IF Impedance Optimization of HEB's for Band 6 at the Herschel Space Observatory

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The Herschel band 6 mixers have recently been assembled and tested together with the SRON prototype LNA IF amplifier. Experimentally we found that the circuit between the HEB mixer and the amplifier resulted in high peaks in the noise at certain IF frequencies and significant ripples in the noise over the entire IF band. Due to design constraints in the HIFI instrument, the IF signal is brought from the mixer unit to the LNA via an approximately 24 cm long semi-rigid coaxial cable without an isolator in between. It is therefore of great importance that the impedance match between the HEB chip and low noise amplifier is good.

In this paper we investigate influences of the HEB device impedance. Devices with different room temperature resistance and dV/dI at the bias point were tried. Also a new IF board was developed. It is designed to better match the HEB IF output impedance to the 50 Ω load at the mixer unit output connector. We will show noise temperature results using HEB's with different impedances operated at different bias points, measured with different LNA's and IF boards, see fig. 1. The results will be discussed in detail.

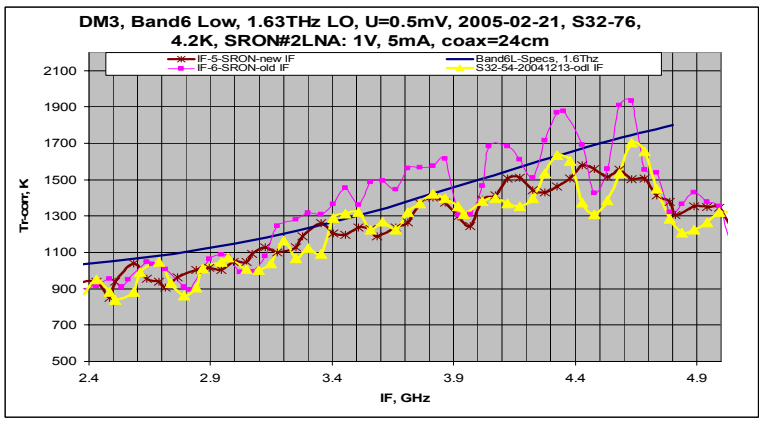

Figure 1 Noise temperature as a function of IF frequency for HEB device S32-76 with the old (squares) and the newly proposed IF board (stars). S32-54 with the old IF board is also shown (triangles).

The result from our investigation show that a well chosen bias point can improve the IF properties since it influences the impedance of the HEB. The IF board acts like a band pass limited transformer between the HEB and LNA, and as such also influences the IF performance of the mixer. For optimimal IF mixer performance, it is therefore important that the entire HEB - IF circuitry - LNA chain are considered in the design.