Radiation Test Report Binder

MSK5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date (MM/DD/YYYY)	Test Method (MIL STD 883)	Test Vehicle	IC Wafer Lot	Transistor Wafer Lot	Pages
11/25/2008	1019, Condition A	MSK5810RH	-	-	2-9
03/26/2009	1019, Condition A	MSK5810RH	-	-	10-17
03/21/2009	1019, Condition A	MSK5822RH	-	-	18-24
09/03/2009	1019, Condition A	MSK5810RH	-	-	25-32
11/06/2009	1019, Condition A	MSK5810RH	-	-	33-40
05/14/2010	1019 ,Condition A	MSK5810RH	-	-	41-48
09/17/2010	1019 ,Condition A	MSK5810RH	-	-	49-56
12/10/2010	1019, Condition A	MSK5810RH	-	-	57-64
04/01/2011	1019, Condition A	MSK5810RH	-	-	65-72
07/08/2011	1019, Condition A	MSK5810RH	-	-	73-80
06/14/2013	1019, Condition A	MSK5810RH	WD0051441 #9	CJ302831 #13	81-88
06/14/2013	1019, Condition A	MSK5810RH	WD0051441 #9	CJ302831 #21	89-96
11/06/2013	1019, Condition A	MSK5810RH	W10809524.1 #8	CJ302831RC #20	97-104
08/28/2015	1019, Condition A	MSK5810RH	WP005144.1	P741F1002 #21	105-112
11/02/2016	1019, Condition A	MSK5810RH	WP005144.1 #9	PF01F1005 #6	113-120
03/29/2017	1019, Condition A	MSK5810RH	WP005144.1 #8	PF01F1005 #6	121-128
09/15/2017	1019, Condition A	MSK5810RH	W10809524.1 #8	DL 153631 #3	129-136
01/12/2018	1019, Condition A	MSK5810RH	WP005144.1 #8	P741F1002 #21	137-144
08/22/2018	1019, Condition A	MSK5810RH	WP005144.1 #8	PG31F100K #17	145-152
04/24/2019	1019 Condition A	MSK5810RH	W1803256.1 #10	PG31F100K #17	153-159
09/01/2020	1019, Condition A	MSK5810RH	W1803256.1 #10	PJ28F101T #17	161-168
09/04/2020	1019, Condition A	MSK5810RH	W1803256.1 #10	PJ28F101T #18	169-176
12/15/2021	1019, Condition A	MSK5810RH	W1803256.1 #8	PJ28F101T #17	177-184
12/16/2021	1019, Condition A	MSK5810RH	W1803256.1 #8	PJ28F101T #18	185-192

TTM, Inc. – MSK Products

Total Dose Radiation Test Report

MSK 5810RH

RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: November 25, 2008
Updated: December 24, 2008

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

J. Douglas
F. Freytag

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 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 5810RH.

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 192 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. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID.

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
11/18/08

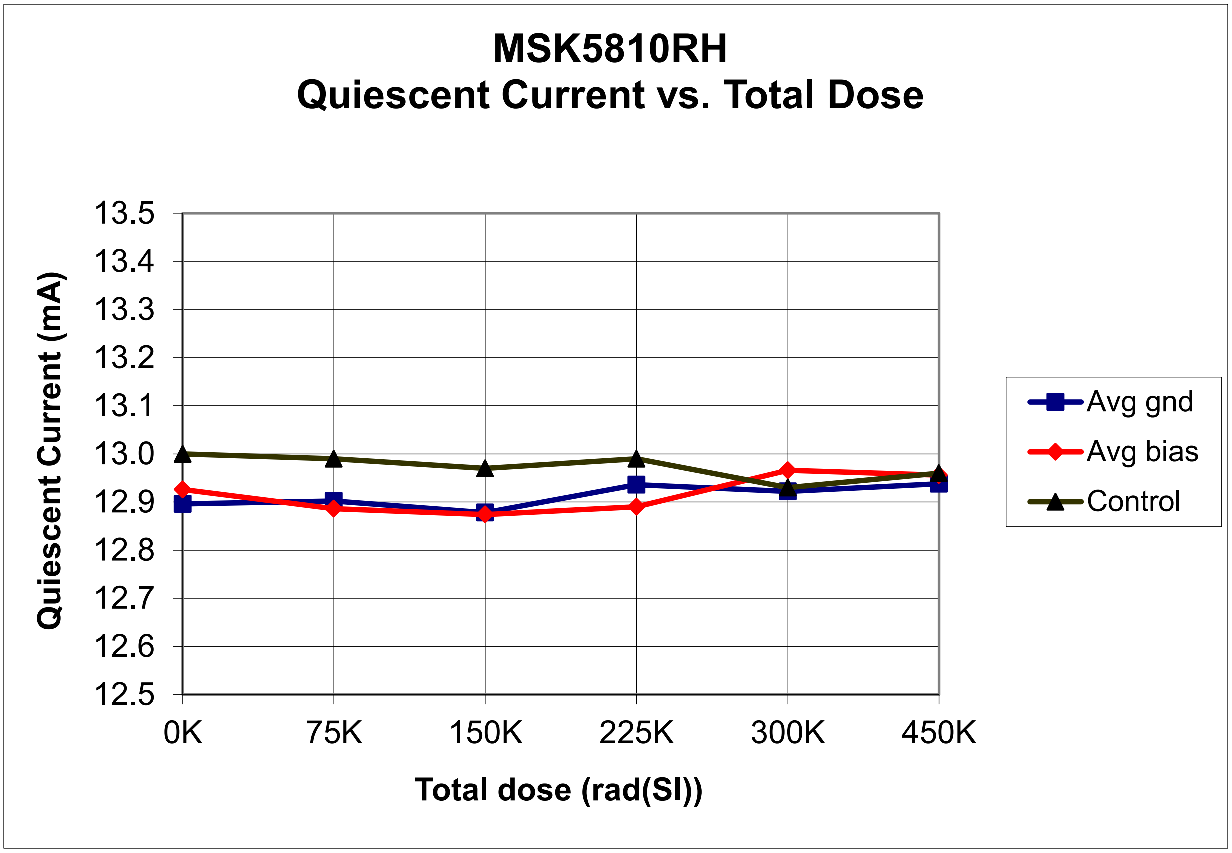
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
6:43	77,376	77,376
6:43	77,376	154,752
6:43	77,376	232,128
6:43	77,376	309,504
13:43	154,560	464,064

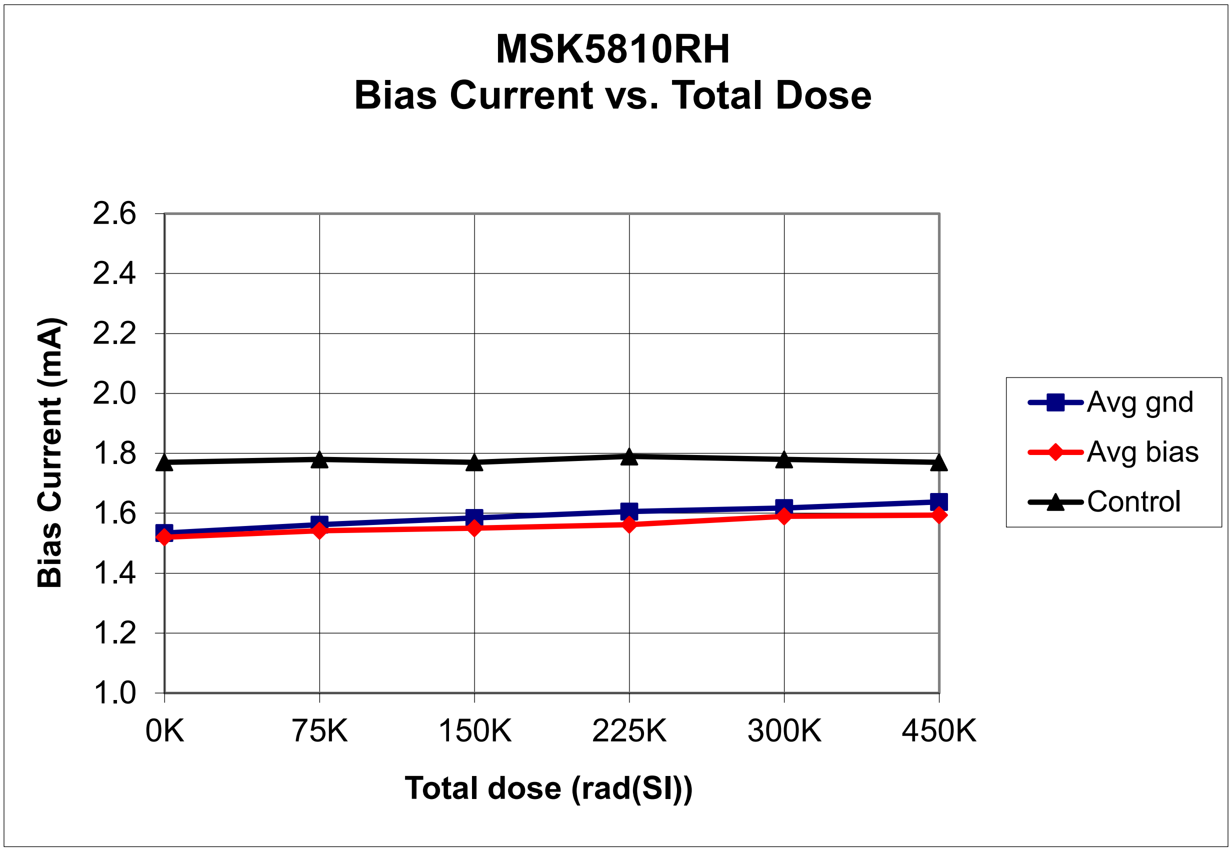
Biased S/N – 0011, 0012, 0013, 0014, 0015

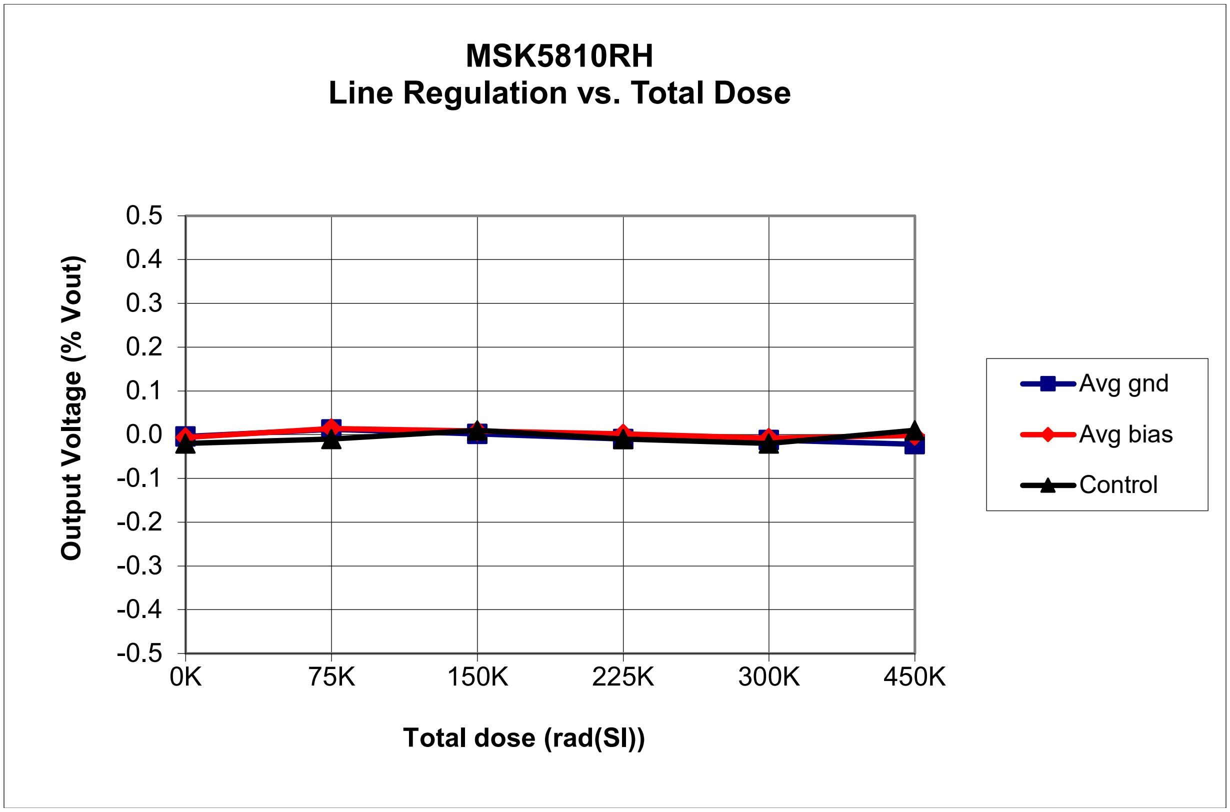
Unbiased S/N – 0020, 0023, 0028, 0029, 0030

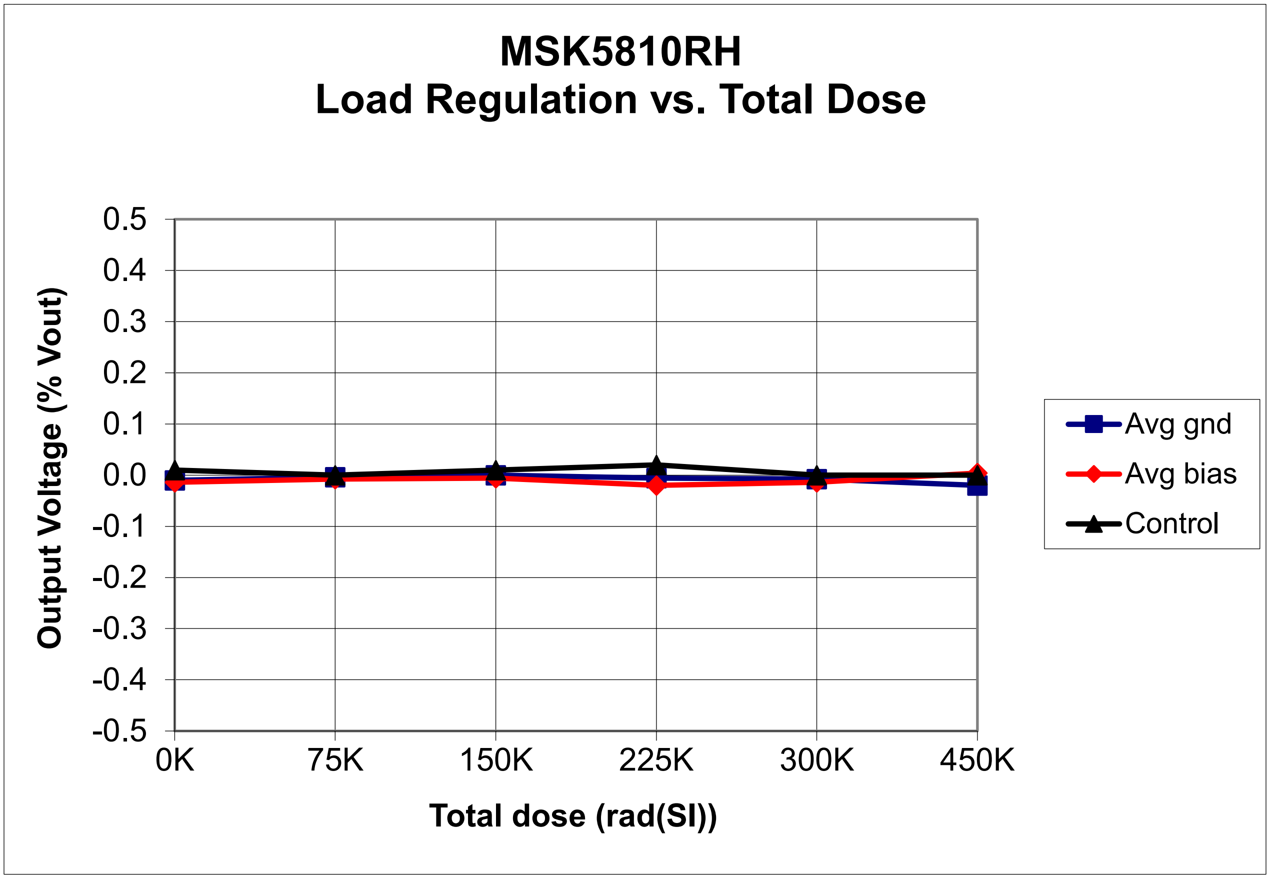
Table 1

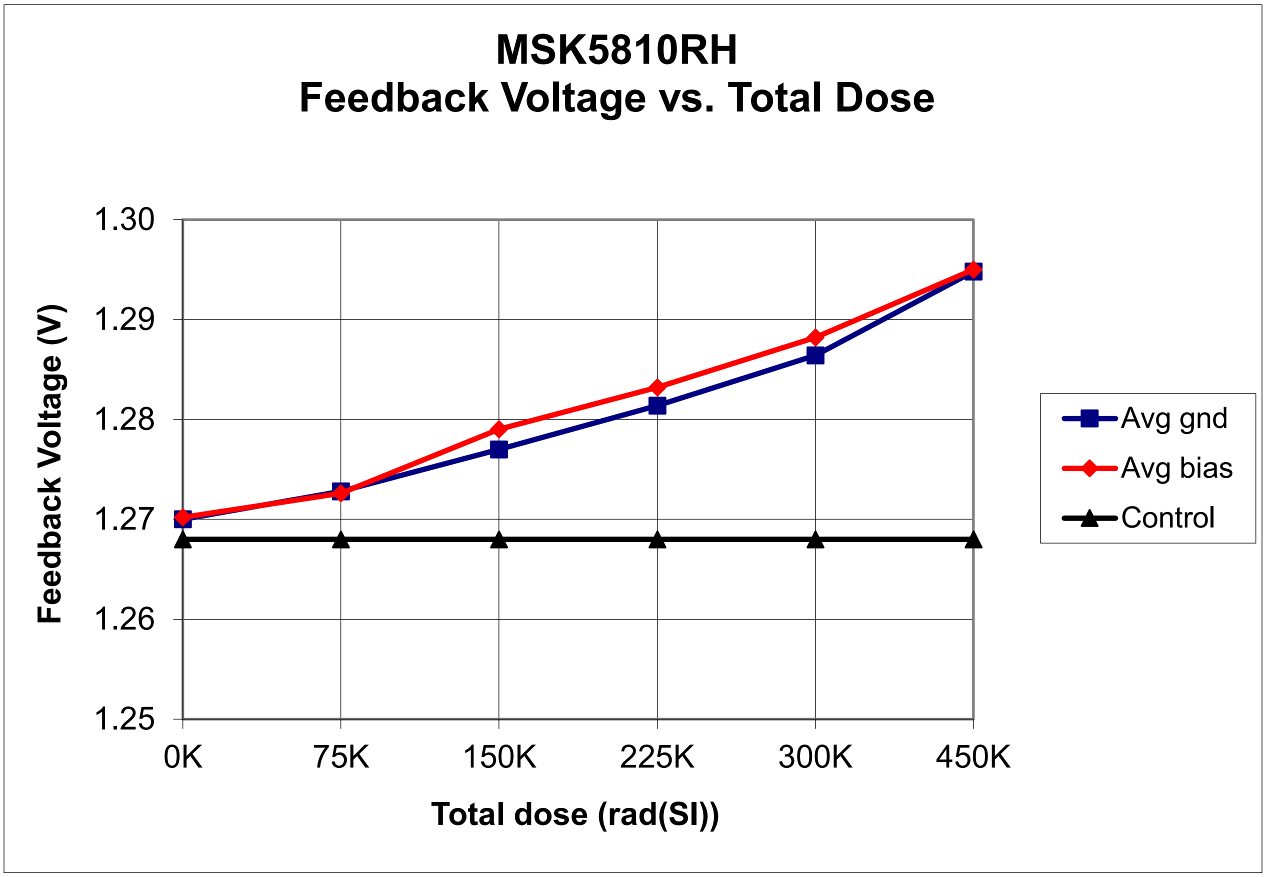
Dose Time, Incremental Dose and Total Cumulative Dose

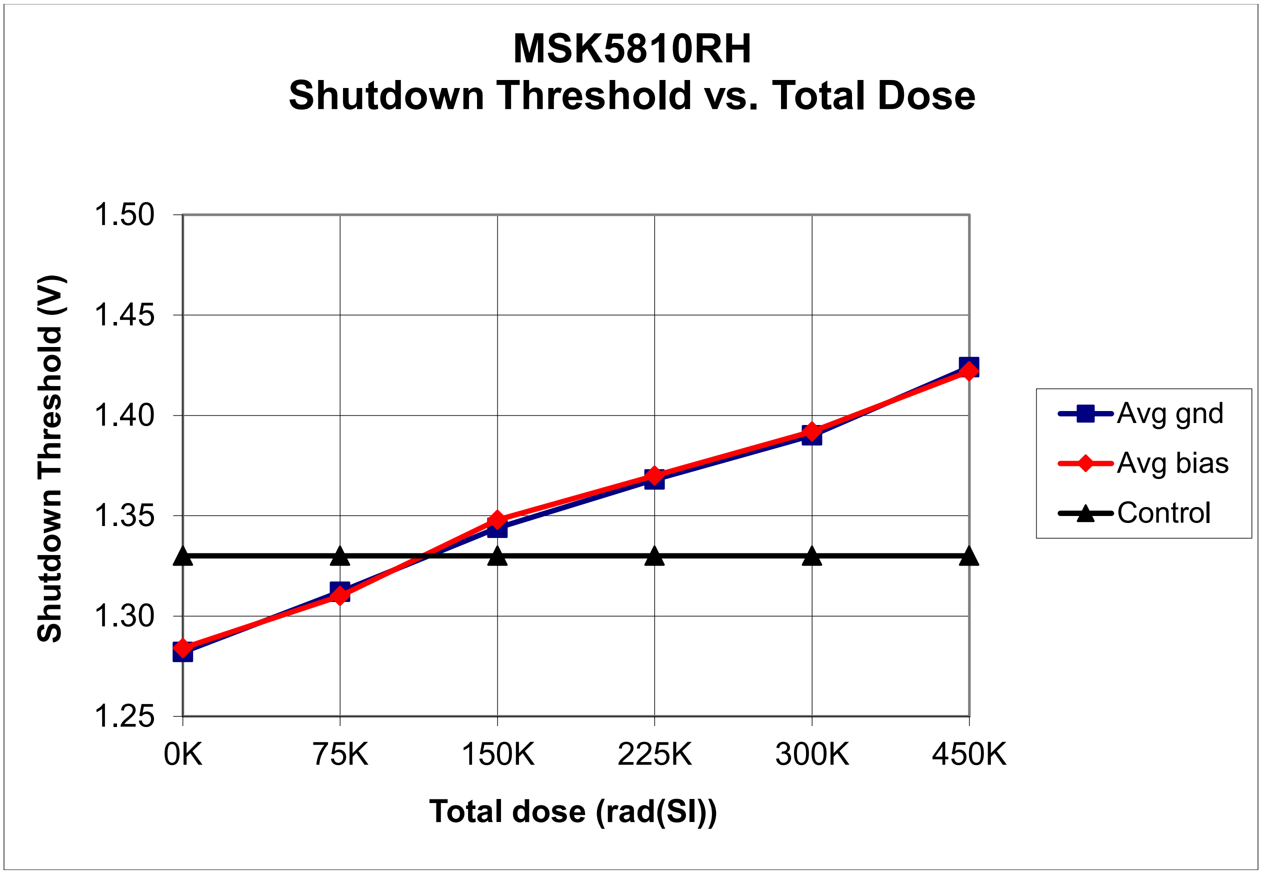

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
13.5
13.4
13.3
13.2
13.1
13.0
12.9
12.8
12.7
12.6
12.5
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

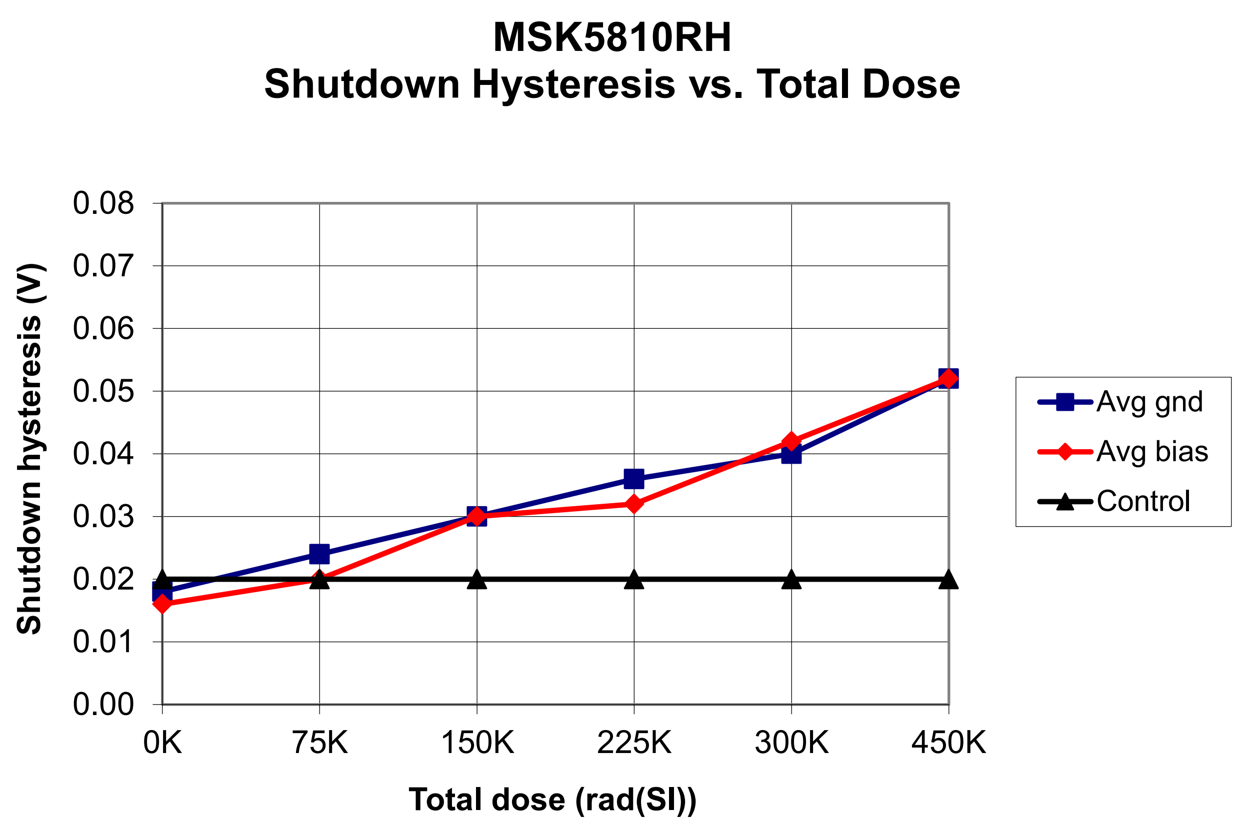

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

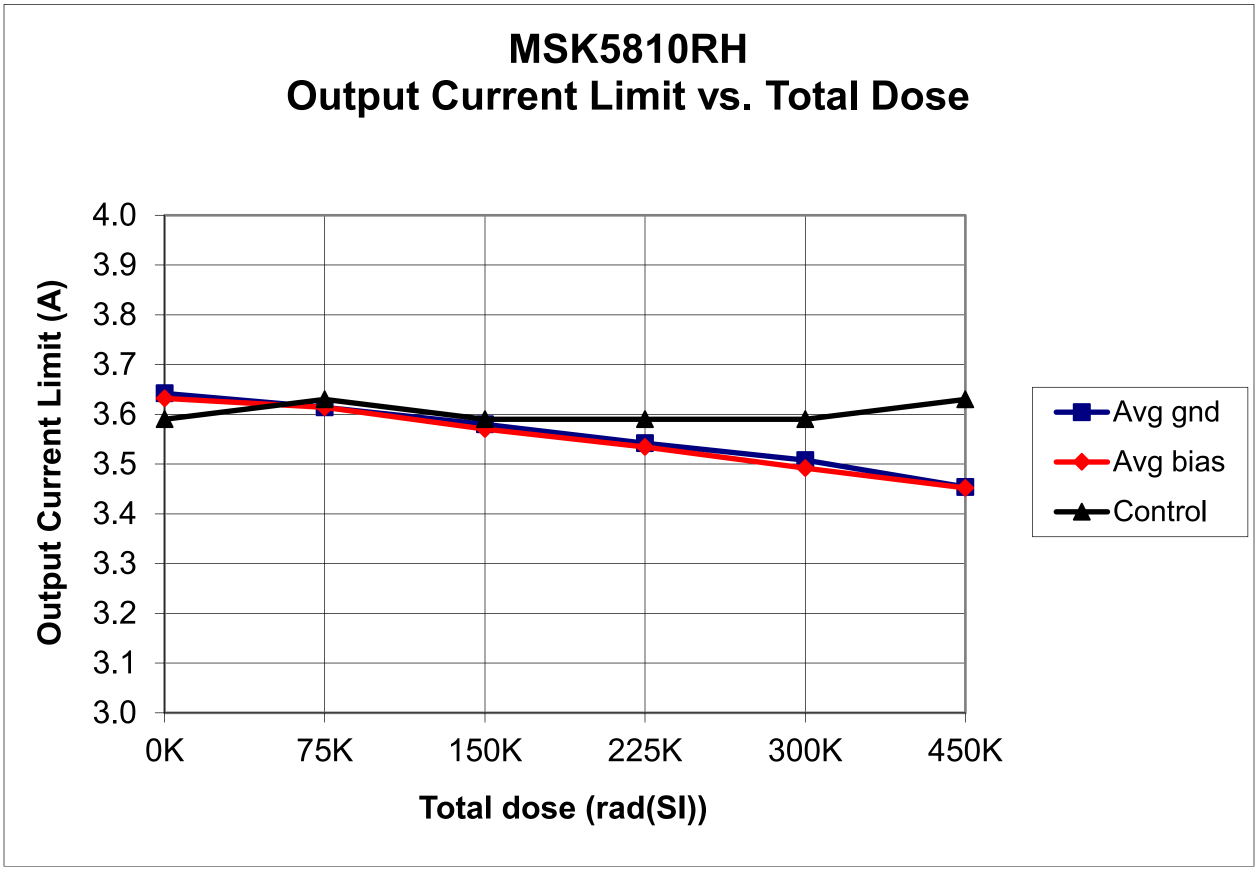

MSK5810RH
Line Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

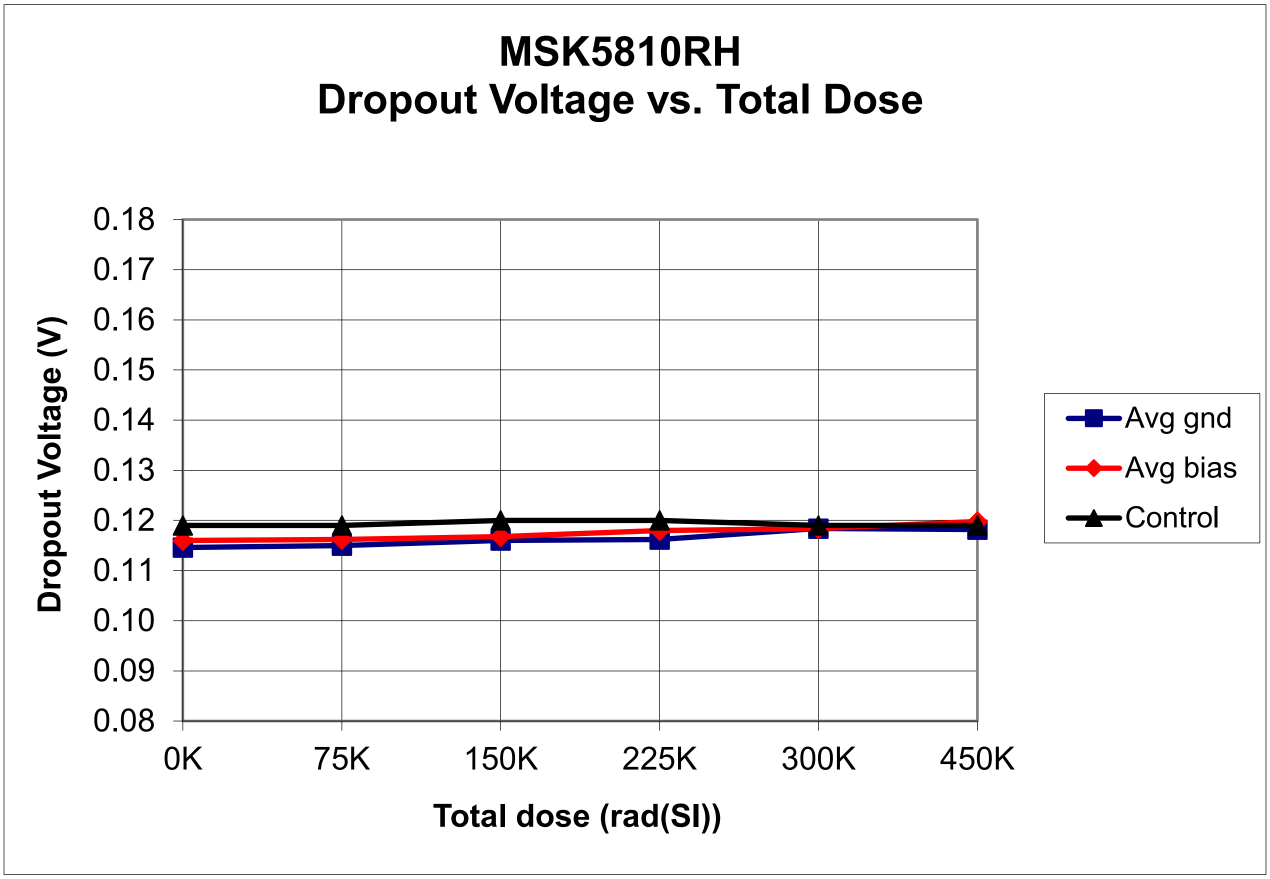

MSK5810RH
Load Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.30
1.29
1.28
1.27
1.26
1.25
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.50
1.45
1.40
1.35
1.30
1.25
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown hysteresis (V)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: March 26, 2009

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

M. Bilecki
P. Musil

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and the MSK5800RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 184 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. Maximum recommended operating voltage of +7.5V 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 MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID.

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
03/17/09

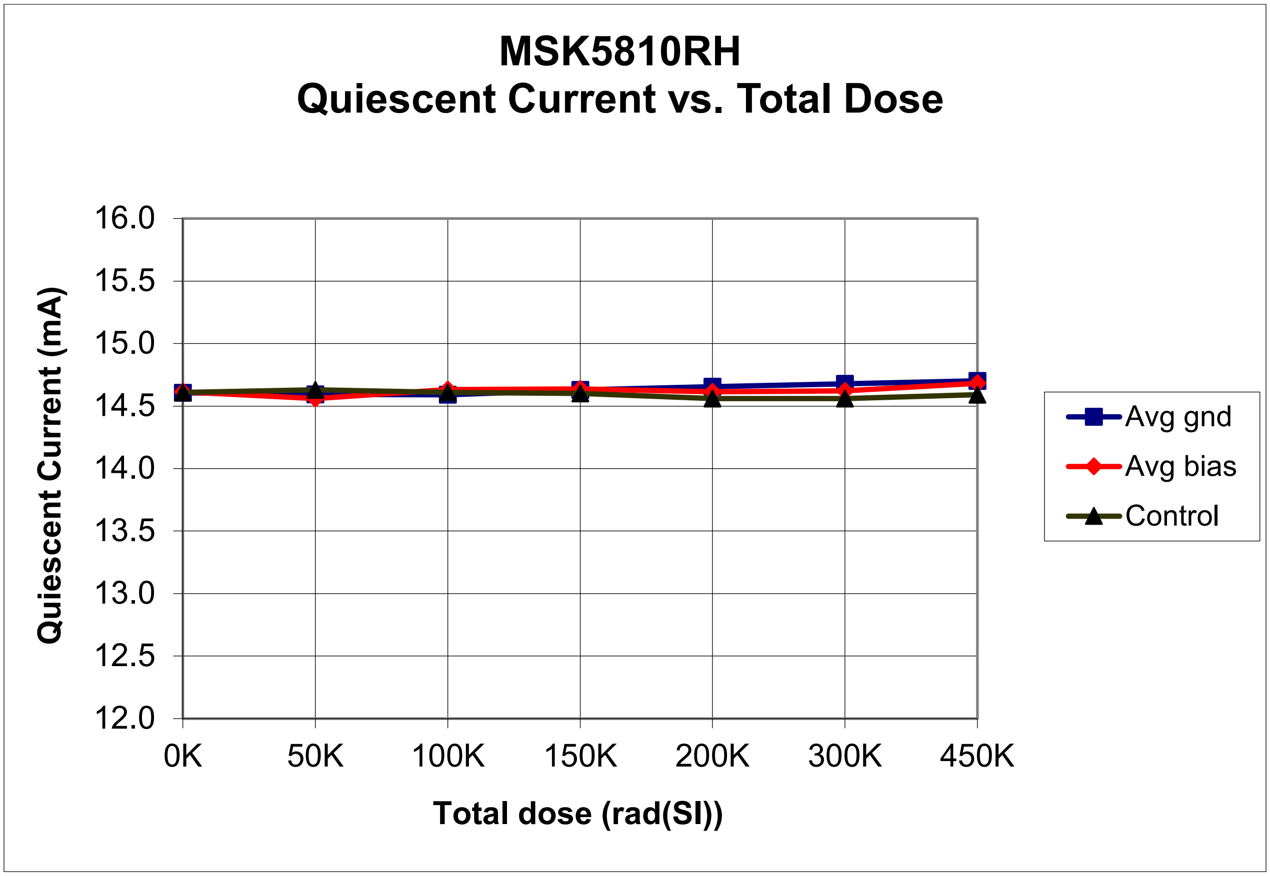
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
4:40	51,520	51,520
4:40	51,520	103,040
4:40	51,520	154,560
4:40	51,520	206,080
9:20	103,040	309,120
14:00	154,560	463,680

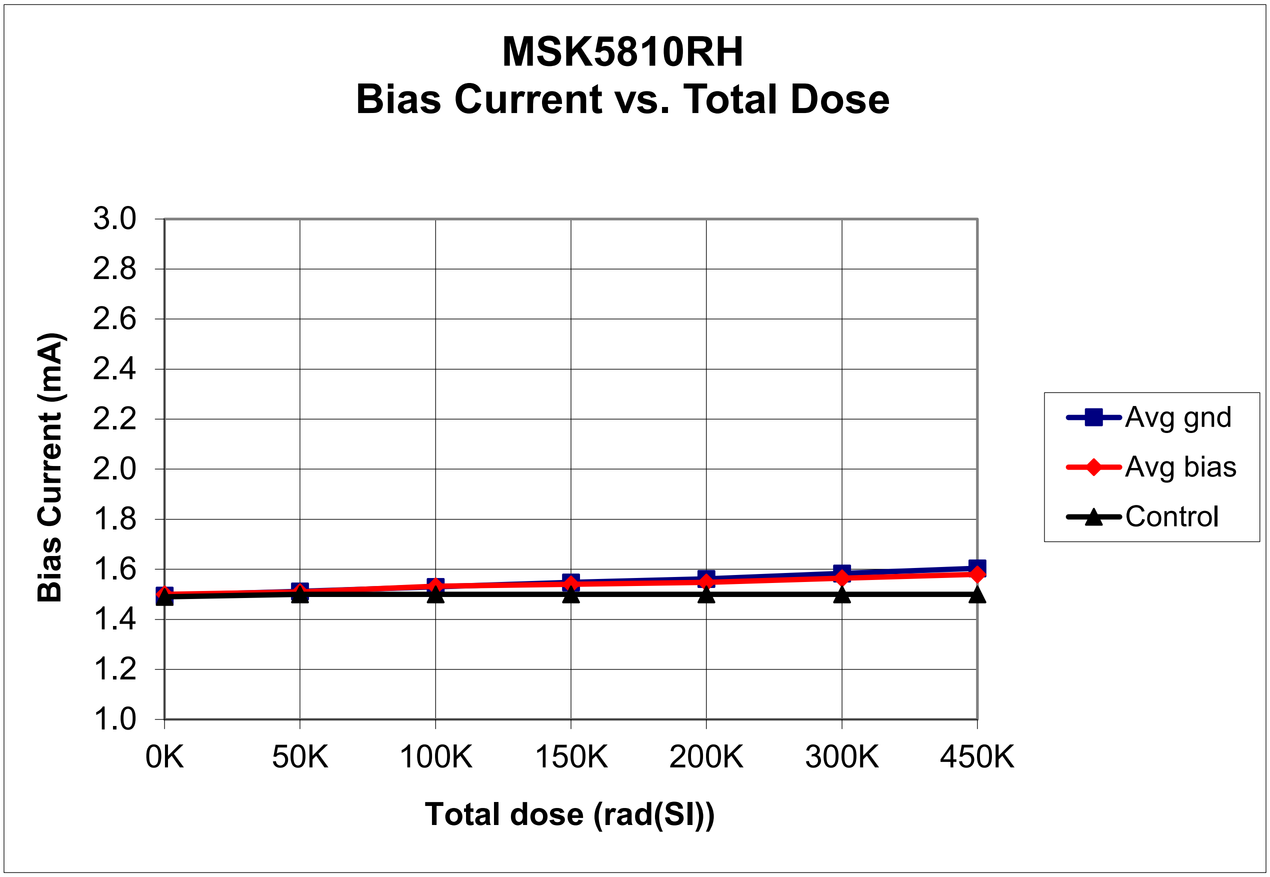
Biased S/N – 0054, 0055, 0056, 0057, 0058

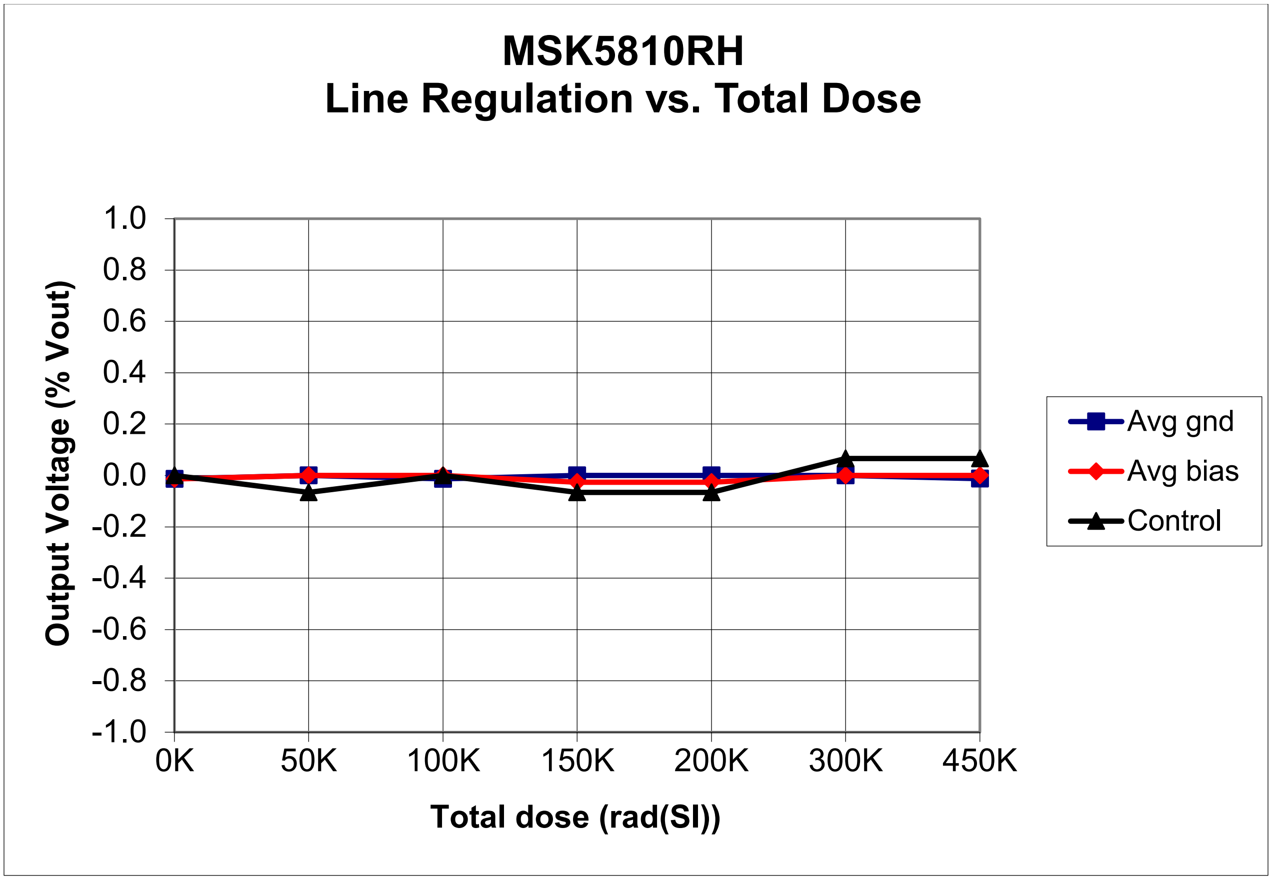
Unbiased S/N – 0059, 0060, 0061, 0062, 0063

Table 1

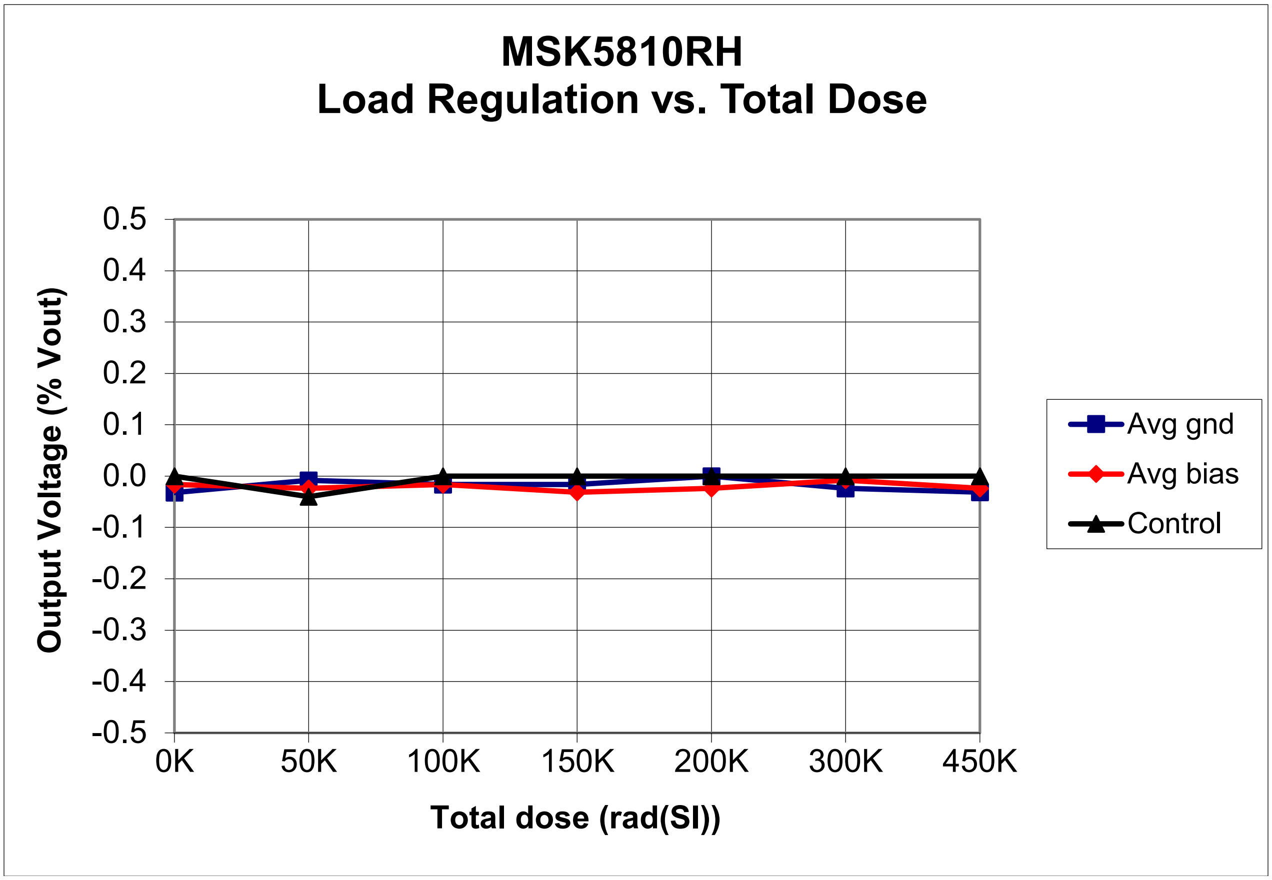
Dose Time, Incremental Dose and Total Cumulative Dose


MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
16.0
15.5
15.0
14.5
14.0
13.5
13.0
12.5
12.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

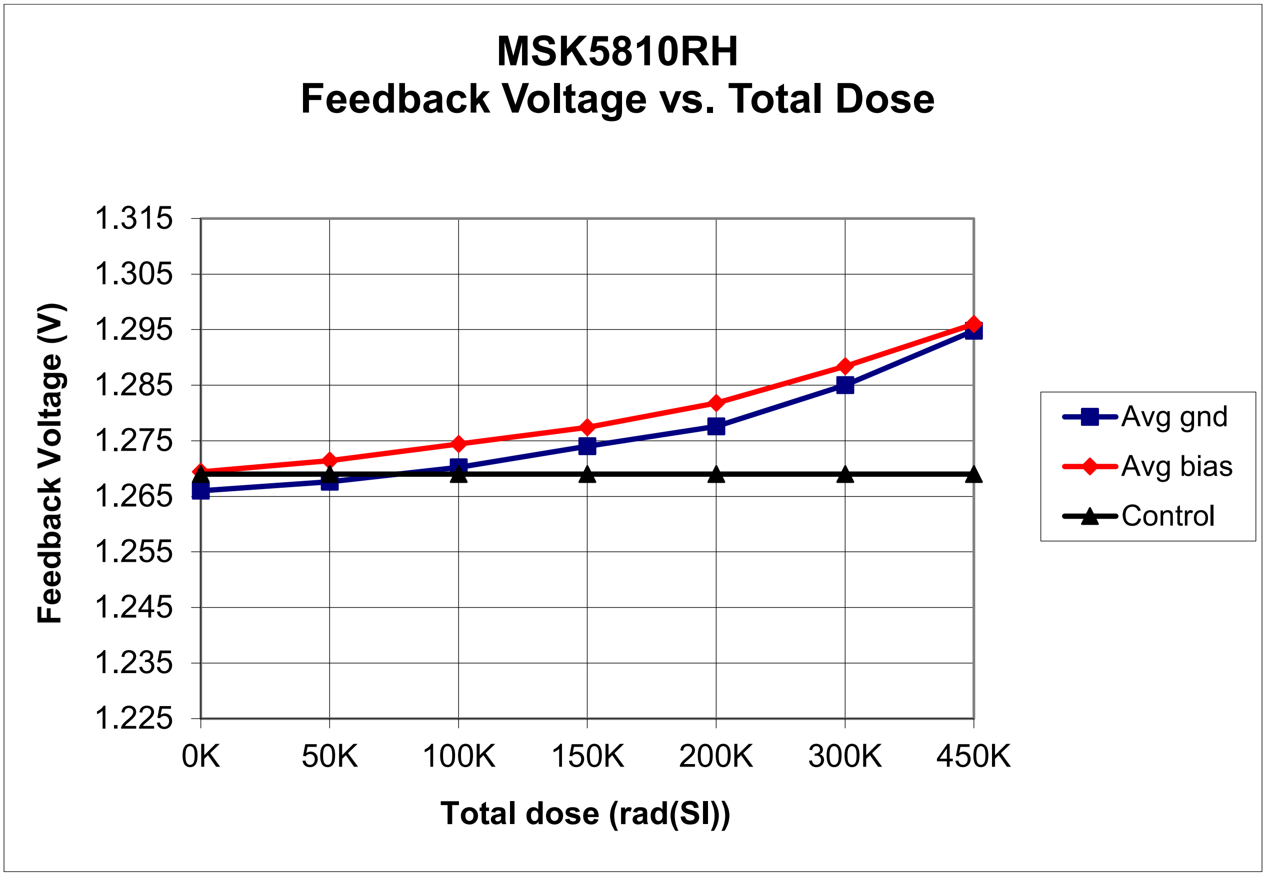

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

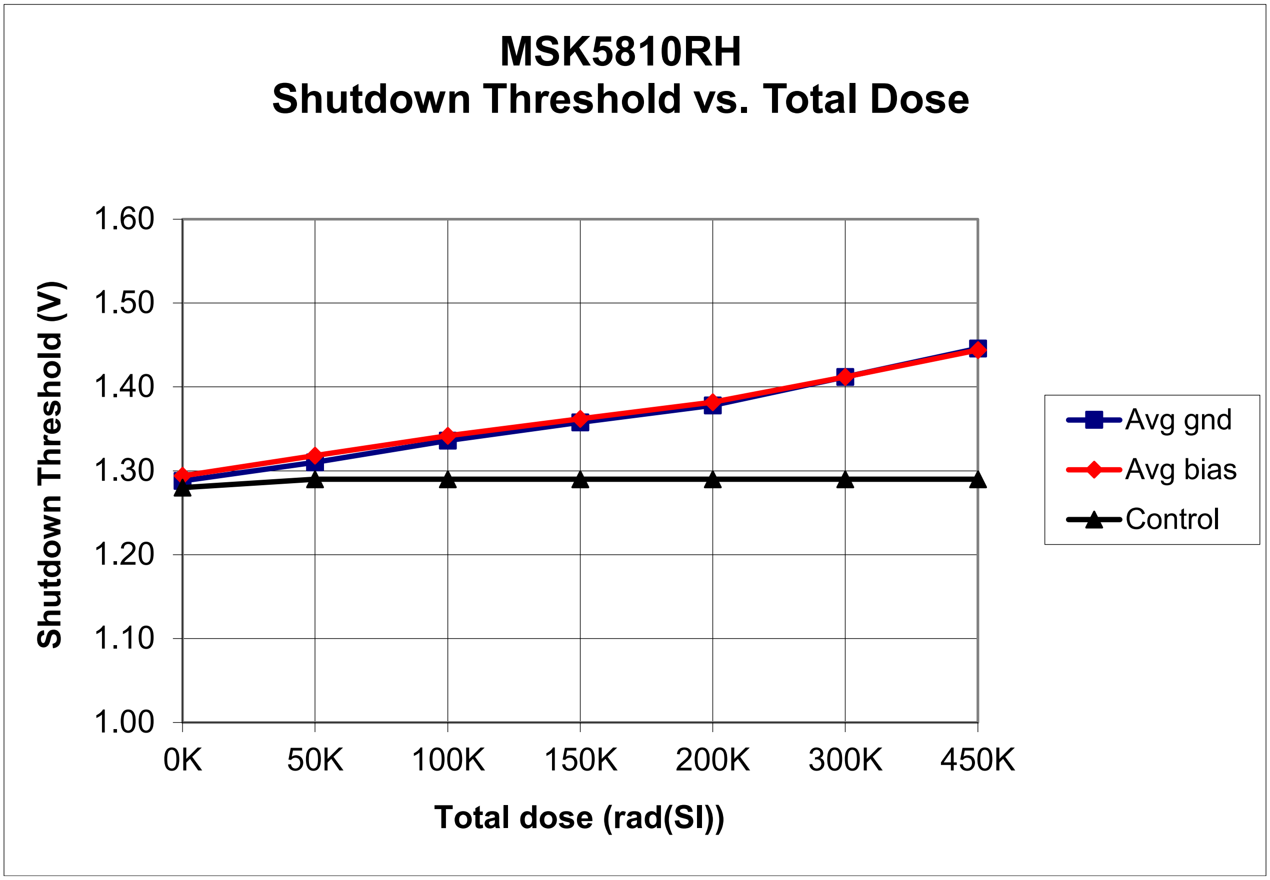


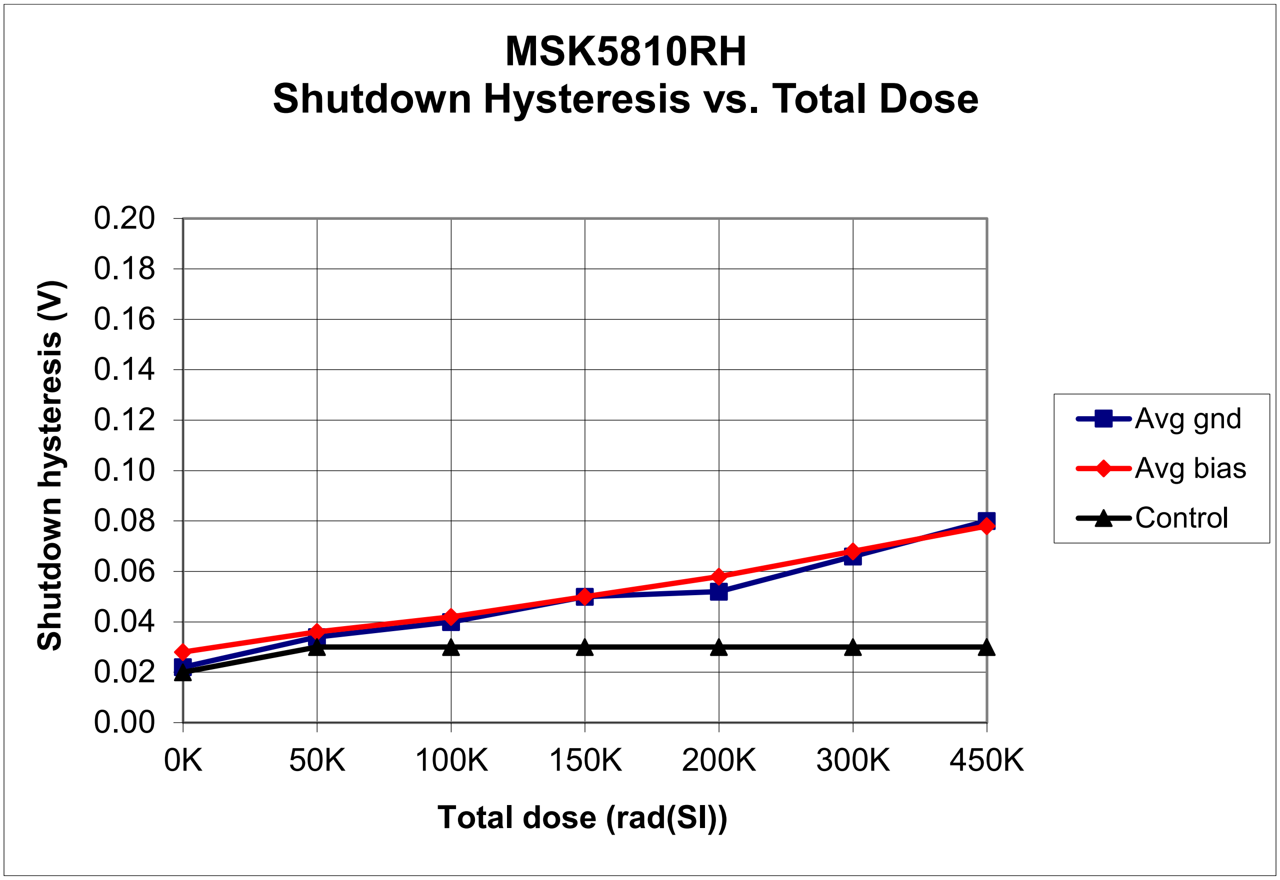
MSK5810RH
Line Regulation vs. Total Dose

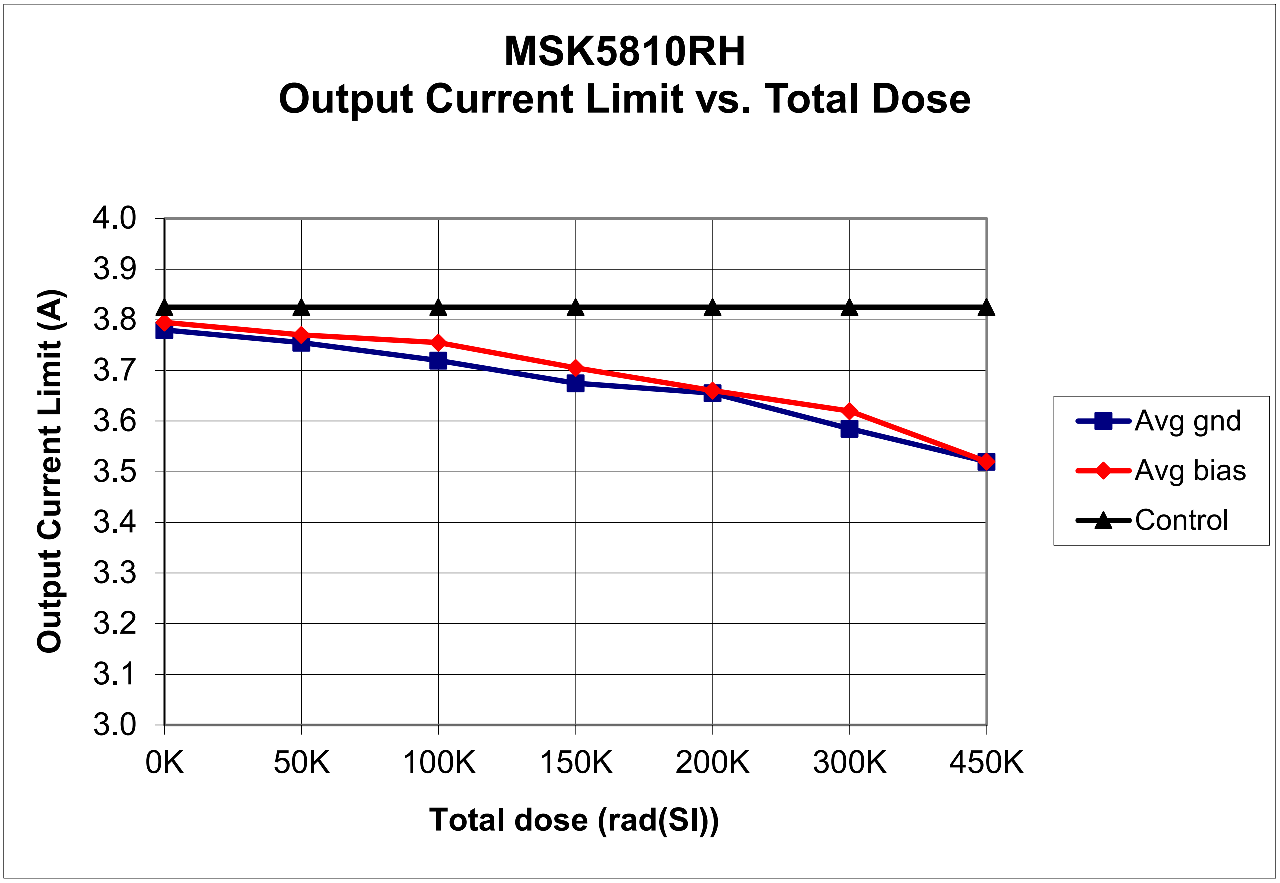


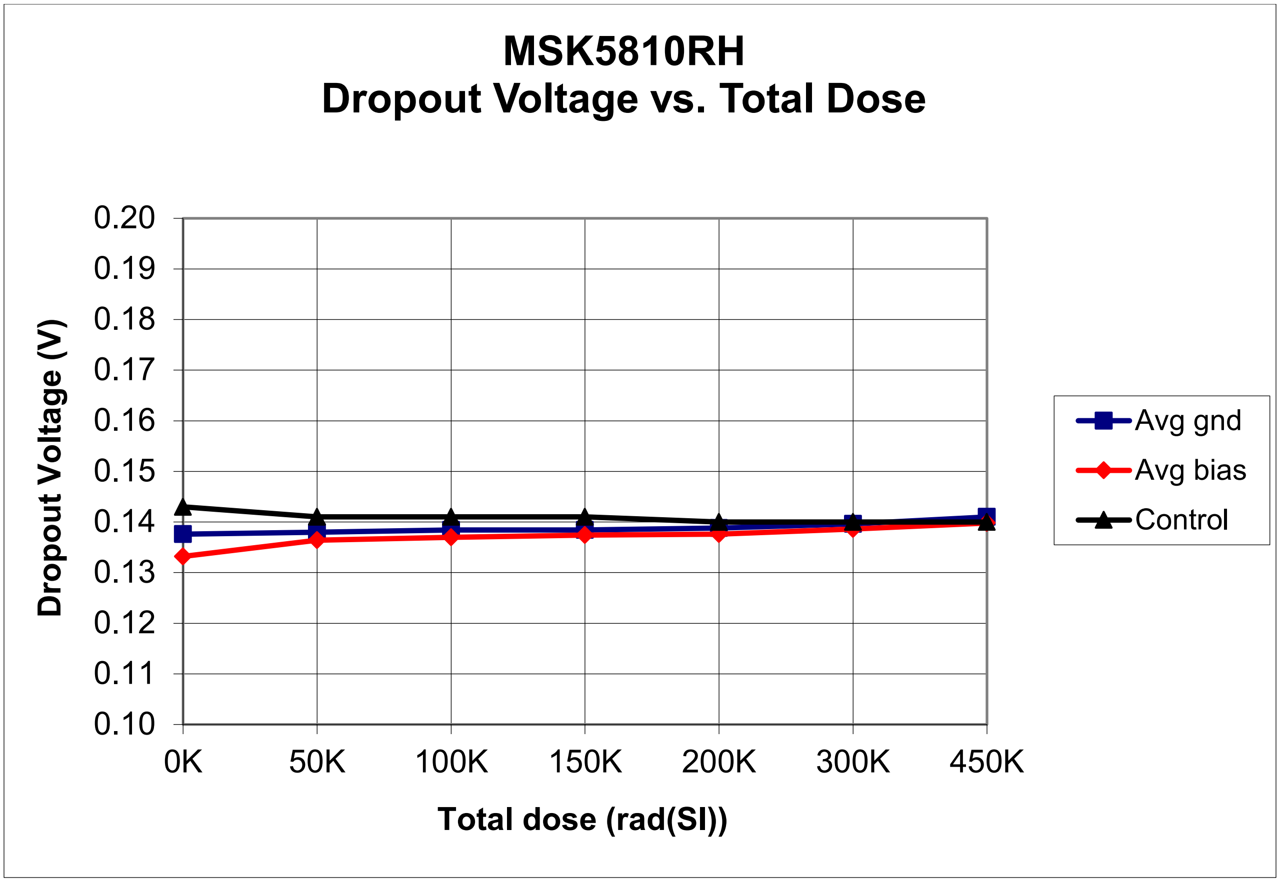
MSK5810RH
Load Regulation vs. Total Dose


MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.315
1.305
1.295
1.285
1.275
1.265
1.255
1.245
1.235
1.225
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown hysteresis (V)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5822RH

RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: March 21, 2009

Test Vehicle: MSK5822RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

J. Douglas
P. Musil

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5822 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 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 5822 RH.

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 179 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. Maximum recommended operating voltage of +7.5V 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, the MSK5822RH qualified as a 300 KRAD (Si) radiation hardened device. Output Voltage, Output Current Limit and Drop Out Voltage exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID.

MSK 5822RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
03/17/09

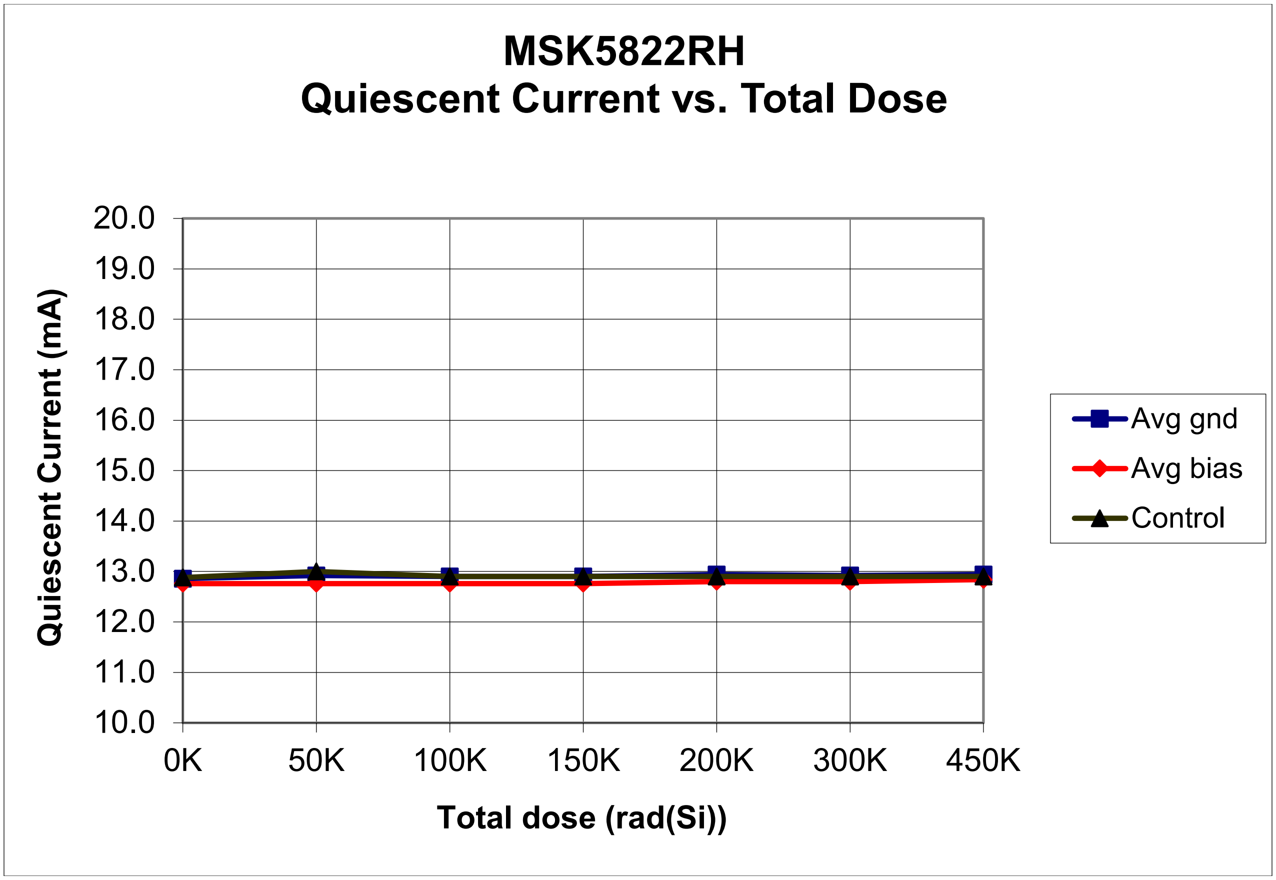
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
4:48	51,552	51,552
4:48	51,552	103,104
4:48	51,552	154,656
4:48	51,552	206,208
9:36	103,104	309,312
14:22	154,298	463,610

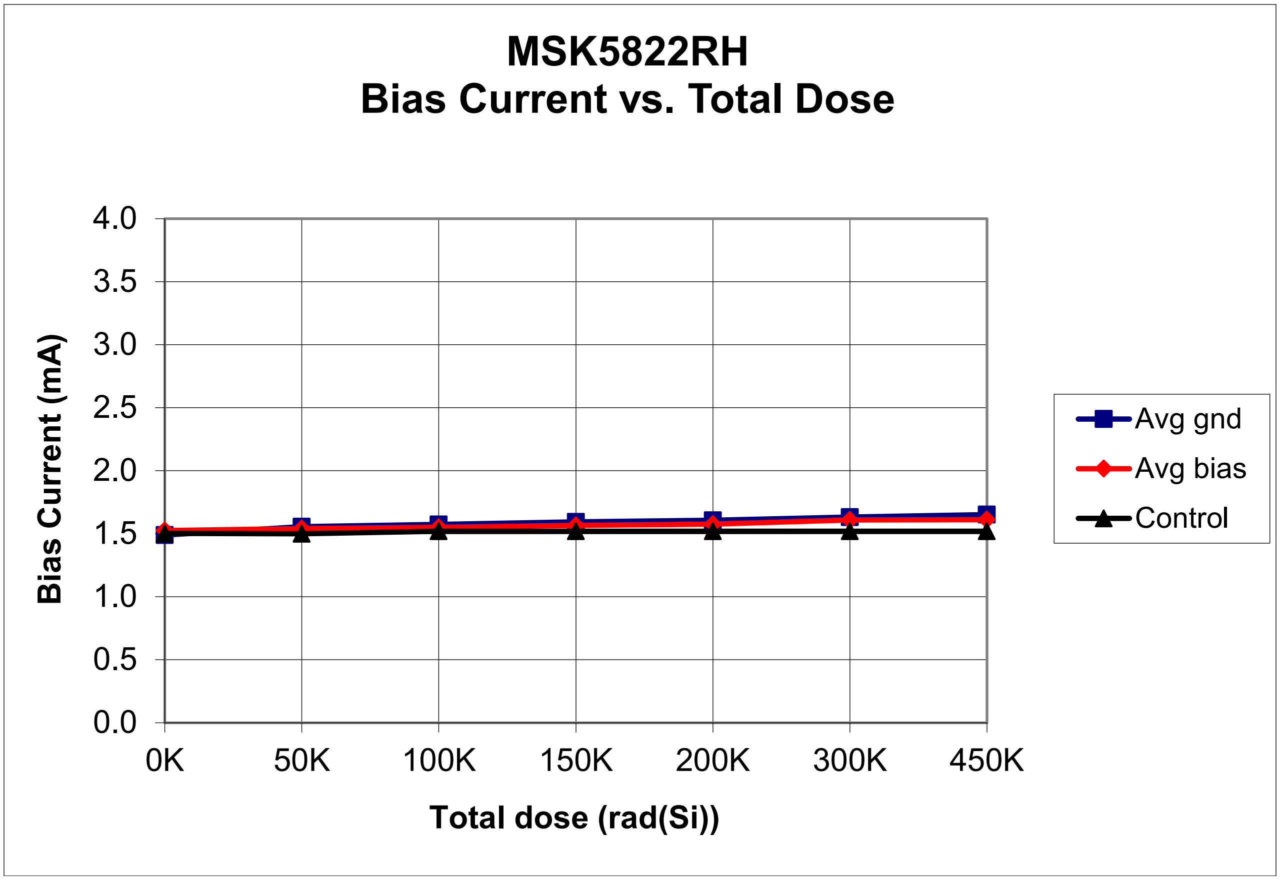
Biased S/N – 5874,5875,5876,5877,5878

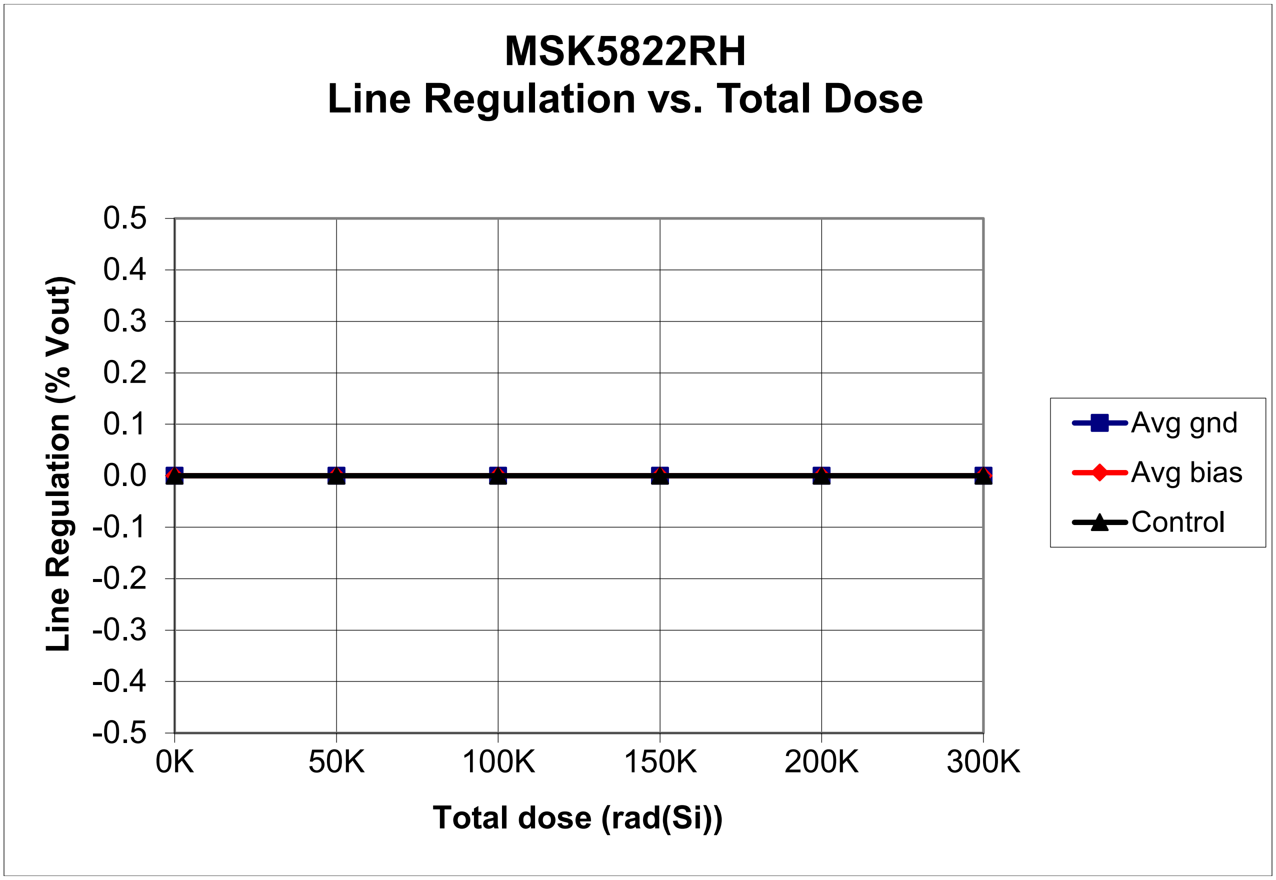
Unbiased S/N – 5879,5880,5881,5883,5885

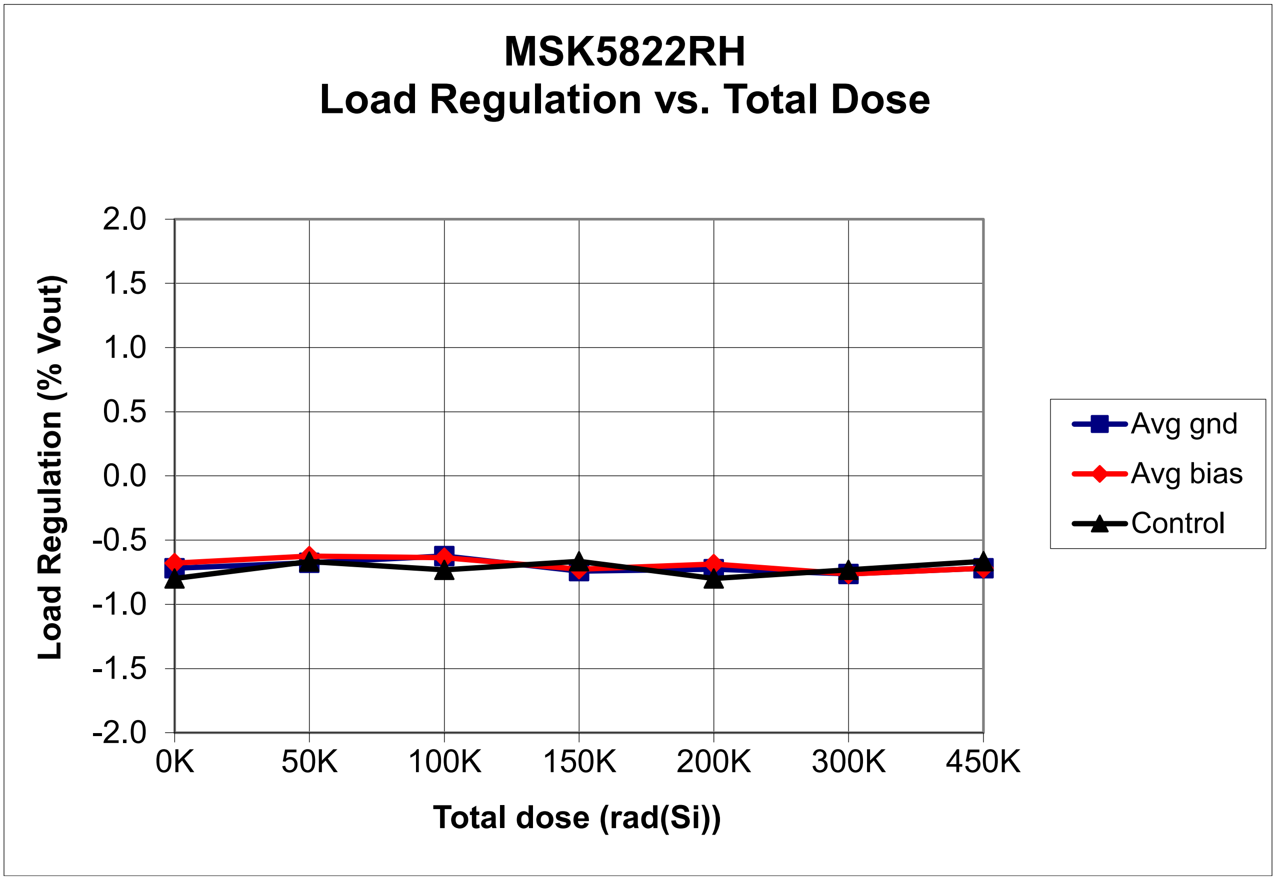
Table 1

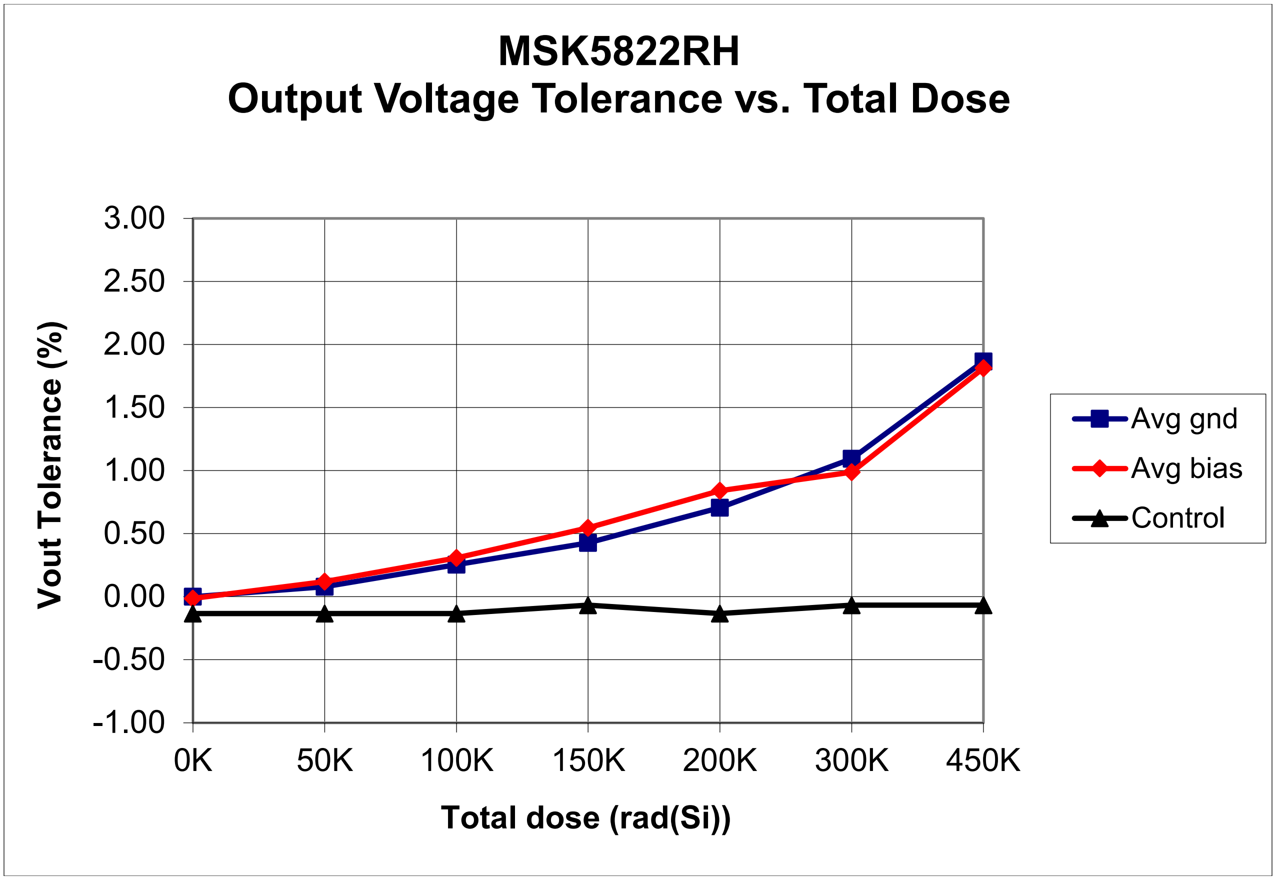
Dose Time, Incremental Dose and Total Cumulative Dose

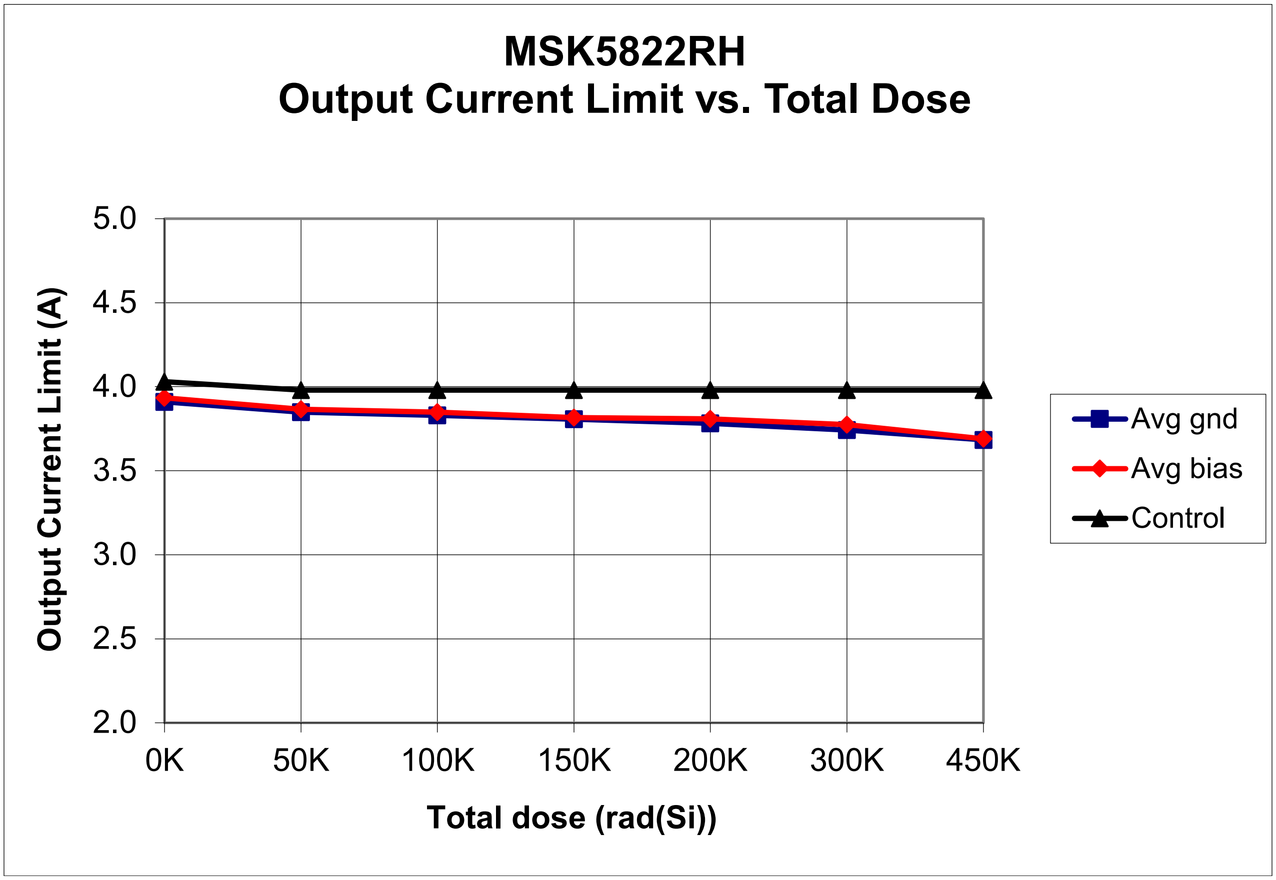

MSK5822RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

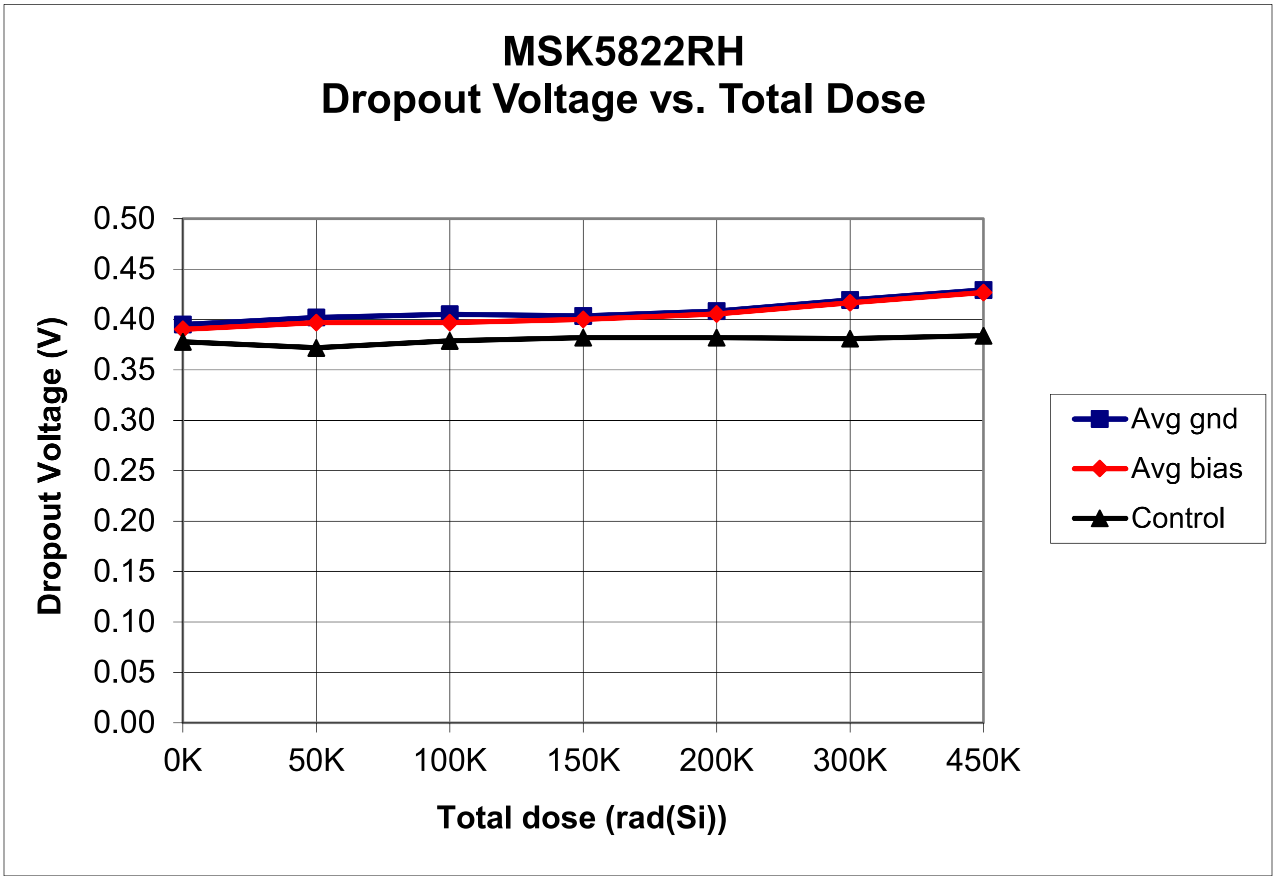

MSK5822RH
Bias Current vs. Total Dose
Bias Current (mA)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5822RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
50K
100K
150K
200K
300K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5822RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5822RH
Output Voltage Tolerance vs. Total Dose
Vout Tolerance (%)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5822RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5822RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(Si))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: September 3, 2009

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

M. Bilecki
B. Erwin

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK 5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 172 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. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID.

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
09/03/09

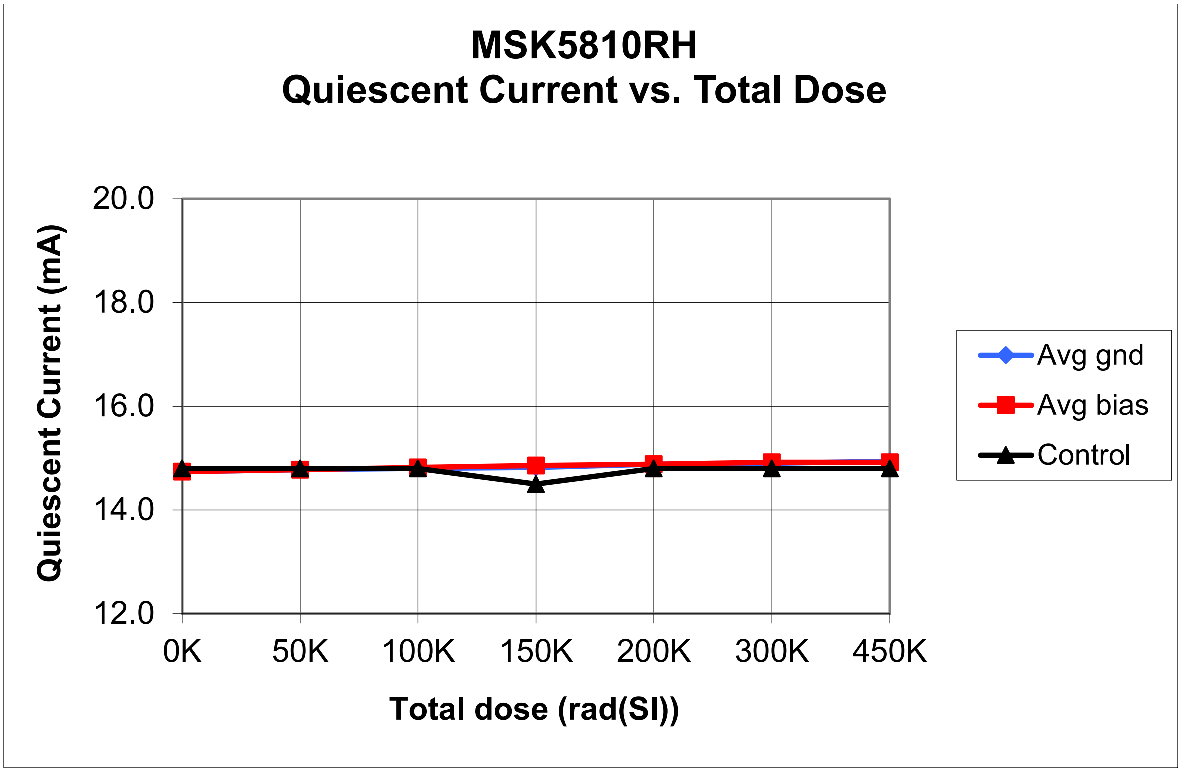
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
5:00	51,600	51,600
5:00	51,600	103,200
5:00	51,600	154,800
5:00	51,600	206,400
9:59	103,028	309,428
14:58	154,456	463,884

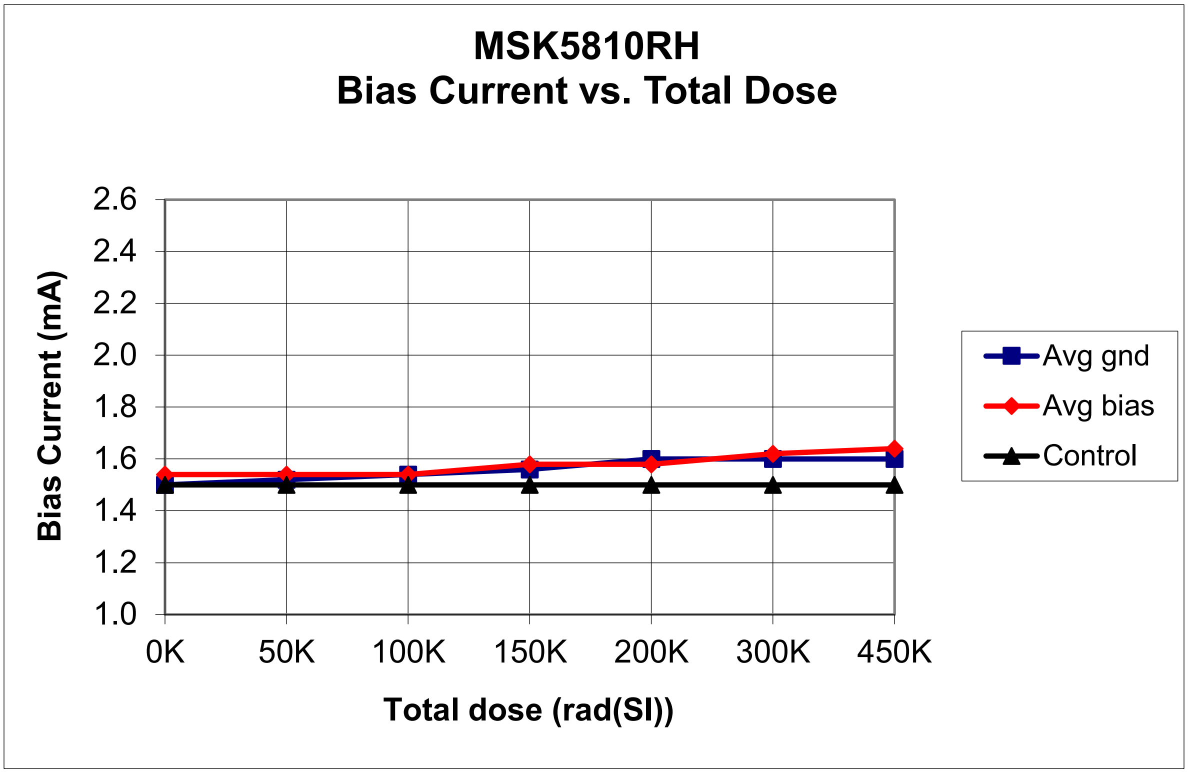
Biased S/N – 0276, 0277, 0278, 0279, 0280

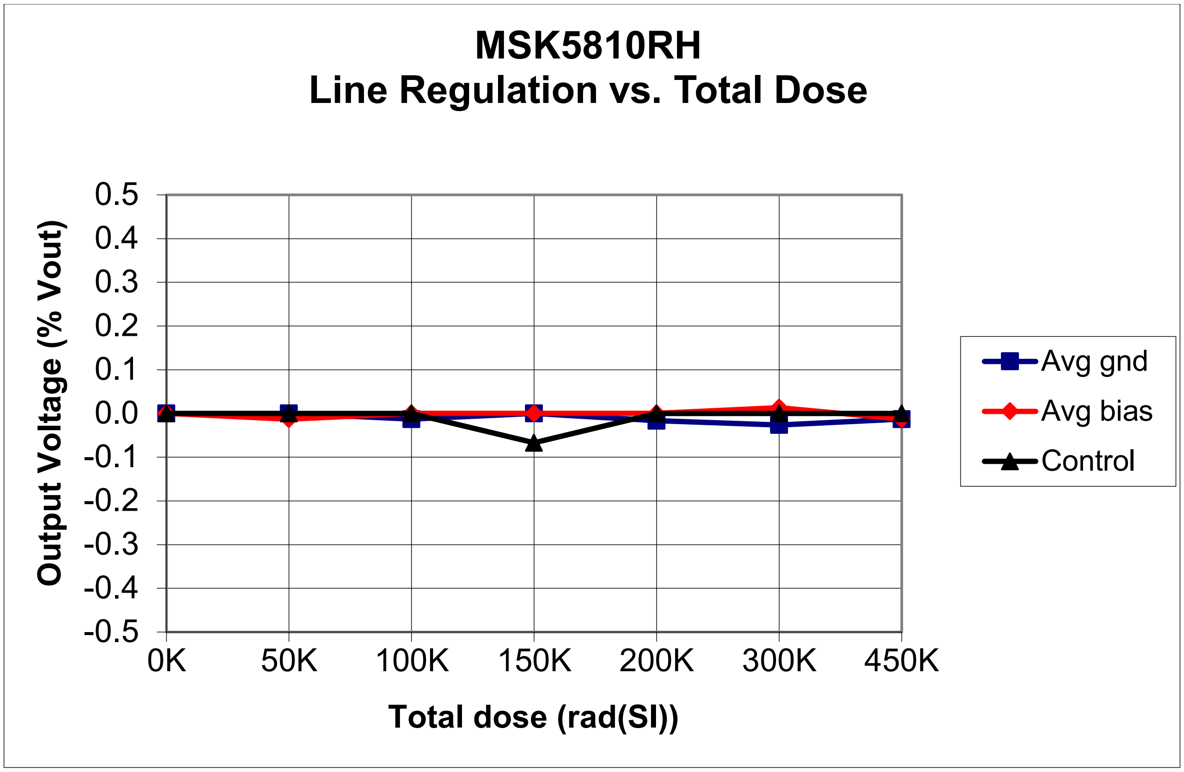
Unbiased S/N – 0281, 0282, 0283, 0284, 0285

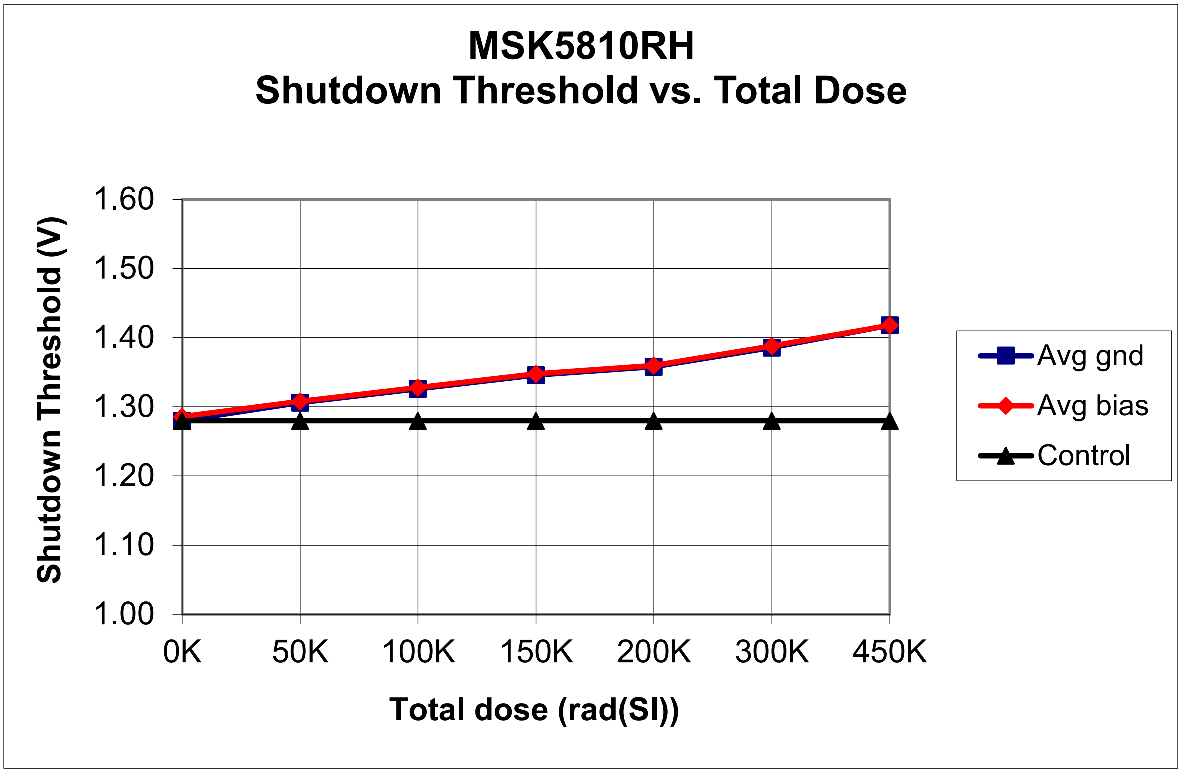
Table 1

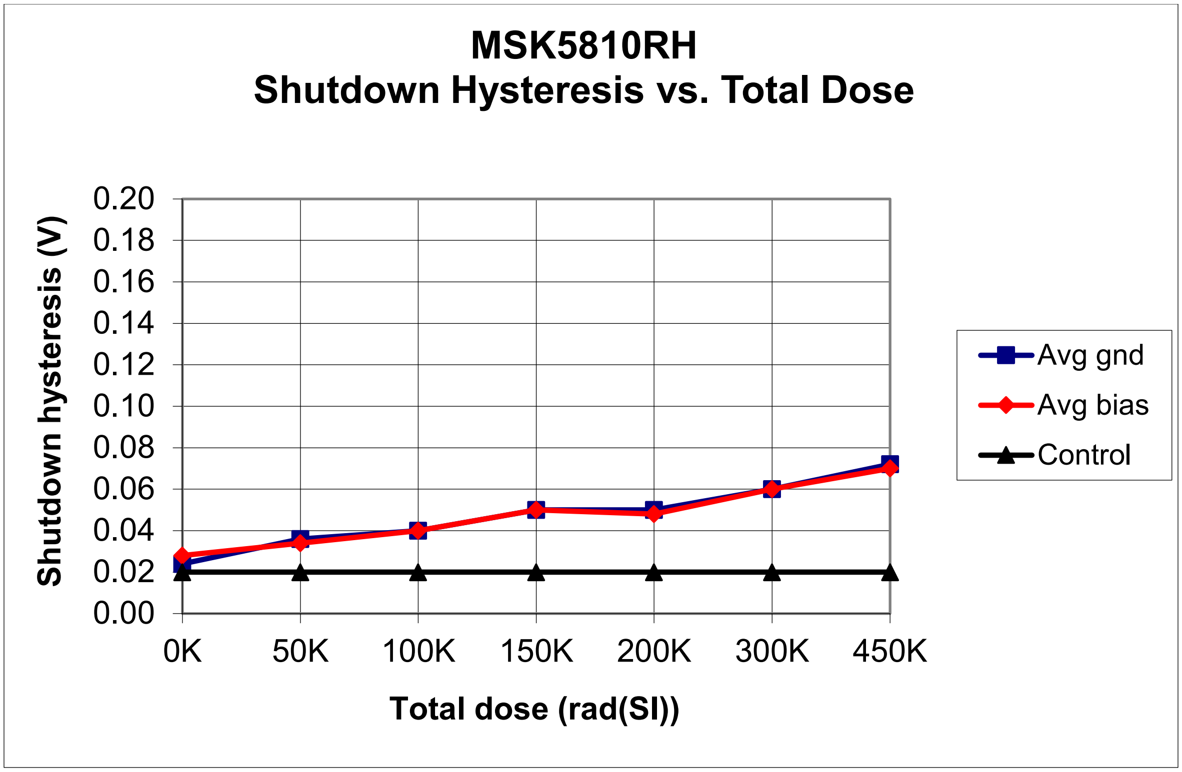
Dose Time, Incremental Dose and Total Cumulative Dose

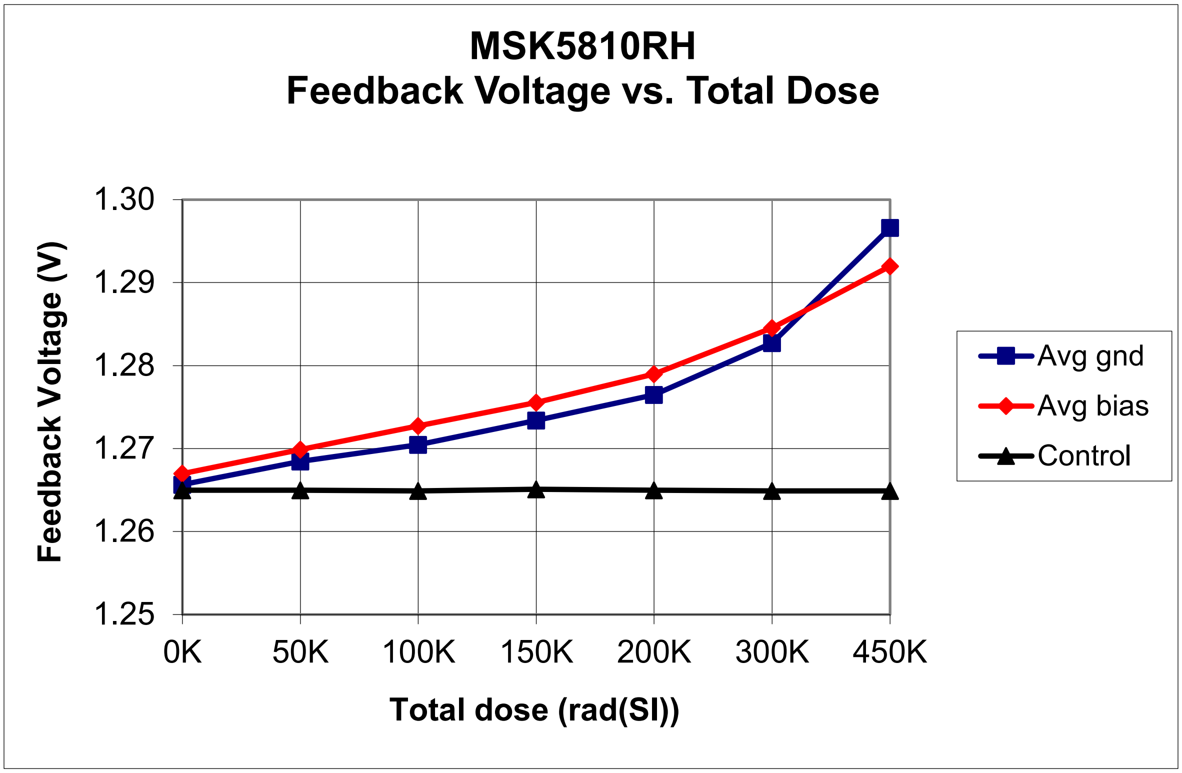

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

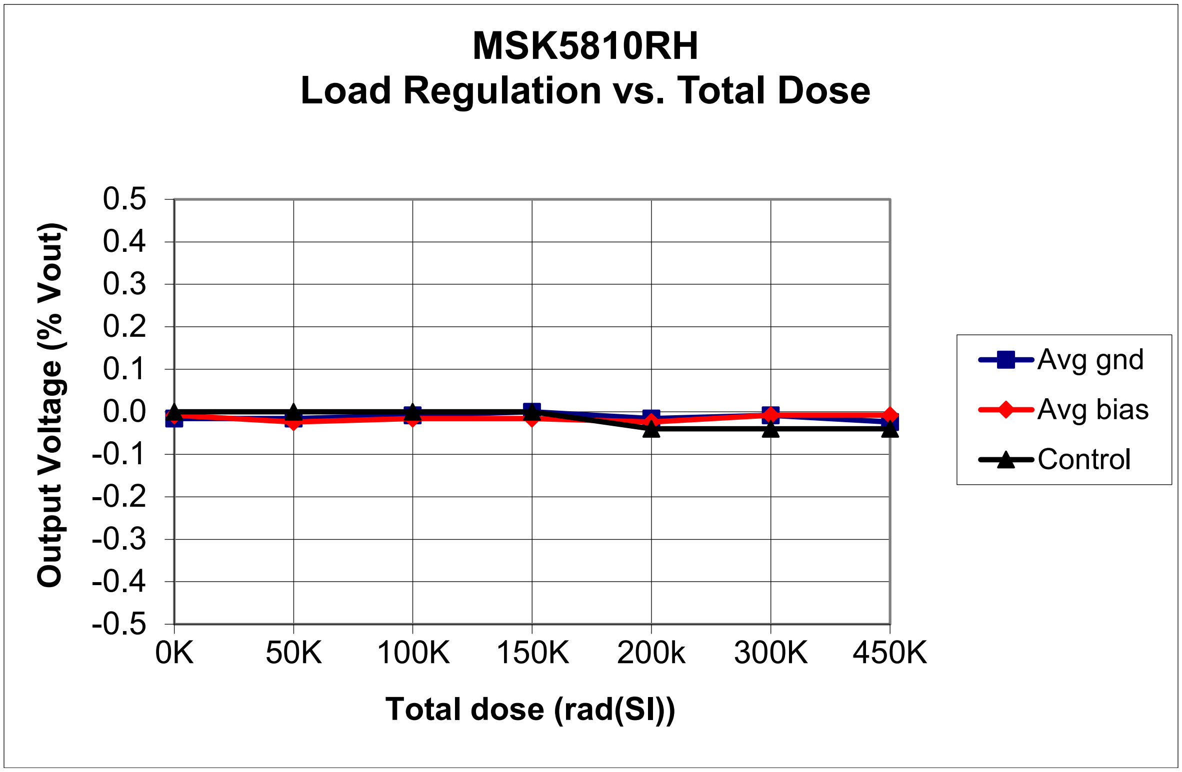

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

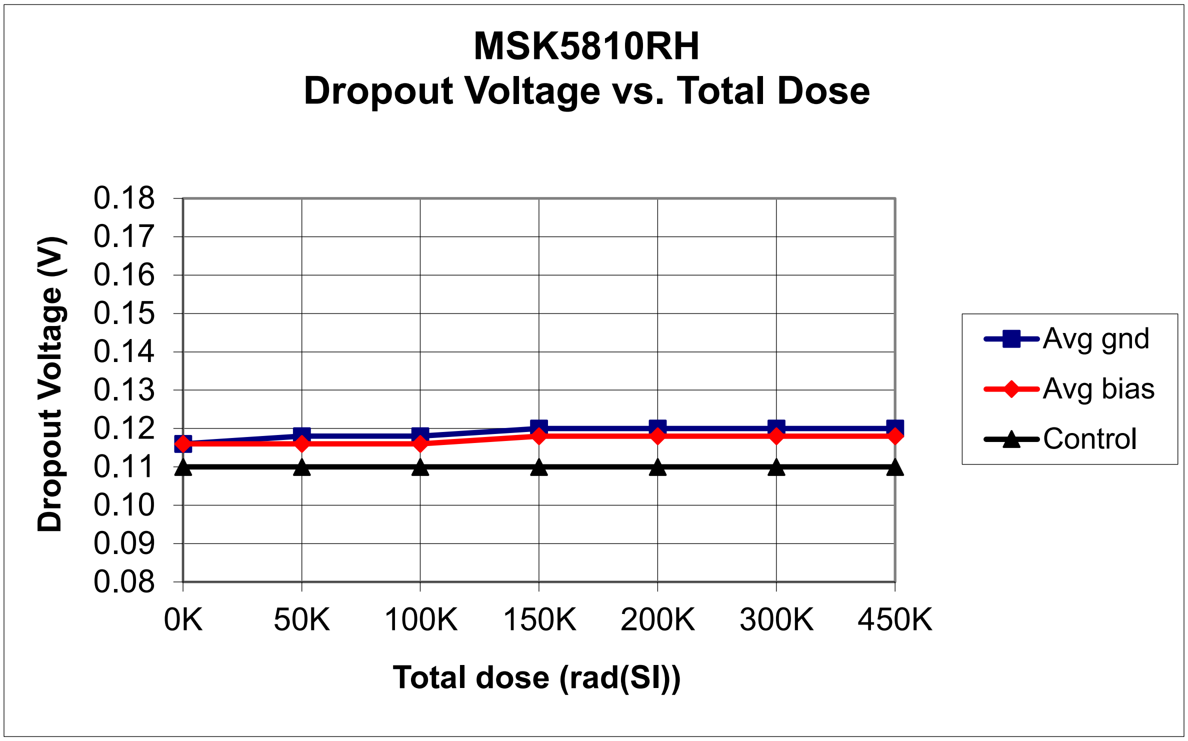

MSK5810RH
Line Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

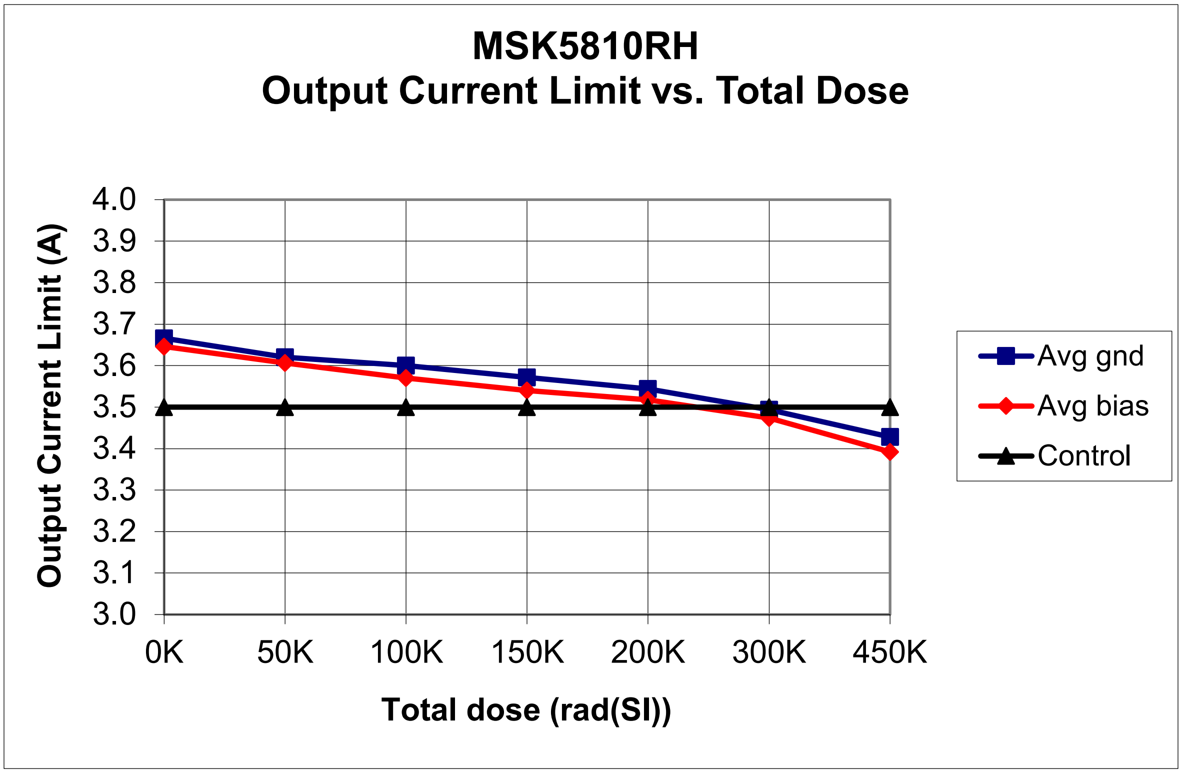

MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown hysteresis (V)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.30
1.29
1.28
1.27
1.26
1.25
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Load Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
50K
100K
150K
200k
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: November 6, 2009

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

M. Bilecki
B. Erwin

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 156 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID.

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
11/06/09

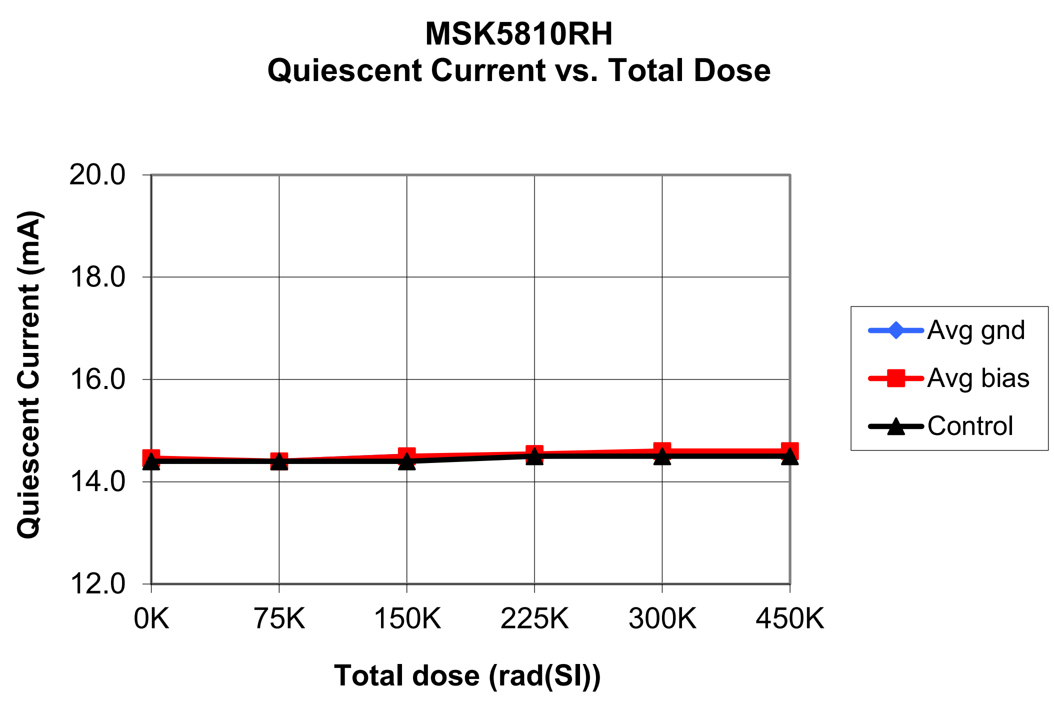
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
8:16	77,376	77,376
8:16	77,376	154,752
8:16	77,376	232,128
8:16	77,376	309,504
16:32	154,752	464,256

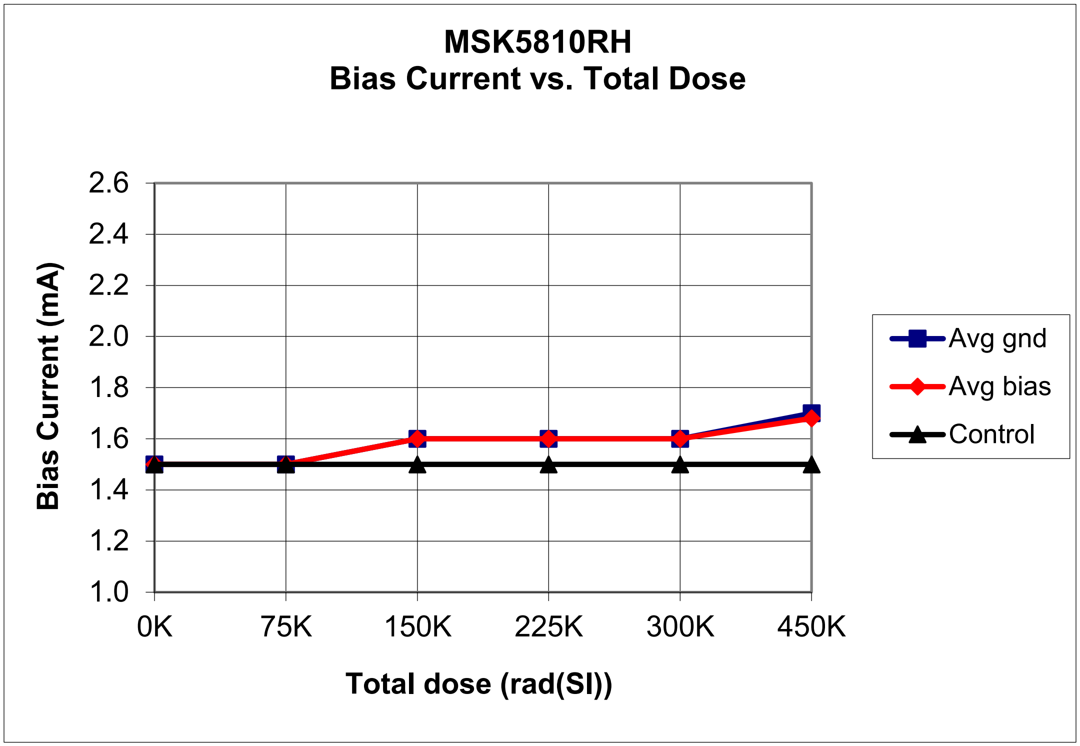
Biased S/N – 0315, 0316, 0317, 0318, 0319

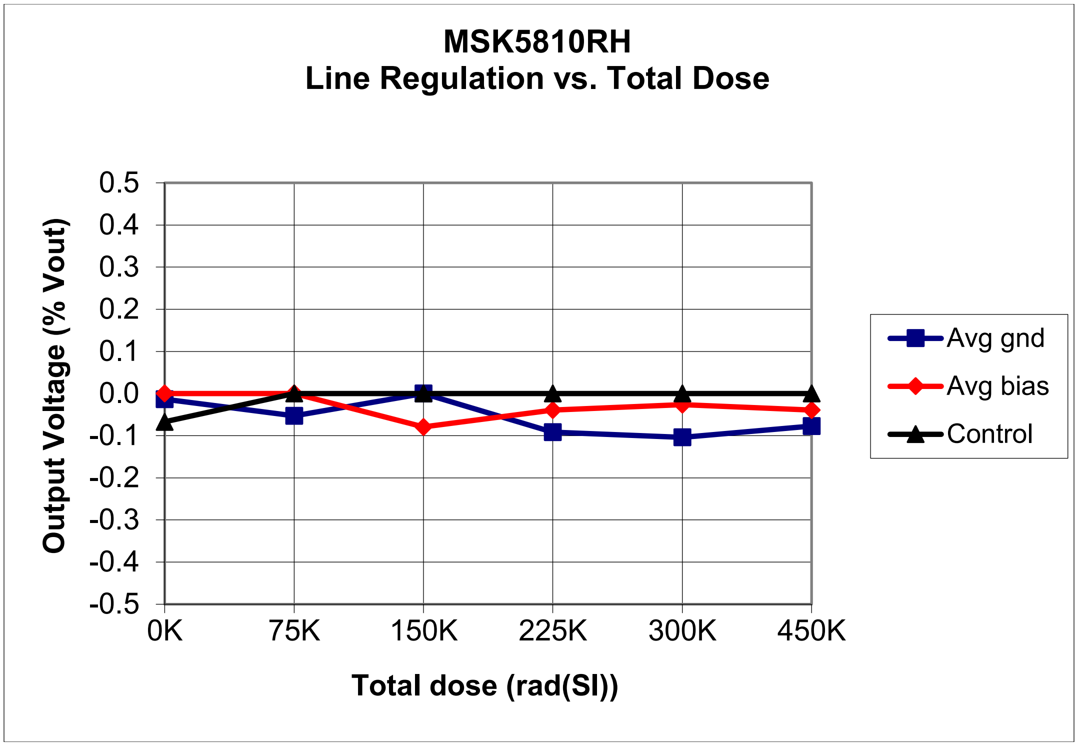
Unbiased S/N – 0320, 0321, 0322, 0324, 0325

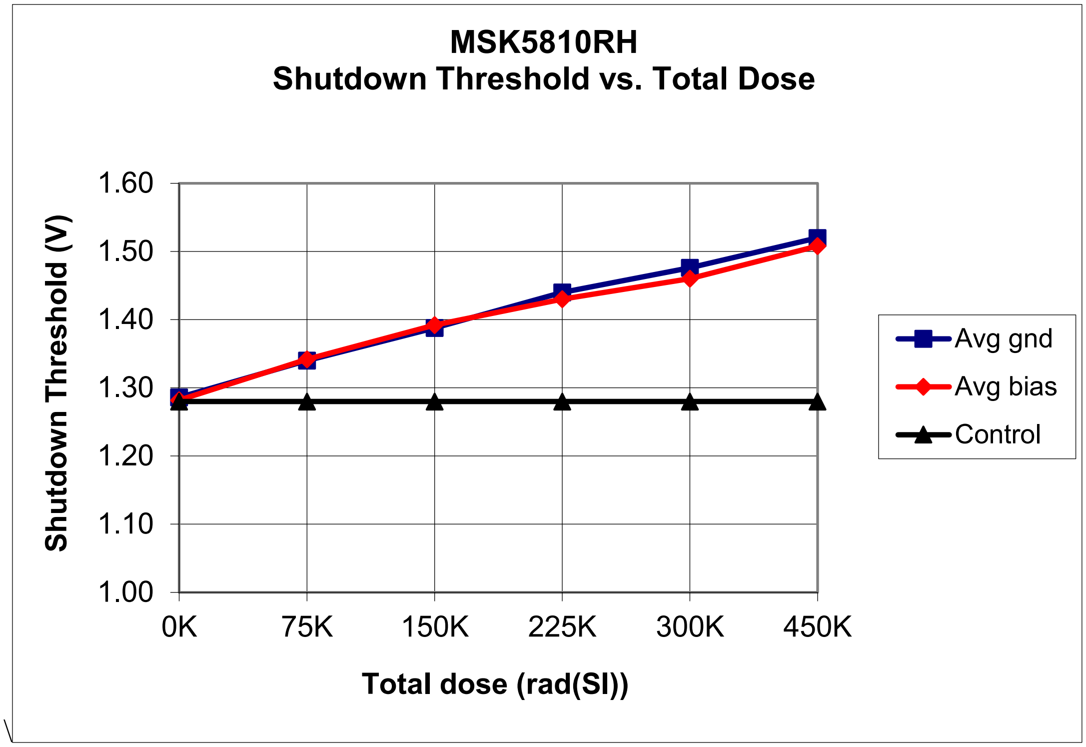
Table 1

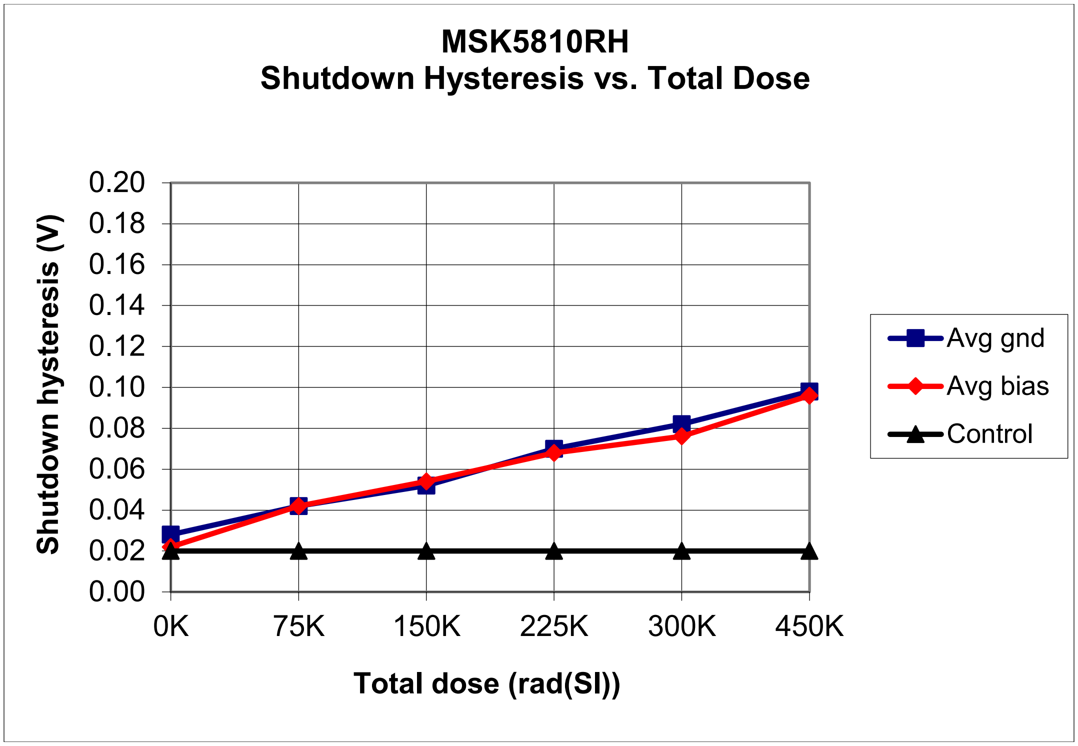
Dose Time, Incremental Dose and Total Cumulative Dose

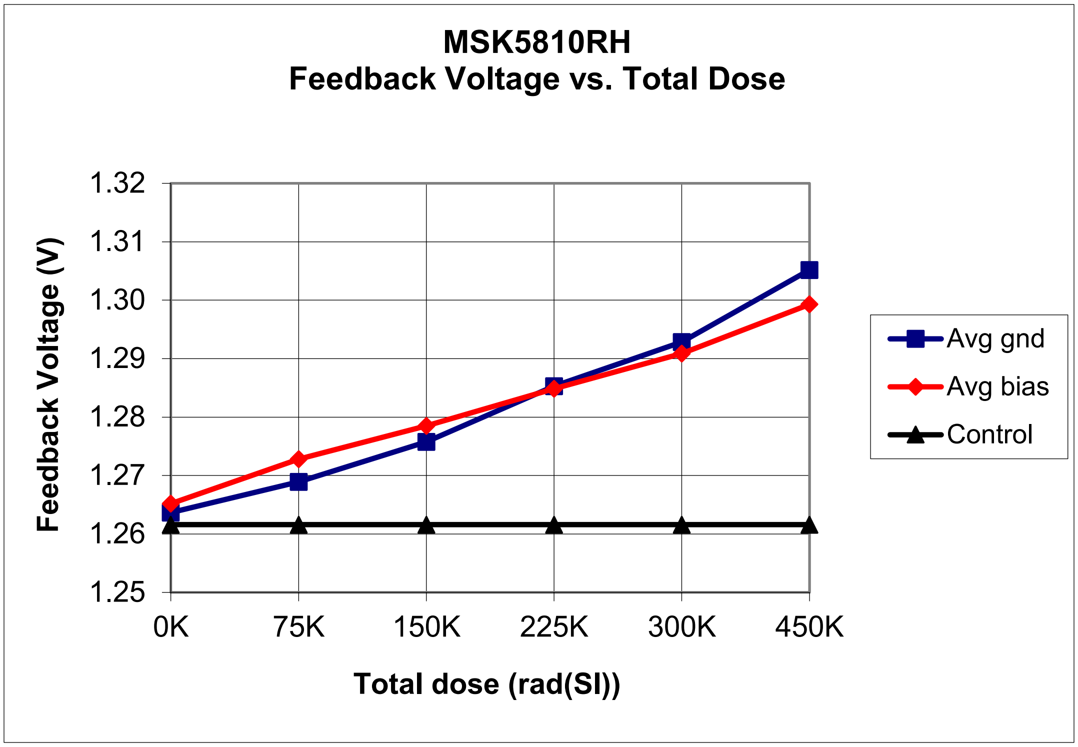

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

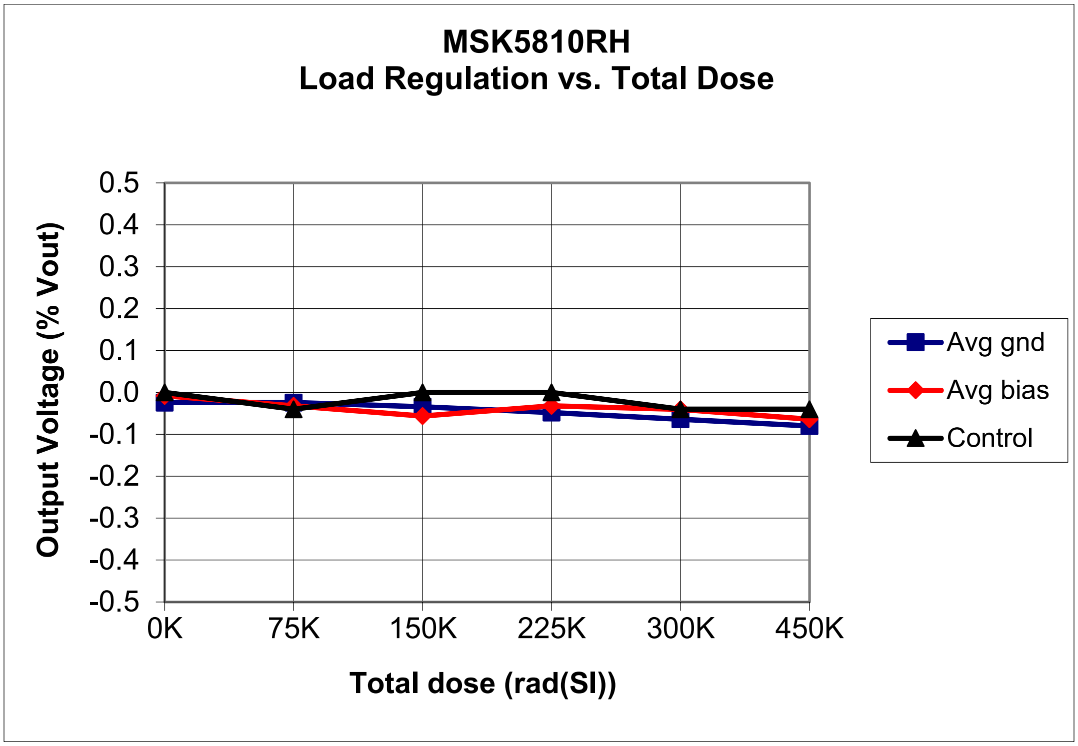

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

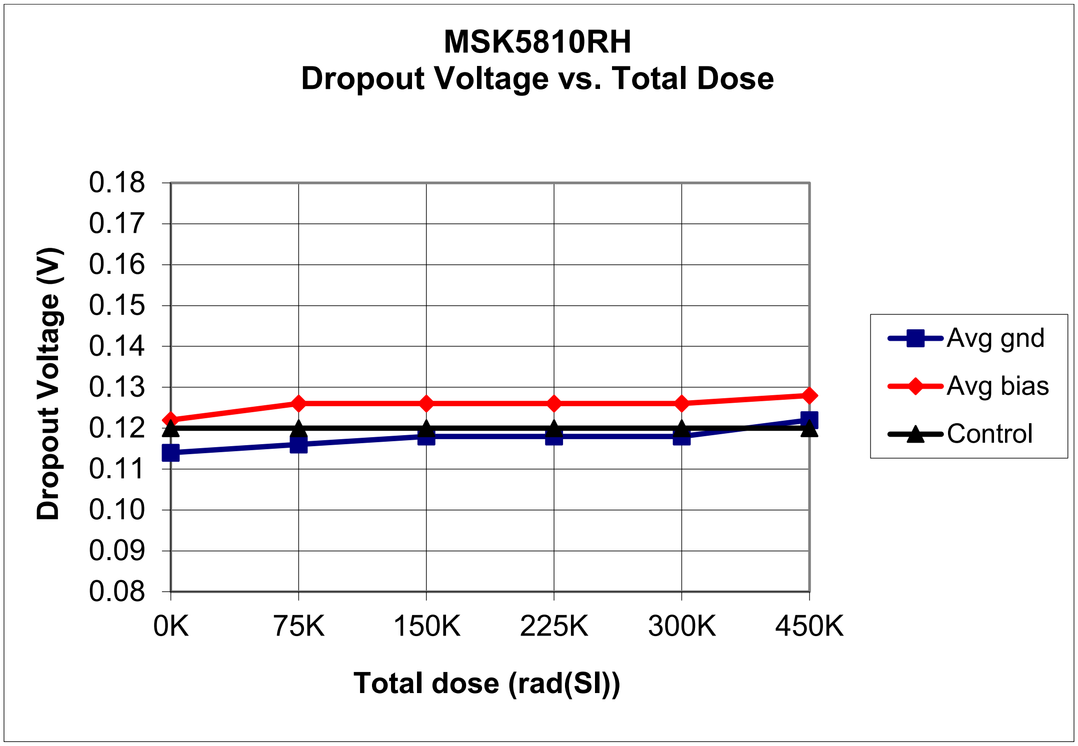

MSK5810RH
Line Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

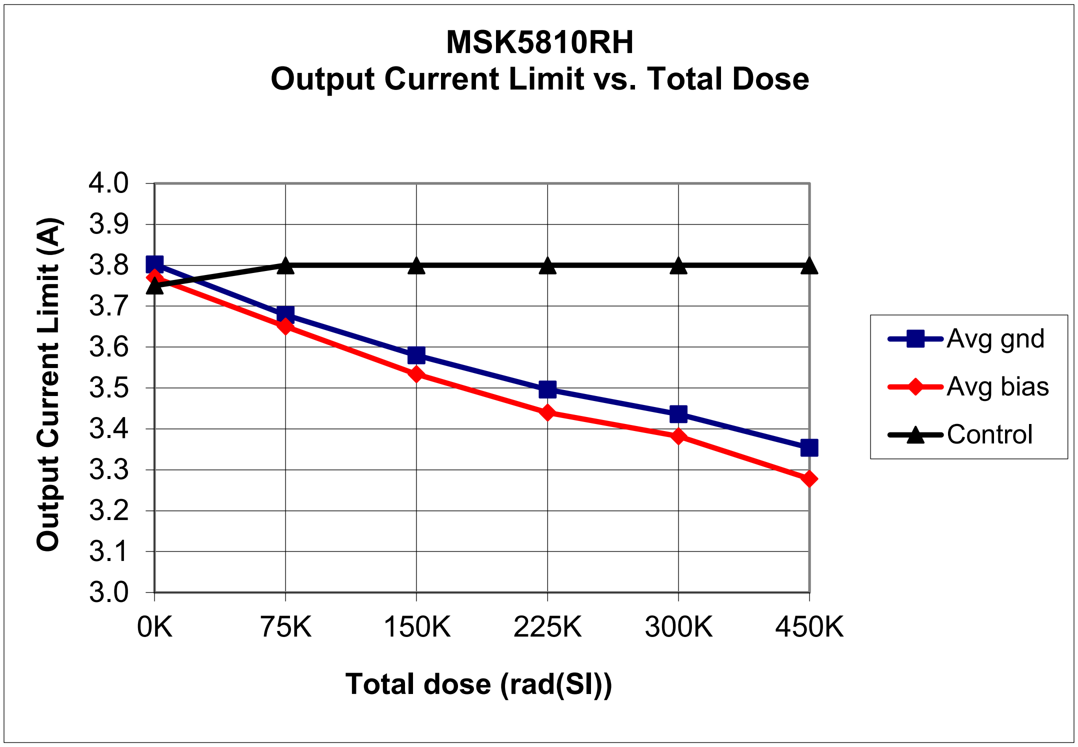

MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown hysteresis (V)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.31
1.30
1.29
1.28
1.27
1.26
1.25
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Load Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
0K
75K
150K
225K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: May 14, 2010

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

M. Bilecki
B. Erwin

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 138 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID.

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
05/14/10

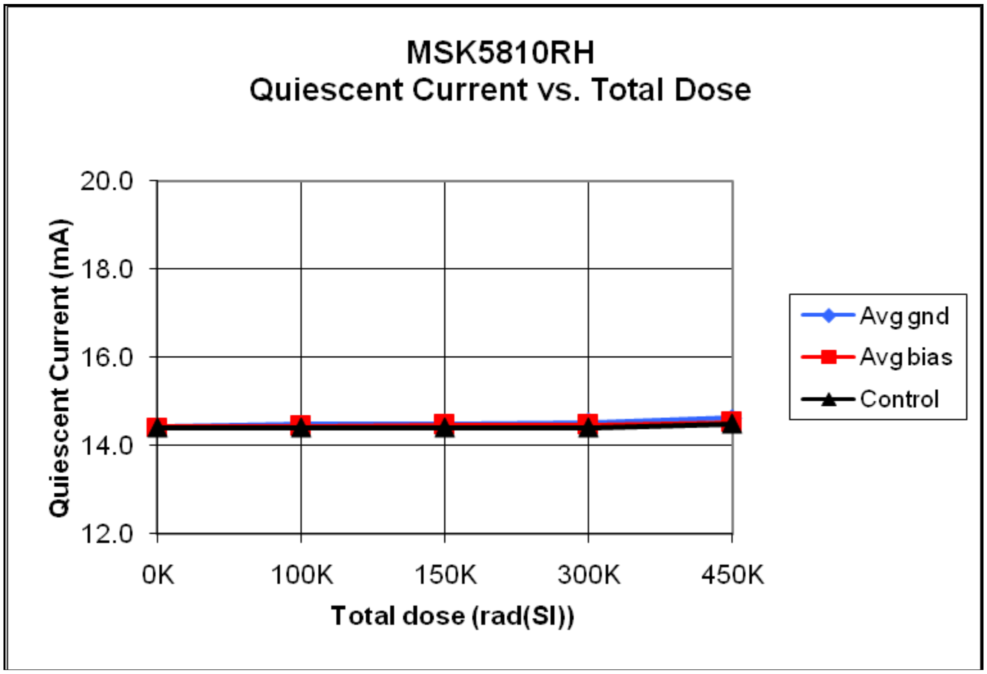
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
12:27	103,086	103,086
6:14	51,612	154,698
18:40	154,560	309,258
18:40	154,560	463,818

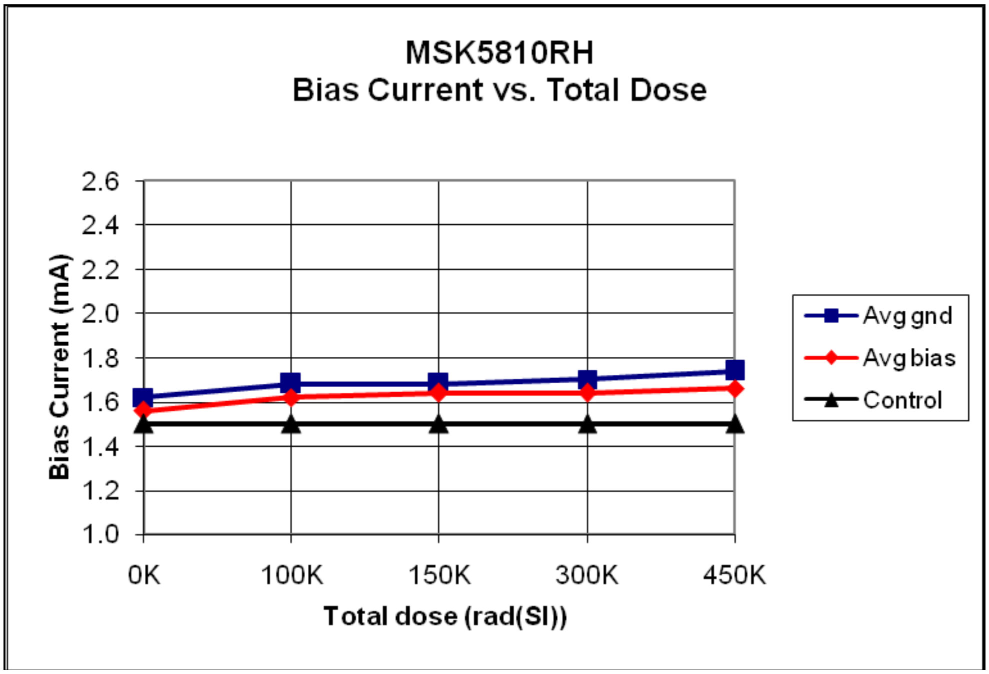
Biased S/N – 0360, 0361, 0362, 0363, 0364

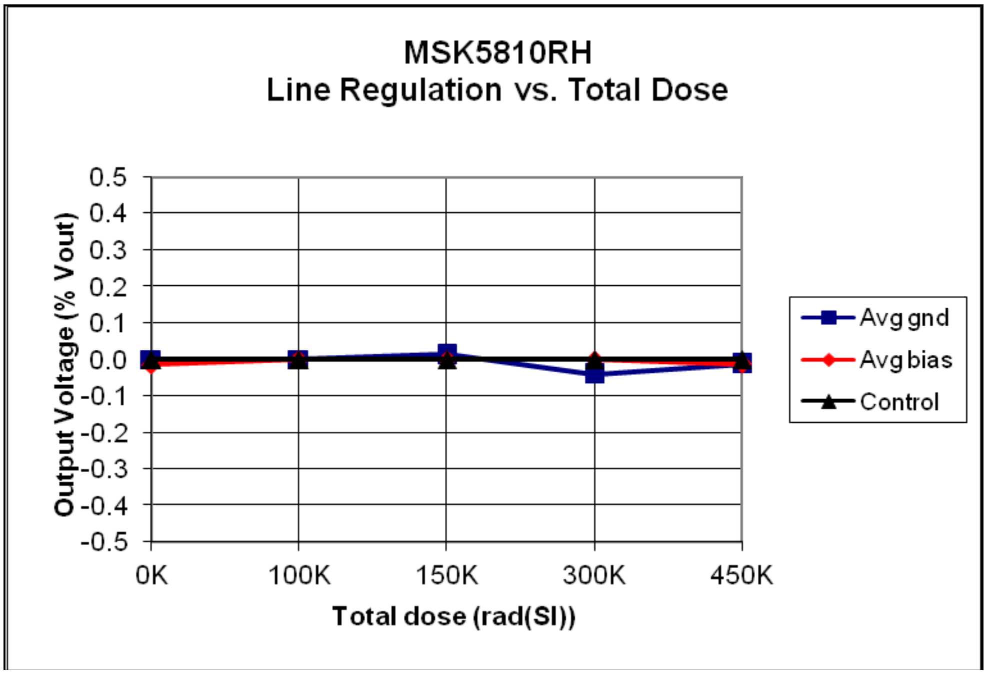
Unbiased S/N – 0365, 0366, 0367, 0368, 0369

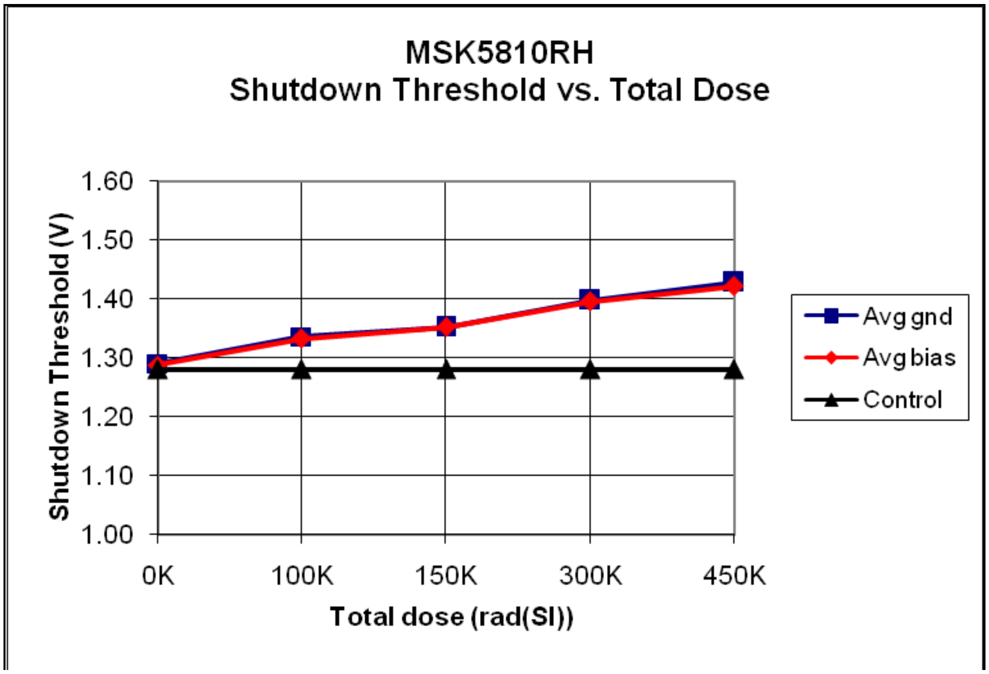
Table 1

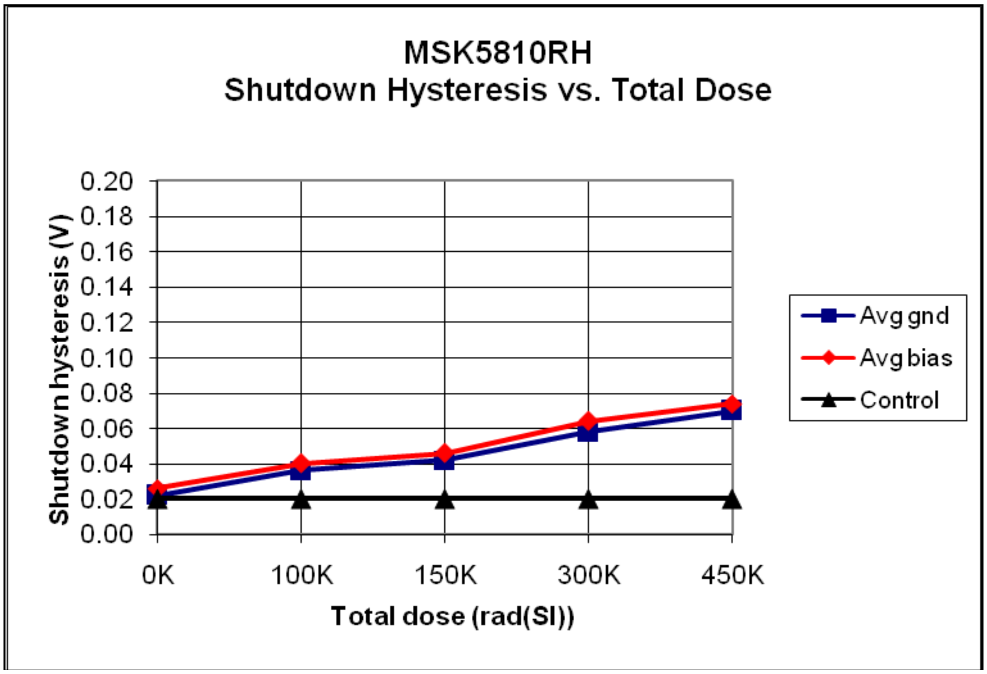
Dose Time, Incremental Dose and Total Cumulative Dose

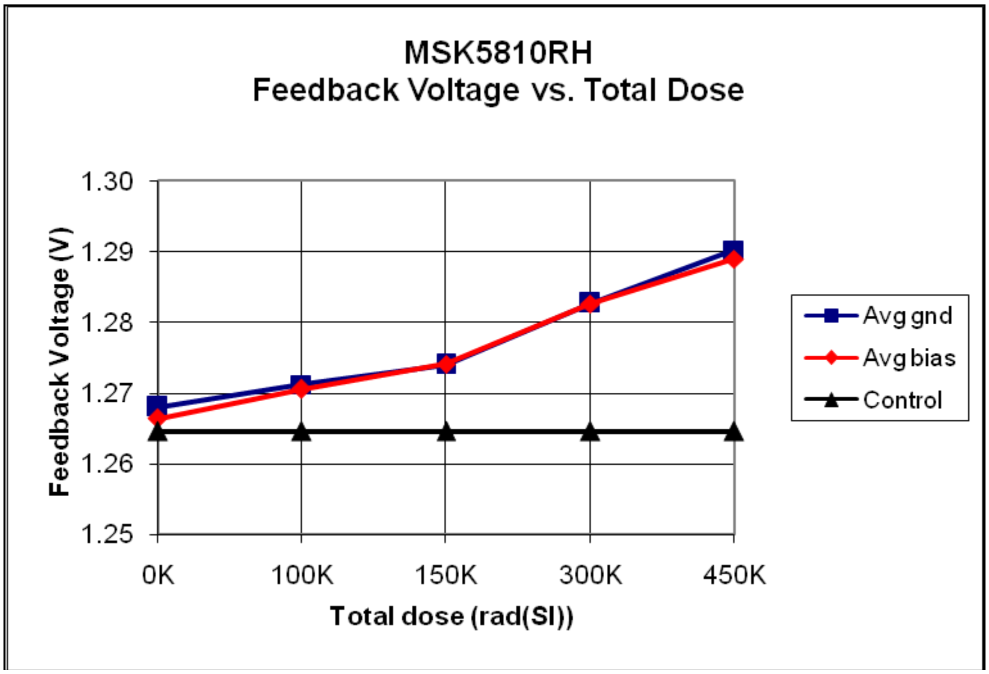

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

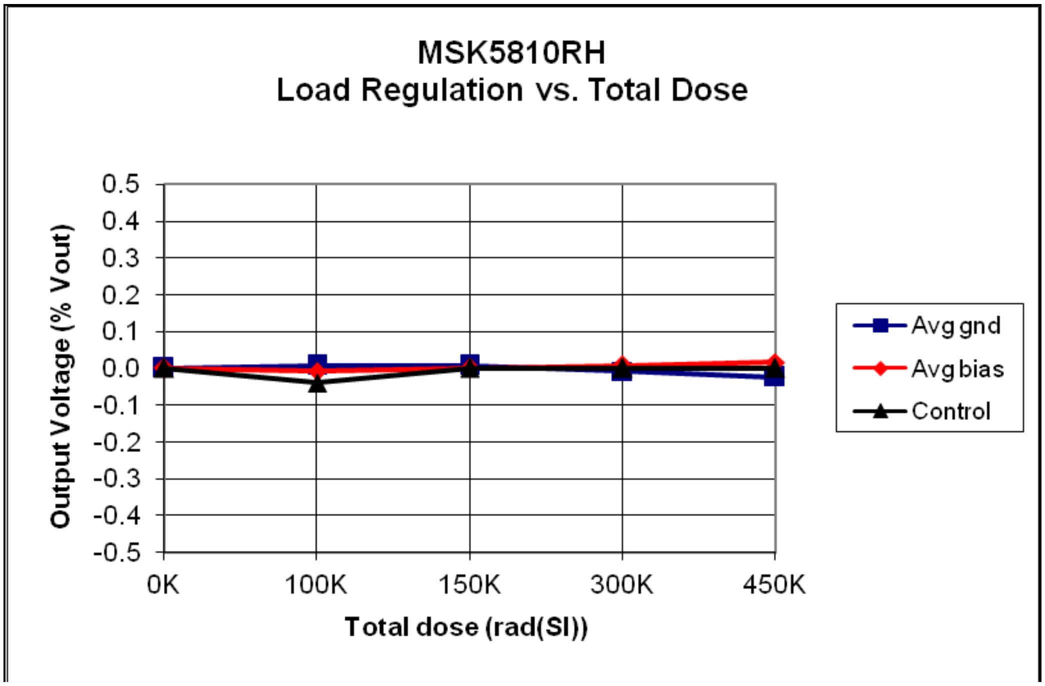

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

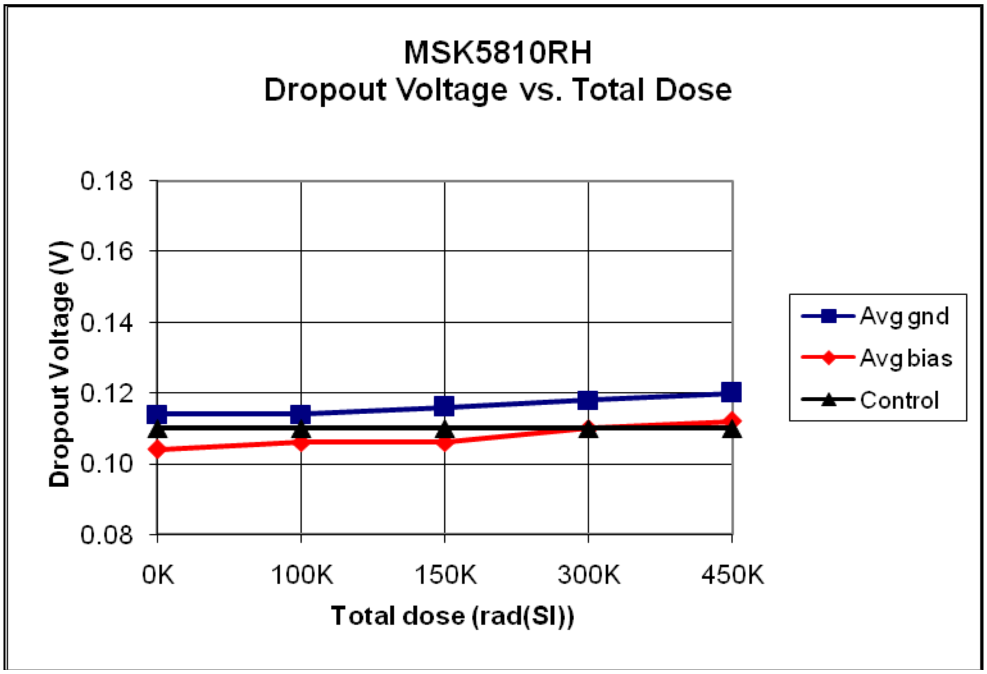

MSK5810RH
Line Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

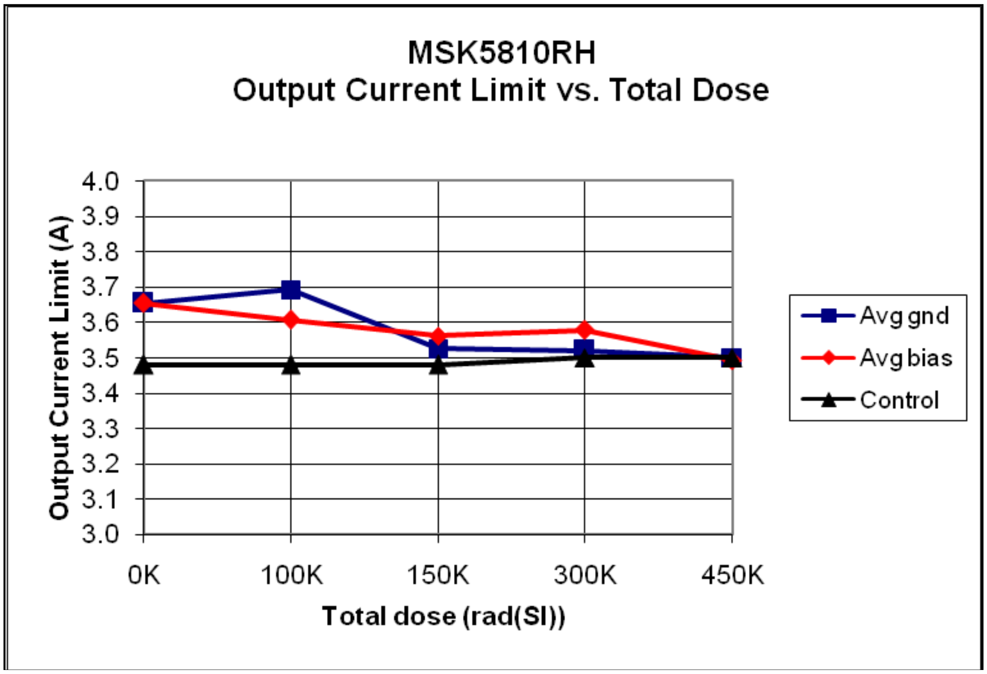

MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown hysteresis (V)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.30
1.29
1.28
1.27
1.26
1.25
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Load Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.18
0.16
0.14
0.12
0.10
0.08
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: September 17, 2010

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

B. Horton
R. Wakeman

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 132 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. Nine 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. Four devices were biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 300 KRAD (Si) TID.

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
09/17/10

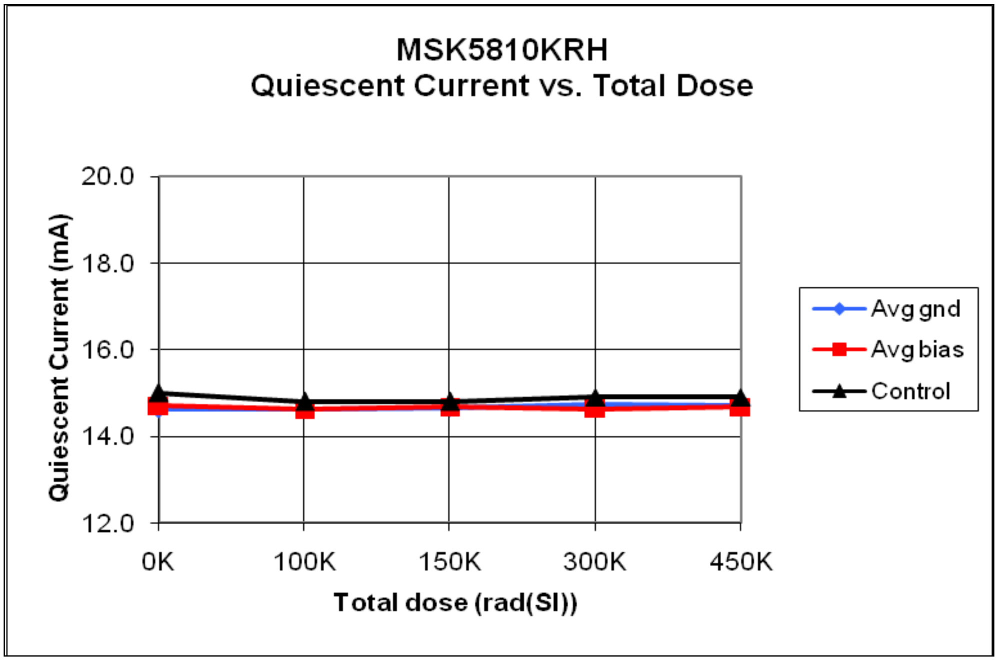
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
13:00	102,960	102,960
6:30	51,480	154,440
19:31	154,572	309,012
19:31	154,572	463,584

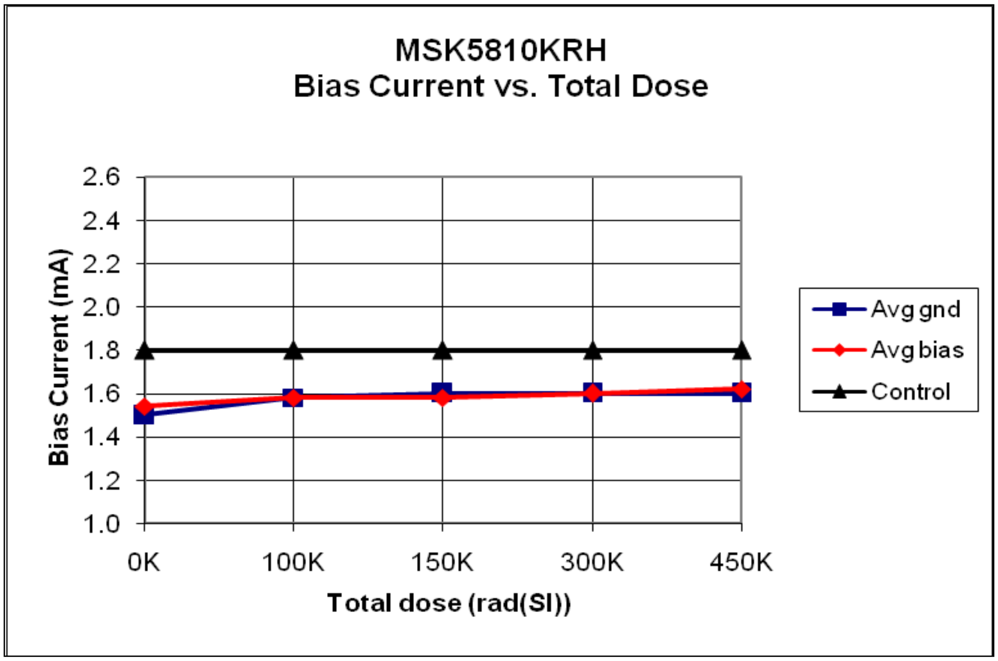
Biased S/N – 0476, 0477, 0478, 0480

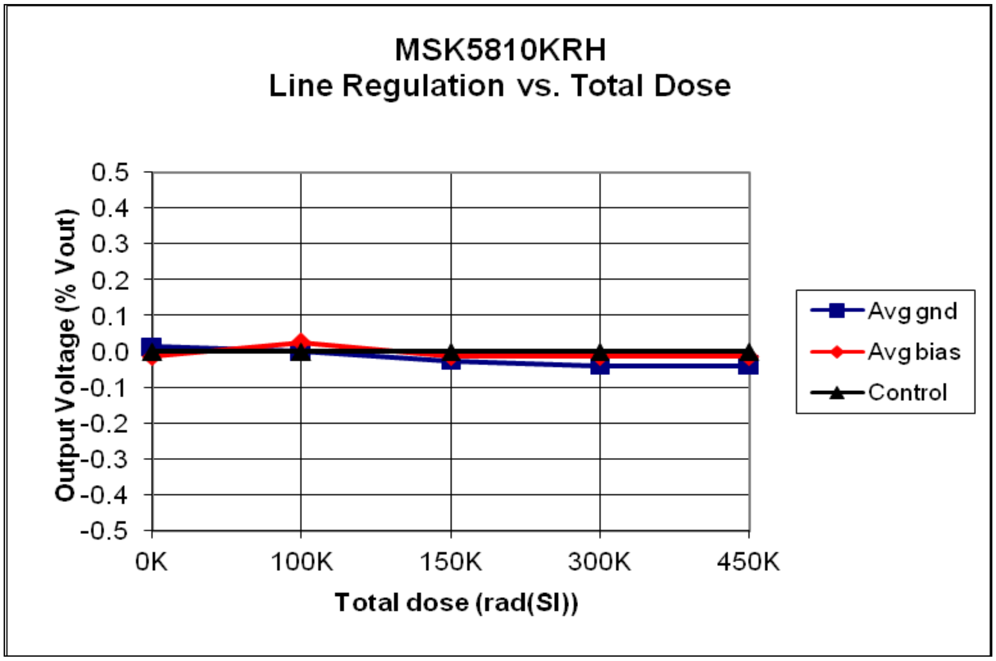
Unbiased S/N – 0471, 0472, 0473, 0474, 0475

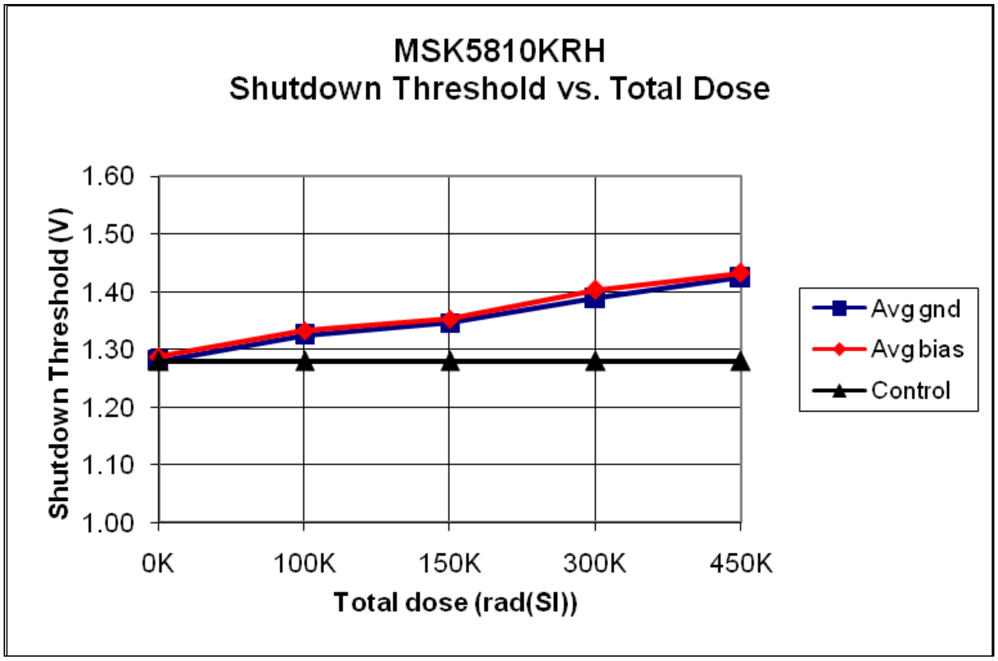
Table 1

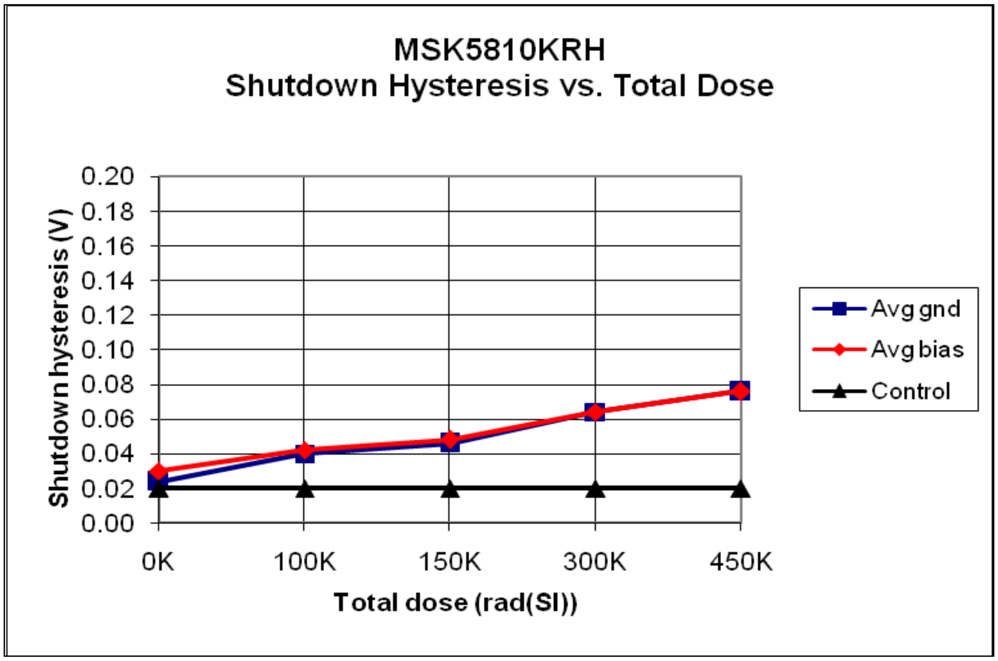
Dose Time, Incremental Dose and Total Cumulative Dose

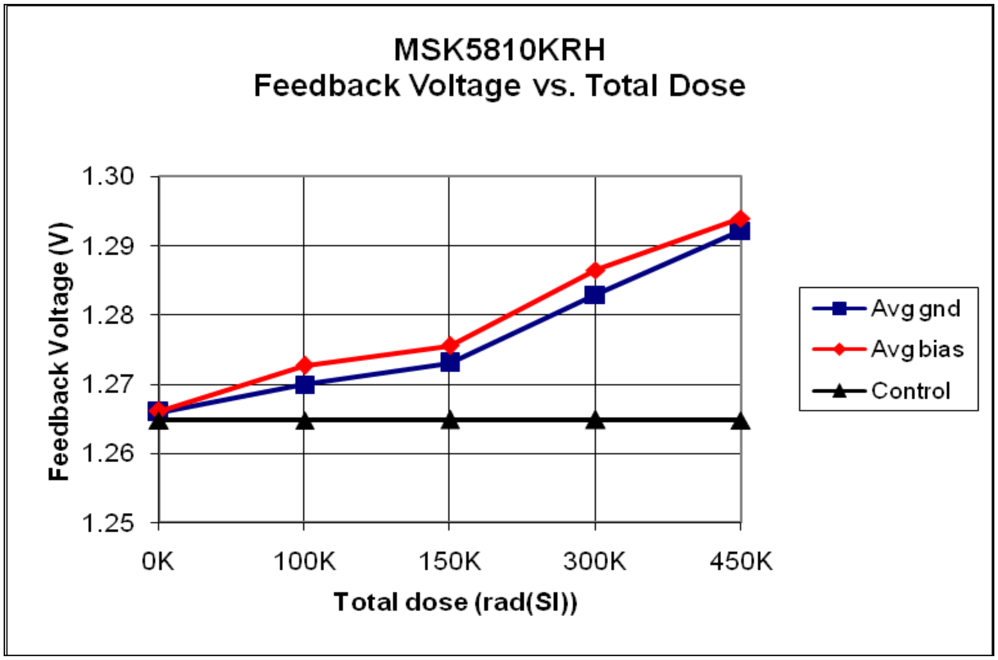

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

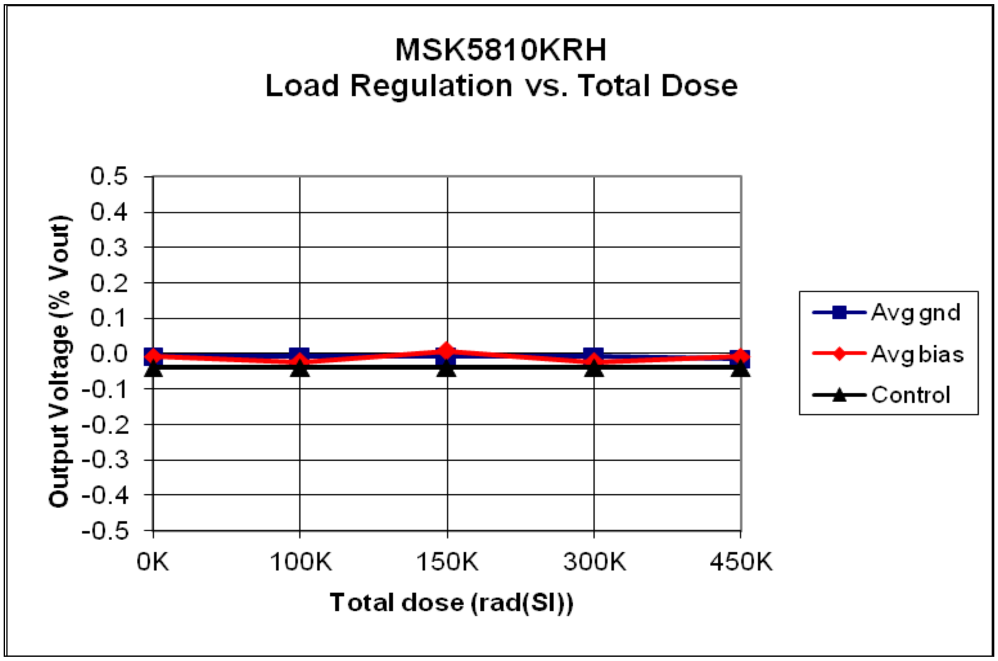

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

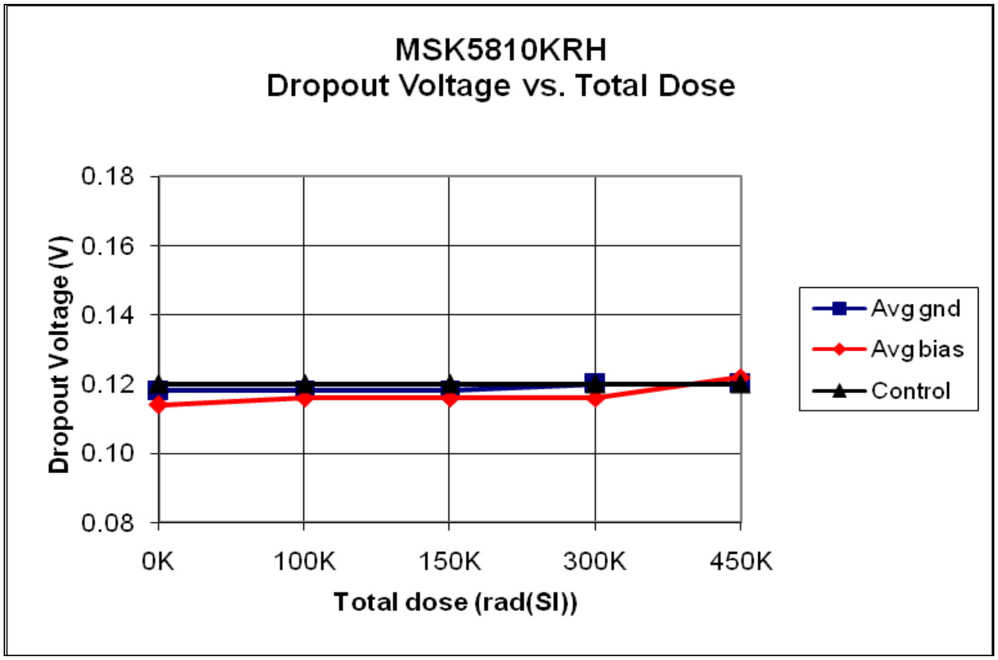

MSK5810KRH
Line Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

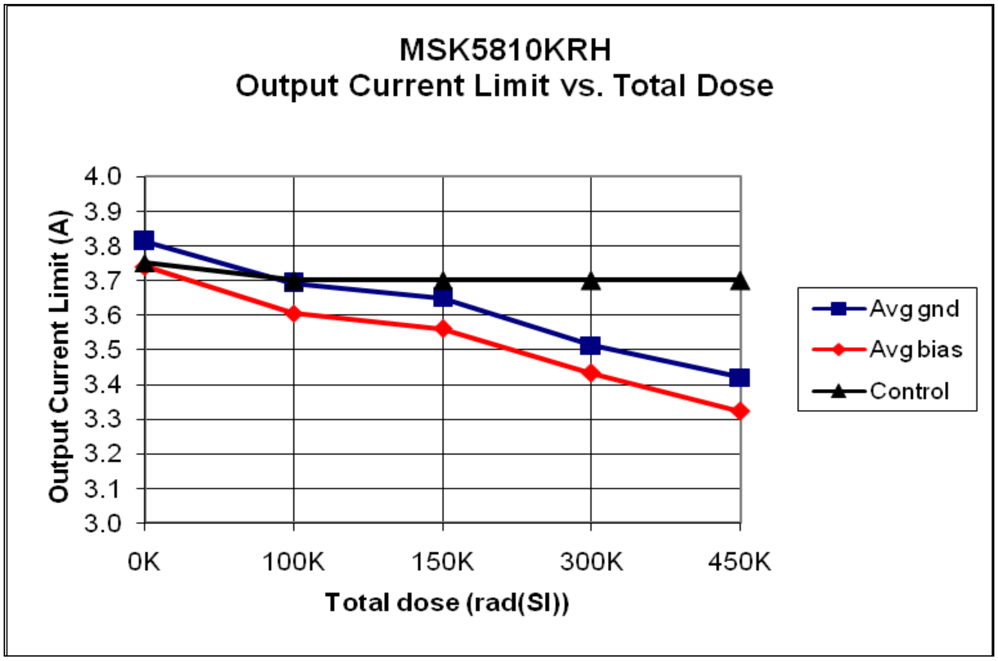

MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown hysteresis (V)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.30
1.29
1.28
1.27
1.26
1.25
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810KRH
Load Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.18
0.16
0.14
0.12
0.10
0.08
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810KRH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
0K
100K
150K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: December 10, 2010

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

B. Erwin
R. Wakeman

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 132 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. Nine 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. Four devices were biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
12/10/10

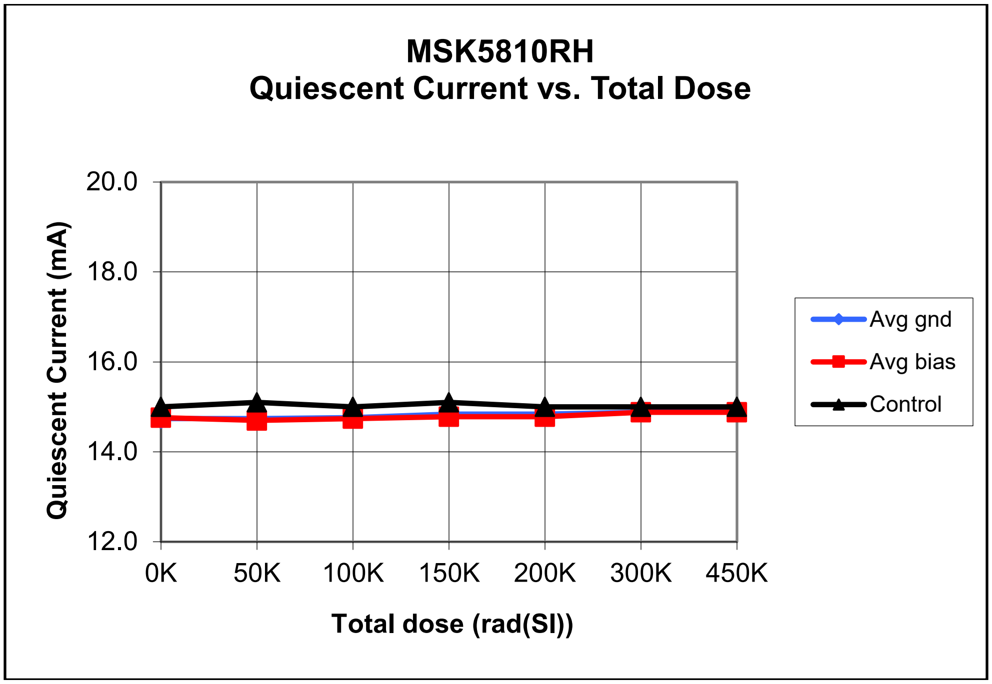
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
6:43	51,584	51,584
6:43	51,584	103,168
6:43	51,584	154,752
6:43	51,584	206,336
13:25	103,040	309,376
20:07	154,496	463,872

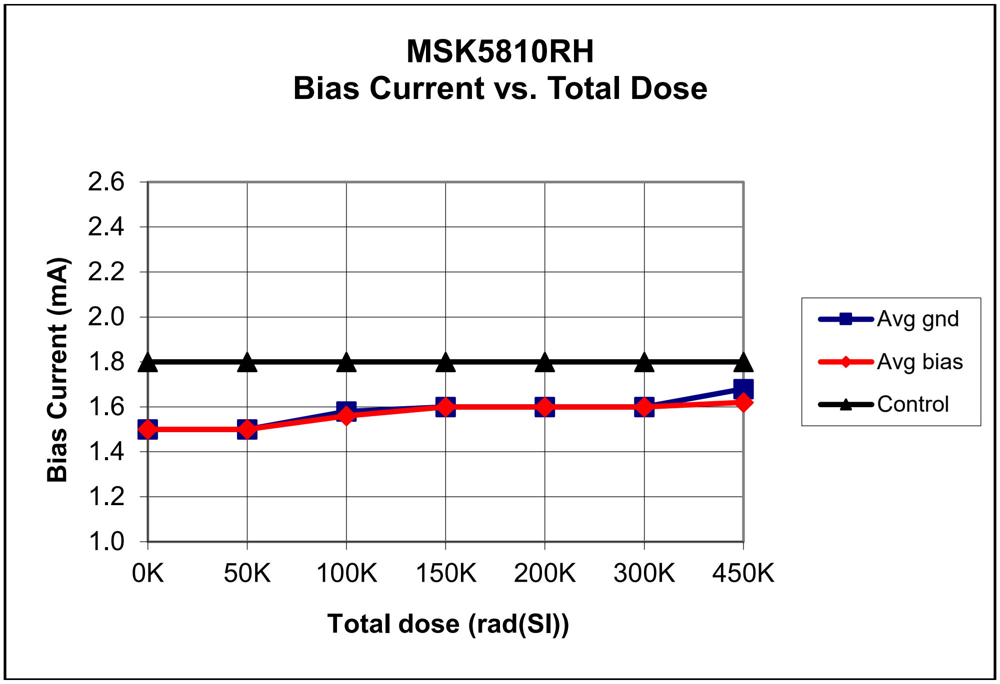
Biased S/N – 0538, 0539, 0540, 0541, 0542

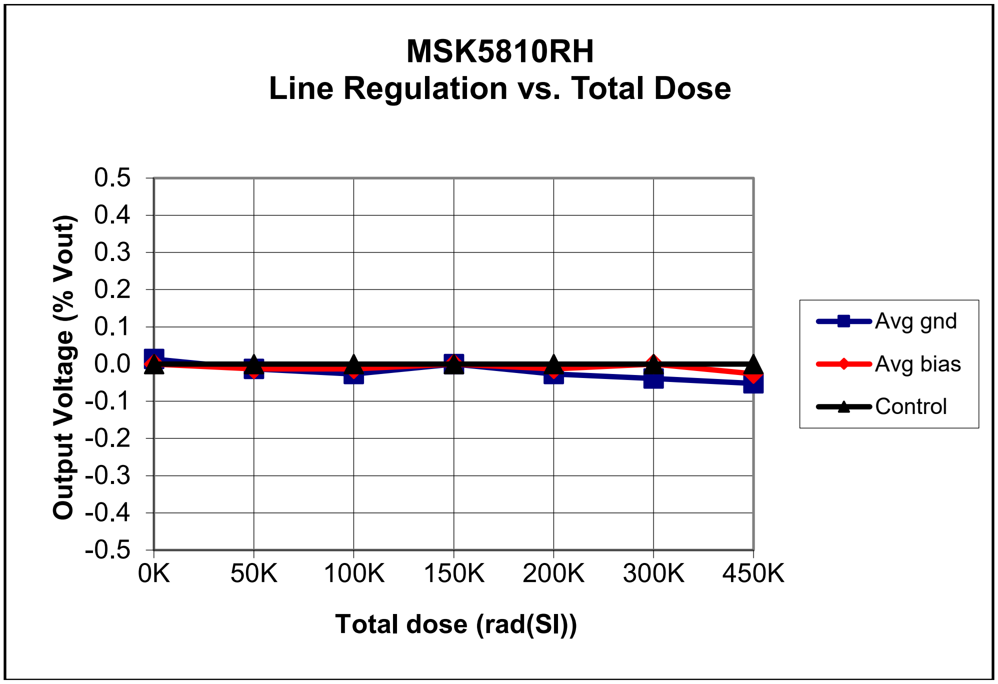
Unbiased S/N – 0543, 0544, 0545, 0546, 0547

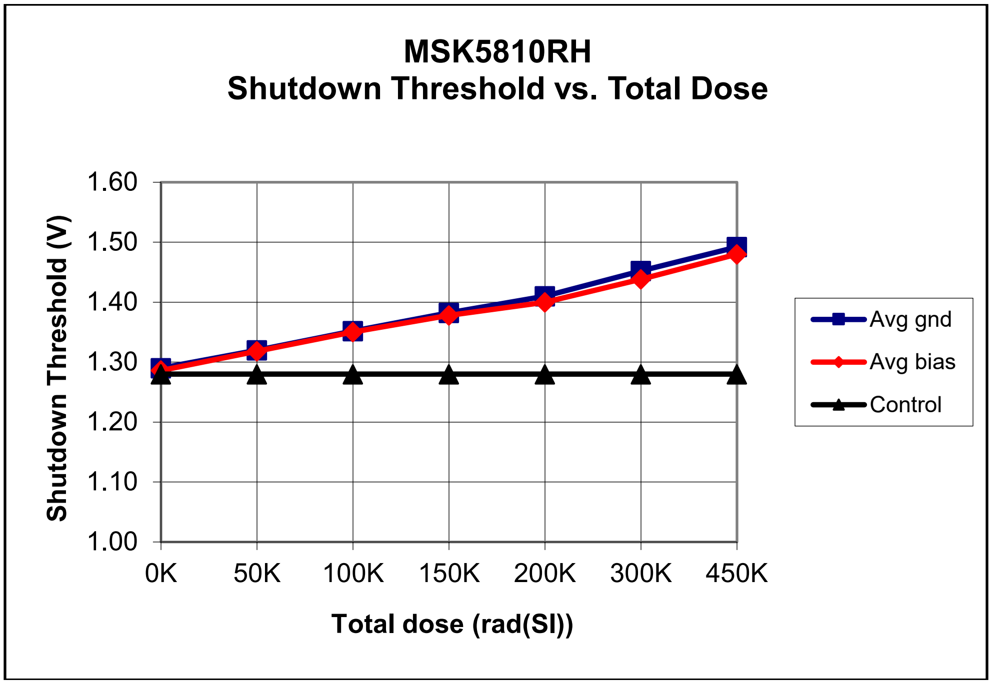
Table 1

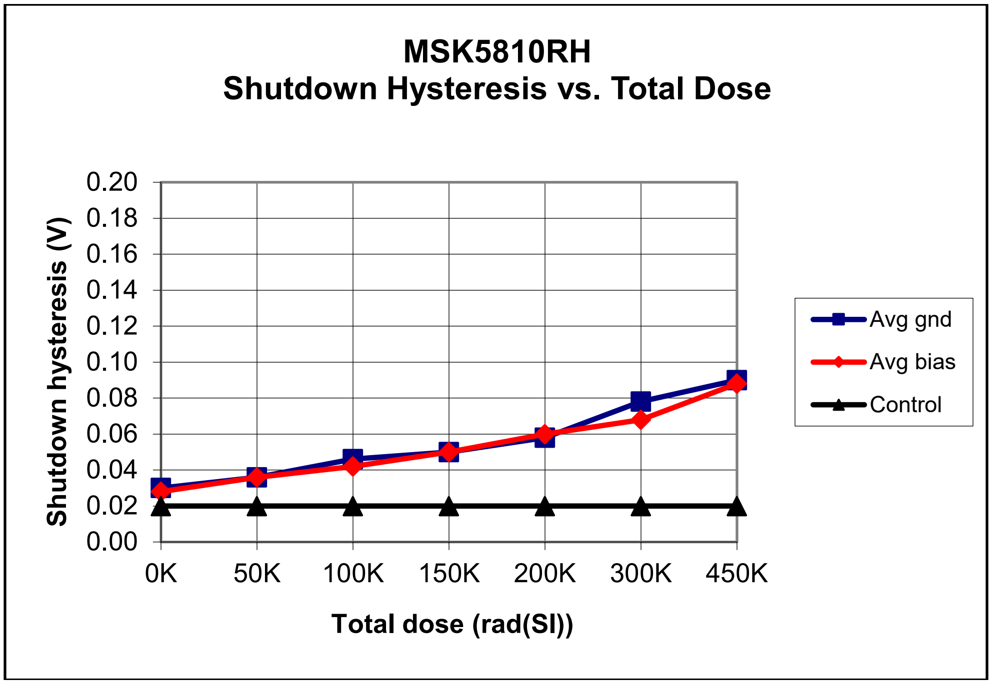
Dose Time, Incremental Dose and Total Cumulative Dose

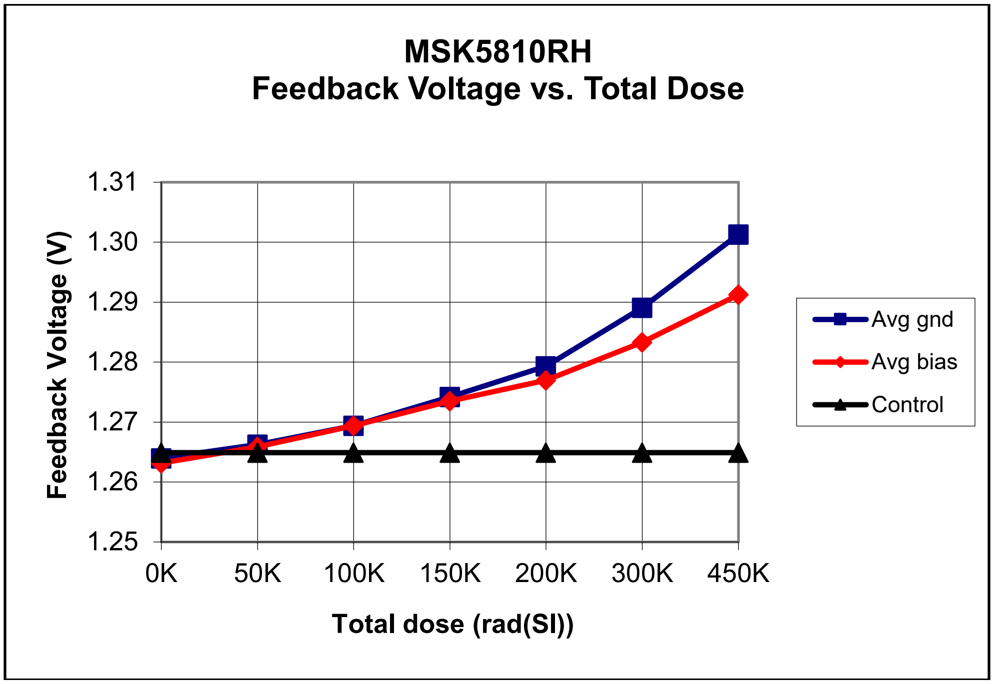

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

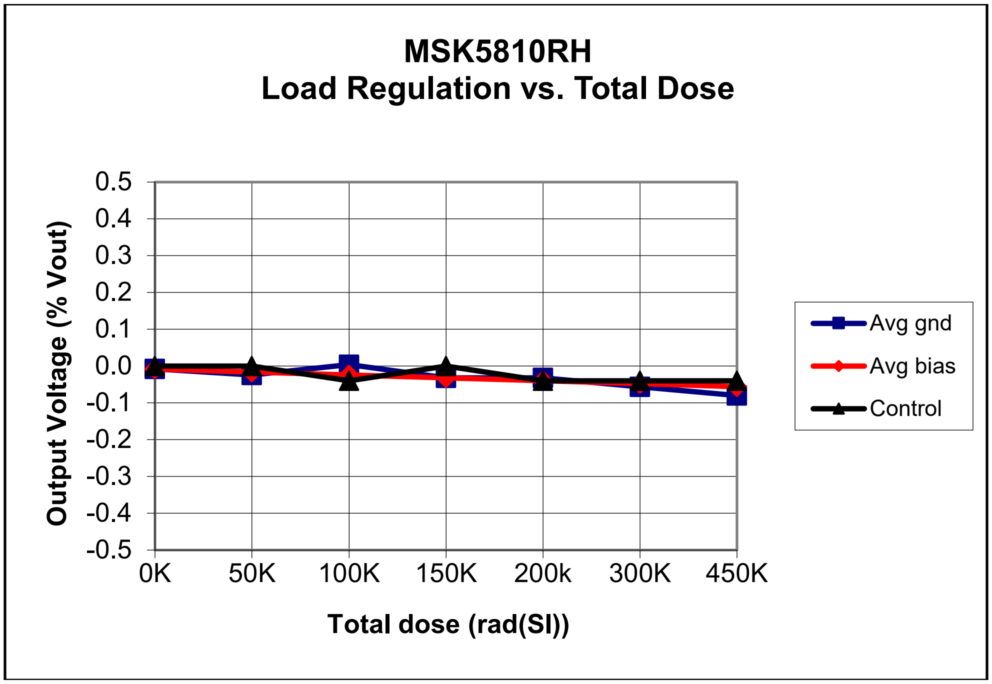

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

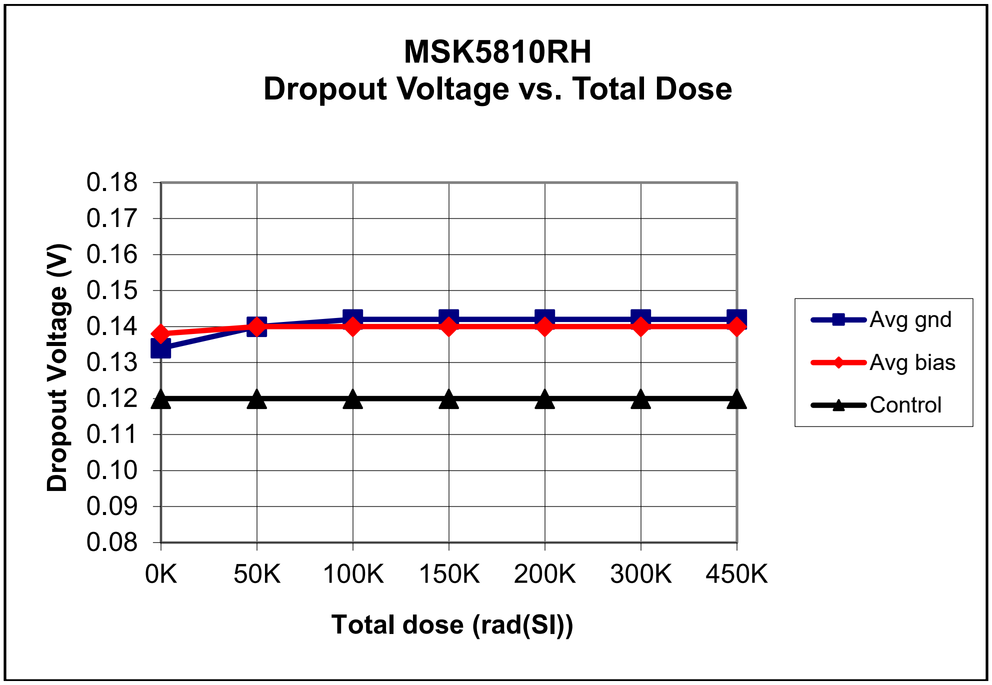

MSK5810RH
Line Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

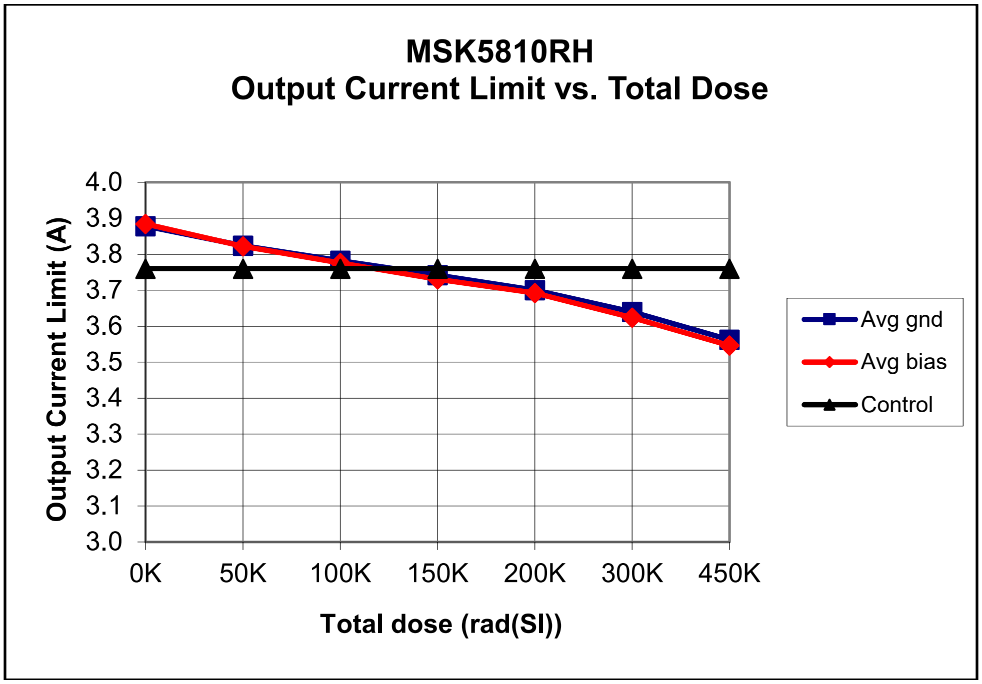

MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown hysteresis (V)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.31
1.30
1.29
1.28
1.27
1.26
1.25
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Load Regulation vs. Total Dose
Output Voltage (% Vout)
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
0K
50K
100K
150K
200k
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
0K
50K
100K
150K
200K
300K
450K
Total dose (rad(SI))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: April 1, 2011

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

M. Bilecki
B. Erwin

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 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 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
4/1/11

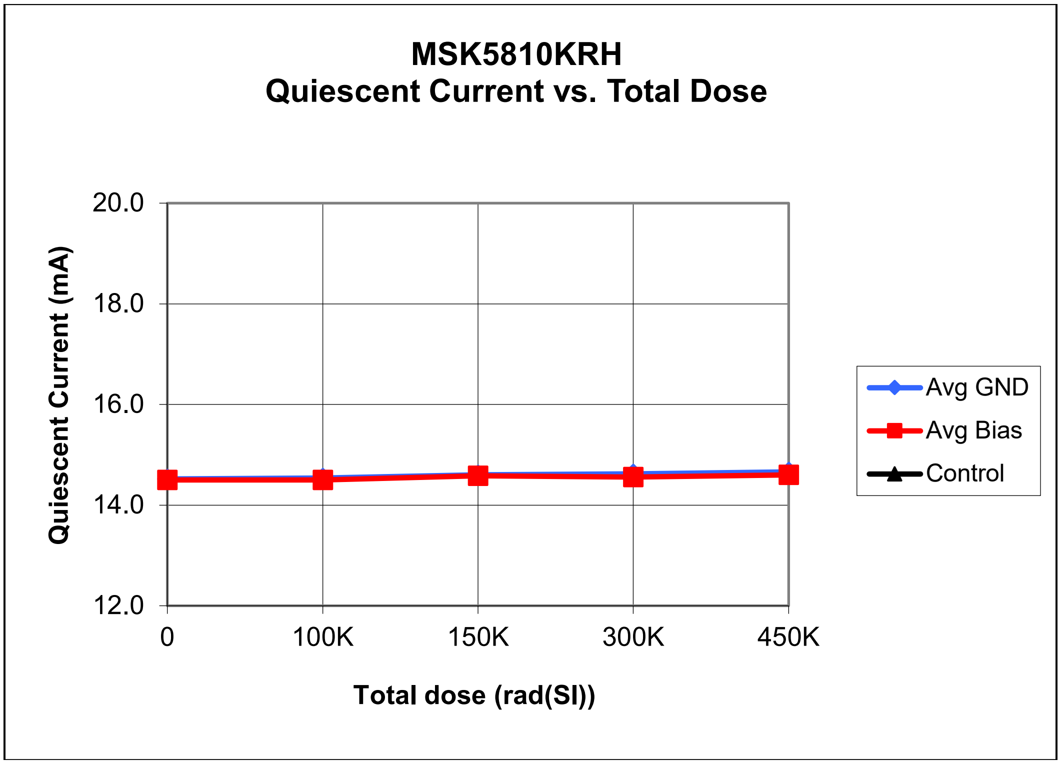
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
13:44	103,000	103,000
6:52	51,500	154,500
20:36	154,500	309,000
20:36	154,500	463,500

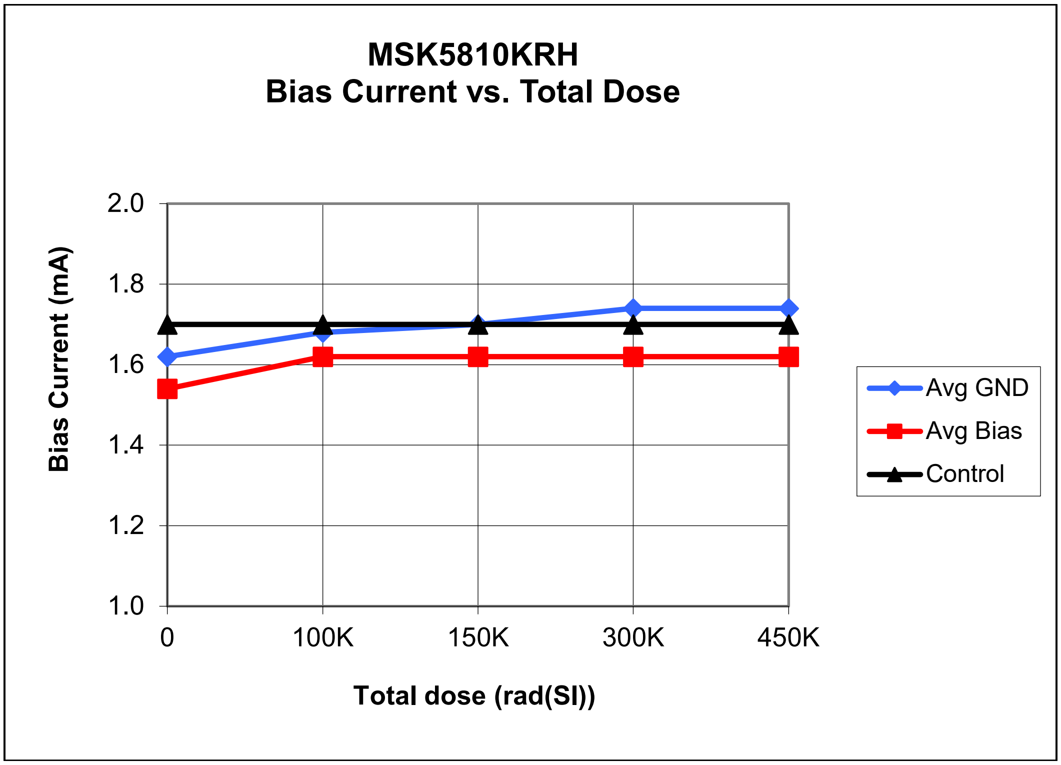
Biased S/N – 0762, 0763, 0764, 0765, 0766

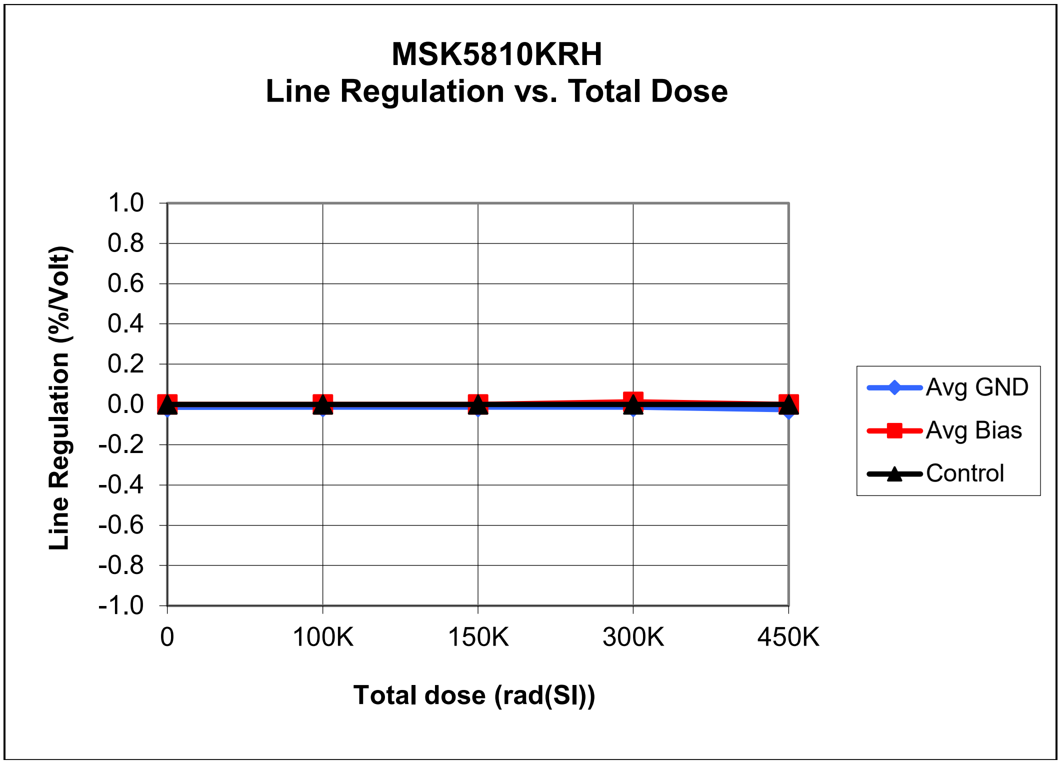
Unbiased S/N – 0757, 0758, 0759, 0760, 0761

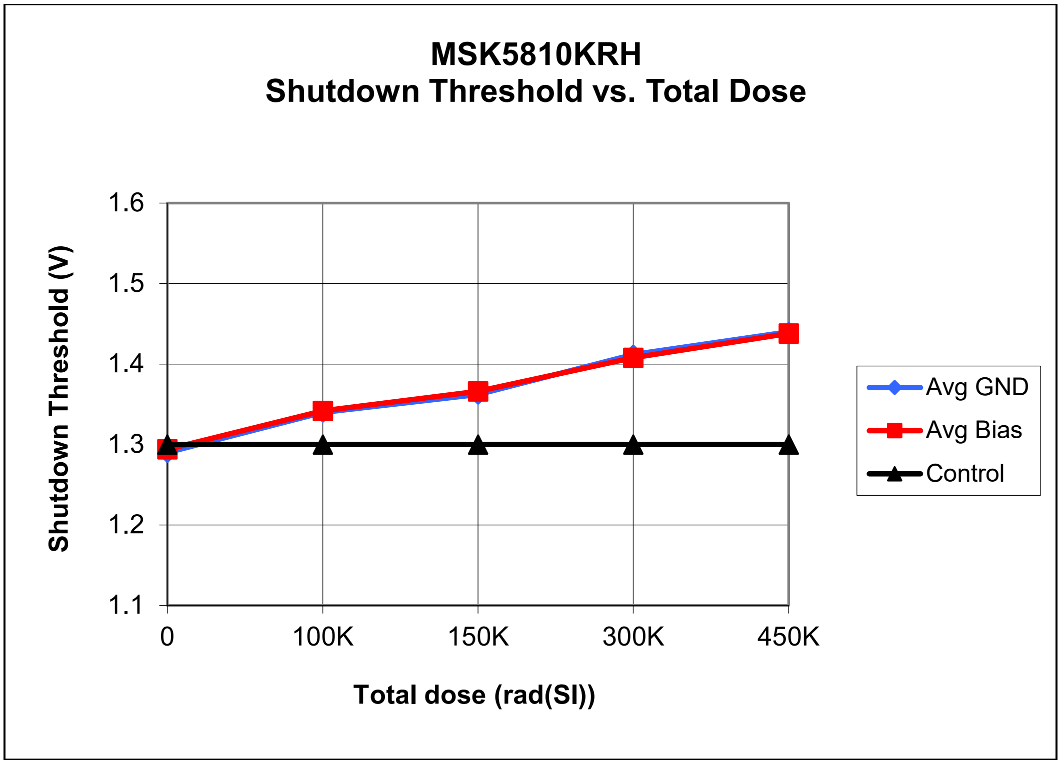
Table 1

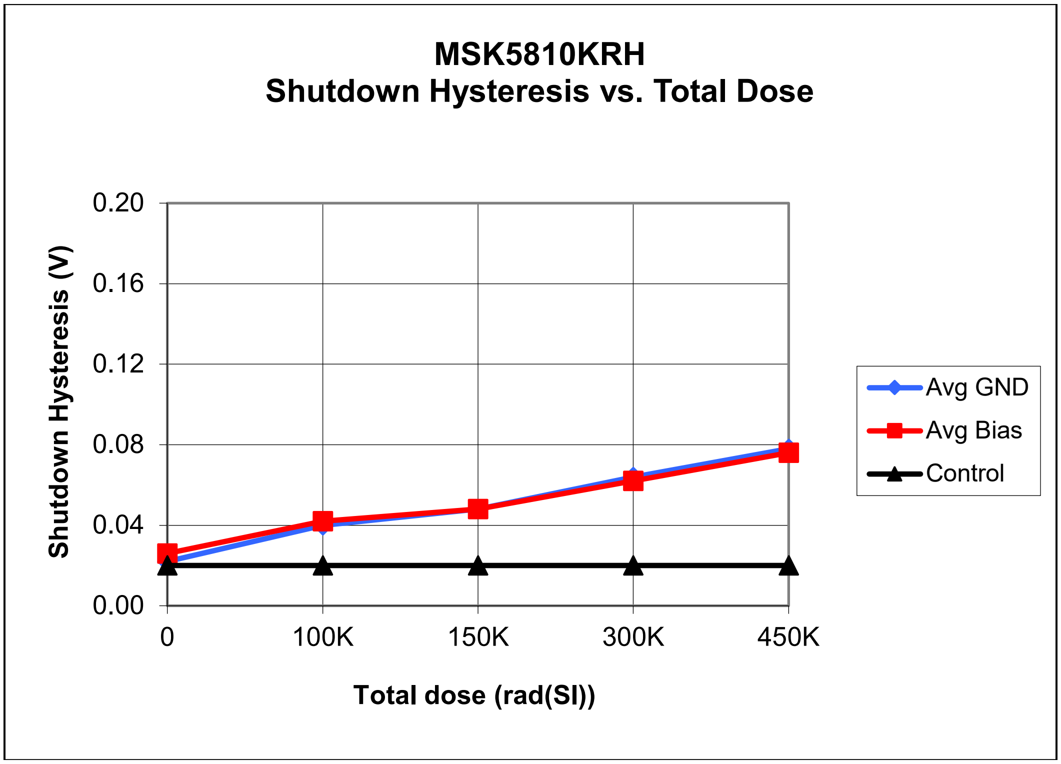
Dose Time, Incremental Dose and Total Cumulative Dose

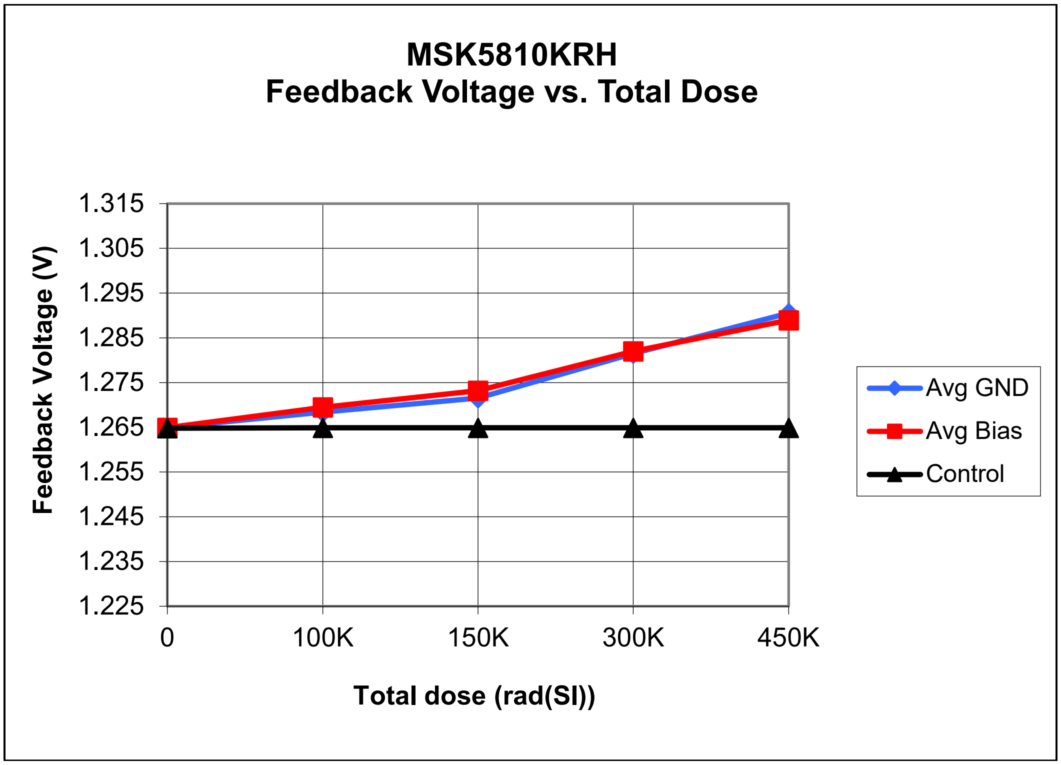

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

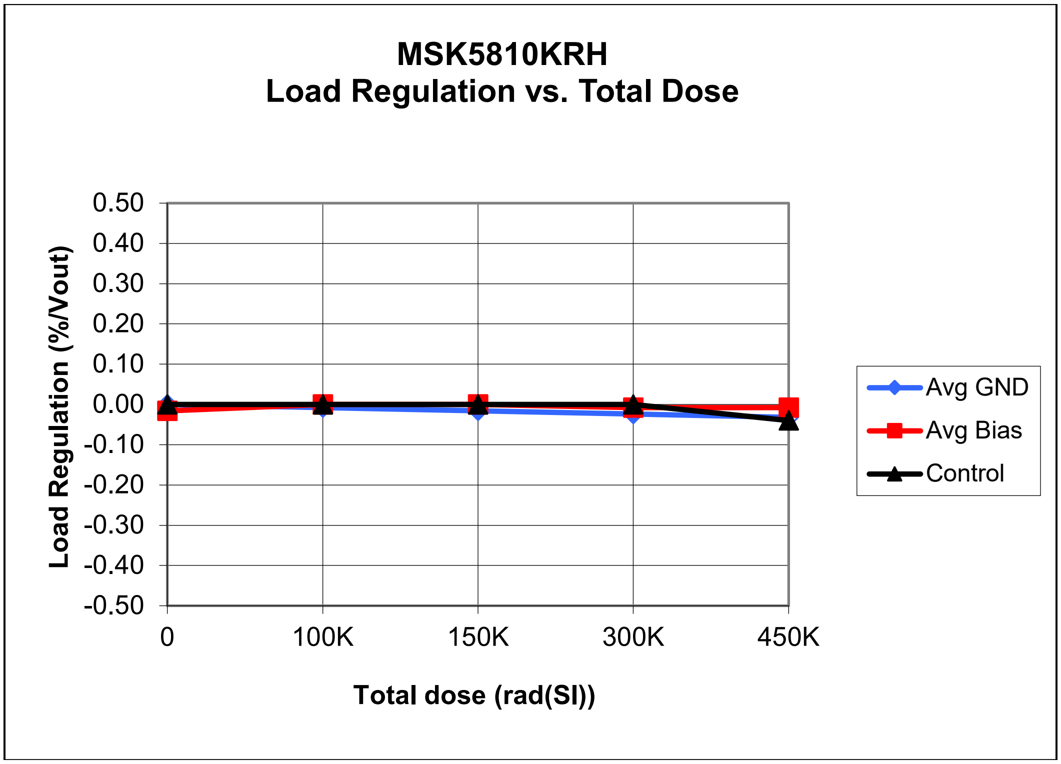

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
2.0
1.8
1.6
1.4
1.2
1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

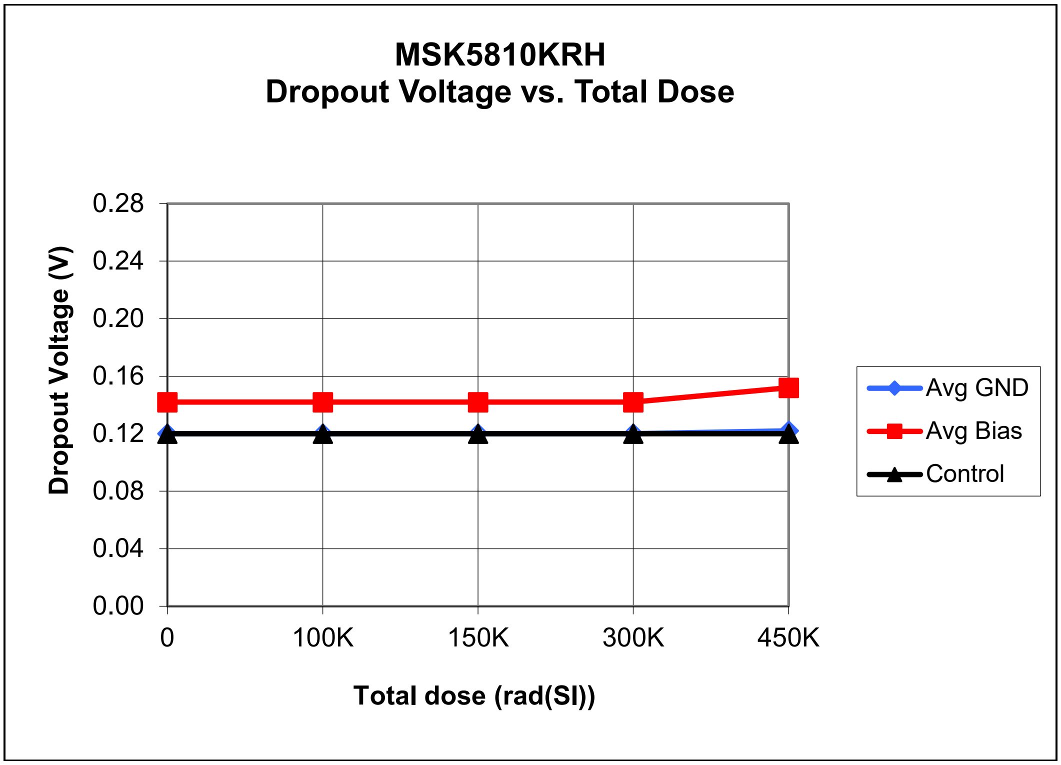

MSK5810KRH
Line Regulation vs. Total Dose
Line Regulation (%/Volt)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

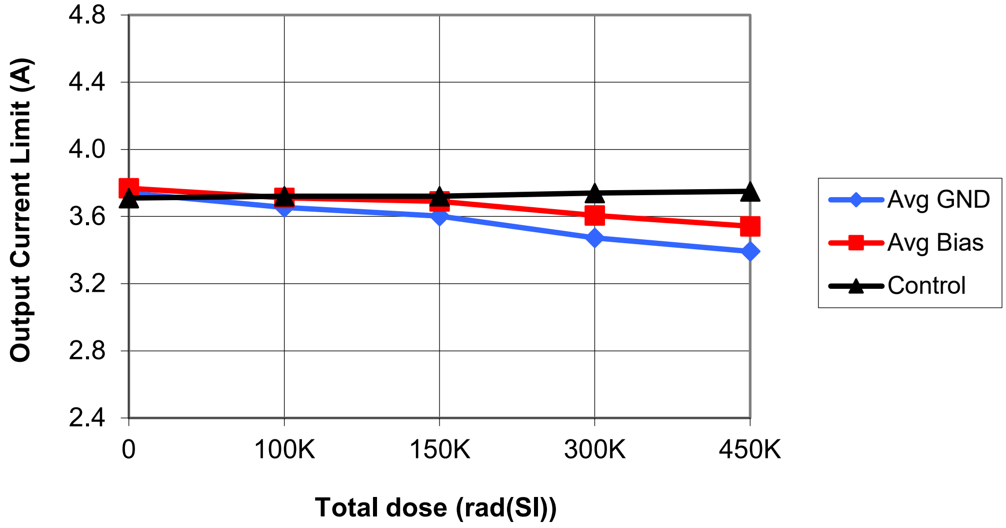

MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.6
1.5
1.4
1.3
1.2
1.1
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.315
1.305
1.295
1.285
1.275
1.265
1.255
1.245
1.235
1.225
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Load Regulation vs. Total Dose
Load Regulation (%/Vout)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control



MSK5810KRH
Output Current Limit vs. Total Dose

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: July 8, 2011

Test Vehicle: MSK5810RH

IC Wafer Lot: NA

Transistor Wafer Lot: NA

B. Horton
C. Salce

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 122 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
7/8/11

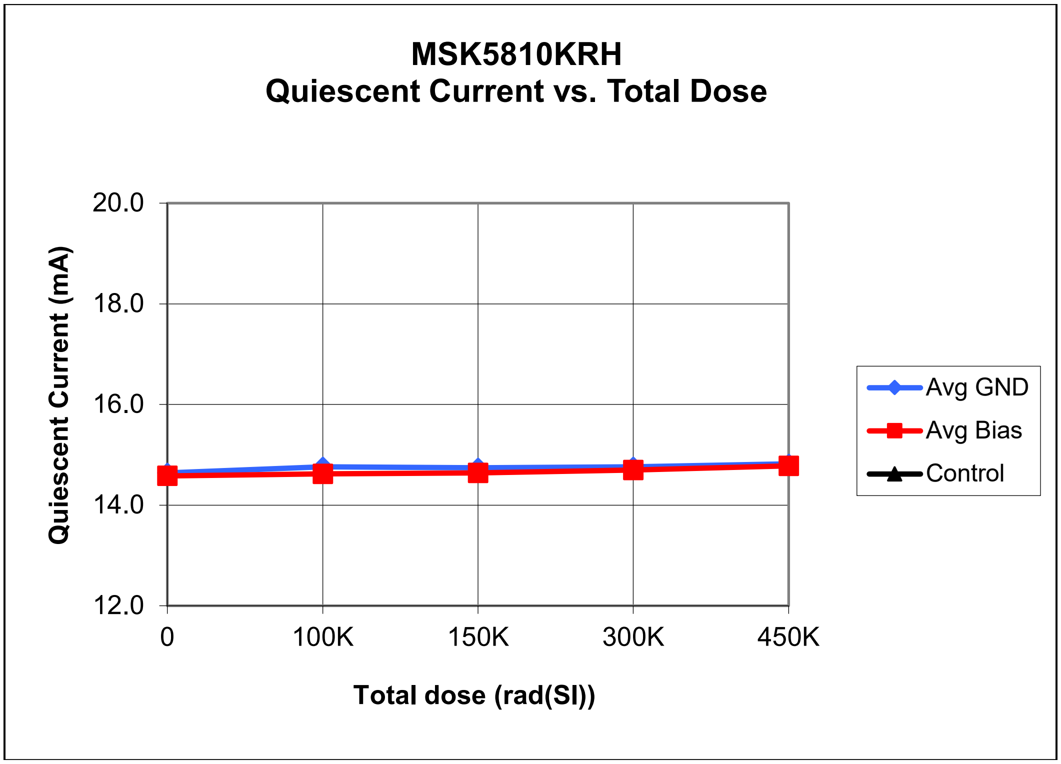
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
14:05	103,090	103,090
7:02	51,484	154,574
21:06	154,452	309,026
21:06	154,452	463,478

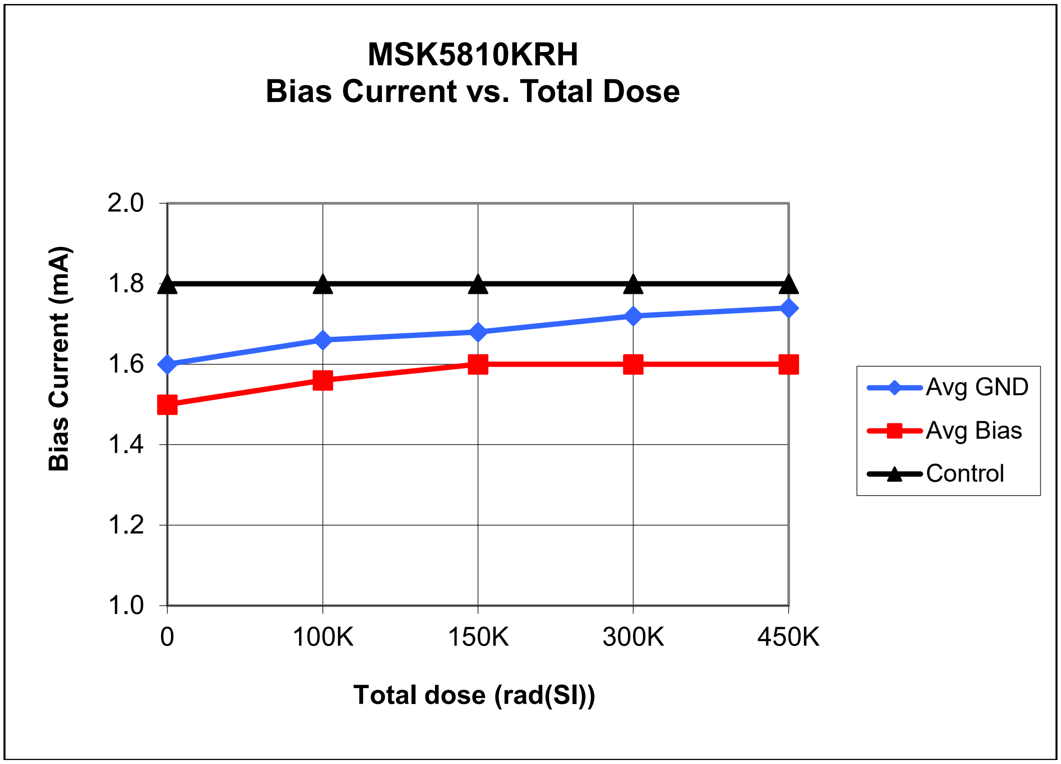
Biased S/N – 0673, 0674, 0675, 0676, 0677

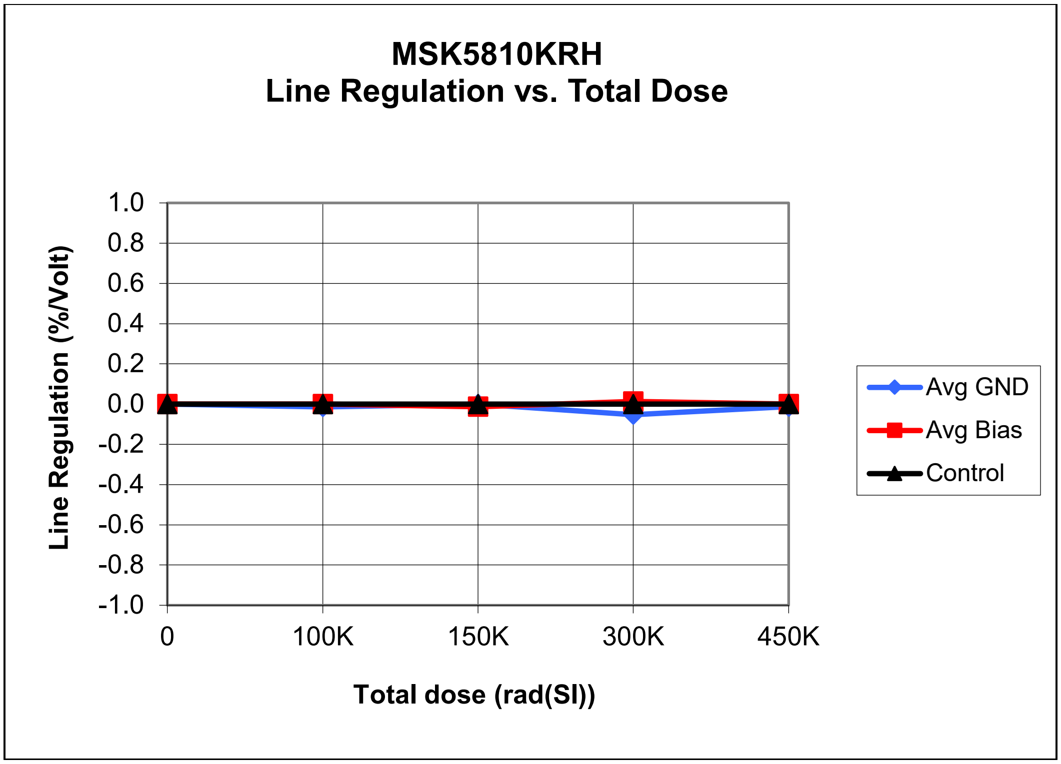
Unbiased S/N – 0678, 0679, 0680, 0681, 0682

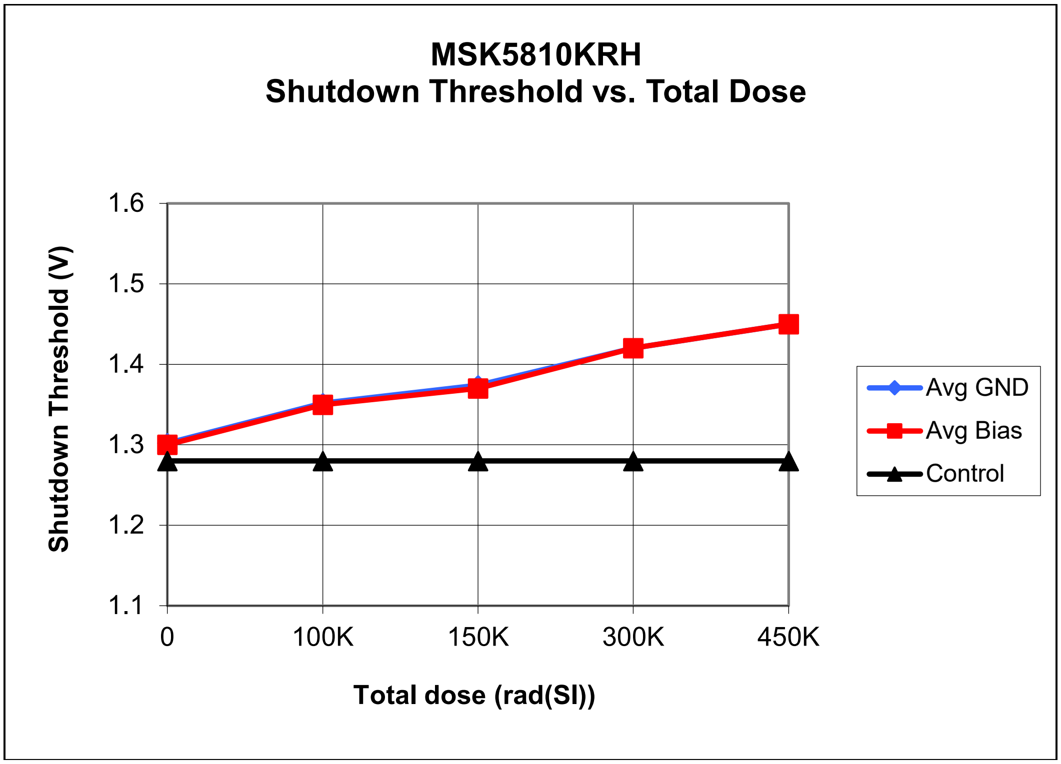
Table 1

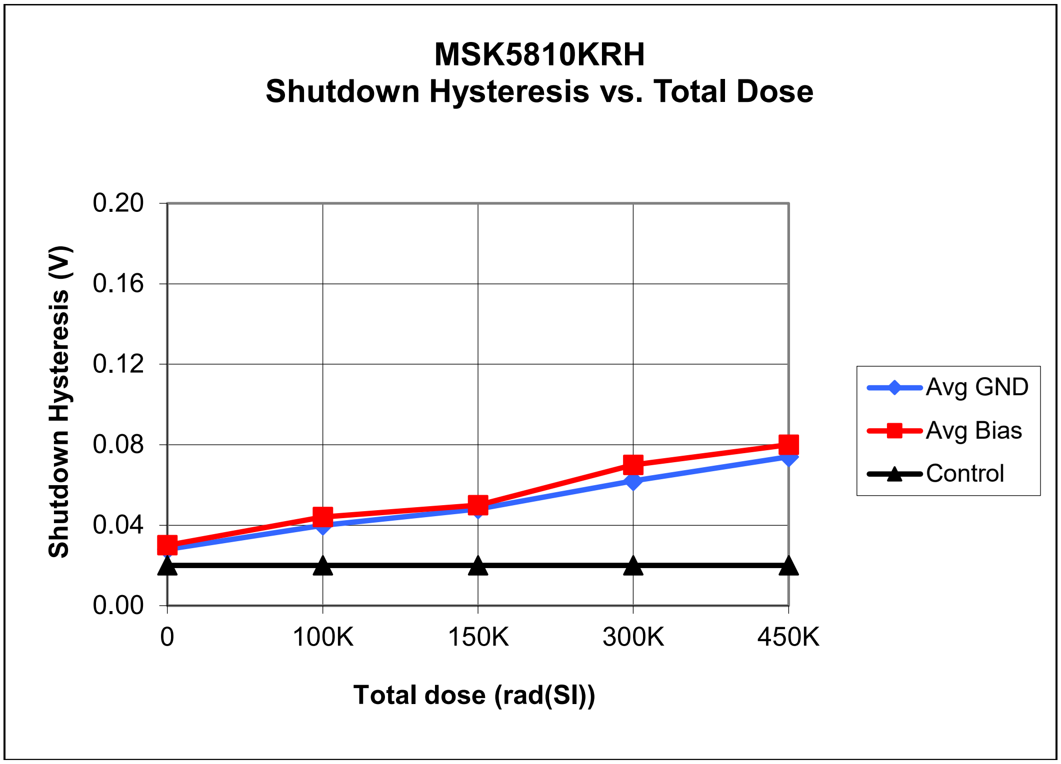
Dose Time, Incremental Dose and Total Cumulative Dose

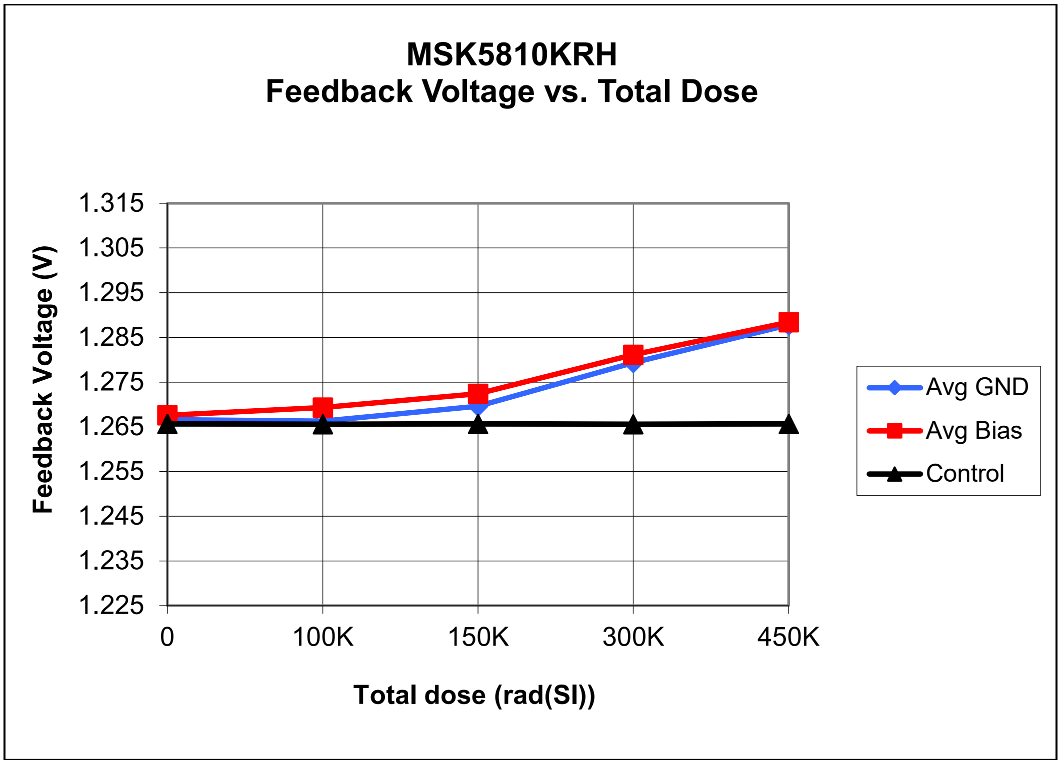

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

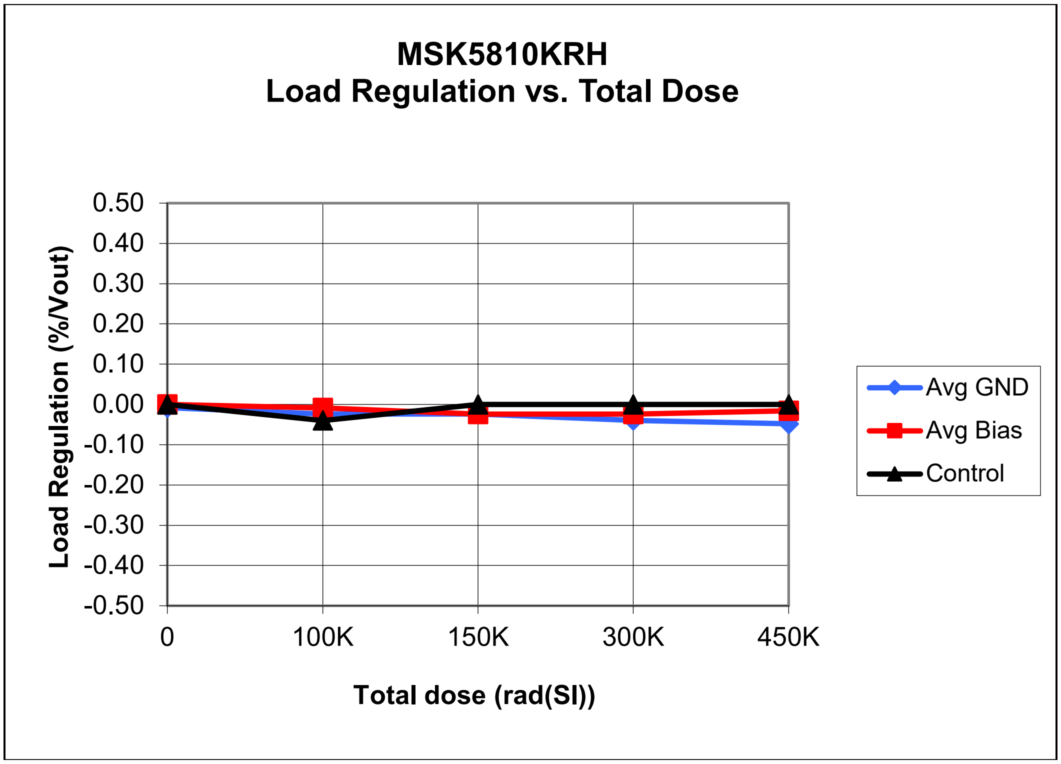

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
2.0
1.8
1.6
1.4
1.2
1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

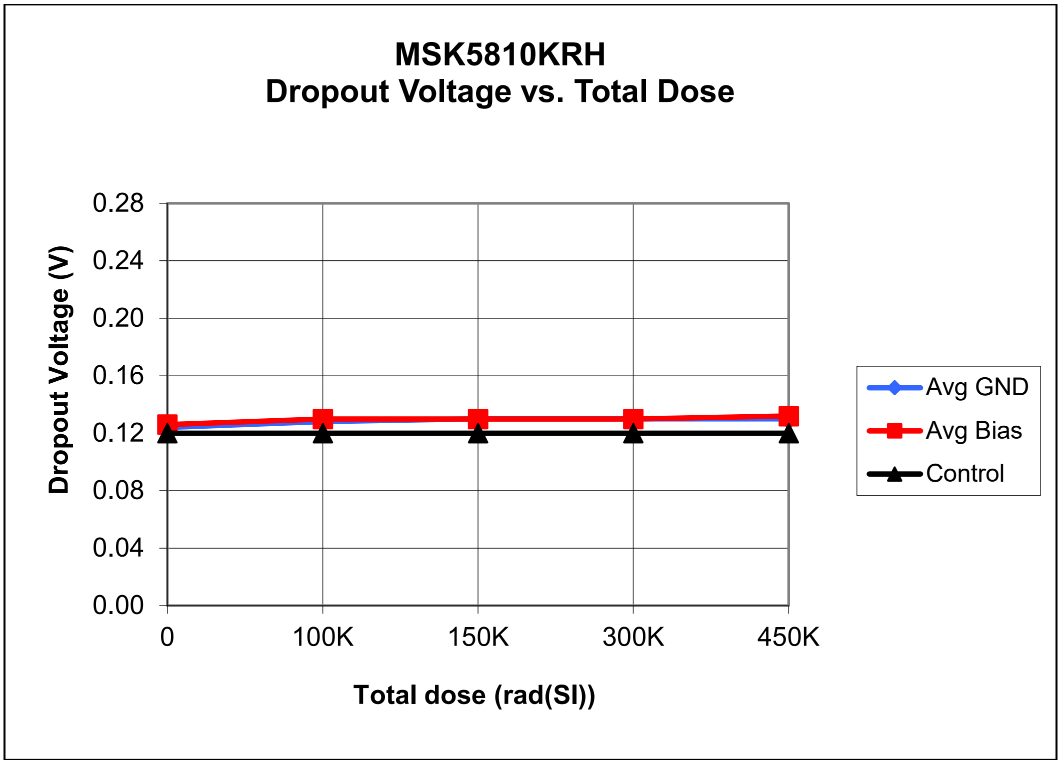

MSK5810KRH
Line Regulation vs. Total Dose
Line Regulation (%/Volt)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

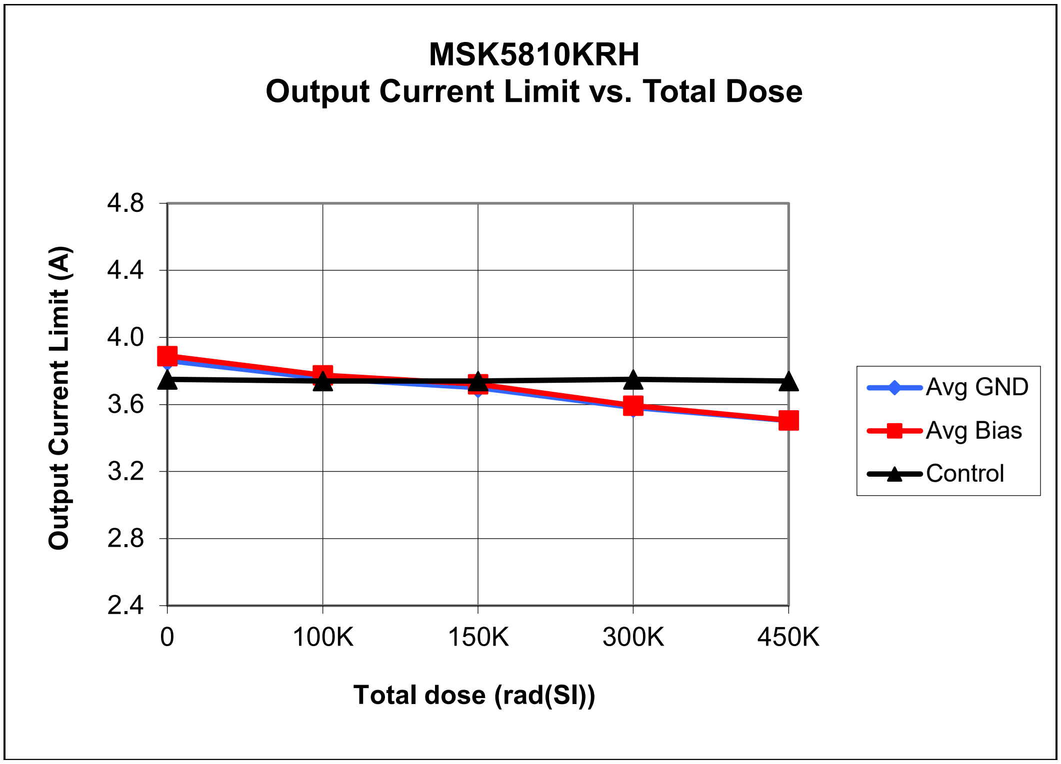

MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.6
1.5
1.4
1.3
1.2
1.1
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.315
1.305
1.295
1.285
1.275
1.265
1.255
1.245
1.235
1.225
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Load Regulation vs. Total Dose
Load Regulation (%/Vout)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.8
4.4
4.0
3.6
3.2
2.8
2.4
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: June 14, 2013

Test Vehicle: MSK5810RH

IC Wafer Lot: WD0051441 #9

Transistor Wafer Lot: CJ302831 #13

B. Horton
C. Salce
P. Dinneen

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 93 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
6/14/13

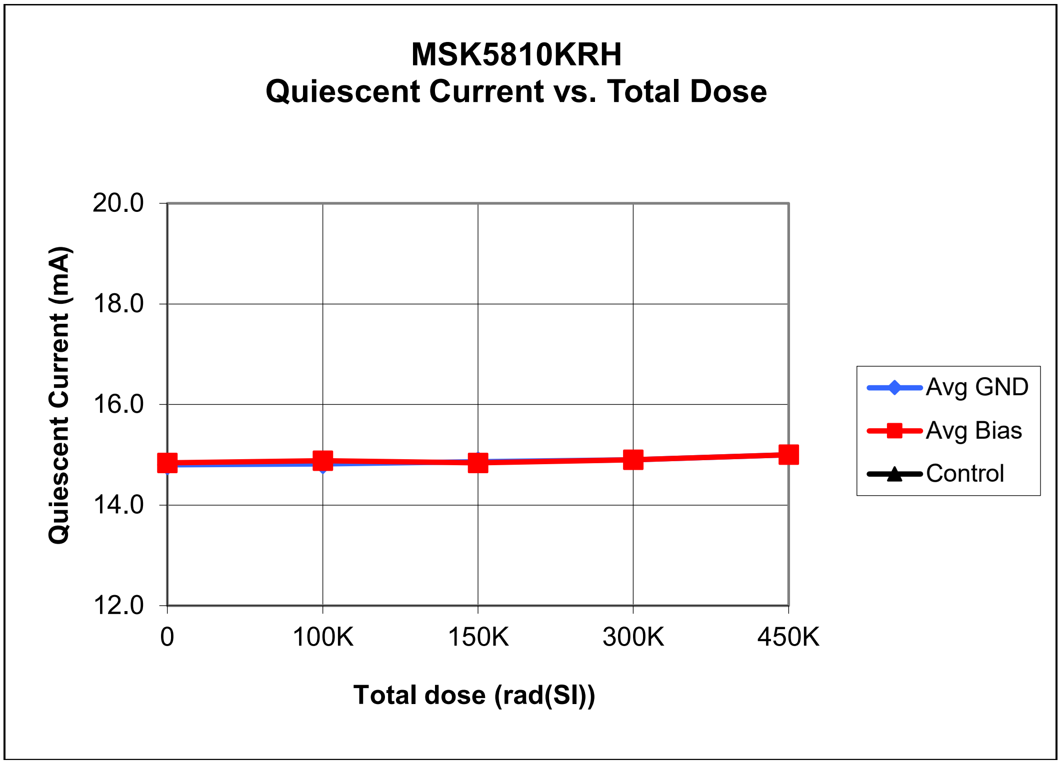
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
18:28	103,044	103,044
9:14	51,522	154,566
27:42	154,566	309,132
27:42	154,566	463,698

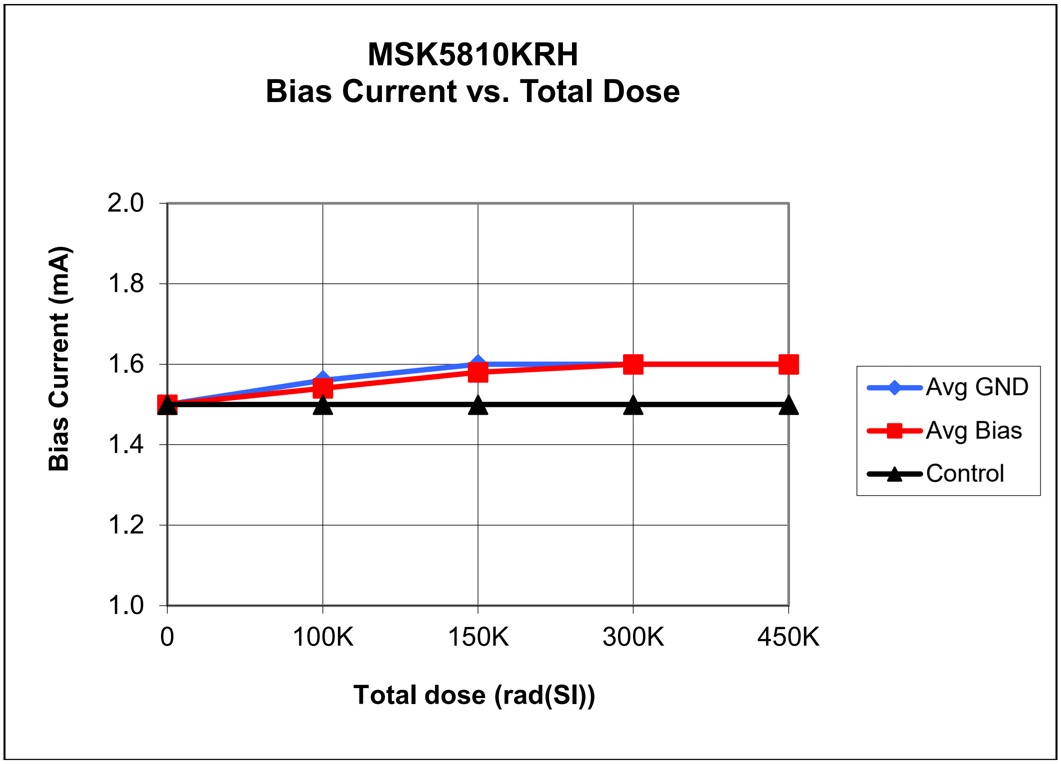
Biased S/N – 0979, 0980, 0981, 0982, 0983

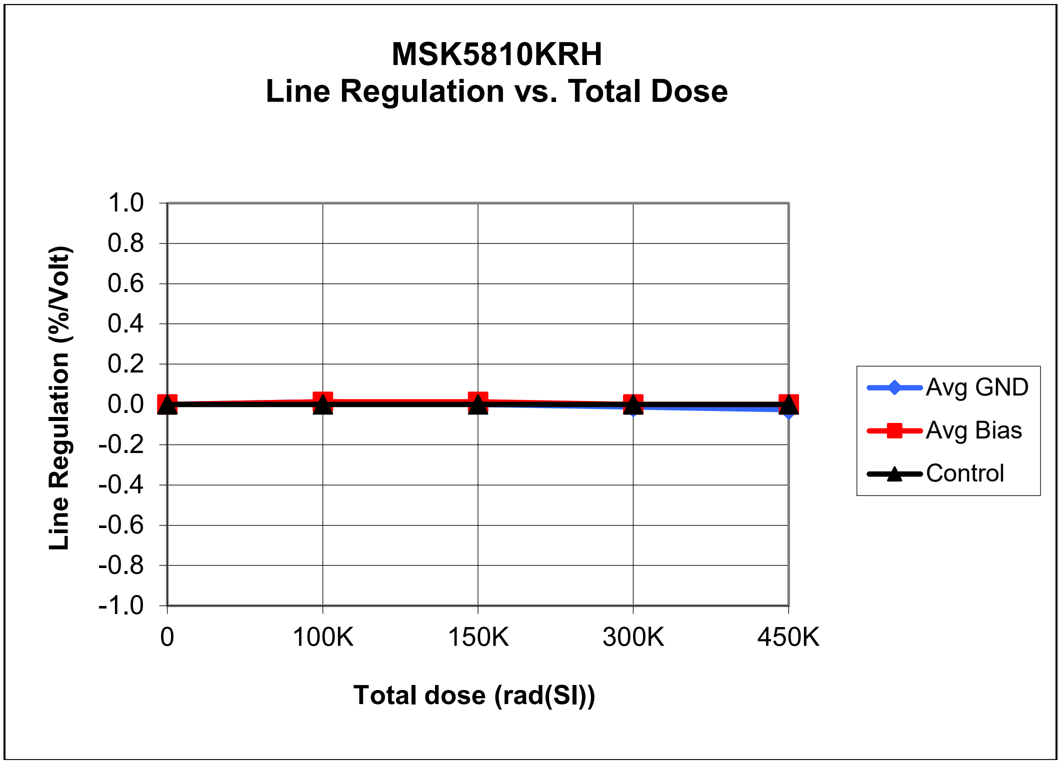
Unbiased S/N – 0984, 0985, 0986, 0987, 0988

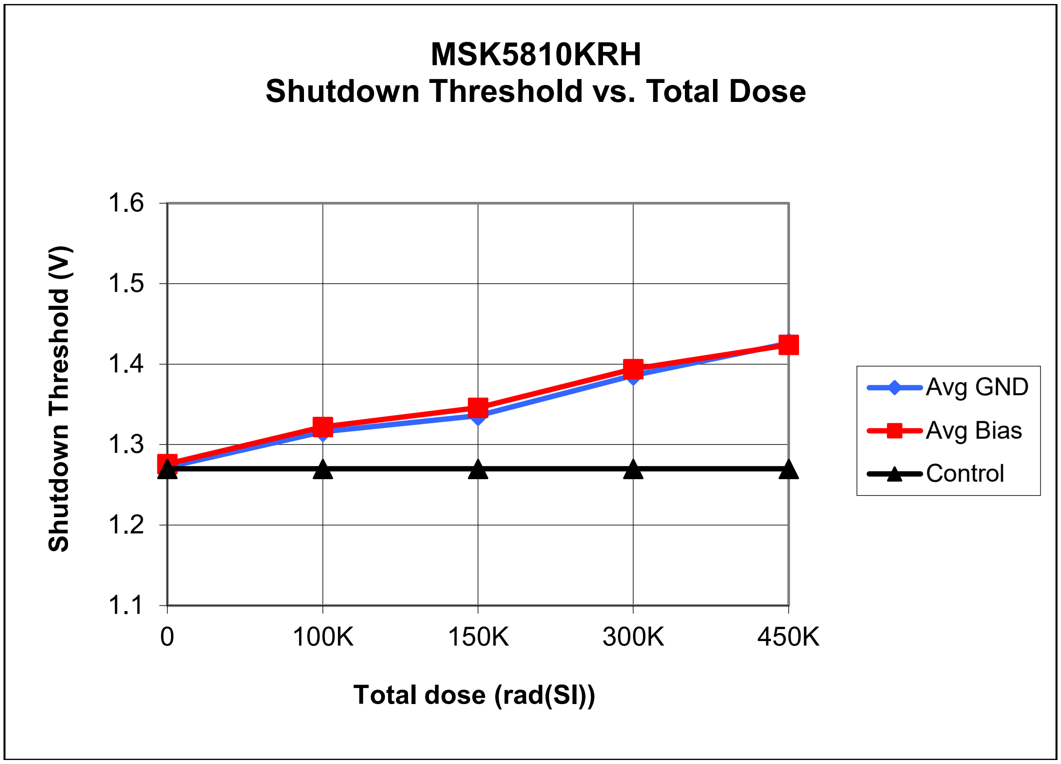
Table 1

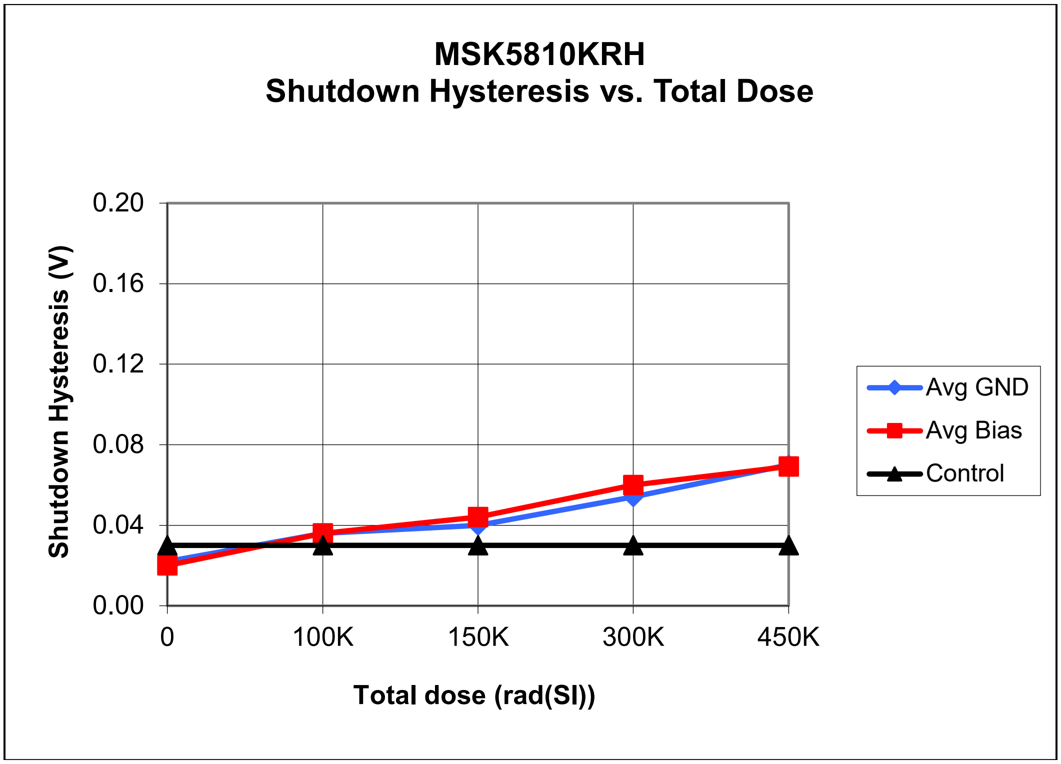
Dose Time, Incremental Dose and Total Cumulative Dose

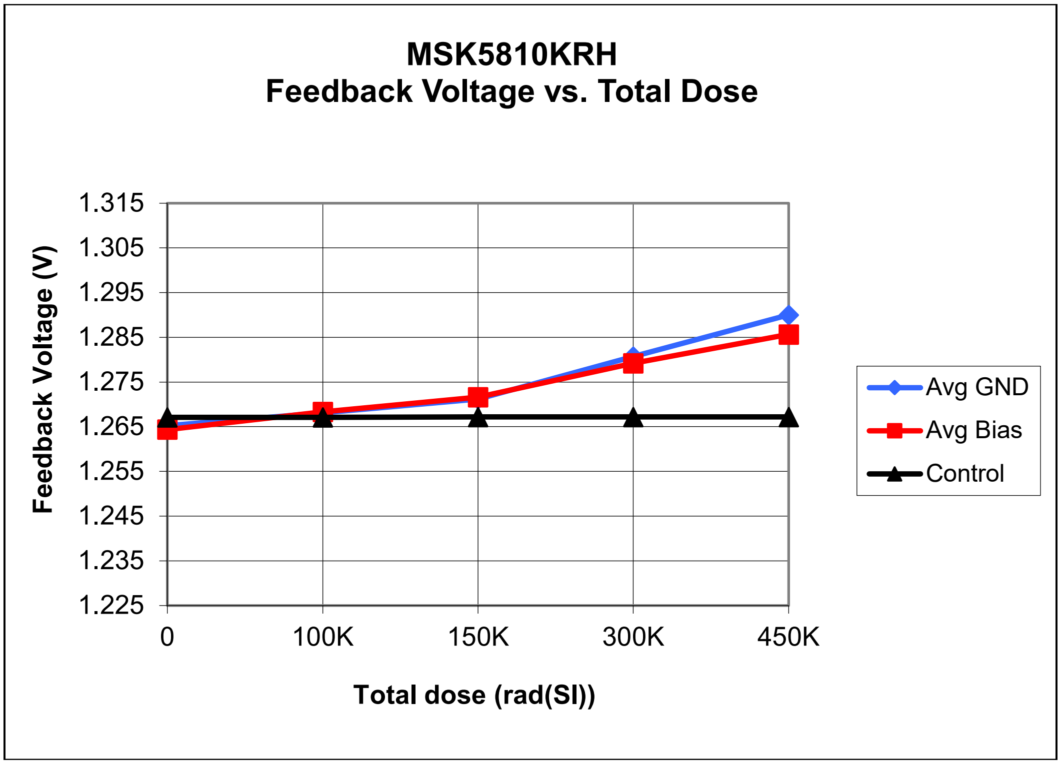

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

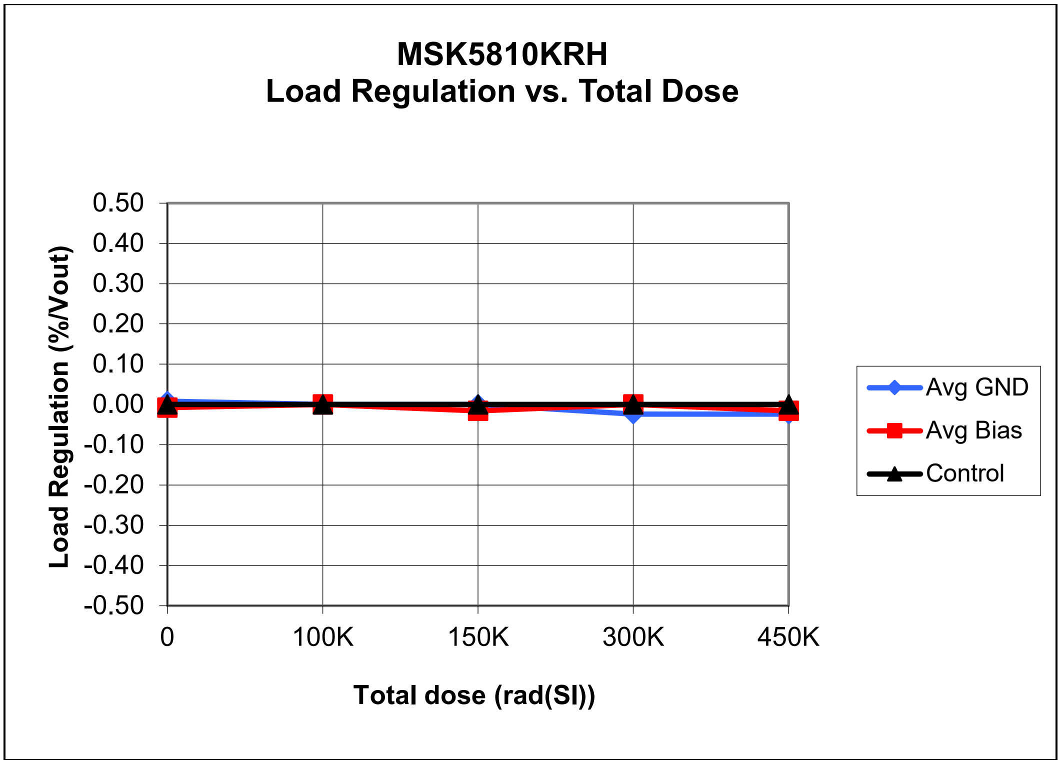

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
2.0
1.8
1.6
1.4
1.2
1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

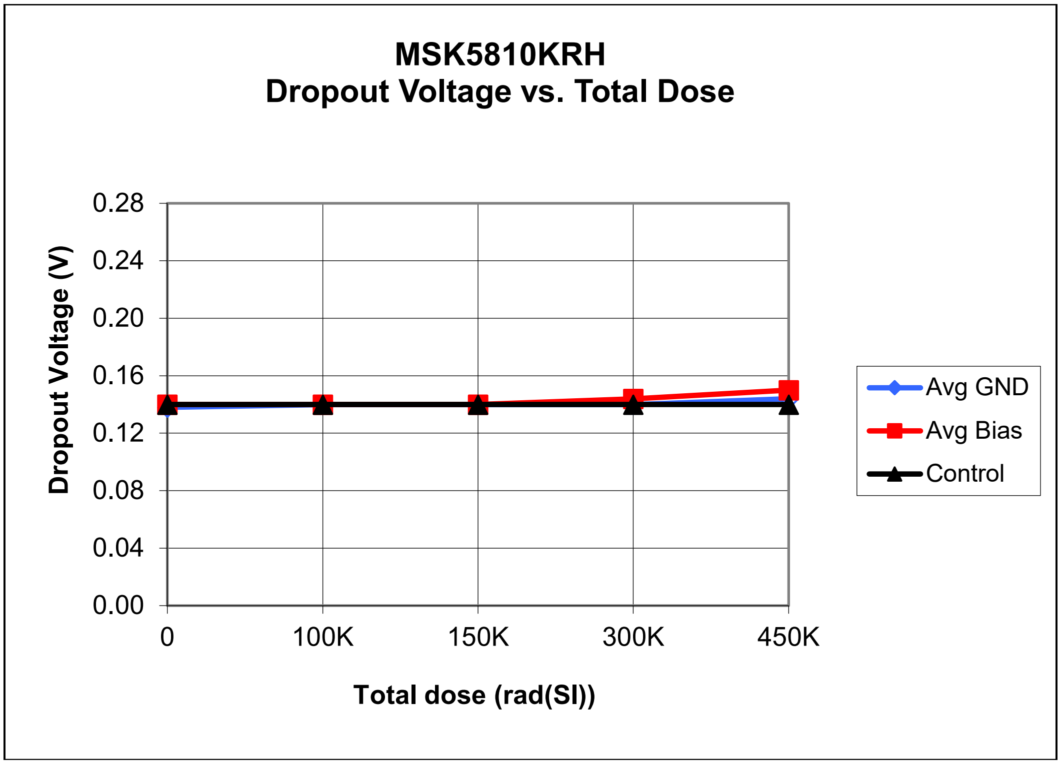

MSK5810KRH
Line Regulation vs. Total Dose
Line Regulation (%/Volt)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

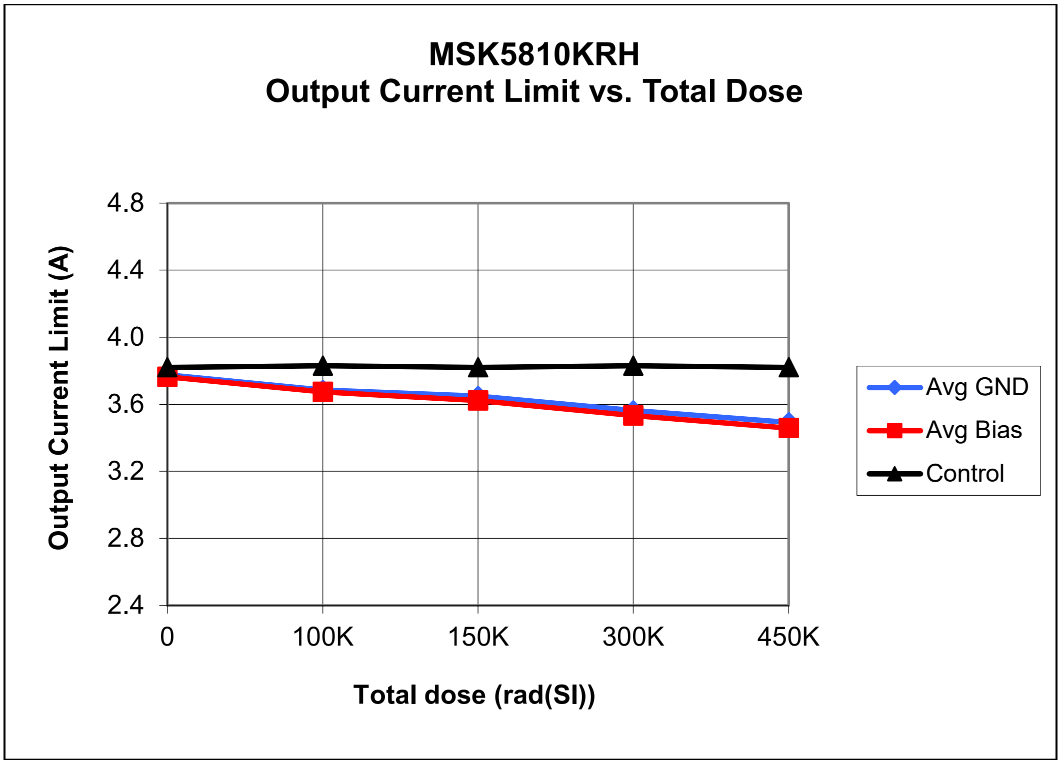

MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.6
1.5
1.4
1.3
1.2
1.1
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.315
1.305
1.295
1.285
1.275
1.265
1.255
1.245
1.235
1.225
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Load Regulation vs. Total Dose
Load Regulation (%/Vout)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.8
4.4
4.0
3.6
3.2
2.8
2.4
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: June 14, 2013

Test Vehicle: MSK5810RH

IC Wafer Lot: WD0051441 #9

Transistor Wafer Lot: CJ302831 #21

B. Horton
C. Salce
P. Dinneen

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 93 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
6/14/13

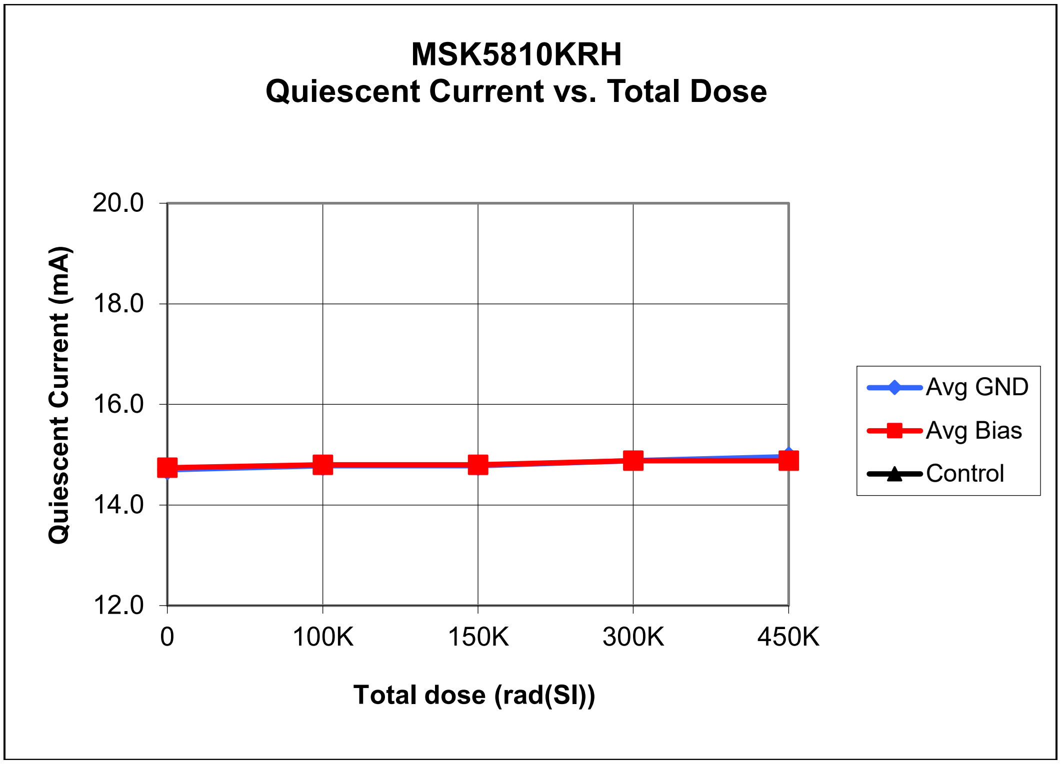
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
18:28	103,044	103,044
9:14	51,522	154,566
27:42	154,566	309,132
27:42	154,566	463,698

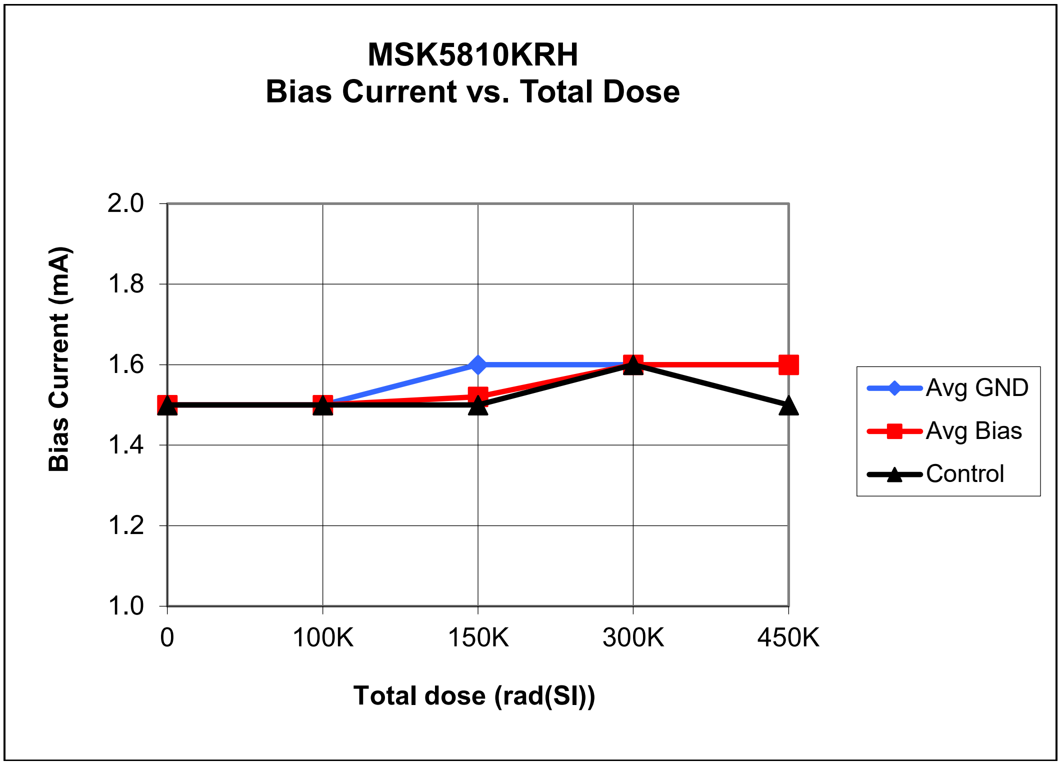
Biased S/N – 0991, 0992, 0993, 0994, 0995

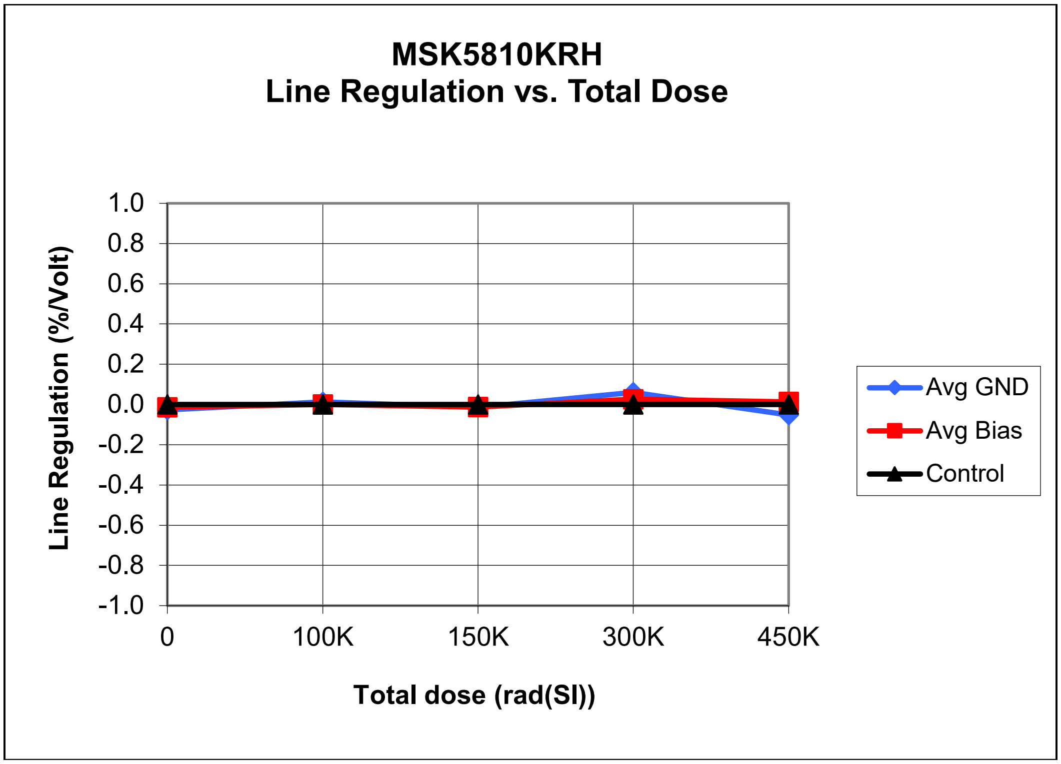
Unbiased S/N – 0996, 0997, 0998, 0999, 1000

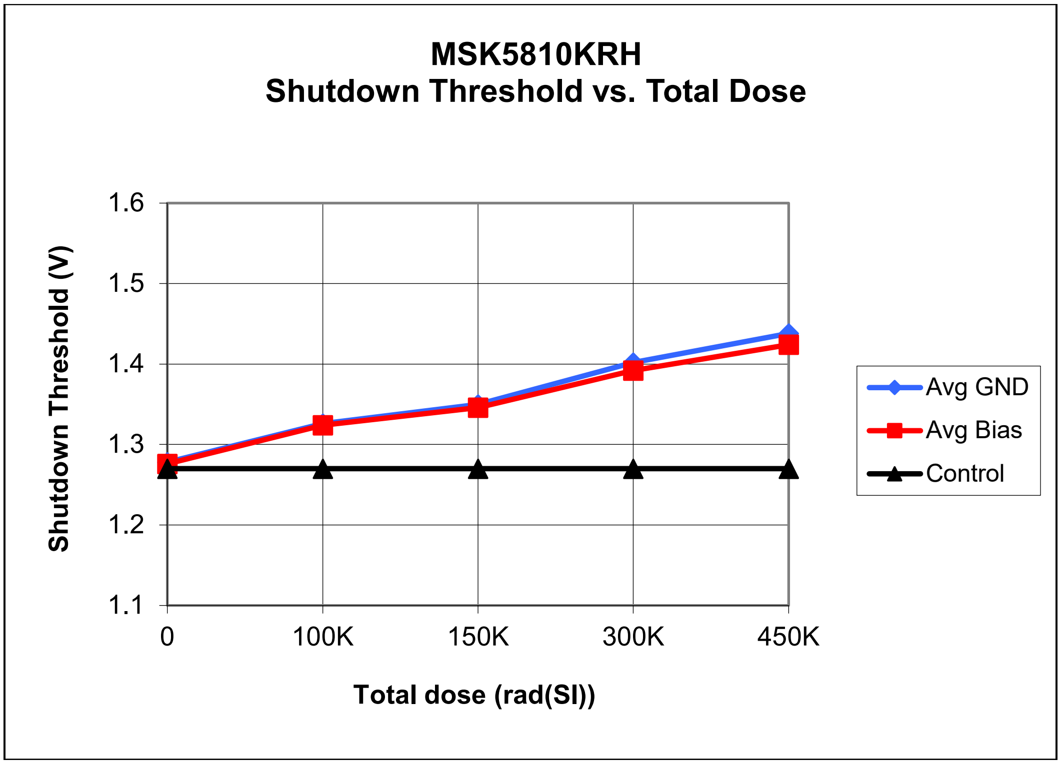
Table 1

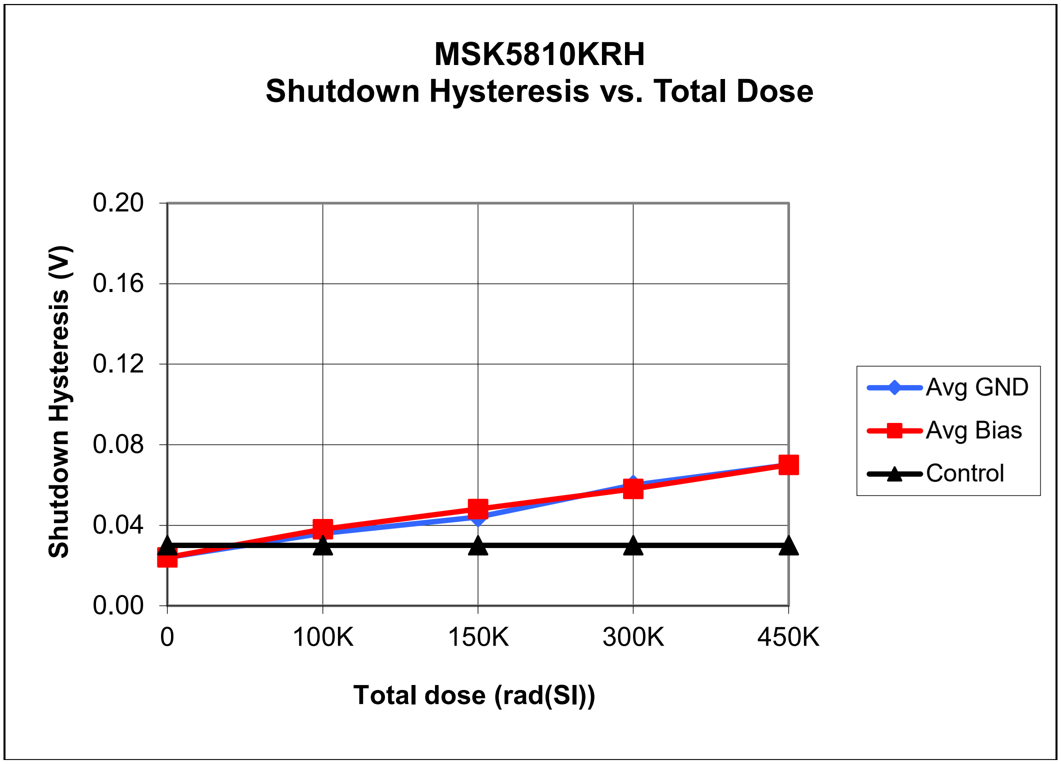
Dose Time, Incremental Dose and Total Cumulative Dose

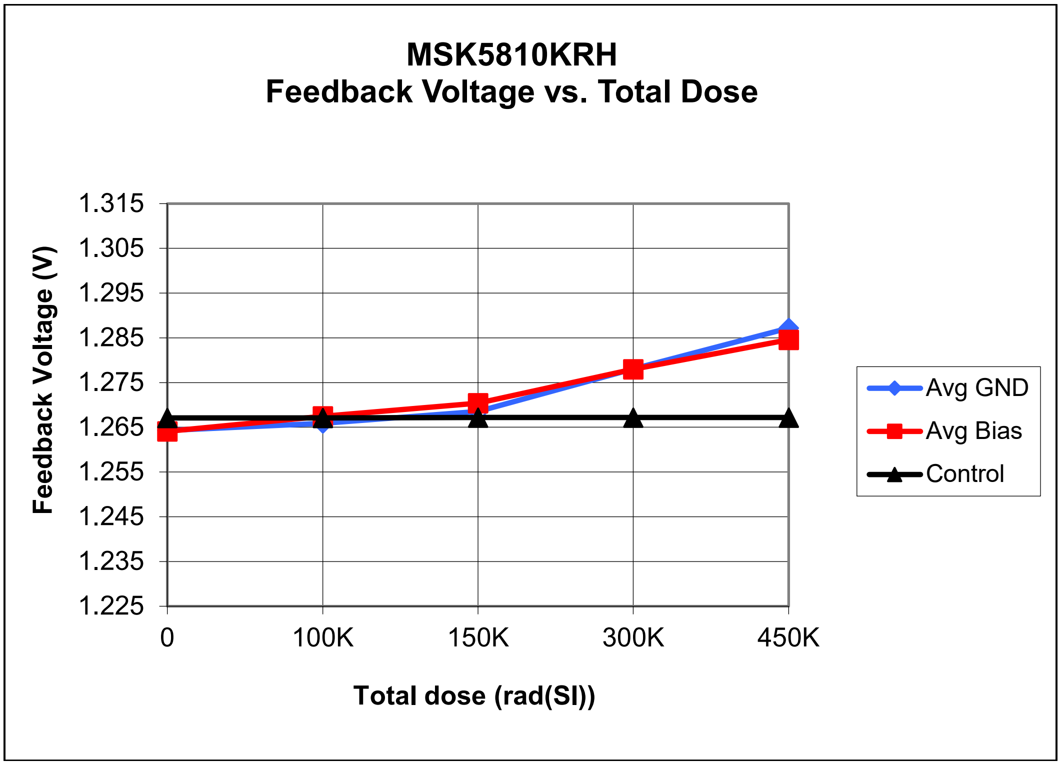

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

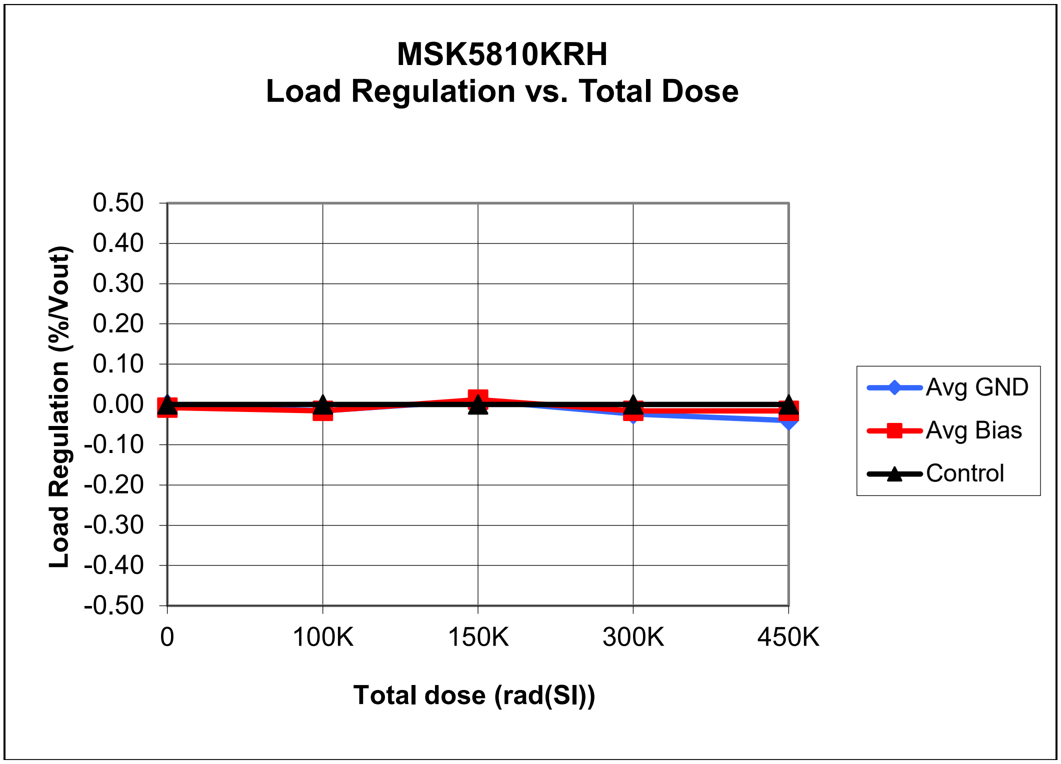

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
2.0
1.8
1.6
1.4
1.2
1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

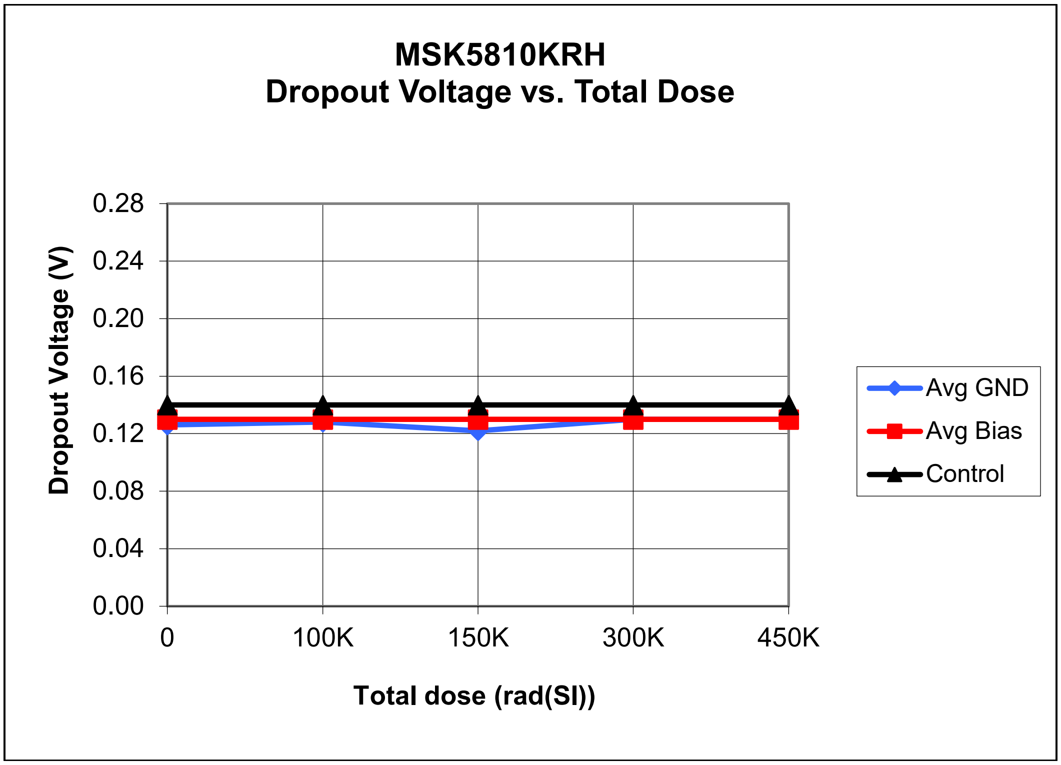

MSK5810KRH
Line Regulation vs. Total Dose
Line Regulation (%/Volt)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

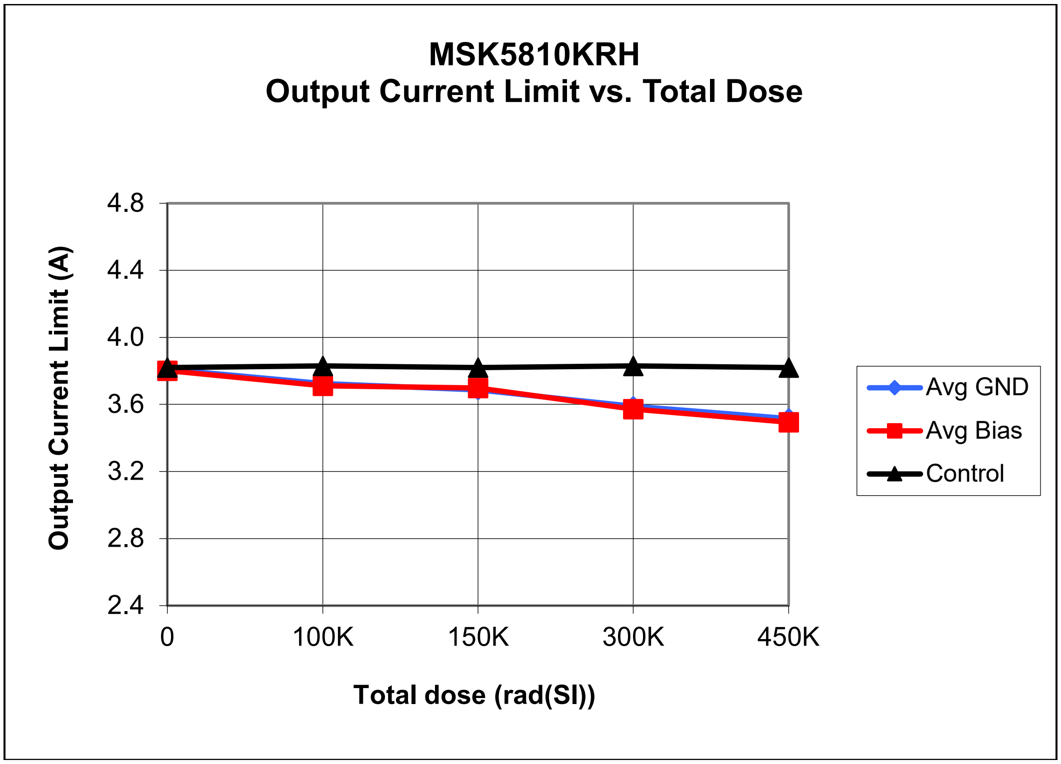

MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.6
1.5
1.4
1.3
1.2
1.1
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.315
1.305
1.295
1.285
1.275
1.265
1.255
1.245
1.235
1.225
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Load Regulation vs. Total Dose
Load Regulation (%/Vout)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.8
4.4
4.0
3.6
3.2
2.8
2.4
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: November 6, 2013

Test Vehicle: MSK5810H

IC Wafer Lot: W10809524.1 #8

Transistor Lot: CJ302831RC #20

B. Horton
R. Wakeman

M.S. Kennedy Corporation
Liverpool, NY

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 88 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
11/6/13

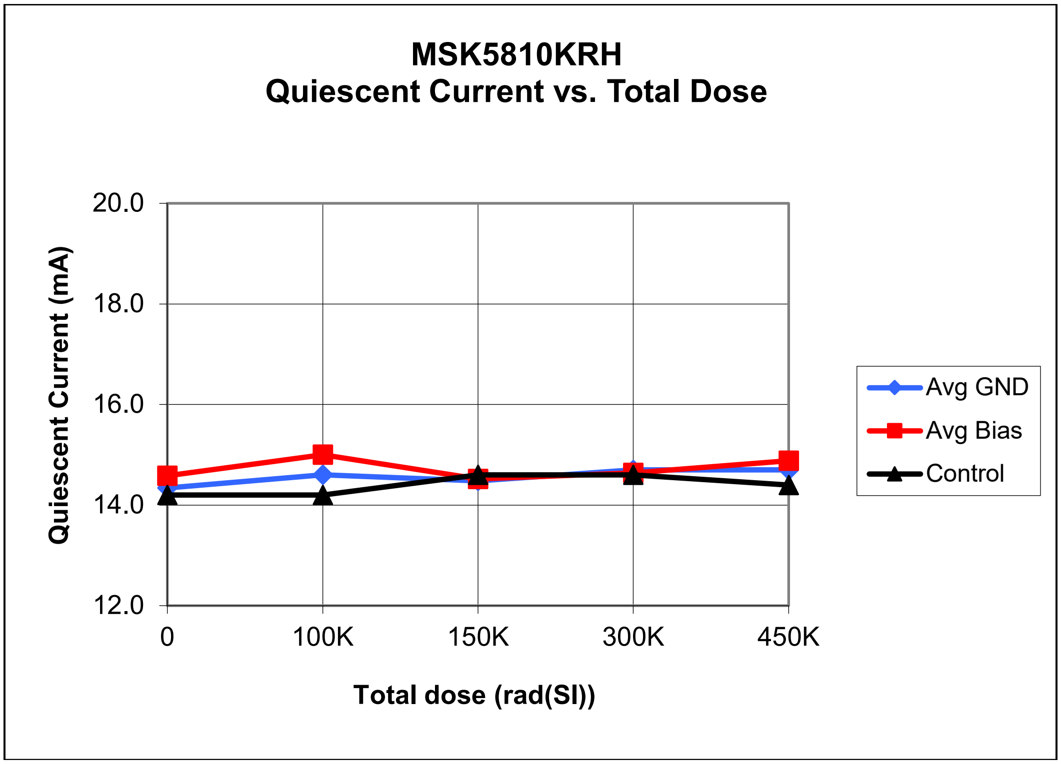
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
0:19:31	103,048	103,048
0:09:46	51,568	154,616
0:29:16	154,528	309,144
0:29:16	154,528	463,672

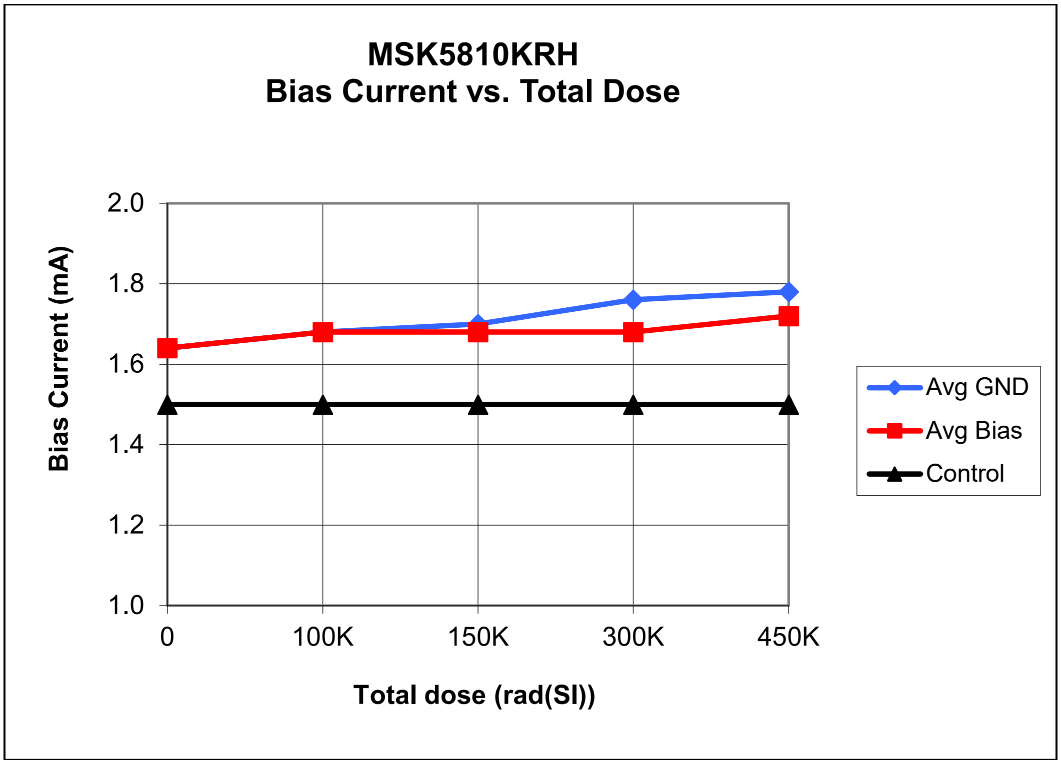
Biased S/N – 1072, 1073, 1075, 1076, 1077

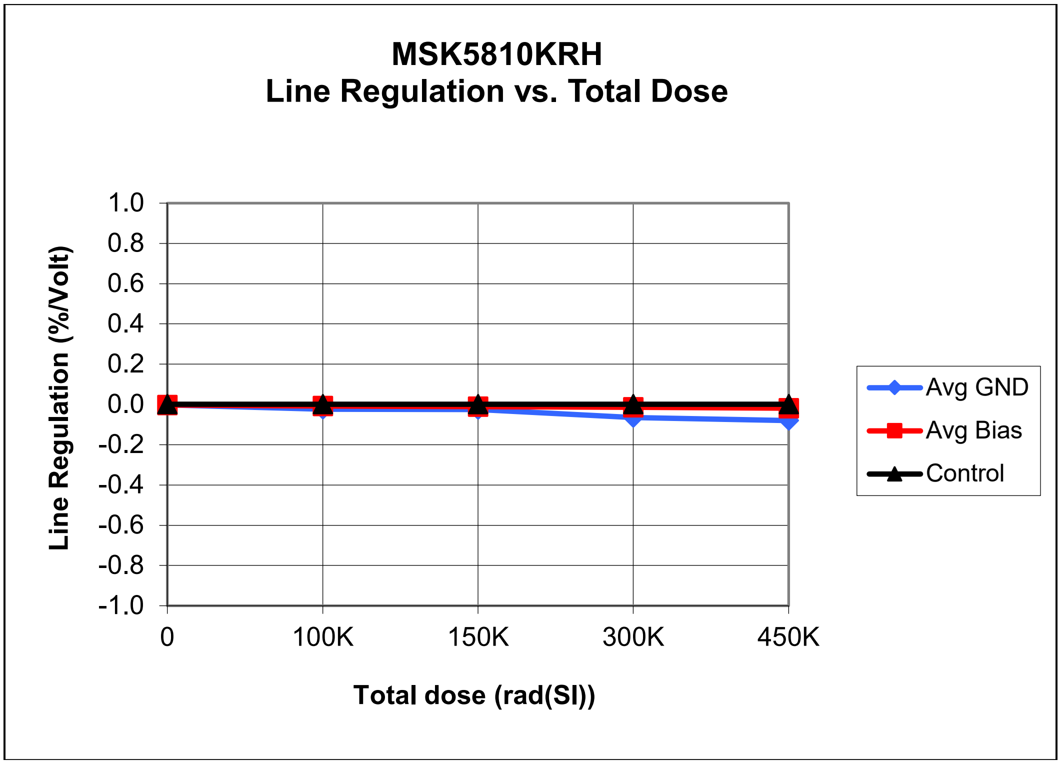
Unbiased S/N – 1078, 1079, 1080, 1081, 1082

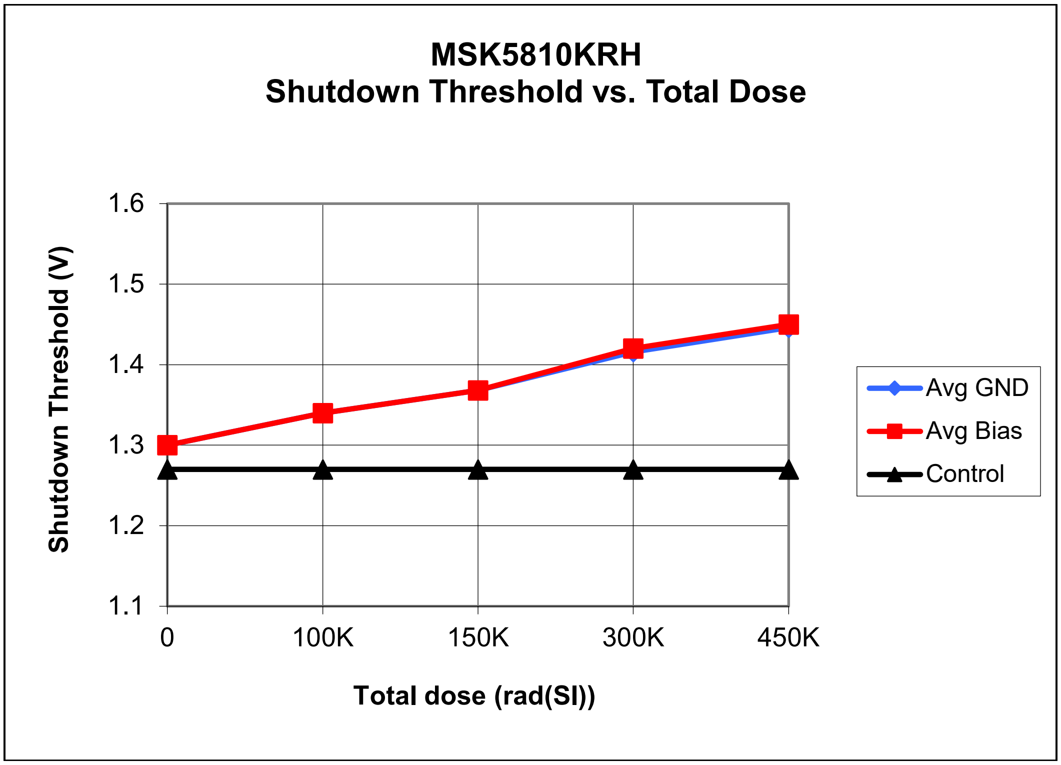
Table 1

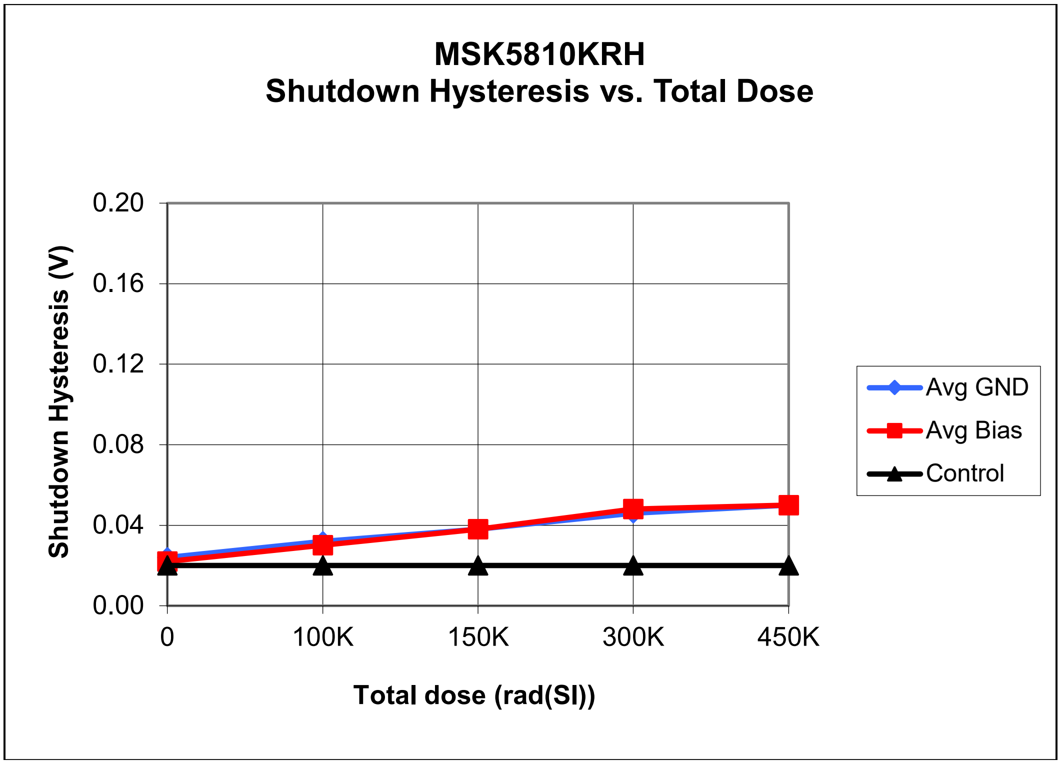
Dose Time, Incremental Dose and Total Cumulative Dose

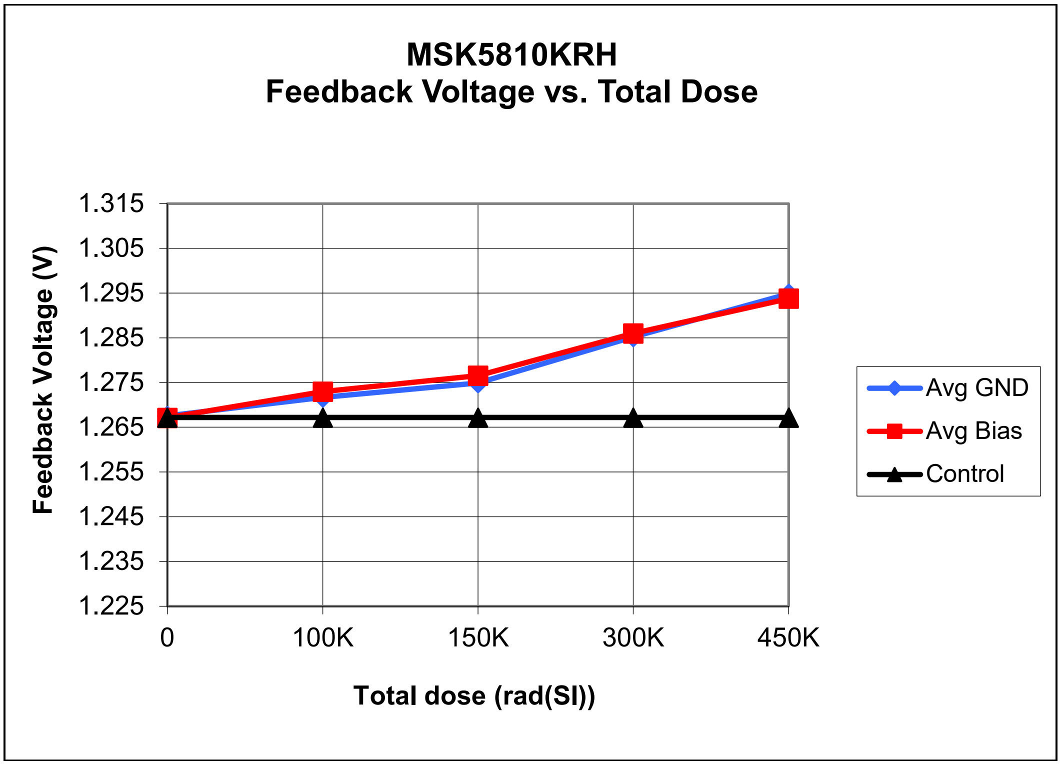

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

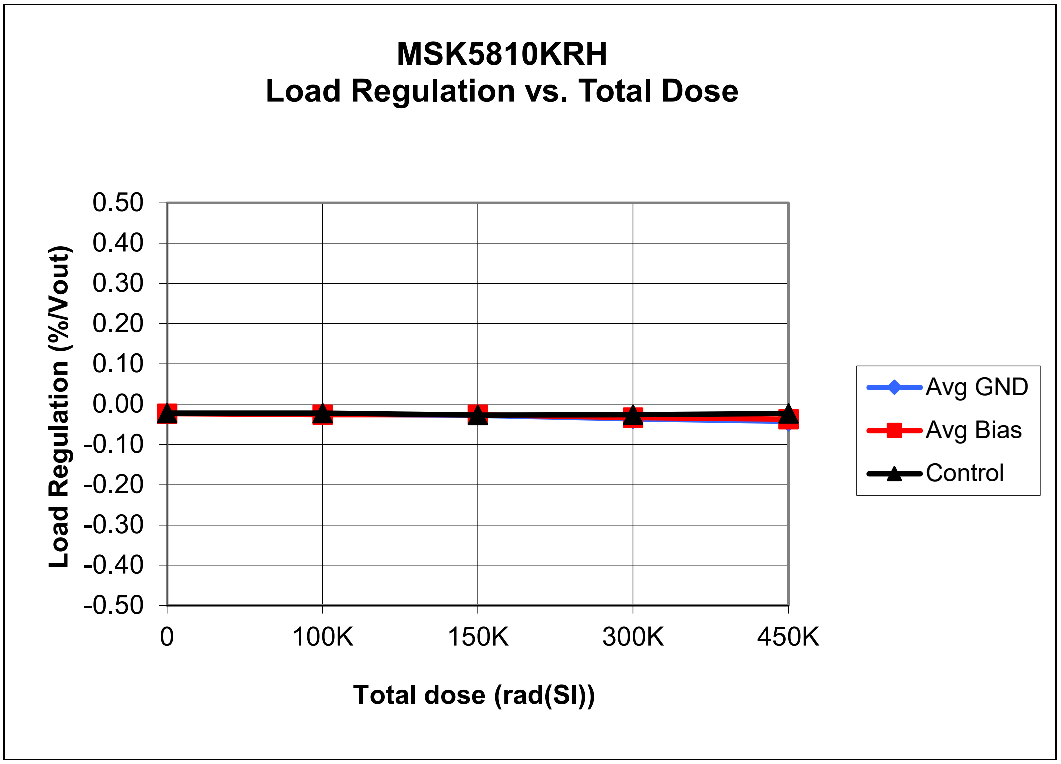

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
2.0
1.8
1.6
1.4
1.2
1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

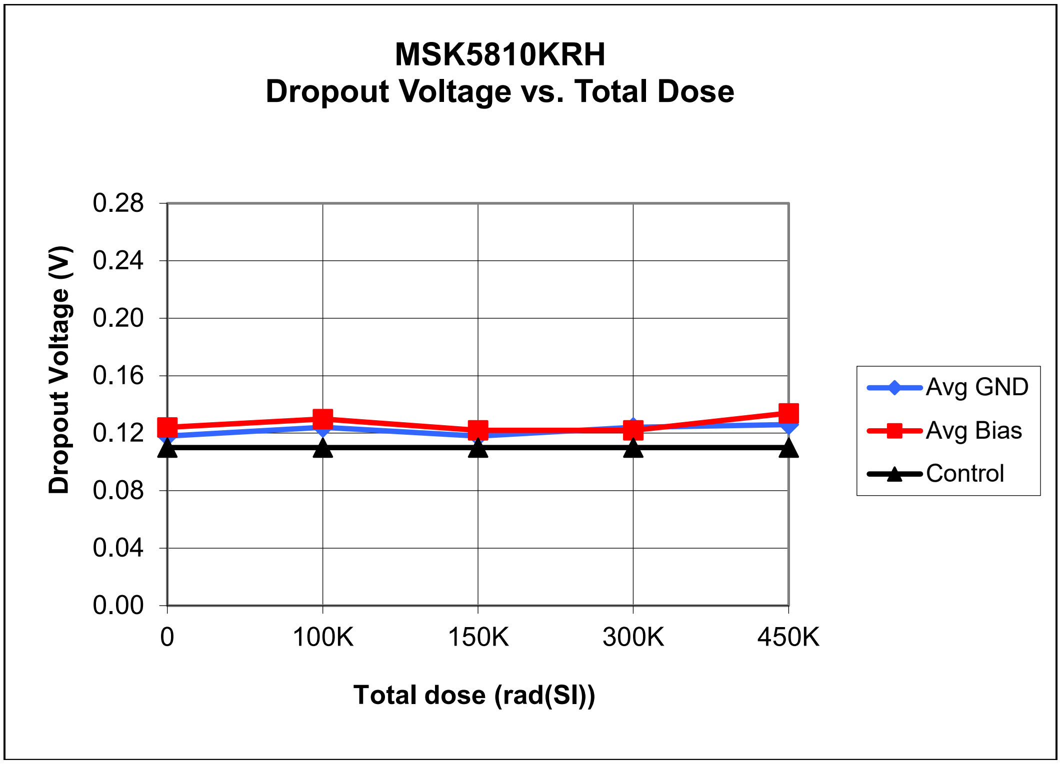

MSK5810KRH
Line Regulation vs. Total Dose
Line Regulation (%/Volt)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

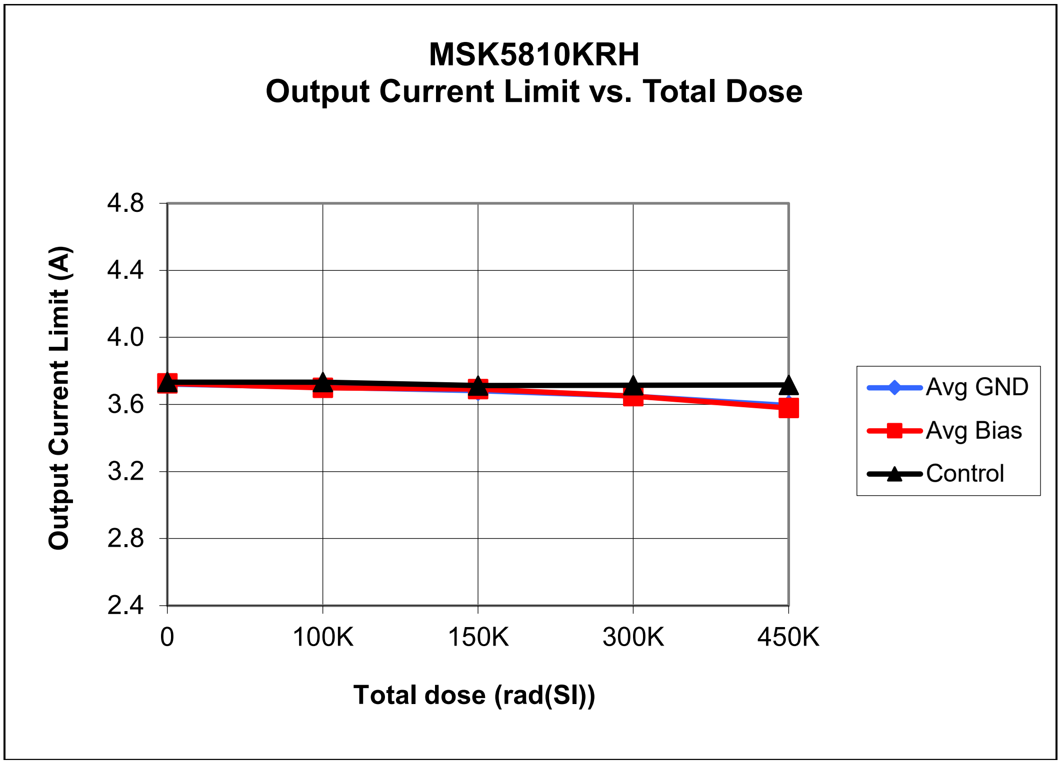

MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.6
1.5
1.4
1.3
1.2
1.1
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.315
1.305
1.295
1.285
1.275
1.265
1.255
1.245
1.235
1.225
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Load Regulation vs. Total Dose
Load Regulation (%/Vout)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.8
4.4
4.0
3.6
3.2
2.8
2.4
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: August 28, 2015

Test Vehicle: MSK5810RH

IC Wafer Lot: WP005144.1

Transistor Wafer Lot: P741F1002 #21

B. Horton
C. Salce

MSK Products, Anaren Inc.

I. Introduction:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 109 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 MSK.

V. Summary:

Based on the test data recorded during radiation testing, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
8/28/15

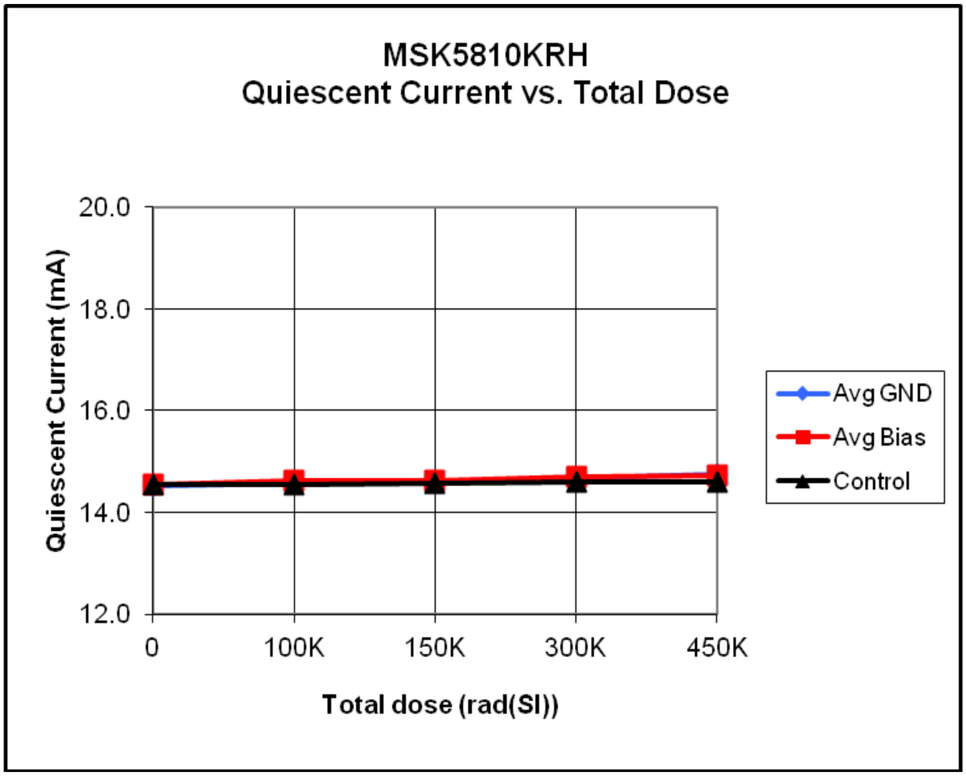
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
15:45	103,005	103,005
07:53	51,557	154,562
23:38	154,562	309,124
23:38	154,562	463,686

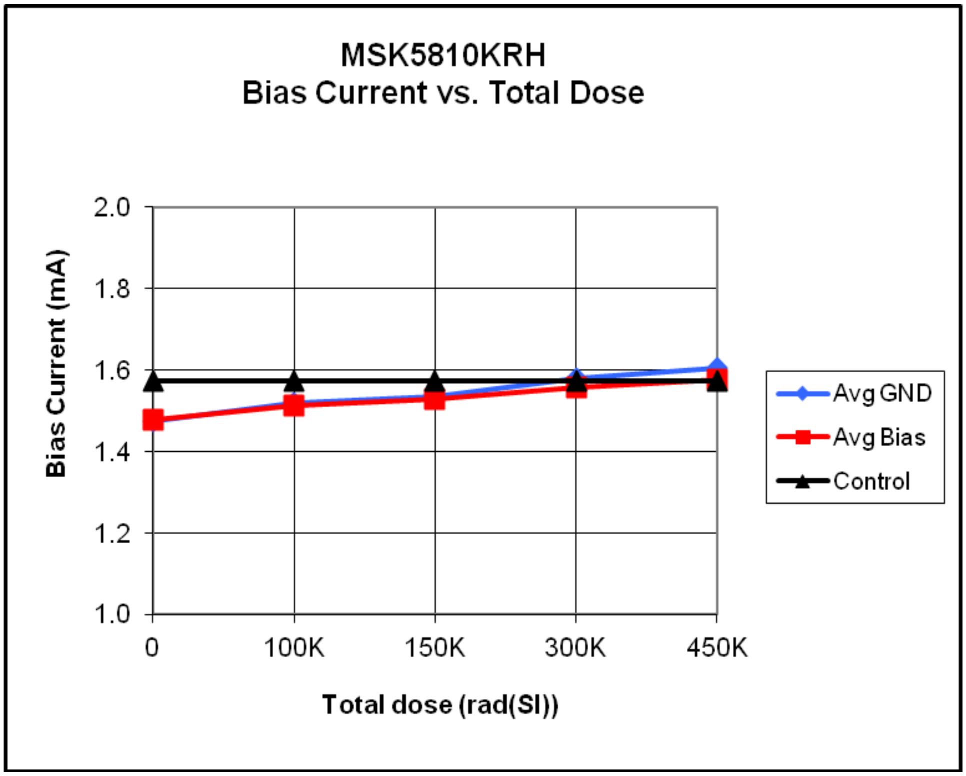
Biased S/N – 1228, 1229, 1230, 1232, 1233

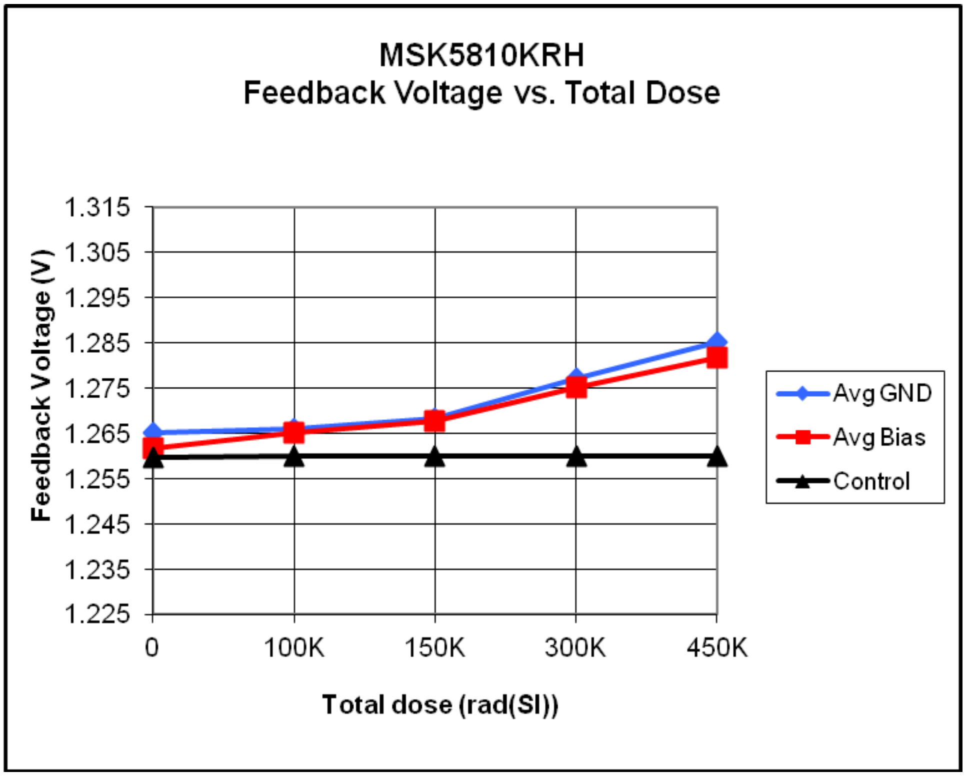
Unbiased S/N – 1234, 1235, 1236, 1237, 1238

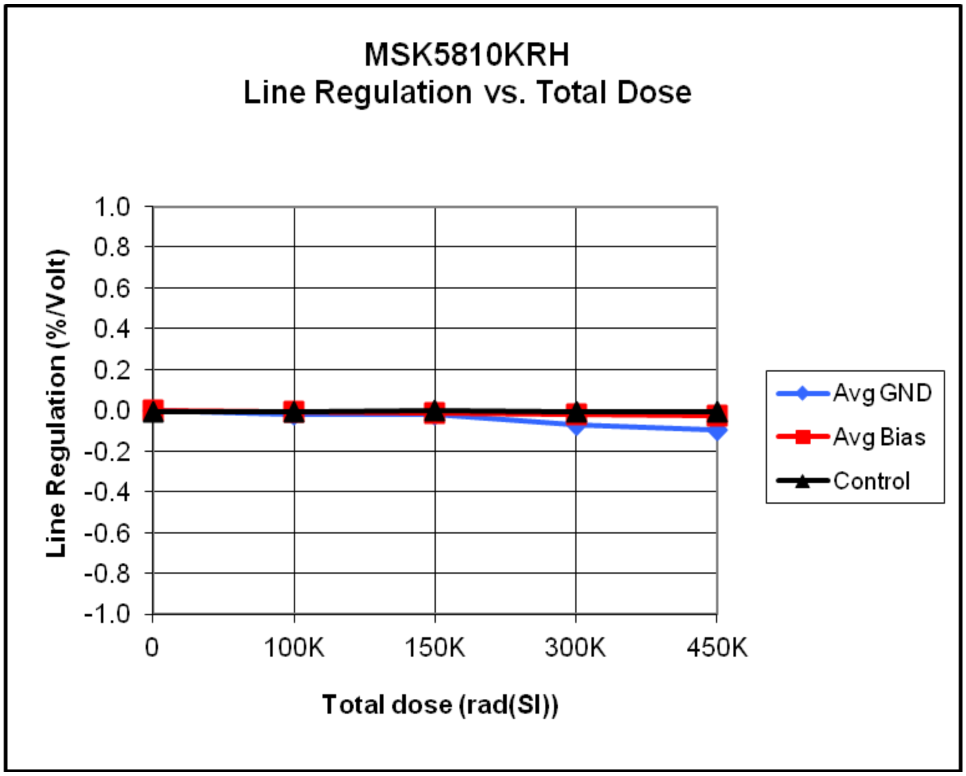
Table 1

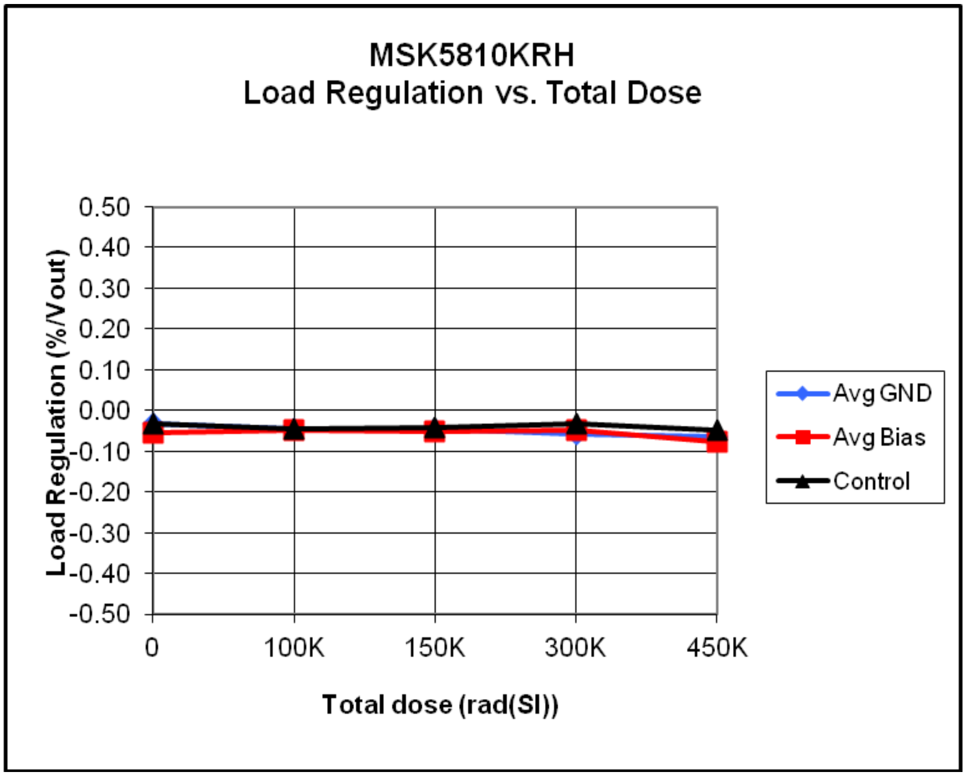
Dose Time, Incremental Dose and Total Cumulative Dose

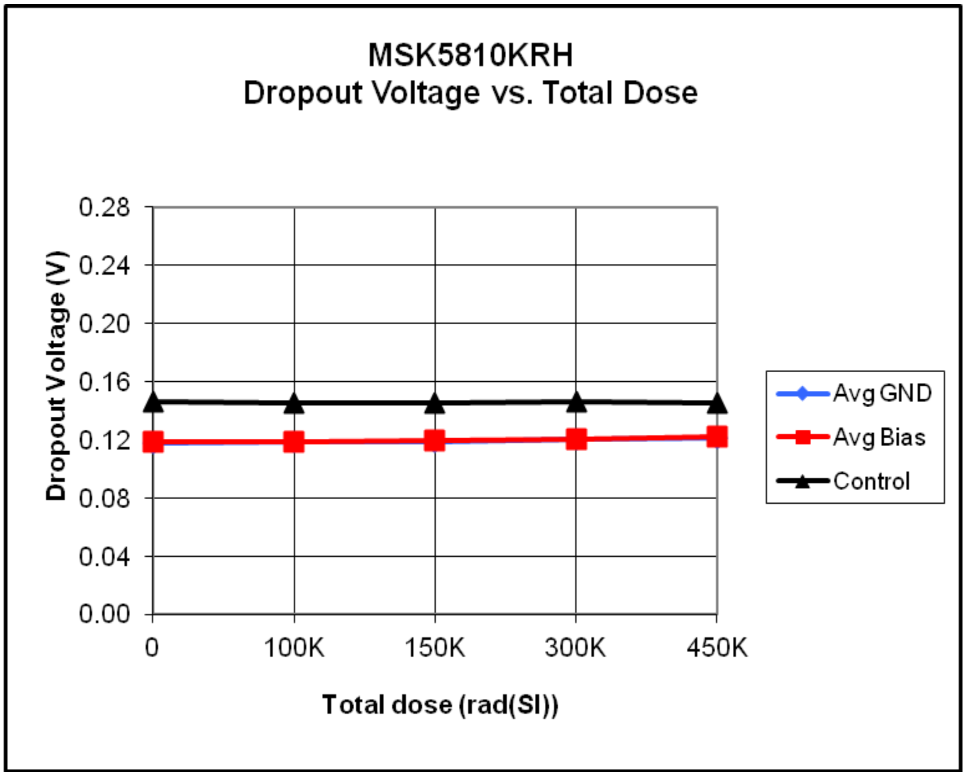

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
20.0
18.0
16.0
14.0
12.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

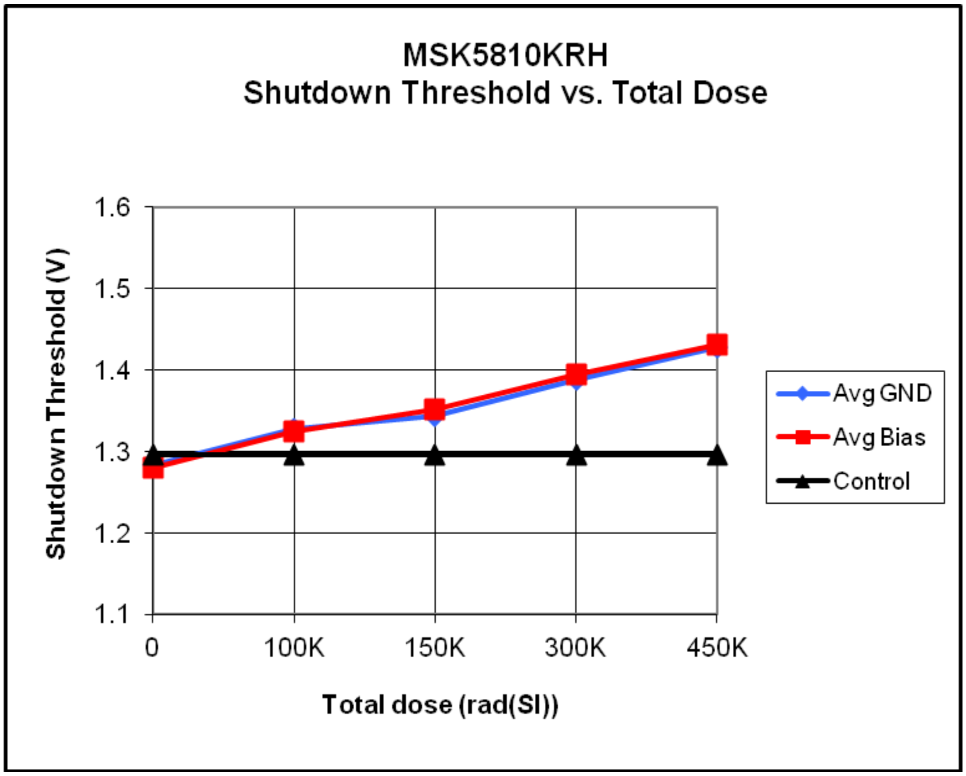

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
2.0
1.8
1.6
1.4
1.2
1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

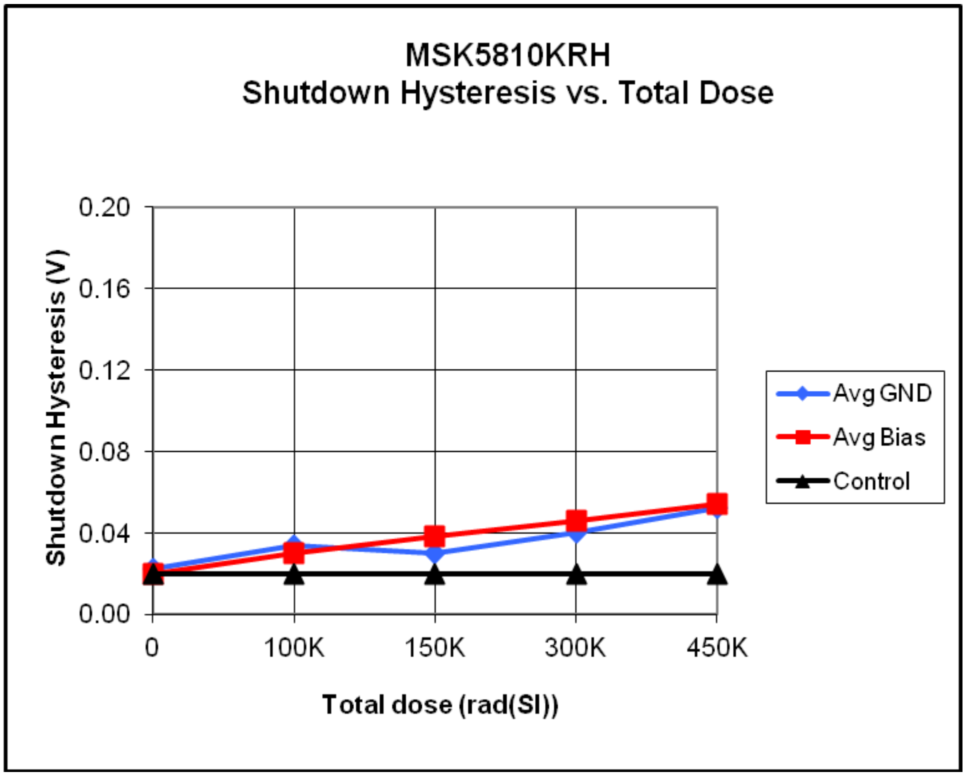

MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.315
1.305
1.295
1.285
1.275
1.265
1.255
1.245
1.235
1.225
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

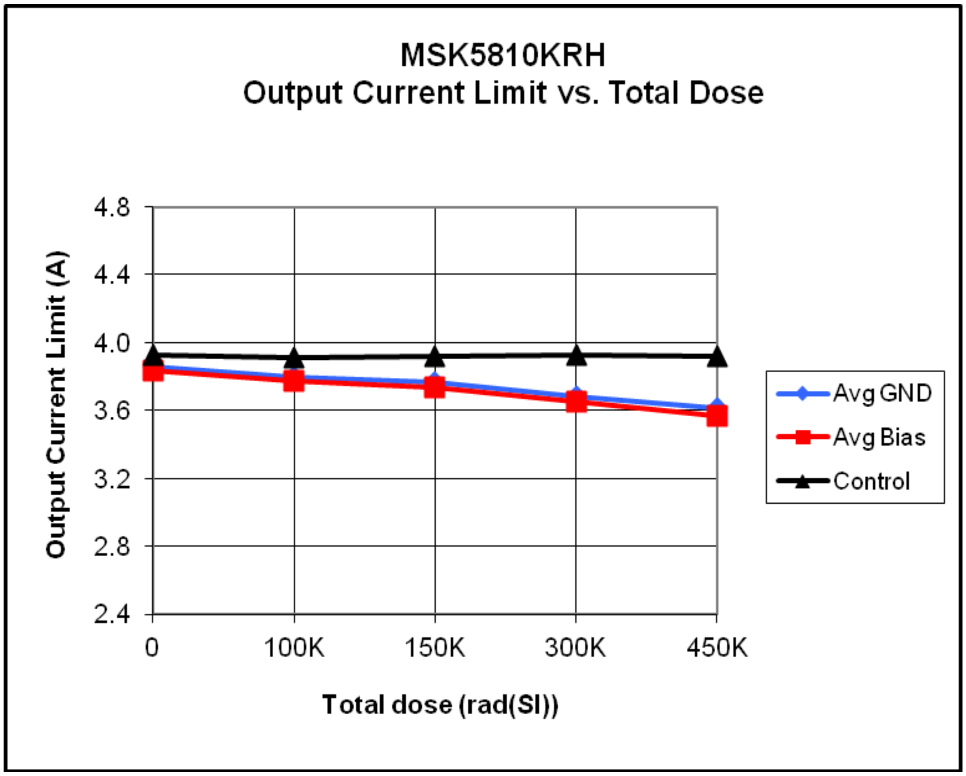

MSK5810KRH
Line Regulation vs. Total Dose
Line Regulation (%/Volt)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Load Regulation vs. Total Dose
Load Regulation (%/Vout)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.6
1.5
1.4
1.3
1.2
1.1
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control


MSK5810KRH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.8
4.4
4.0
3.6
3.2
2.8
2.4
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: November 8, 2016

Test Vehicle: MSK5810RH

IC Wafer Lot: WP005144.1 #9

Transistor Lot: PF01F1005 #6

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

MSK Products – Anaren Inc.

I. Introduction:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 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 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 Anaren Inc. – MSK Products.

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, the MSK5810RH qualified as a 300 KRAD (Si) radiation hardened device. Feedback Voltage, Shutdown Threshold, and Output Current Limit exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 KRAD (Si) TID

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
11/8/16

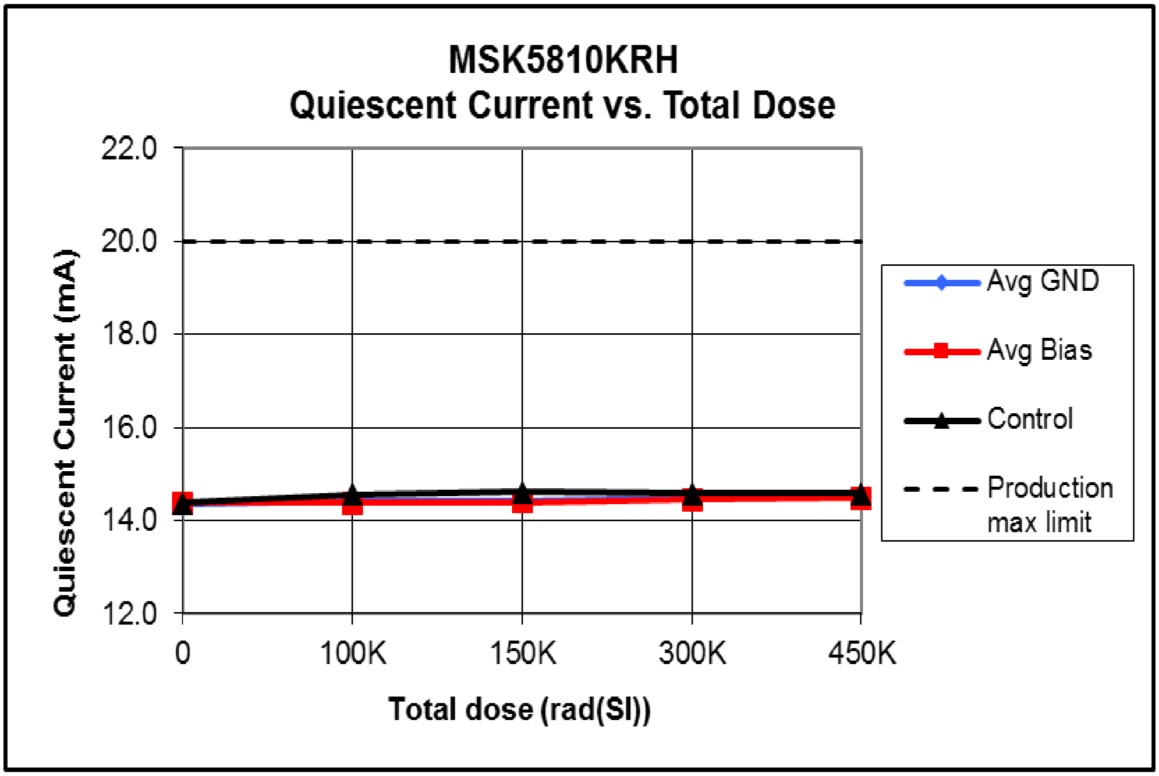
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
0:10:35	100,300	100,300
0:05:17	50,100	150,400
0:15:52	150,400	300,800
0:15:52	150,400	451,200

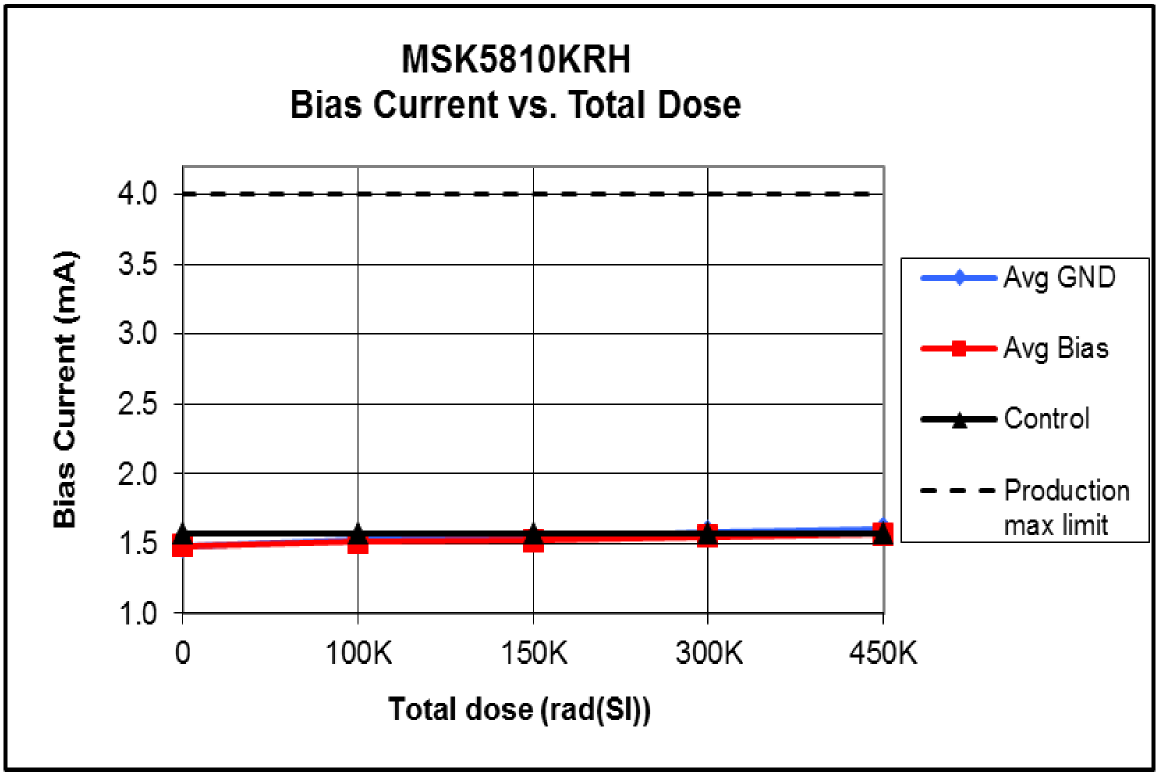
Biased S/N – 1344, 1345, 1346, 1347, 1348

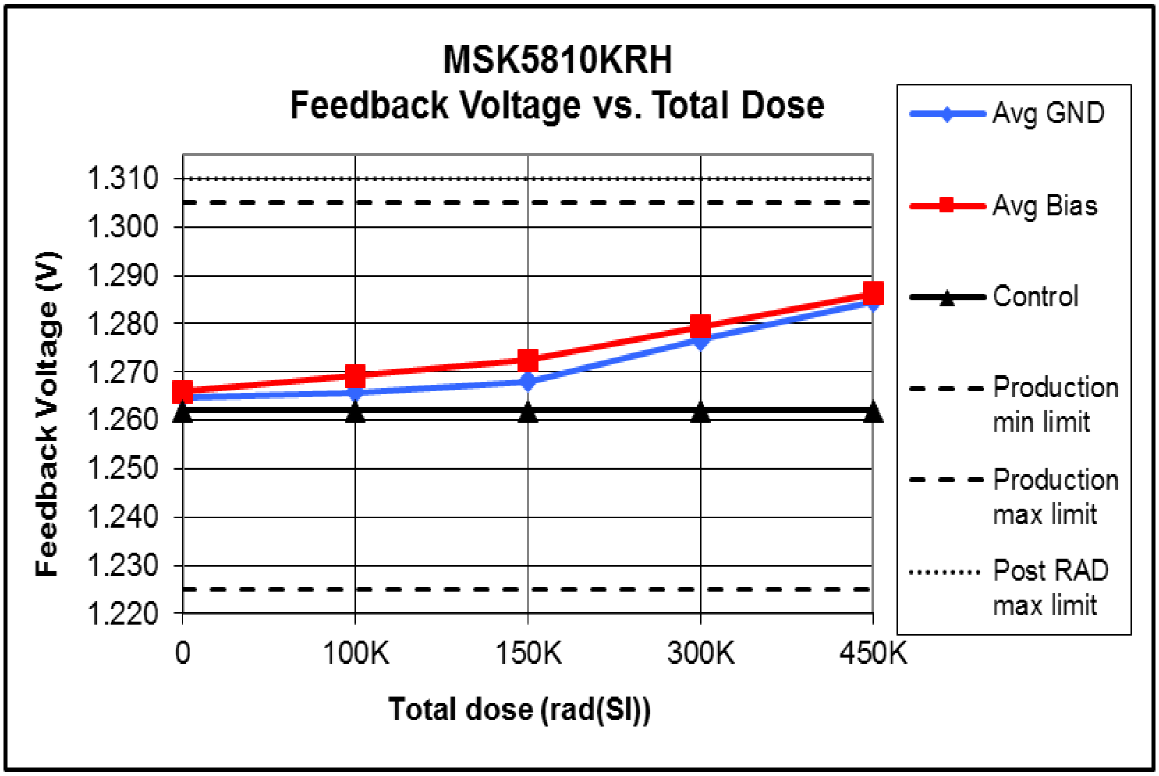
Unbiased S/N – 1349, 1350, 1351, 1352, 1353

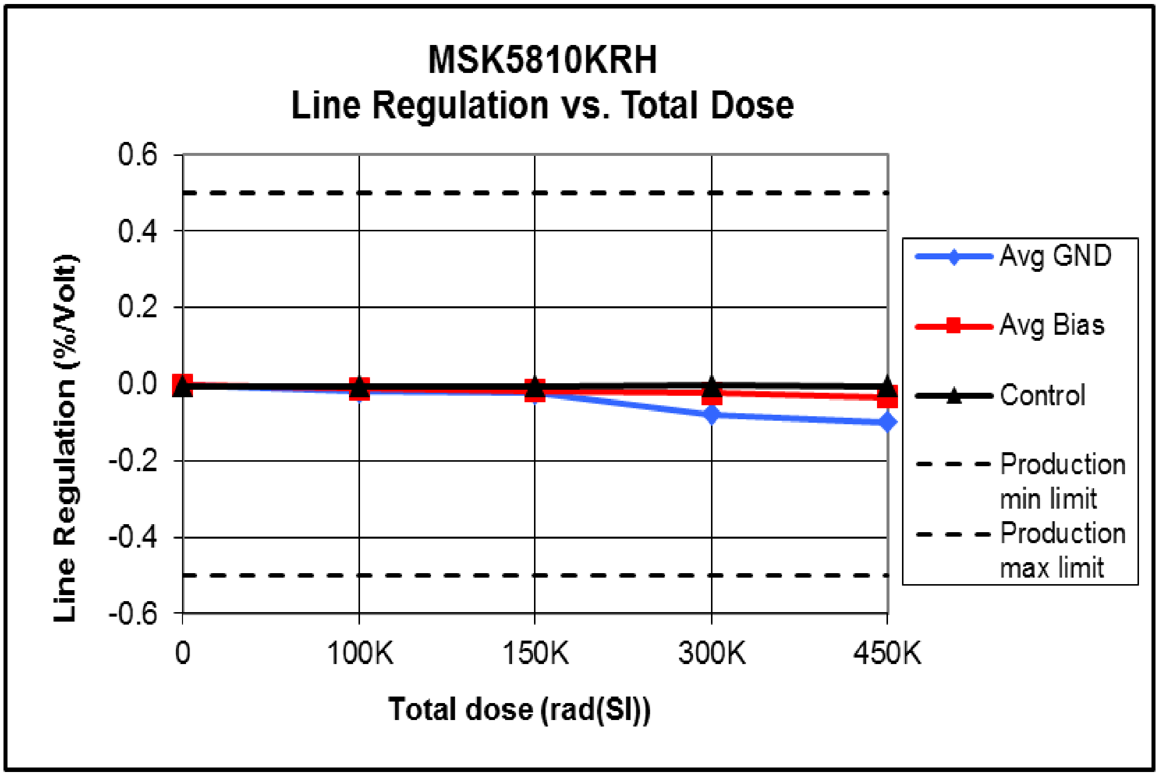
Table 1

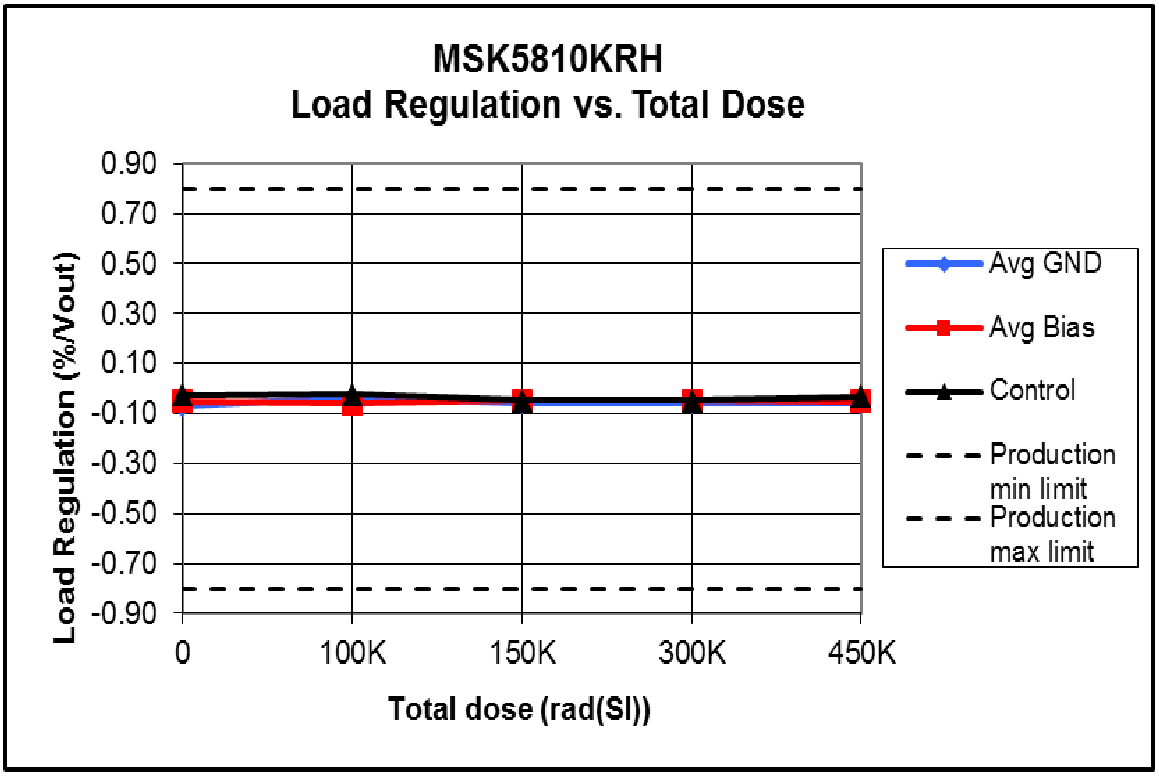
Dose Time, Incremental Dose and Total Cumulative Dose

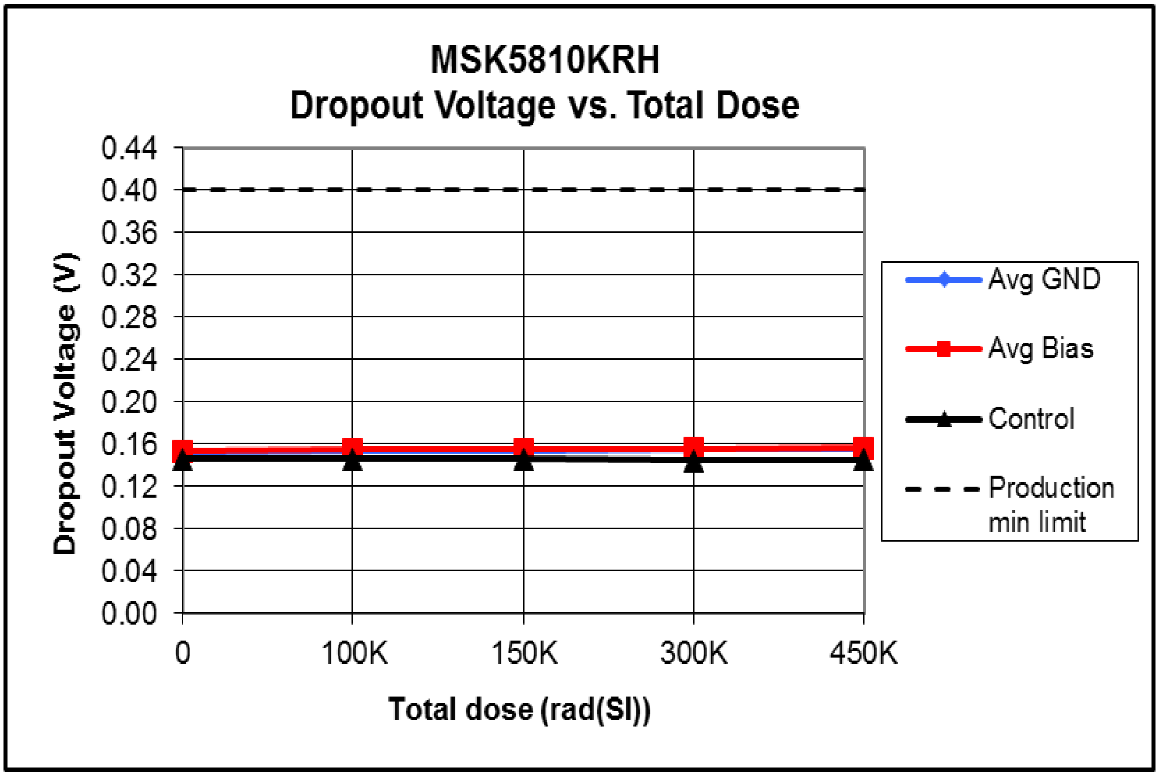

MSK5810KRH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
22.0
20.0
18.0
16.0
14.0
12.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production max limit

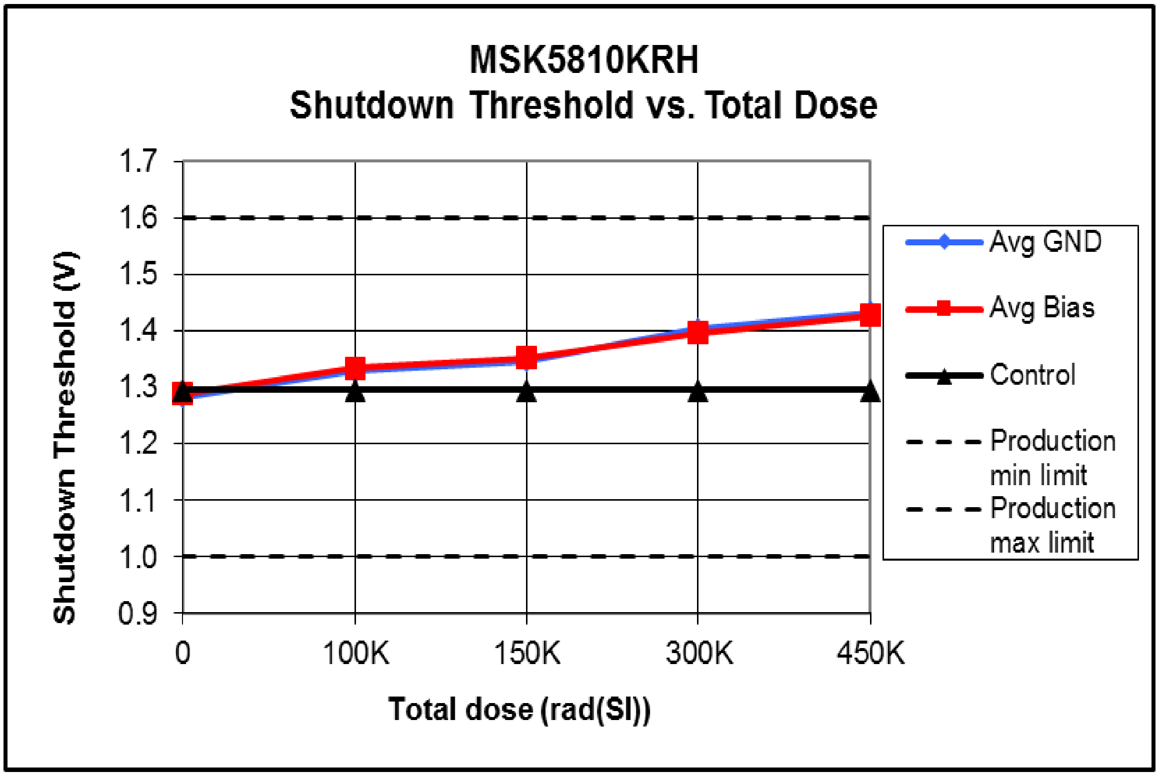

MSK5810KRH
Bias Current vs. Total Dose
Bias Current (mA)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production max limit

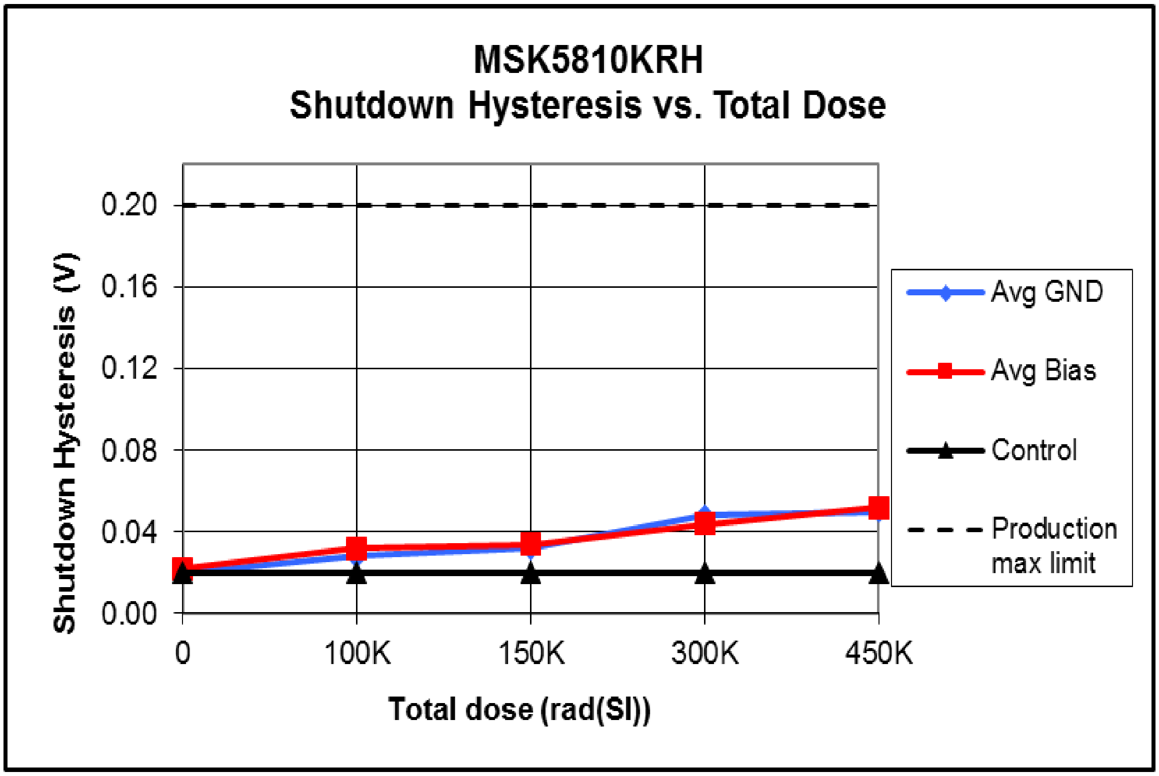

MSK5810KRH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.310
1.300
1.290
1.280
1.270
1.260
1.250
1.240
1.230
1.220
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production min limit
Production max limit
Post RAD max limit

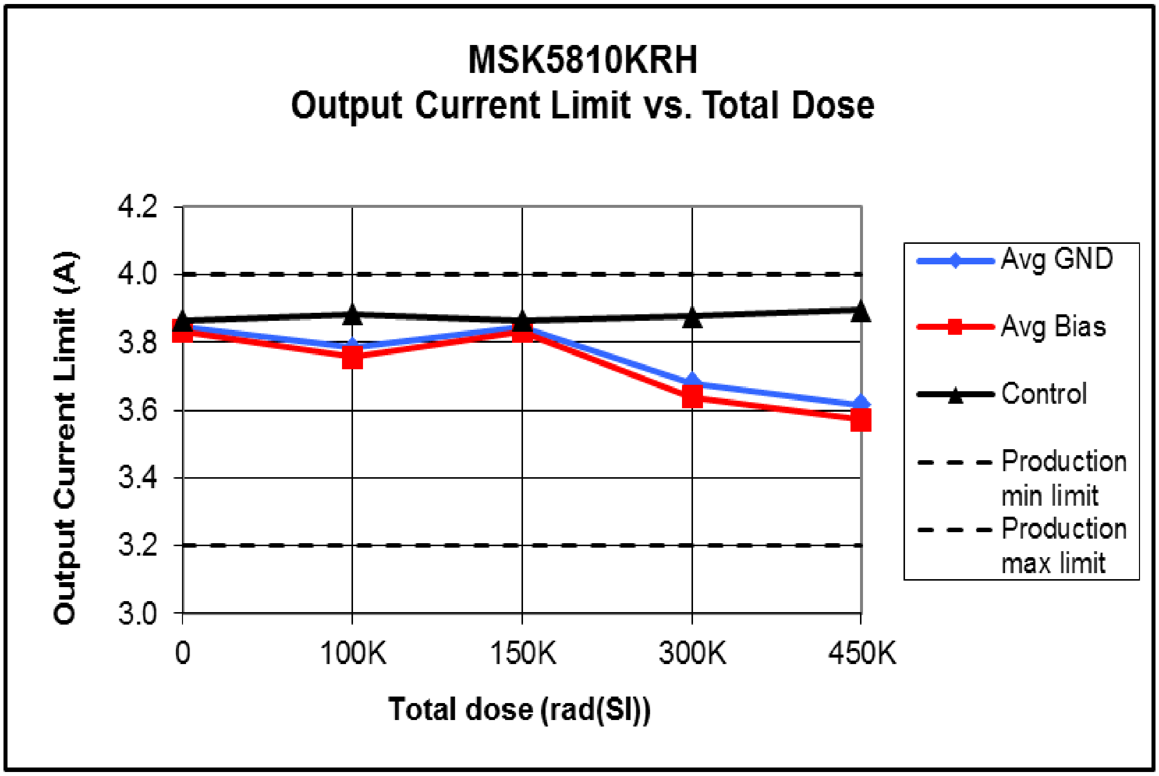

MSK5810KRH
Line Regulation vs. Total Dose
Line Regulation (%/Volt)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production min limit
Production max limit


MSK5810KRH
Load Regulation vs. Total Dose
Load Regulation (%/Vout)
0.90
0.70
0.50
0.30
0.10
-0.10
-0.30
-0.50
-0.70
-0.90
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production min limit
Production max limit


MSK5810KRH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.44
0.40
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production min limit


MSK5810KRH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production min limit
Production max limit


MSK5810KRH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.20
0.16
0.12
0.08
0.04
0.00
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production max limit


MSK5810KRH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.2
4.0
3.8
3.6
3.4
3.2
3.0
0
100K
150K
300K
450K
Total dose (rad(SI))
Avg GND
Avg Bias
Control
Production min limit
Production max limit

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: March 29, 2017

Test Vehicle: MSK5810RH

IC Wafer Lot: WP005144.1 #8

Transistor Wafer Lot: PF01F1005 #6

B. Horton
P. Dinneen
N. Kresse

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MSK Products – Anaren Inc.

I. **Introduction**:

The total dose radiation test plan for the MSK 5810 RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 5810RH.

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 151 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, two control devices were tested at 25°C. Ten devices were then tested at 25°C, prior to irradiation, and were found to be within acceptable test limits.

The devices were vertically aligned with the radiation source and enclosed in a lead/aluminum container during irradiation. Five devices were biased during irradiation. Maximum recommended operating voltage of +7.5V 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 Anaren Inc. – MSK Products.

V. **Summary**:

Based on the test data recorded during radiation testing and statistical analysis, Feedback Voltage, Shutdown Threshold, and Shutdown Hysteresis exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

A Line Regulation data point was an outlier at 300 Krad(Si) but was within family at 100 Krad(Si) and 450 Krad(Si). We can conclude that this was a testing error and therefore removed the data point from the analysis.

MSK 5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
3/29/17

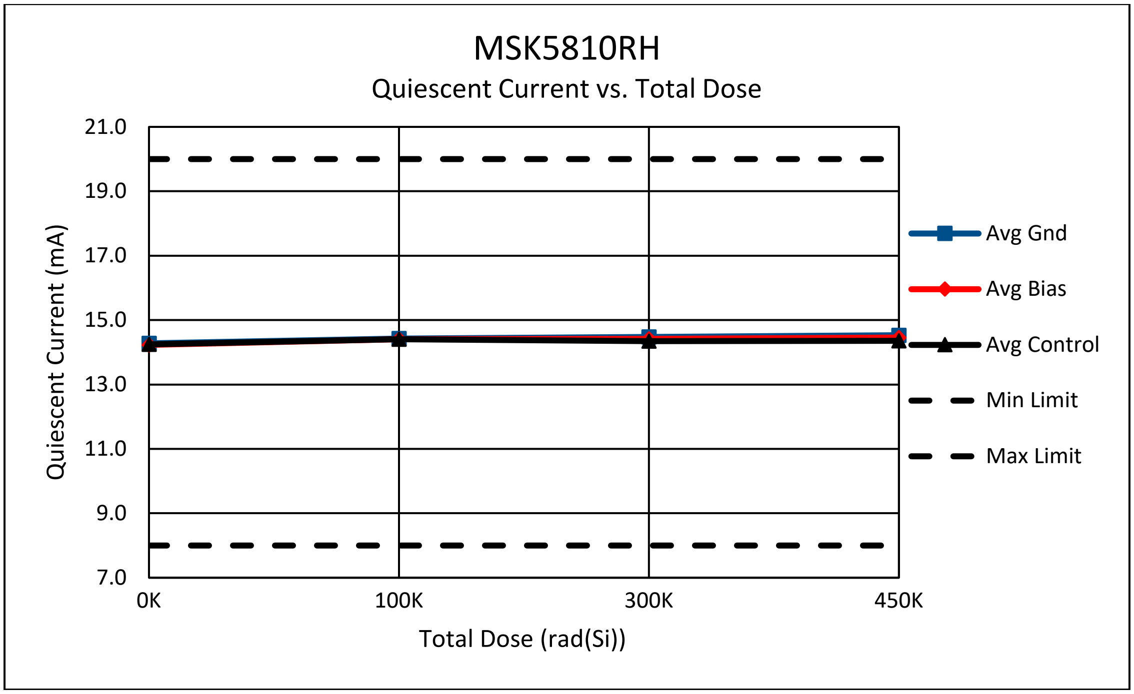
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
11:23	103,000	100,300
22:46	206,000	309,000
17:05	154,500	463,500

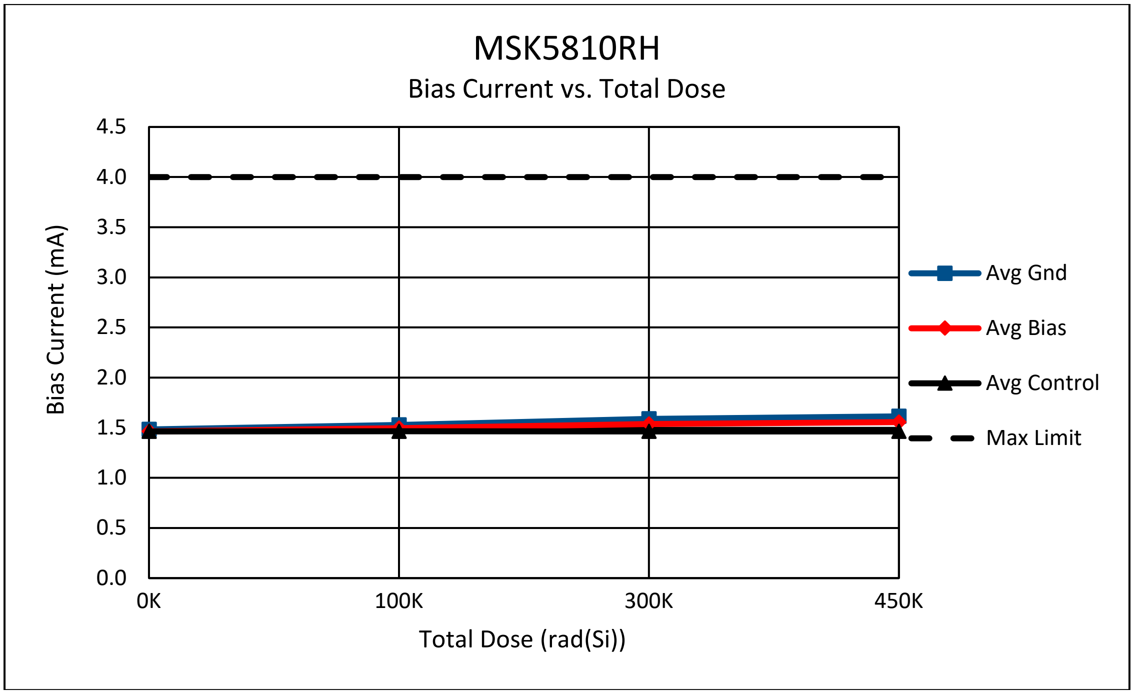
Biased S/N – 1366, 1367, 1368, 1369, 1370

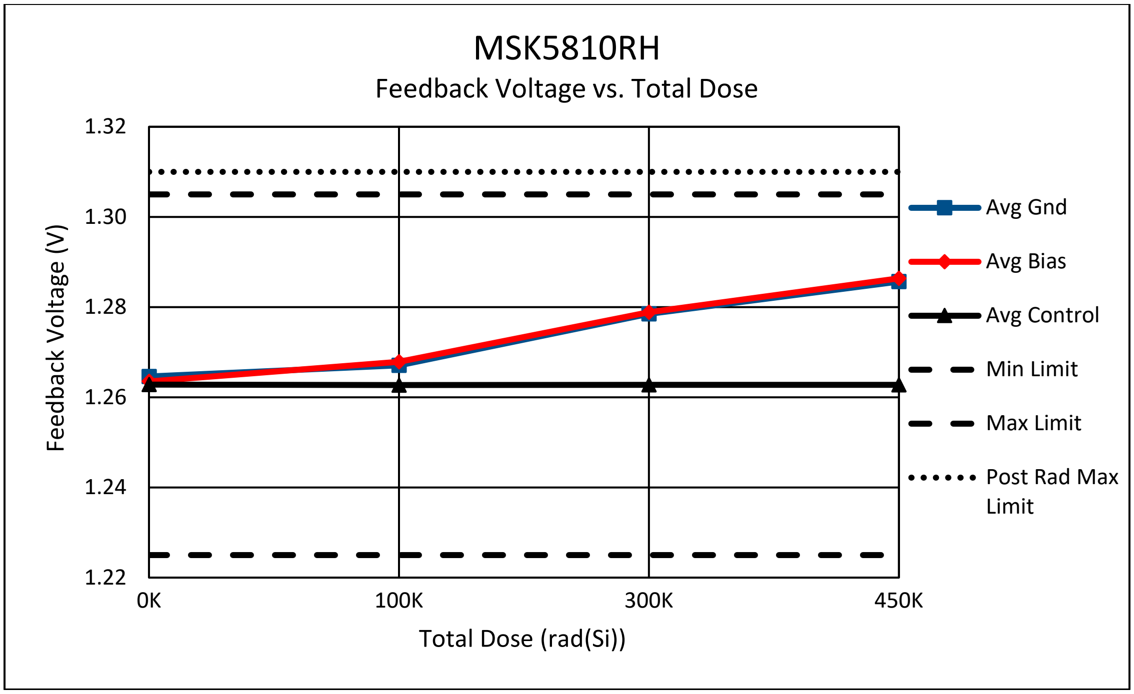
Unbiased S/N – 1371, 1372, 1373, 1374, 1375

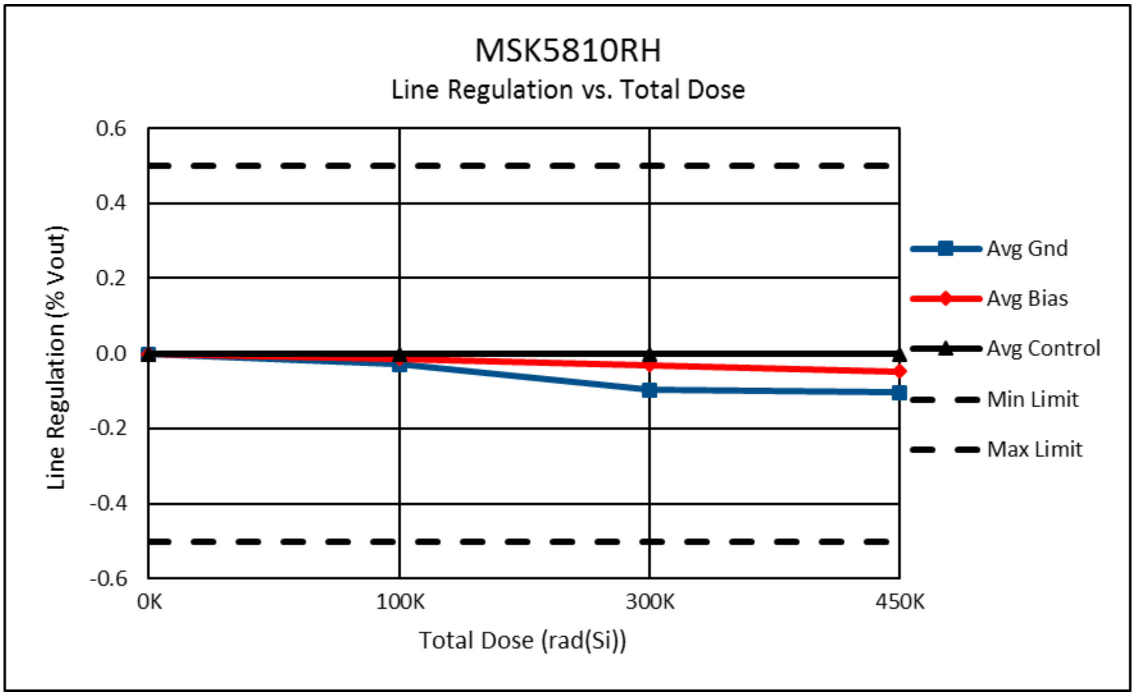
Table 1

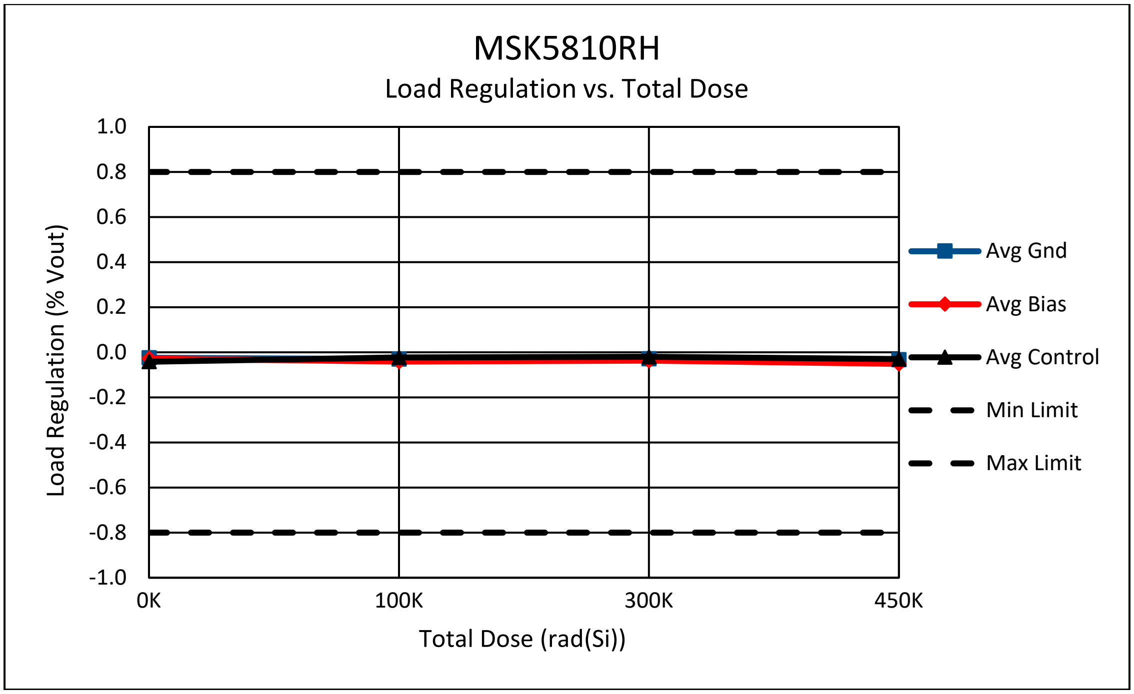
Dose Time, Incremental Dose and Total Cumulative Dose

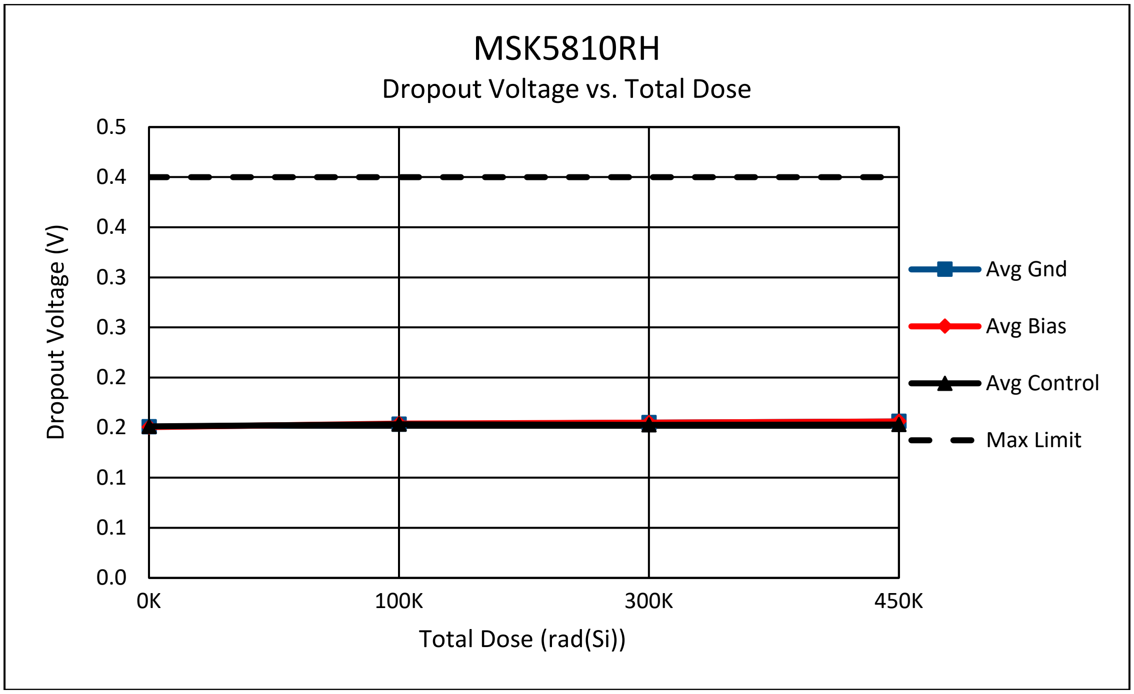

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit

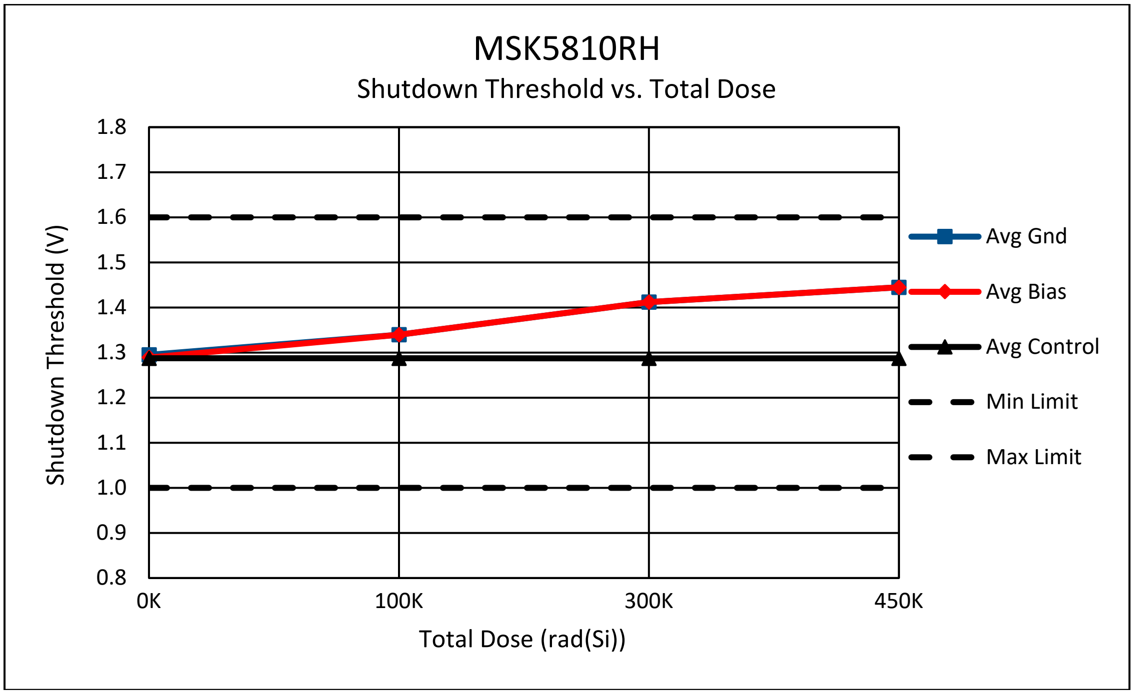

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit

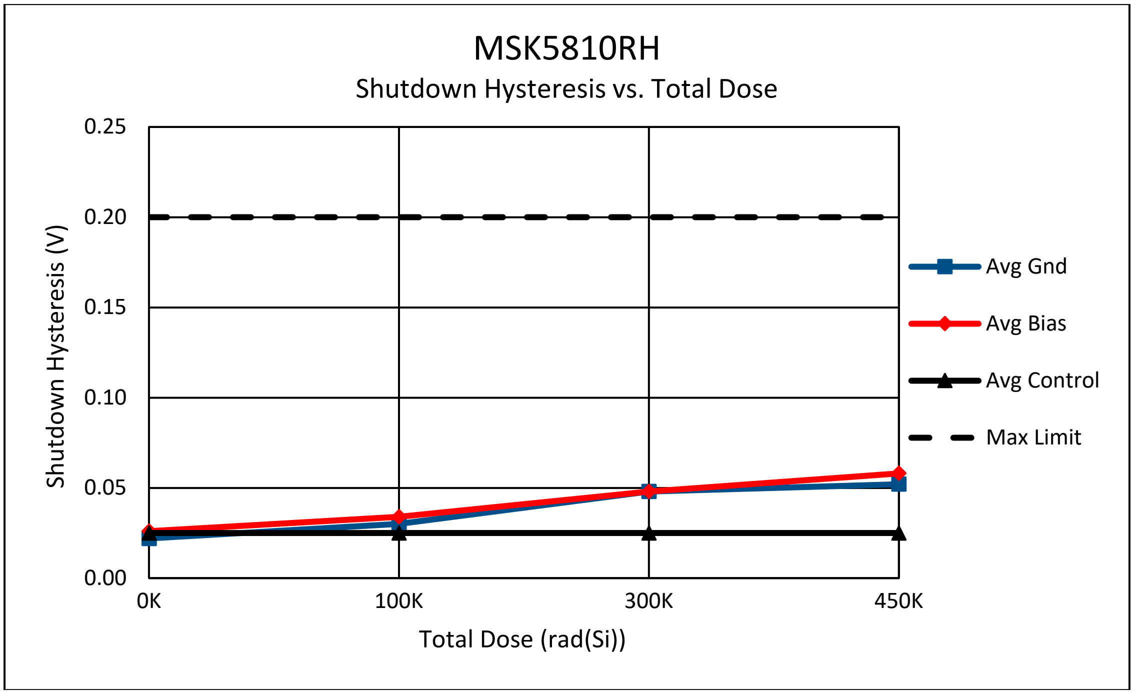

MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.30
1.28
1.26
1.24
1.22
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Max Limit

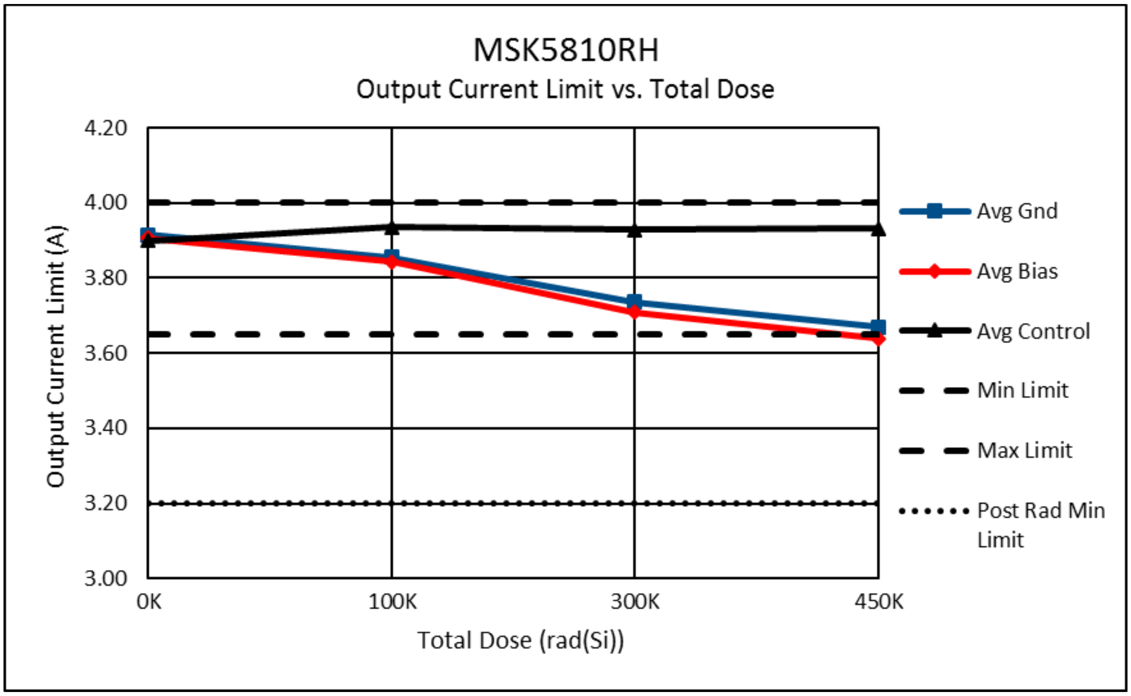

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.5
0.4
0.4
0.3
0.3
0.2
0.2
0.1
0.1
0.0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.20
4.00
3.80
3.60
3.40
3.20
3.00
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: September 15, 2017
Updated: 5/10/19

Test Vehicle: MSK5810RH

IC Wafer Lot: W10809524.1 #8

Transistor Wafer Lot: DL153631 #3

N. Kresse
C. Salce
A. Olesh

Anaren, Inc. – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

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 141 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 160 hours of burn-in per MIL-STD-883 Method 1015. For test platform verification, two control devices were tested at 25°C. Ten devices were then tested at 25°C, prior to irradiation, and were found to be within acceptable test limits.

The devices were vertically aligned with the radiation source and enclosed in a lead/aluminum container during irradiation. Five devices were biased during irradiation. Maximum recommended operating voltage of +7.5V 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 two 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. 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, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
9/15/17

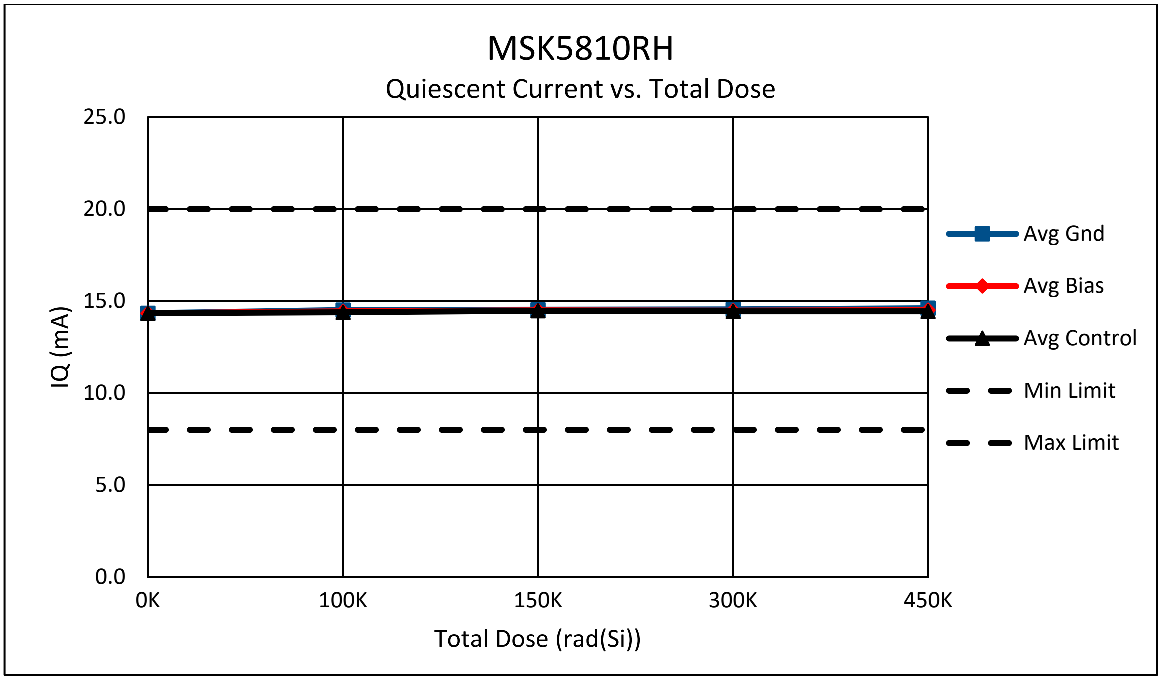
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
12:10	103,000	103,000
6:05	51,500	154,500
18:16	154,500	309,000
18:16	154,500	463,500

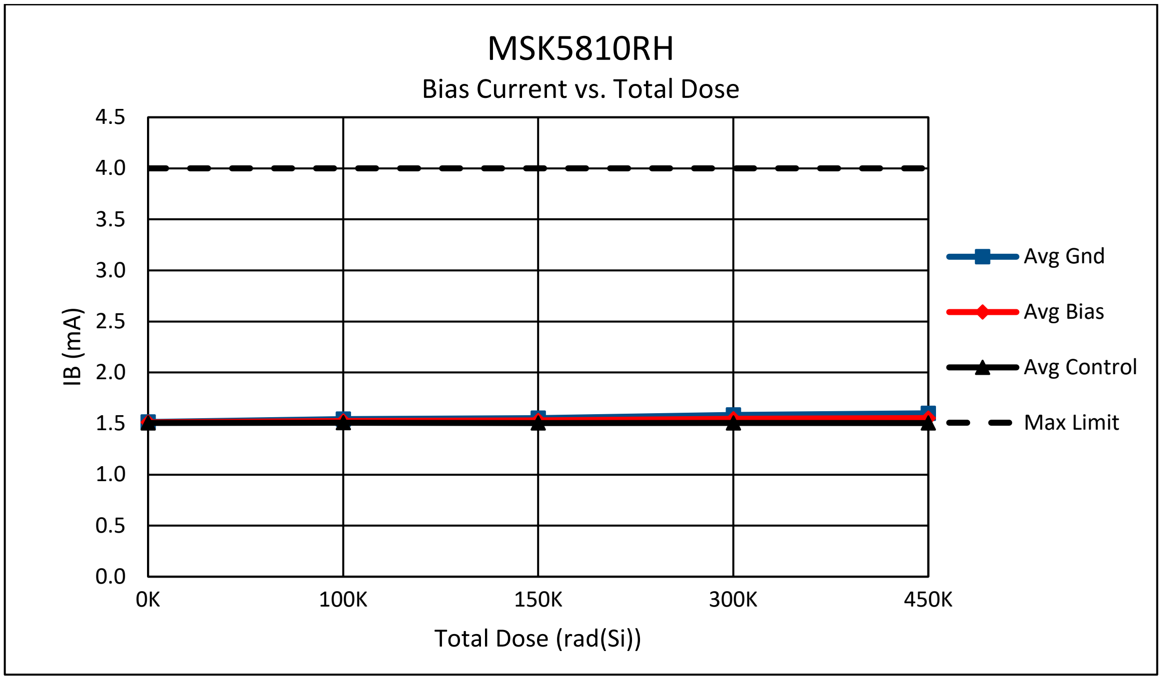
Biased S/N – 1458, 1459, 1460, 1461, 1462

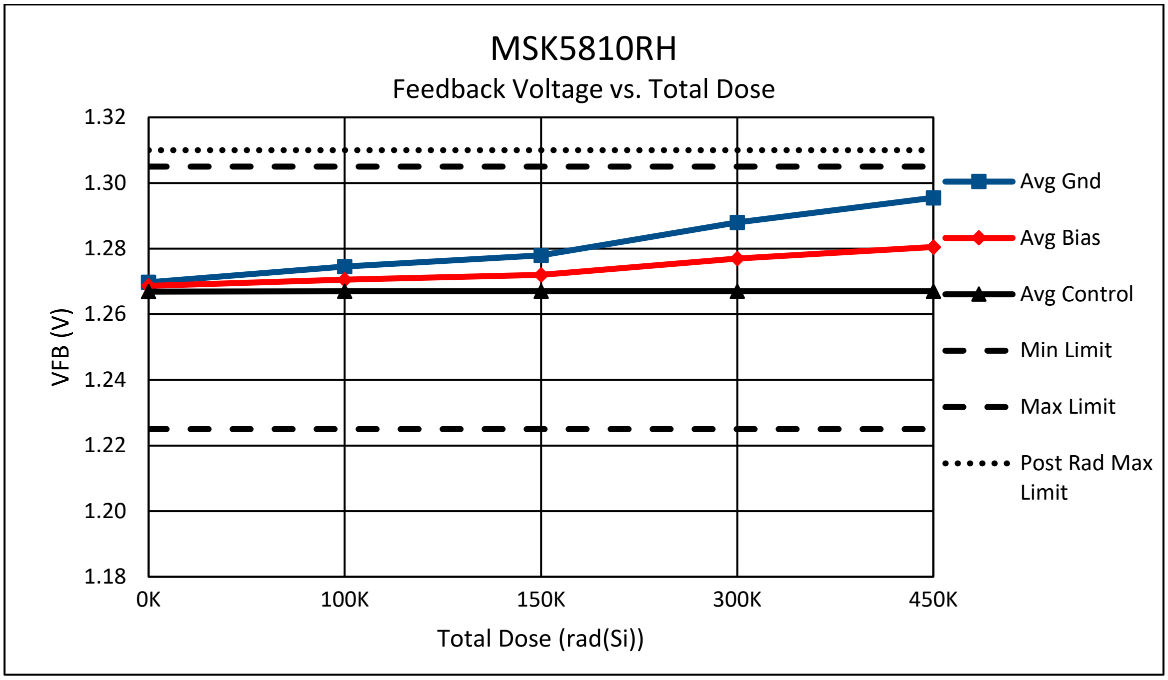
Unbiased S/N – 1463, 1464, 1465, 1466, 1467

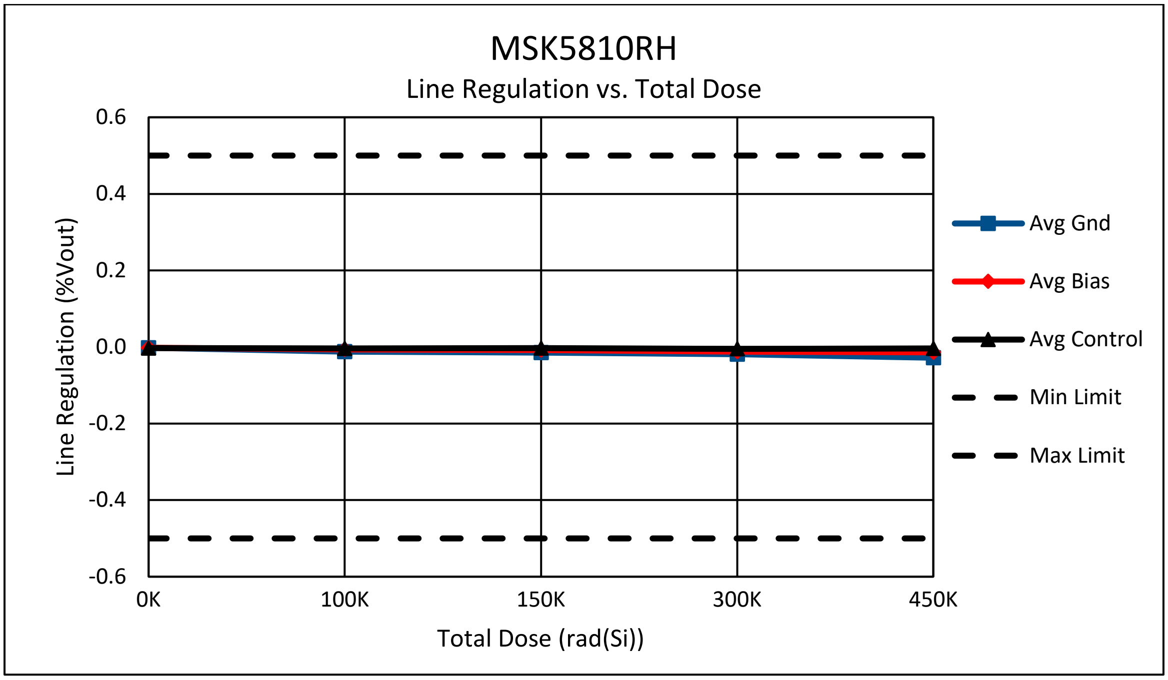
Table 1

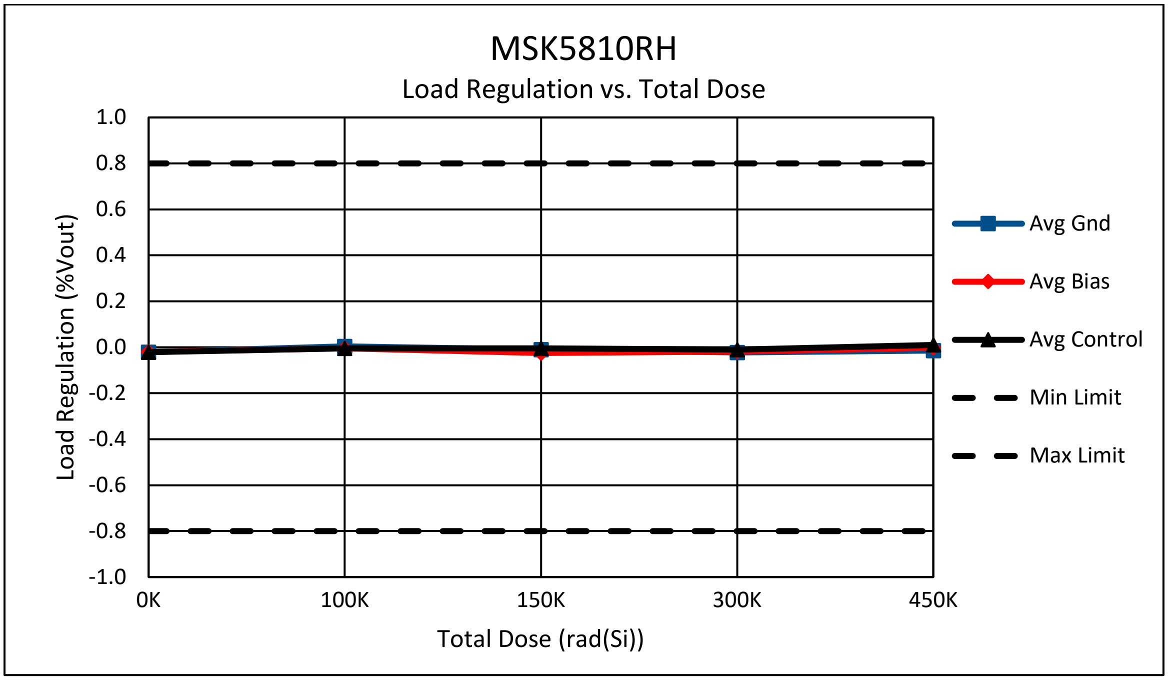
Dose Time, Incremental Dose and Total Cumulative Dose

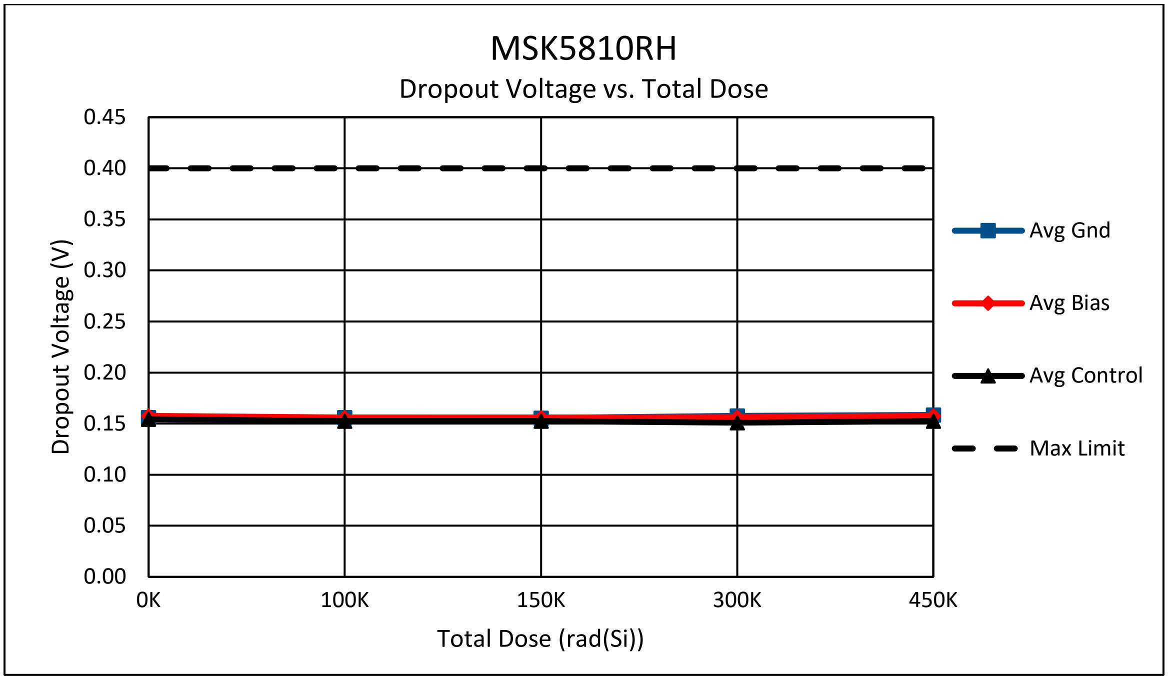

MSK5810RH
Quiescent Current vs. Total Dose
IQ (mA)
25.0
20.0
15.0
10.0
5.0
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit

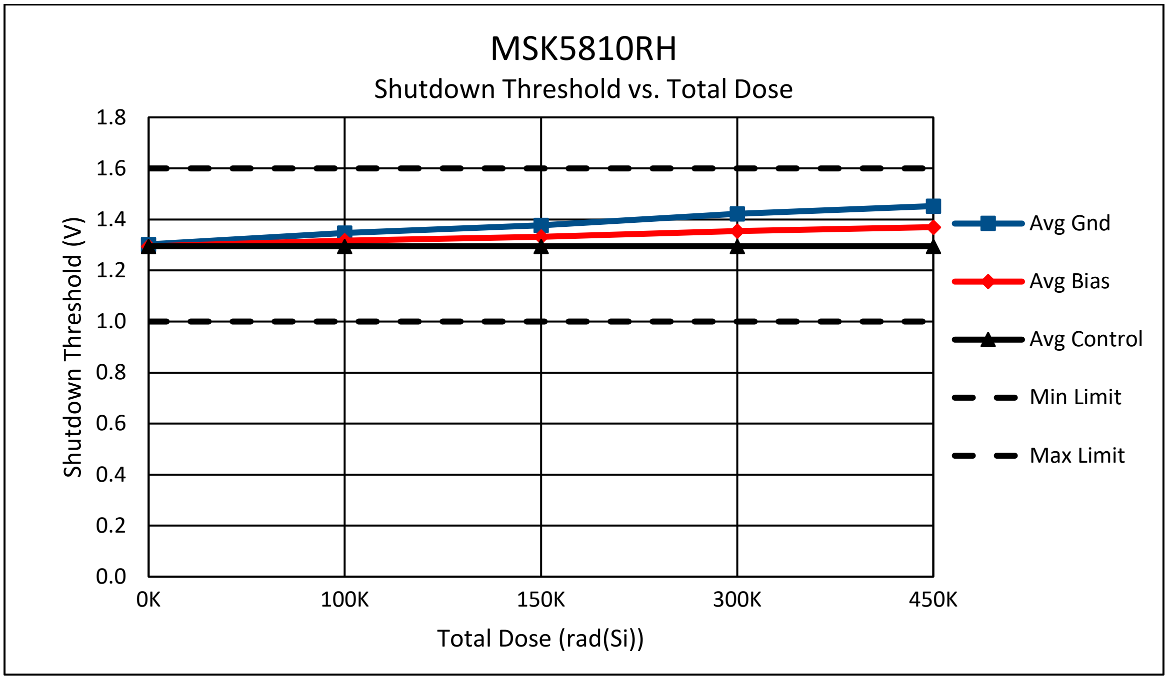

MSK5810RH
Bias Current vs. Total Dose
IB (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit

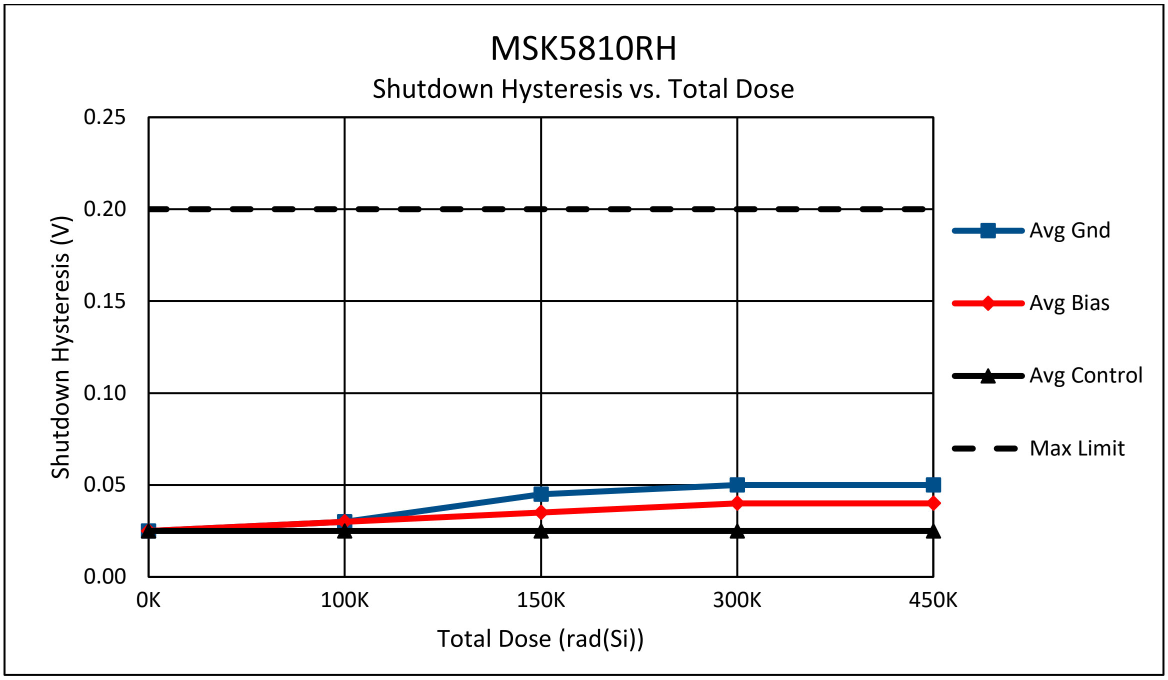

MSK5810RH
Feedback Voltage vs. Total Dose
VFB (V)
1.32
1.30
1.28
1.26
1.24
1.22
1.20
1.18
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Max Limit

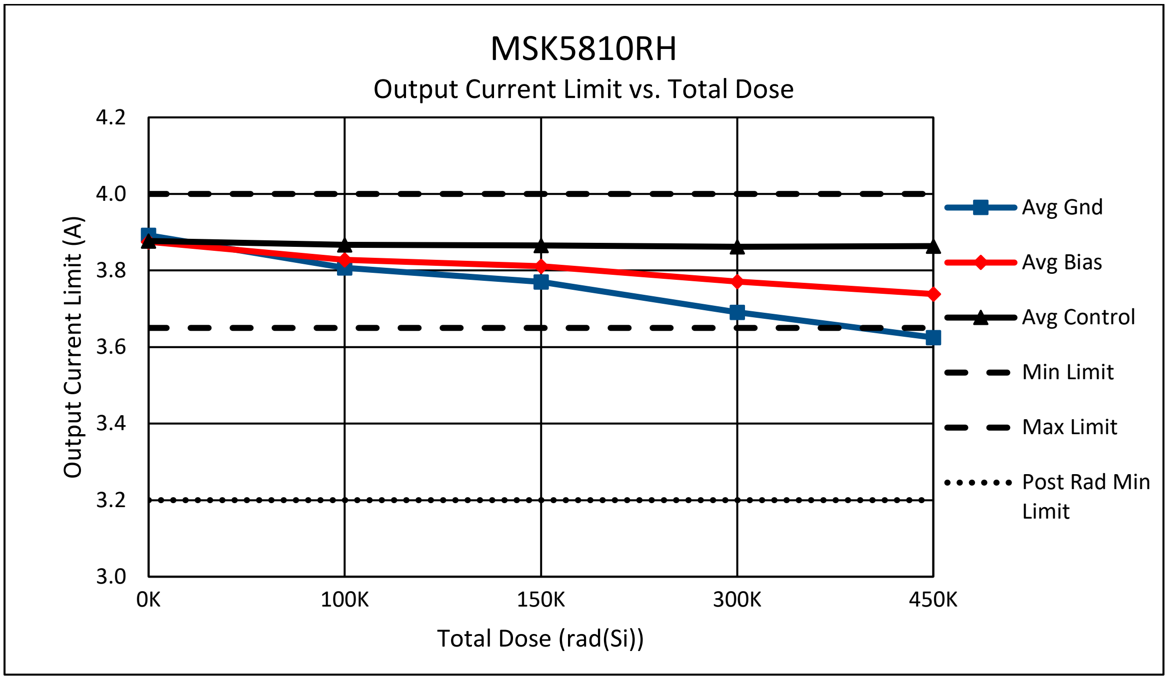

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (%Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (%Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.2
4.0
3.8
3.6
3.4
3.2
3.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK 5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: January 12, 2018
Updated: 05/10/2019

Test Vehicle: MSK5810RH

IC Wafer Lot: WP005144.1 #8

Transistor Wafer Lot: P741F1002 #21

B. Horton
N. Kresse
J. Joy

Anaren, Inc. – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as RAD Hard to 300 KRAD (Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

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

The devices were vertically aligned with the radiation source and enclosed in a lead/aluminum container during irradiation. Five devices were biased during irradiation. Maximum recommended operating voltage of +7.5V 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 two control devices, at each total dose level. The time to complete electrical tests exceeded 1 hour at the 100krad(Si) and 150krad(Si) dose levels due to test equipment malfunctions. Electrical tests were completed within one hour of irradiation at 300krad(Si) and 450krad(Si). Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field at all test points.

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, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
1-12-17

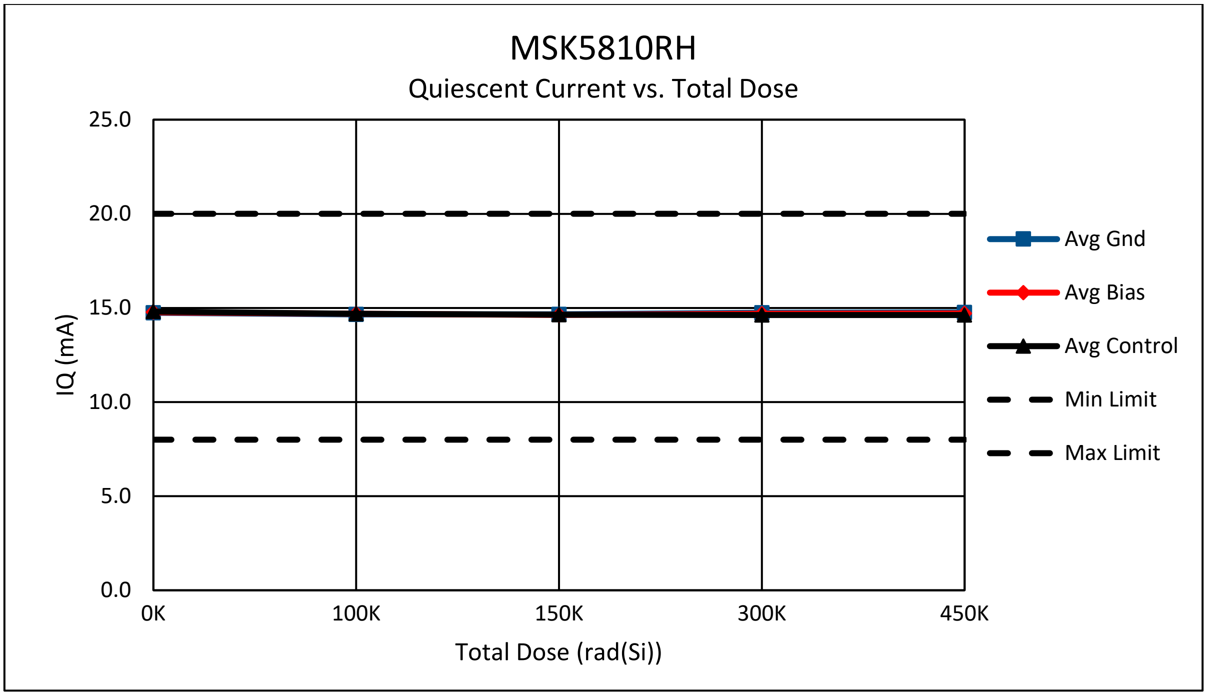
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
13:33	103,00	103,000
6:46	51,500	154,500
20:19	154,500	309,000
20:19	154,500	463,500

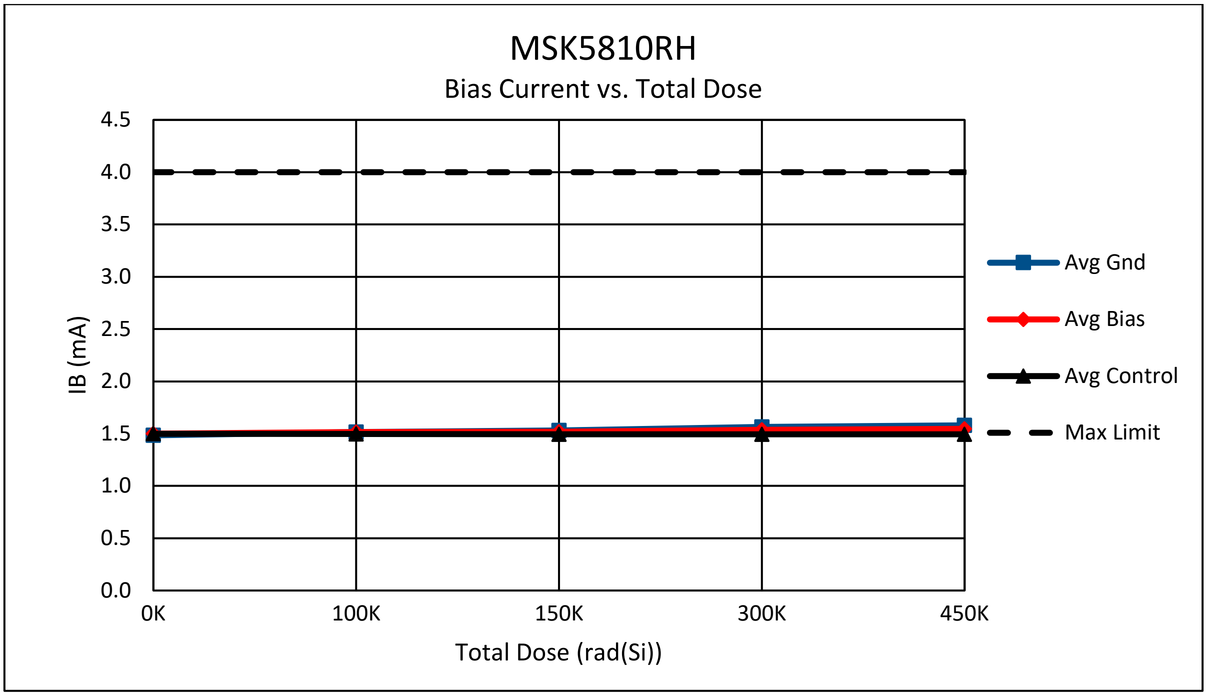
Biased S/N – 0020, 0021, 0022, 0023, 0024

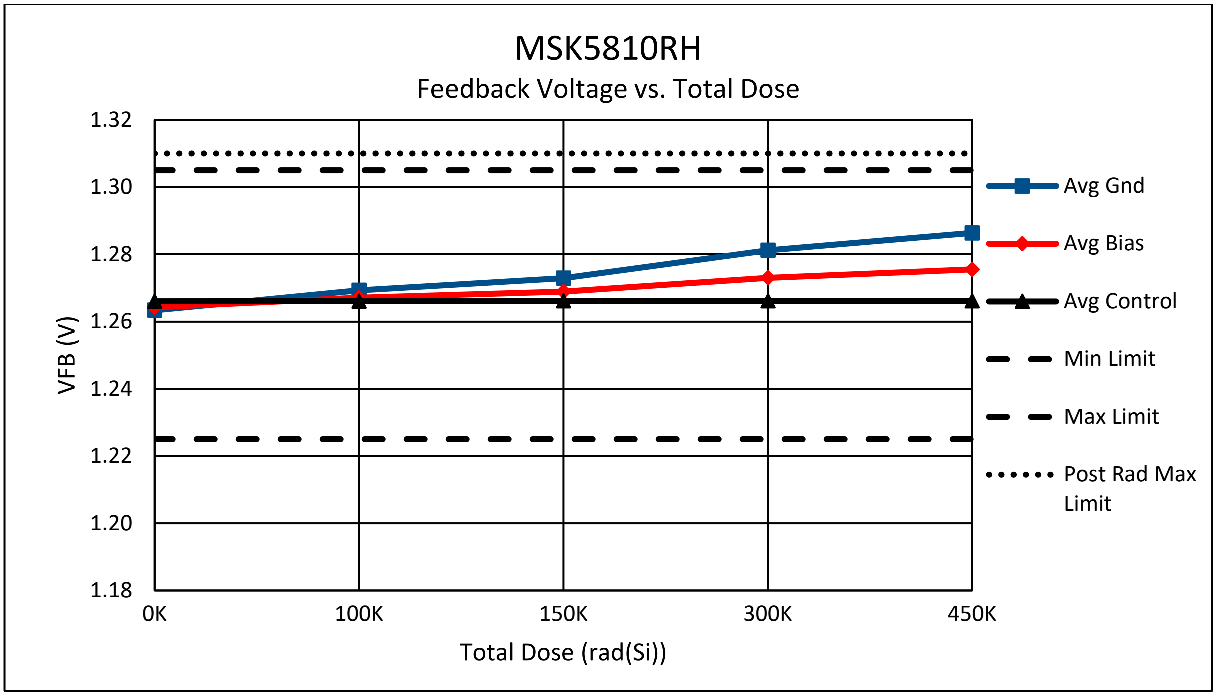
Unbiased S/N – 0015, 0016, 0017, 0018, 0019

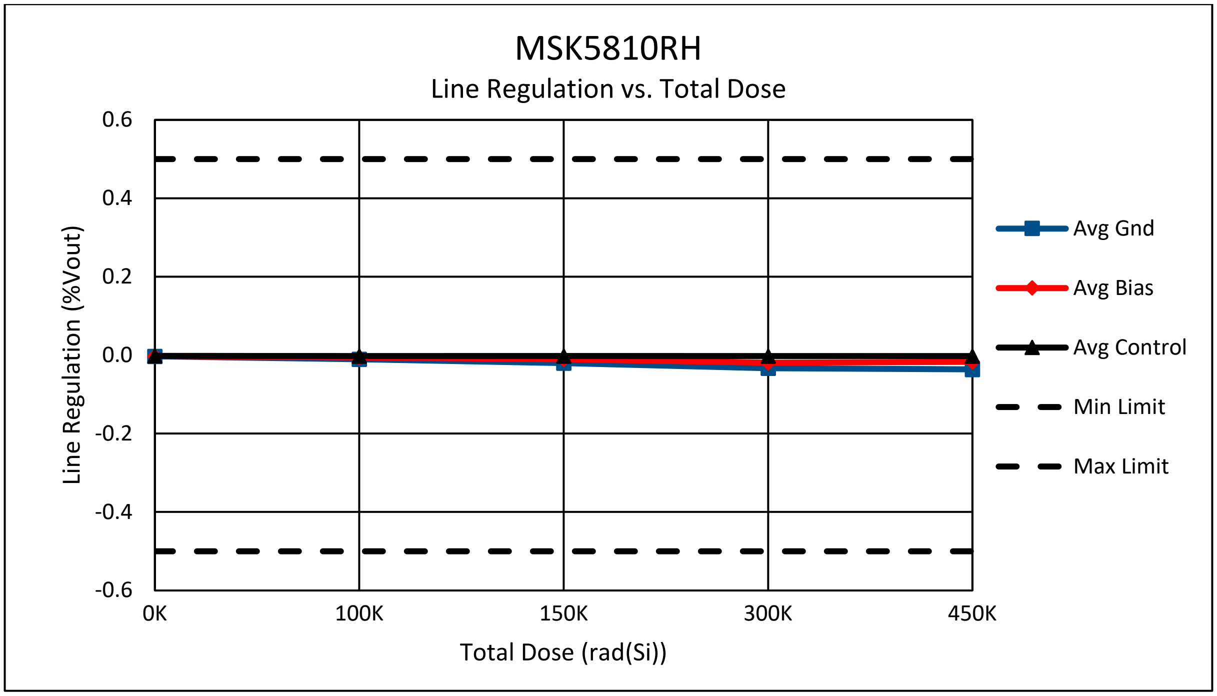
Table 1

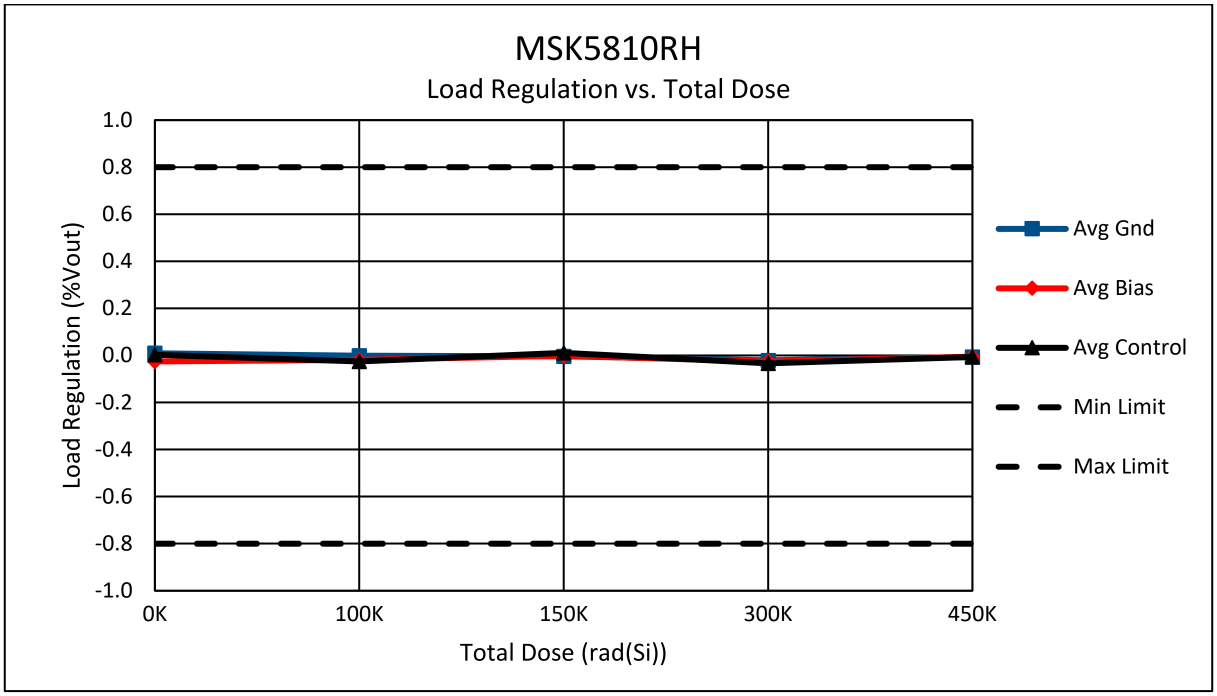
Dose Time, Incremental Dose and Total Cumulative Dose

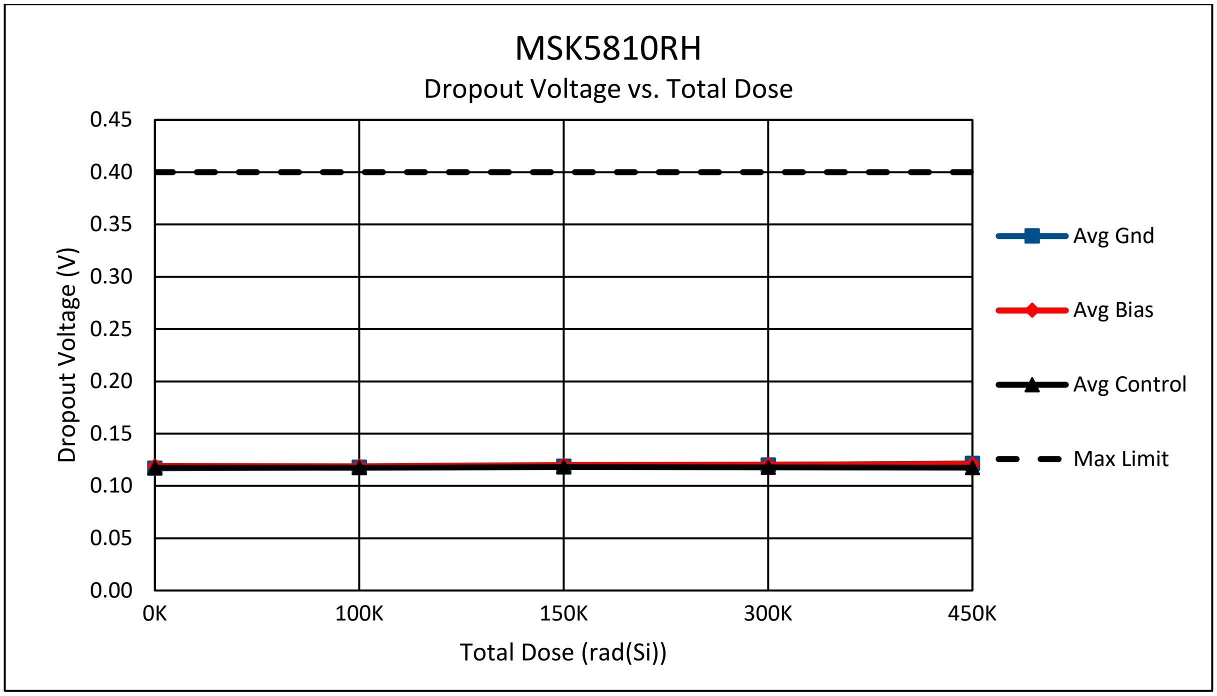

MSK5810RH
Quiescent Current vs. Total Dose
IQ (mA)
25.0
20.0
15.0
10.0
5.0
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit

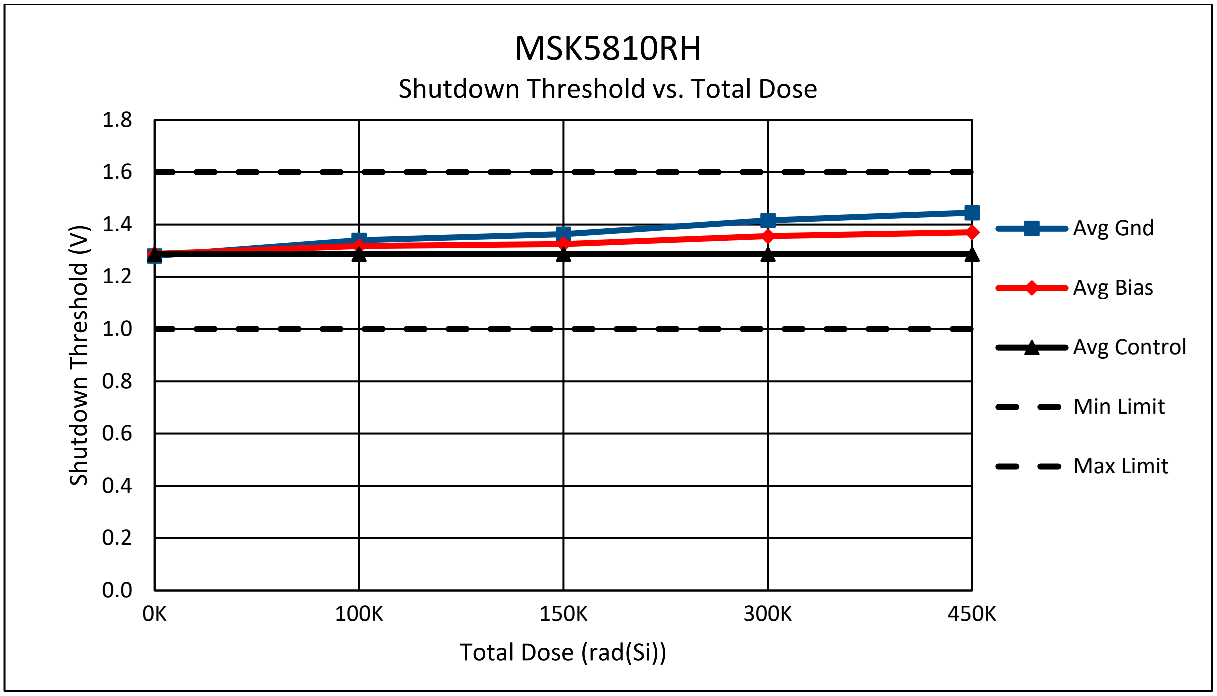

MSK5810RH
Bias Current vs. Total Dose
IB (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit

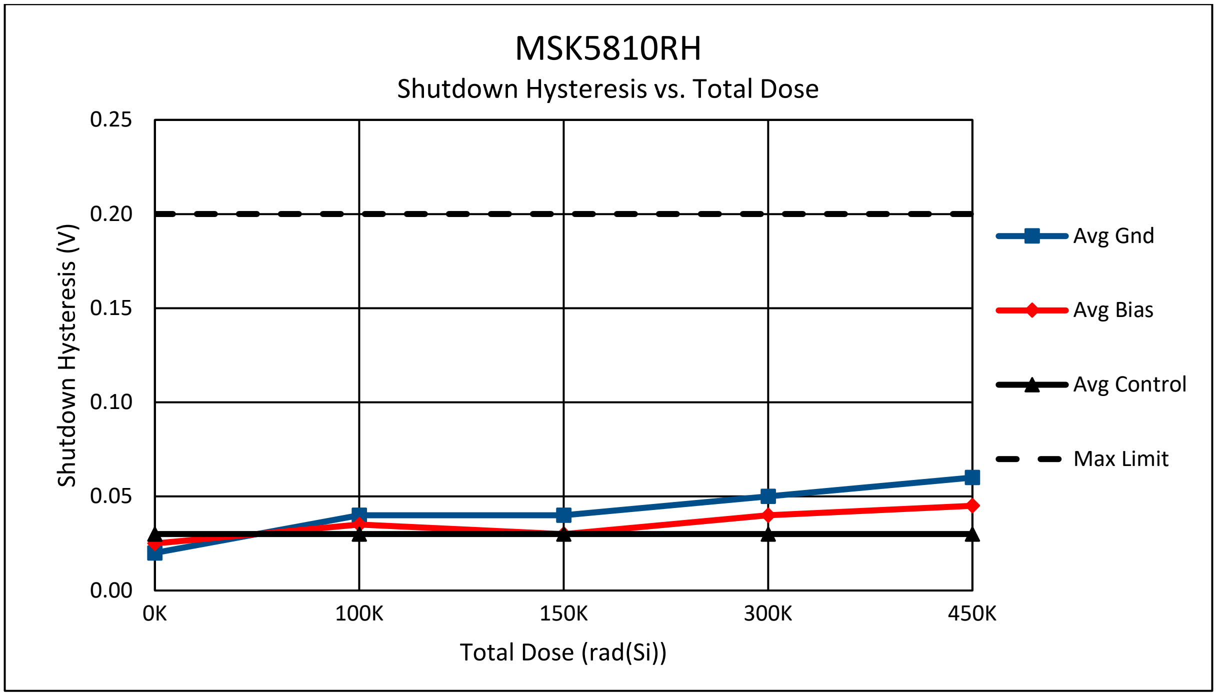

MSK5810RH
Feedback Voltage vs. Total Dose
VFB (V)
1.32
1.30
1.28
1.26
1.24
1.22
1.20
1.18
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Max Limit

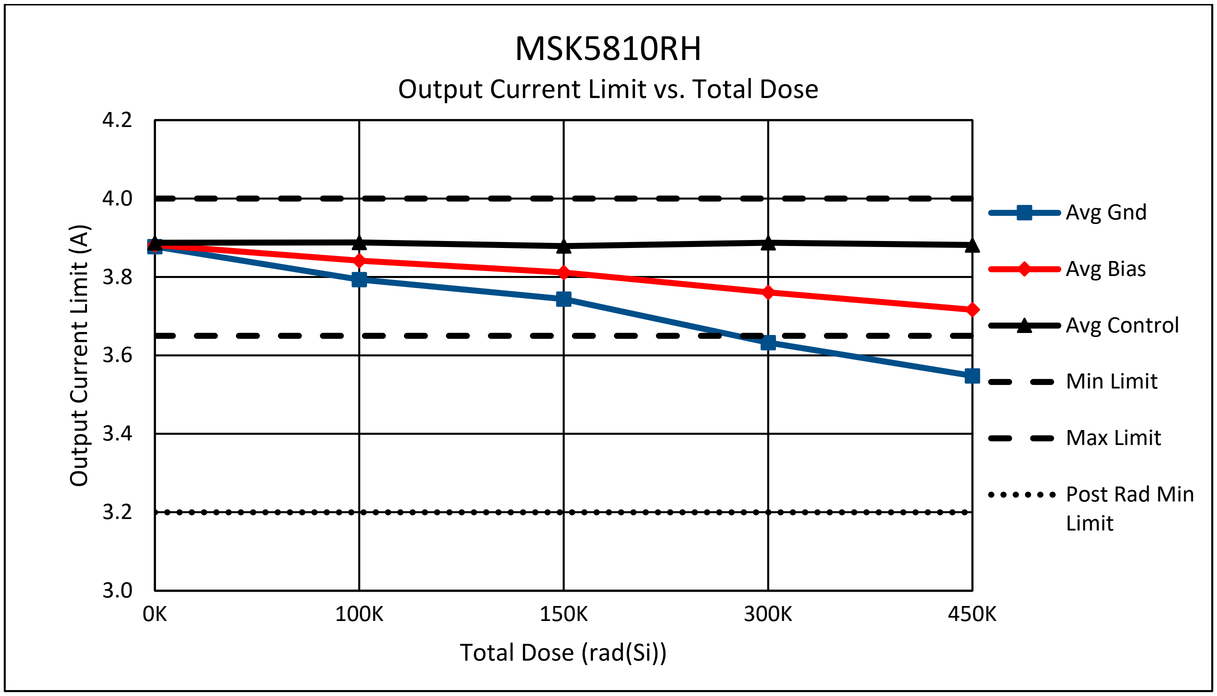

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (%Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (%Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.2
4.0
3.8
3.6
3.4
3.2
3.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: August 22, 2018

Test Vehicle: MSK5810RH

IC Wafer Lot: WP005144.1 #8

Transistor Wafer Lot: PG31F100K #17

N. Kresse
J. Joy

Anaren, Inc. – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as Radiation Hardened to 300 Krad(Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

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 117.4 Rad(Si)/sec. The total dose schedule can be found in Table I.

III. Test Setup:

All test samples were subjected to Group A Electrical Test at 25°C in accordance with the device data sheet. In addition, all devices received 160 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 one control device, at each total dose level. All electrical tests were completed within one hour of irradiation. Each subsequent dose was performed within two hours of the previous irradiation.

IV. Data:

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. 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, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
8/22/18

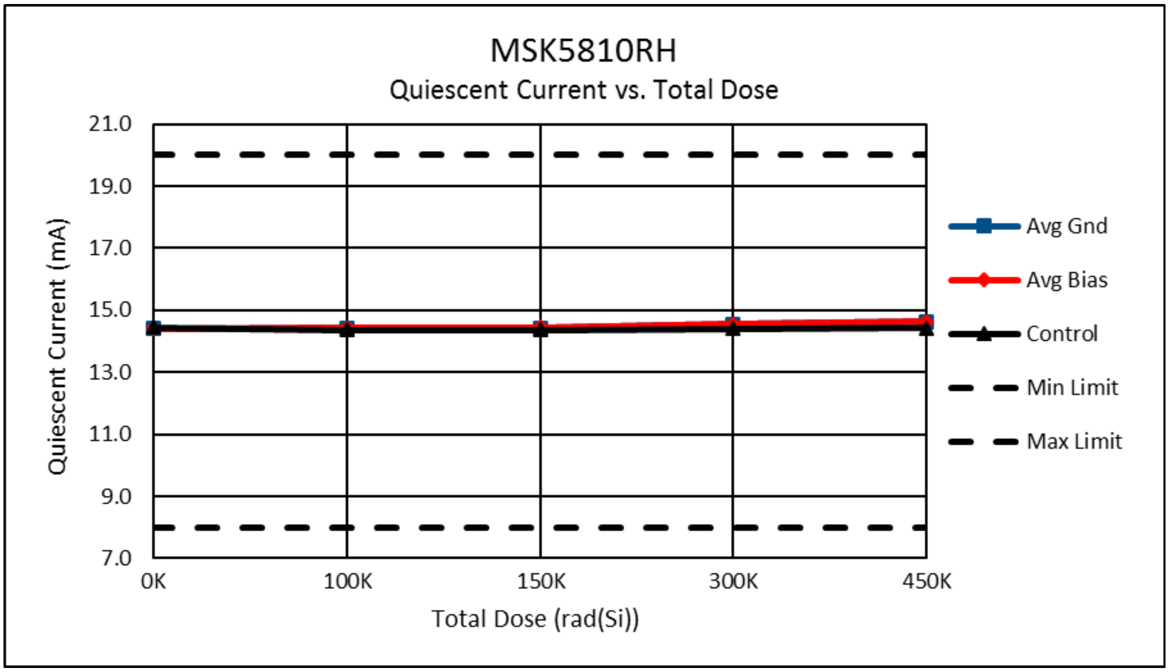
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
14:37	103,00	103,000
7:19	51,500	154,500
21:56	154,500	309,000
21:56	154,500	463,500

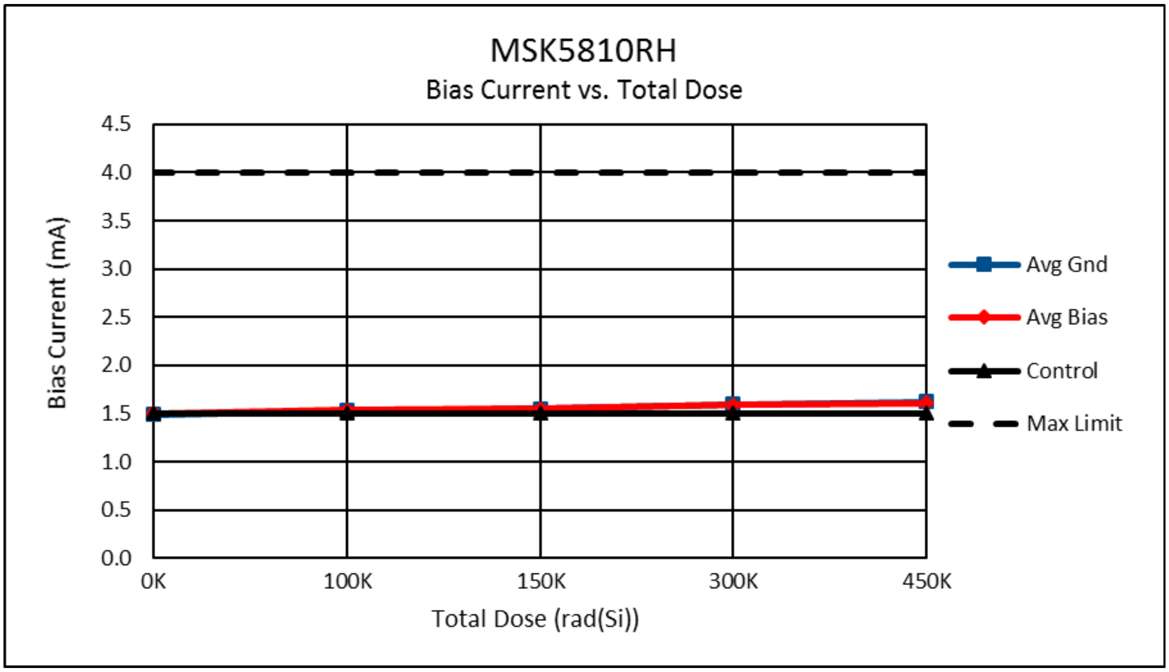
Biased S/N – 0027, 0028, 0029, 0030, 0031

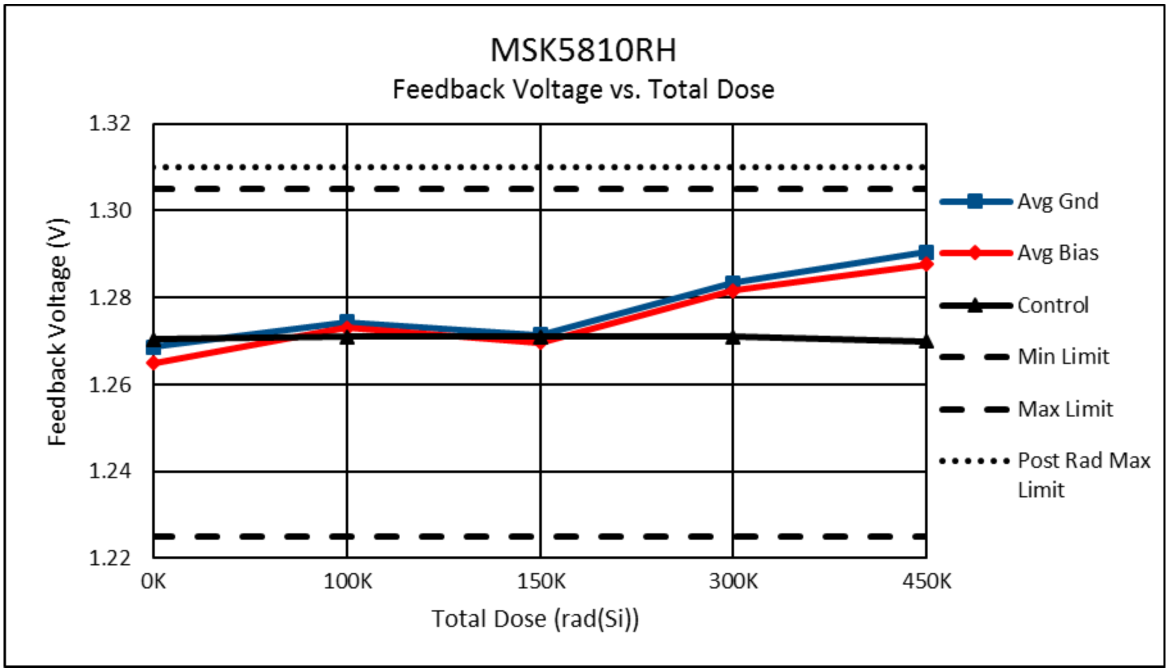
Unbiased S/N – 0032, 0033, 0034, 0035, 0036

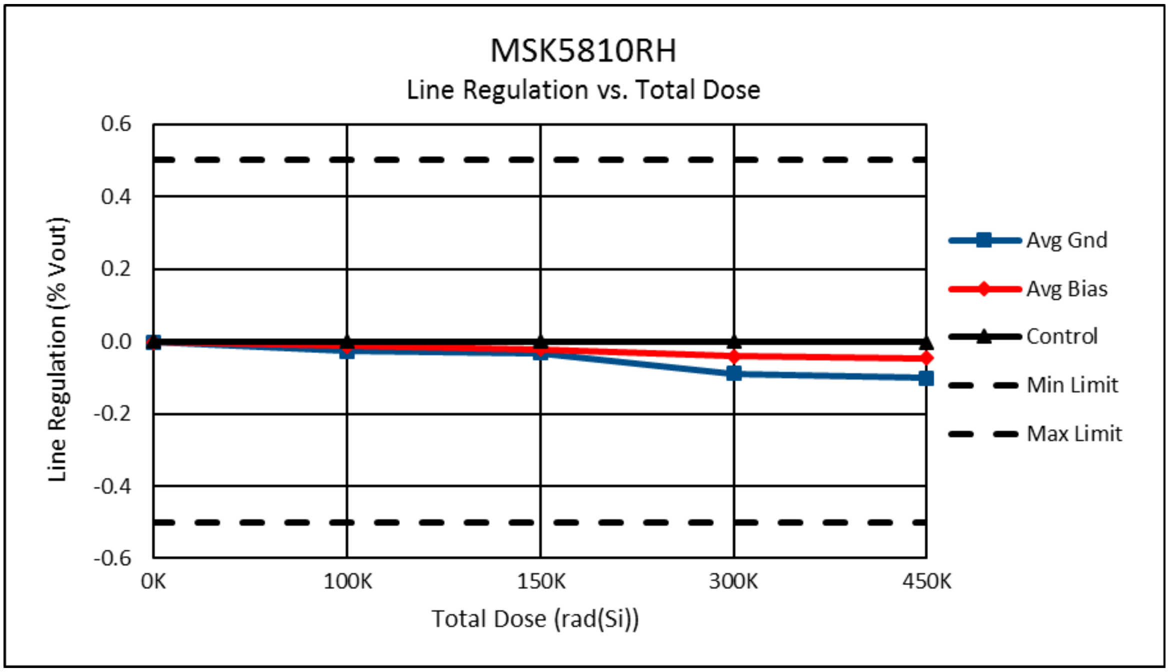
Table 1

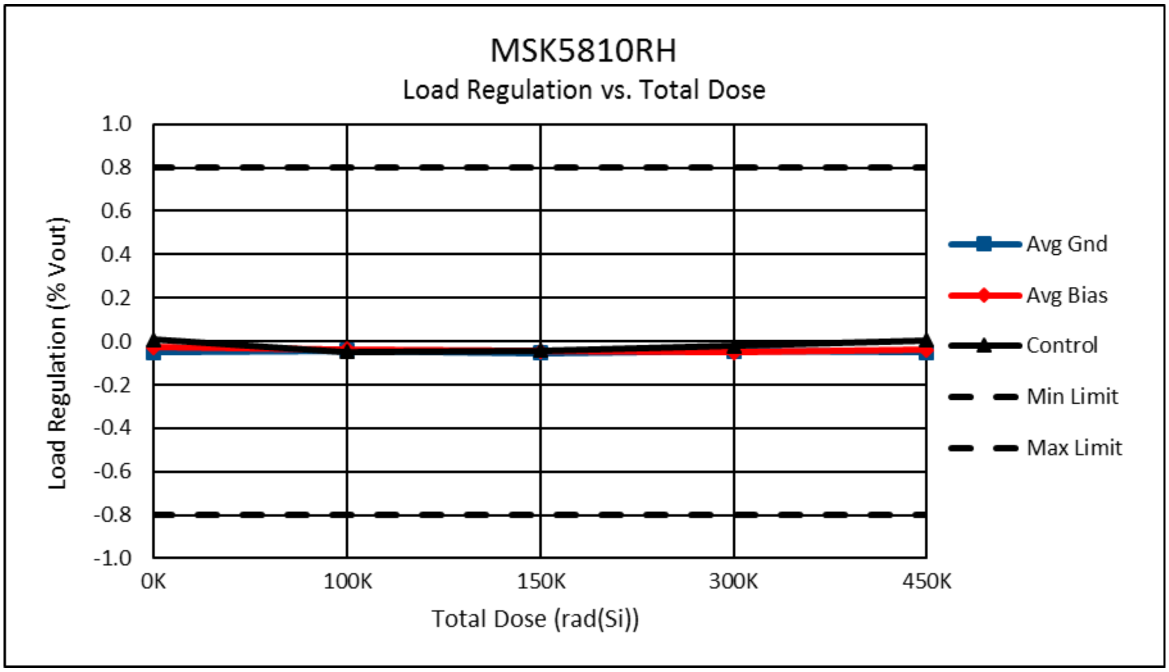
Dose Time, Incremental Dose and Total Cumulative Dose

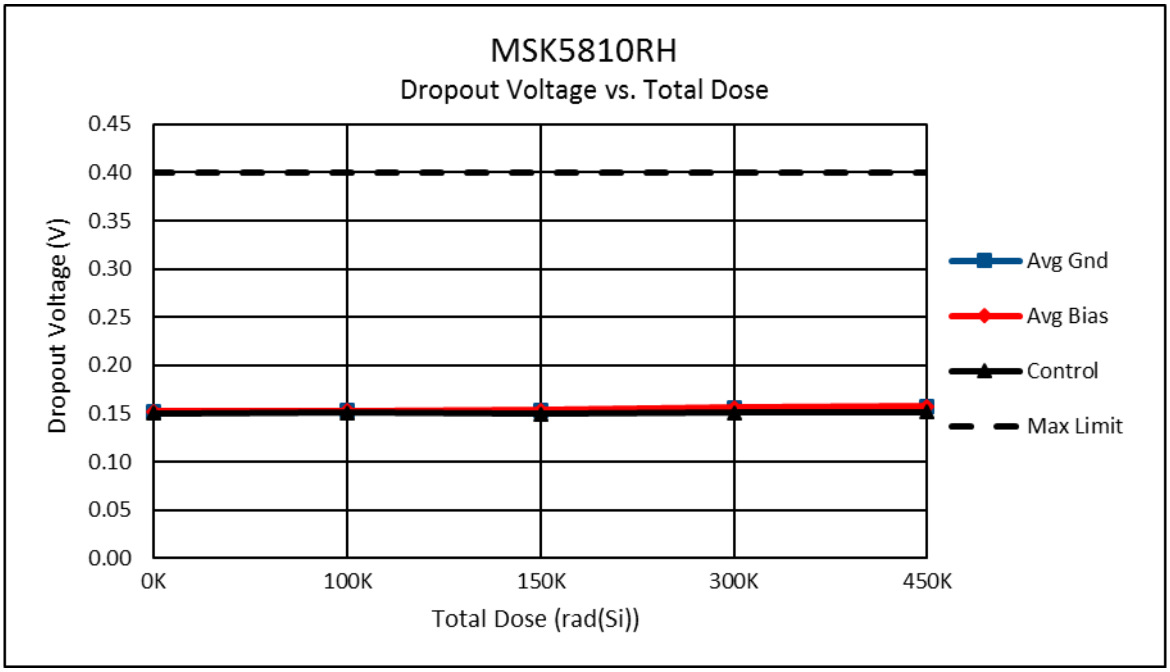

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit

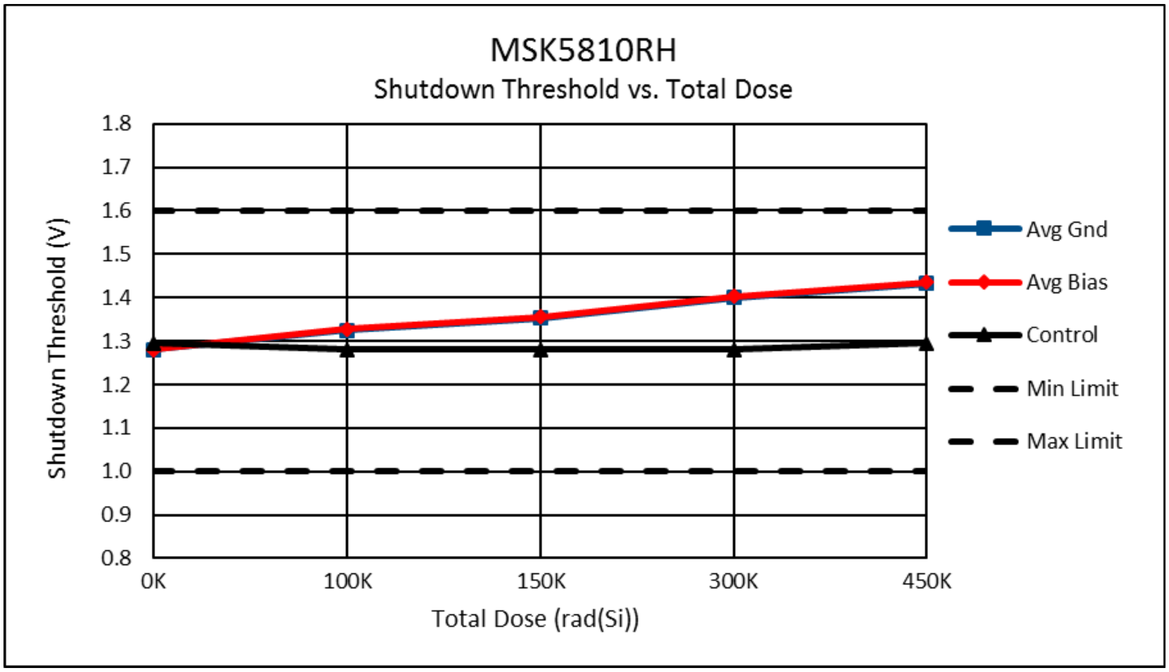

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit

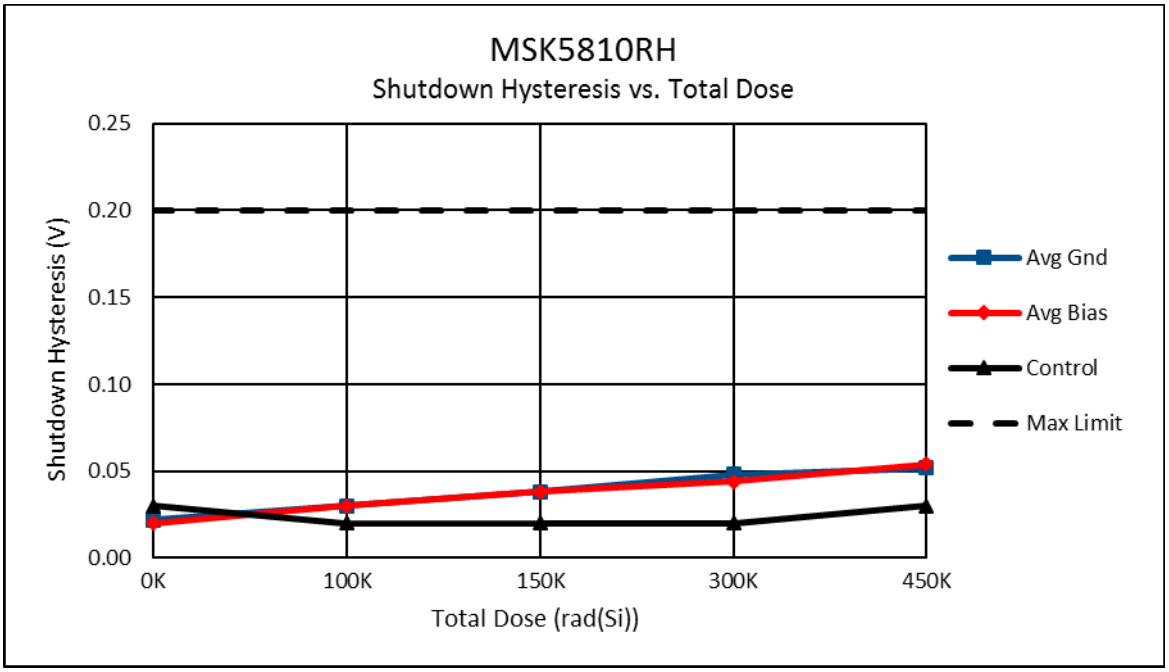

MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.30
1.28
1.26
1.24
1.22
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Max Limit

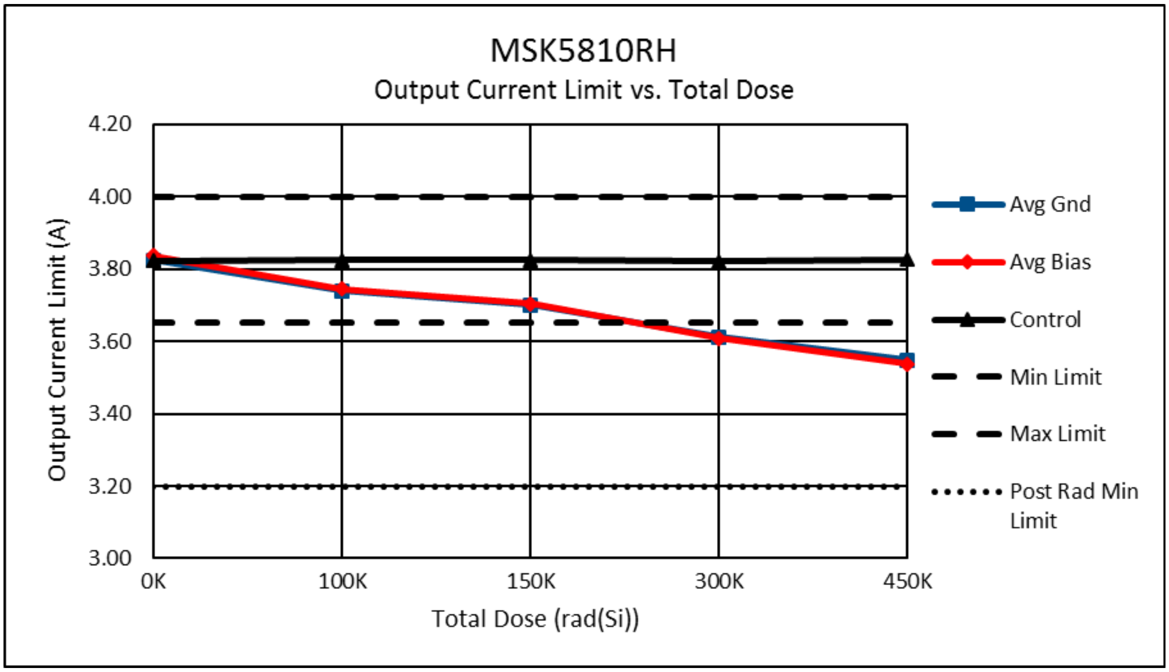

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
4.20
4.00
3.80
3.60
3.40
3.20
3.00
Output Current Limit (A)
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: April 24, 2019

Test Vehicle: MSK5810RH

IC Wafer Lot: W1803256.1 #10

Transistor Wafer Lot: PG31F100K #17

E. Davis
J. Joy

Anaren, Inc. – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as Radiation Hardened to 300 Krad(Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

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 115.9 Rad(Si)/sec. The total dose schedule can be found in Table I.

III. Test Setup:

All test samples were subjected to Group A Electrical Test at 25°C in accordance with the device data sheet. In addition, all devices received 160 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 one control device, at each total dose level. All electrical tests were completed within one hour of irradiation. Each subsequent dose was performed within two hours of the previous irradiation.

IV. Data:

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. 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, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
4/24/2019

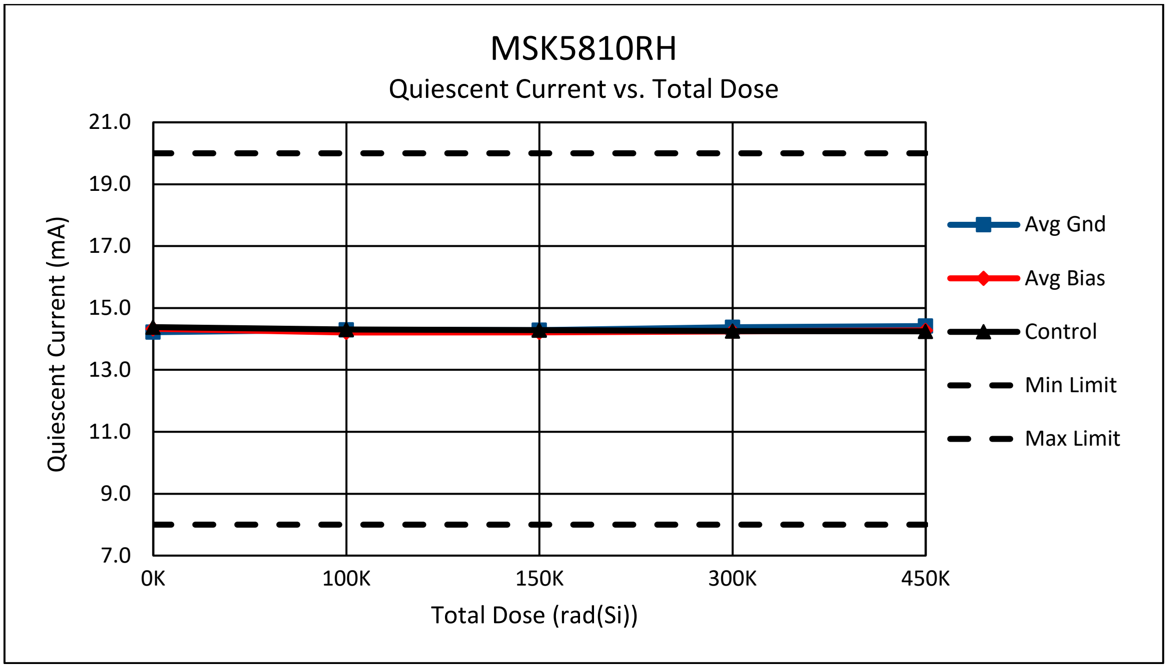
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
14:49	103,00	103,000
7:24	51,500	154,500
22.13	154,500	309,000
22.13	154,500	463,500

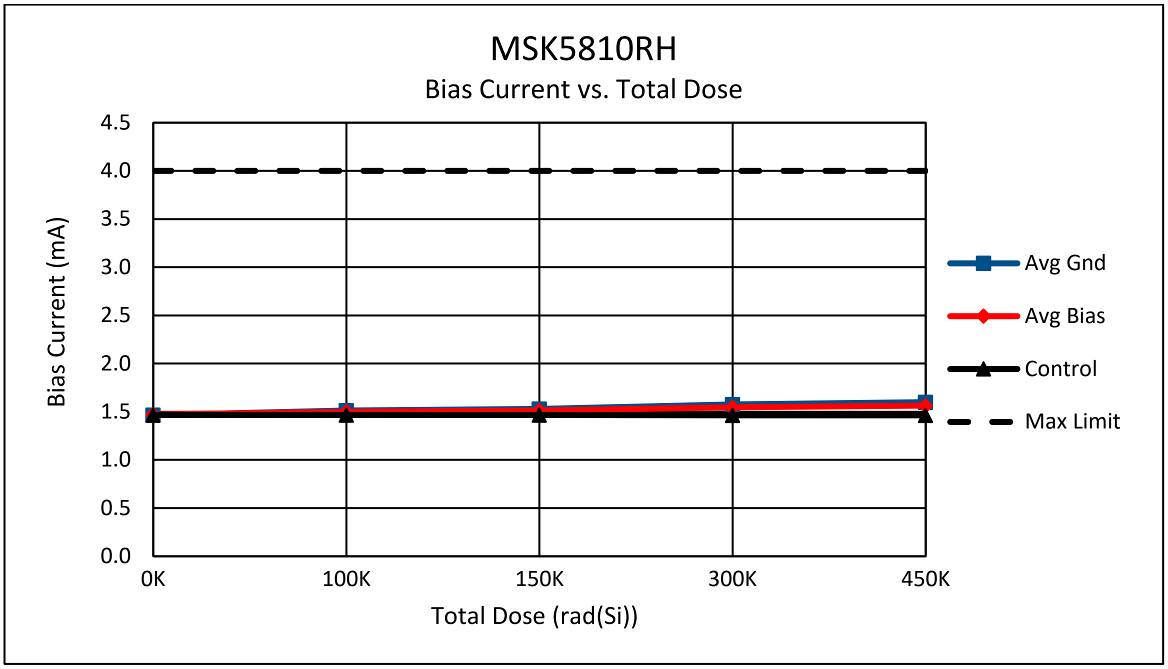
Biased S/N – 0049, 0050, 0051, 0052, 0053

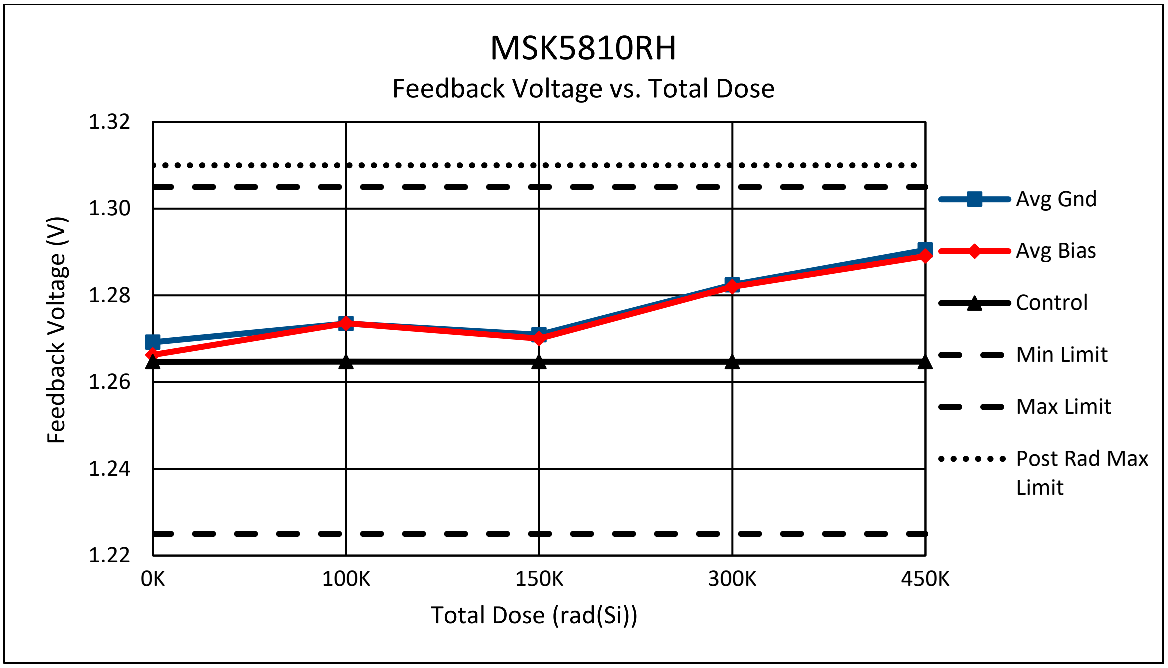
Unbiased S/N – 0054, 0055, 0056, 0057, 0058

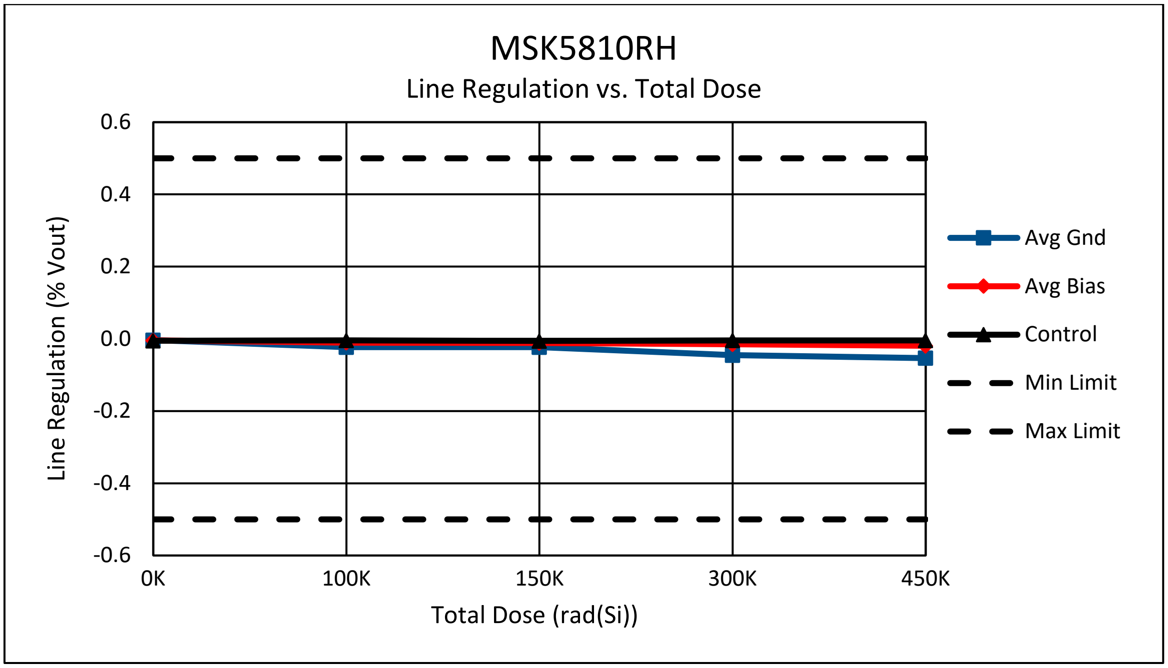
Table 1

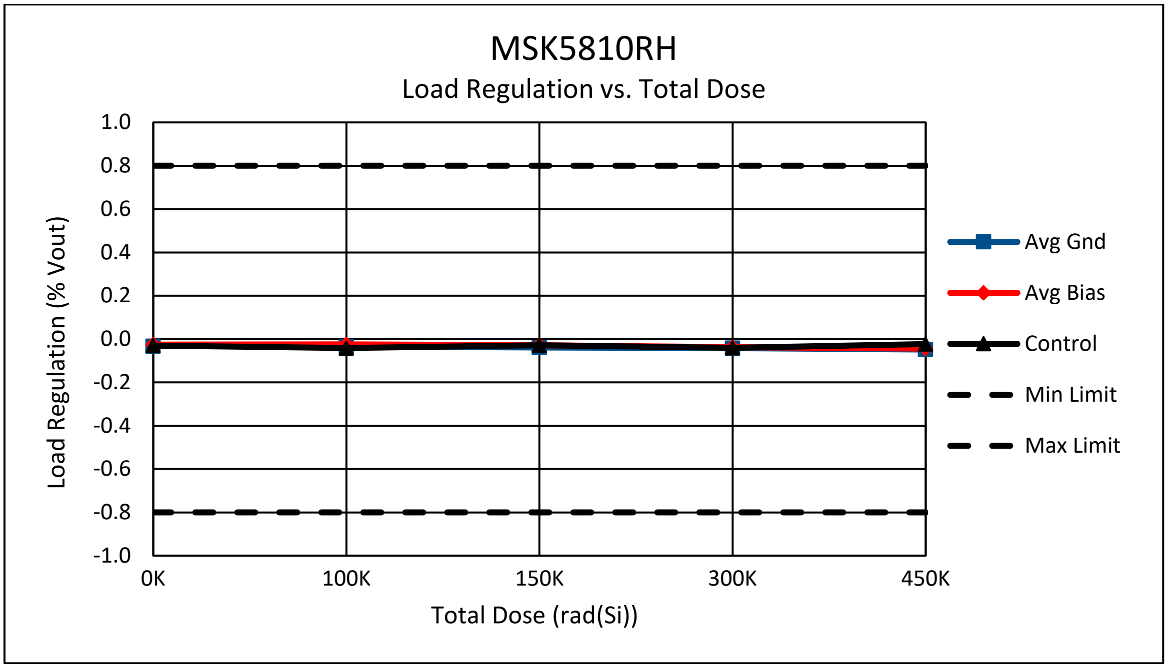
Dose Time, Incremental Dose and Total Cumulative Dose

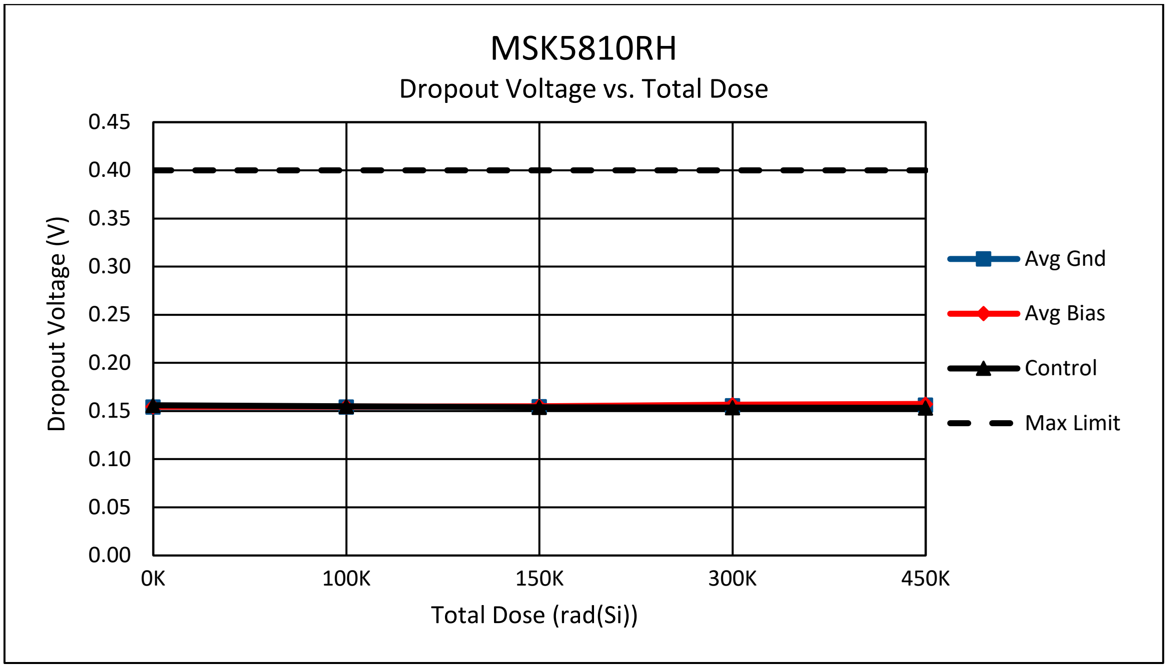

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit

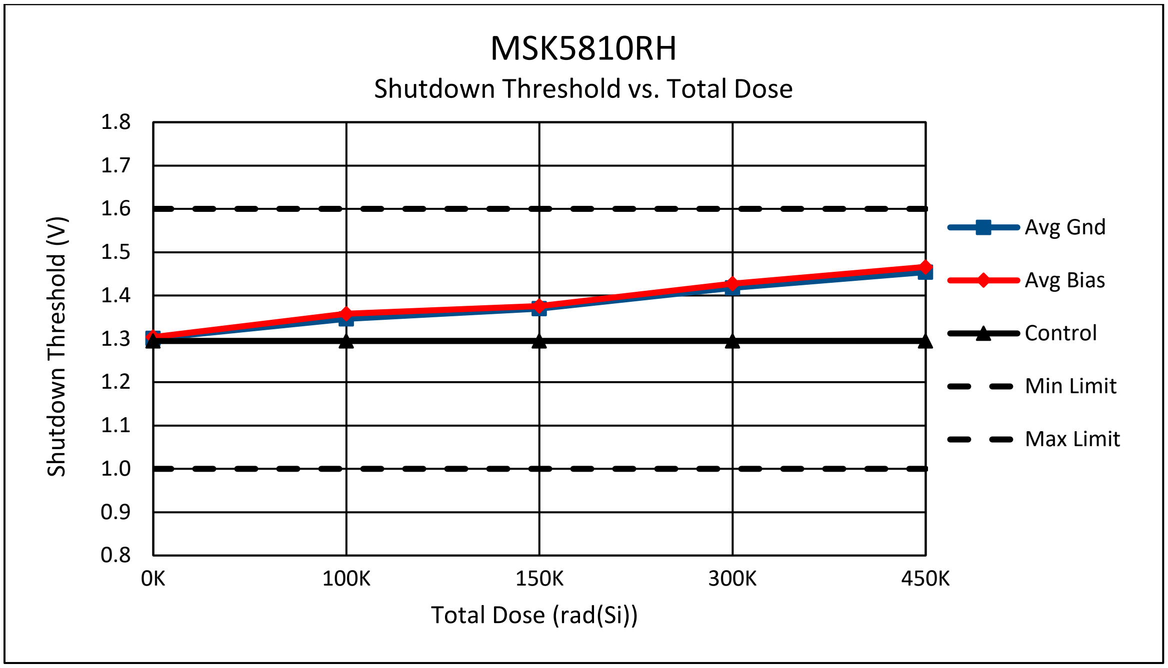

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit

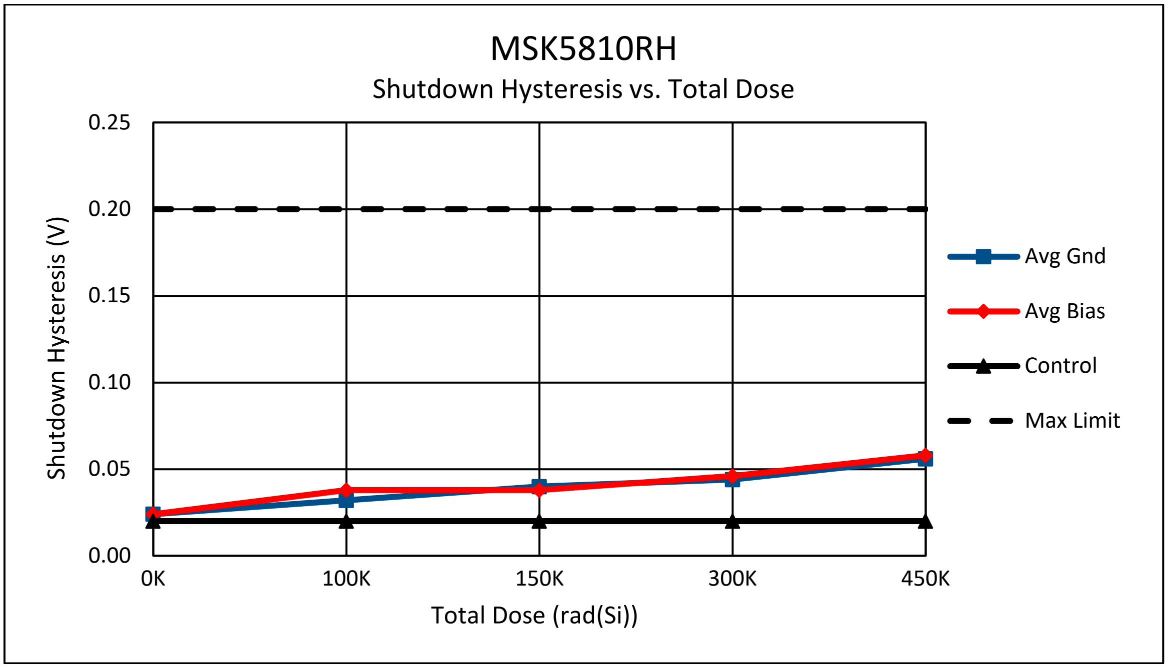

MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.30
1.28
1.26
1.24
1.22
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Max Limit

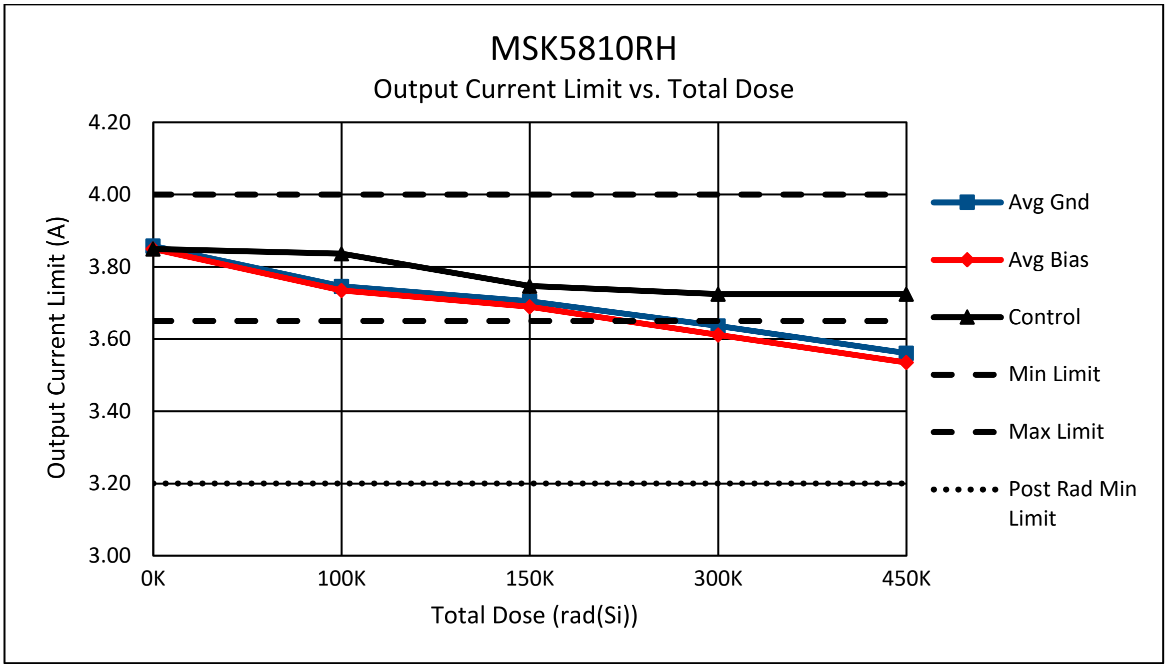

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.20
4.00
3.80
3.60
3.40
3.20
3.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout Adjustable Positive Linear Regulator

Test Date: September 1, 2020

Test Vehicle: MSK5810RH

IC Wafer Lot: W1803256.1 #10

Transistor Wafer Lot: PJ28F101T #17

I. **Introduction**:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as Radiation Hardened to 300 Krad(Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

II. **Radiation Source**:

Total dose was performed at VPT Rad, Chelmsford Massachusetts, using a Cobalt 60 radiation source. The dose rate was determined to be 124 Rad(Si)/sec. The total dose schedule can be found in Table I.

III. **Test Setup**:

All test samples were subjected to Group A Electrical Test at 25°C in accordance with the device data sheet. In addition, all devices received 160 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 one control device, at each total dose level. All electrical tests were completed within one hour of irradiation. Each subsequent dose was performed within two hours of the previous irradiation.

IV. **Data**:

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. 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, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # SC0424

Irradiation Date
9/01/2021

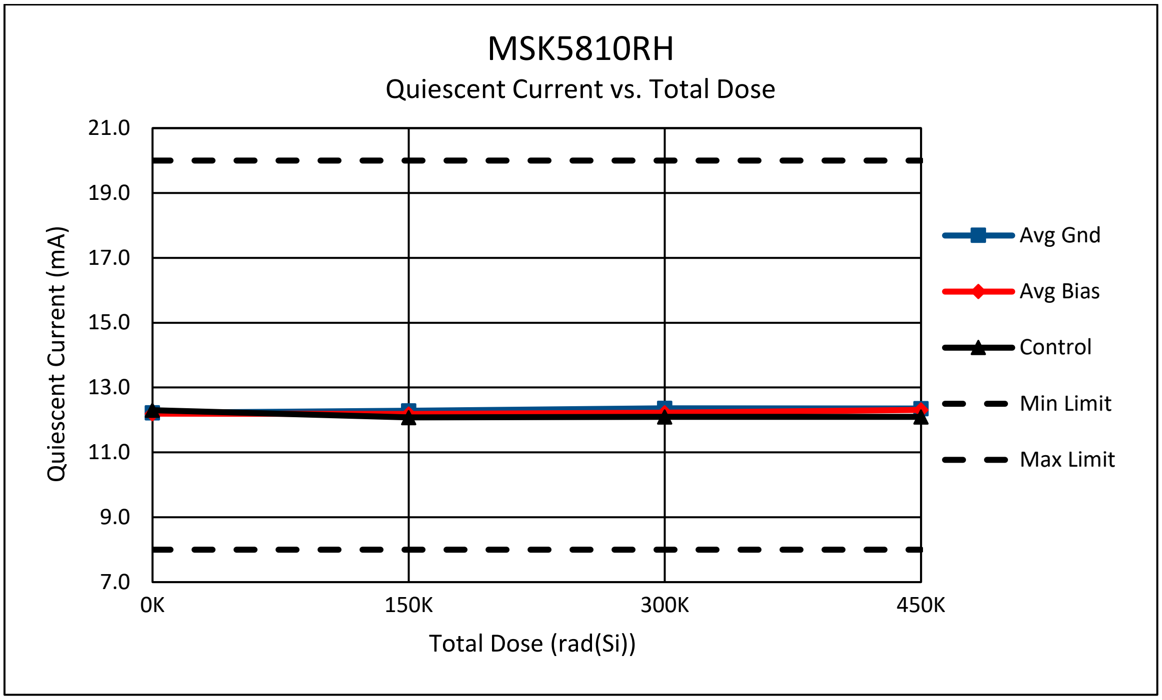
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
20:46	154,504	154,504
20:46	154,504	309,008
20:46	154,504	463,512

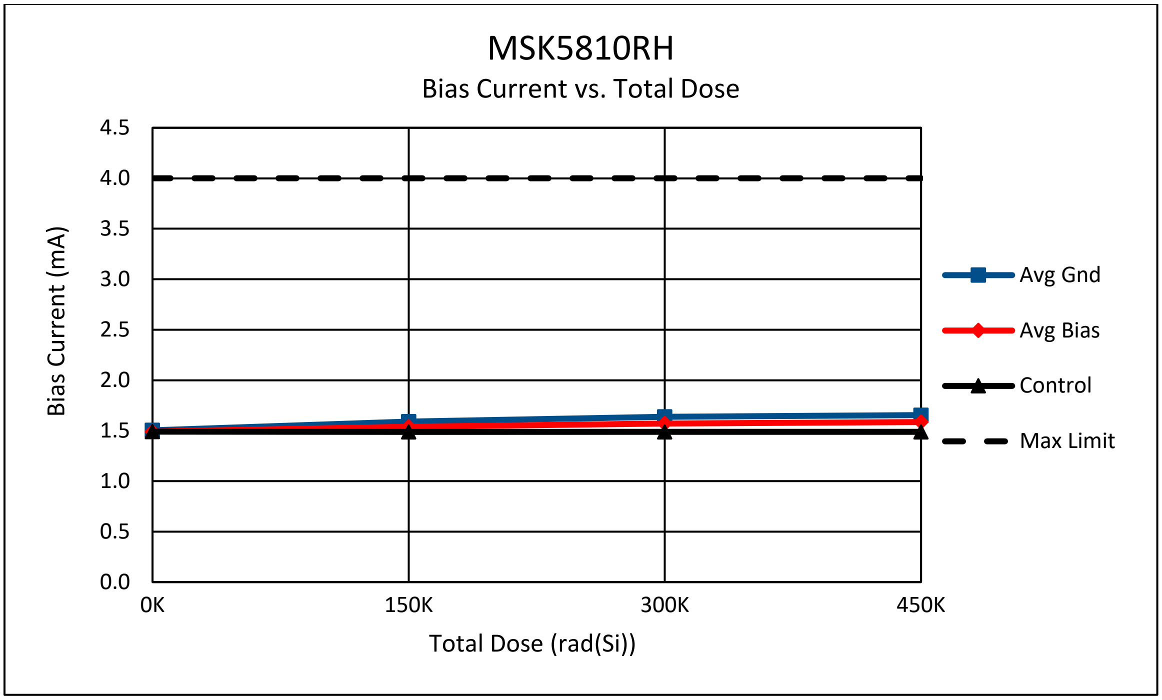
Biased S/N – 0075, 0076, 0077, 0078, 0079

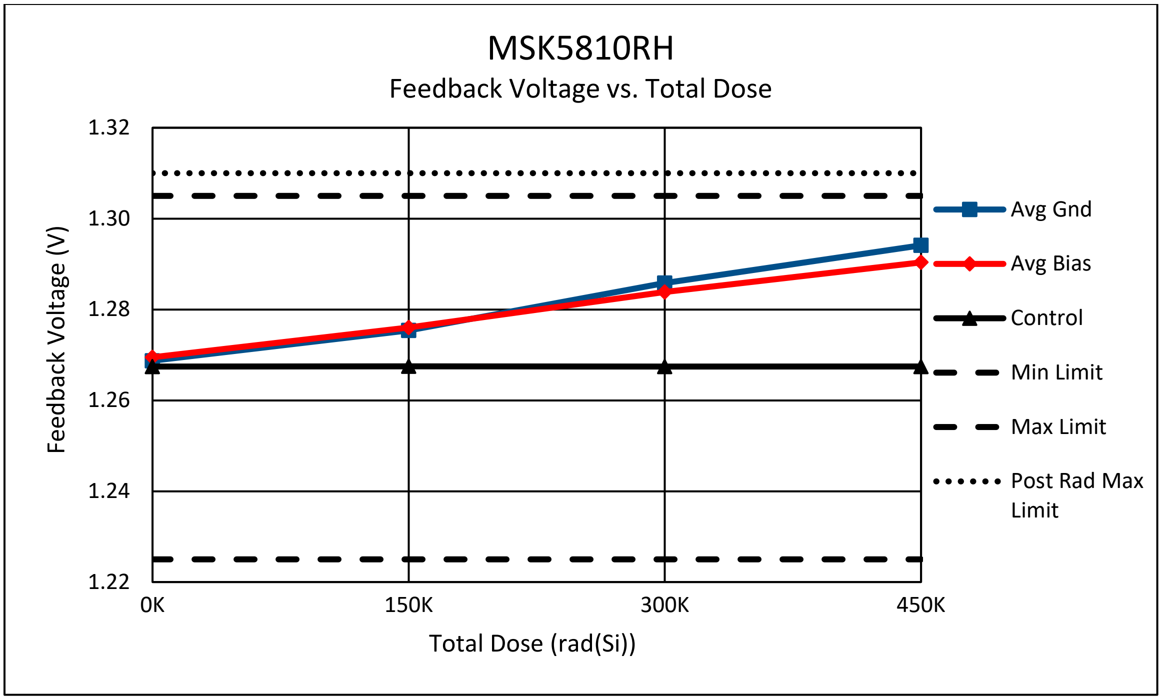
Unbiased S/N – 0080, 0081, 0082, 0083, 0084

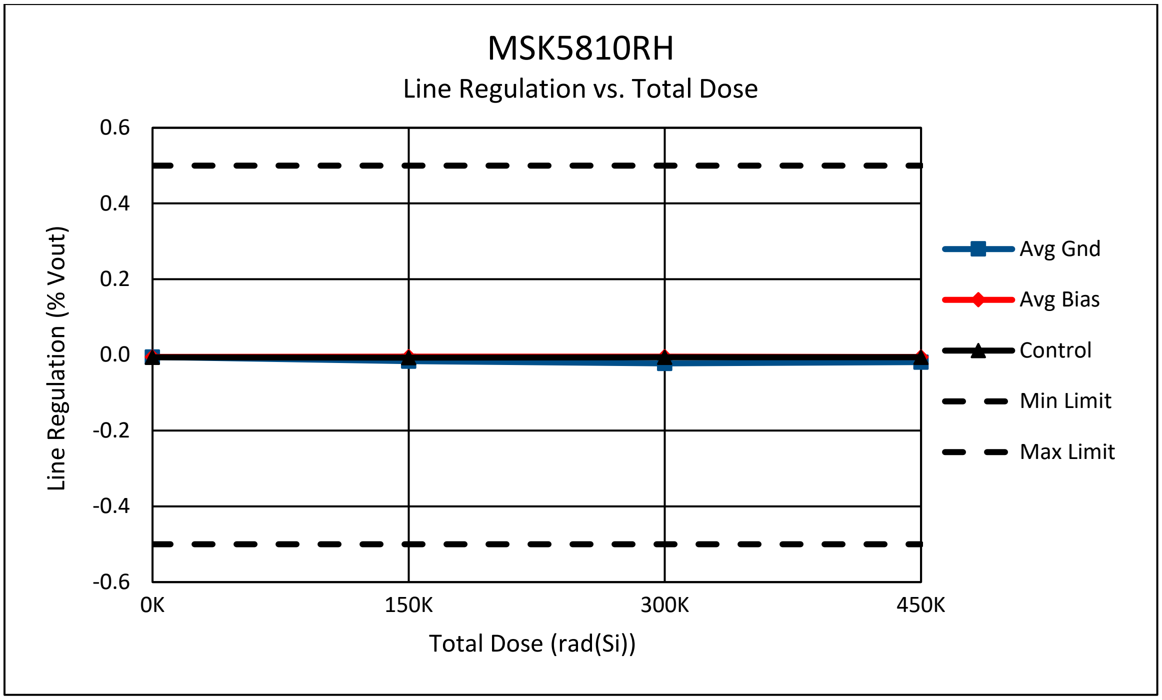
Table 1

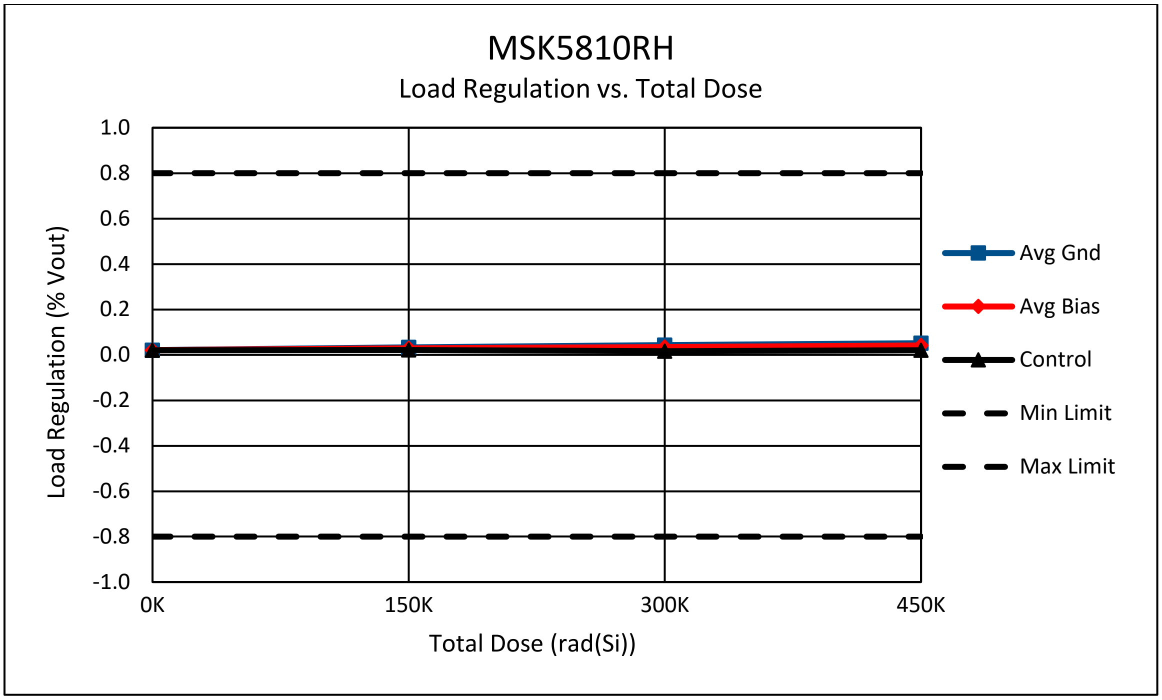
Dose Time, Incremental Dose and Total Cumulative Dose

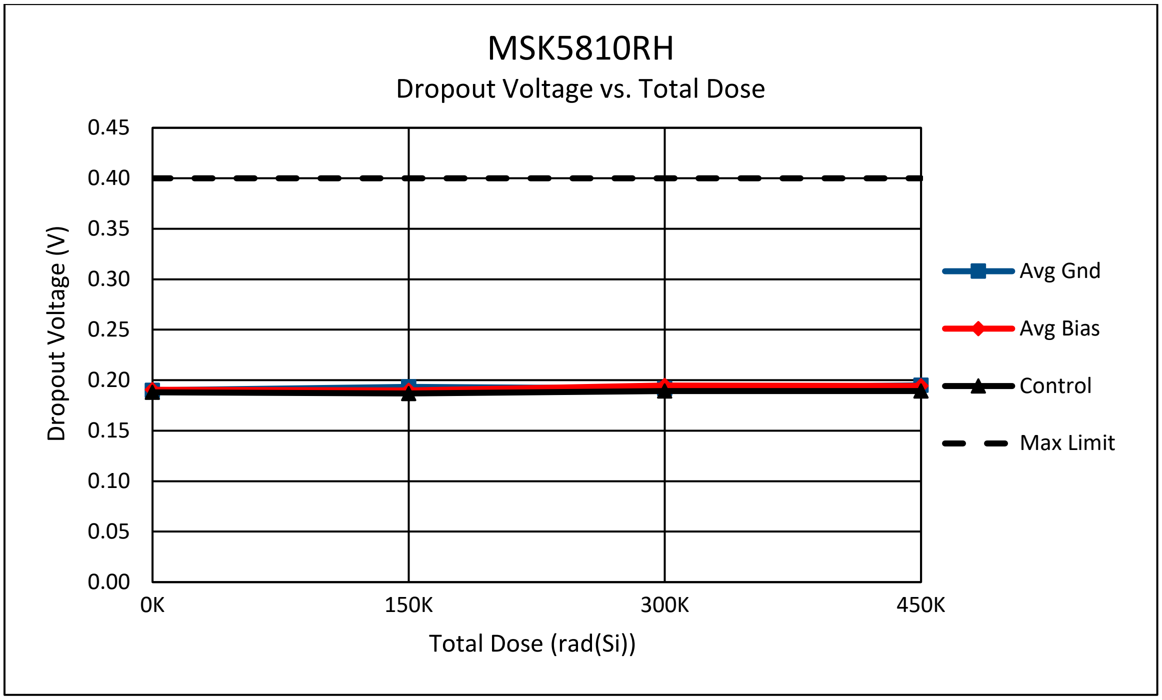

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit

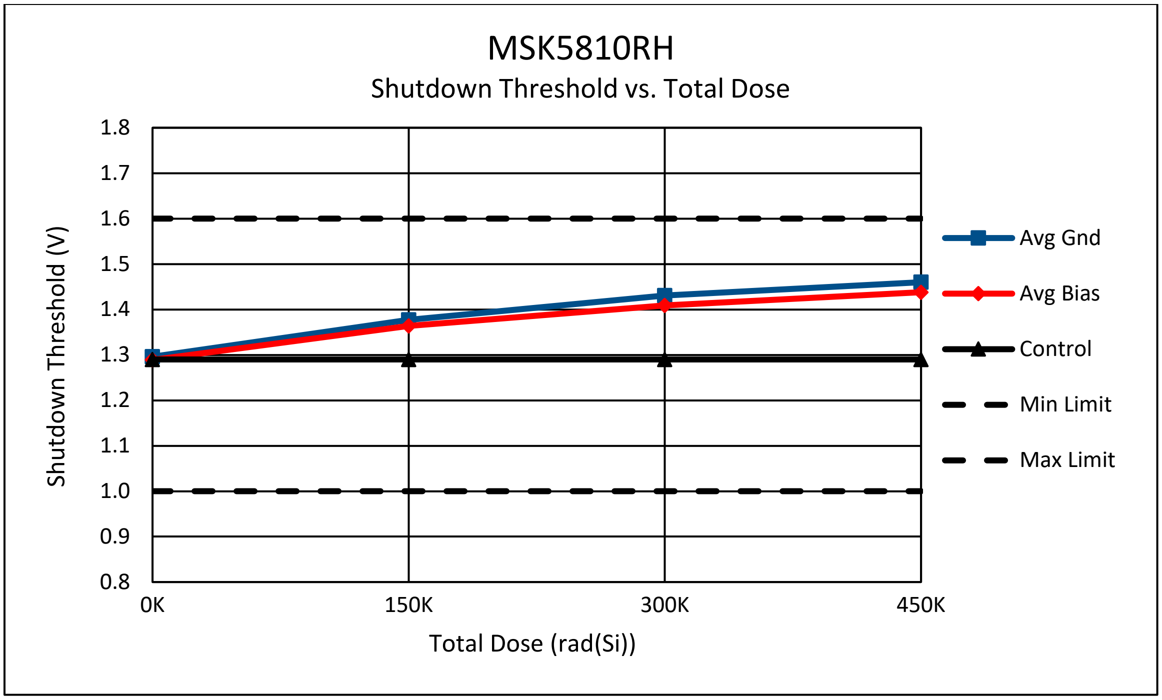

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit

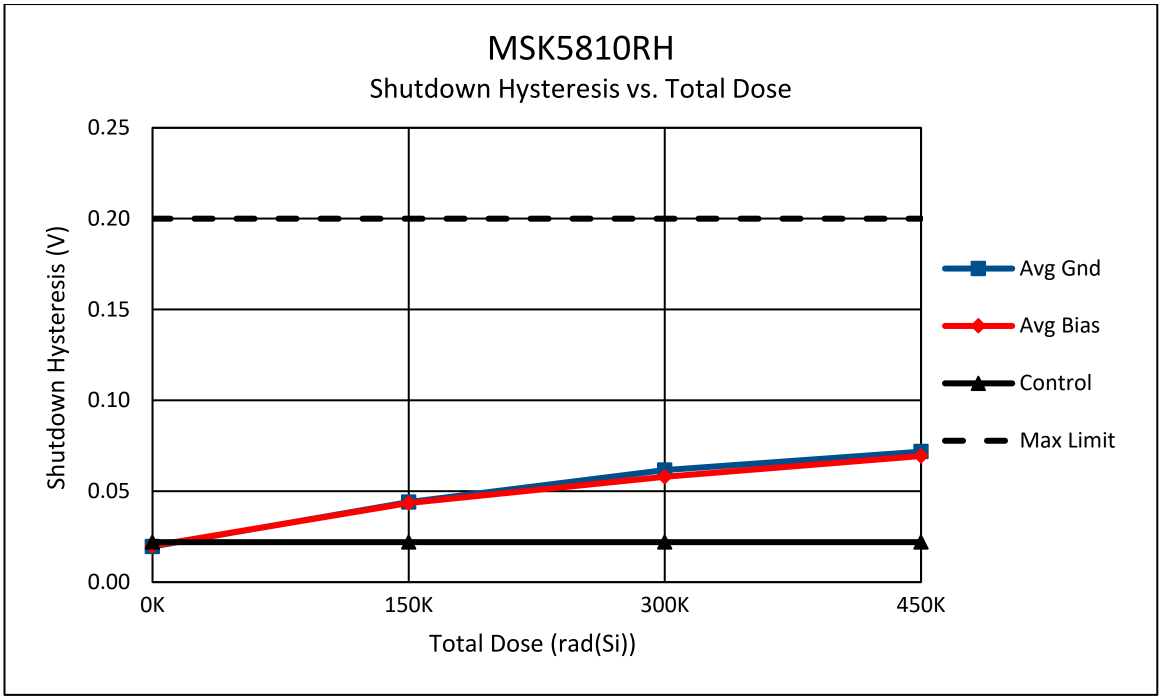

MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.30
1.28
1.26
1.24
1.22
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Max Limit

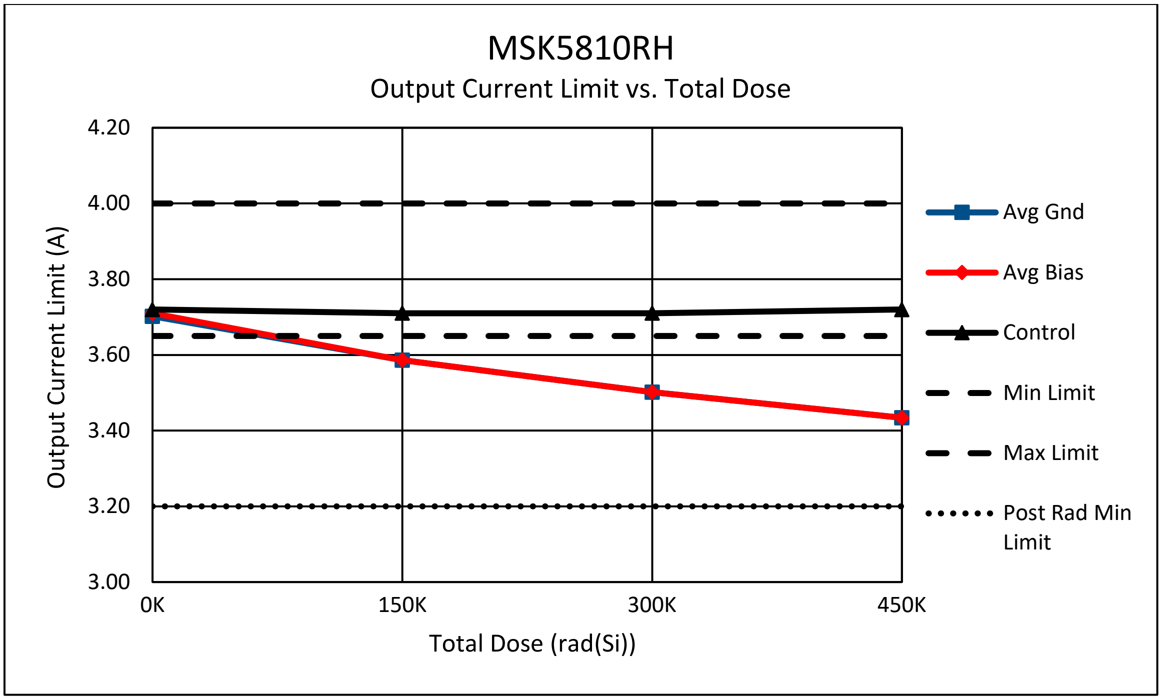

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
4.20
4.00
3.80
3.60
3.40
3.20
3.00
Output Current Limit (A)
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: September 4, 2020

Test Vehicle: MSK5810RH

IC Wafer Lot: W1803256.1 #10

Transistor Wafer Lot: PJ28F101T WF18

I. **Introduction**:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as Radiation Hardened to 300 Krad(Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

II. **Radiation Source**:

Total dose was performed at VPT Rad, Chelmsford Massachusetts, using a Cobalt 60 radiation source. The dose rate was determined to be 124 Rad(Si)/sec. The total dose schedule can be found in Table I.

III. **Test Setup**:

All test samples were subjected to Group A Electrical Test at 25°C in accordance with the device data sheet. In addition, all devices received 160 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 one control device, at each total dose level. All electrical tests were completed within one hour of irradiation. Each subsequent dose was performed within two hours of the previous irradiation.

IV. **Data**:

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. 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, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # SC0424

Irradiation Date
9/04/2021

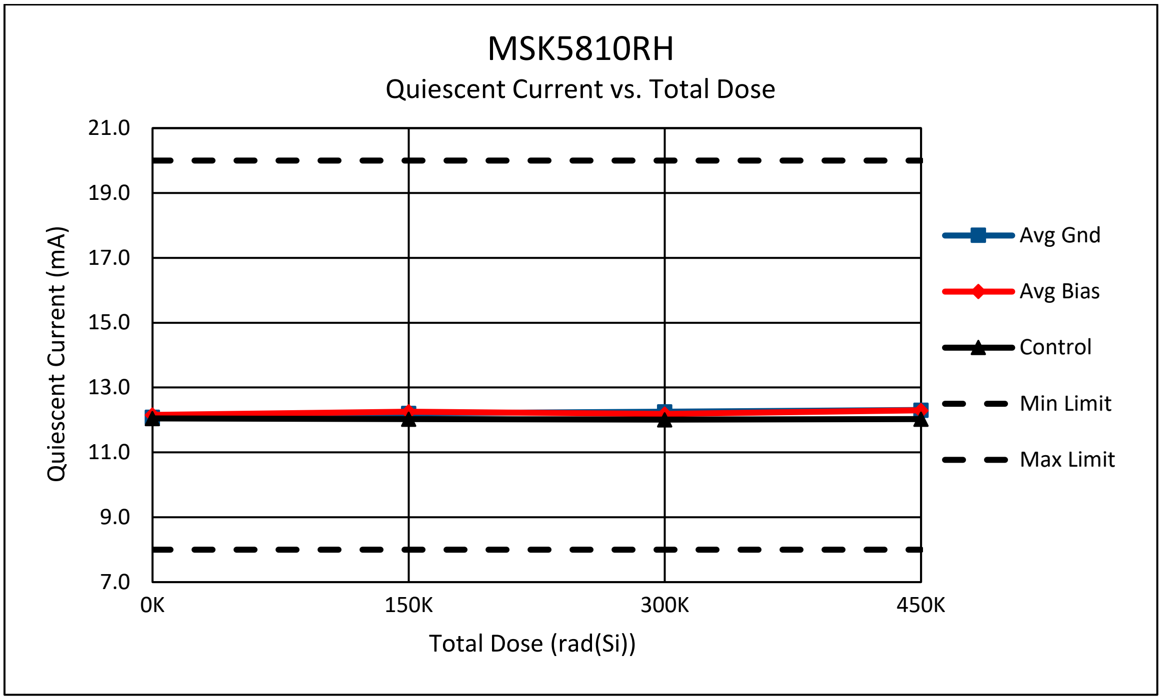
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
20:46	154,504	154,504
20:46	154,504	309,008
20:46	154,504	463,512

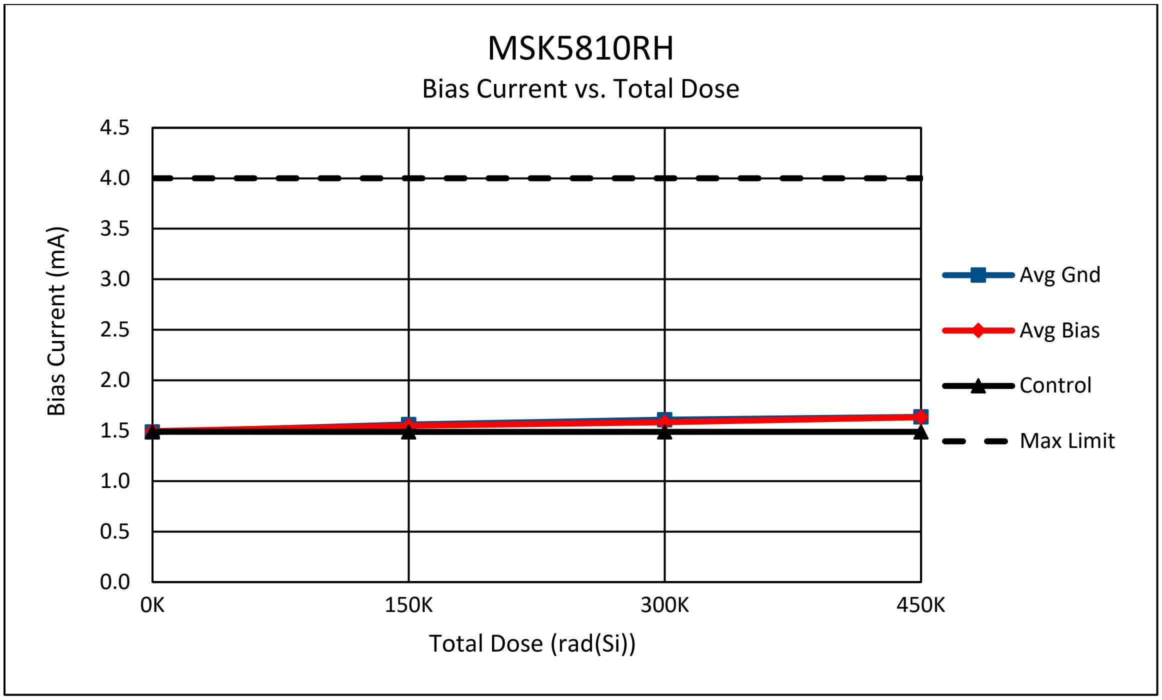
Biased S/N – 0063, 0064, 0065, 0066, 0067

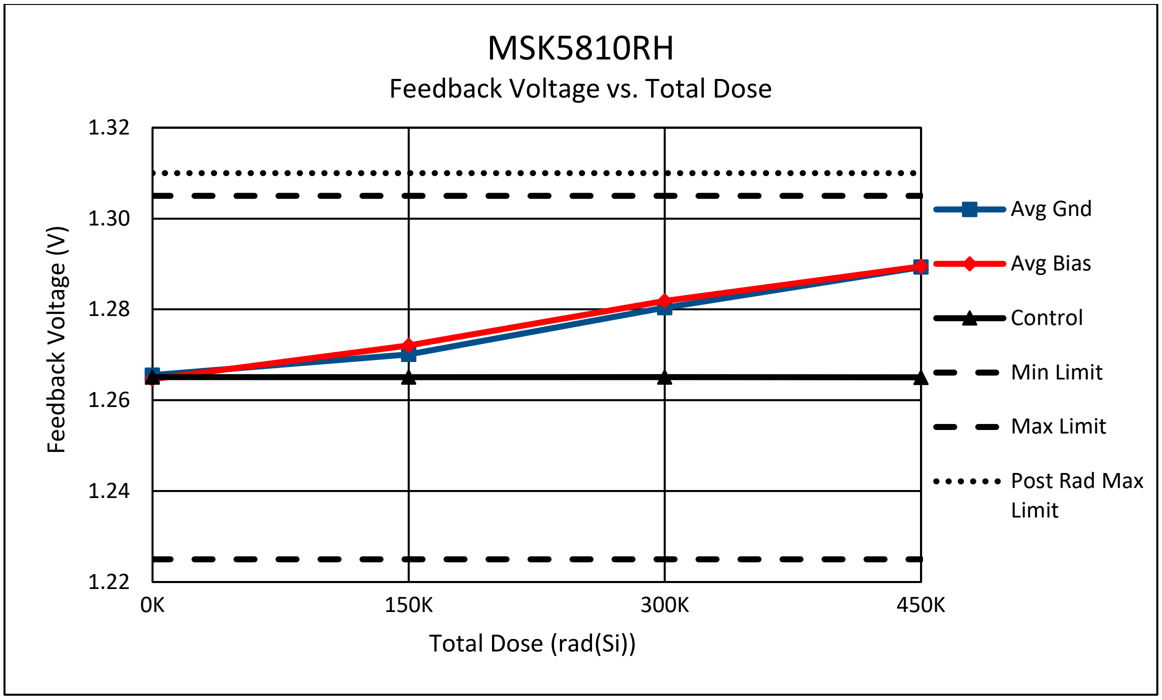
Unbiased S/N – 0068, 0069, 0070, 0071, 0072

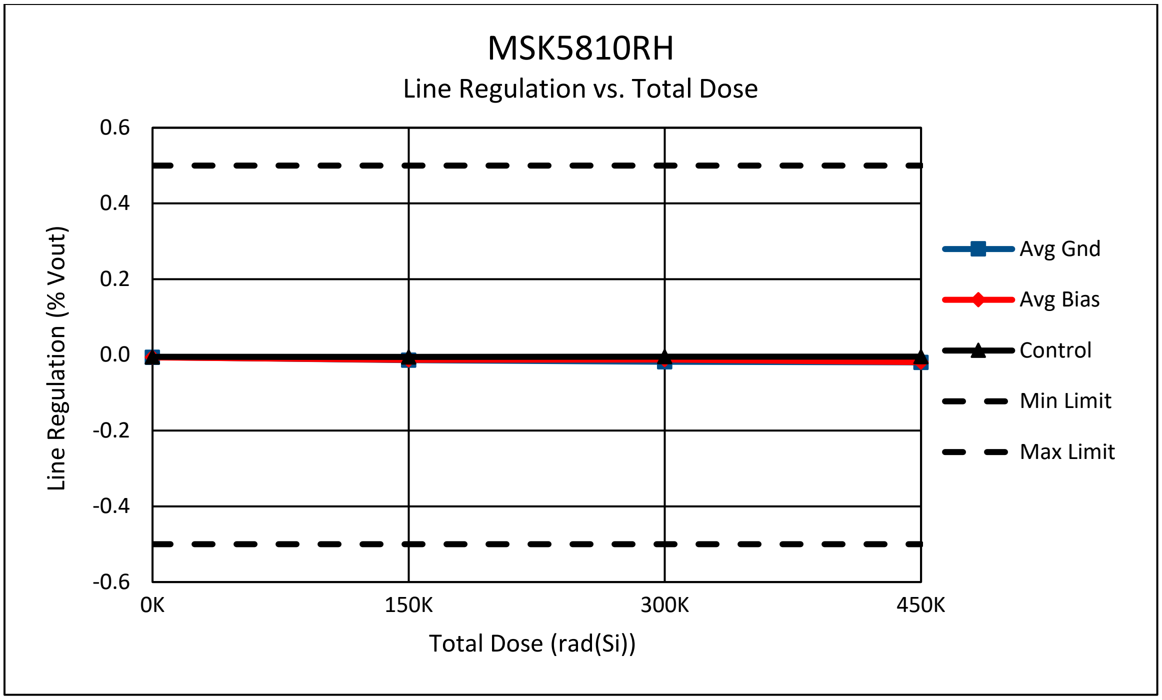
Table 1

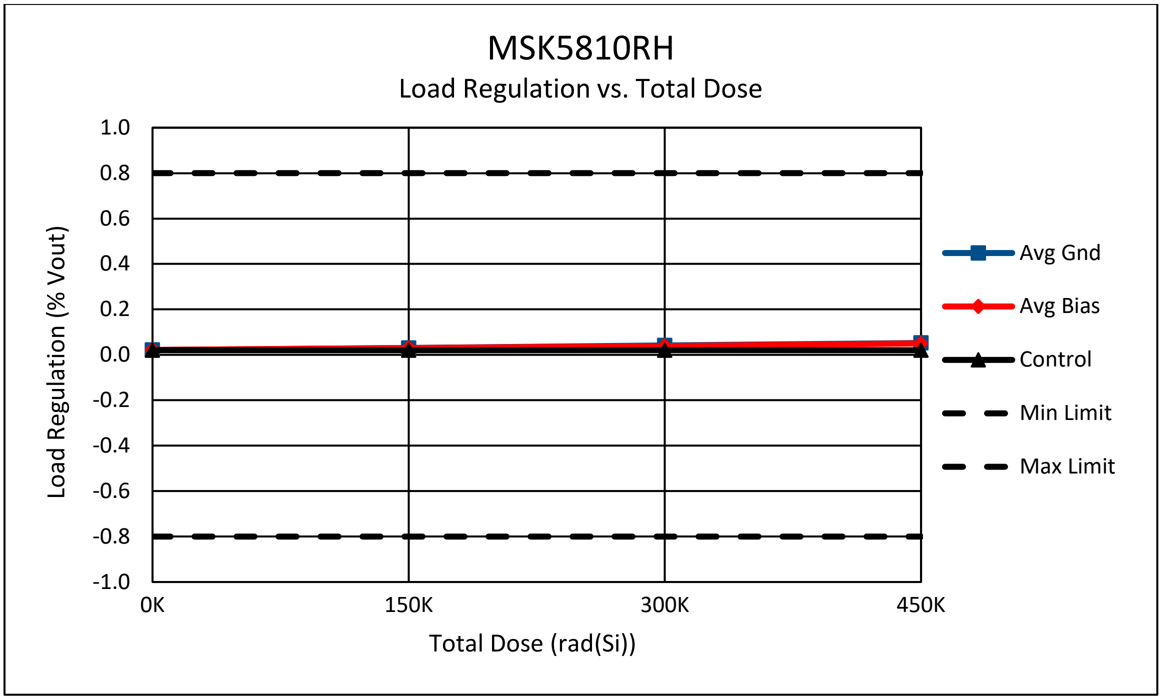
Dose Time, Incremental Dose and Total Cumulative Dose

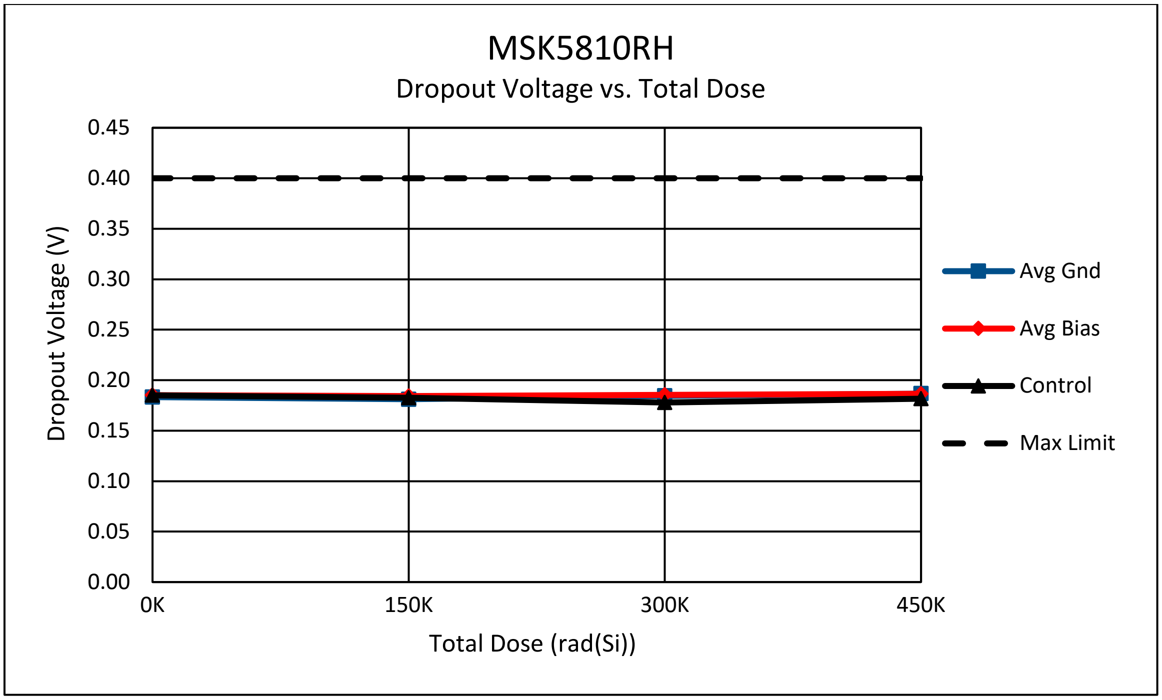

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit

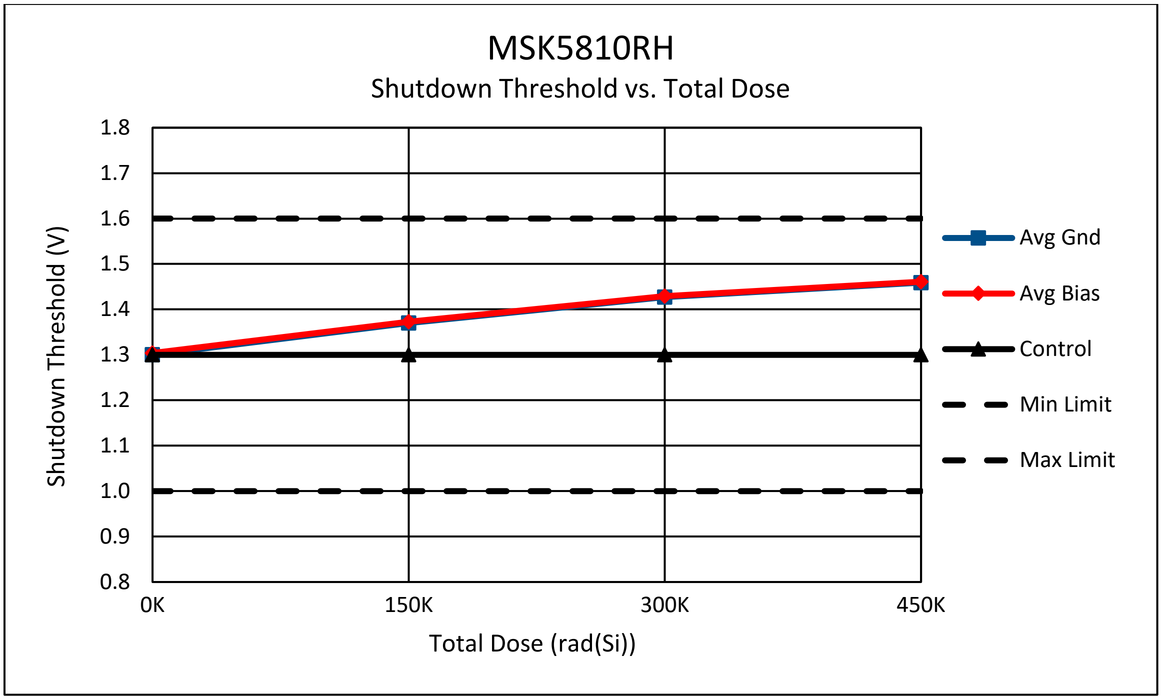

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit

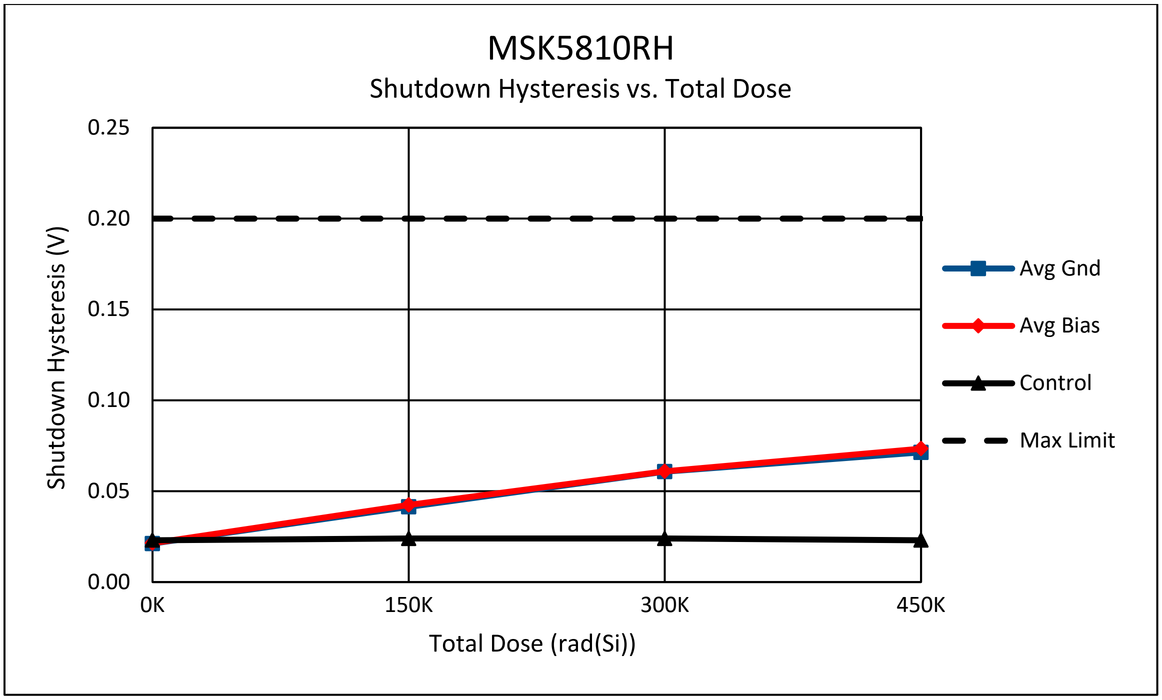

MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.30
1.28
1.26
1.24
1.22
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Max Limit

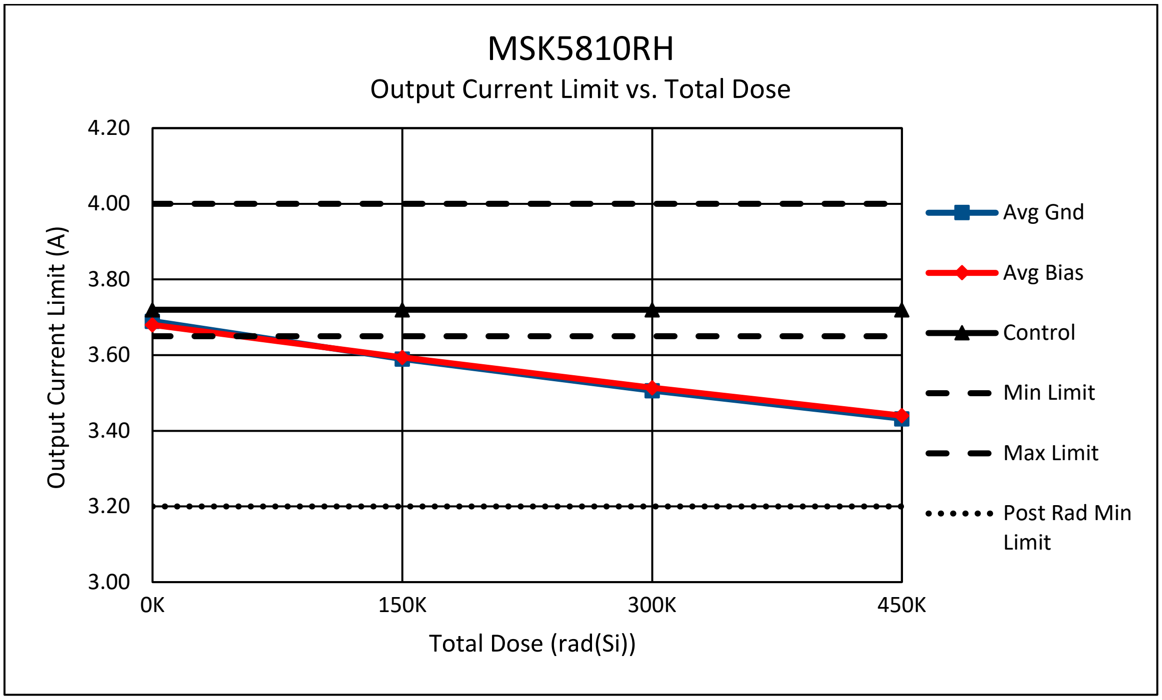

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.20
4.00
3.80
3.60
3.40
3.20
3.00
0K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK 5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: December 15, 2021

Test Vehicle: MSK5810RH

IC Wafer Lot: W1803256.1 WF8

Transistor Wafer Lot: PJ28F101T WF17

B. Horton
J. Saucier

TTM Technologies – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as Radiation Hardened to 300 Krad(Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

II. Radiation Source:

Total dose was performed at the VPT Rad, Chelmsford MA, using a Cobalt 60 radiation source. The dose rate was determined to be 169.5 Rad(Si)/sec. The total dose schedule can be found in Table I.

III. Test Setup:

All test samples were subjected to Group A Electrical Test at 25°C in accordance with the device data sheet. In addition, all devices received 160 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 one control device, at each total dose level. All electrical tests were completed within one hour of irradiation. Each subsequent dose was performed within two hours of the previous irradiation.

IV. Data:

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. If required, full test data can be obtained by contacting TTM Technologies – MSK Products.

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # SC0424

Irradiation Date
12/15/2021

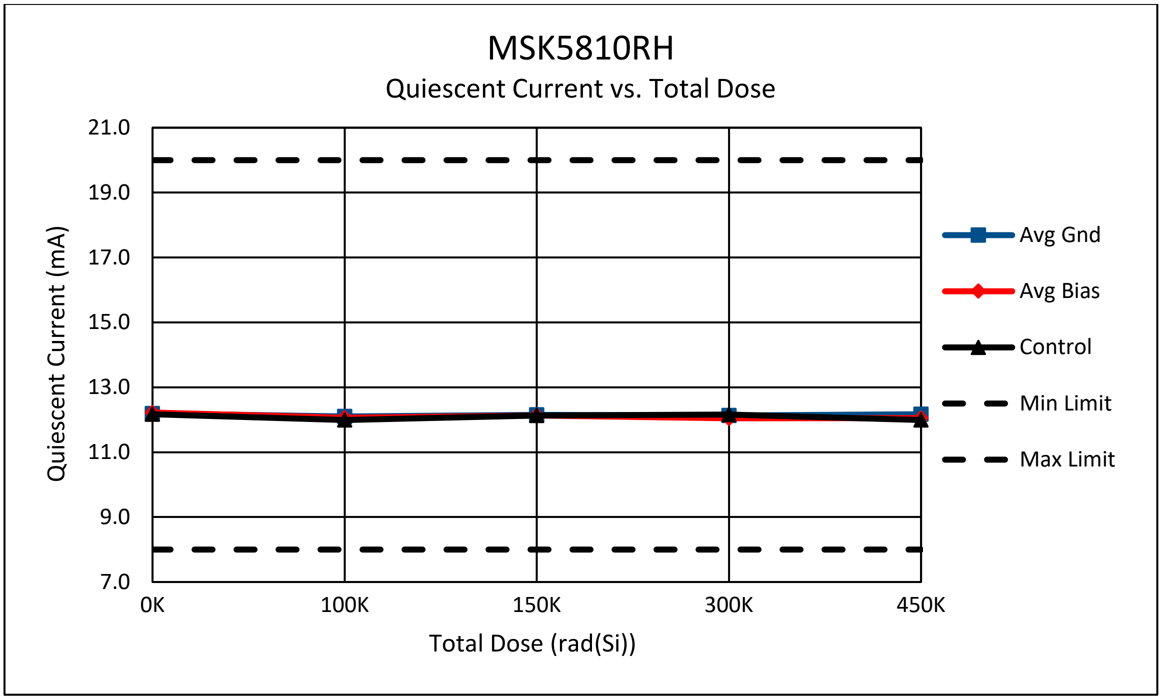
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
10:08	103,022	103,022
5:04	51,562	154,686
15:12	154,500	309,000
15:12	154,584	463,854

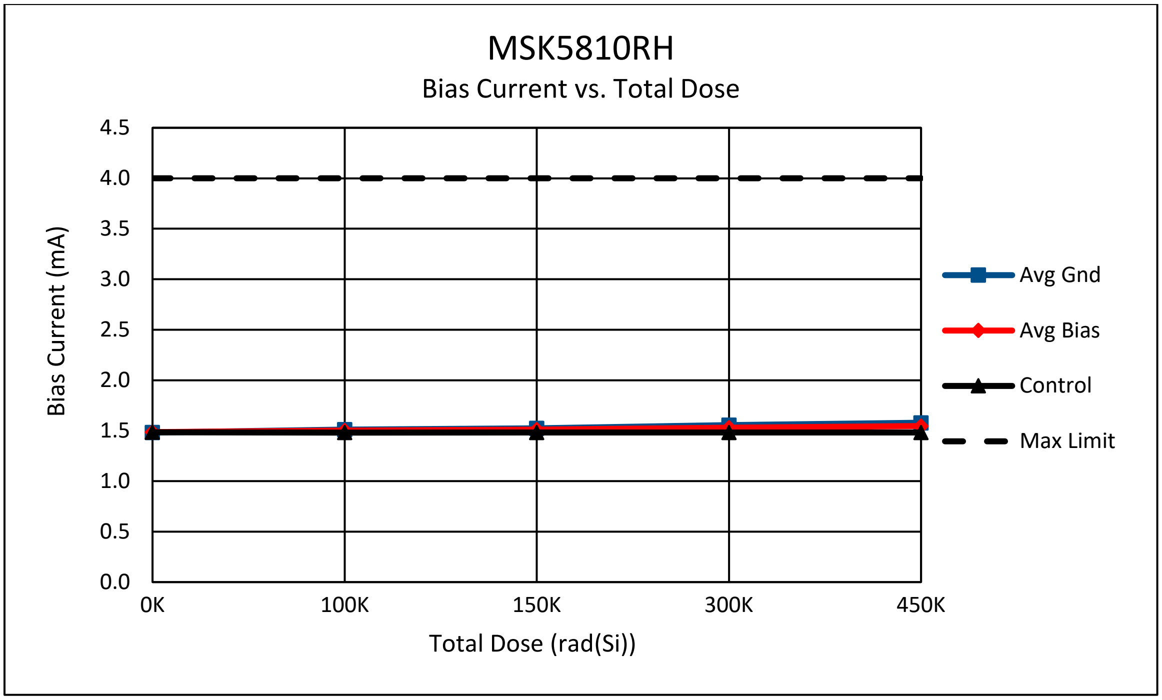
Biased S/N – 0097, 0098, 0099, 0100, 0101

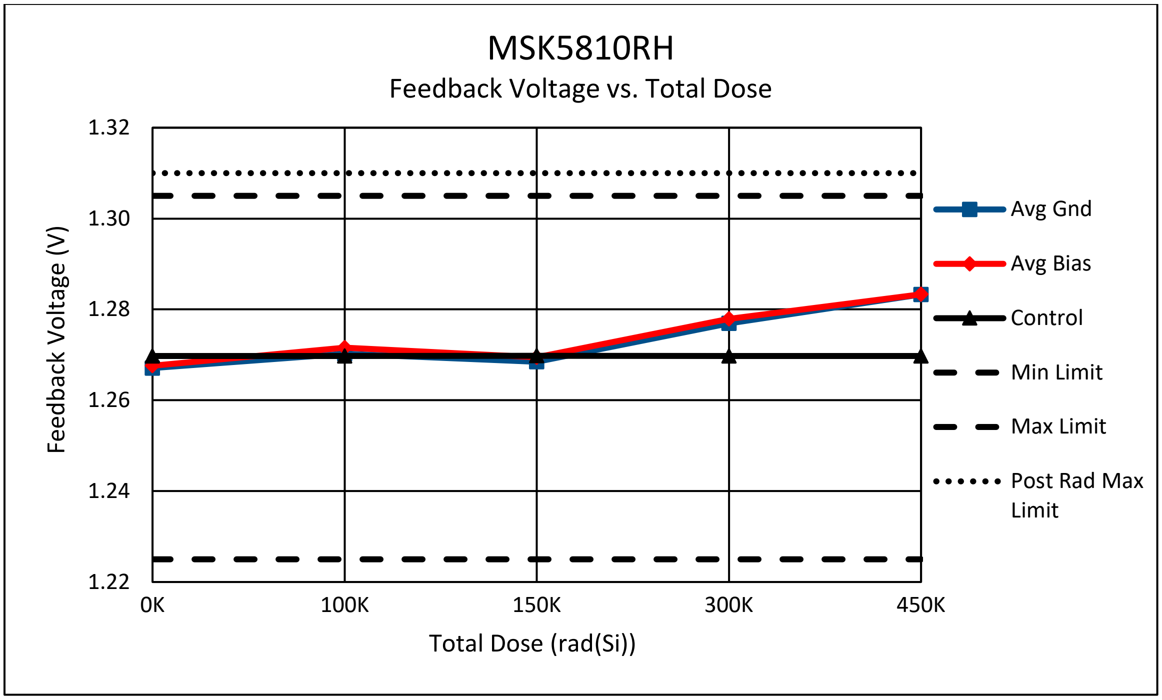
Unbiased S/N – 0102, 0104, 0105, 0106, 0107

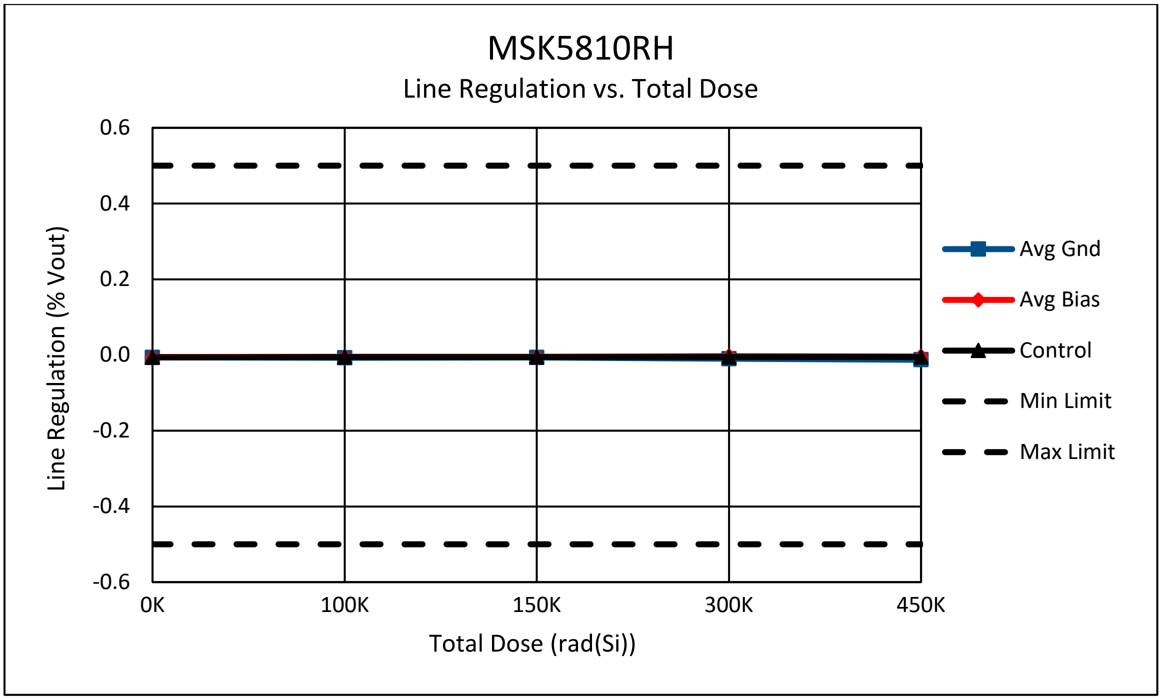
Table 1

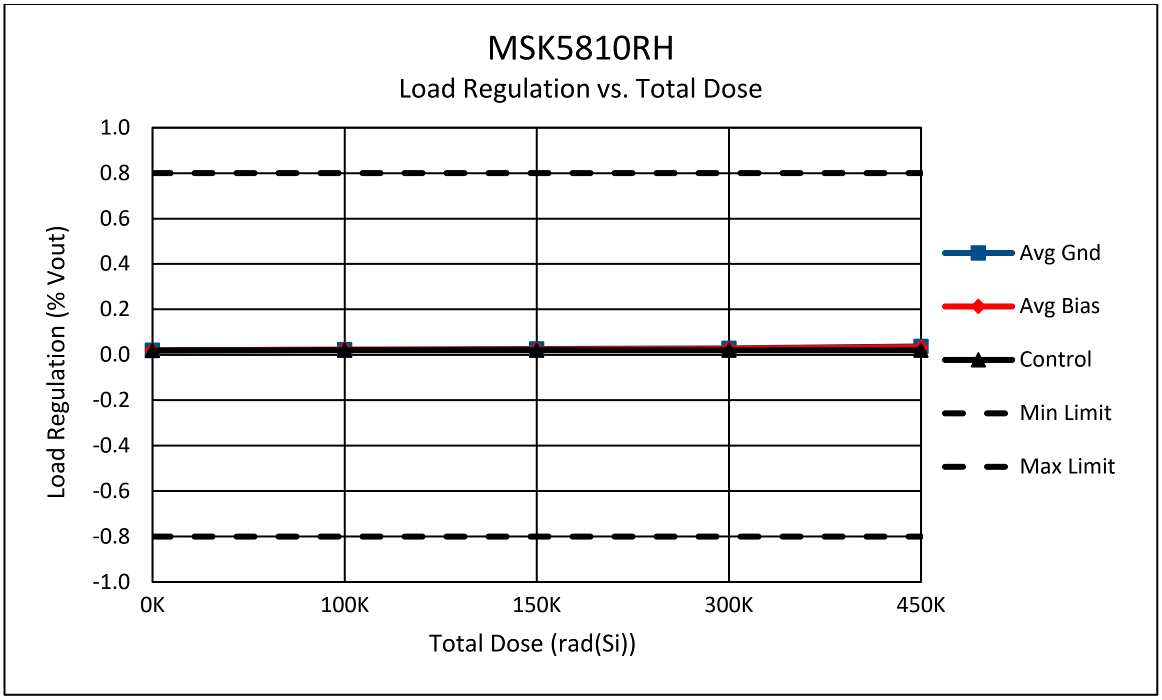
Dose Time, Incremental Dose and Total Cumulative Dose

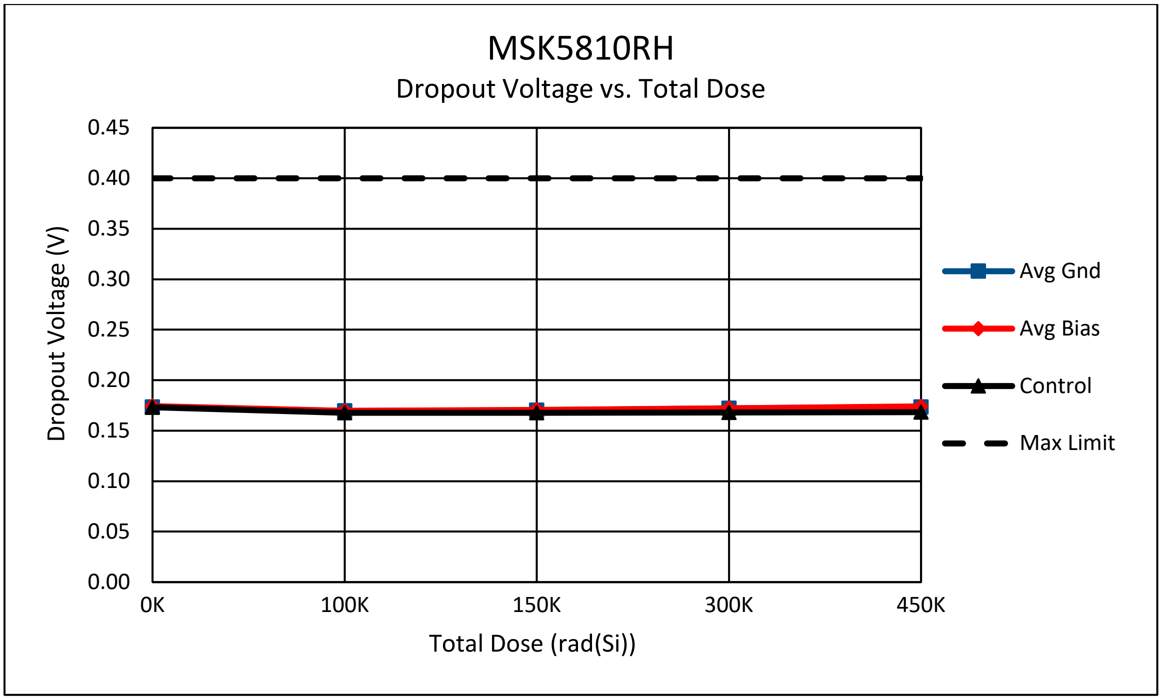

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit

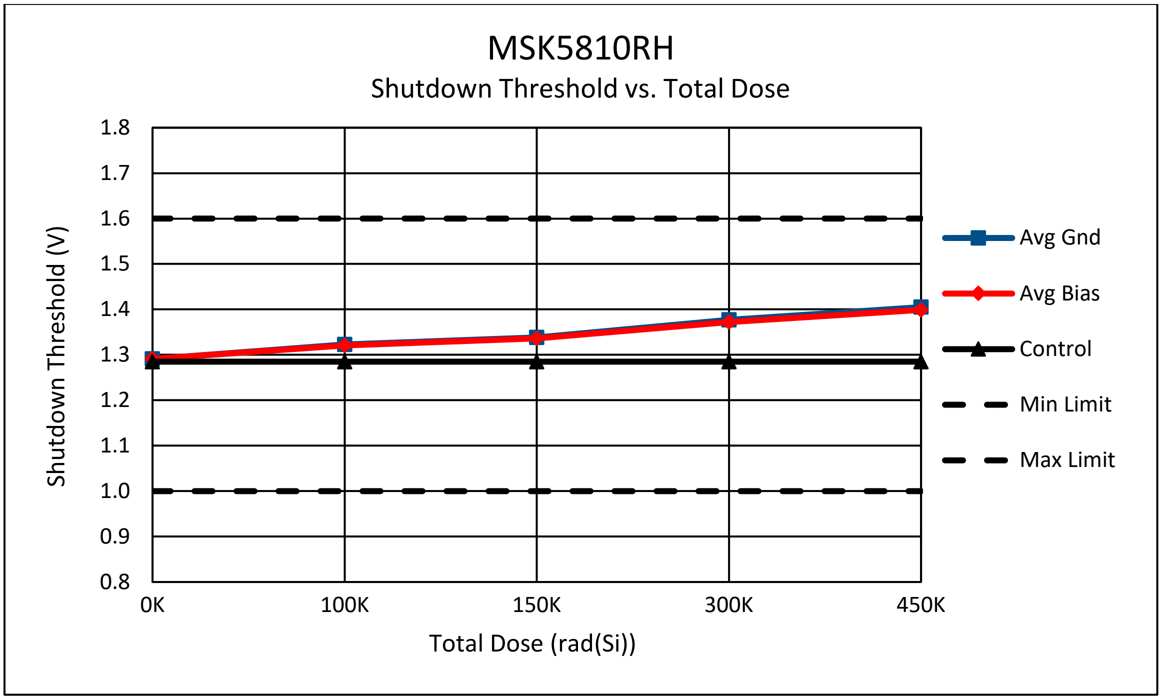

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit

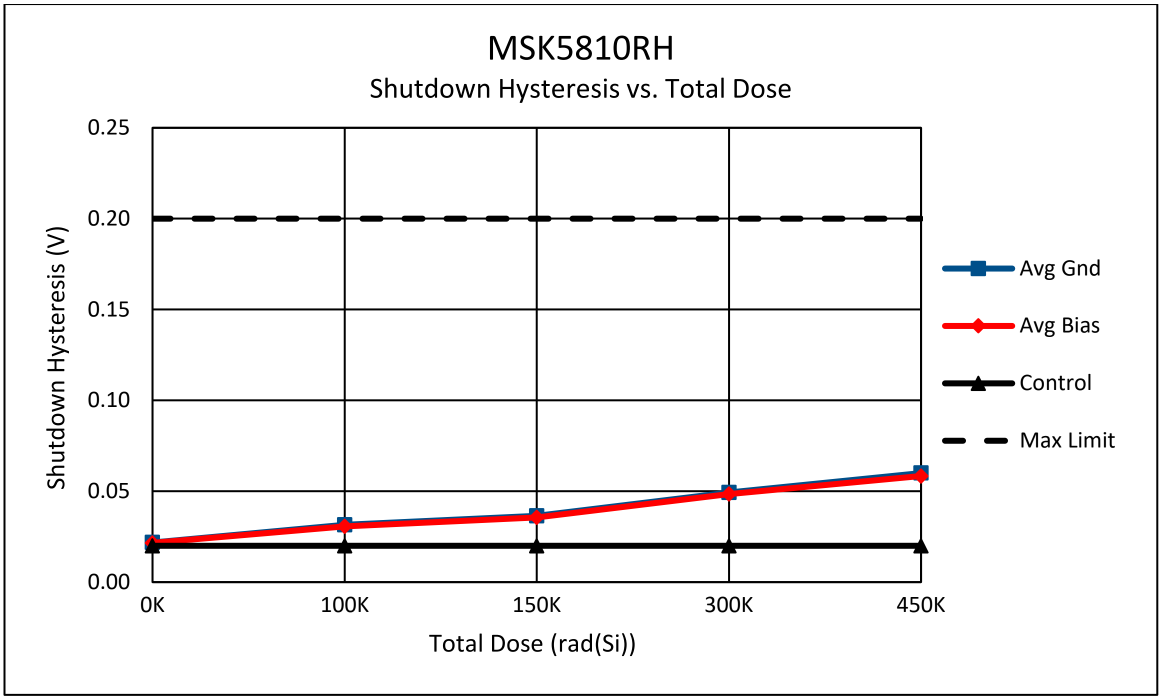

MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.30
1.28
1.26
1.24
1.22
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Max Limit

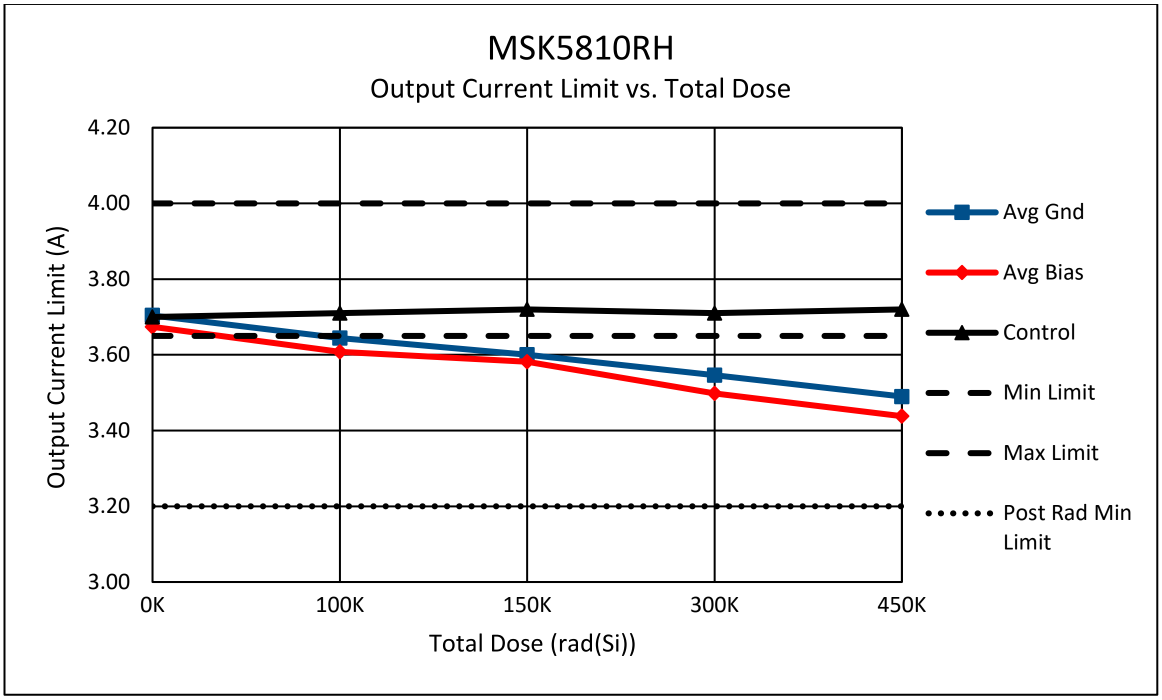

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.20
4.00
3.80
3.60
3.40
3.20
3.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Min Limit

Total Dose Radiation Test Report

MSK5810RH
(MSK5800RH, MSK5820RH, MSK5821RH, MSK5822RH, MSK 5827RH)
RAD Hard Ultra Low Dropout
Adjustable Positive Linear Regulator

Test Date: December 16, 2021

Test Vehicle: MSK5810RH

IC Wafer Lot: W1803256.1 WF8

Transistor Wafer Lot: PJ28F101T WF18

B. Horton
J. Saucier

TTM Technologies – MSK Products

I. **Introduction**:

The total dose radiation test plan for the MSK5810RH series was developed to qualify the devices as Radiation Hardened to 300 Krad(Si). The testing was performed beyond 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 device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK5800RH, MSK5810RH, MSK5820RH, MSK5821RH, MSK5822RH, and MSK5827RH all use the same active components. The data in this report is from direct measurement of the MSK5810RH response to irradiation but it is indicative of the response of all five device types and is applicable to all five 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 MSK5810RH.

II. **Radiation Source**:

Total dose was performed at the VPT Rad, Chelmsford MA, using a Cobalt 60 radiation source. The dose rate was determined to be 105 Rad(Si)/sec. The total dose schedule can be found in Table I.

III. **Test Setup**:

All test samples were subjected to Group A Electrical Test at 25°C in accordance with the device data sheet. In addition, all devices received 160 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 biased during irradiation. Maximum recommended operating voltage of +7.5V 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 one control device, at each total dose level. All electrical tests were completed within one hour of irradiation. Each subsequent dose was performed within two hours of the previous irradiation.

IV. **Data**:

All performance curves are averaged from the test results of the biased and unbiased devices, respectively. If required, full test data can be obtained by contacting TTM Technologies – MSK Products.

V. **Summary**:

Based on the test data recorded during radiation testing and statistical analysis, Feedback Voltage, Shutdown Threshold, Shutdown Hysteresis and Output Current Limit exhibited shift due to irradiation, however all performance curves stayed within specification beyond 300 Krad(Si) TID.

MSK5810RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # SC0424

Irradiation Date
12/16/2021

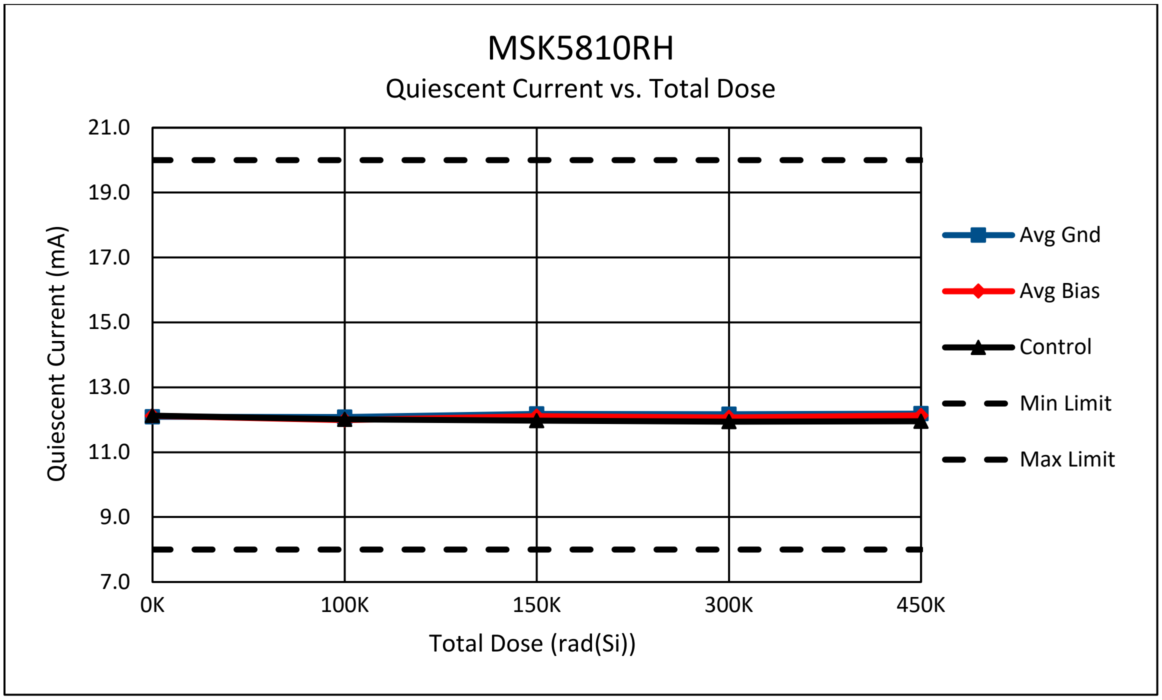
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
16:22	103,110	103,022
8:11	51,555	154,665
24:32	154,560	309,225
24:32	154,560	463,785

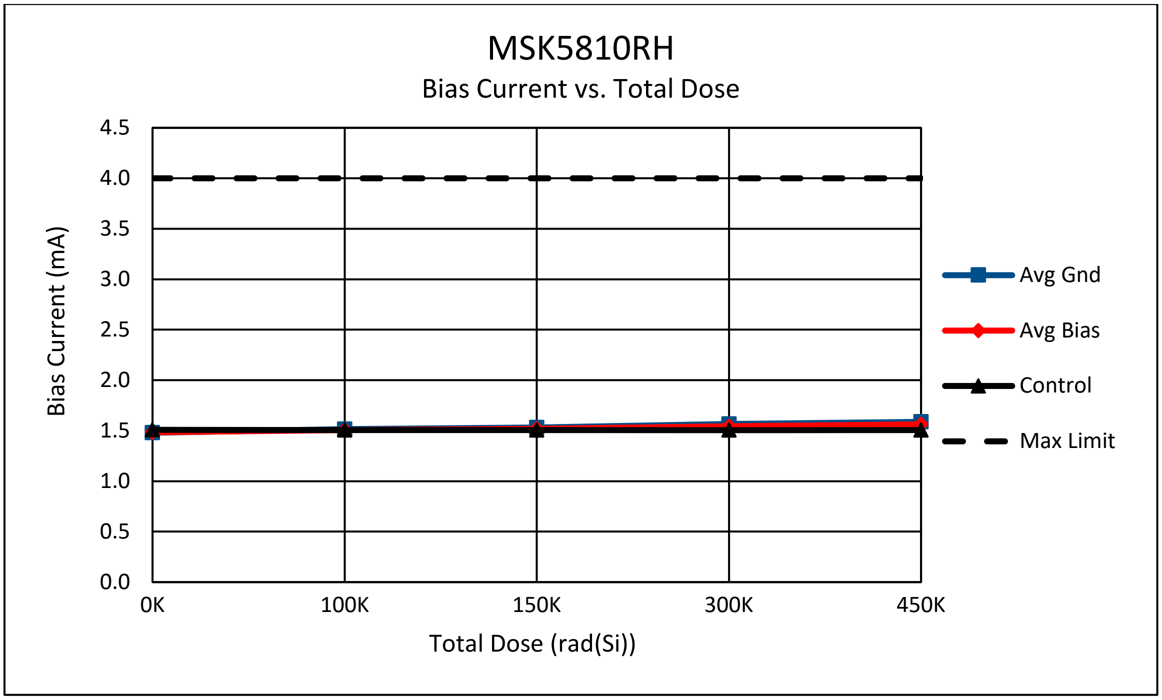
Biased S/N – 0085, 0086, 0087, 0088, 0089

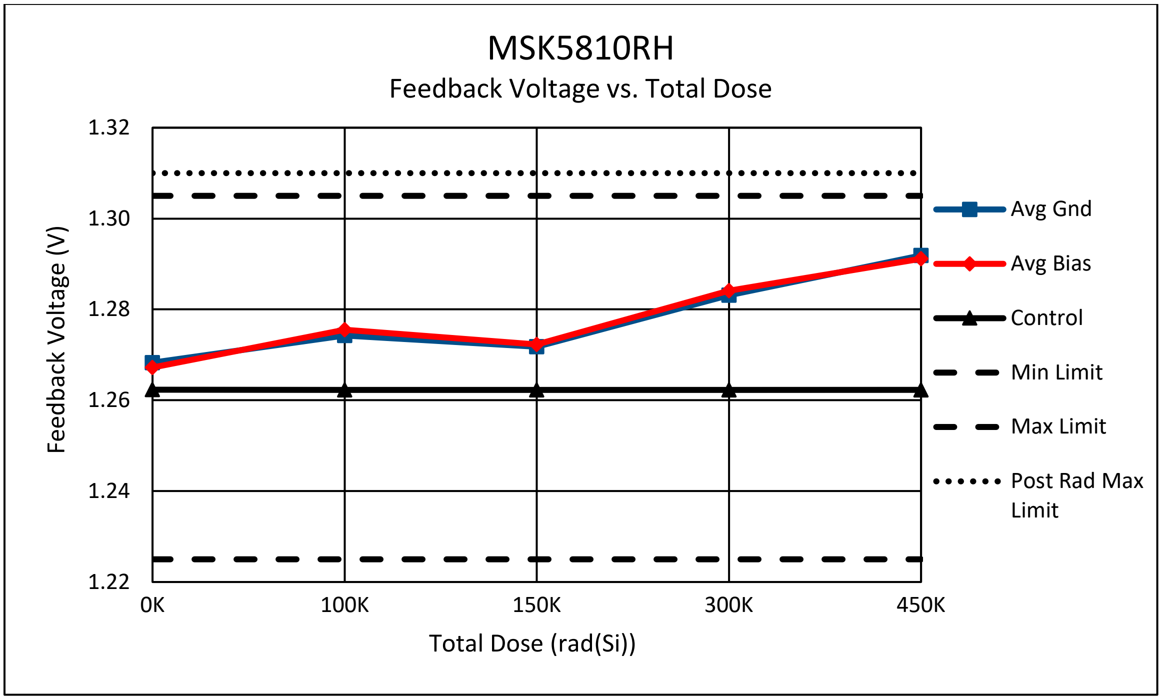
Unbiased S/N – 0090, 0091, 0092, 0094, 0095

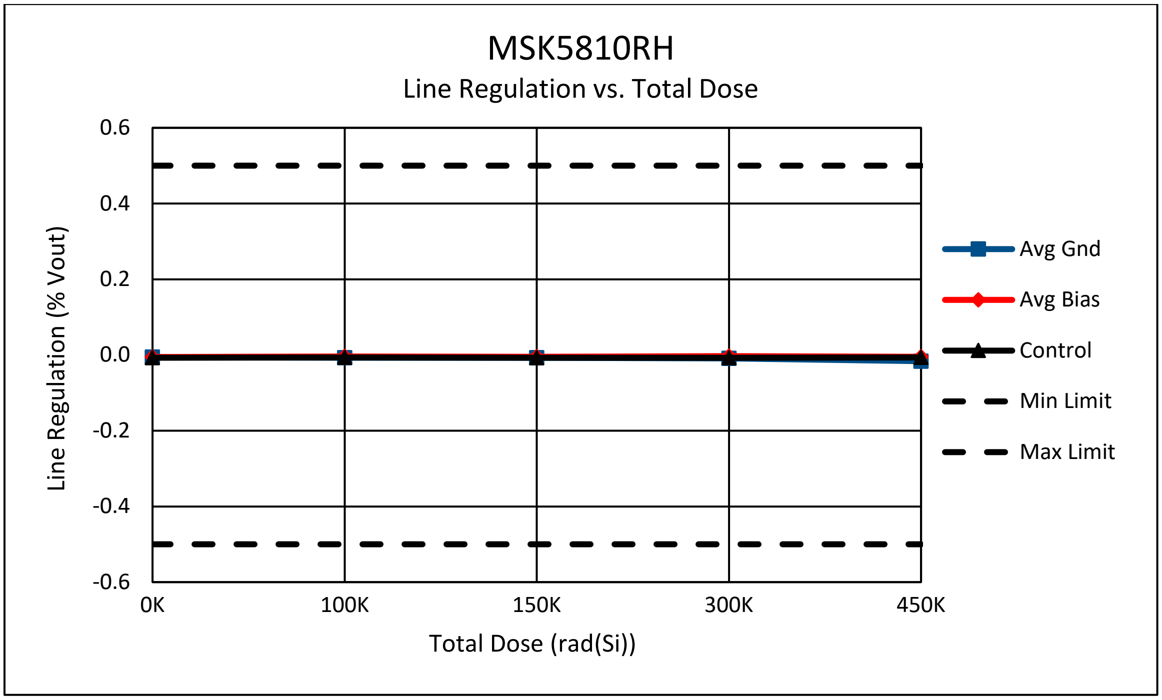
Table 1

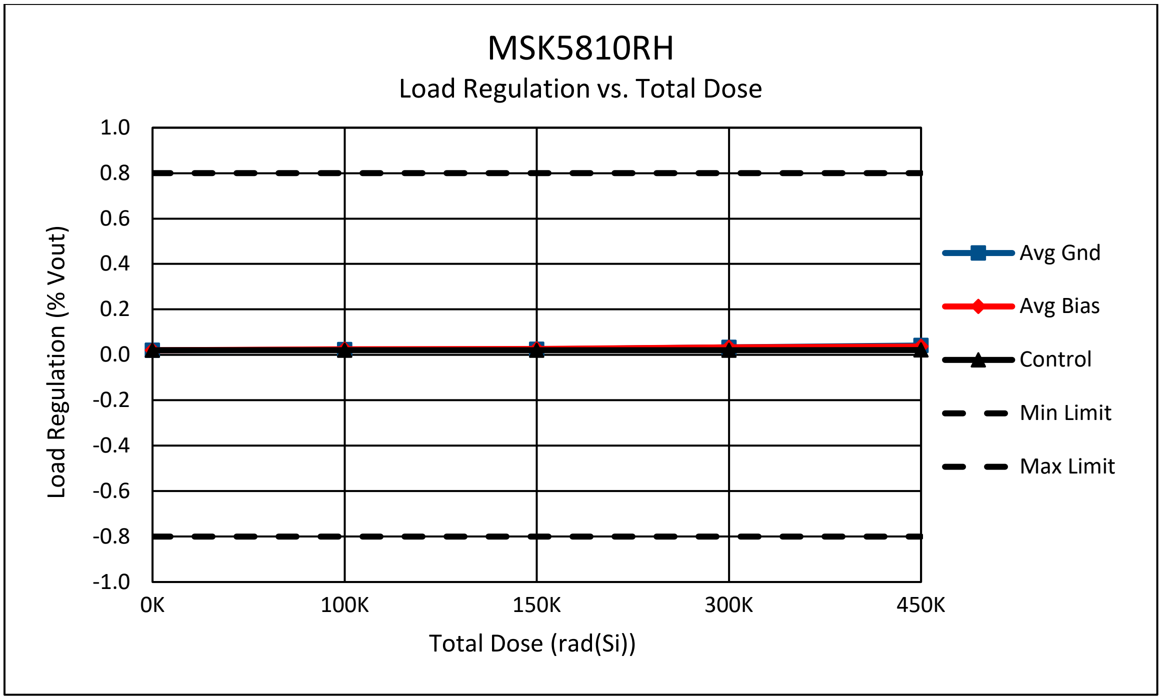
Dose Time, Incremental Dose and Total Cumulative Dose

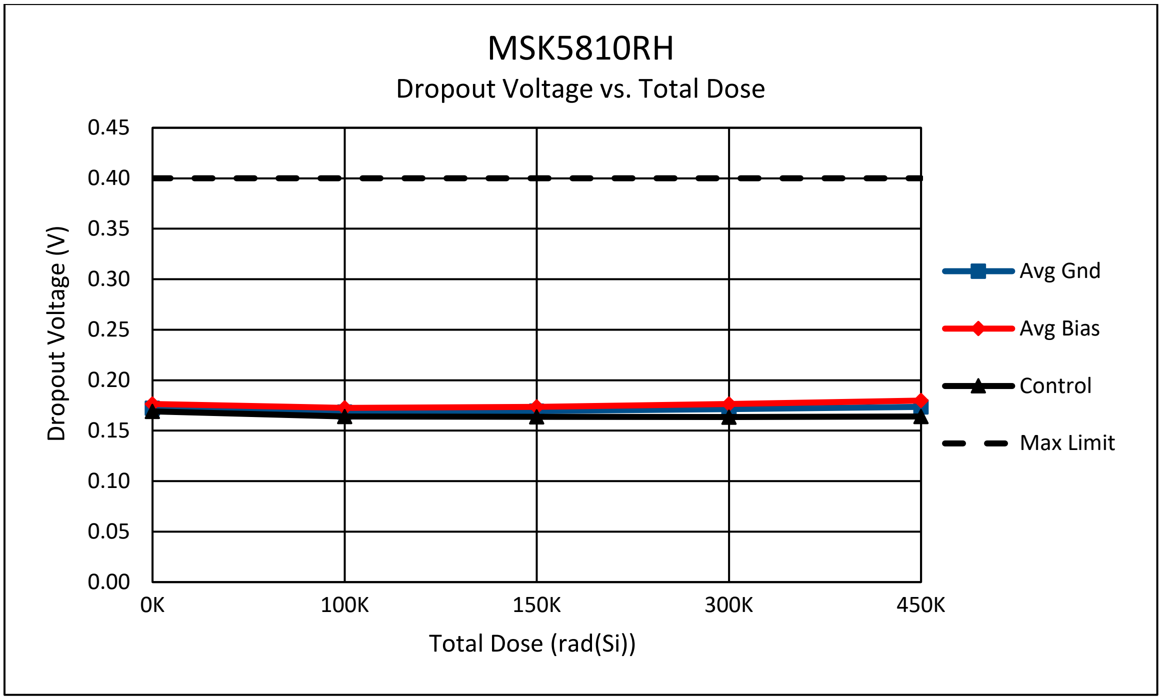

MSK5810RH
Quiescent Current vs. Total Dose
Quiescent Current (mA)
21.0
19.0
17.0
15.0
13.0
11.0
9.0
7.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit

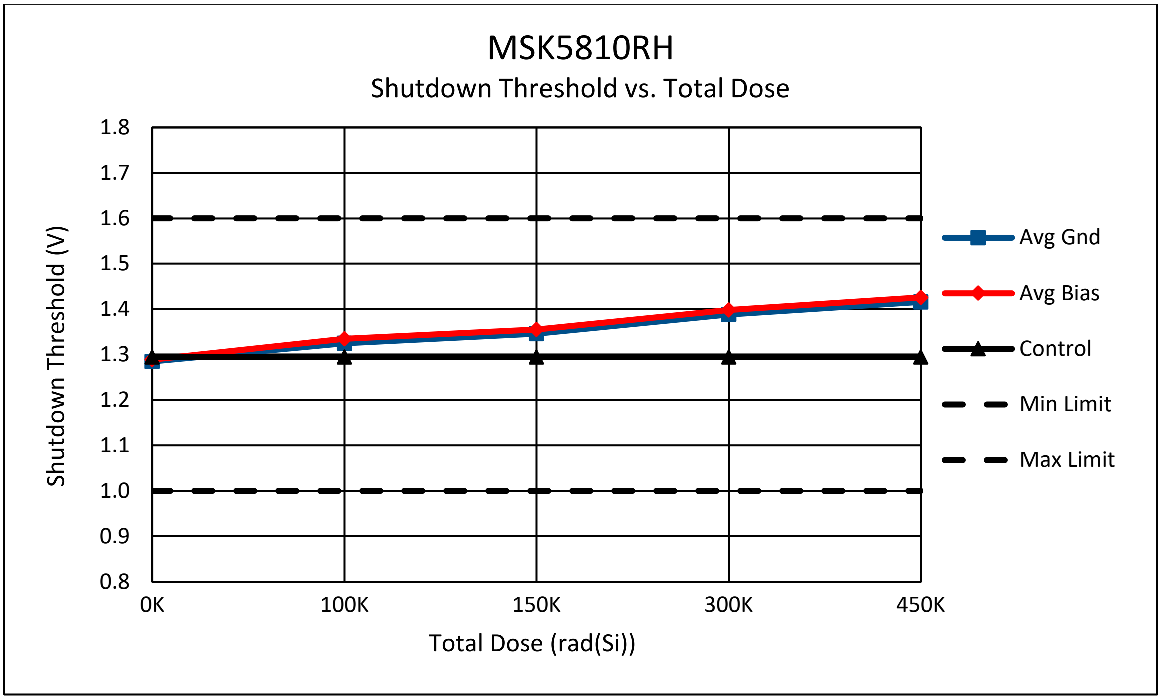

MSK5810RH
Bias Current vs. Total Dose
Bias Current (mA)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit

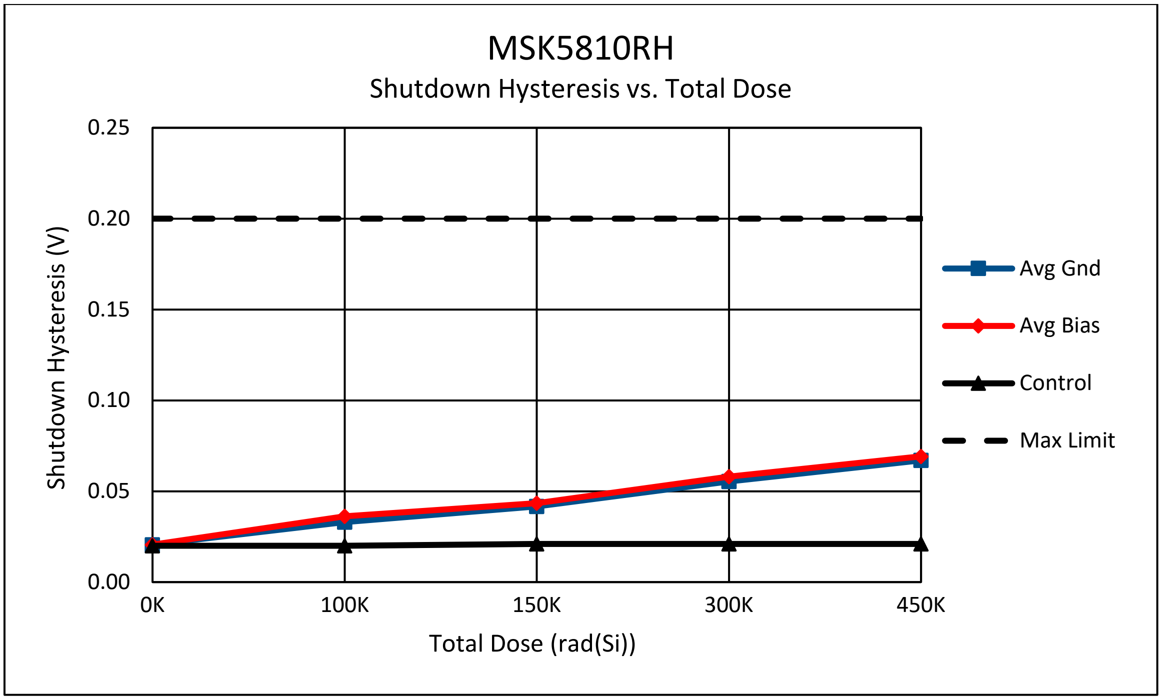

MSK5810RH
Feedback Voltage vs. Total Dose
Feedback Voltage (V)
1.32
1.30
1.28
1.26
1.24
1.22
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Max Limit

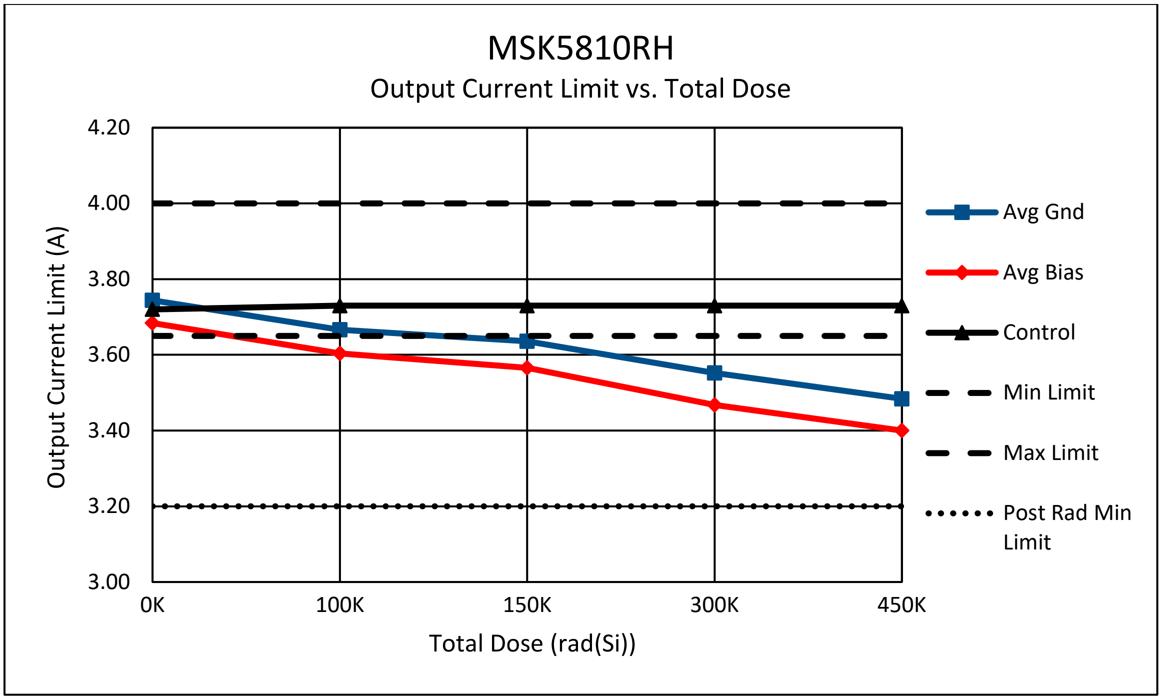

MSK5810RH
Line Regulation vs. Total Dose
Line Regulation (% Vout)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Load Regulation vs. Total Dose
Load Regulation (% Vout)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Dropout Voltage vs. Total Dose
Dropout Voltage (V)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Shutdown Threshold vs. Total Dose
Shutdown Threshold (V)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit


MSK5810RH
Shutdown Hysteresis vs. Total Dose
Shutdown Hysteresis (V)
0.25
0.20
0.15
0.10
0.05
0.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Max Limit


MSK5810RH
Output Current Limit vs. Total Dose
Output Current Limit (A)
4.20
4.00
3.80
3.60
3.40
3.20
3.00
0K
100K
150K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Control
Min Limit
Max Limit
Post Rad Min Limit