

Total Dose Radiation Test Report

MSK0041RH

Rad Hard Medium Power Op-Amp

January 08, 2008 (TID, 1st Test)

May 24, 2018 (TID, 2nd Test NPN Transistor Wafer Lot: J1364 Wf#TH-16
PNP Transistor Wafer Lot: F00004693 Wf#22
IC Wafer Lot: 10224656.1 Wf#7)

August 22, 2018 (TID, 3rd Test NPN Transistor Wafer Lot: J1364 Wf#TH-16
PNP Transistor Wafer Lot: F00006134 Wf#6
IC Wafer Lot: 10224656.1 Wf#7)

N. Kresse
J. Joy

Anaren, Inc – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK0041RH was developed to qualify the device as a Radiation Hardened device to 100 Krad(Si). The testing was performed beyond 100 Krad(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the hybrid, but simply offers designers insight to the critical parameter-shifts beyond the specified total dose level.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK0041RH.

II. Radiation Source:

Total dose was performed at the University of Massachusetts, Lowell, using a cobalt 60 radiation source. Dosimetry was performed and the dose rate was determined to be 117.4 rad(Si)/sec. The total dose schedule can be found in Table I.

III. Test Setup:

All test samples were subjected to Group A Electrical Test in accordance with the device data sheet. In addition, all devices received a minimum of 160 hours of burn-in per MIL-STD-883 Method 1015. For test platform verification, two control devices were tested at 25°C. Ten devices were then tested at 25°C, prior to irradiation and were found to be within acceptable test limits.

The devices were vertically aligned with the radiation source and enclosed in a lead/aluminum container during irradiation. Five devices were biased during irradiation. Maximum operating voltage of $\pm 22V$ was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation the device leads were shorted and the devices were transported to the MSK electrical test platform and tested IAW MSK device data sheet. Testing was performed on irradiated devices, as well as the control devices, at each total dose level. All electrical tests were completed within one hour of irradiation. Each subsequent dose was performed within two hours of the previous irradiation.

IV. Data:

All performance curves are averaged from the test results of the biased and unbiased devices respectively. Post 100 Krad(Si) limits have also been plotted for reference. If required, full test data can be obtained by contacting Anaren, Inc. – MSK Products.

V. Summary:

Based on the test data recorded during radiation testing, the MSK0041RH qualified as a 100 Krad(Si) Radiation Hardened device.

Input Bias Current, Input Offset Current and Slew Rate exhibited the most significant shift with irradiation, however all parameters remained within specifications up to 150Krad(Si) TID.

MSK0041RH Biased/Unbiased Dose Rate
Schedule

Dosimetry Equipment
Bruker Biospin #0162

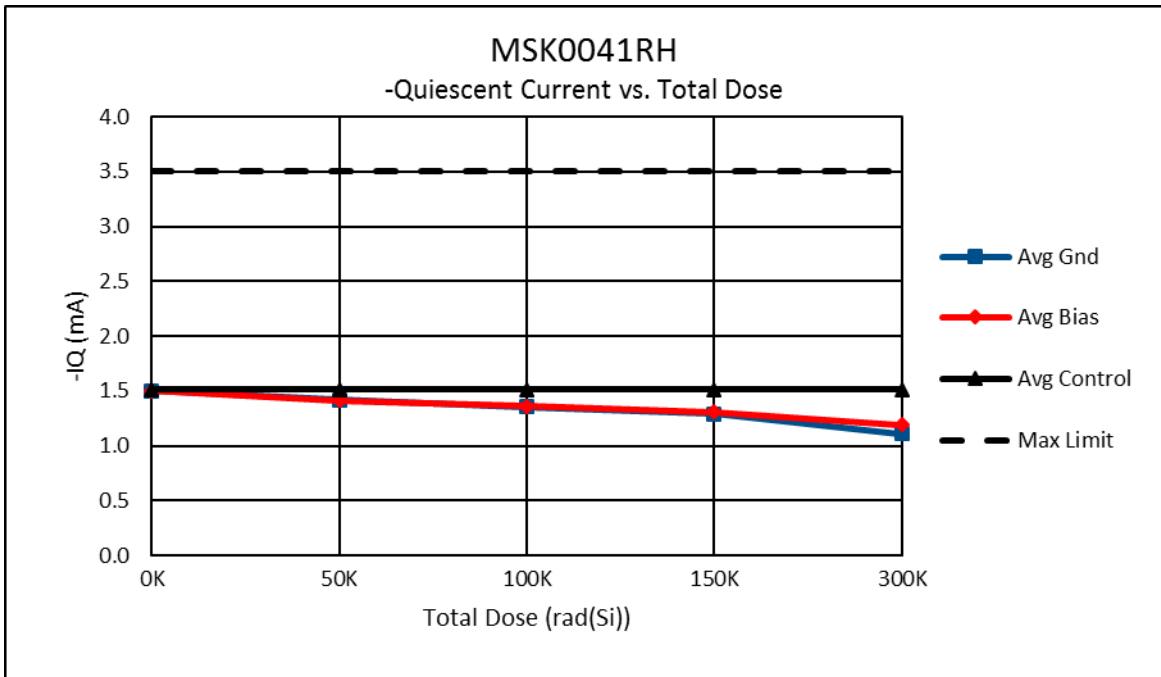
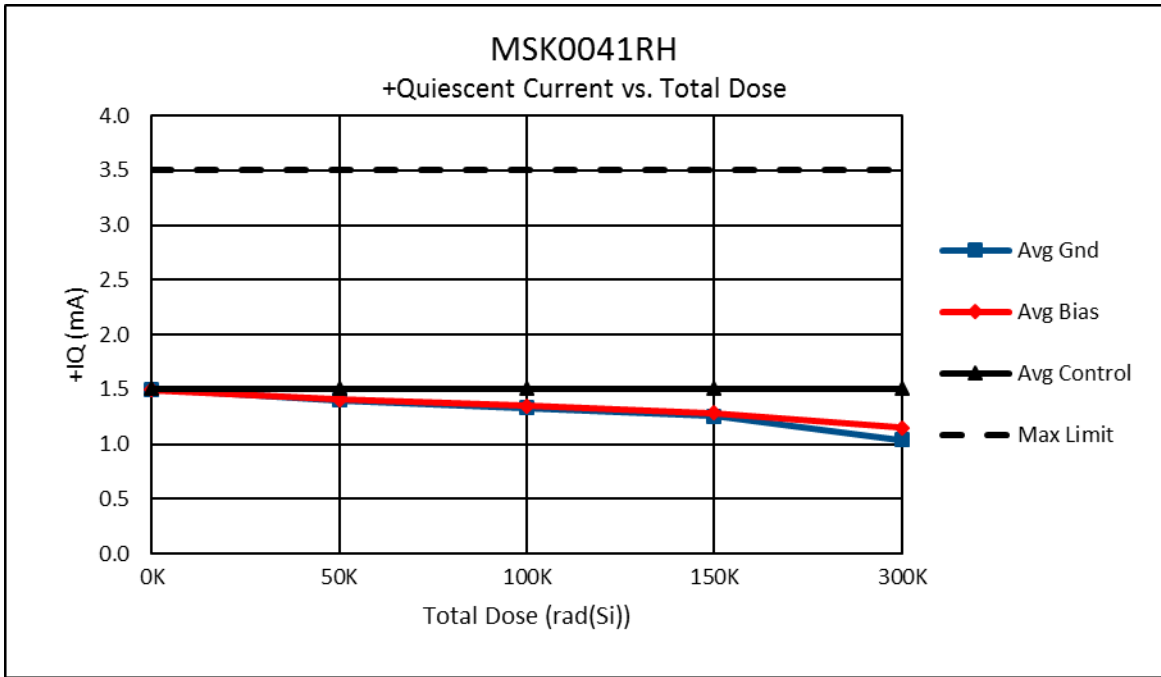
Irradiation Date
8/22/18

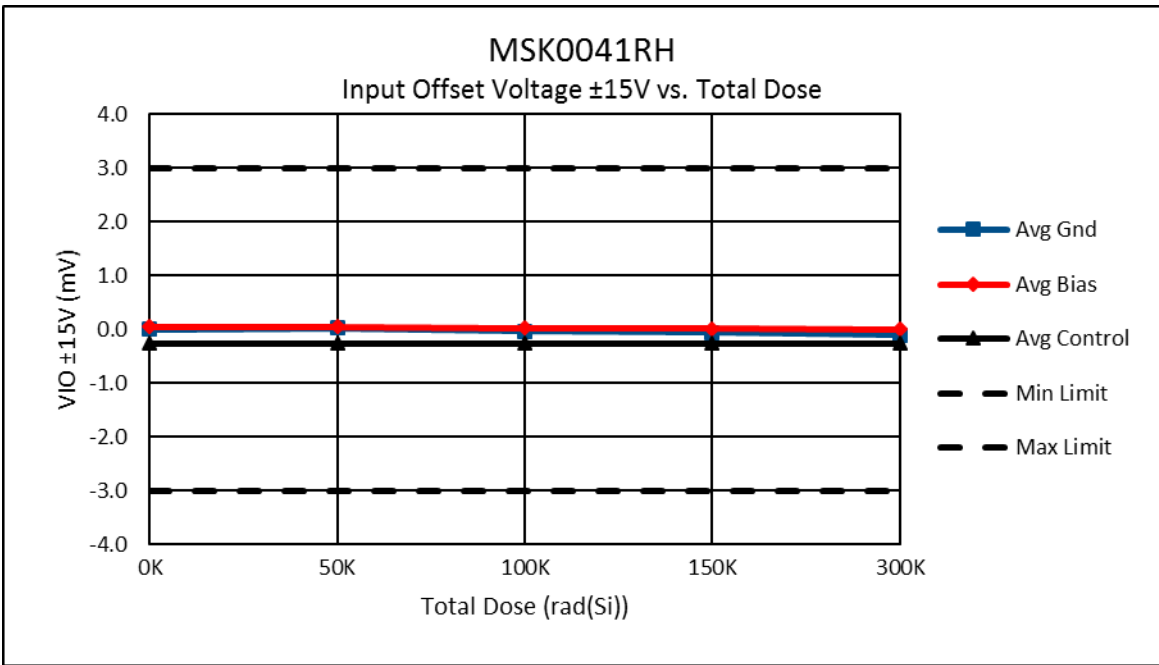
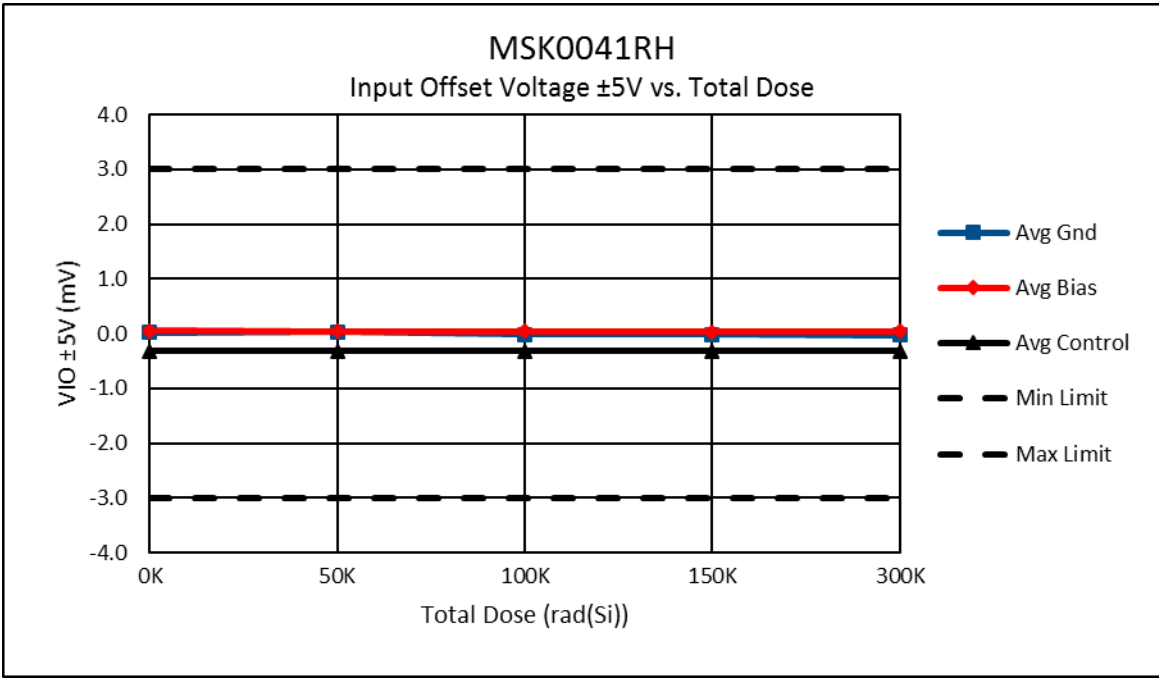
Exposure Length (min:sec)	Incremental Dose rad(Si)	Cumulative Dose rad(Si)
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7:19	51,500	103,000
7:19	51,500	154,500
21:56	154,500	309,000

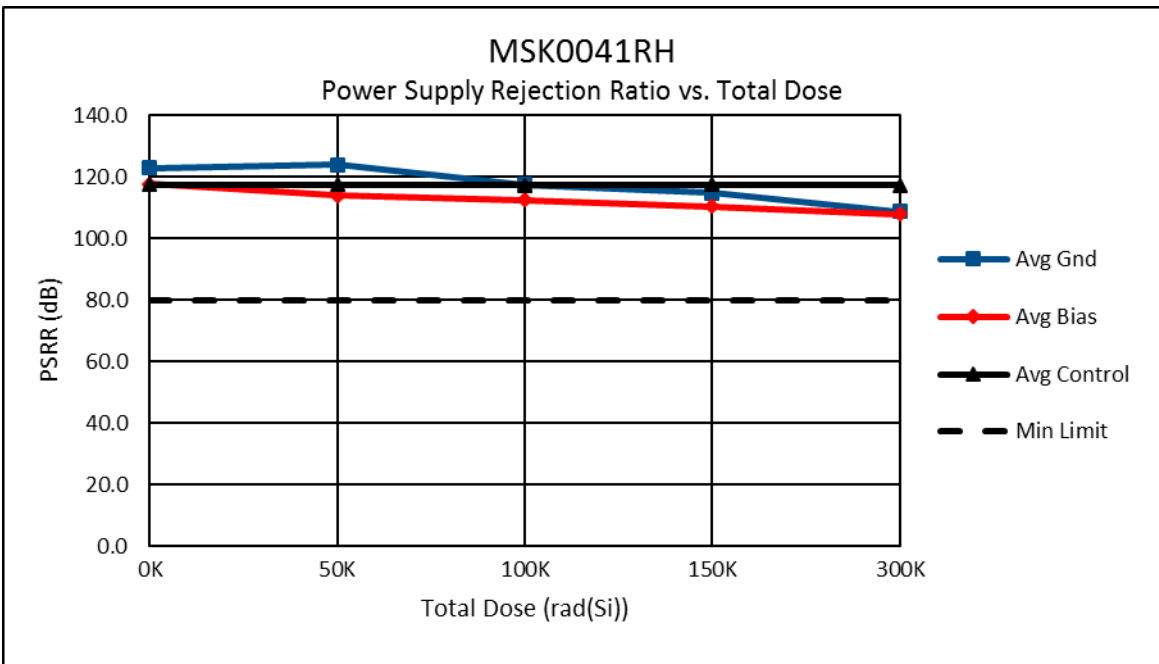
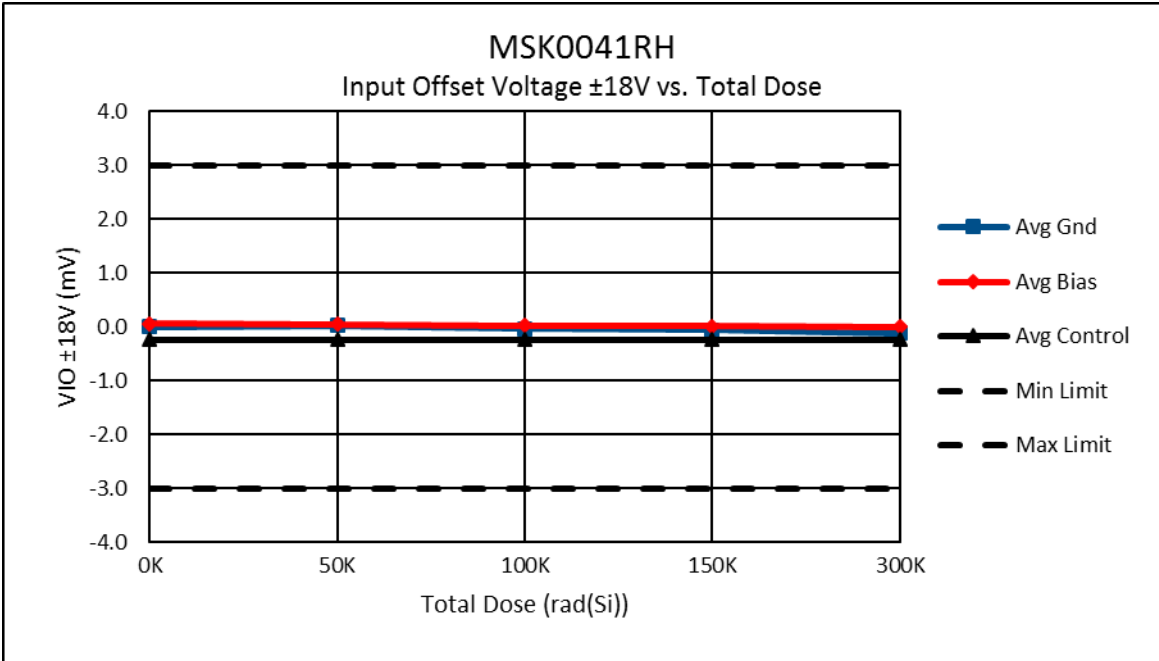
Biased S/N – 0003, 0004, 0005, 0006, 0007

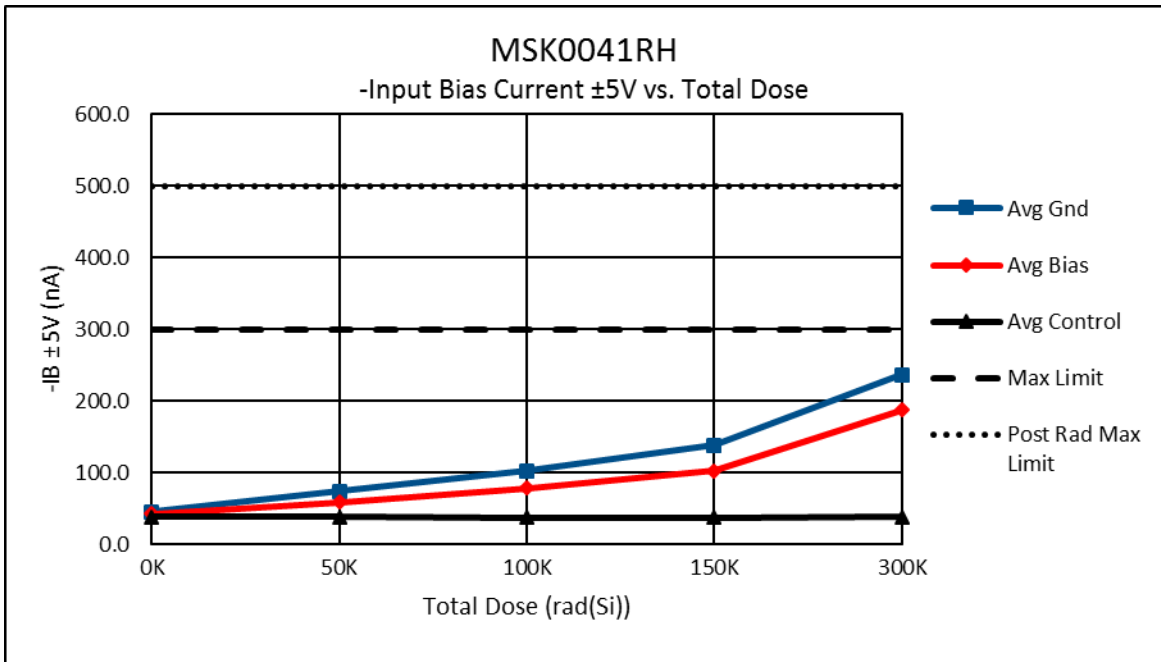
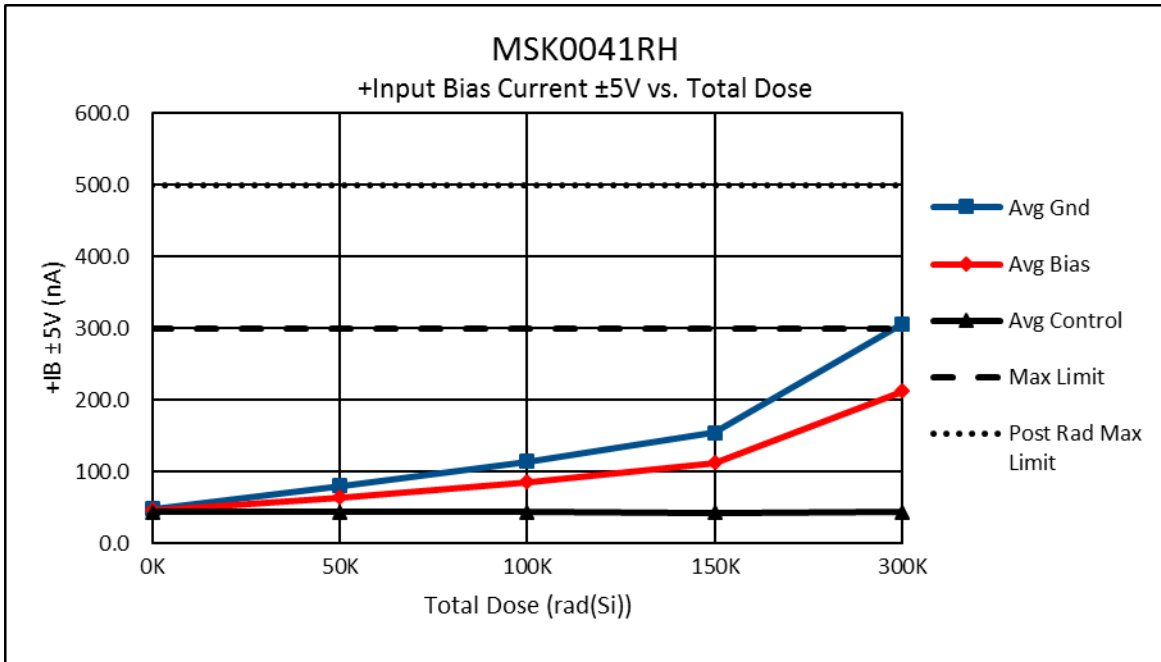
Unbiased S/N – 0008, 0009, 0010, 0011, 0012

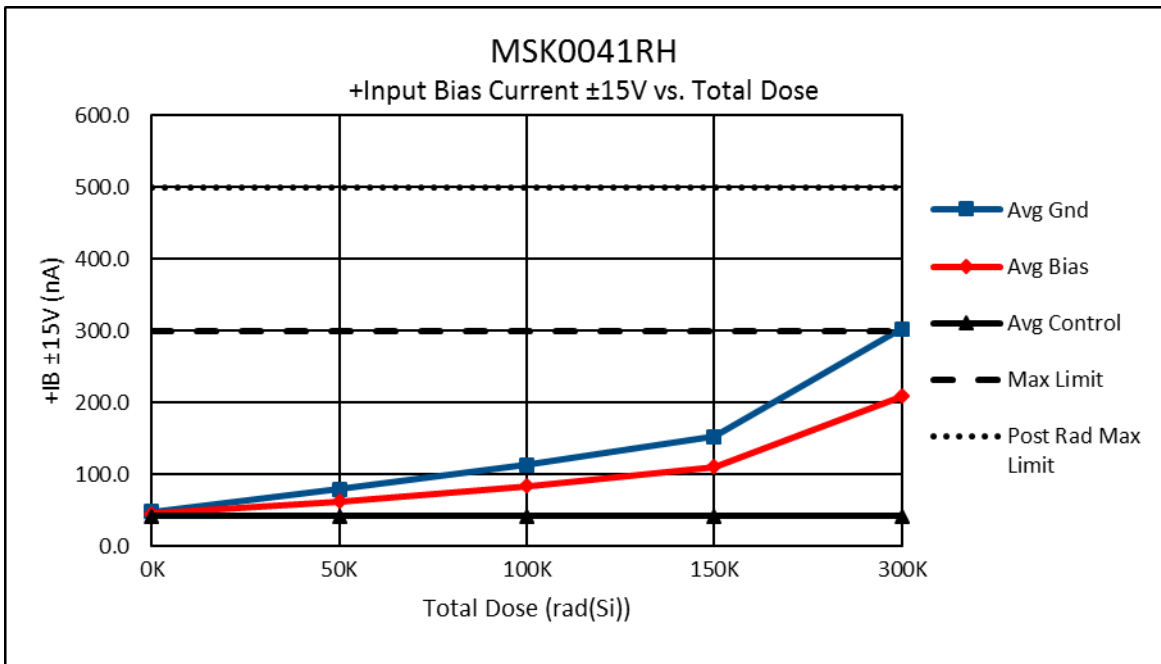
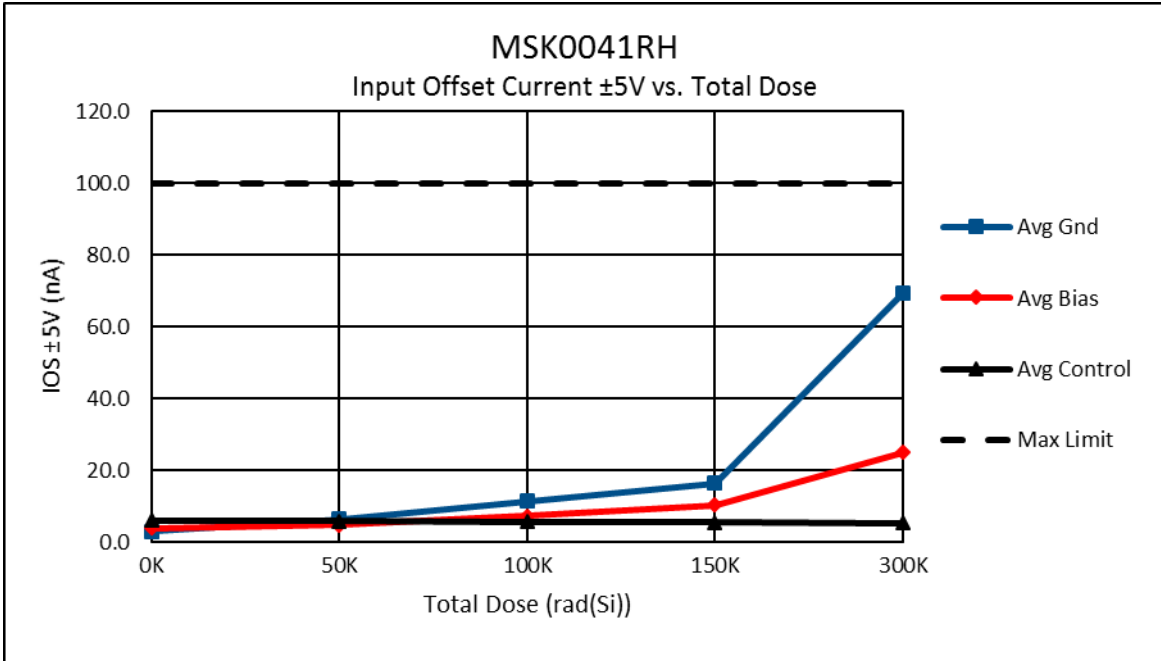
Table I
Dose Time, Incremental Dose and Total Cumulative Dose

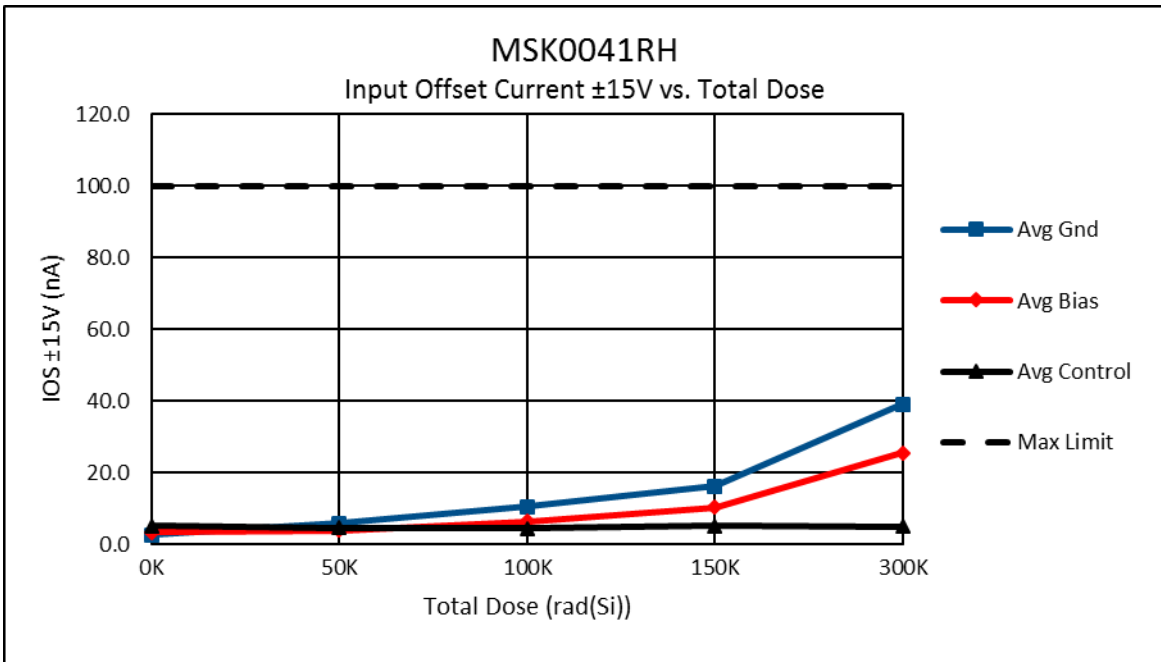
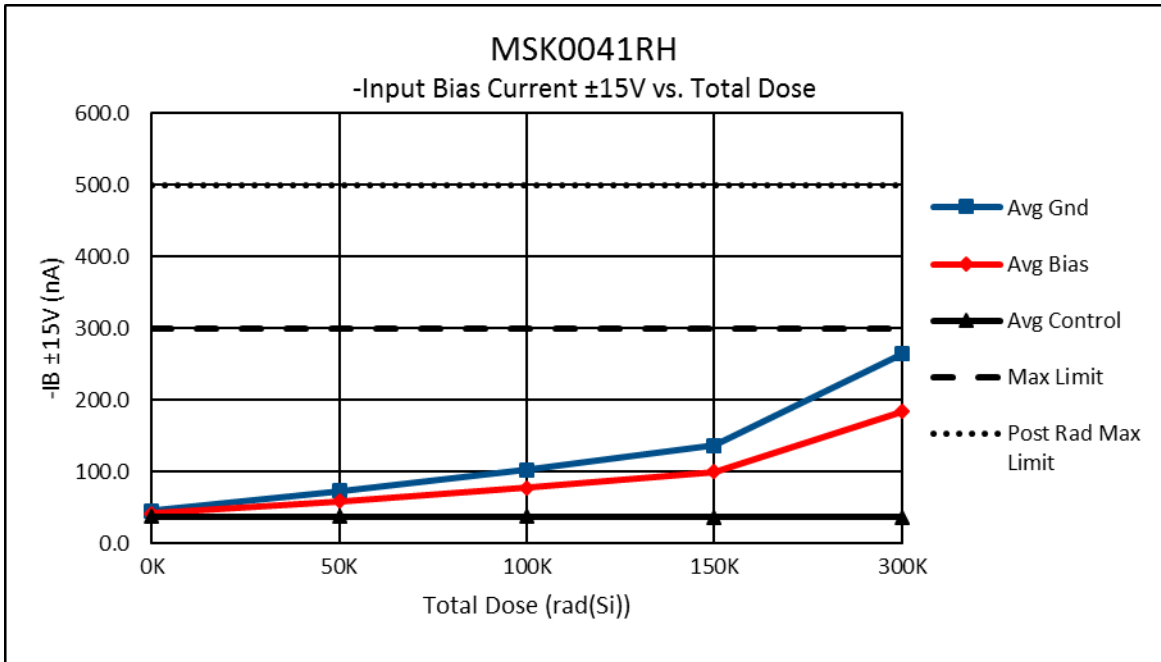


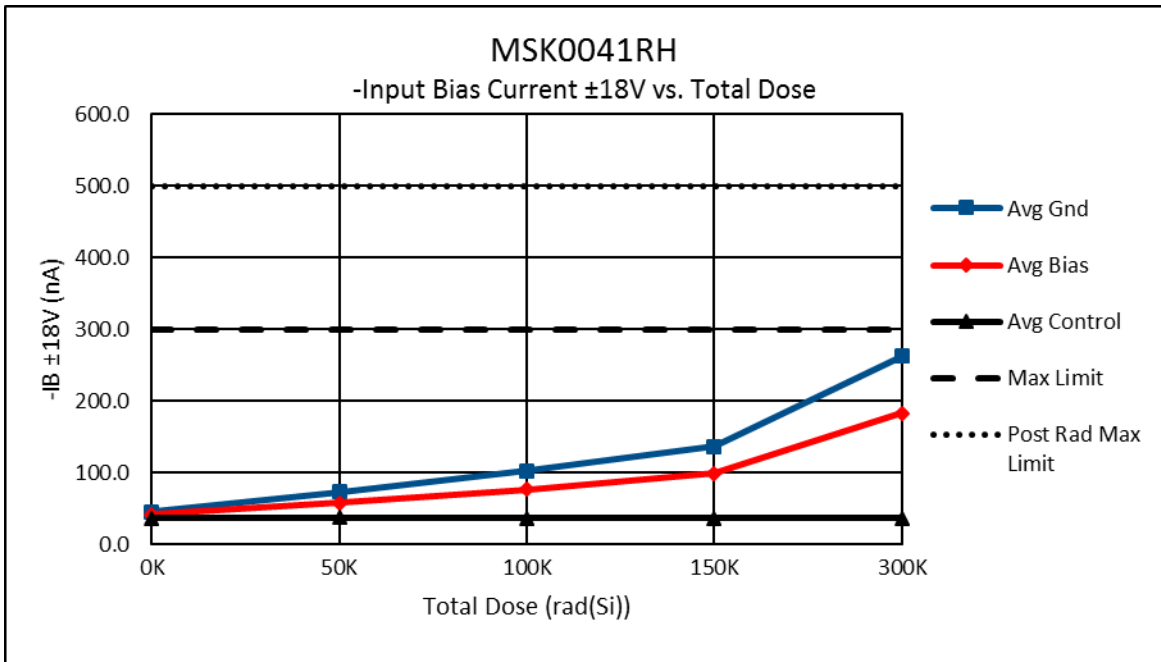
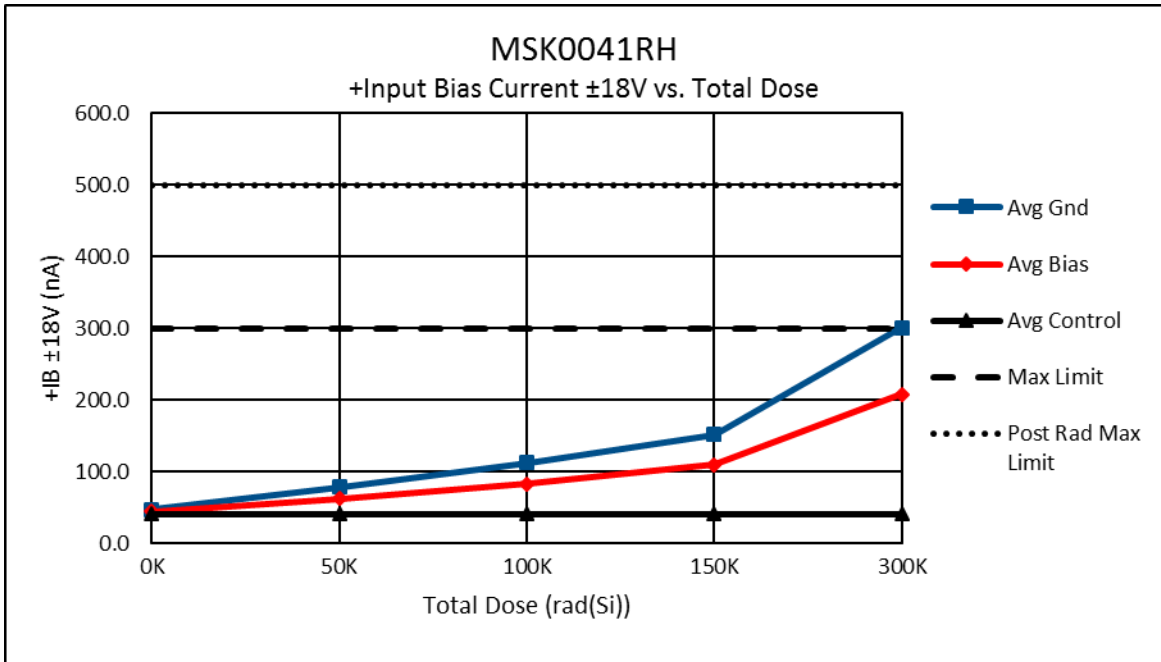


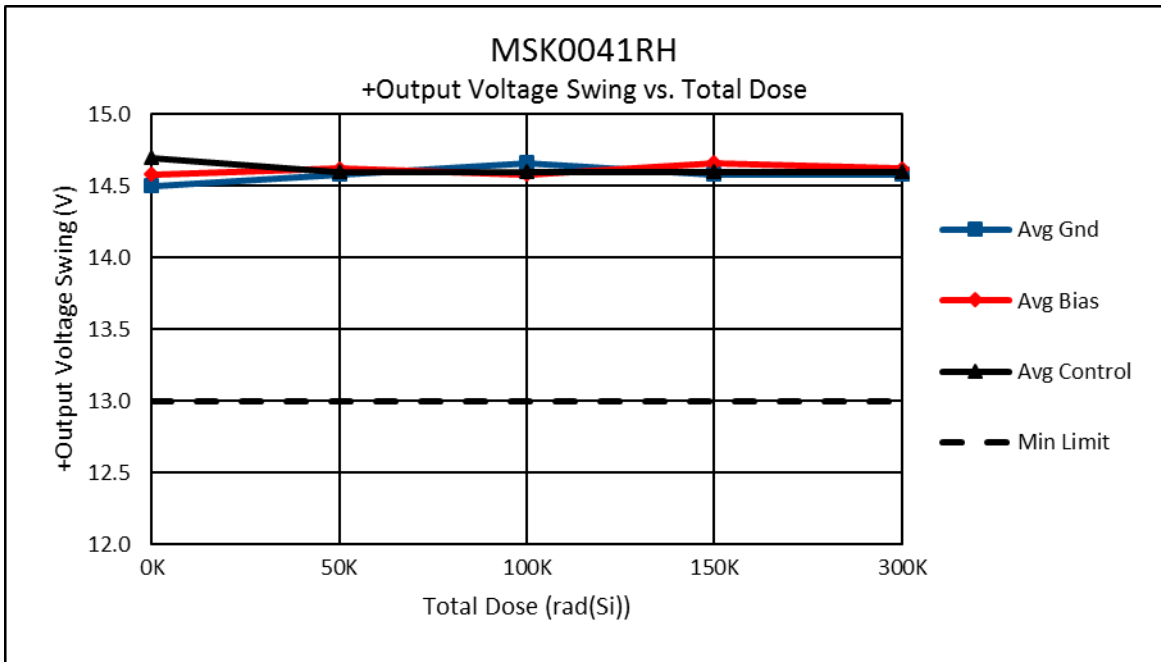
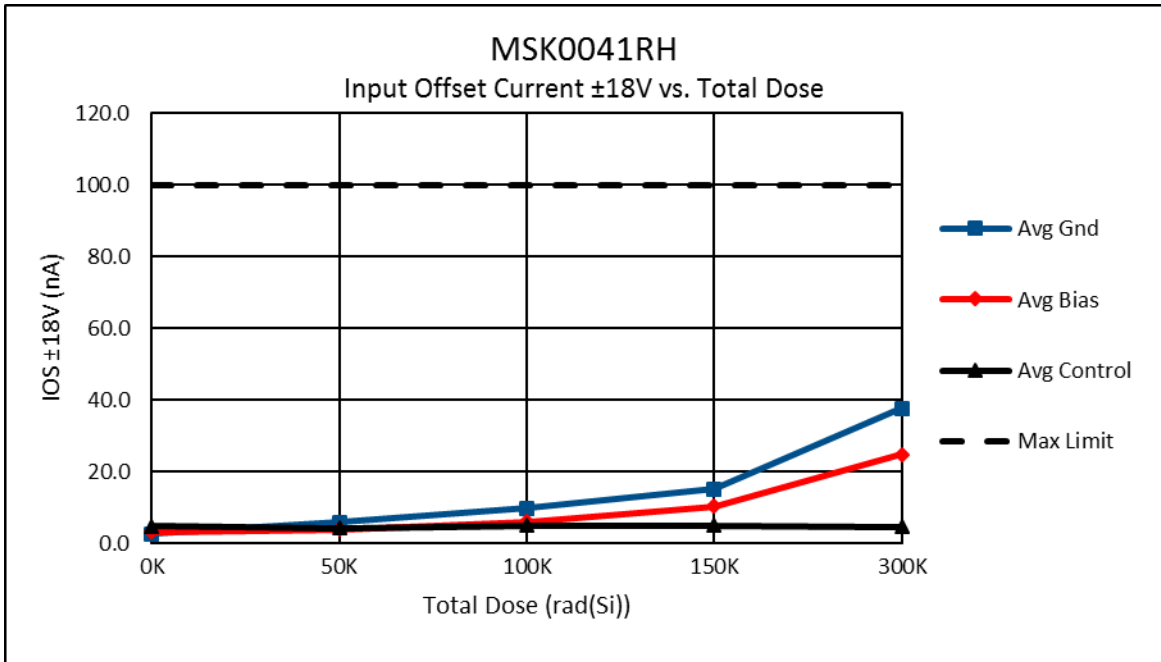


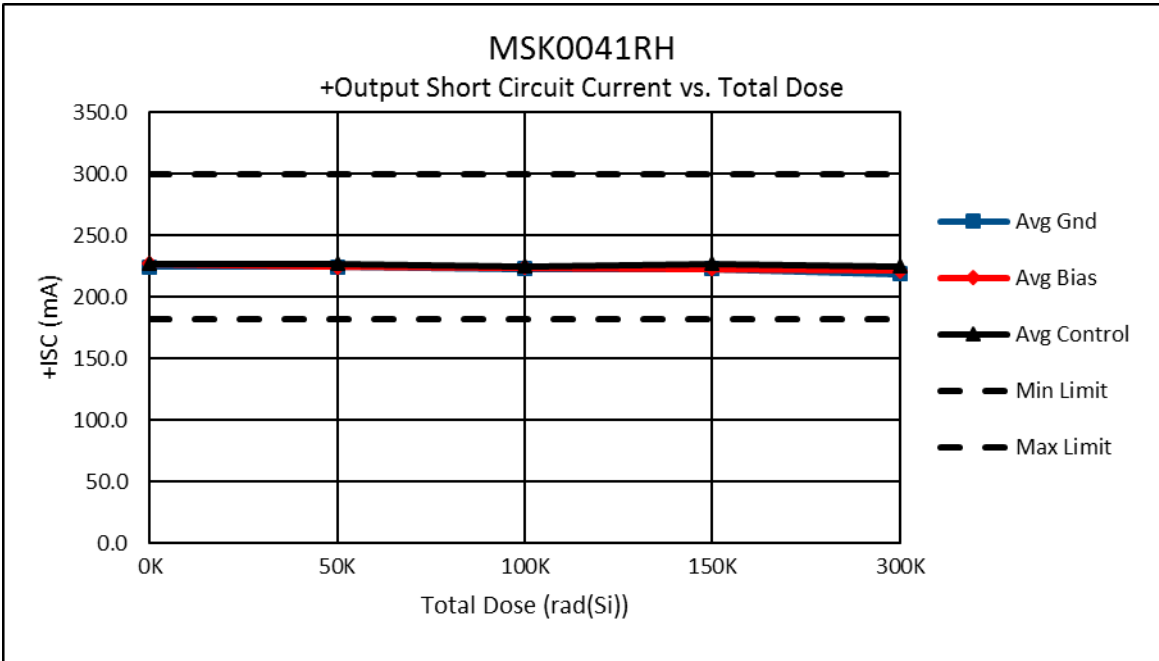
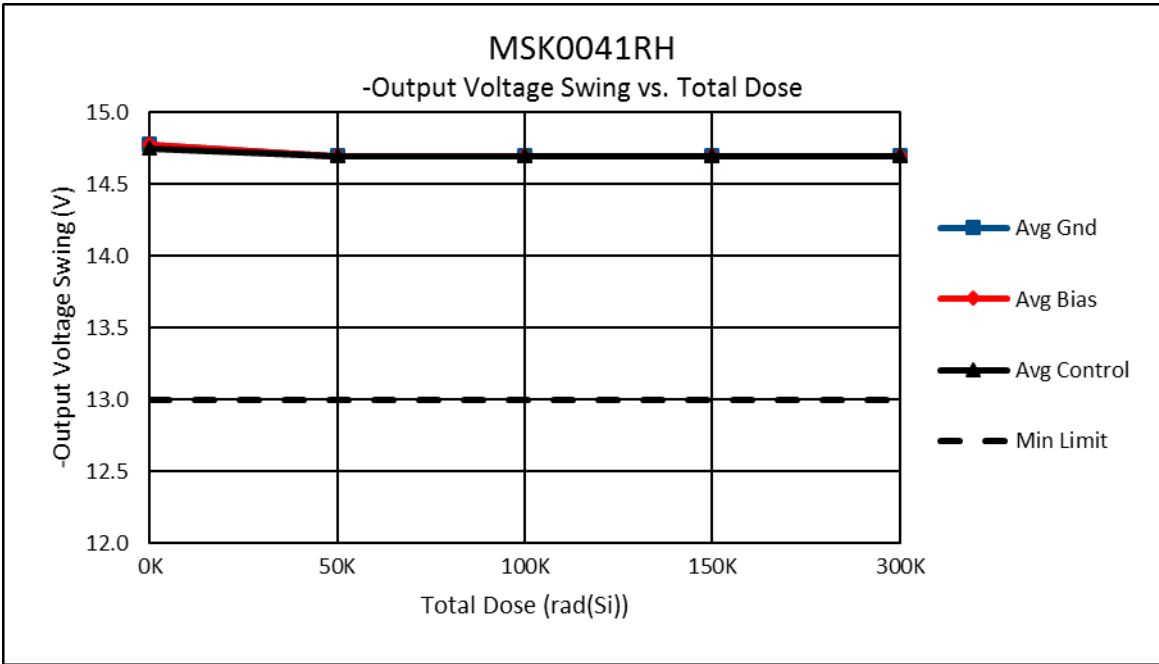


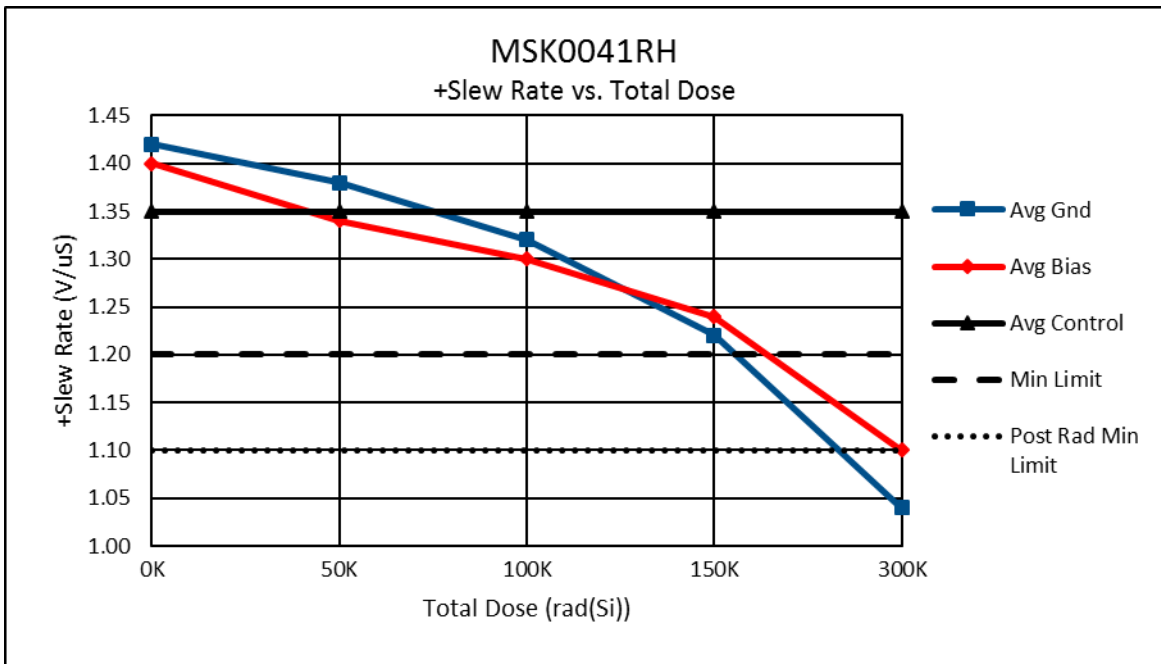
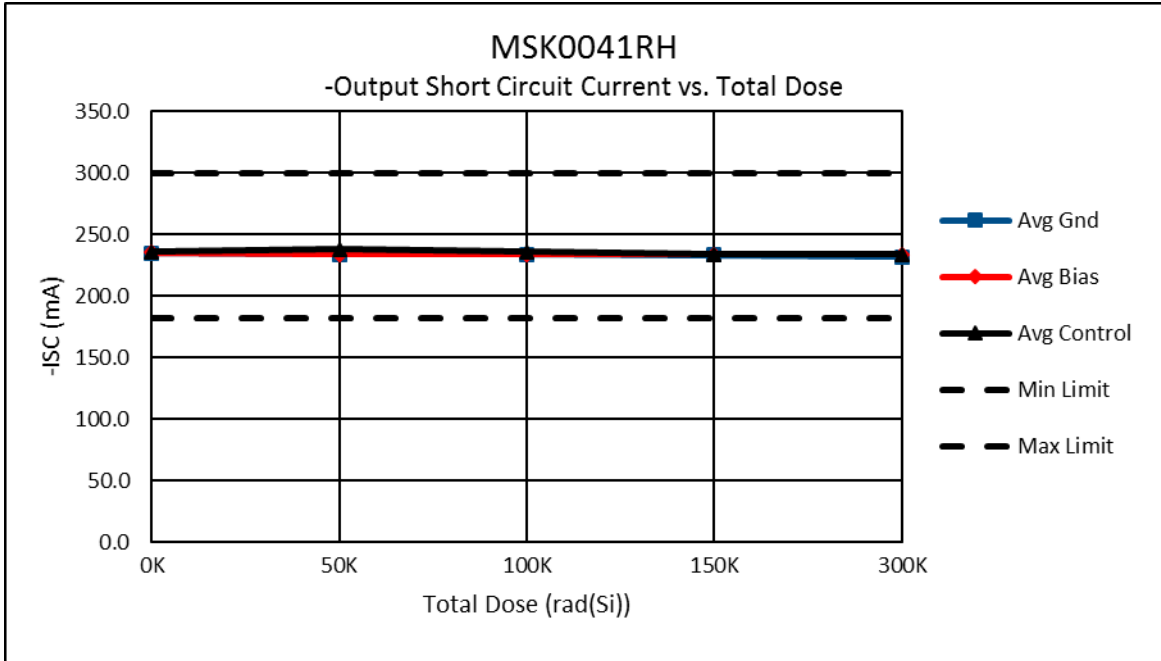


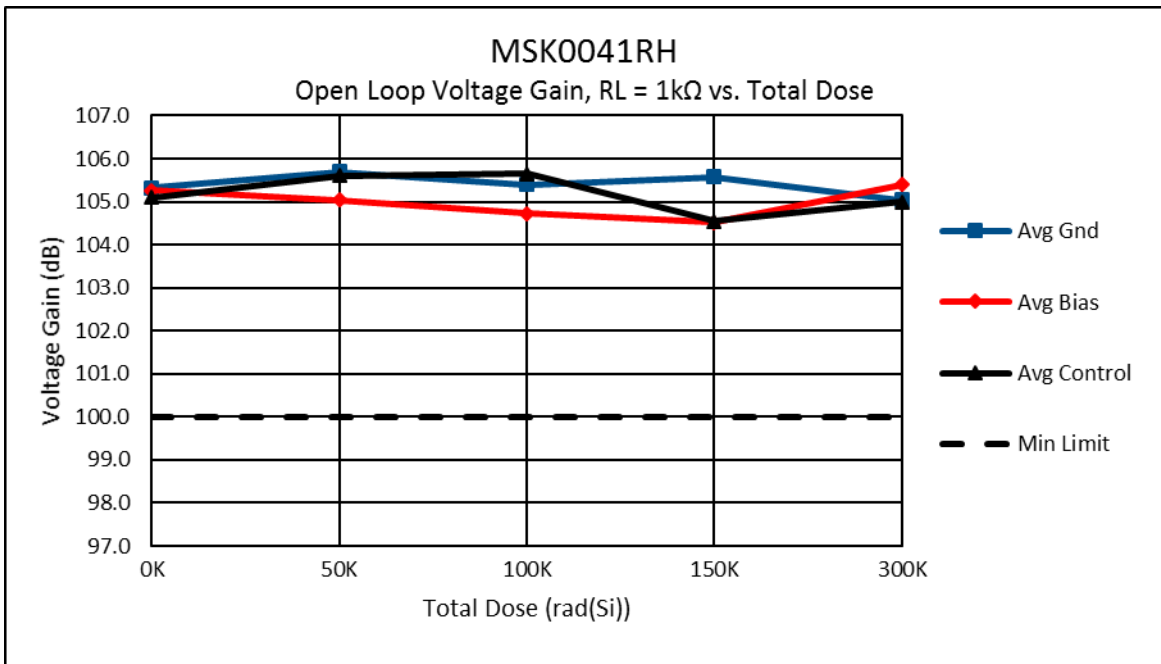
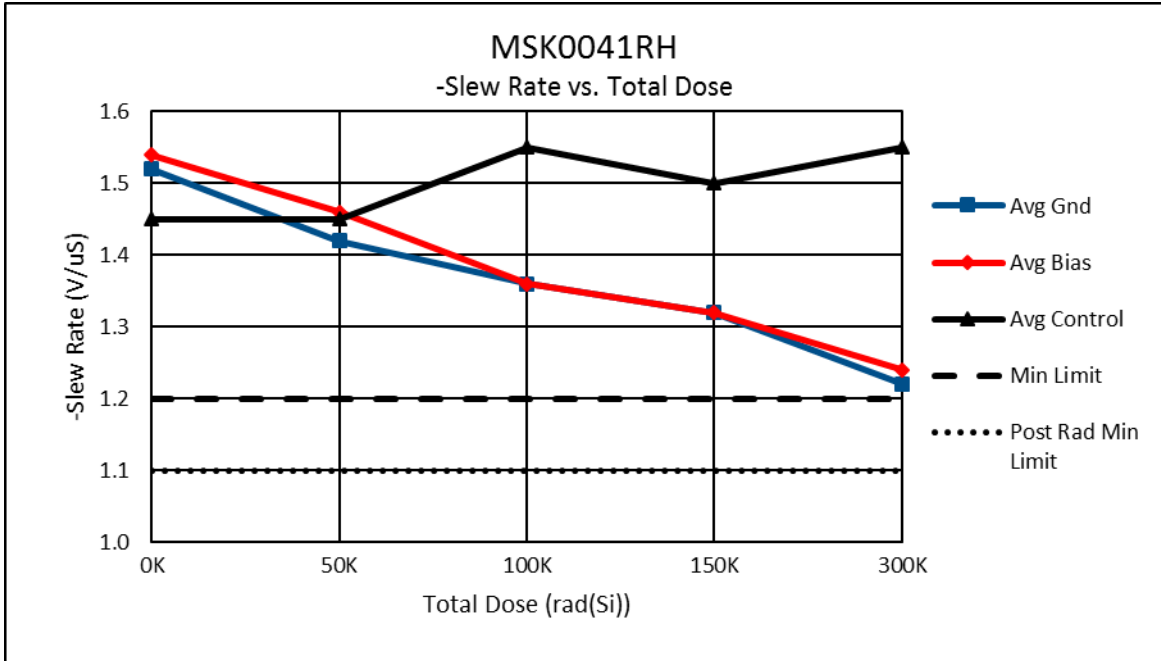


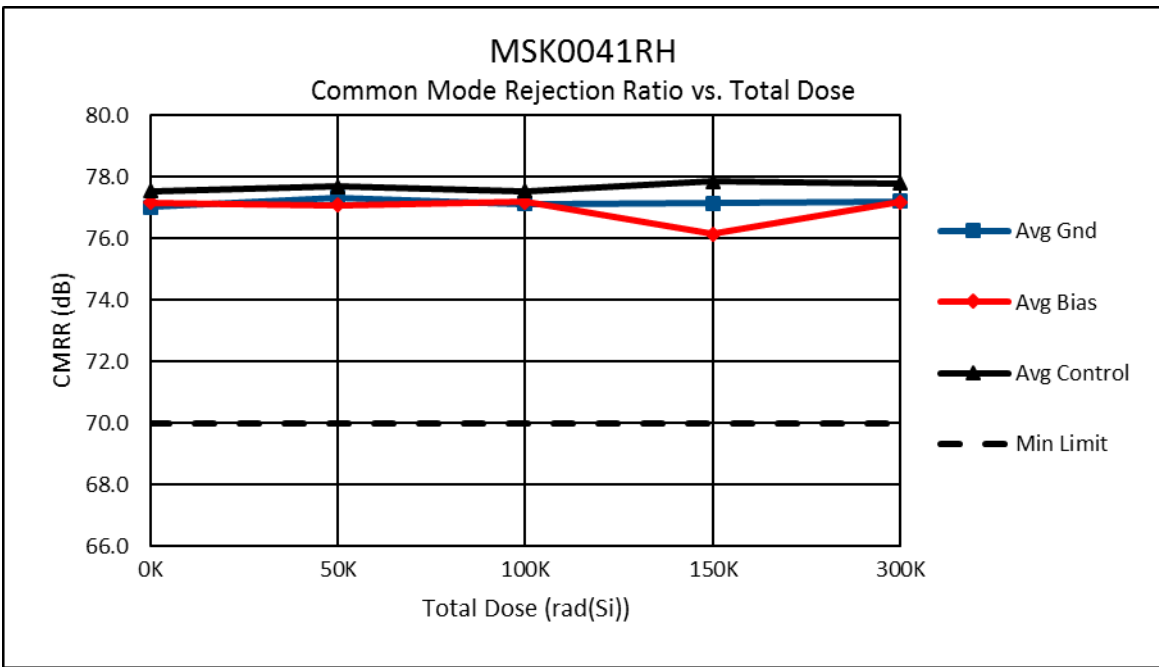
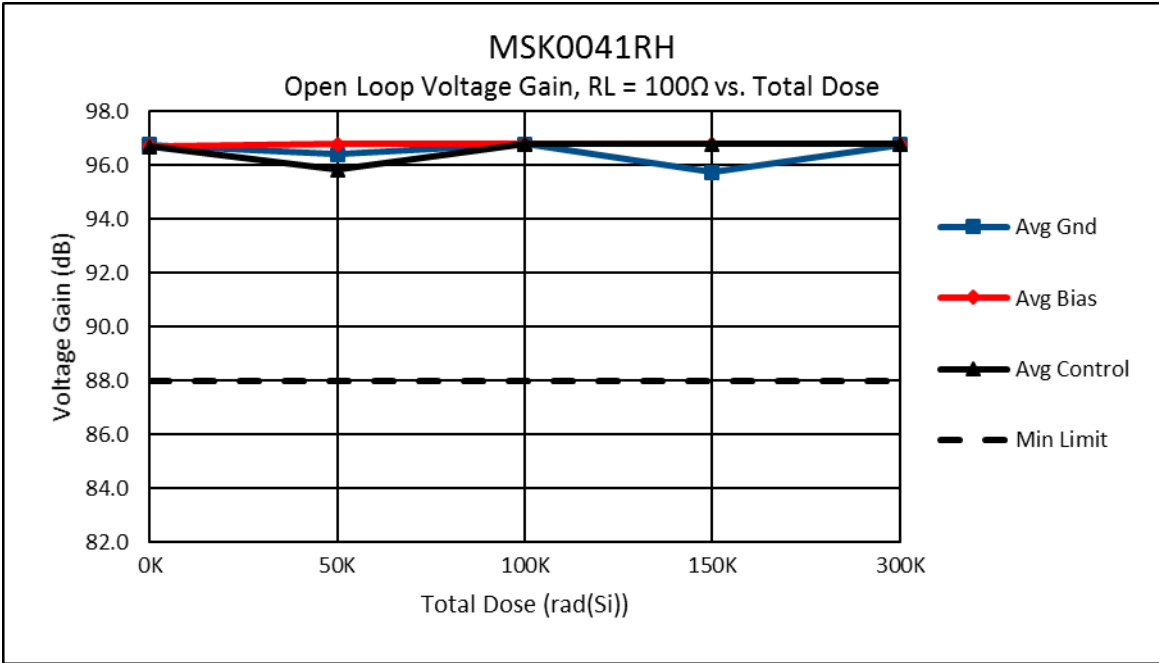


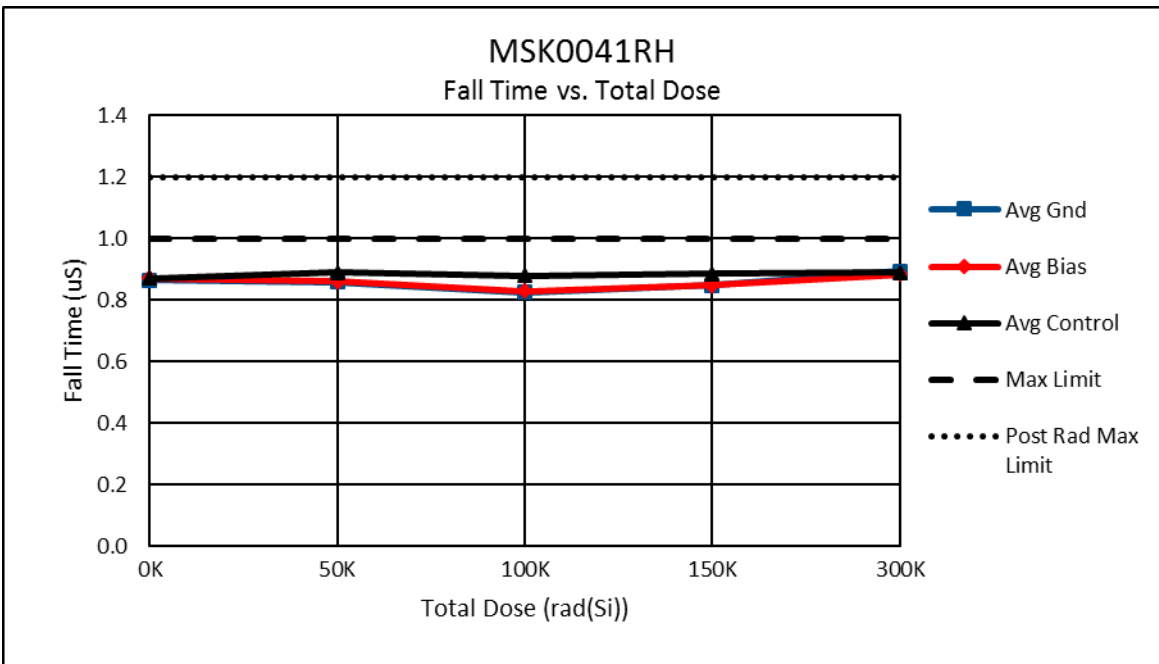
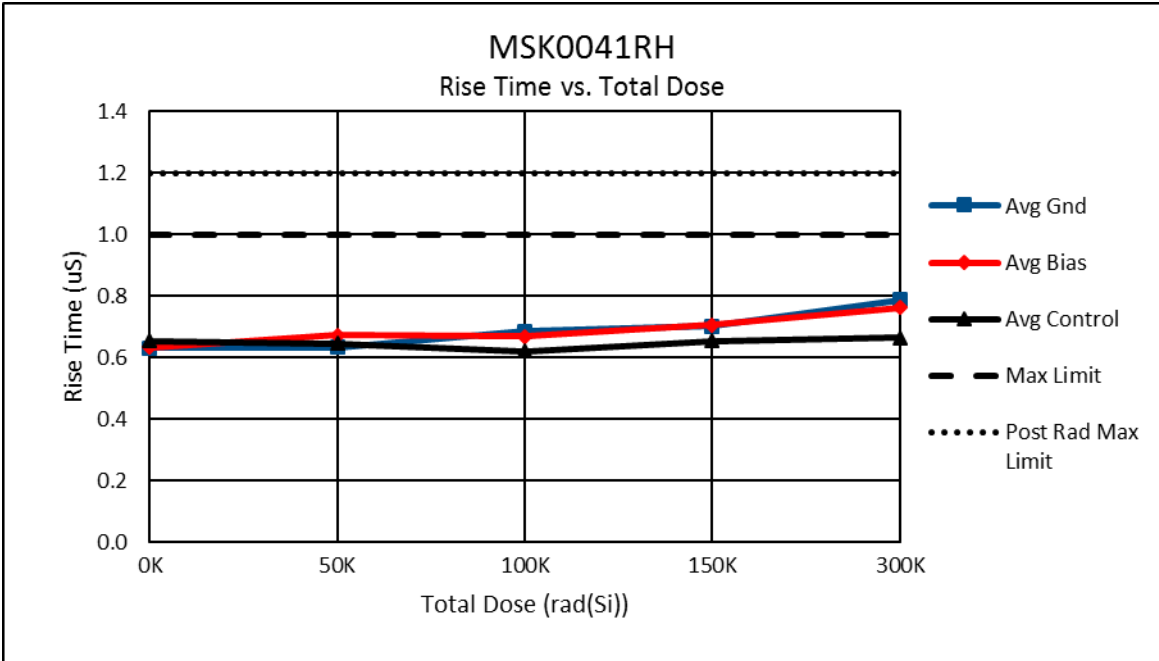


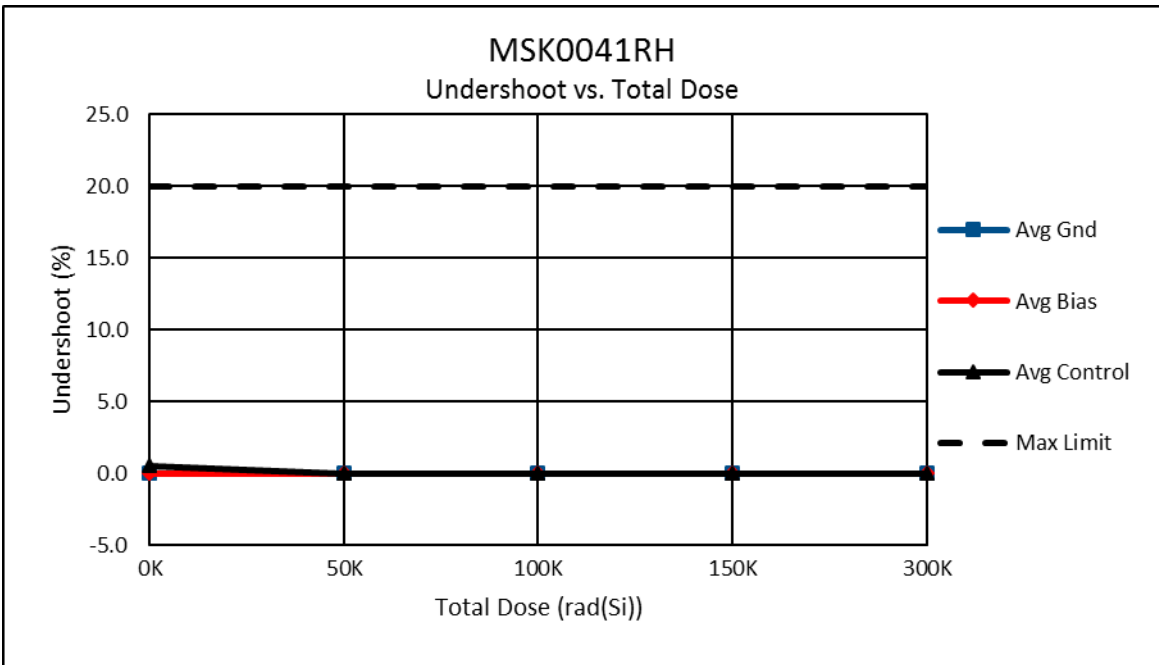
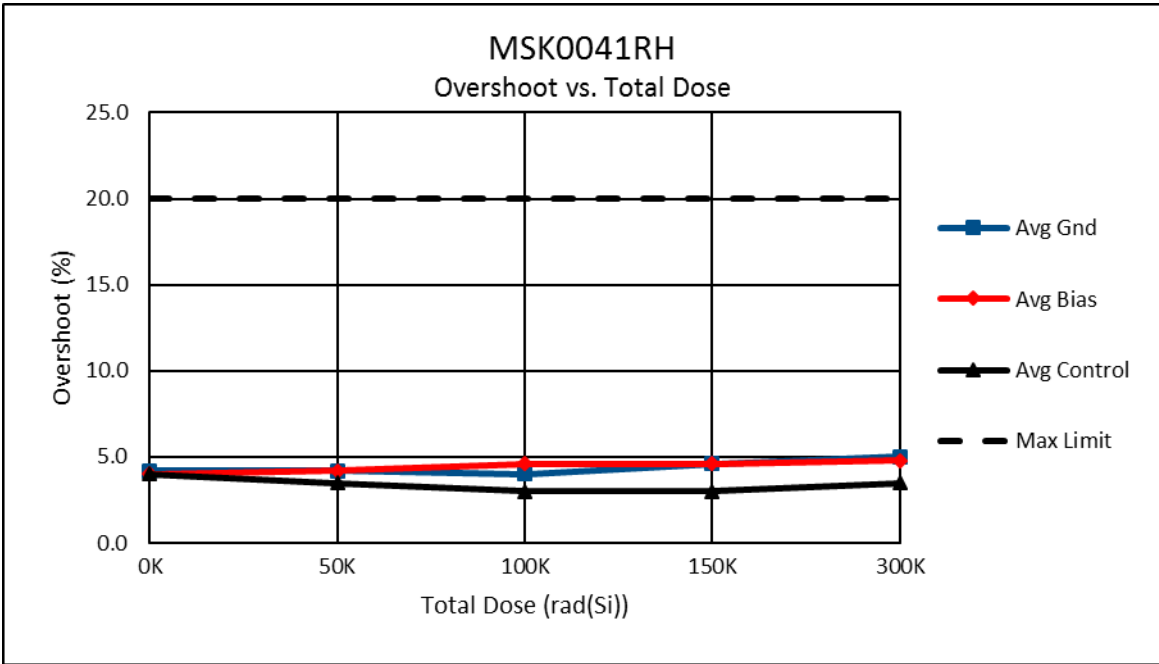












Total Dose Radiation Test Report
MSK 0041RH
Radiation Tolerant Power Operational Amplifier

January 08, 2008

J. Douglas
B. Erwin

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 0041RH was developed to qualify the device as radiation tolerant up to 100 Krad(Si). The testing was performed beyond 100 Krad(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the hybrid, but simply offers designers insight to the critical parameter-shifts beyond the specified total dose level.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK 0041RH.

II. Radiation Source:

Total dose was performed at the University of Massachusetts, Lowell, using a cobalt 60 radiation source. Dosimetry was performed prior to device irradiation and the dose rate was determined to be 98 rads(Si)/sec. The total dose schedule can be found in Table I.

III. Test Setup:

All test samples were subjected to Group A Electrical Test in accordance with the device data sheet. In addition, all devices received 320 hours of burn-in per MIL-STD-883 Method 1015 and were electrically tested prior to irradiation. For test platform verification, one control device was tested at 25°C.

The devices were vertically aligned with the radiation source and enclosed in a Pb/Al container during irradiation to minimize dose enhancement effects. Five devices were kept under bias during irradiation. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and were transported to the MSK automatic electrical test platform and tested IAW MSK device data sheet. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Electrical tests were completed within one hour of irradiation.

IV. Data:

All performance curves are averaged from the test results of the biased and unbiased devices respectively.

V. Summary:

The devices performed very well with respect to TID tolerance. Devices exhibited a slight quiescent current decrease.

Input bias current increased significantly, but stayed within specification limits to 150 Krads(Si).

Positive and negative slew rate decreased as testing progressed to 300 Krads(Si). However, slew rate values stayed within pre-irradiation limits up to 300Krads(Si).

In addition, transition times had a slight increase, but also stayed within pre-irradiation limits throughout testing.

MSK0041RH Biased/Unbiased Dose Rate
Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
12/13/2007

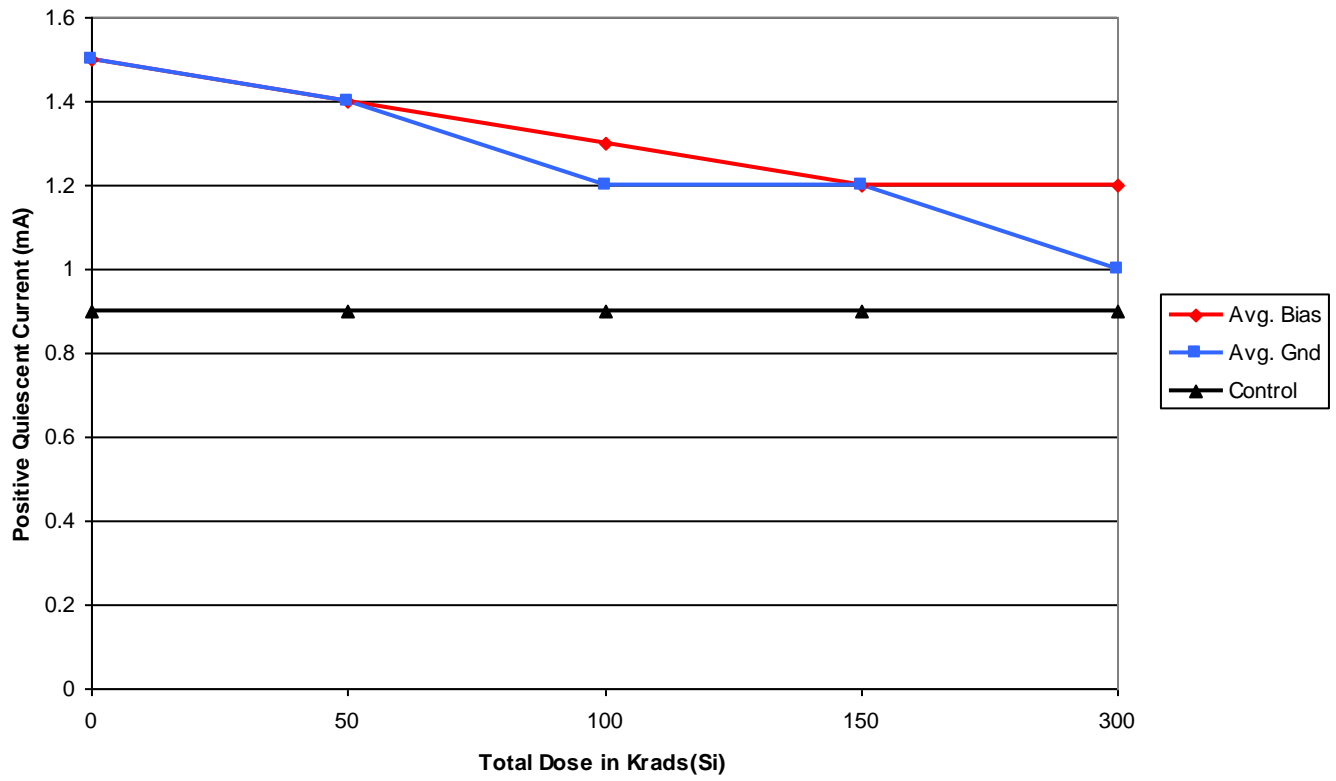
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
8:46	51,548	51,548
8:46	51,548	103,096
8:46	51,548	154,644
26:18	154,644	309,288

Biased S/N - 0016, 0017, 0018, 0019, 0020

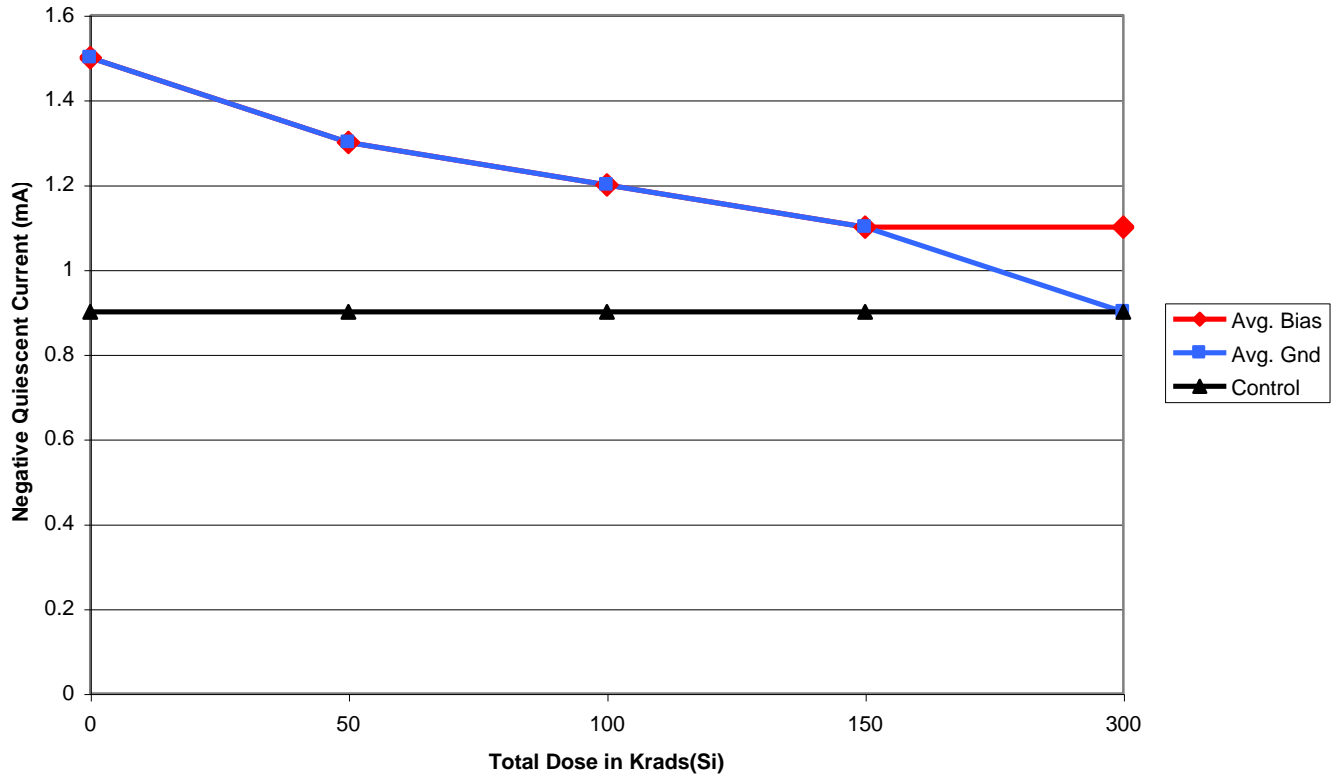
Unbiased S/N - 0021, 0022, 0023, 0024, 0025

Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

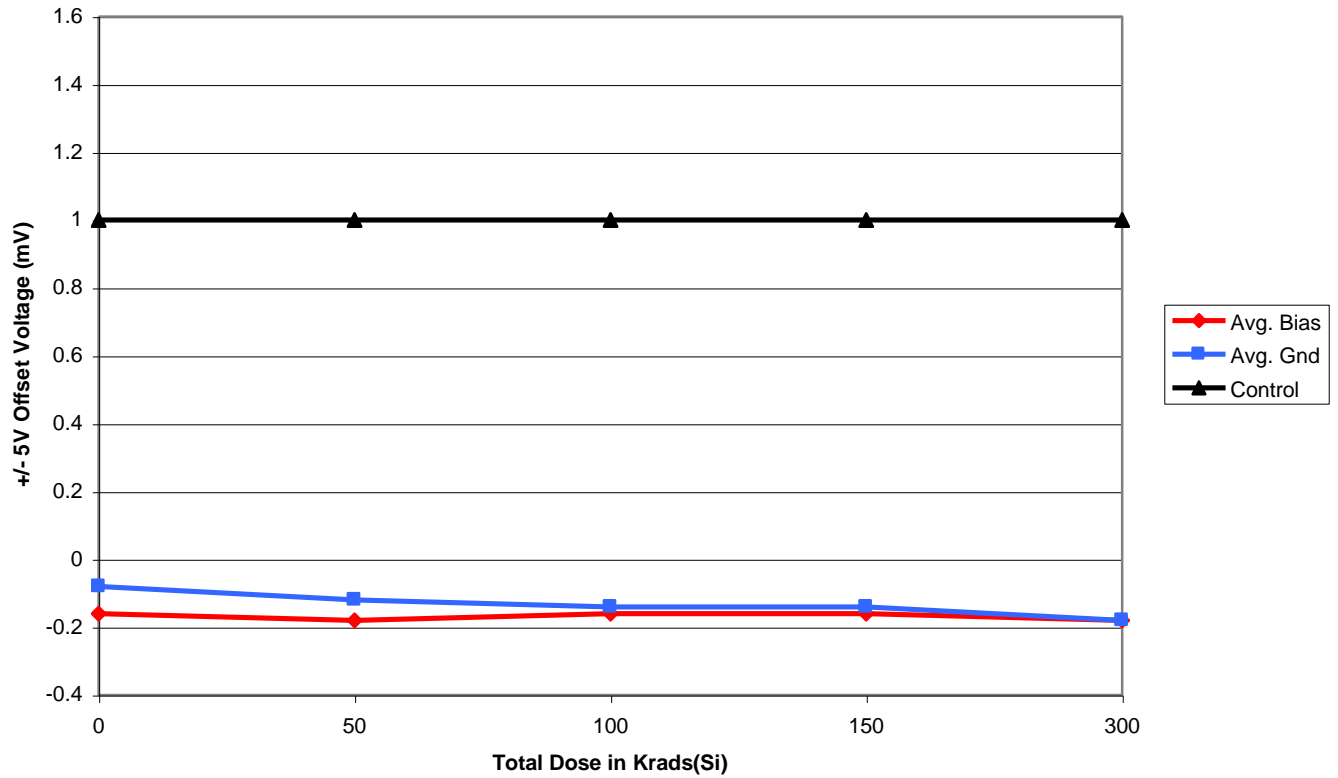
Positive Quiescent Current vs. Total Dose



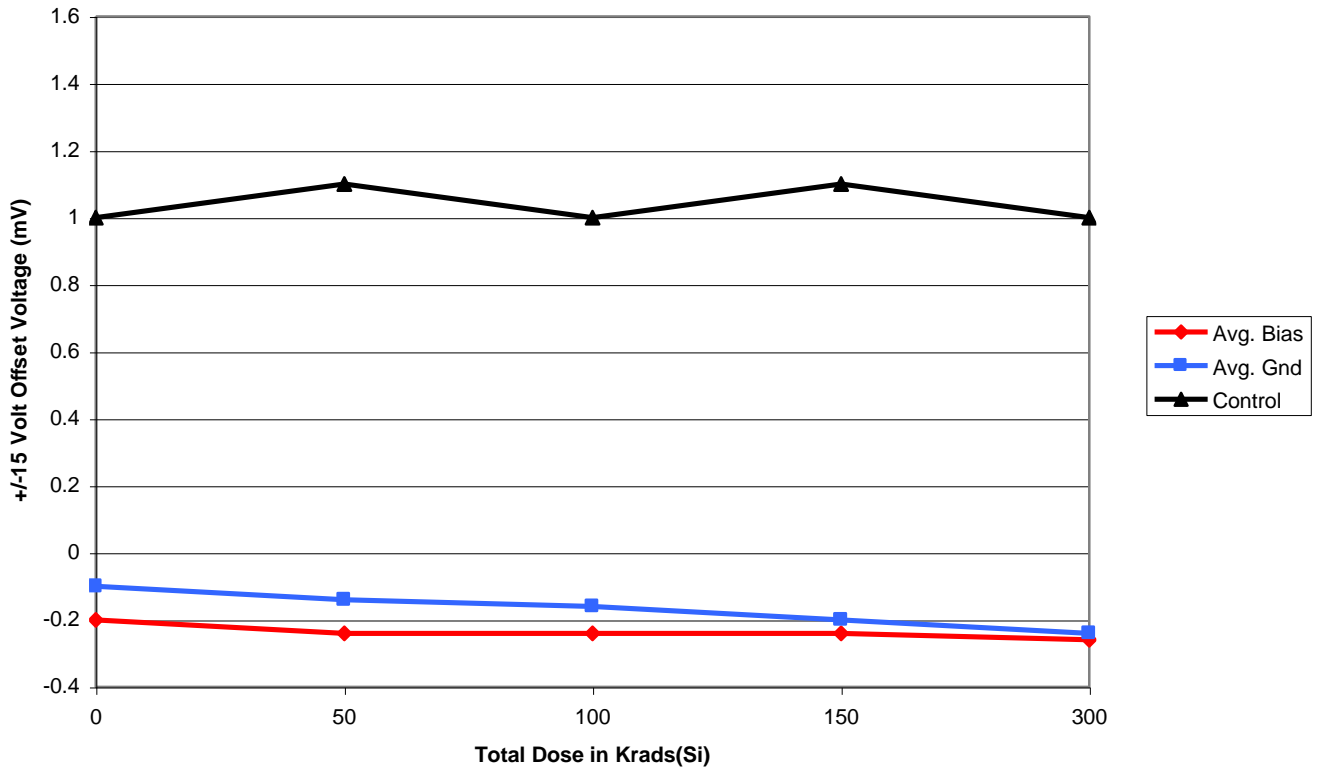
Negative Quiescent Current vs. Total Dose



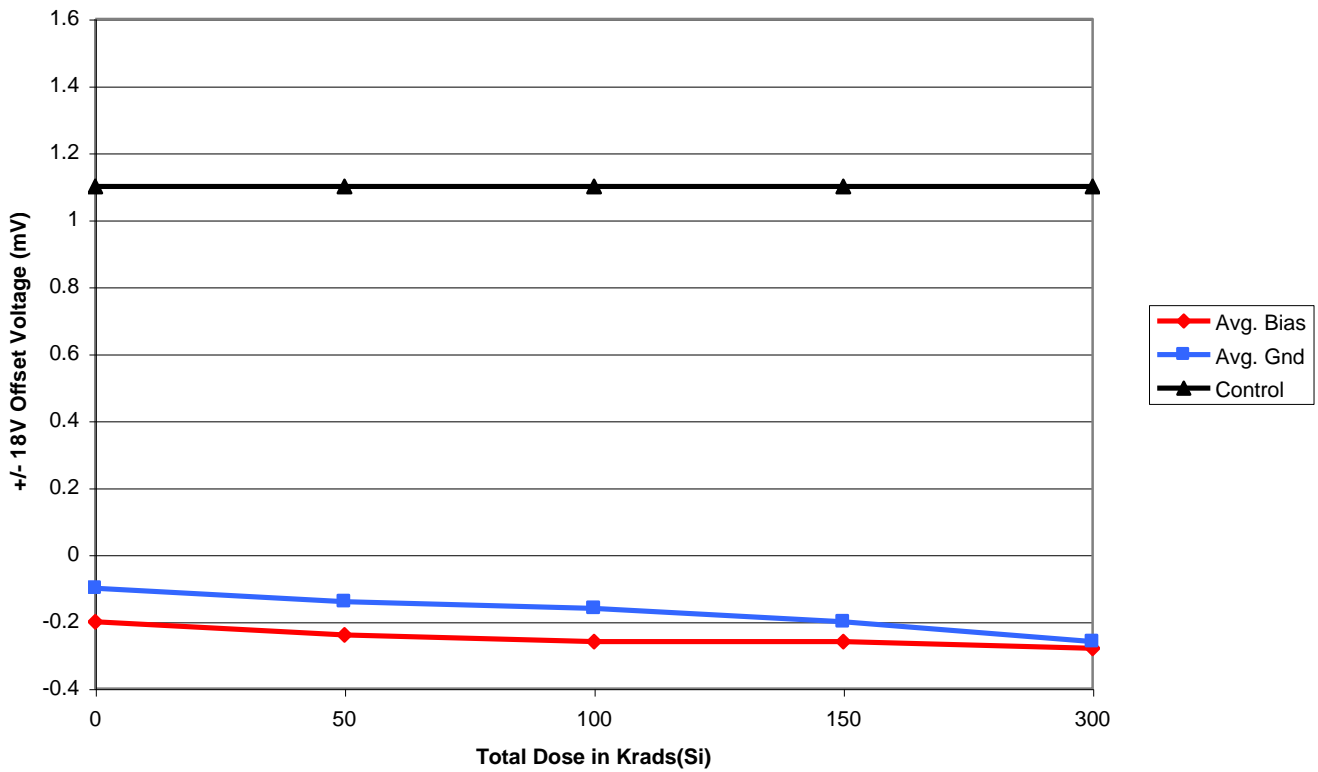
+/- 5V Offset Voltage vs. Total Dose



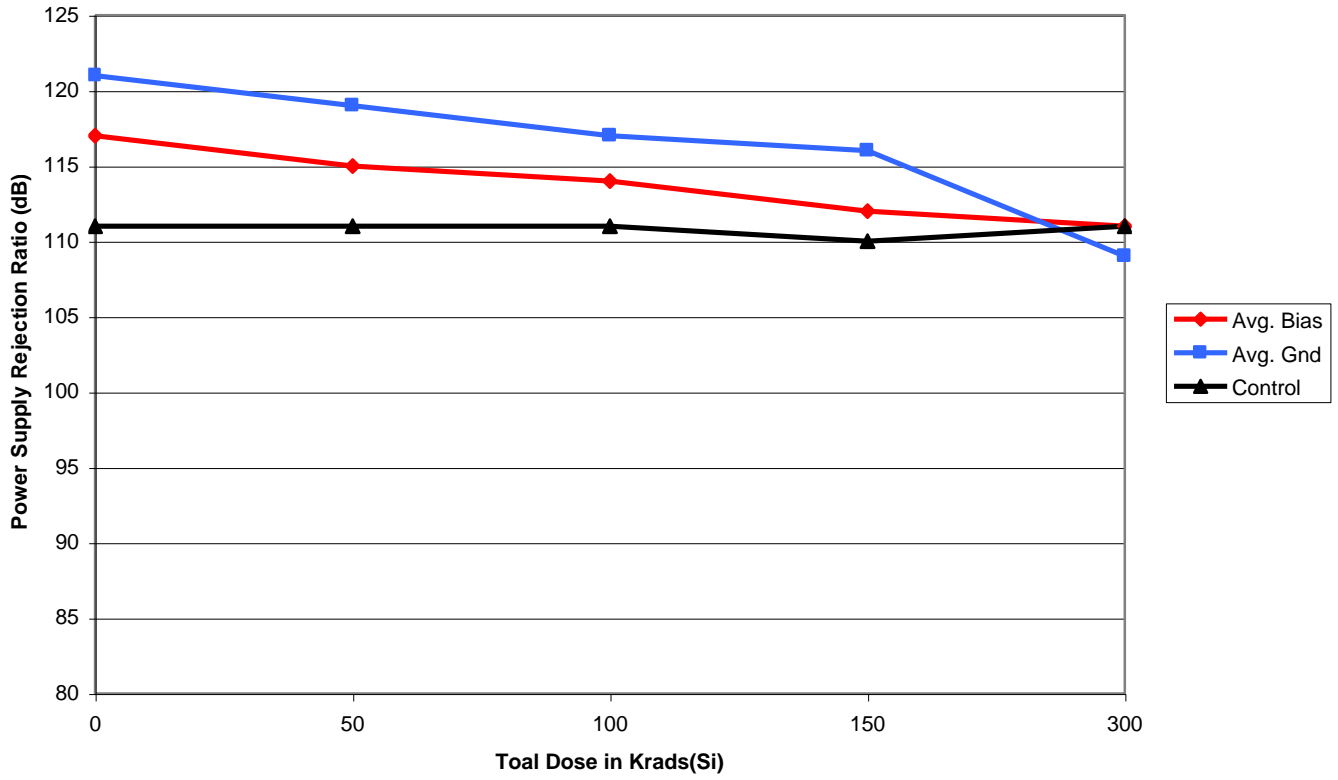
+/- 15 Volt Offset vs. Total Dose



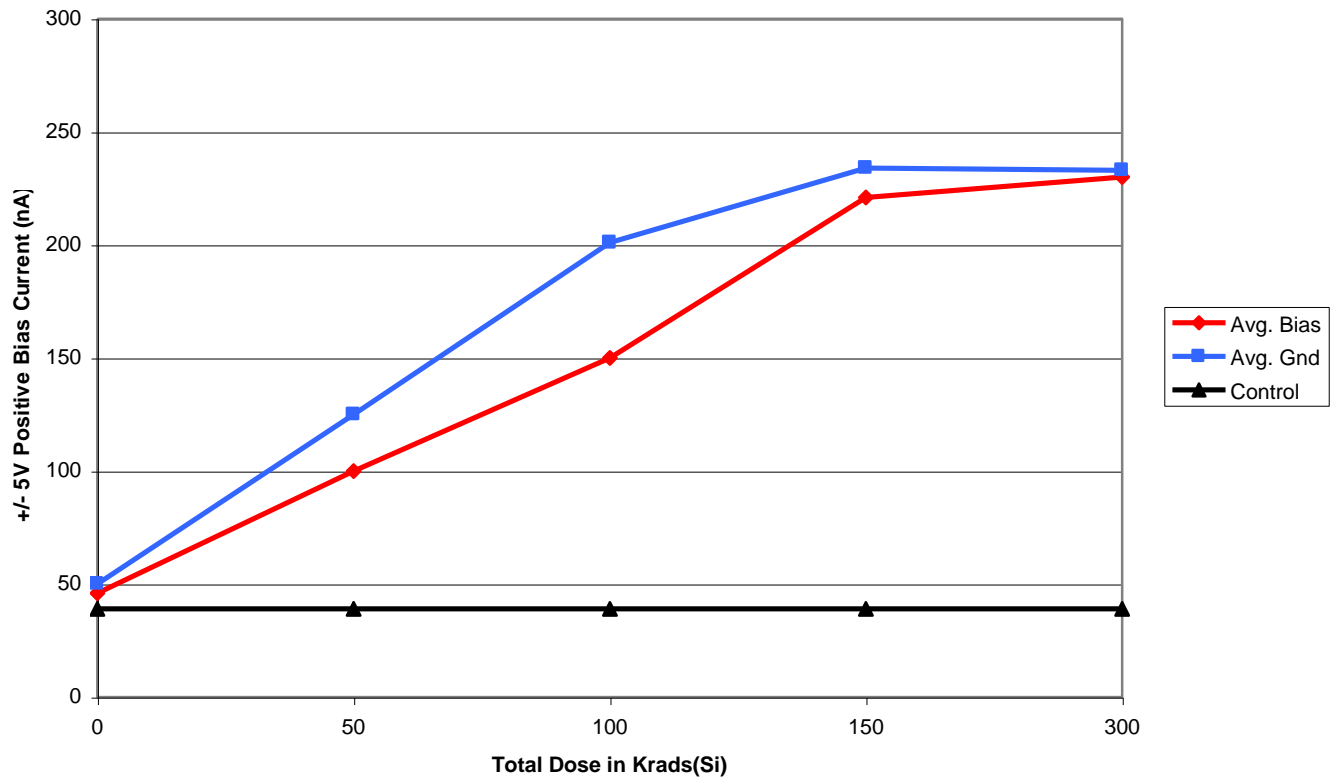
+/- 18V Offset Voltage vs. Total Dose



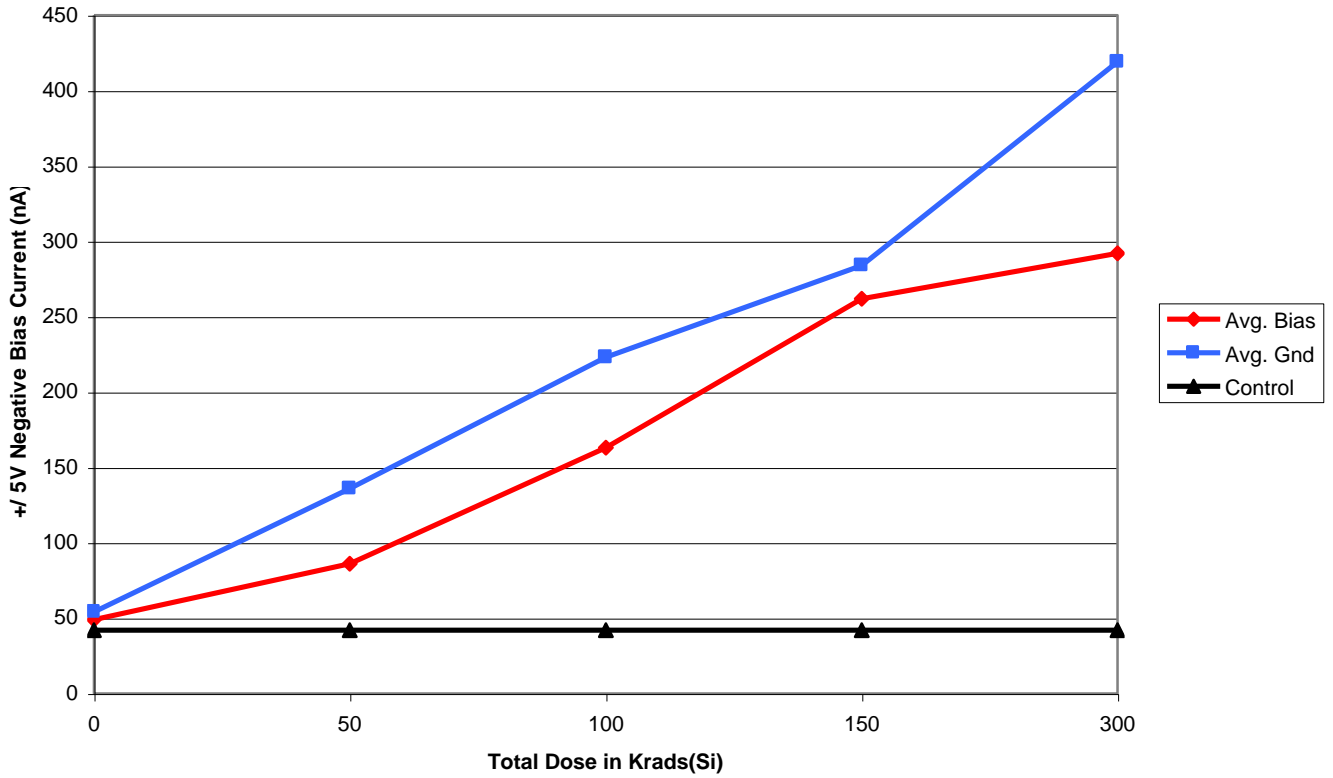
Power Supply Rejection Ratio vs. Total Dose



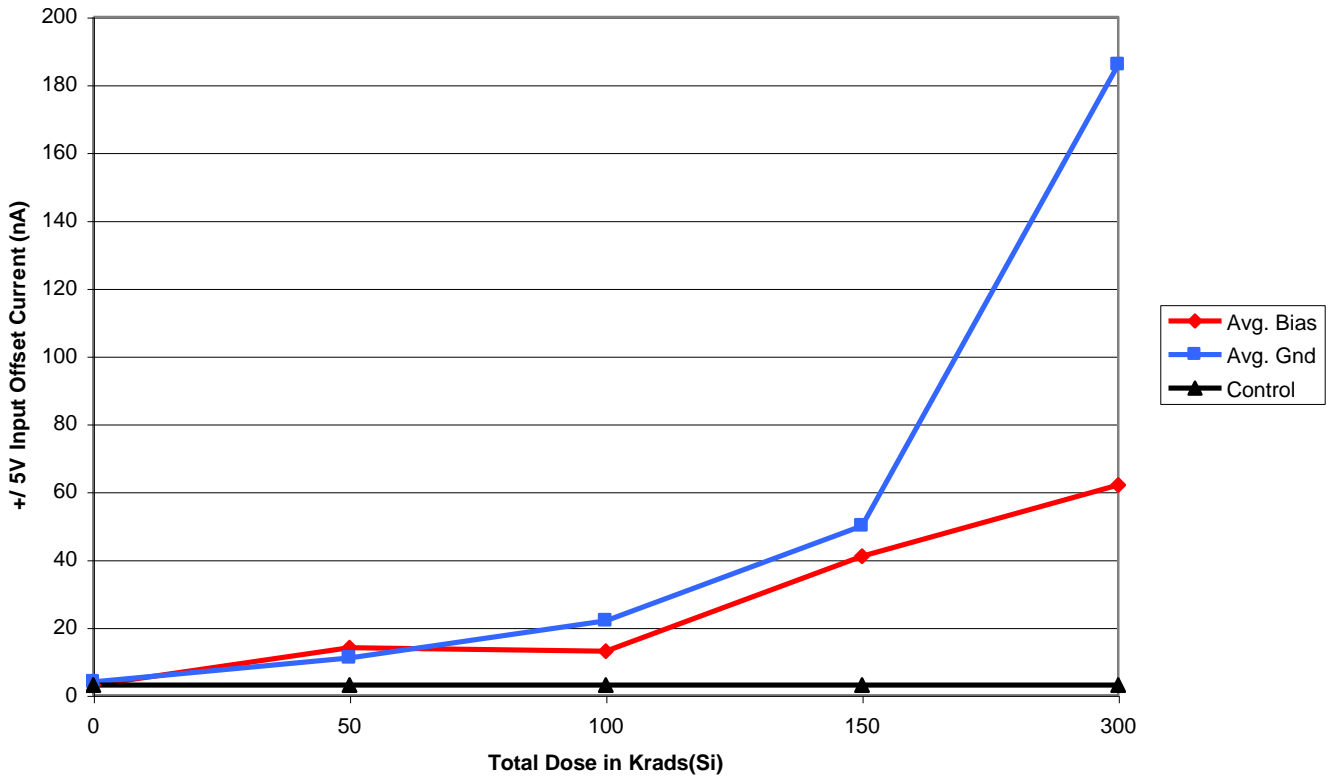
+/- 5V Positive Input Bias Current vs. Total Dose



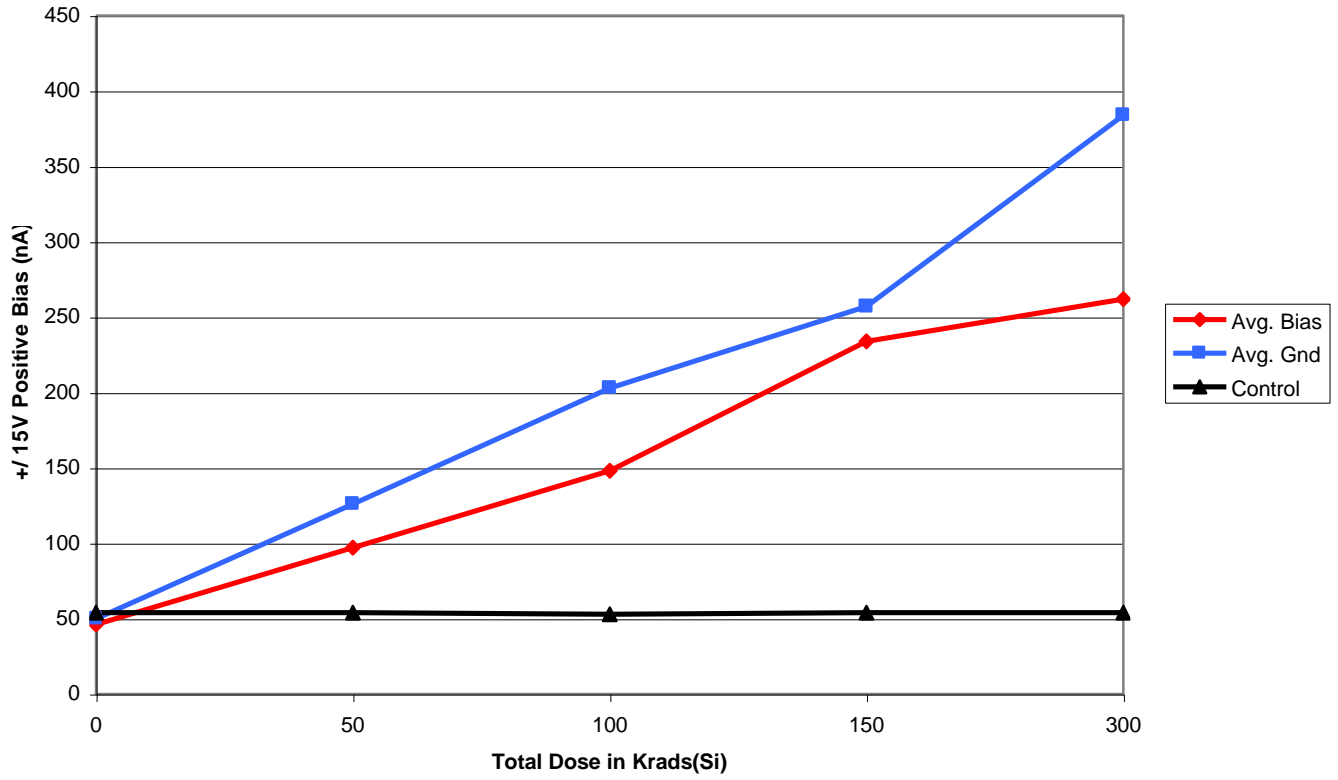
+/- 5V Negative Input Bias Current vs. Total Dose



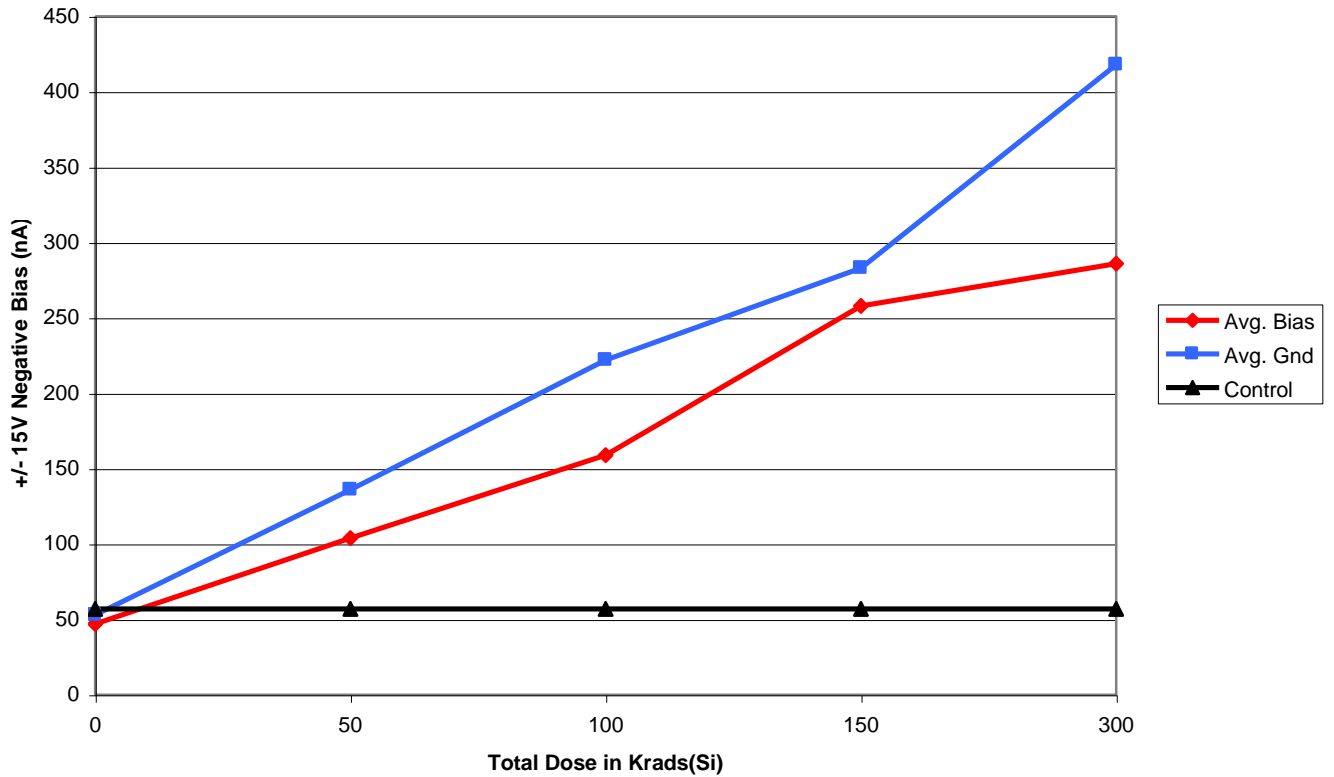
+/- 5V Input Offset Current vs. Total Dose



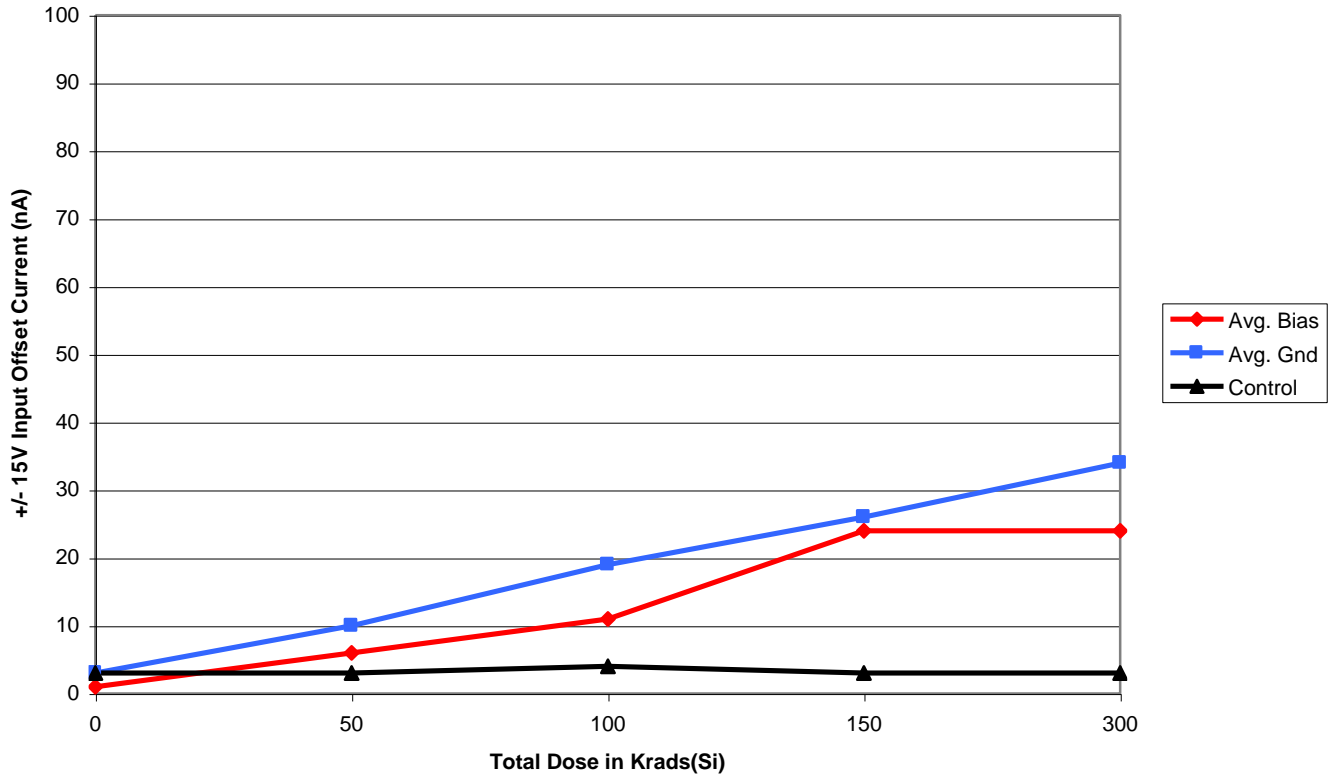
+/- 15V Positive Input Bias vs. Total Dose



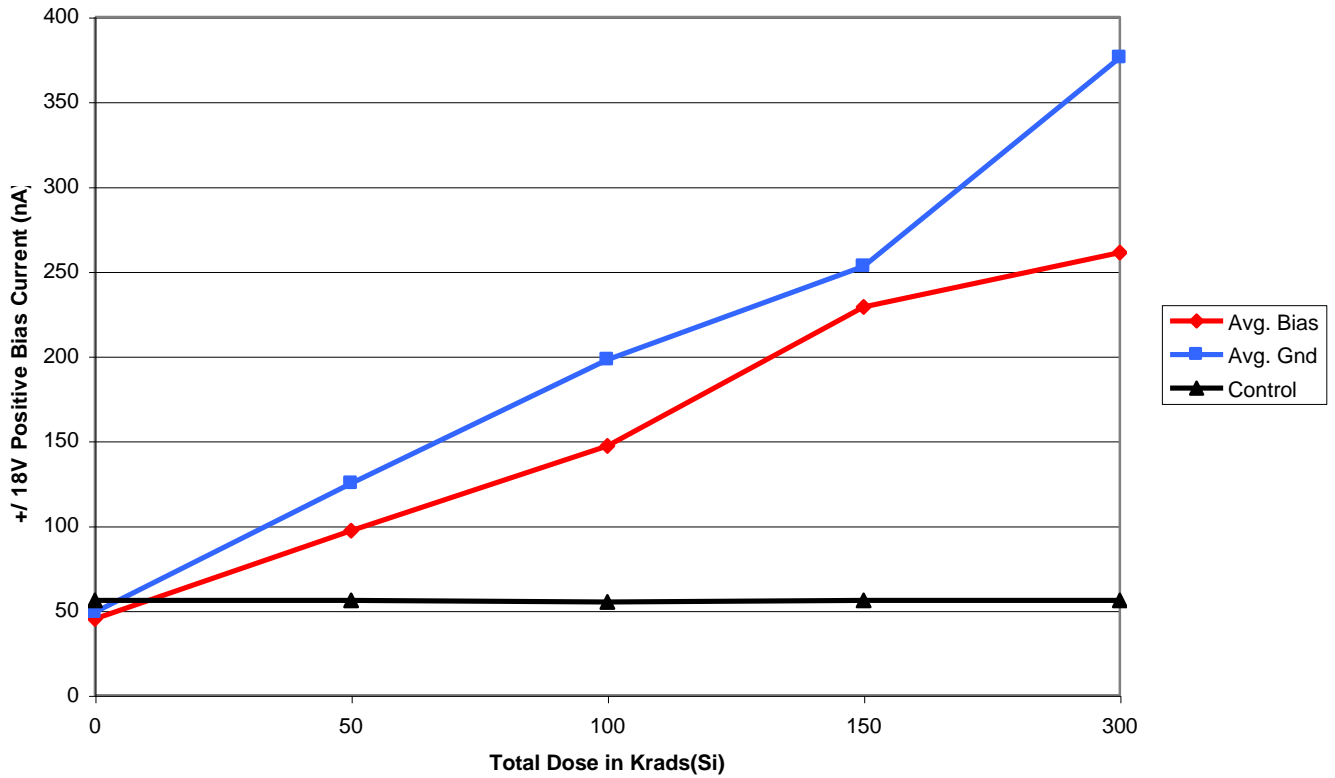
+/- 15V Negative Input Bias Vs. Total Dose



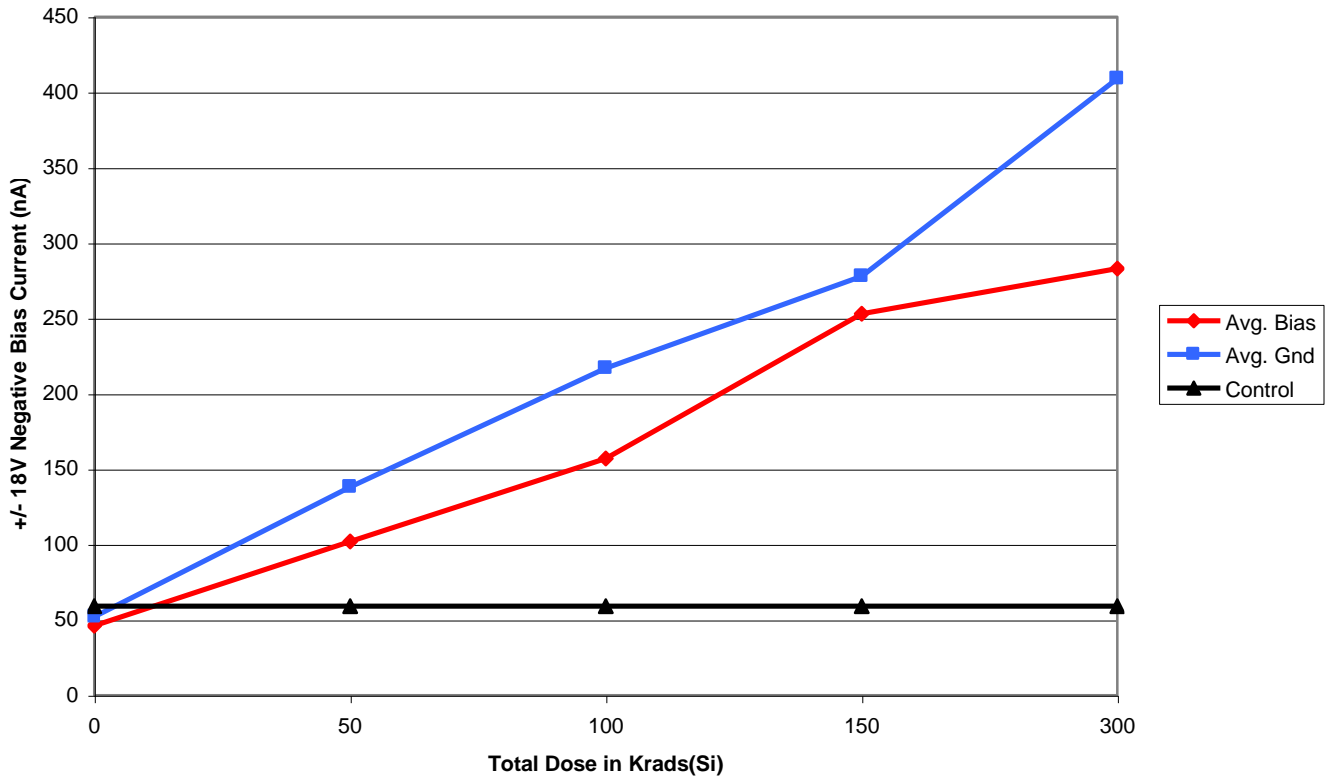
+/- 15V Input Offset Current vs. Total Dose



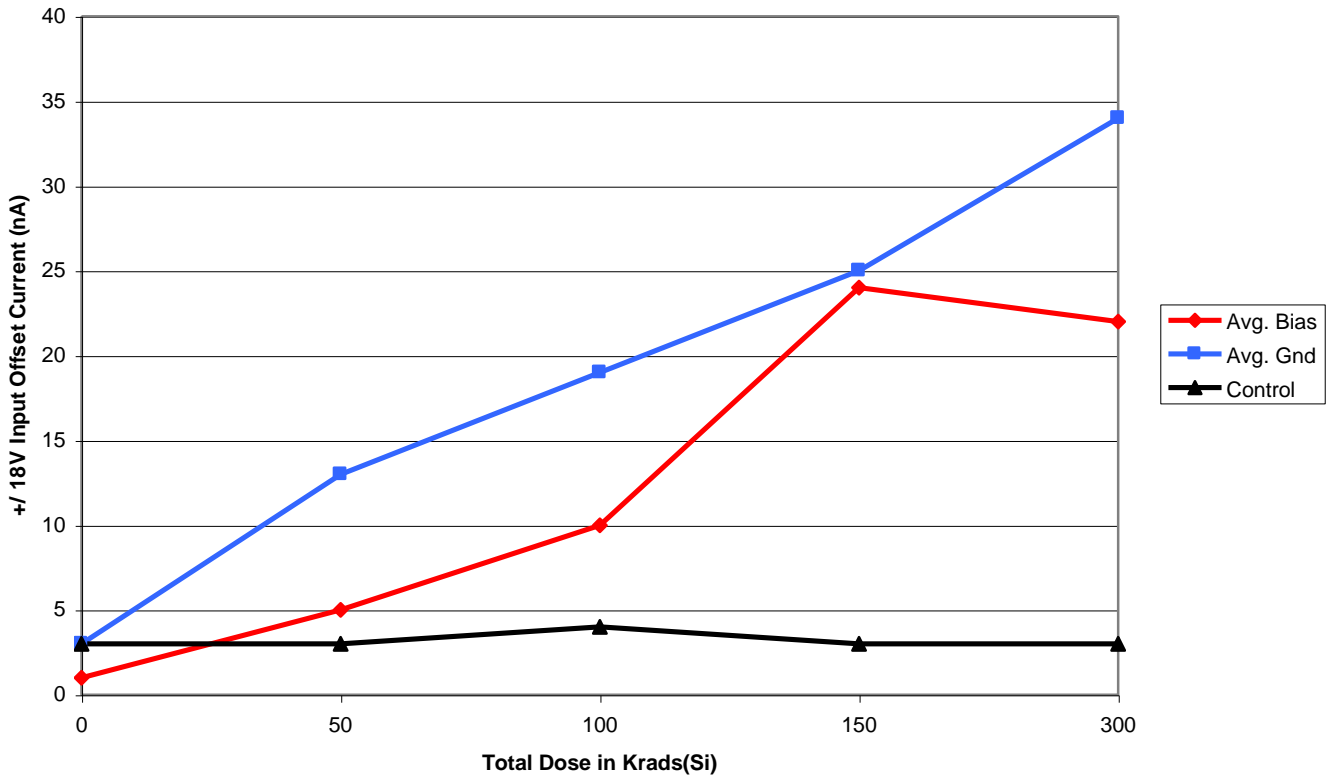
+/- 18V Positive Input Bias Current vs. Total Dose



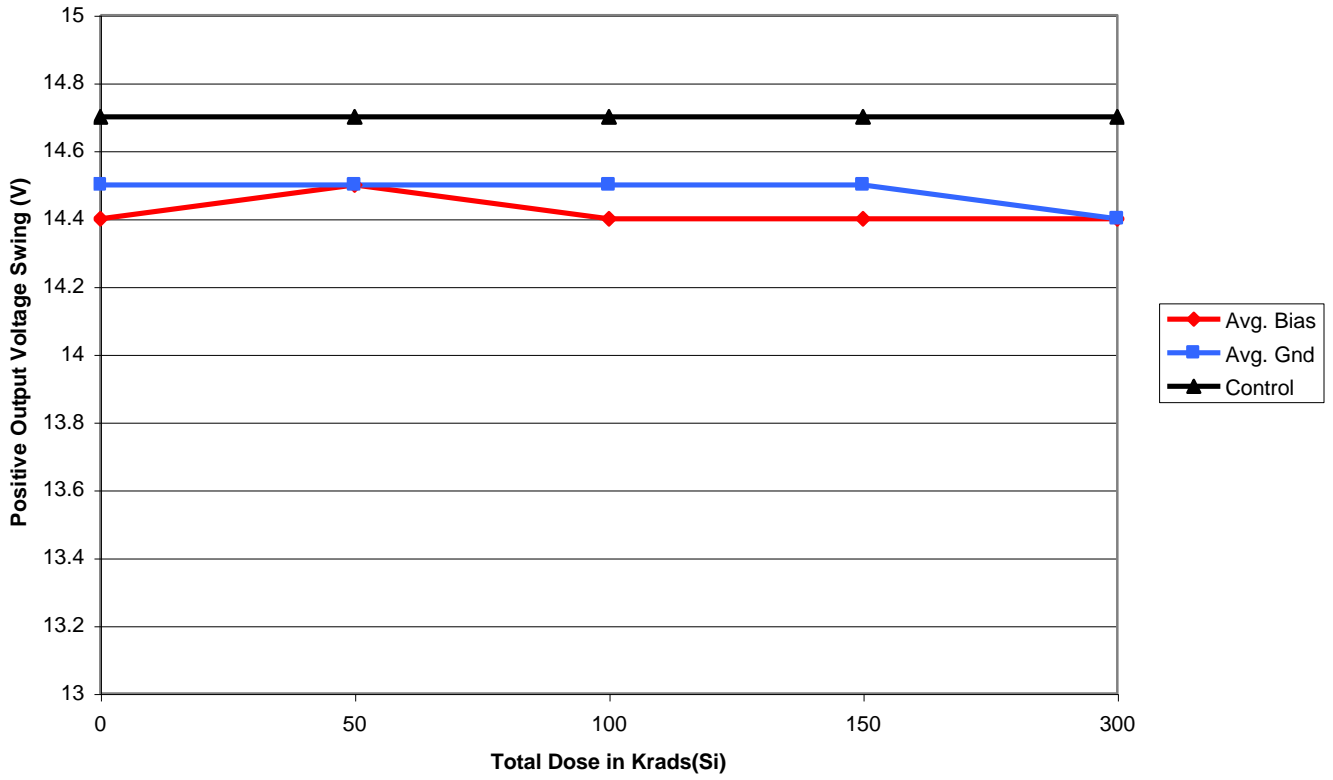
+/- 18V Negative Input Bias Current vs. Total Dose



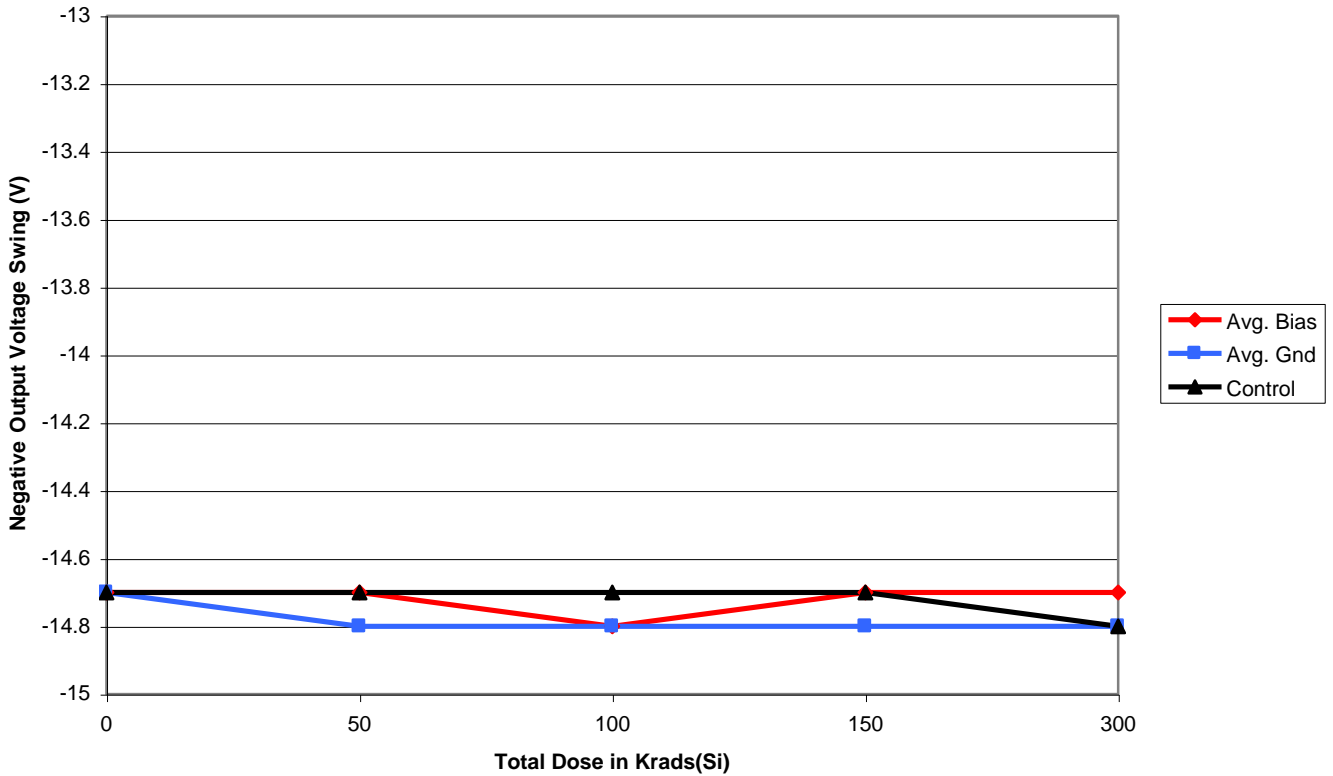
+/- 18V Input Offset Current vs. Total Dose



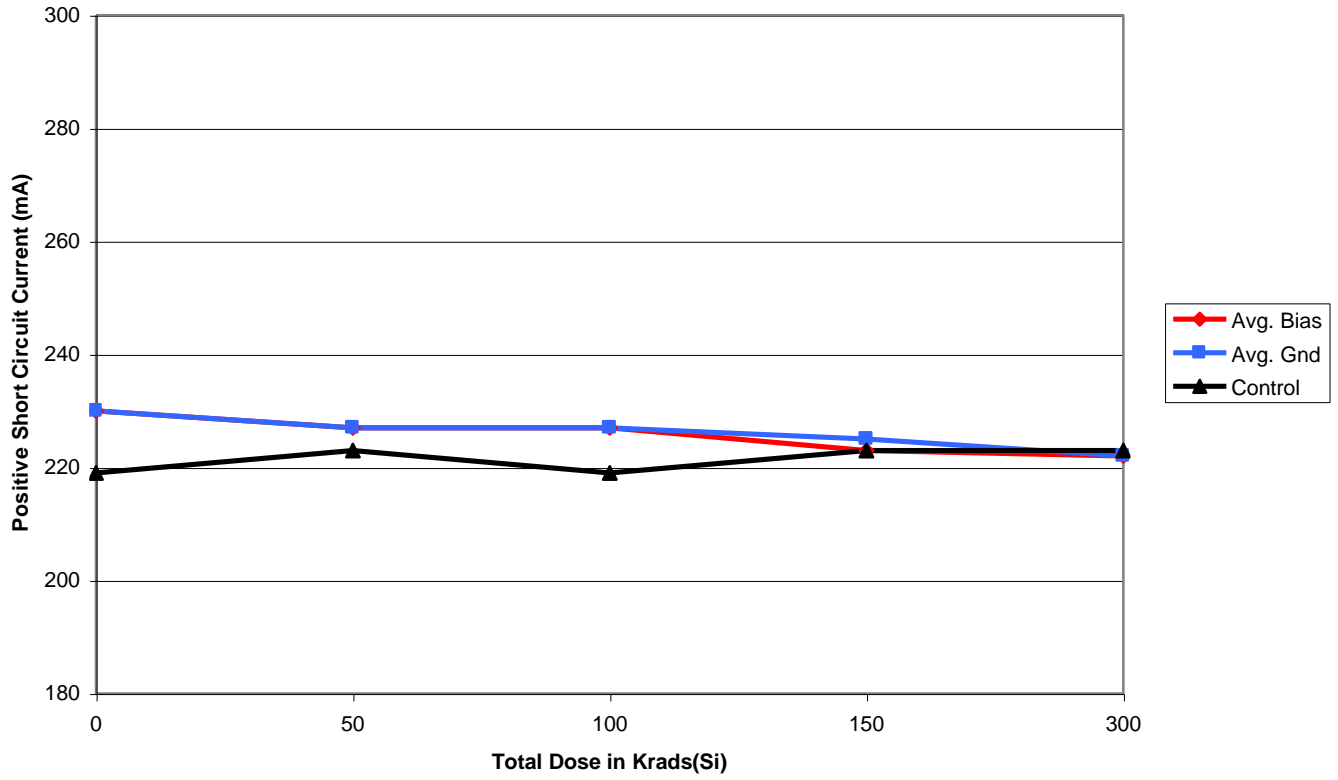
Positive Output Voltage Swing vs. Total Dose



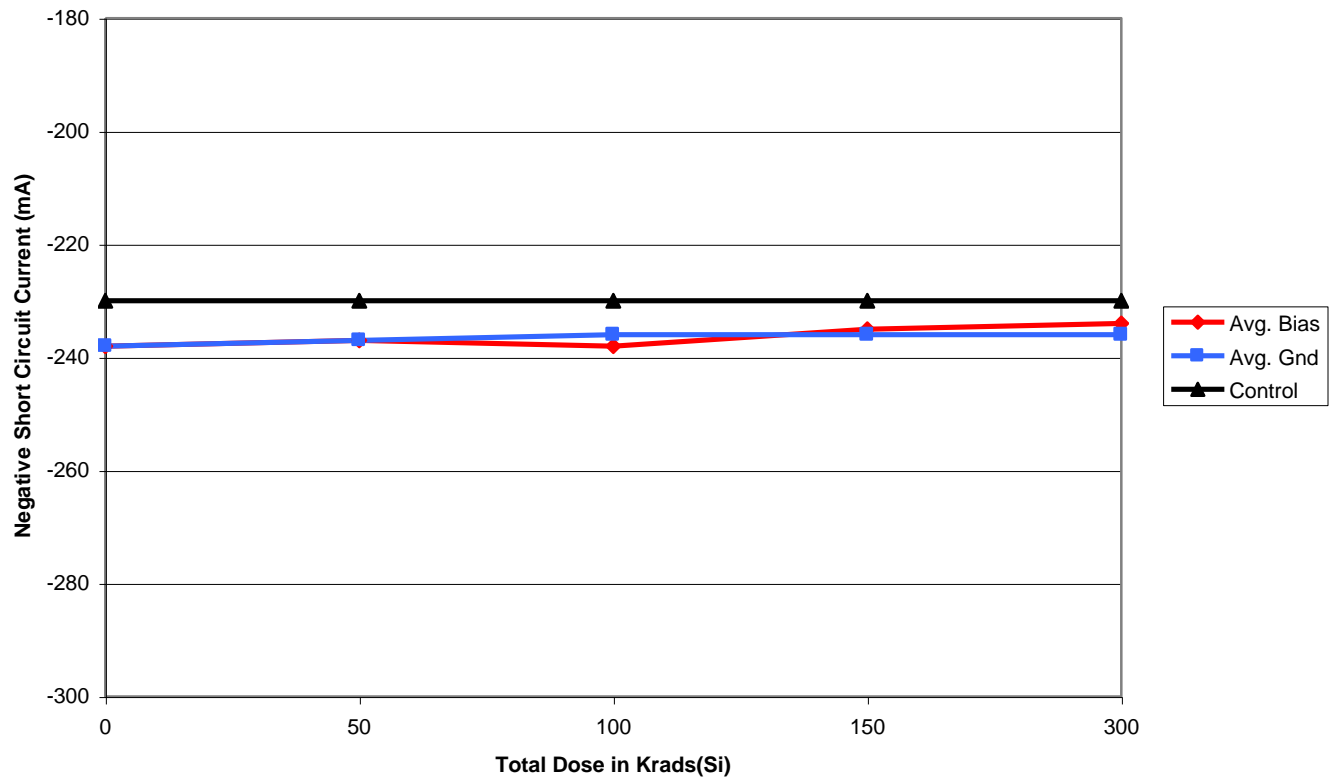
Negative Output Voltage Swing vs. Total Dose



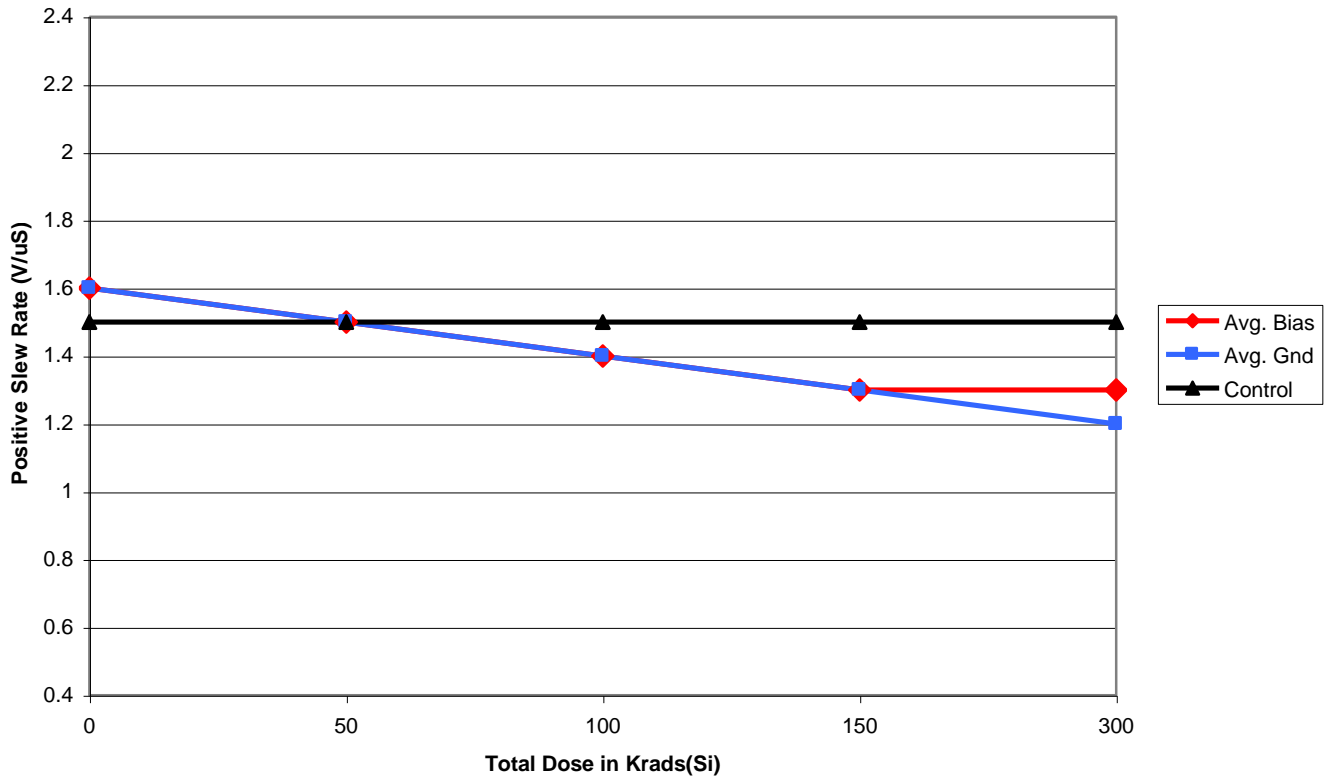
Positive Short Circuit Current vs. Total Dose



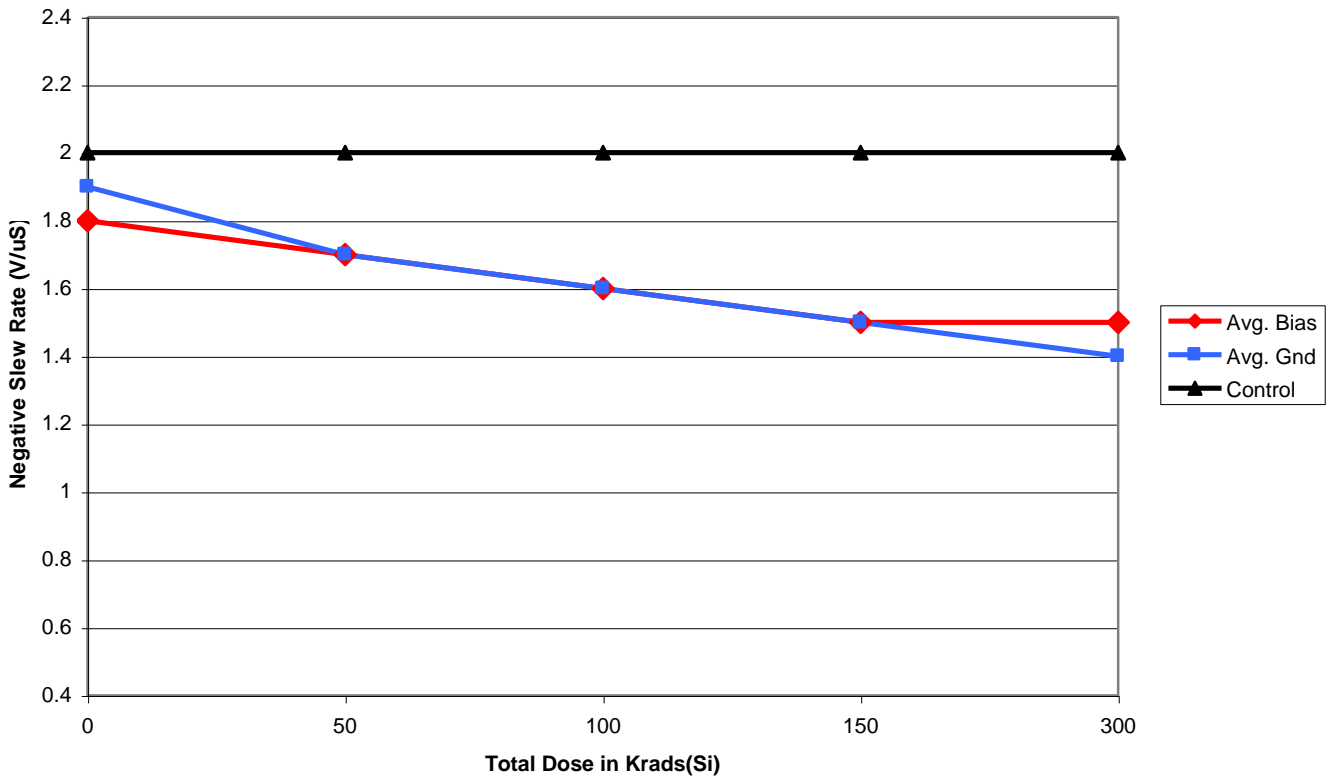
Negative Short Circuit Current vs. Total Dose



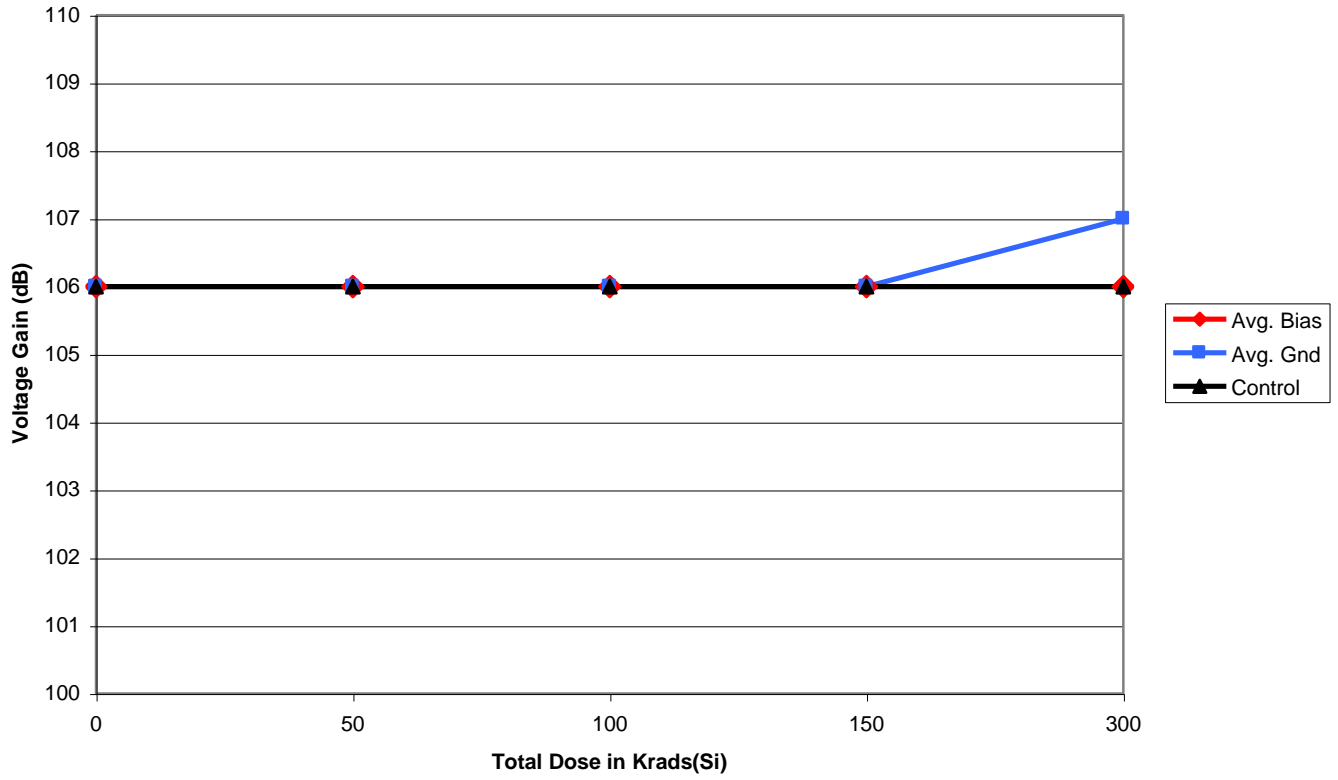
Positive Slew Rate vs. Total Dose



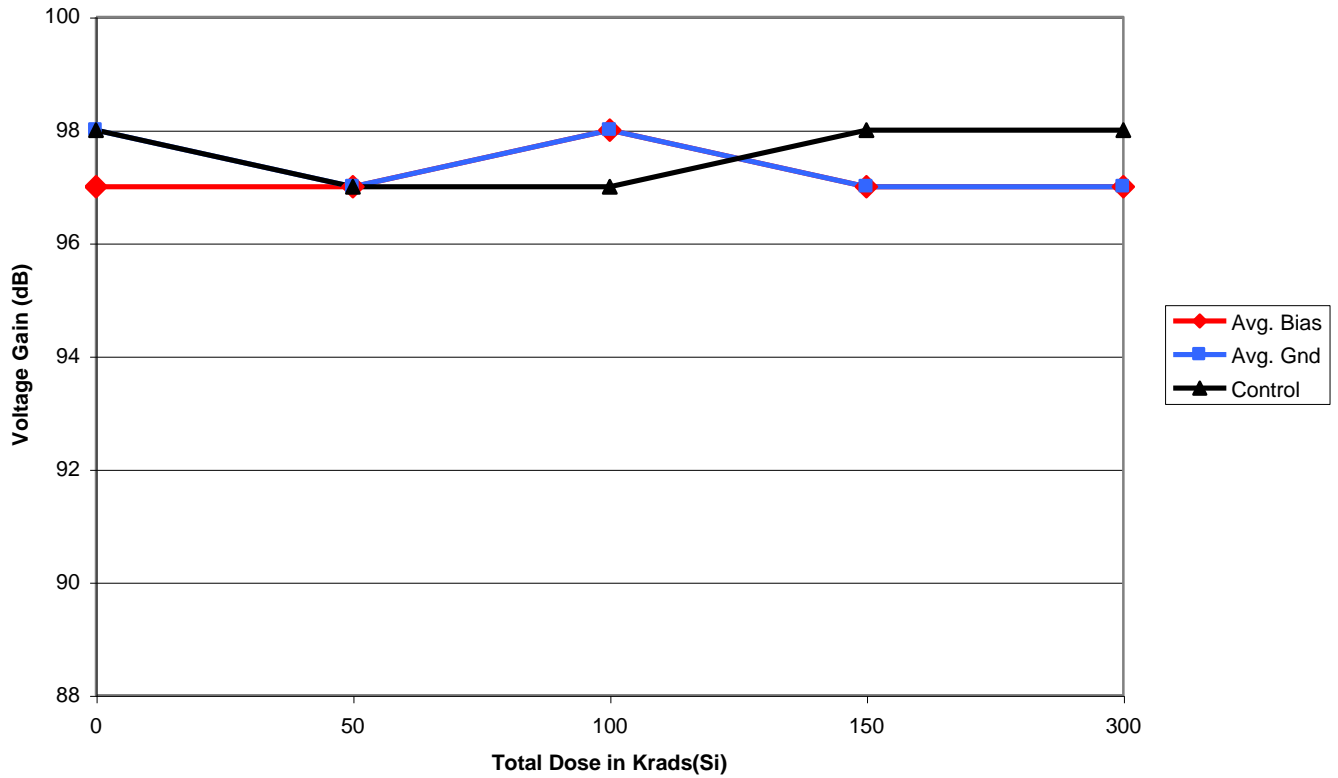
Negative Slew Rate vs. Total Dose



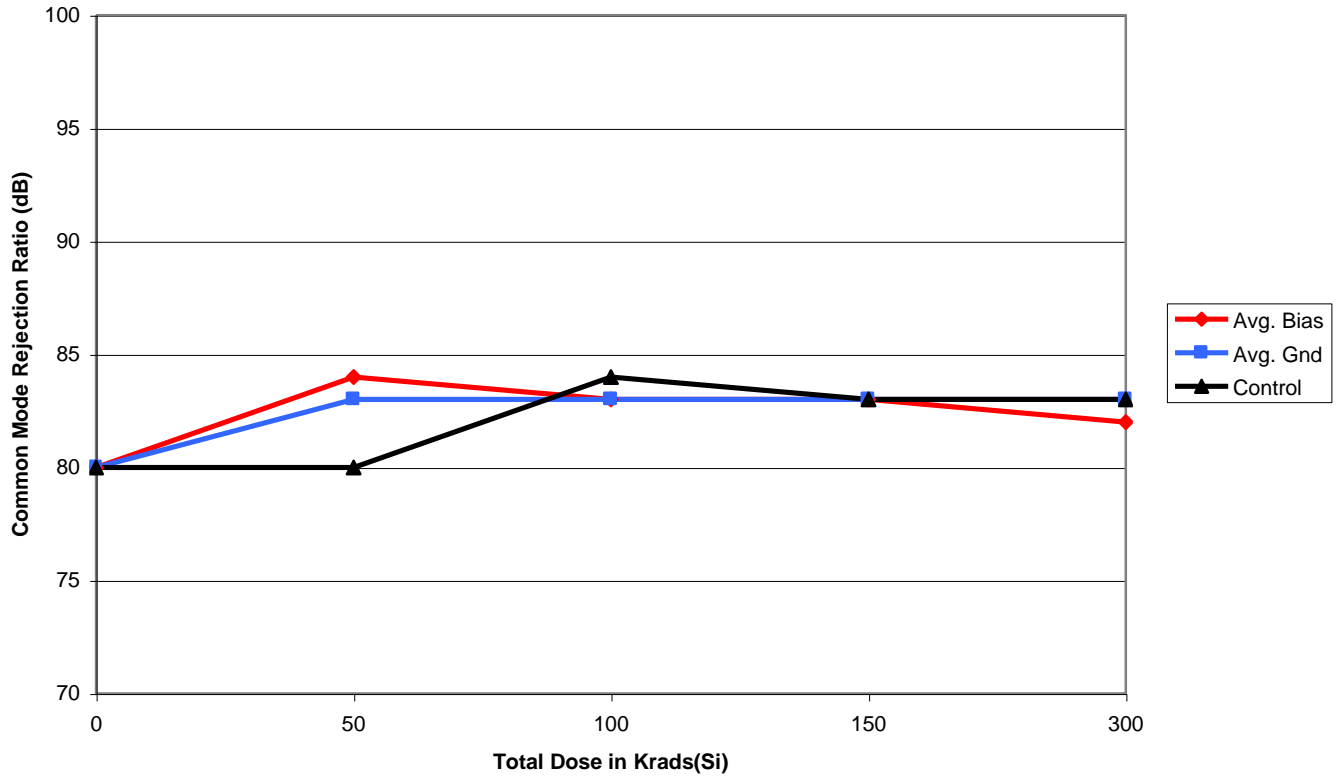
Vgain (RL = 1 K) Vs. Total Dose



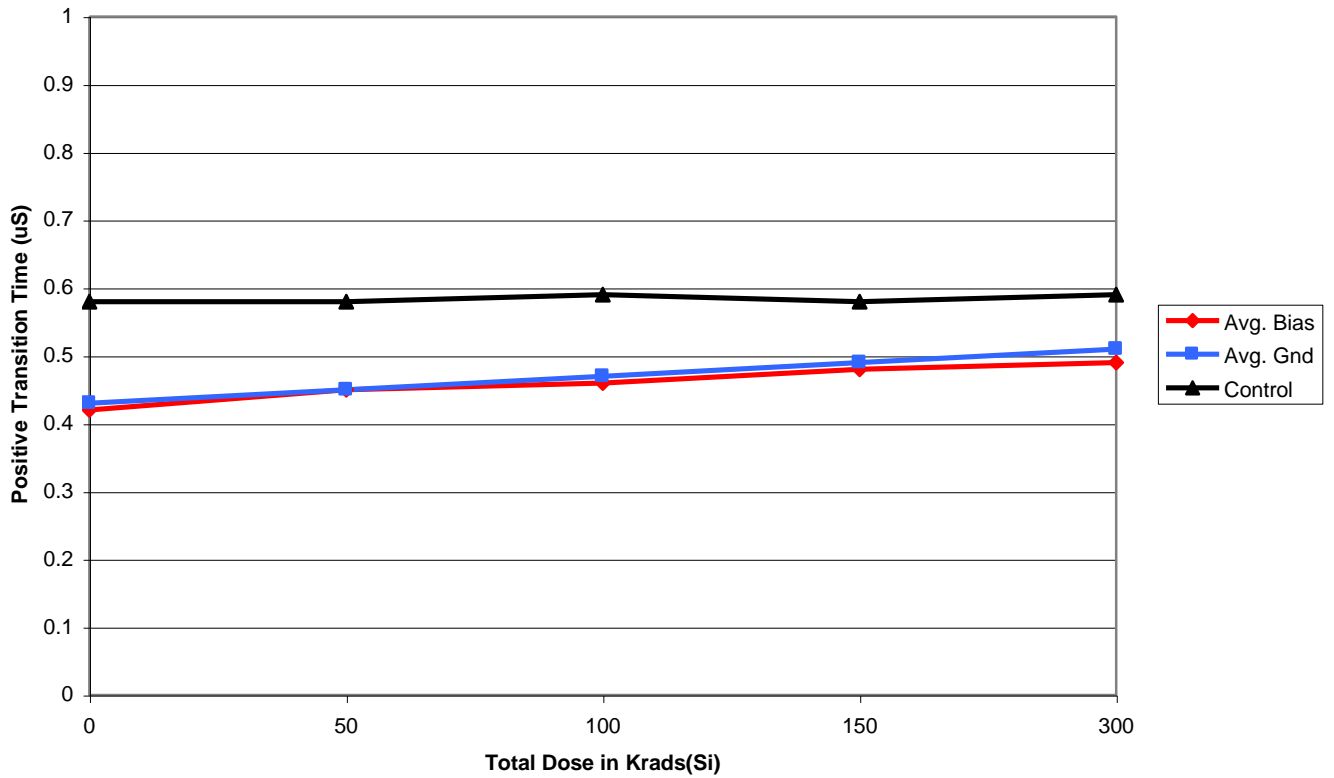
Vgain (RL = 100) vs. Total Dose



Common Mode Rejection Ratio vs. Total Dose



Positive Transition Time vs. Total Dose



Negative Transition Time vs. Total Dose

