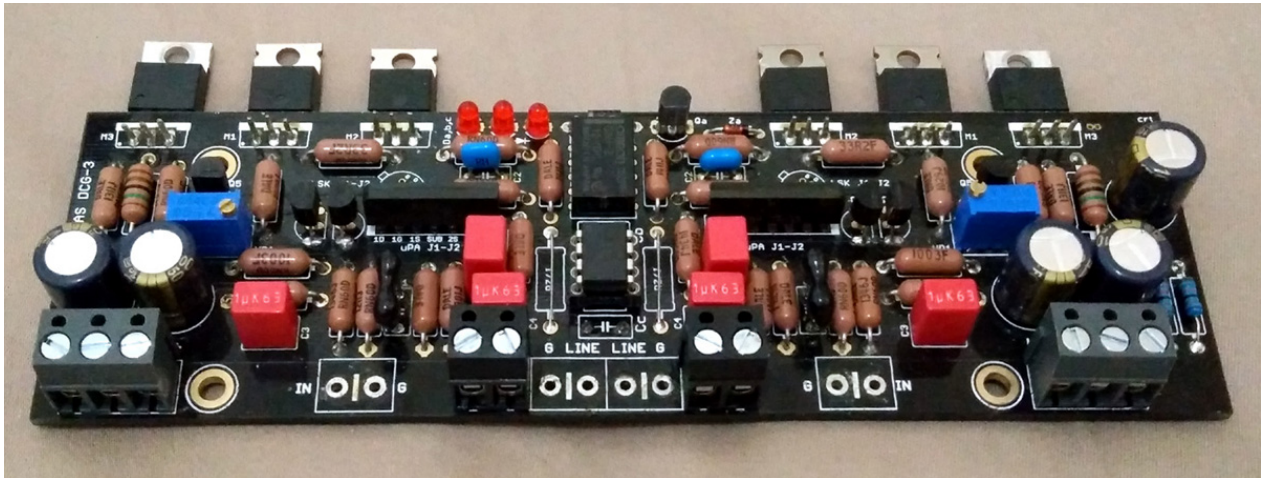
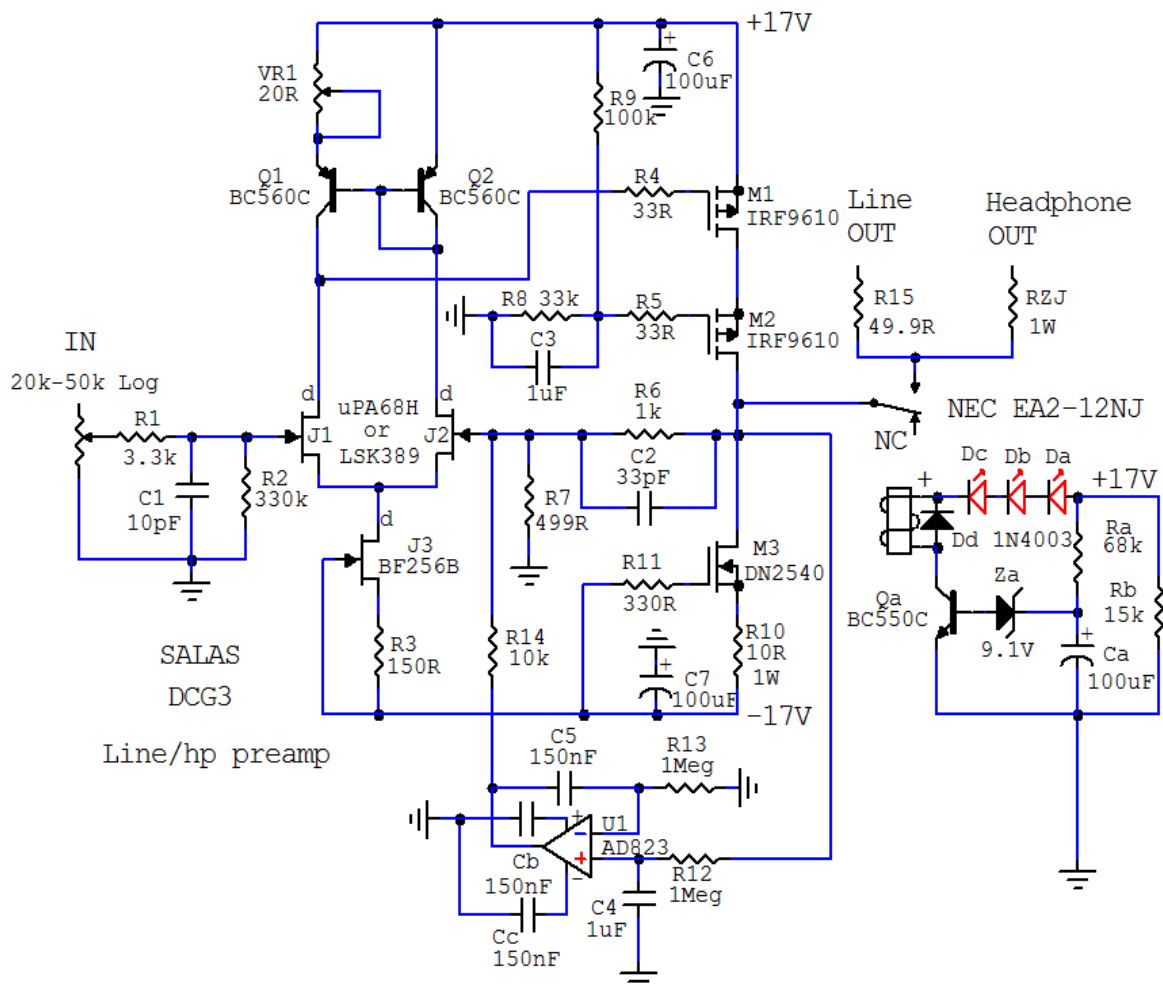


SALAS DCG3 & DCSTB build guide



DCG3 line & headphones preamp

Schematic DCG3



(one channel is shown, the relay and op-amp sections are shared between stereo)

BOM DCG3 (two channels)

Resistors (Dale CMF55)

2x R1 3.3K
2x R2 330K
2x R3 150R
4x R4,R5 33R
2x R6 (see gain in notes section)
2x R7 499R
2x R8 33K
2x R9 100K
2x R10 (CMF60) (see bias in notes section)
2x R11 330R
4x R12,R13 1Meg
2x R14 10K
2x R15 49.9R
1x Ra 68K
1x Rb 15K
2x RZ/J (CMF60) arbitrary value or wire (see decide RZ in notes section)
2x VR1 20 Ohm Bourns 3296Y or 3296W

Capacitors

2x C1 10pF C0G TDK FG28C0G1H100DNT06 (50V through hole 5mm pitch) or Silver Mica
2x C2 33pF C0G TDK FG28C0G1H330JNT06 (50V through hole 5mm pitch) or Silver Mica
4x C3,C4 1uF 63V Wima MKS2
2x C5 0.15uF 63V Wima MKS2 or MKP2
2x Cb Cc 0.15 uF 63V Wima MKS2 (can alternatively be 1206 SMD 0.1uF 25V C0G)
2x C6, C7 100uF 50V Panasonic FC or 35V Nichicon FG (d=10mm, pitch=5mm)
1x Ca 100uF 50V Panasonic FC or 35V Nichicon FG (d=10mm, pitch=5mm)

Semiconductors, relay

2x (J1/J2) uPA68H monolithic JFET pair or 2x LSK389 TO-71 monolithic JFET pair (>3mA idss)
2x J3 BF256B JFET
4x Q1,Q2 BC560C (5% near in Hfe)
1x Qa BC550C
4x M1,M2 IRF9610 MOSFET
2x M3 DN2540 MOSFET
1x U1 AD823ANZ Analog Devices 2 channel through hole OP-AMP
3x Da,Db,Dc red LED 3mm
1x Dd 1N4003 or any other 1N400X diode
1x Za 1N5239B or any other 9.1V 0.5W Zener
1x NEC EA2-12NJ or NU miniature relay

Various

1x Heat sink 1.2C/W for 100mA or 1C/W for 150mA
Alternatively straight to chassis mass sinking. 160x10mmx30mm Alu bar in-between can help
1x DIP IC socket 8 pin for U1
6x Silpads for TO-220 6x plastic grommets for TO-220
6x M3 screws 10mm L for mounting Mosfets
2x 3pole screw terminal block (preferably black) 5mm pitch for the power rails
6x 2pole screw terminal block (preferably black) 5mm pitch or signal wires directly soldered to pcb

**The parts brands & types listed are indicative for quality and size and not mandatory in any case

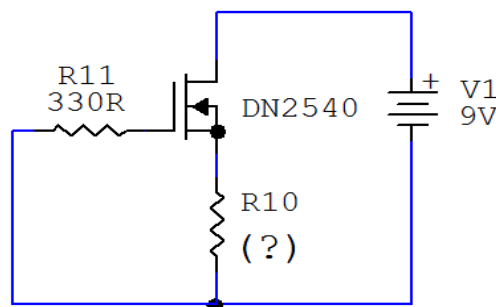
DCG3 notes

1. Decide the output stage bias

100mA bias is fine for line preamp role and driving most headphones. 150mA offers better current headroom and THD for below 60 Ohm headphones. Especially on insensitive cans. Sensitive ones like Grado (32 Ohm) can hit 120dB with 100mA bias nonetheless but the THD will still be better in on those also when at high bias. Even >150mA can be set if you got the sinking. This SE output stage can swing double its bias current before negative peak clipping. It can also swing near rail to rail voltage when the current suffices for that on a given load. Dissipation will be 6.8W at 100mA for two channels on 17V rails. 10.2W at 150mA for two channels. M1 & M2 share half heat on each channel's positive polarity while M3 takes it all in the negative side. But on a common sink the heat averages better.

2. R10 sets the bias

Depletion mode DN2540 (M3) has a wide V_{gs} (off) production spec but many samples measure around 2-2.1V. For those an R10 value of 12R brings 95-105mA, 10R 110-120mA, 7.5R 140-150mA. When not pre-selected as such and to know what bias to expect with any random sample they can be tested with a 9V battery. See the little schematic. Try a range of 6.8R to 15R 1W values. Voltage across R10 will show how many mA to expect later in the preamp. By Ohm's law $I=V/R$. Combining different R10 values with the M3s at hand you can target both the bias of choice and a good match of it in the channels. Do quick enough tests not to heat M3s much or use a small sink. No more than 5% difference in bias between channels is a very good result when 100mA or 150mA are just nominal bias figures. Do not care for meeting them exactly.



3. Decide RZ/J (affecting the headphones output only)

The technically correct value is zero added Ohm so you can use a jumper wire in its place or a 0.1R 1W resistor for the assembly to look nice. This is the headphones output path and some people may want to under damp a pair of cans that sounds dry to them though. More than 10% RZ value of the headphone's nominal creates more than +/- 1dB response changes to them so its considered intentionally coloring. It also eats output power. You do what you like, but keep those things in mind.

4. Decide gain

The standard setting is 3x. That's a good figure for line and headphones. 2x to 4x is a recommended area of customization according to your needs. R6 sets the gain. 1K for 3x, 499R for 2x, 1.5K for 4x. Unity gain can't be set.

5. Assembly

Populate all components except the Mosfets. Don't solder the op-amp use a DIP-8 socket. A practical way to populate the board is to solder the resistors and the socket first, then the relay, the Jfets, the transistors and Leds*, the trimmers and the small capacitors*, the connectors, lastly the electrolytic capacitors. Don't insert the op-amp in its socket yet.

*If you think that the three Da,Db,Dc Leds will be too bright a distraction, because they must pass the relay coil's mA, solder them under the board.

*Also If you plan op-amp types rolling solder Cb Cc MKS2 under the board too or use C0G caps on the extra SMD pads for easier access to pulling a chip from the socket.

Mount and insulate the Mosfets on the sinking now. See how their leads need form if on side sink or chassis as sink (whatever you opted for). Secure the board's position first and lastly solder the leads so to avoid stressing them.

6. Electrical Test

Connect near to +/-17V PSU(s). They should be capable of the currents involved. Two channels can steadily draw 225-325mA at 100mA or 150mA output stage bias including the smaller parts consumption. The positive rail can swing double that bias in AC. When using a mono PSU between channels run wires from both DCG3 channel's power connectors to the PSU's output +/- points. If using double mono PSUs connect each channel's +/- to each PSU separately. Mains earth the chassis and wire a connection from any input or output ground point to chassis also. Fuse the transformer(s) primary as rated by its manufacturer. Power up. The three Leds should light up in about five seconds and a relay click heard. Let it warm up for 15 minutes while periodically checking heat on sinking and on various semis as well as the voltage drops across R10s. The drops divided by the Ohms should indicate 100-150mA. Also see to surely have lower than 18V rails not to fry U1 later on. If anything overheats, blows, smokes, or R10 readings seem way off, shut down and debug. Look for blown fuses, wrong rails wiring, missing components, wrong resistors or transistors in wrong places, cold joints, solder bridges, bad Mosfets insulation etc.

7. DC offset

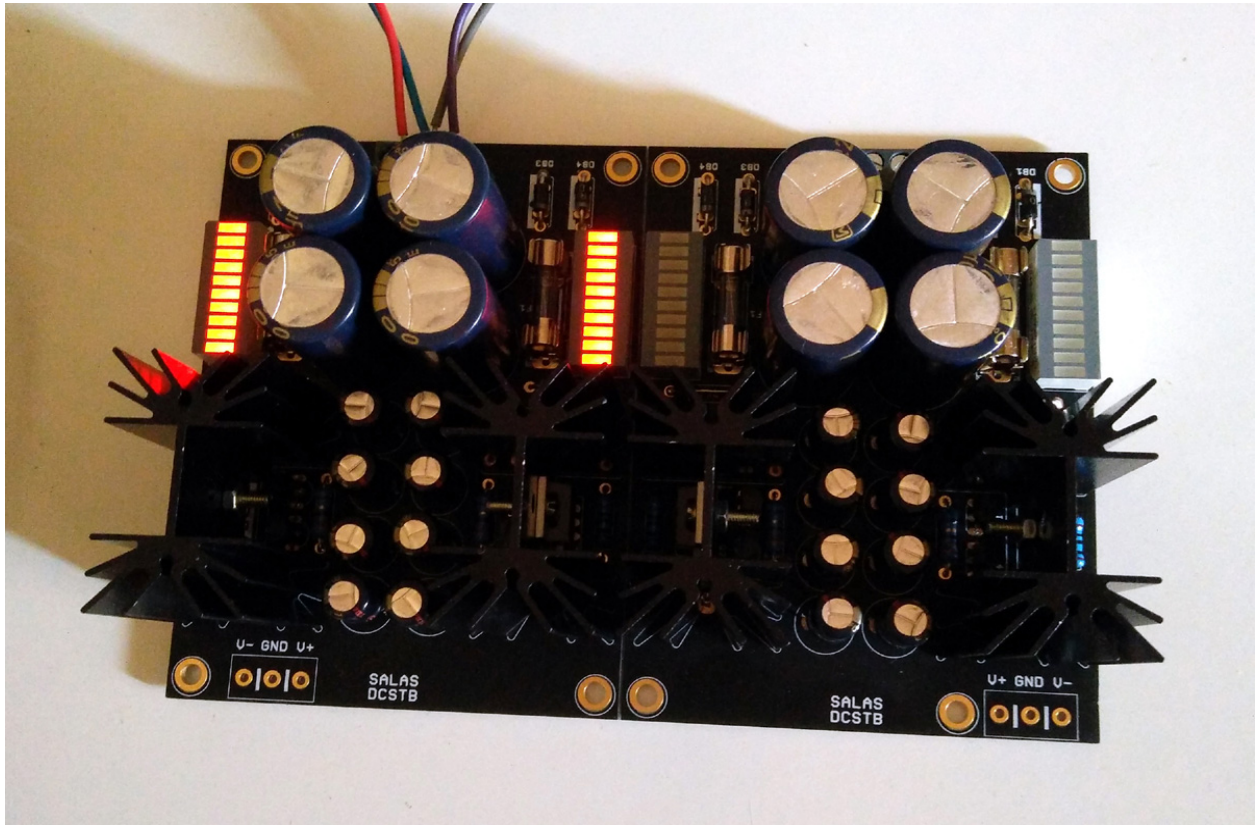
If all is ok and warm, short the signal inputs and measure the DC offset across each line output. It may read many mV at first because VR1's half point starts at a relatively high value for the purpose. Tweak VR1 per channel to the narrower range of hovering mV around zero DC you can. Don't expect it to stop moving about because it will not. Shut down. Measure that the rails are down to zero volts first. Put the op-amp in the socket with its dot oriented towards the relay. Power up. A minute after the click verify that the DC offset is very low in mV. It may prove less than 1 mV even but not all op-amps are doing the same.

8. Finish the build

All usual stuff about putting together a fully finished preamp apply. Can not describe a certain example. Each one will have different ideas for box, number of inputs, control system, or circuit peripherals in mind. Use a 20K-50K log pot or any attenuation system you prefer in the same impedance range. Coaxial signal wire is best for avoiding interference, also make good general grounding and mains earthing. Avoid ground loops by premeditating and inspecting your scheme well. See all metal parts to have continuity with DCG3 ground, PSU(s) ground, and mains ground. Including the pot. There are two extra line out pads and two ground pads underside at the front edge midway area in case you will need them. When connected to an amp follow the typical power on/off sequence. Preamp on first, preamp off last. No matter there is delay to reach DC stability first, which is good safety, relay contact pops are still possible. Due to class A operation its not being a cold idling circuit so some warm up time is recommended before critical listening.

9. HP output

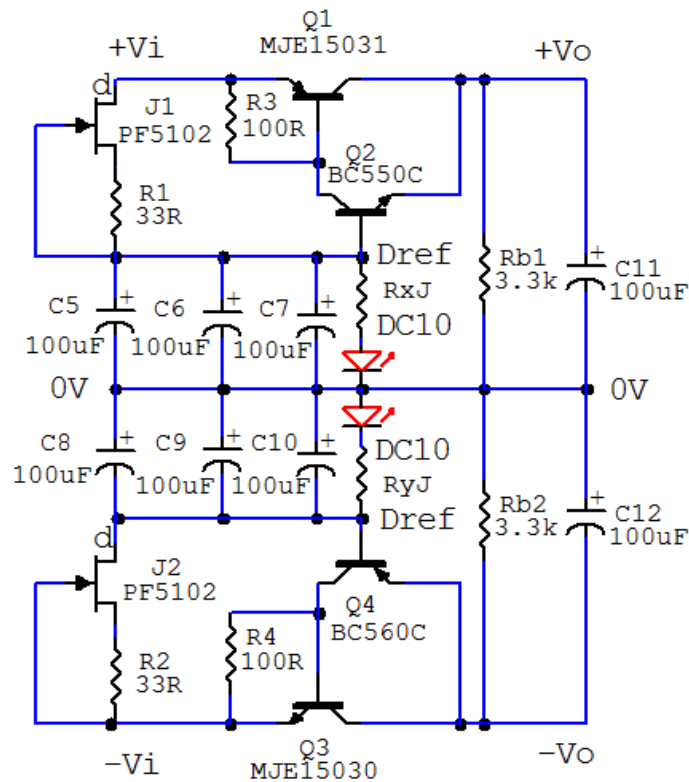
Headphones power when on 150mA bias 32R/360mW RMS 300R/400mW 600R/200mW
Headphones power when on 100mA bias 32R/156mW RMS 300R/400mW 600R/200mW



DCSTB power supply

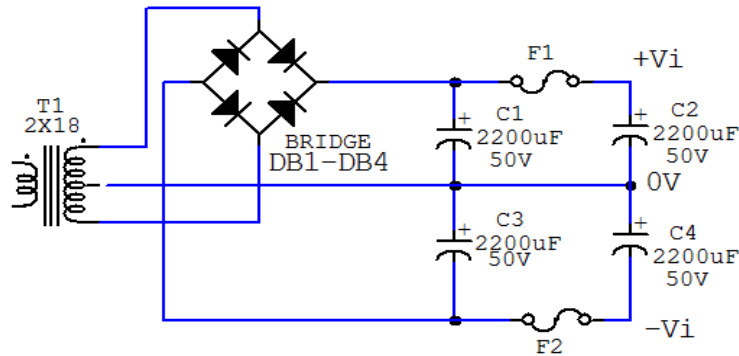
DCSTB is a purpose designed companion double mono PSU. There is no error amplifier to call it a regulator but its voltage stabilized with Leds on JFET CCS. Being a Sziklai pair capacitor multiplier has well extended flat output impedance in the range of 25mΩ.

It gave very good results allowing independent channel supplies without adding too much



dissipation or bulk. Alternatively anything from mono LM317/337 PSU to double mono shunt PSUs like SSLVs can be used.

Rectification and filtering are included (per one pcb section)



BOM DCSTB for two pcb sections (double mono/four polarities)

Resistors (Dale CMF55)

4x R1,R2 33R

4x R3, R4 100R

4x Rb1, Rb2 3.3K

4x RXJ, RYJ 1R or arbitrary values (see construction notes)

Capacitors

8x C1-C4 2200uF 50V Panasonic FC or 35V Nichicon FG (d=18mm pitch=7.5mm)

16x C5-C12 100uF 50V Panasonic FC or 35V Nichicon FG (d=10mm, pitch=5mm)

Semiconductors

2x Q1 MJE15031G or MJE15029G

2x Q2 BC550C

2x Q3 MJE15030G or MJE15028G

2x Q4 BC560C

4x J1,J2 PF5102 JFET (6-8mA idss)

4x Dref1, Dref2 Kingbright DC-10EWA ten segment bar graph led array

8x DB1-DB4 Schottky rectifiers SB180 1A 80V DO-41 or TO-220 of choice

Heat Sinks

4x Wakefield 647-15ABEP or Stonecold HS-142-38

DC rail Fuses

4x F1,F2 20mm T350mA 250V in double mono PSU or T750mA 250V in mono PSU

8x pcb mounting fuse holder end pins (two inline prongs style)

Transformers

2x 18+18V 50VA (example AnTek AS-0518)

Connectors

4x 3pole screw terminal block (preferably black) 5mm pitch

**The parts brands & types listed are indicative for quality and size and not mandatory in any case

DCSTB notes

There are two independent breakable board parts, each one makes two polarities. Notice that the board parts are mirrored so watch the component designations to insert correctly. Solder in the following order: Resistors (preferably put Rxj-yj underside for easy access if needed later.), led bars*, fuse end pins, connectors, TO-92s, 100uF caps, 2200uF caps. Mount the TO-220s on the sinks without isolation unless you have a reason for the sinks to be at no voltage potential, then solder them in. Don't solder the sinks legs yet so you can remove them easier to do repairs if the initial tests don't go well.

The led bars have one slant corner to orient them as found on the silkscreen. If in doubt there is also a dot next to each "REF" designation indicating cathode side. Light up the bars outer leds with a capable DMM in diode mode or a 9V battery to find their cathode (-). Stick the fuses in and wire the transformers secondaries to the AC connectors for a test. All led segments should light up in a red/orange hue and all outputs should measure below +/-18V. When so and the sinks are not overheating its basically OK. DCG3 is not sensitive to some asymmetry between +/-V. Differences like 0.2V or 0.3V just ignore. But If you find some outputs too unmatched (not likely) just because your led bars happened to be so or other tolerances conspired, you can bring up the weaker outputs to the stronger ones by increasing associated Rx or Ry. They are closing circuit for led REFs and serve as test points and as a means of adding balancing or arbitrary voltage to the REFs.

Measure in mV DMM scale across Rx or Ry. For 1R the readings directly translate to mA. Predict the new needed R value for covering a voltage difference by $R=(Vdif/mA)*1000$. Replace with that resistor the relative rail's Rx or Ry. Example: You found got 5mA current running through a rail's leds REF but you need add 0.2V to make it symmetric. $R=0.2V/5mA=0.04*1000=40R$.

Also be careful not to short rails together or to ground by careless probing etc. Not only when powered on but not even while still holding a charge. Q2 or Q4 are likely to go in that case and although cheap & easy to get parts its not easily accessible replacing them either. The reservoir banks will empty fast at power off when the psu is connected to the preamp though because its bias outpaces the bleeder resistors by much. Don't forget to solder the sinks legs in the end.

When powering the preamp the PSU is on higher current duty and warm but it should not go much over 45C on the inner sinks or 40C on the outer ones (when double mono & bias is 100mA). The output voltage will go somewhat lower than in the unloaded state test also. Because the semis drops will increase.

You can break the board in two pieces and situate them as best helping the floor plan. Then the inner sinks become outer too and all are same in temperature. But when facing the preamp unbroken their widths and connectors align for short wiring between them. They can even be brought edge to edge with the rail lines hard wired without connectors. For DCG3 & DCSTB to be looking like one continuous surface.

*Those RxJ, RyJ positions are a place to also add much more voltage for using DCSTB in other projects with higher rails. For a lower rails project individual leds can be shorted out losing 1.75V with each. This PSU has been designed with DCG3 in mind but I knew that you would ask sooner or later :-)

10. Good luck and keep in touch

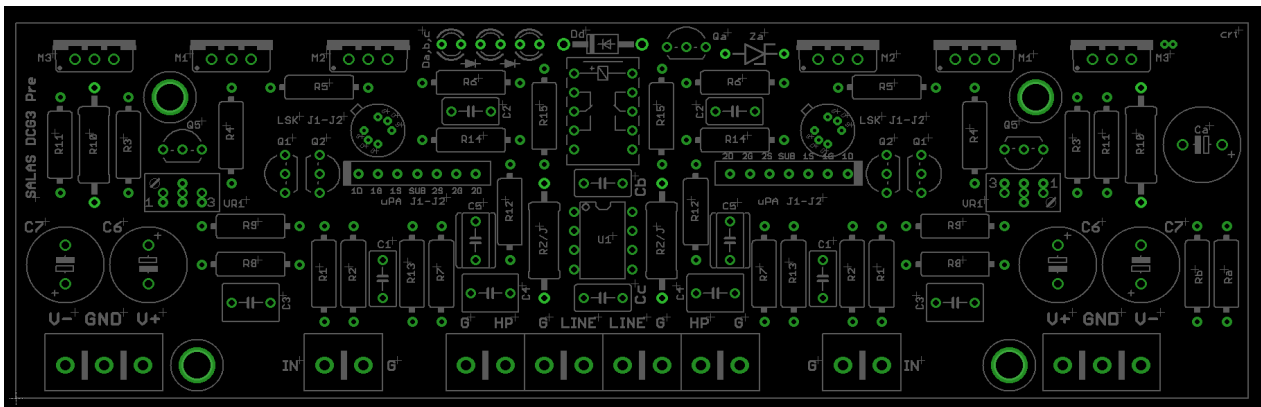
For further discussion & info there is the DIY AUDIO thread. See you there.

<http://www.diyaudio.com/forums/analog-line-level/296406-salas-dcg3-preamp-line-headphone.html>

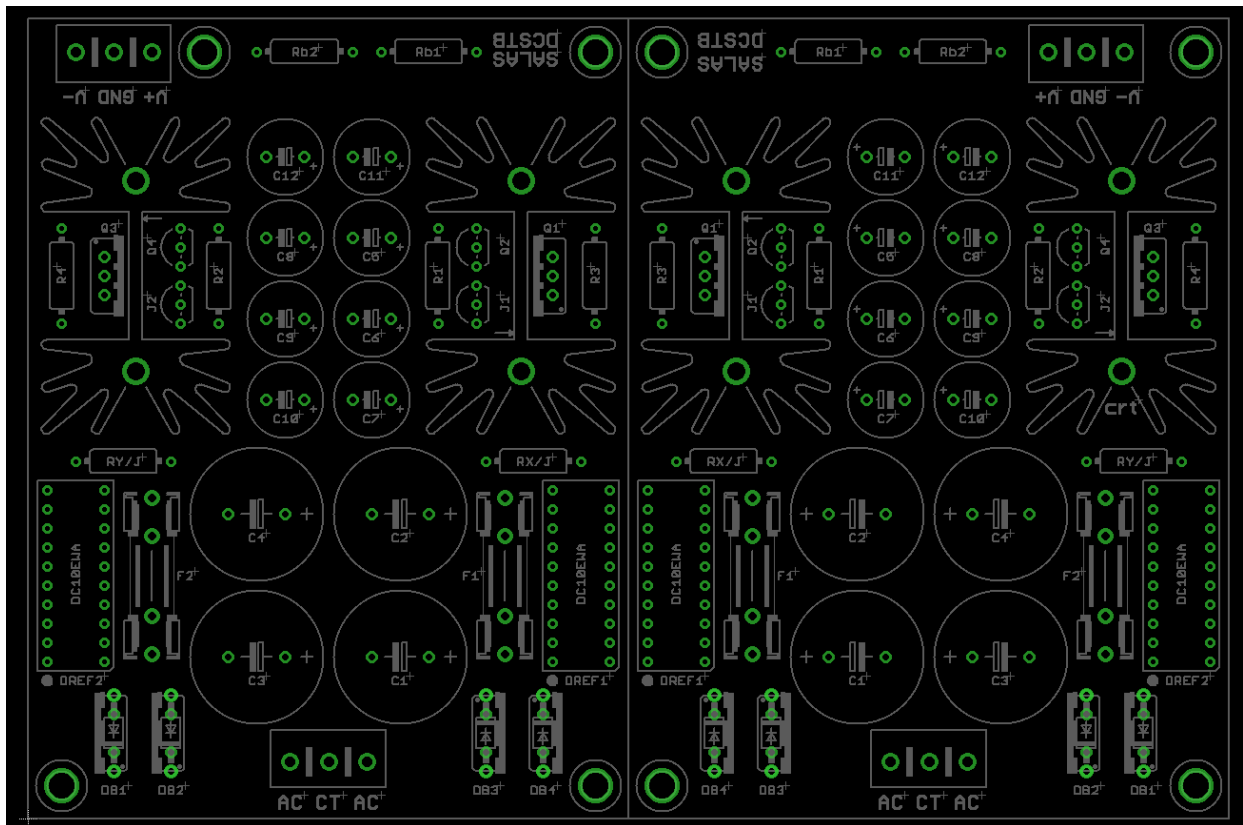
In the next page there are the boards component side references (Rb1,Rb2 added vs photos) For getting boards there is the group buys section of the forum to check how and when they are organized and going on. <http://www.diyaudio.com/forums/group-buys/>

For chassis there is the DIYAUDIO store. <http://diyaudiostore.com/collections/chassis>

A preamp board shall have designations like this (2 channels)



A PSU board shall have designations like this (two sections/double mono)



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