



NASA SBIR 2020 Phase I Solicitation

S1.02 Technologies for Active Microwave Remote Sensing

Lead Center: JPL

Participating Center(s): GSFC

Technology Area: TA8 Science Instruments, Observatories & Sensor Systems

This subtopic supports technologies to aid NASA in its active microwave sensing missions. Specifically, we are seeking:

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) in order to measure smaller particles and enable compact instruments. Solid state amplifiers that meet high efficiency (> 20% PAE) requirements and have small form factors would be suitable for SmallSats, support single satellite missions (such as RainCube), and enable future swarm techniques. No such devices at these high frequencies, high powers, and efficiencies are currently available. We expect a power amplifier with TRL 2-4 at the completion of the project.

GPS (Global Positioning System) Denied Timing Synchronization - This would enable multi-platform instruments to share timing, which is enabling for GPS-denied environments (e.g., planetary exploration or GPS-hostile locations on Earth such as the subsurface). Multi-static radar has many applications for planetary science, but is impractical due to the lack of universal timing systems, such as what GPS provides on Earth. A low SWaP (size, weight, and power) system would be enabling for small, multi-static radars to perform in non-terrestrial environments. We 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. The system should perform at distances of up to 5 km; synchronization hardware should be low mass (<1 kg), low power (<1 W), and small size (<5x5x10 cm). Ideally, the system should have a path to flight qualification to be used for lunar and planetary science. Deliverables include design and analysis of potential solutions, for which realizable hardware exists or is plausibly able to be developed with current technology. We expect a system with TRL 2-4 at the completion of the project.

V Band SSPA (65-71 GHz) – We seek highly efficient solid-state power amplifier (SSPA) for pressure sensing. No commercial solutions exist that satisfy high power added efficiency and bandwidth in a form factor suitable for CubeSat/SmallSat platforms. The desired capability is for smallsats doing surface pressure sensing absorption radar using V-band. The total SSPA bandwidth desired is 65-71 GHz with a maximum power of 10+ Watts at 65 GHz and 1+ Watt at 70 GHz. The package should be suitable for CubeSat/SmallSat platforms with high power added efficiency. SSPA should be pulsed with a minimum duty cycle of 25% and be suitable for a spaceflight environment. Desired deliverables are V-band SSPA prototype. We expect TRL 4-5 at the completion of the project.

Extreme environments Digital-to-Analog Converter (DAC) – We seek a single chip (or single package) DAC, capable of surviving and maintaining performance in high radiation environments (~100's krad), including ELDRS (enhanced low dose rate sensitivity) in the range of approximately 0.5-10 mrad (Si)/s. This capability is relevant to

planetary remote sensing. The DAC should support a sampling rate of 500Ms/s or higher, with an effective number of bits >6. The desired deliverable is a DAC prototype.

NASA has plans to purchase services for delivery of payloads to the Moon through the Commercial Lunar Payload Services (CLPS) contract. Under this subtopic, proposals may include efforts to develop payloads for flight demonstration of relevant technologies in the lunar environment. The CLPS payload accommodations will vary depending on the particular service provider and mission characteristics. Additional information on the CLPS program and providers can be found at this link: <https://www.nasa.gov/content/commercial-lunar-payload-services>. CLPS missions will typically carry multiple payloads for multiple customers. Smaller, simpler, and more self-sufficient payloads are more easily accommodated and would be more likely to be considered for a NASA-sponsored flight opportunity. Commercial payload delivery services may begin as early as 2020 and flight opportunities are expected to continue well into the future. In future years it is expected that larger and more complex payloads will be accommodated. Selection for award under this solicitation will not guarantee selection for a lunar flight opportunity.

References

Radar in a CubeSat (RainCube): <https://www.jpl.nasa.gov/cubesat/missions/raincube.php>

Global Atmospheric Composition Mission: <https://www.nap.edu/read/11952/chapter/9>

Global Precipitation Measurement Mission: https://www.nasa.gov/mission_pages/GPM/overview/index.html

Desired Deliverables of Phase II

Prototype, Analysis, Hardware, Research