THERMOELECTRIC COOLING OF LNAS TO 200 K

Jones, G., Weinreb, S.
Caltech, 1200 E. California Blvd., Pasadena, CA 91125

Abstract Submission Form

2004 National Radio Science Meeting

Abstract: jones24056

Date Received: September 24, 2004

As the performance of room temperature low noise amplifiers (LNAs) continues to improve, very low noise systems can be built without the use of traditional cryogenic coolers. Instead, modern thermoelectric coolers (TECs) can be used to attain a physical temperature of around 200K without the cost and complexity of other refrigeration methods.

TECs have been widely used for cooling infrared and visible imaging devices, but so far they have not been used extensively for cooling LNAs. Cooling to 200K is particularly convenient for emerging LNAs built around SiGe hetero-junction bipolar transistors (HBTs), because the intrinsic gain (beta) is greatly increased from room temperature. Intrinsic gain is a dominant factor in determining the noise performance of HBTs. Traditional high electron mobility transistor (HEMT) technology LNAs also benefit from thermoelectric cooling.

To achieve such low temperatures with TECs, it is necessary to make a multistage stack of thermoelectric modules. Compact, multistage TECs are commercially available which are capable of pumping 300mW or more at 200K while dissipating about 20W of waste heat. Such inefficiency requires that special consideration be given to insulation. A vacuum better than 10 microtorr provides the best insulation, but other options may yield satisfactory results without the complexities of a vacuum.

An experimental module will be described that is designed to be inexpensive, compact, and extremely reliable, while providing exceptional noise performance. A module with these characteristics is especially desirable for radio astronomy arrays employing a large number of antennas. Results and analysis of this module will be presented. Additionally, advantages and disadvantages of thermoelectric cooling versus other methods will be discussed.

1. (a) Glenn Jones
MC 136-93
Caltech
1200 E. California Blvd.
Pasadena, CA
91125 USA
gej@ugcs.caltech.edu

(b) 6263954846

(c) 6263954846

2. J - Radio Astronomy

3. (a)

4. C - Contributed Paper

5. No special instructions