



**Ridgetop Group Inc**  
ENGINEERING INNOVATION

# **DOE-NP SBIR Phase II**

## **Topic 44g**

### **Exchange Meeting**

#### **November 2013**

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Contract No.: DE-SC0006340

Contractor Name: Ridgetop Group, Inc.

Contractor Address: 3580 West Ina Road, Tucson, AZ 85741

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# Ridgetop Group, Inc.

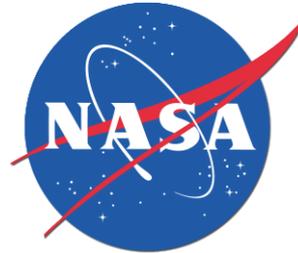


- Arizona-based firm, founded in 2000, with focus on electronics for critical applications
- Two divisions: Semiconductor & Precision Instruments (SPI) and Advanced Diagnostics & Prognostics (ADP)
- Technology leader in precision mixed signal IC design for harsh environments
- Expertise in mitigation of radiation effects
- Complete Cadence-based IC design tool set

- Extensive instrumentation design experience
- Foundation in physics-of-failure for reliable electronic systems



# Representative Partners and Customers



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# Award-Winning Design Recognition



Raytheon Small Business Partner Award



Japanese IP Innovation Award

# Ridgetop Accreditations



ISO9001:2008 Quality Management System



AS9100C Quality Management System



Microelectronics Trusted Supplier (Defense Microelectronics Agency)

# Primary application



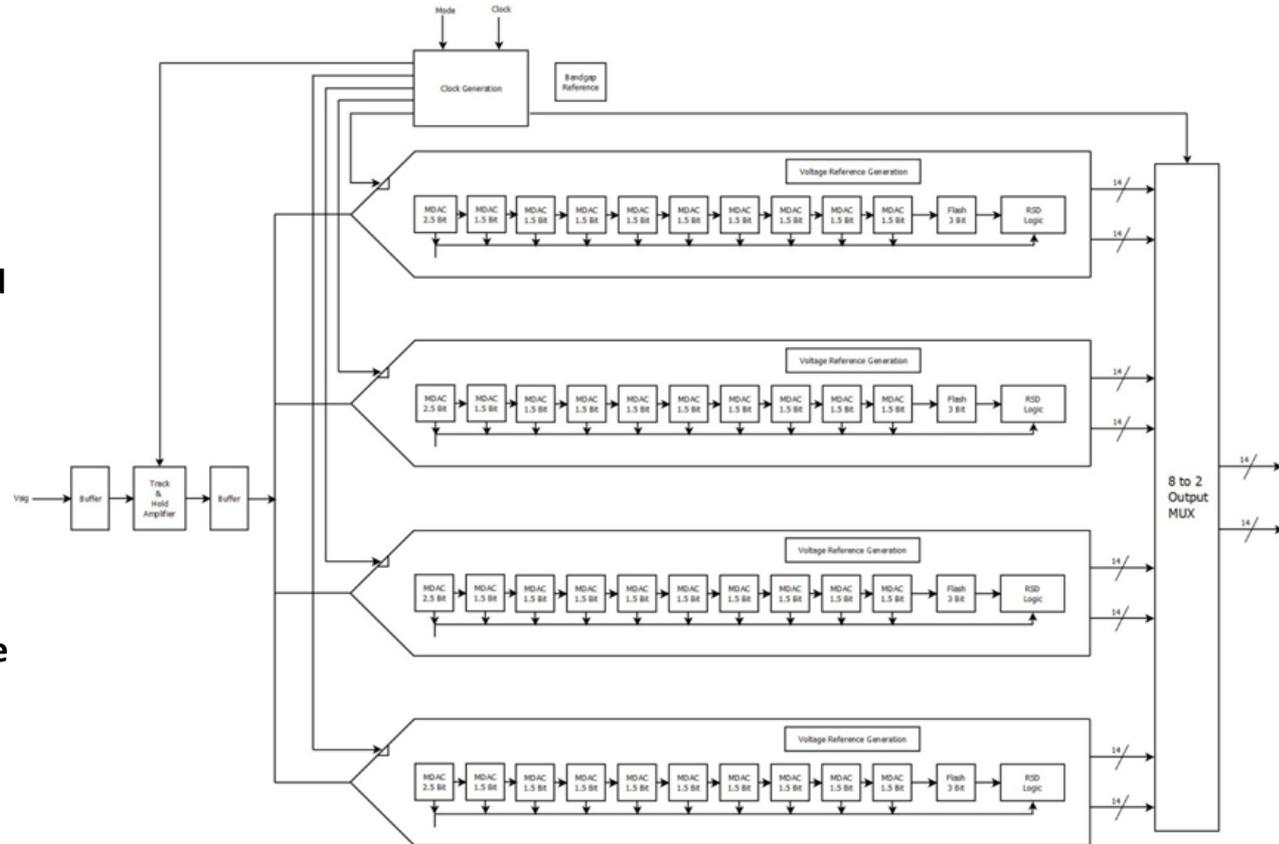
**Radiation-Hardened ADC  
for Particle Accelerator  
Instrumentation clusters**

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# SBIR Program Description

- Program started 8/8/12
- Programmable ADC
- Time-Interleaved double sampled pipeline, high speed (500 MS/s – 3 GS/s)
- High resolution (12-14 bits)
- Highly linear with an INL and DNL of no more than  $\pm 0.5$  LSB,
- Operating temperature range of at least -10 to 80 °C,
- Total ionization dose (TID) rating of 1 Mrad.



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# Secondary application



- **Satellites require Radiation-Hardened components with ADCs being at the top of the list for integration**
- **Commercial and defense space-based systems also require a high performance digitization.**
- **Strong interest from Air Force and Boeing**

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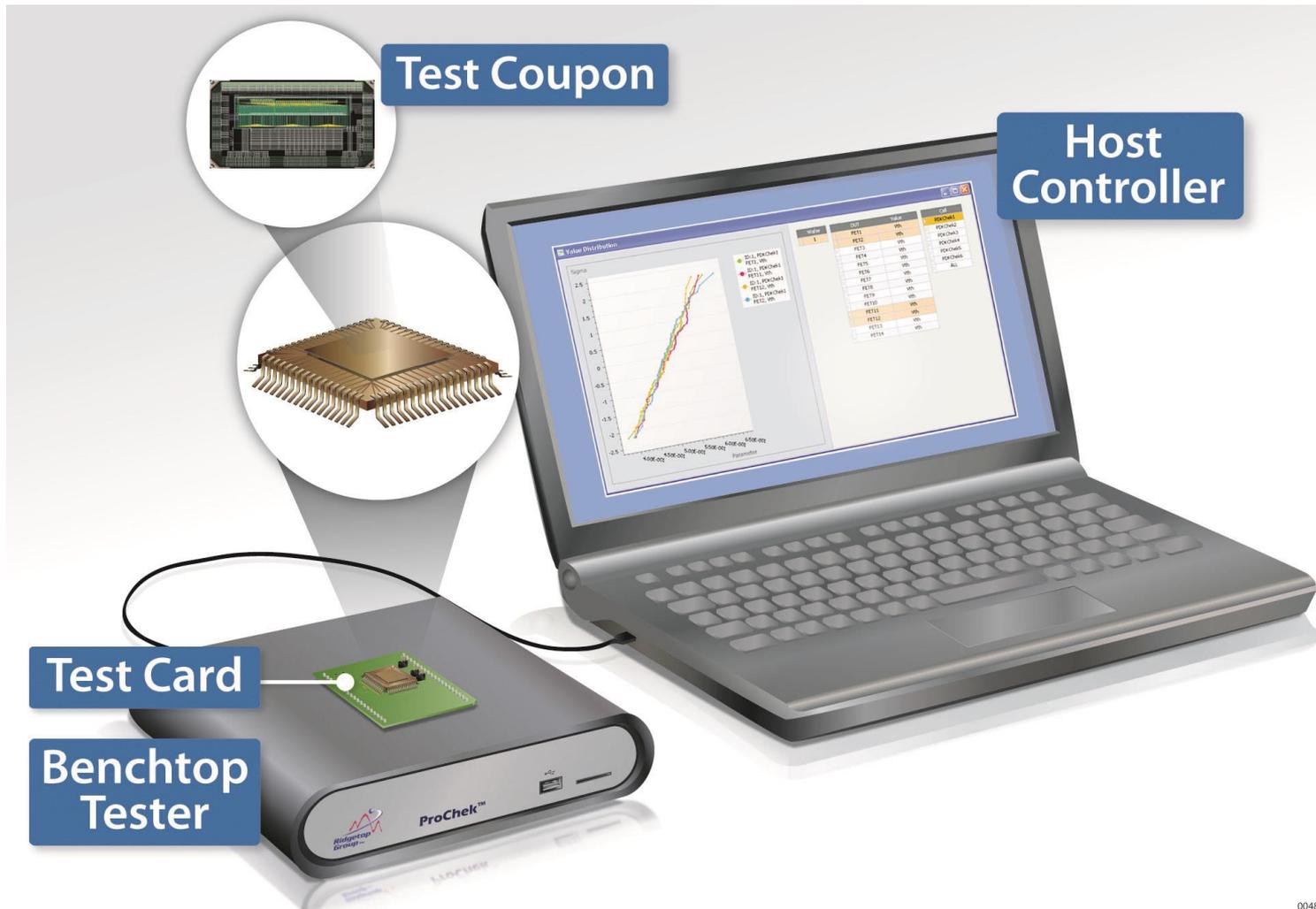
# 44g - ADC Targeted Specifications

Specification	Original Goal	Current Estimate
Resolution [bits]	12	12
Sampling speed [GS/s]	0.5 - 3.0	0.5 - 3.0
Input analog bandwidth [GHz]	2.0	12
Power [W]	1.0	2.5
SFDR [dB]	74	72.7
ENOB at 250MHz input [bits]	11.0	11.0
ENOB at 1.5GHz input [bits]	11.0	8.5
TID hardness [krad]	1000	>1000
SEL hardness [Mev-cm <sup>2</sup> /mg]	120	120
Process	IBM 130 nm SiGe	IBM 130 nm SiGe
Operating Temperature	-40 to +85 °C	-40 to +85 °C

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# ProChek Semi Characterization Platform



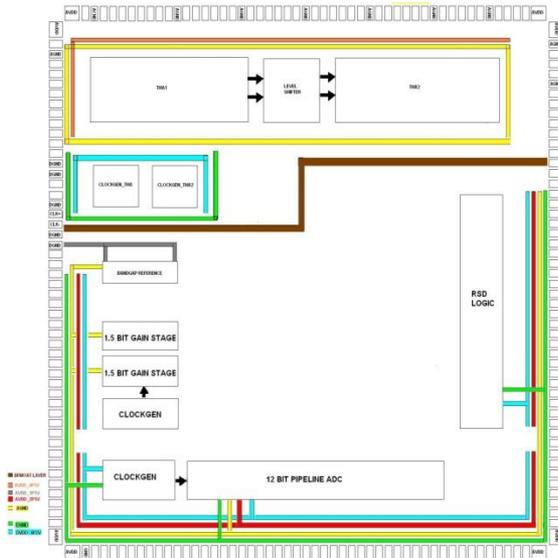
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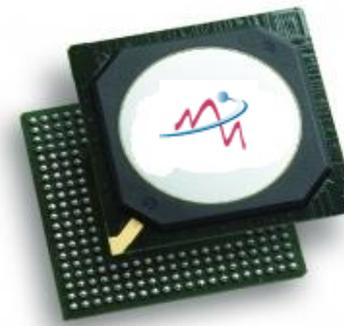
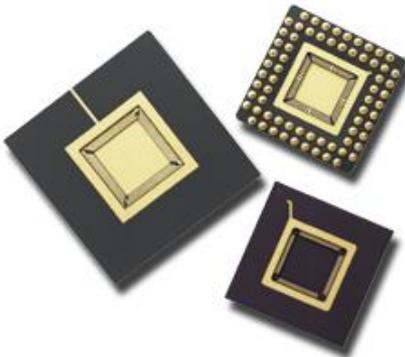
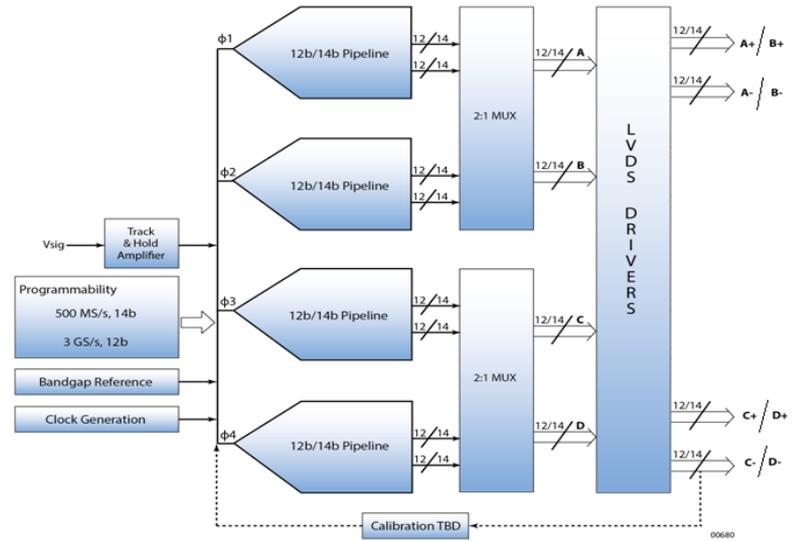


# 44g - Packaging

Test chip



Final chip



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# 44g – Challenges and risks

- **Design of LVDS Drivers to operate at 1.5GS/s with a 1.5V supply.**
- **Integration and Validation of Time –Interleaved pipelines with Track and Hold amplifier and Clock generation blocks.**
- **Design and integration of Calibration Logic with the Time Interleaved Pipeline stages.**
- **Layout of high speed blocks maintaining Signal and Power integrity throughout the chip.**
- **Tradeoff of dynamic range and radiation hardness**

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# 44g– Additional Applications

## Terrestrial Communication Systems

Provides the high-speed ADC required within high performance transceiver hardware.



Software Defined Radio Applications



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# 44g – Path forward

- Exceptionally challenging design that can revolutionize measurements in presence of radiation.
- Continue to use SiGe technology with assistance from Georgia Tech
- Will continue to forge ahead, and develop commercialization paths with CAEN, Boeing, and possibly Struck.
- Have received strong interest in extending our work.

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