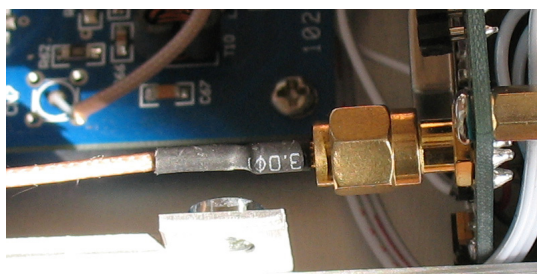
Louder Speaker Gasket

To prevent the friction occurs between the speaker cone and the casing, it is suggested to insert a hard paper gasket (around 1 mm thick) between the speaker frame and the casing. The speaker cone friction causes hoarse or distorted sound when the strong signal presents. Alternatively, 4 spacers can be used to raise the speaker frame a little from the casing. However, the gasket offers better sound. Draw the shape of the speaker on a piece of hard paper (or other materials, say rubber sheeting, mouse pad, etc.), and then cut an opening the size of the speaker cone. Position the

gasket on the speaker mounting, and then put the speaker on the gasket. Insert the screws and tighten them. Do not use too much force to tighten the screws. Too much force might distort the speaker metal frame, resulting in permanent damage to the speaker (unclear and distorted sound). You may tighten the screws with TJ6A on, tightening the screws while listening. Notice the sound changing. The gasket can be made larger, because the paper liner breaks easily if the flange is too narrow.

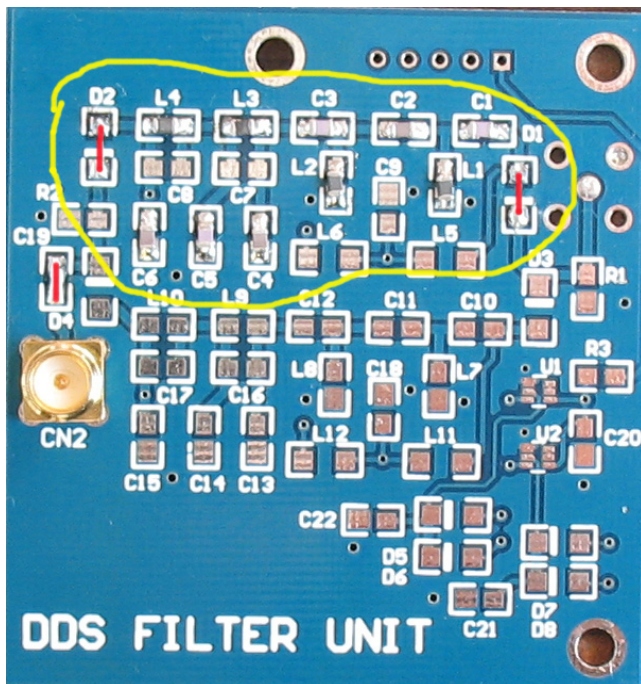
DDS Output SMA Socket

To suit the DDS Filter Unit, Pro DDS Board output (CN3) is used with a female SMA socket (See picture). The connector of LO IN (CN6) of the main board is also used with a female SMA connector. Therefore, when TJ6A is used without the DDS Filter, please insert a piece of copper wire (length of about 6 – 7mm) into the socket, and then fasten the LO IN SMA connector, so that DDS signal can be routed to the LO input of the main board.



Optional DDS Filter

The optional DDS Filter further purifies the DDS signal. However, TJ6A works fine without the filter.



Only L1, L2, L3, L4, C1, C2, C3, C4, C5, C6 are used. D1, D2, C19 are bridged using solder or thin wires.

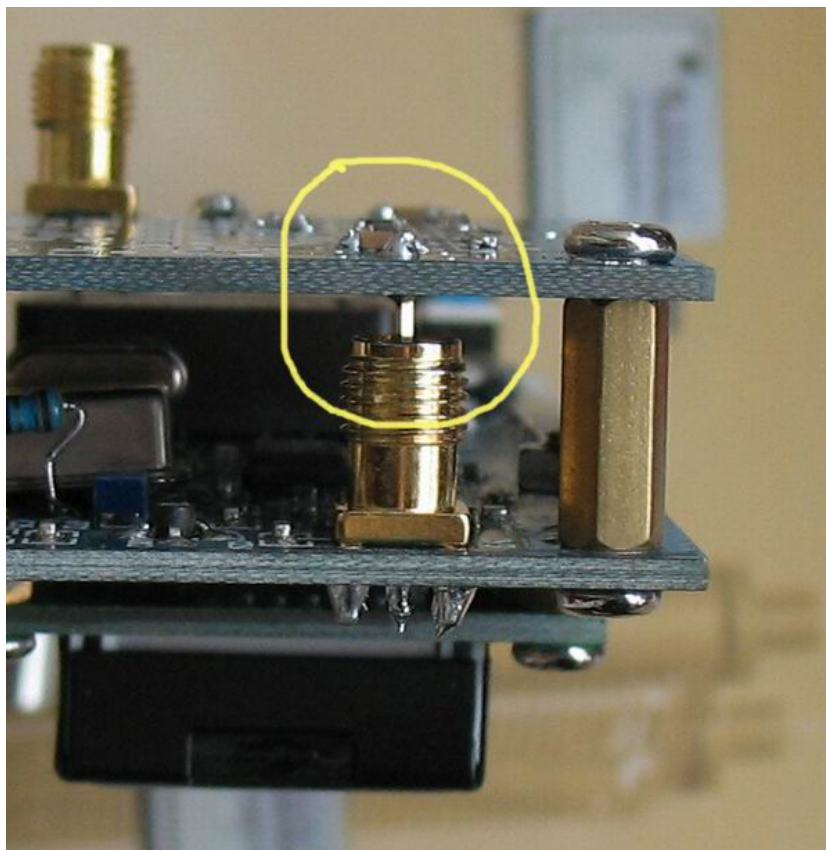
The rest component pads have no components.

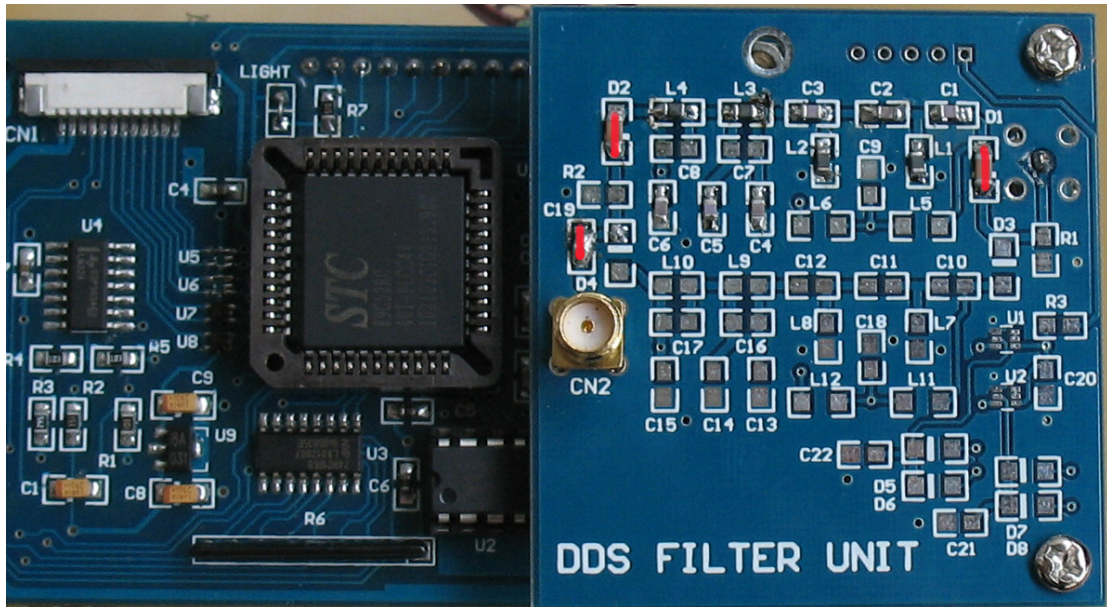
The 4-pin CN3 is not used.

CN1 is the filter input. DDS signal is routed through this point. CN2 is the filter output port. Connect CN2 to LO IN connector. Install a SMA connector in CN2.

Use 2 brass pillars between the DDS board and DDS Filter board and fasten with 2 screws. **No need for a SMA connector in CN1.** Insert a copper wire through

the center hole of CN1, until the wire reaches the end of CN3 of DDS board and makes a good contact. Solder the copper wire.

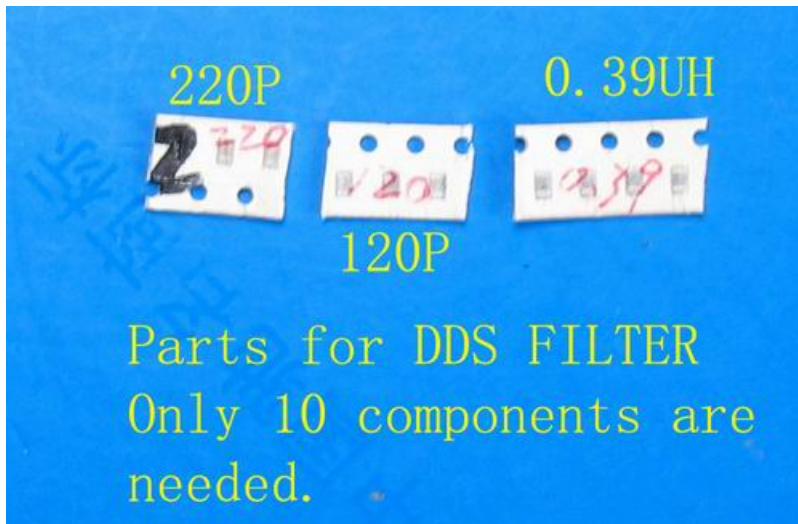




L1, L2, L3, L4 – 0.39 μ H
C1, C3, C5 – 220P
C2, C4, C6 – 120P



Optional
DDS Filter Unit



5. Picture of Connectors CN2, CN5 and Earphone



6. Picture of Cores



Use sleeves to form binocular core.

7. Picture of VC2



VC1 – No component.

VC3 – No component

8. Use TJ6A

Remove the dummy load. Connect the antenna. You can try your luck with this kit.