

# 20GSps 6-bit Low-Power Rad-Tolerant ADC, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



## ABSTRACT

The proposed project aims to develop a 20GSps 6-bit radiation hardened analog to digital converter (ADC) required for microwave radiometers being developed for space and air borne earth sensing applications. Aiming to improve performance and to reduce the size of the electronics, high resolution, high-sampling rate, power efficiency and low spur energy are the requirements for ADCs employed for direct digitization in microwave radiometers. The proposed 20GS/s 6-bit interleaved successive approximation (SAR) ADC is intended to achieve >5 ENOB and 20GHz input bandwidth. A number of innovations will be introduced to the ADC in order to combine low power consumption with high signal to noise and distortion (SINAD), and spurious free dynamic range (SFDR) which is important for spectrography applications. A novel low glitch energy technique coupled with interleaved samples aperture calibration will be introduced to achieve digitization accuracy, improve linearity and achieve high sampling rate. The proposed ADC ASIC will contain on-chip all necessary components, including a frequency synthesizer, serial interface, standard interface with an FPGA, and design-for-testability features. The ADC will be implemented using a deep submicron CMOS technology. The project's Phase I will provide the proof of feasibility of implementing the proposed ADC. Phase II will include finishing design, fabrication, testing and delivering the ADC prototypes which will be ready for commercialization in Phase III.

## ANTICIPATED BENEFITS

### To NASA funded missions:

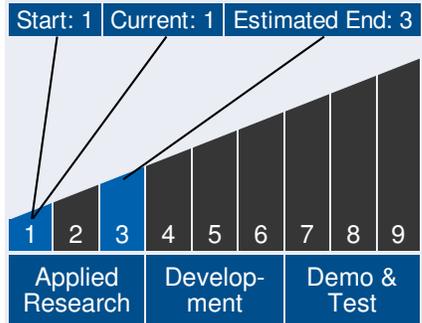
Potential NASA Commercial Applications: The low power 20GS/s 6-bit ADC featuring power optimization capability has great potential in current and future NASA missions. Besides targeted application for microwave radiometers, the proposed ADC ASIC is directly applicable to systems seeking low-power, radiation hardened, flexible solution for direct digitization of wide



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## Technology Maturity



## Management Team

### Program Executives:

- Joseph Grant
- Laguduva Kubendran

### Program Manager:

- Carlos Torrez

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bandwidth RF signals, such as deep space communication radios and/or reconfigurable radios for SDR applications. For example, this ADC can be employed in NASA missions using Ku band, such as OIB (airborne program for precise sea and ice elevation monitoring) or ISS based CONNECT (COmmunications, Navigation, and NEtworking reConfigurable Test-bed).

### To the commercial space industry:

Potential Non-NASA Commercial Applications: In addition to its primary application in spectral radiometry systems, the proposed wideband 20GS/s ADC and its building blocks will be targeting other commercial and military related markets which require high speed capture and digitization of wideband signals. Commercial applications include wireless (WiMAX, 3G, 4G) and fiber optic communication (40G and 100G Ethernet). The ramp-up of 100G Ethernet technologies raises the industry's demand for adequate test equipment. Therefore, the proposed ADC has great commercialization potential in this market segment. Possible military applications include high speed, secure communication and data transmission systems and millimeter-resolution radars.

### Management Team *(cont.)*

#### Principal Investigator:

- Denis Zelenin

### Technology Areas

#### Primary Technology Area:

Science Instruments, Observatories, and Sensor Systems (TA 8)

- └ Remote Sensing Instruments and Sensors (TA 8.1)
  - └ Microwave, Millimeter-, and Submillimeter-Waves (TA 8.1.4)

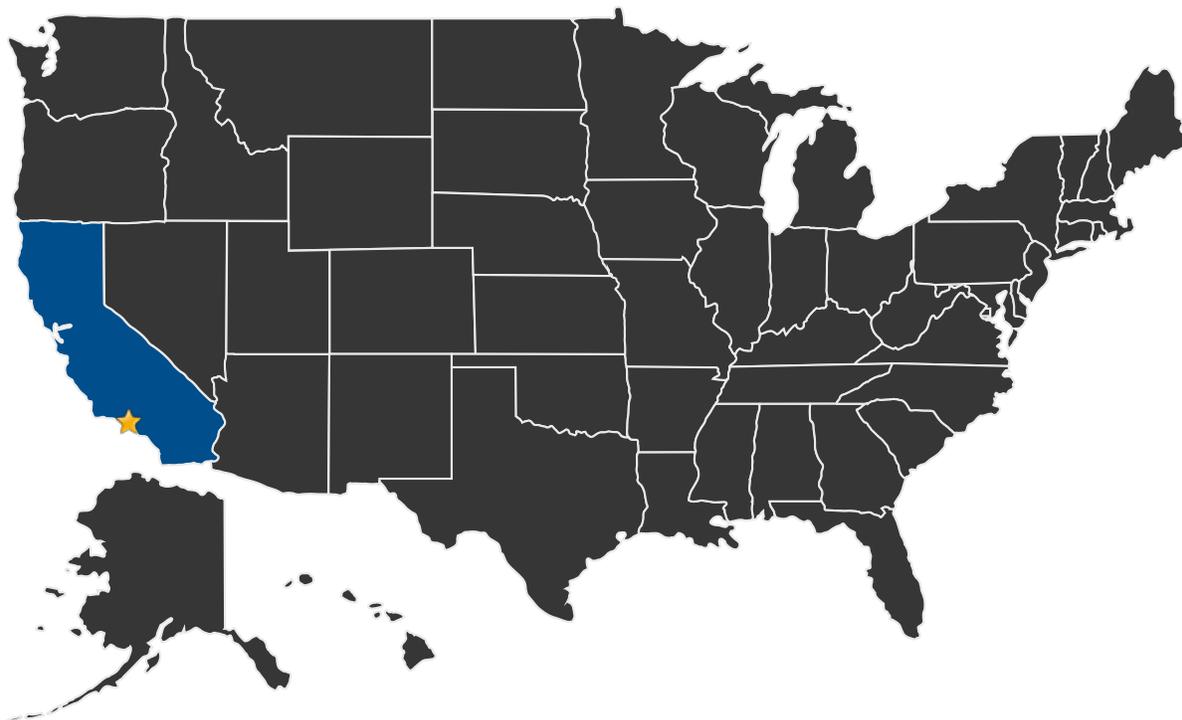
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## U.S. WORK LOCATIONS AND KEY PARTNERS

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- U.S. States With Work
- ★ **Lead Center:**  
Jet Propulsion Laboratory

### Other Organizations Performing Work:

- Pacific Microchip Corporation (Culver City, CA)

## PROJECT LIBRARY

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### Presentations

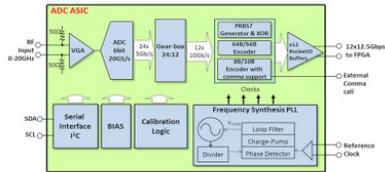
- Briefing Chart
  - (<http://techport.nasa.gov:80/file/23585>)

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## IMAGE GALLERY



Block Diagram of the Proposed ADC

*20GSps 6-bit Low-Power Rad-Tolerant  
ADC, Phase I*

## DETAILS FOR TECHNOLOGY 1

### Technology Title

20GSps 6-bit Low-Power Rad-Tolerant ADC, Phase I

### Potential Applications

The low power 20GS/s 6-bit ADC featuring power optimization capability has great potential in current and future NASA missions. Besides targeted application for microwave radiometers, the proposed ADC ASIC is directly applicable to systems seeking low-power, radiation hardened, flexible solution for direct digitization of wide bandwidth RF signals, such as deep space communication radios and/or reconfigurable radios for SDR applications. For example, this ADC can be employed in NASA missions using Ku band, such as OIB (airborne program for precise sea and ice elevation monitoring) or ISS based CONNECT (COmmunications, Navigation, and NETworking reConfigurable Test-bed).