Achieving Ultra-High Sideband Separation in Millimeter and Sub-Millimeter Receivers

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Abstract—During the last years we have been working in implementing real-time calibrated sideband-separating (2SB) receivers using FPGA technology under different conditions. Briefly speaking, this technique consists in replacing the functionality of the analogue IF hybrid of a 2SB receiver by a digital tool. In this way it is possible to calibrate out the phase and amplitude imbalances that limit the sideband-rejection ratio (SSR) of all-analogue 2SB receivers. After a first demonstration at very low frequencies (below 4 GHz), we have implemented successfully this technique, under laboratory conditions, at the millimeter (80−110 GHz) and sub-millimeter (600−720 GHz) ranges. In all these cases we have achieved sideband rejection ratios above 35 dB across the whole pertinent RF band. More recently, we have been working towards two different goals. First, the implementation of this technique at operating conditions. For that purpose we have used our own 3-mm survey telescope demonstrating that a high SRR can be obtained. The second goal is to correct amplitude and phase imbalances in 2SB receivers containing analogue IF hybrids. We have implemented this correction in a full-analogue ALMA Band-9 receiver, which demonstrates that this technique can be implemented in any existing receiver with no changes at the front-end side. In this paper we will summarize all these efforts and demonstrate the robustness of the technique.