

Unisys

DATE: October 20, 1999
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SUBJECT: Radiation Report on **PA07M/883 (Apex) (LDC 9918)**
PROJECT: GLAS

PPM-99-032

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A radiation evaluation was performed on **PA07M FET input Power Operation Amplifier (Apex)** to determine the total dose tolerance of these parts. The total dose testing was performed using a Co⁶⁰ gamma ray source. During the radiation testing, one part was irradiated under bias to determine the initial degradation level. Seven parts were then irradiated under bias (see Figure 1 for bias configuration) and two parts were used as control samples. The total dose radiation levels were 10.0, 17.5, 20.0, 25.0, and 50.0kRads.¹ The average dose rate was 0.22kRads/hour (0.06Rads/s). See Table II for the radiation schedule and average dose rate calculation. After the 100.0kRad irradiation, the parts were annealed under bias at 25°C for 168 hours.² After each radiation exposure and annealing step, 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.

All parts passed all tests through 17.5kRads. After the 25 and 50kRad irradiations, a few parts marginally exceeded the specification limit for Voffset. After annealing the parts at 25°C for 168 hours, the parts showed a slight increase in Voffset readings. The parts showed no significant change in any parameter.

Initial electrical measurements were made on 10 samples. One part was used to determine the initial degradation level (SN 49). Seven samples (SN's 41, 42, 43, 44, 45, 46, and 47) were used as radiation samples while SN's 40 and 48 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 17.5kRads.

After the 25kRad irradiation, one part marginally exceeded the specification limit of 2.00mV for Voffset with a reading of 2.24mV. **All parts passed all other tests.**

After the 50kRad irradiation, three parts marginally exceeded the specification limit for Voffset with readings in the range of 2.10 to 3.12mV. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, five parts exceeded the specification limit for Voffset with readings in the range of 2.70 to 5.03mV. No significant change was noted in any other 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.

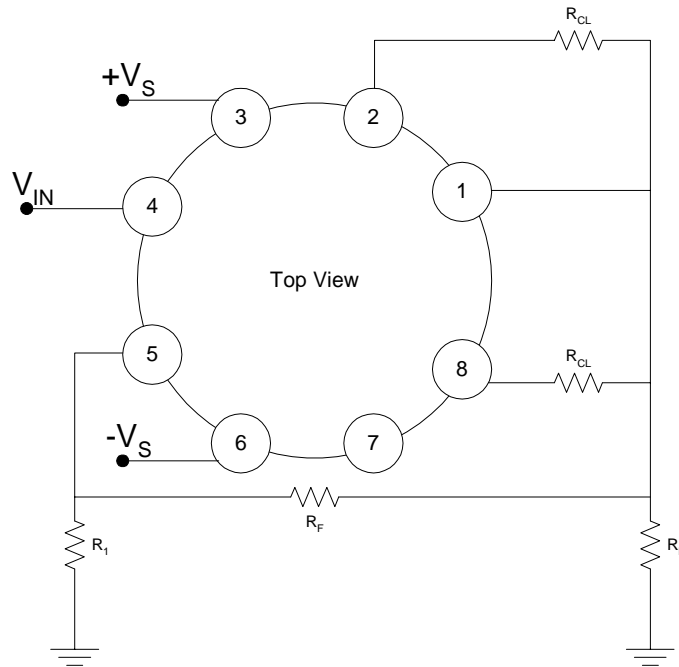
³ These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for PA07M/883



Notes:

1. $+V_S = +25V \pm 0.5V$.
2. $-V_S = -25V \pm 0.5V$.
3. $V_{IN} = +2.5V \pm 0.2V$.
4. $R_L = 22\Omega \pm 5\%$, 2W.
5. $R_{CL} = 1\Omega \pm 5\%$, $\frac{1}{4}W$.
6. $R_1 = R_F = 1k\Omega \pm 5\%$, $\frac{1}{4}W$.
7. Gain = 1.
8. $V_O \approx 5.0V$, $I_O \approx 228mA$.

Pin Out:

1. OUT
2. CL+
3. $+V_S$
4. +IN
5. -IN
6. $-V_S$
7. BAL
8. CL-

TABLE I. Part Information

Generic Part Number:	PA07M
GLAS Part Number	PA07M/883
GLAS TID Requirement	25kRads (RDM = 5)
Charge Number:	M90432
Manufacturer:	Apex
Lot Date Code (LDC):	9918
Quantity Tested:	10
Serial Numbers of Control Samples:	40, 48
Serial Number of Initial Degradation Sample:	49
Serial Numbers of Radiation Samples:	41, 42, 43, 44, 45, 46, 47
Part Function:	FET Input Power Operational Amplifier
Part Technology:	Bipolar
Package Style:	TO-3
Test Equipment:	A540
Test Engineer:	S. Norris

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE II. Radiation Schedule for PA07M/883

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	08/12/99
One Part Test Runs	
2) 8 KRAD IRRADIATION (0.091 KRADS/HOUR).....	08/27/99
POST-8 KRAD ELECTRICAL MEASUREMENT	08/30/99
3) 16.0 KRAD IRRADIATION (0.174 KRADS/HOUR).....	09/15/99
POST-16.0 KRAD ELECTRICAL MEASUREMENT	09/17/99
4) 24.0 KRAD IRRADIATION (0.119 KRADS/HOUR).....	09/17/99
POST-24.0 KRAD ELECTRICAL MEASUREMENT	09/20/99
All Remaining Parts	
5) 10.0 KRAD IRRADIATION (0.158 KRADS/HOUR).....	10/01/99
POST 10.0 KRAD ELECTRICAL MEASUREMENT	10/04/99
6) 17.5 KRAD IRRADIATION (0.192 KRADS/HOUR).....	10/04/99
POST-17.5 KRAD ELECTRICAL MEASUREMENT	10/06/99
7) 25.0 KRAD IRRADIATION (0.170 KRADS/HOUR).....	10/06/99
POST-25.0 KRAD ELECTRICAL MEASUREMENT	10/08/99
8) 50.0 KRAD IRRADIATION (0.278 KRADS/HOUR).....	10/08/99
POST-50.0 KRAD ELECTRICAL MEASUREMENT	10/12/99
9) 168 HOUR ANNEALING @25°C.....	10/12/99
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/19/99

Average Dose Rate = 50,000 RADS/229 HOURS=218.3 RADS/HOUR=0.06RADS/SEC

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

Table III. Electrical Characteristics A250 (1)

Test #	Parameter	Units	Spec. Limit		Test Conditions (2)
			min	max	
1	I _{cc}	mA		30	V _{IN} = 0V, A _v = 100
2	V _{offset}	mV	-2.00	2.00	V _{IN} = 0V, A _v = 100
3	I _{b+}	pA	-50	50	V _{IN} = 0V
4	I _{b-}	pA	-50	50	V _{IN} = 0V
5	I _{io}	pA	-50	50	V _{IN} = 0V
6	Gain	dB	92		R _L = 500Ω, f = 10Hz
7	pos_swing	V	10.0		I _O = 90mA
8	neg_swing	V		-10.0	I _O = 90mA

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) +V_S = +35V, -V_S = -35V unless otherwise specified.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for PA07M (1)

Test #	Parameters	Units	Spec. Lim. (2)		Total Dose Exposure (kRads Si)										Annealing	
					Initial		10.0		17.5		25.0		50.0		168 hours @25°C	
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Icc	mA		30	21	0.4	21	0.4	21	0.4	21	0.4	21	0.4	18	0.5
2	Voffset	mV	-2.00	2.00	-0.21	0.33	0.35	0.58	0.67	0.64	1.00	0.67	1.88	0.78	2.56	2.06
3	Ib+ (3)	pA	-50	50	12	22	15	22	24	9	13	20	19	13	14	25
4	Ib- (3)	pA	-50	50	-8	20	16	27	-4	27	38	36	27	10	16	13
5	Iio (3)	pA	-50	50	33	23	14	18	28	25	34	35	11	11	25	18
6	Gain	dB	92		108	1.4	108	1.7	107	0	107	0	107	0	107	0
7	pos_swing	V	10.0		12.3	0.5	12.4	0.5	12.4	0.5	12.4	0.5	12.4	0.5	12.6	0.5
8	neg_swing	V		-10.0	-14.0	0	-13.6	0	-13.6	0	-13.6	0	-13.6	0	-12.8	0.7

Notes:

- (1) The mean and standard deviation values were calculated over the seven parts irradiated in this testing. The control samples remained constant throughout testing and are not included in the data.
- (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.
- (3) Due to noise in the A540, these parameters occasionally exceed the specification limit but in no way should these readings imply a failure of the part. All readings were taken from the same part.

Radiation sensitive parameters: Voffset.