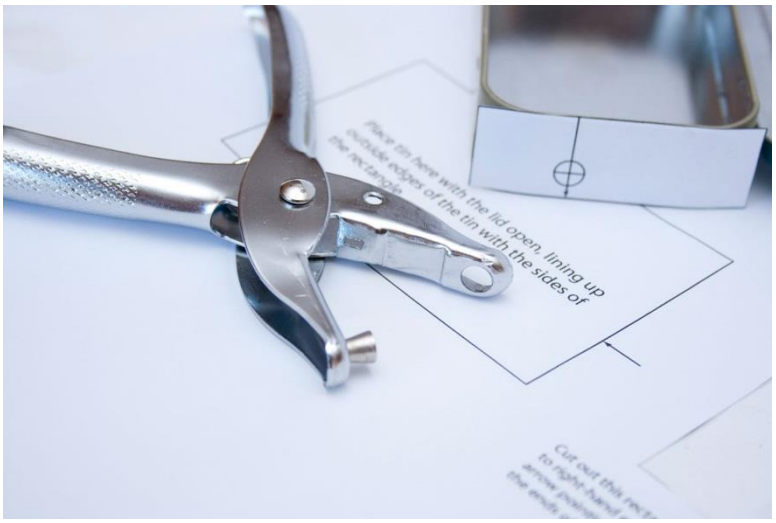
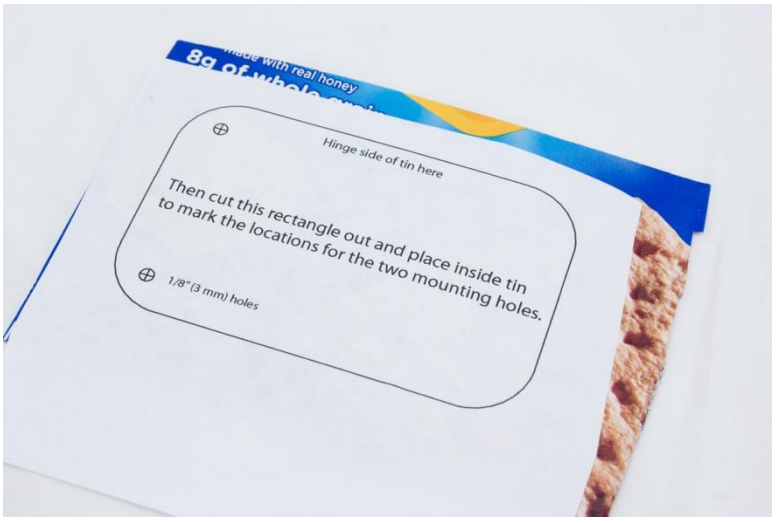
MintySynth Rev. 1.3 Assembly Manual

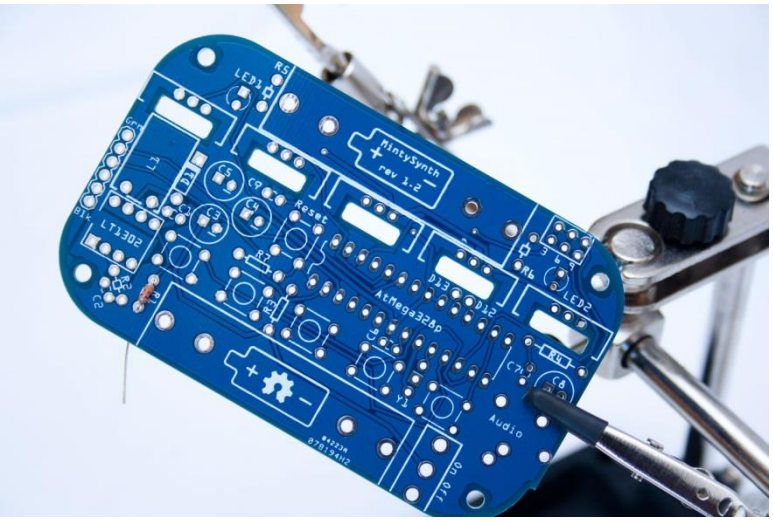
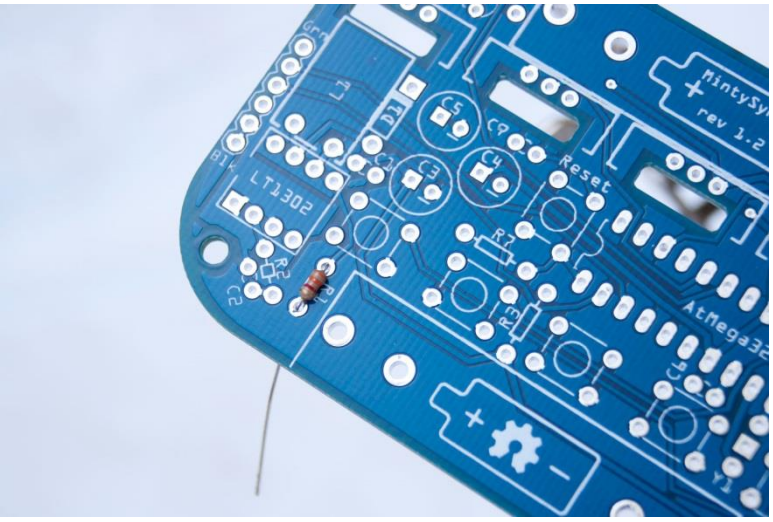
Tools and materials required:

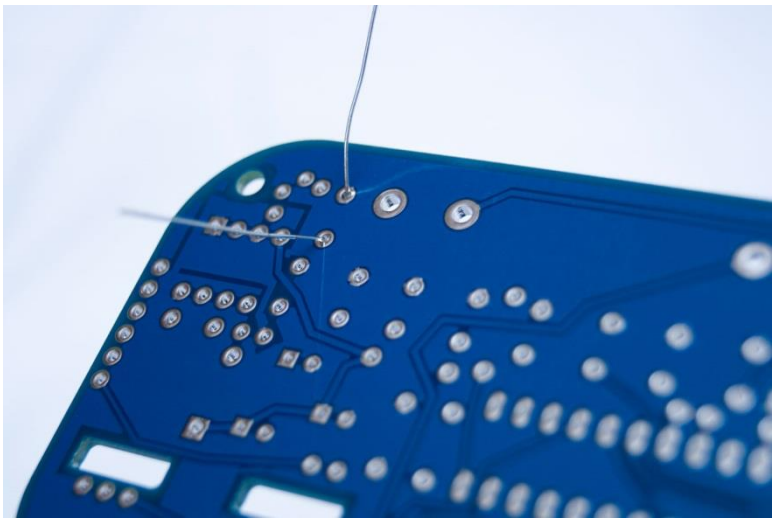
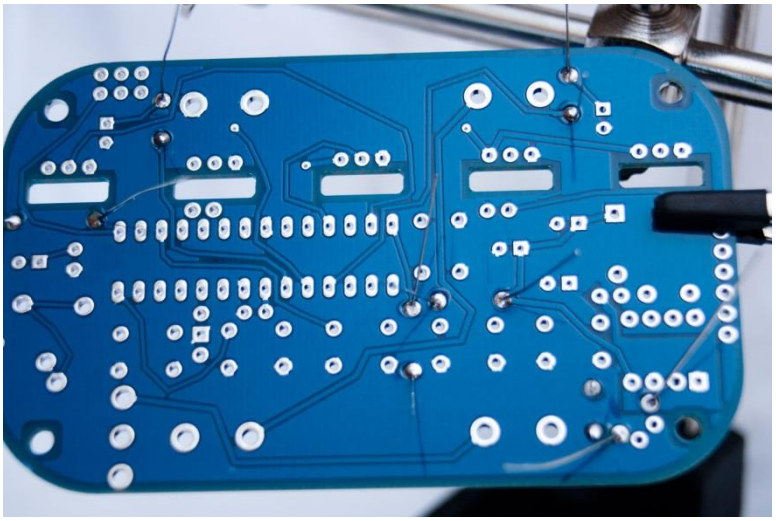
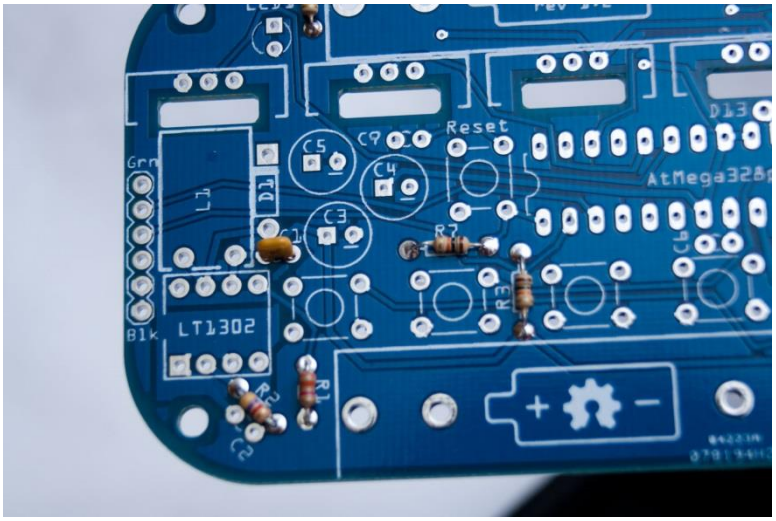
- Soldering iron
- 1/32” solder (leaded solder is easiest to use for beginners)
- End cutters or diagonal cutters
- Small needle-nose pliers
- Paper-hole punch or ¼” drill bit
- 1/8” drill bit and drill
- Small nail for marking holes
- Hammer
- Small Phillips-head screwdriver
- Mint tin (blank tins are 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

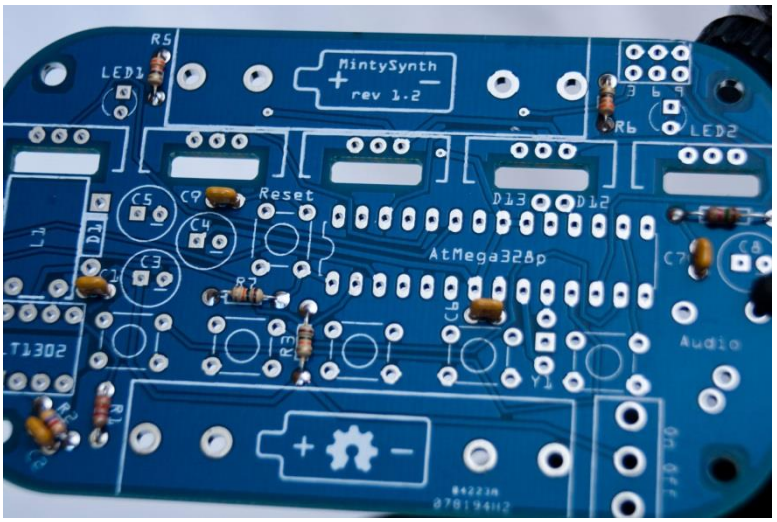
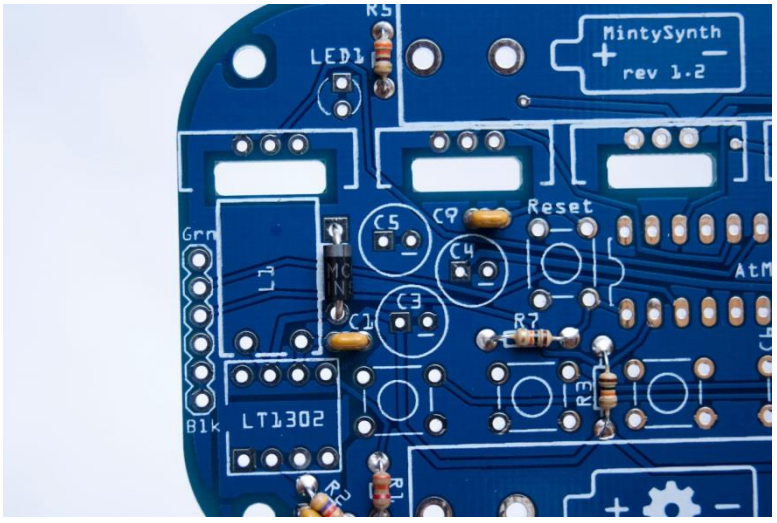
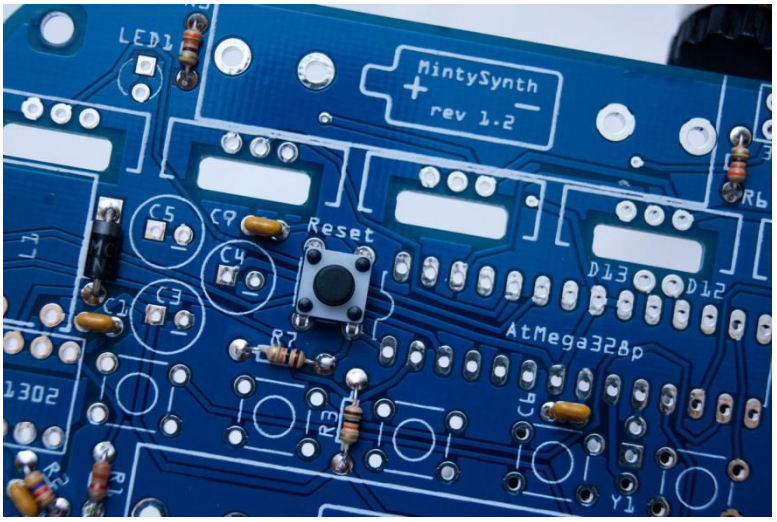
Please open the kit carefully, because there are many small parts inside. Check the parts list to make sure that you have all the parts ready before beginning assembly. Note that some small parts such as resistors may get stuck inside the bag.

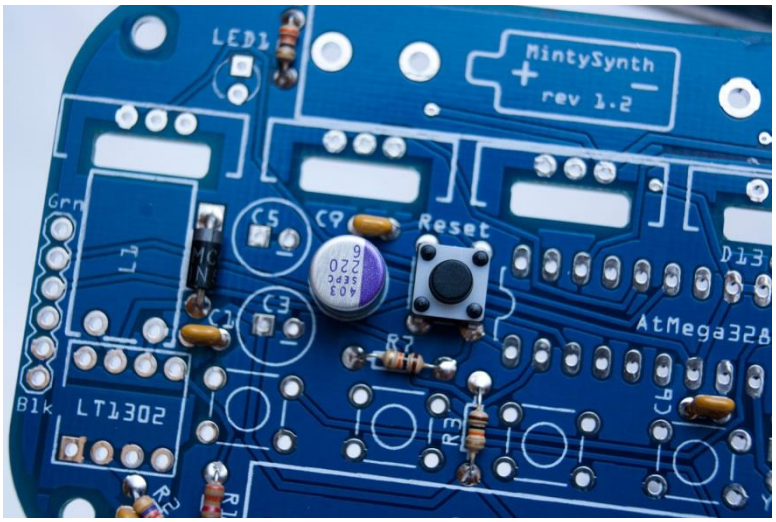
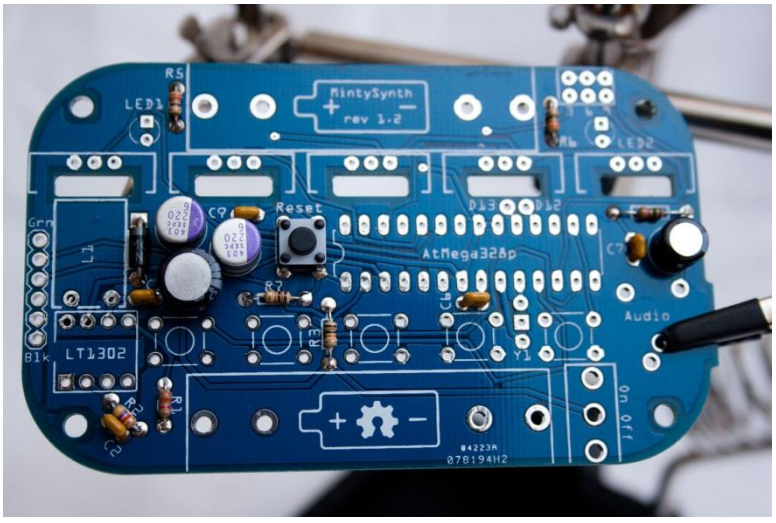
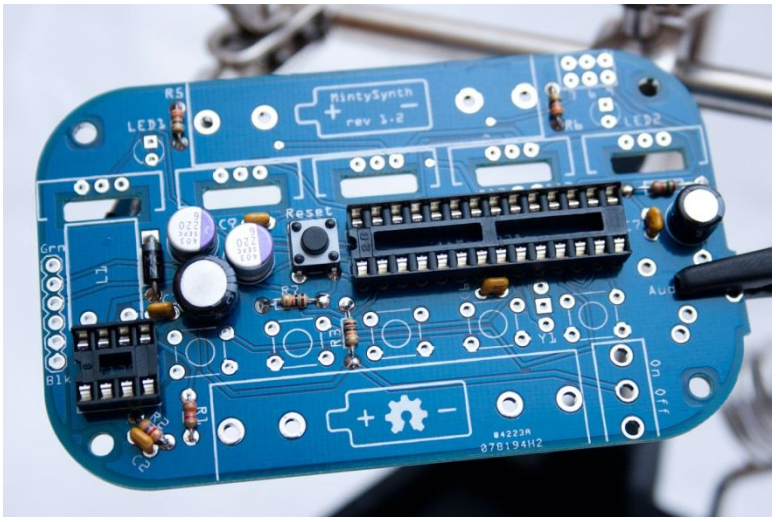
We'll begin by marking the location on the tin for the audio jack hole. Print out the final page of this document, which is the layout diagram. Cut out the small rectangle, then apply a small amount of water-soluble glue (e.g. from a craft glue-stick) or double-sided tape on the right end of the tin. 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.	

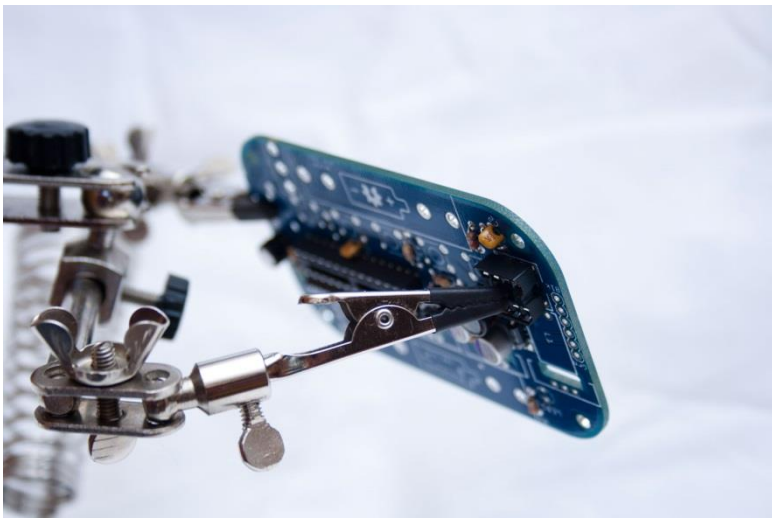
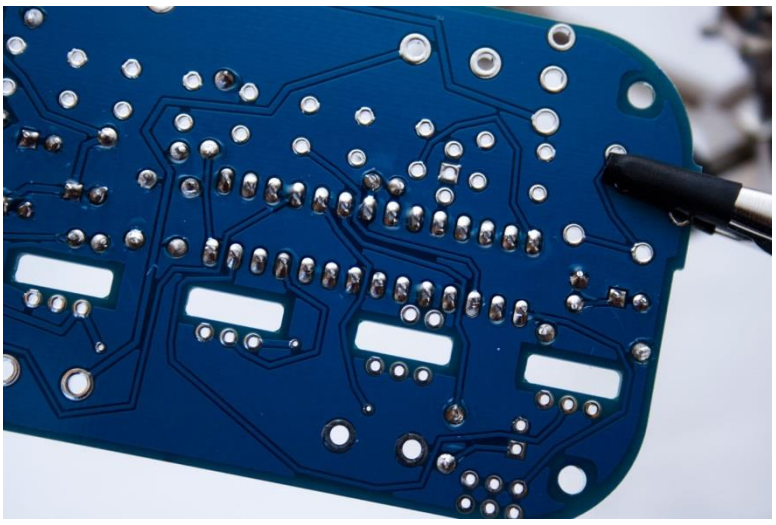
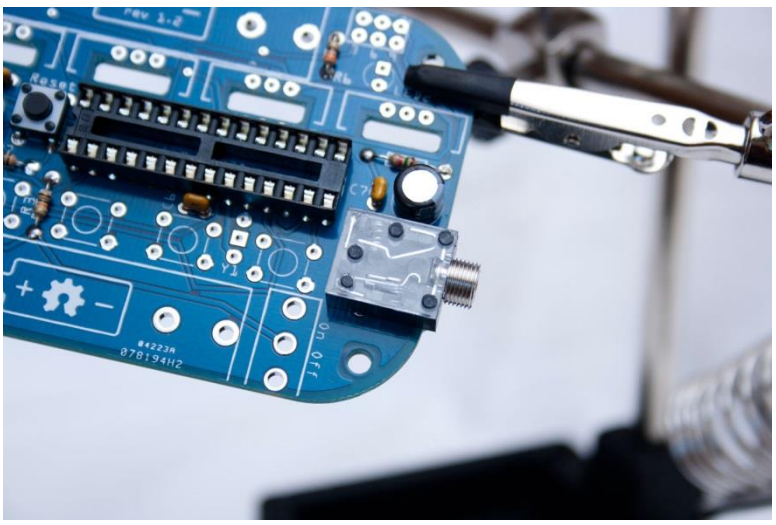
Here's the completed hole. If you prefer to use a drill, a brad-point drill bit is recommended to help minimize deforming the thin metal. Also, it is necessary to put a small block of hardwood under the metal to support it while drilling. Some people recommend filling the tin with water, then freezing 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 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. It's okay if the tin gets deformed slightly around the holes. It may help to lightly punch the holes first with a small nail to keep the drill bit from wandering.	

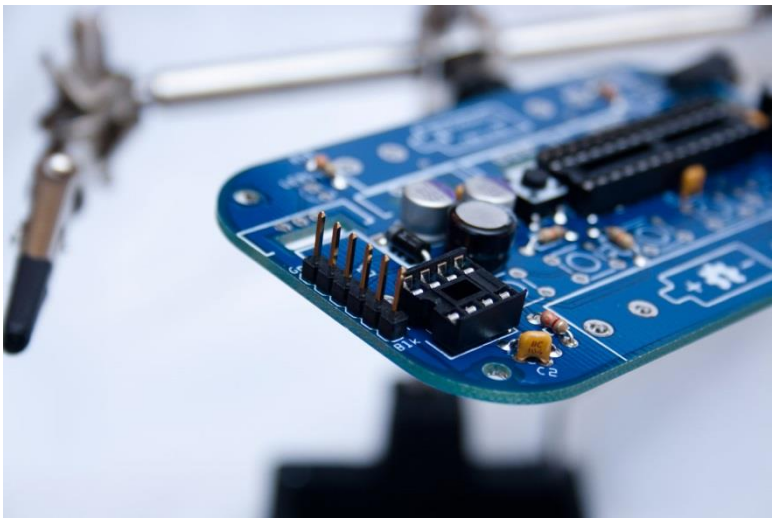
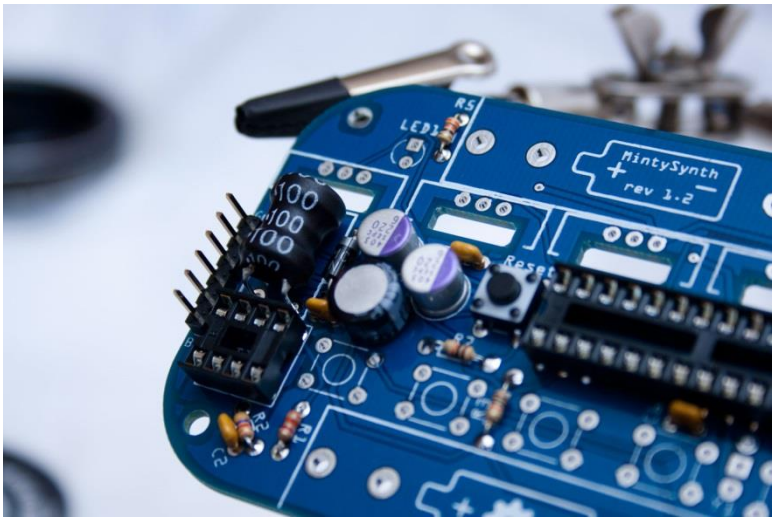
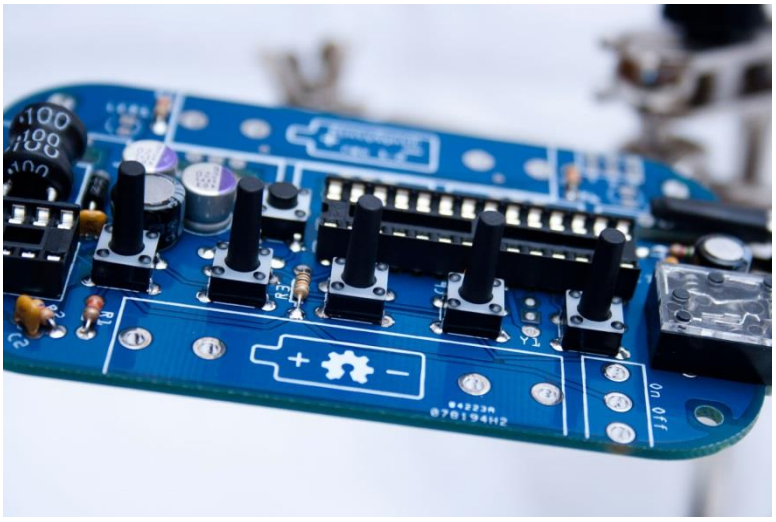
Now, remove the cardboard (you may need to use a toothpick, etc. to hook it by one of the holes and pull it out), turn it over, and put it back in the tin. This way the cardboard will be less visible when the device is complete. An alternative is to use electrical tape to insulate the bottom of the tin, 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. 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 resistor R1 (3.3 kΩ). Form the resistor into a staple shape and insert it. Resistors are not polarized, so it doesn't matter which way it goes. Try to be sure to seat it all the way into the PCB.	

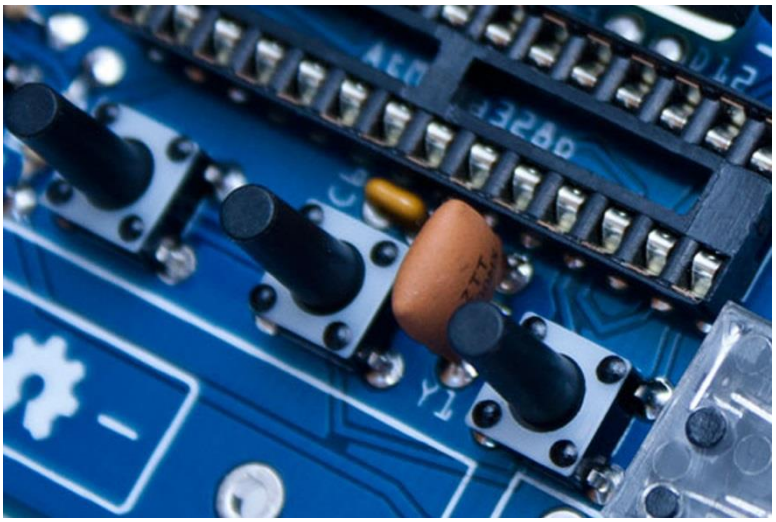
Spreading the leads out on the back of the PCB will hold the resistor in place while you solder it. Solder the leads and clip them off with your end cutters or diagonal cutters. **Note: there will be minimal clearance (~1.5 mm) under the PCB when it is in the tin, so the leads of all the parts need to 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.**	
Next you can solder the rest of the resistors in place, checking the parts list to make sure you have the correct value for each. Here they are before clipping the leads.	
Next we'll add the small yellow ceramic capacitors, C1, C2, C6, C7, and C9. 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 vertical. Capacitor C1 is shown here.	

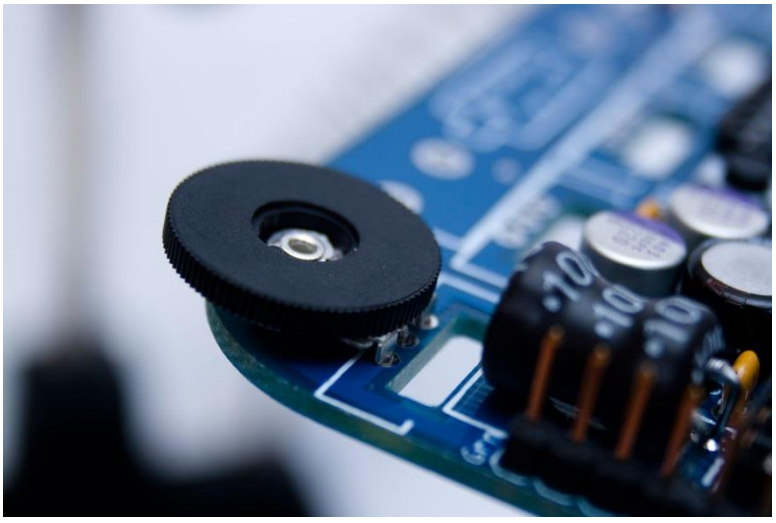
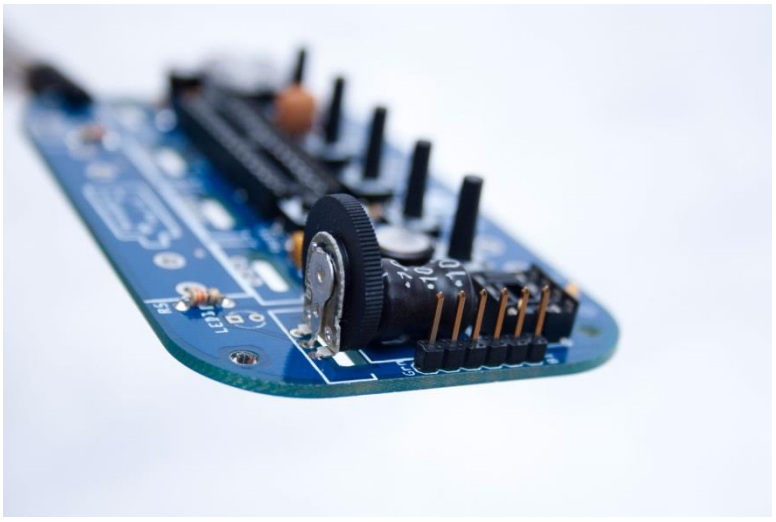
Here all the ceramic capacitors are in place. Again, clip the leads short on the bottom.	
Next we'll install the diode D1, which is used by the boost circuit. It is polarized, so be sure that the end with the grey band is pointed up, as shown. Install it just as you would a resistor.	
Next is the reset button. Note the direction of the legs; on this button they point toward the top and bottom edges of the PCB. The buttons require a small amount of force to snap them in place. It works well to push them down evenly with one fingernail on each side of the button. The button should seat fully onto the PCB and hold itself in place while you solder it.	

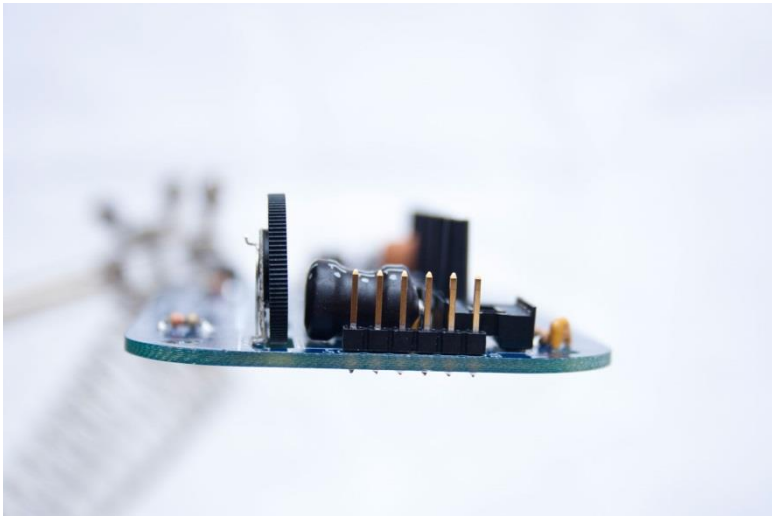
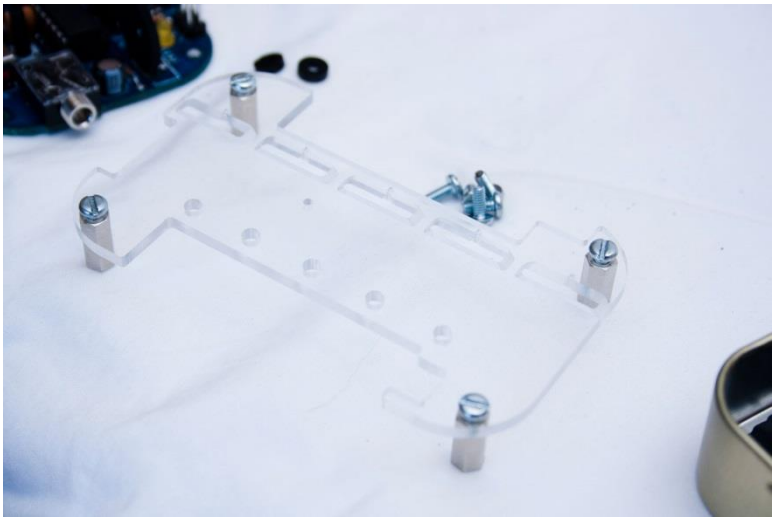
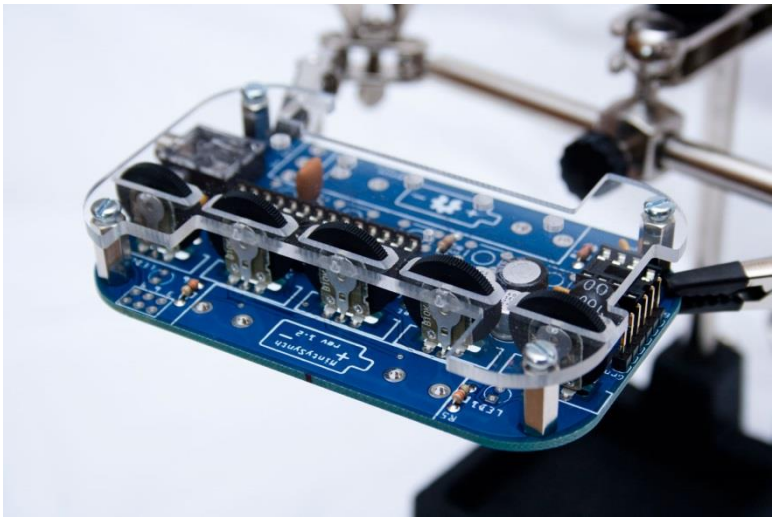
Next we'll start with the four polarized capacitors, C3, C4, C5, and C8. **These must be installed in the proper orientation.** On all four the negative side points toward the right side of the PCB. On C4 and C5 that is the side with the purple band (shown here), and on C3 and C8 it is the side with the grey band (the negative lead is also the shorter of the two leads). Again, make sure they are fully seated—it may help to use the second clip on the helping hand, or a small object, to support the capacitors while you are soldering them.	
Here you can see the four polarized capacitors installed in the proper orientation.	
Next we'll add the DIP sockets for the two integrated circuits. These are both placed with the small semicircular notches facing left as shown.	

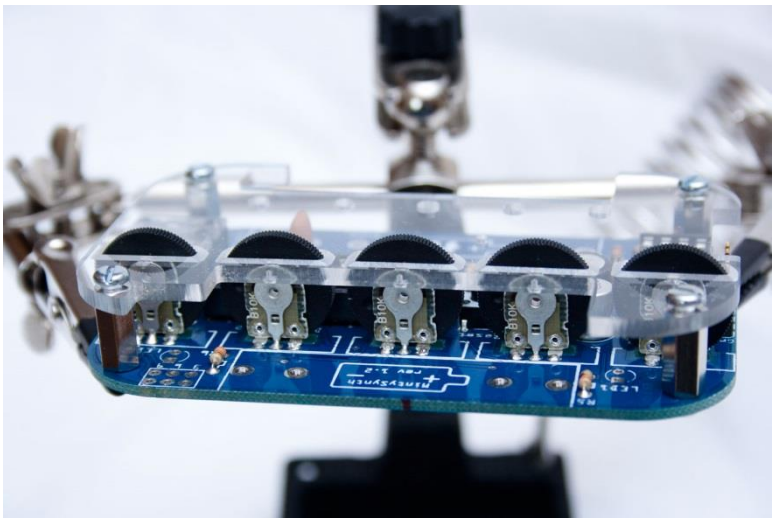
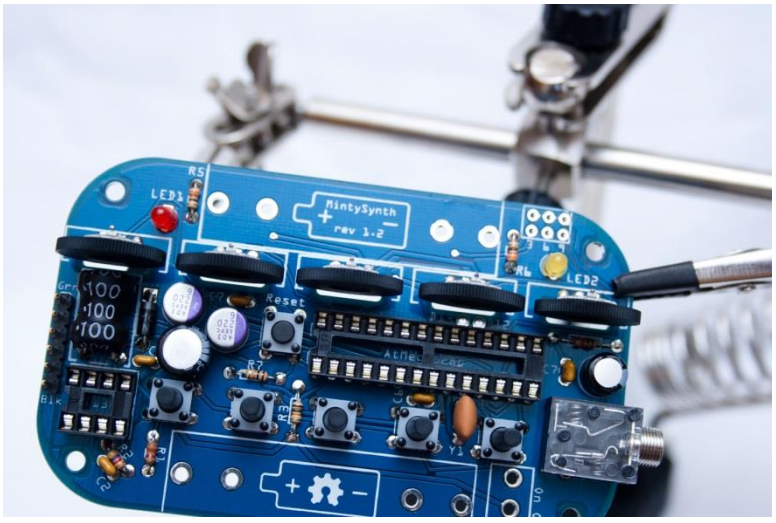
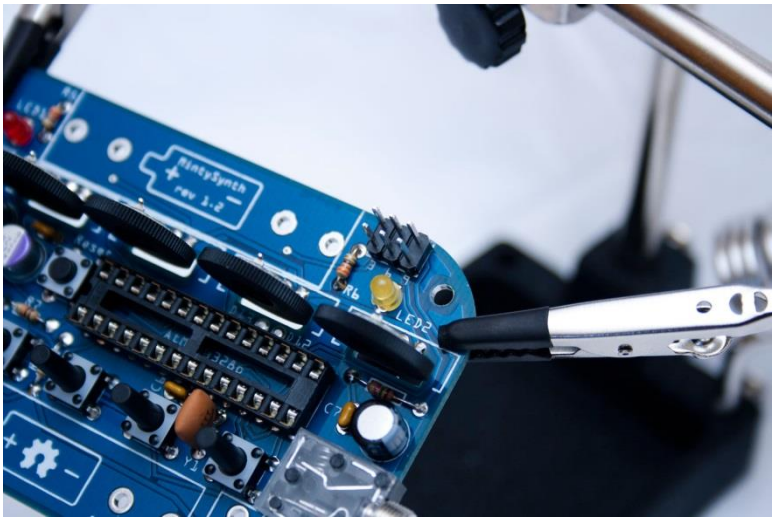
Here one clip on the helping hand is being used to hold the smaller socket in position for soldering. It's a good idea to solder one pin on the socket, then check to make sure it is still fully seated, solder another pin at an opposite corner, make one last check, and finally solder the remaining pins.	
As previously, clip the pins close on the back after soldering. The larger socket (for the AtMega IC) is shown here, with the pins clipped.	
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.	

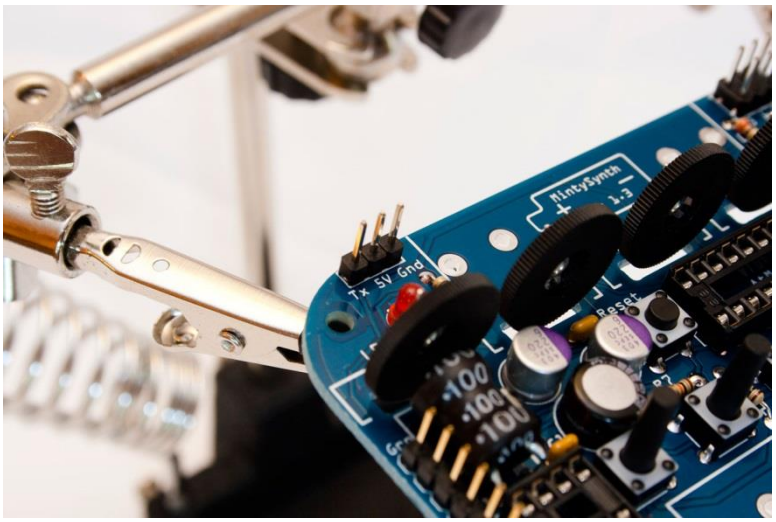
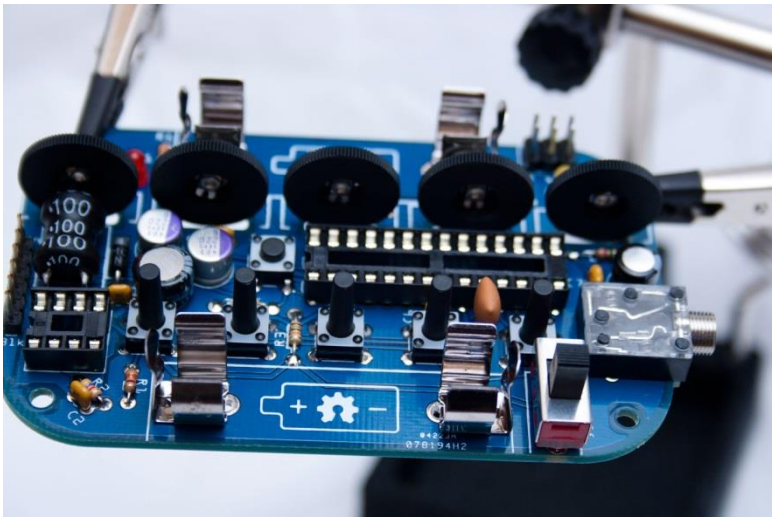
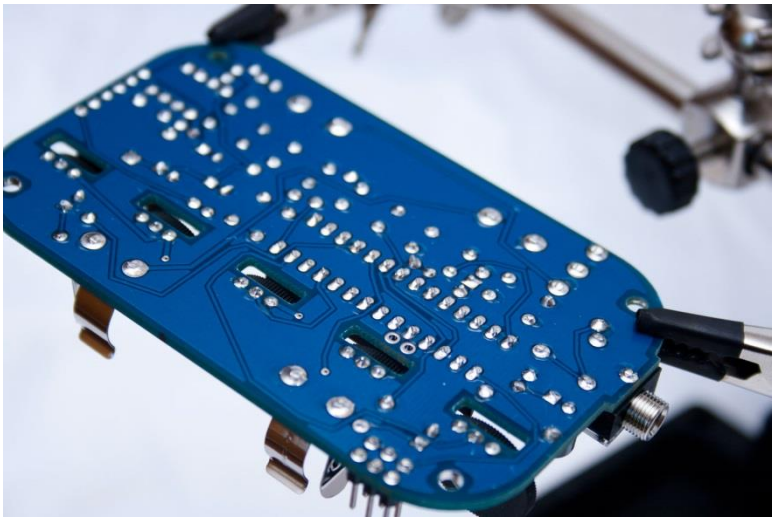
Next is the six-pin FTDI header, as shown. The shorter ends of the pins go through the PCB. Again, try to support it from the back as you solder so that it stays firmly seated and perpendicular to the PCB, double checking the alignment after soldering the first pin.	
Now we'll add the inductor, L1. We'll install it horizontally, so bend the two leads downward as close to the body of the inductor as possible and insert them into the PCB as shown. There's no polarity, so it doesn't matter which way you bend the leads or insert them in the PCB. The inductor should be entirely within the white rectangle when installed.	
Now we're ready for the five tall buttons. It should be clear from the PCB, but note that these are oriented in the opposite direction of the reset button that we installed earlier (the legs are towards the left and right sides of the PCB). Again, you snap them into place by putting even pressure on both sides of the housing. Be sure that each is fully seated before soldering.	

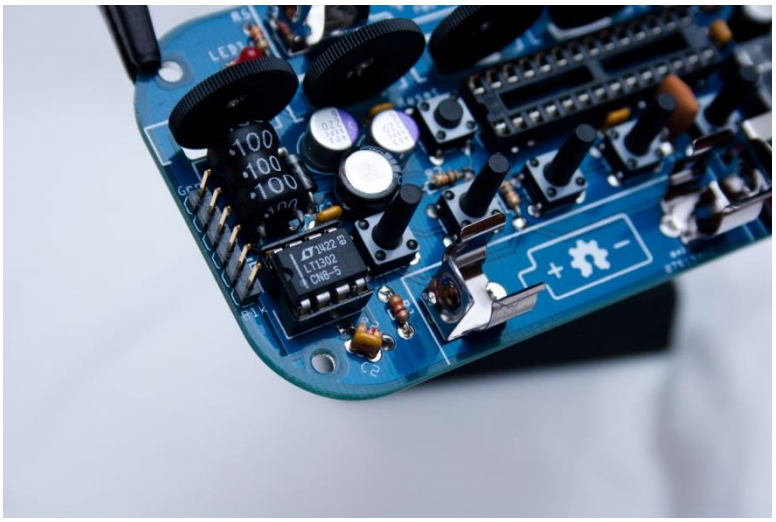
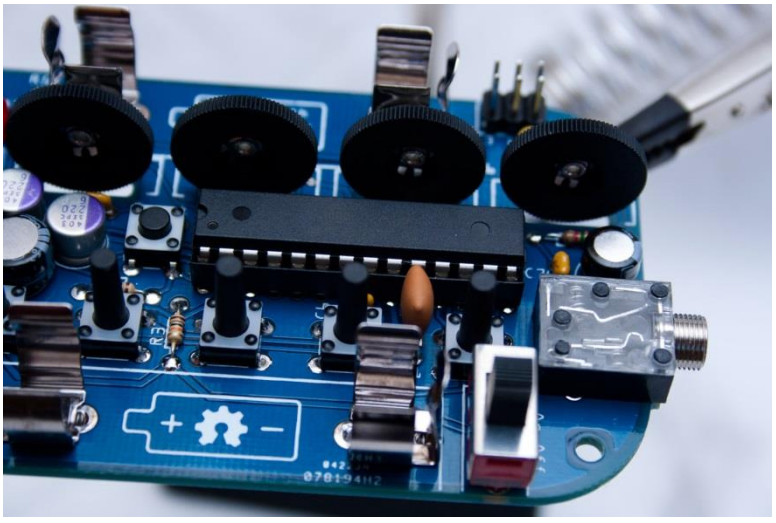
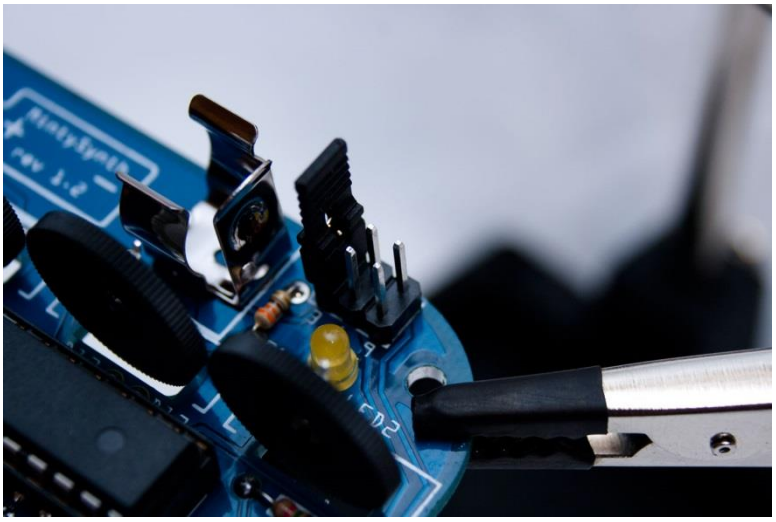
Next is the ceramic resonator, Y1. There's no polarity, so either way is fine. Again, the second clip on the helping hand is useful here to hold it in place while you solder. Check after soldering one pin that it is seated vertically.	
The five thumbwheels require a small amount of preparation: We're going to alter the single unused pin at the top of the thumbwheel so that it can engage in a hole in the underside of the acrylic, holding the thumbwheel secure. First, use small needle-nose pliers to bend the pin upward as shown. **The pin should still angle out away from the wheel slightly, around 25 degress or so.** Try to bend the pin right at the shoulder, which will be its natural tendency.	
Now, use your cutters to clip the pin so it is about 1mm long (past the shoulder) as shown. Repeat this process for all five thumbwheels. Test the fit of the pins in the underside of the acrylic—each pin should slip into the small hole, pulling the thumbwheel snug against the side of its slot. If a pin won't reach the hole, you can bend it out away from the wheel a little more until it fits.	

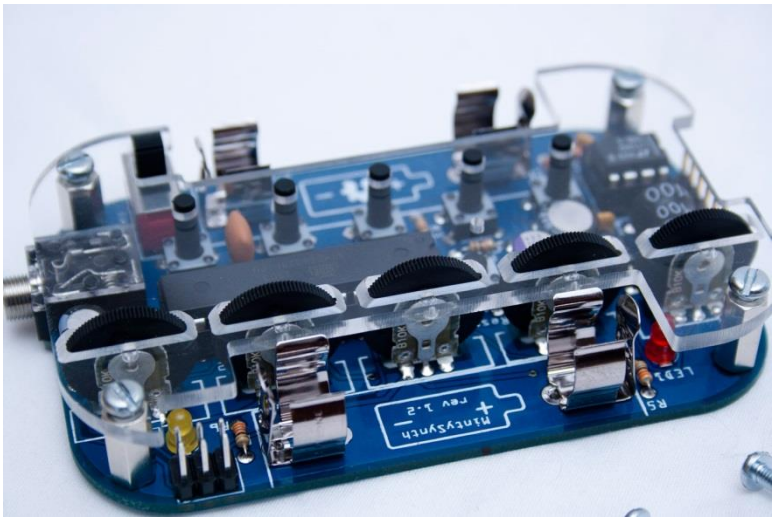
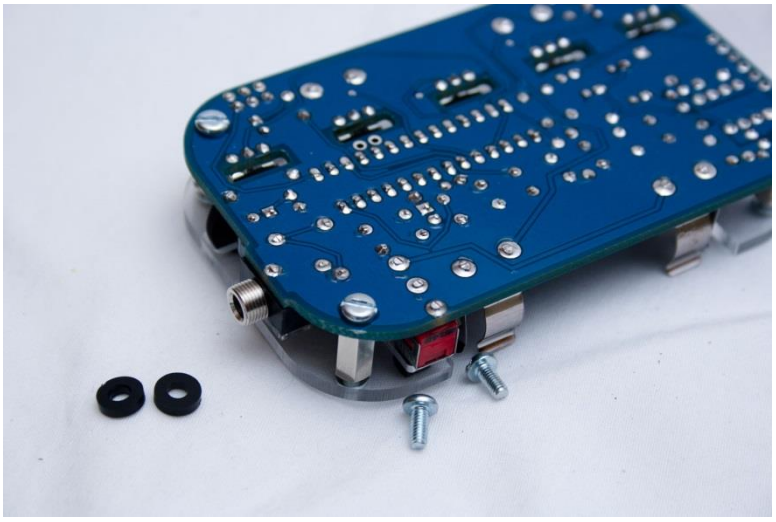
Here are some more thumbwheels prepared for installation.	
To install them, begin by inserting a thumbwheel in the far left position as shown.	
Then, keeping the pins fully seated, gently fold the thumbwheel upward until it is vertical, bending the pins as close to their shoulders as possible.	

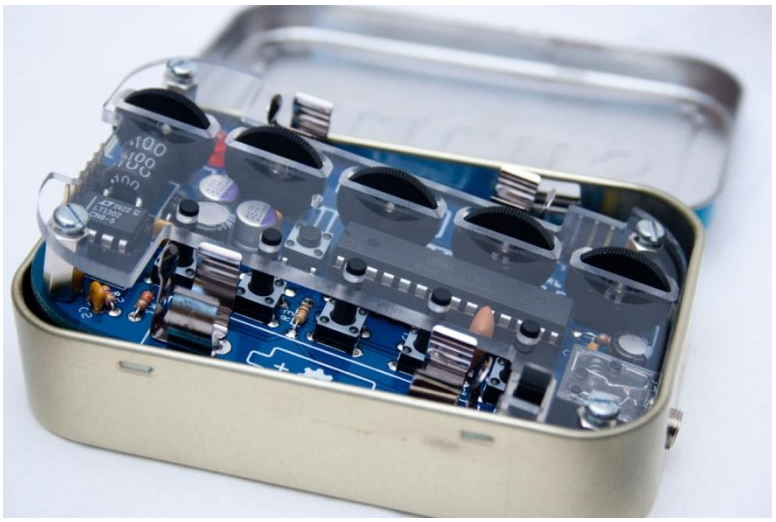
Sight from the side to ensure that the wheel is close to vertical, and then repeat the process with the other four wheels.	
We're going to use the acrylic cover plate to temporarily hold all the thumbwheels in alignment while we solder them, so peel the protective paper off the acrylic and use four of the screws to attach the four hex standoffs to the acrylic.	
Now put the acrylic cover over the thumbwheels, wiggling each wheel slightly until the prepared pin at the top slips into the small hole in the underside of the acrylic. Don't force the acrylic down if it won't go—you don't want to bend the pins. Instead, see which pins are preventing it from dropping into place and re-bend them slightly if necessary. The acrylic should drop in place once all five pins are engaged. Holding it in place, screw the four remaining screws through the bottom of the PCB into the standoffs, locking the acrylic and the five thumbwheels in place.	

Then you can turn the assembly over and solder all five thumbwheels. Use plenty of solder so that it flows through the holes and flows onto the pads on the top side of the PCB as well. This will ensure a strong mechanical connection. Here you can see we've used enough solder to flow through to the top side.	
Now you can remove the bottom four screws and the acrylic cover, and we'll add the final few components. Install the two LEDs as shown, with the red one on the left. The LEDs have a small flat on the negative side of the housing (this is also the side with the shorter wire lead). **This side needs to point toward the thumbwheels. The negative lead will go through the round pad.** You can bend the leads outward slightly like you did with the resistors to help hold them in place while you solder.	
Next is the header for the jumper, as shown. Install it like you did the FTDI header, with the short ends of the pins through the PCB.	

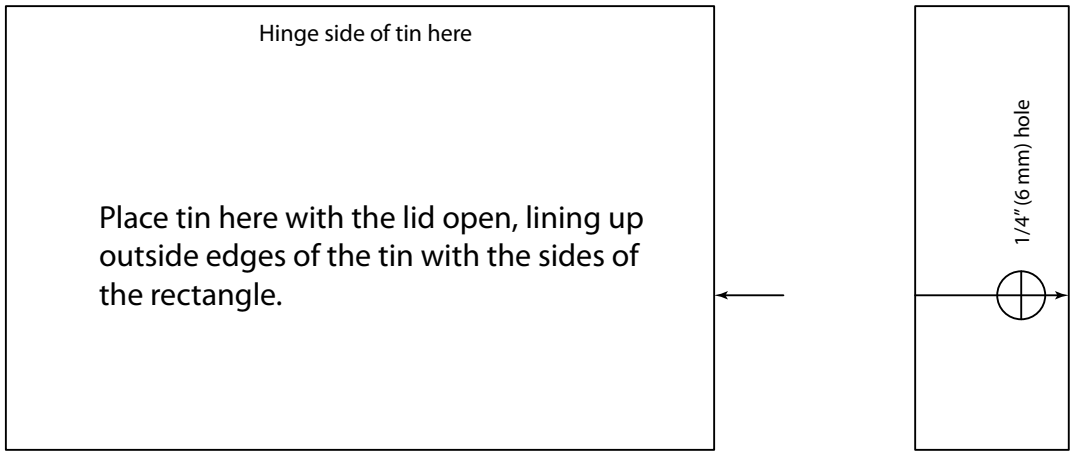
Now add the 3-pin MIDI header in the same manner as shown. Note that his part doesn't appear in some of the other photos because it was a recent addition.	
Now install the power switch (it doesn't matter which way, just make sure to hold it vertical and seated as far as it will go while soldering. It doesn't like to stay in the correct position until soldered ;)). Then install the four battery clips in place as shown and solder them. It will take a fair amount of solder to completely fill the holes for both the switch and the clips. Use plenty so they will be secure.	
Now we're done soldering, and it's a good time to make sure that you've clipped all leads and pins short on the back, and that none of them extend more than about 1 mm. Also check for small bits of solder or ends of pins that are stuck to the PCB and may cause shorts circuits.	

Now we can put both integrated circuits in their sockets. You will have to gently bend both rows of pins inward slightly by laying each IC 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 both ICs points to the left, as shown on the LT1302 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.	
Here's the AtMega328 installed. Again, note the notch pointing to the left.	
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 as 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.** 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. Refrain from putting it in the tin or resting it on a metal table at this point, because there's nothing to prevent the pins from short circuiting. Also, the thumbwheels and buttons are not very stable yet without the acrylic cover plate, so please be gentle.	

Now we're ready to install MintySynth in the case. First insert two of the screws in the holes in the tin from the bottom, and then put the two washers on them as shown. **These washers are important for holding the device off the bottom of the tin, so please don't forget them.**	
Now you can reinstall the acrylic cover, being sure that the thumbwheel pins engage in the holes again.	
Then reinstall the two remaining screws underneath the PCB on the right side (the side with the audio jack, it's actually on the left in this photo).	

Now tilt the device into the tin, engaging the audio jack in the hole on the side. Then drop the left side down into place. It may take a bit of wiggling, especially if you used a paper punch for the audio jack hole and it is slightly shy of ¼" in diameter.	
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.