

# Unisys

DATE: December 10, 1997  
TO: S. Hull/562  
FROM: K. Sahu/S. Kniffin/300.1  
SUBJECT: Radiation Report on: 54ABT245  
Project: IRAC  
Job #: M78281  
Project part #: 54ABT245 (5962-9214801MRA)

PPM-97-054

cc: R. Williams/Swales  
K. LaBel/735  
A. Sharma/311  
OFA Library/300.1

A radiation evaluation was performed on 54ABT245 (5962-9214801MRA) Transceiver with Tri-State I/O (Phillips) 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 Co<sup>60</sup> 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 a control samples. The total dose radiation levels were 5.0, 10.0, 15.0, 20.0, 30.0, 50.0, and 100.0 kRads.\* The dose rate was between 0.125 and 0.625 kRads/hour (0.035 to 0.174 Rads/s). After the 20.0 kRad exposure, the parts were annealed for 48 hours at 25°C. After the 100.0 kRad exposure, the parts were annealed for 168 hours at 25°C and for 168 hours at 100°C. See Table II for the radiation schedule and effective dose rate calculation. The effective dose rate overall testing was 0.032 Rads/sec. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits\*\* listed in Table III.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 53, 54, 55, 56, 57, 58, 59, and 60) were used as radiation samples while SN's 51 and 52 were used as a control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 15.0 kRads with no significant degradation in any parameter.

After the 20.0 kRad irradiation, all parts exceeded the specification limit of 250µA for ICCH with readings in the range of 274 to 660µA. Most parts exceeded the specification limit of 250µA for ICCZ with readings in the range of 257 to 344µA. **All parts passed all other tests (functional and parametric).**

After annealing the parts for 48 hours at 25°C, parts showed significant recovery with only SN 54 exceeding the specification limit for ICCH with a reading of 274µA. **All parts passed all other tests (functional and parametric).**

After the 30.0 kRad irradiation, **SN 56 failed all three functional tests.** This resulted in some test errors in other parameters and they are not included in the data analysis from this point on until the final annealing. Four parts exceeded the specification limit of 20µA for IOZH with readings in the range of 21.6 to 25.0µA. All parts exceeded the specification limit for ICCH with readings in the range of 432 to 1151µA. All parts exceeded the specification limit for ICCZ with readings in the range of 257 to 607µA. **All parts passed all other tests (functional and parametric).**

---

\* 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. The manufacturer provided no post-irradiation limits at the time these tests were performed.

After the 50.0 kRad irradiation, **SN 56 continued to fail all 3 functional tests**. Four parts exceeded the specification limit of 20 $\mu$ A for IOZH with readings in the range of 23.7 to 28.4 $\mu$ A. All parts exceeded the specification limit for ICCH with readings in the range of 450 to 1256 $\mu$ A. All parts exceeded the specification limit for ICCZ with readings in the range of 257 to 642 $\mu$ A. **All parts passed all other tests (functional and parametric).**

After the 100.0 kRad irradiation, **SN 56 continued to fail all 3 functional tests**. All parts exceeded the specification limit of 20 $\mu$ A for IOZH with readings in the range of 21 to 73 $\mu$ A. All parts exceeded the specification limit for ICCH with readings in the range of 1.1 to 3.2mA. All parts exceeded the specification limit for ICCZ with readings in the range of 572 to 1537 $\mu$ A. **All parts passed all other tests (functional and parametric).**

After annealing the parts for 168 hours at 25°C, parts showed significant recovery in all sensitive parameters. **SN 56 passed all functional tests and had no other unusual readings**. All parts passed IOZH. One part passed ICCH with all other readings in the range of 362 to 818 $\mu$ A. Three parts passed ICCZ with all other readings in the range of 274 to 415 $\mu$ A. **All parts passed all other tests (functional and parametric).**

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

Table IV provides a summary of the test results with the mean and standard deviation values for each parameter after each irradiation exposure and 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.

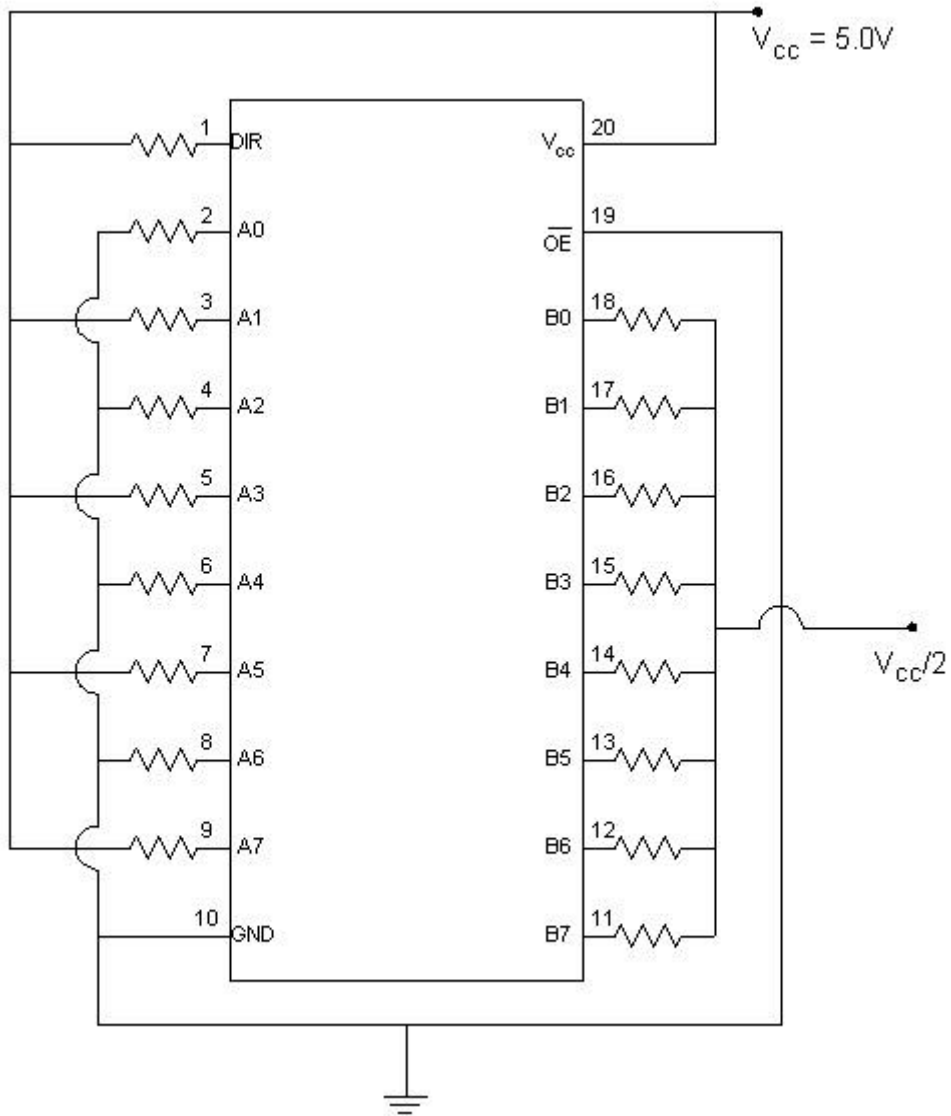
---

#### 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 conditional 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.

Figure 1. Radiation Bias Circuit for 54ABT245



Note:

1. Resistors are 2kΩ ±5%, ¼W.

TABLE I. Part Information

Generic Part Number:	54ABT245
IRAC Part Number	54ABT245
Charge Number:	M78281
Manufacturer:	Phillips
Lot Date Code (LDC):	9722
Quantity Tested:	10
Serial Number of Control Samples:	51, 52
Serial Numbers of Radiation Samples:	53, 54, 55, 56, 57, 58, 59, and 60
Part Function:	Transceiver with tri-state I/O
Part Technology:	Bipolar
Package Style:	20 Pin DIP
Test Equipment:	AD540
Test Engineer:	D. Davis

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

TABLE II. Radiation Schedule for 54ABT245

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS .....	10/16/97
2) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR) .....	10/22/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT .....	10/24/97
3) 10.0 KRAD IRRADIATION (0.062 KRADS/HOUR) .....	10/24/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT .....	10/29/97
4) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR) .....	10/29/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT .....	10/31/97
5) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR) .....	10/31/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT .....	11/03/97
6) 168 HOUR ANNEALING @25°C .....	11/03/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	11/10/97
7) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR) .....	11/10/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT .....	11/13/97
8) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR) .....	11/13/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT .....	11/17/97
9) 100.0 KRAD IRRADIATION (0.625 KRADS/HOUR).....	11/17/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT .....	11/19/97
10) 168 HOUR ANNEALING @25°C .....	11/19/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	11/26/97
11) 168 HOUR ANNEALING @100°C .....	11/26/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT .....	12/10/97

Effective Dose Rate = 100,000 RADS/36 DAYS=115.7 RADS/HOUR=0.032 RADS/SEC

The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim-annealing step.

The interim annealing following the 50.0 kRad step was added due to degradation in the parts. The addition of an interim annealing step better simulates the space environment's lower dose rate for very sensitive devices. This may allow the parts to show satisfactory performance at higher doses or indicate that the part can not be used beyond the previous dose level.

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

Table III. Electrical Characteristics of 54ABT245 /1

Test #	Parameter	Units	Test Conditions	Spec. min	Lim. max
1	VOH1	V	$V_{IN} = 2.0V$ or $0.8V$ , $I_{OH} = -3mA$ , $V_{CC} = 4.5V$	2.5	4.5
2	VOH2	V	$V_{IN} = 2.0V$ or $0.8V$ , $I_{OH} = -3mA$ , $V_{CC} = 5.0V$	2.0	4.5
3	VOH3	V	$V_{IN} = 2.0V$ or $0.8V$ , $I_{OH} = -24mA$ , $V_{CC} = 4.5V$	2.0	4.5
4	VOL1	mV	$V_{IN} = 2.0V$ or $0.8V$ , $I_{OH} = 48mA$ , $V_{CC} = 4.5V$	0	500
5	VOL2	mV	$V_{IN} = 2.0V$ or $0.8V$ , $I_{OH} = 48mA$ , $V_{CC} = 4.5V$	0	500
6	VOL3	mV	$V_{IN} = 2.0V$ or $0.8V$ , $I_{OH} = 48mA$ , $V_{CC} = 4.5V$	0	550
7	IIH	mA	$V_{IN} = V_{CC}$ , $V_{CC} = 5.5V$	-100	100
8	IIL	mA	$V_{IN} = GND$ , $V_{CC} = 5.5V$	-100	100
9	IOZH	mA	$V_{IN} = V_{IH}$ or $V_{IL}$ , $V_{IH} = 2.0V$ , $V_{IL} = 0.8V$ , $V_{OUT} = 2.7V$ , $V_{CC} = 5.5V$	-20.0	20.0
10	IOZL	mA	$V_{IN} = V_{IH}$ or $V_{IL}$ , $V_{IH} = 2.0V$ , $V_{IL} = 0.8V$ , $V_{OUT} = 0.5V$ , $V_{CC} = 5.5V$	-20.0	20.0
11	ICCH	mA	$V_{IN} = V_{CC}$ or $GND$ , $I_{OUT} = 0A$ , $V_{CC} = 5.5V$	0	250
12	ICCL	mA	$V_{IN} = V_{CC}$ or $GND$ , $I_{OUT} = 0A$ , $V_{CC} = 5.5V$	0	30
13	IC CZ	mA	$V_{IN} = V_{CC}$ or $GND$ , $I_{OUT} = 0A$ , $V_{CC} = 5.5V$	0	250

Test #	Functional Tests			
	$V_{CC}$	$V_{IL}$	$V_{IH}$	Frequency
1	4.50V	0.0V	4.50V	1.000MHz
2	5.00V	0.0V	5.00V	1.000MHz
3	5.50V	0.0V	5.50V	1.000MHz

Note:

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

**TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54ABT245 (Phillips) /1**

#	Functional Tests /2 /3	Total Dose Exposure (kRads)												Annealing		Total Dose Exposure (kRads)				Annealing		Annealing				
		Initial		5		10		15		20		48 hrs @ 25°C		30		50		100		168 hrs @ 25°C		168 hrs @ 100°C				
1	V <sub>cc</sub> =4.5V, V <sub>il</sub> =0.0V, V <sub>ih</sub> =4.5V, Freq=1MHz	P		P		P		P		P		P		P		7P/1F		7P/1F		7P/1F		P		P		
2	V <sub>cc</sub> =5.0V, V <sub>il</sub> =0.0V, V <sub>ih</sub> =5.0V, Freq=1MHz	P		P		P		P		P		P		P		7P/1F		7P/1F		7P/1F		P		P		
3	V <sub>cc</sub> =5.5V, V <sub>il</sub> =0.0V, V <sub>ih</sub> =5.5V, Freq=1MHz	P		P		P		P		P		P		P		7P/1F		7P/1F		7P/1F		P		P		
#	Parameters	Units	Spec. Lim. /4		Initial		5		10		15		20		48 hrs @ 25°C		30		50		100		168 hrs @ 25°C		168 hrs @ 100°C	
1	VOH1	V	2.5	4.5	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0	3.0	0
2	VOH2	V	2.0	4.5	2.6	0	2.6	0	2.6	0	2.6	0	2.6	0	2.6	0	2.6	0	2.6	0	2.6	0	2.6	0	2.6	0
3	VOH3	V	2.0	4.5	3.1	0	3.1	0	3.1	0	3.1	0	3.1	0	3.1	0	3.1	0	3.1	0	3.1	0	3.1	0	3.1	0
4	VOL1	mV	0	500	156	1.7	156	1.7	156	1.7	155	1.8	156	1.7	156	1.7	157	1.8	158	1.8	161	1.7	159	1.8	158	1.7
5	VOL2	mV	0	500	285	1.9	285	1.9	285	1.9	284	1.7	285	1.8	285	1.8	288	1.8	292	1.9	303	2.1	300	8.8	295	5.3
6	VOL3	mV	0	550	384	1.3	384	1.3	384	1.3	384	1.3	386	1.4	386	1.4	389	5.9	395	10.1	415	4.3	412	17.8	403	7.8
7	IIH	µA	-100	100	0	0	0	0	0	0	3	0.7	9	2.2	3	1.0	18	4.1	20	6.3	44	15.3	10	4.0	2	0.7
8	IIl	µA	-100	100	0	0	0	0	0	0	0	0	-5	3.6	-2	2.0	-7	4.9	-6	4.9	-1	0.5	-1	0.7	0	0
9	IOZH	µA	-20.0	20.0	0	0	0	0	0	0	2.6	0.8	9.7	2.4	2.6	1.0	19	4.9	20	6.2	46	16.0	9.4	4.0	2	0.7
10	IOZL	µA	-20.0	20.0	0	0	0	0	0	0	0	0	-4.4	3.4	-1.6	1.7	-7.0	5.1	-6.0	4.6	-1.0	1.0	-0.5	0.5	0	0
11	ICCH	µA	0	250	81	0	81	0	92	12	185	45	467	110	193	46	785	226	858	249	2453	1368	524	176	185	42
12	ICCL	mA	0	30	23	0	23	0	23	0	23	0.4	24	0.4	23	0.4	24	0.4	24	0.4	25	0.4	24	0.4	23	0.3
13	IC CZ	µA	0	250	64	0	64	0	75	8.2	121	21	261	49	125	26	432	106	452	118	1022	297	283	79	121	21

- Notes:
- 1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing.
  - 2/ The control samples remained constant throughout the testing are are not included in this table.
  - 3/ "P" indicates that all parts passed this test at this irradiation or annealing level. "F" indicates that all parts failed this test at this irradiation or annealing level. "nPmF" indicates that n parts passed and m parts failed this test at this irradiation or annealing level.
  - 4/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

**Radiation sensitive parameters: Functional tests, IOZH, ICCH, ICCZ.**