SUPPLEMENT TO

ROCK-MITE

INSTRUCTIONS

Revision date- 2/15/2003

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TOOLS:

The following tools are recommended for construction of the Rock-mite board kit:

- Soldering iron- ~25W
- 60/40 solder, small dia.
- Desoldering braid (Radio Shack #64-2090B).
- Diagonal cutters

The following may be useful:

- *Tweezers*
- *Close-up (magnifying) glasses*

STATION BASICS:

- ***Headphones:***

Low-impedance (personal CD-player type)

- ***Antenna:***

50-ohm nominal at frequency of interest
(*typically- a dipole*)

- ***DC Power:***

11-14V DC- regulated or battery

~25 mA (receive)
~200 mA (transmit)

COMPONENT IDENTIFICATION:

RESISTOR COLOR CODES:

Resistor color codes are given in the parts list. Radio Shack's Color-Code Guide, #271-1210, or the ARRL Handbook will help. If you're not sure, verify the resistor values with a multimeter before installing.

For what it's worth, roughly 8% of the male population is red/green color blind. If you're one of these, you should be verifying all resistors with a multimeter before installing them.

The Rock-mite board is double-sided and all holes on the board are plated-through. This means that you do not need to solder on the top side of the board unless directed otherwise.

SOLDERING SKILLS

Hopefully this isn't your first experience with a soldering iron. If it is, though, or this is your first solid-state project, here are some tips to ensure your success:

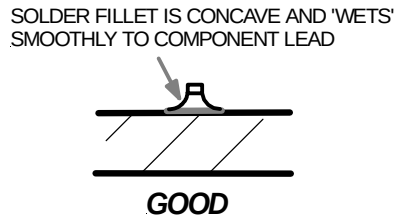
- Soldering Iron:

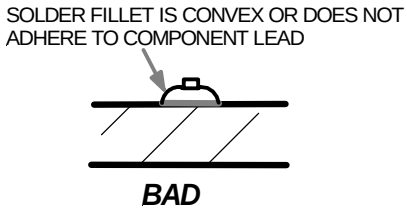
Use a small iron in the 25-watt class (such as a Radio Shack #64-2070) and keep the tip clean. Use a moistened sponge or paper towel to clean the tip periodically as you work.

Apply only as much heat as is needed to get a good joint. A small vise to hold the printed-circuit board may make soldering easier.

Touch the soldering iron tip to the PC board trace and the component lead simultaneously. Within a second or two, apply solder and you'll see the solder flow onto the junction. Withdraw the solder and then the soldering iron.

Avoid the temptation to load solder onto the joint until no more will fit! This is an invitation for trouble, as solder bridges may form across the closer trace separations. Here's what the correct and incorrect joint treatments look like:





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PLEASE READ THE SECTION BELOW BEFORE REMOVING ANY PARTS FROM THE BOARD

Uh-oh! Sooner or later, you may need to remove a part installed in the wrong location, or perhaps pull a component for troubleshooting purposes.

Using desoldering braid, lay the end of the braid down on the joint to be cleaned and press the soldering iron tip over the braid. Within several seconds you'll see the braid begin to wick up solder from the joint. Remove the braid and reapply a new section as needed until the joint is clean. It may be necessary to pull the component out from the top side of the board while heating the joint. Leave the iron tip on the board only as long as necessary to do the job- the PC-board traces will eventually delaminate (peel off) if overheated.

If that still doesn't do the job, it may be necessary to cut the offending part off on the top side and pull the remaining leads through with pliers. Contact me for replacement parts if necessary.

If you need to remove a transistor, I'd highly recommend sacrificing the part by snipping it off on the top side of the board. The leads are best pulled out singly to minimize the risk of lifting pads.

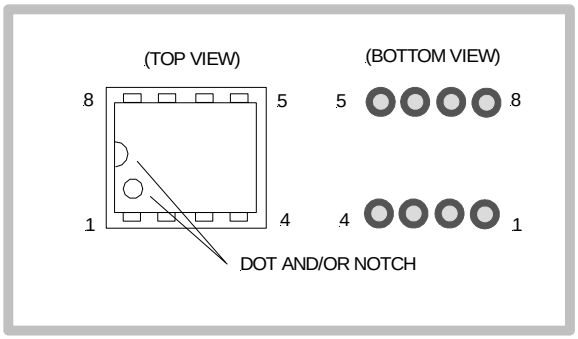
After removing a component from the board, the through-hole will probably still be blocked with solder. Use a dissecting needle or dental probe (explorer), apply heat to the probe and the board trace simultaneously until the tool pushes through. Lacking either of these tools, a round wooden toothpick works well also!

REFERENCE DESIGNATORS:

Each component on the schematic is uniquely identified with a reference designator. Bypass capacitors are identified as C101 and up. Reference designators are shown in blue on the schematic page.

COMPONENT IDENTIFICATION:

- The figure below illustrates pinout for U2 and U3. The "pin 1 at lower left" convention applies to all Dual-Inline-Package (DIP) ICs. **Please note: if you install the sockets backwards- leave them!** In that case, ignore the socket orientation when installing the IC with its dot or notch to the left as shown.



- Resistors and RF chokes

This manual describes the color coding for all resistors and RF chokes. Only the first three bands are described, the fourth band is a tolerance code, typically gold (=5%) for resistors, and is not listed. All resistors are 1/4W 5% carbon film types, RF chokes are also an axial (leads out of each end) component but can be distinguished by their larger size.

- Capacitors:

Disk capacitor [image]
Electrolytic cap [image]
Monolithic cap [image]

Here's the general rule for capacitor nomenclature:

If 3 digits are printed on the capacitor, the first two are significant figures and the third is a multiplier.

Examples:
'471' = 47 x 10^1 = 470 pF
'103' = 10 x 10^3 = 10,000 pF = .01 uF
Letter suffixes: J=5%, K=10%, M=20%.

Please: If you're looking for a '104' monolithic cap, be sure to inspect <u>both sides</u> of the caps before concluding we gave you the wrong value!

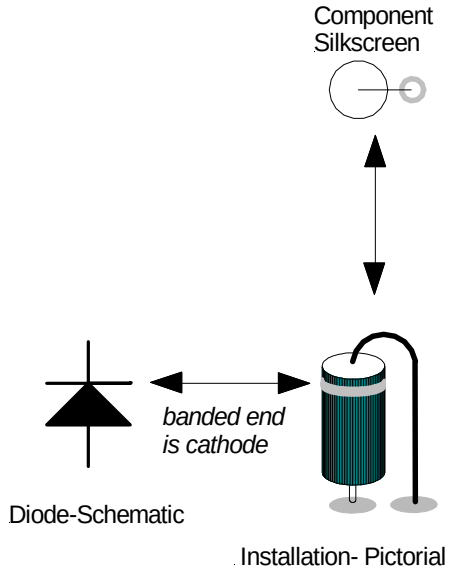
Note: If these parts are supplied with a 0.1" (2.5mm) lead-spacing for installation in a board hole-spacing of 0.2" (5 mm), bend the wire leads gently to spread the spacing . Avoid sharp bends right at the wire-lead exit from the epoxy case; this may cause component damage/failure.

Diodes:

These are provided in a poly bag-strip Since the lettering on these is teeny-weeny teensy-tiny *(thanks, Roseanna*), diodes in each section may be equated by quanity to corresponding entries in the parts list.

- Extra information on components

There's often extraneous information marked on components. Examining a sample IC, I find "MC1458P1 KKJK 8949". You care only about the '1458' or other markings I've specified *If I've specified a capacitor '104' and you find the correct number of parts, but marked "104M', for instance, those are them! "Use the Force, Luke".*



Building instructions:

All parts installed on the PC board should be fully seated unless otherwise noted in the assembly text.

All components are installed on the side with the silkscreen printing- this is the 'top' side of the board.

Static-sensitive Components:

The 2N7000 transistors and the 12C508A IC (U3) are static-sensitive.

- Keep these parts in the antistatic bag until you're ready to install them and handle them no more than necessary.

- Ideally, you've got a grounded-tip iron, but if not- After the part is installed on the board and before soldering, touch the iron tip to shack ground (if available) or to a PC-board ground point.

- Avoid placing these components on paper.

- Diode Installation:

Some of the diodes are bent for "upright" installation on the board. Installation polarity is as shown below. Be sure to note the orientation of the silkscreened circle on the board and install the diode body over this hole. The cathode (banded) end of the diode is oriented at the top. For diodes which are installed 'lying down', match the banded end to that shown on the silkscreen.

- Resistor installation:

Most resistors are likewise installed in 'hairpin' fashion. As with the diodes, try to match the mounting orientation shown on the drawing. (If mounted as shown you've got better troubleshooting access to circuit points from the top side of the board.) Orientation of color bands on resistors and other nonpolar devices is not critical.

- Installing IC sockets:

The "notch" or dot at one end should be oriented as shown in the pictorial drawings. Doublecheck orientation before soldering. *A suggestion*- solder down two opposite corners of each socket, and then go back and press a fingertip on the socket from underneath while reheating both connections in turn. You may then solder the remaining pads. This precaution ensures that the socket is well-seated on the PC board.

Before the "Smoke Test":

Inspect your work to ensure there are no solder bridges or unsoldered joints. Check to see that the ICs are mounted in their proper orientations, or install them if you haven't already done so

You may want to hook up the Rock-mite and test it out on the bench before putting it into an enclosure. *"Do you feel lucky today, punk?"* You'll save yourself a bunch of disassembly work if you need to get at the board for troubleshooting.

Rock-mite Mechanical Details:

The board itself may be mounted in an enclosure at the board's four corners, using #4 machine screw hardware. #4 spacers should be used to separate the PC board from the enclosure by 1/8" or more. (#4 hex nuts are an acceptable substitute for spacers.)

The mounting holes are in the form of a rectangle with the hole center spacing measuring 2.20" by 1.70". *If you have the enclosure in hand before populating the board with parts, it's helpful to lay the blank board down in the enclosure in its planned position. Restrain the board with one hand while tracing the hole outlines on the enclosure with a sharp pencil. (See below about center-punching)*

Enclosures:

Enclosures may be found in a variety of styles. Radio Shack offers several types of metallic enclosures. I'd especially recommend Hosfelt Electronics, Inc., who carry enclosures offered by a number of companies. There's no minimum order, and they can be reached at [800] 524-6464 for a catalog. The 'LMB' line of enclosures is offered by many mail-order companies and pricing is economical. Ten-Tec, Inc. also offers a complete line of enclosures, and they support small orders as well! Call [800] 231-8842 for information.

Metalworking tips:

Plan all enclosure hole placements carefully! You won't enjoy discovering an interference between a connector and one or more on-board-components.

Mark all holes with a center punch (or even a sharp nail) before drilling. Nothing says '*klutz*' like power-drill marks skittering across an enclosure surface! The punched indent gives the drill a slip-resistant starting point.

Trim ragged edges on the drill holes with a knife. This may also be done neatly with a sharp oversized (~3/8") drill. *Careful- you want to chamfer the hole edge, not drill clear through!*

If you're interested in a distinctive custom enclosure for your Rock-mite, check out the 'MityBox' offered by American Morse. *It's a work of art!*

http://americanmorse.com

'Low-budget' enclosures:

The QRP community has embraced the ubiquitious (at least in the US) Altoids mint tins as a enclosure for small projects, and the Rock-mite is 'Altoids-compatible'. You can't beat the price on these, and the rig smells nice when you're done! *If you're using one of these, be aware that the metal is prone to tearing because it's so thin. Be sure to use a wooden backing-block when drilling through this material. If you prefer, small holes made be enlarged by working carefully with a round ('rat-tail') file.*

Connectors and controls:

Here are some recommended part numbers for connectors and controls. *Feel free to substitute.*

AF (headphone) and Key jacks:
3.5mm 3-conductor (stereo) jack: Mouser # **161-3402**

Antenna jack- BNC bulkhead : Mouser # **161-9323**

Power jack: Mouser # **163-4304**

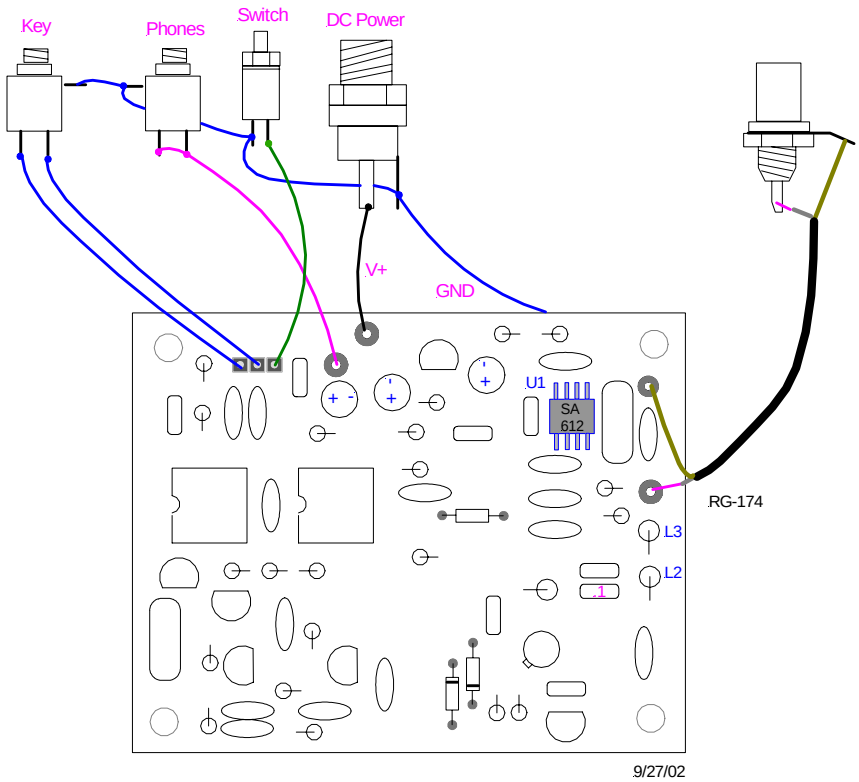
(mating) power plug: Mouser # **1710-2131**

switch: *)* Mouser # **10PA019**

gain pot: (optional- audio) Mouser # **31JN601**

Mouser Electronics- Orders/Catalogs: 800-346-6873
(Equivalent parts may be available from Radio Shack).

Note: Connectors and controls for the Rock-mite are not provided as part of the Rock-mite board kit, nor are they furnished with the 'MityBox'.



Rock-mite hookup- pictorial
Connector placements can vary to suit the builder's enclosure

Design modifications/ things to try:

- **Sidetone**:

  Sidetone level can be altered by changing the value of C8 Note: the 'raspy' nature of the Rock-mite sidetone is due to the square-wave nature of the signal. One or more R-C networks (series-R, shunt-C to ground) in the path [from PIC pin 5 to C8] will soften the tone. A good starting point for this filter is 10 ohms/ 10 uF.

- **Volume control**:

  Changing R5 to a variable resistance provides an audio gain control. [Remove R5 (1M) from the board and wire its two circuit-board pads to a 1 Meg ohm potentiometer- use the pot center terminal and one of the remaining terminals. Keep lead leads short.]

- **Polarity Protection**

  I'd recommend adding a 1N4001 diode in series with the power supply (V+) feed to preclude reverse-polarity mishaps. (*Banded end goes toward the Rock-mite board.)* Or better yet, a 1N5818 Schottky diode for lower voltage drop. Any of the diodes 1N4001-'4007… or '5818-5820 is fine- They're non-critical and all 'overkill' for this application.

- **Reduced Supply voltage**

  The Rock-mite will run on a 9V battery if R1 and R8 are changed from 1K ohms to 470 ohms. This change increases (receiver) current consumption from ~25 mA to 40 mA when using a 12-14V supply.

Troubleshooting the Rock-mite:

The "bugs" you're most likely to encounter often turn out to be caused by the simplest of problems. If your "Rock-mite doesn't play, here are some general troubleshooting guidelines.

General guidelines:

Check once more for solder bridges and missing solder joints. Probing a suspect section of the circuitry with a fingertip or insulated tool will sometimes bring a stubborn circuit to life- if so, check again for a bad connection!

Of the problems I see, about 85% of the problems are caused by cold solder joints, 5% by solder bridges and 5% due to incorrect resistor installation. That leaves only 5% for all the other problems put together. Enough said!

- Ensure that the ICs are installed in the correct location and with the right orientation.

- Likewise ensure that the transistors and all diodes are installed with the correct orientation.

Receiver troubleshooting: (*power applied*)

Remove key/keyer input plug before proceeding

1) Verify that the following DC voltages (use a multimeter set to 'DC volts' are present on U2 as shown below. Expect up to 20% variation in your results- we're looking for things that are broken, and they'll clearly deviate from the given values.

U3 (PIC12C508A)

Pin #	Voltage	
1	4.7 or 5.1V	lower left (topside of board)
2	0V	
3	0V or ~5V	* should alternate with each tap of the switch.
4	~5V	
5	0V	
6	~5V	
7	~5V	
8	0V	

If pins 4, 6 and 7 are not at ~5V, make sure their connections to the key/keyer jack and the switch are not inadvertantly grounded. **You must use a normally-open switch (contact is closed only when depressed).**

2) Verify that the following DC voltages (use a multimeter set to 'DC volts' are present on U2's pins as shown below.

U2 (LM1458)

Pin #	Voltage	
1	don't care	/ lower left (topside)
2	don't care	
3	don't care	
4	0v	
5	4-5V	
6	4-5V	
7	4-5V	
8	12v	/upper left (topside

If pin 8 does not show a DC voltage roughly equal to the DC supply voltage, either DC voltage is not getting to the board (doublecheck the path) or R6 is incorrect value/ open connection.

Pin 5 gets its DC voltage from pin 4 of U1 through resistive voltage divider R3/R4. If this is absent, U2 pins 6 and 7 will also be wrong values. (See 'U1' in that case)

If pin 5 is OK but pins 6, 7 are wrong, doublecheck the continuity (power off, meter on 'ohms') between pins 6 and 7. It should be 1 megohm (or variable between 0 and 1M if you've installed an optional AF gain pot.)

U1: Verify that the following DC voltages (use a multimeter set to 'DC volts') are present on U1 as shown below. **Note***: it may be more convenient to touch the meter probe to a circuit point directly connected to the IC pins (they're tiny)*

Pin #	Voltage	
1	1.4V	/ lower left (top side of board)
2	1.4V	
3	0V	
4	4-5V	
5	4-5V	
6	4-5V	
7	4-5V	
8	5.1 or 6V	/upper left

/ *Trouble spots*:

Since U1 is an SMT device and perhaps unfamiliar to many builders, it's worth noting that an open connection between an IC pin and corresponding board pad accounts for most problems. It may be helpful to

probe directly on the IC pin- its DC reading must match that of the reading taken on the associated PC-board trace. Inspect closely for solder bridges and remove with solder-wick as needed. If in doubt, retouch the solder connections to this IC and wick as needed.

No receiver audio?- *read on…*

1) Using a small screwdriver tip, probe U2 pin 6. You should hear a distinct hum in the headphones.

No joy?

- open connection between U2-7 and headphone jack
- headphone jack incorrectly wired/shorted to ground
- Q1 failed. This may be tested by temporarily adding a jumper between the two end pads for Q1- this closes the connection and should allow full audio through to the headphone jack.

2) Using a small screwdriver tip, probe U1 pin 2. You should hear distinct shortwave noises (possibly voices) in the headphones.

No joy?

- See the 'Local Oscillator' section below
- make sure the DC voltages above are correct
- read and heed the note about 'trouble spots'

3) Receiver- *other*

- If touching pin 2 of U1 yields shortwave sounds but touching the junction of D1,D2 yields nothing, look for an open connection around Y1 or a short to ground or misplaced component around D1/D2.

  Check DC continuity on L2 and L3- this is done "in-curcuit" with a meter set to 'ohms' and power removed from the board. These devices should read several ohms or less. **Rockmite-20 builders**: *Check L2/L3 color codes closely- a limited number of kits went out with incorrect values for L2, L3.*

  -"When I unplug the key, the rig starts transmitting"

  You used a closed-circuit type jack. *You chose... poorly.* You need a 3-conductor stereo jack, or if using a monaural connector- an open-circuit type.

Local Oscillator:

The local oscillator runs continously. Troubleshooting verifies correct DC biases at transistor Q4 and checks for oscillator function

DC voltages: check DC voltages at the follow locations:

Q4-C (upper end- or lower end of C108): 12V
Q4-B (middle lead or R12 lead): 3-5 V
Q4-E (lower end) 3-5 V

These last two readings may vary considerably due the presence of RF on the oscillator stage. Your meter may also indicate AC values, but the results are not trustworthy- your meter is not designed for accurate interpretation of RF signals.

You should be able to hear the Rock-mite's local oscillator by tuning another ham-band rig close to the Rock-mite's operating frequency. If not, and the DC voltages above are OK, suspect the connections to Y2, C10,C11 and D6.

Note: The local oscillator frequency shifts ~700 Hz between 'transmit' and 'receive'. You should be able to hear this shift in the other ham-band rig. If not, ensure that the network comprising Q2, D5 and related resistors are providing a voltage shift between 0V and the rated Zener (D5) voltage. This voltage should change between those two values with each tap of the switch and also with each dot or dash being sent.

Transmitter troubleshooting-

Add a key/keyer paddles and make measurements in the key-down state. One of the two following statements should be true:

/If a straight key is in use, either pin 6 or pin 7 is grounded and the other pin swings from ~5V(key-up) to 0V (keydown).

(or)

/ If a keyer paddle is in use, either pin 6 or pin 7 is at 5V and the other pin swings from ~5V(key-up) to 0V (keydown). If both inputs are grounded simultaneously, U3 generates an alternating stream of dots and dashes at pin 2.

(*continued*)

Voltages at U3 (PIC12C508A)

Pin #	Voltage
1	4.7 or 5.1V / lower left (topside)
2	0V (key-up 5V (keydown- straight key mode) *or* key-down in keyer mode: alternating 0V/5V
3	0V or ~5V * should alternate with each tap of the switch. This pin alternates between 0V and 5V in time with the voltage on pin 2. It may be either high (5V) or low (0V) during key-up depending on whether or not you've tapped the 'switch' to change frequency.
4	~5V switch 'open'/ 0V switch 'closed'
5	2.5V (keydown) This pin ('sidetone') rests at 0V during key-up and provides an 800 Hz 5V p-p waveform during key-down.
6	~5V key-up/ 0V key-down
7	~5V key-up/ 0V key-down
8	0V

Driver (Q5) Integrity:
Check the key-down DC voltages on Q5:

Q5-E (R17 lead): ~0V
Q5-B (R15 lead) ~3-5V
Q5-C (R16 lead) ~10V

In the key-up state, the above points will measure in the 8-12V range. If the U3 voltages are OK but no change to the lower voltages listed above, suspect Q3 (2N7000)- shorting C110 temporarily to ground will test this theory and should allow proper readings at Q5.

PA (Q6) Integrity:
Check the key-down DC voltages on Q6:

Q6-E (R18 lead): ~0V
Q6-B (D8-banded end) ~1V
Q6-C (transistor case) ~5-10V*

*If the rig is working normally, the reading at the collector will be somewhat indeterminate because of the large RF signal present there.

~12V means the supply voltage is gettting to Q6 but the're no RF drive signal getting to the base.

No voltage getting to Q6? Check DC continuity on inductor L1.

Low or no RF output:

- Check DC continuity on inductors L2 and L3. Doublecheck the component color-codes carefully per the values given in the parts list.

- Check for correct values of capacitors installed at C15,C16 and C17.

- Check integrity of connection to antenna jack.

- Open connection to antenna jack.

Other troubleshooting issues:

AC Hum-

- Make sure Y2's case is grounded.

- The Rock-mite has a lot of audio gain. You may experience difficulty when using an unregulated power supply or 'wall-wart' to power the rig. A regulated supply will help considerably in this regard. If in doubt- try a battery supply- you may use a 9V battery temporarily to check out the difference.

'Howl' in headphones

(Make sure you're not in straight-key mode with the key-down- that'd be the sidetone.)

The combination of high audio gain and wire lead treatments can yield an audio oscillation or 'howl', although this has not been reported often. The following guidelines apply:

- If using a battery supply, make sure it's reasonably well charged. A nearly-exhausted battery may cause 'howl' or 'motorboating'.

- provide separation between wires run to and from the Rockmite board and the board components- close lead proximity affords more chances for unwanted signal crosstalk

- where wires do need to cross, keep them at right angles to one another to minimize the coupling

- don't count on the enclosure itself to provide ground -return continuity. It may be helpful to run a ground- return wire from the board to the headphone jack ground lug and from there to the DC power return. If you do this, continue to use a wire from board ground to the main DC power return. {You want to avoid conditions where one circuit path is carrying both audio and DC ground currents, and for that matter, RF as well.

- The Rockmite kit includes a length of RG-174 coax. Ensure that the ground braid is used- connect the rig end to a convenient ground point near the 'Antenna' pad and that the other end makes connection to the antenna jack ground lug.

Broadcast pickup:

There are two potential issues with the Rock-mite:

Shortwave broadcast:

This will be more likely during the evening hours. Despite the presence of the front-end crystal filter, some SWBC may occasionally be heard. A fix involves reducing the signal levels getting to U1- see the second recommended gain-control modification (page 6). The use of an antenna tuner will also assist in reducing the out-of-band RF energy getting to U1.

Local AM broadcast:

This is more likely during daylight hours when local AM stations are on the air. Install a 1K resistor at the two unused pads immediately below D1/D2. Note: this fix does not help with shortwave broadcast. [*This unwanted pickup was not evidenced at my QTH, nor with early Rockmite samples. The fix was tested successfully at the ARRL lab, located within two miles of several 5KW AM broadcast stations.*]

Very low volume:

This is a minimalist transceiver, so it won't provide ear-splitting volume. Even so, with a good antenna and headphones you should have little trouble hearing signals. If everything else checks out, consider the following:

Antenna: This'll be a resonant antenna, 50 ohms nominal. The most familiar example of this is a coax-fed dipole. If the antenna is non-resonant (random wire, etc), a tuner is typically used to make the antenna 'look like' 50 ohms at the rig. SWR's not especially critical here. *The worst that could happen is the loss of a $0.40 transistor (Q6).*

Headphones- This is a low-impedance stereo type, such as are widely available for personal CD players. These are available in a variety of pricetags from $2-up. You generally 'get what you pay for'- avoid the cheapest ones. $8-10 gets you a decent pair, and if there are specifications on the package, look for a sensitivity spec of 104 dB/mW or better.

And a final caution related to audio output: You'd be surprised how often that reports of very low audio are traced to use of incorrect audio jack or plug types- you won't hear much with the audio output shorted to ground!

"Strange but True"- In general, the ICs themselves shouldn't be prime suspects during the troubleshooting process. Despite their complexity, they're very reliable, and I've had to replace these parts at the rate of only 1 for every thousand or so shipped!

- You may contact me for parts replacement or with questions::

  Dave Benson, K1SWL
  e-mail: dave@smallwonderlabs.com

Factory troubleshooting is not available for the Rock-mite. *Let's get real- this is a $25 transceiver, and we just can't economically repair it.*