

**UNISYS**

DATE: November 8, 1994

TO: V. Patel/406.0

FROM: K. Saha/300.1 *KS*

SUBJECT: Radiation Report on EOS/AM  
Part No. F100324  
Control No. 8523

PPM-94-040

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

A radiation evaluation was performed on F100324 (Hex TTL to ECL 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  $^{60}\text{Co}$  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 krad\*. The dose rate was between 0.17 and 1.47 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 50 krad irradiation, the 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 six functional tests, three at 1.0 MHz and three at 10.0 MHz.

All parts passed initial electrical measurements. All irradiated parts passed all electrical tests up to and including the 30 krad level. At the 50 krad level, all parts marginally exceeded the maximum specification limit of -1.62V for VOL1, with readings in the range of -1.59V to -1.61V, and exceeded the maximum specification limit of -1.61V for VOLC1, with readings in the range of -1.59V to -1.6V. After the 75 and 100 krad irradiations, the same degradation in VOL continued, with readings in the range of -1.51 to -1.62 V. All irradiated parts passed all other parametric and functional tests throughout all irradiation and annealing steps.

After annealing for 312 hours\*\*\* at 25°C, all parts passed all electrical 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 non-irradiation data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

\*\*\*Due to a malfunction of the test equipment, the originally-scheduled 168-hour annealing at 25°C was continued for an additional 144 hours.

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TABLE I. Part Information

Generic Part Number:	100324
EOS/AM Part Number:	5962-9153001MYA
EOS/AM Control Number:	8523
Charge Number:	EI44406
Manufacturer:	National Semiconductor
Lot Date Code:	9413A
Quantity Tested:	8
Serial Number of Control Sample:	50, 51
Serial Numbers of Radiation Sample:	52, 53, 54, 55, 56, 57, 58, 59
Part Function:	Low power HEX TTL-To-ECL Translator
Part Technology:	Bipolar
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 for F100324

EVENT'S	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	09/08/94
2) 5 KRAD IRRADIATION (0.26 KRADS/HOUR) POST-5 KRAD ELECTRICAL MEASUREMENT	09/20/94 09/21/94
3) 10 KRAD IRRADIATION (0.29 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENT	09/21/94 09/22/94
4) 20 KRAD IRRADIATION (0.17 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENT	09/22/94 09/26/94
5) 30 KRAD IRRADIATION (0.59 KRADS/HOUR) POST-30 KRAD ELECTRICAL MEASUREMENT	09/26/94 09/27/94
6) 50 KRAD IRRADIATION (1.18 KRADS/HOUR) POST-50 KRAD ELECTRICAL MEASUREMENT	09/27/94 09/28/94
7) 75 KRAD IRRADIATION (1.47 KRADS/HOUR) POST-75 KRAD ELECTRICAL MEASUREMENT	09/28/94 09/29/94
8) 100 KRAD IRRADIATION (1.47 KRADS/HOUR) POST-100 KRAD ELECTRICAL MEASUREMENT	09/29/94 09/30/94
10) 312-HOUR* ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	09/30/94 10/13/94
11) 168-HOUR ANNEALING @100°C** POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/13/94 10/20/94

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

\*Due to a malfunction of the test equipment, the originally-scheduled 168-hour annealing at 25°C was continued for an additional 144 hours.

\*\*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 F100324

PART NO : 5962-9153001MYA (F100324)		LOW POWER HEX TTL->ECL TRANSLATOR								
PCN : SI10667A		SPECS : SMD 5962-9153D 21-MAY-1992								
LOCATION : LIBRARY		DIRECTORY : [LIBRARY.667]								
FUNCTIONAL TESTS PERFORMED										
PARAMETER	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS			
FUNCT. #1	4.5V	-4.2V	0.40V	2.40V	FREQ=1.0MHZ	I/O	VOL<-1.3V	VOH>-1.3V	FREQ=1.0MHZ	
FUNCT. #2	5.5V	-4.2V	0.40V	2.40V	FREQ=1.0MHZ	I/O	VOL<-1.3V	VOH>-1.3V	FREQ=1.0MHZ	
FUNCT. #3	4.5V	-5.7V	0.40V	2.40V	FREQ=1.0MHZ	I/O	VOL<-1.3V	VOH>-1.3V	FREQ=1.0MHZ	
FUNCT. #4	5.5V	-5.7V	0.00V	2.40V	FREQ=1.0MHZ	I/O	VOL<-1.3V	VOH>-1.3V	FREQ=1.0MHZ	
FUNCT. #5	4.5V	-4.2V	0.00V	2.50V	FREQ=10.0MHZ	I/O	VOL<-1.3V	VOH>-1.3V	FREQ=10.0MHZ	
FUNCT. #6	5.5V	-4.2V	0.00V	2.50V	FREQ=10.0MHZ	I/O	VOL<-1.3V	VOH>-1.3V	FREQ=10.0MHZ	
FUNCT. #7	5.5V	-5.7V	0.00V	2.50V	FREQ=10.0MHZ	I/O	VOL<-1.3V	VOH>-1.3V	FREQ=10.0MHZ	
LOAD FOR ALL FUNCTIONAL TESTS IS +/- 20MA										
DC TESTS PERFORMED										
TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS		
VOH1	+25C	5.0V	-4.2V	+0.0V	+5.0V	LOAD=-23.0MA	OUTS	>-1025MV	<-870MV	
VJH2	+25C	5.0V	-5.7V	+0.0V	+5.0V	LOAD=-23.0MA	OUTS	>-1025MV	<-870MV	
VJH1	-25C	5.0V	-4.2V	+0.0V	+5.0V	LOAD=-23.0MA	OUTS	>-1085MV	<-870MV	
VJH2	-25C	5.0V	-5.7V	+0.0V	+5.0V	LOAD=-23.0MA	OUTS	>-1085MV	<-870MV	
VOH1	+125C	5.0V	-4.2V	+0.0V	+5.0V	LOAD=-23.0MA	OUTS	>-1085MV	<-870MV	
VJH2	+125C	5.0V	-5.7V	+0.0V	+5.0V	LOAD=-23.0MA	OUTS	>-1025MV	<-870MV	
VOL1	+25C	5.0V	-4.2V	+0.0V	+5.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1620MV	
VOL2	+25C	5.0V	-5.7V	+0.0V	+5.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1620MV	
VOL1	-25C	5.0V	-4.2V	+0.0V	+5.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1555MV	
VOL2	-25C	5.0V	-5.7V	+0.0V	+5.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1555MV	
VOL1	+125C	5.0V	-4.2V	+0.0V	+5.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1620MV	
VOL2	+125C	5.0V	-5.7V	+0.0V	+5.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1620MV	
TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS		
VOHC1	+25C	5.0V	-4.2V	+0.8V	+2.0V	LOAD=-23.0MA	OUTS	>-1035MV	<-870MV	
VOHC2	+25C	5.0V	-5.7V	+0.8V	+2.0V	LOAD=-23.0MA	OUTS	>-1035MV	<-870MV	
VOHC1	-25C	5.0V	-4.2V	+0.8V	+2.0V	LOAD=-23.0MA	OUTS	>-1085MV	<-870MV	
VOHC2	-25C	5.0V	-5.7V	+0.8V	+2.0V	LOAD=-23.0MA	OUTS	>-1085MV	<-870MV	
VOHC1	+125C	5.0V	-4.2V	+0.8V	+2.0V	LOAD=-23.0MA	OUTS	>-1035MV	<-870MV	
VOHC2	+125C	5.0V	-5.7V	+0.8V	+2.0V	LOAD=-23.0MA	OUTS	>-1035MV	<-870MV	
VOLC1	+25C	5.0V	-4.2V	+0.8V	+2.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1610MV	
VOLC2	+25C	5.0V	-5.7V	+0.8V	+2.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1610MV	
VOLC1	-25C	5.0V	-4.2V	+0.8V	+2.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1555MV	
VOLC2	-25C	5.0V	-5.7V	+0.8V	+2.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1555MV	
VOLC1	+125C	5.0V	-4.2V	+0.8V	+2.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1610MV	
VOLC2	+125C	5.0V	-5.7V	+0.8V	+2.0V	LOAD=-9.0MA	OUTS	>-1830MV	<-1610MV	
TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS		
VFCO	ALL	4.5V	-4.5V	-	-	LOAD=-18.0MA	INS	>-1.200V	<-0.00CV	

Table III (Cont'd.). Electrical Characteristics of FI00324

TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS
I1H1	ALL	5.5V	-4.5V	+0.0V	+2.7V	VTEST = +2.7V	INS	>+0.00UA <+ 20UA
I1BVI	ALL	5.5V	-4.5V	+0.0V	+5.5V	VTEST = +5.5V	INS	>+0.00UA <+100UA
I1L2	ALL	5.5V	-4.5V	+0.0V	+5.5V	VTEST = +0.5V	F	>-5.40MA <+0.0MA
I1L1	ALL	5.5V	-4.5V	+0.0V	+5.5V	VTEST = +0.5V	D	>-0.90MA <+0.0MA
TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS
I1E1	ALL	5.0V	-4.2V	+0.0V	+5.0V	VIN = +5.00V	VEE	>-70.0MA <-22.0MA
I1E2	ALL	5.0V	-5.7V	+0.0V	+5.0V	VIN = +5.00V	VEE	>-70.0MA <-22.0MA
I1TL	ALL	5.5V	-4.5V	+0.0V	+5.5V	VIN = +0.00V	VTTL	>+0.00MA <+38.0MA
AC TESTS PERFORMED								
TEST	TEMP	VTTL	VEE	VIL	VIH	CONDITIONS	PINS	LIMITS
TPLH	+25C	5.0V	-4.5V	+0.0V	+3.0V	FREQ=1.00MHZ	OUTS	>0.5NS <10.0NS
TPHL	+25C	5.0V	-4.5V	+0.0V	+3.0V	FREQ=1.00MHZ	OUTS	>0.5NS <10.0NS
COMMENTS AND EXCEPTIONS								
(1) 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.								
(2) AN ARBITRARY LIMIT OF 10.0NS WAS USED FOR THE PROPAGATION DELAY TESTS. THIS WAS DONE SINCE READINGS LESS THAN THE SPECIFIED 2.9NS COULD NOT BE OBTAINED USING THE LOAD BOARD AND ADAPTER COMBINATION USED ON THE S-50. IT IS BELIEVED THAT THE LEAD LENGTH AND TRACES ON THE ADAPTER CAUSED THE READINGS TO EXCEED THE SPECIFIED TEST LIMITS.								
(3) VOHC AND VOLC ARE SPECIFIED WITH A SINGLE LIMIT. THE MAX LIMIT SHOWN FOR VOHC AND THE MIN LIMIT SHOWN FOR VOLC WERE ADDED TO PROVIDE TWO LIMITS.								
(4) ARBITRARY DELTA LIMITS FOR ALL PARAMETERS ARE +/-20% OF THE TEST LIMIT.								

**TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for F100324 /1**

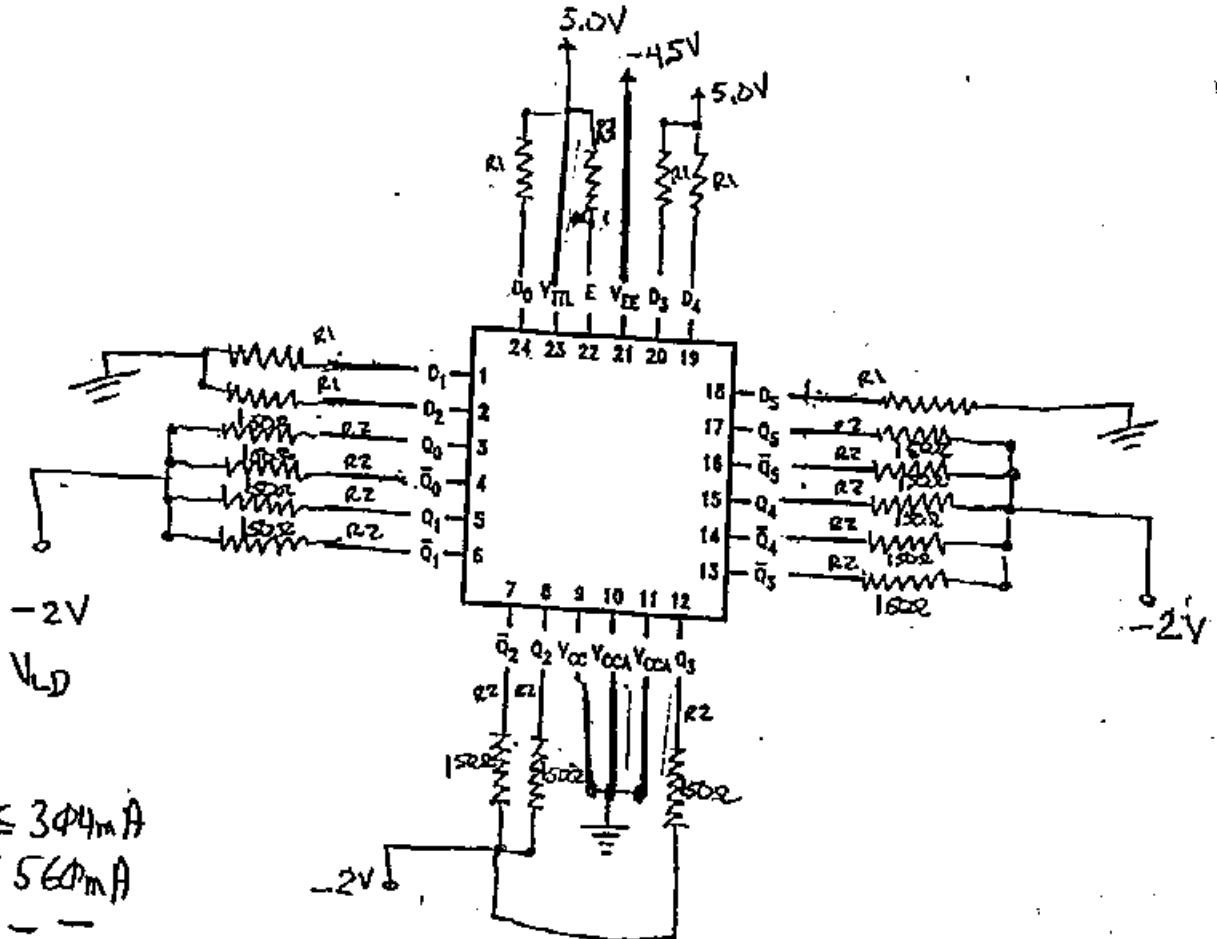
Parameters	Units	Spec. Lim./2		Initials		Total Dose Exposure (krads)												Annealing					
		min	max	mean sd		5		10		20		30		50		75		100		168 hrs @25°C		168 hrs @100°C	
						mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
VOH1	mV	-1020	-870	-940	4	-940	3.63	-939	3.83	-937	3.9	-929	6	-916	12	-909	14.7	-904	18	-930	11	-942	5.4
VOH2	mV	1.02	-870	-961	5	-961	4.08	-961	4.1	-958	4.5	-950	6.4	-935	13	-923	18.2	-917	23	-950	12	-963	5.6
VOL1	V	-1.83	-1.62	-1.7	4.18	-1.7	3.97	-1.7	3.98	-1.69	4.8	-1.7	11	-1.6	31	-1.6	48	-1.6	62	-1.7	28	-1.7	4.1
VOL2	V	-1.83	-1.62	-1.75	4.64	-1.75	4.4	-1.75	4.36	-1.74	5.23	-1.7	11	-1.6	31	-1.6	48	-1.6	62	-1.7	28	-1.7	4.1
VOHC1	mV	-1030	-870	-938	4.18	-938	3.69	-937	3.85	-935	4.07	-927	6.1	-913	12.6	-904	17	-898	21	-928	11	-939	5.3
VOHC2	mV	-1030	-870	-960	4.47	-960	4.09	-959	4.16	-957	4.5	-949	6.5	-934	13.4	-922	19	-915	24	-949	12	-962	5.5
VOLC1	V	-1.83	-1.61	-1.7	4.29	-1.7	4.08	-1.7	4.14	-1.69	4.74	-1.7	11	-1.6	30.9	-1.6	46	-1.6	60	-1.7	27	-1.7	4.2
VOLC2	V	-1.83	-1.61	-1.75	4.76	-1.76	4.31	-1.75	4.45	-1.75	5.29	-1.73	11	-1.7	29.9	-1.7	45	-1.6	59	-1.7	28	-1.7	4.2
VPCD	mV	-1200	0	-770	25.3	-764	17.8	-764	18	-764	18.3	-764	19	-762	20.5	-764	19	-764	23.5	-764	21	-770	20.6
IIB1	µA	0	20	0	0	0	0	0	0	0	.01	0.03	.08	0.12	.30	0.25	.63	0.25	.65	0.05	.12	0.04	.10
IBV1	µA	0	100	0	0	0	0	0	0	0	.01	0.03	.08	0.12	.31	0.25	.65	0.26	.67	0.05	.13	0.04	.10
IIL2	mA	-5.4	0	-3.2	40.4	-3.2	35.9	-3.23	39.5	0.03	39.3	-3.2	38	-3.3	35.4	-3.3	35	-3.3	32	-3.3	43	-3.3	41
IIL1	µA	-900	0	-536	8.61	-538	8.4	-541	8.99	0	9.7	-548	9.7	-546	10.5	-548	11	-543	12	-546	14	-545	12.3
IEE1	mA	-70	-22	-43	143	-43	135	-43.8	129	-44	171	-45	214	-46	291	-47	302	-48	354	-45	481	-44	154
IEE2	mA	-70	-22	-47	165	-47	179	-47.5	157	-47	166	-49	224	-50	284	-51	326	-52	357	-49	491	-47	167
ITTL	mA	0	38	24.5	120	24.6	131	24.5	117	25	152	27	274	29	415	31	461	33	528	27	635	25	118
TPLH	ns	0.5	10	2.6	1.26	3.4	762	3.4	769	3.5	757	3.4	757	3.3	774	3.1	810	4.7	865	5.4	799	5.5	726
TPLH E	ns	0.5	10	2.8	1.36	3.4	703	3.4	723	3.5	708	3.5	711	3.3	722	3.2	727	4.8	746	5.4	761	5.6	718
TPHL	ns	0.5	10	2.47	1.33	2.76	508	2.76	496	2.85	495	2.9	484	3	467	3.1	474	4.8	423	4.9	453	4.9	439
TPHL E	ns	0.5	10	2.6	1.53	2.82	438	2.8	439	2.9	428	3	423	3	410	3.1	416	4.9	389	4.9	417	5	440

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/ The radiation sensitive parameters were VOL1, VOL2 and VOLC1.

Figure 1. Radiation Bias Circuit for F100324



$I_{TL}(total) \leq 304mA$   
 $I_{EE}(total) \leq 560mA$   
 $Q_1, Q_2, Q_5, \bar{Q}_0, \bar{Q}_3, \bar{Q}_4 = Low (\approx -1.8V \text{ to } -1.6V)$   
 $\bar{Q}_1, \bar{Q}_2, \bar{Q}_5, Q_0, Q_3, Q_4 = high (\approx -11V \text{ to } -0.87V)$   
 $I_{out} \approx 5mA$

Pin Names	Description
D <sub>0</sub> -D <sub>5</sub>	Data Inputs
E	Enable Input
Q <sub>0</sub> -Q <sub>5</sub>	Data Outputs
$\bar{Q}_0$ - $\bar{Q}_5$	Complementary Data Outputs

NOTES:

- 1)  $V_{TL} = 5.0V \pm 0.5V$ ,  $V_{cc}, V_{ccA} = 0.0V$ ,  $V_{EE} = -4.5V \pm 0.5V, V_{LD} = -2V$
- 2)  $R_1 = 22\Omega \pm 10\%, \frac{1}{4}W$ ;  $R_2 = 150\Omega \pm 10\%, \frac{1}{4}W$   
 $R_3 = 33\Omega \pm 10\%, \frac{1}{4}W$