

**Total Dose Radiation Test Report**

**MSK 5973RH**

**RAD Hard Adjustable Negative Linear Regulator**

March, 25, 2009 (TID – First Test)  
September 21, 2011(TID - Second Test)

B. Erwin  
R. Wakeman

M.S. Kennedy Corporation  
Liverpool, NY

## **I. Introduction:**

The total dose radiation test plan for the MSK 5973RH series was developed to qualify the devices as RAD Hard to 100 KRADS(Si). The testing was performed beyond 100 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to 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 5973RH.

## **II. Radiation Source:**

Total dose was performed at the University of Massachusetts, Lowell, using a cobalt 60 radiation source. The dose rate was determined to be 119 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 at 25°C in accordance with the device data sheet. In addition, all devices received 320 hours of burn-in per MIL-STD-883 Method 1015. For test platform verification, one control device was 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 kept under bias during irradiation. The maximum recommended operating voltage of -35V 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 together and 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. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

## **IV. Data:**

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. If required, full test data can be obtained by contacting M.S. Kennedy Corporation.

## **V. Summary:**

Based on the test data recorded during radiation testing and statistical analysis, the MSK5973RH qualified as a 100 Krad(Si) radiation hardened device. Reference Voltage, Line Regulation and Load Regulation exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 150 Krad(Si) TID.

MSK 5973RH Biased/Unbiased Dose Rate Schedule
--

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
9/21/11

Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
7:13	51,527	51,527
7:13	51,527	103,054
7:13	51,527	154,581

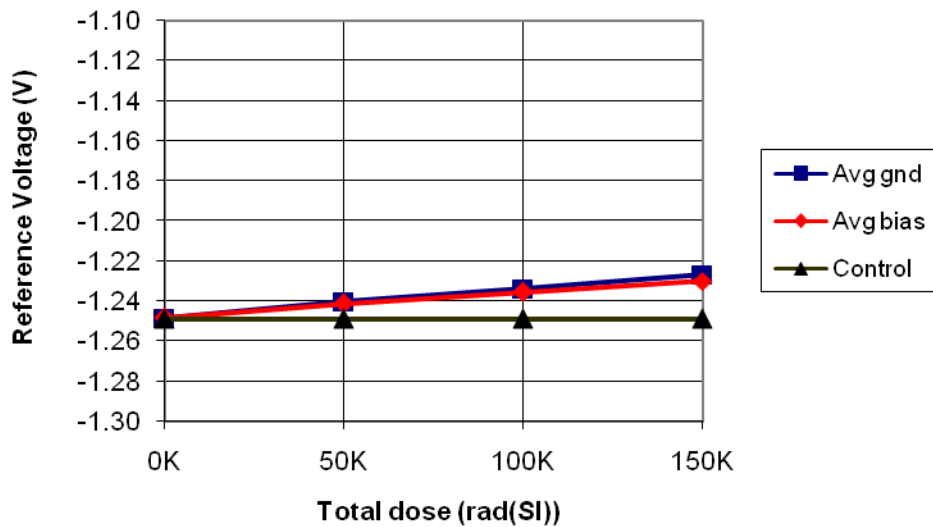
Biased S/N – 1026, 1027, 1028, 1029, 1030
---

Unbiased S/N – 1031, 1032, 1033, 1034, 1035
---

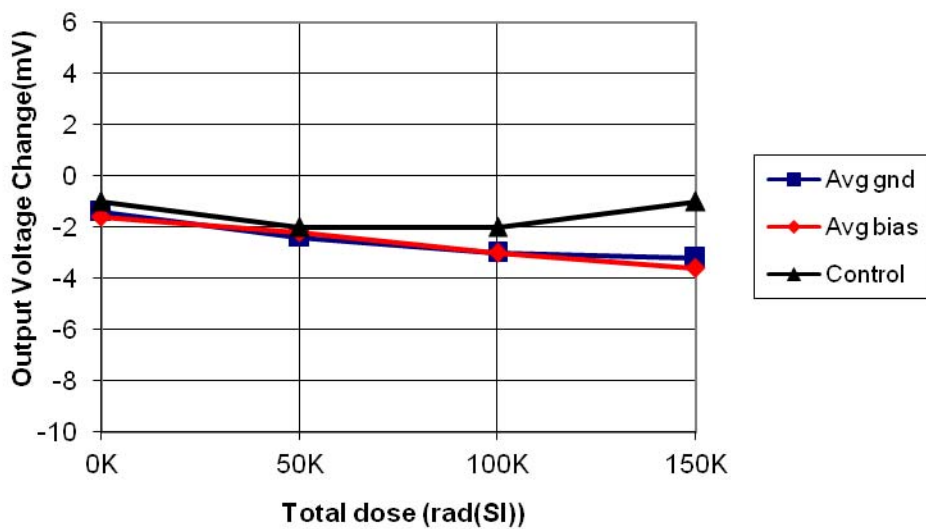
Table 1

**Dose Time, Incremental Dose and Total Cumulative Dose**

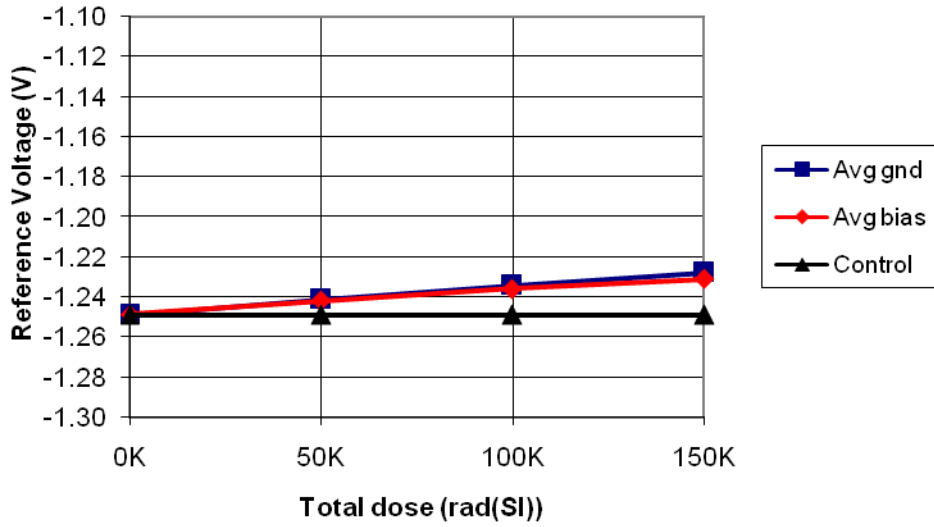
MSK5973RH  
Ref. Voltage @ -8 VIN vs. Total Dose



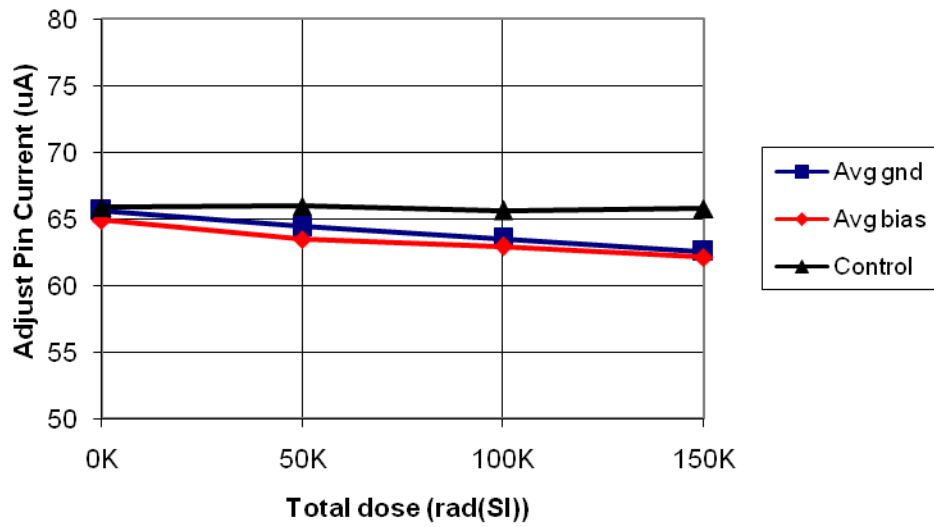
MSK5973RH  
Line Regulation vs. Total Dose



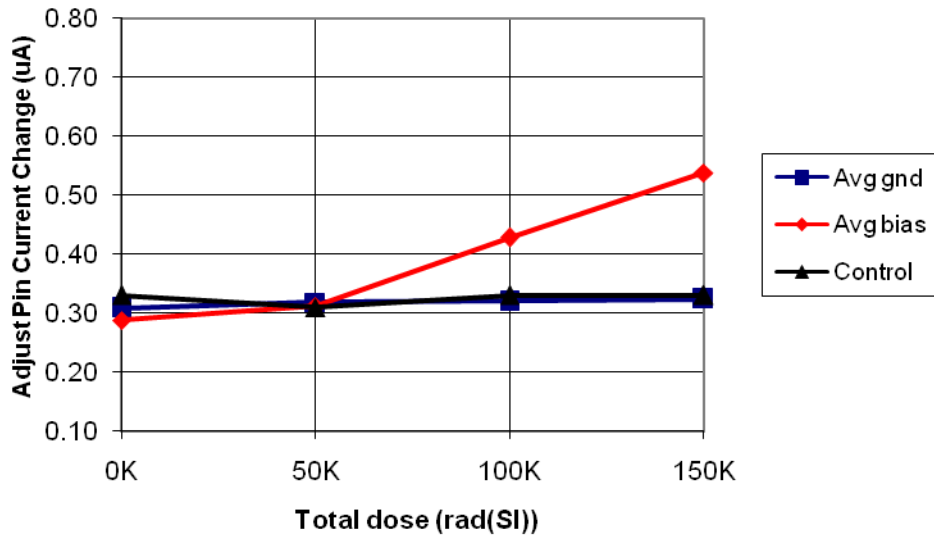
MSK5973RH  
Ref. Voltage @ -35 VIN vs. Total Dose



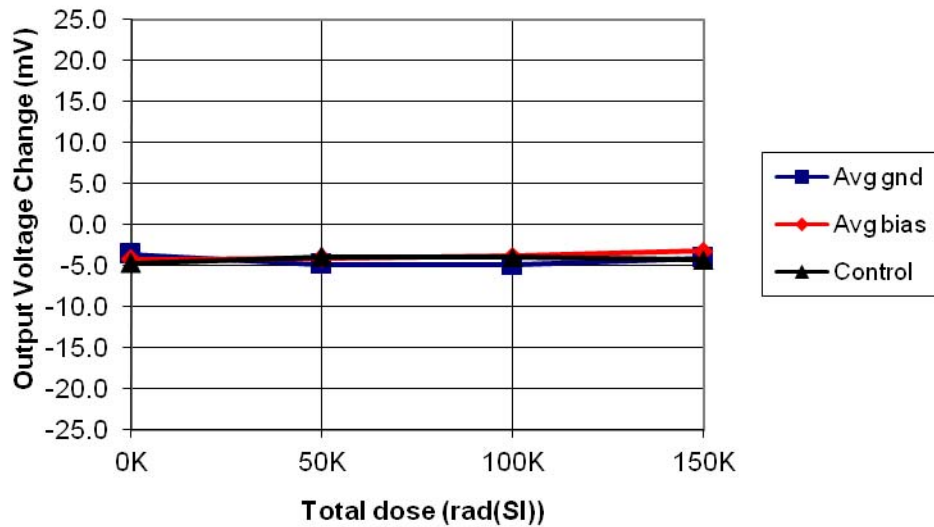
MSK5973RH  
Adjust Pin Current @ -8 VIN vs. Total Dose



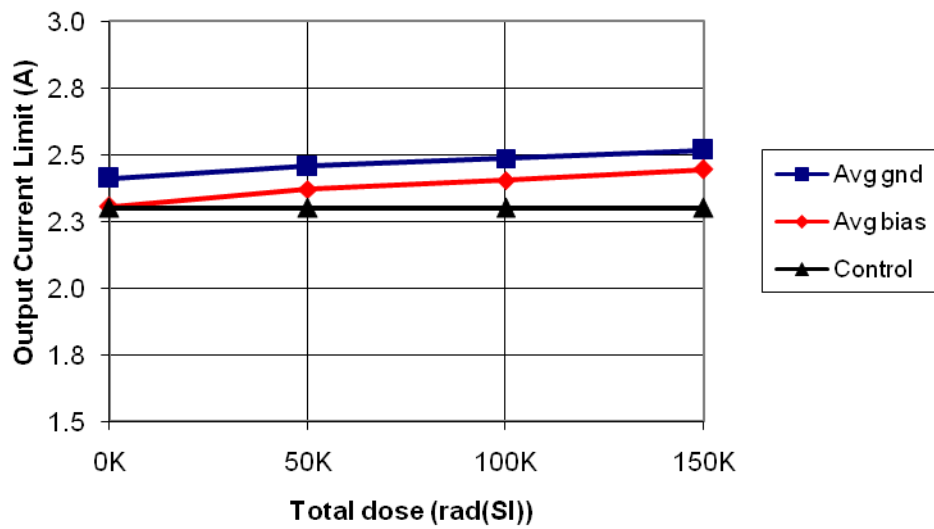
MSK5973RH  
Adjust Pin Current Change ( $-8\text{ V} \leq V_{in} \leq -35\text{ V}$ )  
vs. Total Dose



MSK5973RH  
Load Regulation vs. Total Dose



MSK5973RH  
Output Current Limit vs. Total Dose



**Total Dose Radiation Test Report**  
**MSK 5973RH**  
**RAD Hard Adjustable Negative Linear Regulator**

March 25, 2009

P. Musil  
M. Bilecki  
C. Salce

M.S. Kennedy Corporation  
Liverpool, NY



## **I. Introduction:**

The total dose radiation test plan for the MSK 5973RH series was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to 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 5973RH.

## **II. Radiation Source:**

Total dose was performed at the University of Massachusetts, Lowell, using a cobalt 60 radiation source. The dose rate was determined to be 180 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 at 25°C in accordance with the device data sheet. In addition, all devices received 320 hours of burn-in per MIL-STD-883 Method 1015. For test platform verification, one control device was 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 kept under bias during irradiation. The maximum recommended operating voltage of -35V 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 together and 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. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

## **IV. Data:**

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. If required, full test data can be obtained by contacting M.S. Kennedy Corporation.

## **V. Summary:**

Based on the test data recorded during radiation testing and statistical analysis, the MSK5973RH qualified as a 300 Krad(Si) radiation hardened device. Reference Voltage, Line Regulation and Load Regulation exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK 5973RH Biased/Unbiased Dose Rate Schedule
--

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
3/17/09

Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
4:46	51,480	51,480
4:46	51,480	102,960
4:46	51,480	154,440
4:46	51,480	205,920
9:33	103,140	309,060
14:19	154,620	463,680

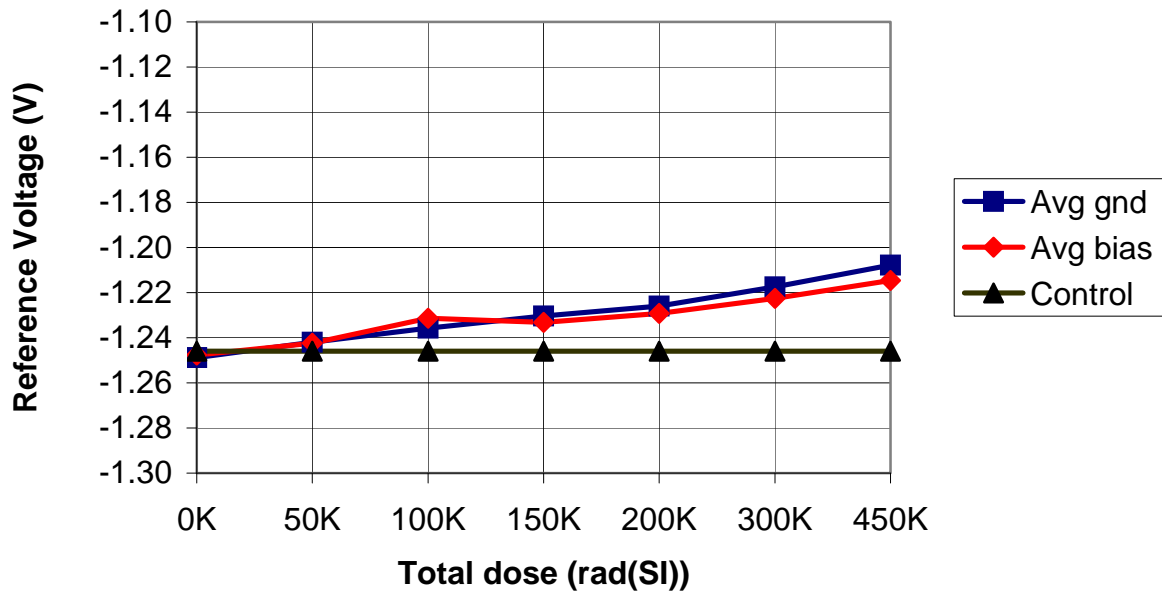
Biased S/N – 0076, 0077, 0078, 0079, 0080
---

Unbiased S/N – 0081, 0082, 0083, 0084, 0085
---

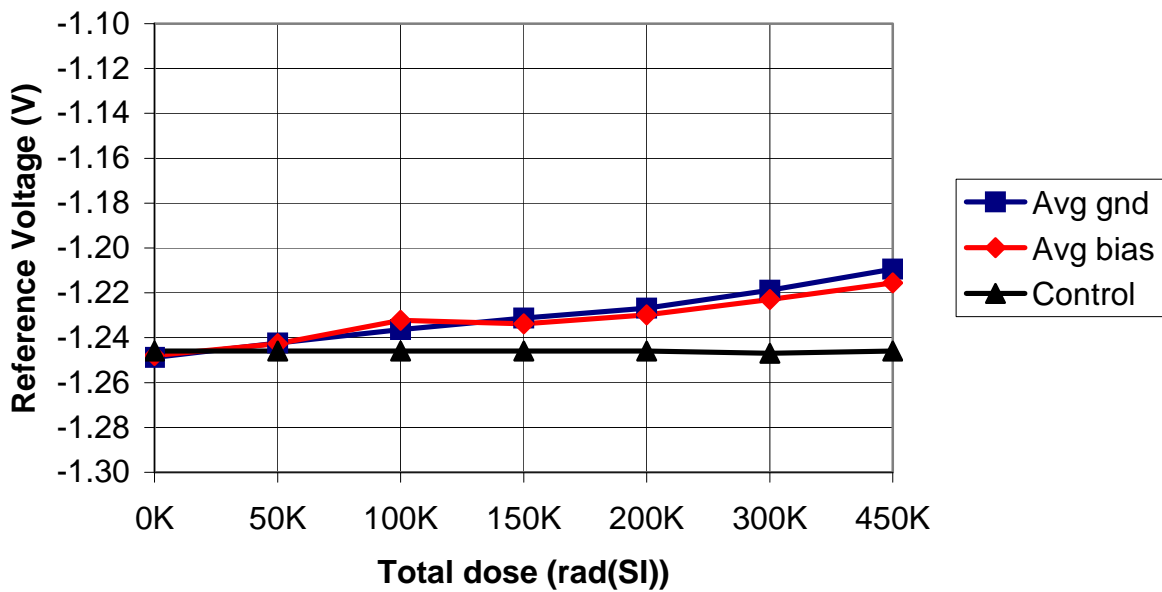
Table 1

**Dose Time, Incremental Dose and Total Cumulative Dose**

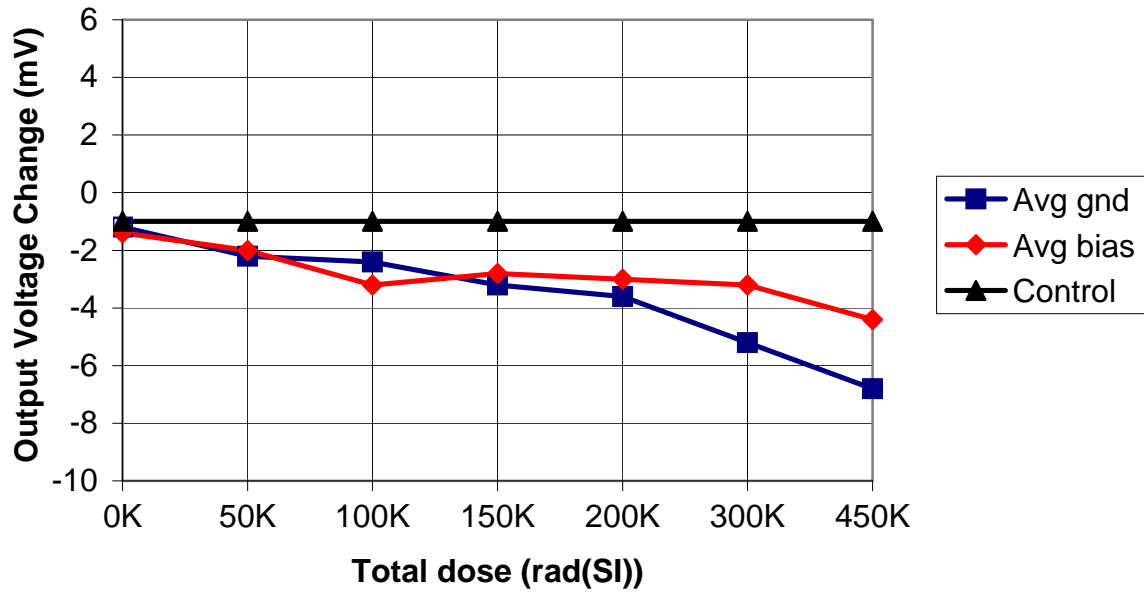
**MSK5973RH**  
**Ref. Voltage @ -8 VIN vs. Total Dose**



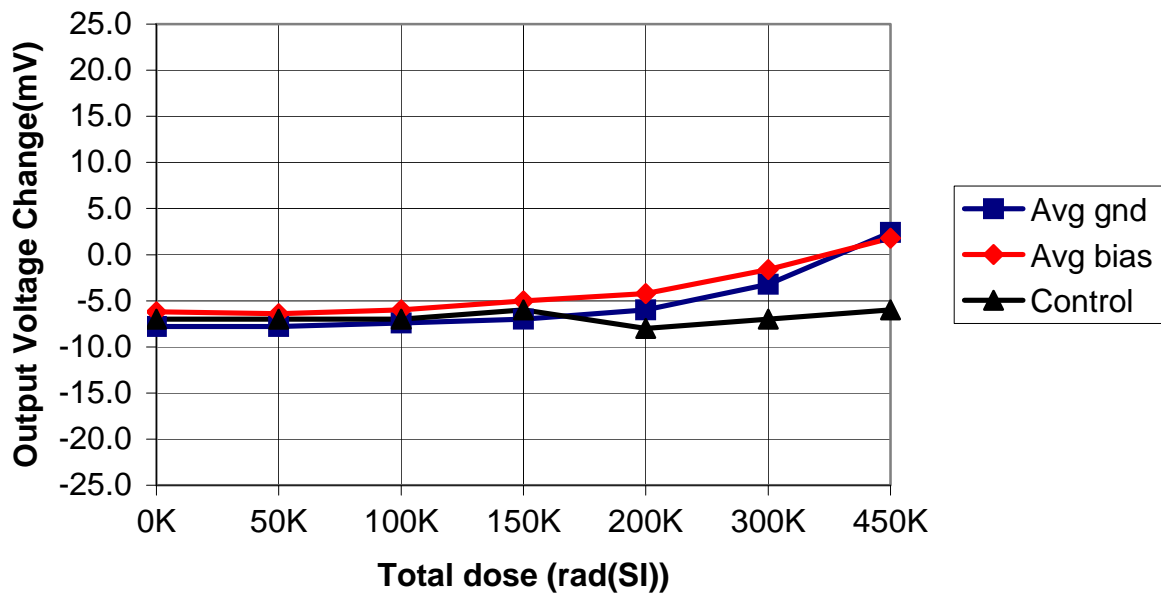
**MSK5973RH**  
**Ref. Voltage @ -35 VIN vs. Total Dose**



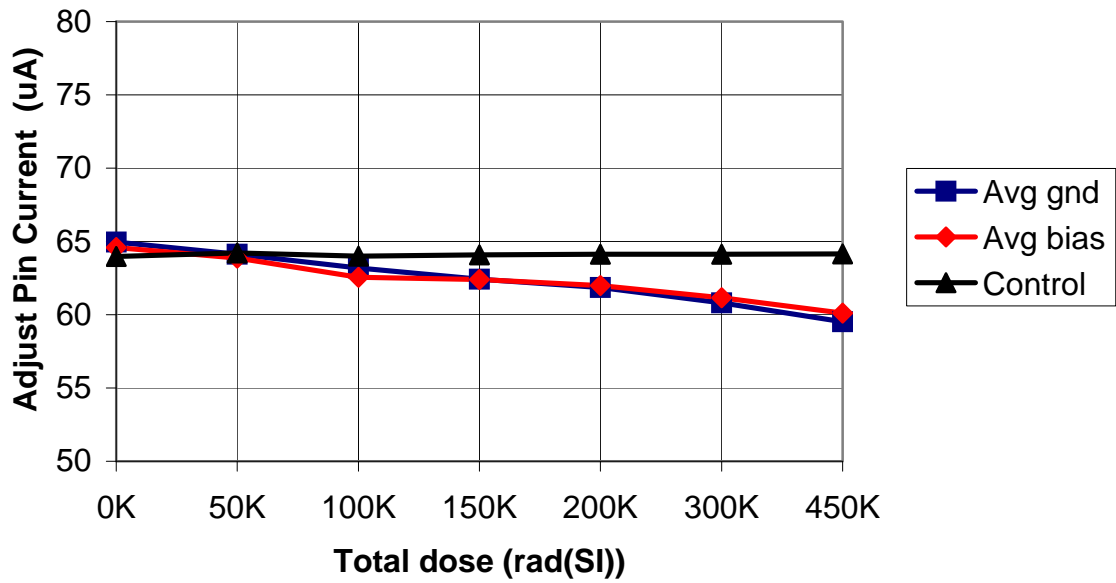
### MSK5973RH Line Regulation vs. Total Dose



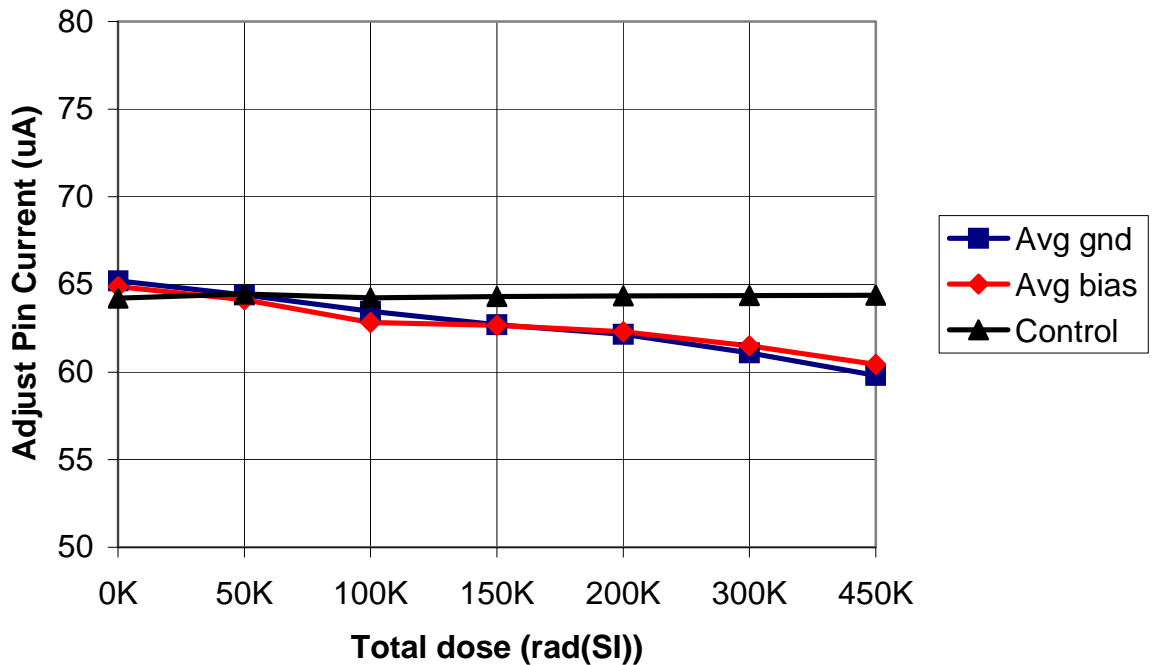
### MSK5973RH Load Regulation vs. Total Dose



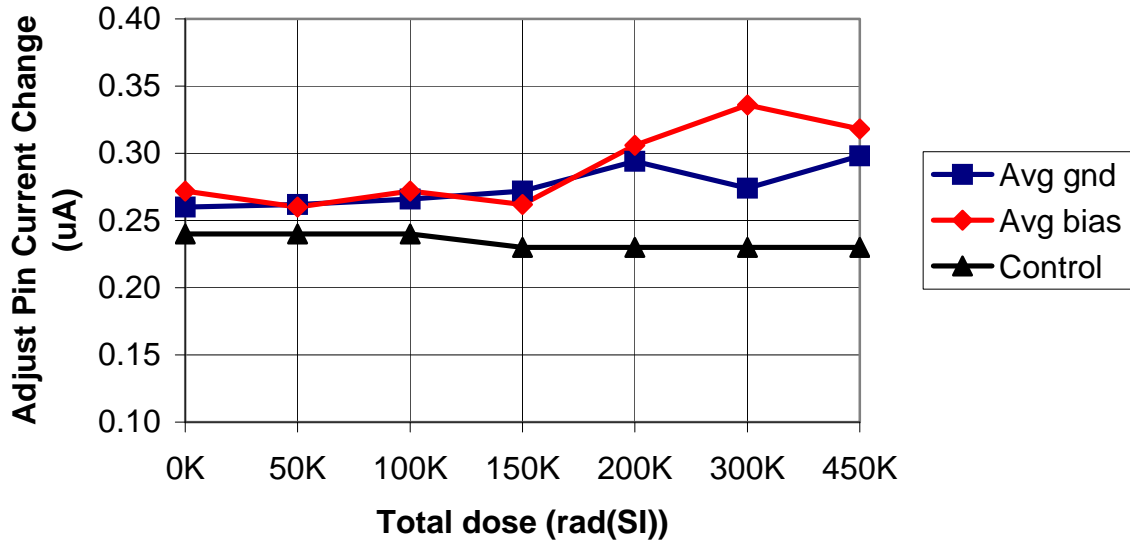
**MSK5973RH**  
**Adjust Pin Current @ -8 VIN vs. Total Dose**



**MSK5973RH**  
**Adjust Pin Current @ -35 VIN vs. Total Dose**



**MSK5973RH**  
**Adjust Pin Current Change ( $-8\text{ V} \leq V_{in} \leq -35\text{ V}$ )**  
**vs. Total Dose**



**MSK5973RH**  
**Output Current Limit vs. Total Dose**

