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Interoffice Memorandum

To
C. Eveland
Department
Code 300.1
From
K. Sahu KS
Department
7809
Subject
Radiation Report on ISTEP
Common Buy Part No. HA7-5170-8

PPM-91-533
Date
August 21, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
S. Pszcolka/311
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A radiation evaluation was performed on HA7-5170-8 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 cobalt-60 gamma ray source. During the radiation testing, ten parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as control samples. The total dose radiation steps were 10, 15, 25, 35, 45, 55, 65 and 100 krad. After 100 krad, parts were annealed at 25°C for 24 and 168 hours. The dose rate was between 0.1 - 1.8 krad/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III.

All (10) parts passed initial electrical measurements. However, after the first radiation exposure of 10 krad, one part (SN 1) marginally exceeded the maximum specification limit of $\pm 300\mu\text{V}$ for VOS@50 with a reading of $-318\mu\text{V}$, while all other part remained well within the specification limits for all parameters. After the next radiation step of 15 krad, three parts (SNs 1, 2 and 7) exceeded this specification limit with failed readings ranging from $-325\mu\text{V}$ to $-443\mu\text{V}$. All other parts continued to pass all tests. More parts began to fail this test as the cumulative radiation dose was increased to 25 and 35 krad, and all parts exceeded the $\pm 300\mu\text{V}$ limit for VOS@50 after 45 krad. Some degradation was observed in AOL and CMRR over these radiation exposures, although all parts continued to pass these tests.

VOS@50 continued to degrade on exposures to 55 and 65 krad. After 100 krad, three parts (SNs 2, 6 and 7) exceeded the 3.8mV measurement limit of the test equipment for VOS@50. In addition, four parts (SNs 5, 6, 7 and 9) did not meet the 85dB minimum

specification limit for CMRR, and two parts (SNs 6 and 7) failed to meet the 85dB minimum specification limit for -PSRR. No significant recovery was observed upon annealing the parts for 24 and 168 hours. Also, another part, SN 9, failed to meet the minimum specification limit for -PSRR after 168 hours of annealing. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments.

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

TABLE I. Part Information

Generic Part Number:	HA7-5170-8
ISTP Common Buy Part Number:	HA7-5170-8
ISTP Common Buy Control Number:	152
Charge Number:	C03807
Manufacturer:	Harris Corp.
Quantity Procured:	352
Lot Date Code:	9016
Quantity Tested:	12
Serial Numbers of Radiation Samples:	1, 2, 5, 6, 7 8, 9, 10, 13, 14
Serial Numbers of Control Samples:	3, 4
Part Function:	Operational Amplifier
Part Technology:	JFET
Package Style:	8-Pin DIP
Test Engineer:	C. Arcila

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	05/03/91
2) 10 krads irradiation @ 500 rads/hr	07/23/91
Post 10 krads Electrical Measurements	07/24/91
3) 15 krads irradiation @ 260 rads/hr	07/24/91
Post 15 krads Electrical Measurements	07/25/91
4) 25 krads irradiation @ 500 rads/hr	07/25/91
Post 25 krads Electrical Measurements	07/26/91
5) 35 krads irradiation @ 150 rads/hr	07/26/91
Post 35 krads Electrical Measurements	07/29/91
6) 45 krads irradiation @ 500 rads/hr	07/29/91
Post 45 krads Electrical Measurements	07/30/91
7) 55 krads irradiation @ 500 rads/hr	07/30/91
Post 55 krads Electrical Measurements	07/31/91
8) 65 krads irradiation @ 500 rads/hr	07/31/91
Post 65 krads Electrical Measurements	08/01/91
9) 100 krads irradiation @ 1750 rads/hr	08/01/91
Post 100 krads Electrical Measurements	08/02/91
10) 24 hour annealing	08/02/91
Post 24 hr Electrical Measurements	08/03/91
11) 168 hour annealing	08/02/91
Post 168 hr Electrical Measurements	08/09/91

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C.
- Annealing was performed at 25°C under bias.

Table III. Electrical Characteristics of HA7-5170-8

Parameter	SYMBOL	V _{supply} = ±15V, R _L = 2KΩ, Unless otherwise indicated						unit	
		Test conditions	25C		-55C		+125C		
			MIN	MAX	MIN	MAX	MIN		MAX
Supply Current (Positive)	I _{CC}	V ₊ = +15V		2.5		2.5		2.5	mA
Supply Current (Negative)	I _{CC}	V ₋ = -15V		-2.5		-2.5		-2.5	mA
OFFSET VOLTAGE	V _{OS}	V ₋ = -15V, V ₊ = +15V		0.3		0.5		0.5	mV
OFFSET CURRENT	I _{OS}	V ₋ = -15V, V ₊ = +15V		1500		5000		5000	pA
BIAS CURRENT (+)	I _{b+}	V ₋ = 15V, V ₊ = +15V		1500		30,000		30,000	pA
BIAS CURRENT (-)	I _{b-}	V ₋ = -15V, V ₊ = +15V		1500		-30,000		-30,000	pA
LARGE SIGNAL VOLTAGE GAIN	AOL	V ₋ = 15V, V ₊ = +15V, ΔV _O = 20V, R _L = 2KΩ	300K		200K		200K		-
COMMON MODE REJECT. RATIO	CMRR	V ₋ = 15V, V ₊ = +15V, ΔV _O = 20V	85		85		85		dB
POWER SUPP. (+) REJECT. RATIO	+PSRR	V ₋ = 15V, V ₊ = +20V, ΔV _C = 10V	85		85		85		dB
POWER SUPP. (-) REJECT. RATIO	-PSRR	V ₋ = -20V, V ₊ = +15V, ΔV _C = 10V	85		85		85		dB
OUTPUT VOLTAGE SWING (+)	+V _O	V ₋ = -15V, V ₊ = +15V, R _L = 2KΩ		+10V					V
OUTPUT VOLTAGE SWING (-)	-V _O	V ₋ = 15V, V ₊ = +15V, R _L = 2KΩ		-10V					V

TABLE IV: Summary of Electrical Measurements
after Total Dose Exposures and Annealing for HA7-5170-8

1/ 2/

Parameters	Spec. Limits min max	Initials mean. sd		Total Dose Exposure (krads)													
				10		15		25		35		45		55			
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
+ICC	mA	-	2.5	2.2	.07	2.2	.07	2.2	.05	2.2	.06	2.2	.04	2.2	.05	2.2	.06
-ICC	(-)mA	-	2.5	2.2	.03	2.3	.07	2.2	.05	2.2	.05	2.2	.06	2.2	.08	2.2	.06
VOS@50	uV	-	300	65	50	150	80	233	100	330	107	593	130	766	150	923	250
IOS	nA	-	1.5	.3	.2	.01	.01	.01	0	.01	0	.01	0	.01	0	.01	0
IB+	nA	-	1.5	.2	.3	.01	.01	.01	.01	.02	.01	.03	.01	.04	.02	.05	.02
IB-	nA	-	1.5	.4	.1	.01	.01	0	.01	.01	.01	.02	.01	.02	.02	.04	.02
AOL	kV/V	300	-	710	30	700	50	697	70	682	75	664	60	634	70	626	80
CMRR	dB	85	-	109	3	110	5	115	8	109	6	103	4	100	7	97	6
+PSRR	dB	85	-	115	5	115	3	115	2	115	2	115	2	115	2	110	5
-PSRR	dB	85	-	109	4	111	5	112	5	110	8	106	6	103	7	107	10
+VO	V	10	-	12.3	.03	12.3	.03	12.3	.03	12.3	.03	12.3	.03	12.3	.03	12.3	.03
-VO	(-)V	10	-	13.3	.03	13.3	.03	13.3	.03	13.3	.03	13.3	.03	13.2	.03	13.3	.03

<Table IV continued on next page>

Table IV. (continued)

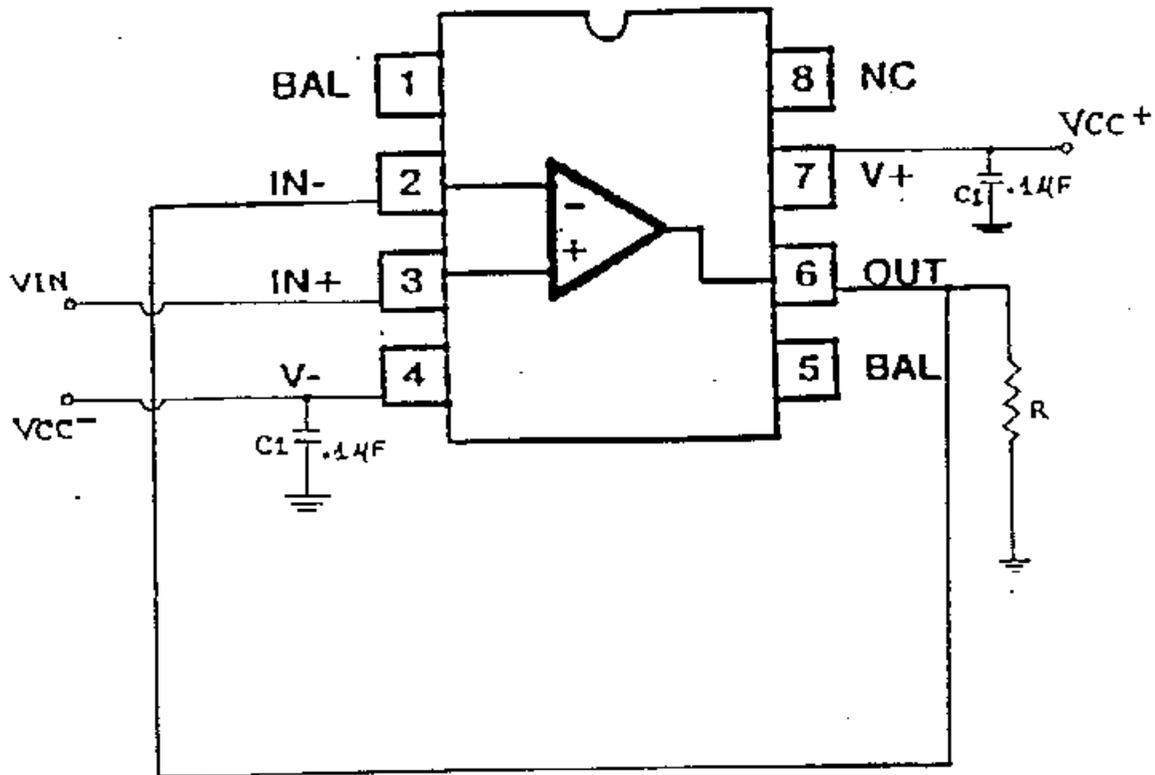
Parameters	Spec. Limits	Initials		Total Dose (krads)				Annealing					
				65		100		24 hrs.		168 hrs.			
				min	max	mean	sd	mean	sd	mean	sd	mean	sd
+ICC	mA	-	2.5	2.2	.07	2.2	.05	2.2	.07	2.2	.07	2.2	.07
-ICC	(-)mA	-	2.5	2.2	.03	2.2	.07	2.2	.07	2.2	.07	2.2	.07
VOS@50	mV	-	300	65	50	1.1E3	350	>2.1E3	1.2E3	*		2.5E3	500
IOS	nA	-	1.5	.3	.2	.01	0	.01	.01	.02	0	.02	.01
IB+	nA	-	1.5	.2	.3	.07	.03	.10	.03	.10	.04	.12	.03
IB-	nA	-	1.5	.4	.1	.05	-.02	.08	.03	.09	.03	.08	.03
AOL	kV/V	300	-	710	30	598	84	530	90	542	80	571	84
CMRR	dB	85	-	109	3	95	4	91	7	92	8	92	8
+PSRR	dB	85	-	115	5	114	2	114	2	117	3	116	5
-PSRR	dB	85	-	109	4	98	6	94	6	93	6	90	8
+VO	V	10	-	12.3	.03	12.3	.03	12.3	0	12.3	.03	12.3	.03
-VO	(-)V	10	-	13.3	.03	13.2	.05	13.2	0	13.2	.03	13.2	.03

1/ The mean and standard deviation values were calculated over the ten parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

2/ After 100 krads, two parts exceeded the 3.8mV testing limit of the ATE for VOS@50. The mean and standard deviation for this parameter at this step in Table IV uses the other 8 data points and 3.8mV values for these two parts. Thus, the actual mean is greater than this calculated value and ">2.1E3" is given.

* Five parts exceeded the 3.8mV testing limit for VOS@50 after 24 hours of annealing, and the remaining five parts had an mean of 1350uV and a standard deviation of 58uV for VOS@50 at this radiation step.

Figure 1. Radiation Bias Circuit for HA7-5170-8



$$V_{CC}^+ = +15V \pm 0.5V$$

$$V_{CC}^- = -15V \pm 0.5V$$

$$V_{IN} = +5V \pm 0.5V \text{ (DC)}$$

$$R = 2 \text{ K}\Omega \pm 5\%, \frac{1}{2}W$$

$$C_1 = 0.1\mu F, 50V$$