Unisys

DATE: November 17, 1998 PPM-99-009
TO: J. Dafnis/303
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SUBJECT: Radiation Report on **LF198H (Linear Technology) (LDC 9129)**
PROJECT: GOES (ITT)

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A radiation evaluation was performed on **LF198H Precision Sample and Hold Amplifier (Linear Technology)** to determine the total ionizing dose (TID) tolerance of these parts. The TID testing was performed using a Co^{60} gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration) and two parts were used as control samples. The total dose radiation levels were 20.0, 40.0, 60.0, 80.0, 100.0, 150.0, and 200.0 kRads.[1] The dose rate was 1.200 kRads/hour (0.33 Rads/s). See Table II for the radiation schedule and effective dose rate calculation. After the 200.0 kRad irradiation, the parts were annealed under bias at 25°C and tested after 72 and 168 hours.[2] After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits[3] 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. For detailed information, refer to Tables I through IV and Figure 1.

Parts showed no significant degradation up to 200kRads. No significant change was observed in any parameter after annealing the parts for 168 hours at 25°C.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 62, 65, 66, 67, 68, 69, 70, and 71) were used as radiation samples while SN's 63 and 64 were used as control samples. All parts passed all tests during initial electrical measurements.

All parts passed all tests up to 200kRads.

After annealing the parts for 72 and 168 hours at 25°C, no significant change was observed 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 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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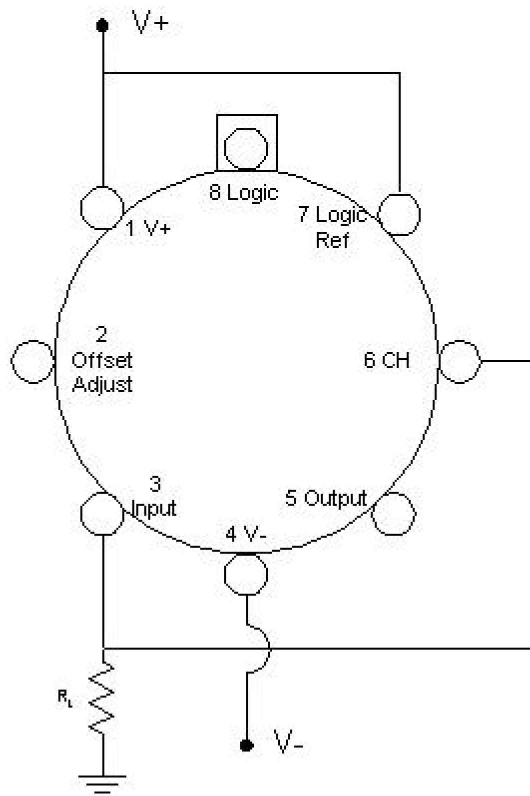
Figure 1. Radiation Bias Circuit for LF198H



Notes:
1. R_L = 10kΩ ±10%, ¼W.
2. V+ = +15V, V- = -15V.

TABLE I. Part Information

Generic Part Number:	LF198H
GOES ITT Part Number	LF198H
Charge Number:	M90402
Manufacturer:	Linear Technology
Lot Date Code (LDC):	9129
Quantity Tested:	10
Serial Number of Control Samples:	63, 64
Serial Numbers of Radiation Samples:	62, 65, 66, 67, 68, 69, 70, and 71
Part Function:	Precision Sample and Hold Amplifier
Part Technology:	Bipolar
Package Style:	8-Pin TO-5 Can
Test Equipment:	A540
Test Engineer:	S. Archer-Davies

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

TABLE II. Radiation Schedule for LF198H

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	10/28/98
2) 20.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	10/28/98
POST-20.0 KRAD ELECTRICAL MEASUREMENT	10/29/98
3) 40.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	10/29/98
POST-40.0 KRAD ELECTRICAL MEASUREMENT	10/30/98
4) 60.0 KRAD IRRADIATION (0.308 KRADS/HOUR) *	10/30/98
POST-60.0 KRAD ELECTRICAL MEASUREMENT	11/02/98
5) 80.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	11/02/98
POST-80.0 KRAD ELECTRICAL MEASUREMENT	11/03/98
6) 100.0 KRAD IRRADIATION (1.200 KRADS/HOUR) **	11/03/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT	11/05/98
7) 150.0 KRAD IRRADIATION (2.941 KRADS/HOUR)	11/05/98
POST-150.0 KRAD ELECTRICAL MEASUREMENT	11/06/98
8) 200.0 KRAD IRRADIATION (0.893 KRADS/HOUR)	11/06/98
POST-200.0 KRAD AND ANNEALING ELECTRICAL MEASUREMENT	11/09/98
9) 72 HOUR ANNEALING @25°C	11/09/98
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/12/98
10) 168 HOUR ANNEALING @25°C	11/09/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/16/98

Effective Dose Rate = 200,000 RADS/12 DAYS=694.4 RADS/HOUR=0.19 RADS/SEC
The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim-annealing step.

* The dose rate was adjusted to allow the parts to receive radiation dose over the weekend.
** The dose rate remained 1.200kRads/hour due to a power failure at the REF.

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

Table III. Electrical Characteristics of LF198H /1 /2

Test #	Parameter	Units	Test Conditions	Spec. min	Lim. max
1	IDD	mA		0	5.5
2	ISS	mA		-5.5	0
3	+IIB	nA	V_S = 0V	-25	25
4	VIO	mV		-3.0	3.0
5	+Gain Error	%	G = 1000	-0.0050	0.0050
6	-Gain Error	%	G = 1000	-0.0050	0.0050
7	+psrr	dB	+V_{DD} = 12V, -V_{DD} = -15V	80	
8	-psrr	dB	+V_{DD} = 12V, -V_{DD} = -15V	80	
9	Iil	mA	+V_{DD} = 8.5V, -V_{DD} = -21.5V	-1.00	1.00
10	Iih	mA	+V_{DD} = 8.5V, -V_{DD} = -21.5V	0	10.0
11	Vth_2.0V	mA	Logic Voltage = 2.0V	1.000	
12	Vth_0.8V	mA	Logic Voltage = 0.8V	-10.0	10.0
A	Step Hold V	mV	C_H = 0.01mf, V_{OUT} = 0V		2.0

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/ Unless other wise noted: $V_S = \pm 15V$, $-11.5V < V_{IN} < 11.5V$, LogicRef = 0V, Logic Voltage = 2.5V, $C_H = 0.01\mu F$, $R_L = 10k\Omega$, and the unit is in "sample" mode.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for LF198H /1

							Total Dose Exposure (kRads Si)																Annealing			
					Initial		20.0		40.0		60.0		80.0		100.0		150.0		200.0		72 hours @25°C		168 hours @25°C			
Test			Spec. Lim. /2																							
#	Parameters	Units	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd		
1	IDD	mA	0	5.5	4.6	0.1	4.5	0.1	4.4	0.1	4.4	0.2	4.3	0.1	4.3	0.1	4.2	0.2	4.2	0.3	4.3	0.3	4.2	0.3		
2	ISS	mA	-5.5	0	-4.6	0.1	-4.5	0.1	-4.4	0.1	-4.4	0.2	-4.3	0.1	-4.3	0.1	-4.2	0.2	-4.2	0.3	-4.3	0.3	-4.2	0.3		
3	+IIB	nA	-25	25	1	0.3	1	0.3	1	0.1	2	0.4	1	0.6	1	0.2	0	0.1	0	0.1	0	0.2	0	0.1		
4	VIO	mV	-3.0	3.0	-0.2	0.0	-0.5	0.0	-0.6	0.0	-0.6	0.1	-0.6	0.0	-0.6	0.0	-0.6	0	-0.6	0	-0.6	0	-0.6	0		
5	+Gain Error	%	-0.0050	0.0050	0.0048	0.0011	0.0000	0.0000	0.0001	0.0000	0.0011	0.0031	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000		
6	-Gain Error	%	-0.0050	0.0050	0.0033	0.0012	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0000		
7	+psrr	dB	80		120	14	145	6	153	7	155	12	153	6	151	11	163	16	156	11	152	17	159	9		
8	-psrr	dB	80		103	6	87	0	87	0	87	1	87	0	87	0	87	0	87	0	87	0	87	0		
9	Iil	?A	-1.00	1.00	-0.36	0.00	-0.36	0.00	-0.36	0.00	-0.35	0.01	-0.35	0.00	-0.35	0.00	-0.35	0.01	-0.35	0.00	-0.35	0.00	-0.36	0.03		
10	Iih	?A	0	10.0	1.8	0.1	2.9	0.1	3.5	0.1	3.7	0.7	4.3	0.2	4.6	0.2	5.3	0.2	5.7	0.3	5.4	0.3	4.9	1.2		
11	Vth_2.0V	mA	1.00		4.99	0.00	4.99	0.00	4.99	0.00	4.99	0.00	4.99	0.00	4.99	0.00	3.71	0.71	2.15	0.48	2.75	0.61	3.45	0.91		
12	Vth_0.8V	?A	-10.0	10.0	-0.4	0.0	-0.3	0.0	-0.4	0.0	-0.4	0.1	-0.3	0.0	-0.3	0.0	-0.4	0.0	-0.3	0.1	-0.3	0.0	-0.3	0.0		
A	Hold Step Voltage /3	mV		2.0	0.4	0.05	0.4	0.04	0.4	0.04	0.4	0.03	0.4	0.04	0.4	0.04	0.4	0.03	0.4	0.03	0.4	0.03	0.4	0.03		

Notes:

1/ The mean and standard deviation values were calculated over the eight 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/ This test was performed using a bench setup.

Radiation sensitive parameters: None.