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

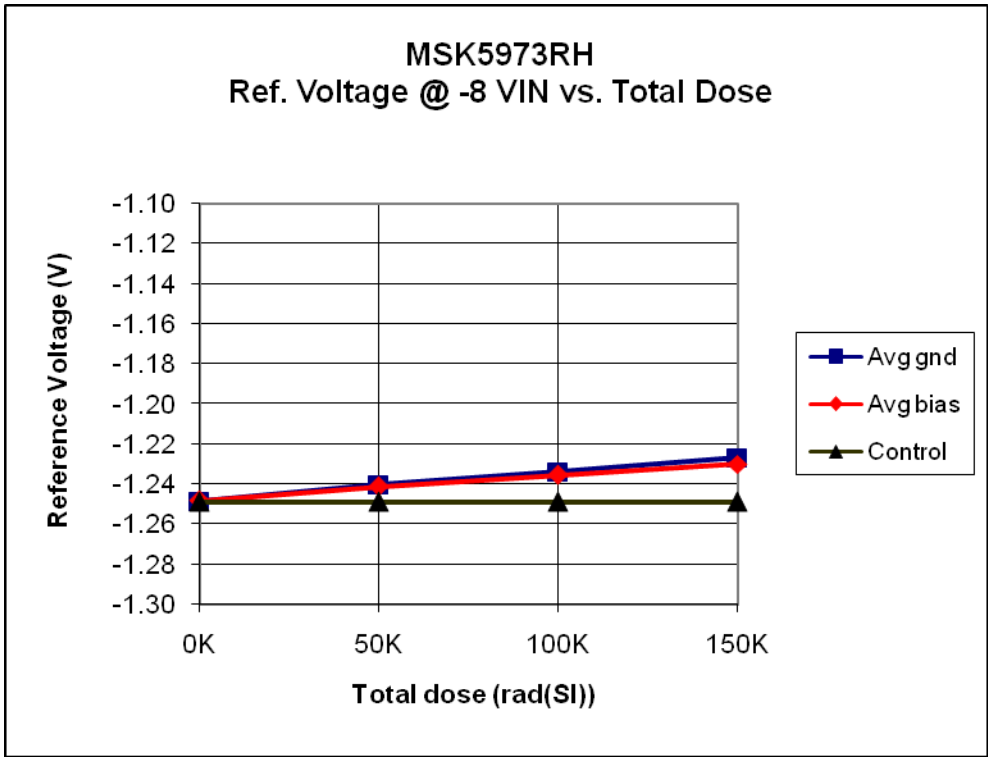
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
7:13	51,527	51,527
7:13	51,527	103,054
7:13	51,527	154,581

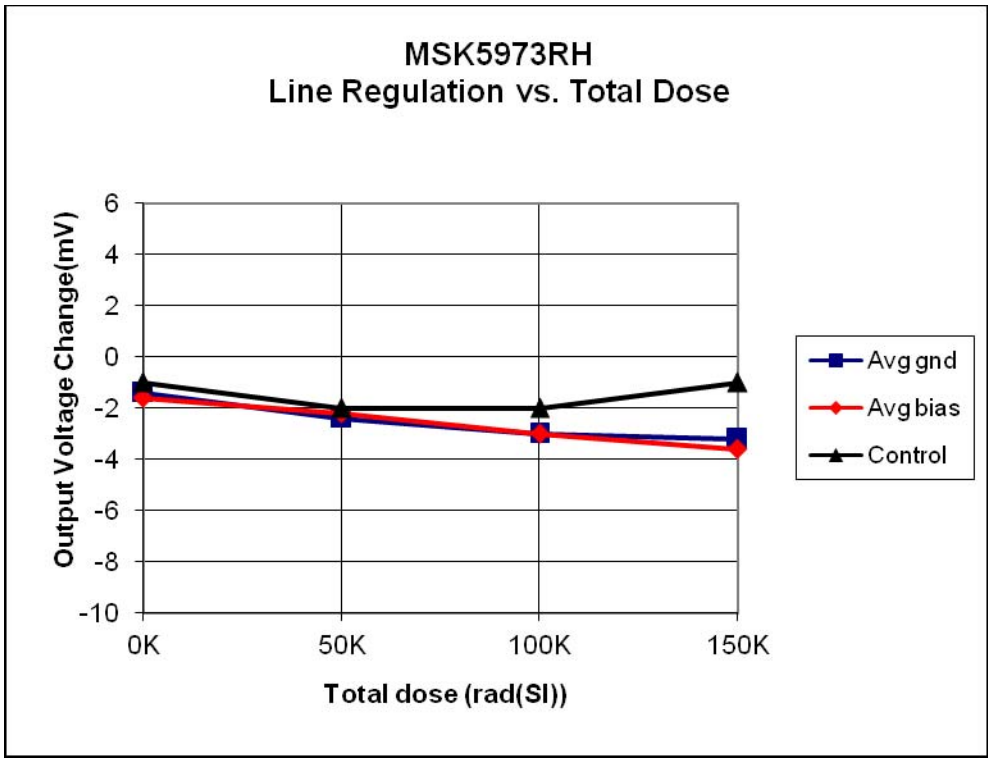
Biased S/N – 1026, 1027, 1028, 1029, 1030

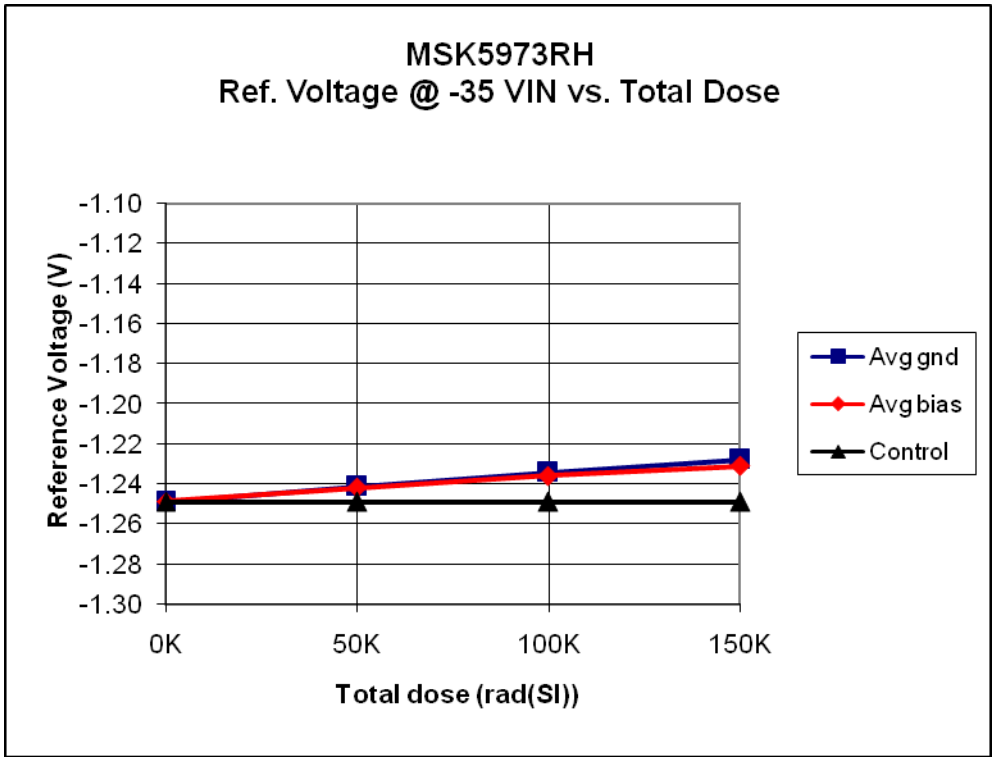
Unbiased S/N – 1031, 1032, 1033, 1034, 1035

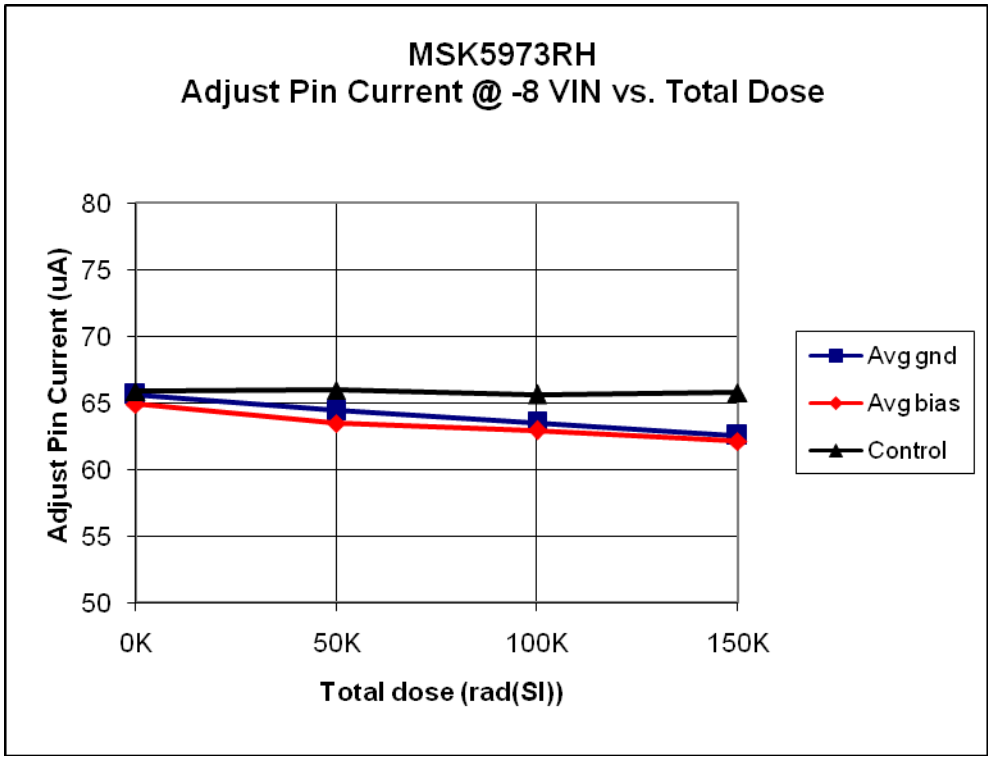
Table 1

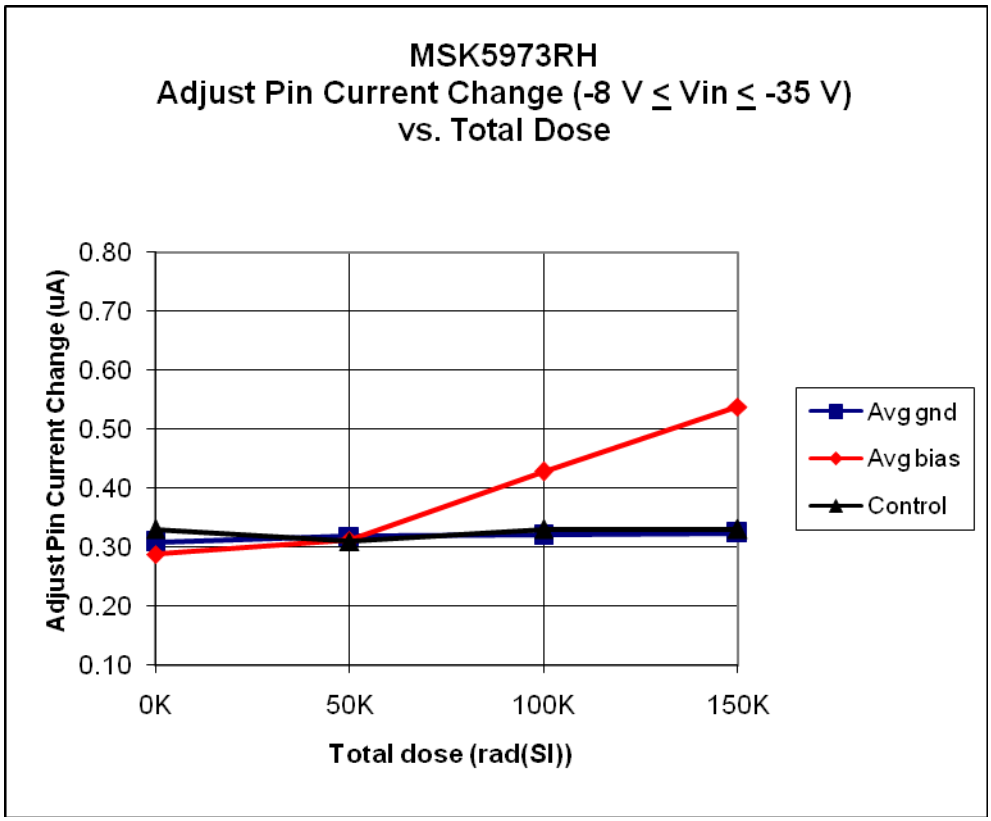
Dose Time, Incremental Dose and Total Cumulative Dose

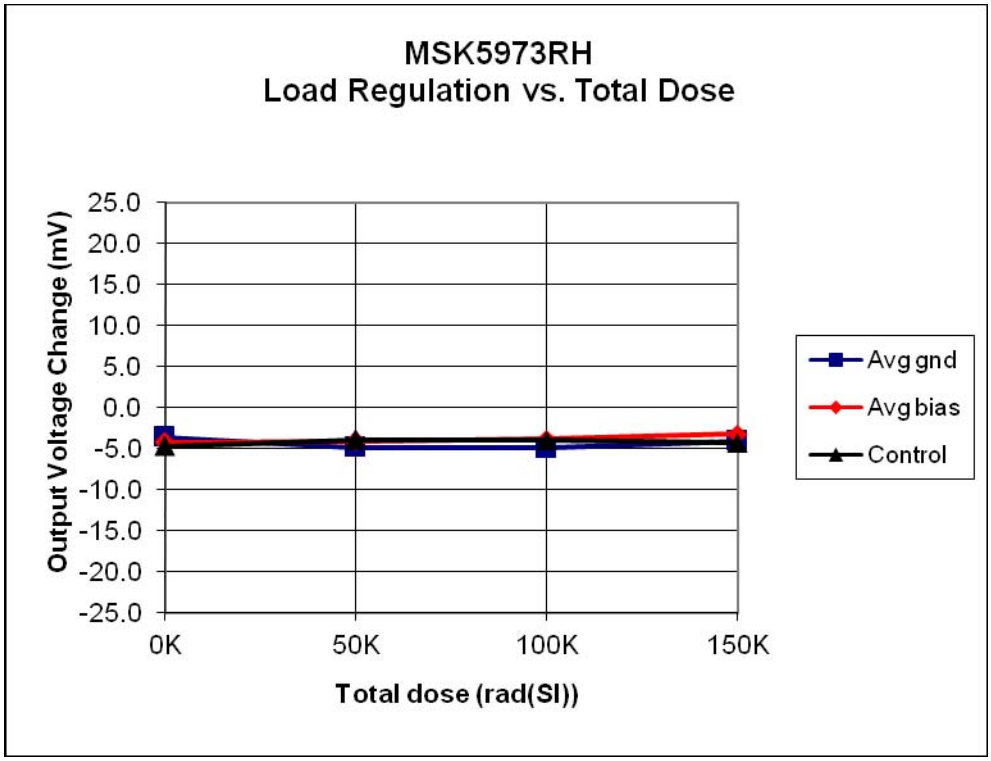

MSK5973RH
Ref. Voltage @ -8 VIN vs. Total Dose
Reference Voltage (V)
-1.10
-1.12
-1.14
-1.16
-1.18
-1.20
-1.22
-1.24
-1.26
-1.28
-1.30
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

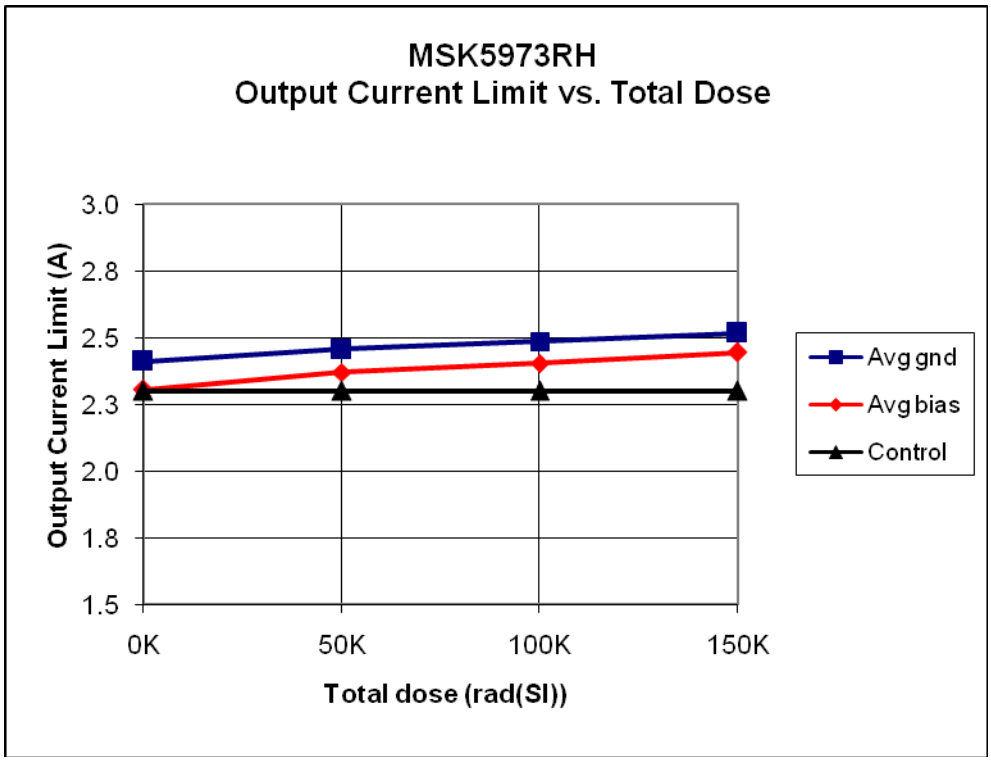

MSK5973RH
Line Regulation vs. Total Dose
Output Voltage Change(mV)
6
4
2
0
-2
-4
-6
-8
-10
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5973RH
Ref. Voltage @ -35 VIN vs. Total Dose
Reference Voltage (V)
-1.10
-1.12
-1.14
-1.16
-1.18
-1.20
-1.22
-1.24
-1.26
-1.28
-1.30
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5973RH
Adjust Pin Current @ -8 VIN vs. Total Dose
Adjust Pin Current (uA)
80
75
70
65
60
55
50
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5973RH
Adjust Pin Current Change (-8 V ≤ Vin ≤ -35 V)
vs. Total Dose
Adjust Pin Current Change (uA)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5973RH
Load Regulation vs. Total Dose
Output Voltage Change (mV)
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5973RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
3.0
2.8
2.5
2.3
2.0
1.8
1.5
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

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

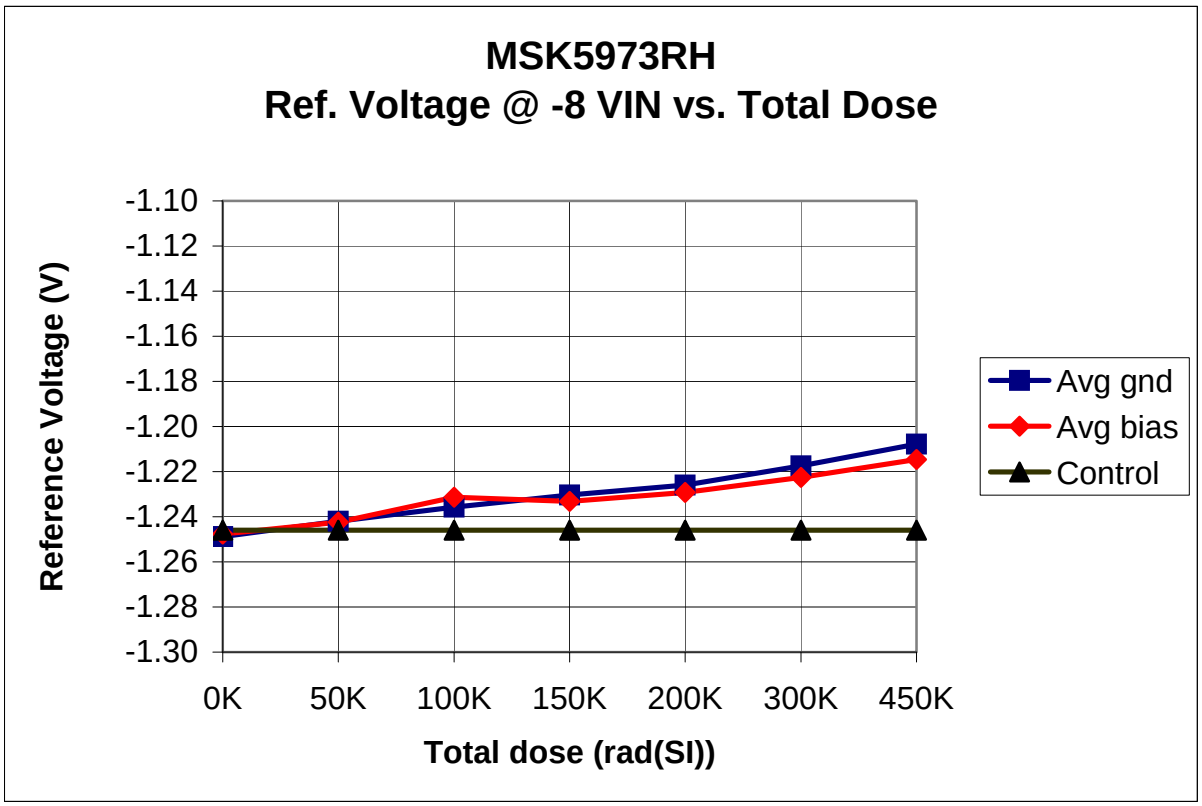
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
4:46	51,480	51,480
4:46	51,480	102,960
4:46	51,480	154,440
4:46	51,480	205,920
9:33	103,140	309,060
14:19	154,620	463,680

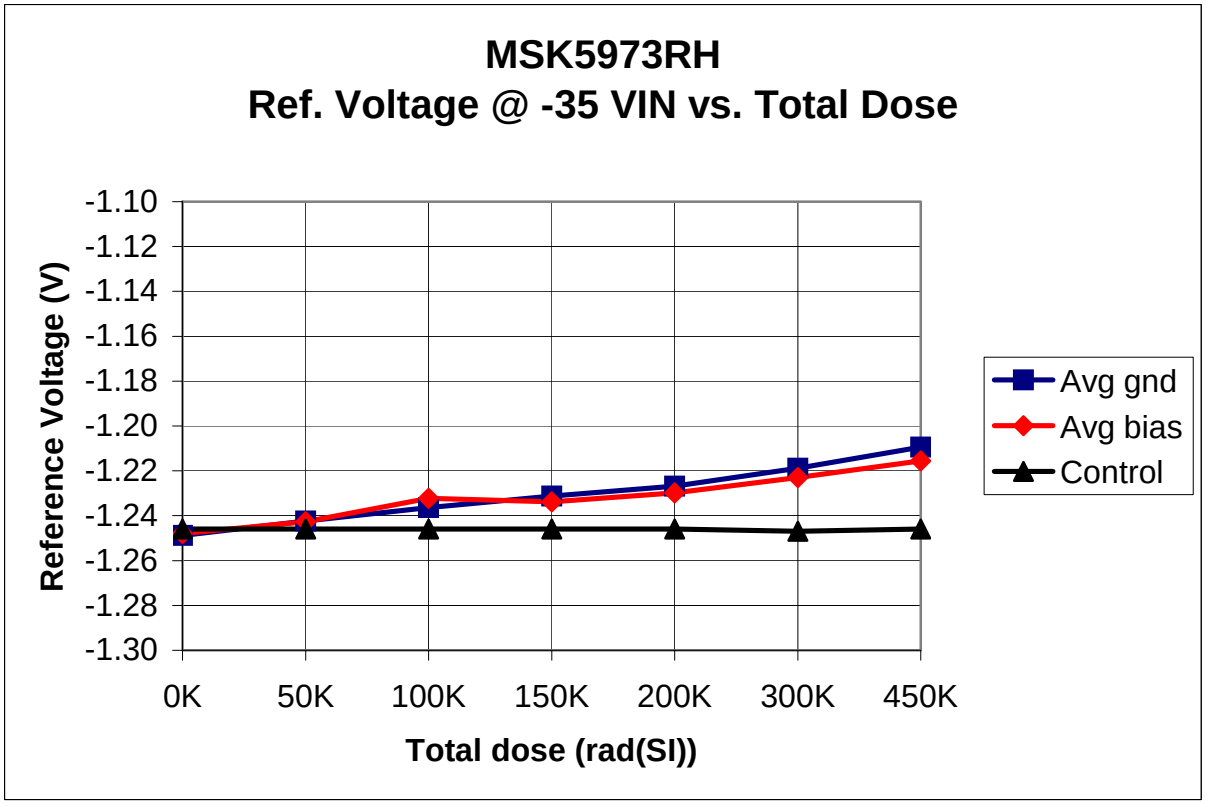
Biased S/N – 0076, 0077, 0078, 0079, 0080

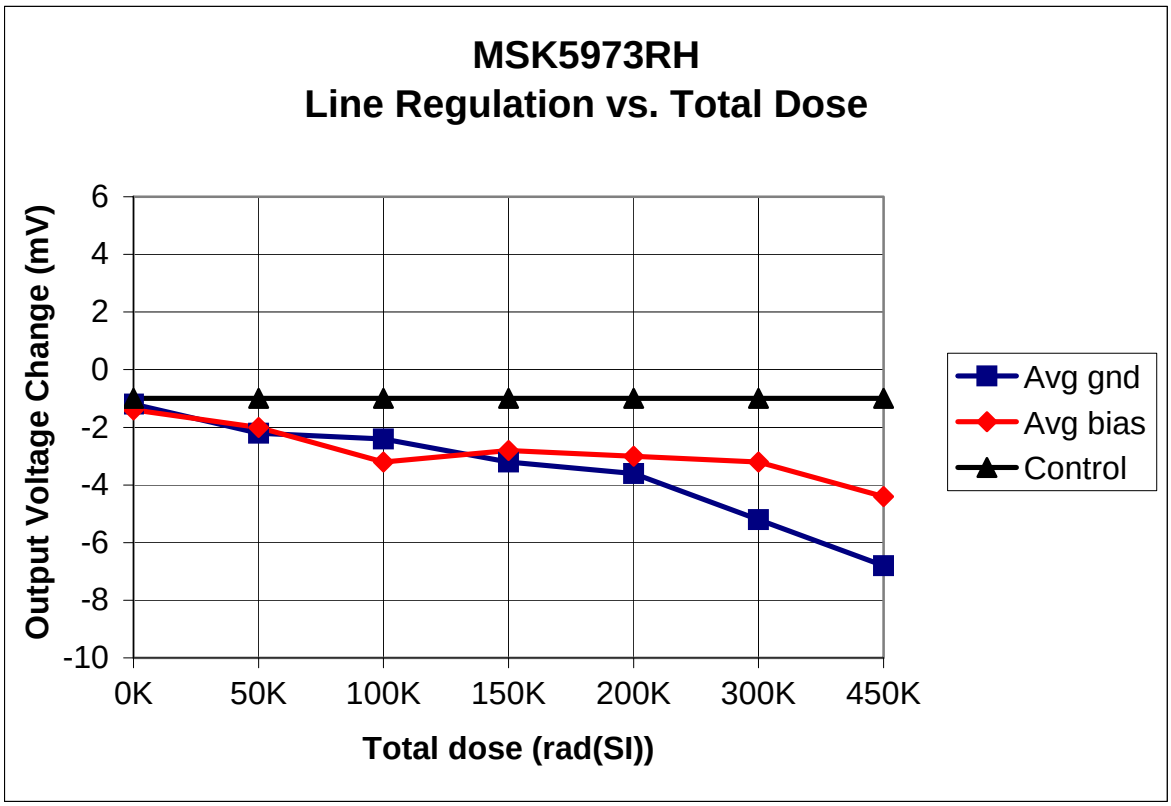
Unbiased S/N – 0081, 0082, 0083, 0084, 0085

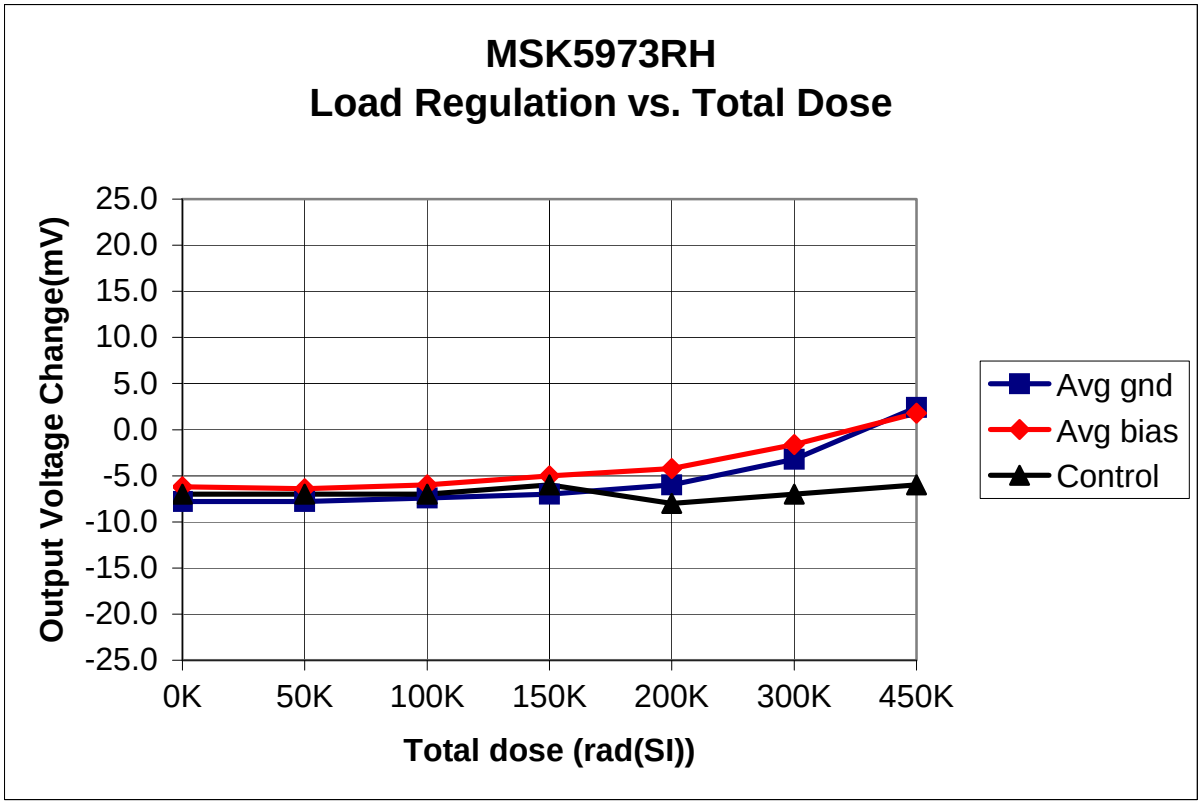
Table 1

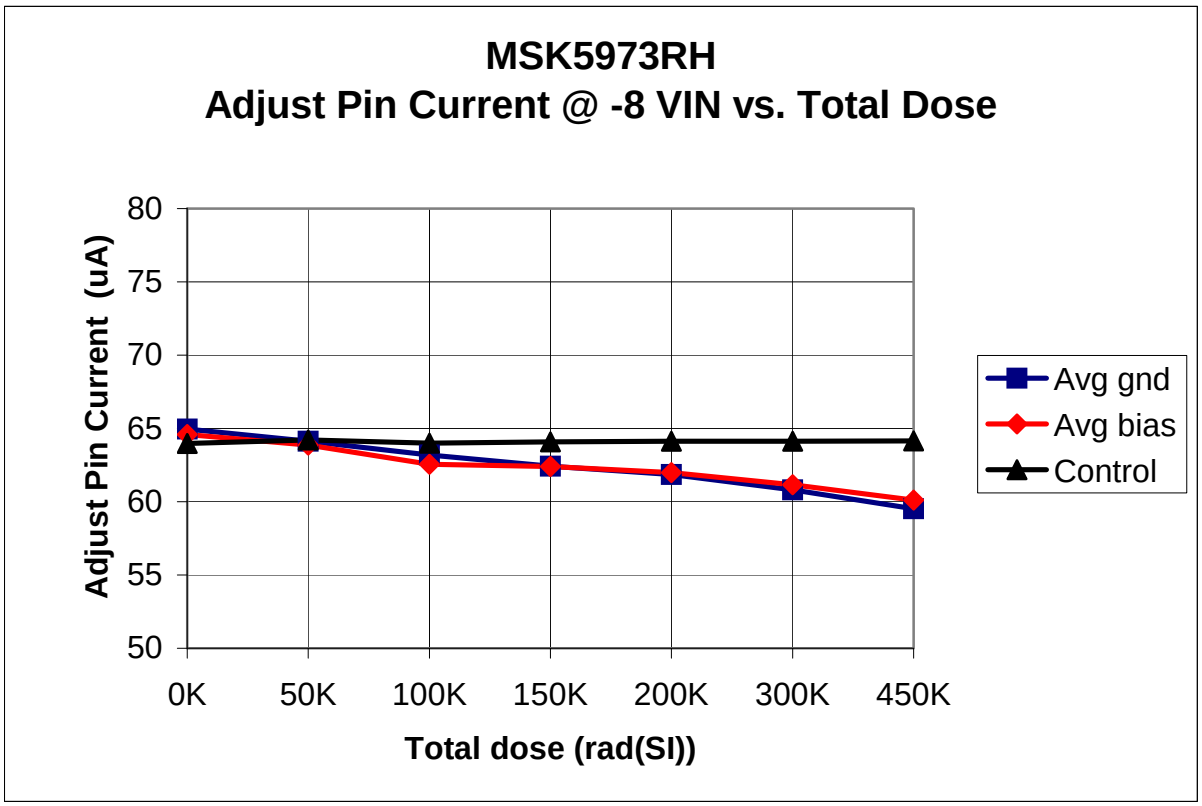
Dose Time, Incremental Dose and Total Cumulative Dose

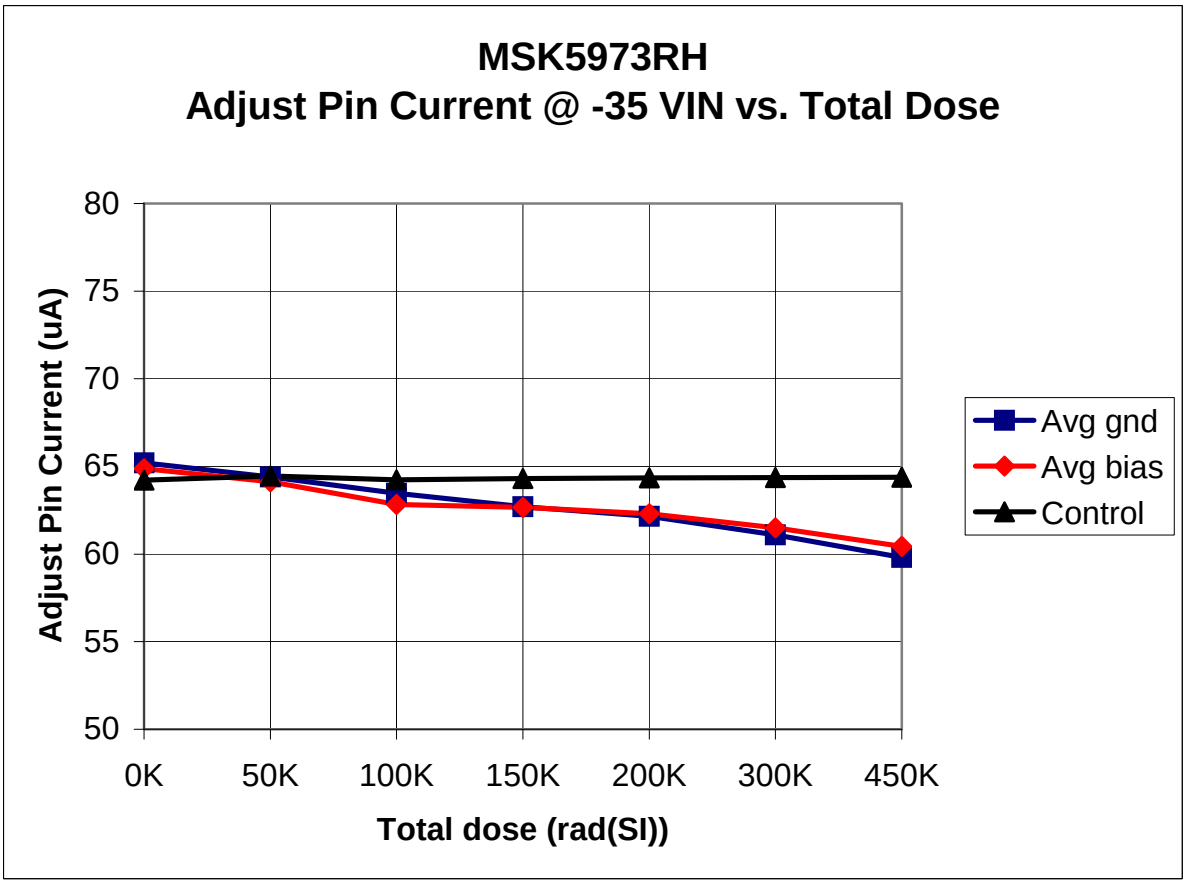

MSK5973RH
Ref. Voltage @ -8 VIN vs. Total Dose
Reference Voltage (V)
-1.10
-1.12
-1.14
-1.16
-1.18
-1.20
-1.22
-1.24
-1.26
-1.28
-1.30
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5973RH
Ref. Voltage @ -35 VIN vs. Total Dose
Reference Voltage (V)
-1.10
-1.12
-1.14
-1.16
-1.18
-1.20
-1.22
-1.24
-1.26
-1.28
-1.30
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

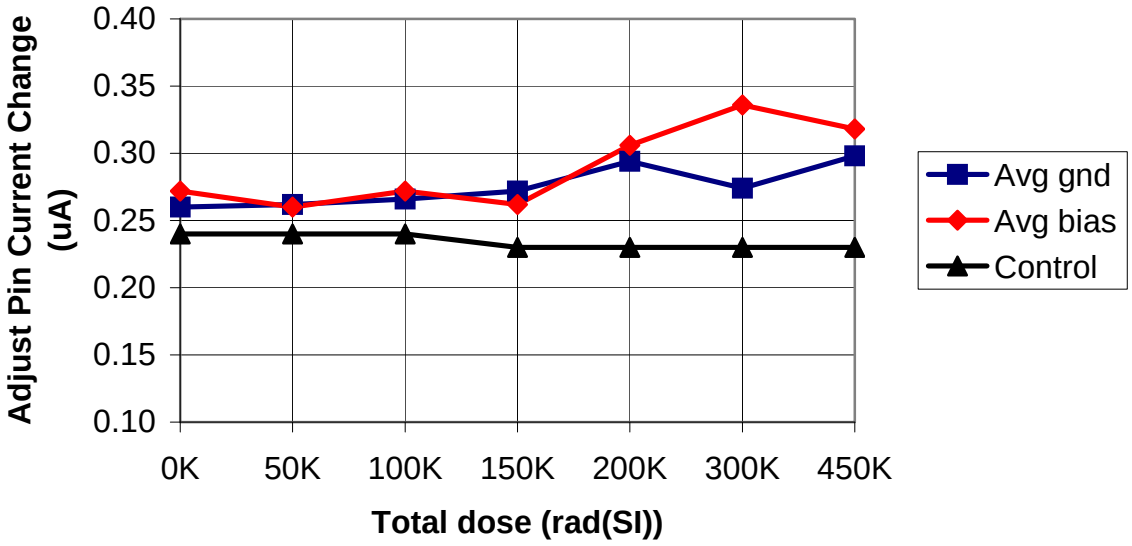

MSK5973RH
Line Regulation vs. Total Dose
Output Voltage Change (mV)
6
4
2
0
-2
-4
-6
-8
-10
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5973RH
Load Regulation vs. Total Dose
Output Voltage Change(mV)
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5973RH
Adjust Pin Current @ -8 VIN vs. Total Dose
Adjust Pin Current (uA)
80
75
70
65
60
55
50
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5973RH
Adjust Pin Current @ -35 VIN vs. Total Dose
Adjust Pin Current (uA)
80
75
70
65
60
55
50
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

MSK5973RH
Adjust Pin Current Change (-8 V ≤ Vin ≤ -35 V)
vs. Total Dose



MSK5973RH
Output Current Limit vs. Total Dose