

# Ultra Simple Class D Audio Amplifier

This is a relatively easy to build circuit to aid in the understanding of the principles of self-oscillating class D amplifiers. It is by no means a hifi amplifier, but works and is adequate for casual listening.

## Supplies

One of the main design goals of this amplifier was to use commonly available / very affordable parts. The amplifier consists of an LM393 comparator, BJT output transistors and some supporting jelly bean parts. Many (possibly all) of the parts can be salvaged from old electronics. Old computer power supplies are a good source of many of these parts. The rest of the parts can be purchased online.

## External Parts / Tools

Item	Notes
Power Supply	9v - 12v You can use a 9v battery, but it will probably drain pretty fast. Otherwise some sort of 9-12V $\underline{DC}$ power supply rated at 1A or more will work. You can also use USB (5V) to power it, though the output volume will be severely limited.
Speaker	8-16 $\Omega$ , 10W or more. It's probably a good idea to use a speaker you don't care about just in case the circuit destroys it. You could probably use a 4 $\Omega$ speaker if you use robust enough output transistors (Q4 & Q5).
Audio Source	Of course you need some sort of audio source to connect to your amplifier's audio in (J2). A cell phone, mp3 player, or anything with a line level output will work.
Wire	Pretty much any solderable wire will do, but single stranded is easier to work with. I normally use strands from an old CAT5 (network) cable.
Wire Cutters / Strippers	
Solder	
Soldering Iron	
Printer	If you wish to use the provided circuit template you'll need these.
Adhesive Spray, Glue, or Double Sided Tape	
Cardboard	
Scissors	

## Circuit Components

Schematic Reference(s) / Name	Part	Purpose / Notes	Subcircuit
J1	Power Connector		Power
C2	470uF-1000uF Capacitor	Decoupling Capacitor	
D1	LED	Power indicator <i>Optional</i>	
R5	2k-10k Resistor	Current limiting resistor for LED (D1). Lower values for brighter LED. <i>Optional</i>	
J2	Audio In Connector (3.5mm, RCA or similar)	Audio Input	Preamp
C1	4.7uF-22uF Capacitor	Coupling Capacitor	
R1	100k Resistor	Bias for Q1.	
R2	10k Resistor		
R3	10k Resistor	Collector resistor for Q1	
R4	1k Resistor	Feedback resistor for Q1	
Q1	Small Signal NPN	Preamp transistor	
C3	100nF-470nF	Coupling Capacitor	

Schematic Reference(s) / Name	Value	Purpose / Notes	Subcircuit
R8, R9	100k-220k	Bias resistors for input to comparator	Comparator
R8	1k	Input resistor	
R19	330k-2M	Hysteresis resistor. This resistor can be omitted, but the circuit might become unstable.	
U1	LM393	Comparator	
C4	100nF	Decoupling Capacitor for U1, Q2 & Q3	
R10	3k-3.3k	Pull up resistor for the open collector output of the comparator (U1).	
Q2	Small Signal NPN	Buffer for comparator output so that the signal will be strong enough for the output stage.	
Q3	Small Signal PNP		

C5	100nF	Decoupling Capacitor for Q4 & Q5	Output
Q4	NPN	Output Transistors. These should be rated 1A or higher. Faster is better.	
Q5	PNP		
L1	100uH-470uH	Inductor for low pass filter.	Output Filter
C6	100nF-680nF	Capacitor for low pass filter.	
R11	1Ω-10Ω	Resistor for low pass filter. You can omit this resistor if you are using a snubber type capacitor.	
C7	1000uF-4700uF	Output coupling capacitor. Saves the speaker from destruction by removing the DC component for the output signal.  Using a higher value will give you lower bass cutoff, conversely lower values will raise the bass cutoff frequency.	
J3	Speaker Connector		