NASA SBIR 2019 Phase I Solicitation

S1.02 Technologies for Active Microwave Remote Sensing

Lead Center: JPL

Participating Center(s): GSFC

Technology Area: TA15 Aeronautics

1 Watt G-band (167-175 GHz) Solid State Power Amplifier for Remote Sensing Radars

Development of 1 Watt G-band (167-175 GHz) Solid State Power Amplifier for Remote Sensing Radars. Future Cloud, water and precipitation missions require higher frequency electronics, with small form factors and high power added efficiencies (PAE).Â Solid state amplifiers that meet high efficiency (>20 % PAE) and have small form factors would be suitable for SmallSats, enabling single satellite missions, such as RainCube, and would enable future swarm techniques.

Relevance to NASA

Cloud, water and precipitation measurements Increase capability of measurements to smaller particles, and enabling much more compact instruments.

The desired deliverables are design and simulation of potential amplifiers meeting the 1 Watt G-band (167-175 GHz) with 20% PAE.Â Â The expected Technology Readiness Level (TRL) range at completion of the project is 2-4.

Ultra-Wide Band (UWB) Non-Contact Ground Penetrating Radar (GPR) Antenna

Development of UWB (ultra-wideband) non-contact GPR (ground penetrating radar) antenna for terrestrial and planetary mobility (aka rover or drone) platforms. Antenna designed to be mounted under rovers and other autonomous vehicles. Planar, or other low-profile antenna desired for easy accommodation onto the underside of a drone or rover. Frequency of operation 120 MHz - 2 GHz, linearly polarized, 3 dB beamwidth > 90Â°, 50 Ohm input, optimized to couple into ice/regolith (er = 1.7 to 3.1) at a standoff distance of 10-20 cm.

Relevance to NASA

Future Earth and planetary science small payload missions.

The desired deliverables are mechanical drawing of antenna, with electromagnetic analysis (such as HFSS) of the antenna performance.Â

The expected Technology Readiness Level (TRL) range at completion of the project is 2-4.

GPS (Global Positioning System) Denied Timing Synchronization

Development of solutions to GPS-denied multi-static radar timing synchronization.Â Â This would enable multi-platform instruments to share timing, which is enabling for GPS denied environments, which could be for planetary science or GPS hostile locations on Earth (such as subsurface).Â Desire to wirelessly distribute a synchronized PPS and/or 10 MHz clock in a GPS-denied environment between multiple radar units with <0.5 ns accuracy. Perform in specification at distances of up to 5 km. Synchronization hardware should be low mass (<1 kg), low power (<1 W), small size (<5x5x10 cm). Should have a path to flight qualification to be used for lunar and planetary science.

Relevance to NASA

Future Earth and planetary science small payload missions.

The desired deliverables are design and analysis of potential solutions, for which realizable hardware exists or is plausibly able to be developed with current technology.Â

The expected Technology Readiness Level (TRL) range at completion of the project is 2-4.

V Band Switch (65-70 GHz)

Currently funded RTD to build technology for developing a pressure sensing absorption radar at V-band is in need for a wideband switch operating over 65-70 GHz range. This technology if developed will allow airborne demonstration of first ever remote measurement of surface pressure that helps better predict path and strength of hurricanes.

Relevance to NASA

Surface Pressure Sensing Absorption Radar using V-band.

The desired deliverables are:

- V-band SPDT switch
- Frequency: 65-70 GHz
- Insertion Loss< 0.5dB
- Isolation>35dB
- Should be able to handle 2W of input power
- Compact, light weight

References:

- 1 Watt G-band (167-175 GHz) Solid State Power Amplifier for Remote Sensing Radars:
  - https://www.jpl.nasa.gov/cubesat/missions/raincube.php
  - https://www.nap.edu/read/11952/chapter/9
  - https://www.nasa.gov/mission_pages/GPM/overview/index.html