Ornament Kit: Distortion

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, you can email me directly <mark@mas-effects.com> or for quicker responses you can post to various DIY pedal groups online (to which I will also reply). For a list of recommended groups, visit mas-effects.com/holiday-instructions/

Happy Holidays!

Overview

This ornament is a playable distortion/overdrive "pedal."

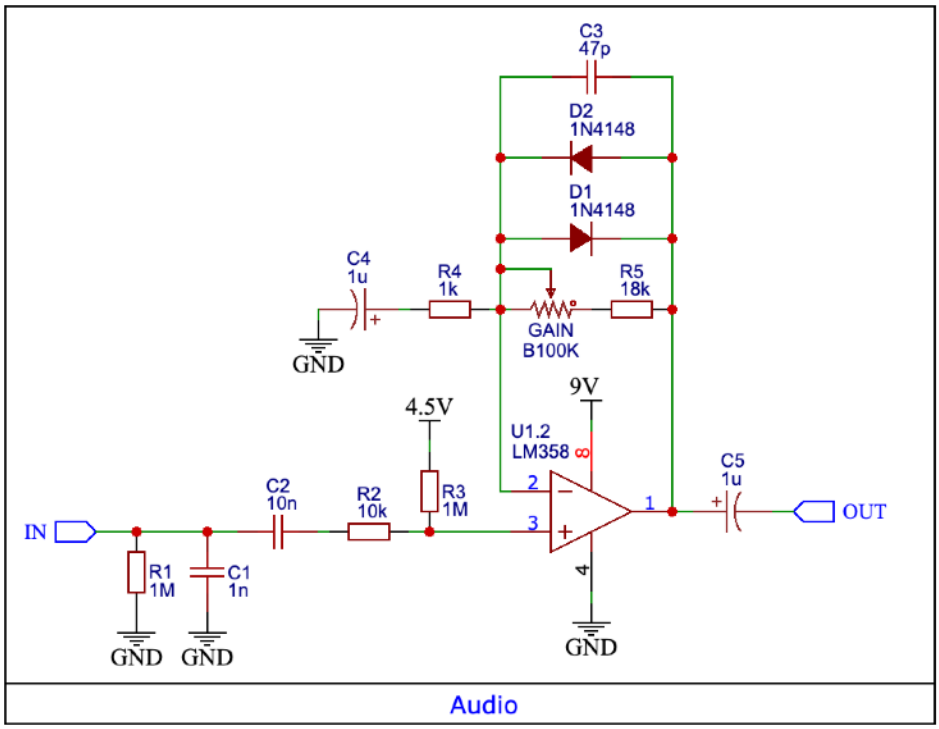
It is supplied power when a mono instrument cable is plugged into the input jack. **Leaving your guitar plugged into this will drain the battery!**

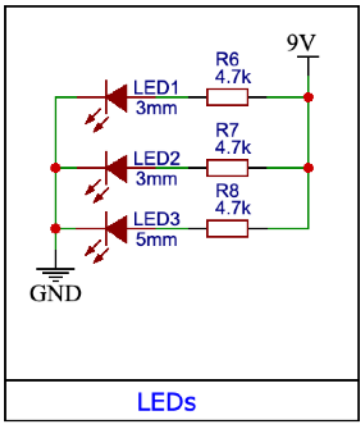
The audio circuit is a simple but great sounding design. It's not based on another pedal, per se, but it shares much in common with so many. It's often said "there are only so many ways to clip a signal."

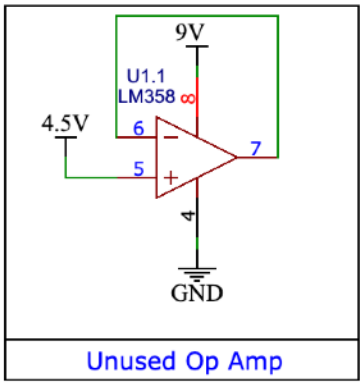
Bill of Materials

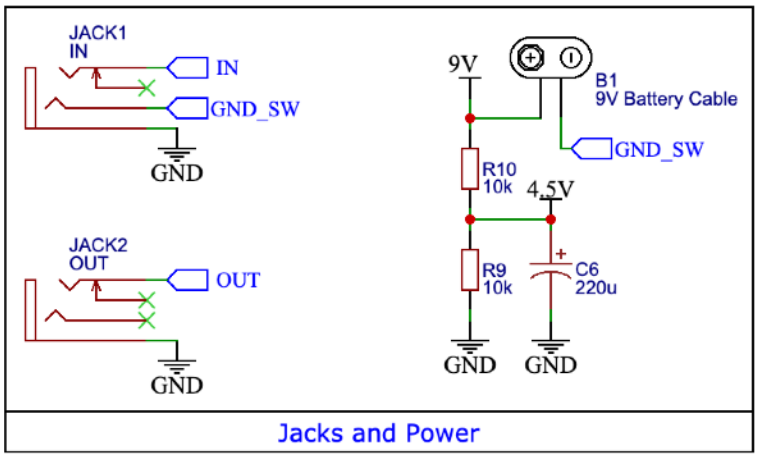
QTY	Designator	Part	Note
2	D1,D2	1N4148	
2	LED1,LED2	3mm	White for midsection "buttons"
1	LED3	5mm	Orange for nose
1	C1	1n	
1	C2	10n	
1	C3	47p	
2	C4,C5	1u	Electrolytic
1	C6	100u	Electrolytic
2	R1,R3	1M	
3	R2,R9,R10	10k	
1	R4	1k	
1	R5	18k	
3	R6,R7,R8	4.7k	
1	U1	LM358	
1	GAIN	B100K	9mm potentiometer
1	B1	9V Battery Cable	
2		Audio jack	
		Ribbon	Optional, decorative

Schematic









Circuit Analysis

Coming soon: Let's walk through each section of the schematic and describe what the groups of components are doing.

If you'd be interested in this let me know and I'll try to bump up its priority. <mark@mas-effects.com> or mas-effects.com/contact

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**

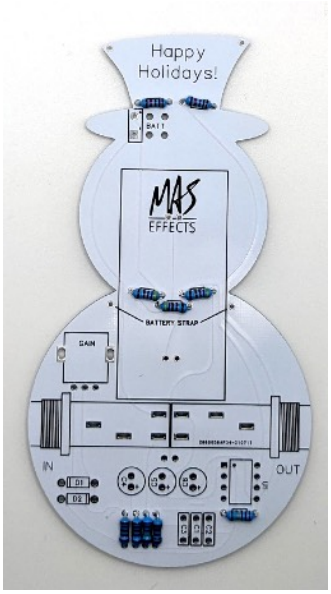
Placing components correctly:

- **Leave the components in the bags** until you are ready to use them. I labeled each bag and kept similar-looking components in separate bags to help ensure you don't mix them up
- 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).
- 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.

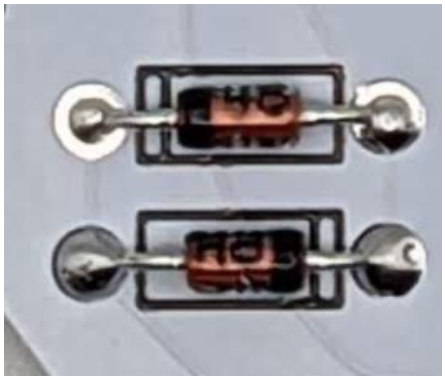
STEP 1: Resistors (R1 - R10)



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.

You may find it easiest to 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.

STEP 2: Diodes (D1, D2)



Diodes must be oriented correctly. The side with the stripe is the cathode (-) and the other side is the anode (+).

Place the diodes so **the cathode (striped side) is over the stripe on the silkscreen** printed on the circuit board.

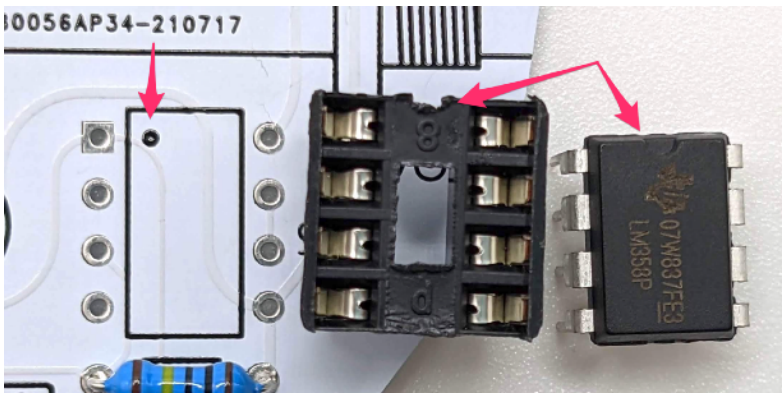
FYI: The diodes in this circuit provide a bit of extra clipping, i.e. distortion. If you omit them you'll get a "softer" sound. You can also try various types of diodes such as LEDs, rectifiers (e.g. 1N4001), or germanium (e.g. 1N34A). You can solder sockets to the PCB to make swapping diodes easier. Sockets weren't included with this kit, but you can carefully break apart the op amp socket (step 3) and use its individual legs if you don't have anything else.

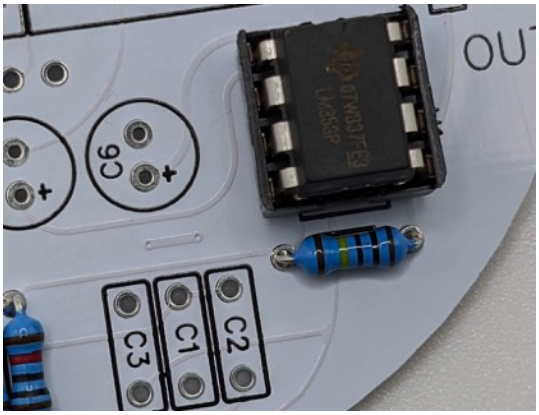
STEP 3: Op Amp (U1)

Orientation matters. The half-circle cutout on the op amp and socket indicate the side with pins 1 and 8. Some op amps may instead have a small off-centered circle next to pin 1. The following picture shows the correct orientation: the half circle or dot should be on the same side.

FYI: The operational amplifier (op amp) we're using with this kit is an LM358, but you can use any other compatible one (this was chosen simply because I had a large stock). You may hear minor differences depending which you use, so if you'd like to try others check their datasheets to ensure each pin is the same as the LM358. Example compatible op amps include the popular TL072 or 4558.

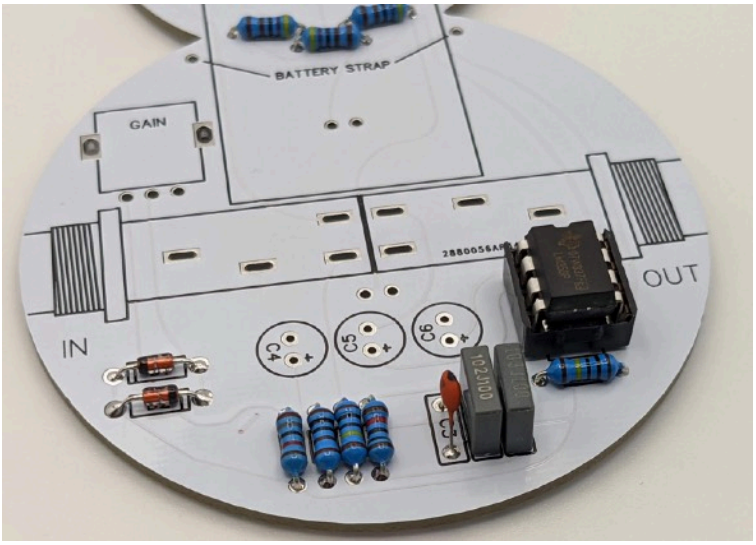
You do not need to use the socket and can instead solder the op amp directly to the PCB.





STEP 4: Non-polarized Capacitors (C1 - C3)

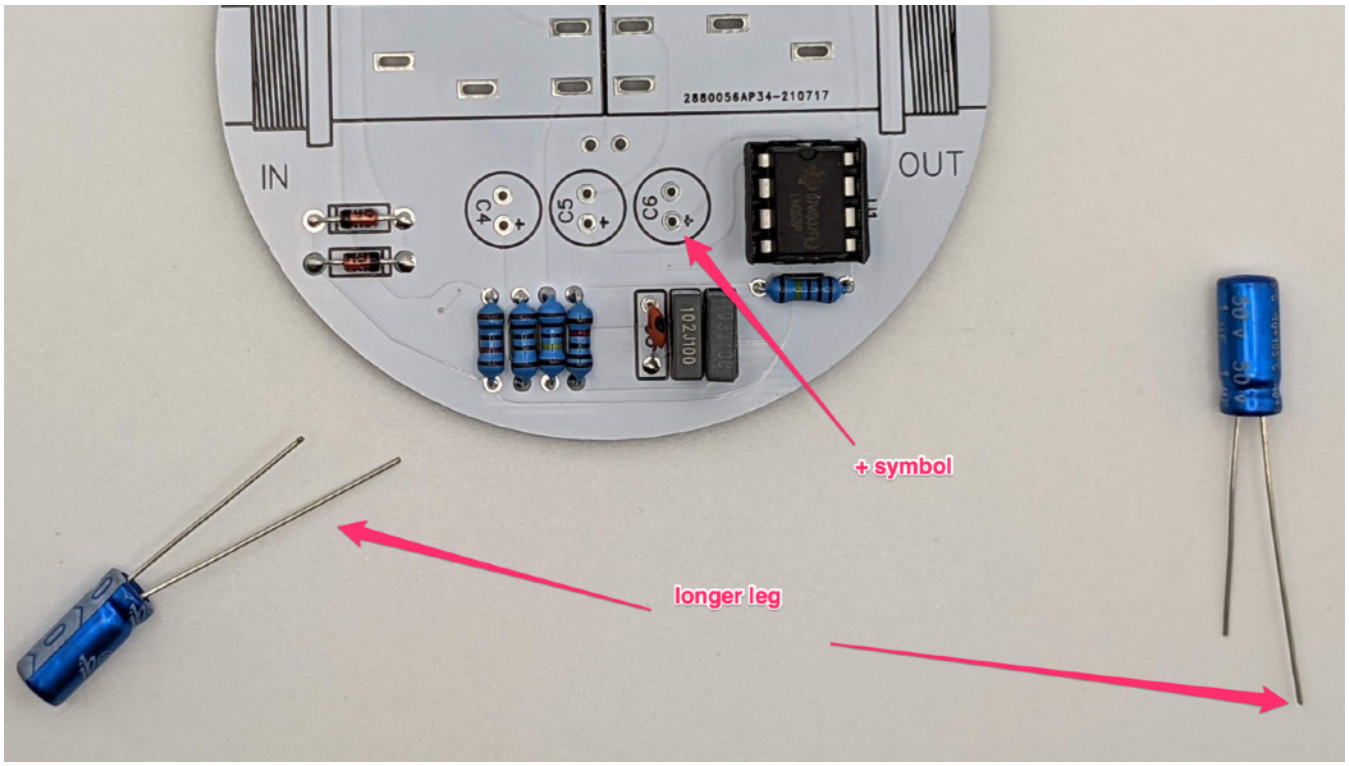
Orientation does not matter for these capacitors, so they can be inserted in either direction.



STEP 5: Polarized Capacitor (C4 - C6)

C4, C5, and C6 have considerably larger capacity, and due to the construction methods for larger capacitors it is necessarily polarized.

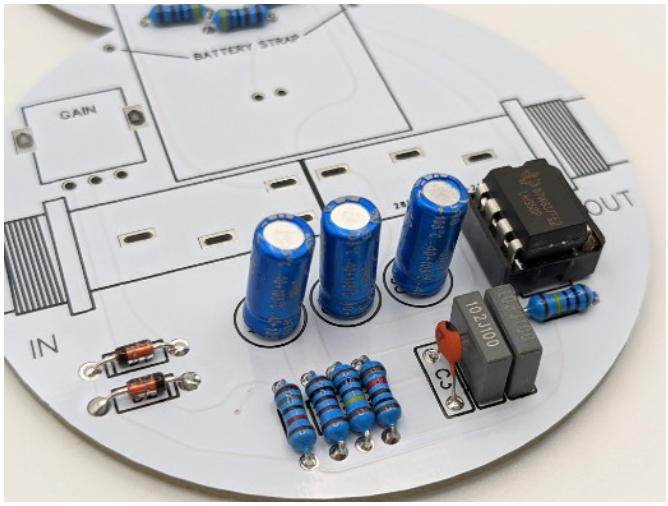
The positive side (+) has a longer leg, and the negative side (-) has the shorter leg.



STEP 5 (continued)

You will also find a stripe down one side of the capacitor with "-" symbols on it, indicating its negative side.

The following picture shows how it should look at this step.

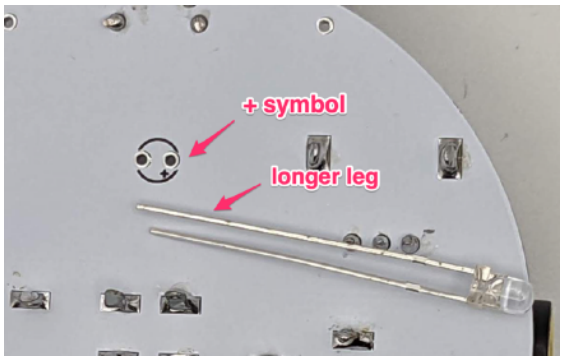


STEP 6: LEDs

Light emitting diodes (LEDs), like the electrolytic capacitors, also have polarity and must be oriented correctly.

The cathode (-) is indicated by a shorter leg, and the anode (+) has a longer leg.

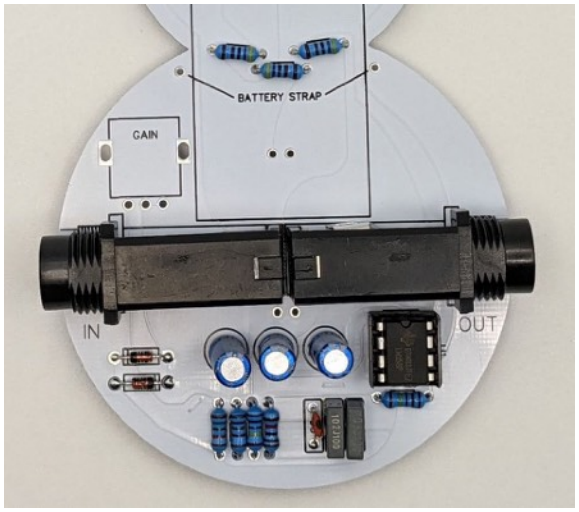
Insert the anode (longer leg) into the hole marked with a plus sign (+).



Solder two 3mm white "button" LEDs, and one 5mm orange "carrot" LED.

STEP 7: Input and Output Jacks

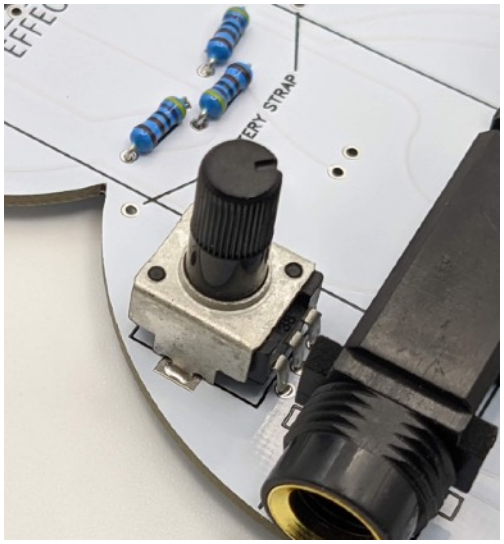
Next, insert and solder the jacks into place.



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 8: Gain Control

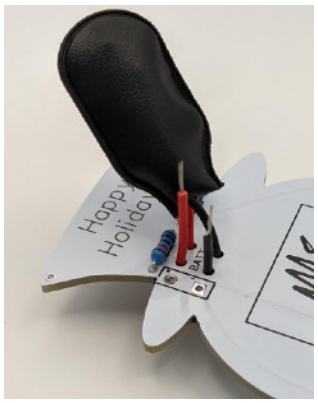
Solder the 9mm gain potentiometer into place.



STEP 9: Battery Clip

Trim the wires to a suitable length and solder **the black wire to the (-) pad** and the **red wire to the (+) pad**.

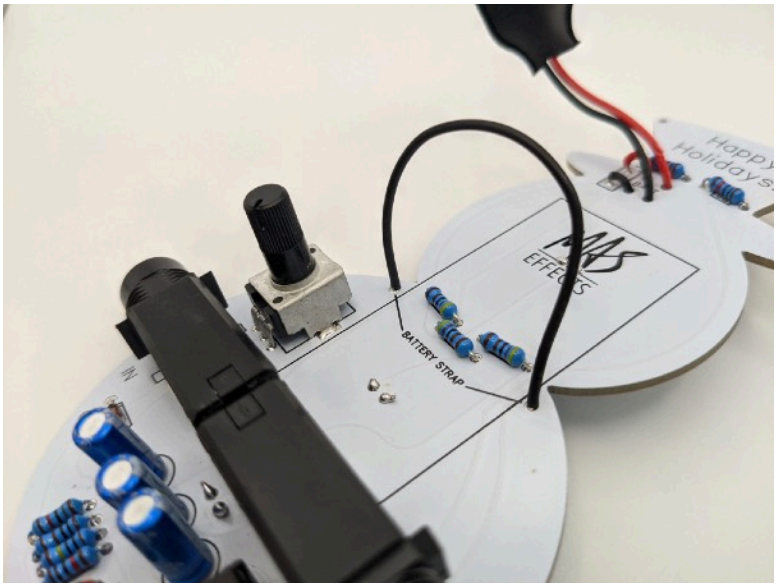
There are holes that can optionally be used to provide strain relief; i.e. so the solder joints don't get stressed if you pull on the battery cable. To use them see the pics below.



STEP 10: Hanger and 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.

10b. Solder both ends of the remaining scrap wire to the top of the bell, forming a loop that can be used to hang the ornament.



STEP 11: Ribbon

Use the included ribbon to tie a band around the hat, and give your snowman a scarf

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** .

Happy Holidays!