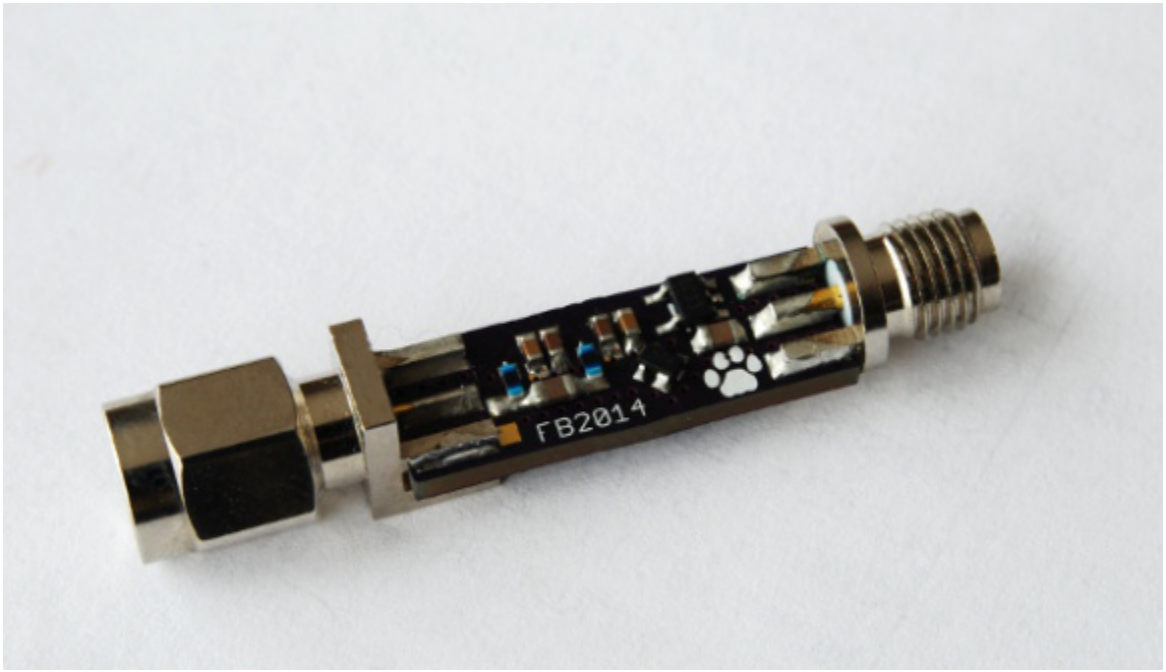
LNA FOR RTL BASED SDR RECEIVERS

SDR is one of the trendy technologies of the moment, and I couldn't resist the temptation to buy one of those cheap RTL2832U based DTV receivers, usable out-of the box as a SDR.

The device comes with a fronted (R820T) with a built-in LNA, which is normally powerful enough to fed the receiver when using a short cable, but since I wanted to experiment with an antenna mounted on a relatively long and thin cable, I built a small LNA to be mounted at the far end, near the antenna.



The LNA is based on the Mini Circuits PSA4-5043+, and the board is designed to be as small as possible to fit in line with the antenna and cable, and to be powered by the receiver itself.

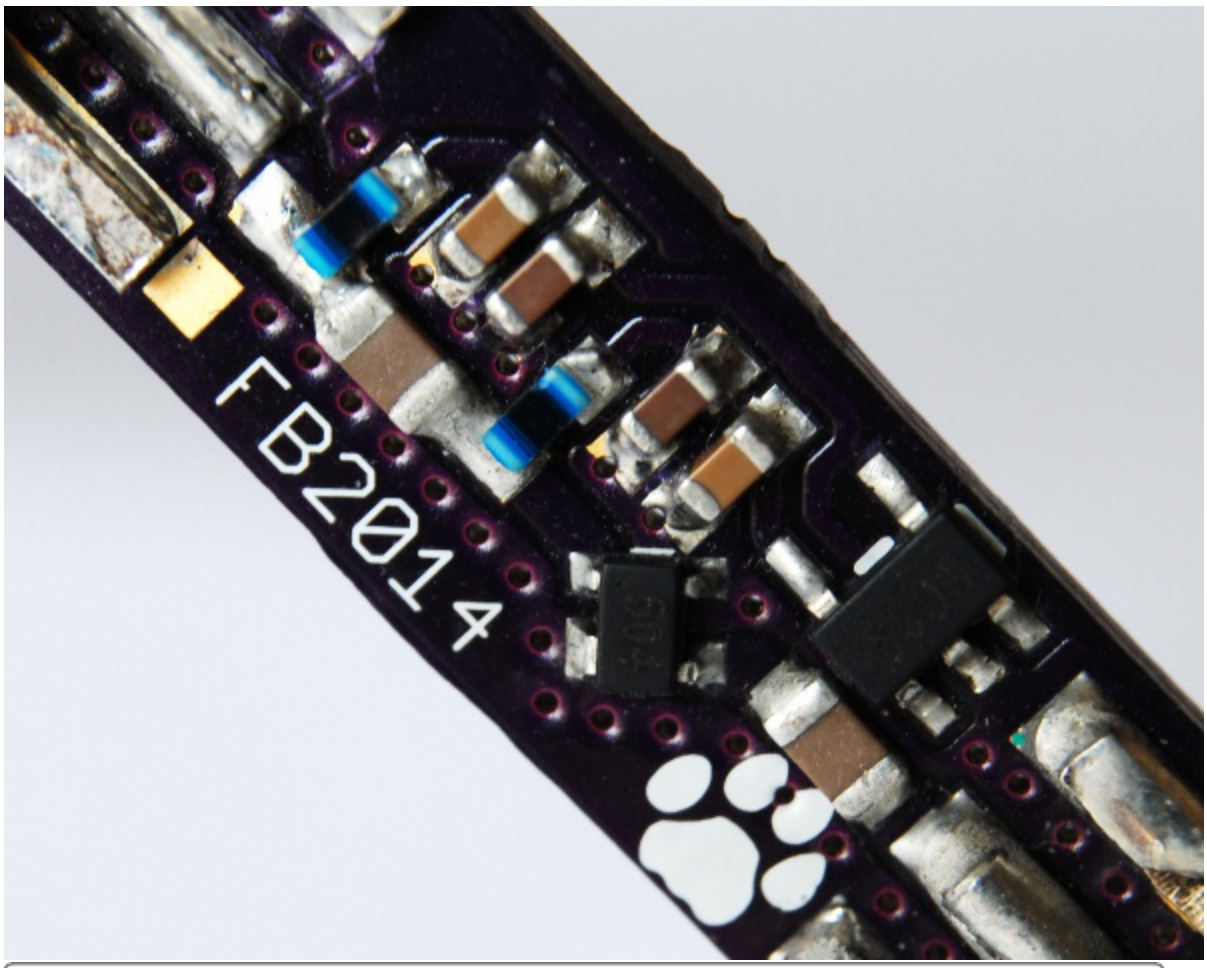
PSA4-5043+

The Mini Circuits PSA4-5043+ is an LNA used in many designs for SDR antennas, including LNA4ALL and F5ANN'sADS-B Active Antenna.

The device operates up to 4GHz, and it's powered by biasing the output pin to DC, usually from 3V to 5V. The power can be provided from a dedicated supply or from the antenna cable itself, which is preferable if you want to mount the LNA near the antenna. The cable is normally biased using a dedicated bias-tee circuit (see F5ANN page), but as I did not want more cables and devices, apart from the receiver, I decided to modify the receiver itself to bias the signal instead.

The LNA

The LNA circuit is very simple, and it only includes connectors, some passive to extract power and bias the amplifier, a linear regulator and the amplifier itself.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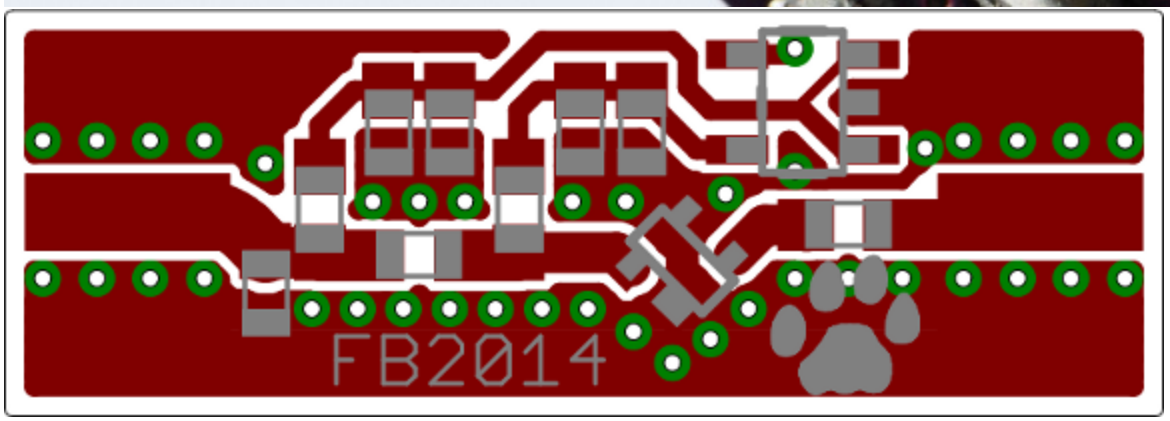
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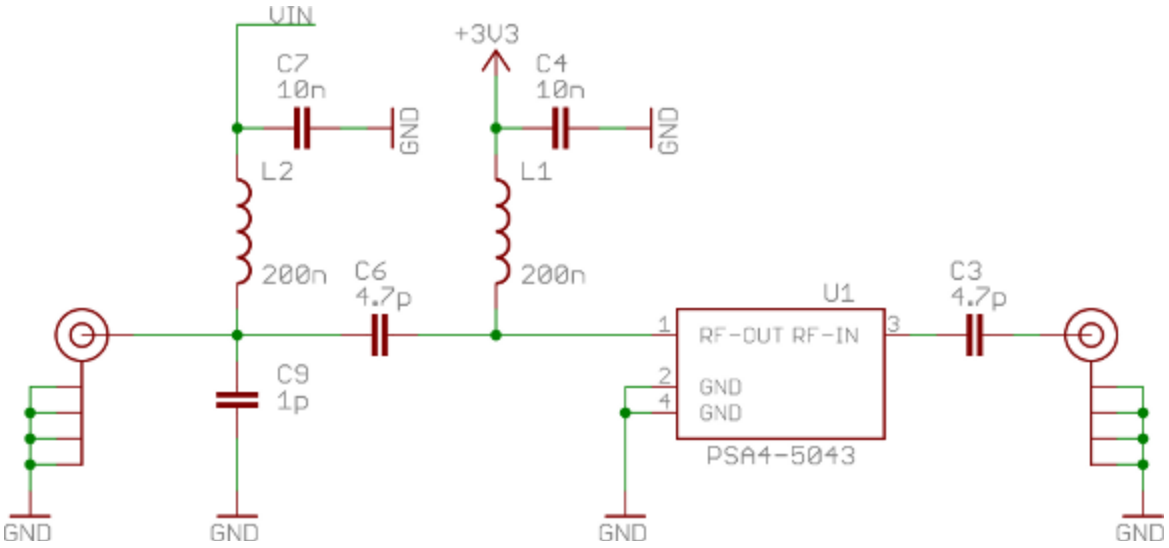
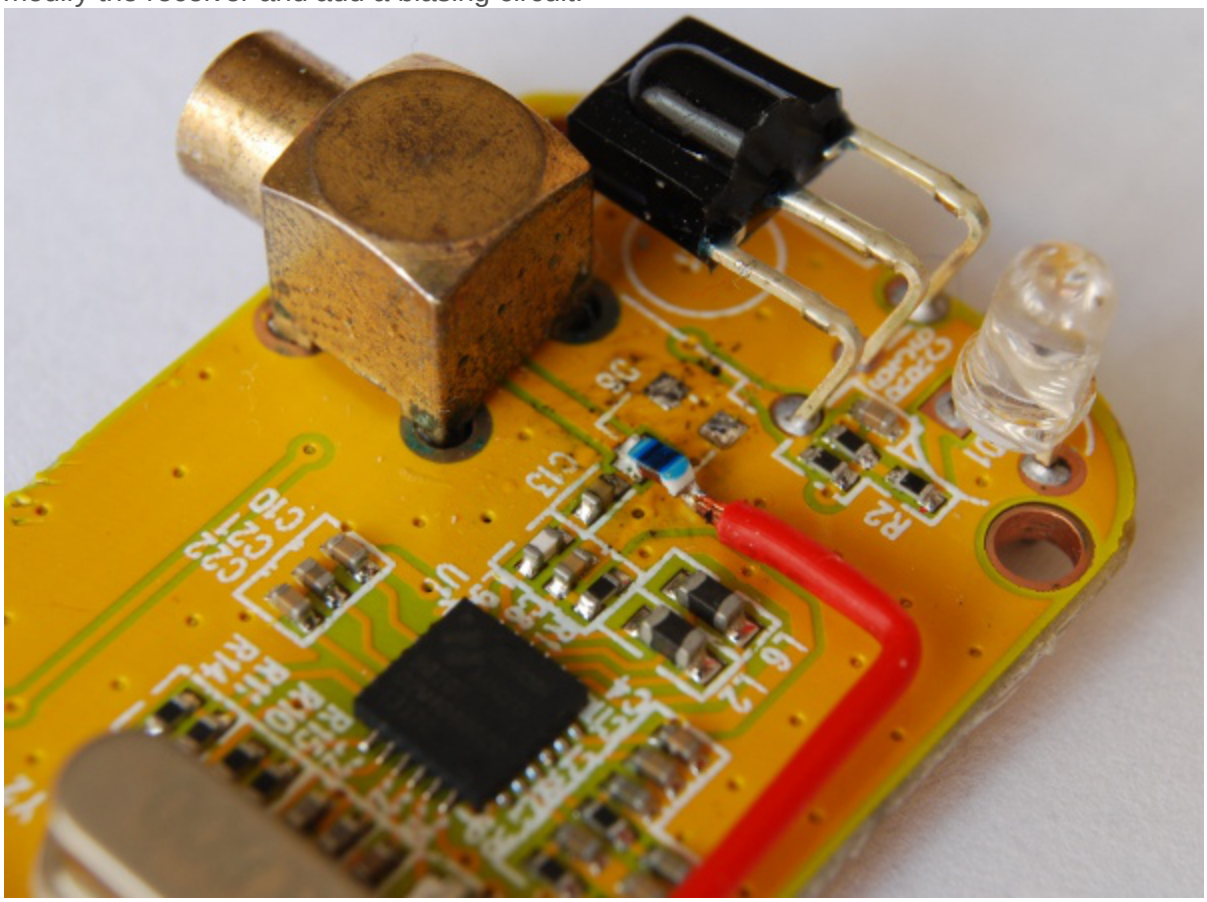


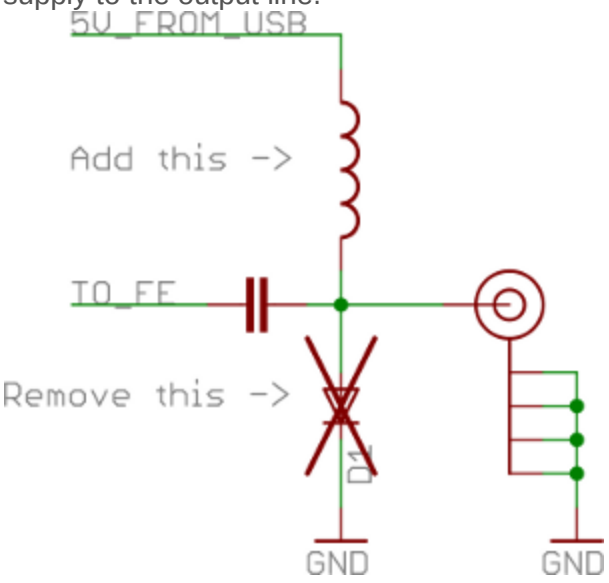
The two signal inductors are used to filter the DC power from the cable (L2), feed it to the linear regulator (not shown here) and feed a regulated DC (L1) back into the amplifier (U1). Optionally a third inductor may be connected from VIN to the antenna connector (after C3) to feed a DC supply back on the input cable, allowing for connection of multiple amplifiers in series.

Radio Modifications

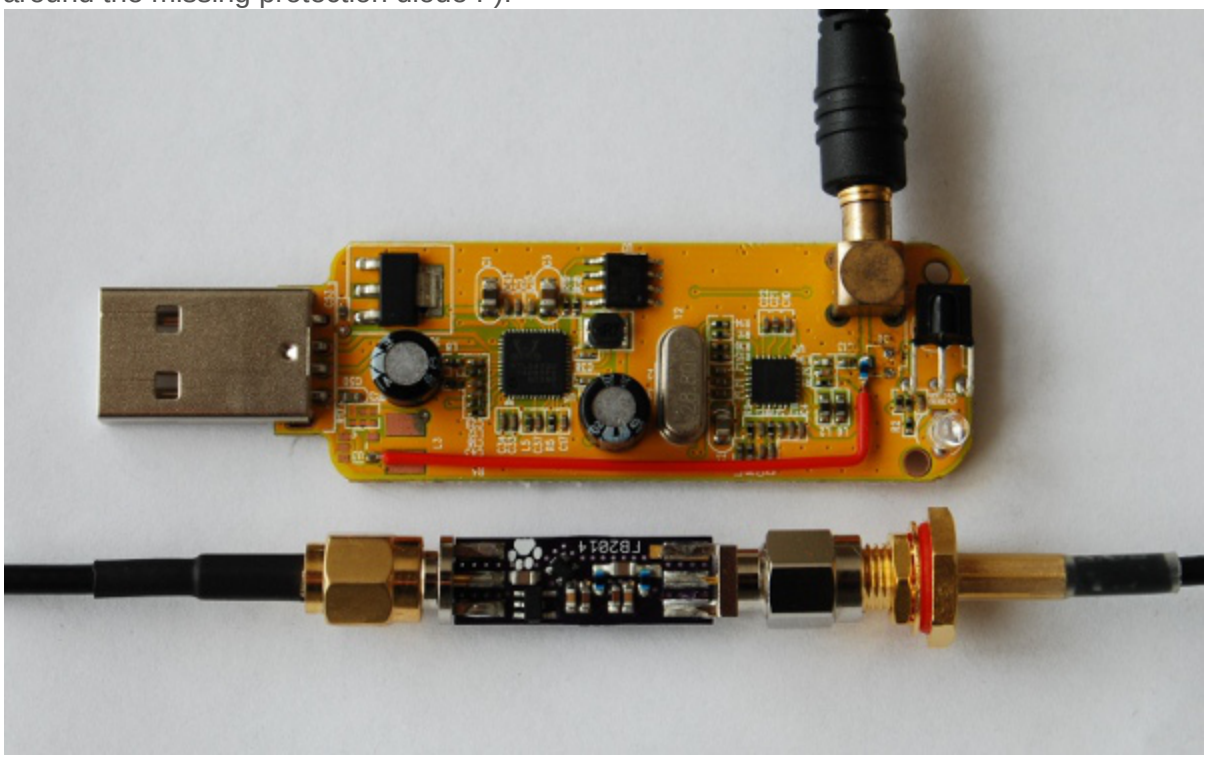
To supply power to the cable, rather than using an additional external device, you can easily modify the receiver and add a biasing circuit.



The modification involves first verifying the existing circuit to ensure that the input is already DC filtered (the series capactior C13), then removing any existing clamping protection that would short the DC to ground (D8 in the picture) and finally mounting a inductor from the USB 5V supply to the output line.

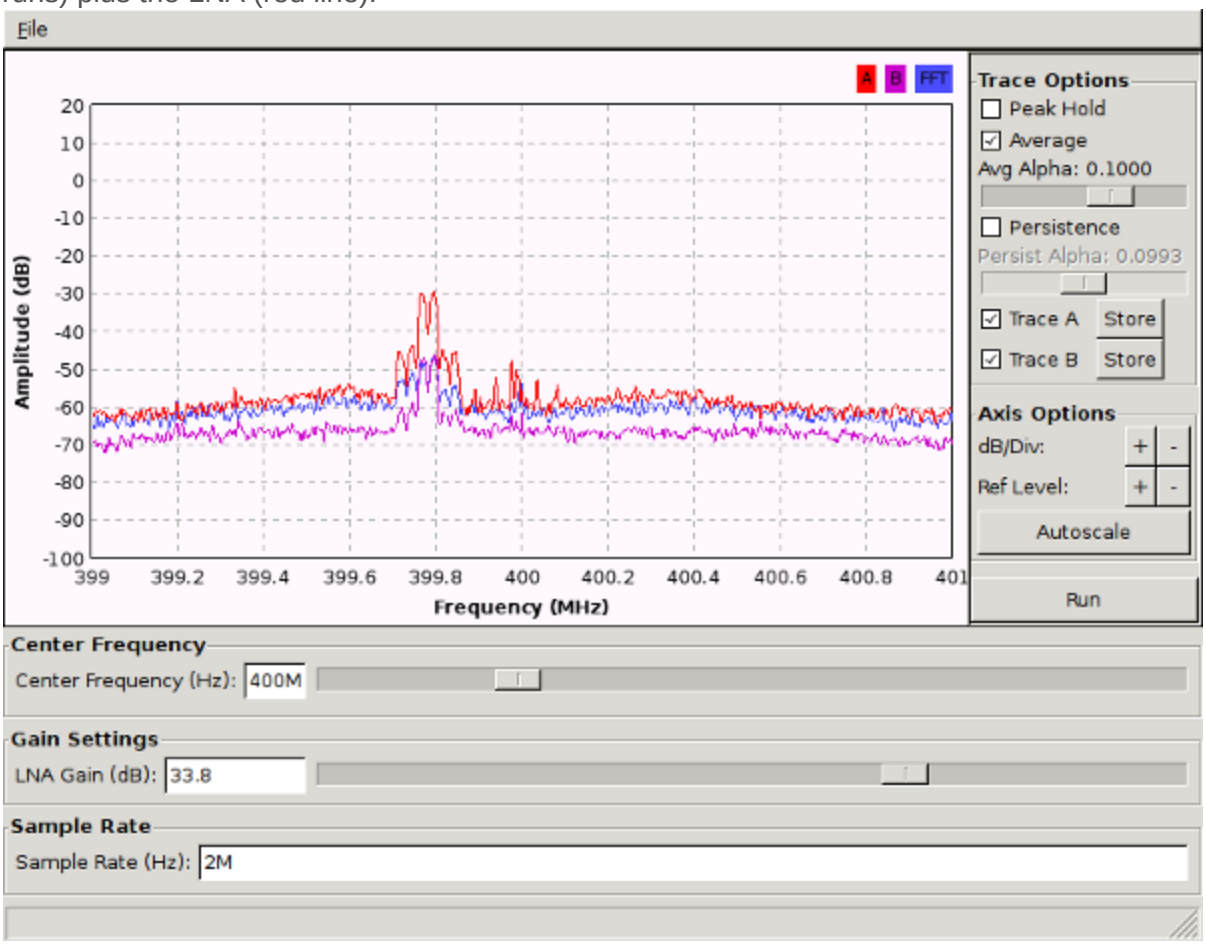


The modification allows to operate an active antenna without external components, but be sure not to connect any passive antenna shorted to ground, as that would quickly destroy the biasing inductor in the radio since there is no current limitation circuit (that's why my board looks so bad around the missing protection diode :-).



Performances

This a screenshot from a test on the radio with a short cable (blue), with a long cable (purple), and with the long cable (about 10m of RG174, a very lossy cable normally not used for long runs) plus the LNA (red line).



The results are quite good and show that the LNA is powerful enough to compensate for the loss for a cable of that length (about 20dB at 400MHz).

Source : http://fabiobaltieri.com/2014/06/22/lna/