Unisys

DATE: January 03, 2000 PPM-99-042
TO: B. Forsbacka/562
FROM: K. Sahu/S. Kniffin/300.1
SUBJECT: Radiation Report on **MX7225UQ/883B (Maxim) (LDC 9321)**
PROJECT: HST/COS

cc: T. Perry/300.1, R. Reed/562, A. Sharma/562, OFA Library/300.1

A radiation evaluation was performed on **MX7225UQ/883B Quad 8-Bit CMOS D/A Converter (Maxim)** to determine the total dose tolerance of these parts. The total dose testing was performed using a Co^{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 levels were 2.5, 5.0, 10.0, 20.0, and 30.0kRads.[1] The average dose rate was 0.15kRads/hour (0.04Rads/s). See Table II for the radiation schedule and average dose rate calculation. After the 30.0kRad irradiation, the parts were annealed under bias at 25°C for 168 hours.[2] After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits[3] listed in Table III. An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step.

All parts passed all tests up to 10kRads. After the 20kRad irradiation, some parts showed minor degradation in IDD_15V and Zero_Code_Error. Four parts showed significant degradation in all NL and RA tests. After the 30kRad irradiation, there was some increase in the degradation in IDD_15V and Zero_Code_Error. One part marginally exceeded the specification limit on one Full_Scale_Error test. All parts showed significant degradation in all NL and RA tests. After annealing the parts at 25°C for 168 hours, the parts showed significant recovery in IDD_15V, Full_Scale_Error and Zero_Code_Error. No significant recovery was noted in any NL or RA parameter. See Figures 2 and 3 for further information in NL and RA.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 50, 52, 53, 54, 55, 57, 58, and 59) were used as radiation samples while SN's 51 and 56 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 10.0kRads.

After the 20kRad irradiation, one part exceeded the specification limit of 10.00mA for IDD_15V with a reading of 10.47mA. Three parts marginally exceeded the specification limit of 15.00mV for some of the Zero_Code_Error tests with readings in the range of 15.63 to 21.52mV. Four parts significantly exceeded the specification limit of 1.00lsb for all NL tests with readings in the range of 85 to 541lsb. Four parts significantly exceeded the specification limit of 0.05lsb for all RA tests with readings in the range of 78 to 927lsb. **All parts passed all other tests.**

After the 30kRad irradiation, six parts exceeded the specification limit for IDD_15V with readings in the range of 10.92 to 14.96mA. One part marginally exceeded the specification limit of 0.50lsb for one Full_Scale_Error test with a reading of 0.66lsb. All parts significantly exceeded the specification limit for all NL and RA tests with readings in the range of 214 to 463lsb. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts showed significant recovery in IDD_15V, Full_Scale_Error and Zero_Code_Error. No significant recovery was noted in any NL or RA parameter.

[1] The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.
[2] The temperature 25°C as used in this document implies room temperature.
[3] These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation specification limits or radiation tolerance guarantees 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 us at (301) 731-8954.

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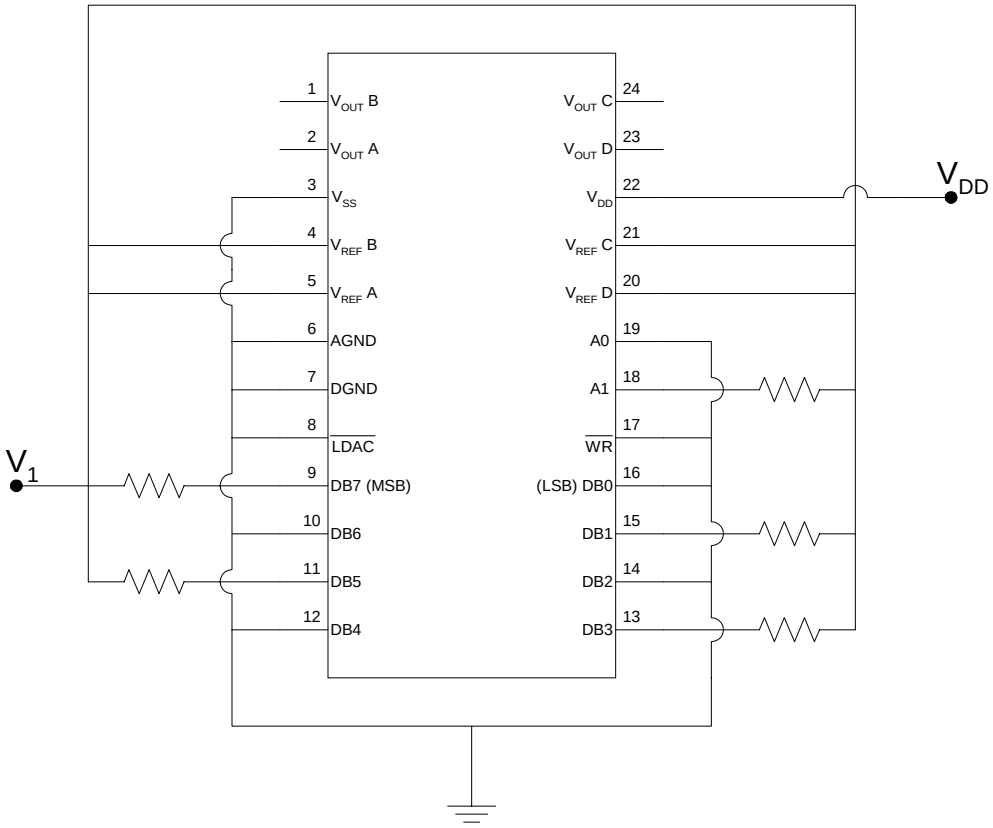
Figure 1. Radiation Bias Circuit for MX7225UQ/883B



Notes:
1. V_{DD} = +15.0V ±0.5V.
2. V_1 = +5.0V ±0.5V.
3. R = 1kΩ, 5%, ½W.

TABLE I. Part Information

Generic Part Number:	MX7225
HST/COS Part Number	MX7225UQ/883B
HST/COS TID Requirement	10kRads (RDM = 5)
Charge Number:	C00167
Manufacturer:	Maxim
Lot Date Code (LDC):	9321
Quantity Tested:	10
Serial Numbers of Control Samples:	51, 56
Serial Numbers of Radiation Samples:	50, 52, 53, 54, 55, 57, 58, 59
Part Function:	Quad 8-Bit CMOS D/A Converter
Part Technology:	CMOS
Package Style:	24 Pin DIP
Test Equipment:	A540
Test Engineer:	S. Archer-Davies

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for MX7225UQ/883B

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	12/02/99
2) 2.5 KRAD IRRADIATION (0.125 KRADS/HOUR)	12/06/99
POST-2.5 KRAD ELECTRICAL MEASUREMENT	12/07/99
3) 5.0 KRAD IRRADIATION (0.106 KRADS/HOUR)	12/07/99
POST-5.0 KRAD ELECTRICAL MEASUREMENT	12/08/99
4) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	12/08/99
POST-10.0 KRAD ELECTRICAL MEASUREMENT	12/10/99
5) 20.0 KRAD IRRADIATION (0.144 KRADS/HOUR)	12/10/99
POST-20.0 KRAD ELECTRICAL MEASUREMENT	12/13/99
6) 30.0 KRAD IRRADIATION (0.219 KRADS/HOUR)	12/13/99
POST-30.0 KRAD ELECTRICAL MEASUREMENT	12/15/99
7) 168 HOUR ANNEALING @25°C	12/03/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/10/99

Average Dose Rate = 30,000 RADS/196 HOURS=153.1 RADS/HOUR=0.04RADS/SEC

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

Table III. Electrical Characteristics MX7225UQ/883B (1)

Test #	Parameter	Units	Spec. Limit min	Spec. Limit max	Test Conditions (2)
10	IDD_15V	mA	0	10.0	V_{DD} = 15V, outputs unloaded
11	ISS_-5V	mA	-9.0	0	V_{SS} = -5V, outputs unloaded
20	Full_Scale_Error_A	lsb	-0.50	0.50	
21	Zero_Code_Error_A	mV	-15	15	
22	Full_Scale_Error_B	lsb	-0.50	0.50	
23	Zero_Code_Error_B	mV	-15	15	
24	Full_Scale_Error_C	lsb	-0.50	0.50	
25	Zero_Code_Error_C	mV	-15	15	
26	Full_Scale_Error_D	lsb	-0.50	0.50	
27	Zero_Code_Error_D	mV	-15	15	
30-41	Iih	nA	-1000	1000	V_{IN} = V_{DD}
50-61	Iil	nA	-1000	1000	V_{IN} = 0V
90	NL_A (3)	lsb	0	1.00	
91	RA_A (3)	lsb	0	0.50	
92	NL_B	lsb	0	1.00	
93	RA_B	lsb	0	0.50	
94	NL_C	lsb	0	1.00	
95	RA_C	lsb	0	0.50	
96	NL_D	lsb	0	1.00	
97	RA_D	lsb	0	0.50	

Notes:

(1) These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

(2) V_{DD} = +15V, V_{SS} = -5V, AGND = DGND = 0V, and V_{REF} = 2.0V to (V_{DD} - 4V) unless otherwise noted.

(3) NL = Differential Non-Linearity, RA = Integral Non-Linearity

LE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for MX7225UQ/883I

					Total Dose Exposure (kRads Si)												Annealing	
					Initial		2.5		5.0		10.0		20.0		30.0		168 hours @25°C	
Test #	Parameters	Units	Spec. Lim. (2) min	Spec. Lim. (2) max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
10	IDD_15V	mA	0	10.0	7.09	0.33	7.06	0.20	7.25	0.19	7.69	0.27	8.94	0.76	11.03	1.72	8.94	1.04
11	ISS_-5V	mA	-9.0	0	-6.03	0.31	-5.99	0.17	-6.09	0.18	-6.26	0.20	-6.80	0.19	-7.42	0.25	-6.85	0.21
20	Full_Scale_Error_A	lsb	-0.50	0.50	-0.02	0.05	-0.03	0.05	-0.02	0.05	-0.03	0.05	-0.02	0.06	0.19	0.23	0.02	0.11
21	Zero_Code_Error_	mV	-15	15	3.91	2.98	4.60	3.13	4.91	3.23	5.40	3.23	6.70	4.08	8.84	4.30	7.11	3.76
22	Full_Scale_Error_I	lsb	-0.50	0.50	-0.03	0.10	-0.02	0.11	-0.03	0.11	-0.05	0.12	-0.03	0.13	0.27	0.25	-0.06	0.13
23	Zero_Code_Error_	mV	-15	15	4.52	5.38	4.08	6.14	4.95	6.21	5.77	6.49	6.13	7.26	2.92	10.36	6.97	7.01
24	Full_Scale_Error_(	lsb	-0.50	0.50	-0.03	0.07	-0.03	0.08	-0.05	0.09	-0.08	0.08	-0.11	0.09	-0.03	0.16	-0.11	0.12
25	Zero_Code_Error_	mV	-15	15	4.15	4.08	3.99	4.68	4.77	4.78	6.12	4.51	11.82	3.10	32.80	7.51	13.99	3.87
26	Full_Scale_Error_I	lsb	-0.50	0.50	-0.05	0.08	-0.04	0.08	-0.03	0.09	-0.07	0.09	-0.08	0.09	0.12	0.20	-0.03	0.15
27	Zero_Code_Error_	mV	-15	15	4.92	4.37	4.52	4.73	4.87	4.63	5.96	4.71	10.61	6.48	23.23	22.24	12.29	15.00
30-41	Iih	nA	-1000	1000	-720	80	-697	67	-721	65	-714	56	-696	50	-696	60	-739	45
50-61	Iil	nA	-1000	1000	-739	61	-731	58	-699	30	-794	25	-750	50	-742	71	-752	47
90	NL_A (3)	lsb	0	1.00	0.16	0.08	0.15	0.08	0.14	0.08	0.15	0.09	4P/4F		8F		8F	
91	RA_A	lsb	0	0.50	0.33	0.07	0.32	0.07	0.31	0.07	0.31	0.07	4P/4F		8F		8F	
92	NL_B	lsb	0	1.00	0.12	0.08	0.09	0.05	0.09	0.05	0.10	0.05	4P/4F		8F		8F	
93	RA_B	lsb	0	0.50	0.29	0.08	0.27	0.05	0.27	0.05	0.27	0.05	4P/4F		8F		8F	
94	NL_C	lsb	0	1.00	0.15	0.11	0.11	0.08	0.11	0.09	0.12	0.09	4P/4F		8F		8F	
95	RA_C	lsb	0	0.50	0.36	0.12	0.29	0.09	0.29	0.09	0.28	0.09	4P/4F		8F		8F	
96	NL_D	lsb	0	1.00	0.11	0.05	0.09	0.04	0.09	0.03	0.09	0.03	4P/4F		8F		8F	
97	RA_D	lsb	0	0.50	0.28	0.05	0.26	0.04	0.26	0.04	0.26	0.04	4P/4F		8F		8F	

Notes:

(1) The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout testir

(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

(3) nP/mF implies that n parts passed and m parts failed this test at this level. 8F implies that all parts failed this test at this level.

Radiation sensitive parameters: IDD_15V, Full_Scale_Error, Zero_Code_Error, NL, RA.