RFI MEMO #021

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To: RFI Group
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Subject: Tests of active antenna for RFI monitor

The elimination of the cable between the antenna and the RFI would be useful for the future evolution of the RFI monitor. The switching technique in which the analyzer is connected to the antenna, a load and a load plus noise results in a complete calibration of the antenna temperature only if the switch is located right at the antenna. In this case

$$P_{ant}(w) = T_{ant}(w)b(w) + n(w)$$
$$P_{load}(w) = T_{amb}b(w) + n(w)$$
$$P_{cal}(w) = (T_{cal} + T_{amb})b(w) + n(w)$$

so that $T_{ant}(w) = T_{cal}(P_{ant} - P_{load})/(P_{cal} - P_{load}) + T_{amb}$

where $b(w)$ = bandpass

$n(w)$ = spectrum analyzer noise

If equal times are spent of the 3 positions of the switch the noise in the measurement nose of T_{ant} for $T_{cal} >> T_{load}$ is given by

$$\left[(T_{ant}+T_R)^2 + (T_{load}+T_R)^2 + (T_{ant}+T_R)(T_{load}+T_R)\right]^{1/2} 6^{1/2} (bT)^{-1/2}$$

where b = resolution bandwidth

T = total integration time

T_R = analyzer noise temperature

If T_{ant} dominates the penalty for the 3 position switching is $6^{1/2}$ or a factor of 2.45.

A good test of the spectrum monitor with an active would be provided by constructing a broadband 70-350 MHz active antenna. I pick this frequency range because it is the frequency range of the LFD and any potential future global EoR system. The antenna pattern points mainly at the sky which will allow precise calibration of performance using a sky model. We could also test the method of antenna pattern measurements using the NIMS satellites at 149.99 MHz and meteorological satellites around 136 MHz.