

CRK-10A CW Transceiver Kit Manual

Rev. A
CRKITS.COM
May 19, 2013



Change History:

May 19, 2013: Initial release - Rev. A

Introduction

Thanks for choosing CRK-10A CW Transceiver kit. It is a great one-evening project to provide you pure fun of both kit building and QRP operation. CRK-10A design is inspired by RockMite from Small Wonder Labs. RockMite was introduced to China years ago by BD6CR/4. BD4RG, the designer of HB-1A and HB-1B, improved the design by rewriting the firmware, increasing RF power output, and smoothing the keying. The improved version is called Octopus in China, and has already received a good reputation and popularity among Chinese QRPers. Previously, we introduced the SMD version 40 meter CW transceiver kit called CRK-10, and now we are glad to announce the through-hole version CRK-10A with improvements.

The major changes from CRK-10:

- CRK-10 is a hybrid kit with all the SMD parts pre-mounted and about 20 pcs through-hole parts to install, but CRK-10A is a pure kit with all through-hole parts to install.
- CRK-10 supports 40 meter band only, while CRK-10A supports 40 meter or 30 meter band.
- CRK-10A removes the paddle dot/dash wiring jumpers, and adds a push button to confirm the side band of the incoming signal
- CRK-10A follows KN-Q7A style to use PCB panels, provides IC sockets and case feet to make it a more complete and good looking kit

The CRK-10A specifications follow CRK-10 that the RF output power is about 3 watt at 12V (slightly lower for 30 meter band). Power supply range is 9-15V. TX current is about 500 mA, and RX current is about 15 mA (measured at 12V). The built-in MCU can generate side tone of about 700 Hz, switch RX/TX, and act as a keyer for not only paddle (normal paddle or bug key simulation mode), but also straight key.

The receiver is a direct conversion receiver, but the sensitivity and selectivity are very high because of a two-pole crystal filter in the receiver front-end and an audio filter, which block interference and filter out background noise. The MCU automatically shifts TX frequency, generates side tone and acts as the keyer, which makes the whole radio quite practical. The power supply polarity protection and the high SWR protection make the radio durable.

Disclaimer

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

Parts Inventory

Follow the part list below to do parts inventory first. Please note the difference between 30 meter kit and 40 meter kit. If there are any missing parts or questions, please contact your local distributor or CRKITS.COM directly by email at rongxh@gmail.com.

Item	Quantity	Value	Comments
Resistor	2	22	R3, R18
Resistor	2	100	R1, R23
Resistor	2	220	R8, R14
Resistor	2	1 k	R5, R9
Resistor	2	2.2 k	R6, R22
Resistor	4	4.7 k	R10, R15, R16, R24
Resistor	2	22 k	R7, R20
Resistor	1	33 k	R2
Resistor	2	47 k	R4, R11
Resistor	3	220 k	R17, R19, R21
Resistor	2	2.2 M	R12, R13
Capacitor, ceramic	3	33 p	C7, C11, C26
Capacitor, ceramic	1	56 p (30 m) or 100 p (40 m)	C9
Capacitor, ceramic	6	100 p	C4, C15, C16, C21, C34, C35
Capacitor, ceramic	2	220 p (30m) or 470 p (40 m)	C6, C8'
Capacitor, ceramic	2	470 p (30m) or 1000 p (40 m)	C8, C10
Capacitor, ceramic	7	0.01 uF	C3, C12~C14, C17, C19, C22
Capacitor, ceramic	1	0.01 uF (30 m) or leave it not installed (40 m)	C25
Capacitor, ceramic	7	0.1 uF	C2, C5, C18, C20, C27~C29
Capacitor, trimmer	2	9-50 pF	C23 (for TX), C24 (for RX)
Capacitor, electrolytic	1	10 uF 25 V	C33
Capacitor, electrolytic	2	100 uF 25 V	C1, C32
Capacitor, polyester film	2	0.01 uF, 2A103J	C30, C31
Diode	7	1N4148, glass body	D2, D4, D5~D9
Diode	1	1N5817, black	D1
Diode	1	1N4755A, silver	D3
Regulator IC	1	78L05	78L05
IC socket	3	8-pin	8-pin

IC, balanced mixer	1	NE602	IC1
IC, op amp	1	NE5532	IC2
IC, MCU	1	12F629, programmed	IC3
Transistor	2	2N3904	Q1, Q2
Transistor	1	2N3906	Q4
Transistor	1	2N4401	Q5
Field Effect Transistor	1	J309	Q3
Power Amp. transistor	1	2SC1162	Q6
Inductor, fixed	1	10 uH	L1
Inductor, toroid	2	T37-2, red	L2 (10 turns), L3 (12 turns)
Enamel wire	0.4m	0.38mm diameter	For L2 and L3 winding
Push button	2	PCB mount	SW, SW1
3.5mm jack	2	3.5 mm stereo type	PHONE, KEY
DC IN connector	1	2.1 mm type	+V
Crystal	3	7.010, 7.020, 7.025, 7.030, 10.106 or 10.130 MHz	X1, X2, X3
Thermal pad / insulator	1	TO-220 type	With back paste, stick to inner side of the rear panel plated area
M3x8 screw	1	M3x8, black, pan head	For fixing 2SC1162
M3 nut	1	M3, black	For fixing 2SC1162
Antenna connector	1	BNC, PCB mount	ANTENNA, with washer and nut
M2.5x6 panel screw	8	Black, pan head	For front and rear panels
Case	1	CRK-10, black	With front and rear panels
PCB	1	CW-DC-1P	

Step by Step Building

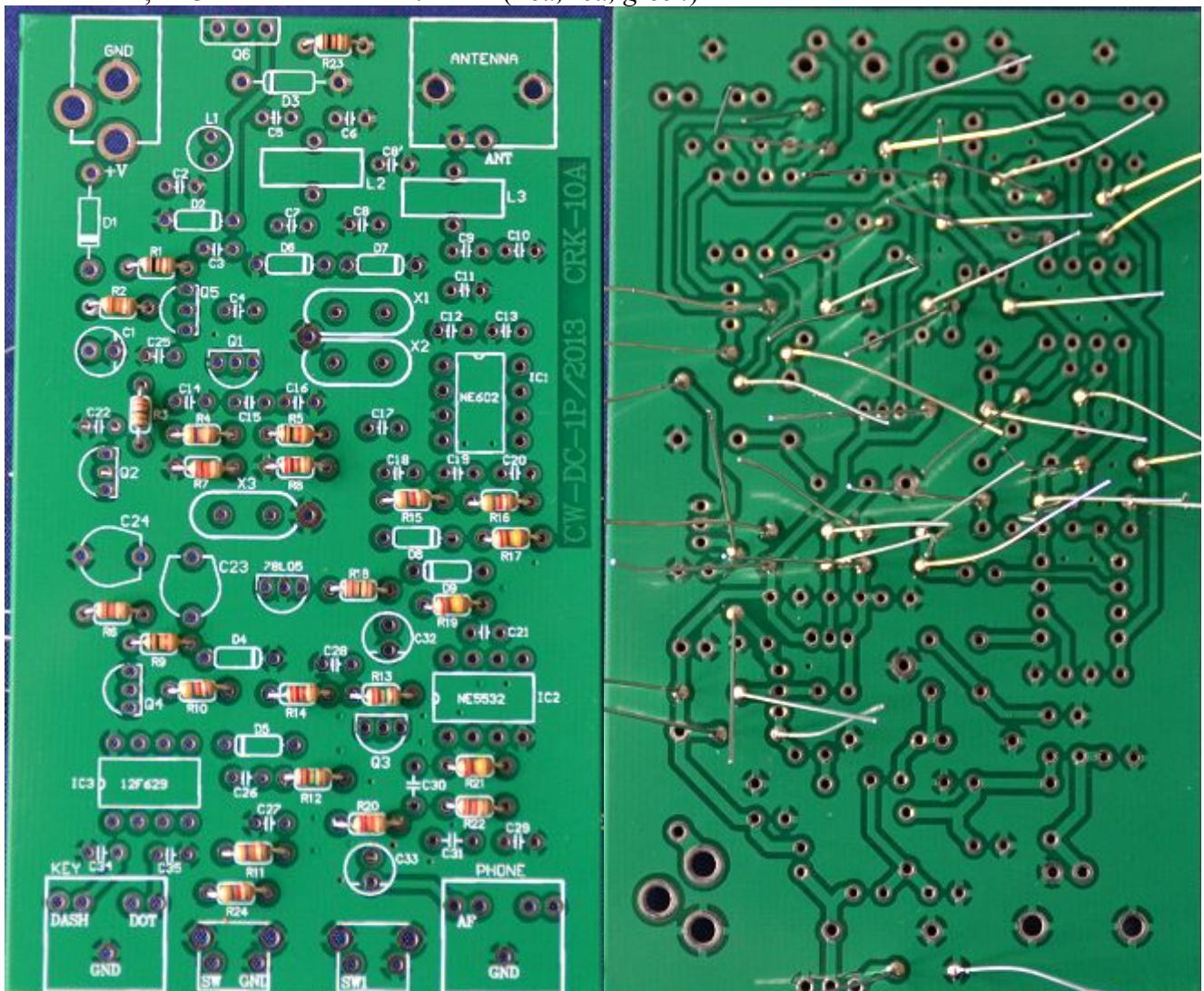
It takes about 2.5 hours to build and align the kit. You will need to prepare basic soldering and alignment tools to be able to build this kit.

Step 1: Resistors

Stuff all the resistors, solder and cut the extra leads. If you are not sure about the color codes, you can use an ohm meter to verify value before you solder.

First 3 colors are listed. If necessary, use an ohmmeter to verify value.

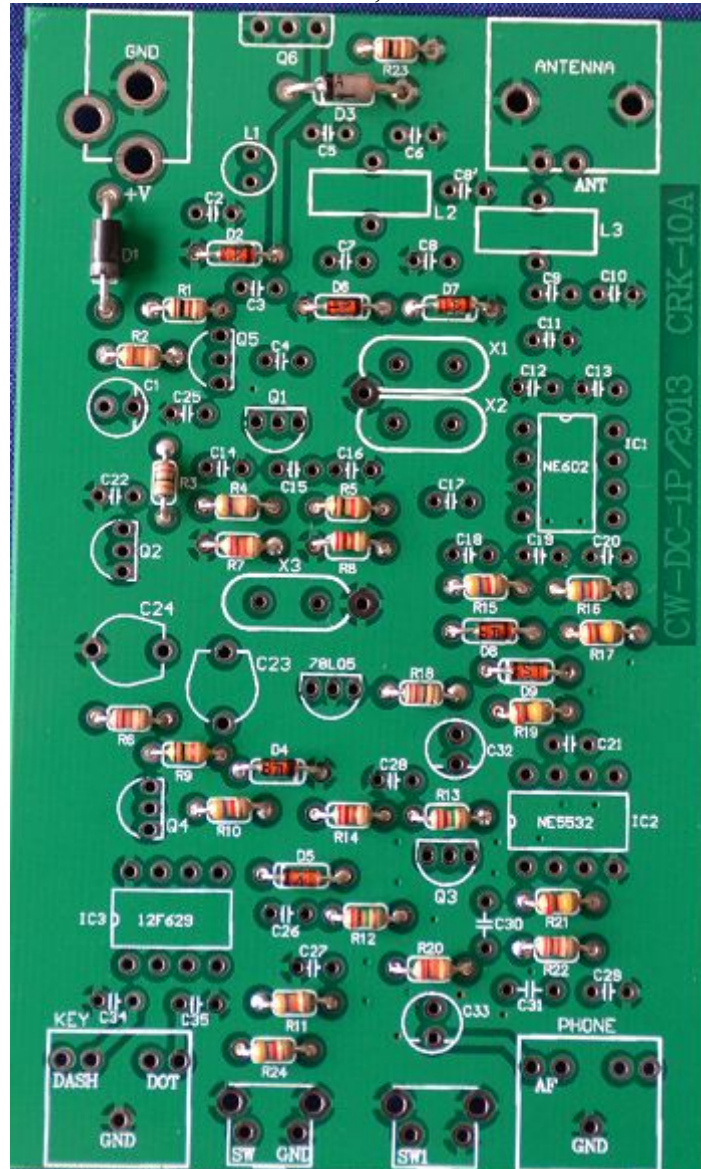
- | | | |
|----------------------|-------|--------------------------|
| • R3, R18 | 22 | (Red, red, black) |
| • R1, R23 | 100 | (Brown, black, brown) |
| • R8, R14 | 220 | (Red, red, brown) |
| • R5, R9 | 1 k | (Brown, black, red) |
| • R6, R22 | 2.2 k | (Red, red, red) |
| • R10, R15, R16, R24 | 4.7 k | (Yellow, violet, red) |
| • R7, R20 | 22 k | (Red, red, orange) |
| • R2 | 33 k | (Orange, orange, orange) |
| • R4, R11 | 47 k | (Yellow, violet, orange) |
| • R17, R19, R21 | 220 k | (Red, red, yellow) |
| • R12, R13 | 2.2 M | (Red, red, green) |



Step 2: Diodes

Stuff all the diodes. Note for the polarity. Solder and cut the extra leads.

- D2, D4, D5~D9 1N4148, glass body
- D1 1N5817, black
- D3 1N4755A, silver



Step 3: Ceramic capacitors, regulator IC and IC sockets

Install all the 0.01 uF (103) and 0.1 uF (104) ceramic capacitors. C25 is only required for 30 meter kit.

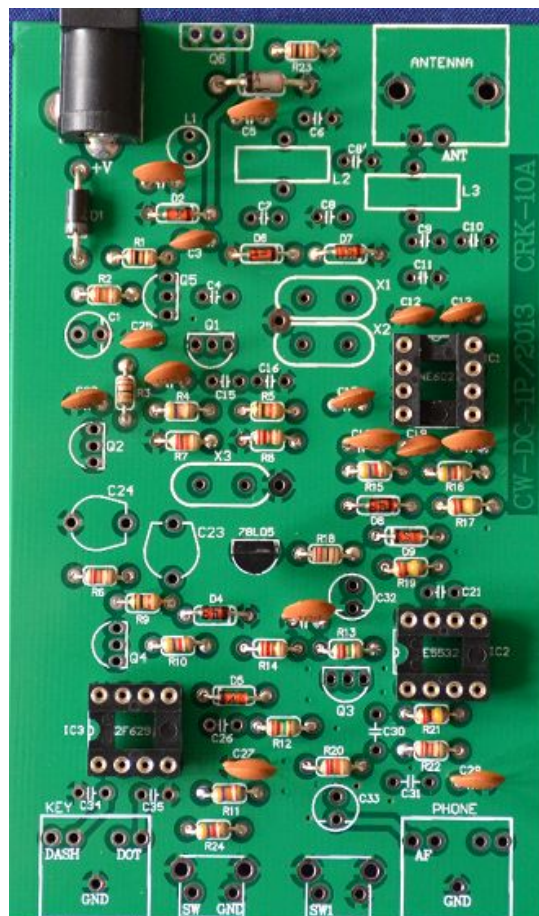
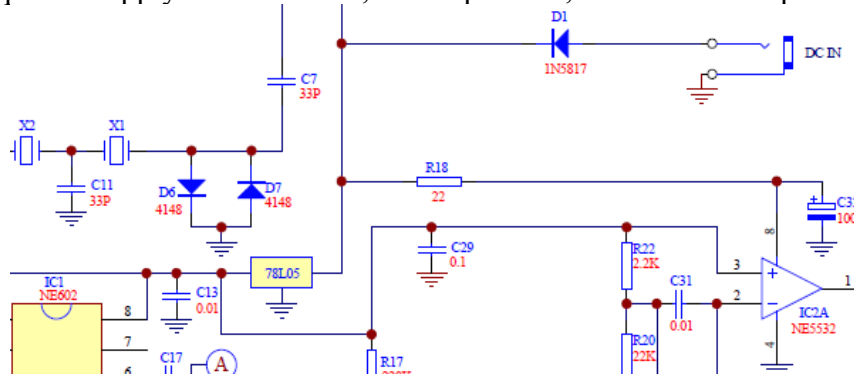
- C3, C12~C14, C17, C19, C22 0.01 uF
- C25 0.01 uF (30 m)
not installed (40 m)
- C2, C5, C18, C20, C27~C29 0.1 uF

Install the DC IN socket. If it is a bit protruding outside of the board edge, press it towards inside then solder.

Install 78L05 regulator IC. Make sure the outline is aligned.

Install 3 pcs IC sockets. Make sure the notches are aligned.

Test: Apply power supply of 9-15 V DC, center positive, measure 5 V at pin 8 of IC1.



Step 4: Audio filter and amplifier

Install Q3 (J309). Note for static sensitive part. Handle with care.

Install C32 (100 uF 25 V) and C33 (10 uF 25 V). Note for polarity.

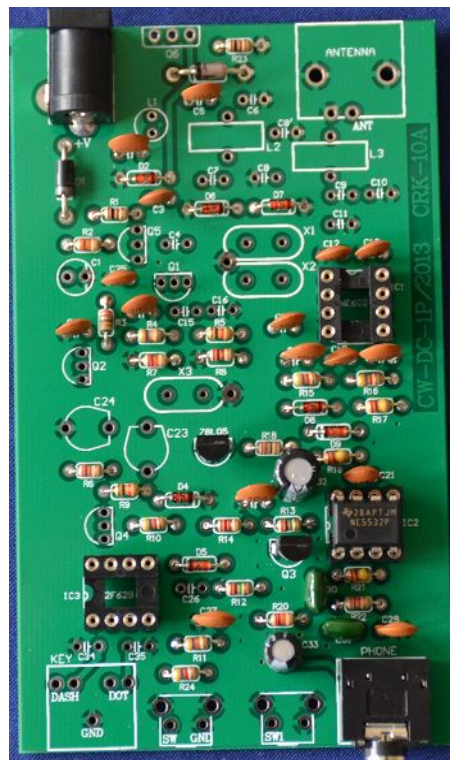
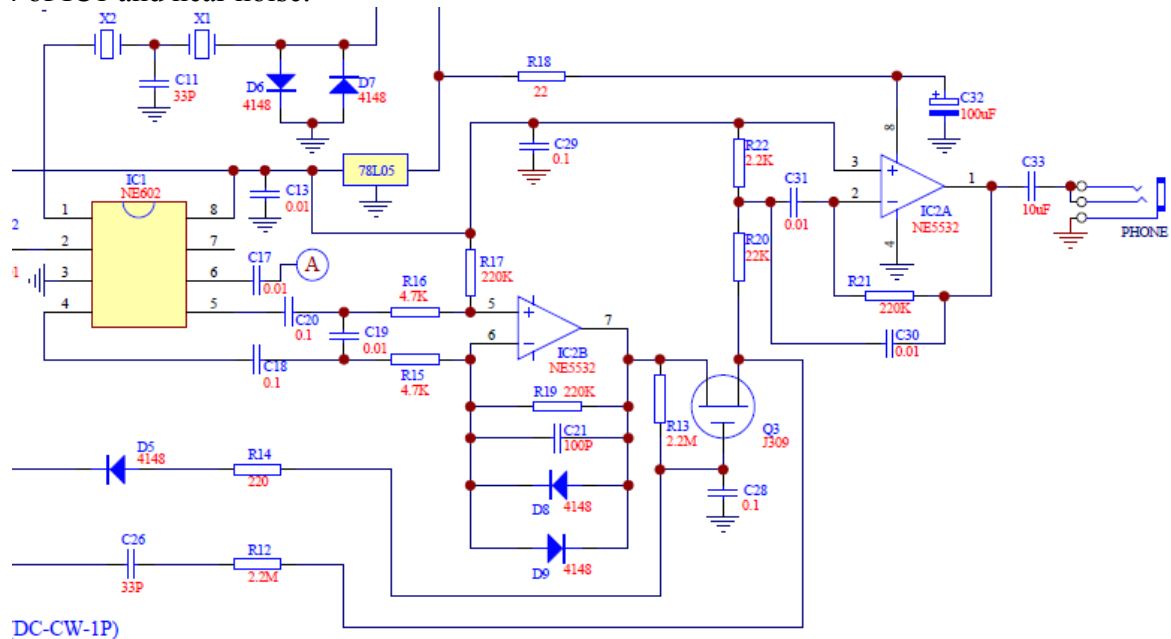
Install C30 and C31 (polyester film 0.01 uF, 2A103J).

Install C21 (100 p).

Install PHONE jack.

Insert IC2 (NE5532). Note for orientation.

Test: Apply power supply, and connector a headphone to PHONE jack. Use tweezers to touch pin 4 of IC1 and hear noise.



Step 5: MCU

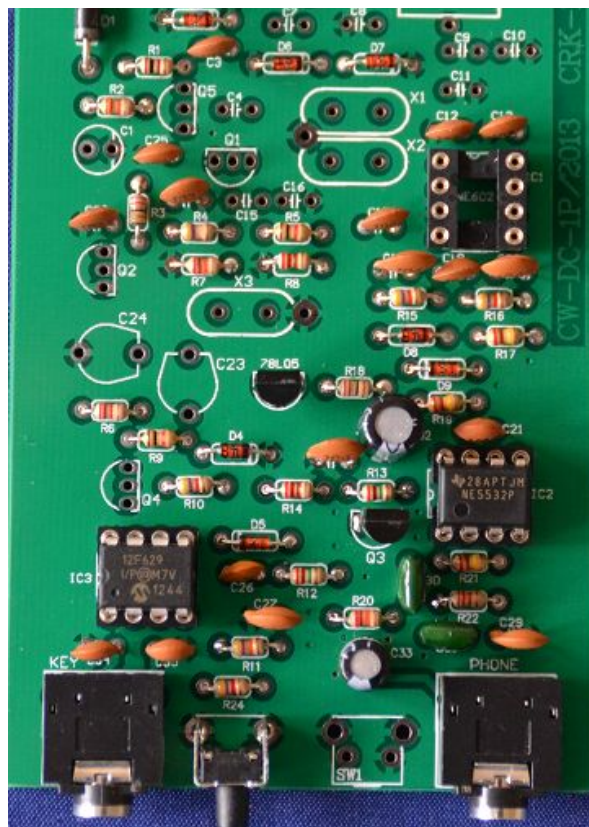
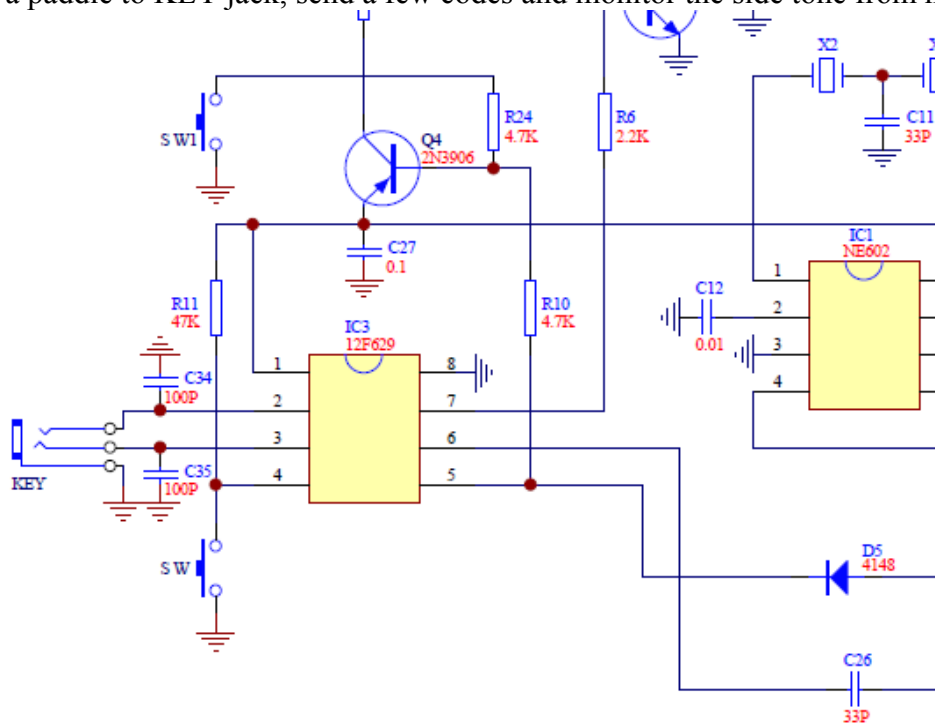
Install KEY jack

Install SW

Install C26 (33 p), C34 (100 p) and C35 (100 p)

Insert IC3 (12F629). Note for orientation.

Test: Apply power supply, and connect a headphone to PHONE jack. Press SW1 to hear Morse code. Connect a paddle to KEY jack, send a few codes and monitor the side tone from headphone.



Step 6: Local Oscillator

Install C23 (9-50 pF), C24 (9-50 pF)

Install Q1 (2N3904), Q4 (2N3906)

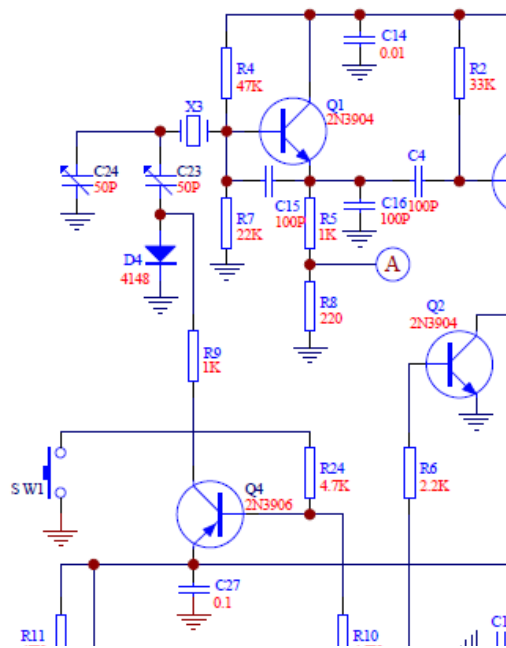
Install crystal X3 (Case grounding pad is reserved, but not used)

Install C1 (100 uF 25V). Note for polarity.

Install C4 (100 p), C15 (100 p), C16 (100 p)

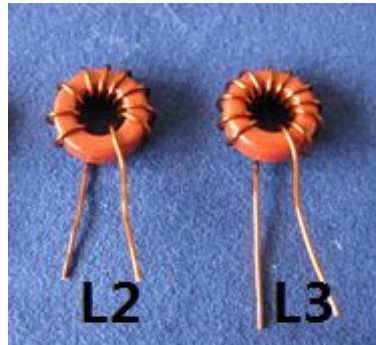
Install SW1

Test: Apply power supply. Place the board near a SSB or CW receiver's antenna. Tune the receiver around the frequency of X3 to hear tone. Press SW1 and you will hear the tone frequency change.



Step 7: Transmitter and Board Complete

Follow the picture to wind 10 turns for L2 and 12 turns for L3. They are parts of the low-pass filter to purify the transmitter output. Scratch the enamel of wire endings and tin them well.



Install Q2 (2N3904), Q5 (2N4401).

Install crystals X1, X2 (Case grounding pad is reserved, but not used)

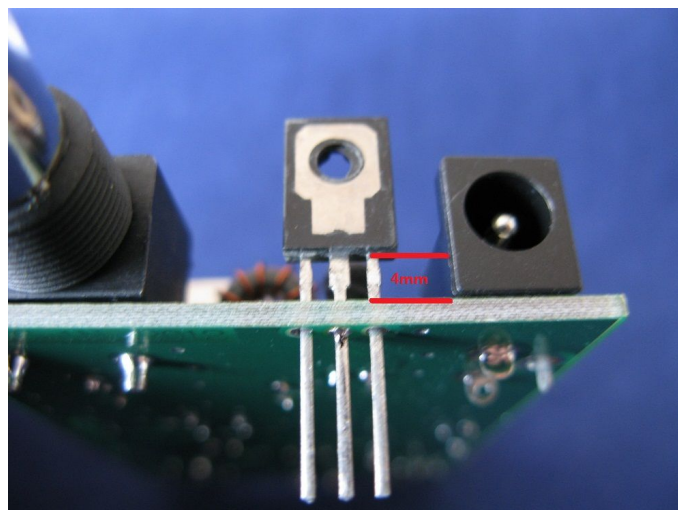
Install L1 (10 μ H), L2 (10 turns) and L3 (12 turns).

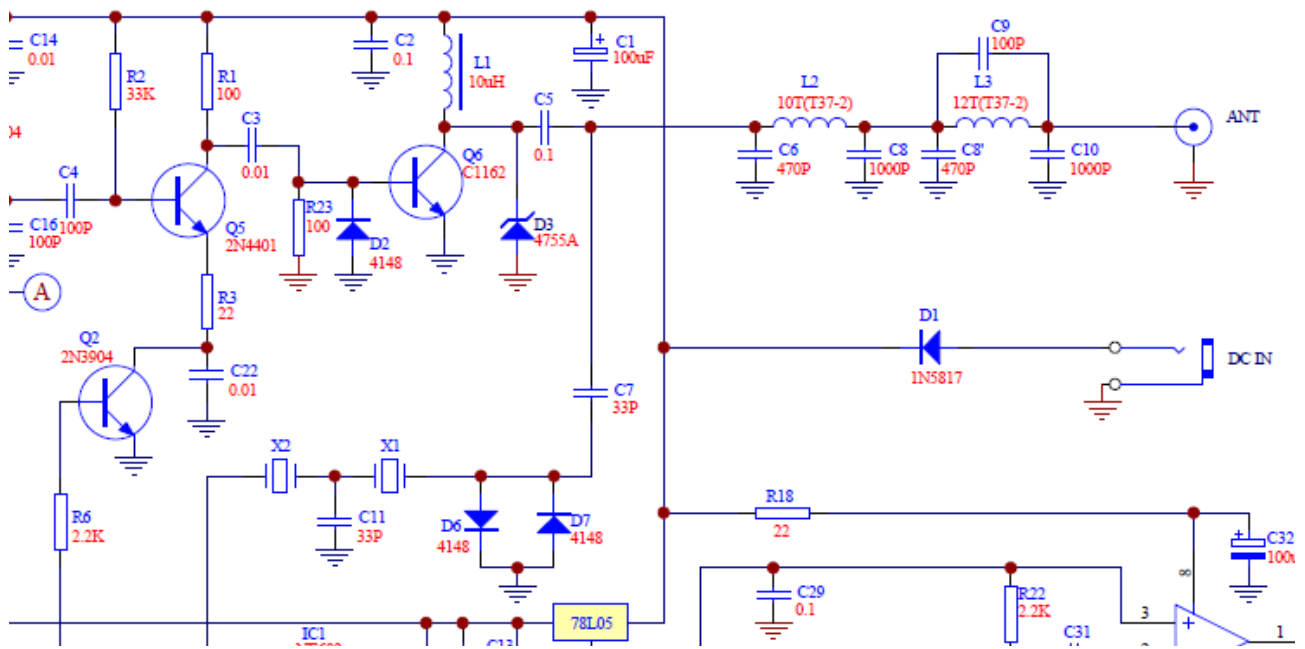
Install C6 (220 p (30m) or 470 p (40 m)), C7 (33 p), C8 (220 p (30m) or 470 p (40 m)), C8' (470 p (30m) or 1000 p (40 m)), C9 (56 p (30 m) or 100 p (40 m)), C10 (470 p (30m) or 1000 p (40 m)), C11 (33 p).

Install antenna connector ANT.

Insert IC1 (NE602). Note for orientation.

Follow the pictures to install the power amplifier transistor Q6 (2SC1162). Keep the pin about 4 mm above the board, and only solder one pin first.





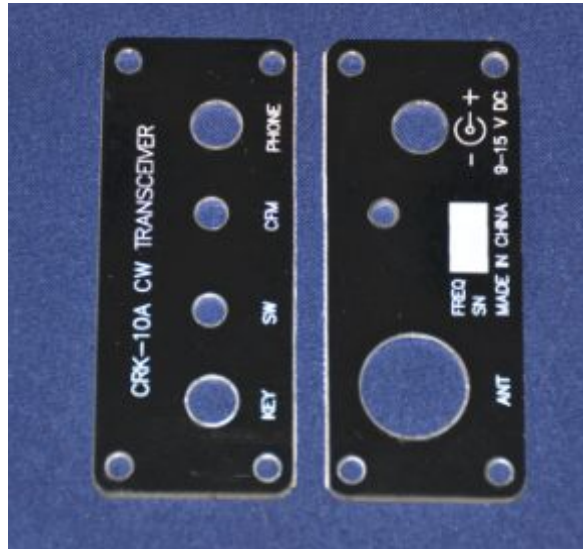
Note: Schematic here is only for 40 m. Refer to the schematic for 30 m at the end of this document.

Test: Apply power supply, connect a dummy load of 50 ohm at least 5 watts. Place a SSB/CW receiver nearby and tune to around the frequency of X1, X2 or X3. Press SW to monitor the Morse code by leakage from dummy load. If your power supply has current meter, check if it draws about 500 mA. Disconnect the dummy load and connect to a resonant antenna, you should be able to hear some band noise.

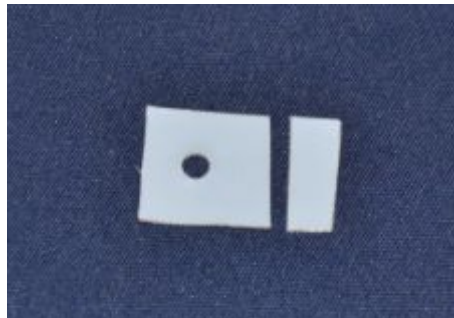


Step 8: Thermal Pad / Insulator

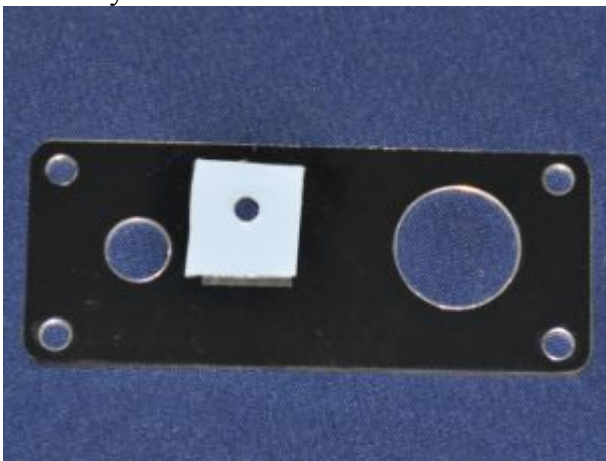
Split the panel board to two halves.



Cut thermal pad about 3~4 mm as shown.



Follow the pictures to stick the thermal pad to the inner side of the rear panel, and fix Q6 (2SC1162) to the rear panel by M3 screw and nut. Make sure the DC IN connector can be plugged in when you fasten the screw. Then solder all the pins of Q6 (2SC1162) and trim the leads.



Step 9: Ready for Alignment

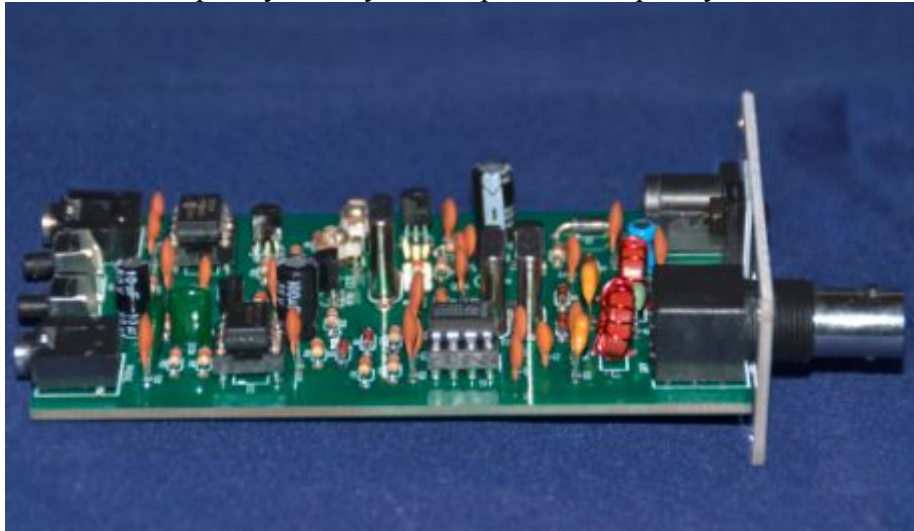
Follow the following alignment section to align the radio, before final assembly.

It is preferred that you have a power supply of 12~13.8V with short circuit protection. Connect the power supply to the CRK-10A to see if it works. The overall receive current should be about 15 mA.

Disconnect the power supply, connect a headphone, a paddle and an antenna or a 50 ohm dummy load, then connect the power supply again, you should hear dot dash. Touch the antenna connector center pin with tweezers, and you should hear some clicks. It means the receiver works.

Now proceed to TX alignment. Enter the straight key mode and press and hold the key to see if the overall current is about 500 mA. If it is, it means the transmitter works.

Use a commercial amateur radio to transmit a CW tone at the specified frequency, and adjust the capacitor trimmer C24 to make the receiver frequency exactly on the specified frequency (the tone from the headphone is loud and clear, within 700~800 Hz range). Adjust the capacitor trimmer C23 to make the transmit frequency exactly to the specified frequency.



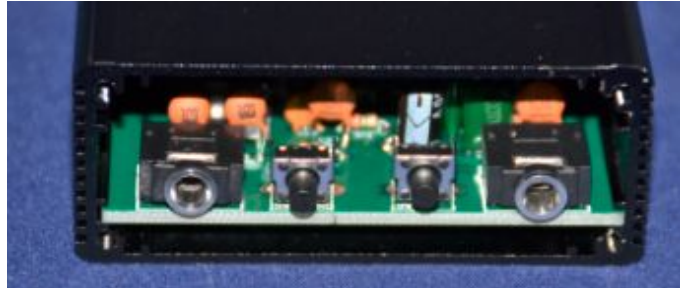
Step 10 : Final Assembly

Follow the pictures to slide the board to the case and finish the final assembly. Note that the bottom side of the case has two lines, while the top side is flat.

Fix the rear panel and front panel by the 8 pcs pan head M2.5 panel screws.

Stick four rubber feet on the bottom side of the case.

Congratulations! You are done with your building and please enjoy some QSO's now.



Operation

If an effective antenna is used, 3 watt RF power is good enough to make others heard. Although it is a QRP radio, you are encouraged to call CQ to be able to make more successful QSO's. Luckily you can use the push button to automatically call CQ.

Sometimes, you can hear a station well, but no matter how you call him, he just cannot hear you. It's normally because he is on the wrong side band. Push button SW1 (CFM) is used to confirm that while in RX. After pressing SW1 and the tone of the signal of interest gets very low or even not heard, the signal is on the right side band, and likely he can hear you when you call back. If the tone gets higher, the signal is on the wrong side band, and unless his receiver bandwidth is wide enough, he will not likely hear you.

Everything else is straightforward but the keyer operation, which will be addressed below. The human-machine interface is made by the push button SW, a paddle and a headphone.

All parameters will be stored in the MCU, and it will not be lost after power down.

Paddle or Straight Key Keyer Mode Switch

The MCU automatically detects paddle or straight key, as long as you plug in the key before power on. The mechanism is that the MCU detects if the ring of the 3.5 mm stereo plug (pin 3 of the MCU) is permanently short with the shield (ground) or floating. For straight key, it is short. For paddle, it is floating. If you hear Morse code A (Automatic) after power on, it means a paddle is detected and it works in normal paddle mode; Morse code B (Bug) means a paddle is detected and it works in bug key simulation mode; and Morse code M (Manual) means a straight key is detected and it works in straight key mode.

Auto CQ

Briefly press SW button and it automatically send CQ CQ CQ DE + your call three times + K. If you want to stop the auto CQ, press and hold SW button for 1 sec and release.

Speed Adjustment

Press SW button for more than 2 sec, you will hear Morse code S (speed). Release it and adjust the keying speed by paddle within 8 sec (or it automatically exits to keep the original speed). Press dot will increase the speed, and press dash will decrease the speed. Briefly press SW button and you can hear Morse code E to confirm exit, or wait about 8 sec to automatically exit.

Call sign Input

Press SW button for about 2 sec, you will hear Morse code S (speed). Keep pressing for another 2 sec, you will hear Morse code I (input). Release it and input your call sign (up to 10 character) just like you make QSO with your paddle within 8 sec (or it automatically exits to keep the original call sign). Briefly press SW button and you can hear Morse code E to confirm exit, or wait about 8 sec to automatically exit.

Paddle Mode Selection (Normal Paddle/ Bug Simulation)

Press SW button for about 2 sec, you will hear Morse code S (speed). Keep pressing for another 2 sec, you will hear Morse code I (input). Keep pressing for another 2 sec, you will hear Morse code M (mode). Release it and send dot by your paddle, you will hear Morse code NOR, and the radio will be chosen to work in normal paddle mode. If you send dash by your paddle, you will hear

Morse code BUG, and the radio will be chosen to work in bug simulation mode. In bug simulation mode, dots will be sent automatically by the MCU and dashes will be sent manually. Note that the keyer does not actually support mechanical bug key.

Adding /QRP

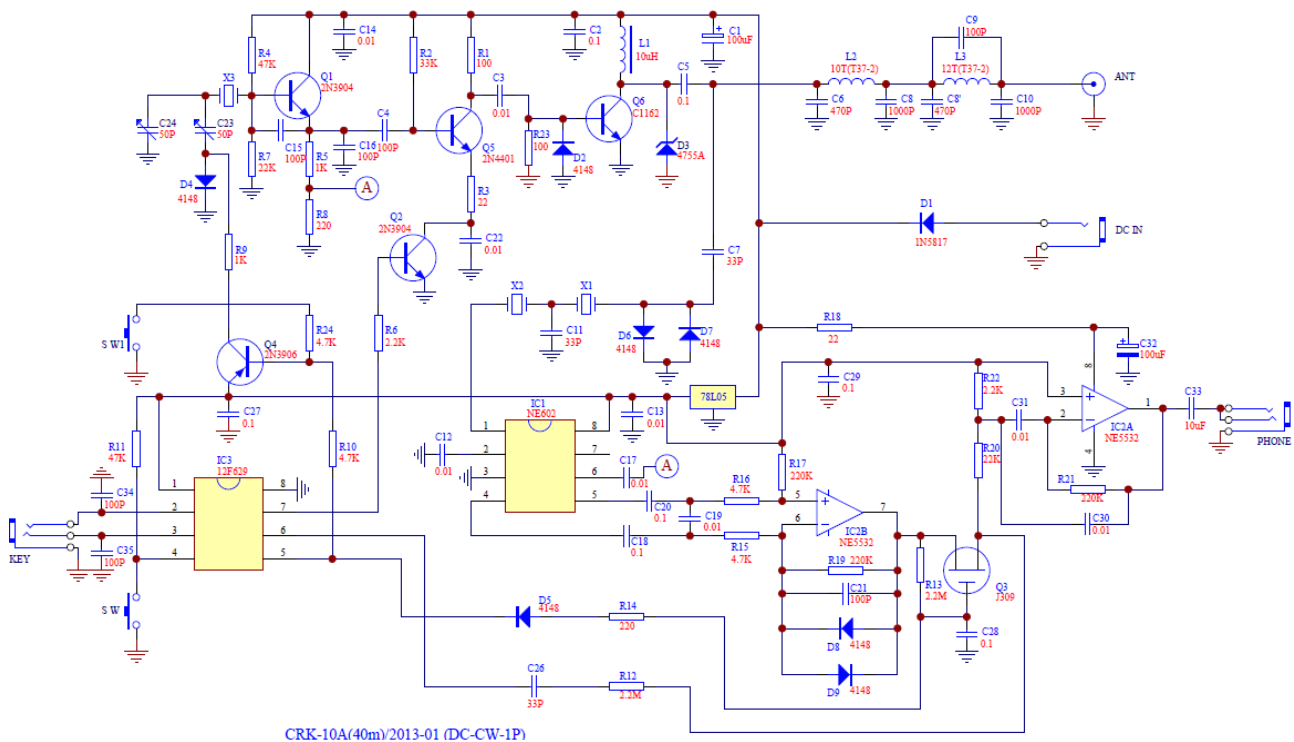
You can choose to add /QRP or not in auto CQ. Press SW button and power on the radio, you will hear normal Morse codes (A or M or B) to indicate working mode. Keep pressing SW button for 1 sec or 2, you will hear Morse code QRP. Release it and now auto CQ will add /QRP after the third time of your call sign. Repeat the above operation you will hear Morse code NO, and it means auto CQ will not add /QRP.

Theory of Operation

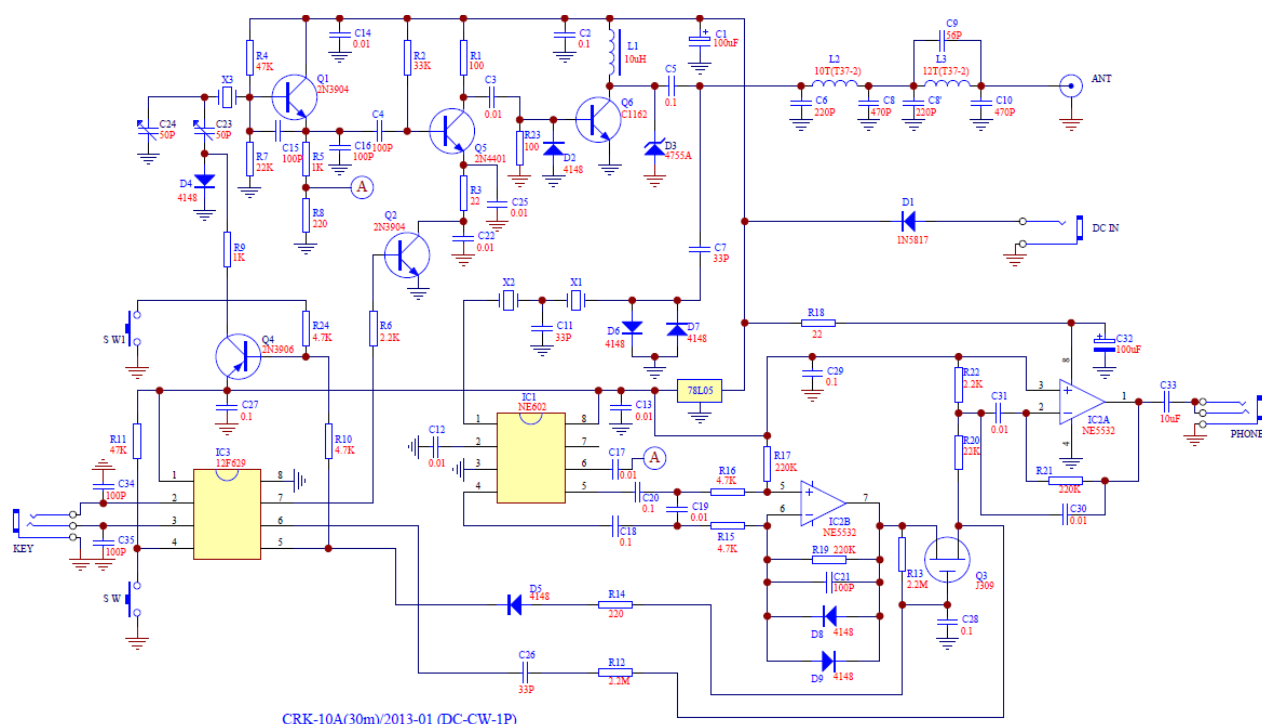
The MCU serves as a controller and a keyer. It controls RX/TX switch, including receiver mute and transmit frequency shift. As a keyer, it reads the key input, keys the transmitter to send the signal and generate side tone as well.

The receiver is a typical NE602 direction conversion receiver, with the exception that it only receives one frequency, so a 2-pole crystal filter is added in the front-end to block most of the broadcast interference out. The NE5532 op-amp serves as an audio filter and amplifier to drive a headphone. Q3 J309 is controlled by the MCU to mute the receiver in transmit.

The transmitter chain is simple. 2N3904 is the oscillator. C24 controls the receiver frequency and C23 in parallel of C24 control the transmit frequency. 2N4401 is a buffer amplifier and it is also a keying circuit. The power amplifier is 2SC1162. The LPF filters the transmit harmonic signals.



Schematic of 40 meter version



Schematic of 30 meter version

Troubleshooting

If the receive current is much higher than 15 mA, it means the circuit has issue. Inspect all the components to make sure they are installed properly, especially the components with polarity such as electrolytic capacitors, and IC orientation. If all the components are installed properly but the symptom persists, most likely it is because of the PCB short. Please inspect carefully and cut the short circuit trace by a knife.

You can also refer to the following voltage chart to help you find the issue. If the voltages of one IC is abnormal, normally you can check the IC itself or its peripheral components.

Reference voltage on each IC: (Power supply 12V, measured in RX mode)

Pin	1	2	3	4	5	6	7	8
IC1	1.4	1.4	0	3.9	3.9	4.9	4.2	5
IC2	5	5	5	0	4.8	5	5	11.8
IC3	5	5	5	5	5	0	0	0