

UNISYS

DATE: April 28, 1997
 TO: J.Lohr/311
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 SUBJECT: Radiation Report on: TL7705
 Project: SMEX-LITE
 Job #: EE71380
 Project part #: TL7705

PPM-97-014

cc: T. Miccolis/311
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 OFA Library/300.1

A radiation evaluation was performed on TL7705 (5962-88685032A) 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 Co⁶⁰ 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 levels were 2.5, 5.0, 10.0, 15.0, 20.0, 30.0, and 50.0 kRads.* The dose rate was between 0.06 and 0.50 kRads/hour (see Table II for radiation schedule). Between the 30.0 and 50.0 kRad exposures, the parts were annealed for 840 hours at 25°C. After the 50.0 kRad exposure, the parts were annealed for 168 hours at 25°C. 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 92, 93, 94, 95, 96, 97, 98, and 99) were used as radiation samples while SN's 90 and 91 were used as control samples. All parts passed all tests during initial electrical measurements.

After the 2.5, 5.0, and 10.0 kRad irradiations, all parts passed all tests.

After 15.0 kRads, all parts except SN 99 exceeded the specification limit for $V_{ref}@3.6V$ and $V_{ref}@18V$. The readings for this part were within the range of 2.58 to 2.60V, against the maximum specification limit of 2.58V. All parts passed all other tests.

After 20.0 kRads, all parts failed to meet the specification limit for $IR_{ST}@V_{cc} 1V$. The readings were within the range of 1.4 to 1.9mA, against the minimum specification limit of 2.0mA. All parts continued to show the same degradation in V_{ref} as at 15.0 kRads. All parts continued to pass all other tests.

After 30.0 kRads, all parts showed increased degradation in $IR_{ST}@V_{cc} 1V$. The readings were within the range of 0.52 to 0.83mA. All parts continued to show the same degradation in V_{ref} as at 15.0 kRads. All parts continued to pass all other tests.

After annealing the parts for 840 hours at 25°C, the parts showed some recovery in $IR_{ST}@V_{cc} 1V$. The readings were in the range of 1.13 to 1.68 mA.

After 50.0 kRads, the parts showed increased degradation in IR_{ST} , with readings in the range of 0.15 to 0.35mA. The parts showed no significant increase in the degradation of V_{ref} with readings in the range of 2.60 to 2.62V. All parts continued to pass all other tests.

* 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 annealing the parts for 168 hours at 25°C, the parts showed significant recovery in IRST, with readings in the range of 0.5 to 2.15mA. Vref readings were in the range of 2.59 to 2.6V for all parts. All parts continued to pass all other tests.

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.

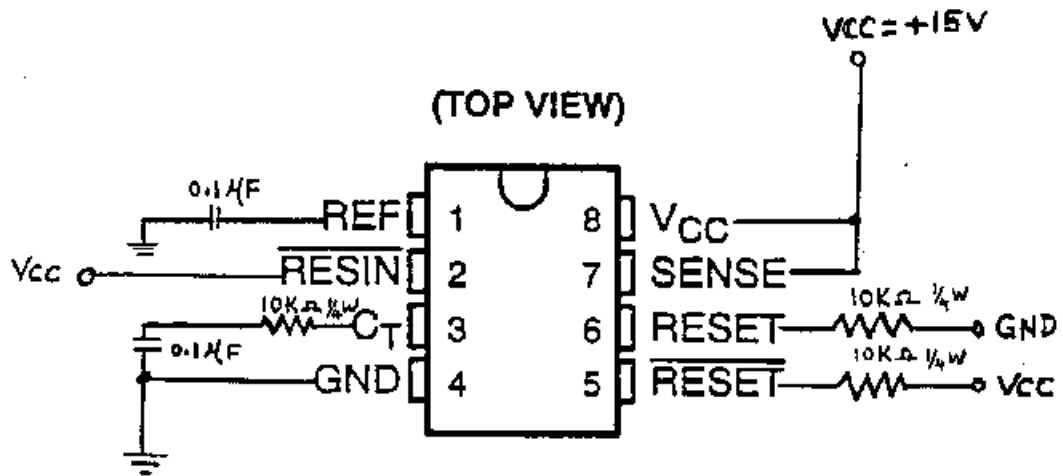
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for TL7705



Note: Use 20 pin LCC to 8 pin DIP socket adapters with 8 pin DIP radiation bias boards.

TABLE I. Part Information

Generic Part Number:	TL7705
SMEX/LITE Part Number	5962-88685032A
Charge Number:	EE71380
Manufacturer:	Texas Instruments
Lot Date Code (LDC):	9543-B
Quantity Tested:	10
Serial Number of Control Samples:	90, 91
Serial Numbers of Radiation Samples:	92, 93, 94, 95, 96, 97, 98, 99
Part Function:	Supply Voltage Supervisor
Part Technology:	Bipolar
Package Style:	20 Pin LCC
Test Equipment:	A540
Test Engineer:	A. Najj

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

TABLE II. Radiation Schedule for TL7705

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	01/27/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	01/29/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT.....	01/31/97
3) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	01/31/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT.....	02/03/97
4) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	02/03/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT.....	02/06/97
5) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	02/06/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT.....	02/10/97
6) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	02/10/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT.....	02/12/97
7) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	02/12/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT.....	02/14/97
8) 840 HOUR ANNEALING @25°C	02/14/97
POST-840 HOUR ANNEAL ELECTRICAL MEASUREMENT	03/25/97
9) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	03/25/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT.....	03/28/97
10) 168 HOUR ANNEALING @25°C	03/28/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/08/97

Effective Dose Rate = 50,000 RADS/70 DAYS = 29.8 RADS/HOUR=0.008 RADS/SEC

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

Table III. Electrical Characteristics of TL7705 /1

Test #	Parameters	Units	Test Conditions	Spec. min	Lim. max
1	ICC @3.6V	mA	Vsense=15V, RESIN>=2V	0.0	3.0
2	ICC @18V	mA	Vsense=15V, RESIN>=2V	0.0	3.0
3	Iol RST @3.6V	uA	Vo=0V	-50.0	
4	Iol RST @18V	uA	Vo=0V	-50.0	
5	Voh RST	V	Ioh=-16mA	2.0	
6	Voh RST	V	Ioh=-16mA	16.5	
7	Ioh RST @3.6V	uA	Vo=18V		50.0
8	Ioh RST @18V	uA	Vo=18V		50.0
9&10	Vol RST	V	Iol=16mA		0.4
11	Iol SNS @3.6V	uA	Vo=0V	-50.0	
12	Iol SNS @18V	uA	Vo=0V	-50.0	
13	Voh SNS	V	Ioh=-16mA	2.0	
14	Voh SNS	V	Ioh=-16mA	16.5	
15	Ioh SNS @3.6V	uA	Vo=18V		50.0
16	Ioh SNS @18V	uA	Vo=18V		50.0
17&18	Vol SNS	V	Iol=16mA		0.4
19	IRST@Vcco 1V /2	mA	Vcco=1V	2.0	
20	I_RES 0.4V	uA	Vi=0.4 to Vcc	-10.0	
21	I_RES 18V	uA	Vi=0.4 to Vcc	-10.0	
22	V Ref @3.6V	V	Iref=500uA	2.48	2.58
23	V Ref @18V	V	Iref=500uA	2.48	2.58

Notes:

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

2/ The parameter "Vcco" or "supply voltage to define the output" could not be measured accurately on the tester (A540) as requested in the specifications. It was instead checked as a current test "IRST" with Vcco at 1.0V and a test limit of 2.0mA.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for TL7705 /1

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads)						Rad level		Rad level		Rad level		Rad level		Annealing		Rad level		Annealing	
					Initial		2.5		5.0		10.0		15.0		20.0		30.0		840 hours @25°C		50.0		168 hours @25°C	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	ICC @3.6V	mA	0.0	3.0	1.4	0	1.4	0	1.4	0	1.4	0	1.4	0	1.4	0	1.3	0	1.3	0	1.3	0	1.3	0
2	ICC @18V	mA	0.0	3.0	1.6	0	1.6	0	1.6	0.05	1.6	0	1.5	0.06	1.5	0	1.5	0	1.5	0.02	1.5	0	1.5	0
3	Iol RST @3.6V	uA	-50.0		-0.004	0	-0.002	0	-0.003	0.001	-0.004	0	-0.002	0.001	-0.004	0	-0.005	0.001	-0.003	0	-0.004	0.001	-0.002	0
4	Iol RST @18V	uA	-50.0		-0.006	0	-0.004	0	-0.004	0.001	-0.005	0	-0.004	0.001	-0.005	0.001	-0.007	0.001	-0.005	0	-0.006	0.001	-0.004	0
5	Voh RST	V	2.1		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
6	Voh RST	V	16.5		17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0
7	Ioh RST @3.6V	uA		50.0	-0.01	0	-0.009	0	-0.009	0	-0.010	0	-0.009	0	-0.011	0	-0.008	0.001	-0.005	0	-0.010	0	-0.009	0
8	Ioh RST @18V	uA		50.0	0.01	0.005	0.012	0	0.014	0.001	0.016	0.001	0.015	0.001	0.006	0	0.019	0	0.018	0	0.012	0.001	0.008	0
9&10	Vol RST	V		0.4	0.16	0	0.16	0	0.17	0.01	0.17	0.005	0.17	0.005	0.17	0.005	0.18	0.01	0.17	0.01	0.18	0.01	0.17	0.01
11	Iol SNS @3.6V	uA	-50.0		-0.006	0	-0.004	0	-0.004	0.001	-0.005	0	-0.004	0.001	-0.005	0	-0.007	0	-0.006	0.001	-0.005	0.001	-0.003	0
12	Iol SNS @18V	uA	-50.0		-0.007	0	-0.005	0.001	-0.005	0.001	-0.006	0	-0.005	0.001	-0.006	0	-0.008	0.001	-0.006	0	-0.006	0	-0.005	0.001
13	Voh SNS	V	2.0		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
14	Voh SNS	V	16.5		17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0	17.0	0
15	Ioh SNS @3.6V	uA		50.0	-0.011	0	-0.009	0	-0.009	0	-0.010	0	-0.009	0	-0.011	0	-0.009	0	-0.009	0	-0.010	0	-0.009	0
16	Ioh SNS @18V	uA		50.0	0.009	0	0.012	0	0.013	0.001	0.015	0	0.015	0.001	0.006	0.001	0.019	0	0.018	0.001	0.012	0.001	0.008	0
17&18	Vol SNS	V		0.4	0.17	0	0.17	0.002	0.17	0	0.17	0	0.17	0.003	0.18	0.005	0.18	0.005	0.18	0.01	0.18	0.01	0.18	0.005
19	IRST@Vcco 1	mA	2.0		3.7	0.5	7.5	0.5	6.2	0.4	4.2	0.3	2.5	0.3	1.6	0.2	0.63	0.13	1.33	0.21	0.25	0.08	1.81	0.66
20	I_RES 0.4V	uA	-10.0		-0.11	0.002	-0.32	0.02	-0.71	0.06	-1.58	0.13	-2.59	0.15	-3.28	0.17	-4.24	0.18	-3.48	0.17	-4.80	0.17	-4.52	0.16
21	I_RES 18V	uA	-10.0		0.012	0.001	0.015	0	0.017	0.002	0.019	0	0.018	0	0.009	0	0.021	0	0.018	0.001	0.014	0.001	0.010	0
22	V Ref @3.6V	V	2.48	2.58	2.54	0.008	2.55	0.01	2.56	0.02	2.57	0.01	2.59	0.01	2.60	0.01	2.62	0.01	2.59	0.01	2.60	0.01	2.60	0.01
23	V Ref @18V	V	2.48	2.58	2.55	0.007	2.55	0.008	2.56	0.008	2.57	0.01	2.60	0.01	2.61	0.01	2.62	0.01	2.59	0.01	2.62	0.01	2.60	0.005

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 are not included in this table.
- 2/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

Radiation-sensitive parameters: IRST@Vcco 1V, Vref@3.6V, and Vref@18V.