

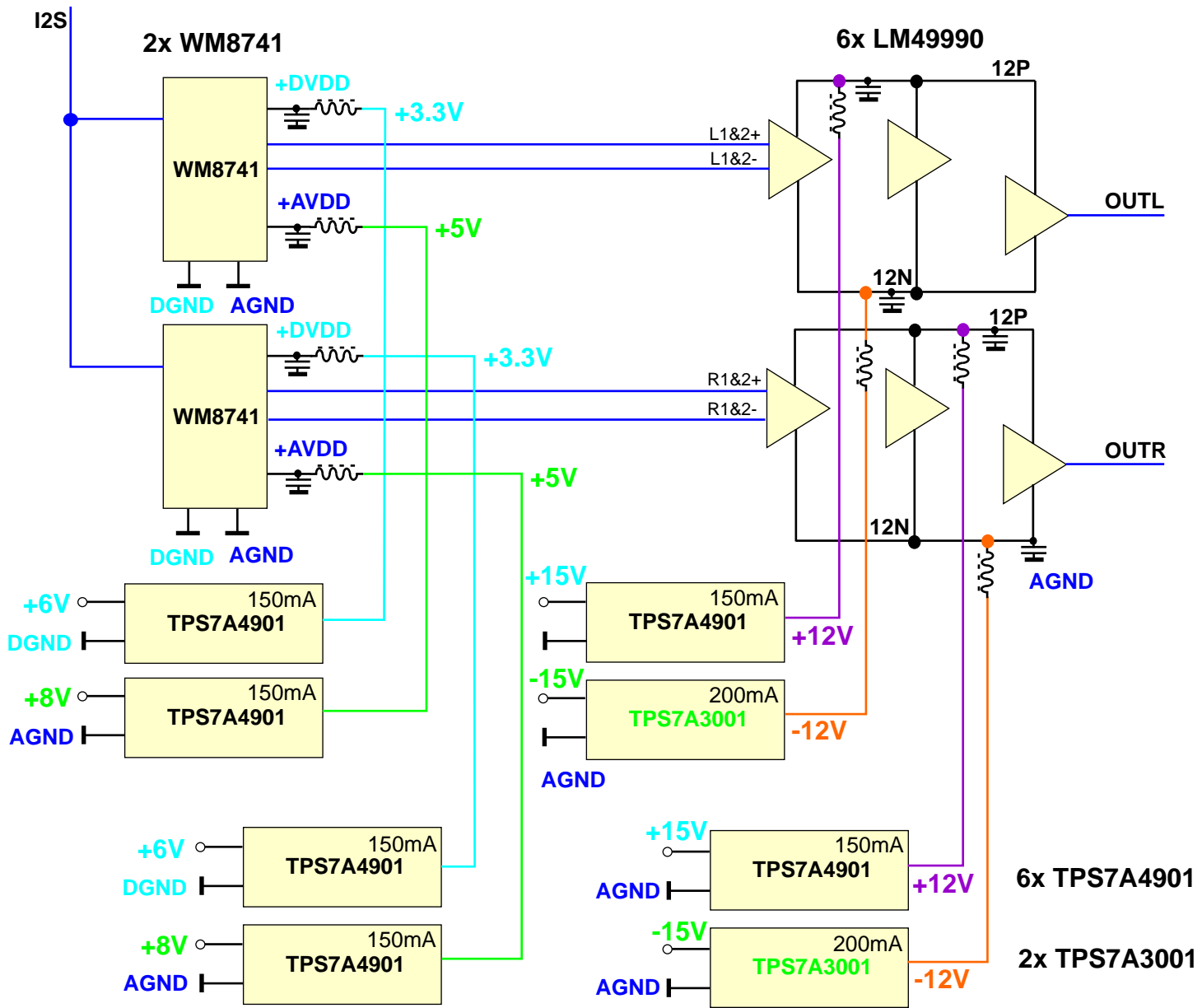
T-DAC / RPi-DAC

Collection of schematics, design drafts, block diagrams

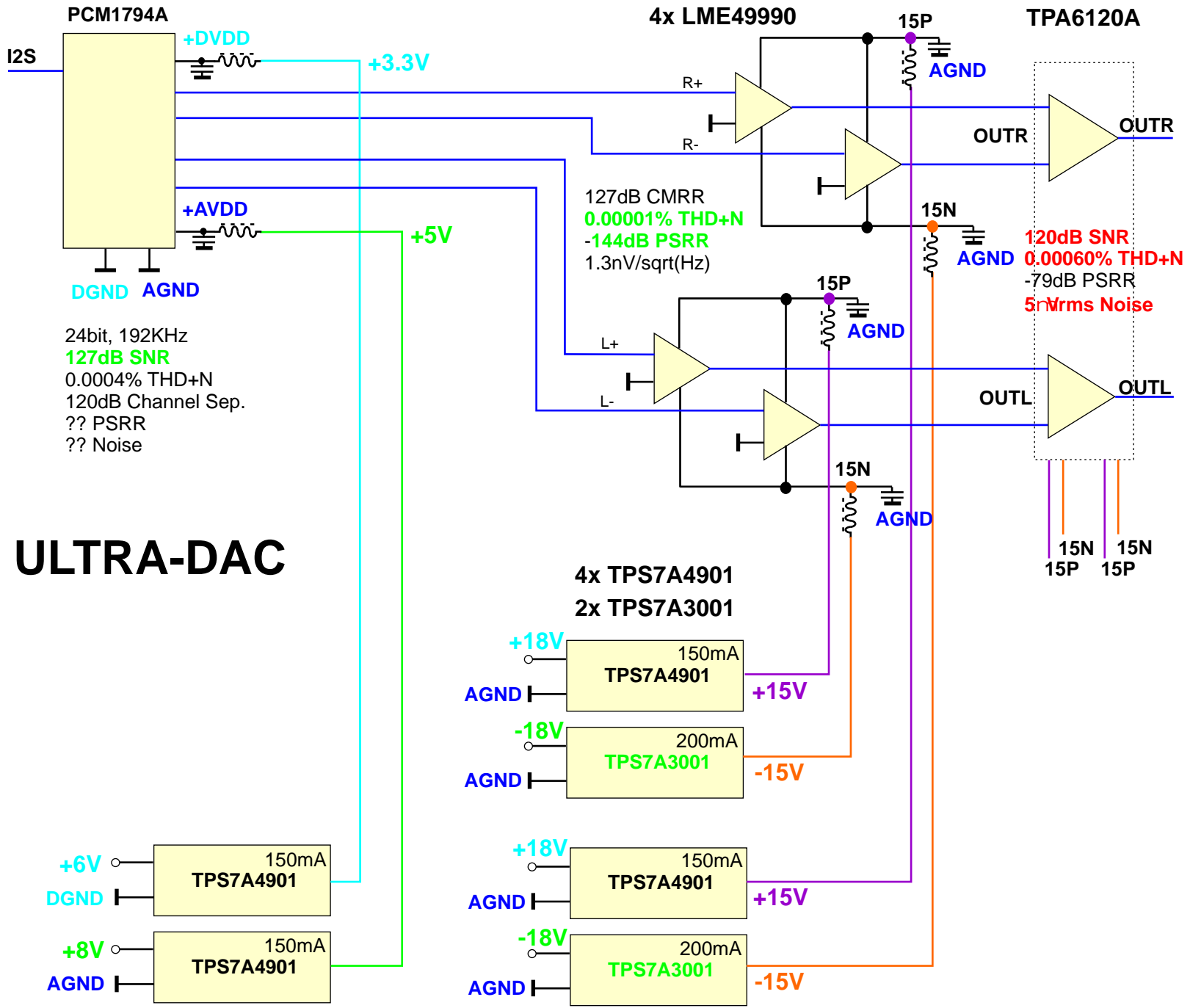
Torsten Jaekel

May 2014

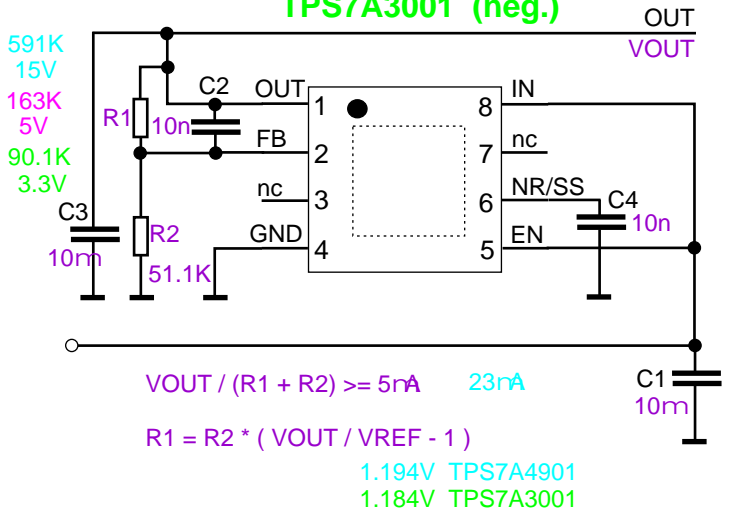
tj@tjaekel.com



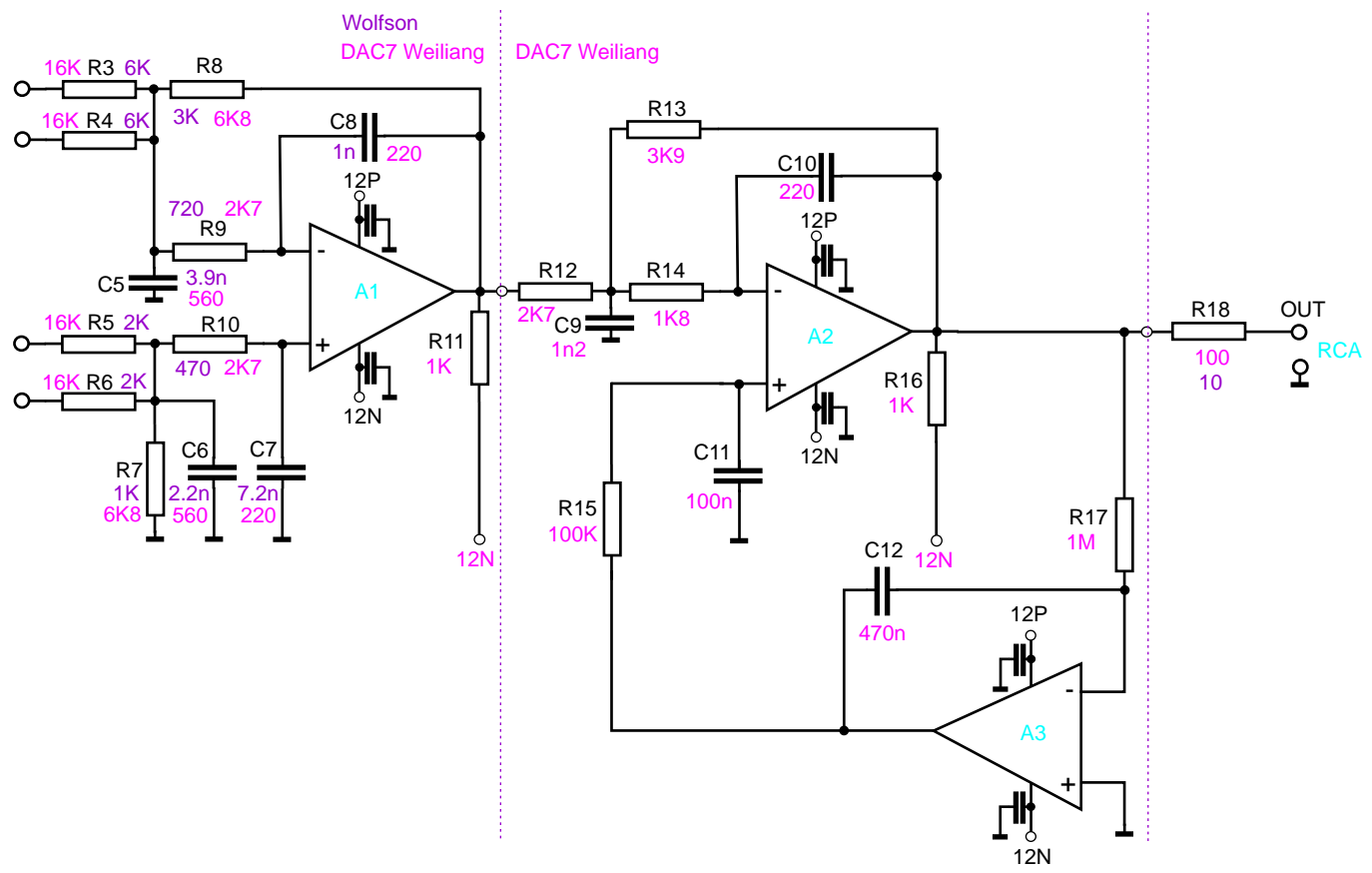
Wolfson Dual-DAC

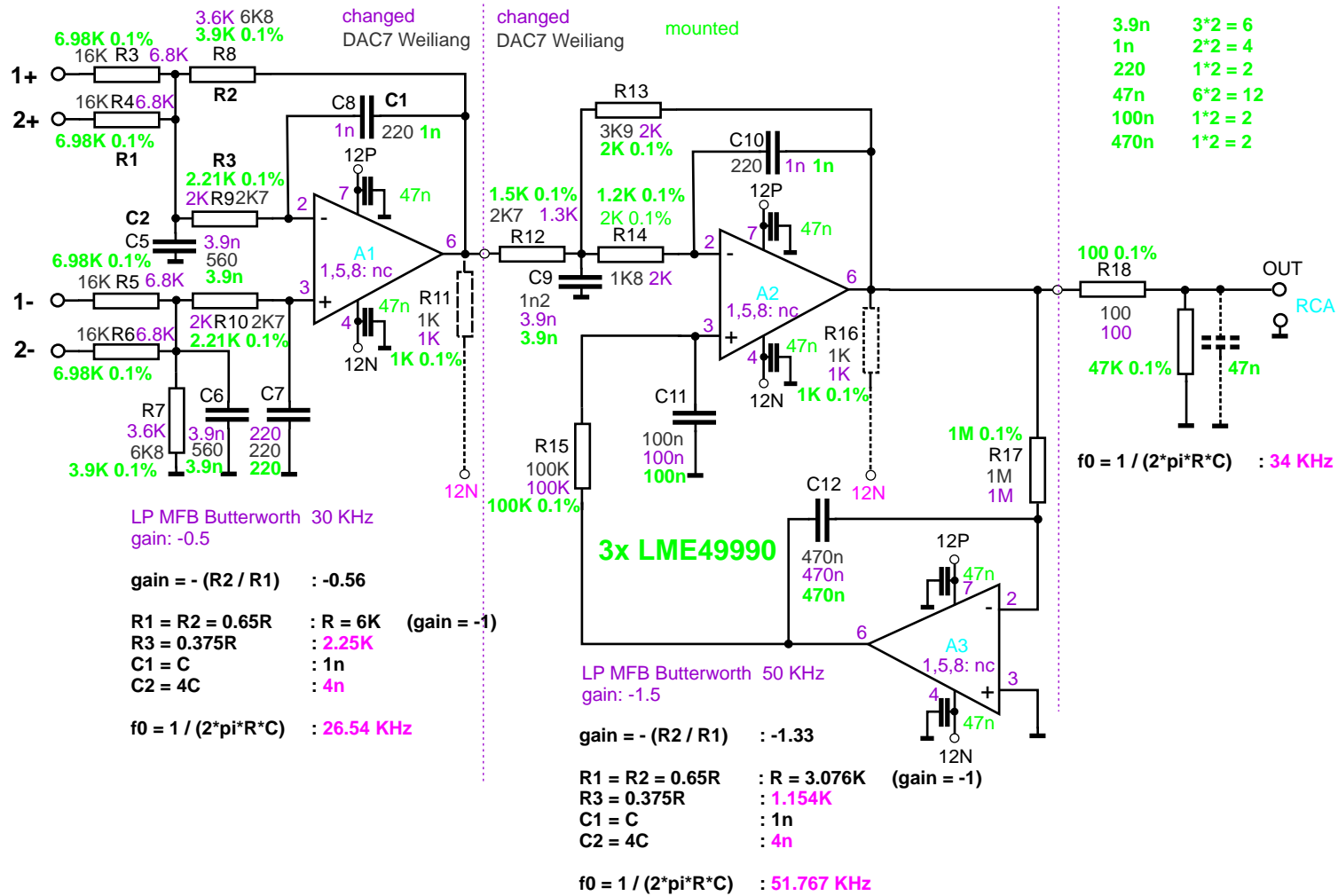


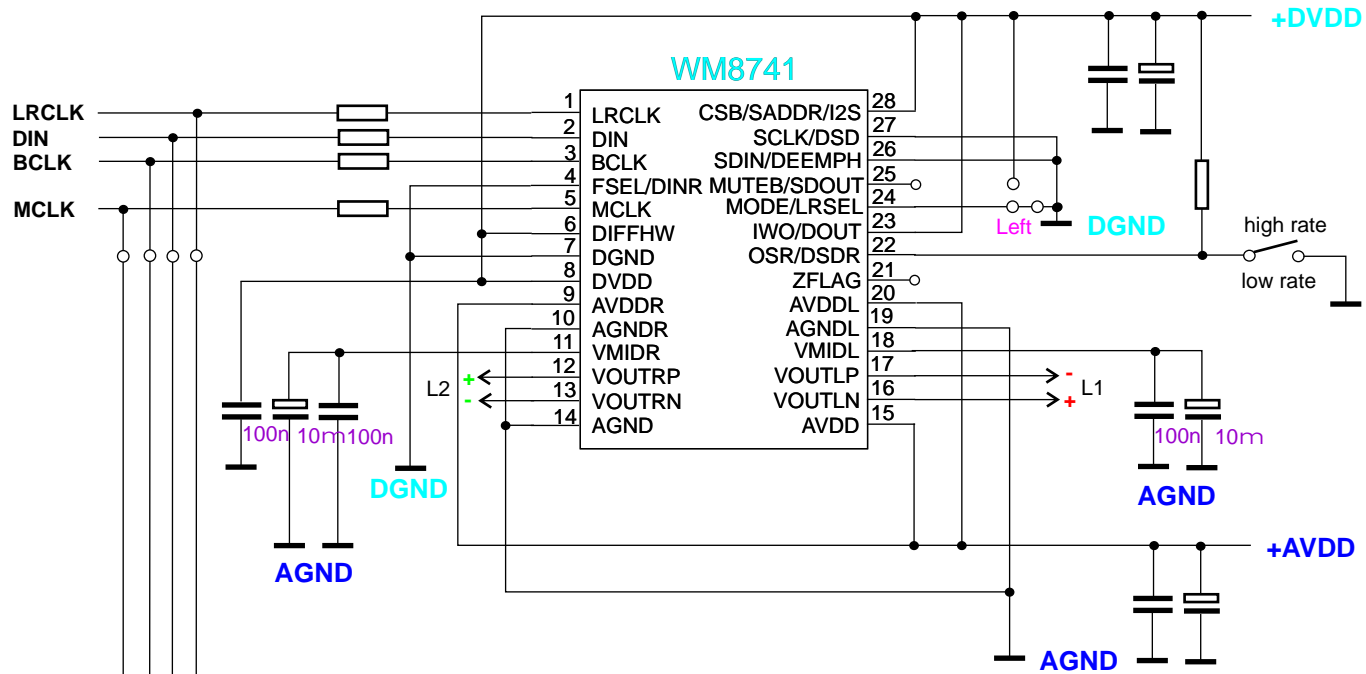
TPS7A4901 (pos.)
TPS7A3001 (neg.)



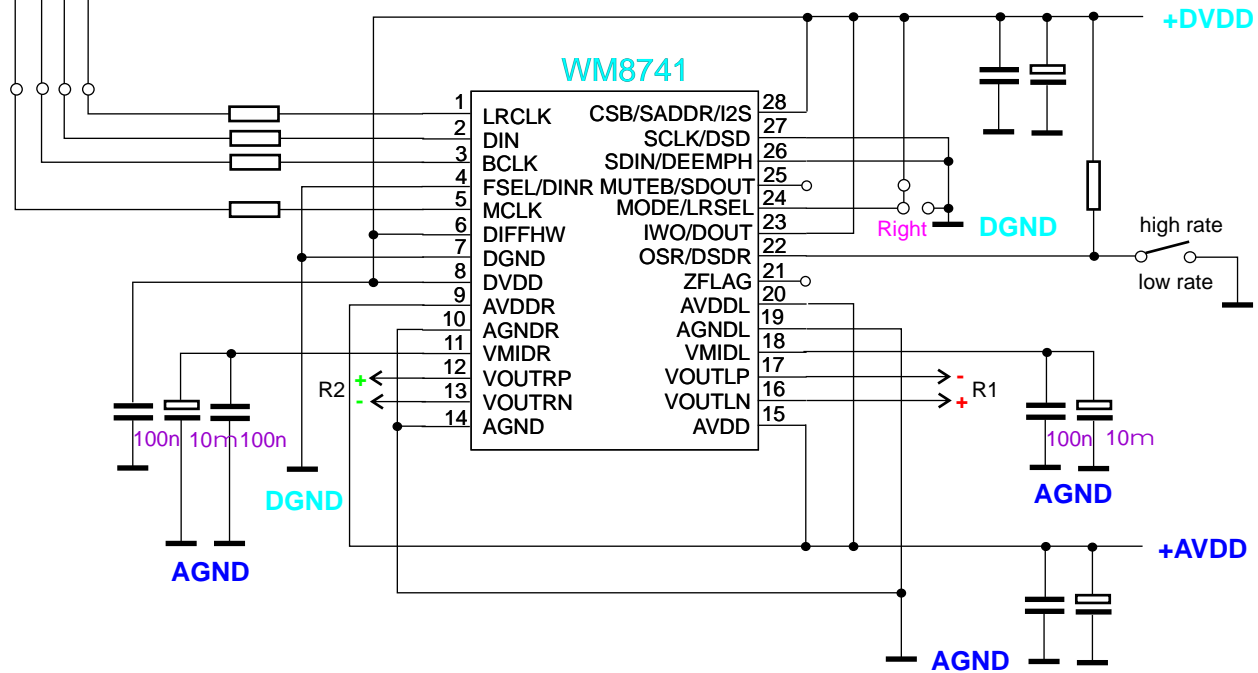
- 10n 2*8 = 16
- 10m 2*8 = 16
- 51.1K
- 462.5K
- 214K
- 90.1K







Wolfson Dual-DAC

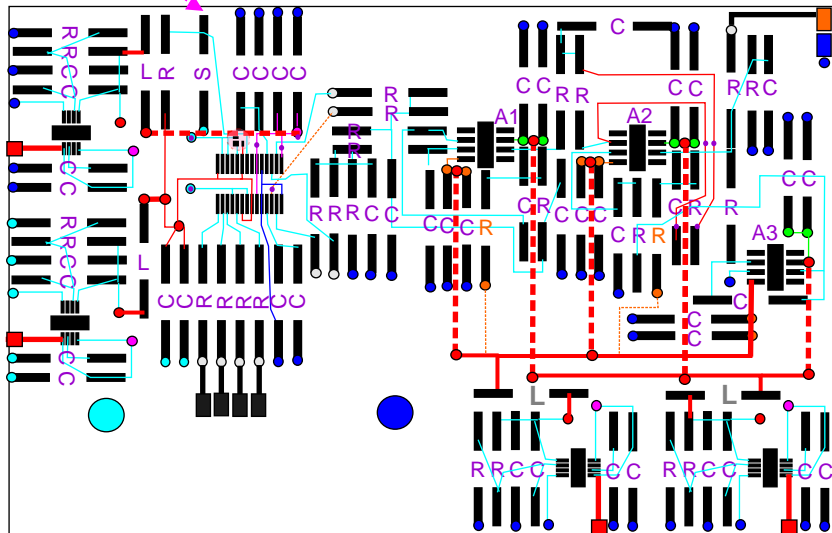


PCB Draft

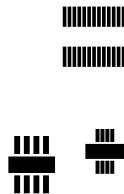
--- power wire
● DGND
● AGND

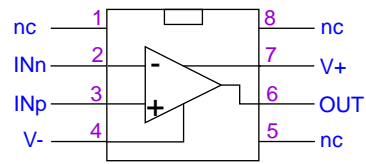
DIP switch = through hole

One Channel Only
stack it vertical

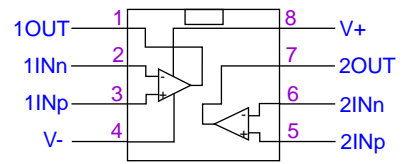


1. separate AGND and DGND
2. combine AGND and DGND on single spot
3. AGND as star, with single ground spot
4. no current over Cblock
5. VDD rails without shared path
6. third layer for power connection

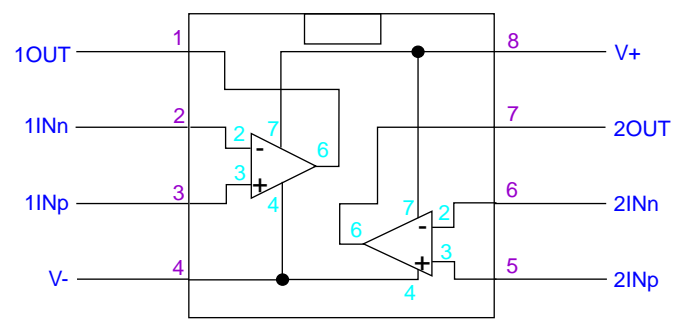




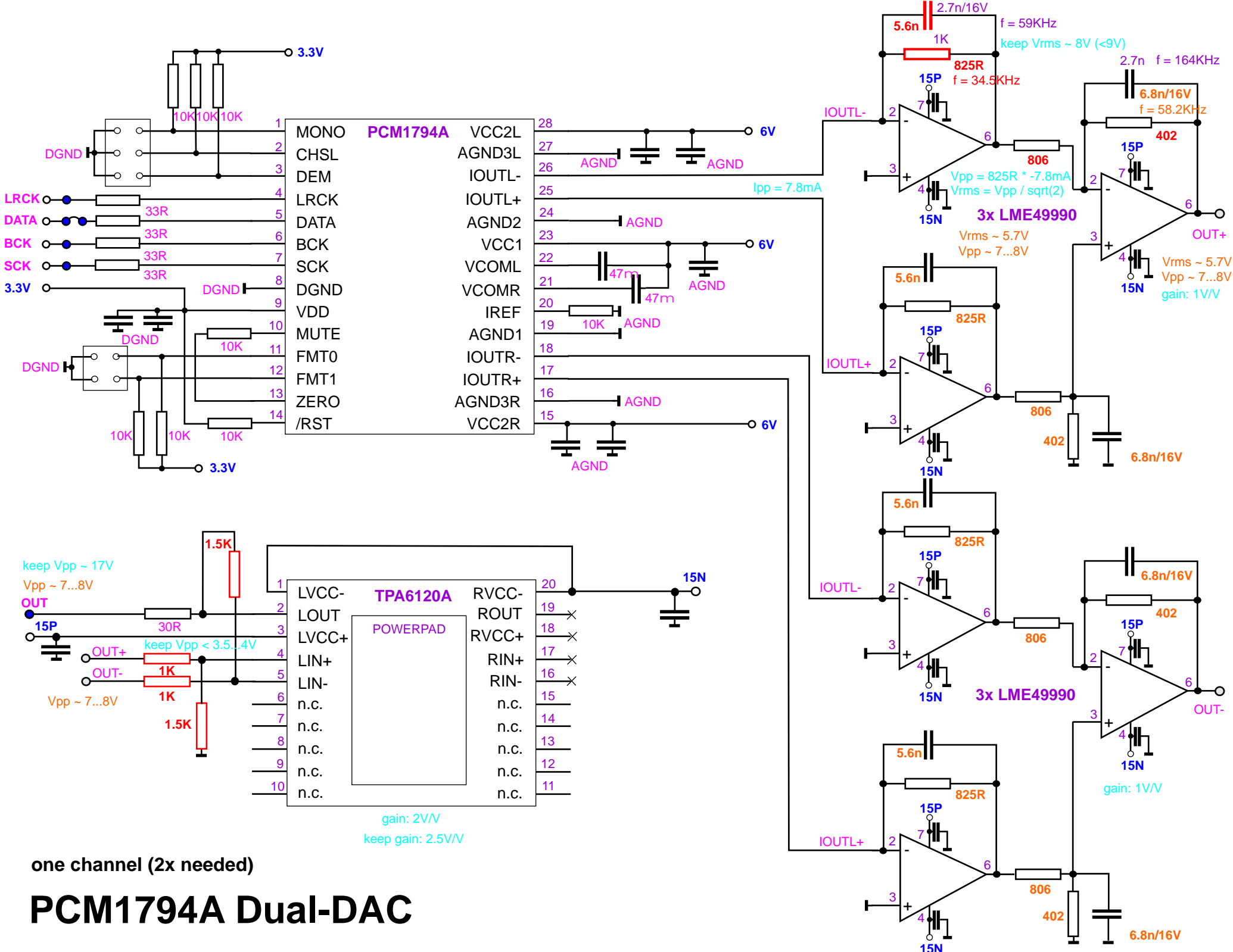
single



dual



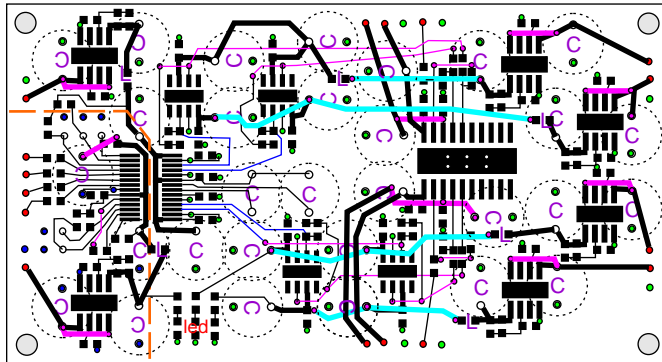
Single vs. Dual OpAmps



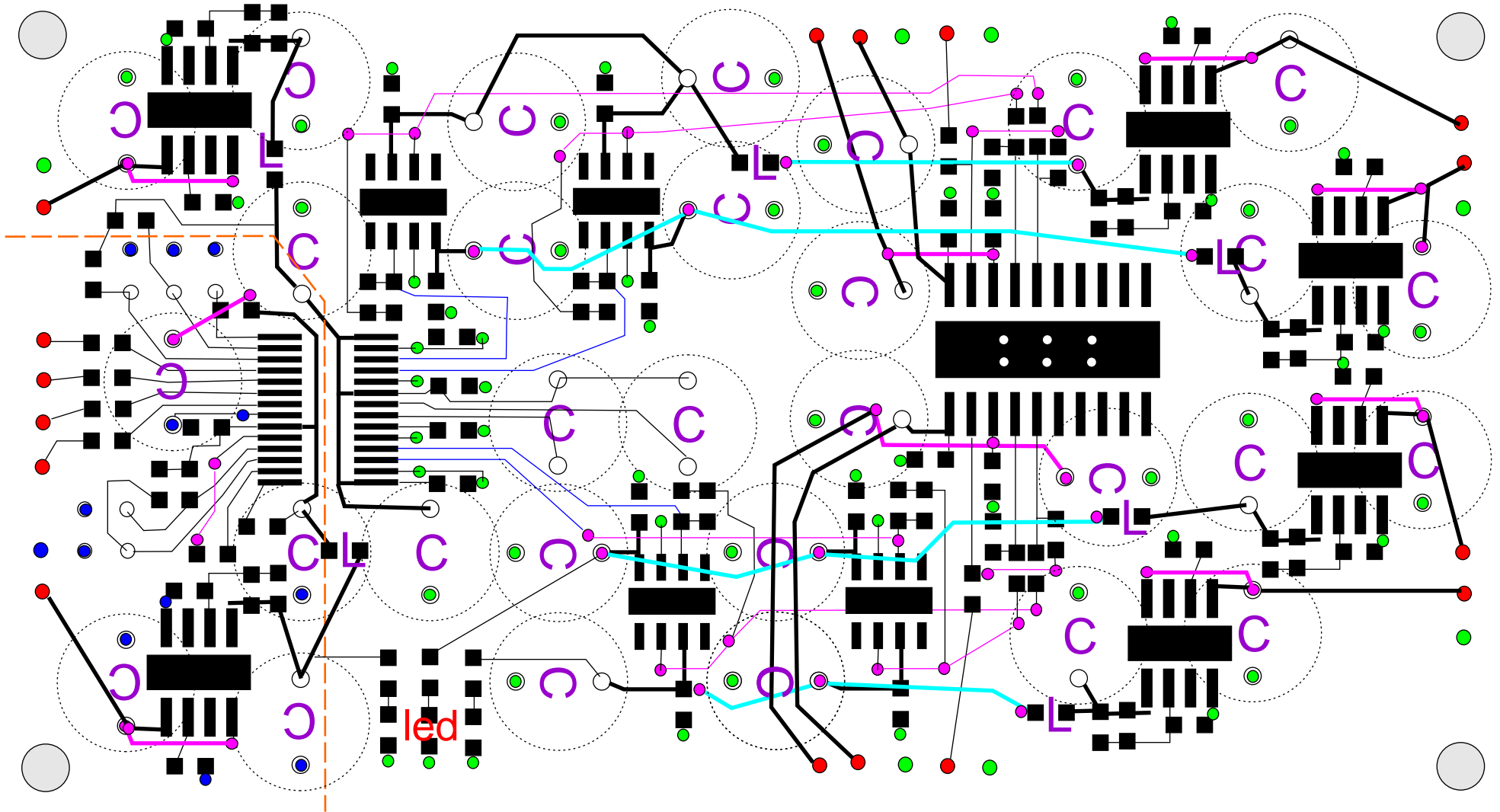
one channel (2x needed)

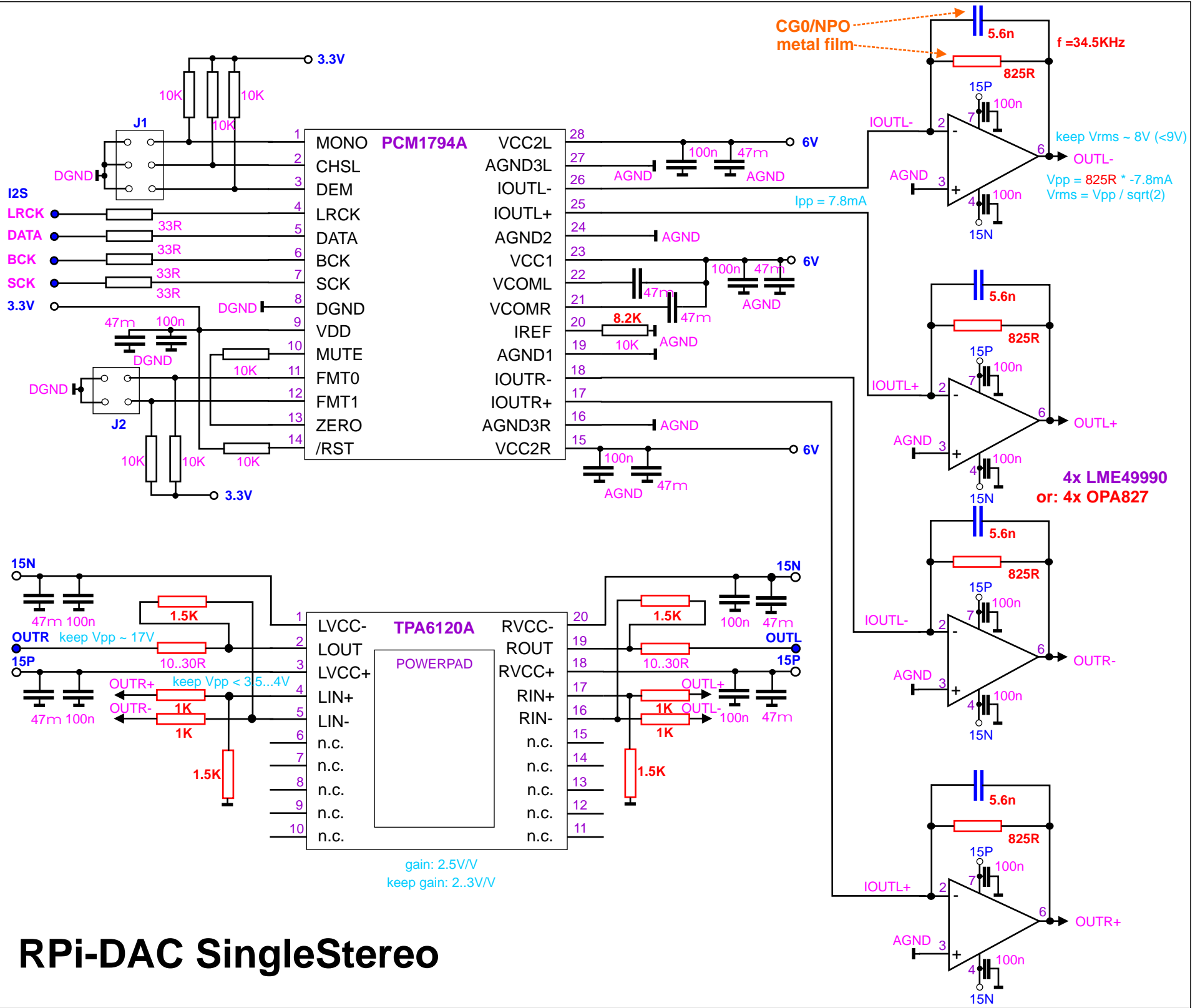
PCM1794A Dual-DAC

PCB Draft



PCB Draft

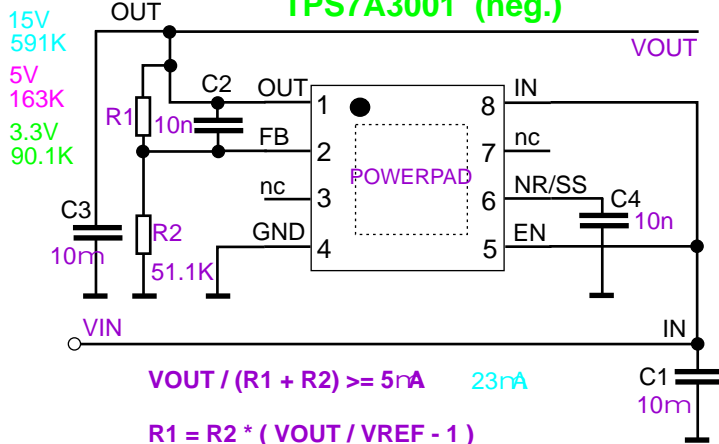




RPi-DAC SingleStereo

Onboard LDO

TPS7A4901 (pos.)
TPS7A3001 (neg.)



$$VOUT / (R1 + R2) \geq 5nA \quad 23nA$$

$$R1 = R2 * (VOUT / VREF - 1)$$

1.194V TPS7A4901
1.184V TPS7A3001

$$VOUT = (1 + R1/R2) * VREF$$

Vdrop:

260mV, 333...600mV @ 150mA TPS7A4901
216mV, 325...600mV @ 200mA TPS7A3001

7A4901
(pos)

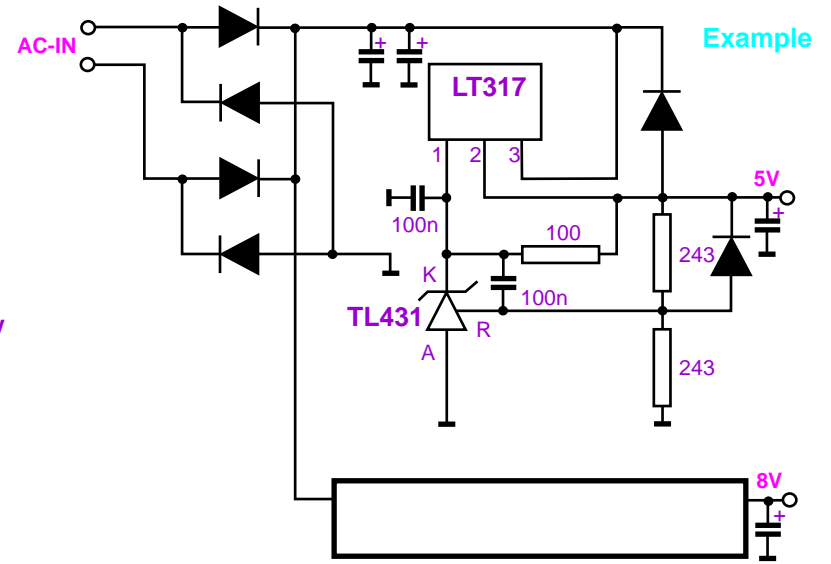
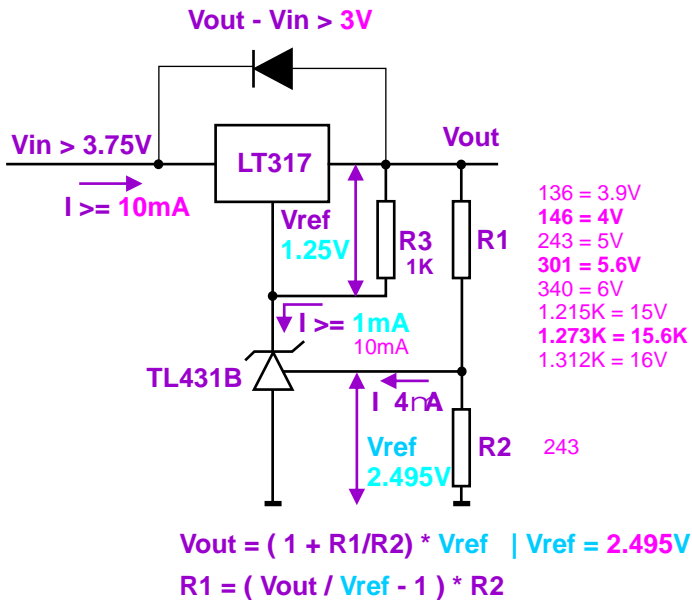
R2	R1	Output Voltage
51.1K	88.7K	= 3.266V
	162K	= 4.979V
	590K	= 14.979V
24.9K	280K	= 14.620V

7A3001
(neg)

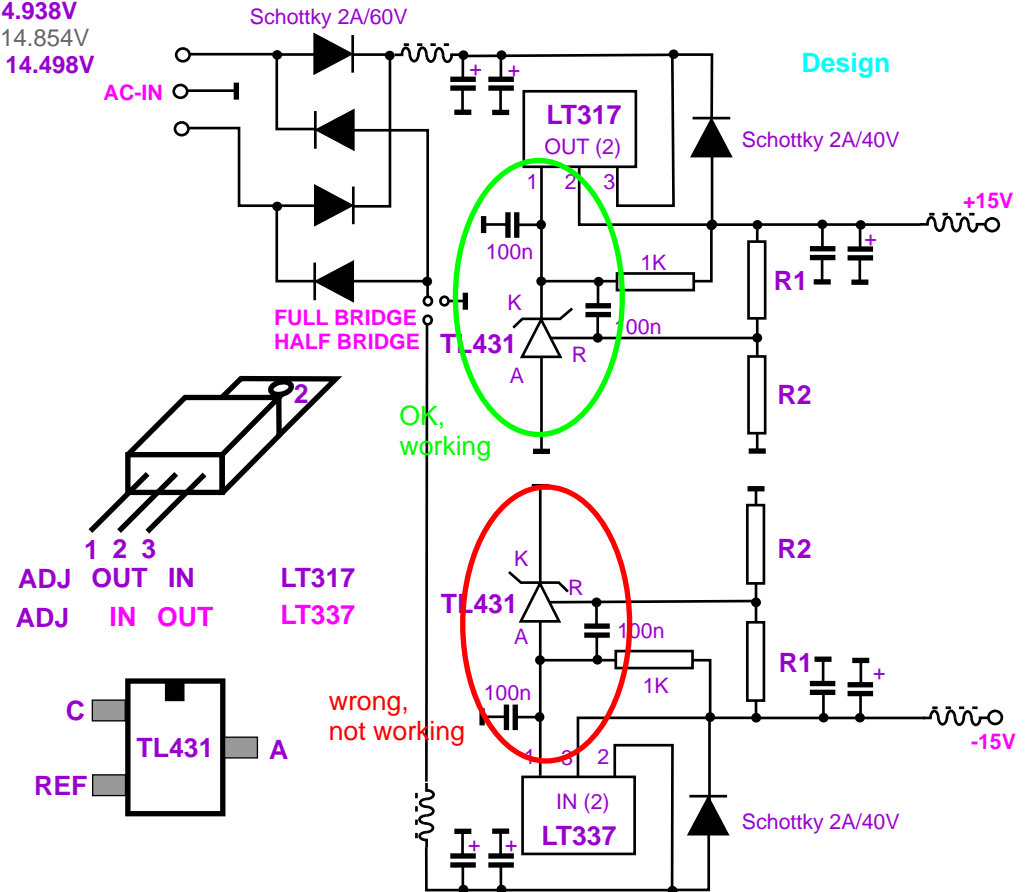
R2	R1	Output Voltage
51.1K	88.7K	= 3.24V
	162K	= 4.938V
	590K	= 14.854V
24.9K	280K	= 14.498V

PSU

Calculation

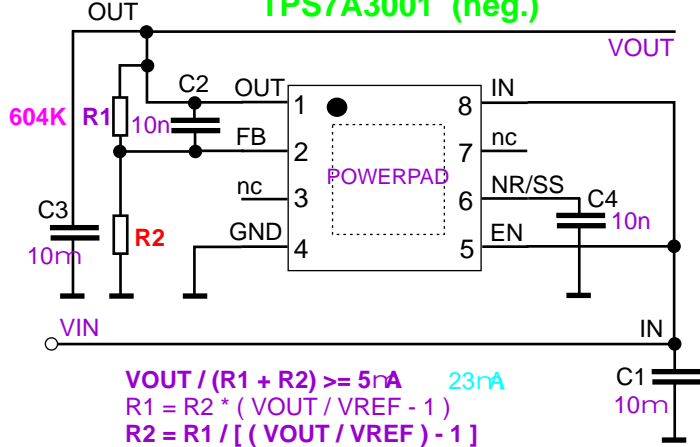


Design



Onboard LDOs

TPS7A4901 (pos.)
TPS7A3001 (neg.)



$$VOUT / (R1 + R2) \geq 5nA \quad 23nA$$

$$R1 = R2 * (VOUT / VREF - 1)$$

$$R2 = R1 / [(VOUT / VREF) - 1]$$

1.176... 1.194... 1.212V TPS7A4901
-1.202... -1.184... -1.166V TPS7A3001

$$VOUT = (1 + R1/R2) * VREF$$

Vdrop:

260mV, 333...600mV @ 150mA TPS7A4901
216mV, 325...600mV @ 200mA TPS7A3001

7A4901 PSRR: 72dB
(pos) Vnoise: 21.15 nVrms

R1 = 604K

R2 341K = 3.309V
342K = 3.303V

189.5K = 4.999V
188K = 5.03V

52.2K = 15V
54.2K = 14.5V
56.3K = 14V

measured:

341K + 1K = 3.25V
301K + 20K = 3.37V
301K + 22.1K = 3.36V

51.1K + 1K = 15.5V
51.1K + 5.11K = 14.47V
51.1K + 3.01K = 14.31V

7A3001 PSRR: 72dB
(neg) Vnoise: 17.5 nVrms

R1 = 604K

R2 51.8K = -15V
53.7K = -14.5V
55.8K = -14V

PSU

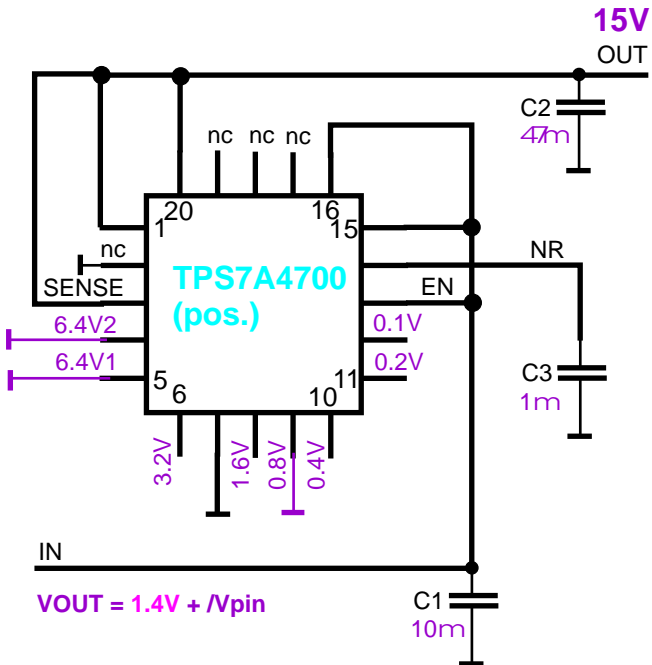
PSRR: 72dB
Vnoise: 16 nVrms

$$R1 = R2 * [(VOUT / VREF) - 1]$$

$$R2 = R1 / [(VOUT / VREF) - 1]$$

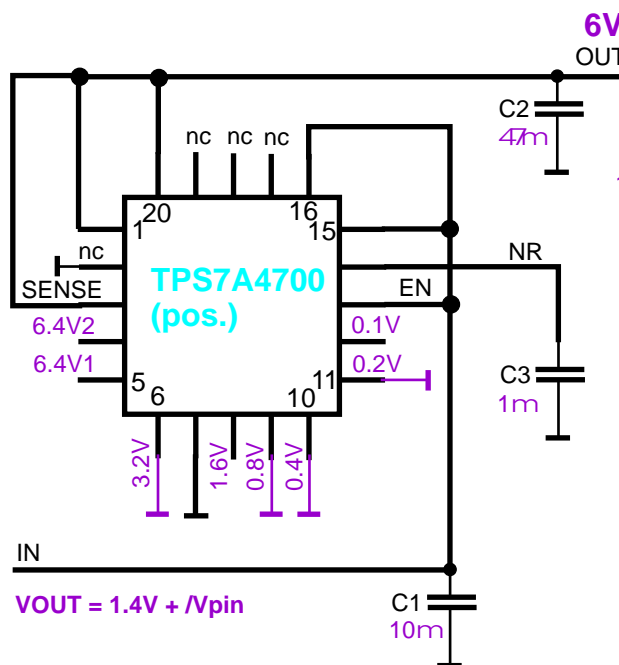
$$VOUT / (R1 + R2) \geq 5nA$$

-1.192... -1.175V... -1.157 TPS7A3301

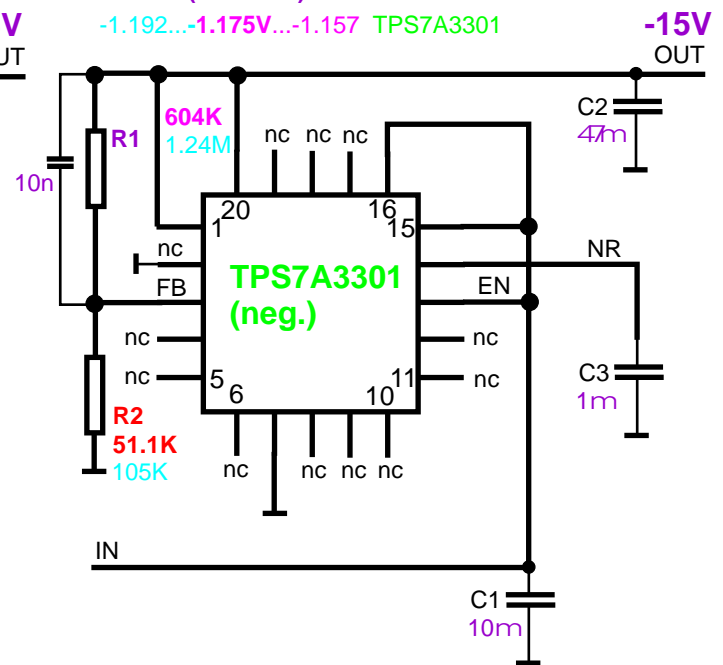


$$VOUT = 1.4V + I_{pin}$$

PSRR: 78dB
Vnoise: 4.67 nVrms

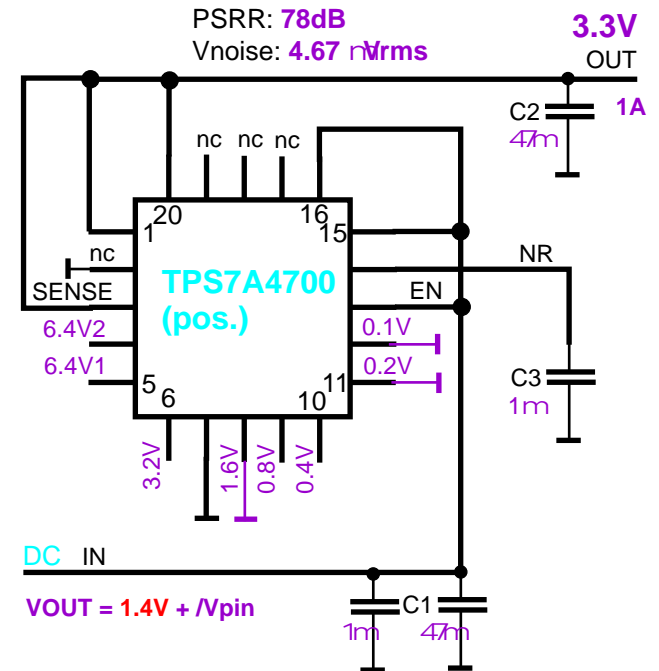
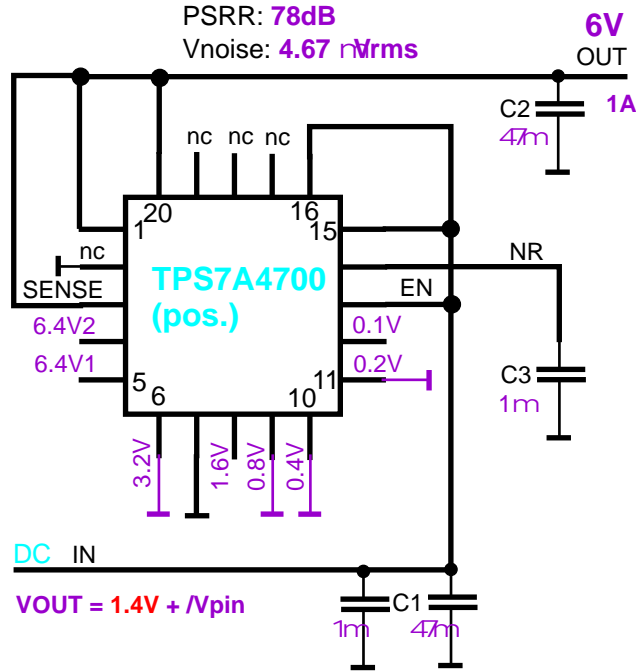
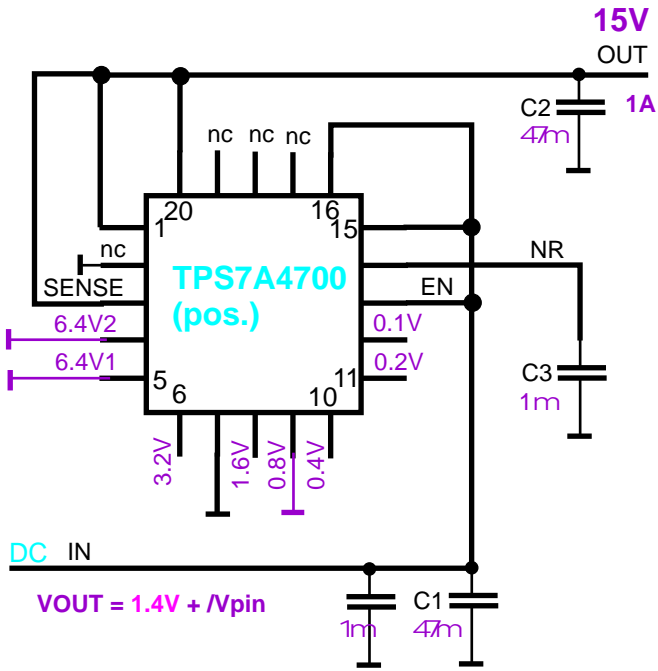


$$VOUT = 1.4V + I_{pin}$$



$$VOUT = 1.4V + I_{pin}$$

PSU

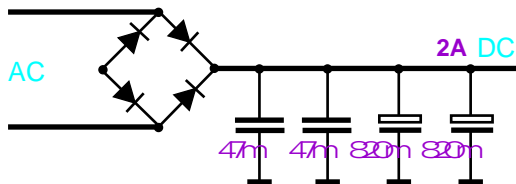


6x TPS7A4700 (pos.)

on -15V - the GND is used, +15V is grounded!

4x Bridge Rectifier

separate coils!

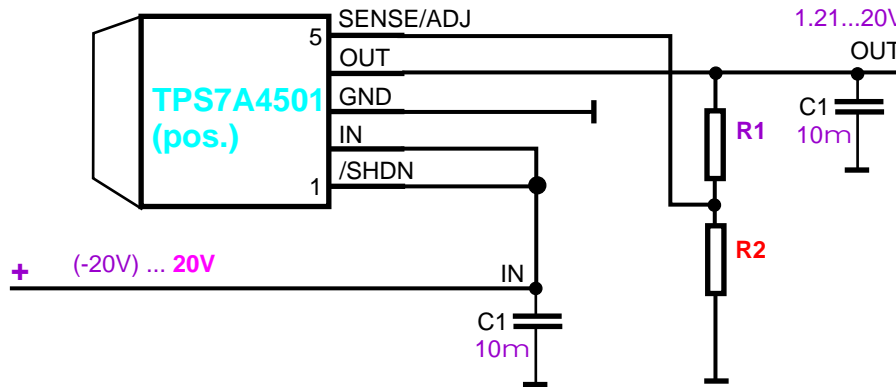


PSU

KTT package

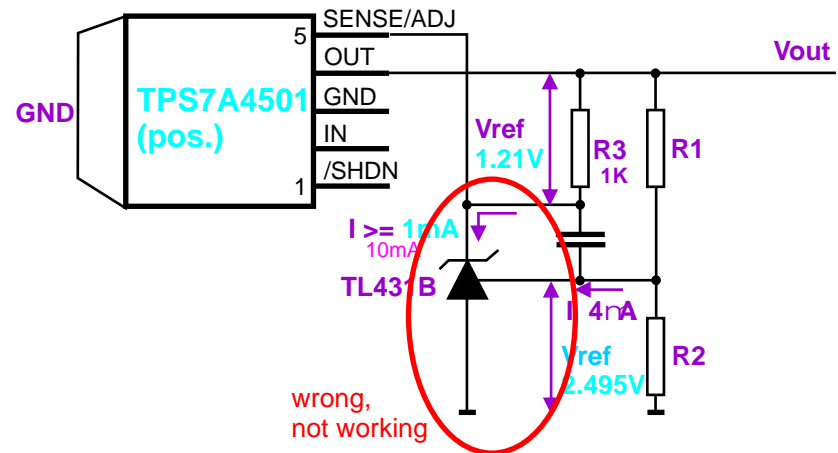
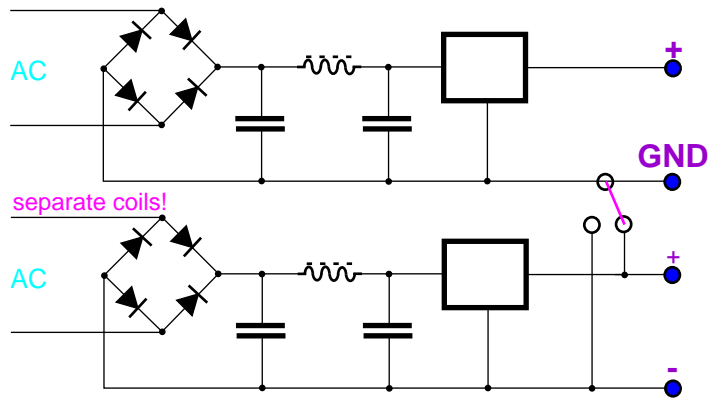
1.174...1.21V...1.246 TPS7A4501

TPS7A4501 (pos.)



$$V_{OUT} = 1.21 * (R1 / R2 + 1) + (I_{ADJ} * R1)$$

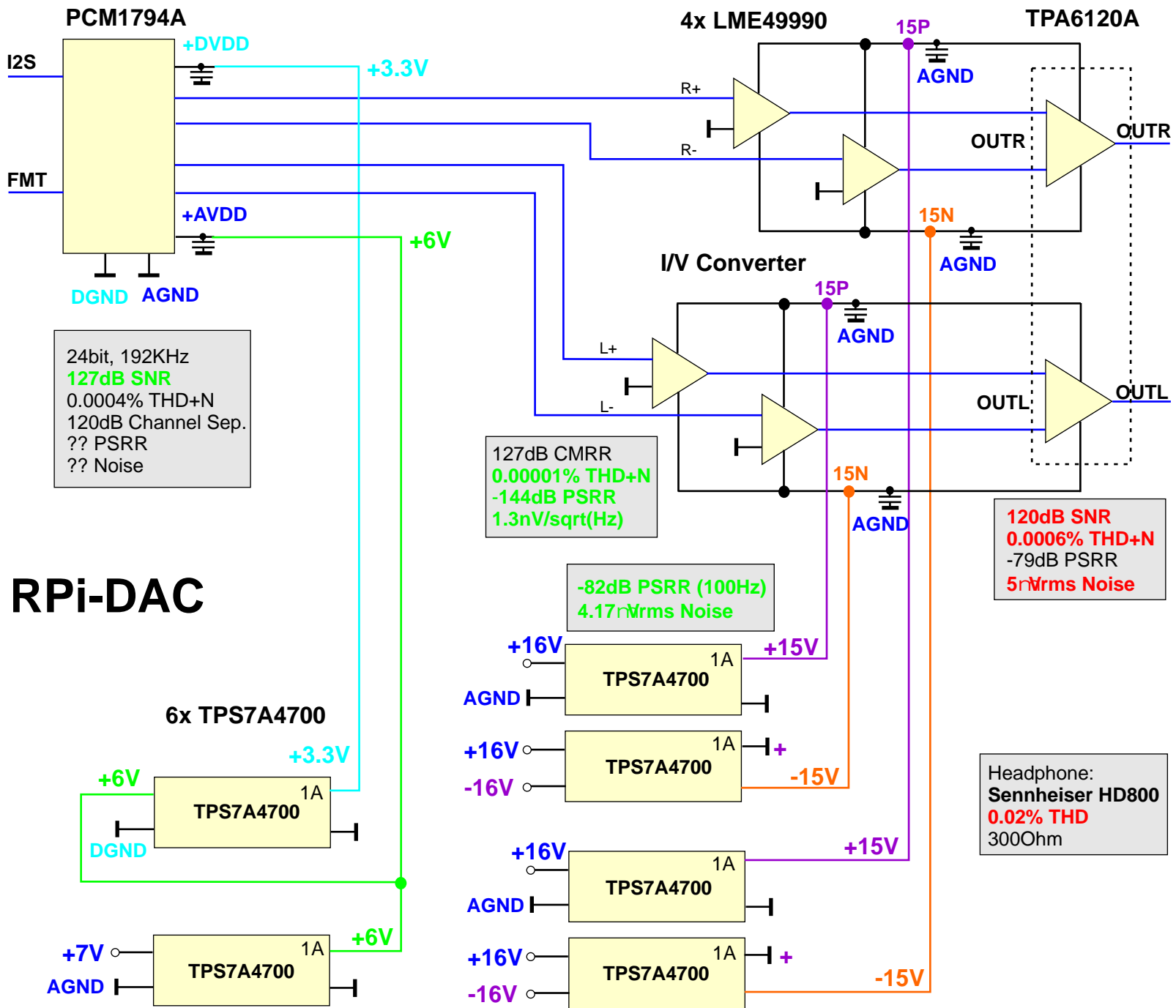
3nA



wrong,
not working

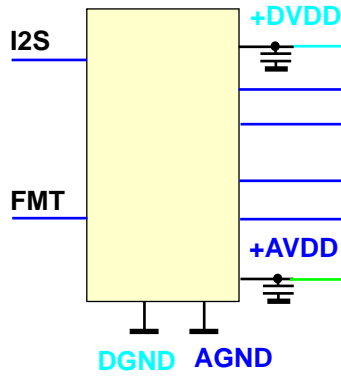
$$V_{out} = (1 + R1/R2) * V_{ref} \quad | \quad V_{ref} = 2.495V$$

$$R1 = (V_{out} / V_{ref} - 1) * R2$$



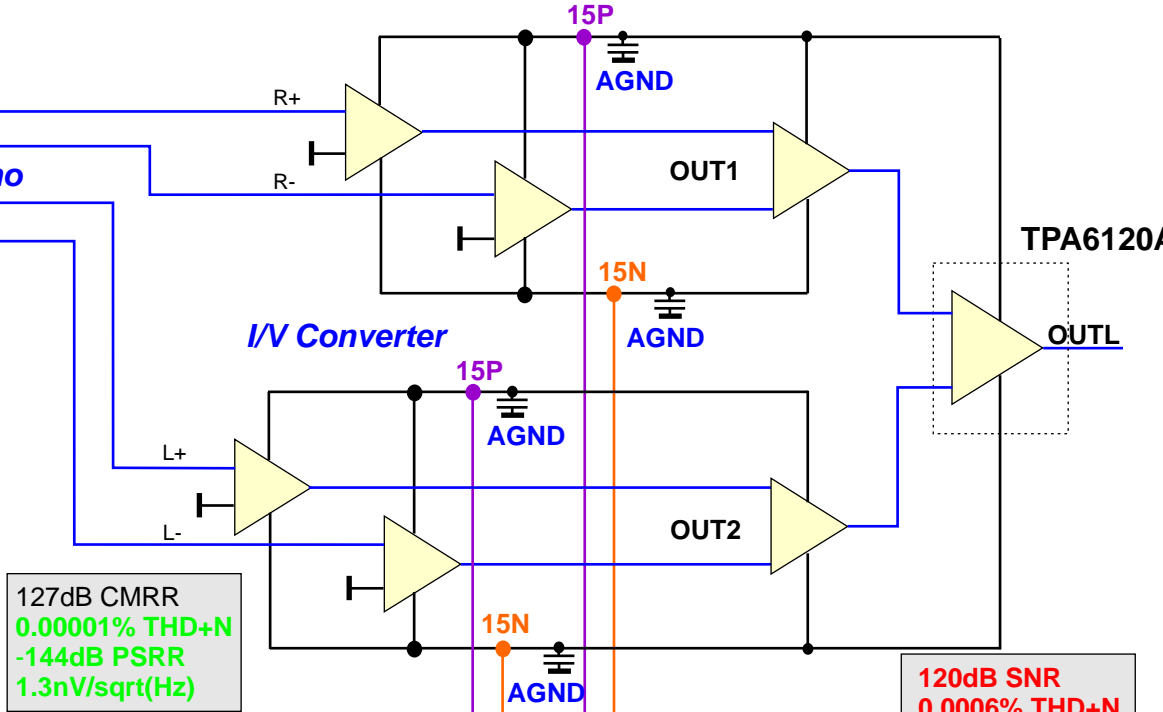
RPi-DAC

PCM1794A - Mono



24bit, 192KHz
132dB SNR
0.0004% THD+N
120dB Channel Sep.
?? PSRR
?? Noise

6x LME49990



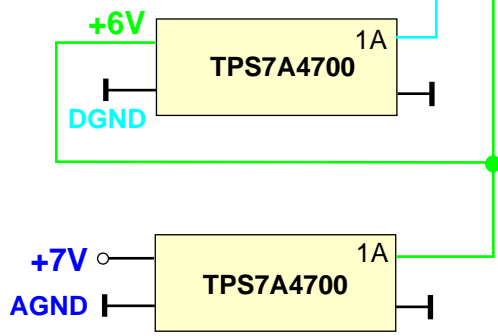
127dB CMRR
0.00001% THD+N
-144dB PSRR
1.3nV/sqrt(Hz)

120dB SNR
0.0006% THD+N
-79dB PSRR
5nVrms Noise

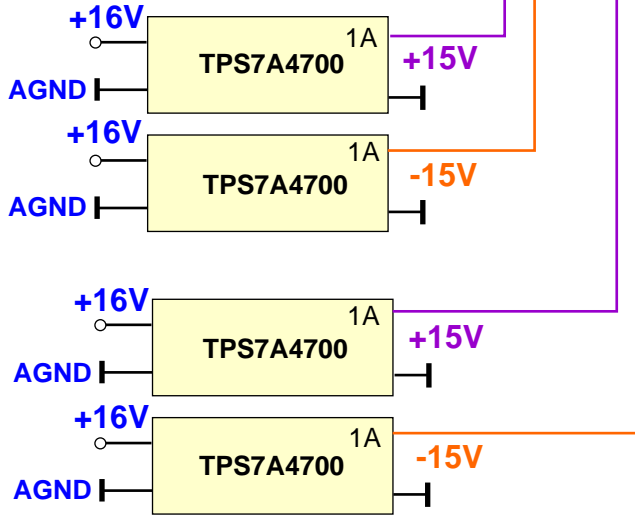
Headphone:
Sennheiser HD800
0.02% THD
300Ohm

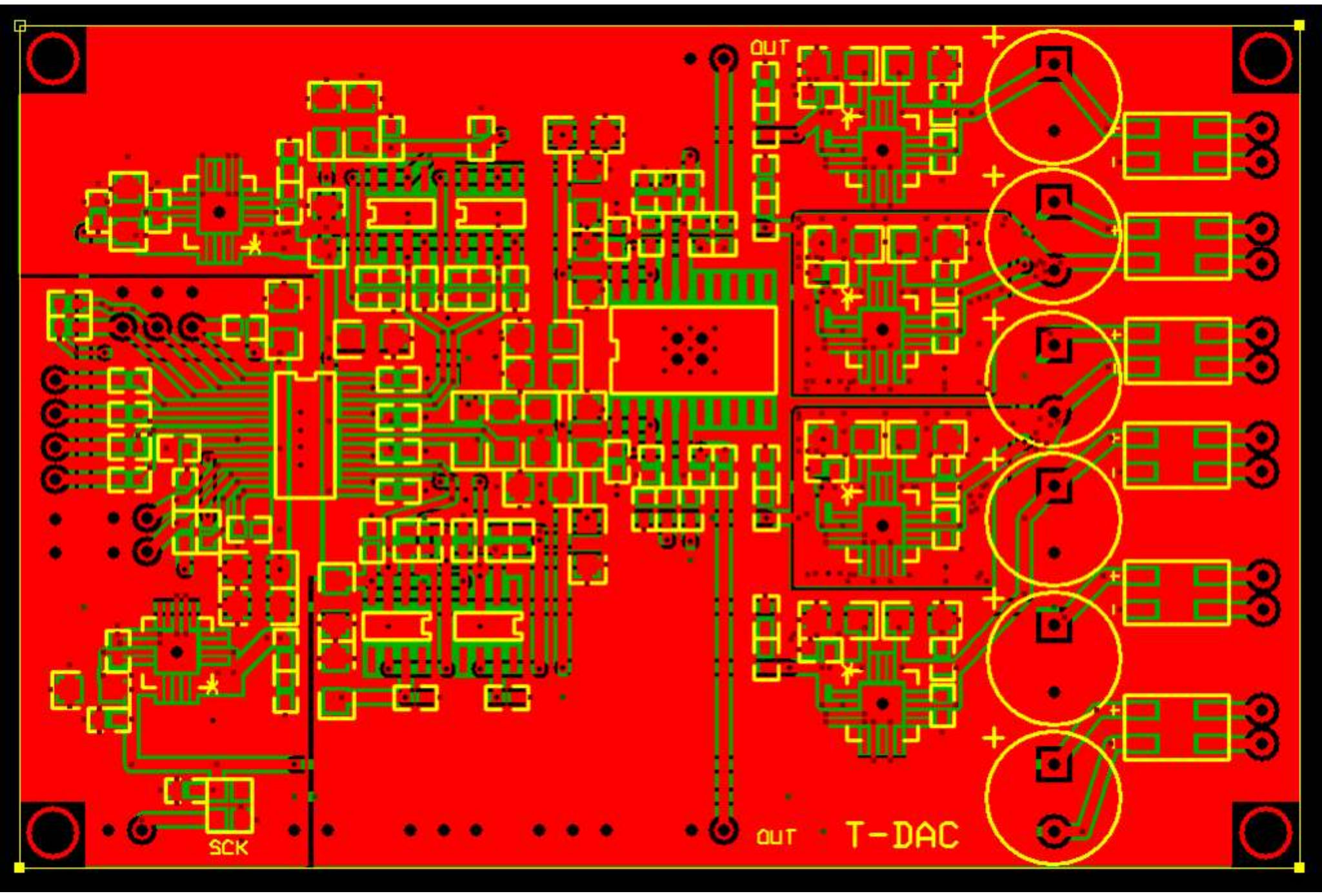
-82dB PSRR (100Hz)
4.17nVrms Noise

RPi-DAC Dual-Mono (2x)



6x TPS7A4700

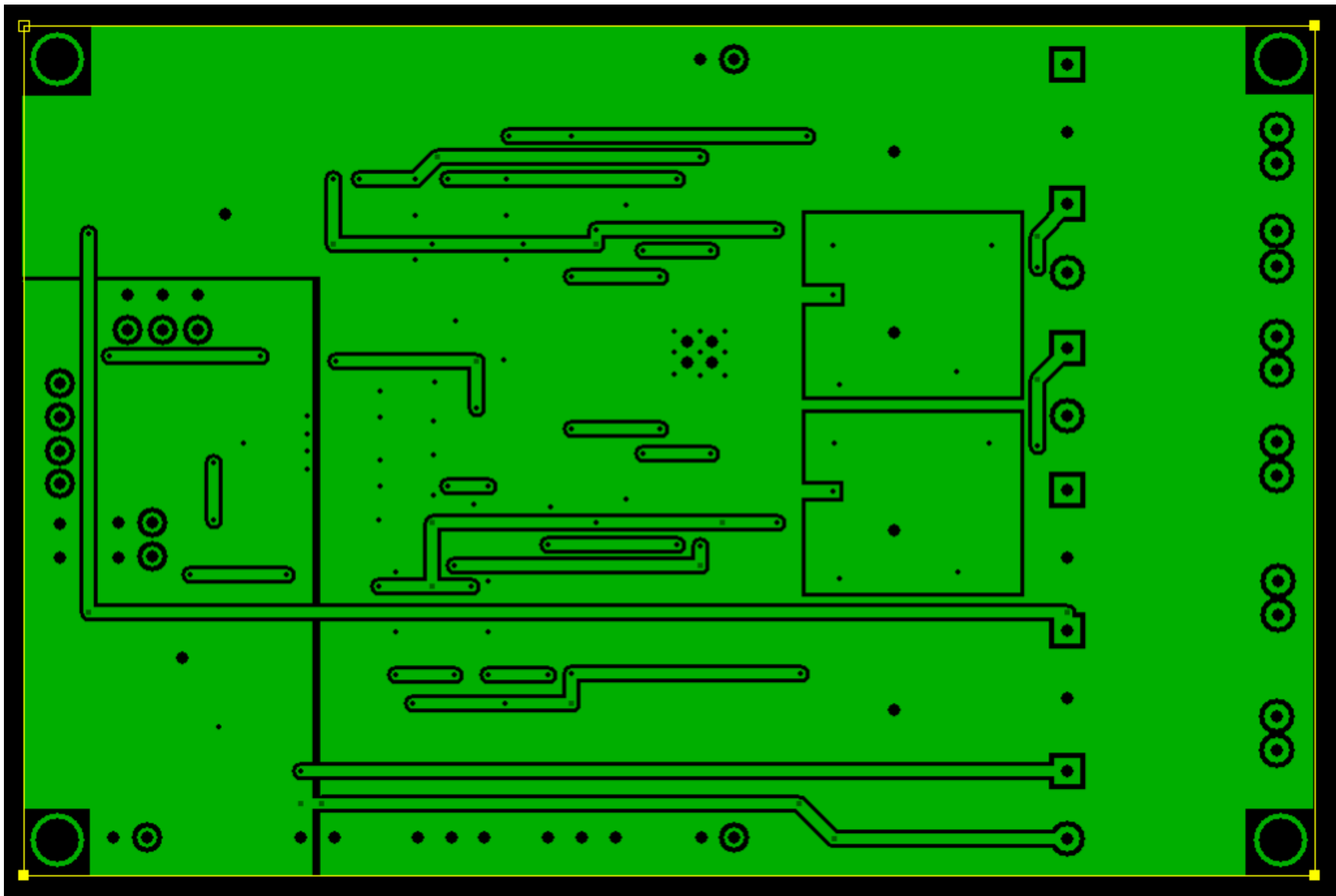


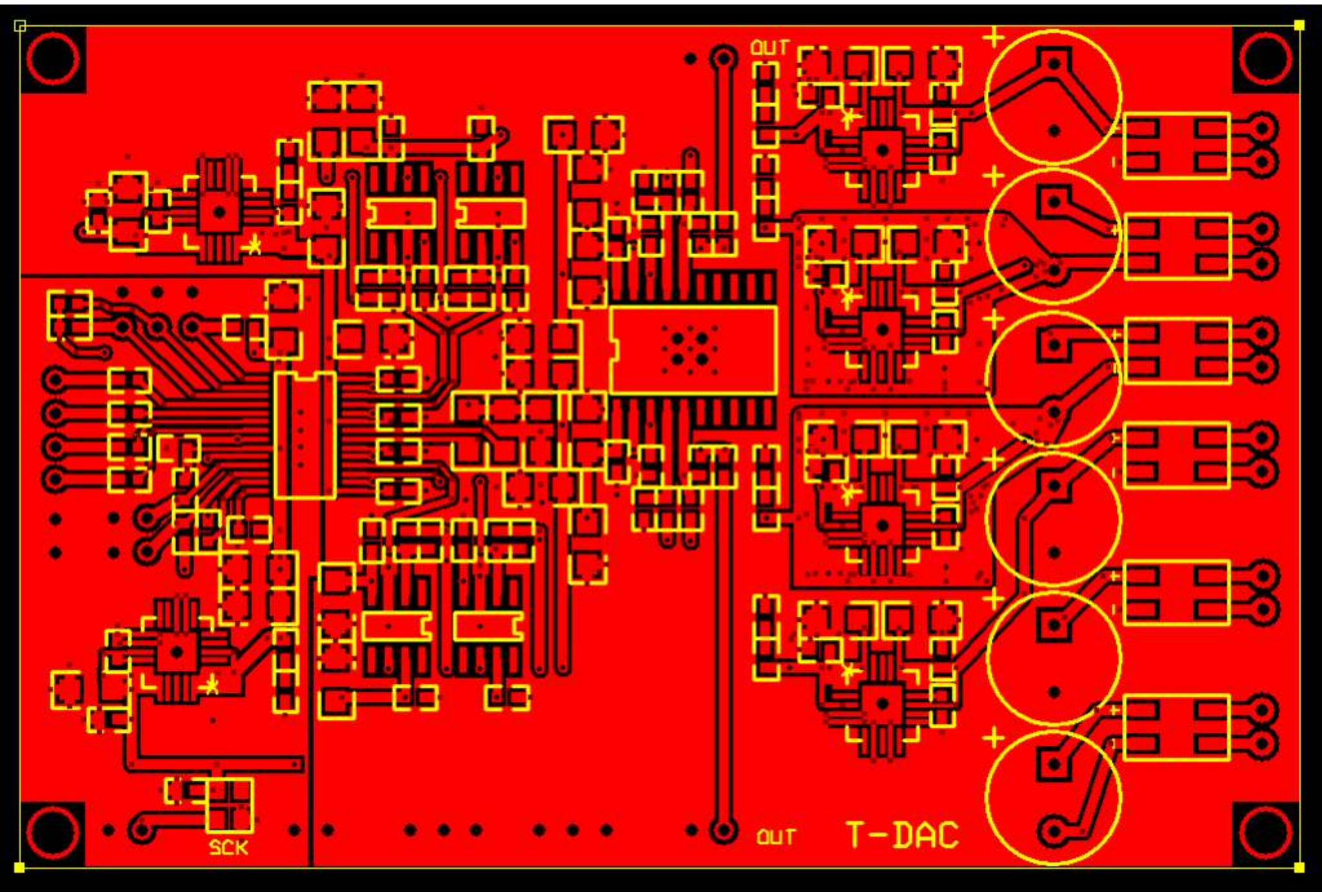


SCK

OUT

T-DAC

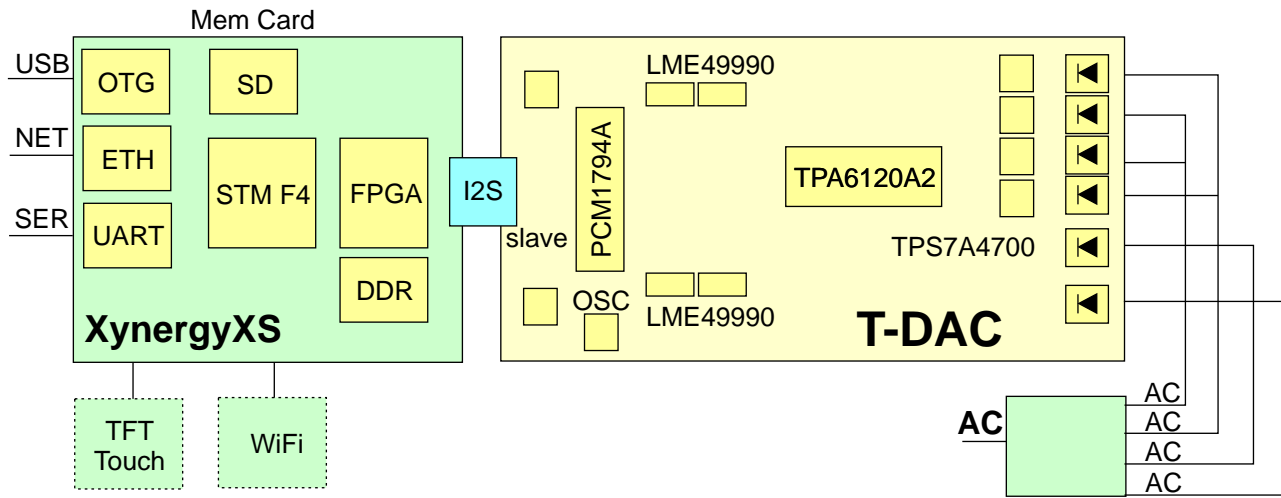


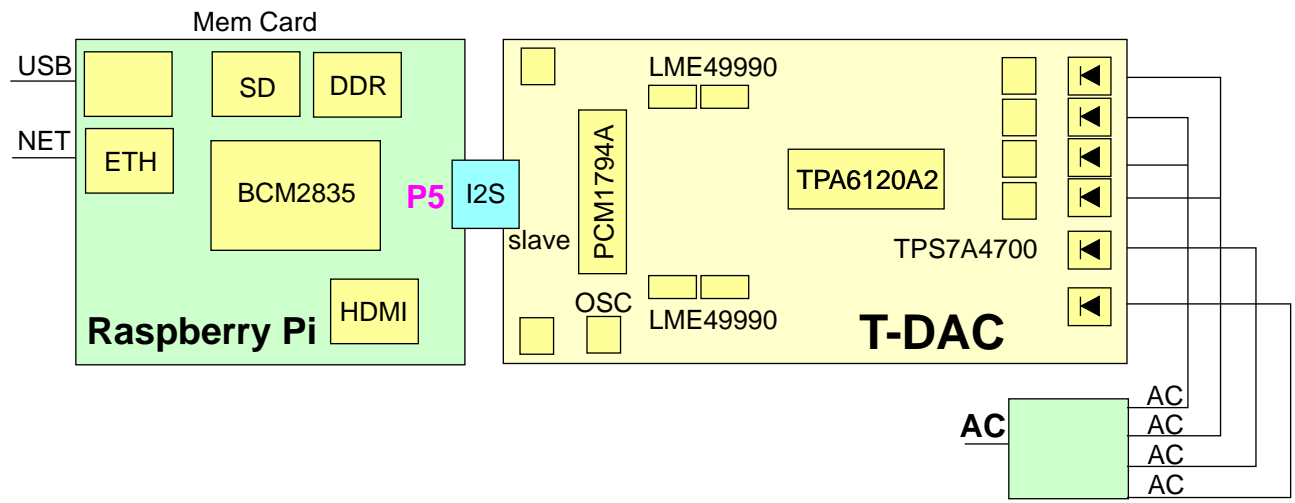


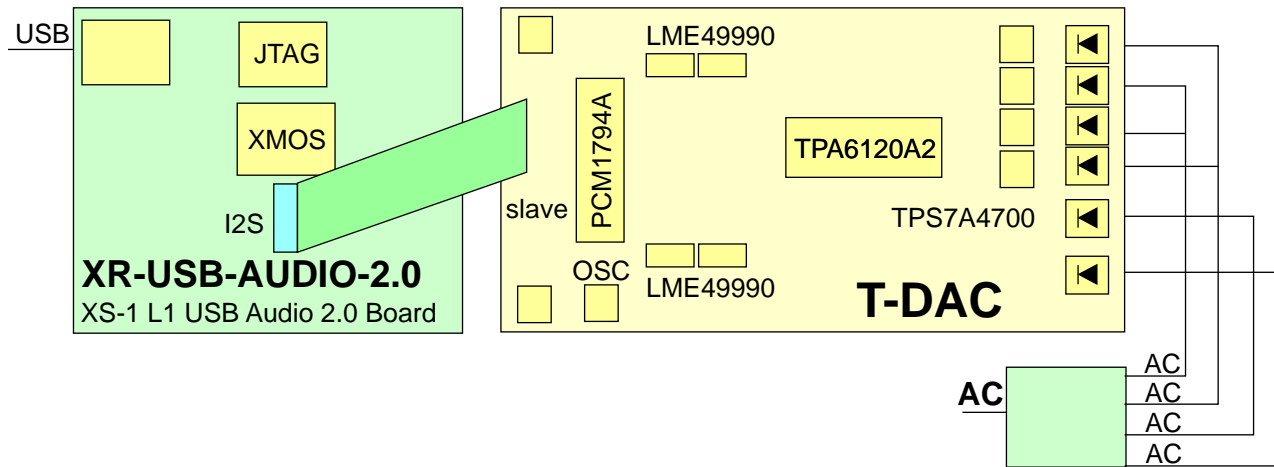
SCK

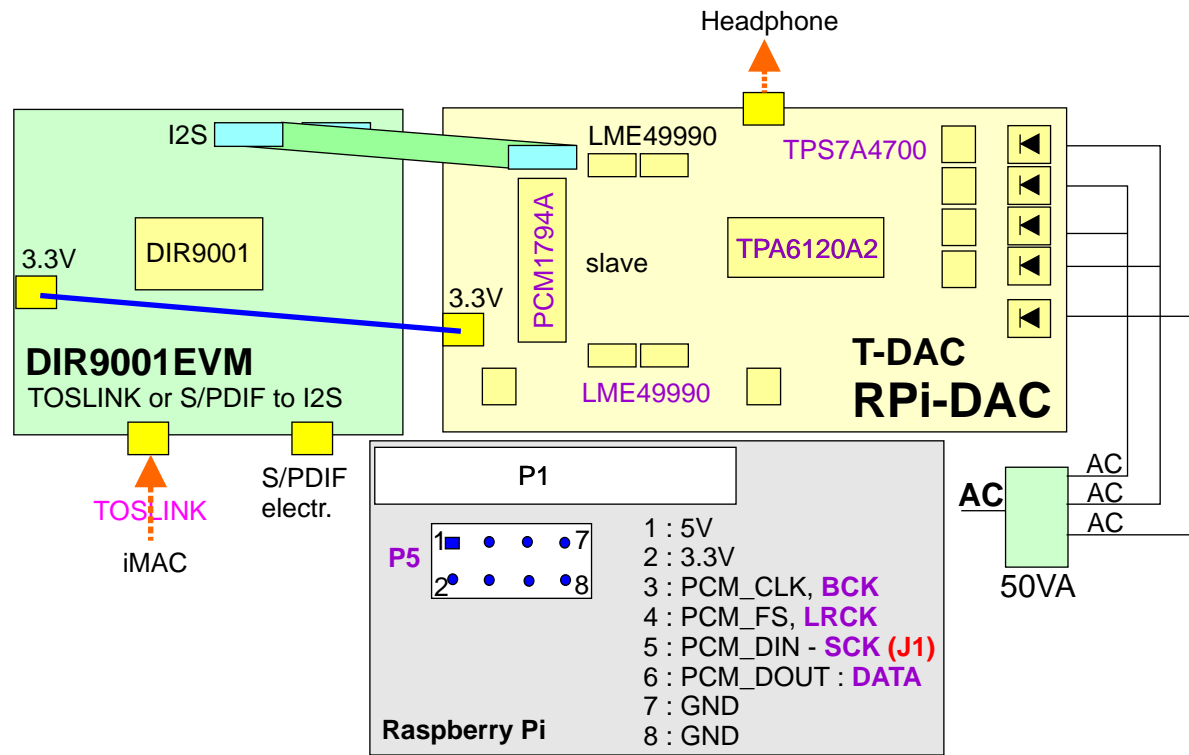
OUT

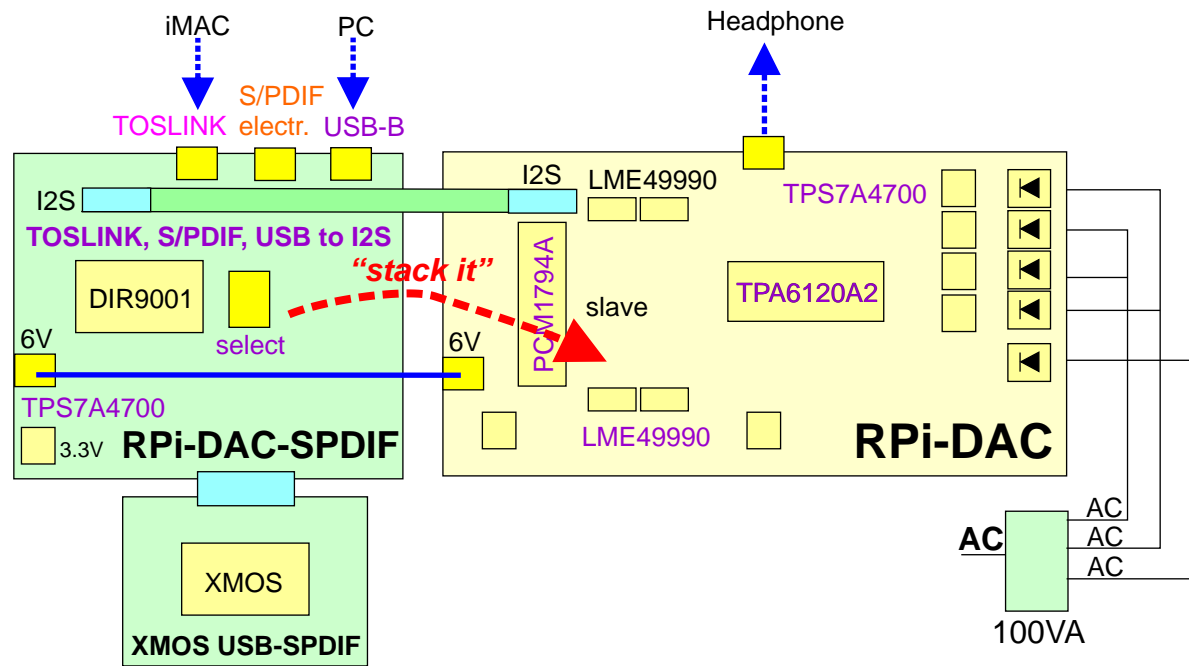
T-DAC

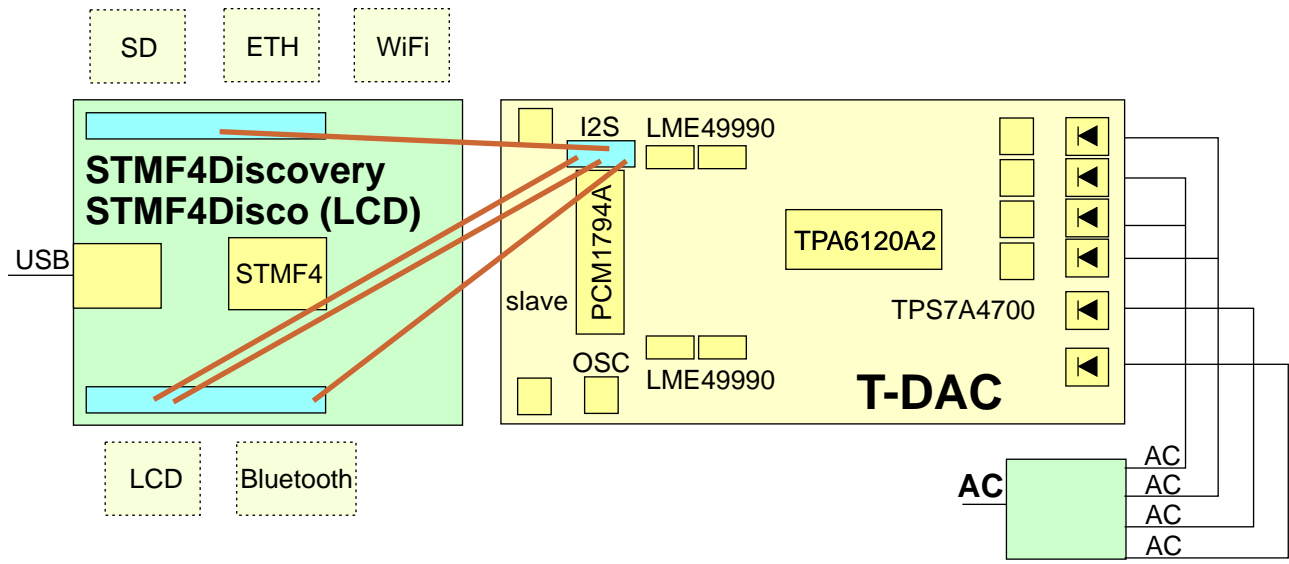


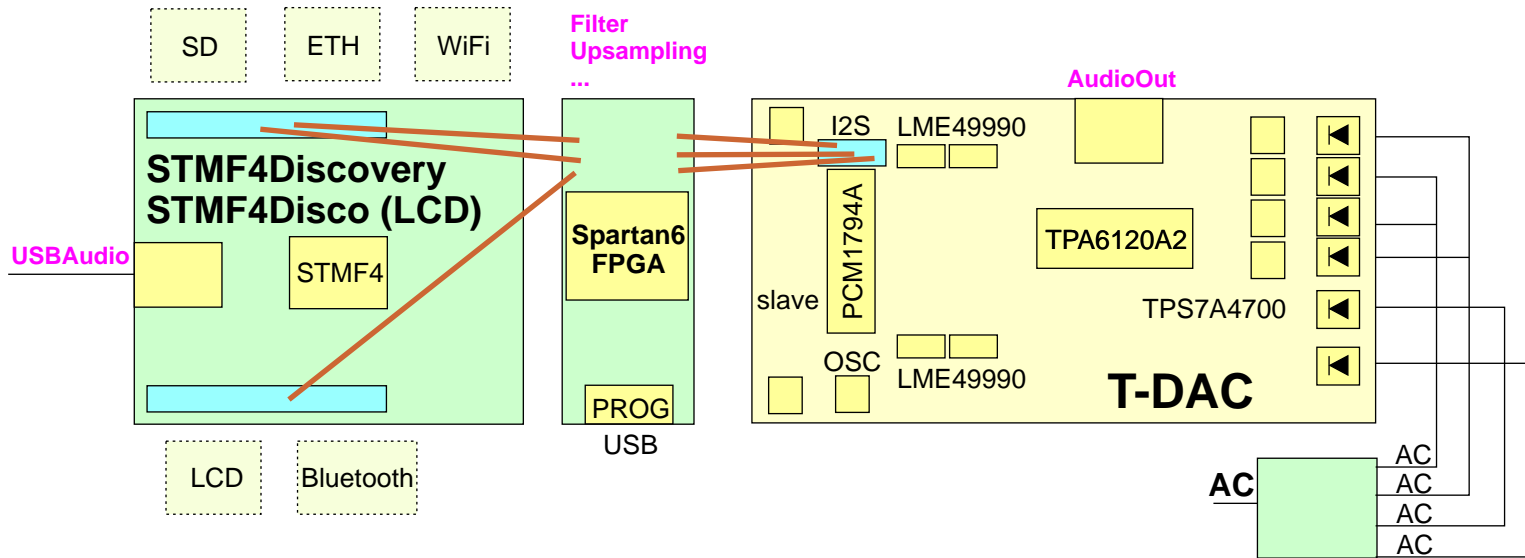


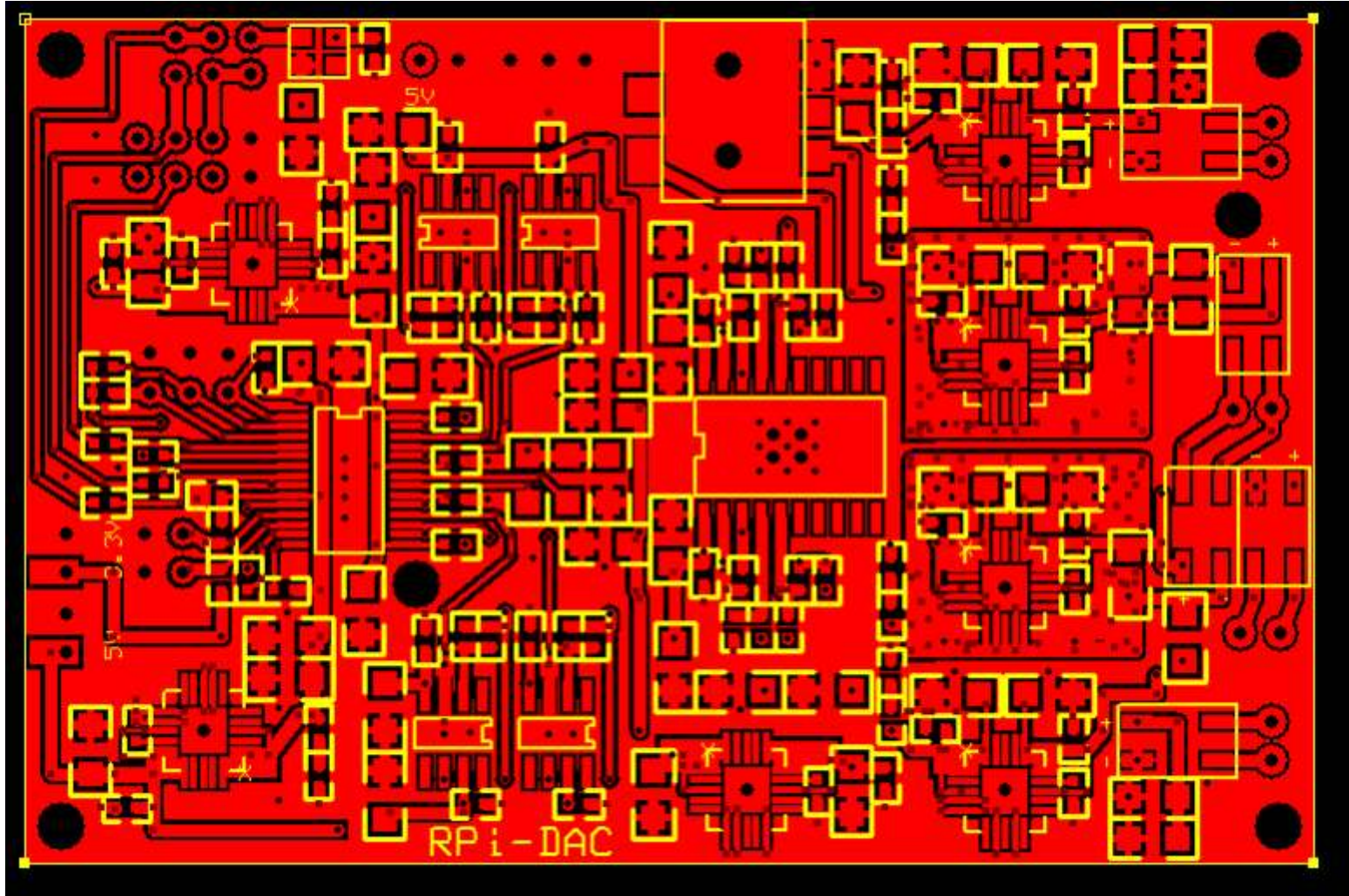








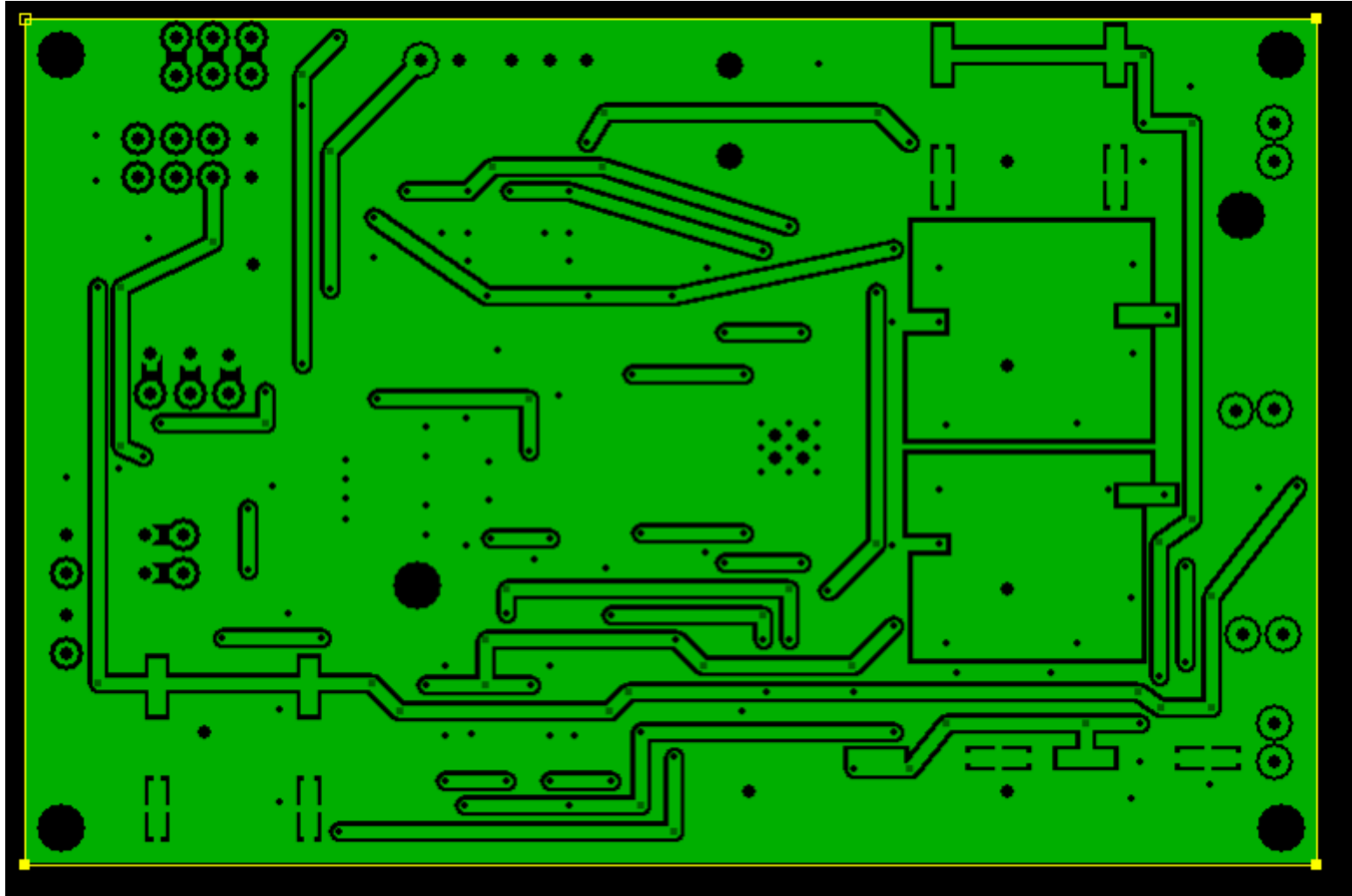




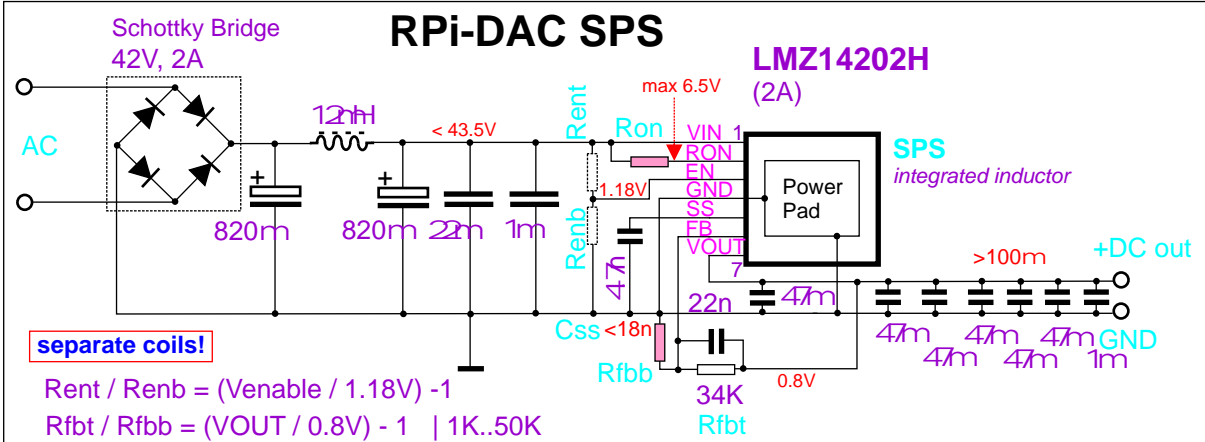
RPi-DAC

5V

5V 3.3V



RPi-DAC SPS



separate coils!

	Venable	fOSC	VOUT		
+DC out	R_{ent}	R_{enb}	R_{on}	R_{fbt}	R_{fbb}
15.91V			340K	34K	1.8K
7V	could be		121K	34K	4.42K
5V	open		100K	34K	6.49K
					2x
					1x
					1x (RPi USB power)

