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 TO: K.Label / 735
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 SUBJECT: Radiation Report on: 64 Mbit DRAMs, 5.0V & 3.3V
 Project: EO-1
 Job #: EE71402
 Project part #s: KM48C8000AS-6, KM48V8000AS-6

PPM-97-017

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A radiation evaluation was performed on KM48C8000AS-6(64 Mbit DRAMs, 5.0 Volt) and KM48V8000AS-6(64 Mbit DRAMs, 3.3 Volt) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Figures 1 and 2, and Tables I through IV.

The total dose testing was performed using a Co⁶⁰ gamma ray source. During the radiation testing, three 5.0V parts (SN's 205, 206, and 207) and two 3.3V parts (SN's 208 and 209) were irradiated under bias (see Figure 1 for bias configuration) and one 5.0V part (SN 204) was used as a control sample. The total dose radiation levels were 2.5, 5, 7.5, 10, 15, 20, 30, 50, 75, and 100 kRads*. The dose rate was between 0.06 and 0.50 kRads/hour (see Table II for radiation schedule). After the 50 kRad irradiation, the parts were annealed under bias for 168 hours at 25°C. After each radiation exposure and the annealing step, the parts were electrically tested according to the test conditions and the specification limits** listed in Table III. The electrical tests included six functional tests. These were as follows: 1. SIMPLE FUNCTIONAL TEST (which consists of randomly accessing two addresses without using the algorithmic pattern generator), 2. COL_ADDRESS, 3. ALL_ONES, 4. ALL_ZEROS, 5. CHECKERBOARD & INVERSE CHECKERBOARD, 6. SURROUND.

KM48C8000AS-6 (64 Mbit DRAMs, 5.0-Volt)

All irradiated parts (SN's 205, 206 and 207) passed all functional and electrical tests initially and on irradiation up to 7.5 kRads. No significant degradation was observed in any DC or AC parameter.

After the 10 kRad irradiation, SN 207 failed functional test #1, a number of VIH and VIL tests, and timing parameters. The parts also showed significant increases in ICC1, ICC2, ICC3, ICC4, ICC5, ICC6, IIH, IIL, IOZH, and IOZL; however, SN's 205 and 206 passed all functional tests and showed no significant degradation in any DC or AC parameter.

After the 15 and 20 kRad irradiations, SN 207 continued to fail the same tests as after 10 kRads. SN's 205 and 206 continued to pass all tests after 15 and 20 kRads.

After the 30 kRad irradiation, SN 207 continued to fail as before. SN's 205 and 206 passed all functional tests but parts showed significant increases in ICC2 and ICC5. Both parts exceeded the specification limit of 1.0mA for ICC5 with readings of 1.69 and 1.79mA respectively.

* The term Rads, as used in this document, means Rads (SiO₂). All radiation levels cited are cumulative.

** These are manufacturer's pre-irradiation data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

After the 50 kRad irradiation, SN 207 continued to fail as before. SN's 205 and 206 passed all functional tests but parts showed similar readings in ICC2 and ICC5 as at 30 kRads.

The parts were annealed @ 25°C for 168 hours and showed no effective change in any parameter. SN 207 was removed from testing at this time due to its complete failure and lack of recovery.

After the 75 kRad irradiation, SN 206 continued to pass all functional tests but exceed the specification limit for ICC5 as before. SN 205 passed all functional tests except the first one and catastrophically failed all other parameter tests. SN 205 was removed from further testing at this time.

After the 100 kRad irradiation, SN 206 continued to pass all functional tests but exceed the specification limit for ICC5 as before.

KM48V8000AS-6 (64 Mbit DRAMs, 3.3-Volt)

Two parts (SN's 208 and 209) were tested. Both parts passed all tests initially and on irradiation up to 30 kRads. No significant degradation was observed in any DC or AC parameter.

After the 50 kRad irradiation, both parts passed all functional tests. Both parts showed significant increases in ICC2, ICC4 and ICC5. SN208 exceeded the specification limits of 1mA for ICC2, 70mA for ICC4 and 0.5mA for ICC5 with readings of 1.73mA, 90.6mA, and 1.72mA respectively. SN 209 exceeded the specification limits of ICC2 and ICC5 with readings of 1.80mA and 1.81mA respectively.

The parts were annealed @ 25°C for 168 hours and showed no significant change and in one case, increased degradation. SN208 exceeded the specification limits for ICC2, ICC4 and ICC5 with similar readings to those at 50 kRads. SN 209 failed the first functional test, exceeded the specification limits of ICC2 and ICC5, and failed one TAA_LH test with a specification limit of 30.0ns, with readings of 1.80mA, 1.81mA, and 42.5ns respectively.

After the 75 kRad irradiation, SN 208 failed functional test 1 and SN 209 failed functional tests 1, 5 and 6. SN 208 failed all parameter tests except for three out of twenty four IIL tests. SN 209 failed all parameter tests except eight out of twenty four IIL tests.

After the 100 kRad irradiation, SN 208 passed all functional tests but exceeded the specification limits for ICC2, ICC4 and ICC5 with readings similar to those after 50 kRads. SN 209 failed all functional tests except #6 and all parameter tests.

Table IV provides a summary of the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

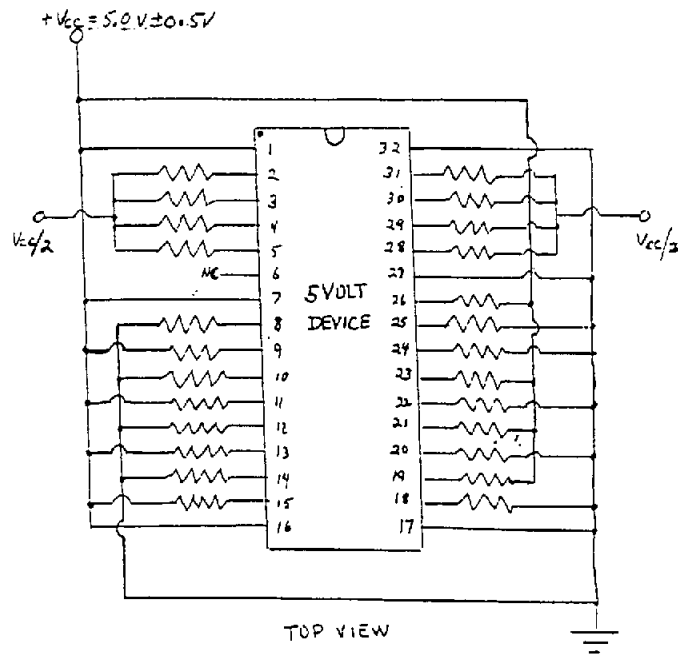
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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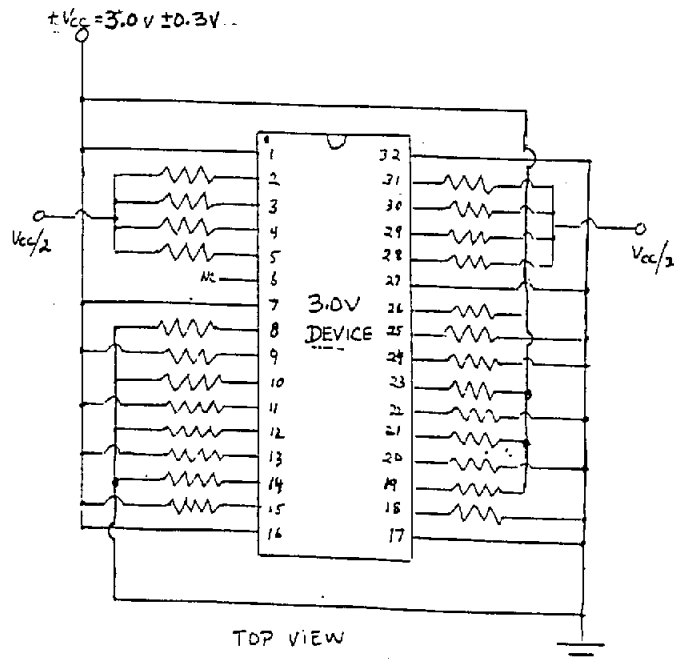
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Figure 1. Radiation Bias Circuit for KM48C8000AS-6(64 Mbit DRAMs, 5.0 Volt)



$V_{cc} = +5.0V \pm 0.5V$, $V_{cc/2} = +2.5V \pm 0.5V$, $GND = 0V \pm 0V$, $R = 2K\Omega \pm 5\%$, $\frac{1}{4} W$.

Figure 2. Radiation Bias Circuit for KM48V8000AS-6(64 Mbit DRAMs, 3.3 Volt)



$V_{cc} = +3.0V \pm 0.3V$, $V_{cc/2} = +1.5V \pm 0.3V$, $GND = 0V \pm 0V$, $R = 2K\Omega \pm 5\%$, $\frac{1}{4} W$.

TABLE I. Part Information

Generic Part Numbers:	KM48C8100AS-6, KM48V8100AS-6
Part Numbers	KM48C8100AS-6 (5.0V), KM48V8100AS-6 (3.3V)
Charge Number:	M71402
Manufacturer:	Samsung
Lot Date Codes (LDC):	none given
Quantities Tested:	4, 2
Serial Numbers of Control Samples:	204 (5.0V)
Serial Numbers of Radiation Samples:	205, 206, 207 (5.0V); 208, 209 (3.3V)
Part Function:	16 Mbit DRAM
Part Technology:	CMOS
Package Style:	32 PIN SOIC
Test Equipment:	S-50
Engineer:	A. Duvalsaint

* No radiation tolerance/hardness was guaranteed by the manufacturer for this part.

TABLE II. Radiation Schedule for KM48C8100AS-6, KM48V8100AS-6

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	04/03/97
2) 2.5 KRAD IRRADIATION (0.06 KRADS/HOUR)	04/07/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT	04/09/97
3) 5.0 KRAD IRRADIATION (0.06 KRADS/HOUR)	04/09/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	04/11/97
4) 7.5 KRAD IRRADIATION (0.06 KRADS/HOUR)	04/14/97
POST-7.5 KRAD ELECTRICAL MEASUREMENT	04/16/97
5) 10.0 KRAD IRRADIATION (0.12 KRADS/HOUR)	04/17/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	04/21/97
6) 15.0 KRAD IRRADIATION (0.12 KRADS/HOUR)	04/21/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	04/23/97
7) 20.0 KRAD IRRADIATION (0.12 KRADS/HOUR)	04/25/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	04/28/97
8) 30.0 KRAD IRRADIATION (0.25 KRADS/HOUR)	04/28/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	04/30/97
9) 50.0 KRAD IRRADIATION (0.50 KRADS/HOUR)	04/30/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	05/05/97
10) 168-HOUR ANNEALING @25°C	05/05/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	05/12/97
11) 75.0 KRAD IRRADIATION (0.50 KRADS/HOUR)	05/15/97
POST-75.0 KRAD ELECTRICAL MEASUREMENT	05/19/97
12) 100.0 KRAD IRRADIATION (0.50 KRADS/HOUR)	05/19/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT	05/23/97

Effective dose rate = 100,000 RADS/47 DAYS = 88.7 RADS/HOUR = 0.025 RADS/SEC.

 All parts were irradiated and annealed under bias. See Figure 1

Table IIIa: Electrical Characteristics of KM48C8100AS-6 (5.0V)

PART NO : M48C8100AS-6		PART TYPE : 8MX8 64MBITS CMOS DYNAMIC RAM		PCN : S110793A		
LOCATION		TEST SPECIFICATIONS				
DIPLCTORY : [LIBRARY.793]		SAMSUNG		DATA SHEETS		
FUNCTIONAL TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C
FUNCT # 1	5.0V	0.0V	5.0V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 2	5.0V	0.0V	5.0V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 3	5.0V	0.0V	5.0V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 4	5.0V	0.0V	5.0V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 5	5.0V	0.0V	5.0V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 6	5.0V	0.0V	5.0V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
DC PARAMETRIC TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C
VIH-4.5V	4.5V	N/A	N/A	FREQ= 5MHZ	INS	>+0.0V / <+2.4V
VIH-5.5V	5.5V	N/A	N/A	FREQ= 5MHZ	INS	>+0.0V / <+2.4V
VIL-4.5V	4.5V	N/A	N/A	FREQ= 5MHZ	INS	>-1.0V / <+2.0V
VIL-5.5V	5.5V	N/A	N/A	FREQ= 5MHZ	INS	>-1.0V / <+2.0V
IIH	5.5V	0.0V	5.8V	VIN = 5.8V	INS	>- 5.0UA / <+ 5.0UA
IIL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>- 5.0UA / <+ 5.0UA
IOZH	5.5V	0.0V	5.5V	VOUT = 0.0V	OUTS	>- 5.0UA / <+ 5.0UA
IOZL	5.5V	0.0V	5.5V	VOUT = 0.0V	OUTS	>- 5.0UA / <+ 5.0UA
ICCC1	5.5V	0.0V	5.5V	FRQ=1/TRC MIN	VCC	> 0.0MA / <+140.0MA
ICCC2	5.5V	0.0V	5.5V	STAND-BY	VCC	> 0.0MA / <+ 2.0MA
ICCC3	5.5V	0.0V	5.5V	FRQ=1/TRC MIN	VCC	> 0.0MA / <+140.0MA
ICCC4	5.5V	0.0V	5.5V	FRQ=1/TPC MIN	VCC	> 0.0MA / <+70.0MA
ICCC5	5.5V	0.0V	5.5V	STAND-BY	VCC	> 0.0MA / <+ 1.0MA
ICCC6	5.5V	0.0V	5.5V	FRQ=1/TRC MIN	VCC	> 0.0MA / <+140.0MA
AC PARAMETRIC TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	OUTPINS	LIMITS 25C
TAA_LH	4.5V	0.0V	3.0V	F=5.0MHZ, VCMP=1.5V	OUTS	> 0NS / < 30NS
TAA_HL	4.5V	0.0V	3.0V	F=5.0MHZ, VCMP=1.5V	OUTS	> 0NS / < 30NS
COMMENTS/EXCEPTIONS						
(1) FUNCTIONAL TESTS ARE PERFORMED AT VCC = 5.0V ONLY						
(2) FUNCTIONAL TESTS CONSIST OF THE FOLLOWING PATTERNS :						
1 - SIMPLE FUNCTIONAL TEST						
2 - COL ADDRESS						
3 - ALL ONES						
4 - ALL ZEROS						
5 - CHECKERBOARD & INVERSE CHECKERBOARD						
6 - SDRROUND						
(3) VIL & VIH WERE TESTED DYNAMICALLY DURING FUNCTIONAL TESTING						
(4) VOL & VOL WERE TESTED DYNAMICALLY DURING SPLIT TESTING						
(5) AC TESTS NOT PERFORMED OR DONE GO/NOGO :						
- ONLY ADDRESS ACCESS TIME PROP. DELAYS WERE PERFORMED (TAA TESTS).						
- ALL OTHER AC TESTS ARE NOT BEING PERFORMED WITHIN THIS PROGRAM.						
(6) THIS PROGRAM TESTS FOR CONTINUITY TEST.						
HARDWARE REQUIREMENTS			TEST TEMPERATURES			
DEVICE CONFIGURATION : 32 PIN TSOP PACKAGE			+25 DEG. C. \X\			
S-50 LOAD BOARD # : LOAD BOARD# 49 CUSTOM			-55 DEG. C. \ \			
			+125 DEG. C. \ \			
PROGRAMMER : S. ARCHER-DAVIES			DATE : 03-31-97			

Table IIIb: Electrical Characteristics of KM48V8100AS-6 (3.3V)

PART NO : M48V8100AS-6		PART TYPE : 8MX8 64MBITS CMOS DYNAMIC RAM		PCN : SI10795A		
LOCATION		TEST SPECIFICATIONS				
DIRECTORY : [LIBRARY.795]		SAMSUNG DATA SHEETS				
FUNCTIONAL TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C
FUNCT # 1	3.3V	0.0V	3.3V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 2	3.3V	0.0V	3.3V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 3	3.3V	0.0V	3.3V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 4	3.3V	0.0V	3.3V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 5	3.3V	0.0V	3.3V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V
FUNCT # 6	3.3V	0.0V	3.3V	FREQ= 5.000MHZ	ALL I/O	VOL<1.0V / VOH>2.0V

DC PARAMETRIC TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C
VIH	3.0V	N/A	N/A	FREQ= 5MHZ	INS	>+0.0V / <+2.4V
VIL	3.0V	N/A	N/A	FREQ= 5MHZ	INS	>+0.0V / <+2.4V
VIL	3.0V	0.0V	N/A	FREQ= 5MHZ	INS	>-1.0V / <+2.0V
VIL	3.0V	0.0V	N/A	FREQ= 5MHZ	INS	>-1.0V / <+2.0V
IIH	3.0V	0.0V	3.9V	VIH = 3.9V	INS	>- 5.0UA / <+ 5.0UA
IIH	3.0V	0.0V	3.6V	VIH = 3.6V	INS	>- 5.0UA / <+ 5.0UA
IOZH	3.0V	0.0V	3.6V	VOUT = 3.6V	OUTS	>- 5.0UA / <+ 5.0UA
IOZH	3.0V	0.0V	3.6V	VOUT = 0.0V	OUTS	>- 5.0UA / <+ 5.0UA
ICCC1	3.0V	0.0V	3.6V	FRQ=1/TPC	MIN VCC	> 0.0MA / <+140.0MA
ICCC2	3.0V	0.0V	3.6V	STAND-BY	VCC	> 0.0MA / <+ 1.0MA
ICCC3	3.0V	0.0V	3.6V	FRQ=1/TRC	MIN VCC	> 0.0MA / <+140.0MA
ICCC4	3.0V	0.0V	3.6V	FRQ=1/TPC	MIN VCC	> 0.0MA / <+70.0MA
ICCC5	3.0V	0.0V	3.6V	STAND-BY	VCC	> 0.0MA / <+500UA
ICCC6	3.0V	0.0V	3.6V	FRQ=1/TRC	MIN VCC	> 0.0MA / <+140.0MA

AC PARAMETRIC TESTS						
PARAMETER	VCC	VIL	VIH	CONDITIONS	OUTPINS	LIMITS 25C
TAA_LH	3.0V	0.0V	3.0V	F=5.0MHZ, VCMP=1.5V	OUTS	> 0NS / < 30NS
TAA_HL	3.0V	0.0V	3.0V	F=5.0MHZ, VCMP=1.5V	OUTS	> 0NS / < 30NS

COMMENTS/EXCEPTIONS

(1) FUNCTIONAL TESTS ARE PERFORMED AT VCC = 3.0V ONLY

(2) FUNCTIONAL TESTS CONSIST OF THE FOLLOWING PATTERNS :

- 1 - SIMPLE FUNCTIONAL TEST
- 2 - COL ADDRESS
- 3 - ALL-ONES
- 4 - ALL-ZEROS
- 5 - CHECKERBOARD & INVERSE CHECKERBOARD
- 6 - SURROUND

(3) VIL & VIH WERE TESTED DYNAMICALLY DURING FUNCTIONAL TESTING

(4) VOL & VOH WERE TESTED DYNAMICALLY DURING SPLOT TESTING

(5) AC TESTS NOT PERFORMED OR DONE G3/NOG3 :

- ONLY ADDRESS ACCESS TIME PROP. DELAYS WERE PERFORMED (TAA TESTS).
- ALL OTHER AC TESTS ARE NOT BEING PERFORMED WITHIN THIS PROGRAM.

(6) THIS PROGRAM TESTS FOR CONTINUITY TEST.

HARDWARE REQUIREMENTS		TEST TEMPERATURES	
DEVICE CONFIGURATION :	32 PIN TSOP PACKAGE	+25 DEG. C.	
S-50 LOAD BOARD # :	LOAD BOARD# 49 CUSTOM	-55 DEG. C.	
		+125 DEG. C.	
PROGRAMMER :	S. ARCHER-DAVIES	DATE : 04-03-97	

TABLE IVa: Summary of Electrical Measurements after Total Dose Exposures and Annealing for KM48C8100AS-6, 5.0V part (see Notes 1-5 below)

Functional Tests /2 /3	Total Dose (kRad/s)										Annealing		Total Dose (kRad/s)				
	Initial		10	15	20	30	50	168 hrs @25°C	75 /5	100 /6							
	Spec. Lim./4	Units	min	max													
V _{OH} MIN_4.5V	V	0	2.4	2.3	0.02	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	1P	
V _{IH} MIN_5.5V	V	0	2.4	2.37	0.01	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	1P	
V _{IL} MAX_4.5V	V	-1.0	2.0	0.82	0.23	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	1P	
V _{IL} MAX_5.5V	V	-1.0	2.0	0.0	0.0	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	2P/IF	1P	
I _{OH}	μA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
I _{IL}	μA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
I _{OZH}	μA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
I _{OZL}	μA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
I _{CC1}	mA	0	140	92.3	2.3	51.9	0.40	51.8	0.36	51.7	0.21	51.9	0.3	50.7	0.3	50.7	0.5
I _{CC2}	μA	0	2000	79.6	40.4	72.5	43.1	72.5	43.1	72.6	41.7	1760	135	1670	22	1652	22
I _{CC3}	mA	0	140	91.3	2.5	51.8	0.64	51.6	0.25	51.6	0.25	51.8	0.8	50.4	0.5	50.3	0.3
I _{CC4}	mA	0	70	37.6	34.5	31.6	0.4	31.6	0.4	31.5	0.23	30.8	0.11	28.6	0.7	29.0	0.2
I _{CC5}	μA	0	1000	82.6	35.2	72.5	43.1	68.1	49.5	72.5	43.1	1756	124	1661	22	1644	22
I _{CC6}	mA	0	140	92.3	2.5	52.1	0.1	51.6	0.36	51.6	0.36	52.2	0.7	50.8	0.7	50.6	0.5
TAA_LH	ns	0	30.0	21.3	0.10	2P/IF		2P/IF		2P/IF		2P/IF		2P/IF		2P/IF	
TAA_HL	ns	0	30.0	20.5	0.20	2P/IF		2P/IF		2P/IF		2P/IF		2P/IF		2P/IF	

- 1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing.
- 2/ The control samples remained constant throughout the testing are are not included in this table.
- 3/ "P" indicates that all parts passed this test at this irradiation or annealing level. "F" indicates that all parts failed this test at this irradiation or annealing level. "nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.
- 4/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.
- 5/ SN 207 was pulled before this exposure level due to its total failure.
- 6/ Only SN 205 was irradiated to this level.

TABLE IVb: Summary of Electrical Measurements after Total Dose Exposures and Annealing for KM48V8100AS-6, 3.3 V part (see Notes 1-5 below)

Functional Tests (2/3)	Total Dose Exposure (kRads)													Annealing		Total Dose (kRads)									
	Initial	5	7.5	10	15	20	30	50	75	100	168hrs @25°C	75	100	168hrs @25°C	75	100									
Vcc=3.3V, Vih=0.0V, Vih=3.3V, Freq=5MHz	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P								
Vcc=3.3V, Vil=0.0V, Vil=3.3V, Freq=5MHz	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P								
Vcc=3.3V, Vih=0.0V, Vih=3.3V, Freq=5MHz	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P								
Vcc=3.3V, Vil=0.0V, Vil=3.3V, Freq=5MHz	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P								
Vcc=3.3V, Vih=0.0V, Vih=3.3V, Freq=5MHz	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P								
Vcc=3.3V, Vil=0.0V, Vil=3.3V, Freq=5MHz	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P								
Parameters	Units	min	max																						
Vih_MIN_4.5V	V	0	2.4	1.74	0.20	1.72	0.15	1.75	0.14	1.74	0.12	1.74	0.15	1.74	0.15	1.74	0.15	1.72	0.05	1.69	0.07	2F	2F	1P/1F	
Vih_MIN_5.5V	V	0	2.4	1.95	0.14	1.94	0.15	1.96	0.14	1.96	0.13	1.97	0.11	1.97	0.13	1.96	0.02	1.96	0.02	1.92	0.07	2F	2F	1P/1F	
Vil_MAX_4.5V	V	-1.0	2.0	0.14	0.07	0.16	0.11	0.12	0.13	0.20	0.17	0.22	0.19	0.23	0.15	0.44	0.1	0.44	0.1	0.74		2F	2F	1P/1F	
Vil_MAX_5.5V	V	-1.0	2.0	0.54	0.04	0.56	0.08	0.56	0.12	0.55	0.10	0.59	0.24	0.54	0.05	0.69	0.03	0.69	0.03	0.49	0.3	2F	2F	1P/1F	
Iih	µA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iil	µA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iozh	µA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Iozl	µA	-5.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ICC1	mA	0	140	77.1	1.1	78.1	0.3	78.4	0.2	78.6	0.7	78.9	0.5	78.1	0.9	80.8	1.6	79.7	2.7	79.7	2.7	2F	2F	1P/1F	
ICC2	µA	0	1000	33.0	0.0	28.5	4.5	85.2	33.4	28.5	4.5	28.5	5.5	28.5	4.5	1762	35	1749	40	1749	40	2F	2F	1P/1F	
ICC3	mA	0	140	75.5	0.6	77.5	0.21	78.1	0.2	77.6	0.6	78.0	0.5	77.5	0.8	80.0	1.5	78.9	3.3	78.9	3.3	2F	2F	1P/1F	
ICC4	mA	0	70	30.3	0.1	30.2	0.03	31.4	0.6	30.4	0.1	30.3	0.1	29.8	0.6	66.7	24	90.0	38	90.0	38	2F	2F	2F	
ICC5	µA	0	500	28.5	4.5	33.0	0.0	28.5	3.1	28.5	4.5	30.3	0.1	28.5	4.5	1762	44	1745	36	1745	36	2F	2F	2F	
ICC6	mA	0	140	76.1	0.5	77.6	0.31	78.6	0.3	78.6	0.5	78.7	0.4	78.3	0.7	80.9	2.0	79.0	3.6	79.0	3.6	2F	2F	1P/1F	
TAA_LH	ns	0	30.0	19.5	0.3	19.5	0.2	19.8	0.2	19.6	0.1	19.5	0.2	19.1	0.3	20.1	0.6	21.8	5.2	21.8	5.2	2F	2F	1P/1F	
TAA_HL	ns	0	30.0	22.3	1.5	22.1	1.3	21.9	1.4	22.3	1.4	22.5	1.5	20.9	1.7	23.4	2.2	23.5	2.1	23.5	2.1	2F	2F	1P/1F	

1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing.

2/ The control samples remained constant throughout the testing are not included in this table.

3/"p" indicates that all parts passed this test at this irradiation or annealing level. "nPmF" indicates that n parts failed this test at this irradiation or annealing level. "nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.

4/ No reliable measurements could be obtained for this test at this level.

5/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.