Radiation Test Report Binder

MSK5980RH,
MSK5978RH

RAD Hard Positive Adjustable Voltage Regulator

Test Date (MM/DD/YYYY)	Test Method (MIL-STD-883)	Test Vehicle	IC Wafer Lot	Pages
09/24/2010	1019, Condition A	MSK 5978	-	2-9
05/11/2012	1019, Condition A	MSK 5978	H0923840.4 W# 3	10-17
01/29/2014	1019, Condition A	MSK 5978	H0923840.4 W# 5	18-25
10/28/2015	1019, Condition A	MSK 5978	H0852403.1 W# 10	26-33
11/23/2016	1019, Condition A	MSK 5978	H0923840.1 W# 13	34-41
03/29/2017	1019, Condition A	MSK 5978	H0923840.1 W# 10	42-49
05/30/2019	1019, Condition A	MSK 5980	H0923840.1 W# 12	50-57

***Note; Minor format change to individual report coversheet implemented 06/07/2019**

Total Dose Radiation Test Report

MSK 5978RH
MSK 5980RH

RAD Hard Positive Adjustable Voltage Regulator

Sept 24, 2010

C. Salce
F. Freytag

Anaren, Inc. – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK 5978RH was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level.

The data herein is from direct measurement of the MSK5978RH response to total dose irradiation, but is indicative of the response of both device types.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK 5978RH.

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 in accordance with the device data sheet. In addition, all devices received burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF-38534 Class K or MIL-PRF 38535 Class V. 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. An operating voltage of +26 Volts was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Electrical tests were completed within one hour of irradiation. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

IV. Data:

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

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, the MSK5978RH and MSK 5980RH qualified as a 300 Krad(Si) radiation hardened device. Set Pin Current and Line Regulation exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK 5978 RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
9/24/10

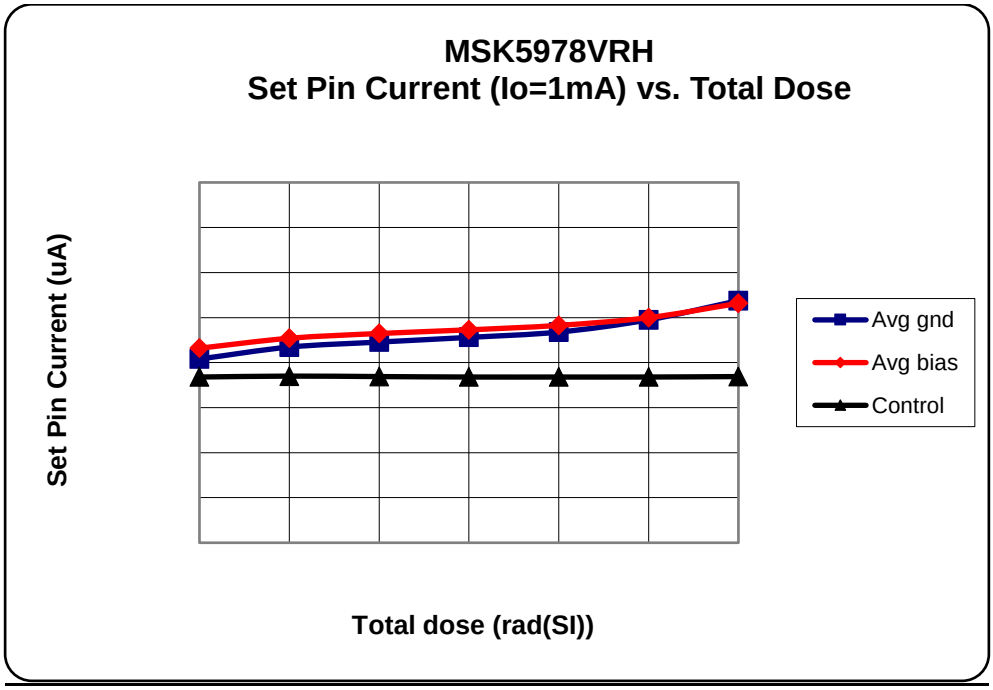
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
6:30	51,480	51,480
6:30	51,480	102,960
6:30	51,480	154,440
6:30	51,480	205,920
13:00	102,960	308,880
19:31	154,572	463,452

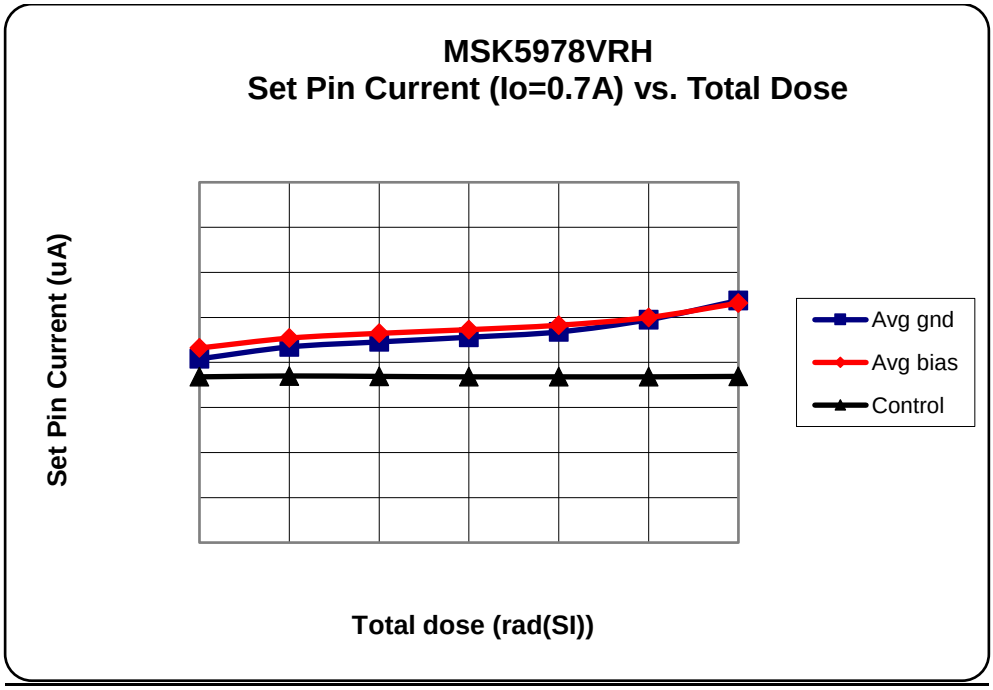
Biased S/N – 0037, 0038, 0039, 0042, 0046

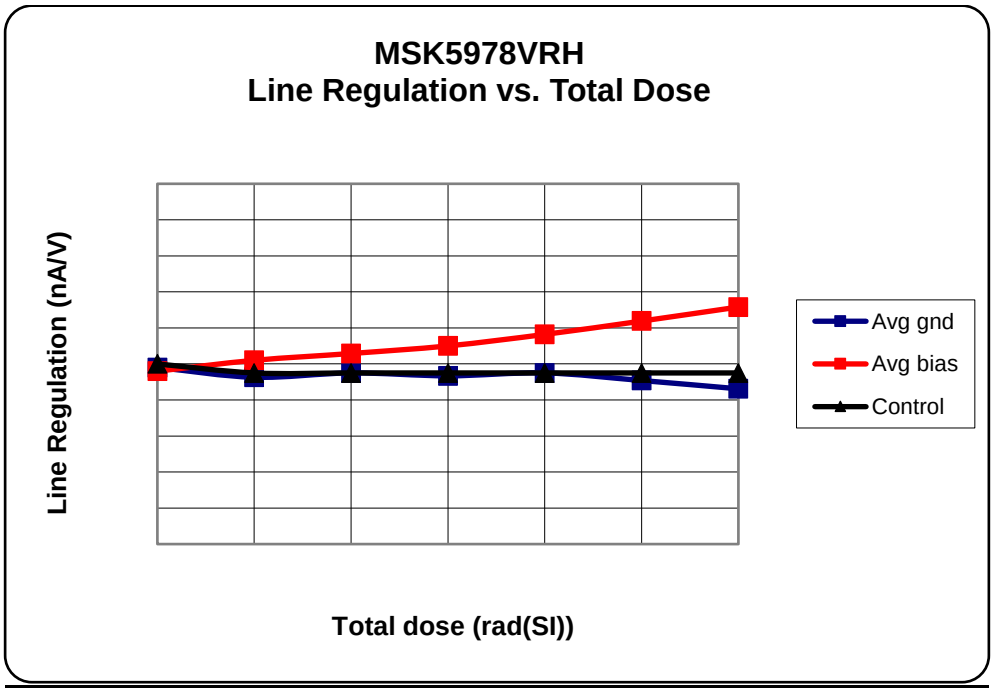
Unbiased S/N – 0049, 0053, 0055, 0059, 0060

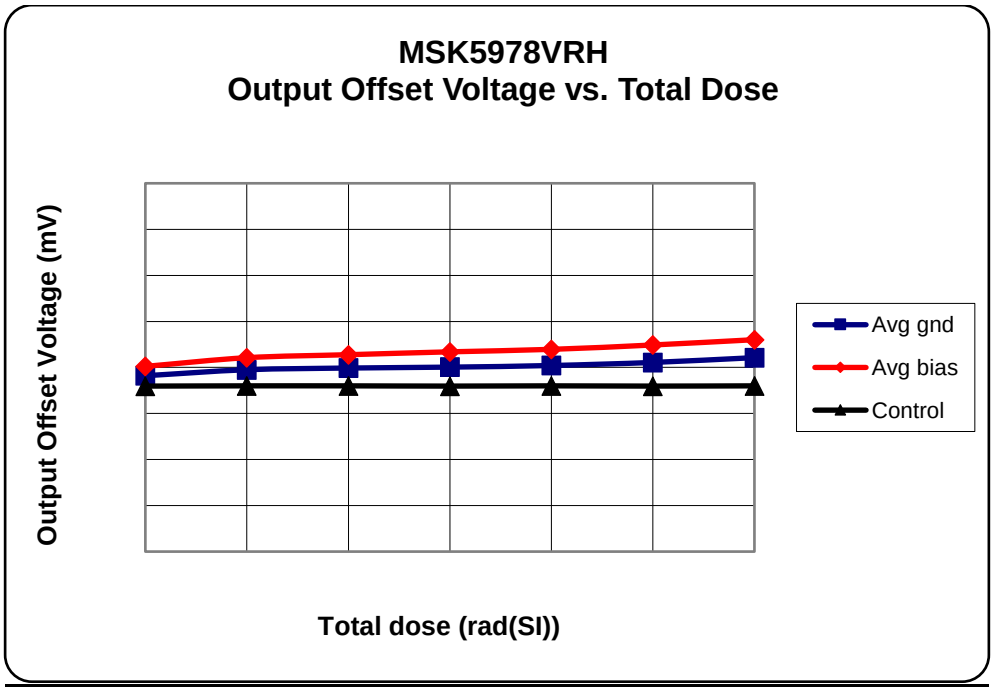
Table 1

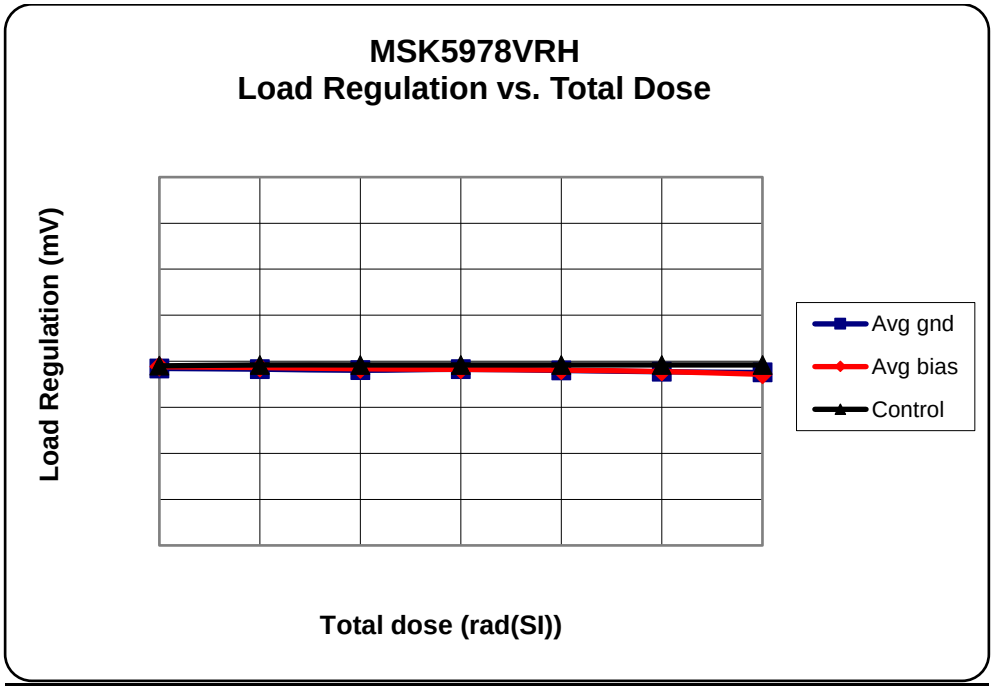
Dose Time, Incremental Dose and Total Cumulative Dose

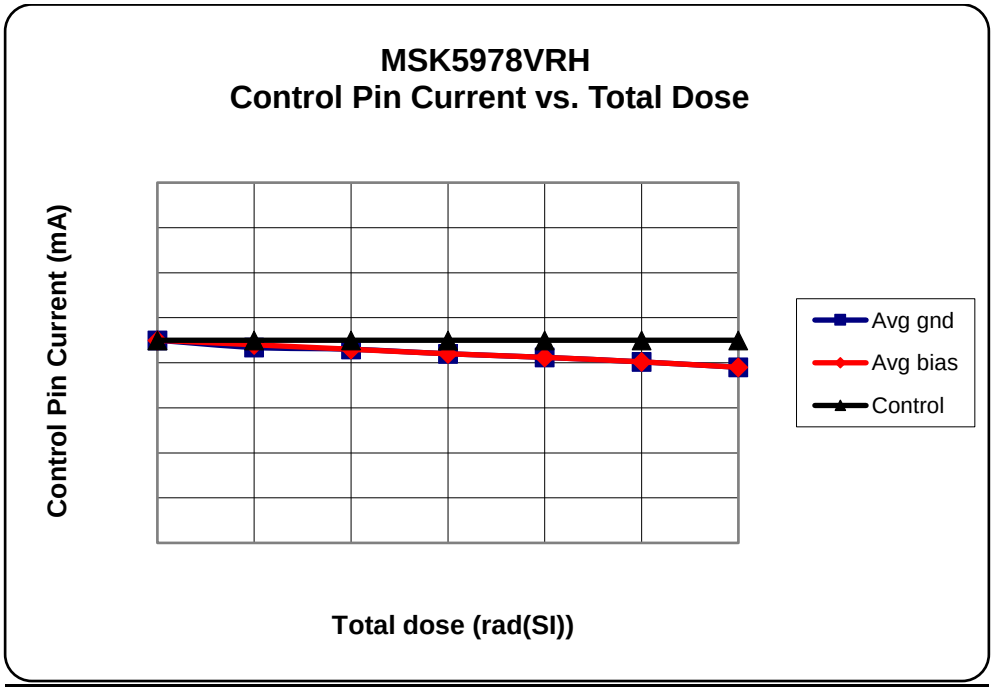

MSK5978VRH
Set Pin Current (Io=1mA) vs. Total Dose
Set Pin Current (uA)
Total dose (rad(Si))
Avg gnd
Avg bias
Control

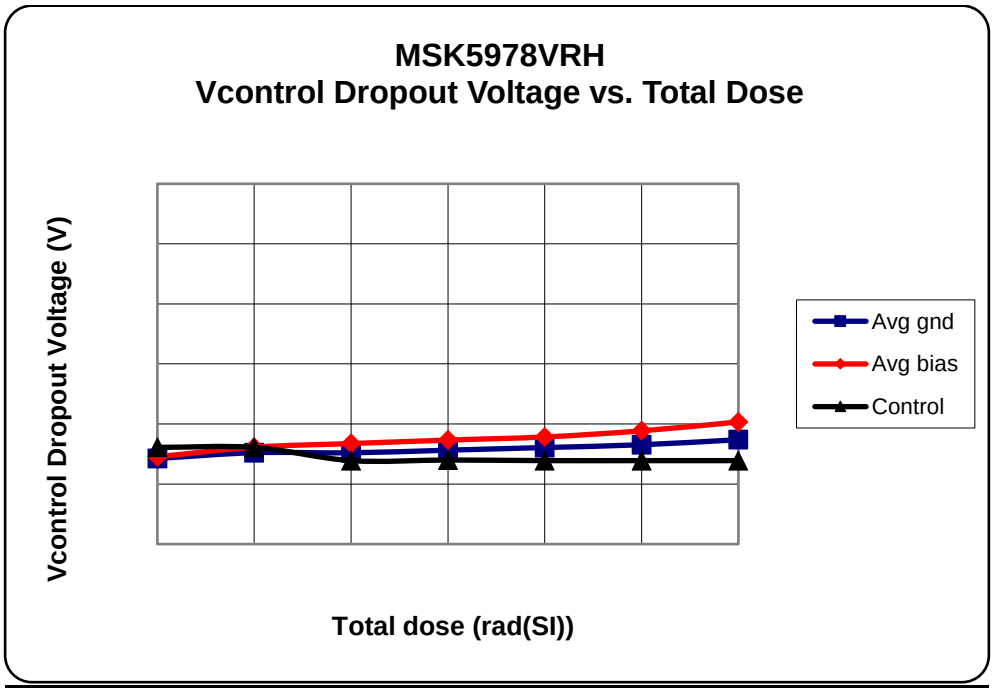

MSK5978VRH
Set Pin Current (Io=0.7A) vs. Total Dose
Set Pin Current (uA)
Total dose (rad(Si))
Avg gnd
Avg bias
Control

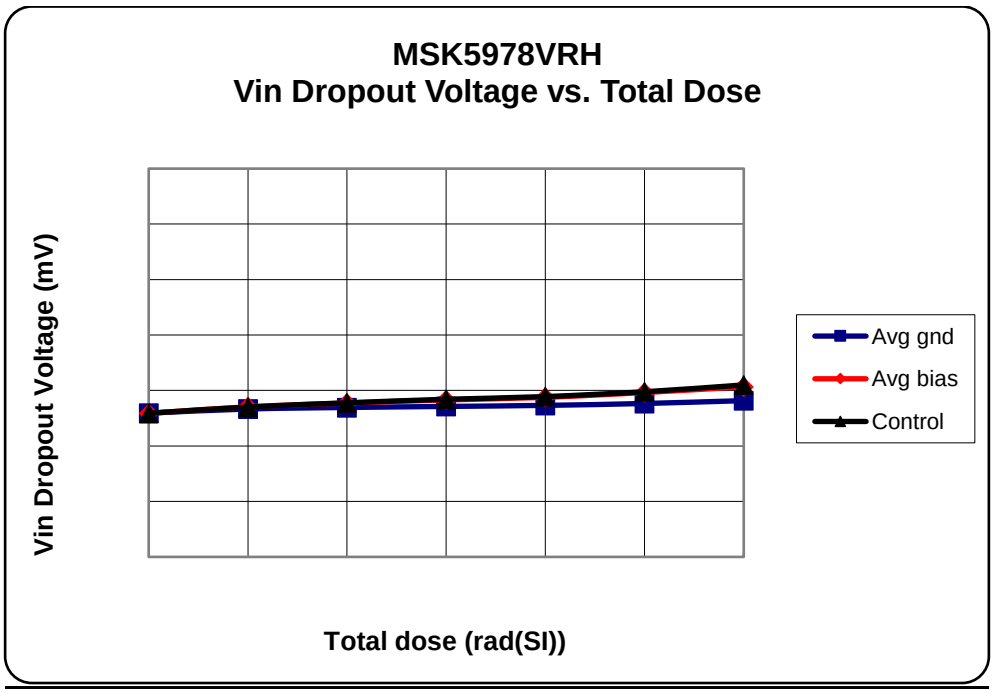

MSK5978VRH
Line Regulation vs. Total Dose
Line Regulation (nA/V)
Total dose (rad(Si))
Avg gnd
Avg bias
Control

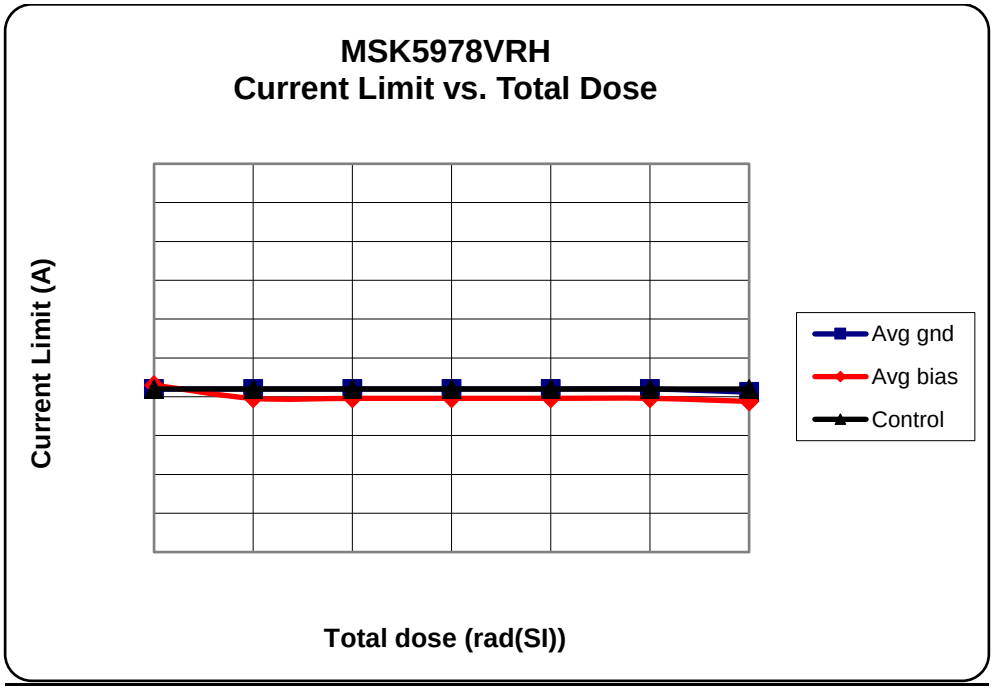

MSK5978VRH
Output Offset Voltage vs. Total Dose
Output Offset Voltage (mV)
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5978VRH
Load Regulation vs. Total Dose
Load Regulation (mV)
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5978VRH
Control Pin Current vs. Total Dose
Control Pin Current (mA)
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5978VRH
Vcontrol Dropout Voltage vs. Total Dose
Vcontrol Dropout Voltage (V)
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5978VRH
Vin Dropout Voltage vs. Total Dose
Vin Dropout Voltage (mV)
Total dose (rad(Si))
Avg gnd
Avg bias
Control


MSK5978VRH
Current Limit vs. Total Dose
Current Limit (A)
Total dose (rad(Si))
Avg gnd
Avg bias
Control

Total Dose Radiation Test Report

MSK 5978RH
MSK 5980RH

RAD Hard Positive Adjustable Voltage Regulator

May 11, 2012

B. Horton
K. Conroy
R. Wakeman

Anaren, Inc.- MSK Products

I. Introduction:

The total dose radiation test plan for the MSK 5978RH was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level.

The data herein is from direct measurement of the MSK5978RH response to total dose irradiation, but is indicative of the response of both device types.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK 5978RH.

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 in accordance with the device data sheet. In addition, all devices received burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF-38534 Class K or MIL-PRF-38535 Class V. 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. An operating voltage of +26 Volts was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Electrical tests were completed within one hour of irradiation. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

IV. Data:

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

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, the MSK5978RH and MSK 5980RH qualified as a 300 Krad(Si) radiation hardened device. Set Control Pin Current and Load Regulation exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK 5978 RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
5/11/12

Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
08:00	51,840	51,480
08:00	51,840	103,680
08:00	51,840	155,520
23:50	154,440	309,960
23:50	154,440	464,400
08:00	51,840	51,480

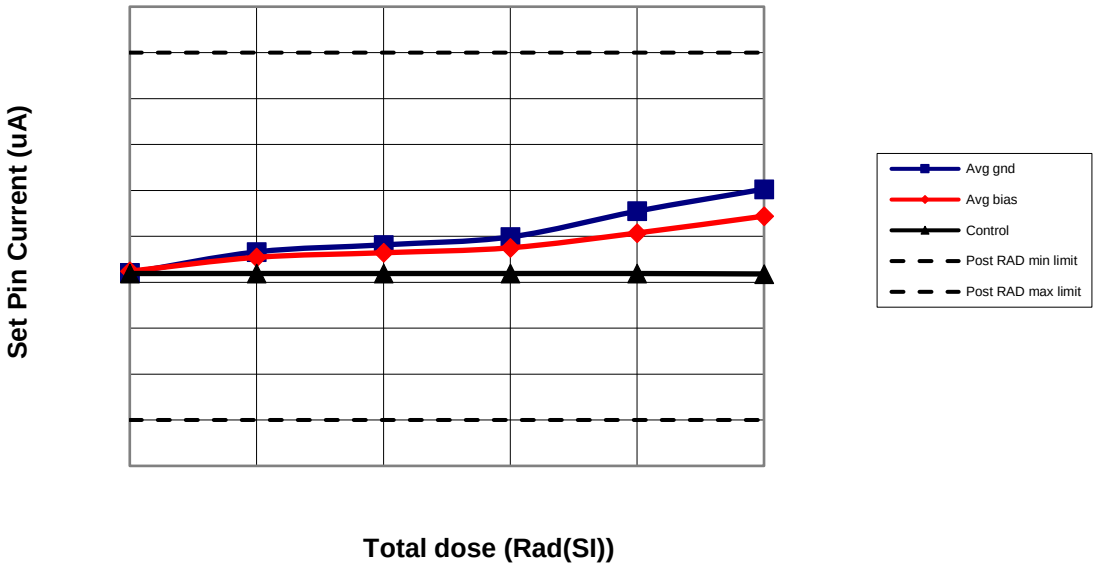
Biased S/N – 0487, 0488, 0489, 0490, 0491

Unbiased S/N – 0492, 0493, 0494, 0495, 0496

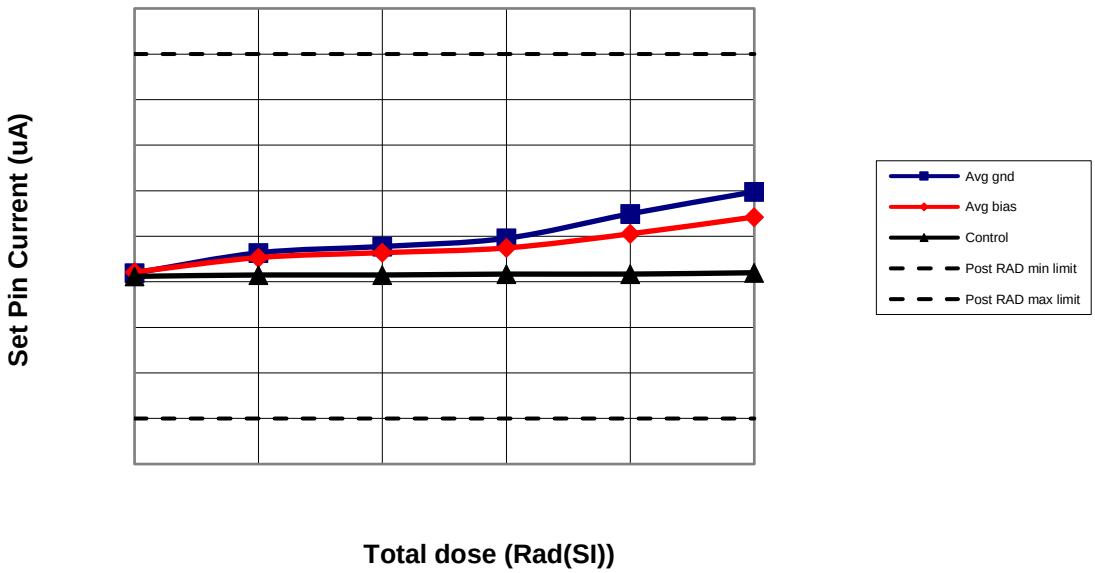
Table 1

Dose Time, Incremental Dose and Total Cumulative Dose

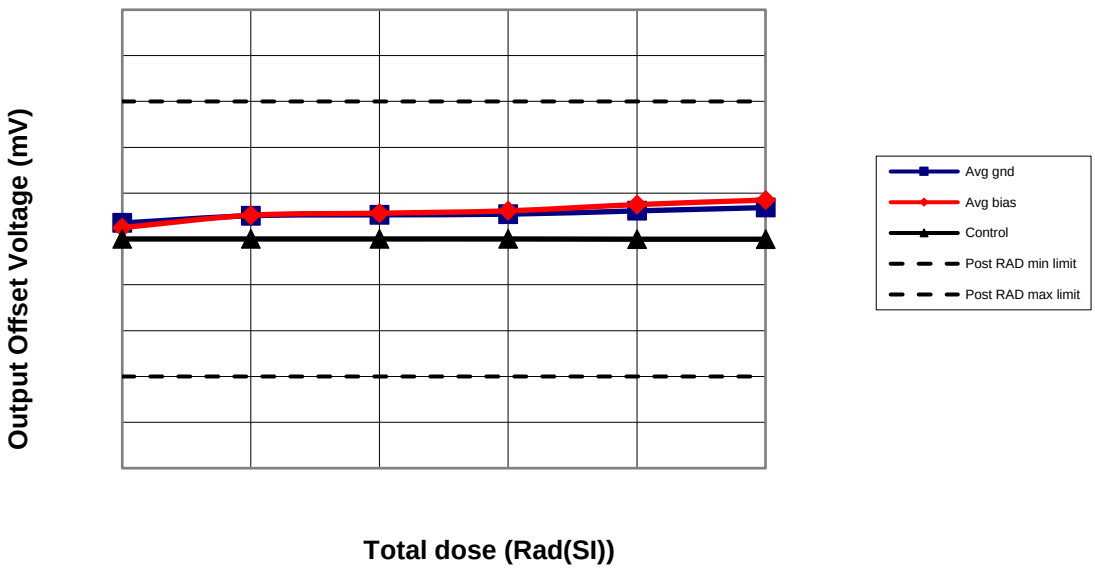
MSK5978VRH
Set Pin Current (Io=1mA) vs. Total Dose



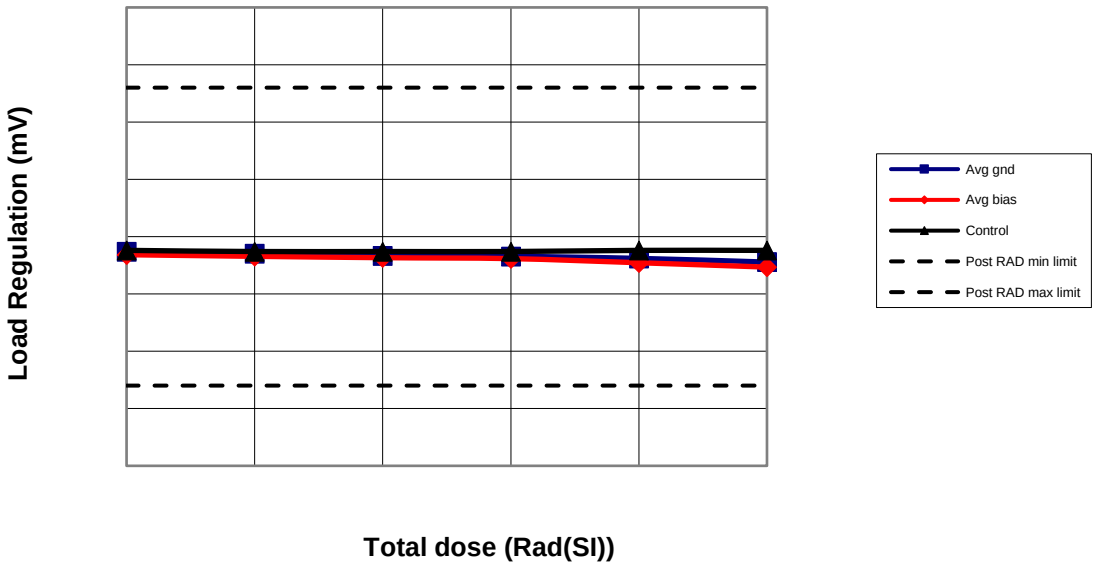
MSK5978VRH
Set Pin Current (Io= 0.7A) vs. Total Dose



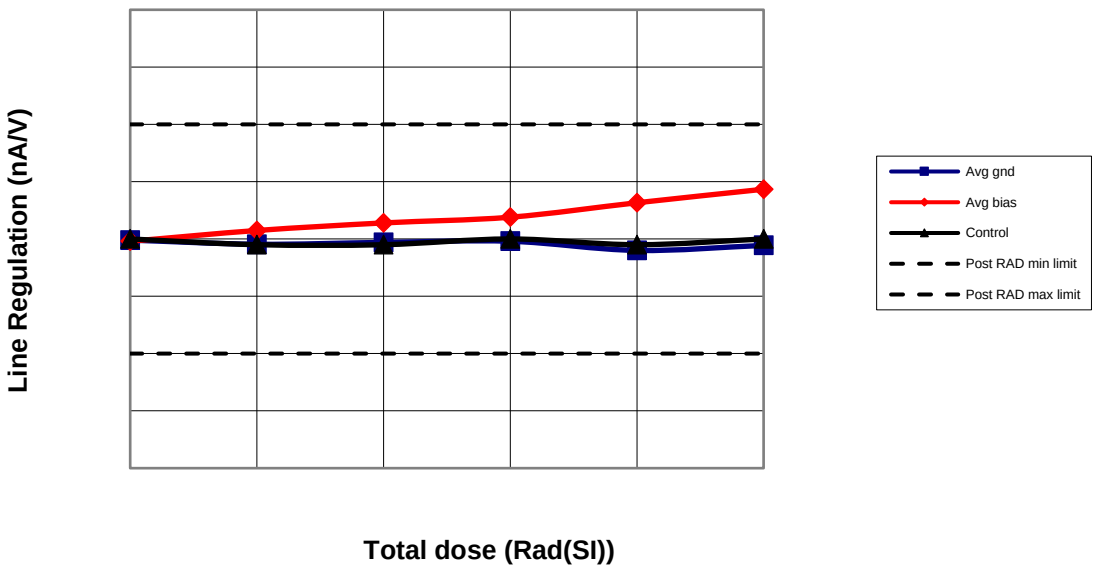
MSK5978VRH
Output Offset Voltage vs. Total Dose



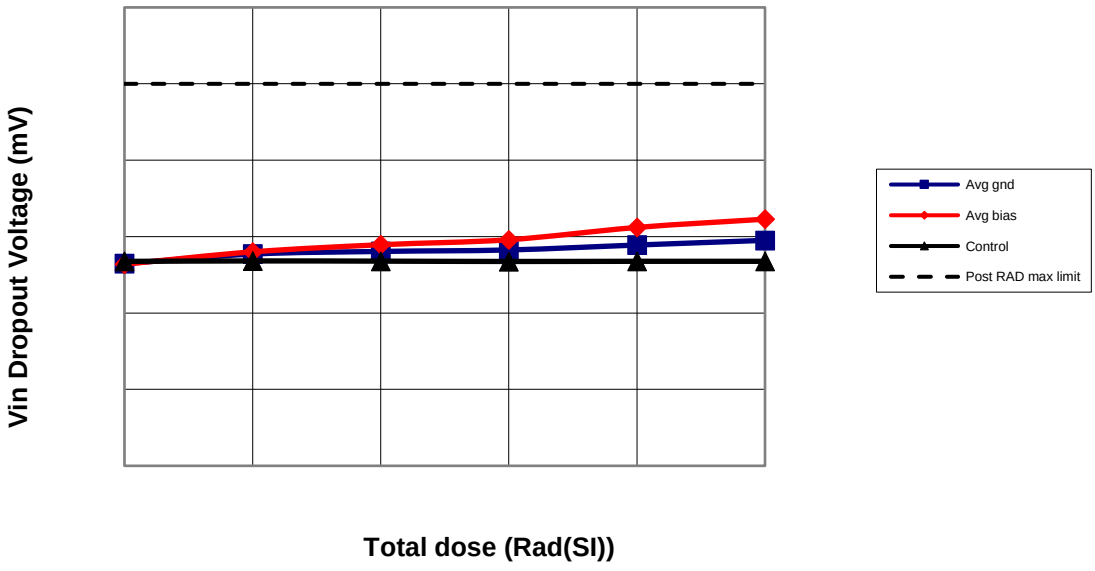
MSK5978VRH
Load Regulation Voltage vs. Total Dose



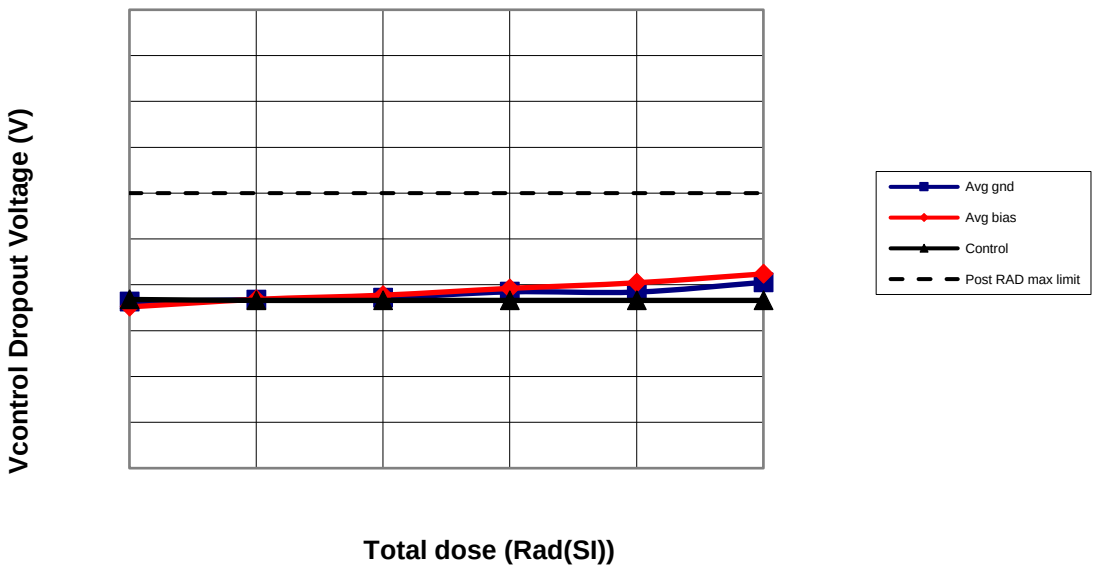
MSK5978VRH
Line Regulation vs. Total Dose



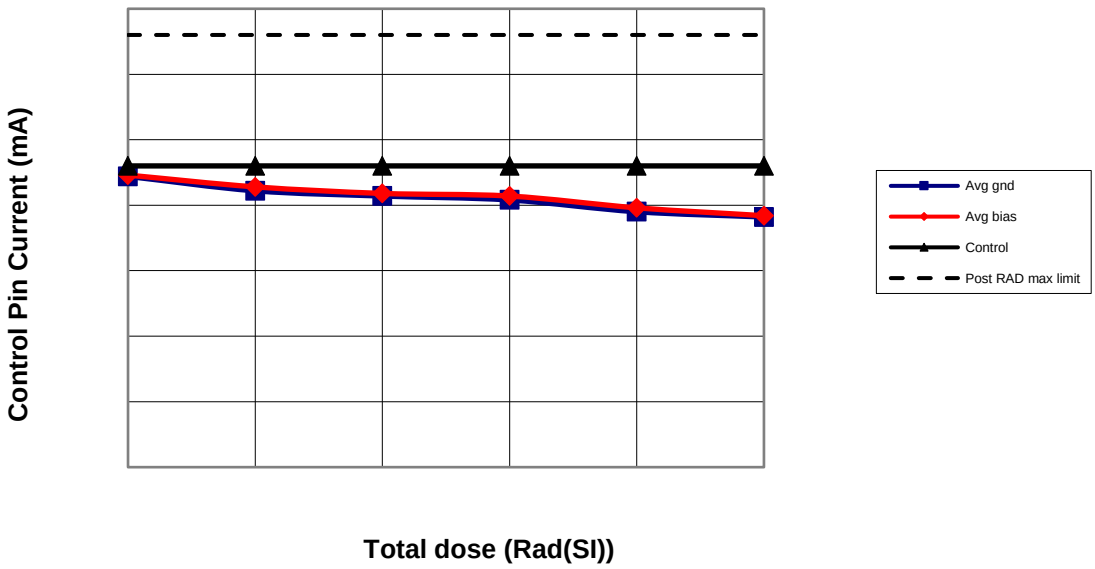
MSK5978VRH
Vin Dropout Voltage vs. Total Dose

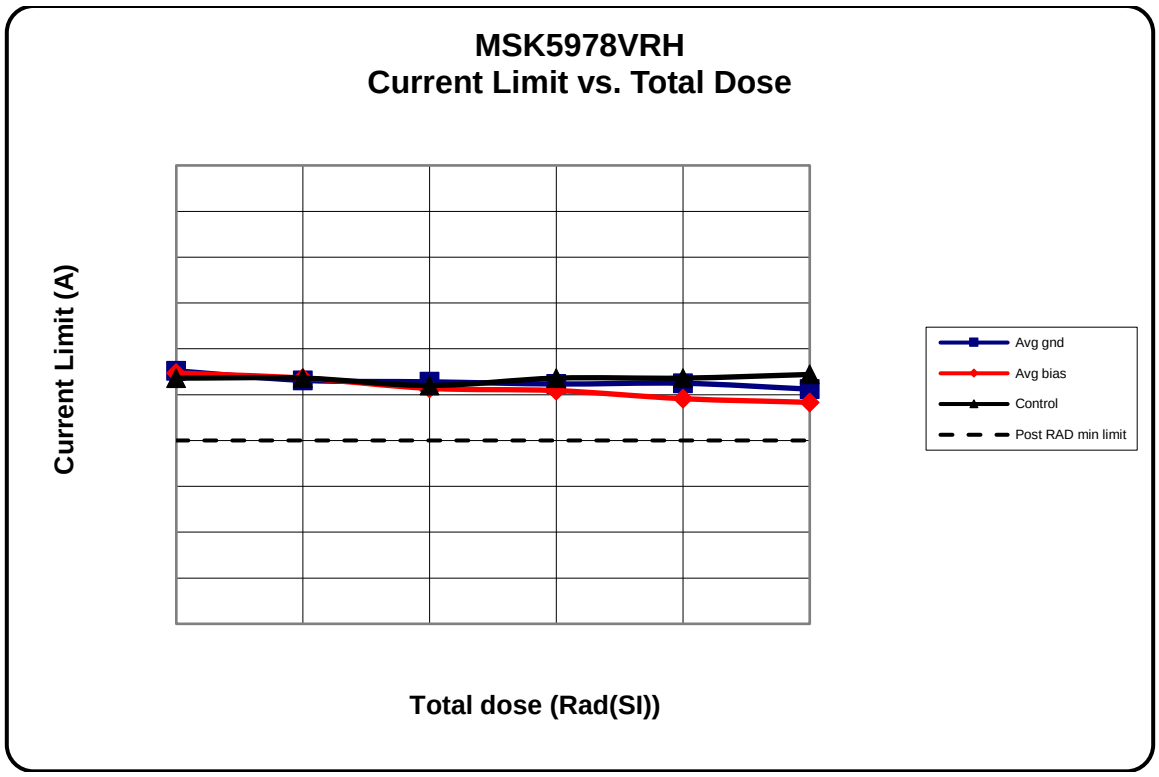


MSK5978VRH
Vcontrol Dropout Voltage vs. Total Dose



MSK5978VRH
Control Pin Current vs. Total Dose




MSK5978VRH
Current Limit vs. Total Dose
Current Limit (A)
Total dose (Rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit

Total Dose Radiation Test Report

MSK 5978RH
MSK 5980RH

RAD Hard Positive Adjustable Voltage Regulator

Jan 29, 2014

B. Horton
P. Dinneen

Anaren, Inc – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK 5978RH was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level.

The data herein is from direct measurement of the MSK5978RH response to total dose irradiation, but is indicative of the response of both device types.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK 5978RH

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

III. Test Setup:

All test samples were subjected to Group A Electrical Test in accordance with the device data sheet. In addition, all devices received burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF 38534 Class K or MIL-PRF-38535 Class V. 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. An operating voltage of +26 Volts was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Electrical tests were completed within one hour of irradiation. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

IV. Data:

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

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, the MSK5978RH and MSK 5980RH qualified as a 300 Krad(Si) radiation hardened device. Set Control Pin Current and Load Regulation exhibited the most significant shift due to irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK 5978 RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
1/29/14

Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
10:06	51,510	51,510
10:06	51,510	103,020
10:06	51,510	154,530
30:18	154,530	309,060
30:18	154,530	463,590

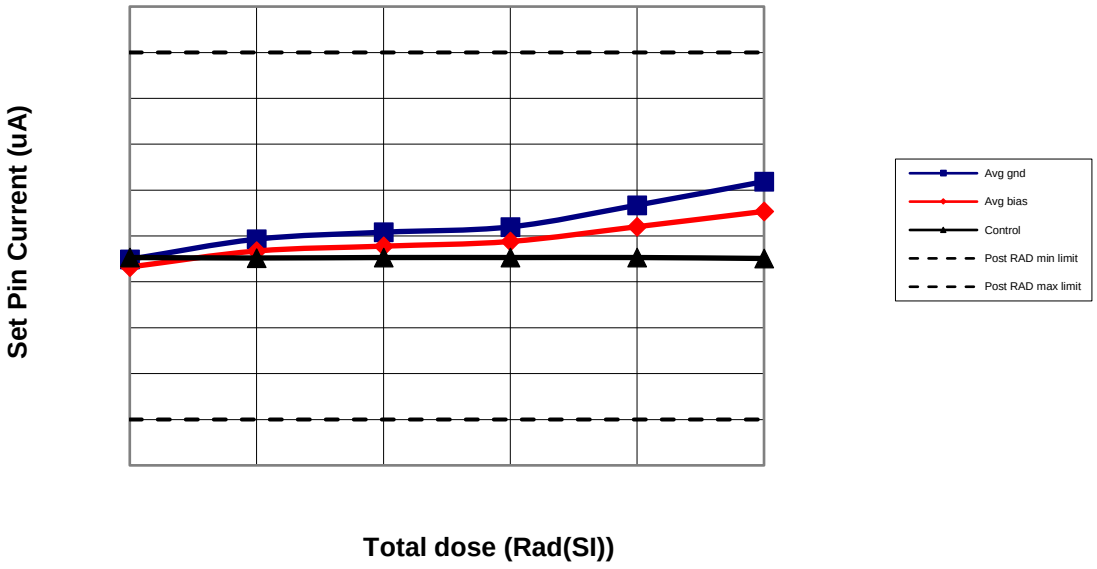
Biased S/N – 1930, 1931, 1932, 1933, 1936

Unbiased S/N – 1937, 1938, 1939, 1943, 1944

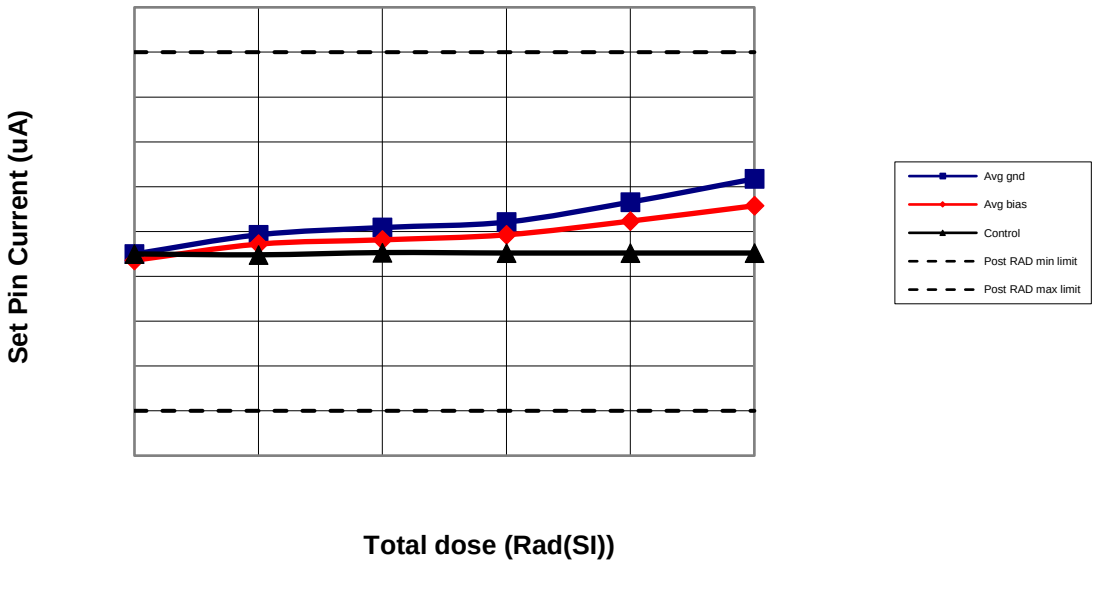
Table 1

Dose Time, Incremental Dose and Total Cumulative Dose

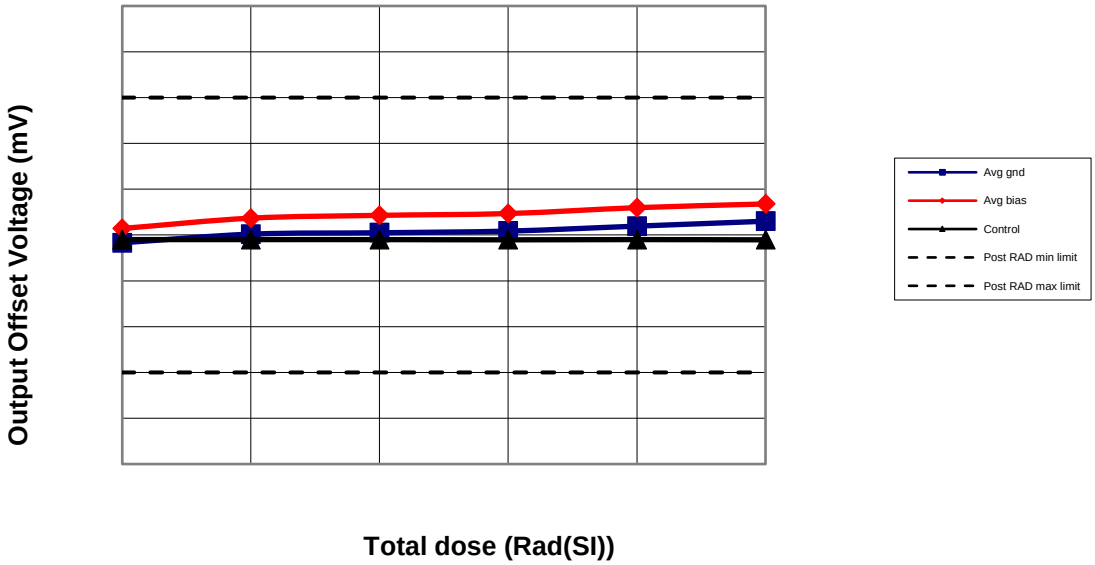
MSK5978VRH
Set Pin Current (Io=1mA) vs. Total Dose



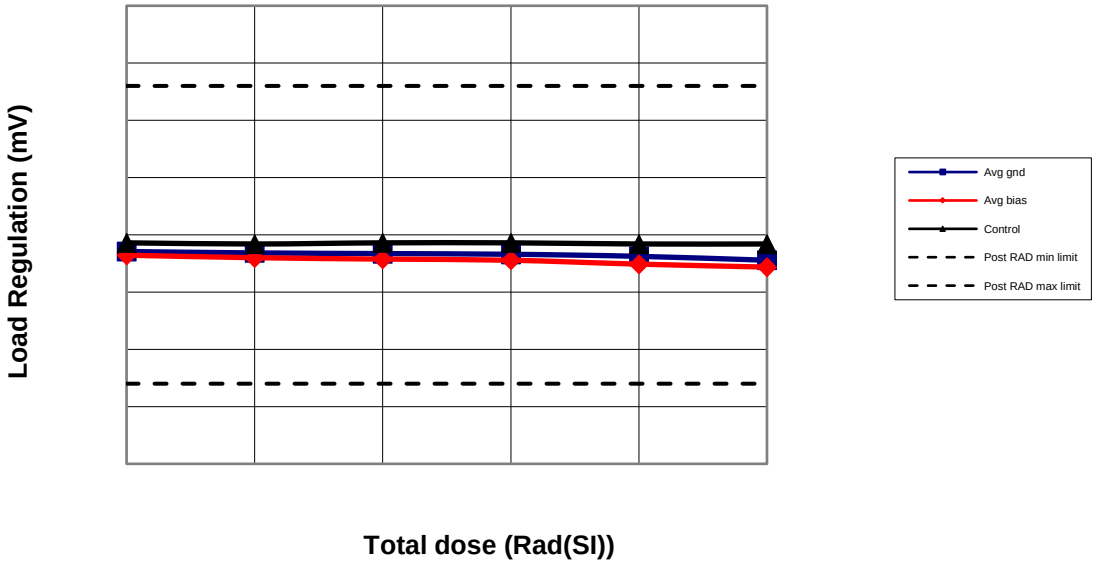
MSK5978VRH
Set Pin Current (Io= 0.7A) vs. Total Dose



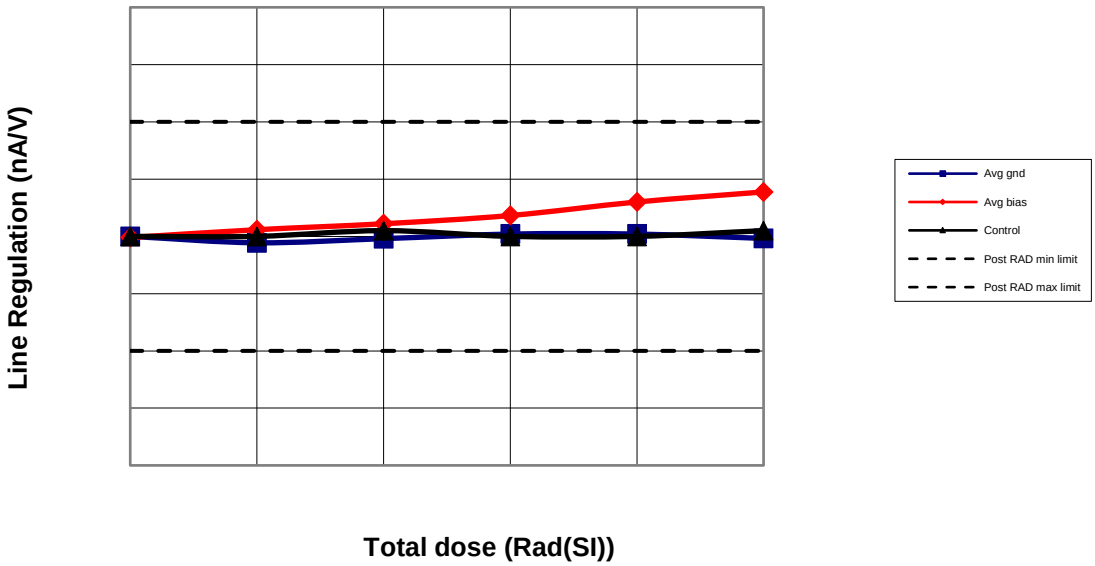
MSK5978VRH
Output Offset Voltage vs. Total Dose



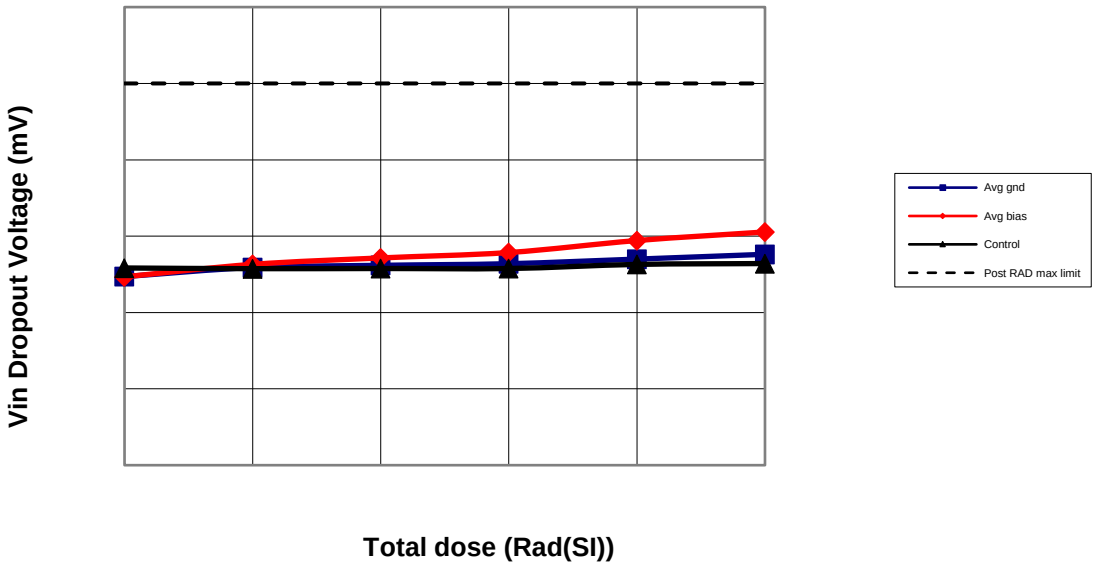
MSK5978VRH
Load Regulation Voltage vs. Total Dose



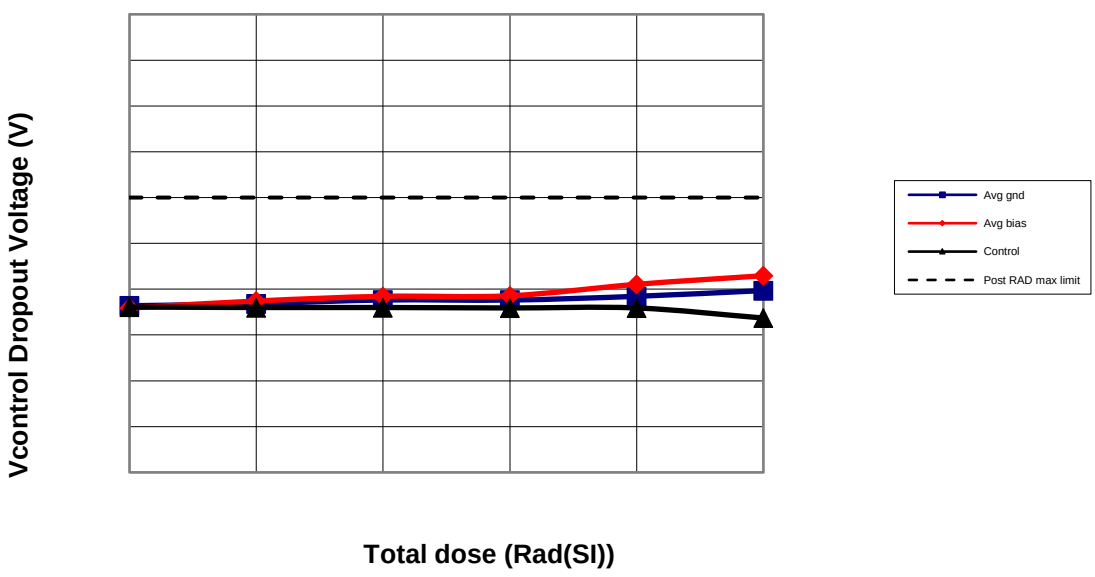
MSK5978VRH
Line Regulation vs. Total Dose



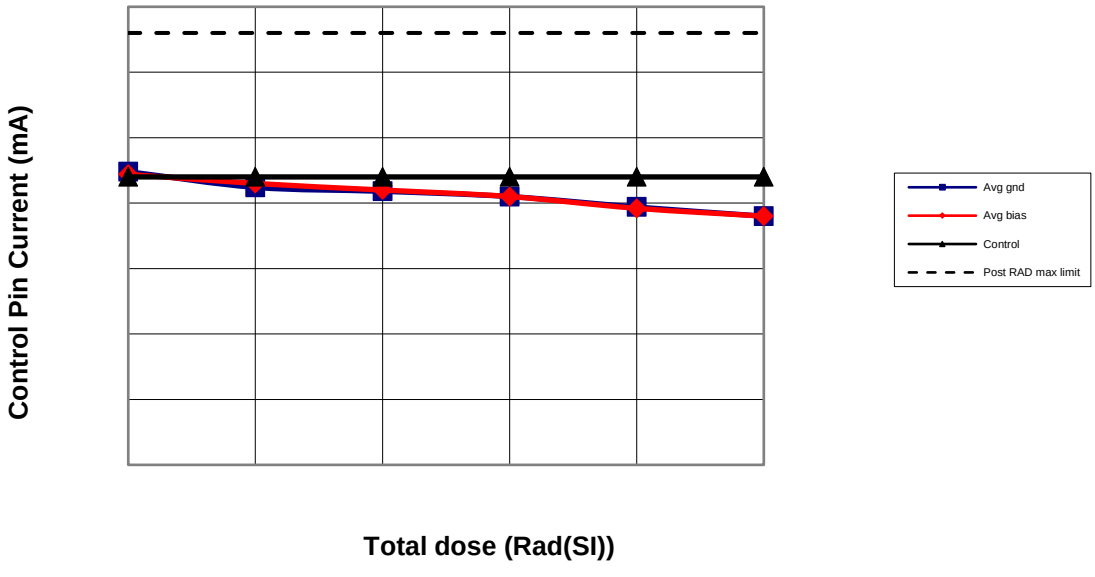
MSK5978VRH
Vin Dropout Voltage vs. Total Dose

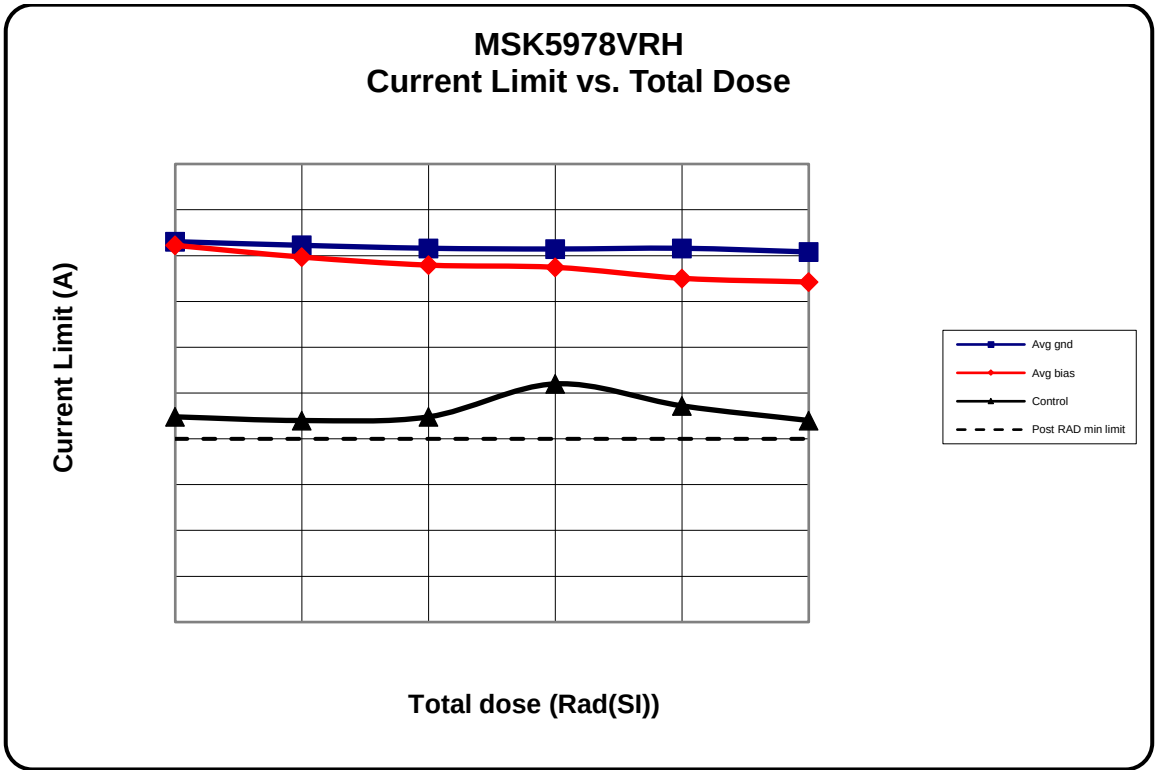


MSK5978VRH
Vcontrol Dropout Voltage vs. Total Dose



MSK5978VRH
Control Pin Current vs. Total Dose




MSK5978VRH
Current Limit vs. Total Dose
Current Limit (A)
Total dose (Rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit

Total Dose Radiation Test Report

MSK 5978RH,
MSK 5980RH

RAD Hard Positive Adjustable Voltage Regulator

October 28, 2015
Revised May 23, 2017

B. Horton
P. Dinneen

Anaren, Inc. – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK 5978RH was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5980RH uses the same active components and package material.

The data herein is from direct measurement of the MSK5978RH response to total dose irradiation, but is indicative of the response of both device types.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK 5978RH and MSK 5980RH..

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

III. Test Setup:

All test samples were subjected to Group A Electrical Test in accordance with the device data sheet. In addition, all devices received burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF 38534 Class K or MIL-PRF-38535 Class V. 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. An operating voltage of +26 Volts was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Electrical tests were completed within one hour of irradiation. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

IV. Data:

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

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, the MSK5978RH and MSK5980RH qualified as a 300 Krad(Si) radiation hardened device. Output Offset Voltage and Load Regulation exhibited the most significant change with irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK 5978 RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
10/28/15

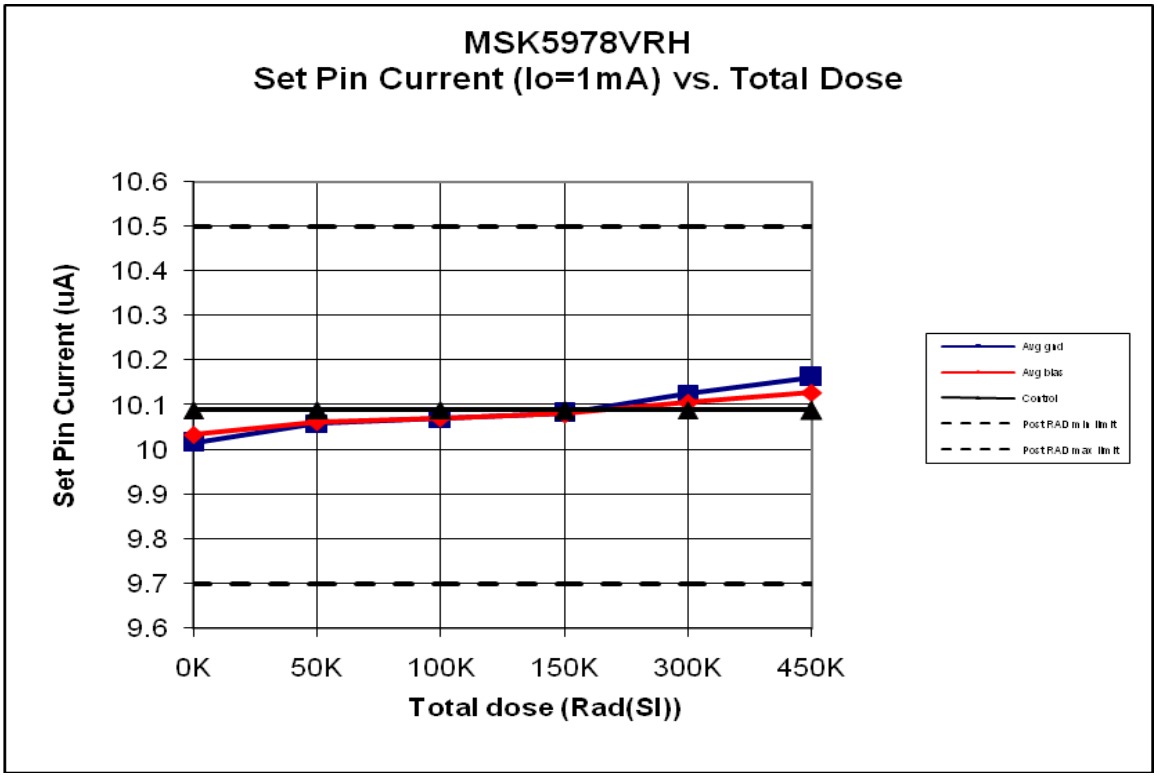
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
8:06	51,516	51,516
8:06	51,516	103,032
8:06	51,516	154,548
24:17	154,442	308,990
24:17	154,442	463,432

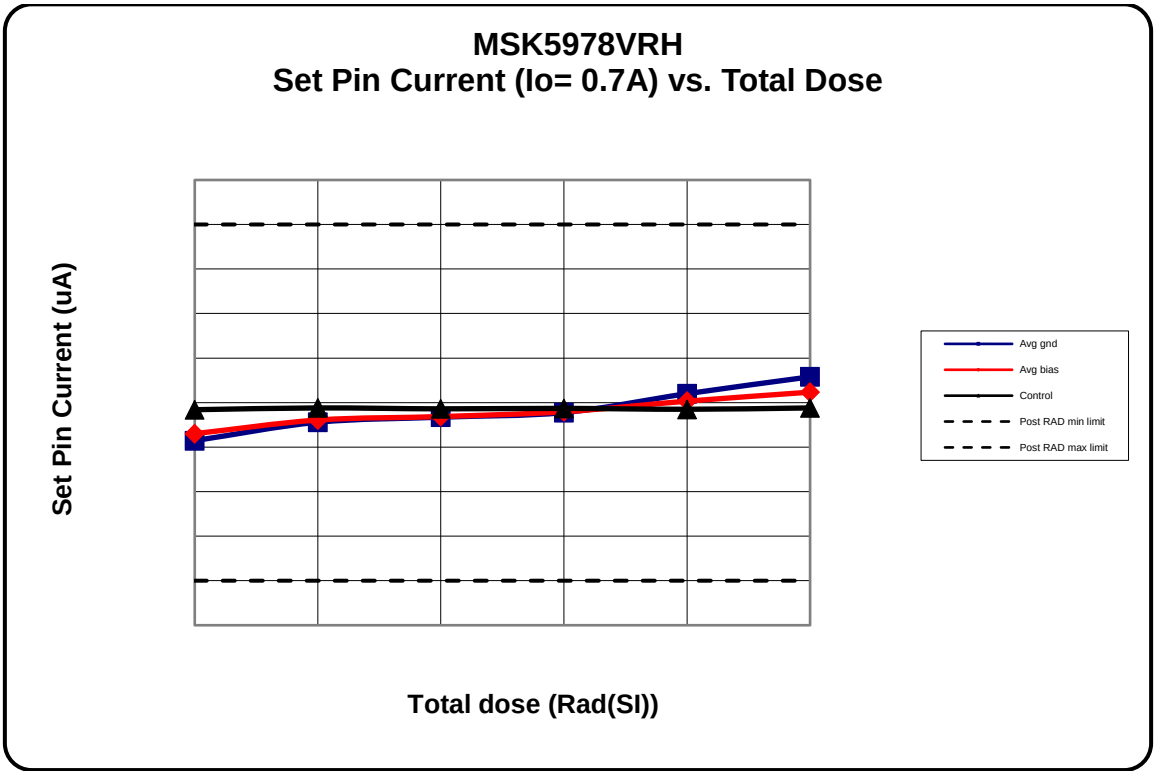
Biased S/N – 3570, 3571, 3572, 3573, 3574

Unbiased S/N – 3575, 3576, 3577, 3579, 3580

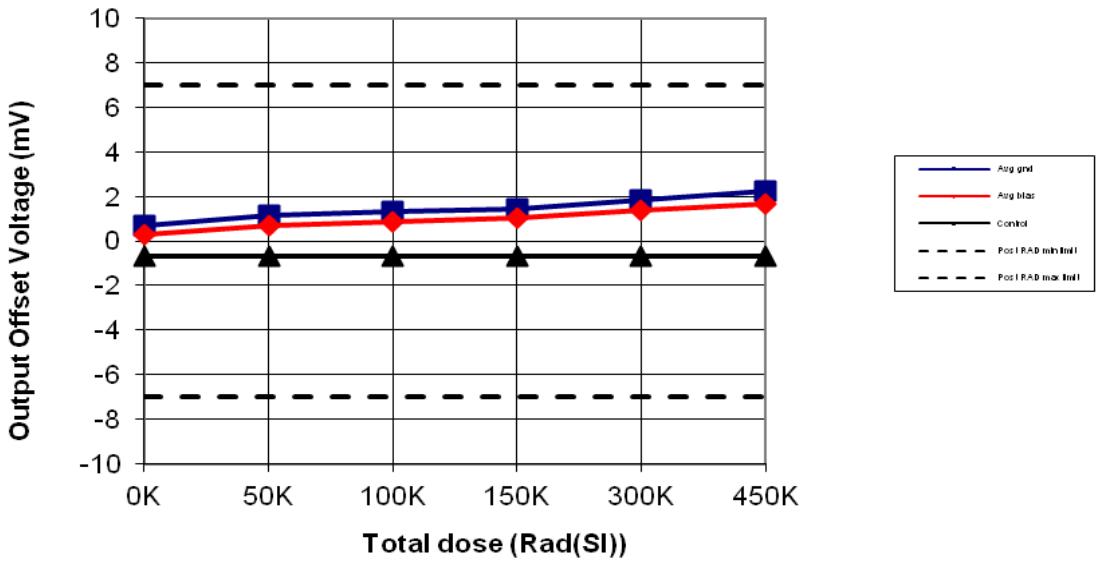
Table 1

Dose Time, Incremental Dose and Total Cumulative Dose

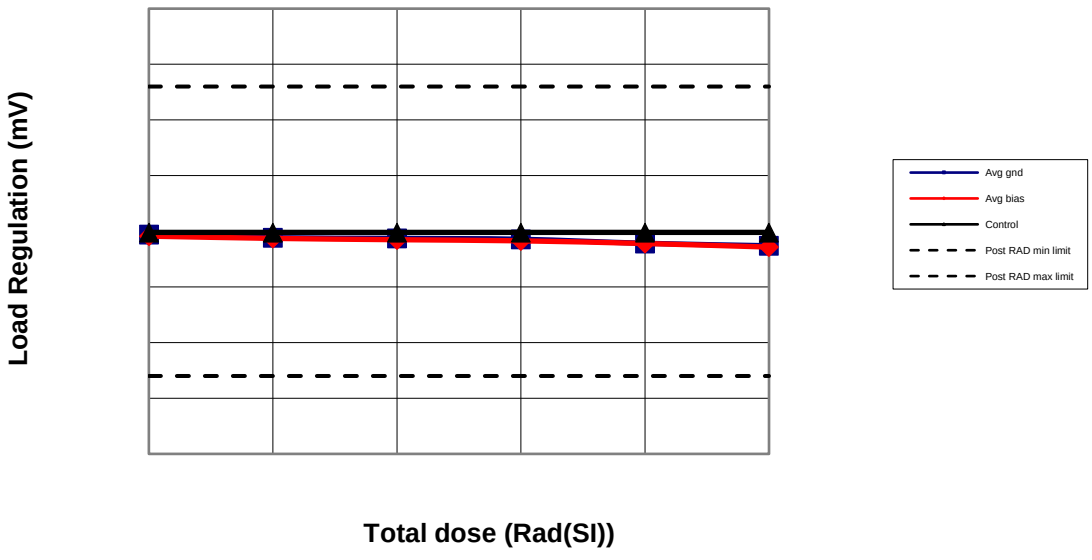

MSK5978VRH
Set Pin Current (Io=1mA) vs. Total Dose
Set Pin Current (uA)
10.6
10.5
10.4
10.3
10.2
10.1
10
9.9
9.8
9.7
9.6
0K
50K
100K
150K
300K
450K
Total dose (Rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit
Post RAD max limit


MSK5978VRH
Set Pin Current (Io= 0.7A) vs. Total Dose
Set Pin Current (uA)
Total dose (Rad(Si))
Avg gnd
Avg bias
Control
Post RAD min limit
Post RAD max limit

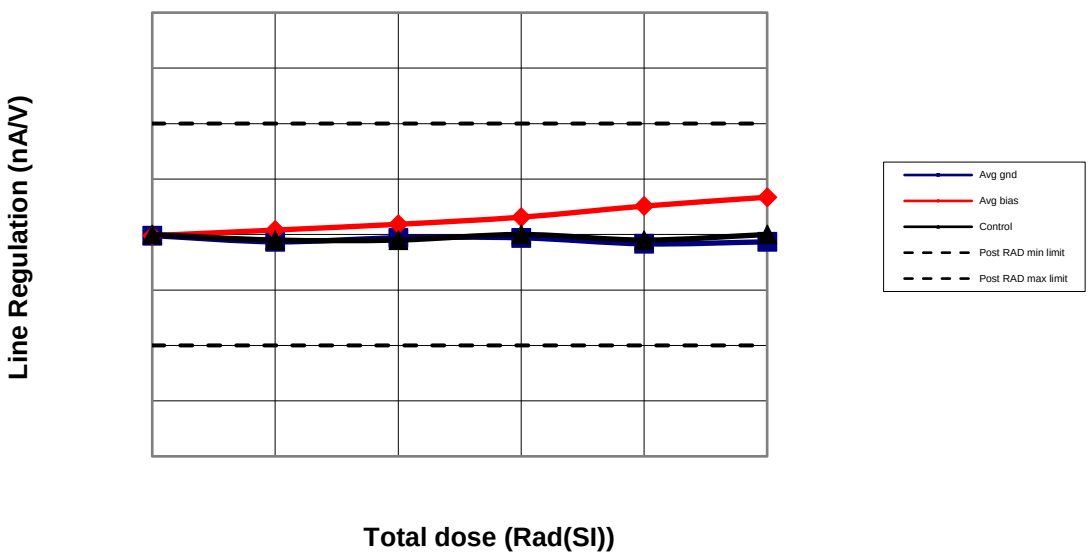
MSK5978VRH
Output Offset Voltage vs. Total Dose



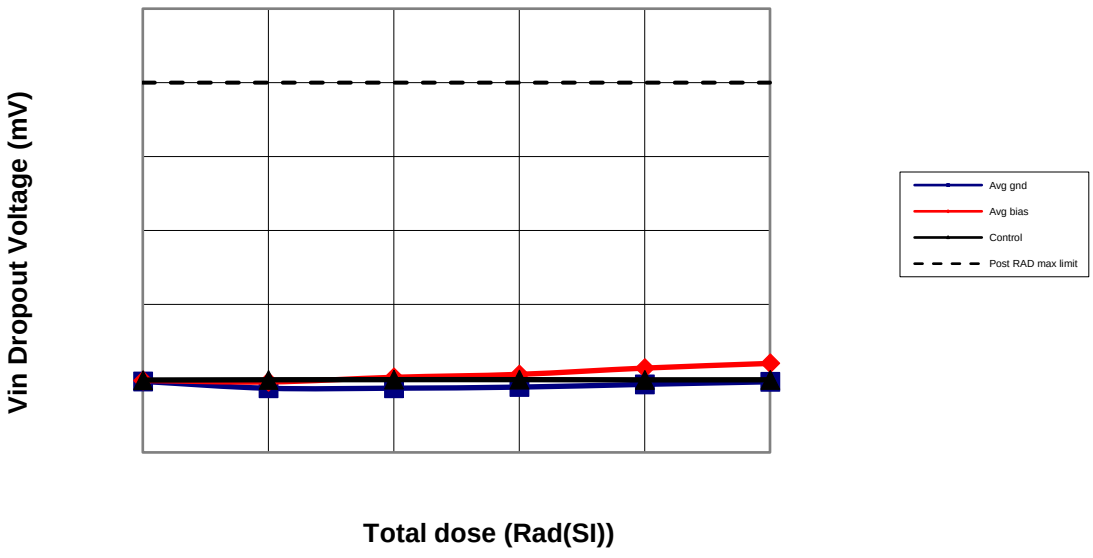
MSK5978VRH
Load Regulation Voltage vs. Total Dose



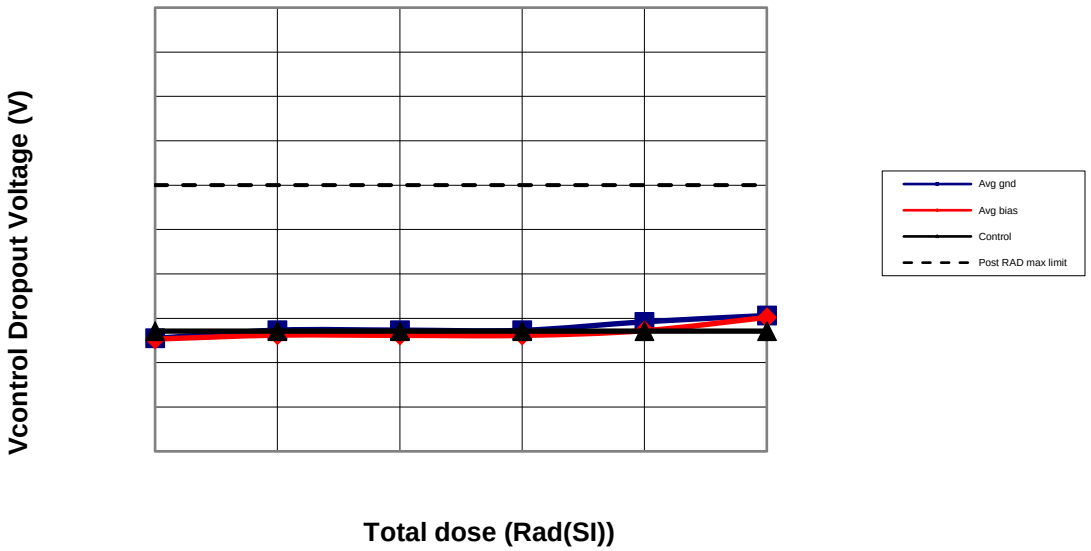
MSK5978VRH
Line Regulation vs. Total Dose



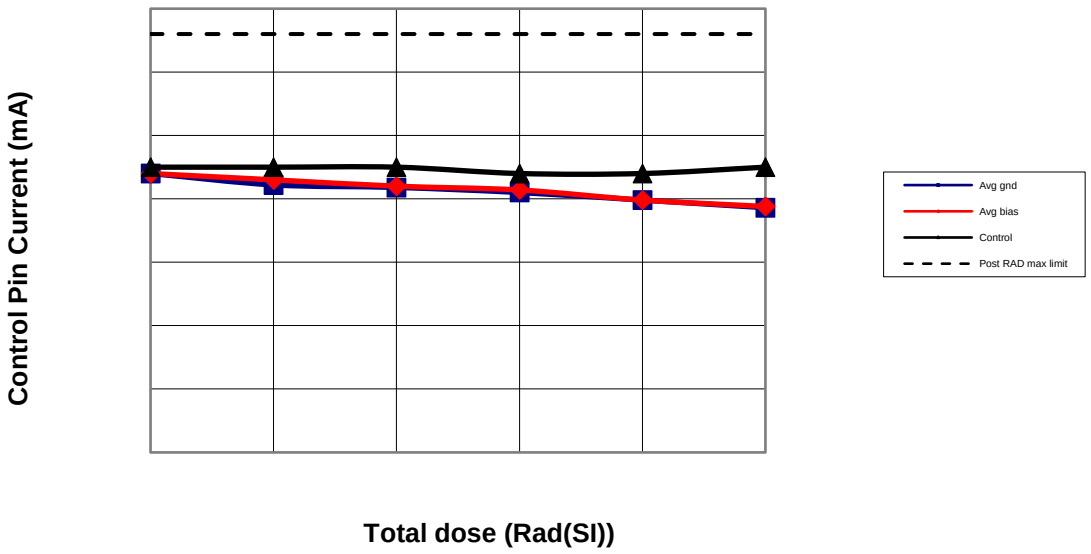
MSK5978VRH
Vin Dropout Voltage vs. Total Dose

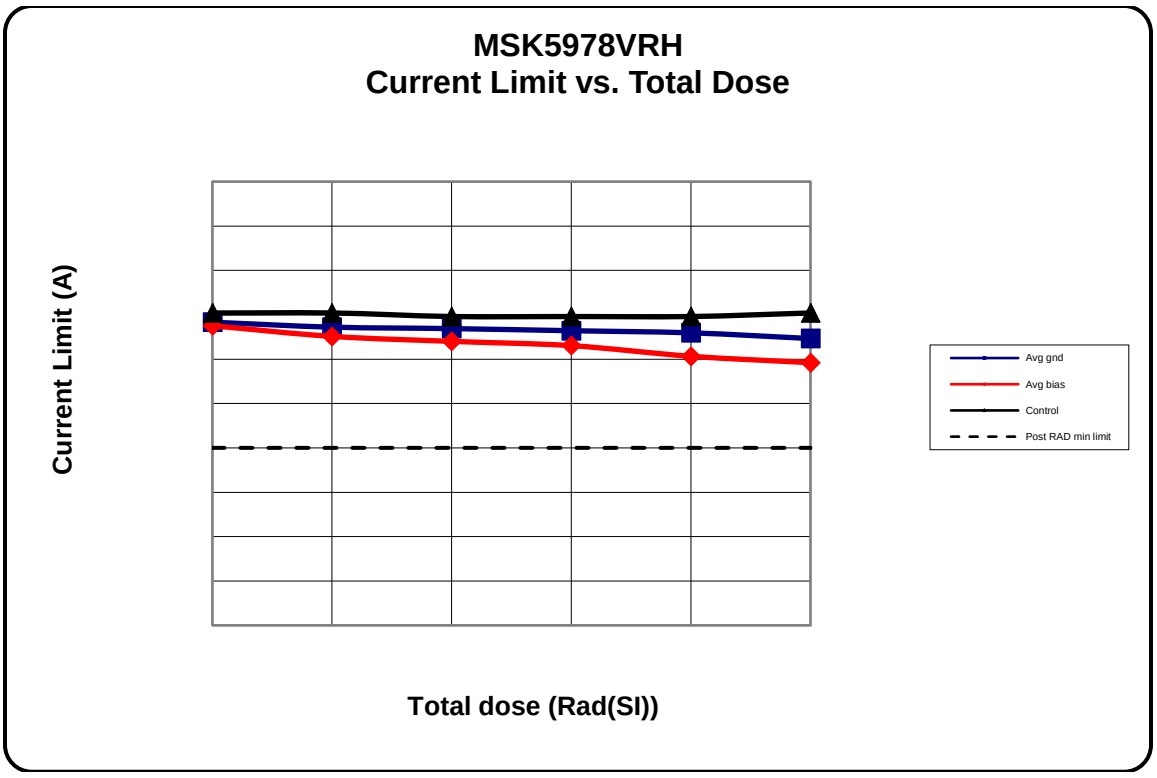


MSK5978VRH
Vcontrol Dropout Voltage vs. Total Dose



MSK5978VRH
Control Pin Current vs. Total Dose




MSK5978VRH
Current Limit vs. Total Dose
Current Limit (A)
Total dose (Rad(SI))
Avg gnd
Avg bias
Control
Post RAD min limit

Total Dose Radiation Test Report

MSK 5978RH,
MSK 5980RH

RAD Hard Positive Adjustable Voltage Regulator1-2

November 23, 2016
Revised May 23, 2017

B. Horton
C. Salce

Anaren, Inc. – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK 5978RH was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5980RH uses the same active components and package material.

The data herein is from direct measurement of the MSK5978RH response to total dose irradiation, but is indicative of the response of both device types.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK 5978RH and MSK 5980RH.

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 in accordance with the device data sheet. In addition, all devices received 240 hours minimum of burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF-38535 Class V. For test platform verification, two control devices were tested at 25°C. Ten devices were then tested at 25°C, prior to irradiation, and were found to be within acceptable test limits.

The devices were vertically aligned with the radiation source and enclosed in a lead/aluminum container during irradiation. Five devices were kept under bias during irradiation. An operating voltage of +26 Volts was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as 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, the MSK5978RH and MSK 5980RH qualified as a 300 Krad(Si) radiation hardened device. Output Offset Voltage and Load Regulation exhibited the most significant change with irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK 5978 RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
11/23/16

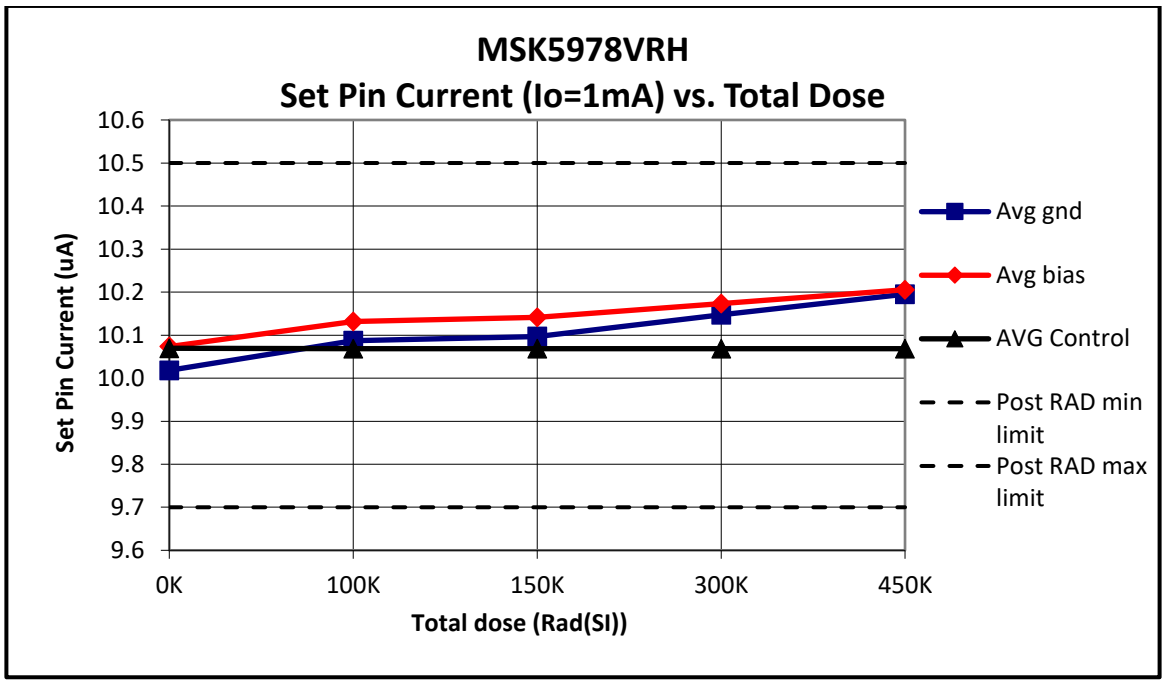
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
10:54	103,100	103,100
5:27	51,500	154,600
16:20	154,500	309,100
16:20	154,500	463,500

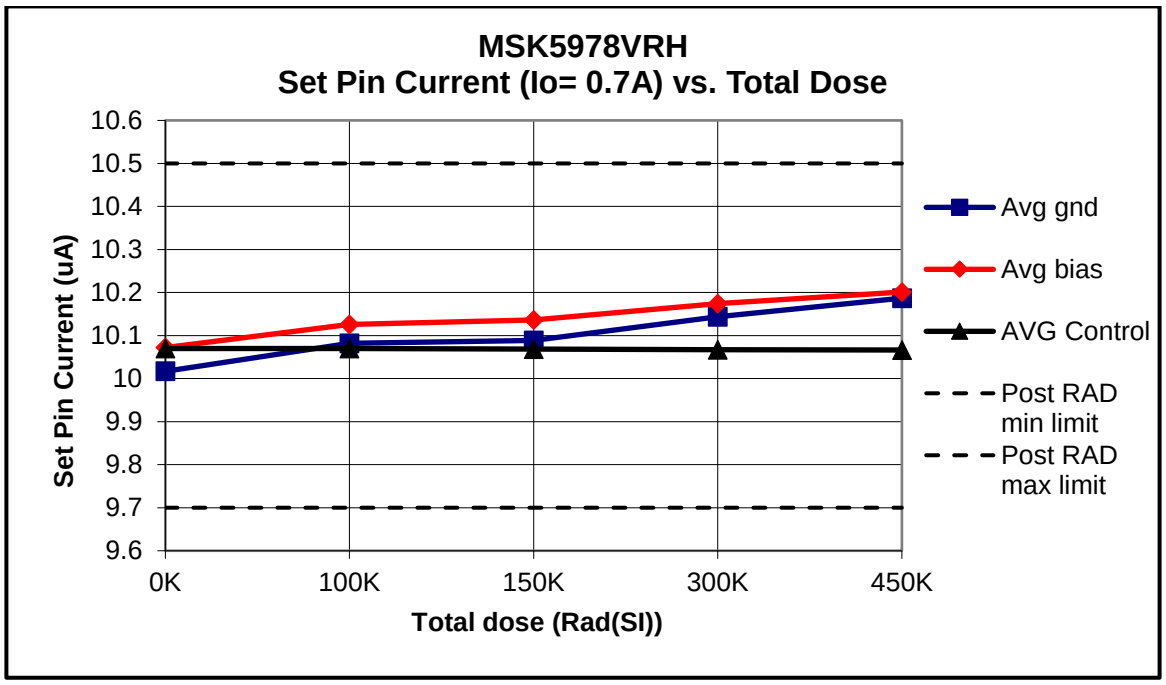
Biased S/N – 3950, 3959, 3960, 3965, 3967

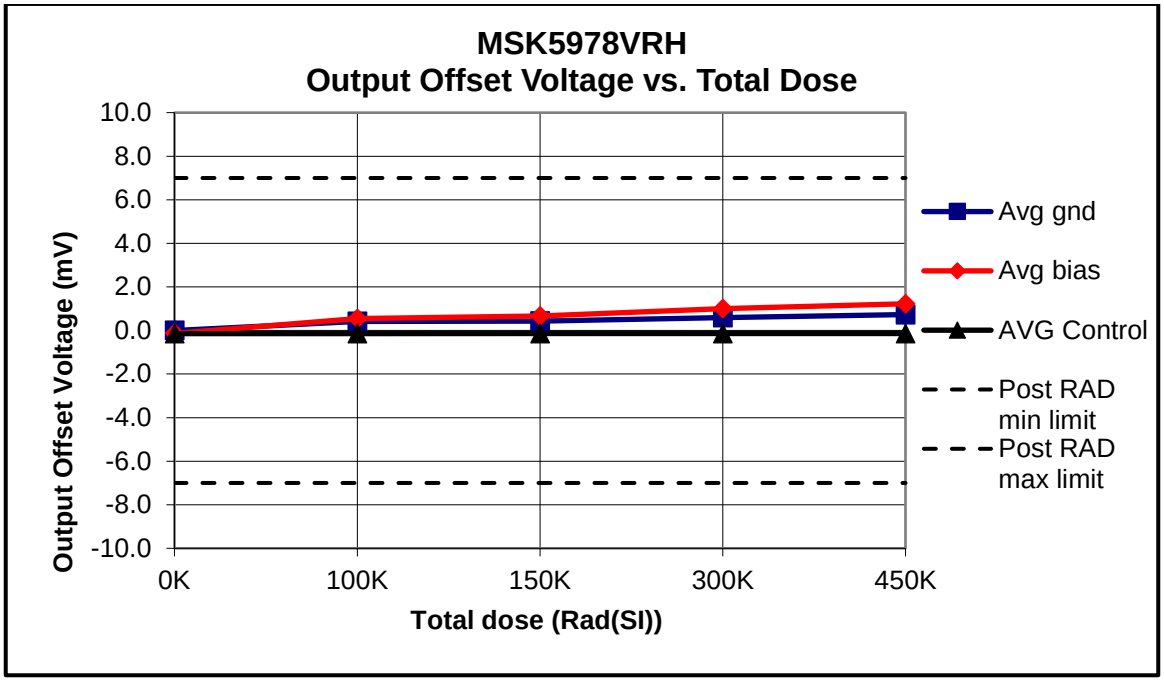
Unbiased S/N – 3972, 3973, 3974, 3976, 3906

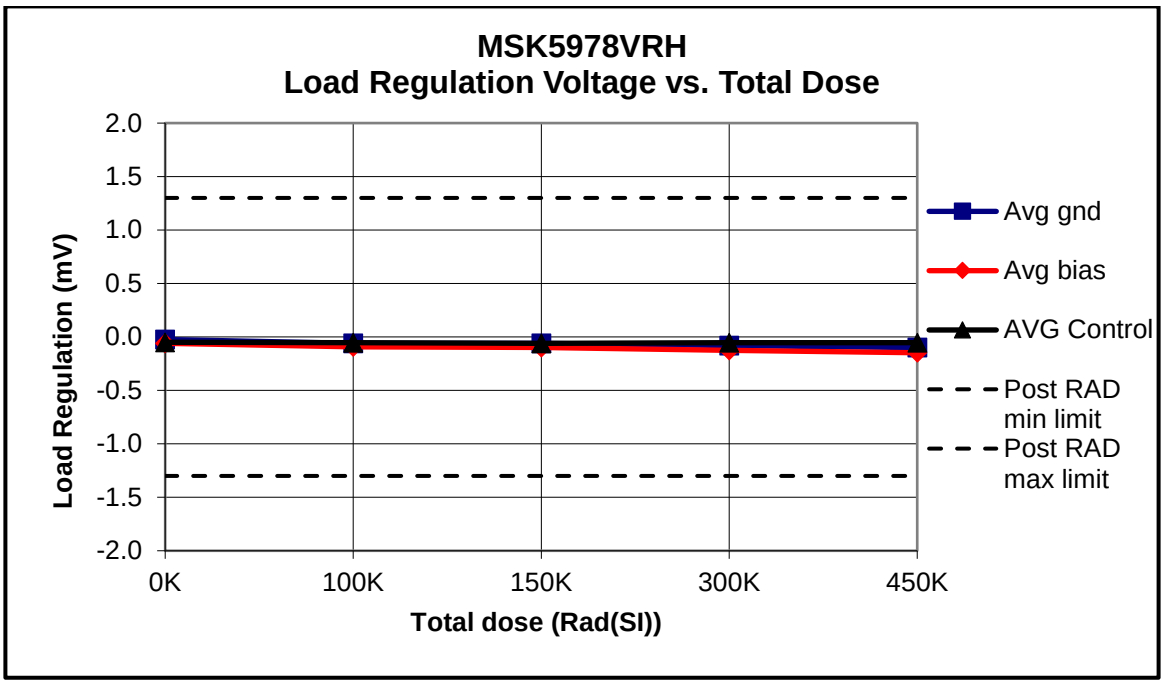
Table 1

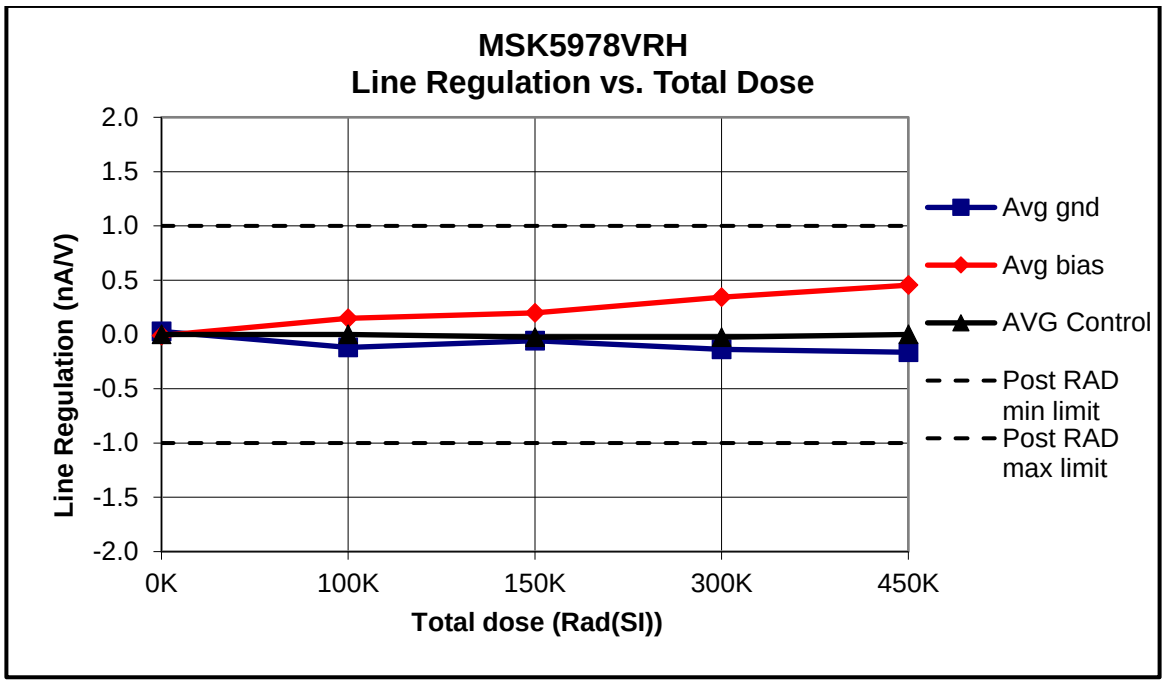
Dose Time, Incremental Dose and Total Cumulative Dose

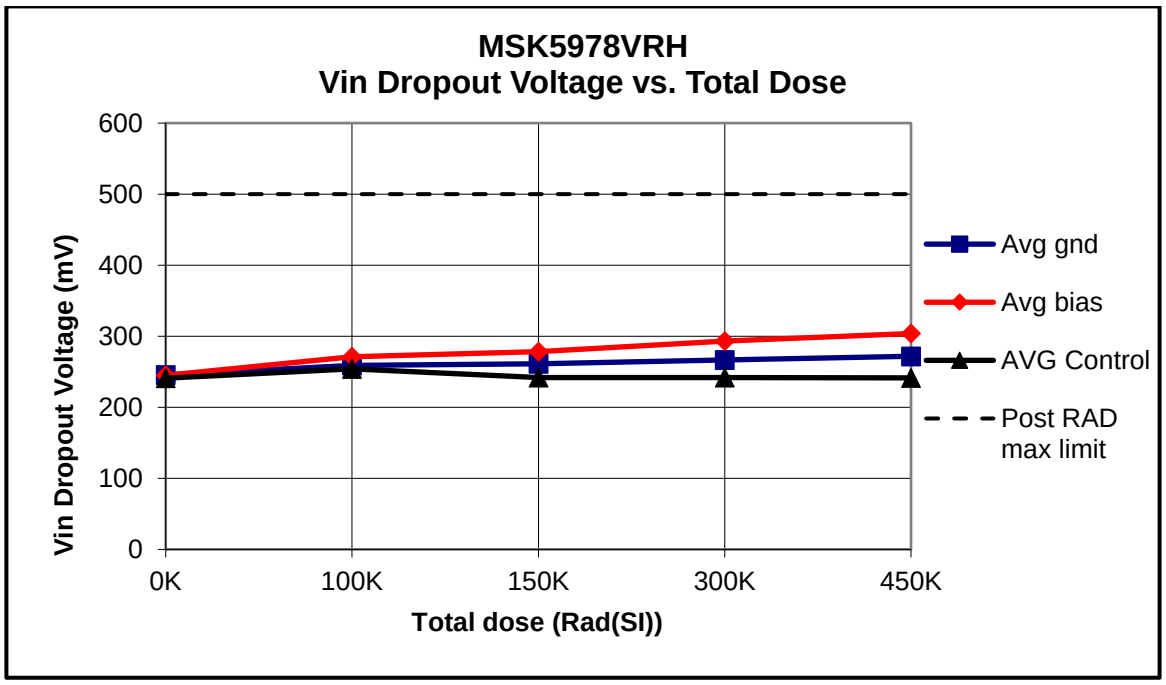

MSK5978VRH
Set Pin Current (Io=1mA) vs. Total Dose
Set Pin Current (uA)
10.6
10.5
10.4
10.3
10.2
10.1
10.0
9.9
9.8
9.7
9.6
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit

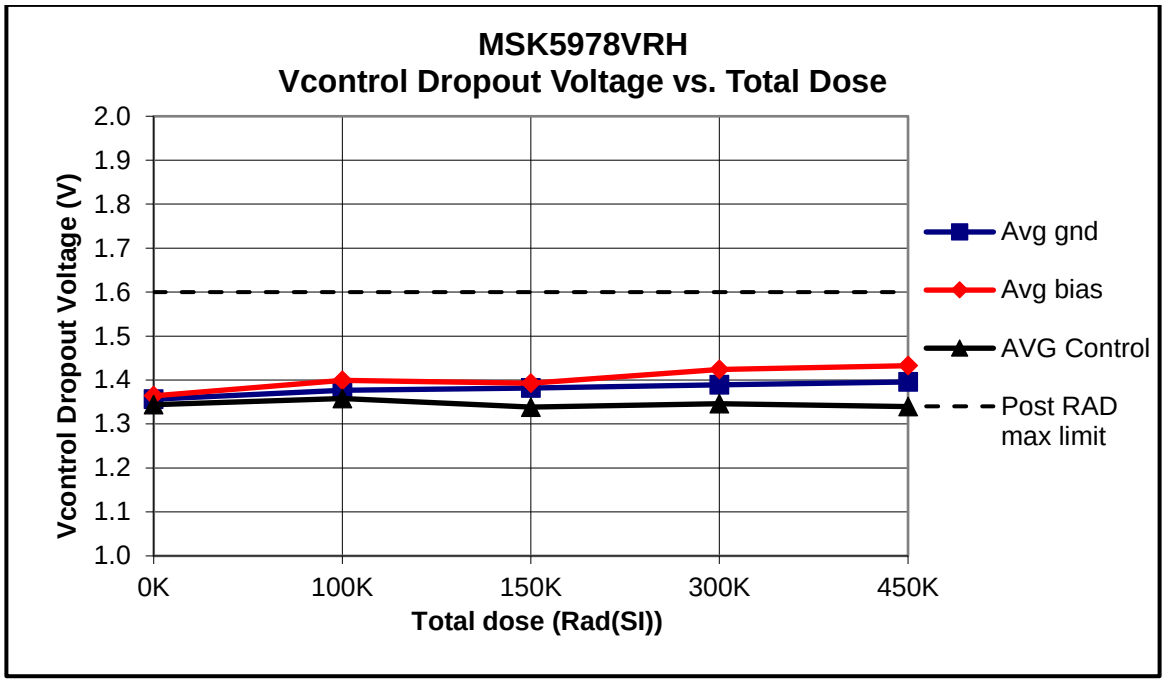

MSK5978VRH
Set Pin Current (Io= 0.7A) vs. Total Dose
Set Pin Current (uA)
10.6
10.5
10.4
10.3
10.2
10.1
10
9.9
9.8
9.7
9.6
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit

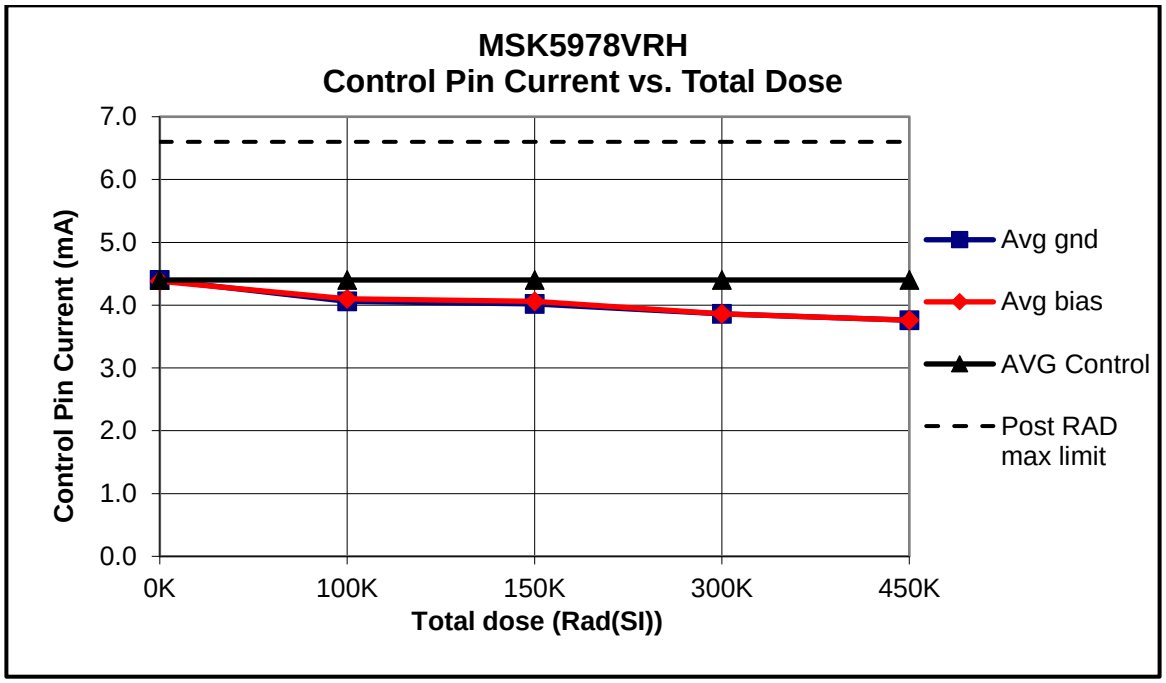

MSK5978VRH
Output Offset Voltage vs. Total Dose
Output Offset Voltage (mV)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit

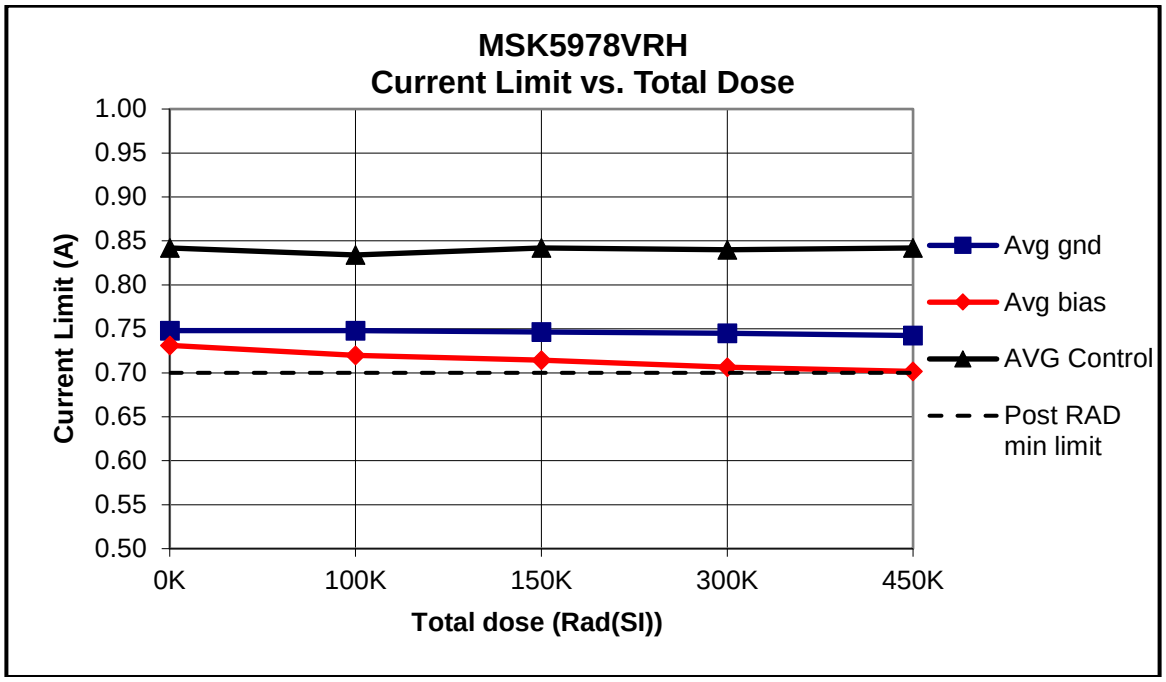

MSK5978VRH
Load Regulation Voltage vs. Total Dose
Load Regulation (mV)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit


MSK5978VRH
Line Regulation vs. Total Dose
Line Regulation (nA/V)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0K
100K
150K
300K
450K
Total dose (Rad(Si))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit


MSK5978VRH
Vin Dropout Voltage vs. Total Dose
Vin Dropout Voltage (mV)
600
500
400
300
200
100
0
0K
100K
150K
300K
450K
Total dose (Rad(Si))
Avg gnd
Avg bias
AVG Control
Post RAD max limit


MSK5978VRH
Vcontrol Dropout Voltage vs. Total Dose
Vcontrol Dropout Voltage (V)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD max limit


MSK5978VRH
Control Pin Current vs. Total Dose
Control Pin Current (mA)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD max limit


MSK5978VRH
Current Limit vs. Total Dose
Current Limit (A)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit

Total Dose Radiation Test Report

MSK5978RH,
MSK5980RH

RAD Hard Positive Adjustable Voltage Regulator

March 29, 2017
Revised May 23, 2017

B. Horton
P. Dinneen
N. Kresse

I. Introduction:

The total dose radiation test plan for the MSK5978RH was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5980RH uses the same active components and package material.

The data herein is from direct measurement of the MSK5978RH response to total dose irradiation, but is indicative of the response of both device types.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK5978RH and MSK5980RH.

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 in accordance with the device data sheet. In addition, all devices received 240 hours minimum of burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF-38535 Class V. For test platform verification, two control devices were tested at 25°C. Ten devices were then tested at 25°C, prior to irradiation, and were found to be within acceptable test limits.

The devices were vertically aligned with the radiation source and enclosed in a lead/aluminum container during irradiation. Five devices were kept under bias during irradiation. An operating voltage of +26 Volts was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Electrical tests were completed within one hour of irradiation. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

IV. Data:

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

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, the MSK5978RH and MSK5980RH qualified as a 300 Krad(Si) radiation hardened device. The Set Pin Currents exhibited the most significant change with irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK5978VRH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
5/29/2017

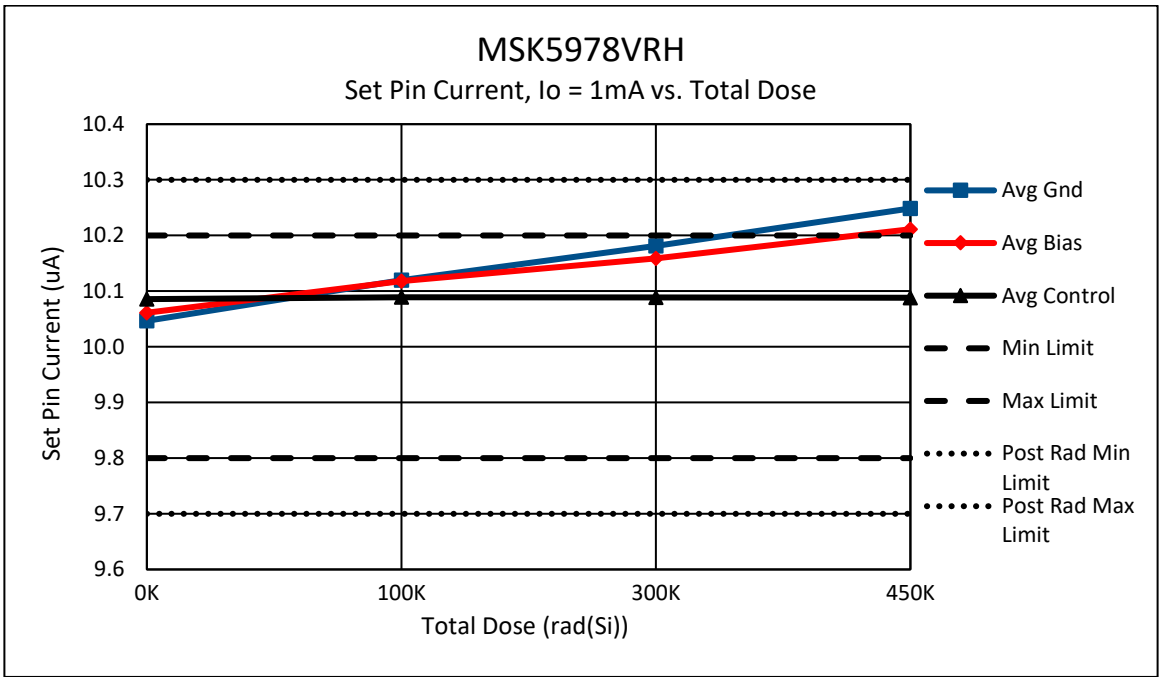
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
11:23	103,000	103,000
22:46	206,000	309,000
17:05	154,500	463,500

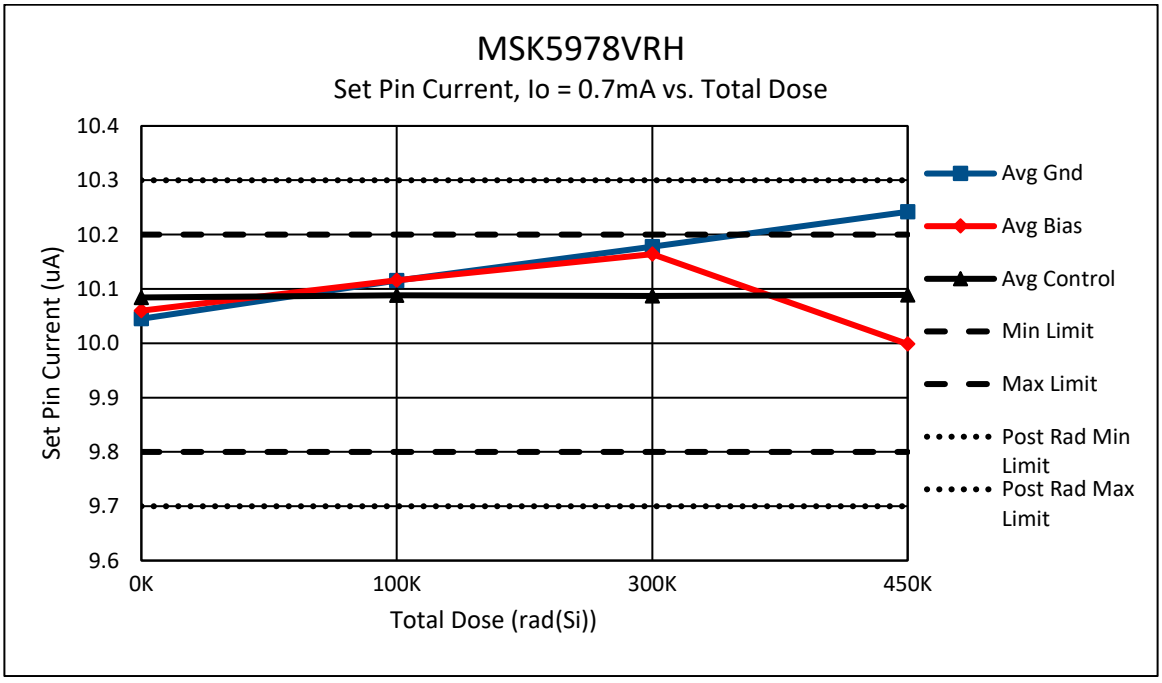
Biased S/N – 4330, 4331, 4332, 4333, 4334

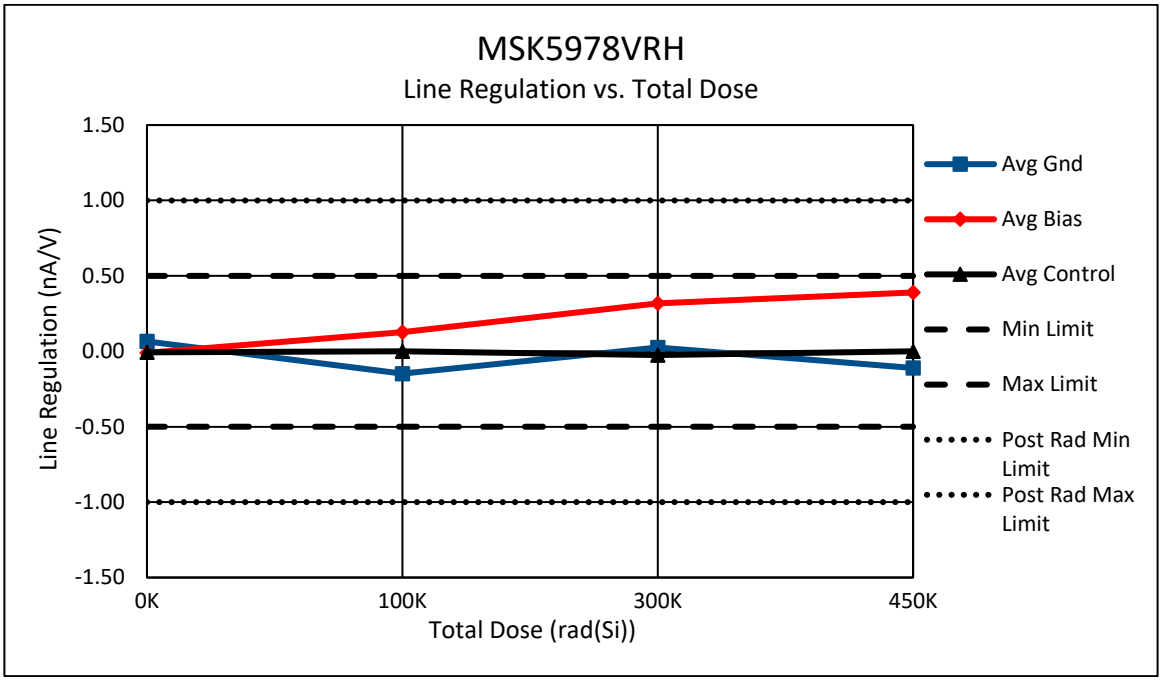
Unbiased S/N – 4335, 4336, 4337, 4338, 4339

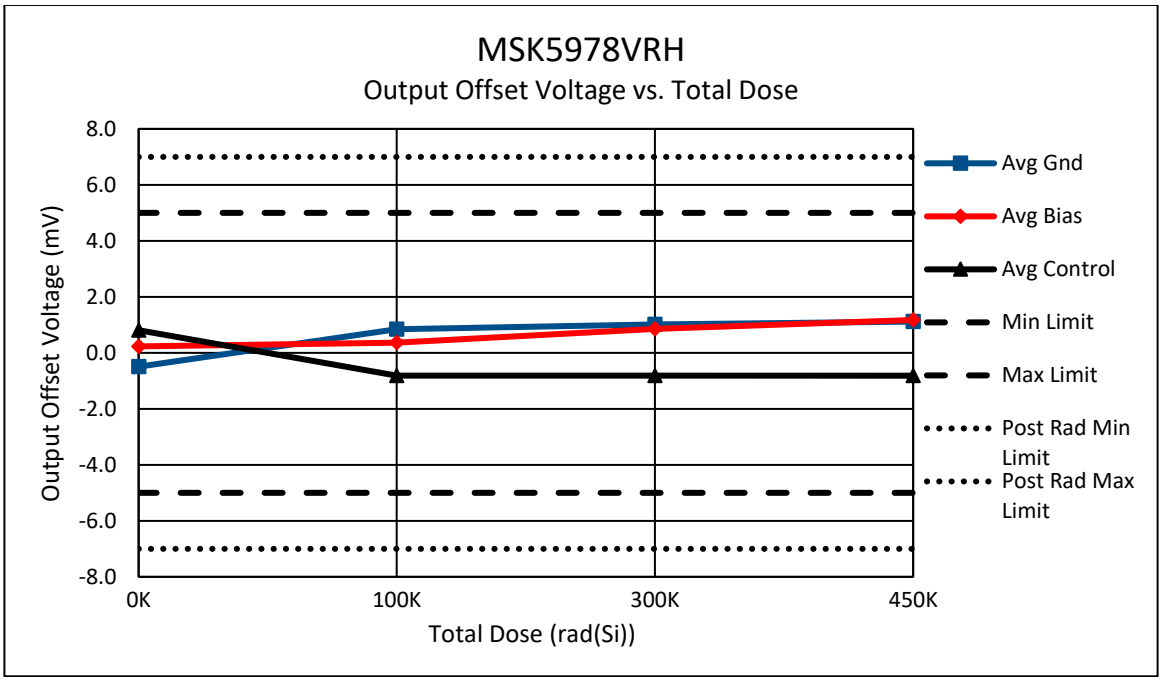
Table 1

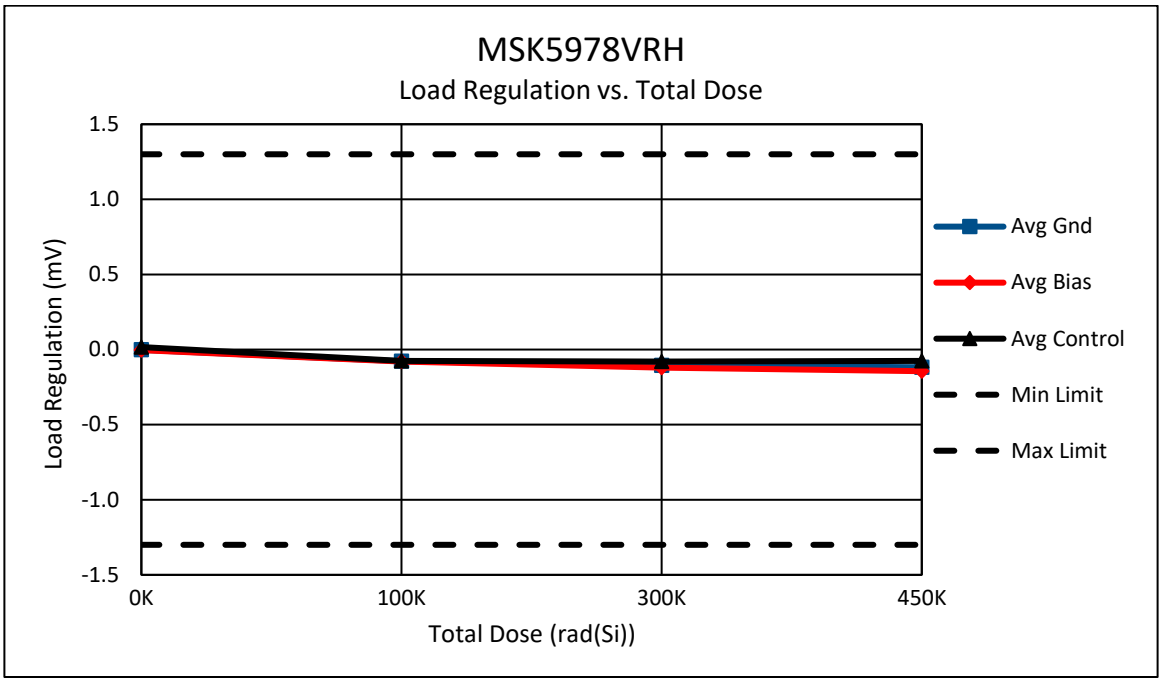
Dose Time, Incremental Dose and Total Cumulative Dose

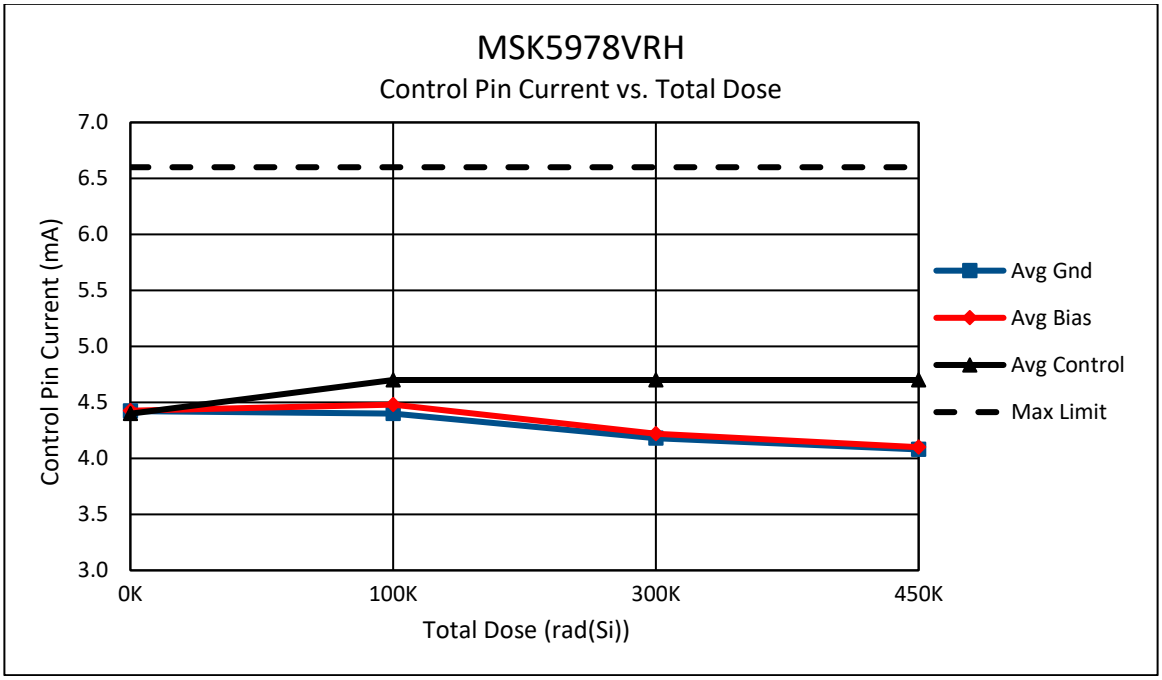

MSK5978VRH
Set Pin Current, Io = 1mA vs. Total Dose
Set Pin Current (uA)
10.4
10.3
10.2
10.1
10.0
9.9
9.8
9.7
9.6
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit
Post Rad Max Limit

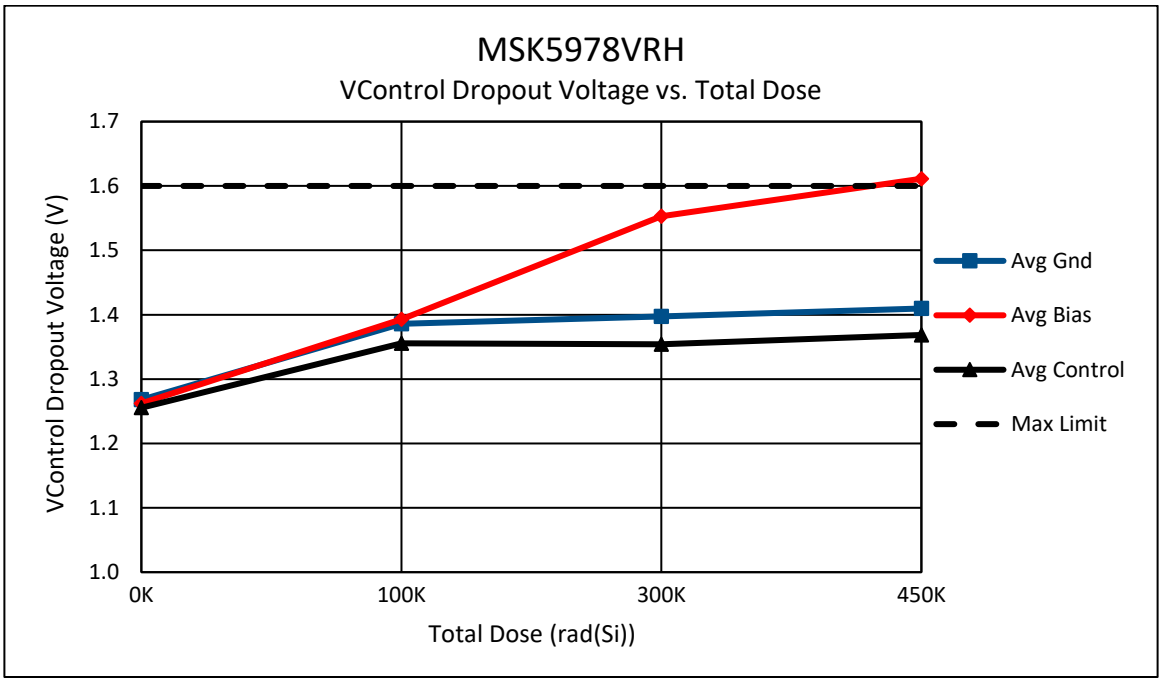

MSK5978VRH
Set Pin Current, Io = 0.7mA vs. Total Dose
Set Pin Current (uA)
10.4
10.3
10.2
10.1
10.0
9.9
9.8
9.7
9.6
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit
Post Rad Max Limit

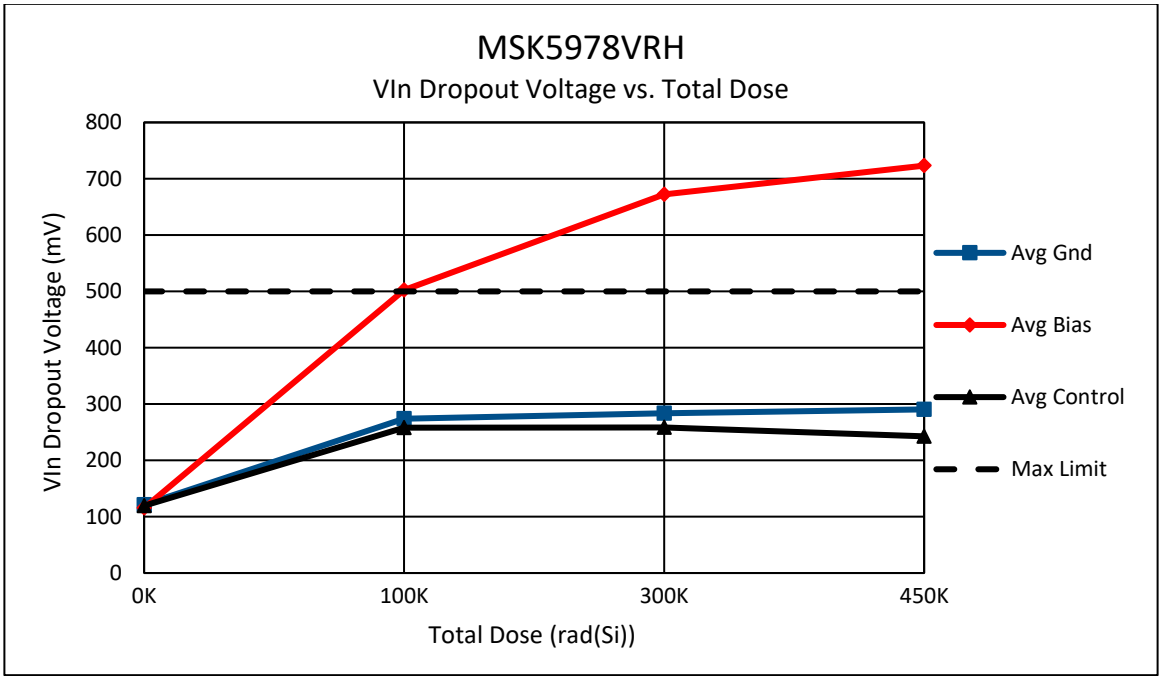

MSK5978VRH
Line Regulation vs. Total Dose
Line Regulation (nA/V)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit
Post Rad Max Limit

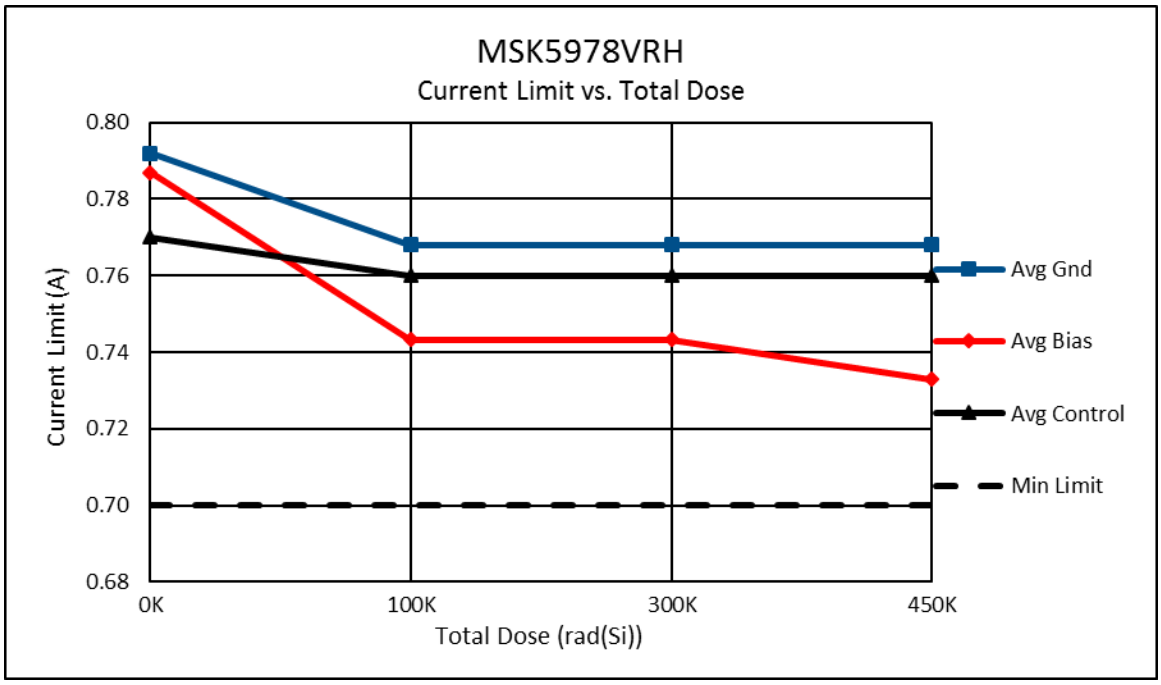

MSK5978VRH
Output Offset Voltage vs. Total Dose
Output Offset Voltage (mV)
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit
Post Rad Min Limit
Post Rad Max Limit


MSK5978VRH
Load Regulation vs. Total Dose
Load Regulation (mV)
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit
Max Limit


MSK5978VRH
Control Pin Current vs. Total Dose
Control Pin Current (mA)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5978VRH
VControl Dropout Voltage vs. Total Dose
VControl Dropout Voltage (V)
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5978VRH
VIn Dropout Voltage vs. Total Dose
VIn Dropout Voltage (mV)
800
700
600
500
400
300
200
100
0
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Max Limit


MSK5978VRH
Current Limit vs. Total Dose
0.80
0.78
0.76
0.74
0.72
0.70
0.68
Current Limit (A)
0K
100K
300K
450K
Total Dose (rad(Si))
Avg Gnd
Avg Bias
Avg Control
Min Limit

Total Dose Radiation Test Report

MSK5980RH,
MSK5978RH

RAD Hard Positive Adjustable Voltage Regulator

May 30, 2019

E. Davis
J. Joy

Anaren, Inc – MSK Products

I. Introduction:

The total dose radiation test plan for the MSK5980RH was developed to qualify the devices as RAD Hard to 300 KRADS(Si). The testing was performed beyond 300 KRADS(Si) to show trends in device performance as a function of total dose. The test does not classify maximum radiation tolerance of the device, but simply offers designers insight to the critical parameter-shifts up to the specified total dose level. The MSK 5978RH uses the same active components and package material.

The data herein is from direct measurement of the MSK5980RH response to total dose irradiation, but is indicative of the response of both device types.

MIL-STD-883 Method 1019.7 and ASTM F1892-06 were used as guidelines in the development and implementation of the total dose test plan for the MSK5980RH and MSK5978RH.

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

III. Test Setup:

All test samples were subjected to Group A Electrical Test in accordance with the device data sheet. In addition, all devices received 240 hours minimum of burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF-38535 Class V. For test platform verification, two control devices were tested at 25°C. Ten devices were then tested at 25°C, prior to irradiation, and were found to be within acceptable test limits.

The devices were vertically aligned with the radiation source and enclosed in a lead/aluminum container during irradiation. Five devices were kept under bias during irradiation. An operating voltage of +26 Volts was used for the bias condition. Five devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together and the devices were transported to the MSK automatic electrical test platform. Testing was performed in accordance with the MSK device data sheet. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Electrical tests were completed within one hour of irradiation. Devices were subjected to subsequent radiation doses within two hours of removal from the radiation field.

IV. Data:

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

V. Summary:

Based on the test data recorded during radiation testing and statistical analysis, the MSK5980RH and MSK5978RH qualified as a 300 Krad(Si) radiation hardened device. The Set Pin Currents exhibited the most significant change with irradiation, however all performance curves stayed within specification up to 450 Krad(Si) TID.

MSK5980RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0162

Irradiation Date
05/30/2019

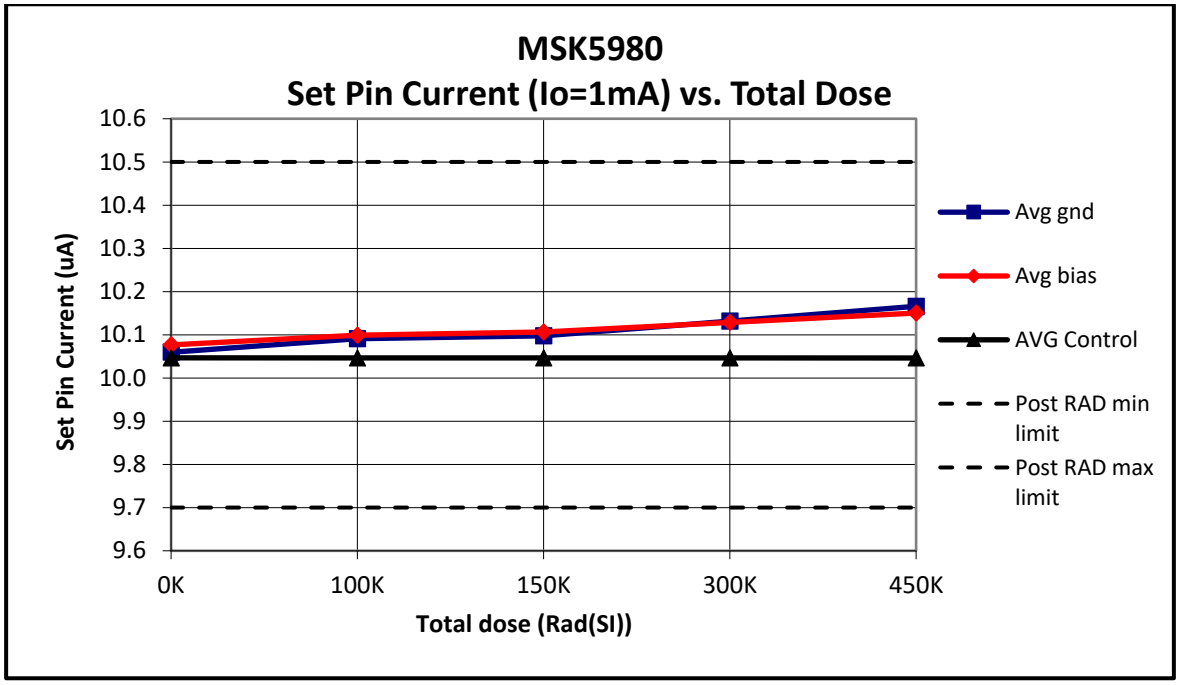
Exposure Length (min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
15.00	103,140	103,140
07.30	51,570	154,710
22.30	154,710	309,420
22.30	154,710	464,130

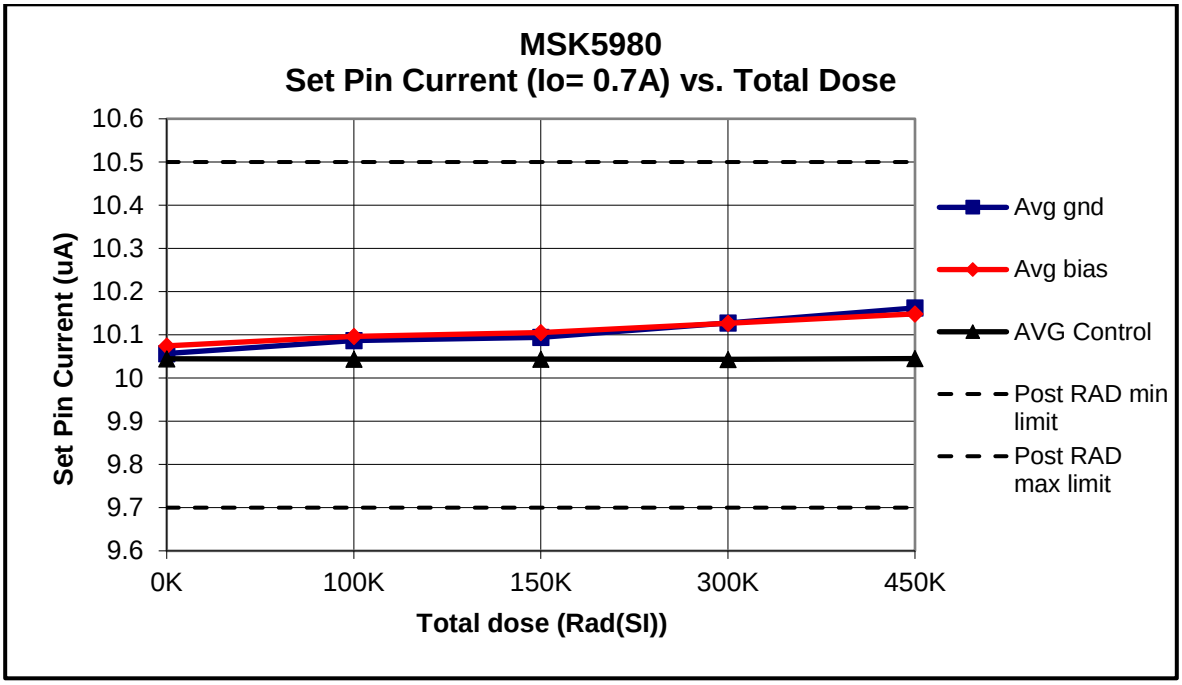
Biased S/N – 0002, 0003, 0004, 0005, 0007

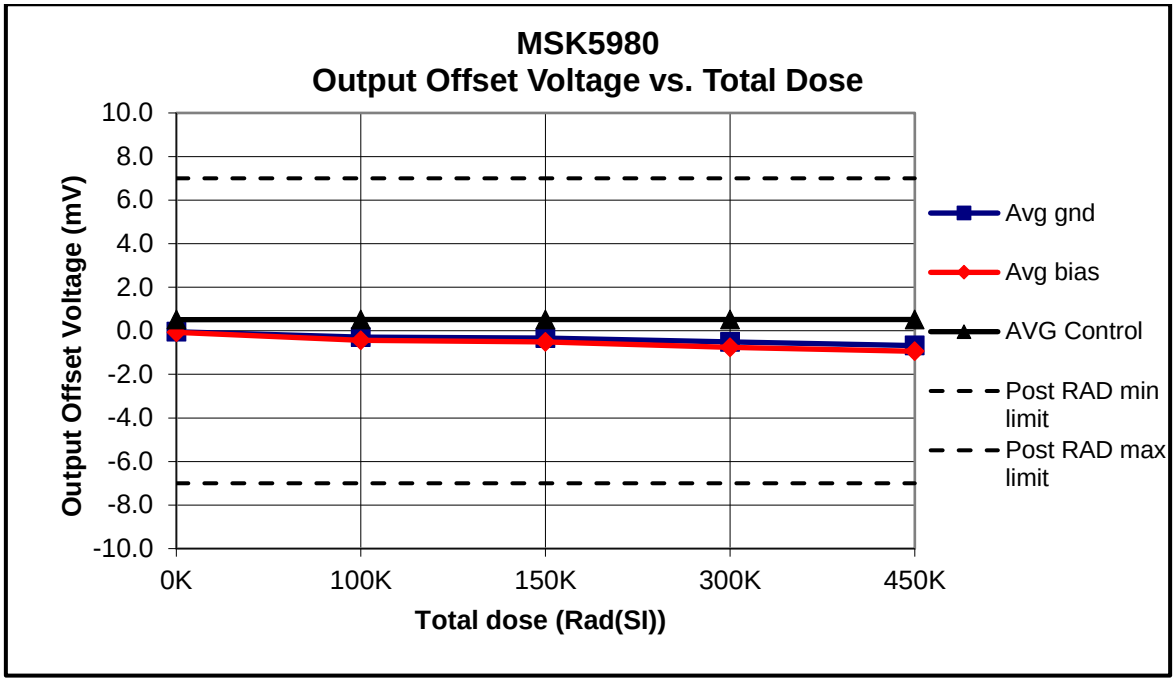
Unbiased S/N – 0008, 0009, 0010, 0011, 0012

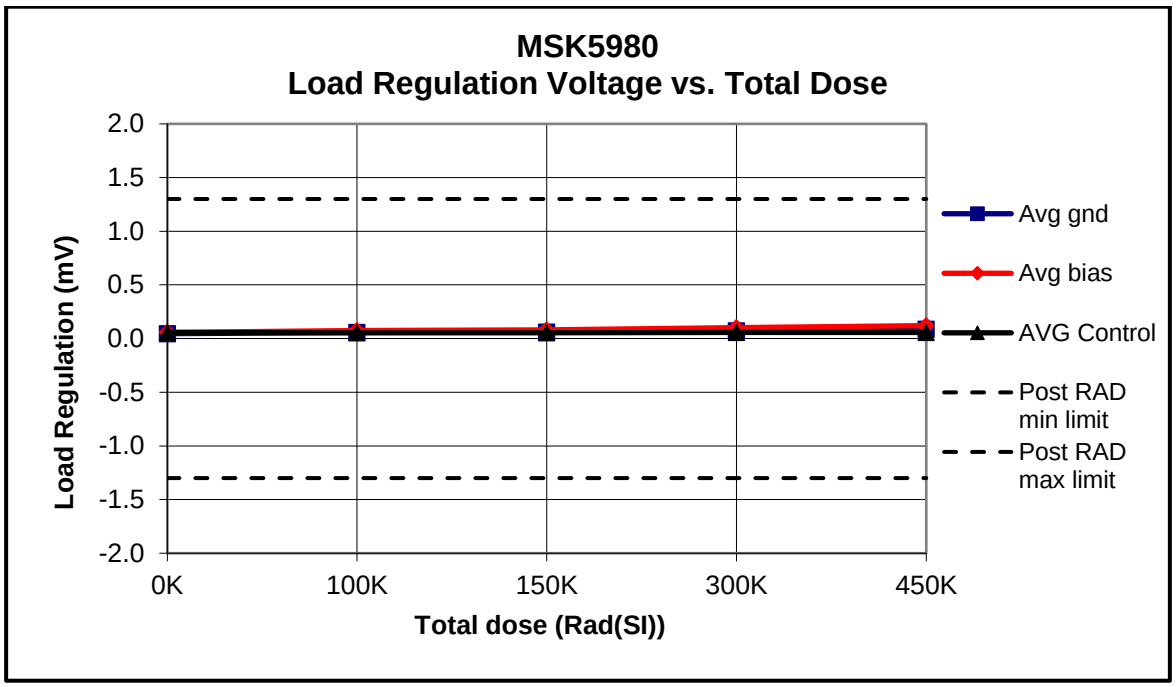
Table 1

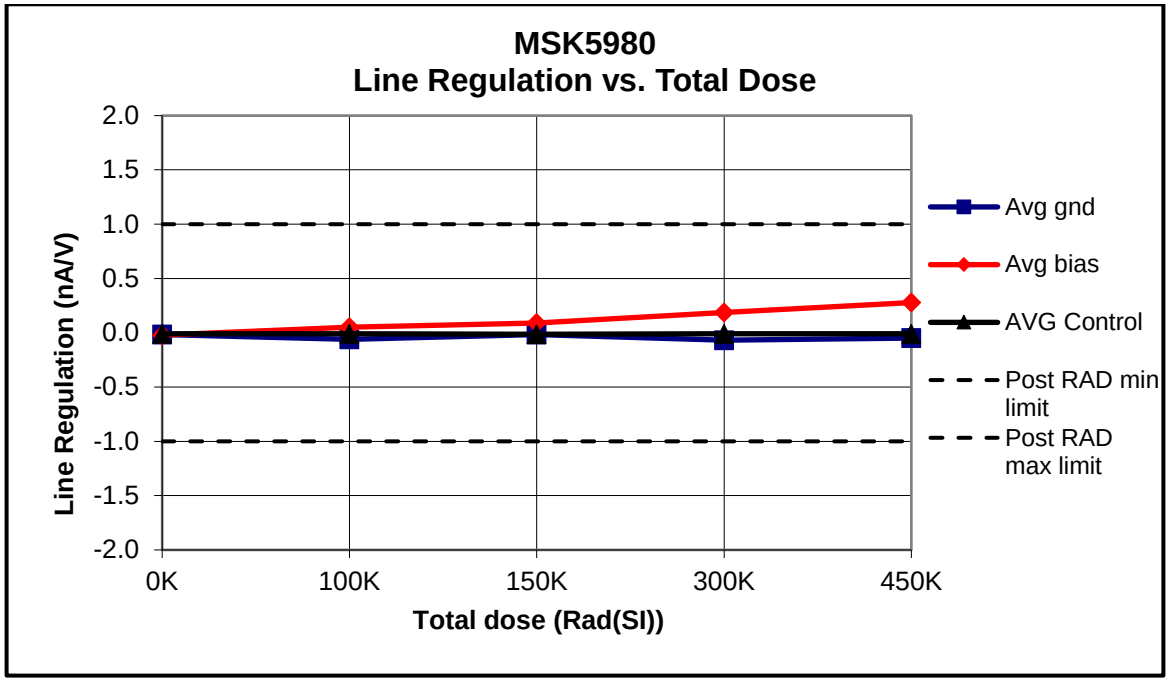
Dose Time, Incremental Dose and Total Cumulative Dose

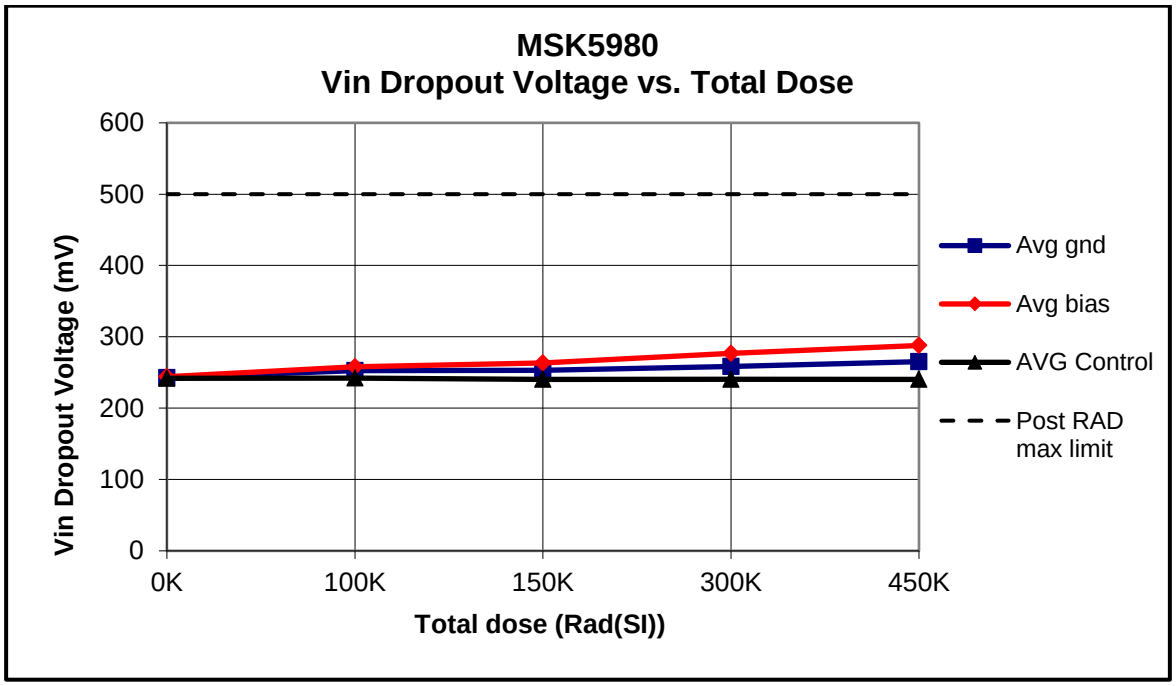

MSK5980
Set Pin Current (Io=1mA) vs. Total Dose
Set Pin Current (uA)
10.6
10.5
10.4
10.3
10.2
10.1
10.0
9.9
9.8
9.7
9.6
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit

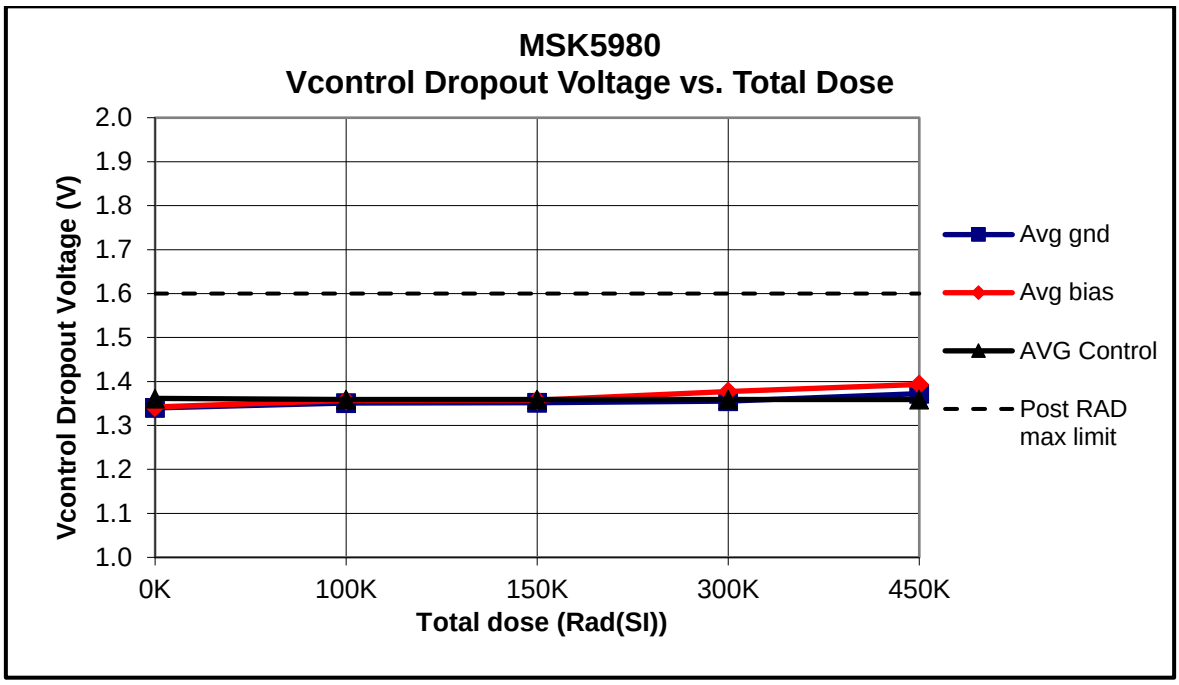

MSK5980
Set Pin Current (Io= 0.7A) vs. Total Dose
Set Pin Current (uA)
10.6
10.5
10.4
10.3
10.2
10.1
10
9.9
9.8
9.7
9.6
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit

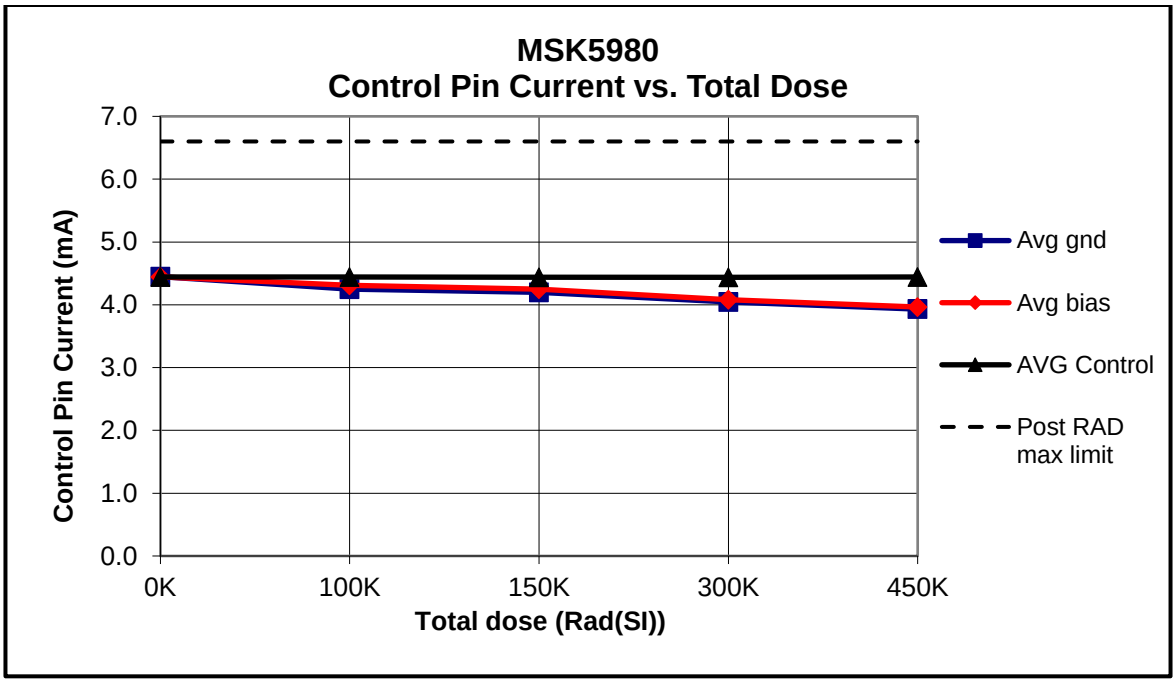

MSK5980
Output Offset Voltage vs. Total Dose
Output Offset Voltage (mV)
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit

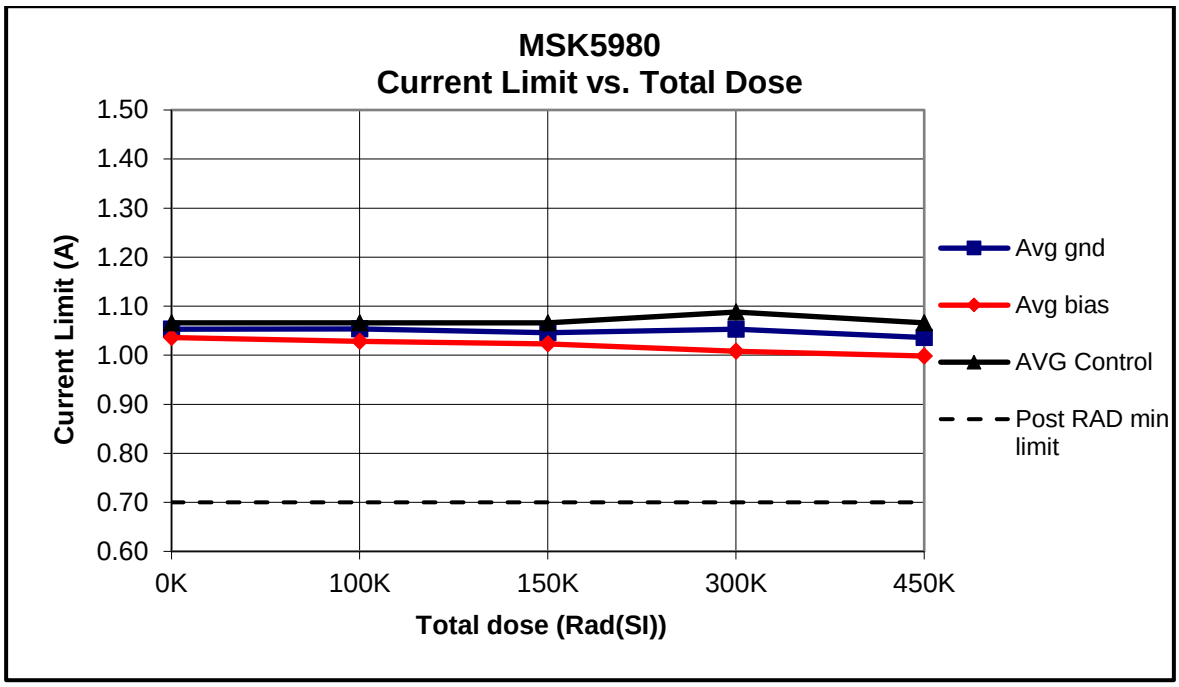

MSK5980
Load Regulation Voltage vs. Total Dose
Load Regulation (mV)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit


MSK5980
Line Regulation vs. Total Dose
Line Regulation (nA/V)
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit
Post RAD max limit


MSK5980
Vin Dropout Voltage vs. Total Dose
Vin Dropout Voltage (mV)
600
500
400
300
200
100
0
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD max limit


MSK5980
Vcontrol Dropout Voltage vs. Total Dose
Vcontrol Dropout Voltage (V)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0K
100K
150K
300K
450K
Total dose (Rad(Si))
Avg gnd
Avg bias
AVG Control
Post RAD max limit


MSK5980
Control Pin Current vs. Total Dose
Control Pin Current (mA)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0K
100K
150K
300K
450K
Total dose (Rad(Si))
Avg gnd
Avg bias
AVG Control
Post RAD max limit


MSK5980
Current Limit vs. Total Dose
Current Limit (A)
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0K
100K
150K
300K
450K
Total dose (Rad(SI))
Avg gnd
Avg bias
AVG Control
Post RAD min limit