A MEMS-based, Dicke-switched radiometer at 560GHz

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Abstract—Future planetary missions require terahertz spectrometers and radiometers to be lower-power and lower-mass to fly on smaller platforms or allow more instruments to be deployed on a single platform. While significant advances have been made in reducing the power and mass of the receivers, LO sources and backend spectrometers, to date, no advances have been made to the calibration system above 200 GHz. Presently, calibration is performed with quasi-optical flip mirror redirecting the feed to a free-space absorber. Although well proven, this approach is problematic for two reasons: 1) it relies on mechanical motion, which presents significant risk to the instrument, and 2) the free-space optics are physically large compared to the waveguide-based components of the receiver.

This work demonstrates a MEMS-based waveguide single-pole double-throw switch to enable compact Dicke-switched calibration of a 560 GHz receiver. This device uses large-deflection, silicon micromachined comb-drive actuators to move a septum across the waveguide to direct the signal path. The MEMS device is packaged within a metal split-block housing for compatibility with standard waveguide components. The packaged switch demonstrates low-loss (<2 dB) and high-isolation (>20dB) to maximize sensitivity and avoid contamination of the received signal by the calibration source. A Dicke-switched Schottky-diode based receiver operating at 560GHz is presented and the implications of standing waves on the calibration accuracy are discussed.