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TID Acceptance Test of the Radiation Testbed for Memory Components (RTMC-3).

Performed at the ESTEC Co-60 Facility, Noordwijk, The Netherlands, July 2004.

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1. Introduction

This is a summary of the test data collected at ESTEC in July 2004. Main intention of this test was to verify the handling and performance of the new built test system, RTMC-3.

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2. Devices

Table 1 shows all tested devices with their markings.

Table 1: Tested Devices

Manufacturer	ID	Package	Type	Remarks
Atmel	ATM21	FP36 0.5”	AT60142-E	Sample; Rad Hard
Atmel	ATM22	FP36 0.5”	AT60142-E	Sample; Rad Hard
Atmel	ATM23	FP36 0.5”	AT60142-E	Sample; Rad Hard
Atmel	ATM24	FP36 0.5”	AT60142-E	Sample; Rad Hard
IDT	IDT31	TSOP44	IDT71V424L12PHI	
IDT	IDT32	TSOP44	IDT71V424L12PHI	
Samsung	SAM41	TSOP44	K6R4008V1D-TI10	
Samsung	SAM42	TSOP44	K6R4008V1D-TI10	

3. Test Facility

The ESTEC Co-60 irradiation facility was used for this total-dose-test. In a first step, the IDT and Samsung devices were irradiated to a dose of 22.3 krad(Si). In the second run all devices were irradiated to increase the dose by another 167.4 krad(Si). So the IDT and Samsung devices accumulated a dose of 189.7 krad(Si), while the Atmel devices collected 167.4 krad(Si). The dose rate for the first irradiation was 3689 rad(Si)/h, the rate for the second step was 3579 rad(Si)/h.

4. Test Results

Table 2: Total Dose Test Results

Manufacturer	ID	1st Error [krad(Si)]	Failure [krad(Si)]	Current Increase [krad(Si)]
Atmel	ATM21	>167.40	>167.40	-
Atmel	ATM22	>167.40	>167.40	-
Atmel	ATM23	>167.40	>167.40	-
Atmel	ATM24	128.98	>167.40	-
IDT	IDT31	110.04	>189.72	88.50
IDT	IDT32	136.46	>159.00	85.30
Samsung	SAM41	>189.72	>189.72	-
Samsung	SAM42	7.96	>130.67	-

Table 2 shows the test results in numerical form. The column “1st Error” determines at which dose the device exhibits the first stuck bit. The column “Failure” shows the dose where 1024 stuck bits are reached. The last column “Current Increase” denotes the dose where the standby current reaches its 120% mark.
Due to an erroneous current measurement the devices IDT32 and SAM42 were switched off too early, current and error recording stopped at 159 krad(Si) and 130.67 krad(Si), respectively.

As expected, the Atmel devices except ATM24 showed no errors and no current increase. ATM24 showed one stuck bit at a dose of 129 krad(Si). Fig. 3 to Fig. 6 show a small increase in operating current but no increase in standby current is remarkable.
The IDT devices show a significant increase in standby current. Unfortunately, the measurement of operating current for IDT31 is erroneous for the first 107 krad(Si), so it isn't shown in the figure.
The device SAM42 showed a few stuck bits at 8 to 10 krad(Si), which then disappeared. For the rest of the test, this device was error-free.

Fig. 1 to Fig. 8 shows the device currents over the accumulated dose in detail.

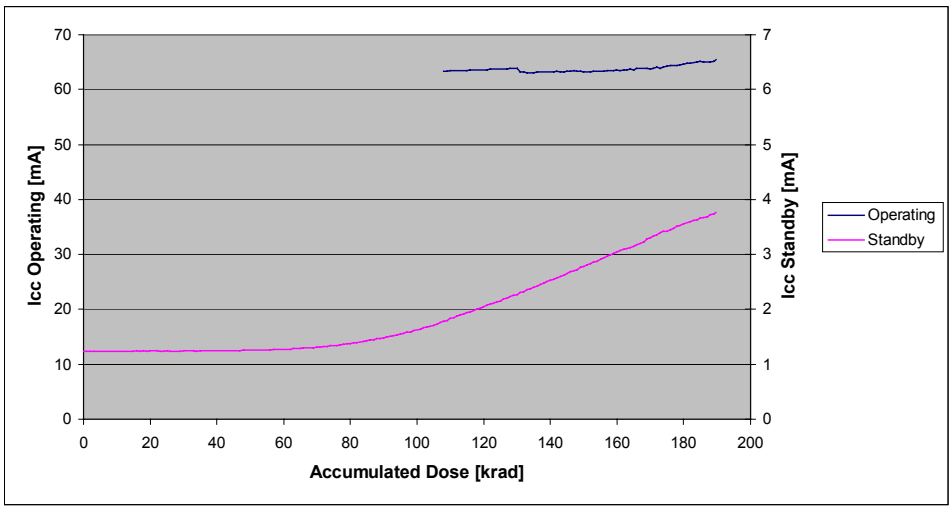

Fig. 1:Currents for IDT31

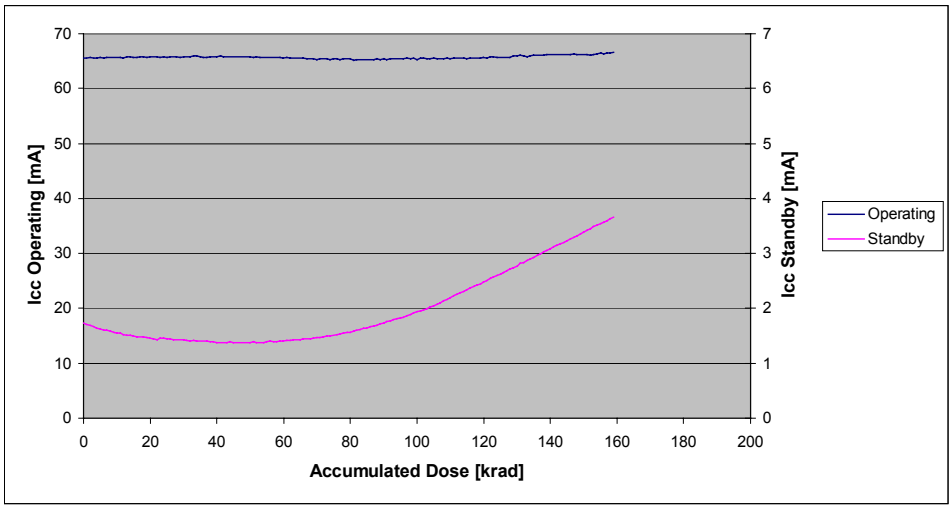

Fig. 2: Currents for IDT32

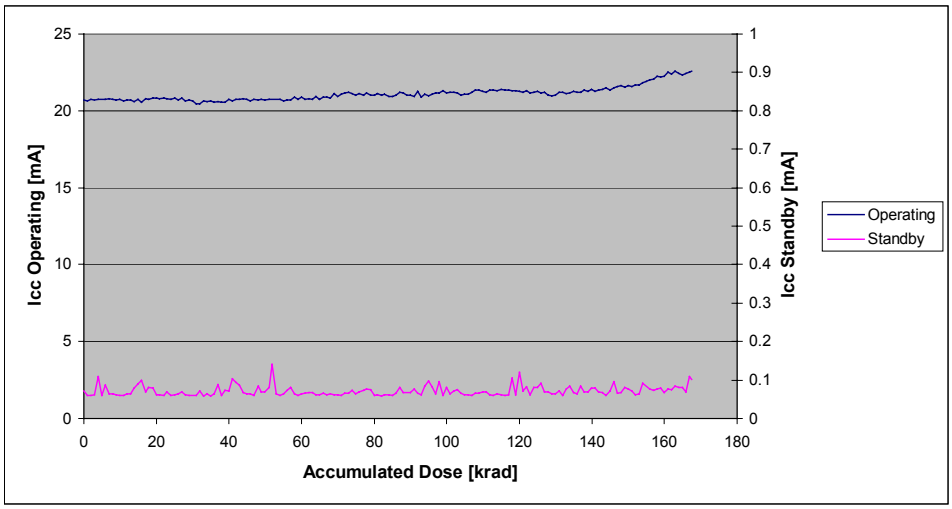

Fig. 3: Currents for ATM21

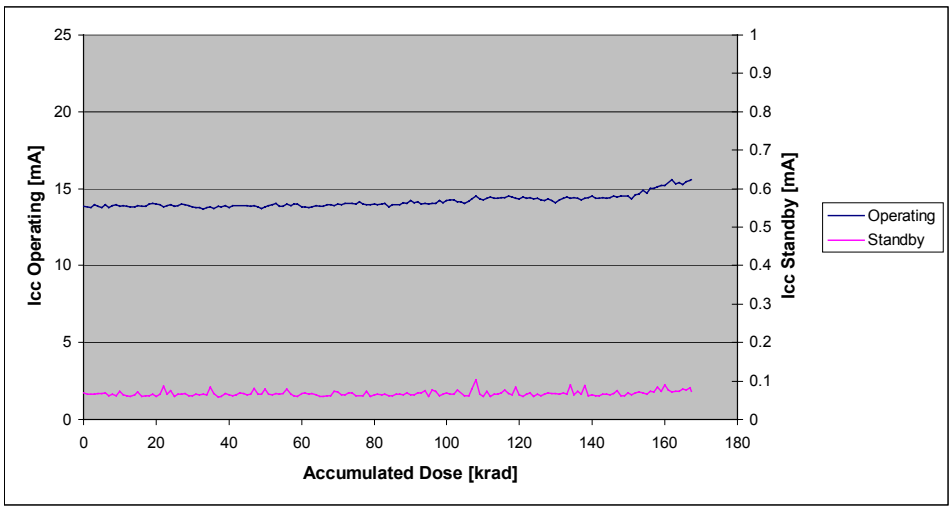

Fig. 4: Currents for ATM22

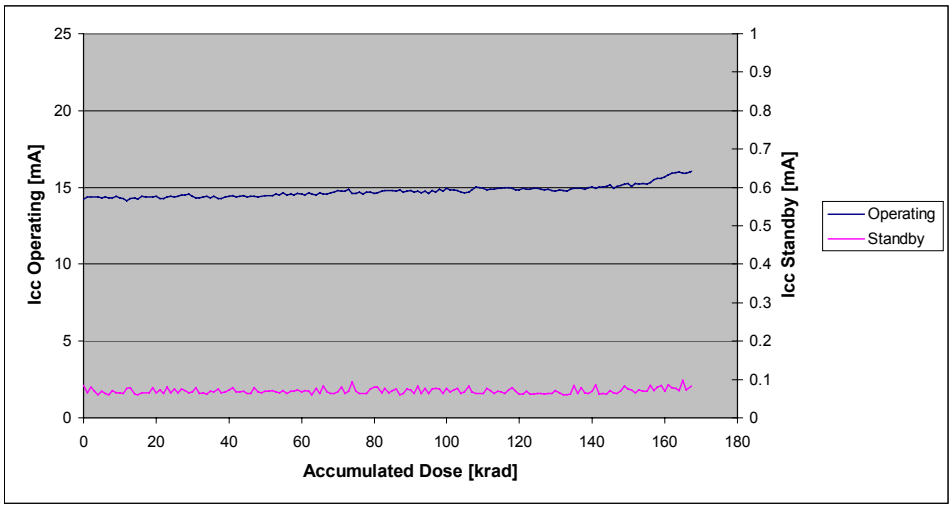

Fig. 5: Currents for ATM23

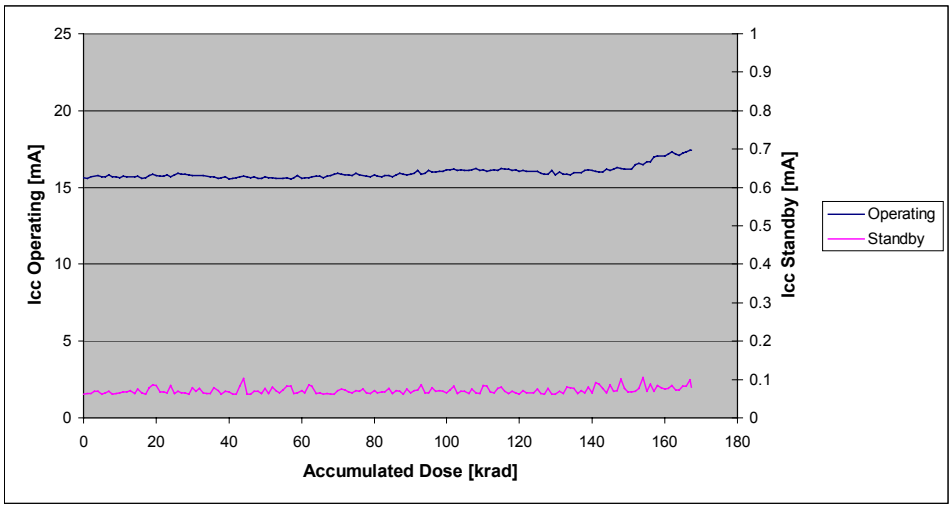

Fig. 6: Currents for ATM24

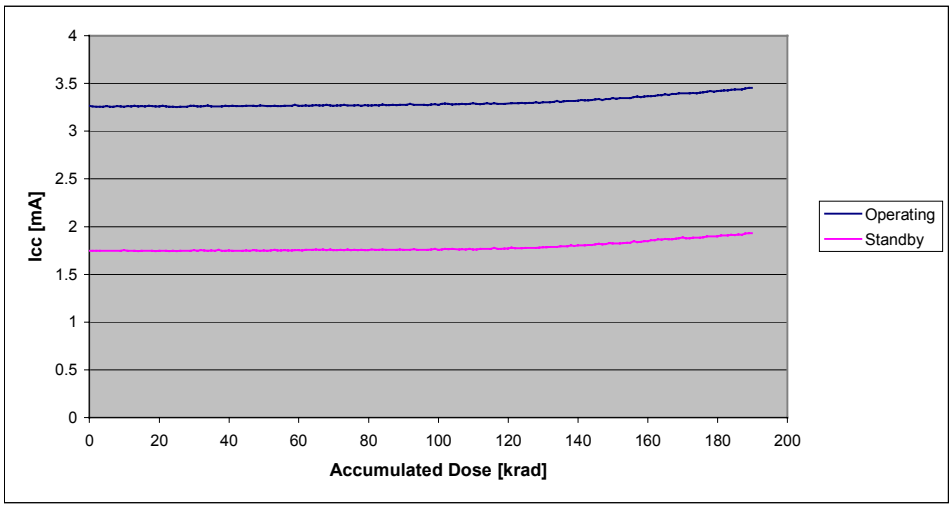

Fig. 7: Currents for SAM41

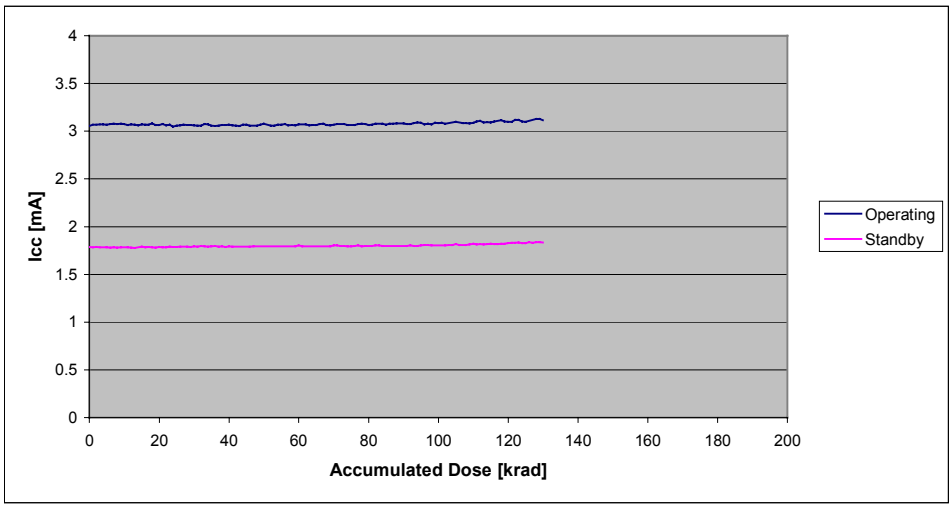

Fig. 8: Currents for SAM42

Fig. 9 to Fig. 12 shows the development of stuck bits over the accumulated dose. The devices ATM21, ATM22, ATM23 and SAM41 showed no error. The device SAM42 showed stuck bits at a dose of 8 krad(Si), which disappeared at a dose of 10 krad(Si). Then no error occurred until the end of the test.

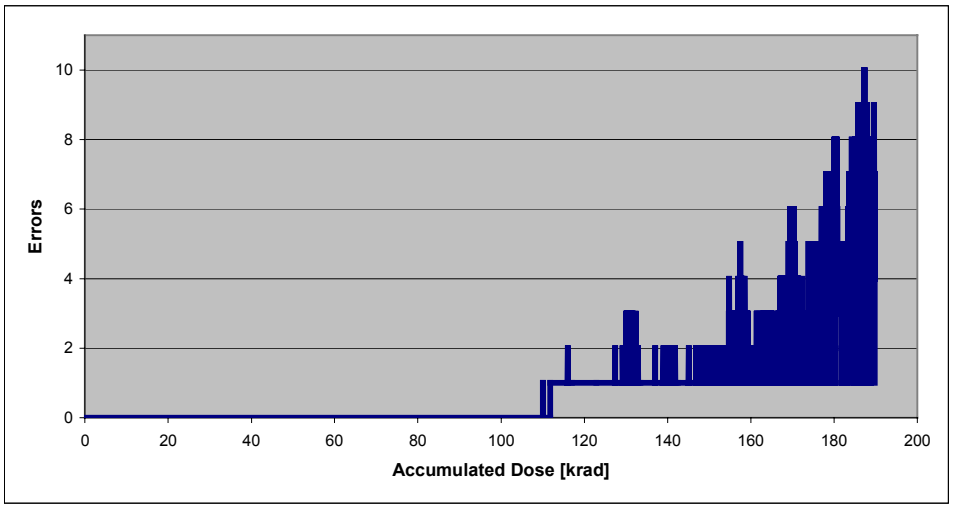

Fig. 9: Error Counts for IDT31

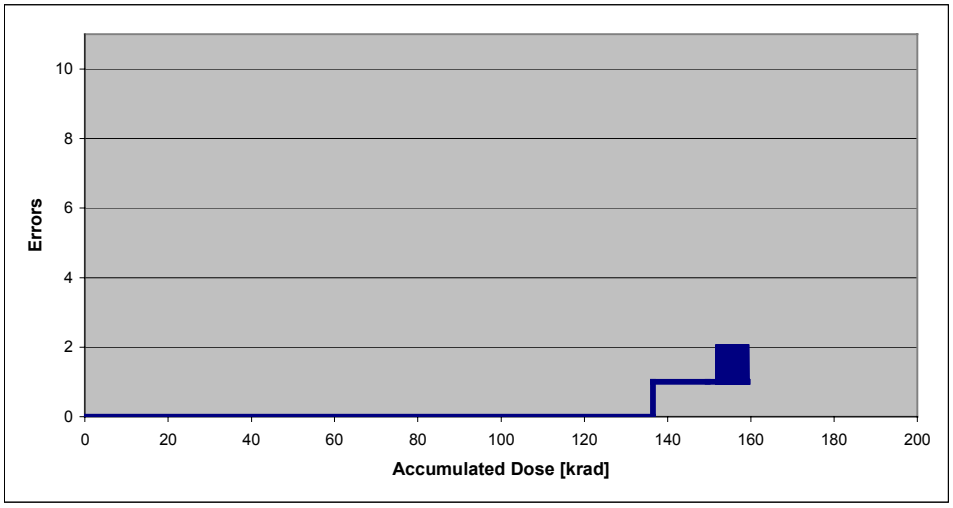

Fig. 10: Error Counts for IDT32

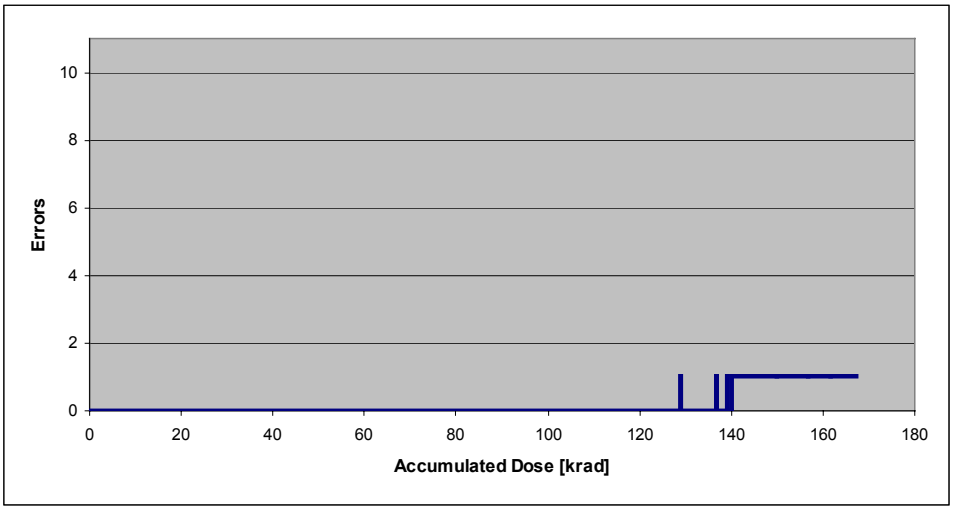

Fig. 11: Error Counts for ATM24

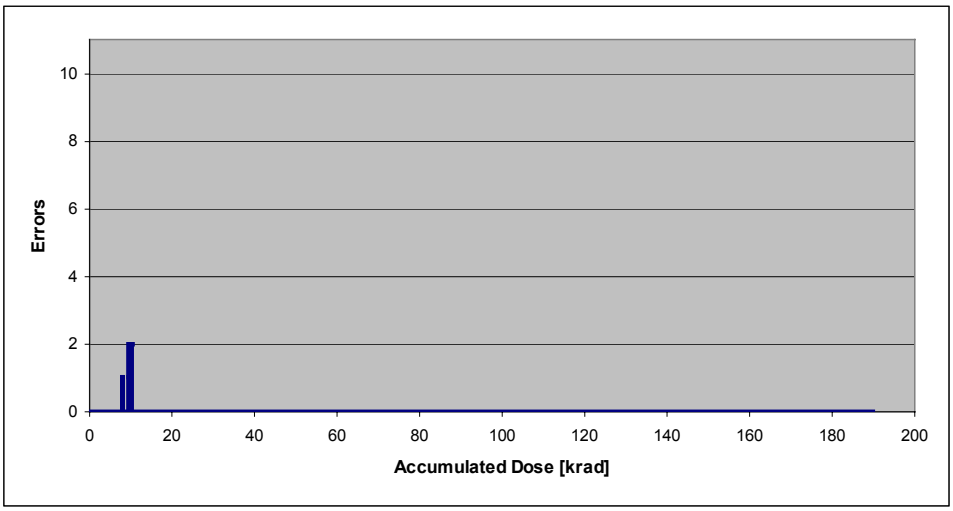

Fig. 12: Error Counts for SAM42

5. Conclusion

The Radiation Testbed (test system) worked stable over the whole test duration of 53 hours. Nevertheless, some improvements need to be done.

- Current measurement isn't synchronised with the test pattern; the test system isn't always capable of determine the operational current. Current measurement needs to be triggered in the firmware, not in the software.
- Operating the test software is too difficult. Changes have to be made to get the operating simpler.
- Current measurement displays show the current at a time of approx. 5 hours. For a quick view of the test progress, it is better to see the current development since test start. This has to be changed in the test software.
- The headstation is positioned in the middle of the headstation adapter. To gain more dose rate, it is better to assemble the headstation at the front edge of the headstation adapter.

The main purpose of this test was to evaluate the RTMC-3 memory test system so the TID data presented here should only be seen as indicative, as only a limited number of memories per device type were tested and no clear end of test reached. The used memory types were purely based on availability and to populate the headstation with different devices.