EDGES MEMO #011
RFI MEMO #026

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Subject: Absolute calibration of an active antenna

An active antenna could be calibrated by placing the antenna in an anechoic chamber and using another antenna to send a noise signal of known strength. The spectrum with the noise turned off is

$$P_0(w) = b(w)T_{amb} + c(w)$$

where $b(w)$ = bandpass function

$c(w)$ = receiver noise

T_{amb} = temperature of chamber walls (assumed perfectly absorbing)

when the noise source is turned on

$$P_1(w) = b(w)\left(T_{amb} + T_{cal}(w)\right) + c(w)$$

given P_o and P_1 we can solve for $b(w)$ and $c(w)$ provided we can calculate $T_{cal}(w)$. T_{cal} can be calculated using

$$\frac{T_c\left(1-|\Gamma|^2\right)G_T G_R \lambda^2}{(4\pi)^2 d^2}$$

where T_c = output of noise source

Γ = calibration antenna reflection coefficient

G_T = gain of calibration antenna

G_R = gain of active antenna

λ = wavelength

d = separation of antennas (assumed to be in the far field)

G_T and G_R are estimated from the directivity of the antennas using NEC simulation. Alternately the path loss can be measured using copies of the active antenna with amplifier replaced with adjustable matching section. This method of calibration avoids the need to estimate the active antenna losses, VSWR and amplifier noise reflected back by the mismatch to the antenna.