

ATLAS TileCal

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TileCal Electronics Radiation Tests

Status

- Status of Tests

TID (Total Ionizing Dose)

NIEL (Non-Ionizing Energy Loss)

SEE (Single Event Effects)

- Summary

Component	Techno	SRL	Safety Factors			Ionizing Radiation Tests (TID)		
			SIM	LDR	LOT	TID	Tested to	No. Comp.
		(Gy 10 y)				(Gy 10 y)	(Gy 10 y)	
HV micro	CMOS	2,53E-01	3.5	1	4	3.5	44.5	10
	Bipolar	2,53E-01	3.5	5	4	17.7	44.5	10
HV opto	CMOS	3,88E-01	3.5	1	4	5.4	61.6	10
	Bipolar	3,88E-01	3.5	5	4	27.2	61.6	10
3-in-1 cards	CMOS	2,64E+00	3.5	1	4	36.9	36 ₍₁₀₀₎	10 ₍₁₂₋₂₀₎
	Bipolar	2,64E+00	3.5	5	4	184.8	178 _(500, 178)	10 _(12-20, 10)
Integrator ADC	CMOS	2,18E-01	3.5	1	4	3.1	10	11+1
	Bipolar	2,18E-01	3.5	1	4	3.1	10	11+1
Adder								
	Bipolar	2,13E+00	3.5	5	4	149.1	536	2x7
Digitizer PC	CMOS	2,64E+00	3.5	1	4	36.9	500	6-12
	Bipolar	2,64E+00	3.5	5	4	184.8	500	6-8
Interface	CMOS	2,53E-01	3.5	1	4	3.5	24 _(99,12-24)	1x2 ₍₁₊₁₎
	Bipolar	2,53E-01	3.5	5	4	17.7	24 ₍₁₇₅₎	1x2 ₍₂₎
Mother board	CMOS	1,22E+00	3.5	1	4	17.1	15	10
	Bipolar	1,22E+00	3.5	5	4	85.4	77	10
Mezannine	CMOS	6,64E-01	3.5	1	4	9.3	15	10
	Bipolar	6,64E-01	3.5	5	4	46.5	77	10

Name of the board	Simulated Radiation Level	Safety Factors			Neutron Radiation Tests (NIEL)		
	NIEL	SIM	LDR	LOT	NIEL (1 MeV n/cm ² 10y)	Tested	
HV micro	4,61E+10	5	1	4	9.2E+11	8.7E+11 (2.60E+12)	10 (1-2)
HV opto	3,66E+10	5	1	4	7.3E+11	8.7E+11 (1.8E+12)	10 (2 -26)
3-in-1 cards	2,31E+11	5	1	4	4.6E12	4.6E12 (4.5E+12 - 10E+13)	10 (6)
Integrator ADC	3,77E+10	5	1	4	7.50E+011	10E+13	2
Adder	1,56E+11	5	1	4	3.1E+12	2.8E+12 (2.0E+13)	2x7 (2x7)
Digitizer PC	2,31E+11	5	1	4	4.6E12	5-7.5E+12	6-30
Interface	2.0E+10	5	1	4	4.0E11	3.0E+11	5x2
Mother board	2.31E+11	5	1	4	4.6E12	4.6E+12	10
Mezannine	7.15E+10	5	1	4	1.4E12	4.6E+12	10

Name of the board	Simulated Radiation Level	Safety Factors			Tests for Single Event Effects (SEE)		
		SEE	SIM	LDR	LOT	SEE Tolerance	SEE Rate in TileCal System
	(> 20 MeV h cm ⁻² 10y)				(> 20 MeV h cm ⁻² 10 y)		
HV micro	2.15E+09	5	1	4	?	(see talk by Philippe)	
HV opto	1.42E+09	5	1	4	?	("")	
Integrator	2.59E+09	5	1	4	?	(No errors up to 1.4E+10 h cm ⁻²)	1
Adder	2.47E+10	5	1	4	?	?	?
Digitizer	5.69E+10	5	1	4	?	(3 soft SEU /min)	4
Interface	8.56E+08	5	1	4	?	1–2 SEE events / week (recover by power cycling)	1
3–in–1 cards	5,2E+09 (avg) 5.69E+10 (max)	5	1	4 (1?)	?	14 SEE events / week (recovers, only affects calibration)	4
Mezannine	6.81E+9	5	1	4 (1?)	?	19 SEE events / week (calibration)	2
Mother board	5,2E+09 (avg) 5.69E+10 (max)	5	1	4	?	Similar components as 3–in–1	

Summary

- Essentially all three classes of radiation tests (TID, NIEL, SEE) performed for all front-end electronics.
- TileCal summary, reports, and table of simulated radiation levels on:

[http://atlas.web.cern.ch/Atlas/
SUB_DETECTORS/TILE/production/
electronics/radiation/rhawgnew.html](http://atlas.web.cern.ch/Atlas/SUB_DETECTORS/TILE/production/electronics/radiation/rhawgnew.html)

- No serious problems uncovered so far, but...
- ATLAS Technical Coordination would like more samples of components tested (10 each TID, NIEL, 4 SEE)
- Report forms to be filled:
[http://atlas.web.cern.ch/Atlas/
GROUPS/FRONTEND/radhard_TILE.htm](http://atlas.web.cern.ch/Atlas/GROUPS/FRONTEND/radhard_TILE.htm)
- SEE tests for Adders? Unclear if necessary.
- Each component expert to calculate: SEE tolerance criteria estimate (hard, soft, destructive)