Heavy Ion Effects on Low Voltage AC/HC Logics.

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Tested AC/HC logic circuits sensitivity to Heavy ion Irradiation for different voltage bias condition: 2.5, 3.3 and 5.0V.

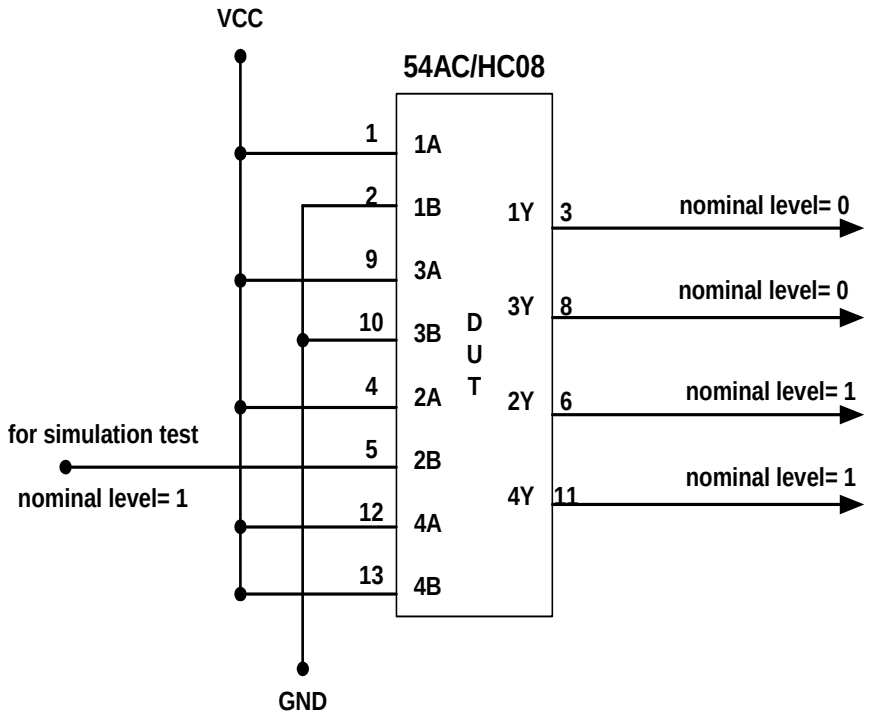
- 54AC/HC08 National S. & ST Microel.
- 54AC/HC157 National S. & ST Microel.
- 54AC244 National S. & ST Microel.
- 54AC257 National S. & ST Microel.
- 54AC/HC273 National S. & ST Microel.
- 54HC4040 ST Microelectronics
- 54HC4053 ST Microelectronics

Heavy ions used at Louvain la Neuve in Belgium (used ions was both with M/Q=5 and M/Q=3.33)

Element	Energy [MeV]	Range [μm]	LET value [MeV/mg/cm^2]
40Ar	372	119	10,1
40Ar	150	42	14,1
58Ni	500	85	21,9
78Kr	756	92	32,4
78Kr	316	43	34,0
132Xe	459	43	55,9

54AC08 / 54HC08 – Quad 2-Input and Gate

Static electrical test configuration



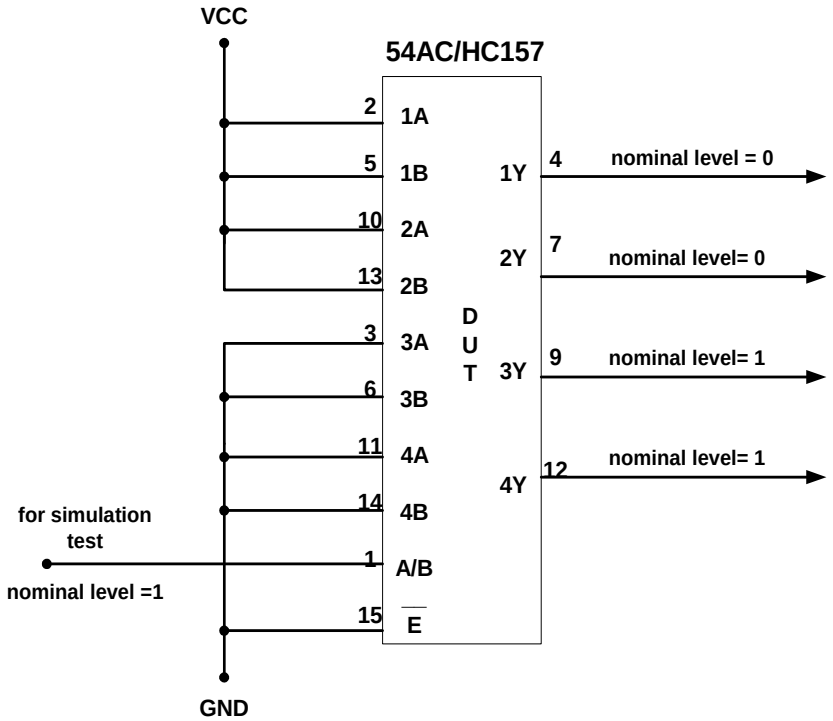
Results

No errors decteded for all bias conditions.

Device	LET	Fluence
54HC08 STM	111.8	1E6
54AC08 STM	111.8	1E6
54AC08 NS	111.8	2E6

54AC157 / 54HC157 – Quad 2-Channel Multiplexer

Static electrical test configuration



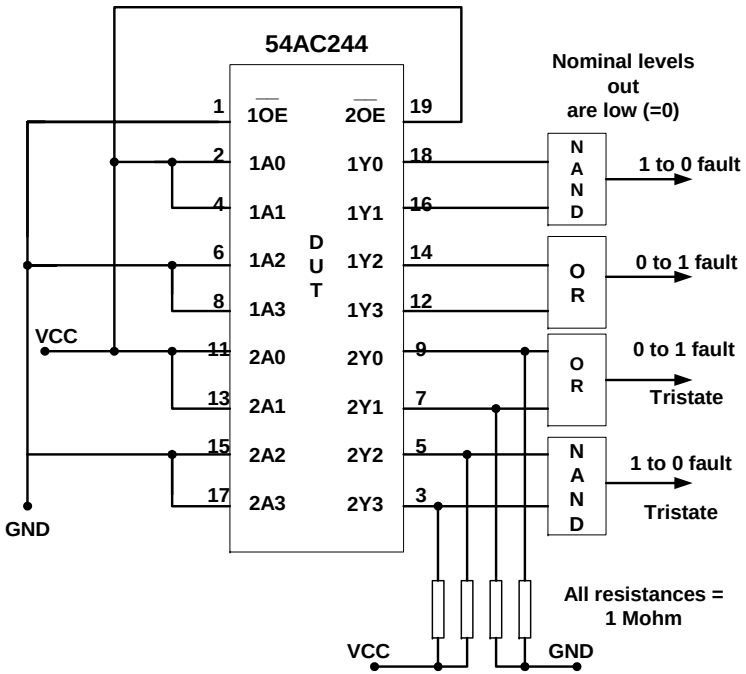
Results

No errors detected for all bias conditions.

Device	LET	Fluence
54HC157STM	111.8	1E6
54AC157STM	111.8	1E6
54AC157NS	111.8	4E6

54AC244 – Octal buffers with Tri-state outputs

Static electrical test configuration



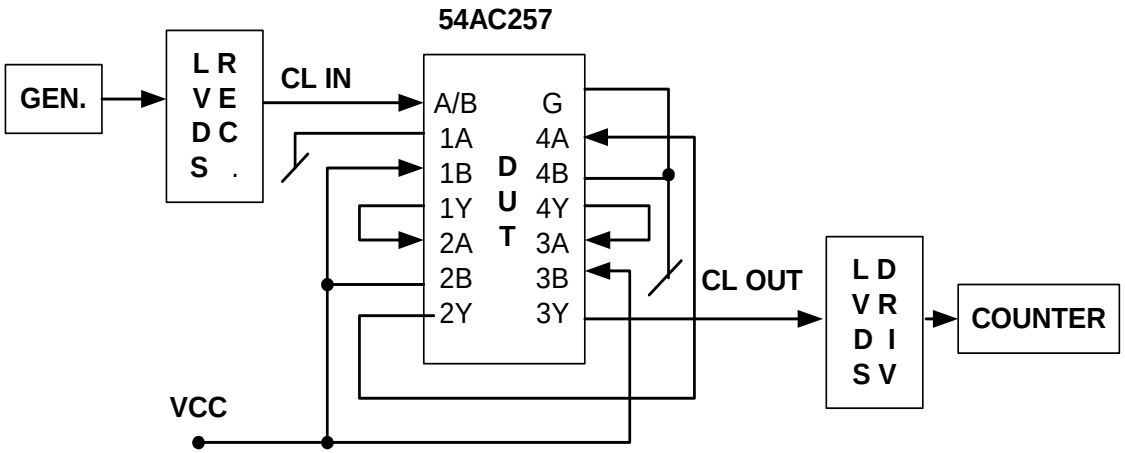
Results

No errors decteded for all bias conditions.

Device	LET	Fluence
54AC244STM	64.8	2E6
54AC244NS	64.8	1E6

54AC257 – Quad 2 to 1 line Selector/Multiplexer

Dynamical electrical test configuration



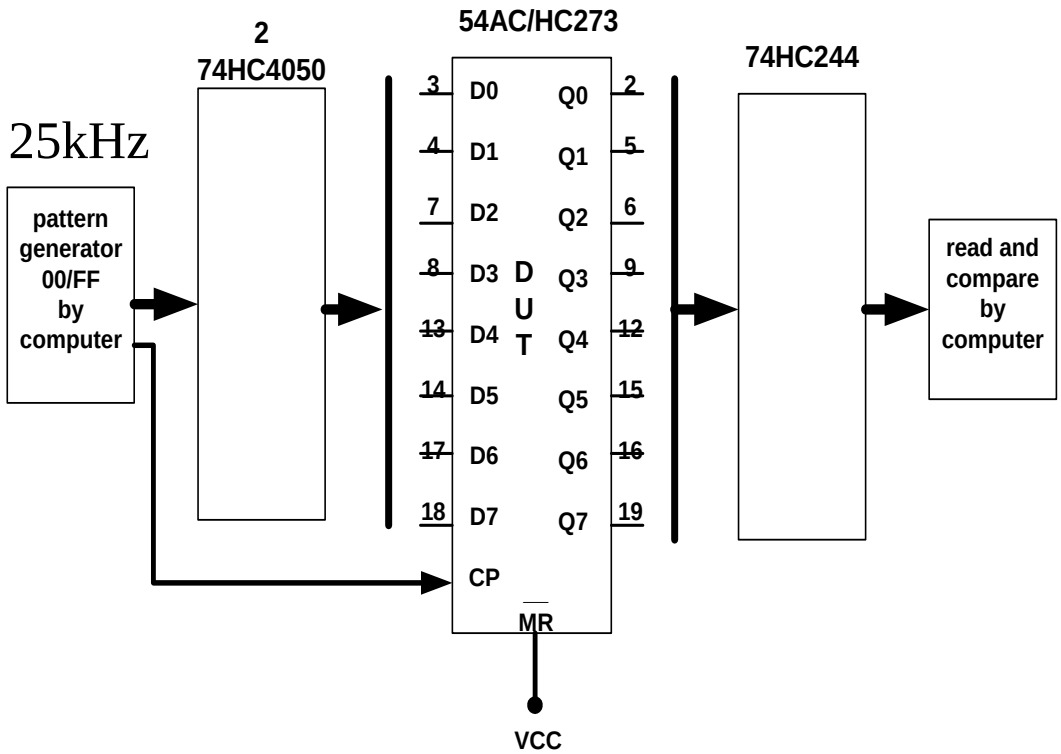
Results

No errors detected for all bias conditions.

Device	LET	Fluence
54AC257STM	111.8	1E6
54AC257NS	111.8	2E6

54AC/HC273 – Octal D type Flip-Flop with Clear

Dynamical electrical test configuration

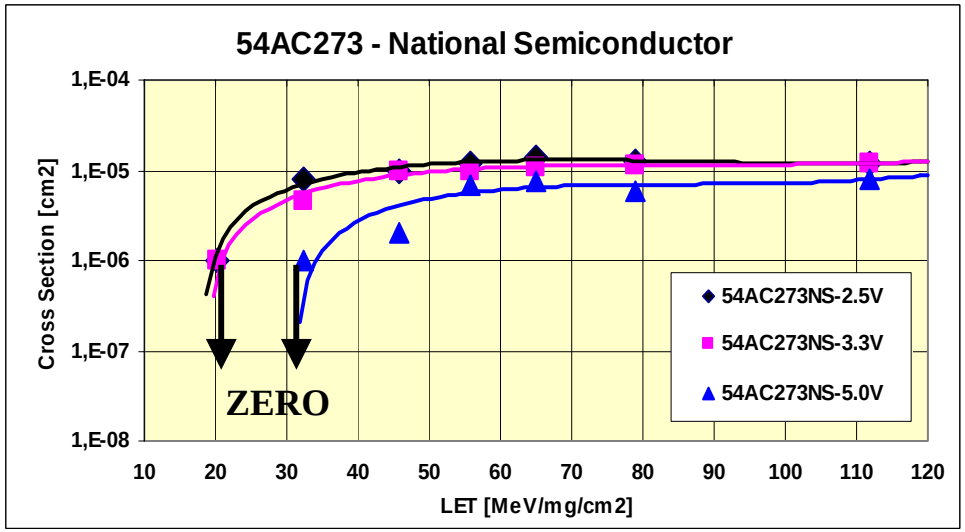


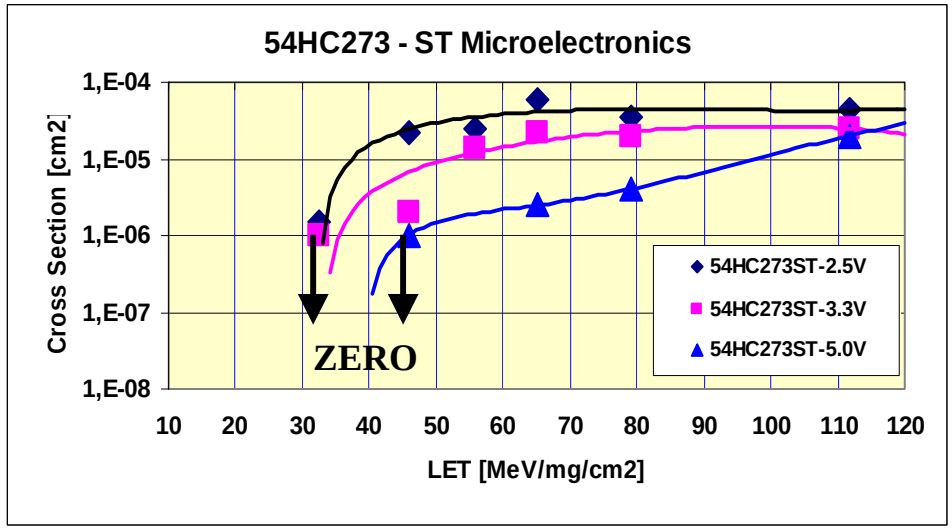
Results

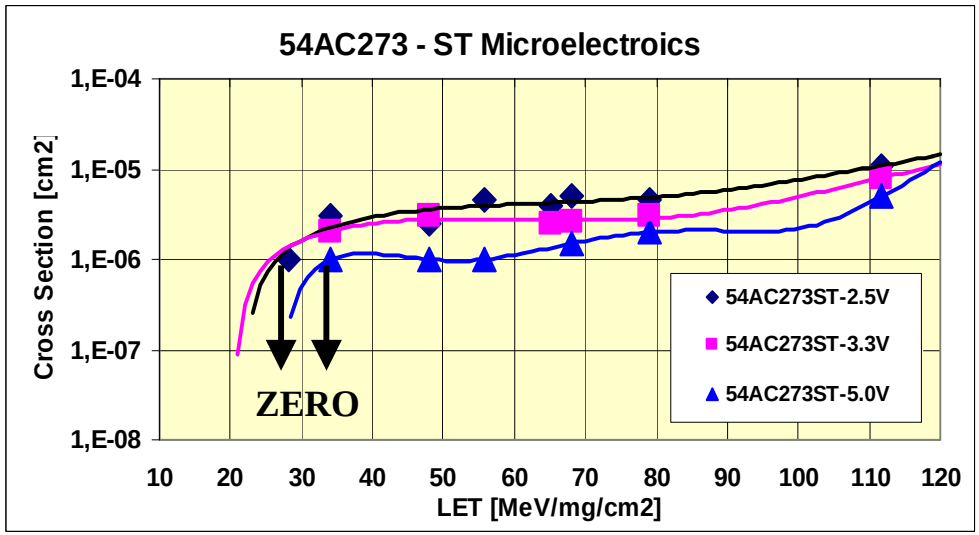
Errors detected for all bias conditions.

Device	LET threshold
54AC273NS	**20 to 30** MeV/mg/cm2
54AC273STM	**23 to 28** MeV/mg/cm2
54HC273STM	**32 to 40** MeV/mg/cm2

Cross Section vs LET and Bias for all three types of devices



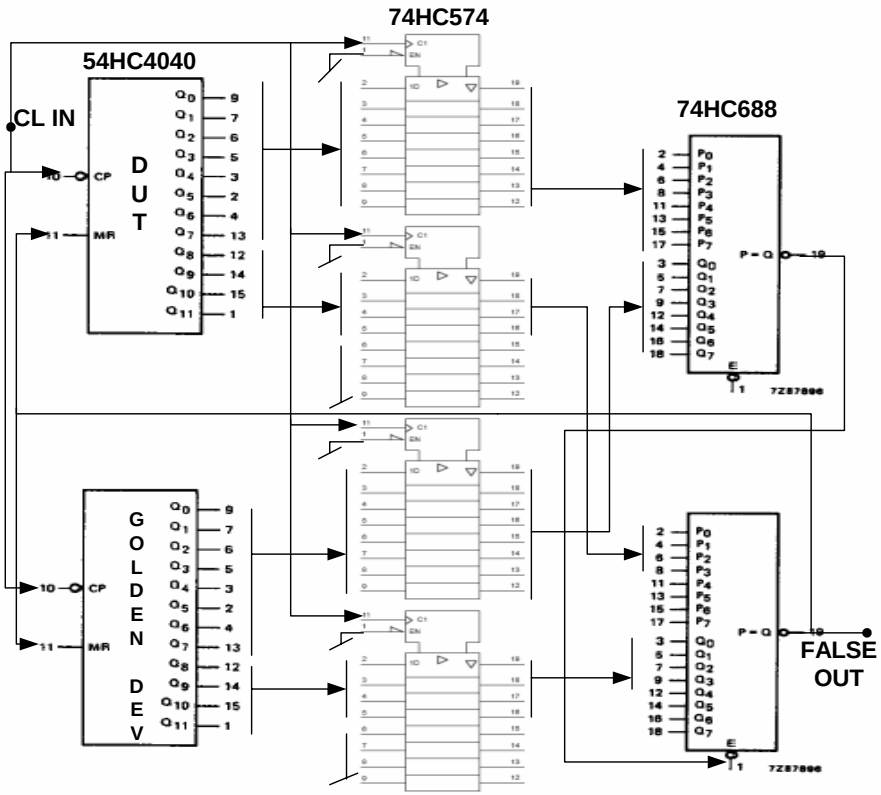




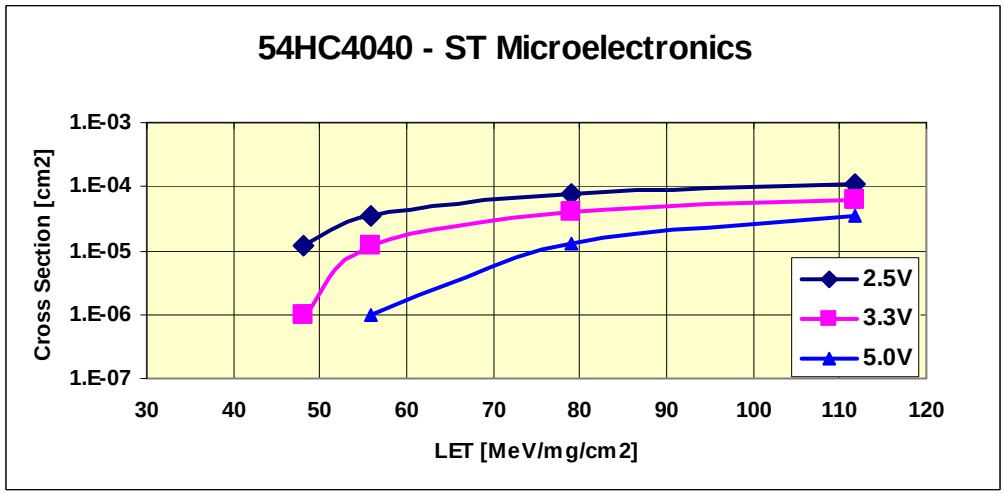
ZERO = measured points with no faults detected and with a fluence = 1E6

54HC4040 – 12 Stage binary Ripple counter

Dynamical electrical test configuration



Results

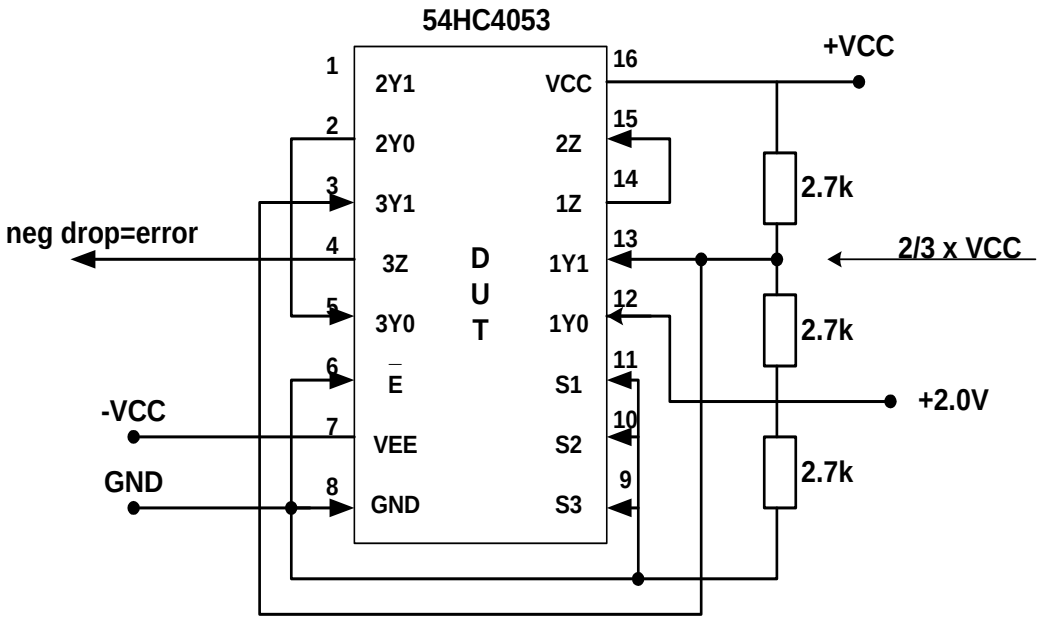


Measured points with no detected faults:

Bias = 2.5V, LET=34 MeV/mg/cm2 => 0 SEE
Bias = 5V, LET=48.1 MeV/mg/cm2 => 0 SEE

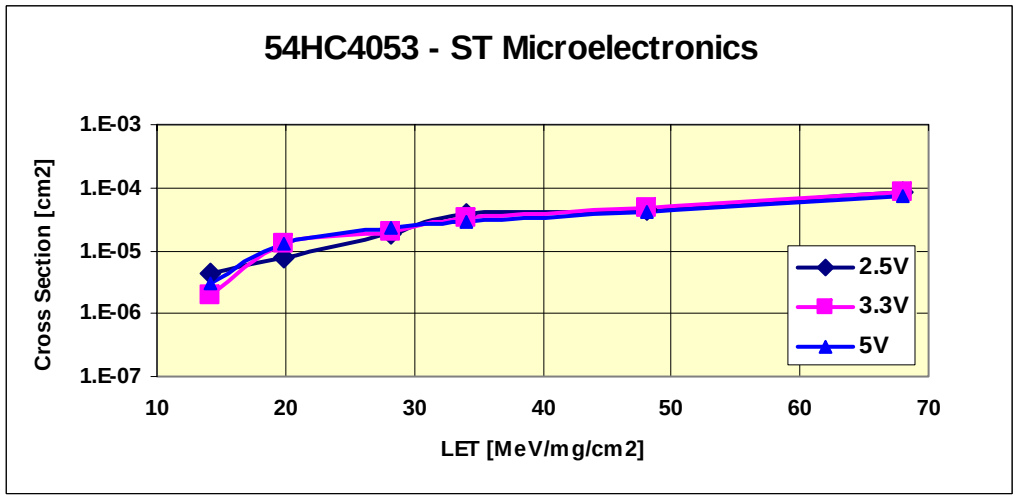
54HC4053 – Analog Mux/Demux, Triple 2 Channels

Static electrical test configuration

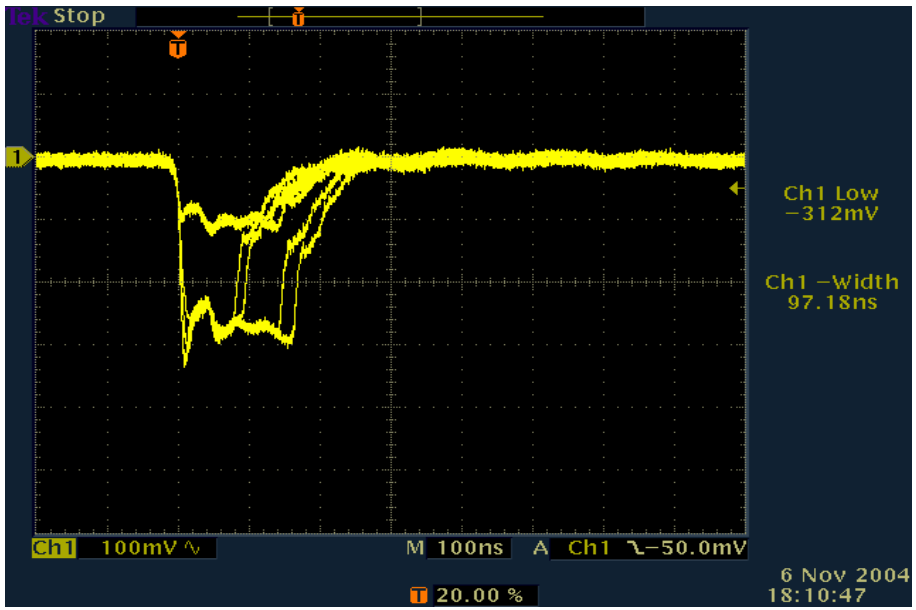


All 3 channels are connected in a chain

Results



Different bias conditions made no significant differences in the cross section.



All the runs look like this oscilloscope image.

Conclusions

- No SEL was detected during all the runs performed on the 7 different AC/HC types.
- All logic data type circuits (-08, -157, -244 & -257) are total insensitive for HI up to a LET=111 MeV/mg/cm2 for all bias conditions. (with a bias = 5V it was measured before with the same result by HIREX 97)
- AC/HC273, HC4040 & HC4053 also show similar results as from earlier measurements for the bias = 5V.
  The lower the bias, the more sensitive the circuits become and the LET threshold values decrease.
  HC4053 did not have here a typical threshold value. Earlier measurements indicate a threshold value to be around 30Mev/mg/cm2.

Otherwise the measured amplitudes were very similar to earlier measurements (HIREX 97).