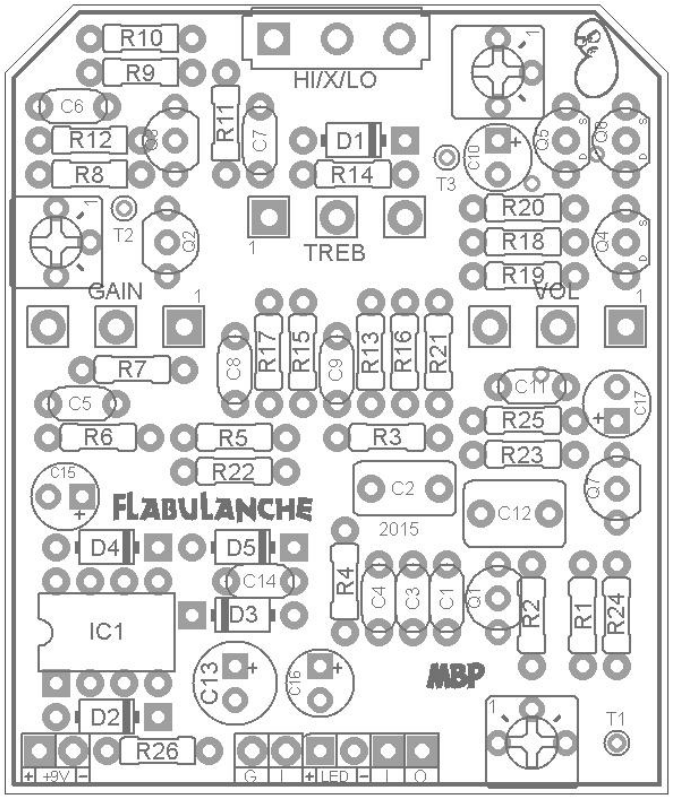
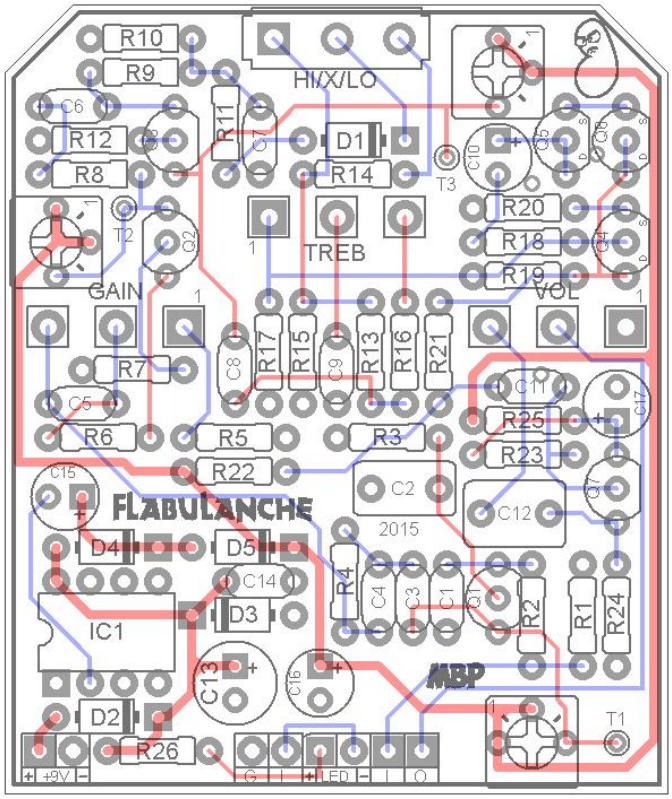
FLABULANCHE

FX TYPE: Overdrive / Compressor

Design by Jon Patton

1.95”W x 2.325”H

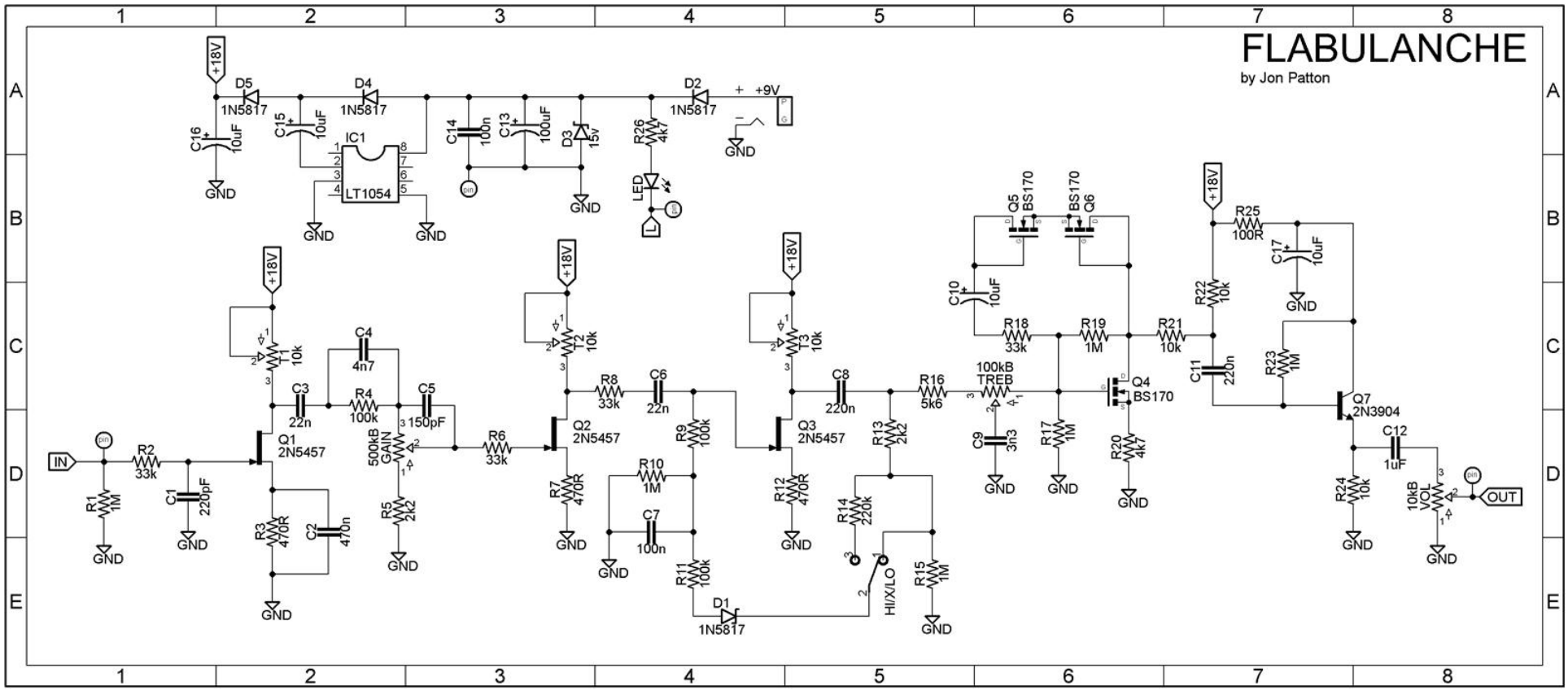




B.O.M.					
Resistors		**Caps**		**Diodes**	
R1	1M	C1	220pF	D1, D2	1N5817
R2	33k	C2	470n	D3	15v Zener
R3	470R	C3	22n	D4, D5	1N5817
R4	100k	C4	4n7	**Transistors**	
R5	2k2	C5	150pF	Q1 - Q3	2N5457
R6	33k	C6	22n	Q4 - Q6	BS170
R7	470R	C7	100n	Q7	2N3904
R8	33k	C8	220n	**I.C.**	
R9	100k	C9	3n3	IC1	LT1054
R10	1M	C10	10uF	**Switch**	
R11	100k	C11	220n	HI/X/LO	SPDT
R12	470R	C12	1uF	**Trimmers**	
R13	2k2	C13	100uF	T1 - T3	10k
R14	220k	C14	100n	**Pots**	
R15	1M	C15	10uF	VOL	10kB
R16	5k6	C16	10uF	TREB	100kB
R17	1M	C17	10uF	GAIN	500kB
R18	33k				
R19	1M				
R20	4k7				
R21	10k				
R22	10k				
R23	1M				
R24	10k				
R25	100R				
R26	4k7				

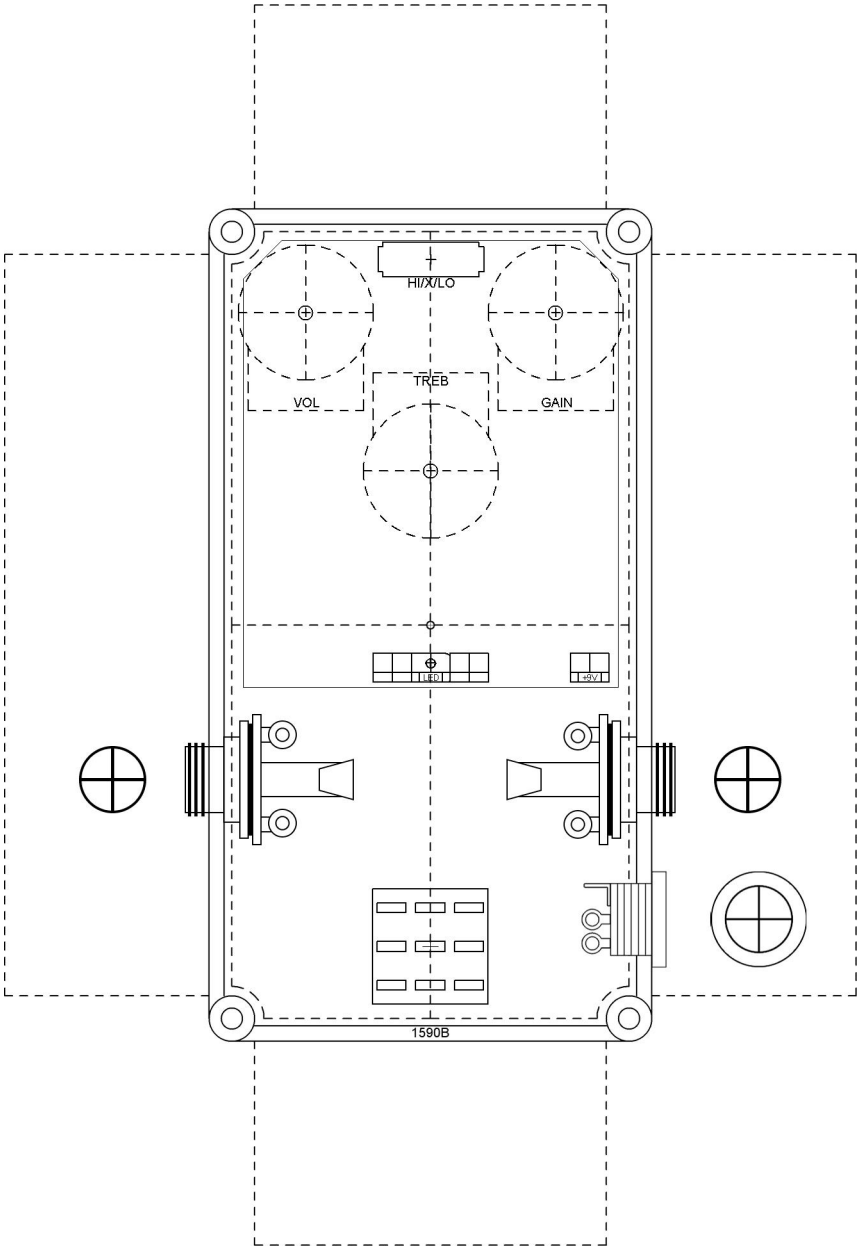
SPDT switch: **http://smallbear-electronics.mybigcommerce.com/spdt-center-off-0219b/**

Shopping List			
Value	QTY	Type	Rating
100R	1	Carbon / Metal Film	1/4W
470R	3	Carbon / Metal Film	1/4W
2k2	2	Carbon / Metal Film	1/4W
4k7	2	Carbon / Metal Film	1/4W
5k6	1	Carbon / Metal Film	1/4W
10k	3	Carbon / Metal Film	1/4W
33k	4	Carbon / Metal Film	1/4W
100k	3	Carbon / Metal Film	1/4W
220k	1	Carbon / Metal Film	1/4W
1M	6	Carbon / Metal Film	1/4W
150pF	1	Ceramic	25v min
220pF	1	Ceramic	25v min
3n3	1	Film	25v min
4n7	1	Film	25v min
22n	2	Film	25v min
100n	2	Film	25v min
220n	2	Film	25v min
470n	1	Film	25v min
1uF	1	Film	25v min
10uF	4	Electrolytic	25v min
100uF	1	Electrolytic	25v min
1N5817	4		
15v Zener	1		
2N5457	3		
BS170	3		
2N3904	1		
LT1054	1		
SPDT	1	On/Off/On	
10k	3	Bourns 3362P	
10kB	1	Short Pin PCB Mount	16mm
100kB	1	Short Pin PCB Mount	16mm
500kB	1	Short Pin PCB Mount	16mm


FLABULANCHE
by Jon Patton
+18V
D5
1N5817
D4
1N5817
D2
1N5817
+ +9V
C16
10uF
C15
10uF
IC1
LT1054
C14
100n
C13
100uF
D3
15v
R26
4k7
LED
GND
T1
10k
C4
4n7
C3
22n
R4
100k
C5
150pF
500kB
GAIN
R5
2k2
IN
R2
33k
R1
1M
C1
220pF
R3
470R
C2
470n
Q1
2N5457
R6
33k
T2
10k
R8
33k
C6
22n
R9
100k
R10
1M
C7
100n
R11
100k
R7
470R
Q2
2N5457
T3
10k
C8
220n
R12
470R
Q3
2N5457
R13
2k2
R14
220k
R15
1M
D1
1N5817
HI/X/LO
R16
5k6
100kB
TREB
C9
3n3
R17
1M
R20
4k7
Q4
BS170
Q5
BS170
Q6
BS170
C10
10uF
R18
33k
R19
1M
R21
10k
R25
100R
C17
10uF
R22
10k
C11
220n
R23
1M
Q7
2N3904
C12
1uF
R24
10k
10kB
VOL
OUT

1590B Drill Guide

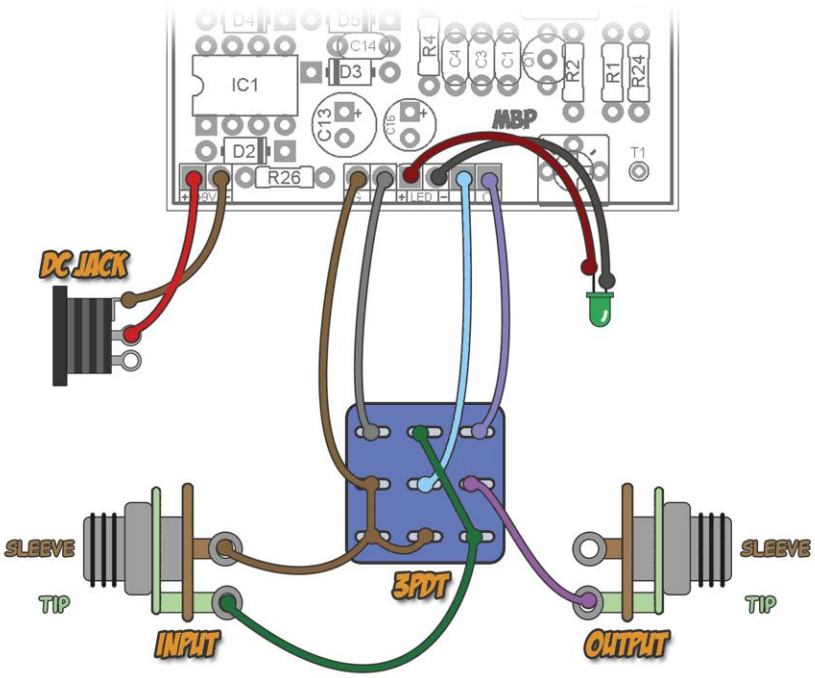
4.44”W x 6.47”H



The indicator LED can be soldered directly to the PCB. Use the drill hole indicated on the guide.

Download the Photoshop file used to make this template here:
www.madbeanpedals.com/projects/Flabulanche/Flabulanche_DRILL.zip

Wiring Guide



Overview

The **Flabulanche** is based directly on Jon Patton's "Snow Day" overdrive. His design cleverly combines different elements to emulate tube amp saturation, compression and sag. All the gain stages and compression are achieved via fet and mofet elements stacked in series. In addition to the standard gain, volume and tone controls, Jon added a mini compressor circuit to impart simulated tube amp compression. Lastly, he used mosfet clipping to emulate power tube sag.

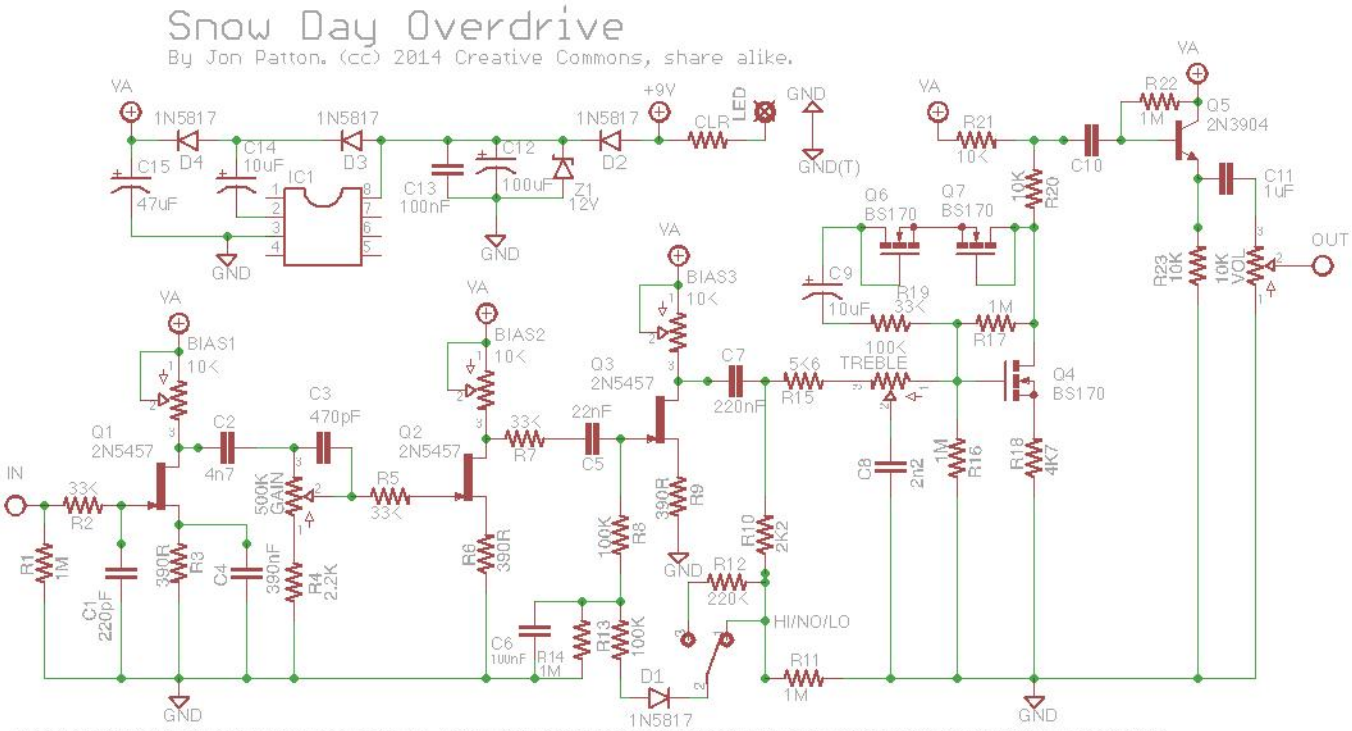
These elements combined create a rich and harmonic overdrive with some extras. It's important to understand that the compressor circuit is subtle in this particular design. It's not going to sound like an Orange Squeezer, for example. What it will do is add some roundess and richness to your guitar without getting in the way of the overdrive. The compressor essentially "blooms" notes a bit and is most useable when the gain is set between 9 and 2 o'clock. At high gain settings you will get natural compression from the overdriven FETs, much like a cranked tube amp.

Jon's original schematic and his explanation of the design can be found here:
http://www.madbeanpedals.com/forum/index.php?topic=14370.0

I am including these later in this document for ease of comparison, as there are differences in part numbering on the Flabulance as well as a few mods I've added to the design.

Several credits are necessary for the inspiration behind the Snow Day/Flabulanche
Run Off Groove's Fetzer Valve, Aquatar's "Umble" compression mod and Mark Hammer's Stupidily Wonderful Tone Control. And, of course, thank you to Jon for permission to produce this excellent circuit through madbeanpedals!

Jon's Schematic and Circuit Analysis



The Snow Day OD is a FET- and MOSFET-based amp simulation overdrive running on 18V that includes a switchable miniature compressor circuit and soft clipping in a "power tube" section. It goes from glassy "mostly" clean to either open or slightly compressed edge of breakup that feels very similar to one of my favorite amps, up to a medium gain compressed sound. It has lots of harmonics without sounding overly clipped, and a very wide dynamic range.

It uses some principles from several Runoff Groove circuits, Aquataur's mini compression circuit from his mods to the Umble, and Mark Hammer's Stupidly Wonderful Tone Control (which rolls off treble without changing the volume).

Although it's not directly based on any amp in particular and I wasn't going for a particular sound, I did have a couple amps in mind (both Deluxes -- a friend's 5E3 clone and a 1949 Deluxe at Invisible Sound Studios in Baltimore) while I was designing, aiming for a similar feel and gain level to them if not necessarily their tonality.

The pedal runs on 18V internally for a lot of drive but also a lot of headroom, making for plenty of volume dynamics even with the clipping.

How It Works

Power section

The power section is a standard voltage doubler. The additional voltage helps coax more gain out of the FETs. FETs always clip when the input signal exceeds a certain voltage, but there is a limit to the voltage gain they can provide at any given supply voltage. They also need to be biased in a particular way to ensure the correct harmonics to emulate tube breakup. (See Runoff Groove's FETzer valve article for more information on the

harmonics generated.) The higher supply voltage means that we can use 2N5457s, which have a higher input voltage threshold before clipping, while getting closer to the voltage gain of a J201 (which clips much, much sooner). This helps increase the total dynamic range of the pedal.

D2 is out polarity protection. Z1 is optional as overvoltage protection, but sometimes zeners can go bad when used with charge pumps. Otherwise the standard power filtering is there.

"Preamp"
The "preamp" section is primarily three FETzer valves in a row. Each 2N5457 is biased to 2/3 supply voltage (ended up being about 11V in mine). The bias point helps generate the correct harmonics to get the FETs sounding closer to tubes.

The gain control is right after Q1. R4 provides some minimum resistance (I didn't have room for this on my perfboard layout, but I added it to the schematic. The lowest setting will be clean even with humbuckers. Noon has a really nice edge of breakup sound -- extremely dynamic and picking attack responsive. Since the gain is simply a volume control after the first stage, rolling down your guitar's volume is pretty much identical, so the effect also cleans up nicely and smoothly.

Different FETs could be used with different results. For instance, a J201 in Q2 (with appropriate re-biasing) would be much gainier (and will also lose some clean settings). I got some good results with a 2SK170 in Q3 when using a telecaster.

Just a note: Runoff Groove's newer circuits use clipping diodes after each stage in a way that ensures smooth breakup and to avoid hard clipping the FETs, but I decided to skip that little innovation because I found they were generating clipping earlier than I liked in this particular instance.

Compression!
A miniature compressor stage, based on the one created by Aquataur for his Umble build, is created by R10-14, D1, and C6. D1 generates a negative voltage, which travels through R7 and pulls the gate of the FET negative (by about 2V at max from my measurements), dropping the input level to Q3.

The result is a bit of sag reminiscent of a tube amp at higher gain settings. The compression kicks in and becomes measurable and observable around noon on the gain dial on the "high" compression setting (at least with my strat; other guitars might trigger it earlier). There's an accompanying reduction in distortion and some added perceived sustain. The compression also swallows a bit of treble when it turns on, which creates a smoother sounding distortion sound. It also means that the effect will bright up a bit when you roll off your guitar volume, which is something I've been dying to find a way to do in overdrives that don't rely on guitar loading for a while now.

The attack time in mine is 10mS, and the decay is 100mS. The switch disconnects the compression in the center; one setting has a threshold-limiting resistor (220K) to ease things up on higher gain settings, and the other setting bypasses that resistor and lets through all of the signal.

It's worth noting that there's no capacitor to set the cutoff frequency of the compression, but I did consider adding it. Unfortunately there's only so much signal to go around, and in any case I like that the compression works more on chords (which have more bass and also need more clarity) than on single notes.

Tone (Treble) Control
The tone control, Mark Hammer's Stupidly Wonderful Tone Control, is after Q3. The pot is a continuous 100K series resistance between Q3 and Q4, and as the resistance increases between lugs 1 and 2 (pot turned clockwise), more treble is dumped through C8. The values were calculated to roll off treble starting at 15KHz down to 685Hz. It can get a little brighter and a little darker than the bypassed signal. It's not extreme (no "playing under water" sounds), but it's effective at controlling the harmonics going into the power tube section. R15 sets the highest cutoff frequency of the treble cut (combined with C8).

"Power Tube" -- Mosfet soft clipping stage

After the tone control comes the "power tube" section. This is a MOSFET amplifier with MOSFETs arranged as diodes in its feedback loop. The MOSFET amplifier part is a pretty standard way to hook it up without needing a Vb reference voltage. I used a MOSFET here because it didn't distort as much as a transistor, and it also sounded a little less harsh when it did overdrive.

I loved the sound of MOSFETs as clipper diodes in the Mossy Sloth, but the arrangement is a little different here. MOSFETs conduct in two directions when you connect the drain and gate together: One way is the body diode (a simple silicon diode -- and no, it has no special sound) and the other way is ... something special that soft clips over a very wide range of a couple volts before it finally hard clips. By connecting them in series at their source pins, the body diode in each one prevents the diode from conducting in reverse, and the result is a very high, soft clipping threshold (about 2V and up).

One last trick to soften the clipping was the use of a limiting resistor (R19) in series with the clipping arrangement, similar to how it's done in certain op amp based designs like the Bluesbreaker and AMZ's big muff mod with a "warp" control. Big thanks to tca on DIYSB for lots of help (and diagrams) in understanding this (plus he suggested the MOSFET as Q4!). Although I don't fully understand everything R19 is doing, but the gist of it is that once the diodes conduct, they appear in parallel with R17, and they will lower the negative feedback. R19 therefore helps set the clipping threshold and ALSO sets how "rubbery" the clipping will sound, AND just for good measure, also acts a bit like a clean blend. Values between 10K and 100K seemed to work with roughly similar overall results, but it's not quite as simple as a lower value = more distortion. I ended up not really being able to decide between 22K and 33K and went with 33K in the schematic simply because there were a bunch of them in the schematic already. So why isn't this a trimpot? I dunno, I guess it could be, but I'm not totally sure it's worth the trouble.

C9 sets the cutoff frequency of the clipping. It's bit enough to definitely pass all the frequencies on the guitar (and might be overkill, but I'm not sure how to calculate it). Smaller values (e.g. 1uF or 100nF) will let through more bass.

Output section

R20 and R21 form a voltage divider, like a volume control permanently set to half. Adjusting their ratio to each other can boost or cut the output. I found it was sufficient to get a small boost to output even at very low gain settings.

Voltages

Q1	vDC
D	11.5
S	0.53
G	0

Q2	vDC
D	11.2
S	0.56
G	0

Q3	OFF
D	13
S	0.67
G	0

Q3	HI
D	3.82
S	1.95
G	2.12

Q3	LO
D	4.31
S	1.88
G	1.94

Q4	vDC
D	10.75
S	3.67
G	1.6

Q5	vDC
D	10.75
G	9.3
S	10.75

Q6	vDC
D	8.7
G	9.1
S	8.7

Q7	vDC
C	17.5
B	12.9
E	13.2

Mods

In comparing the Snow Day and Flabulanche schematics you will notice some differences. These are mods that I have added to Jon's design over the course of several builds. Here's the breakdown:

- Source resistors on Q1 – Q3 were increased to the more common value of 470R (per Jon's suggestion).
- C2 was increased from 390n to 470n. This serves two purposes; the 470n is more common and the larger value in parallel with the 470R resistor shifts the center frequency of that gain stage to the lower mid-range. This felt a bit meatier and familiar since it centers on the ever popular 720Hz rather than the original 1046Hz (which is very close to the "telephone" frequency peak).
- C3 was increased to 22n and C4 and R4 (4n7 and 100k resp.) were added. Again, this serves two functions; the 100k resistor provides a bit of gain limiting from the first gain stage and when combined with the parallel cap it forms a filter to roll-off some low end (below 338Hz). I liked this mod a lot since it felt very balanced over the entire frequency spectrum to me and it should play nicely against a bass.
- C5 was decreased from 470pF to 150pF. This allows a bit more high end through when the Gain knob is turned down.
- C9 was increased from 2n2 to 3n3. Not a big change – just to provide a little extra tone roll-off when the Treble knob is all the way down.
- R25 was added to create an extra power rail for the last gain stage to ward off any potential power supply noise.

If you want to build Jon's exact design do the following:
Change the source resistors back to 390R.
Make C2 390n.
Put the 4n7 in C3, omit C4 and jumper R4.
Make C5 470pF.
Change C9 back to 2n2.
Leave R25 as is…this will not impact the tone.

Biasing

Q1 – Q3 need to biased to amplify properly.

- Using your DMM connect the black lead to ground.
- Connect the red lead to the T1 pad to measure the DC voltage on Q1's drain.
- Set this voltage to 2/3 of the supply voltage using the T1 trimmer.
- Repeat for Q2/T2 and Q3/T3.

In our case, the supply voltage is about 17.5 - 18v so 2/3 is around 12v. I ended up with around 11.5v on Q1 and Q2 from a measured 17.5v supply via the charge pump. Q3 is a little different. I found that putting the bias point slightly higher brought out the compression a bit more when the switch is set to "Hi" or "Lo". In my build, I set Q3 to 13vDC. I suggest you play with this some and see if you can hear the difference. You can always set it back to the nominal bias point if you don't like the result. You may find the sweet spot more easily if you switch the compression switch to the "Hi" (left) position while adjusting the trimmer.