

PM-42-162

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Memorandum

PARAMAX
A Subsidiary of

DATE: May 27, 1992

PPM-92-163

TO: J. Lohr/311

FROM: K. Sahu/7809 *K.S.*

SUBJECT: Radiation Report on GGS/WIND/3D PLASMA Project
Part No. AD712TQ/883B (control no.6296)

cc: L. Rabb/406
A. Sharma/311
Library/300.1

A radiation evaluation was performed on the AD712TQ Dual 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 cobalt-60 gamma-ray source. The total dose radiation steps were 5, 10, 15 and 20 krads (the term rad as used here means rad(Si)). The parts were kept under bias during irradiation and annealing (see Figure 1 for bias configuration). One part was used as a control sample. After 20 krads, parts were annealed at +25°C for 168 hours. The dose rate was between 0.05 and 0.11 krads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the parts were electrically tested at +25°C according to the test conditions and the specification limits listed in Table III.

All parts passed initial electrical tests. After the 5-krad irradiation, two parts, S/N 65 and 68, marginally exceeded the specification limit for Ios; also, one part, S/N 67, failed catastrophically and was removed from any further testing (for details, see table II). After 10 krads, S/N 65 and S/N 68 further exceeded the specification limit for Ios. However, S/N 66 passed all tests on irradiation up to 10 krads. After 15 krads, S/N 65 exceeded the specification limit for Vos and Ios and S/N 66 exceeded the limit for Ios. (Note that, as per Table II, the radiation exposure to S/N 68 was limited to 10 krads only.) After 20 krads, parts showed further degradation in Ios and Vos. No significant recovery was observed after 168 hours of annealing at 25°C.

Table IV gives the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

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:	AD712TQ
GGG/WTND/3D PLASMA Part Number:	AD712TQ/883B
Control Number:	6296
Charge Number:	C23765
Manufacturer:	Analog Devices
Lot Date Code:	8929C
Quantity Tested:	5
Serial Number of Radiation Samples:	65, 66, 67, 68
Serial Number of Control Sample:	64
Part Function:	Dual Op Amp
Part Technology:	BiFET
Package Style:	8-pin DIP
Test Engineer:	A. Phung

TABLE II. Radiation Schedule for AD712TQ

EVENTS	DATE
1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT	04/17/92
2) 5-KRAD IRRADIATION (0.11 krad/hour)* POST-5-KRAD ELECTRICAL MEASUREMENT	04/21/92 04/23/92
3) 10-KRAD IRRADIATION (0.05 krad/hour) POST-10-KRAD ELECTRICAL MEASUREMENT	04/23/92 04/28/92
4) 15-KRAD IRRADIATION (0.11 krad/hour) POST-15-KRAD ELECTRICAL MEASUREMENT	04/28/92 04/30/92
5) 20-KRAD IRRADIATION (0.05 KRAD/HOUR) POST-20-KRAD ELECTRICAL MEASUREMENT	04/30/92 05/04/92
6) 168 HOURS ANNEALING AT +25°C POST-168-HOUR ELECTRICAL MEASUREMENTS	05/04/92 05/11/92

ALL ELECTRICAL MEASUREMENTS WERE PERFORMED AT +25°C.

PART WAS IRRADIATED AND ANNEALED UNDER BIAS; SEE FIGURE 1.

*After the 5 krad irradiation, S/N 67 failed catastrophically. This part was replaced with S/N 68, with the initial electrical measurements taken after the 10 krad irradiation. S/N 68 was then irradiated with the other two parts for the 15 krad and 20 krad steps and the annealing step. S/N 68 thus received only 10 krad total dose during the testing, while the other two parts received a total of 20 krad. Therefore, during the radiation testing, three parts were irradiated under bias up to 10 krad and two parts thereafter.

Table III. Electrical Characteristics of AD712TQ

Unless Otherwise Specified: $T_A = 25^{\circ}\text{C}$, $V_{CC}=15\text{V}$, $-V_{CC}=-15\text{V}$

TEST	CONDITIONS	LIMIT		UNITS
		Min	Max	
+I _{CC}	V _o = 0V		6	mA
-I _{CC}	V _o = 0V		6	mA
V _{OS50}	R _S = 500ohm	-.7	.7	mV
V _{OS}	R _S = 1000ohm	-.7	.7	mV
I _{OS}		-25	25	pA
I _{b+}	V _{CM} = 0V	-75	75	pA
I _{b-}	V _{CM} = 0V	-75	75	pA
I _{bias}	V _{CM} = 0V	-75	75	pA
I _{b+}	V _{CM} = 10V /1	-100	100	pA
I _{b-}	V _{CM} = 10V /1	-100	100	pA
I _{bias}	V _{CM} = 10V /1	-100	100	pA
A _{OL}	V _o = +/- 10V, R _L =2K Ohm	200		V/mV
CMRR	V _{CM} =+/- 10V	80		dB
CMRR	V _{CM} =+/- 11V	76		dB
+PSRR	+V _{CC} =(15,5)V; -V _{CC} =-15V	80		dB
-PSRR	+V _{CC} =15V; -V _{CC} =-(15,5)V	80		dB
+V _o	R _L =2K Ohm	13		V
-V _o	R _L =2K Ohm		-12.5	V

Notes:

1. V_{CM} = 10V is obtained by setting +V_{CC} = 5V and -V_{CC}=-25V.
2. Common Mode Voltage Range Performed GoNoGo in the CMRR

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing Steps for AD712TQ, Section 1 1/

Parameters	Spec. Limits min max	Total Dose Exposure (TDE) (krads)												Anneal	
		0 (Pre-Rad.)		5		10		15		20		168 hrs @25°C			
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
+Icc	nA	5.15	0.4	5.14	0.4	5.11	0.4	5.33	0.8	5.31	0.1	5.30	0.1		
-Icc	nA	-5.13	0.4	-5.15	0.4	-5.11	0.4	-5.34	0.8	-5.31	0.1	-5.30	0.1		
Vcs@50	uV	-57.3	144	-91.3	266	-301	199	562	183	-740	155	-705	149		
Vcs	uV	-57.3	144	-91.3	266	-301	199	562	183	-740	155	-705	149		
Ics	FA	-4.34	13	-17.9	14	-25.8	19	31.7	17	-65.4	14	9.45	88		
Ib+	(0V) pA	1.68	15	-8.32	14	-11.7	18	33.9	17	-39.7	12	-41.8	13		
Ib-	(0V) pA	3.11	6.1	9.61	0.5	14.05	0.4	17.78	0.8	25.67	2.2	20.29	0.5		
Ibias	(0V) pA	3.70	7.9	0.65	6.9	12.52	9	8.35	9.1	-7.02	4.7	-10.7	6.2		
Ib+	(50V) pA	11.69	18	-7.62	17	-11.6	21	28.2	11	-47.3	19	-47.8	21		
Ib-	(50V) pA	15.63	4.3	10.07	4.3	14.61	4.5	19.51	0.6	17.91	5.2	14.33	6.7		
Ibias	(50V) pA	13.66	11	1.23	10	1.50	12	4.37	4.9	-14.7	12	-16.7	14		
Rcl	KV/V	PASS	-	PASS	-	PASS	-	PASS	-	PASS	-	PASS	-		
CMRR(IJV)	dB	194.0	4.7	104.2	15	97.33	6.1	91.14	4.6	83.77	3.5	85.79	3.9		
CMRR(IIV)	dB	195.8	7	98.04	6	95.88	5.9	93.40	3.1	87.88	3.4	88.65	3.6		
+PSRR	dB	115.8	3.2	125.9	2.9	126.5	2.3	115.4	1.8	115.3	2	116.2	1.7		
-PSRR	dB	97.42	1.3	103.6	19	94.94	7.1	87.78	4.8	85.52	3.5	86.43	4		
+Vo	V	13.83	.02	13.84	.02	13.84	.01	13.84	.01	13.87	.01	13.86	.01		
-Vo	V	-13.3	.01	-13.3	.01	-13.3	.01	-13.3	.01	-13.3	0	-13.3	0		

Note:

1/ The mean and standard deviation values for initial through 10 krads were calculated on the basis of three samples, and for 15 krads and higher, on the basis of two samples. The control sample remained constant throughout the testing and is not included in this table.

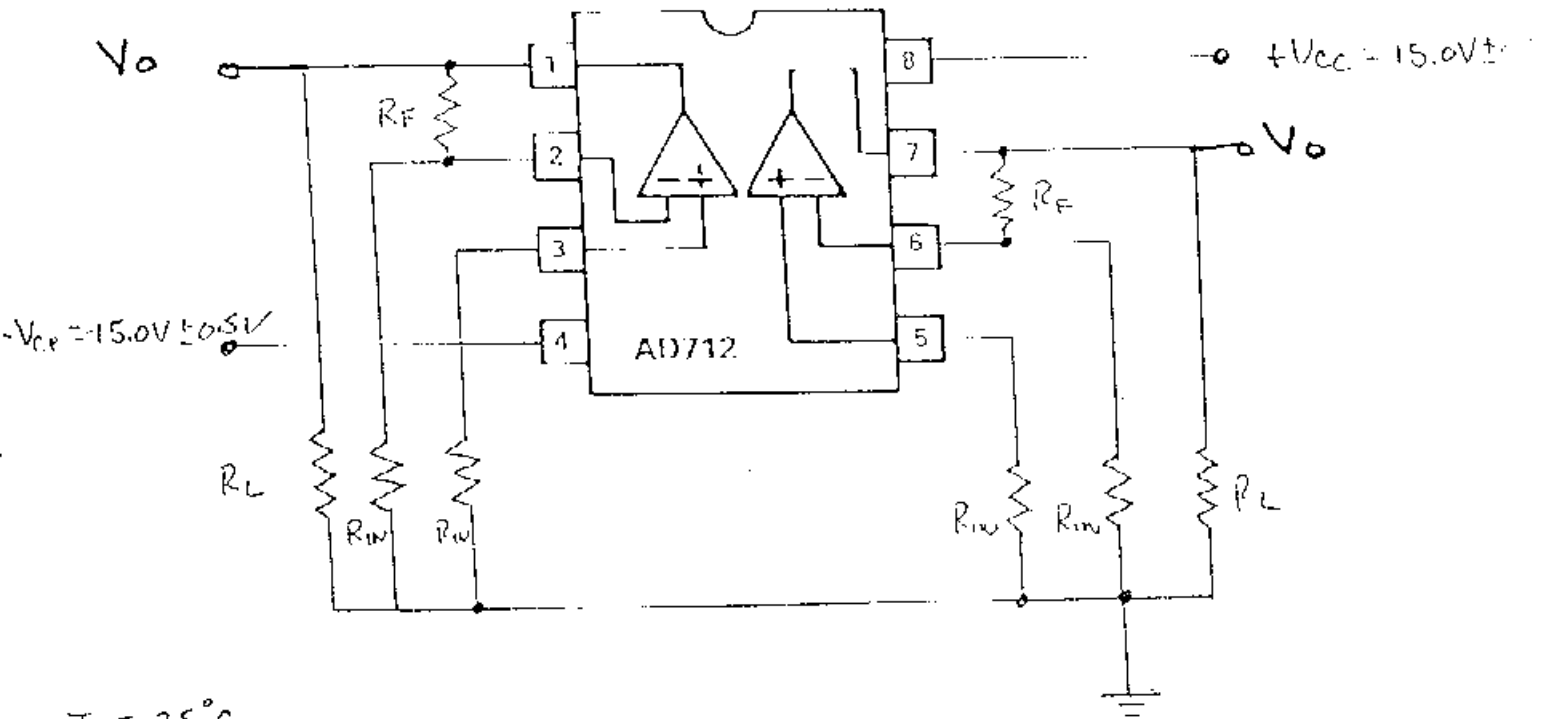
TABLE IV: Summary of Electrical Measurements After
Total Dose Exposures and Annealing Steps for AD712TQ,
Section 2 1/

Parameters	Spec. Limits min. max	Total Dose Exposure (TDE) (krads)												Anneal	
		0		5		10		15		20		166 hrs 325°C			
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
+Icc	mA	-	5	5.13	0.4	5.13	0.4	5.12	0.4	5.34	0.8	5.31	0.1	5.30	0.1
-Icc	mA	-	6	-5.13	0.4	-5.13	0.4	-5.13	0.4	-5.34	0.8	-5.32	0.1	-5.30	0.1
Vos@50	uV	-700	700	-128	195	-357	26	-483	6.3	689	23	-835	22	-791	27
Vos	uV	-700	700	-128	195	-357	26	-483	6.3	689	23	-835	22	-791	27
Ios	PA	-25	25	-3.57	17	-16.4	16	-20.7	27	32.2	32	-45.1	33	-41.2	32
Ib+	PA	-75	75	-9.85	17	-12.2	16	-10.5	28	17.1	32	-23.0	30	-25.5	32
Ib-	PA	-75	75	-0.17	0.4	4.19	1.3	13.12	1.9	13.99	16	22.12	2.5	17.72	5.2
Ibias	PA	-75	75	-2.91	8.4	-4.93	7.3	-0.21	15	11.91	16	-0.45	14	-2.91	16
Ib+	PA	-100	100	11.56	31	29.77	64	6.36	49	11.14	66	-2.36	59	-1.48	61
Ib-	PA	-100	100	15.75	15	36.38	45	23.52	25	42.98	34	43.94	27	39.42	28
Ibias	PA	-100	100	13.71	23	28.57	55	17.47	37	27.51	50	20.79	42	18.97	44
AOI	KV/V	200	-	PASS	-	PASS	-	PASS	-	PASS	-	PASS	-	PASS	-
CMRR(-IV)	dB	80	-	98.95	5	105.4	11	101	9	91.36	4.9	89.43	3.6	90.39	3.9
CMRR(+IV)	dB	76	-	97.91	4.1	99.68	5.9	109	15	93.67	7.7	90.76	5.7	91.76	5.2
PSRR	dB	80	-	117.5	3.4	117.4	3.2	117	2.3	115	3.2	117	2.3	116.4	2.3
-PSRR	dB	80	-	98.63	12	95.25	6.3	104	15	89.17	7.5	86.42	5.4	87.31	5.9
+Vo	V	13	-	13.85	.02	13.87	.01	13.87	.03	13.85	.01	13.67	.01	13.87	.02
-Vo	V	-	-12.5	-13.2	.01	-13.3	.04	-13.3	.02	-13.3	.01	-13.3	.01	-13.3	.01

Note:

1/ The mean and standard deviation values for initial through 10 krad were calculated on the basis of three samples, and for 15 krad and higher, on the basis of two samples. The control sample remained constant throughout the testing and is not included in this table.

Figure 1. Radiation Bias Circuit for AD712TQ



$T_A = 25^\circ\text{C}$

$R_F = 20\text{K } \frac{1}{4}\text{W}$

$R_L = 20\text{K } \frac{1}{4}\text{W}$

$R_{iw} = 2\text{K } \frac{1}{4}\text{W}$

$+I_{CC} < 10\text{mA}$

$-I_{EE} < 10\text{mA}$

* CHECK FOR $v_o = 0\text{V}$