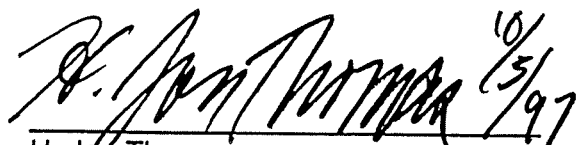


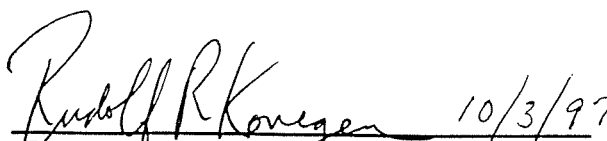
IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

PURPOSE OF TEST	TESTED CHARACTERISTICS
Total dose Characterization	Full Functional and Parametric testing using Sentry 21 VLSI ATE
TEST TEMPERATURES	
Pre-Radiation	25°C., +125°C.
Post Radiation, Pre-Anneal	25°C.
Post Anneal	-55°C., 25°C., +125°C.

IRRADIATION CONDITIONS	
Source	Co60 Gamma Ray
Energy	1.25 MeV
Temperature	25°C.
Dose Rate (rad(Si)/sec)	0.4 rad(Si)/sec.(2 units) and 17 rads(Si)/sec.(2 units)
Total Dose	100 Krads @ 0.4 rad(Si)/sec. and 150 Krads @ 17 rads(Si)/sec.

ANNEALING CONDITIONS	
Bias	V _{cc} = 5V, Static (No clock applied)
Duration	168 Hours
Temperature	100°


H. Jon Thomas
Product Engineering Manager


Rudolf R. Konegen
Vice-President, Operations

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

INTRODUCTION

This report presents the total dose (low dose rate) radiation characterization of the Performance Semiconductor Corporation 1750A/SOS CMOS microprocessor, manufactured with dice fabricated with the Sarnoff radiation hardened 1.15 μ CMOS-SOS-Rad Hard process using 0.4 μ Sarnoff silicon epi-layer on sapphire base wafers. The goal of the test was to perform low dose (0.4 rad(Si)/sec. and 17.0 rads(Si)/sec.) radiation testing on four microprocessors with an accumulated total dose of 100Krads on two of the microprocessors and 150Krads on the other two. The microprocessors were irradiated using the Co60 gamma ray source by ICS Radiation Technologies, Inc. The Co60 source used was a J. L. Shephard model no. 484 Co-60 irradiator at the J. L. Shephard facility located in San Fernando, CA. Electrical testing and annealing were performed at Performance Semiconductor Corporation, Sunnyvale, California.

TEST METHOD

The test sample consisted of four PACE 1750A/SOS CMOS microprocessors. Two were from assembly and test lot PERF03Z3AEA, serial numbers F1019 and F1023, and the other two were from assembly and test lot PERF04-17, serial numbers A01003 and B01004. One device from each lot was irradiated with 100Krads, and the other with 150Krads as shown in Table 1.

	100 Krads @ 0.4rad(Si)/sec.	150Krads @ 17rads(Si)/sec.
PERF03Z3AEA	F1023	F1019
PERF04-17	A01003	B01004

Table 1

IRRADIATION TEST REPORT		
PART NUMBER P1750AS-25QGMB*	DEVICE TYPE 16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS PERF03Z PERF04	PACKAGE CQFP-68 Gullwing	SAMPLE SIZE 4 Microprocessors
IRRADIATION TEST PLAN Per MIL STD 883C, Method 1019		TEST DATE 8/3/97 - 8/7/97

Devices F1023 and A01003 were irradiated at a dose rate of 0.4 rad(Si)/sec. for 69.44 hours giving a total dose of 100Krad. During this time, the microprocessors were in a test fixture supplied by Performance Semiconductor Corp. running a self-test program at a clock frequency of 100KHz. During irradiation, the operating current of each of the microprocessors was monitored and recorded together with the accumulated dose at intervals of approximately 8 - 14 hours.

Devices F1019 and B01004 were tested similarly but using a dose rate of 17 rads(Si)/sec. for 2.45 hours giving a total dose of 150Krad. The microprocessor's operating current and accumulated dose level were recorded every 15 minutes for the duration of the test.

Following irradiation, the four microprocessors were packed in dry ice and transported to Performance Semiconductor's facility in Sunnyvale California; post-radiation and travel time was less than ten hours. At Performance, the microprocessors were tested at 25°C. and then put into a 100° oven under static bias (with no clock applied) for 168 hours for the annealing process. After annealing, the microprocessors were tested again at 25°C., 125°C., and -55°C.

TEST RESULTS

I. RADIATION TESTS

No functional failures were seen during irradiation in any of the four microprocessors. The operating current for the two groups of microprocessors are as shown in Tables 2-3 and Figures 1-2. The difference of approximately 10 mA between the two parts in each set of data is primarily a function of the two test boards which used different terminating resistors and had other minor differences which resulted in an offset in the measured current of approximately 10mA.

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

A. Operating Current - 100Krad test

Total Dose(Krad)	A01003	F1023
0	17.36	7.83
10.8	17.86	8.09
31.97	18.12	9.43
44.64	18.32	10.1
67.46	18.32	10.24
80.23	18.34	10.34
100	18.45	10.53

Table 2

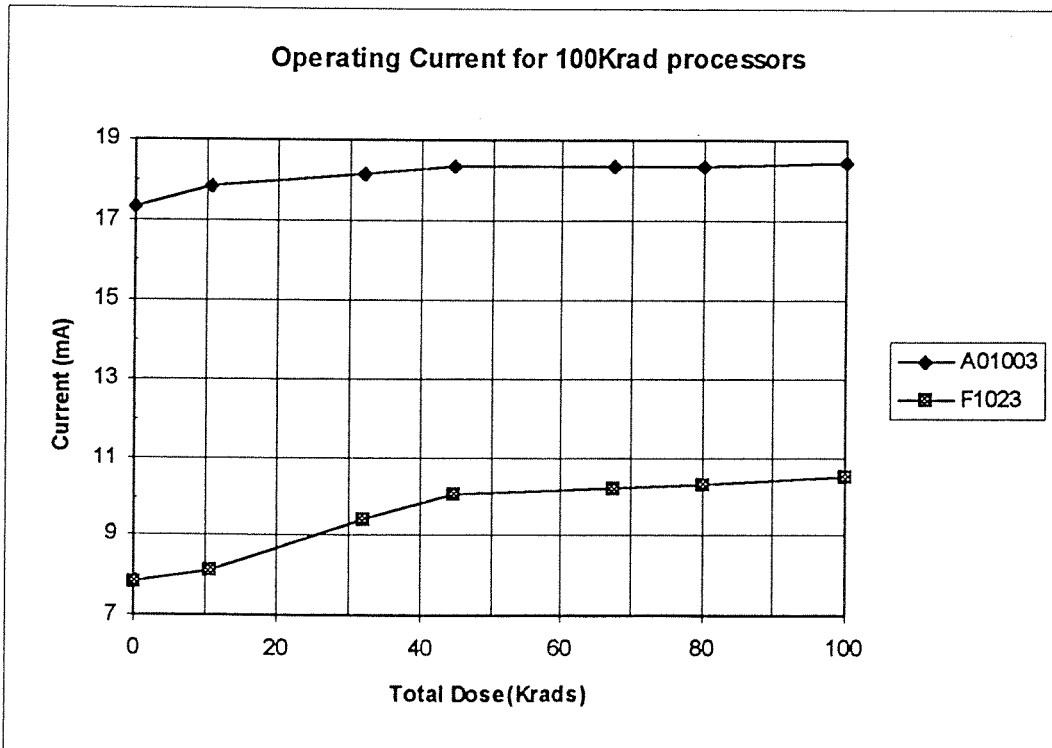


Figure 1

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

Total Dose(Krad)	B01004	F1019
0	17.58	8.58
15.3	18.02	9.26
30.6	18.23	10.01
45.9	18.48	10.35
61.2	18.58	10.42
76.5	18.78	10.78
91.8	18.78	10.86
107.1	18.78	11.23
122.4	18.78	11.53
137.7	18.78	11.58
150	18.78	11.62

B. Operating Current -- 150 Krad test

Table 3

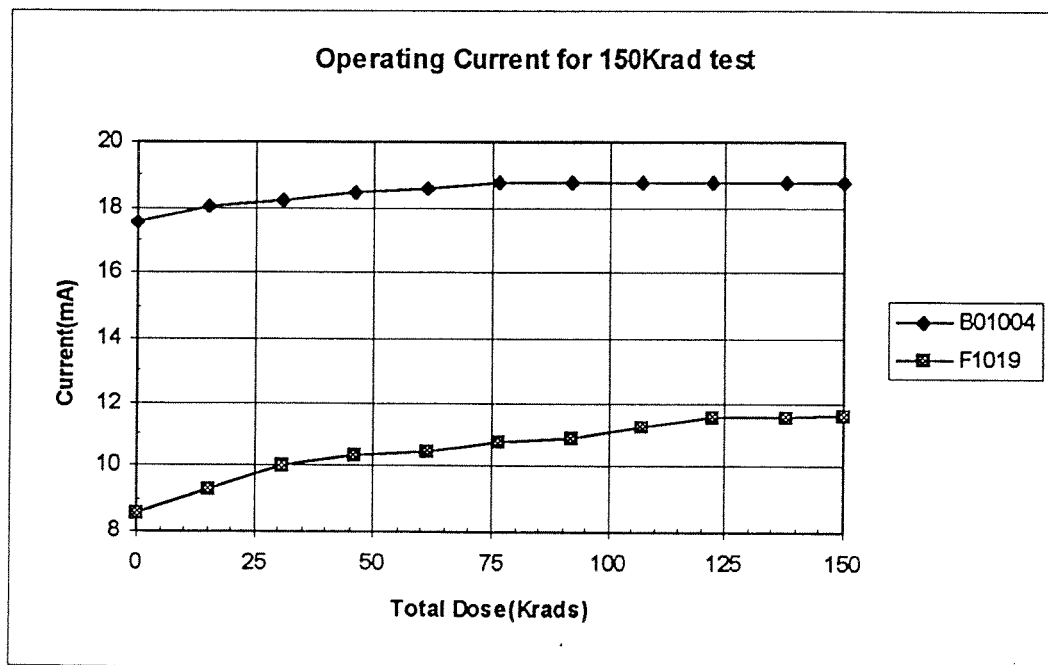


Figure 2

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

As indicated before, the difference in current between the two devices at 100Krad and at 150Krad in Figures 1-2, is due to differences between the two test boxes, not differences in the microprocessors. Prior to the test, this difference in current was noted, and the 1750A microprocessors were temporarily interchanged between the two boxes. Since the operating current did not change significantly for either box, regardless of which microprocessor was inserted, the difference of approximately 10mA between the two boxes can be attributed to differences in the two boxes, rather than to differences between the microprocessors.

II. ELECTRICAL TESTS

The microprocessors were electrically tested at 25°C. and 125°C. prior to irradiation, tested at 25°C. after irradiation and prior to annealing, and then tested at 25°C., 125°C., and -55°C. after annealing. The complete log of these Sentry tests, which include complete parametric and functional tests, has been archived and is available for review at Performance Semiconductor Corporation offices. A representative selection of those results is presented here.

A. ROOM TEMPERATURE TESTS

The I_{IH} test results shown in Table 4 and Figure 3 show the maximum I_{IH} leakage at 25°C. for these parts. This was typically found on pin IB3, and in all cases, it was found on one of the IB bus lines. Dynamic I_{cc} and static I_{cc} are shown in Tables 5-6, and Figures 4-5. IOL and IOH values are shown in Tables 7-8 and Figures 6-7.

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

1. IIH at 25°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Radiation	Post Anneal
PERF03Z3AEA	IIH	F1019	38.00E-9	3.14E-6	657.00E-9
PERF03Z3AEA	IIH	F1023	25.00E-9	437.00E-9	188.00E-9
PERF04-17	IIH	B01004	26.00E-9	147.00E-9	71.00E-9
PERF04-17	IIH	A01003	23.00E-9	80.00E-9	48.00E-9

Table 4

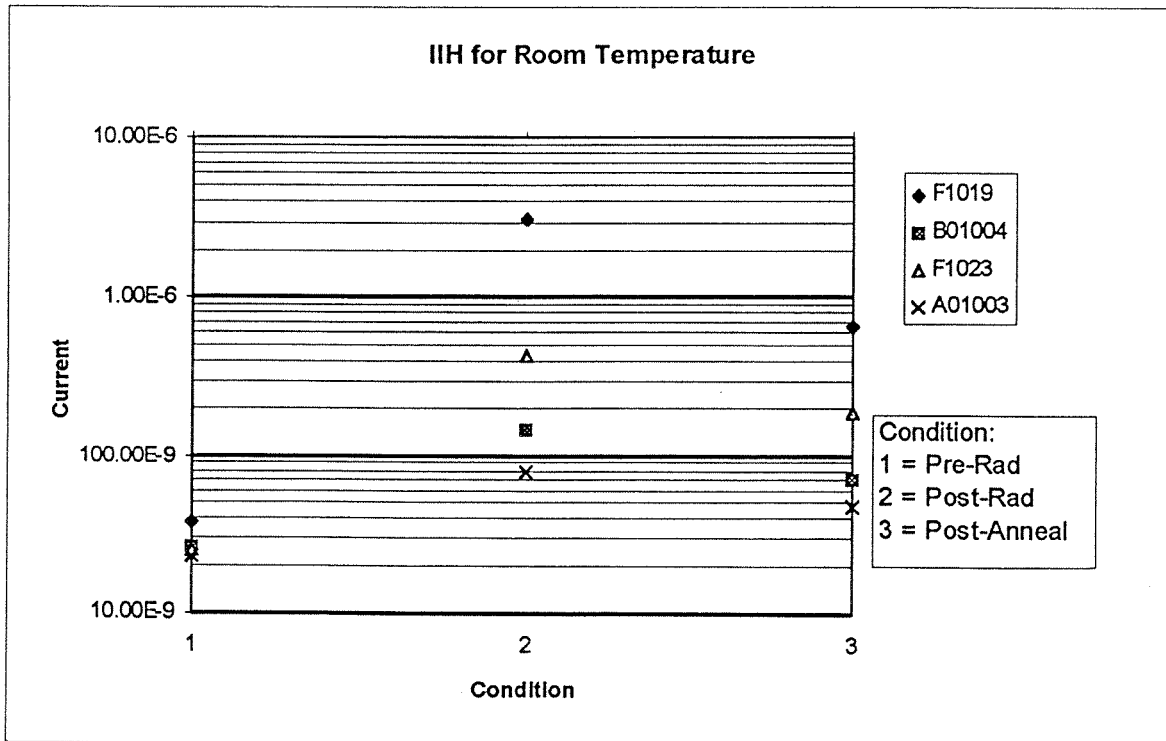


Figure 3

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

2. I_{cc} (dynamic) at 30MHz and 25°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Radiation	Post Anneal
PERF03Z3AEA	I_{cc} @ 30 MHz	F1019	32	40	36
PERF03Z3AEA	I_{cc} @ 30 MHz	F1023	32	36	34
PERF04-17	I_{cc} @ 30 MHz	B01004	32	34	32
PERF04-17	I_{cc} @ 30 MHz	A01003	30	34	32

Table 5

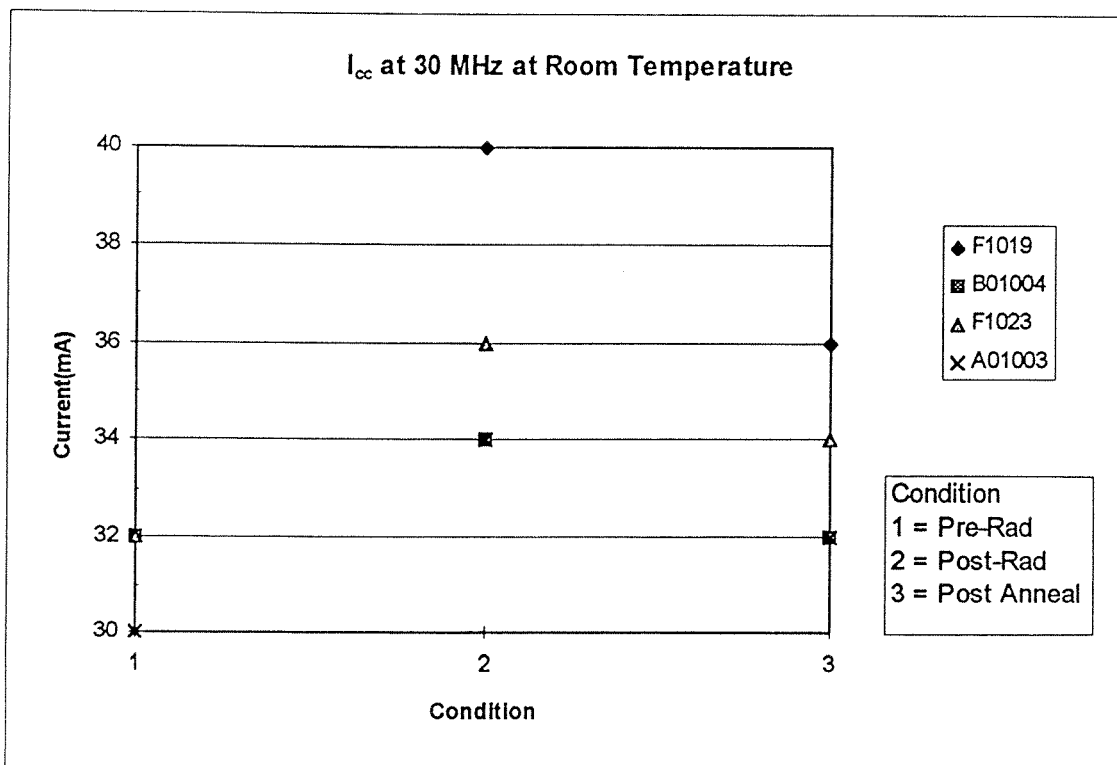


Figure 4

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

3. I_{cc} static with TTL levels

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Radiation	Post Anneal
PERF03Z3AEA	I_{ccq} @ TTL	F1019	4	6	4
PERF03Z3AEA	I_{ccq} @ TTL	F1023	4	4	4
PERF04-17	I_{ccq} @ TTL	B01004	4	4	4
PERF04-17	I_{ccq} @ TTL	A01003	4	4	4

Table 6

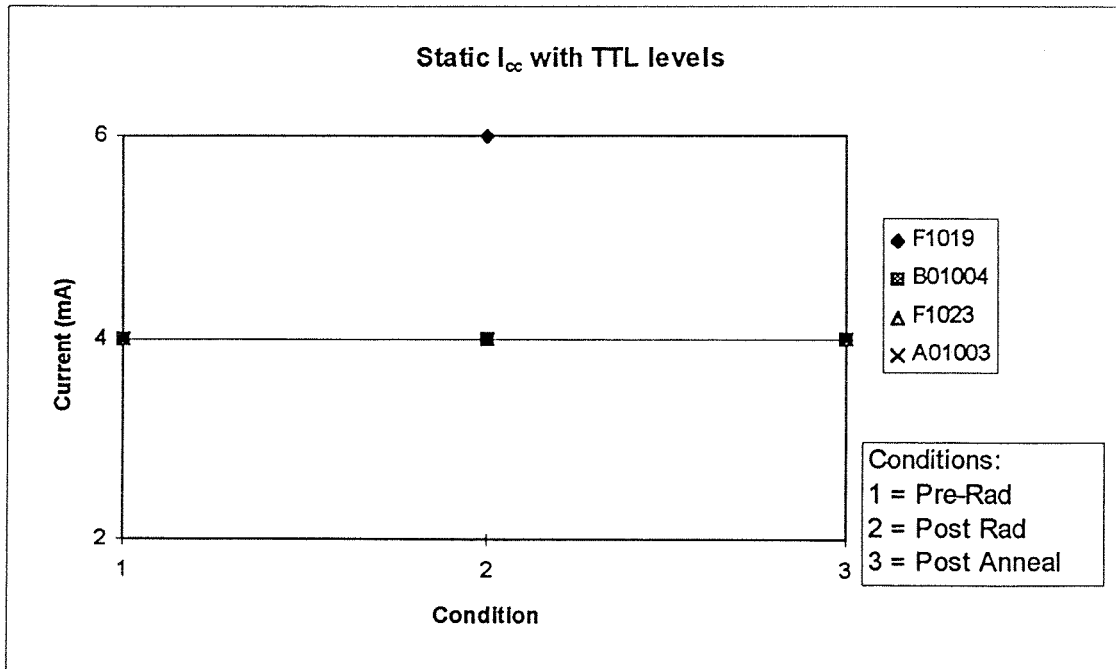


Figure 5

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

4. IOL at 25°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Radiation	Post Anneal
PERF03Z3AEA	IOL	F1019	47.2	48.7	48.8
PERF03Z3AEA	IOL	F1023	47.1	40	48.6
PERF04-17	IOL	A01003	54.9	45.3	57.4
PERF04-17	IOL	B01004	55.3	56.9	57.7

Table 7

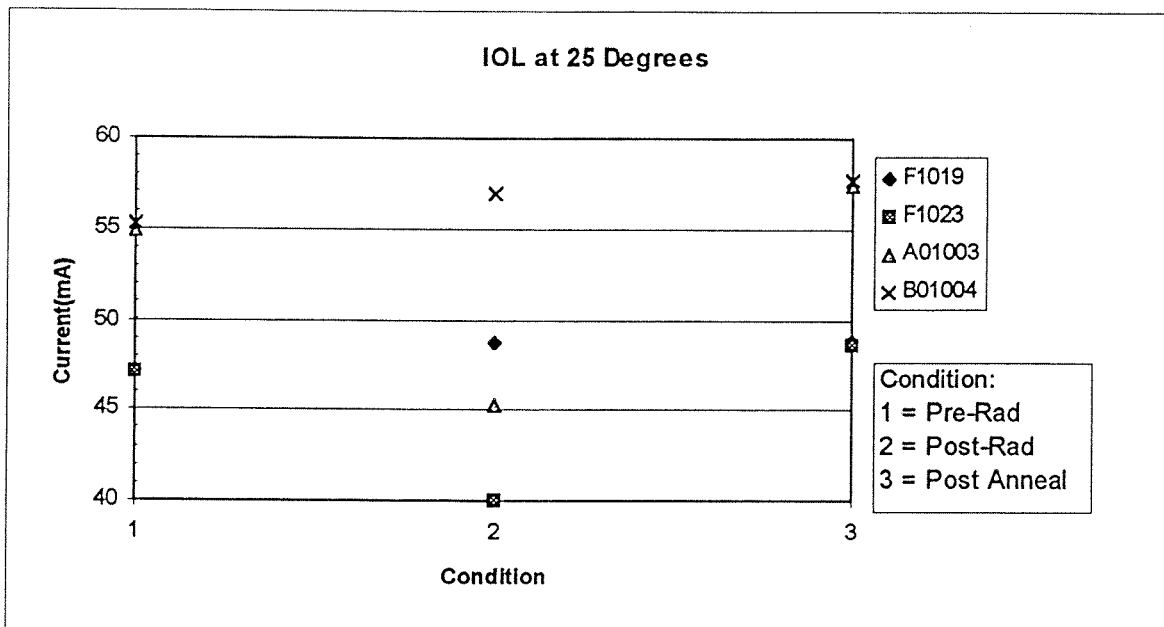


Figure 6

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

5. IOH at 25°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Radiation	Post Anneal
PERF03Z3AEA	IOH	F1019	-40.8	-38.7	-37
PERF03Z3AEA	IOH	F1023	-39.1	-38.9	-37.2
PERF04-17	IOH	A01003	-52.5	-51.6	-50.3
PERF04-17	IOH	B01004	-54.5	-52.1	-50.3

Table 8

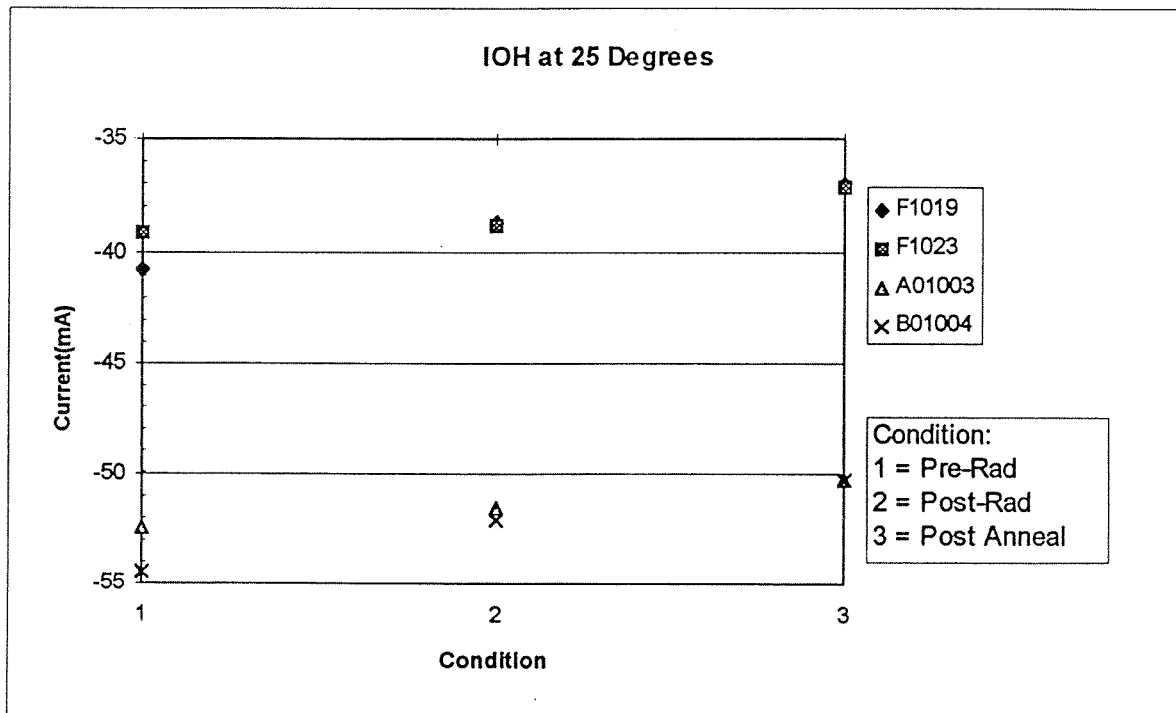


Figure 7

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

6. Maximum pass frequency at 25°C.

One of the parameters measured is the maximum clock rate, or frequency at which the microprocessors operate correctly. The maximum frequency at which functional testing was performed was 40MHz. This is measured by first setting the effective clock cycle time to 25 ns. and executing the functional test. If it fails, the effective clock period is increased by 2.5 ns. to 27.5 ns., placement of input edges and strobes are adjusted appropriately, and the test is run again. The resultant test frequencies using this approach are as shown in Table 9 at the right. This continues until the functional test passes, and the effective clock period at this point is the minimum clock period (maximum clock frequency) at which the microprocessor operates.

PERIOD (ns)	FREQUENCY (MHz)
25	40
27.5	36.36
30	33.33
32.5	30.77
35	28.57
37.5	26.67

Table 9

The results showed that at room temperature, the microprocessors from wafer lot PERF03Z3AEA were all functional at 36.36MHz, while the microprocessors from wafer lot PERF04-17 were all functional at 40 MHz, regardless of whether the microprocessors had received 0rad, 100Krad, or 150Krad of radiation. This is shown in Table 10 below.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Radiation	Post Anneal
PERF03Z3AEA	Max. pass freq	F1019	36.36 MHz	36.36 MHz	36.36 MHz
PERF03Z3AEA	Max. pass freq	F1023	36.36 MHz	36.36 MHz	36.36 MHz
PERF04-17	Max. pass freq	B01004	40 MHz	40 MHz	40 MHz
PERF04-17	Max. pass freq	A01003	40 MHz	40 MHz	40 MHz

Table 10

IRRADIATION TEST REPORT		
PART NUMBER P1750AS-25QGMB*	DEVICE TYPE 16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS PERF03Z PERF04	PACKAGE CQFP-68 Gullwing	SAMPLE SIZE 4 Microprocessors
IRRADIATION TEST PLAN Per MIL STD 883C, Method 1019		TEST DATE 8/3/97 - 8/7/97

B. DRIFT MEASUREMENTS

As mentioned in the Test Method section, full functional and parametric tests were run on the microprocessors at each step in the processing. In order to obtain a greater understanding of the effect of the radiation on specific electrical parameters, 34 different parameters were chosen to be representative, and were tabulated for each unit at pre-radiation, post-radiation, and post-anneal. The overall drift of these measurements from pre-radiation through post-anneal was computed and tabulated. The drift from pre-radiation to post-radiation was computed and the larger of the two drift values was also tabulated as the maximum drift. This data is presented in the appendix. All measurements associated with these drift computations were made at 25°C.

C. 125°C. TEMPERATURE TESTS

The test results for 125°C. are presented in the same way as those for 25°C. Table 11 and Figure 8 show the I_{IH} measurements at 125°C.; Tables 12-13 and Figures 9-10 give the dynamic and static I_{cc} values respectively, and Tables 14-15 and Figures 11-12 show the I_{OL} and I_{OH} measurements. No tests were run at 125°C. after radiation and prior to annealing in order to minimize the possibility of partly annealing the microprocessors during the test.

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

1. IIH at 125°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Anneal
PERF03Z3AEA	IIH	F1019	3.52E-6	29.50E-6
PERF03Z3AEA	IIH	F1023	2.83E-6	13.20E-6
PERF04-17	IIH	B01004	1.13E-6	3.47E-6
PERF04-17	IIH	A01003	1.23E-6	2.63E-6

Table 11

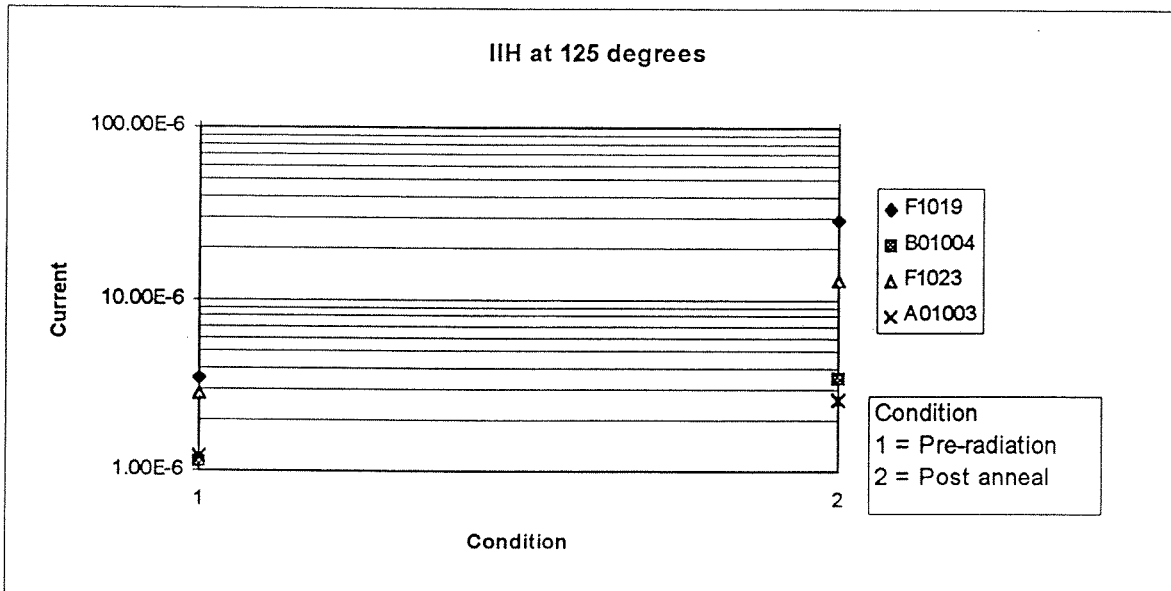


Figure 8

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

2. I_{cc} (dynamic) at 30MHz and 125°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Anneal
PERF03Z3AEA	I_{cc} @ 30 MHz	F1019	36.00E-3	44.00E-3
PERF03Z3AEA	I_{cc} @ 30 MHz	F1023	34.00E-3	34.00E-3
PERF04-17	I_{cc} @ 30 MHz	B01004	36.00E-3	36.00E-3
PERF04-17	I_{cc} @ 30 MHz	A01003	36.00E-3	36.00E-3

Table 12

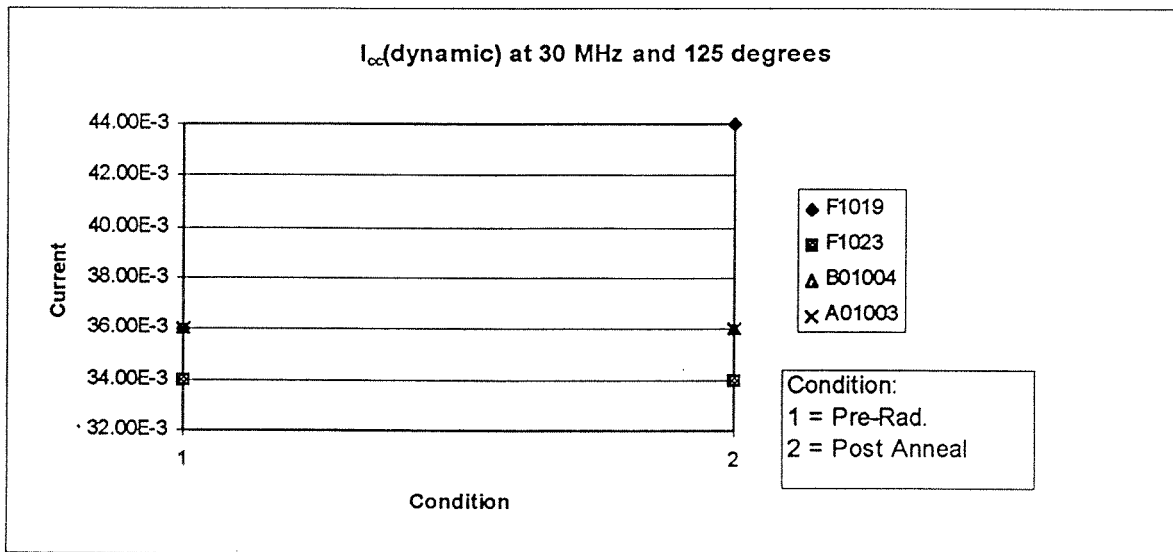


Figure 9

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

3. I_{cc} static with TTL levels at 125°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Anneal
PERF03Z3AEA	I_{ccq} with TTL M	F1019	4.00E-3	8.00E-3
PERF03Z3AEA	I_{ccq} with TTL M	F1023	4.00E-3	6.00E-3
PERF04-17	I_{ccq} with TTL M	B01004	6.00E-3	4.00E-3
PERF04-17	I_{ccq} with TTL M	A01003	6.00E-3	4.00E-3

Table 13

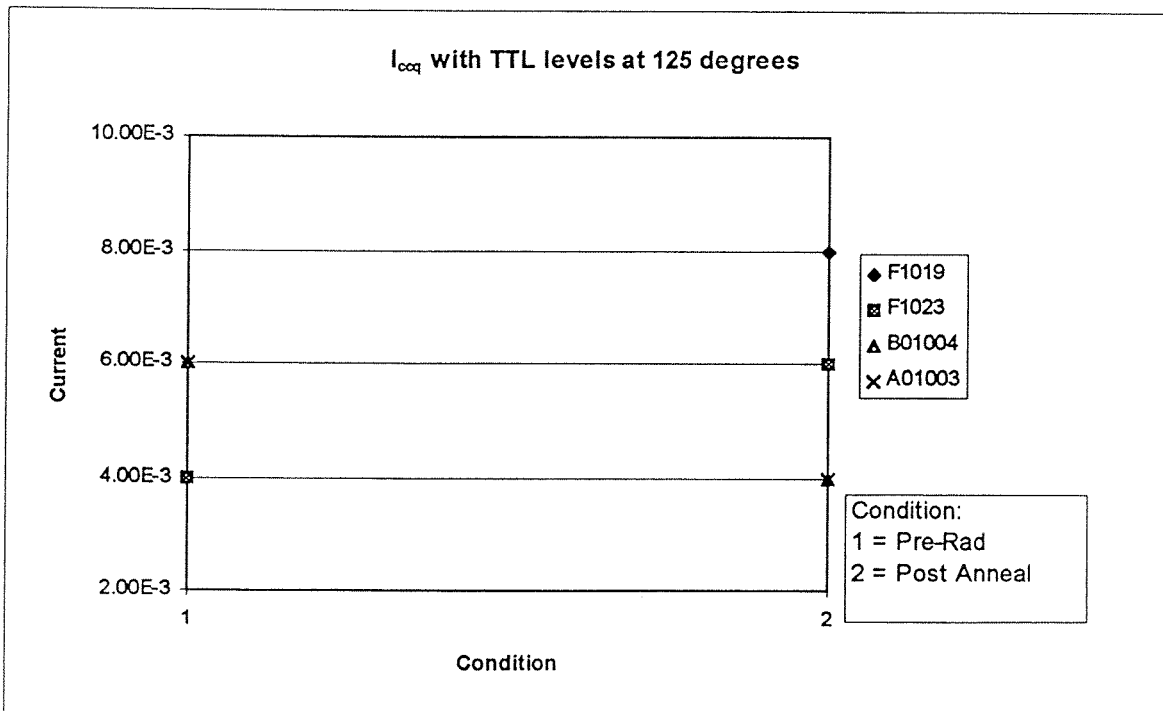


Figure 10

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

4. IOL at 125°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Anneal
PERF03Z3AEA	IOL	F1019	36.6	38.5
PERF03Z3AEA	IOL	F1023	36.5	38
PERF04-17	IOL	A01003	42.8	44.8
PERF04-17	IOL	B01004	45.3	49.2

Table 14

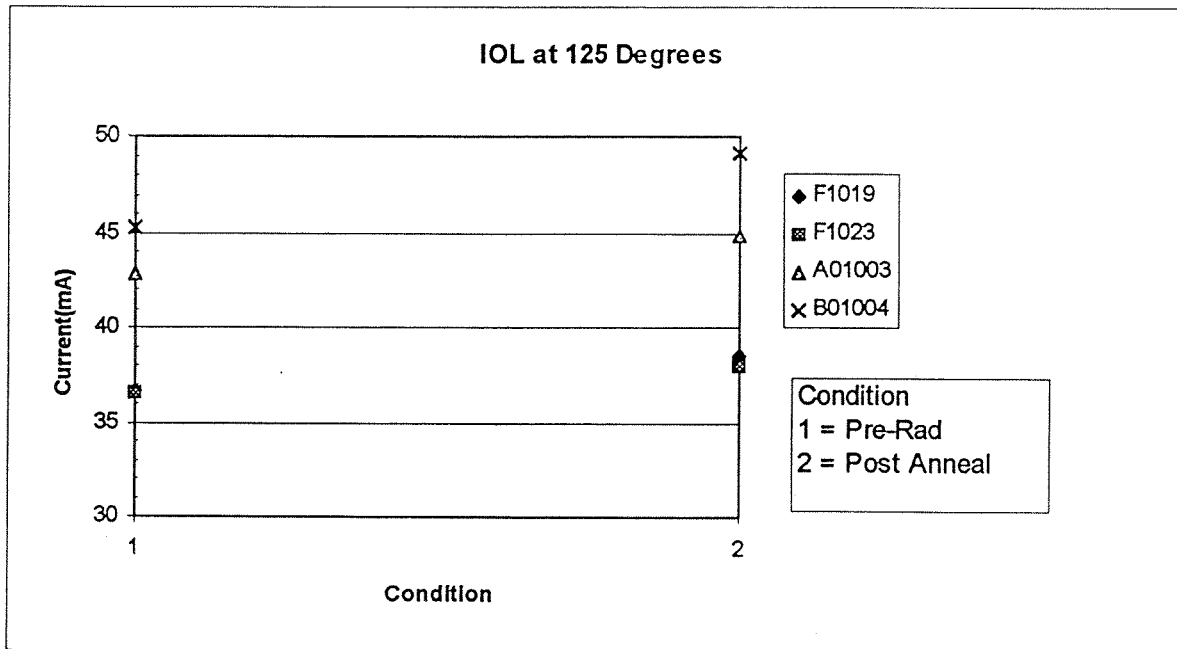


Figure 11

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN	TEST DATE	
Per MIL STD 883C, Method 1019	8/3/97 - 8/7/97	

5. IOH at 125°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Anneal
PERF03Z3AEA	IOH	F1019	-34.8	-31.6
PERF03Z3AEA	IOH	F1023	-32.8	-31.6
PERF04-17	IOH	A01003	-44.3	-43
PERF04-17	IOH	B01004	-46.4	-42.7

Table 15

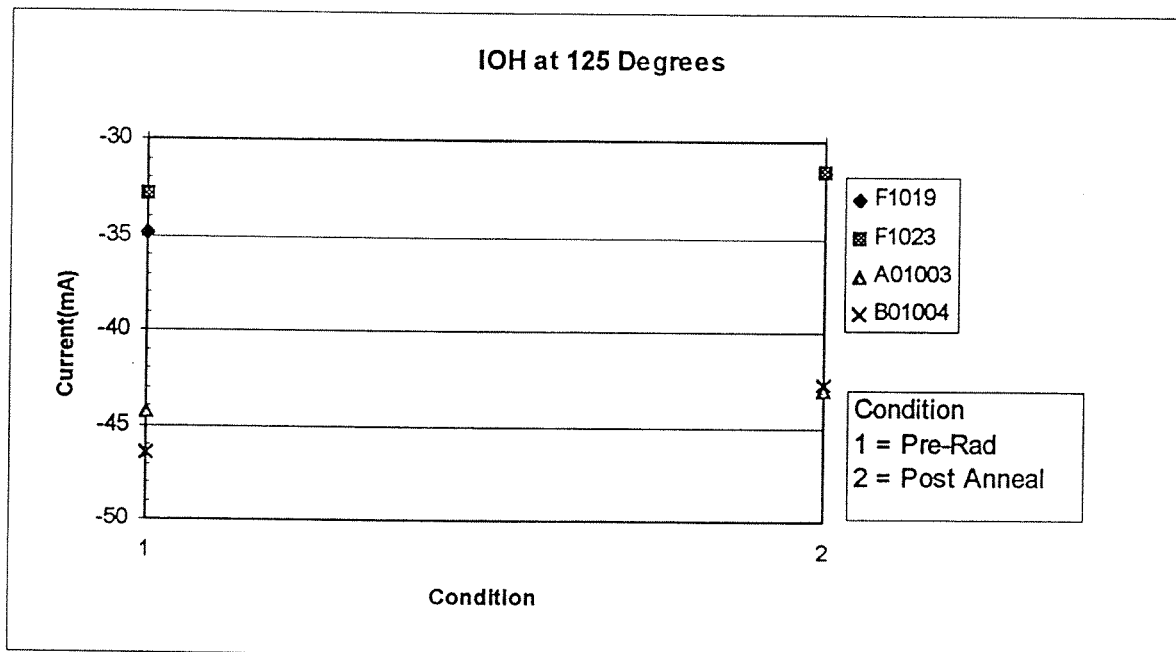


Figure 12

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

6. Maximum pass frequency at 125°C.

Lot Number	Tested Parameter	Serial Number	Pre Radiation	Post Anneal	
PERF03Z3AEA	Max. pass freq	F1019	30.77MHz	28.57MHz	*
PERF03Z3AEA	Max. pass freq	F1023	30.77MHz	28.57MHz	*
PERF04-17	Max. pass freq	B01004	40 MHz	40 MHz	
PERF04-17	Max. pass freq	A01003	40 MHz	40 MHz	

Table 16

* The test frequencies are: 40MHz, 36.36MHz, 33.33MHz, 30.77MHz, 28.57MHz, 26.67mhz, etc. as shown in Table 9, and the significance of the difference between adjacent test frequencies is considered to be minor.

SUMMARY AND CONCLUSIONS

I. SUMMARY OF RESULTS

A. FAILURES

No failures were seen in these four microprocessors before, during, or after radiation.

B. OPERATING FREQUENCY

The two microprocessors from wafer lot PERF03Z3AEA experienced a decrease in maximum operating frequency from 30.77MHz, pre-radiation, at 125°C. to 28.57MHz, post anneal, at 125°C. only. This represents a nominal change in maximum operating frequency of 2.2MHz, and a worst case change of less than 4.76MHz. The two microprocessors from wafer lot PERF04-17 were fully functional at the maximum test frequency of 40MHz at all temperatures and radiation levels tested.

C. I_{cc} (dynamic)

The worst case increase in I_{cc} (dynamic) at 30 MHz room temperature was from 32mA at pre-radiation to 40mA at post-radiation, pre-anneal. The worst case increase in I_{cc} (dynamic) at 30 MHz room temperature from pre-radiation to post anneal was from

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
P1750AS-25QGMB*	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z PERF04	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

32mA at pre-radiation to 36mA at post-anneal. The worst case increase in I_{cc} (dynamic) at 30MHz at 125 degrees was from 36mA at pre-radiation to 44mA post-radiation, post-anneal. All of these increases were seen on S/N F1019. These values of I_{cc} (dynamic) at 30MHz compare quite favorably to the post radiation specification limit of 125mA for this parameter.

D. IIH - worst case

The worst case increase of IIH at room temperature was seen on the IB03 pin of S/N F1019 which increased from 38nA at pre-radiation to 3.14µA at post-radiation, pre-anneal, which compares favorably to the specified limit of 50µA.

II. CONCLUSIONS

Four 1750A CMOS/SOS microprocessors have been subjected to radiation characterization up to a total dose of 100Krad(Si) for two of the microprocessors, and 150Krad(Si) for the other two. Subsequently, all four microprocessors were tested at 25°C., annealed for 168 hours at 100°C. under static bias, then tested again at -55°C., 25°C., and 125°C.

No failures(functional or parametric) were observed at any point during the test, and only minor degradation was seen on any of the parameters specified for these devices. In particular, input leakage currents and supply currents also showed only minor degradation.

It can be concluded, therefore, that the 1750A CMOS/SOS microprocessor using the 1.15µ CMOS-SOS-Rad Hard process with 0.4 µ Samoff silicon epi-layer base wafers demonstrates a high total dose radiation tolerance when subjected to either 100Krad(Si) at 0.4 rad(Si)/sec. or 150Krad(Si) at 17 rad(Si)/sec. It is further concluded that these units can be described as having a total dose radiation tolerance exceeding 100Krad(Si) for satellite applications.

APPENDIX

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
PACE 1750A/SOS	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z3AEA PERF04-17	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

P1750AS - Lot No. PERF03Z3AEA
Serial No. F1019

PARAMETERS	PRE RADIATION	POST RADIATION	POST ANNEAL	MAXIMUM DRIFT	BEGIN-END DRIFT	UNIT
STATIC ICC AT VIN = 5.3V	2.0E-3	4.0E-3	2.0E-3	2.0E-3	000.0E+0	A
STATIC ICC AT VIN = 0.2V	2.0E-3	4.0E-3	2.0E-3	2.0E-3	000.0E+0	A
STATIC ICC AT VIN = 3.4V	4.0E-3	6.0E-3	4.0E-3	2.0E-3	000.0E+0	A
25 MHZ DYNAMIC ICC	30.0E-3	32.0E-3	30.0E-3	2.0E-3	000.0E+0	A
IIH OF EXTADDERR AT VIN = 5.50V	5.0E-9	9.0E-9	6.0E-9	4.0E-9	1.0E-9	A
IIH OF RDY D AT VIN = 5.50V	4.0E-9	7.0E-9	5.0E-9	3.0E-9	1.0E-9	A
IIH OF IOL AT VIN = 5.50V	4.0E-9	9.0E-9	6.0E-9	5.0E-9	2.0E-9	A
IIH OF IB00 AT VIN = 5.50V	33.0E-9	2.1E-6	473.0E-9	2.0E-6	440.0E-9	A
IIH OF IB03 AT VIN = 5.50V	38.0E-9	3.1E-6	657.0E-9	3.1E-6	619.0E-9	A
IIH OF IB12 AT VIN = 5.50V	34.0E-9	2.7E-6	582.0E-9	2.7E-6	548.0E-9	A
IIL OF EXTADDERR AT VIN = 0.00V	-4.0E-9	-4.0E-9	-4.0E-9	000.0E+0	000.0E+0	A
IIL OF RDY D AT VIN = 0.00V	-4.0E-9	-6.0E-9	-5.0E-9	2.0E-9	1.0E-9	A
IIL OF IOL1 AT VIN = 0.00V	-2.0E-9	-15.0E-9	-6.0E-9	13.0E-9	4.0E-9	A
IIL OB IB00 AT VIN = 0.00V	-19.0E-9	-55.0E-9	-31.0E-9	36.0E-9	12.0E-9	A
IIL OF IB03 AT VIN = 0.00V	-14.0E-9	-38.0E-9	-21.0E-9	24.0E-9	7.0E-9	A
IIL OF IB12 AT VIN = 0.00V	-15.0E-9	-35.0E-9	-21.0E-9	20.0E-9	6.0E-9	A
IOL OF IB00 AT VOL = 0.20V	19.9E-3	20.7E-3	21.2E-3	1.3E-3	1.3E-3	A
IOL OF IB00 AT VOL = 0.50V	46.5E-3	48.2E-3	49.1E-3	2.6E-3	2.6E-3	A
IOL OF STRB A AT VOL = 0.20V	20.2E-3	20.9E-3	21.1E-3	900.0E-6	900.0E-6	A
IOL OF STRB A AT VOL = 0.50V	47.2E-3	48.7E-3	48.8E-3	1.6E-3	1.6E-3	A
IOL OF D/I AT VOL = 0.20V	17.3E-3	17.0E-3	20.8E-3	3.5E-3	3.5E-3	A
IOL OF D/I AT VOL = 0.50V	41.2E-3	40.5E-3	48.6E-3	7.4E-3	7.4E-3	A
IOH OF IB00 AT VOH = Vcc-0.2V	-6.2E-3	-6.0E-3	-6.1E-3	200.0E-6	100.0E-6	A
IOH OF IB00 AT VOH = 2.40V	-41.5E-3	-38.5E-3	-37.0E-3	4.5E-3	4.5E-3	A
IOH OF STRB A AT VOH = Vcc-0.2V	-6.2E-3	-6.0E-3	-6.0E-3	200.0E-6	200.0E-6	A
IOH OF STRB A AT VOH = 2.40V	-40.8E-3	-38.7E-3	-37.0E-3	3.8E-3	3.8E-3	A
IOH OF D/I AT VOH = Vcc-0.2V	-5.8E-3	-5.5E-3	-5.9E-3	300.0E-6	100.0E-6	A
IOH OF D/I AT VOH = 2.40V	-39.7E-3	-37.3E-3	-36.2E-3	3.5E-3	3.5E-3	A
IOZH OF IB00 AT VOZH = 2.40V	3.0E-9	168.0E-9	41.0E-9	165.0E-9	38.0E-9	A
IOZL OF IB00 AT VOZL = 0.50V	-10.0E-9	9.0E-9	-9.0E-9	19.0E-9	1.0E-9	A
IOZH OF IB03 AT VOZH = 2.40V	4.0E-9	190.0E-9	49.0E-9	186.0E-9	45.0E-9	A
IOZL OF IB03 AT VOZL = 0.50V	-9.0E-9	24.0E-9	-1.0E-9	33.0E-9	8.0E-9	A
IOZH OF D/I AT VOZH = 2.40V	3.0E-9	204.0E-9	48.0E-9	201.0E-9	45.0E-9	A
IOZL OF D/I AT VOZL = 0.50V	-8.0E-9	25.0E-9	-2.0E-9	33.0E-9	6.0E-9	A

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
PACE 1750A/SOS	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z3AEA PERF04-17	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

P1750AS -Lot No. PERF03Z3AEA
Serial No. F1023

PARAMETERS	PRE RADIATION	POST RADIATION	POST ANNEAL	MAXIMUM DRIFT	BEGIN-END DRIFT	UNIT
STATIC ICC AT VIN = 5.3V	0.0	2.0E-3	0.0	2.0E-3	000.0E+0	A
STATIC ICC AT VIN = 0.2V	0.0	2.0E-3	0.0	2.0E-3	000.0E+0	A
STATIC ICC AT VIN = 3.4V	4.0E-3	4.0E-3	4.0E-3	000.0E+0	000.0E+0	A
25 MHZ DYNAMIC ICC	28.0E-3	30.0E-3	28.0E-3	2.0E-3	000.0E+0	A
IIH OF EXTADDERR AT VIN = 5.50V	3.0E-9	8.0E-9	6.0E-9	5.0E-9	3.0E-9	A
IIH OF RDY D AT VIN = 5.50V	3.0E-9	7.0E-9	5.0E-9	4.0E-9	2.0E-9	A
IIH OF IOL AT VIN = 5.50V	3.0E-9	9.0E-9	6.0E-9	6.0E-9	3.0E-9	A
IIH OF IB00 AT VIN = 5.50V	22.0E-9	382.0E-9	163.0E-9	360.0E-9	141.0E-9	A
IIH OF IB03 AT VIN = 5.50V	24.0E-9	437.0E-9	188.0E-9	413.0E-9	164.0E-9	A
IIH OF IB12 AT VIN = 5.50V	25.0E-9	386.0E-9	173.0E-9	361.0E-9	148.0E-9	A
IIL OF EXTADDERR AT VIN = 0.00V	-4.0E-9	-5.0E-9	-3.0E-9	1.0E-9	1.0E-9	A
IIL OF RDY D AT VIN = 0.00V	-7.0E-9	-10.0E-9	-9.0E-9	3.0E-9	2.0E-9	A
IIL OF IOL1 AT VIN = 0.00V	-3.0E-9	-13.0E-9	-7.0E-9	10.0E-9	4.0E-9	A
IIL OB IB00 AT VIN = 0.00V	-20.0E-9	-52.0E-9	-31.0E-9	32.0E-9	11.0E-9	A
IIL OF IB03 AT VIN = 0.00V	-25.0E-9	-50.0E-9	-35.0E-9	25.0E-9	10.0E-9	A
IIL OF IB12 AT VIN = 0.00V	-21.0E-9	-43.0E-9	-30.0E-9	22.0E-9	9.0E-9	A
IOL OF IB00 AT VOL = 0.20V	17.9E-3	19.8E-3	20.6E-3	2.7E-3	2.7E-3	A
IOL OF IB00 AT VOL = 0.50V	43.1E-3	46.1E-3	47.6E-3	4.5E-3	4.5E-3	A
IOL OF STRB A AT VOL = 0.20V	19.2E-3	20.8E-3	21.3E-3	2.1E-3	2.1E-3	A
IOL OF STRB A AT VOL = 0.50V	46.1E-3	48.4E-3	49.4E-3	3.3E-3	3.3E-3	A
IOL OF D/I AT VOL = 0.20V	19.6E-3	16.8E-3	20.9E-3	2.8E-3	1.3E-3	A
IOL OF D/I AT VOL = 0.50V	47.1E-3	40.0E-3	48.6E-3	7.1E-3	1.5E-3	A
IOH OF IB00 AT VOH = Vcc-0.2V	-6.2E-3	-5.8E-3	-5.8E-3	400.0E-6	400.0E-6	A
IOH OF IB00 AT VOH = 2.40V	-37.7E-3	-36.7E-3	-35.3E-3	2.4E-3	2.4E-3	A
IOH OF STRB A AT VOH = Vcc-0.2V	-6.4E-3	6.1E-3	-6.1E-3	12.5E-3	300.0E-6	A
IOH OF STRB A AT VOH = 2.40V	-39.1E-3	-38.9E-3	-37.2E-3	1.9E-3	1.9E-3	A
IOH OF D/I AT VOH = Vcc-0.2V	-6.3E-3	-5.5E-3	-5.9E-3	800.0E-6	400.0E-6	A
IOH OF D/I AT VOH = 2.40V	-38.0E-3	-36.9E-3	-35.8E-3	2.2E-3	2.2E-3	A
IOZH OF IB00 AT VOZH = 2.40V	1.0E-9	54.0E-9	19.0E-9	53.0E-9	18.0E-9	A
IOZL OF IB00 AT VOZL = 0.50V	-12.0E-9	-18.0E-9	-14.0E-9	6.0E-9	2.0E-9	A
IOZH OF IB03 AT VOZH = 2.40V	1.0E-9	63.0E-9	22.0E-9	62.0E-9	21.0E-9	A
IOZL OF IB03 AT VOZL = 0.50V	-16.0E-9	-16.0E-9	-17.0E-9	1.0E-9	1.0E-9	A
IOZH OF D/I AT VOZH = 2.40V	0.0	62.0E-9	20.0E-9	62.0E-9	20.0E-9	A
IOZL OF D/I AT VOZL = 0.50V	-10.0E-9	-9.0E-9	-10.0E-9	1.0E-9	000.0E+0	A

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
PACE 1750A/SOS	16-Bit Microprocessor	MIL STD 1750A
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z3AEA PERF04-17	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

P1750AS - Lot No. PERF04-17

Serial No. A01003

PARAMETERS	PRE RADIATION	POST RADIATION	POST ANNEAL	MAXIMUM DRIFT	BEGIN-END DRIFT	UNIT
STATIC ICC AT VIN = 5.3V	0.0	0.0	0.0	000.0E+0	000.0E+0	A
STATIC ICC AT VIN = 0.2V	0.0	0.0	0.0	000.0E+0	000.0E+0	A
STATIC ICC AT VIN = 3.4V	4.0E-3	4.0E-3	4.0E-3	000.0E+0	000.0E+0	A
25 MHZ DYNAMIC ICC	28.0E-3	30.0E-3	28.0E-3	2.0E-3	000.0E+0	A
IIH OF EXTADDERR AT VIN = 5.50V	7.0E-9	11.0E-9	9.0E-9	4.0E-9	2.0E-9	A
IIH OF RDY D AT VIN = 5.50V	6.0E-9	8.0E-9	7.0E-9	2.0E-9	1.0E-9	A
IIH OF IOL AT VIN = 5.50V	7.0E-9	10.0E-9	8.0E-9	3.0E-9	1.0E-9	A
IIH OF IB00 AT VIN = 5.50V	23.0E-9	79.0E-9	48.0E-9	56.0E-9	25.0E-9	A
IIH OF IB03 AT VIN = 5.50V	22.0E-9	80.0E-9	48.0E-9	58.0E-9	26.0E-9	A
IIH OF IB12 AT VIN = 5.50V	22.0E-9	74.0E-9	45.0E-9	52.0E-9	23.0E-9	A
IIIL OF EXTADDERR AT VIN = 0.00V	-7.0E-9	-8.0E-9	-8.0E-9	1.0E-9	1.0E-9	A
IIIL OF RDY D AT VIN = 0.00V	-8.0E-9	-10.0E-9	-8.0E-9	2.0E-9	000.0E+0	A
IIIL OF IOL1 AT VIN = 0.00V	-5.0E-9	-9.0E-9	-7.0E-9	4.0E-9	2.0E-9	A
IIIL OB IB00 AT VIN = 0.00V	-82.0E-9	-69.0E-9	-80.0E-9	13.0E-9	2.0E-9	A
IIIL OF IB03 AT VIN = 0.00V	-80.0E-9	-64.0E-9	-76.0E-9	16.0E-9	4.0E-9	A
IIIL OF IB12 AT VIN = 0.00V	-74.0E-9	58.0E-9	-64.0E-9	132.0E-9	10.0E-9	A
IOL OF IB00 AT VOL = 0.20V	20.8E-3	23.3E-3	24.6E-3	3.8E-3	3.8E-3	A
IOL OF IB00 AT VOL = 0.50V	50.0E-3	54.3E-3	56.8E-3	6.8E-3	6.8E-3	A
IOL OF STRB A AT VOL = 0.20V	21.9E-3	23.8E-3	24.8E-3	2.9E-3	2.9E-3	A
IOL OF STRB A AT VOL = 0.50V	52.5E-3	55.5E-3	57.2E-3	4.7E-3	4.7E-3	A
IOL OF D/I AT VOL = 0.20V	22.7E-3	19.0E-3	24.6E-3	3.7E-3	1.9E-3	A
IOL OF D/I AT VOL = 0.50V	54.9E-3	45.3E-3	57.4E-3	9.6E-3	2.5E-3	A
IOH OF IB00 AT VOH = Vcc-0.2V	-8.2E-3	-7.8E-3	-7.9E-3	400.0E-6	300.0E-6	A
IOH OF IB00 AT VOH = 2.40V	-51.5E-3	-51.7E-3	-49.8E-3	1.7E-3	1.7E-3	A
IOH OF STRB A AT VOH = Vcc-0.2V	-8.4E-3	-8.0E-3	-8.1E-3	400.0E-6	300.0E-6	A
IOH OF STRB A AT VOH = 2.40V	-52.2E-3	-52.7E-3	-50.4E-3	1.8E-3	1.8E-3	A
IOH OF D/I AT VOH = Vcc-0.2V	-8.5E-3	-7.3E-3	-8.0E-3	1.2E-3	500.0E-6	A
IOH OF D/I AT VOH = 2.40V	-52.5E-3	-51.6E-3	-50.3E-3	2.2E-3	2.2E-3	A
IOZH OF IB00 AT VOZH = 2.40V	-13.0E-9	1.0E-9	-7.0E-9	14.0E-9	6.0E-9	A
IOZL OF IB00 AT VOZL = 0.50V	-54.0E-9	-43.0E-9	-53.0E-9	11.0E-9	1.0E-9	A
IOZH OF IB03 AT VOZH = 2.40V	-13.0E-9	2.0E-9	-6.0E-9	15.0E-9	7.0E-9	A
IOZL OF IB03 AT VOZL = 0.50V	-54.0E-9	-39.0E-9	-52.0E-9	15.0E-9	2.0E-9	A
IOZH OF D/I AT VOZH = 2.40V	-12.0E-9	1.0E-9	-3.0E-9	13.0E-9	9.0E-9	A
IOZL OF D/I AT VOZL = 0.50V	-62.0E-9	-47.0E-9	-44.0E-9	18.0E-9	18.0E-9	A

IRRADIATION TEST REPORT		
PART NUMBER	DEVICE TYPE	
PACE 1750A/SOS	16-Bit Microprocessor MIL STD 1750A	
WAFER LOTS	PACKAGE	SAMPLE SIZE
PERF03Z3AEA PERF04-17	CQFP-68 Gullwing	4 Microprocessors
IRRADIATION TEST PLAN		TEST DATE
Per MIL STD 883C, Method 1019		8/3/97 - 8/7/97

P1750AS - Lot No. PERF04-17

Serial No. B01004

PARAMETERS	PRE RADIATION	POST RADIATION	POST ANNEAL	MAXIMUM DRIFT	BEGIN-END DRIFT	UNIT
STATIC ICC AT VIN = 5.3V	0.0	0.0	0.0	000.0E+0	000.0E+0	A
STATIC ICC AT VIN = 0.2V	4.0E-3	0.0	0.0	4.0E-3	4.0E-3	A
STATIC ICC AT VIN = 3.4V	4.0E-3	4.0E-3	4.0E-3	000.0E+0	000.0E+0	A
25 MHZ DYNAMIC ICC	28.0E-3	30.0E-3	28.0E-3	2.0E-3	000.0E+0	A
IIH OF EXTADDERR AT VIN = 5.50V	8.0E-9	10.0E-9	9.0E-9	2.0E-9	1.0E-9	A
IIH OF RDY D AT VIN = 5.50V	7.0E-9	8.0E-9	7.0E-9	1.0E-9	000.0E+0	A
IIH OF IOL AT VIN = 5.50V	8.0E-9	10.0E-9	8.0E-9	2.0E-9	000.0E+0	A
IIH OF IB00 AT VIN = 5.50V	23.0E-9	132.0E-9	62.0E-9	109.0E-9	39.0E-9	A
IIH OF IB03 AT VIN = 5.50V	26.0E-9	147.0E-9	71.0E-9	121.0E-9	45.0E-9	A
IIH OF IB12 AT VIN = 5.50V	21.0E-9	128.0E-9	59.0E-9	107.0E-9	38.0E-9	A
III OF EXTADDERR AT VIN = 0.00V	-6.0E-9	-8.0E-9	-7.0E-9	2.0E-9	1.0E-9	A
III OF RDY D AT VIN = 0.00V	-7.0E-9	-8.0E-9	-7.0E-9	1.0E-9	000.0E+0	A
III OF IOL1 AT VIN = 0.00V	-6.0E-9	-11.0E-9	-8.0E-9	5.0E-9	2.0E-9	A
III OB IB00 AT VIN = 0.00V	-67.0E-9	-62.0E-9	-70.0E-9	5.0E-9	3.0E-9	A
III OF IB03 AT VIN = 0.00V	72.0E-9	-64.0E-9	-67.0E-9	139.0E-9	139.0E-9	A
III OF IB12 AT VIN = 0.00V	-75.0E-9	-60.0E-9	-62.0E-9	15.0E-9	13.0E-9	A
IOL OF IB00 AT VOL = 0.20V	22.9E-3	23.9E-3	24.8E-3	1.9E-3	1.9E-3	A
IOL OF IB00 AT VOL = 0.50V	53.7E-3	55.7E-3	57.3E-3	3.6E-3	3.6E-3	A
IOL OF STRB A AT VOL = 0.20V	23.6E-3	24.4E-3	24.9E-3	1.3E-3	1.3E-3	A
IOL OF STRB A AT VOL = 0.50V	55.3E-3	56.9E-3	57.7E-3	2.4E-3	2.4E-3	A
IOL OF D/I AT VOL = 0.20V	18.9E-3	18.9E-3	24.4E-3	5.5E-3	5.5E-3	A
IOL OF D/I AT VOL = 0.50V	44.5E-3	45.2E-3	56.8E-3	12.3E-3	12.3E-3	A
IOH OF IB00 AT VOH = Vcc-0.2V	-7.9E-3	-7.7E-3	-7.9E-3	200.0E-6	000.0E+0	A
IOH OF IB00 AT VOH = 2.40V	-54.2E-3	-51.0E-3	-49.4E-3	4.8E-3	4.8E-3	A
IOH OF STRB A AT VOH = Vcc-0.2V	-8.1E-3	-7.9E-3	-8.0E-3	200.0E-6	100.0E-6	A
IOH OF STRB A AT VOH = 2.40V	-54.5E-3	-52.1E-3	-50.3E-3	4.2E-3	4.2E-3	A
IOH OF D/I AT VOH = Vcc-0.2V	-7.5E-3	-7.3E-3	-7.9E-3	400.0E-6	400.0E-6	A
IOH OF D/I AT VOH = 2.40V	-53.5E-3	-50.8E-3	-49.2E-3	4.3E-3	4.3E-3	A
IOZH OF IB00 AT VOZH = 2.40V	-9.0E-9	7.0E-9	-4.0E-9	16.0E-9	5.0E-9	A
IOZL OF IB00 AT VOZL = 0.50V	-47.0E-9	-38.0E-9	-46.0E-9	9.0E-9	1.0E-9	A
IOZH OF IB03 AT VOZH = 2.40V	-9.0E-9	8.0E-9	-2.0E-9	17.0E-9	7.0E-9	A
IOZL OF IB03 AT VOZL = 0.50V	-48.0E-9	-37.0E-9	-44.0E-9	11.0E-9	4.0E-9	A
IOZH OF D/I AT VOZH = 2.40V	-7.0E-9	6.0E-9	-2.0E-9	13.0E-9	5.0E-9	A
IOZL OF D/I AT VOZL = 0.50V	-38.0E-9	-33.0E-9	-31.0E-9	7.0E-9	7.0E-9	A