

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
HAYSTACK OBSERVATORY
WESTFORD, MASSACHUSETTS 01886
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Telephone: 781-981-5407
Fax: 781-981-0590

To: EDGES Group
From: Alan E.E. Rogers
Subject: LNA Noise Correlation

The EDGES LNA has close to a 50 ohm input impedance and a noise temperature of about 70 K. In addition the output power is close to 140 K for both an open and a shorted input. This condition of equal power output for an open and shorted inputs with an output about twice the noise temperature implies equal uncorrelated noise outputs out of the input port and the output. If this condition is met perfectly then

$$T_a = (1 - |\Gamma|^2) T_{sky} + |\Gamma|^2 T_{LNA}$$

where T_a is the calibrated temperature antenna temperature measured by EDGES.

If the relation above holds the antenna reflection coefficient might be measured in the field with high accuracy from the sidereal modulation of the spectrum assuming a power law for the sky noise. However, further development of the LNA is needed to more accurately meet the conditions of good match and uncorrelated noise over the full frequency range. The advantage to be gained is that the spectrum will become independent of the phase of the reflection coefficient and depend only on its magnitude squared. A full noise model of the LNA is currently under development. Initial indications show that a balance of feedback (see memo #16) and output load impedance can be used to simultaneously obtain a 50 ohm input impedance and zero correlation between the noise emitted from the input port and the noise output.