

Unisys

DATE: November 30, 1999
TO: B. Forsbacka/562
FROM: K. Sahu/S. Kniffin/300.1
SUBJECT: Radiation Report on **AD7885AQ (Analog Devices) (LDC 9827)**
PROJECT: HST/COS

PPM-99-039

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

A radiation evaluation was performed on **AD7885AQ 16-Bit High Speed Sampling ADC (Analog Devices)** 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, six 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, 30.0, and 50.0kRads.¹ The average dose rate was 0.21kRads/hour (0.06Rads/s). See Table II for the radiation schedule and average dose rate calculation. After the 50.0kRad 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 limits³ 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 50kRads. After annealing the parts at 25°C for 168 hours, the parts showed no significant change in any parameter.

Initial electrical measurements were made on 8 samples. Six samples (SN's 4, 5, 7, 8, 9, and 10) were used as radiation samples while SN's 1 and 2 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 50.0kRads.

After annealing the parts for 168 hours at 25°C, the parts showed no significant change in any parameter.

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.

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.

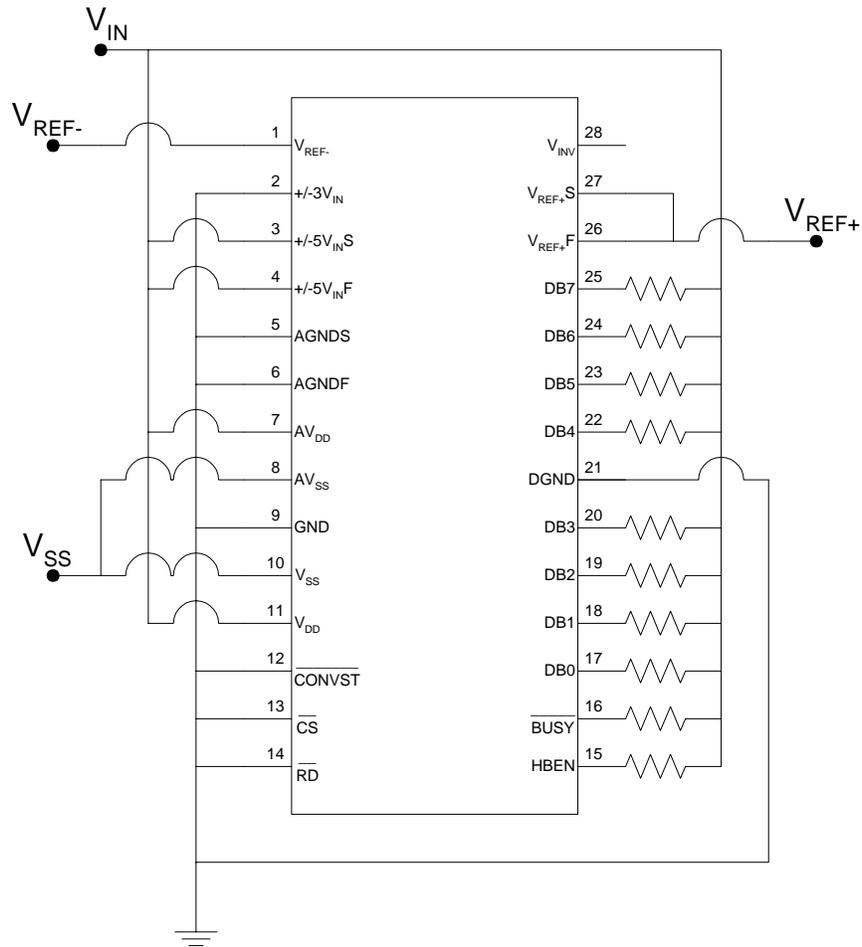
³ These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for AD7885AQ



Notes:

1. $V_{IN} = +5.0V \pm 0.5V$.
2. $V_{SS} = -5.0V \pm 0.5V$.
3. $V_{REF+} = +3.0V \pm 0.3V$.
4. $V_{REF-} = -3.0V \pm 0.3V$.
5. $R = 2k\Omega, 10\%, \frac{1}{2}W$.

TABLE I. Part Information

Generic Part Number:	AD7885
HST/COS Part Number	AD7885AQ
HST/COS TID Requirement	10kRads (RDM = 5)
Charge Number:	C00173
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9827
Quantity Tested:	8
Serial Numbers of Control Samples:	1, 2
Serial Numbers of Radiation Samples:	4, 5, 7, 8, 9, 10
Part Function:	16 Bit High Speed Sampling ADC
Part Technology:	LCCMOS
Package Style:	28 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 AD7885AQ

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	09/23/99
2) 2.5 KRAD IRRADIATION (0.156 KRADS/HOUR).....	11/08/99
POST-2.5 KRAD ELECTRICAL MEASUREMENT	11/09/99
3) 5.0 KRAD IRRADIATION (0.116 KRADS/HOUR).....	11/09/99
POST-5.0 KRAD ELECTRICAL MEASUREMENT	11/10/99
4) 10.0 KRAD IRRADIATION (0.109 KRADS/HOUR).....	11/10/99
POST-10.0 KRAD ELECTRICAL MEASUREMENT	11/12/99
5) 20.0 KRAD IRRADIATION (0.152 KRADS/HOUR).....	11/12/99
POST-20.0 KRAD ELECTRICAL MEASUREMENT	11/15/99
6) 30.0 KRAD IRRADIATION (0.217 KRADS/HOUR).....	11/15/99
POST-30.0 KRAD ELECTRICAL MEASUREMENT	11/17/99
7) 50.0 KRAD IRRADIATION (0.465 KRADS/HOUR).....	11/17/99
POST-50.0 KRAD ELECTRICAL MEASUREMENT	11/19/99
8) 168 HOUR ANNEALING @25°C.....	11/19/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	11/26/99

Average Dose Rate = 50,000 RADS/237 HOURS=211.0 RADS/HOUR=0.06RADS/SEC

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

Table III. Electrical Characteristics AD7885AQ (1)

Test #	Parameter	Units	Spec. Limit		Test Conditions (2)
			min	max	
100	Missing Codes	Codes		1	
110	INL	lsb	0	4.91	
120	DNL	lsb	0	4.91	
200	+Gain_error	%	-0.20	0.20	
210	-Gain_error	%	-0.20	0.20	
300-303	Iil	μA	-10	10	
304-307	Iih	μA	-10	10	
400-408	Voh	V	4.00		$I_{\text{SOURCE}} = 40\mu\text{A}$
500-507	Vol	mV		400	$I_{\text{SINK}} = 1.6\text{mA}$
600-607	Iozl	μA	-10	10	
650-657	Iozh	μA	-10	10	
700	IDD	mA		35	
701	ISS	mA	-30		
702	Pwr_Consumption	mW		320	
800	Conversion Time	μs		5.30	

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) $V_{\text{DD}} = +5\text{V}$, $V_{\text{SS}} = -5\text{V}$, $V_{\text{REF}} + S = 3\text{V}$, $\text{AGND}=\text{DGND}=\text{GND} = 0\text{V}$, $f_{\text{SAMPLE}} = 166\text{kHz}$, unless otherwise noted.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AD7885AQ (1)

Test #	Parameters	Units	Spec. Lim. (2)		Total Dose Exposure (kRads Si)																Annealing	
					Initial		2.5		5.0		10.0		20.0		30.0		50.0		168 hours @25°C			
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
100	Missing Codes	Codes		1	0		0		0		0		0		0		0		0		0	
110	INL	lsb	0	4.91	4.21	0.47	3.86	0.69	3.77	0.76	3.63	0.85	3.57	0.79	3.60	0.73	3.87	0.78	3.60	0.88		
120	DNL	lsb	0	4.91	1.14	0.08	1.14	0.08	1.16	0.17	1.13	0.09	1.13	0.10	1.09	0.10	1.06	0.06	1.18	0.16		
200	+Gain_error	%	-0.20	0.20	0.022	0.022	0.041	0.025	0.036	0.022	0.032	0.018	0.032	0.023	0.036	0.019	0.033	0.024	0.030	0.019		
210	-Gain_error	%	-0.20	0.20	0.040	0.025	0.044	0.031	0.024	0.010	0.046	0.034	0.025	0.014	0.019	0.018	0.049	0.033	0.042	0.021		
300-303	Iil	mA	-10	10	0.03	0.005	0.03	0.005	0.03	0.005	0.03	0.005	0.03	0.005	0.02	0.005	0.02	0.005	0.02	0.005		
304-307	Iih	mA	-10	10	0.02	0.005	0.02	0.005	0.02	0.005	0.02	0.005	0.02	0.005	0.02	0.005	0.02	0.005	0.02	0.005		
400-408	Voh	V	4.0		4.98	0.01	4.98	0.01	4.98	0.01	4.98	0.01	4.98	0.01	4.98	0.01	4.98	0.01	4.98	0.01		
500-507	Vol	mV		400	70	2	70	2	70	2	70	2	70	2	70	2	70	2	70	2		
600-607	Iozl	mA	-10	10	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01		
650-657	Iozh	mA	-10	10	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.03	0.01	0.03	0.01		
700	IDD	mA		35	21	0.5	21	0.5	21	0.5	21	0.5	21	0.5	20	0.5	20	0.5	20	0.5		
701	ISS	mA	-30		-23	0	-23	0	-23	0	-23	0	-23	0.3	-23	0.5	-23	0.5	-23	0.5		
702	Pwr_Consumptio	mW		320	228	2	227	2	226	2	225	2	224	2	223	2	222	2	221	2		
800	Conversion Time	ms		5.30	5.06	0.04	5.03	0.04	5.02	0.04	4.99	0.05	4.94	0.05	-4.93	0.07	4.92	0.07	4.89	0.08		

Notes:

- (1) The mean and standard deviation values were calculated over the six parts irradiated in this testing. The control samples remained constant throughout testing and are not in
- (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: None.