Ornament Kit: Auto-wah

mas-effects.com/holiday

I hope you a have a ton of fun building this ornament, and that it brings some extra holiday cheer to you and everyone around you.

If you have any questions or run into any problems, visit our MAS Effects subreddit:

reddit.com/r/maseffects

This is where you'll get the quickest help. You can also email me directly (mark@mas-effects.com) or post to various DIY pedal groups online (visit mas-effects.com/holiday-instructions/ for a list), but these may take a bit longer.

Happy Holidays!

Overview

This ornament is a playable auto-wah (or envelope filter) "pedal."

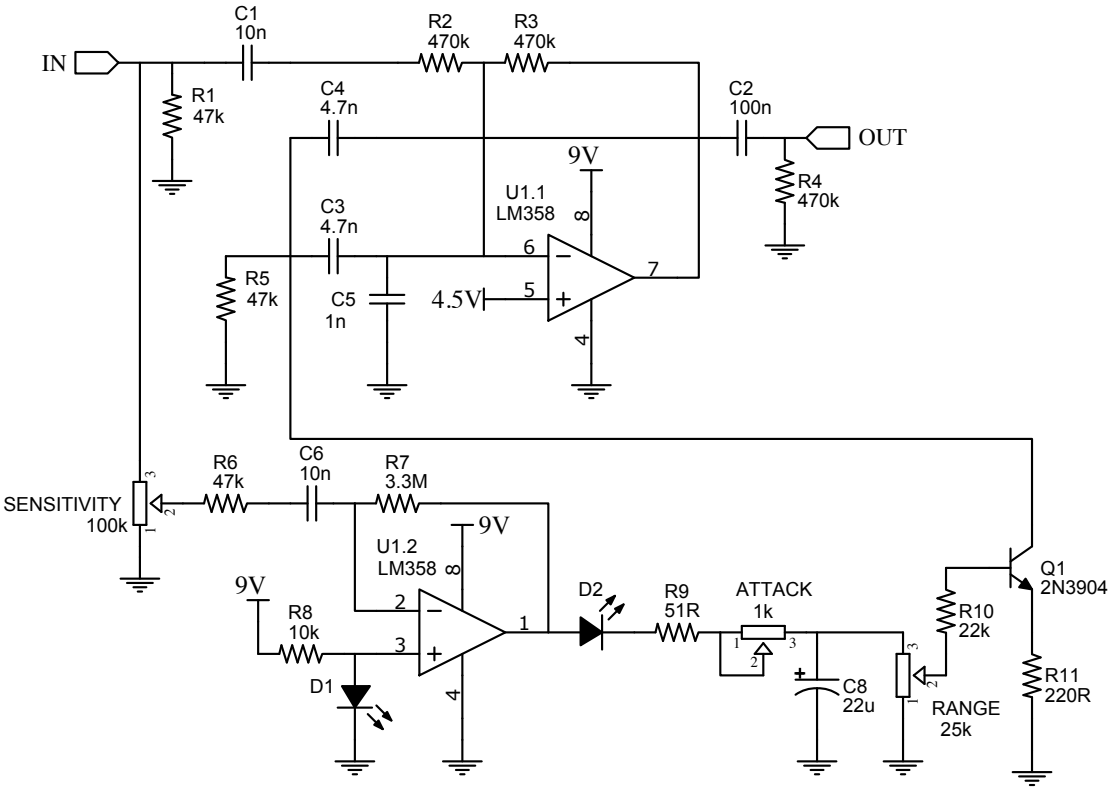
The audio circuit is called Nurse Quacky, and has evolved in the DIY communities to become, arguably, the best analog auto-wah available. Credits are due to Runoffgroove, Mark Hammer, Jack Orman, JD Sleep.

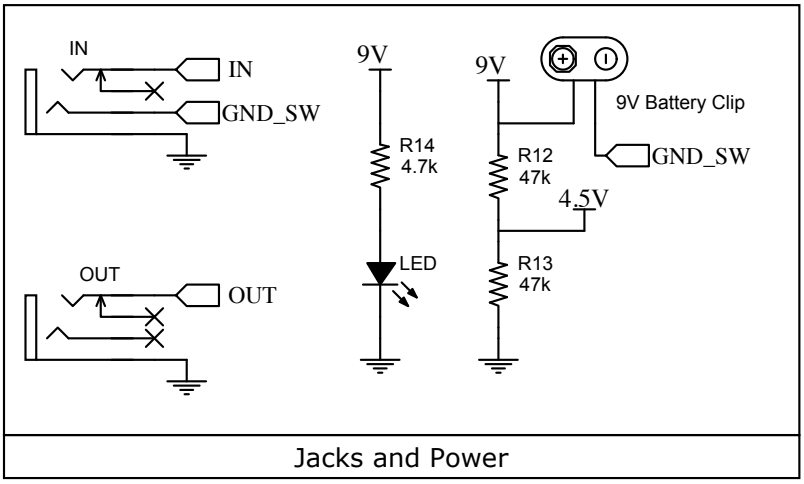
It is supplied power when a mono instrument cable is plugged into the input jack. **Leaving your guitar plugged into this will drain the battery!**

Bill of Materials

QTY	Designator	Part	Note
5	R1,R5,R6,R12,R13	47k	
3	R2,R3,R4	470k	
1	R7	3.3M	
1	R8	10k	
1	R9	51R	
1	R10	22k	
1	R11	220R	
1	R14	4.7k	
2	D1, D2	3mm Red LEDs	Matched with the same forward voltage
1	LED	LED	Power indicator
2	C1,C6	10n	
1	C2	100n	
2	C3,C4	4.7n	
1	C5	1n	
1	C8	22u	
1	Q1	2n3904	
1	ATTACK	1k trimmer	
1	RANGE	30k trimmer	
1	SENSITIVITY	100k trimmer	
1	U1	LM358	
1	BATTERY	9V Battery Cable	
2	IN, OUT	Audio jack	
1		Wire for hanger	
1		Printed Circuit Board (PCB)	Blue; Shaped like a gift

Schematic


IN
C1
10n
R1
47k
R2
470k
R3
470k
C4
4.7n
C2
100n
OUT
R4
470k
9V
U1.1
LM358
C3
4.7n
R5
47k
C5
1n
4.5V
SENSITIVITY
100k
R6
47k
C6
10n
R7
3.3M
U1.2
LM358
D1
R8
10k
D2
R9
51R
ATTACK
1k
C8
22u
RANGE
25k
R10
22k
R11
220R
Q1
2N3904


IN
IN
GND_SW
OUT
OUT
9V
R14
4.7k
LED
9V
9V Battery Clip
R12
47k
GND_SW
4.5V
R13
47k
Jacks and Power

Instructions

PREFACE: For Beginners

If you haven't spent much time soldering components to a PCB (printed circuit board) then here are a couple tips to help you ensure success with this project.

Nearly all problems people face when building kits such as this come from either

A. Placing **components in the wrong spots**, or with the wrong orientation, or

B. **Bad solder joints**

Placing components correctly:

* **Leave the components in the sleeve** until you need them. Cut the edge off the sleeve so you can easily pull out components as you need them. Refer to the component identification sheet to see which is which.
* Read this build instructions document. I will make notes about **polarity and orientation** of diodes, electrolytic capacitors, and transistors. These are very important to follow.
* Take your time

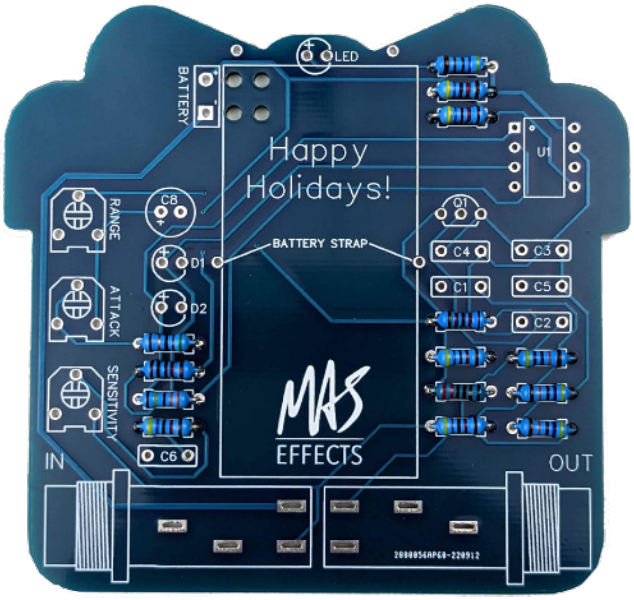
Getting good solder joints:

* First and foremost, watch this excellent, short, and to-the-point video about soldering: youtu.be/IpkkfK937mU
* If possible **practice soldering wires** onto a prototyping or vero board (fiberglass board with holes, and copper pads), or this **practice soldering kit** we offer. The practice kit includes detailed and comprehensive **instructions and step-by-step video to help you learn to solder**.
* Watch carefully to recognize when the solder has been pulled up onto the component legs, and spread across the pad of the board. This indicates both the component and the pad were sufficiently heated, and the solder bonded with them.
* If the solder isn't wicking up against the pad and component within a few seconds: Stop. Wait a few moments. Then try again. Wipe your soldering iron or rotate it against the joint if necessary to get good heat transfer.

SETUP

Leave the components in the plastic sleeve until you need them. Cut the edge off the sleeve so you can easily pull them out. Refer to the component identification sheet to see which is which.

STEP 1: Resistors (R1 - R14)



It's typically easiest to populate the circuit board from the shortest to the tallest components. Resistors sit very low to the board so we start with those.

Bend the legs 90 degrees from body of the resistor before trying to place them. Orientation does not matter. Resistors can be inserted in either direction.

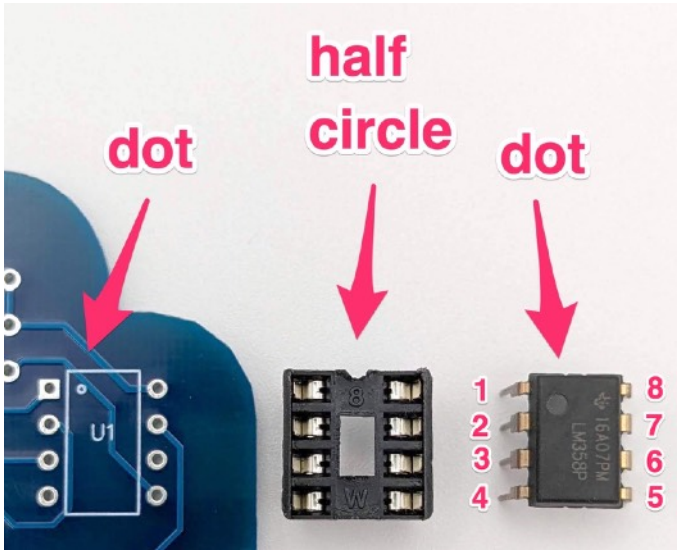
Inserting and soldering **a few at a time** will be easier than trying to do them all at once.

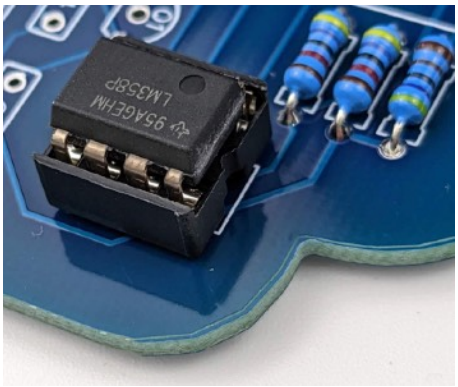
STEP 2: Op Amp (U1)

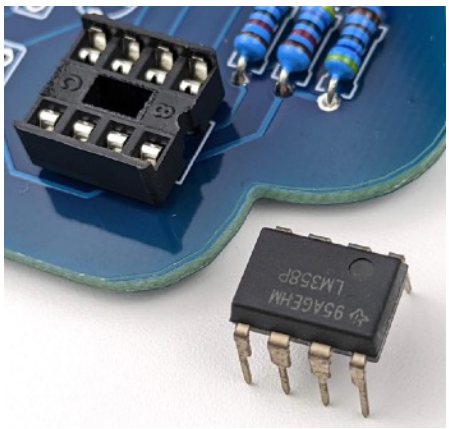
Orientation matters. A half-circle cutout or a dot indicate the side with pins 1 and 8.

Line up the dot or half-circle on the PCB, the socket, and the op amp.

The socket is optional, and if you may instead solder the op amp directly to the PCB.







STEP 3: LEDs (D1 - D2, LED Power Indicator)

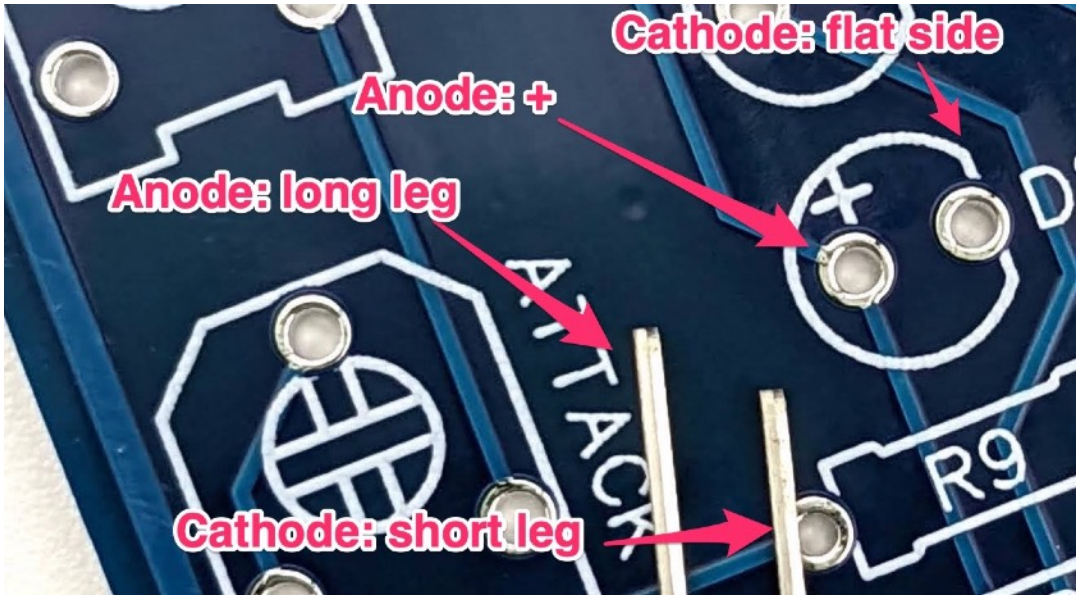
Light emitting diodes (LEDs) have polarity and **must be oriented correctly**.

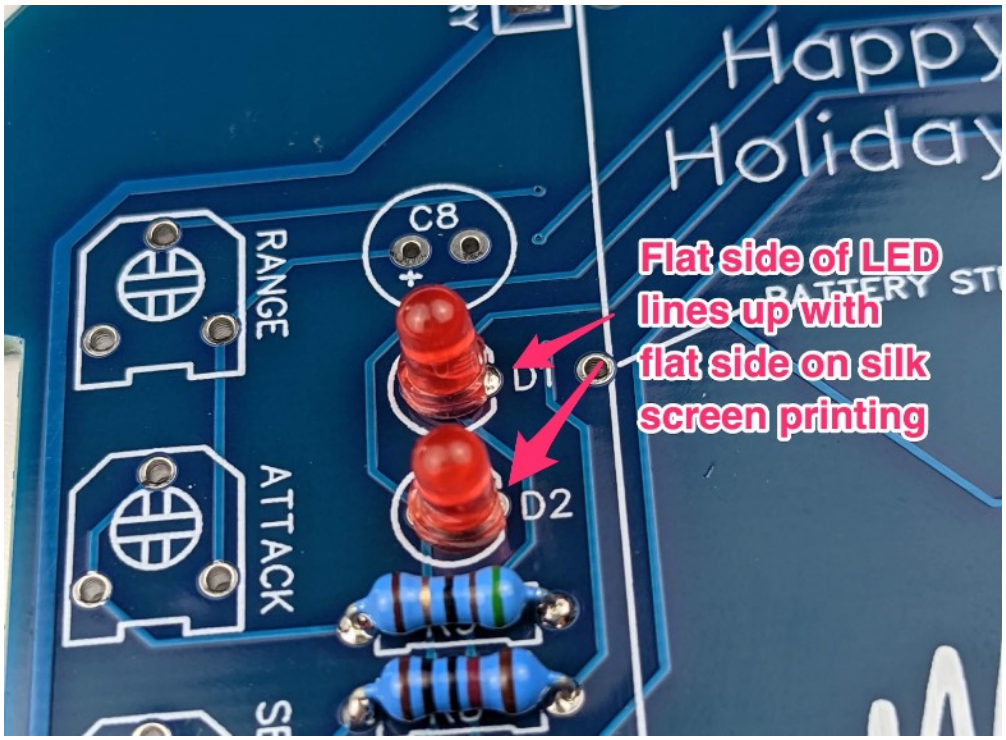
The LED's cathode (-) is indicated by a shorter leg and a flat side of the body, and the anode (+) has a longer leg.

The PCB has a "+" to indicate the anode and a flat side to show the cathode.

D1 and D2 are red LEDs, and have been measured and matched to have identical forward voltages to help the circuit perform ideally. The LED indicator is a blue LED, but you may substitute any color.

Insert and solder all 3 LEDs.





STEP 4: Trim Potentiometers

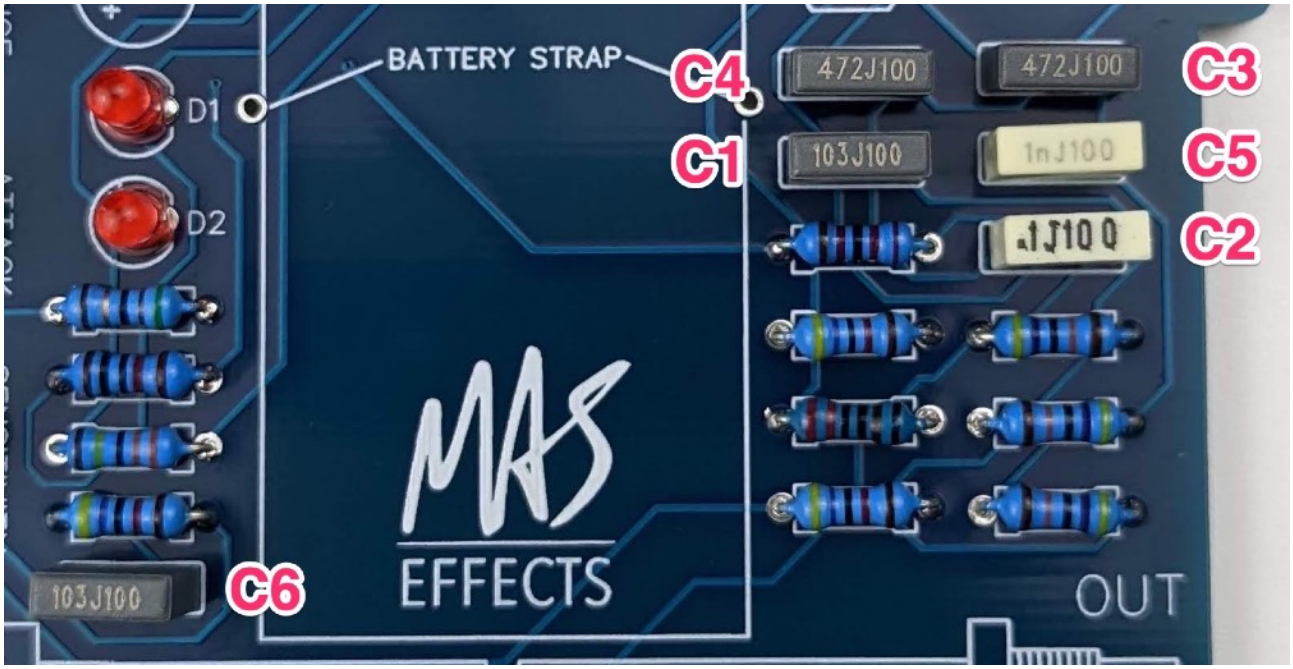
Trimmers are used to help tweak and fine-tune the optimal setting for your guitar. In this case we have three to install and solder:

* RANGE: 30k (303)
* ATTACK: 1k (102)
* SENSITIVITY: 100k (104)

Check and match the 3 digit code printed on the trimmer.

STEP 5: Non-polarized Capacitors (C1 - C6)

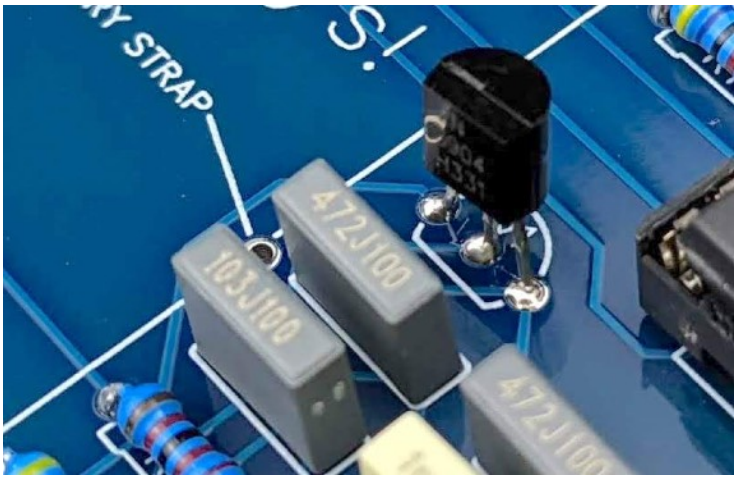
Orientation does not matter for these box film capacitors, so they can be inserted in either direction.



STEP 6: Transistor (Q1)

Insert the transistor so the flat and curved sides of its body matches the drawing on the PCB.

This ensures its leads, which correspond to the Emitter, Base, and Collector (EBC) are inserted in the correct pads.



STEP 7: Polarized Capacitor (C8)

C8 has considerably more capacity than the other capacitors we've soldered so far, and due to the construction methods for larger capacitors it is necessarily polarized.

The positive side (+), or anode, has a longer leg, and the negative side (-), or cathode, has the shorter leg. You will also find a stripe printed down the negative side with minus signs drawn on it.

Match the longer leg (anode) to the pad on the PCB marked with a "+."

STEP 8: Input and Output Jacks

Next, insert and solder the jacks into place. Line up the lugs carefully with the holes on the PCB, then wiggle it slightly while gently pressing down.

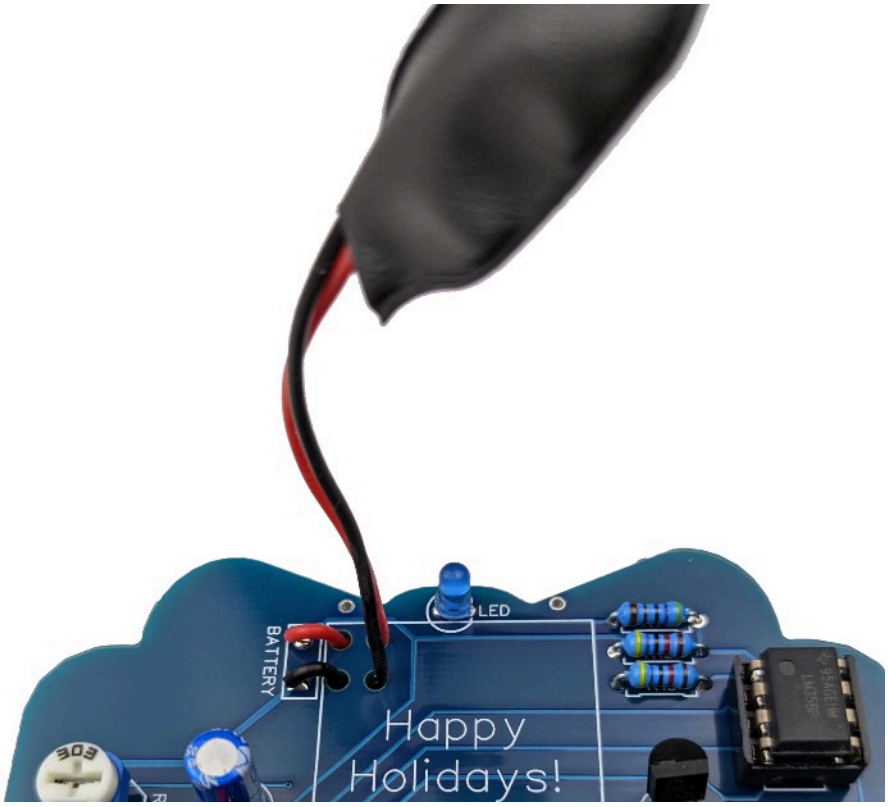
DO NOT FORCE it into the holes or you may damage the jack.

FYI: To power on this circuit, a mono cable needs to be inserted into the input jack. The cable makes a connection between the sleeve, which connects to the circuit's ground, and the ring which connects to the battery's negative (-) terminal.

STEP 9: Battery Clip

Trim the wires of the 9V battery clip to a suitable length (approximately 2-3 inches or 5-8 cm) and solder **the black wire to the (-) pad** and the **red wire to the (+) pad**.

There are holes that can optionally be used to provide strain relief; i.e. so the solder joints don't get stressed if you pull on the battery cable. To use them, weave the battery cables through the holes before soldering, as shown
below.

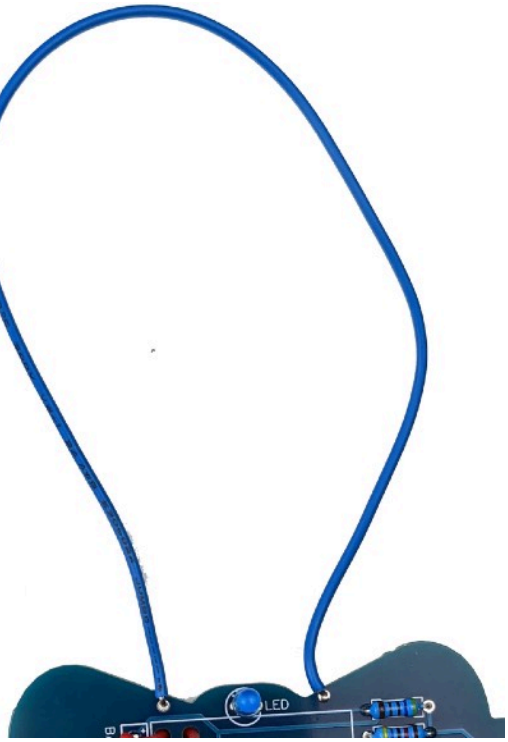


STEP 10: Battery Strap

10a. The battery strap wire will help restrain the 9V battery and keep it from dangling. Take one of the scrap cutoffs from the battery clip and solder to a pad in the middle marked "Battery Strap." Holding a 9V battery in place, loosely wrap a wire around it to estimate an appropriate length. Trim, strip, and solder the other end.

STEP 11: Hanger

Solder both ends of the blue wire to the top of the PCB to form a loop that can be used to hang the ornament.



STEP 12: (Optional) Clean

You can use an old toothbrush or cloth and rubbing alcohol to remove the soldering flux from the circuit board. Less diluted alcohol, e.g. 91%, will make the job easier.

STEP 13: Share with friends, family, bandmates

Be sure to take pics and **post online** to share with everyone. And if you know anyone who might appreciate either a kit or a pre-assembled ornament, **send them to mas-effects.com/holiday** .

We'd love to see it too, so post your build to reddit.com/r/maseffects

Happy Holidays!

Problems? Questions?

If you have any questions or run into any problems, visit our MAS Effects subreddit:

reddit.com/r/maseffects

or email directly: mark@mas-effects.com