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To: RFI Group

From: Alan E.E. Rogers

Subject: Methods for removal of the errors due to reflection of amplifier noise from the antenna

1] Least squares estimation from the data

If there is a long low loss cable to the antenna and there are regions of the spectrum relatively free of signals we can estimate the amplitude and phase of the ripple. In this case we assume a fixed known delay in the cable and solve for a ripple function

$$x(f) = a + b \cos(2\pi f \tau) + c \sin(2\pi f \tau)$$

where f = frequency

τ = cable 2-way delay

For each frequency, f_1 , we find values of a, b, c using a least squares estimation over a range of frequencies, f_2 for which

$$|f_1 - f_2| \lesssim 2/\tau$$

Limiting the range accounts for the uncertainty in τ and the changing phase of the antenna reflection. The delay τ actually includes part of the antenna structure since a narrow pulse would be reflected from many points on the antenna. In practice for a ripple period of 10 MHz (a 2-way cable delay of 100 ns) it is sufficient to estimate the ripple over a bandwidth of 40 MHz which covers 4 ripple periods. Since the antenna dimensions are less than 1 meter the reflection phase can only change by about 80 degrees peak to peak over 40 MHz.

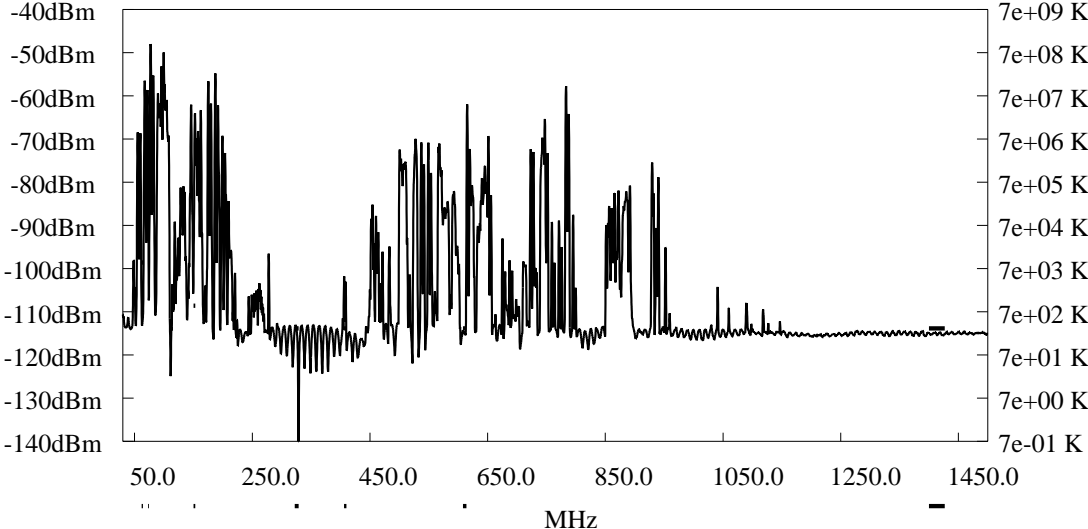
In addition to restricting the range over frequencies used in the estimation of a, b and c at each frequencies we exclude data with noise temperature over 600 K to avoid corrupting the ripple estimate with regions of the spectrum with signals.

For each point in the spectrum we subtract the estimate of the ripple from the estimated parameters b and c at that point. If the least squares estimate is degenerate (i.e. less than 3 data points used) no correction is made. The degeneracy will normally occur only in regions of the spectrum with signals for which a correction is not needed.

2] Anechoic chamber calibration

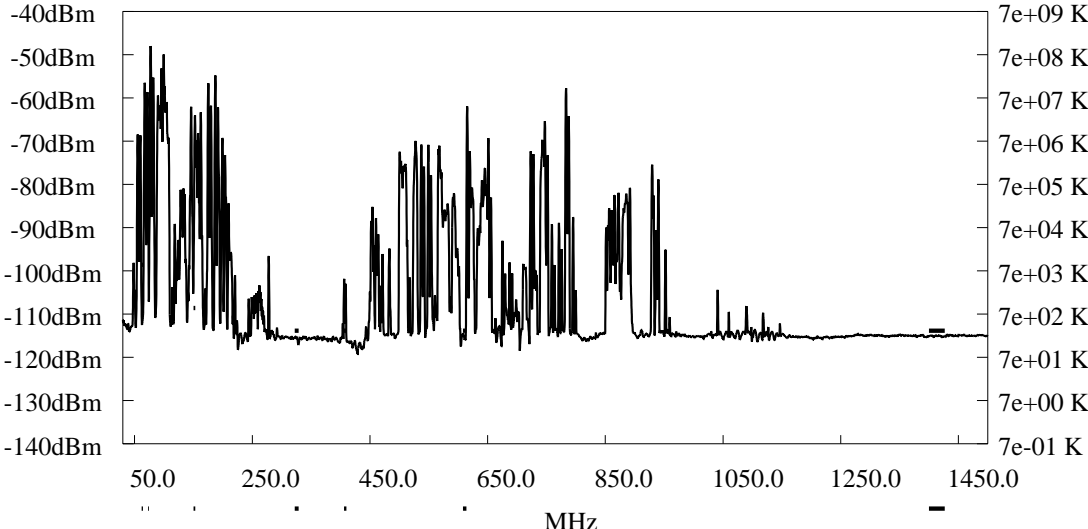
If the RFI system with its antenna is placed in a anechoic chamber or the antenna is placed in an absorbing box then the calibration data could be obtained.

Figure 1 shows the spectrum before removal of the antenna reflection ripple. Figure 2 shows the spectrum after removal of the ripple using the least squares estimation of the ripple at each frequency point.



calibrated spectrum from Tektronix RSA3308A with preamp
start 2005:078:00:01:15 stop 2005:078:11:39:18

Sat Mar 19 16:24:09 2005



calibrated spectrum from Tektronix RSA3308A with preamp
start 2005:078:00:01:15 stop 2005:078:11:39:18

Sat Mar 19 16:25:57 2005