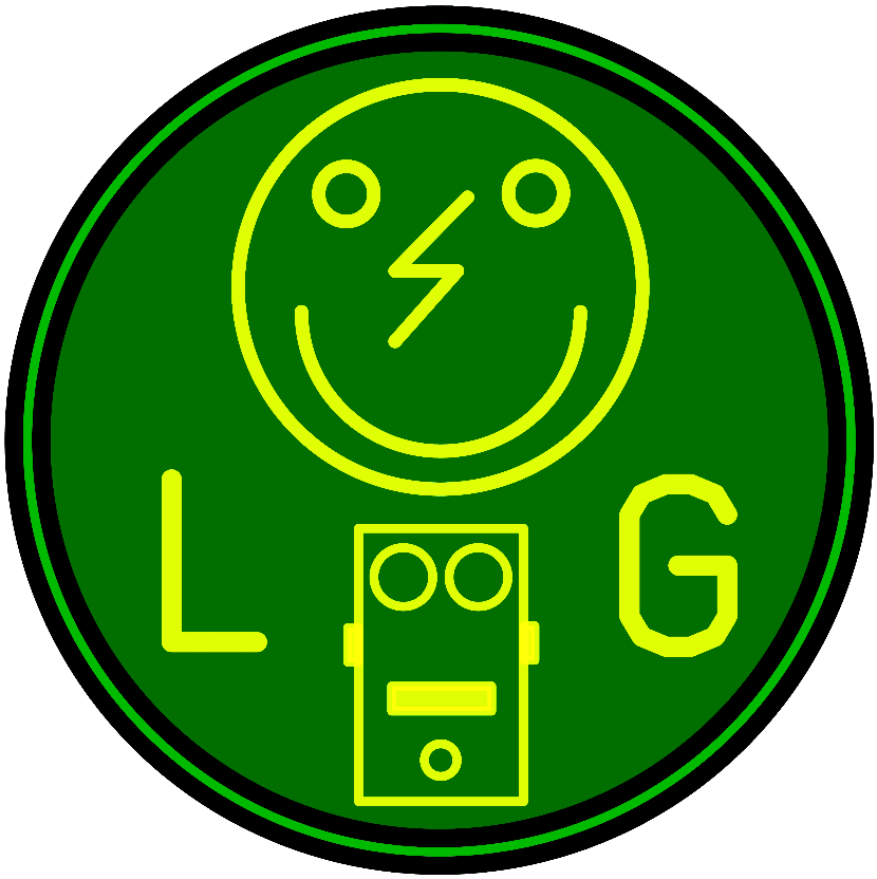
ColoredThro

Building instructions

v1.0



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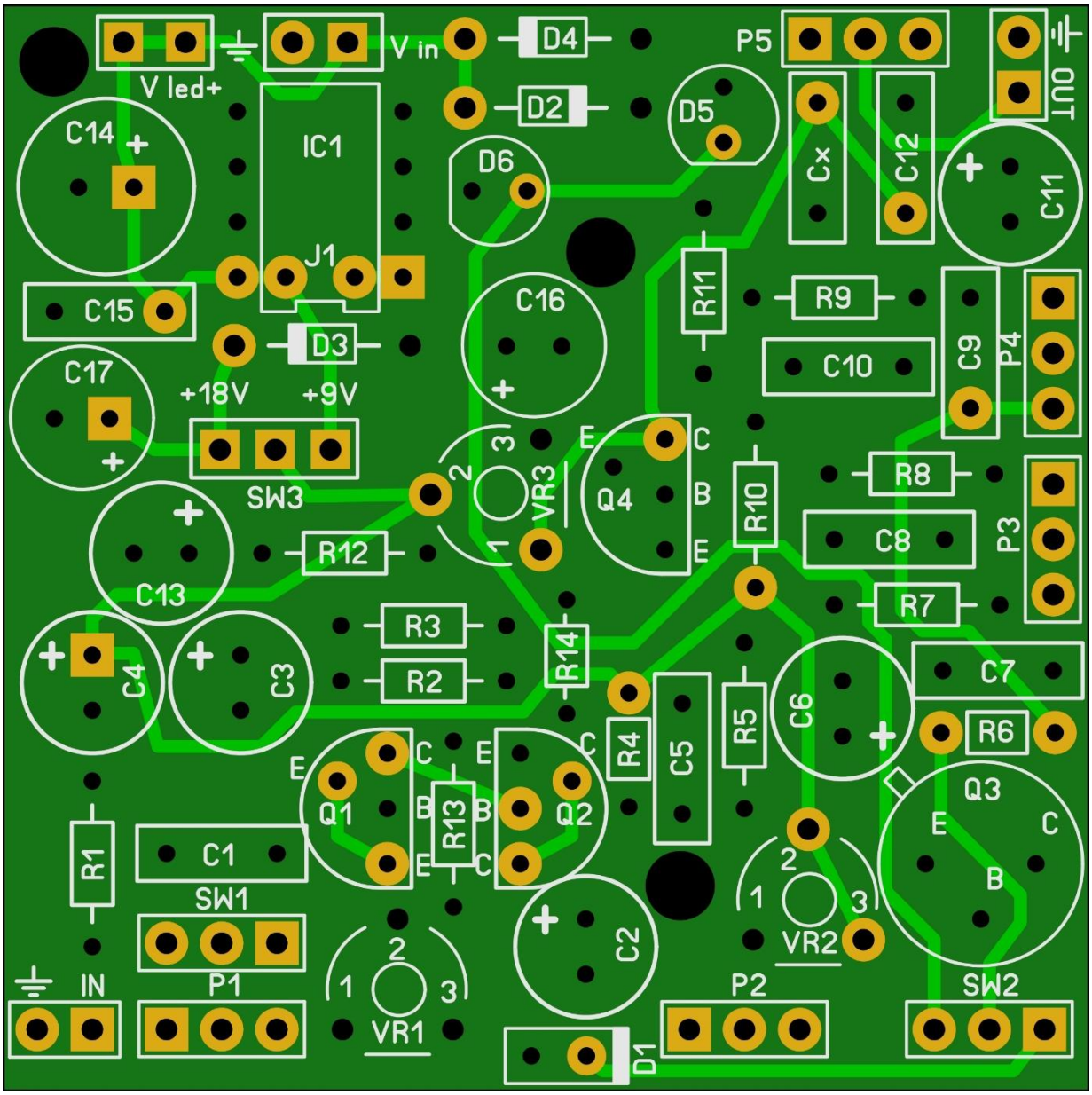
Read this entire manual thoroughly before you start building the effect! There are some available options and mods and you should choose which one you want to incorporate before starting your build.

Last update: 03-10-2017

PCB layout



Dimensions: 50 mm x 50 mm
1.97 inch x 1.97 inch

Components

This PCB gives you the option to build a clone of either a Colorsound Powerboost, Colorsound Overdrive or Throbak Overdrive Boost. Parts differ per type as described in the table below. Decide which one you want to build and choose the appropriate parts. You should also take a good look at the mods section for other options and required parts.

	Colorsound		Throbak
Part	*Power boost*	*Overdriver*	*Overdrive Boost*
C1	220n	220n	220n
C2	22u	10u	22u
C3	22u	22u	22u
C4	22u	22u	22u
C5	220p	220p	200p
C6	10u	10u	4u7
C7	10n	10n	10n
C8	100n	100n	100n
C9	100n	100n	100n
C10	10n	10n	10n
C11	22u	10u	22u
C12	220n	220n	220n
C13	10u	22u	22u
C14	100u	100u	100u
C15	100n	100n	100n
C16	10u	10u	10u
C17	10u	10u	10u
Cx	100p	100p	100p
D1	NC	NC	1N34A/1N270
D2	1N5817	1N5817	1N5817
D3	1N5817	1N5817	1N5817
D4	1N4001	1N4001	1N4001
D5	NC	NC	LED Red 5mm
D6	NC	NC	LED Red 5mm
P1*	NC	NC	B500k
P2	B10k	B10k	C10k
P3	B100k	B100k	B100k
P4	B100k	B100k	B100k
P5	Jumper 2-3	Jumper 2-3	A100k

	Colorsound		Throbak
Part	*Power boost*	*Overdriver*	*Overdrive Boost*
IC1	ICL7990S	ICL7990S	ICL7990S
Q1	BC169C	BC109	2N2222A
Q2	BC184C	BC109	2N2222A
Q3	NC	NC	2N404
Q4	BC109	BC109	2N2222A
R1	NC	NC	2M2
R2	150k	150k	150k
R3	1k2	470R	470R
R4	120k	120k	120k
R5	jumper	12k	12k
R6	4k7	4k7	4k7
R7	5k6	5k6	5k6
R8	39k	39k	3k9
R9	4k7	4k7	4k7
R10	180k	150k	150k
R11	33k	33k	33k
R12	1k2	470R	470R
R13	12k	NC	NC
R14	470R	jumper	jumper
SW1	jumper 2-3	jumper 2-3	2PDT/3PDT
SW2	NC	NC	SP3T ON/OFF/ON
SW3	SPDT	SPDT	SPDT
VR1**	B10k	B10k	B10k
VR2**	B10k	B10k	B10k
VR3**	B10k	B10k	B10k

Capacitors with values < 1nF are MLCC, values of 1nF – 1uF are SMF (except C15, which can be MKT) and all values > 1uF are Electrolyte. P1-P5 are 16mm Alpha pots (A=log, B=linear, C=rev. log) , VR1-VR3 are 6 mm trimpots. **All parts must be rated 25V+**

* The Throbak uses an internal pot. Use a Alpha 16mm (external) or a Bourns 3296W style (internal) trimpot

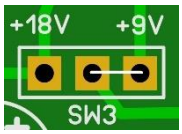
** See the **Biasing** section for options before choosing to solder the trimpots!

Power section

The effect has been designed to be able to operate on 9V or 18V using an internal charge pump. SW3 enables you to switch dynamically between the 9V and 18V setting. If you do not want to use the switch then do not forget to solder a jumper between the middle pad and the desired voltage pad. NEVER let the outer 2 lugs of SW3 tough each other and also never connect all 3 pins of SW3 together. If the IC gets hot then there is a short in the power section and you must disconnect the effect immediately from the adapter and find the fault.

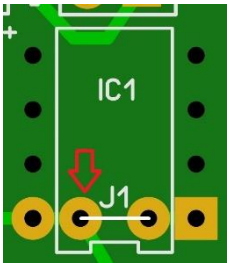
You can choose between 3 options for the power section:

1. **No charge pump**:
   Do NOT install: C16, C17, D2, D3, IC1, J1 and SW3
   Extra jumpers: SW3 on 9V pad and middle pad
   The effect can now be used with a standard 9V adapter or an 18V adapter



2. **Charge pump using a ICL7660S**:
   Place all components as stated on the PCB and connect a jumper wire between leg 1 and 8 (marked J1)of IC1. Do not forget to place the jumper before placing the DIP-8 socket for IC1.
   NB. Only use the 7660S and not any other version without the S.

   The effect can now only be used with a 9V adapter but you can switch it internally to 9V or 18V using SW3.



3. **Charge pump using a LT1054:**
   You can place all components as stated on the PCB just do NOT connect J1 (pin 1 and 8 of IC1)!!
   The effect can now only be used with a 9V adapter but you can switch it internally to 9V or 18V using SW3.

Which IC should I choose? ICL7660S or LT1054? In this application it does not really matter. The LT1054 can give more current @18V (100mA) than the ICL7660S (45mA @18V) but the ColoredThro does not draw that much current in any configuration. On the other hand the ICL7660S is much cheaper than the LT1054, so that could be a good reason to use it. But then again, maybe you have a stash of LT1054 you want to use.

Modifications

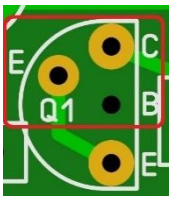
Gain mod

The standard 10K gain pot (**P2**) has all the action crammed up at the end of the sweep. To make it more versatile you could use a C5k of C1k pot instead.

Transistors

Q1,**Q2** and **Q4** can be any silicon transistor you can think of. 2N2222A, 2N508, 2N3904 etc, etc. Note that I modified the PCB so it can both fit standard modern transistors (CBE) and eg. vintage BC169C (CEB). Double check the datasheet of your transistor to be sure that you connect the right pin to the right pad! Here is an example of connecting a 2n5088 to **Q1**

And also a BC169C to **Q1**



NB The pin layout for **Q2** is different so watch carefully when inserting the transistor in the correct pads.

Q3 (only used in the Throbak) can be any germanium PNP transistor you like 2N404, AC128, AC132, etc. or you could even replace it with a germanium diode by connecting the cathode to **Q3 B** and the anode to **Q3 C**

Mix and match

You could mix a few options of different versions to get a custom effect. I think it would be a good idea to add **R1** (pull down resistor) and **P5** (volume) to the Colorsounds. This way you can reduce the pop when switching on the effect and add a volume control. You could also consider adding the clipping options to the Colorsound (**D1**,**Q3** and **D5**, **D6** using **SW2**).

Feedback capacitor

Cx is an optional filter to reduce the harshness and some high frequency hiss from the effect perceived by some. You can experiment with values between 100pF and 470Pf.

Additional clipping options

Originally the Throbak does not come with the LED setting, only the germanium. If you do not want this, you can leave out **D5** and **D6** and use a SPST instead of the SP3T in **SW2**. Otherwise you can always experiment with different types of LED's or use 1N4148, 1N914, etc.

Build sequence

Soldering this board can be very complicated for some people since the solder pads are very close together. Use a magnifying glass to make the job easier. The trick to soldering a PCB is to work from small to big components. My building sequence suggestions in this section are based on the parts I used myself. Sometimes some components are smaller (or bigger) so always use your own common sense and change the order accordingly. Usually capacitors can differ a lot in size depending on their rating and value.

Note: Do not blow on your solder in an attempt to cool it down. That can result in a bad join that might corrode!

Start by soldering the resistors except for R4, R6 and R14 (unless it is jumped). Next come the diodes D2, D3 and D4 and then the MLCC capacitors. If needed you can create a jumper using a spare piece of lead from a resistor or diode.

If you want to experiment with other transistors then you could socket them instead of soldering them to the board. You'll need a some 20 SIL sockets, break off the sockets and solder them to the board. Now is the time to solder these sockets on the PCB as well as the socket for the IC. Place the transistors and IC once you are finished with all soldering and off board wiring!

Now continue by soldering small SMF and MKT capacitors then solder the diodes D5 and D6 and the VR trimpots.. The rest of the resistors R4, R6 and R14 come next and should be mounted upright. Ditto for D1. Next you can solder D5 and D6 and then finish with soldering the electrolytes.

I suggest you now drill the holes in your enclosure so you can use it during the off board wiring.

Note: Really take some time to determine where to place the pots, switches, jacks and PCB in the enclosure before you start drilling. Measure twice, drill once.

You are almost ready to rock, well… not really. The difficult part starts now.

Besides the components mentioned in the Bill Of Materials table, you will need:

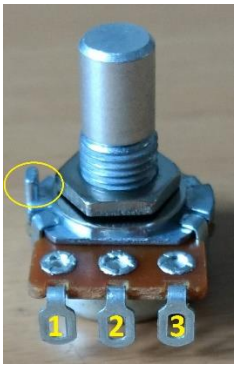
- **2 input jacks**. 2 mono jacks if you are not going to use a battery but only the 9V adapter. 1 mono (for output) and 1 stereo jack (for input) if you will be using both a 9V battery and the 9V adapter.
- **2 x 3PDT footswitch** (9 pins)
- **2,1mm DC jack** (isolated).
- **9v battery clip** (optional).
- **22 gage stranded hook-up wire.**
- **LED holders.** This enables you to mount the LEDs in the enclosure.
- **2 x LED (3mm or 5mm depending on your taste)**
- **Hammond 1590BB** case (or similar) in your favorite color.

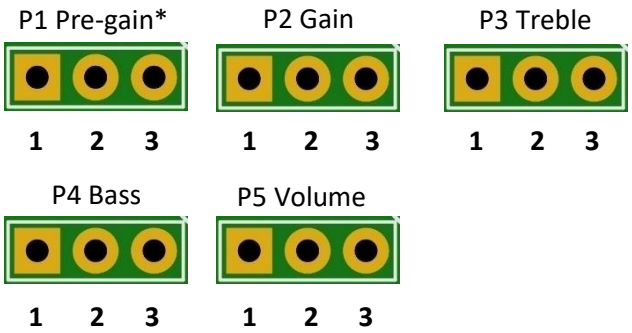
Off board wiring

Potentiometers

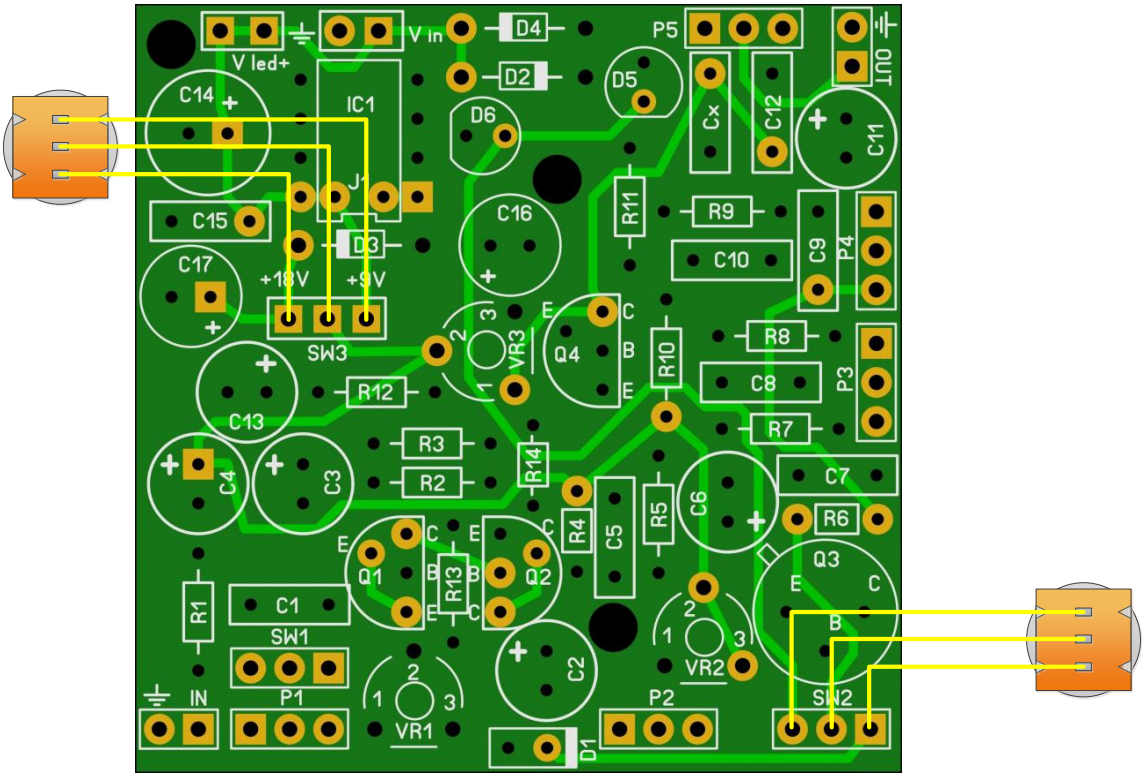
In the pictures below you see the correct pin numbering of the pots (Alpha 16mm style).
Solder the wires accordingly and it is always a good idea to twist the wires together to create a sort of extra shielding against external noise.

You can break off the pin I marked with the yellow circle with a small pair of pliers.



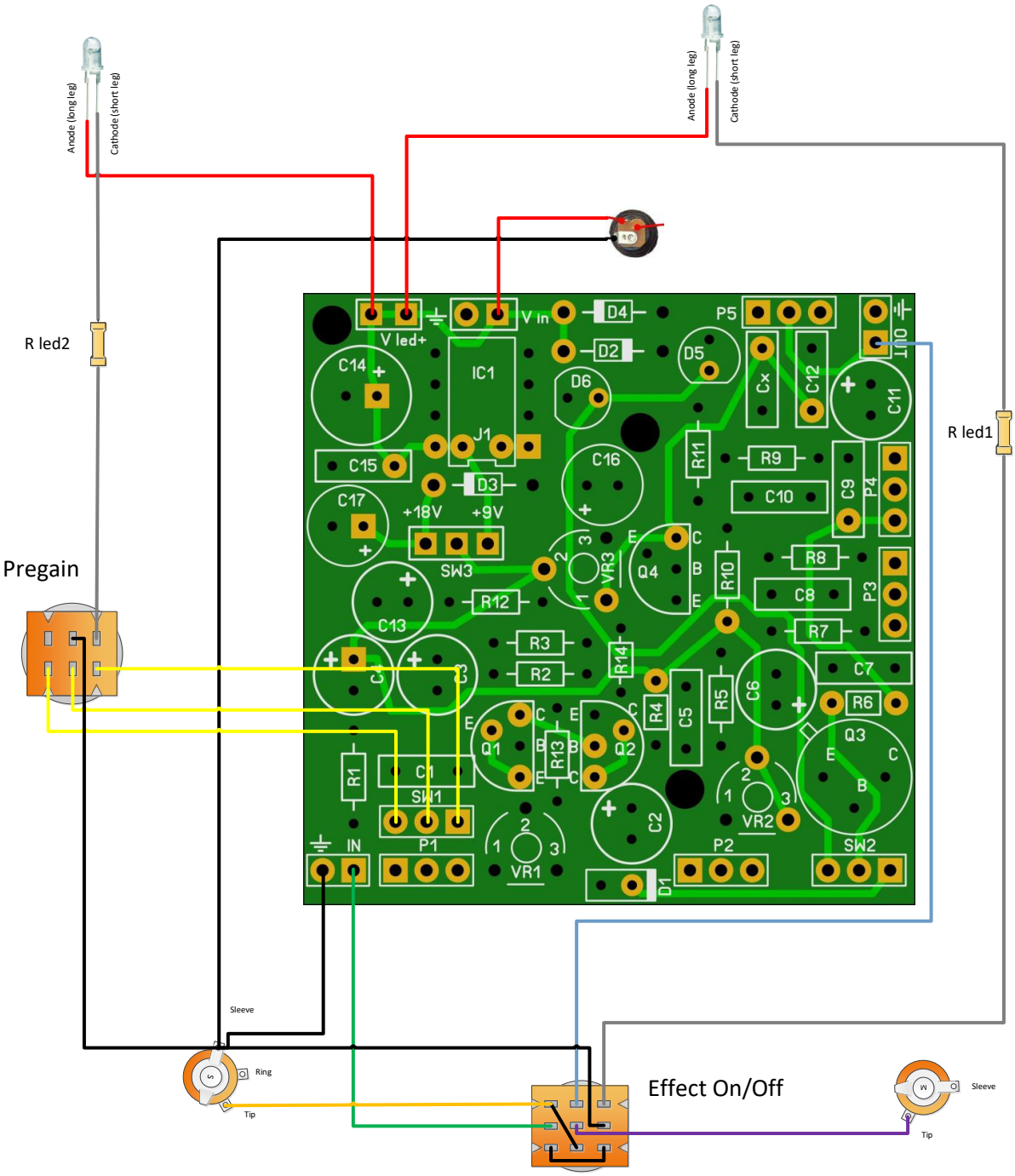


Miniswitches



* The Throbak uses an internal trimpot for the pre-gain. If you do not want an extra external pot you can substitute the P1 Alpha pot for a internal trimpot (Bourns 3296W style)

Footswitches and stargrounding



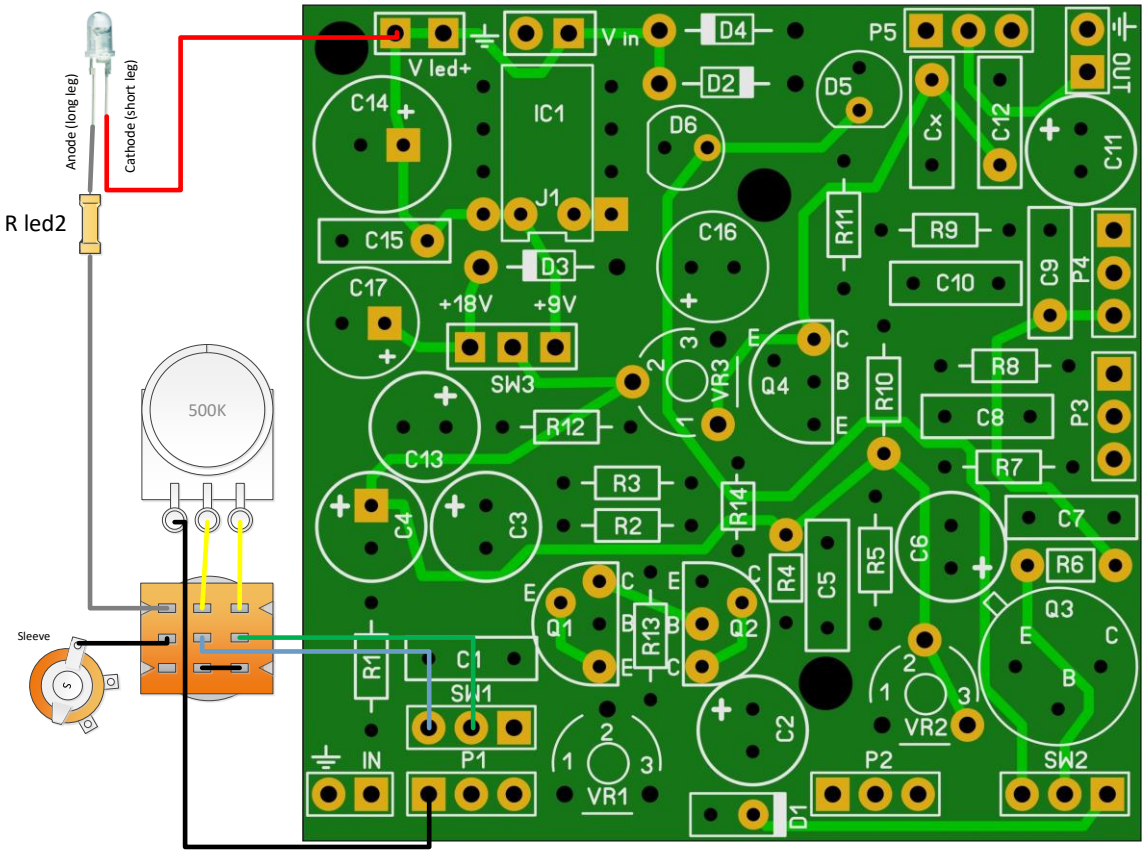
Note that **R led1 and R led2** are **4k7** resistors. You can change this value depending on the type of LED you use but 4k7 is safe enough for almost all LEDs for both 9V as 18V.

It is now time to place your transistors and IC in the sockets if needed. Connect everything, build it in your enclosure and enjoy your effect!

The sleeve on the output jack is not connected on purpose. Make sure the output jack is in good electronic contact with the enclosure else you can try and connect the sleeves of the input and output together. If you test the unit outside of an enclosure you need to connect the output sleeve to ground!

Alternative Pre-gain switching

By design the Pre-gain pot (P1) remains in the circuit even when pre-gain is switched off. This may cause some unwanted behavior of the pre gain pot. When you turn it all the way down it will cut off all sound as it will ground the signal. If you turn it up it will add some extra resistance to ground even when off. This may not really influence your sound, but you can alter the wiring to completely cut out the pot when switched off. To do this I advise you to use a 3PDT footswitch. You can wire it like this:



Biasing

The transistors **Q1**, **Q2** and **Q4** need to be biased. The best way to do this is by using the biaspots **VR1-VR3**.

The Colorsounds did not come with bias pots, but had fixed resistors. These values are mentioned in the table below. If you prefer you can place resistors instead of the trimpots. If so, omit the trimpots and instead connect the fixed resistors with the correct value mentioned below to the pads marked **1** and **2** of **VR1-VR3**.

However, I recommend that you use the trimpots. Every transistor is different and may or may not sound optimal with the given values. Start by setting the trimpots to the values mentioned in the table (preferably before soldering them to the pcb). To measure the resistance correct use an digital multi meter and measure the resistance between pins marked **1** and **2**. For your convenience I marked these pins also on the backside of the PCB. After setting the pots, test the effect. If it does not meet your expectations you can measure the voltage per transistor. I marked the collector pads of each transistor on the backside of the PCB. Use the red probe on these pads and the black probe to ground to get a good reading. Adjust the corresponding trimpot to get to the target voltage. If both techniques do not give you your optimal sound then find your own sweet spot.

		Colorsound		**Throbak**	**Target voltage**	
Biaspots	**Transistor**	*Power boost*	*Overdriver*	*Overdrive Boost*	@9V	@18V
VR1	**Q1**	4k7	6k8	5k6	2.5V	5V
VR2	**Q2**	1k8	1k8	2k	5V	10V
VR3	**Q4**	3k9	1k8	1k5	6.5V	13V

Note that turning VR1 does not really influence the collector voltage of Q1 as it is connected to the emitter.

Troubleshooting

All PCB's have been 100% factory e-tested and out of every batch I receive I build an effect to double check, so there should not be a connection problem on the PCB itself.

The board is not working (at all), what now?

- Check if your 9V is plugged in correctly (and/or soldered correctly on the board). Pay special attention to the polarity.
- Check that you oriented the capacitors, IC's ,transistors and diodes the right way. SMF, MKT and ceramic capacitors as well as resistors do not need to be oriented. A likely sign of incorrect capacitors and/or orientation is when an effect is sputtering, rumbling or "motorboating".
- Check if you used the correct values of the components. For resistors you can look here: http://www.diyaudioandvideo.com/Electronics/Color/
- Double and triple check your soldering! A loose or cold solder can be really bad for your board.
- Replace the IC and/or transistors, one might be defective. Before doing that first unplug the 9V and wait for 5 seconds.
- Check that you have good/high grade components. A lot of Chinese sourced parts are fakes (especially high end opamps, audio capacitors, vintage diodes and transistors) so be careful that you source your parts from reliable suppliers.

Schematic