CALCULATOR KIT

Complete build guide

Version 0004

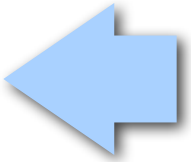
spikenzielabs.com

This guide will show you how to solder and assemble the SpikenzieLabs Calculator Kit.

For the best outcome, follow each step in order. This is a relatively easy kit to build, however there are certain steps that need to precede other steps. What follows in this guide will assure you a proper build.

In this guide, you will see a few different symbols, these are to call attention to certain elements of the build that require additional care & attention.

Caution

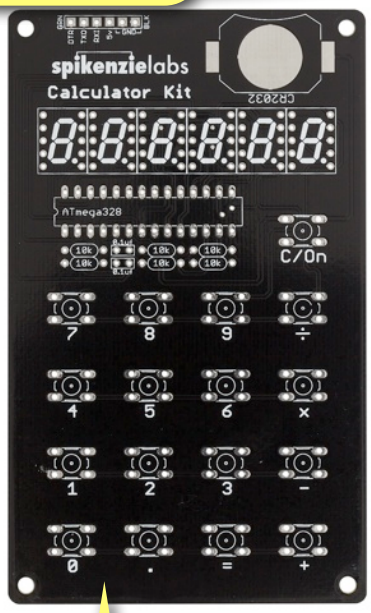


Look here...

Info

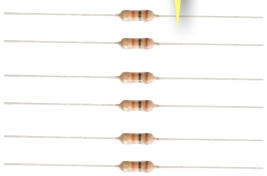
Step One : Unpack the electronics parts.

LED Spacer
Packed with the plastics



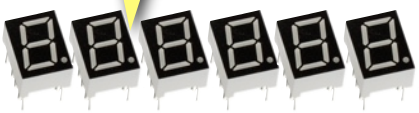
Calculator Kit PCB

10k Ohm Resistors



0.1uF Capacitors

7 Segment displays

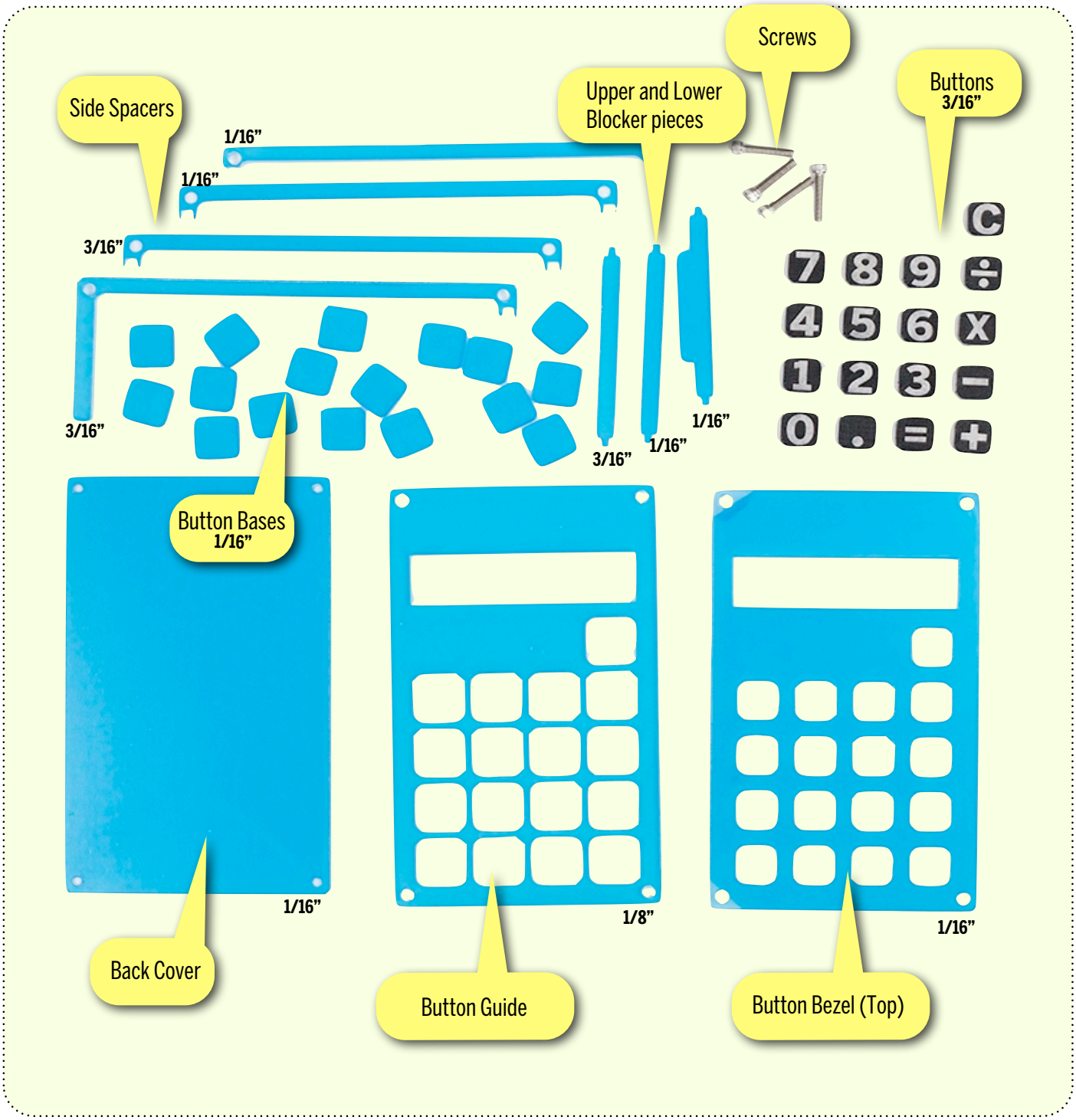


Pre programmed ATmega 328

Battery & battery holder

Momentary buttons

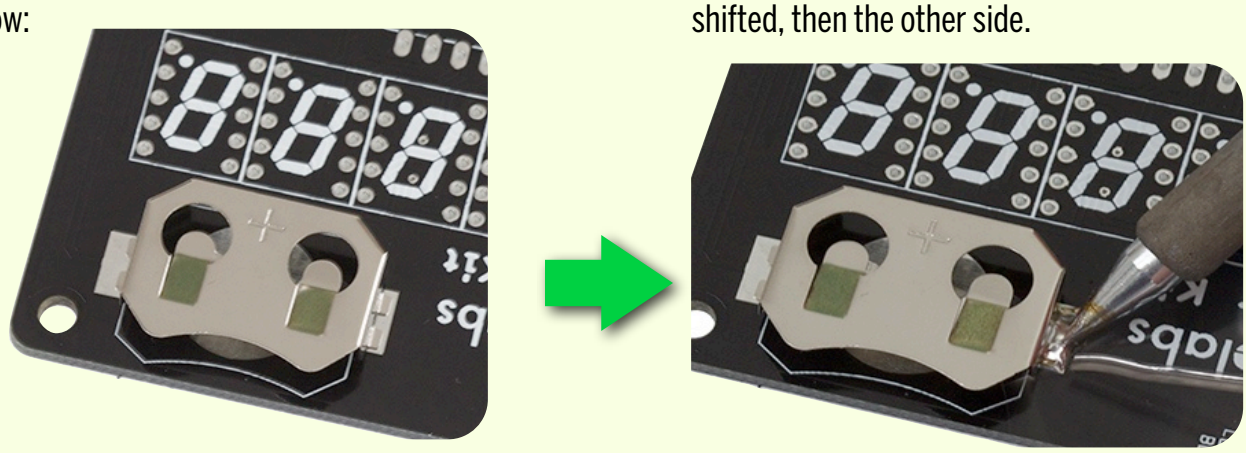
Step Two : Unpack the laser cut acrylic parts



Review the naming of the pieces. Also take note of the 1/16”, 1/8”, 3/16” thicknesses.
In the housing build part of this guide, we will be referring to pieces based on the names above, as well as the thickness of each piece.

Step Three : Battery holder

With the top of the PCB facing you, place the battery holder on top of the PCB as in the photo below:



Now, solder the battery holder on both sides. Solder one side, check to make sure it hasn't shifted, then the other side.

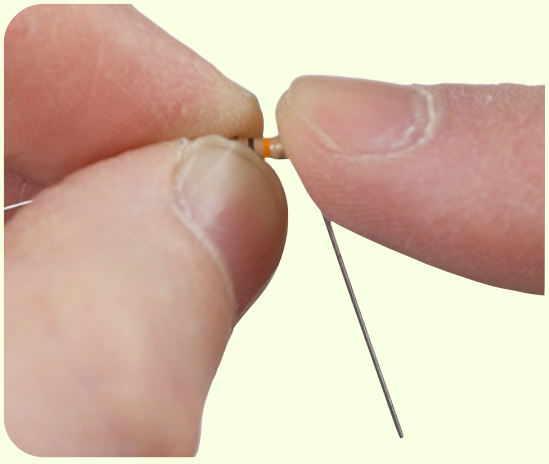
Solder without moving the battery holder. Touch the soldering iron to the pad near the feet of the battery holder. Let it heat up, and feed in some solder. **Don't touch the metal**, it is very hot while doing this step.

Step Four : The resistors

Resistor Bending:

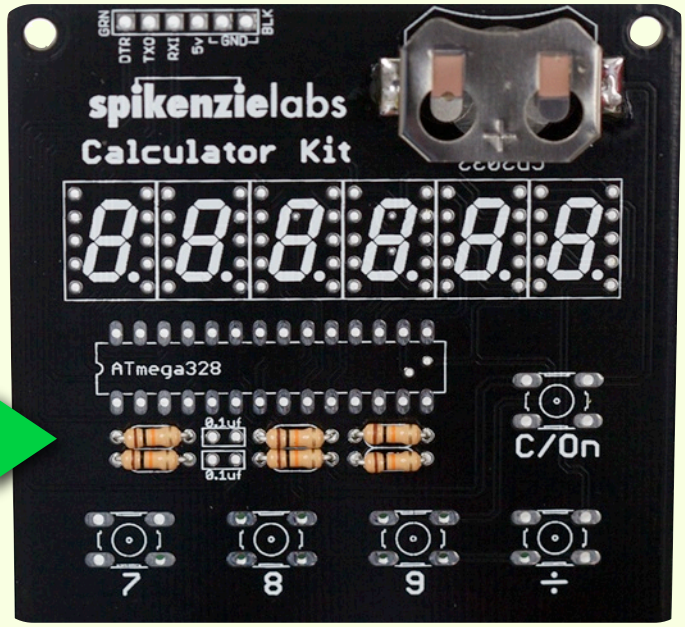
Bend each of the resistors like in the photo below:

You want to have the bend of the leg as close as possible to the body of the resistor.



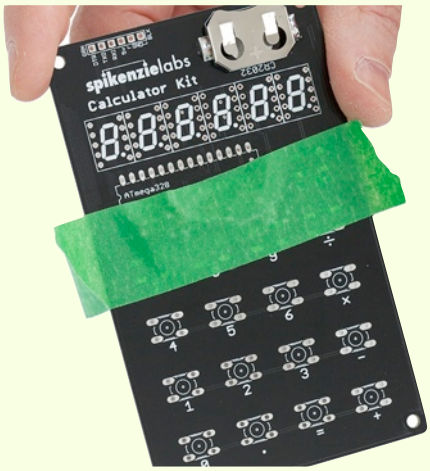
Resistor Inserting:

Place each of the resistors like in this photo.

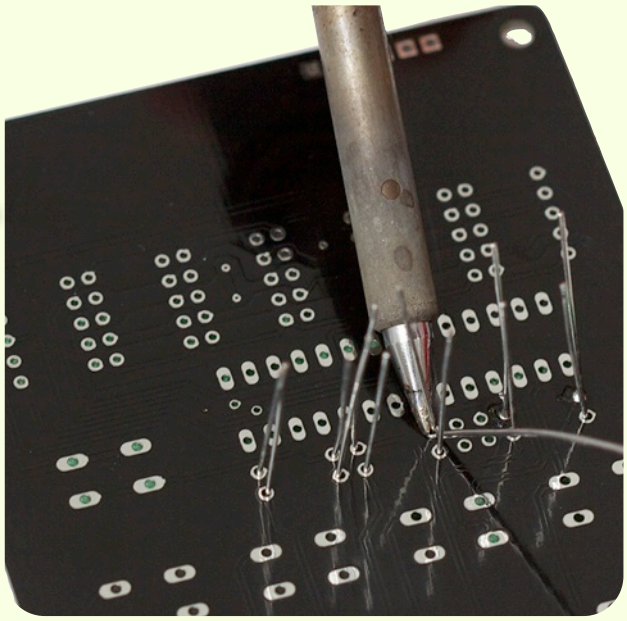


Resistor Soldering:

If you have some, you can put a piece of painter's tape over the resistors to hold them in place before soldering. Alternatively, you can bend the legs out to hold them in place.



Flip the PCB over, and solder the resistor legs as in the photo below:



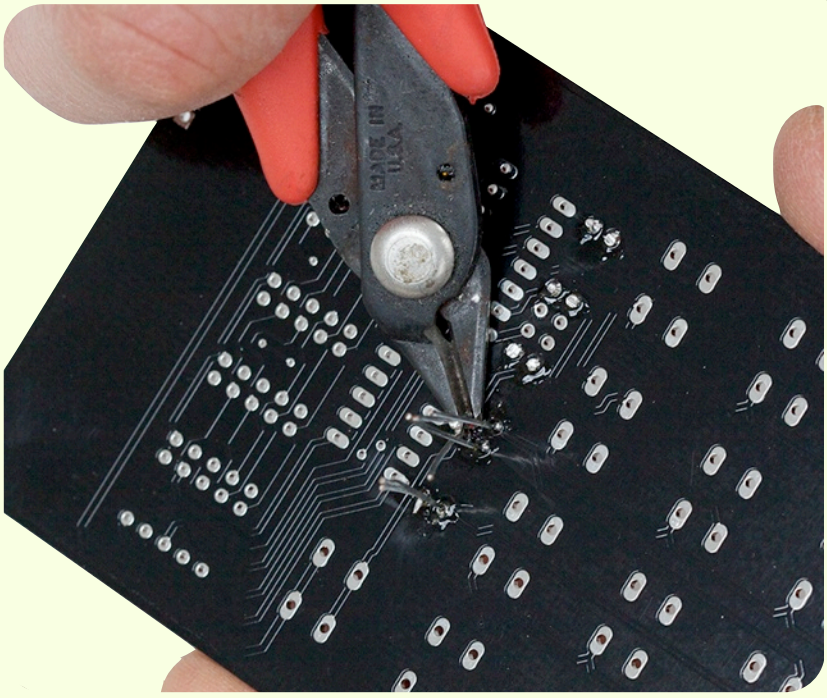
Put on your safety glasses. When trimming the legs, they can fly away fast and unpredictably. Anyone soldering with you should be wearing a set as well, or be in another room. Dogs, cats and your monkey included.

Cut the remaining legs:

Snip just above the solder joint. Pay close attention to not scratch the surface of the PCB when you're snipping.

You will follow this same procedure each time you solder a part that has excess leg length.

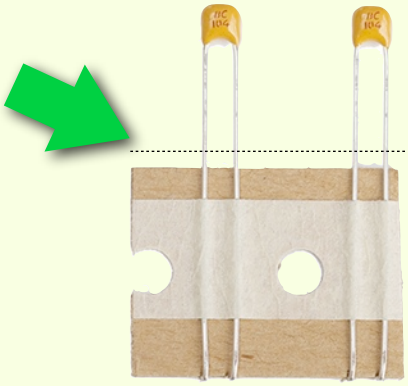
Be sure to wear safety glasses.

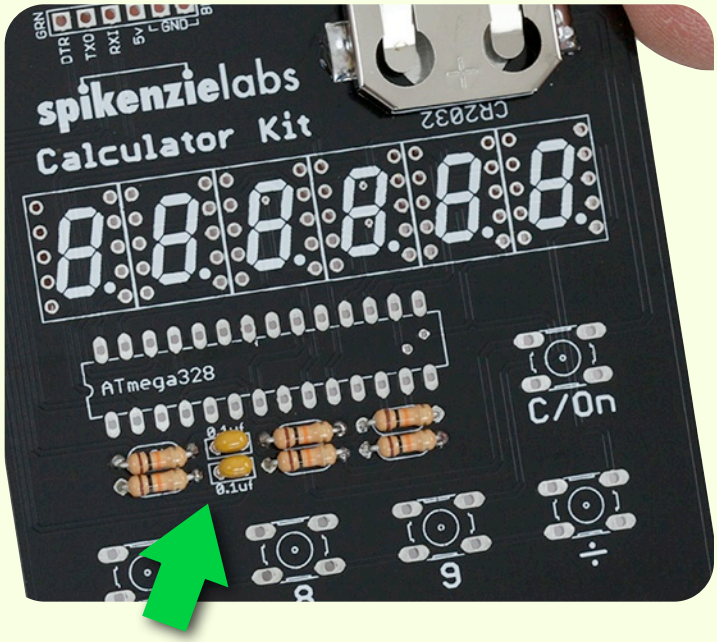


Step Five : The capacitors

Cut the capacitors from the paper tape. You should make your cut as close to the paper as possible.

Mount them to the PCB as shown, secure with tape, or flare out the legs a little to hold them in place. The bottom of the capacitor should be as close as possible to the surface of the PCB.





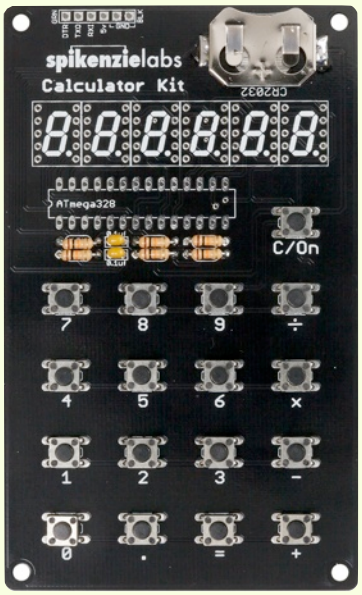
These capacitors do not have a polarity to them. You can install them in either way. Just make sure each one is installed as in this photo, and flush to the PCB.

Solder, and snip the same way we illustrated previously.

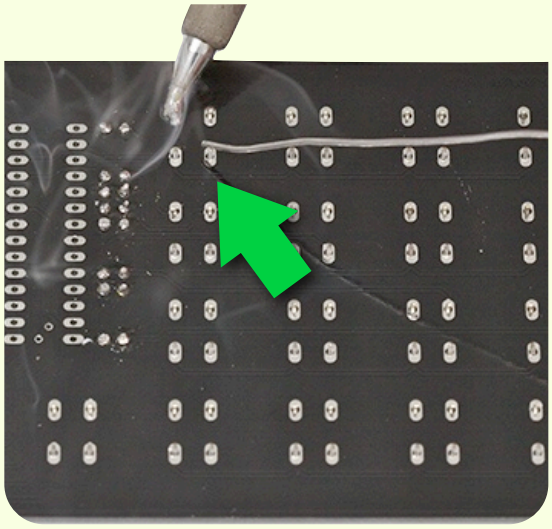
Step Six : Buttons

There are 17 buttons. Mount each of the buttons until the bottom is as flush as possible with the surface of the PCB.

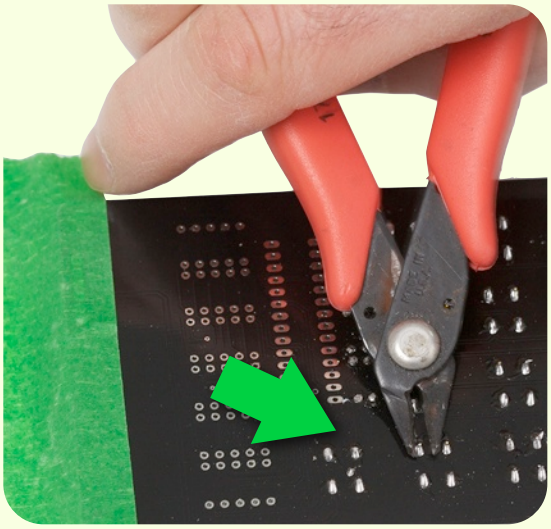
Check to be sure they are all flush before soldering.



Solder the 4 legs of each button.



Trim the small amount of excess.



Step Seven : Preparing the LED modules

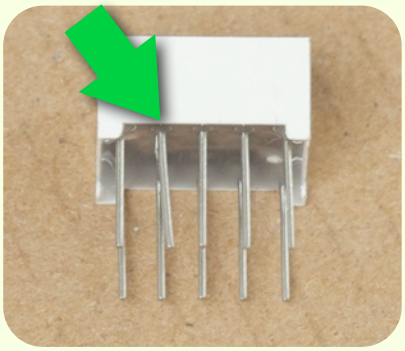
Some of the LED modules **may** have some residual epoxy spots on the left and right sides.

These spots will not allow the LED modules to be flush side-by-each when installed.

Visually inspect the left and right side of each LED, and if required, shave off any spots that may be there using a sharp utility knife.

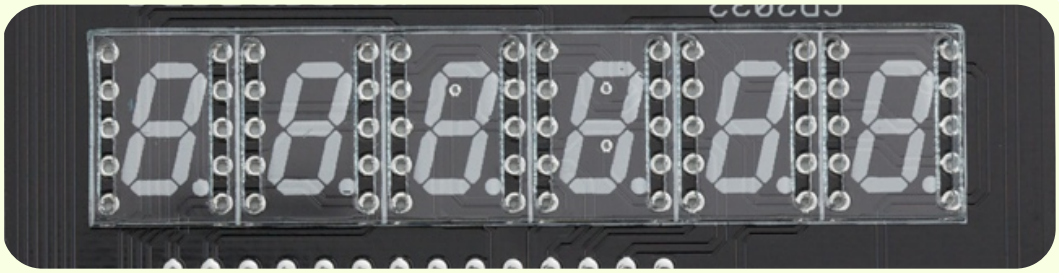
Step Eight : Straighten the LED module legs

Inspect the legs of each LED module, if any of the legs are slightly bent, straighten them. This will make the installation step easier.



Step Nine : LED module spacer

Place the LED spacer on top of the PCB



This is used to make the top of the LED modules more flush with the top of the case.

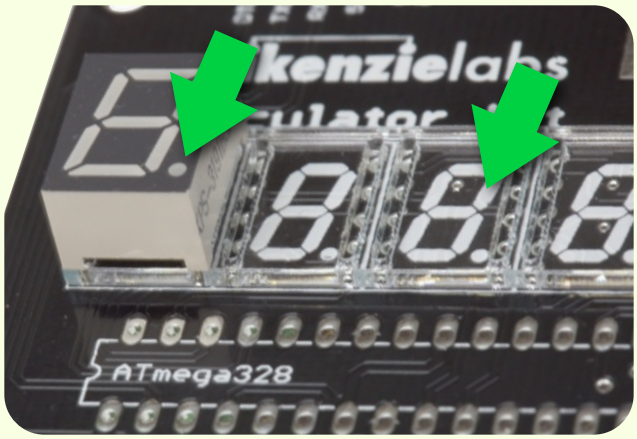
This part is **very fragile**. If you happen to break it, it is still usable. It will not be visible once The Calculator Kit is fully assembled.

Step Ten: LED module mounting

Mount each of the LED modules through the slots in the spacer.

If you have trouble getting the legs to slide all the way through, inspect the legs, adjust and try once again.

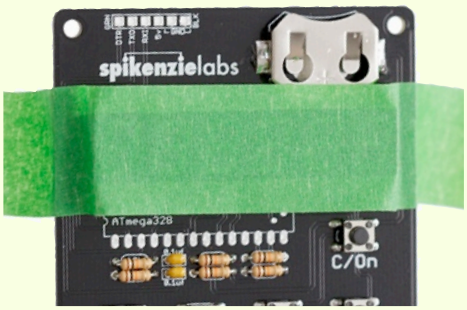
Note the orientation of the decimal point. It is at the bottom.



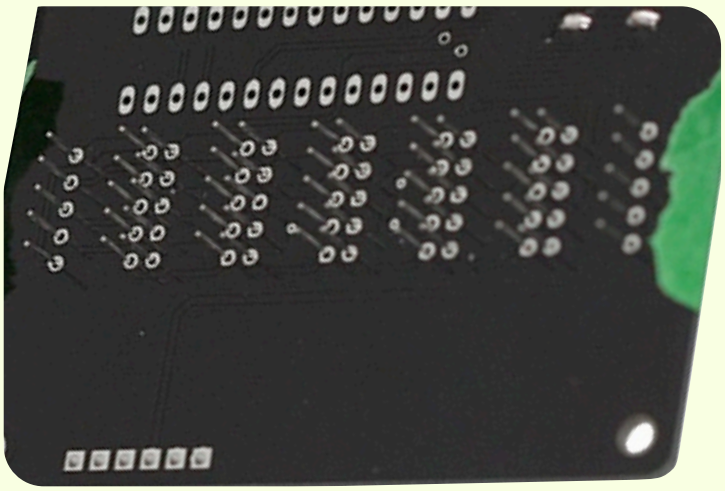
When fully inserted, the led modules will look like this:

Align the modules as best you can to be flush one up against the next, and put a layer of painter's tape across the face of the modules.

This will not only protect them during soldering, but also hold them in place.



Solder and then trim the excess legs. It is easiest to do one column of legs at a time.

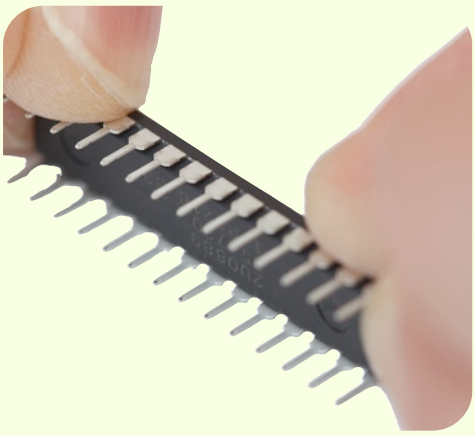


Step Eleven : Preparing the ATmega 328 IC

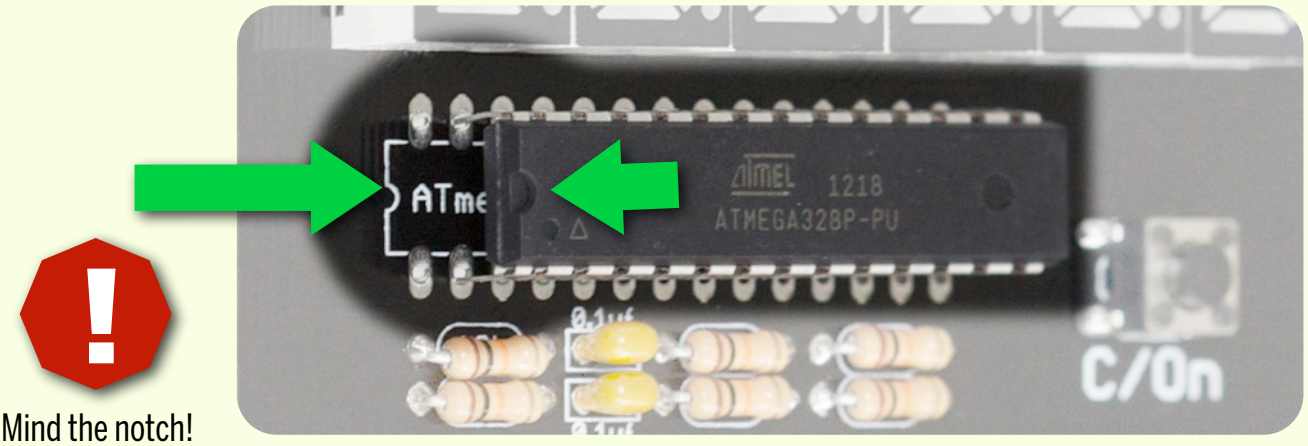
Remove the IC from the antistatic foam. Hold it firmly on either end, and press the legs down on a flat hard surface.

When manufactured, the legs are flared out slightly. To be mounted to the PCB, the legs need to be closer to the body of the IC.

You can test fit it on the PCB if you think you have them straight enough.



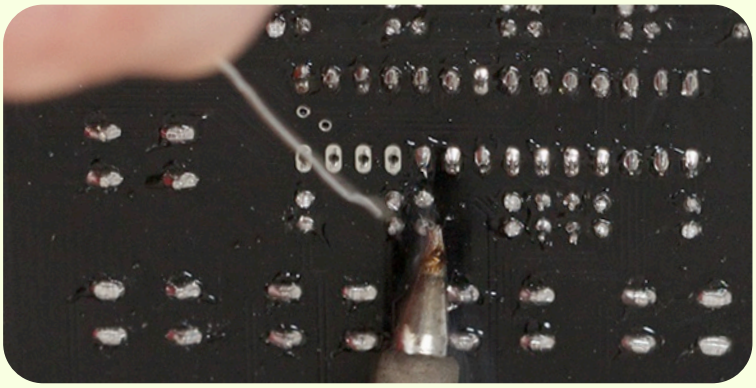
The IC has a notch on one side. The PCB has a printed notch. When you are mounting the IC to the PCB, make sure the notches are lined up.



Mind the notch!

Start by soldering the top left and bottom right leg. Check to make sure the IC is laying flat all the way across the body.

If it has shifted, reheat a leg while pressing on the top of the IC. Careful not to touch any of the metal legs while doing this.

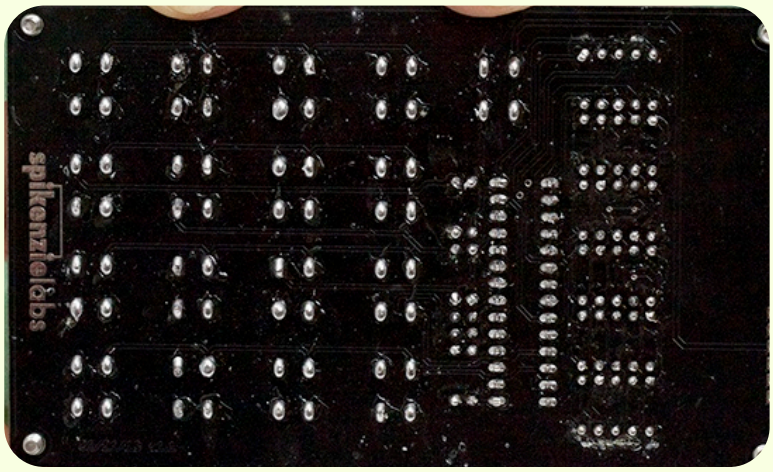


When you are satisfied that the IC is flat, continue to solder and then trim the tips of the legs.

Step Twelve : Visually inspect the bottom of the PCB

Look closely at the bottom of the PCB. Look for errors, solder jumpers between two pads, solder points that you missed etc. Correct any mistakes, see the photo below:

Double Check



Now that you are finished soldering, wash your hands with soap and water, and prepare a clean surface for the construction of the housing assembly.

Test your work: Insert the battery with the (+) facing up. You will see the version of The Calculator's firmware appear on the display when you install a battery for the first time, or any time you put in a battery. This is a great way to check and see if you have the latest firmware release installed.
Test it out, and remove the battery. It doesn't need to be in for the housing construction.

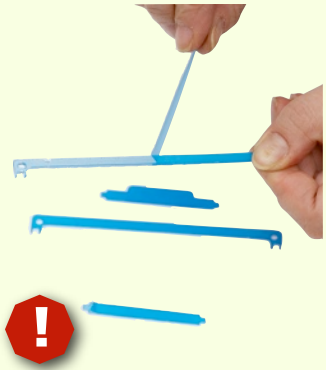
Laser cut housing construction

Now, you are going to build the housing. The plastic parts that shipped in your Calculator Kit need to have their protective backing removed. It comes off somewhat easily. Start at one corner, and peel across.

As you are peeling, if you see scuffs, or fingerprints on the clear acrylic, you can use a soft lint free cloth and some non-alcohol / non-acetone based cleaner to remove dust / little bits of plastic that cling.

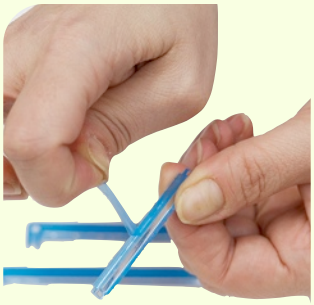
At SpikenzieLabs, we use Windex.™ It works great. You can use a comparable product.

1- 1/8" and 2-1/16" full sized pieces



Fragile

1/16" Spacers



3/16" Spacers

1/16" Button bases

Peel all of these, and group each of the 4 above piece types with each other.

Don't remove the double-sided tape backing yet.

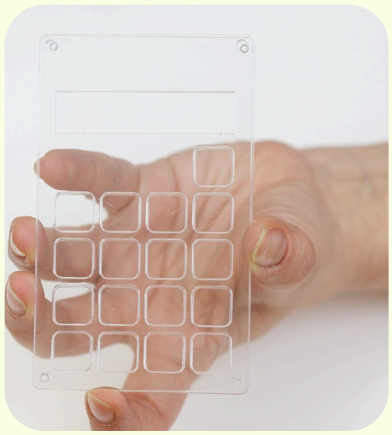
For the black buttons, peel the tape from the top side only. The top side is shown in the photo to the left.

Double sided tape has been pre applied during manufacturing, and you are going to be exposing it in a later step.

The next few steps you will temporarily use the bottom bezel and button guide to help center the buttons on the button bases. This ensures that they both do not bind when installed in the housing.

Take the back cover (1/16” thick), and place the button guide (1/8” thick) on top of it.

Place one of the button bases in each of the 17 place holders. See above:



Now, there is a button base in each of the spaces provided.

Take the remaining large piece, the button bezel, and place it on top of the button guide.

Your layers from top to bottom should be:

- Button bezel
- Button guide (with all 17 bases)
- Back cover

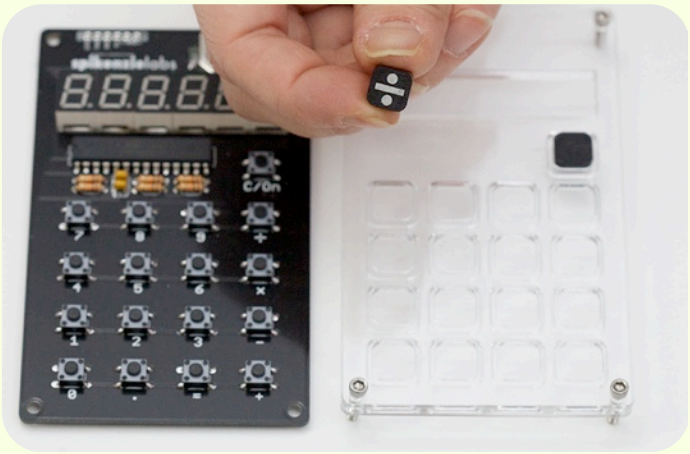
Look directly through the ‘sandwich’ of plastic in front of you. Holding it firmly at the sides, align them all to be perfectly framing each of the button bases and holes in the button bezel centered.

Screw in the 4 provided screws. Do not over-tighten. The screws are going in temporarily to hold the button pad assembly.

The reason why we are going through this temporary measure for securing the plastics together is to achieve a perfect placement of the black button to the button base.

Don't try to place the black buttons freehand.

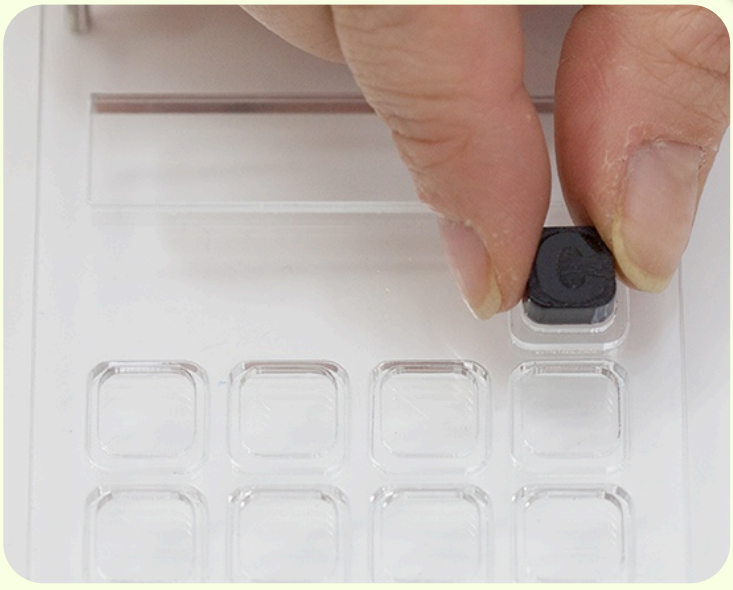
We left the tape on the top of the button for clarity.



Take the PCB, and set it down on your work table in the same orientation as the plastics as in this photo:

Peel the bottom double-sided tape cover off completely. Handle the button from the sides only at this point. Look at the top of the button so that you can orient it in the proper direction when mounting.

If you happen to place a button in the wrong spot, you can move it later on.



Use the PCB to show you where each of the black buttons gets placed.

Hold the black button directly over the opening in the top bezel, and press it down onto the button base (rounded square pieces).

The button will instantly bond to the button base, and contiune to the next one.

The temporarily screwed together plastics in this configuration is the easiest way to accurately stick the buttons into place.

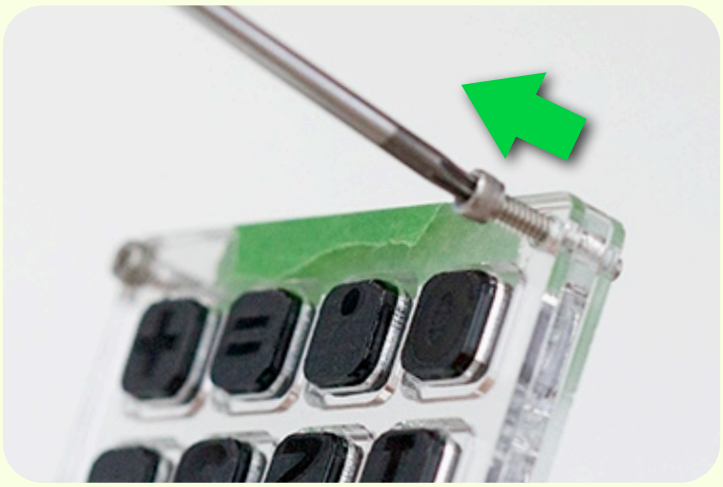
As you go, you will see the buttons array come together like this:

Keep sticking until all the buttons are in place.

Once all the buttons are in place, press firmly on the tops of all the buttons, while supporting underneath.

Hold the plastics assembly in one hand, and give it a shake. You should hear the buttons free and loose, rattling. This is good, and very normal.

Place some tape on the 4 sides to temporarily hold the layers together.

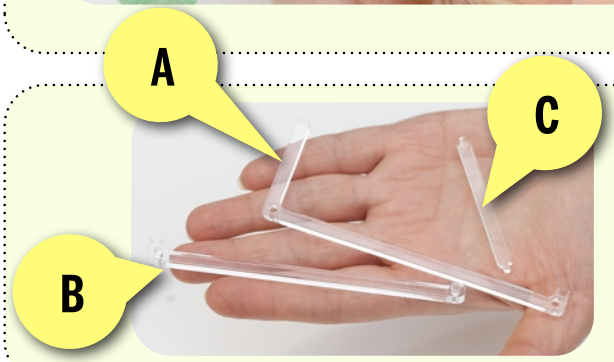


Remove the screws from the plastic.The tape will hold everything in place. Remove the back cover, and set aside.

From the front of the calculator, slide the screws back into place, and move the tape from the sides to the tops of the screws as in the photo.

Careful to hold it in such a way that the buttons don't fall out.

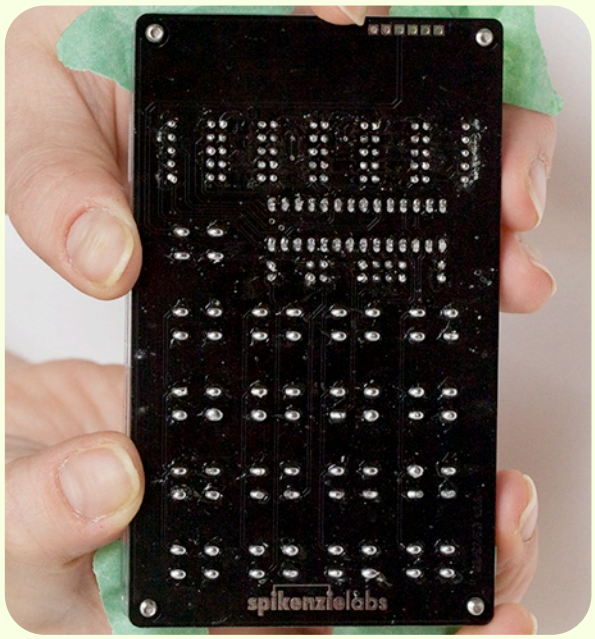
If they do, put them back in their corresponding spots.



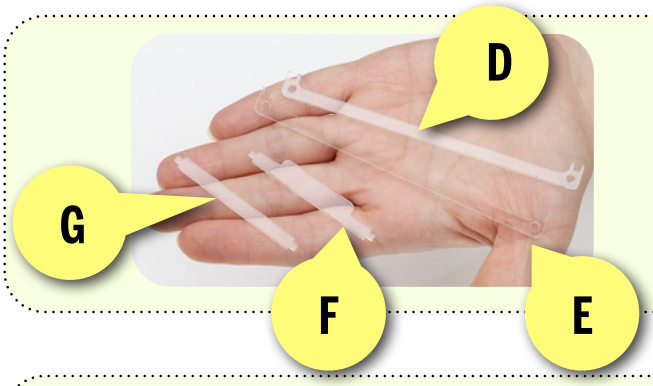
These three pieces go between the button guide, and the PCB. They are all 3/16" thick.

Place each of these pieces in place. The shaft of the screw goes through the holes in the 3/16" acrylic. Do steps A, and B, and then part C will fit right in to the notches and be held in place.

While holding the plastics flat, face down, lower the PCB over the top, and line up the screw holes with the screws. It will slip into position.



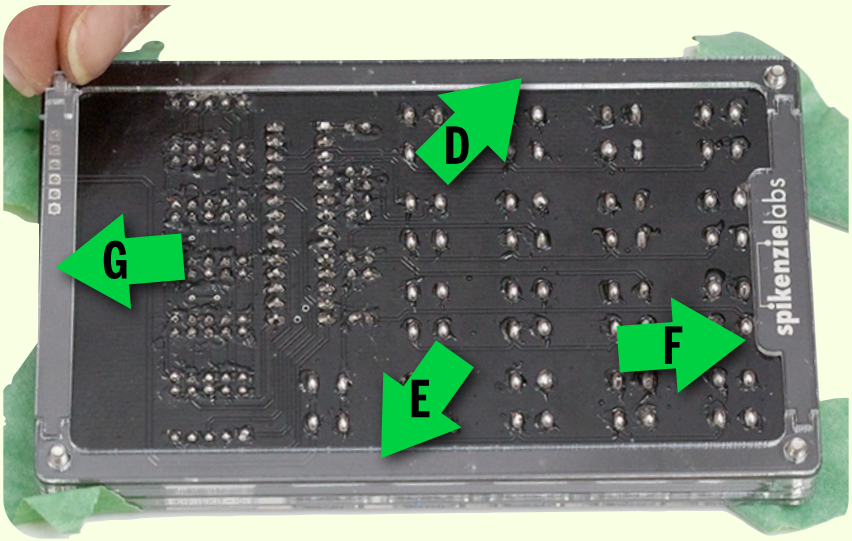
You can now put it face down on your workbench, Take another moment to inspect the back of the PCB for any debris that may be sticking to your soldering.

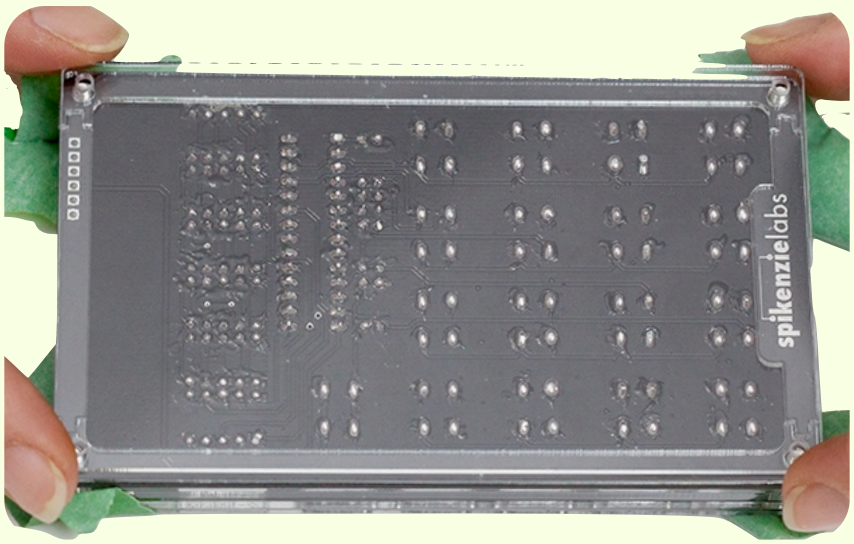


These four pieces go between the bottom side of the PCB, and the back cover. They are all 1/16” thick, and rather fragile. Handle with care.

Note: Part **D**, and **E** are identical.

Just as before, place the 1/16” pieces using the letter guide above. Insert the **D** and **E** pieces before **G**, and **F**.





Place the back cover. It is tapped, so you will be able to screw right into it.

Remove the tape from one screw at a time, and screw the back panel into place.

Peel and place the four silicone feet near each corner. Don't place them directly under the screws, they won't stick as well.

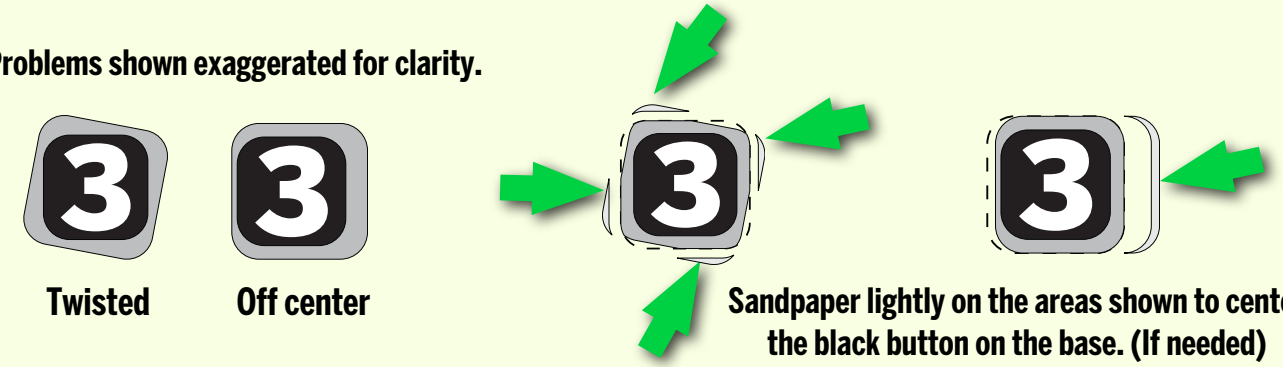
Test all of the buttons, pressing them one at a time. They should all 'Click' (press the momentary switch beneath them) and pop back up. If any are sticking in the down position, unscrew the assembly and check for either or both of these possibilities:

- Irregular or sharp edges.
- Improper alignment of the black button on the button base.

Don't try to remove the black button from the base.

The way to go about fixing this issue is to use a piece of sandpaper, and sand the extra off. See the illustrations below.

***Problems shown exaggerated for clarity.**



Twisted **Off center**

Sandpaper lightly on the areas shown to center the black button on the base. (If needed)

Last Step:

Slide the battery in with the etched side (+) up.

Push all the way in to the battery holder.

Enjoy!

Using The SpikenzieLabs Calculator

- Turn it on by pressing the [C] - Clear key.
- The calculator turns itself off after about 20 seconds of inactivity.

The SpikenzieLabs Calculator kit is based on the ATmega328. An 8 bit microprocessor that is programmed with the Arduino IDE. This means that the calculator has the potential to be improved by users. All that you need to do is download the code, hack it and then reprogram using a FTDI cable.

There are a few limitation to the calculator.

1. Max 6 digits positive or 5 digits negative
2. Numbers are rounded to a maximum of four decimal places. Entry of six decimal places is possible, but like the results, they will get rounded.
3. According to Arduino, the maximum about only 6 digits of accuracy are possible.
4. Can not do zero calculations. Eg 5 + 0 (Why would you need to do this anyway?)

How to play with the code:

Download the software from our webpage: http://www.spikenzielabs.com/Downloadables/calc/code

Open in Arduino, make your modifications and when you want to re-upload, remove the battery, connect a 3 or 5 volt FTDI style cable, and select the type of Arduino in the photo below:

Compile & upload, disconnect the FTDI cable, replace the battery, and have fun.