

The TEMPEST-D Demonstration Radiometer Instrument for Measurement of Clouds and Precipitation

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The TEMPEST-D instrument is a cross-track scanning, 5 channel radiometer operating at 89, 165, 176, 180 and 182 GHz. The instrument is designed to operate in the 6U CubeSat format, with a mass of 3 kg and power consumption of 6.5 W. The instrument uses 35 nm InP MMIC based receivers and will have an expected performance of 0.5 K NEDT.

The radiometer comprises a scanning reflector operating at 30 rpm, calibration reference load mounted inside the CubeSat bus, and corrugated feed horn with diplexer outputs, feeding receivers in two bands. The lower frequency receiver has a low noise amplifier front end, bandpass filter and detector diode. The higher frequency receiver, covering 165-182 GHz, has an amplifier, power divider, 4 bandpass filters and four detectors. All signals are pre-amplified after detection and digitized. This receiver design eliminates the need for local oscillators, simplifying the design and minimizing power consumption. The digitized signals are read out on an FPGA-based microcontroller and the data are passed to the spacecraft for storage and telemetry.

The radiometer was prototyped in two stages. The entire front-end from the reflector through the low-noise RF amplification modules, were used on the MASC (Microwave Atmospheric Sounding CubeSat) system. That system, which has a heterodyne back-end was flown on two airborne field campaigns, clearly demonstrating the concept feasibility. The direct detection back-ends were prototyped for each of the bands and tested with the MASC front end to verify performance.

While the flight instrument will be delivered to the spacecraft integrator in April 2017, we will describe the instrument design, prototype performance, and preliminary flight model component data.