

# Akitika



## ***1 kHz Oscillator ASSEMBLY MANUAL***

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## **Section 1: About This Manual**

This manual gives the information needed to build and use Akitika's 1 kHz oscillator. The oscillator is very useful as a source for signal tracing. Signal tracing is a powerful technique used to locate the problem in sound reproducing equipment. A signal is placed at the input of the equipment under test (EUT), and its progress is traced through the equipment.

The quickest way to locate the problem is by looking for the signal halfway between the signal source and the desired output. If the signal looks ok halfway through the EUT, then the problem is between the halfway point and the desired output point. If the signal is bad at the halfway point, then the problem is between the source and the halfway point.

In this fashion, you can continue to narrow down the location of the problem. This should lead you to the area of the failed components.

### ***Who Should Attempt this Project?***

You can build this kit if you can:

1. Solder (using normal rosin core solder and a soldering iron).
2. Use simple hand tools like screwdrivers, wire cutters, and pliers.
3. Read and follow directions.

It helps if you:

1. know a bit about electronics, or
2. have a friend who knows a bit about electronics
3. can get to YouTube to watch a few helpful videos about the assembly process (none are posted as of this version of the manual).

### ***Tools you'll need***

You'll need the following tools:

1. Phillips screwdriver (#1 and #2)
2. needle nose pliers (helpful, but not strictly necessary)
3. pencil type soldering iron of 25 to 50 Watts (no huge honking soldering guns or blowtorches)
4. wire cutters and strippers
5. multi-meter to confirm resistor values (strongly recommended)!

### ***Helpful Tools***

These tools aren't strictly necessary, but make building the kit easier.

1. Magnifying glass, if you're over 42!
2. Lead bending jig to form axial component leads to the correct span for insertion in the PCB (nice to have, but certainly not necessary).

### ***Project Overview***

The project consists of the following steps:

1. Building the circuit board.

2. Installing the circuit board in the housing (if you have purchased the housing).
3. Testing the oscillator

## ***Specifications***

Number of Outputs: 2

Output Connector: RCA jacks

Output Impedance: 100 Ohms at Full volume, maximum of 2.5K Ohms at half volume

Frequency: 1000 Hz plus or minus 2%

Amplitude: (maximum volume) 1.5 Volts RMS

Distortion: 0.005% in a bandwidth from 100 Hz to 22 kHz ( $Z_{load} > 600$  Ohms)

- 2nd harmonic is -98 dB relative to fundamental (typical)
- 3rd harmonic is -86 dB relative to fundamental
- 4th harmonic is below noise floor
- 5th harmonic is -112 dB relative to fundamental
- no other harmonics are visible
- square root of sum of squares of harmonics yields 0.005% distortion

Power: two 9 volt batteries (not included)

Battery Drain: approximately 10 mA from each battery

## ***Important Safety Notes***

By purchasing, using, or assembling this kit, you have agreed to hold Akitika LLC harmless for any injuries you may receive in its assembly and/or use. To prevent injuries:

- Wear safety glasses when soldering or clipping wires to prevent eye injuries.
- Always unplug the power before working on the equipment.
- Large capacitors hold lots of energy for a long time. Before you put your hands into the equipment:
  - Pull the AC plug!
  - Wait 2 full minutes for the capacitors to discharge!
- Remove jewelry and rings from your hands and wrists, or anything that might dangle into the amplifier.
- If working on the equipment with the power on, keep one hand in your pocket, especially if you're near the power supply or power supply wires. This can prevent serious shocks.
- Build with a buddy nearby. If you've ignored all the previous advice, they can dial 911 or get you to the hospital.
- Read and understand the safety manuals of all the tools you use.

## ***About Components***

We reserve the right to make design and/or component changes at any time without prior notification.

### ***Recommended Solder***

The kit must be assembled with 60/40 Rosin Core solder. The recommended diameter is 0.032 inches. Among many such sources of solder, I have used Radio Shack part number 64-009. It contains 8 oz. of solder, which is much more than you'll need to assemble the kit.

### ***Warranty***

With the exception of fuses, Akitika will replace for free any parts of a correctly assembled kit that fail within one year of the date of purchase when the equipment has been used in home stereo applications. It is the responsibility of the kit builder to install the replacement part(s). This warranty applies to the original purchaser only. It does not apply to units that have been physically or electrically abused, modified without prior factory authorization, or assembled with other than 60/40 Rosin Core solder. Akitika LLC's liability shall in no event exceed the cost paid to Akitika LLC for the kit.

## Section 2: About Building the Kit

Yes, I know you want to ignore this section, and jump right into building the kit. However, please ***take a minute and read the advice of this section.*** I've condensed it into bullets so that even you guys who are in a hurry can benefit.

- There is only 1 PCB to build:
- Stop any time you're feeling confused, tired, or anxious. Taking breaks at those strategic times will keep the build enjoyable and greatly enhance your chances of first-time success.
- A soup bowl is your friend. Before you build a board, *carefully* empty the parts into a broad, flat, light colored soup bowl. That makes it easy to find the parts, and keeps them from getting lost.
- A digital ohm-meter is an easy way to make sure that you've picked the right resistor. It's a great cross-check on the resistor color code. Measure twice and solder once!
- A lead-bending jig can make for quicker, neater assembly. It's certainly not necessary.
- Is something in this manual confusing? Does something look wrong? Send your questions by email to [dan@akitika.com](mailto:dan@akitika.com). You'll help yourself and everyone who builds the kit.

## Section 3: Building the PCB

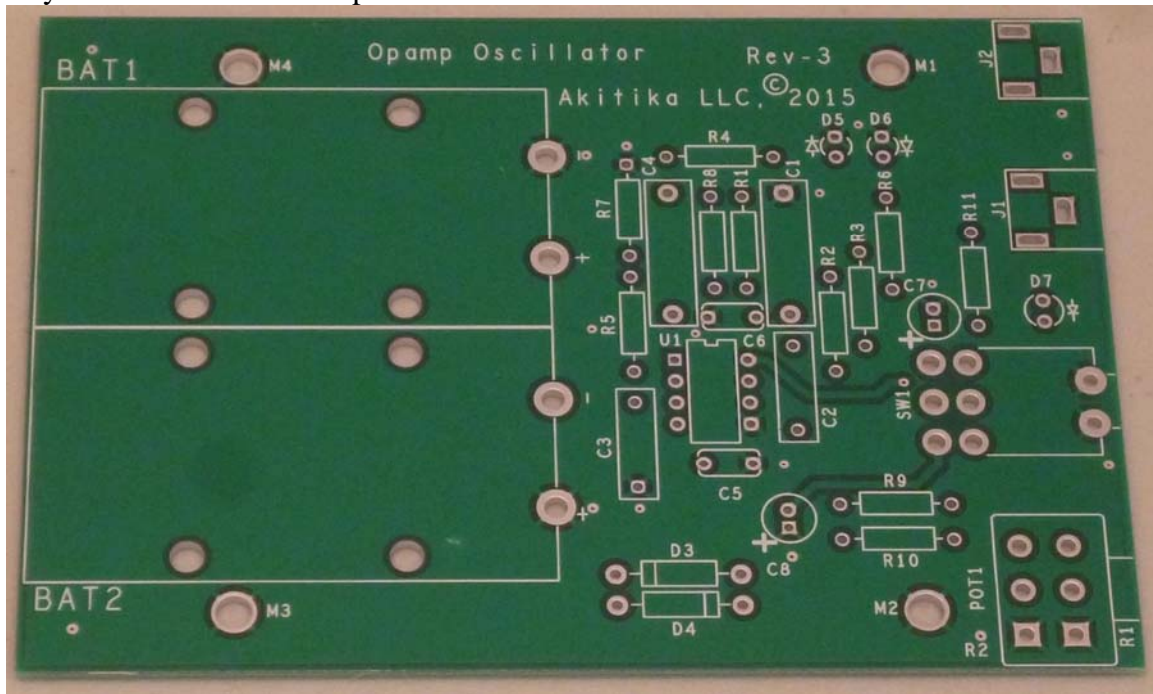
This section details the process of building the circuit board. Begin by *carefully* emptying the contents of the envelope into a broad soup bowl, as shown below. This makes it easy for you to find the components, and much less likely that they will get lost on the floor.



**Figure 1-Empty the power supply components into a soup bowl**

## Component Order

In general, you'll start with the components that lay closest to the board, working your way towards the taller components.



**Figure 2-Component side of oscillator PCB before loading**

You'll notice that the component designations in the directions don't go exactly in order. We have grouped them so that all components with the same value appear together. This makes assembly easier. You'll find in the parts kit that similar parts, e.g. 3 1K resistors, are typically (though not always) taped together.

## Install the Resistors

In general, you install axial leaded components (like the resistors) by placing the body on the silk screen side of the board, and the leads through the indicated holes. Bend the leads over on the back of the board to keep the resistors from falling out until your solder them in place. Try to bend the leads in a direction that won't lead to solder bridges between traces that should remain disconnected.

We recommend the following procedure:

1. Insert all components of the same value or type
2. Bend the leads as described above.
3. Solder the leads on the back of the board.
4. Clip the leads.

Track your progress by placing a check-mark in the done column as you install each component.

Bend resistor leads to 0.45" width			
Designation	Value	Color Code	Done ✓
R10	100	Brown, Black, Black, Black, Brown	
R9	100	Brown, Black, Black, Black, Brown	
R4	140K	Brown, Yellow, Black, Orange, Brown	
R1	15K8	Brown, Green, Gray, Red, Brown	
R2	15K8	Brown, Green, Gray, Red, Brown	
R3	15K8	Brown, Green, Gray, Red, Brown	
R5	15K8	Brown, Green, Gray, Red, Brown	
R8	15K8	Brown, Green, Gray, Red, Brown	
R7	17K8	Brown, Violet, Gray, Red, Brown	
R11	4K99	Yellow, White, White, Brown, Brown	
R6	4K99	Yellow, White, White, Brown, Brown	

### ***Install the Diodes***

Diodes are polarized. Be careful that when you install the diode that the banded end of the diode matches the banded end of the silk-screen.

Diodes – Polarity is important! Make sure that the banded ended of the diode matches the banded end of the silk screen			
Use 0.45" spacing for lead-bending jig (optional) for 1N4004 diodes			
Designation	Type	Rating, Marking	Done? (✓)
D3	1N5817	Schottky Diode	
D4	1N5817	Schottky Diode	

### ***Install the Integrated Circuit***

<i>Orientation matters! Watch pin 1 location carefully.</i>			
U1	5532	Dual Opamp	

### ***Install the Light Emitting Diodes (LEDs)***

LEDs are polarized. Anode and Cathode of the T1 body type LED's can be identified in these two ways:

- Cathode (bar symbol) corresponds to the side of the package with the flat.
- Cathode is the shorter of the two leads

Diodes – Polarity is important! Make sure that the flat on the base of the LED matches the bar-shaped feature of the diode symbol.			
Designation	Type	Body type	Done? (✓)
D5	Green LED	T1	
D6	Green LED	T1	

The last LED, D7, is the pilot light that shows the oscillator has been turned on. It will be installed in the final mechanical assembly section.



## Install the non-polarized Capacitors

The capacitors that you install in this section can be installed in either orientation.

Non Polarized Capacitors			
Designation	Value	Rating, Marking	Done? (✓)
C5	0.1 $\mu$ F	0.2" lead spacing, ceramic cap, 10%	
C6	0.1 $\mu$ F	0.2" lead spacing, ceramic cap, 10%	
C2	1 nF	Box cap, film, 1%, marked 1n0F 2K0	
C3	1 nF	Box cap, film, 1%, marked 1n0F 2K0	
C1	100 nF	Box cap, film, 1%, marked $\mu$ 10F	
C4	100 nF	Box cap, film, 1%, marked $\mu$ 10F	

## Install the Polarized Capacitors

It's important to install these caps with the proper polarity. The negative end of the cap is marked with a minus sign. The silk screen on the board marks where the positive end of the cap goes. Make sure that the negative end of the cap is away from the plus sign on the circuit board.

Polarized Capacitors – polarity matters!			
Designation	Value	Rating	Done? (✓)
C7	22 $\mu$ F	50V electrolytic, 0.1" lead spacing, 5 mm dia.	
C8	22 $\mu$ F	50V electrolytic, 0.1" lead spacing, 5 mm dia.	

## Section 4: Final Electrical Assembly and Test

### Install the Battery Holders

Install both battery holders as shown in Figure 3.

- Use #4-40x5/16" Phillips screws and 4-40 keps nuts to fasten the battery holders to the PCB. Use a total of 4 screws and 4 nuts as shown in Figure 3.
- Solder the two electrical contacts for each battery holder on the solder side of the PCB. Clip the tails after soldering.

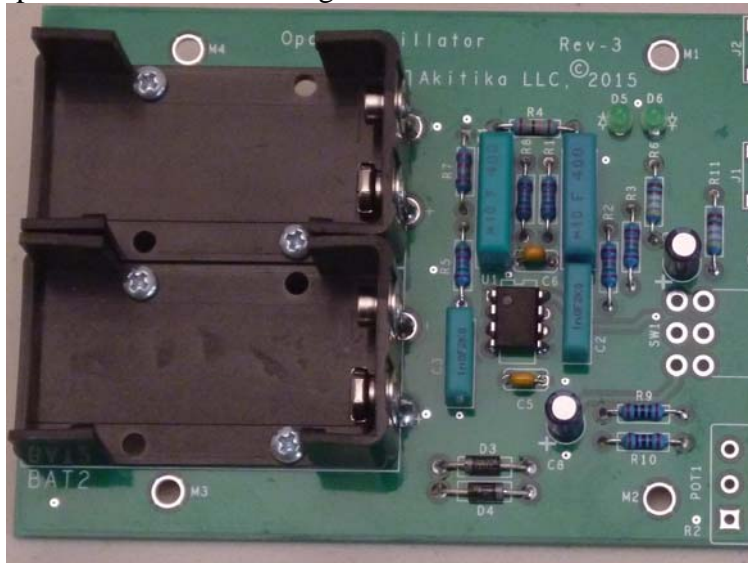
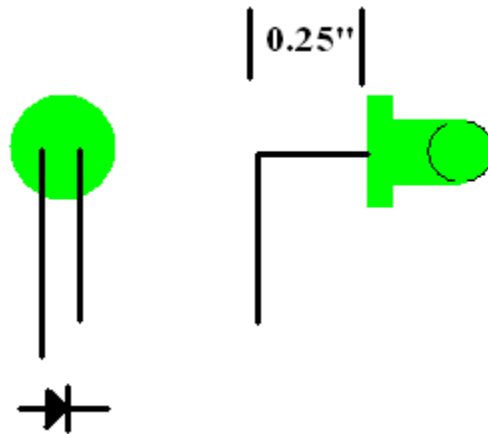


Figure 3-Battery Holder Installation

## ***Front Panel Assembly***

- Insert the RCA jacks to the indicated places, making sure they are also flush against the PCB, then solder them in place.
- Insert the dual 10K volume control to the indicated place, make sure it is level, then solder it in place. Remove the nut and washer (if supplied). They will not be used.
- Insert the toggle switch to the indicated position, flush against the PCB and solder it on the solder side, as usual.
- Bend LED D7's leads as shown in Figure 4. Make sure to watch the orientation of the cathode and anode. Insert the diode into the PCB, but don't solder it yet.
- Slide the front panel in place, sliding the holes over the controls, connectors, and the still unsoldered D7, with the silk-screened side of the front panel facing out.
- Make sure that the LED pokes into its front panel hole and solder the LED in place. It might be better to solder just one lead, then check and adjust its position before soldering the second lead.



**Figure 4-Bending D7's leads**

## ***Assembling the Enclosure***

1. Place the PCB and front panel into the housing bottom, sliding the front panel into the accompanying grooves in the sides of the bottom half of the housing.
2. Install the four short Phillips plastite screws that hold the PCB to the housing bottom.



3. Turn the level control to its counterclockwise stop. Place a finger behind the body of the level control while you push the silver knob onto the splined shaft, lining up the knob indicator at the 7 o'clock position.
4. Install a pair of fresh 9 volt batteries (not supplied). Turn the front panel switch on and off to see the LED illuminate. Leave the front panel switch in the OFF position to save the batteries.
5. Install the back panel by sliding it into the channel in the side of the bottom part of the housing. The lightly textured side should face out.
6. Install the housing top. Note that in one orientation it fits well. In the other orientation, projections from the top and bottom will interfere with proper assembly.
7. Install the two long screws into the bottom of the housing that hold the top in place. The screws cut threads into the post as they are installed, which requires some downward pressure on the screw-driver.
8. Turn the oscillator upside down. Peel the rubber bump-ons from their adhesive backing, and attach them at four corners on the bottom of the enclosure.

### ***Testing the Oscillator***

If you're following the manual closely, the power switch is OFF at this point, and the front panel LED is dark. Turn the power switch on and watch that the LED lights up. Turn the volume control counter-clockwise (minimum output). Connect 1 or both RCA jack outputs to any of the following:

- Oscilloscope
- Power amplifier input.
- High level input on a preamp or integrated amp

Slowly advance the level control and observe or listen to the oscillator output.

### **Section 6: In case of trouble**

Take a break. After you've gained a bit of calm perspective, return to the project. Verify by color-code correct placement of all the resistors. Look closely for unsoldered components, and solder any unsoldered components. Look closely for solder bridges (solder connections that span two points which should be unconnected). Remove the solder bridges. If all of this fails, take well lit, high resolution color pictures of both sides of the PCB and send them to [dan@updatemydynaco.com](mailto:dan@updatemydynaco.com) for trouble-shooting advice.

### **Section 8: About the Oscillator Design**

The goal of this design was to make an easy to build first project that serves a useful purpose. It provides a variable level, dual channel, signal source for both signal tracing and for distortion measurements. Its distortion, while not quite state of the art, is only 50 ppm, or about 0.005%. It puts out 1.5 VRMS, which is sufficient to drive most amplifiers to full output.

The oscillator cascades two relatively high selectivity lowpass filters (Q between 4 and 5). The combination of these two filters lets us use simple non-linear limiting (LED's D5

and D6) to set the output level. 1% resistors and capacitors are used in the filter/oscillator signal path to assure that the two filter sections have the center frequencies aligned.

Two 9 V batteries power the oscillator. D1 and D2 assure that the oscillator isn't damaged if the batteries are inserted backwards. C7 and C8 provide a low impedance for the circuit's power rails at mid-frequencies. C5 and C6 perform that function at high frequencies. R11 and D7 form a pilot light, showing when the power is turned on.

R1, R2, R3, R8, C1, C2, and U1B form an inverting lowpass filter with a gain peak at 1 kHz. R4-R7, C3, C4, and U1A form a non-inverting filter with a gain peak at 1 kHz. Phase shift in those filters caused the feedback taken through R6 to be positive feedback at 1 kHz, enabling oscillator. At DC, the feedback is negative, which assures DC stability for the oscillator.

R9 and R10 isolate U1b's output from capacitive loads, ensuring its stability for all conditions. POT1 is a dual 10K audio taper pot that adjusts the output level for both RCA jack outputs to set a useful level for a wide range of applications.

All the filter capacitors have high linearity dielectrics. This helps assure the low distortion performance of the oscillator.

# Schematics

D1 and D2 are not used in this schematic

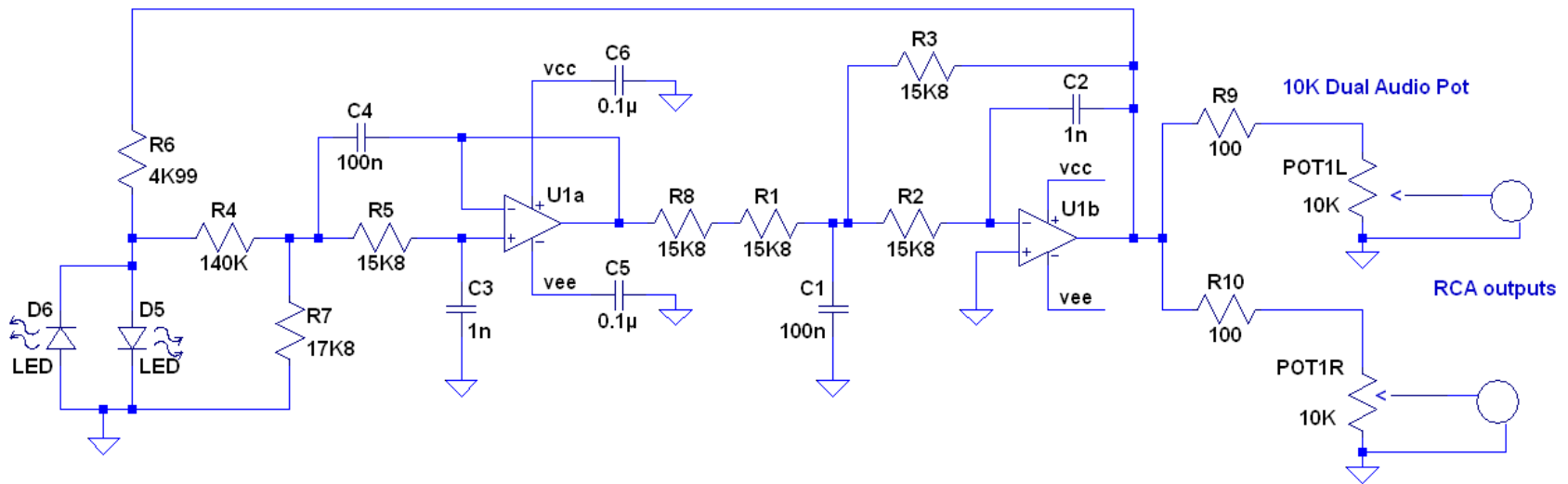
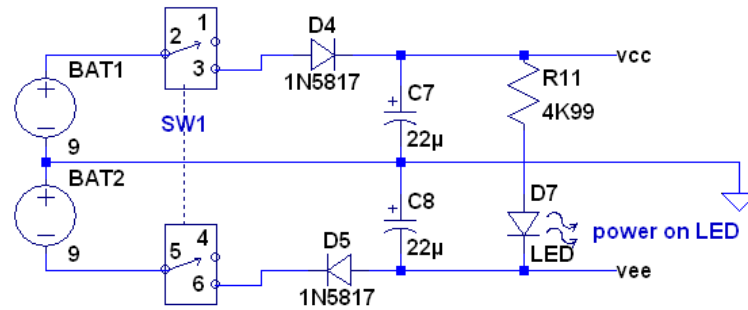


Figure 5-1 kHz Oscillator Schematic