



LETS BUILD AN EFFECTS PEDAL

DIY AUDIO ELECTRONICS



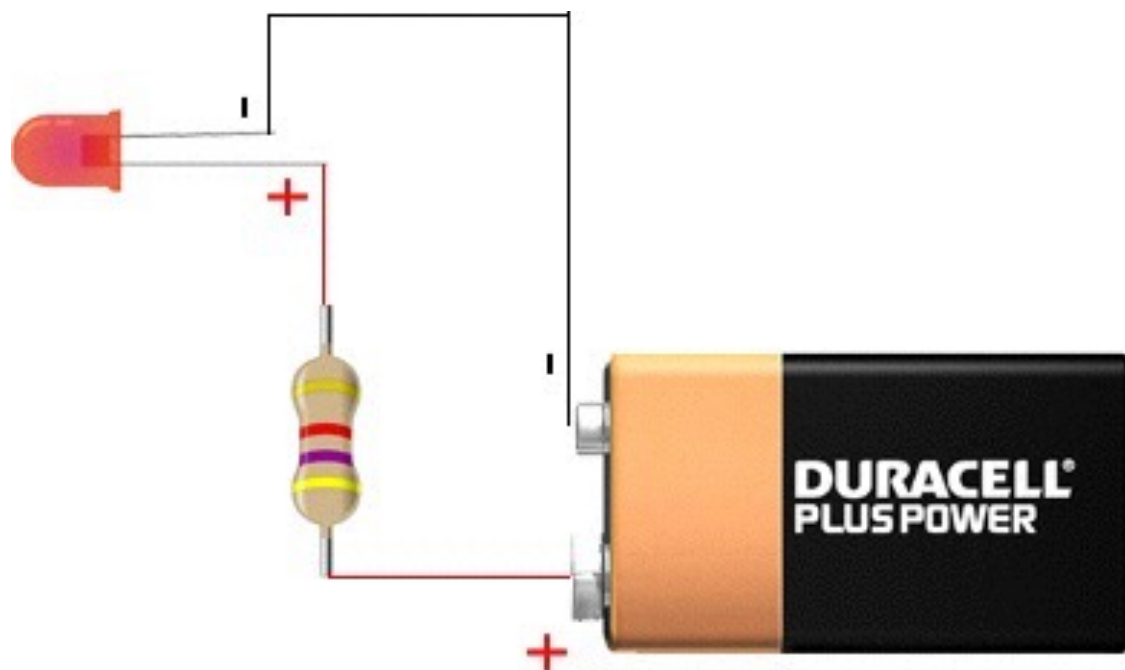
University of
Lethbridge



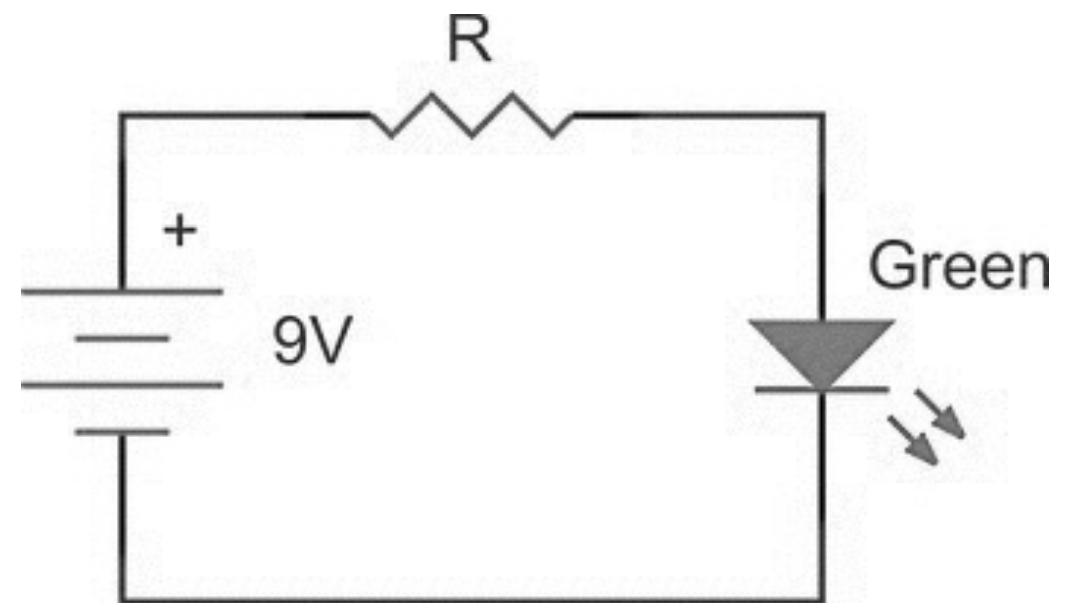
WHY DIY?

CIRCUIT BASICS

- ▶ A circuit contains a power supply and something for electricity to flow through.
- ▶ A power supply provides voltage to a circuit (measured in Volts (V))
- ▶ A power supply will have a + and - connection.
- ▶ In a circuit, electricity flows from the point of high voltage to the point of lower voltage.
- ▶ If we don't have a complete connection from + to -, no electricity will flow. The circuit will not work.
- ▶ The flow of electricity in a completed circuit is called Current. and is measured in Amps (A).



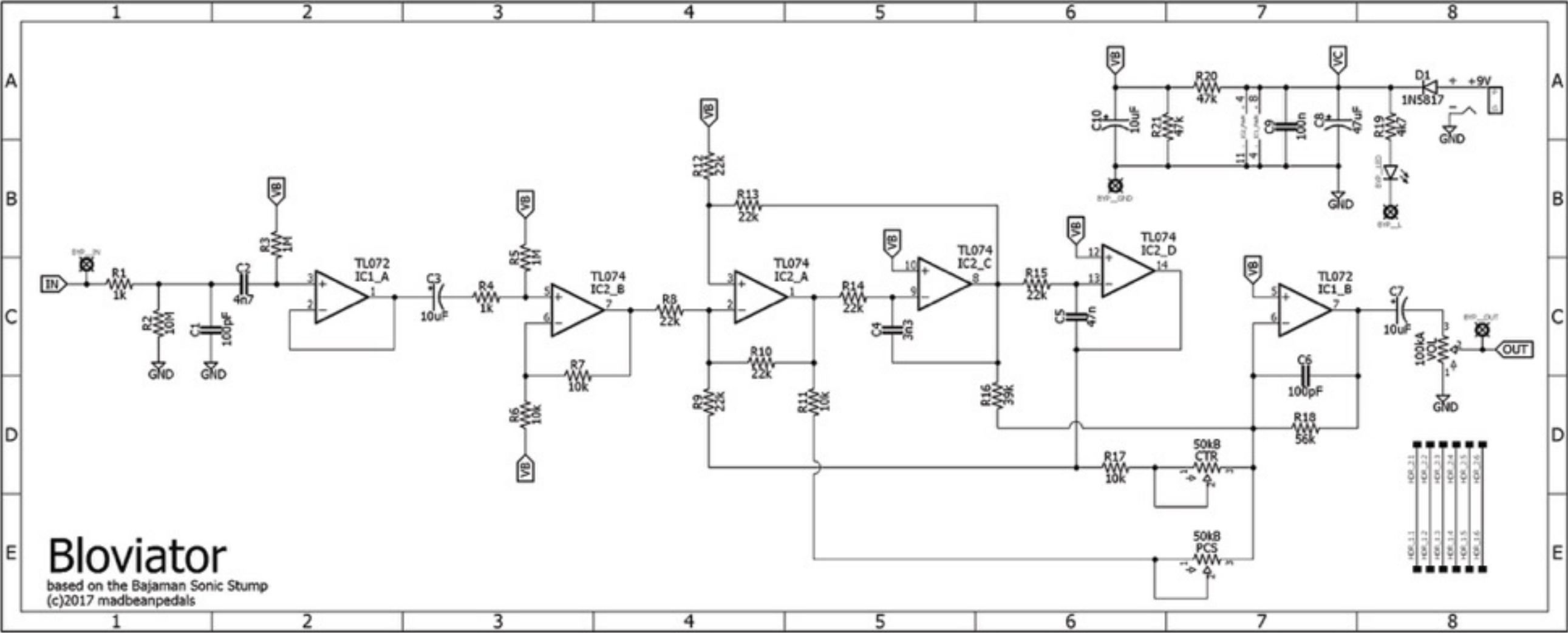
The Circuit



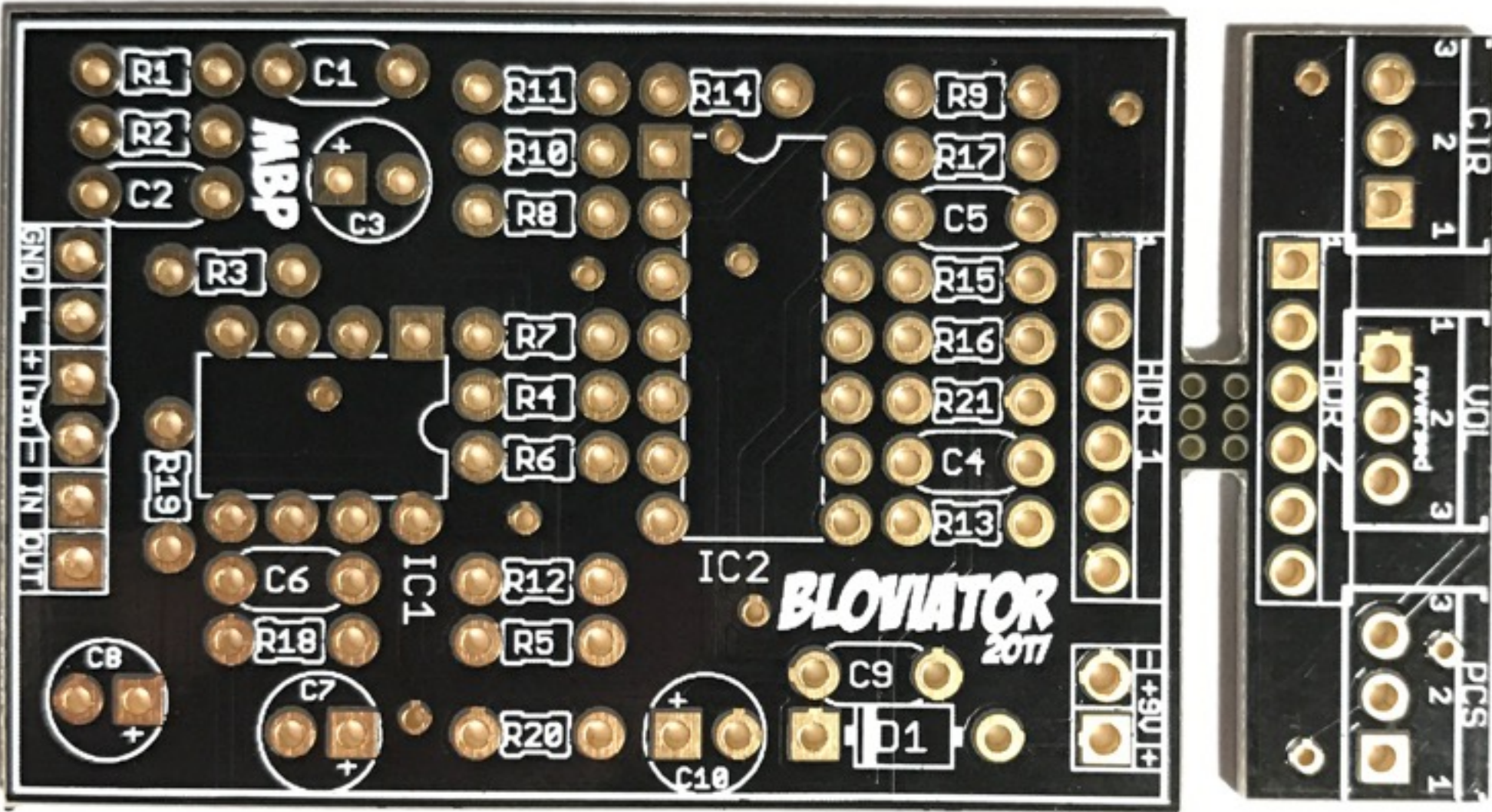
The Schematic

LETS BUILD AN EFFECTS PEDAL

THE CIRCUIT



THE PCB



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THE TOOLS



Soldering Iron



Wire Strippers



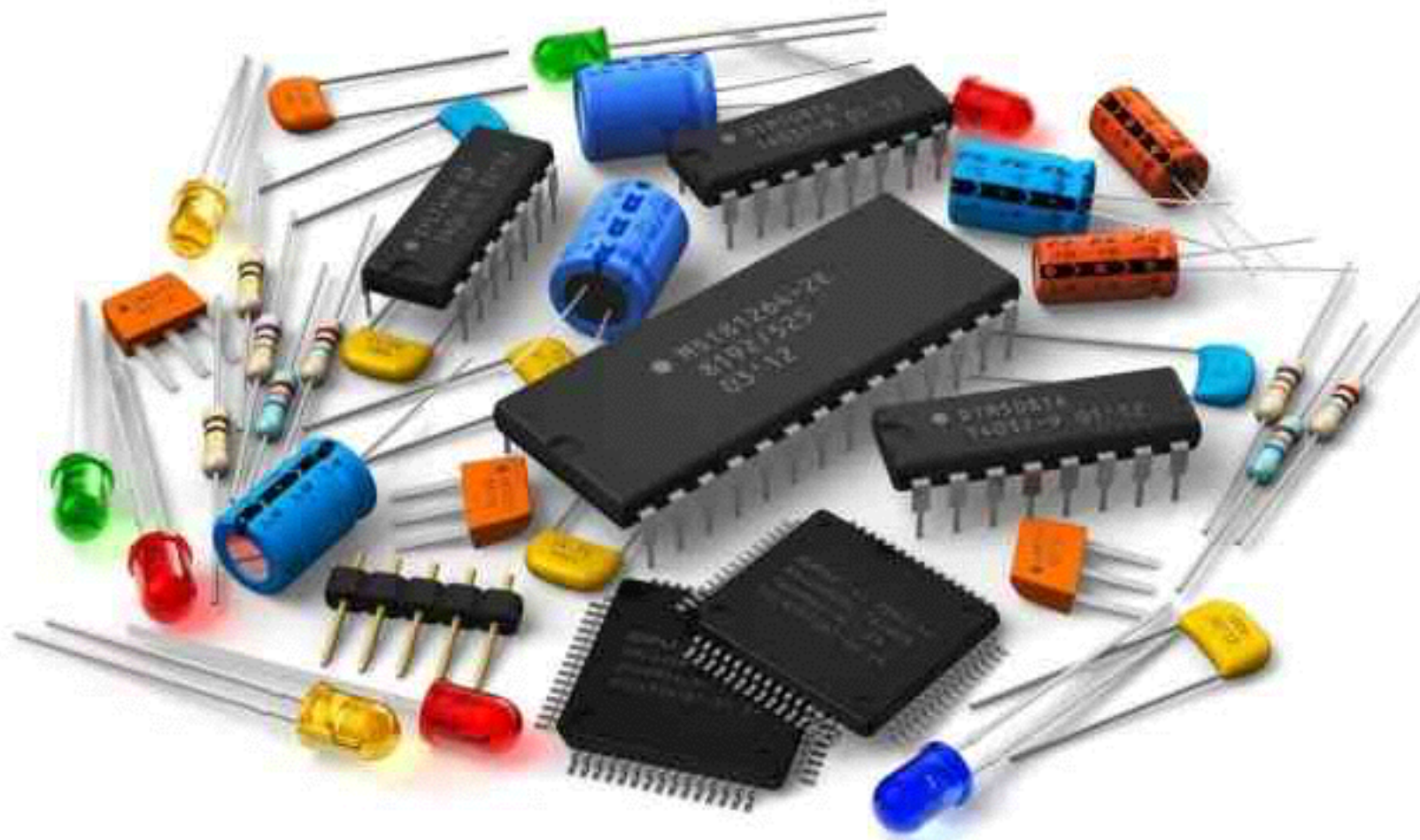
Flush Cutter

\$35.00

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COMPONENTS

The Magic that Makes Things Happen



RESISTORS

- ▶ Resist the flow of electricity between two points.
- ▶ Resistors are measured in Ohms Ω
- ▶ 100Ω Doesn't resist much.
- ▶ $4.7k\Omega$ Resists a bit. (also written $4k7\Omega$)
- ▶ $1M\Omega$ Resists a lot.

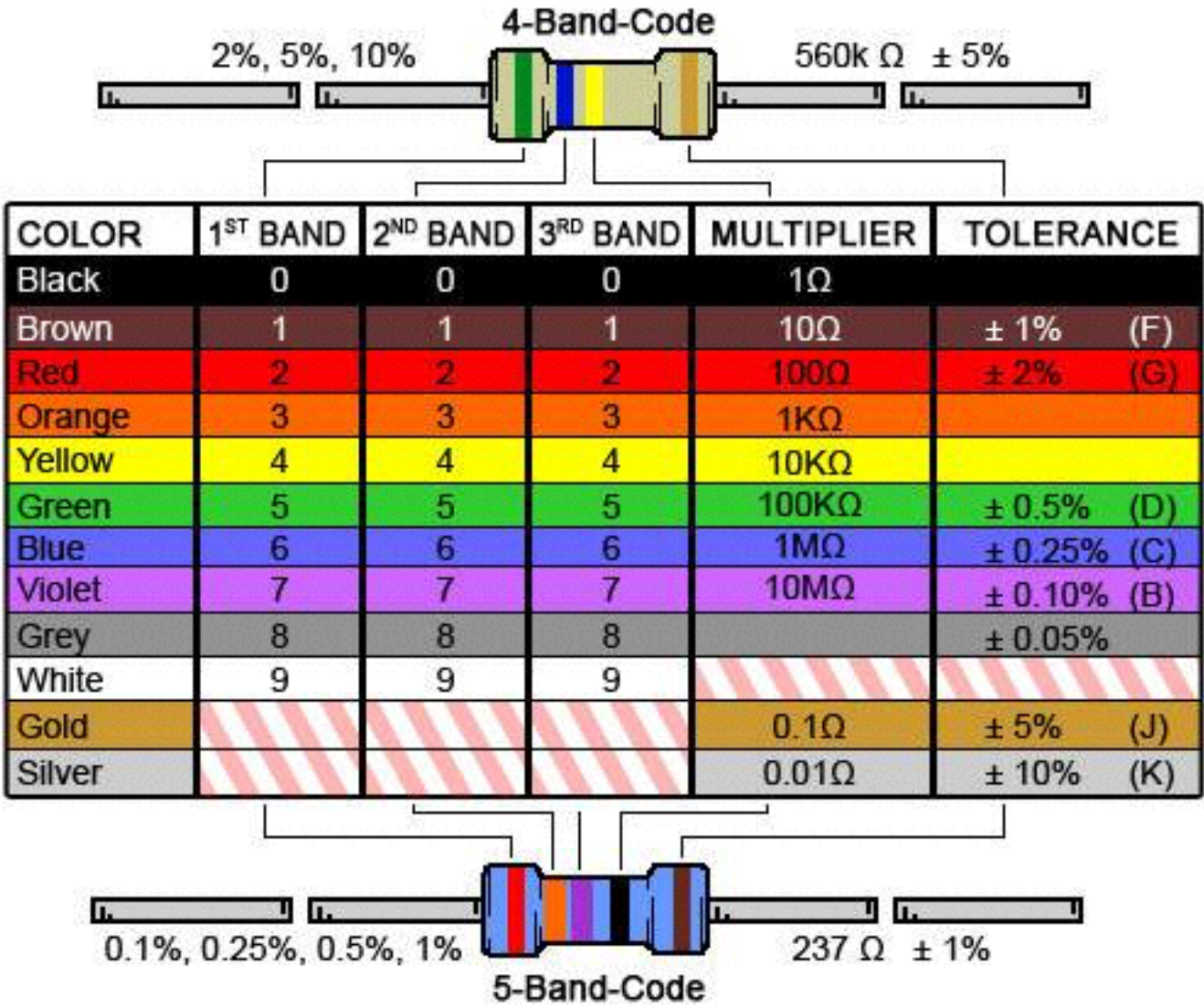


Resistors come in different sizes and power ratings. Unless otherwise stated, $1/4W$ or $1/8W$ are fine for hobby electronics.



RESISTORS

IDENTIFYING RESISTORS



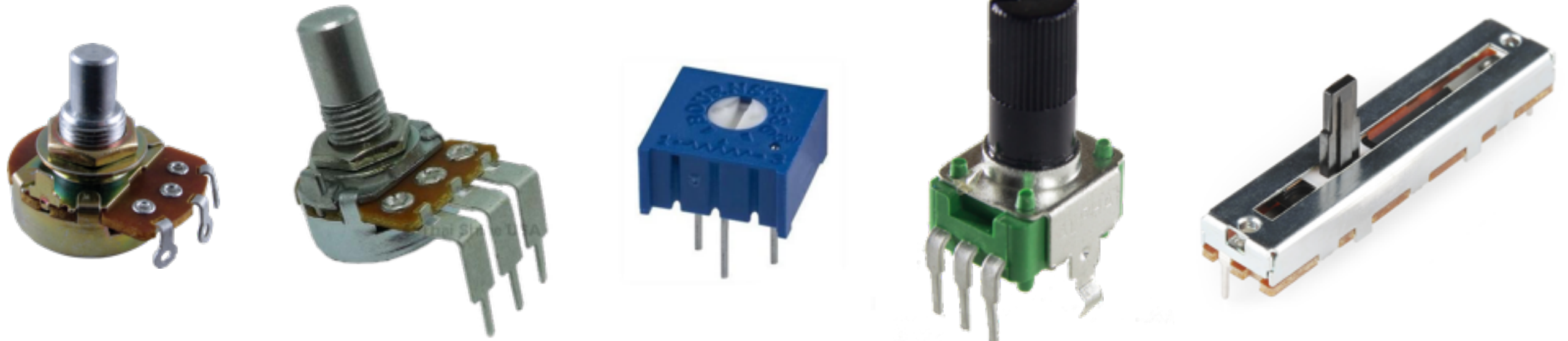
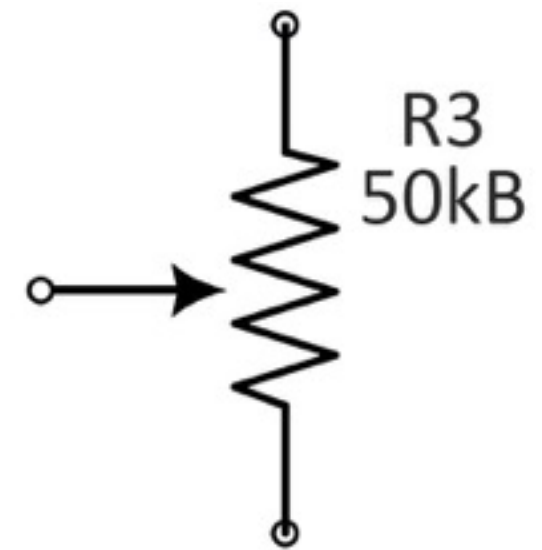
RESISTORS

IDENTIFYING RESISTORS

**“There’s an
app for that.”**

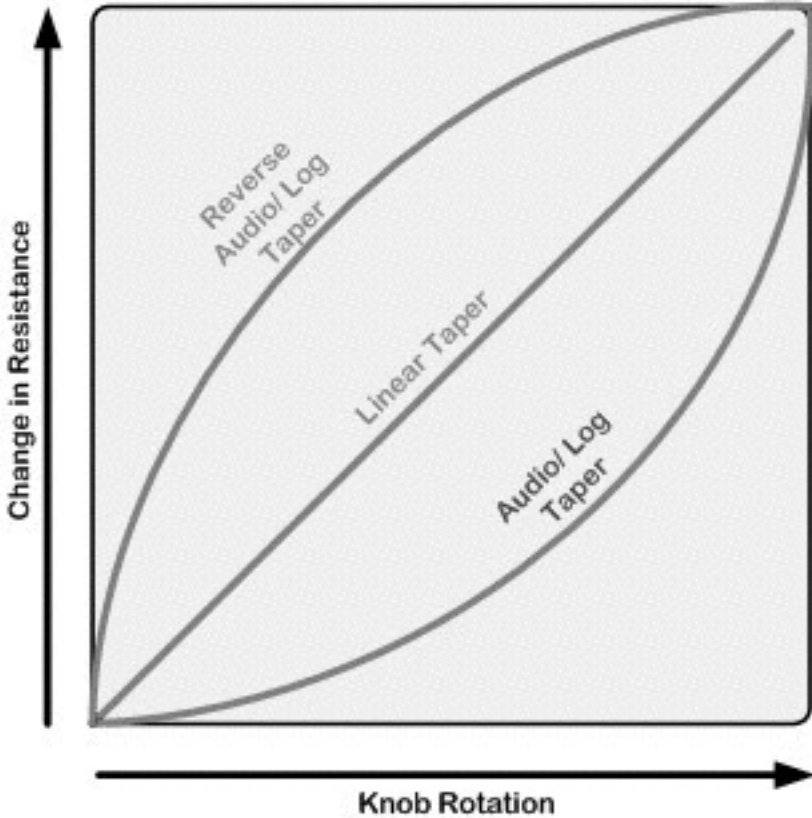
VARIABLE RESISTORS

- ▶ Also known as Potentiometers, Pots, Trimpots, Trimmers.
- ▶ Function the same as a resistor but their value is variable.
- ▶ Variable Resistors can have a different taper (A, B, C). The taper will effect how quickly the value will change as you increase or decrease resistance (turn the knob).



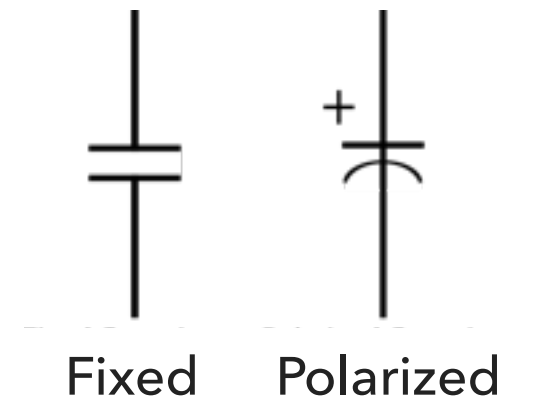
VARIABLE RESISTORS

Taper	Label	Description
Log (audio)	A	Resistance increases slowly at first, quicker near the end.
Linear	B	Steady resistance change as you increase resistance.
Reverse-Log	C	Quick change in the beginning, slower near the end.

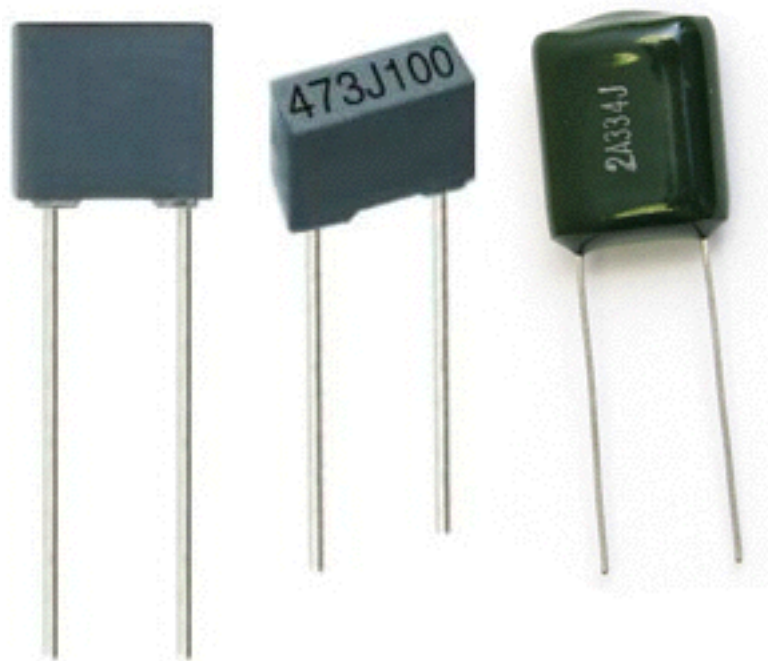


CAPACITORS

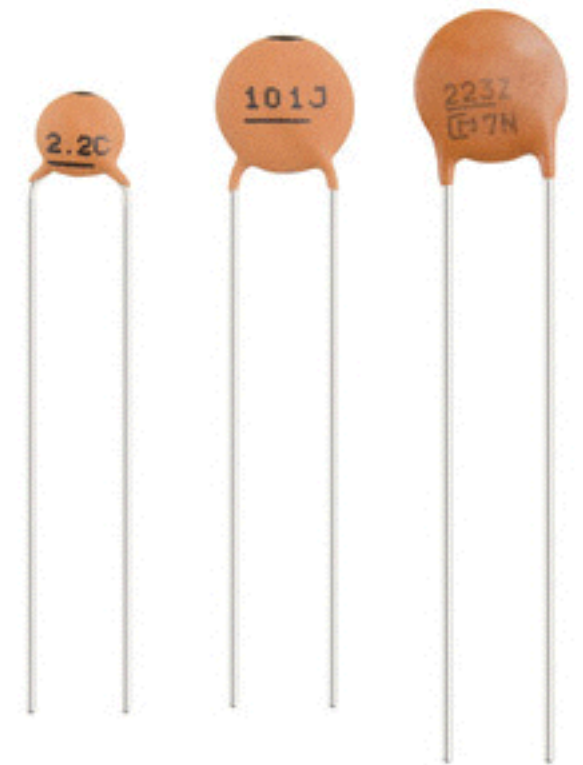
- ▶ Much like a battery, they store energy.
- ▶ Measured in Farads F
 - ▶ *pico Farads* - pF - small
 - ▶ *nano Farads* - nF - medium
 - ▶ *micro Farads* - μF - large



Electrolytic (Radial)
 μF



Film (Box Type)
 nF



Ceramic
 pF

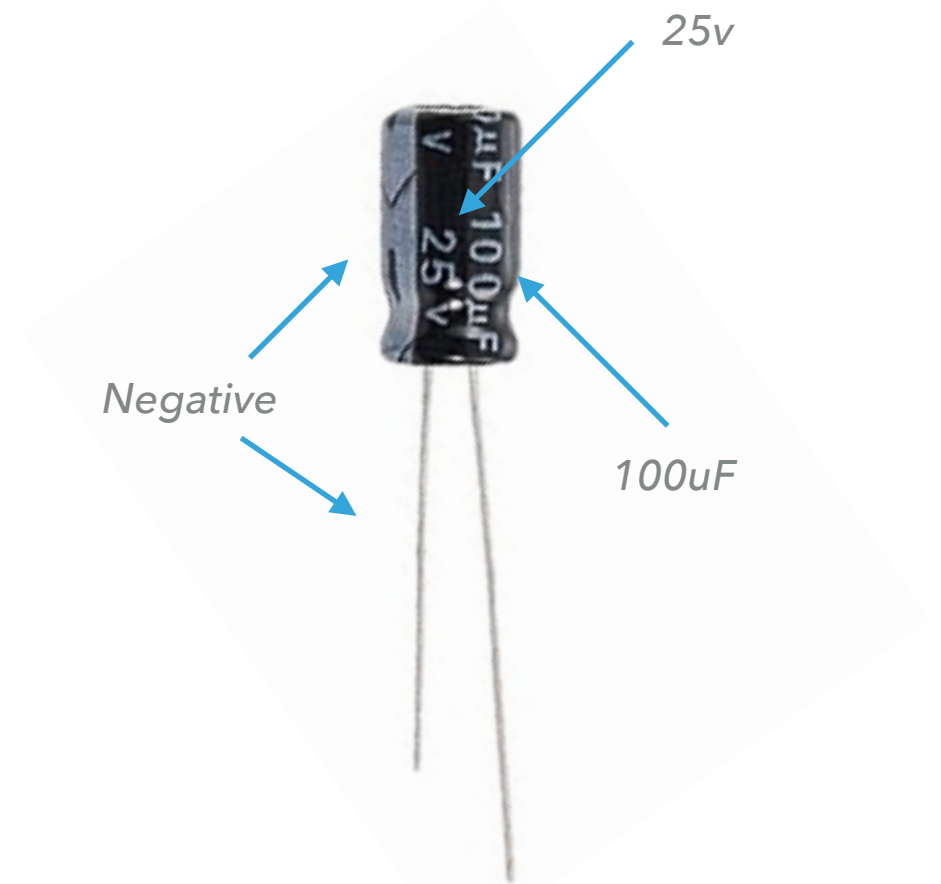
CAPACITORS

ELECTROLYTIC

- ▶ Electrolytic capacitors have polarity. A negative and positive side. The negative side is normally marked with a (-) symbol and a shorter lead.
- ▶ Placing electrolytic capacitors in backwards can cause them to overheat and **possibly burst**.
- ▶ Capacitance and voltage values are written on the component. Always buy capacitors with a voltage rating higher than your circuit.
- ▶ Usually measured in μF .
- ▶ Can be written as $4.7\mu F$ or $4\mu 7$.



Polarized



Electrolytic (Radial)

μF

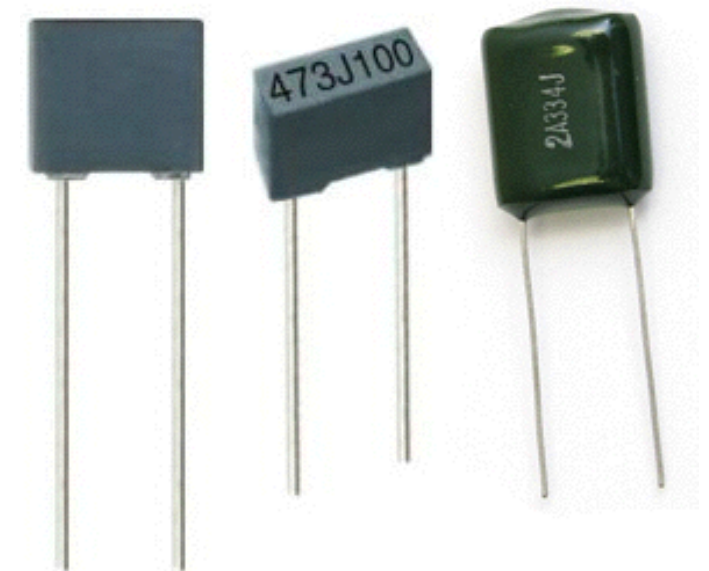
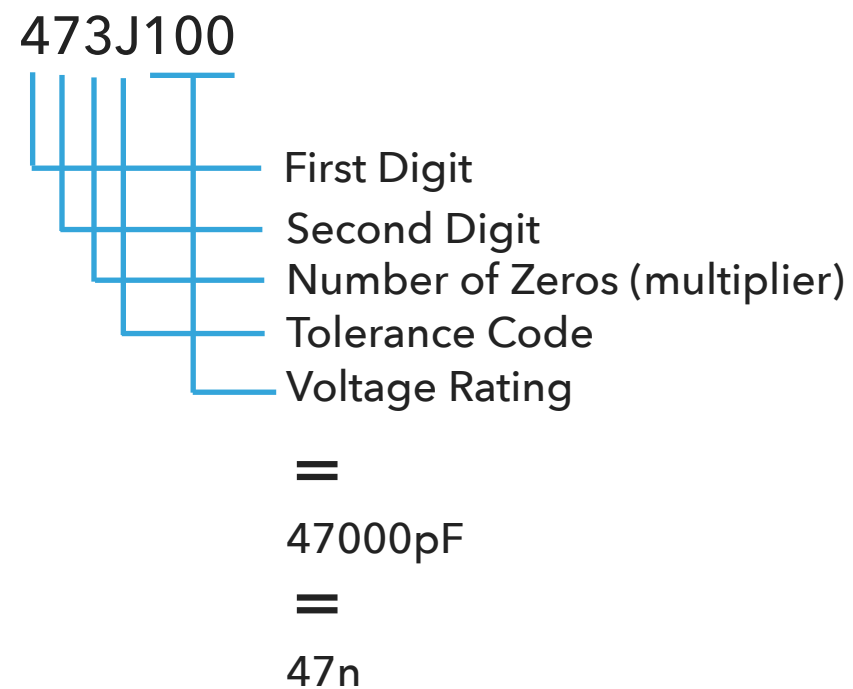
CAPACITORS

METAL FILM (BOX TYPE)

- ▶ Metal Film (Box Type) do not have polarity. There is no wrong direction to place them in a circuit.
- ▶ Usually measured in nF or simply n .
- ▶ Can be written as 4.7n or 4n7.



CAPACITOR CODES



Film (Box Type)
 nF

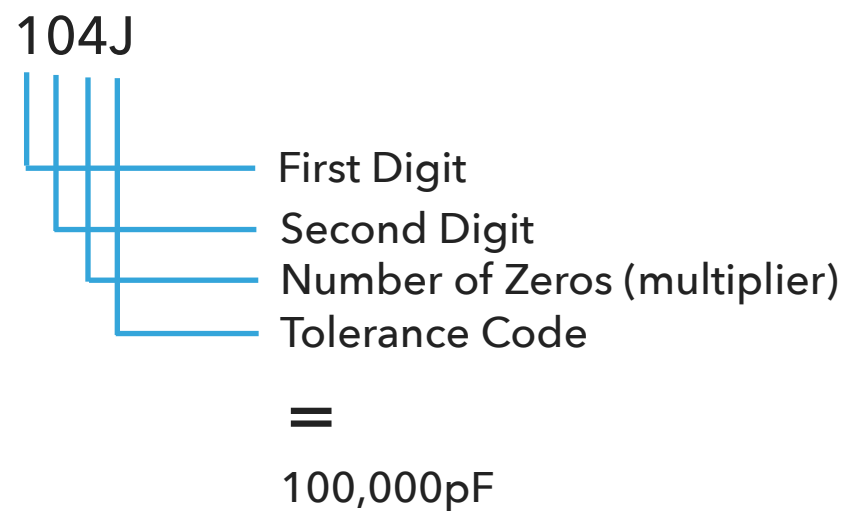
CAPACITORS

CERAMIC

- ▶ Ceramic capacitors do not have polarity. There is no wrong direction to place them in a circuit.
- ▶ Usually measured in pF .



CAPACITOR CODES



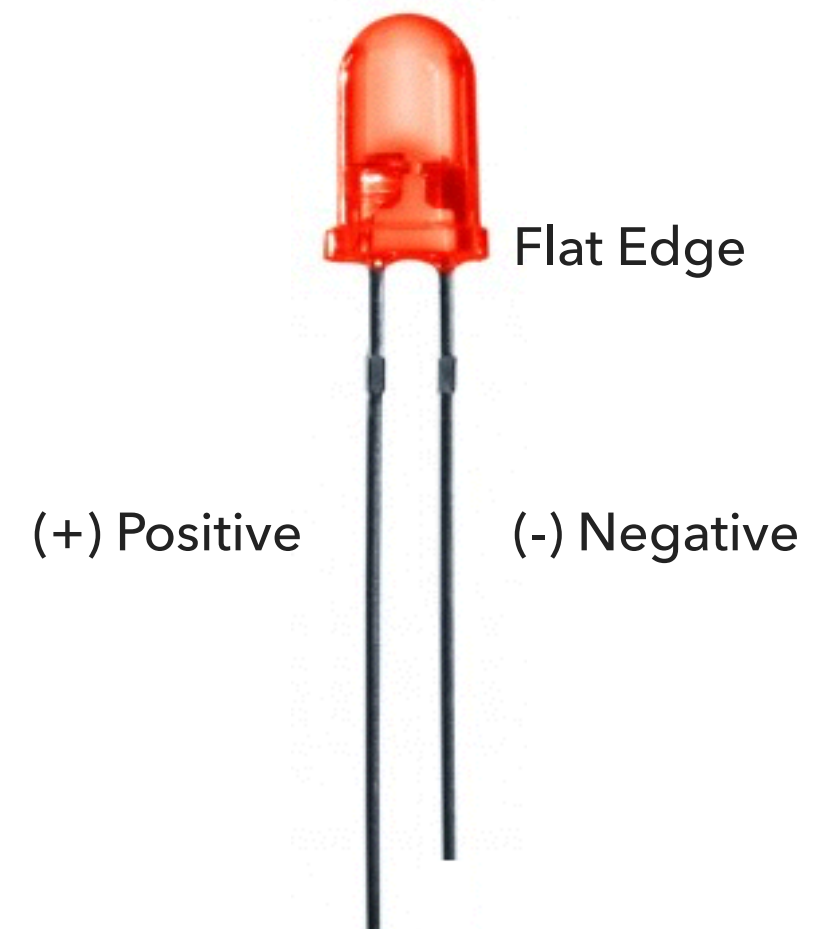
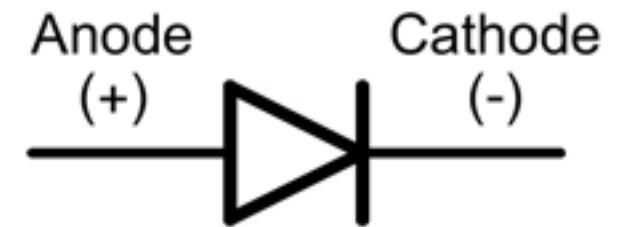
Ceramic
 pF

LETS BUILD AN EFFECTS PEDAL

LEDS

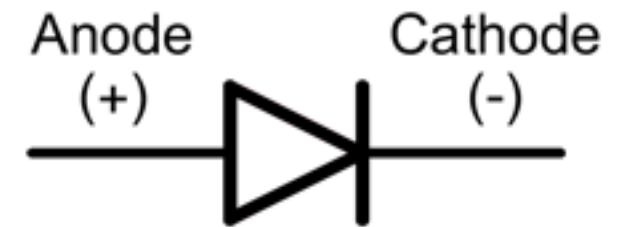
- ▶ LEDs have polarity. They will only work one way.
- ▶ If inserted backwards it will break the circuit and stop the flow of electricity. It will not light up.
- ▶ Short lead with flat side indicates the **negative** side.
- ▶ If they receive too much current, they will burn up.

Sometimes adding a resistor is necessary to regulate the current or can be added to decrease brightness.



DIODES

- ▶ Diodes are like LEDs but they do not light up.
- ▶ Only allows current to flow in one direction.
- ▶ Diodes have polarity. The (-) negative lead is indicated by a stripe on the diode.



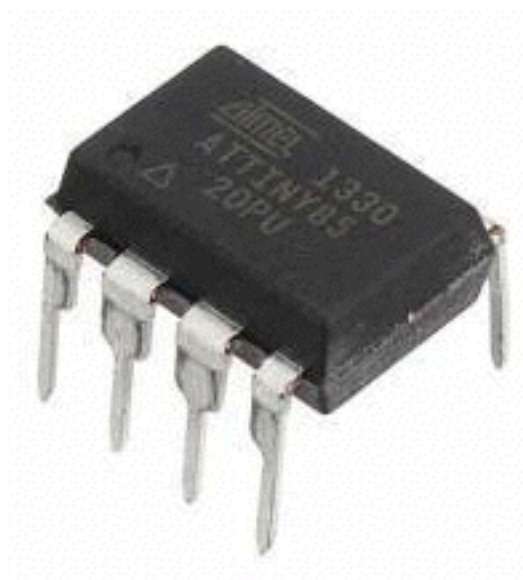
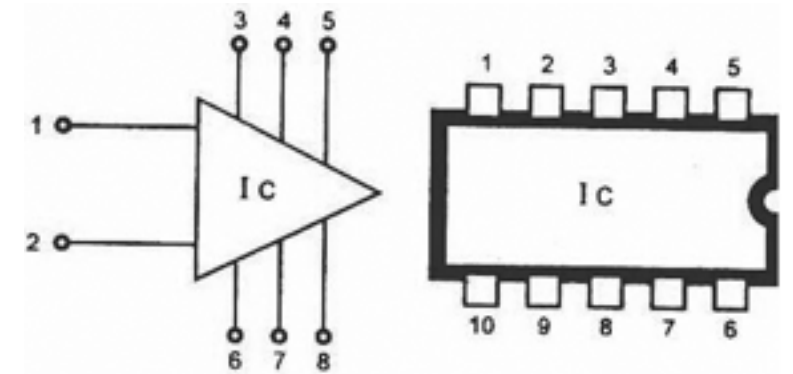
1N913



1N4001

ICs (INTEGRATED CIRCUITS)

- ▶ ICs are chips that contain miniature circuits.
- ▶ These have polarity. The notch indicates it's direction in the circuit.
- ▶ ICs can be delicate. Soldering ICs directly to PCBs can cause them to overheat and break. Socketing ICs is generally recommended.
- ▶ Common ICs for guitar pedals and audio electronics are OpAmps (Operational Amplifiers). They amplify signals.



IC Chip



IC Socket

SWITCHES

- ▶ A switch connects or disconnects a wire.
- ▶ Switches are defined by how many **poles** and how many **throws** they have.

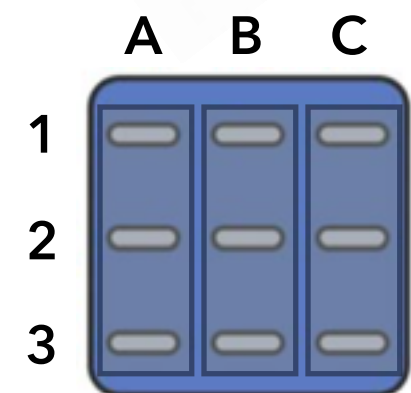
SPST
on-off



SPDT
on-on



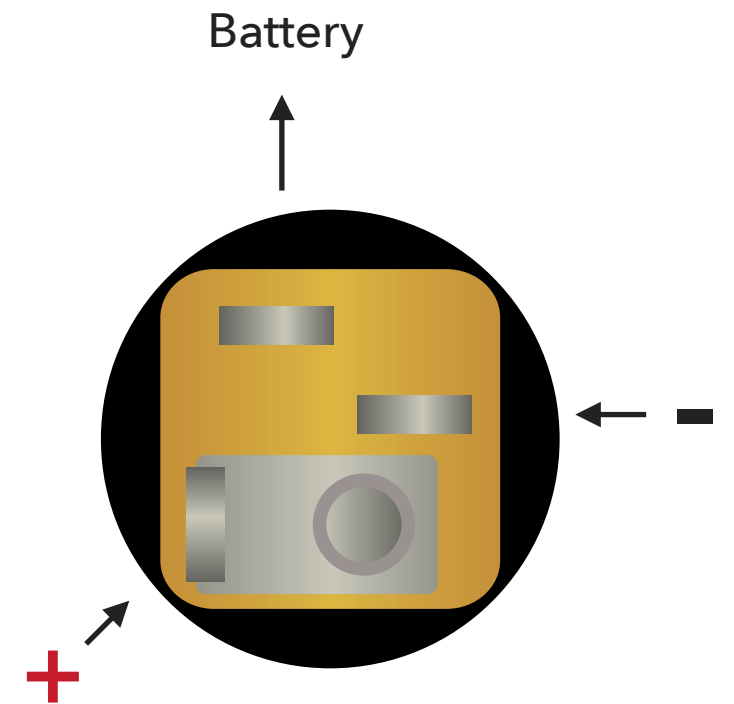
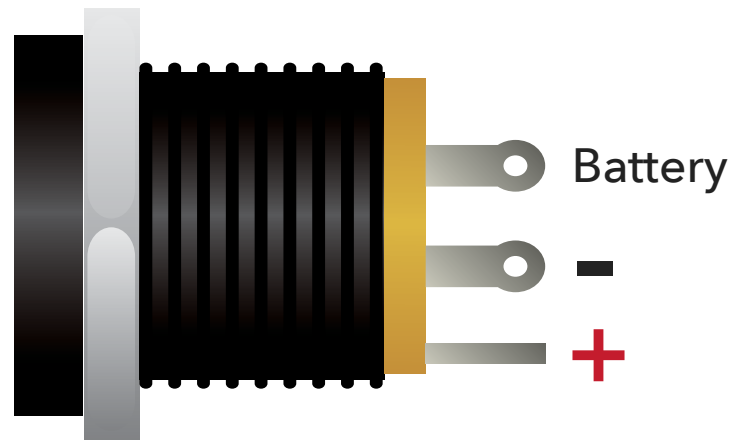
3PDT



POWER SUPPLY

+9v

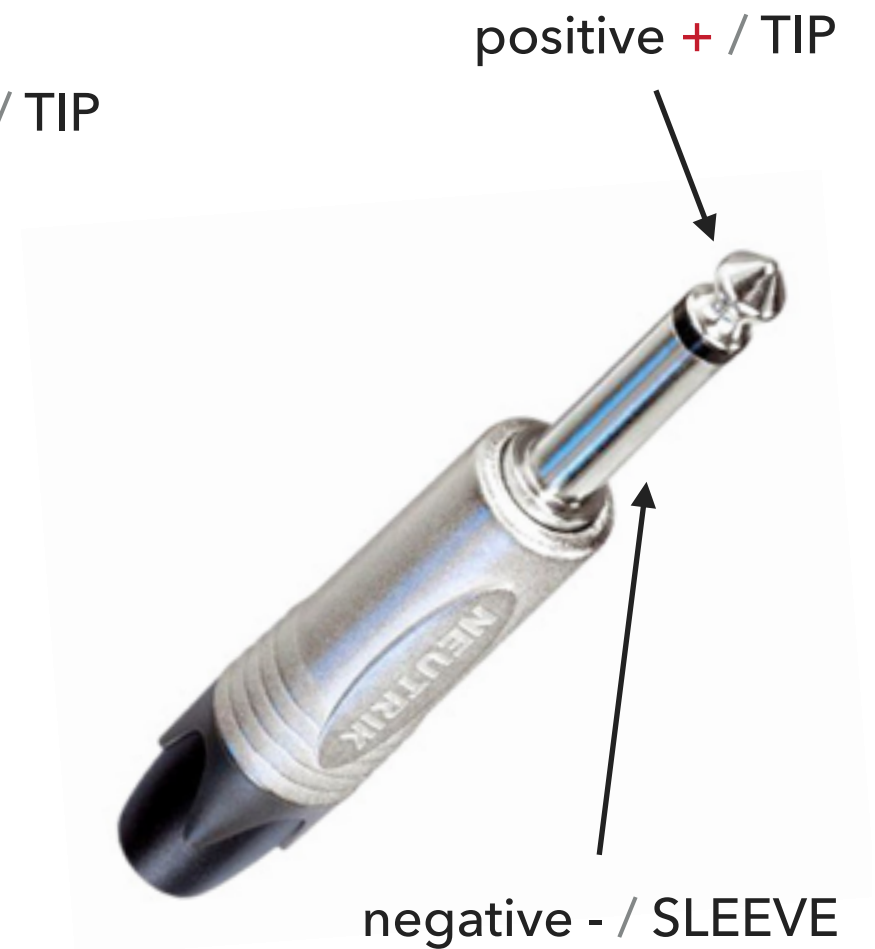
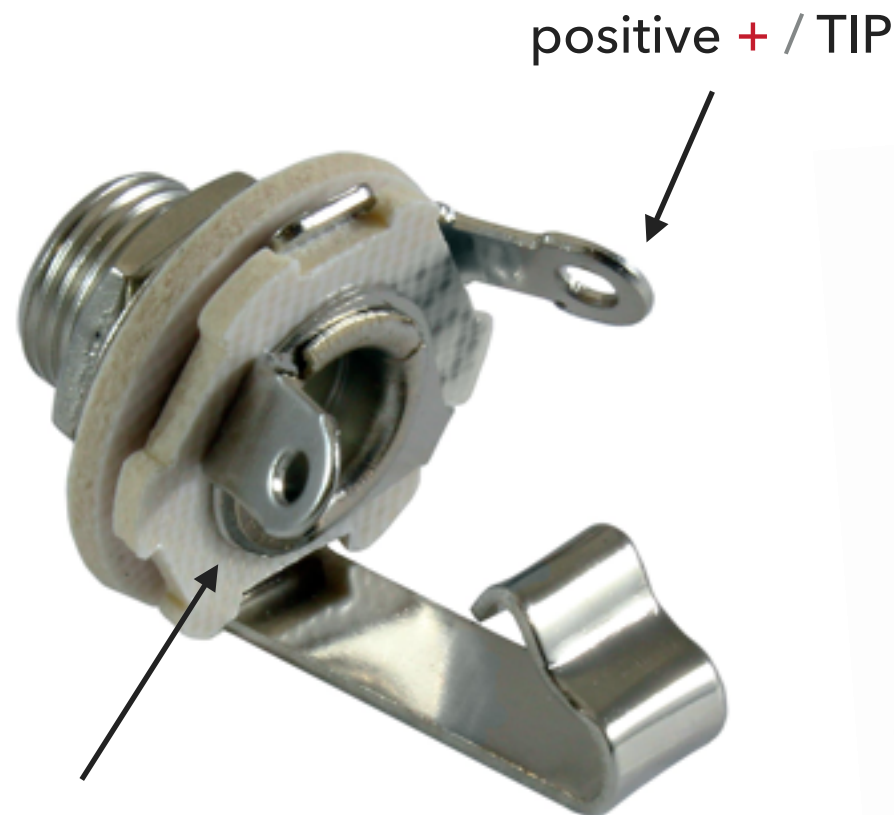
- ▶ Every circuit need external power. 2.1mm socket seems to be a standard.
- ▶ Easier and more reliable than using batteries.
- ▶ 3 Prongs. +, - and a switch to optionally connect a battery snap.



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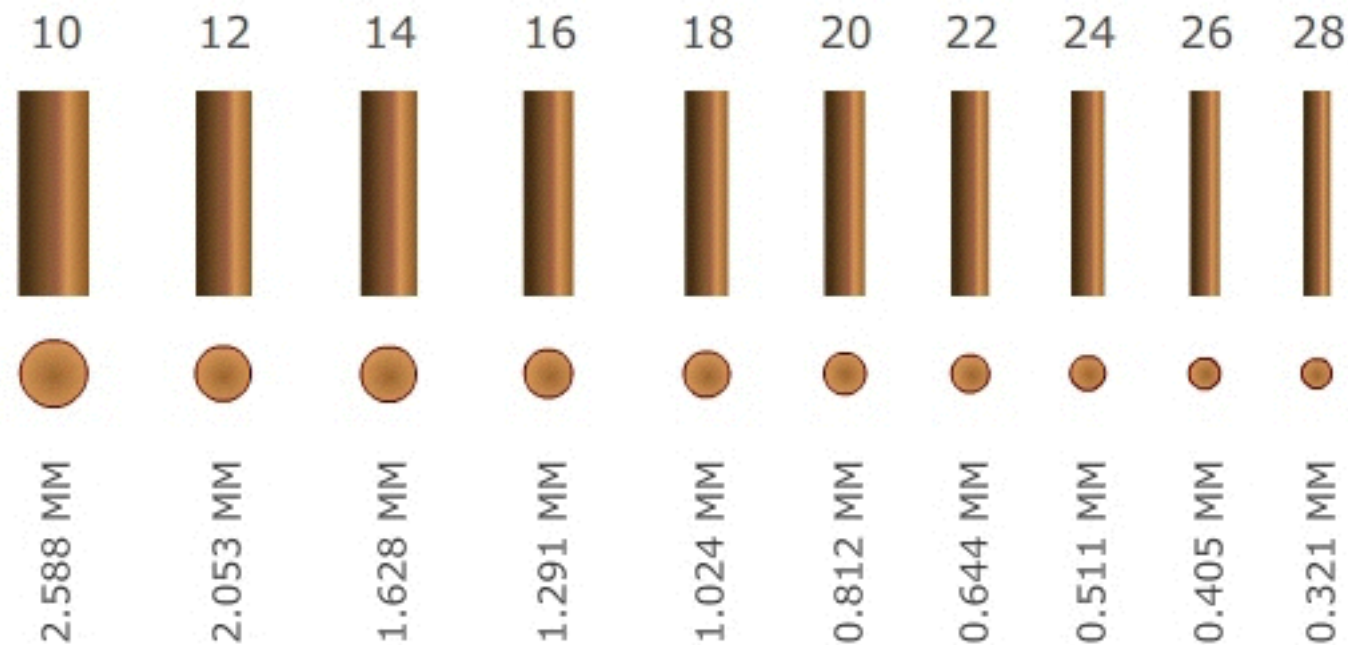
JACKS

- ▶ Mono 1/4" Jacks.



WIRE

- ▶ 24 AWG Stranded wire seems to be the best size for PCBs and hobby electronics.
- ▶ Solid core wire tends to stay in a fixed position better than Stranded but is prone to breaking when flexed too much.
- ▶ Stranded wire is very flexible and easy to manipulate.
- ▶ It's good practice to use different colours of wire throughout your project. It makes troubleshooting issues easier.



SOURCING COMPONENTS & ENCLOSURES

- ▶ Tayda Electronics (taydaelectronics.com) - Great for resistors, caps, transistors, switches)
- ▶ Small Bear Electronics (smallbear-electronics.mybigcommerce.com) - Rare components. Switches.
- ▶ Pedal Parts Plus (pedalpartsplus.com) - Enclosures and knobs.
- ▶ Mammoth Electronics (mammothelectronics.com)
- ▶ Mouser (ca.mouser.com) - Has everything but is quite difficult to navigate.
- ▶ DigiKey (digikey.ca)
- ▶ Ebay (ebay.ca) - watch out for counterfeit ICs and 3PDT switches. Great for cheap, bulk components.

KITS & PCBS

- ▶ madbeanpedals (madbeanpedals.com/)
- ▶ SynthCube (synthcube.com)
- ▶ Build Your Own Clone (buildyourownclone.com)
- ▶ Modular Addict (modularaddict.com)
- ▶ SynthroTek (synthrotek.com)
- ▶ Aion Electronics (<https://aionelectronics.com/diy-pcb-projects/>)
- ▶ 1776 Effects (<http://1776effects.com>)

ENCLOSURES

- ▶ The box you package your project in.
- ▶ Standard enclosure sizes include 1590A, 1590B, 1590BB, 1590D, 125BB.
- ▶ Most PCBs purchased will recommend an enclosure size and provide a drilling template.
- ▶ When drilling your own enclosures, a Step Bit is your best friend.

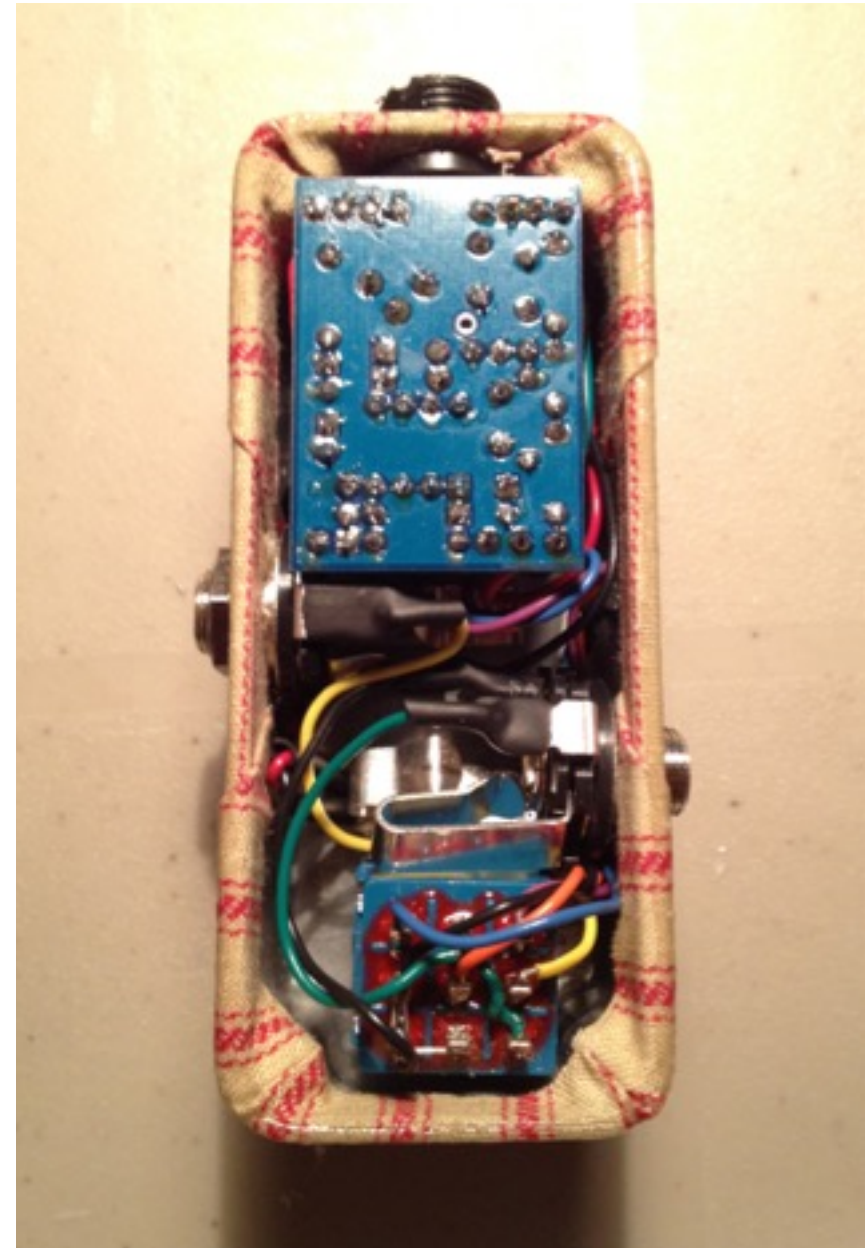


Step Bits & Punch Tool

FINISHING ENCLOSURES

- ▶ There are many different ways to personalize your project.
 - ▶ Painting (Buy them pre-painted).
 - ▶ Water Slide Decals
 - ▶ Acid Etching (Ferric Chloride)
 - ▶ Laser Etching
 - ▶ Fabric
 - ▶ Markers
 - ▶ Repurposing old electronics enclosures

FINISHING ENCLOSURES



Fabric Enclosure Sealed with Modge Podge

LETS BUILD AN EFFECTS PEDAL

FINISHING ENCLOSURES



Paint & Water Slide Decals

FINISHING ENCLOSURES



Etching

FINISHING ENCLOSURES

Enclosure Flair

- ▶ Knobs.
 - ▶ Get them cheap on eBay. They will likely be plastic.
 - ▶ Reappropriate knobs from old/broken gear.
 - ▶ There can be different size shafts on potentiometers.
- ▶ Switch Caps
- ▶ LED Bezels



FINISHING ENCLOSURES

Get some inspiration: <http://www.madbeanpedals.com/forum/buildreports>

HELP & TROUBLESHOOTING

- ▶ MadbeanPedals Forum ([madbeanpedals.com/forum/](https://www.madbeanpedals.com/forum/))
- ▶ FreeStompBoxes (freestompboxes.org)
- ▶ All About Circuits ([allaboutcircuits.com](https://www.allaboutcircuits.com))
- ▶ SparkFun (learn.sparkfun.com)
- ▶ Adafruit (learn.adafruit.com)

SOLDERING

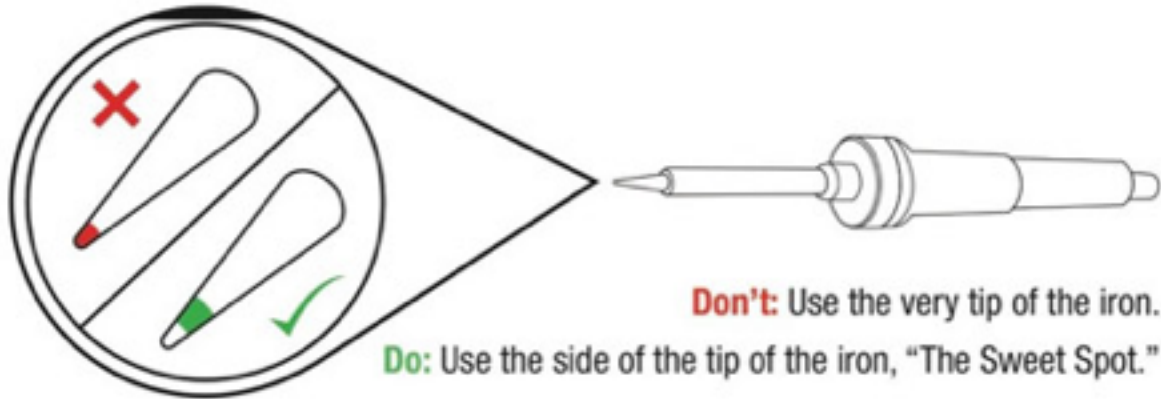
- ▶ Be strategic about soldering your components onto the PCB. Start with the lowest profile components working your way up.

ORDER OF SOLDERING COMPONENTS

- ▶ Resistors
- ▶ Diodes
- ▶ IC Sockets
- ▶ Ceramic Capacitors
- ▶ Box Type Capacitors
- ▶ Electrolytic (Radial) Capacitors



SOLDERING



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.



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.



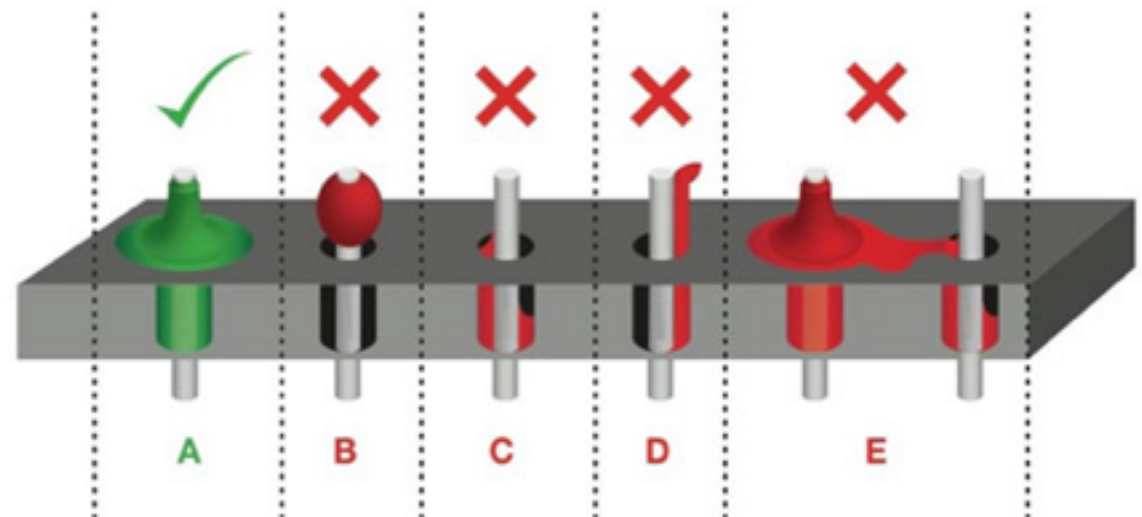
D

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

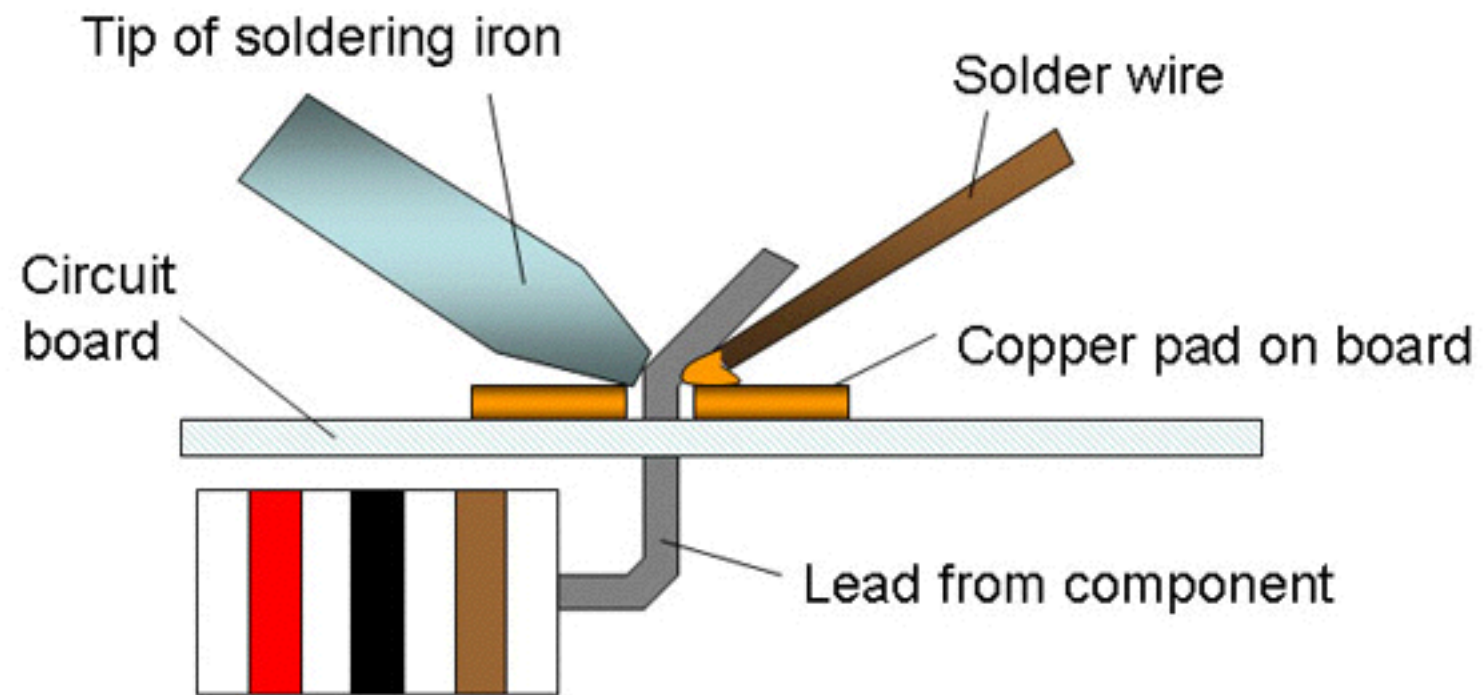


E

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

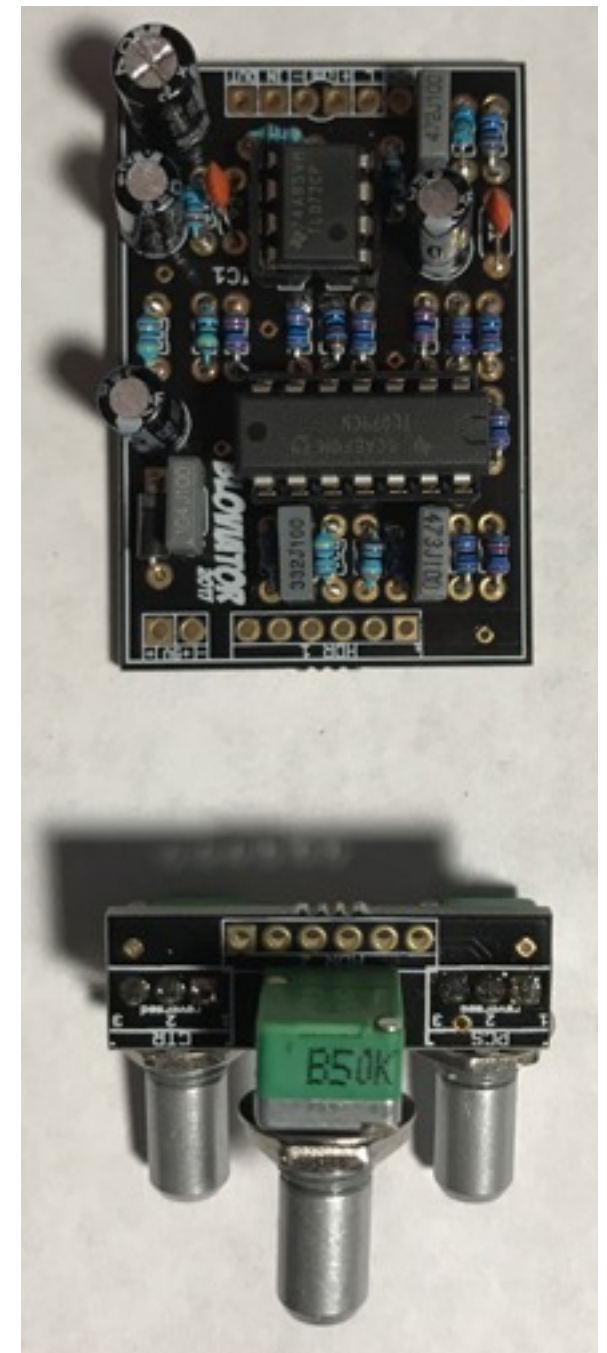
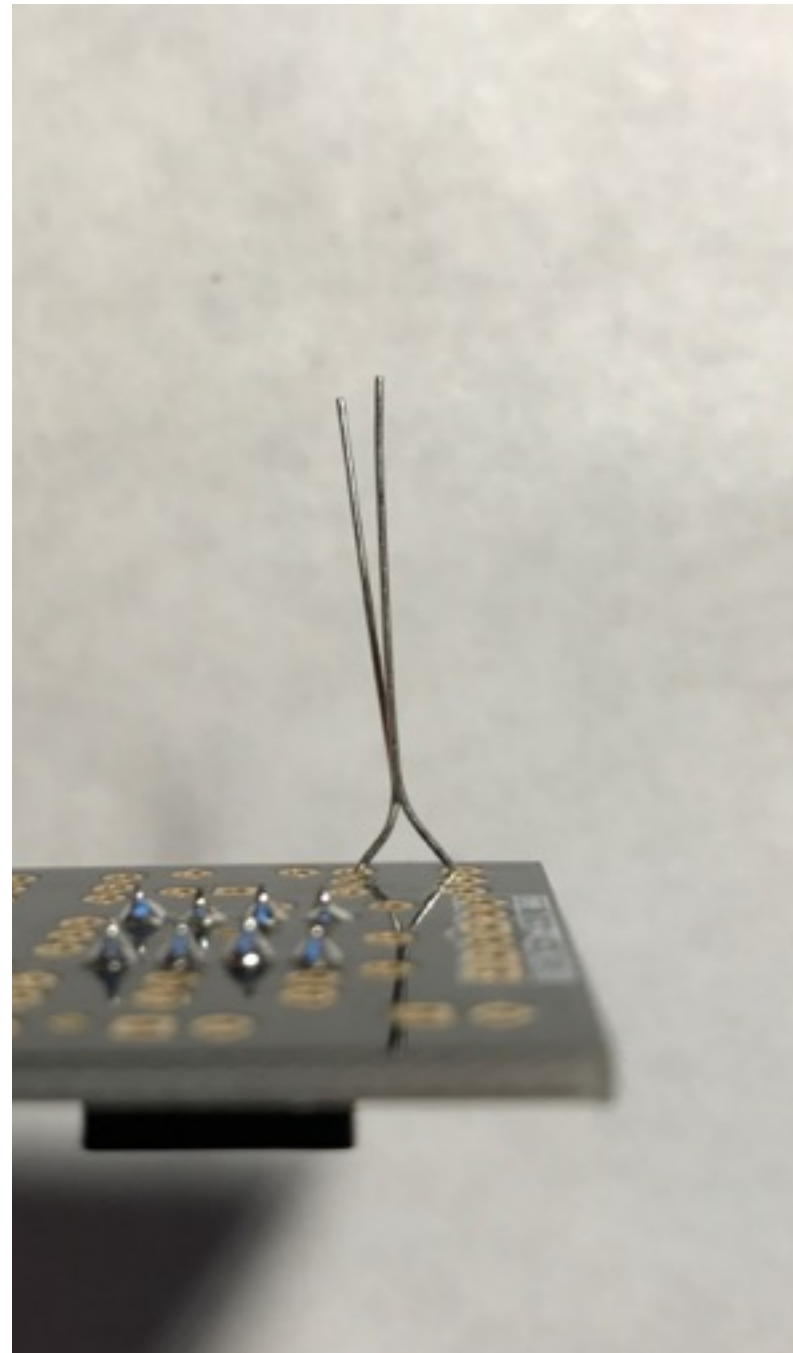
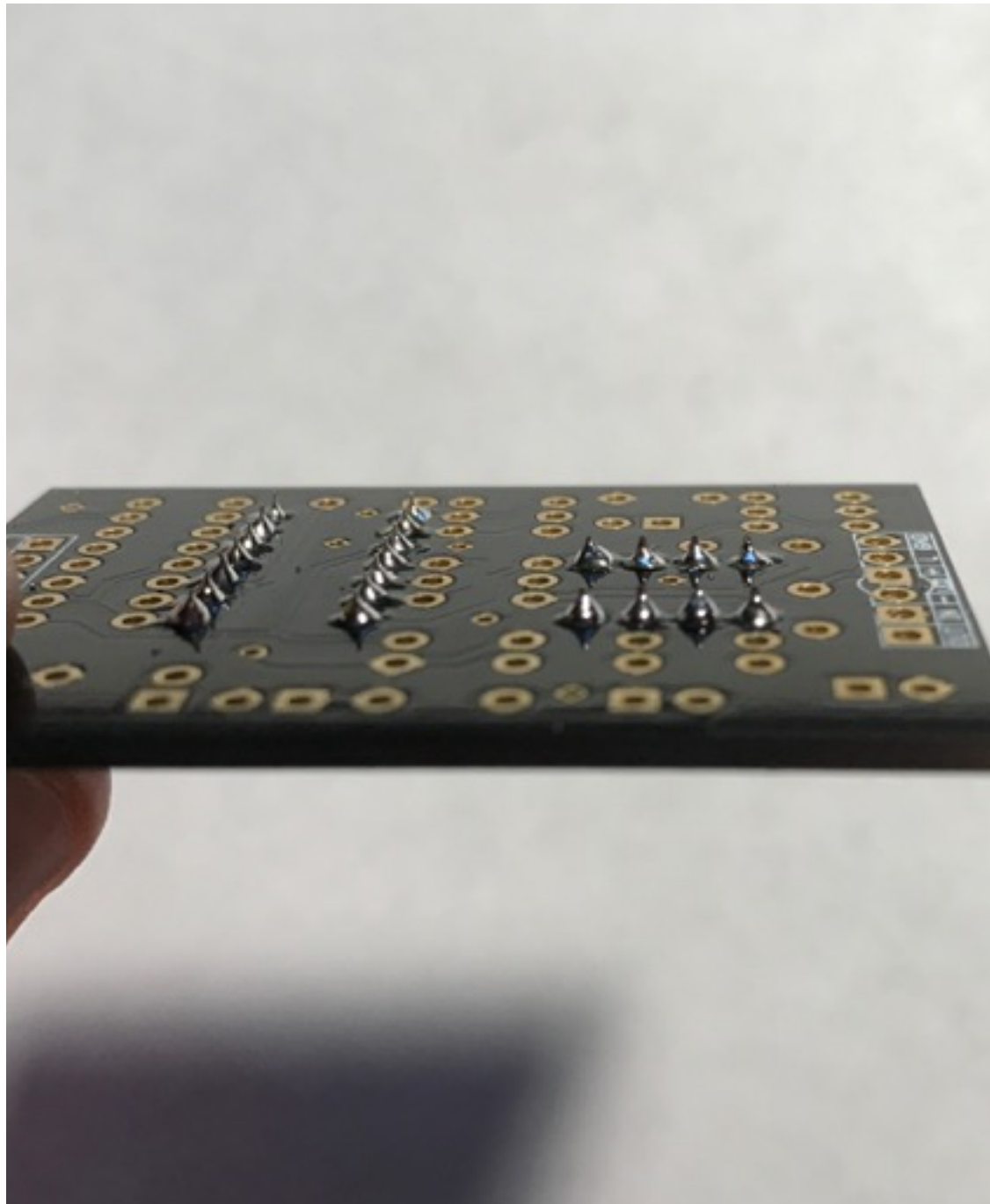


SOLDERING



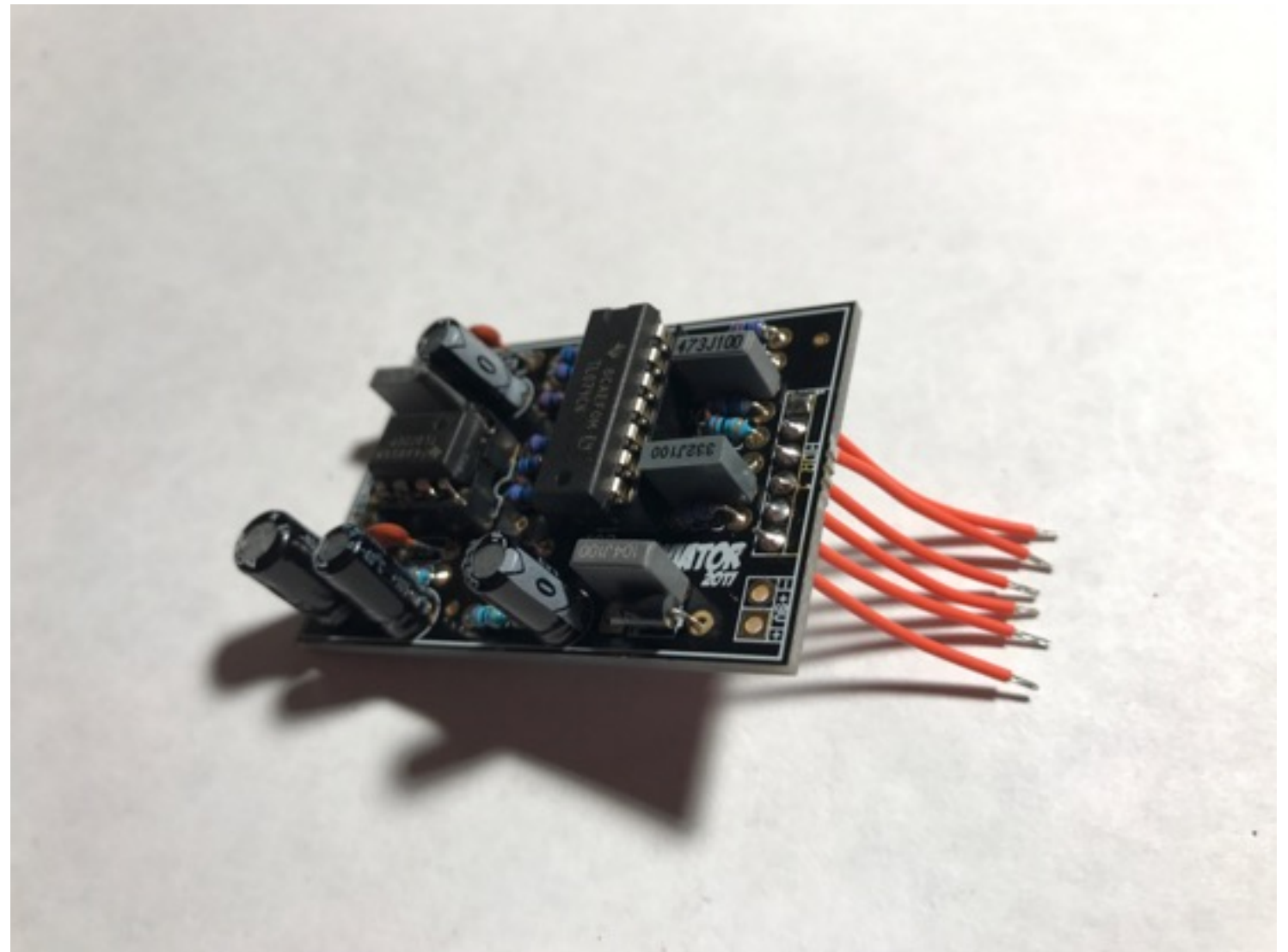
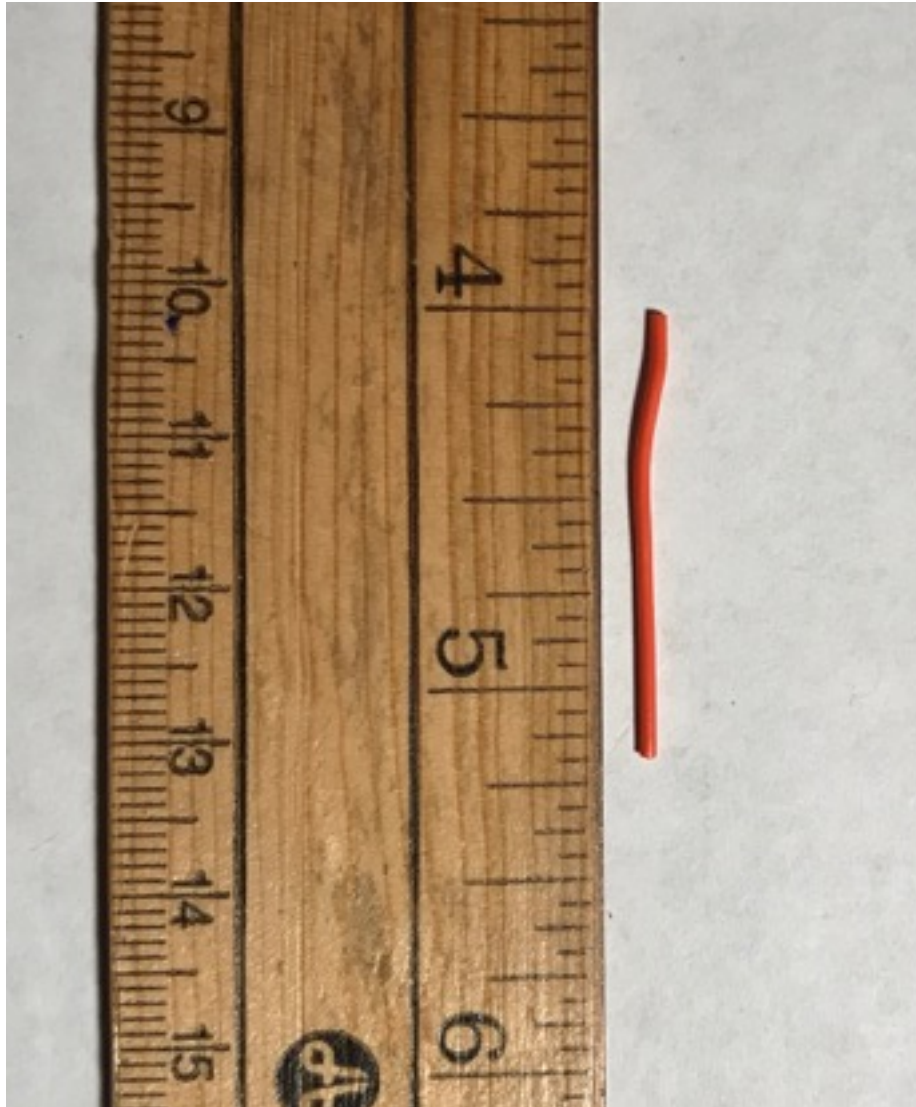
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SOLDERING



LETS BUILD AN EFFECTS PEDAL

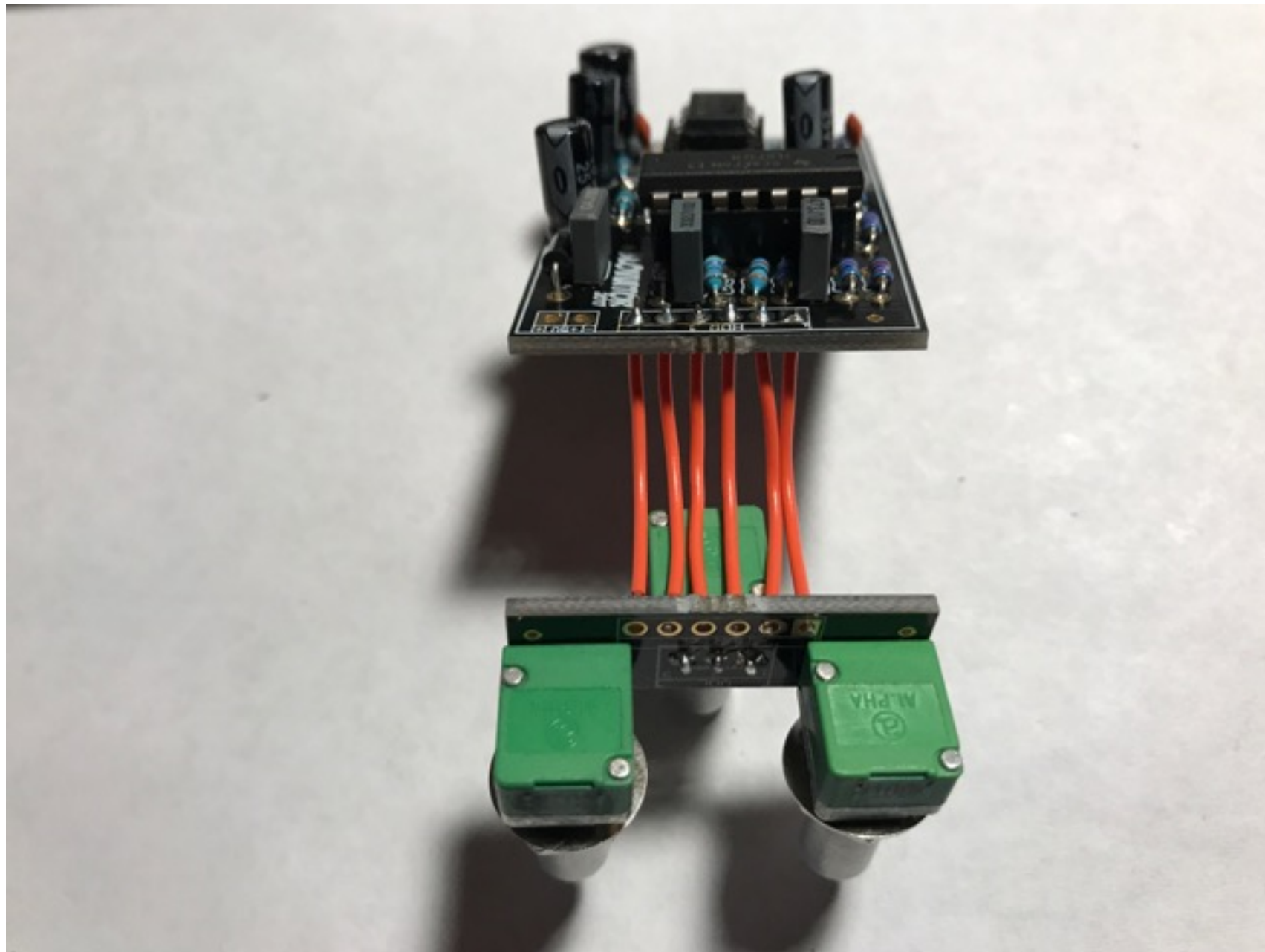
SOLDERING



Jumpers for Potentiometer Board
Preparing PCB with jumpers.

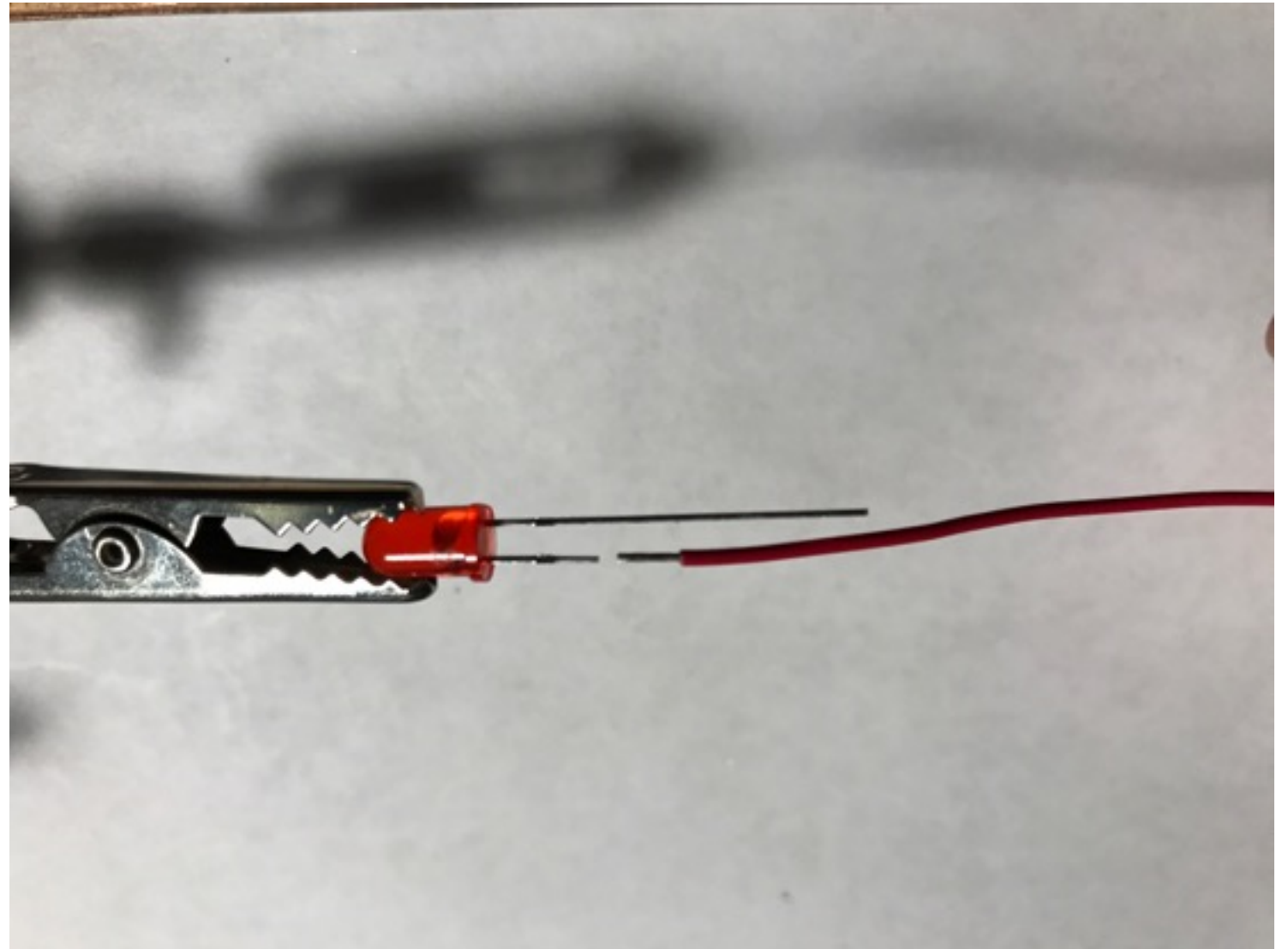
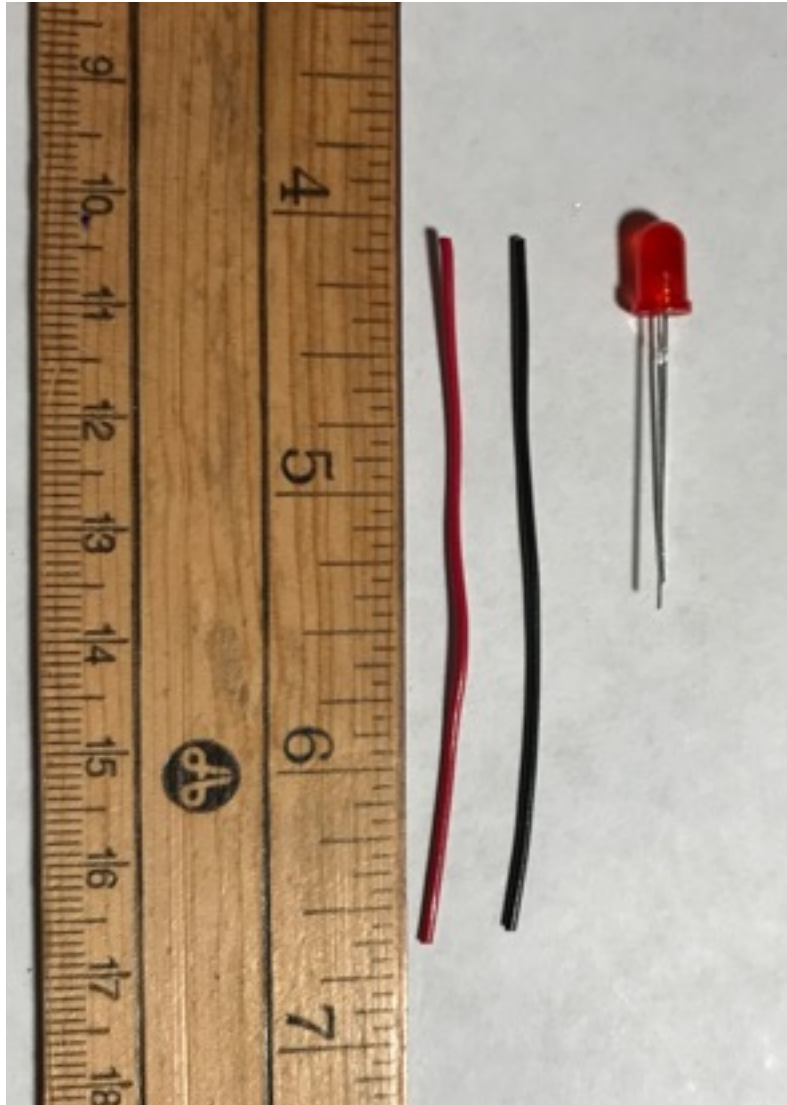
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SOLDERING



Jumpers for Potentiometer Board

SOLDERING



Preparing LED for soldering to the PCB.

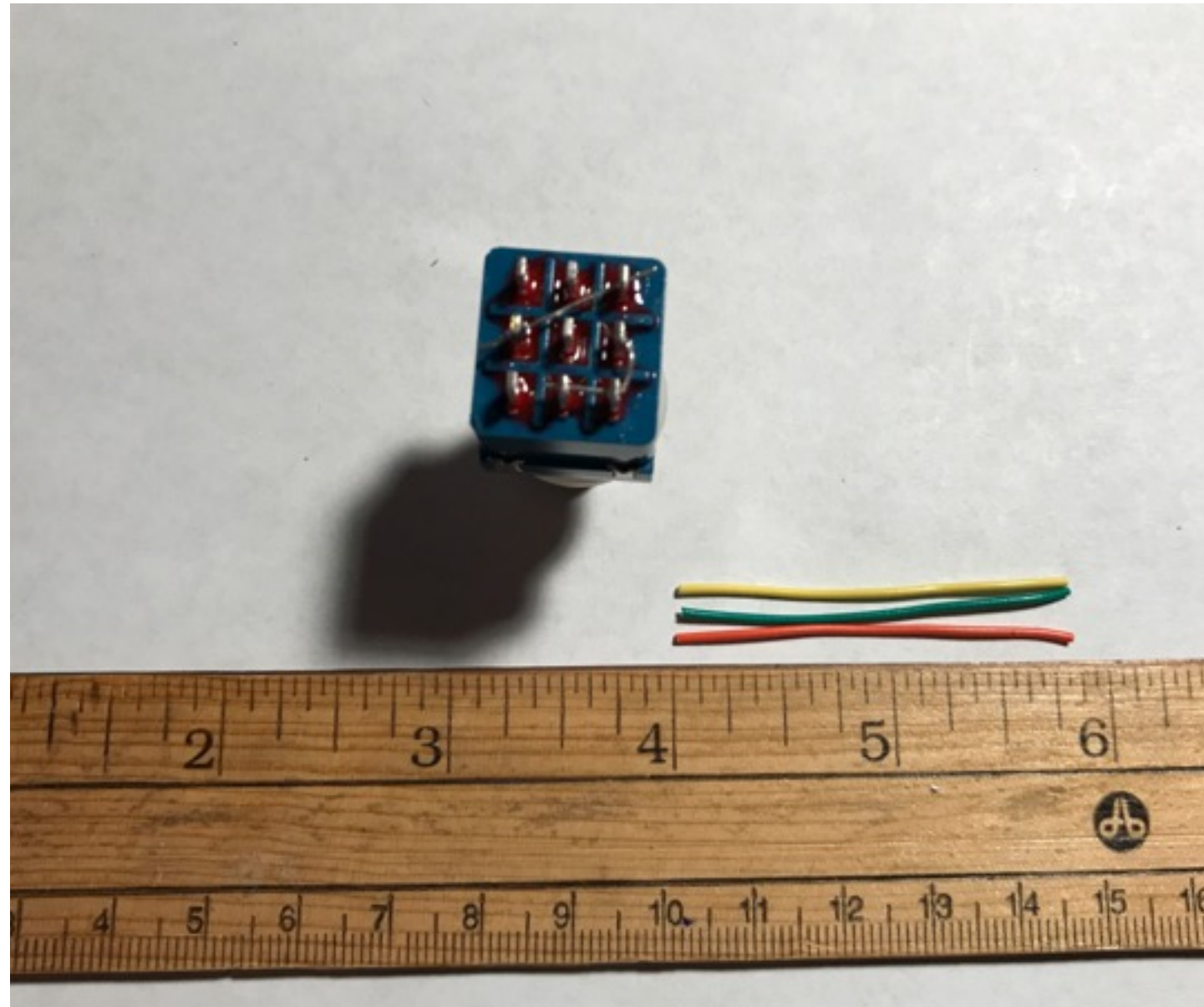
Tin the LED lead and wire separately with a bit of solder.
Hold both leads together then apply heat from soldering iron.

SOLDERING



3PDT Switch Soldering
Preparing switch with jumpers.

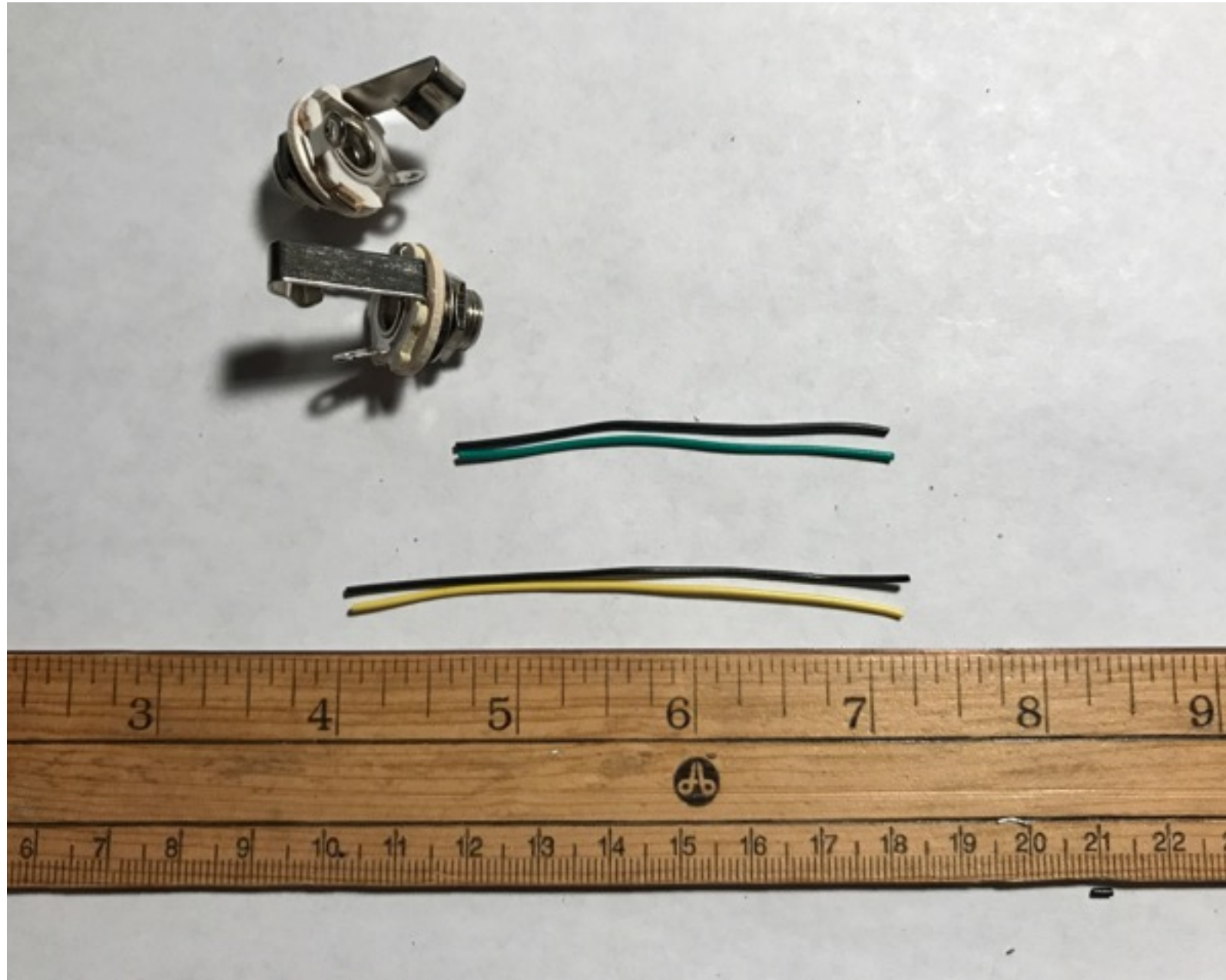
SOLDERING



3PDT Switch Soldering

Prepare all the wires to be soldered onto the 3PDT switch.

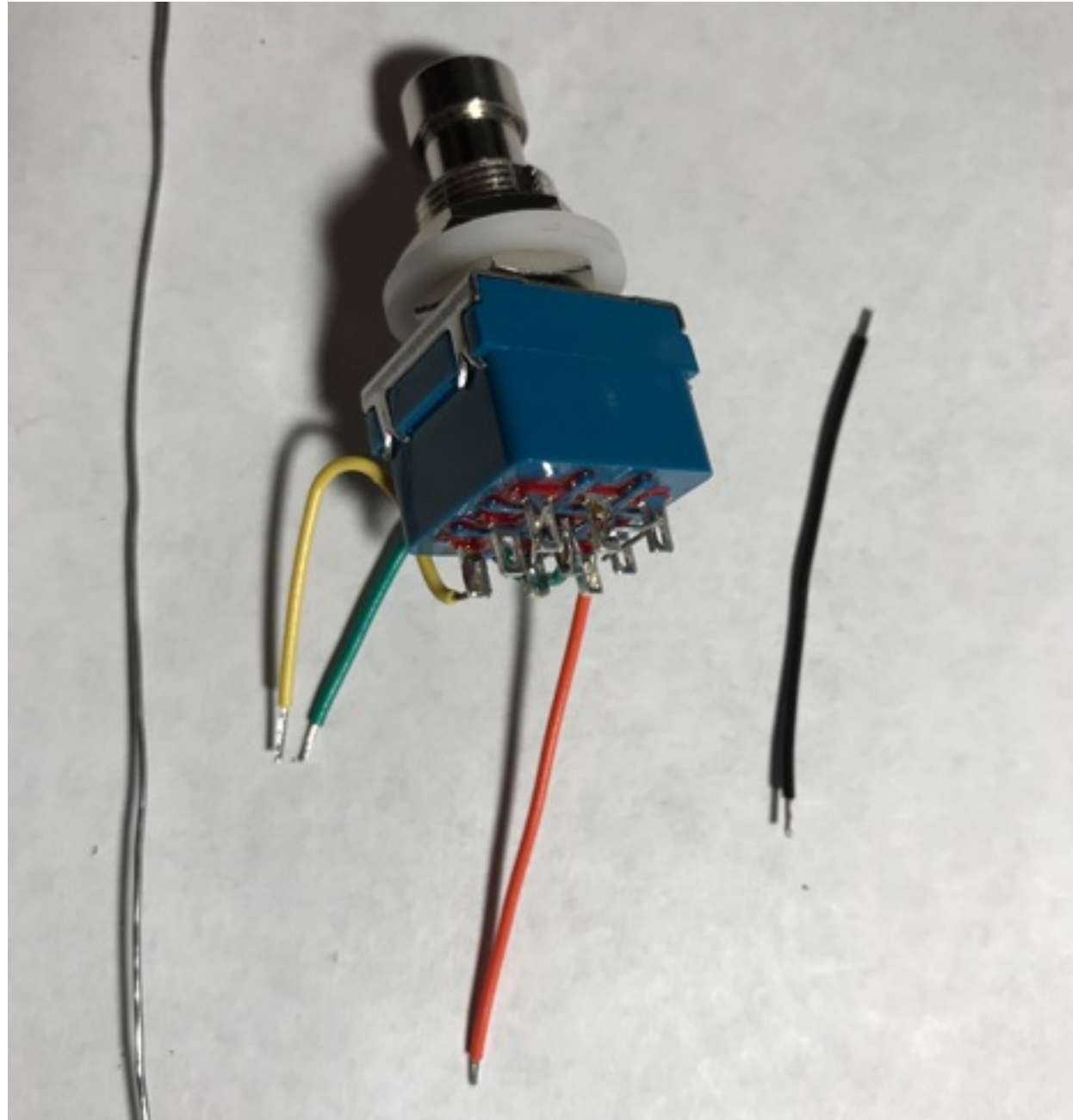
SOLDERING



3PDT Switch Soldering

Prepare IN/OUT Jack Wires for 3PDT switch.

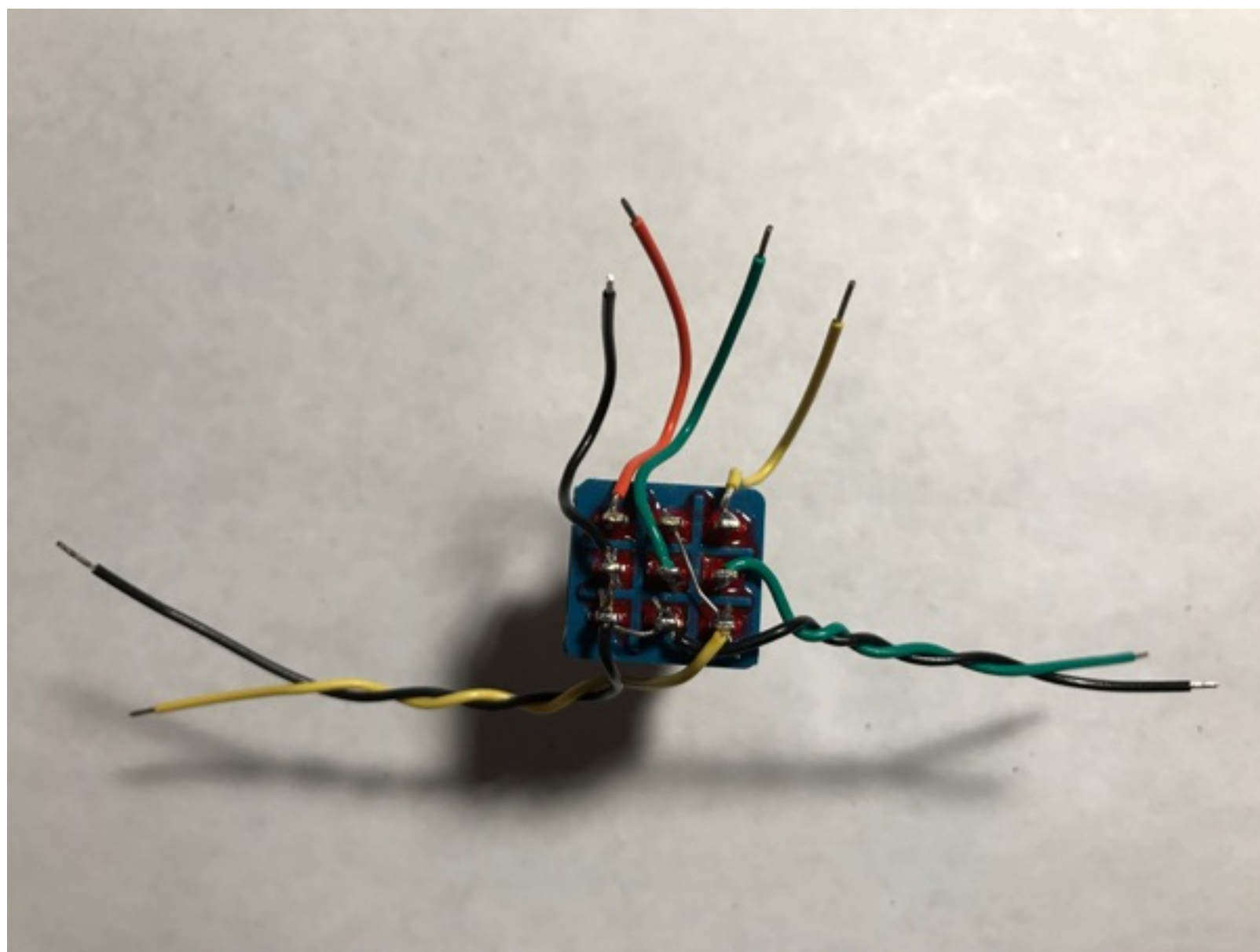
SOLDERING



3PDT Switch Soldering

Get creative with positioning switch and wires for soldering

SOLDERING

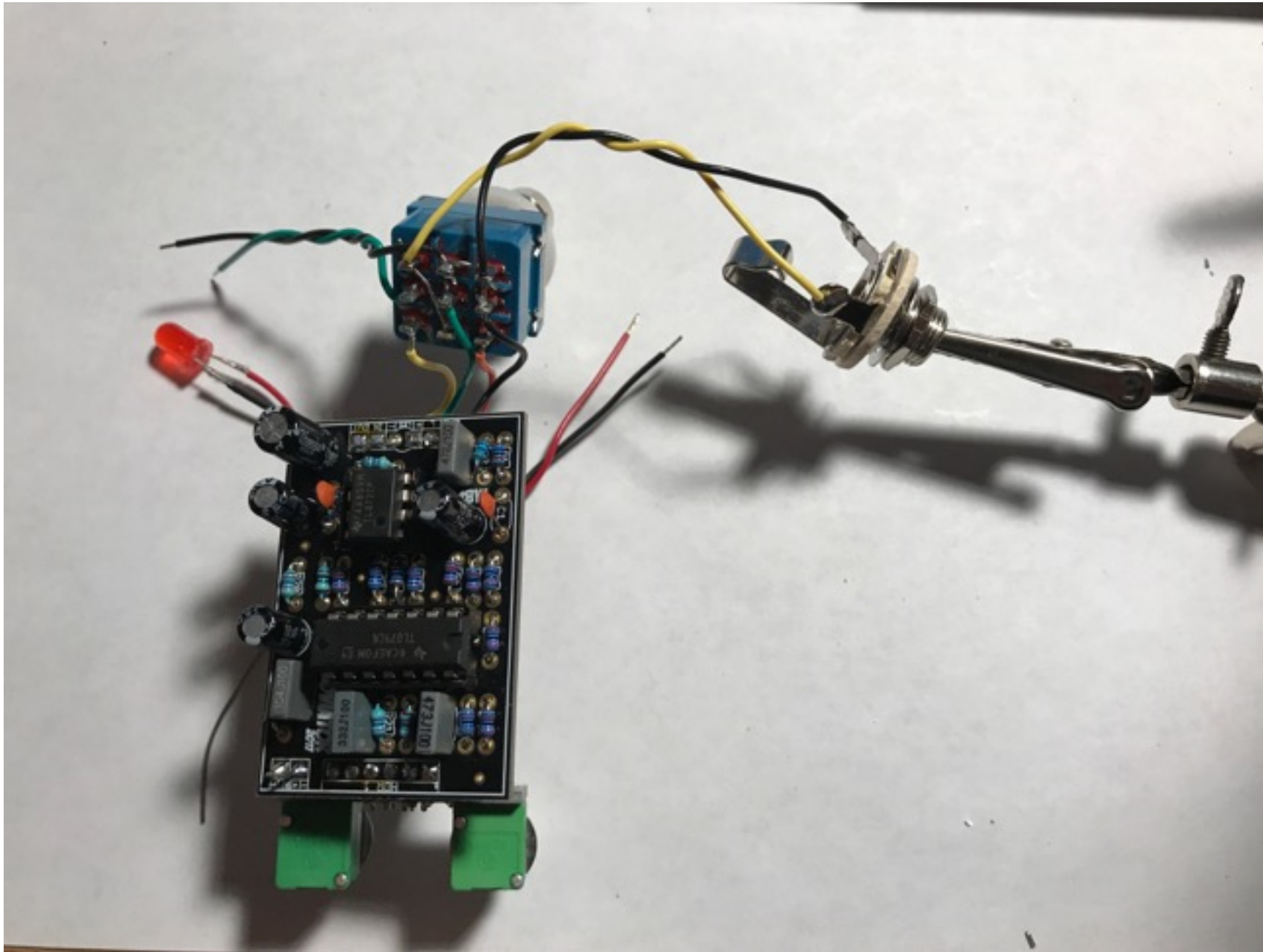


3PDT Switch Soldering

Prepared to be connected to the PCB and Jacks.

LETS BUILD AN EFFECTS PEDAL

SOLDERING



Solder the Jacks & PCB to the 3PDT. Solder the LED to the PCB.

THANK YOU

imetchris.com

chris.morris2@uleth.ca

Download the presentation:

<https://tinyurl.com/aemcon-pedal>