Low Dose Rate Ionizing Radiation Test Report

MSK196RH,
MSK197RH,
(MSK496RH)
RAD Hard (QUAD) Precision Rail To Rail Current Sense Amplifier

April 11, 2014 (Low Dose Rate TID, WAFER LOT: WD005624.3 WF# 7)
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I. Introduction:

The Low Dose Rate ionizing radiation test for the MSK196RH was conducted in cooperation with Linear Technology Corporation to qualify the devices as RAD HARD to 50KRADS(Si), per MIL-STD-883 Method 1019.8 Condition D. The testing was performed beyond 50KRADS(Si) to show trends in device performance as a function of total dose. The over 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 MSK196RH, MSK 197RH and MSK496RH use the same active components. The data in this report is from direct measurement of the MSK196RH response to irradiation but it is indicative of the response of all devices and is applicable to all.

II. Radiation Source:

Sample irradiation was performed at the Defense Microelectronics Activity, Science and Engineering Gamma Irradiation Test Facility using a Co-60 source. The dose rate was determined to be ≤10 mRads(Si)/sec. The total dose schedule can be found in Table I.

III. Test Setup:

All devices received 240 hours of burn-in per MIL-STD-883 Method 1015 and were fully screened IAW MIL-PRF-38524 Class K or MIL-PRF-38535 Class V. All test samples were subjected to Group A Electrical Test in accordance with the device data sheet. For test platform verification, one control device was tested at 25°C. Fifteen devices were then tested at 25°C, prior to irradiation, and were found to be within acceptable test limits.

During irradiation; Five devices were biased at low side sense condition (VS+ = 0.1V) and a power supply rail of 36V. Five devices were biased at high side sense condition (VS+ = 36V) and a power supply rail of 36V. Five devices had all leads grounded during irradiation for the unbiased condition.

Electrical testing was performed on the irradiated devices, as well as the control device, at each total dose level. All post irradiation electrical test point procedures were conducted in accordance with the constraints imposed by MIL-STD-883 Method 1019.8 Condition D.

IV. Data:

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

V. Summary:

The acceptance criteria for each parameter is determined by post irradiation specification compliance of the statistical .99/90 one sided tolerance band. Based on the test data recorded during radiation testing, the MSK196RH, MSK197RH and MSK496RH qualify as a 50KRADS(Si) low dose rate radiation hardened devices. Voltage Gain Error and Input Offset voltage exhibited the most significant shift due to irradiation. PSRR test data exhibits convergence towards a much tighter distribution with dose, however at the different rates up to 25 KRADS(Si) . PSRR test data is likely skewed by the noise floor measurement system, thus acceptance is based on the 50KRADS(Si) statistical .99/90 tolerance band. All other parameters stayed within pre-irradiation specification up to 100KRADS(Si).

MSK 196RH Biased/Unbiased Low Dose Rate Schedule

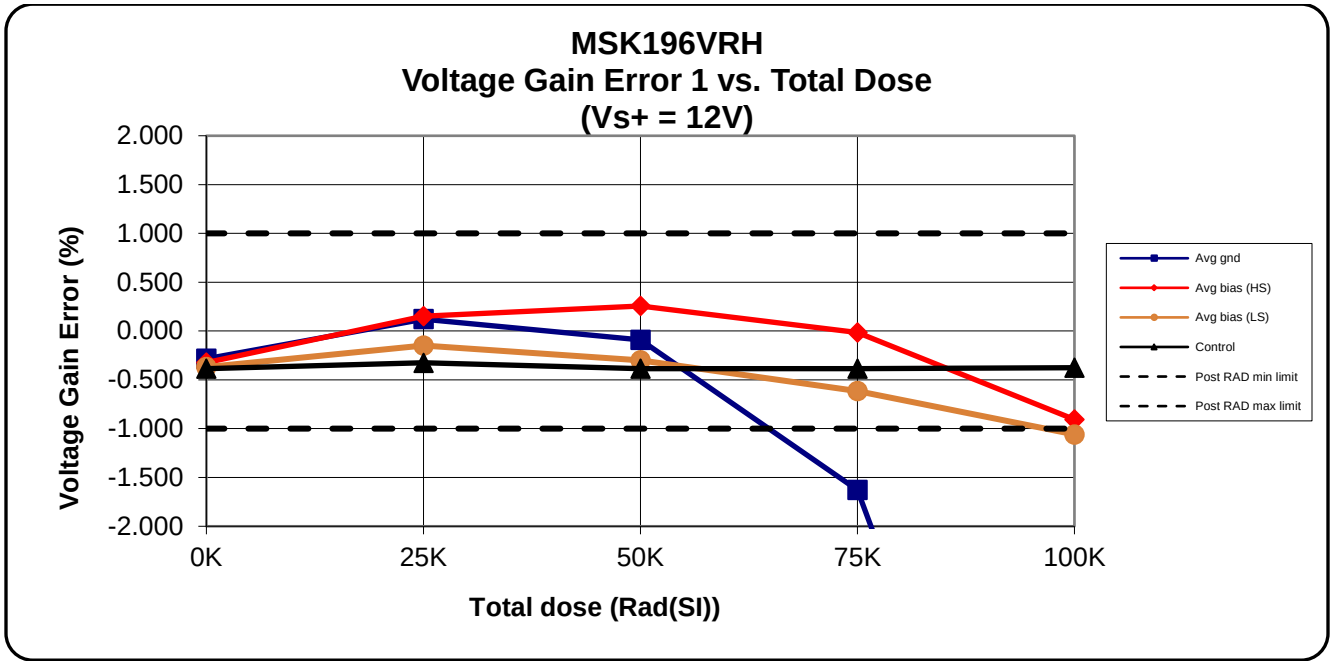
Dosimetry Equipment
Radcal Model No. 9010 Radiation Monitor
Radcal Model No. 90X5-.18 Electrometer/ Ion Chamber

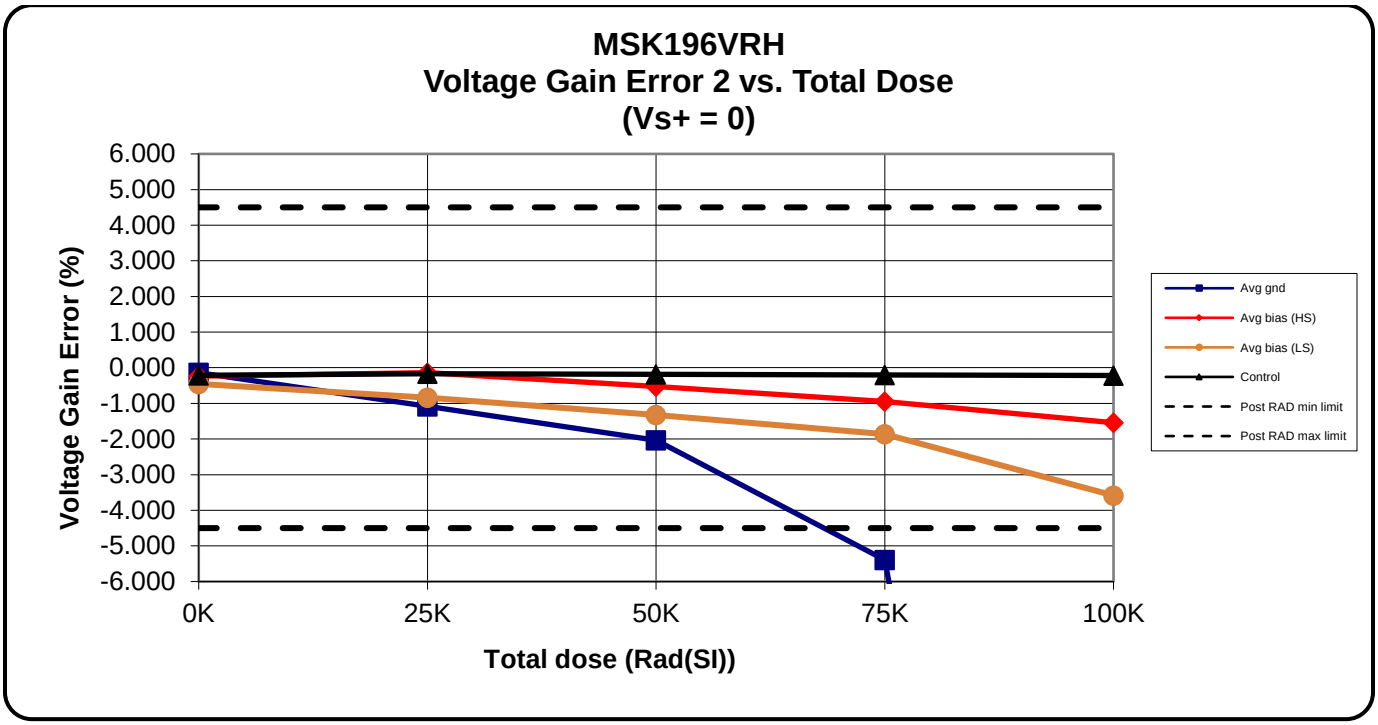
Incremental Dose Test Points rads(Si)	Cumulative Dose rads(Si)
25K	25K
25K	50K
25K	75K
25K	100K

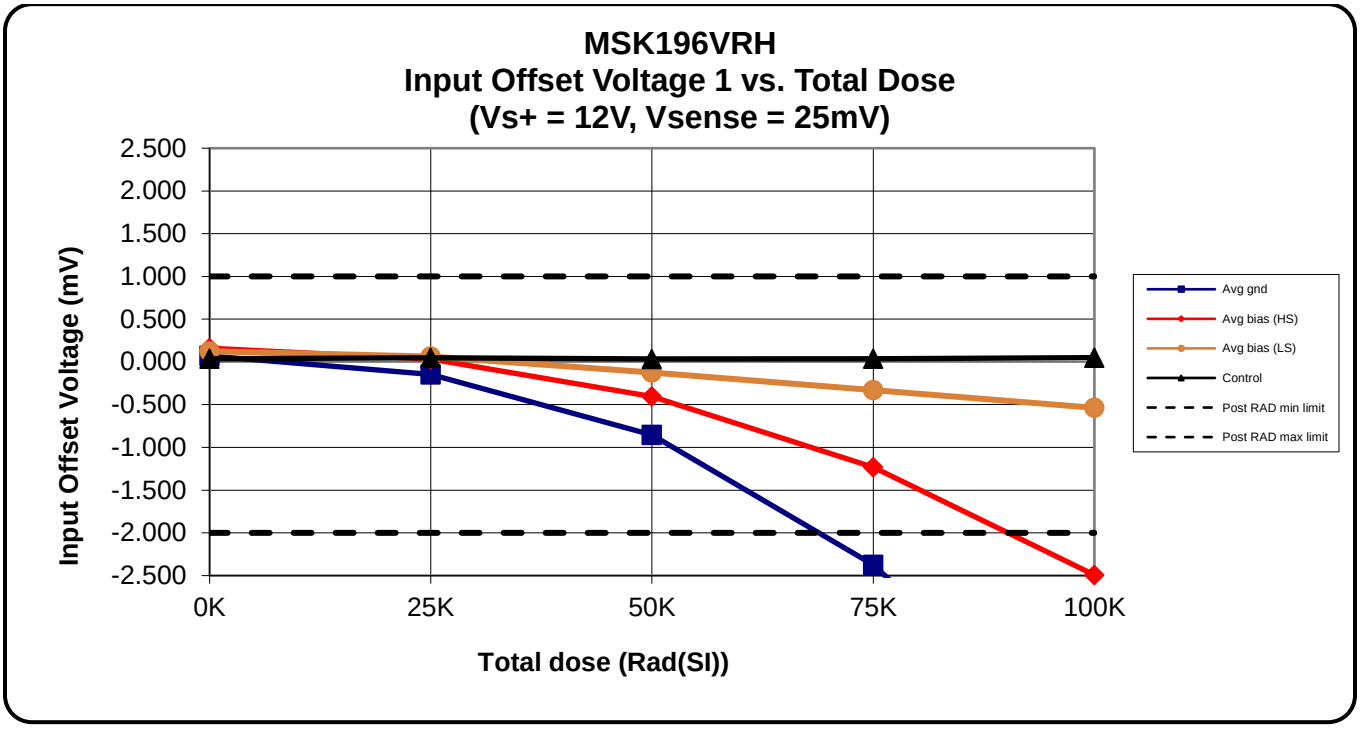
High Side Biased S/N – 0961, 0962, 0963, 0964, 0965
Low Side Biased S/N – 0956, 0957, 0958, 0959, 0960
Unbiased S/N – 0950, 951, 0952, 0953, 0954

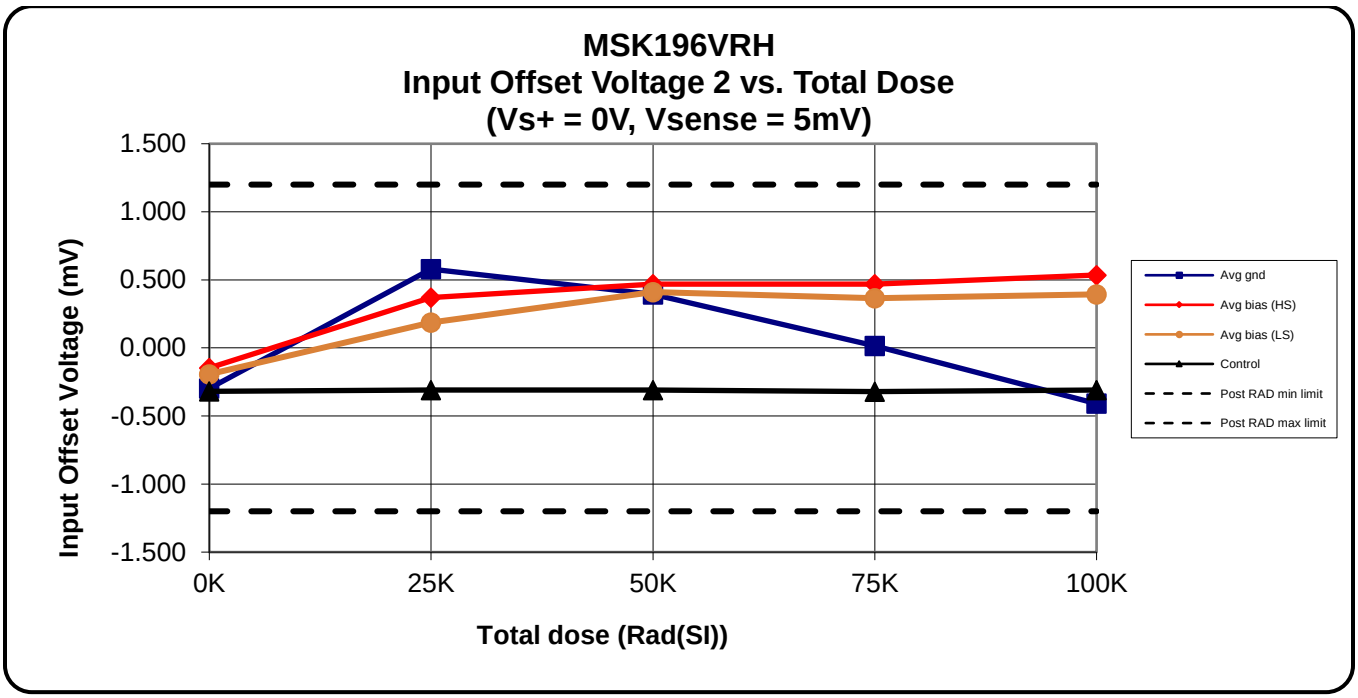
Table 1

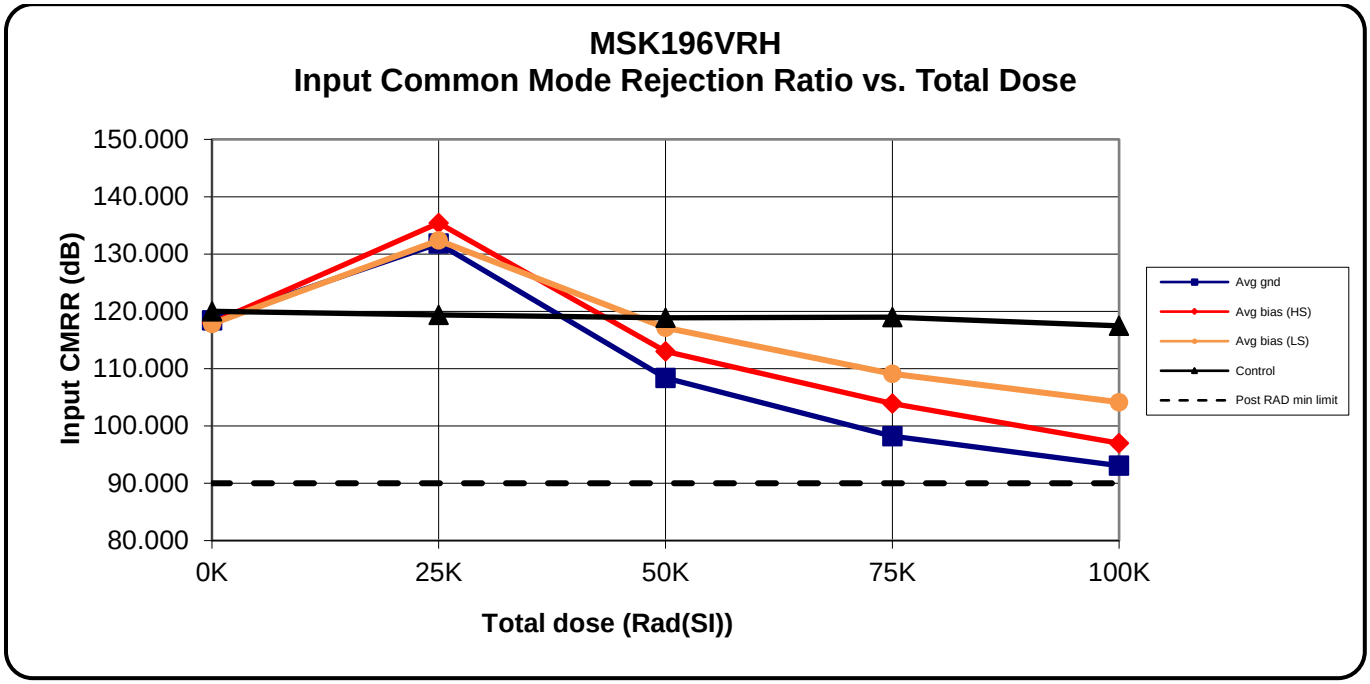
Dose Time, Incremental Dose and Total Cumulative Dose

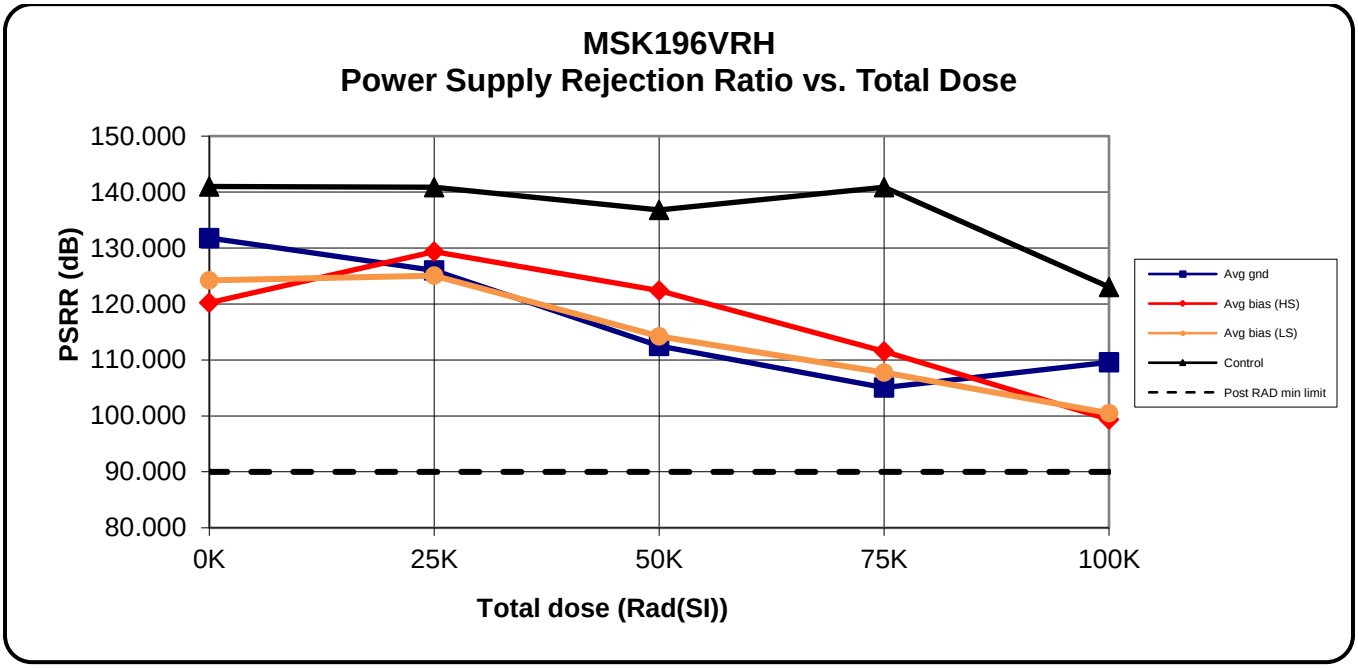

MSK196VRH
Voltage Gain Error 1 vs. Total Dose
(Vs+ = 12V)
Voltage Gain Error (%)
2.000
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
-2.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD min limit
Post RAD max limit

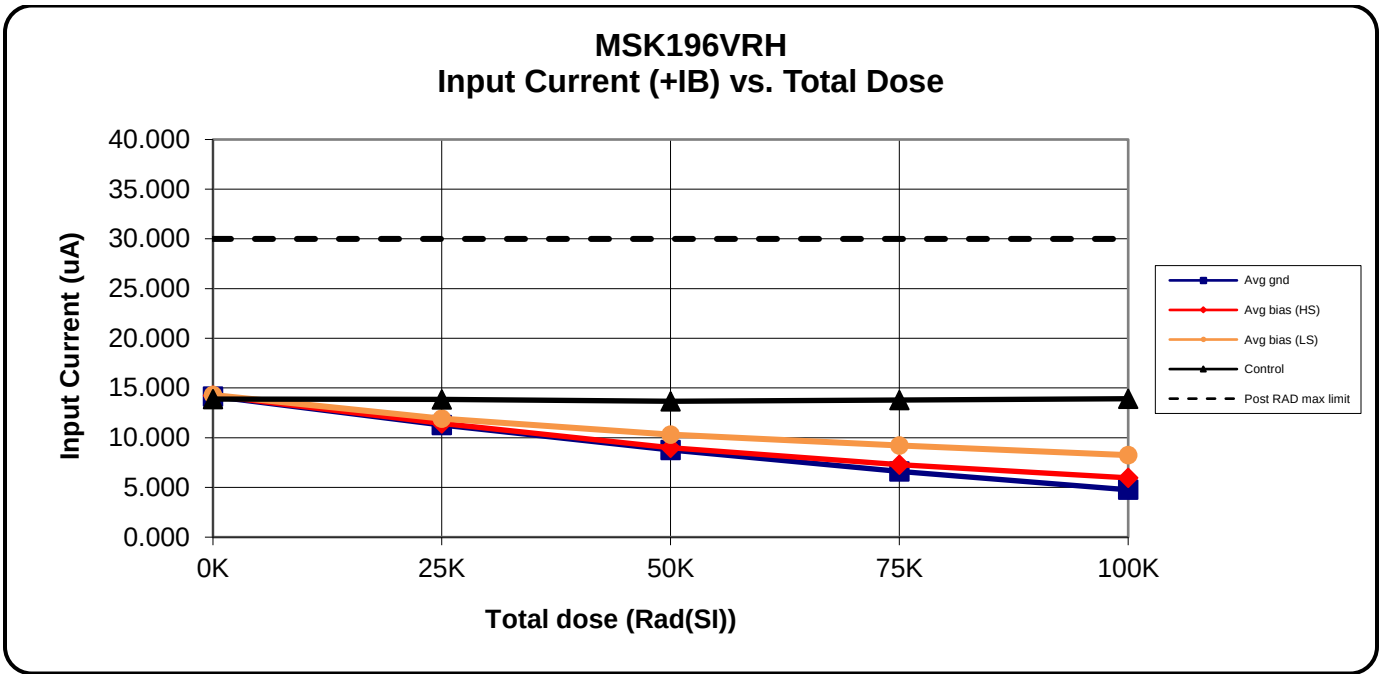

MSK196VRH
Voltage Gain Error 2 vs. Total Dose
(Vs+ = 0)
Voltage Gain Error (%)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
-1.000
-2.000
-3.000
-4.000
-5.000
-6.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD min limit
Post RAD max limit

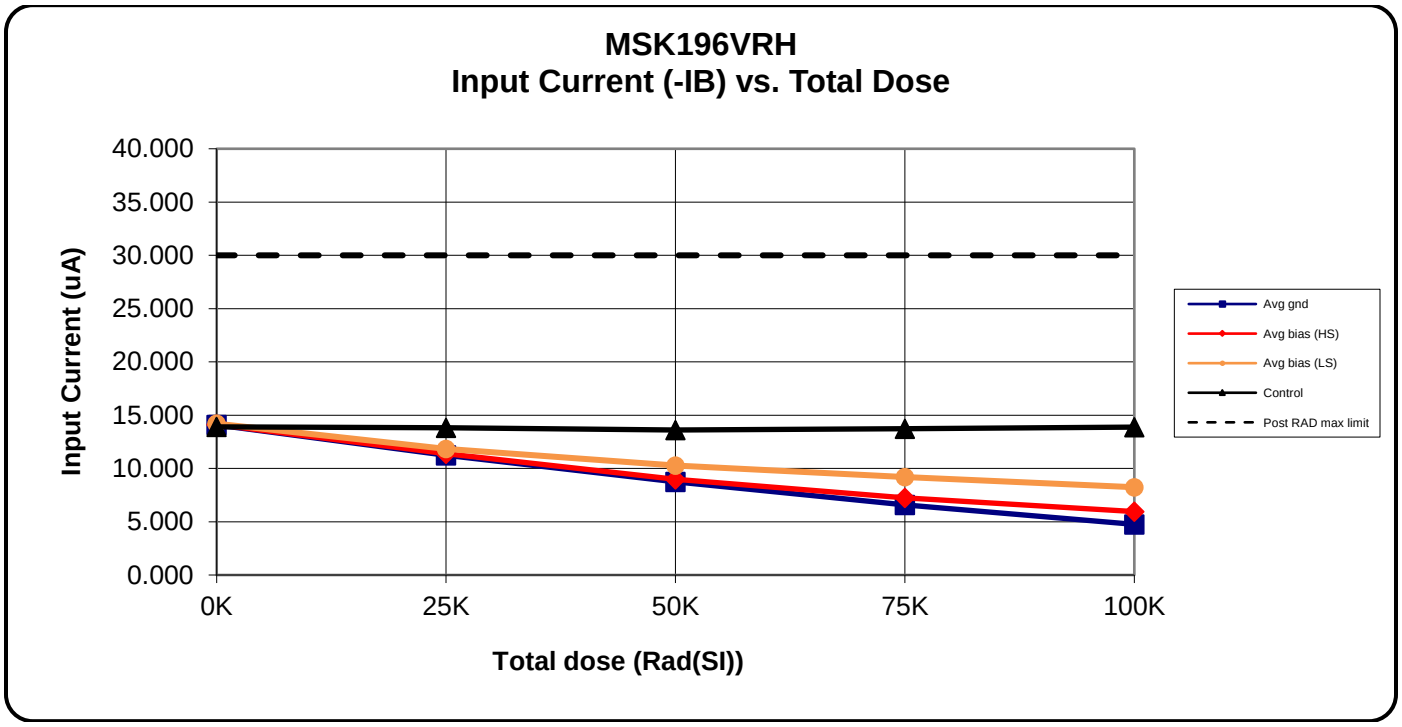

MSK196VRH
Input Offset Voltage 1 vs. Total Dose
(Vs+ = 12V, Vsense = 25mV)
Input Offset Voltage (mV)
2.500
2.000
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
-2.000
-2.500
0K
25K
50K
75K
100K
Total dose (Rad(Si))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD min limit
Post RAD max limit

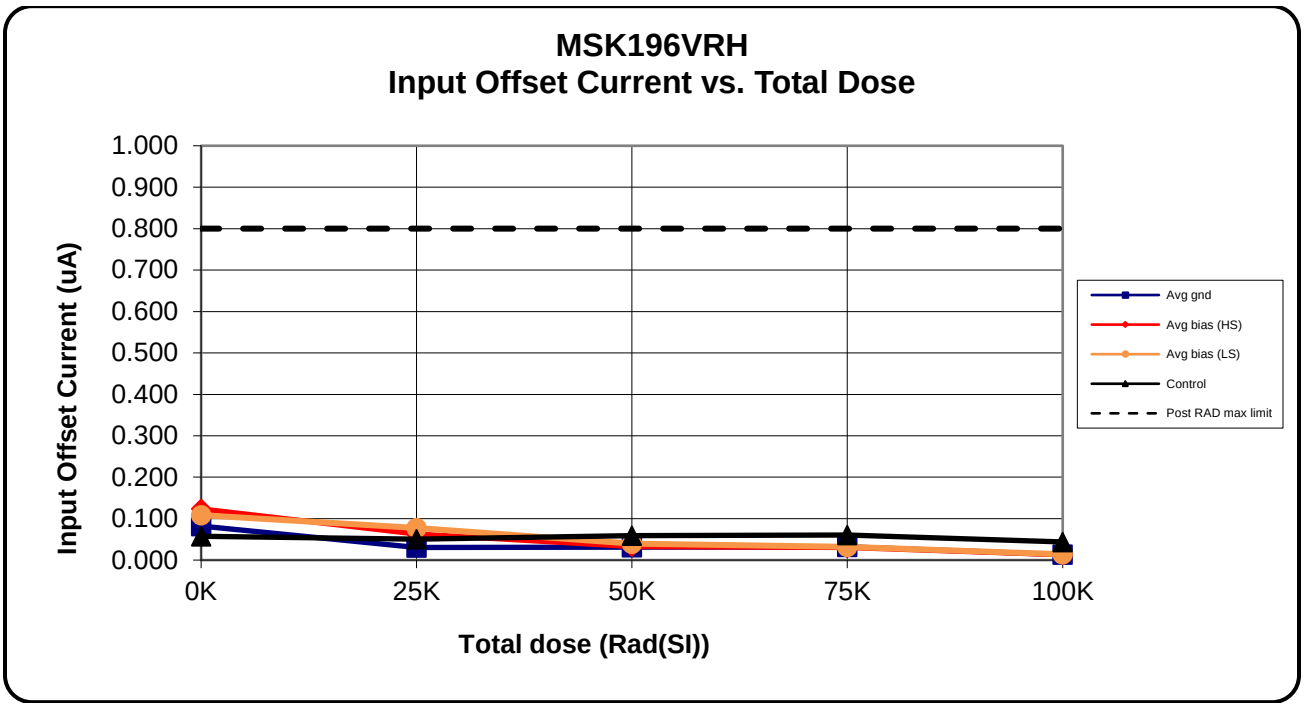

MSK196VRH
Input Offset Voltage 2 vs. Total Dose
(Vs+ = 0V, Vsense = 5mV)
Input Offset Voltage (mV)
1.500
1.000
0.500
0.000
-0.500
-1.000
-1.500
0K
25K
50K
75K
100K
Total dose (Rad(Si))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD min limit
Post RAD max limit

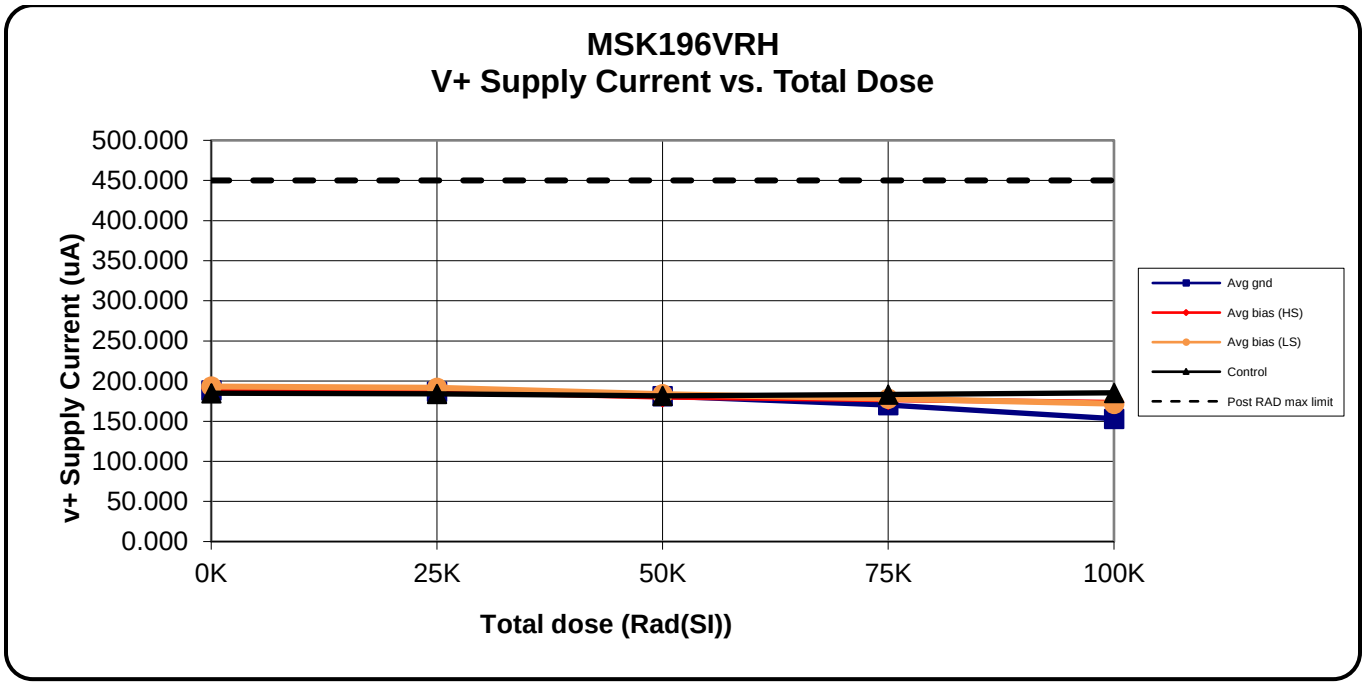

MSK196VRH
Input Common Mode Rejection Ratio vs. Total Dose
Input CMRR (dB)
150.000
140.000
130.000
120.000
110.000
100.000
90.000
80.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD min limit

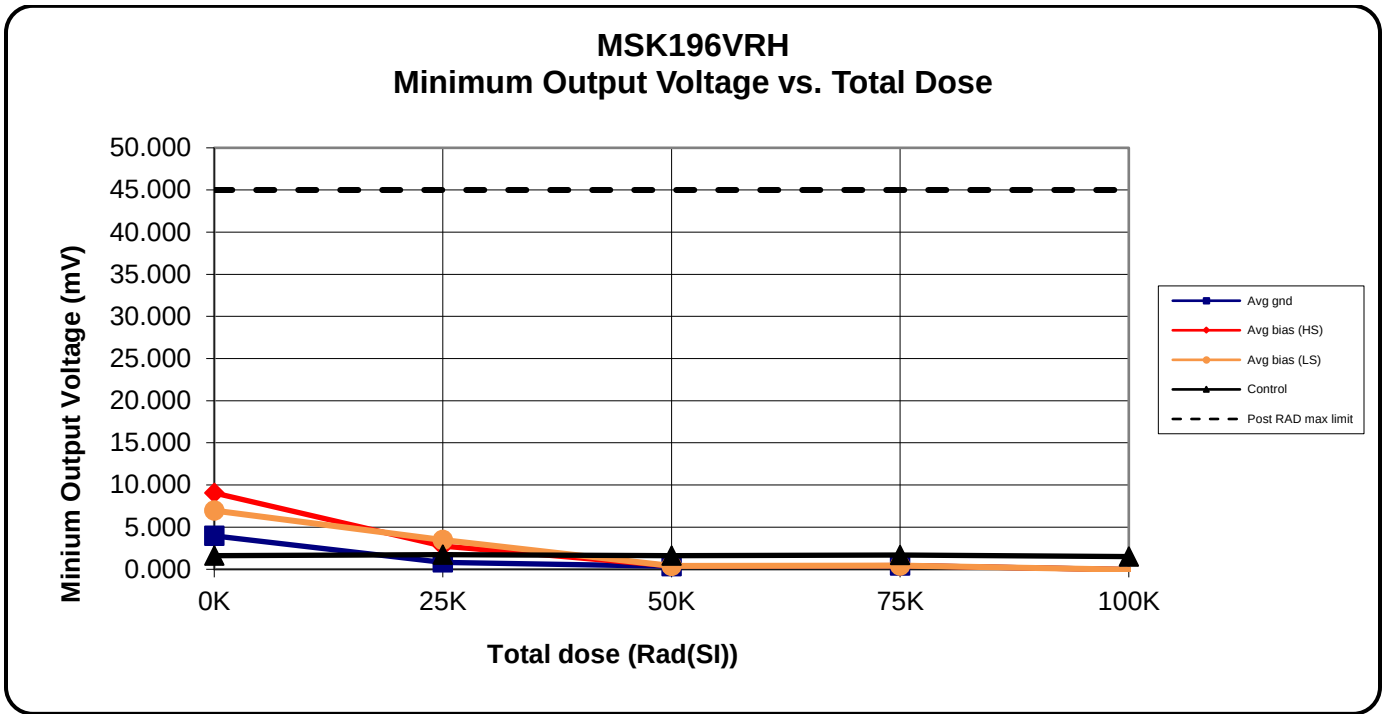

MSK196VRH
Power Supply Rejection Ratio vs. Total Dose
PSRR (dB)
150.000
140.000
130.000
120.000
110.000
100.000
90.000
80.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD min limit

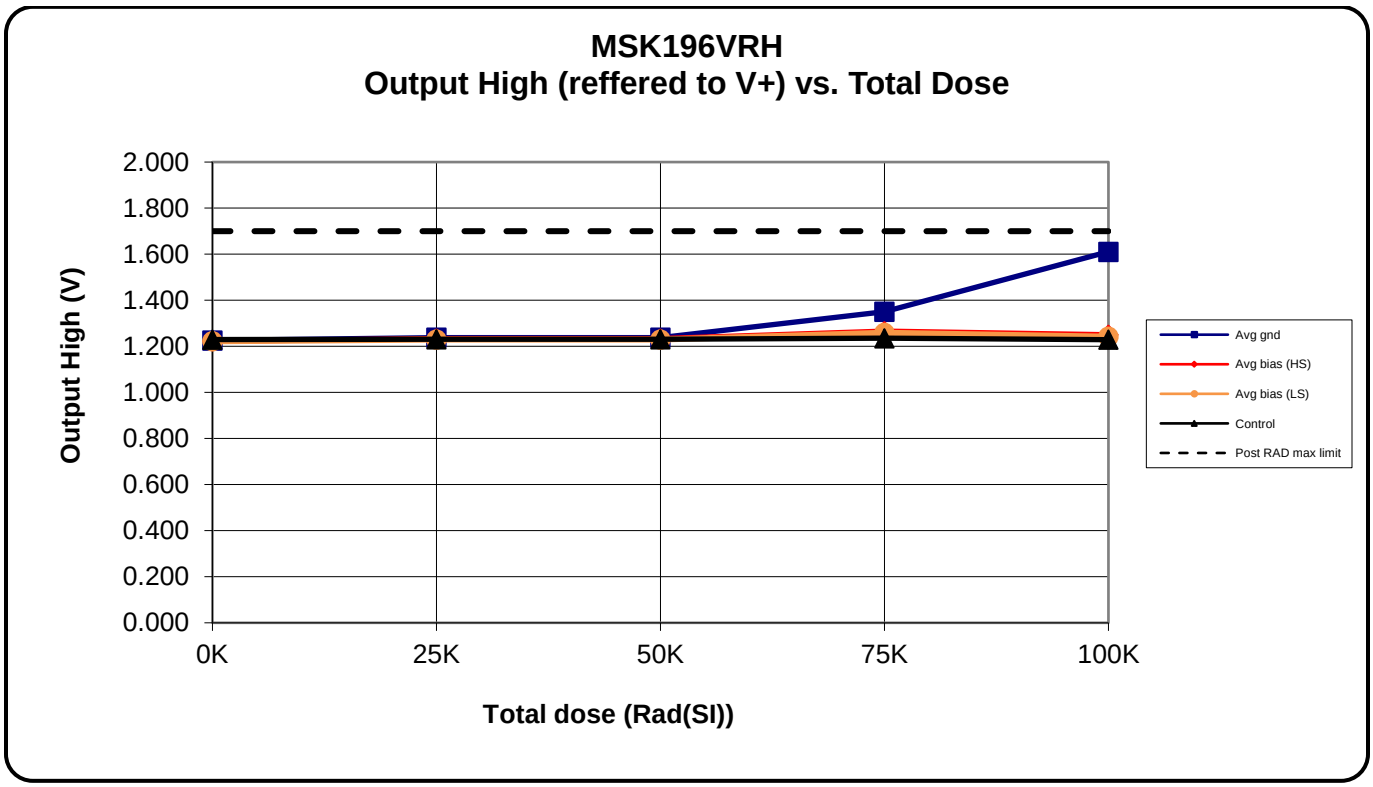

MSK196VRH
Input Current (+IB) vs. Total Dose
Input Current (uA)
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD max limit


MSK196VRH
Input Current (-IB) vs. Total Dose
Input Current (uA)
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD max limit


MSK196VRH
Input Offset Current vs. Total Dose
Input Offset Current (uA)
1.000
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD max limit


MSK196VRH
V+ Supply Current vs. Total Dose
v+ Supply Current (uA)
500.000
450.000
400.000
350.000
300.000
250.000
200.000
150.000
100.000
50.000
0.000
0K
25K
50K
75K
100K
Total dose (Rad(SI))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD max limit


MSK196VRH
Minimum Output Voltage vs. Total Dose
Minium Output Voltage (mV)
50.000
45.000
40.000
35.000
30.000
25.000
20.000
15.000
10.000
5.000
0.000
0K
25K
50K
75K
100K
Total dose (Rad(Si))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD max limit


MSK196VRH
Output High (reffered to V+) vs. Total Dose
Output High (V)
2.000
1.800
1.600
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
0K
25K
50K
75K
100K
Total dose (Rad(Si))
Avg gnd
Avg bias (HS)
Avg bias (LS)
Control
Post RAD max limit