ELDRS Radiation Test Report

MSK106RH

Radiation Hardened High Power Op Amp

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I. Introduction:

The ELDRS radiation test for the MSK106RH was developed to qualify the device to 50 Krad(Si).

MIL-STD-883 Method 1019 Condition C and ASTM F1892-06 were used as guidelines in the development and implementation of the ELDRS test plan for the MSK106RH.

II. Radiation Source:

ELDRS test was performed at the University of Massachusetts, Lowell, using a cobalt 60 radiation source. Dosimetry was performed prior to device irradiation and the dose rate was determined to be 0.01 rads(Si)/sec. The ELDRS dose schedule can be found in Table I.

III. Test Setup:

All test samples were subjected to Group A Electrical Test in accordance with the device data sheet. In addition, all devices received 320 hours of burn-in per MIL-STD-883 Method 1015 and were electrically tested prior to irradiation. For test platform verification, one control device was tested at 25°C.

The devices were vertically aligned with the radiation source in the University of Massachusetts ELDRS facility, chamber #2. Four devices were kept under bias during irradiation. Maximum recommended operating voltages of ± 18 Volts were used for bias. Four devices had all leads grounded during irradiation for the unbiased condition.

After each irradiation, the device leads were shorted together then the devices were packaged for shipment, and shipped overnight to the MSK facility. Electrical testing to the MSK device data sheet was performed within 72 hours from the removal of the radiation source. Testing was performed on irradiated devices, as well as the control device, at each total dose level. Devices were then repackaged for shipment and returned to the UMass facility overnight for subsequent dose level. Devices were returned to the irradiation field within 120 hours of removal from the radiation source per MIL-STD-883 Method 1019 Condition C.

IV. Data:

All performance curves are averaged from the test results of the biased and unbiased devices respectively.

V. Summary:

The devices passed all post irradiation specifications up to 50 Krads(Si). The unbiased devices exhibited a more significant shift than the biased devices throughout testing.

Devices exhibited a slight quiescent current decrease.

Input bias current increased significantly, but stayed within pre irradiation limits to 50 Krads(Si).

Positive and negative slew rate decreased as testing progressed to 50 Krads(Si). All devices passed pre irradiation test limits to 50 Krads(Si) except serial number 0220, which had a final slew rate of 1.19V/uS. The device was still within the post irradiation limits.

Transition times showed a slight increase as well. However, all devices except 0220 stayed within pre irradiation limits up to 50 Krads(Si). Serial number 0020 increased to 1.02 uS, which is still within post irradiation limits.

MSK106RH Biased/Unbiased Dose Rate Schedule

Dosimetry Equipment
Bruker Biospin # 0141

Irradiation Date
6/03/08 – 8/07/08

Exposure Length (hr:min:sec)	Incremental Dose rads(Si)	Cumulative Dose rads(Si)
332:04:00	1.24E4	12,380
264:58:00	9.84E3	22,220
335:38:00	1.24E4	34,620
475:34:00	1.75E4	52,090

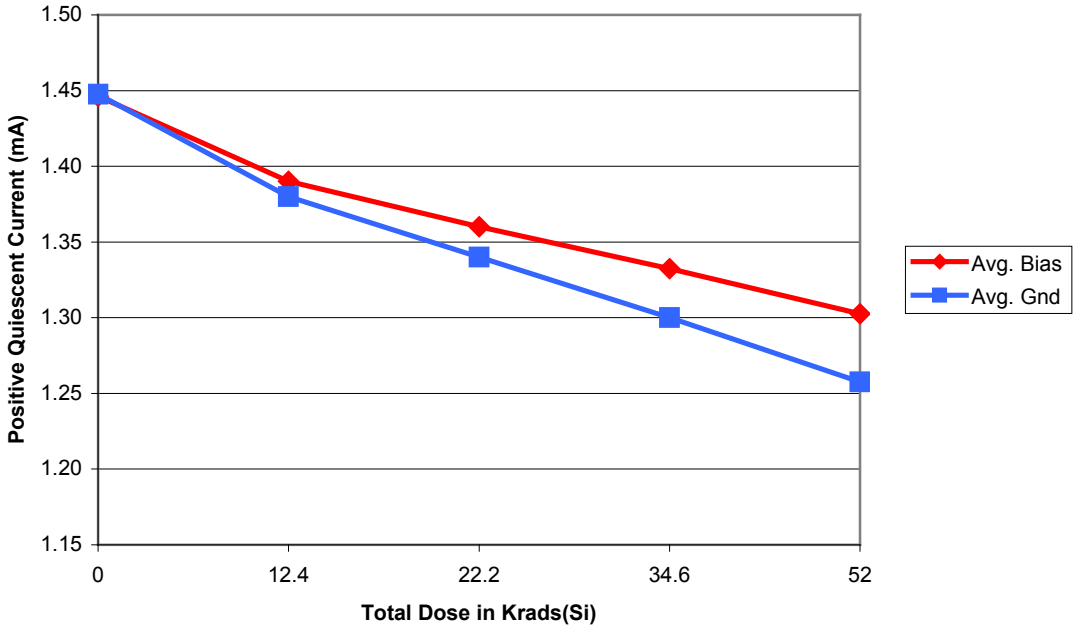
Biased S/N – 0186, 0187, 0197, 0196

Unbiased S/N – 0199, 0203, 0219, 0220

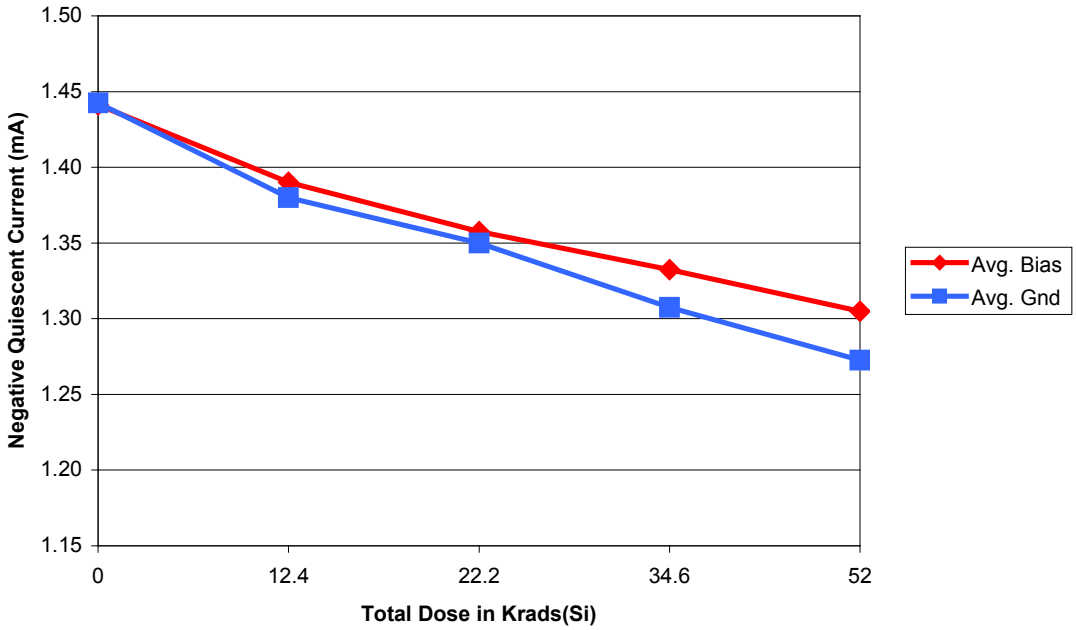
Table 1

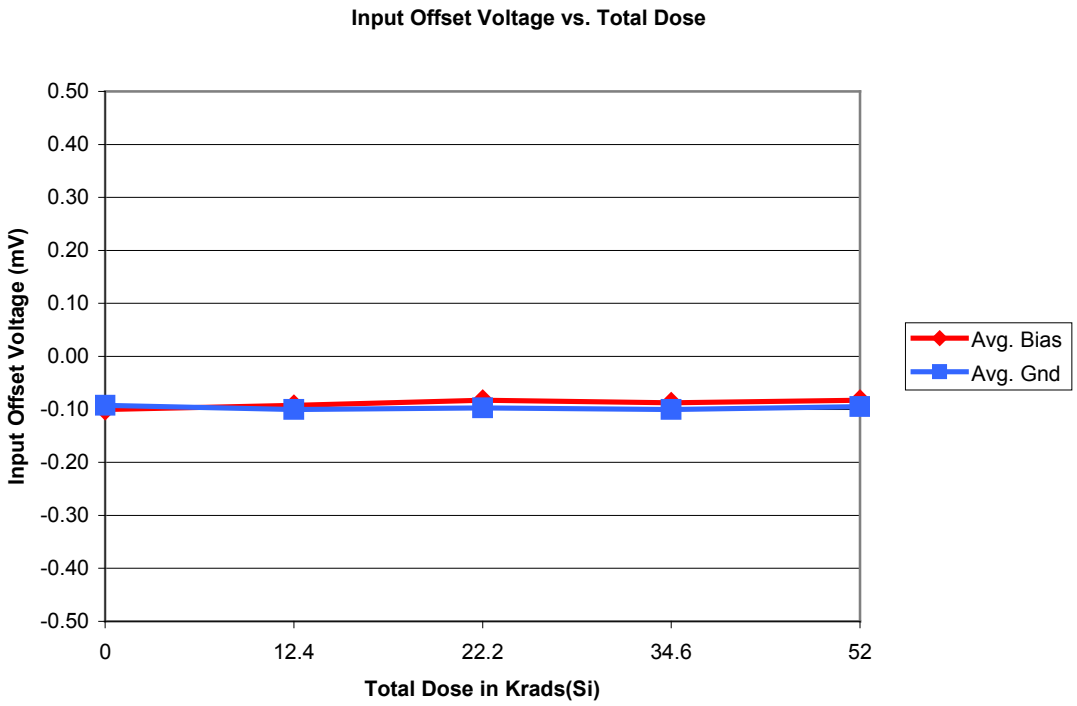
Dose Time, Incremental Dose and Total Cumulative Dose

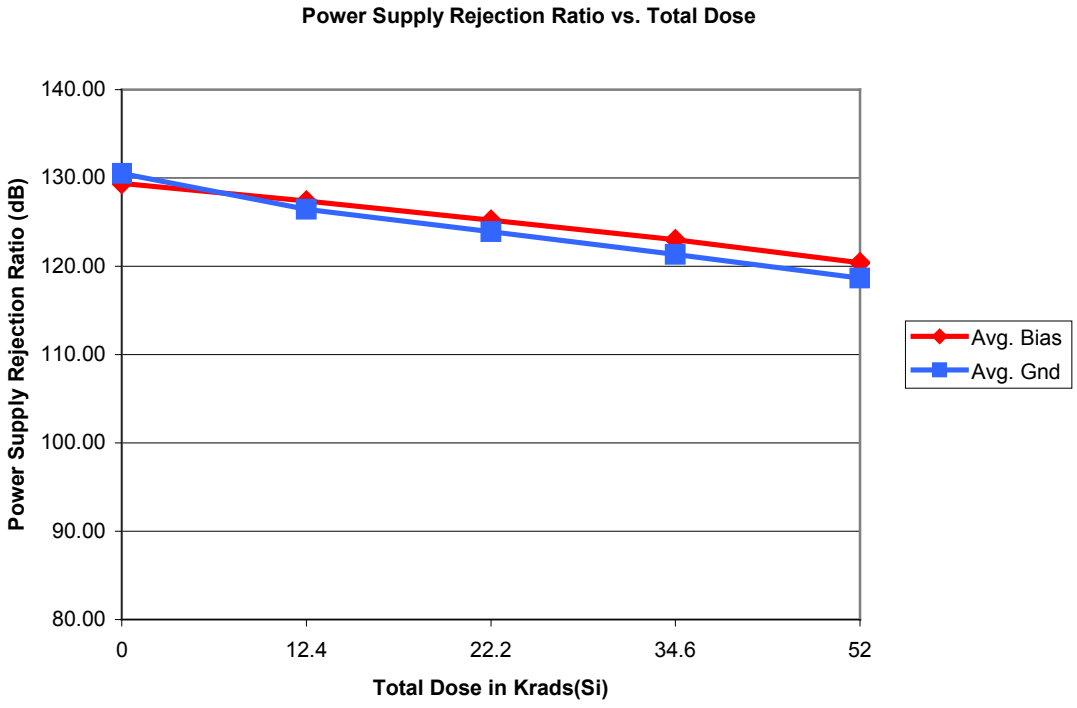
Positive Quiescent Current vs. Total Dose

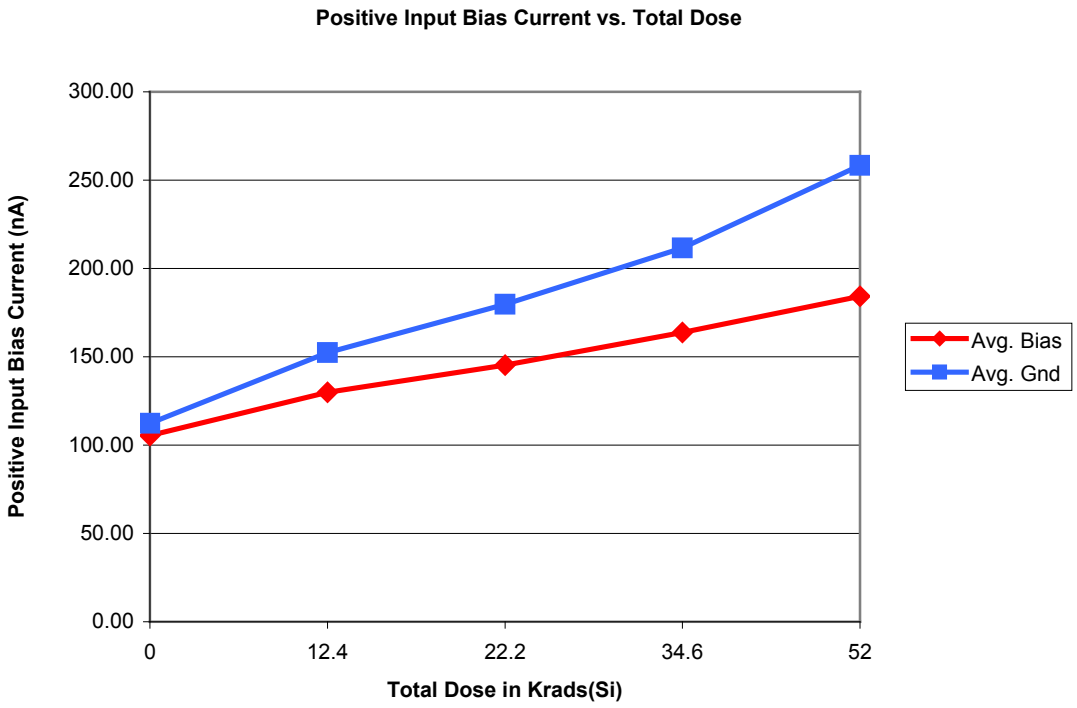


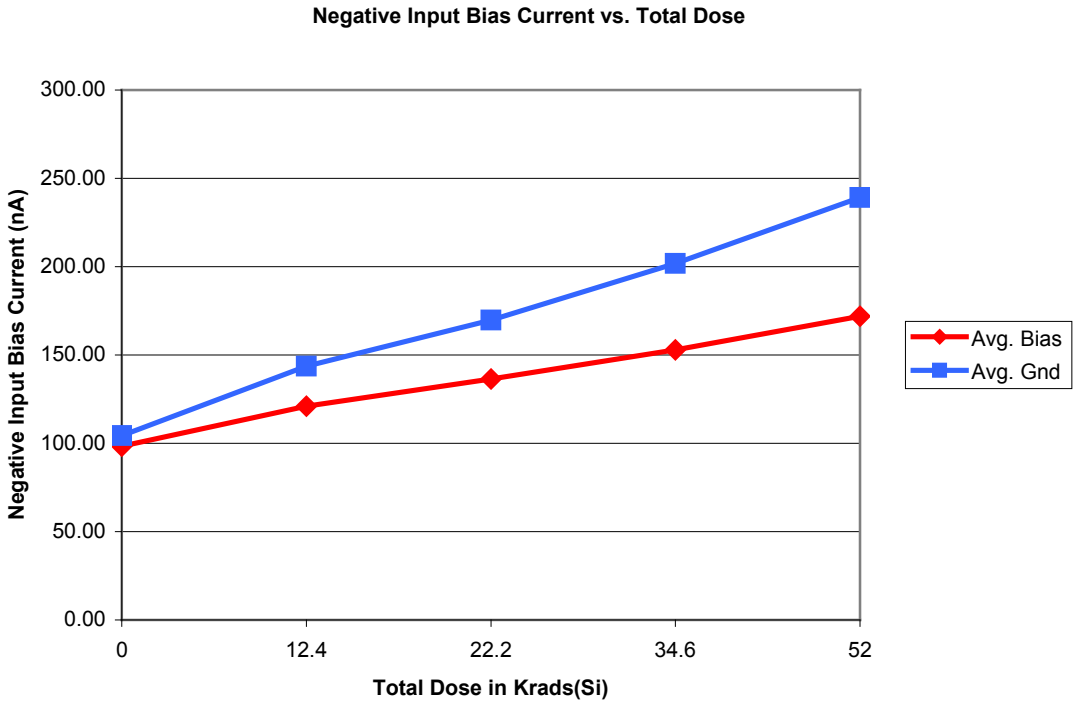
Negative Quiescent Current vs. Total Dose

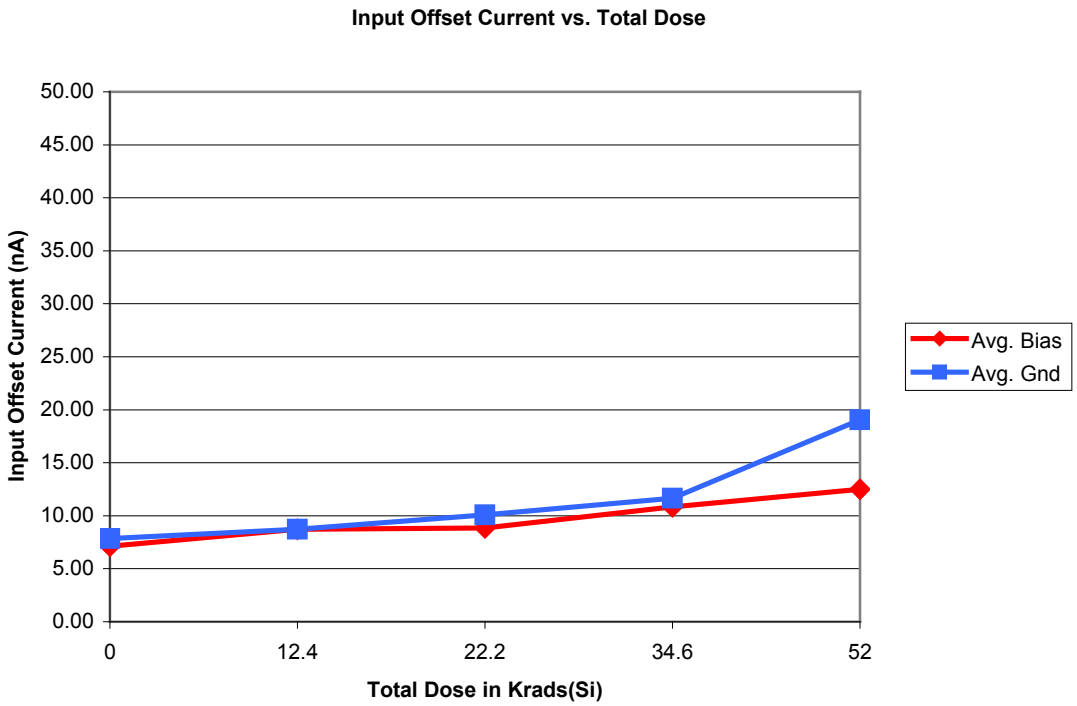


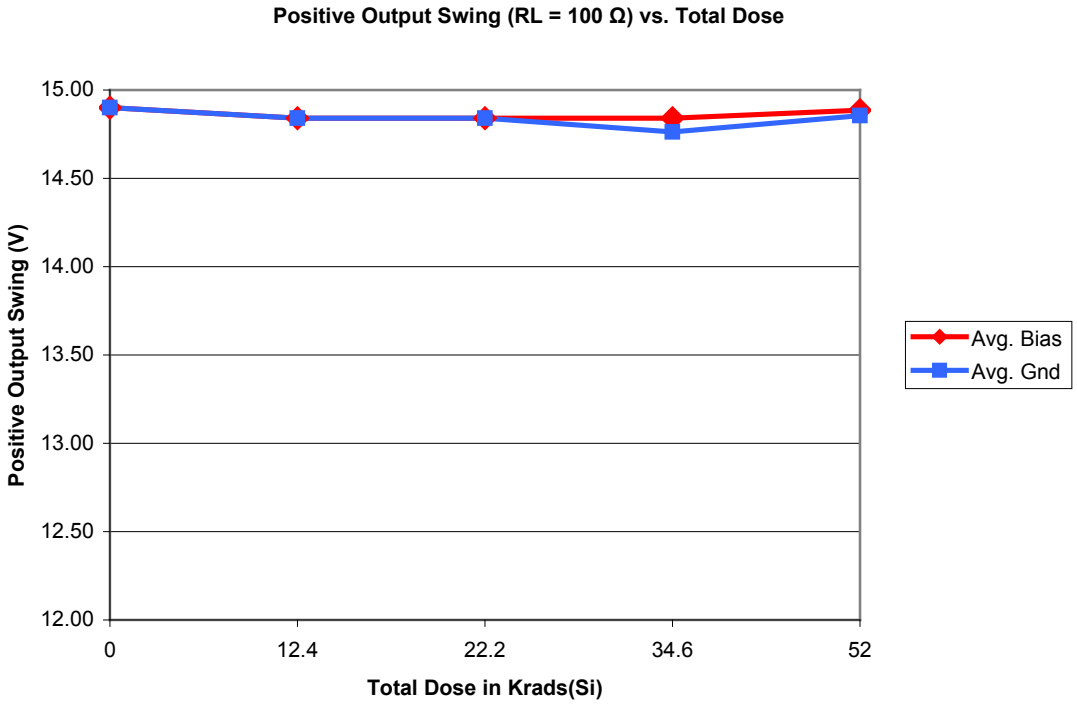

Input Offset Voltage vs. Total Dose
Input Offset Voltage (mV)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

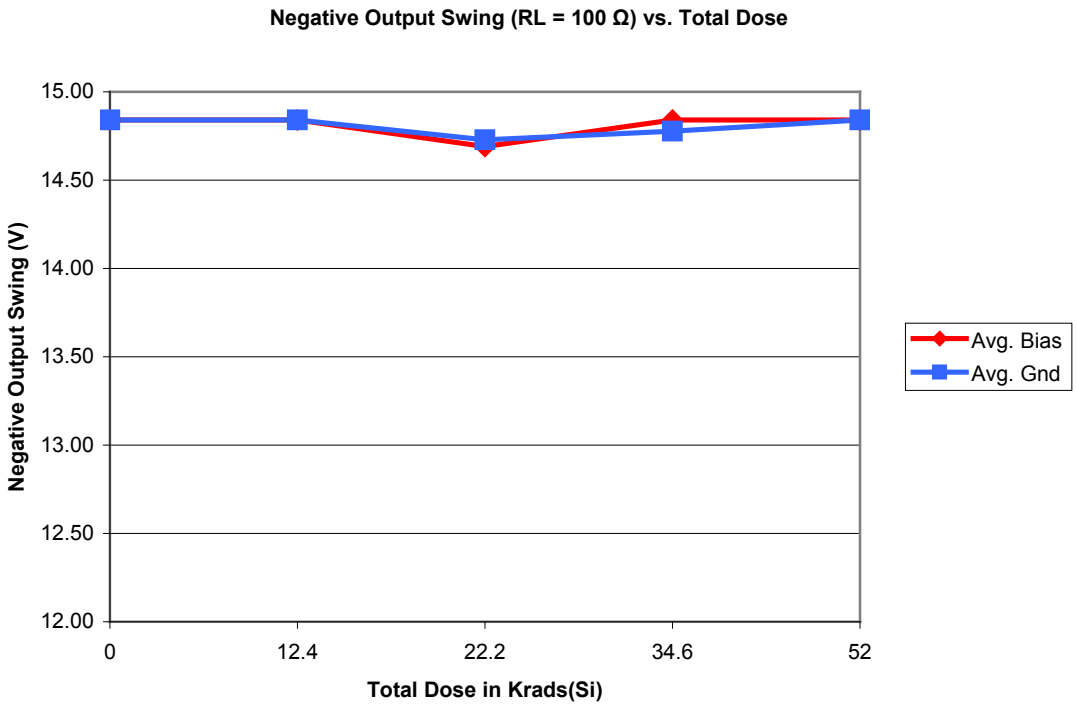

Power Supply Rejection Ratio vs. Total Dose
Power Supply Rejection Ratio (dB)
140.00
130.00
120.00
110.00
100.00
90.00
80.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

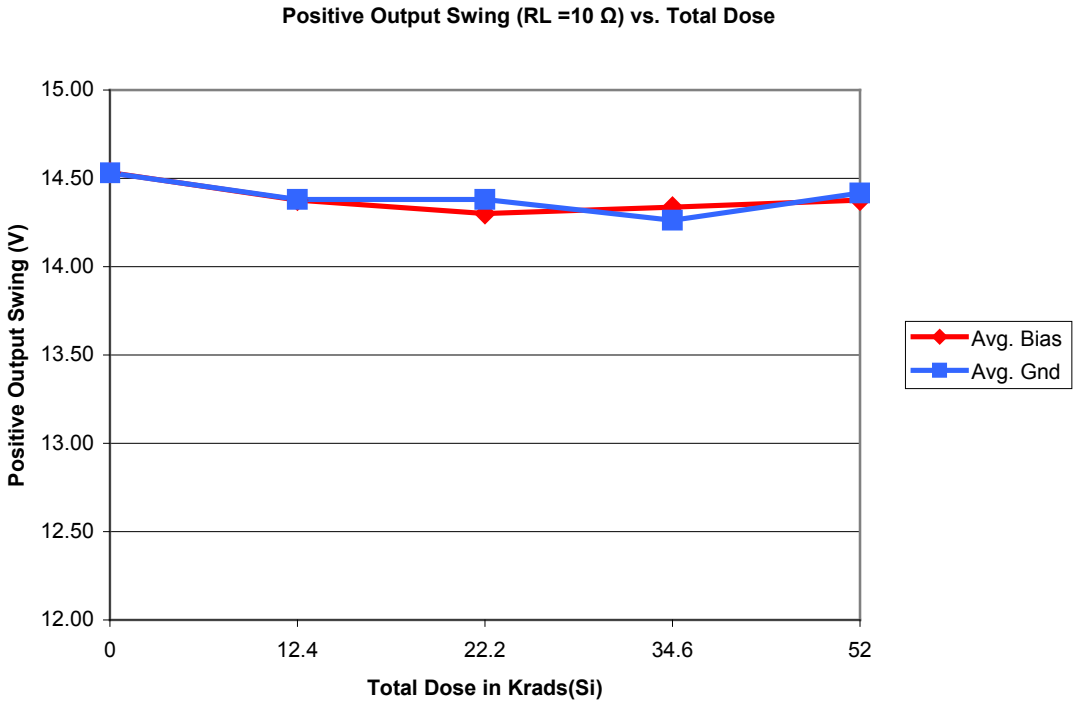

Positive Input Bias Current vs. Total Dose
Positive Input Bias Current (nA)
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

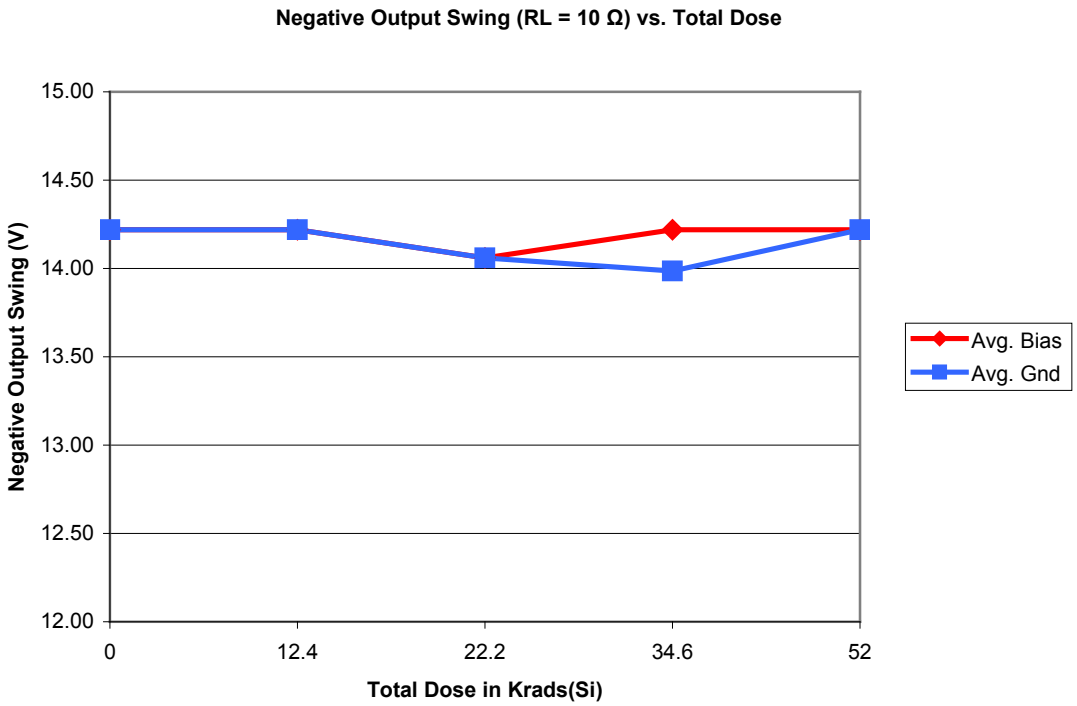

Negative Input Bias Current vs. Total Dose
Negative Input Bias Current (nA)
300.00
250.00
200.00
150.00
100.00
50.00
0.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

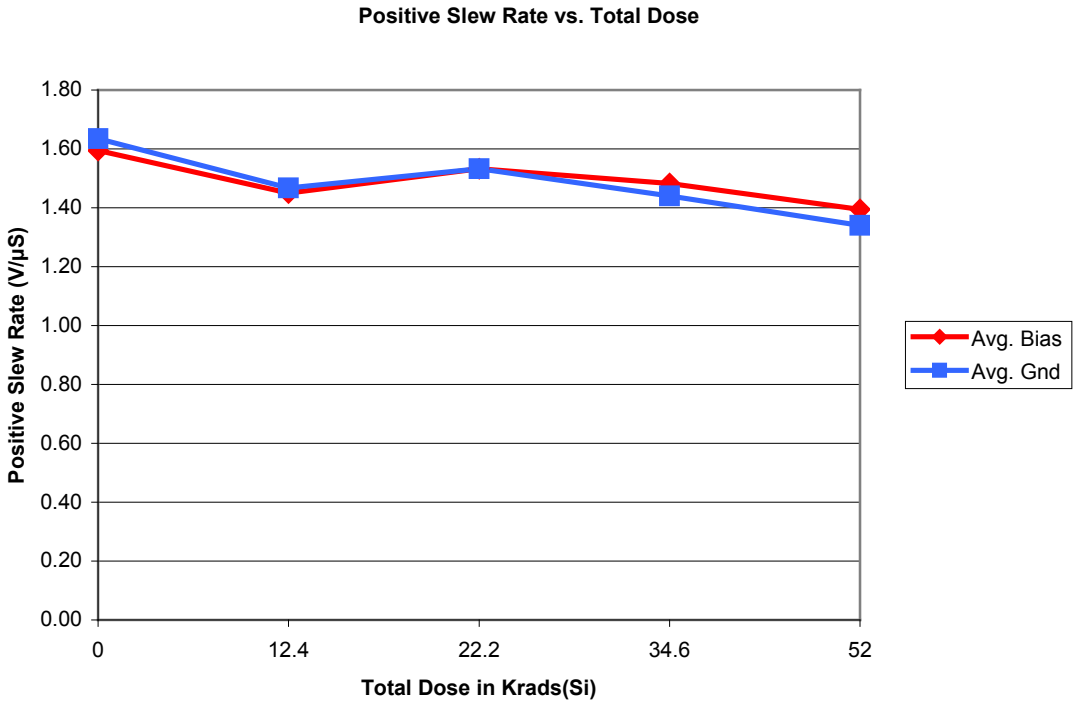

Input Offset Current vs. Total Dose
Input Offset Current (nA)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

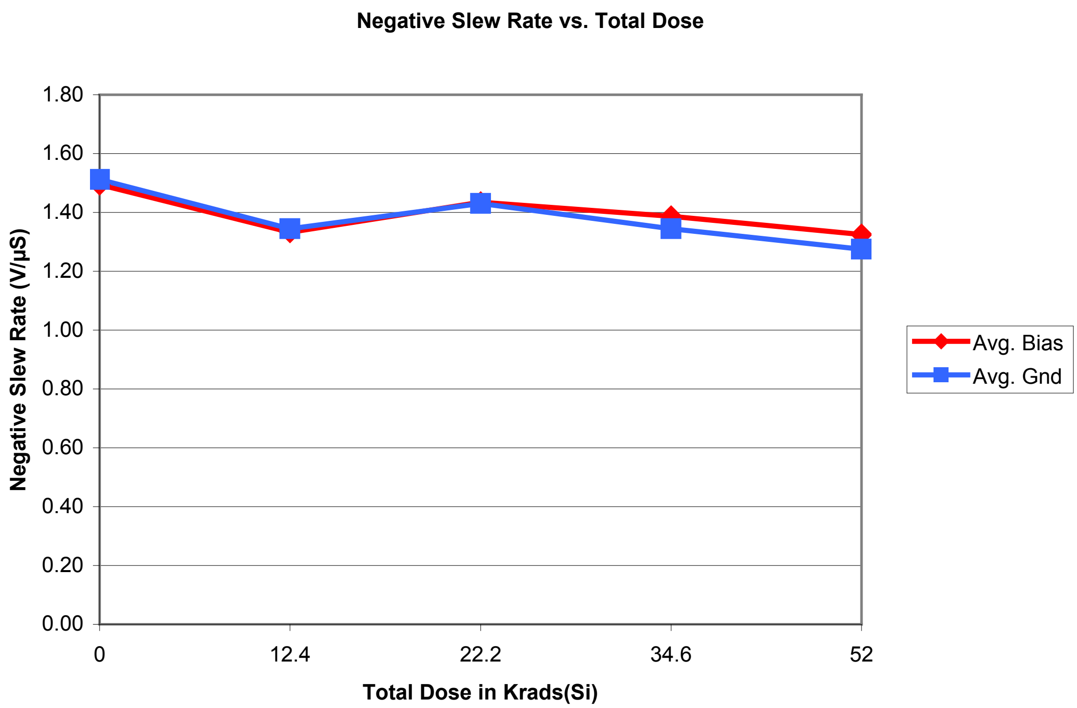

Positive Output Swing (RL = 100 Ω) vs. Total Dose
Positive Output Swing (V)
15.00
14.50
14.00
13.50
13.00
12.50
12.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

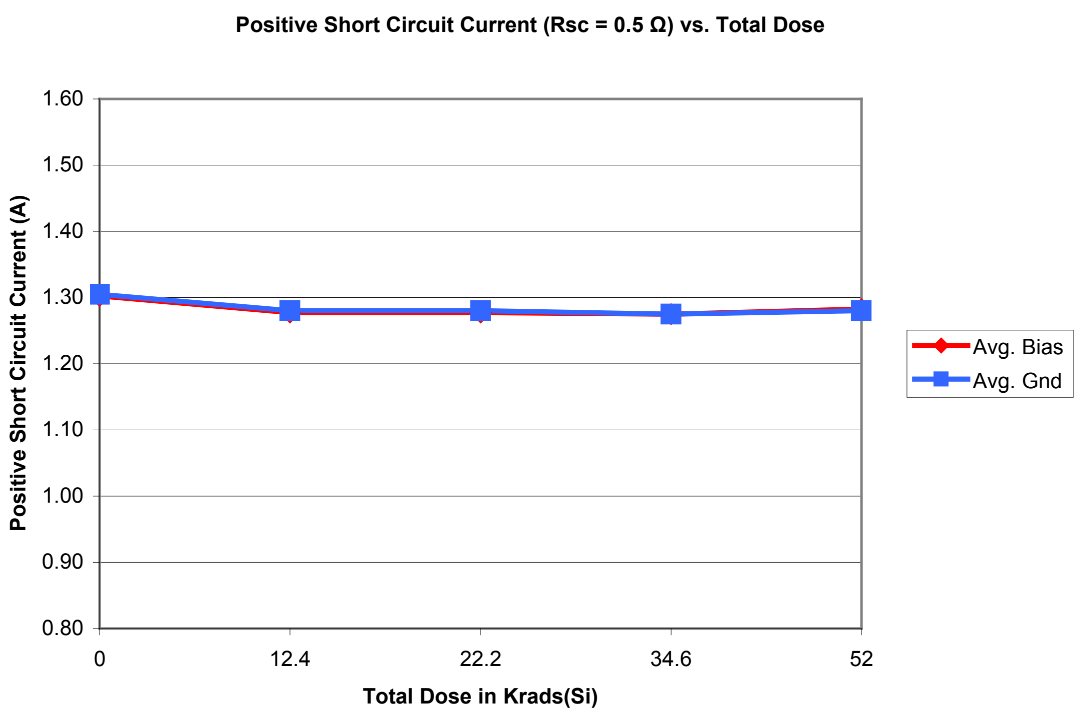

Negative Output Swing (RL = 100 Ω) vs. Total Dose
15.00
14.50
14.00
13.50
13.00
12.50
12.00
Negative Output Swing (V)
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

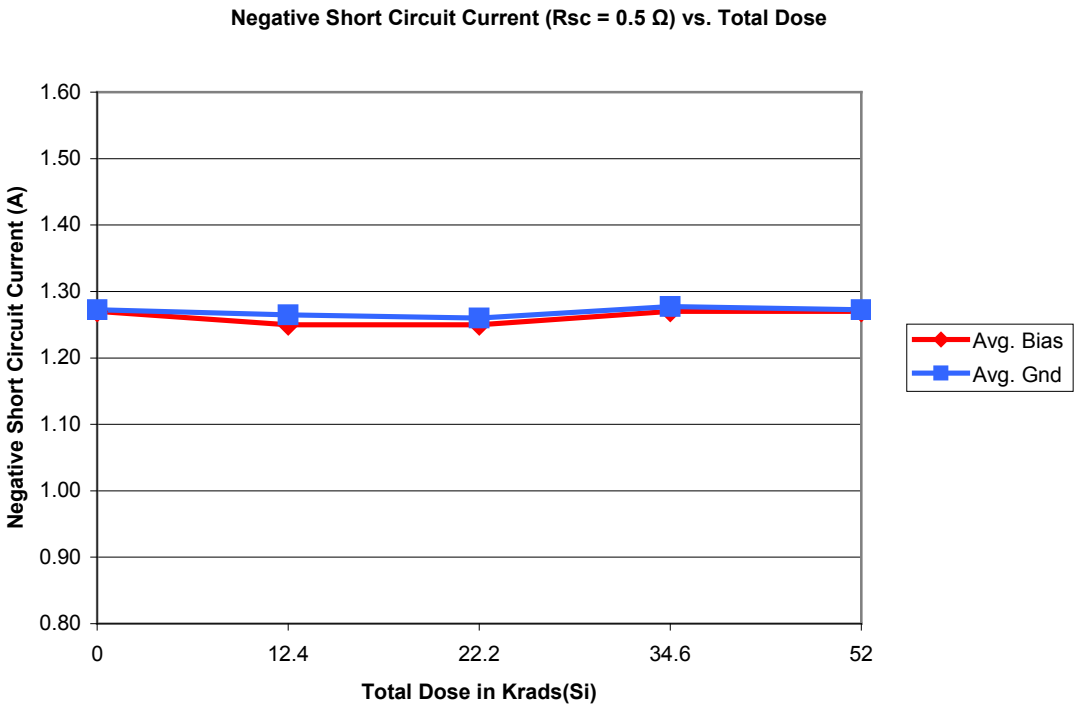

Positive Output Swing (RL =10 Ω) vs. Total Dose
15.00
14.50
14.00
13.50
13.00
12.50
12.00
Positive Output Swing (V)
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

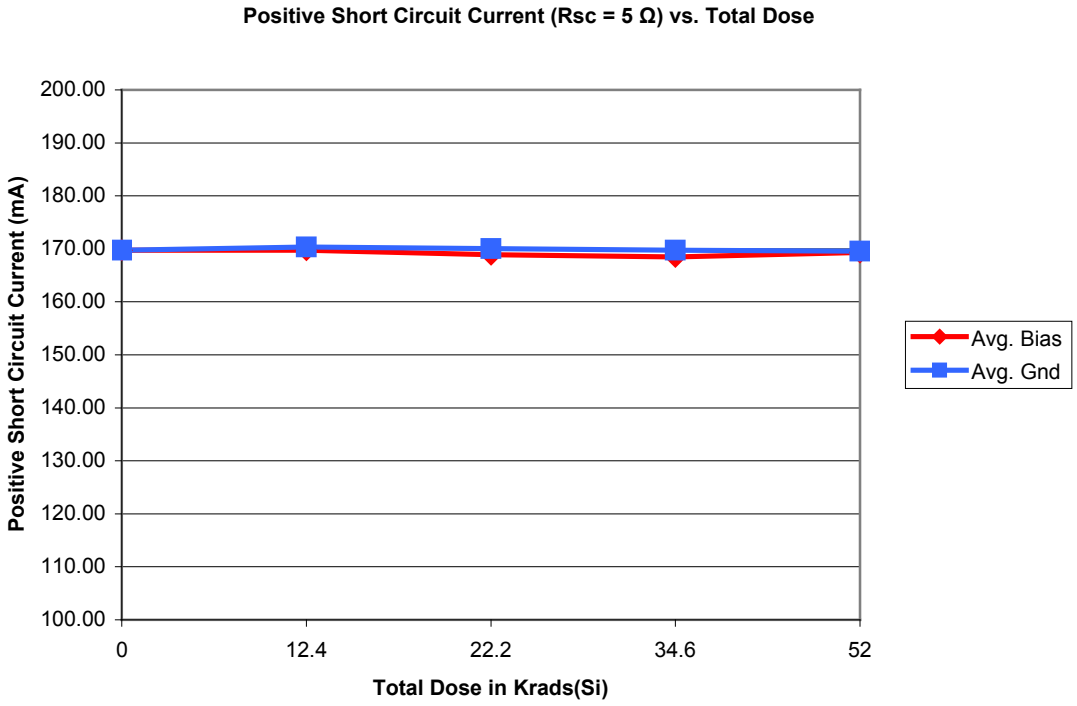

Negative Output Swing (RL = 10 Ω) vs. Total Dose
15.00
14.50
14.00
13.50
13.00
12.50
12.00
Negative Output Swing (V)
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

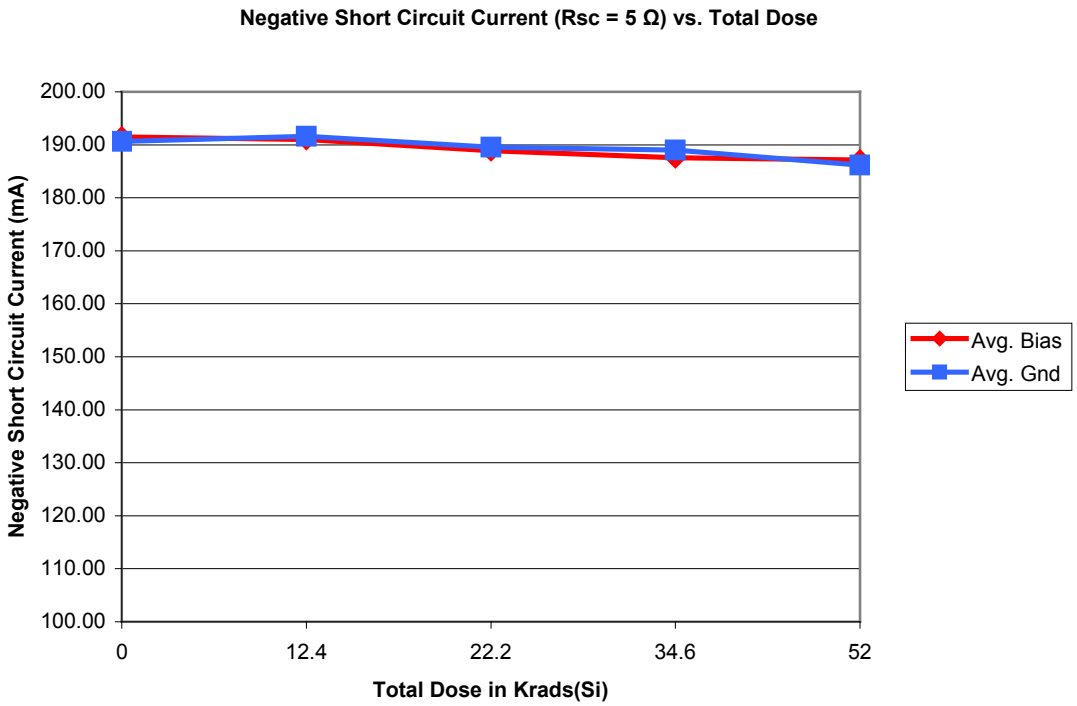

Positive Slew Rate vs. Total Dose
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Positive Slew Rate (V/µS)
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

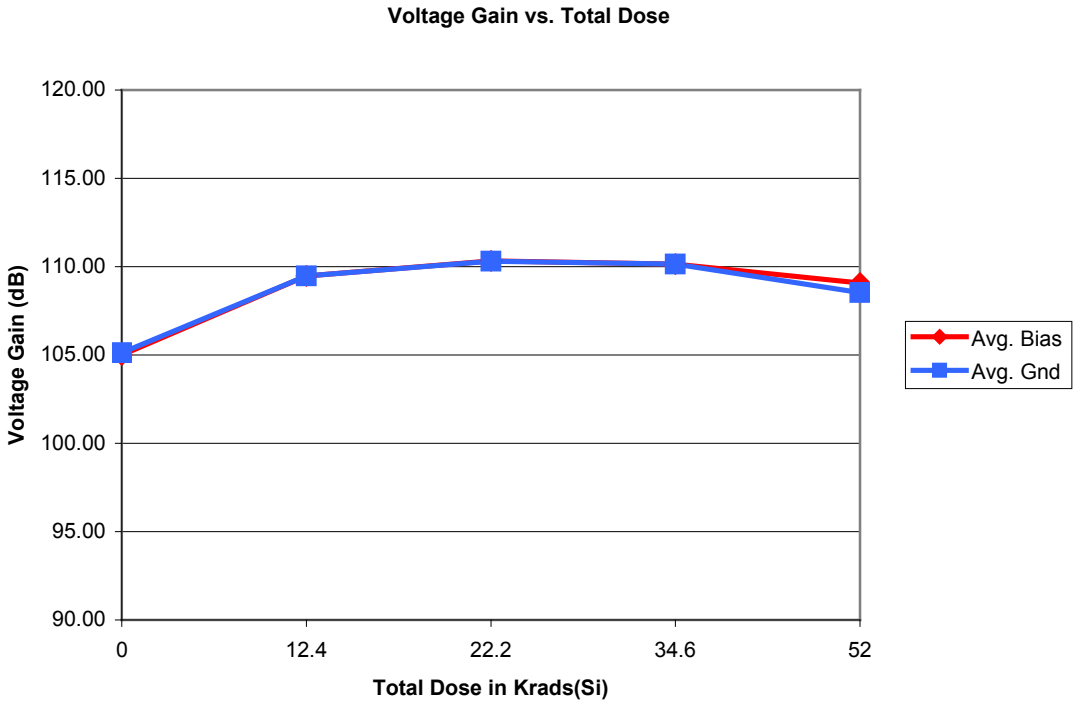

Negative Slew Rate vs. Total Dose
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Negative Slew Rate (V/µS)
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

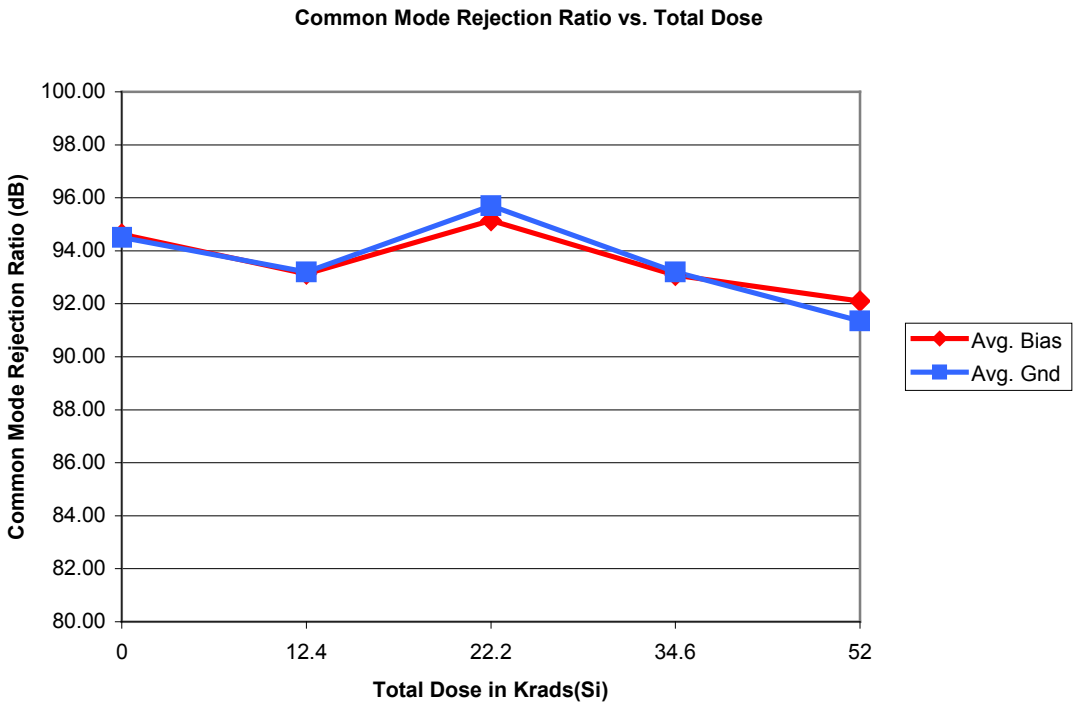

Positive Short Circuit Current (Rsc = 0.5 Ω) vs. Total Dose
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
Positive Short Circuit Current (A)
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

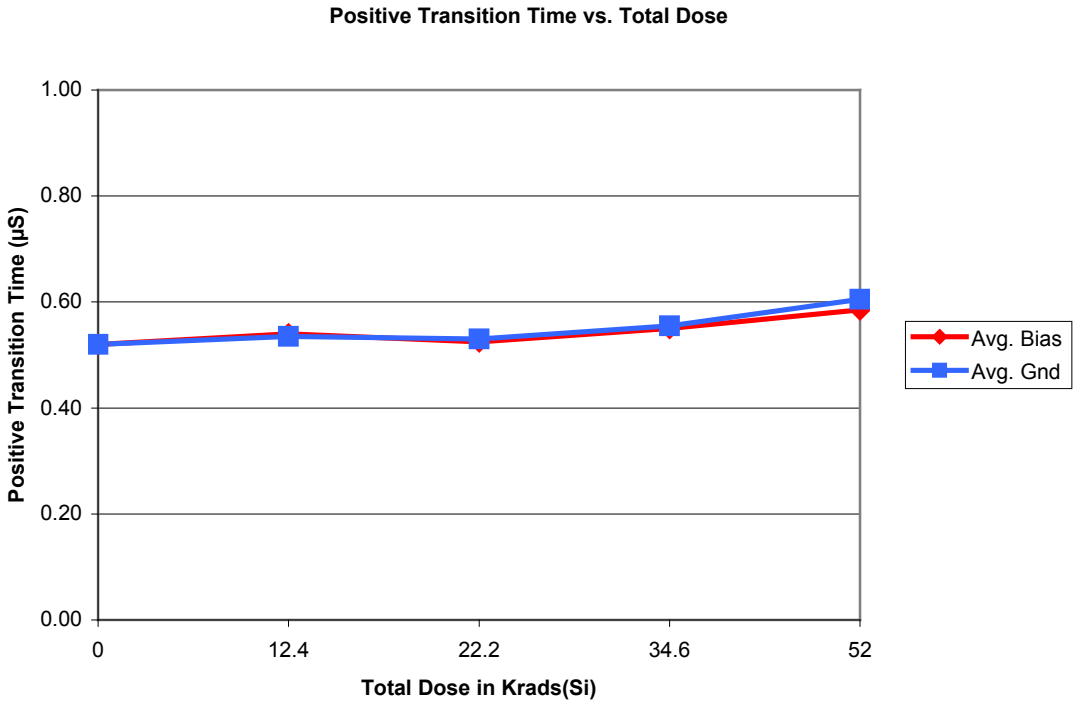

Negative Short Circuit Current (Rsc = 0.5 Ω) vs. Total Dose
Negative Short Circuit Current (A)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

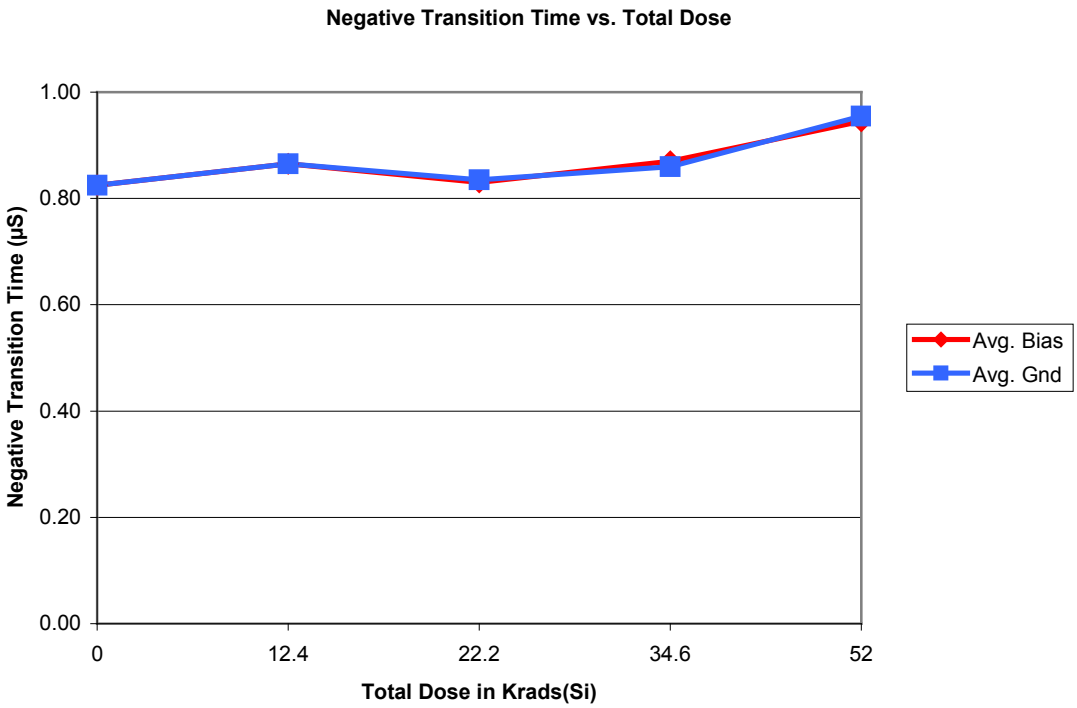

Positive Short Circuit Current (Rsc = 5 Ω) vs. Total Dose
Positive Short Circuit Current (mA)
200.00
190.00
180.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

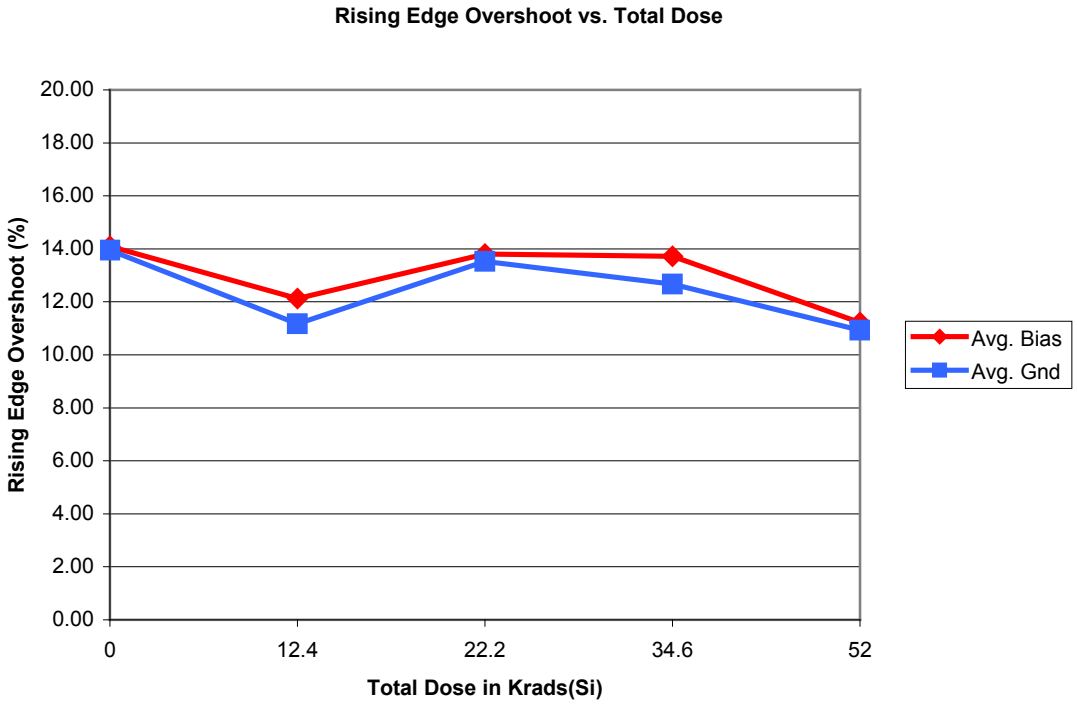

Negative Short Circuit Current (Rsc = 5 Ω) vs. Total Dose
Negative Short Circuit Current (mA)
200.00
190.00
180.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd

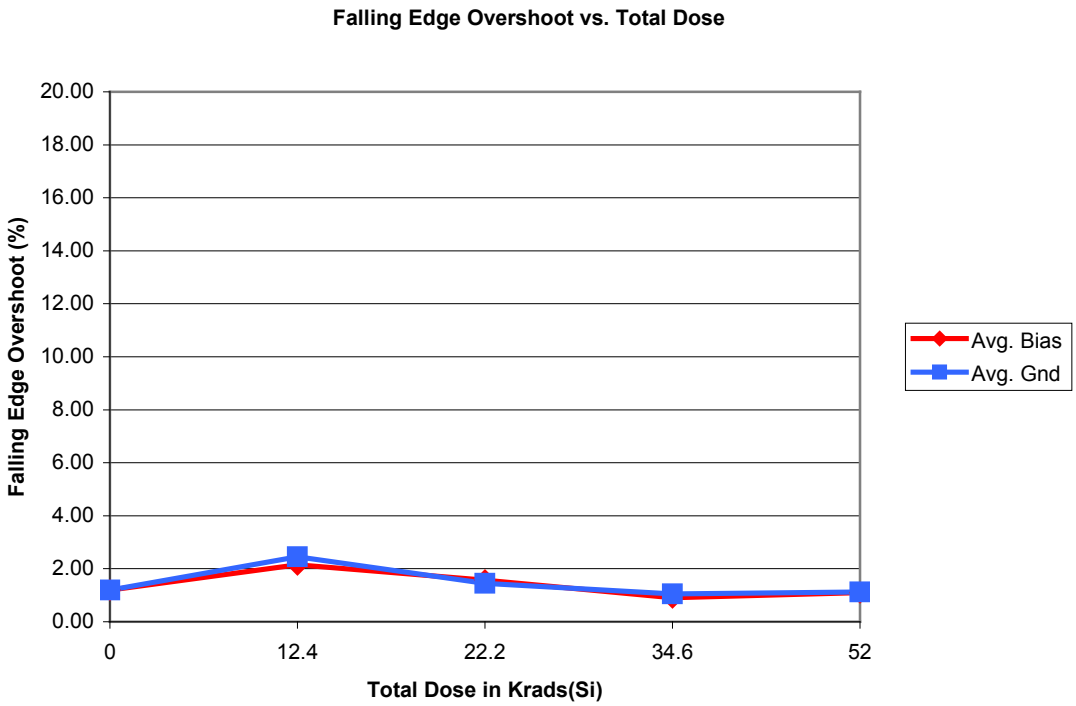

Voltage Gain vs. Total Dose
Voltage Gain (dB)
120.00
115.00
110.00
105.00
100.00
95.00
90.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd


Common Mode Rejection Ratio vs. Total Dose
Common Mode Rejection Ratio (dB)
100.00
98.00
96.00
94.00
92.00
90.00
88.00
86.00
84.00
82.00
80.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd


Positive Transition Time vs. Total Dose
Positive Transition Time (µS)
1.00
0.80
0.60
0.40
0.20
0.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd


Negative Transition Time vs. Total Dose
Negative Transition Time (µS)
1.00
0.80
0.60
0.40
0.20
0.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd


Rising Edge Overshoot vs. Total Dose
Rising Edge Overshoot (%)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd


Falling Edge Overshoot vs. Total Dose
Falling Edge Overshoot (%)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0
12.4
22.2
34.6
52
Total Dose in Krads(Si)
Avg. Bias
Avg. Gnd