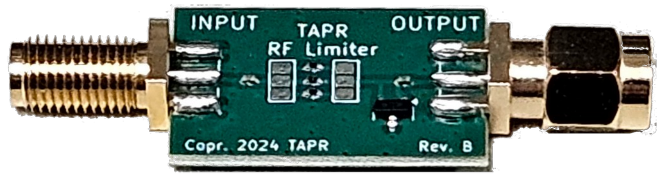
RF Power Limiter for SDR Receivers
Assembly and Operation Manual

Revision B
Revised: 7 February 2025



Introduction

The TAPR RF Limiter provides protection from strong RF signals to a receiver or other sensitive RF input. It starts limiting signals at about -6 dBm input and is effectively "hard limiting" by +10 dBm. In other words, very strong signals that might damage a receiver are limited to a power level that will (hopefully) prevent damage. It is intended for operation at 54 MHz and below, but can be used at 144 MHZ if additional attenuation is acceptable.

Operation is simple – just install it directly ahead of the device (preamplifier or receiver) that you want to protect. If possible, any lowpass or bandpass filter should be installed ahead of the limiter. This minimizes the likelihood of generating spurious signals (see note 3 below).

<u>IMPORTANT NOTES:</u>

1. The RF Limiter is rated for a maximum continuous power dissipation of 200 mW. Power input above one watt will cause the fuse resistor to fail, which should cut off the output. However, we can't guarantee that this will work, so please use care not to exceed safe input levels!

2. Some sensitive preamplifiers or other equipment might not be able to withstand even the reduced power output by the RF Limiter. Review the information in this manual to make sure it is suitable for use with your equipment.

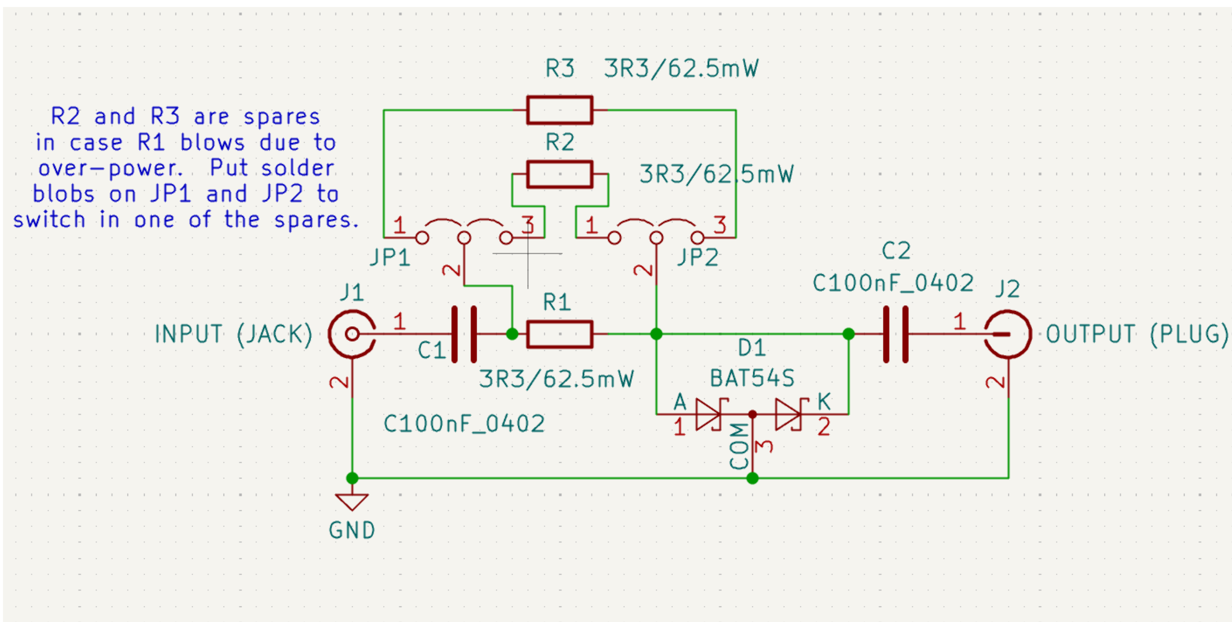
3. The diode in the limiter is a non-linear device. That means that when it is limiting it will generate harmonics of the input signal and possibly other intermodulation products. In other words, it could create interference to nearby receivers on other frequencies. That's why putting it behind a filter may be helpful.

Circuit Description

The RF Limiter is nothing more than a BAT54 dual Schottky diode connected between the antenna signal conductor and ground, with a small series resistor to act as a fuse in the case of extreme overpower. Since the diode will also pass DC, coupling capacitors on both the input and output block any DC voltage that might be present.

The diode starts conducting and thereby shunting the signal to ground when its forward voltage is exceeded, typically at around -6 dBm. At 0 dBm input the output is limited to less than -1 dBm.[1] At higher input levels the output level will increase somewhat, but at a lesser rate than the input. Because of the BAT54's limited switching speed, low-signal insertion loss increases above 50 MHz, but the device may still be usable at 144 MHz if some additional attenuation is acceptable.

You don't really need a schematic, but here one is:



R1 is a 3.3 ohm resistor that acts as a fuse to protect the output from a power level that might cause the diode to fail in a short. Destructive testing (the most fun kind!) indicates that a power level of 1 watt will cause the resistor to burn out within a few seconds. The critical thing is that this level is below the BAT54 diode's damage level, so the diode is protected.

R2 and R3 are OS[2] spares. If R1 blows due to overpower, you can short the solder pads to enable R2, and if both R1 and R2 are blown, you have a last chance by shorting the pads to R3.

1 If you look at the fundamental frequency output, the apparent attenuation is greater than this. But since the diode generates harmonics when it is conducting, the total output power is higher, as shown below.

2 Oh Shit

Performance

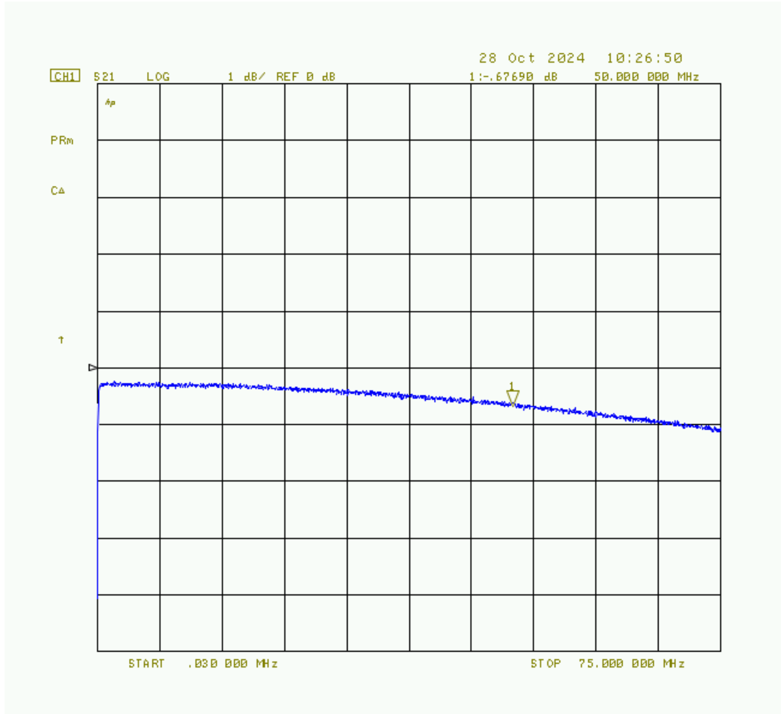


Figure 1: Low-Level Signal Insertion Loss

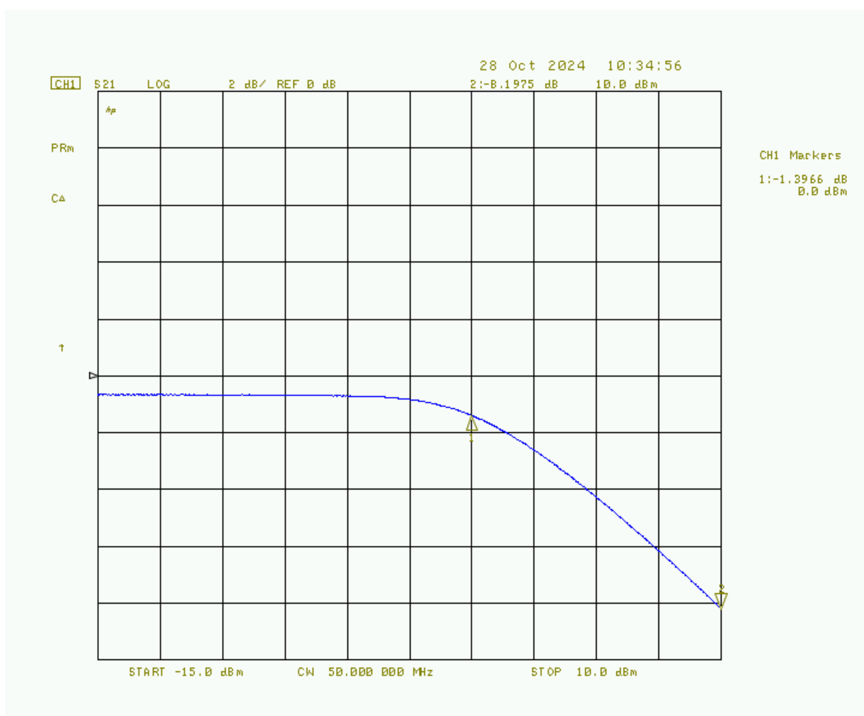


Figure 2: Clipping (-20 to +10 dBm Input)

It’s hard to generate a power sweep at high power levels, and the VNA’s tuned receiver does not capture harmonic or other spurious power, so Figure 2 is of limited value. I also used a 50 MHz frequency for that test, and performance at lower frequencies might be different. To get a better sense of high-level performance, a signal generator, amplifier, power meter, and attenuator were used to measure the wideband output power at various levels of a 10 MHz input, with these results:

-10 dBm	**-10.4 dBm**
0 dBm	**-1.4 dBm**
+10 dBm	**+2.2 dBm**
+20 dBm	**+4.4 dBm**
+30 dBm (1 watt)	**+7.0 dBm**

After several seconds at +30 dBm, the protection resistor did its job and the output dropped to a low level. As you can see, the input vs. output level does not follow a linear relationship, with the output increase for a 10 dB input increase becoming smaller at higher power levels. The diode in the test unit survived two high-level tests, so the resistor opened well below the diode damage level.

Assembly

None required! The kit includes a piece of ½ inch clear heatshrink tubing that can be cut to length and used to protect the circuit board. To replace the fuse resistor, you’ll need to cut off the tubing, but it should remove cleanly with scissors.