220 GHz and 680 GHz Direct Detection Polarimetric Receivers for Cloud Ice Measurements

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Recent advances in transistor technology have led to the development of low noise amplifiers to frequencies as high as 850 GHz. This enables direct detection receivers at submillimeter wave frequencies. In this work, we present two direct detection polarimetric receivers at 220 GHz and 680 GHz using an advanced 25nm InP HEMT transistor process. These 220 and 680 GHz direct detection receivers consume only 0.5 W and 0.6 W of DC power, respectively, and fit in a compact 1.0 x 1.3 x 2.5" modular form factor, making them ideal for CubeSat applications and other SWaP limited instrumentation for the investigation of cloud ice properties.

The receivers are designed for testability, with individual components occupying separate split-block machined housings. A non-standard compressed waveguide flange interface reduces overall receiver dimensions. Each receiver is comprised of a four primary component blocks. First, a machined circular horn and waveguide orthomode transducer block splits the signal into H and V channels. Each channel is then amplified using a two-stage InP HEMT LNA block with approximately 40 dB total gain per channel. The LNA blocks also contain integrated bias voltage regulation, using a single 2 V DC input. Next, a novel Nuvotronics Polystrata band pass filter shim band limits received noise power. Finally, each channel is detected using a zero-bias Schottky diode detector block with an integrated video amplifier PCB, which outputs to a standard MSSS connector. The design of each receiver component at 220 GHz and 680 GHz will be presented. Individual component measured data and overall receiver performance will be shown. Novel techniques for the reduction of 1/f noise in terahertz direct detection receivers will also be presented.