VFESB_V3

FX TYPE: Bypass Switching
Used for all VFE® projects
Enclosure Size: 1590B, 1590B2 or 125B

Overview

New for ver.3

- No PCB mounted jacks (1/4” or DC).
- All parts top mounted.
- Easiest to build of all versions so far.

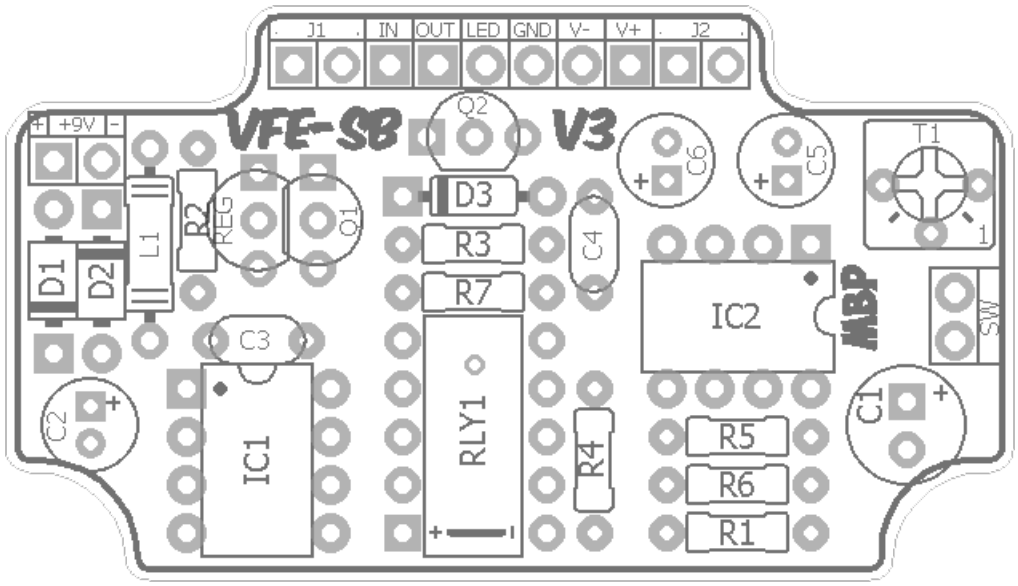
The v.3 switching board has been designed to be more easily be adopted for DIY builds than the original v.1 (which was used for production VFE pedals) and the transitional v.2 board (which was my first redesign meant more for DIY builds). I decided to eliminate all jack mounting options because it is the best option for building these projects into different enclosure sizes.

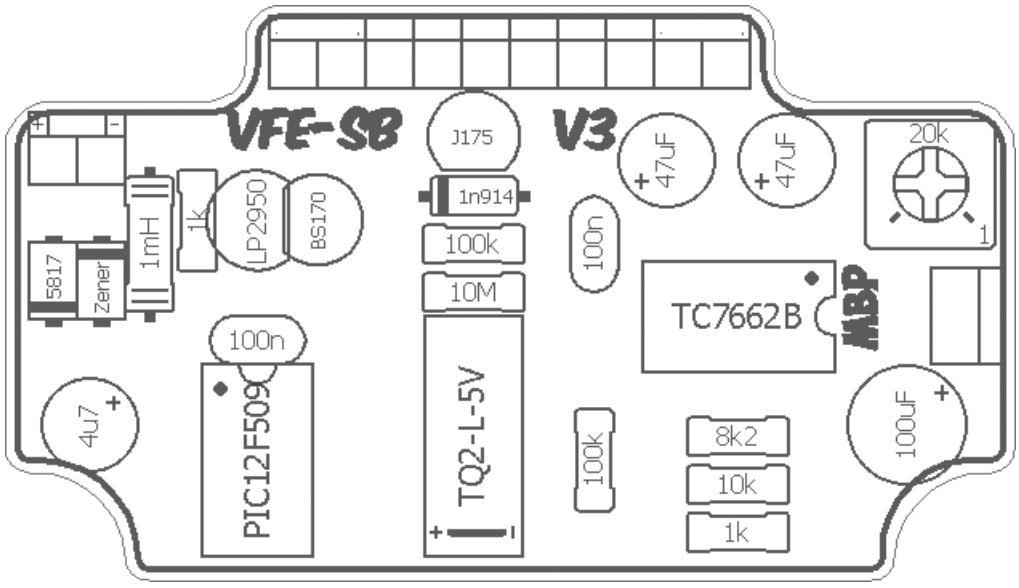
The circuit has one change: the 150uF decoupling cap used in v.1 and v.2 has been replaced with a low profile 100uF cap which is now top-mounted. 100uF is plenty enough for decoupling and the low profile caps are easily obtainable (I use them in most of my DIY builds).

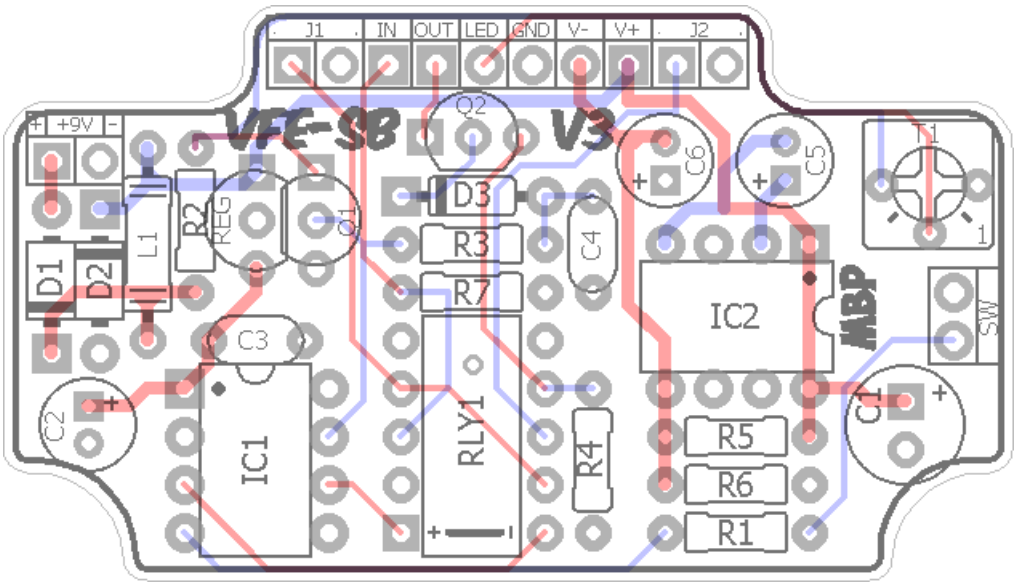
v.3 is also designed to mount closer to the bottom edge of whatever enclosure you are using. Since most of us use power supplies instead of batteries I felt this was an important change to include. However, there is an option to build the v3 board with battery option, if you must.

I do not have the code to program the micro-controllers. This is proprietary to VFE.

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.


J1
IN
OUT
LED
GND
V-
V+
J2
+9V
VFE-SB
V3
Q2
T1
C6
C5
D3
R3
R7
C4
D1
D2
L1
R2
REG
Q1
C3
IC2
MBP
SW
C2
IC1
RLY1
R4
R5
R6
R1
C1


VFE-SB
V3
J175
1n914
100k
10M
100n
47uF
47uF
20k
1
TC7662B
MBP
5817
Zener
1mH
1k
LP2950
BS170
100n
4u7
PIC12F509
TQ2-L-5V
100k
8k2
10k
1k
100uF


J1
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C6
C5
T1
1
D1
D2
L1
R2
REG
Q1
C4
IC2
MBP
SW
C3
C2
IC1
RLY1
R4
R5
R6
R1
C1

B.O.M.

Resistors		Diodes	
R1	1k	D1	1N5817
R2	1k	D2	Zener
R3	100k	D3	1n914
R4	100k	**Inductor**	
R5	8k2	L1	1mH
R6	10k	**Transistors**	
R7	10M	Q1	BS170
Caps		Q2	J175
C1	100uF	**ICs**	
C2	4u7	IC1	PIC12F509
C3	100n	IC2	TC7662B
C4	100n	**Relay**	
C5	47uF	RLY1	TQ2-L-5V
C6	47uF	**Regulator**	
		REG	LP2950
		Trimmer	
		T1	20k

Shopping List

Value	QTY	Type	Rating
1k	2	Metal / Carbon Film	1/4W
8k2	1	Metal / Carbon Film	1/4W
10k	1	Metal / Carbon Film	1/4W
100k	2	Metal / Carbon Film	1/4W
10M	1	Metal / Carbon Film	1/4W
100n	2	MLCC	16v min.
4u7	1	Low Profile Electrolytic	16v min.
47uF	2	Low Profile Electrolytic - LOW ESR	16v min.
100uF	1	Low Profile Electrolytic	16v min.
1N5817	1		
Zener	1	*see chart for values	
1n914	1		
1mH	1		
BS170	1		
J175	1		
TC7662B	1		
TQ2-L-5V	1	4.5v or 5v version can be used	
LP2950	1	LM78L05 can be used	
20k	1	Bourns 3362p	
PIC12F509	1	*included with project	

*used in all builds

**used in split-rail builds

***used in the Choral Reef

Zener Chart	
18v	Alpha Dog, Blues King, Distortion3, The Scream
16v	Blueprint, Bumblebee, Choral Reef, Dark Horse, Fiery Red Horse, Focus, Fuzz Duo, IceScream, Mobius Strip, Old School, Pale Horse, Springboard, The Triplet, Triumvirate, White Horse
13v	Merman

Split Rail Projects
Blueprint, Bumblebee, Dark Horse, Focus, IceScream, Mobius Strip, Pale Horse, Springboard, The Triplet, Triumvirate, White Horse

These are the zeners used in VFE builds for over-voltage protection.

As with previous versions of the switching board, I have created a Mouser cart for all components used.

https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=527e7faced

NOTE: This cart includes every option, including the different Zeners. You will want to delete whichever parts you do not need for your build.

Additional parts needed

Momentary Switch:
https://lovemyswitches.com/spst-momentary-foot-switch-normally-open-soft-touch/
http://smallbear-electronics.mybigcommerce.com/momentary-spst-no-soft-touch/
http://smallbear-electronics.mybigcommerce.com/110-pm-off/
(the last one is expensive but is the same one used on production VFE pedals)

DC Jack:
http://smallbear-electronics.mybigcommerce.com/dc-power-jack-all-plastic-unswitched-2-1-mm/
http://smallbear-electronics.mybigcommerce.com/2-1-mm-all-plastic-round/

Enclosed Mono:
http://smallbear-electronics.mybigcommerce.com/1-4-in-mono-enclosed-jack/
http://smallbear-electronics.mybigcommerce.com/1-4-in-mono-enclosed-switchcraft-111x/

Lumberg Mono:
http://smallbear-electronics.mybigcommerce.com/lumberg-1-4-compact-shrouded-mono-jack/

Switchcraft:
http://smallbear-electronics.mybigcommerce.com/1-4-in-mono-switchcraft-11/

Plus, whatever type of LED you like for your builds.

The Basics

The VFE Switching Board and micro-controller are included with all the VFE projects available from madbeanpedals. This switching scheme employs “soft bypass”, meaning a momentary normally open SPST foot-switch is used in place of the ubiquitous 3PDT. This offers some advantages:

- SPST momentary switches and relays generally have much lower failure rate than the 3PDT.
- It’s easier to actuate than a latching bypass.
- Nearly silent operation (no more mechanical “pops!”).
- Secondary “momentary” function.

The switching scheme utilizes a pre-programmed micro-controller to actuate a DPDT relay. This relay handles I/O functions for the (separate) audio effects boards. Therefore, the Switching Board must be wired to an audio board to complete the bypass switching for the effects.

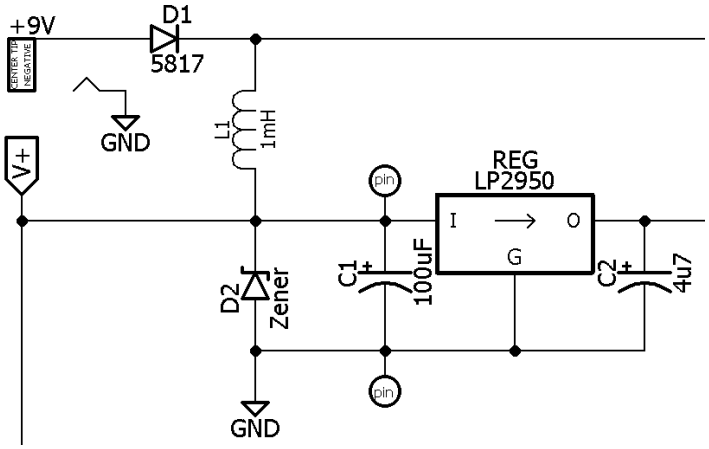
VFE has also gotten very clever; in addition to the components necessary to operate the switching, other circuitry is included. These are power filtering for DC supply, an optional charge pump (since many of the VFE effects use a split-rail power supply), effect input and output pull-down resistors. This greatly simplifies the design of the individual audio boards in each project since the common portions to all audio effects are handled by the Switching Board.

- The BOM lists TQ2-L-5v as the relay in this schematic, but VFE used the TQ2-L-4.5v as well. According to Peter both work fine but he tended to use the 4.5v relay. The 5v is listed in the Mouser BOM because it is more regularly stocked.

How to finish a VFE Pedal build - Peter Rutter
https://www.youtube.com/watch?v=vAvK-yB_29M

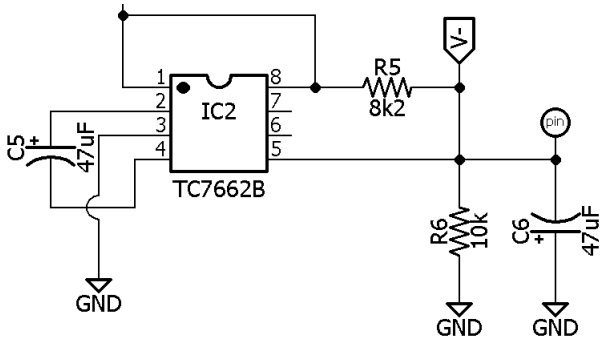
This video shows how Peter built production VFE pedals so it is not as relevant to the v.3 switching board. However, you may find other useful info in it.

I Give You Infinite Powers



The DC Jack inserts into +9v. Power is reverse-polarity protected via D1. It then passes through a 1mH inductor which creates a low pass filter with the C1 decoupler. This helps reduce noise and minimize ripple on the DC power (additional 100n decoupling caps are used on the audio boards). A Zener diode is included to prevent over-voltage to both the audio PCB and the 7662 inverter (when used). The Zener value depends on which audio circuit is being built.

The power splits in two different directions: one goes to the audio board (V+) and the second to the 5v regulator (LP2950 on the switching board). This regulator powers the micro-controller, which in turn activates the coil on the relay. It is decoupled with a 4u7 electrolytic and 100n MLCC.

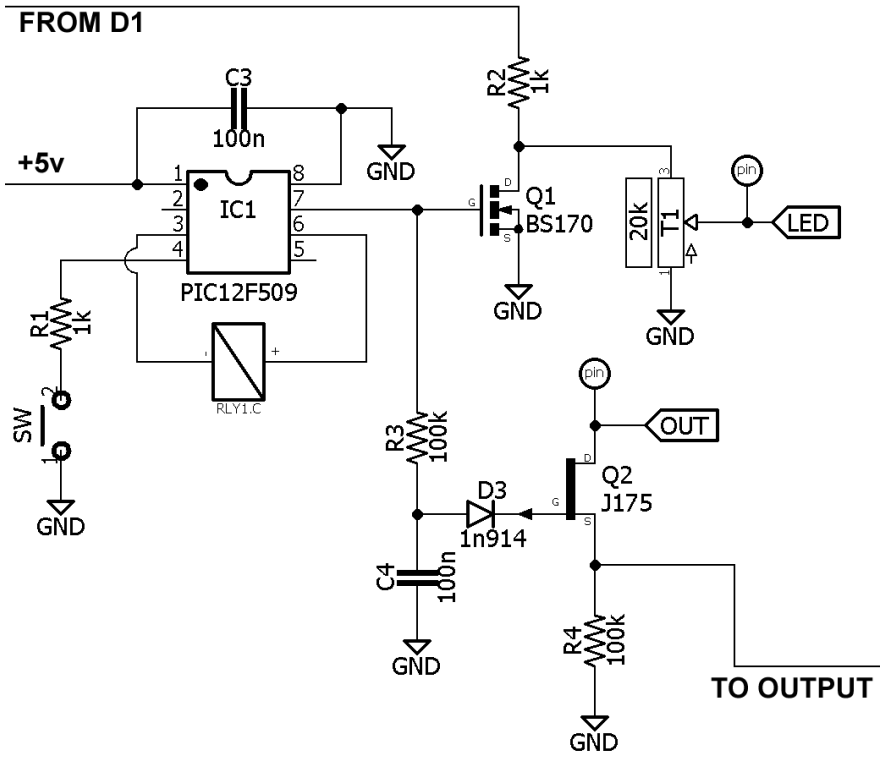


For audio effects that use a split-rail design, a 7662 is used as an inverter. The filtered DC is connected to the 7662 at pin8. Pin1 is shorted to pin8 to utilize the on-board frequency booster. This keeps the internal oscillator of the 7662 out of the audio range. Pin5 outputs a negative voltage (V-) and is decoupled with a 47uF cap (C6). The second 47uF cap (C5) is used to charge up the voltage inversion within the 7662.

In the Choral Reef the following exceptions are applied

- R5 (8k2) and R6 (10k) are only used in the Choral Reef. These resistors are left off in all other VFE projects.
- IC2 AND C5 are also left off in the Choral Reef.
- C6 is still used, but it should be installed backwards. IOW, the + side of the cap goes to the round pad on the PCB and the – side to the square pad on the PCB.
- The V- pad on the switching board is still wired to the V- pad on the Choral Reef audio board. But, in this case it carries approximately +5v to the Choral Reef audio board instead of -9v that we would have when using the charge pump. This is to give the CF board a separate bias rail it needs to operate properly.

Controllers, Coils and Things



The 5v tap connects to the micro-controller (IC1: PIC12F509) for power. The relay coil (TQ2-L-5v) connects to pins 3 and 6 on the PIC. Pin4 of the PIC connects to ground via a 1k resistor and momentary switch. When the momentary switch is depressed, the PIC “reads” that input and sends a voltage pulse to the relay to activate the coil. This causes the internal DPDT of the relay to flip states (between bypass and effect in our case).

A couple other things happen at the same time when the switching engages.

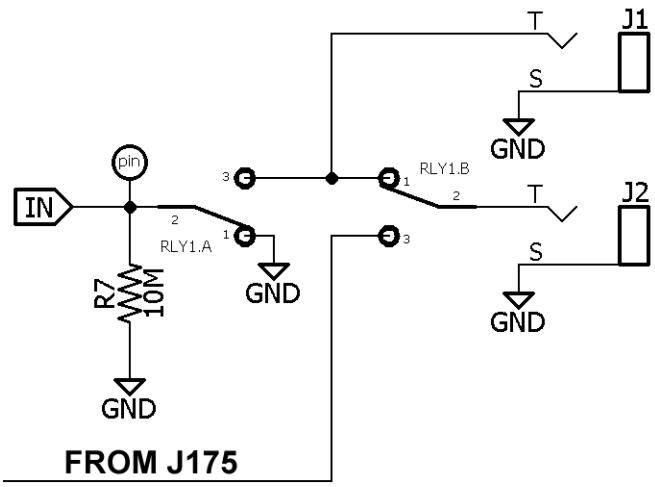
(Pin7 of the PIC is 0v in effect mode, 5v in bypass mode)

- When the relay is in bypass-mode, pin7 of the PIC puts out a continuous 5v which is applied to the gate of Q1. This grounds the power rail created by R2 to turn off the bypass LED by using the mosfet as a switch. IOW, the nominal state for the LED is on and the mosfet “interrupts” (grounds) the power to the LED on bypass. The 20k trimmer is for the user to control their preferred LED brightness.

- Q2 is used as a variable resistor. In effect-mode, pin7 grounds the gate of Q2 and the resistance between the drain and source is on the order of 120 Ohm. This acts as a small series resistance for the audio output and R4 behaves as output pull-down. From there, the audio output goes to the output jack.

- In bypass mode, pin7 switches to 5v and the resistance between drain and source on Q2 goes to its nominal value (infinite for argument’s sake). This mutes the OUT signal as the DPDT switches back to bypass-mode to prevent any noise from going to the output jack. When it goes back to effect mode, the 100k resistor (R3 grounds and the 100n cap begins to discharge. The slower discharge from the 100k/100n time constant may help create more consistent on/off action in the momentary mode (my guess).

Whar Signal Goes? Whar??!!!



The Switching Board utilizes an effect-input grounding scheme. IOW, when the audio circuit is bypassed its input is grounded. A 10M pull-down is used in all VFE projects.

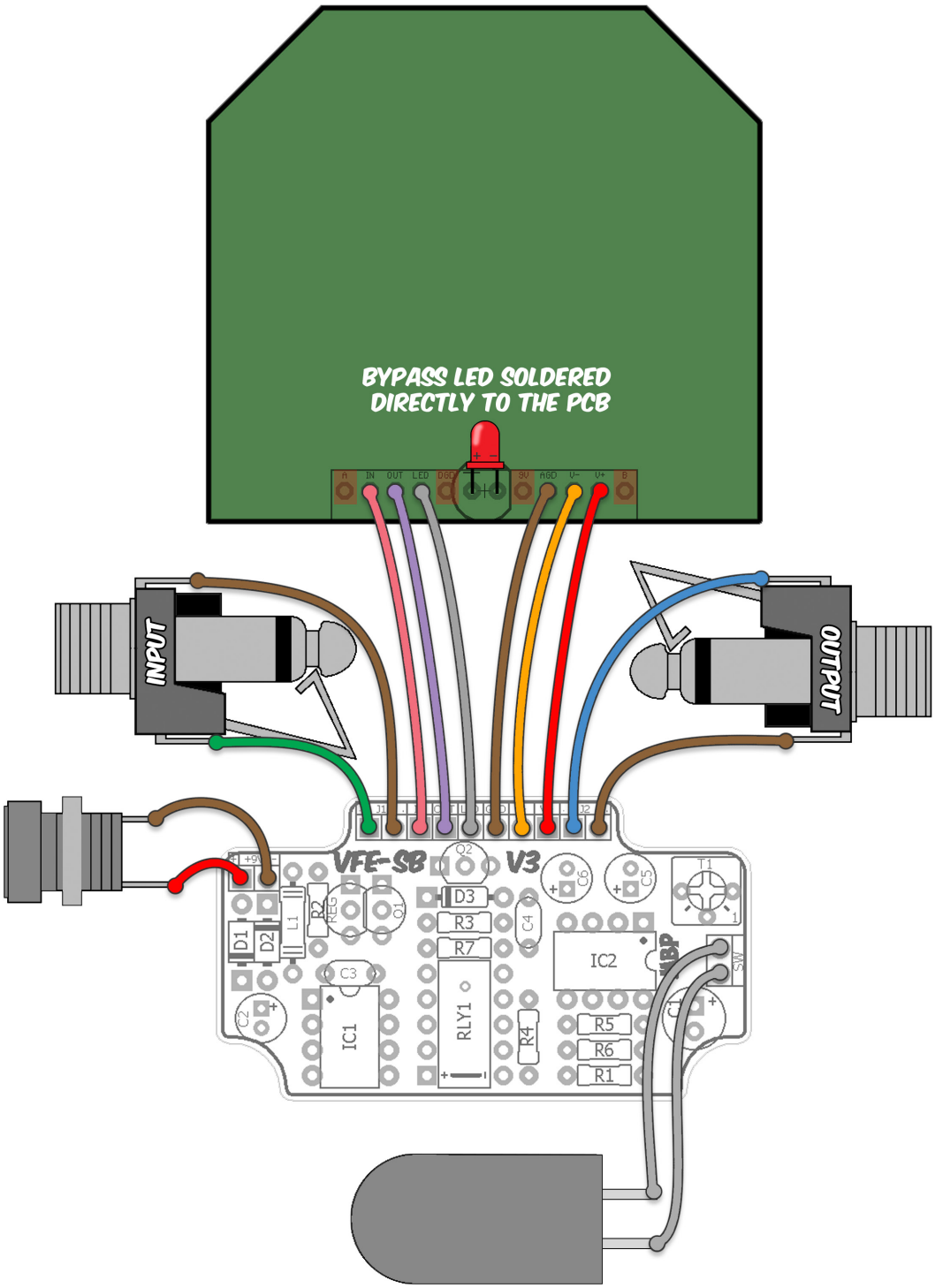
So Good, You Bought It Twice

The Switching Board has one other feature: a secondary momentary mode. In this mode, the switching behaves like a momentary on/off rather than a latching switch. Don't worry – it's still true bypass. In this mode the effect is only on while you have the foot-switch pressed.

To activate momentary mode, do not press the switch for 5 seconds. Then tap it twice quickly. Now press and hold for a few seconds until the LED starts to blink. You are not in momentary mode.

To deactivate momentary mode and go back to latching mode, do the same process again. Wait 5 seconds, tap, tap, hold. If you encounter problems switching back disconnect/reconnect the DC power.

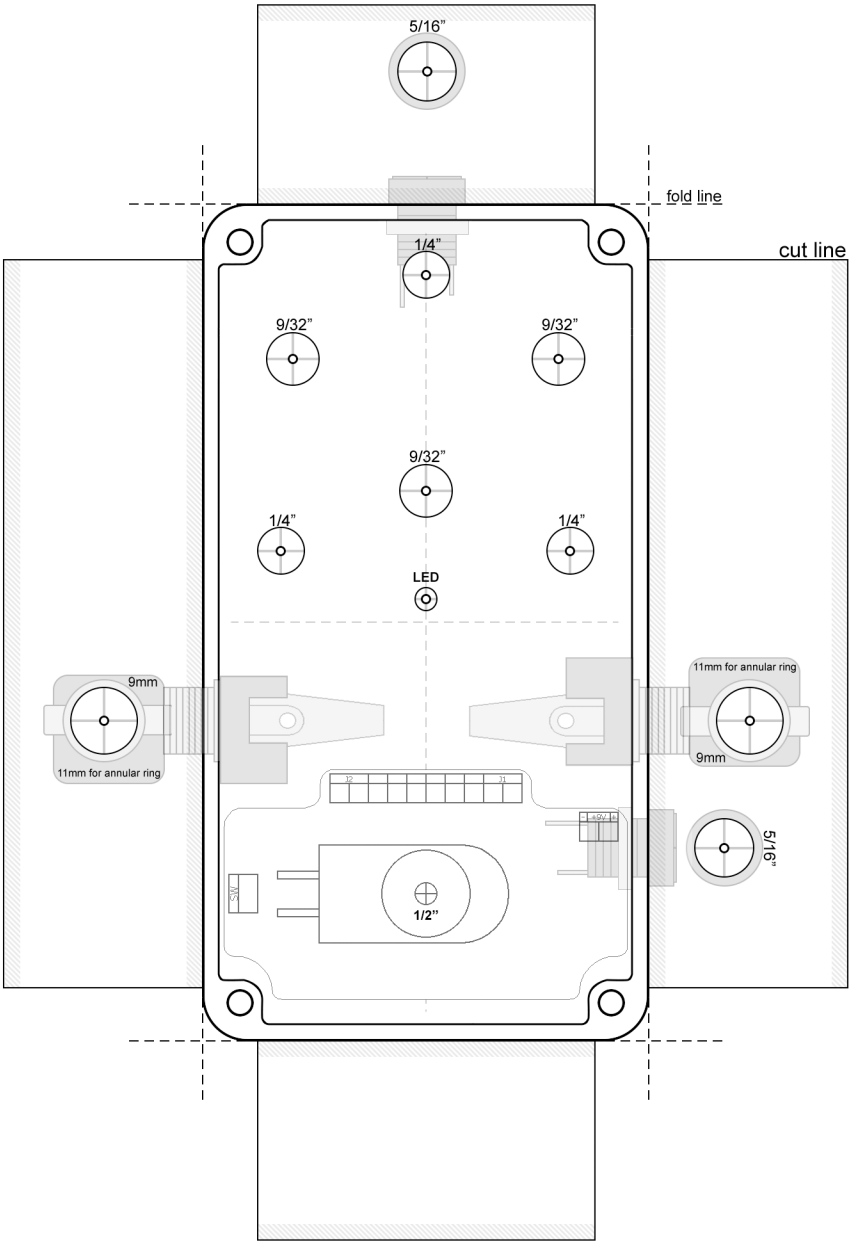
TIP: when you are in "momentary mode" and trying to switch back to latching mode make those first two "taps" very fast. If you hold them too long it won't switch back to latching mode.



The wiring shown is used for all split rail circuits (IOW, when the effect uses both +9v and -9v). For single supply rail (+9v only such as the FuzzDuo, Distoriton3, AlphaDog, etc) the same wiring is used except you will not wire the V- pads on the switching board or VFE PCB (orange wire).

In all projects, ignore the pads in the red squares. These were used for alternative wiring schemes in certain VFE customs builds, I believe.

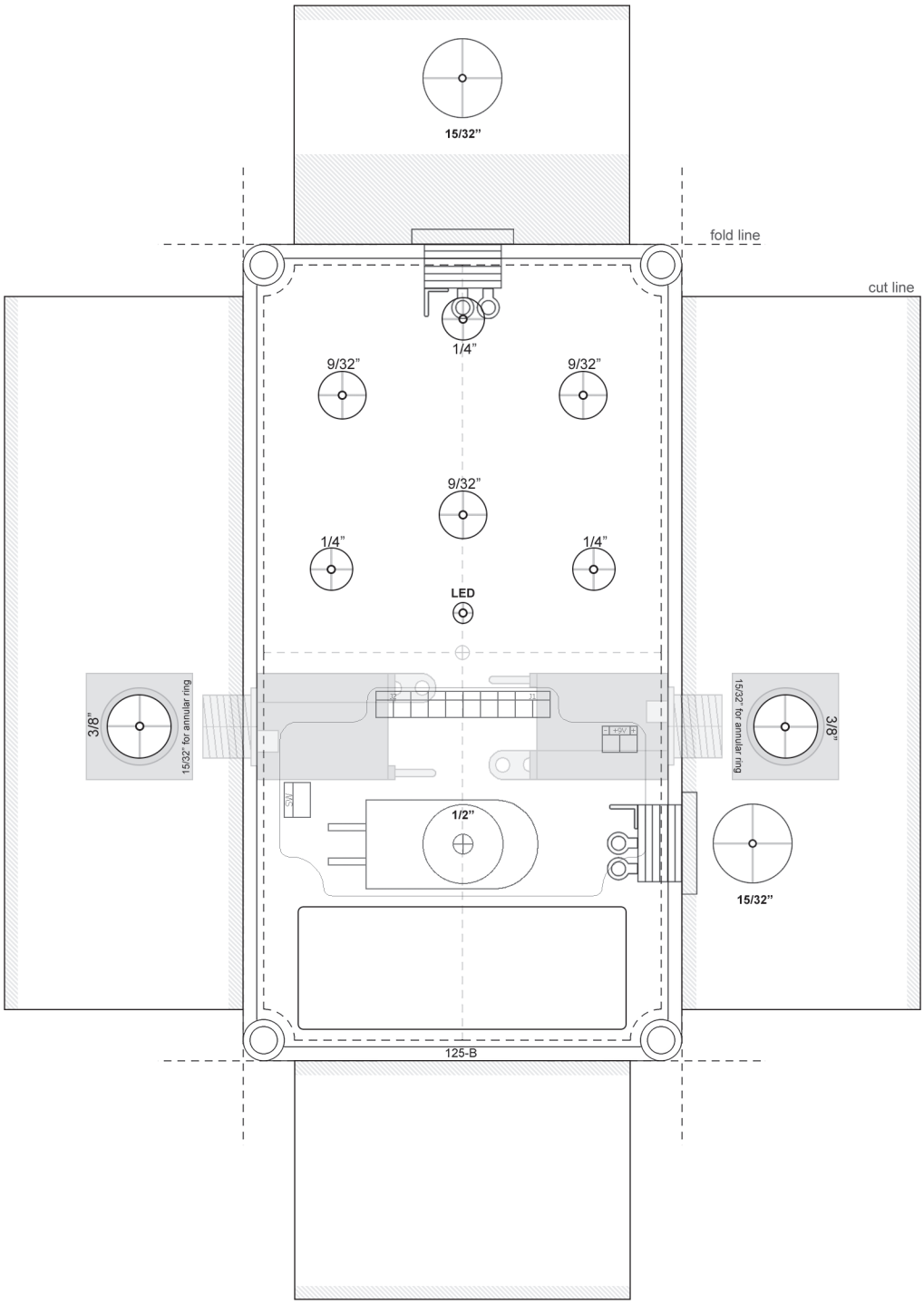
Note: *Drill Guides are approximate and may require tweaking depending on the types of jacks, switches and pots you use.*



This drill diagram covers ALL current VFE projects except the Fuzz Duo (which has a drill diagram in its project doc). I've shown drill diameters for the Lumberg style 1/4" jacks and a Thinline DC jack. You can use the same drill locations for other styles of jacks (enclosed, metal frame like Neutrik, etc) but their drill sizes will be different.

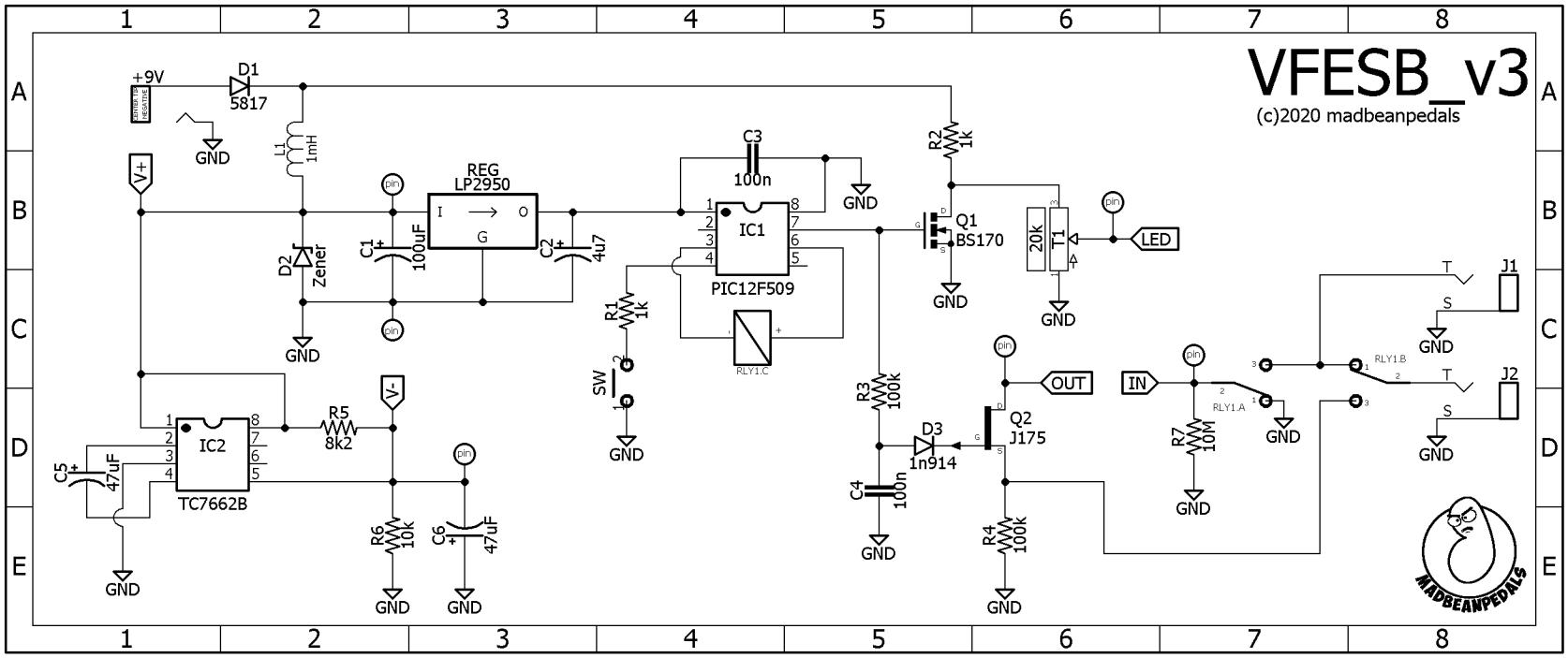
- Two possibilities are shown for DC Jack placement. Make sure you only drill one!
- The drill diameter for the LED will depend on the size of LED you use and whether or not you are using a bezel for it.
- If you want a little more wiggle room, use a 5/16th bit for the 16mm pots instead of 9/32".

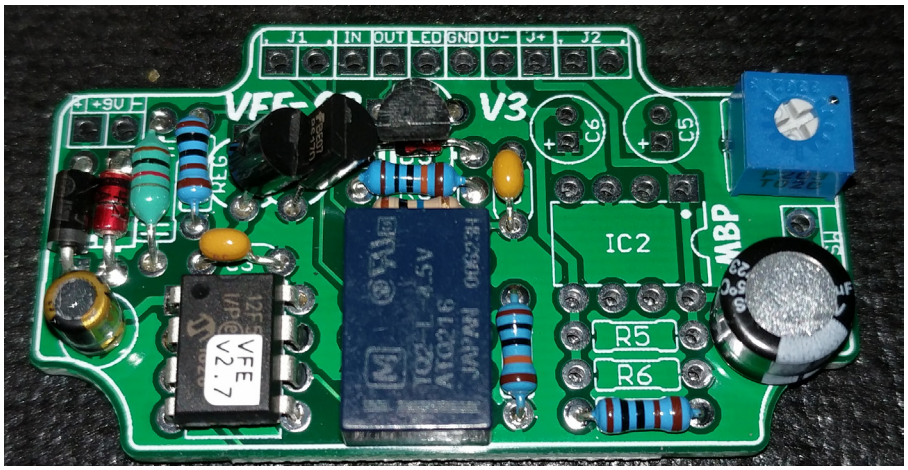
Note: *Drill Guides are approximate and may require tweaking depending on the types of jacks, switches and pots you use.*



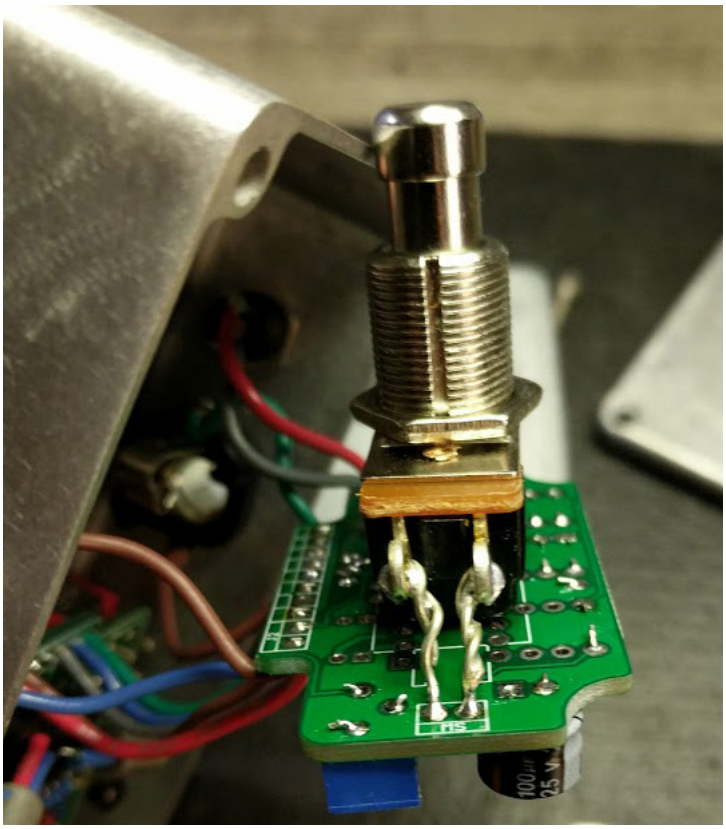
Here is a 125B drill diagram with the option for battery operation. This template has not been tested but everything should fit. Battery wiring is independent of the v3 switching board and should be done directly. If you do use the battery option, I suggest these parts:

Input jack: http://smallbear-electronics.mybigcommerce.com/1-4-in-stereo-enclosed-switchcraft-112bx/
Output Jack: http://smallbear-electronics.mybigcommerce.com/1-4-in-mono-enclosed-switchcraft-111x/
DC Jack: http://smallbear-electronics.mybigcommerce.com/2-1-mm-all-plastic-round/

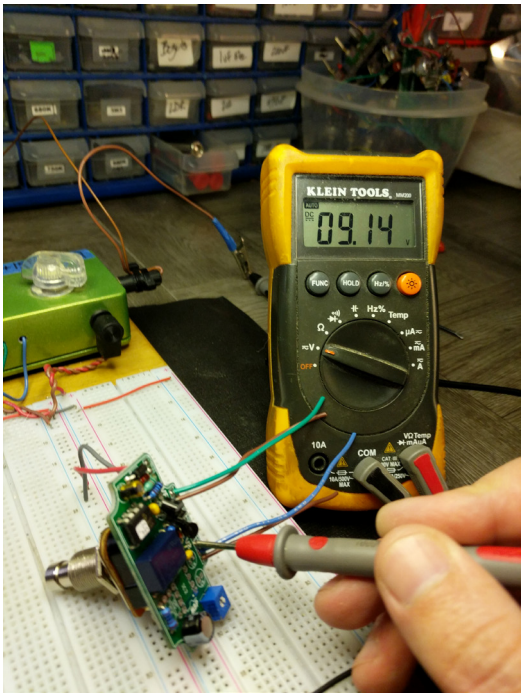

VFESB_v3
(c)2020 madbeanpedals
+9V
D1
5817
GND
L1
1mH
V+
REG
LP2950
C1
100uF
C2
4u7
D2
Zener
C3
100n
IC1
PIC12F509
R1
1k
SW
R2
1k
Q1
BS170
20k
T1
LED
R3
100k
D3
1n914
Q2
J175
OUT
IN
R7
10M
RLY1.A
RLY1.B
RLY1.C
J1
J2
R4
100k
C4
100n
IC2
TC7662B
R5
8k2
V-
R6
10k
C6
47uF
C5
47uF
MADBEANPEDALS



Start by populating your components for the particular switching scheme you need for your VFE build. This is for a single supply circuit so I have left the charge pump and associated electrolytic caps empty. The MCU should be soldered directly to the PCB (as well as charge pump when used) and the three transistors should be bent slightly down after soldering (to clear the bottom lid when in the enclosure).

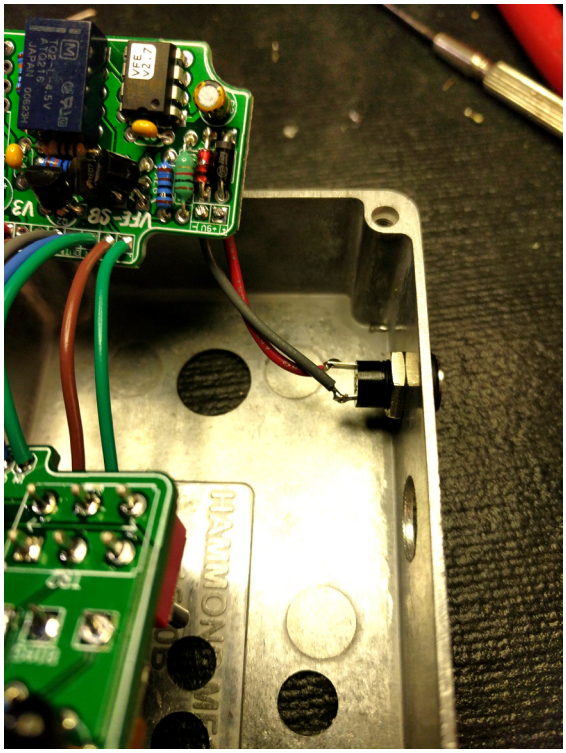


For the switch, I used some 22AWG bus wire and twisted it a bit for extra strength. This holds the momentary switch and switching board firmly in place. But, you don't need to run out and buy bus wire for this. You can use regular wire. All the wiring to this board will help keep it in place plus the enclosure lid will add a slight amount of downward pressure. Use a couple strips of double-sided tape between the board and switch as an alternative.



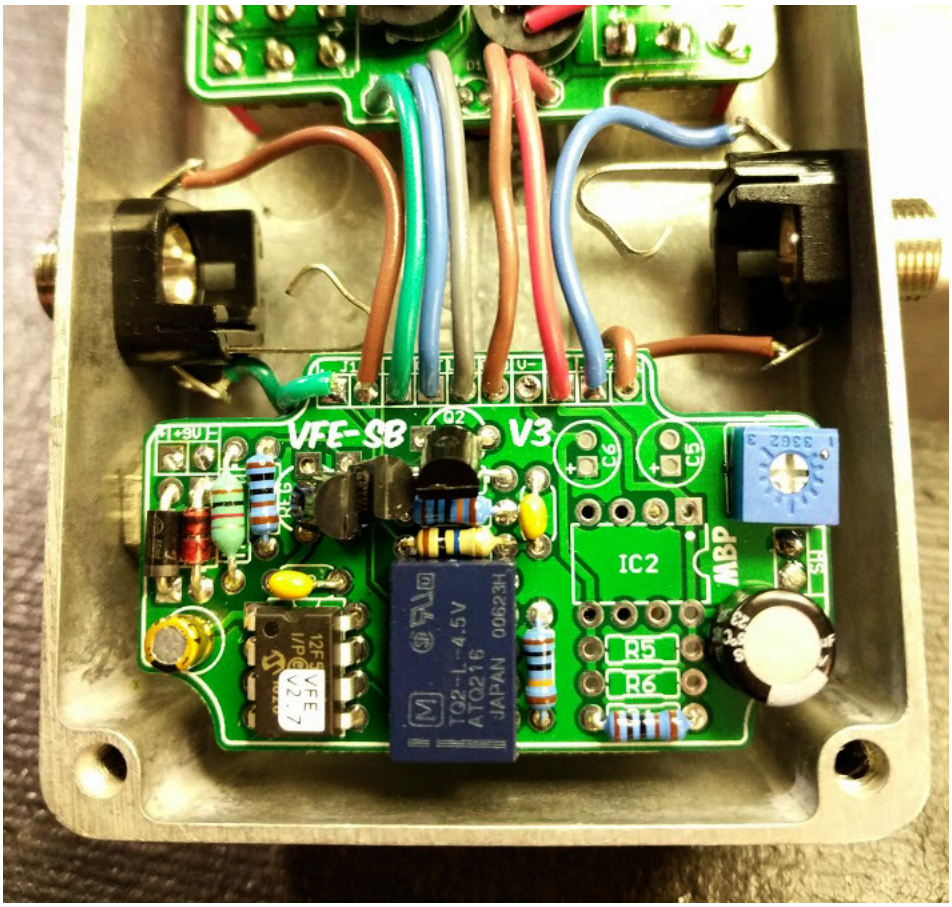
Before hooking up the switching board to any VFE PCB, it's a good idea to first do a couple of simple tests. Power it up on a breadboard and press the momentary switch. You should hear a soft click from the relay as it toggles.

Next use your multimeter to check the V+ and V- (if applicable) voltages. Here I used a One Spot which reads 9.42v with no load. So, the switching board circuit drops that about 300mV. It will drop further once it powers an effect.



After you have you have everything wired up and tested, I suggest first soldering the wires to the DC jack. This will make it much easier to load everything in. Be sure to leave some extra length on these wires so you have enough room to move things into place in the enclosure.

I bottom-soldered the DC wires on the switching board but this isn't necessary.



Make sure you leave some room between the bottom wall of the enclosure and the switching board. This will ensure the lip on the bottom lid clears the relay and can sit flush.