PPM-92-185

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Paramax Systems
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Lanham MD 20706

Memorandum

PARAMAX
A Unisys Company

DATE: June 16, 1992

PPM-92-185

TO: J. Lohr/311

FROM: K. Sahu/7809 KS

SUBJECT: Radiation Report GCS/WIND/3D PLASMA Project
Part No. OP490AY/883B (Control No. 6298)

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

A radiation evaluation was performed on the OP490AY/883B 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, three parts were irradiated under bias (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation steps were 5, 10, 15, and 20 krads*. After 20 krads, the parts were annealed at 25°C for 168 hours. The dose rate was between 74 and 116 rads/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 all parametric tests initially. However, after 5 krads of exposure all three parts dropped significantly below the specification limits for the Open Loop Gain parameters. Upon further irradiation to 10 krads all three parts marginally exceeded the specification limits of 15 nA for Ib+, Ib- and Ibias with readings approaching 20 nA. All three parts were also below the specification limits for Vout(-) terminated into a 2 kohm load. After an accumulated dose of 15 krads the input port currents continued to increase to over 20 nA. After accumulating 20 krads of exposure in addition to the previously mentioned tests the parts were below the specification limits for the Vout(-) test terminated into a 10 kohm load. All of the parts exceeded the limit of 500 uV for Vos with readings in excess of 1 mV. One part also was below the specified limit of 100 dB for the CMRR (readings around 86 dB). The parts showed no significant sign of recovery after the 168 hour annealing step at 25°C.

Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. Any further details about this evaluation can be obtained upon request. If you have any questions, please call me at (301) 731-8954.

* In this report, the term "rads" is used as an abbreviation for rads (Si).

TABLE I. Part Information

Generic Part Number:	OP490
GGS/WIND/3D PLASMA Part Number:	OP490AY/883B
Control Number:	6298
Charge Number:	C23767
Manufacturer:	PMI
Lot Date Code:	8735
Quantity Tested:	4
Serial Numbers of Radiation Samples:	90, 91, 92
Serial Number of Control Sample:	89
Part Function:	Quad Operation Amplifier
Part Technology:	Bipolar Op-Amp
Package Style:	14 pin DIP
Test Engineer:	A. Phung

TABLE II. Radiation Schedule for OP490AY/883B

EVENTS	DATE
1) INITIAL (PRE-IRRADIATION) ELECTRICAL MEASUREMENT	04/30/92
2) 5 KRAD IRRADIATION (76.9 rads/hour)	05/01/92
POST 5 KRAD ELECTRICAL MEASUREMENT	05/04/92
3) 10 KRAD IRRADIATION (113.4 rads/hour)	05/04/92
POST 10 KRAD ELECTRICAL MEASUREMENT	05/06/92
4) 15 KRAD IRRADIATION (116.4 rads/hour)	05/06/92
POST 15 KRAD ELECTRICAL MEASUREMENT	05/08/92
5) 20 KRAD IRRADIATION (74.1 rads/hour)	05/08/92
POST 20 KRAD ELECTRICAL MEASUREMENT	05/11/92
6) 168 HOURS ANNEALING AT 25°C	05/11/92
POST 168 HOURS ELECTRICAL MEASUREMENT	05/18/92

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.
- All annealing steps were performed under bias.

Table III. Electrical Characteristics of OP490AY/883B

TEST NAME	CONDITIONS	LIMITS MIN	LIMITS MAX	UNITS
+ICC	Vcc = ± 15V, Vo = 0V	---	80	uA
-ICC	Vcc = ± 15V, Vo = 0V	-80	---	uA
+ICC	Vcc = ± 1.5V, Vo = 0V	---	60	uA
-ICC	Vcc = ± 1.5V, Vo = 0V	-60	---	uA
VOS	Vcc = ± 15V, Vo = 0V	---	500	uV
VOS	Vcc = ± 1.5V, Vo = 0V	---	500	uV
IOS	Vcc = ± 15V, Vo = 0V	-3	3	nA
IOS	Vcc = ± 1.5V, Vo = 0V	-3	3	nA
Ib+	Vcc = ± 15V	-15	15	nA
Ib-	Vcc = ± 15V	-15	15	nA
Ib+	Vcc = ± 1.5V	-15	15	nA
Ib-	Vcc = ± 1.5V	-15	15	nA
Ibias	Vcc = ± 15V	-15	15	nA
Ibias	Vcc = ± 1.5V	-15	15	nA
CMRR	Vcm = ± 14.25V	100	---	dB
+PSRR	Vcc+ = (15V, 1.5V) Vcc- = -15V	105	---	dB
-PSRR	Vcc+ = 15V	105	---	dB
	Vcc- = (-15V, -1.5V)	105	---	dB
Av	Rl = 100K, Vo = ± 10V	700	---	V/mV
Av	Rl = 10K, Vo = ± 10V	350	---	V/mV
Av	Rl = 2K, Vo = ± 10V	125	---	V/mV
Vout	Rl = 10K	-13.5	13.5	V
Vout	Rl = 2K	-10.5	10.5	V

NOTES:

1/ CMRR Test was performed at Vcm = ± 14.25V due to tester limitations.

2/ All tests performed at 25°C, Vcc+ = 15V, Vcc- = -15V, Rs = 50 ohms unless otherwise specified.

EXCEPTIONS:

1) Slew Rate Test not performed.
2) DUT tested at Vcc = ± 15V and Vcc = ± 1.5V only.
3) Voh and Vol Test not performed due to tester limitations.

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for OP490AY/883 1/, 2/, 3/, 4/

Parameters		Spec Limits @ 25°C min	max	Total Dose Exposure (TDE) (krads) 0 (Pre-Rad) mean	sd	5 mean	sd	10 mean	sd	15 mean	sd	20 mean	sd	Anneal 168 hours mean	sd
+ICC@15V	mA		60	60.59	1.14	50.57	2.30	41.13	3.12	34.27	2.89	28.53	3.07	28.53	3.07
-ICC@15V	mA	-80		-58.77	2.32	-47.87	1.91	-39.73	2.27	-34.27	4.61	-27.53	3.43	-27.53	3.43
+ICC@1.5V	mA		60	47.80	2.03	37.20	1.31	27.13	2.53	18.77	4.24	15.73	3.98	13.80	3.67
-ICC@1.5V	mA	-60		-47.81	1.90	-37.60	0.85	-26.70	2.86	-18.70	4.04	-11.50	4.04	-14.33	2.00
VOS@15V	uV		500	160.0	48.4	202.0	111.2	149.5	78.4	157.9	127.2	594.3	200.1	594.3	200.1
VOS@1.5V	uV		500	159.7	48.1	208.7	125.6	161.3	77.5	494.3	410.9	1103.0	305.4	991.0	759.8
IOS@15V	nA	-3.0	3.0	0.06	0.04	0.17	0.01	0.19	0.14	-0.03	0.41	0.07	0.02	0.07	0.02
IOS@1.5V	nA	-3.0	3.0	0.05	0.04	0.08	0.11	0.15	0.16	0.21	0.07	0.24	0.14	0.20	0.27
IB+@15V	nA	-15.0	15.0	-3.19	0.08	-10.67	1.08	-17.40	1.82	-22.77	2.39	-25.27	1.58	-25.27	1.58
IB-@15V	nA	-15.0	15.0	-3.24	0.12	-10.87	1.08	-17.60	2.00	-22.73	1.99	-25.33	1.53	-25.33	1.53
IB+@1.5V	nA	-15.0	15.0	-3.36	0.07	-10.99	1.11	-16.97	1.51	-20.53	1.07	-21.35	0.74	-21.43	0.55
IB-@1.5V	nA	-15.0	15.0	-3.43	0.12	-11.03	1.02	-17.13	1.62	-20.70	1.08	-21.33	0.87	-21.63	0.64
CMRR	dB	100		117	3	113	4	112	2	115	15	78	68	78	68
PSRR+	dB	105		119	3	118	4	112	6	****		****		****	
PSRR-	dB	105		119	2	115	1	114	2	****		****		****	
AV	V/mV	700		963	30	352	100	401	22	209	115	76	73	76	73
AV	V/mV	350		675	36	859	1029	230	38	114	56	49	45	49	45
[illegible]	V/mV	125		288	45	359	289	97	22	52	20	28	25	28	25
VOUT10K+	V	-13.5	13.5	14.20	0.01	14.20	0.00	14.20	0.00	14.20	0.00	14.20	0.00	14.20	0.00
VOUT10K-	V	-13.5	13.5	-14.24	0.00	-14.21	0.01	-14.20	0.00	-14.17	0.06	-13.60	0.87	-13.87	0.40
VOUT2K+	V	-10.5	10.5	14.10	0.01	14.10	0.00	14.10	0.00	14.10	0.00	14.10	0.00	14.10	0.00
VOUT2K-	V	-10.5	10.5	-13.84	0.11	-11.94	0.58	-8.13	1.26	-4.07	1.93	-1.77	0.75	-2.12	1.34

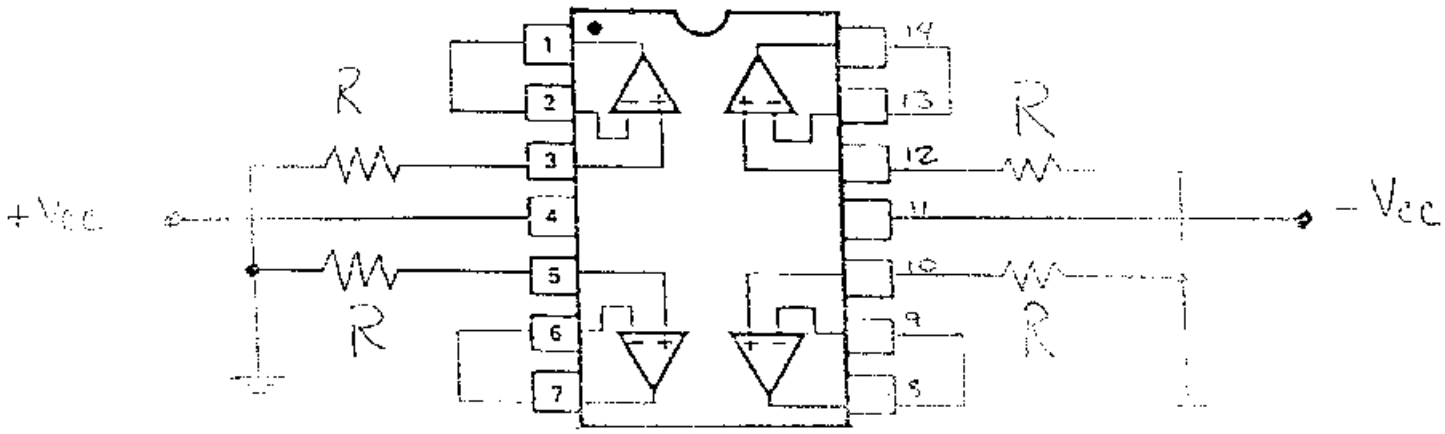
1/ These statistics do not include the control sample which remained constant throughout testing.

2/ The above statistics were computed using data from one section of these Quad Op-Amps.

3/ Places where "****" are placed are instances where no reliable data was available due to difficulties in measuring this parameter.

4/ Statistics for the Ibias parameters are not provided in Table IV. This parameter is an average of the Ib+ and Ib- parameters.

Figure 1. Radiation Bias Circuit for OP490AY/883B



Conditions $T_A = 25°C$

$+V_{CC} = 15.0V \pm 0.5V$

$-V_{CC} = -15.0V \pm 0.5V$

$R = 100K\Omega, 1/4W$