DOCUMENT

SEL Heavy Ion Test Report of 256Kx16 Bit High Speed SRAM (K6R4016V1C-TI10) from Samsung

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CHANGE LOG

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CHANGE RECORD

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1 INTRODUCTION

This study was undertaken in the frame of the Proba 3 project to determine the single event latchup susceptibility of the 256Kx16 Bit High Speed SRAM (K6R4016V1C-TI10) from Samsung. The device was monitored for destructive events induced by exposing it to a heavy ion beam at the UCL Heavy ion facility.

Proba-3 is ESA's – and the world's – first precision formation flying mission. A pair of satellites will fly together maintaining a fixed configuration as a 'large rigid structure' in space to prove formation flying technologies.

The mission will demonstrate formation flying in the context of a large-scale science experiment. The paired satellites will together form a 150-m long solar coronagraph to study the Sun's faint corona closer to the solar rim than has ever before been achieved. Beside its scientific interest, the experiment will be a perfect instrument to measure the achievement of the precise positioning of the two spacecraft.

2 APPLICABLE DOCUMENTS

AD1: ESCC25100 Single Event Effects Test Method and Guidelines
AD2: Datasheet Samsung K6R4016V1C-TI10

3 DEVICES TESTED

Part Type	K6R4016V1C-TI10,
Manufacturer	Samsung
Part Function	SRAM
Technology	CMOS
Date Code	419 (Year and week)
Part Marking	SAMSUNG 419 K6R4016V1C-TI10 TZAL32DD Korea
Sample Size	10

The dice of the parts were exposed by removing the epoxy on the top. The epoxy removal was achieved by chemical etch (wet and/or dry) before soldering the parts on the test board.

Figure 1

the part marking on the top plastic package(TSOP44).

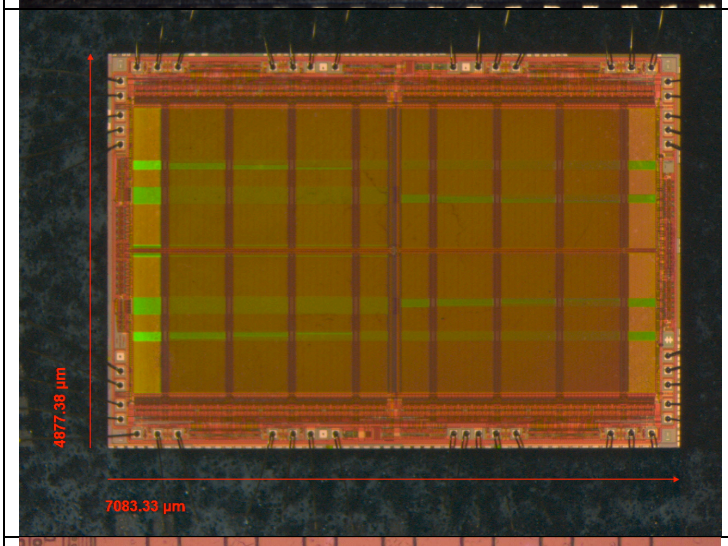


Figure 2

The exposed die after the chemical etch of the covering epoxy.
The measured die size is about 34.6 mm^2.

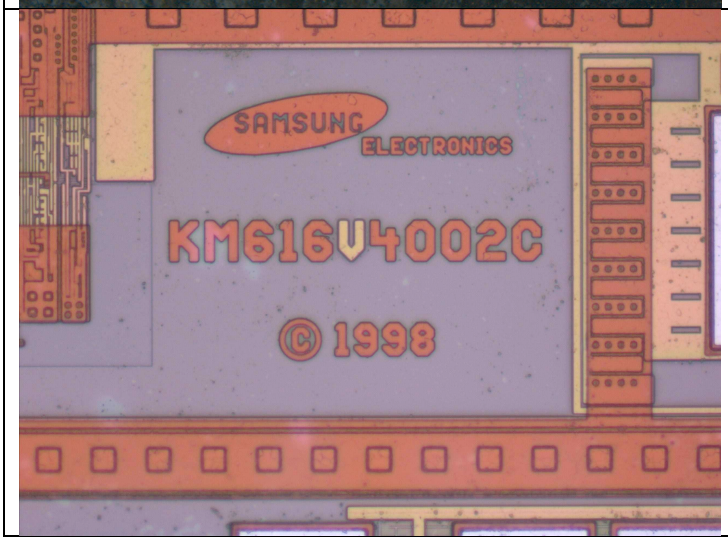


Figure 3

Detail of the die markings

4 TEST FACILITY AND TEST SYSTEM

Facility: UCL HIF with high LET cocktail. If possible, the new high energy Xe beam will be used (Energy = 995MeV, LET = 62.5MeV.cm²/mg, range = 73.1µm)
Flux: Maximum 1 x 10^5 particles/cm²/s
Fluence: All tests will run up to a fluence of 1 x 10^7 particles/cm² or until 100 destructive events occurred

Ion	Energy(1) (MeV)	LET(1) (MeV•cm²/mg)	Range(1) (µm)
$^{13}C^{4+}$	131	1.3	269.3
$^{14}N^{4+}$	122	1.9	170.8
$^{20}Ne^{6+}$	190	3.6	150.6
$^{40}Ar^{12+}$	379	10.0	120.5
$^{58}Ni^{18+}$	582	20.4	100.5
$^{83}Kr^{25+}$	779	32.2	95.0
$^{124}Xe^{35+}$	995	62.5	73.1

note (1): at the device

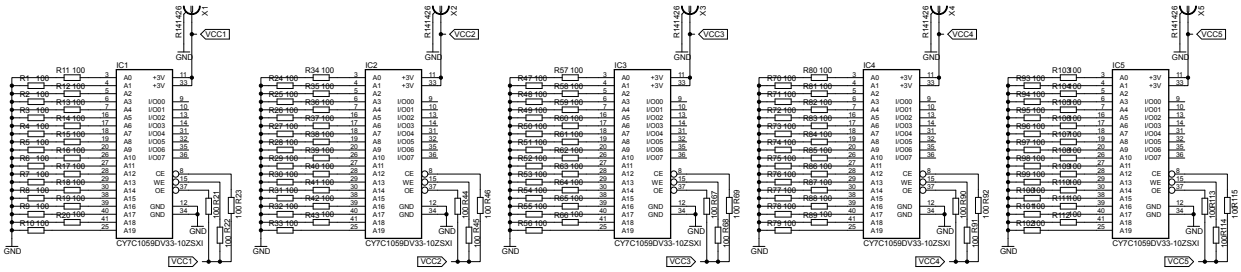
The following test equipment will be used:

- Power supply (Keithley 2612B)
- Oscilloscope Tektronik TDS 3054B
- Latch-up Tester 30463 TRAD

5 TEST CONDITIONS

Test Temperature: Room temperature. Note: the device will be operated at temperatures < 25degC during the Proba 3 mission, hence SEL testing at high temperature is not performed.

Bias Conditions: Supply voltages=+3.45V ; GND=0V

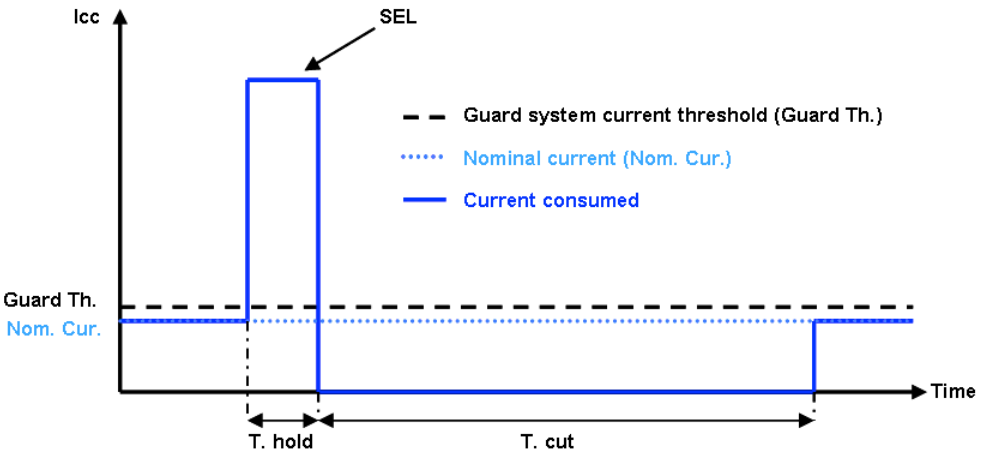


Operating frequency: Static condition

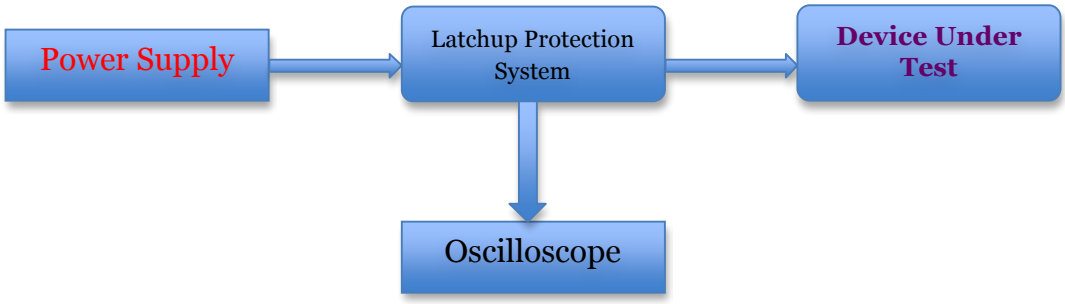
6 TEST METHOD

The goal of this test is to evaluate the potential latchup sensitivity of the Device Under Test (DUT). During the test, the power supply is applied to the DUT via the latchup protection system TRAD 30463 (GUARD system). If the current in stand by condition as measured at the beginning of the irradiation is exceeded by 50% or by 5mA (whichever is the higher) during at least 5 ms (hold time), the latchup protection system is triggered and the DUT is powered off for 5 ms or more (Tc or cut off time). After Tc, the nominal biasing conditions of the DUT are resumed. Each time the SEL protection is triggered, the event is counted as one latchup.

The figure below illustrates the latchup detection and protection scheme of the DUT.



A synoptic view of the test bench is given below:



7 TEST RESULTS

During testing, three devices were irradiated with Xenon beam at normal incidence up to a fluence of 1E7/cm². No latchup occurred during the experiment yielding a threshold LET for latchup > 62.5MeV.cm²/mg.

8 CONCLUSIONS

The goal of this test was to assess the single event latchup susceptibility of the 256Kx16 Bit High Speed SRAM (K6R4016V1C-TI10) from Samsung (DC419). No latchup event was detected up to an LET of 62.5MeV.cm²/mg, which is compliant with the Proba3 requirements.

9 APPENDIX

The test sequence for the three tested devices is shown in the table below:

																				Nb events	Cross Section	
Run	Run UCL	Component	Type of test	Configuration	Frequency (MHz)	Part #	T°	Ion	Energy (MeV)	Range (µm)	LET (MeV.cm2.mg-1)	Tilt (°)	LET Eff (MeV.cm2.mg-1)	Range eff (µm)	Flux Re (#/cm2.sec)	Time Re (s)	Time Re (h:m:s)	Fluence (#/cm2)	Run Dose (krad)	Total Dose (krad)	SEL	SEL	Comments
																						Start at 04:30am
8	211	K6R4016V1C	SEL	Static	N/A	1	25	Xe	995	73	62.5	0	62.50	73.1	12,330	811	0:13:31	1.00E+07	10.000	10.000	0	0.00E+00	Start with flux 2E3, then increase up to 1.5E4
9	212	K6R4016V1C	SEL	Static	N/A	3	25	Xe	995	73	62.5	0	62.50	73.1	15,032	157	0:02:37	2.36E+06	2.360	2.360	0	0.00E+00	Run aborted (Guard param modified while running)
10	213	K6R4016V1C	SEL	Static	N/A	3	25	Xe	995	73	62.5	0	62.50	73.1	15,060	664	0:11:04	1.00E+07	10.000	12.360	0	0.00E+00	
11	214	K6R4016V1C	SEL	Static	N/A	5	25	Xe	995	73	62.5	0	62.50	73.1	15,152	660	0:11:00	1.00E+07	10.000	10.000	0	0.00E+00	