
by

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Abstract

This presentation summarises steps taken by ESA in order to construct and calibrate a ‘Reference SEU Monitor’ system intended for use as a reference system at accelerators. Beam characteristics can be verified by experimenters via this simple system, which uses an SRAM as the detecting element and a laptop as the controller.
Why?

Micron MT48LC16M8A2 128M-bit SDRAM - Heavy Ion SEE Results (UCL0111, JYF0110 & LBN0202).
Introduction I.

Accelerator Single Event Effect (SEE) testing is often carried out using beams calibrated and monitored by the facility provider. Occasionally these beam data have been incorrect due to unknown detector degradations, faulty detectors, set-up changes, misalignments or contaminated beams.

The facility user (experimenter) has no means of checking suspicious beams and often discovers data discrepancies too late, often at home base when analysing the data previously gathered on-site.

So in order to minimise test errors due to faulty beams, the user should have a simple reference system that allows beam re-checking capabilities.

Such a system, based on Single Event Upsets (SEUs) in a Static Random Access Memory (SRAM) and the use of a laptop, will be described here.
Outline:

# Basic design of the ‘Reference SEU Monitor’
# Initial testing of 4 different SRAM types
# Initial Static versus Dynamic test conditions.
# Obtained SEU data will be compared to pre calibrated SEU versus LET or energy curves.
# Beam profile and homogeneity issues will be addressed via the physical locations of SEUs
# Full SEU characterisation under heavy ions, protons and neutrons.
# 15 ‘Reference SEU Monitor’ will be produced
Basic ‘Test’ Design I.

# Simplified design
* One Power Supply
* RS-232/RS-485 interface
* Motherboard
* DUT (Board)
* Any computer

# Initially design
* 5.0 V and 3.3 V
* Long distance
* Microcontroller & E2PROM
* 2 Boards (3 DUTs each)
* Laptop/PC
Basic ‘Test’ Design II.

# Initially design
Basic ‘Test’ Design III.

Step 1: Once the card STB007A is On, this button allows to begin the communication with the motherboard.

Step 2: Choose the pattern to Read and/or Write in the SRAMs.

Step 3: Choose the test to perform (Read and/or Write). Choose also if you want to perform this test on 1, 2 or 3 SRAMs.

Step 4: Launch the test. All status (state of the communication, results …) will be displayed in this window.

SRAMs status with respect to tests already performed.
Evaluated SRAMs I.

# Selection criteria – Low cost
* Potential suited
* Availability
* Ceramic Package

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Evaluated SRAMs II.

# Daughterboard – Two Types
  * Atmel AT60142E (3.3 V)
  * Maxwell 32C408R (5.0 V)
  * Maxwell 32C108R (5.0 V)
Heavy Ion Test Results – Maxwell/Hitachi

Maxwell 32C408RPFE-65 (Hitachi HC628512NM) 512K8 SRAM - Heavy Ion SEE Results (JYFL0504).

Ion LET - MeV/(mg/cm²)

Cross Section - (cm²/bit)

- Static S1-1/65 4M (Hitachi) - JYFL
- Static S1-2/65 4M (Hitachi) - JYFL
- Dynamic D1-1/65 4M (Hitachi) - JYFL
- Dynamic D1-2/65 4M (Hitachi) - JYFL

Ref.: RADECS Workshop 26/05/2005
Heavy Ion Test Results – Maxwell/Hitachi

Maxwell 32C408RPFE-65 (Hitachi HC628512NM) 512K8 SRAM - Heavy Ion SEE Results (JYFL0504).

Cross Section - (cm²/bit)

Ion LET - MeV/(mg/cm²)

- Red - Dynamic D1-1/65 4M (Hitachi) - JYFL - Bit Errors
- Black - Dynamic D1-2/65 4M (Hitachi) - JYFL - Bit Errors
- Green - Dynamic D1-1/65 4M (Hitachi) - JYFL - Word Errors
- Blue - Dynamic D1-2/65 4M (Hitachi) - JYFL - Word Errors

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Ref.: RADECS Workshop 26/05/2005
### Heavy Ion Test Results – Maxwell/Hitachi

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Heavy Ion Test Results – Atmel AT60142E

Atmel AT60142E 3.3 V 512K8 SRAM - Heavy Ion SEE Results (JYFL0504).

Ion LET - MeV/(mg/cm²)

Cross Section - (cm²/bit)

Static S2/1 - Atmel 4M - JYFL
Static S2/2 - Atmel 4M - JYFL
Dynamic D2/1 - Atmel 4M - JYFL
Dynamic D2/2 - Atmel 4M - JYFL

Ref. : RADECS Workshop 26/05/2005
Heavy Ion Test Results – Atmel AT60142E

Atmel AT60142E 3.3 V 512K8 SRAM - Heavy Ion SEE Results (UCL0211), (UCL0404) & (JYFL0504).

Ion LET - MeV/(mg/cm²)

Cross Section - (cm²/bit)

Dynamic D2/1 - Hirex - JYFL
Dynamic D2/2 - Hirex - JYFL
Dynamic #01 - Hirex - UCL
Dynamic 02 & #03 - Hirex - UCL
Dynamic IDA s/n 02 -UCL
Dynamic IDA s/n 03 - UCL

Ref.: RADECS Workshop 26/05/2005
# Heavy Ion Test Results – Atmel

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Heavy Ion Test Results – Atmel AT60142E/Maxwell-Hitachi

![Graphs showing heavy ion SEE results for different SRAMs](image-url)

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Atmel AT60142E – SEU Results: $^{20}\text{Ne}^{6+}$ 186 MeV, 0 Deg.
LET = 3.5 MeV/(mg/cm$^2$) – Beam area 20x20 mm, 15328 Errors.
Atmel AT60142E – SEU Results: $^{131}\text{Xe}^{35+}$ 1217 MeV, 60 Deg.
LET = 106 MeV/(mg/cm$^2$) – Beam area 20x20 mm, 25641 Errors.
Atmel AT60142E – SEU Results: $^{56}\text{Fe}^{15+}$ 523 MeV, 0 Deg. 
LET = 18 MeV/(mg/cm²) – Beam area 10x10 mm, 16992 Errors.
Atmel AT60142E – SEU Results: $^{56}\text{Fe}^{15+}$ 523 MeV, 0 Deg.
LET = 18 MeV/(mg/cm$^2$) – Beam area 5x5 mm, 8181 Errors.
Atmel AT60142E – SEU Results: $^{56}\text{Fe}^{15+}$ 523 MeV, 0 Deg.
LET = 18 MeV/(mg/cm²) – Beam area 1x1 mm, 365 Errors.
Test Results – New Data:

# Not yet analysed

* JYFL, Jyvaskyla, Finland - Proton data April 2005
* TSL, Uppsala, Sweden - Proton data April 2005
* TSL, Uppsala, Sweden - Neutron data April 2005

# New updated design to be evaluated at

* UCL, Louvain-la-Neuve, Belgium – June 2005
* PSI, Villigen, Switzerland – August 2005
Preliminary Conclusions:

# Detector element to be Atmel

# Further devices and technical support also to be provided by Atmel

# New updated design with Atmel SRAM to be further evaluated

# Initially 15 ‘Reference SEU Monitor’ systems will be produced and distributed – fee of charge – to interested European SEE test sites
Acknowledgment:

# Atmel, France for providing 12 pc AT60142E, Ceramic Package 4M-bit SRAMs with the package lid taped on.

# Maxwell, USA for providing 12 pc 32C108RP, Ceramic Package 1M-bit SRAMs with the package lid taped on.

# Maxwell, USA for providing 12 pc 32C408R, Ceramic Package 4M-bit SRAMs with the package lid taped on.

# Maxwell, USA for providing 12 pc 32C408B, Ceramic Package 4M-bit SRAMs with the package lid taped on.