



## Simon SMD

### Kit Information & Instructions



This is a kit of loose components that go along with the SMD Soldering Lecture. This is considered an intermediate kit for people who have soldered through-hole components before and wish to learn how to solder surface mount components. This kit comes with a preprogrammed ATmega328. All parts are listed below.

#### Kit includes:

- NCP1402 IC
- 10k Ohm Resistor
- 47 $\mu$ F Capacitor
- 10 $\mu$ F Capacitor
- 0.1 $\mu$ F Capacitor (qty 2)
- MBRA140 Diode
- 22 $\mu$ H Inductor
- 330 Ohm Resistors (qty 4)
- Pre-programmed ATmega328 TQFP IC
- Buzzer
- LEDs (qty 4)
- Battery Clips (qty 2)
- Switches (qty 2)
- Screws (qty 4)
- Standoffs (qty 4)
- Bezel Frame
- Button Pad
- Battery

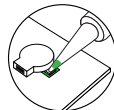
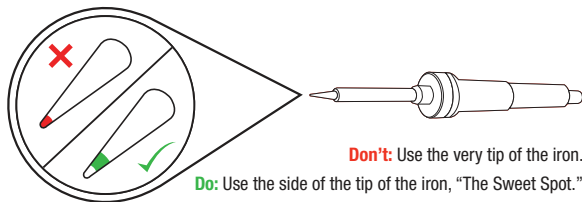
#### Additional Tools Needed:

- Tweezers
- Soldering Iron
- Solder
- Solder Wick
- Flux
- Eye Protection

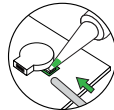
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## ! SMD SOLDERING TIPS



**Do:** Touch the iron to the component leg and metal SMD pad at the same time.



**Do:** While continuing to hold the iron in contact with the leg and metal pad, feed solder into the joint.



**Don't:** Glob the solder straight onto the iron and try to apply the solder with the iron.



**Do:** Use a sponge to clean your iron whenever black oxidization builds up on the tip.

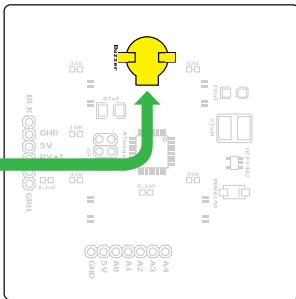


Steps highlighted in yellow represent a polarized component. Pay special attention to the component's markings indicating how to place it on the board.

1 Locate the **Buzzer**.

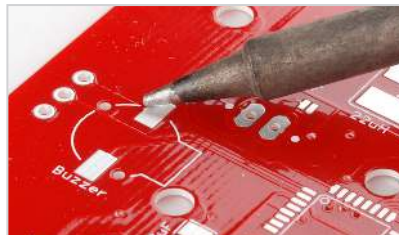


2 Locate the **Buzzer** position on the board.



**BOTTOM OF BOARD**

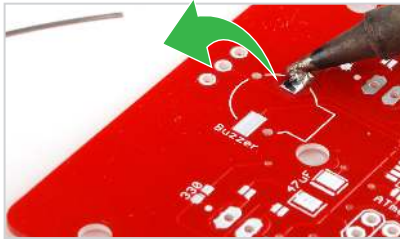
3 Touch iron's sweet spot to the start-pad for 2-3 seconds.



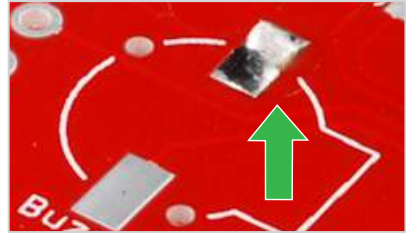
4 Pre-tin the start-pad by feeding solder into the joint.



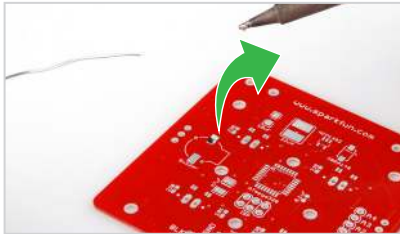
- 5 First, pull solder away.



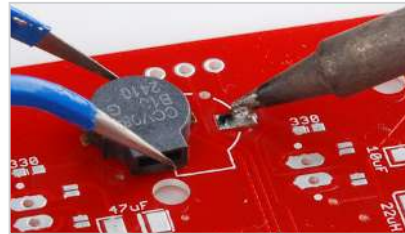
- 7 Solder should cover the entire pad and look like this - a tiny pillow.



- 6 Second, remove the iron.



- 8 Using your tweezers, position the buzzer slightly away from the pad.



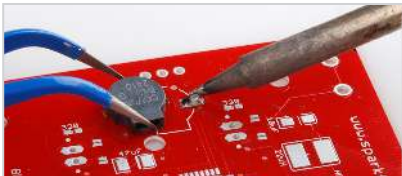


For step 9, understand that alignment of the buzzer is very important. You want to ensure the buzzer is centered and laying flat against the board. See possible errors to the right (Page 9).

9

### Reheat Start-Pad

A



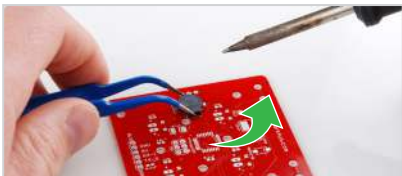
B

### Slide Into Place



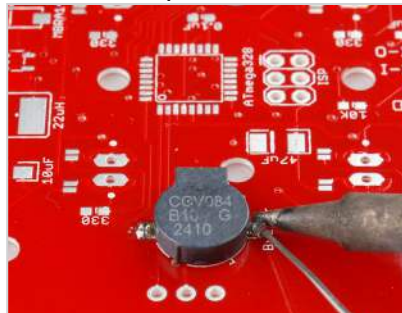
C

### Remove Iron



### Add solder to second pad.

D



BAD



BAD



GOOD



To fix these potential problems, reheat the solder while moving the buzzer into place with your tweezers.



CONTINUE WITH THE **BOTTOM OF THE BOARD** [ STEPS 10 TO 16 ]



Now that you've successfully soldered down your first SMD component, use the same method to place and solder the following components.



**10** 10uF Capacitor

**10uF Capacitor** To help you find this part in your kit, the capacitor is labeled with a **red** marker. The white end of the capacitor should point towards the rounded end on the PCB's silkscreen.



**11** 22uH Inductor

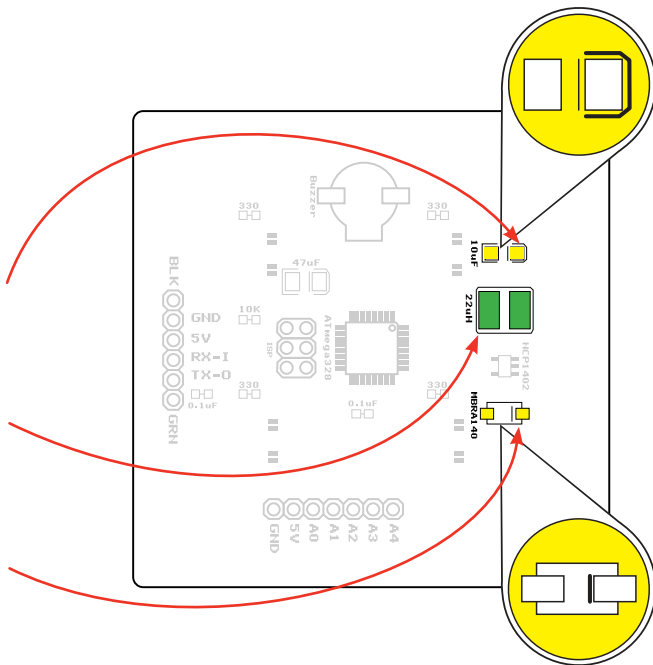
**22uH Inductor** Make sure the inductor remains inside its white outline after you've soldered both legs.



**12** MBRA140 Diode

**MBRA140 Diode** To help you find this part in your kit, the diode is labeled with a **yellow** marker. Before soldering, double-check that the white line on the diode matches the line on the PCB's silkscreen. The white line is similar to the line on the 10uF capacitor in step 10.

## BOTTOM OF BOARD



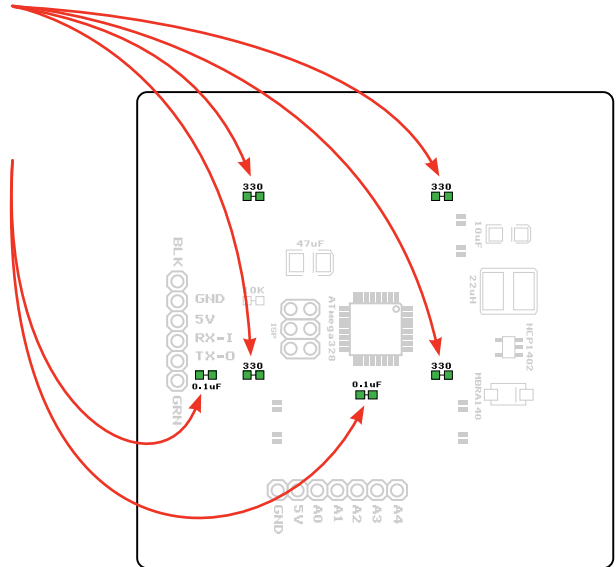
Remember, components highlighted yellow are polarized.

**13** 330 Resistors

**330 Resistors** These resistors are not polarized. However, they do have a value marking on the top side. Make sure the marking is facing up.

**14** 0.1uF Capacitors

**0.1uF Capacitors** Ceramic capacitors like these are not polarized. They don't have a value marking. This means they can be soldered into place in any rotation.





15 47uF Capacitor ⚠

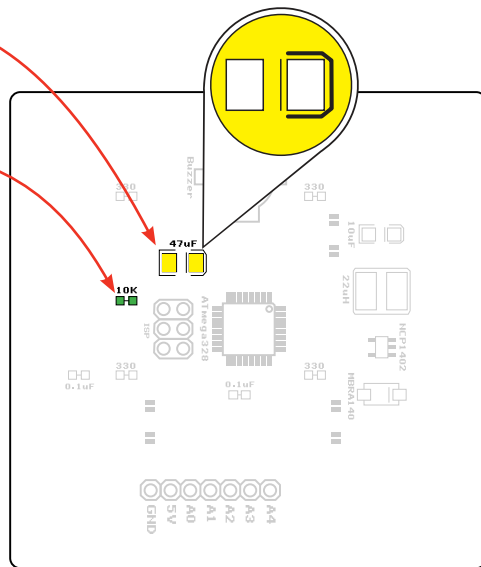
**47uF Capacitor** To help you find this part in your kit, the capacitor is labeled with a **green** marker. The white line on the capacitor should point towards the rounded end on the PCB's silkscreen.



16 10K Resistor

**10K Resistor** To help you find this part in your kit, the resistor is labeled with a **blue** marker. Just like the 330 resistors, these are not polarized. Make sure the writing on the part ('103') is facing up.

## BOTTOM OF BOARD



Remember, components highlighted yellow are polarized.



## QUICKSTART • LEVEL-2 SMD SOLDERING

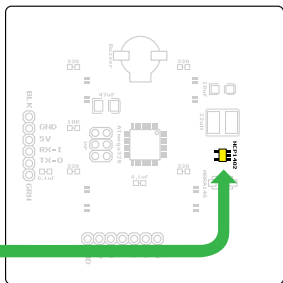
[STEPS 17 TO 21]

Now that you've successfully soldered down all Level-1 components, you are ready to move on to Level-2. The next set of components have five or more pads each, and the pad size is smaller. Although this is more challenging, you will use the same methods as before.

- 17** Locate the **NCP1402**. Be sure to match up the legs with the pads on the PCB. This component is polarized.



- 18** Locate the **NCP1402** position on the board.



Remember, components highlighted yellow are polarized.

- 19** Touch iron's sweet spot to the start-pad for 2-3 seconds.



- 20** Pre-tin the start-pad by feeding solder into the joint.





For step 21, use the same three-step process you learned earlier (Step 9, Page 8). A common error for these smaller types of components is a jumper. To help avoid these, try not to use too much solder.

21

Reheat Start-Pad



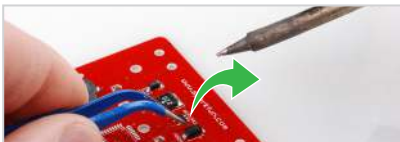
A

Slide Into Place



B

Remove Iron

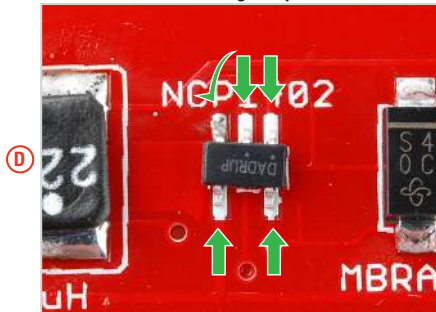


C



Understand the alignment of the component is important, and should be oriented to look like the picture.

Add solder to the remaining four pads.



D

BAD



GOOD



Learn how to fix a jumper on Page 40 in the Troubleshooting section.



CONTINUE WITH THE **BOTTOM OF THE BOARD**



Now that you've successfully soldered down your Level-2 SMD component, use the same method to place and solder the next component. You can choose any pad to be your Start-Pad.



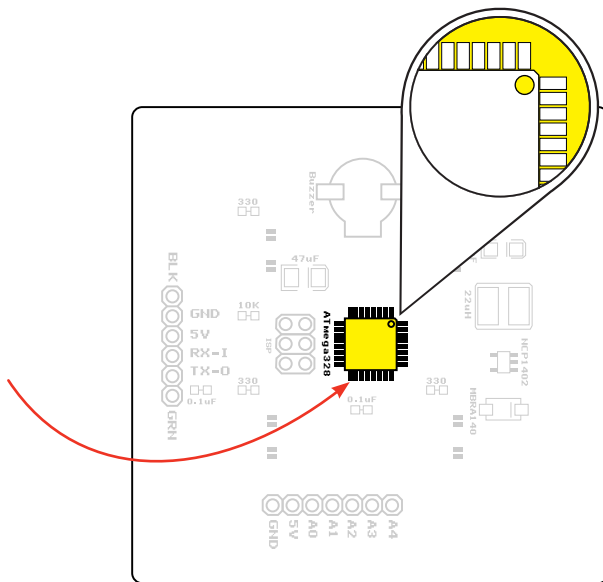
22

ATmega328



**ATmega328 Microcontroller** Match up the circle on the IC with that on the PCB's silkscreen. Solder a corner leg of the IC, and verify that the chip is well-aligned. Continue to solder the remaining 31 legs.

**BOTTOM OF BOARD**



Remember, components highlighted yellow are polarized.

## ! QUICKSTART • PTH SOLDERING



**A** Solder flows around the leg and fills the hole - forming a volcano-shaped mound of solder.



**B** **Error:** Solder balls up on the leg, not connecting the leg to the metal ring.  
**Solution:** Add flux, then touch up with iron.



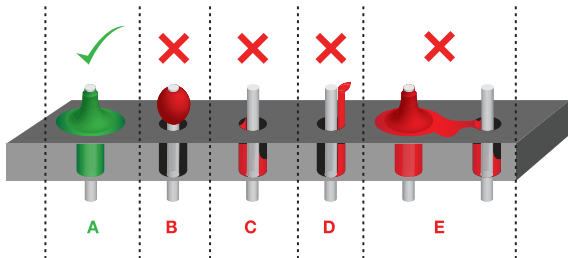
**C** **Error:** Bad Connection (i.e. it doesn't look like a volcano)  
**Solution:** Flux then add solder.



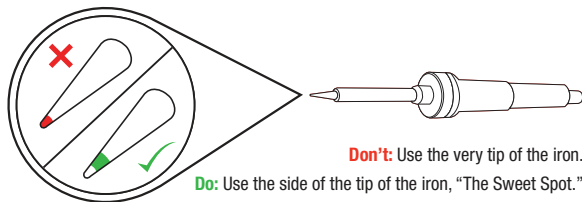
**D** **Error:** Bad Connection...and ugly...oh so ugly.  
**Solution:** Flux then add solder.



**E** **Error:** Too much solder connecting adjacent legs (aka a solder jumper).  
**Solution:** Wick off excess solder.



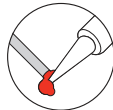
## ! PTH SOLDERING TIPS



**Do:** Touch the iron to the component leg and metal ring at the same time.



**Do:** While continuing to hold the iron in contact with the leg and metal ring, feed solder into the joint.



**Don't:** Glob the solder straight onto the iron and try to apply the solder with the iron.



**Do:** Use a sponge to clean your iron whenever black oxidization builds up on the tip.



CONTINUE WITH THE TOP OF THE BOARD

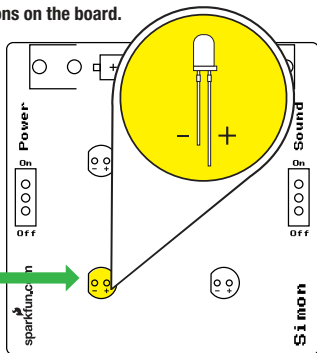
[STEPS 23 TO 27]

- 23 Locate the LEDs (qty 4).



- 24 Turn the board over and locate one of the LED positions on the board.

TOP OF BOARD



Remember, components highlighted yellow are polarized.

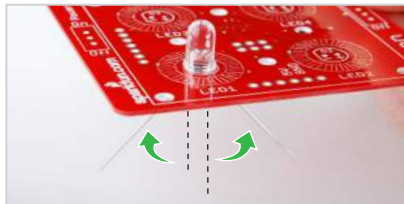
- 25 Insert the LED into the PCB, so that the short leg goes into the hole labeled with the “-” sign.



- 26 Push the LED in so it is flush with the board.



- 27 Slightly bend the legs outward to hold it in place.





CONTINUE WITH THE **BOTTOM OF THE BOARD** [STEPS 28 TO 31]



For step 28 there are four sub-steps.

28

Flip the board over. Hold the soldering iron's "Sweet Spot" so it touches both the leg and the metal ring. Hold for two seconds.



A

[ **BOTTOM OF BOARD** ]

Feed solder into the joint.



B

Pull the solder away.



C

Remove the iron.



D

- 29 Your solder joint should look like this - a tiny volcano.



- 31 Clip off any excess legs.



- 30 Using the same PTH methods, add solder to the second leg.





## CONTINUE WITH THE TOP OF THE BOARD

[STEPS 32 TO 34]



Now that you've successfully soldered your first PTH component, use the same method to place and solder the next components.

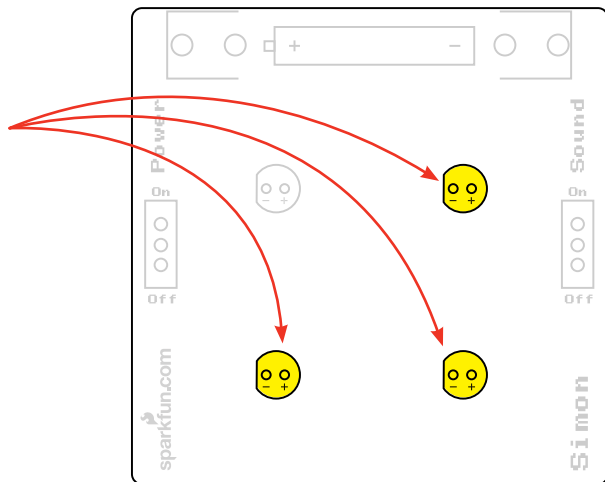


32

LEDs



**LEDs** (indicator lights) Just as you did with the first LED make sure the short leg goes into the hole labeled "-". Also make sure it sits flush with the PCB. Then solder into place.



Remember, components highlighted yellow are polarized.





33 Slide Switches

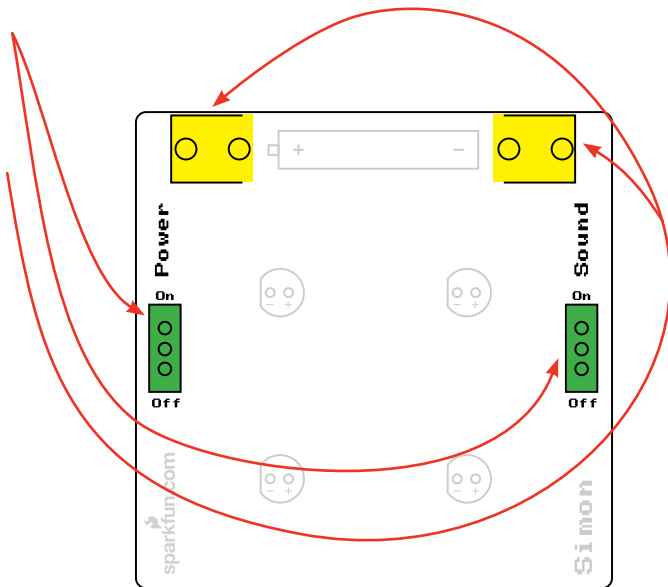
**Slide Switches** Keep the iron tip away from the black part of the switch! Plastic melts easily (and stinks).



34 Battery Clips ⚠

**Battery Clips** Both clips need to be pointed towards each other. The solid backing on each clip should face the outside of the board. These require a lot more heat to melt the solder, you need to leave the iron tip on a bit longer than usual (5-6 seconds). Don't touch the clip after soldering! Give it some time to cool off.

TOP OF BOARD



Remember, components highlighted yellow are polarized.

## FINAL ASSEMBLY

[ STEPS 35 TO 38 ]



**No screwdriver necessary.**  
Please only hand-tighten the screws and standoffs.



**35** Button Pad

**Button Pad** (game control) Attach to top. Lay rubber button pad over LEDs.



**36** Bezel

**Bezel** (holds button pad) Attach to top. Lay bezel over button pad, with notches for the screws pointing up.



**37** Screws x 4

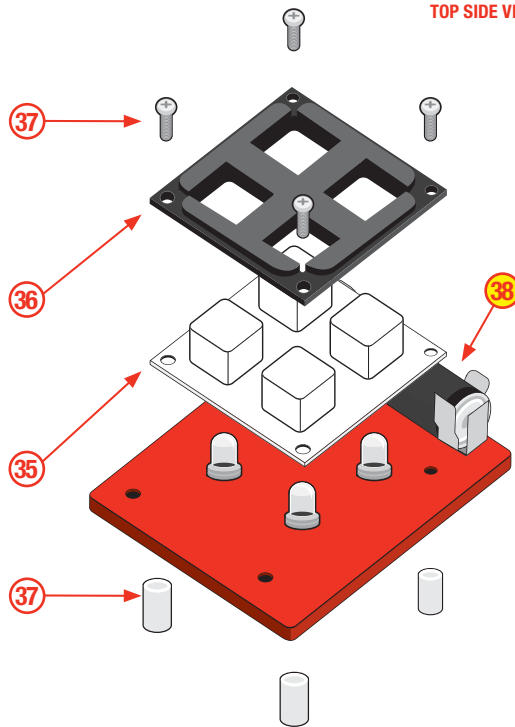
**Standoffs and screws** (mechanical) Insert the screws through the bezel and button pad, then twist standoffs onto the protruding screw. Hand tighten.



**38** AA Battery ⚠

**AA Battery** (power source) Insert the battery, following “+” and “-” indicators on the board. Turn on the board and verify the LEDs are flashing.

TOP SIDE VIEW





## CONGRATULATIONS, YOU'RE DONE!!!

Your Simon game is now complete. Turn it on and have fun! If something is not working (i.e. an LED won't light up), please check out the Troubleshooting LEDs section at the end of this booklet for more help (Pages 38 and 39).

## CREATE YOUR OWN PROJECT WITH SIMON

Did you know that your Simon is much more than it seems? It can be re-programmed to do many different things! You can write code to change your Simon into a new unique project. To learn more, please check out our online tutorial here: [sparkfun.com/tutorials/203](https://sparkfun.com/tutorials/203)

And for even more fun stuff go here: [learn.sparkfun.com](https://learn.sparkfun.com)

## EXTRA FUN

As an example of how the Simon is more than just a game, we have included a special feature in the code. Just for fun, try this out. Don't worry it won't change your Simon permanently.

- A** Turn off power switch.



- B** Press any one button.



- C** While holding button down, turn back on.



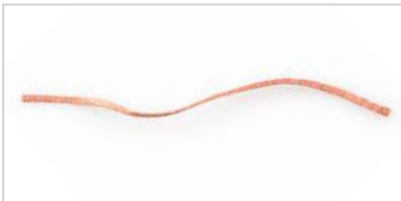


## ! TROUBLESHOOTING JUMPERS

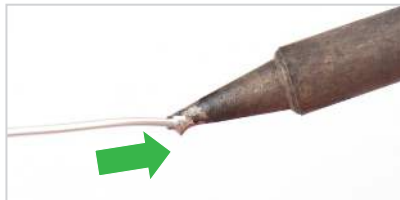
- A** As you solder the other pins down, if you solder multiple pins together, don't worry about it! It can be easily fixed. There are actually two pins under that blob.



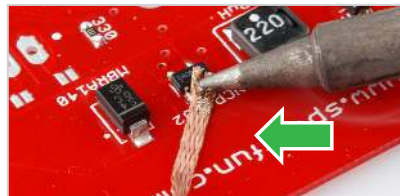
- B** Locate a piece of solder wick.



- C** Put a small amount of solder on the end of your iron (this will transfer heat from iron to wick to the jumper). Sandwich the wick in between the iron and the solder jumper.



- D** Hold still for 2-3 seconds. You will see solder start to flow up the wick.



- E** Pull both away. Nice and clean!





# Learning More

## Microcontroller and PCB

The microcontroller is the brain of the game. It's programmed to light up the buttons and create the game sequence. Bending the legs won't hurt the chip – it is designed to withstand the heat of the soldering iron as well as gentle bending.

Try to be gentle with the board, but a few scratches are not a big deal.

## Soldering

The tip of the iron is normally 700°F, hot enough to melt metal. It is normal for the handle of the soldering iron to heat up a bit. Hold it like a pencil and move your hand further away from the tip if the heat is uncomfortable. The solder smokes because the rosin inside the solder is burning off - it's not harmful.

## Buzzer and Other Components

The buzzer makes the noise for the game – pretty simple! The capacitors help “clean up” the power on the board. The resistor tells the microcontroller not to reset once the power is turned on, so your game can continue uninterrupted. The slide switches turn on and off the power and sound.

## LEDs

Light-emitting diodes (LEDs) are like light bulbs, but much smaller and more efficient.

## Buttons, Bezels, and Standoffs

Squishy buttons are fun! The bezel helps hold the buttons in place. The standoffs hold the board up off a surface, helping to protect the electronics. They also hold the pad and bezel onto the board.