VERY LOW NOISE AMPLIFIERS AT 300K FOR 0.7 TO 1.4 GHZ

Gawande R. S.[1], Wadefalk N. [1], Weinreb S.[12]
[1]California Institute of Technology, 1200 E California Blvd. MSC 136-93, Pasadena, CA 91125, USA
[2]Jet Propulsion Laboratory

The Square Kilometer Array (SKA) is a next generation radio telescope for astronomy which utilizes a large number of array elements. For this large number of receivers a significant reduction in cost and complexity can be achieved by using room temperature very low noise amplifiers instead of the cryogenically cooled amplifiers usually used in radio astronomy.

This paper investigates the different possibilities of achieving a very low noise figure (0.14dB or 10K) at room temperature for the frequency band of 0.7 - 1.4 GHz. High electron mobility transistor (HEMT) and Hetrojunction bipolar transistor (HBT) are studied as the possible active element for the LNA. Theoretical limits on transistor noise temperature will be discussed. In order to achieve a noise figure of 0.14dB the loss introduced by matching network must be very small and this leads to design of special matching networks for the LNA.

In the low microwave frequency band under consideration the key HBT device parameter is the current gain β. The noise temperature at any temperature is limited by base and collector shot noise to 290K/root β. The latest SiGe HBTs exhibit β as high as 800 at 300K and this value increases with cooling; thus noise temperature of the order of 10K appear feasible if circuit losses can be kept very low. Microwave Office simulation results using IBM 8HP generation transistors will be presented.

A noise temperature of 31 K is reported using InP HEMTs for the frequency band 4-8 GHz (N. Wadefalk etc, *IEEE transactions on MTT*, **vol. 51**, 1705-1711, June 2003). The minimum noise in HEMTs drops monotonically with frequency except 1/f noise limits performance below a few GHz. The 1/f limits may vary greatly from one transistor manufacturing process to another and has not been accurately measured in the frequency range of 0.7 to 1.4 GHz. We are investigating this problem and will report our results.

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1. (a) Rohit Gawande
1200 E. California Blvd.
MSC 136-93
Pasadena, CA
91125 USA
rgawande@caltech.edu
(b) 6263954846
(c) 6263952137

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3. (a)

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