# VFE_FUZZDUO

**FX TYPE: Fuzz**

Enclosure Size: 1590B, 125B



## Overview

*From the VFE website:*

The FUZZ DUO lets you switch between low-gain germanium & high-gain silicon transistors, or use a combination of both to create your own signature fuzz tone. The BIAS control lets you dial in that perfect sweet spot, and the revised FILTER control balances between separate bass & treble filters. The FUZZ DUO uses hand-selected germanium & silicon transistors, and works great when daisy-chained on a power supply.

### HOW THE FUZZ DUO CAME TO BE

Anyone who's experimented with simple, transistor-based fuzz circuits knows how much the transistors you select can impact the tone. In true VFE fashion, I wanted to build a fuzz pedal that let the user decide between various transistors. The very first prototype had a 3-way rotary switch to toggle between germanium, silicon, and hybrid fuzz tones.

Over the years the Fuzz Duo has undergone many small revisions to improve usability, lower noise, increase volume output, and most importantly increase the tonal flexibility of the FILTER knob, which is fundamental to getting the right frequency balance in the fuzz.

## Controls

**FUZZ:** Sets the gain of the 2nd transistor stage. Cranking this will bring loads of fuzz saturation, but you can roll back on your guitar's volume knob to clean things up in a hurry.

**BIAS:** Sets the voltage & gain structure of the fuzz. Find the sweet spot for a sustaining fuzz, or pull it way back to starve and glitch out your fuzz tone.

**LEVEL:** Sets the output volume. We improved the output section, so now you can get TONS of volume!

**FILTER:** Controls dual EQ filters in the fuzz circuit. It has been tuned to provide an overall bass boost EQ when fully counterclockwise, a treble boost EQ at 12:00, and mid boost EQ when cranked.

**TR1:** Selects between a medium-gain germanium transistor and a high-gain silicion transistor in the first gain stage.

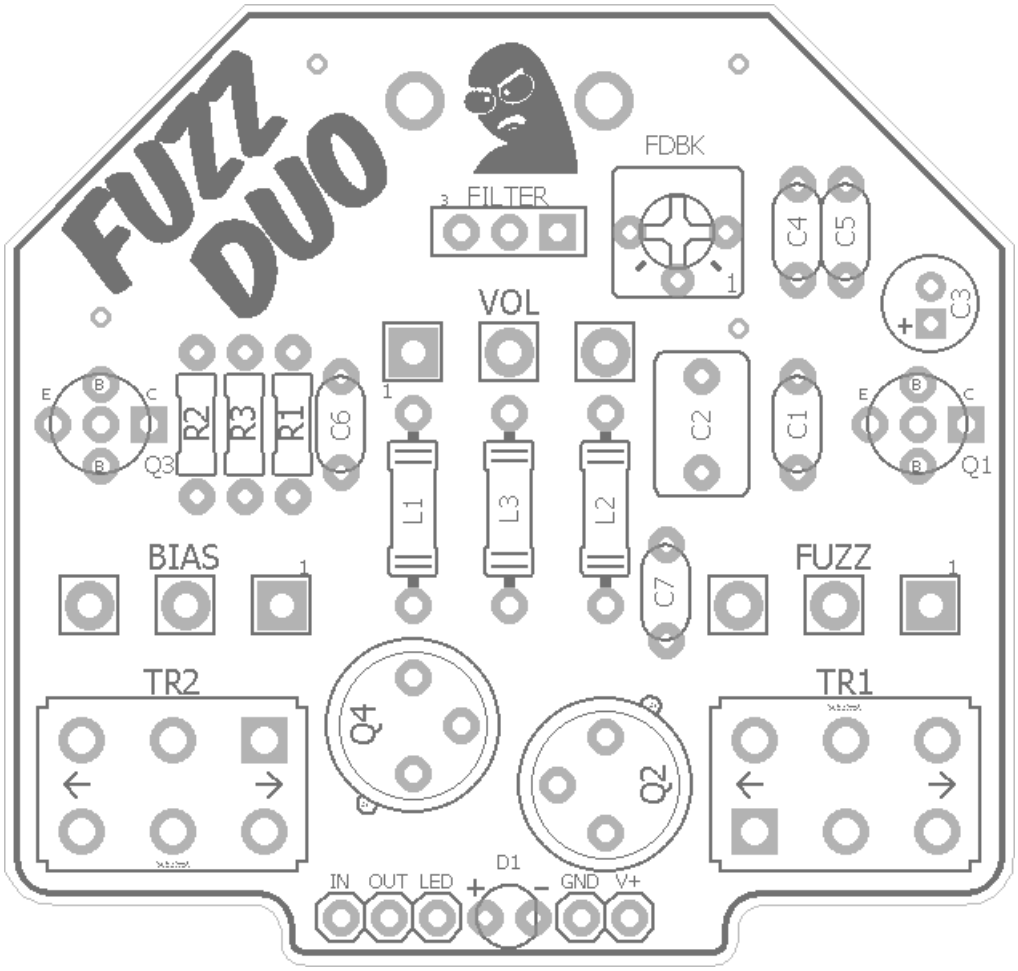
**TR2:** Selects between a medium-gain germanium transistor and a high-gain silicion transistor in the second gain stage Germanium transistors have a smoother fuzz tone that cleans up extremely well with the guitar's volume knob.

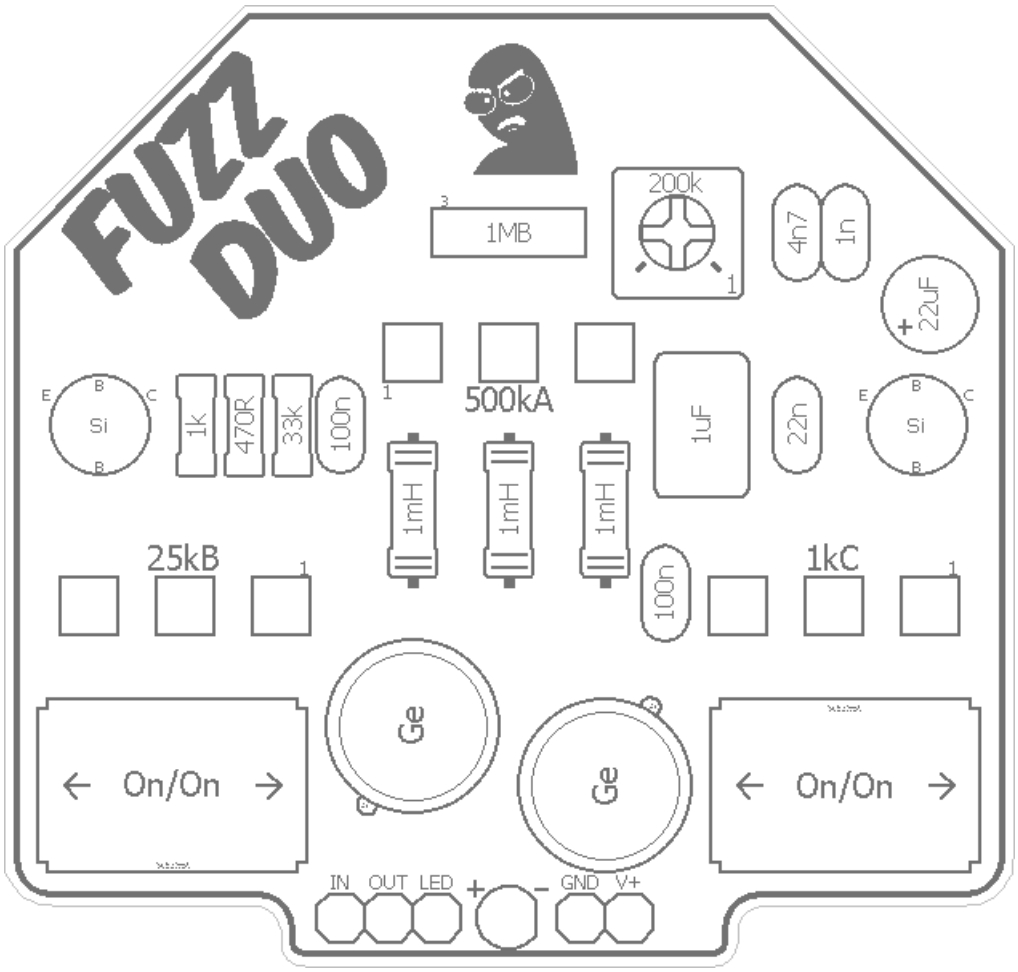
**FEEDBACK:** An internal trimpot lets you dial in your sweet spot.

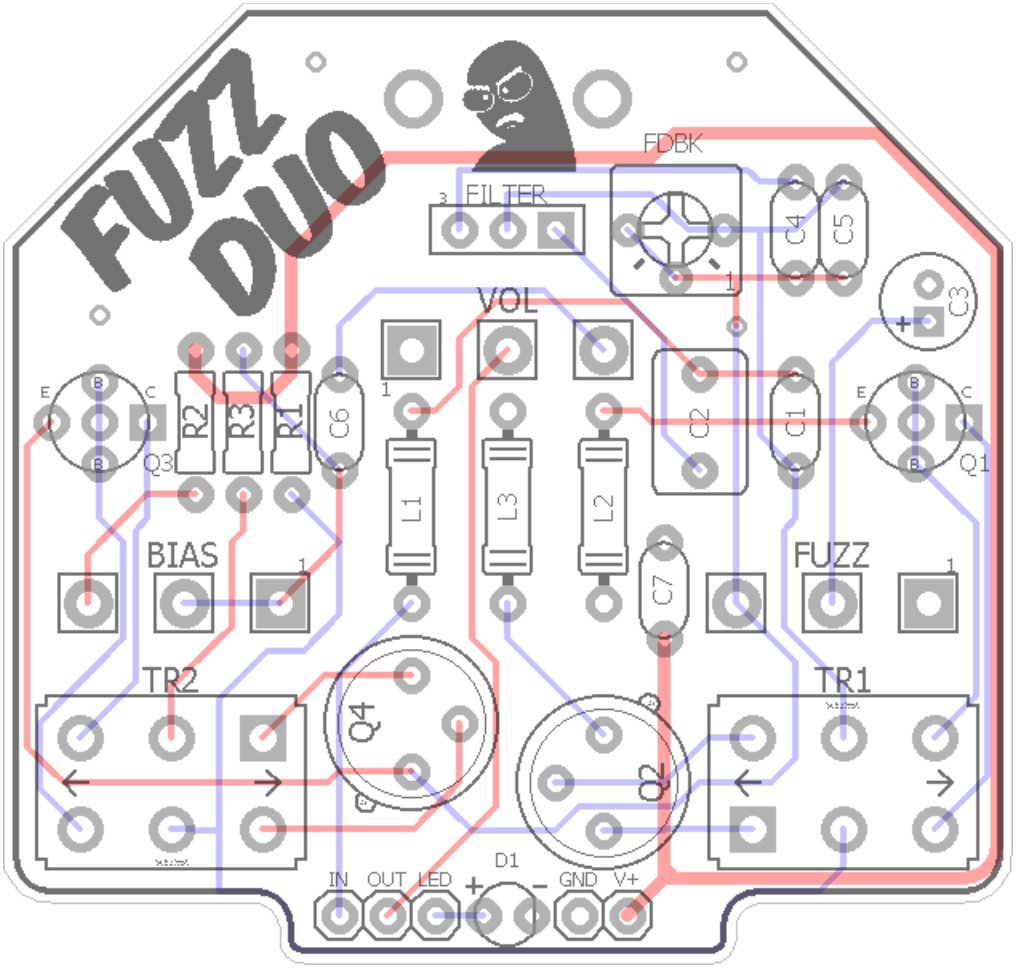
---



**Technical assistance** for your build(s) is available via the madbeanpedals forum. Please go there rather than emailing me for assistance on builds. This is because (1) I'm not always available to respond via email in a timely and continuous manner, and (2) posting technical problems and solutions in the forum creates a record from which other members may benefit.


FUZZ
DUO
FDBK
FILTER
VOL
C4
C5
C3
C2
C1
R2
R3
R1
C6
L1
L3
L2
C7
Q3
Q1
BIAS
FUZZ
TR2
TR1
Q4
Q2
D1
IN
OUT
LED
GND
V+


FUZZ DUO
1MB
200k
4n7
1n
22uF
Si
1k
470R
33k
100n
500kA
1uF
22n
1mH
1mH
1mH
25kB
100n
1kC
Ge
Ge
On/On
On/On
IN OUT LED + - GND V+


FUZZ
DUO
FDBK
FILTER
VOL
C4
C5
C3
C2
C1
R2
R3
R1
C6
L1
L3
L2
C7
Q3
Q1
BIAS
FUZZ
TR2
TR1
Q4
Q2
D1
IN
OUT
LED
GND
V+

| Resistors | |
|---|---|
| R1 | 33k |
| R2 | 1k |
| R3 | 470R |
| **Caps** | |
| C1 | 22n |
| C2 | 1uF |
| C3 | 22uF |
| C4 | 4n7 |
| C5 | 1n |
| C6 | 100n |
| C7 | 100n |
| **Diodes** | |
| D1 | LED |
| **Inductors** | |
| L1 - L3 | 1mH |
| **Transistors** | |
| Q1, Q3 | Si |
| Q2, Q4 | Ge |
| **Switches** | |
| TR1, TR2 | On/On |
| **Trimmers** | |
| FDBK | 200k |
| **Pots** | |
| FUZZ | 1kC |
| BIAS | 25kB |
| VOL | 500kA |
| FILTER | 1MB |

| Value | QTY | Type | Rating |
|---|---|---|---|
| 470R | 1 | Metal / Carbon Film | 1/4W |
| 1k | 1 | Metal / Carbon Film | 1/4W |
| 33k | 1 | Metal / Carbon Film | 1/4W |
| 1n | 1 | Film | 16v min. |
| 4n7 | 1 | Film | 16v min. |
| 22n | 1 | Film | 16v min. |
| 100n | 2 | Film | 16v min. |
| 1uF | 1 | Film | 16v min. |
| 22uF | 1 | Electrolytic | 16v min. |
| LED | 1 | any | 3 or 5mm |
| 1mH | 3 | indcutor, see notes | |
| Si | 2 | NPN, see notes | |
| GE | 2 | NPN, see notes | |
| DPDT | 2 | On/On, Pin Mount | |
| 200k | 1 | Bourns 3362p | |
| 1kC | 1 | PCB Mount | 16mm |
| 25kB | 1 | PCB Mount | 16mm |
| 500kA | 1 | PCB Mount | 16mm |
| 1MB | 1 | PCB-Mount, Plastic Shaft | 9mm |

**1mH inductor:**
https://www.mouser.com/ProductDetail/652-78F102J-TR-RC
This is the same one used on the VFE switching boards

---

**Si NPN:**
Peter mentions he often used BC108 for the Si transistors. He listed hFE b/w 450 and 600 with a combined total between 1000-1200 with whichever one being lower gain in the Q1 position.

http://smallbear-electronics.mybigcommerce.com/bc108c-tfk/
http://smallbear-electronics.mybigcommerce.com/transistor-bc10x-work-alike/

These are lower gain but may work fine:
http://smallbear-electronics.mybigcommerce.com/bc108b-tfk/

In my build, I used SE4002 and they sound great!
http://smallbear-electronics.mybigcommerce.com/transistor-se4002-fairchild/

---

**GE NPN:**
These were listed as either OC139 or OC140 with hFE b/w 70 and 130 and a combined total of 180-220. Again, the lower gain one in the first transistor position.

Smallbear does have a matched set of OC140 but they are expensive.
http://smallbear-electronics.mybigcommerce.com/transistor-pair-fuzz-face-npn-the-continental/

There are some non-matched NPN germaniums available as well:
http://smallbear-electronics.mybigcommerce.com/search.php?search_query=npn+germanium&x=0&y=0

I used NPN AC127 in mine. hFEs were slightly high being about 140 each. But, it worked out fine.

---

**DPDT (On/On) PCB Mount:**
http://smallbear-electronics.mybigcommerce.com/dpdt-on-on-short-lever-pc-mount/

---

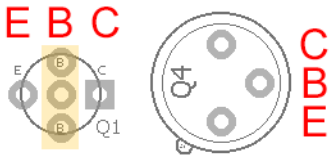
**Bourns 3362p (220k):**
https://www.mouser.com/ProductDetail/Bourns/3362P-1-204LF?qs=sGAEpiMZZMvygUB3GLcD7msVLjsDIwpw3TQu8QwHjhw%3D
https://www.taydaelectronics.com/potentiometer-variable-resistors/cermet-potentiometers/3362p/200k-ohm-trimmer-potentiometer-cermet-1-turn-3362-3362p.html

You can also use a 250k trimmer, if you have one.

---

**16mm Pots (1kC, 25kB, 500kA):**
http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-16mm-right-angle-pc-mount/

**9mm Pot (1MB):**
http://smallbear-electronics.mybigcommerce.com/alpha-single-gang-9mm-right-angle-pc-mount-w-




Just so it is totally clear, these are the pin orientations for the Si and GE transistors. For the Si, all the pads in yellow are Base. This configuration allows for different pinouts and lead styles (straight or triangle).

For the GE transistors, a TO-5 style socket will fit if you want to use one: [http://smallbear-electronics.mybigcommerce.com/to-5-transistor-mill-max/](http://smallbear-electronics.mybigcommerce.com/to-5-transistor-mill-max/)

## I will make you

This is not a VFE PCB but rather an approximation of one. Originally I planned on doing a non-VFE version of the FuzzDuo with just regular bypass switching. But, after obtaining a larger stock of the MCU I changed my mind. Instead of throwing away the work I had already done, I just re-tooled the layout into what the VFE production PCB looked like (without it being an exact layout copy). Some of the controls are in slightly different locations which is why this project has its own drill diagram. But, the circuit is 100% original to VFE.

## Bias control

The BIAS control is really interesting. Often we use a little trimmer to bias the second transistor and it is usually placed between the output cap and collector. In the Fuzz Duo it's placed in series with the 1k resistor. This means it changes the bias setting as well as adds a lot of extra volume. Pretty clever! The Bias knob may also help if your GE transistors start to heat up a drift a bit. Just reset it to your optimal sound after an hour of play :)

The bias control also behaves a little differently with the Si transistors - at CCW it gets more of the "velcro fuzz" sound. And, it changes slightly again when you combine Si and GE together. Very fun!

## Filter control

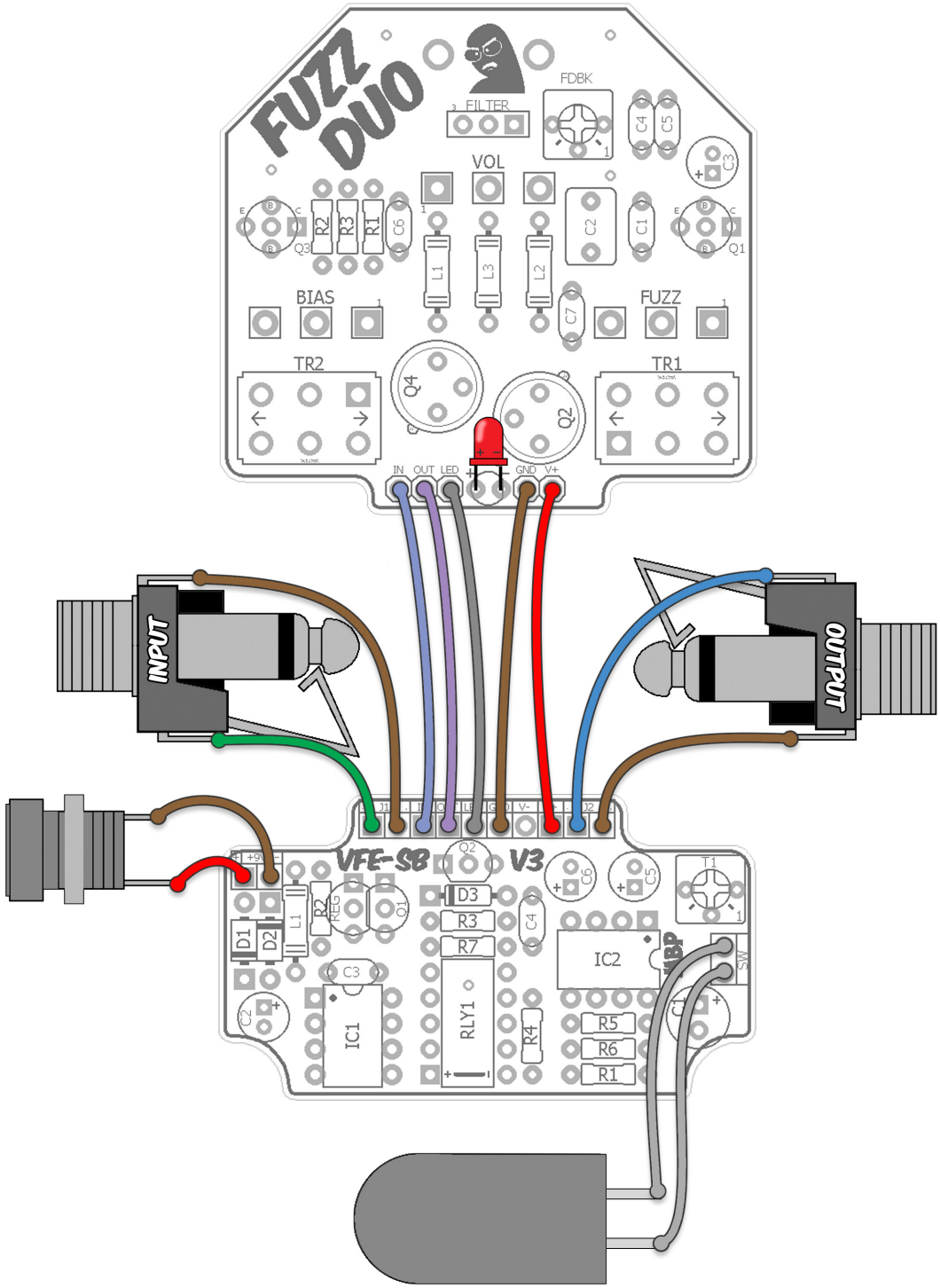
The filter pot in the stock FD was a W1MC (used in many VFE pedals). Since I ran out of these a long time ago (you cannot buy them anywhere as it is a custom order) I subbed in a 1MC first then changed that to a 1MB. Overall, I don't find the Filter control to have as much range as described. It definitely does roll off bass and gives it more mid-focus but not to the point I would consider it a "treble boost". If the lack of the original spec'd pot has an impact here I don't know: can't test it. So, I think the accurate description here is "reduces bass, more mids". Still a very helpful control. I like it best about 1/4th up.

## Build Tip

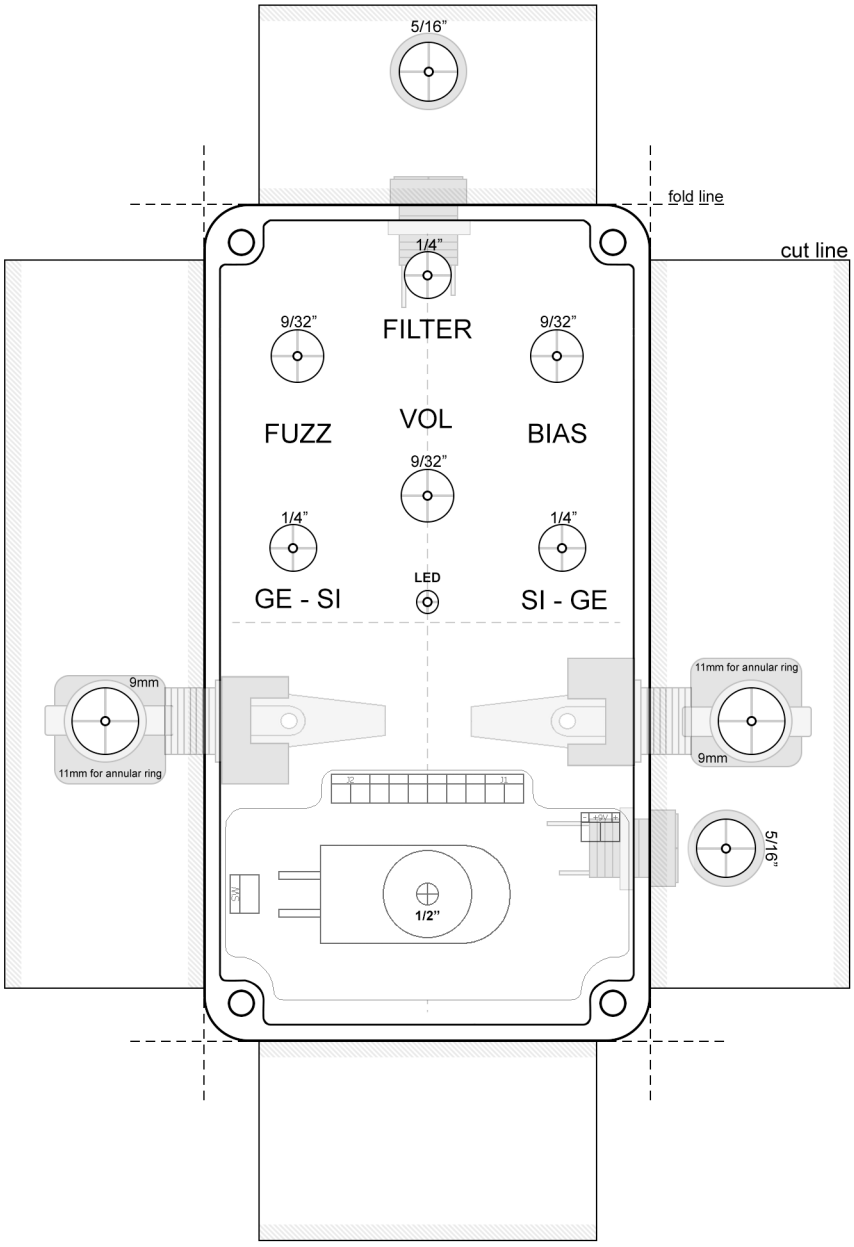
I suggest removing the inner nut of both DPDT switches and just use the lock washers only on the inside. This will help the PCB sit more evenly since the PCB mounted switch + nut tends to have more height than the 16mm pots. As an addendum, if you do this do not over-tighten the outside nut on the switches (you could damage them with no inner nut present).

## Mods

You could socket the 470R resistor to play with the bias of Q2 and Q4 more. I had a pretty good range on my build over the Bias pot but on Q4 I did notice it bottomed out at around 6v on the lowest Bias setting. Had I socketed the 470R before boxing it up, I might have tried a 1k or 1k5 there to see if I heard any difference at a lower collector voltage like 4.5v.

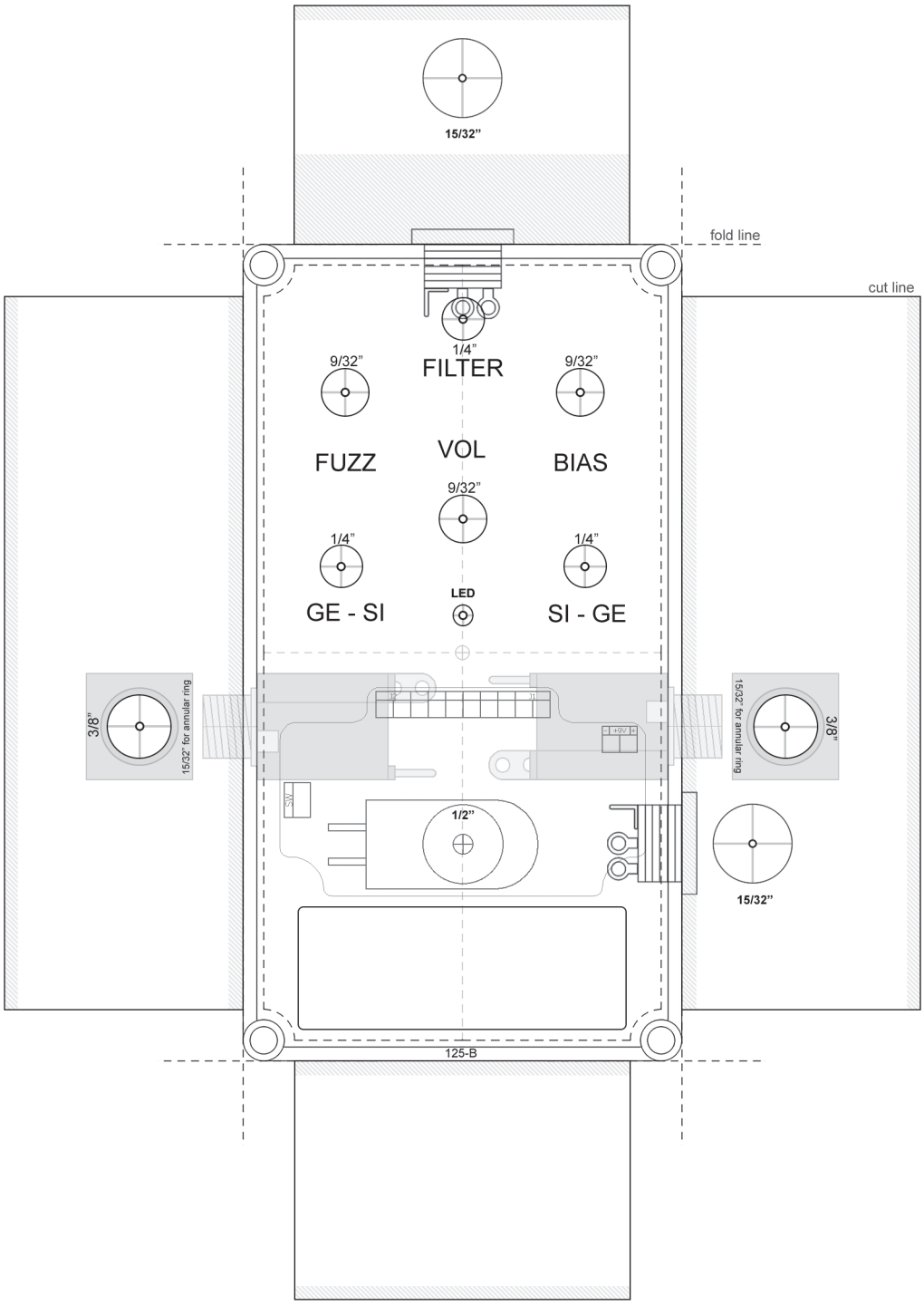

FUZZ DUO
FDBK
FILTER
VOL
BIAS
FUZZ
TR2
TR1
IN OUT LED GND V+
INPUT
OUTPUT
VFE-SB V3

**Note:** *Drill Guides are approximate and may require tweaking depending on the types of jacks, switches and pots you use.*




This diagram show two possible locations for the DC jack. Make sure you only drill one!
LED drill size will depend on your LED and whether or not you use a bezel.

**Note:** *Drill Guides are approximate and may require tweaking depending on the types of jacks, switches and pots you use.*




This diagram show two possible locations for the DC jack. Make sure you only drill one!
LED drill size will depend on your LED and whether or not you use a bezel.

Current Draw: ~11mA
DC Supply: 9.42v One Spot

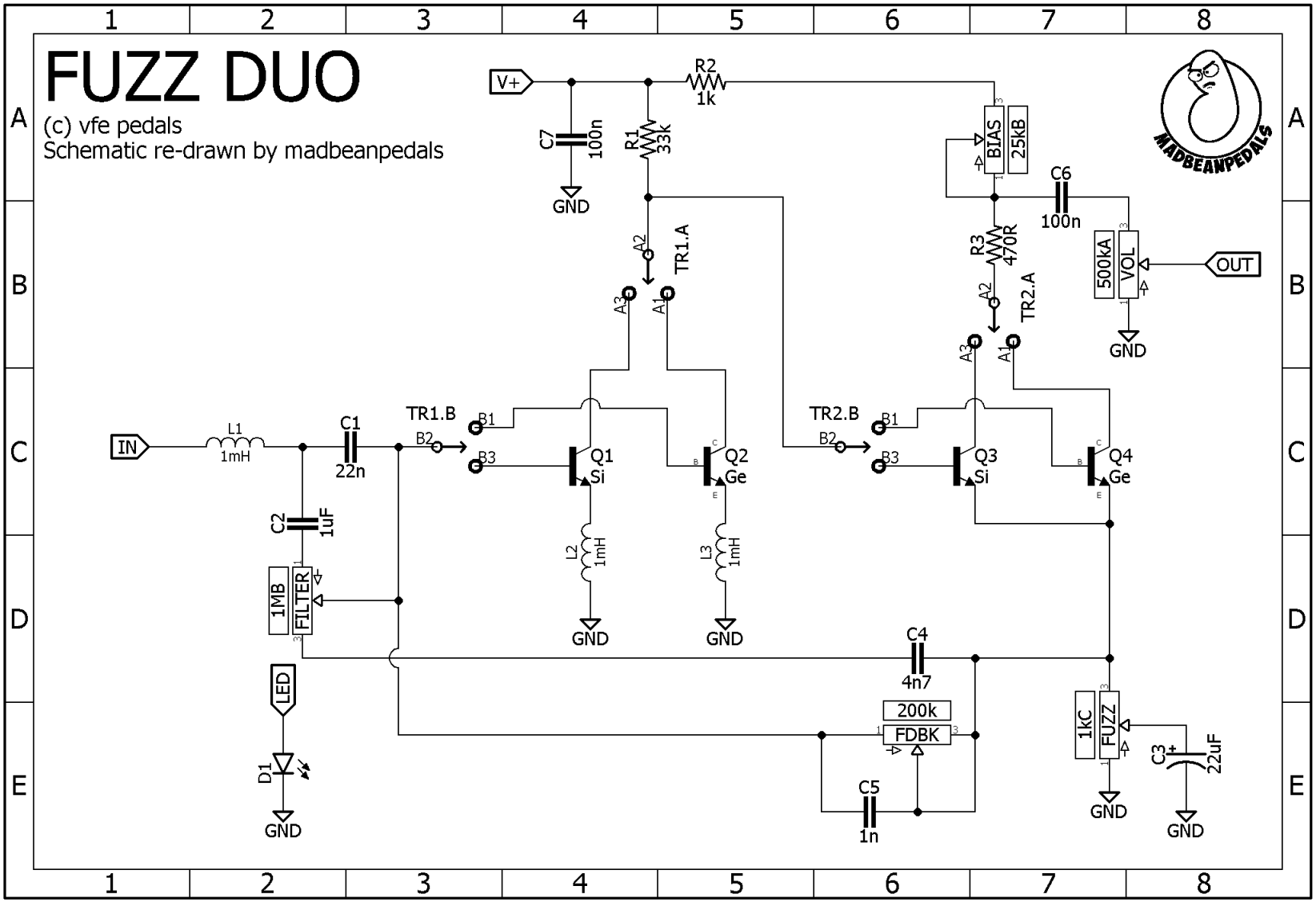
| Q1 | Si | Q2 | GE | Q3 | Si | Q4 | GE |
|---|---|---|---|---|---|---|---|
| C | 1.35 | C | 168mV | C | 0.75 | C | 7.65 |
| B | 81mV | B | 84mV | B | 1.34 | B | 168mV |
| E | 6mV | E | 7mV | E | 0.69 | E | 118mV |

**How I took these measurements:**

Fuzz, Bias and Feedback set to noon for all measurements. Since some measurements will change depending on the position of the two switches, I set both to Si when measuring Si and both to GE when measuring GE.

I am a little puzzled over the Q2 collector measurement as it seems quite low. I rechecked them several times to confirm their accuracy. To what degree that comes down to my particular AC127s or what role the inductor plays off its emitter I am not sure. But, the proof is in the pudding and it does sound like a properly biased FF in the end so I'm not too worried about it. I'll be curious to see what people read there when using other transistors.


My germanium transistors were a bit loose in the TO-5 sockets so I ended up tack soldering the Base leads of each to keep them from falling out :)


FUZZ DUO
(c) vfe pedals
Schematic re-drawn by madbeanpedals
V+
R2
1k
C7
100n
R1
33k
GND
BIAS
25kB
C6
100n
R3
470R
500kA
VOL
OUT
TR1.A
TR2.A
A2
A3
A1
IN
L1
1mH
C1
22n
TR1.B
TR2.B
B1
B2
B3
Q1
Si
Q2
Ge
Q3
Si
Q4
Ge
C2
1uF
1MB
FILTER
L2
1mH
L3
1mH
C4
4n7
200k
FDBK
C5
1n
LED
D1
1kC
FUZZ
C3
22uF
MADBEANPEDALS