

Total Ionization Dose (TID) Test Results of the RH3083MK Adjustable 2.8A Single Resistor Low Dropout Regulator @ Low Dose Rate (LDR)

LDR = 10 mrads(Si)/s

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Duc Nguyen, Sana Rezgui

Acknowledgements

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TID LDR Testing of the RH3083MK Adjustable 2.8A Single Resistor Low Dropout Regulator

Part Type Tested: RH3083MK Adjustable 2.8A Single Resistor Low Dropout Regulator

Traceability Information: Fab Lot # HP201494.1; Wafer # 2. See photograph of unit under test in Appendix A.

Quantity of Units: 12 units received, 2 units for control, 5 units for biased irradiation, and 5 units for unbiased irradiation. Serial numbers 6-10 had all pins tied to ground during irradiation. Serial numbers 1-5 were biased during irradiation. Serial numbers 11 and 12 were used as control. See Appendix B for the radiation bias connection tables.

Radiation and Electrical Test Increments: Ionizing radiation with the following electrical test increments: 25 Krads(Si), 50 Krads(Si), 75 Krads(Si), 100 Krads(Si), 128 Krads(Si), 150 Krads(Si).

Radiation dose: 10 mrads(Si)/sec.

Radiation Test Standard: MIL-STD-883 TM1019.9 Condition D.

Test Hardware and Software: LTX pre-irradiation test program EFR3083R.00; LTX post-irradiation test program EFR3083R.00.

Facility and Radiation Source: Defense Micro Electronic Activity (DMEA) and Cobalt-60.

Irradiation and Test Temperature: Room temperature controlled to $24^{\circ}\text{C}\pm 6^{\circ}\text{C}$ per MIL-STD-883 and MIL-STD-750.

SUMMARY

ALL 12 PARTS PASSED THE ELECTRICAL TEST LIMITS AS SPECIFIED IN THE DATASHEET AFTER EACH IRRADIATION INCREMENT. ADDITIONAL INFORMATION CAN BE PROVIDED PER REQUEST.

1.0 Overview and Background

Among other radiation effects, Total Ionizing Dose (TID) may affect circuits' electrical characteristics, causing parametric and/or functional failures in integrated circuits. During gamma-irradiations, TID-induced and transported electron-hole pairs may result in charge trapping in the transistors' dielectrics and interface regions, affecting hence the devices' basic features. Such effects warrant testing and monitoring of circuits to TID, after which annealing and/or Time Dependent Effects (TDE) may take place, depending on the circuit's design and process technology. Hence is the requirement per Condition D (for low-dose rates ranging from less than or equal to 10 mrads(Si)/sec) in TM1019, MIL-STD-883 to not exceed the allowed time from the end of an incremented irradiation and an electrical test to more than one hour. Additionally, the total time from the end of one incremental irradiation to the start of the next incremental step should be less than two hours.

2.0 Radiation Facility and Test Equipment

The samples were irradiated at Defense Micro-Electronics Activity (DMEA) facility in Sacramento, California. DMEA utilizes J.L. Shepherd model 81-22/484 to provide the dose-rate of 10 mrads(Si)/s. A special design screw-driven automatic cart inside the exposure tunnel positions the Device-Under-Test (DUT) precisely and repeatedly from the source to attain optimal rate verified by ion chamber detectors. See Appendix C for the certificate of dosimetry.

3.0 Test Conditions

The 10 samples were placed in a lead/aluminum container and aligned with the radiation source, Cobalt-60, at DMEA facility in Sacramento, California. During irradiation, five units were biased at +3V and other five had all pads grounded. The devices were irradiated up to 150 Krad(Si) with increments of 25, 50, 75, 100, 128 Krads(Si). After each irradiation, the samples were transported in dry ice to Linear Technology testing facility. Testing was performed on the two control units to confirm the operation of the test system prior to the electrical testing of the 12 units (10 irradiated and 2 control).

The criteria to pass the low dose-rate test is that five samples irradiated under electrical bias 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 and if valid the lot will be scrapped.

4.0 Tested Parameters

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

- SET Pin Current (μA)
- Output Offset Voltage (mV)
- Load Regulation I_{SET} (nA)
- Load Regulation V_{OS} (mV)
- Line Regulation I_{SET} (nA/V)
- Line Regulation V_{OS} (mV/V)
- Minimum Load Current (mA) @ $V_{\text{IN}} = 1\text{V}$, $V_{\text{CONTROL}} = 2\text{V}$
- Minimum Load Current (mA) @ $V_{\text{IN}} = 23\text{V}$, $V_{\text{CONTROL}} = 25\text{V}$
- V_{CONTROL} Dropout Voltage (V) @ $V_{\text{IN}} = 1\text{V}$, $I_{\text{LOAD}} = 0.1\text{A}$
- V_{CONTROL} Dropout Voltage (V) @ $V_{\text{IN}} = 1\text{V}$, $I_{\text{LOAD}} = 1\text{A}$
- V_{CONTROL} Dropout Voltage (V) @ $V_{\text{IN}} = 1\text{V}$, $I_{\text{LOAD}} = 2.8\text{A}$
- V_{IN} Dropout Voltage (V) @ $V_{\text{CONTROL}} = 2\text{V}$, $I_{\text{LOAD}} = 0.1\text{A}$
- V_{IN} Dropout Voltage (V) @ $V_{\text{CONTROL}} = 2\text{V}$, $I_{\text{LOAD}} = 1\text{A}$
- V_{IN} Dropout Voltage (V) @ $V_{\text{CONTROL}} = 2\text{V}$, $I_{\text{LOAD}} = 2.8\text{A}$
- V_{CONTROL} Pin Current (mA) @ $V_{\text{IN}} = 1\text{V}$, $V_{\text{CONTROL}} = 2\text{V}$, $I_{\text{LOAD}} = 0.1\text{A}$
- V_{CONTROL} Pin Current (mA) @ $V_{\text{IN}} = 1\text{V}$, $V_{\text{CONTROL}} = 2\text{V}$, $I_{\text{LOAD}} = 1\text{A}$
- V_{CONTROL} Pin Current (mA) @ $V_{\text{IN}} = 1\text{V}$, $V_{\text{CONTROL}} = 2\text{V}$, $I_{\text{LOAD}} = 2.8\text{A}$
- Current Limit (A) @ $V_{\text{IN}} = 5\text{V}$, $V_{\text{CONTROL}} = 5\text{V}$, $V_{\text{OUT}} = -0.1\text{V}$

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

5.0 Test Results

All ten samples passed the post-irradiation electrical tests. All measurements of the 18 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 by adding to and subtracting from mean the product of standard deviation and the tolerance limit factor K_{TL} where K_{TL} is tabulated from a table of the inverse normal probability distribution. The upper tolerance limit $+K_{TL}$ and the lower tolerance limit $-K_{TL}$ are

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

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

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 $P_{s90\%/90\%}$ 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 dotted lines with diamond markers are the average of the measured data points of five samples irradiated under electrical bias while the dashed lines with X-markers are the average of measured data points of five units irradiated with all pins tied to ground. The solid lines with triangle markers are the average of the data points after the calculation of the K_{TL} statistics on the sample irradiated in the biased setup. The solid lines with square symbols are the average of the measured points after the application of the K_{TL} statistics on the five samples irradiated with all pins grounded. The orange solid lines with circle markers are the specification limits.

The 25 Krads(Si) test limits are using Linear Technology datasheet 20 Krads(Si) specification limits.

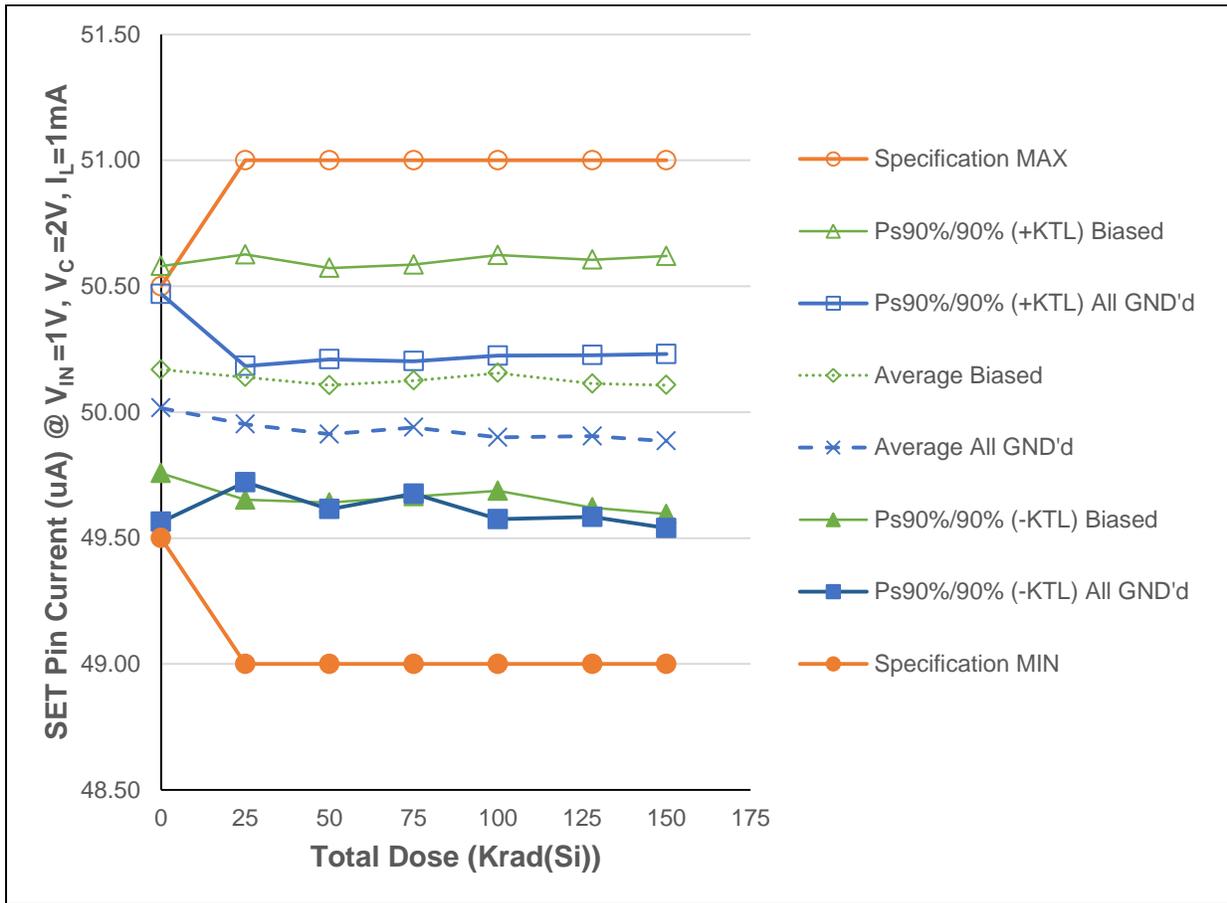


Figure 5.1 Plot of SET Pin Current versus Total Dose

The measured data of 10 samples are within datasheet specification limits. Note the pre-irradiation computed +KTL data point is slightly higher than the maximum limit due to the small 5-piece sample size.

Table 5.1: Raw data for SET Pin current versus total dose including the statistical calculations, minimum specification, maximum specification, and the status of the test (PASS/FAIL) under the orange headers)

Parameter	IS _{ET} @ V _{IN} = 1V, V _C = 2V, I _L = 1mA	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(uA)	0	25	50	75	100	128	150
6	All GND'd Irradiation	49.7925	49.8481	49.7573	49.8250	49.7384	49.7611	49.7410
7	All GND'd Irradiation	50.0863	50.0732	50.0493	50.0640	50.0413	50.0553	50.0384
8	All GND'd Irradiation	49.9738	49.9748	49.9524	49.9674	49.9482	49.9414	49.9349
9	All GND'd Irradiation	49.9879	49.9607	49.9366	49.9779	49.9449	49.9518	49.9426
10	All GND'd Irradiation	50.2430	49.9044	49.8664	49.8619	49.8254	49.8151	49.7692
1	Biased Irradiation	50.1162	49.9607	49.9736	49.9744	50.2435	49.9688	49.9667
2	Biased Irradiation	49.9545	49.9731	49.9172	49.9463	49.8941	49.9155	49.8948
3	Biased Irradiation	50.2078	50.1595	50.1197	50.1466	50.0909	50.1021	50.0914
4	Biased Irradiation	50.1990	50.2176	50.1778	50.2116	50.2103	50.2325	50.2370
5	Biased Irradiation	50.3661	50.3846	50.3448	50.3486	50.3382	50.3470	50.3478
11	Control Unit	50.2360	50.2440	50.2303	50.1062	50.2427	50.2476	50.2517
12	Control Unit	50.1286	50.0961	50.0897	50.0991	50.0908	50.1035	50.1018
All GND'd Irradiation Statistics								
	Average All GND'd	50.0167	49.9522	49.9124	49.9392	49.8996	49.9049	49.8852
	Std Dev All GND'd	0.1651	0.0842	0.1085	0.0960	0.1183	0.1172	0.1260
	Ps90%/90% (+KTL) All GND'd	50.4693	50.1831	50.2099	50.2025	50.2241	50.2262	50.2307
	Ps90%/90% (-KTL) All GND'd	49.5641	49.7214	49.6148	49.6760	49.5752	49.5837	49.5397
Biased-Irradiation Statistics								
	Average Biased	50.1687	50.1391	50.1066	50.1255	50.1554	50.1132	50.1075
	Std Dev Biased	0.1500	0.1777	0.1699	0.1678	0.1708	0.1796	0.1869
	Ps90%/90% (+KTL) Biased	50.5801	50.6262	50.5726	50.5855	50.6237	50.6055	50.6201
	Ps90%/90% (-KTL) Biased	49.7573	49.6520	49.6406	49.6655	49.6871	49.6208	49.5949
	Specification MIN	49.5	49.0	49.0		49.0		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Specification MAX	50.5	51.0	51.0		51.0		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased	PASS	PASS	PASS		PASS		
	Status (+KTL) Biased	FAIL	PASS	PASS		PASS		

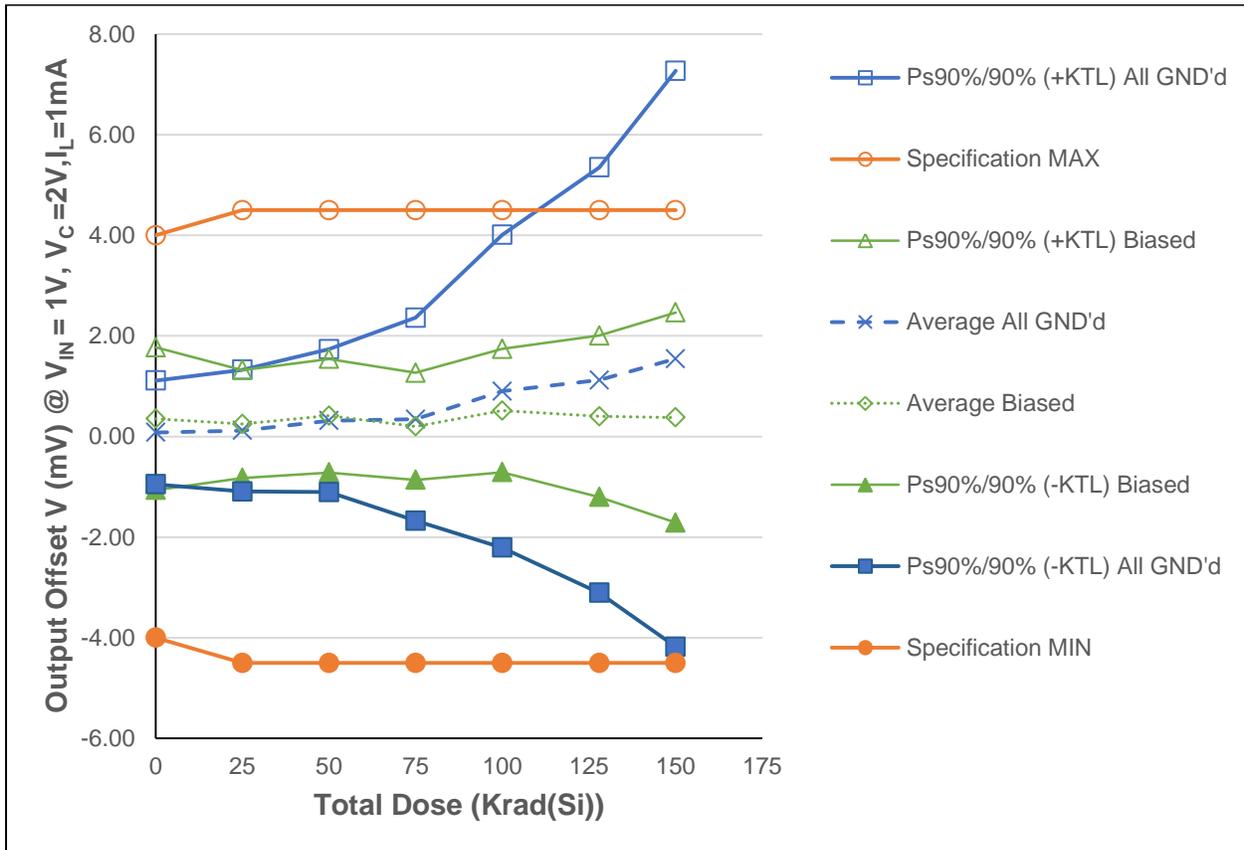


Figure 5.2: Plot of Output Offset Voltage versus Total Dose

The measured values of 10 samples are within datasheet specification limits. The +KTL All GND'd computed data points at 128 and 150 Krads(Si) are higher than the maximum specification limit due to the small 5-piece sample size.

Table 5.2: Raw data for output offset voltage versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL under the second orange header)

Parameter	VOS @ $V_{IN} = 1V, V_C = 2V, I_L = 1mA$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(mV)	0	25	50	75	100	128	150
6	All GND'd Irradiation	-0.4226	-0.6016	-0.4595	-0.6154	-0.3170	-0.3944	-0.3829
7	All GND'd Irradiation	0.0213	0.2596	0.7541	1.2556	2.5209	3.3617	4.5978
8	All GND'd Irradiation	0.5932	0.5136	0.6601	0.5332	0.8648	0.8742	0.9982
9	All GND'd Irradiation	-0.0423	0.0260	0.0239	-0.1592	0.0211	-0.1204	-0.1446
10	All GND'd Irradiation	0.2572	0.3924	0.5929	0.7016	1.4121	1.8887	2.6578
1	Biased Irradiation	-0.5588	-0.4355	-0.2989	-0.4318	-0.0097	-0.2064	-0.1589
2	Biased Irradiation	0.6675	0.5062	0.7138	0.4510	0.6950	0.5819	0.5440
3	Biased Irradiation	0.5152	0.4830	0.6552	0.4078	1.0733	1.2094	1.4539
4	Biased Irradiation	0.4733	0.2987	0.4262	0.0939	0.1298	-0.1370	-0.5235
5	Biased Irradiation	0.6687	0.3883	0.5638	0.4909	0.6877	0.5575	0.5694
11	Control Unit	-0.2918	-0.2357	-0.2202	-0.2257	-0.0051	-0.0709	-0.0596
12	Control Unit	-0.2031	-0.0319	-0.0297	-0.0932	0.0571	-0.0144	0.0148
All GND'd Irradiation Statistics								
	Average All GND'd	0.0814	0.1180	0.3143	0.3432	0.9004	1.1220	1.5453
	Std Dev All GND'd	0.3761	0.4411	0.5181	0.7363	1.1341	1.5418	2.0874
	Ps90%/90% (+KTL) All GND'd	1.1126	1.3275	1.7349	2.3620	4.0100	5.3495	7.2688
	Ps90%/90% (-KTL) All GND'd	-0.9499	-1.0914	-1.1063	-1.6757	-2.2093	-3.1056	-4.1783
Biased-Irradiation Statistics								
	Average Biased	0.3532	0.2481	0.4120	0.2024	0.5152	0.4011	0.3770
	Std Dev Biased	0.5174	0.3909	0.4120	0.3877	0.4465	0.5850	0.7620
	Ps90%/90% (+KTL) Biased	1.7719	1.3200	1.5416	1.2654	1.7396	2.0052	2.4664
	Ps90%/90% (-KTL) Biased	-1.0655	-0.8238	-0.7176	-0.8606	-0.7092	-1.2031	-1.7125
	Specification MIN	-4.0	-4.5	-4.5		-4.5		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Specification MAX	4.0	4.5	4.5		4.5		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased	PASS	PASS	PASS		PASS		
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

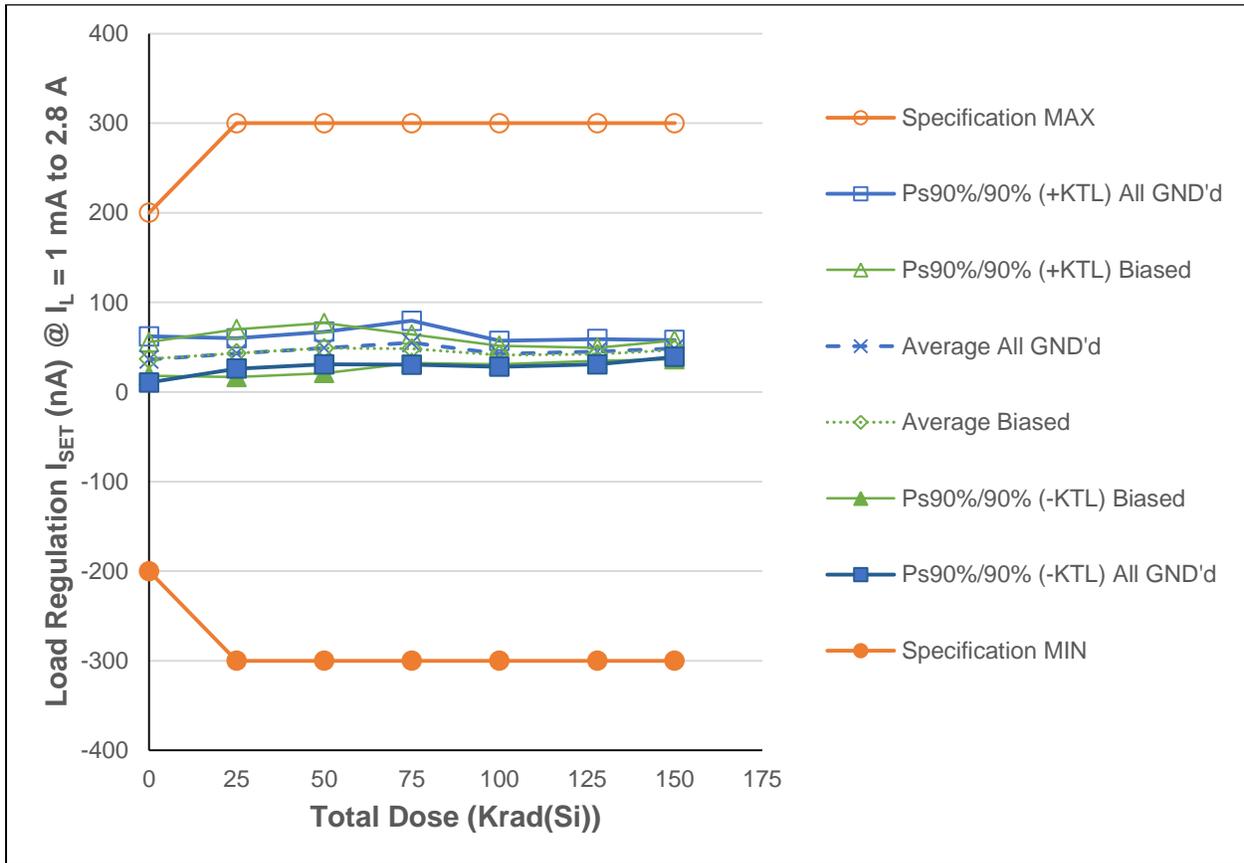


Figure 5.3: Plot of Load Regulation I_{SET} versus Total Dose

All measured post-irradiation data points are within the datasheet specification limits.

Table 5.3: Raw data for load regulation I_{SET} versus total dose including the statistical calculations, minimum specification, maximum specification, and the status of the test (PASS/FAIL).

Parameter	Load Reg. I_{SET} @ $I_L = 1$ mA to 2.8A	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(nA)	0	25	50	75	100	128	150
6	All GND'd Irradiation	34.9101	49.6075	58.4405	64.7560	44.0778	52.2414	46.1878
7	All GND'd Irradiation	50.9754	47.1773	52.0959	63.7519	51.2082	44.0050	50.4660
8	All GND'd Irradiation	33.4403	41.0946	46.9590	45.3001	39.0428	37.7768	46.5079
9	All GND'd Irradiation	25.0293	33.6149	40.7890	47.9486	40.3088	44.6744	45.9550
10	All GND'd Irradiation	36.8164	43.6266	46.7844	52.8671	38.3298	46.0277	53.7111
1	Biased Irradiation	41.8077	49.9131	48.7053	53.6820	34.8373	40.3525	42.3170
2	Biased Irradiation	42.1715	56.0249	41.7786	39.6103	43.2046	40.4980	43.4666
3	Biased Irradiation	40.0760	34.9246	36.2779	53.2164	44.7035	45.8967	50.8735
4	Biased Irradiation	34.4007	42.4043	58.6006	46.1150	41.1965	44.0341	49.5202
5	Biased Irradiation	26.0188	33.1784	59.5319	49.1418	41.9532	39.7558	49.0400
11	Control Unit	46.3187	38.9846	35.0992	36.0305	29.3367	33.2657	31.7668
12	Control Unit	31.2284	36.5690	34.5171	37.2675	32.1888	28.3326	26.9210
All GND'd Irradiation Statistics								
	Average All GND'd	36.2343	43.0242	49.0138	54.9247	42.5935	44.9450	48.5656
	Std Dev All GND'd	9.3908	6.1889	6.6182	8.9458	5.3015	5.1660	3.4202
	Ps90%/90% (+KTL) All GND'd	61.9839	59.9941	67.1608	79.4541	57.1301	59.1102	57.9438
	Ps90%/90% (-KTL) All GND'd	10.4846	26.0543	30.8667	30.3954	28.0568	30.7799	39.1873
Biased-Irradiation Statistics								
	Average Biased	36.8949	43.2890	48.9788	48.3531	41.1790	42.1074	47.0434
	Std Dev Biased	6.8302	9.7346	10.2125	5.7904	3.7862	2.7051	3.8705
	Ps90%/90% (+KTL) Biased	55.6233	69.9814	76.9814	64.2304	51.5609	49.5249	57.6564
	Ps90%/90% (-KTL) Biased	18.1665	16.5967	20.9763	32.4758	30.7972	34.6899	36.4305
	Specification MIN	-200	-300	-300		-300		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Specification MAX	200	300	300		300		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased	PASS	PASS	PASS		PASS		
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

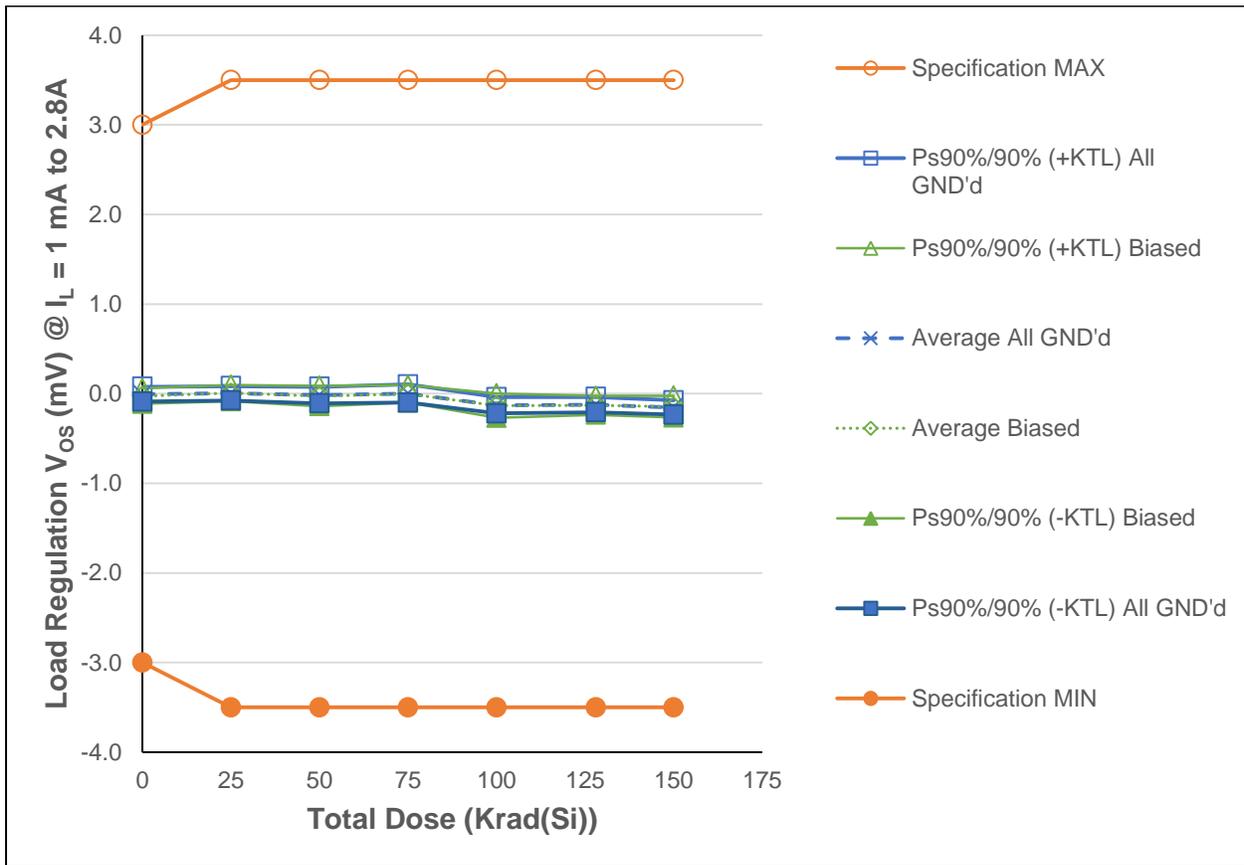


Figure 5.4: Plot of Load Regulation V_{OS} versus Total Dose

All measured post-irradiation data points are within datasheet specification limits.

Table 5.4: Raw data for load regulation V_{OS} versus total dose including the statistical calculations, minimum specification, maximum specification, and the status of the test (PASS/FAIL).

Parameter	Load Reg. V_{OS} @ $I_L = 1mA$ to 2.8A	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(mV)	0	25	50	75	100	128	150
6	All GND'd Irradiation	-0.0202	0.0094	-0.0145	0.0086	-0.1213	-0.1220	-0.1384
7	All GND'd Irradiation	-0.0293	-0.0118	-0.0396	-0.0158	-0.1492	-0.1315	-0.1952
8	All GND'd Irradiation	-0.0296	-0.0148	-0.0360	-0.0103	-0.1392	-0.1428	-0.1552
9	All GND'd Irradiation	0.0379	0.0517	0.0418	0.0631	-0.0749	-0.0682	-0.1175
10	All GND'd Irradiation	0.0128	-0.0180	-0.0306	-0.0322	-0.1591	-0.1442	-0.1652
1	Biased Irradiation	0.0118	0.0410	0.0386	0.0489	-0.0617	-0.0785	-0.0774
2	Biased Irradiation	-0.0207	0.0147	-0.0253	0.0027	-0.1326	-0.1206	-0.1321
3	Biased Irradiation	-0.0640	-0.0378	-0.0668	-0.0458	-0.1971	-0.1837	-0.1942
4	Biased Irradiation	-0.0527	-0.0166	-0.0573	-0.0207	-0.1535	-0.1436	-0.1714
5	Biased Irradiation	-0.0040	0.0330	-0.0190	0.0114	-0.1191	-0.1192	-0.1461
11	Control Unit	0.0018	0.0157	0.0152	0.0435	-0.0715	-0.0626	-0.0668
12	Control Unit	0.0003	0.0135	0.0088	0.0266	-0.0619	-0.0427	-0.0577
All GND'd Irradiation Statistics								
	Average All GND'd	-0.0057	0.0033	-0.0158	0.0027	-0.1287	-0.1218	-0.1543
	Std Dev All GND'd	0.0299	0.0291	0.0336	0.0368	0.0332	0.0313	0.0291
	Ps90%/90% (+KTL) All GND'd	0.0764	0.0831	0.0764	0.1036	-0.0377	-0.0360	-0.0744
	Ps90%/90% (-KTL) All GND'd	-0.0877	-0.0765	-0.1079	-0.0982	-0.2198	-0.2075	-0.2342
Biased-Irradiation Statistics								
	Average Biased	-0.0259	0.0068	-0.0260	-0.0007	-0.1328	-0.1291	-0.1442
	Std Dev Biased	0.0320	0.0334	0.0414	0.0355	0.0495	0.0385	0.0443
	Ps90%/90% (+KTL) Biased	0.0618	0.0984	0.0877	0.0967	0.0030	-0.0236	-0.0228
	Ps90%/90% (-KTL) Biased	-0.1137	-0.0847	-0.1396	-0.0981	-0.2685	-0.2346	-0.2657
	Specification MIN	-3.0	-3.5	-3.5		-3.5		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Specification MAX	3.0	3.5	3.5		3.5		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased	PASS	PASS	PASS		PASS		
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

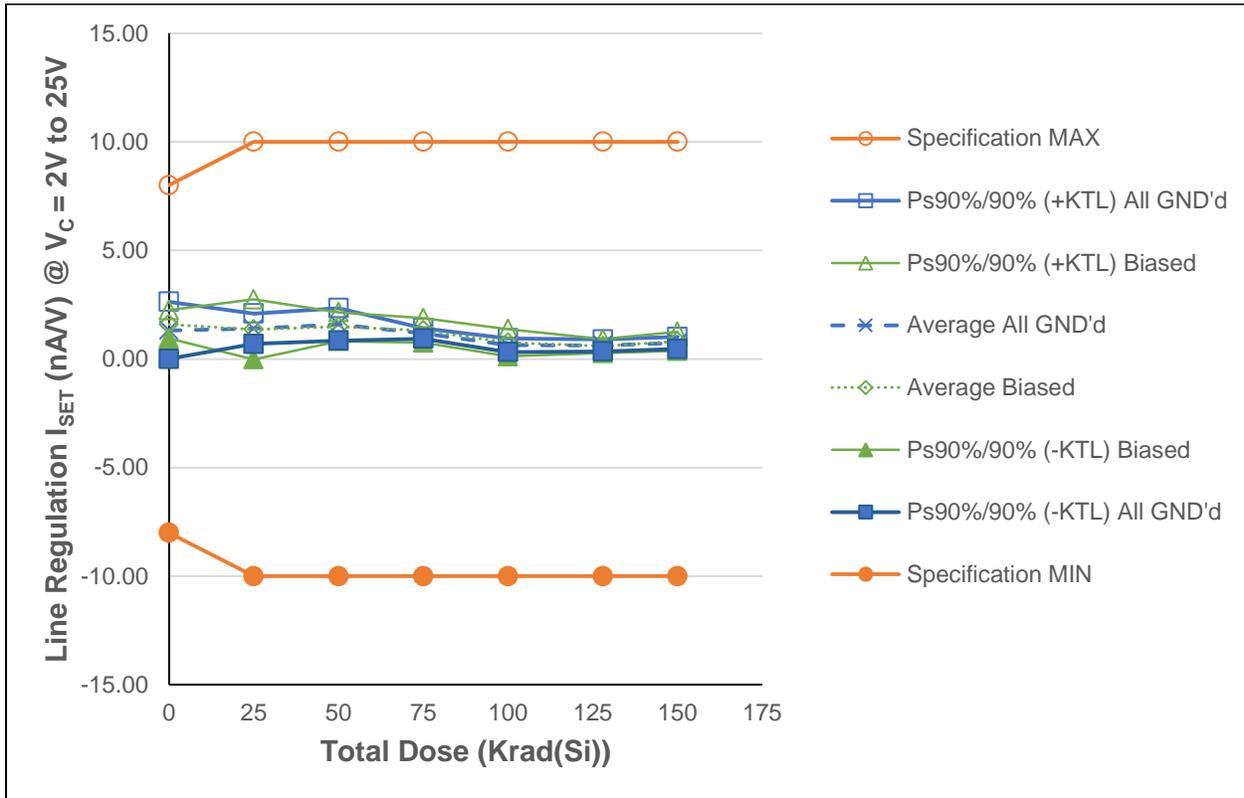


Figure 5.5: Plot of Line Regulation I_{SET} versus Total Dose

The measured parameters are over the specification minimum limits.

Table 5.5: Raw data for line regulation I_{SET} versus total dose including the statistical calculations, minimum specification, maximum specification, and the status of the test (PASS/FAIL)

Parameter	Line Reg. I_{SET} @ $V_C = 2V$ to $25V$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
		0	25	50	75	100	128	150
Units	(nAV)							
6	All GND'd Irradiation	0.6118	1.1490	1.3014	1.1471	0.7023	0.7206	0.7301
7	All GND'd Irradiation	1.1477	1.4539	1.6836	1.1458	0.4808	0.4606	0.6441
8	All GND'd Irradiation	1.7595	1.7601	1.8367	1.2989	0.6896	0.6801	0.8541
9	All GND'd Irradiation	1.7608	1.1477	1.8361	1.2224	0.5473	0.6131	0.6276
10	All GND'd Irradiation	1.3008	1.4539	1.3014	1.0692	0.7523	0.6390	0.8244
1	Biased Irradiation	1.6070	0.5353	1.6083	1.2217	1.1116	0.5239	0.6257
2	Biased Irradiation	1.2249	1.6836	1.5975	1.5280	0.5802	0.5909	0.8605
3	Biased Irradiation	1.5305	1.8373	1.7595	1.0686	0.5327	0.4872	0.6523
4	Biased Irradiation	1.7601	1.3774	1.2249	1.5280	0.7845	0.7864	0.9661
5	Biased Irradiation	1.8373	1.3780	1.2249	1.2217	0.7308	0.5625	0.9440
11	Control Unit	1.6070	1.5311	1.6741	1.6804	1.0863	0.8257	1.3653
12	Control Unit	1.4546	1.2243	2.0664	1.7564	0.9604	0.9092	1.1534
All GND'd Irradiation Statistics								
	Average All GND'd	1.3161	1.3929	1.5919	1.1767	0.6345	0.6227	0.7361
	Std Dev All GND'd	0.4793	0.2559	0.2723	0.0872	0.1148	0.0994	0.1025
	Ps90%/90% (+KTL) All GND'd	2.6304	2.0946	2.3386	1.4157	0.9493	0.8953	1.0170
	Ps90%/90% (-KTL) All GND'd	0.0018	0.6913	0.8451	0.9376	0.3197	0.3501	0.4551
Biased-Irradiation Statistics								
	Average Biased	1.5920	1.3623	1.4830	1.3136	0.7480	0.5902	0.8097
	Std Dev Biased	0.2384	0.5033	0.2442	0.2054	0.2282	0.1165	0.1610
	Ps90%/90% (+KTL) Biased	2.2455	2.7424	2.1526	1.8769	1.3738	0.9096	1.2512
	Ps90%/90% (-KTL) Biased	0.9384	-0.0178	0.8135	0.7503	0.1221	0.2707	0.3682
	Specification MIN	-8	-10	-10		-10		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Specification MAX	8	10	10		10		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased	PASS	PASS	PASS		PASS		
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

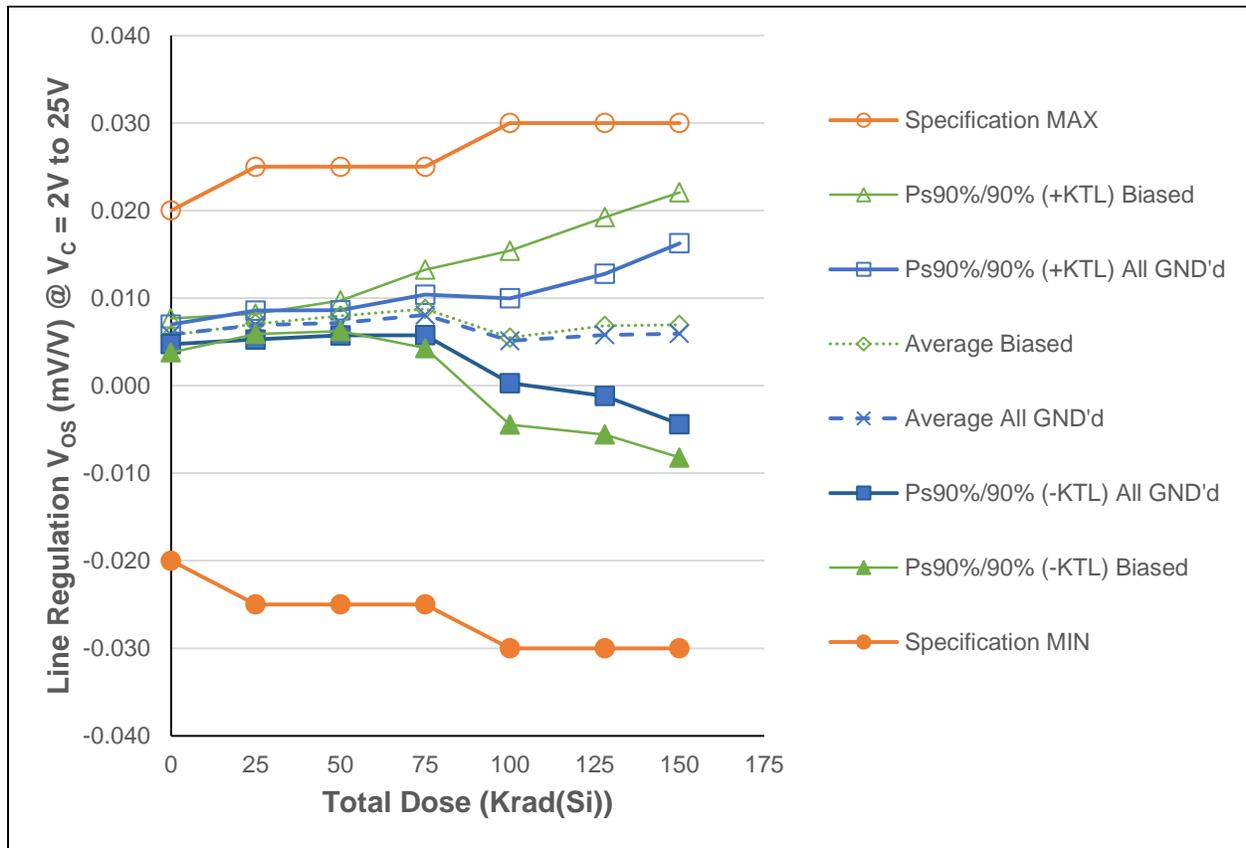


Figure 5.6: Plot of Line Regulation V_{OS} versus Total Dose

The data of five samples are within the datasheet specification limits.

Table 5.6: Raw data for line regulation V_{OS} versus total dose including the statistical calculations, minimum specification, maximum specification, and the status of the test (PASS/FAIL)

Parameter	Line Reg. V_{OS} @ $V_C = 2V$ to $25V$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
		0	25	50	75	100	128	150
Units	(mV/V)							
6	All GND'd Irradiation	0.0054	0.0062	0.0066	0.0077	0.0047	0.0058	0.0047
7	All GND'd Irradiation	0.0058	0.0076	0.0077	0.0091	0.0073	0.0077	0.0100
8	All GND'd Irradiation	0.0058	0.0073	0.0077	0.0088	0.0063	0.0081	0.0091
9	All GND'd Irradiation	0.0057	0.0072	0.0068	0.0073	0.0027	0.0017	0.0006
10	All GND'd Irradiation	0.0065	0.0063	0.0070	0.0074	0.0045	0.0056	0.0053
1	Biased Irradiation	0.0065	0.0075	0.0079	0.0092	0.0035	0.0078	0.0072
2	Biased Irradiation	0.0056	0.0066	0.0072	0.0074	0.0031	0.0025	0.0015
3	Biased Irradiation	0.0049	0.0069	0.0089	0.0113	0.0118	0.0139	0.0159
4	Biased Irradiation	0.0065	0.0075	0.0081	0.0086	0.0053	0.0067	0.0068
5	Biased Irradiation	0.0053	0.0067	0.0078	0.0073	0.0037	0.0033	0.0033
11	Control Unit	0.0065	0.0066	0.0068	0.0063	0.0038	0.0043	0.0040
12	Control Unit	0.0064	0.0062	0.0060	0.0062	0.0029	0.0030	0.0036
All GND'd Irradiation Statistics								
	Average All GND'd	0.0059	0.0069	0.0072	0.0081	0.0051	0.0058	0.0059
	Std Dev All GND'd	0.0004	0.0006	0.0005	0.0008	0.0018	0.0025	0.0038
	Ps90%/90% (+KTL) All GND'd	0.0070	0.0086	0.0086	0.0104	0.0100	0.0128	0.0163
	Ps90%/90% (-KTL) All GND'd	0.0047	0.0053	0.0057	0.0058	0.0003	-0.0012	-0.0044
Biased-Irradiation Statistics								
	Average Biased	0.0057	0.0071	0.0080	0.0088	0.0055	0.0068	0.0069
	Std Dev Biased	0.0007	0.0004	0.0006	0.0016	0.0036	0.0045	0.0055
	Ps90%/90% (+KTL) Biased	0.0077	0.0082	0.0097	0.0132	0.0154	0.0192	0.0221
	Ps90%/90% (-KTL) Biased	0.0038	0.0059	0.0062	0.0043	-0.0045	-0.0056	-0.0082
	Specification MIN	-0.020	-0.025	-0.025		-0.030		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Specification MAX	0.020	0.025	0.025		0.030		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased	PASS	PASS	PASS		PASS		
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

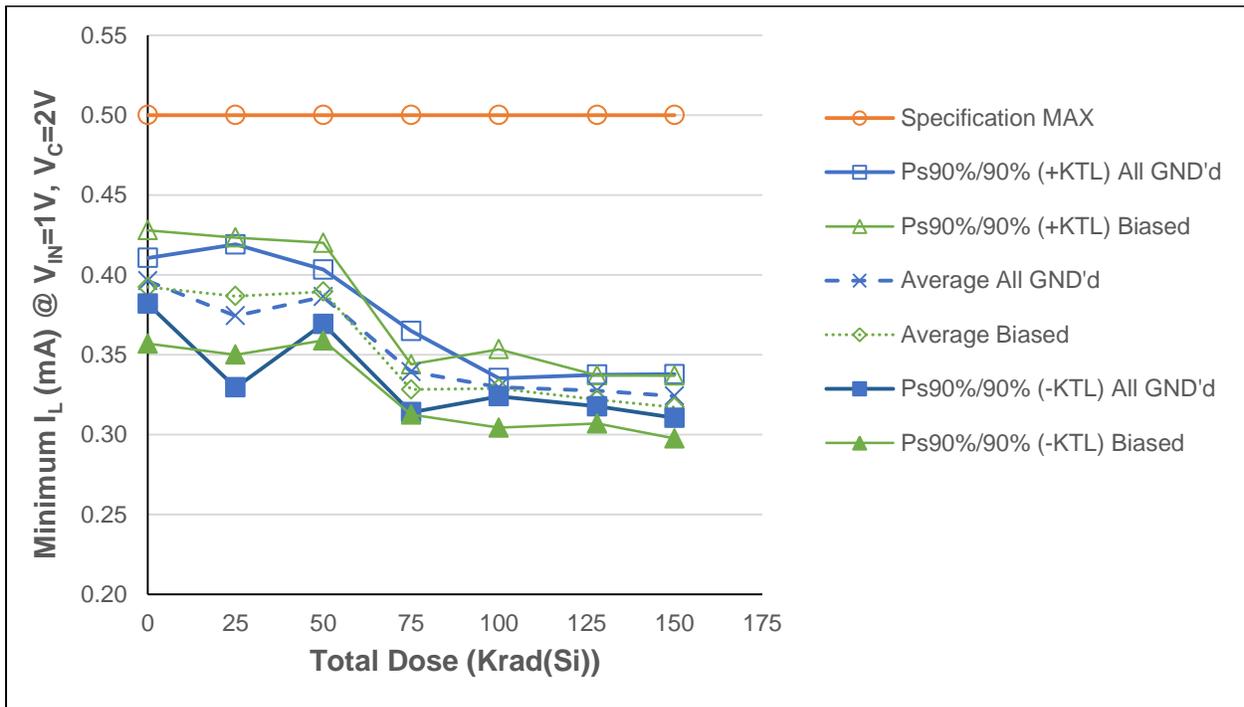


Figure 5.7: Plot of Minimum Load Current I_L (@ $V_{CONTROL} = 2V$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.7: Raw data table for minimum load current (at $V_{CONTROL} = 2V$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	Min I_L @ $V_{IN}=1V, V_C=2V$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
		0	25	50	75	100	128	150
Units	(mA)							
6	All GND'd Irradiation	0.3966	0.3600	0.3839	0.3368	0.3292	0.3281	0.3247
7	All GND'd Irradiation	0.3906	0.3988	0.3839	0.3440	0.3276	0.3242	0.3199
8	All GND'd Irradiation	0.4014	0.3701	0.3785	0.3422	0.3324	0.3324	0.3313
9	All GND'd Irradiation	0.3912	0.3606	0.3940	0.3493	0.3279	0.3239	0.3191
10	All GND'd Irradiation	0.4014	0.3820	0.3911	0.3249	0.3311	0.3293	0.3260
1	Biased Irradiation	0.3823	0.3820	0.3761	0.3249	0.3418	0.3240	0.3191
2	Biased Irradiation	0.3912	0.3659	0.3976	0.3279	0.3260	0.3227	0.3186
3	Biased Irradiation	0.4055	0.3898	0.3785	0.3207	0.3170	0.3124	0.3049
4	Biased Irradiation	0.4055	0.3988	0.3976	0.3333	0.3308	0.3260	0.3237
5	Biased Irradiation	0.3775	0.3970	0.3976	0.3344	0.3287	0.3250	0.3198
11	Control Unit	0.3745	0.3850	0.3696	0.3660	0.3416	0.3419	0.3418
12	Control Unit	0.3823	0.3803	0.3887	0.3607	0.3419	0.3416	0.3418
All GND'd Irradiation Statistics								
	Average All GND'd	0.3962	0.3743	0.3863	0.3394	0.3296	0.3276	0.3242
	Std Dev All GND'd	0.0052	0.0163	0.0062	0.0093	0.0021	0.0036	0.0050
	Ps90%/90% (+KTL) All GND'd	0.4106	0.4191	0.4033	0.3649	0.3353	0.3375	0.3378
	Ps90%/90% (-KTL) All GND'd	0.3819	0.3295	0.3692	0.3140	0.3239	0.3177	0.3106
Biased-Irradiation Statistics								
	Average Biased	0.3924	0.3867	0.3895	0.3283	0.3289	0.3220	0.3173
	Std Dev Biased	0.0130	0.0134	0.0111	0.0057	0.0090	0.0055	0.0072
	Ps90%/90% (+KTL) Biased	0.4280	0.4233	0.4201	0.3440	0.3535	0.3371	0.3369
	Ps90%/90% (-KTL) Biased	0.3569	0.3501	0.3590	0.3125	0.3043	0.3069	0.2976
Specification MIN								
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
Specification MAX								
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
Status (-KTL) All GND'd								
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
Status (-KTL) Biased								
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

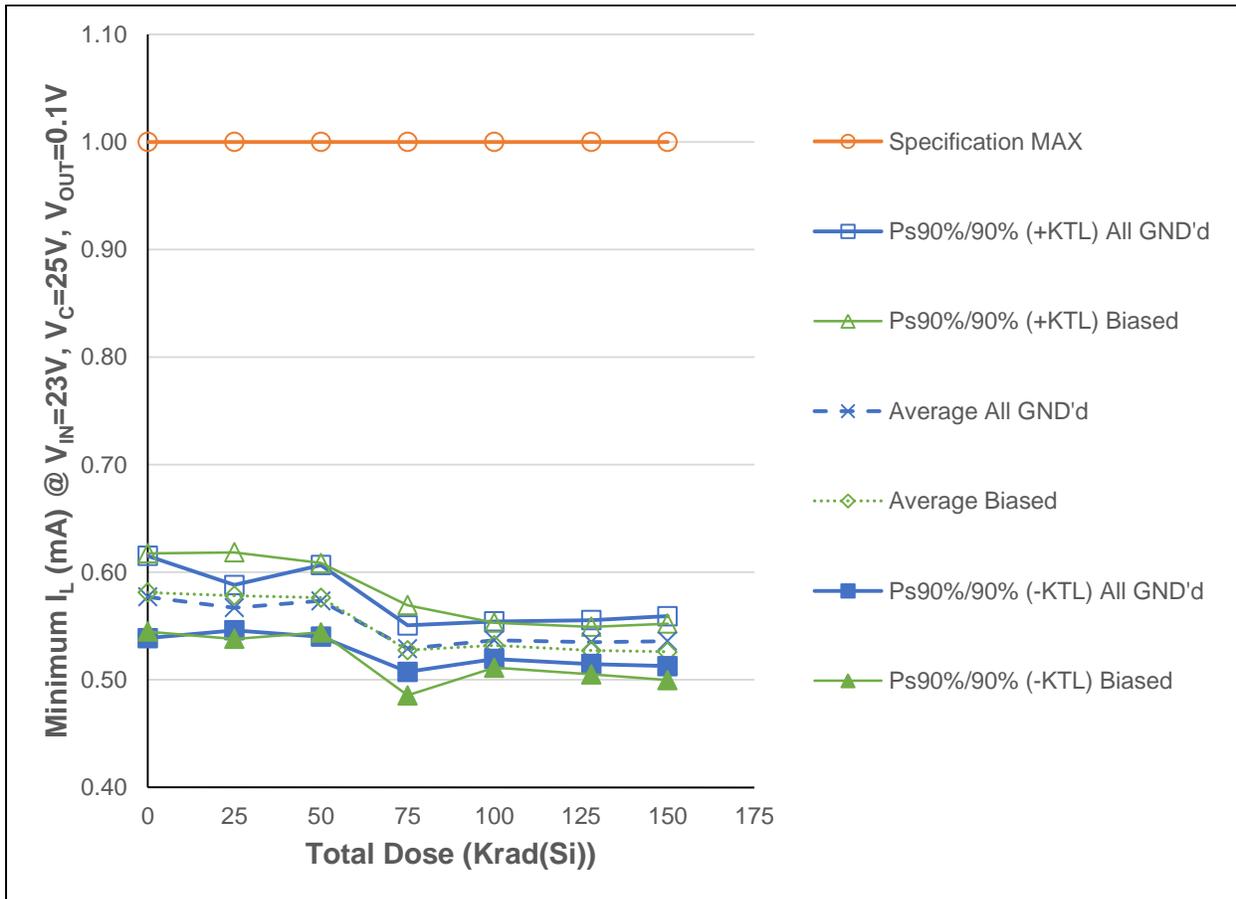


Figure 5.8: Plot of Minimum Load Current I_L (@ $V_{CONTROL} = 25V$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.8: Raw data table for minimum load current (at $V_{CONTROL} = 25V$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	Min I_L @ $V_{IN}=23V, V_C=25V, V_{OUT}=1V$	Total Dose (Krad(Si)) @ 10 mrad(Si)/second						
Units	(mA)	0	25	50	75	100	128	150
6	All GND'd Irradiation	0.5540	0.5604	0.5550	0.5209	0.5287	0.5265	0.5280
7	All GND'd Irradiation	0.5820	0.5783	0.5746	0.5346	0.5391	0.5375	0.5380
8	All GND'd Irradiation	0.5916	0.5616	0.5841	0.5382	0.5448	0.5447	0.5468
9	All GND'd Irradiation	0.5802	0.5633	0.5692	0.5305	0.5322	0.5288	0.5268
10	All GND'd Irradiation	0.5772	0.5717	0.5841	0.5209	0.5394	0.5382	0.5401
1	Biased Irradiation	0.5874	0.5759	0.5794	0.5221	0.5355	0.5254	0.5251
2	Biased Irradiation	0.5642	0.5538	0.5746	0.5346	0.5278	0.5255	0.5235
3	Biased Irradiation	0.5707	0.5896	0.5603	0.5090	0.5215	0.5156	0.5119
4	Biased Irradiation	0.5963	0.5842	0.5931	0.5221	0.5347	0.5327	0.5332
5	Biased Irradiation	0.5874	0.5878	0.5746	0.5495	0.5412	0.5367	0.5365
11	Control Unit	0.5683	0.5783	0.5626	0.5209	0.5349	0.5343	0.5346
12	Control Unit	0.5749	0.5896	0.5925	0.5328	0.5353	0.5323	0.5340
All GND'd Irradiation Statistics								
	Average All GND'd	0.5770	0.5670	0.5734	0.5290	0.5368	0.5351	0.5359
	Std Dev All GND'd	0.0139	0.0077	0.0121	0.0079	0.0064	0.0074	0.0085
	Ps90%/90% (+KTL) All GND'd	0.6152	0.5881	0.6067	0.5507	0.5543	0.5555	0.5592
	Ps90%/90% (-KTL) All GND'd	0.5388	0.5460	0.5401	0.5074	0.5193	0.5148	0.5127
Biased-Irradiation Statistics								
	Average Biased	0.5812	0.5783	0.5764	0.5275	0.5321	0.5272	0.5260
	Std Dev Biased	0.0133	0.0147	0.0118	0.0153	0.0076	0.0081	0.0096
	Ps90%/90% (+KTL) Biased	0.6177	0.6185	0.6086	0.5694	0.5531	0.5493	0.5523
	Ps90%/90% (-KTL) Biased	0.5448	0.5381	0.5441	0.4855	0.5112	0.5051	0.4998
Specification MIN								
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
Specification MAX								
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

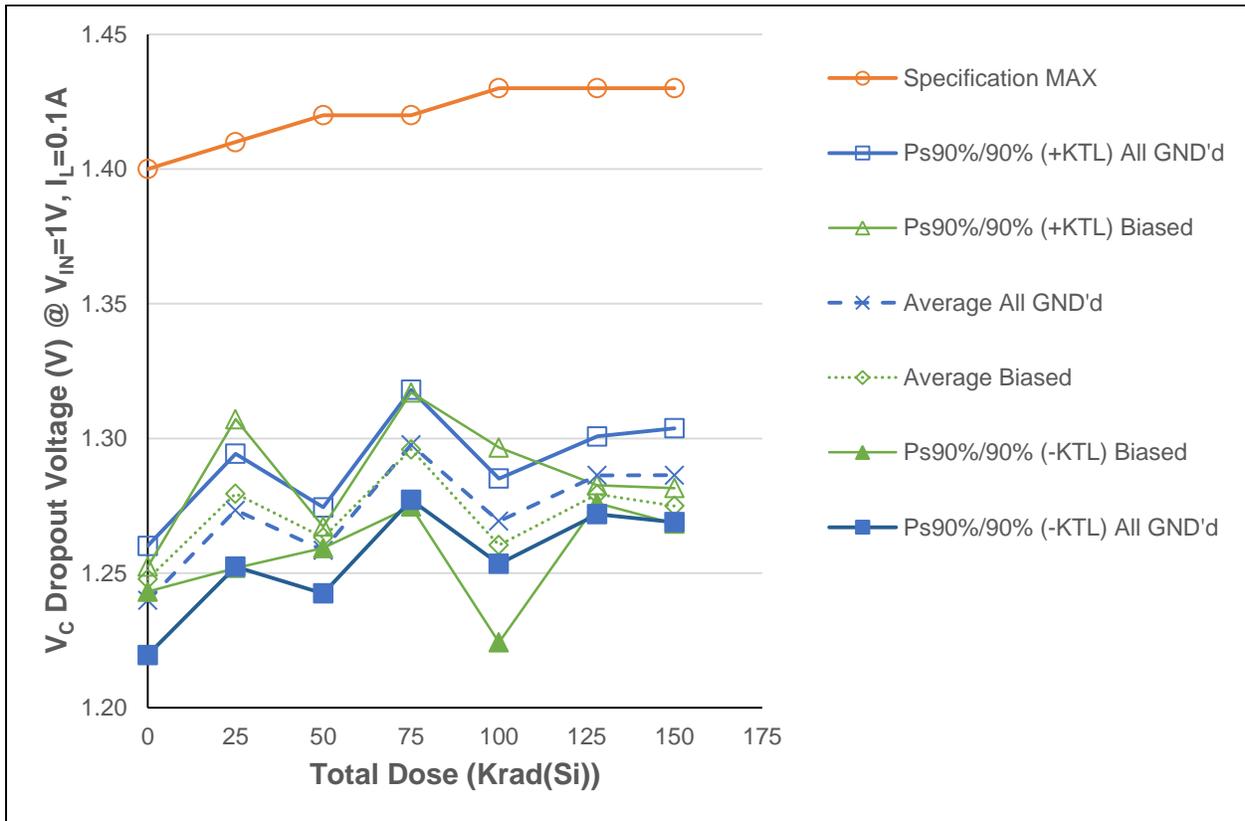


Figure 5.9: Plot of $V_{CONTROL}$ Dropout Voltage (@ $I_{LOAD} = 0.1A$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.9: Raw data table for V_{CONTROL} Dropout Voltage (@ $I_{\text{LOAD}} = 0.1\text{A}$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_C Dropout @ $V_{\text{IN}} = 1\text{V}, I_L = 0.1\text{A}$	Total Dose (Krad(Si)) @ 10 mrad(Si)/second						
Units	(V)	0	25	50	75	100	128	150
6	All GND'd Irradiation	1.2467	1.2862	1.2611	1.3057	1.2712	1.2886	1.2878
7	All GND'd Irradiation	1.2313	1.2694	1.2509	1.2878	1.2624	1.2820	1.2790
8	All GND'd Irradiation	1.2342	1.2729	1.2537	1.2939	1.2639	1.2794	1.2807
9	All GND'd Irradiation	1.2480	1.2661	1.2646	1.3043	1.2746	1.2902	1.2903
10	All GND'd Irradiation	1.2389	1.2721	1.2618	1.2963	1.2743	1.2913	1.2940
1	Biased Irradiation	1.2491	1.2617	1.2626	1.2936	1.2370	1.2782	1.2729
2	Biased Irradiation	1.2472	1.2836	1.2617	1.2964	1.2667	1.2807	1.2779
3	Biased Irradiation	1.2485	1.2826	1.2656	1.3089	1.2673	1.2804	1.2770
4	Biased Irradiation	1.2489	1.2866	1.2634	1.2900	1.2675	1.2786	1.2743
5	Biased Irradiation	1.2450	1.2829	1.2630	1.2905	1.2636	1.2784	1.2726
11	Control Unit	1.2340	1.2387	1.2331	1.2704	1.2369	1.2509	1.2409
12	Control Unit	1.2355	1.2362	1.2327	1.2477	1.2379	1.2523	1.2442
All GND'd Irradiation Statistics								
	Average All GND'd	1.2398	1.2733	1.2584	1.2976	1.2693	1.2863	1.2863
	Std Dev All GND'd	0.0074	0.0077	0.0058	0.0074	0.0058	0.0053	0.0064
	Ps90%/90% (+KTL) All GND'd	1.2601	1.2943	1.2744	1.3180	1.2851	1.3007	1.3038
	Ps90%/90% (-KTL) All GND'd	1.2196	1.2524	1.2425	1.2772	1.2534	1.2718	1.2689
Biased-Irradiation Statistics								
	Average Biased	1.2477	1.2795	1.2632	1.2959	1.2604	1.2793	1.2749
	Std Dev Biased	0.0017	0.0101	0.0015	0.0077	0.0132	0.0012	0.0024
	Ps90%/90% (+KTL) Biased	1.2524	1.3071	1.2672	1.3170	1.2966	1.2826	1.2816
	Ps90%/90% (-KTL) Biased	1.2431	1.2519	1.2593	1.2747	1.2242	1.2759	1.2683
	Specification MIN							
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
	Specification MAX	1.40	1.41	1.42		1.43		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

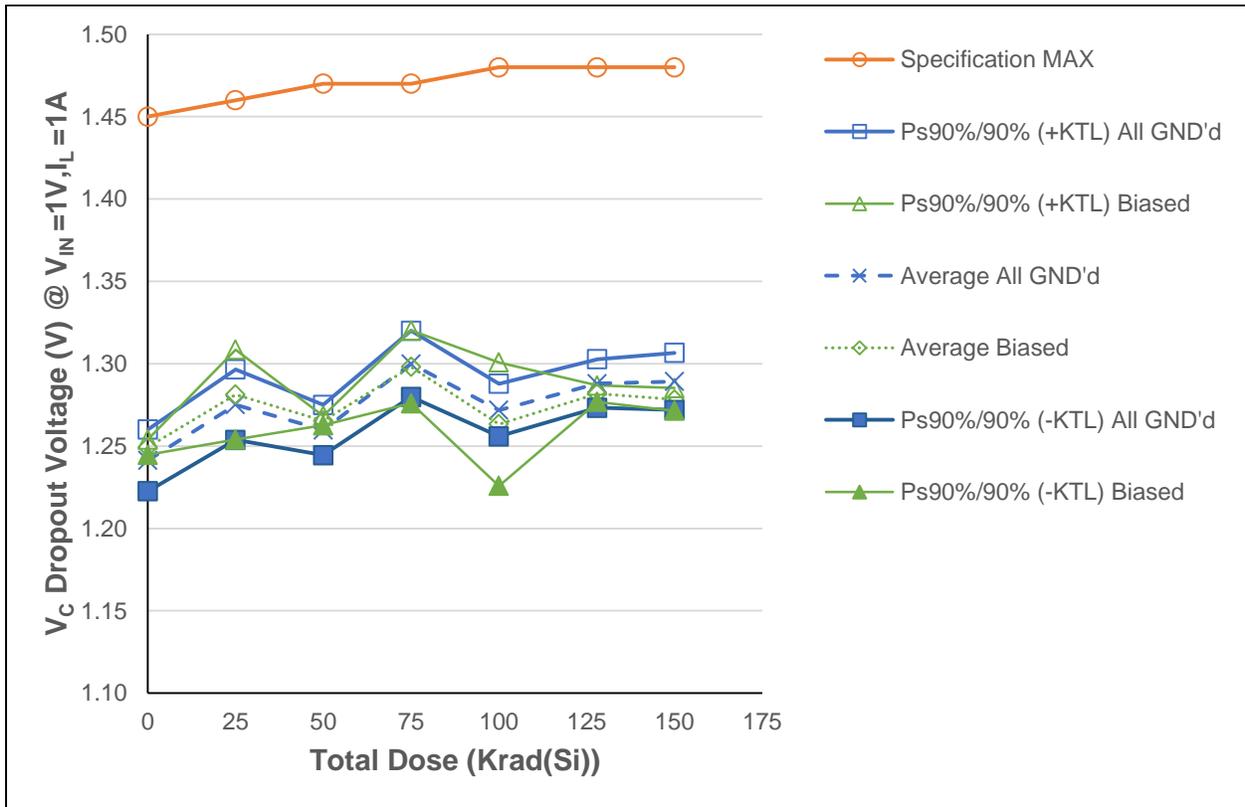


Figure 5.10: Plot of $V_{CONTROL}$ Dropout Voltage (@ $I_{LOAD} = 1A$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.10: Raw data table for V_{CONTROL} Dropout Voltage (@ $I_{\text{LOAD}} = 1\text{A}$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	Dropout V_C @ $V_{\text{IN}} = 1\text{V}, I_L = 1\text{A}$	Total Dose (Krad(Si)) @ 10 mrad(Si)/second						
Units	(V)	0	25	50	75	100	128	150
6	All GND'd Irradiation	1.2483	1.2880	1.2636	1.3077	1.2735	1.2912	1.2904
7	All GND'd Irradiation	1.2334	1.2716	1.2537	1.2902	1.2648	1.2836	1.2820
8	All GND'd Irradiation	1.2362	1.2749	1.2565	1.2963	1.2667	1.2808	1.2836
9	All GND'd Irradiation	1.2483	1.2671	1.2673	1.3067	1.2772	1.2917	1.2934
10	All GND'd Irradiation	1.2404	1.2742	1.2576	1.2986	1.2771	1.2926	1.2968
1	Biased Irradiation	1.2512	1.2638	1.2654	1.2957	1.2391	1.2799	1.2762
2	Biased Irradiation	1.2480	1.2856	1.2646	1.2988	1.2695	1.2837	1.2813
3	Biased Irradiation	1.2499	1.2833	1.2672	1.3117	1.2707	1.2838	1.2807
4	Biased Irradiation	1.2503	1.2887	1.2648	1.2924	1.2706	1.2814	1.2774
5	Biased Irradiation	1.2471	1.2850	1.2655	1.2920	1.2670	1.2804	1.2760
11	Control Unit	1.2347	1.2402	1.2334	1.2720	1.2390	1.2519	1.2413
12	Control Unit	1.2364	1.2365	1.2349	1.2481	1.2387	1.2547	1.2444
All GND'd Irradiation Statistics								
	Average All GND'd	1.2413	1.2752	1.2598	1.2999	1.2719	1.2880	1.2892
	Std Dev All GND'd	0.0068	0.0078	0.0056	0.0073	0.0058	0.0054	0.0063
	Ps90%/90% (+KTL) All GND'd	1.2601	1.2966	1.2750	1.3200	1.2878	1.3027	1.3066
	Ps90%/90% (-KTL) All GND'd	1.2225	1.2538	1.2445	1.2798	1.2559	1.2733	1.2719
Biased-Irradiation Statistics								
	Average Biased	1.2493	1.2813	1.2655	1.2981	1.2634	1.2818	1.2783
	Std Dev Biased	0.0017	0.0100	0.0010	0.0081	0.0137	0.0018	0.0025
	Ps90%/90% (+KTL) Biased	1.2539	1.3086	1.2684	1.3202	1.3008	1.2868	1.2853
	Ps90%/90% (-KTL) Biased	1.2447	1.2540	1.2626	1.2760	1.2259	1.2768	1.2714
	Specification MIN							
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
	Specification MAX	1.45	1.46	1.47		1.48		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

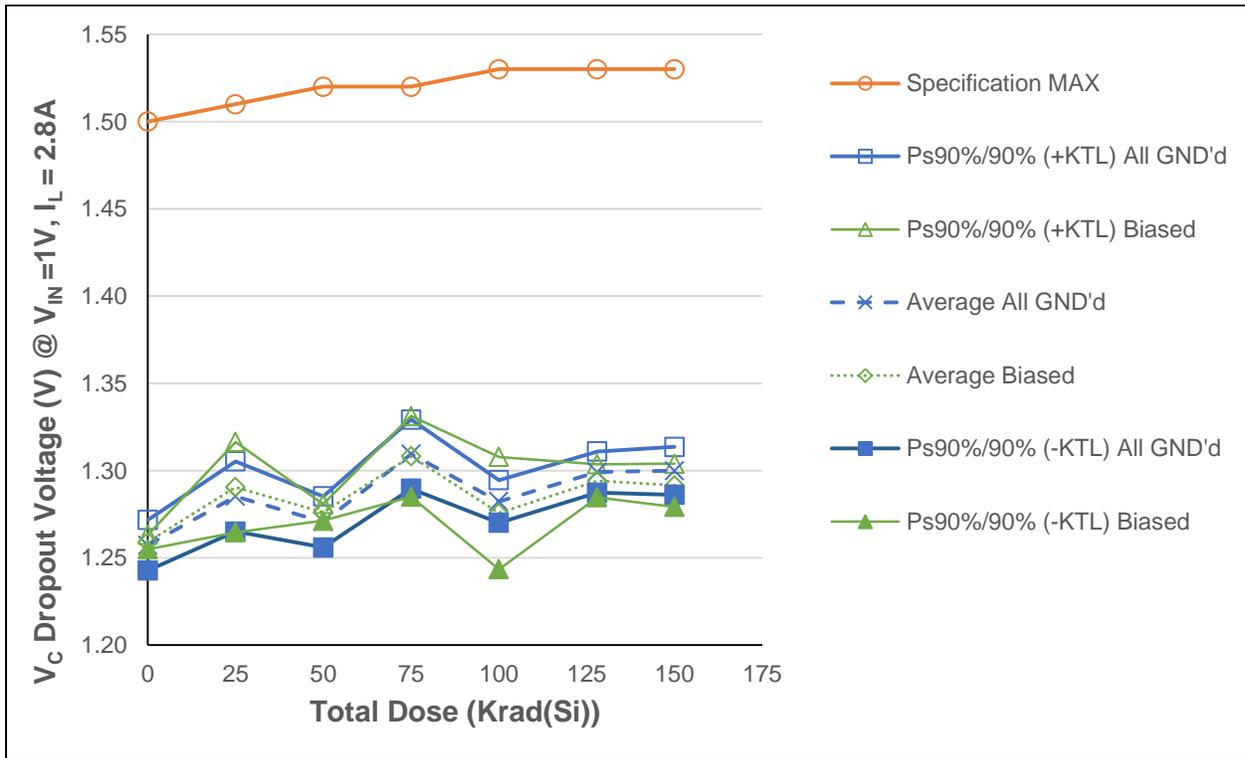


Figure 5.11: Plot of $V_{CONTROL}$ Dropout Voltage (@ $I_{LOAD} = 2.8A$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.11: Raw data table for V_{CONTROL} Dropout Voltage (@ $I_{\text{LOAD}} = 2.8\text{A}$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_C Dropout @ $V_{\text{IN}}=1\text{V}, I_L=2.8\text{A}$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(V)	0	25	50	75	100	128	150
6	All GND'd Irradiation	1.2590	1.2975	1.2724	1.3172	1.2838	1.3013	1.3007
7	All GND'd Irradiation	1.2509	1.2824	1.2645	1.3008	1.2771	1.2957	1.2946
8	All GND'd Irradiation	1.2577	1.2855	1.2666	1.3060	1.2781	1.2934	1.2950
9	All GND'd Irradiation	1.2649	1.2783	1.2781	1.3168	1.2869	1.3029	1.3038
10	All GND'd Irradiation	1.2540	1.2824	1.2716	1.3066	1.2857	1.3026	1.3055
1	Biased Irradiation	1.2606	1.2740	1.2758	1.3049	1.2552	1.2905	1.2872
2	Biased Irradiation	1.2596	1.2967	1.2768	1.3099	1.2828	1.2974	1.2964
3	Biased Irradiation	1.2596	1.2935	1.2788	1.3221	1.2833	1.2983	1.2965
4	Biased Irradiation	1.2591	1.2962	1.2748	1.3012	1.2802	1.2927	1.2894
5	Biased Irradiation	1.2566	1.2925	1.2746	1.3030	1.2770	1.2920	1.2885
11	Control Unit	1.2588	1.2604	1.2532	1.2822	1.2550	1.2709	1.2567
12	Control Unit	1.2575	1.2544	1.2504	1.2624	1.2521	1.2692	1.2558
All GND'd Irradiation Statistics								
	Average All GND'd	1.2573	1.2852	1.2707	1.3095	1.2823	1.2992	1.2999
	Std Dev All GND'd	0.0053	0.0073	0.0053	0.0072	0.0045	0.0043	0.0050
	Ps90%/90% (+KTL) All GND'd	1.2718	1.3054	1.2853	1.3293	1.2946	1.3110	1.3136
	Ps90%/90% (-KTL) All GND'd	1.2428	1.2651	1.2560	1.2897	1.2701	1.2873	1.2862
Biased-Irradiation Statistics								
	Average Biased	1.2591	1.2906	1.2761	1.3082	1.2757	1.2942	1.2916
	Std Dev Biased	0.0015	0.0094	0.0017	0.0084	0.0117	0.0035	0.0045
	Ps90%/90% (+KTL) Biased	1.2632	1.3165	1.2809	1.3313	1.3079	1.3037	1.3039
	Ps90%/90% (-KTL) Biased	1.2550	1.2647	1.2714	1.2851	1.2435	1.2847	1.2792
	Specification MIN							
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
	Specification MAX	1.50	1.51	1.52		1.53		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

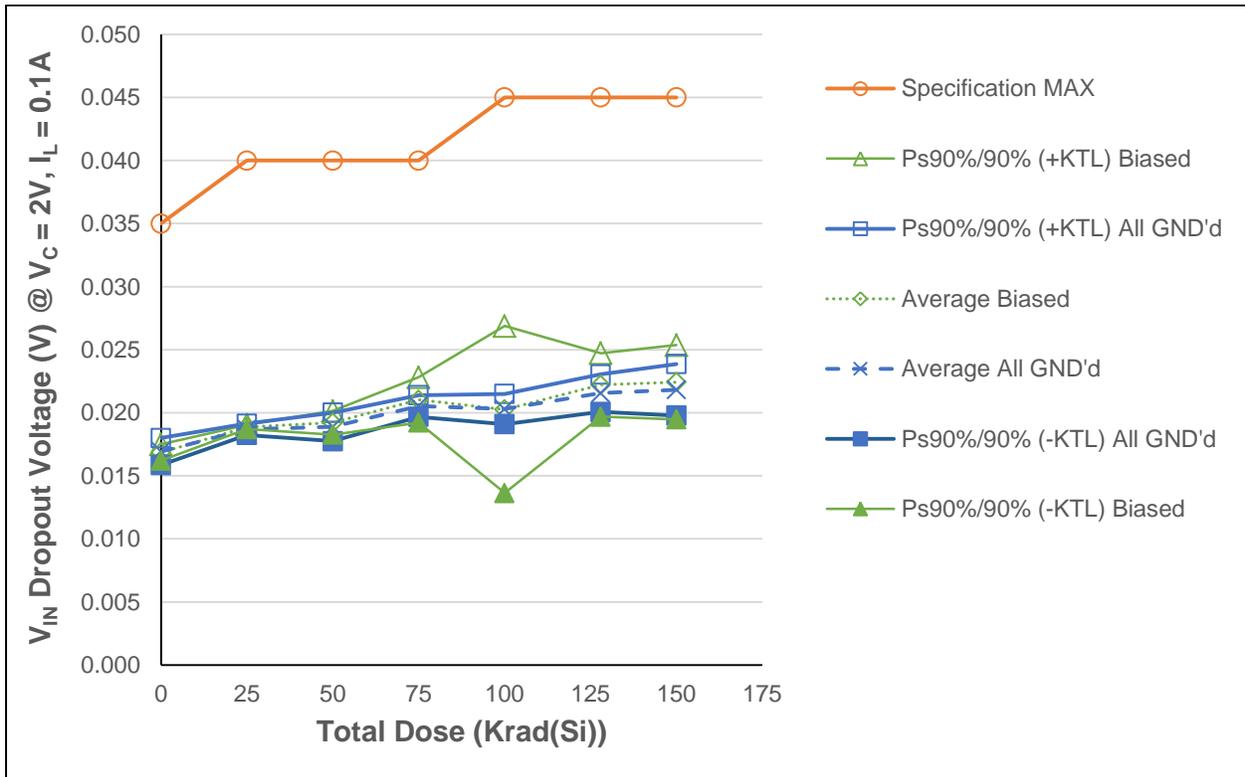


Figure 5.12: Plot of V_{IN} Dropout Voltage (@ $I_{LOAD} = 0.1A$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.12: Raw data table for V_{IN} Dropout Voltage (@ $I_{LOAD} = 0.1A$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_{IN} Dropout @ $V_C = 2V, I_L = 0.1A$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(V)	0	25	50	75	100	128	150
6	All GND'd Irradiation	0.0168	0.0188	0.0184	0.0203	0.0197	0.0209	0.0209
7	All GND'd Irradiation	0.0165	0.0185	0.0186	0.0203	0.0205	0.0220	0.0226
8	All GND'd Irradiation	0.0167	0.0187	0.0187	0.0204	0.0200	0.0211	0.0211
9	All GND'd Irradiation	0.0174	0.0189	0.0193	0.0210	0.0208	0.0220	0.0222
10	All GND'd Irradiation	0.0173	0.0186	0.0193	0.0206	0.0205	0.0218	0.0223
1	Biased Irradiation	0.0173	0.0188	0.0194	0.0210	0.0162	0.0220	0.0221
2	Biased Irradiation	0.0168	0.0189	0.0190	0.0209	0.0208	0.0220	0.0222
3	Biased Irradiation	0.0167	0.0189	0.0197	0.0221	0.0221	0.0238	0.0243
4	Biased Irradiation	0.0168	0.0188	0.0188	0.0203	0.0203	0.0214	0.0215
5	Biased Irradiation	0.0168	0.0189	0.0192	0.0207	0.0219	0.0219	0.0221
11	Control Unit	0.0162	0.0165	0.0161	0.0179	0.0163	0.0167	0.0160
12	Control Unit	0.0168	0.0169	0.0166	0.0173	0.0167	0.0173	0.0166
All GND'd Irradiation Statistics								
	Average All GND'd	0.0169	0.0187	0.0189	0.0205	0.0203	0.0216	0.0218
	Std Dev All GND'd	0.0004	0.0002	0.0004	0.0003	0.0004	0.0005	0.0007
	Ps90%/90% (+KTL) All GND'd	0.0180	0.0191	0.0200	0.0214	0.0215	0.0230	0.0239
	Ps90%/90% (-KTL) All GND'd	0.0159	0.0182	0.0178	0.0197	0.0191	0.0201	0.0198
Biased-Irradiation Statistics								
	Average Biased	0.0169	0.0189	0.0192	0.0210	0.0203	0.0222	0.0224
	Std Dev Biased	0.0002	0.0001	0.0003	0.0007	0.0024	0.0009	0.0011
	Ps90%/90% (+KTL) Biased	0.0175	0.0190	0.0201	0.0228	0.0269	0.0247	0.0254
	Ps90%/90% (-KTL) Biased	0.0162	0.0187	0.0183	0.0192	0.0136	0.0197	0.0195
Specification MIN								
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
Specification MAX								
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

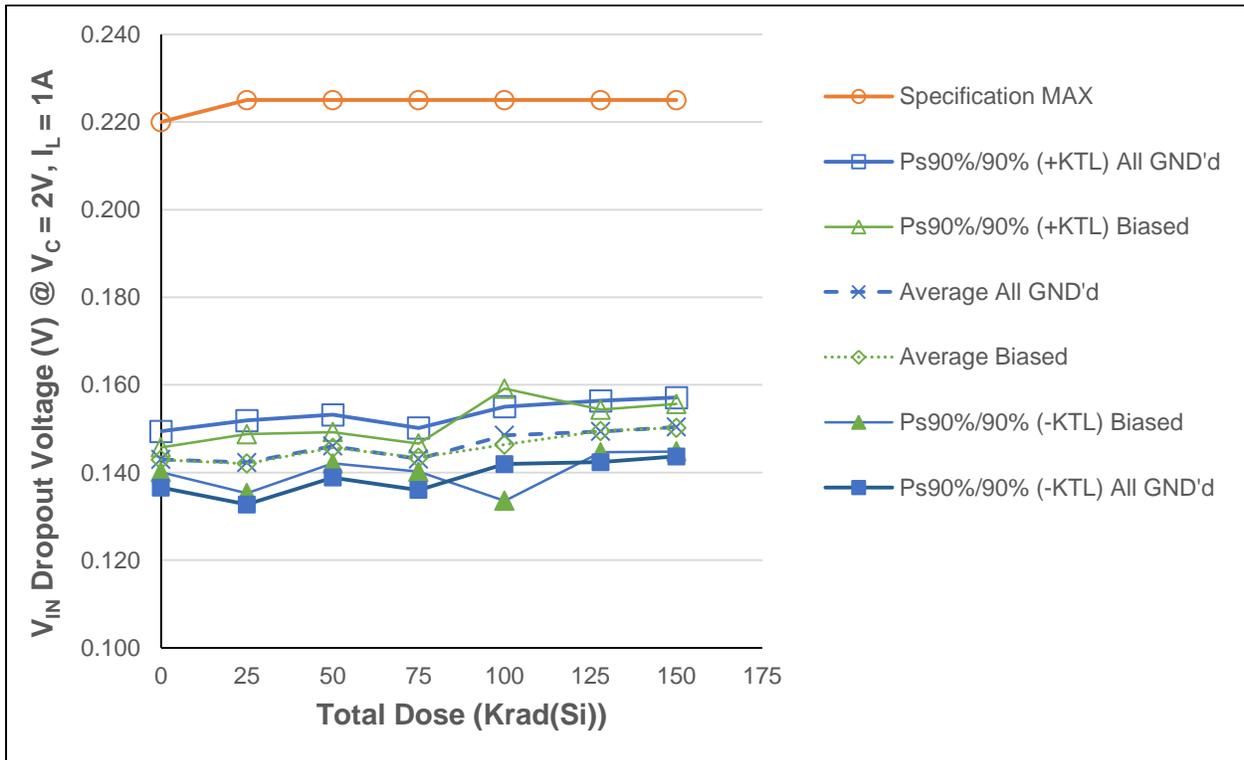


Figure 5.13: Plot of V_{IN} Dropout Voltage (@ $I_{LOAD} = 1A$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.13: Raw data table for V_{IN} Dropout Voltage (@ $I_{LOAD} = 1A$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_{IN} Dropout @ $V_C = 2V, I_L = 1A$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(V)	0	25	50	75	100	128	150
6	All GND'd Irradiation	0.1414	0.1393	0.1437	0.1401	0.1457	0.1461	0.1467
7	All GND'd Irradiation	0.1403	0.1384	0.1428	0.1406	0.1462	0.1473	0.1493
8	All GND'd Irradiation	0.1448	0.1433	0.1476	0.1443	0.1500	0.1507	0.1511
9	All GND'd Irradiation	0.1459	0.1470	0.1488	0.1459	0.1511	0.1520	0.1529
10	All GND'd Irradiation	0.1425	0.1435	0.1472	0.1446	0.1495	0.1508	0.1520
1	Biased Irradiation	0.1441	0.1460	0.1472	0.1451	0.1385	0.1506	0.1512
2	Biased Irradiation	0.1421	0.1406	0.1449	0.1422	0.1476	0.1484	0.1488
3	Biased Irradiation	0.1426	0.1424	0.1466	0.1432	0.1507	0.1519	0.1531
4	Biased Irradiation	0.1419	0.1397	0.1440	0.1425	0.1464	0.1474	0.1481
5	Biased Irradiation	0.1439	0.1414	0.1456	0.1439	0.1486	0.1491	0.1499
11	Control Unit	0.1400	0.1396	0.1395	0.1393	0.1385	0.1378	0.1378
12	Control Unit	0.1429	0.1436	0.1431	0.1418	0.1422	0.1411	0.1411
All GND'd Irradiation Statistics								
	Average All GND'd	0.1430	0.1423	0.1460	0.1431	0.1485	0.1494	0.1504
	Std Dev All GND'd	0.0023	0.0035	0.0026	0.0026	0.0024	0.0026	0.0024
	Ps90%/90% (+KTL) All GND'd	0.1494	0.1519	0.1532	0.1502	0.1551	0.1564	0.1571
	Ps90%/90% (-KTL) All GND'd	0.1366	0.1327	0.1389	0.1360	0.1419	0.1424	0.1437
Biased-Irradiation Statistics								
	Average Biased	0.1429	0.1420	0.1456	0.1434	0.1464	0.1495	0.1502
	Std Dev Biased	0.0010	0.0025	0.0013	0.0012	0.0047	0.0018	0.0020
	Ps90%/90% (+KTL) Biased	0.1457	0.1487	0.1492	0.1466	0.1592	0.1543	0.1556
	Ps90%/90% (-KTL) Biased	0.1401	0.1353	0.1421	0.1402	0.1336	0.1446	0.1448
	Specification MIN							
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
	Specification MAX	0.220	0.225	0.225		0.225		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

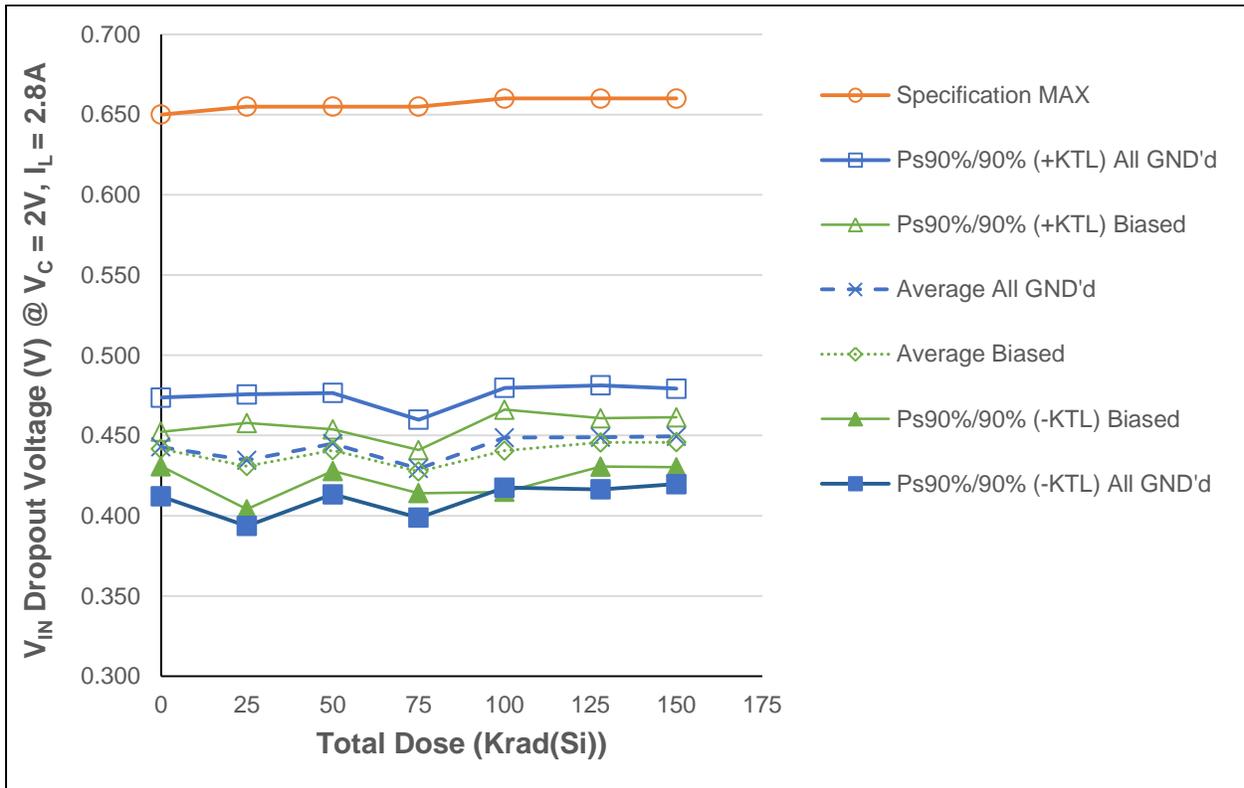


Figure 5.14: Plot of V_{IN} Dropout Voltage (@ $I_{LOAD} = 2.8A$) versus Total Dose

The average measured values of 10 samples pass the datasheet specification maximum limit.

Table 5.14: Raw data table for V_{IN} Dropout Voltage (@ $I_{LOAD} = 2.8A$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_{IN} Dropout @ $V_C = 2V, I_L = 2.8A$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(V)	0	25	50	75	100	128	150
6	All GND'd Irradiation	0.4352	0.4208	0.4352	0.4173	0.4380	0.4367	0.4371
7	All GND'd Irradiation	0.4313	0.4175	0.4304	0.4172	0.4353	0.4356	0.4385
8	All GND'd Irradiation	0.4552	0.4424	0.4553	0.4383	0.4591	0.4594	0.4585
9	All GND'd Irradiation	0.4545	0.4527	0.4550	0.4389	0.4587	0.4592	0.4592
10	All GND'd Irradiation	0.4379	0.4395	0.4489	0.4350	0.4520	0.4532	0.4540
1	Biased Irradiation	0.4450	0.4464	0.4466	0.4349	0.4259	0.4519	0.4514
2	Biased Irradiation	0.4384	0.4250	0.4382	0.4232	0.4417	0.4417	0.4409
3	Biased Irradiation	0.4429	0.4335	0.4440	0.4248	0.4502	0.4504	0.4512
4	Biased Irradiation	0.4365	0.4210	0.4346	0.4244	0.4381	0.4390	0.4392
5	Biased Irradiation	0.4451	0.4286	0.4407	0.4300	0.4465	0.4454	0.4461
11	Control Unit	0.4322	0.4299	0.4294	0.4257	0.4261	0.4228	0.4238
12	Control Unit	0.4443	0.4460	0.4433	0.4376	0.4404	0.4359	0.4363
All GND'd Irradiation Statistics								
	Average All GND'd	0.4428	0.4346	0.4450	0.4293	0.4486	0.4488	0.4495
	Std Dev All GND'd	0.0112	0.0150	0.0115	0.0111	0.0113	0.0118	0.0109
	Ps90%/90% (+KTL) All GND'd	0.4736	0.4756	0.4766	0.4599	0.4797	0.4813	0.4792
	Ps90%/90% (-KTL) All GND'd	0.4121	0.3936	0.4134	0.3988	0.4176	0.4164	0.4197
Biased-Irradiation Statistics								
	Average Biased	0.4416	0.4309	0.4408	0.4275	0.4405	0.4457	0.4458
	Std Dev Biased	0.0039	0.0098	0.0047	0.0049	0.0093	0.0055	0.0057
	Ps90%/90% (+KTL) Biased	0.4524	0.4578	0.4538	0.4409	0.4661	0.4607	0.4613
	Ps90%/90% (-KTL) Biased	0.4308	0.4040	0.4278	0.4141	0.4149	0.4306	0.4302
	Specification MIN							
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
	Specification MAX	0.650	0.655	0.655		0.660		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

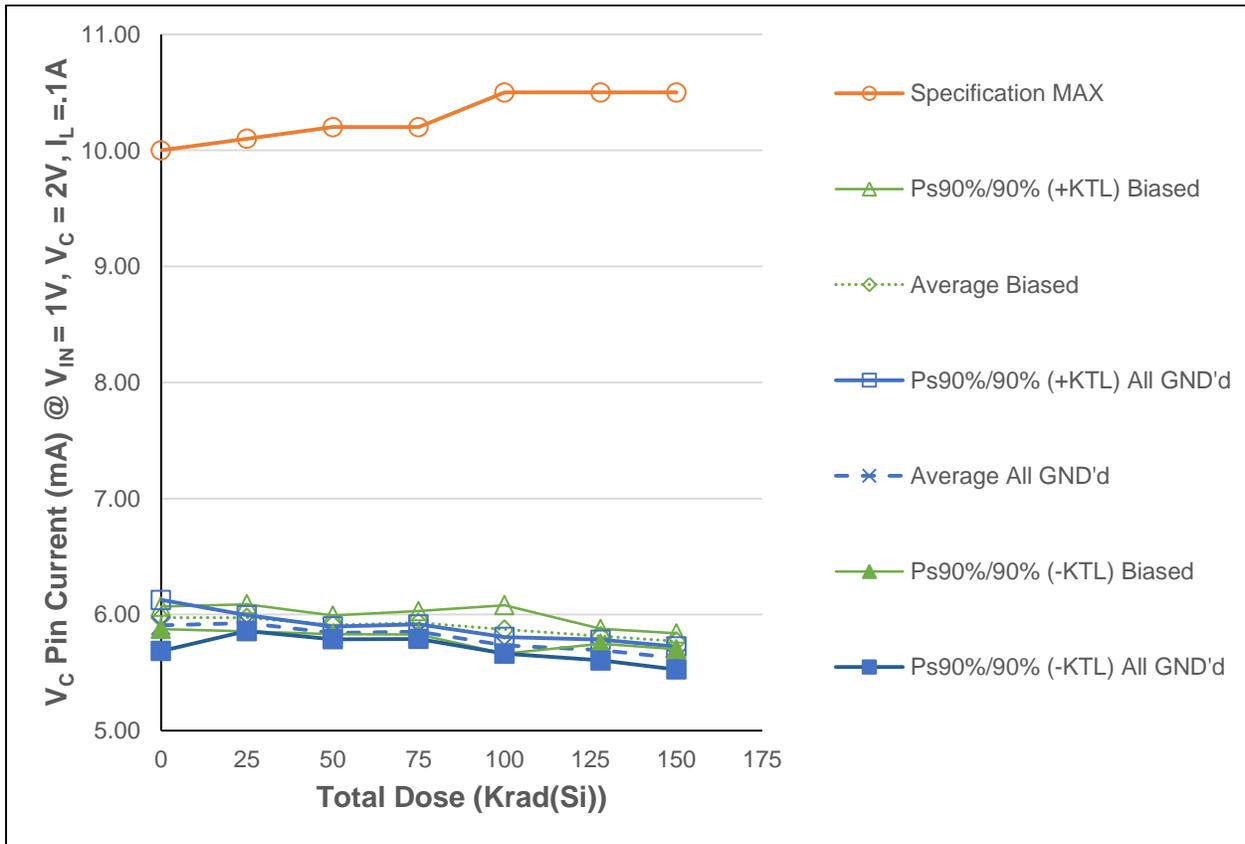


Figure 5.15: Plot of $V_{CONTROL}$ Pin Current (@ $I_{LOAD} = 0.1A$) versus Total Dose

The measured data points are within the datasheet specification maximum limit.

Table 5.15: Raw data table for $V_{CONTROL}$ Pin Current (@ $I_{LOAD} = 0.1A$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_C pin I @ $V_{IN}=1V, V_C=2V, I_L=0.1A$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(mA)	0	25	50	75	100	128	150
6	All GND'd Irradiation	5.9877	5.9528	5.8754	5.8910	5.7781	5.7517	5.6875
7	All GND'd Irradiation	5.9864	5.9374	5.8352	5.8456	5.7085	5.6699	5.5925
8	All GND'd Irradiation	5.8927	5.9308	5.8338	5.8550	5.7286	5.6858	5.6205
9	All GND'd Irradiation	5.8652	5.8858	5.8238	5.8304	5.7258	5.6827	5.6187
10	All GND'd Irradiation	5.8025	5.9286	5.8464	5.8456	5.7359	5.6836	5.6129
1	Biased Irradiation	5.9128	5.9140	5.8827	5.8962	6.0032	5.7932	5.7538
2	Biased Irradiation	6.0019	6.0251	5.9560	5.9829	5.8739	5.8535	5.8144
3	Biased Irradiation	5.9809	5.9931	5.9243	5.9493	5.8367	5.8118	5.7647
4	Biased Irradiation	5.9721	5.9506	5.8901	5.8987	5.8253	5.8039	5.7618
5	Biased Irradiation	5.9950	5.9815	5.9044	5.9223	5.8207	5.8051	5.7575
11	Control Unit	5.8851	5.9784	5.9683	6.0427	6.0003	6.0214	6.0102
12	Control Unit	5.8904	5.9762	5.9754	6.0138	5.9984	6.0214	6.0138
All GND'd Irradiation Statistics								
	Average All GND'd	5.9069	5.9271	5.8429	5.8535	5.7354	5.6948	5.6264
	Std Dev All GND'd	0.0801	0.0249	0.0199	0.0227	0.0259	0.0324	0.0359
	Ps90%/90% (+KTL) All GND'd	6.1266	5.9955	5.8974	5.9159	5.8065	5.7837	5.7249
	Ps90%/90% (-KTL) All GND'd	5.6872	5.8587	5.7885	5.7912	5.6643	5.6058	5.5279
Biased-Irradiation Statistics								
	Average Biased	5.9725	5.9729	5.9115	5.9299	5.8720	5.8135	5.7705
	Std Dev Biased	0.0354	0.0423	0.0295	0.0366	0.0763	0.0233	0.0249
	Ps90%/90% (+KTL) Biased	6.0695	6.0889	5.9924	6.0302	6.0812	5.8775	5.8388
	Ps90%/90% (-KTL) Biased	5.8756	5.8568	5.8306	5.8296	5.6628	5.7496	5.7021
Specification MIN								
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
Specification MAX								
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

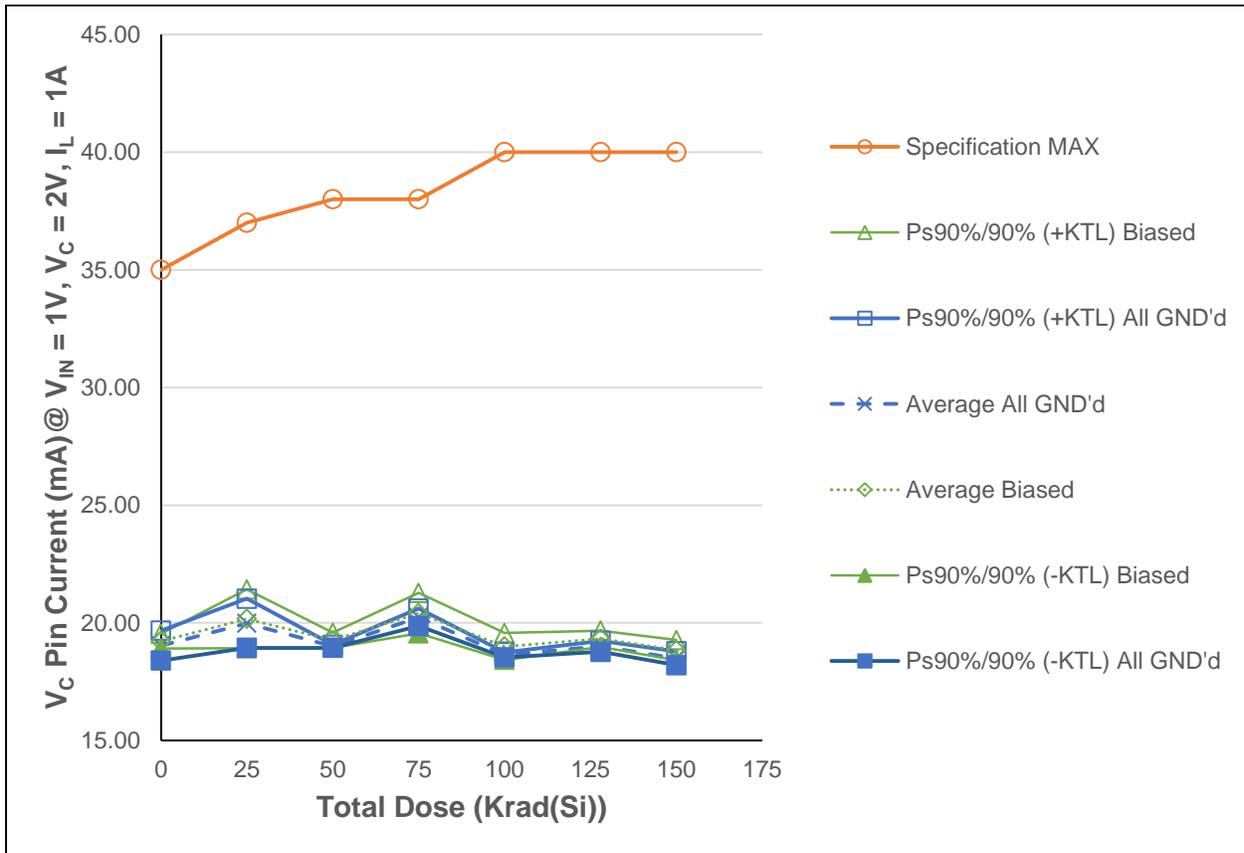


Figure 5.16: Plot of $V_{CONTROL}$ Pin Current (@ $I_{LOAD} = 1A$) versus Total Dose

The measured values are within datasheet specification maximum limit.

Table 5.16: Raw data table for $V_{CONTROL}$ Pin Current (@ $I_{LOAD} = 1A$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_C pin I @ $V_{IN}=1V, V_C=2V, I_L=1A$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(mA)	0	25	50	75	100	128	150
6	All GND'd Irradiation	19.2215	20.2631	19.0080	20.4236	18.7005	19.1486	18.6542
7	All GND'd Irradiation	19.3094	20.2326	19.0409	20.1546	18.5874	18.9956	18.3743
8	All GND'd Irradiation	18.9853	20.1948	19.0141	20.3125	18.6443	18.9562	18.5168
9	All GND'd Irradiation	18.9211	19.3670	18.9774	20.2243	18.6443	18.9930	18.5188
10	All GND'd Irradiation	18.7363	19.8601	19.0008	20.0764	18.6457	18.9294	18.4295
1	Biased Irradiation	19.0927	19.3998	19.2179	20.2840	19.3295	19.2859	18.7962
2	Biased Irradiation	19.3442	20.5550	19.3972	20.6447	19.0772	19.5055	19.0894
3	Biased Irradiation	19.1509	20.1643	19.2534	20.8167	18.8537	19.2878	18.8159
4	Biased Irradiation	19.1861	20.2811	19.0972	20.0337	18.8342	19.1711	18.6591
5	Biased Irradiation	19.3498	20.4510	19.3437	20.2912	18.8991	19.3813	18.8480
11	Control Unit	18.9554	19.4195	19.1215	20.7235	19.3246	19.9818	19.4538
12	Control Unit	18.9751	19.2756	19.1364	19.7775	19.3093	20.0432	19.5400
All GND'd Irradiation Statistics								
	Average All GND'd	19.0347	19.9835	19.0082	20.2383	18.6445	19.0046	18.4987
	Std Dev All GND'd	0.2317	0.3808	0.0230	0.1353	0.0400	0.0851	0.1063
	Ps90%/90% (+KTL) All GND'd	19.6700	21.0278	19.0713	20.6093	18.7541	19.2378	18.7901
	Ps90%/90% (-KTL) All GND'd	18.3994	18.9392	18.9452	19.8672	18.5348	18.7713	18.2074
Biased-Irradiation Statistics								
	Average Biased	19.2247	20.1702	19.2619	20.4140	18.9987	19.3263	18.8417
	Std Dev Biased	0.1165	0.4563	0.1163	0.3131	0.2083	0.1249	0.1561
	Ps90%/90% (+KTL) Biased	19.5442	21.4213	19.5809	21.2725	19.5699	19.6686	19.2698
	Ps90%/90% (-KTL) Biased	18.9053	18.9191	18.9429	19.5556	18.4275	18.9840	18.4137
Specification MIN								
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
Specification MAX								
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

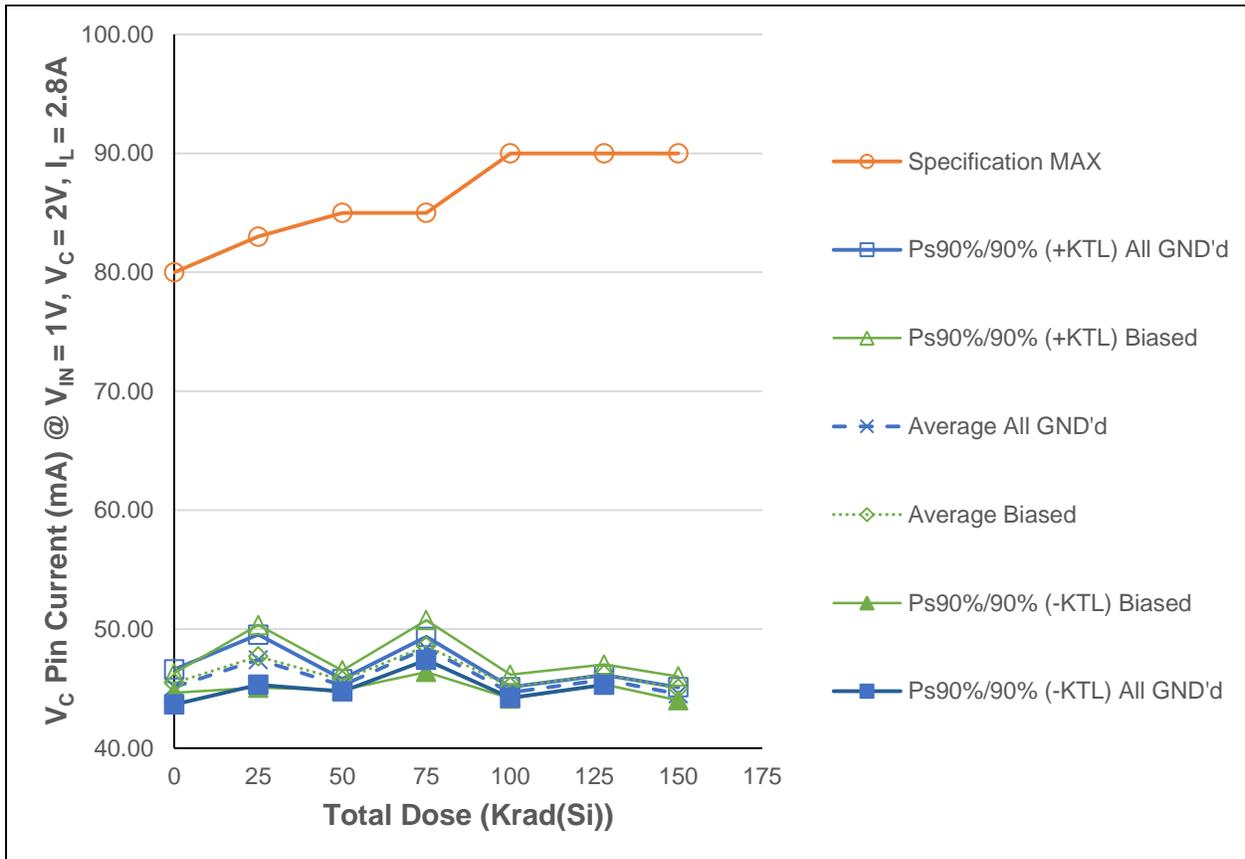


Figure 5.17: Plot of $V_{CONTROL}$ Pin Current (@ $I_{LOAD} = 2.8A$) versus Total Dose

The measured and computed values are within datasheet specification maximum limit.

Table 5.17: Raw data table for $V_{CONTROL}$ Pin Current (@ $I_{LOAD} = 2.8A$) versus total dose including the statistical calculations, maximum specification, and the status of the test (PASS/FAIL)

Parameter	V_C pin I @ $V_{IN}=1V, V_C=2V, I_L=2.8A$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(V)	0	25	50	75	100	128	150
6	All GND'd Irradiation	45.4104	47.8183	45.0153	48.5840	44.4963	45.7454	44.5628
7	All GND'd Irradiation	45.8993	48.0193	45.3731	48.1979	44.5964	45.7890	44.3749
8	All GND'd Irradiation	44.9865	48.0407	45.4345	48.7127	44.8165	45.7747	44.7346
9	All GND'd Irradiation	44.9341	46.2728	45.4357	48.5917	44.8881	45.9178	44.7823
10	All GND'd Irradiation	44.4803	47.0360	45.1632	47.8619	44.6161	45.5028	44.3379
1	Biased Irradiation	45.2483	46.1250	45.7737	48.3915	45.7036	46.2135	45.0251
2	Biased Irradiation	45.6495	48.5201	46.0474	49.0504	45.3600	46.5557	45.5340
3	Biased Irradiation	45.1720	47.5953	45.6617	49.6349	44.9162	46.0817	44.9524
4	Biased Irradiation	45.4492	47.9006	45.2610	47.5378	44.7974	45.7341	44.5097
5	Biased Irradiation	45.9047	48.3979	45.8930	48.2962	45.0689	46.3470	45.0943
11	Control Unit	44.6902	45.9825	45.2723	49.1041	45.6899	47.2534	45.9528
12	Control Unit	44.8554	45.8579	45.4637	46.8980	45.7811	47.5342	46.2809
All GND'd Irradiation Statistics								
	Average All GND'd	45.1421	47.4374	45.2844	48.3896	44.6827	45.7459	44.5585
	Std Dev All GND'd	0.5364	0.7689	0.1873	0.3529	0.1633	0.1511	0.2022
	Ps90%/90% (+KTL) All GND'd	46.6129	49.5459	45.7981	49.3573	45.1306	46.1602	45.1129
	Ps90%/90% (-KTL) All GND'd	43.6714	45.3290	44.7707	47.4220	44.2348	45.3316	44.0041
Biased-Irradiation Statistics								
	Average Biased	45.4847	47.7078	45.7274	48.5822	45.1692	46.1864	45.0231
	Std Dev Biased	0.2994	0.9606	0.2974	0.7963	0.3655	0.3076	0.3656
	Ps90%/90% (+KTL) Biased	46.3057	50.3419	46.5429	50.7655	46.1714	47.0298	46.0256
	Ps90%/90% (-KTL) Biased	44.6638	45.0737	44.9118	46.3988	44.1670	45.3430	44.0206
Specification MIN								
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
Specification MAX								
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Status (-KTL) All GND'd							
	Status (+KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (-KTL) Biased							
	Status (+KTL) Biased	PASS	PASS	PASS		PASS		

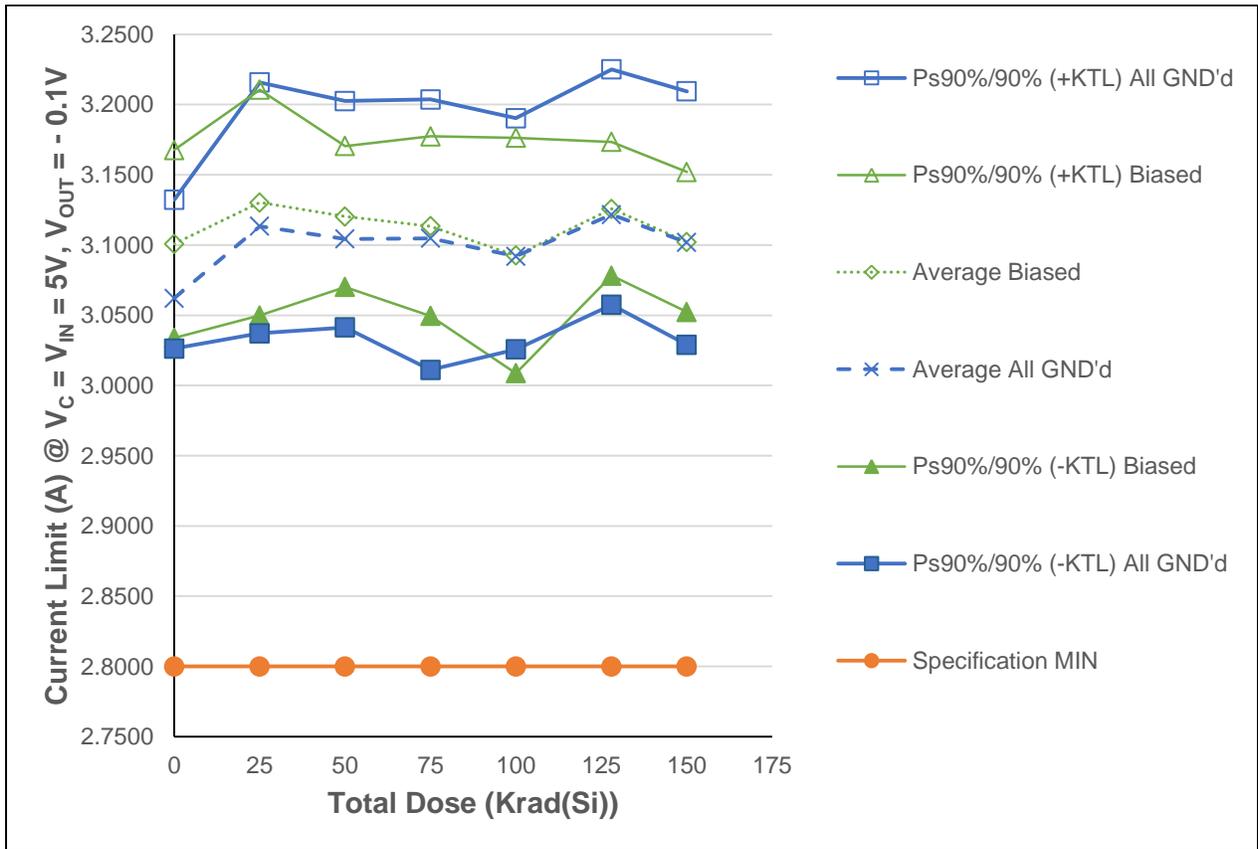


Figure 5.18: Plot of Current Limit versus Total Dose

The measured data are within the datasheet specification minimum limit.

Table 5.18: Raw data table for Current Limit versus total dose including the statistical calculations, minimum specification, and the status of the test (PASS/FAIL)

Parameter	I_{LIMIT} @ $V_C=V_{IN}=5V, V_{OUT} = -0.1V$	Total Dose (Krad(Si)) @ 10 mrads(Si)/second						
Units	(A)	0	25	50	75	100	128	150
6	All GND'd Irradiation	3.1049	3.1484	3.1285	3.1368	3.1170	3.1508	3.1315
7	All GND'd Irradiation	3.0589	3.0990	3.0816	3.0791	3.0656	3.0923	3.0665
8	All GND'd Irradiation	3.0358	3.0873	3.0725	3.0767	3.0640	3.0932	3.0793
9	All GND'd Irradiation	3.0554	3.0746	3.0840	3.0805	3.0703	3.0986	3.0763
10	All GND'd Irradiation	3.0555	3.1576	3.1553	3.1510	3.1427	3.1731	3.1554
1	Biased Irradiation	3.0768	3.0866	3.1017	3.0932	3.0446	3.1064	3.0817
2	Biased Irradiation	3.1195	3.1488	3.1306	3.1246	3.1088	3.1351	3.1129
3	Biased Irradiation	3.1191	3.1429	3.1344	3.1439	3.1158	3.1435	3.1223
4	Biased Irradiation	3.1169	3.1582	3.1357	3.1183	3.1140	3.1360	3.1097
5	Biased Irradiation	3.0714	3.1147	3.0990	3.0872	3.0795	3.1078	3.0842
11	Control Unit	3.0478	3.0610	3.0621	3.0379	3.0455	3.0783	3.0470
12	Control Unit	3.0263	3.0372	3.0414	3.0111	3.0257	3.0574	3.0290
All GND'd Irradiation Statistics								
	Average All GND'd	3.0621	3.1134	3.1044	3.1048	3.0919	3.1216	3.1018
	Std Dev All GND'd	0.0256	0.0373	0.0358	0.0360	0.0359	0.0377	0.0393
	Ps90%/90% (+KTL) All GND'd	3.1322	3.2157	3.2025	3.2036	3.1903	3.2250	3.2094
	Ps90%/90% (-KTL) All GND'd	2.9920	3.0110	3.0063	3.0060	2.9935	3.0182	2.9942
Biased-Irradiation Statistics								
	Average Biased	3.1008	3.1302	3.1203	3.1134	3.0925	3.1258	3.1022
	Std Dev Biased	0.0244	0.0293	0.0183	0.0233	0.0306	0.0174	0.0182
	Ps90%/90% (+KTL) Biased	3.1677	3.2106	3.1705	3.1773	3.1763	3.1734	3.1520
	Ps90%/90% (-KTL) Biased	3.0339	3.0499	3.0701	3.0496	3.0087	3.0782	3.0523
	Specification MIN	2.8	2.8	2.8		2.8		
	Status (Measurements) All GND'd	PASS	PASS	PASS		PASS		
	Status (Measurements) Biased	PASS	PASS	PASS		PASS		
	Specification MAX							
	Status (Measurements) All GND'd							
	Status (Measurements) Biased							
	Status (-KTL) All GND'd	PASS	PASS	PASS		PASS		
	Status (+KTL) All GND'd							
	Status (-KTL) Biased	PASS	PASS	PASS		PASS		
	Status (+KTL) Biased							

Appendix A

Picture of one among ten samples used in the test. The part type is in development and identification number will be marked on top of the future product.



Figure A1: Top View showing serial number



Figure A2: Bottom View

Appendix B

Radiation Bias Connection Tables

Table B1: Biased Conditions

PIN	FUNCTION	CONNECTION / BIAS
1	NC	NC
2	SET	To ground via 10KΩ resistor
3	$V_{CONTROL}$	To pin 4
4	IN	To +3V To ground via 1uF To pin 3
CASE	OUT	To ground via 100Ω resistor To ground via 10uF capacitor

Table B2: All GND'd

PIN	FUNCTION	CONNECTION / BIAS
1	NC	Ground
2	SET	Ground
3	$V_{CONTROL}$	Ground
4	IN	Ground
CASE	OUT	Ground

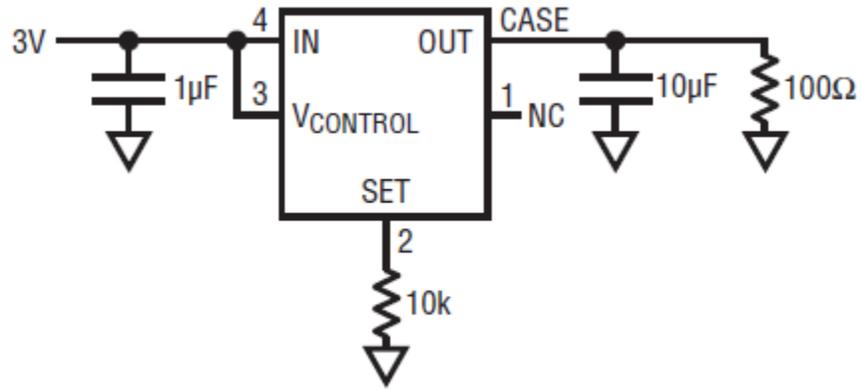


Figure B1: Total Dose Bias Circuit

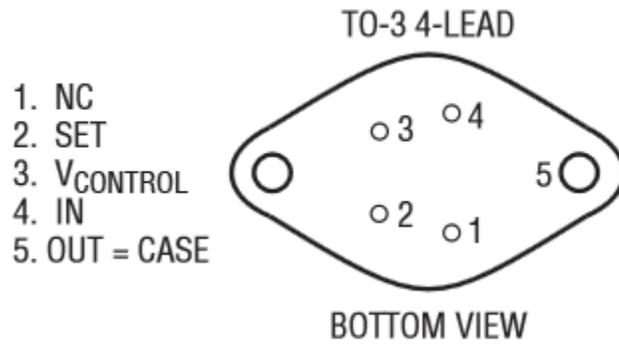


Figure B2: Pin-Out



Figure B3: Bias Board (top view)

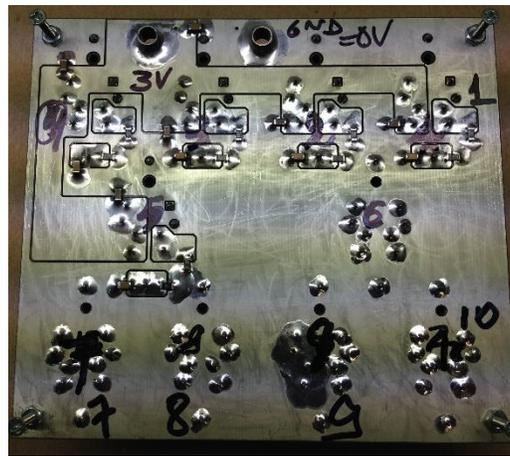


Figure B4: Bias Board (bottom view)

Appendix C

TEST CERTIFICATE

**Defense Microelectronics Activity
Science and Engineering Gamma Irradiation Test Facility
DMEA/MEBC
4234 54th Street
McClellan, CA 95652**



Testing Certificate Number: 1691.01

This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the dosimetry reported in this test certificate has been determined in accordance with the laboratory's terms of accreditation. The results contained herein relate only to the items tested. This certificate may not be reproduced, except in full, without the approval of this laboratory.

Date: 2013-09-11 Test Certificate #: 2013-NRC-048 Total Pages (except cover): 2

WARNING - This document contains technical data whose export is restricted by the Arms Export Control Act (Title 22, U.S.C., Sec 2751, et seq.) or the Export Administration Act of 1979 (Title 50, U.S.C., App. 2401 et seq.), as amended. Violations of these export laws are subject to severe criminal penalties. Disseminate in accordance with provisions of DoD Directive 5230.25.

REQUEST FOR AND RESULTS OF TESTS					PAGE NO. 1	NO. OF PAGES 2				
SECTION A - REQUEST FOR TEST										
1. TO: (Include ZIP Code) Defense Microelectronics Activity Science and Engineering Gamma Irradiation Test Facility 4234 54th Street McClellan, CA 95652-2100			2. FROM: (Include ZIP Code) Dr. Sana Rezgui Linear Technology Corp. 1630 McCarthy Blvd. Milpitas, CA 95035 Phone: (408) 432-1900 Email: srezgui@linear.com							
3. PRIME CONTRACTOR AND ADDRESS (Include ZIP Code) Same as block 2 CONTRACT NUMBER CRADA CR-08-17			4. MANUFACTURING PLANT NAME AND ADDRESS (Include ZIP Code) Linear Technology Corp. 1630 McCarthy Blvd. Milpitas, CA 95035 P.O. NUMBER TBD							
5. END ITEM AND/OR PROJECT N/A	6. SAMPLE NUMBER N/A	7. LOT NO. See below	8. REASON FOR SUBMITTAL Total Ionizing Dose (TID) Testing	9. DATE SUBMITTED 2013-09-09						
10. MATERIAL TO BE TESTED Various biased/unbiased devices - see below	10a. QUANTITY SUBMITTED See below	11. QUANTITY REPRESENTED N/A	12. SPEC. & AMEND AND/OR DRAWING NO. & REV. FOR SAMPLE & DATE N/A							
13. PURCHASED FROM OR SOURCE Linear Technology Corp.		14. SHIPMENT METHOD Hand carry	15. DATE SAMPLED AND SUBMITTED BY 2013-09-10 by Tom Shepherd							
16. REMARKS AND/OR SPECIAL INSTRUCTIONS AND/OR WAIVERS. Dose Rate: 3000 ±10% rad(SiO ₂)/min Irradiation Steps: 10 Type of Test: Customer-Performed Total Dose: see below ±10% krad(SiO ₂) Requested Test Start Date: 2013-09-11 Dimensions: Various Security Requirements, Safety or Handling Precautions: Customer to perform pre- and post-irradiation electrical testing. Parts may be packed by customer in dry ice for transport. Irradiation portion of testing to be conducted per MIL-STD-883G, Test Method 1019.7, Condition A. Customer reserves right to modify parameters, devices, etc. to suit test requirements. Description of parts to be irradiated is as follows: RH3083MK-CS: fab lot #HP201494.1, ass'y lot #N/A, WFR #: 10, 30, 50, 100, 150 and 200 krad, 10 pieces per dose level, biased RH1086MH: fab lot #W1231270.1, ass'y lot #719601.1, WFR #: 50 and 200 krad, 5 pieces per dose level, biased LT1965IT#PBF: fab lot #N/A, ass'y lot #480445.1, WFR #N/A: 10, 30, 50, 100, 150 and 200 krad, 3 pieces per dose level, bias TBD RH1499MW: fab lot #W1046027.1, ass'y lot #713901.1, WFR #11: 50 and 200 krad, 5 pieces per dose level, biased										
Experiment #: 2013-NRC-048		DMEA Approval:		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="font-size: 8px;">SHEPHERD THOMAS J. 125523594</td> <td style="font-size: 8px;">SHEPHERD THOMAS J. 125523594</td> <td style="font-size: 8px;">ARSHAD MOHAMMAD. 1231956693</td> <td style="font-size: 8px;">MELINE CARY. W.1231854033</td> </tr> </table>			SHEPHERD THOMAS J. 125523594	SHEPHERD THOMAS J. 125523594	ARSHAD MOHAMMAD. 1231956693	MELINE CARY. W.1231854033
SHEPHERD THOMAS J. 125523594	SHEPHERD THOMAS J. 125523594	ARSHAD MOHAMMAD. 1231956693	MELINE CARY. W.1231854033							
17. SEND REPORT OF TEST TO Individual identified in Block 2										
SECTION B - RESULTS OF TEST (Continue on plain white paper if more space is required)										
1. DATE SAMPLE RECEIVED 2013-09-11		2. DATE RESULTS REPORTED 2013-09-11		3. LAB REPORT NUMBER N/A						
4. TEST PERFORMED		RESULTS OF TEST		SAMPLE RESULT		REQUIREMENTS				
Please see next page.										
DATE	TYPED NAME AND TITLE OF PERSON CONDUCTING TEST		SIGNATURE							
2013-09-11	Thomas J. Shepherd, SEGIT Technical Manager		SHEPHERD.THOMAS.J.125523594 6							
2013-09-12	Mohammad Arshad, Alt. SEGIT Facility Supervisor		ARSHAD.MOHAMMAD.1231956693							

DD FORM 1222, FEB 62 (EF)

REPLACES DD FORM 1222, 1 JUL 58, WHICH IS OBSOLETE.

Continuation of DD Form 1222

Experiment #: 2013-NRC-048 Page 2 of 2

4.	Test Performed		Results of Test				Sample Result	Requirements	Step No.
	Start	End	Dose Rate	Material	Instrument	Method	Value		
	20130911 09:28:00	20130911 09:31:07	1.000E+04	rad(SiO2) at	3.209E+03	rad(SiO2)/min	RH3083MK-CS, WFR #2, S/Ns 51-60: 10 krad TD	1	
	20130911 09:28:00	20130911 09:31:07	1.000E+04	rad(SiO2) at	3.209E+03	rad(SiO2)/min	LT1965IT#PBF, WFR #N/A, S/Ns 1-3: 10 krad TD	1	
	20130911 09:39:25	20130911 09:48:46	3.000E+04	rad(SiO2) at	3.209E+03	rad(SiO2)/min	RH3083MK-CS, WFR #2, S/Ns 61-70: 30 krad TD	2	
	20130911 09:39:25	20130911 09:48:46	3.000E+04	rad(SiO2) at	3.209E+03	rad(SiO2)/min	LT1965IT#PBF, WFR #N/A, S/Ns 4-6: 30 krad TD	2	
	20130911 09:58:00	20130911 10:13:35	5.000E+04	rad(SiO2) at	3.209E+03	rad(SiO2)/min	RH3083MK-CS, WFR #2, S/Ns 71-80: 50 krad TD	3	
	20130911 09:58:00	20130911 10:13:35	5.000E+04	rad(SiO2) at	3.209E+03	rad(SiO2)/min	LT1965IT#PBF, WFR #N/A, S/Ns 7-9: 50 krad TD	3	
	20130911 10:21:06	20130911 10:52:16	1.000E+05	rad(SiO2) at	3.209E+03	rad(SiO2)/min	RH3083MK-CS, WFR #2, S/Ns 81-90: 100 krad TD	4	
	20130911 10:21:06	20130911 10:52:16	1.000E+05	rad(SiO2) at	3.209E+03	rad(SiO2)/min	LT1965IT#PBF, WFR #N/A, S/Ns 10-12: 100 krad TD	4	
	20130911 10:59:20	20130911 11:46:05	1.500E+05	rad(SiO2) at	3.209E+03	rad(SiO2)/min	RH3083MK-CS, WFR #2, S/Ns 91-100: 150 krad TD	5	
	20130911 10:59:20	20130911 11:46:05	1.500E+05	rad(SiO2) at	3.209E+03	rad(SiO2)/min	LT1965IT#PBF, WFR #N/A, S/Ns 13-15: 150 krad TD	5	
	20130911 11:55:45	20130911 12:58:05	2.000E+05	rad(SiO2) at	3.208E+03	rad(SiO2)/min	RH3083MK-CS, WFR #2, S/Ns 101-110: 200 krad TD	6	
	20130911 11:55:45	20130911 12:58:05	2.000E+05	rad(SiO2) at	3.208E+03	rad(SiO2)/min	LT1965IT#PBF, WFR #N/A, S/Ns 16-18: 200 krad TD	6	
	20130911 13:23:40	20130911 13:39:03	5.000E+04	rad(SiO2) at	3.249E+03	rad(SiO2)/min	RH1086MH, WFR #4, S/Ns 79-80, 97-100, 197-200: 50 krad SD, 50 krad TD	7	
	20130911 13:42:05	20130911 14:28:15	1.500E+05	rad(SiO2) at	3.249E+03	rad(SiO2)/min	RH1086MH, WFR #4, S/Ns 100, 197-200: 150 krad SD, 200 krad TD	8	
	20130911 14:48:00	20130911 15:03:35	5.000E+04	rad(SiO2) at	3.208E+03	rad(SiO2)/min	RH1499MW, WFR #11, S/Ns 102-104, 122-124, 182-184, 202: 50 krad SD, 50 krad TD	9	
	20130911 15:07:11	20130911 15:53:56	1.500E+05	rad(SiO2) at	3.208E+03	rad(SiO2)/min	RH1499MW, WFR #11, S/Ns 124, 182-184, 202: 150 krad SD, 200 krad TD	10	

Uncertainty: Total Doses reported are ± 9.99% (All except RH1086MH)
 8.70% (RH1086MH)

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

//

NOTES:

- ASTM = American Society for Testing and Materials.
- DUT = Device Under Test.
- S/N = Serial Number.
- SD = Step Dose.
- TD = Total Dose.
- Dose rate uniformity across target area:
 - ± 3.74% (All except RH1086MH)
 - ± 2.46% (RH1086MH)
- All irradiation steps met the requirements of ML-STD-883G, Test Method 1019.7, Condition A.
- After the original Test Request (DD Form 1222) was approved, the following changes were made:
 - The LT1965IT#PBF devices were irradiated (unbiased, in ESD bags) at the same time as the RH3083MK-CS devices.
 Latitude to change test parameters to suit customer requirements was included in the original Test Request; no Customer Order Change Request (SEGIT Form QP03-4, Rev. 5) was required/issued.
- Source information:
 - Irradiator = J.L. Shepherd & Associates Model 81-22/484 self-contained irradiation facility, S/Ns 7125/50016.
 - Source selection = two large Co-60 sources.
- Dosimeter system:
 - Radcal Model No. 9010 Radiation Monitor Controller, S/N 90-1313.
 - Radcal Model No. 90X5-0.18 Electrometer/Ion Chamber, S/Ns 95-0478/9771.
 - This dosimeter system was calibrated per ISO/IEC 17025:2005 by University of Wisconsin Medical Radiation Research Center on 30 Aug 2011 (Report No. ION13407). This calibration is effective for two years.
- Irradiation geometry: in accordance with section 7.3.2 of ASTM E1249-00 (2005), the DUT's semiconductor chip plane was perpendicular to the incident radiation beam.
- Filter box: a DMEA Dose Enhancement Chamber (DEC) was used for all testing/dosimetry involved with this experiment.
 The DEC's Pb and Al layers are compliant with section 7.2.2 of ASTM E1249-00 (2005) with respect to thickness and geometry.

Appendix D

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

PARAMETER	CONDITIONS	$T_A = 25^\circ\text{C}$		SUB-GROUP	$-55^\circ\text{C} < T_A < 125^\circ\text{C}$		SUB-GROUP	UNITS
		MIN	MAX		MIN	MAX		
SET Pin Current (Note 6)	$V_{IN} = 1\text{V}, V_{CONTROL} = 2\text{V}, I_{LOAD} = 1\text{mA}$	49.5	50.5	1	49	51.5	2, 3	μA
Output Offset Voltage ($V_{OUT} - V_{SET}$)	$V_{IN} = 1\text{V}, V_{CONTROL} = 2\text{V}, I_{LOAD} = 1\text{mA}$	-4	4	1	-6	6	2, 3	mV
Load Regulation, I_{SET}	$I_{LOAD} = 1\text{mA to } 2.8\text{A}$	-200	200	1	-300	300	2, 3	nA
Load Regulation, V_{OS}	$I_{LOAD} = 5\text{mA to } 2.8\text{A}$	-3	3	1	-4	4	2, 3	mV
Line Regulation, I_{SET}	$V_{IN} = 1\text{V to } 23\text{V}, V_{CONTROL} = 2\text{V to } 25\text{V}, I_{LOAD} = 1\text{mA}$ $V_{IN} = 1\text{V to } 23\text{V}, V_{CONTROL} = 2\text{V to } 25\text{V}, I_{LOAD} = 5\text{mA}$	-8	8	1	-10	10	2, 3	nA/V nA/V
Line Regulation, V_{OS}	$V_{IN} = 1\text{V to } 23\text{V}, V_{CONTROL} = 2\text{V to } 25\text{V}, I_{LOAD} = 1\text{mA}$ $V_{IN} = 1\text{V to } 23\text{V}, V_{CONTROL} = 2\text{V to } 25\text{V}, I_{LOAD} = 5\text{mA}$	-0.02	0.02	1	-0.05	0.05	2, 3	mV/V mV/V
Minimum Load Current (Note 3)	$V_{IN} = 1\text{V}, V_{CONTROL} = 2\text{V}$ $V_{IN} = 23\text{V}, V_{CONTROL} = 25\text{V}$	0.5		1		5	2, 3	mA
		1		1		5	2, 3	mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	$V_{IN} = 1\text{V}, I_{LOAD} = 0.1\text{A}$ $V_{IN} = 1\text{V}, I_{LOAD} = 1\text{A}$ $V_{IN} = 1\text{V}, I_{LOAD} = 2.8\text{A}$	1.4		1		1.55	2, 3	V
		1.45		1		1.6	2, 3	V
		1.5		1		1.65	2, 3	V
V_{IN} Dropout Voltage (Note 4)	$V_{CONTROL} = 2\text{V}, I_{LOAD} = 0.1\text{A}$ $V_{CONTROL} = 2\text{V}, I_{LOAD} = 1\text{A}$ $V_{CONTROL} = 2\text{V}, I_{LOAD} = 2.8\text{A}$	35		1		35	2, 3	mV
		220		1		280	2, 3	mV
		650		1		750	2, 3	mV
$V_{CONTROL}$ Pin Current (Note 5)	$V_{IN} = 1\text{V}, V_{CONTROL} = 2\text{V}, I_{LOAD} = 0.1\text{A}$ $V_{IN} = 1\text{V}, V_{CONTROL} = 2\text{V}, I_{LOAD} = 1\text{A}$ $V_{IN} = 1\text{V}, V_{CONTROL} = 2\text{V}, I_{LOAD} = 2.8\text{A}$	10		1		10	2, 3	mA
		35		1		40	2, 3	mA
		80		1		90	2, 3	mA
Current Limit	$V_{IN} = 5\text{V}, V_{CONTROL} = 5\text{V}, V_{SET} = 0\text{V},$ $V_{OUT} = -0.1\text{V}$	2.8		1	2.8		2, 3	A
Error Amplifier RMS Output Noise (Note 7)	$I_{LOAD} = 500\text{mA}, 10\text{Hz} \leq f \leq 100\text{kHz},$ $C_{OUT} = 10\mu\text{F}, C_{SET} = 0.1\mu\text{F}$	TYP = 40		1				μV_{RMS}
Reference Current RMS Output Noise (Note 7)	$10\text{Hz} \leq f \leq 100\text{kHz}$	TYP = 1		1				nA _{RMS}

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

PARAMETER	CONDITIONS	10KRads(Si)		20KRads(Si)		50KRads(Si)		100KRads(Si)		200KRads(Si)		UNITS
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
SET Pin Current (Note 6)	$V_{IN} = 1V, V_{CONTROL} = 2V, I_{LOAD} = 1mA$	49	51	49	51	49	51	49	51	49	51	μA
Output Offset Voltage ($V_{OUT} - V_{SET}$)	$V_{IN} = 1V, V_{CONTROL} = 2V, I_{LOAD} = 1mA$	-4.5	4.5	-4.5	4.5	-4.5	4.5	-4.5	4.5	-4.5	4.5	mV
Load Regulation, I_{SET}	$I_{LOAD} = 1mA$ to 2.8A	-300	300	-300	300	-300	300	-300	300	-300	300	nA
Load Regulation, V_{OS}	$I_{LOAD} = 5mA$ to 2.8A	-3.5	3.5	-3.5	3.5	-3.5	3.5	-3.5	3.5	-3.5	3.5	mV
Line Regulation, I_{SET}	$V_{IN} = 1V$ to 23V, $V_{CONTROL} = 2V$ to 25V, $I_{LOAD} = 1mA$	-10	10	-10	10	-10	10	-10	10	-10	10	nA/V
Line Regulation, V_{OS}	$V_{IN} = 1V$ to 23V, $V_{CONTROL} = 2V$ to 25V, $I_{LOAD} = 1mA$	-0.025	0.025	-0.025	0.025	-0.025	0.025	-0.03	0.03	-0.04	0.04	mV/V
Minimum Load Current (Note 3)	$V_{IN} = 1V, V_{CONTROL} = 2V$		0.5		0.5		0.5		0.5		0.5	mA
	$V_{IN} = 23V, V_{CONTROL} = 25V$		1		1		1		1		1	mA
$V_{CONTROL}$ Dropout Voltage (Note 4)	$V_{IN} = 1V, I_{LOAD} = 0.1A$		1.41		1.41		1.42		1.43		1.45	V
	$V_{IN} = 1V, I_{LOAD} = 1A$		1.46		1.46		1.47		1.48		1.5	V
	$V_{IN} = 1V, I_{LOAD} = 2.8V$		1.51		1.51		1.52		1.53		1.55	V
V_{IN} Dropout Voltage (Note 4)	$V_{CONTROL} = 2V, I_{LOAD} = 0.1A$		35		40		40		45		45	mV
	$V_{CONTROL} = 2V, I_{LOAD} = 1A$		225		225		225		225		230	mV
	$V_{CONTROL} = 2V, I_{LOAD} = 2.8A$		655		655		655		660		670	mV
$V_{CONTROL}$ Pin Current (Note 5)	$V_{IN} = 1V, V_{CONTROL} = 2V, I_{LOAD} = 0.1A$		10.1		10.1		10.2		10.5		11	mA
	$V_{IN} = 1V, V_{CONTROL} = 2V, I_{LOAD} = 1A$		36		37		38		40		45	mA
	$V_{IN} = 1V, V_{CONTROL} = 2V, I_{LOAD} = 2.8A$		82		83		85		90		100	mA
Current Limit	$V_{IN} = 5V, V_{CONTROL} = 5V, V_{SET} = 0V,$ $V_{OUT} = -0.1V$		2.8		2.8		2.8		2.8		2.8	A
Error Amplifier RMS Output Noise (Note 7)	$I_{LOAD} = 500mA, 10Hz \leq f \leq 100kHz,$ $C_{OUT} = 10\mu F, C_{SET} = 0.1\mu F$		TYP = 40		TYP = 40		TYP = 40		TYP = 40		TYP = 40	μV_{RMS}
Reference Current RMS Output Noise (Note 7)	$10Hz \leq f \leq 100kHz$		TYP = 1		TYP = 1		TYP = 1		TYP = 1		TYP = 1	nA _{RMS}

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: Unless otherwise specified, all voltages are with respect to V_{OUT} . The RH3083MK DICE is tested and specified under pulse load conditions such that $T_J \cong T_A$.

Note 3: Minimum load current is equivalent to the quiescent current of the part. Since all quiescent and drive current is delivered to the output of the part, the minimum load current is the minimum current required to maintain regulation.

Note 4: Dropout results from either of minimum control voltage, $V_{CONTROL}$, or minimum input voltage, V_{IN} , both specified with respect to V_{OUT} . These specifications represent the minimum input-to-output differential voltage required to maintain regulation.

Note 5: The $V_{CONTROL}$ pin current is the drive current required for the output transistor. This current tracks output current with roughly a 1:60 ratio. The minimum value is equal to the quiescent current of the device.

Note 6: The SET pin is clamped to the output with diodes through 1k resistors. These resistors and diodes only carry current under transient overloads.

Note 7: Adding a small capacitor across the reference current resistor lowers output noise. Adding this capacitor bypasses the resistor shot noise and reference current noise; output noise is then equal to error amplifier noise (see LT[®]3083 Data Sheet and Application Note 83).

Note 8: Dice are probe tested at 25°C to the limits shown in Table 1. Except for high current tests, dice are tested under low current conditions which assure full load current specifications when assembled.

Note 9: Dice that are not qualified by Linear Technology with a can sample are guaranteed to meet specifications of Table 1 only. Dice qualified by Linear Technology with a can sample meet specifications in all tables.

Note 10: This IC includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature exceeds the maximum operating junction temperature when overtemperature protection is active. Continuous operation above the specified maximum operating junction temperature may impair device reliability.

Note 11: Please refer to LT3083 standard product data sheet for Typical Performance Characteristics, Pin Functions, Applications Information, and Typical Applications.