PPM-91-425

ADVISORY ON THE USE OF THIS DOCUMENT

The information contained in this document has been developed solely for the purpose of providing general guidance to employees of the Goddard Space Flight Center (GSFC). This document may be distributed outside GSFC only as a courtesy to other government agencies and contractors. Any distribution of this document, or application or use of the information contained herein, is expressly conditioned upon, and is subject to, the following understandings and limitations:

(a) The information was developed for general guidance only and is subject to change at any time;

(b) The information was developed under unique GSFC laboratory conditions which may differ substantially from outside conditions;

(c) GSFC does not warrant the accuracy of the information when applied or used under other than unique GSFC laboratory conditions;

(d) The information should not be construed as a representation of product performance by either GSFC or the manufacturer;

(e) Neither the United States government nor any person acting on behalf of the United States government assumes any liability resulting from the application or use of the information.

UNISYS

(60)

Interoffice Memorandum

To
T. Miccolis
Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on 54AC11
SMEX Common Buy Part No. 5962-8761101CA

PPM-91-425
Date
July 8, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
B. Fafaul/311
J. Denis/311
V. Edson
S. Esmacher
A. Casasnovas
M. Fowler
A. Moor

A radiation evaluation was performed on 54AC11 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 cobalt-60 gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as control samples. The total dose radiation steps were 10, 20, 30, 50, 75, and 100 krads. After 100 krads, parts were annealed at 25°C for 24 and 168 hours, and then the irradiation was continued to 200 and 300 krads (cumulative). The dose rate was between 0.5 - 5.0 krads/hour, depending on the total dose level (see Table II for radiation schedule). 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 two functional tests (1 MHz) at 3.0 V and 5.5 V.

All (8) parts passed initial electrical measurements and subsequent measurements up to and including 20 krads irradiation. Parts continued to pass functionally up to 300 krads, but showed parametric degradation in ICC at 30 krads and above. At 30 krads, one part (SN 10) exceeded the specification limit on I_{CCH} (213 uA against a maximum specification limit of 80 uA). However, all parts passed all other electrical measurements. After 50 krads irradiation, one part (SN 10) continued to exceed the maximum specification limit on I_{CCH}. Also, SN 10 exceeded the maximum specification limit of 80 uA for I_{CCL} (reading was 157.2 uA). After 75 krads, all parts exceeded the maximum specification limit on I_{CCH} (readings ranged from 85.2uA to 3.34mA). Also, SN 10 continued to exceed the maximum specification limit on I_{CCL}. However, all parts stayed within the specification limits for all other parameters. After 100 krads irradiation, all parts continued to fail ICCH and two parts (SN 3 & SN 10) continued to fail ICCL. On annealing for 24 and

168 hours, parts showed partial recovery in I_{CCH} and I_{CCL}. On continued irradiation to 200 and 300 krads irradiation, all parts showed increased degradation in I_{CCH} and I_{CCL}. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. It also provides a summary of functional test results after each radiation/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.

TABLE I. Part Information

Generic Part Number:	54AC11
ISTP Non-Common Buy Part Number:	5962-8761101CA (HA124221)
ISTP Non-Common Buy Control Number:	1646
Charge Number:	C90090
Manufacturer:	National Semiconductor Corp.
Quantity Procured:	100
Lot Date Code:	9036A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	3, 4, 5, 6, 7, 8, 9, 10
Serial Numbers of Control Samples:	1, 2
Part Function:	Triple-3 Input And Gate
Part Technology:	CMOS
Package Style:	14 Pin DIP

TABLE 11. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	03/17/91
2) 10 krads irradiation @ 500 rads/hr	04/29/91
Post 10 krads Electrical Measurements	04/30/91
3) 20 krads irradiation @ 500 rads/hr	04/30/91
Post 20 krads Electrical Measurements	05/01/91
4) 30 krads irradiation @ 500 rads/hr	05/01/91
Post 30 krads Electrical Measurements	05/02/91
5) 50 krads irradiation @ 1000 rads/hr	05/02/91
Post 50 krads Electrical Measurements	05/03/91
6) 75 krads irradiation @ 1250 rads/hr	05/05/91
Post 75 krads Electrical Measurements	05/06/91
7) 100 krads irradiation @ 1250 rads/hr	05/06/91
Post 100 krads Electrical Measurements	05/07/91
8) 24 hour annealing	05/07/91
Post 24 hr Electrical Measurements	05/08/91
9) 168 hour annealing	05/07/91
Post 168 hr Electrical Measurements	05/14/91
10) 200 krads irradiation @ 5000 rads/hr	05/14/91
Post 200 krads Electrical Measurements	05/15/91
11) 300 krads irradiation @ 5000 rads/hr	05/15/91
Post 300 krads Electrical Measurements	05/16/91

Notes:

1) All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.

2) All electrical measurements were performed off-site at 25°C.

3) Annealing performed at 25°C under bias.

Table III. Electrical Characteristics of 54AC11

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
FUNCT #1	3.0V	0.0V	3.0V	FREQ = 1MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT #2	5.5V	0.0V	5.5V	FREQ = 1MHz	ALL I/O	VOL<2.5V , VOH>2.5V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOH1	3.0V	0.90V	2.10V	LOAD = -50UA	OUTS	>2.90V , <6.00V
VOH2	4.5V	1.35V	3.15V	LOAD = -50UA	OUTS	>4.40V , <6.00V
VOH3	5.5V	1.65V	3.85V	LOAD = -50UA	OUTS	>5.40V , <6.00V
VOH4	3.0V	0.90V	2.10V	LOAD = -4MA	OUTS	>2.40V , <6.00V
VOH5	4.5V	1.35V	3.15V	LOAD = -24MA	OUTS	>3.70V , <6.00V
VOH6	5.5V	1.65V	3.85V	LOAD = -24MA	OUTS	>4.70V , <6.00V
VOH7	5.5V	1.65V	3.85V	LOAD = -50MA	OUTS	>3.85V , <6.00V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOL1	3.0V	0.90V	2.10V	LOAD = +50UA	OUTS	>0.00V , <0.10V
VOL2	4.5V	1.35V	3.15V	LOAD = +50UA	OUTS	>0.00V , <0.10V
VOL3	5.5V	1.65V	3.35V	LOAD = +50UA	OUTS	>0.00V , <0.10V
VOL4	3.0V	0.90V	2.10V	LOAD = +12MA	OUTS	>0.00V , <0.50V
VOL5	4.5V	1.35V	3.15V	LOAD = +24MA	OUTS	>0.00V , <0.50V
VOL6	5.5V	1.65V	3.85V	LOAD = +24MA	OUTS	>0.00V , <0.50V
VOL7	5.5V	1.65V	3.35V	LOAD = +50MA	OUTS	>0.00V , <1.65V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
IIH	5.5V	0.00V	5.50V	VIN = 5.5V	INS	> 0.00UA , <+1.00UA
IIL	5.5V	0.00V	5.50V	VIN = 0.0V	INS	>-1.00UA , < 0.00UA
ICCH	5.5V	0.00V	5.50V	VIN = 5.5V	VCC	> 0.00UA , <80.00UA
ICCL	5.5V	0.00V	5.50V	VIN = 0.0V	VCC	> 0.00UA , <80.00UA

VOL1	mV	0.0	100	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.
VOL2	mV	0.0	100	.7	1.8	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.
VOL3	mV	0.0	100	1.0	2.5	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.
VOL4	mV	0.0	500	158	14	146	2	143	2	142	.002	139	2	140	2	137	2	136	2	13
VOL5	mV	0.0	500	228	28	206	4	202	3	200	.003	197	2.5	200	3	192	2	196	2	19
VOL6	mV	0.0	500	200	29	175	3	174	3	172	.002	170	2	173	2	171	2	170	2	17
VOL7	mV	0.0	1650	426	58	375	12	367	10	364	.009	340	9	366	10	350	9	359	10	15
IIH	nA	0.0	1000	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.
IIL	nA	-1000	0.0	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	0.0	---	[illegible]
ICCH	µA	0.0	80	.9	2.3	1.0	.2	5.8	4.0	34	68	206	460	562	1053	1445	1779	1279	1707	98
ICCL	µA	0.0	80	1.8	4.6	.2	.03	1.1	.4	3	3	22	51	60	147	160	303	135	277	99

Note :

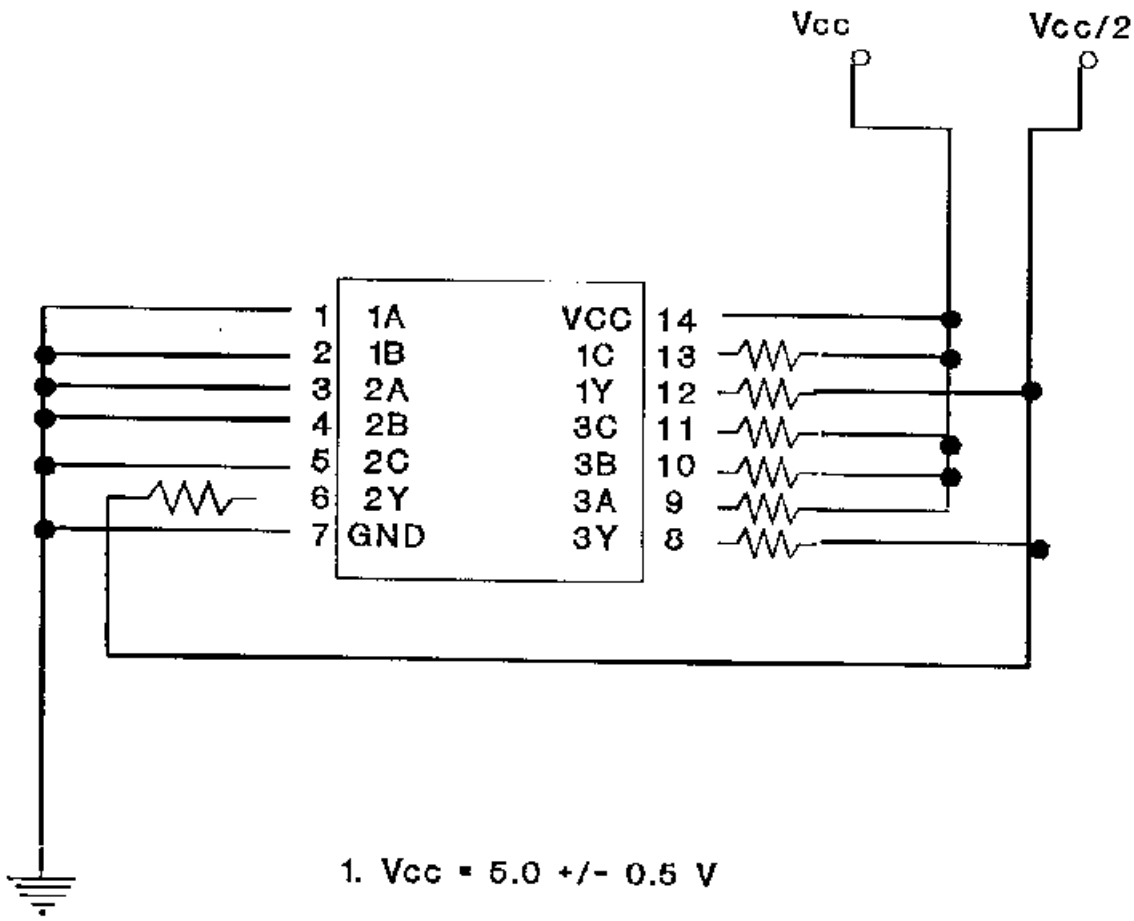
1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing.
The control samples remained constant throughout the testing and are not included in this table.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Anneal for 54AC11

Parameter		Spec. Limits min	Spec. Limits max	Initial mean	Initial sd	Total Dose Exposure (krads) 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 24 hrs mean	24 hrs sd	16[illegible]
Test	#1			8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P
Test	#2			8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P/0F		8P
VOH1	V	2.9	6.0	3.0	.002	3.0	.002	3.0	.003	3.0	.002	3.0	.002	3.0	.005	3.0	.007	3.0	.007	3.
VOH2	V	4.4	6.0	4.5	0.0	4.5	.004	4.5	4.8	4.5	.005	4.5	.004	4.5	.005	4.5	.007	4.5	.007	4.
VOH3	V	5.4	6.0	5.49	.010	5.49	0.0	5.49	.002	5.49	0.0	5.49	.002	5.49	.003	5.49	.005	5.49	.005	5.
VOH4	V	2.4	6.0	2.92	.011	2.92	.002	2.92	0.0	2.92	0.0	2.92	0.0	2.9	.005	2.9	.009	2.9	.008	2.
VOH5	V	3.7	6.0	4.1	.055	4.2	.011	4.2	.010	4.2	.010	4.2	.009	4.2	.012	4.2	.013	4.2	.011	4.
VOH6	V	4.7	6.0	5.2	.052	5.2	.009	5.2	.009	5.2	.009	5.2	.008	5.2	.01	5.2	.011	5.2	.010	5.
VOH7	V	3.85	6.0	4.8	.110	4.9	.019	4.9	.018	4.9	.018	4.9	.017	4.9	.02	4.9	.021	4.9	.019	4.

...ng ...8 hrs mean	sd	Total Dose Exposure (krads) 200 mean	200 sd	300 mean	300 sd
0F		8P/0F		8P/0F	
0F		8P/0F		8P/0F	
0	.006	3.0	.020	3.0	.032
5	.007	4.5	.015	4.5	.025
9	.004	5.48	.013	5.47	.023
[illegible]	.008	2.9	.024	2.9	.036
[illegible]	.011	4.1	.024	4.2	.032
2	.009	5.2	.022	5.2	.027
7	.019	4.9	.032	4.8	.037
[illegible]	---	0.0	---	0.0	---
[illegible]	---	0.0	---	0.0	---
[illegible]	---	0.0	---	0.0	---
[illegible]	2	132	2	128	.003
[illegible]	2	194	4	191	4
[illegible]	2	170	4	169	4
[illegible]	8	358	12	355	13
[illegible]	---	0.0	---	0.0	---
[illegible]	---	0.0	---	0.0	---
[illegible]	1558	5452	3489	9581	4497
[illegible]	230	714	724	1345	938

Figure 1: Radiation Bias Circuit for 54AC11



1. Vcc = 5.0 +/- 0.5 V
2. Vcc/2 = 2.5 +/- 0.25 V
3. All resisters are 1 kohms, 1/4 watts