

Unisys

DATE: August 5, 1997
TO: J. Lohr/311
FROM: K. Sahu/300.1 *KS*
SUBJECT: Radiation Report on: REF-43B
Project: MIDEX/MAP
Job #: LD78198
Project part #: REF-43B (5962-90603012A)

PPM-97-032 / *revised*

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A radiation evaluation was performed on REF-43B (5962-90603012A) +2.5V voltage reference 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, 50.0, and 100.0 kRads.* The dose rate was between 0.06 and 0.50 kRads/hour (0.017 to 0.139 Rads/s). See Table II for the radiation schedule. 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 72, 73, 74, 75, 76, 77, 78, and 79) were used as radiation samples while SN's 70 and 71 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests to 5.0 kRads. No significant degradation was noted in any parameter.

After the 10.0 and 15.0 kRad irradiations, all parts fell below the specification limit for V_{REF} with readings in the range of 2.49743 to 2.49499V. **All parts passed all other tests.**

After the 20.0 kRad irradiation, all parts fell below the specification limit V_{REF} with readings in the range of 2.49663 to 2.49385V except for SN73, which exceeded the specification limit of 2.50250V with a reading of 2.52385V. **All parts passed all other tests.**

After the 30.0 and 50.0 kRad irradiations, all parts continued to fall below the specification limit for V_{REF} with readings in the range of 2.49679 to 2.49181V. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, parts showed little recovery in V_{REF} with readings within the range of 2.49630 to 2.49340V.

After the 100 kRad irradiation, all parts continued to fall below the specification limit for V_{REF} with readings in the range of 2.49480 to 2.49207V. **All parts passed all other tests.**

In summary, the only parameter that showed any degradation was V_{REF} , which degraded by a maximum of 0.23% from the specification limit.

* 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.

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.

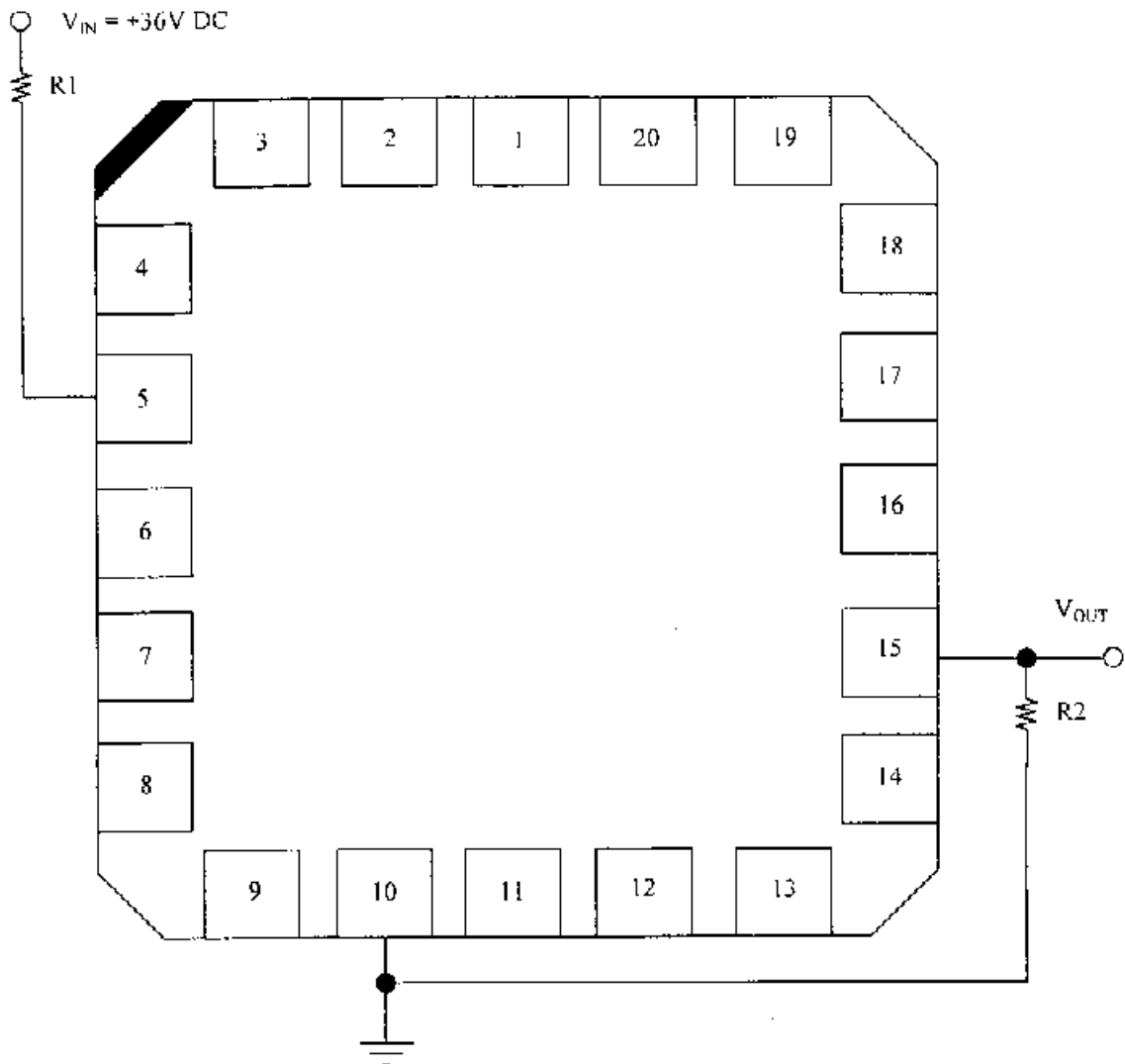
Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for REF-43B



Pin Connection List:

2: REF 5: RESIN 7: CT 10: GND 12: RESET 15: RESET 17: SENSE 20: V_{CC}

Resistor 1 is 10Ω ±5%, ¼ W. Resistor 2 is 100kΩ ± 5%, ¼ W.

Use 20 Pin LCC to 8 Pin DIP converter.

TABLE I. Part Information

Generic Part Number:	REF-43B
MIDEX/MAP Part Number	5962-9060301M2A
Charge Number:	LD78198
Manufacturer:	PMI
Lot Date Code (LDC):	9536A
Quantity Tested:	10
Serial Number of Control Samples:	70, 71
Serial Numbers of Radiation Samples:	72, 73, 74, 75, 76, 77, 78, and 79
Part Function:	+2.5V Low Power Voltage Reference
Part Technology:	Bipolar
Package Style:	20 Pin LCC
Test Equipment:	A540
Test Engineer:	S. Norris

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

TABLE II. Radiation Schedule for REF-43B

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS.....	06/24/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR).....	06/25/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT.....	06/27/97
3) 5.0 KRAD IRRADIATION (0.125 KRADS/HOUR).....	06/27/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT.....	07/01/97
4) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR).....	07/01/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT.....	07/03/97
5) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR).....	07/03/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT.....	07/07/97
6) 20.0 KRAD IRRADIATION (0.250 KRADS/HOUR).....	07/07/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT.....	07/09/97
7) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR).....	07/09/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT.....	07/11/97
8) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR).....	07/11/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT.....	07/14/97
9) 168 HOUR ANNEALING @25°C.....	07/14/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	07/21/97
10) 100.0 KRAD IRRADIATION (0.500 KRADS/HOUR).....	07/21/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT.....	07/23/97

Effective Dose Rate = 100,000 RADS/29 DAYS = 143.7 RADS/HOUR = 0.040 RADS/SEC

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

Table III. Electrical Characteristics of REF 43B /1

Test #	Parameter	Units	Test Conditions /2	Spec. min	Lim. max
1	Quiescent Current	μA	No Load	0.0	450
2	V_{REF}	V	No Load	2.49750	2.50250
3	Line Regulation	μV	$I_L = 0\text{mA to }10\text{mA}$	0.0	71
4	Load Regulation	μV	$V_{\text{IN}} = 4.5\text{V to }40\text{V}$	0.0	200.0
5	i_{SC}	mA	$V_{\text{O}} = 0\text{V}$	-100.0	0.0
6	V_{T}	V		0.540	0.580

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.

2/ For all tests, $V_{\text{IN}} = +5\text{V}$ unless otherwise specified.

**TABLE IV: Summary of Electrical Measurements after
Total Dose Exposures and Annealing for REF-43B /1**

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads)																Annealing		TDE (kRads)	
					Initial		2.5		5.0		10.0		15.0		20.0		30.0		50.0		168 hours @25°C		100	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Quiescent Current	µA	0.0	450	339	2.6	338	3.9	336	2.8	339	3.0	338	2.6	333	1.2	336	2.3	336	3.1	337	1.9	336	3.0
2	VREF	V	2.49750	2.50250	2.50020	0.00061	2.49908	0.00051	2.49802	0.00047	2.49658	0.00059	2.49575	0.00076	2.49519	0.00073	2.49542	0.00074	2.49411	0.00124	2.49485	0.00095	2.49315	0.00093
3	Line Regulation	µV	0.0	71.0	0.2	0.04	1.3	0.7	2.2	0.8	4.0	1.0	6.1	1.1	8.2	1.2	15.2	13.7	3/		10.1	1.3	9.8	2.0
4	Load Regulation	µV	0.0	200	0.3	0.07	0.1	0.06	0.1	0.08	0.2	0.07	0.2	0.12	0.1	0.10	0.1	0.09	3/		0.1	0.15	0.1	0.04
5	ISC	mA	-100	0.0	-59	1.4	-59	1.3	-59	1.1	-57	1.0	-57	1.0	-56	1.0	-57	1.3	3/		-56	1.3	-56	1.3
6	VT	V	0.540	0.580	0.555	0.002	0.553	0.002	0.551	0.002	0.554	0.002	0.557	0.002	0.552	0.002	0.556	0.002	3/		0.552	0.002	0.546	0.002

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.
 - 3/ No reliable measurements were possible at this level.
- 4/ Radiation sensitive parameter: VREF.