Single Event Latch-Up Testing on Samsung Rev. D 4M Fast Asynchronous SRAM

Joseph Benedetto, Ph.D.
Craig Hafer
719-594-8319
craig.hafer@aeroflex.com

Summary*—Single event latch-up (SEL) testing was performed on the Samsung K6R4008V1D and K6R4008C1D 3.3 and 5.0V 4M Asynchronous SRAMs (respectively) at the Texas A&M Cyclotron Institute. Single event latch-up (SEL) was tested at non-worst case room temperature conditions and worst-case voltage conditions (3.6 or 5.5V depending on part type). The Rev. D components were observed to be susceptible to SEL at a LET of 23.6 MeV·cm^2/mg (3.6V and 25°C) and exhibited a very large latch-up error-cross section.*

Introduction

Samsung 3.3 and 5.0V 4M asynchronous SRAM*s* are frequently used for spaceborne applications because of their excellent intrinsic hardness to single event upset, single event latch-up and total dose hardness. The Rev. B and Rev. C versions of these components are part of Aeroflex UTMC's Quantified Commercial Off-The-Shelf (QCOTS^{TM}) family of products. One of the requirements of the QCOTS^{TM} family is that SEU and SEL are tested and qualified on each wafer lot of material. Recently Samsung announced the end of life for the Rev. C product and the beginning of production for their Rev. D components (K6R4008V1D and K6R4008C1D 3.3 and 5.0V 4M Asynchronous SRAMs (respectively)).

As part of our QCOTS flow, we secured a sample of new memory devices from Samsung and started to evaluate the performance of the new die revisions for total dose, SEU and SEL. During our evaluation at Texas A&M we discovered a large SEL sensitivity on the new Rev. D components.

Results

Table 1 shows a summary of the SEL data taken on the Samsung Rev. D 4M SRAMS. The components were tested with a krypton beam at 40 MeV/a. In all cases the parts experienced SEL as soon as the shutter was opened. The fluence and effective fluence numbers shown in the table are essentially the minimum number of ions delivered during the manual shutter opening and closing procedure.

Table 1. Single event latch-up data for the 4 Rev. D samples tested

SN	Ion	Part Type	Angle (Degrees)	Fluence (cm^2)	Effective Fluence (cm^2)	Effective LET (MeV-cm^2/mg)	DVM (V)	Temp	Latch-up
1	Kr	3.3V SRAM	45.3	8.11E+4	5.70E+4	58.8	3.60	25	YES
1	Kr	3.3V SRAM	38.0	1.10E+4	9.10E+3	40.2	3.60	25	YES
1	Kr	3.3V SRAM	31.7	1.81E+4	1.57E+4	31.7	3.60	25	YES
1	Kr	3.3V SRAM	0	1.45E+4	1.45E+4	23.6	3.60	25	YES
2	Kr	5.0V SRAM	0	9.40E+4	9.40E+4	23.6	5.50	25	YES

Summary/Conclusions

One each K6R4008V1D and K6R4008C1D 3.3 and 5.0V 4M Asynchronous SRAMs, respectively, were tested for SEL at the Texas A&M cyclotron. The devices were tested under worst case voltage conditions, but not worst case temperature conditions. The testing was performed in general accordance with EIA/JESD57 "Test Procedures for the Measurement of Single–Event Effects in Semiconductor Devices from Heavy Ion Irradiation." The devices showed a large sensitivity to SEL at a very low LET (of 23.6 $MeV \cdot cm^2/mg$). Based on these poor SEL results, Aeroflex UTMC will not pursue the use of the Samsung Rev. D components as part of their qualified radiation hardness assured product.