A FEW COMMENTS ON CALIBRATING THE NOISE DIODE FOR THE ALFA RECEIVER

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1 Introduction

The ALFA receiver uses a single noise diode, with an eight–way power divider, and injection into waveguides so that signal couples nominally equally to the two separate polarizations. Although there is a single noise diode there will be variations due to the power divider, the cables, and the injection couplers that make it essential to properly calibrate the noise diode signal as seen by each of the 14 receivers.

This task is made more difficult if we are forced to rely on an OMT and coaxial loads to calibrate the receiver noise temperatures and noise diode effective temperatures. This is because although well matched, the OMT and load will inevitably have a different impedance than the feed horn plus telescope optics. To the extent that either (1) the receiver input noise temperature, or (2) the injection of noise diode signal, depend on impedance, the value measured using the OMT could be different from that we will get on telescope. It seems worthwhile checking how significant this effect could be.

I recognize that the tests suggested below will take time, but it may be possible to do them only for a single receiver, or possibly two. If the results are positive, we can plausibly conclude that the sensitivity to input impedance is small, and we can rely on values obtained using the OMT as being representative of what will happen on the telescope.

2 Possible Tests

[1] The receiver noise temperature is defined using the OMT and loads at ambient and liquid nitrogen temperature. The noise diode temperature is determined by turning the diode on and off while the receiver is looking at an input termination at a fixed temperature. The noise diode temperature should not, in principle depend on this termination temperature.

A good test would be to measure the noise diode temperature when the receiver is looking at liquid nitrogen and ambient temperature coaxial loads, and then again when it is looking at an amibent temperature free space load (with feed horn installed). In this test, the different impedance of feedhorn vs. the OMT could make a difference in the power coupled from the noise diode to the receiver. It could, in principle, change the input noise temperature of the receiver, but this should be a very small effect and is actually not of any importance for this measurement. If the receiver **gain** changes noticeably due to the impedance change, we would have a problem, but this would be very surprising since the OMT and feedhorns are both good impedance matches.

[2] A more severe test would be to measure the noise diode temperature when the receiver input was the OMT, but with a short circuit, or other deliberate mismatch as the termination. In an extreme case, one could use a sliding short circuit to see how the power from the noise diode coupled to the receiver depended on the actual impedance. Again, this should be distinguishable from a change in the input noise temperature, but not so easily disentangled from an impedance–dependent gain.

3 Conclusion

Ultimately, knowing the effective temperature produced by the noise diode seems even more important than the actual receiver noise temperature. This is because the **system** noise temperature in place in the Gregorian is what really counts, and to measure that, we need to have well–calibrated noise diodes. From the point of view of acceptance, the receiver temperature is what must meet specification, so being able to measure this accurately is also very important. The noise diode calibration ultimately determines our ability to measure the gains of the pixels as well. Given its importance, I think that spending some time to ensure that we are getting a sensible measurement of noise diode temperature will be worthwhile.