Total Dose Ionising Irradiation of APV25S1 Chips (QA)

Outline:
- Testing Considerations
- Chip Characterisation
- Current Status
- Chip Measurement Example
- Results on all Chips
- Summary
Testing Considerations

X-ray Irradiation:
- 10-keV X-ray field is uniform to within 10% across the chip.
- Chip is biased during irradiation with a continuous random cycling through the pipeline cells.
- Irradiation to 10Mrad(SiO$_2$) takes ~15hrs.

Active area of dosimetry diode, Position for calculation of APV25 dose rate.
Active area of dosimetry diode, Position at maximum dose rate.
Chip Characterisation

Chip is tested Prerad and after irradiation using an automated testing setup including:

- Pulse shaping tuning in peak mode.
- Gain and linearity with externally applied pulse.
- Noise.
- Internal calibration.

Plans (IC and Padova)

- Irradiate 1 chip/wafer.
- Anneal irradiated chip (process takes a week and can only anneal one chip at a time currently).
Current Status

- Irradiated chips:
  - 1 chip from each of the 10 engineering-run wafers.
  - 1 chip from each of the 13 diced wafers from the 3rd production lot. (chip taken close to the centre of the wafer).
- IC X-ray machine now unavailable due to refurbishment work (~until November 02).
- Annealing still ongoing.

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Chip measurement: Prerad

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Chip measurement: 10 Mrad(SiO₂)
All 23 Chips: Bias Register Settings

Pulse Shape Parameters

**ISHA**

- Prerad AVG = 28.2609
  - SD = 3.87553
- 10Mrad AVG = 30.6522
  - SD = 6.95837

**VFS**

- Prerad AVG = 81.7391
  - SD = 12.6678
- 10Mrad AVG = 67.3913
  - SD = 14.8377

Baseline (1/4 of full range)

**VPSP Peak**

- Prerad AVG = 39.3913
  - SD = 2.64127
- 10Mrad AVG = 47.0873
  - SD = 5.14263

**VPSP Decon**

- Prerad AVG = 37.6087
  - SD = 2.96555
- 10Mrad AVG = 45.4348
  - SD = 5.87619
All Chips: Gain

External Pulse

Peak

Deconv.

Internal Calibrate

Peak

Deconv.

Prerad AVG = 199.73
SD = 5.4346
10Mrad AVG = 201.769
SD = 6.55951
Pre 10M

Prerad AVG = 208.707
SD = 22.9885
10Mrad AVG = 206.755
SD = 27.8435
Pre 10M

Prerad AVG = 201.671
SD = 20.6166
10Mrad AVG = 197.582
SD = 25.1554
Pre 10M

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All Chips: Noise

Baseline Noise

Peak

Deconv.

Extra Input Capacitance

Peak

Deconv.
Shape of Pedestals

Peak mode pedestals

S.D. Statistics

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Summary

- 23 chips irradiated.
- All fully operational after 10Mrad(SiO$_2$).
- No significant change in noise or gain.
- Annealing studies to be done.