The Best JFET Preamplifier You've Never Heard

I'm nothing if not obsessed. And I've been obsessed for years with making preamplifiers to connect portable audio gear to hi-fi equipment. If your time isn't worth much, I can heartily recommend you read my other dope-propelled ramblings on the subject.

But enough of that all that rot--how about a super simple, easy to build preamplifier that sounds incredibly bodaciously awesome? Yeah, I thought so.

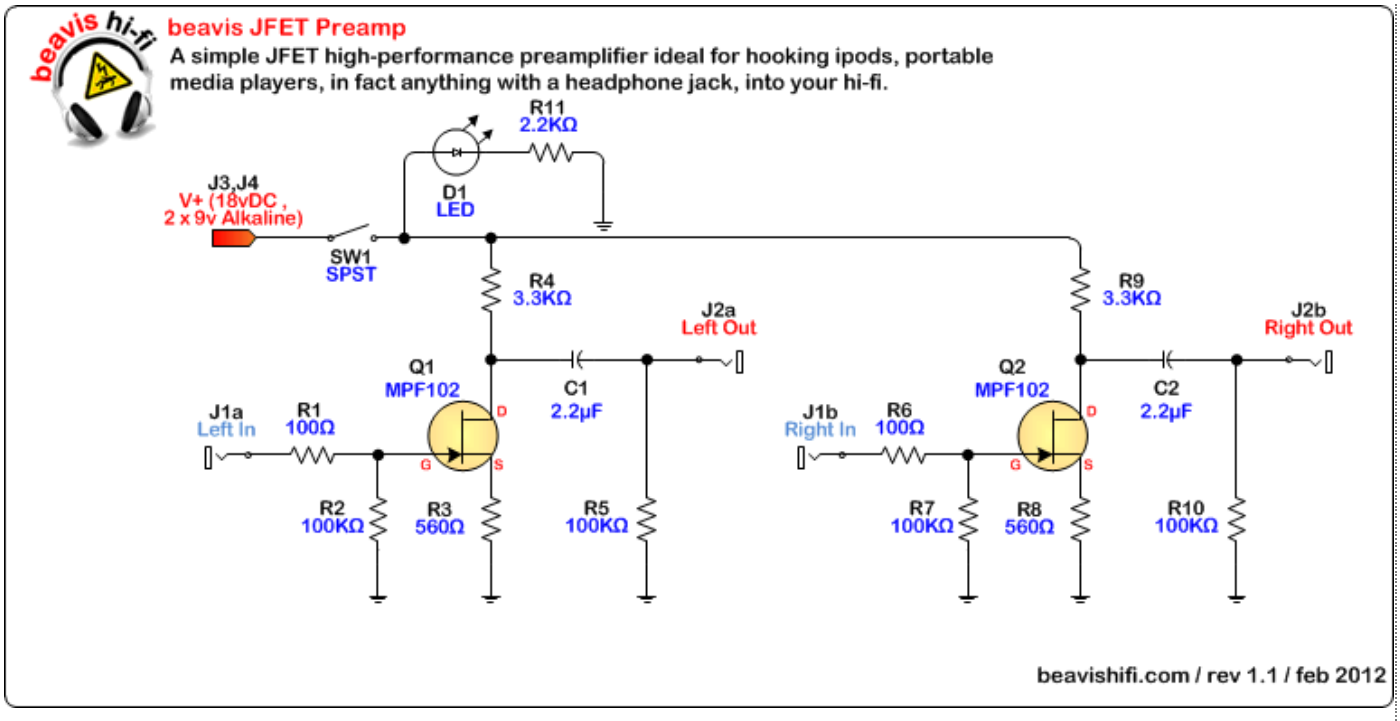
Update, Feb 2012: I've received a lot of email questions about building this circuit. To make things a bit easier, I've expanded the schematic to be a bit less abstract, added some additional notes, and included a parts list.

Synopsis

- Incredible JFETy goodness in a simple "path of least resistance" preamplifier.
- Boost your iPod/phone/laptop (anything with a crappy old headphone jack) for optimal insertion into your kick-ass hi-fi setup.
- Batteries supply power, but you can add a wall wart if you want.

A Brief Description for Your Esteemed Perusal

- Single-stage, JFET preamplifier
- 18 volt DC source (2 x 9v alkaline battery, yo.)
- Minimal parts, only what God intended
- No input coupling caps



The Circuit

This is a textbook example of a simple common-source FET-based amplifier. The general design has been around as long as FETs themselves. If you haven't worked with JFETs before, you are in for a treat. This is because JFETs are commonly used to approximate the tube-like warmness of vacuum tube circuits, but without the cost or high voltage concerns.

The simplicity of this circuit belies its wonderfulness. Connected between your iPod, portable media player or anything else with a headphone jack or under-powered line out, it creates a great boost, restoring the source signal to a much better approximation of what it should be.

But it isn't just about loudness, the JFET adds its magic and the result is better, warmer sounding music. Now I'm not one to bandy about boutique audiophile freak terms like sound stage, and bloom and haunting mids. But I will say that everyone who has ventured into the lab and listened to this little jewel has been mightily impressed.

- R1-4 set the input impedance, transistor operating voltage, and bias.
- R5 provides a slight attenuation of the output signal.

- C1 blocks any DC from the output signal.
- D1 is a on/off indicator LED. R11 reduces current so the LED doesn't burn out from the 18 volt power supply.
- S1 is a simple Single Throw Single Pole on/off switch that connects or disconnects the power

Batteries Only

What? Batteries only? That's not very Green® of me! But hear me out. Because of the simplicity of this circuit (which I love because the fewer parts between the input and output is a good thing) I wanted to forgo the usual bits of power conditioning necessary when using AC adaptors (wallwarts). And even the crappiest alkaline battery is way quieter than the the best wallwart. So all the versions of this that I have tested and built use two 9v alkaline batteries in series to provide the required 18vDC supply. And it is quiet as a church mouse.

Current draw of the circuit hovers around 12 ma, so a pair fresh batteries should last around 80 hours. Obviously, a simple power switch is a good idea.

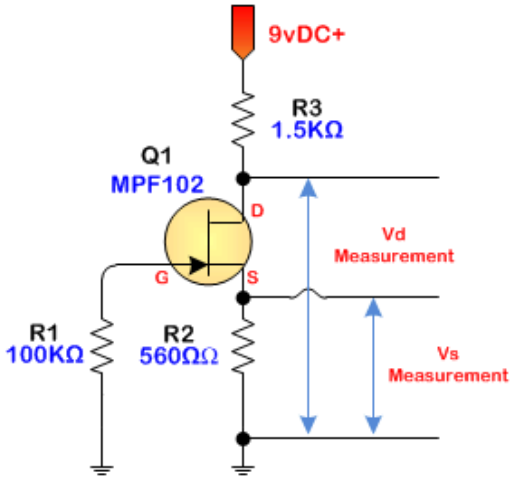
But....if you want a wall wart, go ahead. Below is a schematic for a simple power supply circuit.

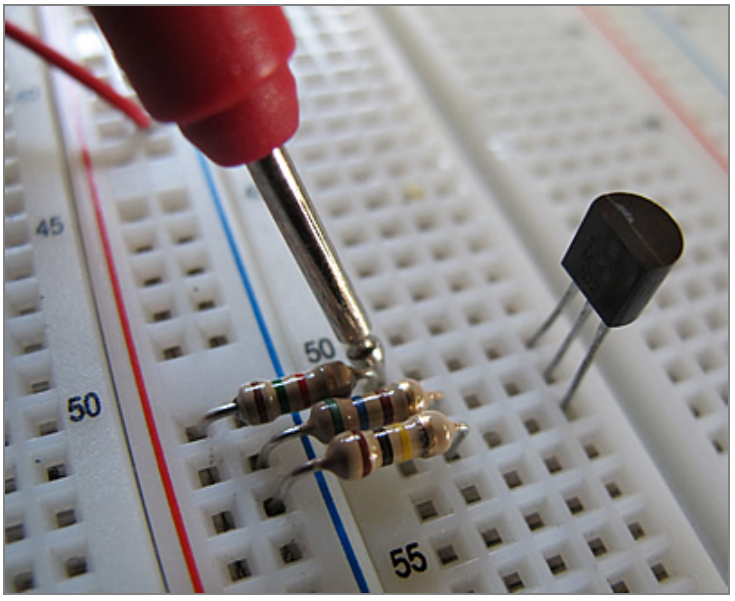
Choosing JFETs and Matching Parts

Another key consideration is the variability of JFETS. Get a bag of MPF102 parts and their parameters can be all over the place. This means that 1 JFET may sound great and another doesn't work at all, even though it meets the manufacturer's specifications. Compound that with the fact that you are creating a two-channel stereo circuit--you want both sides of the circuit to be as close as possible in terms of performance.

So what is the easy way to solve this JFET variability issue? Simple: buy 10-20 JFETs, plug them in and listen to the circuit with a test tone. Immediately discard the ones that don't pass a signal or sound distorted. Then use your ear to find the pair that sound most even. Listen for an out-of-balance signal. If the left channel sounds too loud compared to the right, try some more JFETs.

The better way to match your JFETs is to create a small testing circuit. Here is such a circuit:



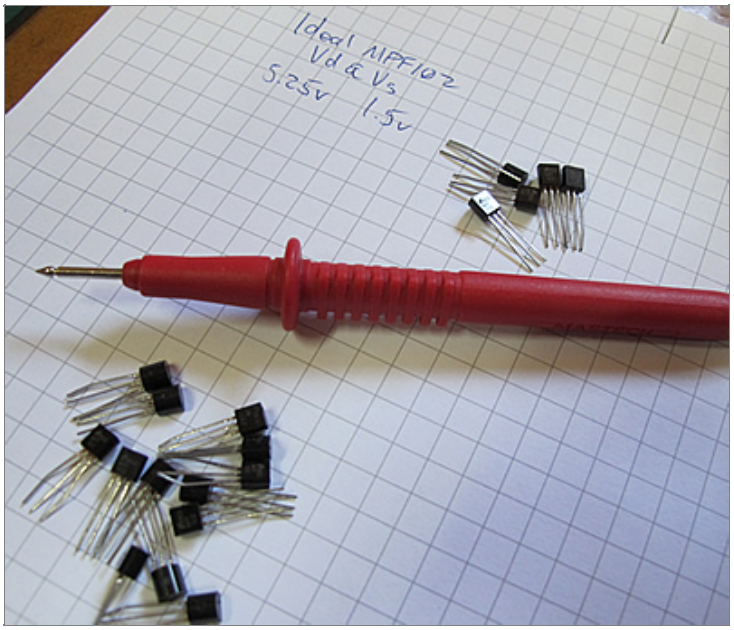


The Testing Circuit on a breadboard

To test your MPF102 devices, connect them up as shown in the schematic. Then set your DMM to DC volts and measure at the spots shown as Vs measurement and Vd measurment. The ideal part will have:

- a Vd measurement of 5.20v - 5.40v
- a Vs measurement of 1.45v - 1.65v

If you are lucky, roughly half of your FETs will measure in this range. More likely, you'll have a 1 in 3 or 1 in 4 success ratio. Good thing MPF102s are cheap.



:

Five out of eighteen MPF102s passed the test

To learn more about measuring and matching JFETs, I'd highly recommend RG Keen's excellent article "JFET Matching for Effects."

As for the other parts, every effort at matching resistors on the left and right sides of circuit will reward you with an even balance and better sound. You can buy some 1% precision resistors and make that effort easier. As far as the electrolytic caps on the output, their tolerance can vary around 20%, so you made need to test more of them.

Parts List

Everything you need to build this can be had at your local Radio Shack (assuming you have a local Radio Shack, and assuming it is a Radio Shack that still carries parts.) I've used this as a baseline reference, hopefully this list will make it easier for you to source parts from other distributors.

Qty	Part #	Description	Source
2	Q1, Q2	MPF102 JFET Transistor	Radio Shack Catalog #276-2062
2	R1,R6	100ohm 1/4 watt resistor	(See notes)
4	R2, R7, R5, R10	100kohm 1/4 watt resistor	
2	R3, R8	560ohm ¼ watt resistor	
2	R4, R9	3.3kohm ¼ watt resistor	
1	R11	2.2Kohm ¼ watt resistor	
2	C1, C2	2.2uf Electrolytic polarized capacitor	Radio Shack Catalog #272-997
1		Enclosure	(See notes)
2	J1, J2	1/8” Stereo Jack	Radio Shack Catalog # 274-249
2	J3, J4	9 volt battery snap	Radio Shack Catalog #270-324
1	SW1	SPST Toggle Switch	Radio Shack Catalog #275-612
1	D1	5mm LED	(any color you like)

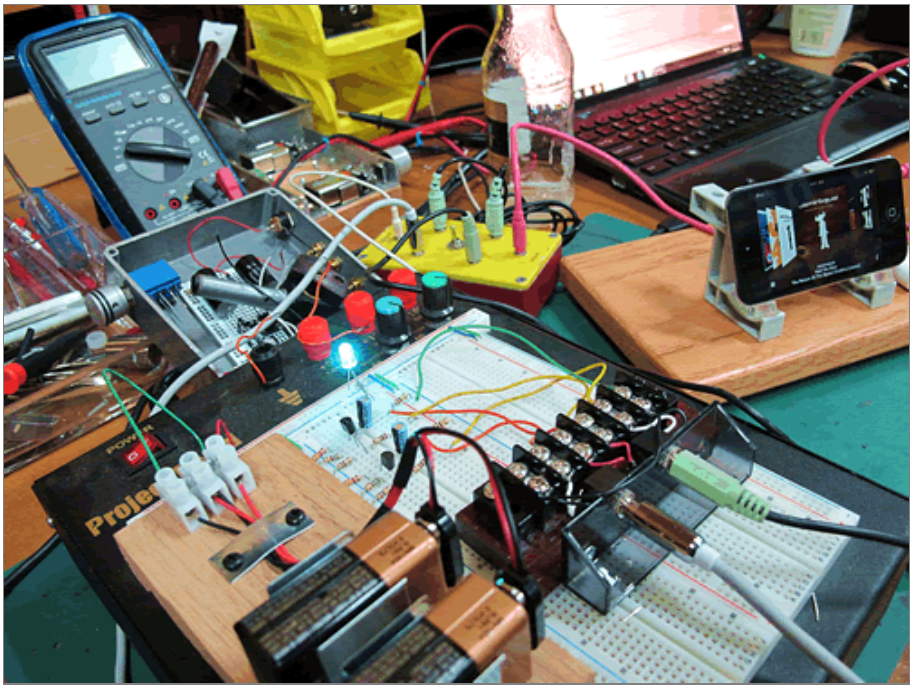
Parts Notes

- For the resistors, any 1/4 watt part will do. In general, metal film resistors are the composition of choice. If you don't already have a good selection of resistors for your parts box, I would suggest getting a grab-bag type arrangement, like the Radio Shack 500-Piece 1/4-Watt Carbon-Film Resistor Assortment, Catalog #: 271-312
- Enclosure: You could build this on a slab of wood I suppose, or in a cigar box or some other interesting enclosure. A more traditional route is to use a metal or plastic project enclosure (Radio Shack has a bunch). Choose one that gives you enough room for your parts, jacks, the switch, circuit board, and batteries.
- D1 LED: Choose any color or brightness you like. 5mm parts are easy to work with and easy to find.

Building It

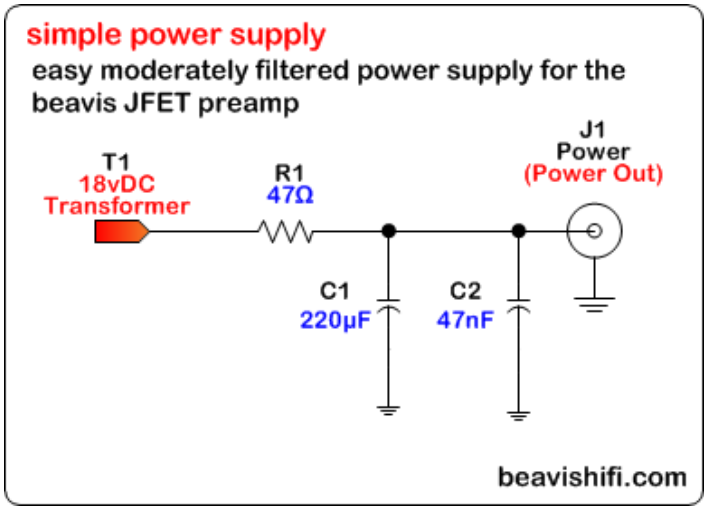
You can use any kind of perfboard or protoboard. Resistors are all 1/4 watt, 1%-5% tolerance parts. The output capacitors are any nice audio-grade electrolytics. The circuit is biased for the MPF102 part, if you use a J201 or 2N5457 FET, you'll have to figure out how to re-bias it. But the MPF102 is so ubiquitous that you can even find it a Radio Shack.

In the meantime, pull out your breadboard, batteries and plugs and give it a try. I guarantee you will not be disappointed.



Add a Power Supply

In general, batteries will supply a quieter noise-free power source than an AC/DC adaptor. But if you want to save on batteries, you can use a power supply. Here's a simple schematic for a moderately filtered PSU.



For the AC/DC adaptor, you'll want a transformer-base unit, **not** a switching power supply. That's because switching power supplies can inject high-frequency noise into the audio circuit. Here's a good example: http://www.jameco.com/webapp/wcs/stores/servlet/Product_10001_10001_163272_-1

References and Acknowledgements

A Discrete FET Guitar Preamp - http://www.till.com/articles/GuitarPreamp/

A great, detailed write-up on jfet preamps - http://www.hawestv.com/amp_projects/fet_preamp/fetpreamp1.htm

(c) 2009-2012. This work is licensed under a Creative Commons License