Government Systems Group

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DATE: November 22, 1994 PPM-95-102

TO: V. Patel/406.0
FROM: K. Sahu/300.1
SUBJECT: Radiation Report on EOS/AM
Part No. F100325
Control No. 8524

cc: A. Sharma/311
P. Dudek/300.1
Library/300.1

A radiation evaluation was performed on F100325 (Hex ECL to TTL Translator) 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 IV and Figure 1.

The total dose testing was performed using a ^{60}Co gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration), and two part were used as control samples. The total dose radiation levels were 5, 10, 20, 30, 50, 75 and 100 krads*. The dose rate was between 0.08 and 1.47 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 100 krad irradiation, parts were annealed at 25°C for 168 hours, after which the parts were annealed at 100°C for 168 hours. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits** listed in Table III. These tests included seven functional tests, four at 1.0MHz and three at 10MHz.

All parts passed initial electrical measurements. All irradiated parts passed all electrical and functional tests up to and including the 100 krad level.

After annealing for 168 hours at 25°C, all parts passed all electrical and functional tests.

After annealing for 168 hours at 100°C, no rebound effects were observed in the parts.

Table IV provides a summary of the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

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

*The term rads, as used in this document, means rads(silicon). 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.

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TABLE I. Part Information

Generic Part Number:	F100325
EOS/AM Part Number:	5962-9153101MYA
EOS/AM Control Number:	8524
Charge Number:	EI44406
Manufacturer:	National Semiconductor
Lot Date Code:	9416A, 9405A
Quantity Tested:	8
Serial Number of Control Samples:	50, 51
Serial Numbers of Radiation Samples:	52, 53, 54, 55, 56, 57, 58, 59
Part Function:	Low power HEX ECL-To-TTL Translator
Part Technology:	Logic Device
Package Style:	24 Lead Quad Flat Package
Test Equipment:	S-50
Test Engineer:	Ted Scharer

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

TABLE II. Radiation Schedule for5962-9153001MYA

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	09/19/94
2) 5 KRAD IRRADIATION (0.08 KRADS/HOUR)	09/22/94
POST-5 KRAD ELECTRICAL MEASUREMENT	09/26/94
3) 10 KRAD IRRADIATION (0.29 KRADS/HOUR)	09/26/94
POST-10 KRAD ELECTRICAL MEASUREMENT	09/27/94
4) 20 KRAD IRRADIATION (0.59 KRADS/HOUR)	09/27/94
POST-20 KRAD ELECTRICAL MEASUREMENT	09/28/94
5) 30 KRAD IRRADIATION (0.89 KRADS/HOUR)	09/28/94
POST-30 KRAD ELECTRICAL MEASUREMENT	09/29/94
6) 50 KRAD IRRADIATION (1.18 KRADS/HOUR)	09/29/94
POST-50 KRAD ELECTRICAL MEASUREMENT	09/30/94
7) 75 KRAD IRRADIATION (0.39 KRADS/HOUR)	09/30/94
POST-75 KRAD ELECTRICAL MEASUREMENT	10/03/94
8) 100 KRAD IRRADIATION (1.47 KRADS/HOUR)	10/03/94
POST-100 KRAD ELECTRICAL MEASUREMENT	10/04/94
10) 168-HOUR ANNEALING @25°C	19/04/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/13/94
11) 168-HOUR ANNEALING @100°C**	10/13/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/20/94

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

*High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of F100325

FUNCTIONAL TESTS PERFORMED

PARAMETER	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS
FUNCT.#1	4.5V	-4.2V	-1.83V	-0.87V	FREQ= 1.0MHZ	I/O	VOL<+2.25V VOH>+2.25V
FUNCT.#2	5.5V	-4.2V	-1.83V	-0.87V	FREQ= 1.0MHZ	I/O	VOL<+2.75V VOH>+2.75V
FUNCT.#3	4.5V	-5.7V	-1.83V	-0.87V	FREQ= 1.0MHZ	I/O	VOL<+2.25V VOH>+2.25V
FUNCT.#3	5.5V	-5.7V	-1.83V	-0.87V	FREQ= 1.0MHZ	I/O	VOL<+2.75V VOH>+2.75V
FUNCT.#5	4.5V	-4.2V	-1.83V	-0.87V	FREQ=10.0MHZ	I/O	VOL<+2.25V VOH>+2.25V
FUNCT.#6	5.0V	-5.2V	-1.83V	-0.87V	FREQ=10.0MHZ	I/O	VOL<+2.5V VOH>+2.5V
FUNCT.#7	5.5V	-5.7V	-1.83V	-0.87V	FREQ=10.0MHZ	I/O	VOL<+2.75V VOH>+2.75V

LOADS USED FOR ALL FUNCTIONAL TESTS, Q'S: IOH = -500UA IOL = +5MA
LOADS USED FOR ALL FUNCTIONAL TESTS, VBB: IOH = -300UA

DC TESTS PERFORMED

TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS	
VOH1	+25C	4.5V	-4.2V	-1.83V	-0.87V	LOAD=-2.0MA	OUTS	>+2.5V	<+4.5V
VOH2	+25C	4.5V	-5.7V	-1.83V	-0.87V	LOAD=-2.0MA	OUTS	>+2.5V	<+4.5V
VOH1	-55C	4.5V	-4.2V	-1.83V	-0.87V	LOAD=-2.0MA	OUTS	>+2.4V	<+4.5V
VOH2	-55C	4.5V	-5.7V	-1.83V	-0.87V	LOAD=-2.0MA	OUTS	>+2.4V	<+4.5V
VOH1	+125C	4.5V	-4.2V	-1.83V	-0.87V	LOAD=-2.0MA	OUTS	>+2.5V	<+4.5V
VOH2	+125C	4.5V	-5.7V	-1.83V	-0.87V	LOAD=-2.0MA	OUTS	>+2.5V	<+4.5V
VOL1	+25C	4.5V	-4.2V	-1.83V	-0.87V	LOAD=+20.0MA	OUTS	>0.0V	<+0.5V
VOL2	+25C	4.5V	-5.7V	-1.83V	-0.87V	LOAD=+20.0MA	OUTS	>0.0V	<+0.5V
VOL1	-55C	4.5V	-4.2V	-1.83V	-0.87V	LOAD=+20.0MA	OUTS	>0.0V	<+0.5V
VOL2	-55C	4.5V	-5.7V	-1.83V	-0.87V	LOAD=+20.0MA	OUTS	>0.0V	<+0.5V
VOL1	+125C	4.5V	-4.2V	-1.83V	-0.87V	LOAD=+20.0MA	OUTS	>0.0V	<+0.5V
VOL2	+125C	4.5V	-5.7V	-1.83V	-0.87V	LOAD=+20.0MA	OUTS	>0.0V	<+0.5V

TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS	
VBB1	+25C	5.0V	-4.2V	-1.65V	-1.02V	LOAD=-3.0UA	VBB	>-4.2V	<-1.260V
VBB1	-55C	5.0V	-4.2V	-1.65V	-1.02V	LOAD=-3.0UA	VBB	>-4.2V	<-1.260V
VBB1	+125C	5.0V	-4.2V	-1.65V	-1.02V	LOAD=-3.0UA	VBB	>-4.2V	<-1.260V
VBB2	+25C	5.0V	-5.7V	-1.65V	-1.02V	LOAD=-2.1MA	VBB	>-1.38V	< 0.0V
VBB2	-55C	5.0V	-5.7V	-1.65V	-1.02V	LOAD=-3.0MA	VBB	>-1.396V	< 0.0V
VBB2	+125C	5.0V	-5.7V	-1.65V	-1.02V	LOAD=-2.1MA	VBB	>-1.38V	< 0.0V

TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS	
IIH	+25C	5.0V	-5.7V	-1.65V	-0.87V	VTEST= -0.87V	INS	>+0.00UA	<+350UA
IIH	-55C	5.0V	-5.7V	-1.65V	-0.87V	VTEST= -0.87V	INS	>+0.00UA	<+500UA
IIH	+125C	5.0V	-5.7V	-1.65V	-0.87V	VTEST= -0.87V	INS	>+0.00UA	<+350UA
IIL	ALL	5.5V	-4.2V	-1.83V	-1.02V	VTEST= -1.83V	INS	>+0.5UA	<+5.0MA

TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS
IOS	ALL	5.5V	-4.5V	-1.65V	-1.02V	VOUT = 0V	OUTS	>-120.0MA <-60.0MA

TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS
IEE1	ALL	5.0V	-4.2V	-1.65V	-1.02V	VIN = -1.02V	VEE	>-35.0MA <-12.0MA
IEE2	ALL	5.0V	-5.7V	-1.65V	-1.02V	VIN = -1.02V	VEE	>-35.0MA <-12.0MA
ITTL	ALL	5.5V	-4.5V	-1.65V	VBB	VIN = VBB	VTTL	>+0.00MA <+65.0MA

AC TESTS PERFORMED

TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS	
TPLH	+25C	5.0V	-4.0V	-1.65V	-1.02V	FREQ=1.00MHZ	OUTS	>100PS	<10.0NS
TPHL	+25C	5.0V	-4.0V	-1.65V	-1.02V	FREQ=1.00MHZ	OUTS	>100PS	<10.0NS

COMMENTS AND EXCEPTIONS

(1) -120MA IS THE MINIMUM LIMIT USED FOR THE IOS TEST INSTEAD OF THE -150MA GIVEN IN THE SMD. THIS IS BECAUSE THE 128MA RANGE OF THE PMU HAD TO BE USED AND THE -120MA LIMIT WILL ALLOW OVERRANGE INDICATIONS TO BE FLAGGED AS FAILURES. THE 256MA RANGE OF THE PMU YIELDS ERRONOUS DATA.

(2) VDIFF IS NOT PERFORMED.

(3) VCM IS NOT PERFORMED.

(4) ARBITRARY LIMITS ARE USED FOR THE AC TESTS TO ASSURE ANY READINGS OBTAINED WILL PASS. THE ACTUAL TESTS LIMITS FOR THE AC TESTS SHOULD BE 1.6NS TO 4.7NS. A SCOPE WAS USED TO MEASURE ACTUAL VALUES OF APPROXIMATELY 1NS FOR TPLH AND 8NS FOR TPHL. THE VALUES RETURNED FOR THESE TESTS DO NOT CORRELATE WITH THESE VALUES.

(5) THE TTLH AND TTHL TESTS ARE NOT PERFORMED DUE TO THE 600PS ACCURACY LIMITATION OF THE TEST EQUIPMENT. THIS ACCURACY WILL ALSO AFFECT THE MEASUREMENTS OF THE TPLH AND TPHL TESTS.

(6) THE INPUT LEVELS USED FOR FUNCTIONAL TESTS 1-4 ARE NOT THE -1.644 AND -1.023 VALUES SPECIFIED IN THE SMD DUE TO THRESHOLD PROBLEMS PROBABLY CAUSED BY THE LOAD BOARD.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for F100325 /1

Test #	Parameters		Spec. Lim./2 min	Spec. Lim./2 max	Initials mean	Initials sd	Total Dose Exposure (krads) 5 mean	5 sd	10 mean	10 sd	20 mean	20 sd	30 mean	30 sd	50 mean	50 sd	75 mean	75 sd	100 mean	100 sd	Annealing 168 hrs @25°C mean	168 hrs @25°C sd	168 hrs @100°C mean	168 hrs @100°C sd
1	VOH1	mV	2500	4500	2923	40	2877	37	2869	31	2892	6.9	2842	38	2891	11	2877	5.6	2877	5.8	2870	5.8	2913	41
2	VOH2	mV	2590	4500	2952	18	2913	19	2913	17	2895	7.1	2906	18	2895	8.99	2880	3.8	2881	3.9	2880	4.2	2891	19
3	VOL1	mV	0	500	359	2.8	359	2.8	360	3.1	360	3.1	360	4.1	360	2.5	360	2.9	363	3.2	362	3.1	360	2.7
4	VOL2	mV	0	500	358	2.8	359	2.8	360	2.9	360	2.9	360	3.9	360	2.7	360	2.9	369	3.3	365	3.1	360	2.8
5	VBB1	mV	-4200	-1260	-1302	4.3	-1303	4.7	-1306	4.9	-1306	4.7	-1306	4.9	-1305	4.8	-1305	4.6	-1304	5	-1304	4.9	-1305	5.1
6	VBB2	mV	-1380	0	-1313	5.9	-1329	6.3	-1334	6.4	-1333	6.2	-1333	5.9	-1331	5.8	-1331	5.4	-1331	5.7	-1330	5.6	-1331	5.7
7	IIH	uA	0	350	139	6.8	134	6.3	133	6.6	130	6.5	130	6.8	130	6.8	130	7.1	131	7	130	6.9	129	6.2
8	IIL	uA	0.5	5000	62	2.3	60	2.1	59	2.3	58	2.2	58	2.4	58	2.3	57	2.4	58	2.3	57	2.4	57	2.2
9	IOS	mA	-120	-60	-88	0.5	-93	0.5	-90	0.5	-88	0.5	-88	0.5	-89	0.5	-89	0.5	-89	0.5	-88	0.5	-89	0.7
10	IEE1	mA	-35	-12	-21	0.6	-21	0.6	-21	0.6	-21	0.6	-21	0.5	-21	0.6	-21	0.5	-21	0.5	-21	0.5	-21	0.5
11	IEE2	mA	-35	-12	-22	0.9	-23	0.8	-22	0.8	-21	0.7	-22	0.6	-22	0.6	-22	0.6	-22	0.6	-22	0.6	-22	0.6
12	ITTL	mA	0	65	49	0.7	49	0.7	49	0.7	49	0.6	49	0.6	48	0.6	48	0.6	48	0.6	49	0.6	48	0.6
13	TPLH	nS	0.1	10	2.9	0.4	2.8	0.4	2.9	0.4	3	0.4	2.8	0.4	3.7	0.4	4.6	0.4	5.1	0.4	5.2	0.4	4.9	0.4
14	TPHL	nS	0.1	10	4.1	1.3	4.1	1.3	4.3	1.4	4.3	1.3	4.2	1.3	5.7	1.4	5.7	1.3	6	1.2	5.5	1.3	6.2	1.1
15	FUNC1, Vcc=-4.2V, Vih=-1.83V, Vil=-0.87V, 1MHz /3				P		P		P		P		P		P		P		P		P		P	
16	FUNC2, Vcc=-4.2V, Vih=-1.83V, Vil=-0.87V, 1MHz				P		P		P		P		P		P		P		P		P		P	
17	FUNC3, Vcc=-5.7V, Vih=-1.83V, Vil=-0.87V, 1MHz				P		P		P		P		P		P		P		P		P		P	
18	FUNC5, Vcc=-5.7V, Vih=-1.83V, Vil=-0.87V, 1MHz				P		P		P		P		P		P		P		P		P		P	
19	FUNC5, Vcc=-4.2V, Vih=-1.83V, Vil=-0.87V, 10MHz				P		P		P		P		P		P		P		P		P		P	
20	FUNC6, Vcc=-5.2V, Vih=-1.83V, Vil=-0.87V, 10MHz				P		P		P		P		P		P		P		P		P		P	
21	FUNC7, Vcc=-5.7V, Vih=-1.83V, Vil=-0.87V, 10MHz				P		P		P		P		P		P		P		P		P		P	

Notes:

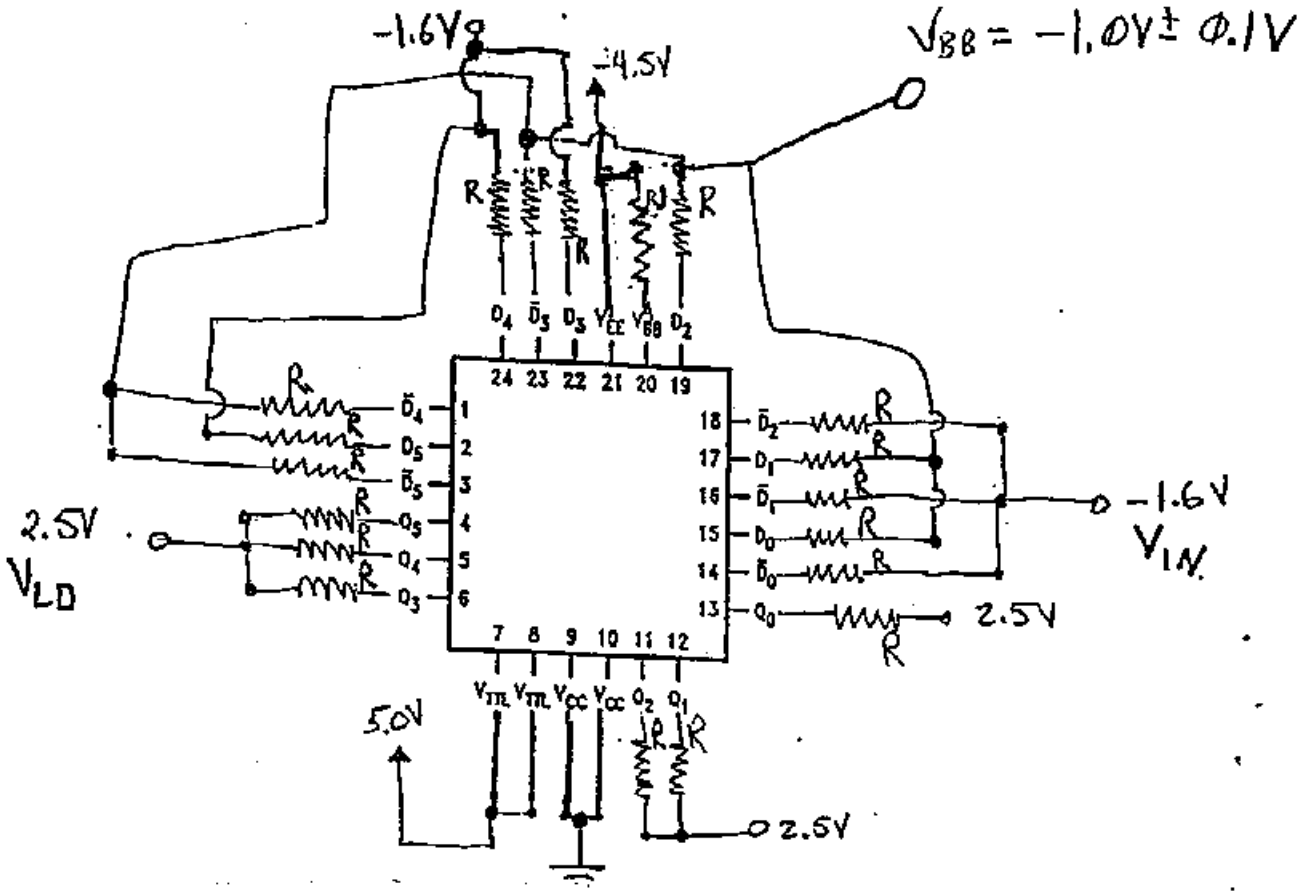
1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the testing and is not included in this table.

2/ These are manufacturer's non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

3/ In the Functional Tests, "P" means that all parts passed this test at this irradiation or annealing level, "F" means that all parts failed this test at this irradiation or annealing level and, "nPmF" means that n parts passed at this level and m parts failed at this level.

4/ **Radiation-sensitive parameters: none.**

Figure 1. Radiation Bias Circuit for F100325



I_{TT} (total) ≤ 520 mA
I_{EE} (total) ≤ 280 mA
Q_0, Q_1, Q_2 = high
Q_3, Q_4, Q_5 = low
$V_{BB} \cong$ -103 V

Pin Names	Description
D_0–D_5	Data Inputs
$\overline{D}_0$–$\overline{D}_5$	Inverting Data Inputs
Q_0–Q_5	Data Outputs

NOTES

1. V_{TT} =5.0 V ± 0.5 V, V_{CC}=0.0V
2. V_{EE} =-4.5 V ± 0.5 V
3. V_{IN} =-1.6 V ± 0.1 V
4. V_{LD}= 2.5 V ± 0.5 V
5. R=2000Ω ± 10%, 1/4 W (max I_{out} = 2.5V/2kΩ=1.25mA)
6. R_1=10kΩ ± 10%, 1/4 W
7. V_{BB}=-1.0V ± 0.1 V