

RadiØKit-180

80M CW HAM RADIO TRANSCEIVER KIT

Ver: 2.0



Assembly and operating manual

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Thank you for buying RadiØKit-1, a ham radio CW transceiver for the 80M (RadiØKit-180) or the 40M band (RadiØKit-140).

RadiØKit-1 is part of a series of electronic kits that we offer not only to radio amateurs who want to discover the joy of building their own equipment, but also to all the electronics DIY enthusiasts who like to construct various devices for everyday use or just for the fun of it.

The kit is based on the famous Pixie transceiver introduced many years ago. The design was improved over the years and still catches the interest of many radio amateurs over the world due to it's simplicity, satisfying performance and ease of construction.

RadiØKit-1 incorporates additions and improvements that we will discuss later on. The circuit board is constructed by FR-4 material, the placement of the components is silk screened on the top side. All the copper traces on the bottom side are solder masked to prevent short circuits and accidental bridging between conductors. All component holes are already drilled. There are also four drilled holes for placing the board inside a box using appropriate screws and spacers. The components that are used for RadiØKit-1 are of the highest quality. All the resistors are metal film 1% type. The capacitors are of the MLCC type except for the electrolytic ones that are mini sized 85°C types. The inductors used are resistor type and provide high performance and minimum space usage. The famous 2N2222A and 2N2219 transistors are used in order to achieve a little bit more output power.

DC voltage is applied by a 9 Volt battery (not included) or a 9V to 12V power supply (not included) and the output RF power produced can reach or exceed 500mW depending on the voltage applied. You only need to connect the battery, a Morse key, an earphone or small speaker and an appropriate antenna to have a fully working ham radio transceiver. RadiØKit-1 comes in two flavors. One for the 80M CW radio amateur band and one for the 40M band.

CIRCUIT DIAGRAM DESCRIPTION OSCILLATOR

The main oscillator of RadiØKit-1 is a classic colpitts circuit and is comprised by the components T1, R1, R2, C1, C2, C3, C12 and the crystal (XTAL) for either 80m or 40m band (one of the two crystals is supplied according to the model). R1 is used only when the power is applied to kickstart the oscillations. C1 and C2 are a capacitive voltage divider and provide positive feedback from the emitter of T1 back to it's base. The crystal behaves like an inductor and sets the frequency of oscillation which can be slightly altered by C12. R2 is the load resistor of the oscillator and sets it's output impedance. It also provides a small amount of negative feedback at the emitter of T1 making the operation of the oscillator more stable. The oscillator is active during both reception and transmission of the transceiver. C3 is used to couple the output of the oscillator to the base of T2 which functions as an amplifier during transmit and as a mixer during reception.

AMPLIFIER/MIXER

During transmit the RF power delivered by the oscillator is amplified by T2 and delivered to the antenna through a band pass filter. During receive the signal received by the antenna is applied at the collector of T2 through the same band pass filter. This signal is mixed with the oscillator signal applied to the base of the same transistor and the audible difference/sum between the two signals is taken from the emitter and applied to the input of the audio amplifier chip IC1. R3 and R4 form a voltage divider that biases the base-emitter junction of T2 during receive. L2 acts as an RF choke that has a high impedance at the operating frequency but remains a short circuit for DC voltage. This ensures that Q2 is turned off during transmit until a signal is injected via capacitor C3. The positive half of the oscillator signal causes the base-emitter junction of T2 to conduct while the negative half of the signal allows T2 to turn off. Thus T2 is operating in Class C. L1 acts also as an RF Choke and serves as the collector load of T2 during transmit. C4 is placed in the circuit to ensure that any interference inserted in the circuit from the keying line during receive is shorted to the ground. During transmit C4 and R4 are shorted to the ground.

FILTER

C5 drives the amplified signal during transmit to the bandpass filter comprising of C6, C7, C13, L3, L4 and L5. The use of a band pass filter instead of a low pass one not only suppresses the harmonics during transmit but also rejects interference from the MW band during reception, something that was very noticeable when we did our initial tests.

AUDIO AMPLIFIER

The detected audio from the emitter of T2 is delivered to the inverting input of IC1 through capacitor C8. Power is delivered to IC1 by R5 while C10 is used to suppress any noise introduced by the power line. C9 sets the amount of voltage gain of IC1 thus controlling the audio amplification and C11 is used to deliver the amplified audio to a small speaker or earphone. D1 grounds during transmit pin 7 of IC1 thus muting any audio coming out of the speaker during transmit.

KEYING

When the transceiver is keyed R4 and C4 are grounded so T2 is operating as a class C amplifier and the oscillator's output is amplified and delivered to the antenna through the band pass filter. In the same time D1's anode is grounded and IC1 is muted so no audio is coming out of the speaker.

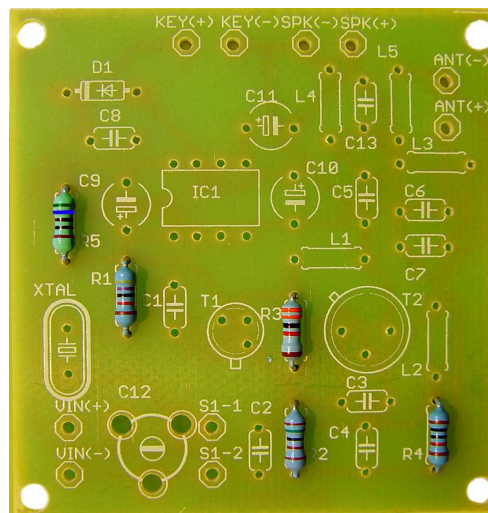
INPUT/OUTPUT CONNECTIONS

A 9V clip is provided for connecting a 9V battery at the VIN(+) and VIN(-) pins. The red cable is connected to VIN(+) and the black cable is connected to VIN(-). Alternatively you may use a 9 to 12V power supply. The antenna is connected to ANT(+) and ANT(-) output pins. A Morse key needed to operate the transceiver may be connected to KEY(+) and KEY(-) pins while a small

speaker or earphone may be connected to SPK(+) and SPK(-) pins. S1-1 and S1-2 pins are provided as a convenience if you want to bypass C12 variable capacitor by the means of a switch during receive or transmit in order to accomplish RIT or XIT functions.

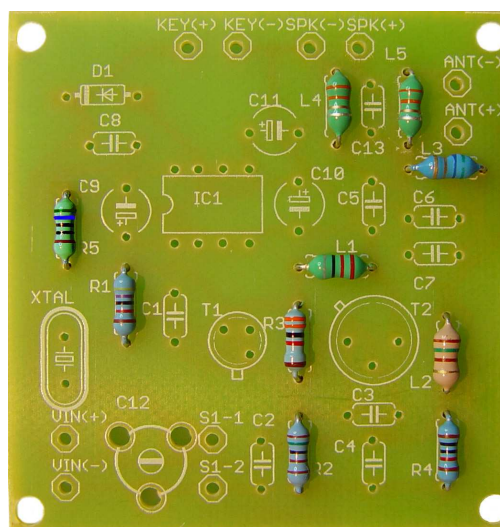
ASSEMBLING RadiØKit-180

Start construction by first identifying all the components included in the kit. Make sure that nothing is missing and that all the indicated in the parts list values are correct. In case of any trouble do not hesitate to contact us for help. In order to help you identify the components all the color codes and markings are mentioned in the parts list. First solder the resistors R1 to R5.

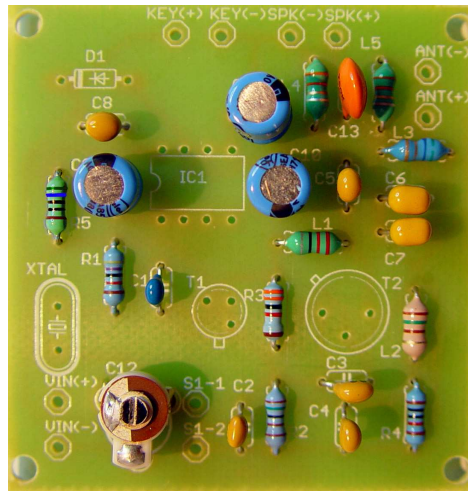


This is how the board should look after soldering the resistors.

Then solder the inductors L1 to L5 followed by the capacitors C1 to C13.

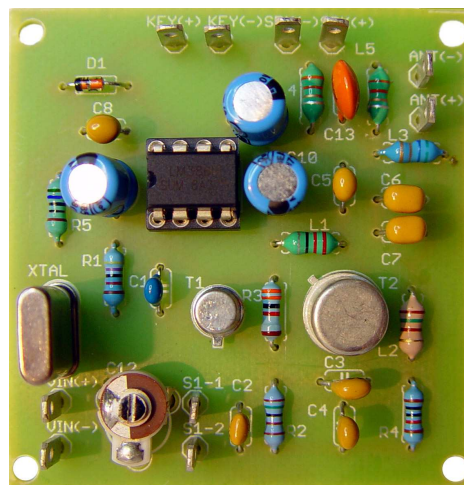


The board after soldering the inductors.



The board with the capacitors placed.

Give special attention to soldering the electrolytic capacitors C9, C10 and C11 since they are polarized. The correct polarity is printed on the board. Finish the construction by soldering IC1's 8 pin base, D1, T1, T2. Take care regarding the placement of Transistors T1 and T2. Just follow the printed impressions on the board. Solder the crystal, the provided input output pins and the 9V clip last.



Finished board

Please beware that there may be differences between the components shown in the photos and the actual components provided with the kit because of revision and production changes. See revision list at the end of this document.

After finishing soldering check your work and make sure that there are no accidental solder joints between different pads or conductors on the board. Recheck the placement of all the components and make sure that everything is in it's correct place.

TESTING

Now it is time to check the functionality of your new QRP transceiver. Connect

an appropriate antenna or dummy load at the antenna terminals of the transceiver. Connect a Morse key and an earphone or small speaker to the appropriate pins located on the board and finally connect a 9V battery on the 9V clip. If there are no signs of smoke or overheating of any component proceed to the next step. If on the other hand you see smoke or feel excessive heat on any of the components remove power and recheck the placement of components and all the soldering joints and connections. Supposing that everything is in order tune a ham radio receiver in CW mode at or near the crystal's frequency. You should hear the carrier produced by the oscillator. Key the transceiver and watch the receivers S-Meter. You should see the signal strength increase since when keyed the transceiver amplifies the oscillators signal. Listen to the audio from the earphone of the speaker. If you have connected a good antenna then you should hear the bands noise or other CW signals from fellow ham radio operators. If everything checks OK then you are ready to have your first QSO's with your new home build transceiver.

RadiØKit-180 parts list

Part	Value	Markings
C1	390pF	391
C2	100pF	101
C3	82pF	82
C4	100nF	104
C5	10nF	103
C6	1.8nF	182
C7	1.8nF	182
C8	100nF	104
C9	10uF	
C10	10uF	
C11	10uF	
C12	10-100 pF Variable Capacitor	
C13	270pF	271
D1	1N914	
IC1	LM386N-1	
L1	22uH	Red, Red, Black, Silver
L2	100uH	Brown, Black, Brown, Silver
L3	8.2uH	Gray, Red, Gold, Silver
L4	1.2uH	Brown, Red, Gold, Silver
L5	1.2uH	Brown, Red, Gold, Silver
R1	47k	Yellow, Purple, Black, Red, Brown
R2	1.5k	Brown, Green, Black, Brown, Brown
R3	33k	Orange, Orange, Black, Red, Brown
R4	10k	Brown, Black, Black, Red, Brown
R5	560 Ohm	Green, Blue, Black, Black, Brown
T1	2N2222A	
T2	2N2219	
XTAL	3.57MHz	3.5795
8 PIN DIL SOCKET		
9 VOLT BATTERY CLIP		
INPUT/OUTPUT PINS X 10 PCS		

HOW TO READ RESISTOR VALUES

Resistor values are marked on the resistors by the means of color bands. Standard 5%, 10% or 20% tolerance resistors use a 4 color bands scheme while 1% and 2% use a 5 color bands scheme. The first two bands represent the most significant digits of the resistors value. Colors are assigned to all the numbers between 0 and 9, and the color bands basically translate the numbers into a visible code. Black is 0, brown is 1, red is 2 and so on (see the color code table below). The third band indicates the multiplier telling you the power of ten to which the two significant digits must be multiplied (or how many zeros to add), using the same assigned value for each color as in the previous step.

Note: If the multiplier band is gold or silver, the decimal point is moved to the left by one or two places (divided by 10 or 100).

The tolerance band (the deviation from the specified value) is next, usually spaced away from the others, or it's a little bit wider. A color is assigned to each tolerance: gold is 5%, silver is 10%. 20% resistors have only 3 color bands - the tolerance band is missing. The 5 band code is used for marking high quality, precision resistors with 2%, 1% or lower tolerances. The rules are similar to the previous system; the only difference is the number of digit bands. The first 3 bands will represent the value, the 4th band will be the multiplier and the 5th stripe will give us the tolerance. In the case of RadiØKit-1 the resistors used are of the 1% tolerance type so the 5 band code applies.

Resistor color code table:

Color	1st digit	2nd digit	3rd digit	Multiplier	Tolerance
Black	0	0	0	$\times 10^0$	
Brown	1	1	1	$\times 10^1$	$\pm 1\%$
Red	2	2	2	$\times 10^2$	$\pm 2\%$
Orange	3	3	3	$\times 10^3$	
Yellow	4	4	4	$\times 10^4$	
Green	5	5	5	$\times 10^5$	$\pm 0.5\%$
Blue	6	6	6	$\times 10^6$	$\pm 0.25\%$
Violet	7	7	7	$\times 10^7$	$\pm 0.1\%$
Gray	8	8	8	$\times 10^8$	$\pm 0.05\%$
White	9	9	9	$\times 10^9$	
Gold				$\times 0.1$	$\pm 5\%$
Silver				$\times 0.01$	$\pm 10\%$
None					$\pm 20\%$

HOW TO READ CAPACITOR VALUES

Usually large value capacitors in the uF range have their value printed on them. Smaller value capacitors usually have two or three numbers printed on them. The first two numbers are the first two significant digits of the capacitors value and the third point is the multiplier. Actually the third digit tells you how many zeros to add after the two significant digits to get the value of the capacitor in picofarads. Sometimes the value of the capacitor is directly printed on it.

Third digit	Multiplier
0	1
1	10
2	100
3	1000
4	1000
5	100000
6	Not used
7	Not used
8	.01
9	.1

HOW TO READ INDUCTOR VALUES

For the inductors used in RadiØKit-1 the 4 band resistor code scheme applies.

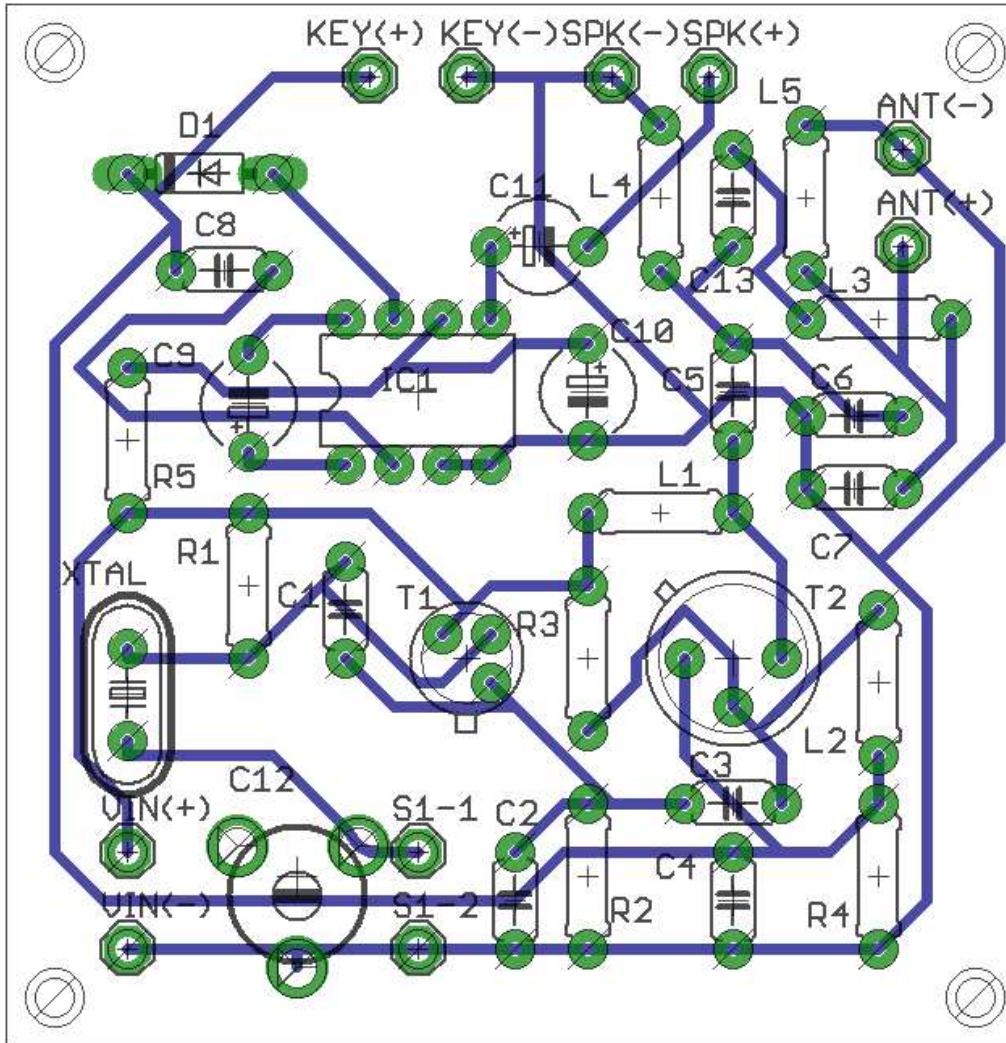
For examples and actual readings of resistors, capacitors and inductor values please check the parts list.

TECHNICAL ASSISTANCE

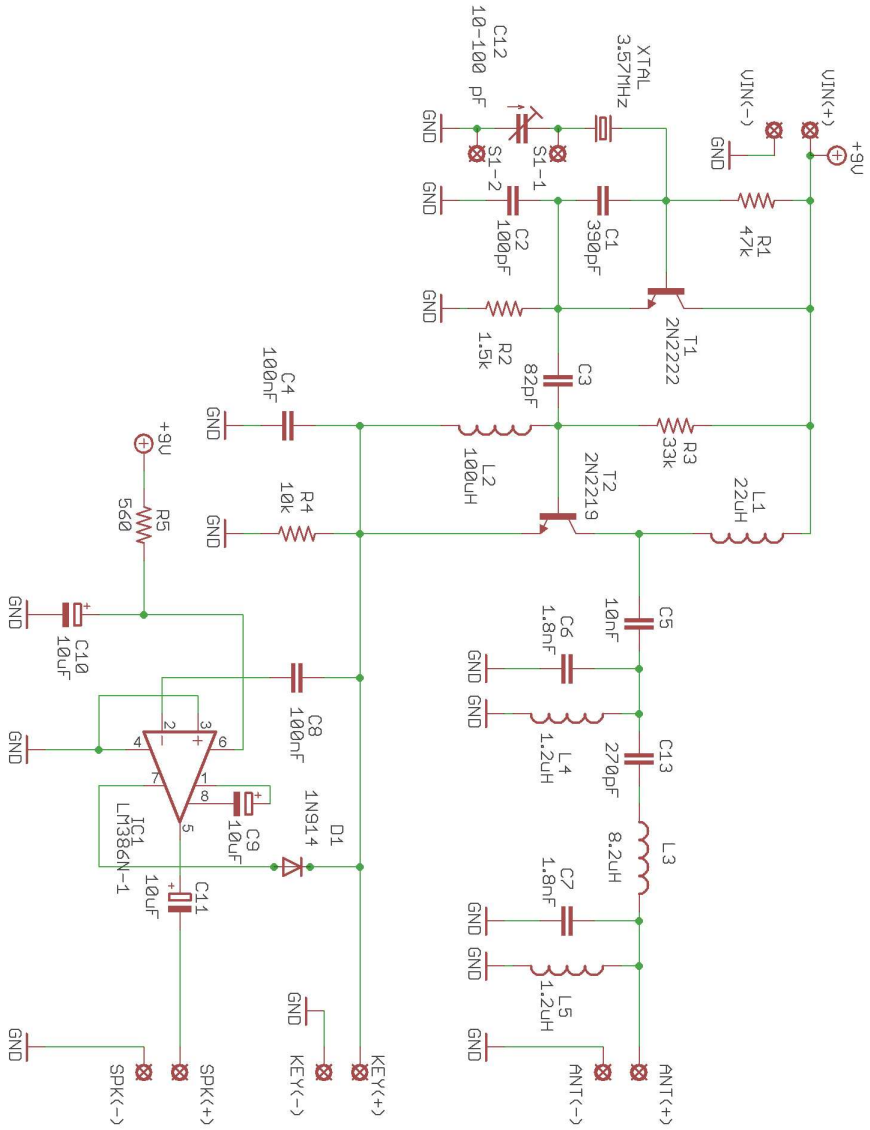
For any kind of technical assistance do not hesitate to contact us at support@radi0kit.com or visit www.radi0kit.com.

Please note the "0" in the word radi0kit is a zero.

PARTS PLACEMENT



RadiØKit-180 SCHEMATIC DIAGRAM



80M CW HAM RADIO TRANSCEIVER

TITLE: RadiØkit-180-Ver2.0

Document Number:

REV:
2.0

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Sheet: 1/1

Revisions

Version 1.1 : R5 changed from 56 Ohm to 560 Ohm for more stable operation of IC1.

Version 1.2 : L2 changed from 150uH to 100uH for better matching between oscillator and power amplifier.

Version 2.0 : C6, C7 changed from 1200pF to 1.8nF. C13 changed from 750pF to 270pF. L4, L5 changed from 3.3uH to 1.2uH. L3 changed from 5.6uH to 8.2uH. All changes relate to output band pass filter and were made in order to obtain better frequency response.