



## Portfolio Overview

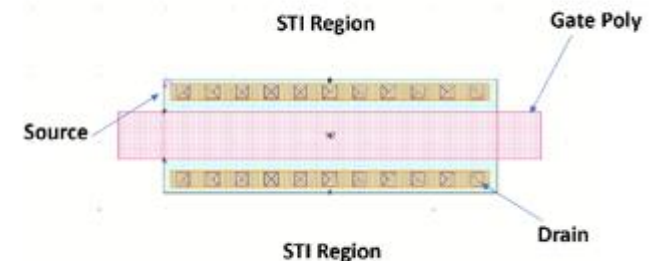
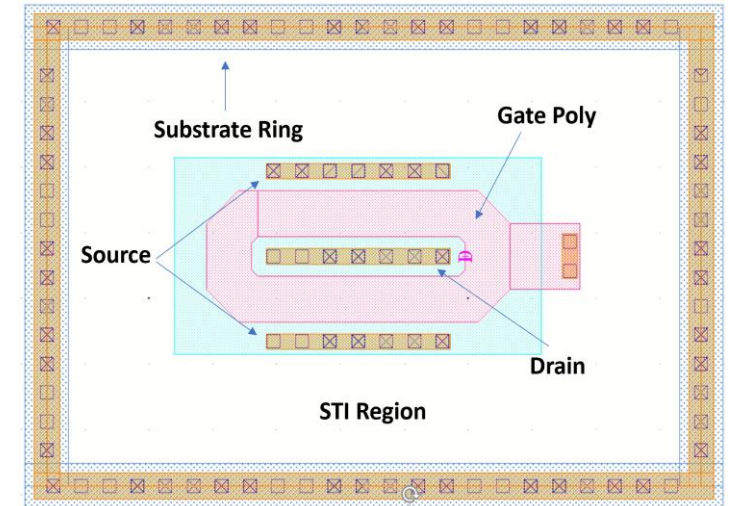
# Our Company



- Enabling small satellite applications by:
  - Bridging the technology gap between commercial and high reliability components
  - Significantly lowering the cost of rad-hard ICs
- Focused on Power and Analog rad-hard IC design, IP and process development
- R&D contracts with AFRL, DoE, NSF and NASA
- Growing portfolio
  - 17 products sampling in 2020
  - Expected to double in 2021
- Partnered with a Trusted 180 nm high-voltage CMOS foundry to develop a rad-hard process (TalRad™)

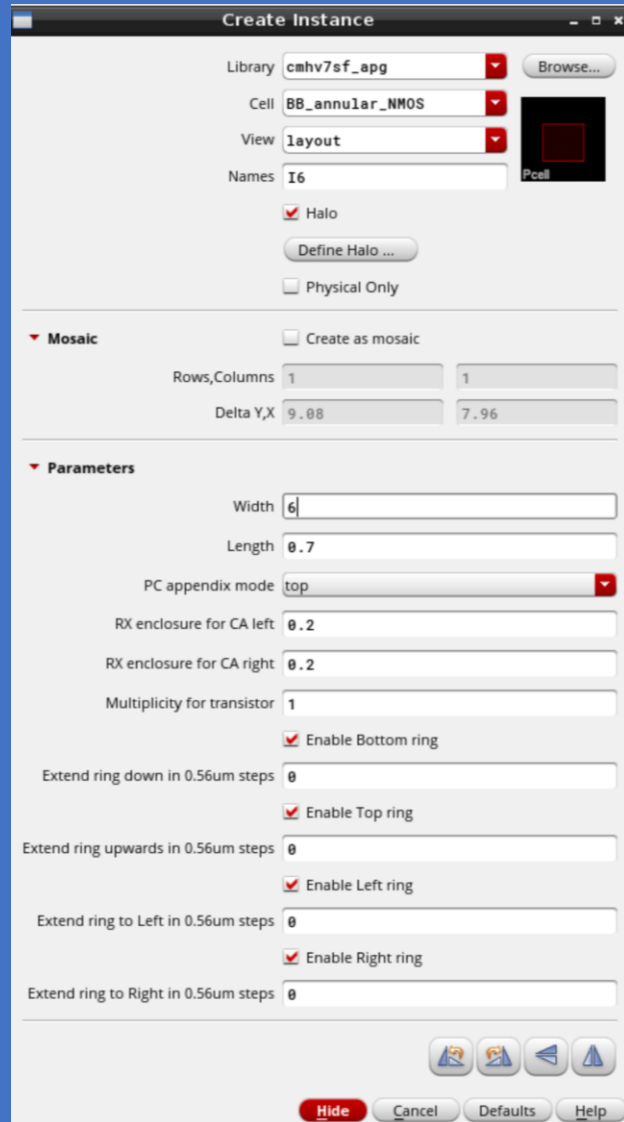
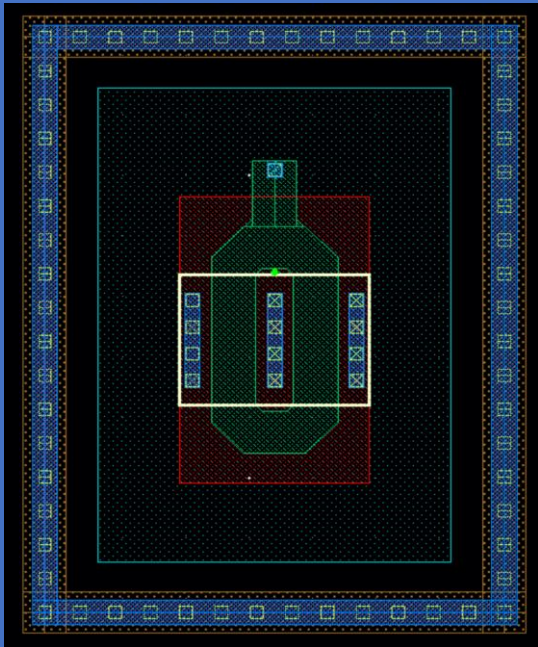
# The TalRad™ Rad-Hard PDK includes:

- Annular 1.8V and 5V Transistor
  - Great for greater than 300krad(Si) applications
- TalRad™ 1.8V and 5V Transistors
  - Reduced size and capacitance and improved performance compared to annular transistors
  - Great for precision analog applications
  - Lower quiescent current
- TalRad™ ESD Cells
  - Class II 4kV ESD, 300krad(Si) radiation tolerance
- Rad-Hard 1.8V Digital Cell Library
- Roadmap devices and PDK improvements as they become available
- Available in TSI Semiconductors 180nm process



# TalRad™ PDK and PCELLs (**Available Now!**)

**Custom PCELL  
(Annular)**

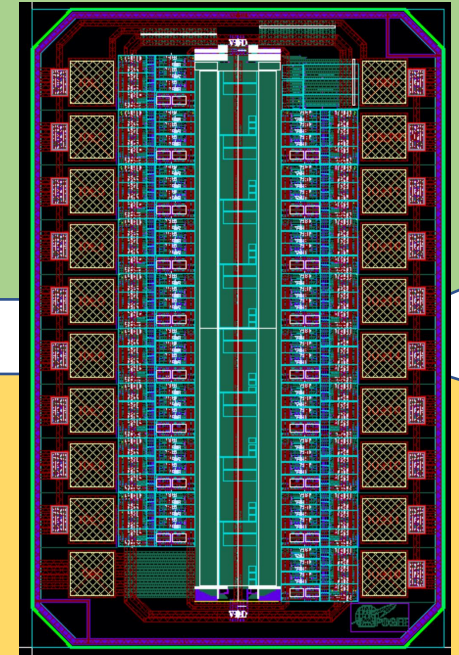


**CUSTOM LVS Deck  
(TALRAD, Annular, and ESD)**

*Less Errors + Efficiency*

*= Better ICs*

**CUSTOM DRC Deck  
(TALRAD and Annular)**



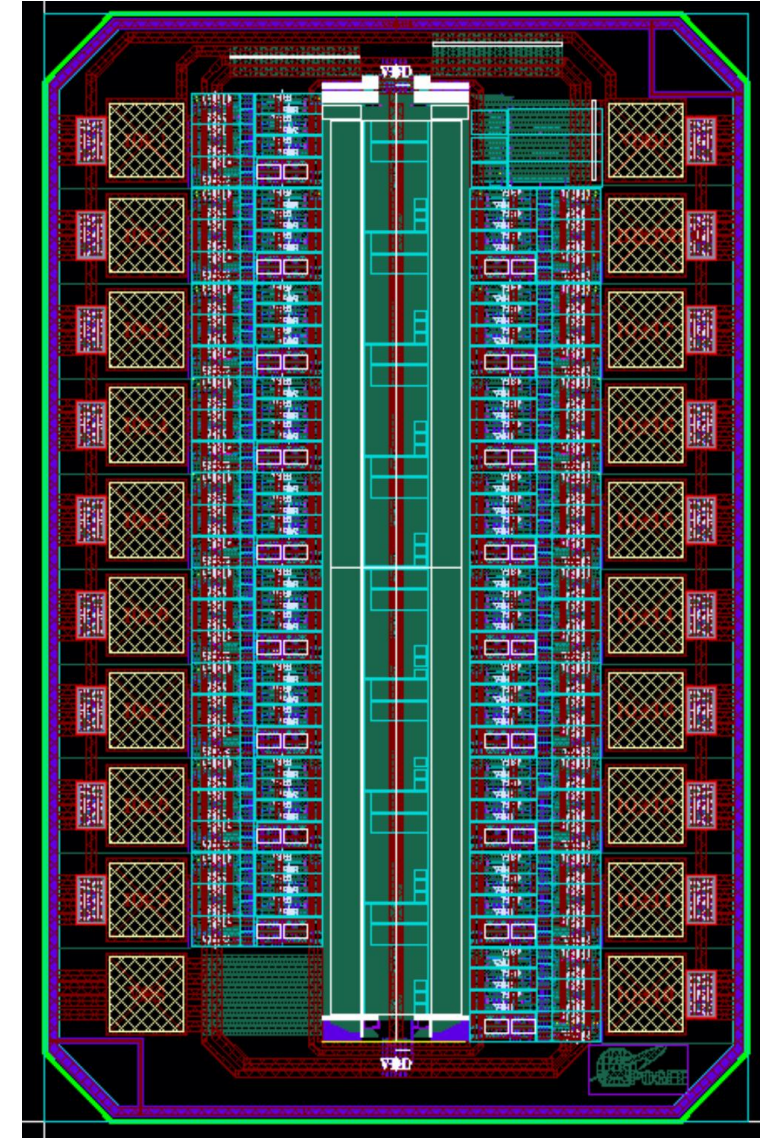


# AP54RHCXXX family

Sampling now!

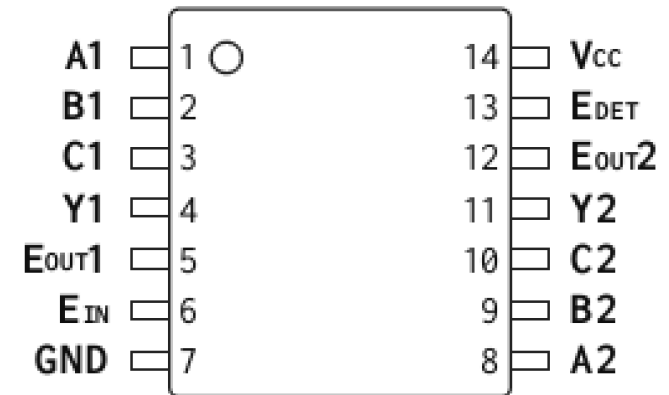
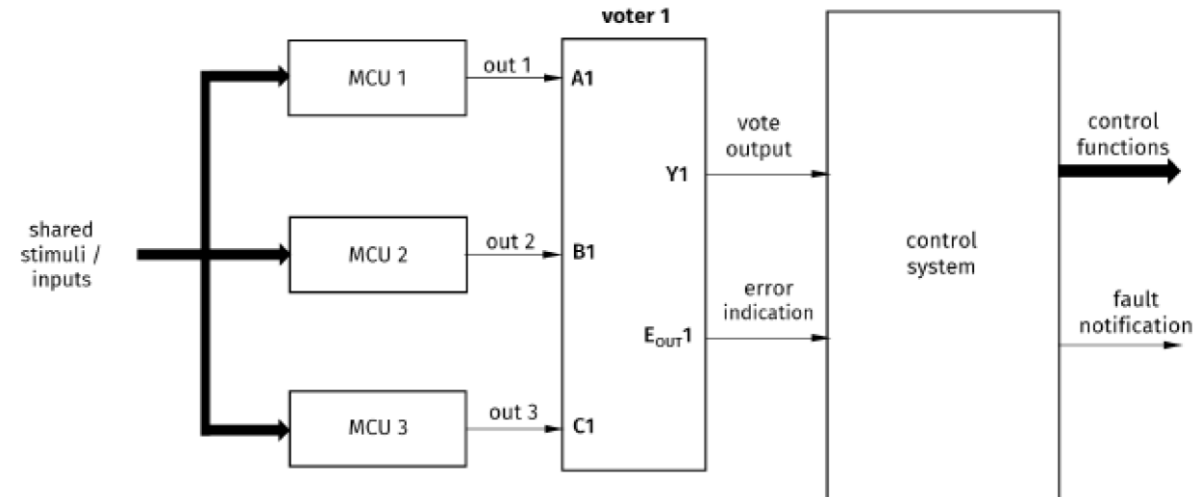
A family of radiation hardened logic gates in plastic packages built with the TalRad™ PDK:

- Industry standard pinout includes a:
  - Two supply level shifter
  - Single supply transceiver
  - Voter with daisy chain error detect
  - Other 7400 series logic functions
- TID/SEL hardened up to 30krad (Si) and 80 MeV-cm<sup>2</sup>/mg
- Latches are DICE (SEU hardened)
- All parts have cold-spare capability
  - Fail-safe inputs and outputs with no static power penalty
- Designed for Class 2 ESD
- TSSOP package, 14 pin package
- Specified over -55°C to +125°C, 1.6V to 5.5V V<sub>DD</sub>
- View portfolio at: <https://apogeesemi.com/products/>



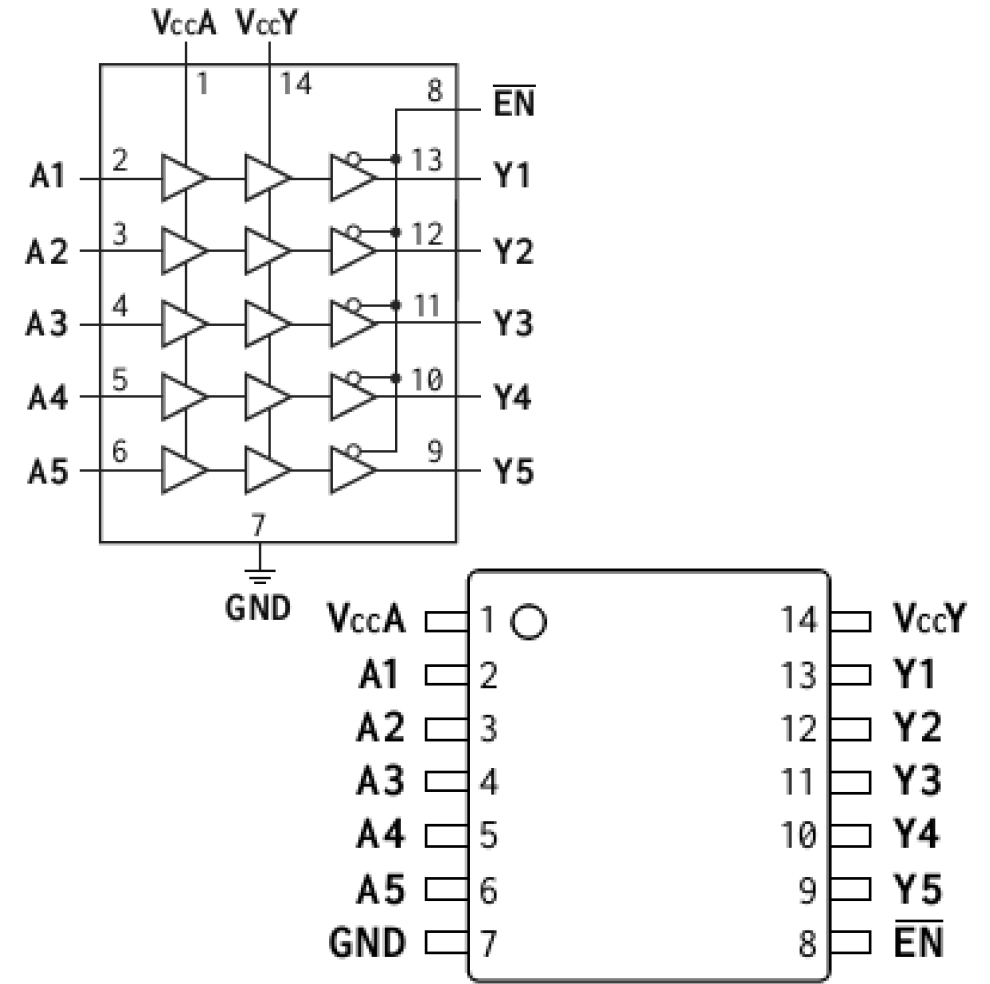
# AP54RHC301 – Dual 3-input Majority Voter

- 1.65 VDC to 5.5 VDC operation
- Provides logic-level down translation to VCC
- Extended operating temperature range
  - (-55 °C to +125 °C)
- Proprietary cold-sparing capability with zero static power penalty
- Built-in triple redundancy
- Internal power-on reset (POR)
- Class 2 ESD protection
  - (4000 V HBM, 500 V CDM)
- TID resilience of 30 krad (Si)
- SEL resilient up to LET of 80 MeV-cm<sup>2</sup>/mg



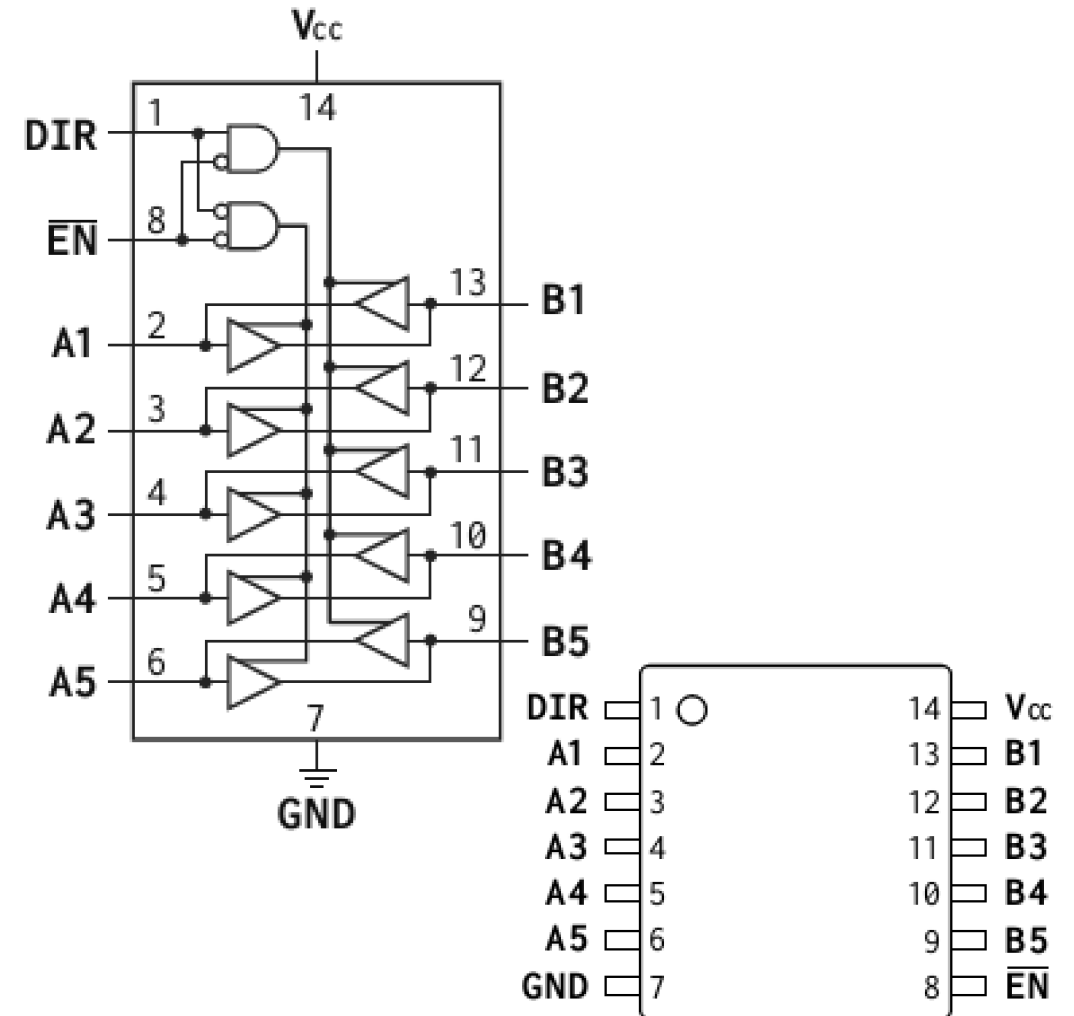
# AP54RHC504 – 5-Channel Level Translator

- 1.65 VDC to 5.5 VDC operation
- Inputs tolerant up to 5.5 VDC at any  $V_{CC}A$  or  $V_{CC}Y$
- Extended operating temperature range
  - (-55 °C to +125 °C)
- Proprietary cold-sparing capability with zero static power penalty
- Built-in triple redundancy
- Internal power-on reset (POR)
- Class 2 ESD protection
  - (4000 V HBM, 500 V CDM)
- TID resilience of 30 krad (Si)
- SEL resilient up to LET of 80 MeV-cm<sup>2</sup>/mg



# AP54RHC506 – 5-Ch 100MHz Transceiver

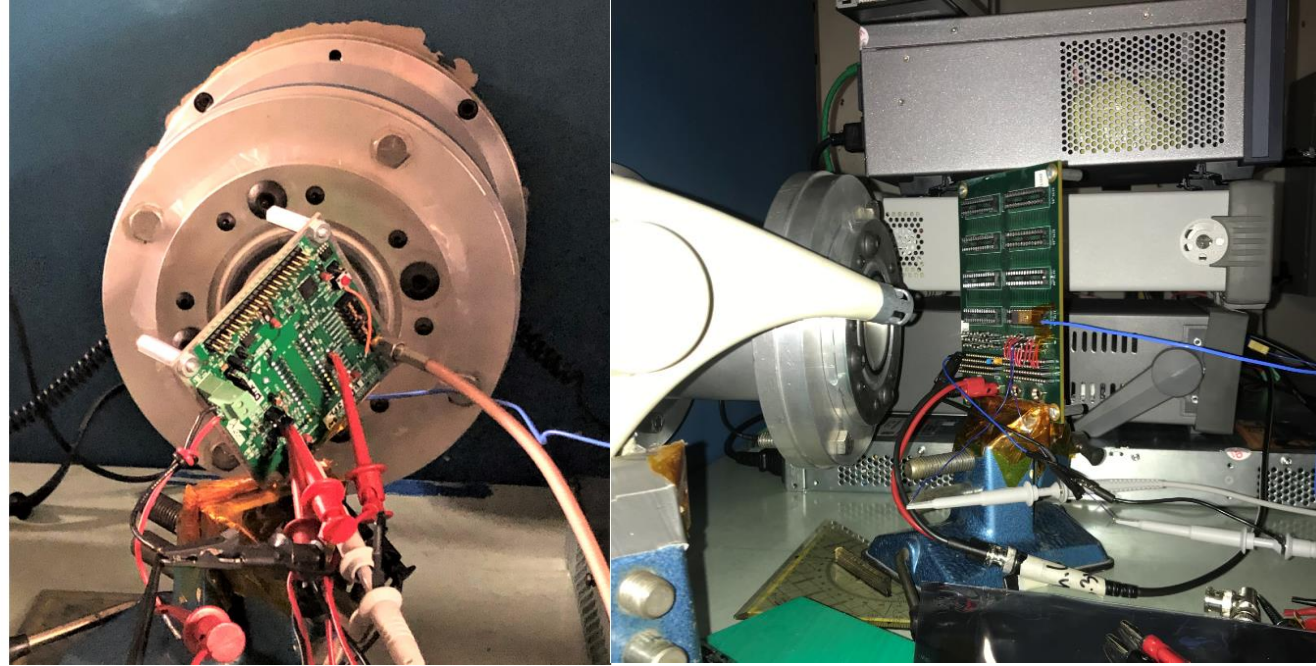
- 1.65 VDC to 5.5 VDC operation
- Extended operating temperature range
  - (-55 °C to +125 °C)
- Proprietary cold-sparing capability with zero static power penalty
- Built-in triple redundancy
- Internal power-on reset (POR)
- Class 2 ESD protection
  - (4000 V HBM, 500 V CDM)
- TID resilience of 30 krad (Si)
- SEL resilient up to LET of 80 MeV-cm<sup>2</sup>/mg





# SEE Test Campaign

- Test conducted at LBNL Base Facility
- Testing conducted in air using Xenon
- Angle varied from incident (LET = 55 MeV\*cm<sup>2</sup>/mg) to 45° (LET = 79 MeV\*cm<sup>2</sup>/mg)
- Temperature forcing implemented with hot air gun and remotely monitored with thermo-couple
- NO LATCHUP on any of the runs conducted up to LET 80 T = 100c
- Outputs of IO Cells (High/Low) monitored for perturbations



Unit 1 Warhol Triple 3 AND (Monitoring 2 IO Outputs Driving High/Low)								
113	Xe	80	25	5	NA	1.00E+04	1.42E+07	Passed
114	Xe	80	100	5	NA	1.00E+04	1.42E+07	Passed
115	Xe	80	100	5.5	NA	1.00E+04	1.42E+07	Passed

# Thank You!