

Unisys

DATE: September 10, 1998 PPM-98-024
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SUBJECT: Radiation Report on **AD571 (Analog Devices) (LDC 9746)**
PROJECT: GOES (ITT)

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A radiation evaluation was performed on **AD571 10 Bit A/D Converter (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, 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 20.0, 40.0, 60.0, 80.0, 100.0, 150.0, and 200.0 kRads.¹ The dose rate was 1.200 kRads/hour (0.33 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 200.0 kRad irradiation, the parts were annealed under bias at 25°C and tested after 24 and 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. For detailed information, refer to Tables I through IV and Figure 1.

All parts passed all tests through 200kRads with no significant degradation in any parameter. No change was noted after any annealing step at 25°C.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 171, 172, 174, 177, 178, 179, 180, and 518) were used as radiation samples while SN's 169 and 170 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests through 200kRads with no significant degradation in any parameter.

After annealing the parts for 24 hours at 25°C, the parts showed no significant change in any parameter.

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.

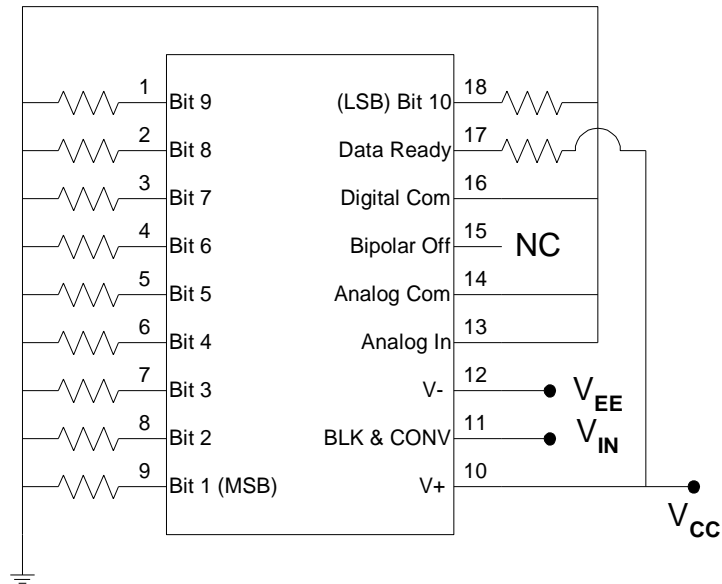
³ These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for AD571



Notes:

1. $V_{EE} = -15.0V \pm 0.5V$.
2. $V_{IN} = 5.0V \pm 0.5V$.
3. $V_{CC} = 5.0V \pm 0.5V$.
4. $R = 3.0k\Omega \pm 1\%$, $\frac{1}{4}W$.
5. Add $C = 3.3\mu F \pm 10\%$ @50V tantalum capacitors to pins 10 and 12 of each device if needed to prevent oscillation.

TABLE I. Part Information

Generic Part Number:	AD571
GOES (ITT) Part Number	AD571
Charge Number:	C80709/C80825
Manufacturer:	Analog Devices
Lot Date Code (LDC):	9746
Quantity Tested:	10
Serial Number of Control Samples:	169, 170
Serial Numbers of Radiation Samples:	171, 172, 174, 177, 178, 179, 180, and 518
Part Function:	10 Bit A/D Converter
Part Technology:	Bipolar
Package Style:	18 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 AD571

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	08/13/98
2) 20.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	08/17/98
POST-20.0 KRAD ELECTRICAL MEASUREMENT	08/18/98
3) 40.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	08/18/98
POST-40.0 KRAD ELECTRICAL MEASUREMENT	08/19/98
4) 60.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	08/19/98
POST-60.0 KRAD ELECTRICAL MEASUREMENT	08/20/98
5) 80.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	08/20/98
POST-80.0 KRAD ELECTRICAL MEASUREMENT	08/21/98
6) 72 HOUR ANNEALING @25°C *	08/21/98
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	08/24/98
7) 100.0 KRAD IRRADIATION (1.200 KRADS/HOUR).....	08/24/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT	08/25/98
8) 150.0 KRAD IRRADIATION (1.200 KRADS/HOUR).....	08/25/98
POST-150.0 KRAD ELECTRICAL MEASUREMENT	08/27/98
9) 200.0 KRAD IRRADIATION (0.450 KRADS/HOUR).....	08/27/98
POST-200.0 KRAD ELECTRICAL MEASUREMENT	08/31/98
10) 24 HOUR ANNEALING @25°C	08/31/98
POST-24 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	09/01/98
11) 168 HOUR ANNEALING @25°C	08/31/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT.....	09/08/98

Effective Dose Rate = 200,000 RADS/14 DAYS=595.2 RADS/HOUR=0.16 RADS/SEC

The effective dose rate is lower than that of the individual radiation steps as it takes into account the weekend and the extended step.

* The annealing step was included due to the weekend.

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

Table III. Electrical Characteristics of AD571 /1

Test #	Parameter	Units	Test Conditions /2	Spec. Lim.	
				min	max
100	Missing Codes		Analog INPUT PIN: 0V to 10V		
110	DNL	lsb	Analog INPUT PIN: 0V to 10V	0.00	0.50
230	full_scale_cal	lsb	Analog INPUT PIN: 9.99V	-3	3
240	bi-polar_zero	lsb	Analog INPUT PIN: 0V	-1	1
250	uni-polar_offset	lsb	Analog INPUT PIN: 0V	-1	1
260	PSRR_5V	lsb	4.5V < V+ < 5.5V	-2	2
270	PSRR_neg_15V	lsb	-16V < V- < -13.5	-2	2
300	IIL_BLK_CONV	mA	V _{IN} = 0V	-100	100
301	IIH_BLK_CONV	mA	V _{IN} = 5V	-100	100
400-410	VOL	mV	I _{OL} = 3.0mA, bit 1 - bit 10, data_ready		400
500-509	VOH	V	I _{OH} = -0.5mA, bit 1 - bit 10	2.400	
600-609	IOZH	mA	BLK_CNV = 5V, bit 1 - bit 10, V _{IN} = 5V	-40	40
700-709	IOZL	mA	BLK_CNV = 5V, bit 1 - bit 10, V _{IN} = 0V	-40	40
800	I_VPOS	mA	+V = 5.5V, -V = 16.5V	0.0	10.0
801	I_VNEG	mA	+V = 5.5V, -V = 16.5V	-15.0	0.0
900	Conversion_Time	ms	T _{MIN} = T _{MAX} , BLK_CNV = 5V, bit 1 - bit 10, V _{IN} = 5V	0.0	30.0

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/ For all tests, +V = 5V, -V = -15V, all voltages measured with respect to digital common, unless otherwise noted.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AD571 /1

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads Si)																Annealing		Total Dose Exposure (kRads Si)								Annealing			
					Initial		20.0		40.0		60.0		80.0		72 hours @25°C		100.0		150.0		200.0		24 hours @25°C		168 hours @25°C									
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd						
110	DNL	lsb	0.00	0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
230	full_scale_cal	lsb	-3	3	0.2	0.07	0.2	0.06	0.3	0.06	0.4	0.07	0.5	0.07	0.5	0.07	0.5	0.08	0.7	0.08	0.8	0.09	0.8	0.08	0.8	0.09								
240	bi-polar_zero	lsb	-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
250	uni-polar_offset	lsb	-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
260	PSRR_5V	lsb	-2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
270	PSRR_neg_15V	lsb	-2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
300	III_BLK_CONV	?A	-100	100	-1	0.1	-1	0.1	-1	0.1	-1	0.1	-1	0.1	-1	0.1	-1	0.1	-1	0.1	-1	0.1	-1	0.1	-1	0.1								
301	IIH_BLK_CONV	?A	-100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
400-410	VOL	mV		400	136	4	140	6	142	7	148	8	151	7	151	9	152	8	157	8	160	10	156	9	159	9								
500-509	VOH	V	2.400		3.575	0.004	3.581	0.005	3.573	0.006	3.574	0.007	3.567	0.009	3.576	0.007	3.574	0.007	3.568	0.007	3.568	0.007	3.564	0.007	3.569	0.007								
600-609	IOZH	?A	-40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
700-709	IOZL	?A	-40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
800	I_VPOS	mA	0.0	10.0	1.5	0	1.5	0	1.5	0	1.4	0	1.4	0	1.4	0	1.4	0	1.4	0	1.4	0	1.4	0	1.4	0								
801	I_VNEG	mA	-15.0	0.0	-8.9	0.1	-8.8	0.1	-8.7	0.1	-8.7	0.1	-8.6	0.1	-8.6	0.1	-8.6	0.1	-8.5	0.1	-8.4	0.2	-8.4	0.1	-8.5	0.1								
900	Conversion_Time	?s	0.0	30.0	24.6	0.5	24.7	0.5	25.1	0.4	25.7	0.7	26.0	0.7	25.9	0.6	26.3	0.7	27.1	0.7	27.7	0.7	27.5	0.7	27.4	0.7								

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout 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: None.