Total Dose Radiation Test Report

MSK0002RH

Rad Hard High Speed, Buffer Amp

March 29, 2007 (First Test)	
April 7, 2009 (Second Test)	
February 25, 2011 (Third Test)	
June 1, 2012 (Fourth Test)	
June 13, 2014 (5th Test,	NPN Wafer Lot: J1978W#PD-10
	PNP Wafer Lot: J1951W#SQ-7)
November 8, 2016 (6th Test,	NPN Wafer Lot: J2183W#TT-1
	PNP Wafer Lot: J2067W#MU-9)
January 11, 2018 (7th Test,	NPN Wafer Lot: J1364
	PNP Wafer Lot: F00004693W22)
October 11, 22018 (8th Test,	NPN Wafer Lot: J1364 TH-16
	PNP Wafer Lot: F00006134WF6)

B. Horton
F. Freytag

MSK Products – Anaren Inc.

I. Introduction:

The total dose radiation test plan for the MSK0002RH was developed to qualify the device as Rad Hard up to 100 Krad(Si). The testing was performed to 150 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 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 MSK0002RH.

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 111.5 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 160 hours of burn-in per MIL-STD-883 Method 1015 and were electrically tested prior to irradiation. For test platform verification, three control devices were 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. An operating voltage of +/-15 Volts was used for the bias condition. Four devices were kept under bias during irradiation. Four 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 in accordance with MSK0002RH datasheet. Testing was performed on irradiated devices and control devices 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. 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 MSK0002RH qualifies as a 100 KRad(Si) radiation hardened device. Input current and output offset voltage both decreased with increasing irradiation. Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. However all parameters stayed well with post irradiation specifications.

MSK0002RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
10/11/18

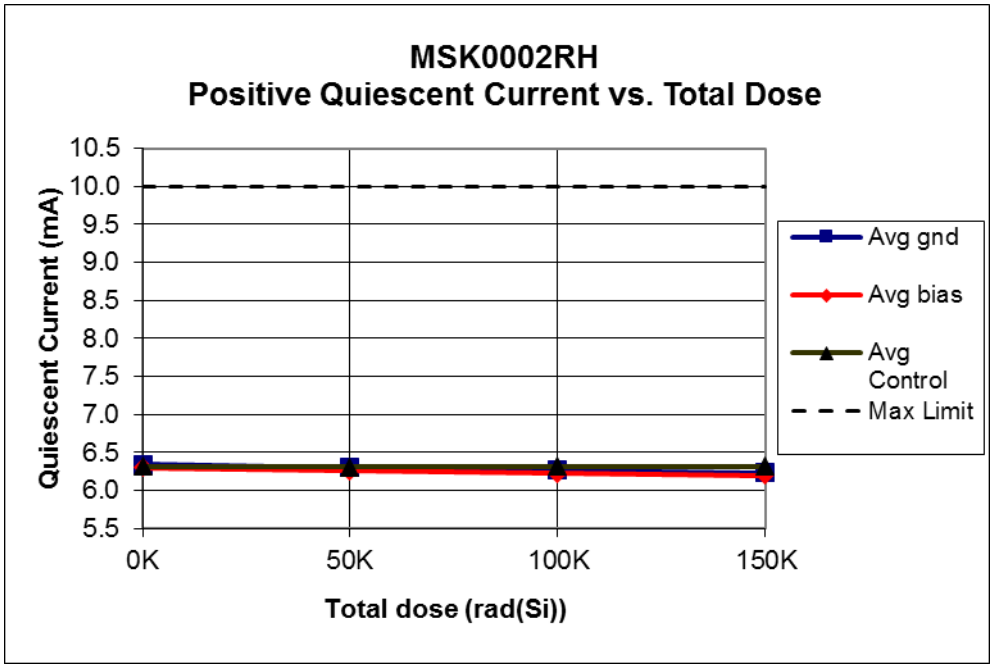
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
0:07:42	51,500	51,500
0:07:42	51,500	103,000
0:07:42	51,500	154,500

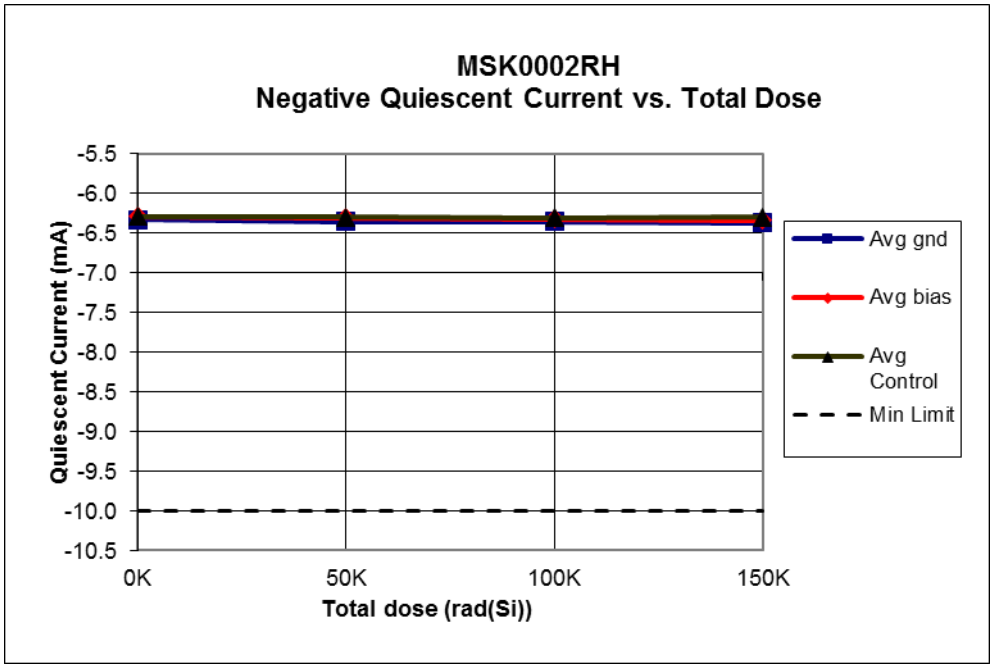
Biased S/N – 0182, 0183, 0184, 0185

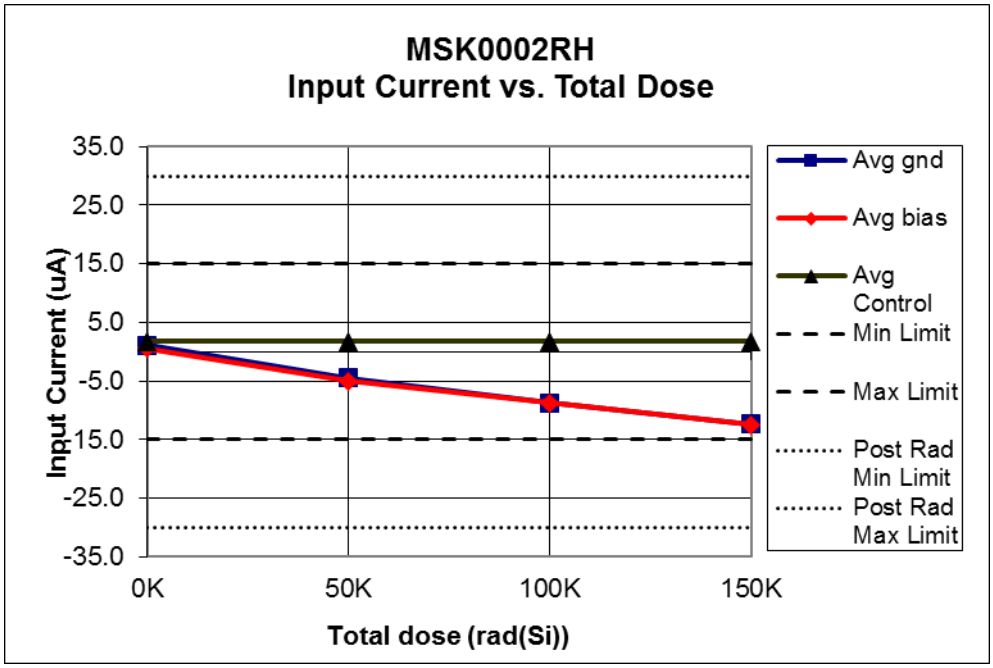
Unbiased S/N – 0189, 0190, 0191, 0192

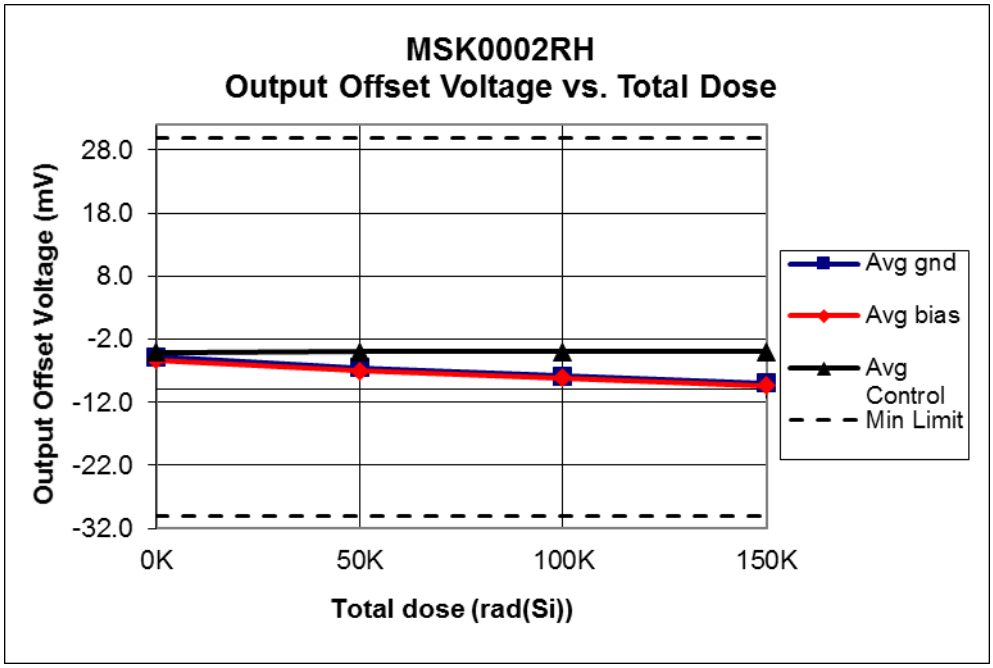
Table 1

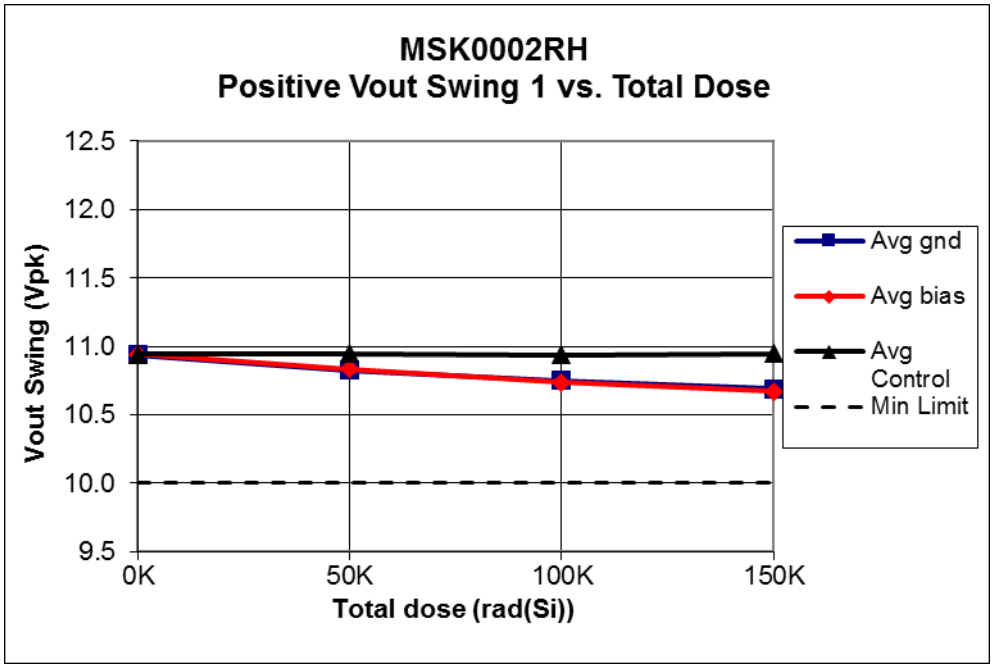
Dose Time, Incremental Dose and Total Cumulative Dose

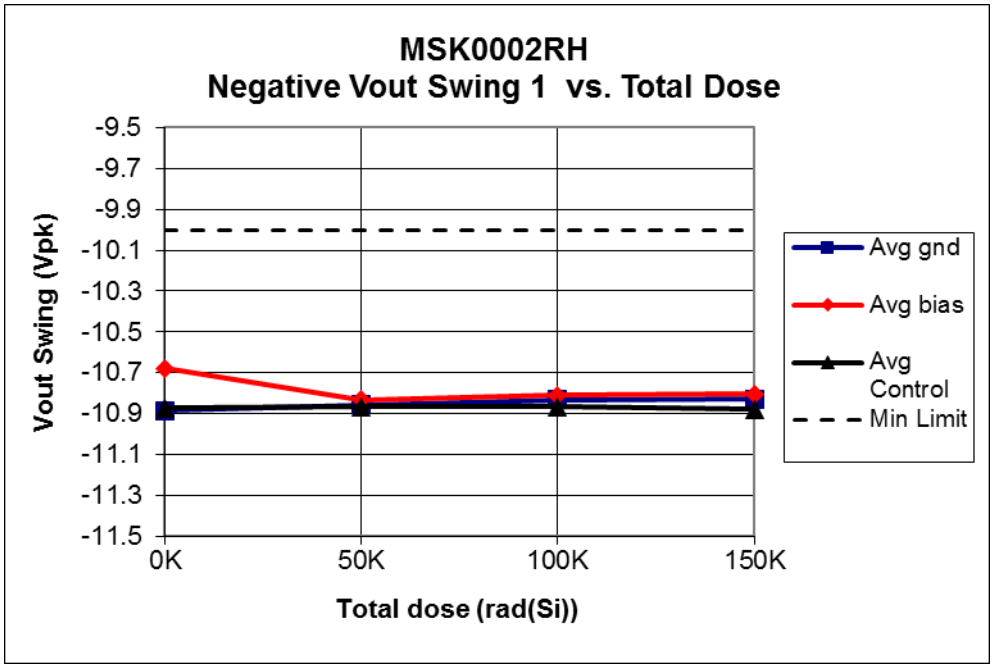

MSK0002RH
Positive Quiescent Current vs. Total Dose
Quiescent Current (mA)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Max Limit

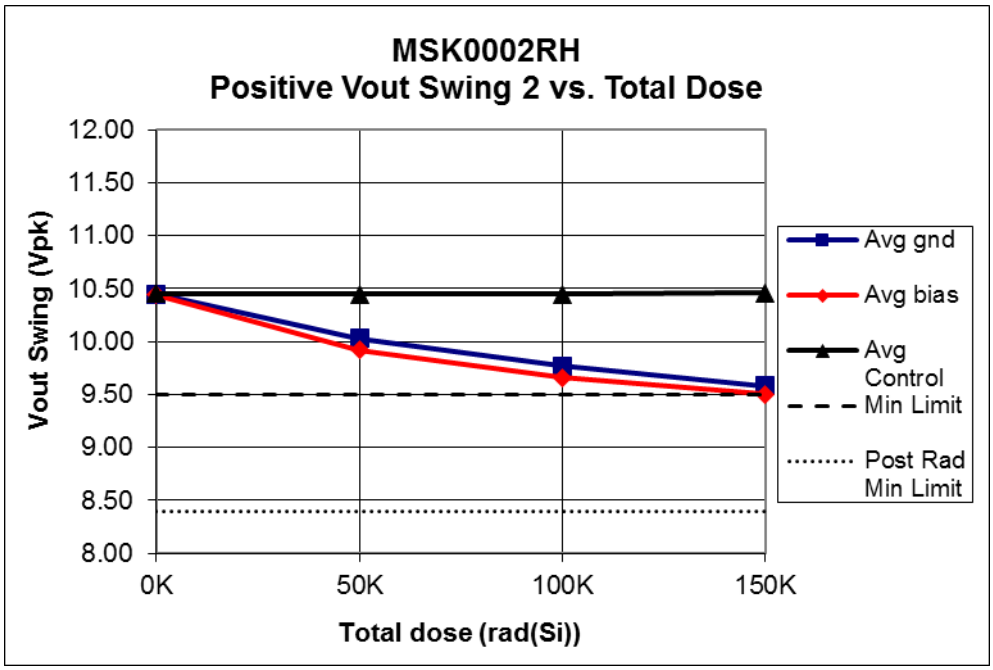

MSK0002RH
Negative Quiescent Current vs. Total Dose
Quiescent Current (mA)
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
-10.5
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit

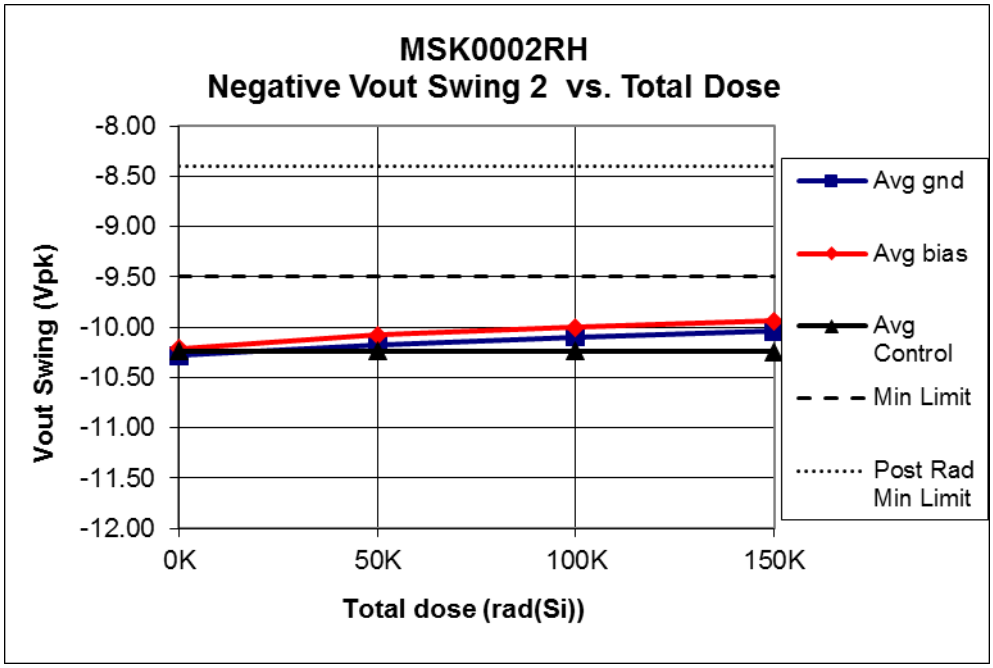

MSK0002RH
Input Current vs. Total Dose
35.0
25.0
15.0
5.0
-5.0
-15.0
-25.0
-35.0
Input Current (uA)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit
Post Rad Max Limit

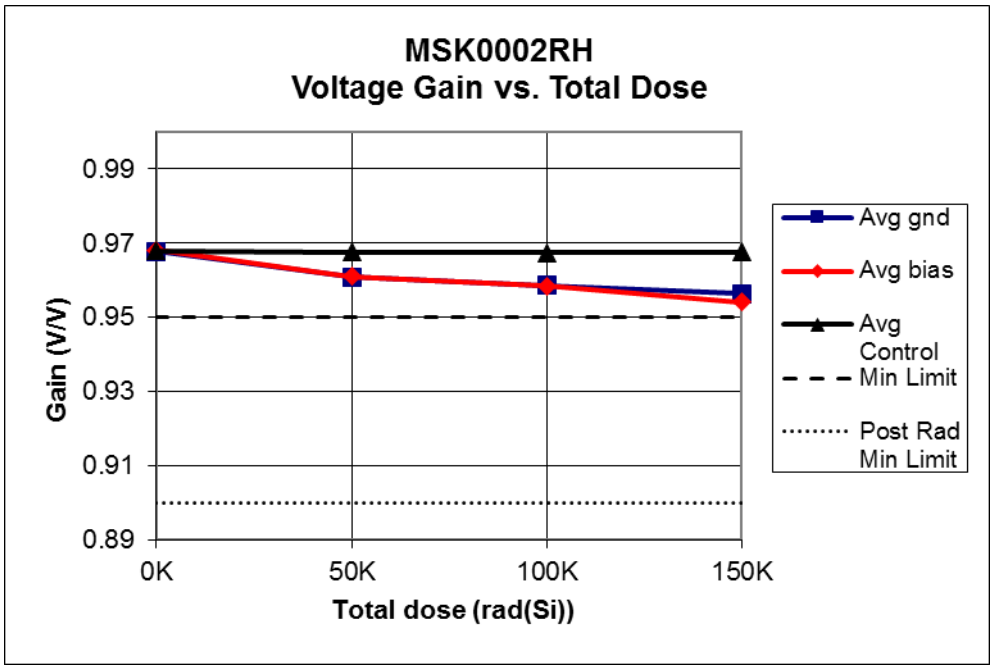

MSK0002RH
Output Offset Voltage vs. Total Dose
28.0
18.0
8.0
-2.0
-12.0
-22.0
-32.0
Output Offset Voltage (mV)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit

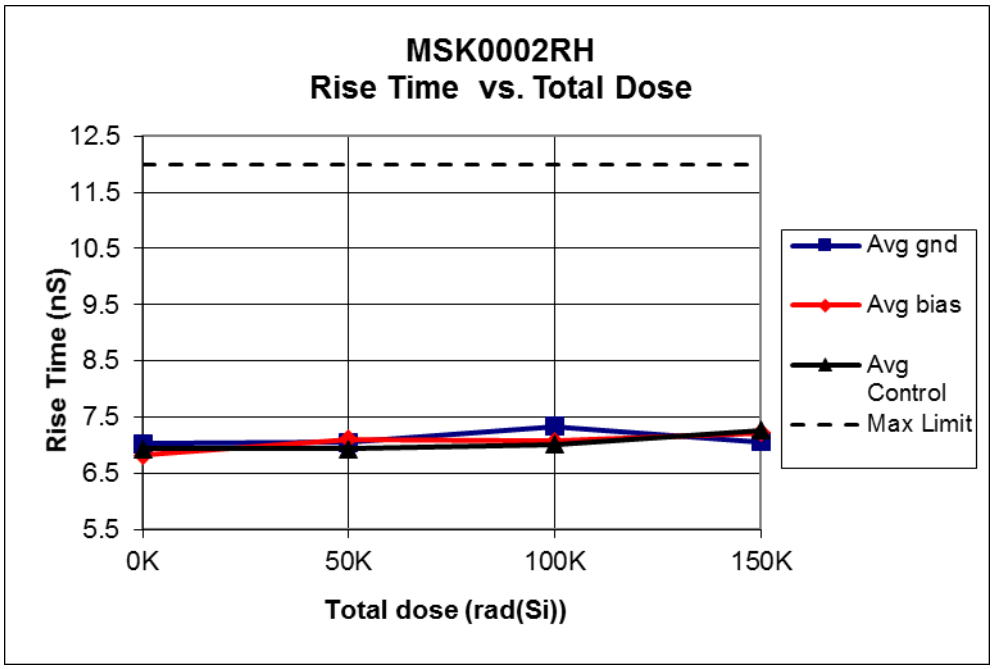

MSK0002RH
Positive Vout Swing 1 vs. Total Dose
Vout Swing (Vpk)
12.5
12.0
11.5
11.0
10.5
10.0
9.5
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit


MSK0002RH
Negative Vout Swing 1 vs. Total Dose
Vout Swing (Vpk)
-9.5
-9.7
-9.9
-10.1
-10.3
-10.5
-10.7
-10.9
-11.1
-11.3
-11.5
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit


MSK0002RH
Positive Vout Swing 2 vs. Total Dose
Vout Swing (Vpk)
12.00
11.50
11.00
10.50
10.00
9.50
9.00
8.50
8.00
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Negative Vout Swing 2 vs. Total Dose
Vout Swing (Vpk)
-8.00
-8.50
-9.00
-9.50
-10.00
-10.50
-11.00
-11.50
-12.00
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Voltage Gain vs. Total Dose
0.99
0.97
0.95
0.93
0.91
0.89
Gain (V/V)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Rise Time vs. Total Dose
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
Rise Time (nS)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Max Limit

Total Dose Radiation Test Report

MSK0002RH

Rad Hard High Speed, Buffer Amp

March 29, 2007 (First Test)
April 7, 2009 (Second Test)
February 25, 2011 (Third Test)
June 1, 2012 (Fourth Test)
June 13, 2014 (5th Test, NPN Wafer Lot: J1978W#PD-10 PNP Wafer Lot: J1951W#SQ-7)
November 8, 2016 (6th Test, NPN Wafer Lot: J2183W#TT-1 PNP Wafer Lot: J2067W#MU-9)
January 11, 2018 (7th Test, NPN Wafer Lot: J1364 PNP Wafer Lot: F00004693W22)

B. Horton
J. Joy
N. Kresse

MSK Products – Anaren Inc.

I. Introduction:

The total dose radiation test plan for the MSK0002RH was developed to qualify the device as Rad Hard up to 100 Krad(Si). The testing was performed to 300 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 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 MSK0002RH.

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 126.7 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, two control device were 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. Four devices were kept under bias during irradiation. Four 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 in accordance with MSK0002RH datasheet. Testing was performed on irradiated devices and control devices 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. 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 MSK0002RH qualifies as a 100 KRad(Si) radiation hardened device. Input current and output offset voltage both decreased with increasing irradiation. Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. However all parameters stayed well with post irradiation specifications.

MSK0002RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

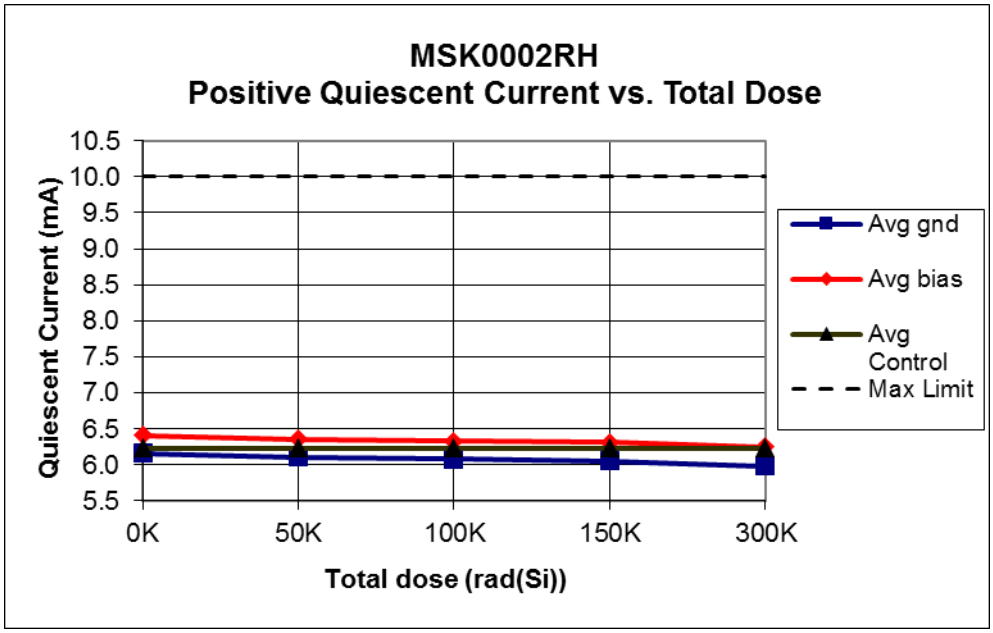
Irradiation Date
1/11/18

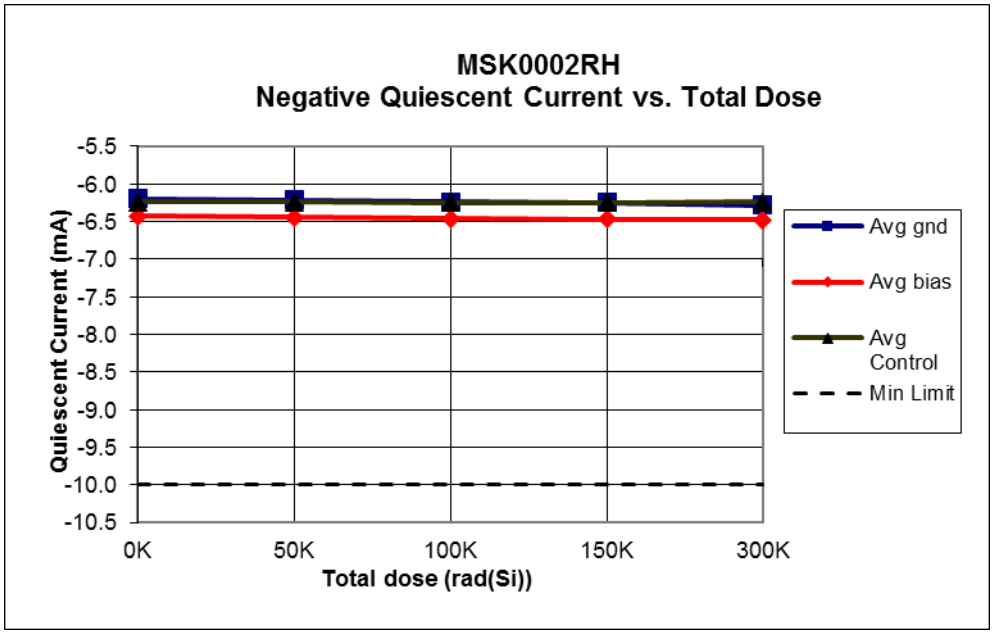
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
6:46	51,500	51,50
6:46	51,500	103,000
6:46	51,500	154,500
20:19	154,500	309,000

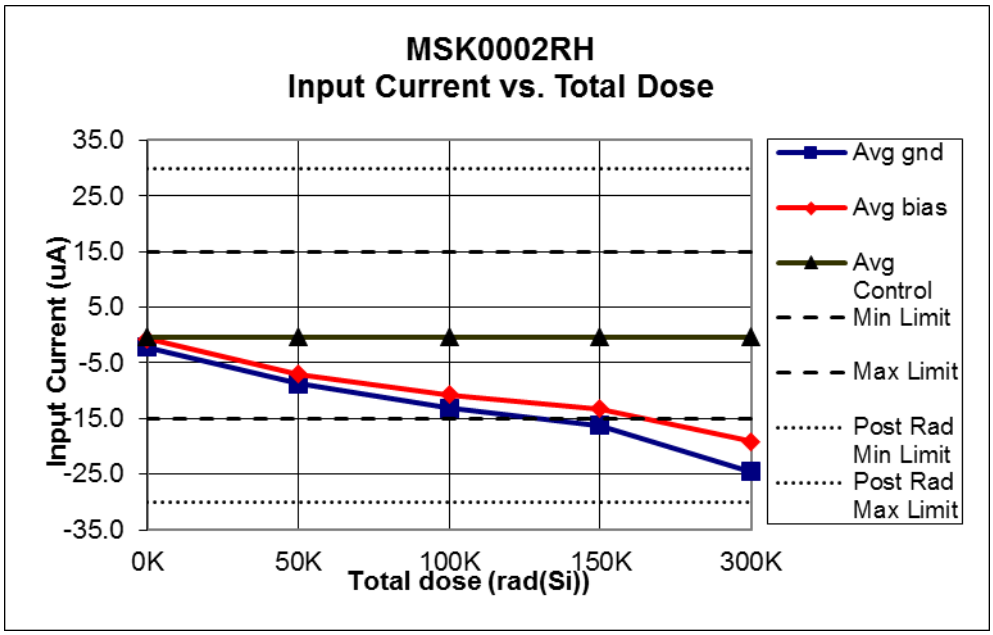
Biased S/N – 0003, 0004, 0005, 0006

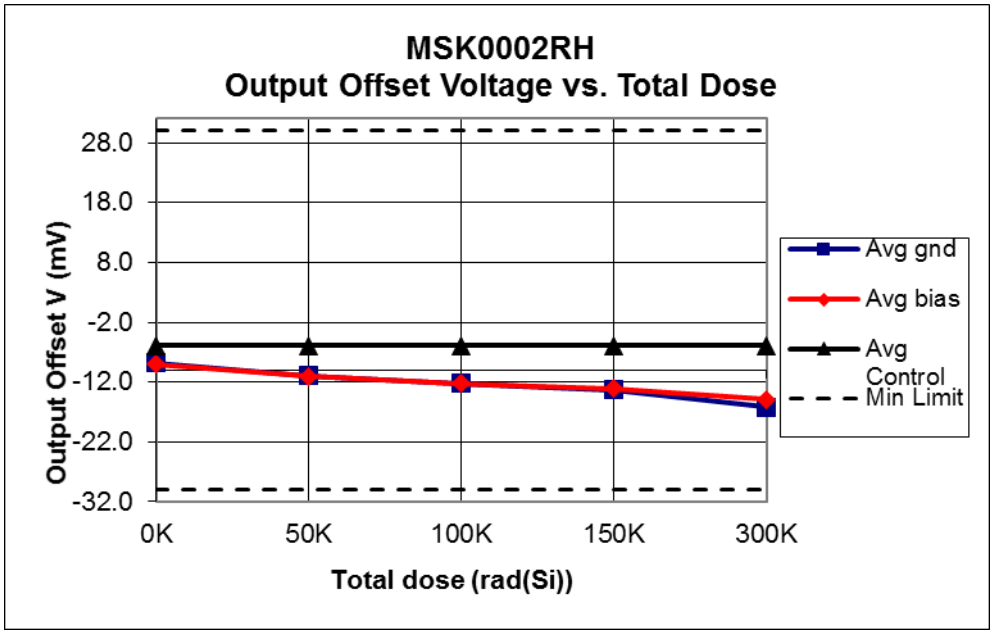
Unbiased S/N – 0007, 0008, 0009, 0010

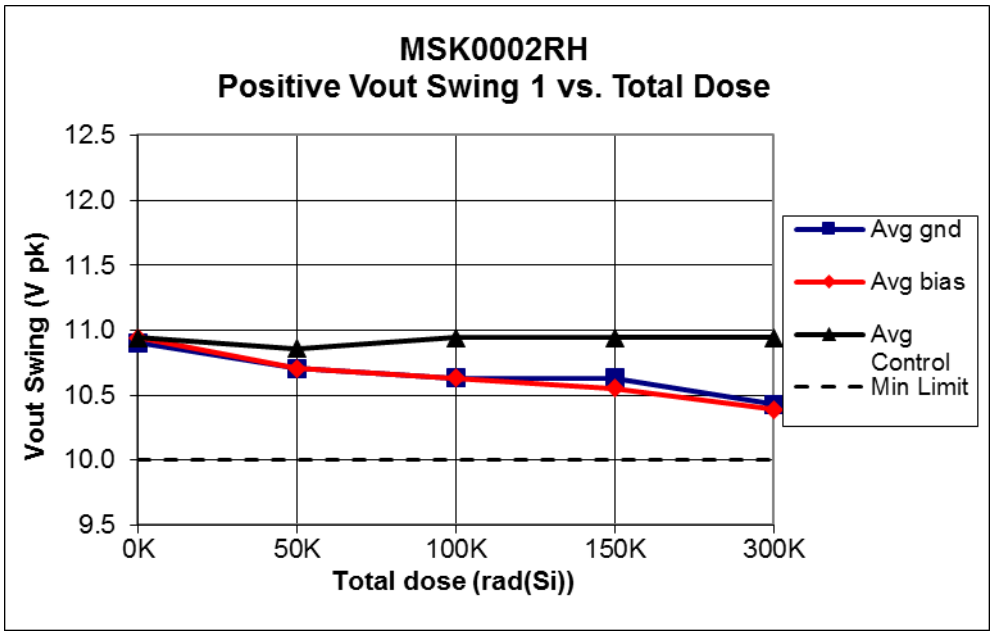
Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

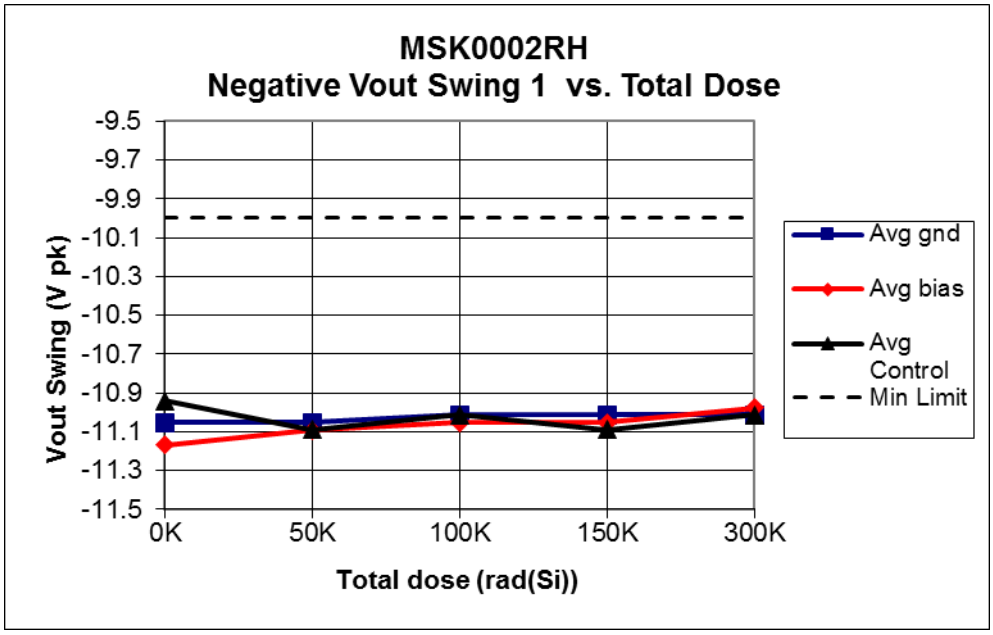

MSK0002RH
Positive Quiescent Current vs. Total Dose
Quiescent Current (mA)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Max Limit

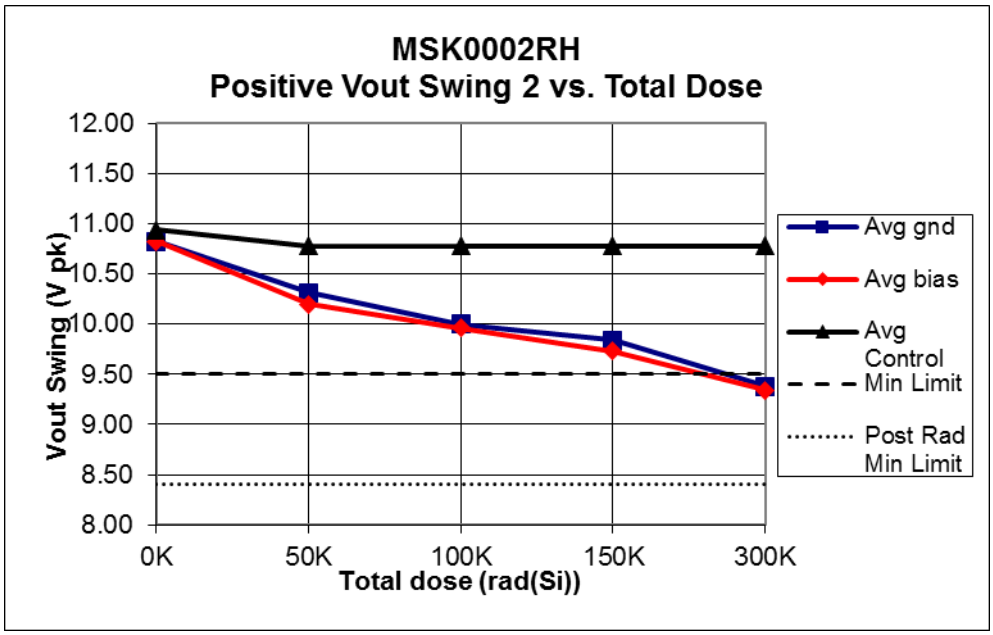

MSK0002RH
Negative Quiescent Current vs. Total Dose
Quiescent Current (mA)
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
-10.5
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit

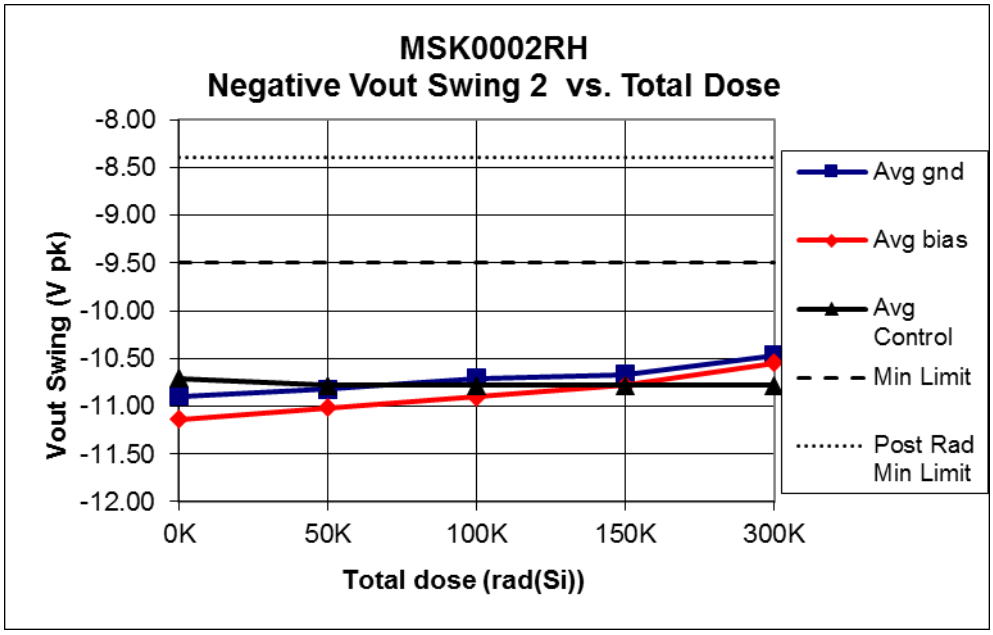

MSK0002RH
Input Current vs. Total Dose
35.0
25.0
15.0
5.0
-5.0
-15.0
-25.0
-35.0
Input Current (uA)
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit
Post Rad Max Limit

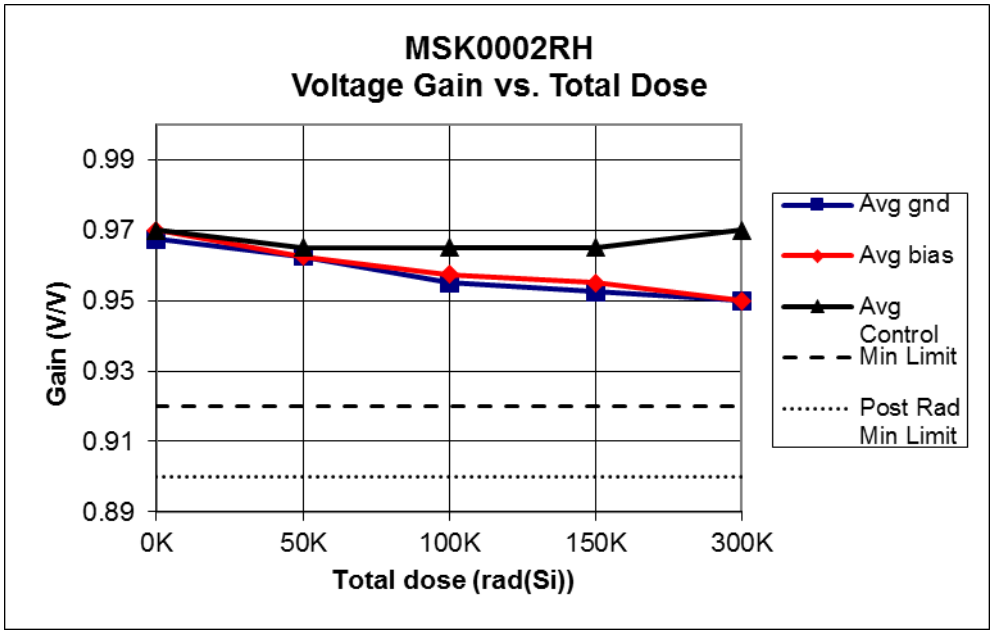

MSK0002RH
Output Offset Voltage vs. Total Dose
28.0
18.0
8.0
-2.0
-12.0
-22.0
-32.0
Output Offset V (mV)
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit

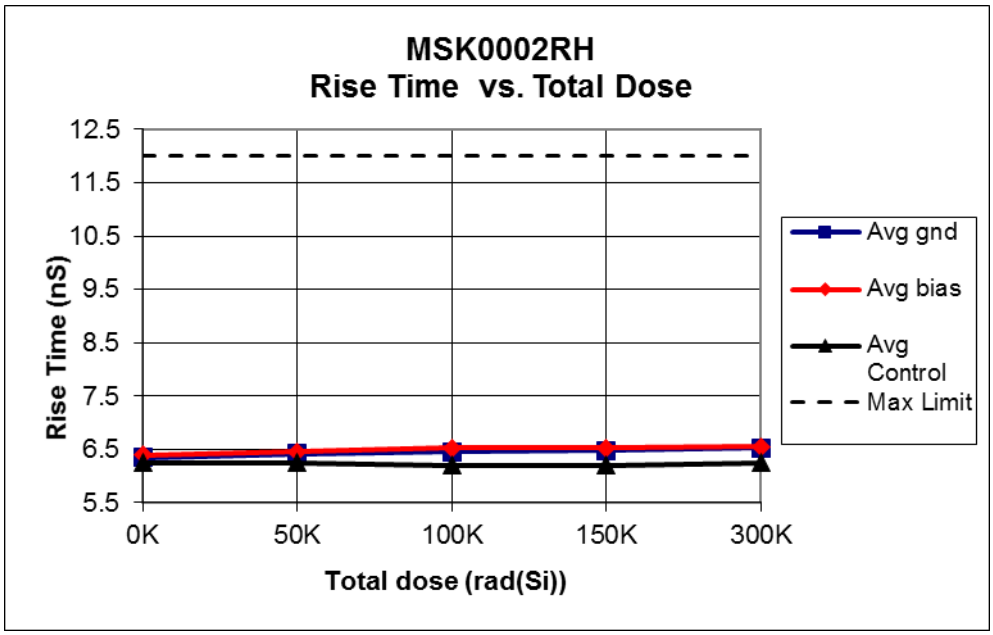

MSK0002RH
Positive Vout Swing 1 vs. Total Dose
Vout Swing (V pk)
12.5
12.0
11.5
11.0
10.5
10.0
9.5
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit


MSK0002RH
Negative Vout Swing 1 vs. Total Dose
Vout Swing (V pk)
-9.5
-9.7
-9.9
-10.1
-10.3
-10.5
-10.7
-10.9
-11.1
-11.3
-11.5
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit


MSK0002RH
Positive Vout Swing 2 vs. Total Dose
12.00
11.50
11.00
10.50
10.00
9.50
9.00
8.50
8.00
Vout Swing (V pk)
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Negative Vout Swing 2 vs. Total Dose
-8.00
-8.50
-9.00
-9.50
-10.00
-10.50
-11.00
-11.50
-12.00
Vout Swing (V pk)
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Voltage Gain vs. Total Dose
0.99
0.97
0.95
0.93
0.91
0.89
Gain (V/V)
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Rise Time vs. Total Dose
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
Rise Time (nS)
0K
50K
100K
150K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Max Limit

Total Dose Radiation Test Report

MSK0002RH

Rad Hard High Speed, Buffer Amp

March 29, 2007 (First Test)
April 7, 2009 (Second Test)
February 25, 2011 (Third Test)
June 1, 2012 (Fourth Test)
June 13, 2014 (5th Test, NPN Wafer Lot: J1978W#PD-10 PNP Wafer Lot: J1951W#SQ-7)
November 8, 2016 (6th Test, NPN Wafer Lot: J2183W#TT-1 PNP Wafer Lot: J2067W#MU-9)

B. Horton
F. Freytag
J. Joy
N. Kresse

MSK Products – Anaren Inc.

I. Introduction:

The total dose radiation test plan for the MSK0002RH was developed to qualify the device as Rad Hard up to 100 Krad(Si). The testing was performed to 450 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 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 MSK0002RH.

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
158 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, two control device were 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. Four devices were kept under bias during irradiation. Four 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 in accordance with MSK0002RH datasheet. Testing was performed on irradiated devices and control devices 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. 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 MSK0002RH qualifies as a 100 KRad(Si) radiation hardened device. Input current and output offset voltage both decreased with increasing irradiation. Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. However all parameters stayed well with post irradiation specifications.

MSK0002RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

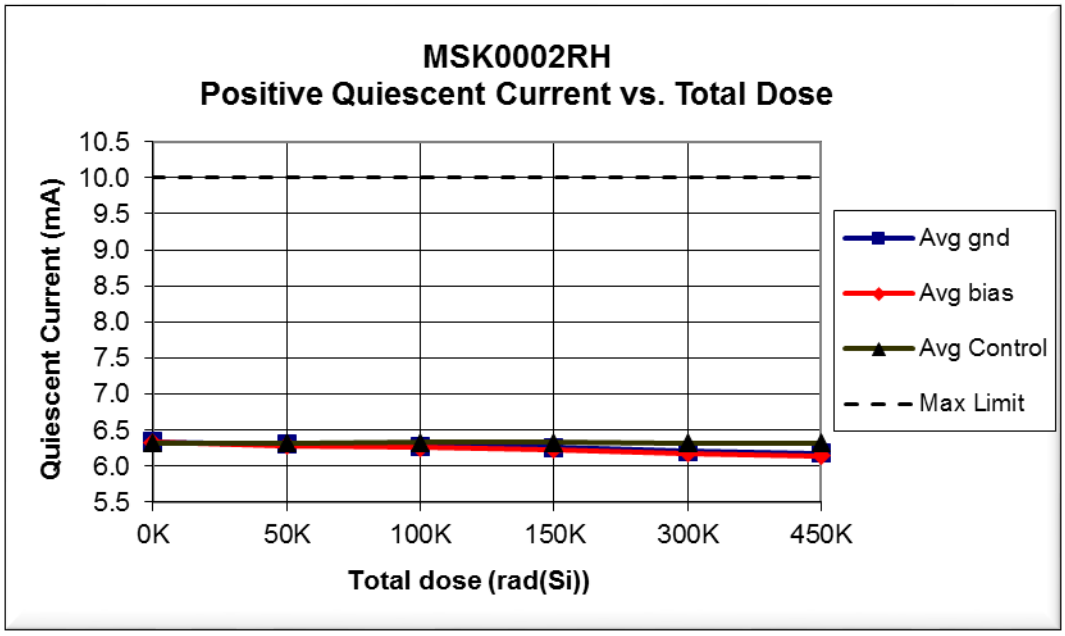
Irradiation Date
11/8/16

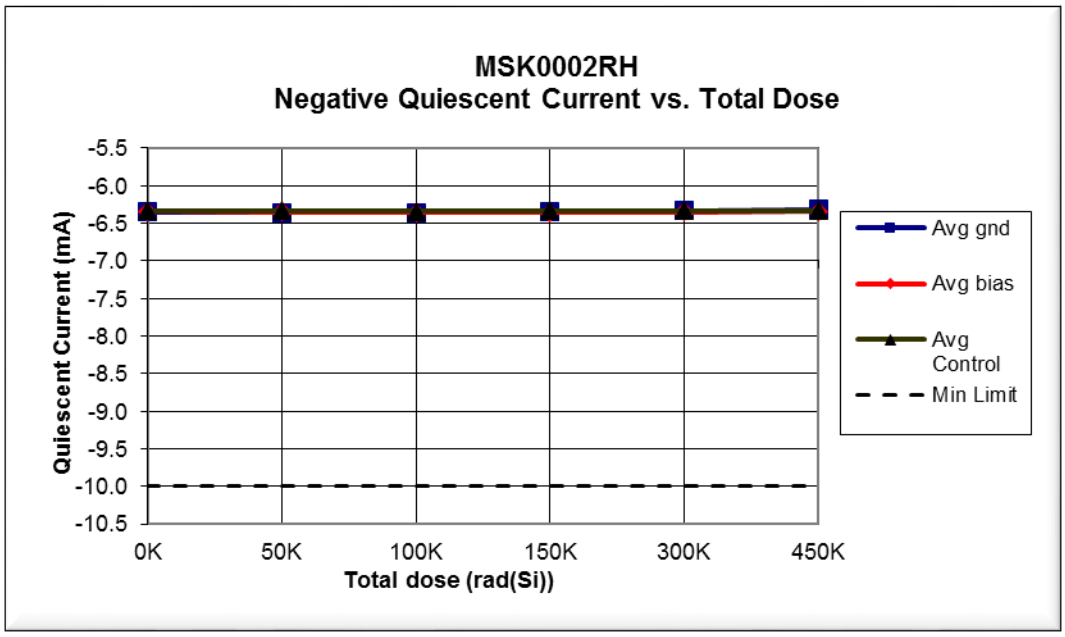
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
05:17	50,100	50,100
05:17	50,100	100,200
05:17	50,100	150,300
15:52	150,400	300,700
15:52	150,400	451,100

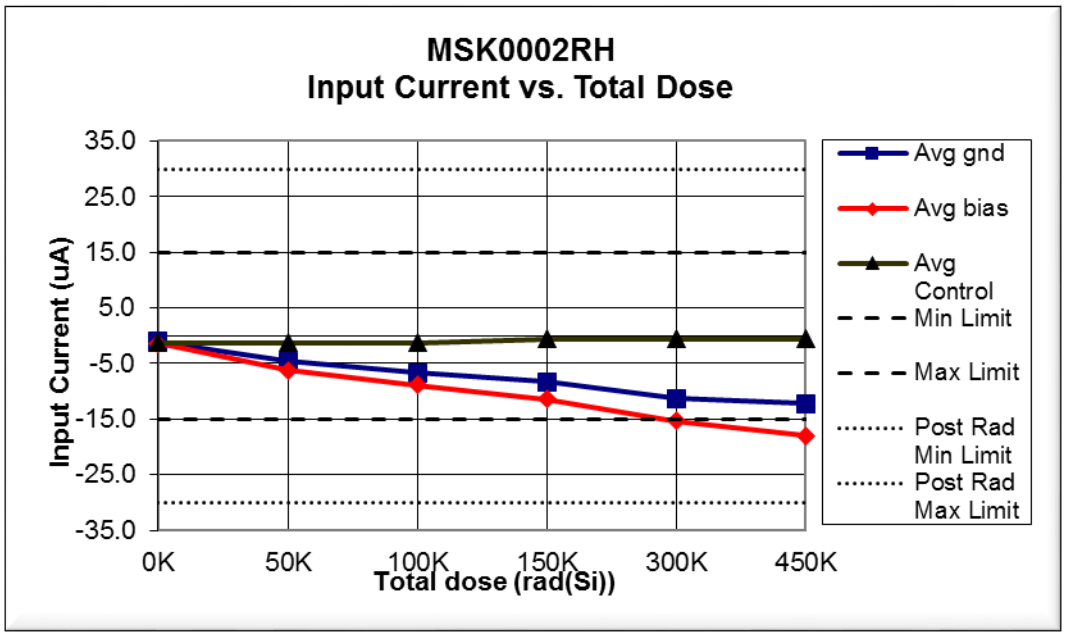
Biased S/N – 0032, 0033, 0034, 0035

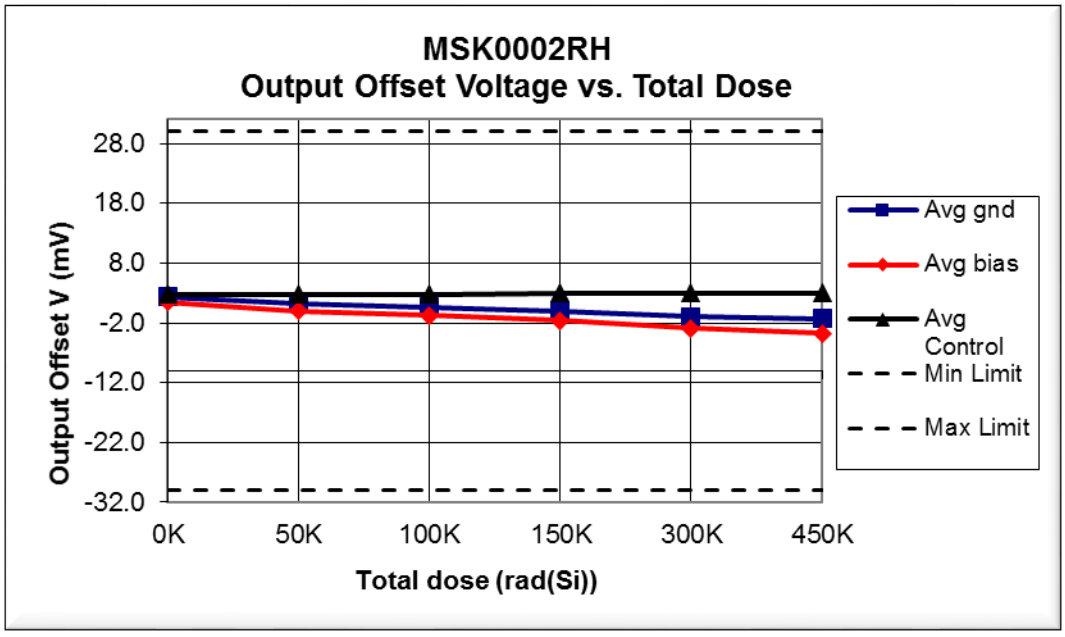
Unbiased S/N – 0036, 0037, 0038, 0039

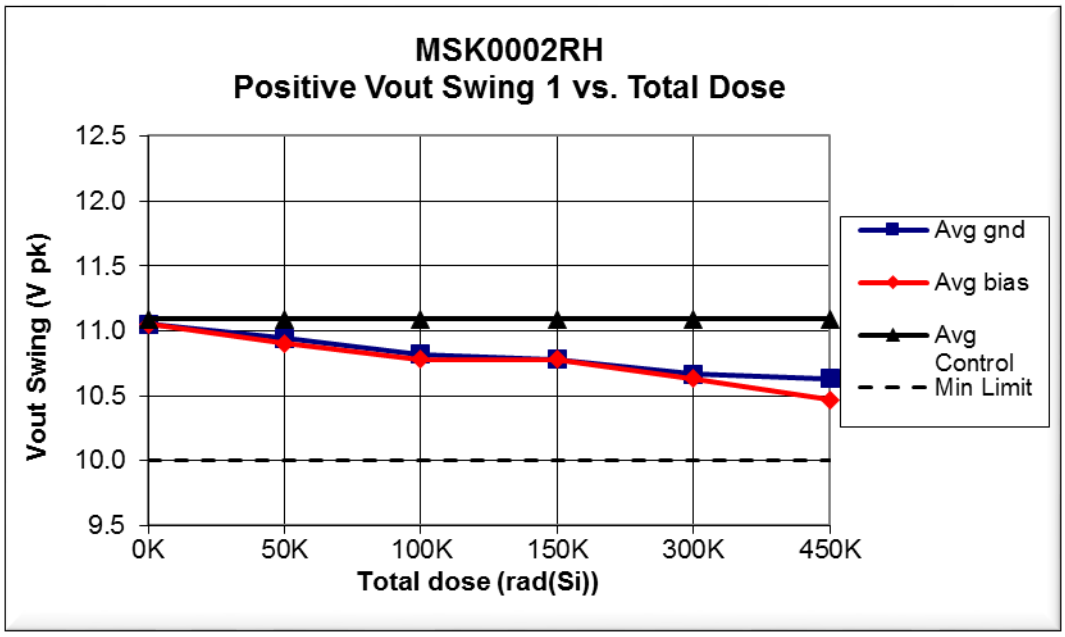
Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

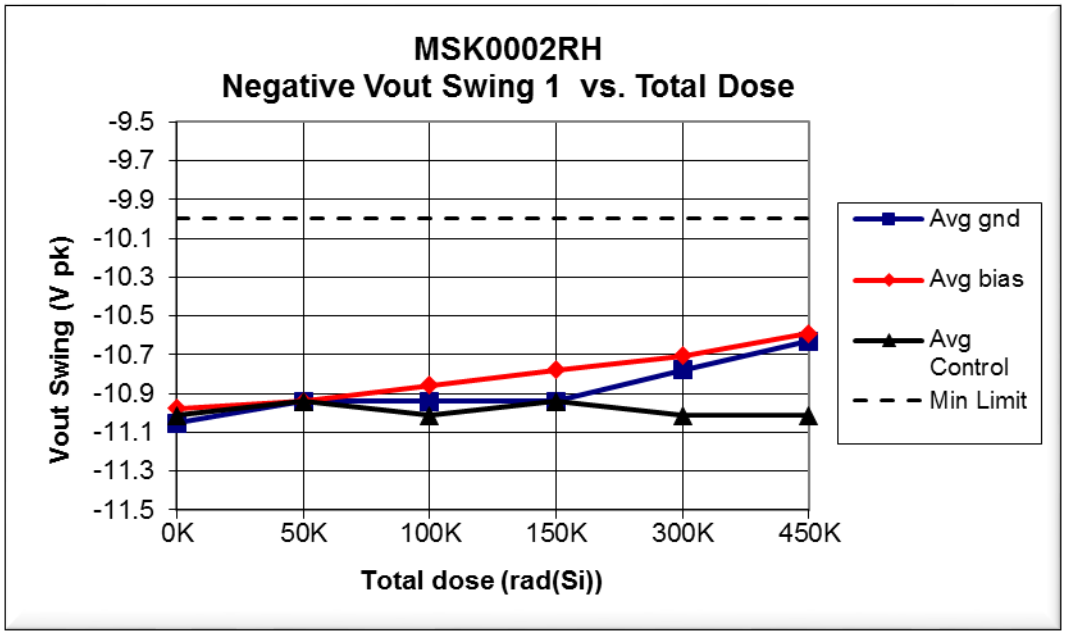

MSK0002RH
Positive Quiescent Current vs. Total Dose
Quiescent Current (mA)
10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Max Limit

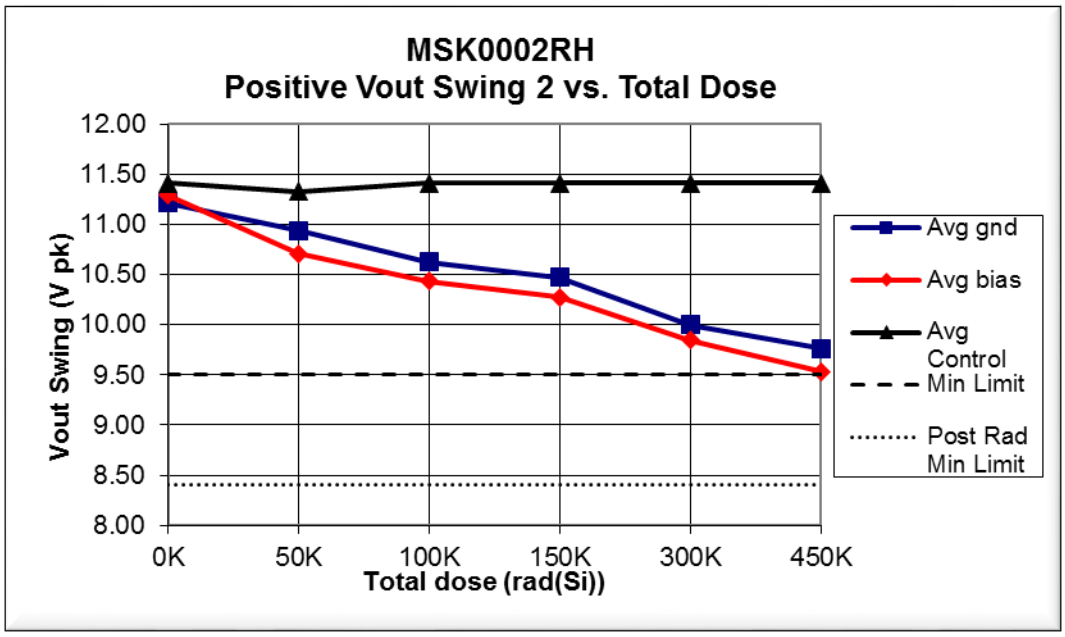

MSK0002RH
Negative Quiescent Current vs. Total Dose
Quiescent Current (mA)
-5.5
-6.0
-6.5
-7.0
-7.5
-8.0
-8.5
-9.0
-9.5
-10.0
-10.5
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit

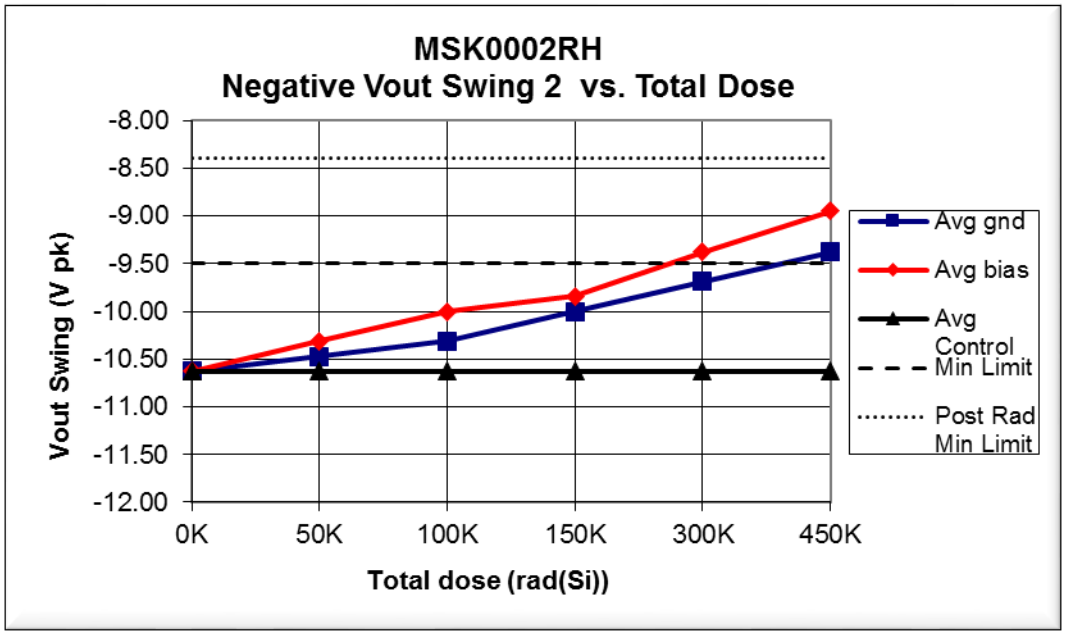

MSK0002RH
Input Current vs. Total Dose
35.0
25.0
15.0
5.0
-5.0
-15.0
-25.0
-35.0
Input Current (uA)
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit
Post Rad Max Limit

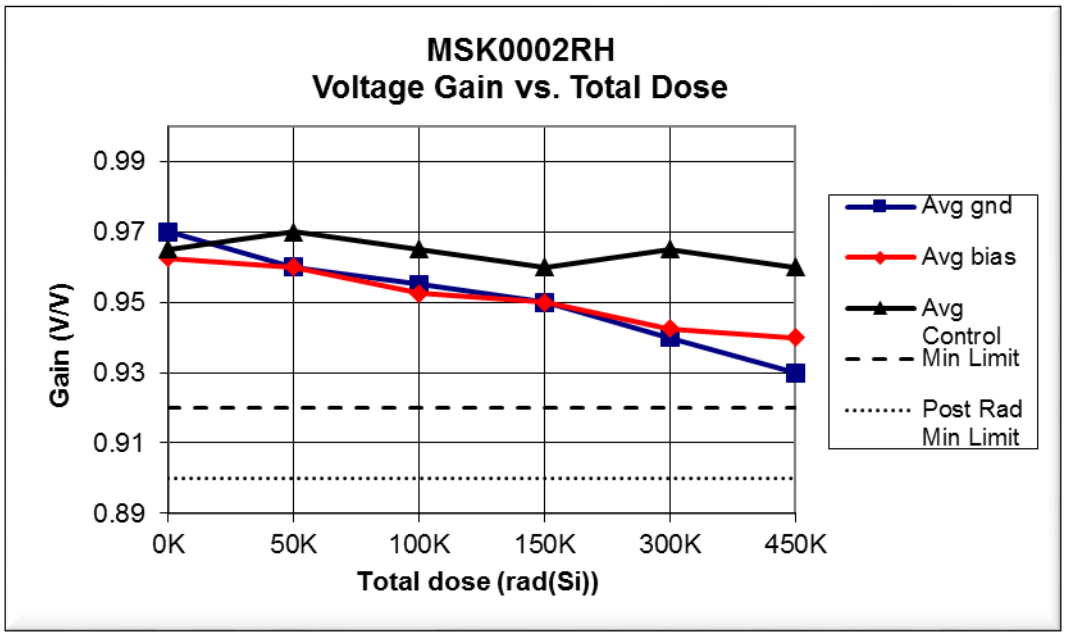

MSK0002RH
Output Offset Voltage vs. Total Dose
28.0
18.0
8.0
-2.0
-12.0
-22.0
-32.0
Output Offset V (mV)
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Max Limit

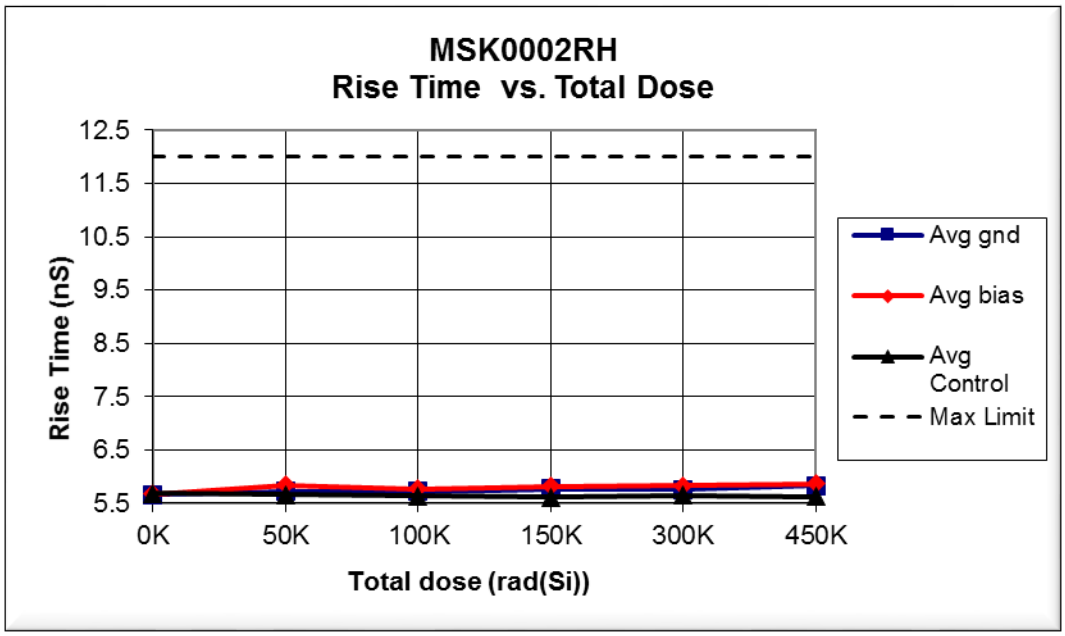

MSK0002RH
Positive Vout Swing 1 vs. Total Dose
Vout Swing (V pk)
12.5
12.0
11.5
11.0
10.5
10.0
9.5
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit


MSK0002RH
Negative Vout Swing 1 vs. Total Dose
Vout Swing (V pk)
-9.5
-9.7
-9.9
-10.1
-10.3
-10.5
-10.7
-10.9
-11.1
-11.3
-11.5
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit


MSK0002RH
Positive Vout Swing 2 vs. Total Dose
12.00
11.50
11.00
10.50
10.00
9.50
9.00
8.50
8.00
Vout Swing (V pk)
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Negative Vout Swing 2 vs. Total Dose
-8.00
-8.50
-9.00
-9.50
-10.00
-10.50
-11.00
-11.50
-12.00
Vout Swing (V pk)
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Voltage Gain vs. Total Dose
Gain (V/V)
0.99
0.97
0.95
0.93
0.91
0.89
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Min Limit
Post Rad Min Limit


MSK0002RH
Rise Time vs. Total Dose
Rise Time (nS)
12.5
11.5
10.5
9.5
8.5
7.5
6.5
5.5
0K
50K
100K
150K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Avg Control
Max Limit

Total Dose Radiation Test Report

MSK0002RH

Radiation Tolerant High Speed, Buffer Amp

March 29, 2007 (First Test)
April 7, 2009 (Second Test)
February 25, 2011 (Third Test)
June 1, 2012 (Fourth Test)
June 13, 2014 (5th Test, NPN Wafer Lot: J1978W#PD-10
PNP Wafer Lot: J1951W#SQ-7)

B. Horton
K. Conroy

M.S. Kennedy Corporation

I. Introduction:

The total dose radiation test plan for the MSK0002RH 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 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 MSK0002RH.

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 120 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. Four devices were kept under bias during irradiation. Four 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, at each total dose level. The control device was tested at the 0K rad(Si) and 150K rad(Si) test points. 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:

Based on post irradiation performance, the MSK0002RH qualifies as 100K rad hardened. Input current and output offset voltage both increases with increasing irradiation. Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. However all parameters stayed well with post irradiation specifications.

MSK0002RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0371

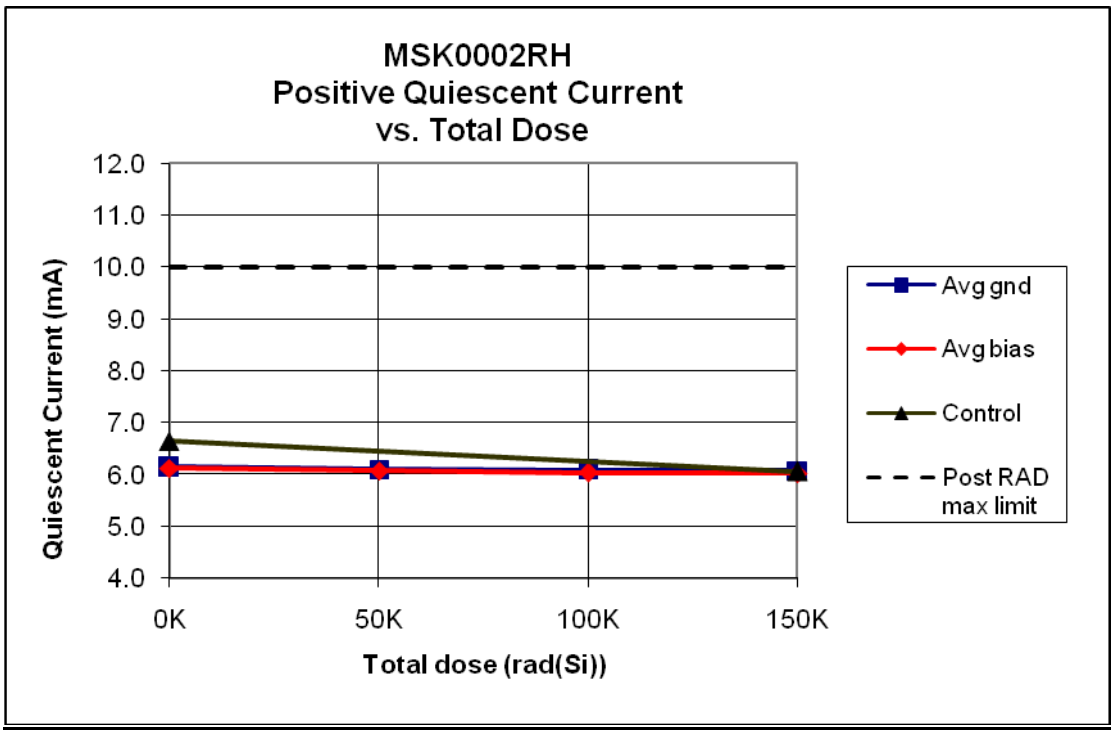
Irradiation Date
6/13/2014

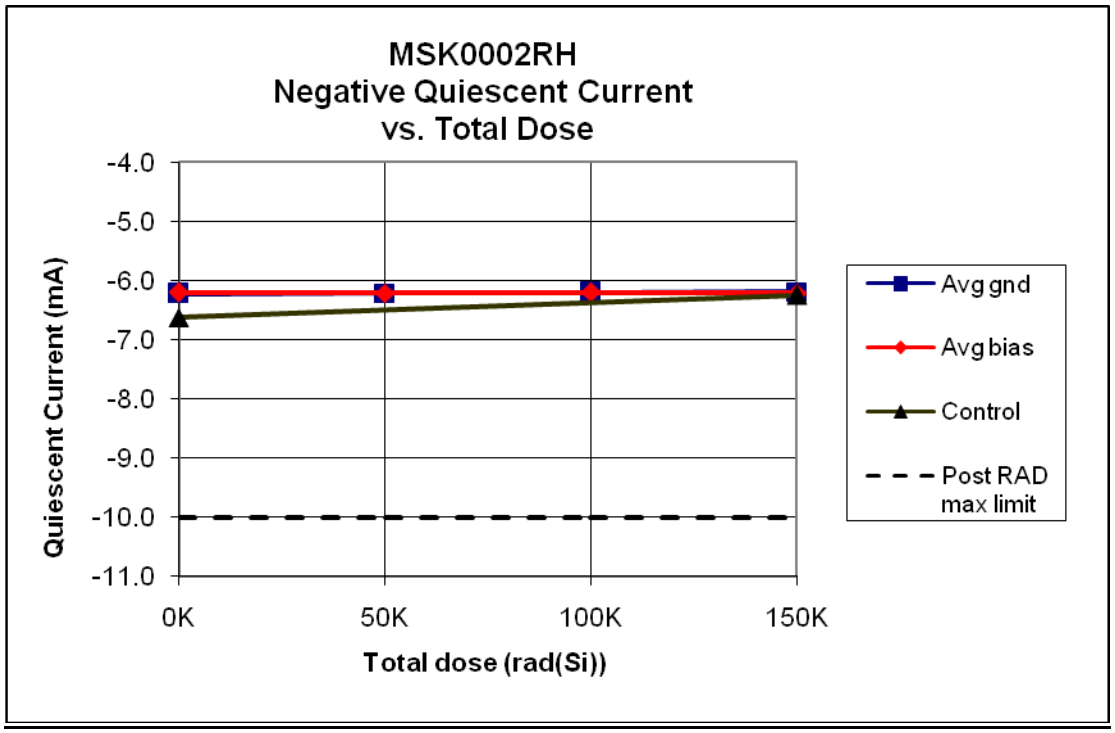
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
7:09	51,480	51,480
7:09	51,480	102,960
7:09	51,480	154,440

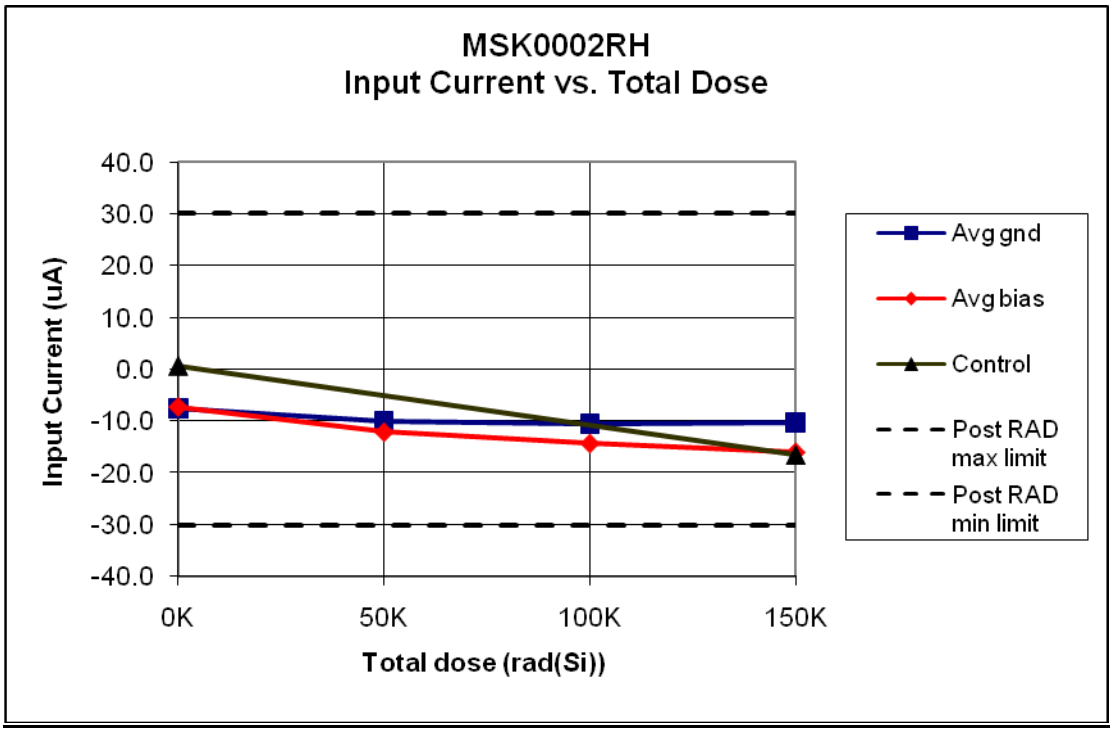
Biased S/N – K632, K650, K651, K655

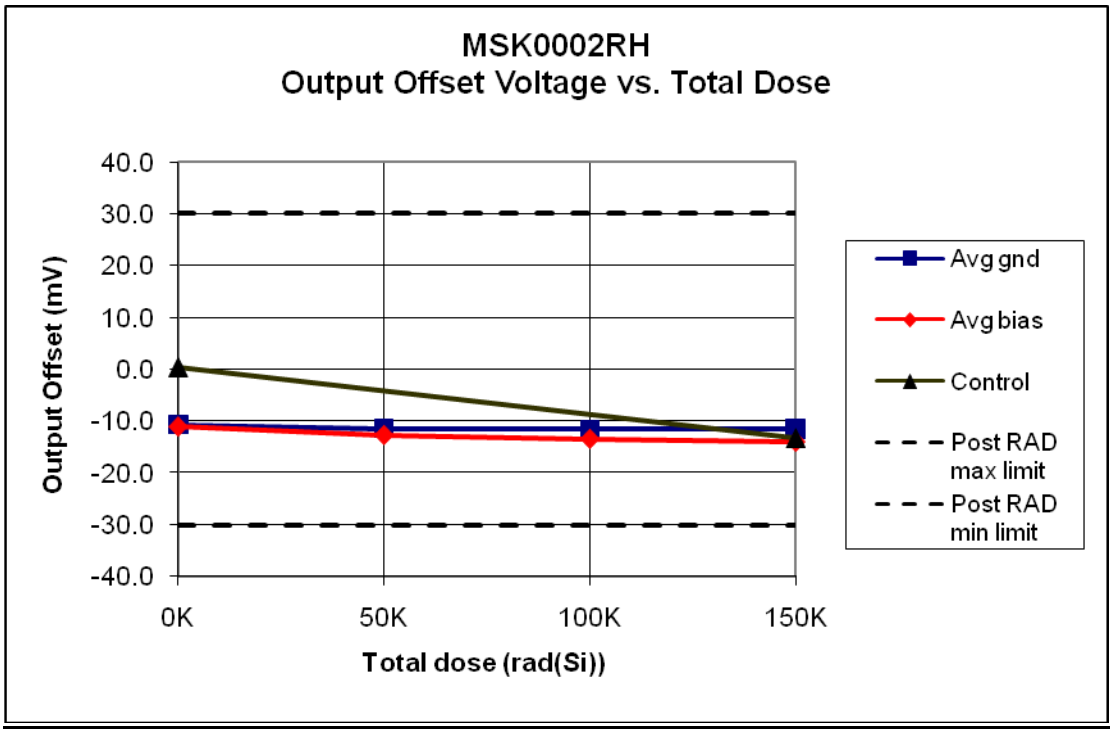
Unbiased S/N – K673, K680, K681, K688

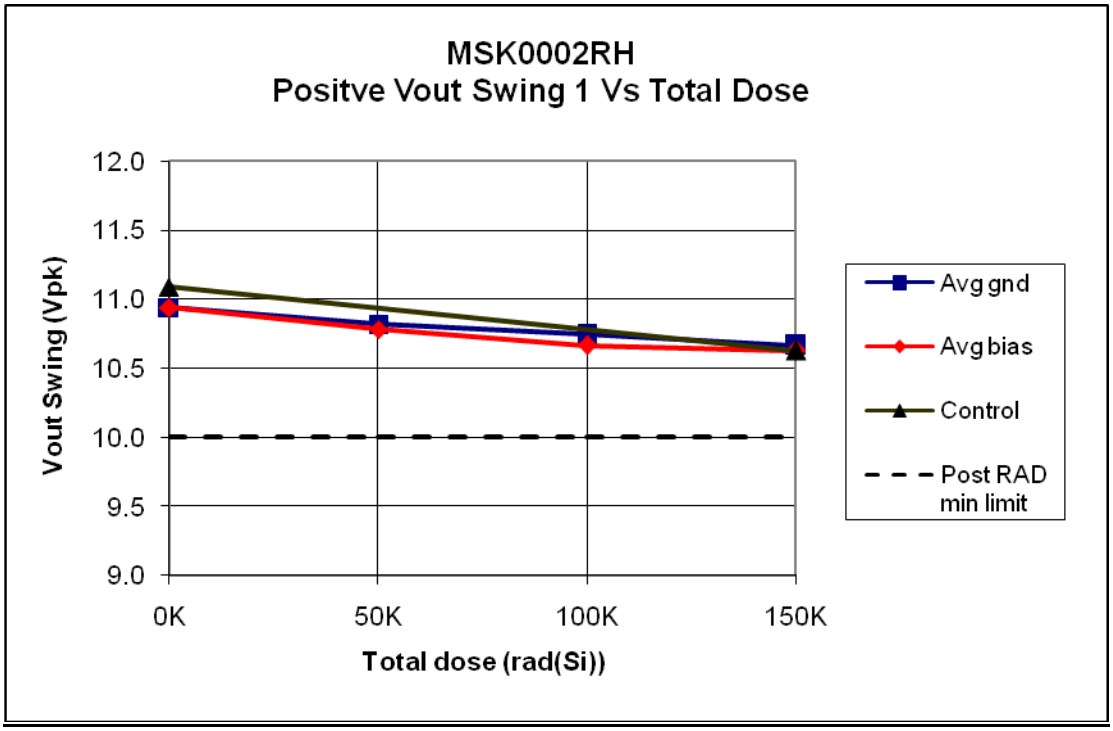
Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

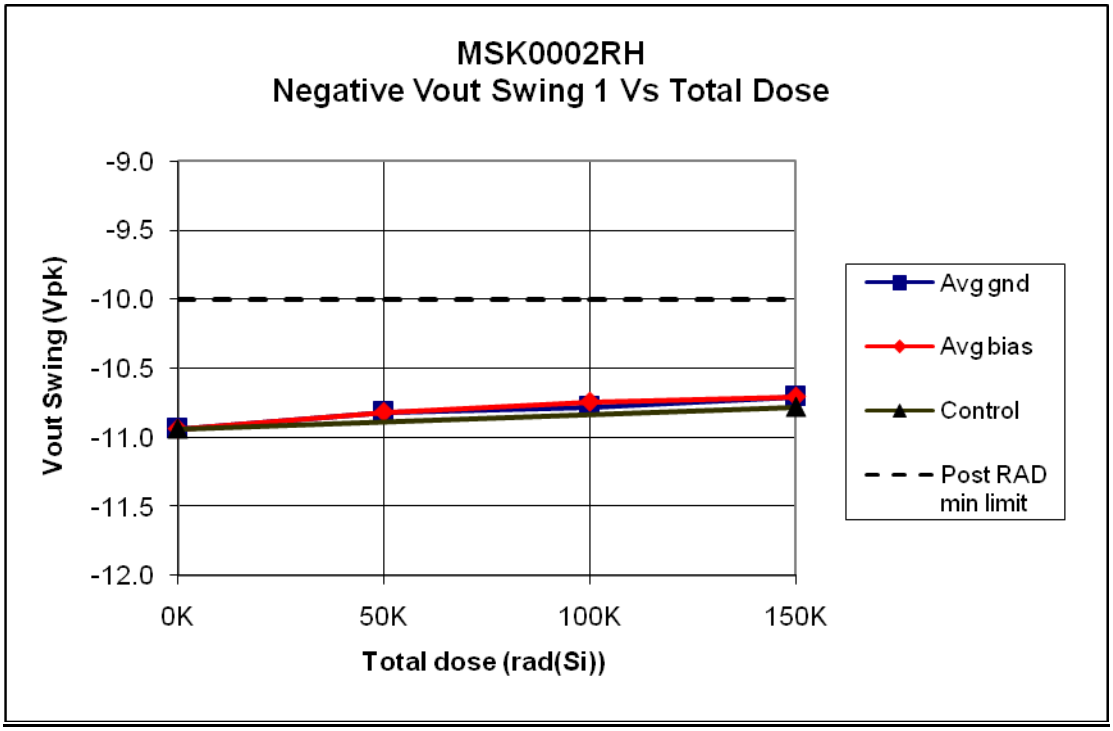

MSK0002RH
Positive Quiescent Current
vs. Total Dose
Quiescent Current (mA)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit

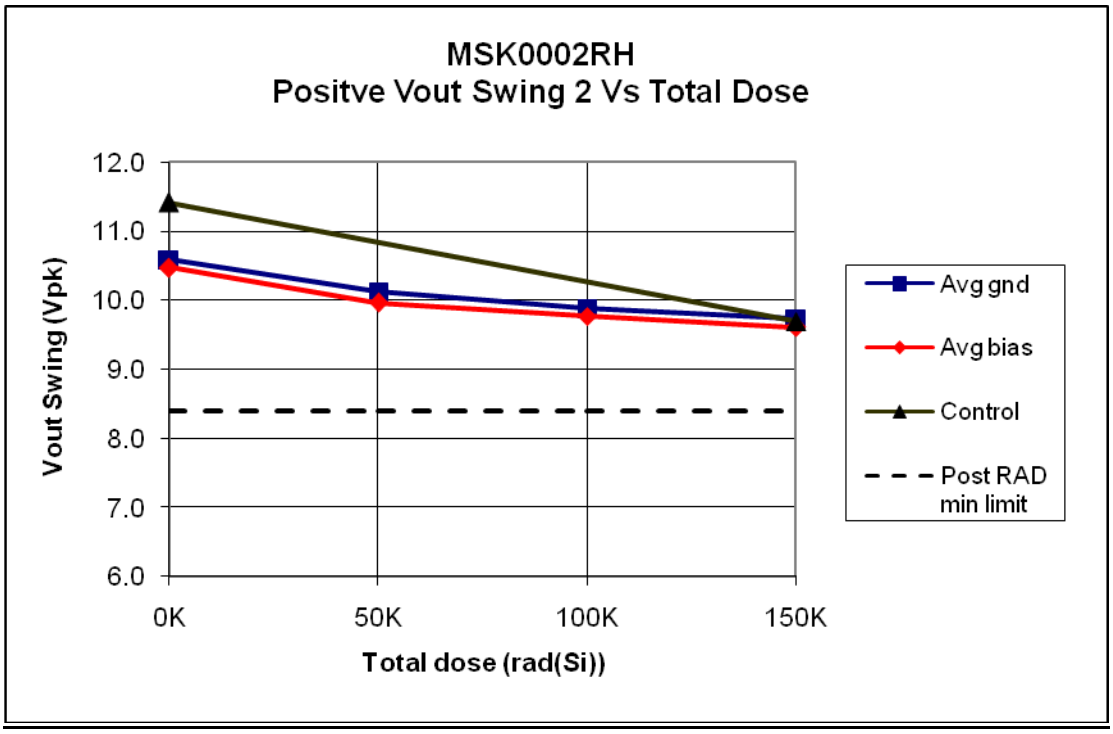

MSK0002RH
Negative Quiescent Current
vs. Total Dose
Quiescent Current (mA)
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit

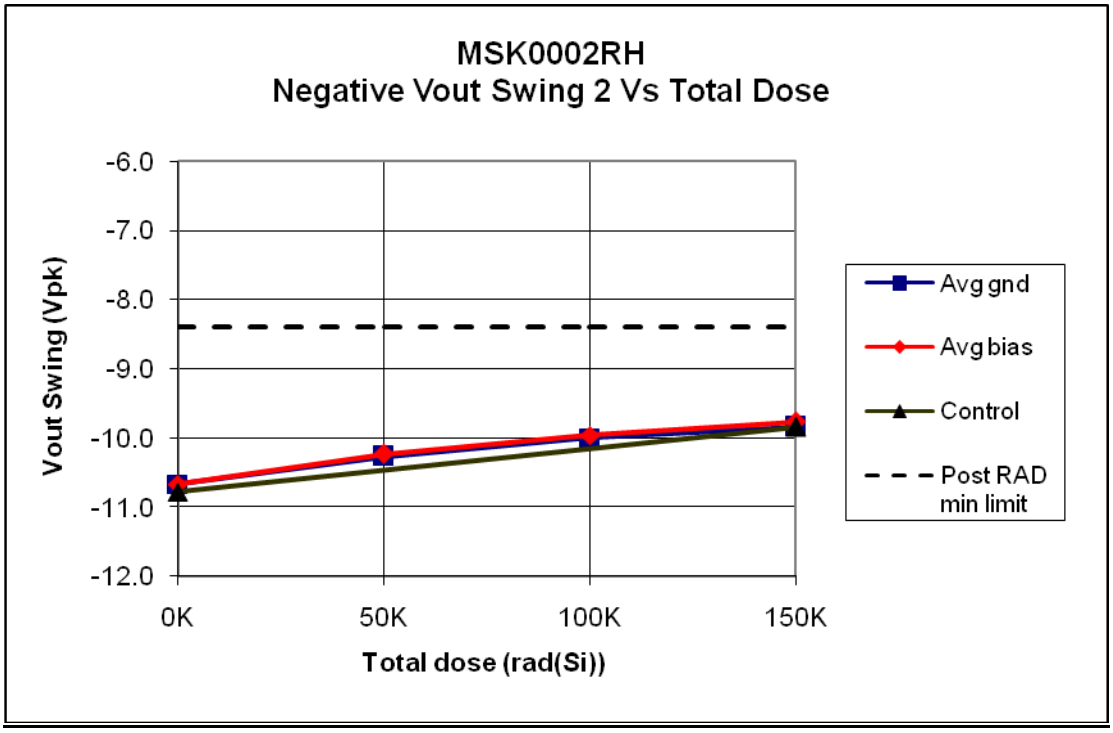

MSK0002RH
Input Current vs. Total Dose
Input Current (uA)
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit
Post RAD min limit

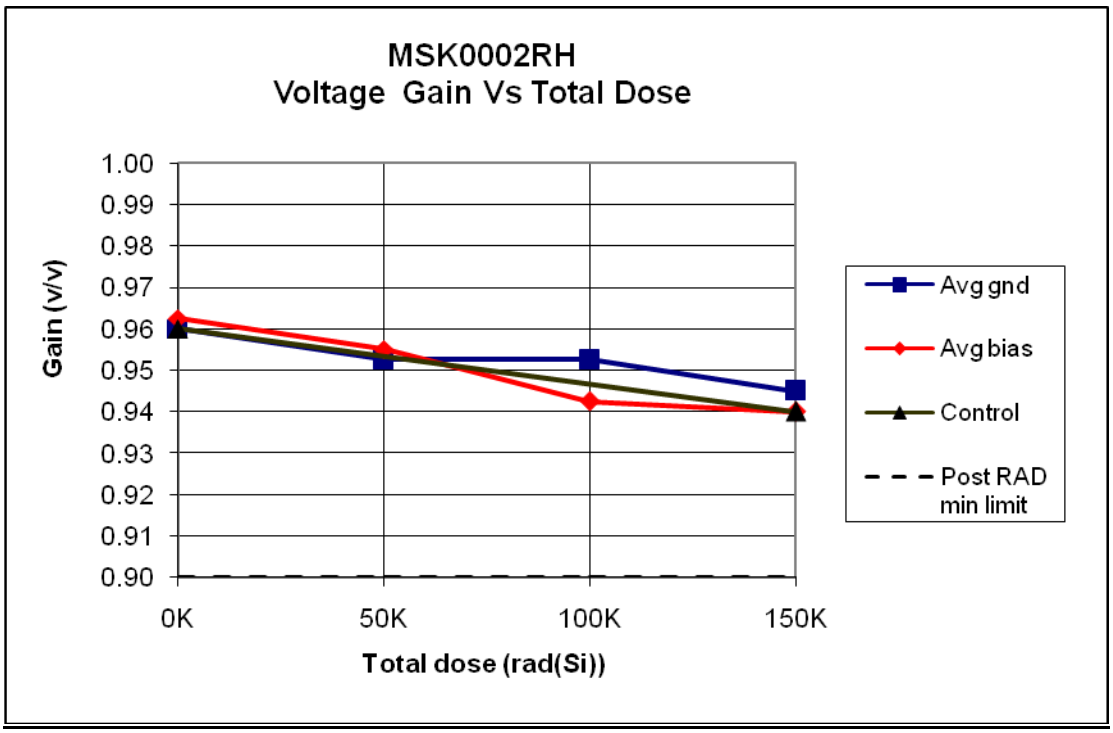

MSK0002RH
Output Offset Voltage vs. Total Dose
Output Offset (mV)
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit
Post RAD min limit

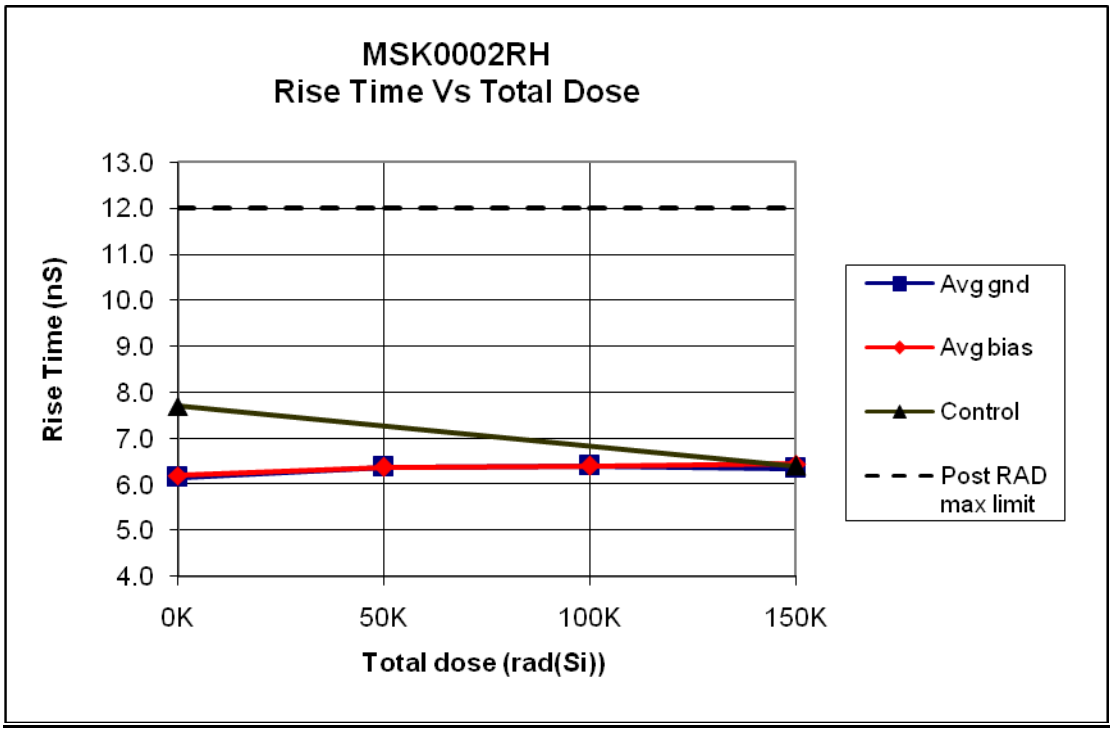

MSK0002RH
Positve Vout Swing 1 Vs Total Dose
12.0
11.5
11.0
10.5
10.0
9.5
9.0
Vout Swing (Vpk)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Negative Vout Swing 1 Vs Total Dose
-9.0
-9.5
-10.0
-10.5
-11.0
-11.5
-12.0
Vout Swing (Vpk)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Positve Vout Swing 2 Vs Total Dose
Vout Swing (Vpk)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Negative Vout Swing 2 Vs Total Dose
Vout Swing (Vpk)
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
-12.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Voltage Gain Vs Total Dose
Gain (v/v)
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Rise Time Vs Total Dose
Rise Time (nS)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit

Total Dose Radiation Test Report

MSK 0002RH

Radiation Tolerant High Speed, Buffer Amp

March 29, 2007 (First Test)
April 7, 2009 (Second Test)
February 25, 2011 (Third Test)
June 1, 2012 (Fourth Test)

B. Horton
C. Salce

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 0002RH 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 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 0002RH.

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 107 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. Four devices were kept under bias during irradiation. Four 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:

Based on post irradiation performance, the MSK0002RH qualifies as 100KRad hardened. Input current and output offset voltage both increases with increasing irradiation. Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. However all parameters stayed well with post irradiation specifications.

MSK0002RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

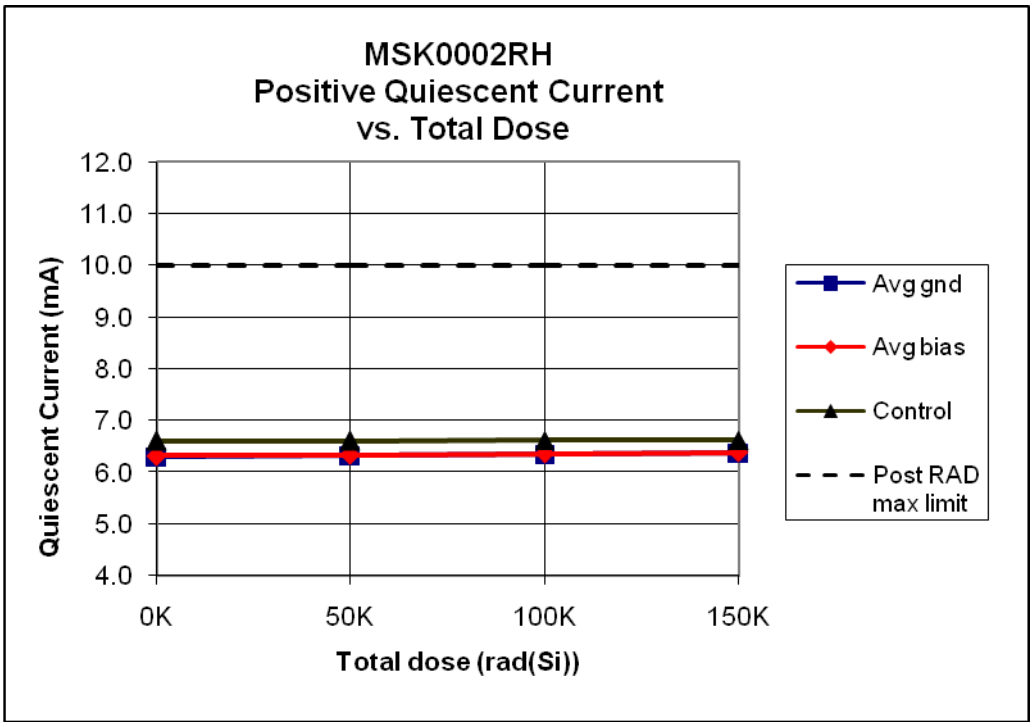
Irradiation Date
6/1/2012

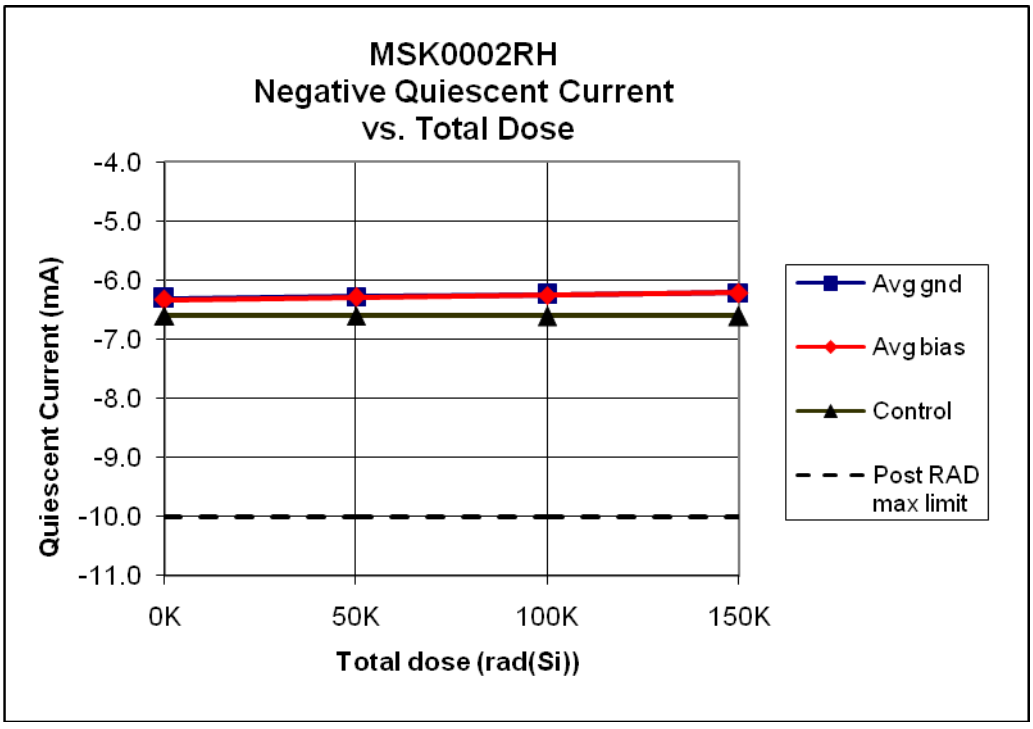
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
0:08:01	51,467	51,467
0:08:01	51,467	102,934
0:08:01	51,467	154,401

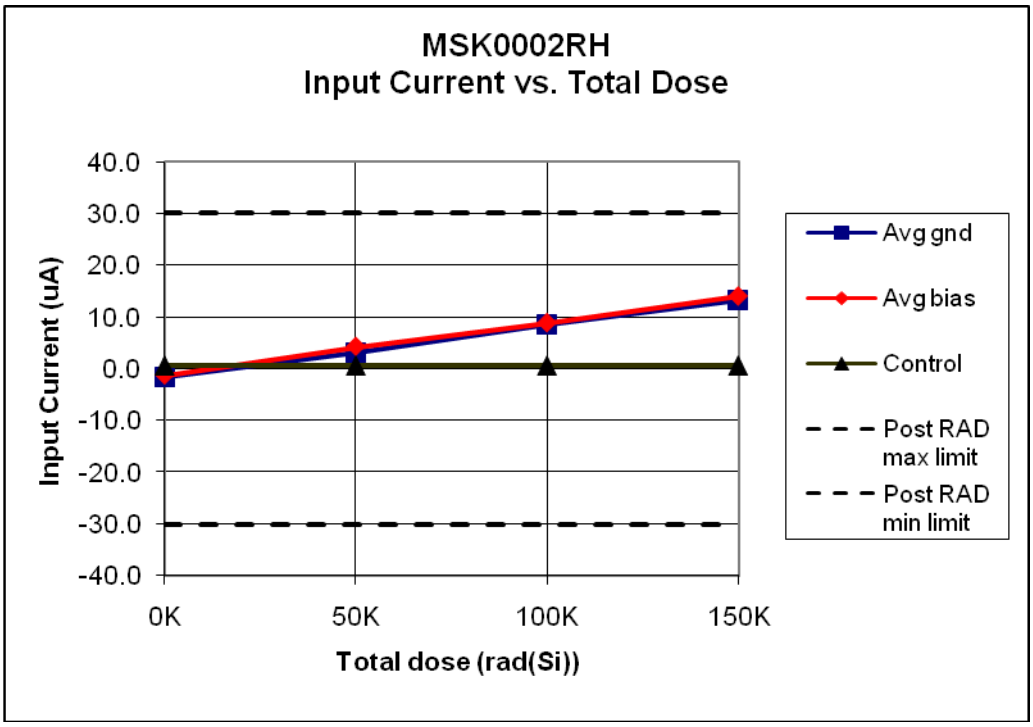
Biased S/N – F875, F876, F877, F878

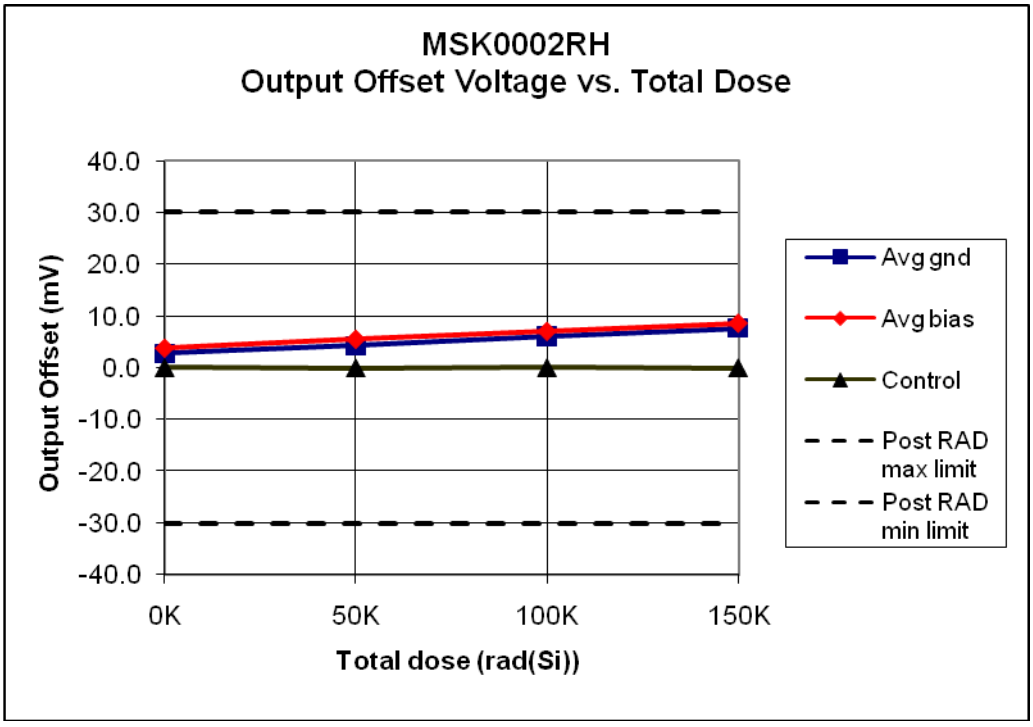
Unbiased S/N – F879, F880, F881, F882

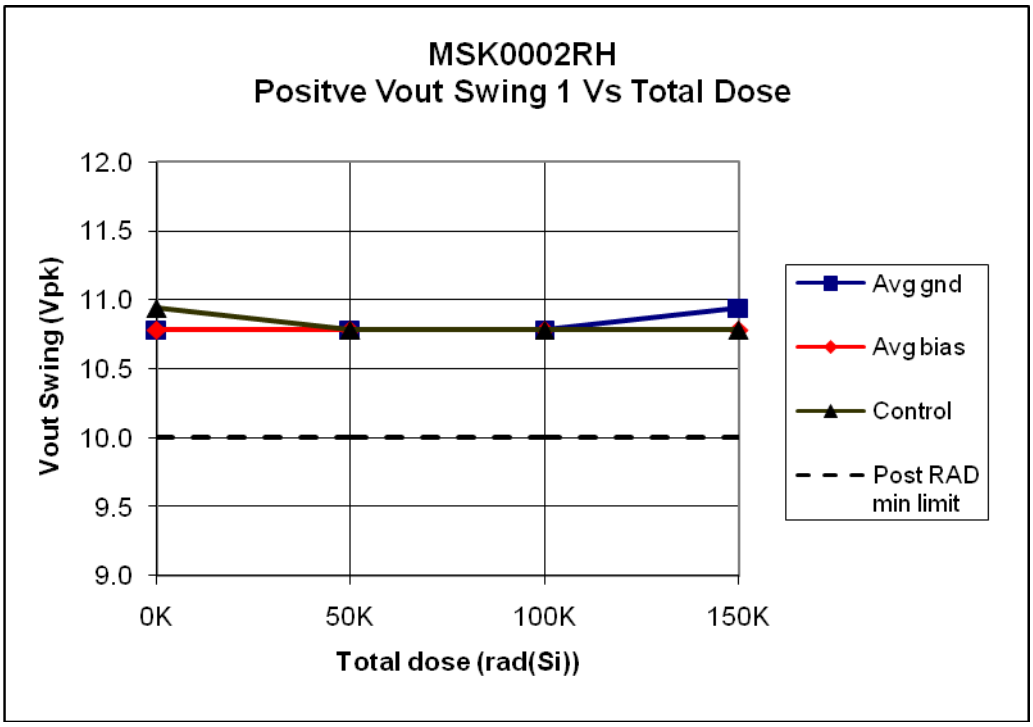
Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

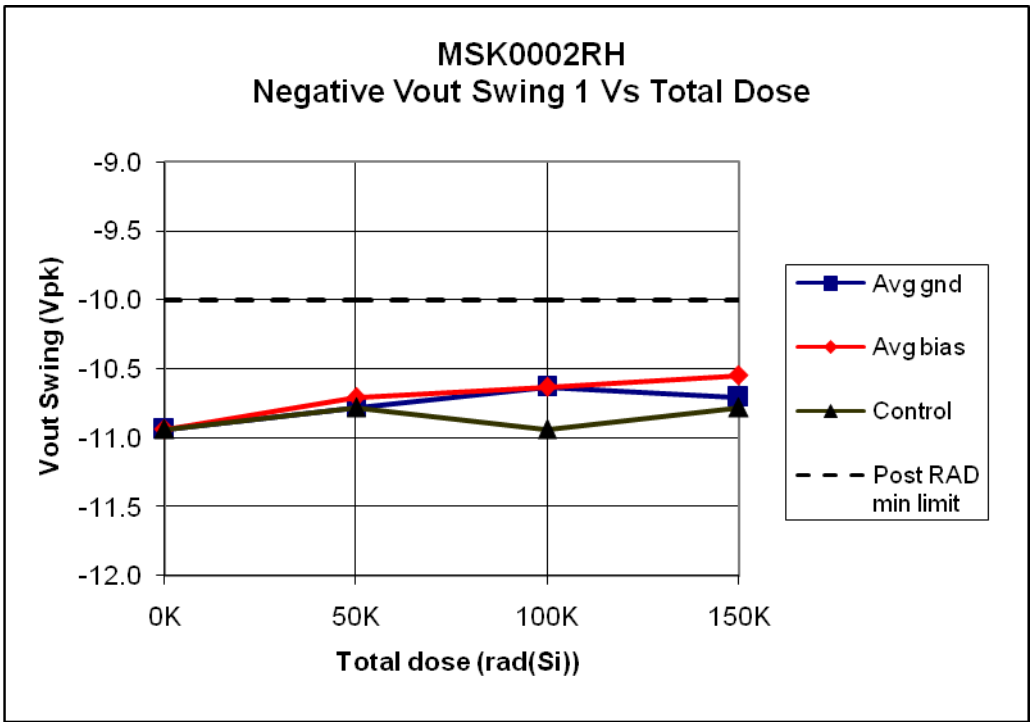

MSK0002RH
Positive Quiescent Current
vs. Total Dose
Quiescent Current (mA)
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit

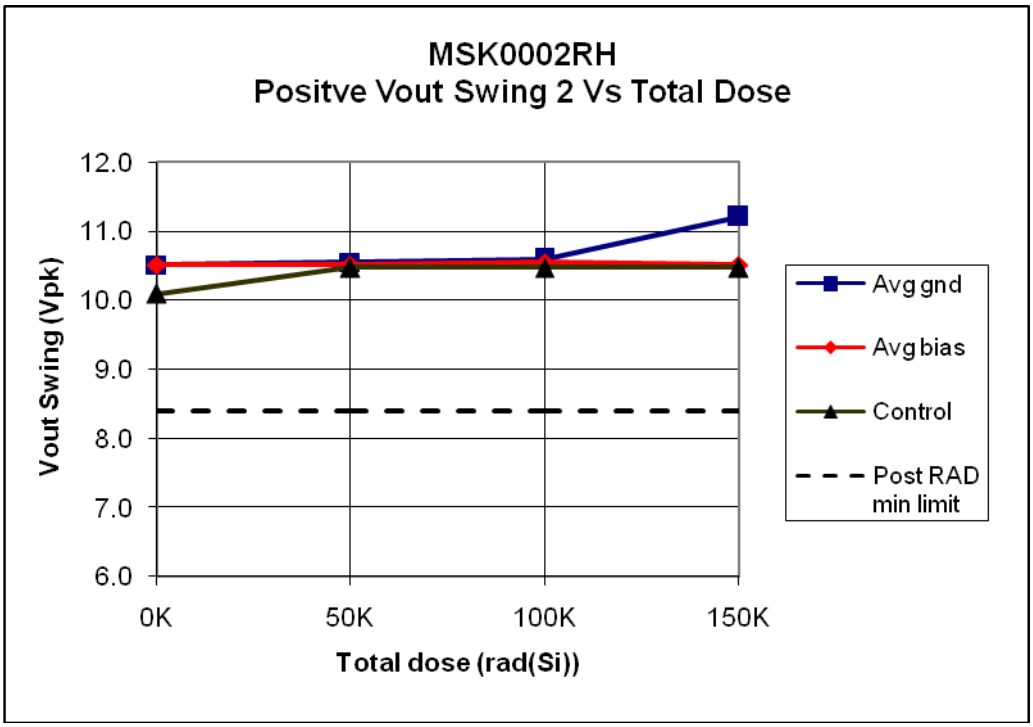

MSK0002RH
Negative Quiescent Current
vs. Total Dose
Quiescent Current (mA)
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit

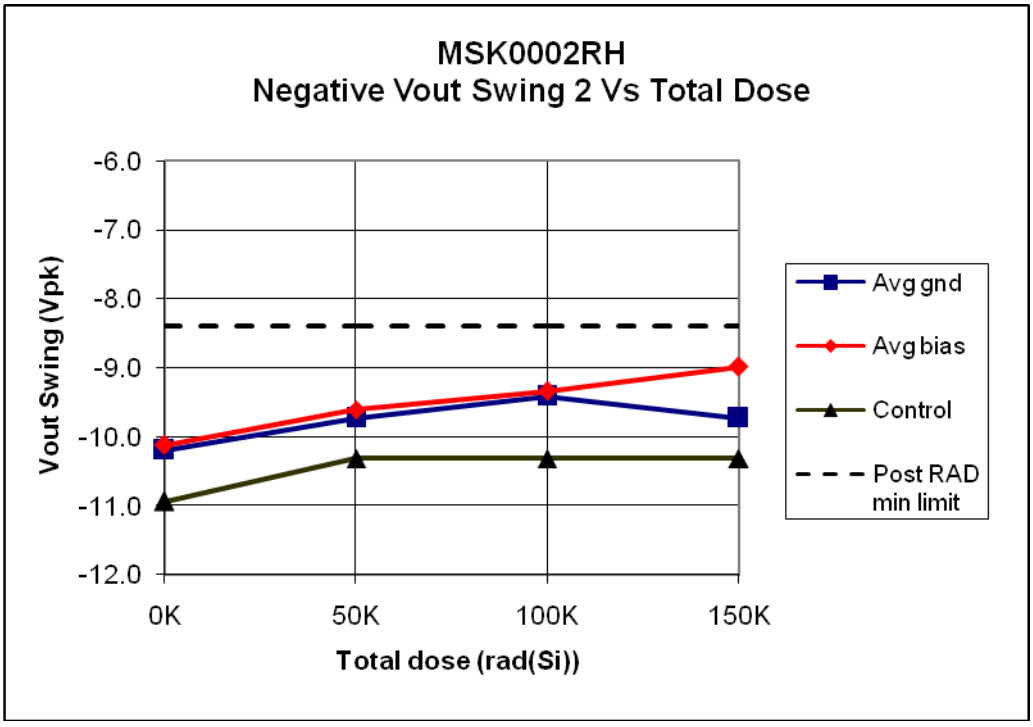

MSK0002RH
Input Current vs. Total Dose
Input Current (uA)
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit
Post RAD min limit

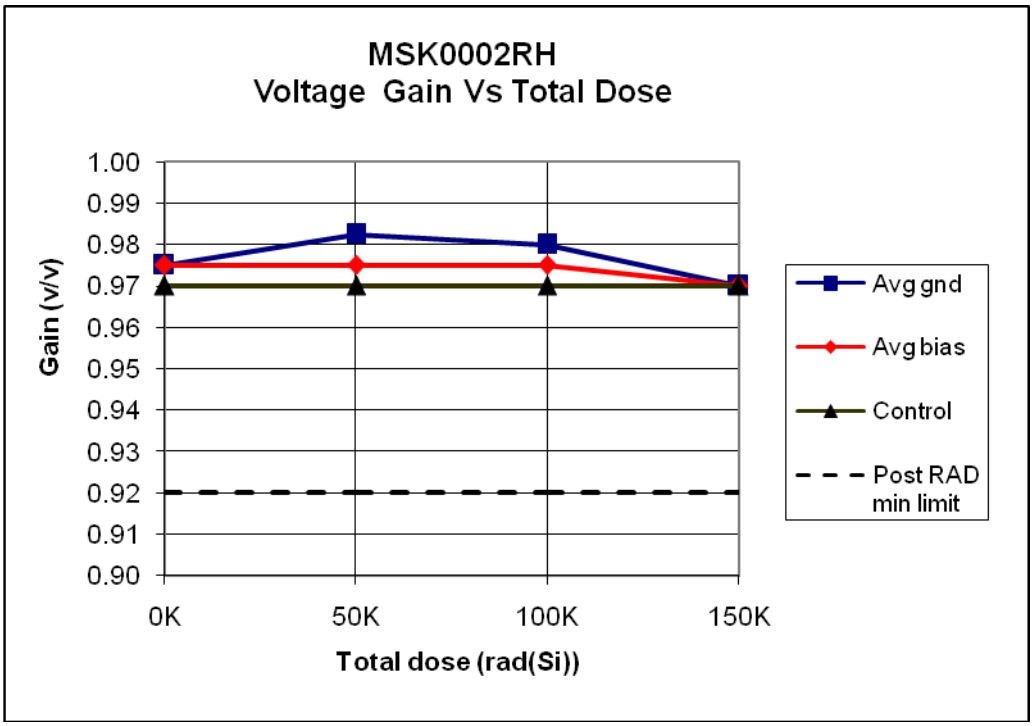

MSK0002RH
Output Offset Voltage vs. Total Dose
Output Offset (mV)
40.0
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
-40.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit
Post RAD min limit

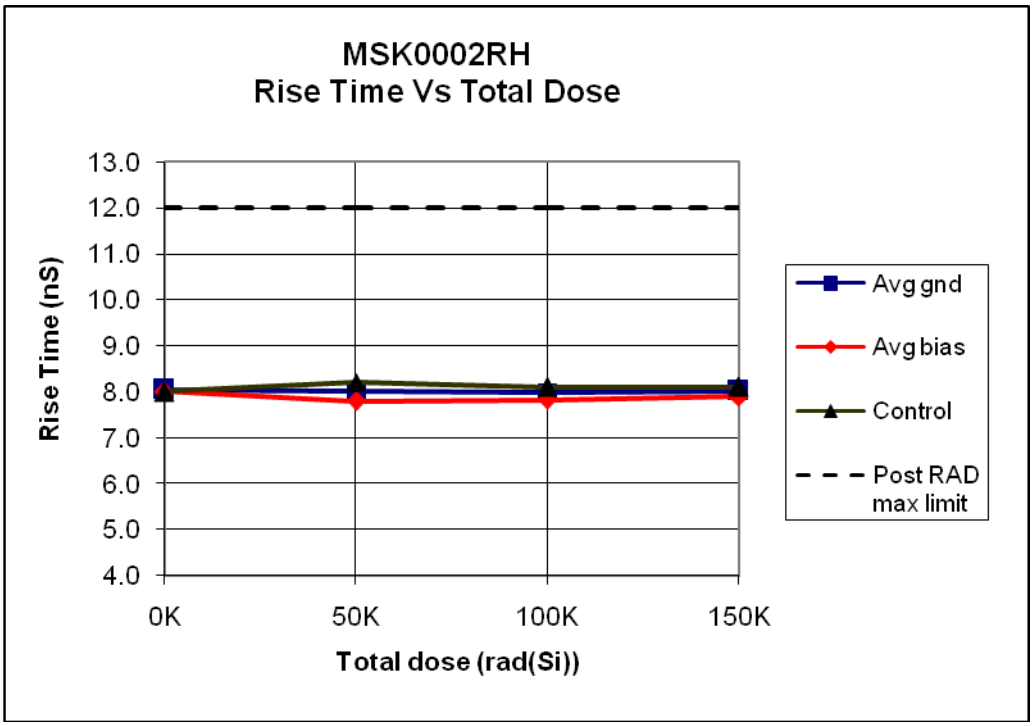

MSK0002RH
Positve Vout Swing 1 Vs Total Dose
12.0
11.5
11.0
10.5
10.0
9.5
9.0
Vout Swing (Vpk)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Negative Vout Swing 1 Vs Total Dose
-9.0
-9.5
-10.0
-10.5
-11.0
-11.5
-12.0
Vout Swing (Vpk)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Positve Vout Swing 2 Vs Total Dose
12.0
11.0
10.0
9.0
8.0
7.0
6.0
Vout Swing (Vpk)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Negative Vout Swing 2 Vs Total Dose
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
-12.0
Vout Swing (Vpk)
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Voltage Gain Vs Total Dose
Gain (v/v)
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit


MSK0002RH
Rise Time Vs Total Dose
Rise Time (nS)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
0K
50K
100K
150K
Total dose (rad(Si))
Avg gnd
Avg bias
Control
Post RAD max limit

Total Dose Radiation Test Report

MSK 0002RH

Radiation Tolerant High Speed, Buffer Amp

March 29, 2007 (First Test)
April 7, 2009 (Second Test)
February 25, 2011 (Third Test)

B. Horton
R. Wakeman

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 0002RH 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 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 0002RH.

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 125 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. Four devices were kept under bias during irradiation. Four 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. Input current and output offset voltage both increases with increasing irradiation. Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. The devices also exhibited a slight voltage gain decrease. This was most pronounced from 0Krad(Si) to 100Krad(Si) with less change from occurring from 100Krad(Si) to 300Krad(Si).

MSK0002RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

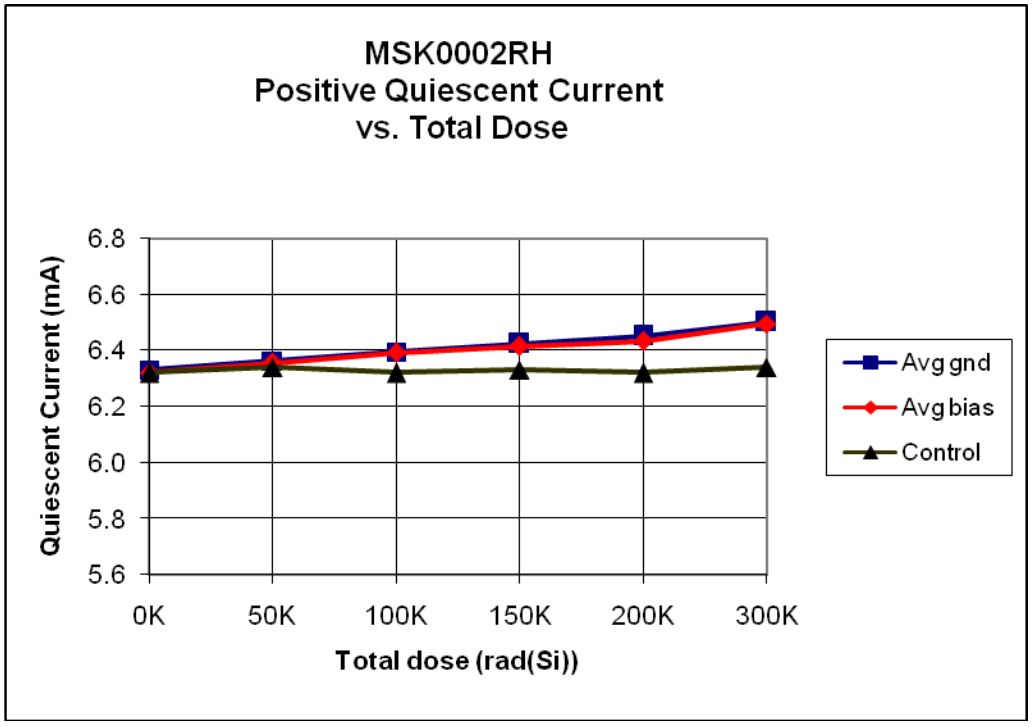
Irradiation Date
02/25/2011

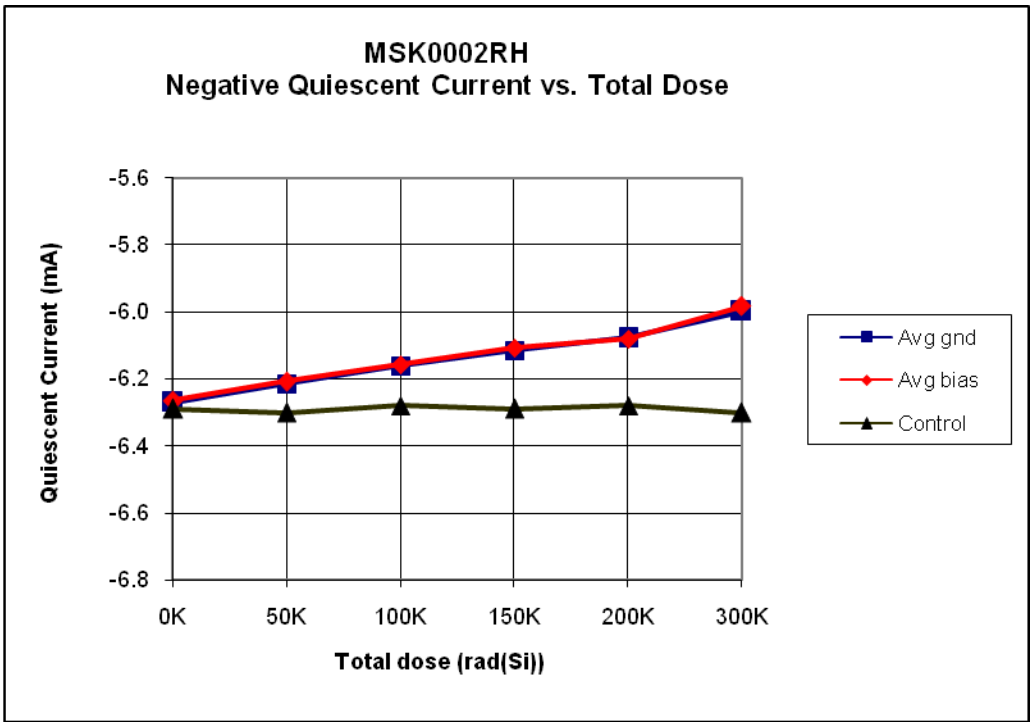
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
6:52	51,500	51,500
6:52	51,500	103,000
6:52	51,500	154,500
6:52	51,500	206,000
13:44	103,000	309,000

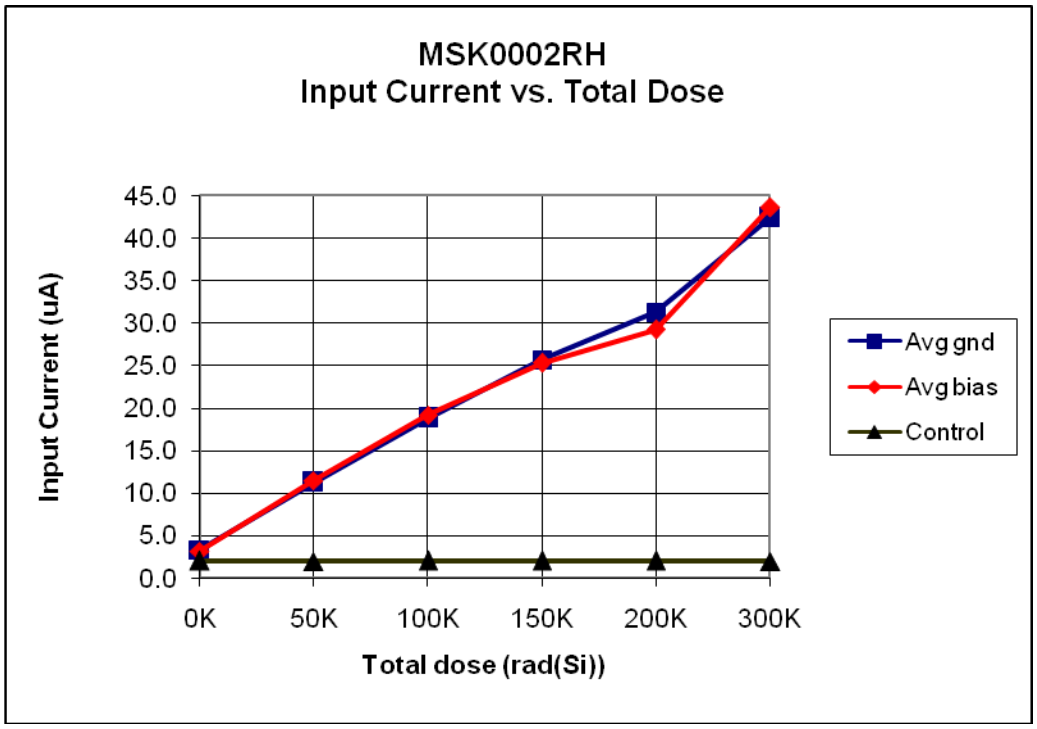
Biased S/N – D202, D204, D205, D206

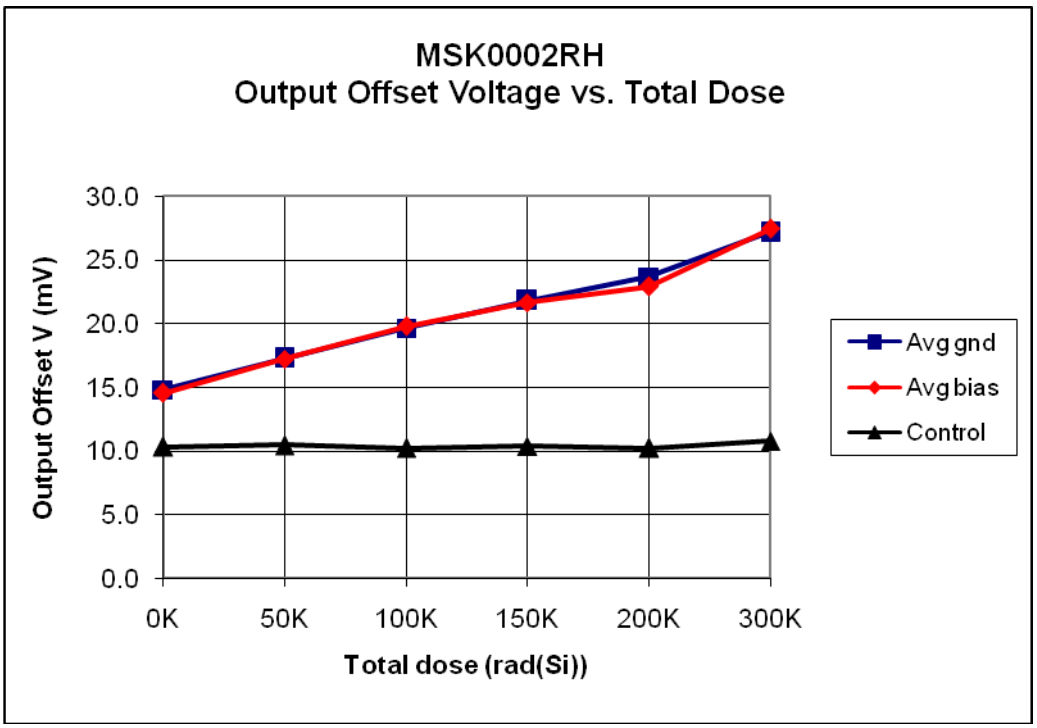
Unbiased S/N – D207, D212, D213, D215

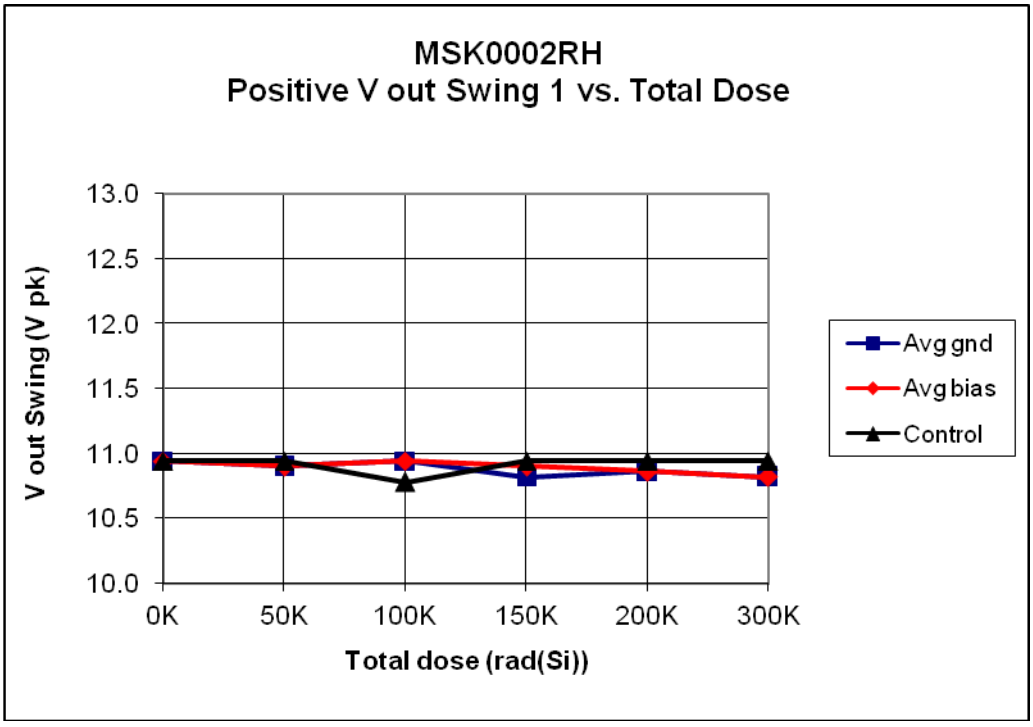
Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

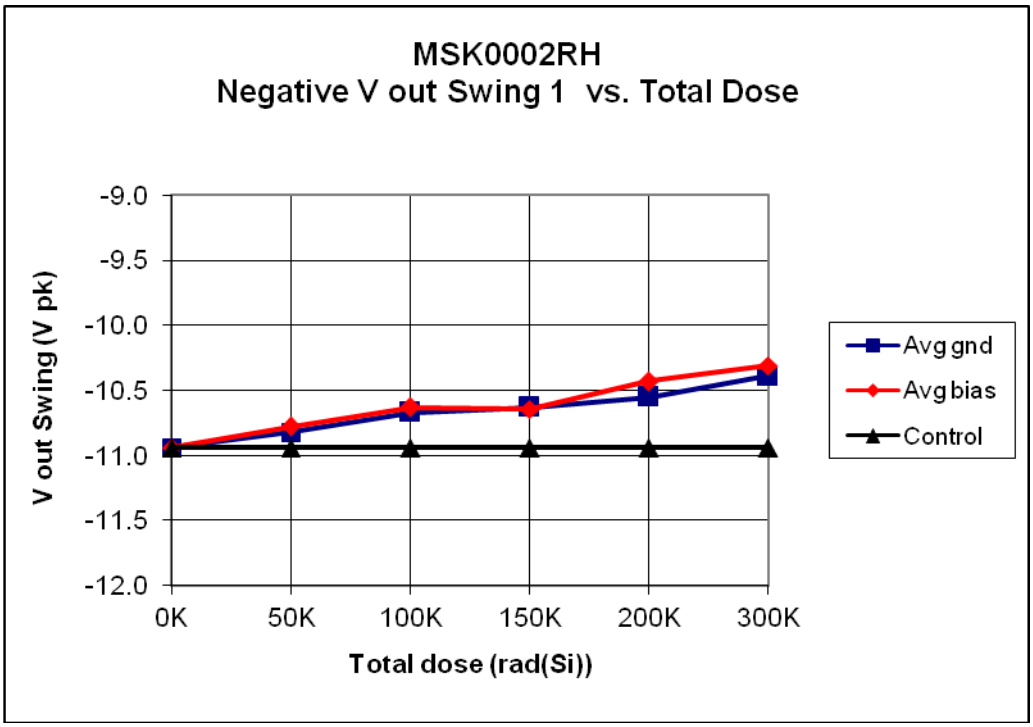

MSK0002RH
Positive Quiescent Current
vs. Total Dose
Quiescent Current (mA)
6.8
6.6
6.4
6.2
6.0
5.8
5.6
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

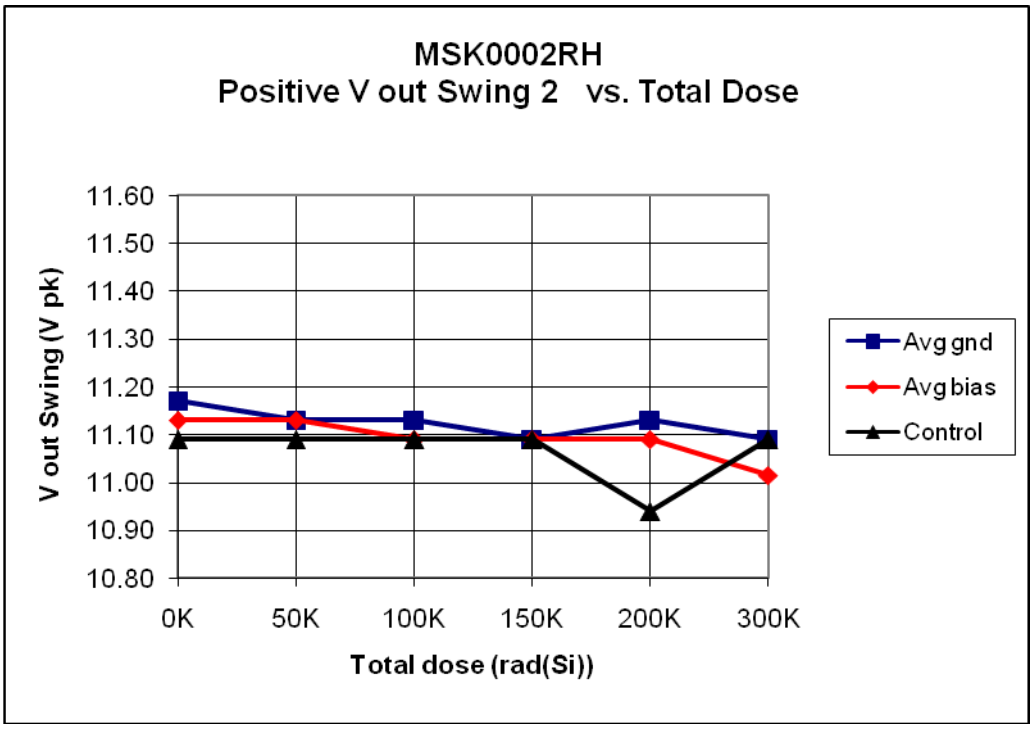

MSK0002RH
Negative Quiescent Current vs. Total Dose
Quiescent Current (mA)
-5.6
-5.8
-6.0
-6.2
-6.4
-6.6
-6.8
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

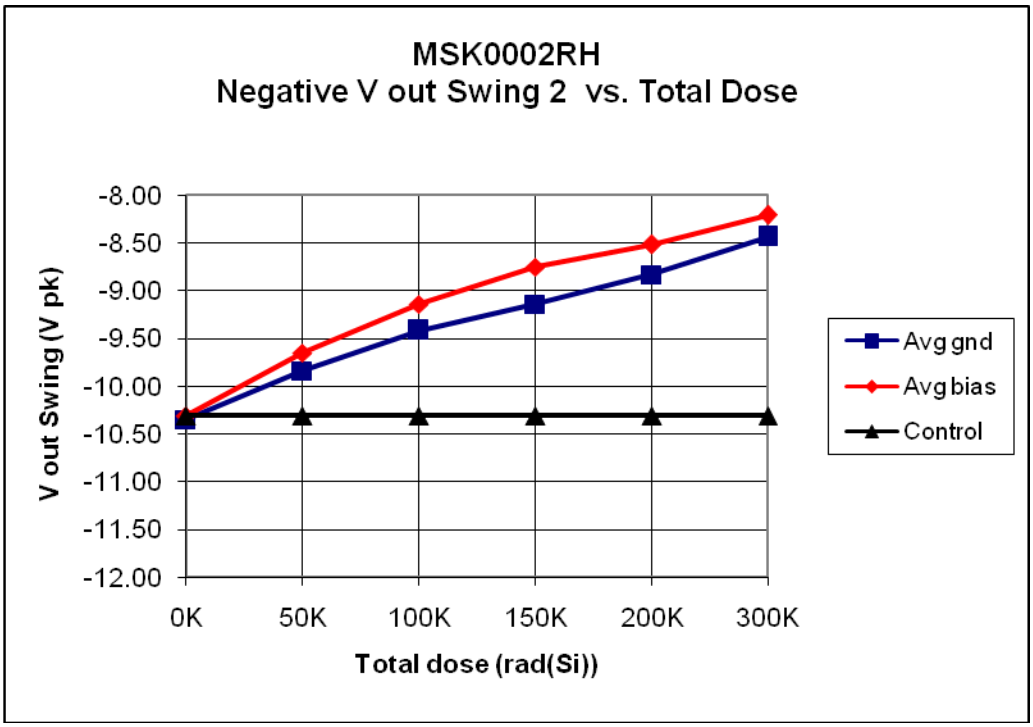

MSK0002RH
Input Current vs. Total Dose
Input Current (uA)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

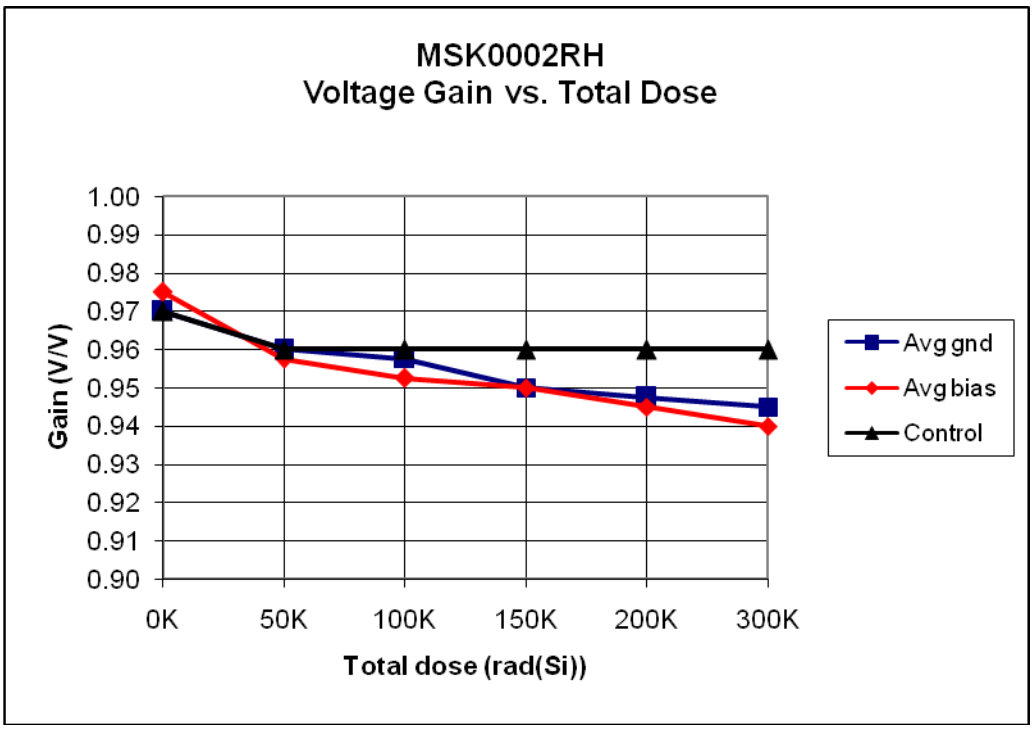

MSK0002RH
Output Offset Voltage vs. Total Dose
Output Offset V (mV)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

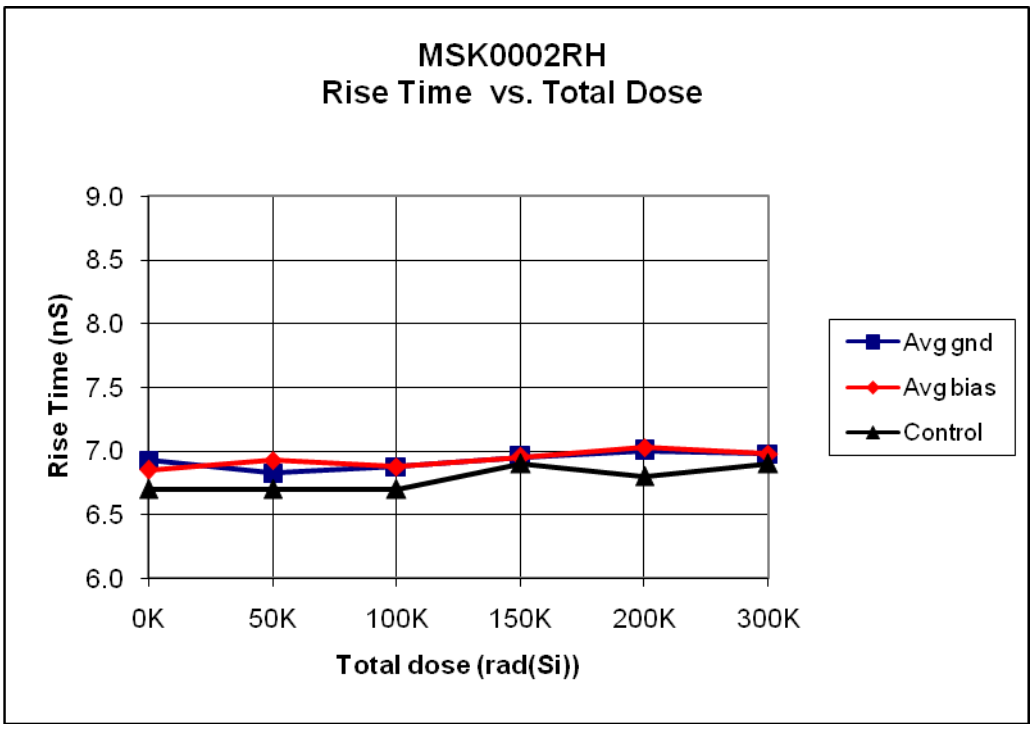

MSK0002RH
Positive V out Swing 1 vs. Total Dose
V out Swing (V pk)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Negative V out Swing 1 vs. Total Dose
V out Swing (V pk)
-9.0
-9.5
-10.0
-10.5
-11.0
-11.5
-12.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Positive V out Swing 2 vs. Total Dose
V out Swing (V pk)
11.60
11.50
11.40
11.30
11.20
11.10
11.00
10.90
10.80
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Negative V out Swing 2 vs. Total Dose
V out Swing (V pk)
-8.00
-8.50
-9.00
-9.50
-10.00
-10.50
-11.00
-11.50
-12.00
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Voltage Gain vs. Total Dose
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
Gain (V/V)
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Rise Time vs. Total Dose
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Rise Time (nS)
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 0002RH

Radiation Tolerant High Speed, Buffer Amp

March 29, 2007 (First Test)
April 7, 2009 (Second Test)

B. Erwin
R. Wakeman

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 0002RH 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 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 0002RH.

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 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 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. Four devices were kept under bias during irradiation. Four 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. Some shift in the output offset current was seen from 0Krad(Si) to 300Krad(Si)..

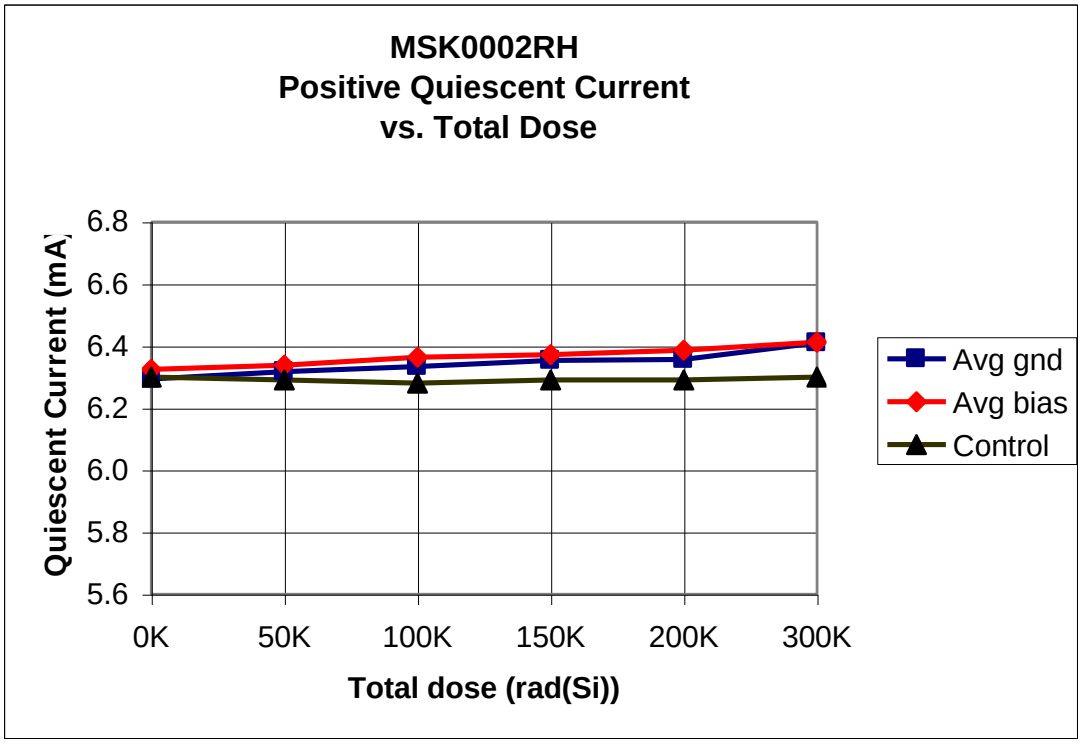
Negative Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. However, the devices stayed within post irradiation limits throughout all testing.

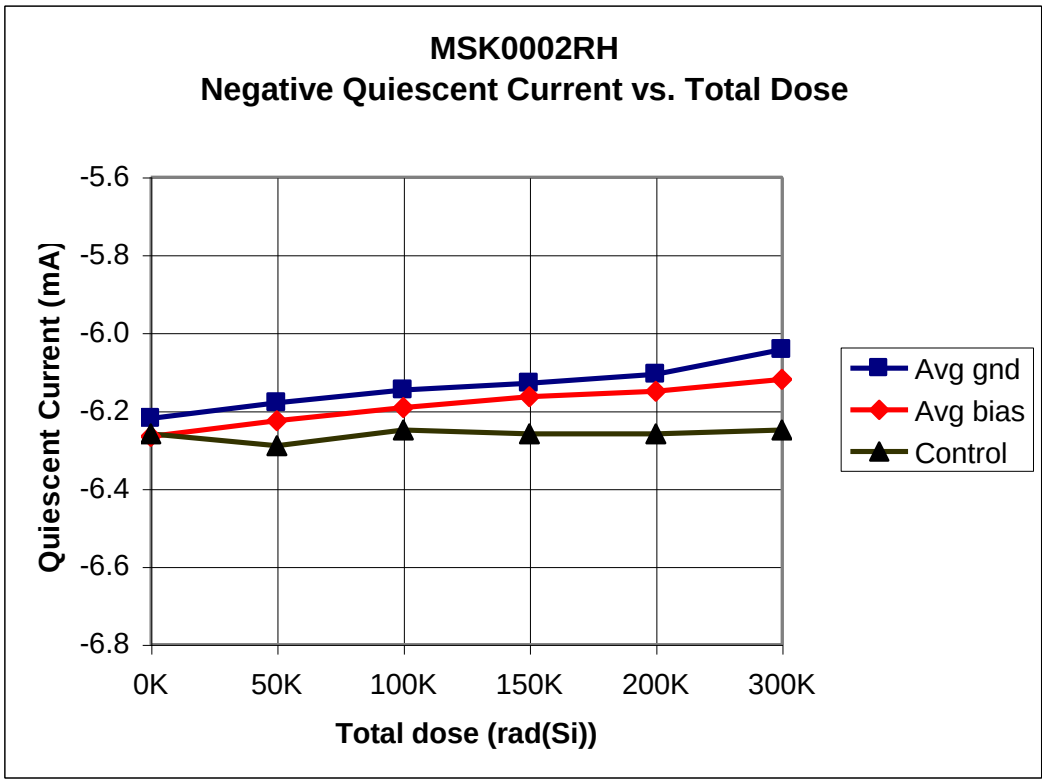
The devices also exhibited a slight voltage gain decrease. This was most pronounced from 0 Krad(Si) to 50Krad(Si).

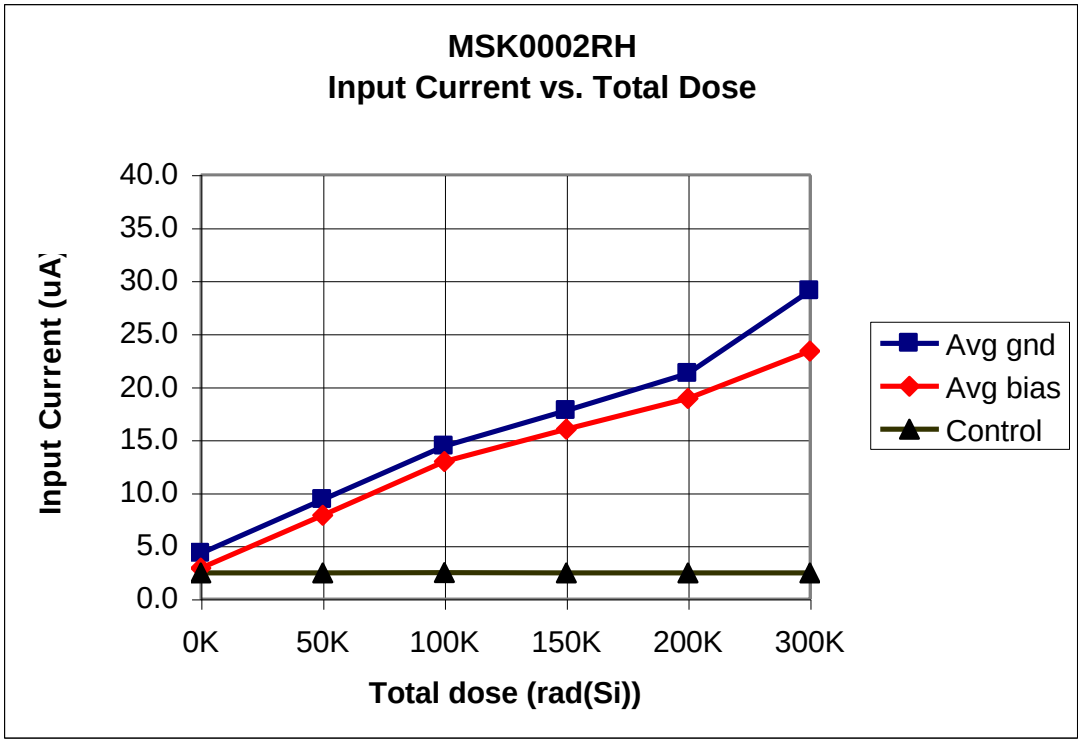
Dosimetry Equipment	Irradiation Date
Bruker Biospin #0141	4/07/2009

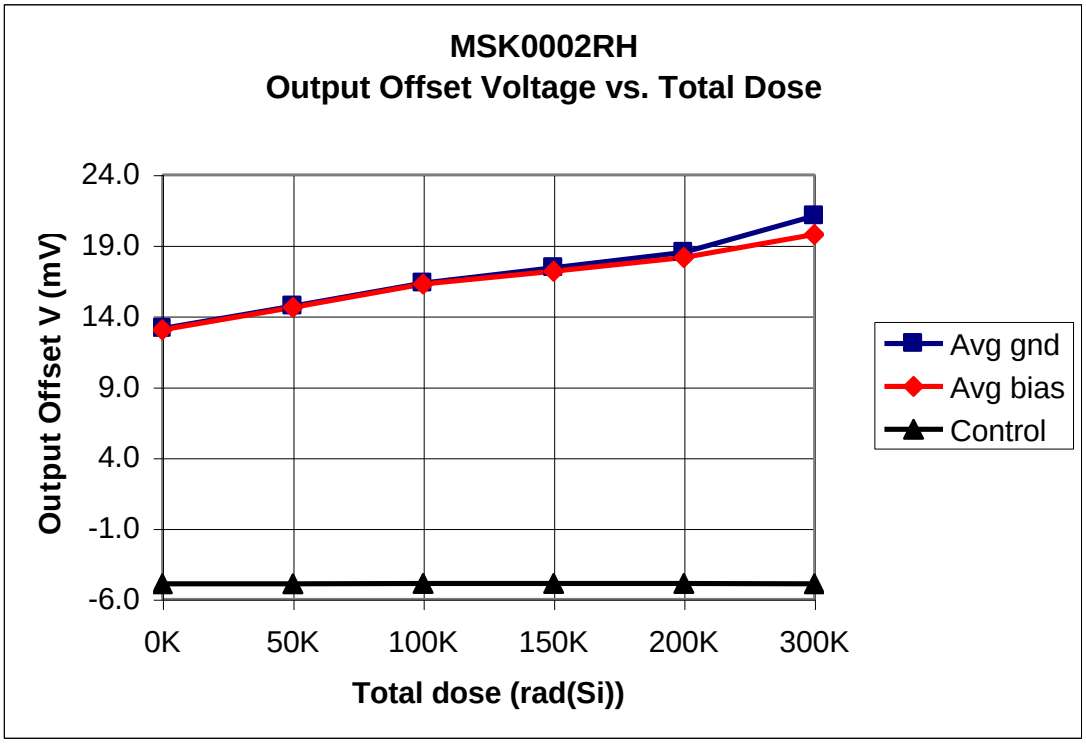
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
4:46	51,480	51,480
4:46	51,480	102,960
4:46	51,480	154,440
4:46	51,480	205,920
9:33	103,140	309,060
Biased Devices: 621, 622, 623, 624		
Unbiased Devices: 625, 641, 651, 652		

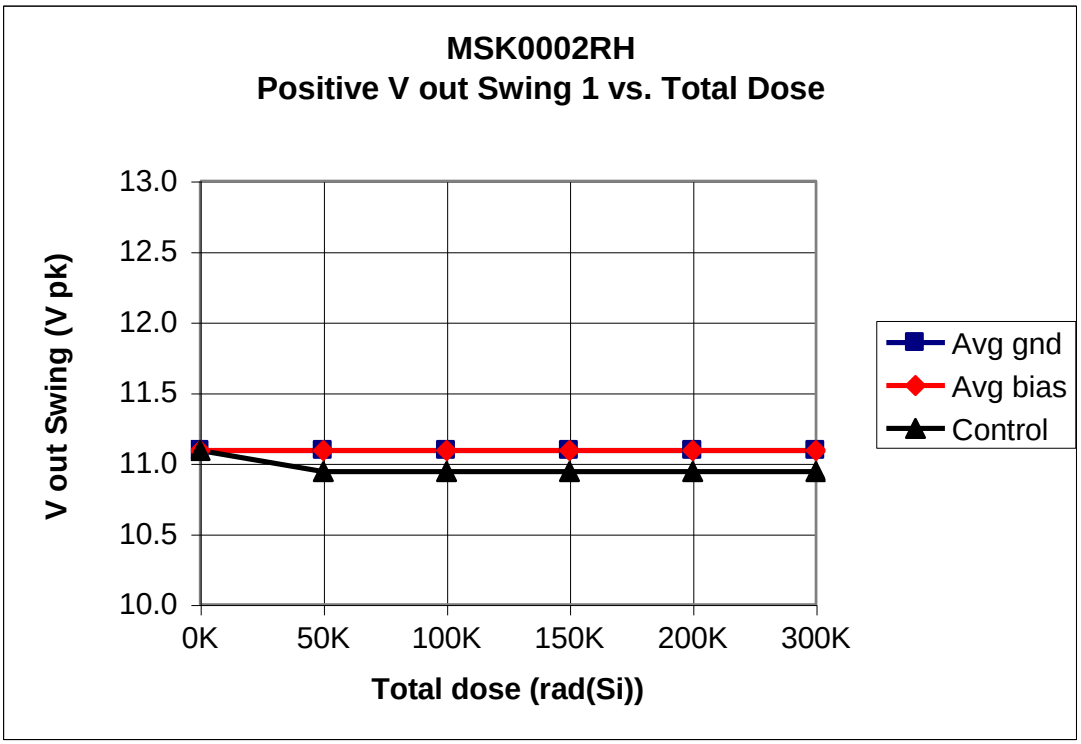
Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

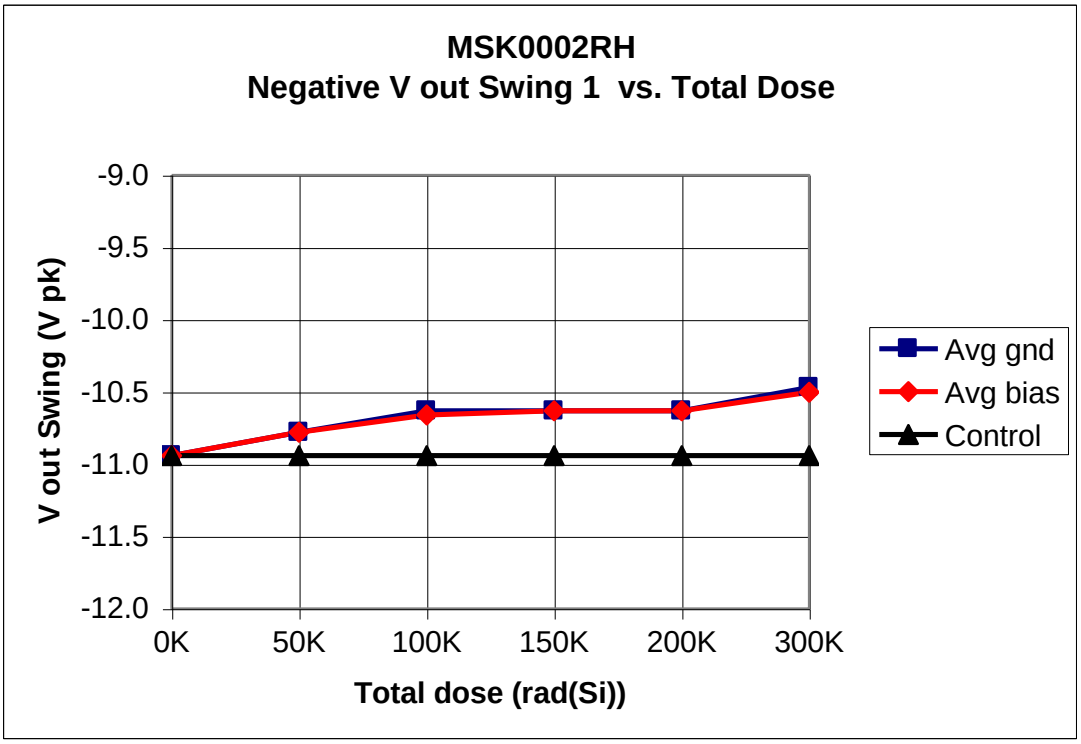

MSK0002RH
Positive Quiescent Current
vs. Total Dose
Quiescent Current (mA)
6.8
6.6
6.4
6.2
6.0
5.8
5.6
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

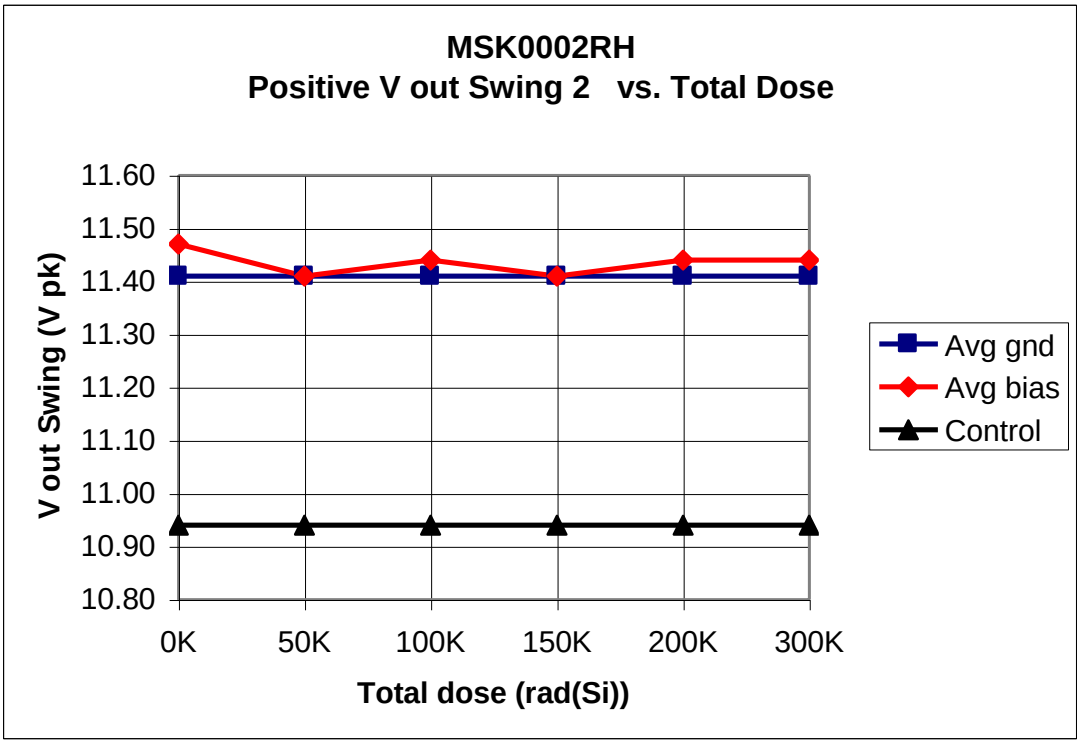

MSK0002RH
Negative Quiescent Current vs. Total Dose
Quiescent Current (mA)
-5.6
-5.8
-6.0
-6.2
-6.4
-6.6
-6.8
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

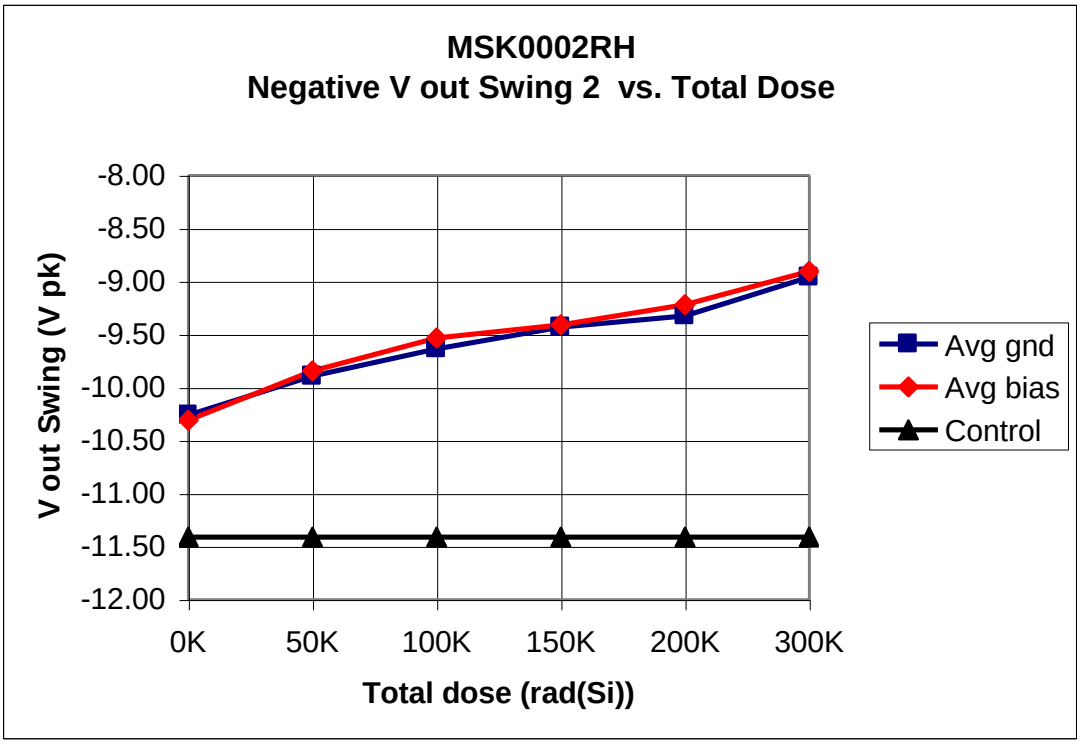

MSK0002RH
Input Current vs. Total Dose
Input Current (uA)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

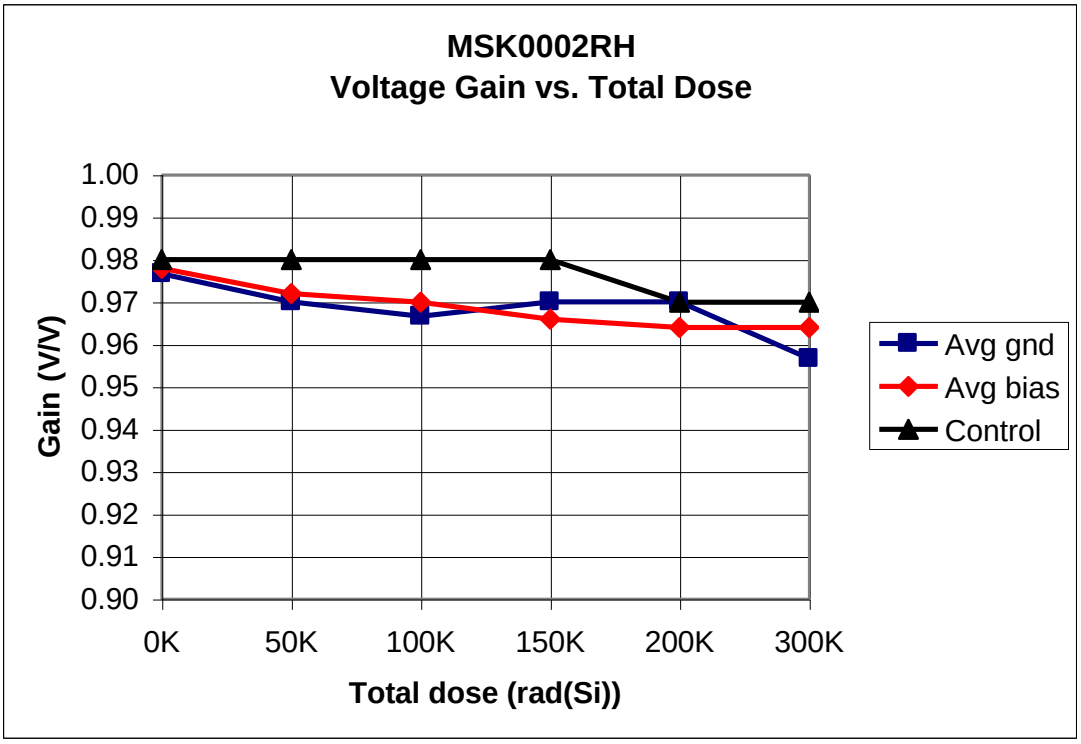

MSK0002RH
Output Offset Voltage vs. Total Dose
Output Offset V (mV)
24.0
19.0
14.0
9.0
4.0
-1.0
-6.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

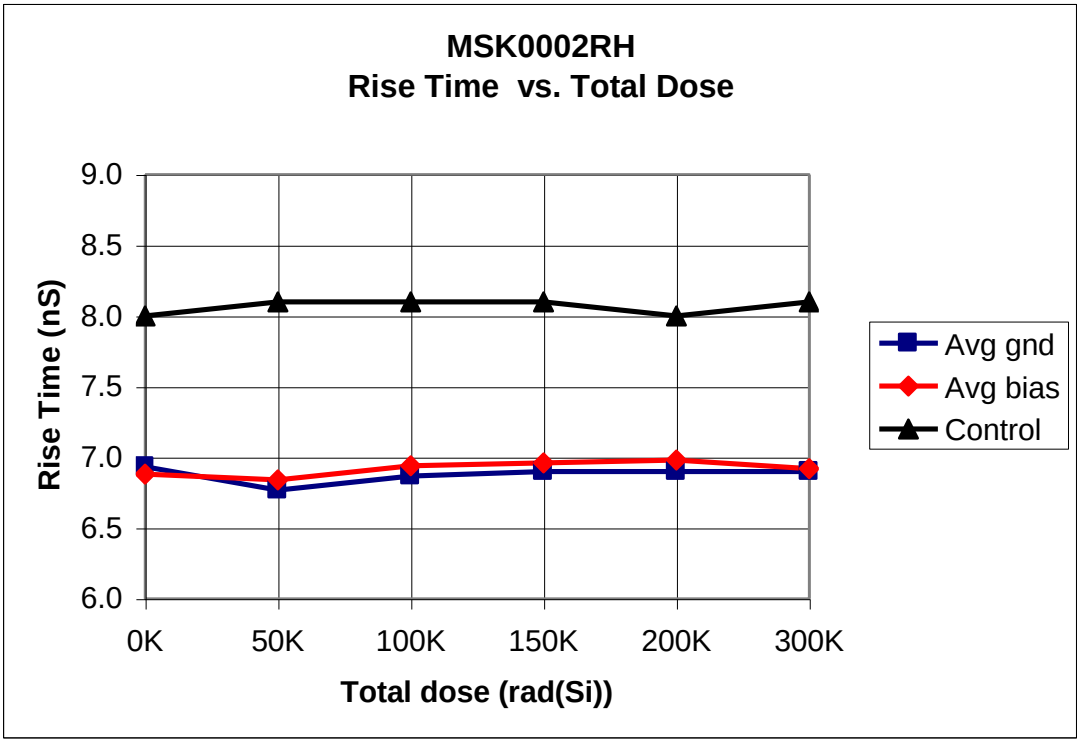

MSK0002RH
Positive V out Swing 1 vs. Total Dose
V out Swing (V pk)
13.0
12.5
12.0
11.5
11.0
10.5
10.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Negative V out Swing 1 vs. Total Dose
V out Swing (V pk)
-9.0
-9.5
-10.0
-10.5
-11.0
-11.5
-12.0
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Positive V out Swing 2 vs. Total Dose
V out Swing (V pk)
11.60
11.50
11.40
11.30
11.20
11.10
11.00
10.90
10.80
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Negative V out Swing 2 vs. Total Dose
-8.00
-8.50
-9.00
-9.50
-10.00
-10.50
-11.00
-11.50
-12.00
V out Swing (V pk)
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Voltage Gain vs. Total Dose
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
Gain (V/V)
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK0002RH
Rise Time vs. Total Dose
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Rise Time (nS)
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 0002RH

Radiation Tolerant High Speed, Buffer Amp

March 29, 2007

J. Douglas
B. Erwin
P. Musil

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 0002RH 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 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 0002RH.

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 108 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. Four devices were kept under bias during irradiation. Four 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:

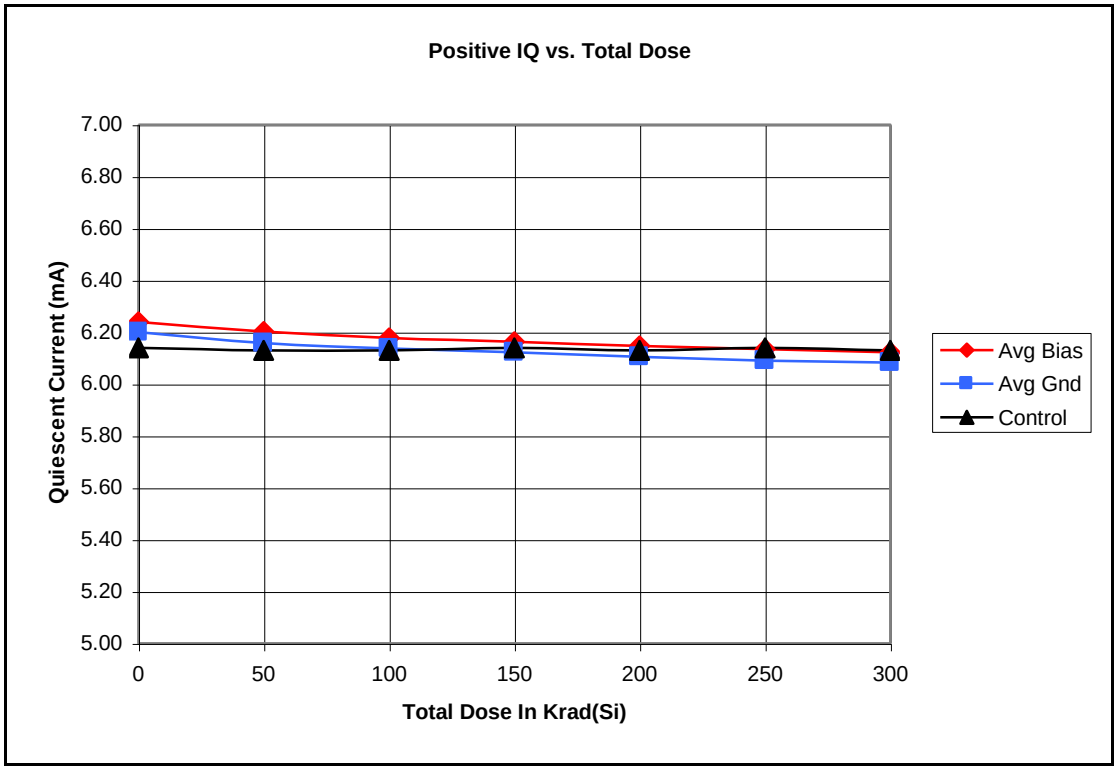
The devices performed very well with respect to TID tolerance. Some negative shift in the input offset current was seen from 0Krad(Si) to 100Krad(Si). The devices stabilized and input offset current stayed fairly constant with a slightly negative shift from 100Krad(Si) up to 300Krad(Si).

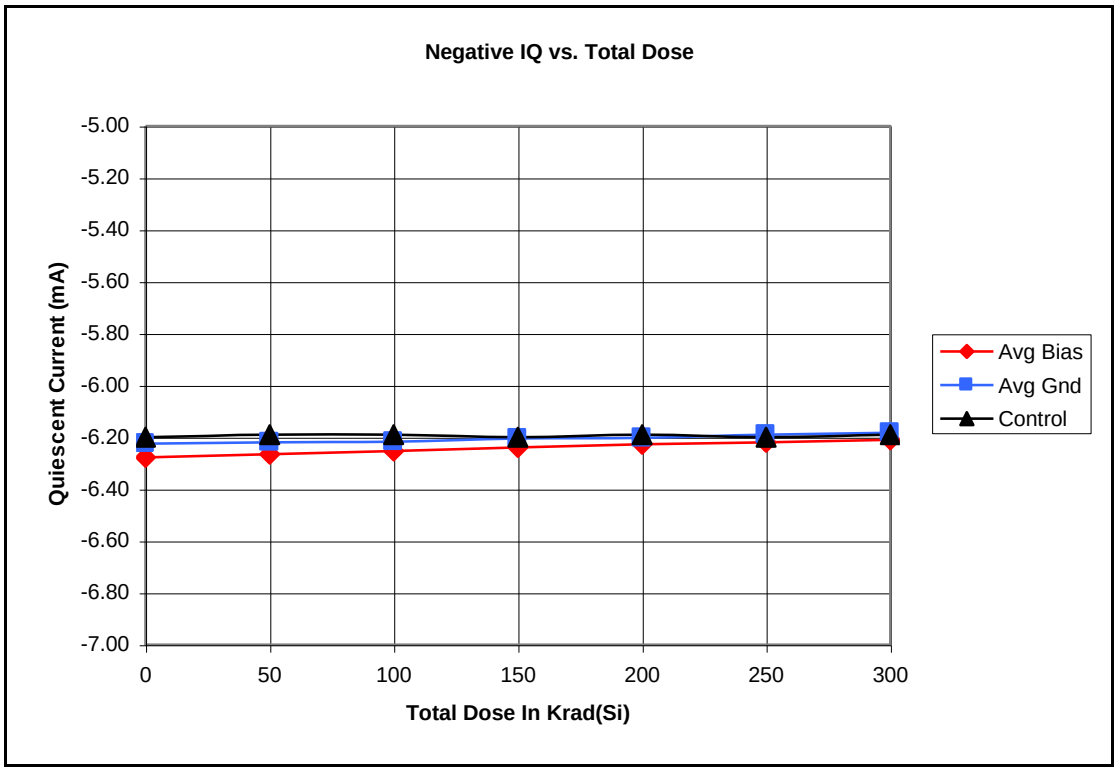
Vout2, which is output voltage swing at maximum load, decreased with increased irradiation. The decrease occurred between 0Krad(Si) and 100Krad(Si). This parameter also stabilized at higher radiation doses.

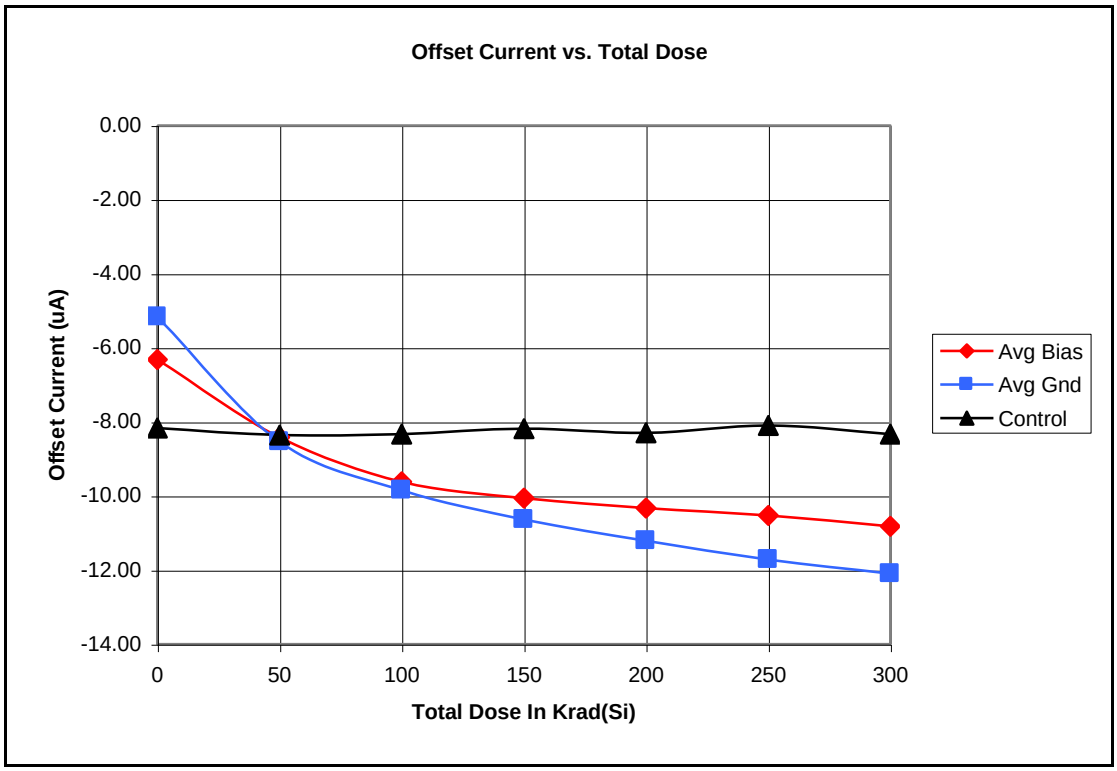
The devices also exhibited a slight voltage gain decrease. Again, this was most pronounced from 50Krad(Si) to 100Krad(Si) with less change from occurring from 100Krad(Si) to 300Krad(Si).

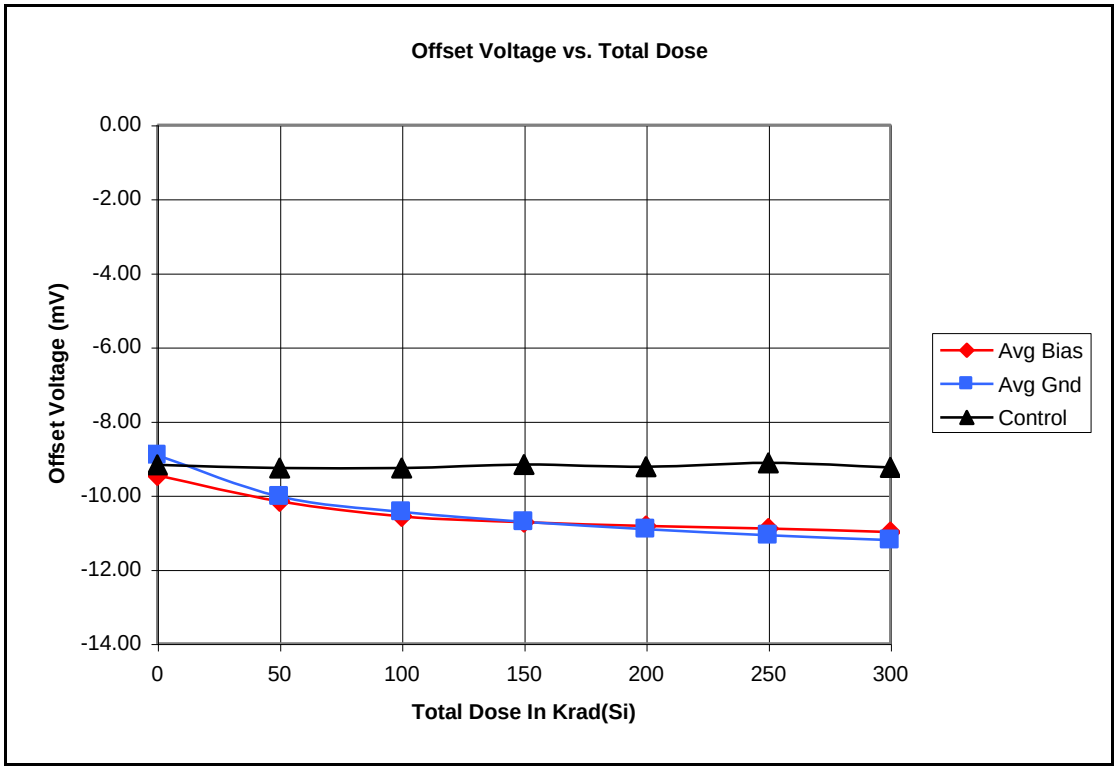
Dosimetry Equipment			Irradiation Date
Bruker Biospin #0141			3/29/2007
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)	
7:57	51,516	51,516	
7:57	51,516	103,032	
7:57	51,516	154,548	
7:57	51,516	206,064	
7:57	51,516	257,580	
7:57	51,516	309,096	

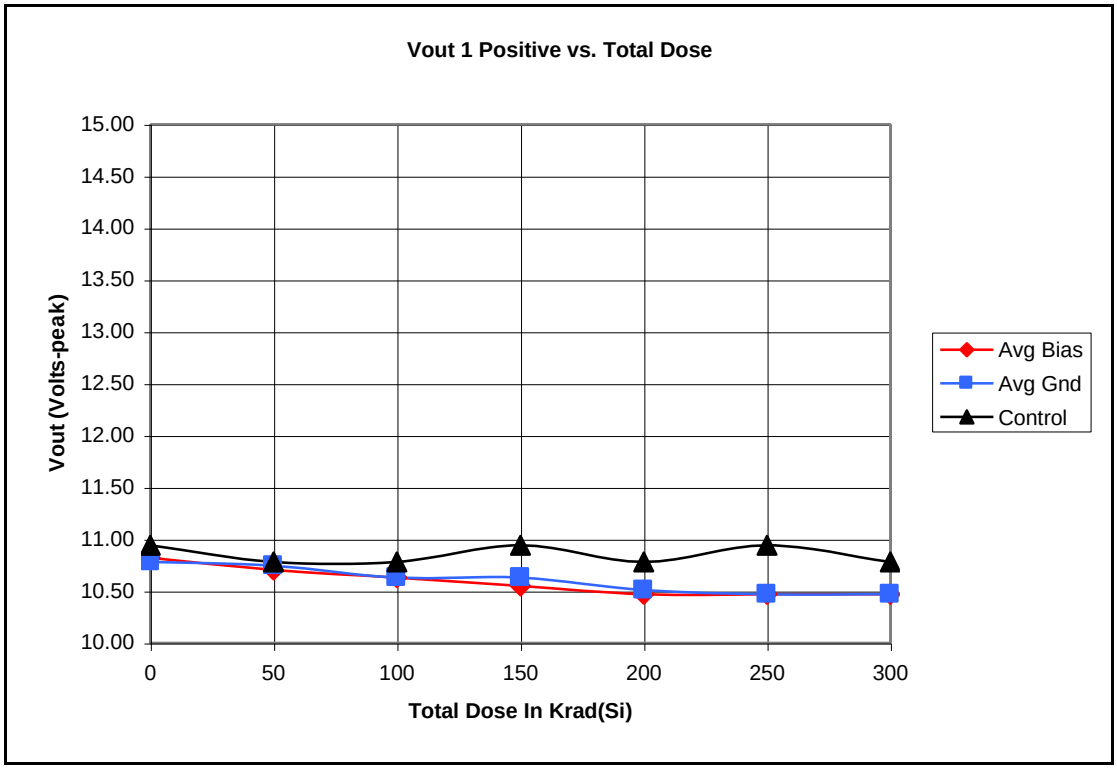
Table 1
Dose Time, Incremental Dose and Total Cumulative Dose

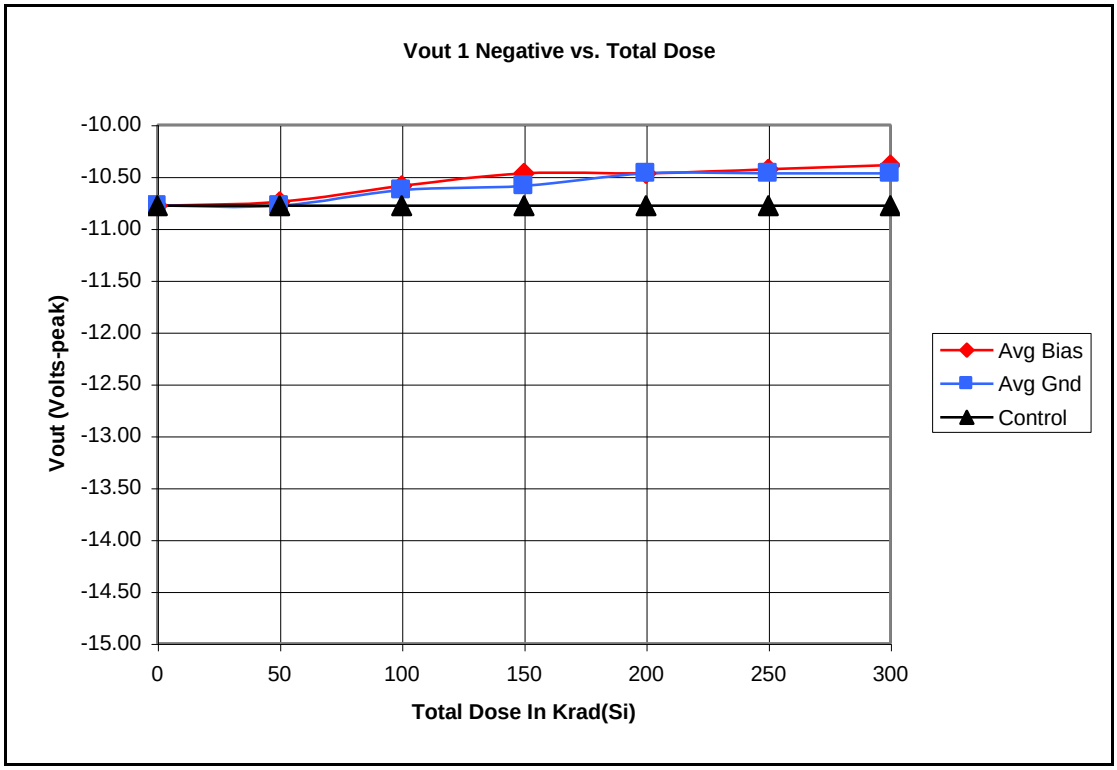

Positive IQ vs. Total Dose
Quiescent Current (mA)
7.00
6.80
6.60
6.40
6.20
6.00
5.80
5.60
5.40
5.20
5.00
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control

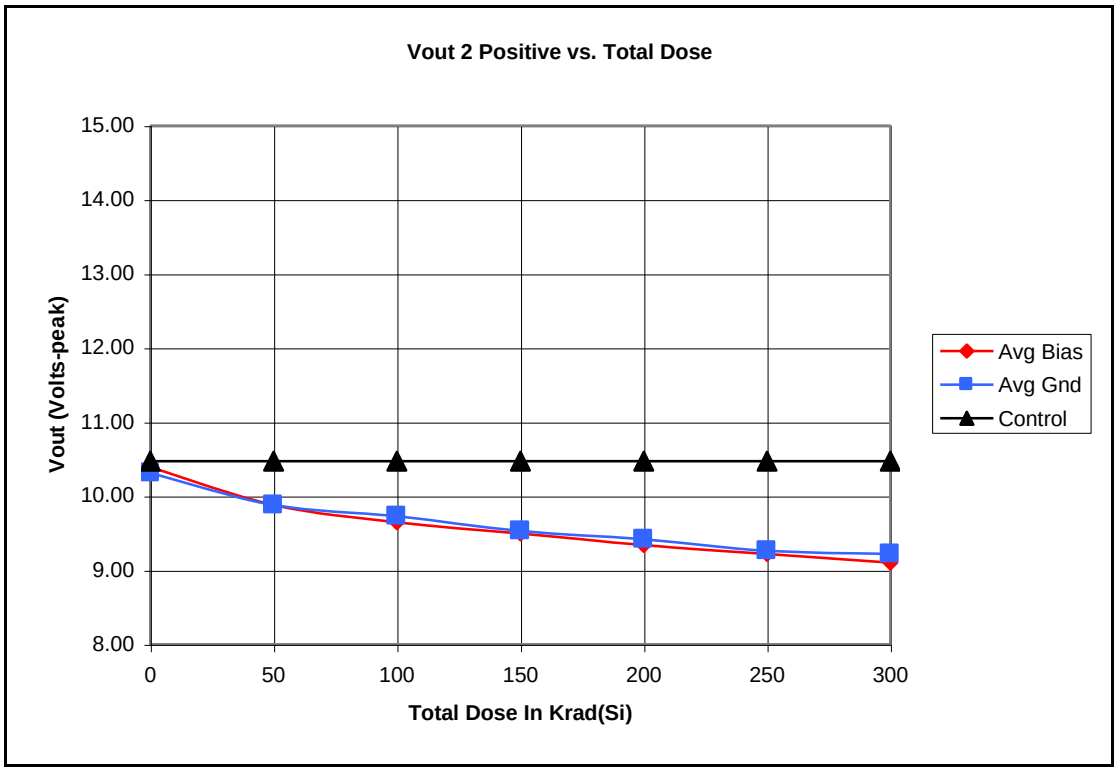

Negative IQ vs. Total Dose
Quiescent Current (mA)
-5.00
-5.20
-5.40
-5.60
-5.80
-6.00
-6.20
-6.40
-6.60
-6.80
-7.00
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control

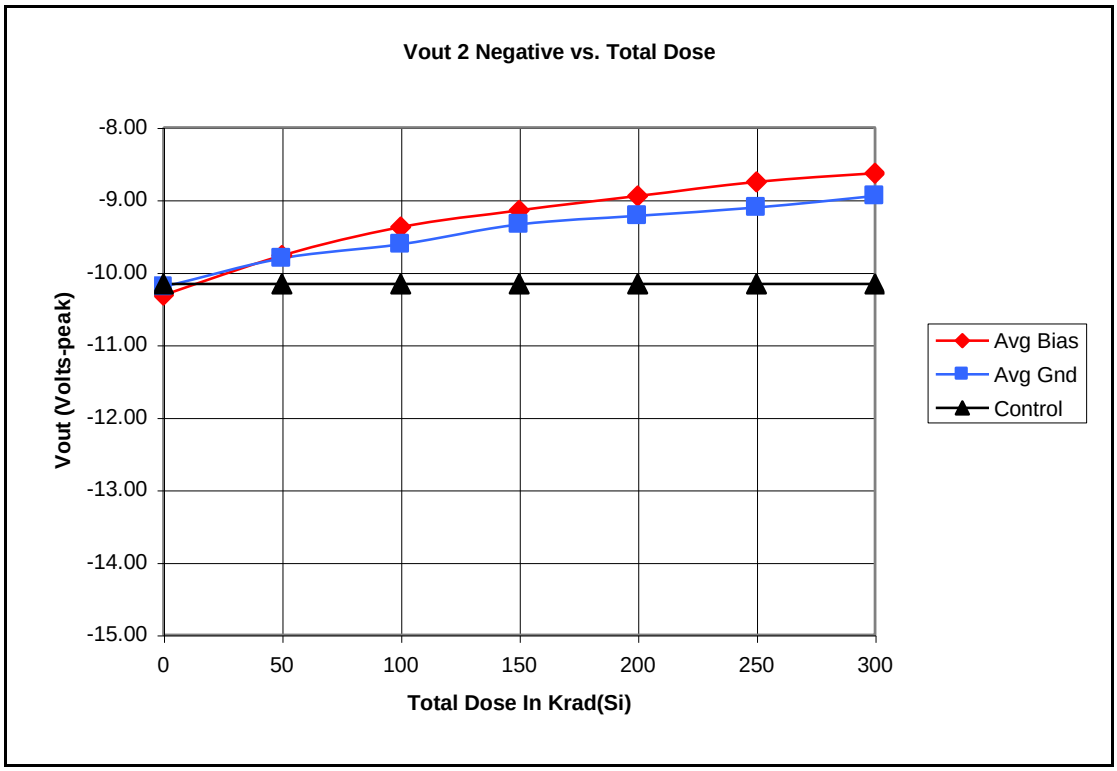

Offset Current vs. Total Dose
Offset Current (uA)
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control

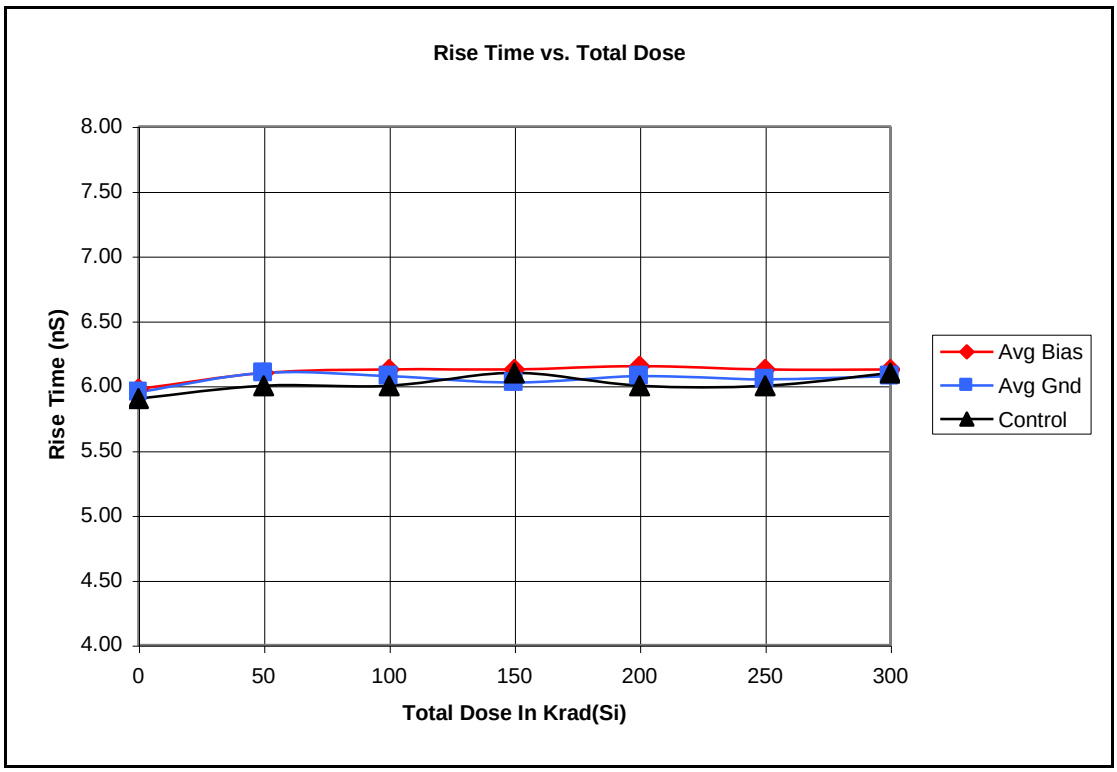

Offset Voltage vs. Total Dose
Offset Voltage (mV)
0.00
-2.00
-4.00
-6.00
-8.00
-10.00
-12.00
-14.00
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control

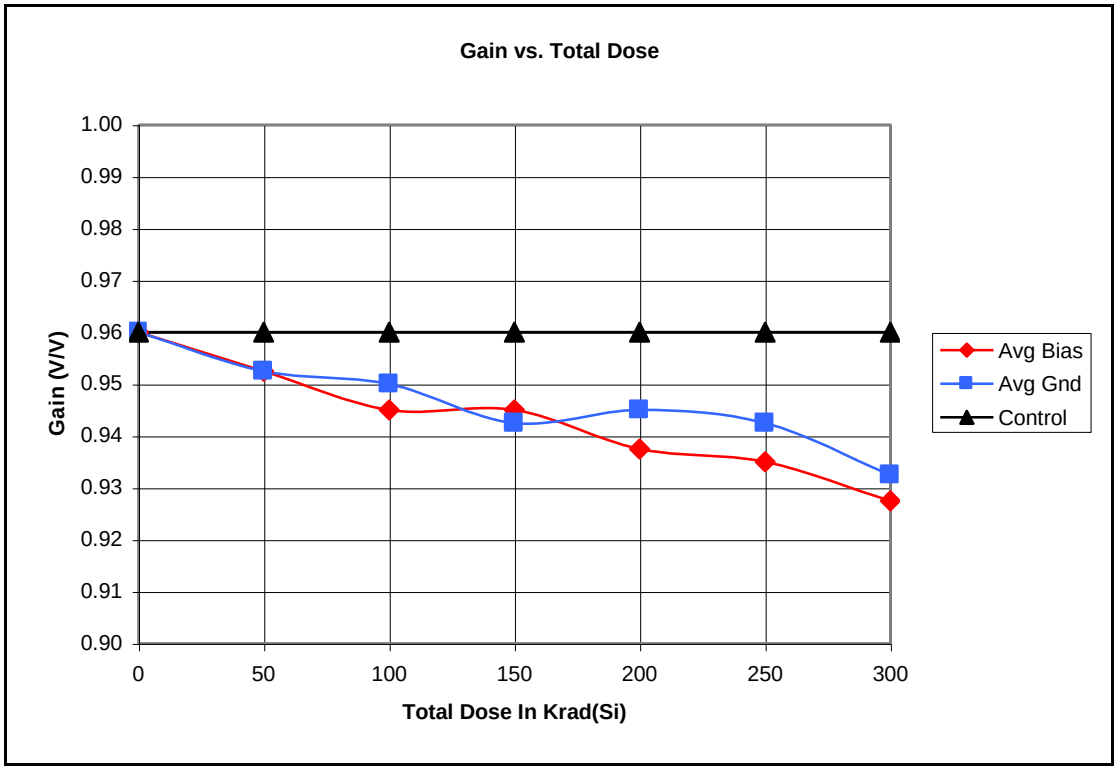

Vout 1 Positive vs. Total Dose
15.00
14.50
14.00
13.50
13.00
12.50
12.00
11.50
11.00
10.50
10.00
Vout (Volts-peak)
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control


Vout 1 Negative vs. Total Dose
-10.00
-10.50
-11.00
-11.50
-12.00
-12.50
-13.00
-13.50
-14.00
-14.50
-15.00
Vout (Volts-peak)
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control


Vout 2 Positive vs. Total Dose
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
Vout (Volts-peak)
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control


Vout 2 Negative vs. Total Dose
-8.00
-9.00
-10.00
-11.00
-12.00
-13.00
-14.00
-15.00
Vout (Volts-peak)
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control


Rise Time vs. Total Dose
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
Rise Time (nS)
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control


Gain vs. Total Dose
1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.90
Gain (V/V)
0
50
100
150
200
250
300
Total Dose In Krad(Si)
Avg Bias
Avg Gnd
Control