

Unisys

DATE: May 08, 1998 PPM-98-014
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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 dose tolerance of these parts. The total dose 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 288 hours.² After each radiation exposure and annealing treatment, 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. For detailed information, refer to Tables I through IV and Figure 1.

Parts showed no significant degradation up to 200kRads. Although, some parts exceeded the specification limits for VIO, Iil, and PSRR intermittently at radiation levels between 60 and 200kRads. Due to a mechanical failure of the test equipment, the data for post 200kRads was combined with the final annealing data once repairs were made.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 486, 491, 494, 589, 636, 638, 649, and 653) were used as radiation samples while SN's 393 and 472 were used as control samples. All parts passed all tests during initial electrical measurements.

No significant degradation was seen up to 60kRads. Four parts marginally exceeded the specification limits for VIO and Iil at 40kRads; however, all parts passed all tests after 60kRads.

After annealing the parts for 72 hours at 25°C, parts showed some degradation in several parameters. Five parts exceeded the specification limit of 3.000mV for VIO with readings in the range of 3.320 to 4.331mV. SN's 638 and 653 fell below the specification limit of 80dB for +psrr with readings of 66.4 and 69.8dB. SN 653 also fell marginally below the specification limit of 80dB for -psrr with a reading of 78.1dB. All parts exceeded the specification limit of 1.00µA for Iil with readings in the range of 1.84 to 3.13µA. **All parts passed all other tests.**

After the 80.0 kRad irradiation, all parts had readings within the specification limits for VIO. All parts fell below the specification limit for +psrr with readings in the range of 66.2 to 69.8dB. Seven parts fell below the specification limit for -psrr with readings of 78.2dB. All parts exceeded the specification limit for Iil with readings in the range of 2.40 to 3.76µA. **All parts passed all other tests.**

After the 100.0 kRad irradiation, all parts fell below the specification limit for +psrr with readings in the range of 69.7 to 69.8dB. All parts fell below the specification limit for -psrr with readings of 78.2dB. All parts exceeded the specification limit for Iil with readings in the range of 2.87 to 4.38µA. **All parts passed all other tests.**

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.

After the 150.0 kRad irradiation, all parts fell below the specification limit for +psrr with readings in the range of 69.7 to 69.8dB. All parts fell below the specification limit for -psrr with readings of 78.4dB. All parts exceeded the specification limit for Iil with readings in the range of 3.34 to 4.60 μ A. **All parts passed all other tests.**

After the 200.0 kRad irradiation and annealing the parts for 288 hours at 25°C, all parts exceeded the specification limits for VIO with readings in the range of 5.11 to 5.93mV. All parts exceeded the specification limits for +psrr and -psrr with readings in the range of 107 to 120dB for both. All parts passed Iil. **All parts passed all other tests.**

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.

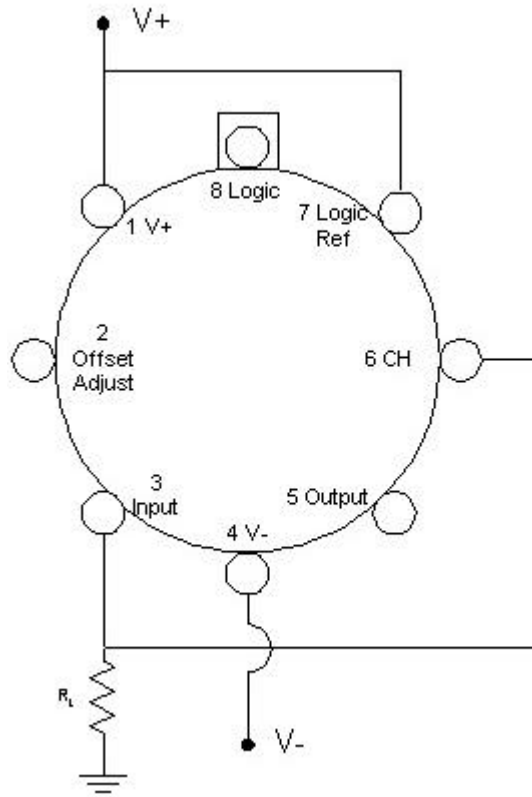
Any further details about this evaluation can be obtained upon request. If you have any questions, please call us at (301) 731-8954.

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Figure 1. Radiation Bias Circuit for LF198H



Notes:

1. $R_L = 10k\Omega \pm 10\%$, $\frac{1}{4}W$.
2. $V_+ = +15V$, $V_- = -15V$.

TABLE I. Part Information

Generic Part Number:	LF198H
GOES ITT Part Number	LF198H
Charge Number:	C80709/C80825
Manufacturer:	Linear Technology
Lot Date Code (LDC):	9129
Quantity Tested:	10
Serial Number of Control Samples:	393, 472
Serial Numbers of Radiation Samples:	486, 491, 494, 589, 636, 638, 649, and 653
Part Function:	Precision Sample and Hold Amplifier
Part Technology:	Bipolar
Package Style:	8-Pin TO 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.....	04/10/98
2) 20.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	04/13/98
POST-20.0 KRAD ELECTRICAL MEASUREMENT	04/14/98
3) 40.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	04/14/98
POST-40.0 KRAD ELECTRICAL MEASUREMENT	04/15/98
4) 60.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	04/15/98
POST-60.0 KRAD ELECTRICAL MEASUREMENT	04/16/98
5) 72 HOUR ANNEALING @25°C *	04/16/98
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENT	04/20/98
6) 80.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	04/20/98
POST-80.0 KRAD ELECTRICAL MEASUREMENT	04/21/98
7) 100.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	04/21/98
POST-100.0 KRAD ELECTRICAL MEASUREMENT	04/22/98
8) 150.0 KRAD IRRADIATION (1.200 KRADS/HOUR)	04/22/98
POST-150.0 KRAD ELECTRICAL MEASUREMENT	04/24/98
9) 200.0 KRAD IRRADIATION (0.450 KRADS/HOUR) + 288 HOUR ANNEALING @25°C **	04/24/98
POST-200.0 KRAD AND ANNEALING ELECTRICAL MEASUREMENT.....	05/09/98

Effective Dose Rate = 200,000 RADS/14 DAYS=595.2 RADS/HOUR=0.17 RADS/SEC

The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim-annealing step.

* This 72 hour annealing step was added to maintain the prescribed dose rate due to the weekend.

** The dose rate was adjusted to allow the parts to receive radiation dose over the weekend.

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	μA	$+V_{DD} = 8.5V, -V_{DD} = -21.5V$	-1.00	1.00
10	Iih	μA	$+V_{DD} = 8.5V, -V_{DD} = -21.5V$	0	10.0
11	Vth_2.0V	mA	Logic Voltage = 2.0V	1.000	
12	Vth_0.8V	μA	Logic Voltage = 0.8V	-10.0	10.0

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 LF198

Test #	Parameters	Units	Spec. Lim. /2		Total Dose Exposure (kRads Si)								Annealing		Total Dose Exposure (kRads Si)							
					Initial		20.0		40.0		60.0		72 hours @25°C		80.0		100.0		150.0		200.0 + 288 h Ann. @25°C	
					min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	IDD	mA	0	5.5	3.7	0.1	3.7	0.1	3.7	0.1	3.7	0.1	3.8	0.1	4.0	0.1	4.1	0.2	4.0	0.2	4.0	0.2
2	ISS	mA	-5.5	0	-3.7	0.1	-3.7	0.1	-3.7	0.1	-3.7	0.1	-3.9	0.1	-3.9	0.1	-4.1	0.2	-3.9	0.3	-4.0	0.2
3	+IIB	nA	-25	25	-0.8	0.1	-0.8	0.5	-1.1	0.2	-2.3	0.8	-0.6	0.2	-0.5	0.1	-0.4	0.2	-0.3	0.1	6.5	2.2
4	VIO	mV	-3.0	3.0	2.0	0.3	2.6	0.3	2.5	0.3	2.4	0.3	3.3	0.7	2.4	0.1	2.1	0.2	2.0	0.1	5.7	0.3
5	+Gain Error	%	0.0050	0.0050	0.0010	0	0.0019	0.0008	0.0021	0.0007	0.0022	0	0.0012	0	0.0002	0	0.0003	0	0.0002	0	0.0018	0.0006
6	-Gain Error	%	0.0050	0.0050	0.0009	0	0.0012	0.0004	0.0012	0.0005	0.0013	0	0.0009	0	0.0001	0	0.0001	0	0.0001	0	0.0017	0.0006
7	+psrr	dB	80		110	2.5	112	2.5	112	2.8	123	8.0	95	23	69	1.1	>70		>70		110	2.9
8	-psrr	dB	80		101	1.1	100	1.0	100	1.1	101	1.2	94	6.6	80	5.7	78	0.1	78	0.1	113	3.8
9	Iil	?A	-1.00	1.00	0.39	0.31	0.51	0.66	0.34	0.15	0.44	0.22	2.53	0.46	3.18	0.49	3.74	0.56	4.03	0.48	-0.35	0.01
10	Iih	?A	0	10.0	2.16	0.22	3.28	0.31	4.01	0.38	4.78	0.52	4.12	0.45	4.60	0.50	5.01	0.57	5.32	0.50	5.41	0.48
11	Vth_2.0V	mA	1.00		1.41	0.33	1.64	0.46	1.24	0.22	1.16	0.11	1.01	0	1.00	0	1.00	0	1.00	0	1.55	0.05
12	Vth_0.8V	?A	-10.0	10.0	-0.1	0.04	-0.1	0.04	-0.2	0.02	-0.2	0.02	0.1	0.7	-0.2	0.2	-0.1	0.1	-0.1	0.1	-0.1	0.1

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.
- 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.

Radiation sensitive parameters: VIO, psrr, Iil.