



DATE: April 25, 1994  
TO: J. Denis/311.1  
FROM: K. Sahu/300.1 *KS*  
SUBJECT: Radiation Report on GOES/SXI  
Part No. M38510/008-01BCA (5406)  
Control No. 10702

PPM-94-011

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A radiation evaluation was performed on 5406 (Hex Inverting Buffer) 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, four parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation levels were 10, 20, 30, 50, 75 and 100 krads\*. The dose rate was between 0.37 and 1.25 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 100 krad irradiation, the parts were annealed for 168 hours at 25°C, after which the parts were annealed for 168 hours at 100°C. After each radiation exposure, parts were electrically tested according to the test conditions and the specification limits\*\* listed in Table III. The electrical tests included three functional tests at 1.0 MHz, with  $V_{CC} = 4.50$  V, 5.00 V and 5.50 V.

All parts passed initial electrical measurements. All four irradiated parts passed all electrical measurements throughout all irradiation and annealing steps. No significant sensitivity to radiation was observed in any parameter. After annealing for 168 hours at 100°C, no rebound effects were observed.

Table IV provides 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.

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\*The term rads, as used in this document, means rads(silicon). All radiation levels cited are cumulative.

\*\*These are manufacturer's non-irradiated 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:	5406
GOES/SXI Part Number:	M38510/00801BCA*
GOES/SXI Control Number:	10701
Charge Number:	C42992
Manufacturer:	TI
Lot Date Code:	9333G
Quantity Tested:	5
Serial Number of Control Sample:	51
Serial Numbers of Radiation Samples:	52, 53, 54, 55
Part Function:	Hex Inverting Buffer
Part Technology:	Bipolar
Package Style:	14-pin DIP
Test Equipment:	S-50
Test Engineer:	T. Mondy

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

TABLE II. Radiation Schedule for 5406

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	03/25/94
2) 10 KRAD IRRADIATION (0.50 KRADS/HOUR) POST-10 KRAD ELECTRICAL MEASUREMENT	03/28/94 03/29/94
3) 20 KRAD IRRADIATION (0.50 KRADS/HOUR) POST-20 KRAD ELECTRICAL MEASUREMENT	03/29/94 03/30/94
4) 30 KRAD IRRADIATION (0.50 KRADS/HOUR) POST-30 KRAD ELECTRICAL MEASUREMENT	03/30/94 03/31/94
5) 50 KRAD IRRADIATION (1.00 KRADS/HOUR) POST-50 KRAD ELECTRICAL MEASUREMENT	03/31/94 04/01/94
6) 75 KRAD IRRADIATION (0.37 KRADS/HOUR) POST-75 KRAD ELECTRICAL MEASUREMENT	04/01/94 04/04/94
7) 100 KRAD IRRADIATION (1.25 KRADS/HOUR) POST-100 KRAD ELECTRICAL MEASUREMENT	04/04/94 04/05/94
8) 168-HOUR ANNEALING @25°C POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	04/05/94 04/12/94
9) 168-HOUR ANNEALING @100°C* POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENTS	04/12/94 04/19/94

\*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-8830, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of 5406

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
FUNCT 1	4.5V	0.0V	4.5V	FREQ=1.000MHz	ALL I/O	VOL<2.0V / VOH>2.0V
FUNCT 2	5.0V	0.0V	5.0V	FREQ=1.000MHz	ALL I/O	VOL<2.0V / VOH>2.0V
FUNCT 3	5.5V	0.0V	5.5V	FREQ=1.000MHz	ALL I/O	VOL<2.0V / VOH>2.0V
LOAD USED <= <ul style="list-style-type: none"> <li>( IOH = -2.0mA</li> <li>( VREF = 3.0V</li> <li>( IOL = +14.0mA</li> </ul>						
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS @ +25C
VOL1	4.5V	0.0V	2.0V	LOAD=30.0MA	DUTS	>+0.0V / <+0.7V
VOL2	4.5V	0.0V	2.0V 5.5V	LOAD=16.0MA	DUTS	>+0.0V / <+0.4V
ICEX	4.5V	0.8V	5.5V	VTST=+30.0V	DUTS	>+0.0A / <+250UA
VIC	4.5V	0.8V	5.5V	ITST=-12MA	INS	>-1.5V / <+0.0V
I <sub>IH1</sub>	5.5V	0.0V	5.5V	VIN = 2.4V	INS	>+0.0UA / <+40.0UA
I <sub>IH2</sub>	5.5V	0.0V	5.5V	VIN = 5.5V	INS	>+0.0UA / <+100UA
I <sub>IL</sub>	5.5V	0.0V	5.5V	VIN = 0.4V	INS	>-1.3MA / <-0.4MA
ICCL	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>+0.0UA / <+48.0MA
ICCH	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0UA / <+51.0MA

TABLE IV: Summary of Electrical Measurements after  
Total Dose Exposures and Annealing for M38510/008-01BCA (5406) /1

Parameters	spec. Lim. /2 min max	Total Dose Exposure (krads)												Annealing					
		Initial		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
Func1 VCC= 4.5V/3		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
Func2 VCC= 5.0V/3		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
Func3 VCC= 5.5V/3		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS		PASS	
VOL1	0 700	265	8.0	268	9.3	274	14	270	14	272	12	292	26	279	14	270	9.4	280	11
VOL2	0 400	189	5.2	191	5.8	195	9.0	192	7.3	193	7.2	209	18	199	10	193	5.8	198	6.1
ICEX	0 250	0.01	.02	0.01	.02	0.01	.02	0	.01	0	.01	0.02	.02	0.02	.02	0	.01	0.05	.04
VIC	-1.5 0	-1.06	.01	-1.01	.01	-1.09	.01	-1.01	.01	-1.03	.01	-0.99	.01	-1.00	.01	-1.00	.01	-0.99	.01
IIH1	0 40	4.97	.31	4.87	.31	4.93	.31	4.84	.30	4.90	.30	4.99	.32	5.03	.30	4.92	.30	5.24	.31
IIH2	0 100	5.70	.37	5.57	.36	5.64	.36	5.55	.35	5.63	.36	5.72	.37	5.75	.35	5.64	.35	5.99	.36
IIL	-1300 -400	-716	2.5	-717	2.4	-715	2.7	-717	2.7	-716	2.7	-713	2.5	-713	2.6	-715	2.6	-710	2.8
ICCL	0 48	35.9	.12	35.9	.06	35.8	.10	35.6	.07	35.8	.07	35.7	.20	35.7	.07	35.7	.11	35.6	.12
ICCH	0 51.	33.2	.07	33.2	.06	33.1	.10	33.2	.07	33.1	.10	33.0	.10	33.0	.10	33.0	.07	32.8	.10

- 1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing. The control sample remained constant throughout the testing and is not included in this table.
- 2/ These are manufacturers' non-irradiated data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.
- 3/ "PASS" means that all irradiated parts passed this functional test at this irradiation or annealing level. "FAIL" means that all irradiated parts failed this test at this irradiation or annealing level. "nPMF" means that n parts passed and m parts failed the test at this level.

Figure 1. Radiation Bias Circuit for 5406

