

Assembly Instructions: Shortwave Radio Kit

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Fig 1: The assembled Shortwave Radio Kit

Introduction

The **SHORTWAVE RADIO KIT (#SWRAD)** from MTM Scientific is a complete parts kit for building a shortwave radio. This kit will allow you to build a shortwave radio for listening to worldwide broadcasts. In addition to the kit, you will also need a simple wire antenna, a pair of common headphones and a 9 Volt transistor radio battery. Tuning and controlling the regenerative feedback requires operator skill and technique. This kit is for advanced electronic hobbyists.

Background

This simple radio uses 3 transistors, a wire wound coil, an air variable capacitor and some common electrical parts. This circuit is from Charles Kitchin, who has provided a multitude of great radio plans to the hobbyist community. A unique feature of this circuit is the ability to control the regenerative feedback at the first transistor amplifier stage for high gain.

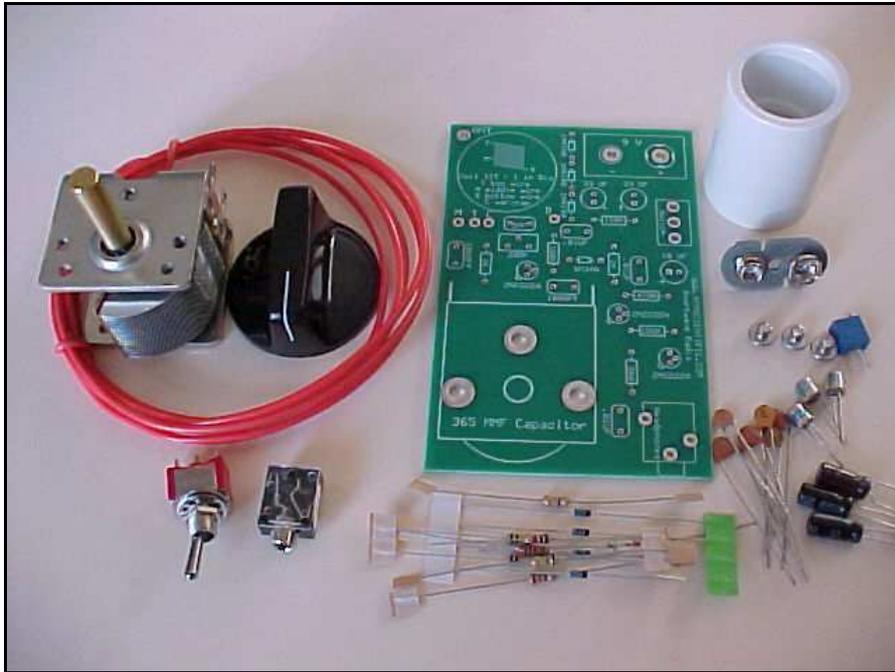


Fig 2: View of the kit components before assembly.

The resonant RF front end is tuned using the variable capacitor and the small air wound coil. The coil is wound on a plastic 1 inch diameter coil form with 12 turns. The coil is tapped 4 turns from the bottom to provide a regenerative feedback signal. The first transistor comprises the RF amplification stage, and signal regeneration is controlled by adjusting the variable potentiometer using a small screwdriver. (The trick in using the regeneration is to adjust the gain just short of causing feedback oscillation.) The signal from the RF front end is detected by a 1N34A germanium diode, and amplified by a two stage audio amplifier using the two additional transistors.

Assembly Details

Assembly of the kit does not need to be done in any particular order. The placement of individual parts on the printed circuit board is aided with the artwork outline. Be sure to insert the components correctly. We present some photographs here of the important assembly points:



Fig 3: Insert the transistors with the tab aligned with the board art.

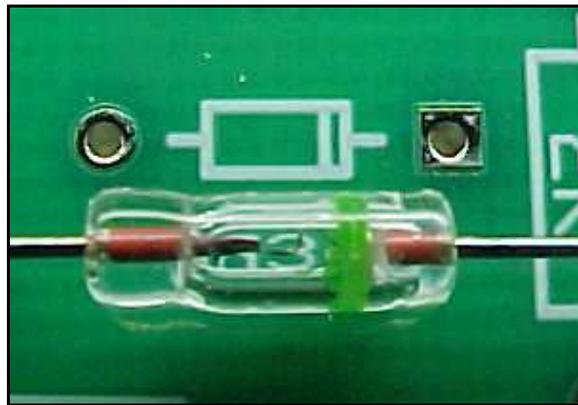


Fig 4: Insert the diodes with the band mark aligned with the board art.

The 2N2222 transistors have a metal case with a small tab on the edge. The transistor is inserted correctly when the tab is aligned with the marking on the circuit board. The diodes also have a marking that should be used for indicating correct assembly orientation.



Fig 5: Install the electrolytic capacitors according to polarity markings marked on the cases and on the circuit board.

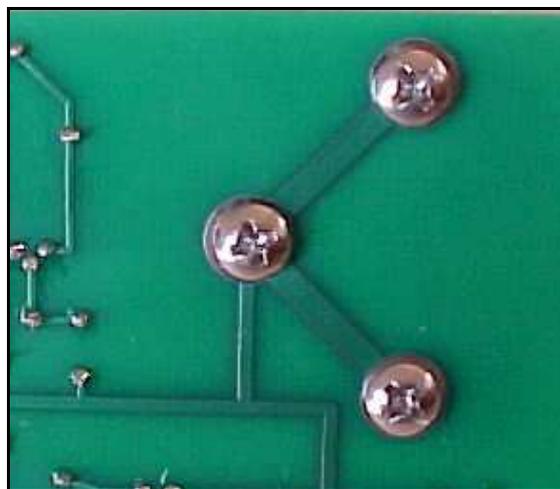


Fig 6: Attach the air variable capacitor to the board using the short screws. Do not use longer screws! The capacitor will be damaged.

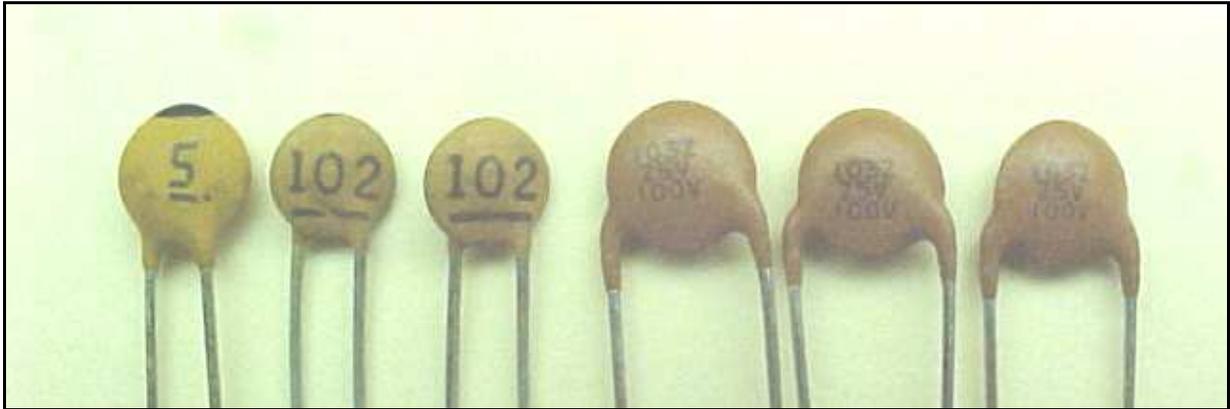


Fig 7: View of the 5 pF, 1000 pF (.001 uF) and .01uF capacitors

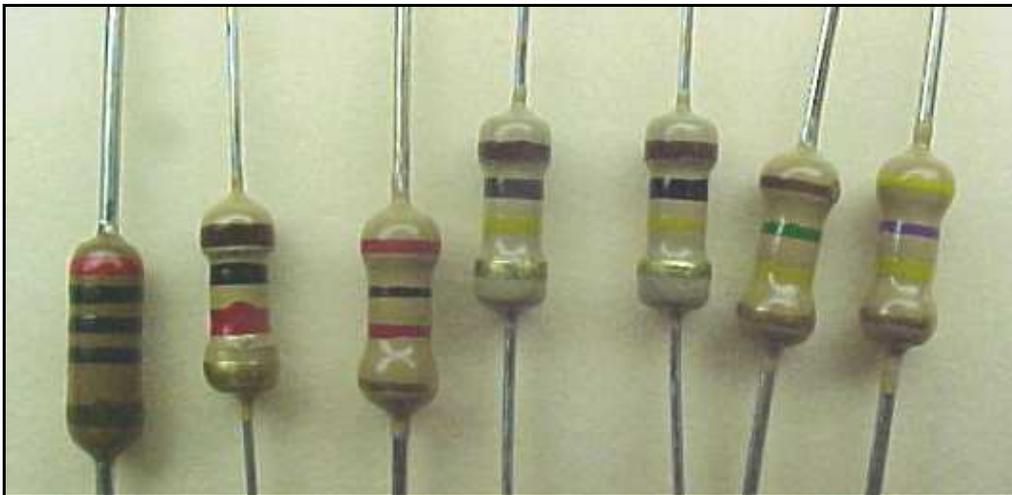


Fig 8: View of 200 ohm, 1K ohm, 2K ohm, 100K ohm (2 pcs), 150K ohm and 470K ohm resistors.

Resistor Color Codes:

200 Ohm	Red	Black	Brown
1K Ohm	Brown	Black	Red
2K Ohm	Red	Black	Red
100K Ohm	Brown	Black	Yellow
150K Ohm	Brown	Green	Yellow
470K Ohm	Yellow	Purple	Yellow

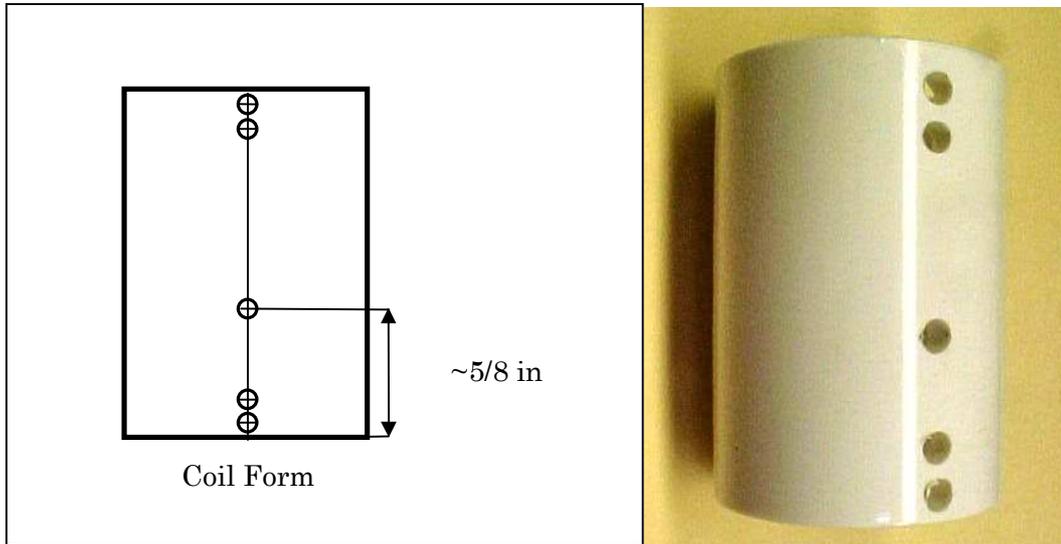


Fig 9: Details of the coil Form. Drill a total of 5 holes, hole size is approximately 1/8 inch diameter as shown.

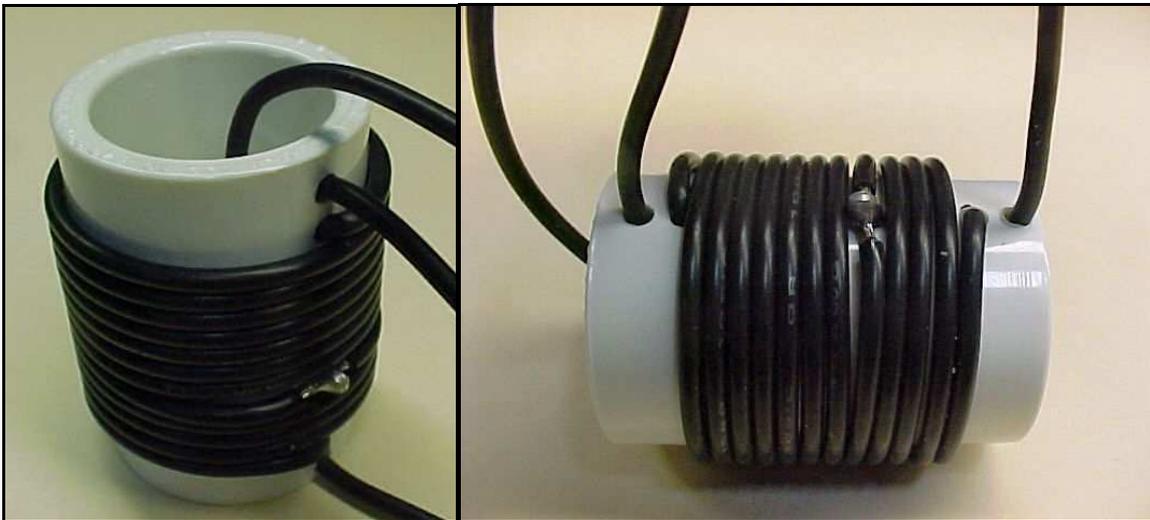


Fig 10: Two photos of the completed coil.

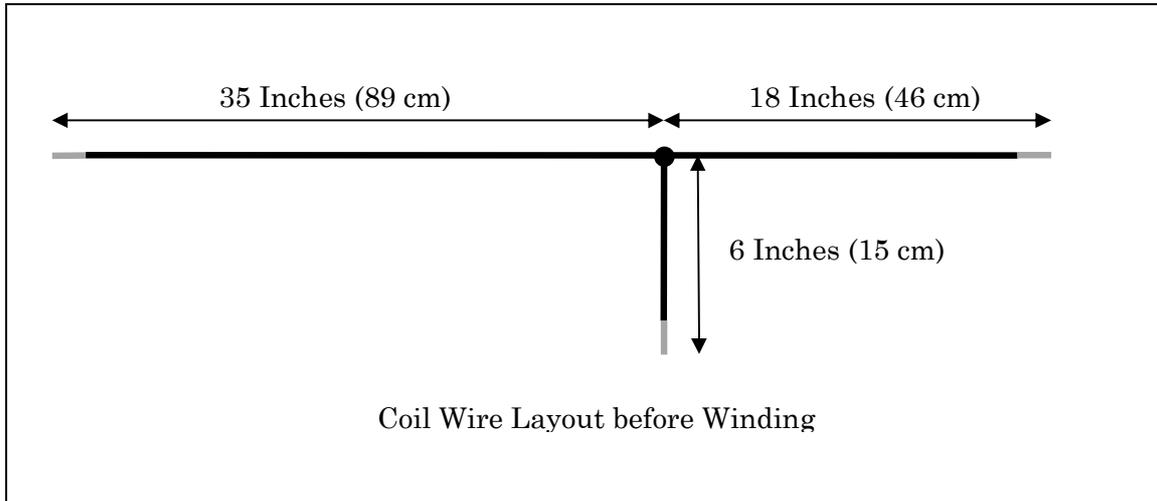


Fig 11: Details of wire assembly for the coil before winding. Build this assembly first, and then wind it onto the drilled coil bobbin.

Here is a view of the layout of the printed circuit board. Several convenient features exist in the board layout. The 9V transistor battery is mounted upright using a snap type battery connector, which is soldered directly to the board. The air variable capacitor is also mounted directly to the board. Headphones are easily used with the radio because of the convenient plug type connector.



Fig 12: Detailed view of assembled kit from another angle. The wire from the air variable capacitor to the board location 'T' is visible



Fig 13: Another view of the assembled kit.

Antenna

A short length of wire strung indoors makes a satisfactory antenna. We suggest beginning with a length of wire about 20 feet long. Any type of wire will work, for example 22 Gauge magnet wire is good. Solder the bare end of the antenna wire to the circuit board for a good electrical connection. The nominal tuning range of the radio is 5-15 MHz. The tuning range can adjusted lower by adding more coil turns, or or higher by removing turns. A more substantial outdoor antenna will improve reception, however it is important to observe all relevant precautions regards lightning protection with outdoor antennas.

If you have a ferrite rod, you can also experiment by holding the ferrite near the tuning coil. You can also try wrapping the external antenna wire around a ferrite rod to change the tuning and reception. We have found that sometimes this can be adjusted to work extremely well.

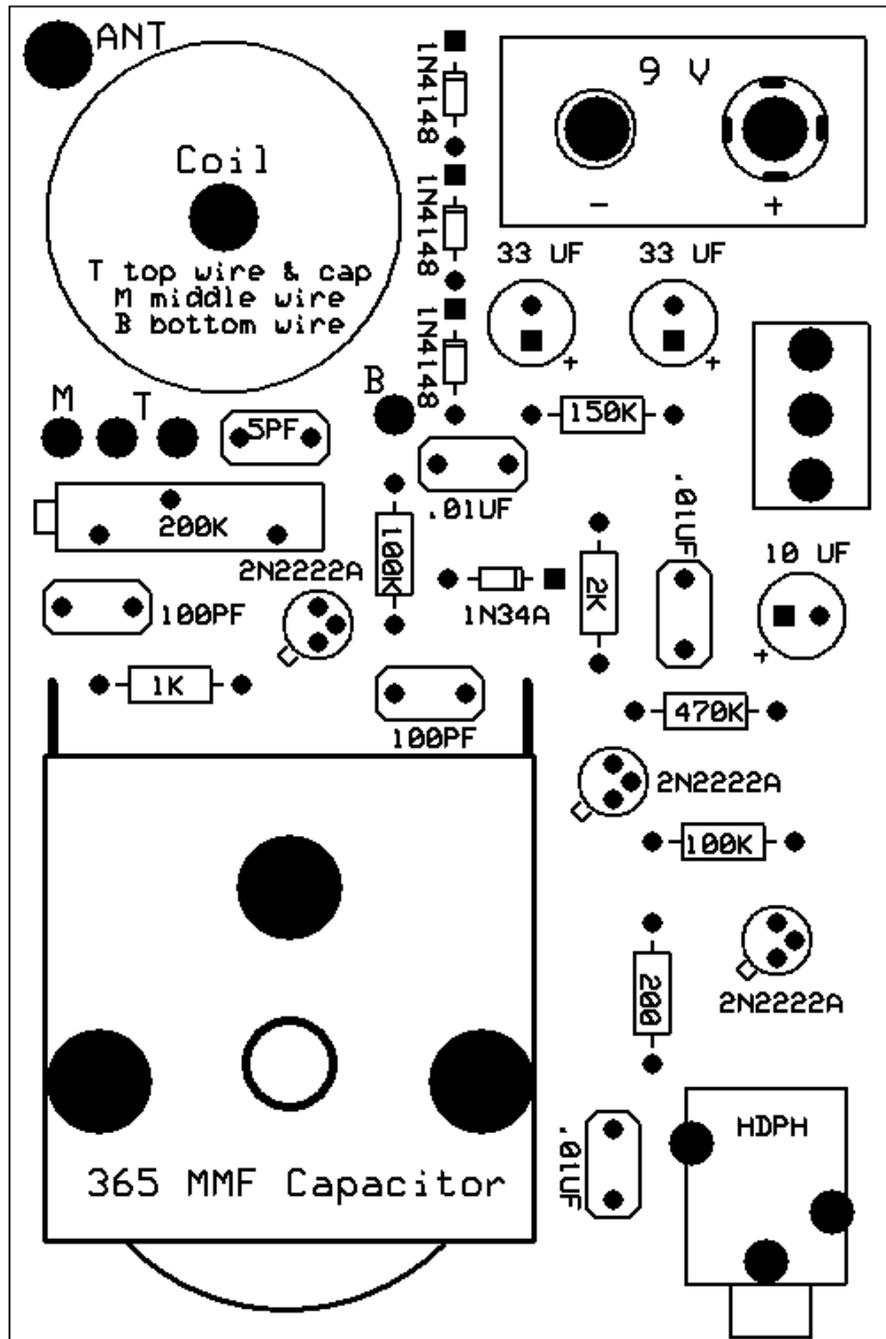


Fig. 15: Detailed view of layout of the Circuit Board. Attach bottom of coil to location 'B', top of coil to location 'T' and middle wire tap of coil to location 'M'. Also attach a wire from any of the 4 lugs on the capacitor to location 'T'.

Using the Radio

A common pair of stereo type headphones should be used with the radio. The radio has monaural output, but the headphone connector is pre-wired to provide sound to both channels on stereo headphones.

Shortwave radio reception depends on many factors, including the time of day, sun activity and atmospheric propagation. The radio performance can range from almost no reception, to very good reception... depending on the propagation conditions.

The tuning of the radio is very sensitive. It is important to use the plastic knob for tuning because touching the metallic components will interfere with the balance of the circuit.

The regenerative feedback is adjusted using a small screwdriver to turn the potentiometer. You will find a 'sweet spot' that is just short of oscillation for maximum gain. If you plan on using the radio for DX work, you may find it useful to epoxy a small plastic straw to the adjustment knob on the potentiometer to make adjustment easier.

Skill and practice are required for adjusting the tuning, and thereafter tweaking the regenerative feedback. If the circuit whines with a constant pitch the feedback is too high. The best course of action when using the radio is to start with low feedback and slowly increase as conditions permit.

Adding or removing turns of wire from the coil will change the tuning range of the radio. You may also want to experiment with a ferrite rod core near the tuning coil and antenna, as it will substantially change the tuning.

Parts List: Shortwave Radio Kit by MTM Scientific, Inc.

Circuit Board Qty:1	2N2222A Transistor Qty: 3
9V Battery Snap Qty: 1	Audio Jack Qty: 1
Air Variable Capacitor 365 pF Qty: 1	Toggle Switch Qty:1
Copper Wire Qty: 22 Gauge 5 Feet	1 Knob Qty:1
Plastic Coil Form Qty: 1	200K Potentiometer Qty:1
1N4148 Diodes Qty:3	1N34A Diode Qty: 1
470K Resistor Qty: 1	150K Resistor Qty: 1
100K Resistor Qty: 2	2K Resistor Qty: 1
1K Resistor Qty:1	200 Resistor Qty: 1
33 uF Capacitors Qty: 2	10 uF Capacitor Qty: 1
.01 uF Capacitors Qty: 3	1000 pF Capacitors Qty: 2
5 pF Capacitor Qty: 1	Screws #6-32 x 1/8" Qty: 3