

Unisys

DATE: December 8, 1997
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SUBJECT: Radiation Report on: UC1706
Project: SMEX/LITE
Job #: C78111
Project part #: UC1706 (5962-89611012A)

PPM-97-055

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A radiation evaluation was performed on UC1706 (5962-89611012A) pulse-width modulator (Unitrode) 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 Co⁶⁰ gamma ray source. During the radiation testing, five parts were irradiated under bias (see Figure 1 for bias configuration) and one part was used as a control sample. The total dose radiation levels were 2.5, 5.0, 10.0, 15.0, 20.0, 30.0, 50.0, 75.0, and 100.0 kRads.* The dose rate was between 0.062 and 0.625 kRads/hour (0.017 to 0.174 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 100 kRad exposure, the parts were annealed for 168 hours at 25°C. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits** listed in Table III.

Initial electrical measurements were made on 6 samples. Four samples (SN's 185, 186, 187, 188, and 189) were used as radiation samples while SN 184 was used as a control sample. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 100.0 kRads and through the final annealing for 168 hours at 25°C with no significant degradation in any 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 me at (301) 731-8954.

* The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.

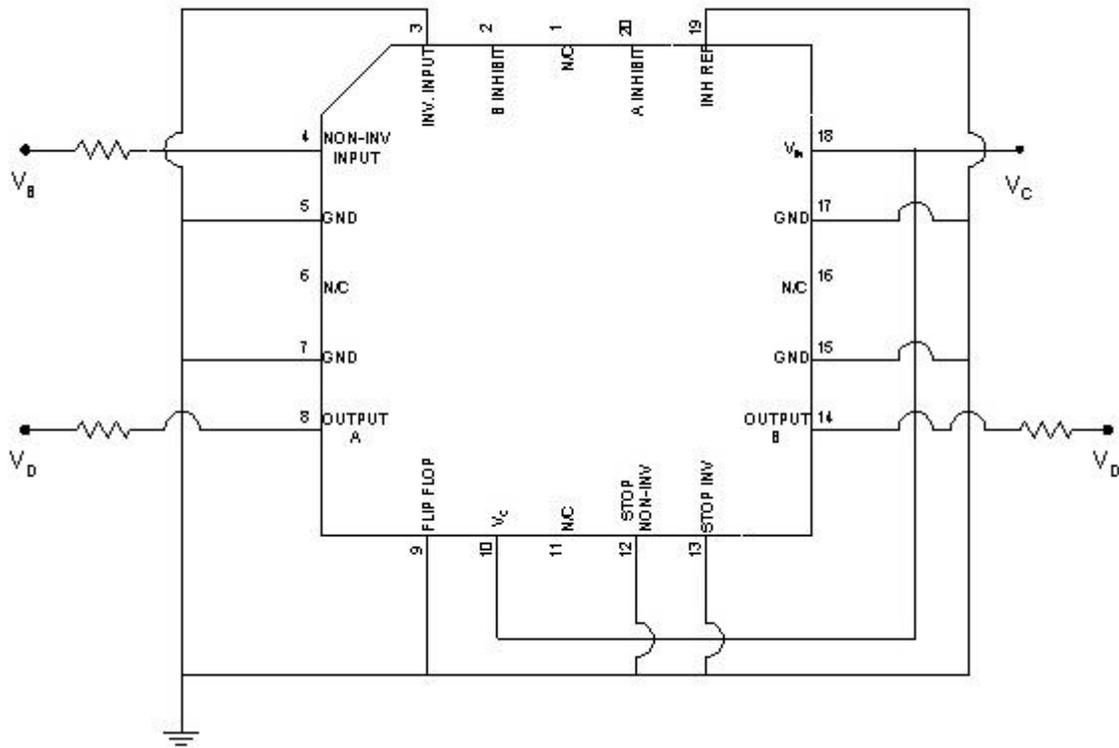
** These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

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Figure 1. Radiation Bias Circuit for UC1706



Notes:

1. $V_B = 5V \pm 0.5V$
2. $V_C = V_{IN} = 20VDC \pm 0.5V$.
3. $V_D = 2.5V \pm 0.3V$.
4. All $R = 2k\Omega \pm 5\%$, $\frac{1}{4}$ W.
5. $I_{20V} \leq 21.5mA$ (for one DUT).
6. $I_{5V} \leq 0.1mA$ (for one DUT).
7. $I_{2.5V} \leq 2.5mA$ (for one DUT) for A output.
8. $I_{2.5V} \leq 8.0mA$ (for one DUT) for B output.

TABLE I. Part Information

Generic Part Number:	UC1706
SMEX/LITE Part Number	UC1706 (5962-89611012A)
Charge Number:	C78111
Manufacturer:	Unitrode
Lot Date Code (LDC):	9533
Quantity Tested:	6
Serial Number of Control Sample:	184
Serial Numbers of Radiation Samples:	185, 186, 187, 188, and 189
Part Function:	Pulse-Width Modulator
Part Technology:	Bipolar
Package Style:	20 Pin LCC
Test Equipment:	A540
Test Engineer:	D. Davis

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

TABLE II. Radiation Schedule for UC1706

EVENT.....	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	10/23/97
2) 2.5 KRAD IRRADIATION (0.062 KRADS/HOUR)	11/01/97
POST-2.5 KRAD ELECTRICAL MEASUREMENT	11/03/97
3) 5.0 KRAD IRRADIATION (0.062 KRADS/HOUR)	11/03/97
POST-5.0 KRAD ELECTRICAL MEASUREMENT	11/05/97
4) 10.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	11/05/97
POST-10.0 KRAD ELECTRICAL MEASUREMENT	11/07/97
5) 15.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	11/07/97
POST-15.0 KRAD ELECTRICAL MEASUREMENT	11/10/97
6) 20.0 KRAD IRRADIATION (0.125 KRADS/HOUR)	11/10/97
POST-20.0 KRAD ELECTRICAL MEASUREMENT	11/12/97
7) 30.0 KRAD IRRADIATION (0.250 KRADS/HOUR)	11/12/97
POST-30.0 KRAD ELECTRICAL MEASUREMENT	11/17/97
8) 50.0 KRAD IRRADIATION (0.500 KRADS/HOUR)	11/17/97
POST-50.0 KRAD ELECTRICAL MEASUREMENT	11/19/97
9) 75.0 KRAD IRRADIATION (0.625 KRADS/HOUR)	11/19/97
POST-75.0 KRAD ELECTRICAL MEASUREMENT	11/21/97
10) 100.0 KRAD IRRADIATION (0.625 KRADS/HOUR).....	11/21/97
POST-100.0 KRAD ELECTRICAL MEASUREMENT	11/24/97
11) 168 HOUR ANNEALING @25°C	11/24/97
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/05/97

Effective Dose Rate = 100,000 RADS/24 DAYS=166.7 RADS/HOUR=0.046 RADS/SEC

The effective dose rate is lower than that of the individual radiation steps as it takes into account the time during testing.

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

Table III. Electrical Characteristics of UC1706 /1 /3

Test #	Parameter	Units	Test Conditions /2	Spec. min	Lim. max
1	ICC_in	mA	V _{IN} = 40V		10.0
2	ICC_coll	mA	V _C = 40V, outputs low		5.0
3	IC_leak	mA	V _{IO} = 0V, V _C = 30V		100
4	V_input	mA	V _{IN} = 0V	-1000	
5	INV_Input	mA	Inverting input to output		100
6	NI_Input	mA	Non-inverting input to output		100
7	inv_t_rise	ns	C _L = 2.2nf, Inverting input to output		95.0
8	inv_t_fall	ns	C _L = 2.2nf, Inverting input to output		90.0
9	ni_t_rise	ns	C _L = 2.2nf, non-inverting input to output		95.0
10	ni_t_fall	ns	C _L = 2.2nf, non-inverting input to output		90.0
11	Analog_shutdown	mV	0V ≤ V _{CM} ≤ 15V	100	170
12	I_Inhibit_A	mA	V _{REF} = 0V	-20.0	
13	I_Inhibit_B	mA	V _{REF} = 0V	-20.0	

Note:

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_{IN} = V_C = 20V unless otherwise noted.

3/ The functional performance of the parts is verified by the timing tests (#7-10). If the timing can be measured, then the part passes the functional test. If no timing measurement can be made, then the part has failed functionally.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for UC1706 /1 /3

Test #	Parameters	Units	Spec. Lim. /2 min	max	Total Dose Exposure (kRads)																				Annealing			
					Initial		2.5		5.0		10.0		15.0		20.0		30.0		50.0		75.0		100.0		168 hours @25°C			
					mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	ICC_in	mA		10.0	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07	7.8	0.07
2	ICC_coll	mA		5.0	3.9	0.1	3.8	0.2	3.7	0.3	3.6	0.3	3.5	0.3	3.5	0.3	3.5	0.3	3.5	0.3	3.5	0.3	3.5	0.3	3.5	0.3	3.5	0.3
3	IC_leak	mA		100	1	0.3	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
4	V_input	mA	-1000		-1	0.3	-1	0.3	-1	0.3	-1	0.4	-2	1	-2	1	-2	1	-2	1	-1	1	-1	1	-1	1	-1	1
5	INV_Input	mA		100	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0
6	NI_Input	mA		100	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0
7	inv_t_rise	ns		95	16	3.3	17	3.1	18	2.9	19	3.1	20	2.8	19	3.6	21	2.5	22	3.6	23	2.9	23	2.5	22	2.2	2.2	
8	inv_t_fall	ns		90	50	5.2	51	5.1	46	3.6	31	9.4	32	10.5	29	10.4	28	9.8	15	1.9	14	1.9	13	1.1	14	1.9	1.9	
9	ni_t_rise	ns		95	16	3.3	17	3.1	18	2.9	19	3.1	20	2.8	19	3.6	21	2.5	22	3.6	23	2.9	23	2.5	22	2.2	2.2	
10	ni_t_fall	ns		90	50	5.2	51	5.1	46	3.6	31	9.4	32	10.5	29	10.4	28	9.8	15	1.9	14	1.9	13	1.1	14	1.9	1.9	
11	Analog_shutdown	mV	100	150	120	0	120	0	120	0	124	8	124	8	124	8	124	8	124	8	128	10	120	0	124	8	8	8
12	I_Inhibit_A	mA	-20.0		23.4	0	62.5	0	23.4	0	78.1	0	39.1	0	31.3	0	46.9	0	46.9	0	54.7	0	54.7	0	54.7	0	54.7	0
13	I_Inhibit_B	mA	-20.0		23.4	0	62.5	0	23.4	0	78.1	0	39.1	0	31.3	0	46.9	0	46.9	0	54.7	0	54.7	0	54.7	0	54.7	0

Notes:

- 1/ The mean and standard deviation values were calculated over the five parts irradiated in this testing. The control samples remained constant throughout 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.
- 3/ The functional performance of the parts is verified by the timing tests (#7-10). If the timing can be measured, then the part passes the functional test. If no timing measurement can be made, then the part has failed functionally.

Radiation sensitive parameters: none.