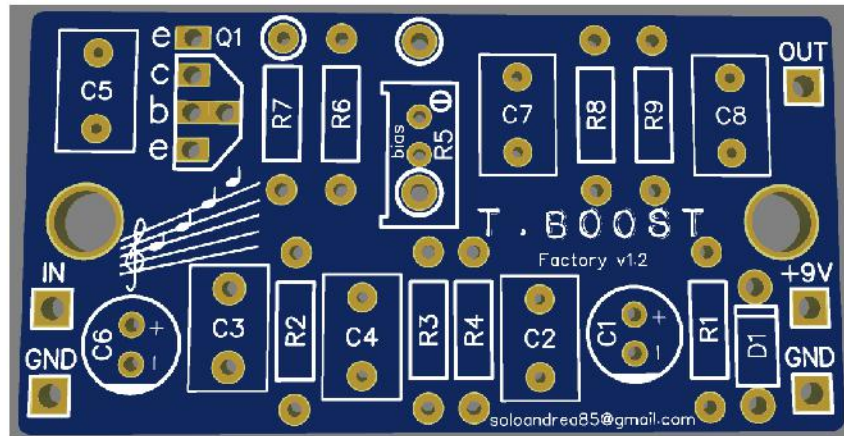


T. BOOST FACTORY V1.2

FOR NPN TRANSISTOR

Doc rev.: 146



Proudly designed in Italy by:

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T.BOOST Factory is the definitive board to build any type of treble booster you want; it's a very simple type of guitar effect, which increases the presence of medium and high frequencies with a very sweet and musical character.

The father of the treble boosters is the Dallas Arbiter Rangemaster, many variations are born from it. The circuit is made up of a single transistor and a handful of passive components.

One of the biggest users of treble boosters is Brian May, inside the pdf you will find all the instructions to build all the types of TB that Brian used for each "era" with Queen.

For its simplicity, you can undoubtedly build it with a veroboard, but with this **Printed Circuit Board** it will be even easier to build one immediately.

This pcb designed by me for fun, wants to be a platform where you can experience all the nuances of this pedal.

So, take your solder and let's build your treble booster!

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Specs

This circuit is designed to be powered with 9V DC.

Resistors should be 0.25W (1/4W).

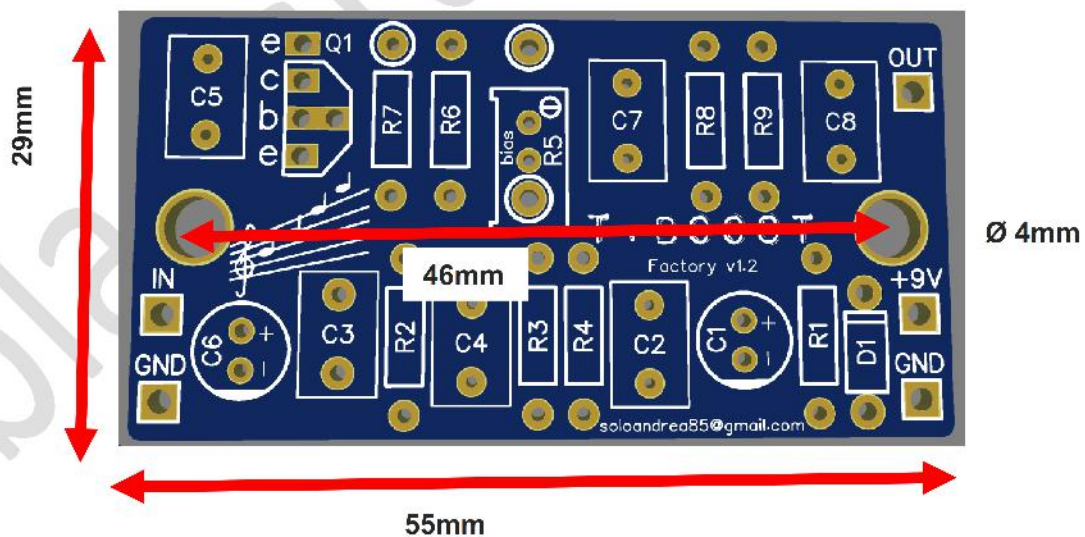
I recommend to always use metal film resistor with 1% tolerance (the blue one).

The carbon resistor has a tolerance of 5% which could introduce noise and deviate from the designed resistive mesh.

Electrolytics caps should be at least 16V or even better 25V.

I recommend using quality electrolytic capacitors with a low ESR value.

- pcb dimensions 55mm x 29mm
- hole diameter 4mm
- hole spacing 46mm (center to center)



I took my favorite artist as a reference and from there I did a lot of research around the net... Brian May was definitely one of the main users of the treble booster, in his career with Queen he has owned several.

But during the *magic years* with Queen (the years with Freddie) he always used a treble booster in particular: the T.BOOST.

All treble boosters differ from T.BOOST in small or significant shades highlighted in yellow.

In this table I have tried to summarize almost all the treble boosters used for each "era".

	RANGEMASTER	T.BOOST	STARFLEET BOOSTER	TOURING-ISH	DLX	PLS	T.BOOST.2020	MAY83
Era	Late '60 – '73	'75-'90	1983	'97-'20				
Q1	2N388A/MP38A	BC149	BC182L*	BC182L*	BC239C	BC239C	BC239C	BC549C
R1	wire	100	100	100	100	100	100	100
R2	1M	120k	120k	120k	120k	120k	120k	120k
R3	470k	100k	100k	100k	100k	100k	100k	100k
R4	wire	1k	1k	1k	1k	1k	1k	1k
R5	100k trim**	22k	22k	22k	22k	22k	22k	22k
R6	3,9k	2,4k	2,4k	2,4k	2,2k	2,2k	2,4k	2,4k
R7	10k	6,8k	6,8k	6,8k	6,8k	6,8k	6,8k	6,8k
R8	wire	wire	wire	2,2k	560	wire	wire	wire
R9	empty	47k	47k	47k	180k	empty	47k	47k
C1	100uF/25v	47uF/25v	47uF/25v	47uF/25v	100uF/25v	100uF/25v	47uF/25v	47uF/25v
C2	empty	empty	empty	empty	empty	empty	empty	empty
C3	5nF	4,7nF	4,7nF	4,7nF	6,8nF	10nF	4,7nF	10nF
C4	empty	empty	empty	empty	4.7pF	empty	empty	empty
C5	empty	1nF	1nF	1nF	1nF	1nF	1nF	1nF
C6	47uF/25v	47uF/25v	47uF/25v	47uF/25v	47uF/25v	47uF/25v	47uF/25v	47uF/25v
C7	10nF	47nF	47nF	47nF	47nF	47nF	47nF	47nF
C8	empty	4,7nF	4,7nF	4,7nF	4,7nF	4,7nF	4,7nF	4,7nF
D1	1N4001	1N4001	1N4001	1N4001	1N4001	1N4001	1N4001	1N4001

* read the "transistor pinout" section

** read the "biasing R5" section

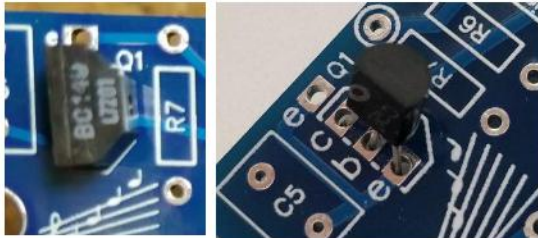
Transistor pinout

The pcb is designed to host many types of transistors:

- "LockFit" transistor (BC149)
- Transistors with different pinouts:
 - o CBE like BC239C and BC149
 - o ECB like BC182L
- Transistors with wider pins (BD139)
- Center pin transistor with forward offset, "molded"

CBE

This is the most common pinout, follow the footprint

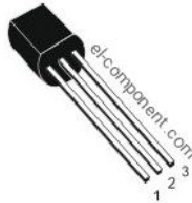
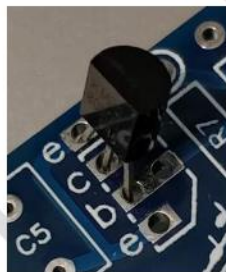


BC239C pinout

1. Collector
2. Base
3. Emitter

ECB

The BC182L has **ECB** pinout, to use these transistors, just move it upward.

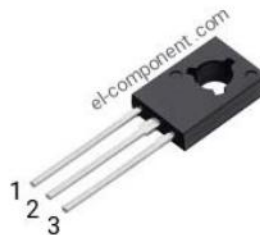
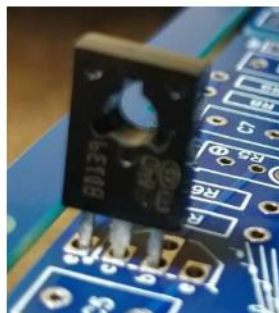


BC182L pinout

1. Emitter
2. Collector
3. Base

ECB reverse

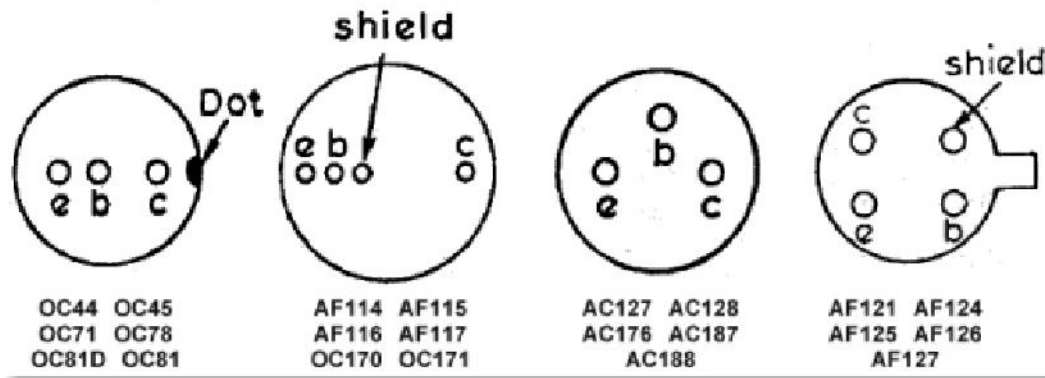
BD139 should be rotate and move upward:



BD139 pinout

1. Emitter
2. Collector
3. Base

Germanium transistor pinout



BC149

The T.BOOST, is a derivative of its predecessor (the rangemaster), which eliminates some problems such as:

- Getting a PNP or NPN Germanium transistor with low leakage and proper hfe (50-100) preferring the most common silicon transistors of the time
- Bias variation with temperature
- Poor noise performance (mainly hiss)

The transistor used by Brian in his original pedalboard is the Mullard BC149 "Miniwatt - Lockfit" (without letters).

This series of transistors was very popular in 1970, it is interesting to know that they shared the same technology as the BC109 which, together with the BC108, were very famous for being used in the first silicon Fuzz Face (blue version).

Typically, manufacturers divide the transistors into categories based on gain (and other parameters), typically the categories are: A, B and C.

If the transistor is not marked with this letter, it means that it could belong to any group.

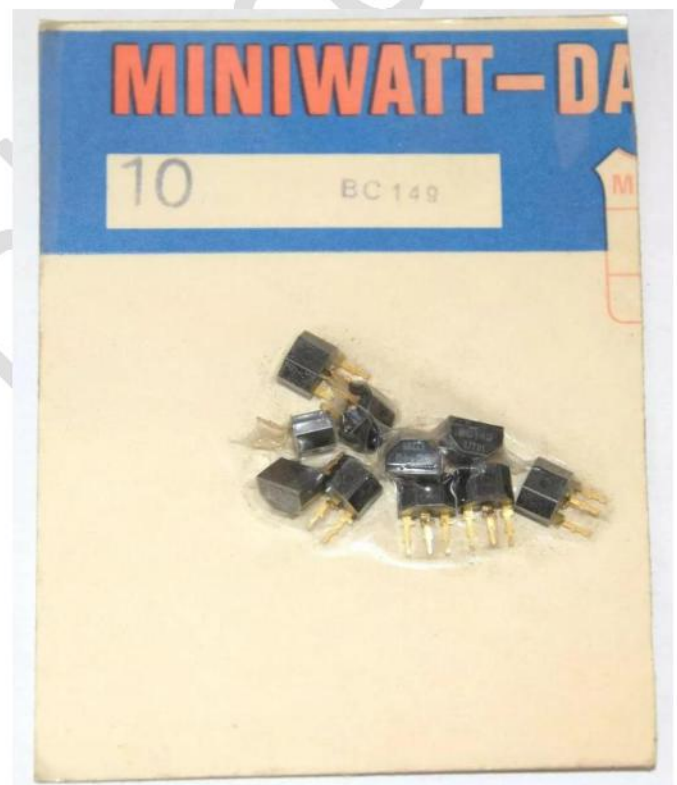
Nowadays BC149 equivalents can be: BC549 or BC239

As for the gain, the exact value is not known, but presumably a transistor with a gain of **400-420 Hfe** should be fine.

The best way is to go "by ear" trying more transistors and gains... maybe playing on the bias.

Read more:

https://www.markhennessy.co.uk/articles/vintage_transistors.htm



Transistor alternatives

If you plan to experiment with multiple types of transistors, I suggest you solder a transistor socket to the PCB so that you can quickly replace the transistor and try some alternatives like:

2N3904, 2N5088, 2N5089, 2SC1815, 2SC732, BC107, BC108, BC109, BC182, BC183, BC184, BC149, BC173, BC546, BC547, BC548, BC549, MPS8098, MPSA05, MPSA06, MPSA18, MPSA20, BD139, 2N2369A.



Female strip pin used as transistor socket

We can quickly summarize this way:

High gain silicon NPN	2n5088 , 2n5089
Medium gain silicon NPN	2n4401 , 2n3904
Low gain silicon NPN	2n3903, 2n2369 , 2n2270

Usually low gain transistors are used for the rangemaster.

Germanium transistor for Rangemaster

The germanium transistor for the Rangemaster should be have a gain value between 75 and 100 Hfe; 90Hfe is the *perfection*. Preferably with a very low current leakage.

A good germanium NPN transistor should be: 2N388A

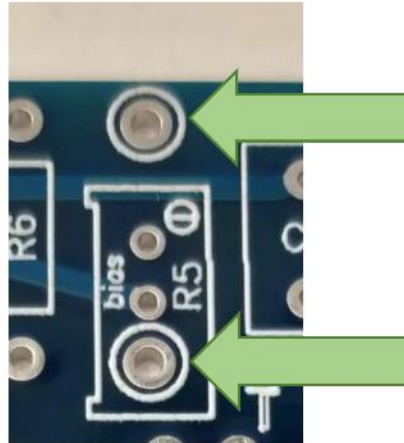
Today the best germanium transistors you can buy online are undoubtedly the **Russian military-made transistors**.

They have characteristics that make them almost perfect, try to find a good: CV7351 or MP38A.



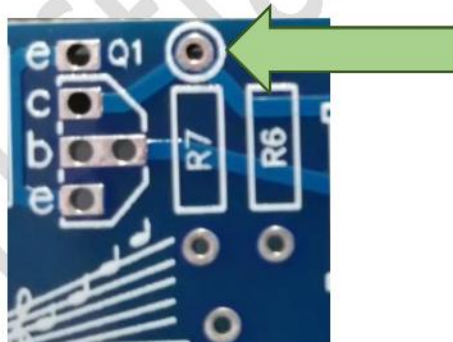
Biasing R5

If you want to use a fixed resistor, solder it between the two circled holes:



For the Rangemaster Treble booster, after assembling the pedal completely, solder a 100k multiturn Burns trimmer.

Applies voltage to the pedal and place the negative digital multimeter test probe on any GND point, place the other probe on the collector of Q1, the closest point is the circled R7 pin:



It is commonly agreed that the ideal bias point for the Dallas Rangemaster Treble Booster is to have Q1 collector voltage at 7.0V (any value between 6.9 and 7.1 would be great).

For the other treble boosters it is not strictly necessary to adjust the bias, especially for silicon transistors.

But you may find it fun to find the right spot by acting on the trimmer.

For example, with a voltage of 9v a good bias point at the collector would be around 6.114v.

You may also think you have an external potentiometer to adjust by "ear" and increase the fun!

Use a 100k for the rangemaster or 50k for the other boosters, join pin 1 and 2 of the potentiometer and solder two pieces of cable on pin 1 and 3, on the other end solder the cables respectively on the two holes circled as if it were a fixed resistance.

Power section

In many TBs there is no **D1**, but I highly recommend adding a protection diode in case of accidental reverse polarity, typically a *1n4001* diode can be an excellent choice. An alternative could also be a 1n5401.

R1, **C1** and **C2** form a ripple protection filter due to external not well regulated power supplies that cause noise.

If you use external power supplies I suggest these values based on the *Huminator* at Beavis Audio Research:

R1: 100 Ohm

C1 (electrolytic): 100nF / 25v

C2: 47nF

Input cap mod C3

One of the best mods to do is that of the *input cap mod*.

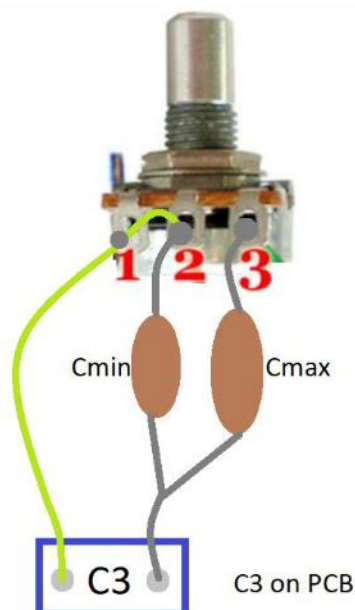
Essentially changing the capacitor C3 changes the sound output of the treble booster.

As for the transistors, also in this case I suggest you to solder a socket to quickly and simply change the capacitor in order to test by *ear*.

I suggest you any value between 1nf to 22nf, but keep in mind that the "*right*" value is 4.7nF.

You can also try this mod, solder two caps like this:

- Cmin: 3.3nF
- Cmax: 68nF
- 500kA pot



PNP mod

The original rangemaster was built with Mullard OC44 germanium transistors which is a PNP transistor.

The board was designed to work with NPN transistors because silicon transistors are practically all NPN.

It is much easier to find PNP germanium transistors than NPN, but it is even easier to find a NPN Russian-made germanium transistors.

Buying this type of transistor, you will not complicate your life to build your rangemaster.

But if you really want to build a rangemaster with PNP transistors with my board designed for NPN transistors you have two possibilities that you could follow:

Positive Ground Wiring or Real Negative Ground Wiring.

PNP Positive Ground

On the T. BOOST Factory:

- **reverse** all electrolytic capacitors
- **reverse** the diode
- **reverse** the voltage

Use only the battery, do NOT use external power supply.

PNP Real Negative Ground

If you really need to use an external power supply, you can consider using this type of wiring.

This is the most complete and clean version to use PNP transistors: we will use an additional board that converts the voltage from +9V to -9V.

<http://tagboardeffects.blogspot.com/2012/05/negative-voltage-inverter.html>

This is called “negative voltage inverter” board.

1. Both the connectors of the external power supply and the battery (if any) is soldered to the input of the voltage inverter board.
2. The output of the voltage inverter board goes to the voltage input of the T.BOOST Factory.

OUTPUT Voltage Inverter Board	T.BOOST Factory
GND	GND
-9V	+9V

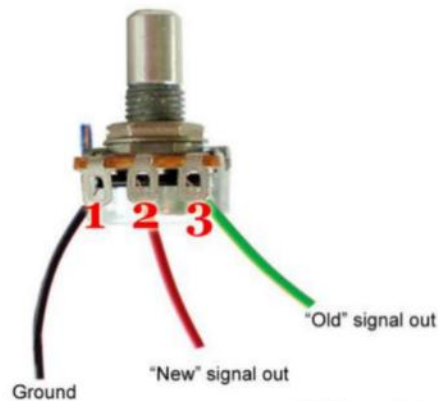
3. On the T.BOOST Factory:
 - **reverse** all electrolytic capacitors

- **reverse** the diode

Output Volume

You may think you want additional control on the pedal, maybe a volume.

To do this you should solder the potentiometer in this way:



I suggest you a 100k potentiometer or, even better, a logarithmic 250k.

The guild's double knob treble booster (the red one) had two controls: gain and intensity.

Both were two 250k potentiometers (probably logarithmic) placed like this:

The gain was at the pcb input and the intensity was at the pcb output.

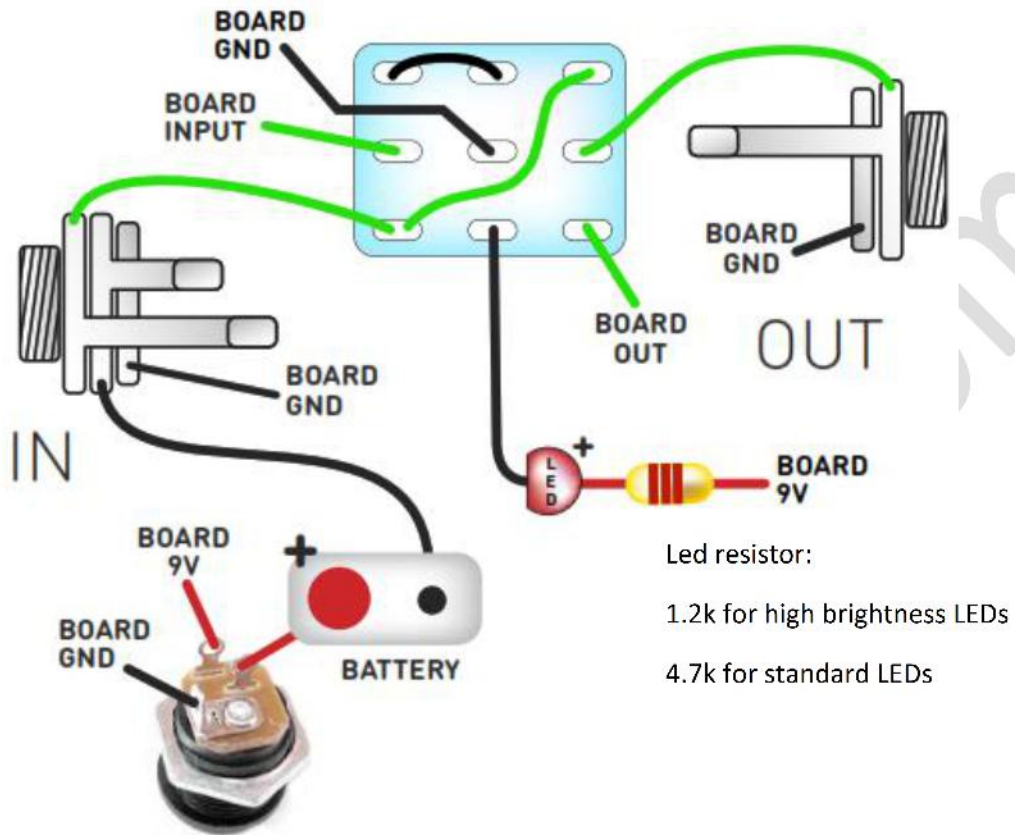
Again, try this method to have more control of your treble booster!

Q2 SMD

If you want to experiment with other possibilities and have good soldering capabilities, in addition to the TO-92 package transistors you could try some SOT-23 SMD transistors.

Do not use Q1 and test something like BC847 or BC850C on Q2.

Wire it up



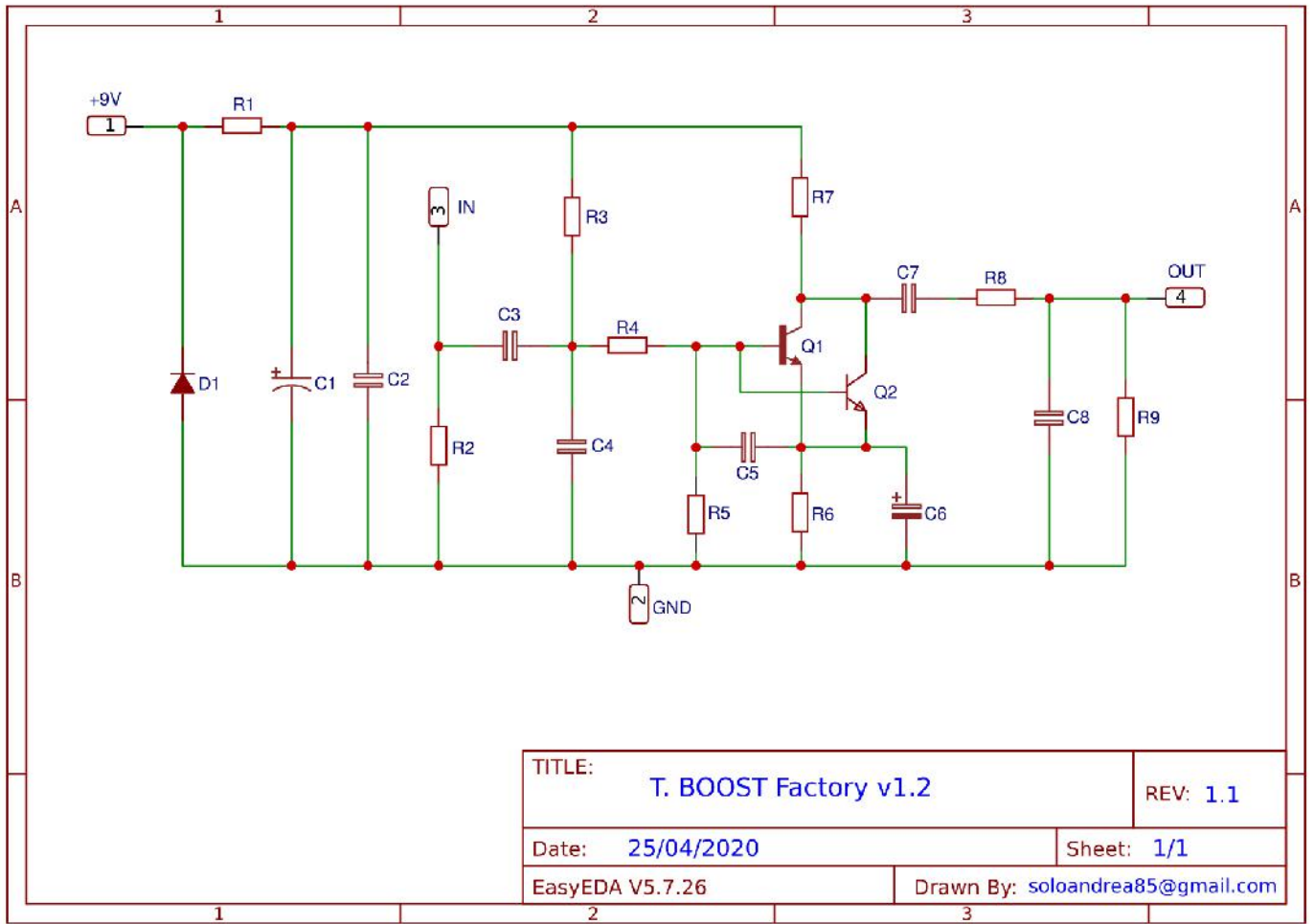
Wiring shown above will disconnect the battery when you remove the jack plug from the input, and also when a DC plug is inserted.

The Board GND connections don't all have to directly attach to the board. You can run a couple of wires from the DC connector, one to the board, another to the IN jack, then daisy chain that over to the OUT jack.

It doesn't matter how they all connect, as long as they do.

This circuit is standard, Negative GND. Your power supply should be Tip Negative / Sleeve Positive. That's the same as your standard pedals (Boss etc), and you can safely daisy-chain your supply to this pedal.

Schematic



blackst

Resources

[Rangemaster Technology from "Guitar Amplifiers"](#)

[Dallas Rangemaster Study By RG Keen](#)

[ElectroSmash](#)

[FuzzCentral](#)

<https://fryerguitars.wordpress.com/history-of-brian-mays-treble-boosters-and-pedalboard-used-with-queen-from-1970-to-around-1986>

<https://fryerguitars.wordpress.com/history-of-the-brian-may-fryer-treble-boosters-and-other-greg-fryer-pedals-made-from-1997-to-2019/>

<http://www.petecornish.co.uk/queen.html>

<http://www.petecornish.co.uk/Vintage.html>

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