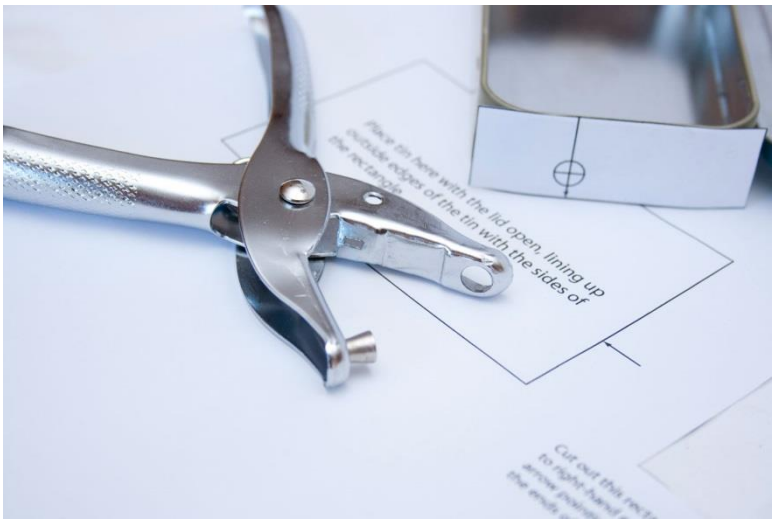
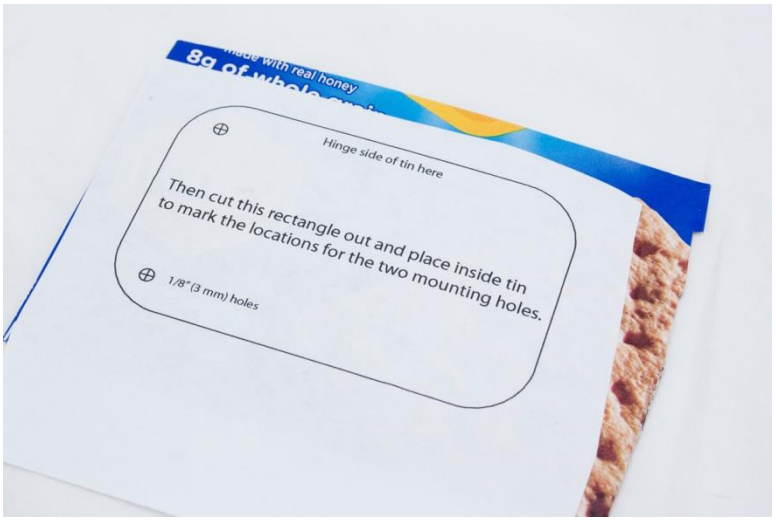
MintySynth Rev. 2.0 Assembly Manual

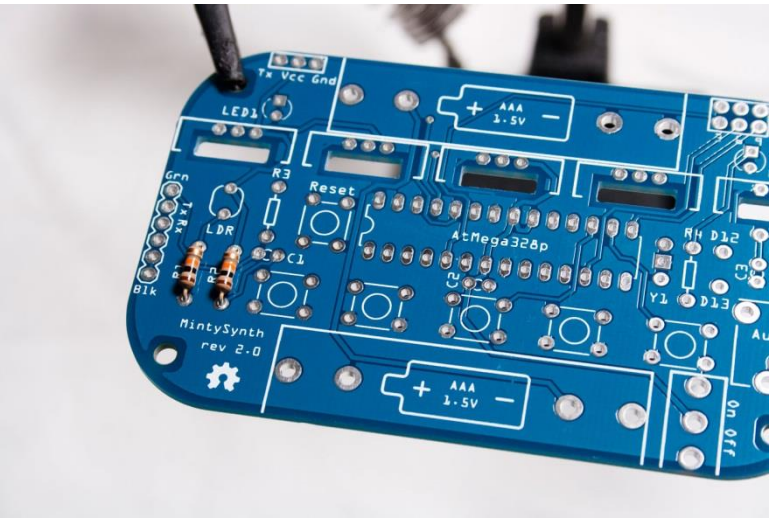
Tools and materials required:

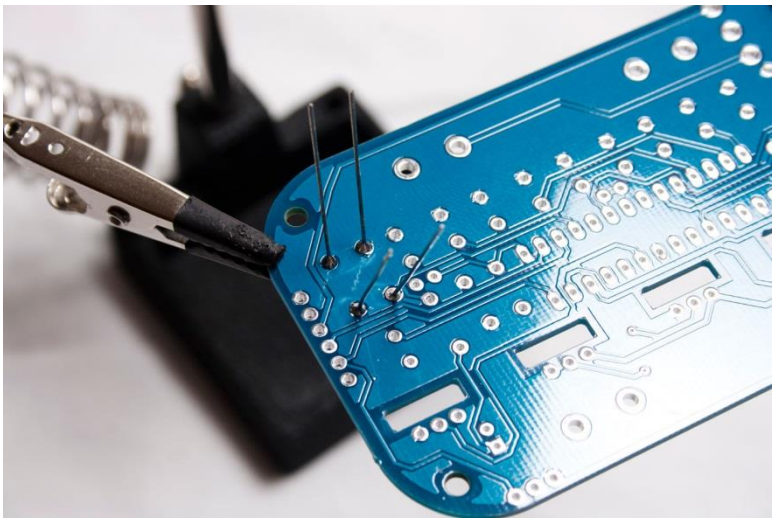
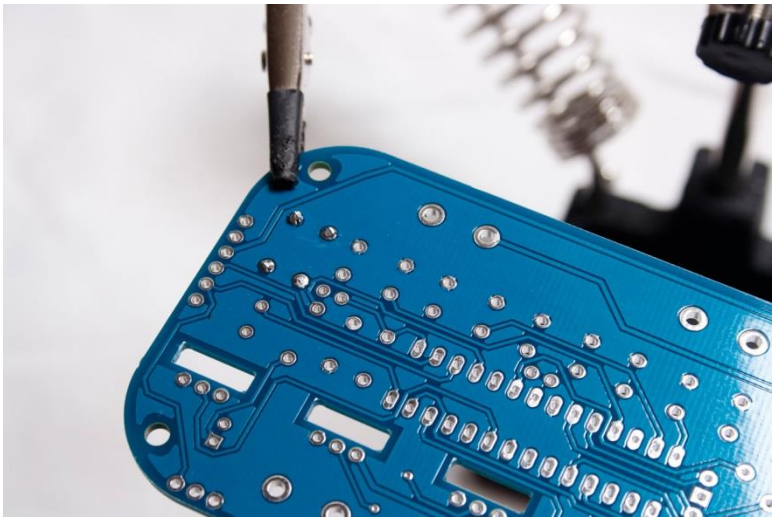
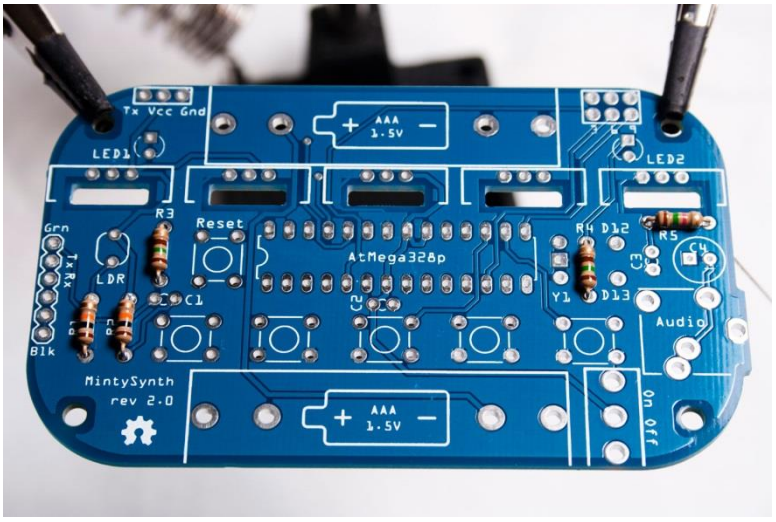
- Soldering iron
- 1/32” solder (leaded solder is easiest to use for beginners)
- End cutters or diagonal cutters
- Small needle-nose pliers are helpful but not necessary
- Paper-hole punch or ¼” drill bit
- 1/8” drill bit and drill
- Small Phillips-head screwdriver
- Mint tin (blank tins are available from Adafruit if you prefer)
- Glue stick, other water-soluble adhesive, or double-sided tape
- Thin cardboard or electrical tape for insulating the bottom of the tin

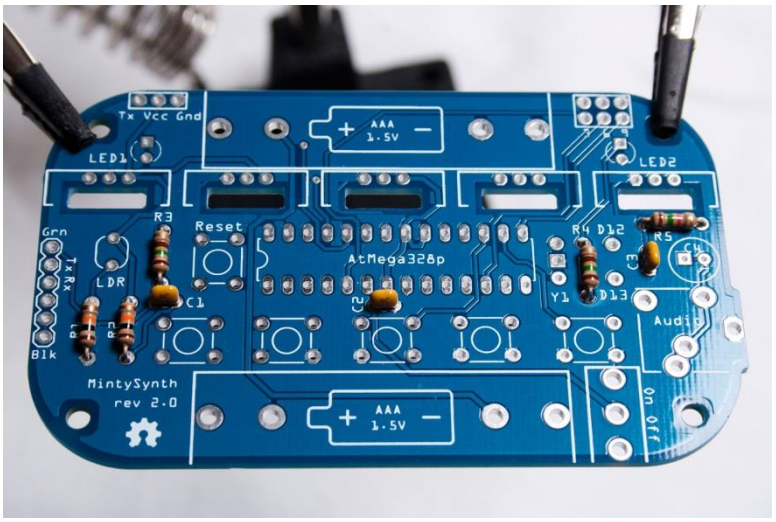
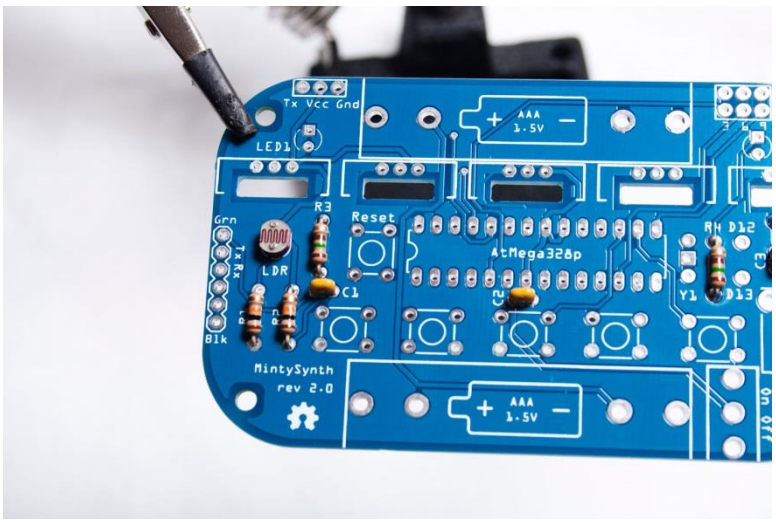
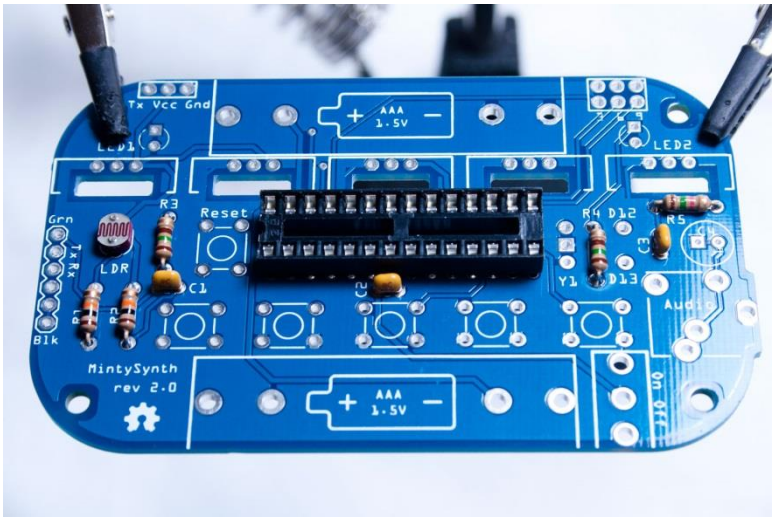
Please open the kit carefully, because there are small parts inside. Check the parts list to make sure that you have all the parts ready before beginning assembly. Note that some small parts such as resistors may get stuck inside the bag.

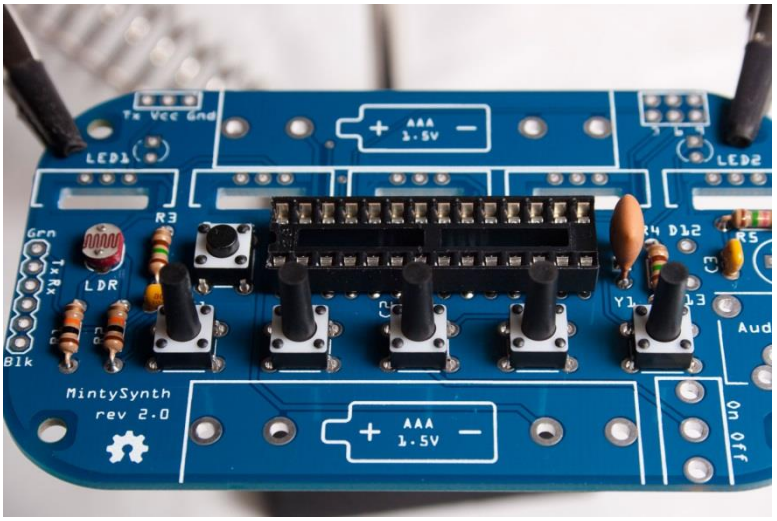
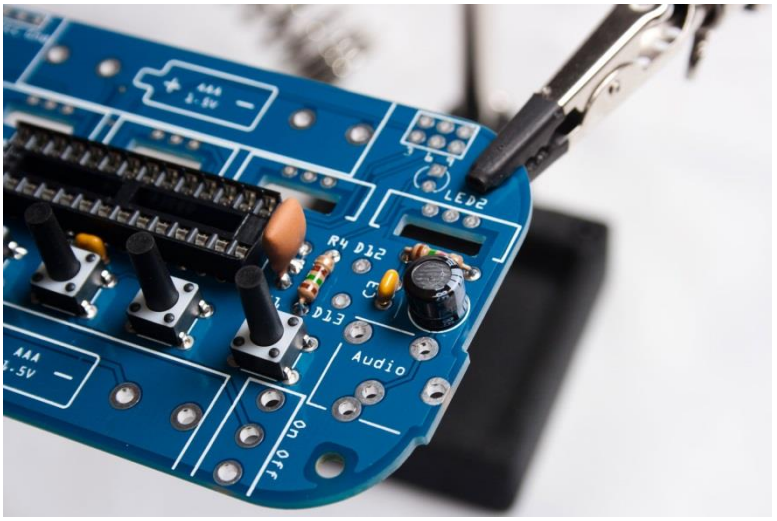
We'll begin by marking the location on the tin for the audio jack hole. Print out the final page of this document, which is the layout diagram. Cut out the small rectangle, then apply a small amount of water-soluble glue (e.g. from a craft glue-stick) or double-sided tape on the right end of the tin. Position the tin in the large rectangle, and stick the small rectangle to the end of the tin as shown, with the two arrows aligned. Make sure the top and bottom edges of the small rectangle are aligned with the top and bottom edges of the tin.	
The easiest way to make the ¼" hole for the audio jack is with a paper-hole punch, which typically costs less than $2. However, the punch may need to be modified to remove the paper guide, as shown, so that it can reach close enough to the bottom of the tin. The guide can often be removed by pulling it out with a pair of pliers. If there's a small tray on the bottom of the punch for collecting "dots", you may have to remove that too (you can usually just pull them off).	
Punching the hole.	

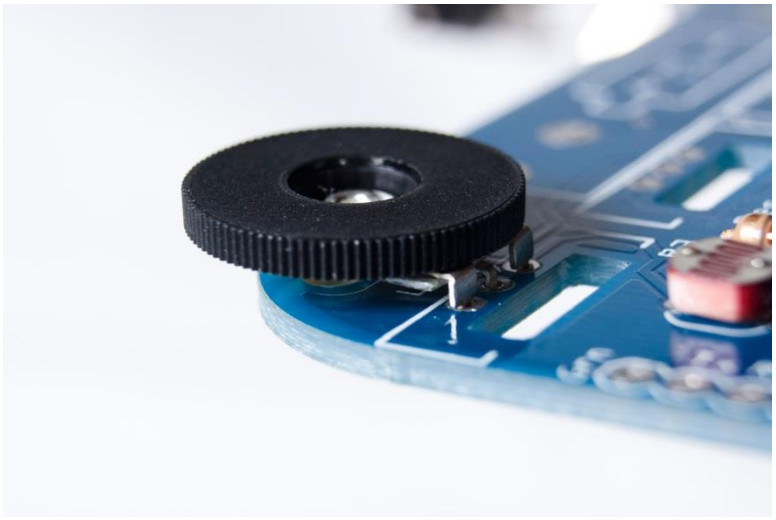
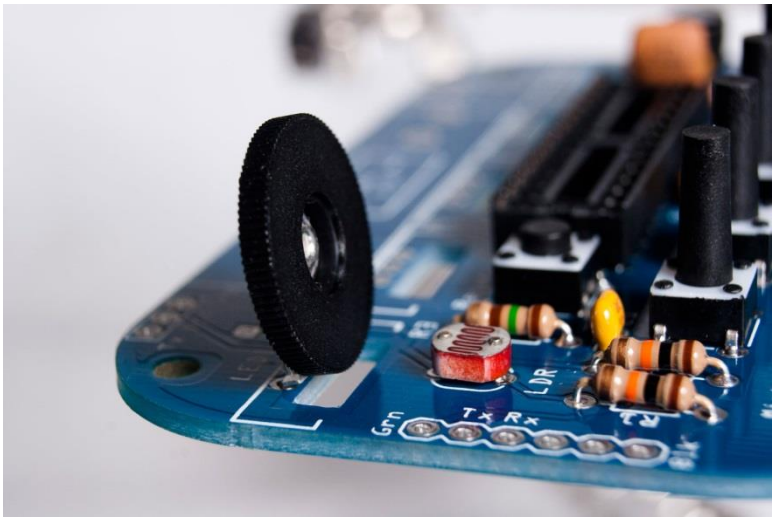
Here's the completed hole. If you prefer to use a drill, a brad-point drill bit is recommended to help minimize deforming the thin metal. Also, it is necessary to put a small block of hardwood under the metal to support it while drilling. Some people recommend filling the tin with water, then freezing it, so the ice will support the metal as you drill. Another option is to start the hole with a small drill bit (~1/8") and enlarge it with needle files or a Dremel tool. Remove the paper, and if necessary wash off any remaining adhesive.	
Next, cut out the rectangle on the lower half of the page and glue it onto the colored side of a sheet of thin cardboard (cereal-box cardboard, etc.). Then cut it out on the outline. The cardboard will serve to insulate the bottom of the PCB from the tin.	
Insert the cardboard/drilling guide into the tin as shown. Place the PCB on a block of hardwood and drill the two mounting holes through the tin with a 1/8" (or 3 mm) drill bit. Begin drilling slowly to keep the drill bit centered on the marks. It's okay if the tin gets deformed slightly around the holes.	

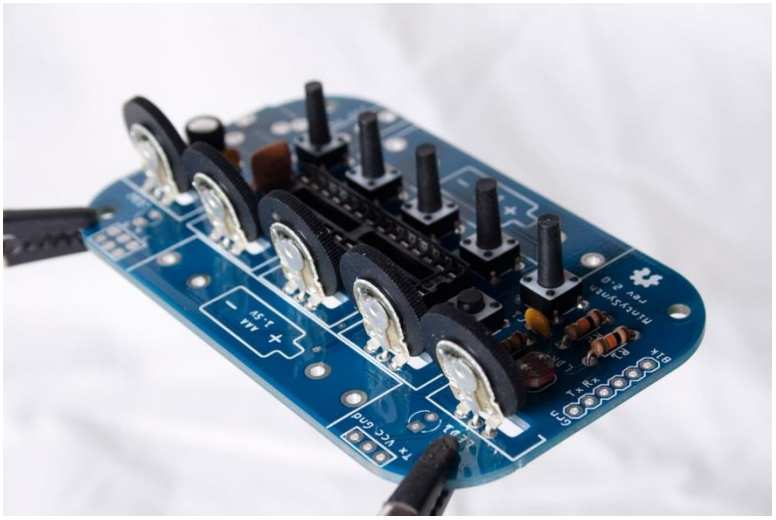
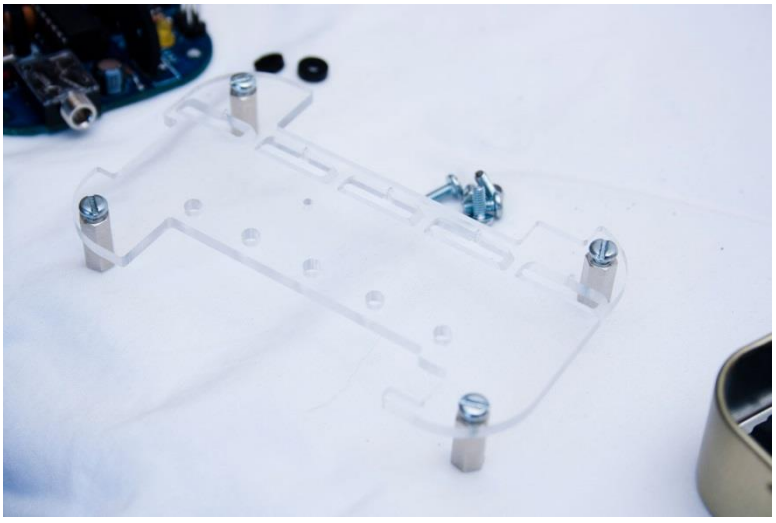
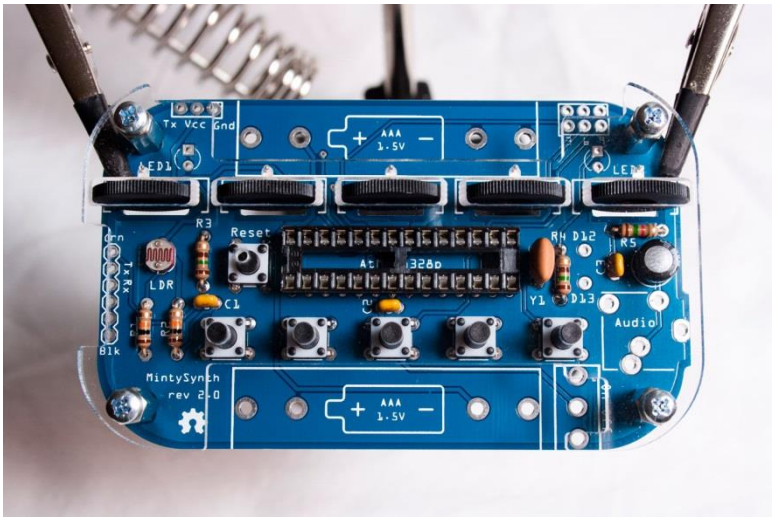
Now, remove the cardboard (you may need to use a toothpick, etc. to hook it by one of the holes and pull it out), turn it over, and put it back in the tin with the plain brown side up. This way the cardboard will be less visible when the device is complete. An alternative is to use electrical tape to insulate the bottom of the tin, but thin cardboard works well and gives a cleaner look.	
Now we're ready to begin soldering. If you're new to through-hole soldering, there are great tutorials available at Adafruit and Sparkfun. The most important thing is to not spend more than a few seconds making a soldering joint, because you may overheat the part. A "helping hand" tool is useful but not essential for holding the PCB while soldering. If you don't have one you can just rest the PCB on a table. In order to hold some of the components in place while soldering, you may need to place a small object under each component to support it, or you may be able to use tape to temporarily hold it in place. We'll begin with resistors R1 and R2 (10 kΩ). Form the resistors into a staple shape and insert them. Resistors are not polarized, so it doesn't matter which way they go. Try to to seat them all the way into the PCB.	

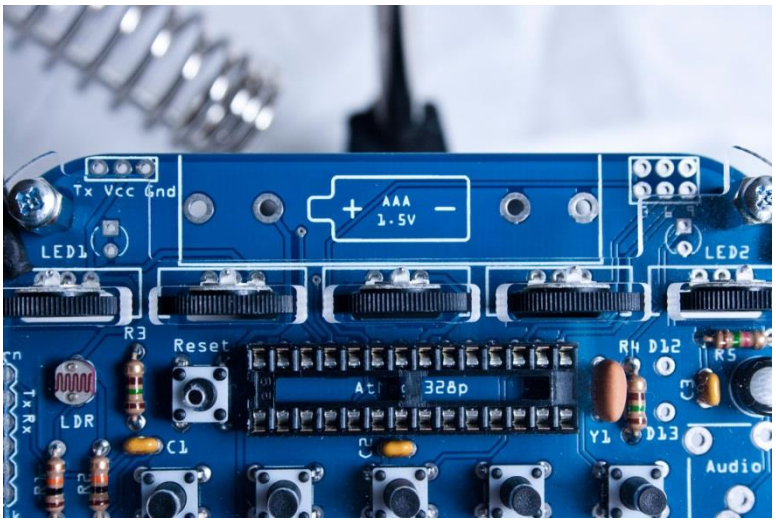
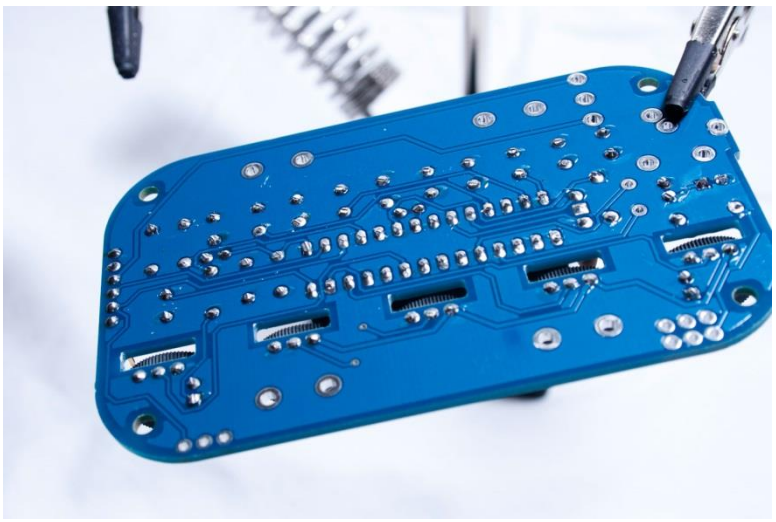
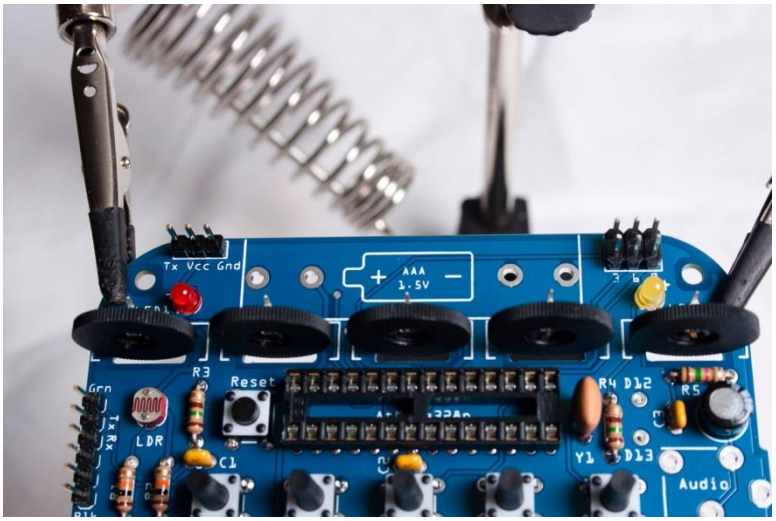
Spreading the leads out on the back of the PCB will hold the resistors in place while you solder them. Solder the leads and clip them off with your end cutters or diagonal cutters. **Note: there will be minimal clearance (~1.5 mm) under the PCB when it is in the tin, so the leads of all the parts need to be clipped close (1 mm or less) to the PCB. This may mean clipping off the top bit of the mound of solder as well, which is fine. We'll insulate the inside of the tin as well, but we want to make sure that none of the leads have a chance of coming into contact with the metal tin.**	
Here you can see the leads clipped close.	
Next you can solder the rest of the resistors in place. R2 and R3 are 150 Ω, and R4 is 1.5 kΩ.	

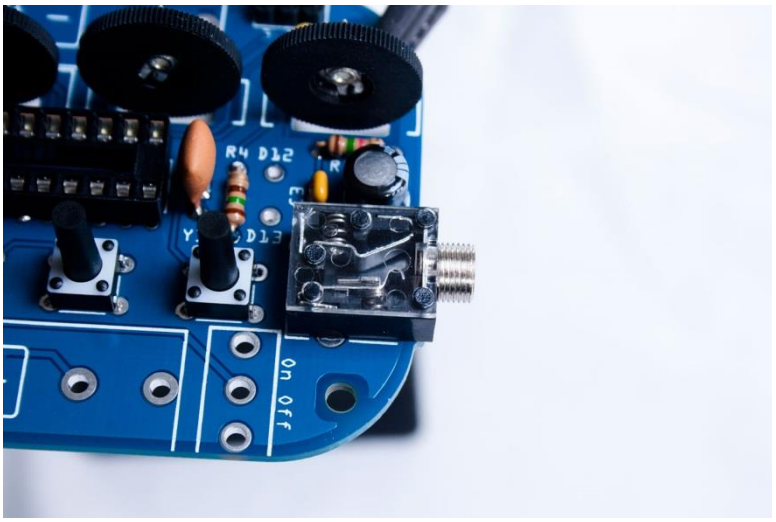
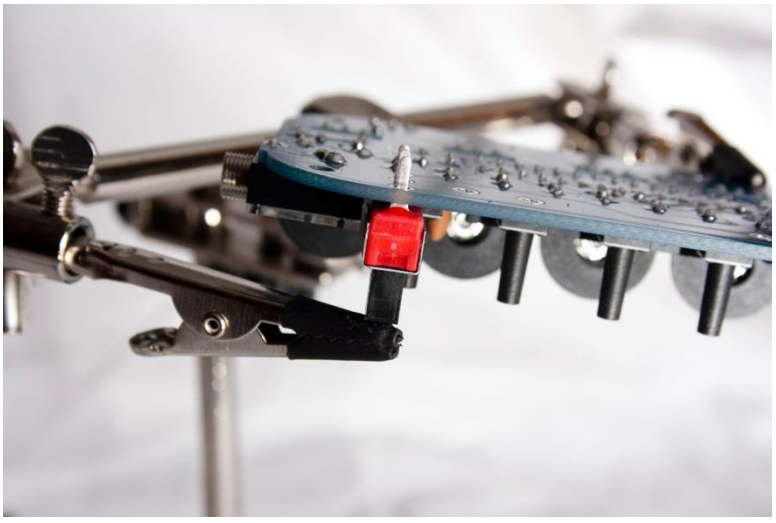
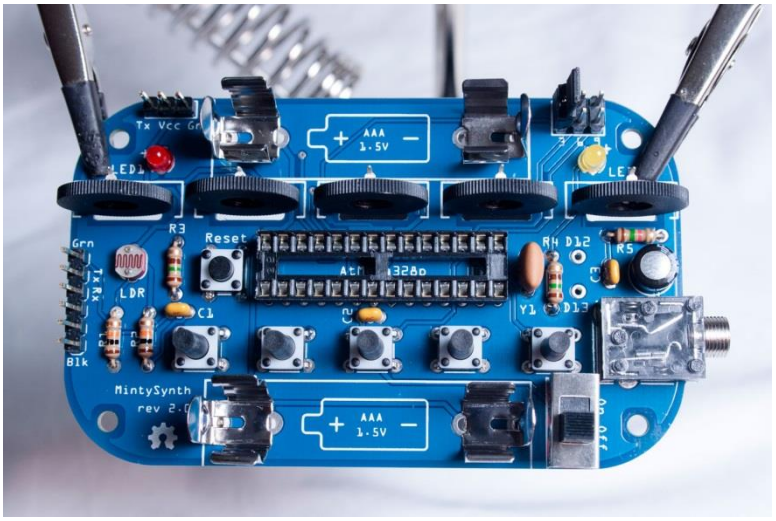
Next we'll add the small yellow ceramic capacitors, C1, C2, and C3. These are all the same, so you don't need to worry about the value. There's also no polarity, so they can go either way. Try to make sure that they are fully seated in the PCB, and sitting vertically. You can bend out the leads on the back to hold them in place, as you did with the resistors.	
Now we'll add the photocell in the same manner, seating it as far as it will go. Again, it doesn't matter which way it goes in. It should hold itself in place while you solder it.	
Next is the socket for the ATmega328. The small notch on one end of the socket should point to the left, as an indicator of which way the microcontroller will go later. You can bend the four corner pins outward to hold it in place while you solder. It helps to solder to corner pins first and then checking to make sure the socket is fully seated before committing to soldering the rest.	

Now add the ceramic oscillator, Y1. Again, there's no polarity, so it can go either way. It helps to have some method of holding it vertical while you solder. Here I've used one of the clips on the helping hand to support it while I solder.	
Now for the six buttons. The reset button is the short one. Note that the reset button is oriented differently from the other five, with the pins pointing to the front and back of the PCB rather than side to side. This should be clear from the spacing of the holes. The buttons snap into place; make sure all four pins are started in their holes and then push the button straight down, using a fingernail on each side of the housing. Solder all the buttons, checking frequently to see that they're all still fully seated, and clip all the leads.	
Now let's add the electrolytic capacitor, C4. This one *is* polarized, so be sure that the gray band on the side of the capacitor points to the edge of the PCB, as shown.	

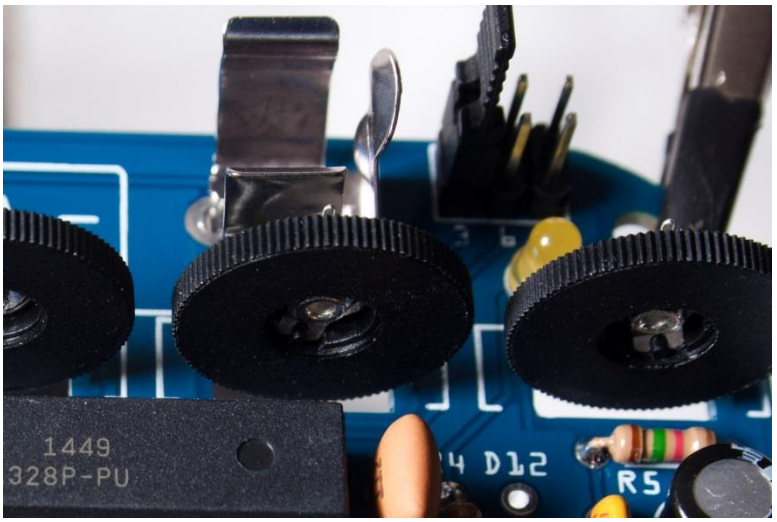
Now we're ready for the five thumbwheels. To prepare them, bend the single unused pin upward as shown in the photo. It should still be angled outward just slightly (maybe 5-10 degrees). This pin will engage in the underside of the acrylic cover plate, holding each wheel securely.	
Now insert the first wheel into the PCB as shown.	
Then gently fold the wheel upward until it is vertical, keeping the pins fully seated in the holes in the PCB as you do this. When you let go the wheel will spring back slightly away from vertical, which is fine.	

Then repeat for the other four wheels. **Don't solder them yet.** We're going to temporarily install the acrylic cover plate to hold them in perfect alignment while we solder them.	
Peel the protective paper off the acrylic and use four of the screws to attach the four hex standoffs to the underside of the acrylic as shown.	
Now position the cover plate over the buttons and wheels. Gently guide each thumbwheel so the small pin that you bent upward engages into the tiny hole in the acrylic. You will gradually be able to lower the cover plate down until the standoffs are almost touching the PCB. Don't force the cover plate down if it won't go—it probably means that one of the pins isn't engaged correctly.	

The small plate to which each thumbwheel is mounted should extend into the slot in the cover plate, held firmly against the back of the slot by the pin. Now you can insert all four remaining screws into the bottom of the PCB, pulling the cover plate down and securing the thumbwheels. Check to make sure that the wheels are all aligned. If necessary you can twist them slightly.	
Then you can solder the pins on all the thumbwheels. Next remove the bottom screws and the cover plate again. You can leave the hex standoffs attached to the cover plate. Here's what the bottom of the PCB looks like at this point.	
Now add the three headers, with the short ends of the pins in the PCB. These can be a little tricky to hold vertically while you solder, so again use the helping hand where necessary. Solder one or two pins first and check to make sure the header is vertical. Then we can add the two LEDs. LED1 is red, and LED2 is yellow. **LEDs are polarized, and they won't work if they're installed backwards.** The longer lead on each LED is the positive lead. This goes in the hole marked with the "+" sign. The housing on the LEDs also has a small flat on one side, which should point toward the thumbwheels (down, in this photo).	

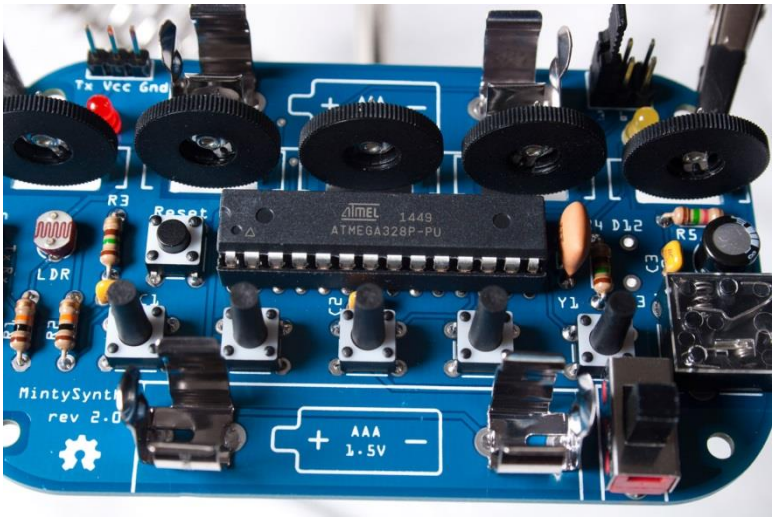
Now we'll add the audio jack as shown. These pins are bigger than on any previous components, so it will take more solder to make a good joint. Use plenty so the jack will be firmly attached to the PCB.	
Then install the power switch (it doesn't matter which way). This is another one that can be a little tricky to keep fully seated and vertical while you solder, so take your time and use some means of holding it in place correctly. Be generous with solder here too.	
Finally, snap the four battery clips in place as shown and solder them. They will hold themselves in place while you solder, but do make sure that they're fully seated. Again, these will take plenty of solder. Now we're done soldering! Clip any remaining leads short, and check the underside of the PCB carefully for any long leads or any bits of solder or clipped leads that need to be brushed away so they don't cause short circuits.	

If you'll be using the preinstalled software, put the jumper in place in position 3 as shown. You also have the option of using digital pin 6 or 9 for the audio output if you're using other software. **Note: don't forget the jumper, or you won't get any sound. It's easy to forget.**



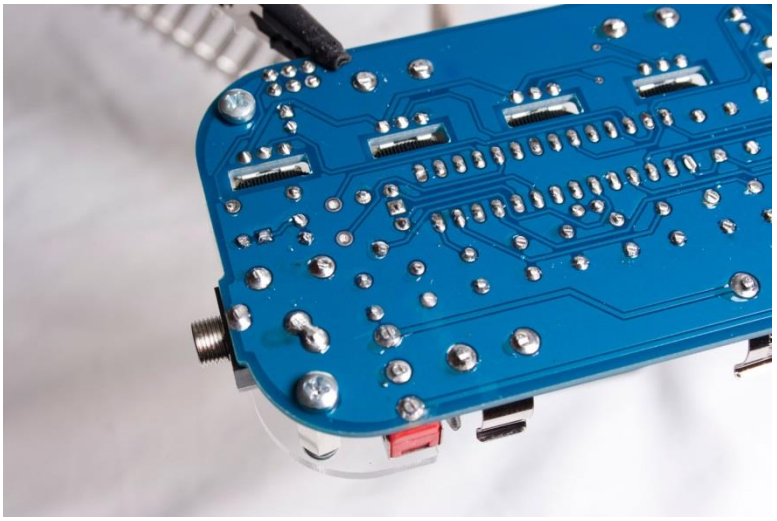
Now we can put the ATmega328 in its socket. You will have to gently bend both rows of pins inward slightly by laying the ATMega on its side on a table and gently folding it over until the row of pins is vertical (then repeat with the other row).

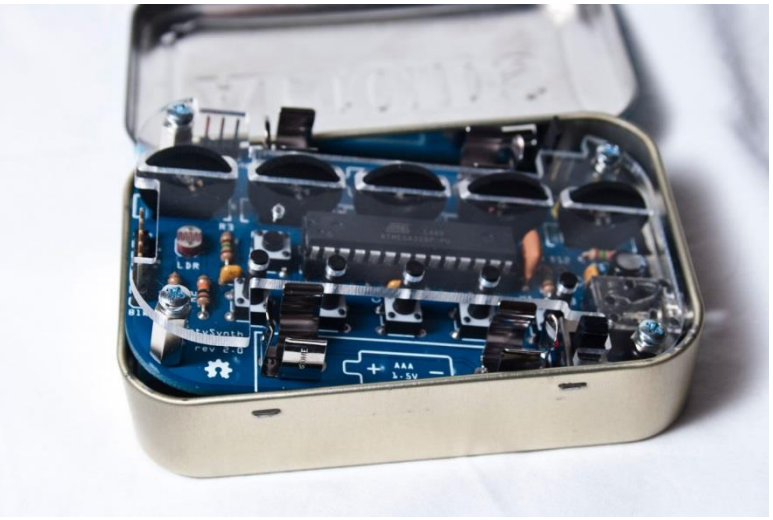
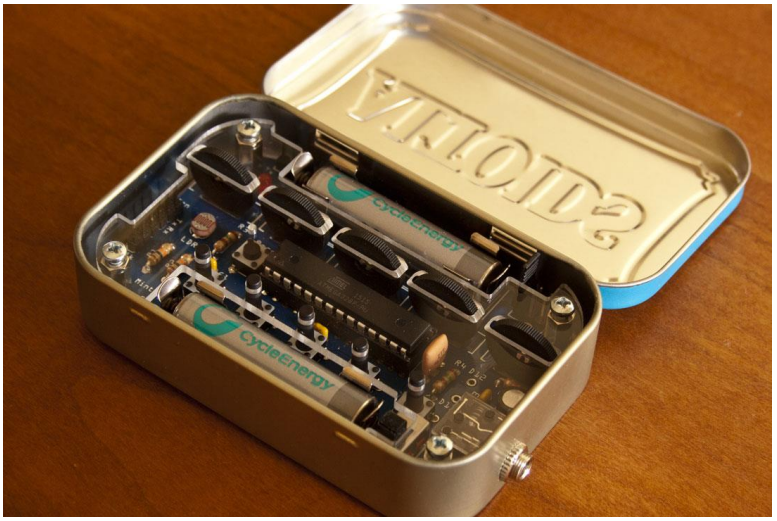
The small notch on the ATmega points to the left, as shown here. The notch should line up with the notch in the socket. Press the IC evenly in place after making sure all the pins are lined up with their respective positions in the socket.



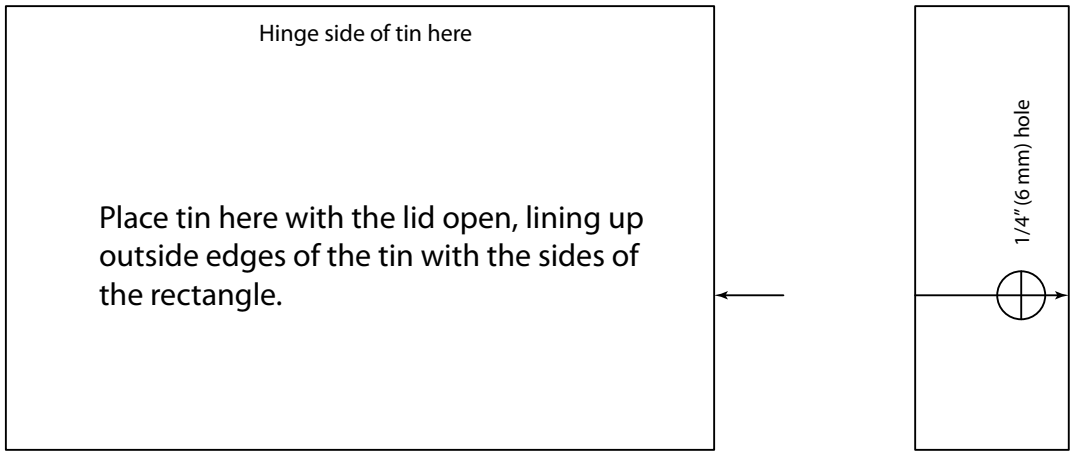
If you'd like you can now put AAA batteries in the device **(always noting proper polarity)** and turn it on. You should see the LEDs flashing.

Now reinstall the cover plate, but only use the two screws at the end of the PCB with the audio jack to hold it in place as shown. The two screws at the other end will be installed through the bottom of the tin.



Insert the remaining two screws up through the holes in the tin and cardboard, and place the two washers on them. **These washers are important for holding the device off the bottom of the tin, so please don't forget them.**	
Then tip the whole assembly into the tin and insert the audio jack through the hole in the side. Finally, engage the two screws in the tin into the bottoms of the hex standoffs (they may take a little wiggling), and tighten them. Then screw the small knurled nut onto the outside of the audio jack. Using fingers for this is probably best so you don't scratch the side of the tin.	
Congratulations, you've done it! You're ready to try out MintySynth with the preloaded software or upload your own sketches. Here's the Quick Start Guide And the Software Manual	

MintySynth tin hole location guide



Cut out this rectangle and glue to right-hand end of tin with the arrow pointing down, lining up the ends of the arrows.