

AncASIC MPW1 irradiation testing

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ePIC SVT DSC meeting

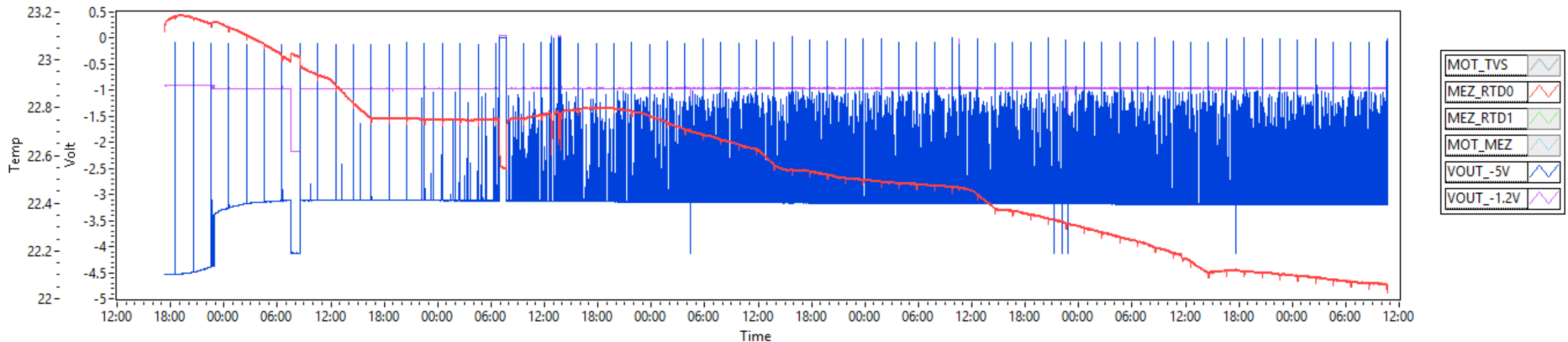


Irradiation of NVBG test structure (1)

Reconnaissance mission of exposing NVBG test structure for 3 Mrads irradiation

- NVBG operated in open loop – real operation should be in closed loop
- Output voltage set up to maximum negative = $\sim -4.5V$
- Blue curve show that NVBG operates to the end, there is jump of voltage observed after ~ 12 hrs – needs to be understood but probably one set of RF drivers got lost
- Some drift observed – probably slowing down oscillators or decrease drive of RF buffers – should not be visible if operate in closed loop

All



Irradiation of NVBG test structure (2)

Continuation of reconnaissance mission est setup

- Irradiated NVBG test structures was tested to verify write – read operation of I2C programming interface.
- All registers respond correctly – confirming no problem with digital implementation of AncASIC (to be) logic at the expected EIC doses
- Caveat: I2C will not be present in the final AncASIC realization as programming interface will be proprietary EIC_SC_protocol via IpGBT D channel
- Tests provide confidence for radiation hardness in XT011 process for AncBrain and other parts of digital implementation in AncASIC.

0000 0000 0000 0000 00	SENT	●	EQUAL	FFFF FFFF 0700 0000 00	SENT	●	EQUAL	FFFF FFFF FFFF FFFF 3F	SENT	●	EQUAL
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0F00 0000 0000 0000 00	SENT	●	EQUAL	FFFF FFFF 7F00 0000 00	SENT	●	EQUAL				
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FFFF FF07 0000 0000 00	RECEIVED	●		FFFF FFFF FFFF FF3F 00	RECEIVED	●					
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FFFF FF1F 0000 0000 00	SENT	●	EQUAL	FFFF FFFF FFFF FFFF 00	SENT	●	EQUAL				
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Towards Device Irradiations

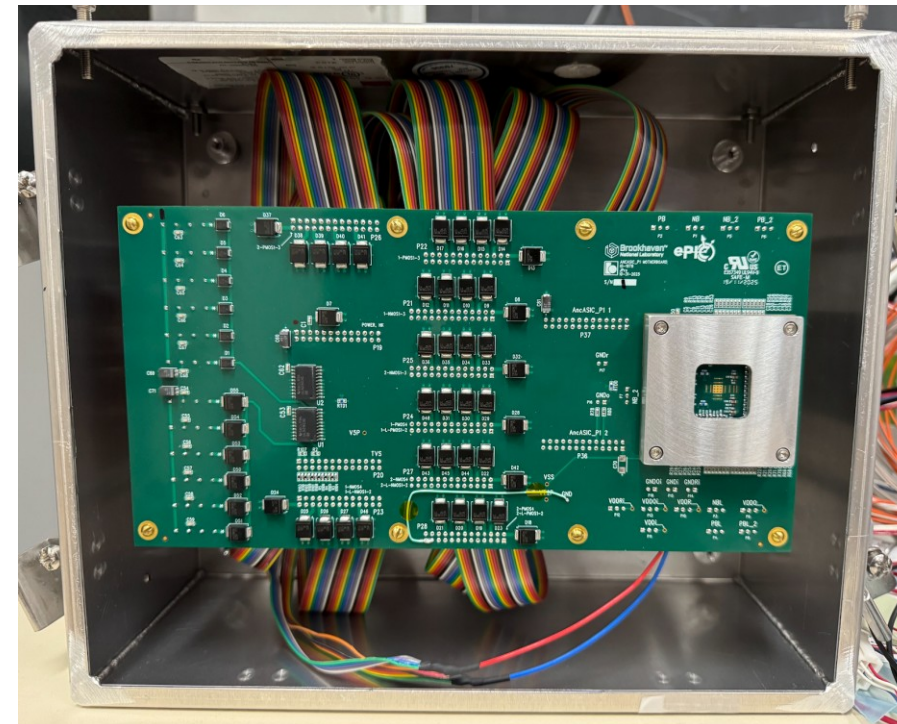
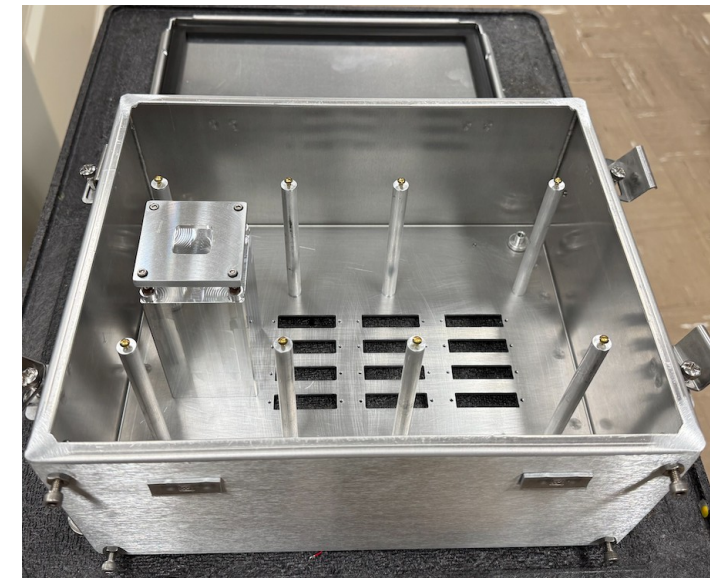
Test setup prepared for device irradiation characterization

- TID up to 3 Mrad, under and without bias exposures, 3 selected temperatures, all 20 + devices irradiated and characterized in parallel
- NiPXle crate with 8 × 4 input SMUs with 100 pA precision
- No connect / disconnect between doses
- measurements made in situ



- NiPXle chassis with 8 Ni 4141 SMUs, each with 4 source/measurements ports
- 100 pA precision • DB20 plug cables allows 32 terminals to be connected •

- metal box for hosting motherboard/daughter board
- slots cut for DB20 sockets
- suitable for filling with nitrogen during irradiation/measurements •

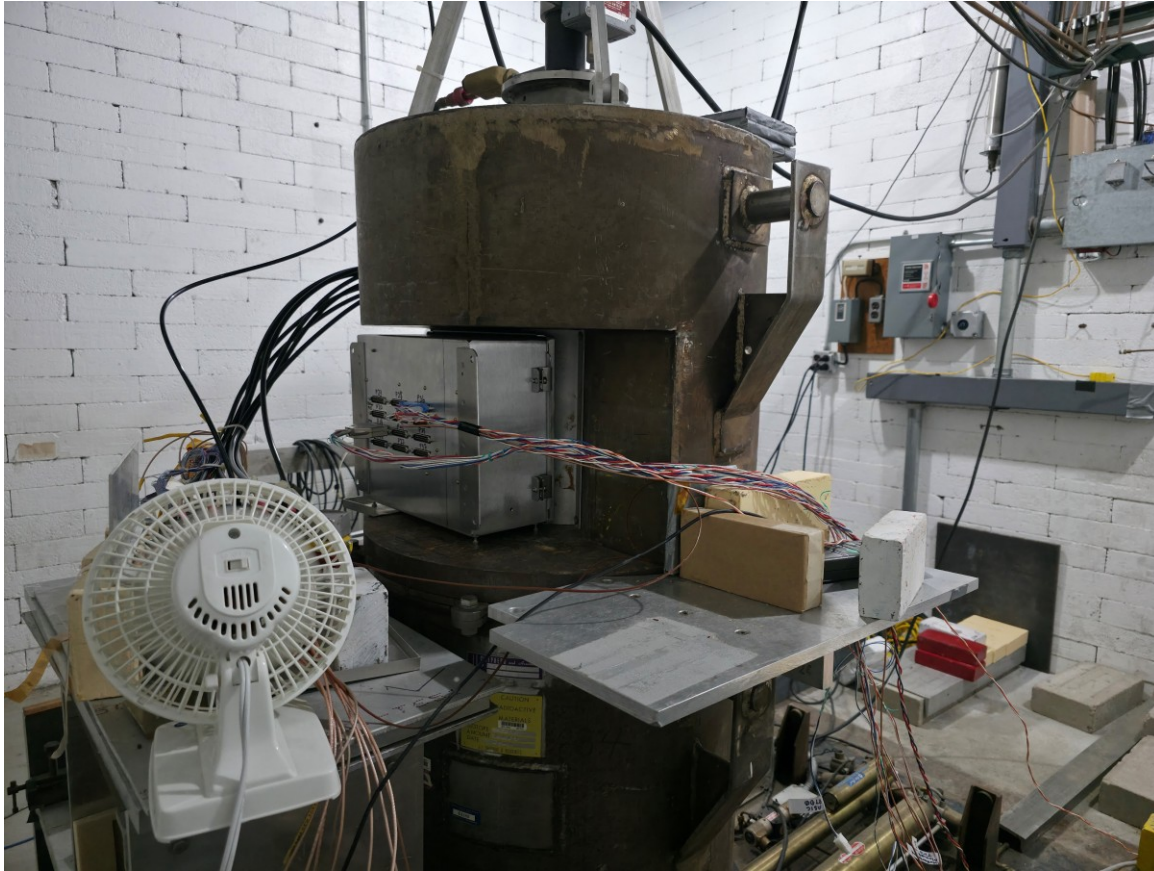


- motherboard/daughter board with temperature control fixture and pig-tail connectors to DB20 socket inside metal box (no chip mounted) •

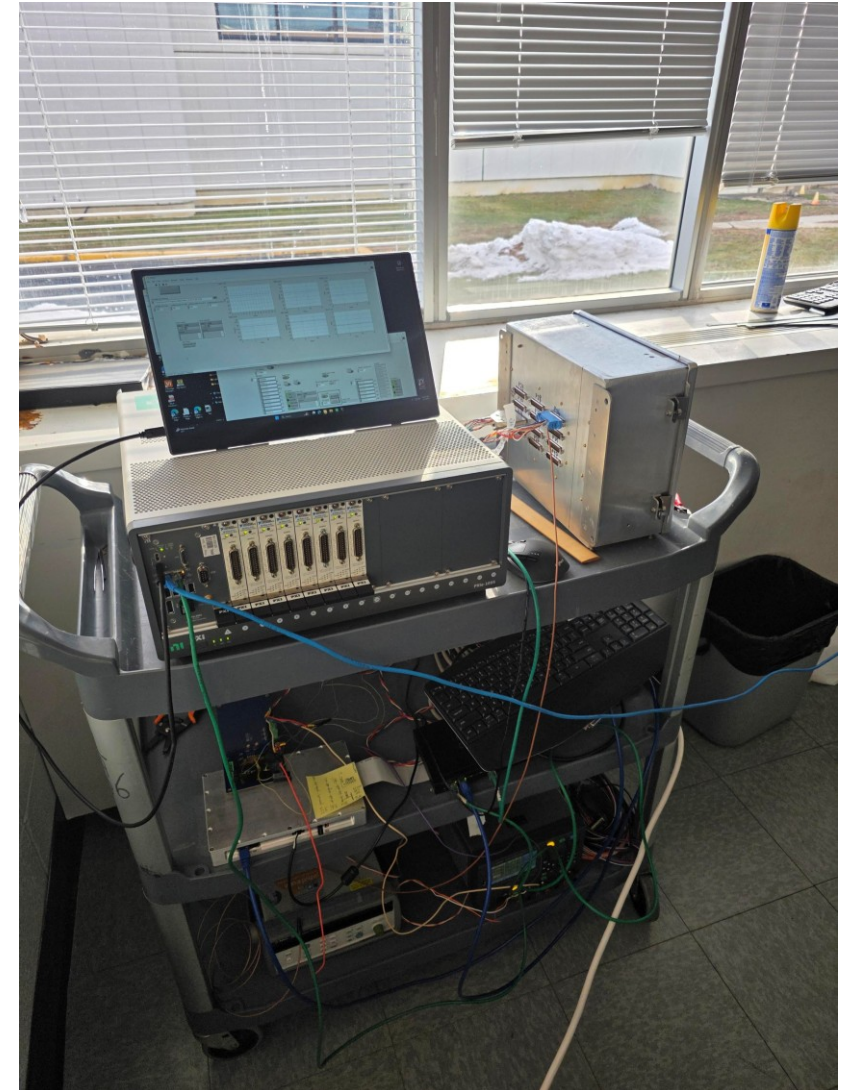
Towards Device Irradiations

Test setup prepared for device irradiation characterization

- TID up to 3 Mrad,



- box with NVBG exposed to the Co-60 source – source is down •

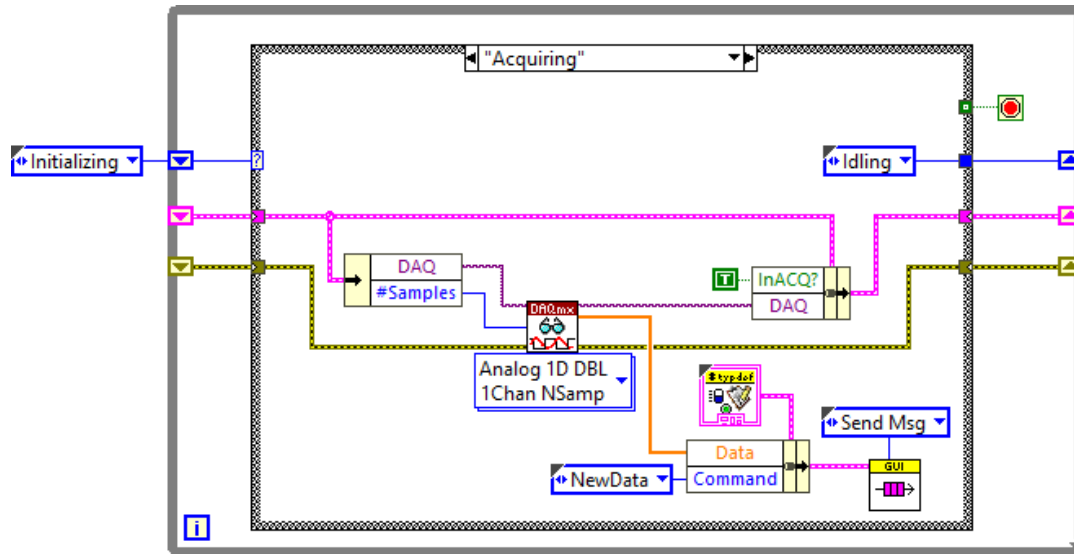


- complete irradiation test setup on cart •

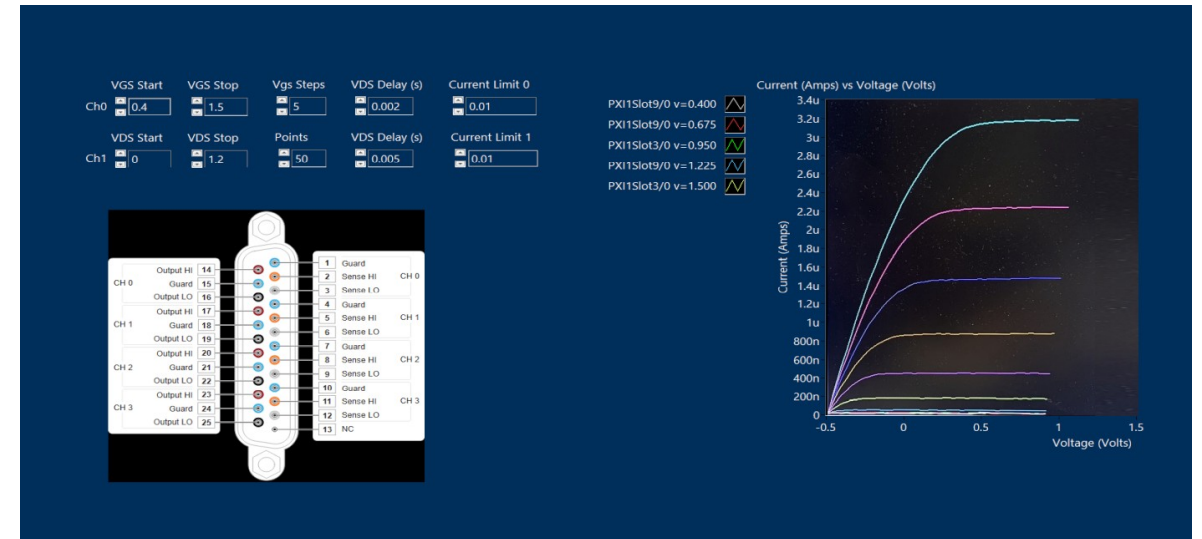
Towards Device Irradiations

Test irradiation / measurements application (underway)

- All in LabView:
 - Controlling bias / no bias during irradiations
 - Sequencing irradiation /measurements steps from 0 to 3 Mrads in progressing steps
 - Performing measurements of $I_{DS}(V_{GS})$ and $I_{DS}(V_{DS})$ characteristics in ranges and with compliance from simulations for transistors
 - Performing measurements of other devices: diodes, resistors
- Application is under development



- application for automated single transistor measurements •



- GUI for application for automated single transistor measurements •

Towards Device Irradiations

Test irradiation / measurements application

- Hardware Preparations
 - reviewed grounding for test-structures testing, and it looks ok. Return currents are connected to Output LOs and with a high DC impedance to the GND of the board.
 - mapping spreadsheet available to indicate possible connections between SMUs and transistors.
 - Simultaneous irradiation of NVBG and transistors - RIO board needs: ADC to read Vout1p2, Vout5, Vc_o, Vfb_go; DAC to generate VREF (0-1.2V) <- wait for electrical tests of NVBG
 - A digital multimeter (4-wire measurement) to read temperature and NI USB-8452 for I2C communication
- Software
 - A first draft of software for test is available, sync among SMUs might be needed for transistors with terminals across SMUs
 - ADC and DAC readout to be developed
 - NI USB-8452 software should be available and needs to be integrated with main software
 - Readout of digital multimeter: to be done, depending on the hardware found.
- Plan
 - Motherboard "fix" should complete it on Monday 2/23.

...ing of test-structures: Tuesday-Wed

Towards Device Irradiations

Test irradiation / measurements application

- Hardware Preparations
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 - NI USB-8452 software should be available and needs to be integrated with main software
 - Readout of digital multimeter: to be done, depending on the hardware found.
- Plan
 - Motherboard modifications: completed on 2/26.
 - Motherboard connections and debugging of test-structures: 2/30-3/3
 - NVBG readout and control: 3/4-3/6
 - Integrate system with aux features (temperature measurement) and integrate software: 3/9 - 3/11
 - Dry run: Wednesday-Thursday 3/12-3/13