Considerations on Local Oscillator Isolation in a Terahertz Wireless Link Used for Future Communication Systems

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***Abstract*—Monolithic integrated circuits operating in the low terahertz region, at frequencies beyond 275 GHz, have been successfully employed in communication systems, demonstrating that high data rates can be achieved. This paper analyzes and identifies the main factors that influence one important impairment of a 300 GHz wireless system: the isolation of the local oscillator. Improving this isolation will have a positive effect on the quality of the data transmissions, allowing better figures of merit, like error vector magnitude and bit error rates and higher order modulation formats, which will result in an even higher data rate.**

I. INTRODUCTION

THE continuously increasing demand for higher data rates and as a direct consequence for higher bandwidths is the main motivation for aiming at frequencies above 275 GHz when planning future wireless systems. An overview of successful data transmissions at these frequencies done with different technologies can be found in [1]. Frontends operating at such high frequencies need to meet very high requirements and even small variations of non-idealities can disturb the performance of the data transmission. One important non-ideality, which is the main topic of this paper, is the isolation of the local oscillator (LO).

In the transmitter a low LO to the radio frequency signal (RF) isolation causes bit errors and, with increasing energy, could lead to an early saturation of the subsequent amplifier stages. On the receiver side an LO leaked into the received RF signal leads to the self-biasing of the mixer resulting in a strong DC offset at the IF. Another effect of a low LO to RF isolation appears if the leaked LO signal reaches the antenna and is sent and intercepted by other receivers. But the LO leakage has been proven to be not only a disturbing factor but also a useful one. Using the leaked LO signal a new analog carrier recovery method has been recently developed [2]. In all cases it is important to have a reliable measurement of the LO isolation and to be able to estimate its effect on the transmission.

II. MEASUREMENT OF THE LO ISOLATION

The analysis of the LO isolation presented in this paper is made on a complete electrical 300 GHz wireless link, which achieved data rates of up to 64 Gbps. The link and the data transmission experiment have been presented in detail in [3]. For the LO isolation measurement a slightly different LO frequency was used for the quadrature transmitter and for the quadrature receiver and this frequency difference was measured with the help of a spectrum analyzer at the baseband output of the receiver. By setting an offset between the LO frequencies we are able to measure the transmitters leaked LO. We investigate the LO isolation by applying different baseband signals of different powers. The measurement has shown that the LO isolation is strongly dependent on the applied baseband signal type and power and that different results are achieved if we transmit on the I-channel or on the Q-channel. Fig. 1 shows the measured difference in isolation between the transmission on the I- and the Q-channel (ΔIQ) as well as the normalized LO isolation measured on the Q channel for a single tone baseband signal with a frequency of 0.1 GHz. The LO isolation has been normalized to the best measured value, which was achieved for -5 dBm. While better isolations are achieved for high input powers the isolation imbalance grows significantly especially after the 1 dB compression point at -8 dBm, reaching 5 dB at -6 dBm input power.

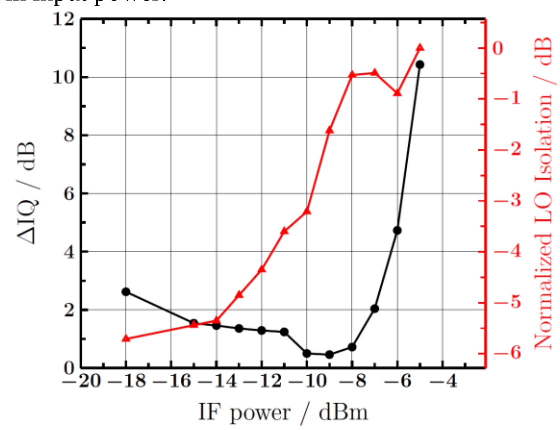

Fig. 1. Measured LO isolation and isolation imbalances (ΔIQ) in dependency of baseband input power.

Depending on the system requirements and application a trade-off between imbalance and absolute isolation can be made. This measurement can help to improve the quality of a wireless link based on monolithic integrated circuits working in the low terahertz region.

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