PROJECT NAME

NEUROTRON

aion DIY GUITAR EFFECTS

BASED ON
Lovetone Ring Stinger

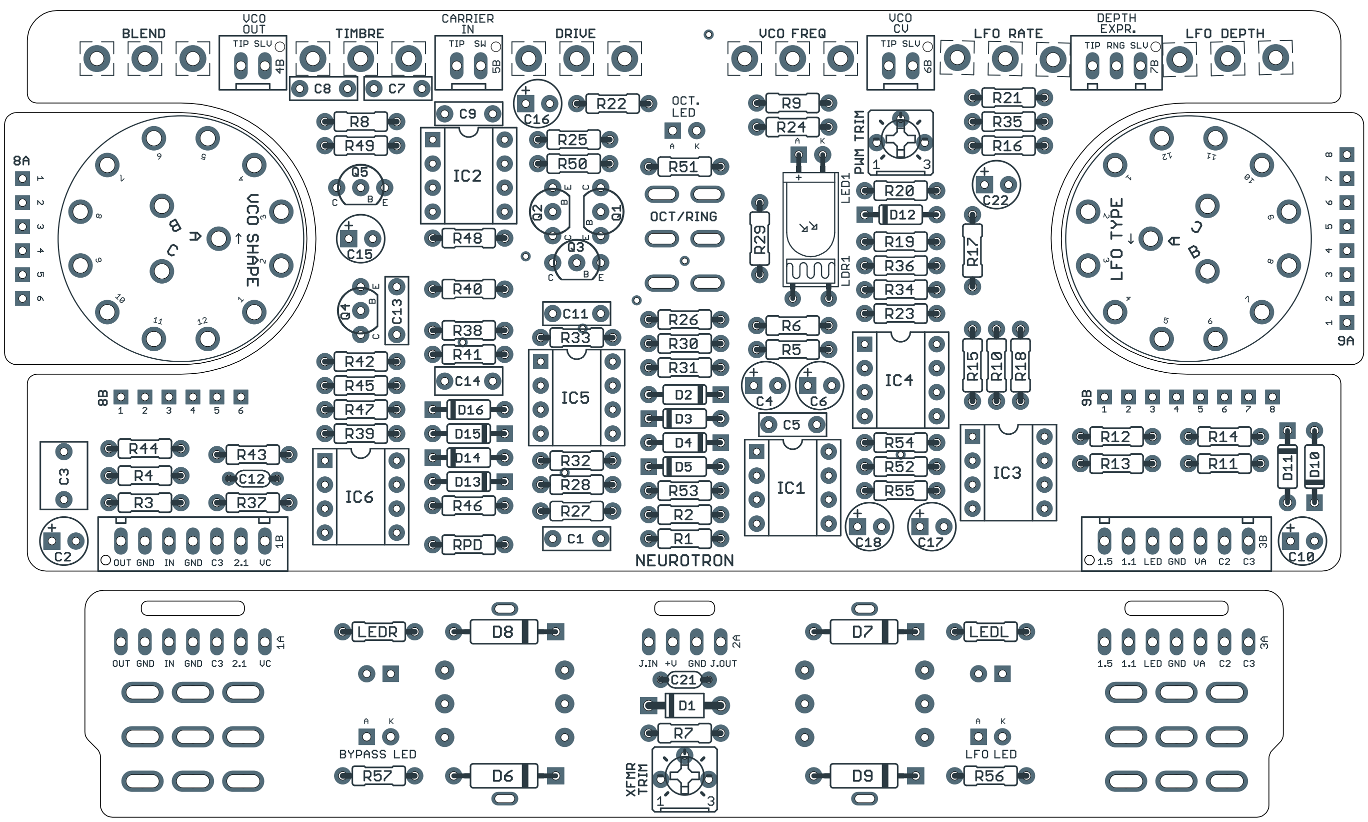
BUILD DIFFICULTY
Advanced

EFFECT TYPE
Ring modulator and octave fuzz

DOCUMENT VERSION
1.0.0 (2023-05-20)

PROJECT SUMMARY

A highly original ring modulator and octave fuzz with LFO modulation for a stunning array of tones and sound effects. Used by Johnny Marr, Billy Corgan and Ed O'Brien among others.



Actual size is 5.67" x 2.33" (main board) and 5.00" x 0.95" (bypass board).

IMPORTANT NOTE

This is a complex circuit and it takes experience and attention to detail in order to build it successfully. If you've never built a guitar pedal before, this shouldn't be your first! Please read all of the build documentation to familiarize yourself with the project before you begin. Aion FX cannot provide direct technical support.

TABLE OF CONTENTS

INTRODUCTION

The Neurotron Ring Modulator is an adaptation of the Lovetone Ring Stinger, initially released in 1998 until production ceased in 2001. It's a ring modulator in the same way that the Flange With No Name is a flanger—that is to say, there's a ring modulator at the center of it, but it's surrounded by so many other features and concepts that it bears almost no resemblance to other ring mods. (According to Dan Coggins, the designer, it was "the most bizarre pedal we ever made".)

In addition to pure transformer-based ring modulation, it also gets into octave fuzz and synth territory. The carrier wave is modulated by an LFO, and it can be used in either PWM (pulse width modulation) or FM (frequency modulation) modes. Expression controls are available for the LFO depth and VCO frequency, and it has both CV input and VCO output for syncing with other effects and external systems.

As you might have gathered by now, it's a very complex effect. Because of this, we've taken the step of recreating the original Lovetone user manual as a separate document, and the controls are only described briefly in this main build document. Keep the manual handy when using it. You really need to understand how it works in order to get the most out of it.

Curiously, the most identifiable recorded example of the Ring Stinger is not an instrument at all. On Radiohead's "Kid A" (the title track of the album), the vocals are processed through a Ring Stinger. And once you play with the pedal awhile, it's surprisingly easy to pick out what settings they likely used.

The Neurotron is a faithful recreation of the original Lovetone circuit. The major difference is that the Octave/Ring footswitch has been changed to a toggle. (More on the rationale for this on the next page, if you're curious.) We also improved the bypass method is improved from the original, which helps keep the modulation signal tamed in bypass mode, and we improved the power supply filtering, but otherwise all of the features are the same as the original.

We have also created an Interactive BOM tool for this project to help with the build process. Components are grouped by value, and you can click any component to see which other parts have the same value and where they're located. (Chrome-based browsers only)

Special thanks to Ian (LaceSensor / Gigahearts FX), the DIY community's resident Lovetone expert, for help verifying the Neurotron prototype against an original Ring Stinger for accuracy.

CIRCUIT DESIGN NOTES

Octave switch

The Neurotron's main point of departure from the original Ring Stinger was to change the Octave/Ring footswitch into a standard toggle switch, so ours has only two footswitches: LFO Unlock and Bypass.

This was a usability design decision as well as an engineering one. On an engineering level, the transformers needed to go on the footswitch board or there was no way this was going to fit in a 1590XX enclosure. In addition, the main board needed an anchor point in the middle so the PCB is securely mounted to the enclosure, since the six potentiometers are all along a single axis at the top, and the toggle switch is perfectly positioned for that purpose.

When considering usability, a cardinal rule of effects pedals is that a footswitch is not justified unless the mode has some sort of control to go along with it—for example, a gain boost with its own independent gain control that is activated with the footswitch. If the footswitched mode will always or usually need some sort of knob adjustments to dial in the right sound, then it defeats the purpose of a footswitch, which is to be able to select between two previously-dialed-in sounds in a live setting.

In the Ring Stinger, the Octave mode shares the same controls as the Ring mode, and it's very unlikely that you'll be able to have both an ideal octave tone and an ideal ring-mod tone with identical control positions. This means that a footswitch is not the right type of control for this mode change. A toggle switch is not only more appropriate but also more convenient.

With that said, you might not agree with our design philosophy! It's almost certainly possible to mount a low-profile DPDT footswitch underneath the footswitch board so it's in line with the other two switches. There is space between the transformers on the underside, and there should be enough clearance underneath the footswitch board. You can run the wires from the Oct/Ring pads and even relocate the octave LED to be closer to the switch if you'd like.

However, we want to stress that this is fully untested and we can offer no other advice other than the speculation that it can probably be done. Make sure you know exactly what kind of space you're working with before drilling. Also, make sure the main PCB is as level as possible so the rotary switch sub-PCBs are directly lined up with the corresponding pads on the main board. Without the toggle switch to act as a leveling guide, you may set yourself up for some issues later in the build.

Bypass

Like all other Lovetone pedals, the original Ring Stinger used a DPDT footswitch for bypass, with the pedal output taken from either the circuit output or the input jack.

This means that the unit is not true bypass because the input signal is always connected to the circuit input. The input stage has an impedance of around 1.1M, so loading is minimal, but by modern standards there is room for improvement. We've upgraded the circuit to use standard true bypass with a 3PDT switch, and the circuit input is grounded in bypass mode to prevent oscillation.

Some Ring Stinger adaptations have taken the additional step of disconnecting the LFO in bypass mode using the extra pole on a 4PDT footswitch. We did not find this to be necessary on the Neurotron as long as the input signal is buffered, as covered in the build notes later on. As a rule we avoid designing with 4PDT switches due to their unreliability and inconvenience of sourcing.

USAGE

The Neurotron has the following controls. Note that this is only a very high-level overview and is not a substitute for reading the full user's manual. Many of the controls have different functions depending on what mode is selected.

Potentiometers

- **LFO Depth** sets the level of effect that the LFO has in modulating the VCO signal.
  - In LFO Lock mode, it becomes a manual control, allowing fine-tuning of the VCO frequency (but only when the LFO Type is set to one of the two square-wave modes).
  - It can be set externally by connecting an expression pedal to the "Depth Expr" jack. The LFO Depth control should be set to maximum to allow the widest expression sweep.
  - In Octave mode, this control has no effect.
- **LFO Rate** sets the speed of the LFO.
- **VCO Frequency** sets the frequency of the VCO. It has no effect in octave mode.
- **Drive** sets the level of signal going into the ring mod section. In Octave mode, it acts as a standard drive control. At zero, the volume is cut off entirely (or very nearly so).
- **Timbre** is a tone control for the effect signal, which happens before the clean signal is blended back in. On either end, it cuts treble, but in the middle it primarily impacts the midrange, going from scooped to boosted.
- **Blend** controls how much of the ring or octave fuzz signal is blended with the dry signal.

Switches

- **Octave/Ring** (toggle switch) selects between ring modulator and octave fuzz modes. The same knobs are active in each mode, but have different functions.
- **LFO Type** (rotary switch) selects the pairing of two LFO shapes (triangle and sine) with two different VCO modes (pulse-width modulation or frequency modulation) for a total of four positions. This rotary has no effect in octave mode since the octave always uses the square wave.
- **VCO Shape** (rotary switch) selects between sine, triangle, sawtooth or square VCO waveforms. The triangle mode is lower in volume than the others. This rotary also has no effect in octave mode.
- **LFO Lock/Unlock** (footswitch) freezes the LFO at the current point in its sweep. Its operation is most predictable in square wave mode and at low LFO speeds.
- **Bypass** (footswitch) engages or disengages the effect.

Expression jacks

The LFO Depth and CV expression jacks can be used with external pedals such as the Boss FV-50. The depth expression pedal is in parallel with the Depth control, so the range of the expression pedal will be determined by the knob setting on the main unit. Turn the depth knob all the way down to allow the expression pedal to control the full range of the knob.

PARTS LIST

This parts list is also available in a spreadsheet format which can be imported directly into Mouser for easy parts ordering. Mouser doesn't carry all the parts (most notably potentiometers) so the second tab lists all the non-Mouser parts as well as sources for each.

View parts list spreadsheet → Interactive BOM →

PART	VALUE	TYPE	NOTES
R1	1k	Metal film resistor, 1/4W	
R2	2M2	Metal film resistor, 1/4W	
R3	470R	Metal film resistor, 1/4W	
R4	22k	Metal film resistor, 1/4W	
R5	150R	Metal film resistor, 1/4W	
R6	150R	Metal film resistor, 1/4W	
R7	100k	Metal film resistor, 1/4W	
R8	100k	Metal film resistor, 1/4W	
R9	2k2	Metal film resistor, 1/4W	
R10	39k	Metal film resistor, 1/4W	
R11	39k	Metal film resistor, 1/4W	
R12	100k	Metal film resistor, 1/4W	
R13	39k	Metal film resistor, 1/4W	
R14	10k	Metal film resistor, 1/4W	
R15	39k	Metal film resistor, 1/4W	
R16	330R	Metal film resistor, 1/4W	
R17	2k2	Metal film resistor, 1/4W	
R18	1k2	Metal film resistor, 1/4W	
R19	22k	Metal film resistor, 1/4W	
R20	39k	Metal film resistor, 1/4W	
R21	39k	Metal film resistor, 1/4W	
R22	39k	Metal film resistor, 1/4W	
R23	1k2	Metal film resistor, 1/4W	
R24	39k	Metal film resistor, 1/4W	
R25	10k	Metal film resistor, 1/4W	
R26	10k	Metal film resistor, 1/4W	
R27	39k	Metal film resistor, 1/4W	
R28	39k	Metal film resistor, 1/4W	
R29	100k	Metal film resistor, 1/4W	
R30	1k	Metal film resistor, 1/4W	
R31	10k	Metal film resistor, 1/4W	
R32	10k	Metal film resistor, 1/4W	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
R33	10k	Metal film resistor, 1/4W	
R34	100k	Metal film resistor, 1/4W	
R35	10k	Metal film resistor, 1/4W	
R36	150k	Metal film resistor, 1/4W	
R37	100k	Metal film resistor, 1/4W	
R38	10k	Metal film resistor, 1/4W	
R39	10k	Metal film resistor, 1/4W	
R40	15k	Metal film resistor, 1/4W	
R41	100k	Metal film resistor, 1/4W	
R42	10k	Metal film resistor, 1/4W	
R43	150k	Metal film resistor, 1/4W	
R44	10k	Metal film resistor, 1/4W	
R45	15k	Metal film resistor, 1/4W	
R46	100k	Metal film resistor, 1/4W	
R47	39k	Metal film resistor, 1/4W	
R48	100k	Metal film resistor, 1/4W	
R49	100k	Metal film resistor, 1/4W	
R50	470R	Metal film resistor, 1/4W	
R51	22k	Metal film resistor, 1/4W	
R52	10k	Metal film resistor, 1/4W	
R53	10k	Metal film resistor, 1/4W	
R54	10k	Metal film resistor, 1/4W	
R55	10k	Metal film resistor, 1/4W	
R56	100R	Metal film resistor, 1/4W	Power supply filter resistor.
R57	100R	Metal film resistor, 1/4W	Power supply filter resistor.
RPD	2M2	Metal film resistor, 1/4W	Input pulldown resistor. Can be as low as 1M.
LEDL	2k2	Metal film resistor, 1/4W	
LEDR	10k	Metal film resistor, 1/4W	Bypass LED current-limiting resistor.
C1	100n	Film capacitor, 7.2 x 2.5mm	
C2	OMIT	Electrolytic capacitor, 5mm	Use 10uF electrolytic if you can't find 2.2uF film for C3. See build notes.
C3	2.2uF	Film capacitor, 7.2 x 5mm	
C4	47uF	Electrolytic capacitor, 5mm	
C5	3n3	Film capacitor, 7.2 x 2.5mm	
C6	10uF	Electrolytic capacitor, 5mm	
C7	1n5	Film capacitor, 7.2 x 2.5mm	
C8	6n8	Film capacitor, 7.2 x 2.5mm	
C9	100n	Film capacitor, 7.2 x 2.5mm	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
C10	2.2uF	Electrolytic capacitor, 4mm	
C11	33n	Film capacitor, 7.2 x 2.5mm	
C12	68pF	MLCC capacitor, NP0/C0G	
C13	6n8	Film capacitor, 7.2 x 2.5mm	
C14	470n	Film capacitor, 7.2 x 3mm	
C15	10uF	Electrolytic capacitor, 5mm	
C16	10uF	Electrolytic capacitor, 5mm	
C17	47uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.
C18	47uF	Electrolytic capacitor, 5mm	Reference voltage filter capacitor.
C19	220uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C20	220uF	Electrolytic capacitor, 6.3mm	Power supply filter capacitor.
C21	100n	MLCC capacitor, X7R	Power supply filter capacitor.
C22	47uF	Electrolytic capacitor, 5mm	Power supply filter capacitor.
D1	1N5817	Schottky diode, DO-41	
D2-D5	1N914	Fast-switching diode, DO-35	
D6-D9	BAT46	Schottky diode, DO-35	Original Ring Stinger uses germanium. See build notes.
D10-D16	1N914	Fast-switching diode, DO-35	
Q1-Q5	BC549C	BJT transistor, NPN, TO-92	Can also sub 2N5088 (rotate 180 degrees).
IC1	TL072	Operational amplifier, dual, DIP-8	
IC1-S	DIP8 socket	IC socket, DIP-8	
IC2	TL072	Operational amplifier, dual, DIP-8	
IC2-S	DIP8 socket	IC socket, DIP-8	
IC3	TL022	Operational amplifier, dual, DIP-8	
IC3-S	DIP8 socket	IC socket, DIP-8	
IC4	TL022	Operational amplifier, dual, DIP-8	
IC4-S	DIP8 socket	IC socket, DIP-8	
IC5	TL022	Operational amplifier, dual, DIP-8	
IC5-S	DIP8 socket	IC socket, DIP-8	
IC6	TL072	Operational amplifier, dual, DIP-8	
IC6-S	DIP8 socket	IC socket, DIP-8	
PWM TRIM	100k trimmer	Trimmer, 10%, 1/4"	
XFMR TRIM	100k trimmer	Trimmer, 10%, 1/4"	
XFM1	LT44	Transformer, 20k:1k CT	Available from Aion FX. Also called P631M from some suppliers.
XFM2	LT44	Transformer, 20k:1k CT	
LFO TYPE	3P4T rotary	Rotary switch, 3 pole / 4 position	Must be Alpha SR2612F. See parts spreadsheet (2nd tab) for sources.
VCO SHAPE	3P4T rotary	Rotary switch, 3 pole / 4 position	
BLEND	100kB	16mm right-angle PCB mount pot	

PARTS LIST, CONT.

PART	VALUE	TYPE	NOTES
TIMBRE	100kB	16mm right-angle PCB mount pot	
DRIVE	100kA	16mm right-angle PCB mount pot	
VCO FREQ	100kB	16mm right-angle PCB mount pot	See build notes for potentiometer selection.
LFO RATE	100kB	16mm right-angle PCB mount pot	
LFO DEPTH	100kB	16mm right-angle PCB mount pot	
OCT/RING	DPDT	Toggle switch, DPDT on-on	
LDR1	NSL-19M51	LDR, 20-100k light, 20M dark	See build notes for LED/LDR information.
LED1	5mm green	LED, 5mm, green diffused	See build notes for LED/LDR information.
BYP. LED	5mm red	LED, 5mm, red diffused	
LFO LED	5mm green	LED, 5mm, green diffused	
OCT. LED	5mm green	LED, 5mm, green diffused	
IN	1/4" mono	1/4" phone jack, closed frame	Switchcraft 111X or equivalent.
OUT	1/4" mono	1/4" phone jack, closed frame	Switchcraft 111X or equivalent.
VCO OUT	NMJ6HC-S	1/4” phone jack, stereo, switched	Neutrik NMJ6HC-S
VCO IN/CV	NMJ6HC-S	1/4” phone jack, stereo, switched	Neutrik NMJ6HC-S
CARRIER IN	NMJ6HC-S	1/4” phone jack, stereo, switched	Neutrik NMJ6HC-S
DEPTH EXPR	NMJ6HC-S	1/4” phone jack, stereo, switched	Neutrik NMJ6HC-S
DC	2.1mm	DC jack, 2.1mm panel mount	Mouser 163-4302-E or equivalent.
BYPASS	3PDT	Stomp switch, 3PDT	
LFO LOCK	3PDT	Stomp switch, 3PDT	
ENCLOSURE	1590XX	Enclosure, die-cast aluminum	1790NS equivalent.

BUILD NOTES

LDR selection

While the original LDR used in the Ring Stinger is unknown, the Advanced Photonix NSL-19M51 is a likely candidate that meets the specifications. It has been tested extensively in this circuit and has been found to perform identically, and it's readily available from Digikey and Mouser.

LED selection

The Ring Stinger circuit works best with a 5mm diffused green LED, and these ones from Tayda Electronics have been tested and work perfectly. You can also use other green diffused LEDs, just make sure they're not the high-brightness type. There are also some diffused types that have a much higher MCD specification, and these will not work well.

What about heat shrink?

Homemade optocouplers are very common among DIYers since they can be made for less than 50 cents compared to true vactrols that can cost around $6 to $8 USD each. This involves using heat shrink to seal the LED and LDR from outside light, as shown in this Instructable.

However, the original Lovetone unit does not use any sort of light seal on the LED and LDR. When developing the Quadratron (Doppelganger), it was found when testing against a real Doppelganger that the clone only sounded exactly like an original when they were unsealed. While this is anecdotal, it seemed as though there was some crosstalk between the LEDs and LDRs such that as one LED lights up, it affects the other LDRs slightly as well.

This likely matters less in the Ring Stinger since there is only one LED/LDR combo. But, to be as accurate to an original Ring Stinger as possible, it's recommended to leave the LED and LDR uncovered as in the original unit, angled toward each other and making physical contact.

This does present a problem for those who like to test the effect outside of the enclosure before boxing it up, because it will only work properly if the environment is as dark as the inside of the enclosure would be. You can try wrapping it in a towel or putting it in a closed box while testing.

What about vactrols?

It may be tempting to use a manufactured optocoupler (vactrol) such as the VTL5C3 for the LED/LDR pair. This will result in a functional effect, but it likely won't sound the same since there is no equivalent vactrol with the same specifications as the LED/LDR used in the original Ring Stinger.

However, if you do want to experiment, others have reported success with tweaking the value of the R9 resistor to compensate, or replacing it with a 5k trimmer + 680R resistor in series. This changes the brightness of the LED which impacts the resistance range of the LDR.

Rotary switches

The rotary switch sub-PCBs are designed for the Alpha SR2612F 3P4T PCB-mount rotary switch. We are not aware of any other brands with this form factor, so there are no substitutes. It's available from Mouser, Small Bear, Tayda and several more. See the parts list spreadsheet (2nd tab) for links.

The drill template includes holes for the anti-rotation pins. Precise drilling is needed in order for the anti-rotation pins to work. If you need to drill the hole a size larger because it's slightly out of alignment, then it loses its anti-rotation function.

The rotary switches have daughterboards that snap off the main board. It's recommended to solder these in place once the main PCB has been installed into the enclosure. This way, everything will be at the correct height and will not cause any stress to the joints after everything is together. Think of it as a PCB-mounted pot that requires some assembly.

When soldered to the rotary switch, the pads on the daughterboard should line up perfectly with the pads on the main PCB if the drilling is precise. However, be aware that there is not a lot of clearance between the top PCB and bottom PCB.

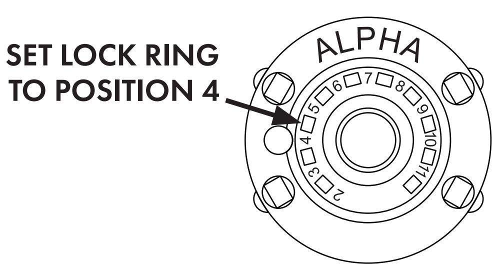
The easiest method for connecting the sub-PCB to the main PCB is via straight wires, e.g. clipped resistor leads. Solder them to the main PCB first, then thread the daughterboard through the wires and down onto the rotary switch. Solder the daughterboard to the rotary pins, then solder each of the wires on the daughterboard.

You can also use a snap-apart wire header. If you do this, the daughterboard PCB will need to sit a little higher on the pins of the rotary switch since there isn't quite the 0.1" clearance needed for the plastic insulators. Be careful because this will be extremely difficult to desolder if you make any mistakes.

Alternately, you can add another 3/8" hex nut (e.g. from 1/4" jack) on the inside of the rotary switch to mount it higher inside the enclosure. You will lose the use of the anti-rotation pin, so it's possible that the rotary switch can come loose over time due to the rotational force, but it gives enough space to run flexible wires between the main board and daughterboard in case they are slightly out of alignment.

Rotary lock washer

The rotaries come with a lock washer that physically prevents the rotary switch from going past a set number of positions. The rotary switches typically come with this lock washer set to the "4" position, which is what this circuit uses for both rotaries, so normally nothing needs to be done. But to avoid potential headaches later, always double-check to ensure the lock washer is set to the correct position before soldering anything.



BUILD NOTES, CONT.

Rotary shaft

You will likely need to cut the shaft of the rotary switches by around 0.4” to match the height of the potentiometer shaft so the knobs sit at the same level.

A rotary tool cutoff wheel works great, but you can do it with normal snippers as well—it just won’t be a clean cut this way so it may need some sanding or filing to level it off.

VCO calibration

The PWM TRIM trimmer is located in the upper-right section of the main PCB, below the “VCO Freq” and “LFO Rate” potentiometers. Its adjustment procedure is as follows.

To start, turn your amplifier all the way down. Set the VCO Frequency control to 12:00 and LFO Depth to minimum, VCO Wave Shape to “Sine”, and the PWM trimmer to the 12:00 position.

Then, connect the VCO Out jack (not the main pedal output) to your amplifier’s input and turn the volume up slowly. This output is much higher than the output of the main circuit, so use caution.

Adjust the trimmer slowly back and forth to find the position that gives the mellowest sound, called the “null point”. You can also use a scope to determine the null point, but the pedal will not really benefit from that level of accuracy, so it’s recommended to just do it by ear.

Note that the VCO frequency is somewhat dependent on the supply voltage. Provided you use the same power supply, no further tuning should be necessary, but if you decide to try it at 12V (the maximum recommended supply voltage) then you may need to redo the above steps. This may also be needed when going from a wall wart (9.6-9.8V) to a typical pedalboard power supply (often 9.0V).

Transformer trimming

The XFMR TRIM trimmer is located on the footswitch board. Its adjustment procedure is as follows.

To start, connect the main audio output of the pedal to your amp and turn the trimmer to the 12:00 position. Leave the pedal input unconnected. Turn up the amp volume until you can hear the VCO bleeding through to the main signal. Adjust the VCO Frequency control to confirm that what you’re hearing is the VCO. It should change in pitch with the knob.

Then, adjust the trimmer until you find the position where the VCO volume is lowest, or eliminated entirely. This may very well be the 12:00 position where you started, but the transformers often vary a bit in spec so it will usually need a slight adjustment in one direction or the other.

Transformer selection

The Ring Stinger was designed around the LT44 miniature transformer, which was commonly sold at hobbyist shops within the UK but not widely distributed outside the country.

There is no direct equivalent to the LT44 in either Xicon or Triad’s current product lines. The Ring Stinger circuit is designed around the DC resistance and turns ratio of that specific model and will not sound the same without a transformer of the same spec.

Fortunately, the LT44 (also known as the P631M) is still in production, though still only distributed within the UK. This project is a pretty significant one for us, so we opted to import a large quantity of LT44s from the manufacturer to simplify parts sourcing. You can find it on our Components page.

Note that the LT44's primary (P) is the side with two leads and the secondary (S) has three. The PCB has three pads on each side to allow for other types of transformers to be used, for example the Xicon 42TM006, which is not currently manufactured but still available old-stock from some sources.

D6-D9: Schottky or germanium?

Following the tradition of vintage ring modulators, the original Ring Stinger used germanium diodes for D6-D9, selected for a matching forward voltage (Fv).

However, in these old ring mod designs, the important characteristic of the diodes was not the germanium itself, but the low Fv, which was 0.2V to 0.4V on average as compared to the 0.7V of standard silicon diodes. Today, Schottky diodes are typically used as substitutes for germanium in nearly all applications (including ring modulators) because they have a similarly low Fv and are very close in tolerance with no selection needed. They are also much more stable across fluctuations in temperature.

We tested the Neurotron with Schottky diodes against an original Ring Stinger and found them to be sonically identical in all modes, and as a result we strongly recommend the use of BAT46 Schottky diodes. But the PCB is sized for the larger germanium diodes, so they'll work just fine if you do want to go through the trouble of sorting them.

Footswitch PCB component placement

The Neurotron makes use of all available space, and to that end several of the components are mounted on both sides of the footswitch PCB. The transformers, footswitches, electrolytic capacitors and indicator LEDs are mounted to the underside, while the resistors, diodes and bias trimmer are mounted to the top side. The components are always mounted onto the silkscreen outline.

VCO Frequency pot value

The value of the VCO Frequency pot should be as close as possible to 100k for best operation and full range of control. Most potentiometers have a 20% tolerance, so an individual pot can be pretty far off in either direction and still be within the manufacturer's specification.

If you have more than one 100kB pot available, measure several of them to find the closest. It's better to overshoot than undershoot, so for example if you have one 97k and one 105k, use the 105k.

LFO Rate and Depth potentiometers

You may notice on the silkscreen that the LFO Rate and Depth potentiometers are slightly out of alignment with the others. Good eye! They're rotated 1 degree to the left and right to make room for the Depth Expression pads. This has no impact on the drill template or control layout, but you may need to rotate them very slightly inside the enclosure in order for them to fit the PCB.

Omitting the expression jacks

If you want to omit the CV jack, just leave the pads unconnected. To omit the Depth jack, jumper the "TIP" and "RNG" pads and leave "SLV" unconnected.

LFO ticking in bypass mode

The input and output jacks can pick up LFO ticking noise in bypass mode in certain setups. The most likely scenario is if the Neurotron is plugged directly into the guitar without a buffer or any other active pedals in between.

This is because when the source impedance of the input signal is high, it's more susceptible to interference, and the Ring Stinger emits strong LFO signals internally, particularly the square wave output. If the source impedance is low, e.g. from a buffer earlier in the chain, there should be no ticking. The original Ring Stinger has this same issue, as do all clones, so it's inherent to the circuit itself.

If you are still having issues even when using a buffered input, try changing the position of the wires within the enclosure. You can also use shielded wire for the input. Just make sure the shield is only grounded on one end to avoid ground loops.

Output volume control

The original Ring Stinger did not have a volume control of any kind. While it does not have an excessive volume boost, some settings are definitely above unity.

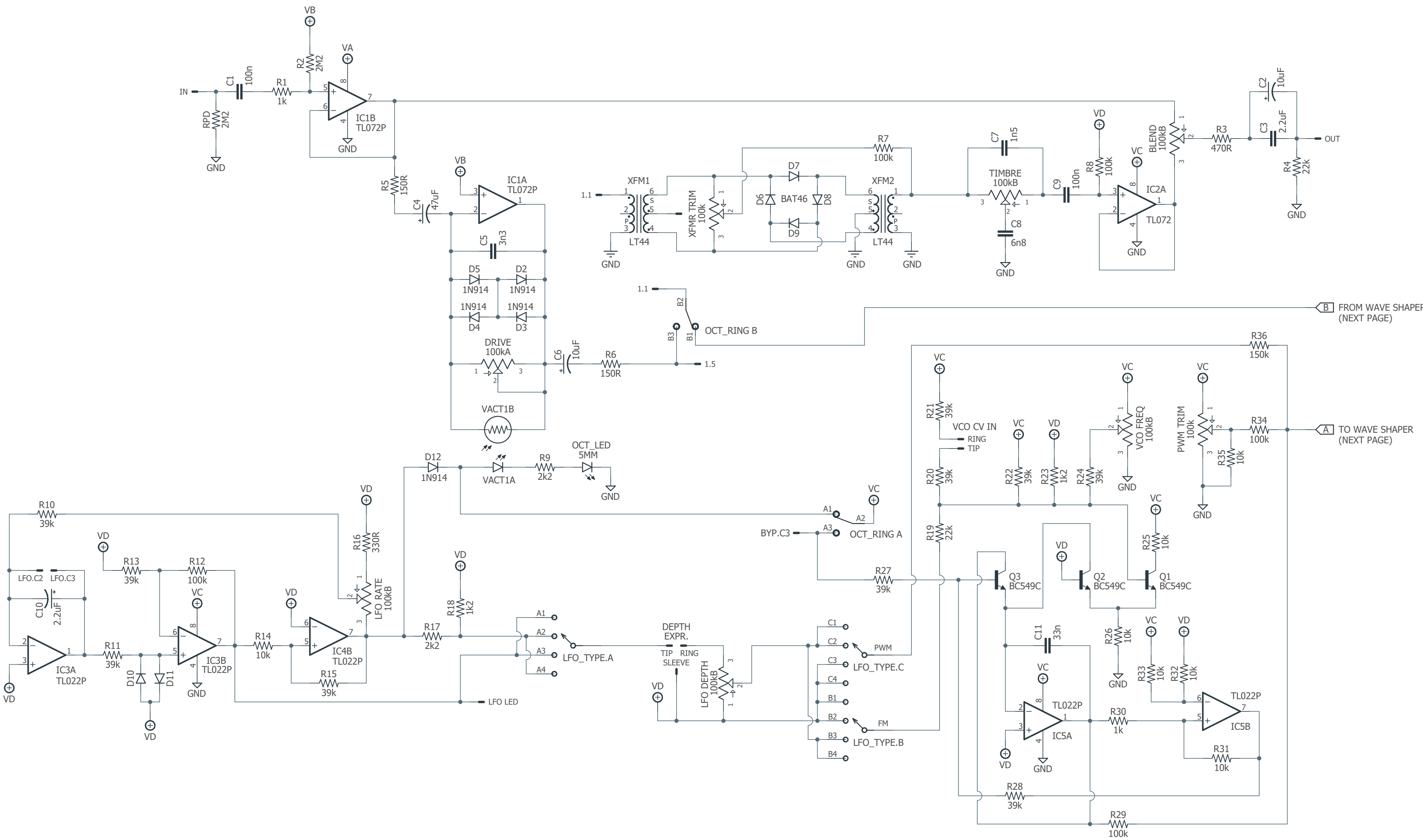
We elected not to include the volume control in the Neurotron. However, it can easily be added by omitting R4 and adding a 25kA potentiometer to the end of the circuit. This preserves the output impedance at max volume but allows it to be dialed back to unity gain. Wire the "Out" pad to lug 3, connect lug 1 to any ground point, and take the effect output from lug 2. If you use a 9mm pot, you'll have a much easier time mounting it almost anywhere on the enclosure.

Some Ring Stinger adaptations (including the String Ringer, the original project from DIYStompboxes dating back to 2005) add a gain stage at the end to increase the maximum volume before the volume control to dial it back. Again, we did not feel that the original Ring Stinger was deficient in this regard, so we opted to exclude this gain stage.

Electrolytic and film capacitors

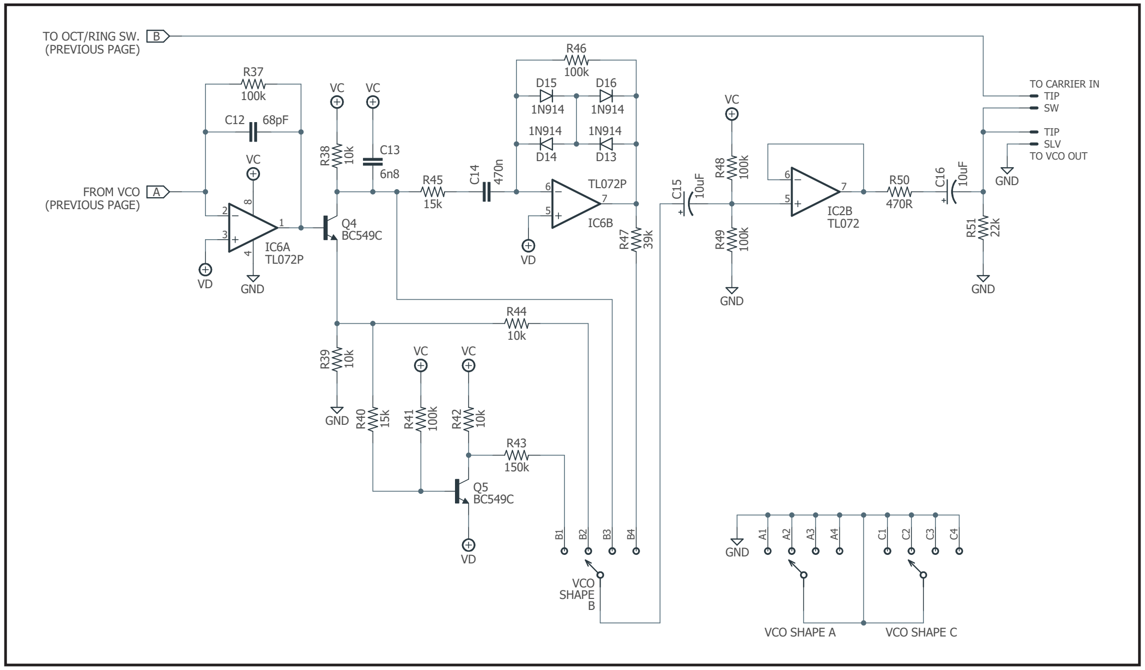
The original Ring Stinger uses a 10uF electrolytic capacitor in the audio path (C2). Since film is much better quality, we've added space for a film capacitor to be used instead (C3). While the spacing allows for box capacitors up to 4.7uF to be used, the parts list calls for 2.2uF since it's somewhat cheaper and easier to source. However, even 1uF is fine too.

SCHEMATIC (MAIN AUDIO CIRCUIT, RING MOD, LFO, VCO)

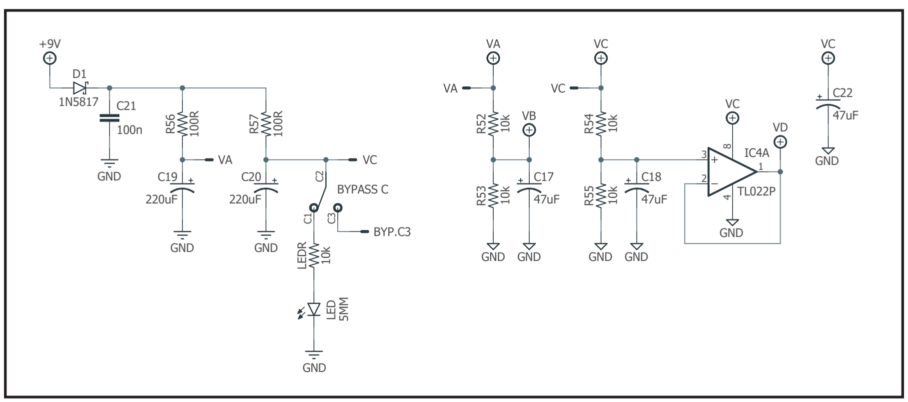


SCHEMATIC (WAVE SHAPER, POWER, BYPASS)

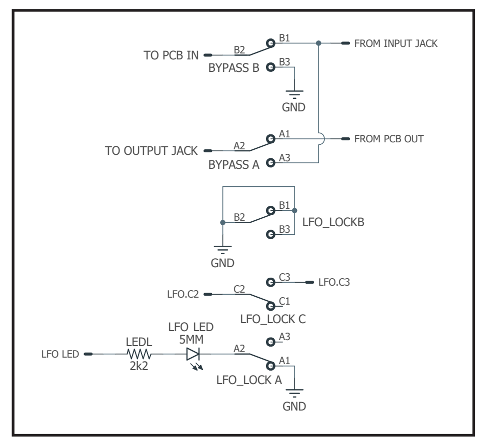
Wave shaper



Power and filtering



Bypass switching



DRILL TEMPLATE

Cut out the drill template on the following page, fold the edges and tape it to the enclosure. Before drilling, it's recommended to first use a center punch for each of the holes to help guide the drill bit.

Ensure that the template is printed at 100% or "Actual Size". You can double-check this by measuring the scale on the printed page with a ruler or calipers.

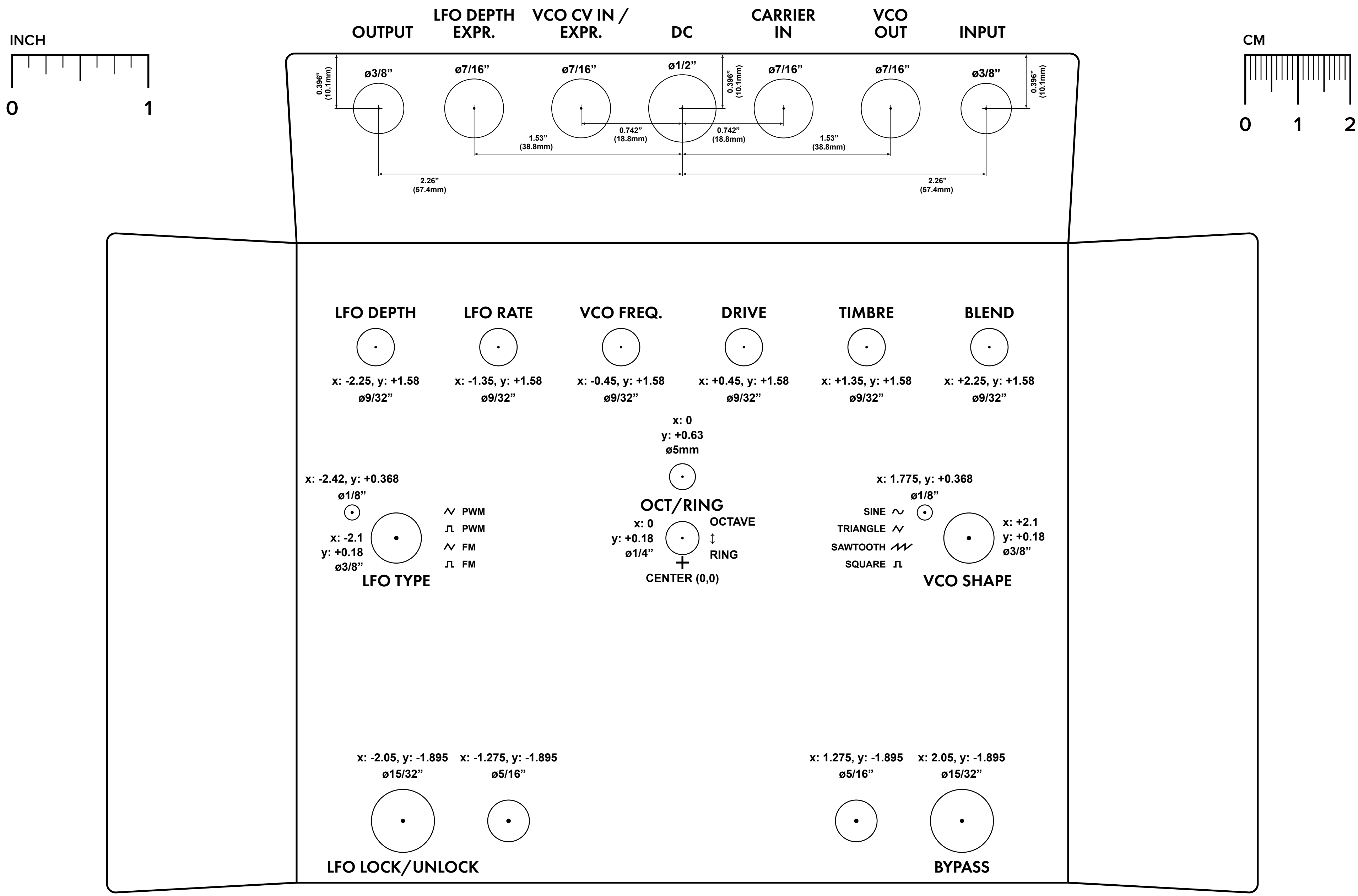
The LEDs next to the footswitches are sized for a 5mm LED bezel, available from several parts suppliers. Adjust the drill size accordingly if using something different, such as a 3mm bezel, a plastic snap-in bezel, or just a plain LED.

The Octave LED drill hole is sized for a plain LED with no bezel. If you don't have a 5mm bit, use 7/32".

Important: Due to the high number of PCB-mounted parts, it's crucial that the drilling be accurate, especially the rotary switches. There's not a lot of room for error.

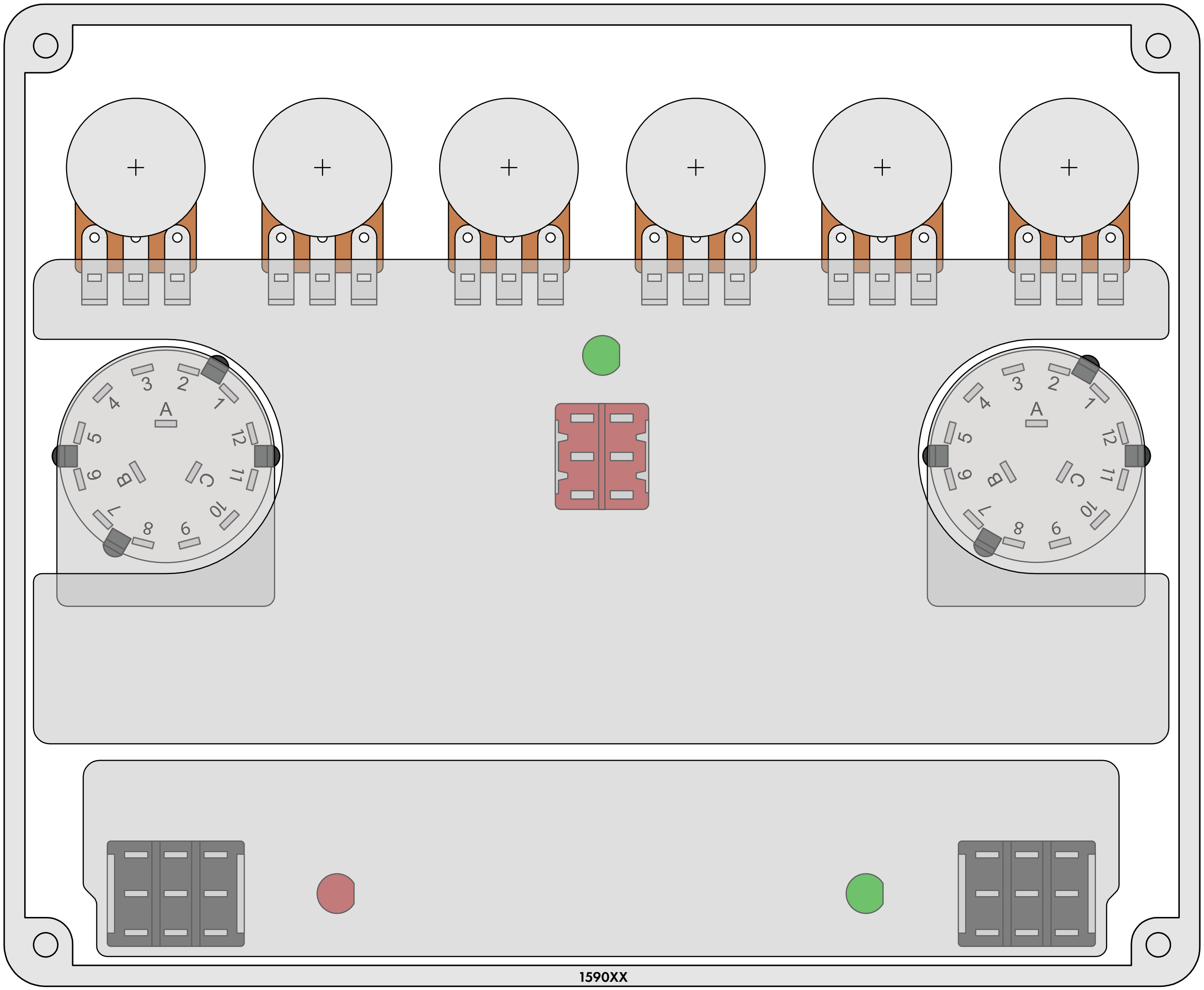
If the toggle switch doesn't align to the PCB, you can always drill one step larger (9/32") to allow a little more room correct any errors. The toggle switch washer and nut will still fully cover the hole.

DRILL TEMPLATE

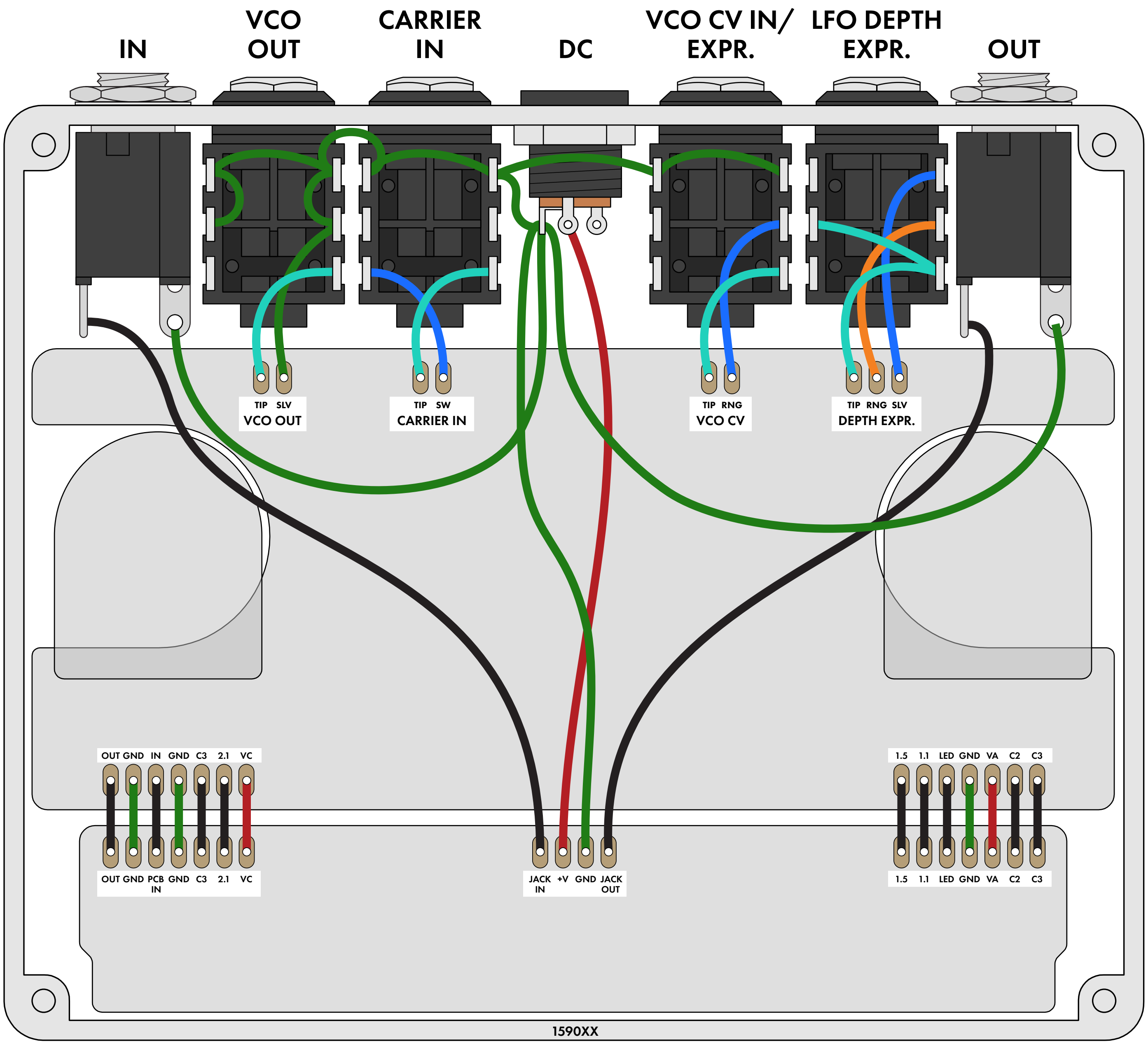


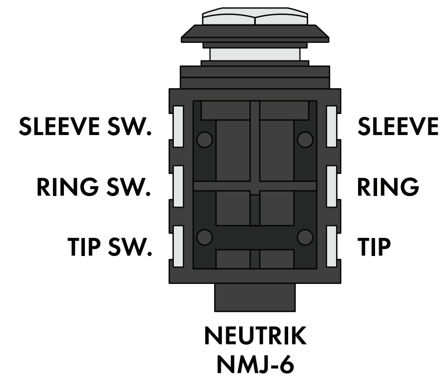
ENCLOSURE LAYOUT

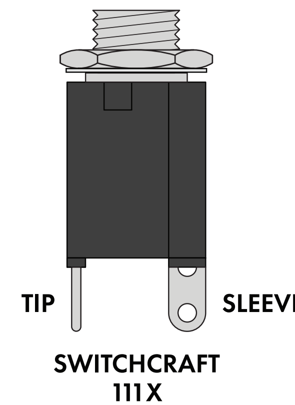
Enclosure is shown without jacks. See next page for jack layout and wiring.



WIRING DIAGRAM







LICENSE & USAGE

No direct support is offered for these projects beyond the provided documentation. It's assumed that you have at least some experience building pedals before starting one of these. Replacements and refunds cannot be offered unless it can be shown that the circuit or documentation are in error.

All of these circuits have been tested in good faith in their base configurations. However, not all the modifications or variations have necessarily been tested. These are offered only as suggestions based on the experience and opinions of others.

Projects may be used for commercial endeavors in any quantity unless specifically noted. No attribution is necessary, though a link back is always greatly appreciated. The only usage restrictions are that **(1) you cannot resell the PCB as part of a kit without prior arrangement**, and **(2) you cannot "goop" the circuit, scratch off the screenprint, or otherwise obfuscate the circuit to disguise its source**. (In other words: you don't have to go out of your way to advertise the fact that you use these PCBs, but please don't go out of your way to hide it. The guitar effects industry needs more transparency, not less!)

DOCUMENT REVISIONS

1.0.0 (2023-05-20)
Initial release.