Federal Systems

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DATE: October 10, 1995

PPM-95-183

TO: S. Hull/311.1 ks
FROM: K. Sahu/300.1
SUBJECT: Radiation Report on HST/NICMOS
Part No. AD620SQ/883B
Control No. 12892

cc: A. Sharma/311.0
R. Williams/300.1
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A radiation evaluation was performed on AD620 (Op-Amp) 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 Co^{60} gamma ray source. During the radiation testing, five 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 1, 2, 3, and 10 krads*. The dose rate was between 0.06 and 0.41 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

All parts passed initial electrical measurements.

All parts passed all electrical tests throughout all irradiation steps up to and including the 3 krad irradiation level.

After the 10 krad irradiation, all irradiated parts exceeded the maximum specification limit of 2 nA for P_IIB and 2nA for N_IIB, with readings ranging from 3.2 nA to 4.7 nA and 3.1 nA to 4.8 nA. In addition S/N 23 readings for PSRR_X1, PSRR_X10, PSRR_X100, PSRR_X1000 and ERROR_X1000 are 67.6 dB, 90.7 dB, 100 dB, 116 dB and -0.74%, which are slightly less than the specification limits of 80 dB, 95 dB, 110 dB, 110 dB and -0.70%.

Table IV provides a summary of the mean and standard deviation values for each parameter after different irradiation exposures.

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

*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. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

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TABLE I. Part Information

Generic Part Number:	AD620
HST/NICMOS Part Number:	AD620SQ/883B
HST/NICMOS Control Number:	12892
Charge Number:	EE61747
Manufacturer:	Analog Devices Inc
Lot Date Code:	9435
Quantity Tested:	7
Serial Number of Control Samples:	20, 21
Serial Numbers of Radiation Samples:	22, 23, 24, 25, 26
Part Function:	Op-Amp
Part Technology:	CMOS
Package Style:	8-pin Cerdip
Test Equipment:	A540
Test Engineer:	Tim Mondy

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

TABLE II. Radiation Schedule for AD620

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	08/24/95
2) 1 KRAD IRRADIATION (0.06 KRADS/HOUR)	08/28/95
POST-1 KRAD ELECTRICAL MEASUREMENT	08/29/95
3) 2 KRAD IRRADIATION (0.06 KRADS/HOUR)	08/29/95
POST-2 KRAD ELECTRICAL MEASUREMENT	08/30/95
4) 3 KRAD IRRADIATION (0.06 KRADS/HOUR)	08/30/95
POST-3 KRAD ELECTRICAL MEASUREMENT	08/31/95
5) 10 KRAD IRRADIATION (0.41 KRADS/HOUR)	08/31/95
POST-10 KRAD ELECTRICAL MEASUREMENT	09/01/95

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

Table III. Electrical Characteristics of AD620

Unless Otherwise Specified: T_A =25°C, VCC = +/- 15Vdc, RL = 2K Ohms

TEST NAME	SYMBOL	CONDITIONS	LIMITS	
			MIN	MAX
		SUPPLY CURRENT		
Plus_Icc	Icc			1.30mA
Minus_Icc	Icc		-1.30mA	
		OFFSET TESTS		
Input Offset Voltage	V_{OSI_0V} RTI	GAIN = 1,000	-125.0uV	125.0uV
Output Offset Voltage	V_{OSO_0V} RTI	GAIN = 1	-1.00mV	1.00mV
CMRR	P_CMRR_X1	V_{IN} = 0V to +10V, GAIN =1	73dB	
CMRR	N_CMRR_X1	V_{IN} = 0V to -10V, GAIN =1	73dB	
CMRR	P_CMRR_X10	V_{IN} = 0V to +10V, GAIN =10	93dB	
CMRR	N_CMRR_X10	V_{IN} = 0V to -10V, GAIN =10	93dB	
CMRR	P_CMRR_X100	V_{IN} = 0V to +10V, GAIN =100	110dB	
CMRR	N_CMRR_X100	V_{IN} = 0V to -10V, GAIN =100	110dB	
CMRR	P_CMRR_X1000	V_{IN} = 0V to +10V, GAIN =1000	110dB	
CMRR	N_CMRR_X1000	V_{IN} = 0V to -10V, GAIN =1000	110dB	
PSRR	PSRR_X1	(Vcm=-0.0V) +/-Vcc = 2.3V, +/-Vcc= 18, GAIN =1	80dB	
PSRR	PSRR_X10	(Vcm=-0.0V) +/-Vcc = 2.3V, +/-Vcc= 18, GAIN =10	95dB	
PSRR	PSRR_X100	(Vcm=-0.0V) +/-Vcc = 2.3V, +/-Vcc= 18, GAIN =100	110dB	
PSRR	PSRR_X1000	(Vcm=-0.0V) +/-Vcc = 2.3V, +/-Vcc= 18, GAIN =1000	110dB	
		INPUT PORT CURRENT TESTS		
IIB	P_IIB	GAIN = 1	-2.0nA	2.0nA
IIB	N_IIB	GAIN = 1	-2.0nA	2.0nA
IOS	IIOS	GAIN = 1	-1.0nA	1.0nA
		GAIN ERROR TESTS		
GAIN_X1	ERROR_X1	V_{IN} = +10V to -10V, GAIN =1	-0.1%	0.1%
GAIN_X10	ERROR_X10	V_{IN} = +1V to -1V, GAIN =10	-0.3%	0.3%
GAIN_X100	ERROR_X100	V_{IN} = +0.1V to -0.1V, GAIN =100	-0.3%	0.3%
GAIN_X1000	ERROR_X1000	V_{IN} = +0.01V to -0.01V, GAIN =1000	-0.7%	0.7%
NON-LINEARITY_X1	ERROR_X1 ppm	V_{IN} = +10V to -10V, GAIN =1	-95 ppm	95 ppm
POS_VOUT	POS_VOUT	V_{IN} = +12.6V, GAIN =1, RL =10KΩ		13.614V
NEG_VOUT	NEG_VOUT	V_{IN} = -13.1V, GAIN =1, RL =10KΩ	-13.8V	

PARAMETER	SYMB	CONDITIONS	MIN	MAX	UNITS
Settling Time	Ts	To 0.01% for a 10V step. Gain=100	-	15 (typical)	µs
Small Signal - 3 dB Bandwidth	GBW	-	100 (Typical)	-	kHz
Slew Rate	SR	To 0.01% for a 10V step. Gain = 100	0.75	-	µs
Voltage Noise, 1 kHz Input	Vnoise	-	-	13	nV
Low Frequency RMS Noise	Inoise	0.1 Hz to 10 Hz	-	10 (Typical)	fA

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for AD620 /1

Test #	Parameters	Units	Spec. Lim./2 min	Spec. Lim./2 max	Initial mean	Initial sd	Total dose Exposure (krads) 1 mean	1 sd	2 mean	2 sd	3 mean	3 sd	10 mean	10 sd
1	Plus_Icc	mA	0	1.3	0.94	0.04	0.94	0.04	0.93	0.04	0.93	0.04	0.92	0.04
2	Minus_Icc	mA	-1.3	0	-0.99	0.04	-0.98	0.04	-0.98	0.04	-0.98	0.04	-0.97	0.04
3	VOSI_0V	uV	-125	125	42	9	45	9	45	9	44	9	53	12
4	VOSO_0V	mV	-1	1	0.0	0.09	0.04	0.06	0.10	0.07	0.06	0.09	0.09	0.11
5	P_CMRR_X1	dB	73	-	97.4	13.1	102	20.2	98.5	14.6	96.9	11.3	97.6	13.6
6	N_CMRR_X1	dB	73	-	96.7	12.1	95.1	8.58	100	18.6	95.8	9.51	95.8	10.3
7	P_CMRR_X10	dB	93	-	113	7.70	113	7.06	114	7.56	115	9.75	112	6.99
8	N_CMRR_X10	dB	93	-	120	14.7	118	14.1	119	17.5	119	13.7	118	15.1
9	P_CMRR_X100	dB	110	-	131	6.62	122	2.07	125	5.74	122	1.27	128	7.56
10	N_CMRR_X100	dB	110	-	135	12.5	127	4.65	134	9.88	137	10.6	124	4.80
11	P_CMRR_X100	dB	110	-	128	8.91	130	5.78	133	7.47	131	3.49	130	8.96
12	N_CMRR_X100	dB	110	-	129	6.07	130	13.0	129	7.16	128	9.84	127	8.79
13	PSRR_X1	dB	80	-	109	9.56	109	9.45	109	9.86	108	9.23	103	22.6
14	PSRR_X10	dB	95	-	130	14.5	129	8.69	129	7.43	126	5.02	117	15.5
15	PSRR_X100	dB	110	-	145	10.6	136	6.62	137	8.13	135	7.12	121	12.7
16	PSRR_X1000	dB	110	-	128	3.33	131	2.96	133	5.56	136	16.1	121	4.29
17	P_IIB	nA	-2	2	-0.11	0.09	0.75	0.10	1.15	0.15	1.63	0.16	3.72	0.62
18	N_IIB	nA	-2	2	-0.11	0.08	-0.13	0.11	0.28	0.15	1.42	0.19	3.69	0.65
19	IIOS	nA	-1	1	0.0	0.02	0.88	0.02	0.86	0.01	0.21	0.03	0.05	0.03
20	ERROR_X1		-0.10%	0.10%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	ERROR_X10		-0.30%	0.30%	0.0	0.0	0.03	0.01	0.03	0.01	0.0	0.01	0.03	0.01
22	ERROR_X100		-0.30%	0.30%	-0.04	0.01	-0.04	0.02	-0.05	0.02	-0.06	0.02	-0.04	0.02
23	ERROR_X1000		-0.70%	0.70%	-0.43	0.05	-0.38	0.08	-0.49	0.11	-0.47	0.09	-0.42	0.07
24	ERROR_X1 ppm		-95	95	-40.6	6.53	-10.9	38.9	26.9	37.4	-26.6	32.5	-43.7	18.3
25	POS_VOUT	V	-	13.6	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0	13.6	0.0
26	NEG_VOUT	V	-13.8	-	-13.1	0.0	-13.1	0.0	-13.1	0.0	-13.1	0.0	-13.1	0.0
27	Ts	µs	-	-	18	0	17	0	17	0	17	0	17	0
28	GBW	kHz	100	-	106	4.8	106	3.5	108	2.5	107	4.0	105	3.3
29	SR	µs	0.75	-	1.12	.04	1.04	.05	1.05	.05	1.02	.04	1.02	.04
30	Vnoise	nV	-	13	10.2	.44	10.7	.13	10.7	.10	10.6	.11	11.0	.19
31	Inoise	fA	-	-	290	7.1	295	2.6	299	1.3	301	1.1	319	4.7

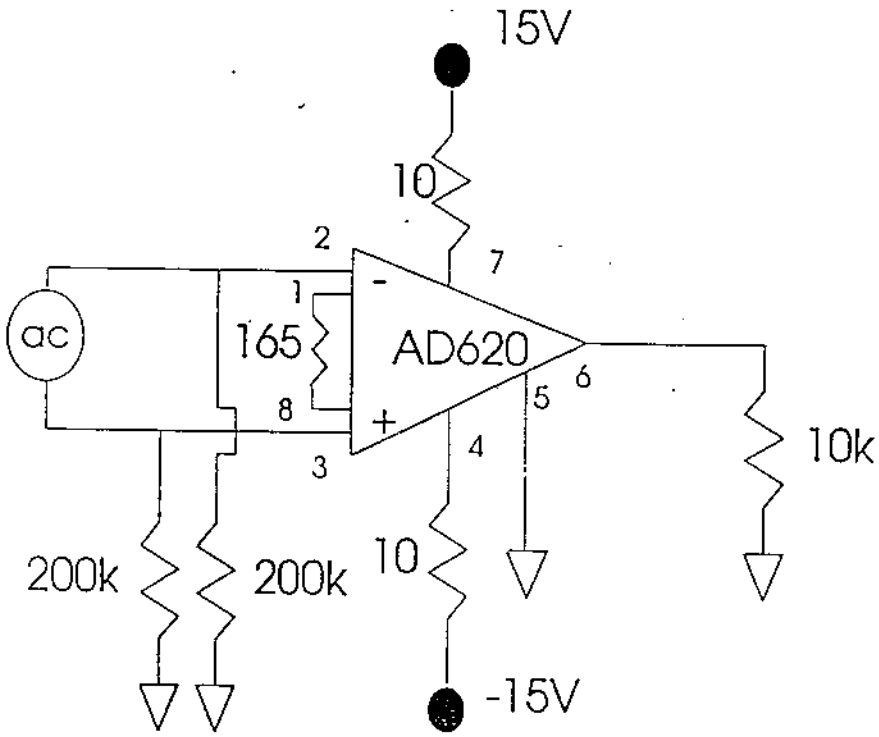
Notes:

1/ The mean and standard deviation values were calculated over the five 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: PSRR_X1, PSRR_X10, PSRR_X100, PSRR_X1000, P_IIB, N_IIB and ERROR_X1000.

Figure 1. Radiation Bias Circuit for AD620



NOTES:

ac: 20mVpp, 10kHz
All resistances in ohms
RG = 49.4k/(G-1) = 165 (for G =300)