

**Total Dose Radiation Test Report**  
**MSK5972KRH and MSK5972KRHL**  
**RAD Hard Positive Voltage Regulator**

May 28, 2009 (TID – First Test)  
July 16, 2010 (TID - Second Test)  
June 27, 2018(TID – Third Test Wafer Lot: WP1058.2 Wf#8)

N. Kresse  
J. Joy

Anaren, Inc – MSK Products

**I. Introduction:**

The Total Ionizing Dose radiation test plan for the MSK5972RH was developed to qualify the devices as RAD Hard to 100Krad(Si). The testing was performed beyond 100Krad(Si) to show trends in the 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 MSK5972RH.

**II. Radiation Source:**

Total ionizing dose testing was performed at the University of Massachusetts, Lowell, using a cobalt 60 radiation source. The dose rate was determined to be 120.0Rad(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 and were fully screened IAW MIL-PRF-38535 Class H. 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 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 the devices were transported to the electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as the control devices, 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. Post 100Krad(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 and statistical analysis, the MSK5972RH qualifies as a 100Krad(Si) radiation hardened device. All performance curves stayed well within specifications up to the maximum test dose, 150Krad(Si) TID.

MSK5972RH Biased/Unbiased Dose Rate  
Schedule

Dosimetry Equipment  
Bruker Biospin # 0162

Irradiation Date  
6/27/18

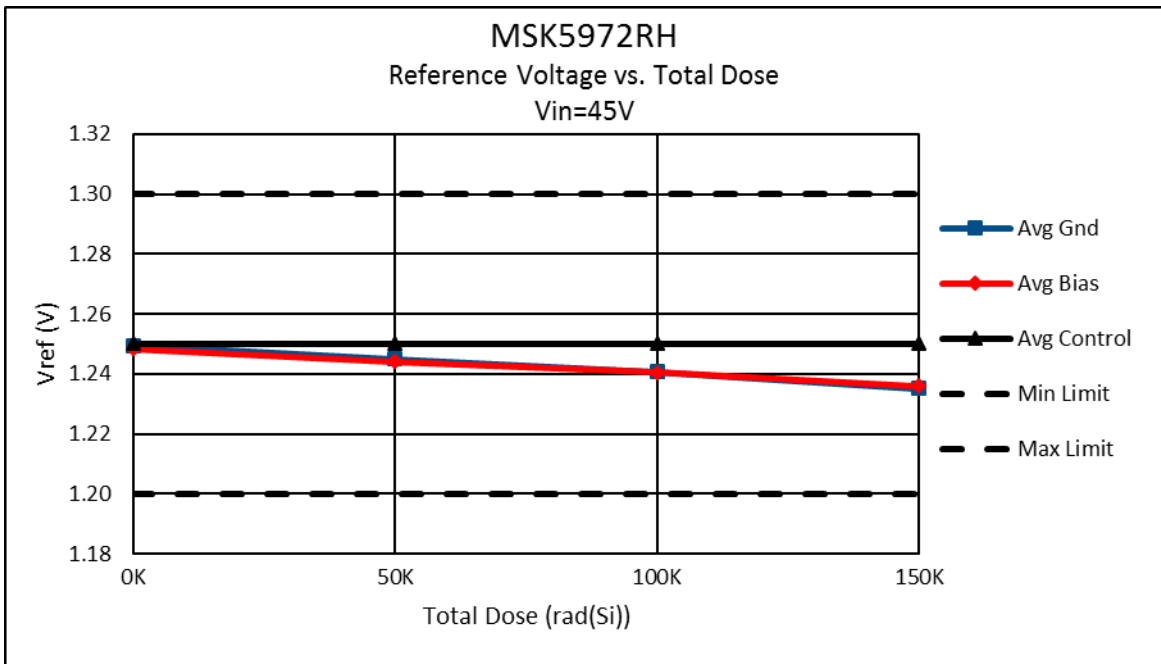
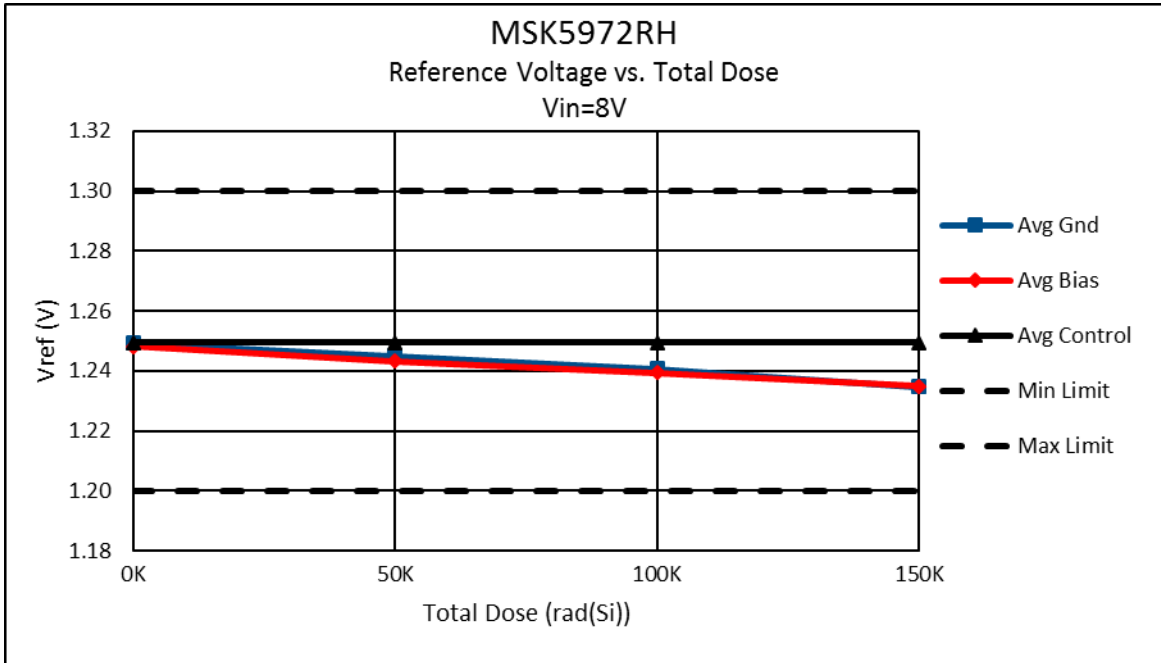
Exposure Length (min:sec)	Incremental Dose rad(Si)	Cumulative Dose rad(Si)
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7:09	51,500	103,000
7:09	51,500	154,500

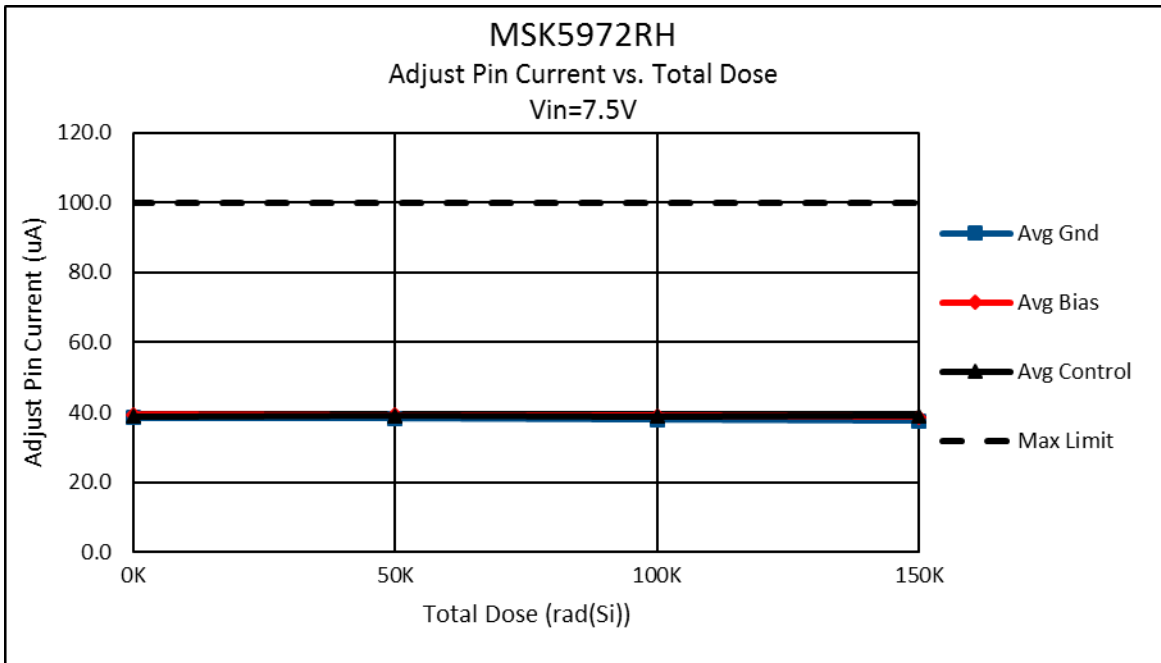
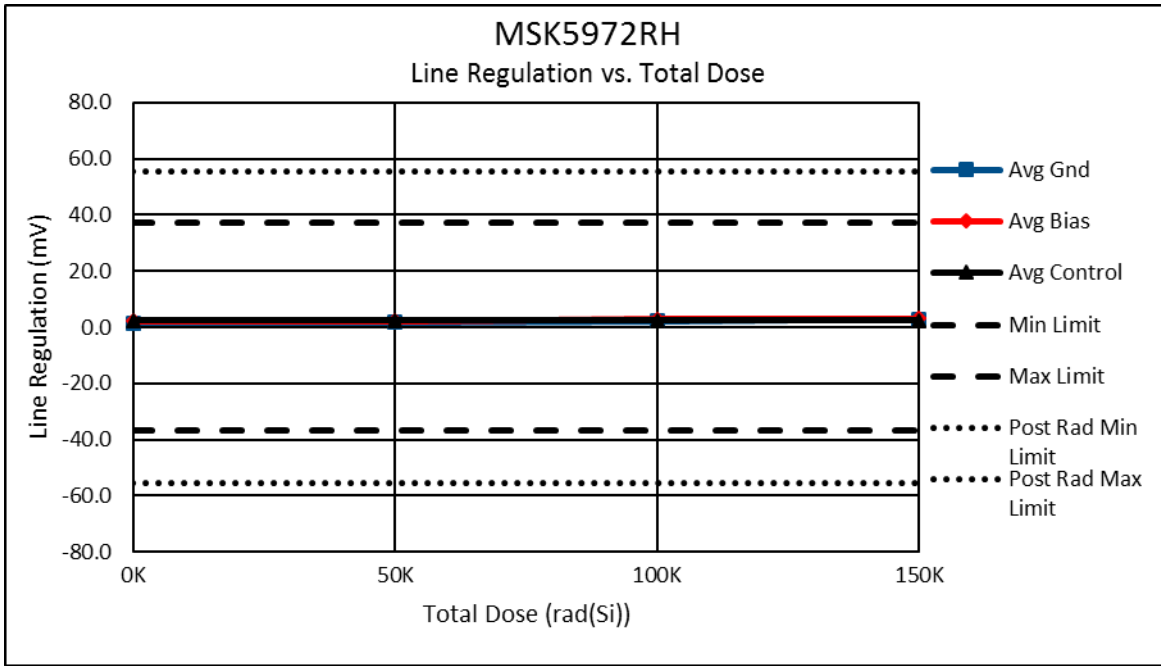
Biased S/N – 3777, 3778, 3779, 3780, 3781

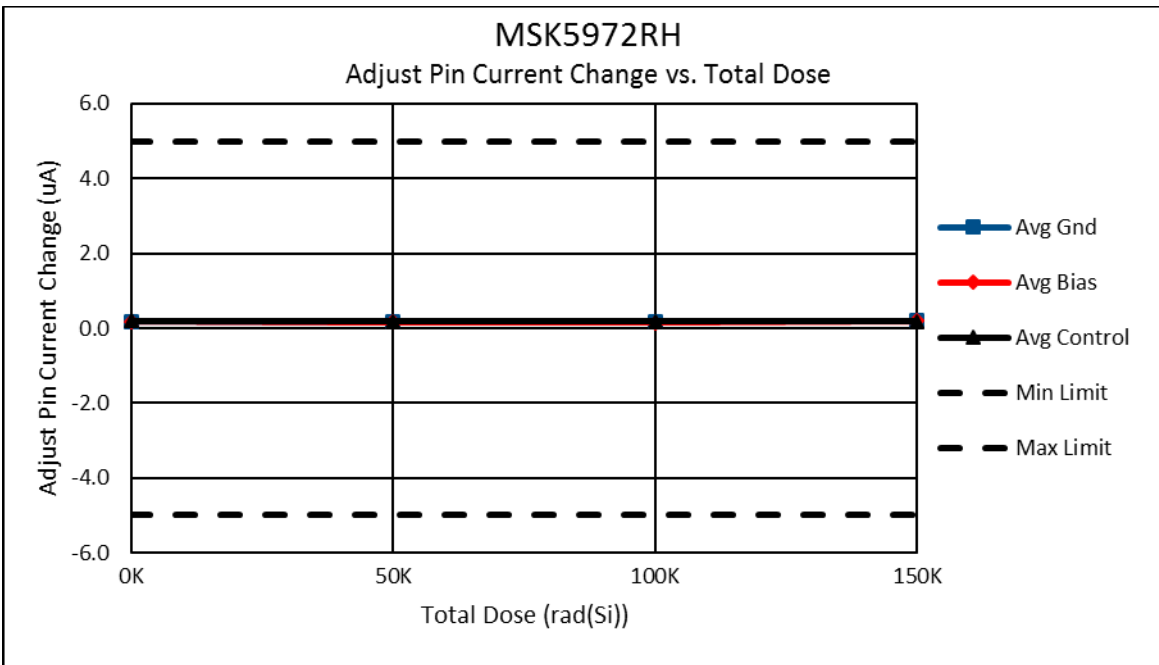
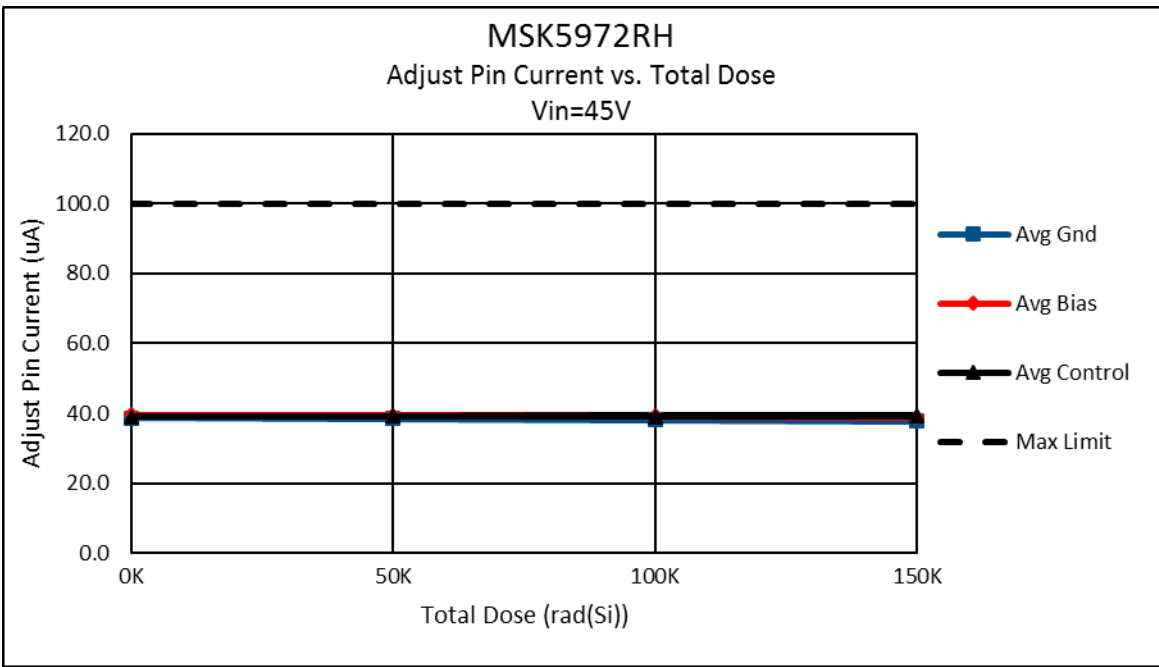
Unbiased S/N – 3782, 3783, 3784, 3785, 3786

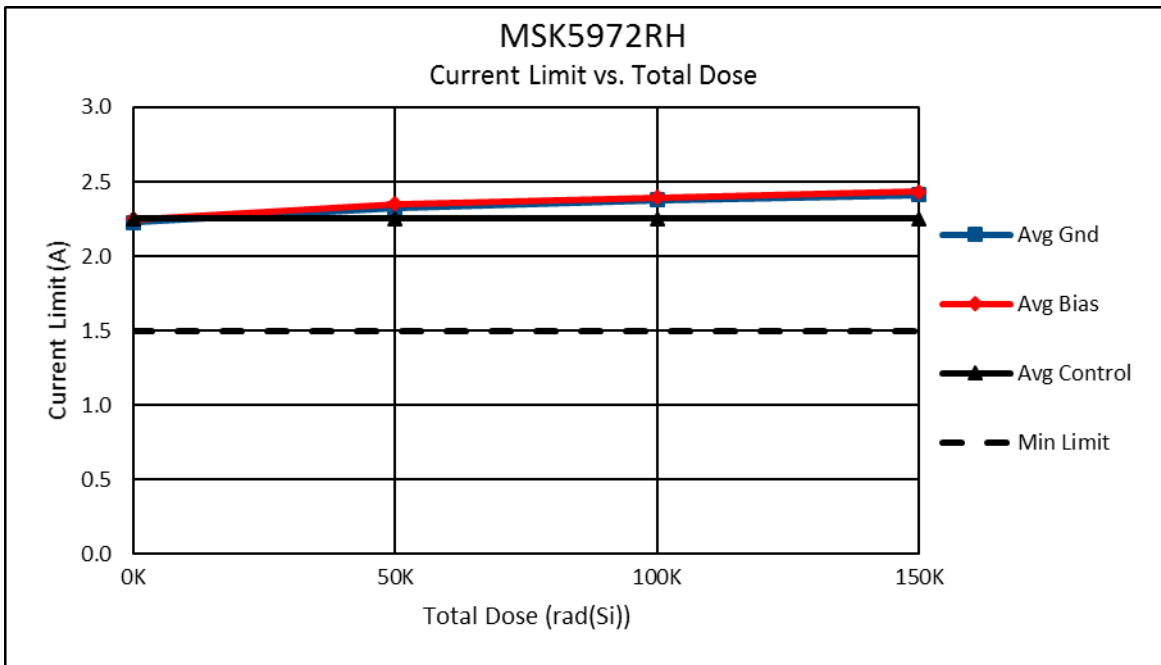
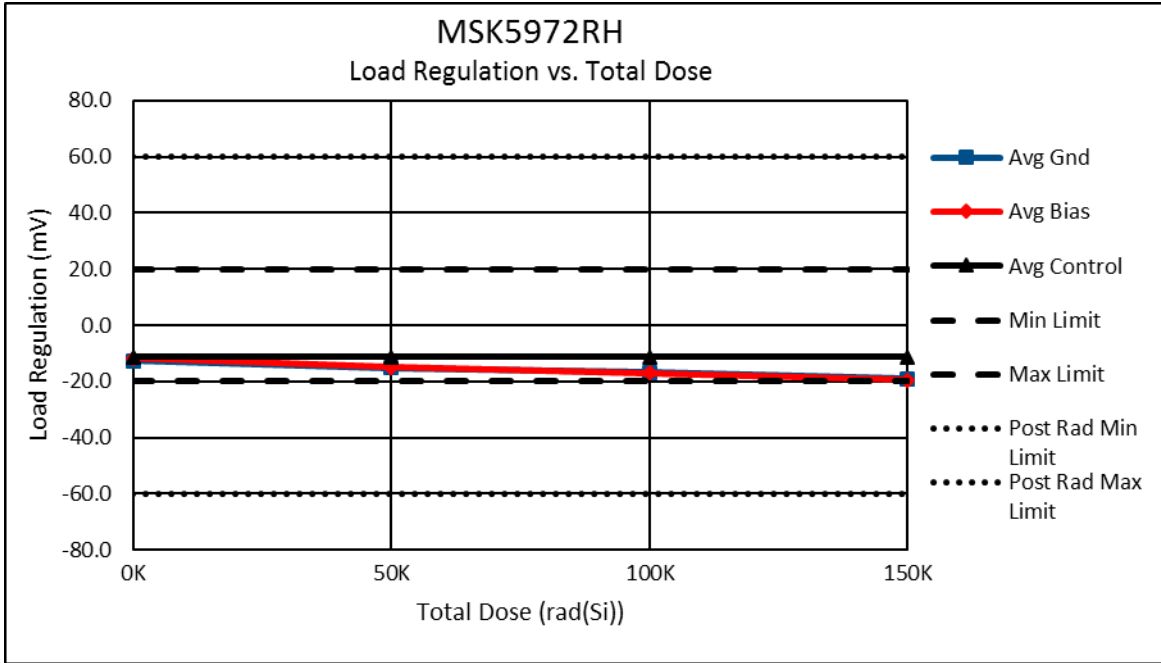
Table 1

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









**Total Dose Radiation Test Report**  
**MSK 5972KRH and MSK 5972KRHL**  
**RAD Hard Positive Voltage Regulator**

May 28, 2009 (TID – First Test)  
July 16, 2010 (TID - Second Test)

M. Bilecki  
B. Erwin

M.S. Kennedy Corporation  
Liverpool, NY



## I. Introduction:

The total dose radiation test plan for the MSK 5972KRH 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. The MSK 5972KRH and the MSK 5972KRHL use the same active component. The data in this report is from the direct measurement of the MSK 5972KRH response to irradiation but is indicative of the response of both device types.

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 5972KRH series.

## 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 135 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 fully screened IAW MIL-PRF-38534 Class K. 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. Maximum recommended operating voltage of +40 Volts was used for the bias condition. Four devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the 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:

Load regulation exhibited significant shifts due to irradiation. The load regulation started at approximately -14mV and increased with each successive dose. The reference voltage also exhibited shifts, but not as significant as the load regulation. The line regulation shift was very small up to 100 Krad(Si), however the unbiased units showed a slightly higher shift from 100 to 150 Krad(Si).

It is important to note however, that all parameters maintained post irradiation tolerance levels up to 150 Krad(Si).

MSK 5972KRH Biased/Unbiased Dose Rate  
Schedule

Dosimetry Equipment  
Bruker Biospin # 0141

Irradiation Date  
7/16/10

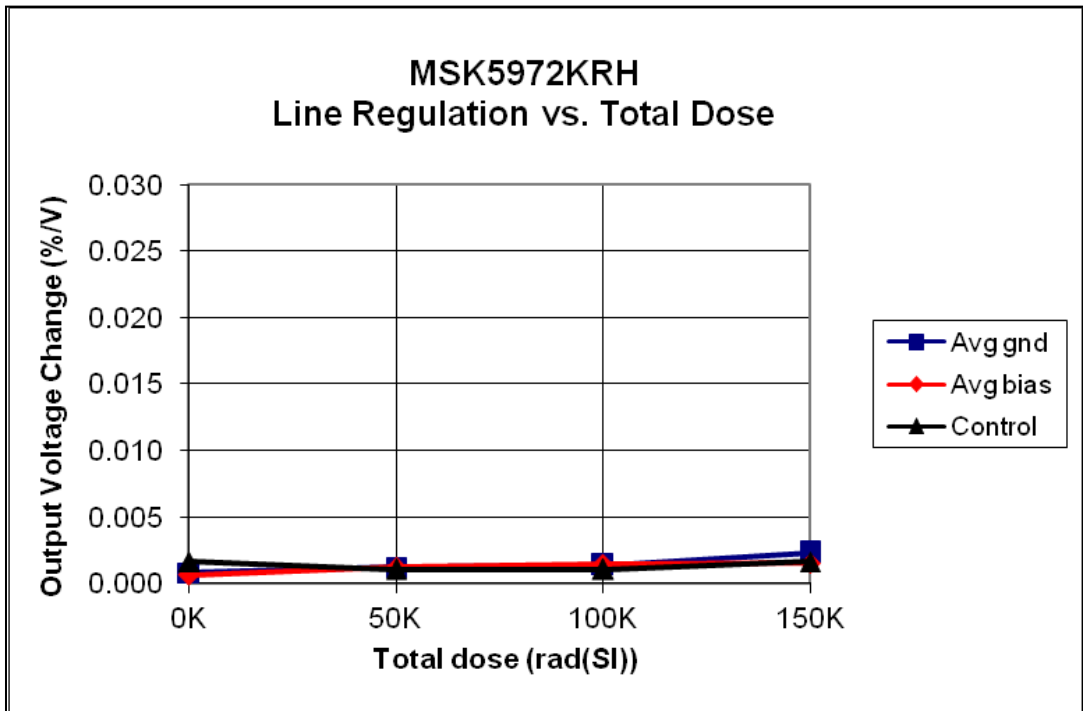
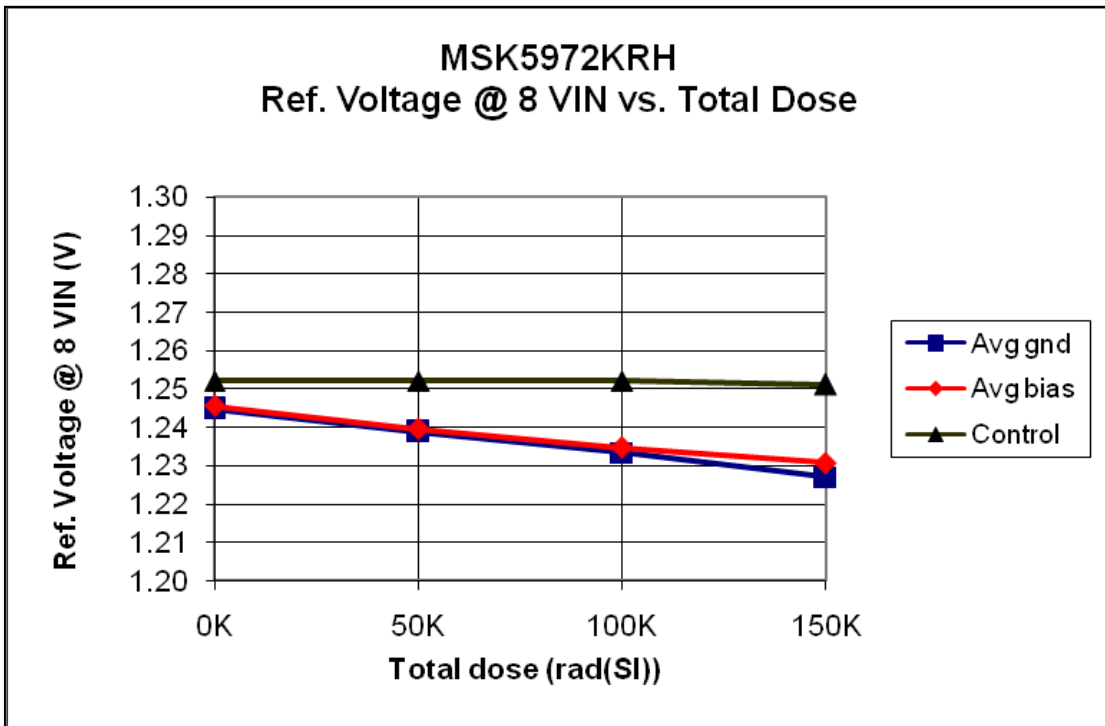
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
6:22	51,570	51,570
6:22	51,570	103,140
6:22	51,570	154,710

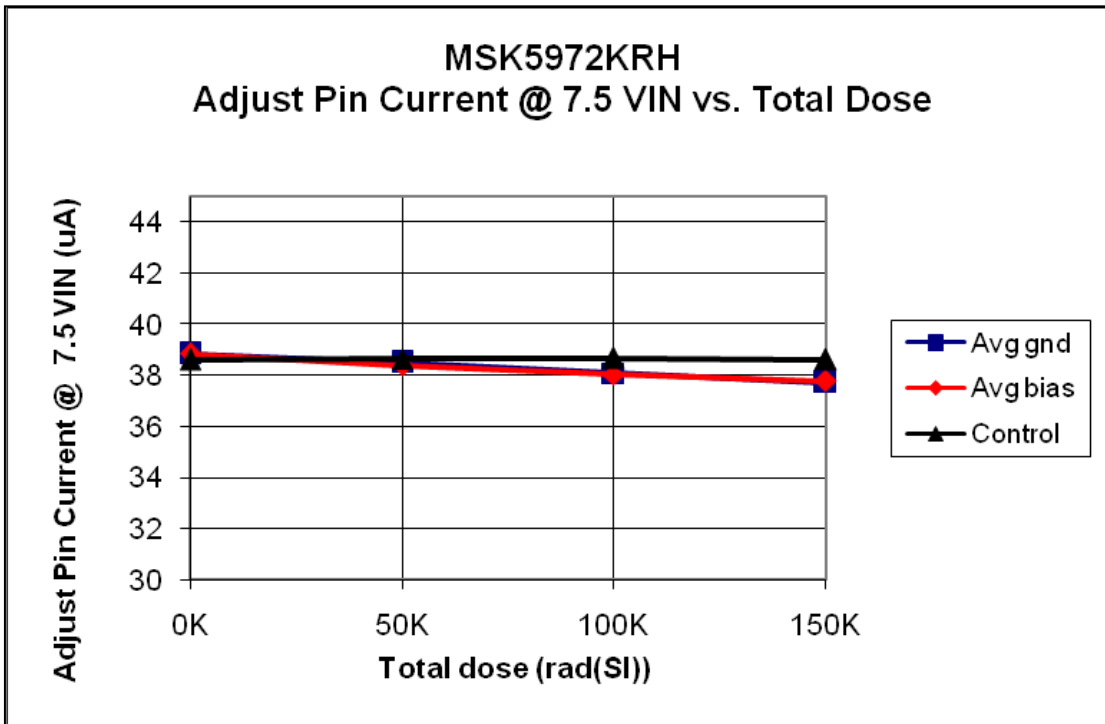
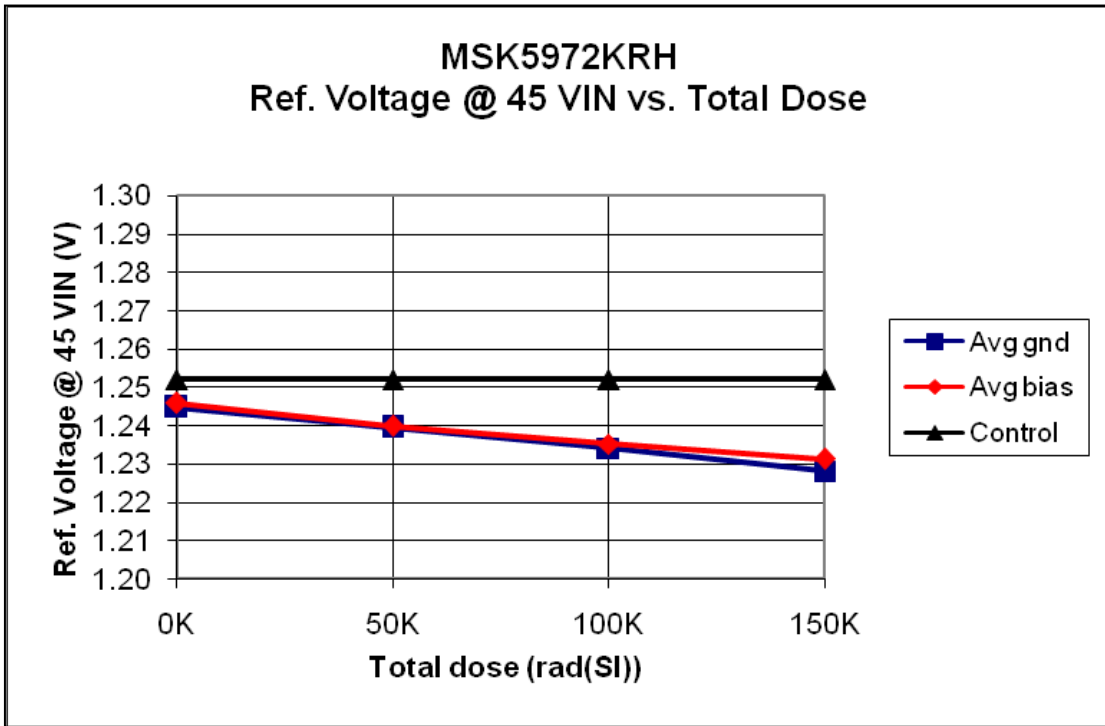
Biased S/N – 0200, 0201, 0202, 0203, 0204

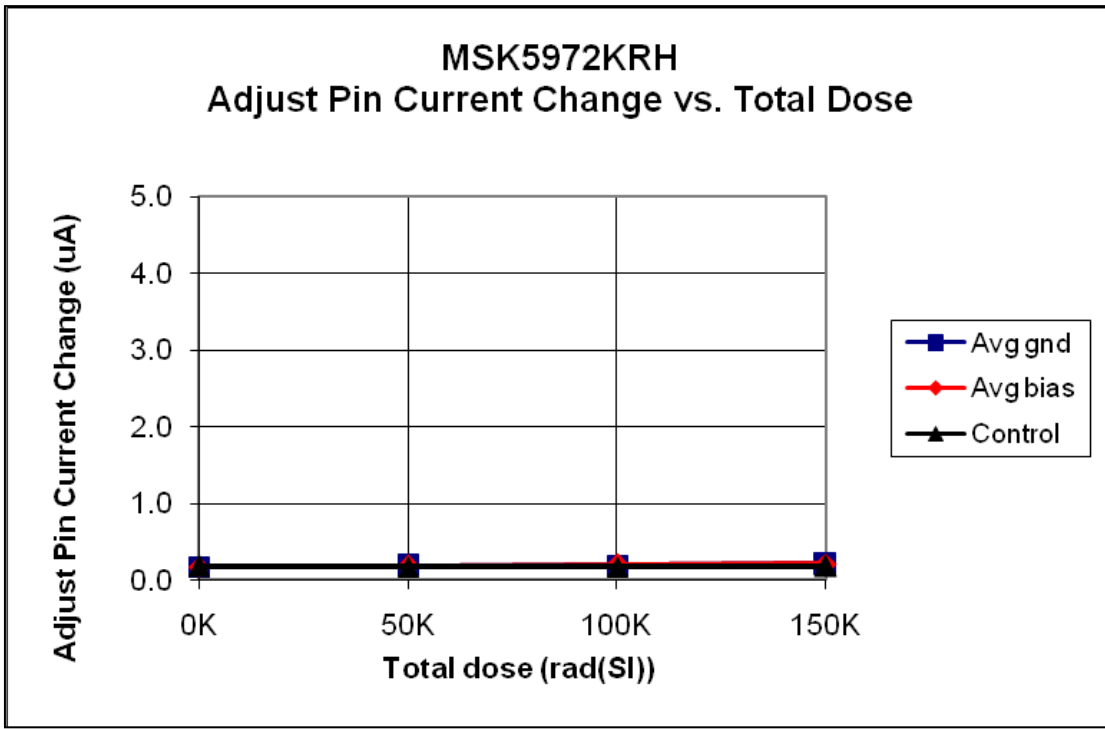
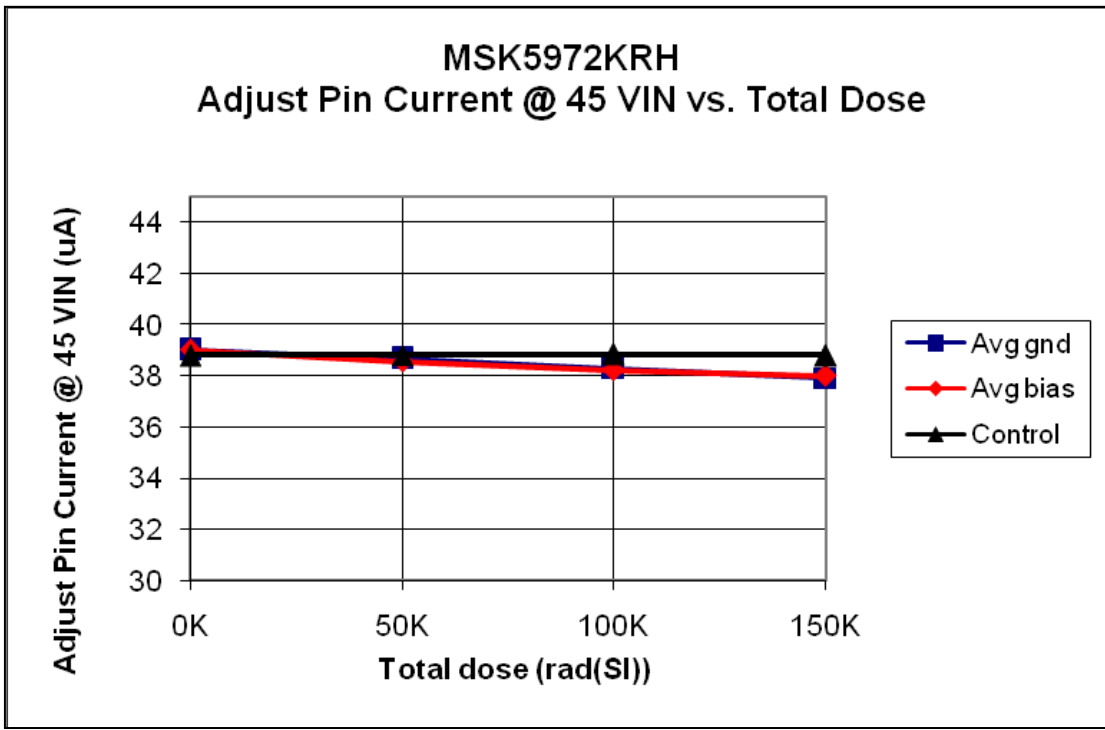
Unbiased S/N – 0205, 0206, 0207, 0208

Table 1

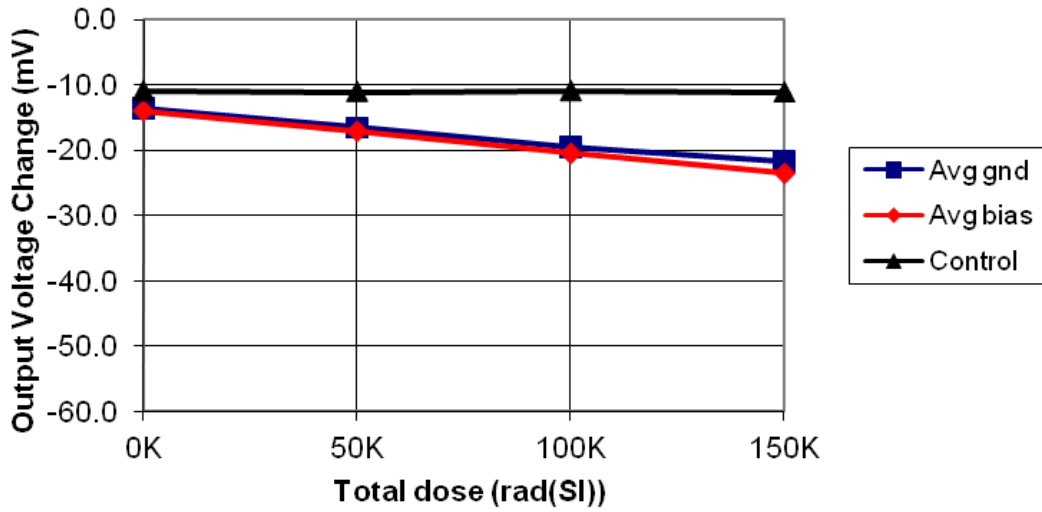
**Dose Time, Incremental Dose and Total Cumulative Dose**



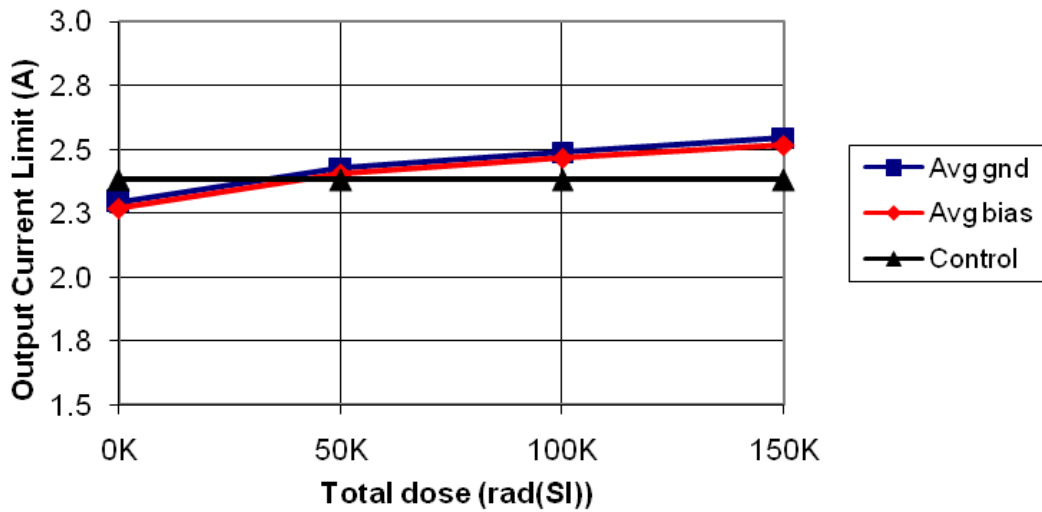




MSK5972KRH  
Load Regulation vs. Total Dose



MSK5972KRH  
Output Current Limit vs. Total Dose



**Total Dose Radiation Test Report**  
**MSK 5972RH and MSK 5972RHL**  
**RAD Hard Positive Voltage Regulator**

May 28, 2009

J. Douglas  
M. Bilecki

M.S. Kennedy Corporation  
Liverpool, NY

**I. Introduction:**

The total dose radiation test plan for the MSK 5972RH and MSK 5972RHL 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. The MSK 5972RH and the MSK 5972RHL use the same active component. The data in this report is from the direct measurement of the MSK 5972RH response to irradiation but is indicative of the response of both device types.

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 5972RH series.

**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 176 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 fully screened IAW MIL-PRF-38534 Class K. 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. Maximum recommended operating voltage of +40 Volts 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 the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the 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:**

Load regulation exhibited significant shifts due to irradiation. The load regulation started at approximately -10mV and decreased with each successive dose. The reference voltage also exhibited shifts, but not as significant as the load regulation. The line regulation shift was very small up to 100 Krad(Si), however the unbiased units showed significant shift from 100 to 150 Krad(Si).

It is important to note however, that all parameters maintained post irradiation tolerance levels up to 150 Krad(Si).



MSK 5972 RH Biased/Unbiased Dose Rate  
Schedule

Dosimetry Equipment  
Bruker Biospin # 0141

Irradiation Date  
5/14/09

Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
4:53	51,568	51,568
4:53	51,568	103,136
4:53	51,568	154,704
4:53	51,568	206,272
9:46	103,136	309,408
14:39	154,704	464,112

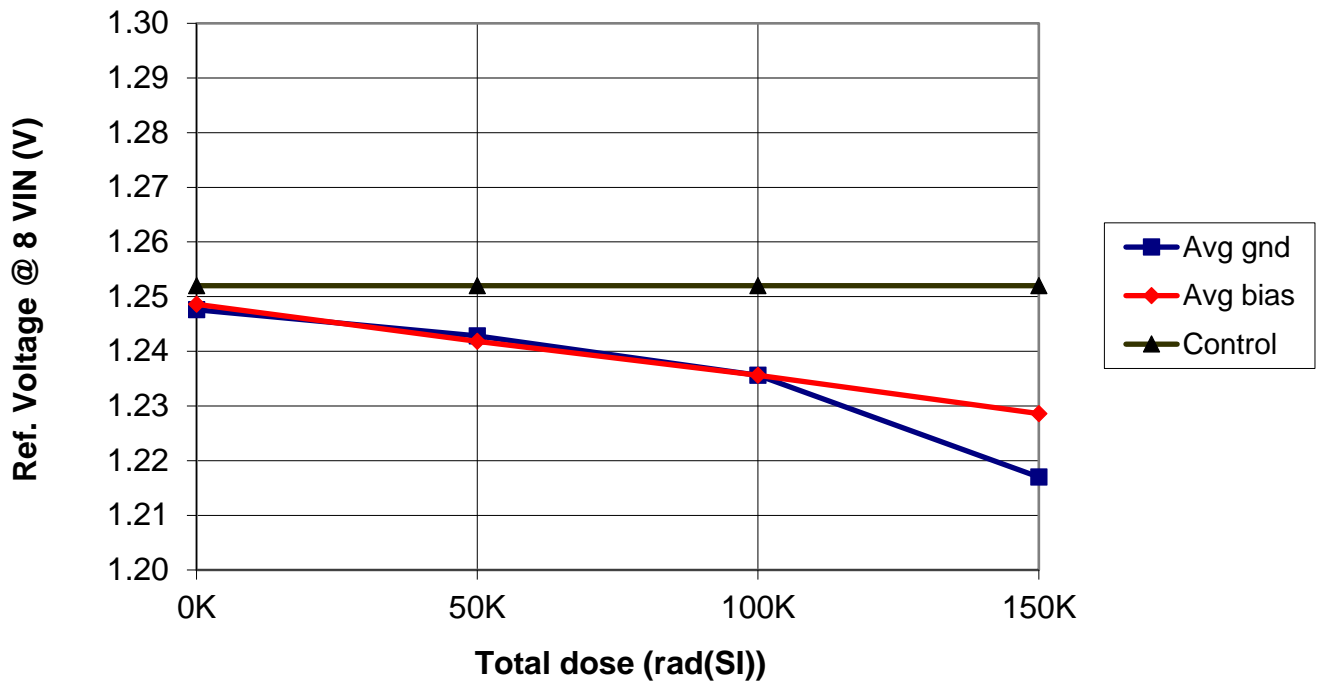
Biased S/N – 0061, 0062, 0063, 0064, 0065

Unbiased S/N – 0066, 0067, 0068, 0069, 0070

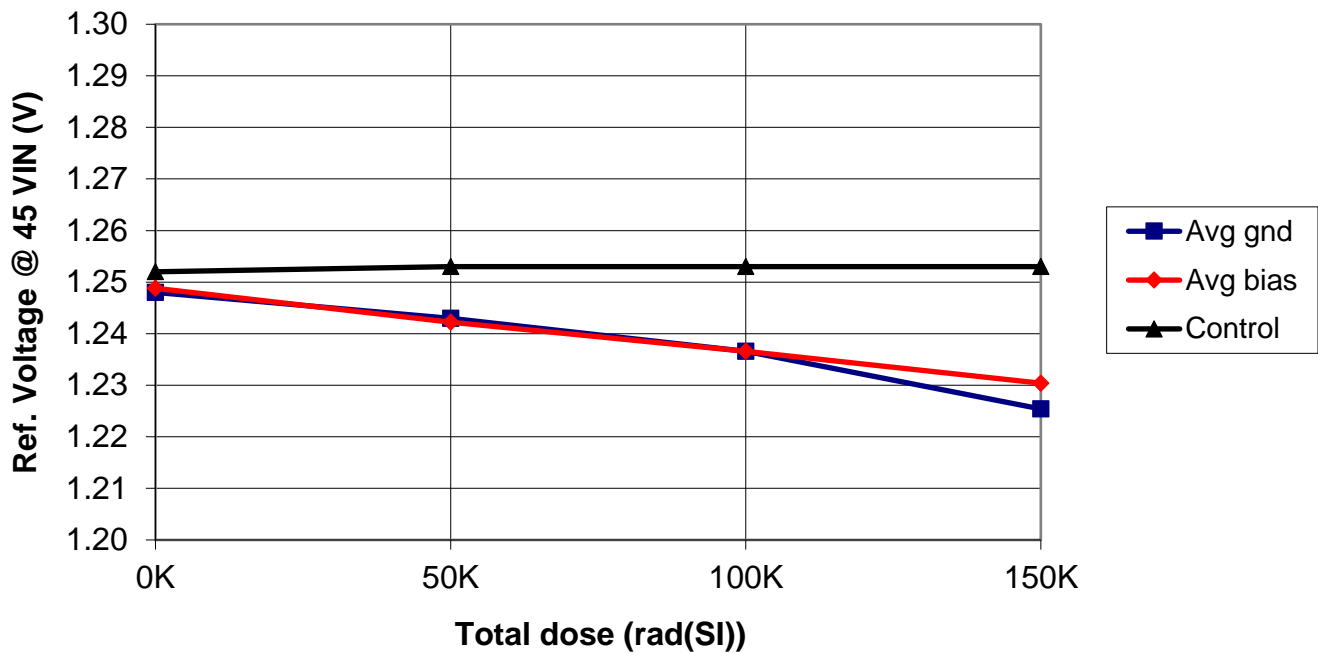
Table 1

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

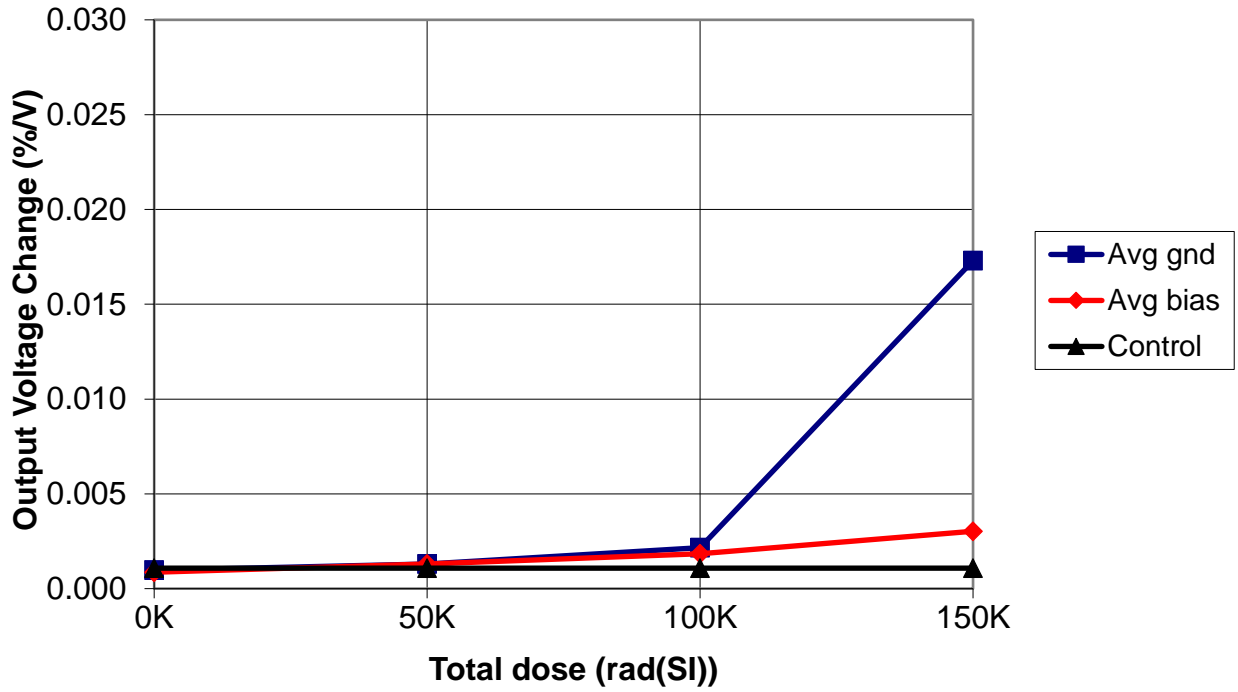
### MSK5972RH Ref. Voltage @ 8 VIN vs. Total Dose



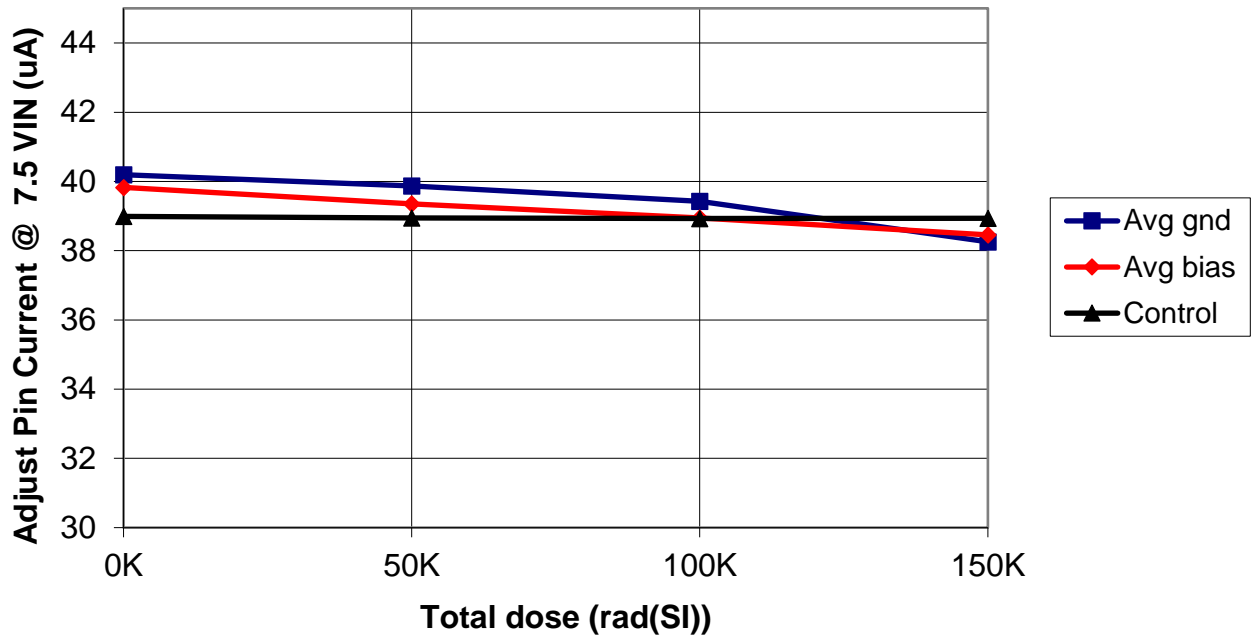
### MSK5972RH Ref. Voltage @ 45 VIN vs. Total Dose



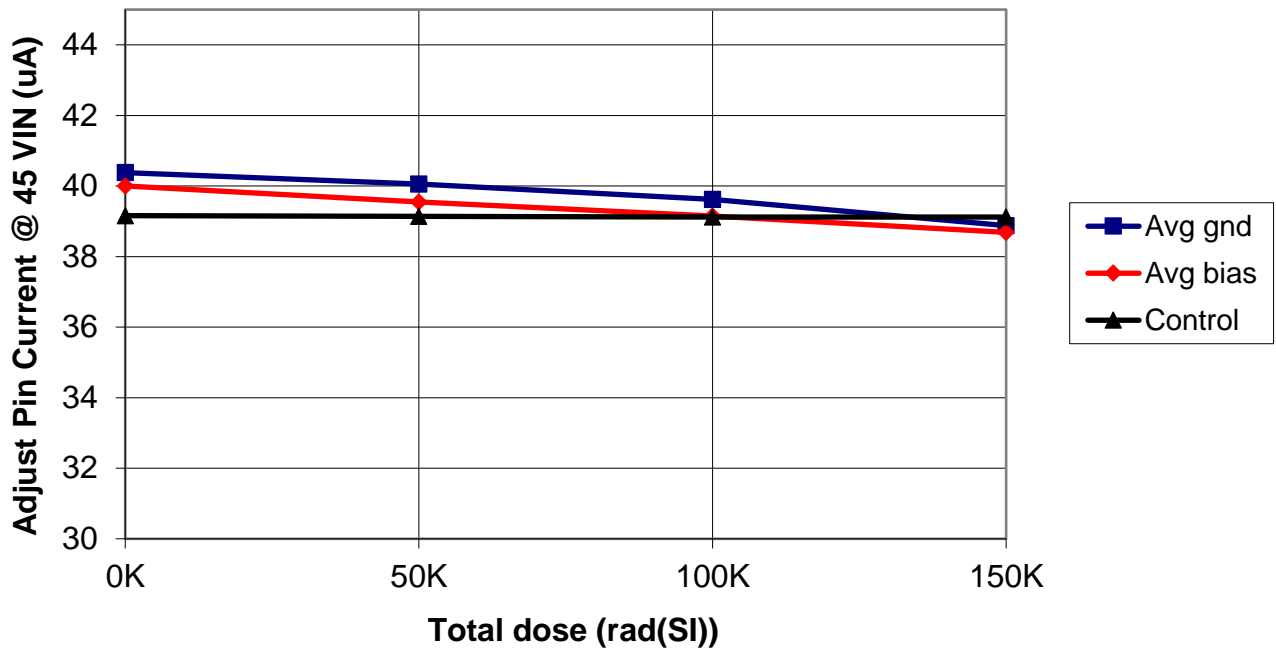
## MSK5972RH Line Regulation vs. Total Dose



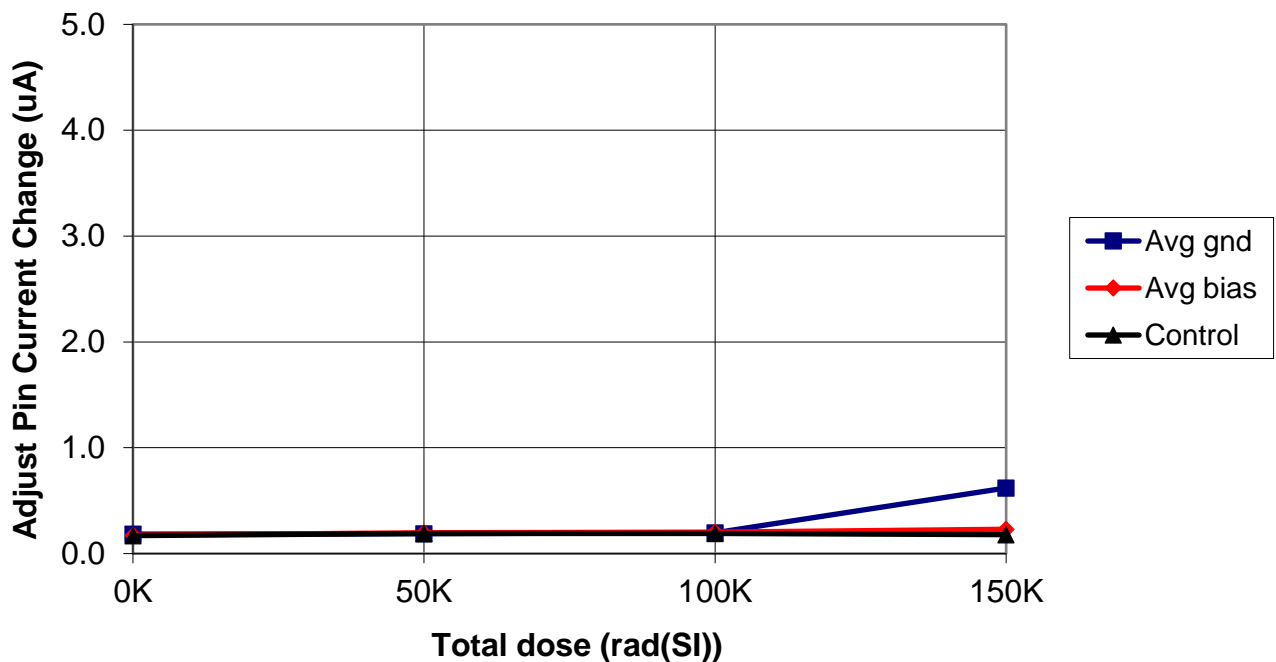
## MSK5972RH Adjust Pin Current @ 7.5 VIN vs. Total Dose



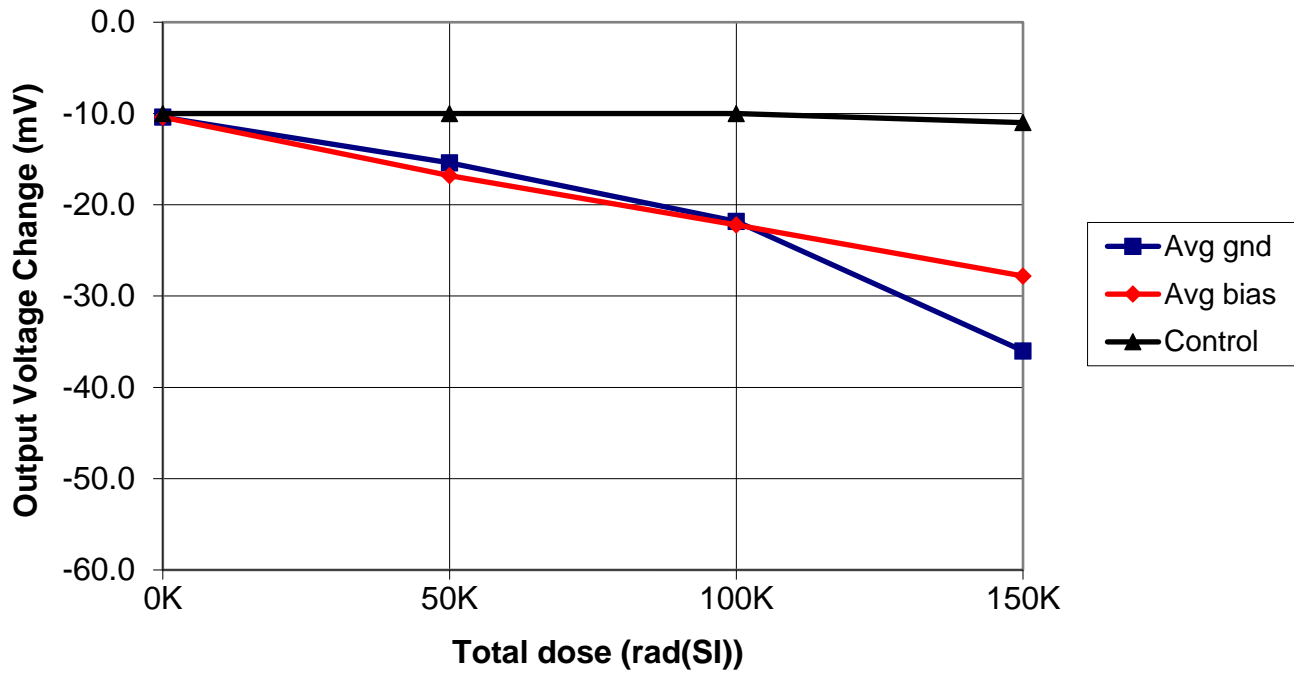
### MSK5972RH Adjust Pin Current @ 45 VIN vs. Total Dose



### MSK5972RH Adjust Pin Current Change vs. Total Dose



## MSK5972RH Load Regulation vs. Total Dose



## MSK5972RH Output Current Limit vs. Total Dose

