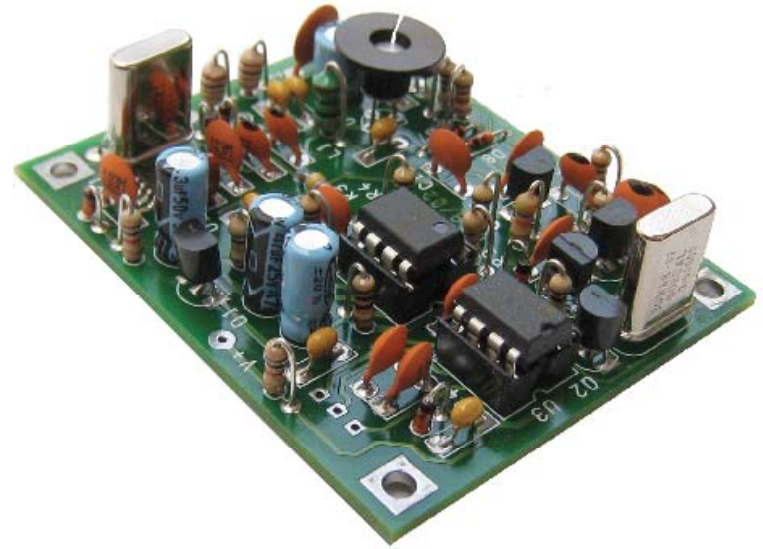


# Small Wonder Labs RockMite

Assembly Manual



## RockMite Assembly Instructions

### About this manual

This manual was developed by B. Scott Andersen (NE1RD) to provide guidance for the first time kit builder. The author has no connection what-so-ever with Small Wonder Labs, Dave Benson (K1SWL) the owner of Small Wonder Labs, or any other vendor mentioned herein including Mouser, Radio Shack, or Bud.

If you have problems with the contents of this manual please contact the author at the email address [ne1rd@arrl.net](mailto:ne1rd@arrl.net) . Please check <http://www.bsandersen.com> for possible updates or errata to this manual before contacting the author.

If you have trouble with things specific to your radio such as missing parts, broken or defective parts, or other “warranty related” issues please visit the Small Wonder Labs web site and follow the directions there to get more help. As of this writing, Steve Webber was providing assistance with Small Wonder Labs products.

Steve Weber, KD1JV  
633 Champlain St  
Berlin, NH 03570

Please exercise caution and use common sense at all time when working with electronics. Let’s keep this fun for everybody.

B. Scott Andersen (NE1RD)  
25 February 2008  
(Manual revision “B-1”)

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**Acknowledgements:** Special thanks to Dave Benson of Small Wonder Labs for permission to use the diagram in Figure 1. Also, big thanks to the ten brave builders of RockMites in the *PART* radio club of Westford, Massachusetts who helped “debug” this manual during the 23 February 2008 kit building event. For more information on *PART* see <http://www.wb1gof.org>

## Welcome

Welcome to the world of kit building. Whether you have built many kits in the past, or this is your very first kit building experience, it is hoped that building this kit will bring both joy and a sense of accomplishment.

This manual has been prepared to assist you in the construction of your radio. Please read it carefully and thoroughly during the build process. By doing so you will produce a device that should serve you well for many years to come.

## How to use this manual

There is something special about using a radio that you have built with your own two hands. This manual will help you build such a radio: a *RockMite*, a 40m very-low-power transceiver. The RockMite is a small radio but it is packed with features including a built-in iambic keyer. This is a serious radio, not a toy!

This manual is divided into sections associated with phases of construction of the RockMite. There may be many different ways to build this radio but this manual prescribes one specific way to successfully build the device. Follow the instructions in this manual carefully and you will have a working, high-quality unit when you have finished.

Each step of the process is described in detail and is specified with a checkbox and text similar to the following:

- ☐ Put the widget into hole A and solder.

The construction process is an ordered one. It is important to follow the steps indicated in the order they are presented. There are some parts that would be difficult or impossible to install if not done in the order specified herein.

As you finish each step put a ✓ in the checkbox. Proceed slowly, reading each step fully before performing it. Take your time!

If you have a question it is best to stop work and get that question answered. Rework is much more difficult than simply doing things correctly the first time. **Note that there is a picture inventory of all parts in Appendix A of this manual.** The most common error is installing the wrong part on the board. Double-check the component identifier before installation using the descriptions in Appendix A as needed.

Let this manual be your guide. Proceed step-by-step. Enjoy the experience. Let's get started!

## Prerequisites

- ☐ Assembly of the RockMite requires a minimum number of tools and apparatus. Ensure you have:
  1. A set of small diagonal or flush cutters
  2. A set of small needle-nose pliers
  3. A temperature controlled soldering iron (set to approximately 700-750 degrees F), wet sponge, and stand
  4. Solder – 60/40 type of small diameter (0.032 inches is a good size)
  5. Eye protection – **Always use eye protection!**
  6. A magnifying glass or loupe
  7. Set of small screwdrivers

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Also helpful are:

1. A solder wick, solder “sucker”, or other desoldering tools
2. A circuit board vice
3. Antistatic mat, ground strap, or other Electrostatic Discharge management systems
4. A digital multimeter (DMM)
5. A watt meter accurate in the 0-5 watt range
6. A BNC patch cable approximately three feet in length to connect the RockMite to the watt meter
7. A dummy load capable of dissipating approximately 1 watt for brief periods of time
8. A toothbrush and alcohol to remove excess solder flux from the circuit board
9. A ruler

### Safety first!

❑ Electronics and kit building can be a very safe and enjoyable activity but certain safety guidelines must be observed. Please read and understand the following safety guidelines:

1. No eating, drinking, or smoking while soldering. A significant component of solder is lead, a heavy metal linked to neurological damage as well as renal disease, cardiovascular effects, and reproductive toxicity. There is no “safe” level of lead for humans. Eating, drinking, or smoking near a soldering station increases the likelihood of ingesting minute particles of lead. Wash your hands vigorously when leaving an area where soldering has been done. Take care not to inhale smoke or vapors from soldering activities.

2. Soldering involves melting metals at temperatures exceeding 700 degrees F. The opportunities for serious burns or fire are always present where soldering is done. Take care to keep the soldering area free of debris. Ensure the circuit being soldered is mechanically stable so that hot components, circuit boards, or soldering irons do not move suddenly. Always store the iron in its stand when not being actively used. It only takes one moment of distraction to produce a very serious burn or fire with a soldering iron. Turn off the soldering iron when not in use.
3. Batteries may be used to power the RockMite or other radios. Even small batteries can produce significant amounts of current and even fire. Always wire batteries with appropriate fuses and ensure that the battery leads cannot come into contact with metal surfaces and short circuit.
4. Eye injuries are most easily avoided by the use of proper eye protection devices. A snapped component lead can fly many feet under the right circumstances. Do not trust that you, or others around you, will always keep leads from flying. Protect your eyes at all times when working on electronic devices.

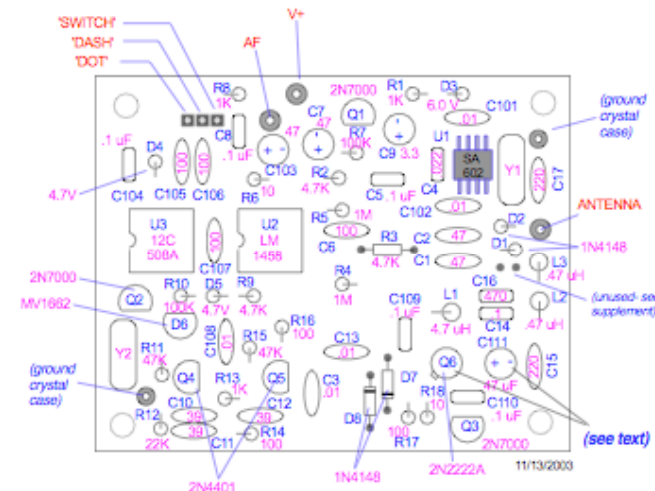
## Assembly Phase 1

- ❑ Locate the main RockMite bag. Open the bag and identify the contents. Locate:
  1. A circuit board,
  2. Bag with inductors and diodes,
  3. Bag with resistors, capacitors, and crystals,
  4. and an antistatic bag contain semiconductors, integrated circuits (ICs), and other small parts.
- ❑ The antistatic bag contains components that can be damaged by static discharge. Even the smallest voltage differential can be disastrous. You may never feel the jolt that is the death knell for a static-sensitive part. **Please read and understand these static sensitive procedures before opening the antistatic bag or handling static-sensitive parts.**

Electrostatic discharge (ESD) damage can be avoided by taking very reasonable precautions. A wrist strap connected to ground provides continuous protection against ESD, but touching an unpainted, grounded metal surface prior to handling static-sensitive parts can also be very effective. Avoid wearing static-generating clothing such as wool or some synthetics while working with ESD-sensitive parts. Also, ensure that the work surface is also static-free by using an antistatic-mat or other surface that will ensure that static charges will not accumulate. Most medium- to high-end soldering irons also provide ESD protection and should be used for this type of work whenever possible.

Examine the diagram in Figure 1 and compare it to the circuit board. The side of the circuit board that

receives the components is referred to as the *top side* of the circuit board; the side of the circuit board that is soldered is referred to as the *bottom side* of the circuit board. The diagram below corresponds to the *top side* of the circuit board. Familiarize yourself with the *top side* of the circuit board before proceeding.



**Figure 1 Top side of RockMite board**

- ❑ The first component to be placed on the circuit board is also one of the most difficult to install. The integrated circuit U1 is an SA602 “mixer”. It is packaged as a *surface mount* device. It does not mount to the circuit board by having its pins fed through holes; it mounts to the circuit board by being connected (and soldered) directly to the *surface* of the circuit board. The Surface Mount Technology (SMT) packaging provides a very small footprint for a device. Locate the U1 outline first in the circuit board diagram of Figure 1 and then on the circuit board.

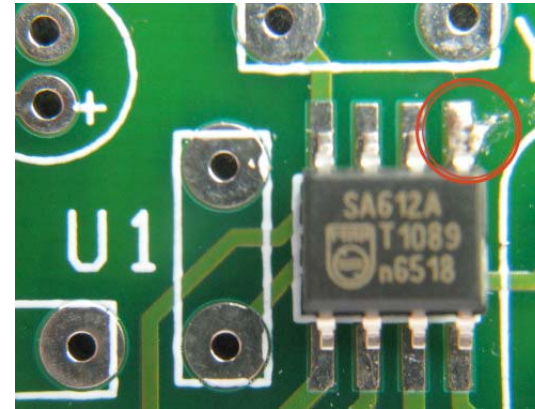
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(NOTE: U1 may be any one of a family of “mixers” and may be marked SA602, SA602A, SA612, SA612A, or some other similar marking. It can be identified easily, though, as it is the only SMT part within the RockMite kit.)

- ❑ Open the antistatic bag and carefully sort the parts within. **Observe ESD precautions as described above!** Locate the U1 integrated circuit SA602 (or similar) mixer. This device may be package in another, smaller, antistatic bag within the main antistatic bag. Use a magnifying glass or loupe to verify the markings. **Do not open any other component bags at this time.**
- ❑ Apply power to the soldering iron. Set the temperature to 700-750 degrees F (if the device has a user-controlled temperature setting). Allow the iron to heat and stabilize in temperature. Add water to the sponge of the soldering system if the sponge is not already moist. Once the iron is hot, *tin* the iron by adding a small amount of solder to the tip and allowing it to flow over the tip. After a few moments, shake off the excess solder or wipe the iron on the clean, moist sponge. The tip of the soldering iron should always appear clean and shiny.
- ❑ Carefully place the SA602 (or equivalent) on the *front side* of the circuit board over the 8 pins for U1. Ensure that the markings on the IC are facing the same way as the other markings on the circuit board in that area (“U1”, “Y1”, “C5” etc.) The orientation of U1 is critical. All eight pins of the IC must mate to the corresponding eight pads of the circuit board and

the IC must be oriented so that pin 1 of the IC faces the “U1” marking on the board.

- ❑ Using the smallest amount of solder possible, solder the upper-right pin of U1 to its pad. If the IC moves during this first attempt, heat the small pool of solder on the pad and carefully *slide* the IC back into position. The IC must be centered on *all* its pads.



**Figure 2 Upper-right pin of U1 soldered**

- ❑ Solder the lower-left pin of U1 using a minimum of solder.





**Figure 3 Lower-left pin of U1 soldered**

- ❑ If either connection soldered thus far on U1 (upper-right, or lower-left) has excess solder, use a solder wick or other desoldering mechanisms to remove the excess solder. Work on one pad at a time to ensure U1 remains centered on its pads.
- ❑ Solder the remaining pins on U1 applying the minimum solder possible at each solder joint. Remove excess solder carefully if necessary.
- ❑ Examine U1. There should be no solder-bridges between IC leads or pads. Each solder joint should be clean and shiny. If the solder joints had too much solder, too little solder (and do not make a solid contact with the pad), have solder bridges, or the joints are not shiny, rework those areas by reheating the joint and removing any excess solder.

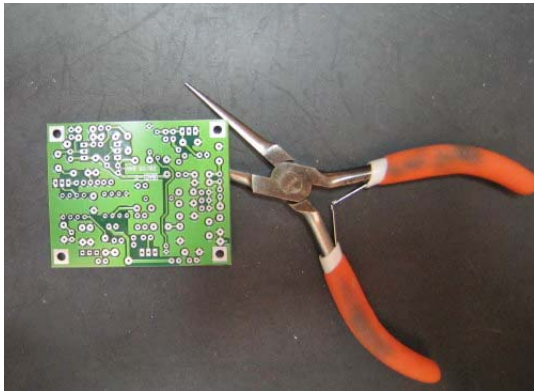


**Figure 4 All pins of U1 soldered**

- ❑ If desired, use a small toothbrush and alcohol to remove any excess solder flux that may be left after soldering U1. Examine U1 again. U1 is the only surface-mount device in the RockMite. It is difficult to access these pins after other components on the board have been installed. If there are any problems with these solder joints (cold solder joints, excess solder, solder bridges, etc.) correct them before moving to the next step.
- ❑ The remaining construction on the circuit board is through-hole type construction. Begin by installing an 8-pin IC socket at U2. Note that the silk-screen image on the circuit board shows a notch on the left side. Similarly, there is a notch on the 8-pin IC socket. Insert the socket into the circuit board with the notch oriented towards the left as depicted by the silk-screen outline.
- ❑ Using needle-nose pliers or another tool to hold the socket in place, turn the circuit board over so that the *bottom side* of the board is face-up with the pins from the IC socket sticking through their holes. Once the

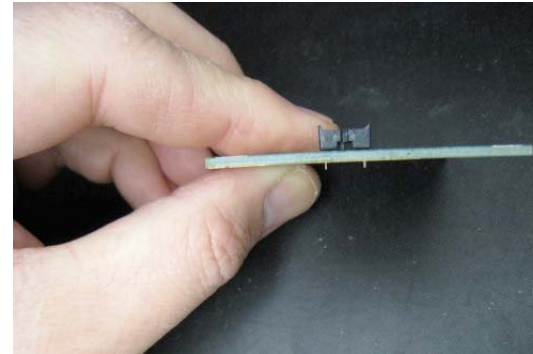
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board is in place, use the needle-nose pliers or other tool to hold the board level so that all IC pins are visible through their holes. The IC socket should be flush with the circuit board on the reverse side of the board, also (or close to being flush).



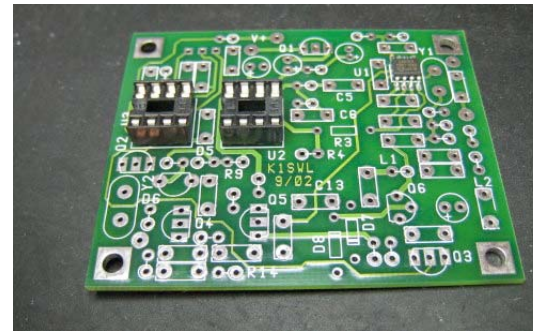
**Figure 5 Preparing to solder the first pin of the socket for U2**

- ☐ Solder the upper-right pin of the socket for U2.
- ☐ Pick up the circuit board and examine it. The socket for U2 should be flush and level with the *top side* of the circuit board. If it is not, reheat the pin and push the socket down until it is flush with the top of the board.



**Figure 6 IC socket flush on the circuit board**

- ☐ Solder the remaining pins on the IC socket for U2.
- ☐ Install the IC socket for U3 in a similar manner.

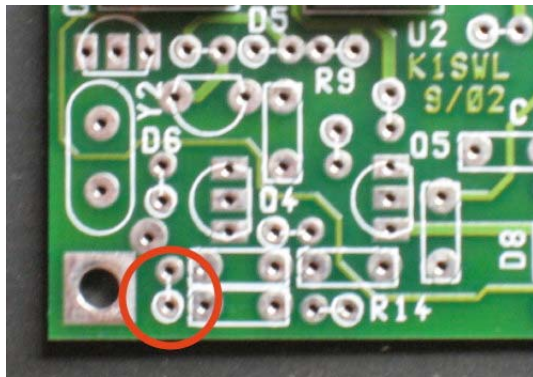


**Figure 7 RockMite circuit board after installation of two IC sockets**

- ☐ Place the parts remaining from the antistatic bag back into the bag and set the bag aside.
- ☐ The resistors will now be added to the circuit board. Locate the bag with the resistors and open the bag. Lay the resistors out in a flat, clean area so the color bands are visible.



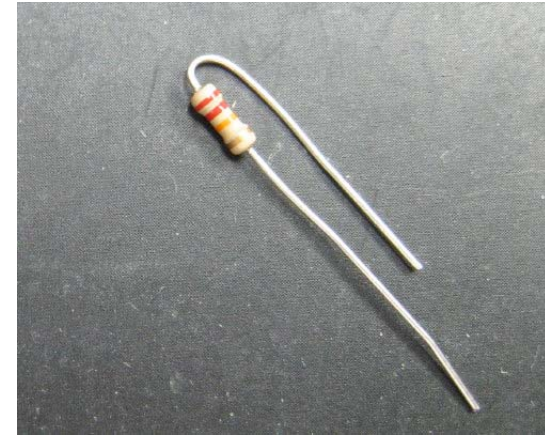
- ❑ Locate R12, a 22K-ohm resistor (red-red-orange). [If you are ever unsure you have the correct resistor, or you have a color deficiency in your vision, use a digital multimeter to verify the value of the resistor before installation.] R12 will be installed in the lower-left corner of the circuit board. There is no silk-screen marking for R12 on the board so examine Figure 1 for the precise placement of the component. Like most components, R12 is installed upright with one lead straight down into the board and the other lead emanating from the top of the component and bending over to feed back into the board through a second hole. Note the circle in Figure 1 for this component indicates where the body of the resistor should be placed. There may also be a circle in the silk-screen image indicating where the body of the installed component should be placed.



**Figure 8 Circle around pad shows where component bodies should be placed**

Hold R12 so that the color bands (red-red-orange) are visible. The “top” of the resistor is the end towards the red bands\*. Carefully and gently bend the lead

from the “top” of the resistor over until it is parallel with the other lead.



**Figure 9 Component prepared for insertion**

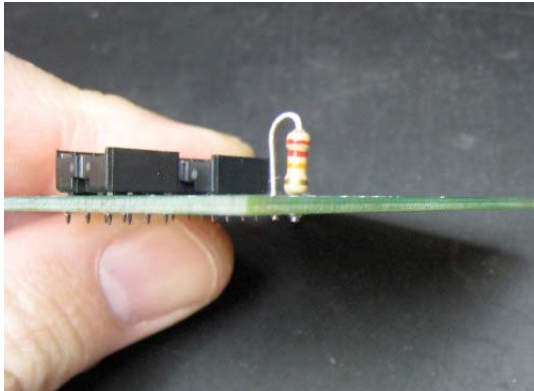
\* Technically, resistors do not have “tops” or “bottoms”, but it is best to install resistors so that their color bands are easily read. By doing this, any subsequent examination of the board can be done without struggling to see the resistor values. You will also have a much better looking project by being consistent with the placement and orientation of the resistors.

- ❑ Insert the lead of R12 (red-red-orange) emanating from the “bottom” of the resistor (the end towards the gold band) into the hole that is indicated by Figure 1 (and perhaps the silk-screen) to hold the body of the component. The other lead should be inserted into the companion hole indicated by a thin line. The “bottom” of the resistor should be resting on the circuit board.

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- ❑ Turn the board over and solder both leads of R12 on the *bottom* of the circuit board.
- ❑ Examine R12 again. The “bottom” of the resistor should be resting on the *top* of the circuit board. The two solder joints on the *bottom* of the circuit board should be clean and shiny. If this is not the case, reheat the joints and repair the problems before proceeding to subsequent steps.
- ❑ Trim the leads of R12 using diagonal cutters or flush cutters. Trim the leads so they are very close to flush with the circuit board without marring the solder joint. **Use eye protection for all activities, especially lead trimming.**

*Save a few of the trimmed leads from these resistors for use in subsequent steps.*



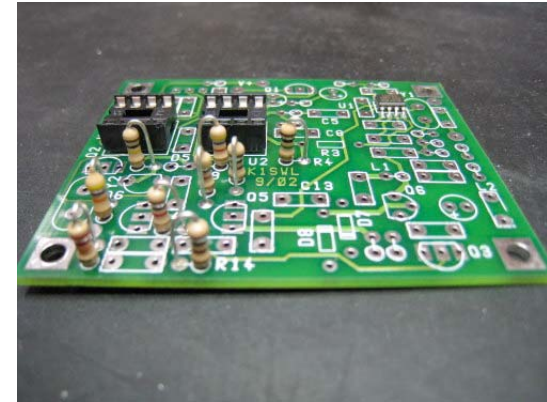
**Figure 10 R12 installed and leads flush trimmed**

- ❑ Locate R11, a 47K-ohm resistor (yellow-violet-orange). Prepare the “top” lead as you did with R12

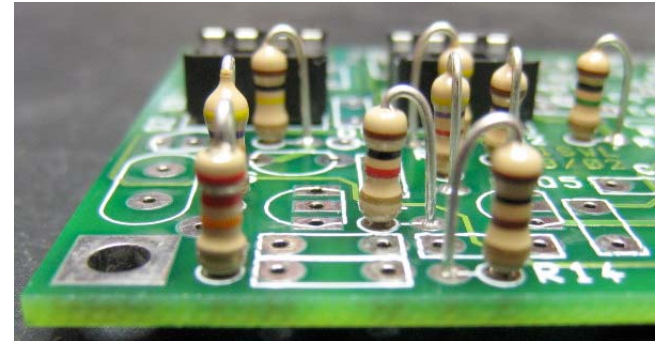
bending it over until it is parallel with the “bottom” lead. Examine Figure 1 and locate R11 on the circuit board. It is just above R12. Install R11 with the body of the resistor over the hole with the circle. The bottom of R11 should rest on the circuit board. Solder and trim the leads of R11 as you did with R12.

- ❑ Locate R10, a 100K-ohm resistor (brown-black-yellow). Refer to Figure 1 and locate the holes for R10 above R11 and just below the socket for U3. The body of R10 is on the left, the other lead is inserted to the right. Install R10, solder, and trim its leads.
- ❑ Locate R9, a 4.7K-ohm resistor (yellow-violet-red). Refer to Figure 1 and locate the holes for R9 to the right of R10, just past the holes for D5. Prepare the leads as you have done before. The body of R9 goes in the right hole; the other lead goes in the left hole. Install R9, solder, and trim its leads.
- ❑ Locate R4, a 1M-ohm resistor (brown-black-green). Refer to Figure 1 and locate the holes for R4 to the right of R9 and near the center of the board. R4 is also marked in the silk-screen image on the board. Prepare the leads as you have done before. The body of R4 goes in the left hole; the other lead goes into the hole on the right. Install R4, solder, and trim its leads.
- ❑ Locate R16, a 100-ohm resistor (brown-black-brown). Refer to Figure 1 and locate the holes for R16 to the right and down from R9. Prepare the leads as you have done before. The body of R16 goes in the top hole; the other lead goes into the hole below it. Install R16, solder, and trim its leads.

- ❑ Locate R15, a 47K-ohm resistor (yellow-violet-orange). Refer to Figure 1 and locate the holes for R15 to the left of R16. Prepare the leads as you have done before. The body of R15 goes in the top hole; the other lead goes in the bottom hole. Install R15, solder, and trim its leads.
- ❑ Locate R13, a 1K-ohm resistor (brown-black-red). Refer to Figure 1 and locate the holes for R13 to the left and down from R15. Prepare the leads as you have done before. The body of R13 goes in the left hole; the other lead goes in the right hole. Install R13, solder, and trim its leads.
- ❑ Locate R14, a 100-ohm resistor (brown-black-brown). Refer to Figure 1 and locate the holes for R14 down and to the right of R13, along the edge of the board. R14 is also marked in the silk-screen image on the board. Prepare the leads as you have done before. The body of R14 goes in the right hole; the other lead goes in the left hole. Install R14, solder, and trim its leads.
- ❑ Examine the board and the work done to this point. Half of the resistors are installed on the board at this time. Each resistor should be standing straight-up with its other lead folded nicely back into the board. The bottom of each resistor should be resting on the circuit board. Each solder joint on the bottom should be clean and shiny. Leads should be trimmed close (but not so close as to disrupt the solder joint). If any component or connection does not meet this criteria, stop, rework that component or connection, and reexamine the board before proceeding to subsequent steps.



**Figure 11 Board with half the resistors installed**



**Figure 12 Close-up with half the resistors installed**

- ❑ Locate R17, a 100-ohm resistor (brown-black-brown). Refer to Figure 1 and locate the holes for R17 to the right of R14, along the edge of the board. Prepare the leads as you have done before. The body of R17 goes in the bottom hole; the other lead goes in the top hole. Install R17, solder, and trim its leads.
- ❑ Locate R18, a 10-ohm resistor (brown-black-black). Refer to Figure 1 and locate the holes for R18 to the right of R17, along the edge of the board. Prepare the

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leads as you have done before. The body of R18 goes in the bottom hole; the other lead goes in the top hole. Install R18, solder, and trim its leads.

- ❑ Locate R1, a 1K-ohm resistor (brown-black-red). Refer to Figure 1 and locate the holes for R1 along the top edge of the board. Prepare the leads as you have done before. The body of R1 goes in the hole on the left; the other lead goes in the hole on the right. Install R1, solder, and trim its leads.
- ❑ Locate R7, a 100K-ohm resistor (brown-black-yellow). Refer to Figure 1 and locate the holes for R7 to the left and down from R1. Prepare the leads as you have done before. The body of R7 goes in the hole on the right; the other lead goes in the hole on the left. Install R7, solder, and trim its leads.
- ❑ Locate R2, a 4.7K-ohm resistor (yellow-violet-red). Refer to Figure 1 and locate the holes for R2 to the left and down from R7. Prepare the leads as you have done before. The body of R2 goes in the hole on the right; the other lead goes in the hole on the left. Install R2, solder, and trim its leads.
- ❑ **NOTE: If you are going to use the RockMite connectors and controls kit and its potentiometer for gain control, do not install R5--skip this step and proceed to the next step.**

Locate R5, a 1M-ohm resistor (brown-black-green). Refer to Figure 1 and locate the holes for R5 to the right and down from R2. Prepare the leads as you have done before. The body of R5 goes in the hole on

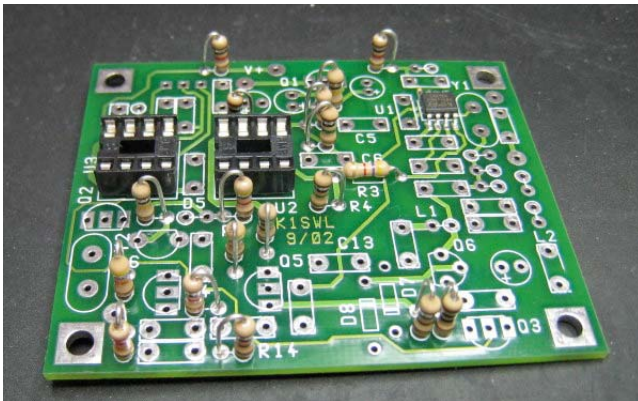
the right; the other lead goes in the hole on the left. Install R5, solder, and trim its leads.

- ❑ Locate R6, a 10-ohm resistor (brown-black-black). Refer to Figure 1 and locate the holes for R6 to the left of R2. Prepare the leads as you have done before. The body of R6 goes in the hole on the left; the other lead goes in the hole on the right. Install R6, solder, and trim its leads.
- ❑ Locate R8, a 1K-ohm resistor (brown-black-red). Refer to Figure 1 and locate the holes for R8 near the top edge of the board on the left side. Prepare the leads as you have done before. The body of R8 goes in the hole on the right; the other lead goes in the hole on the left. Install R8, solder, and trim its leads.
- ❑ Locate R3, a 4.7K-ohm resistor (yellow-violet-red). Figure 1 and locate the holes for R3. The silk-screen image also shows the position of R3. R3 is the only resistor installed horizontally on the circuit board. Pre-form the leads for R3 to match the outline on the board. The orientation of R3 is unimportant. (It can be installed either way.) Install R3, solder, and trim its leads.
- ❑ All fixed resistors have now been installed on the board. If you have resistors left over, verify that the resistors that have been installed are in their proper holes. Then, install any left over resistors by locating the proper step for that resistor above and performing that step.
- ❑ Examine the *top side* of the board. All resistors except R3 should be vertical with the top lead folded back

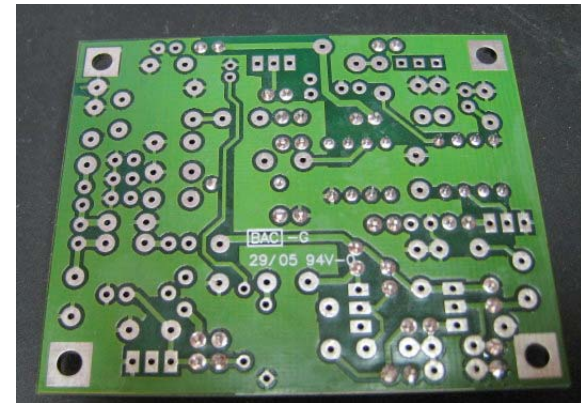


into the circuit board. R3 should be flush against the circuit board.

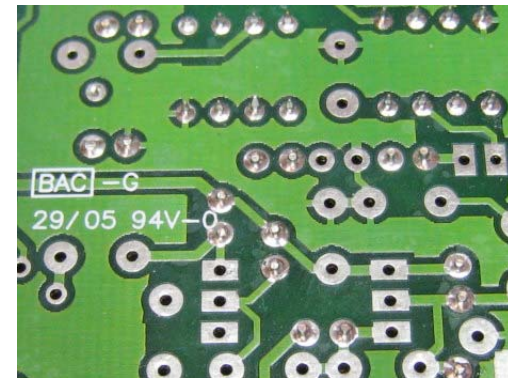
- ☐ Examine the *bottom side* of the board. All solder joints should be clean and shiny. All leads should be trimmed flush as described above. There should be no solder-bridges between pads. If there is excess solder on any joint use a solder wick or other desoldering tool to remove the excess solder.
- ☐ Optionally, a small toothbrush with alcohol may be used to gently remove any remaining solder flux from the bottom of the board.
- ☐ This completes Assembly Phase 1.



**Figure 13 Top side after Phase 1**



**Figure 14 Back side after Phase 1**



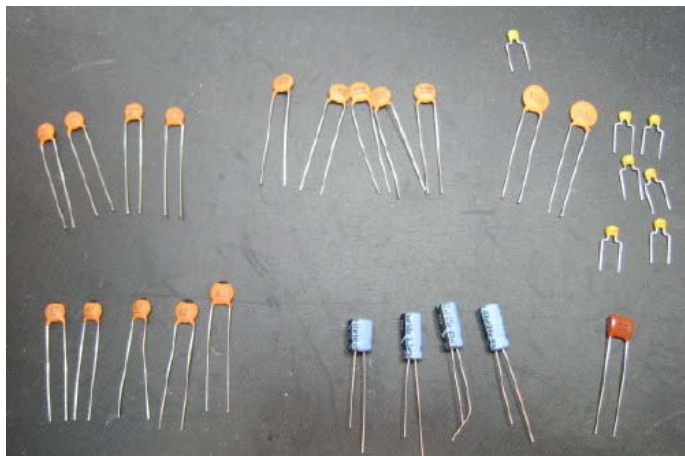
**Figure 15 Shiny solder joints**

## RockMite Assembly Instructions

### Assembly Phase 2

The second phase of assembly will add all of the capacitors to the board. There are several types of capacitors packaged with the RockMite. The values of the capacitors printed on the components can be cryptic. Please read the descriptions in the assembly steps carefully to ensure the correct component is placed in each step.

- ❑ Locate the bag with all the capacitors. Open the bag and sort the contents by value. Even if you do not know what the markings on the capacitors mean right now, just sort the capacitors so similarly marked parts are grouped together.



**Figure 16 Capacitors sorted and grouped**

- ❑ Locate C11, a 68 pF NPO capacitor. This is a small, round, disc capacitor marked '68' or '68J'. (The black mark on the top of the capacitor indicates it is an NPO-type capacitor, very stable over a wide range of

temperatures.) Refer to Figure 1 and locate the holes for C11 along the front edge of the board. Although capacitors of this type can be installed in either orientation, it is best to install components such that their markings are visible after assembly. Insert C11 into the holes indicated by Figure 1 with the markings of the capacitor facing the edge of the board. Pull the capacitor leads *gently* until the bottom of the capacitor rests against the top of the circuit board, or until the orange coating does not permit any further travel. It is good practice to have all components mounted closely and evenly on the circuit board. Examine the component again viewing from the edge of the board. You should see the '68' or '68J' marking and very little space (if any) should appear between the top of the board and the bottom of the part. Solder the two leads of the capacitor and trim the leads.

- ❑ Locate C10, a 68 pF NPO capacitor ('68' or '68J'). Refer to Figure 1 and locate the holes for C10 immediately behind C11. Insert C10 into its appropriate holes with the markings visible. (That is, ensure the markings are not *facing* C11!) You should be able to read the values of both C11 and C10 with these two components installed. Pull the capacitor leads *gently* until the capacitor is as close to the board as it can be. Solder and trim the leads.
- ❑ Locate C12, a 47pF NPO capacitor ('47' or '47J'). Refer to Figure 1 and locate the holes for C12 to the right of C10. Install C12 so the markings face the edge of the board. Solder and trim the leads.



- ❑ Locate C3, a 0.01  $\mu$ F disc capacitor ('103' or '103M'). Refer to Figure 1 and locate the holes for C3 to the right of C12. Install C3 so the markings face right. Solder and trim the leads.
- ❑ Locate C13, a 0.01  $\mu$ F disc capacitor ('103' or '103M'). Refer to Figure 1 and locate the holes for C13 to the right and above C3. Install C13 so the markings face the edge of the board. Solder and trim the leads.
- ❑ Locate C109, a 0.1  $\mu$ F capacitor ('104'). Refer to Figure 1 and locate the holes for C109 to the right and above C13. Install C109 so the markings face left. (NOTE: There is one capacitor similar in size with a marking '102'. Ensure this capacitor is set aside and not installed here.) Solder and trim the leads.
- ❑ Locate C104, a 0.1  $\mu$ F capacitor ('104'). Refer to Figure 1 and locate the holes for C104 near the upper-left corner of the board. Install C104 so the markings face left. Solder and trim the leads.
- ❑ Locate C105, a 100pF capacitor ('101' or '101J'). Refer to Figure 1 and locate the holes for C105 to the right of C104. Install C105 so the markings face left. Solder and trim the leads.
- ❑ Locate C106, a 100pF capacitor ('101' or '101J'). Refer to Figure 1 and locate the holes for C106 to the right of C105. Install C106 so the markings face right. Solder and trim the leads.
- ❑ Locate C8, a 0.1 $\mu$ F capacitor ('104'). Refer to Figure 1 and locate the holes for C8 up and to the right from C106. Install C8 so the markings face left. Solder and trim the leads.
- ❑ Locate C107, a 100pF capacitor ('101' or '101J'). Refer to Figure 1 and locate the holes for C107 between U2 and U3. Install C107 so the markings face right. Solder and trim the leads.
- ❑ Locate C5, a 0.1 $\mu$ F capacitor ('104'). Refer to Figure 1 and locate the holes for C5 near the IC in the upper right of the board. The holes for C5 are marked on the circuit board in the silk-screen image. Install C5 in either orientation. Solder and trim the leads.
- ❑ Locate C6, a 100pF capacitor ('101' or '101J'). Refer to Figure 1 and locate the holes for C6 down and to the left of C5. The holes for C6 are marked on the circuit board in the silk-screen image. Install C6 so that the markings face R4. Solder and trim the leads.
- ❑ Locate C102, a 0.01 $\mu$ F capacitor ('103' or '103M'). Refer to Figure 1 and locate the holes for C102 adjacent to U1. Install C102 so that the markings face U1. Solder and trim the leads.
- ❑ Locate C2, a 47pF capacitor ('47' or '47J'). Refer to Figure 1 and locate the holes for C2 just below C102. Install C2 so that the markings face C102. Solder and trim the leads.
- ❑ Locate C1, a 47pF capacitor ('47' or '47J'). Refer to Figure 1 and locate the holes for C1 just below C2. Install C1 so that the markings face away from C2. Solder and trim the leads.

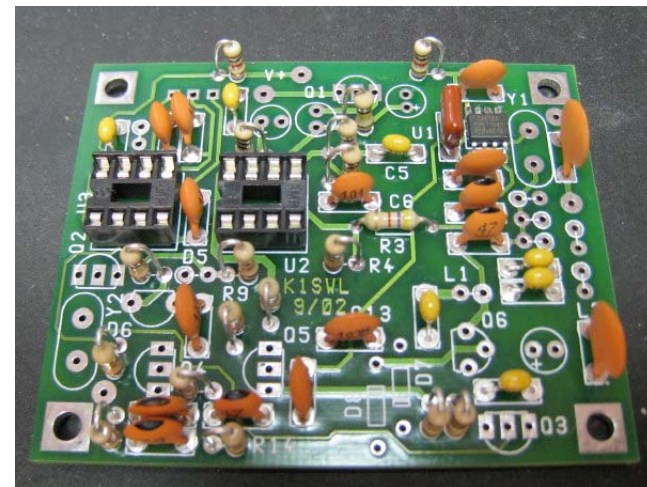
## RockMite Assembly Instructions

- ❑ Locate C16, a 0.001 $\mu$ F capacitor ('102'). Refer to Figure 1 and locate the holes for C16 below and to the right of C1. Install C16 so that the markings face towards U1. Solder and trim the leads.
- ❑ Locate C14, a 0.1 $\mu$ F capacitor ('104'). Refer to Figure 1 and locate the holes for C14 just below C16. Install C14 so that the markings face away from C16. Solder and trim the leads.
- ❑ Locate C15, a 470pF capacitor ('471' or '471J'). Refer to Figure 1 and locate the holes for C15 down and to the right of C14, along the edge of the board. Install C15 so that the markings face right. Solder and trim the leads.
- ❑ Locate C110, a 0.1 $\mu$ F capacitor ('104'). Refer to Figure 1 and locate the holes for C110 down and to the left from C15. Install C110 so that the markings face away from the edge of the board. Solder and trim the leads.
- ❑ Locate C17, a 470pF capacitor ('471' or '471J'). Refer to Figure 1 and locate the holes for C17 on the right edge of the board near U1. Install C17 so that the markings face the edge of the board. Solder and trim the leads.
- ❑ Locate C4, a 0.022 $\mu$ F capacitor ('223'). Refer to Figure 1 and locate the holes for C4 on the left end of U1. Install C4 so that the markings face left. Solder and trim the leads.

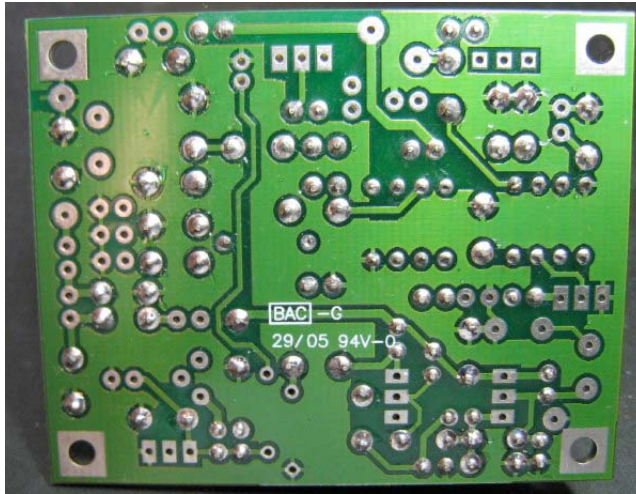
Locate C108, a 0.01 $\mu$ F capacitor ('103' or '103M'). Refer to Figure 1 and locate the holes for C108 in the

lower-left area of the board. Install C108 so the markings face right. Solder and trim the leads.

- ❑ Locate C101, a 0.01 $\mu$ F capacitor ('103' or '103M'). Refer to Figure 1 and locate the holes for C101 near the edge of the board near U1. Install C101 so the markings face the edge of the board. Solder and trim the leads.
- ❑ At this point in the assembly only four electrolytic capacitors and no ceramic capacitors should be left to install. If there are small capacitors left uninstalled, review the previous steps and install those capacitors before proceeding to subsequent steps.



**Figure 17 Board with small capacitors installed**



**Figure 18 Board with small capacitors installed (rear)**

- ❑ Locate C111, a 47 $\mu$ F capacitor that is shorter than the other three. Refer to Figure 1 and locate the holes for C111 near the lower right edge of the board. C111 is an electrolytic-type capacitor with leads for plus (+) and minus (-). The minus (-) lead is identified by a dark stripe running down the side of the capacitor. The lead without the dark stripe is the plus (+) lead. It is important to observe the polarity of this part during installation.

The silk-screen image on the board identifies the hole that should accept the plus (+) lead of the capacitor. Insert the C111 capacitor leads into the two holes identified for this component, observing the polarity, until the bottom of the part rests on the top of the circuit board. Once the part is seated, bend the leads

slightly to hold it in place. Verify that the capacitor is seated on the board. Solder and trim the leads.

- ❑ Locate C103, a 47 $\mu$ F capacitor. Refer to Figure 1 and locate the holes for C103 above U2. Insert the leads from C103 into the holes observing the polarity until the bottom of the part rests on the top of the circuit board. Solder and trim the leads.
- ❑ Locate C7, a 47 $\mu$ F capacitor. Refer to Figure 1 and locate the holes for C7 to the right of C103. Insert the leads from C7 into the holes observing the polarity until the bottom of the part rests on the top of the circuit board. Solder and trim the leads.
- ❑ Locate C9, a 3.3 $\mu$ F capacitor. Refer to Figure 1 and locate the holes for C9 up and to the right of C7. Insert the leads from C9 into the holes observing the polarity until the bottom of the part rests on the top of the circuit board. Solder and trim the leads.
- ❑ At this point all of the capacitors have been installed on the circuit board. Examine the board and look for components that are not properly seated on the front of the board. If components are mounted high off the board, re-heat the solder for those leads on the back of the board and *gently* push the component into place. Examine all solder joints on the rear of the board. If any solder joints appear dull, reheat the area to make a shiny joint. If there is excess solder on any joint, or if there are solder-bridges, use a solder wick or other desoldering tool to remove the excess solder.
- ❑ This completes phase 2 of the assembly.

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### Assembly Phase 3

This phase of assembly will add the remaining parts to the board. Open the bags only as instructed and try to keep parts segregated during this phase of assembly.

- ❑ Locate L1, a 10 $\mu$ H RF choke (brown-black-black). This is the largest of the chokes. (Recall that Appendix A contains photos and descriptions of all parts for the RockMite.) This component will be installed in the same manner as the resistors: with one component lead bent over to be parallel with the other. Carefully and gently bend the “top” lead (the lead on the end with the brown stripe) so that it is parallel with the lead coming out of the “bottom” of the part.



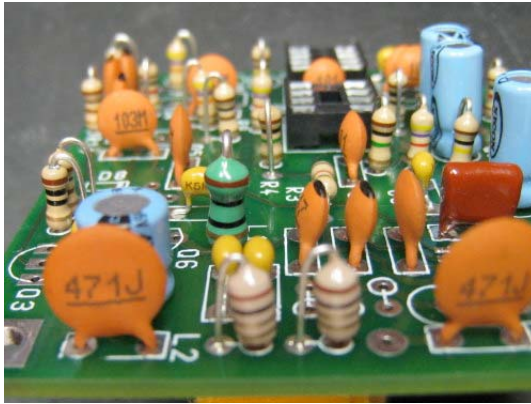
**Figure 19 L1 prepared for insertion**

- ❑ Locate the holes for L1 on the board. The location of L1 is marked within the silk-screen image on the board about a half-an-inch to the left of the right edge of the board. Note that the two holes for L1 are

connected by a thin line. One hole, the right hole, has a small circle around it in the silk-screen image. Insert L1 into these holes by placing the “bottom” lead into the hole with the circle and the other lead into the adjacent hole. Gently push the part down until it rests on the top of the circuit board. (Because of the molding, the part may still stand a fraction of an inch above the board.) Solder and trim the leads of L1.

- ❑ Locate L2, a 1 $\mu$ H RF choke (brown-black-gold). Bend the “top” lead (near the brown stripe) over until it is parallel with the bottom lead as you have done before. The holes for L2 may be found along the right edge of the board and shown in the silk-screen image. One hole has a small white circle indicating where the body of the component should be placed. Insert L2 into the holes in the board and gently push it down until the body of the choke rests on the top of the board. Solder and trim the leads.
- ❑ Locate L3, a 1 $\mu$ H RF choke (brown-black-gold). Bend the “top” lead (near the brown stripe) over until it is parallel with the bottom lead as you have done before. The holes for L3 may be found just above those of L2. One hole has a small white circle indicating where the body of the component should be placed. Insert L3 into the holes in the board and gently push it down until the body of the choke rests on the top of the board. Solder and trim the leads.





**Figure 20 Board with RF chokes installed**

- ❑ Locate the bag with the diodes. There are three types of diodes used within the RockMite. To avoid confusion, do not remove diodes from the bag until instructed to do so. There are four (4) 1N4148 type diodes, two (2) 1N5231B type diodes, and one (1) 1N5236 type diode. The numbers are printed on the diodes but it is much easier to simply keep the diodes separate throughout the assembly process than to attempt to sort them after they have been mixed.
- ❑ Locate D5, a 1N5236B diode in the parts bag. Remove it from the bag. (Note that other diode types may be substituted for this part. See Appendix A for more information.) Using a loupe or magnifying glass, verify the number on the part. The number is on several “lines” so you may need to rotate the part to see the whole number.
- ❑ Diodes have two ends: an *anode* and a *cathode*. It is critical that each lead be placed into the correct hole in the board. The end with the dark band is the

*cathode* end of the diode. Locate the banded end of D5.

- ❑ Diodes D1 through D5 are installed on the board vertically, just as the majority of resistors and RF chokes had been installed. Each of these diodes will have the *cathode* end bent over and made parallel with the *anode* end before installation.



**Figure 21 Diode D5 prepared for insertion**

- ❑ Verify that the hairpin bend is on the banded (*cathode*) side of the diode as pictured above.
- ❑ Locate the holes for D5 on the circuit board just below U2 and U3. The label for D5 may be found in the silk-screen image on the board. Note that one hole is surrounded by a white circle indicating the proper placement of the body of the diode. Insert the anode of the diode (the lead from the “bottom” of the part) into the circled hole; insert the *cathode* into the adjacent hole. Bend the leads slightly on the bottom of the board to hold the component in place.
- ❑ Ensure the body of the diode is over the circled hole. Verify that the dark band indicating the *cathode* end of the diode is near the top of the part (not near the

## RockMite Assembly Instructions

bottom of the part close to the top surface of the circuit board). The diode body should be resting on the top of the circuit board. Solder the two leads of D5 and trim the leads.

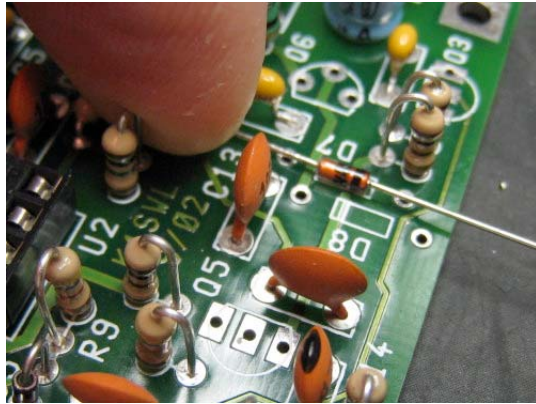
- ❑ Remove D3 and D4, 1N5231B type diodes from the bag. Use a loupe or magnifying glass to verify the part number of this diode as you did with D5.
- ❑ Locate D3, a 1N5231B type diode. Gently bend the *cathode* (banded-end) lead around until it is parallel with the *anode* lead as you did with D5.
- ❑ Refer to Figure 1 and locate the holes for D3 near the upper right of the board next to R1 and C101. The hole to the right has a small circle around it indicating the proper placement of the diode body on the board. Insert D3 into its holes with the body centered over the right hole (the *anode* lead goes into the right hole) and the *cathode* lead going into the adjacent hole. Push the part down until it is flush with the top of the circuit board. Bend the leads on the bottom of the board slightly to hold the part in place. Solder and trim the leads of D3.
- ❑ Locate D4, a 1N5231B type diode. Gently bend the *cathode* (banded-end) lead around until it is parallel with the *anode* lead as you did with D3.
- ❑ Refer to Figure 1 and locate the holes for D4 near U3. The top hole has a small circle around it indicating the proper placement of the diode body on the board. Insert D4 into its holes with the *anode* end going into the hole with the circle. Push the part down until it is flush with the top of the circuit board. Bend the leads

on the bottom of the board slightly to hold the part in place. Solder and trim the leads of D4.

- ❑ Remove the last four diodes from the bag.
- ❑ Locate D1, a 1N4148 type diode. Gently bend the *cathode* (banded-end) lead around until it is parallel with the *anode* lead as you have done with the other diodes.
- ❑ Refer to Figure 1 and locate the holes for D1 near the right edge of the board and near U1. The hole to the right has a small circle around it indicating the proper placement of the diode body on the board. Insert D1 into its holes with the body centered over the right hole and the *cathode* lead going into the adjacent hole. Push the part down until it is flush with the top of the circuit board. Bend the leads on the bottom of the board slightly to hold the part in place. Solder and trim the leads of D1.
- ❑ Locate D2, a 1N4148 type diode. Gently bend the *cathode* (banded-end) lead around until it is parallel with the *anode* lead as you have done with the other diodes.
- ❑ Refer to Figure 1 and locate the holes for D2 up from D1. The hole to the left has a small circle around it indicating the proper placement of the diode body on the board. Insert D2 into its holes with the body centered over the left hole and the *cathode* lead going into the adjacent hole. Push the part down until it is flush with the top of the circuit board. Bend the leads on the bottom of the board slightly to hold the part in place. Solder and trim the leads of D2.

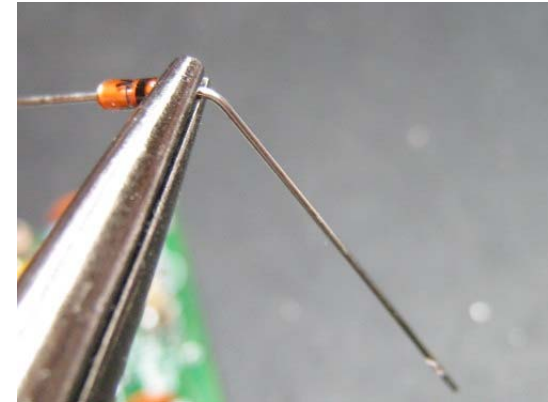


- ❑ Locate D7, a 1N4148 type diode. D7 is mount on the board horizontally. Refer to Figure 1 and locate the holes for D7 on the board near the front edge. The silk-screen image also shows the position of D7. Note the band-end of the diode is also shown in the silk-screen image.
- ❑ Hold the diode over the area where it will be installed centering the body of the diode over its silk-screen marking.



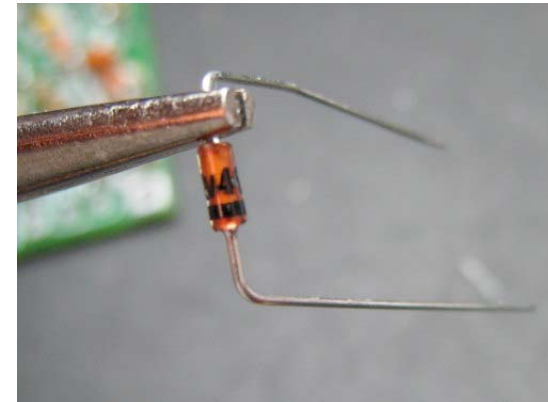
**Figure 22 Placement of D7**

- ❑ Note the approximate distances from the ends of the diode to the corresponding hole for the component lead.
- ❑ Using needle nose pliers, hold the diode lead and gently bend it over at a right-angle. The jaws of the pliers should provide a good spacing for the distance between the end of the part and the hole that lead must be placed through.



**Figure 23 Preparing a diode lead for horizontal installation**

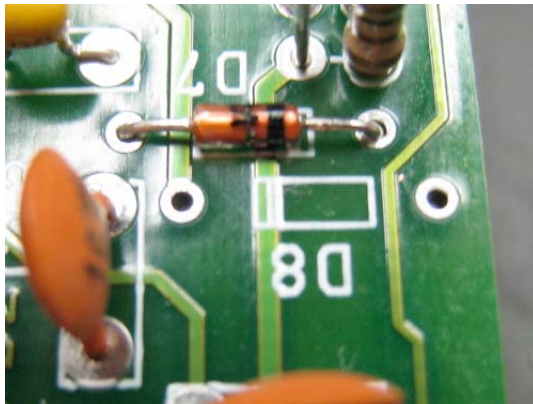
- ❑ Bend the other lead in the same manner.



**Figure 24 Creating spaced leads for horizontal installation**

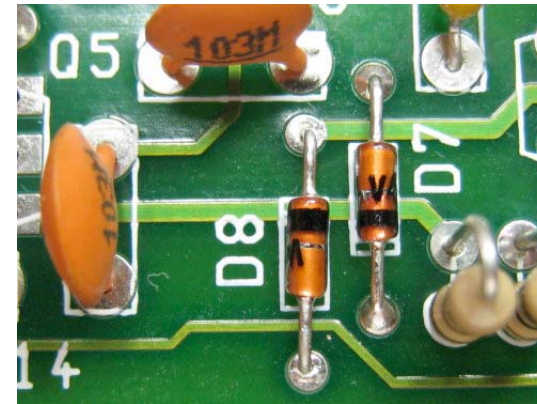
- ❑ Carefully route the two leads from D7 into the proper holes observing the band on the diode and the corresponding band in the silk-screen image.

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**Figure 25 D7 placed**

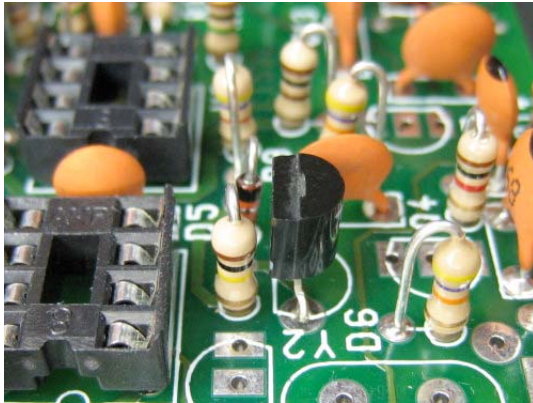
- ☐ The diode D7 should now install easily into the proper holes on the board with right-angle bends properly spaced so the leads descend into their holes without excess stress.
- ☐ Bend the leads of D7 slightly on the bottom of the board to hold the part in place. Solder and trim the leads of D7.
- ☐ Locate D8, a 1N4148 type diode. D8 is also mounted on the board horizontally. Refer to Figure 1 and locate the holes for D8 near D7. The silk-screen image also shows the position of D8 with the band-end of the diode shown.
- ☐ Prepare the leads for D8 as you did for D7.
- ☐ Insert D8 into the circuit board observing the band ends of the diode and silk-screen image. Bend the leads slightly on the bottom of the board to hold the component in place. Solder and trim the leads of D8.



**Figure 26 D7 and D8 properly installed**

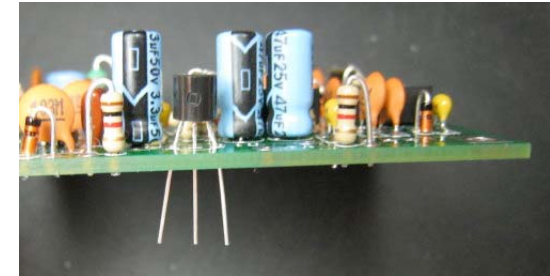
- ☐ There should be no small diodes left from the parts bag at this time. If there are uninstalled diodes, determine the diode types, which diodes were skipped, and locate the appropriate steps for those parts above. These components must be installed before proceeding.
- ☐ Locate the antistatic bag. **Observe ESD precautions when handling these parts.** Remove all parts from the antistatic bag and array them before you. Sort and group these parts.
- ☐ Locate D6, an MV1662 type varactor diode. This part looks like a transistor, but it has only 2 leads and stripes instead of text to identify it. See appendix A for a photo of this part (and others).
- ☐ Refer to Figure 1 and locate the holes for D6 near U3. The silk-screen identifies D6 and shows a shape with a flat side and rounded side in the image. The orientation of D6 is important. Insert the leads of D6 such that the rounded side of the component aligns

with the rounded image found in the silk-screen on the circuit board. The flat side should face U3. The leads are pre-formed to be properly spaced for the holes. Lower the part until it rests on the elbow of the bent leads. Turn the board over. Solder and trim the leads of D6.



**Figure 27 D6 installed with flat side facing U3**

- ❑ Locate Q1, a 2N7000 transistor. **Observe ESD precautions when handling this part.** Refer to Figure 1 and locate the holes for Q1 near the top edge of the circuit board. Q1 (and all transistors in the RockMite) must be installed in the proper orientation. Note the outline shape in the silk-screen image for Q1. One side is rounded; one side is flat. Install Q1 matching the orientation shown in the silk-screen image by inserting the leads one-by-one in the corresponding holes and *gently* pushing the part down until it stands about 1/8<sup>th</sup> inch above the board, or until the resistance from the leads prevents a lower insertion.



**Figure 28 Q1 inserted and ready to be soldered**

- ❑ Solder and trim the leads of Q1.
- ❑ Locate Q2, a 2N7000 transistor. **Observe ESD precautions when handling this part.** Refer to Figure 1 and locate the holes for Q2 near the left edge of the board below U3. Note the orientation of this component in the silk-screen image. Install Q2 as you did with Q1. Solder and trim the leads of Q2.
- ❑ Locate Q3, a 2N7000 transistor. **Observe ESD precautions when handling this part.** Refer to Figure 1 and locate the holes for Q3 near the bottom edge of the board. Note the orientation of this component in the silk-screen image. Install Q3 as you did with Q1 and Q2. Solder and trim the leads of Q3.
- ❑ Locate Q4, a 2N4401 transistor. **Observe ESD precautions when handling this part.** Refer to Figure 1 and locate the holes for Q4 near the bottom-left corner of the circuit board. Some transistors will come from the factory with their leads slightly bent. The RockMite circuit board has holes for this component arrayed in a straight line. If the leads of the transistors package with this kit have a bent center

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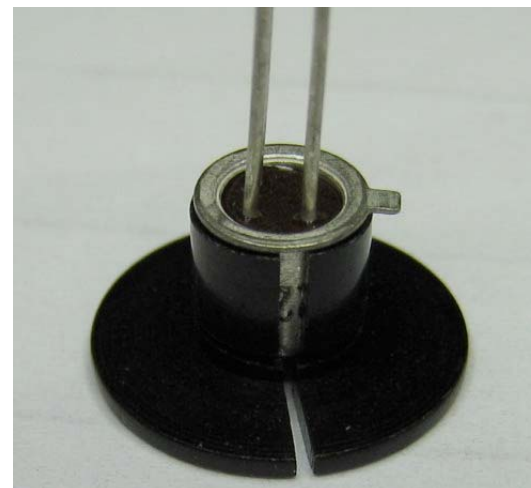
lead, use the needle nose pliers to *gently* straighten the center leads before installation.

- ❑ Install Q4 observing the orientation in the silk-screen image. Solder and trim the leads of Q4.
- ❑ Locate Q5, a 2N4401 transistor. **Observe ESD precautions when handling this part.** Refer to Figure 1 and locate the holes for Q5 near Q4. If necessary, prepare the leads for this transistor as you did for Q4. Install Q5 observing the orientation in the silk-screen image. Solder and trim the leads of Q5.
- ❑ Locate Q6, a 2N2222 transistor in a metal can. This is the Power Amplifier for the radio so it will dissipate heat when transmitting. A heat sink will be affixed to this component before installation.
- ❑ Locate the small, round, flat heat sink. The heat sink will be mounted on Q6 like a tight-fitting hat. The large aluminum disk will help dissipate heat from Q6 during transmission.
- ❑ Lay the heat sink on the surface in front of you with the flat side down. Insert Q6 into the heat sink as shown below.



**Figure 29 Preparing Q6 and its heat sink**

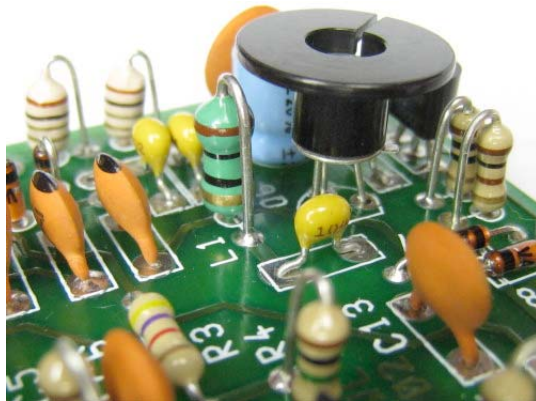
- ❑ **Be careful not to damage the leads of Q6 in the next few steps!** Place fingertips on two sides of the transistor Q6 and *gently* push the can straight down into the heat sink until the bottom ring of the can is flush with the top of the heat sink.



**Figure 30 Heat sink mounted on Q6**



- ❑ Verify that the transistor is fully inserted into the heat sink. The transistor leads should be vertical (and not leaning towards one side or another) if the transistor is fully inserted into the heat sink. If the transistor is not fully inserted, take your time and *carefully* push the transistor down again until it is fully inserted.
- ❑ Q6 has three leads arrayed in a triangular pattern. Locate the holes for Q6 on the circuit board in the lower-right area of the circuit board. Note that the holes for Q6 are similarly arrayed in a triangular pattern. Align the leads with the corresponding holes and insert the transistor Q6 into the board a short distance.
- ❑ Examine the components near Q6. The tallest is likely L1, a molded RF choke. Push Q6 down until the heat sink is just above the tallest object around Q6. Installation of Q6 must insure that the heat sink cannot touch any other components. As a result, Q6 will stand high off the board. This is normal and expected.



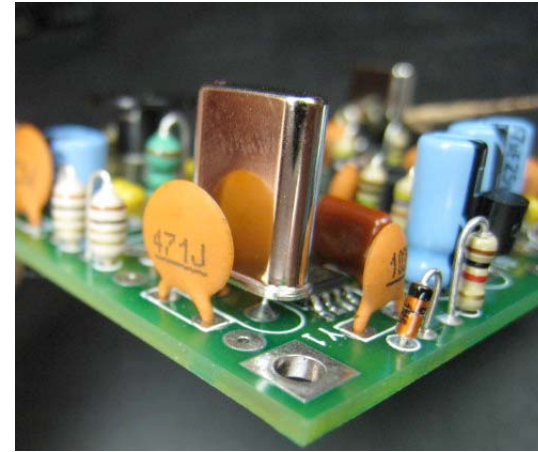
**Figure 31 Q6 with heat sink clear of other parts**

- ❑ Verify the position of Q6 and ensure that the heat sink cannot touch other components. Solder and trim the leads of Q6.
- ❑ There should be no other transistors left at this time. If there are transistors uninstalled, locate the proper instructions from previous instructions and install those transistors before proceeding to subsequent steps.
- ❑ Locate the two crystals in metal cans. The crystals will be installed in the next steps. The crystals are identical.
- ❑ Locate the holes for the first crystal Y1 in the upper right corner of the circuit board. Crystals can be mounted in either orientation but it is best to mount any component with the markings visible if possible. Insert the leads from one of the crystals into the holes for Y1.
- ❑ The crystals must not be mounted flush to the board. A small air gap must exist between the bottom of the crystal and the top of the circuit board. In the following steps be sure that the crystal is mounted above the board. An easy way to keep this spacing is to slide a short piece of solder wick (copper mesh) between the crystal and the board. The solder wick can be pulled free after soldering leaving the desired small gap.
- ❑ Crystals are delicate parts. They can be damaged by excessive heat during soldering. When soldering the leads of the crystals heat the leads only briefly, apply a minimum of solder, and remove the soldering iron

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immediately. Soldering times should be limited to 2 or 3 seconds for each lead.

- ❑ Solder one lead of Y1. Remember to keep soldering times to 2-3 seconds.
- ❑ Examine the crystal at Y1. The bottom of the crystal should be up off the top of the circuit board. The crystal should be vertical and straight in its position centered over its holes. If it is not, reheat the solder joint for the lead you soldered in the above step and correct the orientation of Y1.
- ❑ When you are satisfied that the crystal is now installed properly, with its base off the circuit board and the component level, vertical, and centered, solder the other lead of Y1. Remember to keep soldering times to 2-3 seconds.
- ❑ Verify that Y1 is satisfactorily installed based on the instructions above. If not, correct the problems. If you are satisfied with the installation, trim the leads of Y1.



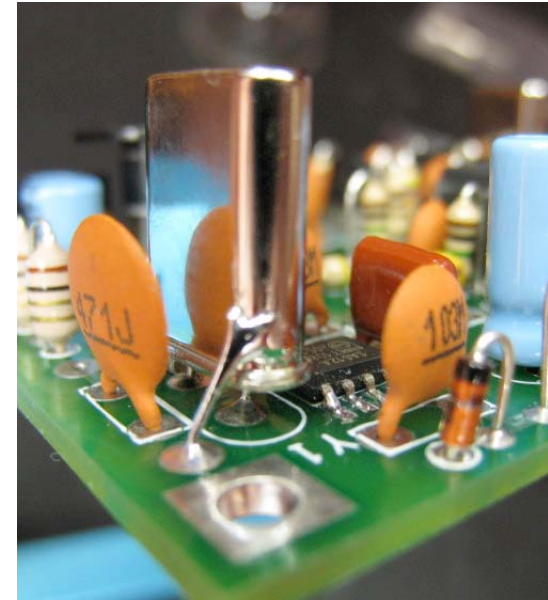
**Figure 32 Y1 installed**

- ❑ Install Y2 on the other side of the board as you did Y1.
- ❑ Locate U2, a MC1458 or LM1458 integrated circuit (IC). **Observe ESD precautions when handling this part.** Straighten the leads of U2 by laying the IC on a flat, ridged surface with one set of leads flush with that surface. *Gently* roll the IC so that the leads are straightened to point directly down from the bottom of the part. Repeat that procedure with the leads on the other side of the component.
- ❑ Observe that the socket for U2 on the circuit board has a notch on the left end. Similarly, the IC U2 has a notch, indent, dot, or other marker on one end of the component. U2 must be installed in the correct orientation for it to work. Observing the orientation as indicated by the notches or dots, place U2 on the socket. The pins from U2 should align well with the



socket positions. If they do not, use the above procedure again to shape the leads of U2 properly.

- ❑ With U2 sitting on its socket, put your finger on the IC and *gently* push the IC into its socket until it is firmly seated. Be sure to apply equal pressure on both sides of the component when pushing.
- ❑ Locate U3, a pre-programmed PIC microprocessor with part number 12C508A. **Observe ESD precautions when handling this part.**
- ❑ Prepare the leads for U3 as you did with U2.
- ❑ Locate the socket for U3. Insert U3 into its socket as you did U2.
- ❑ Locate a component lead that was trimmed from a part in a previous step. This lead will be used to ground the case of the crystal Y1. The discarded component lead should be about  $\frac{3}{4}$  of an inch long.
- ❑ Examine Figure 1 and locate the hole in the circuit board near Y1 marked with a dark gray circle. This is where the component lead will be installed.
- ❑ Lay the circuit board face-up on a flat surface. Insert the component lead into the indicated hole near Y1.
- ❑ Solder this lead on the top of the circuit board.
- ❑ Bend the lead so it touches a point near the bottom of the crystal's can. *Carefully* solder this lead to the can. Trim the lead just above the solder joint.

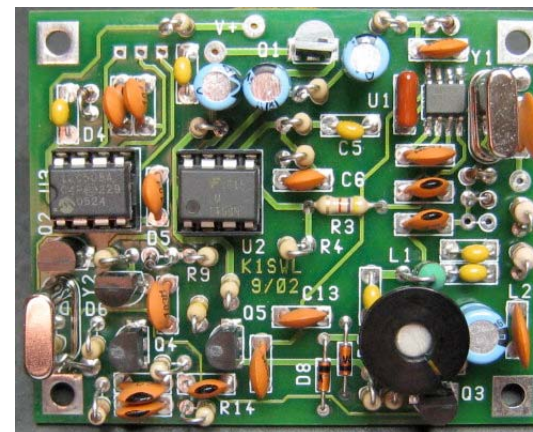


**Figure 33 Y1 ground in place**

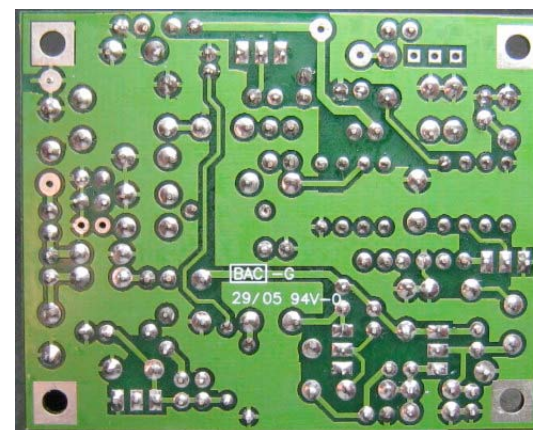
- ❑ Locate another component lead trimmed from a part in a previous step. This lead will be used to ground the case of the crystal Y2.
- ❑ Examine Figure 1 and locate the hole in the circuit board identified for grounding Y2.
- ❑ Place the circuit board face-up on a flat surface and insert the component lead in the grounding hole as you did for Y1. Solder this lead on the top of the circuit board.
- ❑ Bend this lead to touch a point near the bottom of Y2. Solder and trim that lead as you did with Y1.

## RockMite Assembly Instructions

- ☐ Examine the bottom of the circuit board. If there are any solder bridges, joints with excess solder, cold solder joints, or other assembly problems then correct those problems at this time. Each solder joint should be shiny and clean. Component leads should be trimmed close to the top of the solder joint without disturbing the joint.
- ☐ Any excess solder flux left on the circuit board may now be optionally removed by gently scrubbing the bottom of the board with alcohol and a small brush. The bottom of the board should be clean without residues.
- ☐ This completes the construction for the circuit board for the RockMite. Connectors and controls for the radio are assembled in the next section.



**Figure 34 Completed RockMite circuit board top**



**Figure 35 Completed RockMite circuit board bottom**

## Final Assembly

Final assembly of the RockMite radio is performed within the context of an enclosure. A suitable enclosure must be used to hold the circuit board, antenna connector, power connector, jacks, and switch. There are many alternatives. This manual will assume that the kit is to be completed by installing the parts into a *MityBox*, an aluminum enclosure designed and marketed by *American Morse Equipment*.

American Morse Equipment

Doug Hauff KE6RIE

[dhauff@digitalputty.com](mailto:dhauff@digitalputty.com)

[www.americanmorse.com](http://www.americanmorse.com)

Alternatively, a “Bud” box sold by Mouser with properly drilled holes can also provide a very elegant enclosure for considerably less cost than the American Morse box.

Bud part number CU-124

Mouser 563-CU-124

4.38” x 2.38” x 1.06”

These assembly instructions are suitable for either enclosure. The remainder of the manual will assume the MityBox is being used for assembly.



Figure 36 Bud box



Figure 37 MityBox

- ❑ If R5, a 1M ohm resistor (brown-black-green), was installed during assembly of the circuit board remove that resistor at this time. This fixed resistor will be replaced by a 1M ohm potentiometer in later steps. Locate the pads for R5 on the bottom of the circuit board near the two more widely-spaced pads for C6. Using a desoldering tool or solder wick, remove all solder from the connection and gently remove the resistor. Be careful not to disturb other nearby parts during this process.

- ❑ Open the controls kit bag and sort the items.
- ❑ Locate the push button switch. The switch will be installed in the end of the MityBox that corresponds to the *front* of the radio. The front of the radio is identified by the large hole on one side (rather than a large hole in the center which will be used for the BNC connector on the *rear* of the radio in later steps).
- ❑ Install the push button switch in the center hole in the front of the MityBox. If there is a lock washer with the switch hardware, install the lock washer on the inside of the box so that only a hex nut is on the outside. Orient the switch during assembly such that the two pins of the switch are horizontal.



**Figure 38 Switch installed**

- ❑ Locate one of the 1/8 inch jacks. This will be the headphone jack. Install the jack in the smaller of the two remaining holes in the front of the radio. Orient the jack so that the lead that extends perpendicular to the jack is up.



**Figure 39 Headphone jack installed**

- ❑ Locate the 1M ohm potentiometer. This will be the AF gain control for the radio. Insert the potentiometer into the large hole in the front of the radio, secure with the washer and hex nut on the outside of the box. Orient the potentiometer such that the lugs are horizontal and facing the switch.



**Figure 40 AF control installed**

- ❑ Locate the ribbon cable wire. Strip the black wire from the cable. This will be used for connecting various components to ground.
- ❑ Take the black wire and cut a 1 inch piece from it. Strip the wire removing about 1/8<sup>th</sup> of an inch of



insulation from each end. Solder one end of the wire to the lug of the switch closest to the jack.



**Figure 41 Ground wire for switch soldered**

- ❑ Loop the other end of the black wire through the connector sticking up out of the headphone jack. **DO NOT SOLDER.**



**Figure 42 Ground to top of jack**

- ❑ Separate the white and grey wires from the ribbon cable. Keep the two wires together when removing them from the other wires of the ribbon cable. Cut a 3 inch length of these two wires. Separate the two wires about 1/4<sup>th</sup> of an inch on each end. Remove about

1/8<sup>th</sup> of an inch of insulation from each end of both wires.

- ❑ Loosen the potentiometer and rotate it so that the lugs are oriented up. Solder one end of a wire to the center lug of the potentiometer and the other wire to the lug closest to the push button switch. Either grey or white wire can be connected to either lug.



**Figure 43 AF wires soldered**

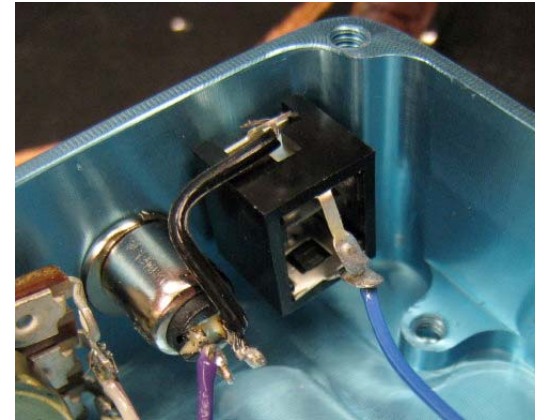
- ❑ Rotate the potentiometer back into position so that the lugs face the switch. Tighten the hex nut to secure the part.
- ❑ Separate the purple wire from the ribbon cable. Cut a 3 inch piece from this purple wire. Remove 1/8<sup>th</sup> of an inch of insulation from both ends of the wire.
- ❑ Solder one end of this 3 inch purple wire to the remaining lug of the push button switch.

- ❑ Separate the blue wire from the ribbon cable. Cut a 3 inch piece from the blue wire. Remove 1/4 of an inch of insulation from one end of the wire. Remove 1/8<sup>th</sup> of an inch from the other end.
- ❑ Using the end of the blue wire with the 1/4 inch wire exposed, thread the wire through the two lugs located in the back of the jack.



**Figure 44 Connect the wire for the AF**

- ❑ Solder the wire to both lugs of the connector.

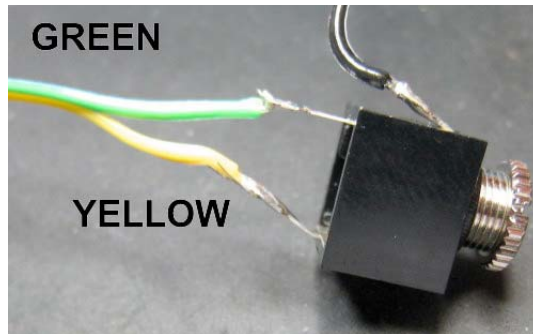


**Figure 45 AF signals soldered**

- ❑ Locate the remaining black wire. Cut a 4 inch length. Remove 1/8<sup>th</sup> of an inch of insulation from each end.
- ❑ Connect one end of the black wire to the headphone jack ground (the other black wire is there yet to be soldered). Solder both wires to this lug at this time.
- ❑ Locate the second 1/8<sup>th</sup> inch jack. Solder the other end of this black wire to the ground lug of the second jack. (Note that the second jack is not yet installed in the box.)
- ❑ Separate the yellow and green wires from the ribbon cable. Keep them together. Separate the two wires about a half of an inch on one end and strip off 1/8<sup>th</sup> of an inch of insulation. Separate the two wires about 1/4 of an inch on the other end and strip 1/8<sup>th</sup> inch of insulation.

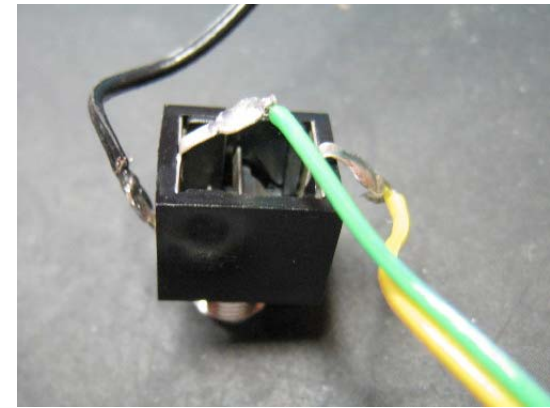


- ❑ On the end of the wire with the half of an inch separation solder the green wire to the lug closest to the ground lug (with the black wire). Solder the yellow wire to the remaining lug.



**Figure 46 Key jack wiring**

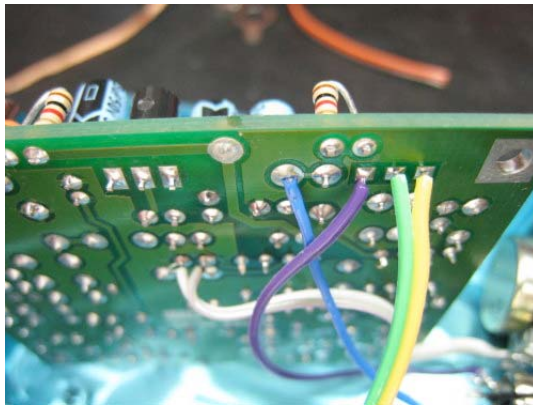
- ❑ Bend the leads of the key jack so that the ground lug is close to the body of the jack. Bend the lug with the yellow lead so that it is on close the body of the jack on the other side. Bend the lug with the green lead so it is at about a 45 degree angle to the back of the jack.



**Figure 47 Bend key jack lugs**

- ❑ Builders have an option. Wires from the controls can be connected to either the *top* or *bottom* of the board. Connecting the wires to the bottom of the board will result in a nicer looking kit (leaving more of the components on the top of the board visible).
- ❑ The RockMite circuit board is installed in the metal enclosure with the two integrated circuits oriented towards the front of the radio. Observe this orientation when connecting wires in the following steps.
- ❑ Insert the two wires from the potentiometer into the two holes for R5. Solder and trim the wires.
- ❑ Locate the hole just down and to the left of the V+ pad. Install the blue wire from the headphone jack to this hole. Solder and trim the wire.

- ❑ There are three holes arrayed in a straight line near the pad marked V+. Insert the purple wire that connects to the switch into the hole closest to the pad with the blue wire (that was just installed). Solder and trim the purple wire.
- ❑ The remaining holes in this three hole array are filled with the green wire installed next to the purple wire (in the middle) and the yellow wire (on the end).



**Figure 48 Blue, Purple, Green, Yellow (L-R)**

- ❑ Separate the remaining red, brown, and orange wires from the ribbon cable into three separate wires.
- ❑ Cut a 3.5 inch piece of the red wire. Strip 1/8<sup>th</sup> of an inch of insulation from each end.
- ❑ Install the red wire into the V+ hole on the top of the board. Solder and trim the red wire.
- ❑ Locate the power connector. Note that there are three lugs on this connector at approximately 8, 12, and 4

O'Clock positions. Orient the part so that the three lugs are arrayed in this configuration.



**Figure 49 Power connector lugs**

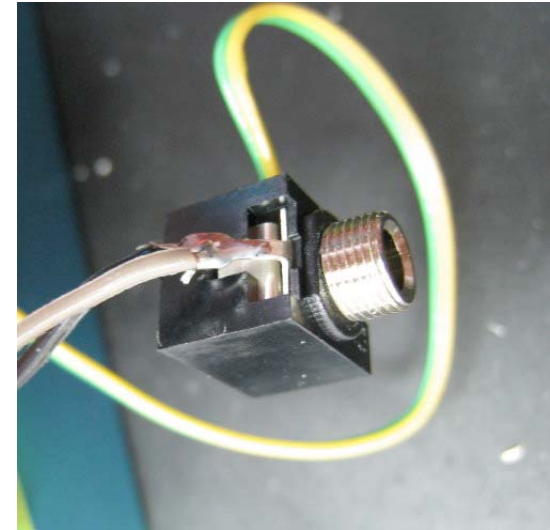
- ❑ Note that one lug, the lug at the 8 O'Clock position, connects to the solid metal piece on the back of the connector. This is the center connector of the socket. Connect the cathode lead (the non-banded end) of the diode (1N5818) to the lug at the 8 O'Clock position and bend the lead with needle nose pliers until it has a tight fit around that lug. The diode should be on the inside of the lug. Make this bend so that the body of the diode is very close to the lug. Solder and trim the cathode lead. See figures 50 and 53 to see how this diode will ultimately be positioned. Study these two photographs before completing this step.



**Figure 50 Diode connected to power pin**

- ❑ Cut a two 3 inch pieces of brown wire. Strip 1/8<sup>th</sup> of an inch of insulation from each end of both wires.
- ❑ Insert one end of each of the two brown wires into the power connector's 12 O'Clock lug. Solder and trim the wires.
- ❑ Insert one of the ends from a brown wires into the ground lug of the keyer jack. This lug has already been soldered. The easiest way to accomplish this is to carefully melt the solder of that lug again and, while the solder is molten, stick the end of the brown

wire into the hole. When you remove the soldering iron, the solder will cool and the connection will be solid.



**Figure 51 Ground from power connected to key jack**

- ❑ Solder the free end of the red wire to the anode (banded) end of the diode connected to the power connector. Solder the wire close to the body of the diode. Trim the diode lead so it is very short.



**Figure 52 Power wire (red) connected to diode**

- ☐ There are two holes near Y1 that serve as the ground and antenna connections for the radio. The ground connection already has a lead soldered in it that grounds the case of Y1. The other hole is near the edge of the board and near the two molded inductors. This is the antenna lead. The two wires leading to the BNC antenna connector should be as short as possible. The orange wire will be used for the antenna connection. A length of left-over grey wire will be used for the ground connection leading to the BNC connector.
- ☐ Cut a 2 inch piece of orange wire and strip  $1/8^{\text{th}}$  of an inch from each end. Insert that wire into the hole near the two molded inductors near Y1. Solder and trim the lead.
- ☐ Locate a left-over piece of the grey wire. Cut a 2 inch piece of the grey wire and strip  $1/4$  inch of insulation from each end.
- ☐ The free brown wire from the power connector and one end of the grey wire are grounds. Solder those two wires to the wire grounding Y1 on the top of the board. Try to keep the wires as close to the board as possible. Try to use a minimum of solder. Do not heat the connection on the crystal.
- ☐ There should be only two wires with free ends at this point in the assembly: the orange and grey wires for the antenna connection. If there are free ends of wires still present at this time, go back and review the previous instructions and made those connections. Do not proceed until you have only two wires with free ends.
- ☐ If you have connected the wires leading to the controls in the front of the radio to the bottom of the board, carefully route those wires beneath the board now. The black wire between the headphone and key jack should not be routed beneath the board. The power wire (red) should not be routed beneath the board.
- ☐ Affix the circuit board to the enclosure. If you are using a MityBox, mount the circuit board to the box using four pan head screws.
- ☐ Bend the diode and the lug it is solder to so that the diode is perpendicular to the connector. It is important that the diode does not protrude from the back of the



connector as it might short against components on the RockMite circuit board.



**Figure 53 Diode tucked away**

- ❑ Mount the power connector in the larger of the two holes in the rear of the radio. Orient the lugs so that the 12 O'Clock lug (with the two brown ground wires) is up. Secure the connector with a flat washer and hex nut on the outside of the box.
- ❑ Mount the key jack in the other small hole in the rear of the radio. Orient the ground lug (with the black and brown wires) towards the center. Secure with the ring nut.

- ❑ Carefully route the wires so that they travel along the side and bottom of the box.



**Figure 54 Wiring routed along the side**

- ❑ Solder the ring connector for the BNC connector to the grey lead.



**Figure 55 Ring connector**



- ☐ Insert the BNC connector into the large center hole and secure by adding the ground ring, then the internal tooth lock washer, and the hex nut. Orient the connector so the lip of the center pin is up. Tighten the connector. (It may be easier to hold the nut and rotate the connector to tighten it.) Bend the ground lug over.
- ☐ The RockMite comes with a two component addition to reduce spurious emissions. Those two parts are a molded inductor and a small capacitor with values selected for the specific band serviced by this RockMite. Locate those parts now.
- ☐ Solder the capacitor to the inductor and trim the leads as shown below.



**Figure 56 Inductor and capacitor prepared**

- ☐ Solder the short lead of the inductor to the center pin of the BNC connector. Solder the orange lead to the unsoldered lead of the capacitor. Trim the capacitor lead as shown in the figure. All of this should be well above other components on the circuit board.



**Figure 57 Low pass filter installed**

**Initial checkout of the radio**

- ☐ Using a DMM, measure the resistance between the red wire (connected to the diode) and the ground connection on the power connector (with the two brown wires). The resistance should be greater than 1K ohms. If it is not, then there is a problem with the radio. DO NOT APPLY POWER UNTIL THIS PROBLEM IS RESOLVED.
- ☐ Create a power cord for the RockMite by either obtaining a preassembled 2.1mm barrel connector power cord, or by soldering the leads of the included zip cord to the connector supplied with the kit.
- ☐ Connect a pair of low impedance head phones (8-32 ohms) to the headphone jack in the front of the radio.
- ☐ Connect an antenna to the BNC connector (antenna jack).
- ☐ Set the potentiometer to about the middle of its range.
- ☐ Connect a power supply (10-14v) to the radio. **If you smell smoke or sense any heat coming from the radio remove the power immediately!**
- ☐ You should hear signals in the headphones. Adjust the AF gain control to a comfortable level.
- ☐ Press and hold the button. You should hear three short beeps. Release the button. In a few seconds, you should hear a short beep.
- ☐ Remove power from the radio. Disconnect the antenna and headphones.
- ☐ Mount the knob on the potentiometer.
- ☐ Visually inspect the unit. Ensure that no component, wire, or any other surface extend above the top of the box. Any item that breaks that barrier would short against the metal top of the box so it is important to perform this check.
- ☐ Mount the box top on the box and secure with four screws.
- ☐ Connect a 50 ohm dummy load to the antenna jack. **WARNING! Never transmit without a 50 ohm load connected to the radio. The final transistor (2n2222) can be easily damaged by overheating.**
- ☐ Connect the headset, a set of paddles to the key jack, and apply power.
- ☐ Test the paddles. The dot and dash paddles should be correct (not reversed). If they are reversed, then the yellow and green wires have been reversed during assembly. (Typically, the “dot” is the left paddle.) **If you have this problem, stop and correct that now.**
- ☐ If possible, connect a watt meter to the antenna jack and ensure that a 50 ohm load is still present. Key the transmitter with a series of “dashes”. The watt meter should show approximately 200mW or more, depending on power supply voltage.

- ❑ Press and hold the button. A series of the dots (“S”) will be heard in the headphones. Use the dot paddle lever to increase the keyer speed; use the dash paddle lever to decrease keyer speed. Releasing both dot and dash paddles for a few seconds “exits speed change mode” and a single beep will be emitted. (Neither the “S” or the final beep are transmitted.)

NOTE: There is no mechanism to change the side tone volume.

- ❑ A brief ( $< 1/4$  of a second) push of the switch swaps the offset frequency. This has the effect of giving the radio 2 working frequencies. When you wish to work another station, select the switch setting that provides the higher of the two pitches.
- ❑ This concludes the assembly of the RockMite for 40m. There are a number of online resources to support the RockMite and many options, additions, and alterations possible. Congratulations!



Figure 58 A Masterpiece

## Appendix A – RockMite Parts List





Photo	Reference Designator	Description	Quantity
	--	Circuit board for the RockMite (K1SWL 9/02)	1
	R6, R18	10 ohm resistor (brown-black-black)	2
	R14, R16, R17	100 ohm resistor (brown-black-brown)	3
	R1, R8, R13	1K ohm resistor (brown-black-red)	3
	R2, R3, R9	4.7K ohm resistor (yellow-violet-red)	3
	R12	22K ohm resistor (red-red-orange)	1
	R11, R15	47K ohm resistor (yellow-violet-orange)	2
	R7, R10	100K ohm resistor (brown-black-yellow)	2
	R4, R5	1M ohm resistor (brown-black-green)	2
	U1	SA602AD SMT IC or equivalent (SA612, etc.) This is the only surface mount part in the kit. <i>This is a static sensitive part</i>	1
	U2	MC1458, LM1458 IC 8-pin DIP IC <i>This is a static sensitive part</i>	1





Photo	Reference Designator	Description	Quantity
	U3	12C508A PIC microprocessor <i>Preprogrammed</i> 8-pin DIP IC <i>This is a static sensitive part</i>	1
	--	8-pin DIP IC socket	2
	C1, C2, C12	47 pF NPO disc capacitor '47' or '47J' ceramic type	3
	C10, C11	68 pF NPO disc capacitor '68' or '68J' ceramic type	2






Photo	Reference Designator	Description	Quantity
	C6, C105, C106, C107	100 pF disc or mono capacitor '101' or '101J' ceramic type	4
	C15, C17	470 pF disc or mono capacitor '471' or '471J' ceramic type	2
	C16	1000 pF (0.001 $\mu$ F) mono capacitor '102' or '102J' epoxy case	1




Photo	Reference Designator	Description	Quantity
	C5, C8, C14, C104, C109, C110	0.01 $\mu$ F disc or mono capacitor '103' or '103M' ceramic type	6
	C4	0.022 $\mu$ F monolithic capacitor '223' or '223J' epoxy case	1
	C5, C8, C14, C104, C109, C110	0.1 $\mu$ F monolithic '104' epoxy case	6



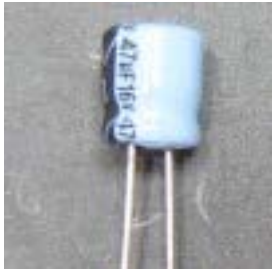

Photo	Reference Designator	Description	Quantity
	C9	3.3 $\mu$ F electrolytic capacitor, 50v	1
	C7, C103	47 $\mu$ F electrolytic capacitor, 50v There are two “tall” capacitors and one “short” capacitor with this value. Observe instruction in the assembly text carefully.	2
	C111	47 $\mu$ F electrolytic capacitor, 16v, low-profile There are two “tall” capacitors and one “short” capacitor with this value. Observe instruction in the assembly text carefully.	1
	Y1, Y2	7.030 MHz crystal	2









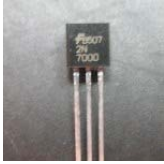
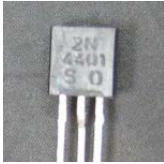

Photo	Reference Designator	Description	Quantity
	L1	10 $\mu$ H RF choke (brown-black-black)	1
	L2, L3	1 $\mu$ H RF choke (brown-black-gold) (Smaller than L1)	2
	HS1	TO-18 heat sink, anodized	1
	--	RG-174/U coax, 2.5 inch length	1
	D1, D2, D7, D8	1N4148 small signal diode	4
	D3, D4	1N5233B 5.1 volt zener diode	2
	D5	1N5236B 7.5 volt zener diode Note: similar diodes may be substituted including 1N5233 (6.0 volt zener diode) or similar.	1

Photo	Reference Designator	Description	Quantity
	D6	MV1662 varactor diode Two stripes appear on the component, no numbers	1
	Q1, Q2, Q3	2N7000 transistor <i>This is a static sensitive part</i>	3
	Q4, Q5	2N4401 transistor <i>This is a static sensitive part</i>	2
	Q6	2N2222 transistor in a metal can <i>This is a static sensitive part</i>	1



## Appendix B – Control and Connector Parts List











Photo	Reference Designator	Description	Quantity
	--	SPST temporary push button switch Mouser 10PA019 RS 275-1571 Or equivalent	1
	--	Power connector Mouser 163-4305 (plug 1710 2510) RS 274-1583 (plug 274-1584) Or equivalent	1
	--	BNC Antenna jack Mouser 523-31-221-RFX RS 278-0105 Or equivalent	1
	--	1/8 inch stereo jack (audio type) Mouser 161-3402 RS 274-1571 Or equivalent	2
	--	Knob, 1/4 inch mount	1

Photo	Reference Designator	Description	Quantity
	--	1N5818 Diode	1
	--	Potentiometer, audio taper 1M Mouser 31JN601	1
	--	Ribbon cable (hook-up wire)	1
	--	Light gauge zip cord for power	1
	--	Barrel connector Mouser 171 2510 RS 274-1584	1