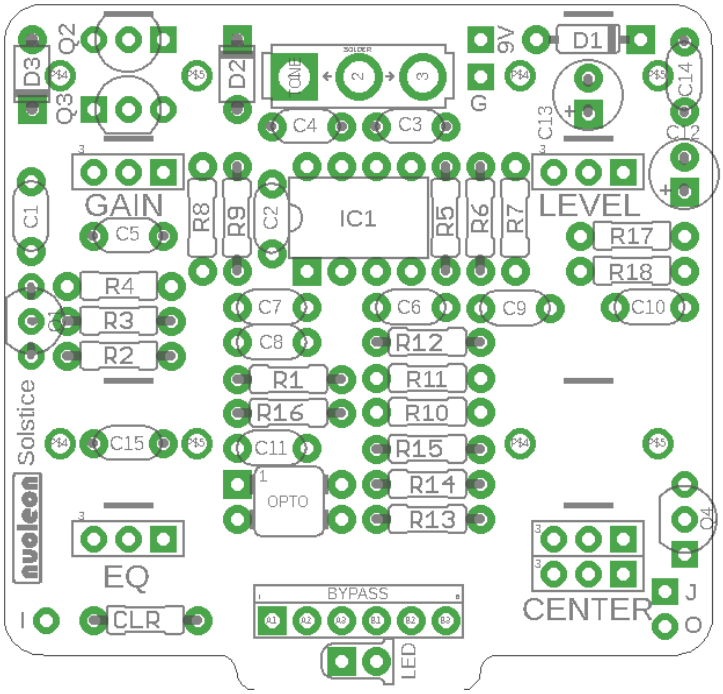
Solstice Parametric OD

Last modified: September 20 2018

The Solstice is all about versatility, packing a lot of tonal options but having a small footprint. There's a lot of possibilities to tweak to taste. It starts with a JFET input stage that can act as a buffer or a preamp that adds a bit of extra harmonic content to the break up. Then there's a very familiar drive section with LED clipping. The bass content of the clipping stage is controlled with a three way switch. This already opens up a lot of tonal possibilities. After the drive section there's a semi parametric EQ that lets you zone in to your favourite mid frequencies. Everything is rounded out nicely with an output buffer to drive the rest of your chain.



BOM

Resistors	
R1	1M
R2	1k
R3	1k
R4	6k8 - 15k
R5	10k
R6	1k
R7	1k8
R8	10k
R9	10k
R10	10k
R11	10k
R12	1k
R13	470k
R14	10k
R15	100R
R16	10k
R17	10k
R18	10k
CLR	3k3

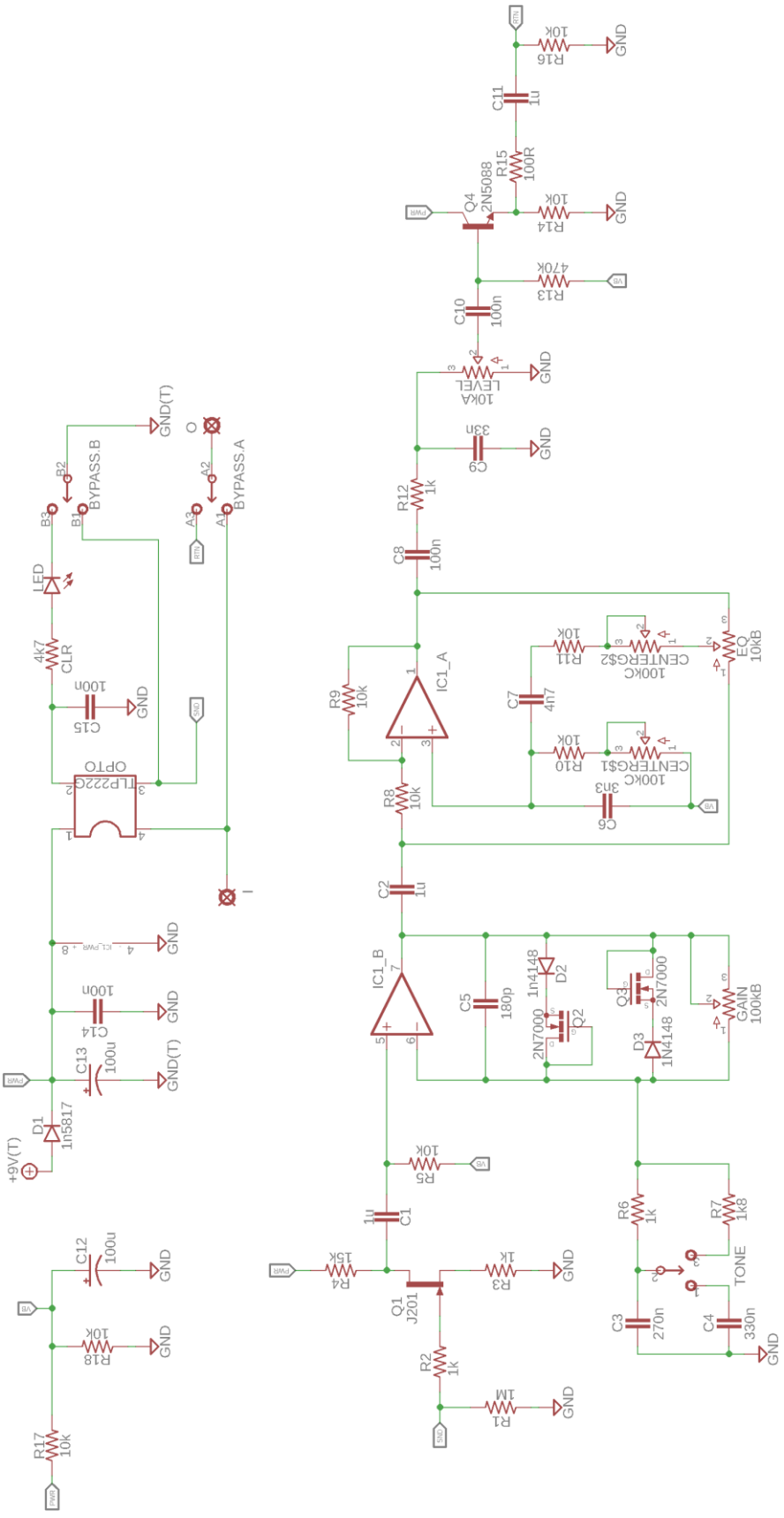
Capacitors	
C1	1u
C2	1u
C3	270n
C4	330n
C5	180p
C6	3n3
C7	5n6
C8	100n
C9	33n
C10	100n
C11	1u
C12	100u
C13	100u
C14	100n MLCC
C15	100n MLCC

Diodes and misc	
D1	1N5817
D2, D3	1N4148
Opto	TLP222G
Q1	J201 / 2N5457
Q2 Q3	2N7000 2N7000
Q4	2N5088

Controls	
GAIN	100kB
LEVEL	10kA
EQ	10kB
CENTER	100kC dual
Bypass	DPDT Stomp
TONE	SPDT Toggle (center off)
IC1	OPA2134

Don't forget to check out the notes below with suggestions to fine tune the Solstice to your personal requirements. There's a few key places that can really make a difference and are worthwhile to play around with.

Schematic


R16
10K
GND
C11
1u
R15
100R
Q4
2N5088
R14
10K
GND
R13
470K
C10
100n
LEVEL
10KA
GND
C9
33n
GND
R12
1k
C8
100n
IC1_A
R9
10k
R8
10k
C7
4n7
R11
10K
CENTER$2
100KC
EQ
10kB
R10
10K
CENTER$1
100KC
C6
3n3
C2
1u
IC1_B
C5
180p
1n4148
D2
2N7000
Q2
Q3
2N7000
D3
1N4148
GAIN
100kB
R5
10K
C1
1u
R4
15K
R3
1K
GND
Q1
J201
R2
1k
R1
1M
GND
R6
1k
R7
1k8
TONE
C3
270n
C4
330n
GND
GND(T)
BYPASS.B
BYPASS.A
LED
4k7
CLR
C15
100n
GND
OPTO
TLP222G
GND
C14
100n
GND
C13
100u
GND(T)
D1
1n5817
+9V(T)
C12
100u
GND
R18
10K
GND
R17
10k

NOTES

JFET Input Stage – Preliminaries

There are a few ways to select the parts for the JFET input stage. Specifically, selecting Q1 and R4 can have a noticable impact on the sound. It depends on how easily the stage distorts. The story on JFETs is that they bias and distort in ways similar to vacuum tubes (toobz) and thus produce a similar character. The people at runoffgroove.com have really digged into this. If you want to go ultra deep, read their Fetzer Valve article: http://www.runoffgroove.com/fetzervalve.html. Long story short: bias your JFET at about 6.5V. I look at the Solstice input stage a bit more simplistic: just a way to boost the input with some different clipping characteristics than the opamp in the main gain section.

The gain of the input stage is determined by R4 divided by R3. The other thing to consider is the transistor's bias point. For most headroom the JFETs drain (the part connected to R4) should be at about 5.5V (give or take 1 Volt). JFETS vary from device to device. It pays off to bias the particular device you have properly, though being a little off bias is no biggy. You can go quick and dirty, or be thorough. In practice, both work out fine usually.

Here is a (not complete) list of JFETs you can use in order of how easily they distort: J201, J202, 2N5457, 2N5458, 2N5458. All of these can be used in the Solstice. As you move up the list, headroom increases, distortion and gain are lowered. So in general a 2N5457 sounds less gainy than a J201. They also bias differently and both R3 and R4 influence the bias point.

JFET Input Stage – Quick and Dirty

Determine if you want the input to act more as a buffer (2N5458 or 59), a gently amplifier that only distorts when hit with the hottest of humbucker signals (2N5457, J202) or something that distorts easily even with single coils (J201). Once you've got a transistor in mind, choose a value for R4. For a 2N5457 a good place to start with is 6k8. For a J201, go with 12k. These broad strokes should get you in the ball park. If you've only got (say) a J201 but wanted only a little distortion (like 2N5457) you can bring up R3 (say 1k5 or 2k2) to bring the gain down. It's shooting from the hip but with these educated guesses you probably will have a well (enough) behaved circuit.

You can go a little further to ensure a proper setup. Solder in the JFET and R3. Apply power to the board and push a resistor into the pads for R4. Put some pressure on it with your fingers to ensure contact with the pads. Clip the black probe of a multimeter to a ground point and measure the voltage with the red probe at the R4/Q1 junction. If bias is way off select a different R4.

JFET Input Stage - Proper Biasing

If you like fooling around a bit more, set up a circuit (on a breadboard) with the JFET, R1, R2 (or jumper), R3 (1k for starters) and R4 and connect 9V and ground as in the schematic. This is enough for bias measurements. If you recreate the Solstice circuit from the input up to and including R5, you can play guitar through it and hear if and how it distorts. Measure the voltage at the junction of R4 and the JFETs drain. Adjust the value of R4 to get in the 5.0V – 6.5V ball park. Lower values of R4 raise the bias point. The J201 is the one to go for if you want to add some grit to your drive. Use the J202 or 2N5457 for a cleaner sound or 2N5458/59 to just have a lot of headroom.

Opamp

The suggested OPA2134 is an expensive bugger compared to the JRC4558 often used in TS-style overdrives. Definitely use a socket and experiment with opamps but aim for the ones that have low noise figures. TL072 and NE5532 come to mind in particular. Active EQs are noisy things and this circuit is no exception. A good quality, low noise opamp really makes a difference in how well the Solstice behaves. The OPA2134 has a very good track record here.

Calculating Frequencies

The next three sections deal with the different parts of the circuit where the frequency response of the circuit is setup and can be altered. In all these cases, a frequency f can be calculated with the following relation, where R is a resistor value and C is a capacitor value:

$$f = \frac{1}{2\pi \cdot R \cdot C}$$

Bass Content

Using a SPDT switch with a center of position gives you the ability to select three different bass responses. This can be a real powerful switch, it immediately changes the character of the overdrive from full and fat (let) to a more treble boosted sizzle (right) or in between (middle). The stock values have bass roll off frequencies at 265 Hz, 590 Hz and 917 Hz. You can tweak this to your liking by adjusting C3, C4, R6 and R7. Look at the schematic to understand what's going on. In the middle position only C3 and R6 are in the circuit. With the switch to the left, the value of C4 is added to C3 which results in a lower frequency cut off and thus more bass. With the switch to the right R6 is parallel with R7 and the total resistance of these two resistors is lowered, resulting in a higher cut off. For Tube Screamer lovers: the frequency a TS is all about is 720 Hz, which you can get in the middle position by using 220 nF for C3 (instead of the suggested 270 nF).

Parametric EQ

The EQ section has a boost/cut control and a (dual ganged) control to select the center frequency. It is based on a circuit snippet called a Wien bridge in the feedback path of an opamp. One thing to be aware of that this type of circuit will become an oscillator if the gain rises to more than 10dB. This won't happen with the suggested values but it might if you start tweaking and experimenting with the circuit a bit more, as explained below.

The center frequency is determined by a 10kΩ resistor in series with the resistance setting of the pot and the average of C6 and C7. With the suggested values this sets up a frequency range of 325 Hz to 3.6 kHz, a 1 to 11 ratio. The quality factor, or Q, is about 1.3. This means that the EQ is 'painting' with quite broad strokes (attenuating frequencies in about 75% of an octave). Moving C6 and C7 further apart around the same average frequency does two things: it increases gain and it increases Q. So there's more gain on tap (with the risk of oscillation) and the EQ section becomes more frequency specific. You can thus better zoom in on a particular frequency (range). Because the tracking of the dual gang pot won't be a 100% accurate, you can probably lower C6 or increase C7 by one part value without running into oscillation (too quickly).

High Frequency Roll Off

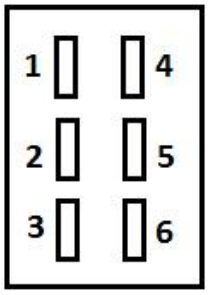
R12 and C9 form a low pass filter. With the suggested values of 1kΩ and 33nF the -3dB point is just below 5 kHz. I find this keeps unpleasant fizzy noises nicely in check without the Solstice losing its character or sounding dull. You can experiment a bit here with lower values of C9: 27 nF, 22 nF and down to 18nF (9kHz) shifts the cut off frequency. Lower than that won't make any difference. If you've got some room to spare in your enclosure, this could be a nice place for a Nucleon Capacitor mod board.

Wiring

I - tip of input jack
O - tip of output jack
J - sleeve of output jack

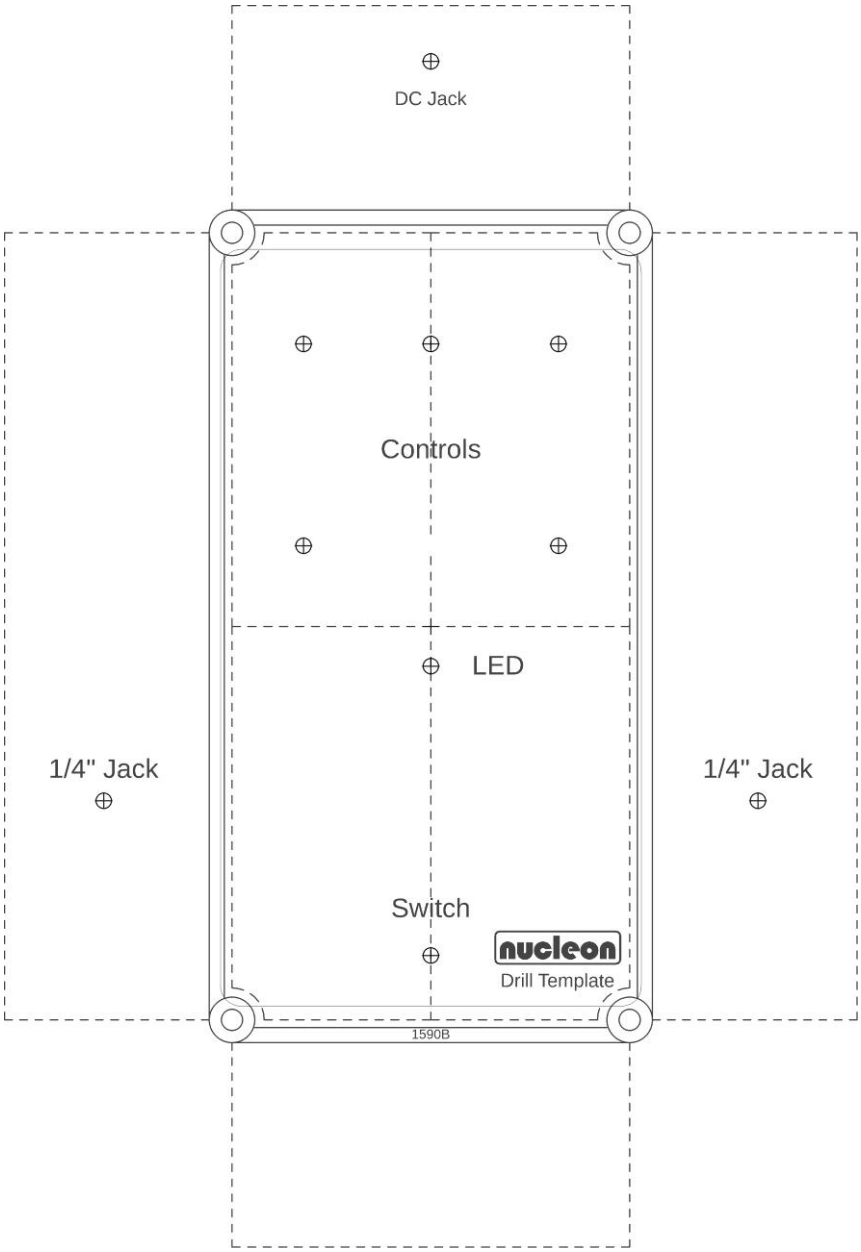
9V - sleeve of power jack
G - center of power jack

Bypass DPDT
Two sets of three (1 + 2 + 3 and 4 + 5 + 6) corresponding to columns on a DPDT switch.
1 and 4: top lug
2 and 5: center lug
3 and 6: bottom lug



For quick and easy wiring consider using the Nucleon Bypass board and a ribbon cable (0.10” spacing).

1590B Drilling template (side mounted jacks)

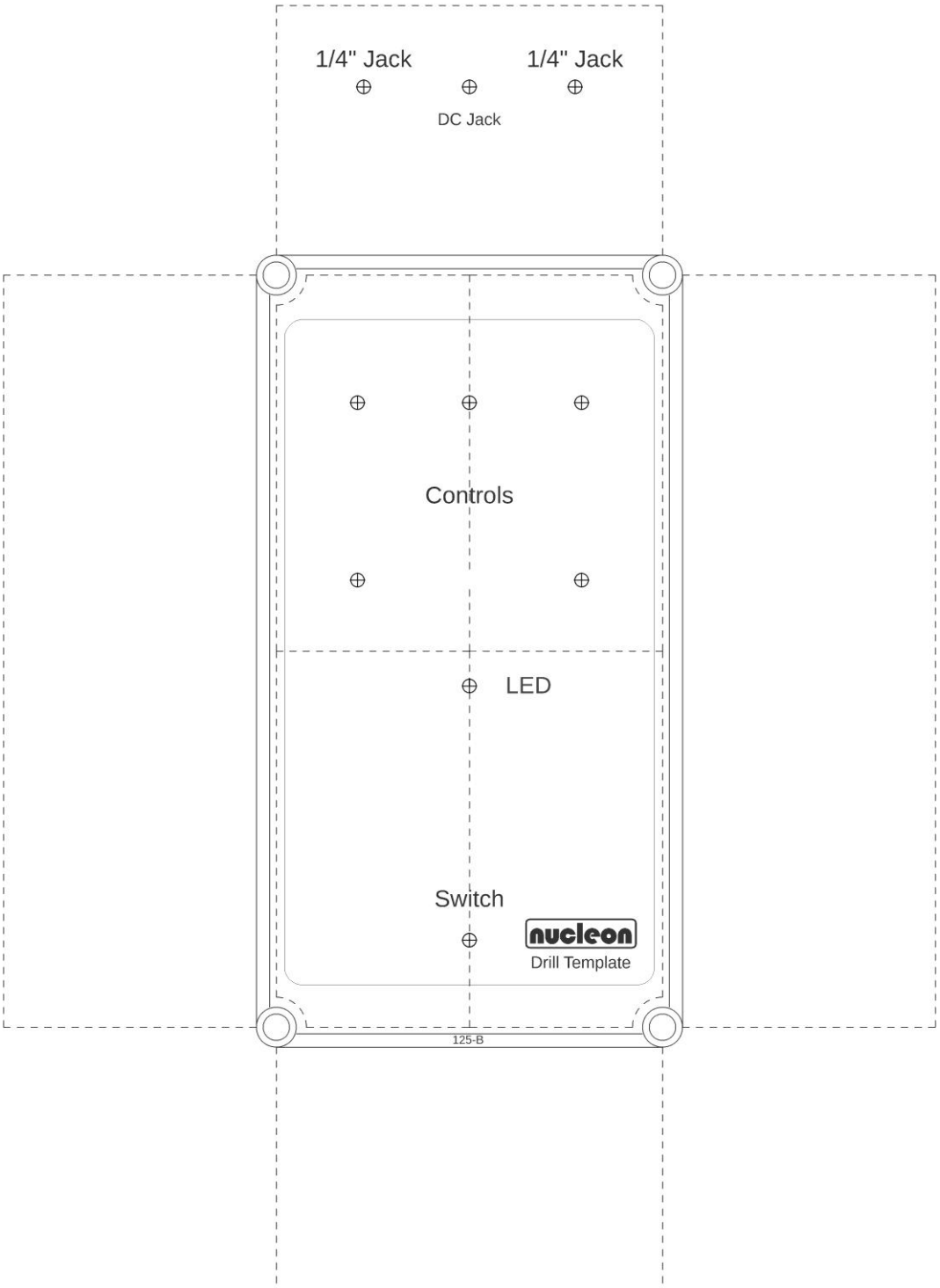


Drill Sizes

Pots: 7 mm minimum (use 8mm if you need some wiggle room)
Toggle switch: 6mm (7mm for extra wiggle room)
Jacks: 9 or 10 mm
Stomp: 12 or 13 mm (5 inches usually)
DC Jack: 7 mm (small barrel, no switch) to 13 mm (round 'Boss style' switched jacks)

125B Drilling template (top mounted jacks)

(unverified)



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