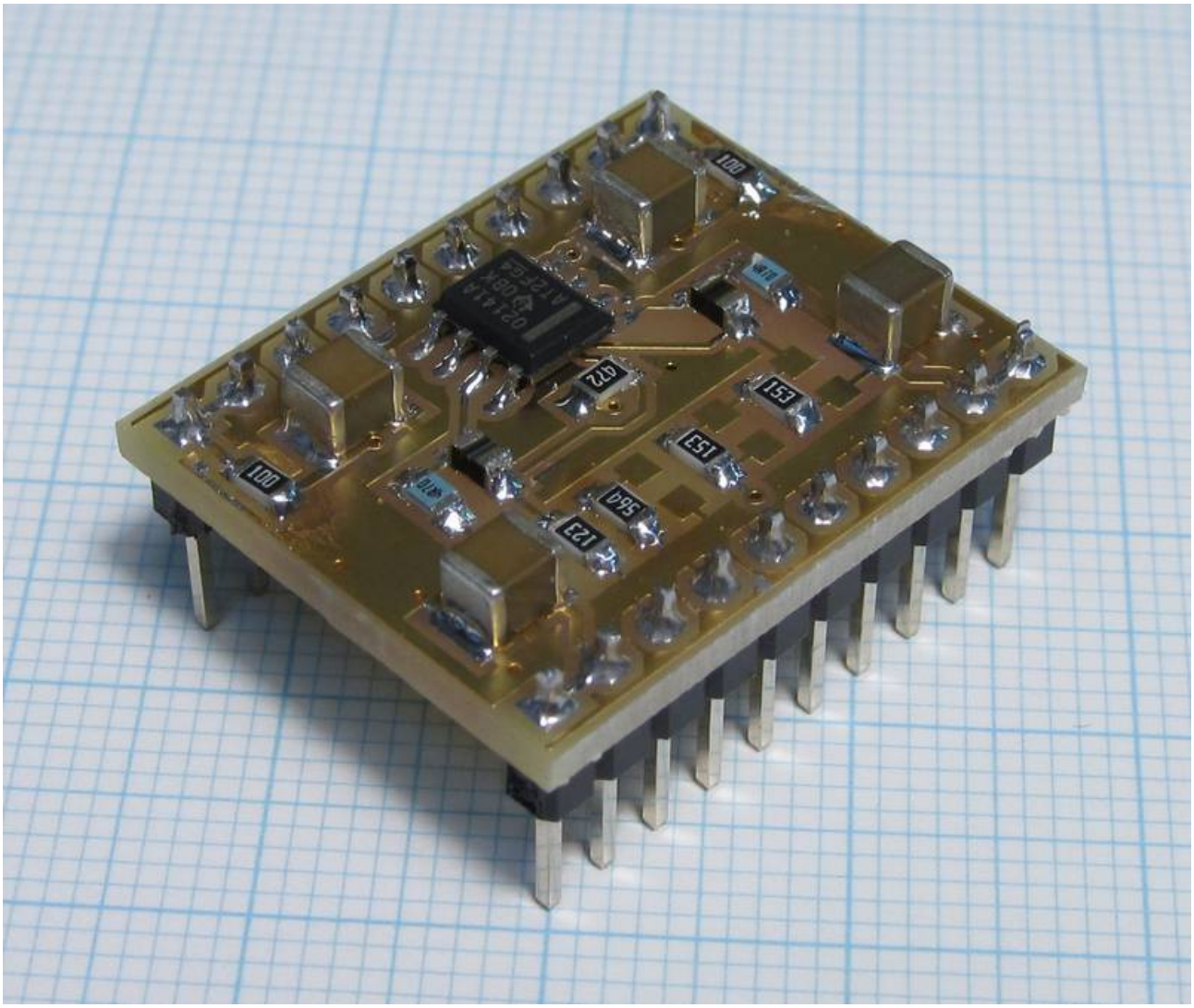
Description

voltage_regulator_2013_0.02

Low Noise Voltage Stabilizer, +14V, -14V



Content

Introduction

For low noiseapplications like preamplifiers the noise of the power supply can be seen in the amplified signal. PSRR (power supply rejection ratio) of some amplifiers is not high enough, especially at higher frequencies.

voltage_regulator_2013_0.02 can reduce noise of standard voltage supplies. The circuit board is small and can be placed directly next to the sensitive electronic.

Standard regulators like 78L15 or similar or even “ultralow-noise” regulators, like TPS7A49, have much more noise.

Noise

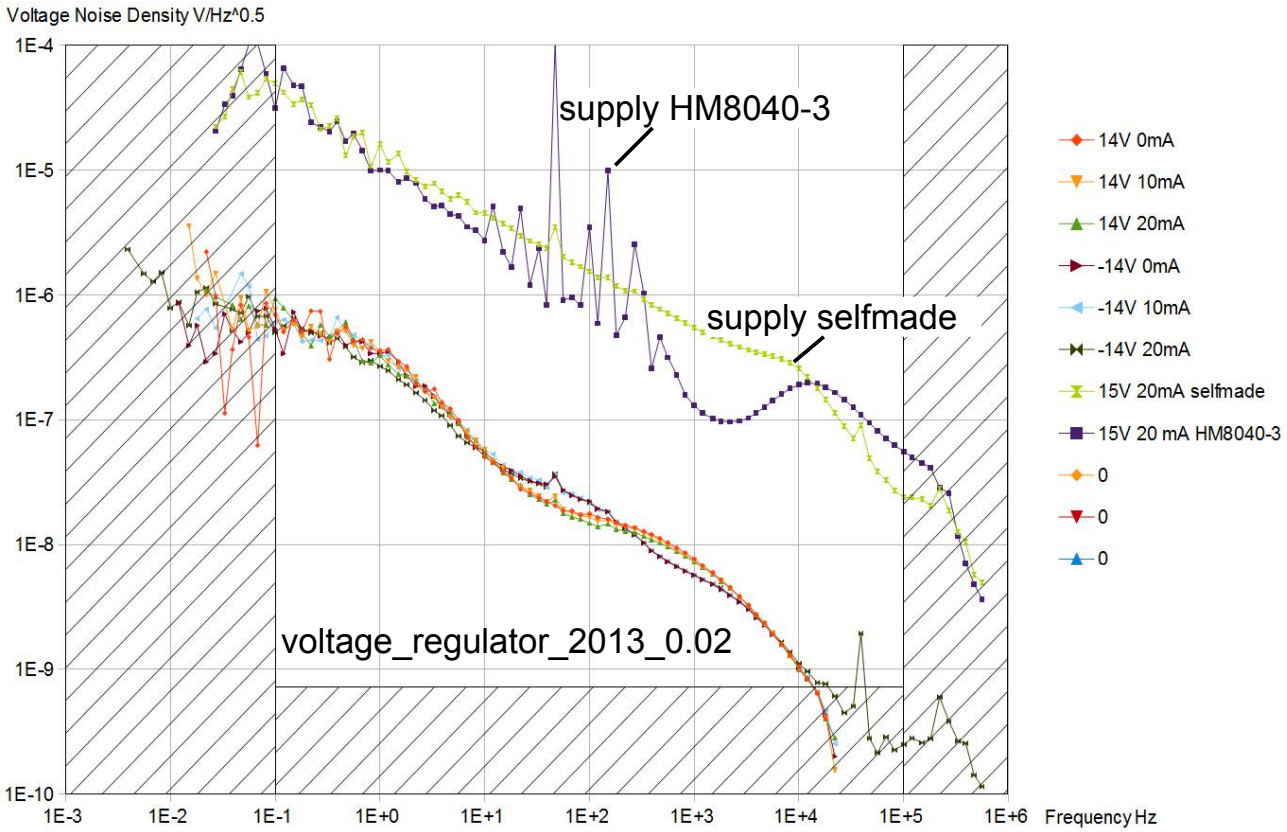


Figure 1 Voltage Noise Density of one prototype and two other supplies

Frequency range above 100kHz: Drop because of antialiasing filter of measurement setup.
Frequency range below 100 mHz: imprecise due to the coupling network.
Measured noise levels below 1 nV/Hz^0.5 are imprecise due to the measurement setup.

The higher the output voltage, the higher the influence of the voltage reference, the higher the noise. For example, if you need 7V instead of 14V, you would have about half of the noise.

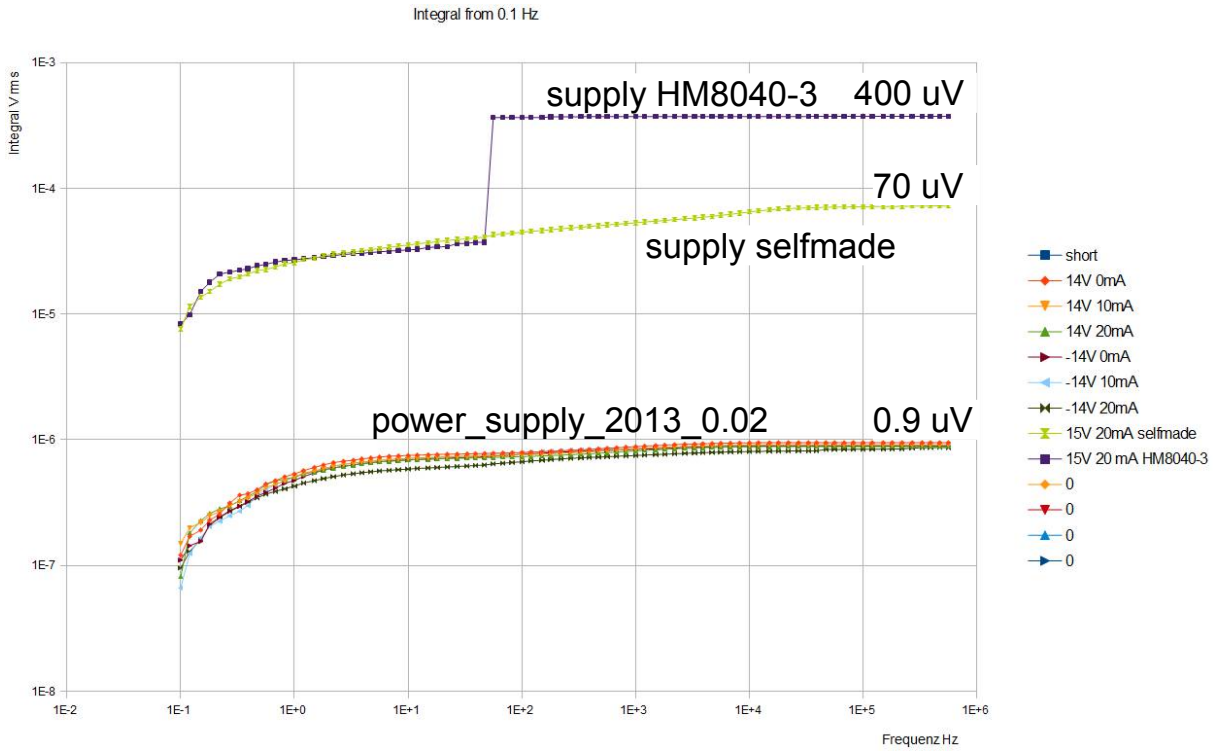


Figure 2 Voltage Noise, integrated from 0.1 Hz

The noise of commercial, linear supplies is often strongly dependent of the load current. At some points, oscillations can happen; some 10 mV are nothing special.

Schematic

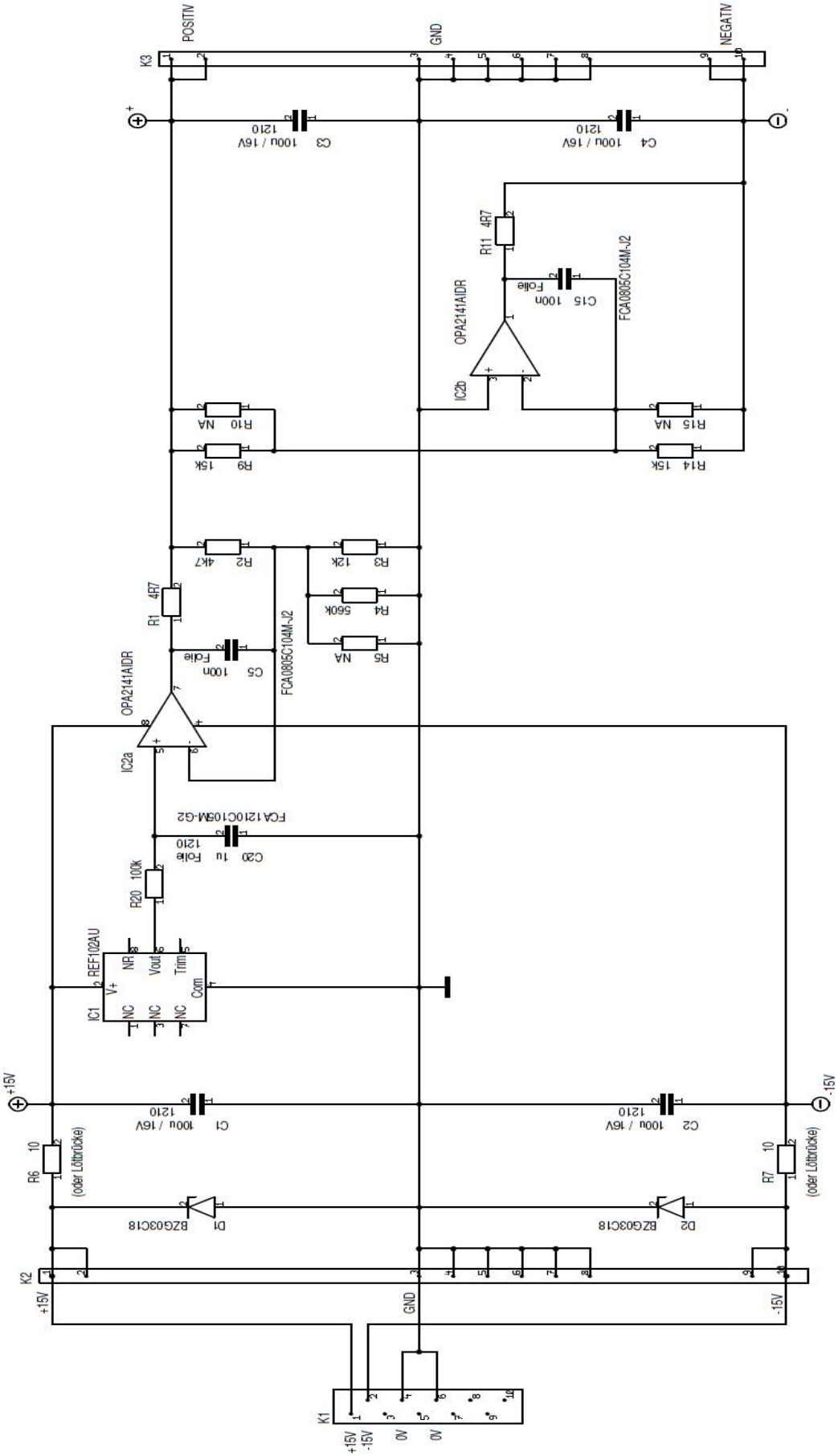


Figure 3 Schematic

The lowpass R6, C6 reduces the noise of the supply. REF102AU is a 10V low noise zener-reference. R20 C20 reduce the noise of the reference. The OPA2141 IC2a amplifies to 14V. IC2b inverts the voltage to -14V.

You can modify the circuit to your needs.
Depending on the voltage drop and the power consumption you can increase R6.

Typical Voltages
Input ± 15 V
Output, stabilized ± 14 V

You can use it for lower voltages by replacing the reference REF102 with an REF02 for example.

You can influence the voltage by choosing the appropriate gain resistors.

If you need an accurate voltage, you can fine adjust by placing R4, R5, R10 and R15.
Note: Never use trimmers, they will be very noisy.

The output-current is limited by the OPA2141 to about 30 mA.

Components

You can get all parts from mouser.com for example.

Resistors

R1, R11: thickfilm is ok

others: ERA-6AED 0805

Capacitors:

100n: FCA0805C104M-J2

100u: EMK325ABJ107MM-T (they have about 15 uF @ 15V)

Zener: BZG03C18

OP: OPA2141AIDR

Reference: REF102AU Note: No maximal noise is specified in the datasheet, only typical values. Take care!

General recommendation:
Use thin film resistors only (no thick film). For example ERA-6AED 0805 resistors, 0.5 %, 25 ppm, from mouser. 0.02 CHF each @ 100 piece. Available in E96, values between 10 Ohm and 1 MOhm.
Avoid cermet trimmers! They would destroy the noise performance. To adjust something, use multiple fix value resistors in parallel. Measure the needed value with a trimmer, place the first to big fix value resistor. Measure again with a trimmer, place the second fix value resistor and so on.

Circuit-board

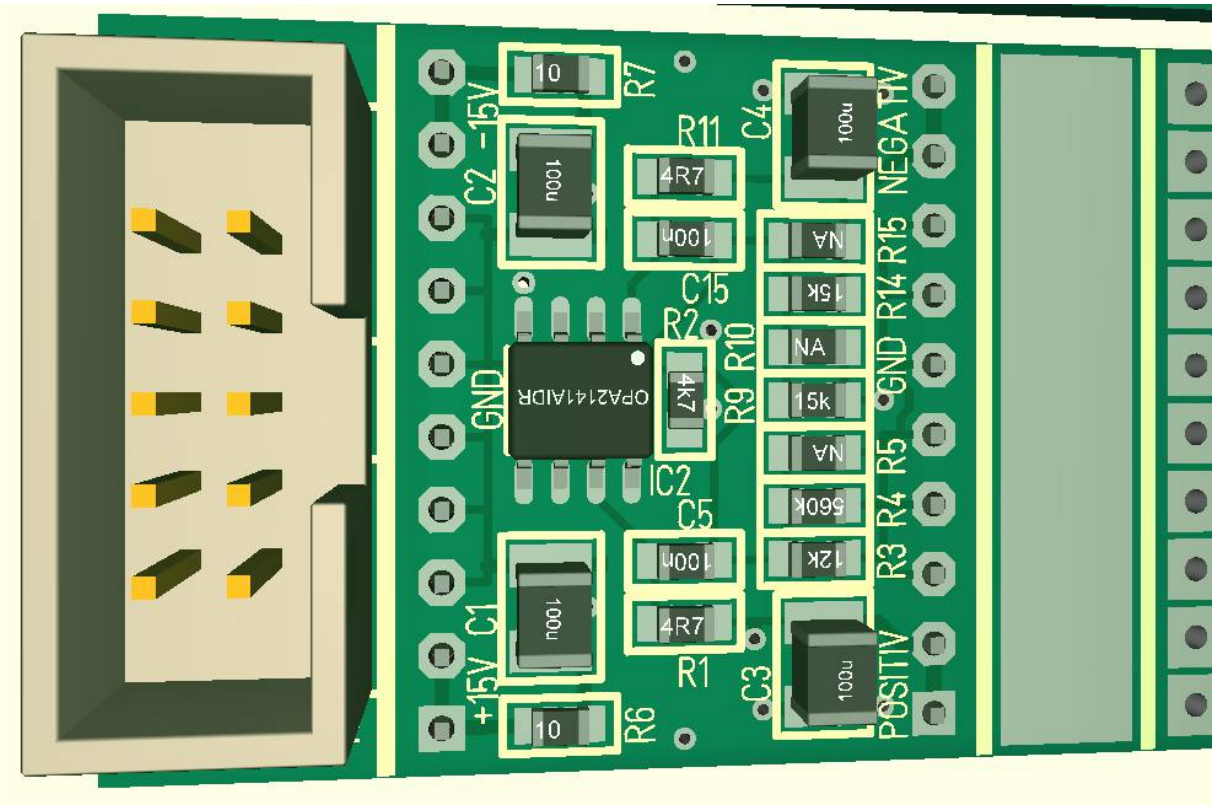


Figure 4 Layout Top

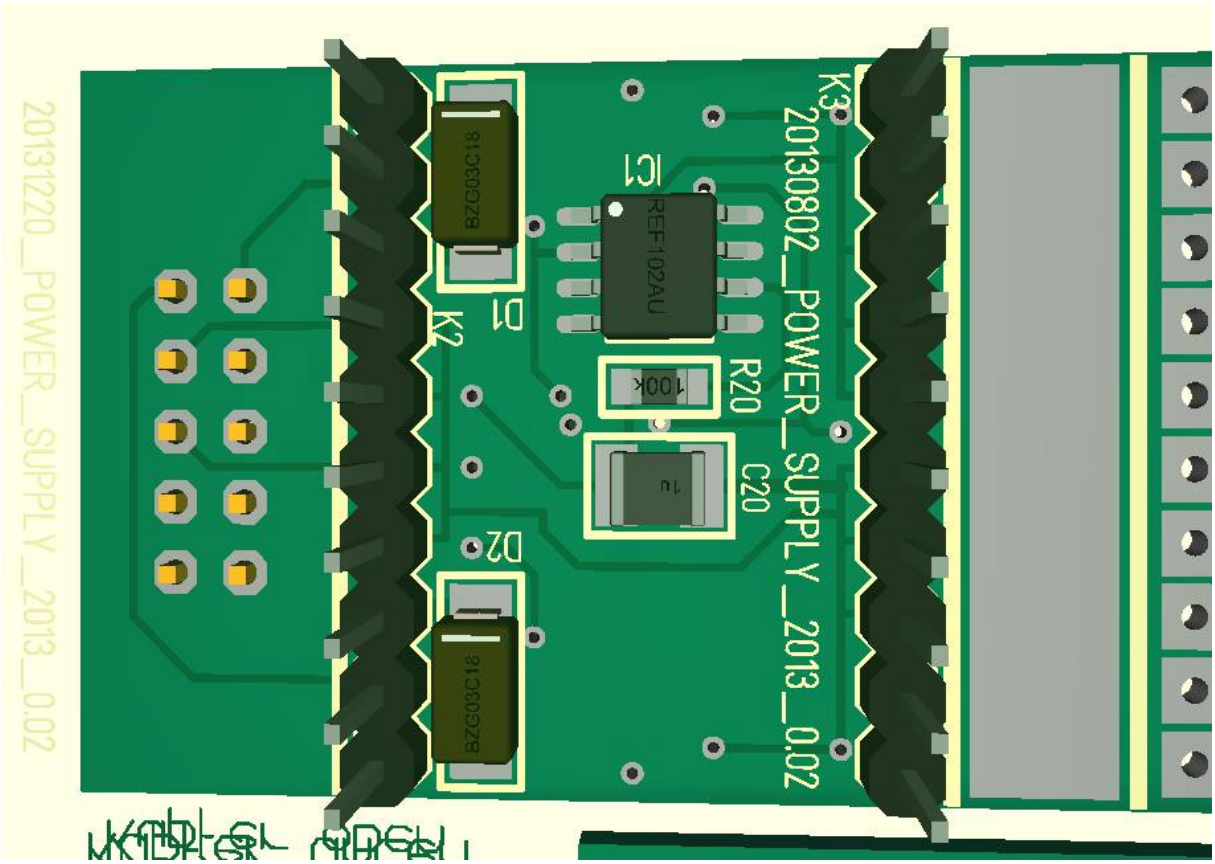


Figure 5 Layout Bottom

Complete pcb

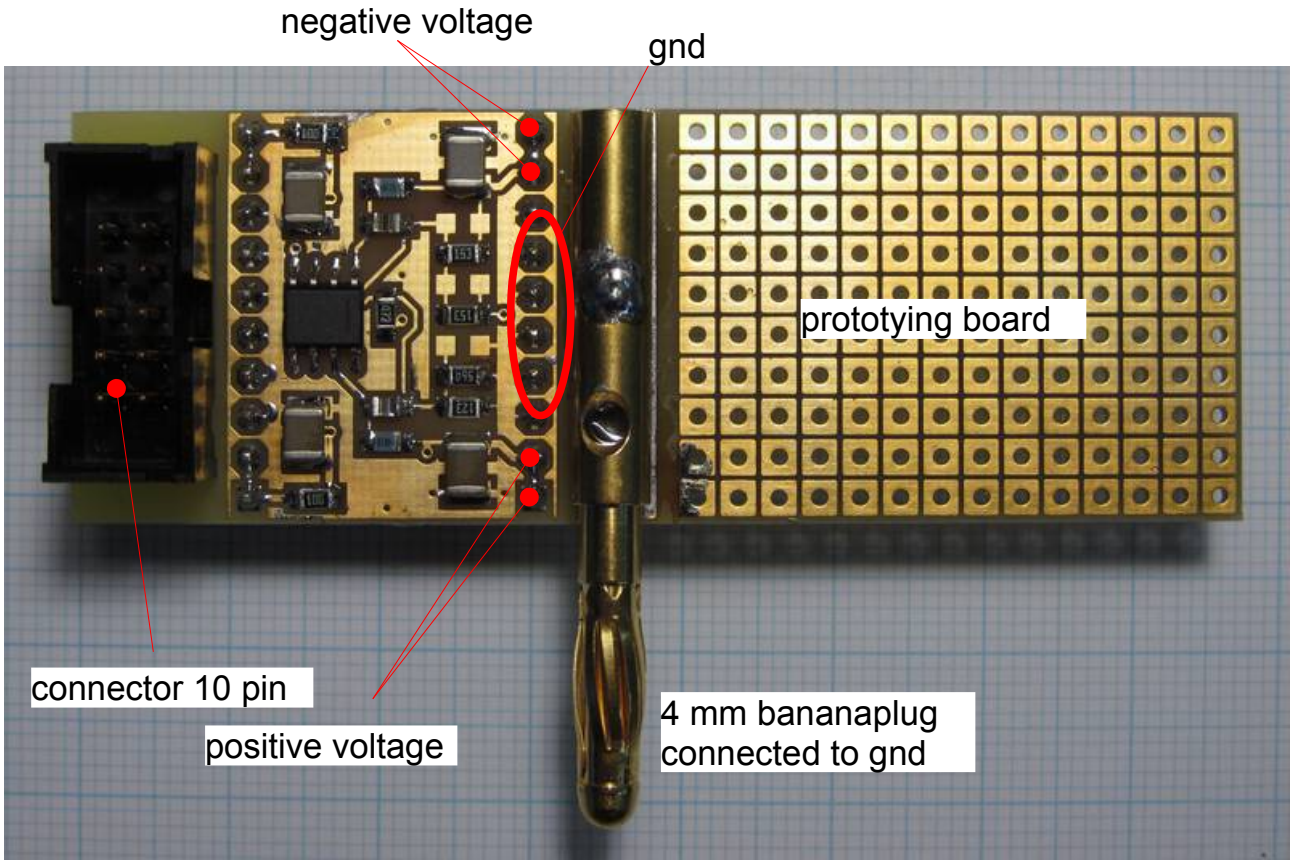


Figure 6 complete pcb

In our laboratory we often use it like this:
Powersupply with sub D female 9P: 15 V on Pin 1, -15V on pin 6, 0V on Pin 7 and 8. Sub D 9P connector crimped on planar cabel, 2.54 mm connector crimped on the other side. This connector is pluged into voltage_regulator_2013_0.02. The 4 mm banana-plug is connected to the shielded electronic enclosure.

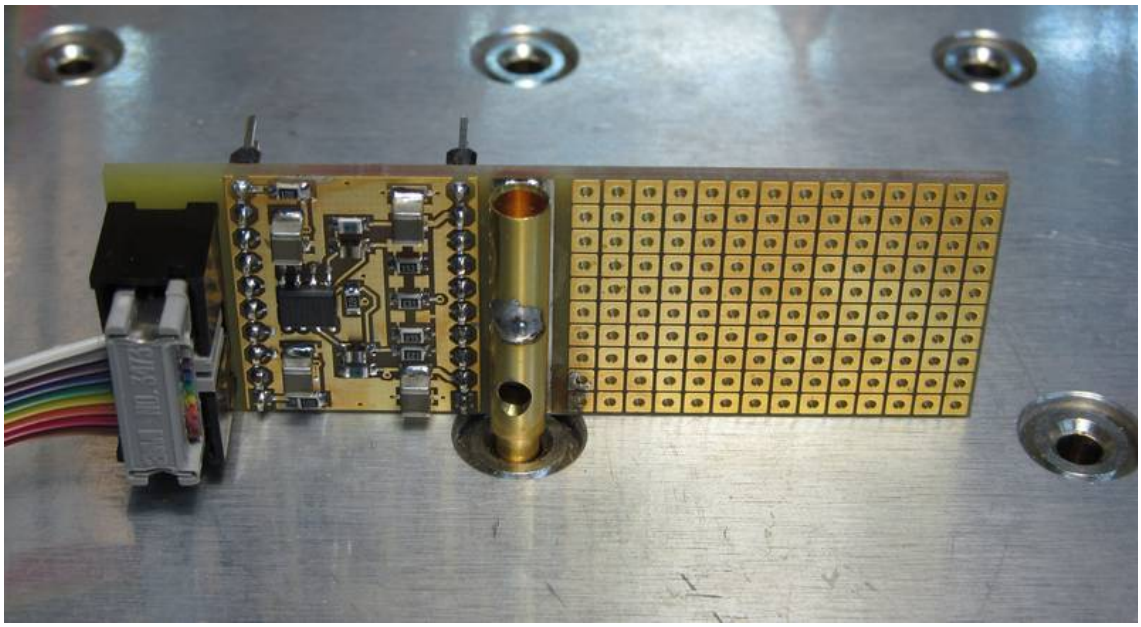


Figure 7 Typical usage with 4 mm banana-connector

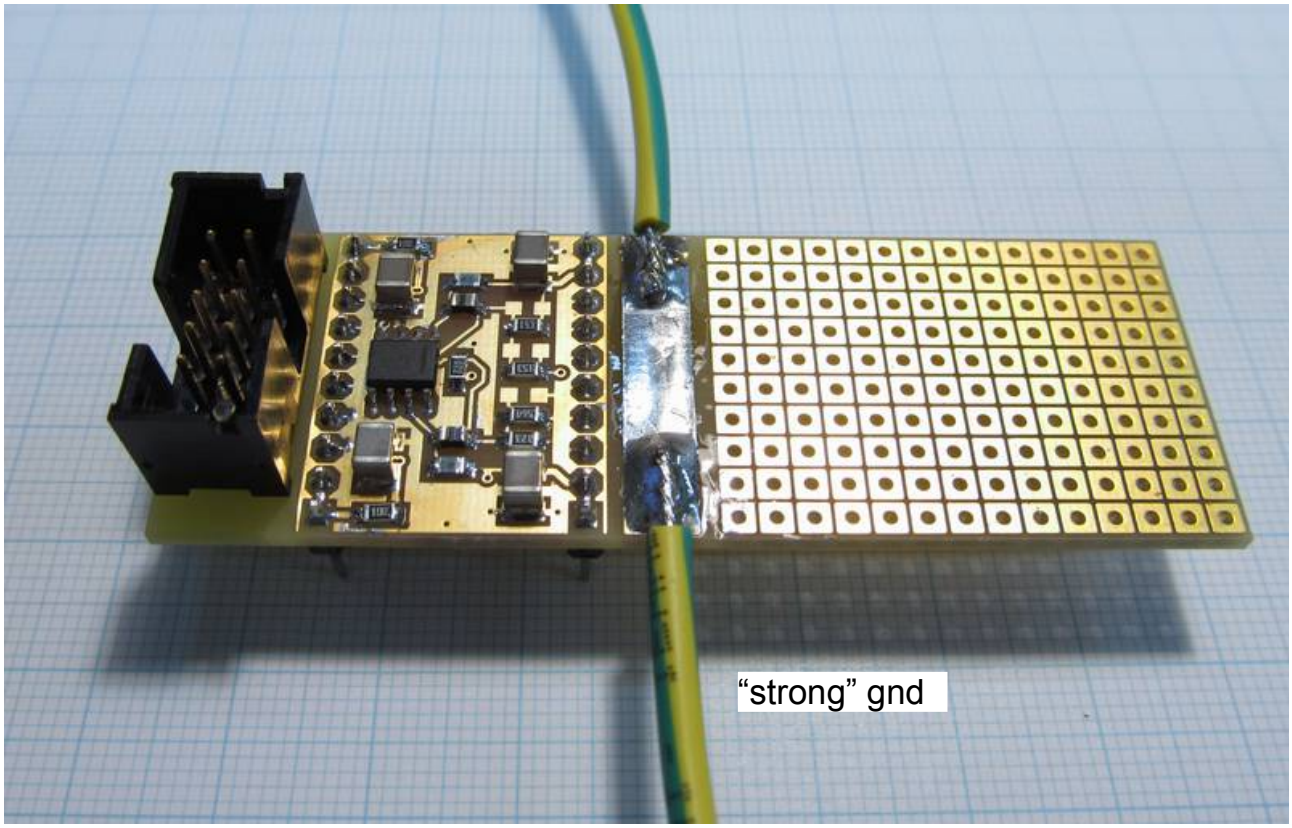


Figure 8 Example: gnd over wires.

Small pcb

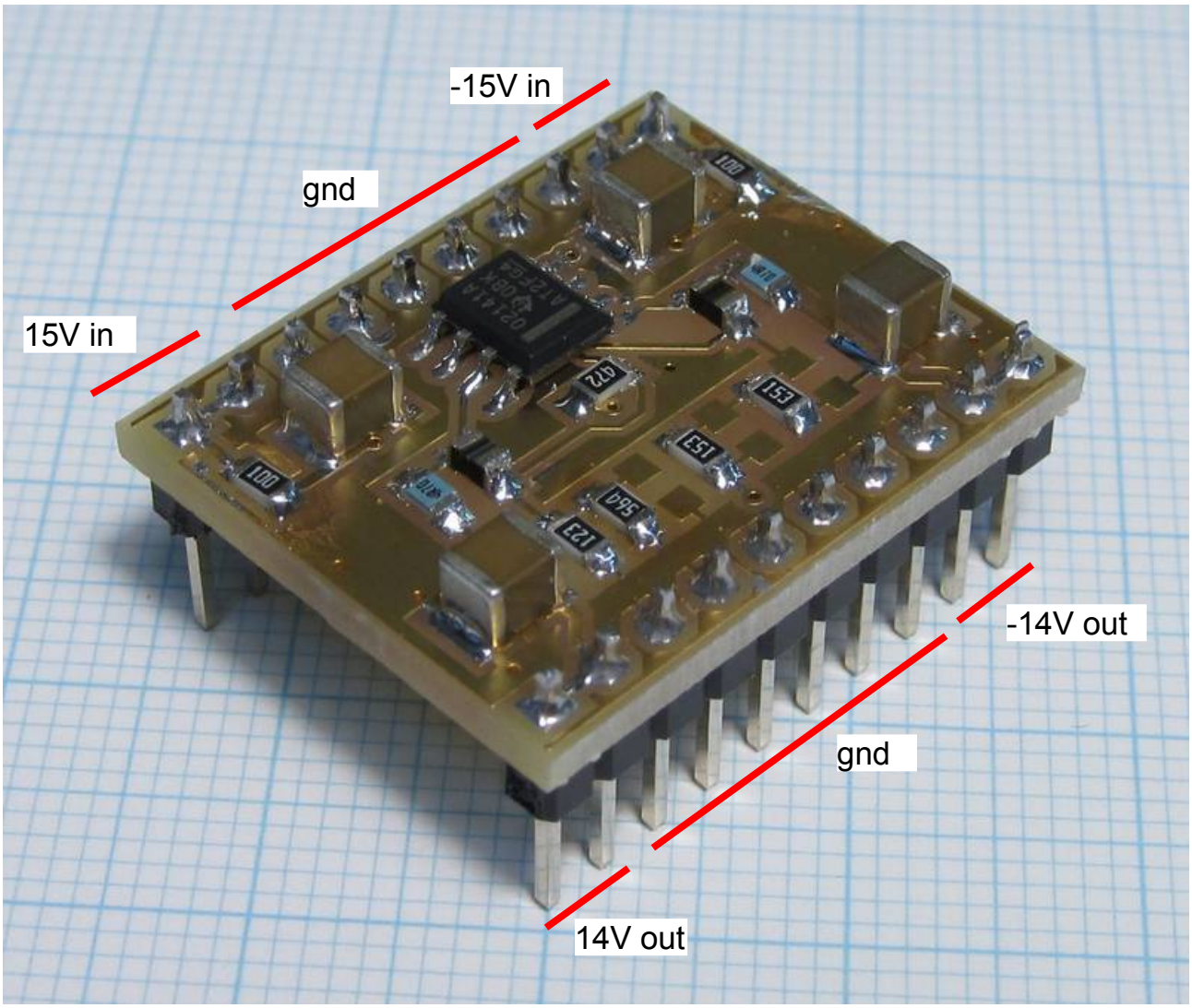


Figure 9 small, top

You can easily cut away the connector-part and the prototyping board. You get a small pcb with regulators only: 21 mm x 26 mm.

You can plug the voltage_regulator_2013_0.02 on your own pcb.

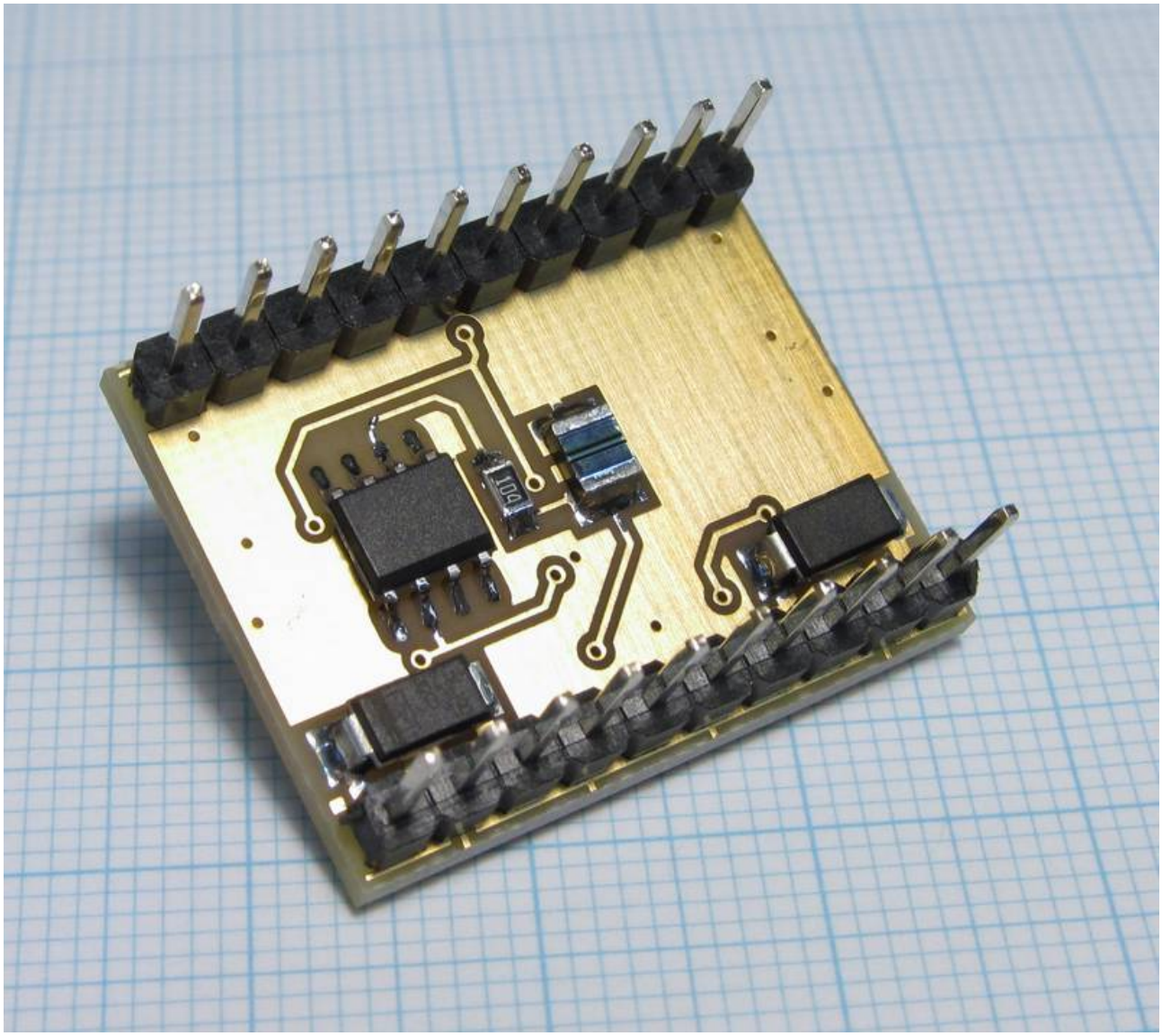


Figure 10 small, bottom

Size

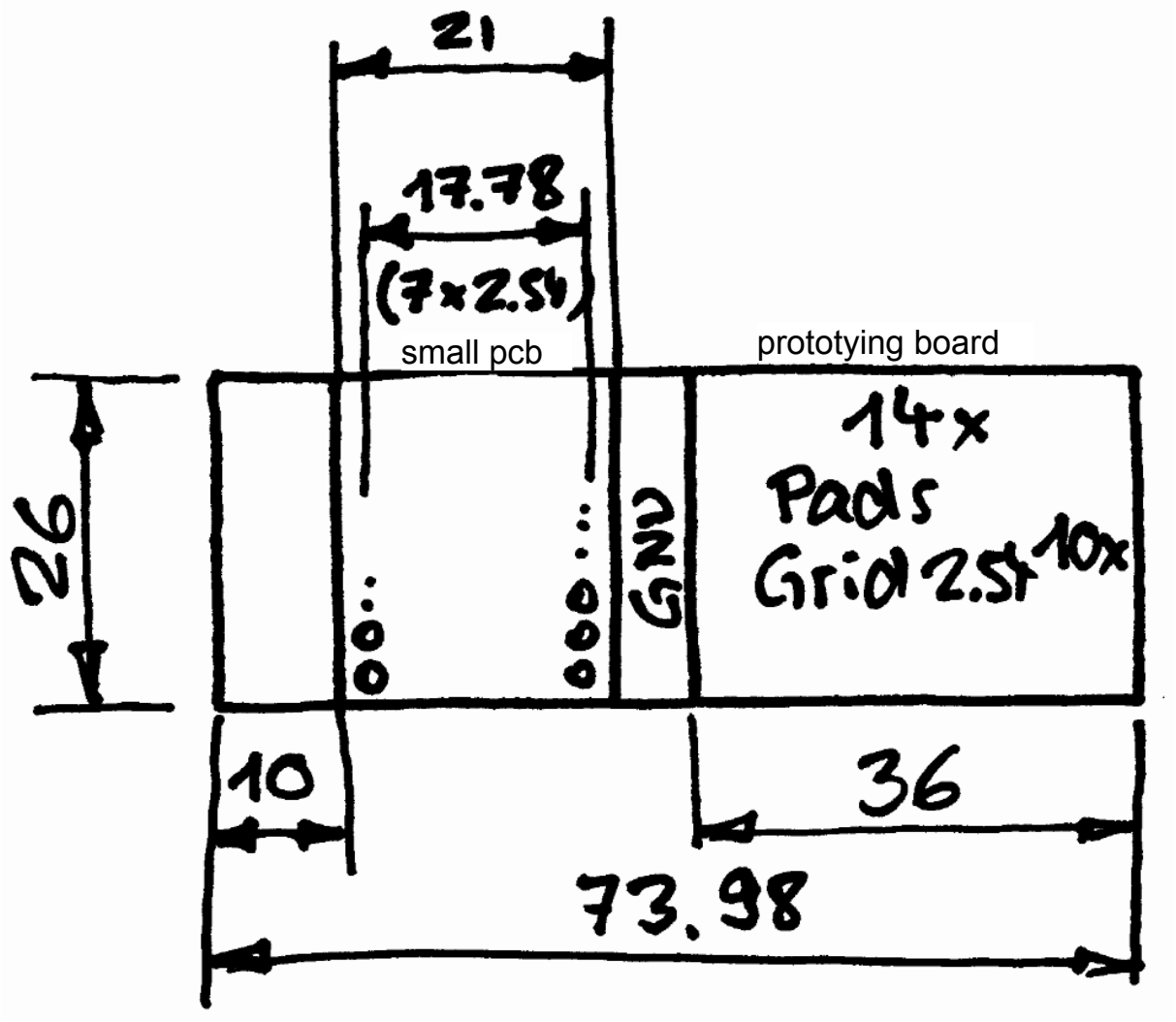


Figure 11 Size

Avoid leakage currents

It is important not to have leakage currents on the surface of the circuit board. Especially around R20 and C20. Clean the board with isopropanol for 30 minutes in ultrasound. Use brush to remove any flux. Remove isopropanol with compressed air. Dry circuit board at 110°C for 1 hour.

If you do not like cleaning: use pure rosin flux only.

Installation

Its best to place voltage_regulator_2013_0.02 directly next to your low noise circuit. Provide a low impedance gnd connection. Avoid gnd-loops.

No current spikes

Do not use this regulator to supply digital electronics. If you do: check the reaction to current spikes.

Limits

See specifications for OPA2142...
Current up to 20 mA is no problem, and this is sufficient for typical low noise amplifiers.
Dropout voltage: I recommend 1V or more.

Design your own pcb

Please feel free to design the regulator directly into your circuit board. Yo don't need to buy voltage_regulator_2013_0.02.

I can give you my target-files.

For an easy start you can buy voltage_regulator_2013_0.02 for 50 CHF each. You get a complete pcb. No 4 mm banana-plug and no connector.

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