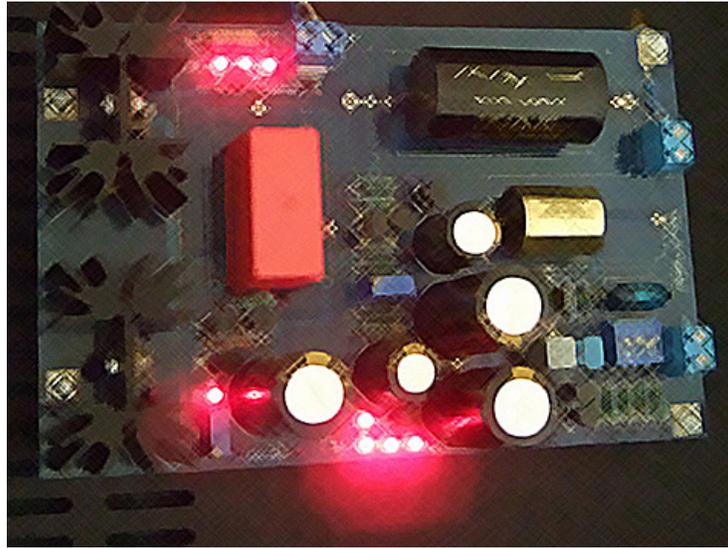


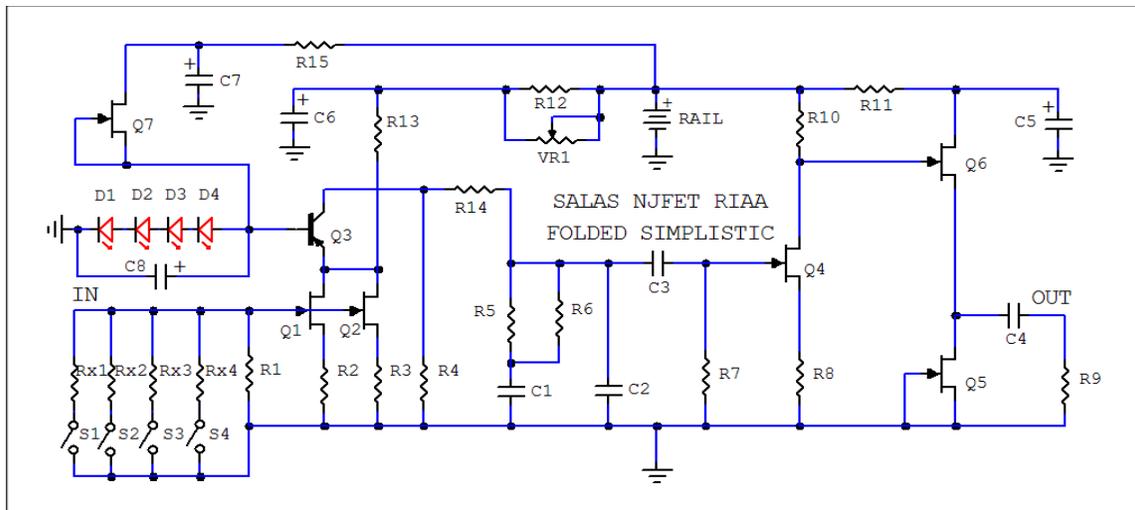
Salas Folded Simplistic PCB build guide



Intro

This document has the information to put together a Salas NJFET phono stage of simple design. It uses a folded cascode input stage, passive RIAA filter, common source second stage, a source follower buffer with constant current bias. No form of feedback between stages is employed. It can be made for different voltage gain. Input load is switchable. Suitable for LMC-MC-HMC-MM. There is an official double layer PCB available for it that carries two channels and two MOSFET shunt regulators. Comes in one piece and it is pre-grooved to be breakable into separate channels.

The main circuit



Parts lists, procedures, notes, and support schematics follow next. Read enough times to comprehend. All info in this document is Salas I.P. It's only shared for use in private non commercial DIY projects.

Main circuit BOM both channels

Max sensitivity list, see **gain** in the notes section first

PCB 1 Heavily gold plated double layer & double sided 142x190x2mm

Resistors

R1,R14	47K	4	
R2,R3	3-11R	4	See notes
R4	2.2K	2	
R5,R10	6.8K	4	
R6,R7,R9	1Meg	6	
R8	47R	2	
R11	1.5K	2	
R12	120R	2	
R13	1.2K	2	100 ppm 2W as Dale CCF02 (17.8mm pads)
R15	3.3K	2	
Rx1	100R	2	
Rx2	220R	2	
RX3	470R	2	
Rx4	1K	2	
VR1	1K	2	Bourns 3296 or alike

All resistors Dale CMF55 or PRP PR9372-1/4 or Takman Rey 25 else noted otherwise.
50ppm 0.5% are welcome. R1, R14 are important, use Vishay VAR naked Z-Foil if able.
All Rx also have 5 mm pads for Z-Foil VAR.

Capacitors

C1	47nF	2	Vishay MKP1837 1%
C2	15nF	2	Vishay MKP1837 1%
C2Y		2	Polystyrene, Smica 2-5% (notes). Pads, 5mm 10mm 12.5mm 14.5mm
C3		2	Film capacitor* for value see notes. Pads, 5mm 22.5mm 39.5mm
C4	2.2uF	2	Film capacitor* Pads at 45.5mm 56.5mm 64.5mm
C5,C7	47uF	4	Nichicon KZ or ELNA SILMIC II 100V
C6,C8	470uF	4	Nichicon KZ or ELNA SILMIC II 50V

*Industrial radial caps like Vishay MKP1837 for C3 and axial like SCR MKP for C4 can be used.
Also "specials" like Obbligato Gold, Mundorf SIO, Jantzen, Audyn TC etc.

Semiconductors

Q1,Q2		4	Toshiba 2SK369BL see notes
Q3Y		2	BC560C or Q3Z
Q3Z		2	Toshiba 2SA970BL see notes
Q4,Q5,Q6		6	Toshiba 2SK170BL see notes
Q7		2	Toshiba 2SK117GR 4-5 mA IDSS
D1,D2,D3,D4		8	LEDS 3mm RED generic see notes

Misc

DIP switch	2	Four positions 2.54mm pitch
IN,OUT	4	Molex double screw terminal 5mm pitch
Coaxial wire	1	RG174 signal cable or audio special 0.5m
Ground lug	1	For TT ground wire termination
RCA female	4	Chassis type good quality
XLR female	1	Chassis type 4 pin or "aviation" GX16-4P female

Regulator BOM both channels

R1x	15R	2	Low ppm 1W as Dale CMF60 or thick film as Caddock MP930
R2x,R4x	120R	4	
R3x	9.1K*	2	Dale CMF55 or PRP9372-1/2 or alike
R5x	1.2R	2	
R6x	22R*	2	
VR2x	2k	2	Bourns 3296 or alike
C1x	470uF	2	Nichicon KZ or ELNA SILMIC II 50V
C2x	4.7uF>63V	2	Wima MKP4, MKP10, or alike. 22.5 27.5 37.5mm pcm, MCap EVO
Elcap	22uF/63V	2	Alternative termination to C2x+R5x. Normal ESR, skips R5x. See notes
C3x	0.1uF	2	MKT 5mm pitch 63-100V
Q1x		2	IRF9610 MOSFET TO-220
Q6x		2	IRF9530 MOSFET TO-220
Q2x,Q3x,Q5x		6	Toshiba 2SK117GR 3-4mA IDSS
Q4x		2	BC550C 7% hfe match, the higher the better
D1x-D4x		8	LEDS 3mm RED generic see notes
Sinks		4	Wakefield 647-15ABP 38.1mm height 25.4mm pitch, board level sinks.
DCin		2	Molex double screw terminal 5mm pitch

*If batches of 2SK117GR are yielding circa 5mA IDSS then use 6.2K R3x 0.5W and 33R R6x.

Raw PSU BOM both channels

Transformers	2	Single 36VAC or 18+18VAC secondaries, 30VA power
MUR120	8	Fast diodes 1A 200V
1R	2	Resistors 2W
10R	1	Resistor 2W
10K	4	Resistors 2W
47K	2	Resistors 1/4W
4700uF/63V	2	Main PSU capacitors. Nichicon KG, M-LYTIC AG etc.
IEC	1	Male mains socket chassis mount
Fuse holder	1	Chassis mount round type
Fuse	4	Fuse T300mA for 230VAC or T600mA for 115VAC primary.
On/Off switch	1	Panel mount 1A / 115-230V rated
XLR female	1	Chassis type 4 pin or "aviation" GX16-4P female
Star quad	1	Four wire cable for umbilical and internal use 1.5m
XLR male	2	Inline type 4pin or "aviation" GX16-4P male
Lift diodes	2	Silicon 5A any type
Boxes	2	Metal boxes for PSU and main unit housing. 2U height.

PCB assembly

-Prepare the JFETS IDSS and LEDS Vf selection as in notes. Break the pre-grooved board in two. Check for any grease and dirt, wipe with a soft cloth. Use alcohol only if really necessary.

-Solder the small components first. Resistors, LEDS, MKP1837s, TO-92 semis, dip switches, trimmers, connectors. Most pads are small, thin solder wire is recommended.

Place R13 3mm off board and check that all the trimmers are set at half point value before soldering. Square pads are used for the LEDS cathodes. Also a diode symbol shows the cathode orientation.

Insert the dip switches in a way that 1,2,3,4 select the same Rx1-Rx4 values between channels.

-Mount the MOSFETS on the sinks before mounting the sinks to PCB.

Don't use insulation pads, just a tiny drop of thermal grease for the IRF9530.

Place the nut at the TO-220 tab so the mounting screw will be accessible from the sink's back.

Don't tighten the MOSFETS to the sinks strongly yet, so they can align when inserted to PCB.

Fix the assembly on board, move it for everything to align.

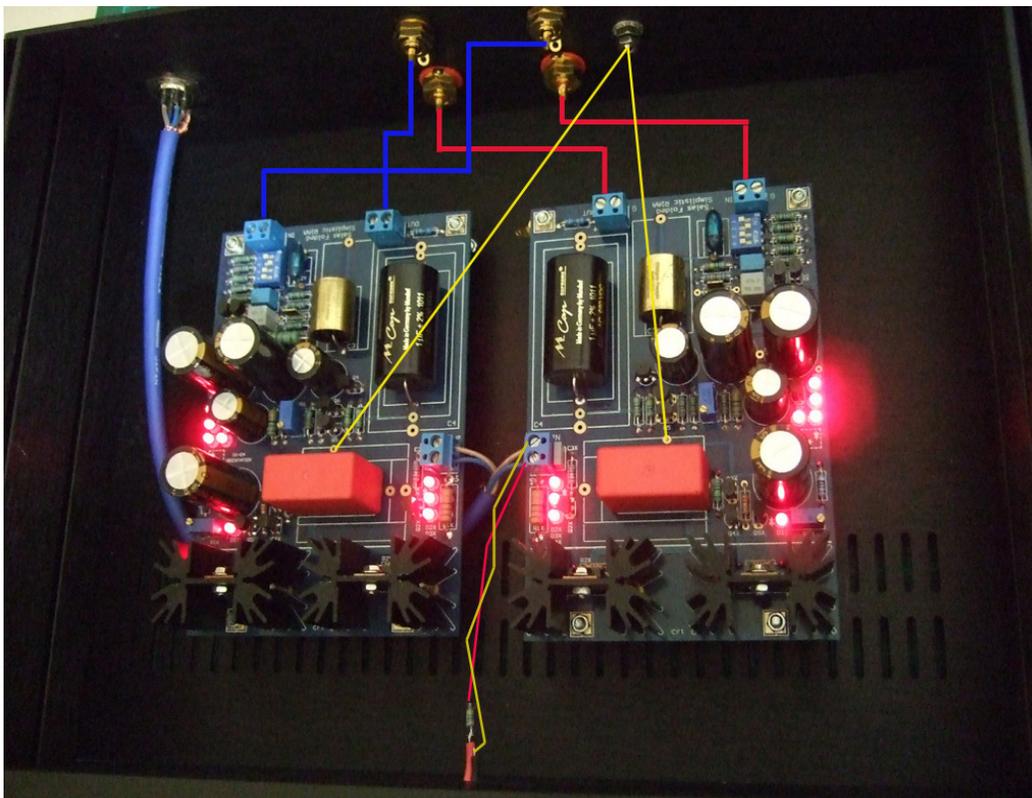
Hold in place each sink and solder its legs only. Now tighten the Mosfets and solder their pins last.

-Solder the big film capacitors.

C2x in PSU when MKP should keep one leg in the big pad next to R5x. If Elco it has its own pads.

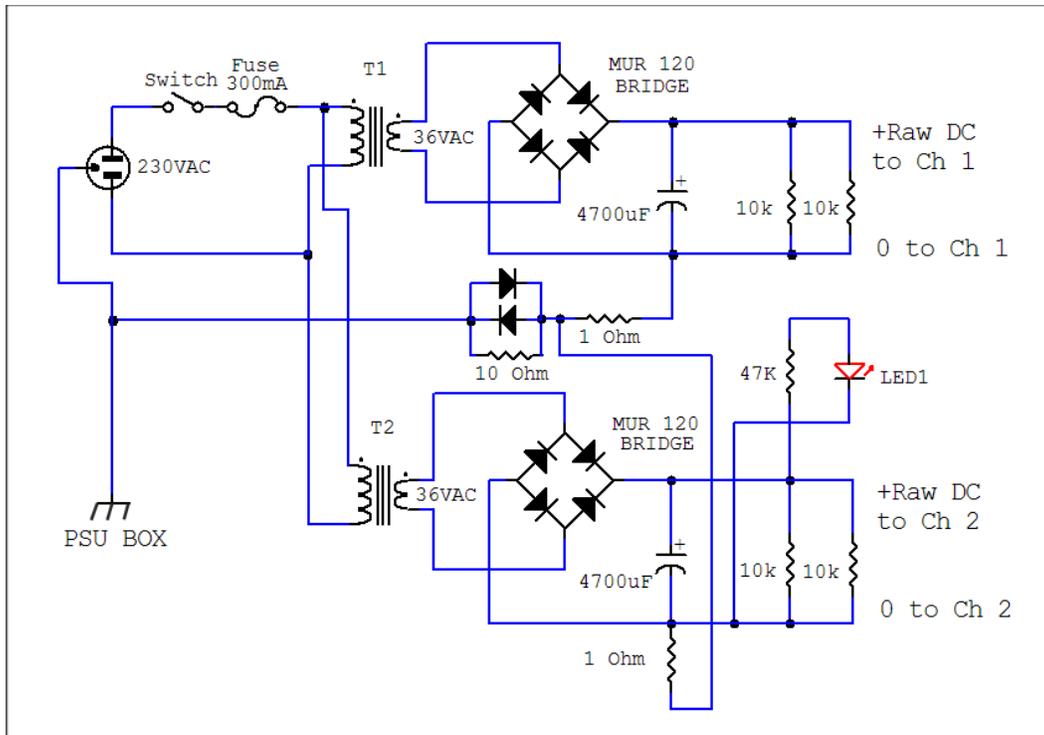
-Lastly solder the electrolytics watching their polarity. Inspect you did not forget inserting some component or any joint is left unsoldered before a power up attempt.

General wiring



Pic 1

Pic 2



Arrange the channels with facing DC in terminals. Keeps the hottest pair of output sinks far apart. Let the sinks ventilate. Wire as in Pic1. The thick blue and red lines are coax cable. The yellow lines are grounds. You may solder the signal cables directly and skip the In&out connectors if you prefer. When anodized box panels don't show continuity, link them from the common ground point at the ground lug. Fit the two raw PSUs in a separate box, follow the schematic in Pic2.* Each pair of wires in the umbilical cable carries separate +/0 to the respective PCB DC in terminal. Connect the umbilical cable's shield only at one raw PSU's 0 point, cut its other shield end off. For a phono box indicator LED or two, wire as shown in the PSU, feed from Ch1, Ch2 raw DC lines. *More elaborate and costly PSUS are up to you. The basic one shown in pic2 is satisfactory enough.

Biassing

- Connect V+ and GND raw PSU lines to the DC IN side connectors.
- Make no catastrophic polarity mistake. There are V+ and G marks for +/0 next to the connectors.
- Power on. The LEDs should come up instantly except the bunch of four at the side. Those should delay a second or two. Wait for 2 minutes.
- Use a DMM at DCV. Measure between RAIL+ and GND pads. Shall read somewhere between 34 & 36V. If not, set VR2x for about 35V. Leave it alone for half an hour to fully warm up.
- Q6 sink must be well hot when Q1 sink just warm, nothing smelling, no dark LED or too bright.
- Measure between TP1 and TP2. Red probe on TP1. Looking for a 3-4V range reading.
- If it reads much less, lower the rail voltage via VR2x slowly for taking TP1-TP2 to ballpark.
- If it reads much high, turn up B+ slowly. Let it alone for a minute. Tweak VR2x for 3.6V.
- Lastly use VR1 for better resolution tweaking at TP1-TP2. (TP1=D4,Q3 node. TP2=R4,R14 node).
- Between different gain set ups or due to tolerances the optimum RAIL+ may range from 33V to 37V. Each channel may require a bit different rail voltage also, this is normal.
- There will be drifts due to the input JFETs are sensitive but there is enough margin.
- You may check and reset after use in a closed box when the inside temp has climbed to max.

Notes

2SK369BL. Select IDSS pairs for Q1, Q2. Test them in same ambient temp for long enough each so to settle. You may need a batch of 20pcs. Use corresponding resistor values for **R2, R3** from this table:

IDSS mA 10 11 12 13 14 15 Tolerance 2%. [How to measure](#)

Rs Ohms 3.0 3.9 5.1 6.8 9.1 11 ~9mA through R2, R3 (each) is the expected bias.

Prefer matches from the 11-13mA range if you got, for better balance between current bias and source pin resistors noise.

2SK170BL. Find 8.2-8.5 mA 1% IDSS for Q4 between channels. Use 7.5-8.5mA Q5 fairly matched between channels. Use a little higher Q6 IDSS than what you got for Q5. Even up to 9-10mA is OK.

Q3Y Q3Z. BC560C goes to the Q3Y position. 2SA970BL goes to the Q3Z position. The 970 is more linear if you can get it. Use HFE over 350 +/-7% between channels in both cases. The more HFE the better. Its either Q3Y or Q3Z, not both.

LEDS. Have about 40, measure each, note Vf and assemble two quartets and two triplets for 7.75V 1% and 5.8V 2% total Vf. You may use a 9V battery and series 1.5K resistor to check each LED with a DVM.

Elcap. For those who want to experiment with the reg's termination altering its tone VS film cap Zobel

Input load DIP switch. Each ON position selects its according Rx load resistor value.

If all positions are OFF then the load is 47K. The BOM Rx values may be altered to preference.

By selecting more than one position ON, new values than those of single Rx are made by paralleling.

To skip calculations, just use the Ohm meter across the input and select various combinations.

For high MC and MM use higher loads like 3.3K 10K 20K 33K for Rx1-Rx4 resistors.

Gain. With Q1 and Q2 populated expect 62-63dB. Its OK for 0.2mV-0.4mV MC cartridges.

For 0.5mV+ MC cartridge and enough amplification in your control preamp or when having a medium MC 0.8mV-1mV, don't populate Q2,R3, use 2.2K 2W R13 for 56-57dB. Q1 IDSS and R2 as in the mentioned table. By trimming R8 when with FFT test gear you may match the channels better.

For high MC cartridge 2-2.5mV don't populate Q2,R3, use 68R R2 and 5.6K 1W R13 for 43dB gain.

Choose Q1 between channels from a 10.5-12.5mA range at 5% IDSS pair tolerance.

For circa 5mV MM cartridge don't populate Q2,R3, use 91R R2, 5.6K 1W R13, 1.8K R4, for 40dB gain and proper overload margin. Use 100nF C3 only value when with MM.

Choose Q1 between channels from a 10.5-12.5mA range at 5% IDSS pair tolerance.

C3 interstage. Use 100nF when your line stage input impedance is below 50K. 47nF is tighter for high impedance preamps but you may still prefer 100nF if looking for a bit rounder bass system synergy.

C2Y treble trim. If you got a 0.5% or better LCR meter measure each C2 15nF 1% nominal cap and note its exact value. Measure to find a C2Y trim cap so C2+C2Y=15.2nF. Gives almost neutral RIAA curve. Use the most tonally balanced input load value for your cartridge in combination.

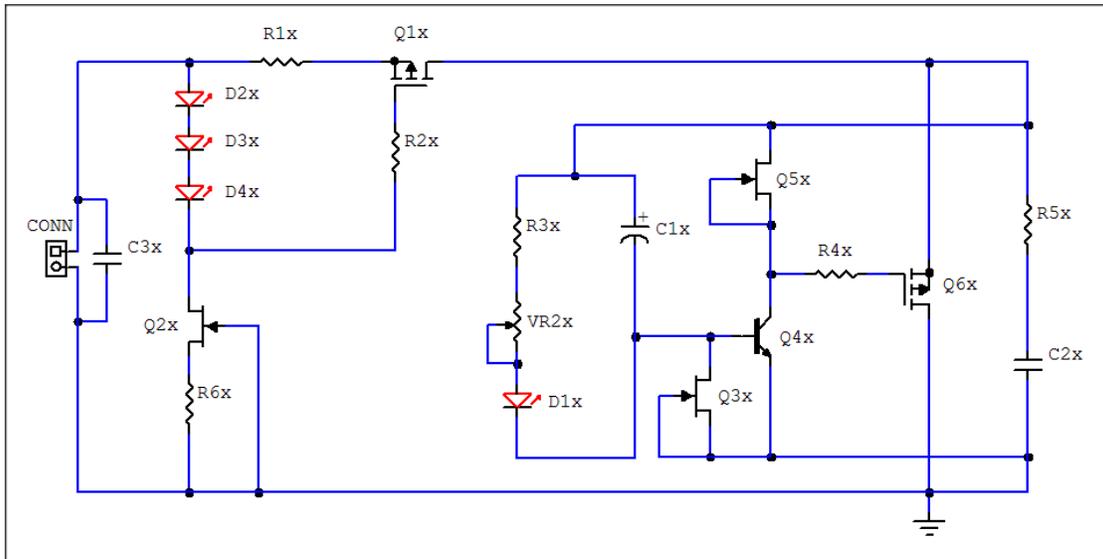
If you don't have such a meter, install random C2 1% and 200pF up to 5% C2Y.

By listening, if the treble is dull exchange for 100pF. If its bright exchange for 300pF. You may use

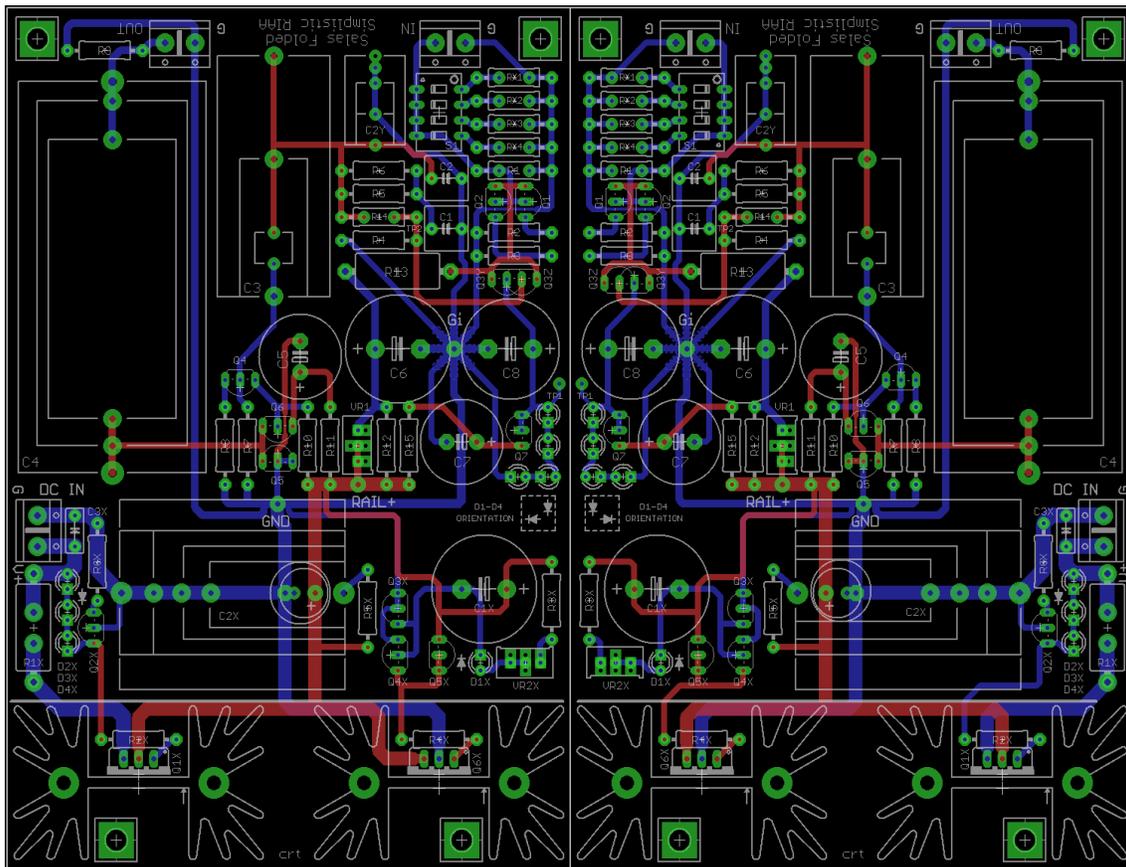
50pF intermediate value piggyback on C2Y if you can hear differences. Its an opportunity to tune your phono preamp to the tonal balance of your TT and speakers. Verify VS listening to other audio sources.

References

The integrated shunt regulator circuit



The board design



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