PPM - 91 - 696

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UNISYS

(87)

Interoffice Memorandum

PPM-91-696

To
A. Sharma
Department
Code 716
From
K. Sahu KS
Department
7809

Subject
Radiation Report on GPEP/PPL
Part No. S128K8L-55MC
(128k x 8 SRAM)

Date
November 21, 1991
Location
GSFC
Telephone
731-8954
Location
Lanham
cc
S. Archer-Davies
T. Perry

A radiation evaluation was performed on S128K8L-55MC to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through V and Figure 1.

The total dose testing was performed on twelve parts using a cobalt-60 gamma ray source, while three parts were used as control samples. The twelve irradiated parts were separated into three test groups of four parts each, in order to test the effect of different biasing conditions on the parts during irradiation. Test Groups 1 and 2 (TG1 and TG2) were biased during irradiation using the circuit in Figure 1 with SW1 in the Static 1 and 2 positions, respectively. Test Group 3 (TG3) was left unbiased during irradiation. The total dose radiation steps for each group were 5, 10, 20, 40 and 80 krads*. The dose rate was between 0.3 - 1.2 krads/hour, depending on the total dose level (see Table II for radiation schedule). After 80 krads, parts were annealed for 24 and 192 hours at 25°C. After each radiation exposure and annealing treatment, parts were electrically tested at 25°C, according to the test conditions and the specification limits listed in Table III. After the final annealing treatment, electrical measurements were also made at high and low temperature (125°C, -55°C).

Six functional[1/] tests were also performed on all parts after each radiation exposure and annealing treatment (see Table III and the notes that follow). Functional tests #1, #3 and #5 (at 10 MHz, 5 MHz and 2 MHz, respectively) consisted of writing and reading the following patterns: all ones, all zeros, checkerboard and inverse checkerboard. Functional tests #2 and #4 (at 10 MHz and 5 MHz, respectively) used the following test patterns: "1 On" march, row address, column address, sliding diagonally, ping-pong, surround, row galpat, and column galpat. Functional Test #6 consisted of writing a checkerboard pattern to the parts, reducing the VCC voltage from 5V to 2V for 55ns and then reading the pattern from the parts at 1MHz. This test is also referred to as a data retention test.

During initial electrical measurements, nine of the fifteen parts failed functional tests #2 and #4 at 5 and 10 MHz; however, all

parts, except one from TG2, passed all other functional tests. After the first radiation exposure of 5 krads, parts from TG3 continued to pass functional tests 1,3,5, and 6; however, parts from test groups 1 and 2 (parts that were biased during irradiation) showed a higher number of functional failures - all parts in TG2 failed all functional testing, and some parts in TG1 failed all tests - except functional test #5, which was performed at a lower frequency (2 MHz). After 10 krads, all parts from TG1 and TG2 failed all functional testing, although most of the parts from TG3 continued to pass functional tests 1,3,5 and 6. At 30 krads and above, all parts from the three test groups failed all functional tests. For details of functional test results, refer to Table VI.

All parts from the three test groups passed all parametric testing to 40 krads. Parts from TG3 passed all parametric tests at 25°C throughout the radiation testing; however, at 80 krads, parts from the other two test groups failed VIH, VIL, VOH, VOL tests at 25°C, and parts from TG2 failed some AC timing tests at 25°C.

During low temperature (-55°C) measurements after 192 hours of annealing, parts from TG1 and TG2 failed VIH and VIL tests. During high temperature (125°C) measurements after 192 hours of annealing, current measurements drastically increased for all three test groups for the following test parameters: ISBL/H, ICCDR and ICCX. ICCX currents for parts in TG1 and TG2 exceeded the measurement limit of the test equipment. Although, current readings for parts in TG3 were way beyond the specification limit for ICCX, the readings were much lower than those for parts in TG1 and TG2. Also, parts from all three test groups failed VIH and VIL tests and AC timing measurements could not be made. Parts from TG2 also failed VOH tests.

Table IV provides the mean and standard deviation values for each test parameter after each radiation exposure and annealing treatment, separated by test group. Table V provides this data for electrical measurements performed at low and high temperature after the final annealing treatment. Table VI provides a summary of functional test results for the three test groups.

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

* In this report, the term "rads" is used as an abbreviation for rads (Si).

1/ The test vectors for the functional tests were generated using the Algorithmic Pattern Generator (APG).

TABLE I. Part Information

Generic Part Number:	S128K8L
GPEP/PPL Part Number:	S128K8L-55MC
GPEP/PPL Control Number:	4100
Charge Number:	C14070
Manufacturer:	Inova MicroElectronics
Lot Date Code:	9104E
Quantity Tested:	15
Serial Numbers of Radiation Samples:	8, 9, 16, 20 (TG1) 3, 5, 6, 7 (TG2) 17, 21, 24, 25 (TG3)
Serial Numbers of Control Samples:	4, 22, 23
Part Function:	128k x 8 SRAM
Part Technology:	CMOS
Package Style:	32-Pin DIP
Test Engineer:	J. Lander

TABLE II. Radiation Schedule for S128K8L-55MC

EVENTS	DATE
1) Initial Electrical Measurements	08/09/91
2) 5 krads irradiation @ 260 rads/hr	08/12/91
Post 5 krads Electrical Measurements	08/13/91
3) 10 krads irradiation @ 260 rads/hr	08/13/91
Post 10 krads Electrical Measurements	08/14/91
4) 20 krads irradiation @ 500 rads/hr	08/14/91
Post 20 krads Electrical Measurements	08/15/91
5) 40 krads irradiation @ 1200 rads/hr	08/15/91
Post 40 krads Electrical Measurements	08/16/91
6) 80 krads irradiation @ 600 rads/hr	08/16/91
Post 80 krads Electrical Measurements	08/19/91
7) 24 hour annealing	08/19/91
Post 24 hr Electrical Measurements	08/20/91
8) 192 hour annealing	08/19/91
Post 192 hr Electrical Measurements	08/27/91

Notes:

- All parts were radiated at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C, except for the 192 hour annealing electrical measurements, which were performed at 25°C, -55°C, and 125°C.
- Annealing performed at 25°C under bias.

Table III. Electrical Characteristics of S128K8L-55MC

FUNCTIONAL TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C,-55C & 125C
FUNCT # 1	5.0V	0.0V	5.0V	FREQ = 10 MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 2	5.0V	0.0V	5.0V	FREQ = 10 MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 3	5.0V	0.0V	5.0V	FREQ = 5 MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 4	5.0V	0.0V	5.0V	FREQ = 5 MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 5	5.0V	0.0V	5.0V	FREQ = 2 MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 6	5.0V	0.0V	5.0V	FREQ = 1 MHz	ALL I/O	VOL<1.5V , VOH>1.5V

DC PARAMETRIC TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C,-55C & 125C
VIH_5.5V	5.5V	0.0V	0.8V	FREQ= 1MHZ	INS	> 0.0V , <+2.2V
VIL_4.5V	4.5V	2.2V	4.5V	FREQ= 1MHZ	INS	>+0.8V , <+5.5V
VOH1	4.5V	0.8V	2.2V	LOAD= -4MA	OUTS	>+2.4V , <+5.5V
VOH2	4.5V	0.0V	4.5V	LOAD= -4MA	OUTS	>+2.4V , <+5.5V
[illegible]1	4.5V	0.8V	2.2V	LOAD= +8MA	OUTS	> 0.0V , <+0.4V
[illegible]2	4.5V	0.0V	4.5V	LOAD= +8MA	OUTS	> 0.0V , <+0.4V
IIH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	> 0.0UA , <+10UA
IIL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>-10UA , < 0.0UA
ILOH	5.5V	0.0V	5.5V	VOUT= 5.5V	OUTS	>-10UA , <+10UA
ILOL	5.5V	0.0V	5.5V	VOUT= 0.0V	OUTS	>-10UA , <+10UA
ISBL_TTL	5.5V	0.8V	2.2V	CS+OE=2.2V	VCC	> 0.0MA , <+25MA
ISBH_TTL	5.5V	0.8V	2.2V	CS+OE=2.2V	VCC	> 0.0MA , <+25MA
ISBL_CMS	5.5V	0.0V	5.3V	CS+OE=2.2V	VCC	> 0.0MA , <+10MA
ISBH_CMS	5.5V	0.0V	5.3V	CS+OE=2.2V	VCC	> 0.0MA , <+10MA
ICCDR	2.0V	0.2V	1.8V	CS+OE+WE=1.8V	VCC	> 0.0UA , <+1.0MA
ICCX	5.5V	0.0V	5.3V	F=1MHZ,1K BLK	VCC	> 0.0MA , <+10MA
ICCD	5.5V	0.0V	5.5V	FRQ=18.2MHZ	VCC	> 0.0MA , <+115MA

AC PARAMETRIC TESTS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS 25C,-55C & 125C
TAA1_LH	4.5V	0.0V	3.0V	F=1.0MHz,VCMP=1.5V	OUTPUTS	> 0ns , < 55ns
TAA1_HL	4.5V	0.0V	3.0V	F=1.0MHz,VCMP=1.5V	OUTPUTS	> 0ns , < 55ns
TAA2_LH	5.5V	0.0V	3.0V	F=1.0MHz,VCMP=1.5V	OUTPUTS	> 0ns , < 55ns
TAA2_HL	5.5V	0.0V	3.0V	F=1.0MHz,VCMP=1.5V	OUTPUTS	> 0ns , < 55ns

Notes for Table III

(1) FUNCTIONAL TESTS ARE PERFORMED AT VCC=5.0V ONLY.

(2) FUNCTIONAL TESTS #1, #3 & #5 CONSISTS OF THE FOLLOWING PATTERNS :

1 - ALL_ONES	2 - ALL_ZEROS
3 - CHECKERBOARD	4 - INVERSED CHECKERBOARD

(3) FUNCTIONAL TESTS #2 & #4 CONSISTS OF THE FOLLOWING APG PATTERNS :

1 - "10N" MARCH	2 - ROW_ADDRESS
3 - COL_ADDRESS	4 - SLIDING_DIAGONALLY
5 - PING_PONG	6 - SURROUND
7 - ROW_GALPAT	8 - COL_GALPAT

(4) FUNCTIONAL TESTS #6 CONSISTS OF THE FOLLOWING :
- WRITE CHECKERBOARD (ALL ADDRESSES)
- REDUCE VCC TO 2.0V TO PERFORM DATA RETENTION TEST.
- WAIT 55nS AT VCC = 2.0V
- INCREASE VCC BACK TO 5.0V
- READ CHECKERBOARD (ALL ADDRESSES)

(5) VIL & VIH WERE TESTED DYNAMICALLY @ 1MHZ FUNCTIONAL AND GO/NOGO DURING VOL & VOH DC TESTS.

(6) ICCX : STAND BY QUIESCENT CURRENT MEASUREMENT FOR EVERY 1024 ADDRESS LOCATIONS. CONSIST OF THE FOLLOWING PROCEDURE :
(a) - WRITE ZEROES (ALL ADDRESSES).
(b) - WRITE ONES TO THE FIRST 1024 ADDRESSES.
(c) - PERFORM AN ICCSB MEASUREMENTS.
(d) - WRITE ZEROES TO THE FIRST 1024 ADDRESSES.
(e) - REPEAT STEPS (b)-)(d) FOR THE NEXT 1024 ADDRESSES AND SO ON, FOR A TOTAL OF 128 READINGS (128K ADDRESSES).

(7) TESTS NOT PERFORMED :
- CIN , CCLKL & COUT TEST.
- WRITE/READ CYCLE TIMING PERFORMED GO/NOGO @ 10.0MHz (FUNCT #1 & #2).
- ONLY ADDRESS ACCESS TIME PROP. DELAYS WERE PERFORMED (TAA TESTS).
- ALL OTHER AC TESTS ARE NOT BEING PERFORMED WITHIN THIS PROGRAM.

(8) THIS PROGRAM TESTS FOR CONTINUITY AND ORIENTATION TESTS. ALSO THIS PROGRAM WILL PERFORM AN OPPOSITE STATE VOL & VOH TEST.

TABLE IV: Summary of El   al Measurements after
Total Dose Exposures and Annealing for S128K8L-55MC 1/

Group 1 - Static 1, Biased

Parameters		Spec. Limits		Pre-Irradiation		Total Dose Exposure (krads)										Annealing			
						5		10		20		40		80		24 hrs		192 hrs	
		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VIH. min	V	0	2.2	1.78	.03	1.72	.01	1.73	.04	1.65	.01	1.60	.01	4.58	1.6	5.51	0	3.53	2.0
VIL. max	V	0.8	5.5	1.35	.03	1.33	.01	1.33	.03	1.14	.02	1.06	.02	0	0	0	0	0.6	0.6
VOH1	V	2.4	5.5	3.83	0.1	3.83	0.1	3.79	0.1	3.82	0.1	3.60	0.9	0.2	.01	0.2	.01	2.1	2.0
VOH2	V	2.4	5.5	4.11	.04	4.10	.04	4.09	.05	4.10	.04	3.49	1.4	0.2	.01	0.2	.01	1.3	1.8
VOL1	mV	0	400	237	7	239	7	236	6	238	7	237	5	239	7	238	5	239	6
VOL2	mV	0	400	236	7	238	7	236	6	237	7	236	5	238	7	238	6	239	6
IIH	uA	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIL	uA	-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ILDH	uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ILDL	uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ISBL_TTL	mA	0	25	2.2	.09	2.3	.07	3.0	0.2	2.8	0.1	2.8	0.1	3.0	0.1	2.7	0.1	1.3	.08
ISBH_TTL	mA	0	25	2.0	.08	2.0	0.1	2.67	0.1	2.4	0.1	2.4	0.1	2.6	0.1	2.3	0.1	1.2	.07
ISBL_CMS	mA	0	10	.06	.07	0.1	.04	0.4	0.1	0.4	.04	0.5	.06	0.8	.09	0.6	.05	0.4	0.1
ISBH_CMS	mA	0	10	.05	.03	0.1	.04	0.4	0.1	0.4	.04	0.5	.06	0.8	.09	0.6	.05	0.6	0.1
ICCDR	uA	0	1000	34	47	22	22	-107	116	26	4	83	7	237	20	177	10	85	27
ICCX	mA	0	10	0.4	0.3	0.4	0.3	0.8	0.3	0.8	0.3	0.9	0.3	1.2	0.3	0.9	0.3	0.5	0.2
ICCD	mA	0	115	104	3	102	3	106	3	94	1	92	6	85	2	90	2	78	1.8
TAA1_LH	ns	0	55	25.0	6.4	26.2	7.1	26.6	1.0	25.7	0.9	25.9	0.9	21.0	5.2	21.8	5.4	21.4	5.3
TAA1_HL	ns	0	55	25.6	3.0	25.1	4.7	29.7	2.4	29.3	1.3	29.8	1.4	28.4	4.8	30.2	2.7	31.0	1.3
TAA2_LH	ns	0	55	28.1	12.9	24.7	0.8	24.3	0.8	23.1	0.7	23.0	2.0	23.3	1.2	23.4	0.8	23.9	0.7
TAA2_HL	ns	0	55	22.5	3.1	34.4	7.4	43.5	6.1	26.9	1.0	27.9	1.2	28.4	1.1	28.4	1.1	28.9	1.1

<Table IV continued on next page>

Table IV. (continued)

Group 2 – Static 2, Biased

					Total Dose Exposure (krads)										Annealing			
	Spec. Limits		Pre-Irradiation		5		10		20		40		80		24 hrs		192 hrs	
Parameters	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VIH. min V	0	2.2	1.77	.03	1.73	.04	1.76	.02	1.71	.03	1.68	.02	5.51	0	4.59	1.6	3.56	1.95
VIL. max V	0.8	5.5	1.38	.07	1.34	.01	1.30	.05	1.15	.01	1.11	.01	0	0	0.2	0.4	0.3	0.5
VOH1 V	2.4	5.5	3.84	0.1	3.80	0.1	3.79	0.1	3.83	0.1	3.82	0.1	3.81	0.1	3.81	0.1	4.31	.01
VOH2 V	2.4	5.5	4.12	.04	4.08	.06	4.06	.06	4.11	.04	4.09	.04	4.09	.03	4.08	.04	4.31	.01
VOL1 mV	0	400	236	7	237	8	237	7	239	9	243	14	244	11	244	9	241	6
VOL2 mV	0	400	236	8	237	8	236	7	239	9	242	14	243	11	243	9	241	6
IIH uA	0	10	0	0	0	0	0	0	0	0	.01	.01	.05	.03	.04	.02	.03	.02
IIL uA	-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ILDH uA	-10	10	0	0	0	0	0	0	0	0	0	0	.01	0	.01	.01	.01	.01
ILDL uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ISBL_TTL mA	0	25	2.2	.07	2.3	.09	2.91	0.2	2.69	0.1	3.02	0.2	3.0	0.1	2.6	0.1	1.2	.05
ISBH_TTL mA	0	25	2.0	.06	2.0	.05	2.57	.09	2.33	.08	2.6	0.1	2.6	0.1	2.3	.09	1.1	.06
ISBL_CMS mA	0	10	.03	.03	.08	.03	0.4	0.2	0.4	.03	0.7	.06	0.8	.05	0.6	.04	0.3	.06
ISBH_CMS mA	0	10	.02	.03	.08	.06	0.2	.05	0.3	.03	0.7	.07	0.8	.06	0.6	.03	0.3	.06
ICCDR uA	0	1000	52	28	66	69	162	142	62	49	118	47	245	29	184	24	92	22
ICCX mA	0	10	0.2	.04	0.3	.05	0.6	0.2	0.8	.06	1.0	.09	1.1	.08	0.8	.05	0.3	.06
ICCD mA	0	115	103	2	102	1.2	107	2.6	92	2.7	94	4	89	1.6	91	2	78	1
TAA1_LH ns	0	55	22.8	3.1	25.1	5.1	26.9	1.0	25.2	1.5	25.3	3.0	*		*		*	
TAA1_HL ns	0	55	26.9	1.3	27.6	4.3	30.5	1.3	28.1	3.0	29.7	1.2	27.6	7.0	31.6	7.1	*	
TAA2_LH ns	0	55	23.1	0.8	24.8	0.8	24.5	0.8	23.5	0.8	23.7	0.7	*		43.7	11	*	
TAA2_HL ns	0	55	27.3	8.4	36.2	6.7	47.1	6.0	27.3	0.9	27.7	0.9	26.2	2.4	28.4	5.7	*	

* No measurements could be made due to radiation damage in the parts.

<Table IV continued on next page>

Table IV. (continued)

Group 3 – Unbiased

Parameters		Spec. Limits		Pre-Irradiation		Total Dose Exposure (krads)										Annealing			
						5		10		20		40		80		24 hrs		192 hrs	
		min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VIH. min	V	0	2.2	1.77	.02	1.74	.03	1.77	.05	1.66	.02	1.65	.02	1.6	.03	1.64	.01	1.45	.01
VIL. max	V	0.8	5.5	1.32	.04	1.29	.04	1.30	.03	1.20	.06	1.26	0.1	1.0	.01	1.02	.01	1.06	.01
VOH1	V	2.4	5.5	3.83	0.1	3.84	0.1	3.74	0.1	3.83	0.1	3.81	0.1	3.59	0.8	3.72	0.6	4.31	.01
VOH2	V	2.4	5.5	4.11	.04	4.11	.04	4.05	.05	4.10	.04	4.09	.04	4.09	.06	4.11	.04	4.31	.01
VOL1	mV	0	400	235	10	235	7	237	10	237	9	238	10	238	9	239	11	235	7
VOL2	mV	0	400	234	10	235	7	236	10	236	9	237	10	237	9	238	11	235	7
IIH	uA	0	10	0	0	0	0	0	0	0	0	0	0	0.7	0	0	0	0	0
IIL	uA	-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ILDH	uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ILDL	uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ISBL_TTL	mA	0	25	2.2	.06	2.1	.06	2.4	0.1	2.2	.03	2.2	.02	2.1	.03	2.1	.02	1	.02
ISBH_TTL	mA	0	25	2.0	.05	1.8	0.1	2.1	0.1	1.9	.02	1.9	.03	1.8	.02	1.8	.05	1	.02
ISBL_CMS	mA	0	10	.03	.04	.03	.04	.01	.08	.09	.02	.08	.02	0.1	0	0.1	.02	0.1	.02
ISBH_CMS	mA	0	10	.06	.04	.07	.02	0.2	0.1	.07	0	.08	.02	0.1	0	0.1	.02	0.1	.02
ICCDR	uA	0	1000	13	29	46	8	90	105	0	0	0	0	50	0	38	4.5	26	4
ICCX	mA	0	10	0.2	.04	0.2	.04	0.3	0.1	0.2	.04	0.3	.02	0.3	.01	0.2	.03	0.1	.01
ICCD	mA	0	115	102	1	99	1.5	108	2.8	92	0.8	92	1.4	90	2.2	96	0.9	81	0.7
TAA1_LH	ns	0	55	23.4	2.5	*		26.9	1.0	23.7	4.2	23.6	4.1	22.8	4.7	23.3	4.3	22.8	5.1
TAA1_HL	ns	0	55	27.3	1.3	30.3	1.2	30.8	1.3	29.5	1.3	29.5	1.3	30.5	1.3	30.3	1.3	28.9	3.2
TAA2_LH	ns	0	55	23.1	0.8	24.8	0.8	24.5	0.8	23.0	0.7	23.0	0.7	23.4	0.7	23.1	1.5	23.9	0.6
TAA2_HL	ns	0	55	24.6	2.1	34.7	7.0	38.9	7.2	27.4	0.9	27.5	0.9	28.3	1.0	28.2	1.1	28.6	1.1

* No measurements could be made due to radiation damage in the parts.

1/ The mean and standard deviation were calculated over the four irradiated parts in each test group.

Table V. Summary of Low and High Temperature Electrical Measurements after 168 hours of annealing. 1/

Parameters		Spec. Limits min	Spec. Limits max	Low Temp. -55°C TG1 mean		TG2 mean		TG3 mean		High Temp. 125°C TG1 mean		TG2 mean		TG3 mean	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VIH. min	V	0	2.2	5.51	0	3.74	1.77	1.52	.02	5.51	0	5.51	0	5.51	0
VIL. max	V	0.8	5.5	0	0	0.4	0.4	1.16	.02	0	0	0	0	0	0
VOH1	V	2.4	5.5	0.2	.01	4.34	.01	4.34	0	0.3	.01	4.27	.01	4.26	.01
VOH2	V	2.4	5.5	0.2	.01	4.34	.01	4.34	0	0.3	.01	4.27	.01	4.27	.01
VOL1	mV	0	400	206	11	212	12	203	6	294	5	300	6	289	8
VOL2	mV	0	400	206	11	211	10	203	6	294	5	300	6	289	8
IIH	uA	0	10	0	0	0	0	0	0	0.5	0.3	2.7	1.5	0.3	0.1
IIL	uA	-10	0	0	0	0	0	0	0	-.03	.02	-0.1	.05	-.02	.01
ILDH	uA	-10	10	0	0	0	0	0	0	0.2	.01	0.7	0.4	0.1	.01
ILDL	uA	-10	10	0	0	0	0	0	0	-.02	0	-.05	.02	-.01	0
ISBL_TTL	mA	0	25	1.0	.04	1.0	.01	1.1	.02	27.4	1.1	27.2	2.3	10	0.3
ISBH_TTL	mA	0	25	1.0	.04	1.0	.01	1.1	.02	27.3	1.1	27.0	2.3	10	0.3
ISBL_CMS	mA	0	10	0	0	0	0	0	0	26.5	1.1	26.2	2.2	9.3	0.3
ISBH_CMS	mA	0	10	0	0	0	0	0	0	26.4	1.1	26.2	2.2	9.3	0.3
ICCDR	uA	0	1000	0	0	0	0	0	0	13E3	369	13E3	847	6E3	227
ICCX	mA	0	10	0.1	0.2	0	0	0	0	>16		>16	0	9.3	0.4
ICCD	mA	0	115	97	2.5	95	2.3	97	1.7	94	1.2	93	3.0	75	0.8
TAA1_LH	ns	0	55	21.7	1.0	30.0	10.1	21.6	0.9	*		36.9	1.5	*	
TAA1_HL	ns	0	55	25.1	1.3	23.6	2.3	24.5	1.2	*		*		*	
TAA2_LH	ns	0	55	18.9	0.6	27.2	10.1	18.9	0.6	*		54.3	19.2	*	
TAA2_HL	ns	0	55	39.0	10.9	48.6	12.9	44.5	2.0	*		*		*	

* No measurements could be made due to radiation damage in the parts.

1/ The mean and standard deviation were calculated over the four parts in each test group.

Table VI. Funct[illegible] Test Summary for S128K8L-55MC

Group1 – Static 1, Biased

Test #	Test Description *	Freq. (MHz)	Pre-Irrad.	Total Dose Exposure (krads)					Annealing	
				5	10	20	40	80	24 hrs	192 hrs
1	0's, 1's, chkbd	10	Pass	3P/1F	Fail	Fail	Fail	Fail	Fail	Fail
2	March, Galpat, etc.	10	1P/3F	2P/2F	Fail	Fail	Fail	Fail	Fail	Fail
3	0's, 1's, chkbd	5	Pass	3P/1F	Fail	Fail	Fail	Fail	Fail	Fail
4	March, Galpat, etc.	5	1P/3F	2P/2F	Fail	Fail	Fail	Fail	Fail	Fail
5	0's, 1's, chkbd	2	Pass	Pass	Fail	Fail	Fail	Fail	Fail	Fail
6	Data Retention	1	Pass	3P/1F	Fail	Fail	Fail	Fail	Fail	Fail

Group2 – Static 2, Biased

Test #	Test Description *	Freq. (MHz)	Pre-Irrad.	Total Dose Exposure (krads)					Annealing	
				5	10	20	40	80	24 hrs	192 hrs
1	0's, 1's, chkbd	10	3P/1F	Fail	Fail	Fail	Fail	Fail	Fail	Fail
2	March, Galpat, etc.	10	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail
3	0's, 1's, chkbd	5	3P/1F	Fail	Fail	Fail	Fail	Fail	Fail	Fail
4	March, Galpat, etc.	5	Fail	Fail	Fail	Fail	Fail	Fail	Fail	Fail
5	0's, 1's, chkbd	2	3P/1F	Fail	Fail	Fail	Fail	Fail	Fail	Fail
6	Data Retention	1	Pass	Fail	Fail	Fail	Fail	Fail	Fail	Fail

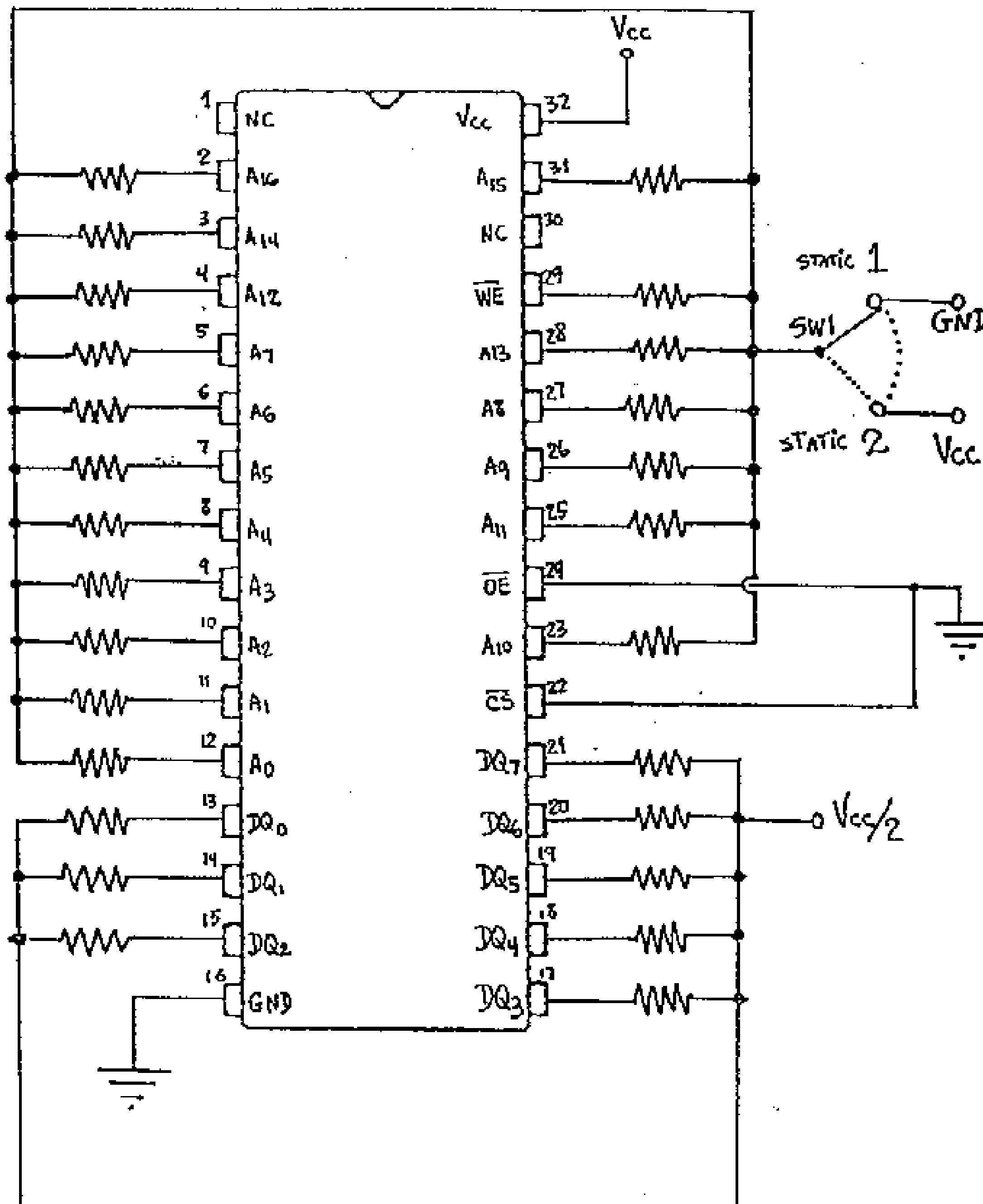
Group3 – Unbiased

Test #	Test Description *	Freq. (MHz)	Pre-Irrad.	Total Dose Exposure (krads)					Annealing	
				5	10	20	40	80	24 hrs	192 hrs
1	0's, 1's, chkbd	10	Pass	Pass	Pass	Fail	Fail	Fail	Fail	Fail
2	March, Galpat, etc.	10	1P/3F	1P/3F	1P/3F	Fail	Fail	Fail	Fail	Fail
3	0's, 1's, chkbd	5	Pass	Pass	3P/1F	Fail	Fail	Fail	Fail	Fail
4	March, Galpat, etc.	5	Fail	1P/3F	1P/3F	Fail	Fail	Fail	Fail	Fail
5	0's, 1's, chkbd	2	Pass	Pass	Pass	Fail	Fail	Fail	Fail	Fail
6	Data Retention	1	Pass	Pass	3P/1F	Fail	2P/2F	Fail	Fail	Fail

* See notes after Table 3 for details on the functional testing.

Figure 1. Radiation Bias Circuit for S128K8L-55MC

(Test Groups 1 and 2 only)



NOTES:
1. ALL RESISTORS ARE $2K\Omega \pm 5\%$ & 1/4 WATT.
2. $V_{CC} = 6V\ ^{+0V}_{-0.25V}$, $V_{CC}/2 = 2.5V$ to $3V$