SDRPlay RSP1-A Response Curves With and Without a Multicoupler.

R S Flagg 17 May 2021

The purpose of this experiment is to determine the response curve of the SDRPlay RSP1-A when the unit is connected directly to an antenna, or preceeded by a low noise multicoupler having either 3 or 10 dB of gain.

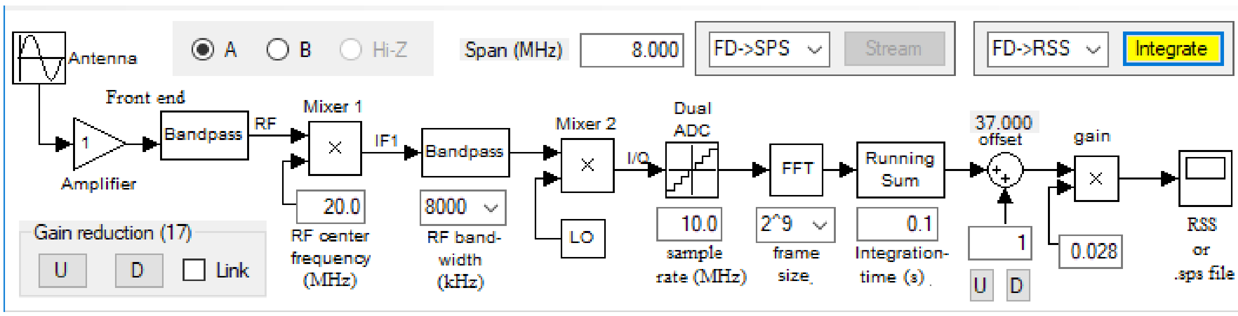

Figure 1 shows the settings for the RSP1-A from Nathan Towne's SDRPlay2RSS interface and control panel used in this experiment.

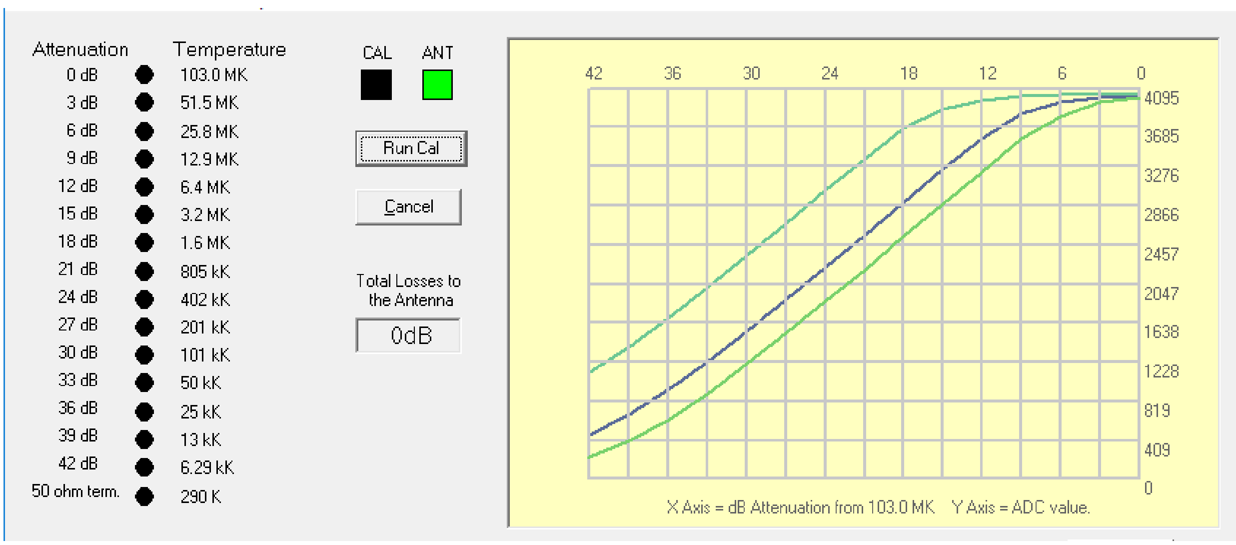

Figure 2 depicts the response curves of the RSP1-A with and without the multicoupler. The vertical axis of the plot represents the ADC count (signal strength) and the horizontal axis is input temperature given in dB of attenuation of a 103 kK noise generator. The left hand column of Figure 2 gives the relationship between attenuation and input temperature.

The lower green curve is the RSP1-A response curve with no multicoupler using the settings seen in Figure 1. The middle blue curve is with the RSP1-A connected to a 3 dB gain port of the multicoupler. The top green curve is with the RSP1-A connected to the 10 dB gain port of the multicoupler.

All three curves terminate at 4095 on the vertical axis because the RSP1-A is in saturation at that point. Adding the gain of the multicoupler can't raise the ADC level signal because the RSP1-A is already in saturation – so as we see the saturation point is simply reached at lower signal levels (lower input temperatures).

The effect of going into saturation earlier is to reduce the dynamic range.

The temperature reaching the MC (or the RSP1-A if no MC) from a TFD antenna is about 7 kK at 20 MHz, assuming 3 dB of cable loss.

While the skyside temperature due to the galactic background is about 50 kK, the TFD itself is inefficient and this loss coupled with cable loss from the antenna accounts for about 8 dB of sky temperature reduction. The result is a noise floor of about 7kK which does not include any noise contribution due to the noise figure of the receiving system itself.

In Table 1 below we see the receiving system noise temperature and the total temperature which includes the temperature delivered by the antenna. IF the RSP1A is used without the lower noise MC about 56% of the noise is generated in the 1A. This drops to a more acceptable 16% if the 10 dB MC port is used.

System	Noise Figure	Rcvr System Temp	Total Temp	%
RSP-1A	15 dB	8.8 kK	15.8 kK	56
RSP1-A + 3dB MC	12.5 dB	4.9 kK	11.9 kK	41
RSP1-A + 10 dB MC	7.5 dB	1.3 kK	8.3 kK	16

The advantage of using the 10 dB port of the low noise multicoupler is lowering the noise figure of the receiving system but the disadvantage of adding that multicoupler gain in front of the 1A is that the system dynamic range is reduced.

Lowering the noise figure is advantageous to seeing weak Jupiter close to the galactic background whereas reducing the dynamic range is a disadvantage to observing the peaks of very strong solar bursts.

The optimum solution may be changing 1A gain/configuration settings depending if you are observing Jupiter or the Sun, but this is probably not realistic. Given that the very strongest solar bursts are infrequent I would probably configure the system for best performance when observing Jupiter.