

# SynShop Solder Buildup

Presented by Charley Jones, PMP aka Dataman





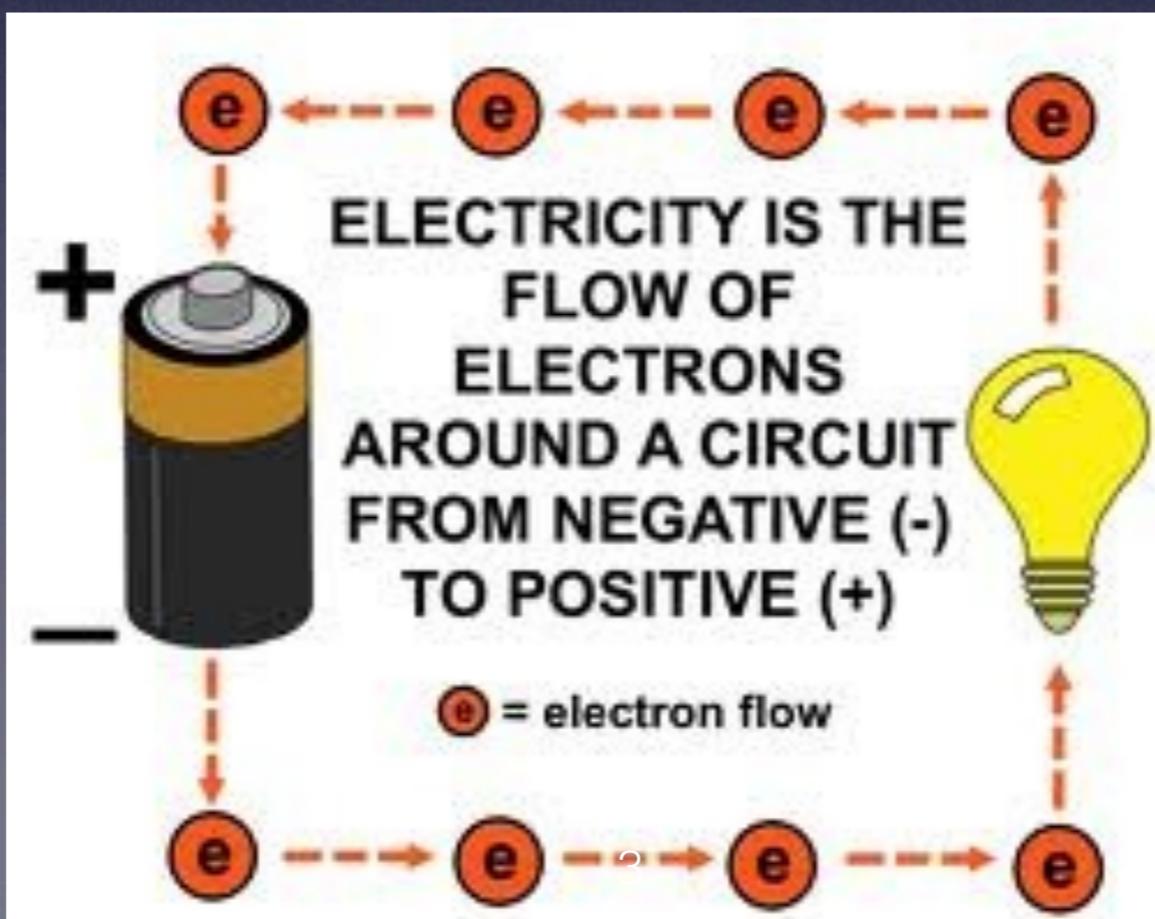
# SynShop Prototyping

**Just a review  
from the last class...**



# SynShop Prototyping

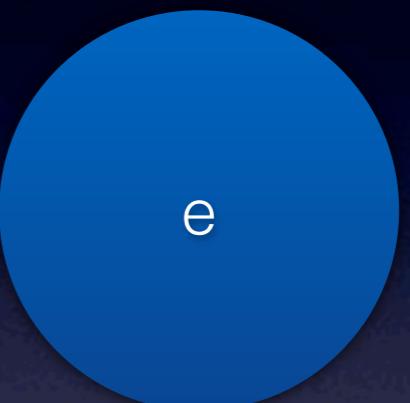
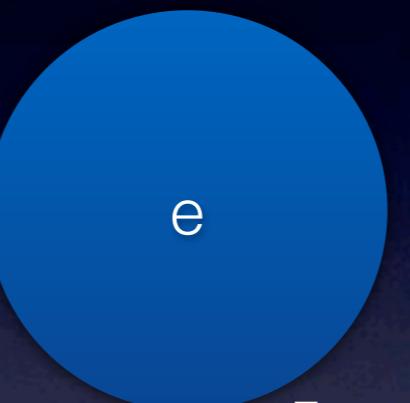
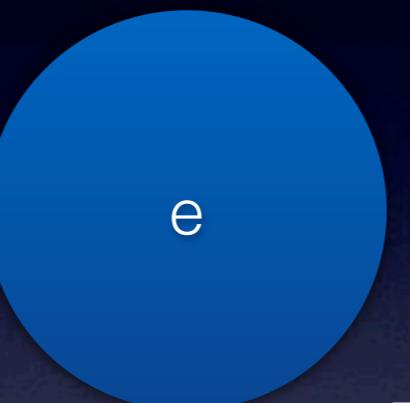
## Electrons flow from negative to positive





# SynShop Prototyping

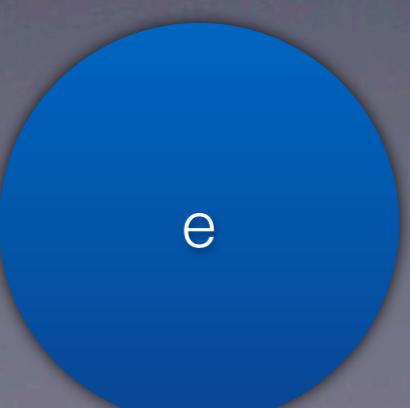
Hole  
flow



Hole  
flow



Hole  
flow



e

e

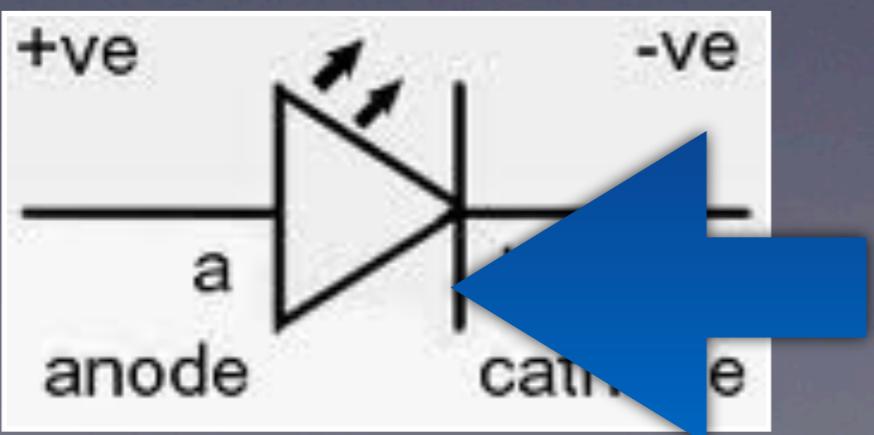
e



# SynShop Prototyping

Engineers got to design the symbols, so arrows typically point towards negative. You're a salmon Swimming up river... Against the arrows...

+  
Positive



-  
Negative





SynShop  
Prototyping

Voltage  
How badly electrons want to move.  
Potential...





# SynShop Prototyping

## Current

How quickly electrons are moving.  
Amps... Like mph...  
Water moving through a firehose.





SynShop  
Prototyping

**Resistance  
Limits How much current is  
allowed to flow. Ohms.**





# SynShop Prototyping

Ohms law.

$$V=IR$$

$$R=V/I$$

$$I=V/R$$



SynShop  
Prototyping

Mega x 1 Million  
Kilo x 1 Thousand  
Milli / Thousand  
Micro / Million  
Nano / Billion

1k ohm = 1,000 ohms  
1milli volt = 0.001 volts



# SynShop Prototyping

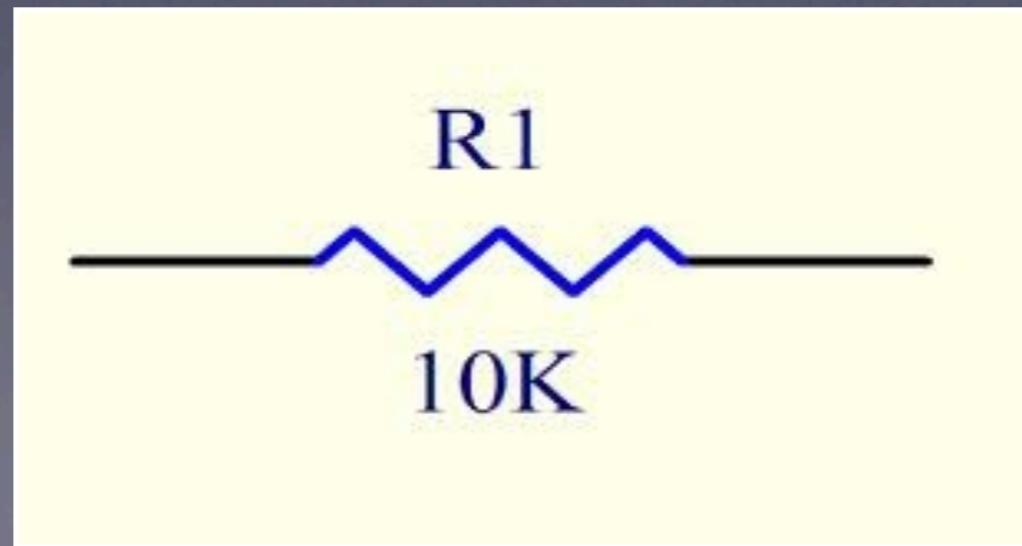
## Resistor

Most common electrical part.

Resists current. In Ohms.

higher value = higher resistance

Color coded



4-Band-Code

2%, 5%, 10%

560Ω ± 5%

| COLOR  | 1st BAND | 2nd BAND | 3rd BAND | MULTIPLIER | TOLERANCE   |
|--------|----------|----------|----------|------------|-------------|
| Black  | 0        | 0        | 0        | 1Ω         | ± 1% (F)    |
| Brown  | 1        | 1        | 1        | 10Ω        | ± 2% (G)    |
| Red    | 2        | 2        | 2        | 100Ω       | ± 2.5% (H)  |
| Orange | 3        | 3        | 3        | 1KΩ        |             |
| Yellow | 4        | 4        | 4        | 10KΩ       |             |
| Green  | 5        | 5        | 5        | 100KΩ      | ± 0.5% (P)  |
| Blue   | 6        | 6        | 6        | 1MΩ        | ± 0.25% (C) |
| Violet | 7        | 7        | 7        | 10MΩ       | ± 0.10% (B) |
| Grey   | 8        | 8        | 8        |            | ± 0.05%     |
| White  | 9        | 9        | 9        |            |             |
| Gold   |          |          |          | 0.1        | ± .5% (D)   |
| Silver |          |          |          | 0.01       | ± 10% (E)   |

5-Band-Code

0.1%, 0.25%, 0.5%, 1%

237Ω ± 1%

Electronics Express / RS<sup>R</sup>  
<http://www.elex.com>

1-800-972-2225  
In NJ 732-581-8020



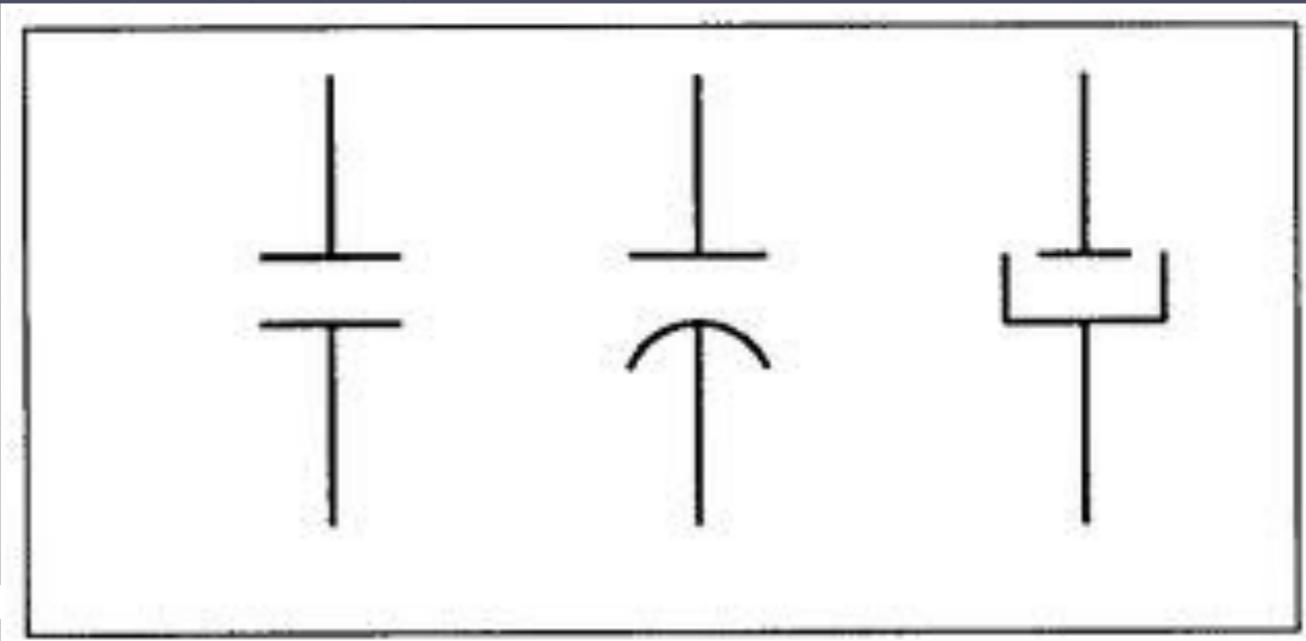
SynShop  
Prototyping

# Capacitors

Resist changes in voltage.

Polarized, long leg positive.

Value, in farads, written on side.





**RC Time Constant**  
**Resistor and capacitor in series**  
**charge at a known rate...**

**RC seconds = R ohms x C farads**

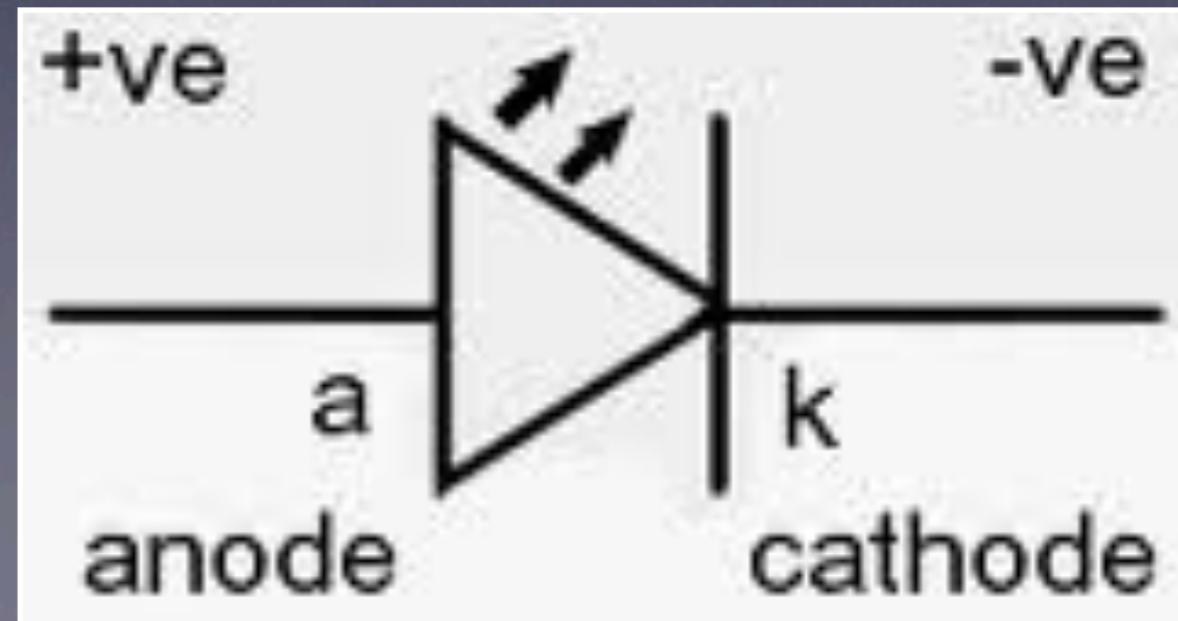
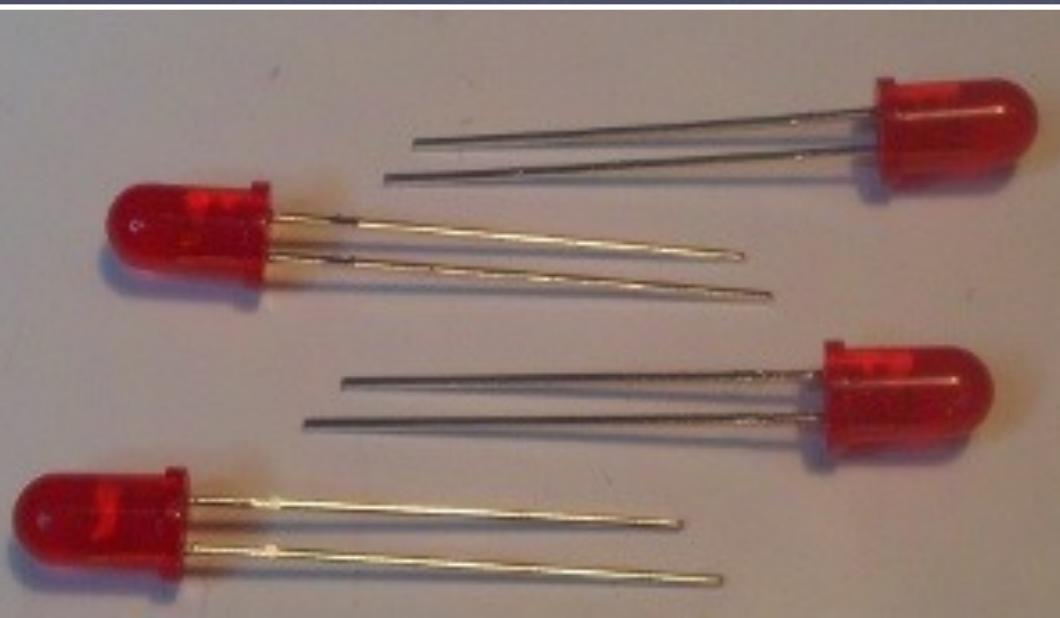
**RC = 100k ohms x 10u farads**

**RC = 100,000 ohms x 0.000,010f**

**RC = 1 second**



LEDs  
**Light Emitting Diode**  
**Allows current in one direction**  
**Polarized, long leg positive.**

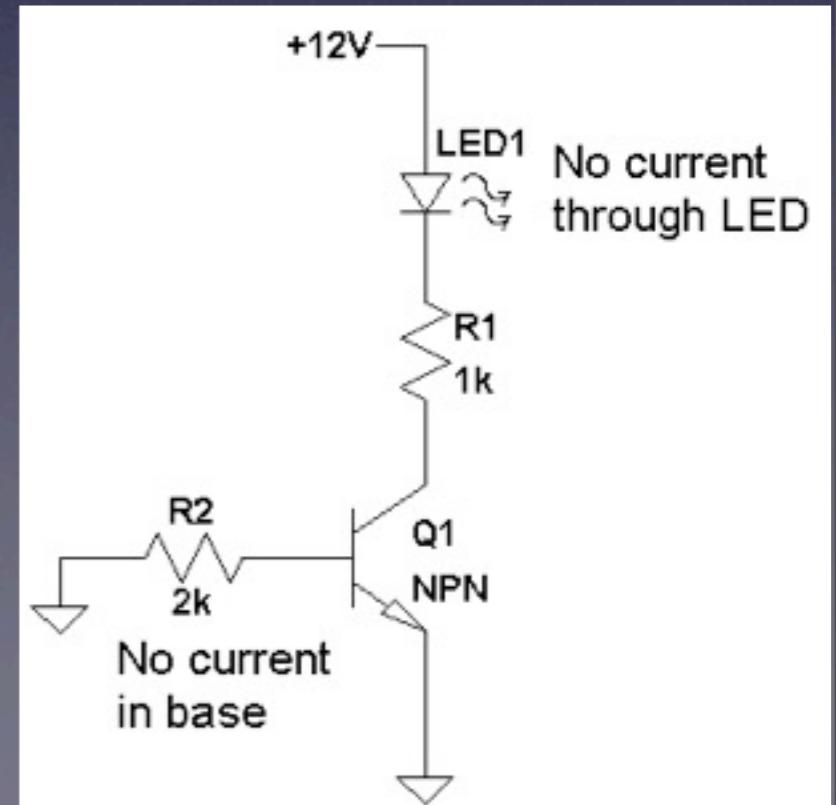
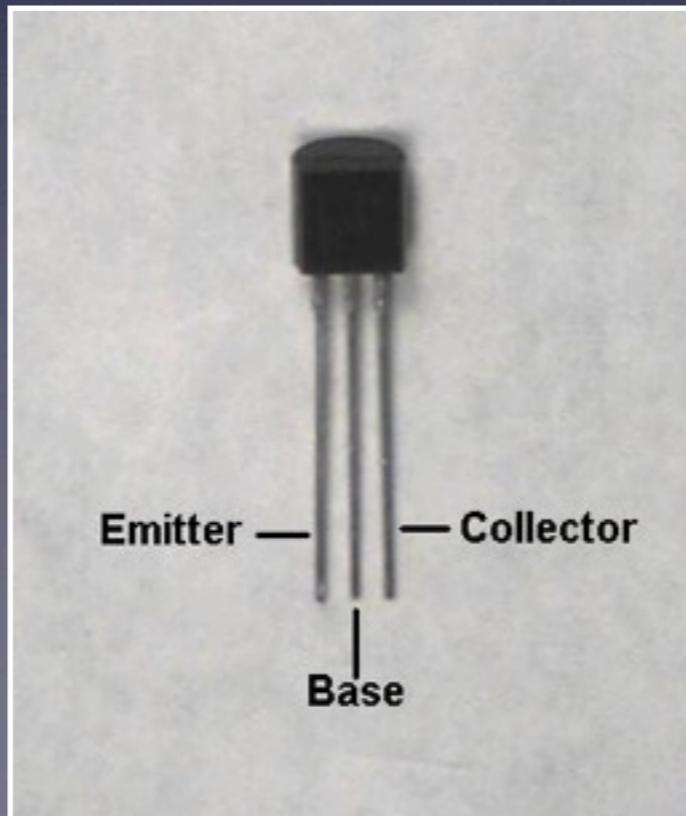
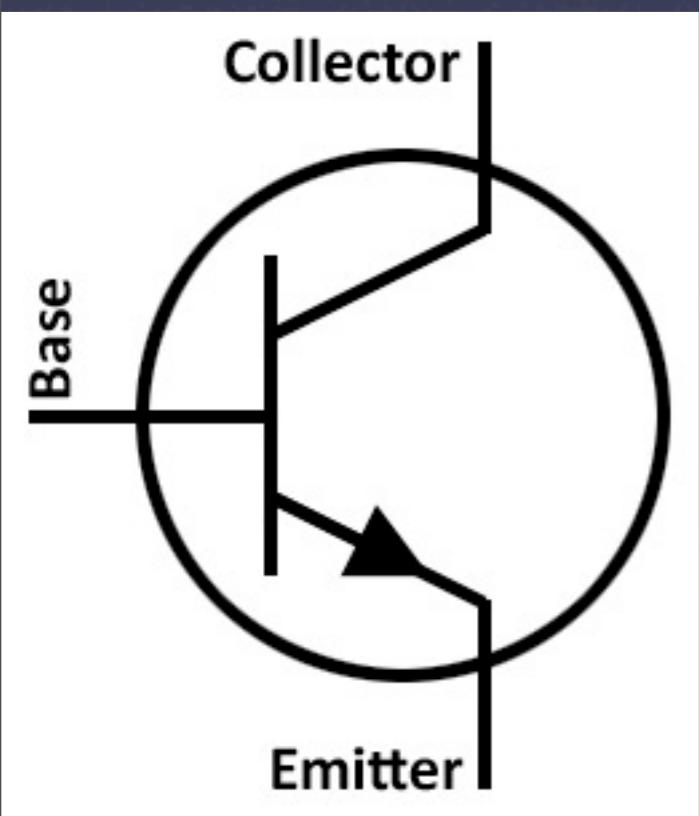




SynShop  
Prototyping

# Transistor Electronic switch.

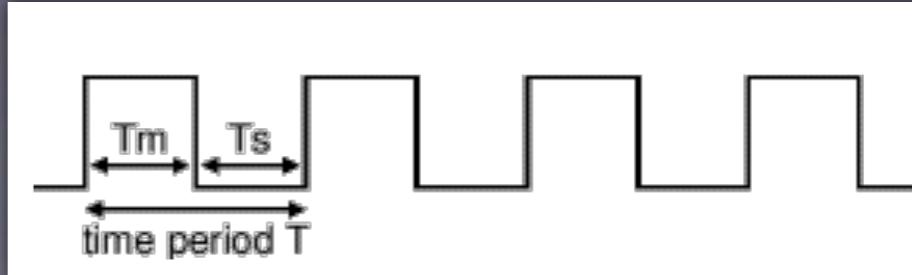
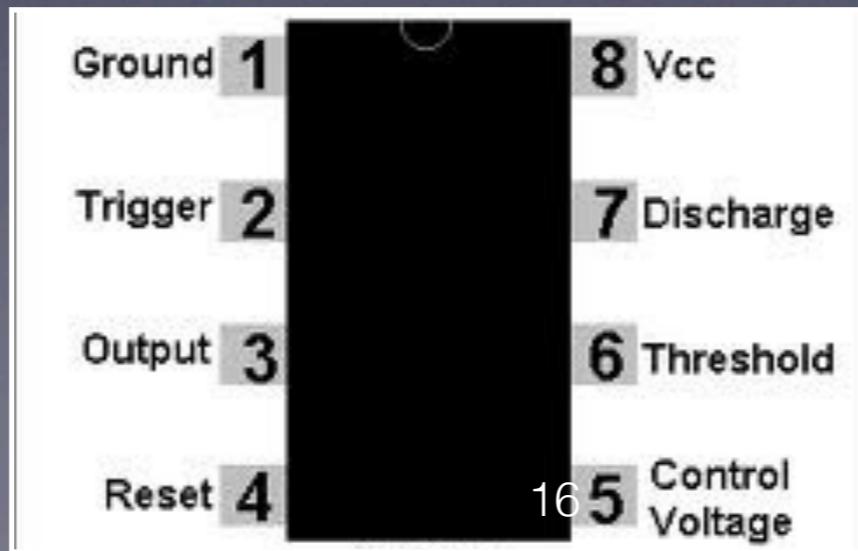
## 1.67v at base, allows flow between collector to emitter.





# SynShop Prototyping

**Integrated Circuit - IC**  
**Notch typically goes to the left.**  
**Pin 1 is lower left.**  
**Lots of functionality.**  
**Lots of transistors.**  
**555 is a timer chip.**

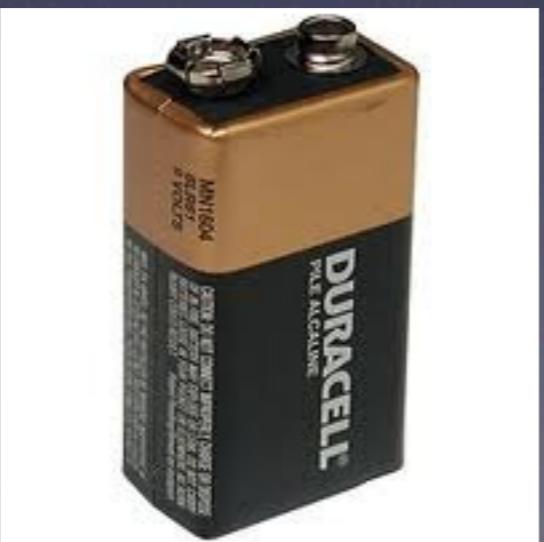




# SynShop Prototyping

## Battery

**Red + is positive.  
Black - is negative.**



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# SynShop Prototyping

And now...

Solder Buildup



# SynShop

## Solder Buildup

# Safety First!



# SynShop

## Solder Buildup

1

**Wear  
safety  
goggles at  
all times.**

**Molten  
solder  
may fly  
and cause  
permanent  
blindness!**





# SynShop

## Solder Buildup

2

**Be Safe**

**Soldering  
tip is 700  
degrees.**

**NEVER  
grab a tip,  
even when  
off. Parts  
and joints  
are also  
700  
degrees!**





# SynShop

## Solder Buildup

# How to Solder!



# SynShop

## Solder Buildup

1

700

degrees F

A temper-  
ature  
controlled  
iron is  
best.





# SynShop

## Solder Buildup

2

Clean  
Tip

Clean tip  
by twirling  
in brass  
tip  
cleaner.

Removes  
carbon  
and  
residue.





# SynShop

## Solder Buildup

3

### Wet Tip

Immediately prime the tip by adding a little bit of solder. A dry tip will not conduct heat.



(c) 2010 CuriousInvento



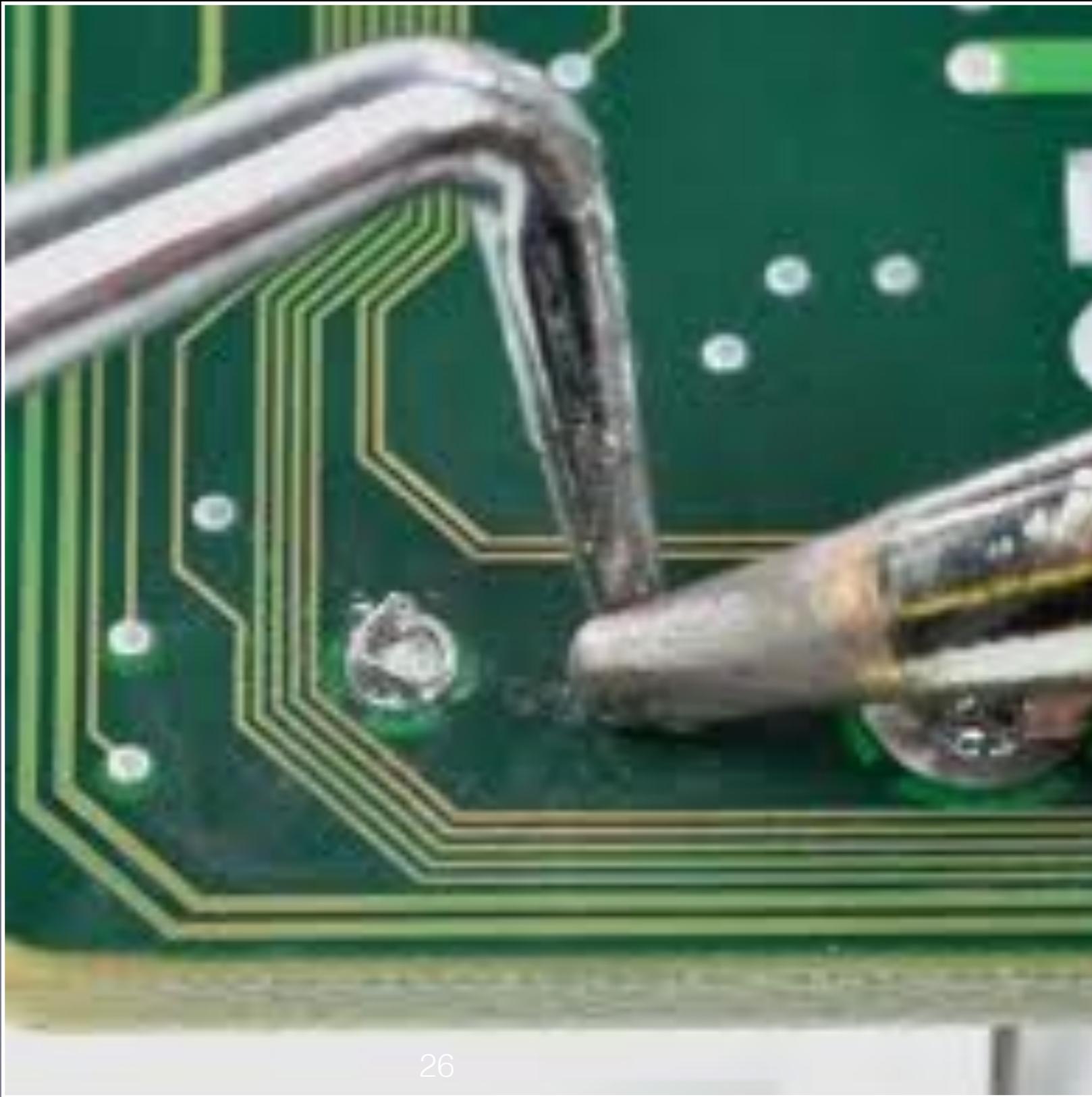
# SynShop

## Solder Buildup

4

### Proper Angle

Hold the iron at 45 degrees. Don't use the point of the tip, but the whole side of the tip.





# SynShop

## Solder Buildup

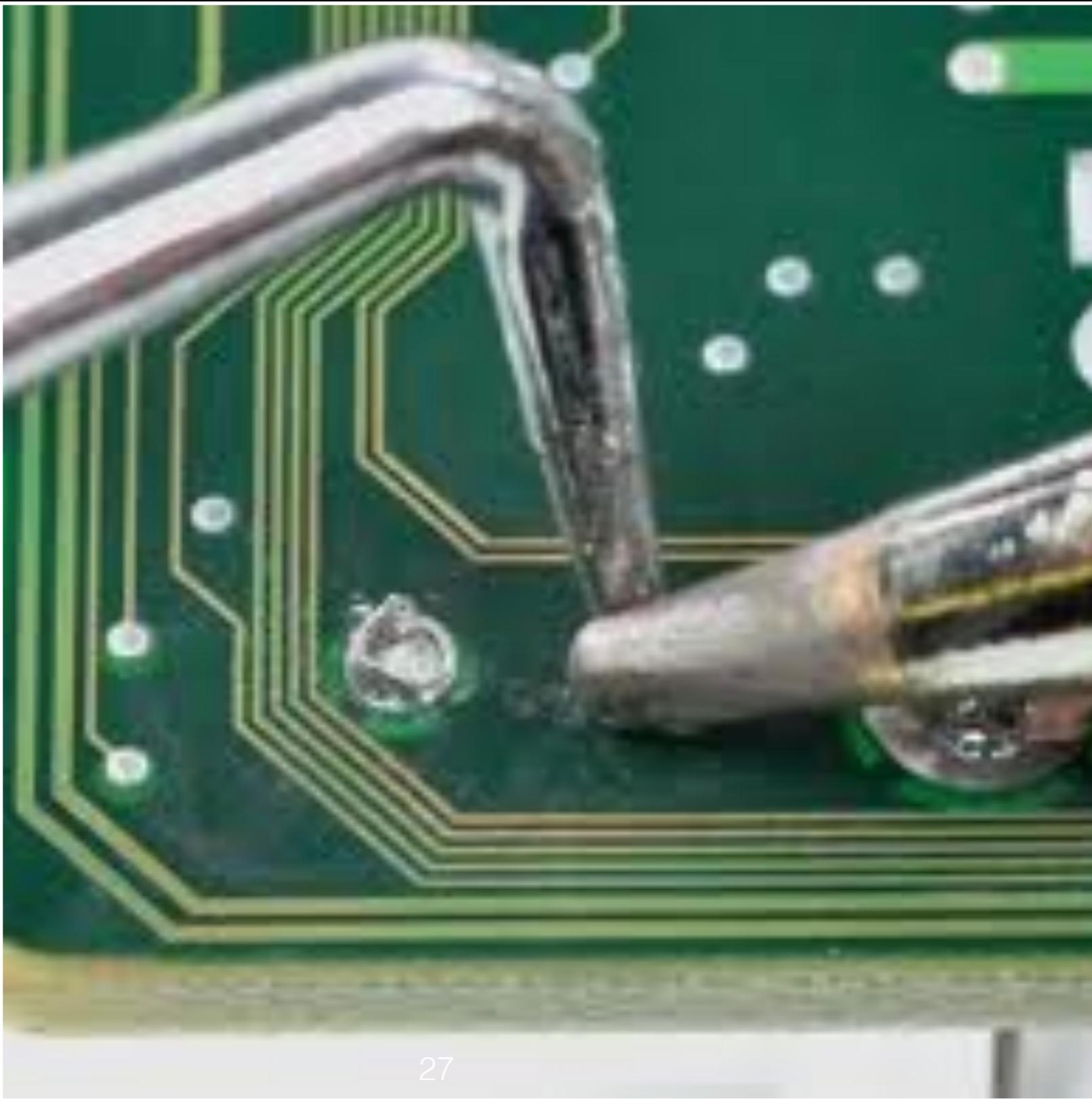
5

**Heat part**

**The part  
will heat  
quickly.**

**Too much  
heat will  
destroy  
the part.**

**Heat for  
1/2-1  
second.**





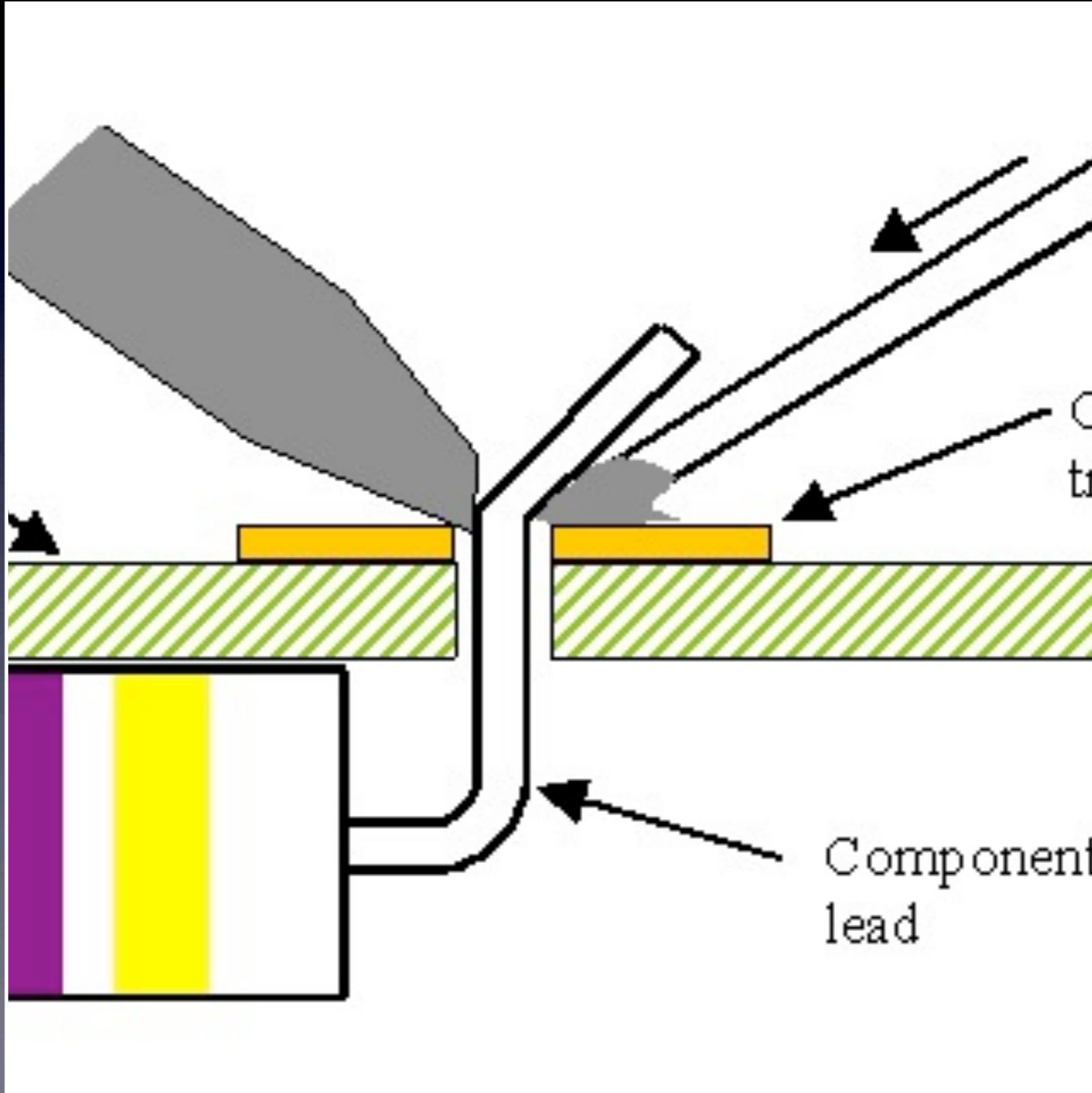
# SynShop

## Solder Buildup

6

### Apply Solder

Add solder from the opposite side of the tip. The part will draw in the solder.





# SynShop

## Solder Buildup

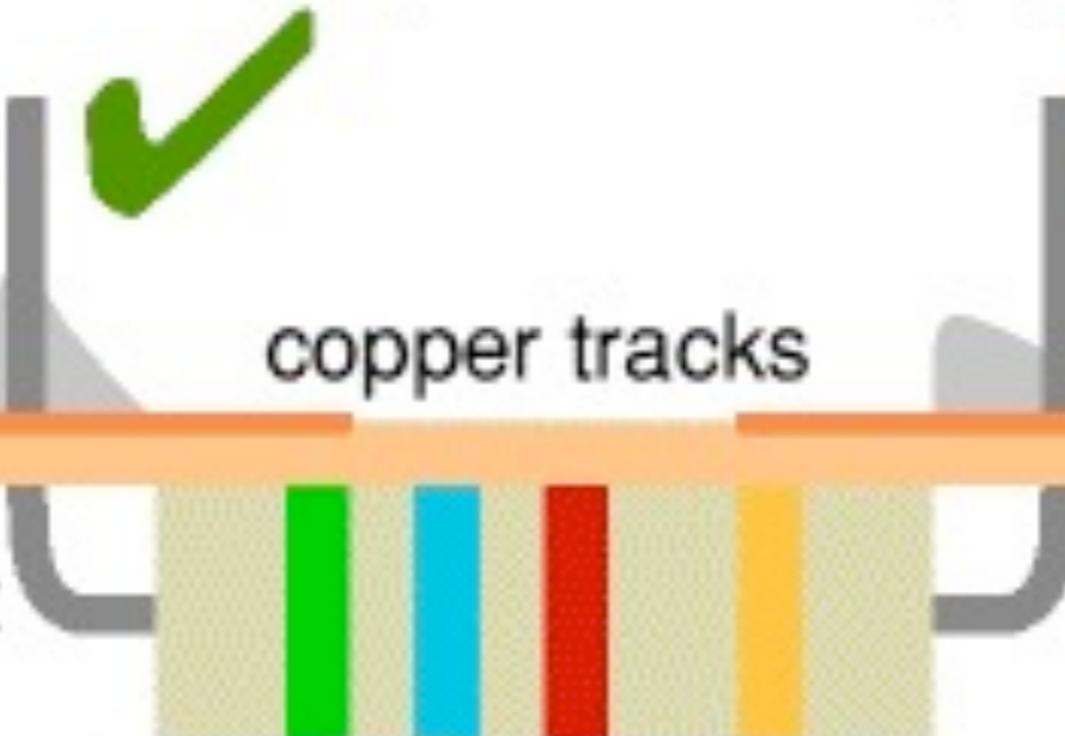
7

Dome

We are looking for nice dome shapes. If it isn't a dome, reheat, add more solder if needed.

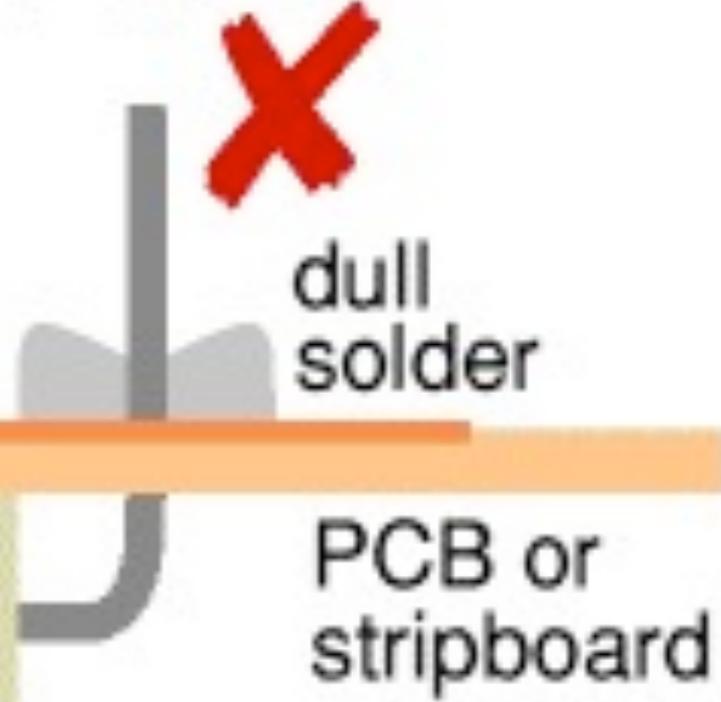
### GOOD JOINT

(volcano shape)



### BAD JOINT

(dry joint)





# SynShop

## Solder Buildup

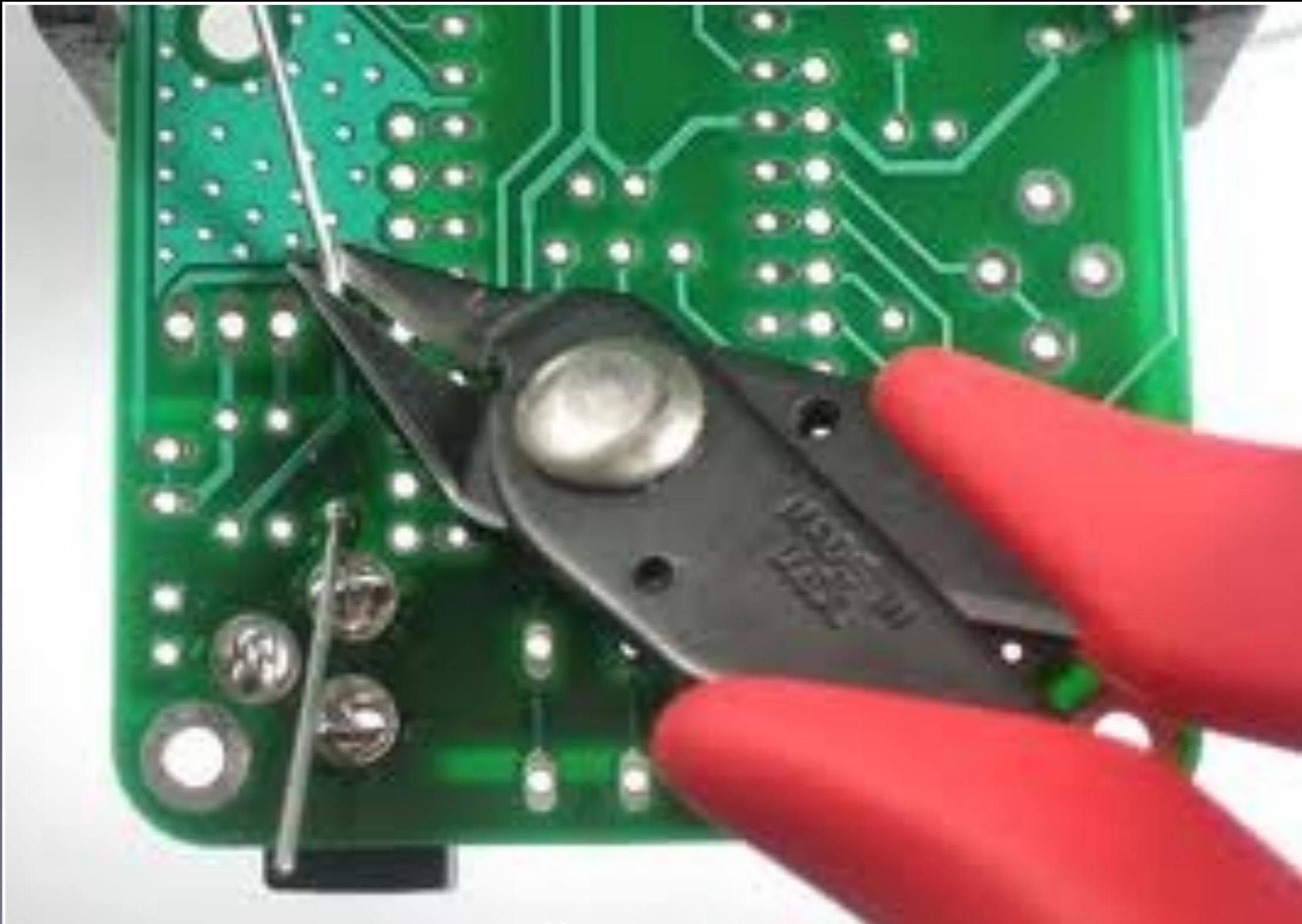
8

Clip

**Lastly clip  
the lead  
just above  
the joint.**

**Do not  
clip  
through  
solder.**

**Hold lead,  
don't let it  
fly.**





# SynShop

## Solder Buildup

9

**Keep Tip  
Clean**

**Carbon  
will  
naturally  
form on  
the tip,  
prevents  
solder  
from  
adhering.**





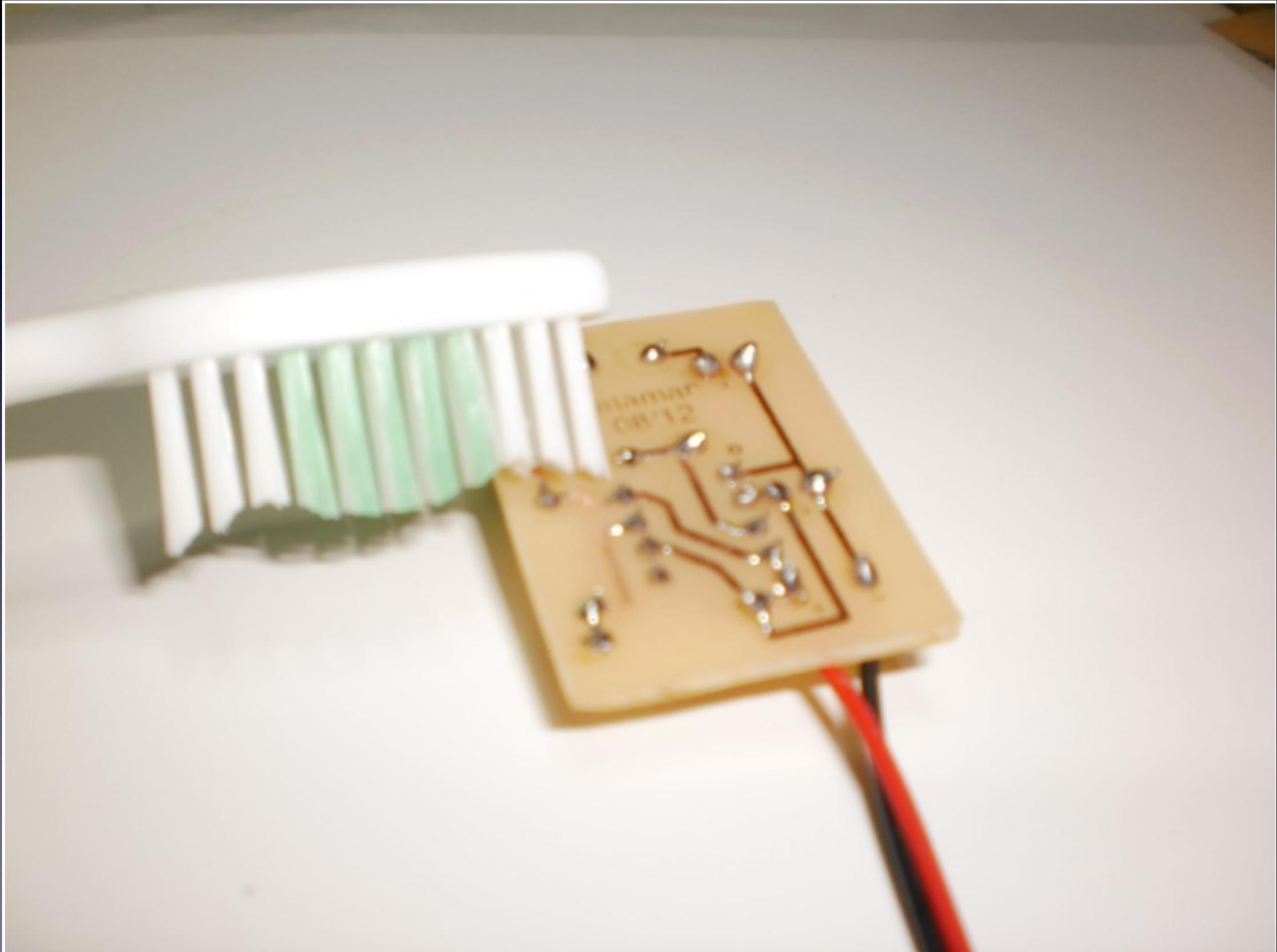
# SynShop

## Solder Buildup

10

**Alcohol  
wash the  
board.**

**Flux will  
continue  
to eat til  
removed.**





# SynShop

## Solder Buildup

**Steps to a good solder joint.**

- 1) Safety Goggles**
- 2) Be safe**
- 3) 700 degrees F**
- 4) Clean tip**
- 5) Wet tip**
- 6) Proper angle**
- 7) Heat part and joint**
- 8) Solder joint not the tip**
- 9) Make a dome**
- 10) Clip above joint**
- 11) Clean tip**
- 12) Alcohol wash**

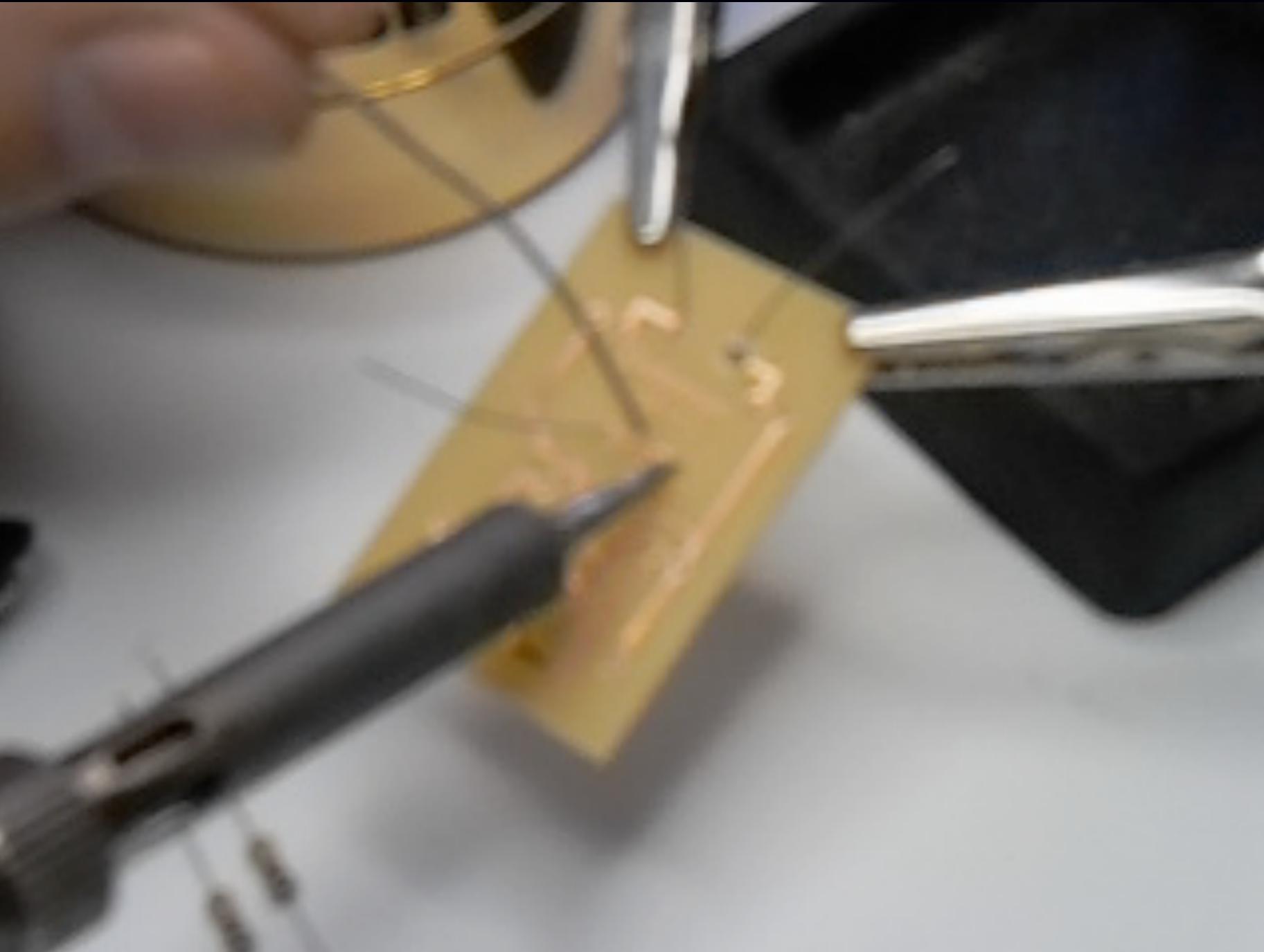




# SynShop

## Prototyping

### Let's see that in action





SynShop  
Solder Buildup

# Beta testing For SYNshop

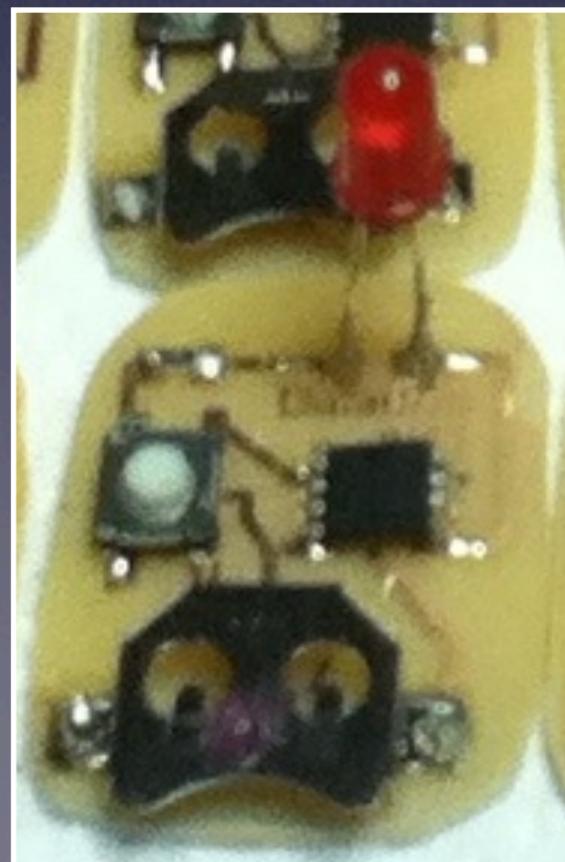


SynShop  
Prototyping

## SynShop Guinea Pig

You have been recruited as a guinea pig for the Buildup Timer.

Click at start of step.  
Perform step.  
Click at end of step.

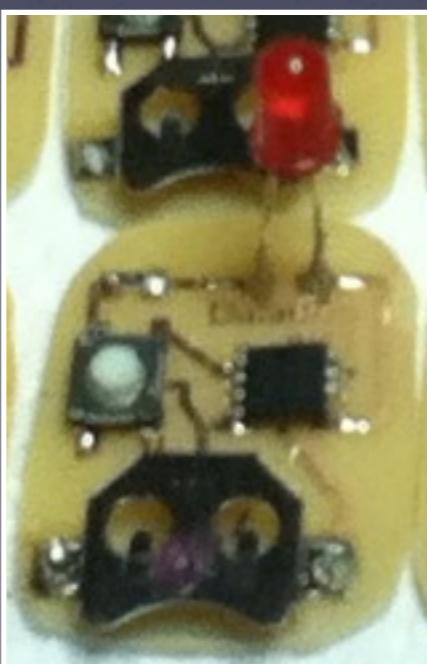




SynShop  
Prototyping

## SynShop Guinea Pig

**Builder Timer blinks faster each minute. Let's us know who's having trouble. It's not a race!**





# SynShop Solder Buildup

# LED Tester!



# SynShop Solder Buildup

## Led Tester

To practice what we've leaned we are going to solder a very simple project with 3 main components.

Go slow and don't glop!



# SynShop

## Solder Buildup

1

**Start with  
proto-  
board  
copper  
part facing  
table.**



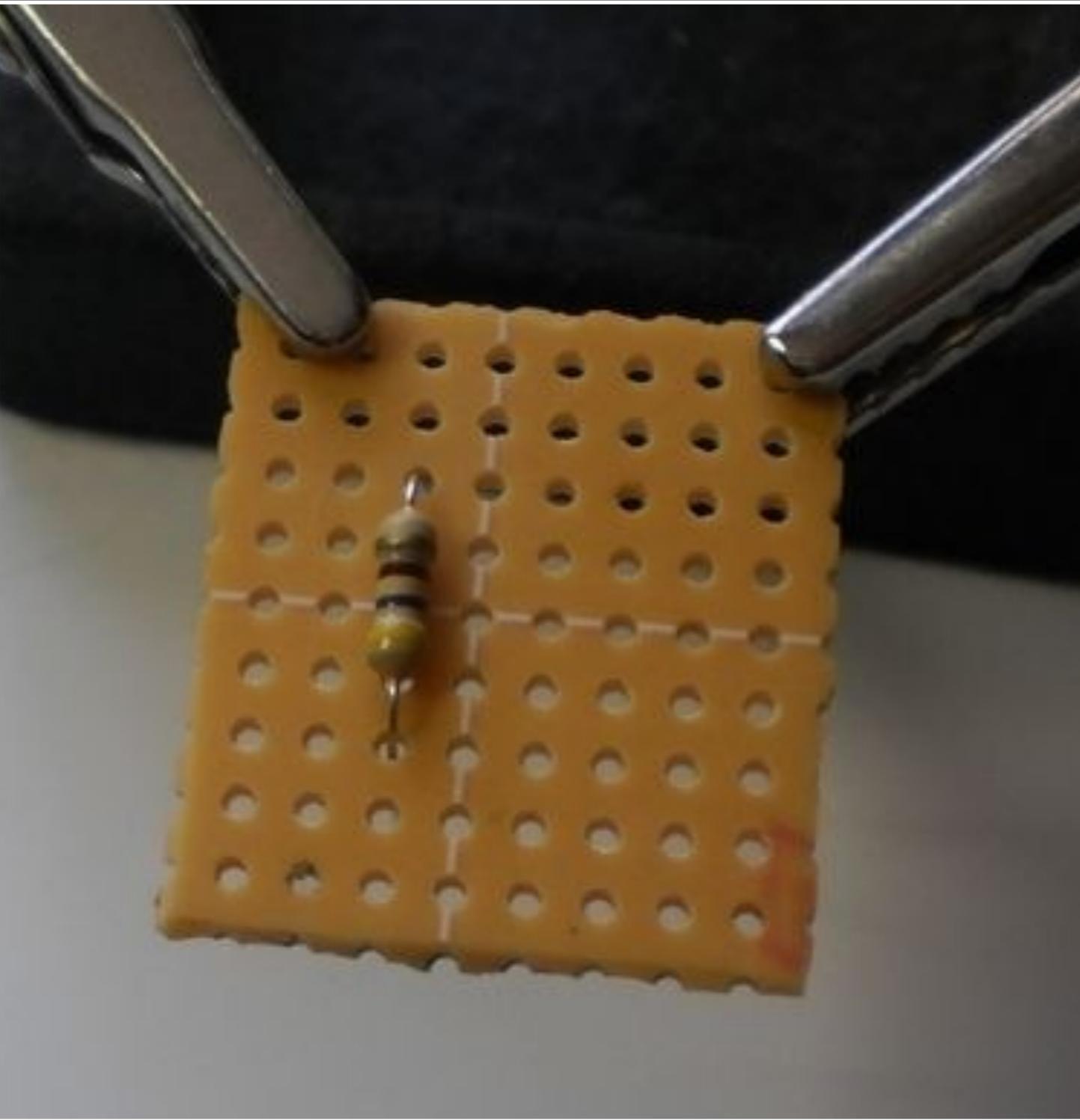


# SynShop

## Solder Buildup

2

**Place  
resistor as  
shown. Do  
not clip  
leads.**



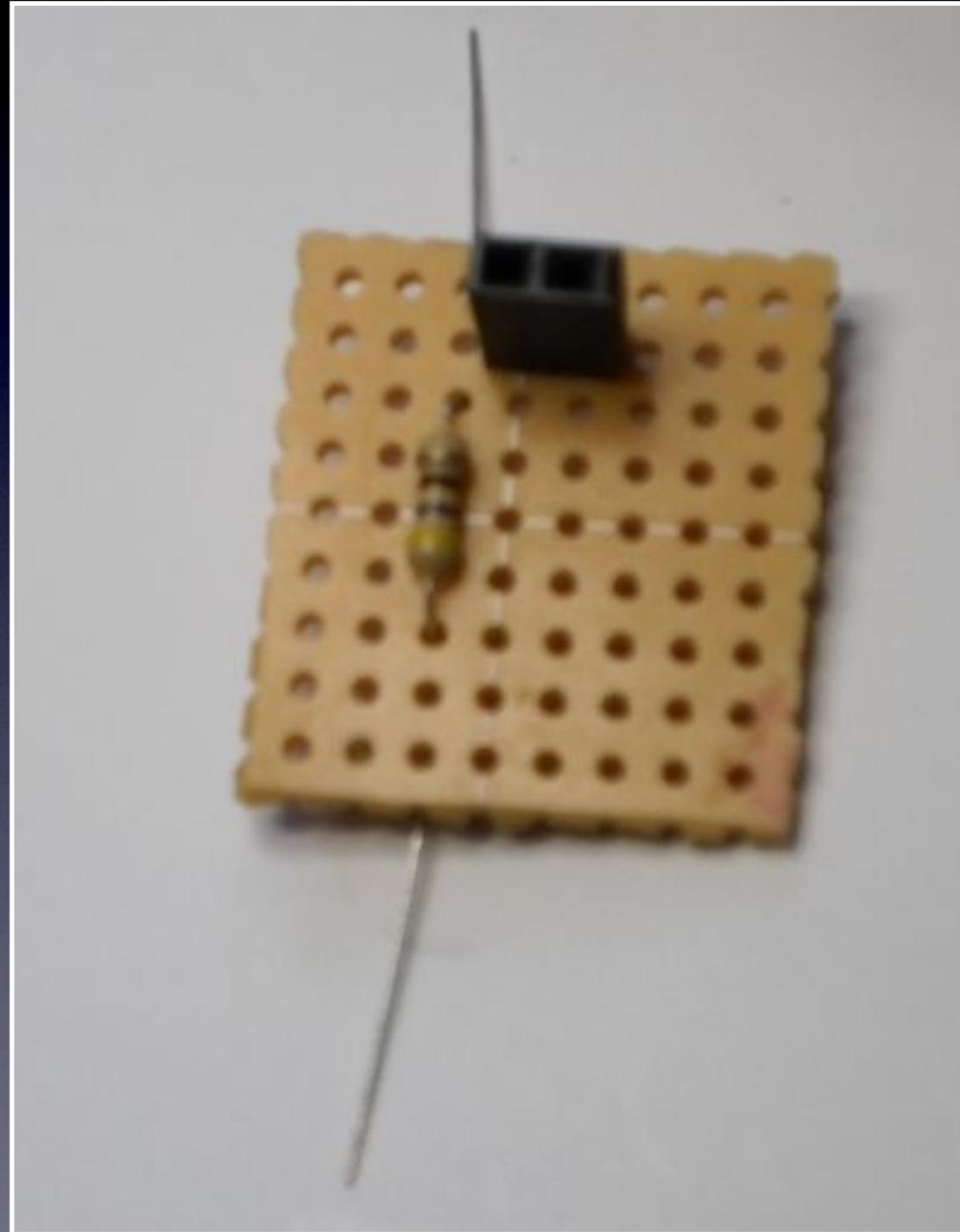


# SynShop

## Solder Buildup

3

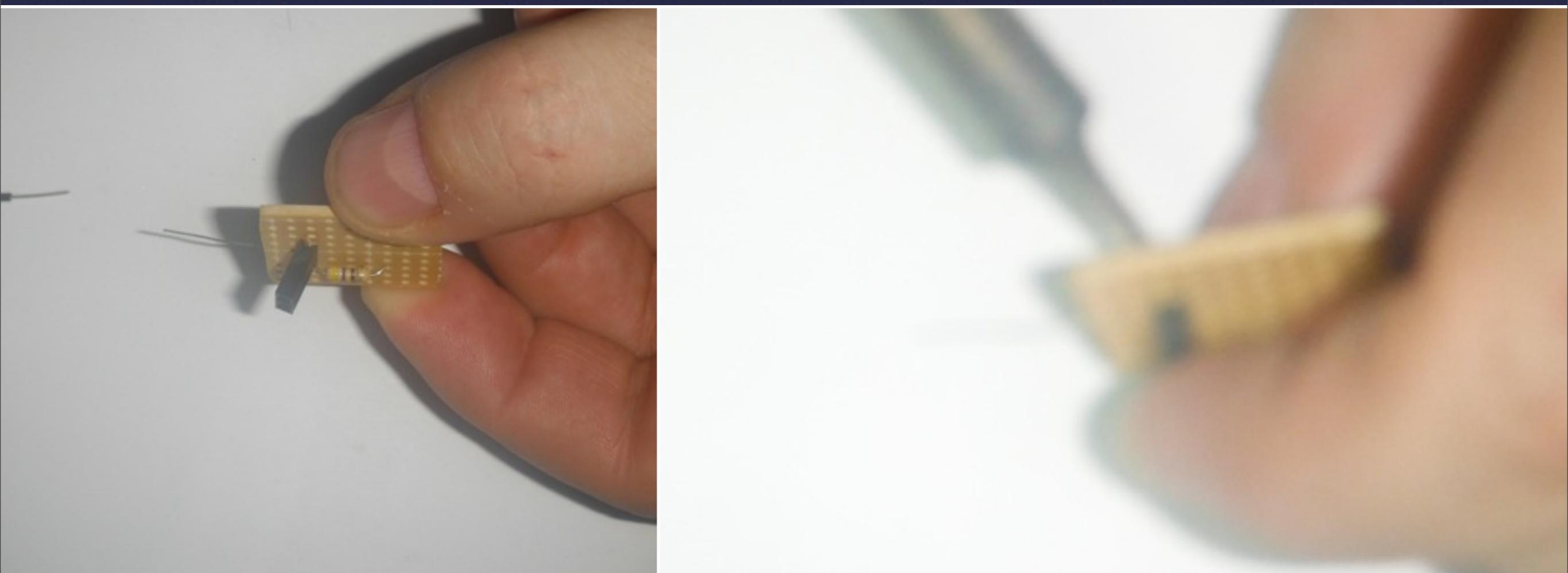
**Place and  
solder 2  
pin female  
header as  
shown.**





SynShop  
Solder Buildup

# Interrupt: The Align the Pins Trick



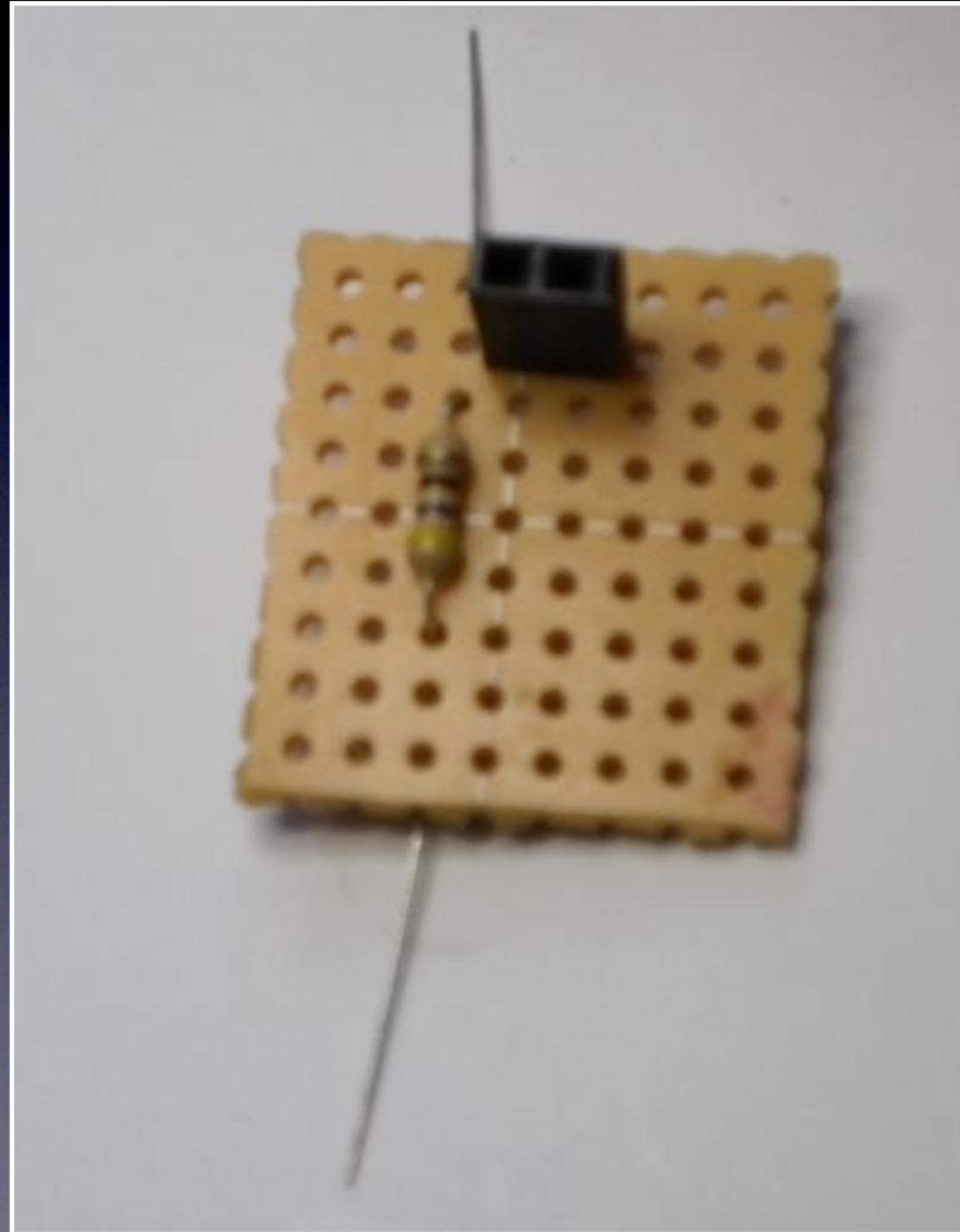


# SynShop

## Solder Buildup

3

**Place and  
solder 2  
pin female  
header as  
shown.**



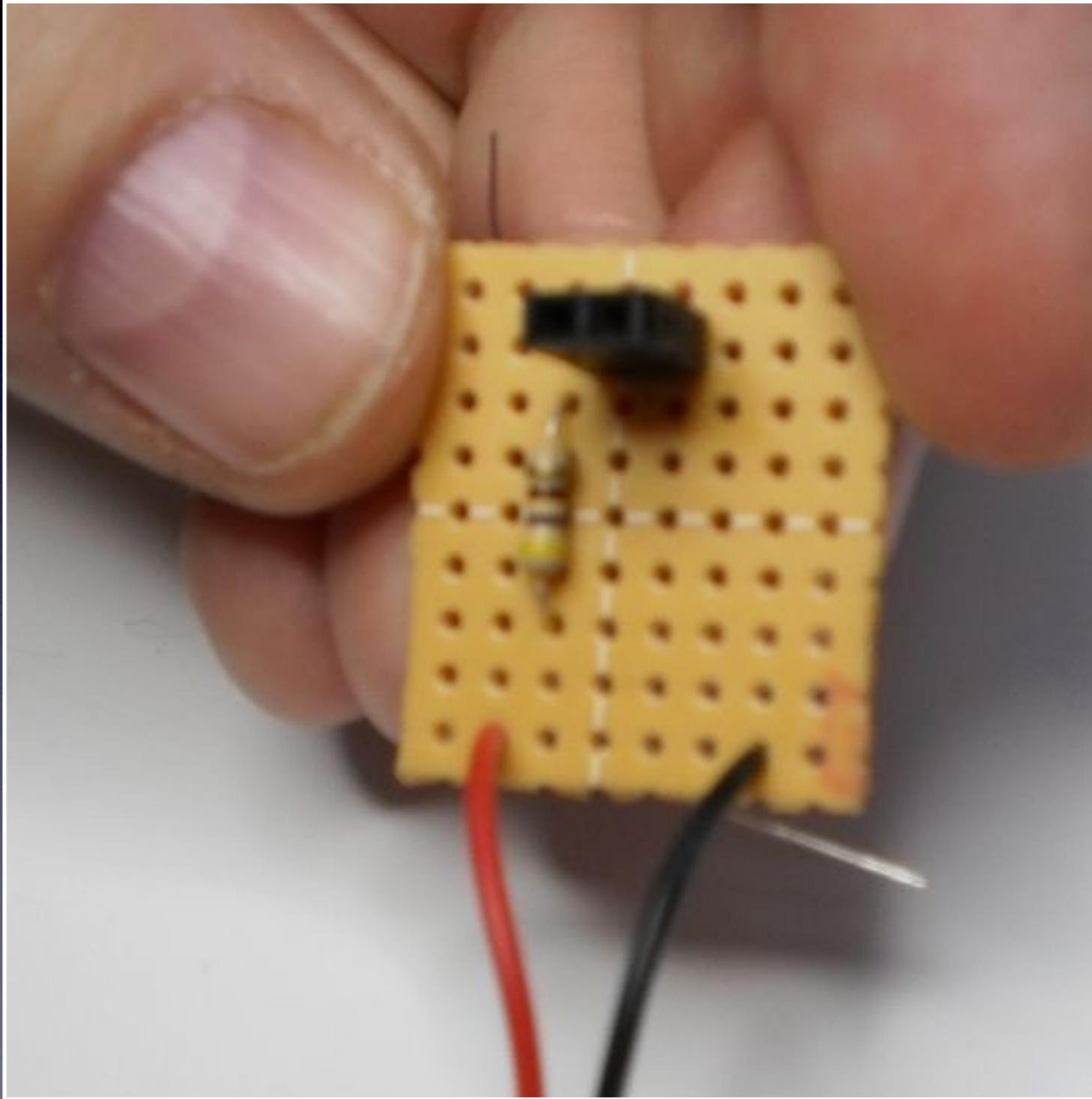


# SynShop

## Solder Buildup

4

**Place and  
solder  
battery  
clip as  
shown.**



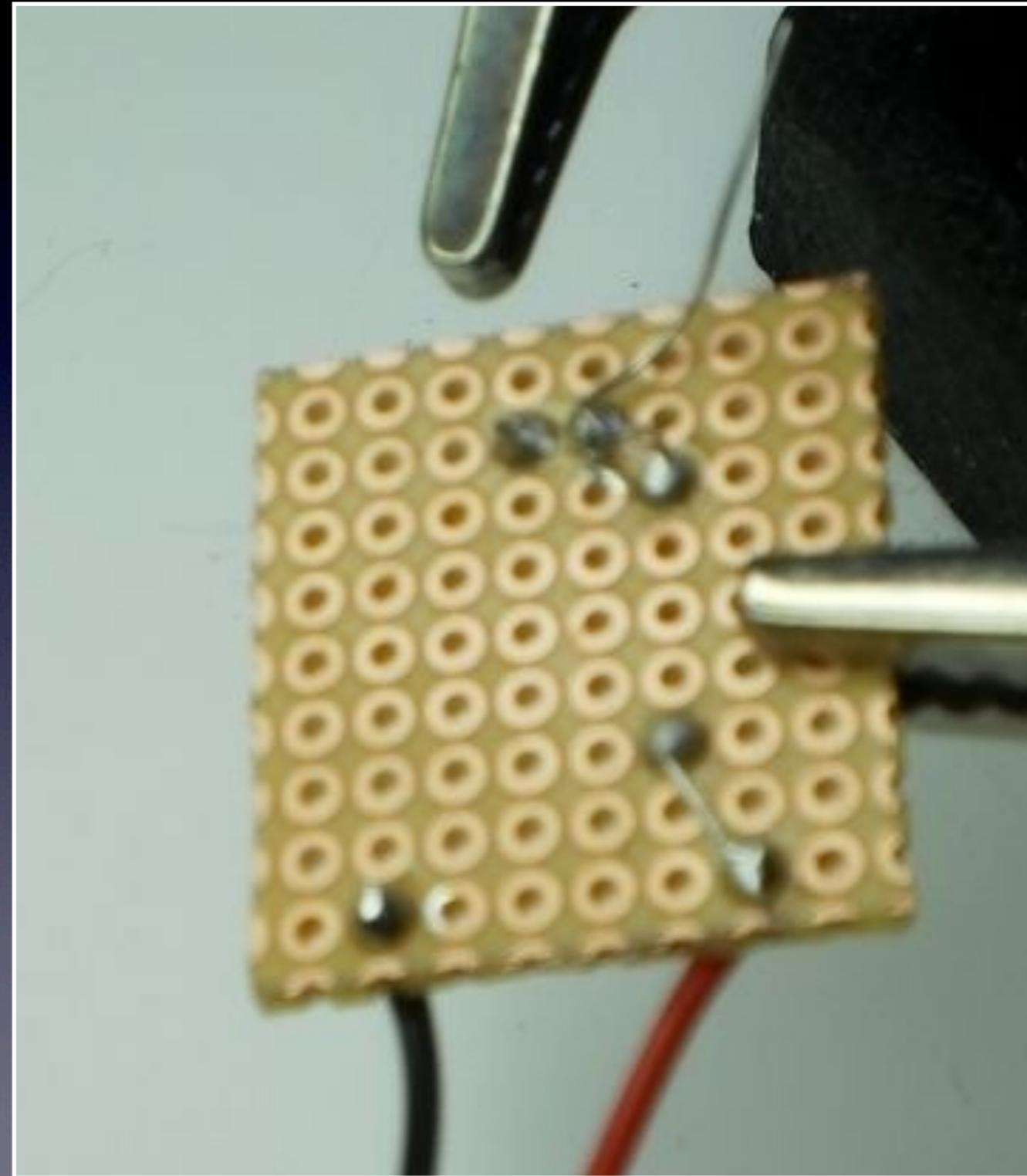


# SynShop

## Solder Buildup

5

**Working  
from the  
bottom  
side now,  
extend  
resistor  
legs to  
positive  
lead and  
solder.**



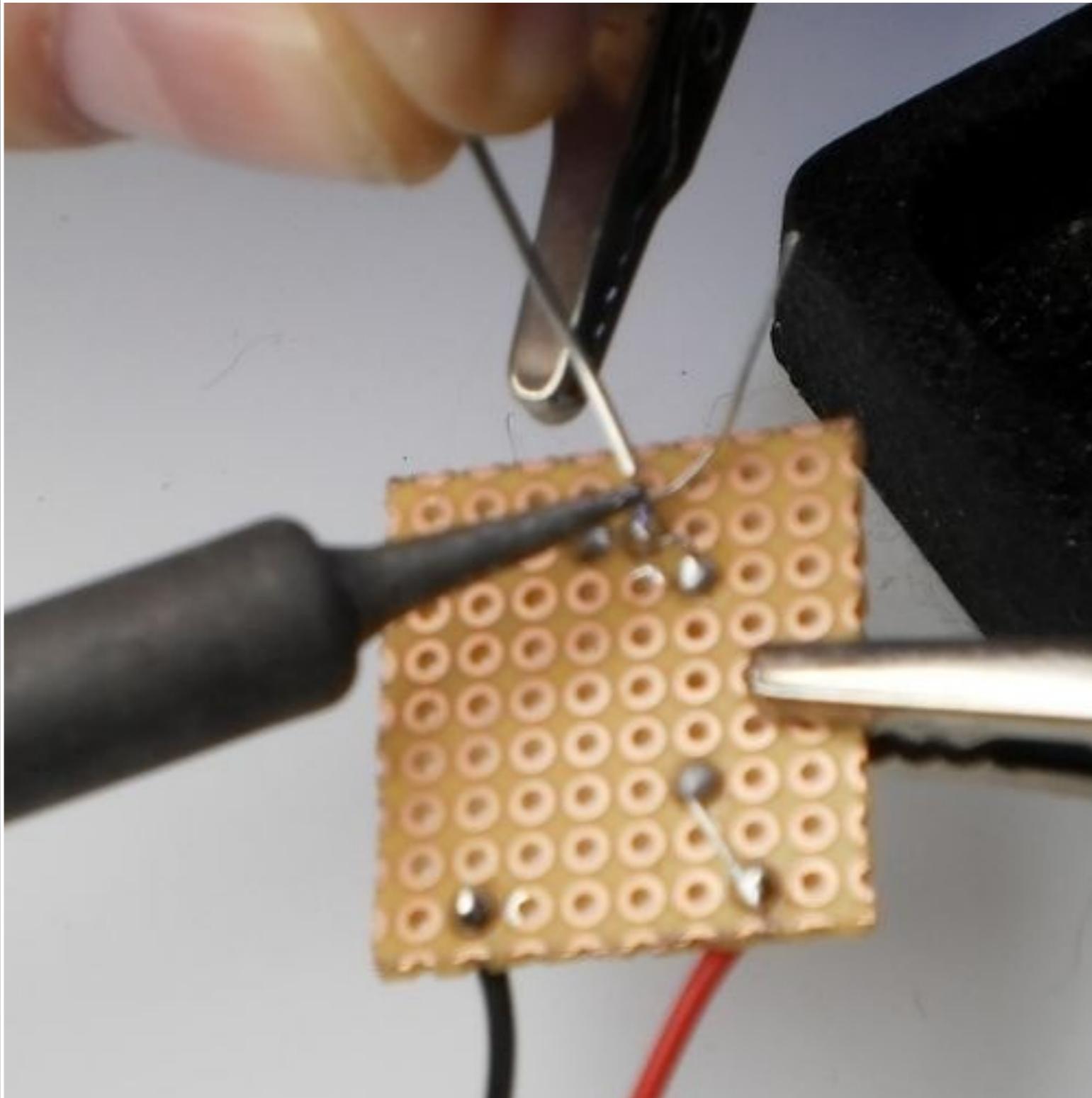


# SynShop

## Solder Buildup

6

**Solder  
remaining  
lead to  
one side  
of two pin  
header.**



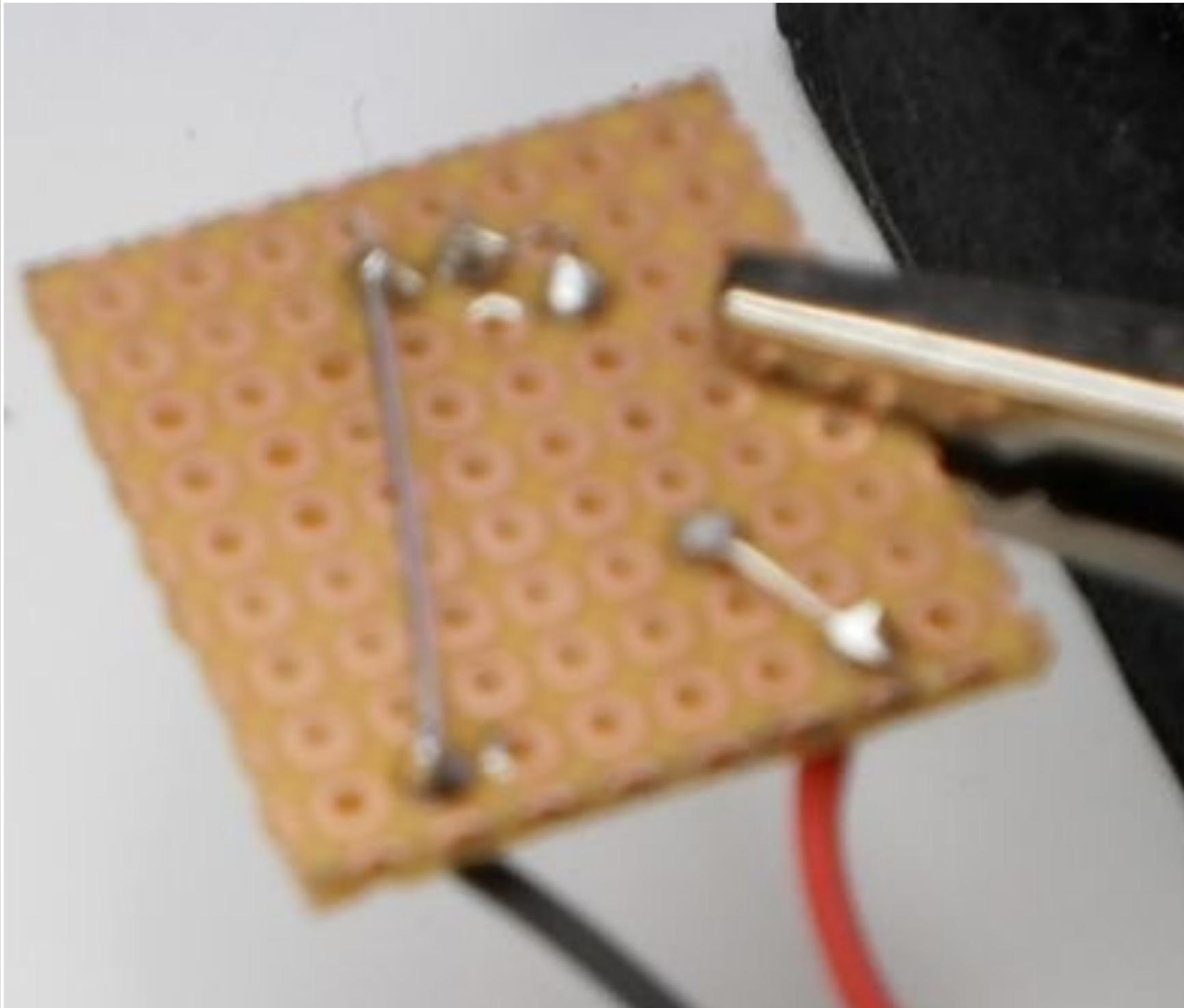


# SynShop

## Solder Buildup

7

**Solder  
jumper  
from two  
pin header  
to positive  
lead.**



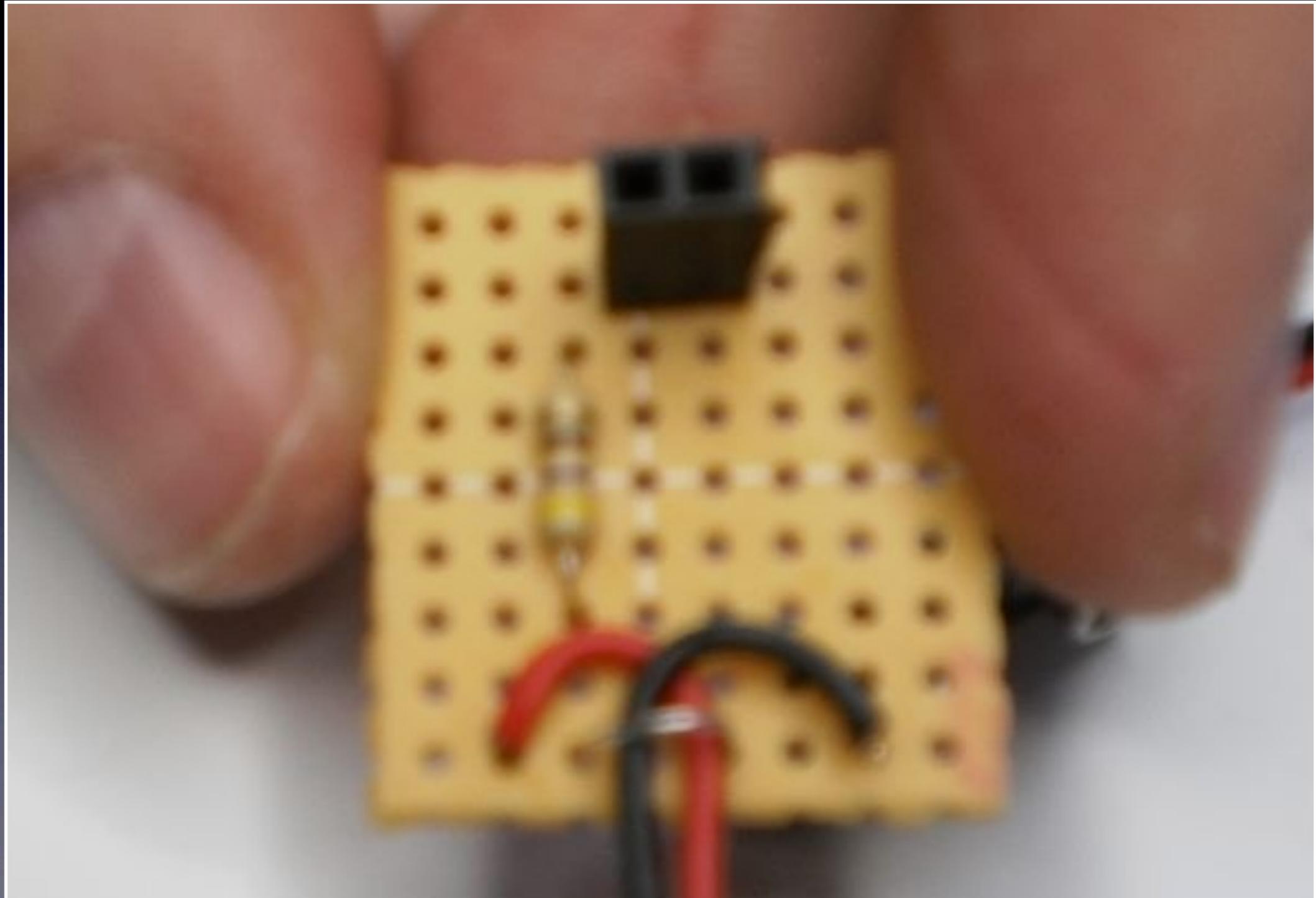


# SynShop

## Solder Buildup

8

**Add strain  
relief as  
shown.  
Solder in  
place.**





# SynShop

## Solder Buildup

9

Connect  
battery  
and place  
led long  
leg into  
the right  
hole, short  
leg into  
left hole.

Led  
should  
light.





# SynShop

## Solder Buildup

10

Reverse  
the LED.  
LED  
should  
turn off.





# SynShop Solder Buildup

You now have an  
**excellent LED  
tester.**



# SynShop

## Solder Buildup

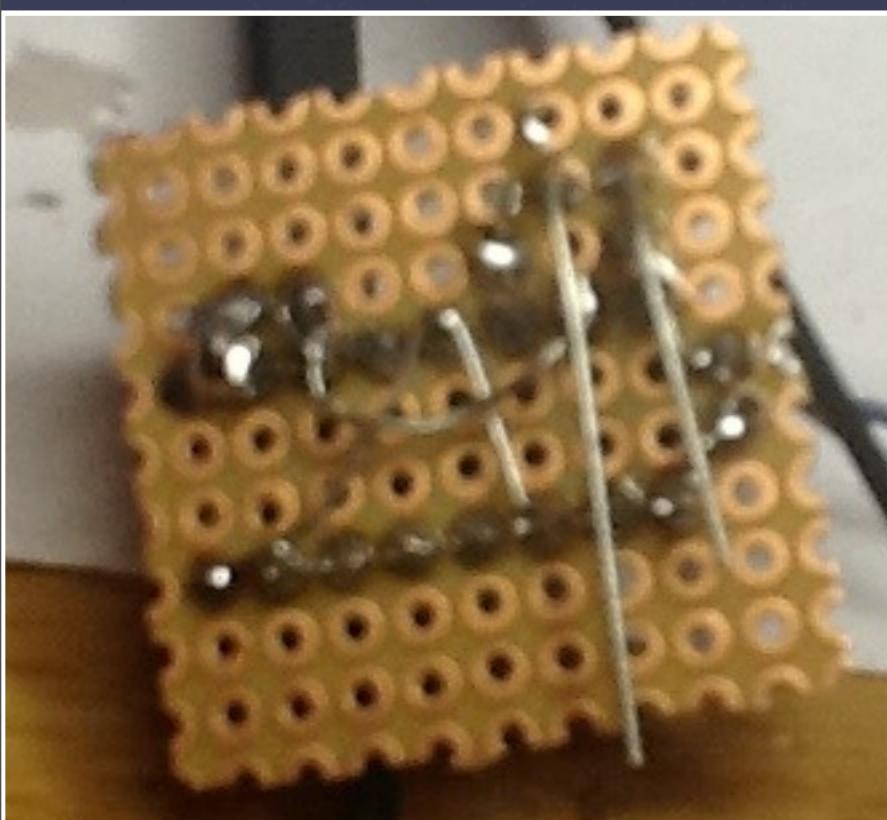
# Remove battery.



# SynShop

## Solder Buildup

Protoboards are great for one of a kind proof of concepts, but quickly get messy.

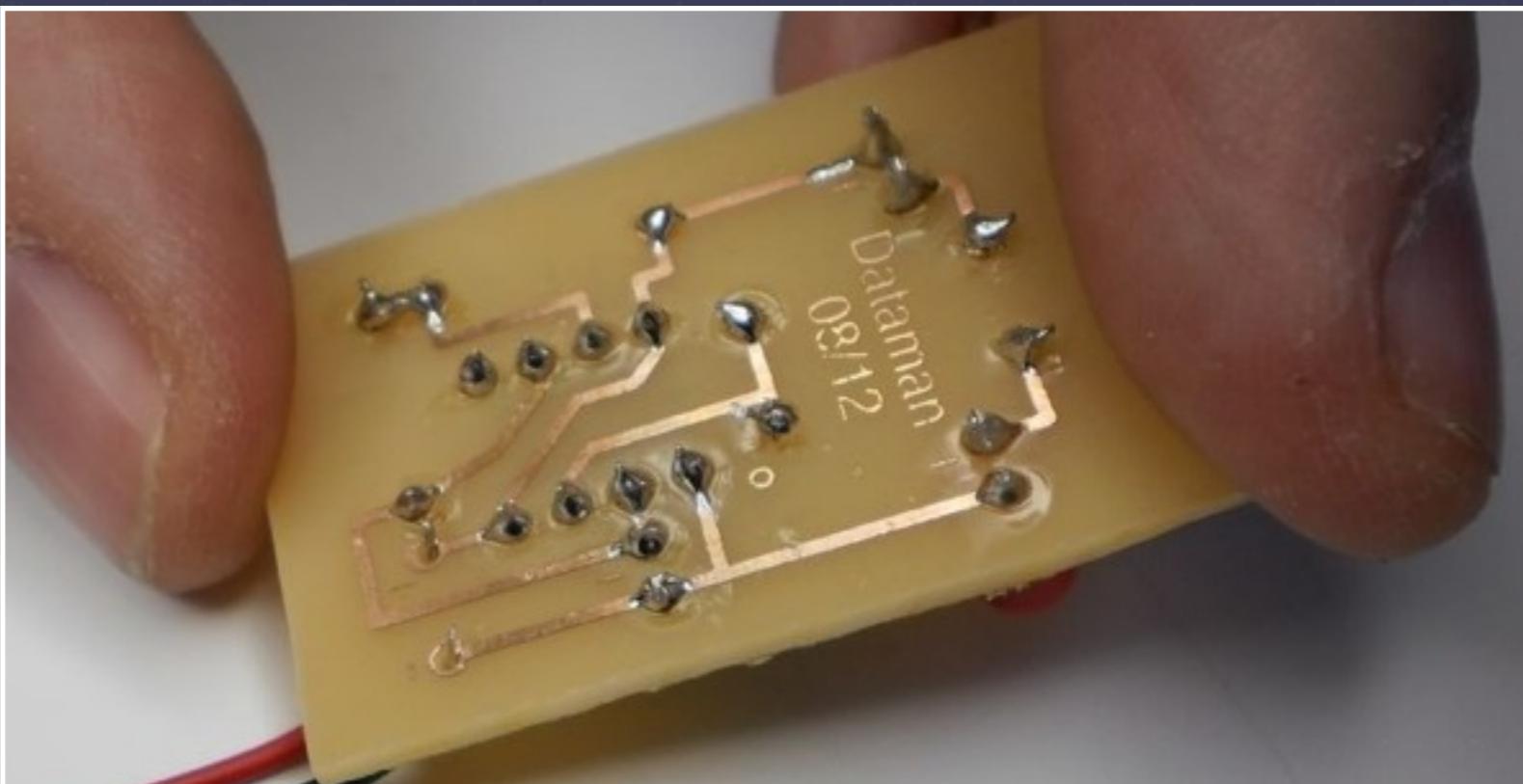




# SynShop

## Solder Buildup

The next logical step is PCBs. All the connections are already made.

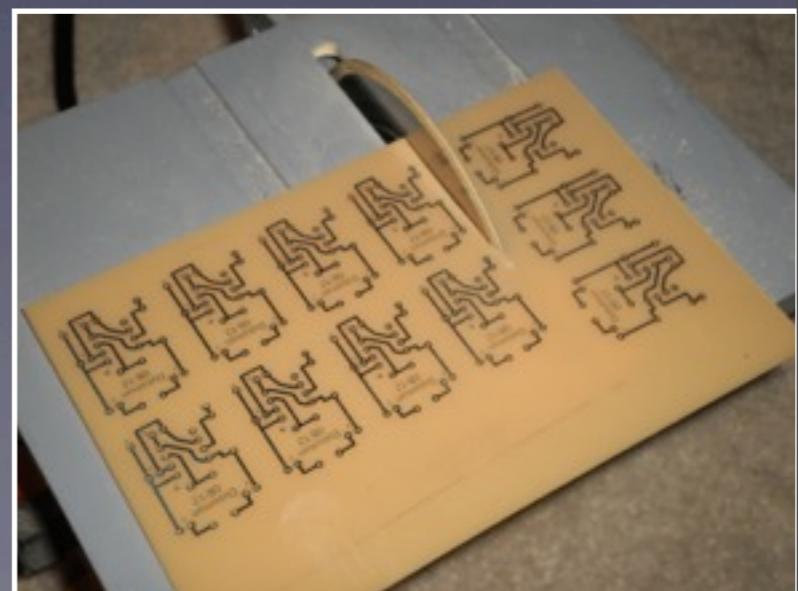
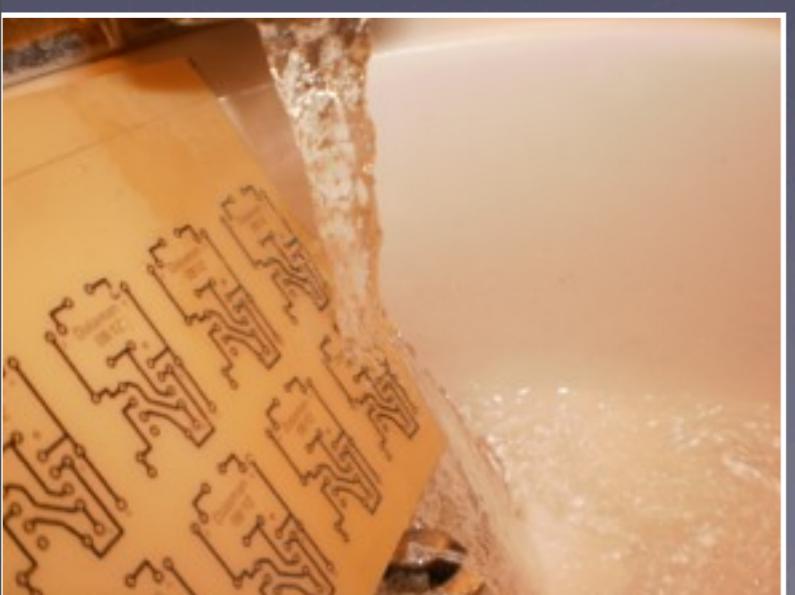




# SynShop

## Solder Buildup

I learned how to make PCBs at home 3 years ago. It's cheap and simple.





SynShop  
Solder Buildup

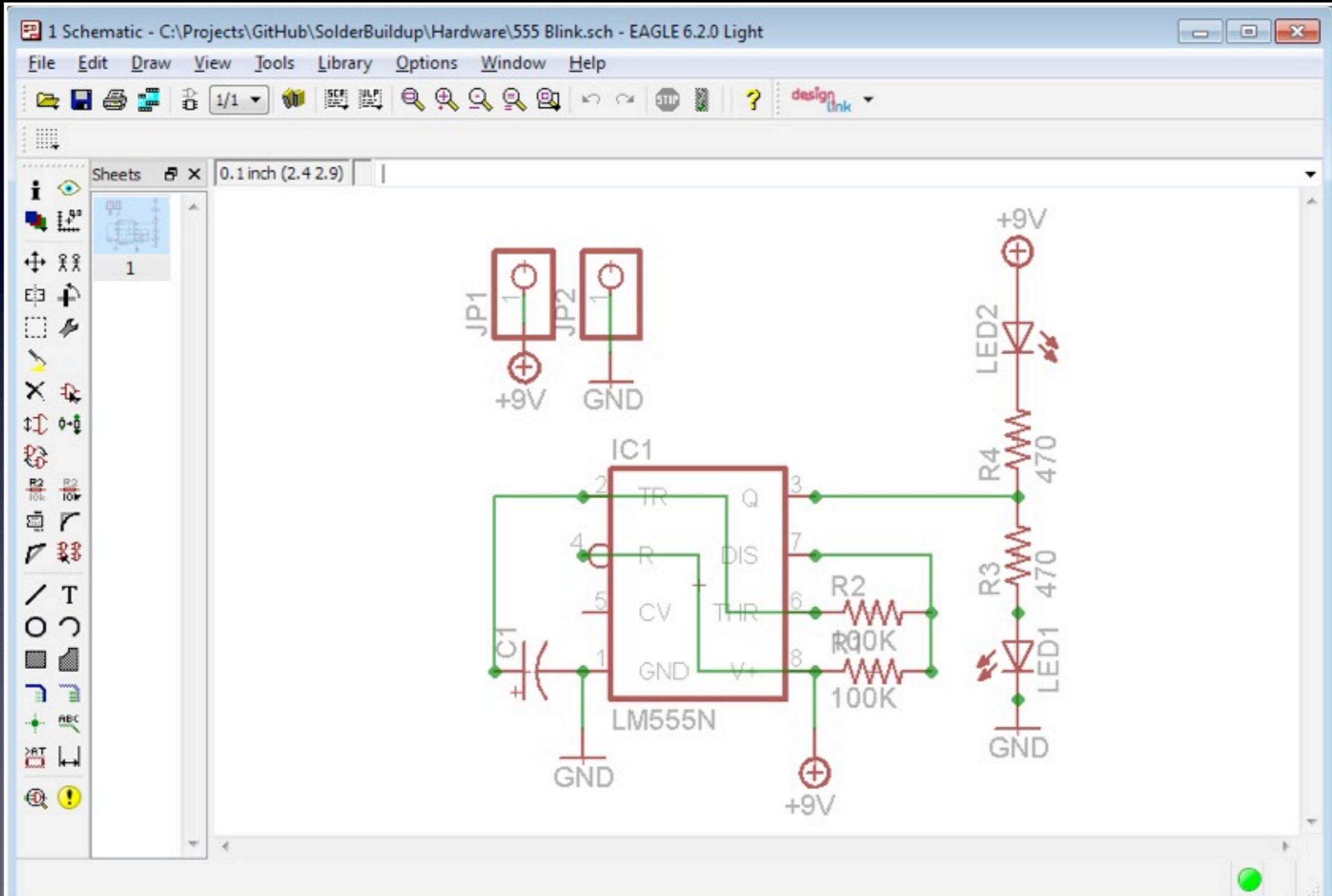
# How to make PCBs!



# SynShop Solder Buildup

1

Design the  
schematic  
in  
EagleCad.



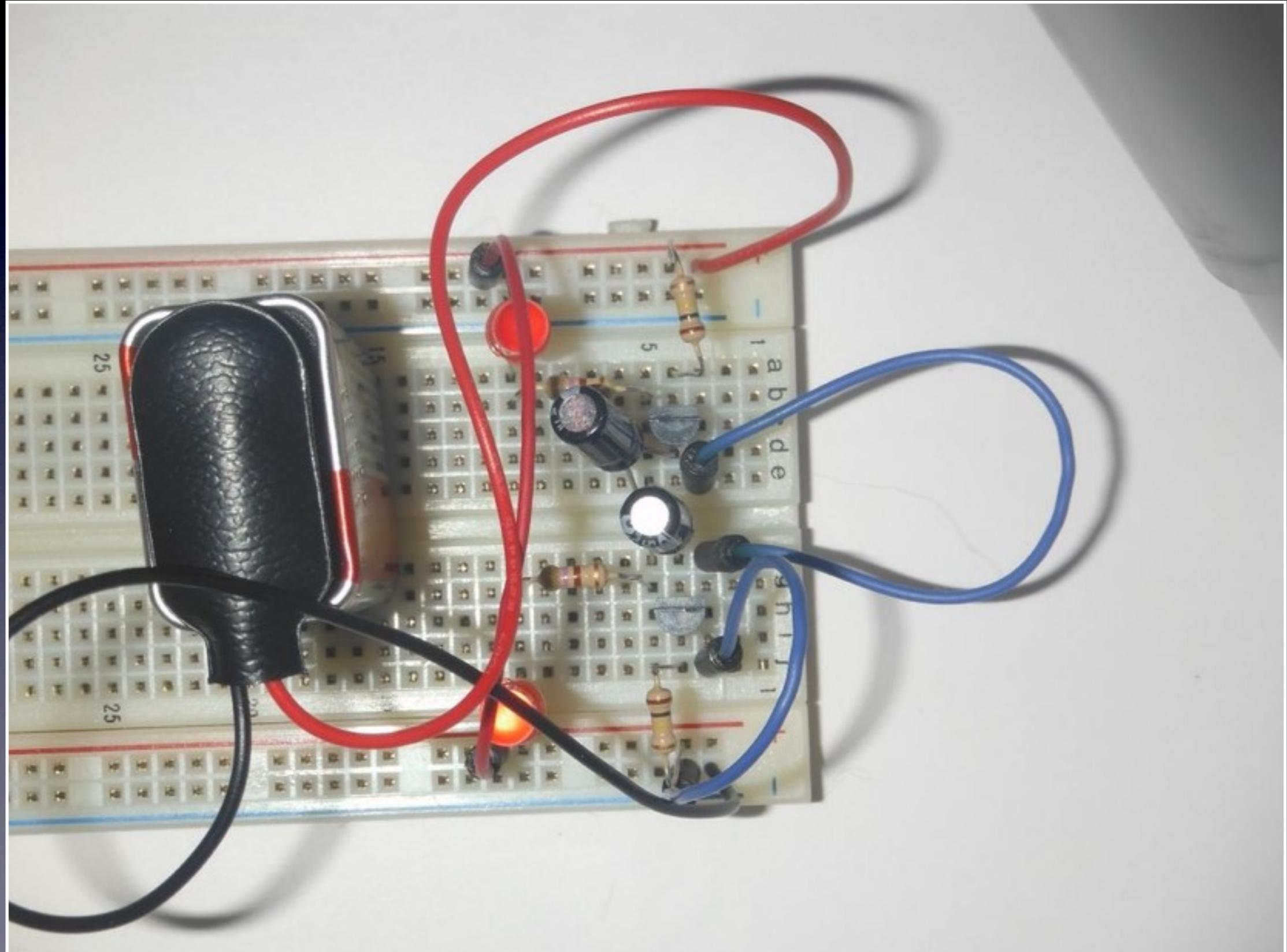


# SynShop

## Solder Buildup

2

**Test the circuit using a breadboard.**

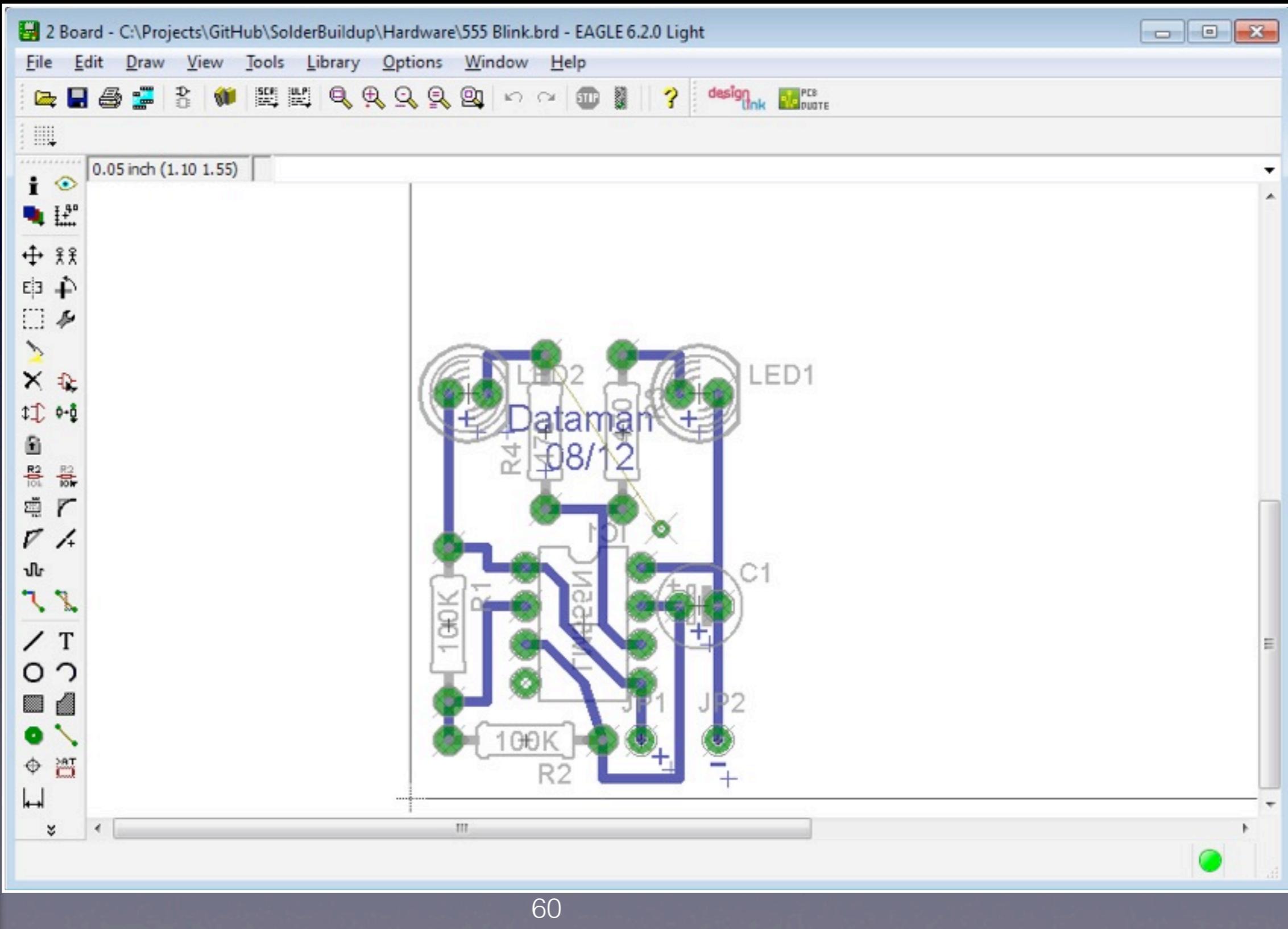




# SynShop Solder Buildup

3

## Layout board

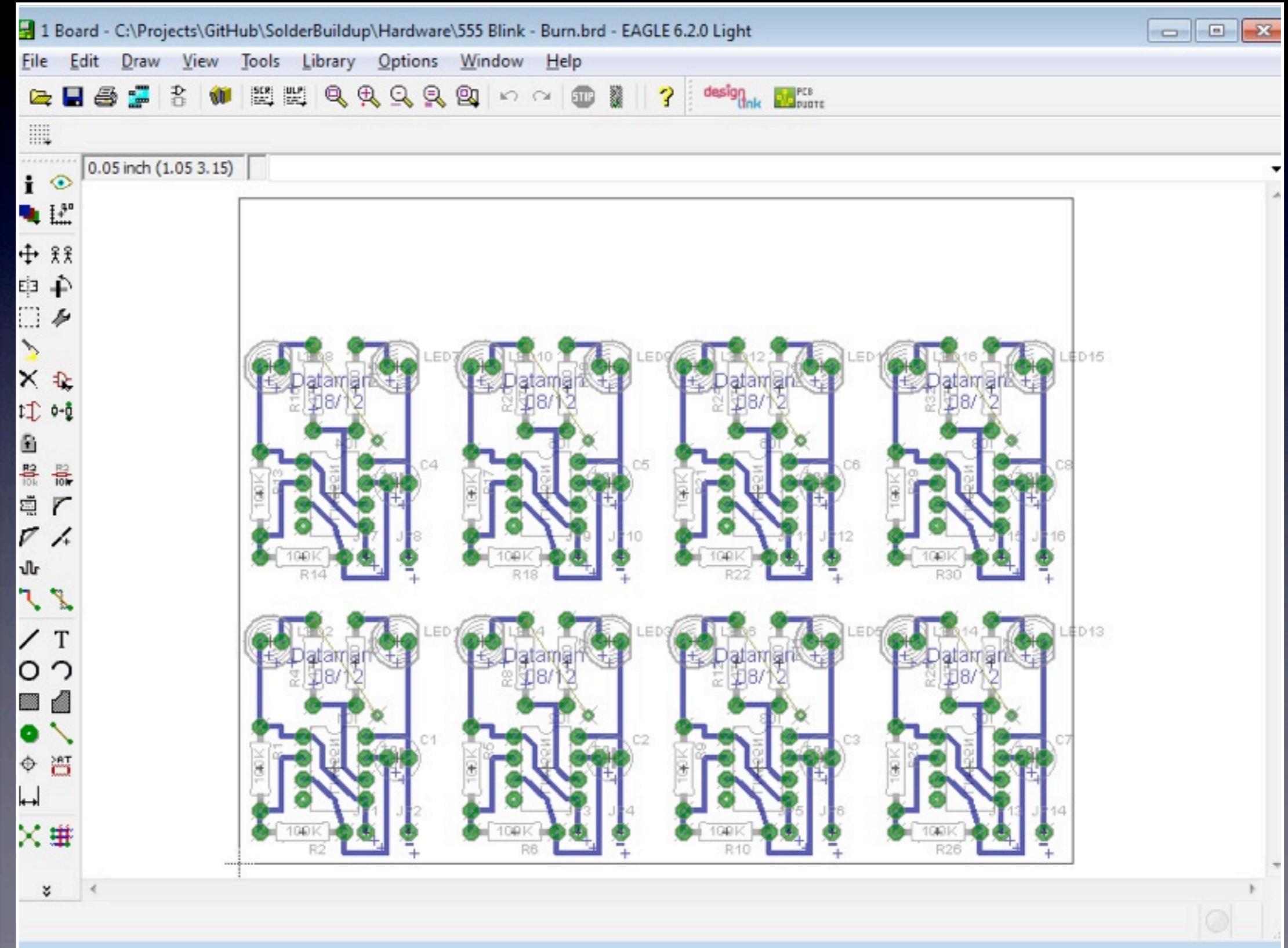




# SynShop Solder Buildup

4

Replicate  
the design  
into a  
burn  
layout.



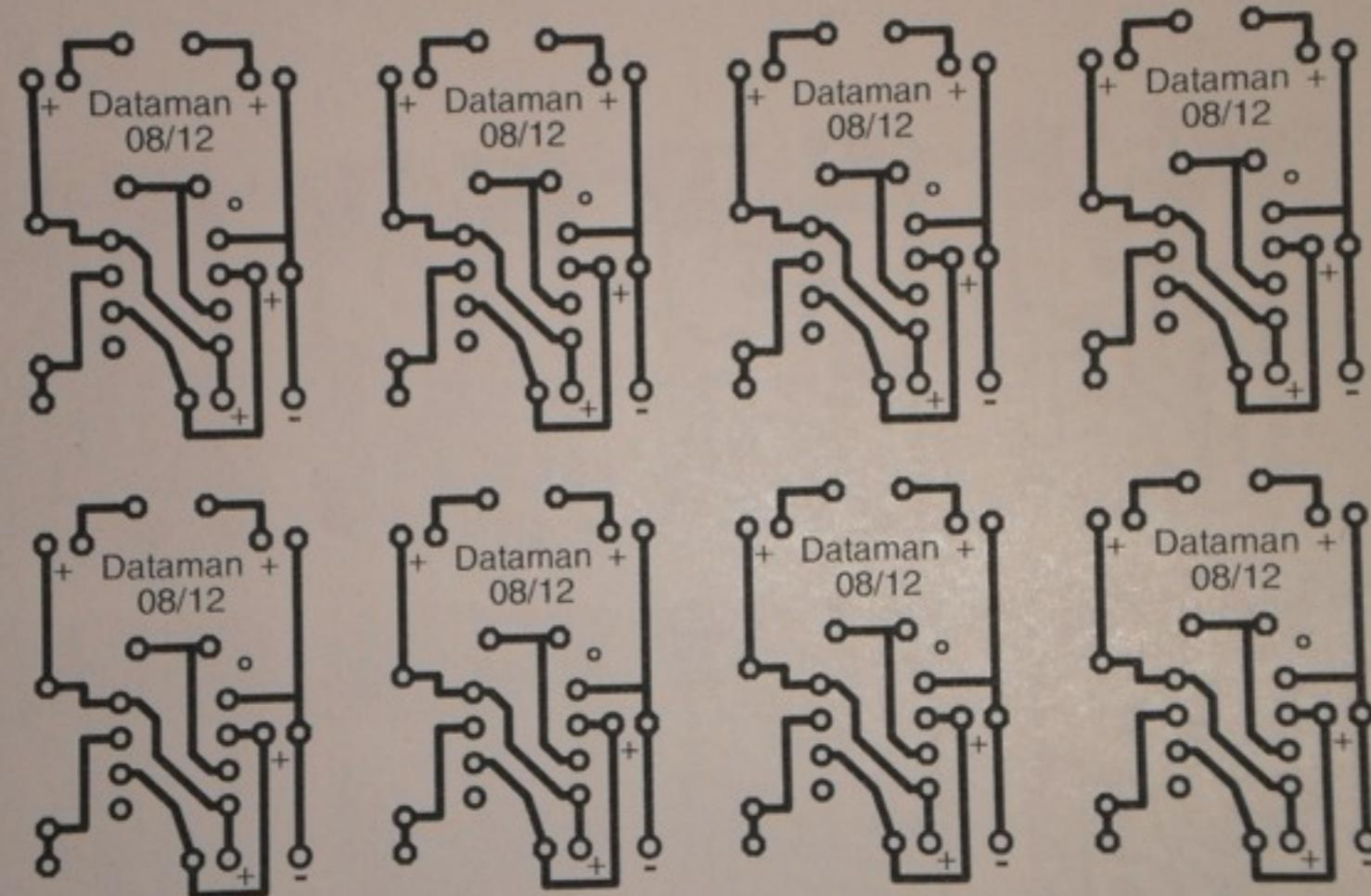


# SynShop

## Solder Buildup

5

**Print tops,  
bottoms,  
pads, vias  
onto  
trans-  
parency.**



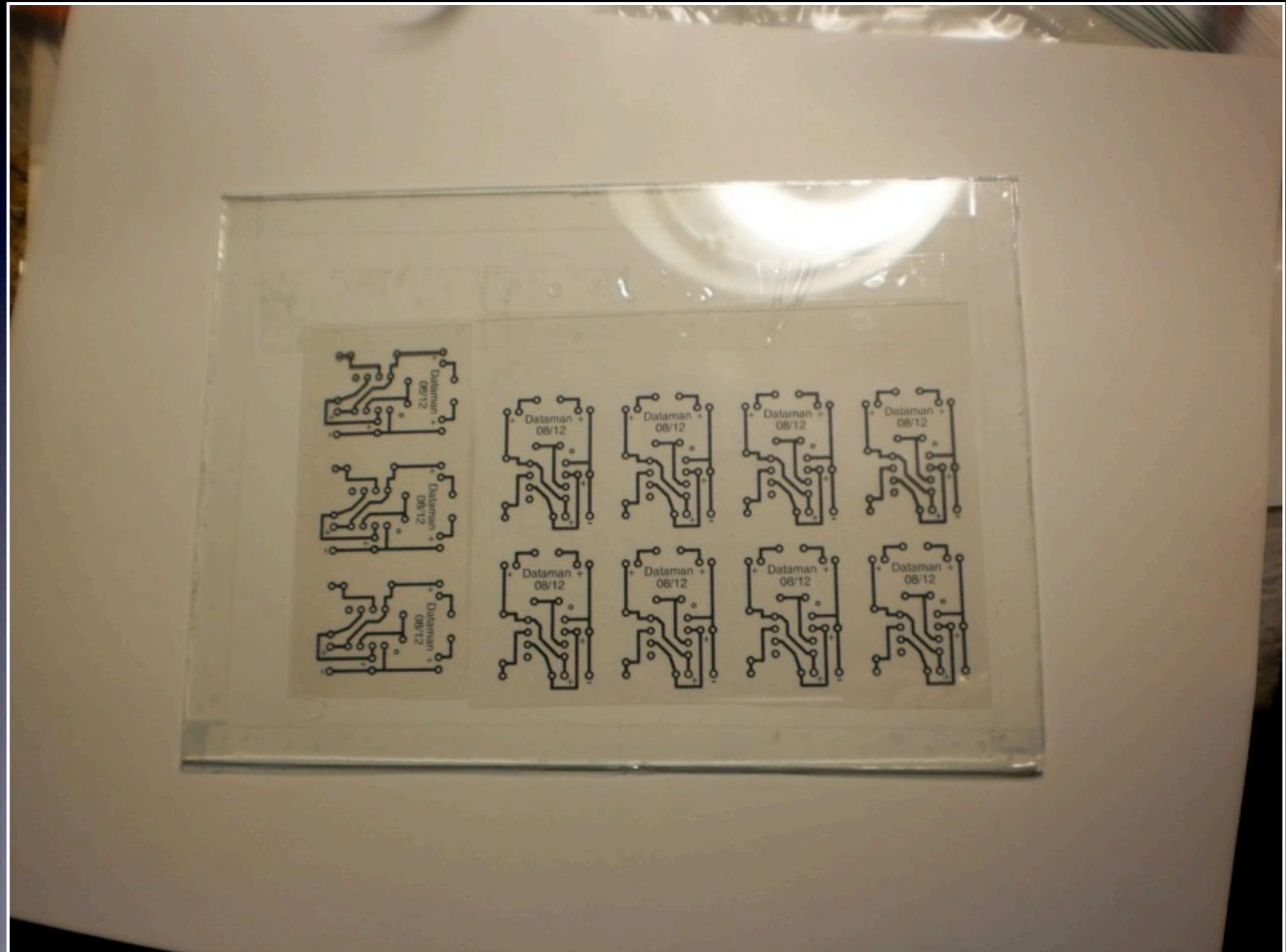


# SynShop

## Solder Buildup

6

Layout  
trans-  
parency  
on board.



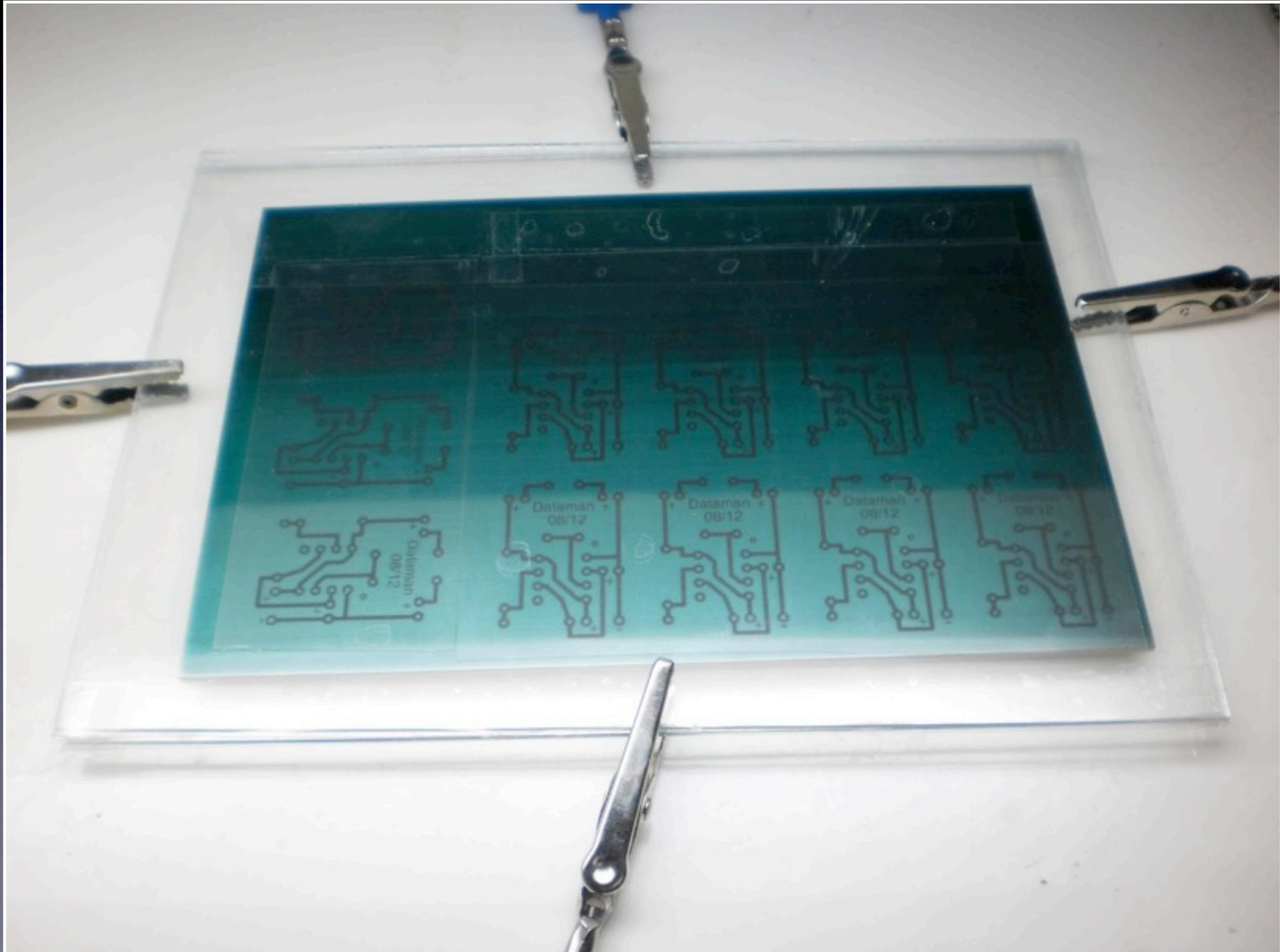


# SynShop

## Solder Buildup

7

**Remove  
protective  
layer and  
expose for  
12  
minutes.**



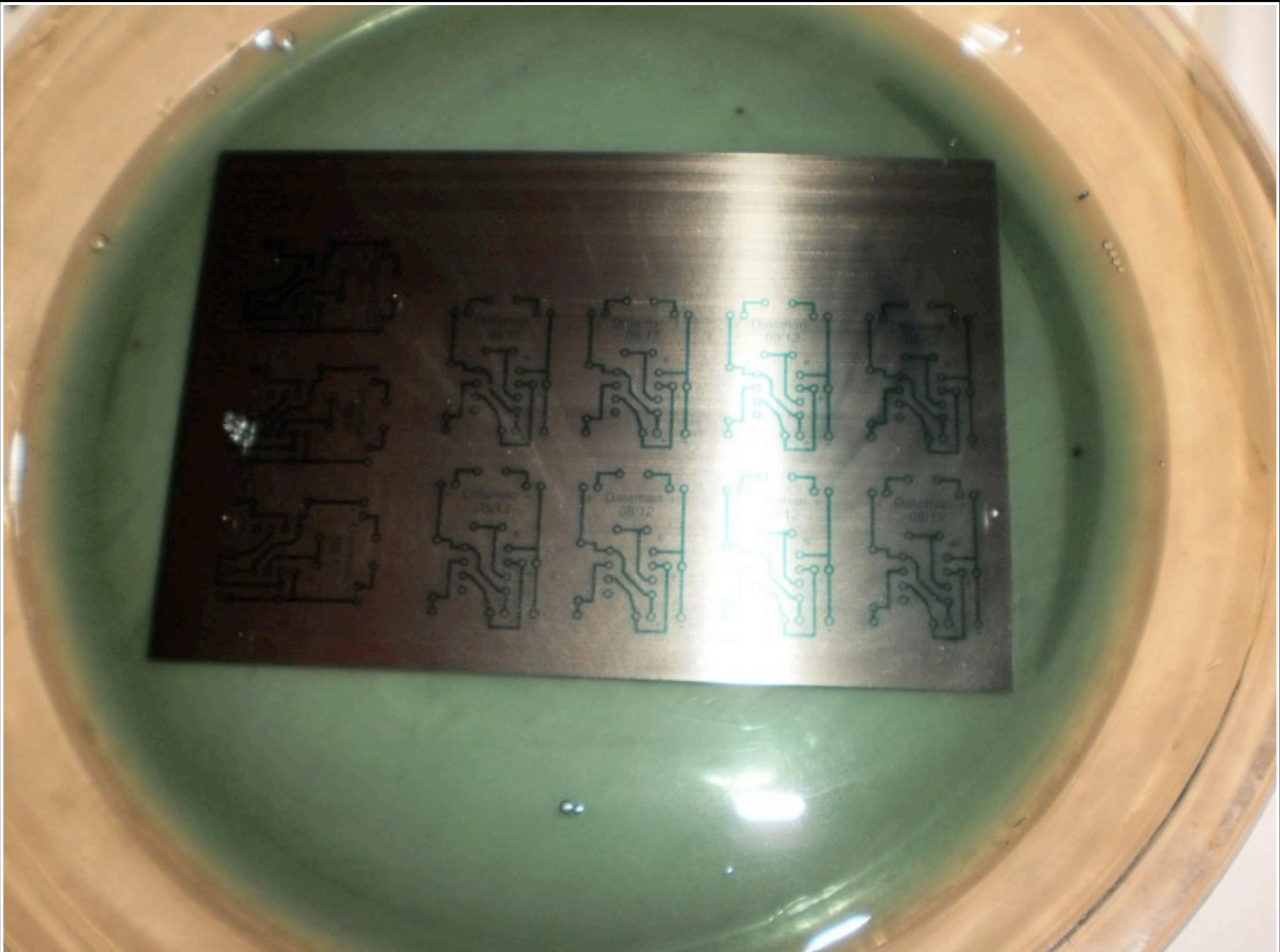


# SynShop

## Solder Buildup

8

Develop.  
Green dye  
is  
removed,  
copper is  
exposed.



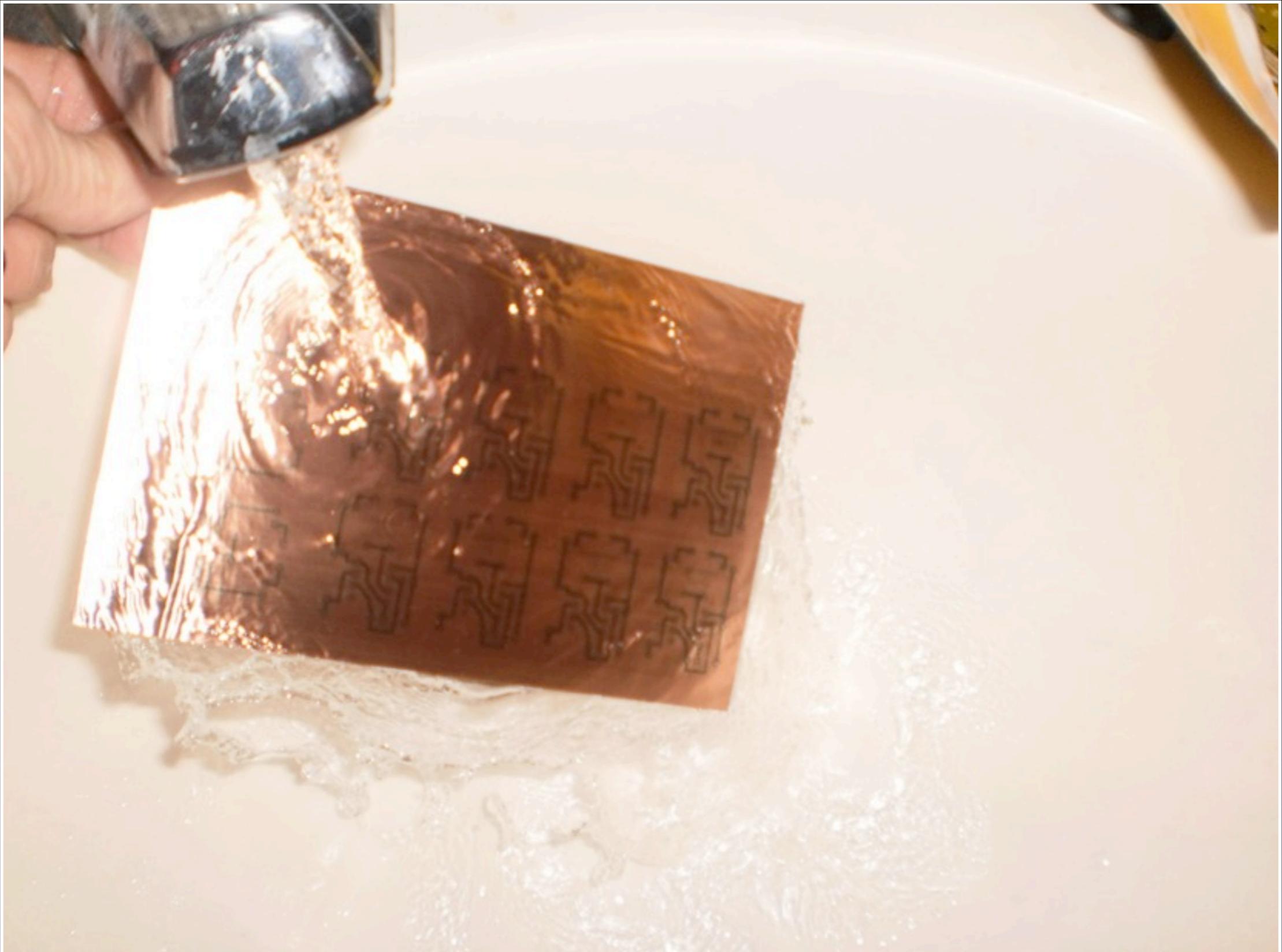


# SynShop

## Solder Buildup

9

**Fix in cold  
water.**





# SynShop

## Solder Buildup

10

Etch in  
hydro-  
chloric  
acid.





# SynShop

## Solder Buildup

10

Rinse and  
dry.



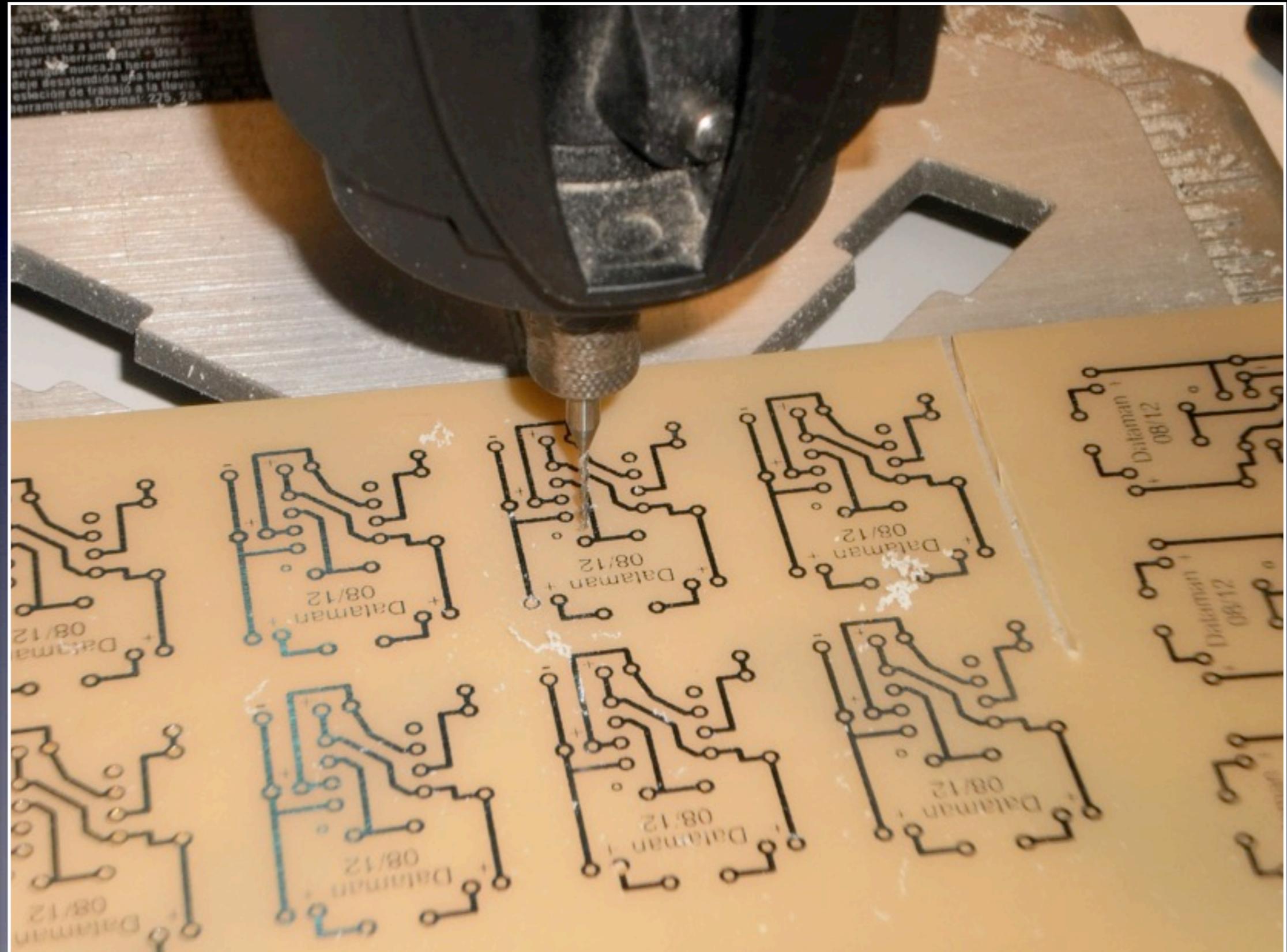


# SynShop

## Solder Buildup

10

Drill



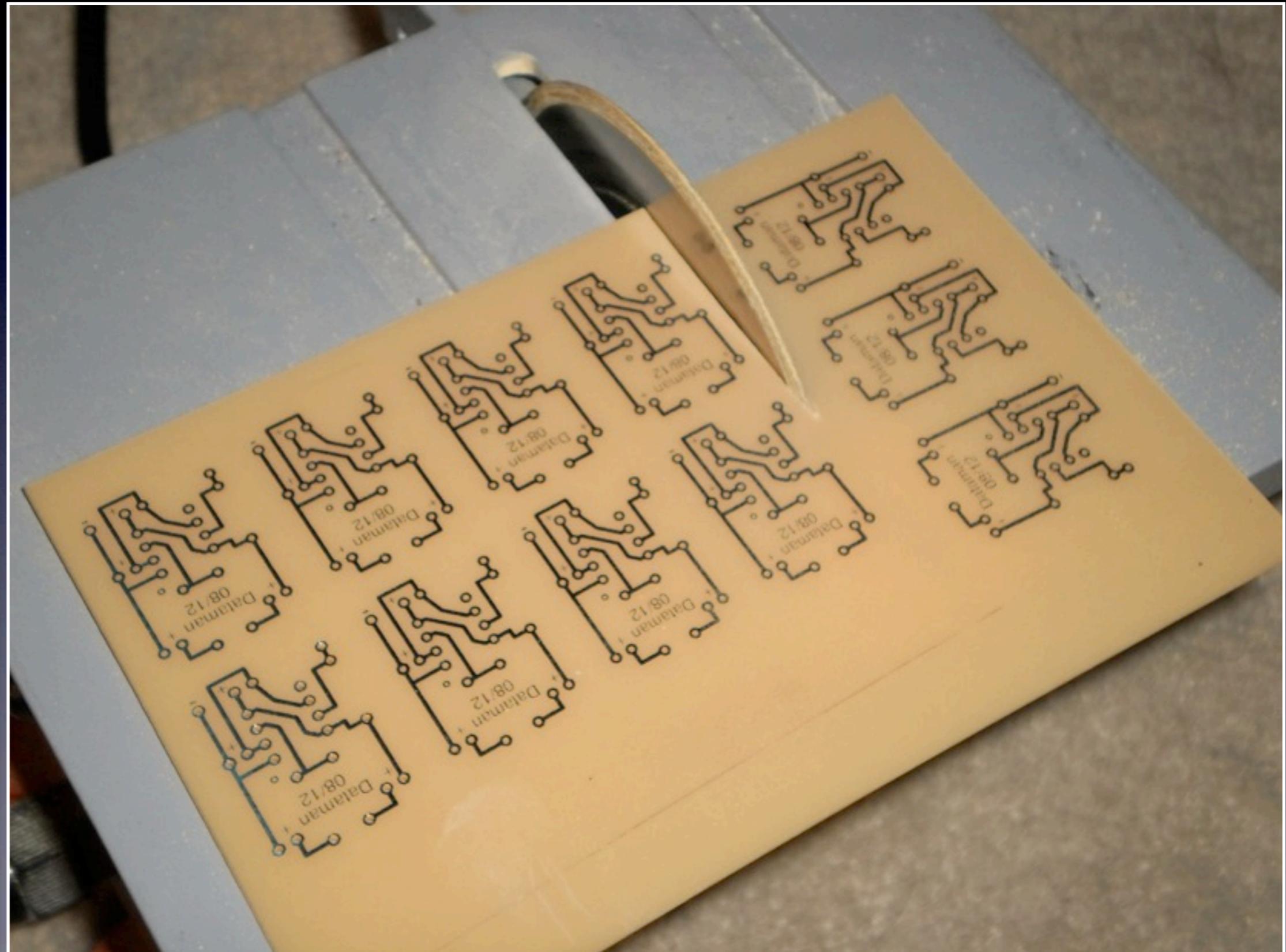


# SynShop

## Solder Buildup

10

Cut





# SynShop

## Solder Buildup

10  
**Shape.**



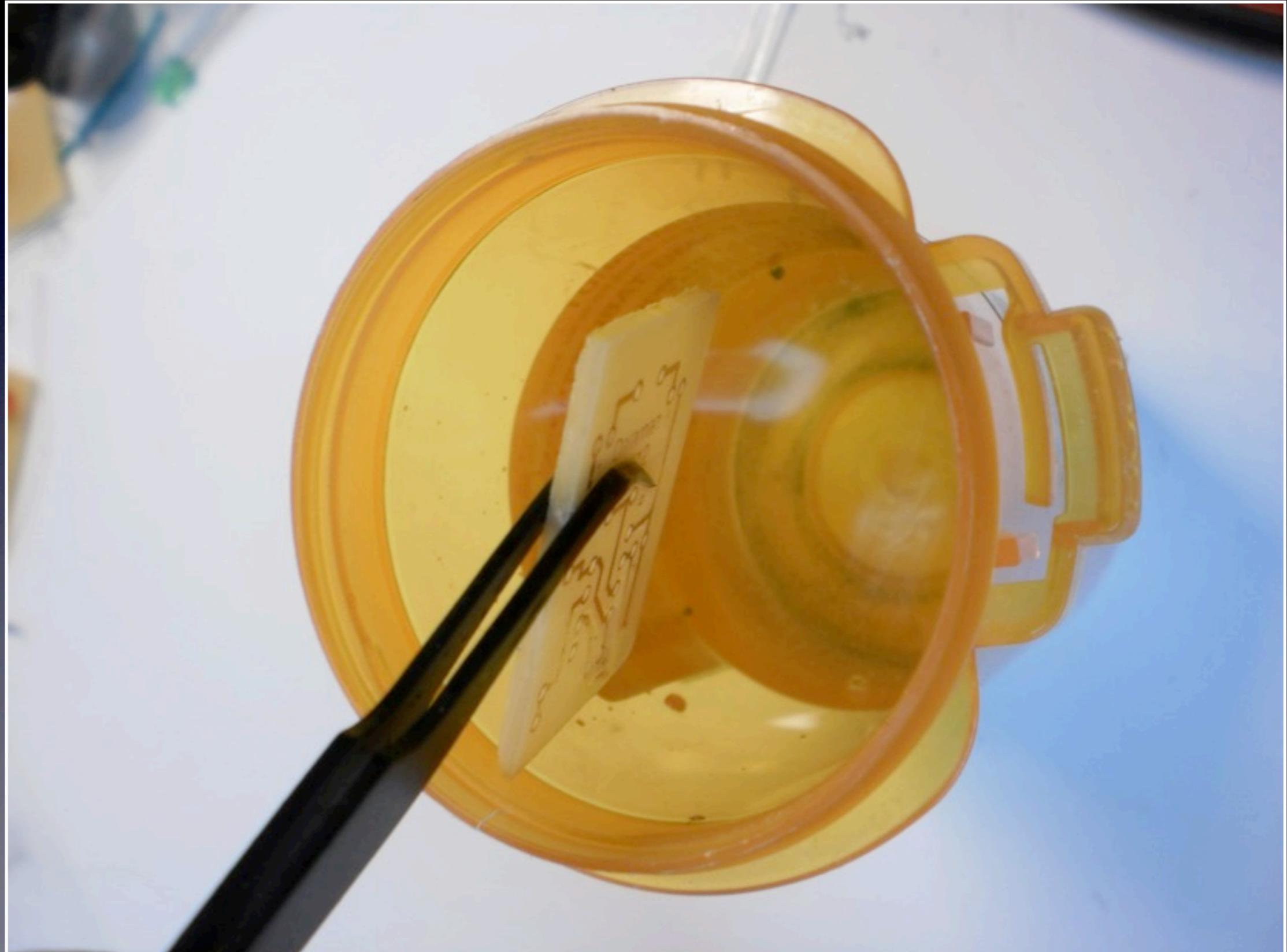


# SynShop

## Solder Buildup

10

**Clean. Dip  
in acetate.**



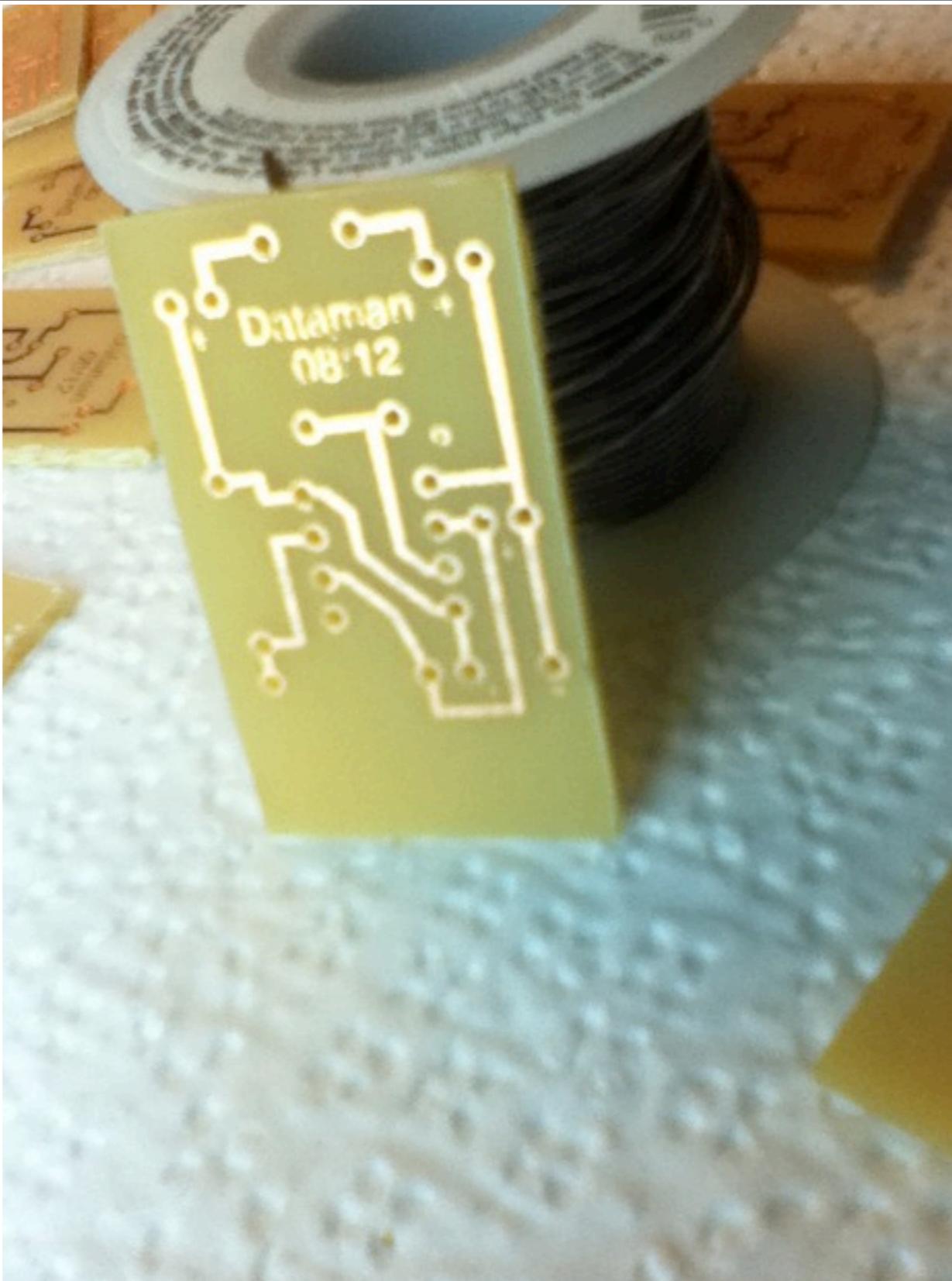


# SynShop

## Solder Buildup

10

Complete.





SynShop  
Solder Buildup

# Stop and Go 555 PCB Build

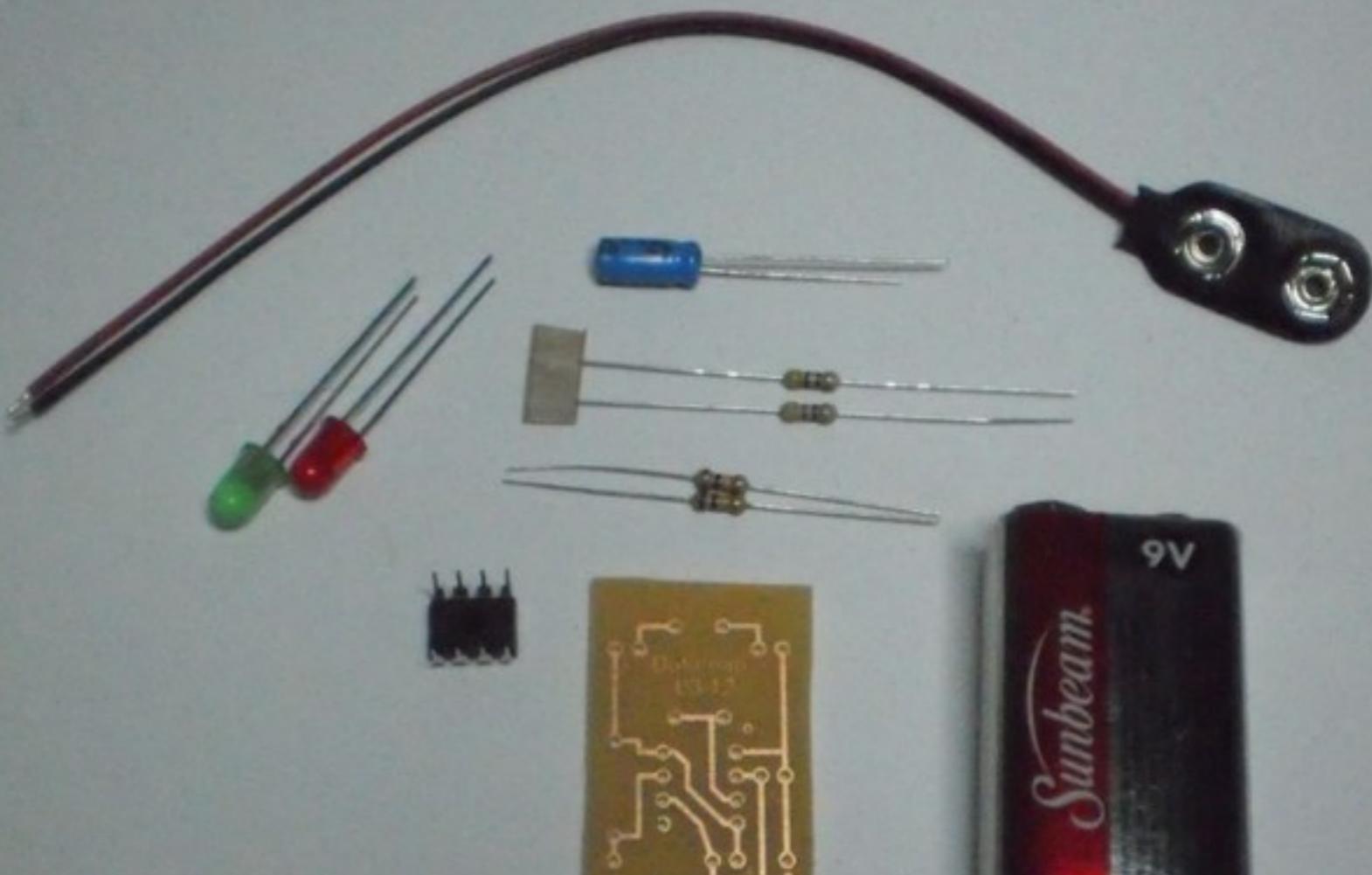


# SynShop

## Solder Buildup

1

Parts for  
the build.



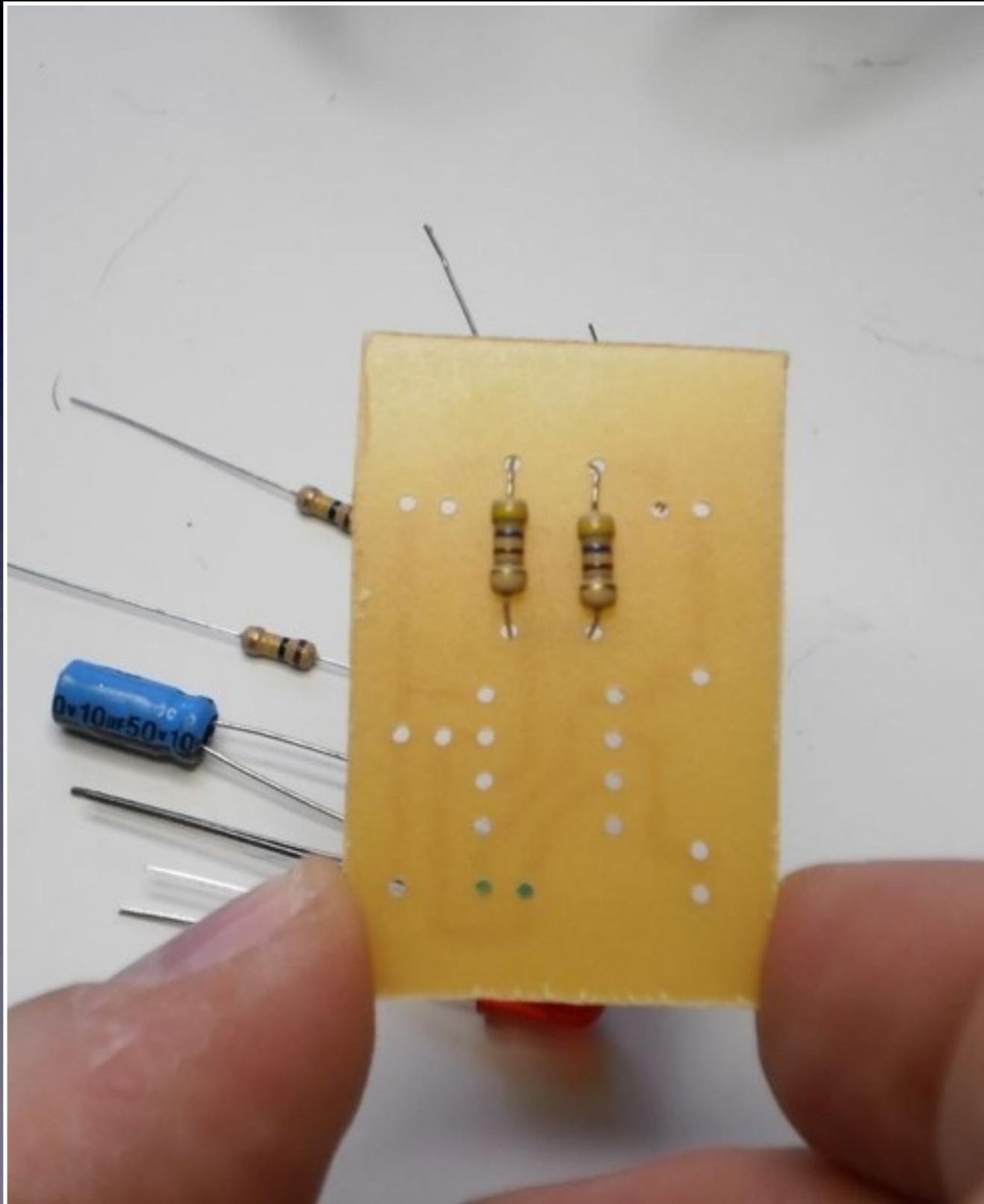


# SynShop

## Solder Buildup

2

**Solder the  
two 470  
resistors,  
yellow,  
violet,  
brown.  
Orient-  
ation is  
not  
important.**



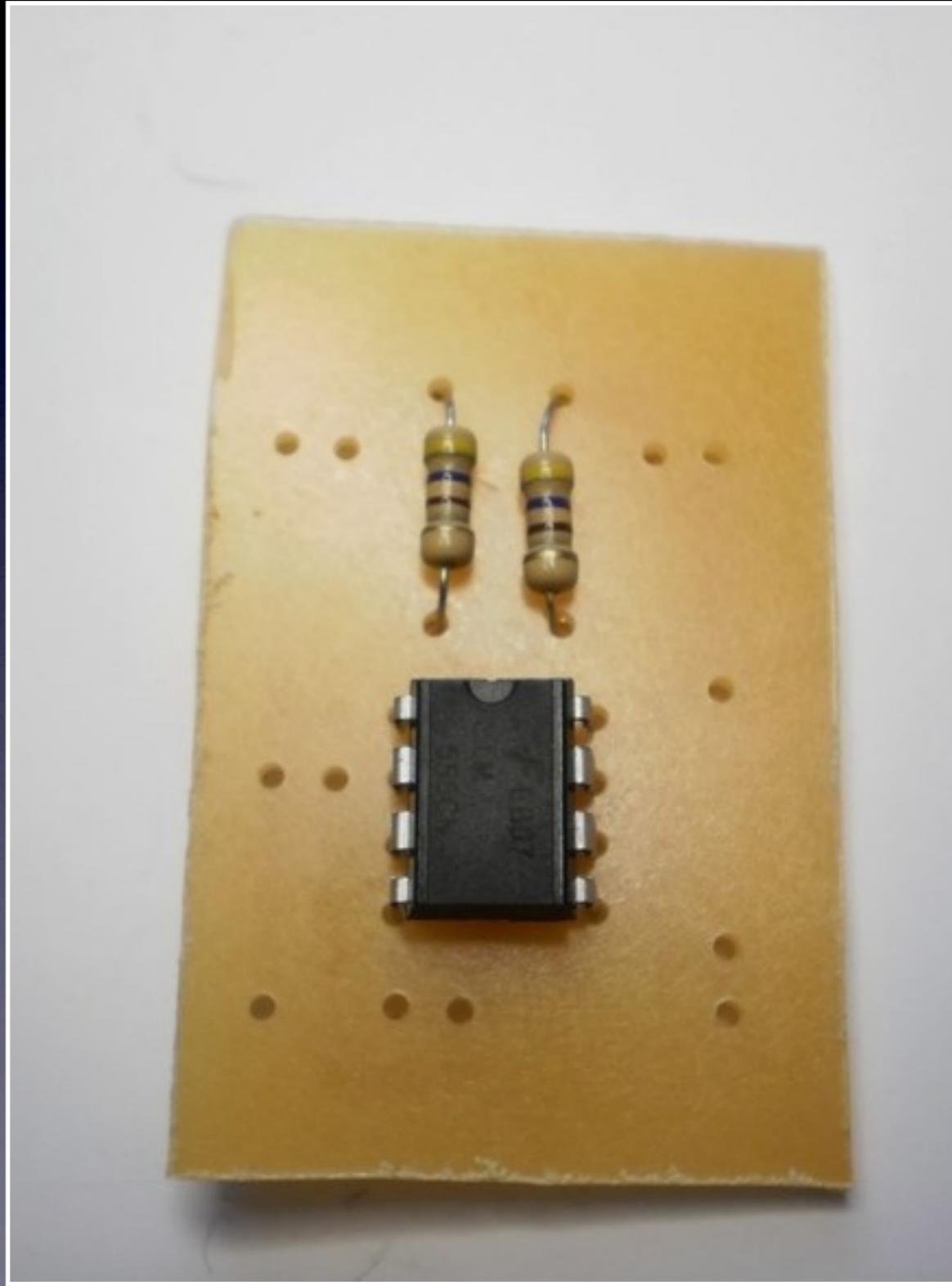


# SynShop

## Solder Buildup

3

**Solder the chip. Note that notch faces up towards the 470 ohm resistors.**





# SynShop Solder Buildup

## Interrupt: The Roll the Chip Technique



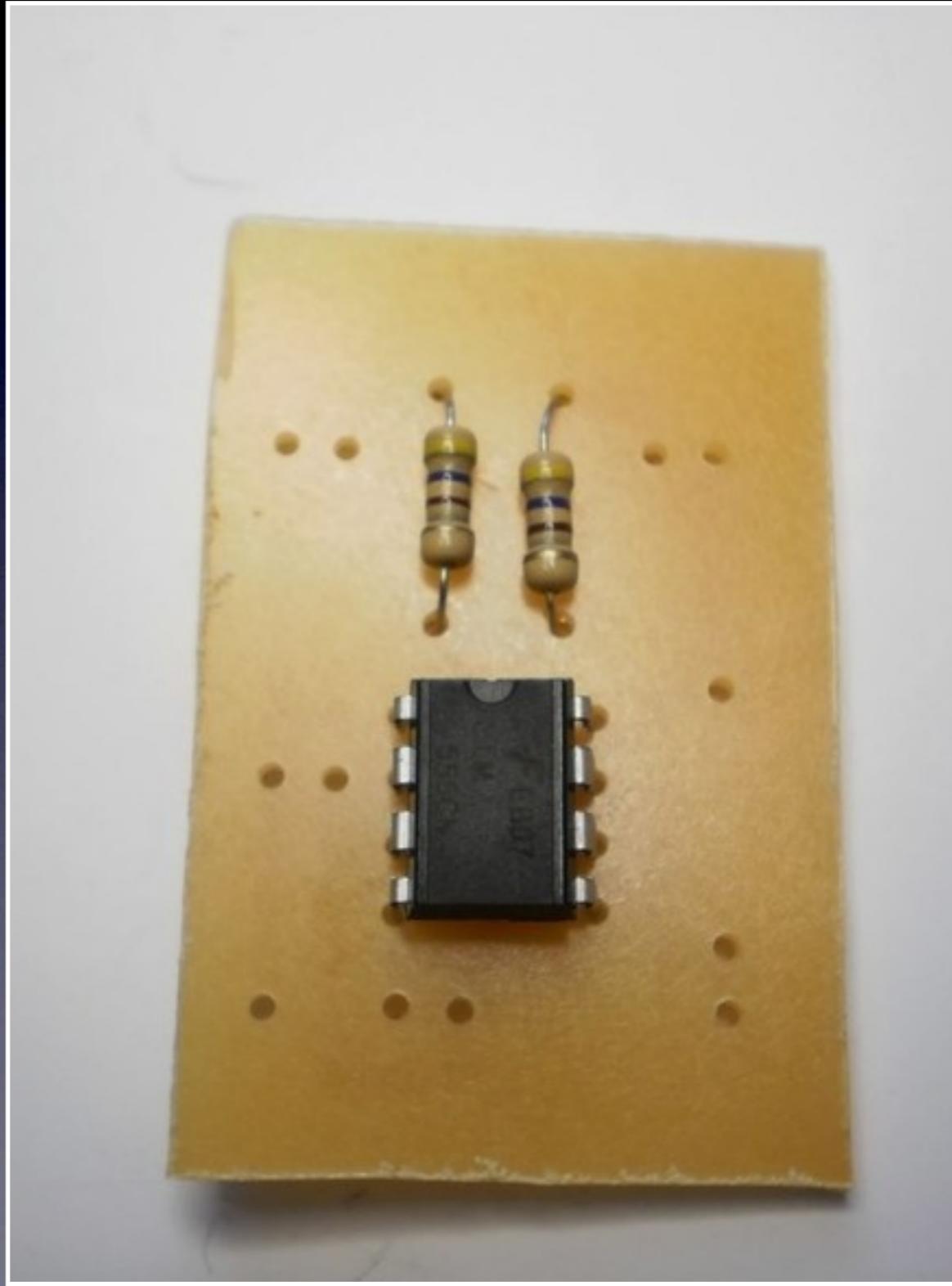


# SynShop

## Solder Buildup

3

**Solder the chip. Note that notch faces up towards the 470 ohm resistors.**



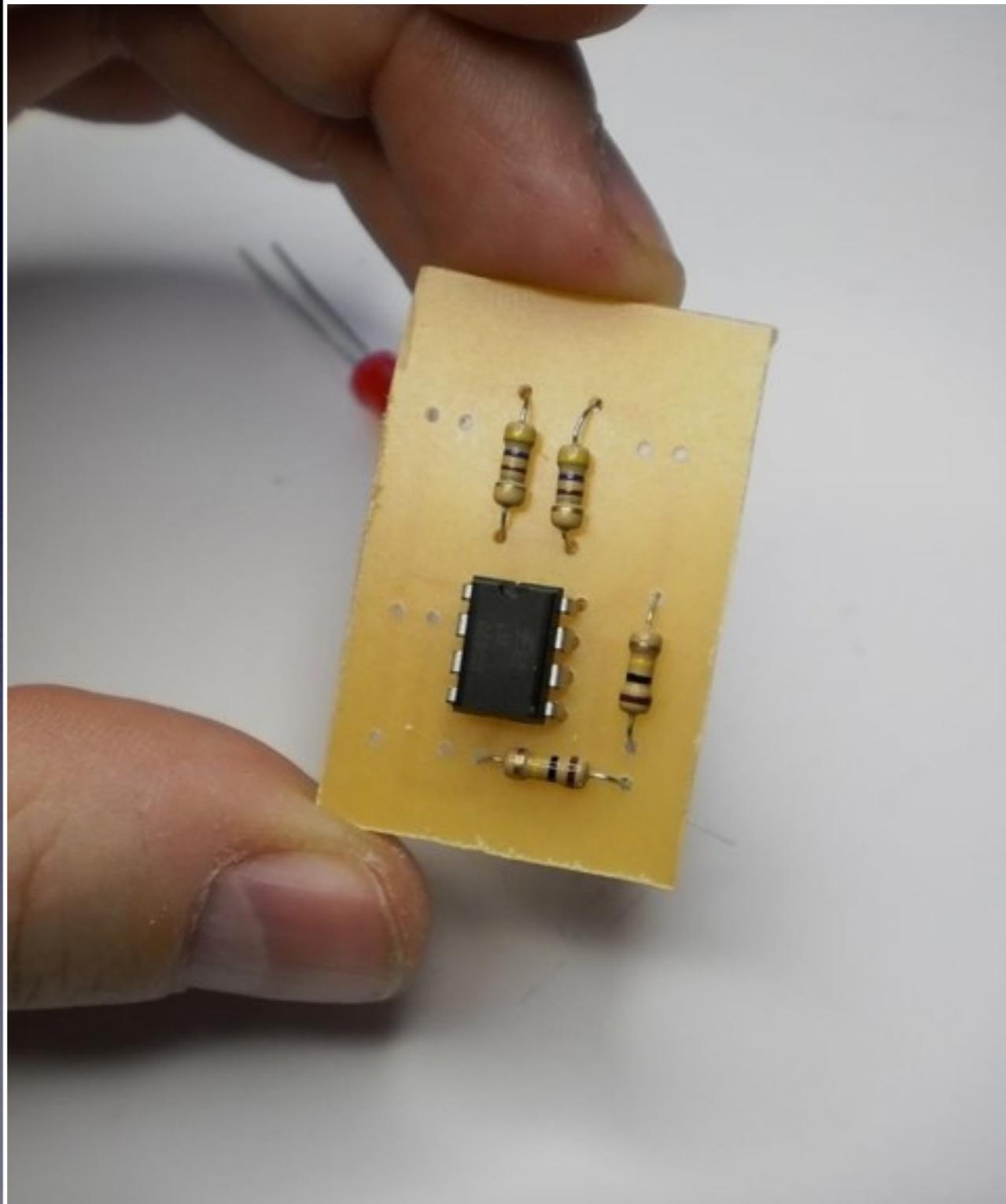


# SynShop

## Solder Buildup

4

**Next,  
solder the  
two 100k  
resistors,  
brown,  
black,  
yellow.  
Orient-  
ation is  
not  
important.**



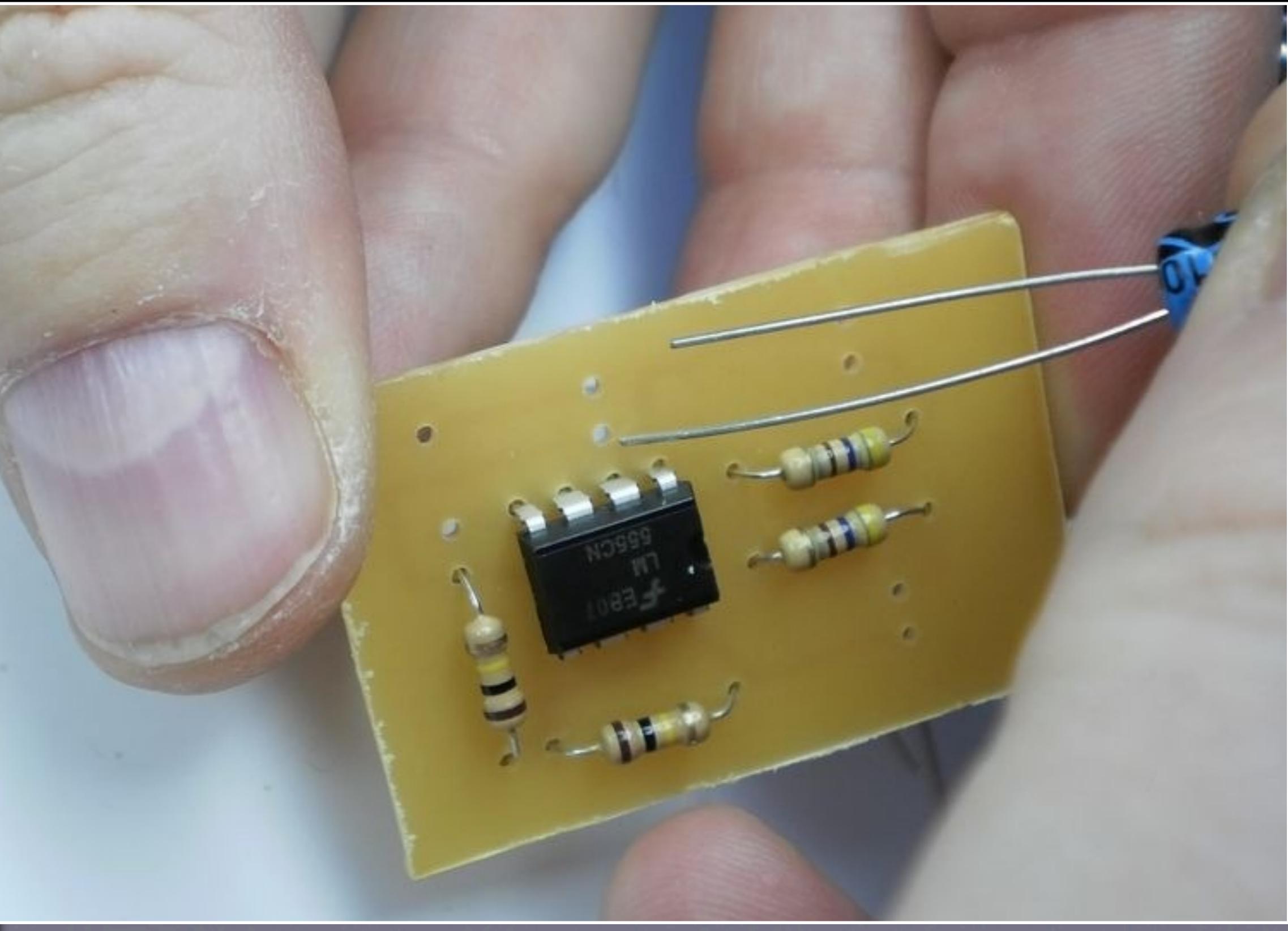


# SynShop

## Solder Buildup

5

**Next,  
place the  
capacitor.  
Long leg  
to the  
right. You  
may lay  
capacitor  
flat.  
Double  
check  
before  
solder.**

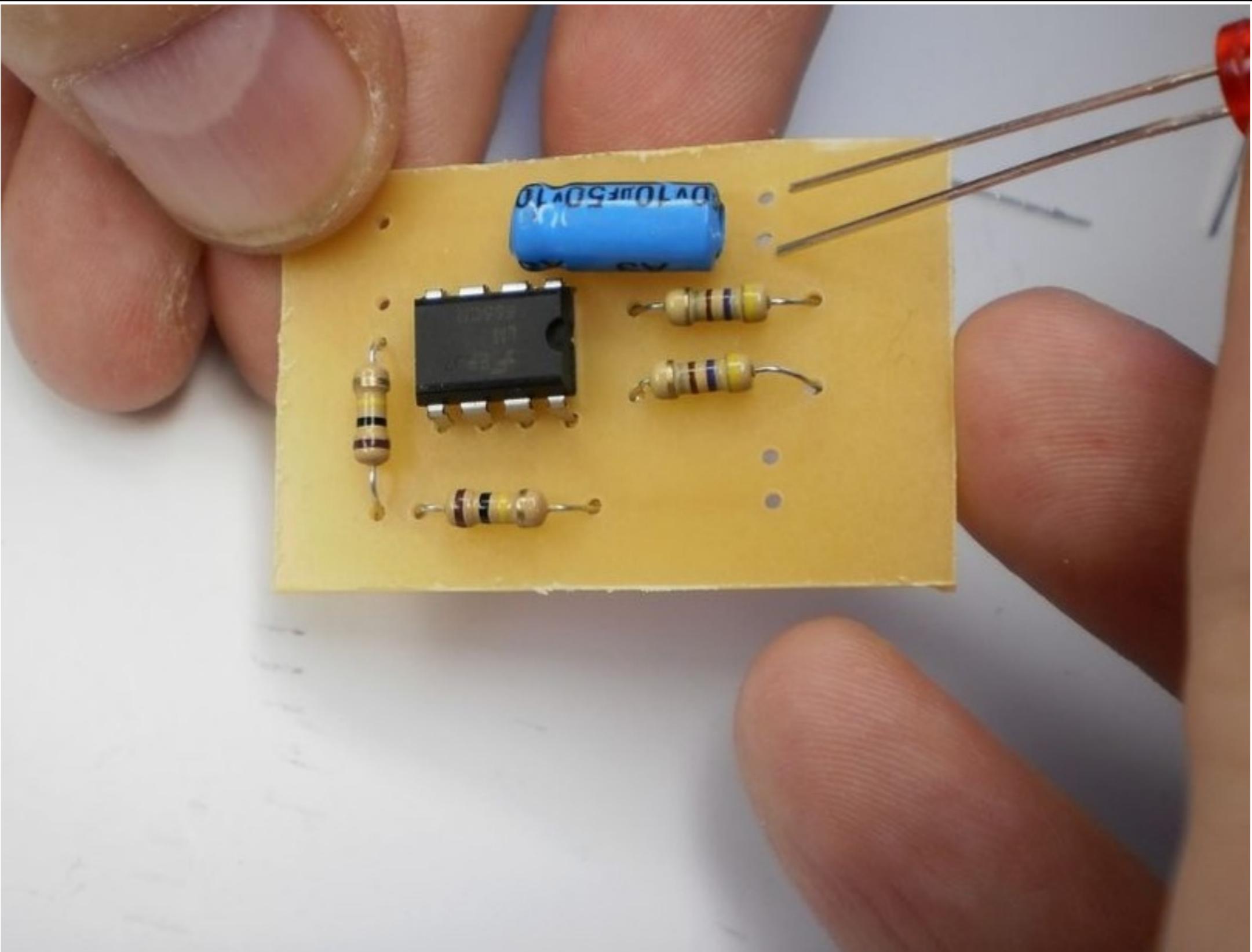




# SynShop

## Solder Buildup

6  
Next,  
solder the  
two LEDs.  
Long leg  
goes into  
the right  
hole.  
Color is  
not  
important.  
Double  
check  
before  
solder.



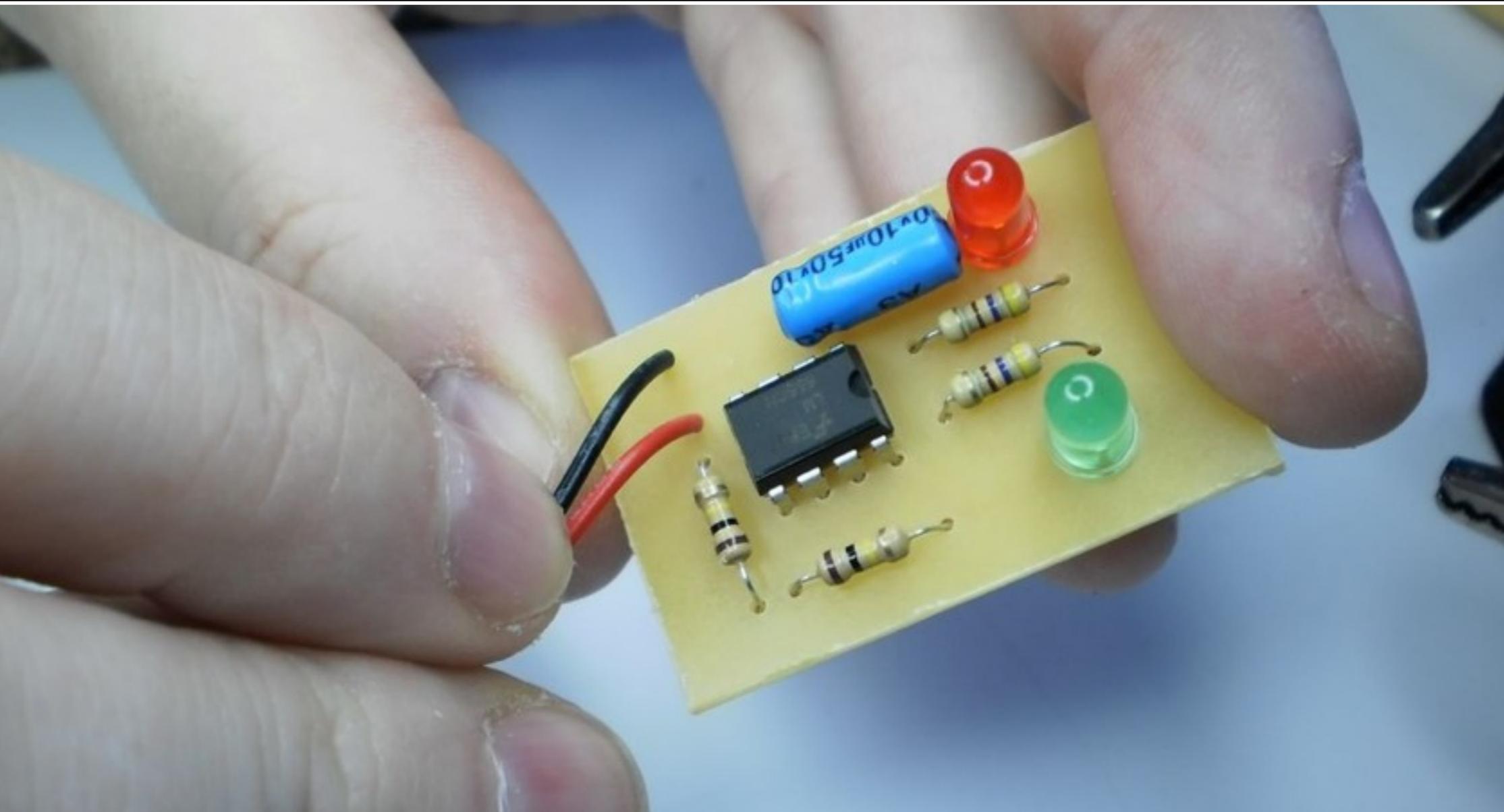


# SynShop

## Solder Buildup

7

**Solder  
battery  
clip. Note  
the + for  
red wire,  
top, and -  
for  
negative  
wire  
bottom.**





# SynShop

## Solder Buildup

8

**Attach  
battery.  
Should  
immed-  
iately start  
blinking.**





# SynShop Solder Buildup

**That was a fun  
build!**



SynShop  
Solder Buildup

Where can I find  
more easy to build  
kits?



SynShop  
Solder Buildup

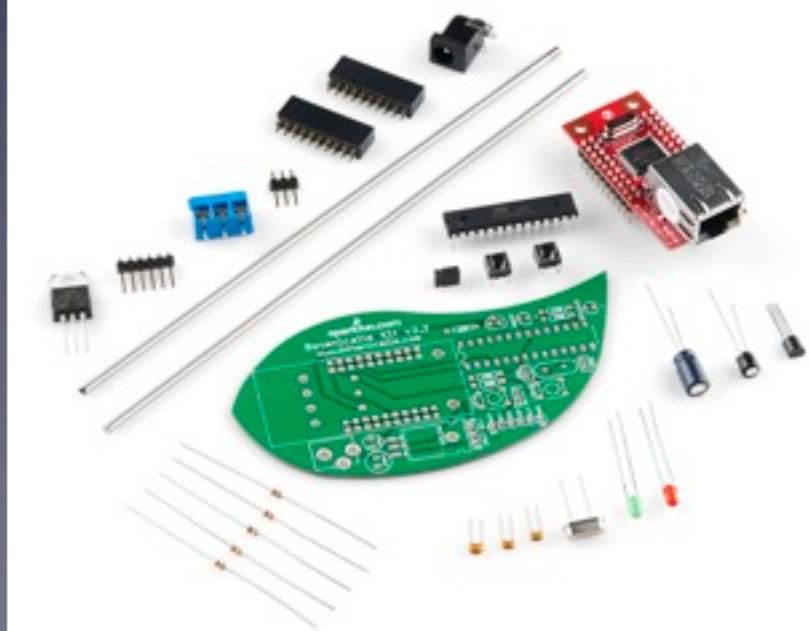
Lady Ada has lots  
of great stuff at  
[AdaFruit.Com](http://AdaFruit.Com)





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Solder Buildup

**SparkFun.Com  
has lots of cool  
stuff**



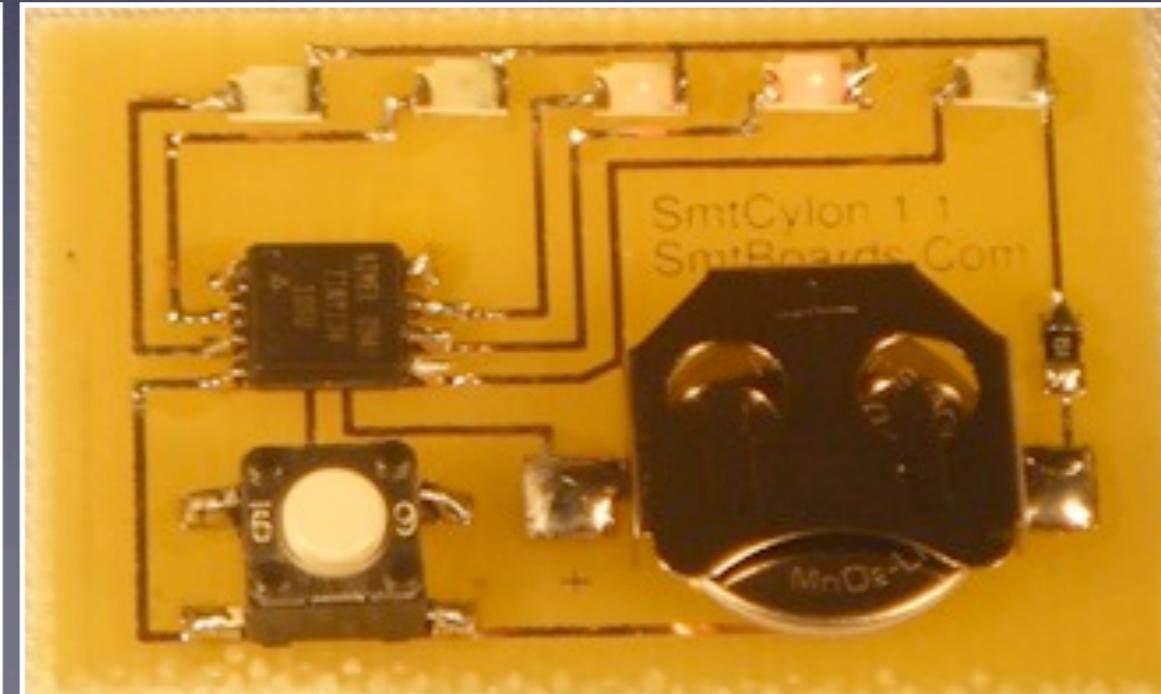


# SynShop Solder Buildup

# And even I have designed kits for **SMTboards.com**

The screenshot shows the SMTboards.com website with a navigation bar at the top: Home, Blog, Projects (selected), Shop, Support. Below the navigation, there are three main sections:

- SMTtinyCylon**: A micro-sized (1 1/4" x 1") tinyCylon! Our first kit! 14 different modes of operation. 11 parts, about a 20 minutes build. Design Docs, Code, Instructions, Kits, Parts available [here](#).
- SMTtinyISP**: Or, how did I program all those SMTcytons? This teeny timer board measures 3/4" x 1", But oh what power in such a small package. This board adds a temporary ISP port to a Tiny13. Great for programming batches of CPUs. Design Docs, Code, Instructions, Kits, Parts available [here](#).
- SMTTester**: Or, are you really sure about that SMT LED's polarity?





# SynShop

## Solder Buildup

**And that's the  
class!**



# SynShop Solder Buildup

This entire course is published  
[github.com/Dataman/SolderBuildup](https://github.com/Dataman/SolderBuildup)

Or simply go to  
[github.com/dataman](https://github.com/dataman)





# SynShop

## Solder Buildup



Thank You!