Neutron Irradiation Test Results of the RH117K Positive Adjustable Regulator

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Acknowledgements

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Neutron Radiation Testing of the RH117K Positive Adjustable Regulator

Part Type Tested: RH117K Positive Adjustable Regulator.

Traceability Information: Fab Lot# 9529063.1; Wafer # 9; Assembly Lot # 263277.2, D/C 0912B. See photograph of unit under test in Appendix A.

Quantity of Units: 7 units received, 2 units for control, and 5 units for unbiased irradiation. Leads of devices, serial numbers 15-17, 20, and 22 were shorted together using anti-static foam during irradiation. Serial numbers 33 and 34 were used as control. See Appendix B for the radiation bias connection tables.

Radiation Dose: Total fluence of 1E12 neutron/cm^2.

Radiation Test Standard: MIL-STD-883 TM1017

Test Hardware and Software: LTX test program EQ2CR117K.03

Facility and Radiation Source: University of Massachusetts, Lowell and Reactor Facility-FNI.

Irradiation and Test Temperature: Room temperature controlled to 24°C±6°C per MIL-STD-883 and MIL-STD-750.

SUMMARY

ALL FIVE PARTS PASSED THE ELECTRICAL TEST LIMITS AS SPECIFIED IN THE DATASHEET AFTER IRRADIATION TO 1E12 N/cm^2. ADDITIONAL INFORMATION CAN BE PROVIDED PER REQUEST.

1.0 Overview and Background

Neutron particles incident on semiconductor materials lose energy along their paths. The energy loss produces electron-hole pairs (ionization) and displaces atoms in the material lattice (displacement damage defects or DDD). DDD induces a mixture of isolated and clustered defects or broken bonds. Such defects elevate the energy level of the material and consequently change material and electrical properties. The altering energy level creates the combination of any of the following processes, thermal generation of electron-hole pairs, recombination, trapping, compensation, tunneling, affecting hence the device's basic features.

Bipolar technology is susceptible to neutron displacement damage around a fluence level of 1E12 neutron/cm^2. The neutron radiation test for the RH117K determines the change in device performance as a function of neutrons' fluence.

2.0 Radiation Facility:

Five samples were irradiated unbiased at the University of Massachusetts, Lowell, using the Reactor Facility-FNI. The neutron flux was determined by system S/P-32, method ASTM E-265, to be 4.05E9 N/cm^2-s (1MeV equivalent) for each irradiation step. Refer to Appendix C for the certificate of dosimetry.

3.0 Test Conditions

Five samples and two control units were electrically tested at 25°C prior to irradiation. The testing was performed on the two control units to confirm the operation of the test system prior to the electrical testing of the 7 units (5 irradiated and 2 control). During irradiation, devices leads were shorted together using anti-static foam and devices then were placed into an anti-static bag. Devices were then vertically aligned with the radiation source.

The criteria to pass the neutron displacement damage test is that five irradiated samples must pass the datasheet limits. If any of the tested parameters of these five units do not meet the required limits then a failure-analysis of the part should be conducted in accordance with method 5004, MIL-STD-883, and if valid the lot will be scrapped.

4.0 Tested Parameters

The following parameters were measured pre- and post-irradiations:

- Reference Voltage V_{REF} (V) @ 3V ≤ V_{IN} – V_{OUT} ≤ 40V, 10mA ≤ I_L ≤ 1.5A
- Line Regulation $\Delta V_{OUT}/\Delta V_{IN}$ (%/V) @ 3V ≤ V_{IN} – V_{OUT} ≤ 50V, I_L = 10mA
- Load Regulation $\Delta V_{OUT}/\Delta I_{OUT}$ (mV) @ 10mA ≤ I_L ≤ 1.5A, V_{OUT} ≤ 5V
- Load Regulation $\Delta V_{OUT}/\Delta I_{OUT}$ (%) @ 10mA ≤ I_L ≤ 1.5A, V_{OUT} ≥ 5V
- Adjust Pin Current I_{ADJ} (uA)
- Adjust Pin Current Change ΔI_{ADJ} (uA) @ 10mA ≤ I_L ≤ 1.5A
- Adjust Pin Current Change ΔI_{ADJ} (uA) @ 3V ≤ V_{IN} – V_{OUT} ≤ 40V, I_{OUT} = 10mA
- Minimum Load Current I_{MIN} (mA) @ V_{IN} – V_{OUT} = 40V
- Current Limit (A) @ V_{IN} – V_{OUT} ≤ 15V
- Current Limit (A) @ V_{IN} – V_{OUT} = 40V

Appendix D details the test conditions, minimum and maximum values at different accumulated doses.

5.0 Test Results

All five samples passed the post-irradiation electrical tests. All measurements of the ten listed parameters in section 4.0 are within the specification limits.

The used statistics in this report are based on the tolerance limits, which are bounds to gage the quality of the manufactured products. It assumes that if the quality of the items is normally distributed with known mean and known standard deviation, the two-sided tolerance limits can be calculated as follows:

$+K_{TL}$ = mean + (K_{TL}) (standard deviation)

$-K_{TL}$ = mean - (K_{TL}) (standard deviation)

Where $+K_{TL}$ is the upper tolerance limit and $-K_{TL}$ is the lower tolerance limit.
These tolerance limits are defined in a table of inverse normal probability distribution.

However, in most cases, mean and standard deviations are unknown and therefore it is practical to estimate both of them from a sample. Hence the tolerance limit depends greatly on the sample size. The Ps90%/90% K_{TL} factor for a lot quality P of 0.9, confidence C of 0.9 with a sample size of 5, can be found from the tabulated table (MIL-HDBK-814, page 94, table IX-B). The K_{TL} factor in this report is 2.742.

In the plots, the dashed lines with X-markers are the measured data points of five post-irradiated samples. The solid lines with square symbols are the computed KTL values of five post-irradiated samples with the application of the K_{TL} statistics. The orange solid lines with circle markers are the datasheet specification limits.

The post-irradiation test limits are taken from the Linear Technology datasheet's 10 Krads(Si) specification limits.

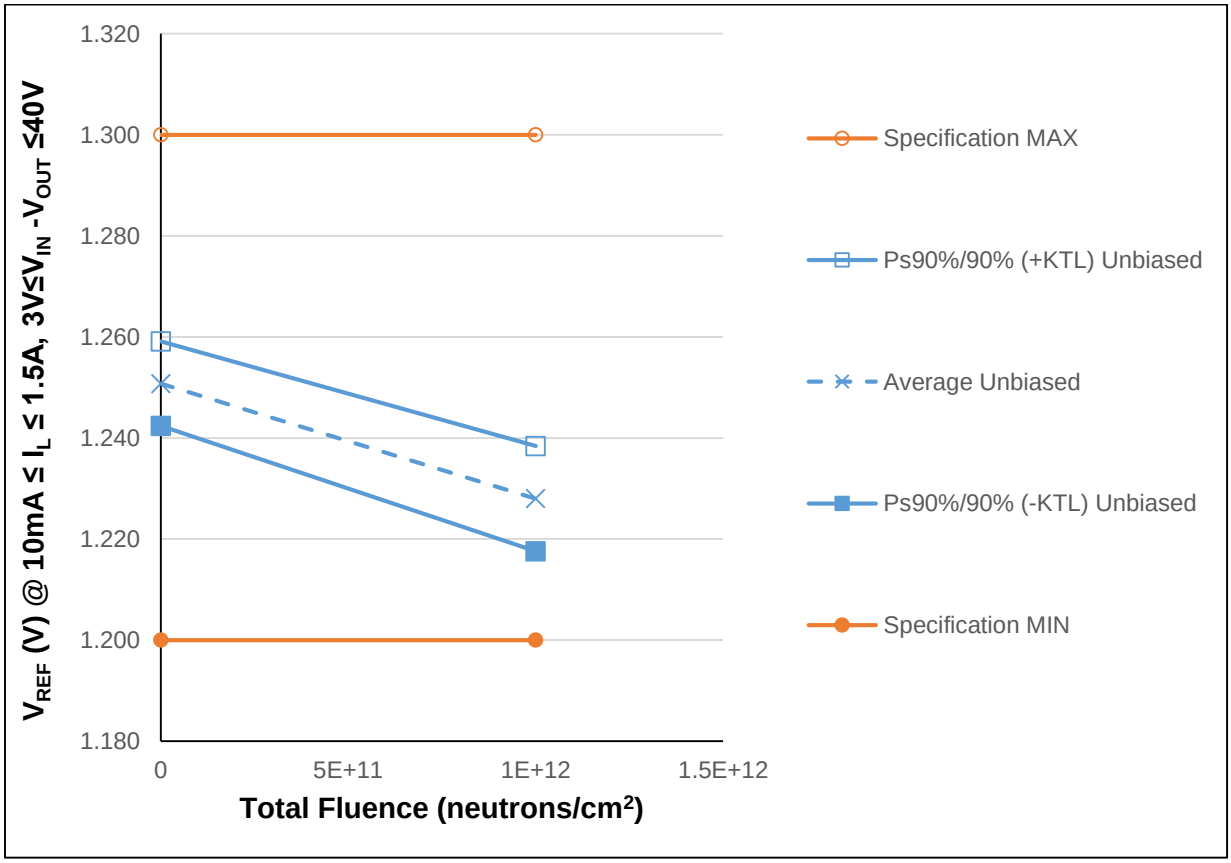

Figure 5.1 Plot of Reference Voltage @ 10mA ≤ I_L ≤ 1.5A, 3V ≤ V_{IN} – V_{OUT} ≤ 40V versus Total Fluence

Table 5.1: Raw data table for V_{REF} of pre- and post-irradiation (1E12 N/cm^2)

Parameter	V_{REF} @ 10mA≤I_L≤1.5A,3V≤V_I-V_O≤40V	Total Fluence (N/cm^2)	
Units	(V)	0	1.E+12
15	Unbiased Irradiation	1.24690	1.22289
16	Unbiased Irradiation	1.25349	1.23058
17	Unbiased Irradiation	1.25164	1.22662
20	Unbiased Irradiation	1.25353	1.23274
22	Unbiased Irradiation	1.24825	1.22712
33	Control Unit	1.25334	1.25317
34	Control Unit	1.24166	1.24160
	Unbiased Irradiation Statistics		
	Average Unbiased	1.25076	1.22799
	Std Dev Unbiased	0.00305	0.00380
	Ps90%/90% (+KTL) Unbiased	1.25911	1.23842
	Ps90%/90% (-KTL) Unbiased	1.24241	1.21756
	Specification MIN	1.2	1.2
	Status (Measurements)	PASS	PASS
	Specification MAX	1.3	1.3
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased	PASS	PASS
	Status (+KTL) Unbiased	PASS	PASS

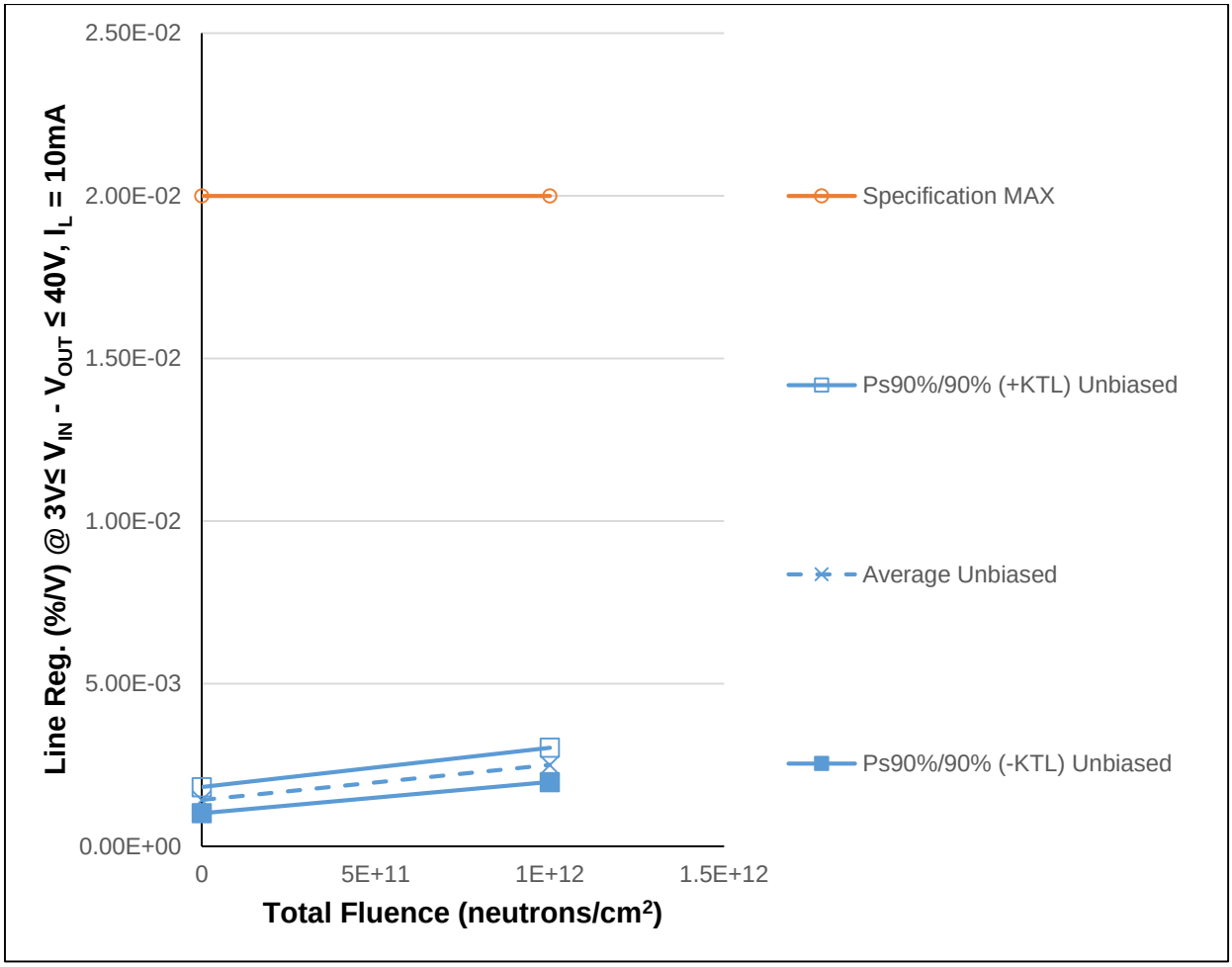

Figure 5.2: Plot of Line Regulation @ 3V ≤ V_{IN} – V_{OUT} ≤ 40V, I_L = 10 mA *versus Total Fluence*

Table 5.2: Raw data table for Line Regulation @ 3V ≤ V_{IN} – V_{OUT} ≤ 40V, I_L = 10mA of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Line Reg @ 3V≤V_I-V_O ≤40V,I_L=10mA	Total Fluence (N/cm^2)	
Units	(%/V)	0	1.E+12
15	Unbiased Irradiation	1.296E-03	2.361E-03
16	Unbiased Irradiation	1.382E-03	2.367E-03
17	Unbiased Irradiation	1.312E-03	2.375E-03
20	Unbiased Irradiation	1.484E-03	2.679E-03
22	Unbiased Irradiation	1.650E-03	2.752E-03
33	Control Unit	1.392E-03	1.318E-03
34	Control Unit	1.573E-03	1.331E-03
	Unbiased Irradiation Statistics		
	Average Unbiased	1.425E-03	2.507E-03
	Std Dev Unbiased	1.461E-04	1.923E-04
	Ps90%/90% (+KTL) Unbiased	1.825E-03	3.034E-03
	Ps90%/90% (-KTL) Unbiased	1.024E-03	1.979E-03
	Specification MIN		
	Status (Measurements)		
	Specification MAX	2.00E-02	2.00E-02
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased		
	Status (+KTL) Unbiased	PASS	PASS

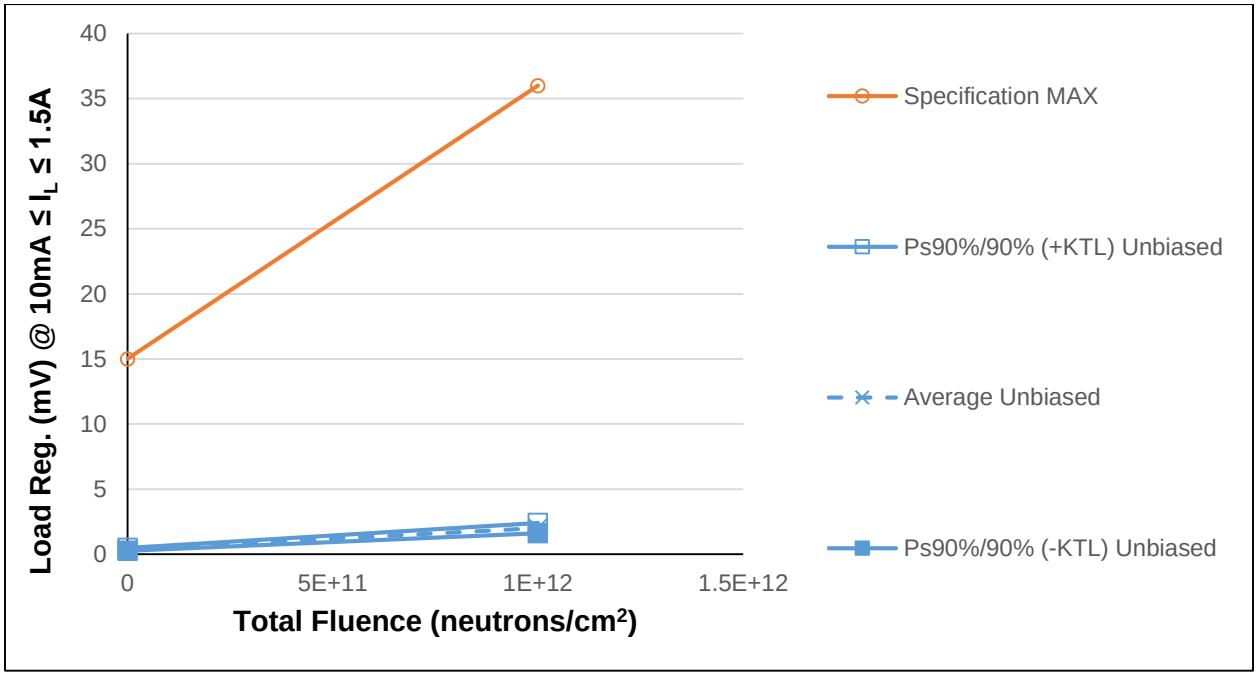

Figure 5.3: Plot of Load Regulation @ 10mA ≤ I_L ≤ 1.5A, V_{OUT} ≤ 5V *versus Total Fluence*

Table 5.3: Raw data table for Load Regulation @ 10mA ≤ I_L ≤ 1.5A, V_{OUT} ≤ 5V of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Load Reg @ 10mA≤I_L≤1.5A,V_{OUT}≤5V	Total Fluence (N/cm^2)	
Units	(mV)	0	1.E+12
15	Unbiased Irradiation	0.39196	2.03133
16	Unbiased Irradiation	0.30231	1.98364
17	Unbiased Irradiation	0.39291	2.12765
20	Unbiased Irradiation	0.39768	2.13718
22	Unbiased Irradiation	0.40150	1.78337
33	Control Unit	0.38242	0.37098
34	Control Unit	0.48828	0.45776
	Unbiased Irradiation Statistics		
	Average Unbiased	0.37727	2.01263
	Std Dev Unbiased	0.04208	0.14361
	Ps90%/90% (+KTL) Unbiased	0.49265	2.40641
	Ps90%/90% (-KTL) Unbiased	0.26189	1.61886
	Specification MIN		
	Status (Measurements)		
	Specification MAX	15	36
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased		
	Status (+KTL) Unbiased	PASS	PASS

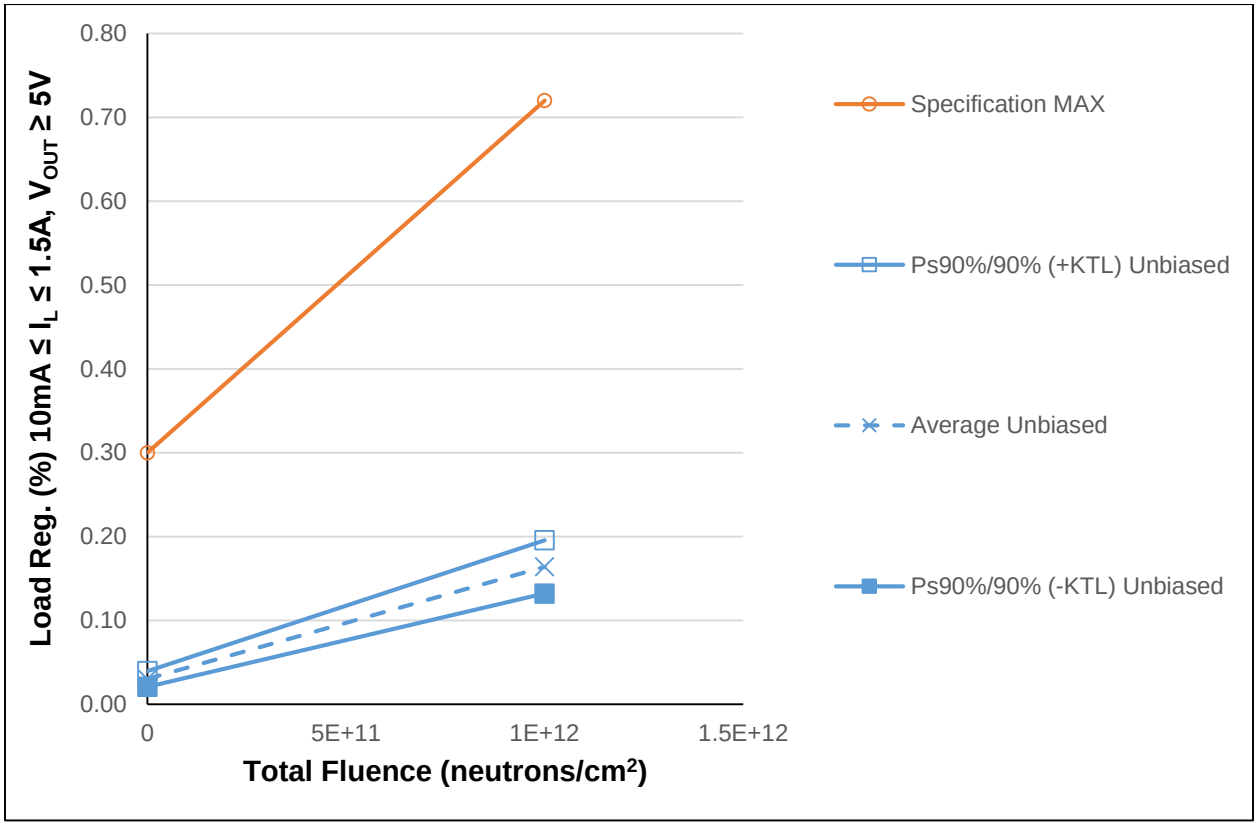

Figure 5.4: Plot of Load Regulation @ 10mA ≤ I_L ≤ 1.5A, V_{OUT} ≥ 5V *versus Total Fluence*

Table 5.4: Raw data table for Load Reg. @ 10mA ≤ I_L ≤ 1.5A, V_{OUT} ≥ 5V of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Load Reg @ 10mA≤IL≤1.5A,V_{OUT}≥5V	Total Fluence (N/cm^2)	
Units	(%)	0	1.E+12
15	Unbiased Irradiation	0.03143	0.16611
16	Unbiased Irradiation	0.02412	0.16120
17	Unbiased Irradiation	0.03139	0.17346
20	Unbiased Irradiation	0.03172	0.17337
22	Unbiased Irradiation	0.03216	0.14533
33	Control Unit	0.03051	0.02960
34	Control Unit	0.03933	0.03687
	Unbiased Irradiation Statistics		
	Average Unbiased	0.03017	0.16389
	Std Dev Unbiased	0.00340	0.01160
	Ps90%/90% (+KTL) Unbiased	0.03948	0.19569
	Ps90%/90% (-KTL) Unbiased	0.02086	0.13209
	Specification MIN		
	Status (Measurements)		
	Specification MAX	0.3	0.72
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased		
	Status (+KTL) Unbiased	PASS	PASS

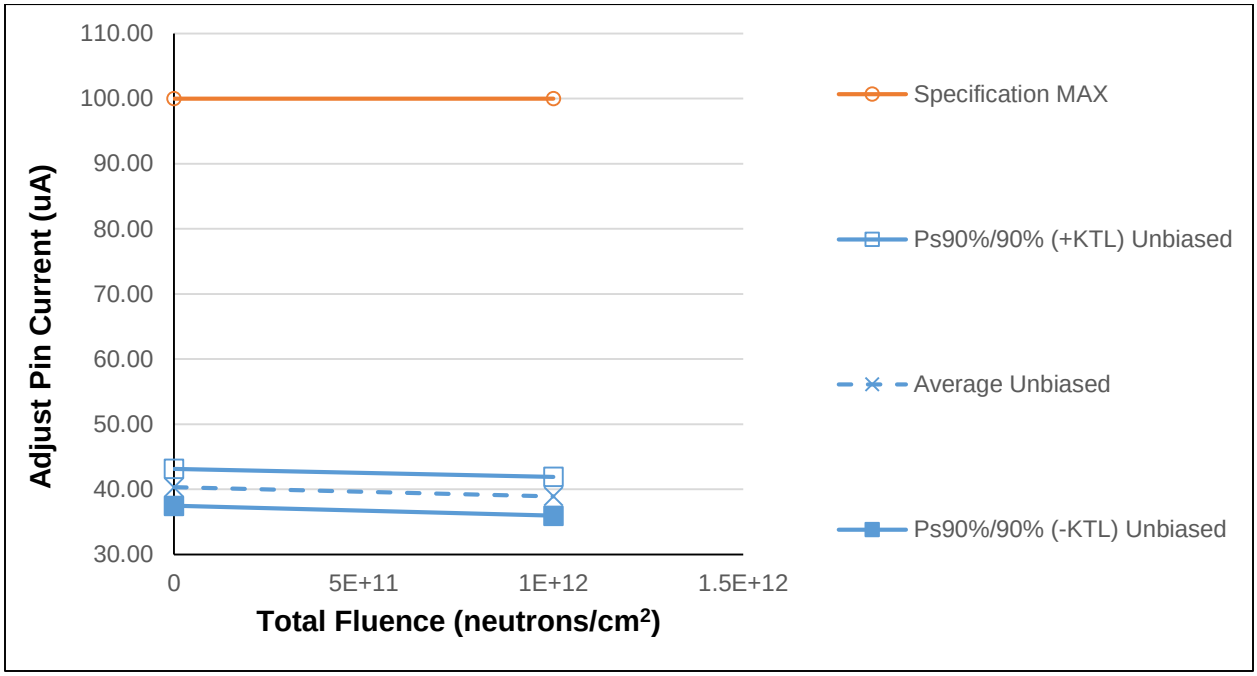

Figure 5.5: Plot of Adjust Pin Current versus Total Fluence

Table 5.5: Raw data table for Adjust Pin Current of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Adjust Pin Current	Total Fluence (N/cm^2)	
Units	(uA)	0	1.E+12
15	Unbiased Irradiation	40.63614	39.13647
16	Unbiased Irradiation	40.64212	39.27094
17	Unbiased Irradiation	39.20321	37.72747
20	Unbiased Irradiation	41.73219	40.48119
22	Unbiased Irradiation	39.40331	38.09047
33	Control Unit	41.97947	41.95026
34	Control Unit	41.10741	41.14221
	Unbiased Irradiation Statistics		
	Average Unbiased	40.32339	38.94131
	Std Dev Unbiased	1.03507	1.08574
	Ps90%/90% (+KTL) Unbiased	43.16155	41.91840
	Ps90%/90% (-KTL) Unbiased	37.48524	35.96421
	Specification MIN		
	Status (Measurements)		
	Specification MAX	100	100
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased		
	Status (+KTL) Unbiased	PASS	PASS

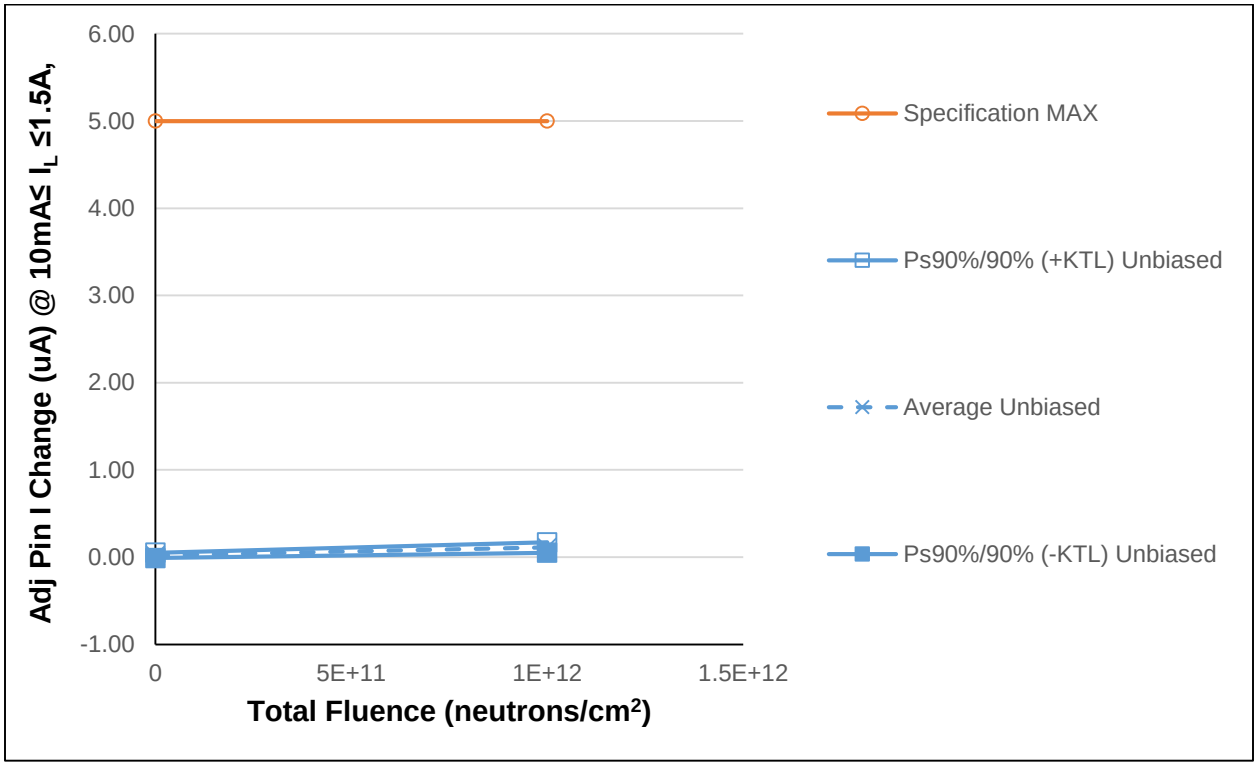

Figure 5.6: Plot of Adjust Pin Current Change @ 10mA ≤ I_L ≤ 1.5A *versus Total Fluence*

Table 5.6: Raw data table for Adjust Pin Current Change @ 10mA ≤ I_L ≤ 1.5A of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Adj Pin I change @ 10mA ≤ I_L ≤ 1.5A	Total Fluence (N/cm^2)	
Units	(uA)	0	1.E+12
15	Unbiased Irradiation	0.01433	0.09884
16	Unbiased Irradiation	0.03345	0.09754
17	Unbiased Irradiation	0.00598	0.14638
20	Unbiased Irradiation	0.02807	0.11420
22	Unbiased Irradiation	0.01672	0.09409
33	Control Unit	0.01433	0.01362
34	Control Unit	0.04660	0.04884
	Unbiased Irradiation Statistics		
	Average Unbiased	0.01971	0.11021
	Std Dev Unbiased	0.01101	0.02164
	Ps90%/90% (+KTL) Unbiased	0.04991	0.16956
	Ps90%/90% (-KTL) Unbiased	-0.01049	0.05087
	Specification MIN		
	Status (Measurements)		
	Specification MAX	5	5
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased		
	Status (+KTL) Unbiased	PASS	PASS

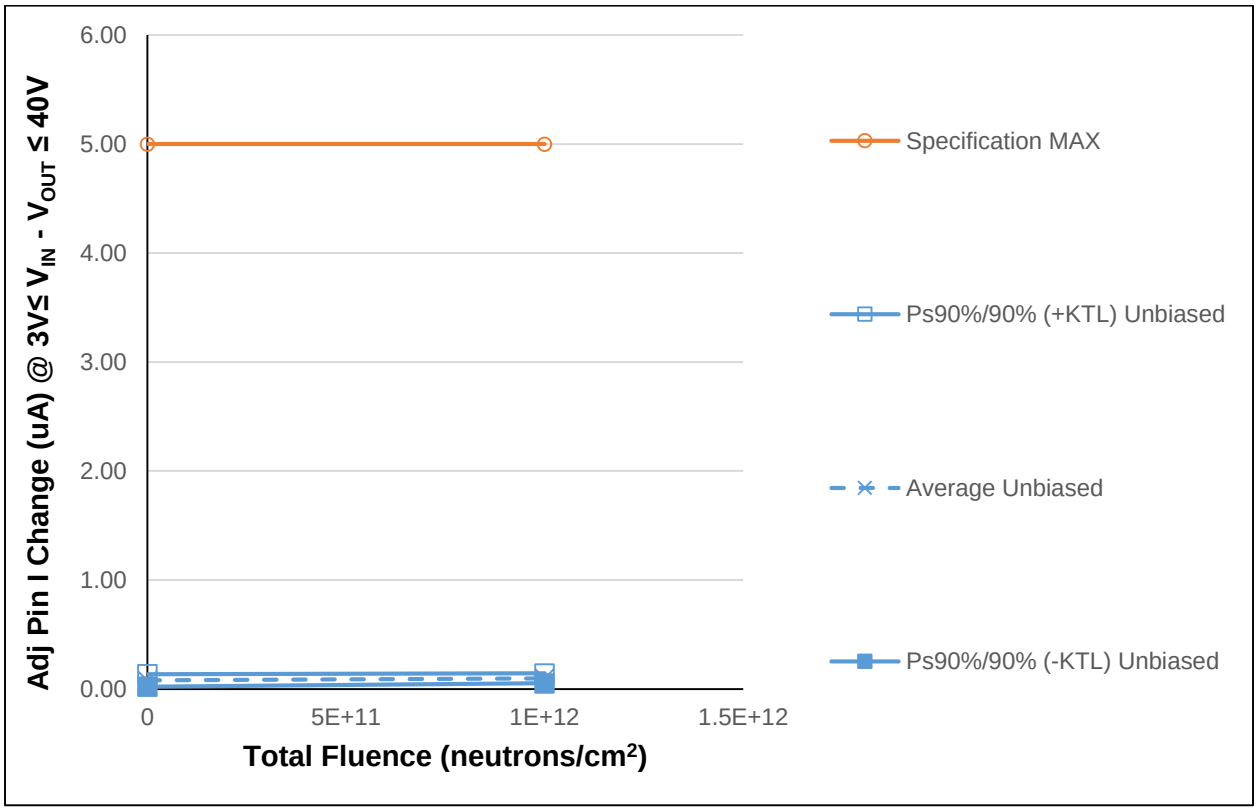

Figure 5.7: Plot of Adjust Pin Current Change @ $3V \le V_{IN} - V_{OUT} \le 40V$ *versus Total Fluence*

Table 5.7: Raw data table for Adjust Pin Current Change @ 3V ≤ V_{IN} – V_{OUT} ≤ 40V of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Adj. I Change @ 3V≤ V_{IN} - V_{OUT}≤ 40V	Total Fluence (N/cm^2)	
Units	(uA)	0	1.E+12
15	Unbiased Irradiation	0.04839	0.08801
16	Unbiased Irradiation	0.09258	0.08564
17	Unbiased Irradiation	0.09200	0.12612
20	Unbiased Irradiation	0.09497	0.08919
22	Unbiased Irradiation	0.06630	0.09991
33	Control Unit	0.06332	0.09171
34	Control Unit	0.07226	0.06311
	Unbiased Irradiation Statistics		
	Average Unbiased	0.07885	0.09777
	Std Dev Unbiased	0.02066	0.01677
	Ps90%/90% (+KTL) Unbiased	0.13548	0.14375
	Ps90%/90% (-KTL) Unbiased	0.02221	0.05180
	Specification MIN		
	Status (Measurements)		
	Specification MAX	5	5
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased		
	Status (+KTL) Unbiased	PASS	PASS

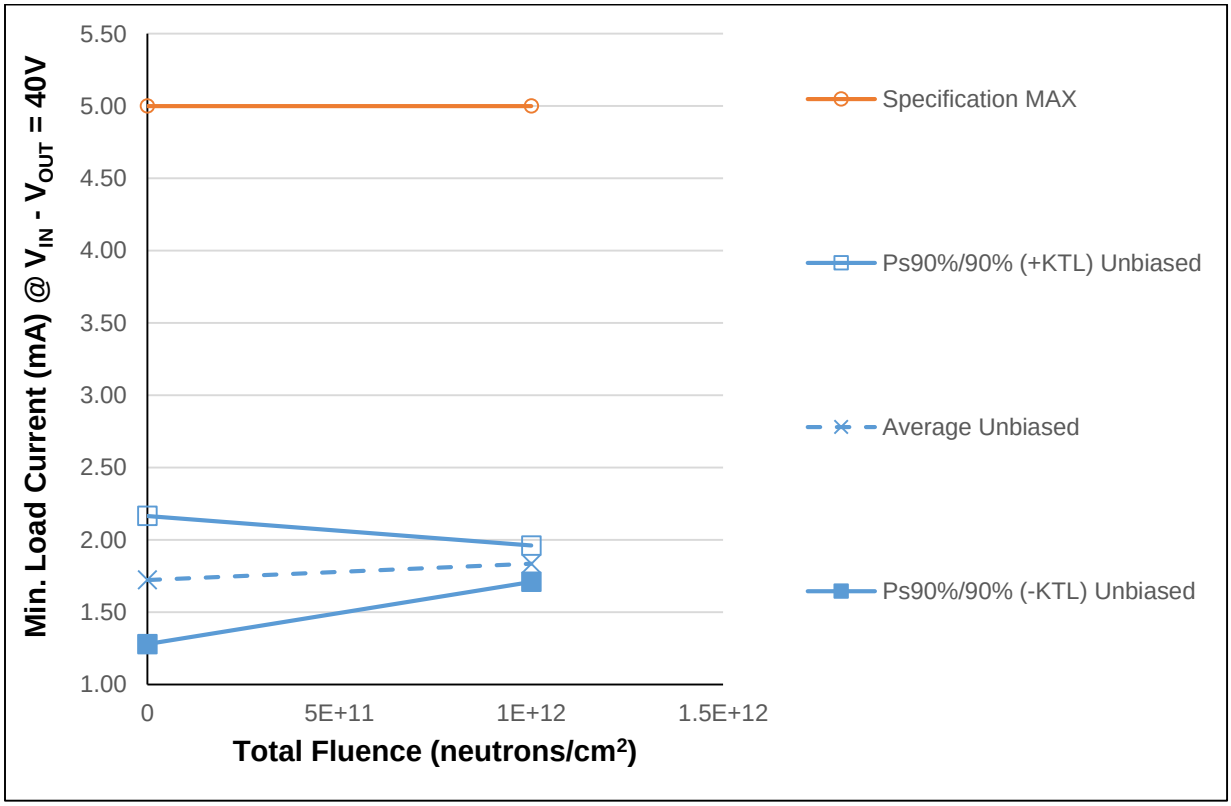

Figure 5.8: Plot of Minimum Load Current @ V_{IN} – V_{OUT} = 40V *versus Total Fluence*

Table 5.8: Raw data table for Minimum Load Current @ V_{IN} – V_{OUT} = 40V of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Min Load Current @ V_{IN} - V_{OUT} = 40V	Total Fluence (N/cm^2)	
Units	(mA)	0	1.E+12
15	Unbiased Irradiation	1.70252	1.90104
16	Unbiased Irradiation	1.65555	1.82570
17	Unbiased Irradiation	1.59205	1.77362
20	Unbiased Irradiation	2.00202	1.82540
22	Unbiased Irradiation	1.65647	1.84545
33	Control Unit	1.73548	1.74128
34	Control Unit	1.73931	1.74059
	Unbiased Irradiation Statistics		
	Average Unbiased	1.72172	1.83424
	Std Dev Unbiased	0.16154	0.04587
	Ps90%/90% (+KTL) Unbiased	2.16467	1.96000
	Ps90%/90% (-KTL) Unbiased	1.27877	1.70848
	Specification MIN		
	Status (Measurements)		
	Specification MAX	5	5
	Status (Measurements)	PASS	PASS
	Status (-KTL) Unbiased		
	Status (+KTL) Unbiased	PASS	PASS

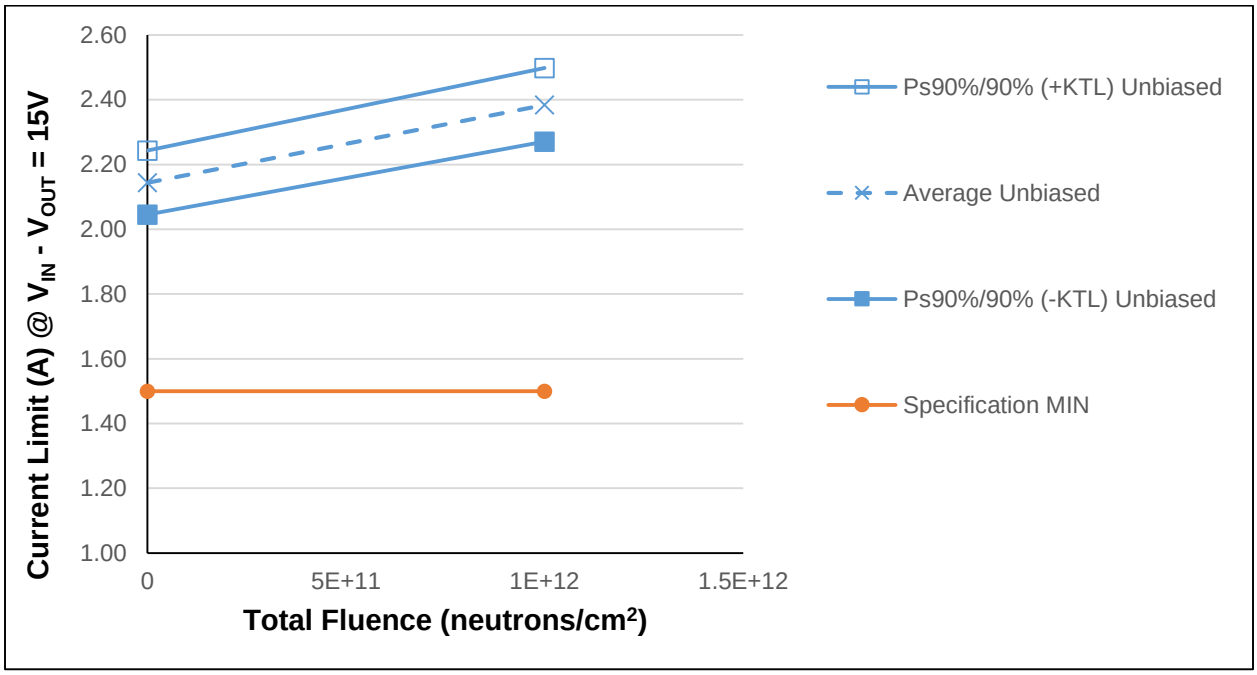

Figure 5.9: Plot of Minimum Load Current @ V_{IN} – V_{OUT} = 15V *versus Total Fluence*

Table 5.9: Raw data table for Minimum Load Current @ V_{IN} – V_{OUT} = 15V of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Current Limit @ V_{IN} - V_{OUT} = 15V	Total Fluence (N/cm^2)	
Units	(A)	0	1.E+12
15	Unbiased Irradiation	2.11072	2.35190
16	Unbiased Irradiation	2.14302	2.38990
17	Unbiased Irradiation	2.17582	2.43460
20	Unbiased Irradiation	2.18508	2.41109
22	Unbiased Irradiation	2.10641	2.33404
33	Control Unit	2.17289	2.16394
34	Control Unit	2.04869	2.04170
	Unbiased Irradiation Statistics		
	Average Unbiased	2.14421	2.38430
	Std Dev Unbiased	0.03613	0.04140
	Ps90%/90% (+KTL) Unbiased	2.24327	2.49782
	Ps90%/90% (-KTL) Unbiased	2.04515	2.27079
	Specification MIN	1.5	1.5
	Status (Measurements)	PASS	PASS
	Specification MAX		
	Status (Measurements)		
	Status (-KTL) Unbiased	PASS	PASS
	Status (+KTL) Unbiased		

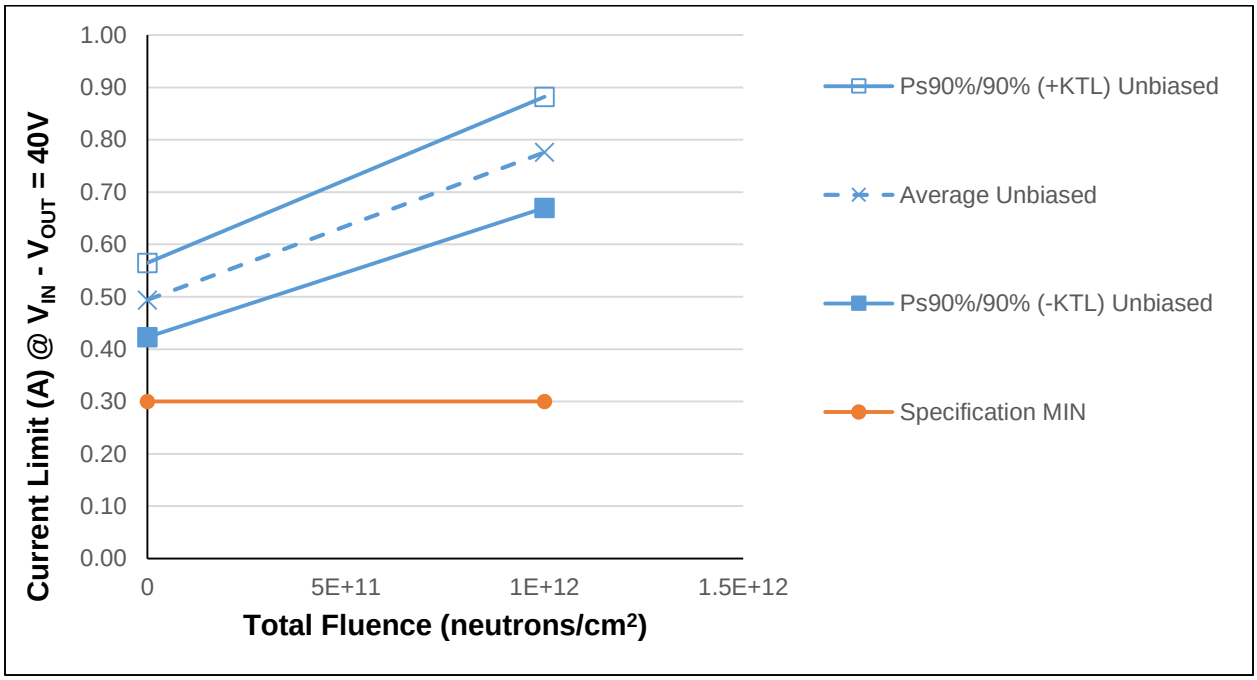

Figure 5.10: Plot of Current Limit @ V_{IN} – V_{OUT} = 40V versus Total Fluence

Table 5.10: Raw data table for Current Limit @ $V_{IN} – V_{OUT} = 40V$ of pre- and post-irradiation (1E12 N/cm^2)

Parameter	Current Limit @ V_{IN} - V_{OUT} = 40V	Total Fluence (N/cm^2)	
Units	(A)	0	1.E+12
15	Unbiased Irradiation	0.51440	0.79628
16	Unbiased Irradiation	0.49515	0.78122
17	Unbiased Irradiation	0.51818	0.82392
20	Unbiased Irradiation	0.48936	0.75740
22	Unbiased Irradiation	0.45346	0.72220
33	Control Unit	0.51732	0.51620
34	Control Unit	0.46042	0.46200
	Unbiased Irradiation Statistics		
	Average Unbiased	0.49411	0.77620
	Std Dev Unbiased	0.02582	0.03865
	Ps90%/90% (+KTL) Unbiased	0.56491	0.88219
	Ps90%/90% (-KTL) Unbiased	0.42331	0.67022
	Specification MIN	0.3	0.3
	Status (Measurements)	PASS	PASS
	Specification MAX		
	Status (Measurements)		
	Status (-KTL) Unbiased	PASS	PASS
	Status (+KTL) Unbiased		

Appendix A

Pictures of one among five samples used in the test.

Figure A1: Top View showing date code, lot and wafer numbers

Appendix B

Radiation Bias Connection Table

Table B1: Unbiased condition

Pin	Function	Connection
1	Adjust	Float
2	V_{IN}	Float
3	V_{OUT} (CASE)	Float

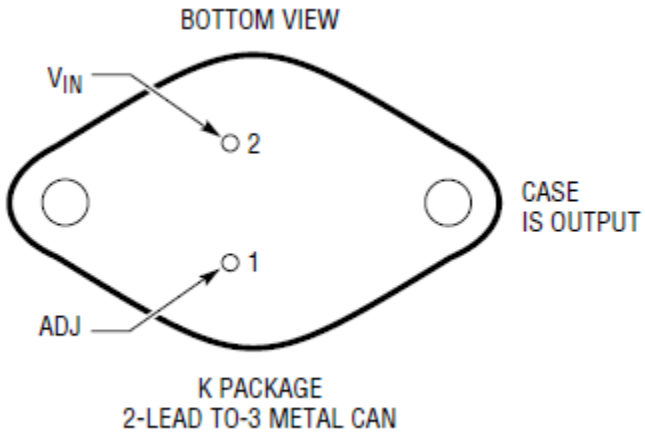

Figure B1: Pin-Out

Appendix C

Pinanski Building
One University Avenue
Lowell, Massachusetts 01854
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Thomas Regan
Reactor Engineering

University of Massachusetts
UMASS Lowell

RADIATION LABORATORY

7/2/2012
Linear Technology Corporation
Attention: Sana Rezgui
1530 Buckeye Drive
Milpitas, CA 95035

Subject: **Certificate of Neutron Exposure**

Product: Multiple products see attached table

Irradiation Date: June, 27th, 2012
Irradiation Facility: Reactor Facility- FNI
Dosimetry system: S/P-32, ASTM E-265

Neutron Dosimetry Results:

Irradiation	Requested Fluence (n/cm^2)	Reactor Power (kW)	Time (s)	Fluence Rate (n/cm^2-s)(2,3)	Gamma Dose rad (Si) (1)	Measured Fluence (n/cm^2)(4)	Total Integral Fluence (n/cm^2)
Group 1	1.00E+12	45.0	228	4.05E+09	117	1.03E+12	1.03E+12
Group 2	1.00E+12	45.0	228	4.05E+09	117	9.41E+11	9.41E+11
Group 3	1.00E+13	475	234	4.28E+10	1266	9.22E+12	9.22E+12
Group 4	1.00E+13	90	1235	8.10E+09	1266	9.03E+12	9.03E+12

(1) Based on reactor power at 1,000kW, the gamma dose is 41+/- 5.3% krad(Si)/hr as mapped by TLD-based dosimetry
(2) Dosimetry method: ASTM E-265
(3) The neutron fluence rate is determined from "Initial Testing of the New Ex-Core Fast Neutron Irradiator at UMass Lowell " (6/18/02)
(4) Validated by S-32 flux monitors

The neutron fluence for this irradiation was determined using the previously measured neutron radiation field for this facility, measured with ASTM E-265 "Measuring Reaction Rates and Fast Neutron Fluence by Radioactivation of Sulfur-32" and correlated to the measured reactor power level.

Group 1 Average Integrated Neutron Fluence (1 MeV Si Eq.) =1.03E12 n/cm^2
Group 2 Average Integrated Neutron Fluence (1 MeV Si Eq.) =9.41E11 n/cm^2
Group 3 Average Integrated Neutron Fluence (1 MeV Si Eq.) =9.22E12 n/cm^2
Group 4 Average Integrated Neutron Fluence (1 MeV Si Eq.) =9.03E12 n/cm^2

Reviewed by _____
Thomas Regan
Reactor Engineer

Appendix D

Table D1: Electrical Characteristics of Device-Under-Test Pre-Irradiation

SYMBOL	PARAMETER	CONDITIONS	NOTES	$T_J = 25°C$ MIN	TYP	MAX	SUB-GROUP	$-55°C \le T_J \le 150°C$ MIN	TYP	MAX	SUB-GROUP	UNITS
V_{REF}	Reference Voltage	$3V \le (V_{IN} - V_{OUT}) \le 40V$, $10mA \le I_{OUT} \le I_{MAX}$, $P \le P_{MAX}$		1.20		1.30	1	1.20		1.30	2,3	V
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	$3V \le (V_{IN} - V_{OUT}) \le 40V$, $I_{OUT} = 10mA$	2			0.02	1			0.05	2,3	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$10mA \le I_{OUT} \le I_{MAX}$, $V_{OUT} \le 5V$ $10mA \le I_{OUT} \le I_{MAX}$, $V_{OUT} \ge 5V$	2 2			15 0.3	1 1			50 1	2,3 2,3	mV %
	Thermal Regulation	20ms Pulse				0.07	1					%/W
	Ripple Rejection	$V_{OUT} = 10V$, f = 120Hz, $C_{ADJ} = 0$			65				65			dB
		$V_{OUT} = 10V$, f = 120Hz, $C_{ADJ} = 10\mu F$	3	66				66				dB
I_{ADJ}	Adjust Pin Current					100	1			100	2,3	µA
ΔI_{ADJ}	Adjust Pin Current Change	$10mA \le I_{OUT} \le I_{MAX}$				5	1			5	2,3	µA
		$2.5V \le (V_{IN} - V_{OUT}) \le 40V$, $I_{OUT} = 10mA$				5	1			5	2,3	µA
I_{MIN}	Minimum Load Current	$(V_{IN} - V_{OUT}) = 40V$				5	1			5	2,3	mA
	Current Limit	$(V_{IN} - V_{OUT}) \le 15V$ H Package K Package		0.5 1.5			1 1	0.5 1.5			2,3 2,3	A A
		$(V_{IN} - V_{OUT}) = 40V$ H Package K Package		0.15 0.30			1 1					A A
$\frac{\Delta V_{OUT}}{\Delta Temp}$	Temperature Stability	$-55°C \le T_J \le 150°C$							1			%
$\frac{\Delta V_{OUT}}{\Delta Time}$	Long Term Stability	$T_A = 125°C$	3							1		%
e_n	RMS Output Noise	$10Hz \le f \le 10kHz$			0.001							%
θ_{JC}	Thermal Resistance (Junction to Case)	H Package K Package	3 3			15 3						°C/W °C/W

Table D2: Electrical Characteristics of Device-Under-Test Post-Irradiation

SYMBOL	PARAMETER	CONDITIONS	NOTES	10KRAD(Si) MIN	10KRAD(Si) MAX	20KRAD(Si) MIN	20KRAD(Si) MAX	50KRAD(Si) MIN	50KRAD(Si) MAX	100KRAD(Si) MIN	100KRAD(Si) MAX	UNITS
V_{REF}	Reference Voltage	$3V \le (V_{IN} - V_{OUT}) \le 40V$, $10mA \le I_{OUT} \le I_{MAX}$, $P \le P_{MAX}$		1.20	1.30	1.20	1.30	1.20	1.30	1.20	1.30	V
$\frac{\Delta V_{OUT}}{\Delta V_{IN}}$	Line Regulation	$3V \le (V_{IN} - V_{OUT}) \le 40V$, $I_{OUT} = 10mA$	2		0.02		0.02		0.02		0.03	%/V
$\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$	Load Regulation	$10mA \le I_{OUT} \le I_{MAX}$, $V_{OUT} \le 5V$ $10mA \le I_{OUT} \le I_{MAX}$, $V_{OUT} \ge 5V$	2 2		36 0.72		42 0.84		48 0.96		60 1.20	mV %
I_{ADJ}	Adjust Pin Current				100		100		100		100	µA
ΔI_{ADJ}	Adjust Pin Current Change	$10mA \le I_{OUT} \le I_{MAX}$			5		5		5		5	µA
		$3V \le (V_{IN} - V_{OUT}) \le 40V$, $I_{OUT} = 10mA$			5		5		5		5	µA
I_{MIN}	Minimum Load Current	$(V_{IN} - V_{OUT}) = 40V$			5		5		5		5	mA
	Current Limit	$(V_{IN} - V_{OUT}) \le 15V$ H Package K Package		0.5 1.5		0.5 1.5		0.5 1.5		0.5 1.5		A A
		$(V_{IN} - V_{OUT}) = 40V$ H Package K Package		0.15 0.30		0.15 0.30		0.15 0.30		0.15 0.30		A A

Note 1: Unless otherwise specified, these specifications apply for $V_{IN} - V_{OUT} = 5V$; and $I_{OUT} = 0.1A$ for the H package (TO-39) and $I_{OUT} = 0.5A$ for the K package (TO-3) package. Although power dissipation is internally limited, these specifications are applicable for power dissipations of 2W for the TO-39 and 20W for the TO-3. I_{MAX} is 0.5A for the TO-39 and 1.5A for the TO-3.

Note 2: Regulation is measured at a constant junction temperature using pulse testing with a low duty cycle. Changes in output voltage due to heating effects are covered under the specification for thermal regulation.

Note 3: Guaranteed by design, characterization or correlation to other tested parameters.

Note 4: $T_J = 25°C$ unless otherwise noted.