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To: EDGES Group

From: Alan E.E. Rogers

Subject: EDGES LNA Improvements

In memo #62 it was shown that changes in the feedback from the HEMT drain and gate could lower the correlated noise from the LNA. A more complete simulation based on the noise model of Pospieszalski, shown in Figure 3 of memo #62, has shown that while it may be difficult to obtain low correlated noise over the frequency range of 50 to 200 MHz considerable improvement has been made in the input S11 and the noise correlation in the EDGES-2 LNA. Figure 1 shows the return loss and noise waves for the LNA based on the original circuit along with results for the improved design. The improvements were the result of the following changes:

1] change of feedback from 1000Ω to 920Ω in series with 100 nH.

2] Replacing the 2^{nd} stage GALI-1 with ERA-1

3] Some improvements in circuit board layout to reduce some unwanted coupling between the 2^{nd} stage output.

The main reason the expected performance improvements were not as significant as predicted in memo #65 was due to an error in the simulation code and an oversimplification of the effect of the input circuitry on the input of the LNA. The input circuitry includes back to bake diodes to protect against lightening transients alone with a high pass filter to attenuate strong H.F. signals that are present some ionospheric conditions. Figure 2 shows the results expected from the simulation based on the nominal transconductance of 0.41 S along with those expected for the range of transconductance (0.23 to 0.56 S) for the ATF-54143 thought to be the main reason for differences between transistors. The lack of perfect agreement between the simulation and the measured data is most likely due to imperfect knowledge of HEMT parameters along with some uncertainty in the inductance of the pc board vias.

If the main differences between HEMTs is the transconductance it might be possible to adjust the feedback for each PC board. Alternately a number of boards could be produced and the best selected.

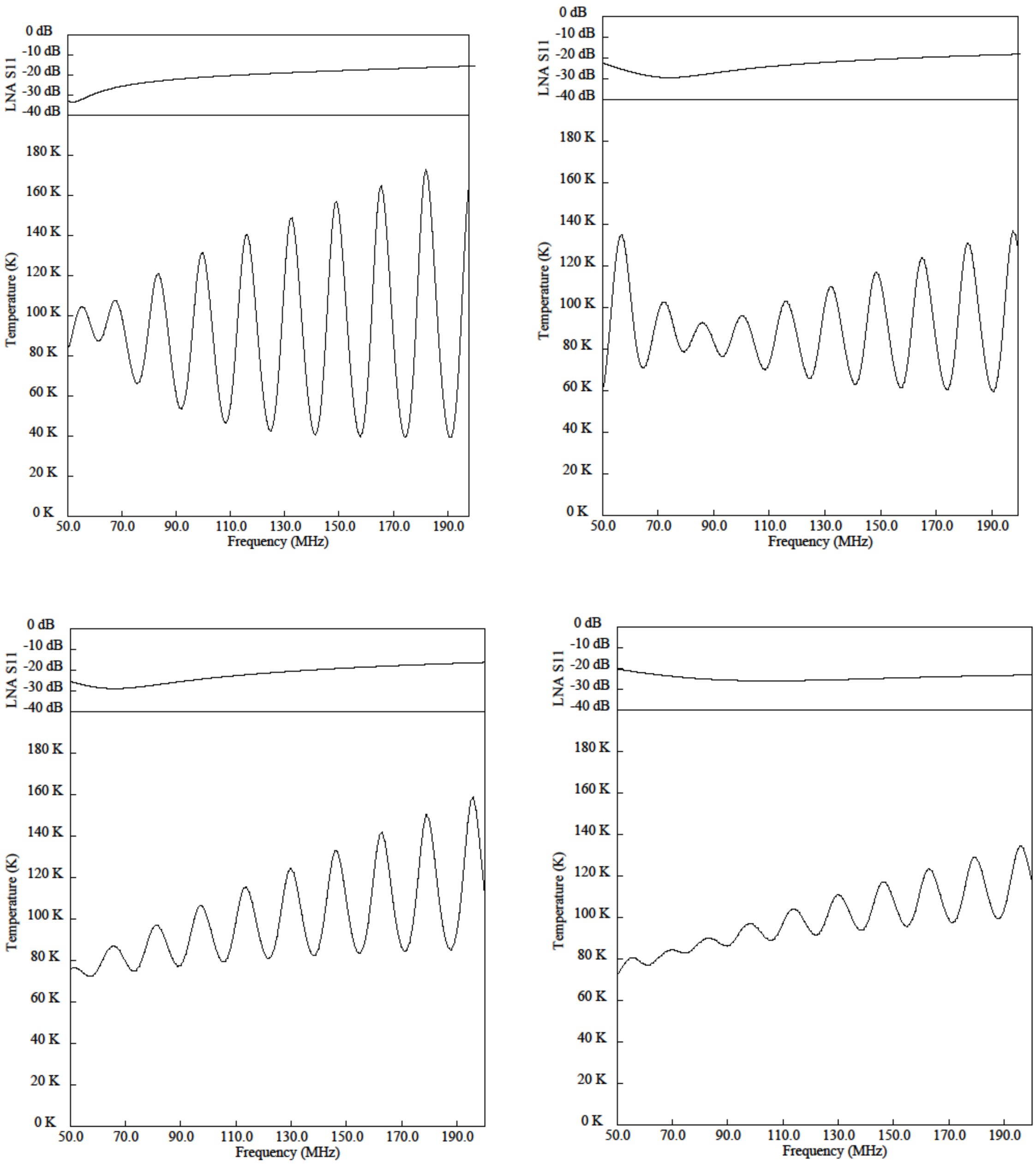
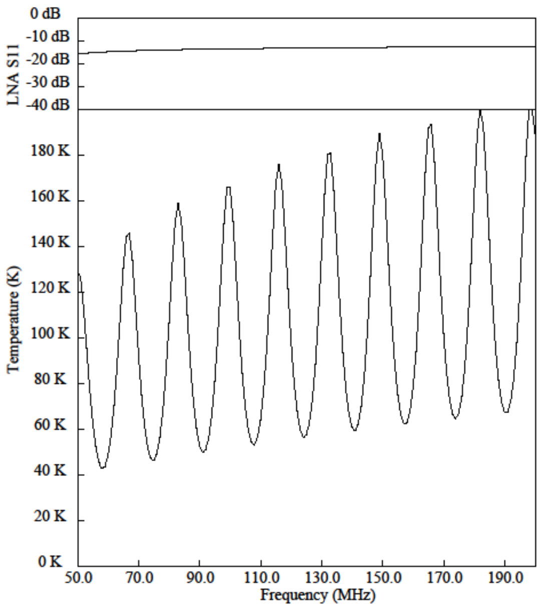
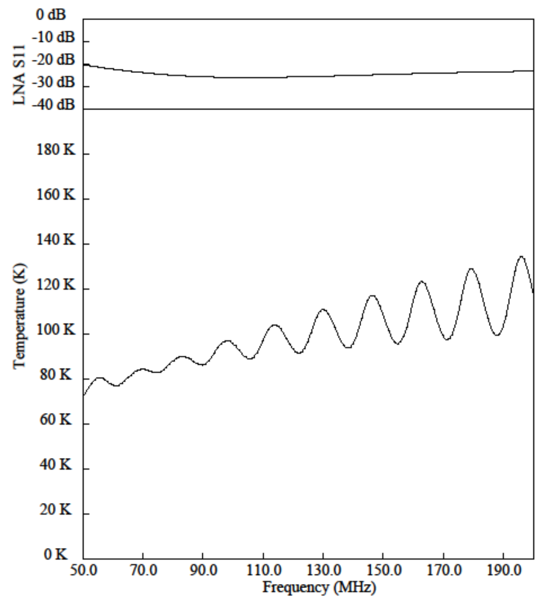


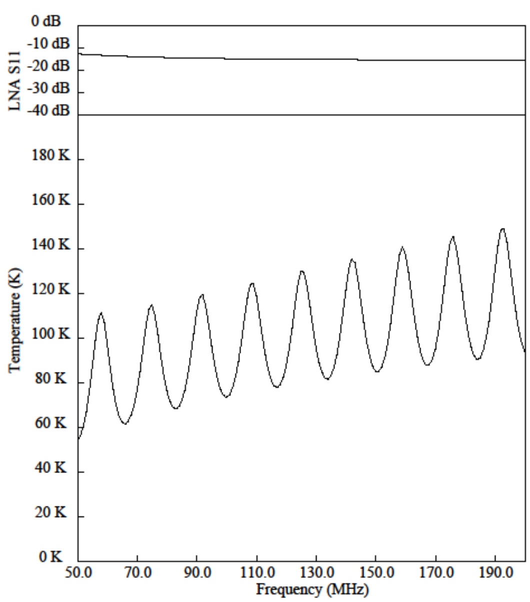
Figure 1. Upper plots are the measured performance (new on the right) and below are the simulations.



Transconductance 0.23



Transconductance 0.41



Transconductance 0.56

Figure 2. Simulations for a range of transconductance.