Radiation Assured Devices
5017 N. 30th Street
Colorado Springs, CO 80919
(719) 531-0800

# *Radiation Lot Acceptance Testing (RLAT) of the RH1078MW Dual Precision Op Amp for Linear Technology*

**Customer:** Linear Technology, PO# 53274L

**RAD Job Number:** 09-300

**Part Type Tested:** Linear Technology RH1078MW Dual Precision Operational Amplifier

**Commercial Part Number:** RH1078MW

**Traceability Information:** Lot Date Code: 0808B, Fab # WP1630.2 Wafer 8, Assy Lot A21527.1. Information obtained from Linear Technology PO#53274L. See Appendix A for a photograph of the unit-under-test

**Quantity of Units:** 12 units total, 5 units for biased irradiation, 5 units for unbiased irradiation (all pins tied to ground) and 2 control units. Serial numbers 408-412 were biased during irradiation, serial numbers 413-415, 418 and 419 were unbiased during irradiation and serial numbers 420 and 421 were used as the controls. See Appendix B for the radiation bias connection table.

**External Traveler:** None required

**Pre-Irradiation Burn-In:** Burn-In performed by Linear Devices prior to receipt by RAD.

**TID Dose Rate and Test Increments:** 50-300rad(Si)/s with readings at pre-irradiation, 20, 50, 100, and 200krad(Si).

**TID Overtest and Post-Irradiation Anneal:** No overtest or anneal.

**TID Test Standard:** MIL-STD-883G, Method 1019.7, Condition A

**TID Electrical Test Conditions:** Pre-irradiation, and within one hour following each radiation exposure.

**Test Hardware and Software:** LTS2020 Tester (TS03), 2101 Family Board (FB02), 0600 Fixture (TF01) and RH1078 DUT Board (BGSS-080820) and RH1078LT.SRC test program.

**Facility and Radiation Source:** Radiation Assured Devices Longmire Laboratories, Colorado Springs, CO using the JLSA 81-24 high dose rate Co60 source. Dosimetry performed by CaF TLDs traceable to NIST. RAD's dosimetry has been audited by DSCC and RAD has been awarded Laboratory Suitability for MIL-STD-750 TM 1019.5.

**Irradiation and Test Temperature:** Room temperature for irradiation and test controlled to 24°C±6°C per MIL-STD-883.

## RLAT Result: PASSED. Units passed to 200krad(Si) for the ±15V supply condition and to 100krad(Si) for the single sided 5V supply condition with all parameters remaining within specification, including after application of 90/90 KTL statistics.

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### *1.0. Overview and Background*

It is well known that total dose ionizing radiation can cause parametric degradation and ultimately functional failure in electronic devices. The damage occurs via electron-hole pair production, transport and trapping in the dielectric and interface regions. In discrete devices the bulk of the damage is frequently manifested as a reduction in the gain and/or breakdown voltage of the device. The damage will usually anneal with time following the end of the radiation exposure. Due to this annealing, and to ensure a worst-case test condition MIL-STD-883 TM1019.7 calls out a dose rate of 50 to 300rad(Si)/s as Condition A and further specifies that the time from the end of an incremental radiation exposure and electrical testing shall be 1-hour or less and the total time from the end of one incremental irradiation to the beginning of the next incremental radiation step should be 2-hours or less. The work described in this report was performed to meet MIL-STD-883 TM1019.7 Condition A.

### *2.0. Radiation Test Apparatus*

The total ionizing dose testing described in this final report was performed using the facilities at Radiation Assured Devices' Longmire Laboratories in Colorado Springs, CO. The high dose rate total ionizing dose (TID) source is a JLSA 84-21 irradiator modified to provide a panoramic exposure. The Co-60 rods are held in the base of the irradiator heavily shielded by lead, during the radiation exposures the rod is raised by an electronic timer/controller and the exposure is performed in air. The dose rate for this irradiator in this configuration ranges from <1rad(Si)/s to a maximum of approximately 120rad(Si)/s, determined by the distance from the source. For high-dose rate experiments the bias boards are placed in a radial fashion equidistant from the raised Co-60 rods with the distance adjusted to provide the required dose rate. The irradiator calibration is maintained by Radiation Assured Devices Longmire Laboratories using thermoluminescent dosimeters (TLDs)) traceable to the National Institute of Standards and Technology (NIST). Figure 2.1 shows a photograph of the JLSA 81-24 Co-60 irradiator at RAD's Longmire Laboratory facility.

RAD is currently certified by the Defense Supply Center Columbus (DSCC) for Laboratory Suitability under MIL STD 750. Additional details regarding Radiation Assured Devices dosimetry for TM1019 Condition A testing are available in RAD's report to DSCC entitled: "Dose Rate Mapping of the J.L. Shepherd and Associates Model 81 Irradiator Installed by Radiation Assured Devices"

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Figure 2.1. Radiation Assured Devices' high dose rate Co-60 irradiator. The dose rate is obtained by positioning the device-under-test at a fixed distance from the gamma cell. The dose rate for this irradiator varies from approximately 120rad(Si)/s close to the rods down to 1rad(Si)/s at a distance of approximately 2-feet.

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### *3.0. Radiation Test Conditions*

The RH1078MW dual precision op amps described in this final report were irradiated using a split 15V supply and with all pins tied to ground, that is biased and unbiased. See the TID Bias Table in Appendix B for the full bias circuits. These bias circuits satisfy the requirements of MIL-STD-883G TM1019.7 Section 3.9.3 Bias and Loading Conditions which states "The bias applied to the test devices shall be selected to produce the greatest radiation induced damage or the worst-case damage for the intended application, if known. While maximum voltage is often worst case some bipolar linear device parameters (e.g. input bias current or maximum output load current) exhibit more degradation with 0 V bias."

The devices were irradiated to a maximum total ionizing dose level of 200krad(Si) with incremental readings at 20, 50, 100 and 200krad(Si) for all electrical tests using the ±15V supply and with incremental readings at 20, 50 and 100krad(Si) for all electrical tests using the +5V and 0V supply conditions (See LINEAR TECHNOLOGY CORPORATION RH1078M Dual Precision Operational Amplifier Datasheet). Note that although we tested this device to 100krad(Si) using the +5V supply condition and the units-under-test passed to 100krad(Si) it is only guaranteed by the manufacturer to 75krad(Si).

Electrical testing occurred within one hour following the end of each irradiation segment. For intermediate irradiations, the parts were tested and returned to total dose exposure within two hours from the end of the previous radiation increment.

The TID bias board was positioned in the Co-60 cell to provide the required minimum of 50rad(Si)/s and was located inside a lead-aluminum enclosure. The lead-aluminum enclosure is required under MIL-STD-883G TM1019.7 Section 3.4 that reads as follows: "Lead/Aluminum (Pb/Al) container. Test specimens shall be enclosed in a Pb/Al container to minimize dose enhancement effects caused by low-energy, scattered radiation. A minimum of 1.5 mm Pb, surrounding an inner shield of at least 0.7 mm Al, is required. This Pb/Al container produces an approximate charged particle equilibrium for Si and for TLDs such as CaF2. The radiation field intensity shall be measured inside the Pb/Al container (1) initially, (2) when the source is changed, or (3) when the orientation or configuration of the source, container, or test-fixture is changed. This measurement shall be performed by placing a dosimeter (e.g., a TLD) in the device-irradiation container at the approximate test-device position. If it can be demonstrated that low energy scattered radiation is small enough that it will not cause dosimetry errors due to dose enhancement, the Pb/Al container may be omitted".

The final dose rate within the lead-aluminum enclosure was determined based on TLD dosimetry measurements (see previous section). The final dose rate for this work was 62.6rad(Si)/s with a precision of ±5%.

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### *4.0. Tested Parameters*

During the radiation lot acceptance testing the pre- and post-irradiation electrical parameters measured were:

**±15V Tests**
Positive Supply Current (ICC2)
Negative Supply Current (IEE2)
Input Offset Voltage (VOS3 &VOS4)
Input Offset Current (IOS3 & IOS4)
+ Input Bias Current (IB+3 & IB+4)
- Input Bias Current (IB-3 & IB-4)
Common Mode Rejection Ratio (CMRR3 & CMRR4)
Power Supply Rejection Ratio (PSRR3 & PSRR4)
Large Signal Voltage Gain (AVOL 5 &AVOL6)
Large Signal Voltage Gain (AVOL 7 &AVOL8)
VOUT High (VOUTHIGH5 & VOUTHIGH6)
VOUT High (VOUTHIGH7 & VOUTHIGH8)
VOUT Low (VOUTLOW7 & VOUTLOW8)
VOUT Low (VOUTLOW9 & VOUTLOW10)
+SR (Slew Rate 5 and Slew Rate 6)
-SR (Slew Rate 7 and Slew Rate 8)

**+5V Tests**
Positive Supply Current (ICC2)
Negative Supply Current (IEE2)
Input Offset Voltage (VOS1 &VOS2)
Input Offset Current (IOS1 & IOS2)
+ Input Bias Current (IB+1 & IB+2)
- Input Bias Current (IB-1 & IB-2)
Common Mode Rejection Ratio (CMRR1 & CMRR2)
Power Supply Rejection Ratio (PSRR1 & PSRR2)
Large Signal Voltage Gain (AVOL 1 &AVOL2)
Large Signal Voltage Gain (AVOL3 &AVOL4)
VOUT Low (VOUTLOW1 & VOUTLOW2)
VOUT Low (VOUTLOW3 & VOUTLOW4)
VOUT Low (VOUTLOW5 & VOUTLOW6)
VOUT High (VOUTHIGH1 & VOUTHIGH2)
VOUT High (VOUTHIGH3 & VOUTHIGH4)
+SR (Slew Rate 1 and Slew Rate 2)
-SR (Slew Rate 3 and Slew Rate 4)

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The parametric data was obtained as read and record and all the raw data plus an attributes summary are contained in a separate Excel file. The attributes data contains the average, standard deviation and the average with the KTL values applied. The KTL value used is 2.742 per MIL HDBK 814 using one sided tolerance limits of 90/90 and a 5-piece sample size. Note that the following criteria must be met for a device to pass the RLAT: following the radiation exposure each of the 5 pieces shall pass the specification value and the average value for the ten-piece sample must pass the specification value when the KTL limits are applied. If either of these conditions is not satisfied following the radiation exposure, then the lot could be logged as a failure.

### *5.0. Total Ionizing Dose Test Results*

The RH1078MW operational amplifiers passed the RLAT to the maximum tested level of 200krad(Si) (for the ±15V supply conditions) and 100krad(Si) (for the +5V and 0V supply conditions) with all measured parameters remaining within specification, including after application of the KTL statistics. The following exception should be noted, the input offset voltage for the 5V supply condition was out of specification intermittently after application of the KTL statistics due to a combination of an aggressive specification value and relative large distribution of the sample population. The input offset voltage was within specification at the 100krad(Si) read point.

Figures 5.1 and 5.62 show plots of all the measured parameters versus total ionizing dose while Tables 5.1 – 5.62 show the corresponding raw data for each of these parameters. Appendix D lists all the figures in this section to aid in locating a particular parameter. As seen in the data tables the control units, as expected, show no significant changes throughout the test indicating that our electrical testing remained stable throughout the testing.

In the data plots the solid diamonds are the average of the measured data points for the sample irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the units irradiated with all pins tied to ground. The black lines (solid or dashed) are the average of the data points after application of the KTL statistics on the sample irradiated in the biased condition while the shaded lines (solid or dashed) are the average of the data points after application of the KTL statistics on the sample irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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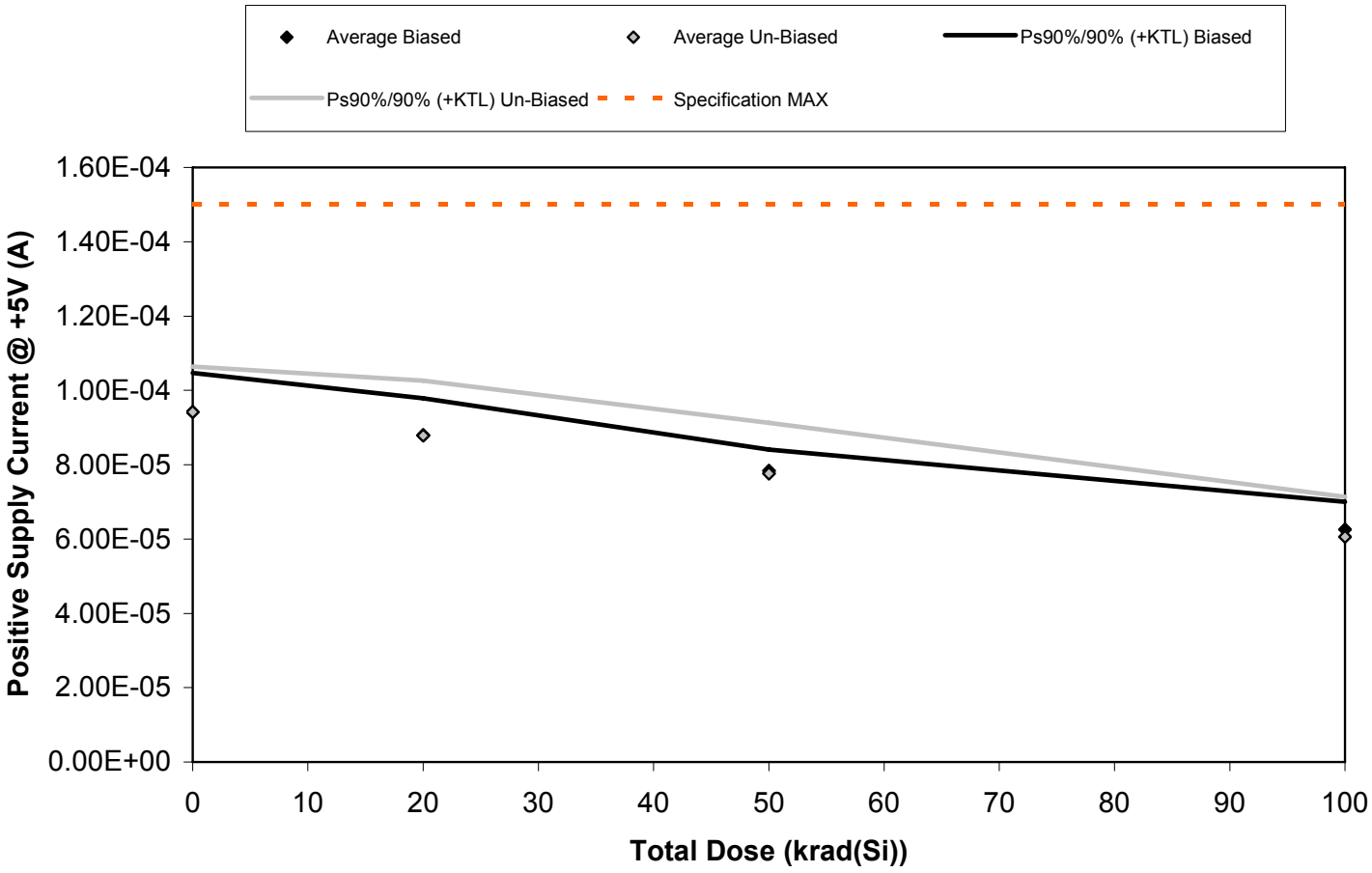


Figure 5.1. Plot of Positive Supply Current @ +5V (A) versus total dose. The data show no significant change (or slight improvement) with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.1. Raw data for Positive Supply Current @ +5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Supply Current @ +5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 9.40E-05 | 8.80E-05 | 7.80E-05 | 6.50E-05 |
| 409 | 9.10E-05 | 8.70E-05 | 7.70E-05 | 6.30E-05 |
| 410 | 9.90E-05 | 9.30E-05 | 8.20E-05 | 6.40E-05 |
| 411 | 9.70E-05 | 8.90E-05 | 7.80E-05 | 6.30E-05 |
| 412 | 9.00E-05 | 8.30E-05 | 7.70E-05 | 5.80E-05 |
| 413 | 9.00E-05 | 8.20E-05 | 7.10E-05 | 5.40E-05 |
| 414 | 9.10E-05 | 8.60E-05 | 7.70E-05 | 6.10E-05 |
| 415 | 9.90E-05 | 9.30E-05 | 8.20E-05 | 6.40E-05 |
| 418 | 9.90E-05 | 9.40E-05 | 8.30E-05 | 6.10E-05 |
| 419 | 9.20E-05 | 8.40E-05 | 7.50E-05 | 6.30E-05 |
| 420 | 9.30E-05 | 9.60E-05 | 9.50E-05 | 9.40E-05 |
| 421 | 8.90E-05 | 8.60E-05 | 8.80E-05 | 8.60E-05 |
| Biased Statistics | | | | |
| Average Biased | 9.42E-05 | 8.80E-05 | 7.84E-05 | 6.26E-05 |
| Std Dev Biased | 3.83E-06 | 3.61E-06 | 2.07E-06 | 2.70E-06 |
| Ps90%/90% (+KTL) Biased | 1.05E-04 | 9.79E-05 | 8.41E-05 | 7.00E-05 |
| Ps90%/90% (-KTL) Biased | 8.37E-05 | 7.81E-05 | 7.27E-05 | 5.52E-05 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 9.42E-05 | 8.78E-05 | 7.76E-05 | 6.06E-05 |
| Std Dev Un-Biased | 4.44E-06 | 5.40E-06 | 4.98E-06 | 3.91E-06 |
| Ps90%/90% (+KTL) Un-Biased | 1.06E-04 | 1.03E-04 | 9.13E-05 | 7.13E-05 |
| Ps90%/90% (-KTL) Un-Biased | 8.20E-05 | 7.30E-05 | 6.39E-05 | 4.99E-05 |
| Specification MAX | 1.50E-04 | 1.50E-04 | 1.50E-04 | 1.50E-04 |
| Status | PASS | PASS | PASS | PASS |

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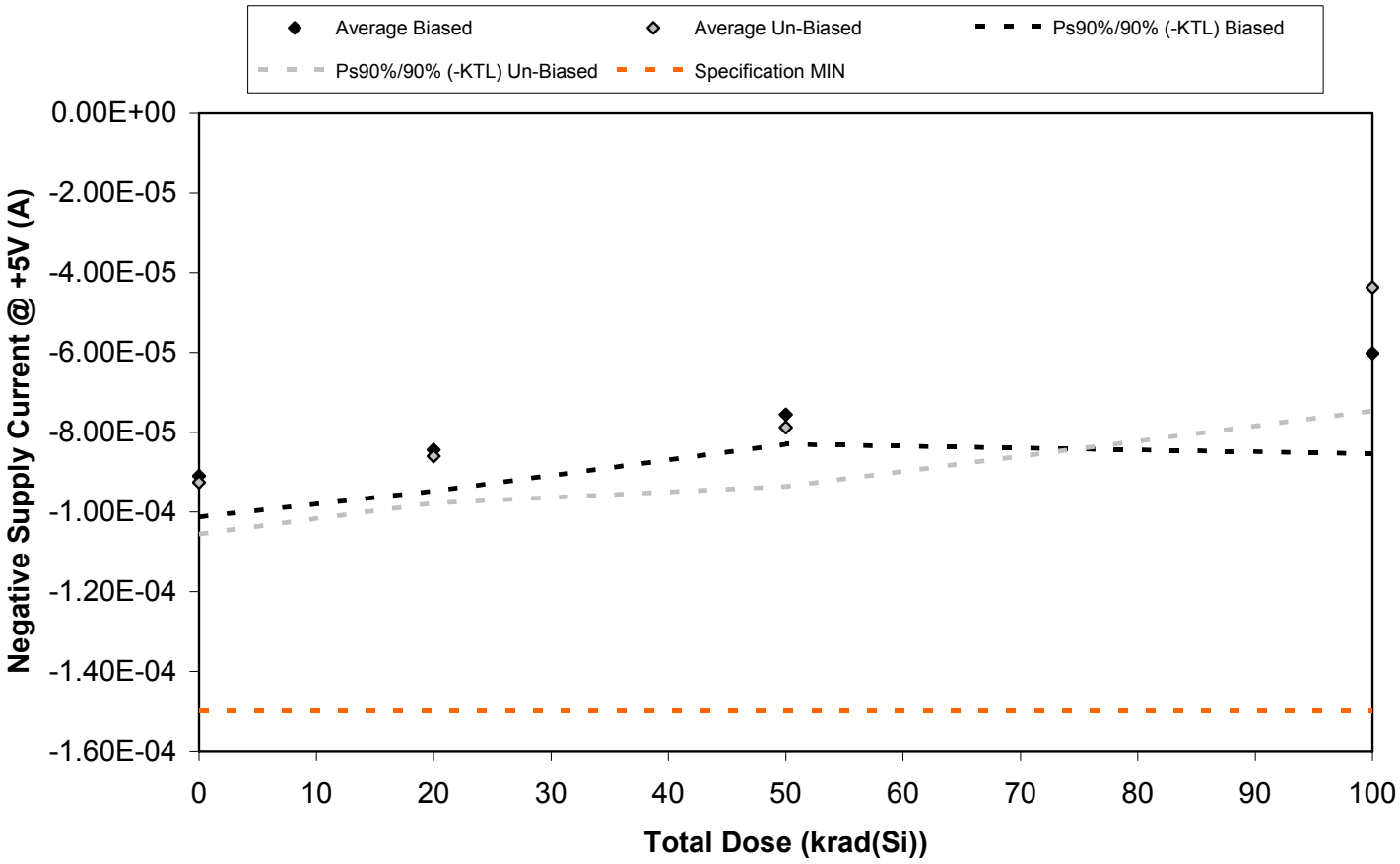


Figure 5.2. Plot of Negative Supply Current @ +5V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.2. Raw data for Negative Supply Current @ +5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Supply Current @ +5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | -9.00E-05 | -8.30E-05 | -7.50E-05 | -4.60E-05 |
| 409 | -9.00E-05 | -8.30E-05 | -7.40E-05 | -7.00E-05 |
| 410 | -9.60E-05 | -9.00E-05 | -8.00E-05 | -6.60E-05 |
| 411 | -9.30E-05 | -8.60E-05 | -7.60E-05 | -6.10E-05 |
| 412 | -8.60E-05 | -8.00E-05 | -7.30E-05 | -5.80E-05 |
| 413 | -8.70E-05 | -8.10E-05 | -8.70E-05 | -3.60E-05 |
| 414 | -9.00E-05 | -8.40E-05 | -7.50E-05 | -6.20E-05 |
| 415 | -9.70E-05 | -9.10E-05 | -8.00E-05 | -3.30E-05 |
| 418 | -9.80E-05 | -9.00E-05 | -7.90E-05 | -4.50E-05 |
| 419 | -9.10E-05 | -8.40E-05 | -7.30E-05 | -4.20E-05 |
| 420 | -9.00E-05 | -9.00E-05 | -9.10E-05 | -9.10E-05 |
| 421 | -8.50E-05 | -8.50E-05 | -8.50E-05 | -8.50E-05 |
| Biased Statistics | | | | |
| Average Biased | -9.10E-05 | -8.44E-05 | -7.56E-05 | -6.02E-05 |
| Std Dev Biased | 3.74E-06 | 3.78E-06 | 2.70E-06 | 9.18E-06 |
| Ps90%/90% (+KTL) Biased | -8.07E-05 | -7.40E-05 | -6.82E-05 | -3.50E-05 |
| Ps90%/90% (-KTL) Biased | -1.01E-04 | -9.48E-05 | -8.30E-05 | -8.54E-05 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | -9.26E-05 | -8.60E-05 | -7.88E-05 | -4.36E-05 |
| Std Dev Un-Biased | 4.72E-06 | 4.30E-06 | 5.40E-06 | 1.13E-05 |
| Ps90%/90% (+KTL) Un-Biased | -7.97E-05 | -7.42E-05 | -6.40E-05 | -1.25E-05 |
| Ps90%/90% (-KTL) Un-Biased | -1.06E-04 | -9.78E-05 | -9.36E-05 | -7.47E-05 |
| Specification MIN | -1.50E-04 | -1.50E-04 | -1.50E-04 | -1.50E-04 |
| Status | PASS | PASS | PASS | PASS |

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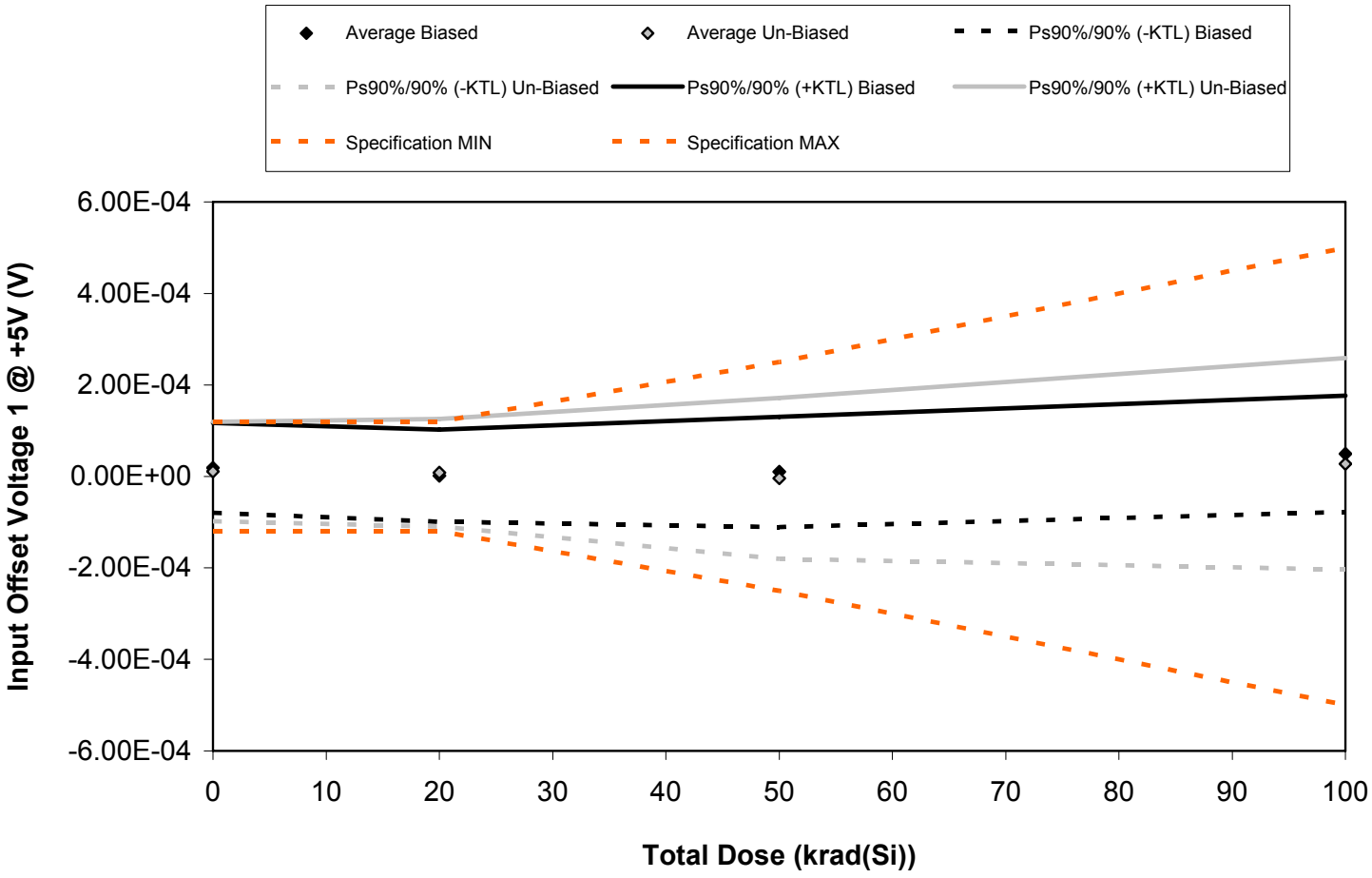


Figure 5.3. Plot of Input Offset Voltage 1 @ +5V (V) versus total dose. The data show no significant change with radiation, however the KTL values are out of specification early in the test due to a combination of an aggressive specification and relatively large distribution within the sample population. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.3. Raw data for Input Offset Voltage 1 @ +5V (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Voltage 1 @ +5V (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | -3.82E-05 | -5.77E-05 | -5.87E-05 | -2.56E-05 |
| 409 | 4.09E-05 | 2.87E-05 | 5.22E-05 | 9.47E-05 |
| 410 | 4.22E-05 | 1.41E-05 | 7.38E-06 | 4.00E-05 |
| 411 | 4.60E-06 | -8.57E-06 | 3.75E-06 | 6.35E-05 |
| 412 | 4.45E-05 | 3.08E-05 | 4.46E-05 | 7.44E-05 |
| 413 | 5.24E-05 | 4.87E-05 | 5.19E-05 | 1.09E-04 |
| 414 | 4.77E-05 | 4.72E-05 | 5.21E-05 | 9.32E-05 |
| 415 | -4.19E-05 | -5.38E-05 | -9.88E-05 | -9.72E-05 |
| 418 | -8.80E-06 | -1.01E-05 | -3.59E-05 | -1.16E-05 |
| 419 | 3.76E-06 | 8.23E-06 | 9.41E-06 | 4.43E-05 |
| 420 | 1.34E-05 | 1.34E-05 | 1.17E-05 | 1.62E-05 |
| 421 | -1.89E-05 | -1.80E-05 | -1.98E-05 | -1.68E-05 |
| Biased Statistics | | | | |
| Average Biased | 1.88E-05 | 1.47E-06 | 9.84E-06 | 4.94E-05 |
| Std Dev Biased | 3.58E-05 | 3.66E-05 | 4.40E-05 | 4.63E-05 |
| Ps90%/90% (+KTL) Biased | 1.17E-04 | 1.02E-04 | 1.30E-04 | 1.76E-04 |
| Ps90%/90% (-KTL) Biased | -7.95E-05 | -9.90E-05 | -1.11E-04 | -7.76E-05 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.06E-05 | 8.05E-06 | -4.25E-06 | 2.76E-05 |
| Std Dev Un-Biased | 3.97E-05 | 4.28E-05 | 6.41E-05 | 8.42E-05 |
| Ps90%/90% (+KTL) Un-Biased | 1.19E-04 | 1.25E-04 | 1.72E-04 | 2.58E-04 |
| Ps90%/90% (-KTL) Un-Biased | -9.81E-05 | -1.09E-04 | -1.80E-04 | -2.03E-04 |
| Specification MIN | -1.20E-04 | -1.20E-04 | -2.50E-04 | -5.00E-04 |
| Status | PASS | PASS | PASS | PASS |
| Specification MAX | 1.20E-04 | 1.20E-04 | 2.50E-04 | 5.00E-04 |
| Status | PASS | FAIL | PASS | PASS |

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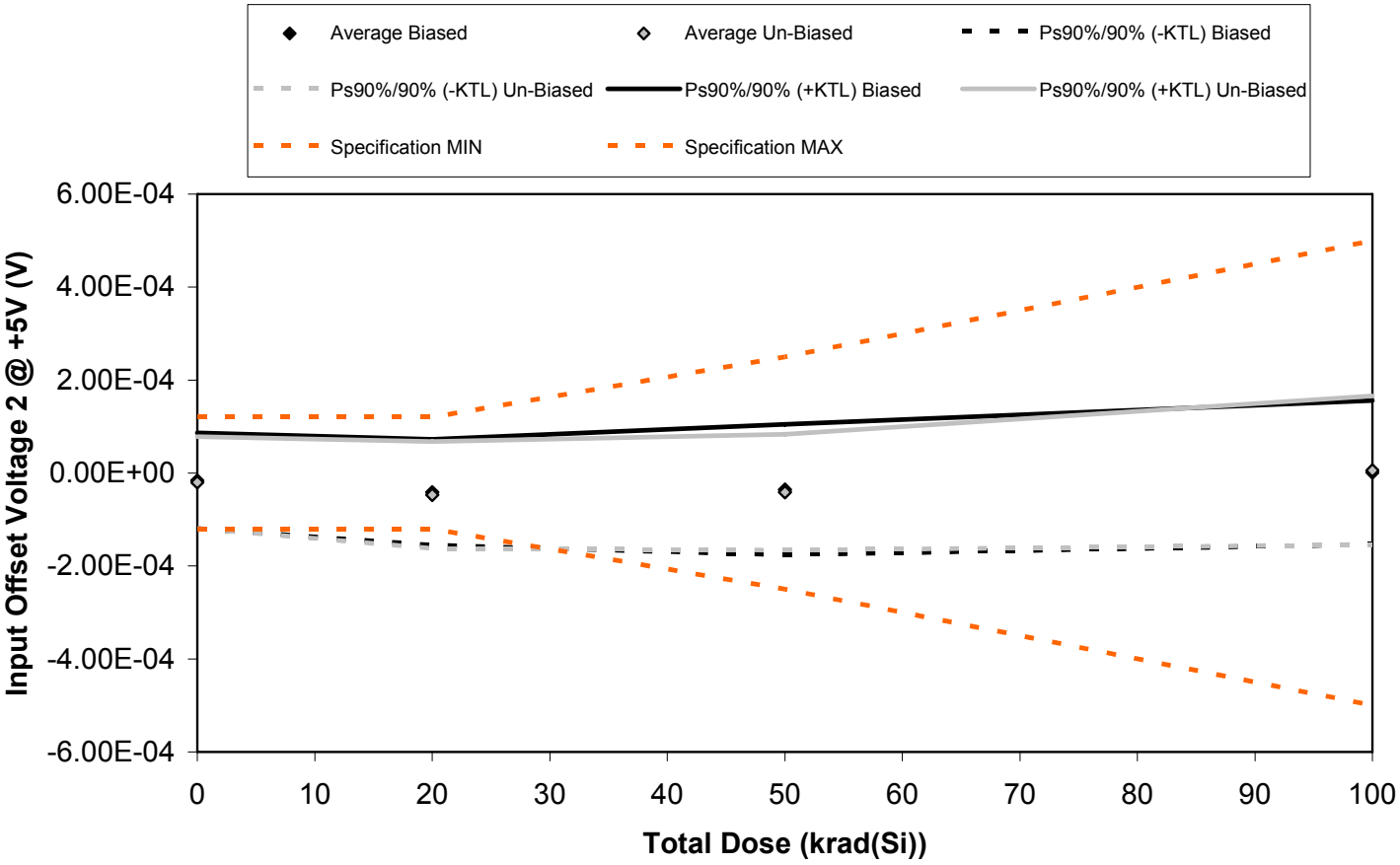


Figure 5.4. Plot of Input Offset Voltage 2 @ +5V (V) versus total dose. The data show no significant change with radiation, however the KTL values are out of specification early in the test due to a combination of an aggressive specification and relatively large distribution within the sample population. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.4. Raw data for Input Offset Voltage 2 @ +5V (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Voltage 2 @ +5V (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | -3.17E-05 | -5.93E-05 | -5.89E-05 | -3.79E-05 |
| 409 | -3.21E-05 | -6.16E-05 | -5.71E-05 | -1.62E-05 |
| 410 | -6.17E-05 | -8.92E-05 | -9.65E-05 | -6.04E-05 |
| 411 | 1.05E-05 | -8.82E-06 | 9.19E-06 | 6.12E-05 |
| 412 | 3.25E-05 | 1.21E-05 | 2.56E-05 | 6.04E-05 |
| 413 | -3.88E-05 | -6.57E-05 | -5.48E-05 | -4.34E-06 |
| 414 | -4.60E-05 | -7.08E-05 | -6.17E-05 | -6.63E-06 |
| 415 | -4.54E-05 | -8.77E-05 | -9.68E-05 | -8.02E-05 |
| 418 | -1.00E-05 | -2.85E-05 | -1.29E-05 | 6.42E-05 |
| 419 | 3.86E-05 | 1.70E-05 | 2.01E-05 | 5.62E-05 |
| 420 | -2.98E-05 | -3.13E-05 | -2.72E-05 | -2.76E-05 |
| 421 | -5.36E-05 | -5.36E-05 | -5.46E-05 | -5.45E-05 |
| Biased Statistics | | | | |
| Average Biased | -1.65E-05 | -4.14E-05 | -3.55E-05 | 1.43E-06 |
| Std Dev Biased | 3.76E-05 | 4.16E-05 | 5.12E-05 | 5.64E-05 |
| Ps90%/90% (+KTL) Biased | 8.65E-05 | 7.28E-05 | 1.05E-04 | 1.56E-04 |
| Ps90%/90% (-KTL) Biased | -1.19E-04 | -1.56E-04 | -1.76E-04 | -1.53E-04 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | -2.03E-05 | -4.71E-05 | -4.12E-05 | 5.85E-06 |
| Std Dev Un-Biased | 3.61E-05 | 4.19E-05 | 4.54E-05 | 5.83E-05 |
| Ps90%/90% (+KTL) Un-Biased | 7.86E-05 | 6.77E-05 | 8.33E-05 | 1.66E-04 |
| Ps90%/90% (-KTL) Un-Biased | -1.19E-04 | -1.62E-04 | -1.66E-04 | -1.54E-04 |
| Specification MIN | -1.20E-04 | -1.20E-04 | -2.50E-04 | -5.00E-04 |
| Status | PASS | FAIL | PASS | PASS |
| Specification MAX | 1.20E-04 | 1.20E-04 | 2.50E-04 | 5.00E-04 |
| Status | PASS | PASS | PASS | PASS |

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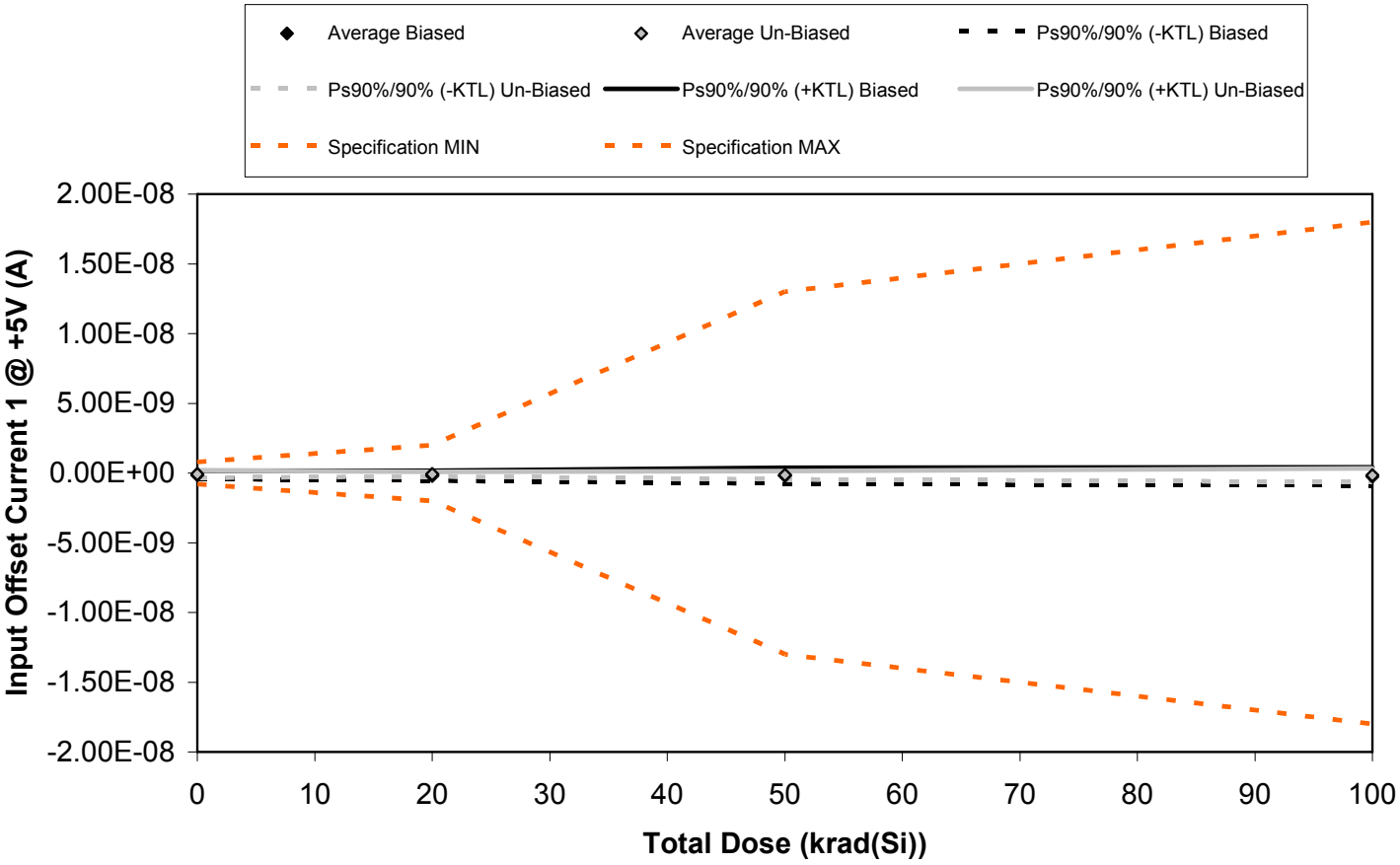


Figure 5.5. Plot of Input Offset Current 1 @ +5V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.5. Raw data for Input Offset Current 1 @ +5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Current 1 @ +5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | -9.00E-11 | -3.30E-10 | -4.50E-10 | -5.60E-10 |
| 409 | 4.00E-11 | -3.00E-11 | 7.00E-11 | 2.00E-11 |
| 410 | -2.50E-10 | -9.00E-11 | -3.20E-10 | -1.50E-10 |
| 411 | -1.50E-10 | -2.50E-10 | -1.50E-10 | -1.00E-10 |
| 412 | -1.50E-10 | -2.80E-10 | -8.00E-11 | -4.10E-10 |
| 413 | -1.40E-10 | -1.00E-10 | -1.50E-10 | -1.30E-10 |
| 414 | 3.00E-11 | -1.00E-10 | -2.10E-10 | -3.20E-10 |
| 415 | -2.10E-10 | -1.80E-10 | -3.10E-10 | -3.30E-10 |
| 418 | -1.00E-11 | -7.00E-11 | -9.00E-11 | -1.20E-10 |
| 419 | -5.00E-11 | -1.00E-11 | -2.00E-11 | 1.00E-10 |
| 420 | 9.00E-11 | 4.00E-11 | -5.00E-11 | 0.00E+00 |
| 421 | -3.00E-11 | -6.00E-11 | 3.00E-11 | -1.30E-10 |
| Biased Statistics | | | | |
| Average Biased | -1.20E-10 | -1.96E-10 | -1.86E-10 | -2.40E-10 |
| Std Dev Biased | 1.06E-10 | 1.29E-10 | 2.04E-10 | 2.38E-10 |
| Ps90%/90% (+KTL) Biased | 1.71E-10 | 1.58E-10 | 3.72E-10 | 4.13E-10 |
| Ps90%/90% (-KTL) Biased | -4.11E-10 | -5.50E-10 | -7.44E-10 | -8.93E-10 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | -7.60E-11 | -9.20E-11 | -1.56E-10 | -1.60E-10 |
| Std Dev Un-Biased | 9.79E-11 | 6.14E-11 | 1.11E-10 | 1.76E-10 |
| Ps90%/90% (+KTL) Un-Biased | 1.92E-10 | 7.64E-11 | 1.49E-10 | 3.24E-10 |
| Ps90%/90% (-KTL) Un-Biased | -3.44E-10 | -2.60E-10 | -4.61E-10 | -6.44E-10 |
| Specification MIN | -8.00E-10 | -2.00E-09 | -1.30E-08 | -1.80E-08 |
| Status | PASS | PASS | PASS | PASS |
| Specification MAX | 8.00E-10 | 2.00E-09 | 1.30E-08 | 1.80E-08 |
| Status | PASS | PASS | PASS | PASS |

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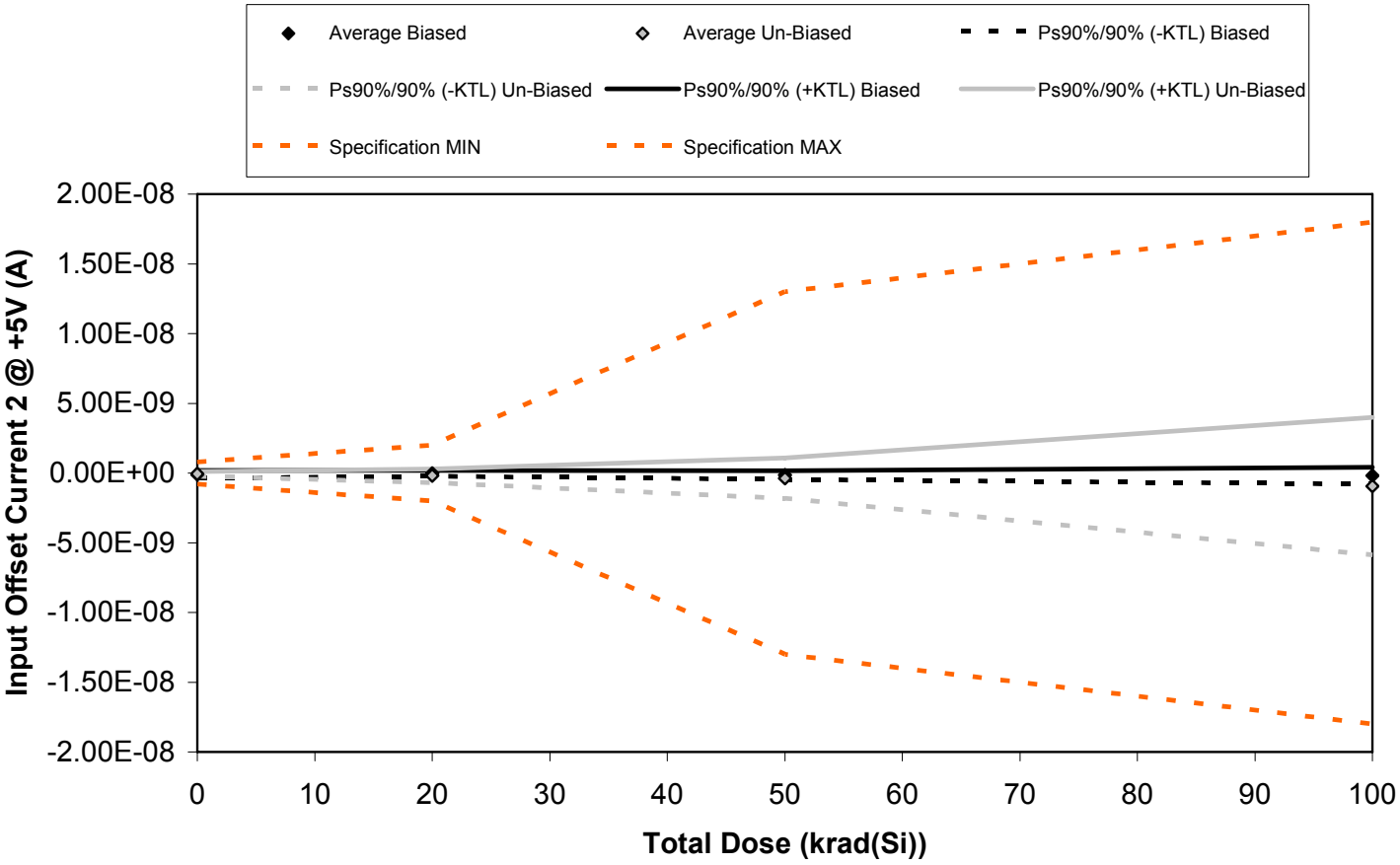


Figure 5.6. Plot of Input Offset Current 2 @ +5V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.6. Raw data for Input Offset Current 2 @ +5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Current 2 @ +5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.00E-11 | 3.00E-11 | 3.00E-11 | 1.20E-10 |
| 409 | -9.00E-11 | -9.00E-11 | -2.20E-10 | -4.20E-10 |
| 410 | -1.60E-10 | 0.00E+00 | -1.50E-10 | -3.60E-10 |
| 411 | -1.80E-10 | 4.00E-11 | -1.50E-10 | -2.30E-10 |
| 412 | -1.20E-10 | -1.30E-10 | -2.70E-10 | -6.00E-11 |
| 413 | 0.00E+00 | -6.00E-11 | -1.60E-10 | -1.30E-10 |
| 414 | -4.00E-11 | -9.00E-11 | -9.00E-11 | -1.90E-10 |
| 415 | -3.00E-11 | -2.00E-10 | 2.00E-11 | -8.00E-11 |
| 418 | -5.00E-11 | -5.10E-10 | -1.29E-09 | -4.15E-09 |
| 419 | -1.60E-10 | -1.30E-10 | -3.20E-10 | -1.50E-10 |
| 420 | -2.50E-10 | -2.30E-10 | -7.00E-11 | -1.50E-10 |
| 421 | -3.00E-11 | 3.00E-11 | 0.00E+00 | 3.00E-11 |
| Biased Statistics | | | | |
| Average Biased | -9.40E-11 | -3.00E-11 | -1.52E-10 | -1.90E-10 |
| Std Dev Biased | 1.03E-10 | 7.58E-11 | 1.14E-10 | 2.22E-10 |
| Ps90%/90% (+KTL) Biased | 1.89E-10 | 1.78E-10 | 1.60E-10 | 4.18E-10 |
| Ps90%/90% (-KTL) Biased | -3.77E-10 | -2.38E-10 | -4.64E-10 | -7.98E-10 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | -5.60E-11 | -1.98E-10 | -3.68E-10 | -9.40E-10 |
| Std Dev Un-Biased | 6.11E-11 | 1.82E-10 | 5.30E-10 | 1.79E-09 |
| Ps90%/90% (+KTL) Un-Biased | 1.11E-10 | 3.01E-10 | 1.09E-09 | 3.98E-09 |
| Ps90%/90% (-KTL) Un-Biased | -2.23E-10 | -6.97E-10 | -1.82E-09 | -5.86E-09 |
| Specification MIN | -8.00E-10 | -2.00E-09 | -1.30E-08 | -1.80E-08 |
| Status | PASS | PASS | PASS | PASS |
| Specification MAX | 8.00E-10 | 2.00E-09 | 1.30E-08 | 1.80E-08 |
| Status | PASS | PASS | PASS | PASS |

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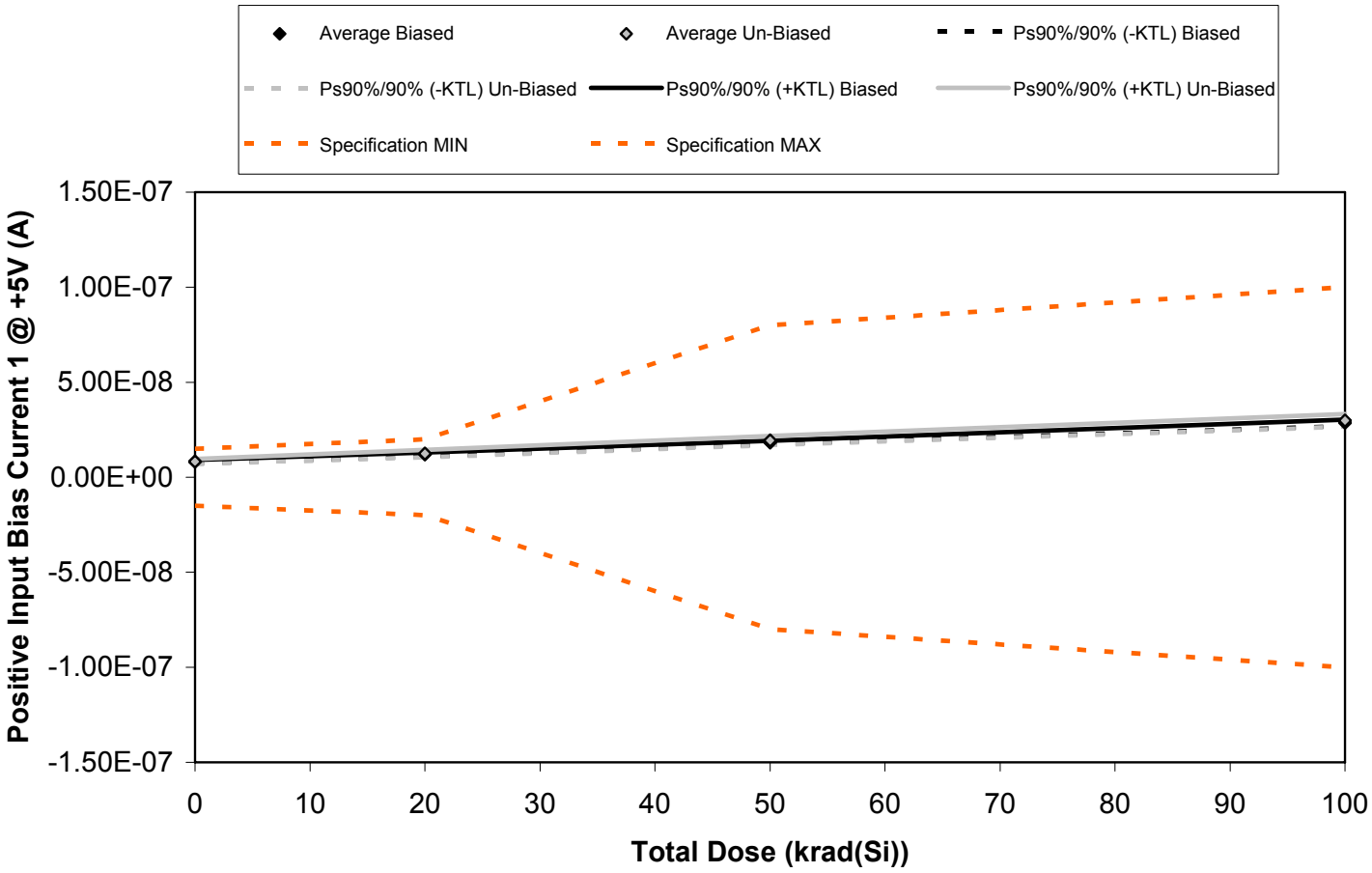


Figure 5.7. Plot of Positive Input Bias Current 1 @ +5V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.7. Raw data for Positive Input Bias Current 1 @ +5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Input Bias Current 1 @ +5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 7.75E-09 | 1.17E-08 | 1.81E-08 | 2.90E-08 |
| 409 | 8.28E-09 | 1.16E-08 | 1.79E-08 | 2.80E-08 |
| 410 | 8.62E-09 | 1.24E-08 | 1.87E-08 | 2.95E-08 |
| 411 | 8.23E-09 | 1.18E-08 | 1.84E-08 | 2.81E-08 |
| 412 | 8.45E-09 | 1.24E-08 | 1.86E-08 | 2.84E-08 |
| 413 | 8.06E-09 | 1.19E-08 | 1.84E-08 | 2.79E-08 |
| 414 | 8.68E-09 | 1.26E-08 | 1.95E-08 | 3.00E-08 |
| 415 | 7.73E-09 | 1.18E-08 | 1.86E-08 | 2.99E-08 |
| 418 | 8.01E-09 | 1.24E-08 | 1.97E-08 | 3.03E-08 |
| 419 | 8.88E-09 | 1.35E-08 | 2.06E-08 | 3.13E-08 |
| 420 | 8.27E-09 | 8.18E-09 | 8.24E-09 | 8.20E-09 |
| 421 | 8.67E-09 | 8.83E-09 | 8.78E-09 | 8.76E-09 |
| Biased Statistics | | | | |
| Average Biased | 8.27E-09 | 1.20E-08 | 1.83E-08 | 2.86E-08 |
| Std Dev Biased | 3.27E-10 | 3.84E-10 | 3.26E-10 | 6.41E-10 |
| Ps90%/90% (+KTL) Biased | 9.16E-09 | 1.30E-08 | 1.92E-08 | 3.04E-08 |
| Ps90%/90% (-KTL) Biased | 7.37E-09 | 1.09E-08 | 1.74E-08 | 2.68E-08 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.27E-09 | 1.24E-08 | 1.93E-08 | 2.99E-08 |
| Std Dev Un-Biased | 4.86E-10 | 6.98E-10 | 8.96E-10 | 1.25E-09 |
| Ps90%/90% (+KTL) Un-Biased | 9.60E-09 | 1.44E-08 | 2.18E-08 | 3.33E-08 |
| Ps90%/90% (-KTL) Un-Biased | 6.94E-09 | 1.05E-08 | 1.69E-08 | 2.65E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.00E-07 |
| Status | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.00E-07 |
| Status | PASS | PASS | PASS | PASS |

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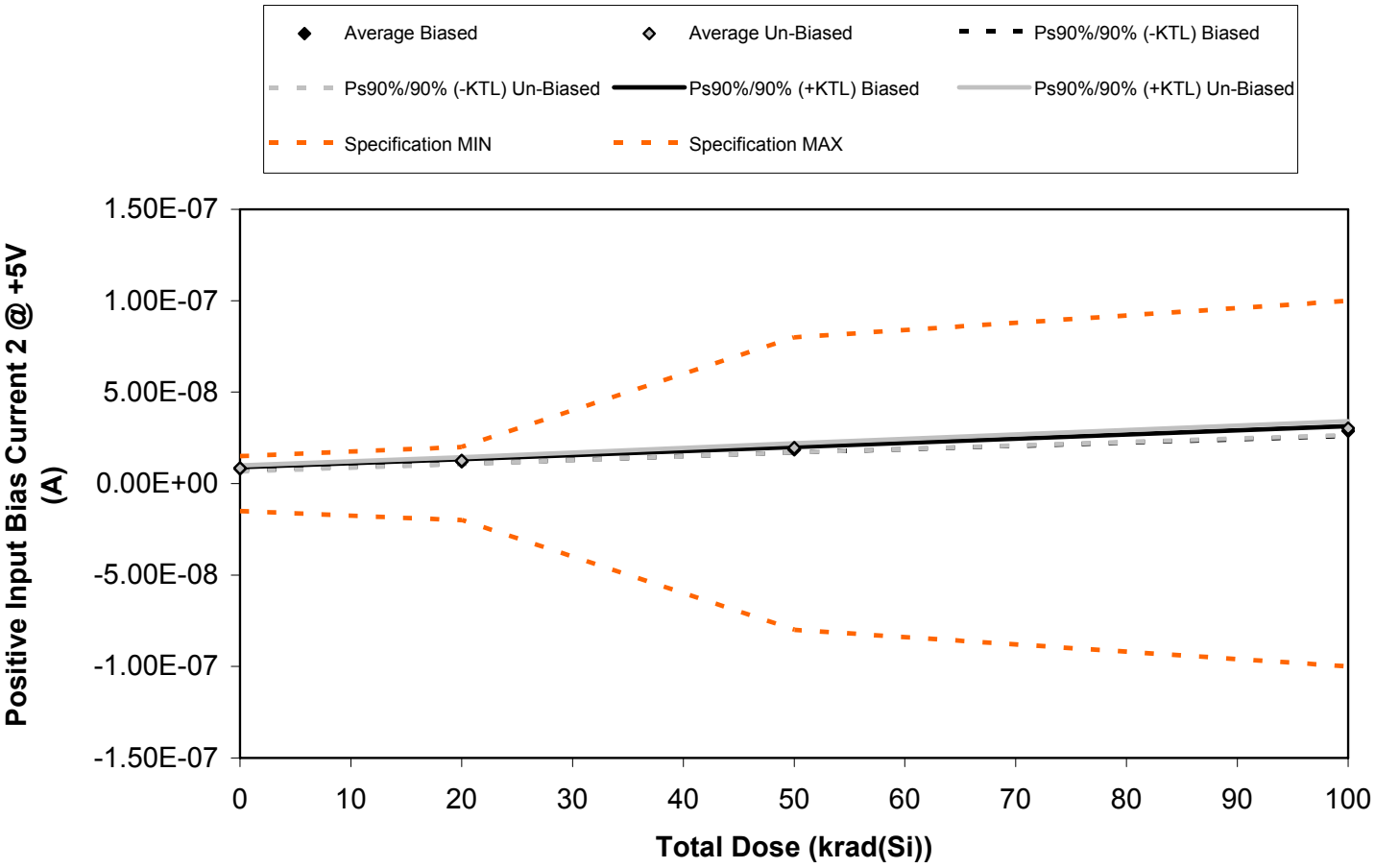


Figure 5.8. Plot of Positive Input Bias Current 2 @ +5V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.8. Raw data for Positive Input Bias Current 2 @ +5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Input Bias Current 2 @ +5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.13E-09 | 1.22E-08 | 1.90E-08 | 3.00E-08 |
| 409 | 8.13E-09 | 1.14E-08 | 1.76E-08 | 2.75E-08 |
| 410 | 8.59E-09 | 1.25E-08 | 1.87E-08 | 2.96E-08 |
| 411 | 8.06E-09 | 1.20E-08 | 1.86E-08 | 2.84E-08 |
| 412 | 8.48E-09 | 1.25E-08 | 1.87E-08 | 2.84E-08 |
| 413 | 8.21E-09 | 1.21E-08 | 1.84E-08 | 2.80E-08 |
| 414 | 8.86E-09 | 1.28E-08 | 1.97E-08 | 3.06E-08 |
| 415 | 7.65E-09 | 1.17E-08 | 1.88E-08 | 3.01E-08 |
| 418 | 7.89E-09 | 1.25E-08 | 2.00E-08 | 3.13E-08 |
| 419 | 9.00E-09 | 1.35E-08 | 2.06E-08 | 3.15E-08 |
| 420 | 8.18E-09 | 8.29E-09 | 8.18E-09 | 8.25E-09 |
| 421 | 8.85E-09 | 8.87E-09 | 8.89E-09 | 8.83E-09 |
| Biased Statistics | | | | |
| Average Biased | 8.28E-09 | 1.21E-08 | 1.85E-08 | 2.88E-08 |
| Std Dev Biased | 2.40E-10 | 4.27E-10 | 5.46E-10 | 9.92E-10 |
| Ps90%/90% (+KTL) Biased | 8.93E-09 | 1.33E-08 | 2.00E-08 | 3.15E-08 |
| Ps90%/90% (-KTL) Biased | 7.62E-09 | 1.09E-08 | 1.70E-08 | 2.61E-08 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.32E-09 | 1.25E-08 | 1.95E-08 | 3.03E-08 |
| Std Dev Un-Biased | 5.92E-10 | 6.77E-10 | 9.01E-10 | 1.40E-09 |
| Ps90%/90% (+KTL) Un-Biased | 9.94E-09 | 1.44E-08 | 2.20E-08 | 3.41E-08 |
| Ps90%/90% (-KTL) Un-Biased | 6.70E-09 | 1.07E-08 | 1.70E-08 | 2.64E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.00E-07 |
| Status | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.00E-07 |
| Status | PASS | PASS | PASS | PASS |

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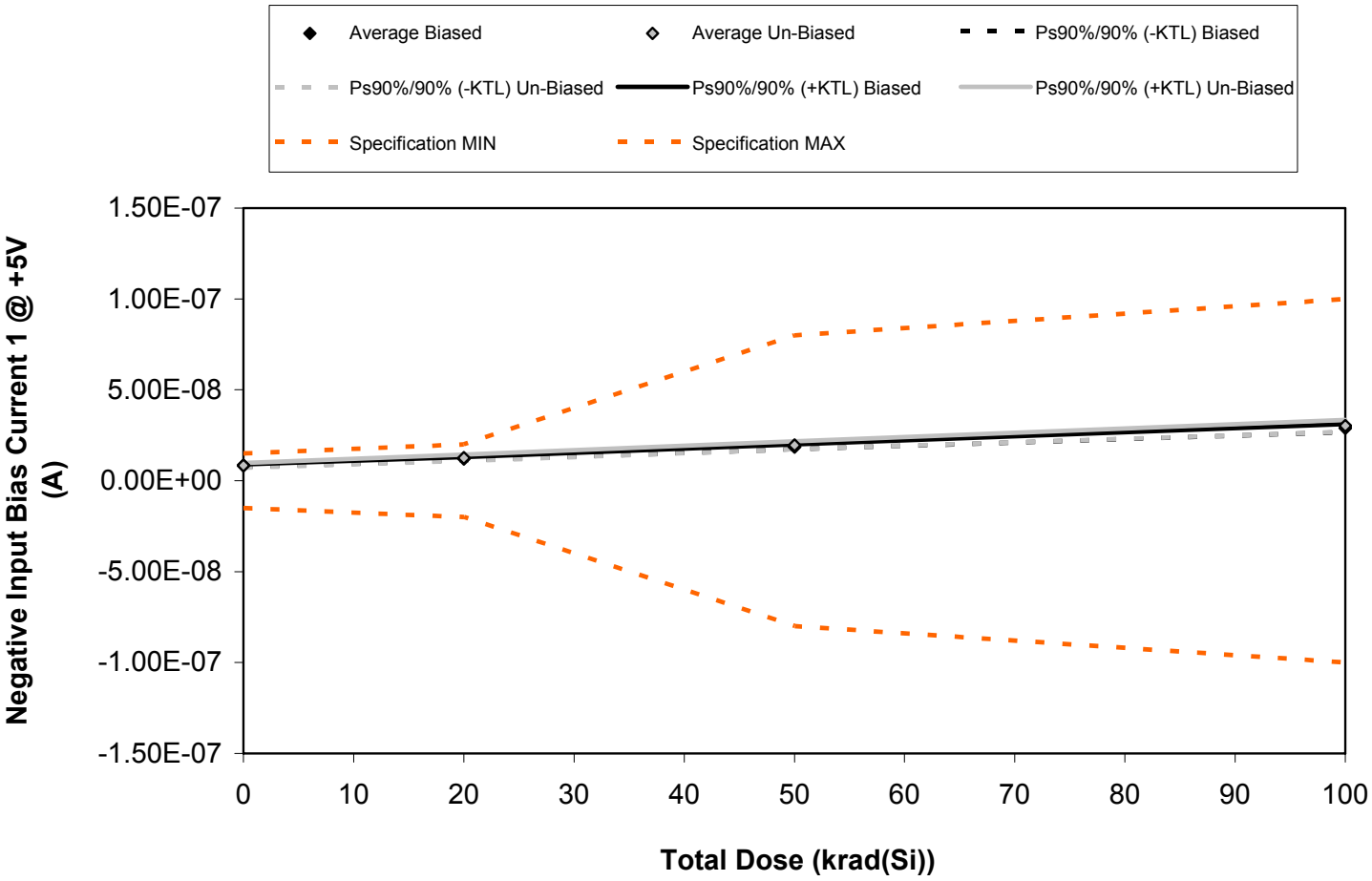


Figure 5.9. Plot of Negative Input Bias Current 1 @ +5V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.9. Raw data for Negative Input Bias Current 1 @ +5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Input Bias Current 1 @ +5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.02E-09 | 1.19E-08 | 1.85E-08 | 2.96E-08 |
| 409 | 8.15E-09 | 1.18E-08 | 1.79E-08 | 2.80E-08 |
| 410 | 8.64E-09 | 1.23E-08 | 1.91E-08 | 2.99E-08 |
| 411 | 8.37E-09 | 1.20E-08 | 1.86E-08 | 2.84E-08 |
| 412 | 8.52E-09 | 1.26E-08 | 1.90E-08 | 2.88E-08 |
| 413 | 8.26E-09 | 1.21E-08 | 1.85E-08 | 2.83E-08 |
| 414 | 8.74E-09 | 1.28E-08 | 1.96E-08 | 3.07E-08 |
| 415 | 7.87E-09 | 1.20E-08 | 1.90E-08 | 3.02E-08 |
| 418 | 8.10E-09 | 1.26E-08 | 1.99E-08 | 3.07E-08 |
| 419 | 9.04E-09 | 1.36E-08 | 2.05E-08 | 3.15E-08 |
| 420 | 8.25E-09 | 8.24E-09 | 8.27E-09 | 8.19E-09 |
| 421 | 8.79E-09 | 8.82E-09 | 8.83E-09 | 8.86E-09 |
| Biased Statistics | | | | |
| Average Biased | 8.34E-09 | 1.21E-08 | 1.86E-08 | 2.89E-08 |
| Std Dev Biased | 2.56E-10 | 3.44E-10 | 4.74E-10 | 8.11E-10 |
| Ps90%/90% (+KTL) Biased | 9.04E-09 | 1.30E-08 | 1.99E-08 | 3.12E-08 |
| Ps90%/90% (-KTL) Biased | 7.64E-09 | 1.12E-08 | 1.73E-08 | 2.67E-08 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.40E-09 | 1.26E-08 | 1.95E-08 | 3.03E-08 |
| Std Dev Un-Biased | 4.78E-10 | 6.28E-10 | 7.84E-10 | 1.18E-09 |
| Ps90%/90% (+KTL) Un-Biased | 9.71E-09 | 1.43E-08 | 2.16E-08 | 3.35E-08 |
| Ps90%/90% (-KTL) Un-Biased | 7.09E-09 | 1.09E-08 | 1.73E-08 | 2.70E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.00E-07 |
| Status | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.00E-07 |
| Status | PASS | PASS | PASS | PASS |

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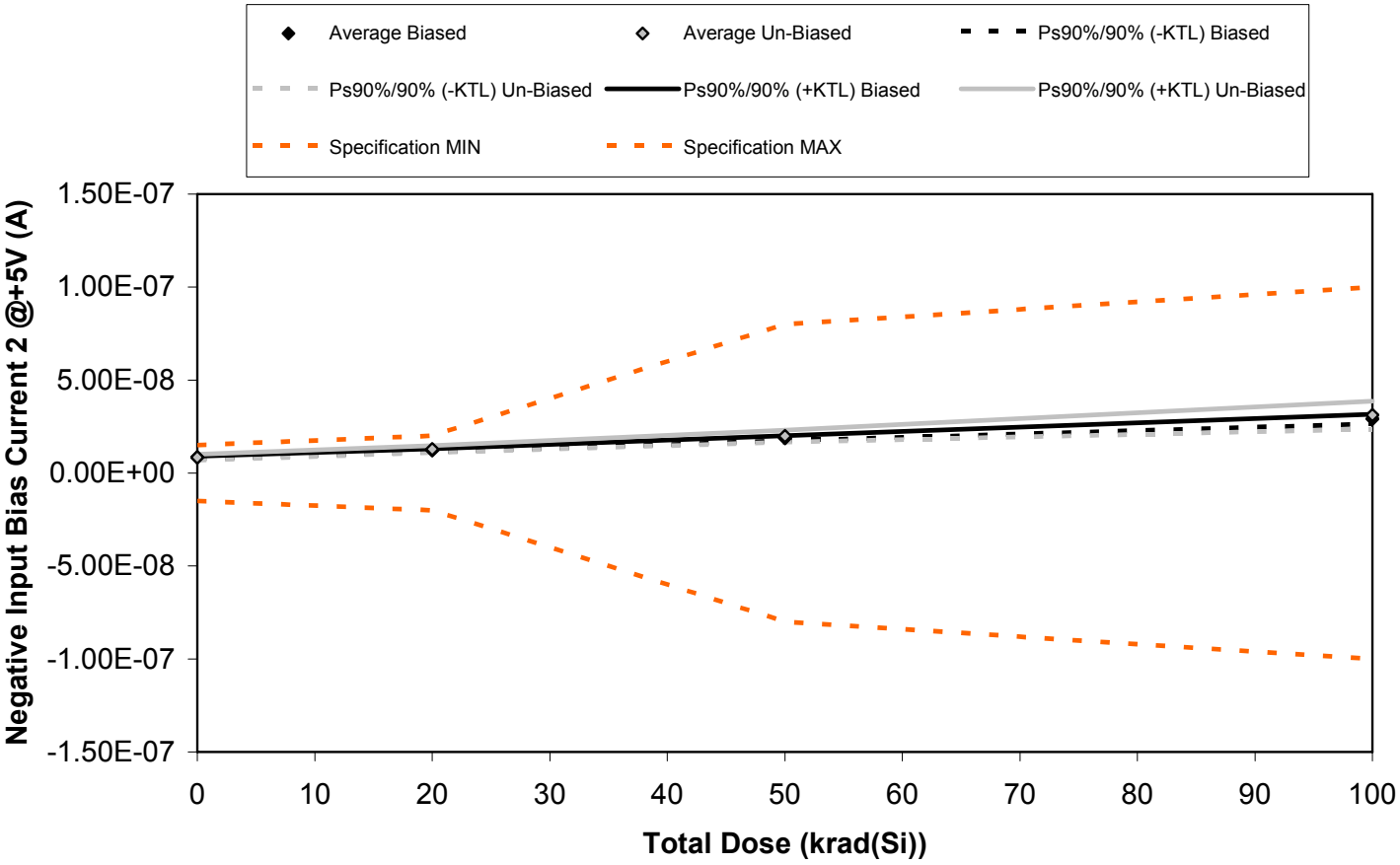


Figure 5.10. Plot of Negative Input Bias Current 2 @+5V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.10. Raw data for Negative Input Bias Current 2 @+5V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Input Bias Current 2 @+5V (A)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.18E-09 | 1.21E-08 | 1.89E-08 | 3.02E-08 |
| 409 | 8.29E-09 | 1.18E-08 | 1.80E-08 | 2.80E-08 |
| 410 | 8.69E-09 | 1.25E-08 | 1.92E-08 | 2.99E-08 |
| 411 | 8.21E-09 | 1.21E-08 | 1.87E-08 | 2.86E-08 |
| 412 | 8.62E-09 | 1.25E-08 | 1.91E-08 | 2.87E-08 |
| 413 | 8.16E-09 | 1.21E-08 | 1.86E-08 | 2.81E-08 |
| 414 | 8.96E-09 | 1.31E-08 | 1.98E-08 | 3.06E-08 |
| 415 | 7.89E-09 | 1.21E-08 | 1.88E-08 | 3.01E-08 |
| 418 | 8.07E-09 | 1.29E-08 | 2.13E-08 | 3.55E-08 |
| 419 | 9.21E-09 | 1.37E-08 | 2.08E-08 | 3.16E-08 |
| 420 | 8.31E-09 | 8.43E-09 | 8.37E-09 | 8.33E-09 |
| 421 | 9.01E-09 | 8.95E-09 | 8.86E-09 | 8.95E-09 |
| Biased Statistics | | | | |
| Average Biased | 8.40E-09 | 1.22E-08 | 1.88E-08 | 2.91E-08 |
| Std Dev Biased | 2.39E-10 | 3.17E-10 | 4.79E-10 | 9.42E-10 |
| Ps90%/90% (+KTL) Biased | 9.05E-09 | 1.30E-08 | 2.01E-08 | 3.17E-08 |
| Ps90%/90% (-KTL) Biased | 7.74E-09 | 1.13E-08 | 1.75E-08 | 2.65E-08 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.46E-09 | 1.28E-08 | 1.98E-08 | 3.12E-08 |
| Std Dev Un-Biased | 5.87E-10 | 6.94E-10 | 1.18E-09 | 2.73E-09 |
| Ps90%/90% (+KTL) Un-Biased | 1.01E-08 | 1.47E-08 | 2.31E-08 | 3.87E-08 |
| Ps90%/90% (-KTL) Un-Biased | 6.85E-09 | 1.09E-08 | 1.66E-08 | 2.37E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.00E-07 |
| Status | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.00E-07 |
| Status | PASS | PASS | PASS | PASS |

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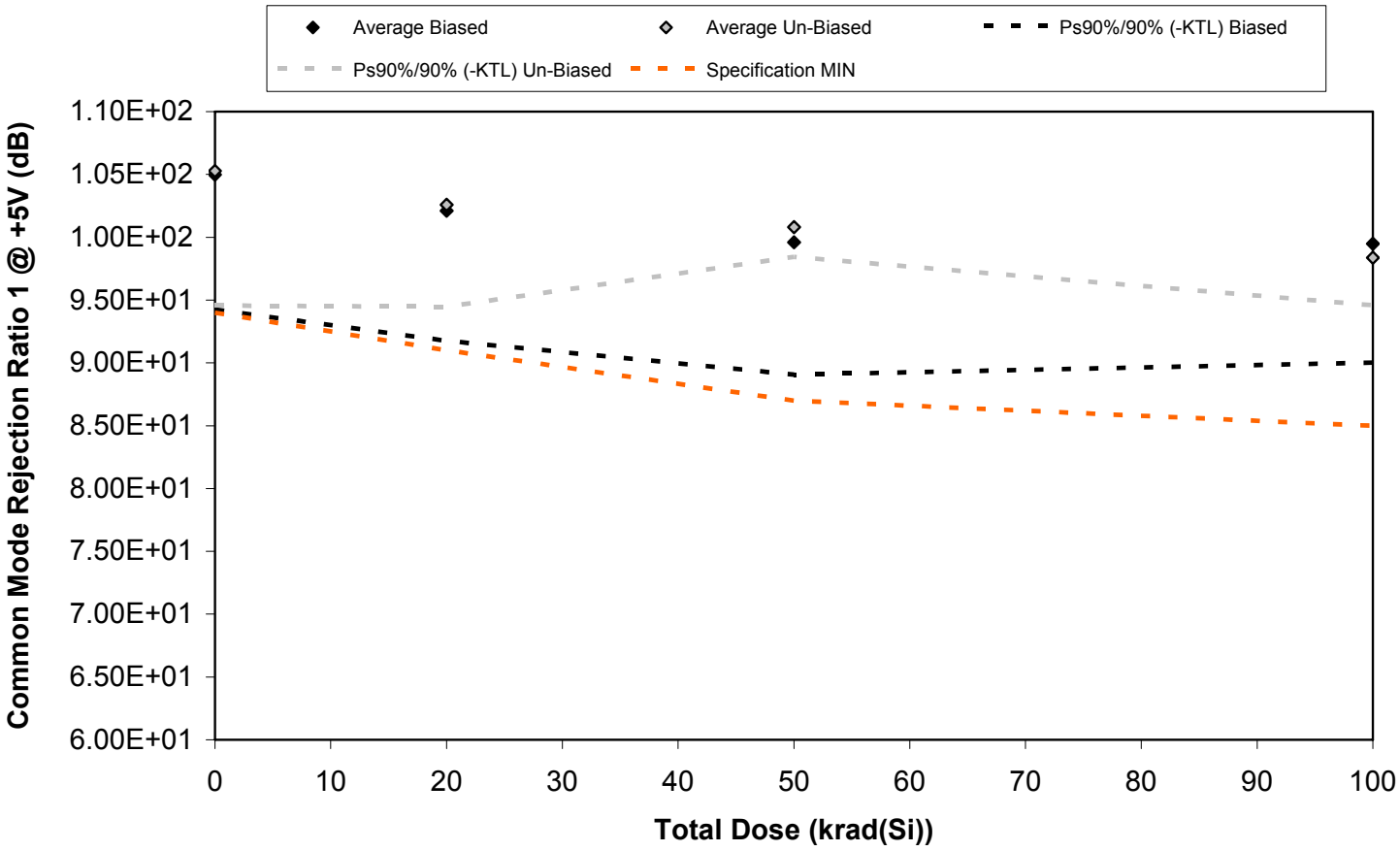


Figure 5.11. Plot of Common Mode Rejection Ratio 1 @ +5V (dB) versus total dose. The data show some degradation with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.11. Raw data for Common Mode Rejection Ratio 1 @ +5V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Common Mode Rejection Ratio 1 @ +5V (dB)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.11E+02 | 1.08E+02 | 1.06E+02 | 1.05E+02 |
| 409 | 1.00E+02 | 9.84E+01 | 9.74E+01 | 9.74E+01 |
| 410 | 1.07E+02 | 9.95E+01 | 9.75E+01 | 9.69E+01 |
| 411 | 1.04E+02 | 1.02E+02 | 9.71E+01 | 9.85E+01 |
| 412 | 1.03E+02 | 1.02E+02 | 9.98E+01 | 9.92E+01 |
| 413 | 1.11E+02 | 9.82E+01 | 9.99E+01 | 9.65E+01 |
| 414 | 1.03E+02 | 1.04E+02 | 1.01E+02 | 9.74E+01 |
| 415 | 1.06E+02 | 1.04E+02 | 1.02E+02 | 9.91E+01 |
| 418 | 1.06E+02 | 1.06E+02 | 1.01E+02 | 9.98E+01 |
| 419 | 1.00E+02 | 1.01E+02 | 1.00E+02 | 9.92E+01 |
| 420 | 1.01E+02 | 1.05E+02 | 1.03E+02 | 1.02E+02 |
| 421 | 1.09E+02 | 1.01E+02 | 1.05E+02 | 1.05E+02 |
| Biased Statistics | | | | |
| Average Biased | 1.05E+02 | 1.02E+02 | 9.96E+01 | 9.95E+01 |
| Std Dev Biased | 3.91E+00 | 3.77E+00 | 3.84E+00 | 3.45E+00 |
| Ps90%/90% (+KTL) Biased | 1.16E+02 | 1.12E+02 | 1.10E+02 | 1.09E+02 |
| Ps90%/90% (-KTL) Biased | 9.43E+01 | 9.18E+01 | 8.91E+01 | 9.00E+01 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.05E+02 | 1.03E+02 | 1.01E+02 | 9.84E+01 |
| Std Dev Un-Biased | 3.91E+00 | 2.96E+00 | 8.61E-01 | 1.39E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.16E+02 | 1.11E+02 | 1.03E+02 | 1.02E+02 |
| Ps90%/90% (-KTL) Un-Biased | 9.46E+01 | 9.45E+01 | 9.85E+01 | 9.46E+01 |
| Specification MIN | 9.40E+01 | 9.10E+01 | 8.70E+01 | 8.50E+01 |
| Status | PASS | PASS | PASS | PASS |

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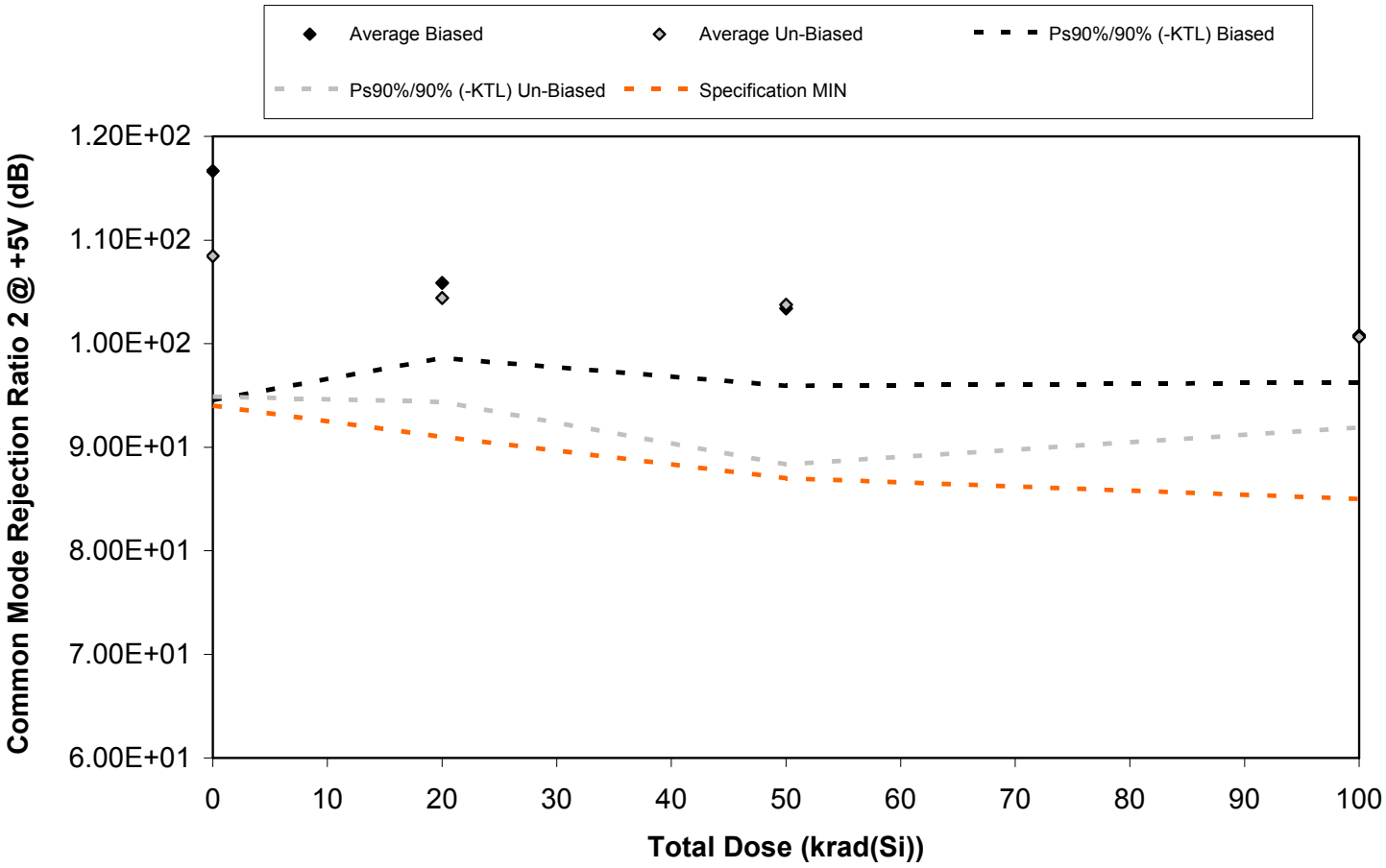


Figure 5.12. Plot of Common Mode Rejection Ratio 2 @ +5V (dB) versus total dose. The data show some degradation with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.12. Raw data for Common Mode Rejection Ratio 2 @ +5V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Common Mode Rejection Ratio 2 @ +5V (dB)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.26E+02 | 1.09E+02 | 1.07E+02 | 1.02E+02 |
| 409 | 1.10E+02 | 1.02E+02 | 1.02E+02 | 9.86E+01 |
| 410 | 1.10E+02 | 1.08E+02 | 1.01E+02 | 1.00E+02 |
| 411 | 1.13E+02 | 1.05E+02 | 1.01E+02 | 1.00E+02 |
| 412 | 1.25E+02 | 1.05E+02 | 1.06E+02 | 1.03E+02 |
| 413 | 1.06E+02 | 1.03E+02 | 1.00E+02 | 9.81E+01 |
| 414 | 1.06E+02 | 1.03E+02 | 1.00E+02 | 9.85E+01 |
| 415 | 1.16E+02 | 1.05E+02 | 1.09E+02 | 1.02E+02 |
| 418 | 1.10E+02 | 1.10E+02 | 1.11E+02 | 1.06E+02 |
| 419 | 1.04E+02 | 1.01E+02 | 9.87E+01 | 9.92E+01 |
| 420 | 1.09E+02 | 1.06E+02 | 1.05E+02 | 1.09E+02 |
| 421 | 1.10E+02 | 1.07E+02 | 1.06E+02 | 1.10E+02 |
| Biased Statistics | | | | |
| Average Biased | 1.17E+02 | 1.06E+02 | 1.03E+02 | 1.01E+02 |
| Std Dev Biased | 8.06E+00 | 2.64E+00 | 2.73E+00 | 1.65E+00 |
| Ps90%/90% (+KTL) Biased | 1.39E+02 | 1.13E+02 | 1.11E+02 | 1.05E+02 |
| Ps90%/90% (-KTL) Biased | 9.46E+01 | 9.86E+01 | 9.59E+01 | 9.63E+01 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.08E+02 | 1.04E+02 | 1.04E+02 | 1.01E+02 |
| Std Dev Un-Biased | 4.95E+00 | 3.66E+00 | 5.61E+00 | 3.19E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.22E+02 | 1.14E+02 | 1.19E+02 | 1.09E+02 |
| Ps90%/90% (-KTL) Un-Biased | 9.49E+01 | 9.44E+01 | 8.83E+01 | 9.19E+01 |
| Specification MIN | 9.40E+01 | 9.10E+01 | 8.70E+01 | 8.50E+01 |
| Status | PASS | PASS | PASS | PASS |

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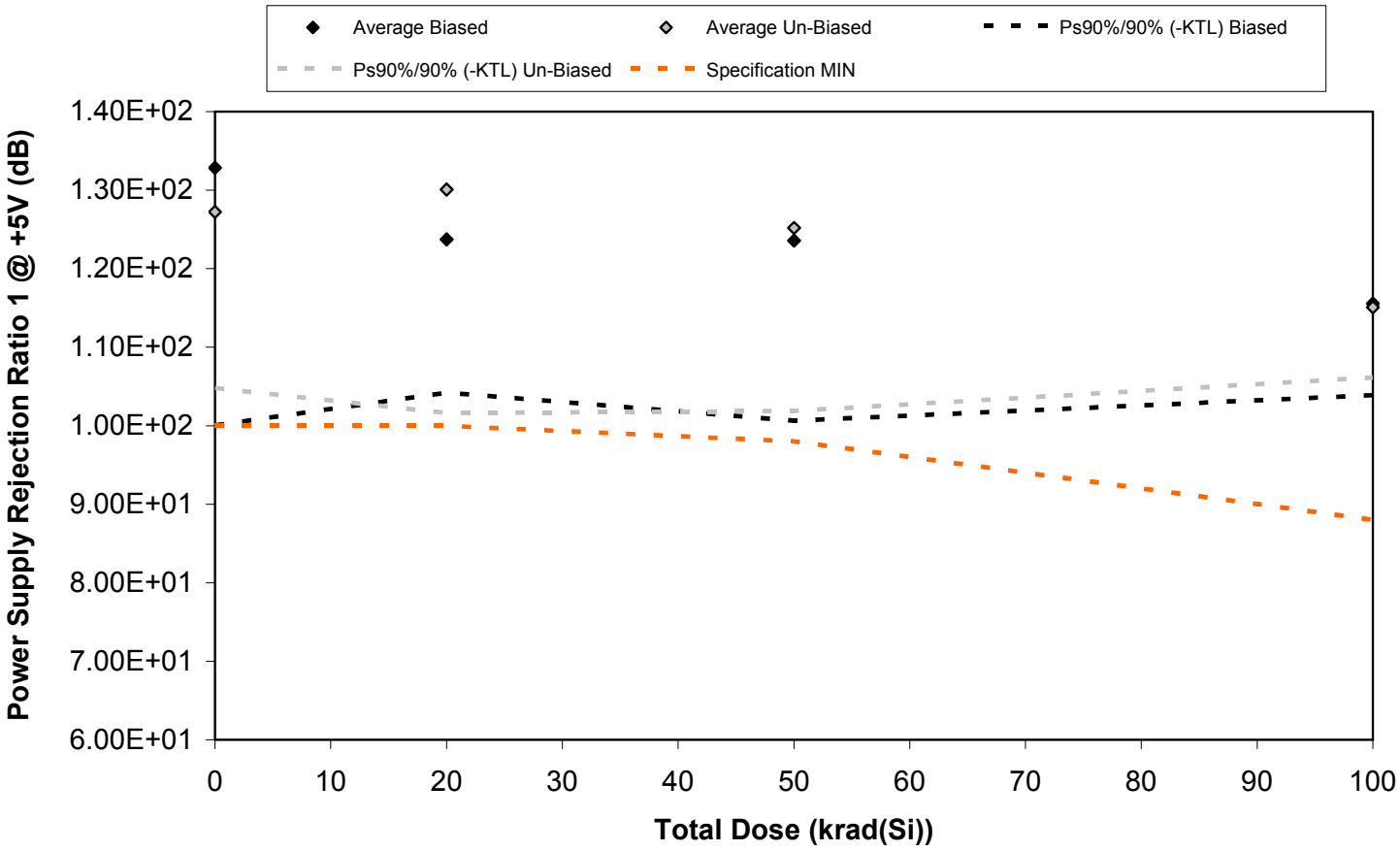


Figure 5.13. Plot of Power Supply Rejection Ratio 1 @ +5V (dB) versus total dose. The data show some degradation with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.13. Raw data for Power Supply Rejection Ratio 1 @ +5V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Power Supply Rejection Ratio 1 @ +5V (dB)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.23E+02 | 1.16E+02 | 1.15E+02 | 1.12E+02 |
| 409 | 1.20E+02 | 1.19E+02 | 1.36E+02 | 1.21E+02 |
| 410 | 1.40E+02 | 1.33E+02 | 1.27E+02 | 1.17E+02 |
| 411 | 1.49E+02 | 1.21E+02 | 1.19E+02 | 1.10E+02 |
| 412 | 1.32E+02 | 1.30E+02 | 1.21E+02 | 1.17E+02 |
| 413 | 1.27E+02 | 1.23E+02 | 1.20E+02 | 1.14E+02 |
| 414 | 1.26E+02 | 1.19E+02 | 1.30E+02 | 1.15E+02 |
| 415 | 1.41E+02 | 1.44E+02 | 1.38E+02 | 1.21E+02 |
| 418 | 1.23E+02 | 1.38E+02 | 1.19E+02 | 1.12E+02 |
| 419 | 1.20E+02 | 1.26E+02 | 1.19E+02 | 1.14E+02 |
| 420 | 1.17E+02 | 1.15E+02 | 1.16E+02 | 1.28E+02 |
| 421 | 1.29E+02 | 1.22E+02 | 1.21E+02 | 1.19E+02 |
| Biased Statistics | | | | |
| Average Biased | 1.33E+02 | 1.24E+02 | 1.24E+02 | 1.16E+02 |
| Std Dev Biased | 1.20E+01 | 7.11E+00 | 8.37E+00 | 4.25E+00 |
| Ps90%/90% (+KTL) Biased | 1.66E+02 | 1.43E+02 | 1.47E+02 | 1.27E+02 |
| Ps90%/90% (-KTL) Biased | 1.00E+02 | 1.04E+02 | 1.01E+02 | 1.04E+02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.27E+02 | 1.30E+02 | 1.25E+02 | 1.15E+02 |
| Std Dev Un-Biased | 8.18E+00 | 1.04E+01 | 8.50E+00 | 3.27E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.50E+02 | 1.58E+02 | 1.48E+02 | 1.24E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.05E+02 | 1.02E+02 | 1.02E+02 | 1.06E+02 |
| Specification MIN | 1.00E+02 | 1.00E+02 | 9.80E+01 | 8.80E+01 |
| Status | PASS | PASS | PASS | PASS |

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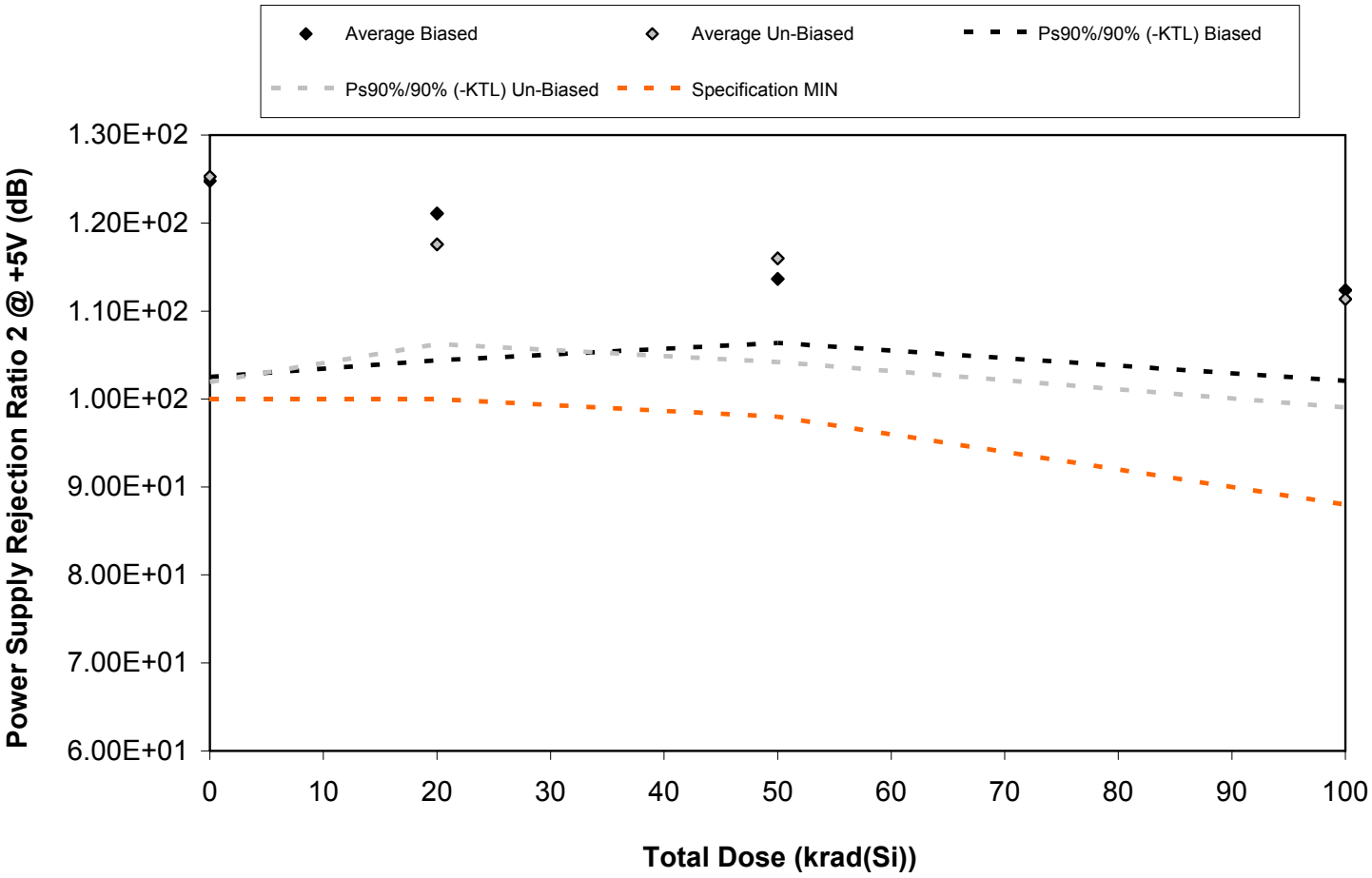


Figure 5.14. Plot of Power Supply Rejection Ratio 2 @ +5V (dB) versus total dose. The data show some degradation with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.14. Raw data for Power Supply Rejection Ratio 2 @ +5V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Power Supply Rejection Ratio 2 @ +5V (dB)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.16E+02 | 1.15E+02 | 1.12E+02 | 1.08E+02 |
| 409 | 1.27E+02 | 1.22E+02 | 1.18E+02 | 1.18E+02 |
| 410 | 1.26E+02 | 1.19E+02 | 1.12E+02 | 1.13E+02 |
| 411 | 1.36E+02 | 1.19E+02 | 1.13E+02 | 1.11E+02 |
| 412 | 1.19E+02 | 1.31E+02 | 1.13E+02 | 1.13E+02 |
| 413 | 1.28E+02 | 1.11E+02 | 1.20E+02 | 1.08E+02 |
| 414 | 1.19E+02 | 1.17E+02 | 1.12E+02 | 1.11E+02 |
| 415 | 1.16E+02 | 1.18E+02 | 1.14E+02 | 1.08E+02 |
| 418 | 1.25E+02 | 1.22E+02 | 1.21E+02 | 1.19E+02 |
| 419 | 1.38E+02 | 1.20E+02 | 1.13E+02 | 1.11E+02 |
| 420 | 1.19E+02 | 1.16E+02 | 1.20E+02 | 1.21E+02 |
| 421 | 1.12E+02 | 1.13E+02 | 1.13E+02 | 1.09E+02 |
| Biased Statistics | | | | |
| Average Biased | 1.25E+02 | 1.21E+02 | 1.14E+02 | 1.12E+02 |
| Std Dev Biased | 8.12E+00 | 6.10E+00 | 2.65E+00 | 3.76E+00 |
| Ps90%/90% (+KTL) Biased | 1.47E+02 | 1.38E+02 | 1.21E+02 | 1.23E+02 |
| Ps90%/90% (-KTL) Biased | 1.03E+02 | 1.04E+02 | 1.06E+02 | 1.02E+02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.25E+02 | 1.18E+02 | 1.16E+02 | 1.11E+02 |
| Std Dev Un-Biased | 8.52E+00 | 4.13E+00 | 4.30E+00 | 4.49E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.49E+02 | 1.29E+02 | 1.28E+02 | 1.24E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.02E+02 | 1.06E+02 | 1.04E+02 | 9.90E+01 |
| Specification MIN | 1.00E+02 | 1.00E+02 | 9.80E+01 | 8.80E+01 |
| Status | PASS | PASS | PASS | PASS |

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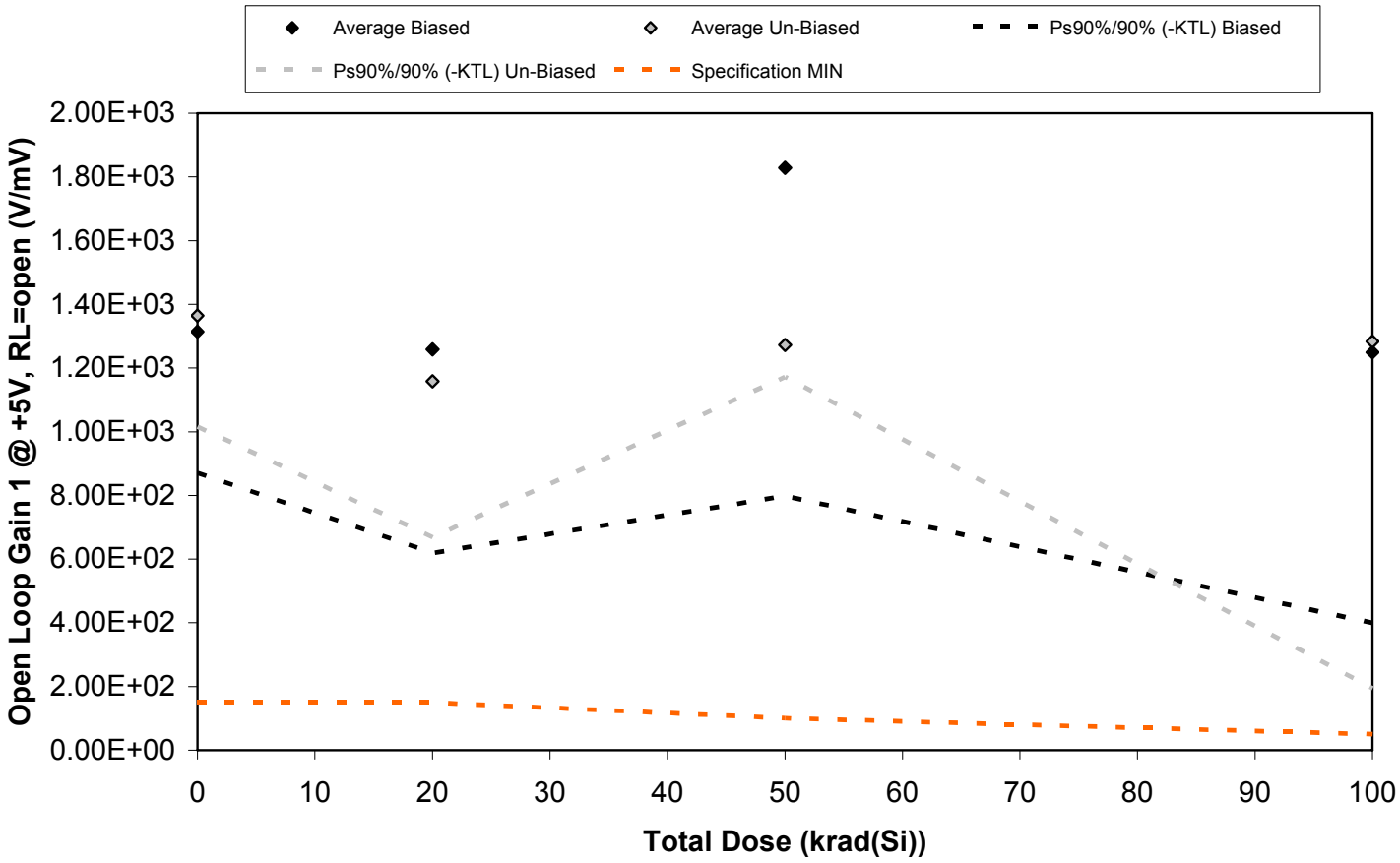


Figure 5.15. Plot of Open Loop Gain 1 @ +5V, RL=open (V/mV) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.15. Raw data for Open Loop Gain 1 @ +5V, RL=open (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 1 @ +5V, RL=open (V/mV)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.36E+03 | 1.44E+03 | 1.35E+03 | 9.99E+02 |
| 409 | 1.08E+03 | 1.12E+03 | 1.67E+03 | 1.12E+03 |
| 410 | 1.23E+03 | 1.06E+03 | 1.78E+03 | 1.71E+03 |
| 411 | 1.48E+03 | 1.10E+03 | 1.99E+03 | 1.42E+03 |
| 412 | 1.42E+03 | 1.57E+03 | 2.36E+03 | 9.99E+02 |
| 413 | 1.29E+03 | 1.01E+03 | 1.30E+03 | 9.99E+02 |
| 414 | 1.59E+03 | 1.40E+03 | 1.23E+03 | 1.88E+03 |
| 415 | 1.29E+03 | 1.04E+03 | 1.26E+03 | 1.51E+03 |
| 418 | 1.35E+03 | 1.30E+03 | 1.32E+03 | 9.99E+02 |
| 419 | 1.31E+03 | 1.04E+03 | 1.25E+03 | 1.03E+03 |
| 420 | 1.32E+03 | 1.28E+03 | 1.34E+03 | 1.33E+03 |
| 421 | 1.53E+03 | 1.30E+03 | 1.22E+03 | 1.46E+03 |
| Biased Statistics | | | | |
| Average Biased | 1.31E+03 | 1.26E+03 | 1.83E+03 | 1.25E+03 |
| Std Dev Biased | 1.62E+02 | 2.33E+02 | 3.76E+02 | 3.10E+02 |
| Ps90%/90% (+KTL) Biased | 1.76E+03 | 1.90E+03 | 2.86E+03 | 2.10E+03 |
| Ps90%/90% (-KTL) Biased | 8.70E+02 | 6.19E+02 | 7.98E+02 | 4.00E+02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.36E+03 | 1.16E+03 | 1.27E+03 | 1.28E+03 |
| Std Dev Un-Biased | 1.27E+02 | 1.79E+02 | 3.66E+01 | 3.97E+02 |
| Ps90%/90% (+KTL) Un-Biased | 1.71E+03 | 1.65E+03 | 1.37E+03 | 2.37E+03 |
| Ps90%/90% (-KTL) Un-Biased | 1.02E+03 | 6.68E+02 | 1.17E+03 | 1.95E+02 |
| Specification MIN | 1.50E+02 | 1.50E+02 | 1.00E+02 | 5.00E+01 |
| Status | PASS | PASS | PASS | PASS |

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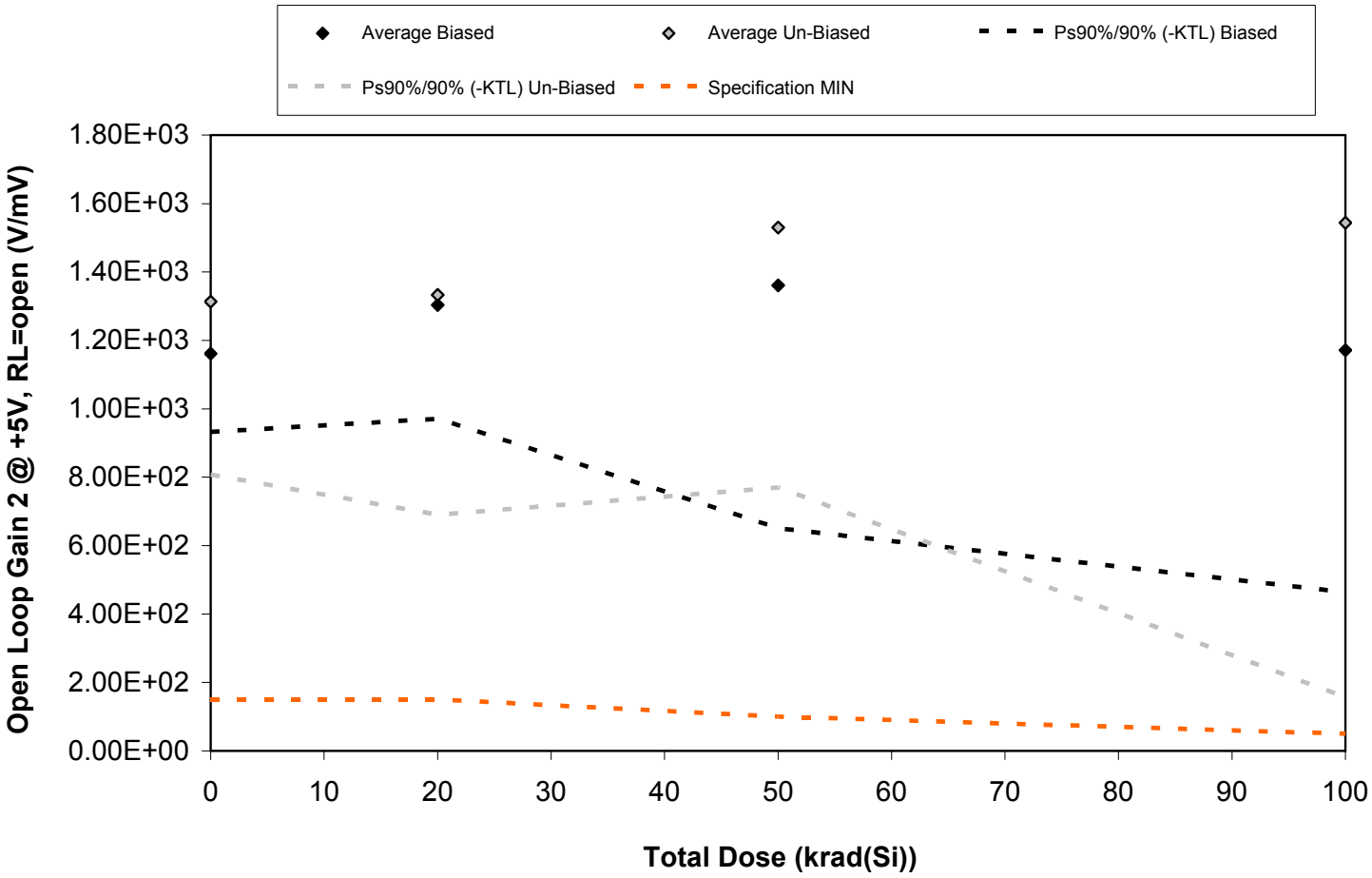


Figure 5.16. Plot of Open Loop Gain 2 @ +5V, RL=open (V/mV) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.16. Raw data for Open Loop Gain 2 @ +5V, RL=open (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 2 @ +5V, RL=open (V/mV)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.28E+03 | 1.35E+03 | 1.28E+03 | 1.58E+03 |
| 409 | 1.09E+03 | 1.38E+03 | 1.28E+03 | 9.99E+02 |
| 410 | 1.14E+03 | 1.21E+03 | 1.23E+03 | 1.28E+03 |
| 411 | 1.21E+03 | 1.43E+03 | 1.19E+03 | 9.99E+02 |
| 412 | 1.09E+03 | 1.15E+03 | 1.82E+03 | 9.99E+02 |
| 413 | 1.34E+03 | 1.40E+03 | 1.68E+03 | 1.78E+03 |
| 414 | 1.62E+03 | 1.10E+03 | 1.62E+03 | 9.99E+02 |
| 415 | 1.14E+03 | 1.13E+03 | 1.85E+03 | 2.04E+03 |
| 418 | 1.23E+03 | 1.68E+03 | 1.15E+03 | 9.99E+02 |
| 419 | 1.23E+03 | 1.35E+03 | 1.35E+03 | 1.90E+03 |
| 420 | 1.18E+03 | 1.54E+03 | 1.52E+03 | 1.81E+03 |
| 421 | 1.44E+03 | 1.27E+03 | 1.34E+03 | 1.21E+03 |
| Biased Statistics | | | | |
| Average Biased | 1.16E+03 | 1.30E+03 | 1.36E+03 | 1.17E+03 |
| Std Dev Biased | 8.35E+01 | 1.21E+02 | 2.59E+02 | 2.58E+02 |
| Ps90%/90% (+KTL) Biased | 1.39E+03 | 1.64E+03 | 2.07E+03 | 1.88E+03 |
| Ps90%/90% (-KTL) Biased | 9.32E+02 | 9.71E+02 | 6.51E+02 | 4.64E+02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.31E+03 | 1.33E+03 | 1.53E+03 | 1.54E+03 |
| Std Dev Un-Biased | 1.85E+02 | 2.34E+02 | 2.77E+02 | 5.06E+02 |
| Ps90%/90% (+KTL) Un-Biased | 1.82E+03 | 1.98E+03 | 2.29E+03 | 2.93E+03 |
| Ps90%/90% (-KTL) Un-Biased | 8.08E+02 | 6.90E+02 | 7.70E+02 | 1.57E+02 |
| Specification MIN | 1.50E+02 | 1.50E+02 | 1.00E+02 | 5.00E+01 |
| Status | PASS | PASS | PASS | PASS |

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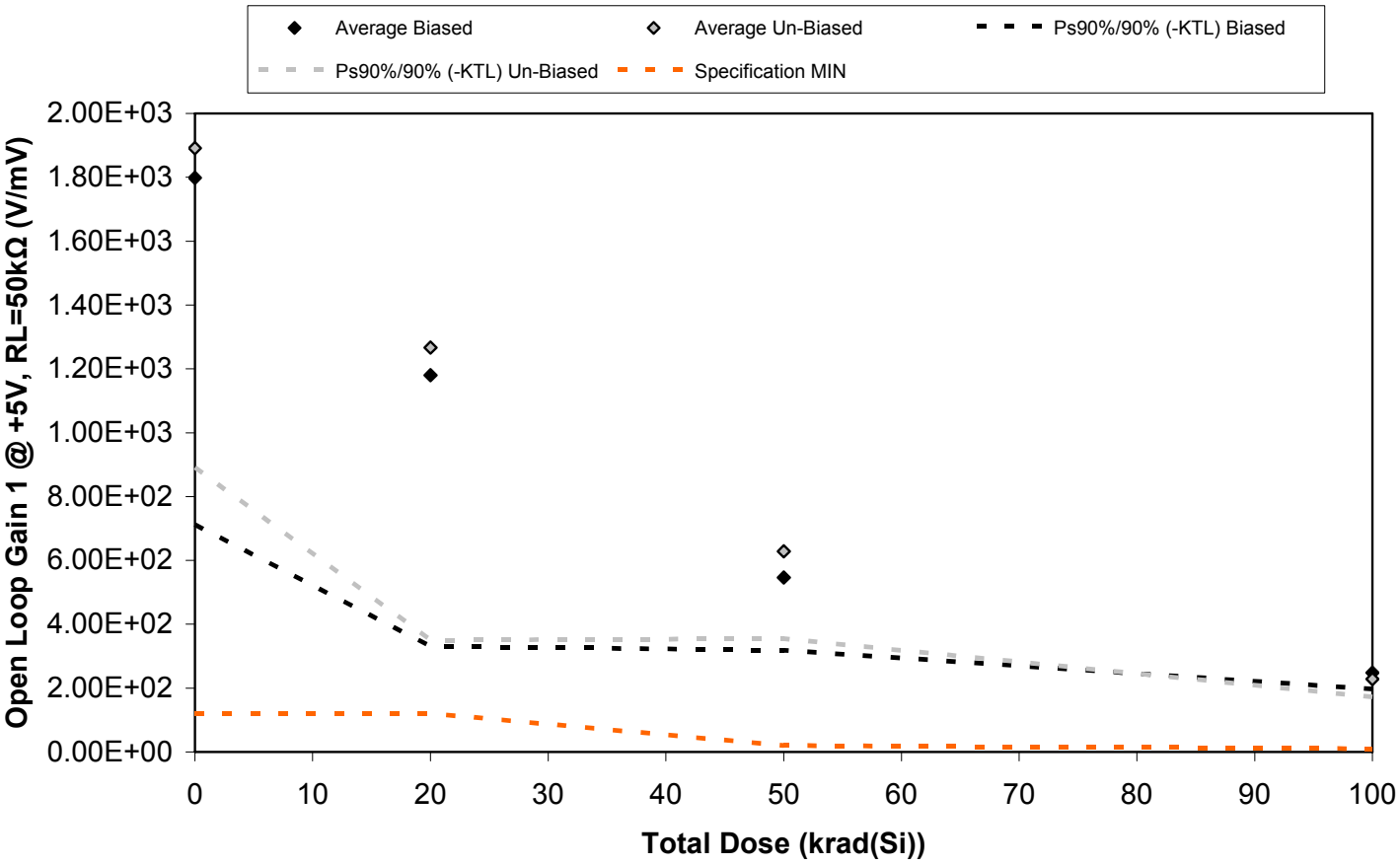


Figure 5.17. Plot of Open Loop Gain 1 @ +5V, RL=50kΩ (V/mV) versus total dose. The data show significant degradation with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.17. Raw data for Open Loop Gain 1 @ +5V, RL=50kΩ (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 1 @ +5V, RL=50kΩ (V/mV)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.41E+03 | 1.09E+03 | 5.28E+02 | 2.38E+02 |
| 409 | 2.31E+03 | 1.28E+03 | 5.10E+02 | 2.54E+02 |
| 410 | 2.01E+03 | 1.67E+03 | 6.67E+02 | 2.72E+02 |
| 411 | 1.88E+03 | 9.69E+02 | 4.45E+02 | 2.23E+02 |
| 412 | 1.39E+03 | 8.91E+02 | 5.82E+02 | 2.55E+02 |
| 413 | 1.46E+03 | 1.28E+03 | 4.83E+02 | 2.13E+02 |
| 414 | 2.41E+03 | 1.27E+03 | 6.39E+02 | 2.47E+02 |
| 415 | 1.82E+03 | 1.71E+03 | 7.65E+02 | 2.42E+02 |
| 418 | 2.07E+03 | 7.67E+02 | 6.20E+02 | 2.39E+02 |
| 419 | 1.71E+03 | 1.31E+03 | 6.35E+02 | 2.00E+02 |
| 420 | 1.16E+03 | 1.30E+03 | 1.59E+03 | 1.67E+03 |
| 421 | 1.23E+03 | 1.75E+03 | 1.32E+03 | 1.35E+03 |
| Biased Statistics | | | | |
| Average Biased | 1.80E+03 | 1.18E+03 | 5.46E+02 | 2.48E+02 |
| Std Dev Biased | 3.96E+02 | 3.10E+02 | 8.32E+01 | 1.87E+01 |
| Ps90%/90% (+KTL) Biased | 2.89E+03 | 2.03E+03 | 7.75E+02 | 3.00E+02 |
| Ps90%/90% (-KTL) Biased | 7.12E+02 | 3.31E+02 | 3.18E+02 | 1.97E+02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.89E+03 | 1.27E+03 | 6.28E+02 | 2.28E+02 |
| Std Dev Un-Biased | 3.65E+02 | 3.34E+02 | 1.00E+02 | 2.04E+01 |
| Ps90%/90% (+KTL) Un-Biased | 2.89E+03 | 2.18E+03 | 9.03E+02 | 2.84E+02 |
| Ps90%/90% (-KTL) Un-Biased | 8.91E+02 | 3.50E+02 | 3.54E+02 | 1.72E+02 |
| Specification MIN | 1.20E+02 | 1.20E+02 | 2.00E+01 | 1.00E+01 |
| Status | PASS | PASS | PASS | PASS |

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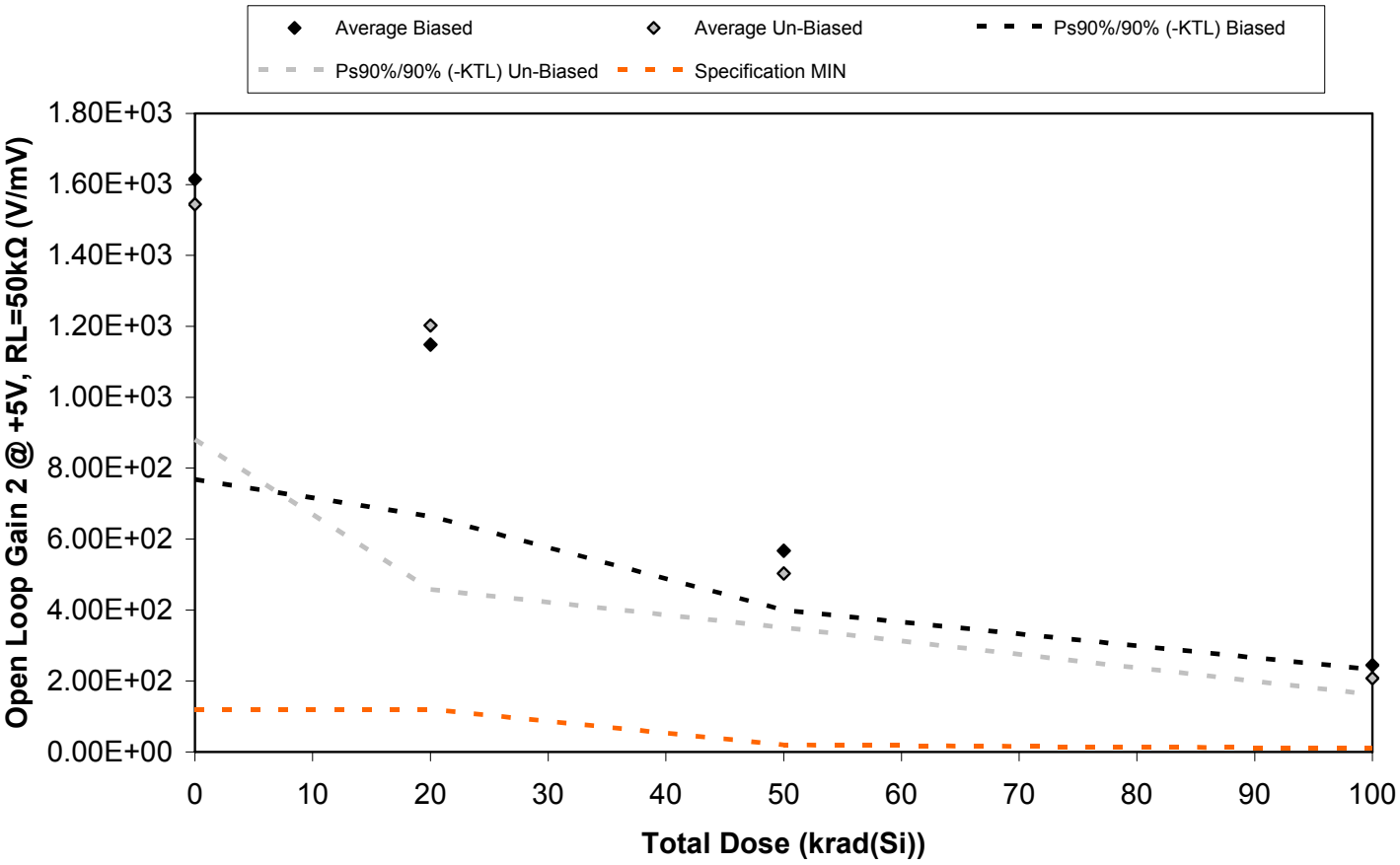


Figure 5.18. Plot of Open Loop Gain 2 @ +5V, RL=50kΩ (V/mV) versus total dose. The data show significant degradation with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.18. Raw data for Open Loop Gain 2 @ +5V, RL=50kΩ (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 2 @ +5V, RL=50kΩ (V/mV)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.13E+03 | 9.74E+02 | 5.73E+02 | 2.46E+02 |
| 409 | 1.66E+03 | 1.38E+03 | 6.34E+02 | 2.46E+02 |
| 410 | 1.67E+03 | 1.29E+03 | 5.50E+02 | 2.52E+02 |
| 411 | 1.98E+03 | 1.04E+03 | 6.06E+02 | 2.43E+02 |
| 412 | 1.64E+03 | 1.05E+03 | 4.74E+02 | 2.39E+02 |
| 413 | 1.87E+03 | 1.07E+03 | 4.35E+02 | 1.79E+02 |
| 414 | 1.37E+03 | 9.37E+02 | 5.90E+02 | 2.12E+02 |
| 415 | 1.35E+03 | 1.09E+03 | 4.91E+02 | 2.10E+02 |
| 418 | 1.73E+03 | 1.63E+03 | 5.12E+02 | 2.21E+02 |
| 419 | 1.40E+03 | 1.29E+03 | 4.90E+02 | 2.17E+02 |
| 420 | 1.37E+03 | 1.27E+03 | 1.32E+03 | 1.69E+03 |
| 421 | 1.04E+03 | 1.19E+03 | 1.22E+03 | 1.19E+03 |
| Biased Statistics | | | | |
| Average Biased | 1.61E+03 | 1.15E+03 | 5.67E+02 | 2.45E+02 |
| Std Dev Biased | 3.09E+02 | 1.77E+02 | 6.10E+01 | 4.51E+00 |
| Ps90%/90% (+KTL) Biased | 2.46E+03 | 1.63E+03 | 7.35E+02 | 2.57E+02 |
| Ps90%/90% (-KTL) Biased | 7.68E+02 | 6.64E+02 | 4.00E+02 | 2.33E+02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 1.54E+03 | 1.20E+03 | 5.03E+02 | 2.08E+02 |
| Std Dev Un-Biased | 2.42E+02 | 2.72E+02 | 5.59E+01 | 1.67E+01 |
| Ps90%/90% (+KTL) Un-Biased | 2.21E+03 | 1.95E+03 | 6.57E+02 | 2.54E+02 |
| Ps90%/90% (-KTL) Un-Biased | 8.80E+02 | 4.58E+02 | 3.50E+02 | 1.62E+02 |
| Specification MIN | 1.20E+02 | 1.20E+02 | 2.00E+01 | 1.00E+01 |
| Status | PASS | PASS | PASS | PASS |

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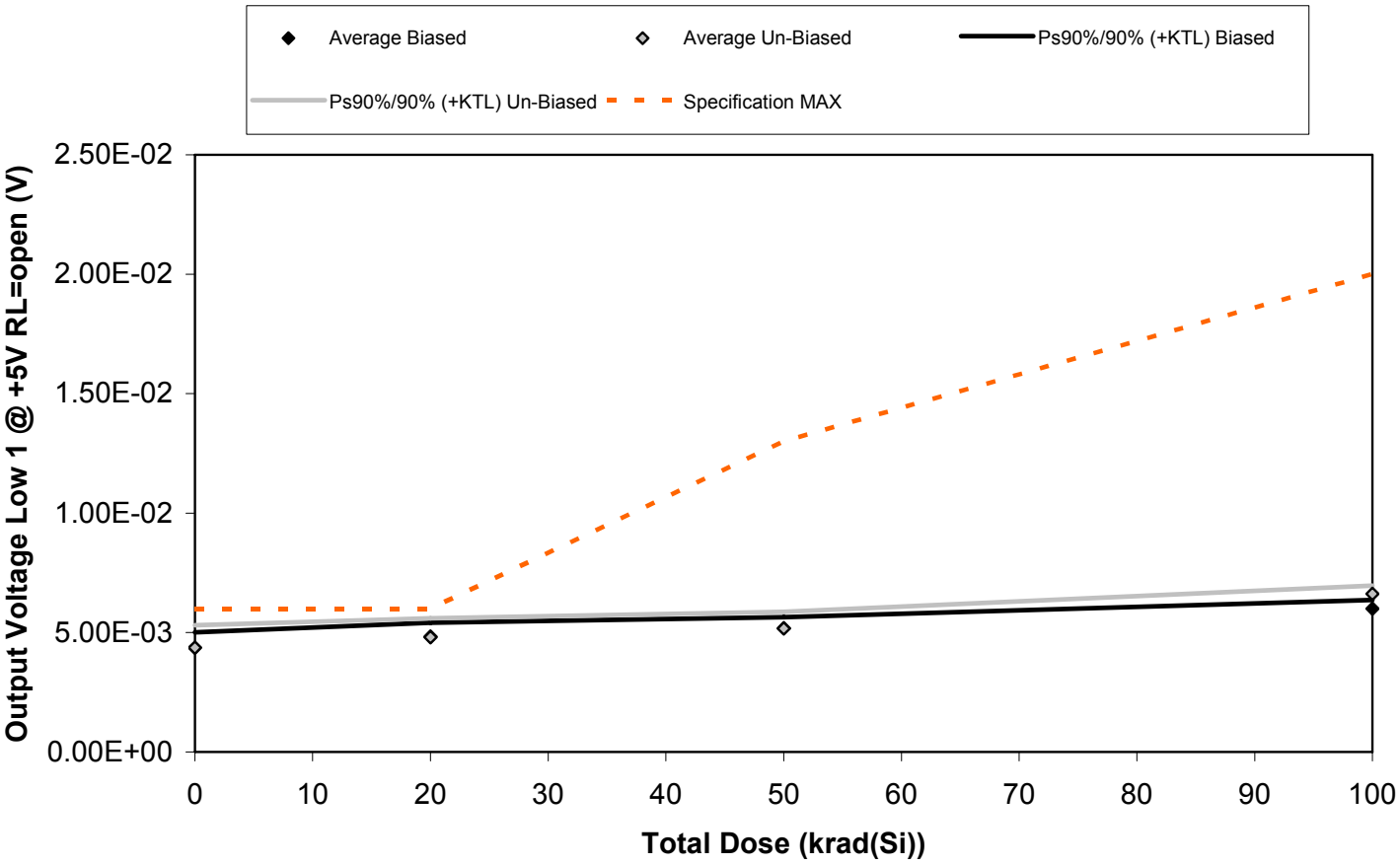


Figure 5.19. Plot of Output Voltage Low 1 @ +5V RL=open (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.19. Raw data for Output Voltage Low 1 @ +5V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 1 @ +5V RL=open (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 4.06E-03 | 4.84E-03 | 4.95E-03 | 6.23E-03 |
| 409 | 4.62E-03 | 4.46E-03 | 5.04E-03 | 5.91E-03 |
| 410 | 4.41E-03 | 4.92E-03 | 5.31E-03 | 5.98E-03 |
| 411 | 4.55E-03 | 5.02E-03 | 5.32E-03 | 5.90E-03 |
| 412 | 4.20E-03 | 4.87E-03 | 5.26E-03 | 5.98E-03 |
| 413 | 4.94E-03 | 4.43E-03 | 5.34E-03 | 6.77E-03 |
| 414 | 4.20E-03 | 5.19E-03 | 4.73E-03 | 6.69E-03 |
| 415 | 4.30E-03 | 4.62E-03 | 5.22E-03 | 6.45E-03 |
| 418 | 4.31E-03 | 4.85E-03 | 5.31E-03 | 6.54E-03 |
| 419 | 4.04E-03 | 4.90E-03 | 5.27E-03 | 6.64E-03 |
| 420 | 4.25E-03 | 4.58E-03 | 4.65E-03 | 4.85E-03 |
| 421 | 4.63E-03 | 4.58E-03 | 4.57E-03 | 4.63E-03 |
| Biased Statistics | | | | |
| Average Biased | 4.37E-03 | 4.82E-03 | 5.18E-03 | 6.00E-03 |
| Std Dev Biased | 2.35E-04 | 2.14E-04 | 1.70E-04 | 1.34E-04 |
| Ps90%/90% (+KTL) Biased | 5.01E-03 | 5.41E-03 | 5.64E-03 | 6.37E-03 |
| Ps90%/90% (-KTL) Biased | 3.72E-03 | 4.24E-03 | 4.71E-03 | 5.63E-03 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 4.36E-03 | 4.80E-03 | 5.17E-03 | 6.62E-03 |
| Std Dev Un-Biased | 3.43E-04 | 2.89E-04 | 2.52E-04 | 1.26E-04 |
| Ps90%/90% (+KTL) Un-Biased | 5.30E-03 | 5.59E-03 | 5.87E-03 | 6.96E-03 |
| Ps90%/90% (-KTL) Un-Biased | 3.42E-03 | 4.01E-03 | 4.48E-03 | 6.27E-03 |
| Specification MAX | 6.00E-03 | 6.00E-03 | 1.30E-02 | 2.00E-02 |
| Status | PASS | PASS | PASS | PASS |

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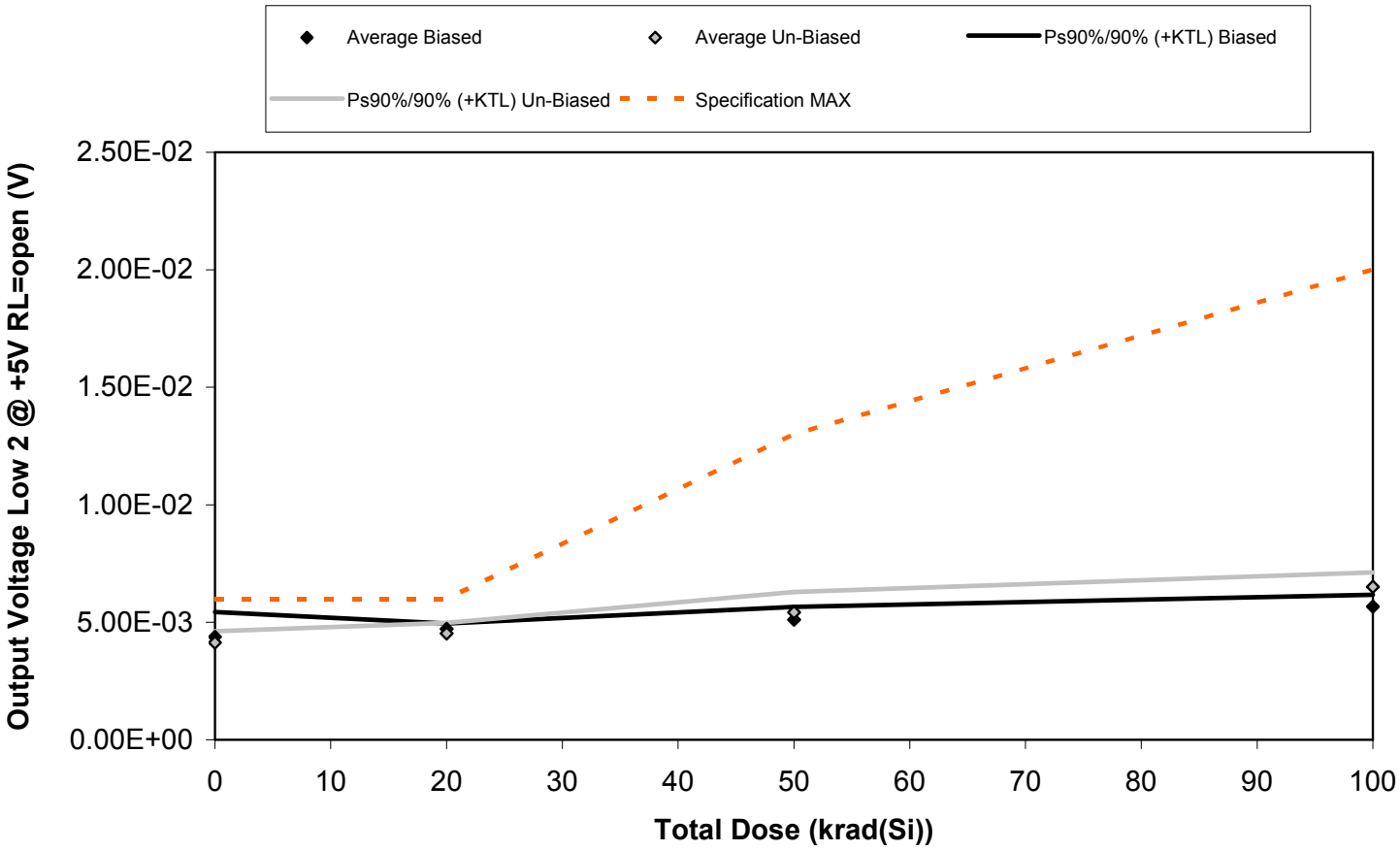


Figure 5.20. Plot of Output Voltage Low 2 @ +5V RL=open (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.20. Raw data for Output Voltage Low 2 @ +5V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 2 @ +5V RL=open (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 4.31E-03 | 4.84E-03 | 4.89E-03 | 5.41E-03 |
| 409 | 4.38E-03 | 4.75E-03 | 5.34E-03 | 5.74E-03 |
| 410 | 3.94E-03 | 4.67E-03 | 4.90E-03 | 5.91E-03 |
| 411 | 5.00E-03 | 4.62E-03 | 5.22E-03 | 5.64E-03 |
| 412 | 4.28E-03 | 4.68E-03 | 5.17E-03 | 5.66E-03 |
| 413 | 4.08E-03 | 4.78E-03 | 5.90E-03 | 6.72E-03 |
| 414 | 4.14E-03 | 4.33E-03 | 5.39E-03 | 6.44E-03 |
| 415 | 3.86E-03 | 4.48E-03 | 5.02E-03 | 6.17E-03 |
| 418 | 4.23E-03 | 4.55E-03 | 5.44E-03 | 6.54E-03 |
| 419 | 4.33E-03 | 4.46E-03 | 5.37E-03 | 6.69E-03 |
| 420 | 4.25E-03 | 4.30E-03 | 4.79E-03 | 4.45E-03 |
| 421 | 3.96E-03 | 4.19E-03 | 4.20E-03 | 4.30E-03 |
| Biased Statistics | | | | |
| Average Biased | 4.38E-03 | 4.71E-03 | 5.10E-03 | 5.67E-03 |
| Std Dev Biased | 3.85E-04 | 8.53E-05 | 2.01E-04 | 1.81E-04 |
| Ps90%/90% (+KTL) Biased | 5.44E-03 | 4.95E-03 | 5.65E-03 | 6.17E-03 |
| Ps90%/90% (-KTL) Biased | 3.33E-03 | 4.48E-03 | 4.55E-03 | 5.18E-03 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 4.13E-03 | 4.52E-03 | 5.42E-03 | 6.51E-03 |
| Std Dev Un-Biased | 1.77E-04 | 1.66E-04 | 3.14E-04 | 2.22E-04 |
| Ps90%/90% (+KTL) Un-Biased | 4.61E-03 | 4.97E-03 | 6.28E-03 | 7.12E-03 |
| Ps90%/90% (-KTL) Un-Biased | 3.64E-03 | 4.07E-03 | 4.56E-03 | 5.90E-03 |
| Specification MAX | 6.00E-03 | 6.00E-03 | 1.30E-02 | 2.00E-02 |
| Status | PASS | PASS | PASS | PASS |

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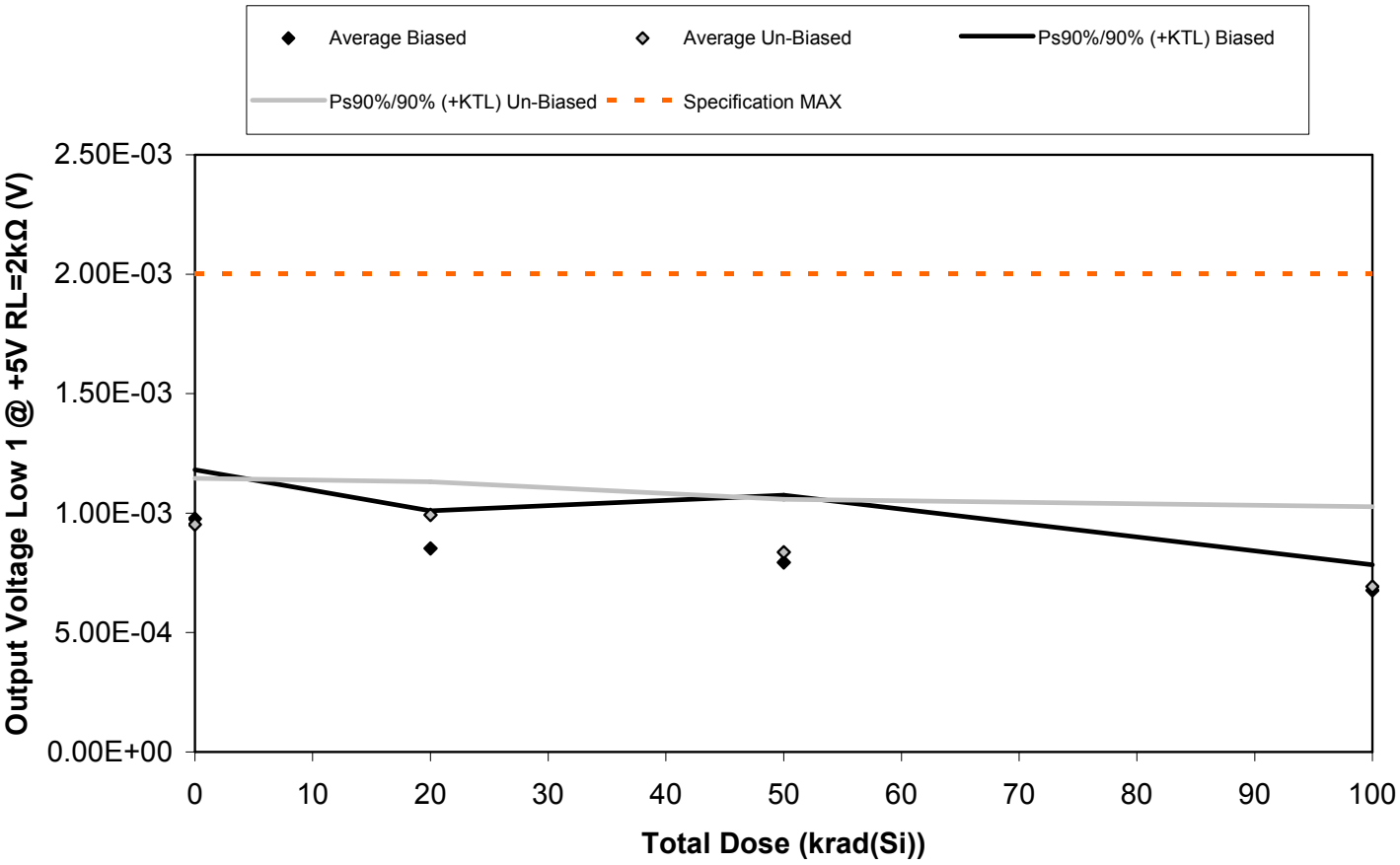


Figure 5.21. Plot of Output Voltage Low 1 @ +5V RL=2kΩ (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.21. Raw data for Output Voltage Low 1 @ +5V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 1 @ +5V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 1.05E-03 | 7.90E-04 | 7.00E-04 | 6.40E-04 |
| 409 | 9.70E-04 | 9.00E-04 | 9.00E-04 | 6.80E-04 |
| 410 | 1.05E-03 | 7.90E-04 | 8.40E-04 | 7.40E-04 |
| 411 | 8.80E-04 | 8.80E-04 | 8.60E-04 | 6.70E-04 |
| 412 | 9.30E-04 | 9.00E-04 | 6.70E-04 | 6.50E-04 |
| 413 | 8.90E-04 | 9.80E-04 | 7.50E-04 | 6.20E-04 |
| 414 | 9.80E-04 | 9.50E-04 | 8.20E-04 | 5.30E-04 |
| 415 | 8.70E-04 | 1.04E-03 | 9.30E-04 | 6.90E-04 |
| 418 | 9.80E-04 | 9.40E-04 | 9.10E-04 | 8.10E-04 |
| 419 | 1.04E-03 | 1.05E-03 | 7.70E-04 | 8.10E-04 |
| 420 | 1.03E-03 | 1.04E-03 | 8.40E-04 | 9.30E-04 |
| 421 | 9.00E-04 | 8.10E-04 | 8.20E-04 | 9.20E-04 |
| Biased Statistics | | | | |
| Average Biased | 9.76E-04 | 8.52E-04 | 7.94E-04 | 6.76E-04 |
| Std Dev Biased | 7.47E-05 | 5.72E-05 | 1.02E-04 | 3.91E-05 |
| Ps90%/90% (+KTL) Biased | 1.18E-03 | 1.01E-03 | 1.07E-03 | 7.83E-04 |
| Ps90%/90% (-KTL) Biased | 7.71E-04 | 6.95E-04 | 5.13E-04 | 5.69E-04 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 9.52E-04 | 9.92E-04 | 8.36E-04 | 6.92E-04 |
| Std Dev Un-Biased | 7.05E-05 | 5.07E-05 | 8.11E-05 | 1.22E-04 |
| Ps90%/90% (+KTL) Un-Biased | 1.15E-03 | 1.13E-03 | 1.06E-03 | 1.03E-03 |
| Ps90%/90% (-KTL) Un-Biased | 7.59E-04 | 8.53E-04 | 6.14E-04 | 3.58E-04 |
| Specification MAX | 2.00E-03 | 2.00E-03 | 2.00E-03 | 2.00E-03 |
| Status | PASS | PASS | PASS | PASS |

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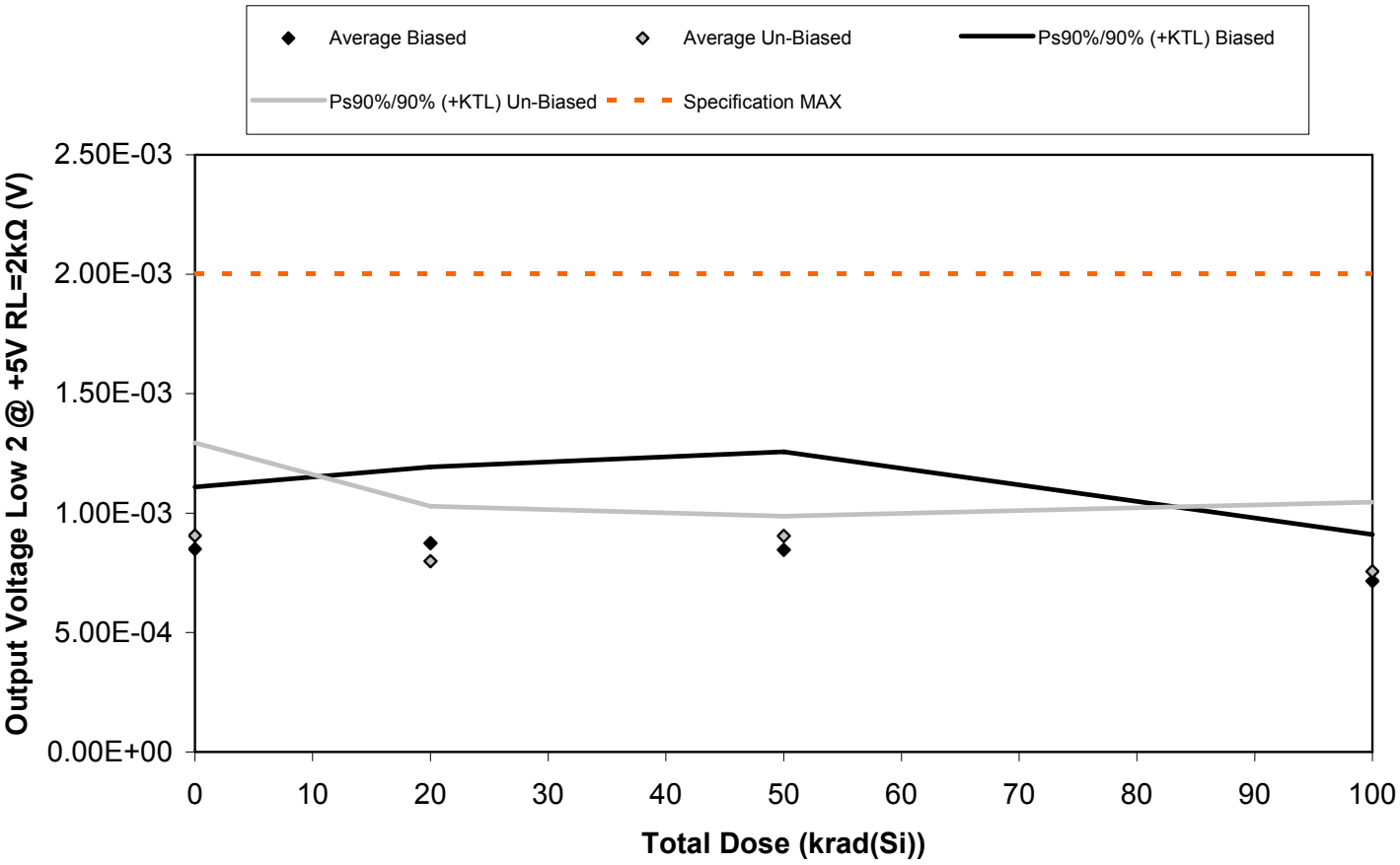


Figure 5.22. Plot of Output Voltage Low 2 @ +5V RL=2kΩ (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.22. Raw data for Output Voltage Low 2 @ +5V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 2 @ +5V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 7.50E-04 | 9.30E-04 | 9.10E-04 | 7.50E-04 |
| 409 | 7.80E-04 | 6.80E-04 | 5.90E-04 | 7.80E-04 |
| 410 | 9.10E-04 | 9.80E-04 | 9.60E-04 | 6.00E-04 |
| 411 | 9.80E-04 | 8.60E-04 | 9.30E-04 | 7.50E-04 |
| 412 | 8.30E-04 | 9.20E-04 | 8.40E-04 | 7.00E-04 |
| 413 | 9.60E-04 | 6.60E-04 | 9.10E-04 | 7.00E-04 |
| 414 | 8.60E-04 | 8.00E-04 | 9.20E-04 | 8.70E-04 |
| 415 | 1.03E-03 | 8.90E-04 | 9.20E-04 | 8.40E-04 |
| 418 | 1.00E-03 | 8.20E-04 | 9.20E-04 | 7.60E-04 |
| 419 | 6.80E-04 | 8.20E-04 | 8.50E-04 | 6.10E-04 |
| 420 | 9.40E-04 | 8.90E-04 | 9.80E-04 | 8.40E-04 |
| 421 | 9.20E-04 | 8.30E-04 | 9.10E-04 | 6.90E-04 |
| Biased Statistics | | | | |
| Average Biased | 8.50E-04 | 8.74E-04 | 8.46E-04 | 7.16E-04 |
| Std Dev Biased | 9.46E-05 | 1.17E-04 | 1.50E-04 | 7.09E-05 |
| Ps90%/90% (+KTL) Biased | 1.11E-03 | 1.19E-03 | 1.26E-03 | 9.10E-04 |
| Ps90%/90% (-KTL) Biased | 5.91E-04 | 5.54E-04 | 4.35E-04 | 5.22E-04 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 9.06E-04 | 7.98E-04 | 9.04E-04 | 7.56E-04 |
| Std Dev Un-Biased | 1.42E-04 | 8.44E-05 | 3.05E-05 | 1.05E-04 |
| Ps90%/90% (+KTL) Un-Biased | 1.29E-03 | 1.03E-03 | 9.88E-04 | 1.05E-03 |
| Ps90%/90% (-KTL) Un-Biased | 5.17E-04 | 5.67E-04 | 8.20E-04 | 4.67E-04 |
| Specification MAX | 2.00E-03 | 2.00E-03 | 2.00E-03 | 2.00E-03 |
| Status | PASS | PASS | PASS | PASS |

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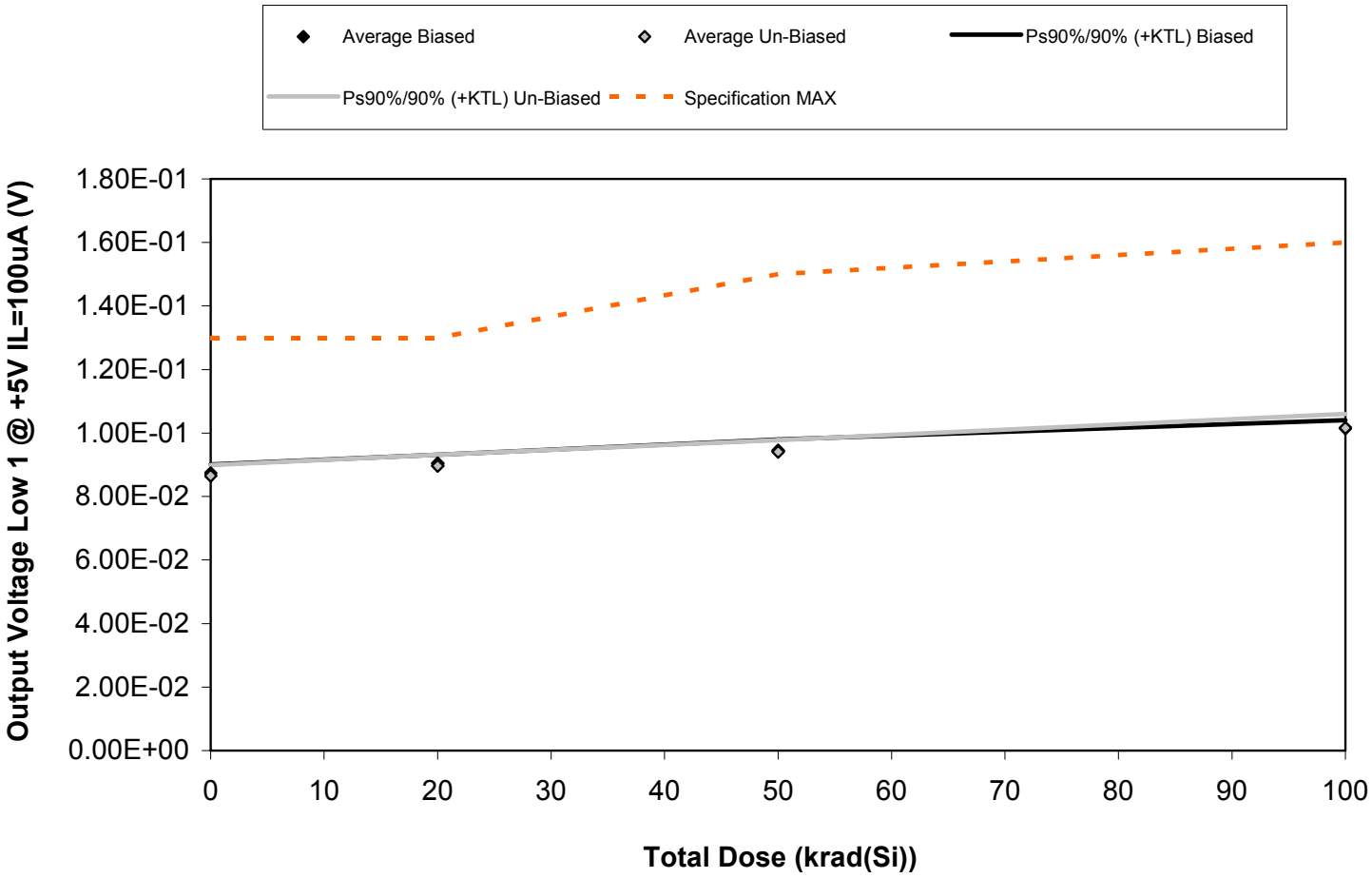


Figure 5.23. Plot of Output Voltage Low 1 @ +5V IL=100uA (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.23. Raw data for Output Voltage Low 1 @ +5V IL=100uA (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 1 @ +5V IL=100uA (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.66E-02 | 8.94E-02 | 9.42E-02 | 1.01E-01 |
| 409 | 8.77E-02 | 9.10E-02 | 9.49E-02 | 1.02E-01 |
| 410 | 8.63E-02 | 8.93E-02 | 9.29E-02 | 1.00E-01 |
| 411 | 8.74E-02 | 9.05E-02 | 9.42E-02 | 1.02E-01 |
| 412 | 8.88E-02 | 9.17E-02 | 9.63E-02 | 1.02E-01 |
| 413 | 8.84E-02 | 9.18E-02 | 9.63E-02 | 1.04E-01 |
| 414 | 8.71E-02 | 8.96E-02 | 9.39E-02 | 1.01E-01 |
| 415 | 8.54E-02 | 8.83E-02 | 9.27E-02 | 1.00E-01 |
| 418 | 8.55E-02 | 8.91E-02 | 9.37E-02 | 1.01E-01 |
| 419 | 8.62E-02 | 8.94E-02 | 9.35E-02 | 1.01E-01 |
| 420 | 8.71E-02 | 8.83E-02 | 8.83E-02 | 8.78E-02 |
| 421 | 8.88E-02 | 8.95E-02 | 8.87E-02 | 8.88E-02 |
| Biased Statistics | | | | |
| Average Biased | 8.74E-02 | 9.04E-02 | 9.45E-02 | 1.02E-01 |
| Std Dev Biased | 1.00E-03 | 1.03E-03 | 1.25E-03 | 9.23E-04 |
| Ps90%/90% (+KTL) Biased | 9.01E-02 | 9.32E-02 | 9.79E-02 | 1.04E-01 |
| Ps90%/90% (-KTL) Biased | 8.46E-02 | 8.76E-02 | 9.10E-02 | 9.90E-02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.65E-02 | 8.97E-02 | 9.40E-02 | 1.02E-01 |
| Std Dev Un-Biased | 1.25E-03 | 1.28E-03 | 1.37E-03 | 1.60E-03 |
| Ps90%/90% (+KTL) Un-Biased | 8.99E-02 | 9.32E-02 | 9.78E-02 | 1.06E-01 |
| Ps90%/90% (-KTL) Un-Biased | 8.31E-02 | 8.61E-02 | 9.03E-02 | 9.72E-02 |
| Specification MAX | 1.30E-01 | 1.30E-01 | 1.50E-01 | 1.60E-01 |
| Status | PASS | PASS | PASS | PASS |

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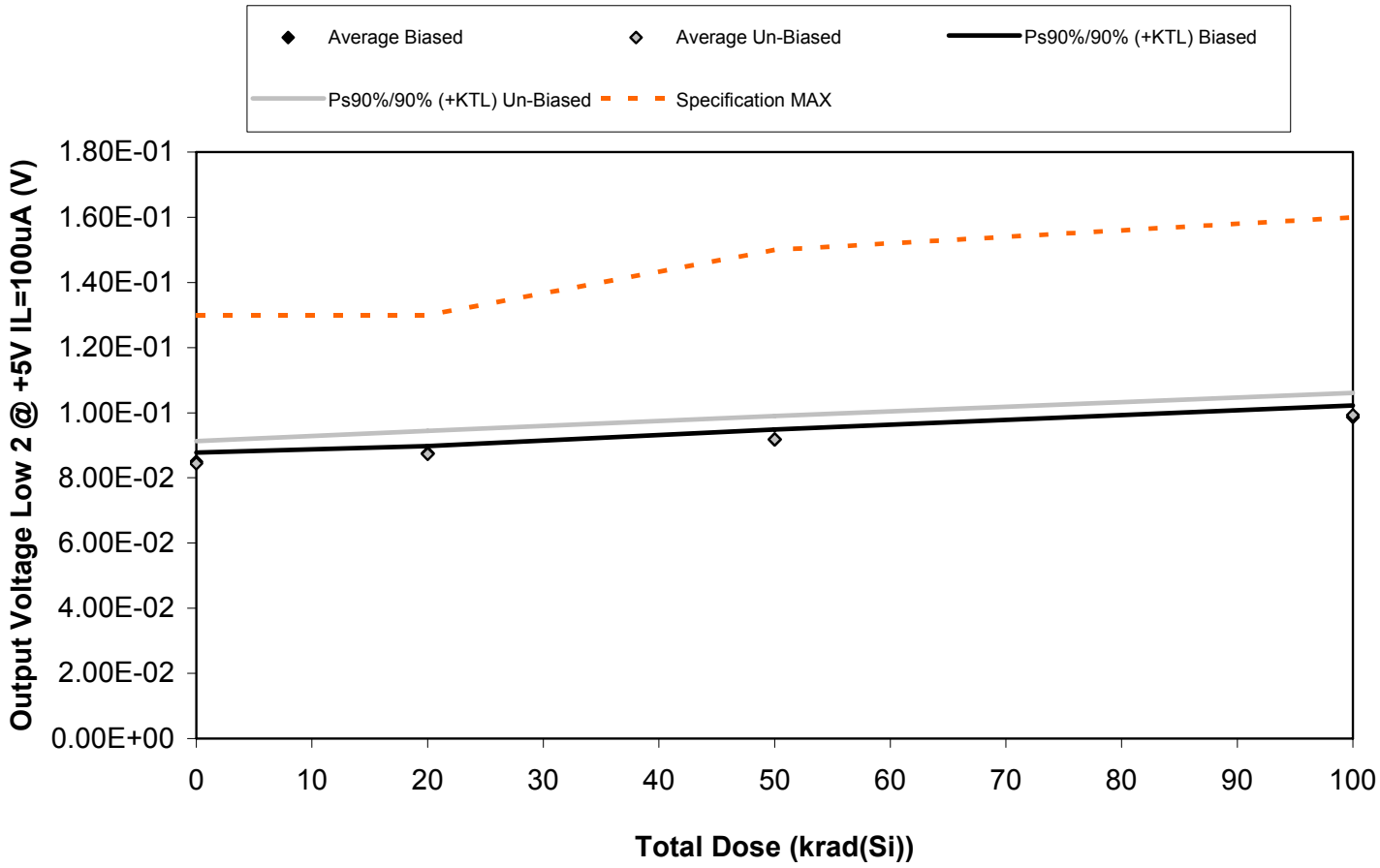


Figure 5.24. Plot of Output Voltage Low 2 @ +5V IL=100uA (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.24. Raw data for Output Voltage Low 2 @ +5V IL=100uA (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 2 @ +5V IL=100uA (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.45E-02 | 8.69E-02 | 9.11E-02 | 9.78E-02 |
| 409 | 8.54E-02 | 8.78E-02 | 9.18E-02 | 9.88E-02 |
| 410 | 8.38E-02 | 8.72E-02 | 9.12E-02 | 9.76E-02 |
| 411 | 8.46E-02 | 8.71E-02 | 9.14E-02 | 9.81E-02 |
| 412 | 8.65E-02 | 8.89E-02 | 9.38E-02 | 1.01E-01 |
| 413 | 8.64E-02 | 8.92E-02 | 9.40E-02 | 1.01E-01 |
| 414 | 8.67E-02 | 8.95E-02 | 9.38E-02 | 1.01E-01 |
| 415 | 8.19E-02 | 8.41E-02 | 8.85E-02 | 9.67E-02 |
| 418 | 8.17E-02 | 8.50E-02 | 8.94E-02 | 9.64E-02 |
| 419 | 8.56E-02 | 8.90E-02 | 9.34E-02 | 1.01E-01 |
| 420 | 8.50E-02 | 8.55E-02 | 8.55E-02 | 8.57E-02 |
| 421 | 8.78E-02 | 8.81E-02 | 8.80E-02 | 8.78E-02 |
| Biased Statistics | | | | |
| Average Biased | 8.49E-02 | 8.76E-02 | 9.18E-02 | 9.86E-02 |
| Std Dev Biased | 1.02E-03 | 8.04E-04 | 1.11E-03 | 1.32E-03 |
| Ps90%/90% (+KTL) Biased | 8.77E-02 | 8.98E-02 | 9.49E-02 | 1.02E-01 |
| Ps90%/90% (-KTL) Biased | 8.21E-02 | 8.54E-02 | 8.88E-02 | 9.50E-02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.45E-02 | 8.73E-02 | 9.18E-02 | 9.93E-02 |
| Std Dev Un-Biased | 2.48E-03 | 2.58E-03 | 2.63E-03 | 2.50E-03 |
| Ps90%/90% (+KTL) Un-Biased | 9.13E-02 | 9.44E-02 | 9.90E-02 | 1.06E-01 |
| Ps90%/90% (-KTL) Un-Biased | 7.77E-02 | 8.03E-02 | 8.46E-02 | 9.24E-02 |
| Specification MAX | 1.30E-01 | 1.30E-01 | 1.50E-01 | 1.60E-01 |
| Status | PASS | PASS | PASS | PASS |

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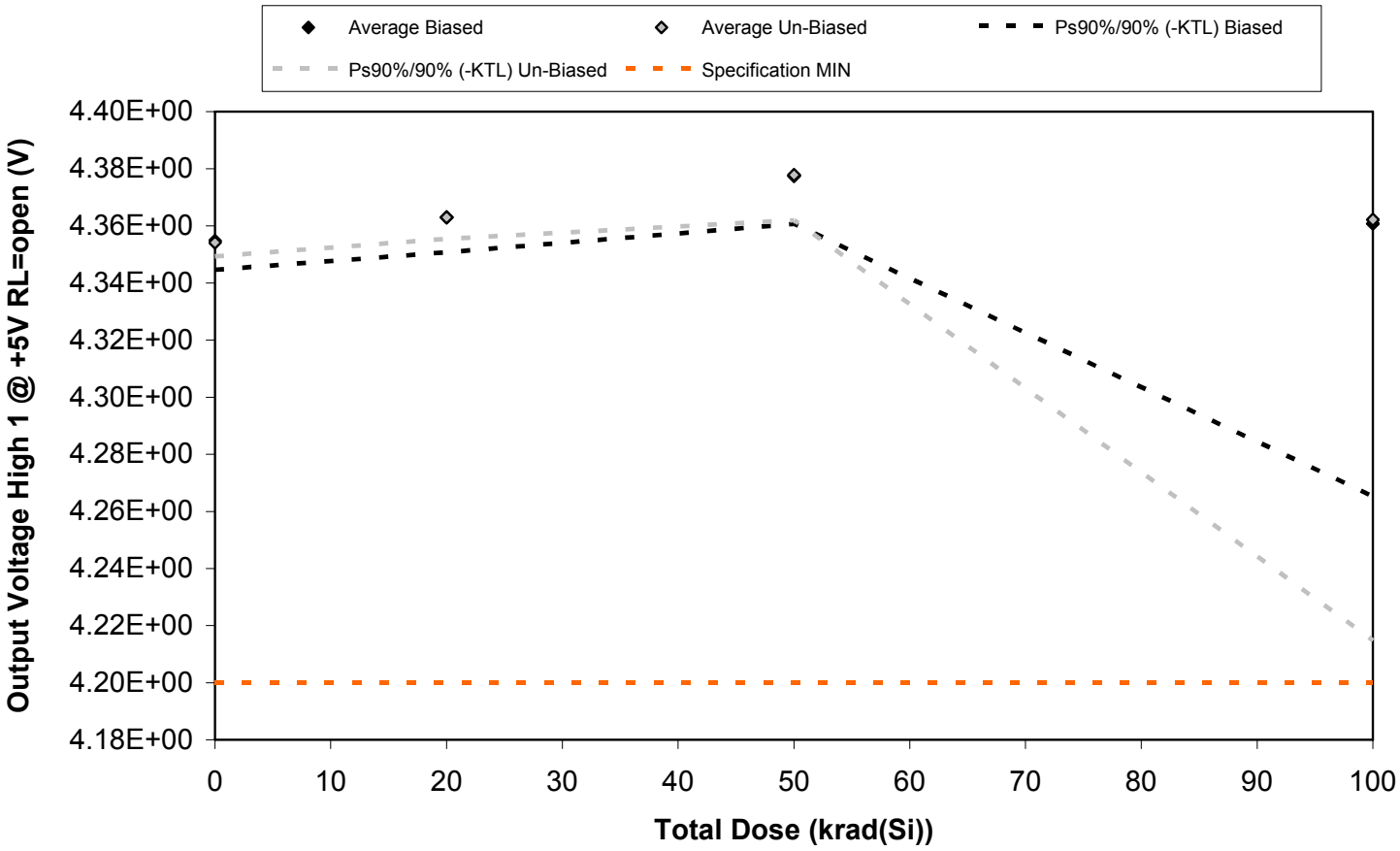


Figure 5.25. Plot of Output Voltage High 1 @ +5V RL=open (V) versus total dose. The data show significant degradation with radiation at the 100krad(Si) read point, however the parameter remains within specification even after application of the KTLs statistics. Note that this part is only guaranteed by the manufacturer to 75krad(Si). The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.25. Raw data for Output Voltage High 1 @ +5V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 1 @ +5V RL=open (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 4.36E+00 | 4.37E+00 | 4.38E+00 | 4.39E+00 |
| 409 | 4.36E+00 | 4.36E+00 | 4.38E+00 | 4.31E+00 |
| 410 | 4.35E+00 | 4.36E+00 | 4.37E+00 | 4.38E+00 |
| 411 | 4.35E+00 | 4.36E+00 | 4.38E+00 | 4.38E+00 |
| 412 | 4.36E+00 | 4.37E+00 | 4.38E+00 | 4.34E+00 |
| 413 | 4.36E+00 | 4.37E+00 | 4.38E+00 | 4.38E+00 |
| 414 | 4.35E+00 | 4.36E+00 | 4.37E+00 | 4.27E+00 |
| 415 | 4.35E+00 | 4.36E+00 | 4.38E+00 | 4.39E+00 |
| 418 | 4.36E+00 | 4.36E+00 | 4.38E+00 | 4.39E+00 |
| 419 | 4.35E+00 | 4.36E+00 | 4.37E+00 | 4.39E+00 |
| 420 | 4.36E+00 | 4.36E+00 | 4.36E+00 | 4.36E+00 |
| 421 | 4.36E+00 | 4.36E+00 | 4.36E+00 | 4.36E+00 |
| Biased Statistics | | | | |
| Average Biased | 4.35E+00 | 4.36E+00 | 4.38E+00 | 4.36E+00 |
| Std Dev Biased | 3.70E-03 | 4.47E-03 | 6.11E-03 | 3.48E-02 |
| Ps90%/90% (+KTL) Biased | 4.36E+00 | 4.38E+00 | 4.39E+00 | 4.46E+00 |
| Ps90%/90% (-KTL) Biased | 4.34E+00 | 4.35E+00 | 4.36E+00 | 4.27E+00 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 4.35E+00 | 4.36E+00 | 4.38E+00 | 4.36E+00 |
| Std Dev Un-Biased | 1.79E-03 | 2.74E-03 | 5.76E-03 | 5.38E-02 |
| Ps90%/90% (+KTL) Un-Biased | 4.36E+00 | 4.37E+00 | 4.39E+00 | 4.51E+00 |
| Ps90%/90% (-KTL) Un-Biased | 4.35E+00 | 4.36E+00 | 4.36E+00 | 4.21E+00 |
| Specification MIN | 4.20E+00 | 4.20E+00 | 4.20E+00 | 4.20E+00 |
| Status | PASS | PASS | PASS | PASS |

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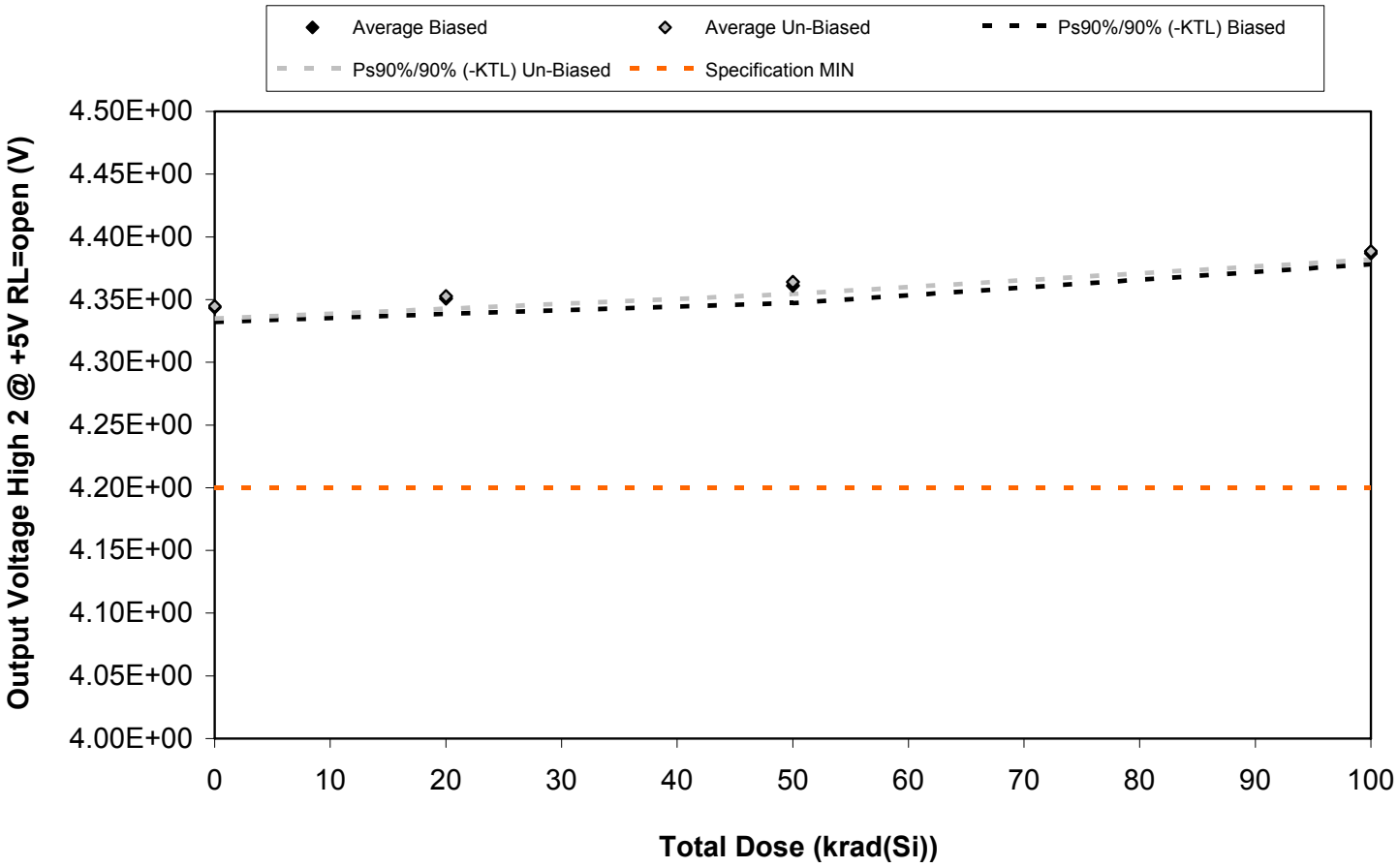


Figure 5.26. Plot of Output Voltage High 2 @ +5V RL=open (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.26. Raw data for Output Voltage High 2 @ +5V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 2 @ +5V RL=open (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 4.35E+00 | 4.36E+00 | 4.37E+00 | 4.39E+00 |
| 409 | 4.34E+00 | 4.35E+00 | 4.36E+00 | 4.39E+00 |
| 410 | 4.34E+00 | 4.35E+00 | 4.35E+00 | 4.38E+00 |
| 411 | 4.34E+00 | 4.35E+00 | 4.36E+00 | 4.39E+00 |
| 412 | 4.35E+00 | 4.35E+00 | 4.37E+00 | 4.39E+00 |
| 413 | 4.34E+00 | 4.35E+00 | 4.37E+00 | 4.39E+00 |
| 414 | 4.35E+00 | 4.36E+00 | 4.37E+00 | 4.39E+00 |
| 415 | 4.34E+00 | 4.35E+00 | 4.36E+00 | 4.39E+00 |
| 418 | 4.34E+00 | 4.35E+00 | 4.36E+00 | 4.39E+00 |
| 419 | 4.35E+00 | 4.36E+00 | 4.37E+00 | 4.39E+00 |
| 420 | 4.34E+00 | 4.35E+00 | 4.35E+00 | 4.35E+00 |
| 421 | 4.35E+00 | 4.36E+00 | 4.36E+00 | 4.35E+00 |
| Biased Statistics | | | | |
| Average Biased | 4.34E+00 | 4.35E+00 | 4.36E+00 | 4.39E+00 |
| Std Dev Biased | 4.27E-03 | 4.44E-03 | 5.07E-03 | 3.11E-03 |
| Ps90%/90% (+KTL) Biased | 4.36E+00 | 4.36E+00 | 4.38E+00 | 4.40E+00 |
| Ps90%/90% (-KTL) Biased | 4.33E+00 | 4.34E+00 | 4.35E+00 | 4.38E+00 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 4.34E+00 | 4.35E+00 | 4.36E+00 | 4.39E+00 |
| Std Dev Un-Biased | 3.56E-03 | 3.65E-03 | 3.49E-03 | 2.41E-03 |
| Ps90%/90% (+KTL) Un-Biased | 4.35E+00 | 4.36E+00 | 4.37E+00 | 4.40E+00 |
| Ps90%/90% (-KTL) Un-Biased | 4.34E+00 | 4.34E+00 | 4.35E+00 | 4.38E+00 |
| Specification MIN | 4.20E+00 | 4.20E+00 | 4.20E+00 | 4.20E+00 |
| Status | PASS | PASS | PASS | PASS |

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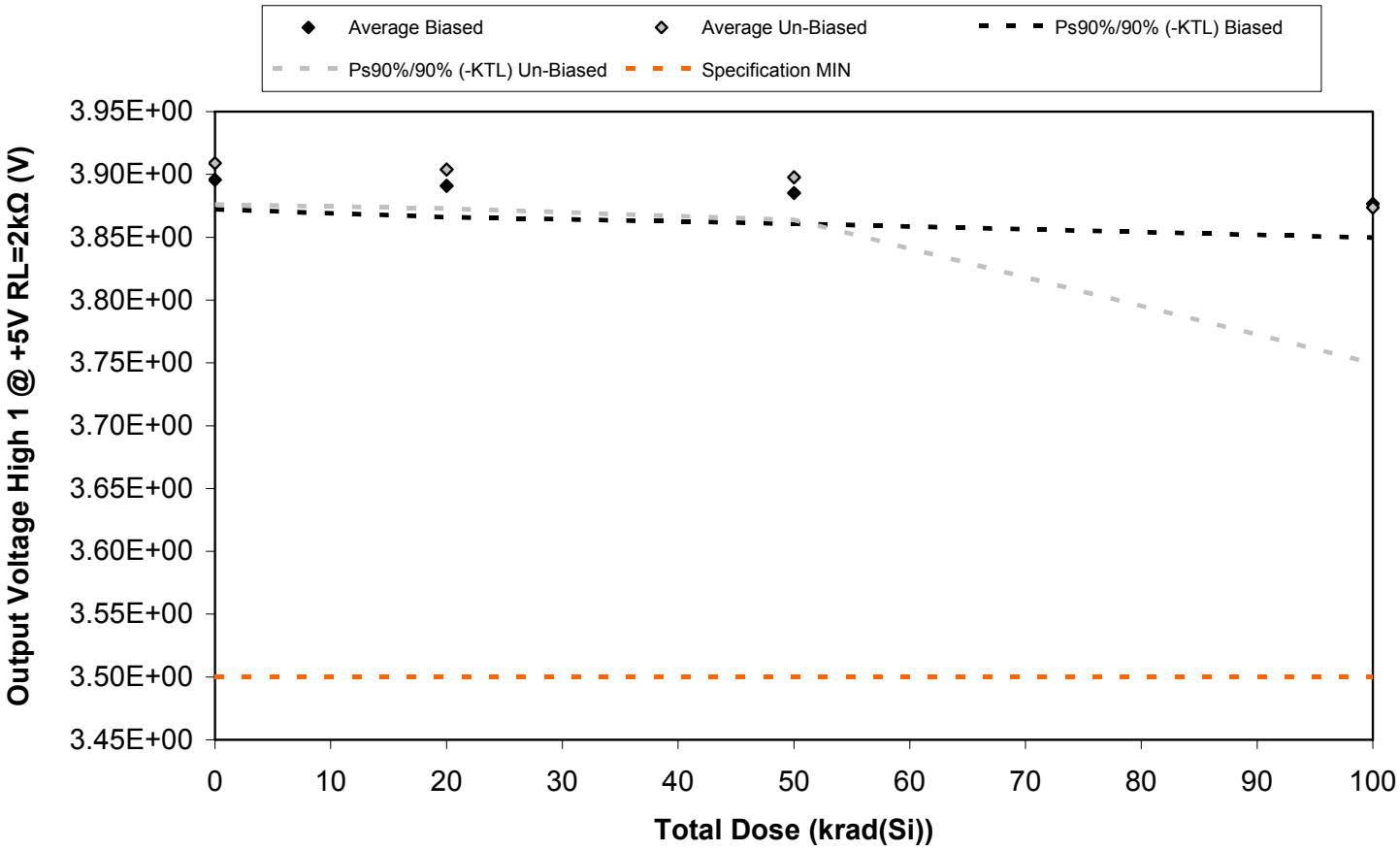


Figure 5.27. Plot of Output Voltage High 1 @ +5V RL=2kΩ (V) versus total dose. The data show significant degradation with radiation at the 100krad(Si) read point, however the parameter remains within specification even after application of the KTLs statistics. Note that this part is only guaranteed by the manufacturer to 75krad(Si). The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.27. Raw data for Output Voltage High 1 @ +5V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 1 @ +5V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 3.91E+00 | 3.91E+00 | 3.90E+00 | 3.89E+00 |
| 409 | 3.89E+00 | 3.89E+00 | 3.88E+00 | 3.87E+00 |
| 410 | 3.89E+00 | 3.89E+00 | 3.88E+00 | 3.87E+00 |
| 411 | 3.89E+00 | 3.89E+00 | 3.88E+00 | 3.87E+00 |
| 412 | 3.89E+00 | 3.89E+00 | 3.88E+00 | 3.87E+00 |
| 413 | 3.89E+00 | 3.89E+00 | 3.88E+00 | 3.79E+00 |
| 414 | 3.91E+00 | 3.91E+00 | 3.90E+00 | 3.89E+00 |
| 415 | 3.92E+00 | 3.91E+00 | 3.91E+00 | 3.90E+00 |
| 418 | 3.92E+00 | 3.91E+00 | 3.91E+00 | 3.90E+00 |
| 419 | 3.91E+00 | 3.90E+00 | 3.90E+00 | 3.89E+00 |
| 420 | 3.89E+00 | 3.89E+00 | 3.90E+00 | 3.90E+00 |
| 421 | 3.91E+00 | 3.91E+00 | 3.91E+00 | 3.91E+00 |
| Biased Statistics | | | | |
| Average Biased | 3.90E+00 | 3.89E+00 | 3.89E+00 | 3.88E+00 |
| Std Dev Biased | 8.58E-03 | 9.06E-03 | 8.90E-03 | 9.84E-03 |
| Ps90%/90% (+KTL) Biased | 3.92E+00 | 3.92E+00 | 3.91E+00 | 3.90E+00 |
| Ps90%/90% (-KTL) Biased | 3.87E+00 | 3.87E+00 | 3.86E+00 | 3.85E+00 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 3.91E+00 | 3.90E+00 | 3.90E+00 | 3.87E+00 |
| Std Dev Un-Biased | 1.20E-02 | 1.14E-02 | 1.24E-02 | 4.52E-02 |
| Ps90%/90% (+KTL) Un-Biased | 3.94E+00 | 3.94E+00 | 3.93E+00 | 4.00E+00 |
| Ps90%/90% (-KTL) Un-Biased | 3.88E+00 | 3.87E+00 | 3.86E+00 | 3.75E+00 |
| Specification MIN | 3.50E+00 | 3.50E+00 | 3.50E+00 | 3.50E+00 |
| Status | PASS | PASS | PASS | PASS |

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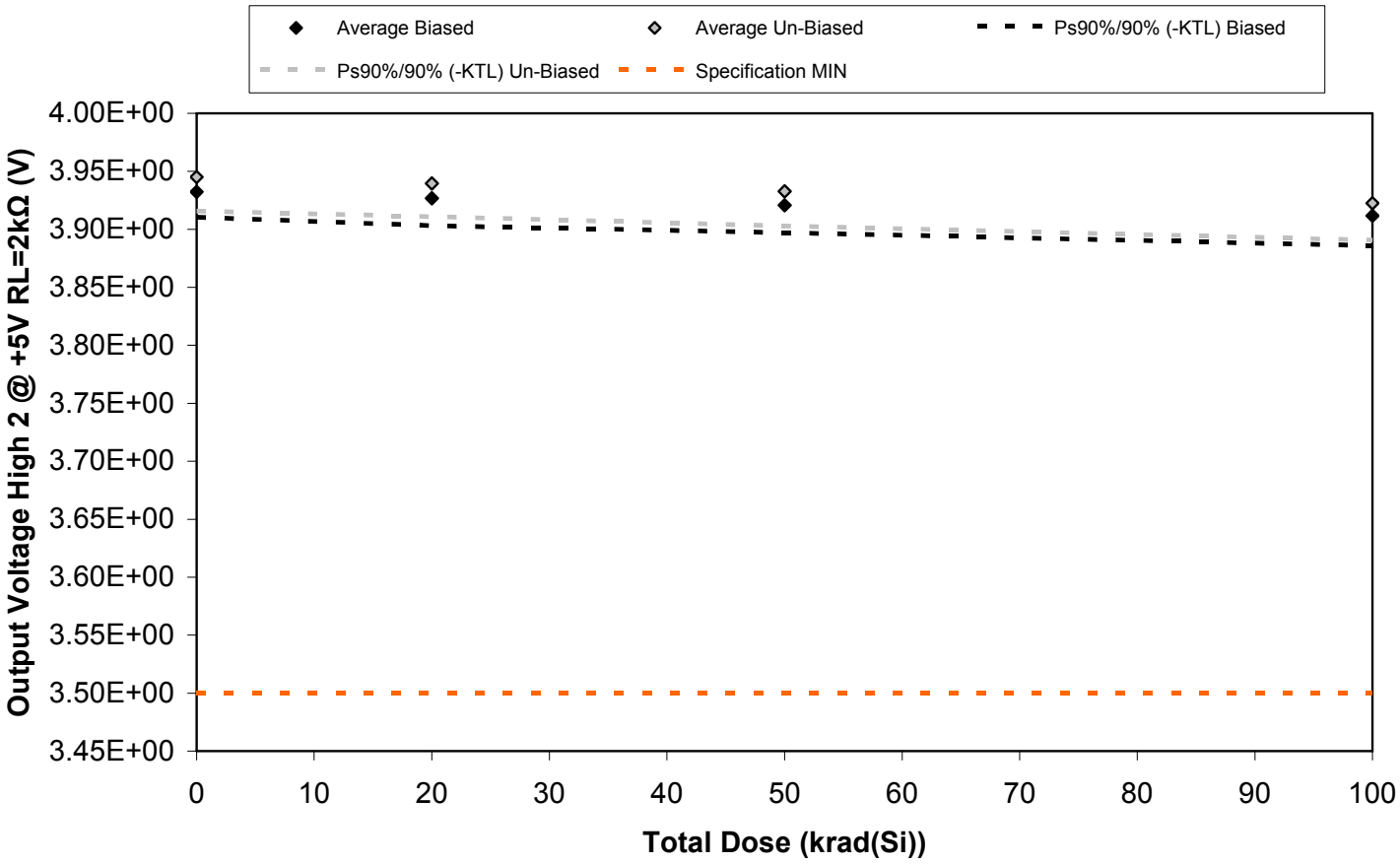


Figure 5.28. Plot of Output Voltage High 2 @ +5V RL=2kΩ (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.28. Raw data for Output Voltage High 2 @ +5V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 2 @ +5V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 3.95E+00 | 3.94E+00 | 3.94E+00 | 3.93E+00 |
| 409 | 3.93E+00 | 3.92E+00 | 3.92E+00 | 3.91E+00 |
| 410 | 3.93E+00 | 3.92E+00 | 3.92E+00 | 3.91E+00 |
| 411 | 3.93E+00 | 3.93E+00 | 3.92E+00 | 3.91E+00 |
| 412 | 3.93E+00 | 3.92E+00 | 3.92E+00 | 3.91E+00 |
| 413 | 3.93E+00 | 3.92E+00 | 3.92E+00 | 3.90E+00 |
| 414 | 3.94E+00 | 3.94E+00 | 3.93E+00 | 3.92E+00 |
| 415 | 3.96E+00 | 3.95E+00 | 3.94E+00 | 3.93E+00 |
| 418 | 3.95E+00 | 3.95E+00 | 3.94E+00 | 3.93E+00 |
| 419 | 3.95E+00 | 3.94E+00 | 3.93E+00 | 3.92E+00 |
| 420 | 3.93E+00 | 3.93E+00 | 3.94E+00 | 3.93E+00 |
| 421 | 3.94E+00 | 3.94E+00 | 3.94E+00 | 3.94E+00 |
| Biased Statistics | | | | |
| Average Biased | 3.93E+00 | 3.93E+00 | 3.92E+00 | 3.91E+00 |
| Std Dev Biased | 7.95E-03 | 8.61E-03 | 8.61E-03 | 9.34E-03 |
| Ps90%/90% (+KTL) Biased | 3.95E+00 | 3.95E+00 | 3.94E+00 | 3.94E+00 |
| Ps90%/90% (-KTL) Biased | 3.91E+00 | 3.90E+00 | 3.90E+00 | 3.89E+00 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 3.95E+00 | 3.94E+00 | 3.93E+00 | 3.92E+00 |
| Std Dev Un-Biased | 1.07E-02 | 1.05E-02 | 1.09E-02 | 1.16E-02 |
| Ps90%/90% (+KTL) Un-Biased | 3.97E+00 | 3.97E+00 | 3.96E+00 | 3.95E+00 |
| Ps90%/90% (-KTL) Un-Biased | 3.92E+00 | 3.91E+00 | 3.90E+00 | 3.89E+00 |
| Specification MIN | 3.50E+00 | 3.50E+00 | 3.50E+00 | 3.50E+00 |
| Status | PASS | PASS | PASS | PASS |

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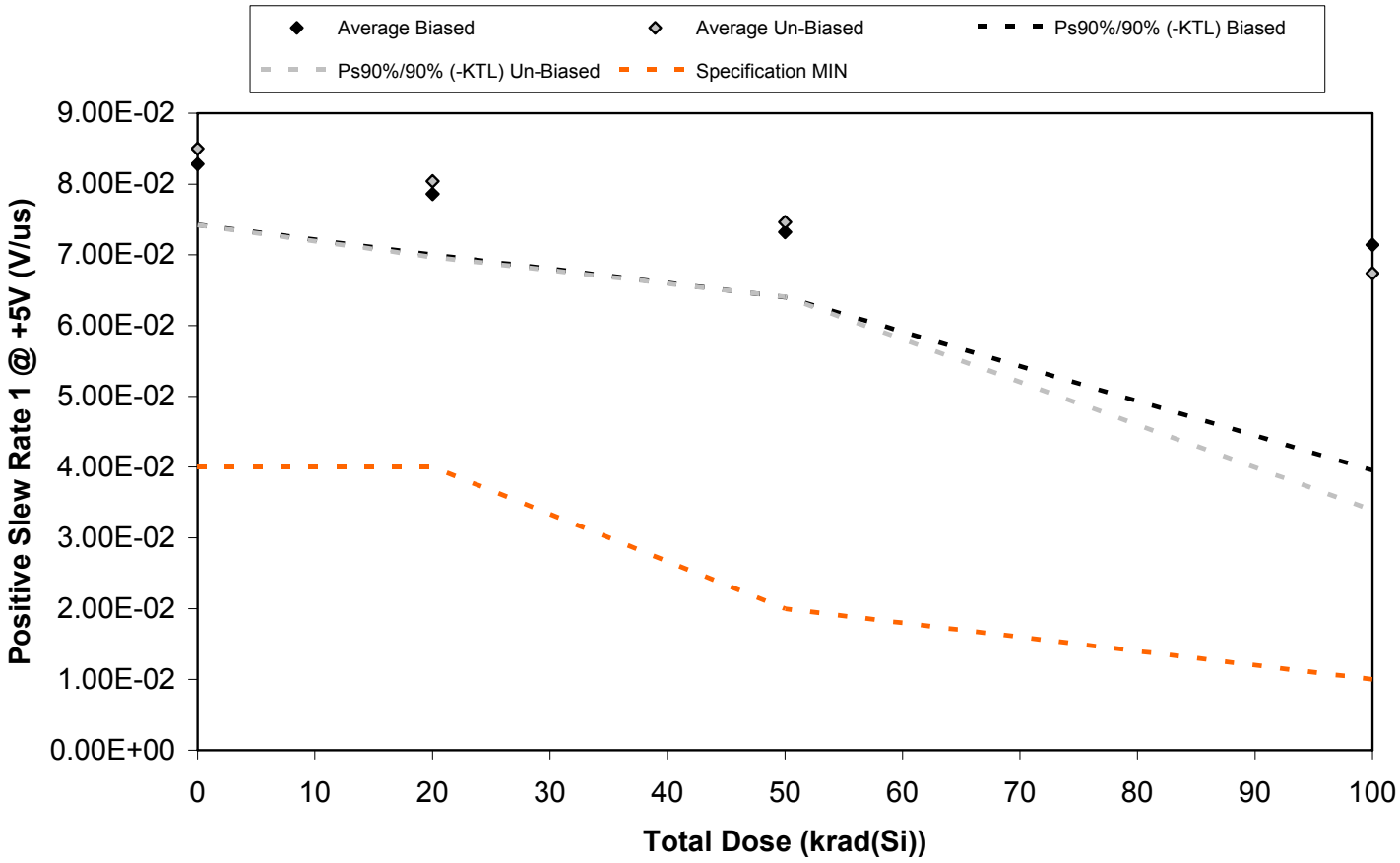


Figure 5.29. Plot of Positive Slew Rate 1 @ +5V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.29. Raw data for Positive Slew Rate 1 @ +5V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Slew Rate 1 @ +5V (V/us)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.50E-02 | 8.10E-02 | 7.60E-02 | 8.90E-02 |
| 409 | 8.30E-02 | 7.80E-02 | 7.40E-02 | 7.10E-02 |
| 410 | 8.60E-02 | 8.20E-02 | 7.60E-02 | 7.50E-02 |
| 411 | 8.20E-02 | 7.80E-02 | 7.20E-02 | 6.20E-02 |
| 412 | 7.80E-02 | 7.40E-02 | 6.80E-02 | 6.00E-02 |
| 413 | 8.00E-02 | 7.60E-02 | 7.00E-02 | 5.60E-02 |
| 414 | 8.40E-02 | 7.90E-02 | 7.40E-02 | 6.20E-02 |
| 415 | 8.90E-02 | 8.50E-02 | 7.90E-02 | 8.70E-02 |
| 418 | 8.90E-02 | 8.40E-02 | 7.80E-02 | 7.10E-02 |
| 419 | 8.30E-02 | 7.80E-02 | 7.20E-02 | 6.10E-02 |
| 420 | 8.20E-02 | 8.10E-02 | 8.20E-02 | 8.20E-02 |
| 421 | 7.90E-02 | 7.90E-02 | 8.00E-02 | 8.00E-02 |
| Biased Statistics | | | | |
| Average Biased | 8.28E-02 | 7.86E-02 | 7.32E-02 | 7.14E-02 |
| Std Dev Biased | 3.11E-03 | 3.13E-03 | 3.35E-03 | 1.16E-02 |
| Ps90%/90% (+KTL) Biased | 9.13E-02 | 8.72E-02 | 8.24E-02 | 1.03E-01 |
| Ps90%/90% (-KTL) Biased | 7.43E-02 | 7.00E-02 | 6.40E-02 | 3.95E-02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.50E-02 | 8.04E-02 | 7.46E-02 | 6.74E-02 |
| Std Dev Un-Biased | 3.94E-03 | 3.91E-03 | 3.85E-03 | 1.22E-02 |
| Ps90%/90% (+KTL) Un-Biased | 9.58E-02 | 9.11E-02 | 8.51E-02 | 1.01E-01 |
| Ps90%/90% (-KTL) Un-Biased | 7.42E-02 | 6.97E-02 | 6.41E-02 | 3.39E-02 |
| Specification MIN | 4.00E-02 | 4.00E-02 | 2.00E-02 | 1.00E-02 |
| Status | PASS | PASS | PASS | PASS |

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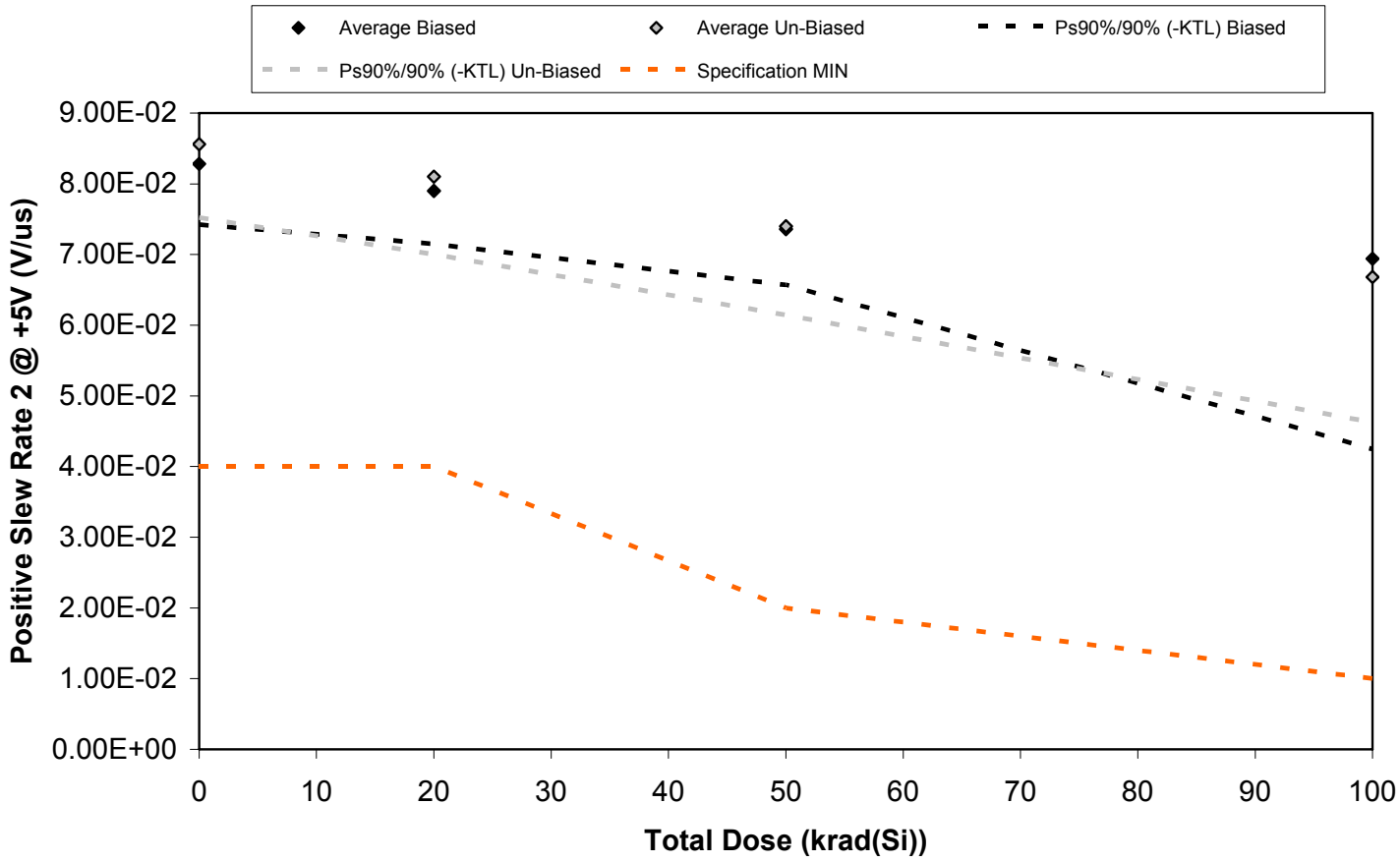


Figure 5.30. Plot of Positive Slew Rate 2 @ +5V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.30. Raw data for Positive Slew Rate 2 @ +5V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Slew Rate 2 @ +5V (V/us)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | 8.50E-02 | 8.10E-02 | 7.60E-02 | 8.20E-02 |
| 409 | 8.30E-02 | 7.90E-02 | 7.30E-02 | 6.30E-02 |
| 410 | 8.60E-02 | 8.20E-02 | 7.70E-02 | 7.80E-02 |
| 411 | 8.20E-02 | 7.80E-02 | 7.20E-02 | 6.30E-02 |
| 412 | 7.80E-02 | 7.50E-02 | 7.00E-02 | 6.10E-02 |
| 413 | 8.10E-02 | 7.60E-02 | 6.70E-02 | 5.70E-02 |
| 414 | 8.40E-02 | 8.00E-02 | 7.40E-02 | 7.10E-02 |
| 415 | 9.00E-02 | 8.60E-02 | 7.90E-02 | 7.50E-02 |
| 418 | 8.90E-02 | 8.40E-02 | 7.70E-02 | 7.00E-02 |
| 419 | 8.40E-02 | 7.90E-02 | 7.30E-02 | 6.10E-02 |
| 420 | 8.10E-02 | 8.10E-02 | 8.20E-02 | 8.20E-02 |
| 421 | 7.90E-02 | 8.00E-02 | 8.00E-02 | 8.00E-02 |
| Biased Statistics | | | | |
| Average Biased | 8.28E-02 | 7.90E-02 | 7.36E-02 | 6.94E-02 |
| Std Dev Biased | 3.11E-03 | 2.74E-03 | 2.88E-03 | 9.81E-03 |
| Ps90%/90% (+KTL) Biased | 9.13E-02 | 8.65E-02 | 8.15E-02 | 9.63E-02 |
| Ps90%/90% (-KTL) Biased | 7.43E-02 | 7.15E-02 | 6.57E-02 | 4.25E-02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | 8.56E-02 | 8.10E-02 | 7.40E-02 | 6.68E-02 |
| Std Dev Un-Biased | 3.78E-03 | 4.00E-03 | 4.58E-03 | 7.50E-03 |
| Ps90%/90% (+KTL) Un-Biased | 9.60E-02 | 9.20E-02 | 8.66E-02 | 8.74E-02 |
| Ps90%/90% (-KTL) Un-Biased | 7.52E-02 | 7.00E-02 | 6.14E-02 | 4.62E-02 |
| Specification MIN | 4.00E-02 | 4.00E-02 | 2.00E-02 | 1.00E-02 |
| Status | PASS | PASS | PASS | PASS |

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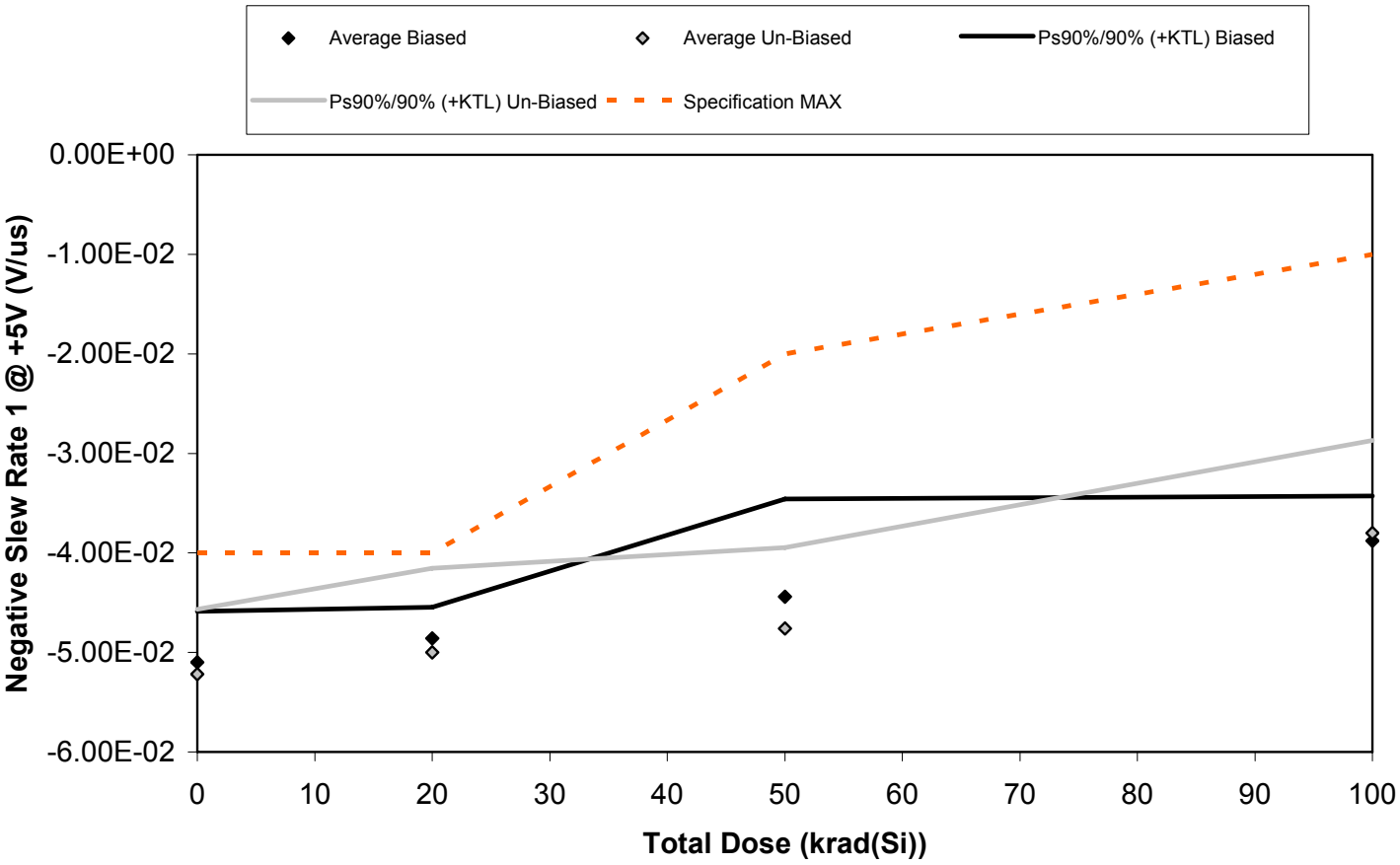


Figure 5.31. Plot of Negative Slew Rate 1 @ +5V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.31. Raw data for Negative Slew Rate 1 @ +5V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Slew Rate 1 @ +5V (V/us)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | -5.20E-02 | -4.90E-02 | -3.90E-02 | -4.00E-02 |
| 409 | -5.10E-02 | -4.90E-02 | -4.70E-02 | -3.90E-02 |
| 410 | -5.30E-02 | -5.00E-02 | -4.80E-02 | -4.00E-02 |
| 411 | -5.10E-02 | -4.80E-02 | -4.50E-02 | -3.90E-02 |
| 412 | -4.80E-02 | -4.70E-02 | -4.30E-02 | -3.60E-02 |
| 413 | -4.90E-02 | -4.60E-02 | -4.30E-02 | -3.30E-02 |
| 414 | -5.10E-02 | -4.90E-02 | -4.80E-02 | -3.70E-02 |
| 415 | -5.50E-02 | -5.40E-02 | -5.10E-02 | -4.20E-02 |
| 418 | -5.40E-02 | -5.20E-02 | -4.90E-02 | -4.00E-02 |
| 419 | -5.20E-02 | -4.90E-02 | -4.70E-02 | -3.80E-02 |
| 420 | -5.00E-02 | -4.90E-02 | -5.10E-02 | -5.00E-02 |
| 421 | -4.80E-02 | -5.00E-02 | -4.80E-02 | -4.80E-02 |
| Biased Statistics | | | | |
| Average Biased | -5.10E-02 | -4.86E-02 | -4.44E-02 | -3.88E-02 |
| Std Dev Biased | 1.87E-03 | 1.14E-03 | 3.58E-03 | 1.64E-03 |
| Ps90%/90% (+KTL) Biased | -4.59E-02 | -4.55E-02 | -3.46E-02 | -3.43E-02 |
| Ps90%/90% (-KTL) Biased | -5.61E-02 | -5.17E-02 | -5.42E-02 | -4.33E-02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | -5.22E-02 | -5.00E-02 | -4.76E-02 | -3.80E-02 |
| Std Dev Un-Biased | 2.39E-03 | 3.08E-03 | 2.97E-03 | 3.39E-03 |
| Ps90%/90% (+KTL) Un-Biased | -4.57E-02 | -4.15E-02 | -3.95E-02 | -2.87E-02 |
| Ps90%/90% (-KTL) Un-Biased | -5.87E-02 | -5.85E-02 | -5.57E-02 | -4.73E-02 |
| Specification MAX | -4.00E-02 | -4.00E-02 | -2.00E-02 | -1.00E-02 |
| Status | PASS | PASS | PASS | PASS |

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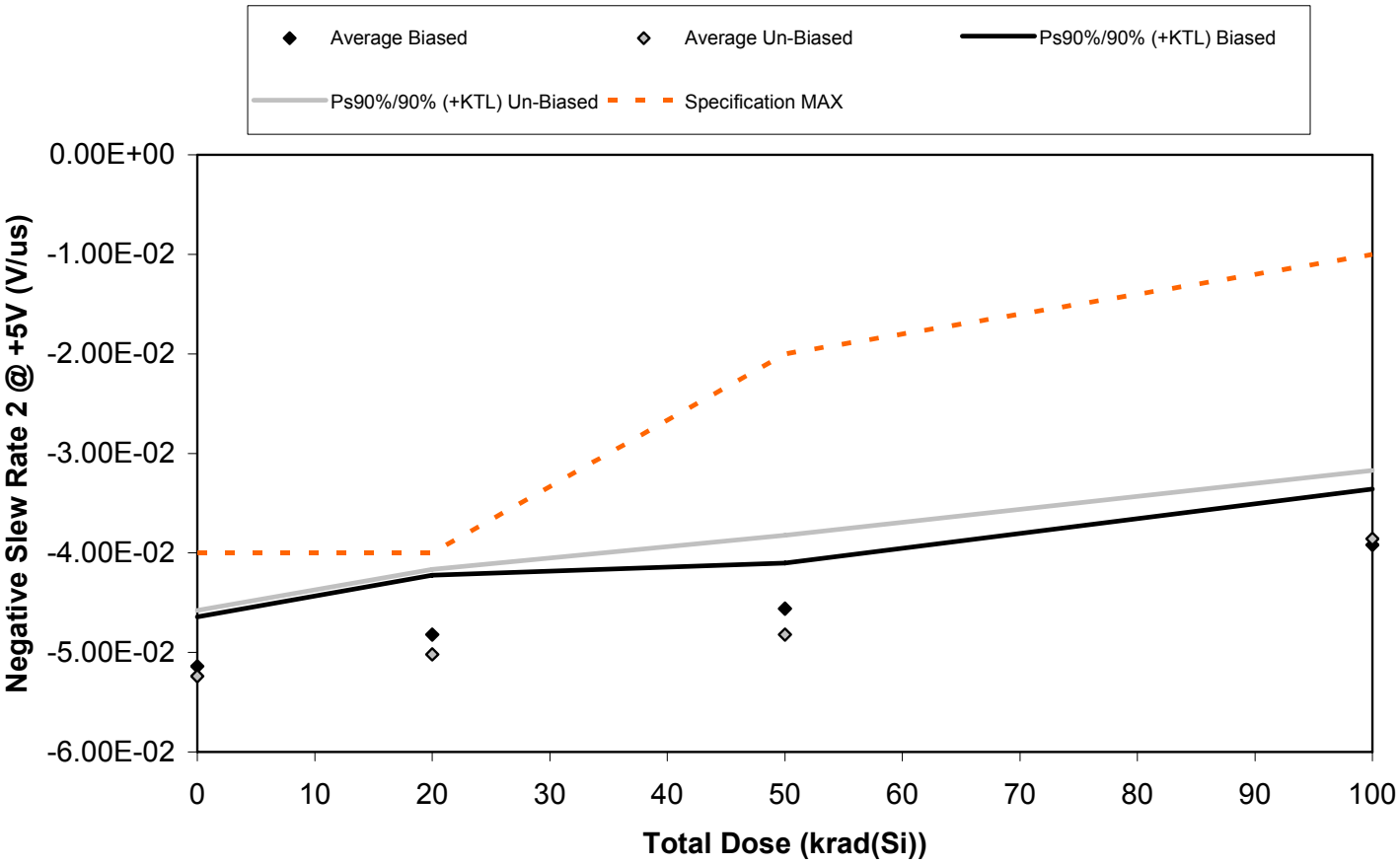


Figure 5.32. Plot of Negative Slew Rate 2 @ +5V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.32. Raw data for Negative Slew Rate 2 @ +5V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Slew Rate 2 @ +5V (V/us)** | Total Dose (krad(Si)) | | | |
|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 |
| 408 | -5.20E-02 | -4.90E-02 | -4.70E-02 | -4.10E-02 |
| 409 | -5.10E-02 | -4.80E-02 | -4.50E-02 | -3.90E-02 |
| 410 | -5.40E-02 | -5.10E-02 | -4.70E-02 | -4.10E-02 |
| 411 | -5.10E-02 | -4.80E-02 | -4.60E-02 | -3.90E-02 |
| 412 | -4.90E-02 | -4.50E-02 | -4.30E-02 | -3.60E-02 |
| 413 | -5.00E-02 | -4.70E-02 | -4.40E-02 | -3.50E-02 |
| 414 | -5.10E-02 | -4.90E-02 | -4.70E-02 | -3.80E-02 |
| 415 | -5.50E-02 | -5.40E-02 | -5.20E-02 | -4.10E-02 |
| 418 | -5.50E-02 | -5.30E-02 | -5.20E-02 | -4.10E-02 |
| 419 | -5.10E-02 | -4.80E-02 | -4.60E-02 | -3.80E-02 |
| 420 | -5.00E-02 | -5.00E-02 | -5.20E-02 | -5.10E-02 |
| 421 | -4.90E-02 | -5.00E-02 | -4.90E-02 | -4.90E-02 |
| Biased Statistics | | | | |
| Average Biased | -5.14E-02 | -4.82E-02 | -4.56E-02 | -3.92E-02 |
| Std Dev Biased | 1.82E-03 | 2.17E-03 | 1.67E-03 | 2.05E-03 |
| Ps90%/90% (+KTL) Biased | -4.64E-02 | -4.23E-02 | -4.10E-02 | -3.36E-02 |
| Ps90%/90% (-KTL) Biased | -5.64E-02 | -5.41E-02 | -5.02E-02 | -4.48E-02 |
| Un-Biased Statistics | | | | |
| Average Un-Biased | -5.24E-02 | -5.02E-02 | -4.82E-02 | -3.86E-02 |
| Std Dev Un-Biased | 2.41E-03 | 3.11E-03 | 3.63E-03 | 2.51E-03 |
| Ps90%/90% (+KTL) Un-Biased | -4.58E-02 | -4.17E-02 | -3.82E-02 | -3.17E-02 |
| Ps90%/90% (-KTL) Un-Biased | -5.90E-02 | -5.87E-02 | -5.82E-02 | -4.55E-02 |
| Specification MAX | -4.00E-02 | -4.00E-02 | -2.00E-02 | -1.00E-02 |
| Status | PASS | PASS | PASS | PASS |

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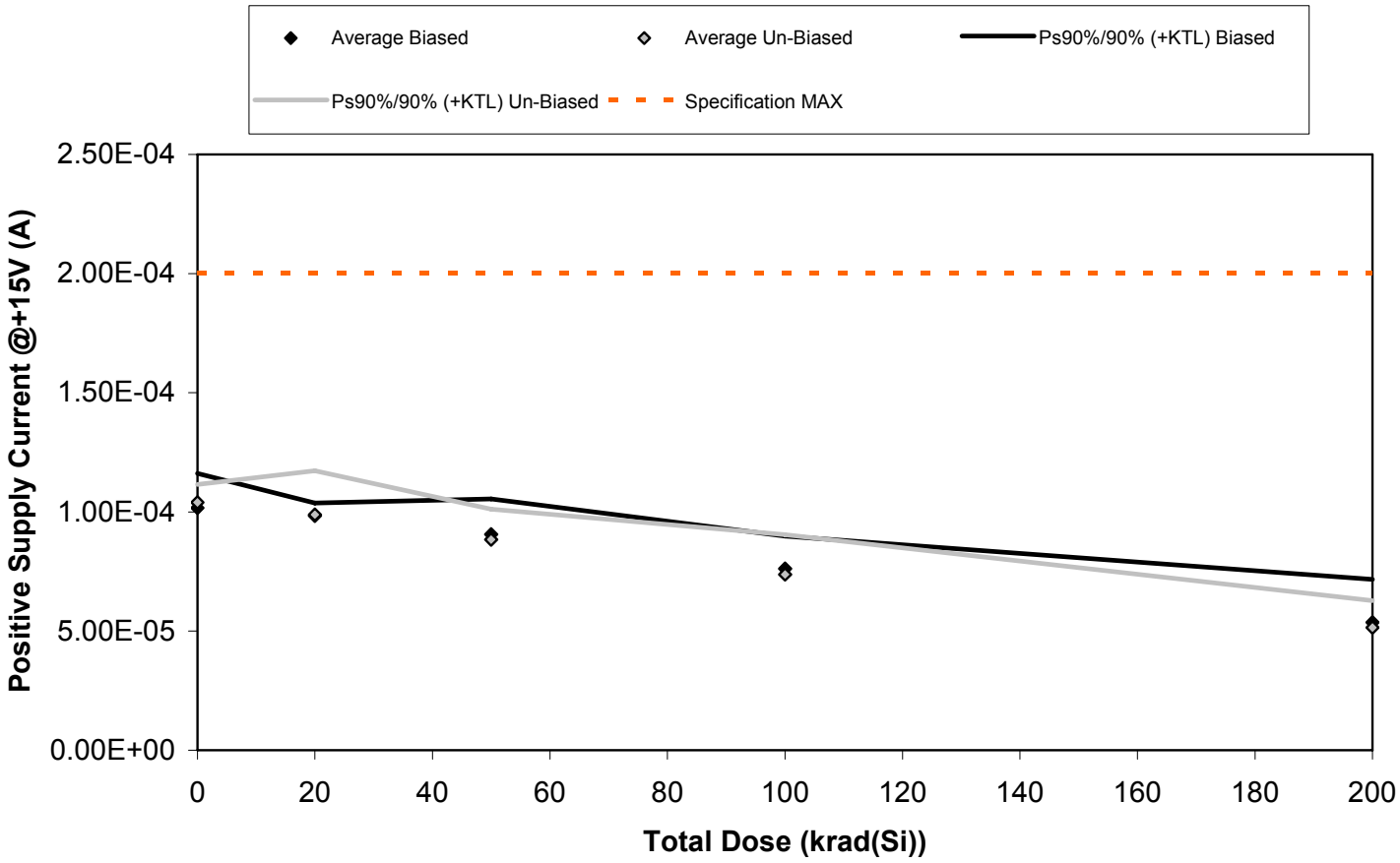


Figure 5.33. Plot of Positive Supply Current @ +15V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.33. Raw data for Positive Supply Current @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Supply Current @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.04E-04 | 9.70E-05 | 9.50E-05 | 7.50E-05 | 4.90E-05 |
| 409 | 9.70E-05 | 1.01E-04 | 8.40E-05 | 8.00E-05 | 5.40E-05 |
| 410 | 1.09E-04 | 1.00E-04 | 9.70E-05 | 7.90E-05 | 6.30E-05 |
| 411 | 1.02E-04 | 9.70E-05 | 9.00E-05 | 7.90E-05 | 5.60E-05 |
| 412 | 9.60E-05 | 9.70E-05 | 8.70E-05 | 6.80E-05 | 4.60E-05 |
| 413 | 1.03E-04 | 8.80E-05 | 8.10E-05 | 6.40E-05 | 4.60E-05 |
| 414 | 1.04E-04 | 1.05E-04 | 8.70E-05 | 7.90E-05 | 4.80E-05 |
| 415 | 1.06E-04 | 1.03E-04 | 9.00E-05 | 7.70E-05 | 5.50E-05 |
| 418 | 1.07E-04 | 1.01E-04 | 9.30E-05 | 7.20E-05 | 5.50E-05 |
| 419 | 1.00E-04 | 9.70E-05 | 9.10E-05 | 7.70E-05 | 5.30E-05 |
| 420 | 1.03E-04 | 9.80E-05 | 9.90E-05 | 1.00E-04 | 9.70E-05 |
| 421 | 9.70E-05 | 9.50E-05 | 9.70E-05 | 9.90E-05 | 1.01E-04 |
| Biased Statistics | | | | | |
| Average Biased | 1.02E-04 | 9.84E-05 | 9.06E-05 | 7.62E-05 | 5.36E-05 |
| Std Dev Biased | 5.32E-06 | 1.95E-06 | 5.41E-06 | 4.97E-06 | 6.58E-06 |
| Ps90%/90% (+KTL) Biased | 1.16E-04 | 1.04E-04 | 1.05E-04 | 8.98E-05 | 7.16E-05 |
| Ps90%/90% (-KTL) Biased | 8.70E-05 | 9.31E-05 | 7.58E-05 | 6.26E-05 | 3.56E-05 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.04E-04 | 9.88E-05 | 8.84E-05 | 7.38E-05 | 5.14E-05 |
| Std Dev Un-Biased | 2.74E-06 | 6.72E-06 | 4.67E-06 | 6.06E-06 | 4.16E-06 |
| Ps90%/90% (+KTL) Un-Biased | 1.12E-04 | 1.17E-04 | 1.01E-04 | 9.04E-05 | 6.28E-05 |
| Ps90%/90% (-KTL) Un-Biased | 9.65E-05 | 8.04E-05 | 7.56E-05 | 5.72E-05 | 4.00E-05 |
| Specification MAX | 2.00E-04 | 2.00E-04 | 2.00E-04 | 2.00E-04 | 2.00E-04 |
| Status | PASS | PASS | PASS | PASS | PASS |

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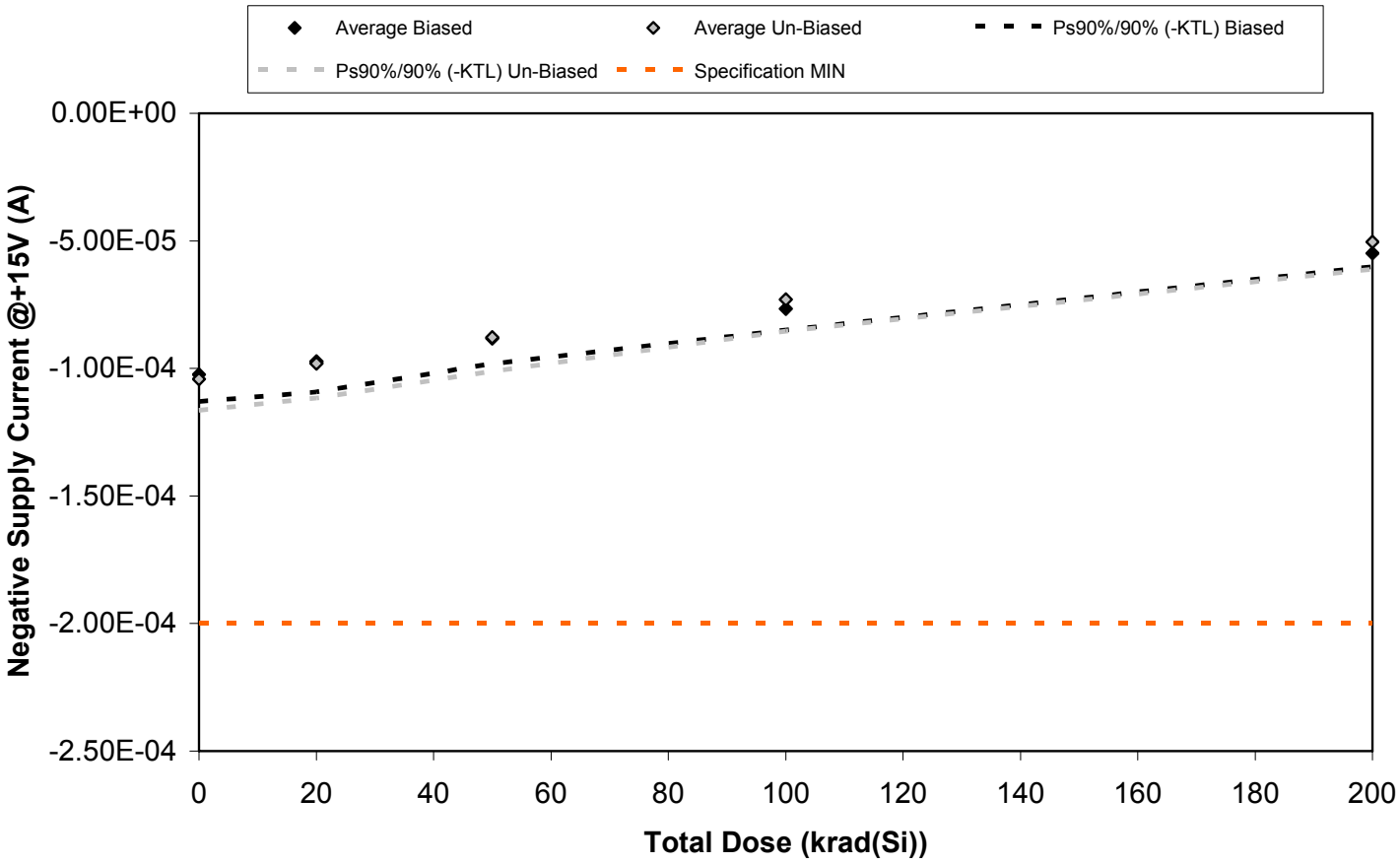


Figure 5.34. Plot of Negative Supply Current @ +15V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.34. Raw data for Negative Supply Current @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Supply Current @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.02E-04 | -9.50E-05 | -8.70E-05 | -7.80E-05 | -5.50E-05 |
| 409 | -1.00E-04 | -9.50E-05 | -8.80E-05 | -7.50E-05 | -5.40E-05 |
| 410 | -1.08E-04 | -1.04E-04 | -9.40E-05 | -8.10E-05 | -5.70E-05 |
| 411 | -1.04E-04 | -9.90E-05 | -8.80E-05 | -7.60E-05 | -5.60E-05 |
| 412 | -9.80E-05 | -9.30E-05 | -8.40E-05 | -7.30E-05 | -5.20E-05 |
| 413 | -9.80E-05 | -9.20E-05 | -8.10E-05 | -6.60E-05 | -4.50E-05 |
| 414 | -1.03E-04 | -9.70E-05 | -8.70E-05 | -7.30E-05 | -5.10E-05 |
| 415 | -1.08E-04 | -1.04E-04 | -9.30E-05 | -7.70E-05 | -5.40E-05 |
| 418 | -1.09E-04 | -1.02E-04 | -9.20E-05 | -7.70E-05 | -5.40E-05 |
| 419 | -1.03E-04 | -9.50E-05 | -8.60E-05 | -7.20E-05 | -4.80E-05 |
| 420 | -1.01E-04 | -1.01E-04 | -1.02E-04 | -1.02E-04 | -1.02E-04 |
| 421 | -9.60E-05 | -9.60E-05 | -9.80E-05 | -9.70E-05 | -9.80E-05 |
| Biased Statistics | | | | | |
| Average Biased | -1.02E-04 | -9.72E-05 | -8.82E-05 | -7.66E-05 | -5.48E-05 |
| Std Dev Biased | 3.85E-06 | 4.38E-06 | 3.63E-06 | 3.05E-06 | 1.92E-06 |
| Ps90%/90% (+KTL) Biased | -9.19E-05 | -8.52E-05 | -7.82E-05 | -6.82E-05 | -4.95E-05 |
| Ps90%/90% (-KTL) Biased | -1.13E-04 | -1.09E-04 | -9.82E-05 | -8.50E-05 | -6.01E-05 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.04E-04 | -9.80E-05 | -8.78E-05 | -7.30E-05 | -5.04E-05 |
| Std Dev Un-Biased | 4.44E-06 | 4.95E-06 | 4.87E-06 | 4.53E-06 | 3.91E-06 |
| Ps90%/90% (+KTL) Un-Biased | -9.20E-05 | -8.44E-05 | -7.45E-05 | -6.06E-05 | -3.97E-05 |
| Ps90%/90% (-KTL) Un-Biased | -1.16E-04 | -1.12E-04 | -1.01E-04 | -8.54E-05 | -6.11E-05 |
| Specification MIN | -2.00E-04 | -2.00E-04 | -2.00E-04 | -2.00E-04 | -2.00E-04 |
| Status | PASS | PASS | PASS | PASS | PASS |

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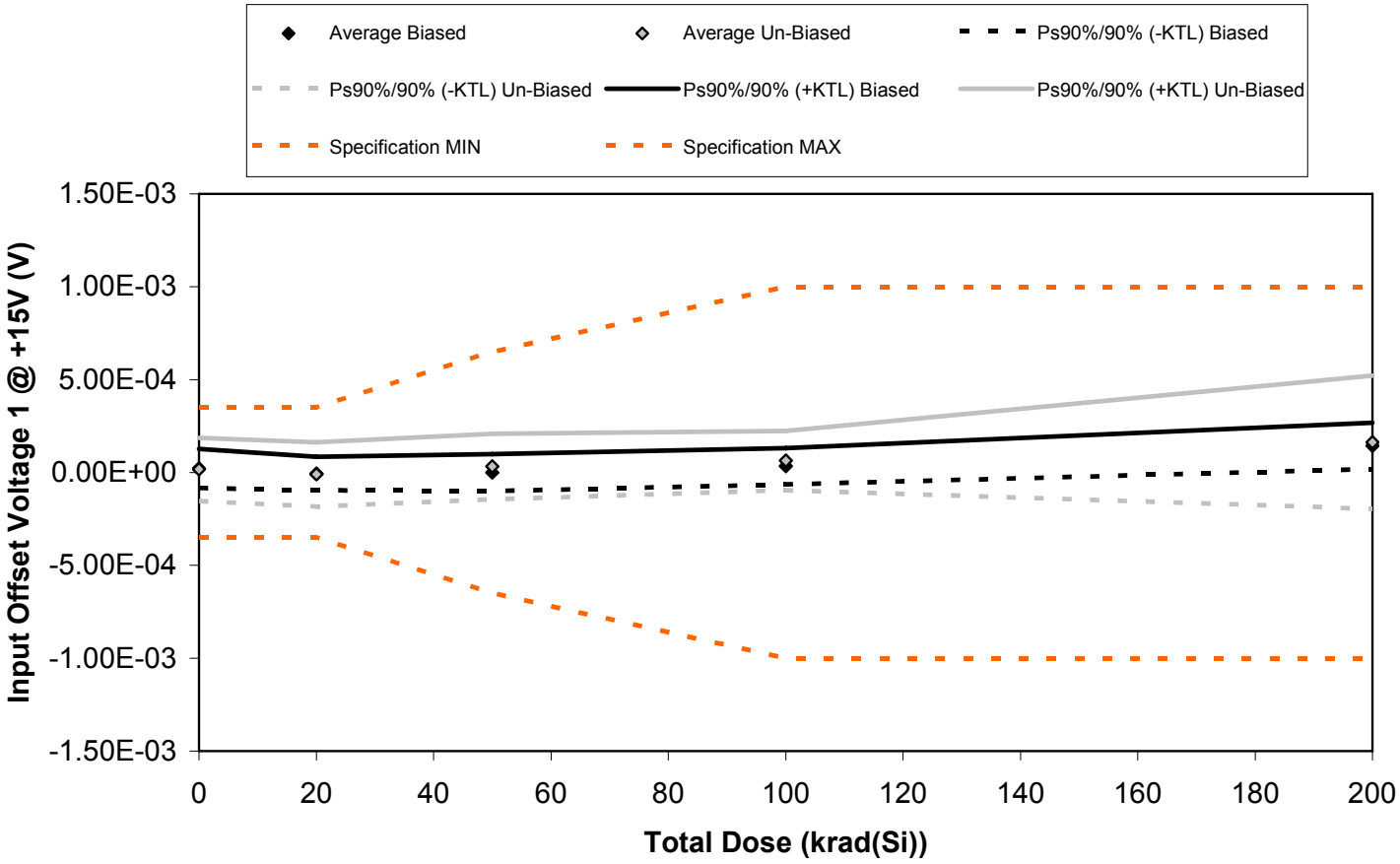


Figure 5.35. Plot of Input Offset Voltage 1 @ +15V (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.35. Raw data for Input Offset Voltage 1 @ +15V (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Voltage 1 @ +15V (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.61E-05 | -3.96E-05 | -4.15E-05 | -1.54E-05 | 8.71E-05 |
| 409 | 5.05E-05 | 1.75E-05 | 3.93E-05 | 7.77E-05 | 1.73E-04 |
| 410 | 5.01E-05 | 1.23E-05 | 7.38E-06 | 3.41E-05 | 1.02E-04 |
| 411 | -2.38E-05 | -4.32E-05 | -3.43E-05 | 1.74E-05 | 1.76E-04 |
| 412 | 4.76E-05 | 2.40E-05 | 2.78E-05 | 5.57E-05 | 1.81E-04 |
| 413 | 8.17E-05 | 5.62E-05 | 5.83E-05 | 1.09E-04 | 2.97E-04 |
| 414 | 7.51E-05 | 5.06E-05 | 5.39E-05 | 9.34E-05 | 2.55E-04 |
| 415 | -6.60E-05 | -9.32E-05 | 1.15E-04 | 1.14E-04 | -2.54E-05 |
| 418 | 2.91E-06 | -2.90E-05 | -3.65E-05 | -1.39E-05 | 9.09E-05 |
| 419 | -9.29E-06 | -3.43E-05 | -2.90E-05 | 1.84E-05 | 1.97E-04 |
| 420 | -6.87E-06 | -6.52E-06 | -6.51E-06 | -4.58E-06 | -9.05E-06 |
| 421 | -3.42E-05 | -3.36E-05 | -3.14E-05 | -3.09E-05 | -3.26E-05 |
| Biased Statistics | | | | | |
| Average Biased | 2.17E-05 | -5.80E-06 | -2.82E-07 | 3.39E-05 | 1.44E-04 |
| Std Dev Biased | 3.81E-05 | 3.28E-05 | 3.63E-05 | 3.57E-05 | 4.54E-05 |
| Ps90%/90% (+KTL) Biased | 1.26E-04 | 8.42E-05 | 9.92E-05 | 1.32E-04 | 2.68E-04 |
| Ps90%/90% (-KTL) Biased | -8.27E-05 | -9.58E-05 | -9.98E-05 | -6.40E-05 | 1.94E-05 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.69E-05 | -9.95E-06 | 3.23E-05 | 6.41E-05 | 1.63E-04 |
| Std Dev Un-Biased | 6.19E-05 | 6.31E-05 | 6.40E-05 | 5.81E-05 | 1.31E-04 |
| Ps90%/90% (+KTL) Un-Biased | 1.87E-04 | 1.63E-04 | 2.08E-04 | 2.23E-04 | 5.21E-04 |
| Ps90%/90% (-KTL) Un-Biased | -1.53E-04 | -1.83E-04 | -1.43E-04 | -9.51E-05 | -1.95E-04 |
| Specification MIN | -3.50E-04 | -3.50E-04 | -6.50E-04 | -1.00E-03 | -1.00E-03 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 3.50E-04 | 3.50E-04 | 6.50E-04 | 1.00E-03 | 1.00E-03 |
| Status | PASS | PASS | PASS | PASS | PASS |

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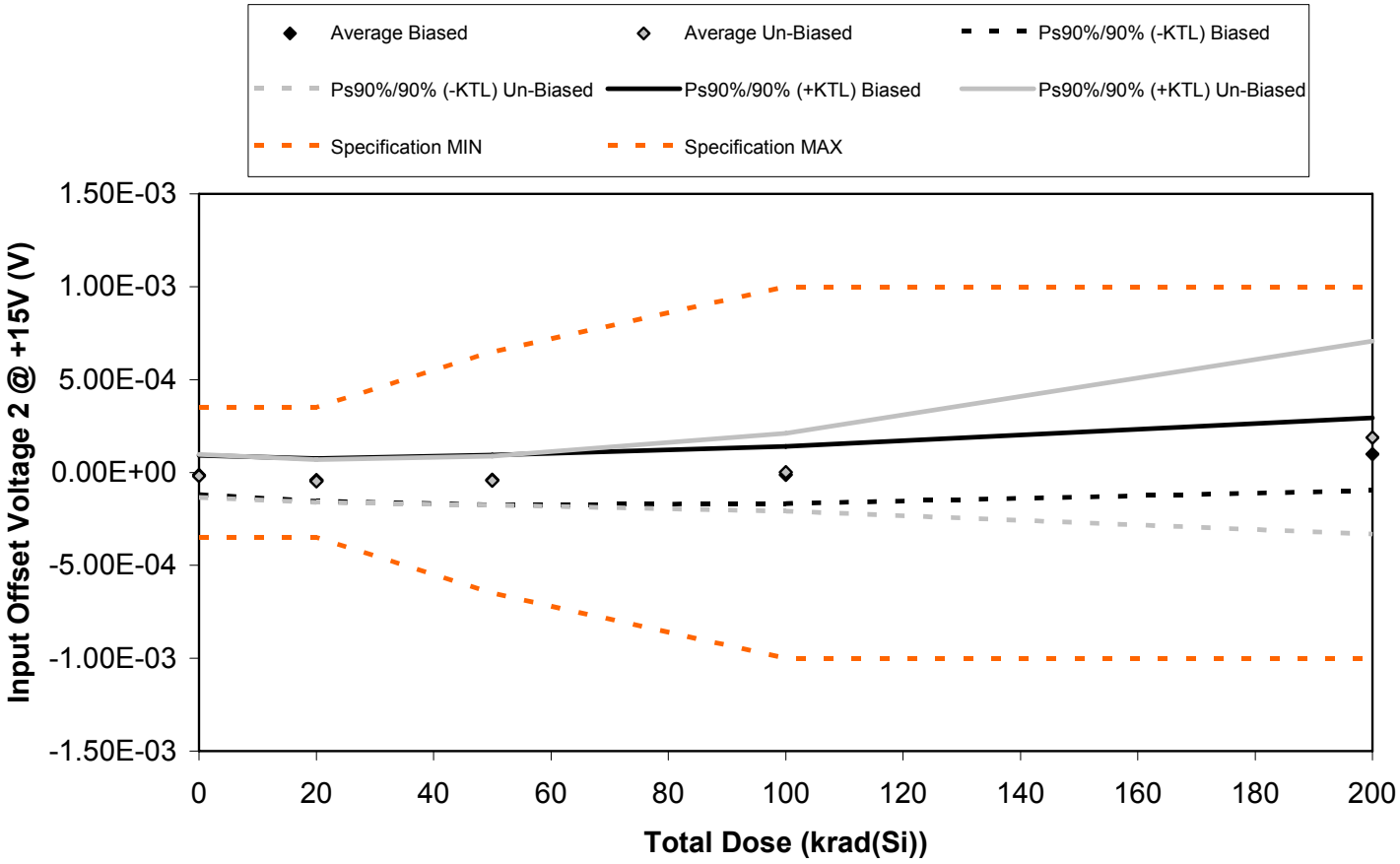


Figure 5.36. Plot of Input Offset Voltage 2 @ +15V (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.36. Raw data for Input Offset Voltage 2 @ +15V (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Voltage 2 @ +15V (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -3.61E-05 | -6.19E-05 | -6.44E-05 | -5.34E-05 | 3.99E-05 |
| 409 | -3.57E-05 | -6.12E-05 | -6.42E-05 | -3.75E-05 | 7.21E-05 |
| 410 | -5.03E-05 | -8.45E-05 | -9.27E-05 | -6.85E-05 | 3.24E-05 |
| 411 | 1.32E-05 | -8.82E-06 | 1.29E-07 | 3.99E-05 | 1.61E-04 |
| 412 | 4.01E-05 | 1.62E-05 | 2.28E-05 | 5.42E-05 | 1.88E-04 |
| 413 | -3.88E-05 | -7.00E-05 | -6.36E-05 | -3.28E-05 | 1.41E-04 |
| 414 | -5.61E-05 | -8.15E-05 | -7.72E-05 | -3.38E-05 | 1.05E-04 |
| 415 | -5.01E-05 | -7.82E-05 | -9.48E-05 | -8.02E-05 | 3.27E-06 |
| 418 | 1.27E-05 | -7.37E-06 | 7.25E-06 | 1.17E-04 | 5.05E-04 |
| 419 | 3.87E-05 | 5.55E-06 | 6.17E-06 | 3.50E-05 | 1.84E-04 |
| 420 | -4.35E-05 | -4.27E-05 | -4.26E-05 | -4.26E-05 | -4.38E-05 |
| 421 | -6.41E-05 | -6.48E-05 | -6.18E-05 | -6.12E-05 | -6.19E-05 |
| Biased Statistics | | | | | |
| Average Biased | -1.38E-05 | -4.01E-05 | -3.97E-05 | -1.31E-05 | 9.85E-05 |
| Std Dev Biased | 3.86E-05 | 4.20E-05 | 4.88E-05 | 5.62E-05 | 7.13E-05 |
| Ps90%/90% (+KTL) Biased | 9.20E-05 | 7.50E-05 | 9.41E-05 | 1.41E-04 | 2.94E-04 |
| Ps90%/90% (-KTL) Biased | -1.20E-04 | -1.55E-04 | -1.73E-04 | -1.67E-04 | -9.69E-05 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.87E-05 | -4.63E-05 | -4.44E-05 | 9.50E-07 | 1.88E-04 |
| Std Dev Un-Biased | 4.20E-05 | 4.19E-05 | 4.80E-05 | 7.66E-05 | 1.89E-04 |
| Ps90%/90% (+KTL) Un-Biased | 9.65E-05 | 6.86E-05 | 8.71E-05 | 2.11E-04 | 7.07E-04 |
| Ps90%/90% (-KTL) Un-Biased | -1.34E-04 | -1.61E-04 | -1.76E-04 | -2.09E-04 | -3.32E-04 |
| Specification MIN | -3.50E-04 | -3.50E-04 | -6.50E-04 | -1.00E-03 | -1.00E-03 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 3.50E-04 | 3.50E-04 | 6.50E-04 | 1.00E-03 | 1.00E-03 |
| Status | PASS | PASS | PASS | PASS | PASS |

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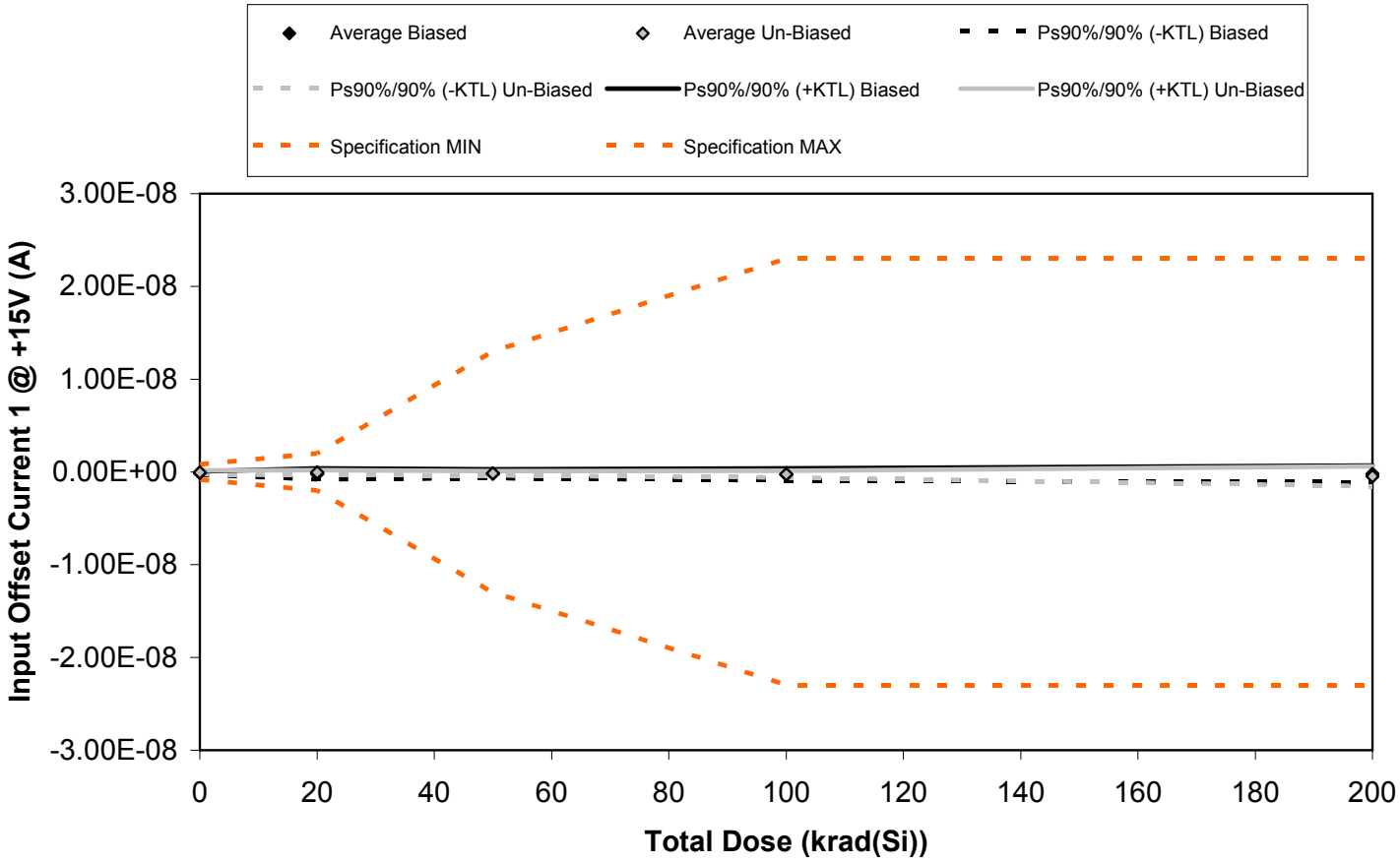


Figure 5.37. Plot of Input Offset Current 1 @ +15V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.37. Raw data for Input Offset Current 1 @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Current 1 @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -9.00E-11 | -5.00E-10 | -4.90E-10 | -6.00E-10 | -5.30E-10 |
| 409 | -5.00E-11 | -8.00E-11 | -4.00E-11 | -3.00E-11 | -3.90E-10 |
| 410 | -2.10E-10 | 2.00E-11 | -1.40E-10 | -3.50E-10 | -4.20E-10 |
| 411 | -1.10E-10 | -1.40E-10 | -1.40E-10 | -7.00E-11 | 2.40E-10 |
| 412 | -8.00E-11 | -3.50E-10 | -1.40E-10 | -3.00E-10 | 4.00E-11 |
| 413 | -8.00E-11 | -9.00E-11 | -1.30E-10 | -2.50E-10 | -4.50E-10 |
| 414 | 3.00E-11 | -3.00E-11 | -2.80E-10 | -2.30E-10 | -5.30E-10 |
| 415 | -1.20E-10 | -2.20E-10 | -1.60E-10 | -4.00E-10 | -5.40E-10 |
| 418 | -1.30E-10 | 0.00E+00 | -1.00E-10 | -2.80E-10 | -9.90E-10 |
| 419 | 1.00E-11 | 2.00E-11 | -6.00E-11 | -4.00E-11 | 1.00E-10 |
| 420 | 4.00E-11 | -2.00E-11 | 5.00E-11 | 5.00E-11 | 3.00E-11 |
| 421 | 2.00E-11 | 6.00E-11 | -4.00E-11 | -3.00E-11 | -3.00E-11 |
| Biased Statistics | | | | | |
| Average Biased | -1.08E-10 | -2.10E-10 | -1.90E-10 | -2.70E-10 | -2.12E-10 |
| Std Dev Biased | 6.10E-11 | 2.11E-10 | 1.73E-10 | 2.31E-10 | 3.33E-10 |
| Ps90%/90% (+KTL) Biased | 5.92E-11 | 3.69E-10 | 2.85E-10 | 3.64E-10 | 7.01E-10 |
| Ps90%/90% (-KTL) Biased | -2.75E-10 | -7.89E-10 | -6.65E-10 | -9.04E-10 | -1.13E-09 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -5.80E-11 | -6.40E-11 | -1.46E-10 | -2.40E-10 | -4.82E-10 |
| Std Dev Un-Biased | 7.40E-11 | 9.66E-11 | 8.35E-11 | 1.30E-10 | 3.88E-10 |
| Ps90%/90% (+KTL) Un-Biased | 1.45E-10 | 2.01E-10 | 8.31E-11 | 1.16E-10 | 5.83E-10 |
| Ps90%/90% (-KTL) Un-Biased | -2.61E-10 | -3.29E-10 | -3.75E-10 | -5.96E-10 | -1.55E-09 |
| Specification MIN | -8.00E-10 | -2.00E-09 | -1.30E-08 | -2.30E-08 | -2.30E-08 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 8.00E-10 | 2.00E-09 | 1.30E-08 | 2.30E-08 | 2.30E-08 |
| Status | PASS | PASS | PASS | PASS | PASS |

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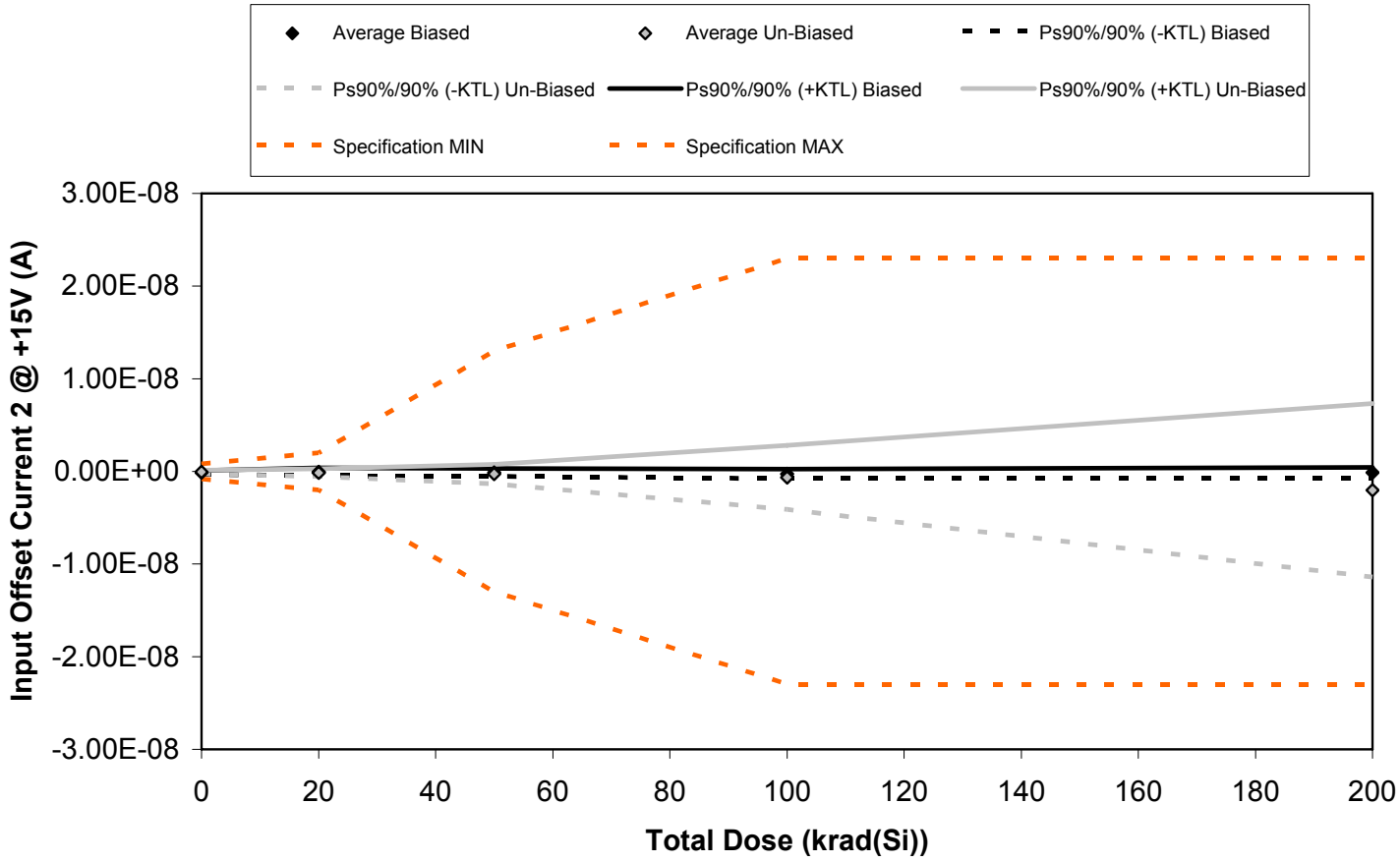


Figure 5.38. Plot of Input Offset Current 2 @ +15V (A) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.38. Raw data for Input Offset Current 2 @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Input Offset Current 2 @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -4.00E-11 | 1.80E-10 | 1.30E-10 | -6.00E-11 | 0.00E+00 |
| 409 | -3.00E-11 | -2.60E-10 | -1.50E-10 | -4.70E-10 | -4.20E-10 |
| 410 | -1.00E-10 | -6.00E-11 | -2.80E-10 | -4.80E-10 | -1.70E-10 |
| 411 | -2.00E-10 | -7.00E-11 | -8.00E-11 | -2.20E-10 | -1.50E-10 |
| 412 | -1.80E-10 | -6.00E-11 | -1.70E-10 | -1.50E-10 | 1.10E-10 |
| 413 | -3.00E-11 | 0.00E+00 | -1.20E-10 | -7.00E-11 | -9.90E-10 |
| 414 | -1.30E-10 | -4.00E-11 | -5.00E-11 | 2.00E-11 | -1.30E-10 |
| 415 | -1.20E-10 | -9.00E-11 | -1.30E-10 | -1.40E-10 | -4.90E-10 |
| 418 | 3.00E-11 | -3.20E-10 | -9.70E-10 | -2.90E-09 | -8.13E-09 |
| 419 | -9.00E-11 | -3.20E-10 | -2.00E-10 | -1.20E-10 | -4.60E-10 |
| 420 | -1.80E-10 | -7.00E-11 | -1.50E-10 | -1.40E-10 | -3.00E-11 |
| 421 | -5.00E-11 | 3.00E-11 | -1.00E-11 | 0.00E+00 | 2.00E-11 |
| Biased Statistics | | | | | |
| Average Biased | -1.10E-10 | -5.40E-11 | -1.10E-10 | -2.76E-10 | -1.26E-10 |
| Std Dev Biased | 7.81E-11 | 1.56E-10 | 1.52E-10 | 1.90E-10 | 2.00E-10 |
| Ps90%/90% (+KTL) Biased | 1.04E-10 | 3.74E-10 | 3.07E-10 | 2.46E-10 | 4.23E-10 |
| Ps90%/90% (-KTL) Biased | -3.24E-10 | -4.82E-10 | -5.27E-10 | -7.98E-10 | -6.75E-10 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -6.80E-11 | -1.54E-10 | -2.94E-10 | -6.42E-10 | -2.04E-09 |
| Std Dev Un-Biased | 6.72E-11 | 1.55E-10 | 3.82E-10 | 1.26E-09 | 3.42E-09 |
| Ps90%/90% (+KTL) Un-Biased | 1.16E-10 | 2.71E-10 | 7.52E-10 | 2.82E-09 | 7.33E-09 |
| Ps90%/90% (-KTL) Un-Biased | -2.52E-10 | -5.79E-10 | -1.34E-09 | -4.11E-09 | -1.14E-08 |
| Specification MIN | -8.00E-10 | -2.00E-09 | -1.30E-08 | -2.30E-08 | -2.30E-08 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 8.00E-10 | 2.00E-09 | 1.30E-08 | 2.30E-08 | 2.30E-08 |
| Status | PASS | PASS | PASS | PASS | PASS |

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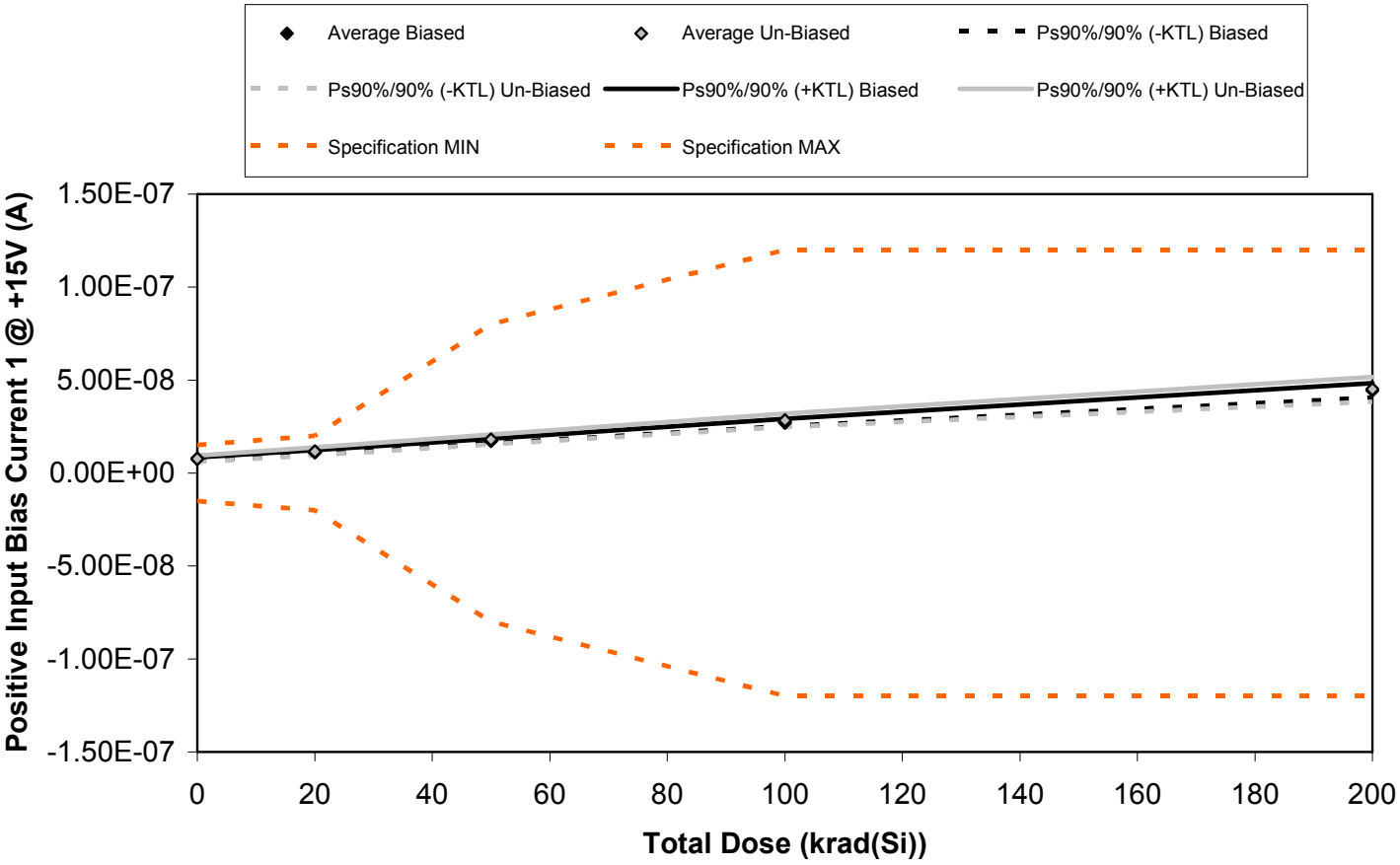


Figure 5.39. Plot of Positive Input Bias Current 1 @ +15V (A) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.39. Raw data for Positive Input Bias Current 1 @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Input Bias Current 1 @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 7.28E-09 | 1.08E-08 | 1.68E-08 | 2.74E-08 | 4.58E-08 |
| 409 | 7.57E-09 | 1.08E-08 | 1.68E-08 | 2.63E-08 | 4.33E-08 |
| 410 | 8.01E-09 | 1.16E-08 | 1.77E-08 | 2.82E-08 | 4.61E-08 |
| 411 | 7.58E-09 | 1.10E-08 | 1.73E-08 | 2.66E-08 | 4.29E-08 |
| 412 | 7.85E-09 | 1.16E-08 | 1.77E-08 | 2.73E-08 | 4.41E-08 |
| 413 | 7.59E-09 | 1.12E-08 | 1.72E-08 | 2.66E-08 | 4.09E-08 |
| 414 | 8.23E-09 | 1.21E-08 | 1.83E-08 | 2.89E-08 | 4.62E-08 |
| 415 | 7.01E-09 | 1.08E-08 | 1.69E-08 | 2.75E-08 | 4.52E-08 |
| 418 | 7.32E-09 | 1.15E-08 | 1.82E-08 | 2.85E-08 | 4.58E-08 |
| 419 | 8.51E-09 | 1.27E-08 | 1.94E-08 | 3.01E-08 | 4.72E-08 |
| 420 | 7.66E-09 | 7.72E-09 | 7.55E-09 | 7.64E-09 | 7.65E-09 |
| 421 | 8.27E-09 | 8.38E-09 | 8.32E-09 | 8.36E-09 | 8.31E-09 |
| Biased Statistics | | | | | |
| Average Biased | 7.66E-09 | 1.11E-08 | 1.72E-08 | 2.72E-08 | 4.44E-08 |
| Std Dev Biased | 2.82E-10 | 4.21E-10 | 4.48E-10 | 7.19E-10 | 1.43E-09 |
| Ps90%/90% (+KTL) Biased | 8.43E-09 | 1.23E-08 | 1.85E-08 | 2.91E-08 | 4.84E-08 |
| Ps90%/90% (-KTL) Biased | 6.89E-09 | 9.99E-09 | 1.60E-08 | 2.52E-08 | 4.05E-08 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 7.73E-09 | 1.16E-08 | 1.80E-08 | 2.83E-08 | 4.50E-08 |
| Std Dev Un-Biased | 6.25E-10 | 7.73E-10 | 9.83E-10 | 1.32E-09 | 2.44E-09 |
| Ps90%/90% (+KTL) Un-Biased | 9.45E-09 | 1.37E-08 | 2.07E-08 | 3.19E-08 | 5.17E-08 |
| Ps90%/90% (-KTL) Un-Biased | 6.02E-09 | 9.51E-09 | 1.53E-08 | 2.47E-08 | 3.83E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.20E-07 | -1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.20E-07 | 1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |

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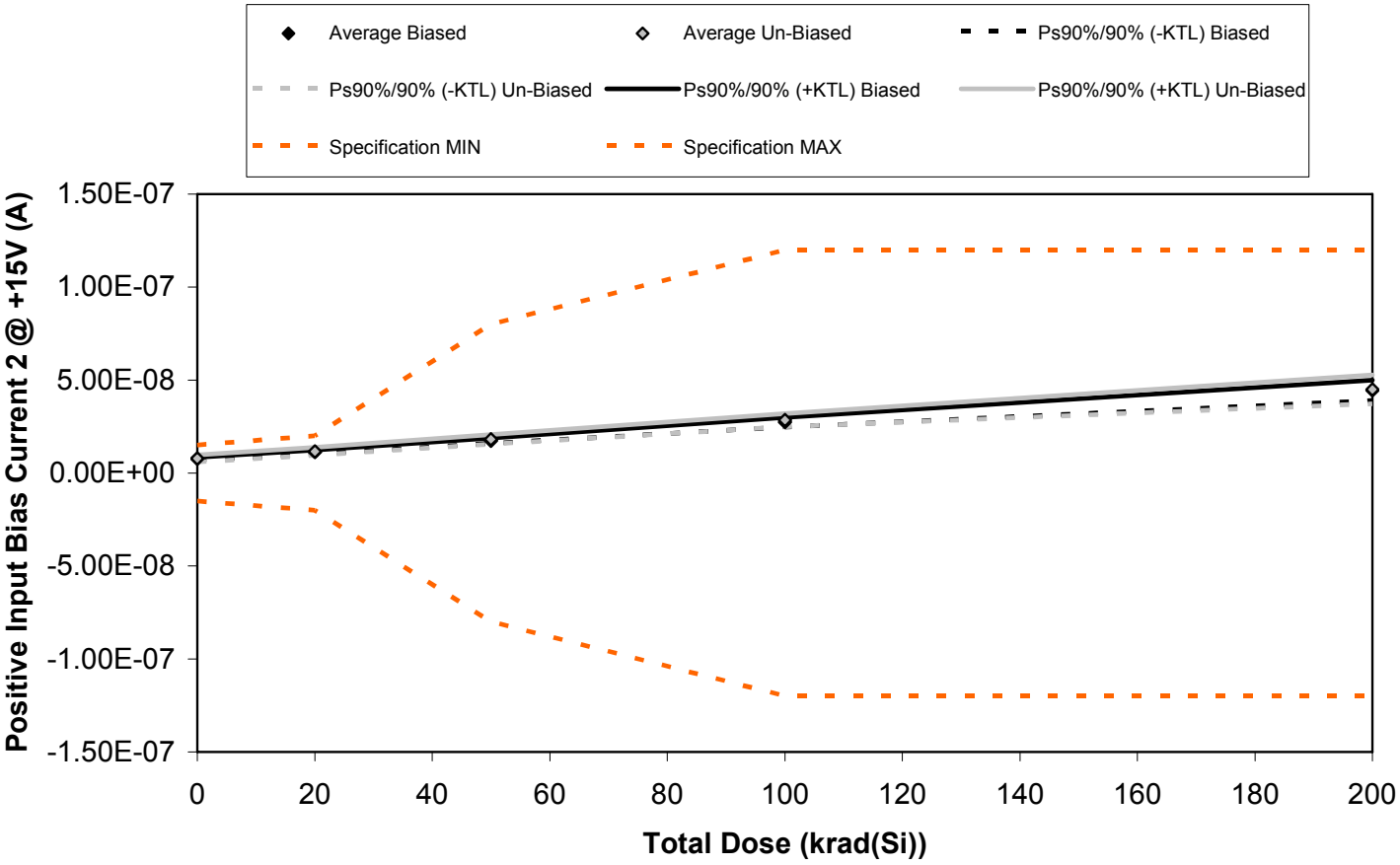


Figure 5.40. Plot of Positive Input Bias Current 2 @ +15V (A) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.40. Raw data for Positive Input Bias Current 2 @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Input Bias Current 2 @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 7.60E-09 | 1.14E-08 | 1.77E-08 | 2.83E-08 | 4.67E-08 |
| 409 | 7.58E-09 | 1.07E-08 | 1.65E-08 | 2.61E-08 | 4.23E-08 |
| 410 | 8.05E-09 | 1.17E-08 | 1.77E-08 | 2.83E-08 | 4.64E-08 |
| 411 | 7.42E-09 | 1.12E-08 | 1.74E-08 | 2.69E-08 | 4.31E-08 |
| 412 | 7.94E-09 | 1.16E-08 | 1.77E-08 | 2.72E-08 | 4.37E-08 |
| 413 | 7.62E-09 | 1.13E-08 | 1.73E-08 | 2.69E-08 | 4.02E-08 |
| 414 | 8.40E-09 | 1.21E-08 | 1.85E-08 | 2.90E-08 | 4.59E-08 |
| 415 | 7.01E-09 | 1.08E-08 | 1.71E-08 | 2.75E-08 | 4.52E-08 |
| 418 | 7.35E-09 | 1.14E-08 | 1.83E-08 | 2.89E-08 | 4.72E-08 |
| 419 | 8.62E-09 | 1.27E-08 | 1.94E-08 | 3.01E-08 | 4.66E-08 |
| 420 | 7.63E-09 | 7.62E-09 | 7.64E-09 | 7.56E-09 | 7.64E-09 |
| 421 | 8.36E-09 | 8.43E-09 | 8.40E-09 | 8.43E-09 | 8.43E-09 |
| Biased Statistics | | | | | |
| Average Biased | 7.72E-09 | 1.13E-08 | 1.74E-08 | 2.73E-08 | 4.44E-08 |
| Std Dev Biased | 2.65E-10 | 3.94E-10 | 5.09E-10 | 9.45E-10 | 1.99E-09 |
| Ps90%/90% (+KTL) Biased | 8.45E-09 | 1.24E-08 | 1.88E-08 | 2.99E-08 | 4.99E-08 |
| Ps90%/90% (-KTL) Biased | 6.99E-09 | 1.02E-08 | 1.60E-08 | 2.47E-08 | 3.90E-08 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 7.80E-09 | 1.17E-08 | 1.81E-08 | 2.85E-08 | 4.50E-08 |
| Std Dev Un-Biased | 6.88E-10 | 7.69E-10 | 9.45E-10 | 1.28E-09 | 2.81E-09 |
| Ps90%/90% (+KTL) Un-Biased | 9.69E-09 | 1.38E-08 | 2.07E-08 | 3.20E-08 | 5.27E-08 |
| Ps90%/90% (-KTL) Un-Biased | 5.91E-09 | 9.55E-09 | 1.55E-08 | 2.49E-08 | 3.73E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.20E-07 | -1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.20E-07 | 1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |

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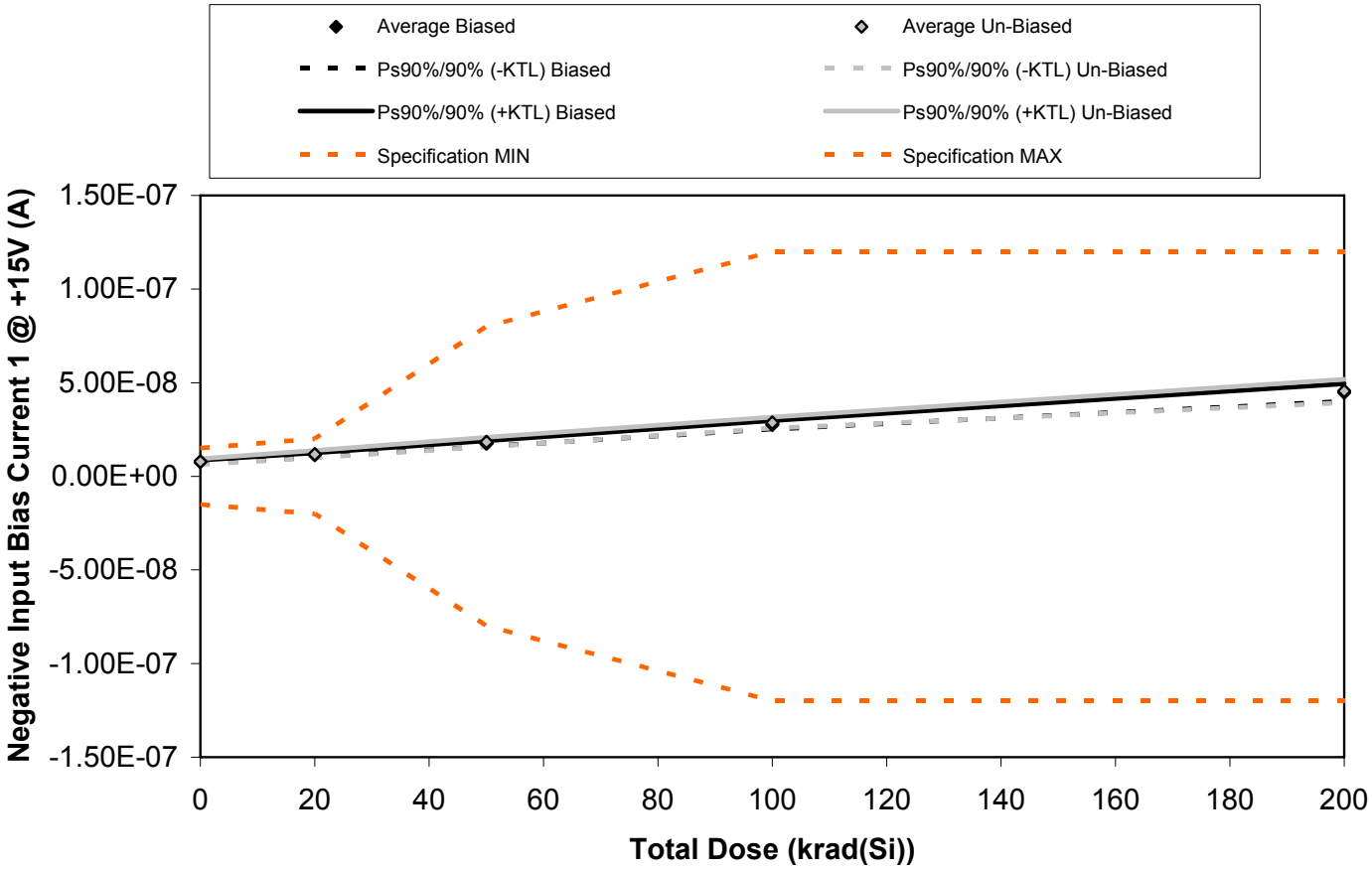


Figure 5.41. Plot of Negative Input Bias Current 1 @ +15V (A) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.41. Raw data for Negative Input Bias Current 1 @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Input Bias Current 1 @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 7.45E-09 | 1.12E-08 | 1.75E-08 | 2.80E-08 | 4.66E-08 |
| 409 | 7.49E-09 | 1.09E-08 | 1.67E-08 | 2.65E-08 | 4.40E-08 |
| 410 | 8.21E-09 | 1.16E-08 | 1.79E-08 | 2.86E-08 | 4.64E-08 |
| 411 | 7.69E-09 | 1.14E-08 | 1.74E-08 | 2.70E-08 | 4.27E-08 |
| 412 | 7.95E-09 | 1.20E-08 | 1.80E-08 | 2.76E-08 | 4.41E-08 |
| 413 | 7.76E-09 | 1.13E-08 | 1.76E-08 | 2.71E-08 | 4.16E-08 |
| 414 | 8.33E-09 | 1.22E-08 | 1.87E-08 | 2.93E-08 | 4.67E-08 |
| 415 | 7.26E-09 | 1.10E-08 | 1.72E-08 | 2.80E-08 | 4.57E-08 |
| 418 | 7.37E-09 | 1.16E-08 | 1.84E-08 | 2.88E-08 | 4.67E-08 |
| 419 | 8.48E-09 | 1.28E-08 | 1.95E-08 | 2.99E-08 | 4.72E-08 |
| 420 | 7.58E-09 | 7.66E-09 | 7.73E-09 | 7.69E-09 | 7.65E-09 |
| 421 | 8.32E-09 | 8.31E-09 | 8.35E-09 | 8.43E-09 | 8.35E-09 |
| Biased Statistics | | | | | |
| Average Biased | 7.76E-09 | 1.14E-08 | 1.75E-08 | 2.76E-08 | 4.48E-08 |
| Std Dev Biased | 3.21E-10 | 4.22E-10 | 5.36E-10 | 8.27E-10 | 1.71E-09 |
| Ps90%/90% (+KTL) Biased | 8.64E-09 | 1.25E-08 | 1.90E-08 | 2.98E-08 | 4.95E-08 |
| Ps90%/90% (-KTL) Biased | 6.88E-09 | 1.02E-08 | 1.60E-08 | 2.53E-08 | 4.01E-08 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 7.84E-09 | 1.18E-08 | 1.83E-08 | 2.86E-08 | 4.56E-08 |
| Std Dev Un-Biased | 5.51E-10 | 7.20E-10 | 9.04E-10 | 1.08E-09 | 2.30E-09 |
| Ps90%/90% (+KTL) Un-Biased | 9.35E-09 | 1.37E-08 | 2.08E-08 | 3.16E-08 | 5.19E-08 |
| Ps90%/90% (-KTL) Un-Biased | 6.33E-09 | 9.79E-09 | 1.58E-08 | 2.56E-08 | 3.93E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.20E-07 | -1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.20E-07 | 1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |

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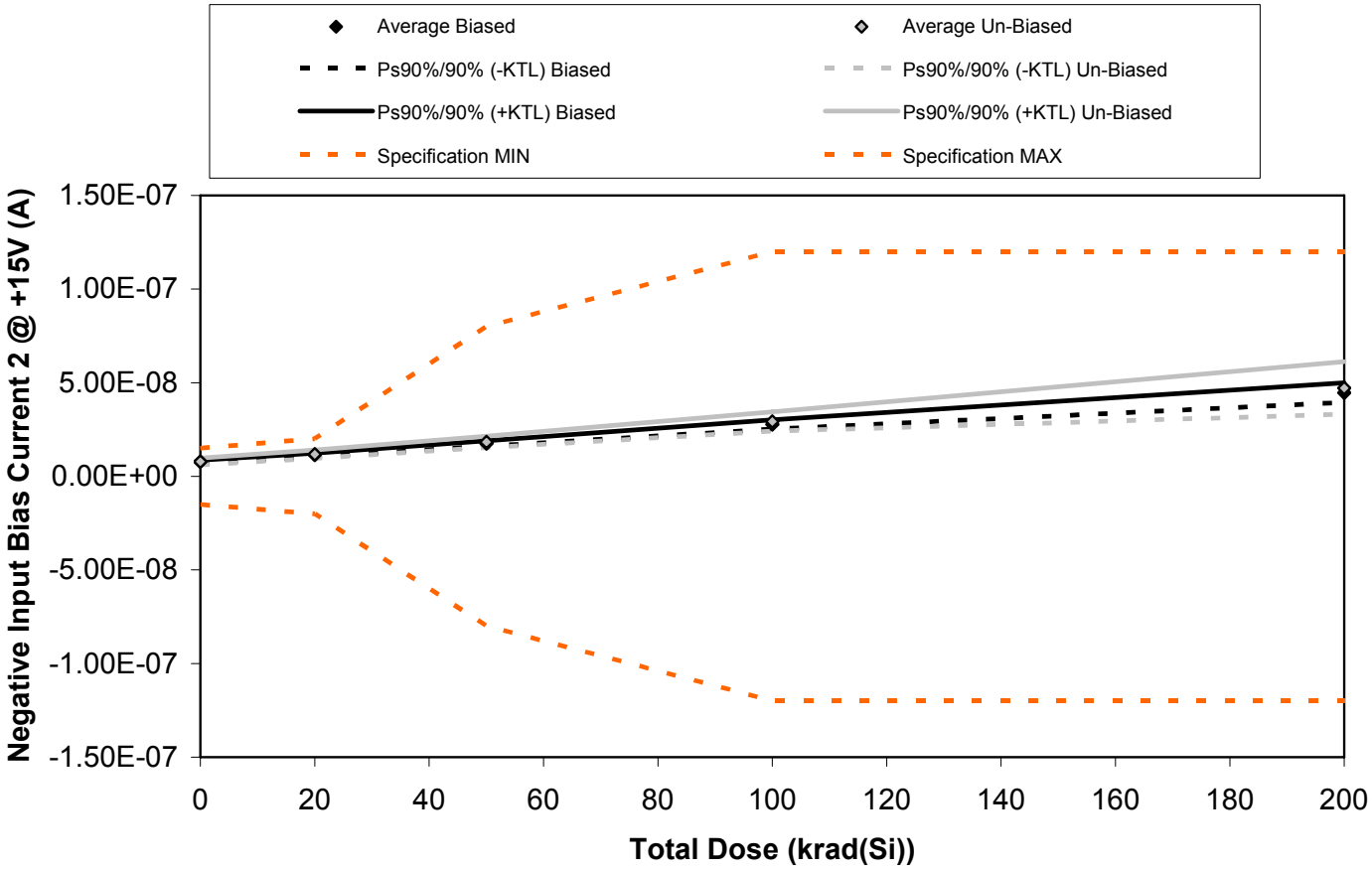


Figure 5.42. Plot of Negative Input Bias Current 2 @ +15V (A) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.42. Raw data for Negative Input Bias Current 2 @ +15V (A) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Input Bias Current 2 @ +15V (A)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 7.52E-09 | 1.13E-08 | 1.76E-08 | 2.85E-08 | 4.69E-08 |
| 409 | 7.64E-09 | 1.10E-08 | 1.67E-08 | 2.66E-08 | 4.31E-08 |
| 410 | 8.19E-09 | 1.17E-08 | 1.80E-08 | 2.88E-08 | 4.66E-08 |
| 411 | 7.63E-09 | 1.12E-08 | 1.76E-08 | 2.72E-08 | 4.30E-08 |
| 412 | 8.06E-09 | 1.18E-08 | 1.79E-08 | 2.76E-08 | 4.38E-08 |
| 413 | 7.75E-09 | 1.12E-08 | 1.74E-08 | 2.70E-08 | 4.13E-08 |
| 414 | 8.53E-09 | 1.22E-08 | 1.87E-08 | 2.92E-08 | 4.63E-08 |
| 415 | 7.10E-09 | 1.08E-08 | 1.71E-08 | 2.79E-08 | 4.59E-08 |
| 418 | 7.43E-09 | 1.18E-08 | 1.91E-08 | 3.18E-08 | 5.54E-08 |
| 419 | 8.62E-09 | 1.30E-08 | 1.96E-08 | 3.03E-08 | 4.71E-08 |
| 420 | 7.75E-09 | 7.79E-09 | 7.66E-09 | 7.73E-09 | 7.76E-09 |
| 421 | 8.36E-09 | 8.35E-09 | 8.39E-09 | 8.41E-09 | 8.40E-09 |
| Biased Statistics | | | | | |
| Average Biased | 7.81E-09 | 1.14E-08 | 1.76E-08 | 2.77E-08 | 4.47E-08 |
| Std Dev Biased | 2.97E-10 | 3.32E-10 | 5.27E-10 | 9.01E-10 | 1.92E-09 |
| Ps90%/90% (+KTL) Biased | 8.62E-09 | 1.23E-08 | 1.90E-08 | 3.02E-08 | 4.99E-08 |
| Ps90%/90% (-KTL) Biased | 6.99E-09 | 1.05E-08 | 1.61E-08 | 2.52E-08 | 3.94E-08 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 7.89E-09 | 1.18E-08 | 1.84E-08 | 2.93E-08 | 4.72E-08 |
| Std Dev Un-Biased | 6.70E-10 | 8.27E-10 | 1.10E-09 | 1.89E-09 | 5.12E-09 |
| Ps90%/90% (+KTL) Un-Biased | 9.72E-09 | 1.41E-08 | 2.14E-08 | 3.44E-08 | 6.12E-08 |
| Ps90%/90% (-KTL) Un-Biased | 6.05E-09 | 9.52E-09 | 1.54E-08 | 2.41E-08 | 3.31E-08 |
| Specification MIN | -1.50E-08 | -2.00E-08 | -8.00E-08 | -1.20E-07 | -1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |
| Specification MAX | 1.50E-08 | 2.00E-08 | 8.00E-08 | 1.20E-07 | 1.20E-07 |
| Status | PASS | PASS | PASS | PASS | PASS |

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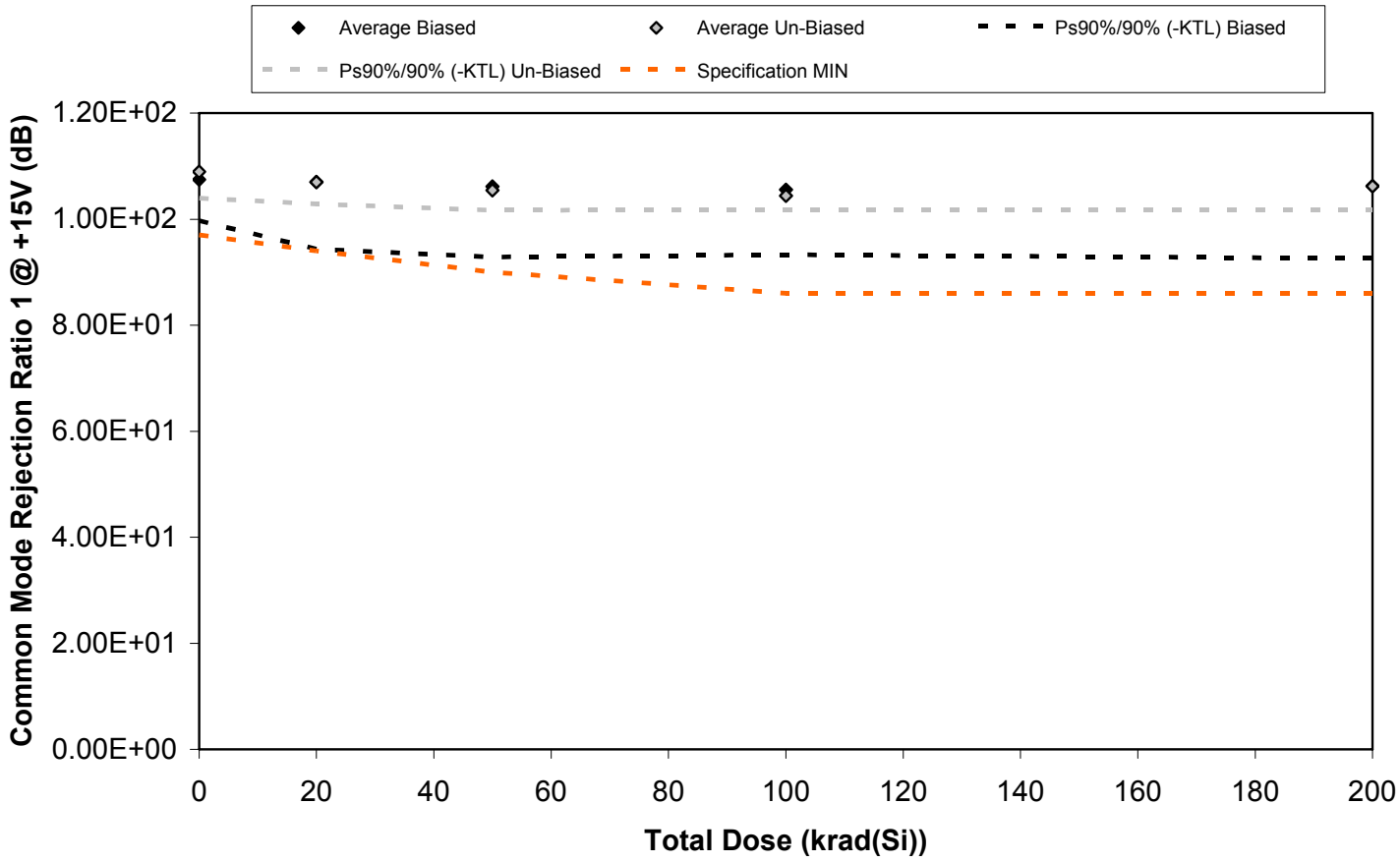


Figure 5.43. Plot of Common Mode Rejection Ratio 1 @ +15V (dB) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.43. Raw data for Common Mode Rejection Ratio 1 @ +15V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Common Mode Rejection Ratio 1 @ +15V (dB)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.13E+02 | 1.15E+02 | 1.15E+02 | 1.14E+02 | 1.15E+02 |
| 409 | 1.06E+02 | 1.05E+02 | 1.04E+02 | 1.03E+02 | 1.05E+02 |
| 410 | 1.06E+02 | 1.05E+02 | 1.04E+02 | 1.03E+02 | 1.03E+02 |
| 411 | 1.06E+02 | 1.05E+02 | 1.04E+02 | 1.04E+02 | 1.04E+02 |
| 412 | 1.06E+02 | 1.05E+02 | 1.04E+02 | 1.04E+02 | 1.04E+02 |
| 413 | 1.09E+02 | 1.07E+02 | 1.05E+02 | 1.04E+02 | 1.05E+02 |
| 414 | 1.09E+02 | 1.08E+02 | 1.06E+02 | 1.05E+02 | 1.07E+02 |
| 415 | 1.08E+02 | 1.06E+02 | 1.04E+02 | 1.04E+02 | 1.04E+02 |
| 418 | 1.12E+02 | 1.09E+02 | 1.08E+02 | 1.06E+02 | 1.09E+02 |
| 419 | 1.07E+02 | 1.05E+02 | 1.04E+02 | 1.04E+02 | 1.06E+02 |
| 420 | 1.08E+02 | 1.08E+02 | 1.08E+02 | 1.08E+02 | 1.08E+02 |
| 421 | 1.08E+02 | 1.09E+02 | 1.08E+02 | 1.09E+02 | 1.08E+02 |
| Biased Statistics | | | | | |
| Average Biased | 1.07E+02 | 1.07E+02 | 1.06E+02 | 1.06E+02 | 1.06E+02 |
| Std Dev Biased | 2.83E+00 | 4.63E+00 | 4.85E+00 | 4.45E+00 | 4.99E+00 |
| Ps90%/90% (+KTL) Biased | 1.15E+02 | 1.20E+02 | 1.19E+02 | 1.18E+02 | 1.20E+02 |
| Ps90%/90% (-KTL) Biased | 9.97E+01 | 9.43E+01 | 9.29E+01 | 9.33E+01 | 9.26E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.09E+02 | 1.07E+02 | 1.05E+02 | 1.04E+02 | 1.06E+02 |
| Std Dev Un-Biased | 1.83E+00 | 1.50E+00 | 1.38E+00 | 9.68E-01 | 1.64E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.14E+02 | 1.11E+02 | 1.09E+02 | 1.07E+02 | 1.11E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.04E+02 | 1.03E+02 | 1.02E+02 | 1.02E+02 | 1.02E+02 |
| Specification MIN | 9.70E+01 | 9.40E+01 | 9.00E+01 | 8.60E+01 | 8.60E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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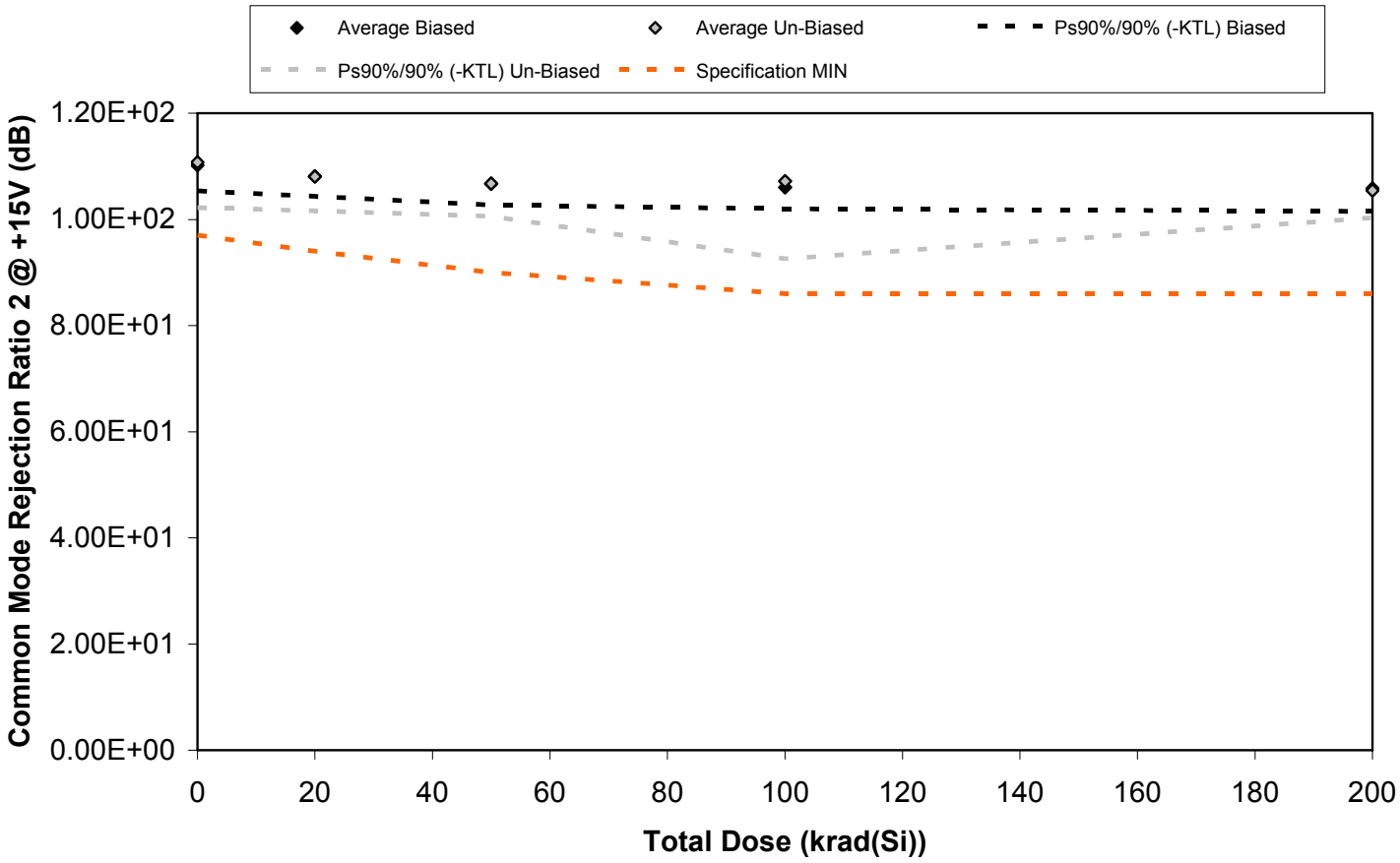


Figure 5.44. Plot of Common Mode Rejection Ratio 2 @ +15V (dB) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.44. Raw data for Common Mode Rejection Ratio 2 @ +15V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Common Mode Rejection Ratio 2 @ +15V (dB)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.13E+02 | 1.10E+02 | 1.09E+02 | 1.08E+02 | 1.08E+02 |
| 409 | 1.08E+02 | 1.07E+02 | 1.05E+02 | 1.04E+02 | 1.05E+02 |
| 410 | 1.10E+02 | 1.08E+02 | 1.06E+02 | 1.05E+02 | 1.05E+02 |
| 411 | 1.09E+02 | 1.07E+02 | 1.06E+02 | 1.05E+02 | 1.05E+02 |
| 412 | 1.10E+02 | 1.09E+02 | 1.07E+02 | 1.07E+02 | 1.07E+02 |
| 413 | 1.09E+02 | 1.06E+02 | 1.05E+02 | 1.03E+02 | 1.05E+02 |
| 414 | 1.09E+02 | 1.07E+02 | 1.06E+02 | 1.05E+02 | 1.07E+02 |
| 415 | 1.16E+02 | 1.12E+02 | 1.09E+02 | 1.08E+02 | 1.08E+02 |
| 418 | 1.12E+02 | 1.10E+02 | 1.09E+02 | 1.16E+02 | 1.03E+02 |
| 419 | 1.09E+02 | 1.06E+02 | 1.05E+02 | 1.04E+02 | 1.06E+02 |
| 420 | 1.09E+02 | 1.09E+02 | 1.09E+02 | 1.09E+02 | 1.09E+02 |
| 421 | 1.12E+02 | 1.11E+02 | 1.12E+02 | 1.12E+02 | 1.12E+02 |
| Biased Statistics | | | | | |
| Average Biased | 1.10E+02 | 1.08E+02 | 1.07E+02 | 1.06E+02 | 1.06E+02 |
| Std Dev Biased | 1.75E+00 | 1.37E+00 | 1.45E+00 | 1.47E+00 | 1.59E+00 |
| Ps90%/90% (+KTL) Biased | 1.15E+02 | 1.12E+02 | 1.11E+02 | 1.10E+02 | 1.10E+02 |
| Ps90%/90% (-KTL) Biased | 1.05E+02 | 1.04E+02 | 1.03E+02 | 1.02E+02 | 1.01E+02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.11E+02 | 1.08E+02 | 1.07E+02 | 1.07E+02 | 1.05E+02 |
| Std Dev Un-Biased | 3.11E+00 | 2.37E+00 | 2.24E+00 | 5.33E+00 | 1.88E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.19E+02 | 1.15E+02 | 1.13E+02 | 1.22E+02 | 1.11E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.02E+02 | 1.02E+02 | 1.01E+02 | 9.26E+01 | 1.00E+02 |
| Specification MIN | 9.70E+01 | 9.40E+01 | 9.00E+01 | 8.60E+01 | 8.60E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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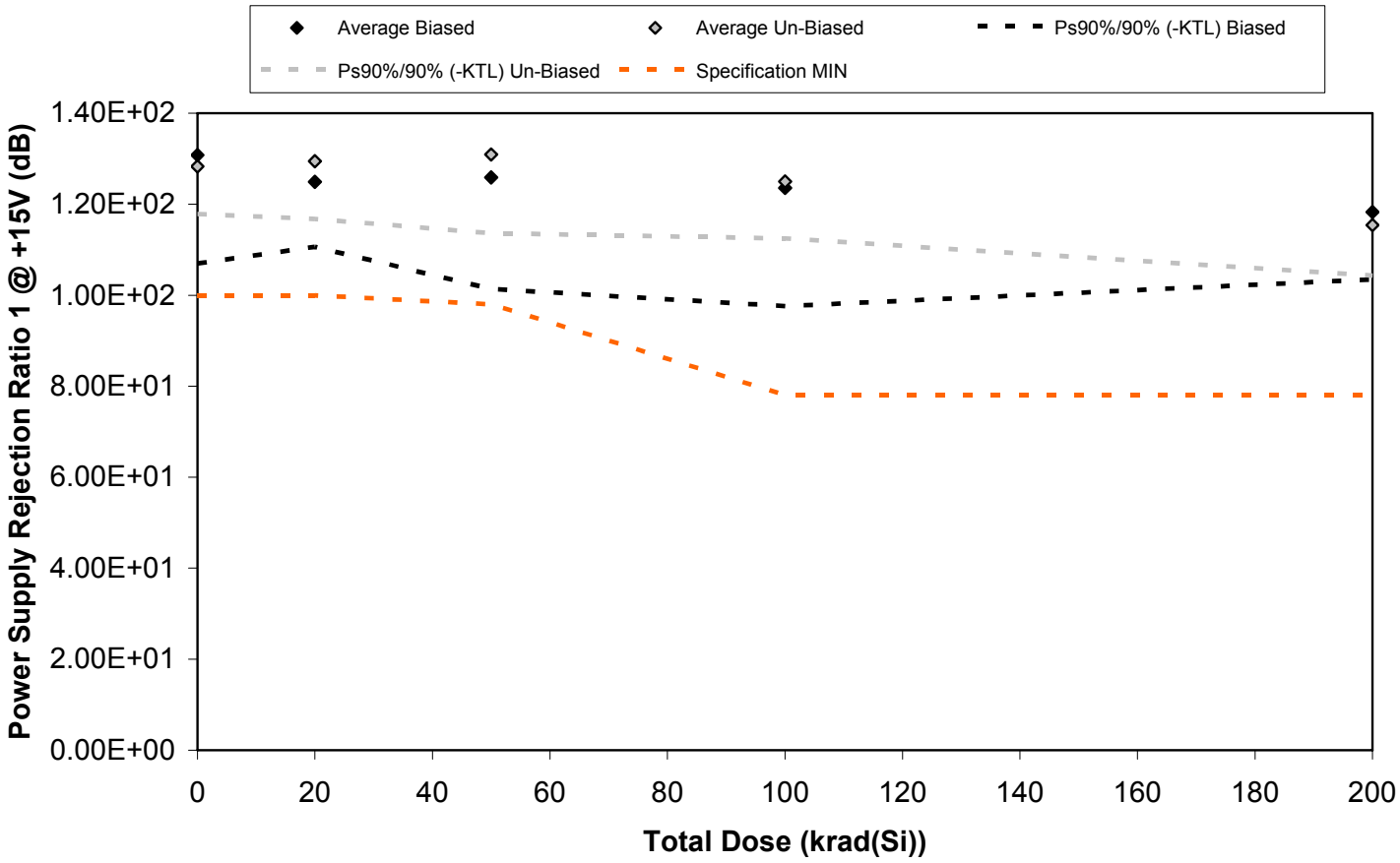


Figure 5.45. Plot of Power Supply Rejection Ratio 1 @ +15V (dB) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.45. Raw data for Power Supply Rejection Ratio 1 @ +15V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Power Supply Rejection Ratio 1 @ +15V (dB)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.28E+02 | 1.22E+02 | 1.24E+02 | 1.26E+02 | 1.24E+02 |
| 409 | 1.40E+02 | 1.26E+02 | 1.22E+02 | 1.19E+02 | 1.17E+02 |
| 410 | 1.38E+02 | 1.32E+02 | 1.40E+02 | 1.39E+02 | 1.23E+02 |
| 411 | 1.18E+02 | 1.18E+02 | 1.16E+02 | 1.13E+02 | 1.10E+02 |
| 412 | 1.31E+02 | 1.26E+02 | 1.28E+02 | 1.21E+02 | 1.18E+02 |
| 413 | 1.29E+02 | 1.27E+02 | 1.34E+02 | 1.25E+02 | 1.13E+02 |
| 414 | 1.28E+02 | 1.28E+02 | 1.35E+02 | 1.30E+02 | 1.22E+02 |
| 415 | 1.30E+02 | 1.27E+02 | 1.25E+02 | 1.23E+02 | 1.15E+02 |
| 418 | 1.33E+02 | 1.38E+02 | 1.38E+02 | 1.29E+02 | 1.14E+02 |
| 419 | 1.22E+02 | 1.28E+02 | 1.23E+02 | 1.19E+02 | 1.12E+02 |
| 420 | 1.20E+02 | 1.18E+02 | 1.20E+02 | 1.21E+02 | 1.20E+02 |
| 421 | 1.27E+02 | 1.26E+02 | 1.27E+02 | 1.21E+02 | 1.22E+02 |
| Biased Statistics | | | | | |
| Average Biased | 1.31E+02 | 1.25E+02 | 1.26E+02 | 1.24E+02 | 1.18E+02 |
| Std Dev Biased | 8.70E+00 | 5.21E+00 | 8.96E+00 | 9.49E+00 | 5.39E+00 |
| Ps90%/90% (+KTL) Biased | 1.55E+02 | 1.39E+02 | 1.50E+02 | 1.50E+02 | 1.33E+02 |
| Ps90%/90% (-KTL) Biased | 1.07E+02 | 1.11E+02 | 1.01E+02 | 9.76E+01 | 1.04E+02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.28E+02 | 1.29E+02 | 1.31E+02 | 1.25E+02 | 1.15E+02 |
| Std Dev Un-Biased | 3.82E+00 | 4.64E+00 | 6.31E+00 | 4.57E+00 | 4.05E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.39E+02 | 1.42E+02 | 1.48E+02 | 1.38E+02 | 1.27E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.18E+02 | 1.17E+02 | 1.14E+02 | 1.12E+02 | 1.04E+02 |
| Specification MIN | 1.00E+02 | 1.00E+02 | 9.80E+01 | 7.80E+01 | 7.80E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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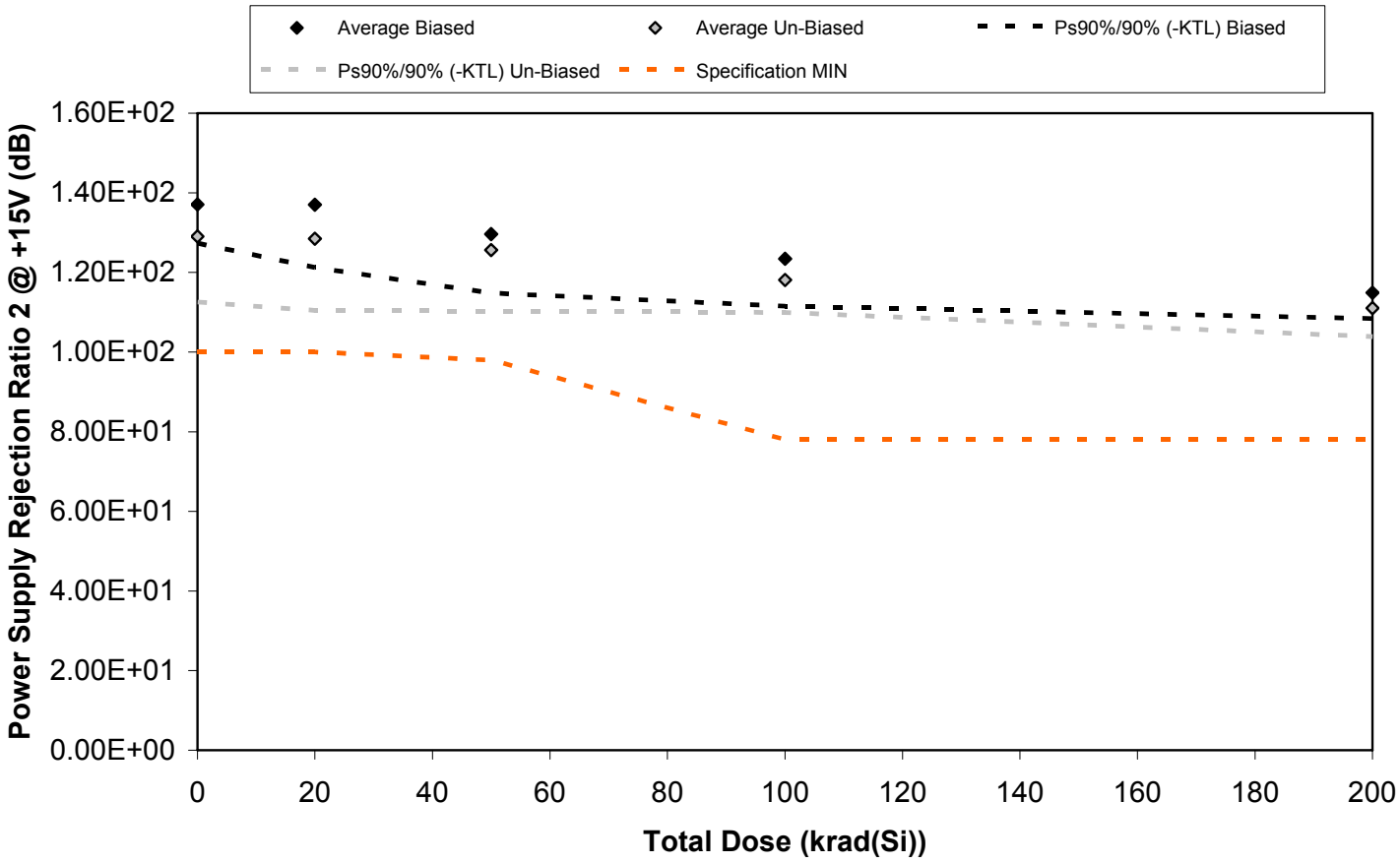


Figure 5.46. Plot of Power Supply Rejection Ratio 2 @ +15V (dB) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.46. Raw data for Power Supply Rejection Ratio 2 @ +15V (dB) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Power Supply Rejection Ratio 2 @ +15V (dB)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.41E+02 | 1.29E+02 | 1.23E+02 | 1.17E+02 | 1.14E+02 |
| 409 | 1.38E+02 | 1.43E+02 | 1.32E+02 | 1.27E+02 | 1.15E+02 |
| 410 | 1.33E+02 | 1.42E+02 | 1.37E+02 | 1.27E+02 | 1.13E+02 |
| 411 | 1.34E+02 | 1.37E+02 | 1.28E+02 | 1.21E+02 | 1.13E+02 |
| 412 | 1.40E+02 | 1.34E+02 | 1.28E+02 | 1.24E+02 | 1.19E+02 |
| 413 | 1.38E+02 | 1.28E+02 | 1.20E+02 | 1.15E+02 | 1.10E+02 |
| 414 | 1.30E+02 | 1.26E+02 | 1.26E+02 | 1.22E+02 | 1.15E+02 |
| 415 | 1.28E+02 | 1.40E+02 | 1.35E+02 | 1.20E+02 | 1.12E+02 |
| 418 | 1.21E+02 | 1.24E+02 | 1.26E+02 | 1.16E+02 | 1.08E+02 |
| 419 | 1.29E+02 | 1.25E+02 | 1.22E+02 | 1.17E+02 | 1.11E+02 |
| 420 | 1.27E+02 | 1.26E+02 | 1.25E+02 | 1.23E+02 | 1.30E+02 |
| 421 | 1.25E+02 | 1.28E+02 | 1.28E+02 | 1.28E+02 | 1.27E+02 |
| Biased Statistics | | | | | |
| Average Biased | 1.37E+02 | 1.37E+02 | 1.30E+02 | 1.23E+02 | 1.15E+02 |
| Std Dev Biased | 3.53E+00 | 5.74E+00 | 5.42E+00 | 4.34E+00 | 2.34E+00 |
| Ps90%/90% (+KTL) Biased | 1.47E+02 | 1.53E+02 | 1.45E+02 | 1.35E+02 | 1.21E+02 |
| Ps90%/90% (-KTL) Biased | 1.27E+02 | 1.21E+02 | 1.15E+02 | 1.12E+02 | 1.08E+02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.29E+02 | 1.28E+02 | 1.26E+02 | 1.18E+02 | 1.11E+02 |
| Std Dev Un-Biased | 6.03E+00 | 6.57E+00 | 5.60E+00 | 2.96E+00 | 2.61E+00 |
| Ps90%/90% (+KTL) Un-Biased | 1.46E+02 | 1.46E+02 | 1.41E+02 | 1.26E+02 | 1.18E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.13E+02 | 1.10E+02 | 1.10E+02 | 1.10E+02 | 1.04E+02 |
| Specification MIN | 1.00E+02 | 1.00E+02 | 9.80E+01 | 7.80E+01 | 7.80E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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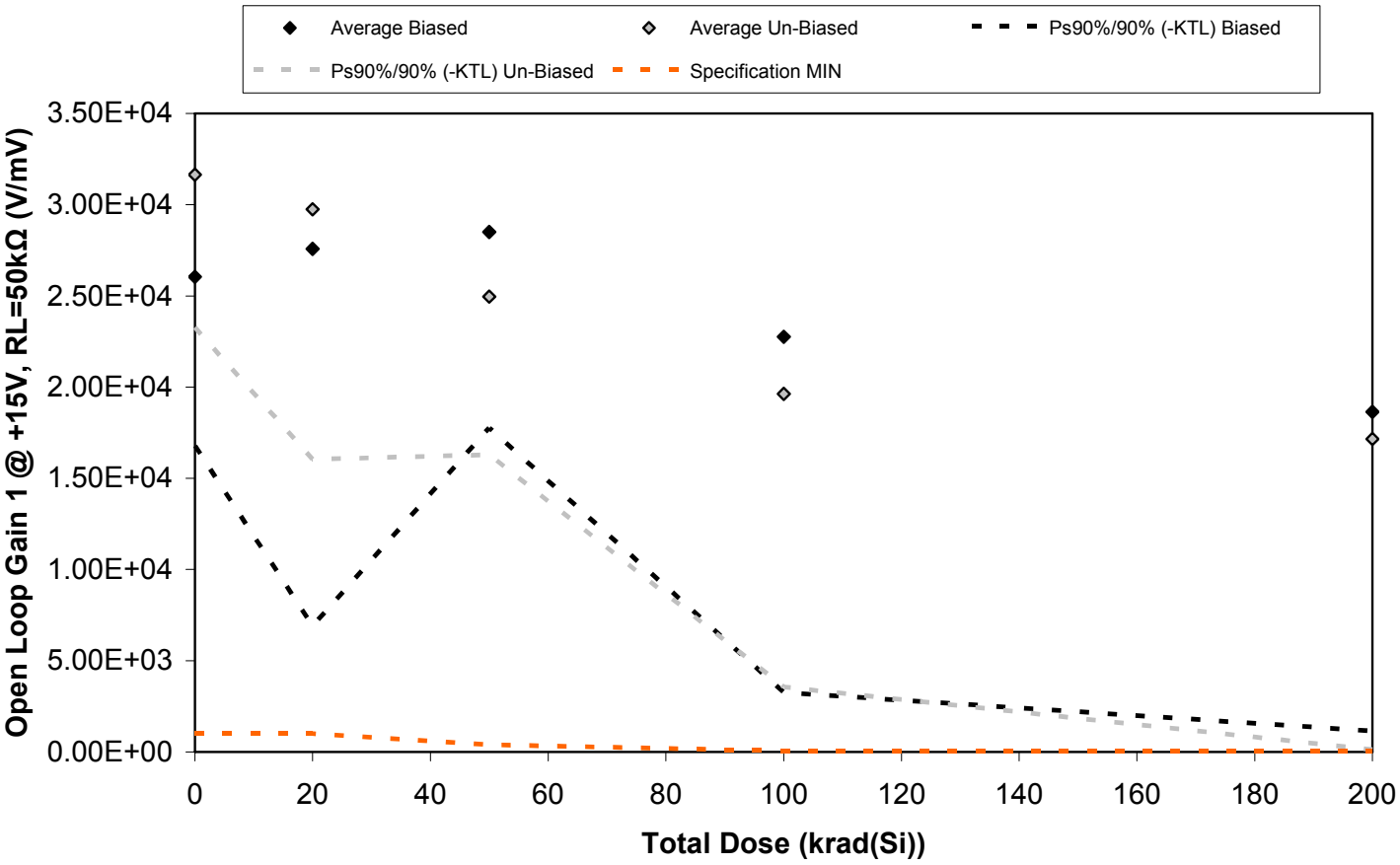


Figure 5.47. Plot of Open Loop Gain 1 @ +15V, RL=50kΩ (V/mV) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.47. Raw data for Open Loop Gain 1 @ +15V, RL=50kΩ (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 1 @ +15V, RL=50kΩ (V/mV)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 2.56E+04 | 1.90E+04 | 3.29E+04 | 2.21E+04 | 2.56E+04 |
| 409 | 2.39E+04 | 3.53E+04 | 3.25E+04 | 1.40E+04 | 2.00E+04 |
| 410 | 2.99E+04 | 3.34E+04 | 2.69E+04 | 2.37E+04 | 8.16E+03 |
| 411 | 2.19E+04 | 3.00E+04 | 2.56E+04 | 3.36E+04 | 1.95E+04 |
| 412 | 2.90E+04 | 2.02E+04 | 2.46E+04 | 2.03E+04 | 1.99E+04 |
| 413 | 3.56E+04 | 3.21E+04 | 2.07E+04 | 2.43E+04 | 1.07E+04 |
| 414 | 3.14E+04 | 2.89E+04 | 2.41E+04 | 1.11E+04 | 1.03E+04 |
| 415 | 3.18E+04 | 3.23E+04 | 2.89E+04 | 2.59E+04 | 2.32E+04 |
| 418 | 2.70E+04 | 3.41E+04 | 2.71E+04 | 1.89E+04 | 1.96E+04 |
| 419 | 3.25E+04 | 2.14E+04 | 2.39E+04 | 1.79E+04 | 2.20E+04 |
| 420 | 2.52E+04 | 3.03E+04 | 3.23E+04 | 2.94E+04 | 2.97E+04 |
| 421 | 3.22E+04 | 2.77E+04 | 3.52E+04 | 3.51E+04 | 2.64E+04 |
| Biased Statistics | | | | | |
| Average Biased | 2.60E+04 | 2.76E+04 | 2.85E+04 | 2.28E+04 | 1.86E+04 |
| Std Dev Biased | 3.39E+03 | 7.54E+03 | 3.92E+03 | 7.12E+03 | 6.38E+03 |
| Ps90%/90% (+KTL) Biased | 3.53E+04 | 4.83E+04 | 3.93E+04 | 4.23E+04 | 3.61E+04 |
| Ps90%/90% (-KTL) Biased | 1.68E+04 | 6.90E+03 | 1.78E+04 | 3.25E+03 | 1.15E+03 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 3.16E+04 | 2.98E+04 | 2.50E+04 | 1.96E+04 | 1.72E+04 |
| Std Dev Un-Biased | 3.06E+03 | 5.00E+03 | 3.16E+03 | 5.86E+03 | 6.21E+03 |
| Ps90%/90% (+KTL) Un-Biased | 4.00E+04 | 4.35E+04 | 3.36E+04 | 3.57E+04 | 3.42E+04 |
| Ps90%/90% (-KTL) Un-Biased | 2.33E+04 | 1.60E+04 | 1.63E+04 | 3.55E+03 | 1.29E+02 |
| Specification MIN | 1.00E+03 | 1.00E+03 | 4.00E+02 | 5.00E+01 | 5.00E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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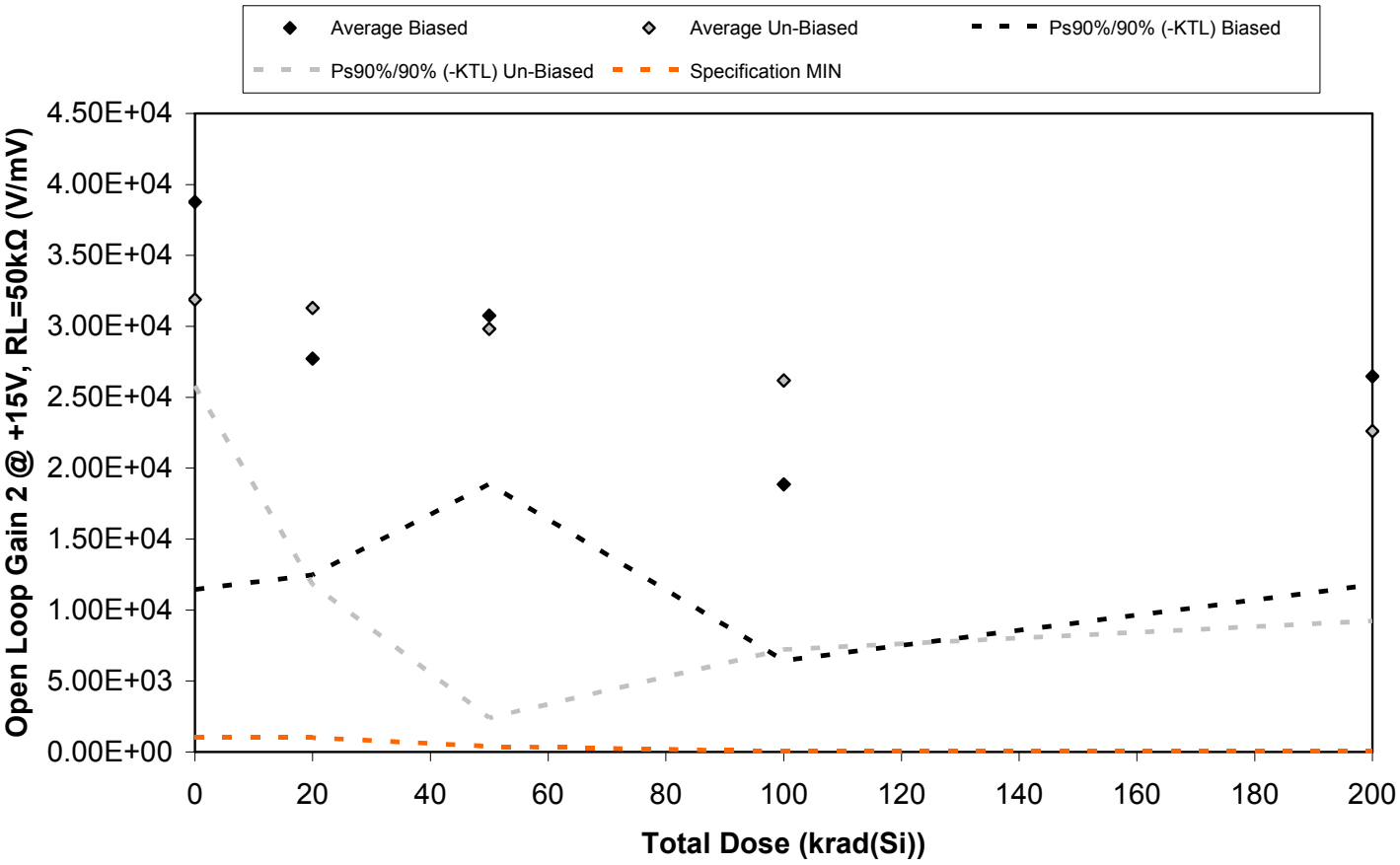


Figure 5.48. Plot of Open Loop Gain 2 @ +15V, RL=50kΩ (V/mV) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.48. Raw data for Open Loop Gain 2 @ +15V, RL=50kΩ (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 2 @ +15V, RL=50kΩ (V/mV)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 4.04E+04 | 2.57E+04 | 2.88E+04 | 1.61E+04 | 3.06E+04 |
| 409 | 4.00E+04 | 3.62E+04 | 3.29E+04 | 2.56E+04 | 2.34E+04 |
| 410 | 4.05E+04 | 2.56E+04 | 3.65E+04 | 1.53E+04 | 3.17E+04 |
| 411 | 5.02E+04 | 2.97E+04 | 3.05E+04 | 1.57E+04 | 1.88E+04 |
| 412 | 2.27E+04 | 2.15E+04 | 2.50E+04 | 2.15E+04 | 2.79E+04 |
| 413 | 3.53E+04 | 3.33E+04 | 2.56E+04 | 2.89E+04 | 1.96E+04 |
| 414 | 3.12E+04 | 3.14E+04 | 1.76E+04 | 3.21E+04 | 3.06E+04 |
| 415 | 3.18E+04 | 3.72E+04 | 3.58E+04 | 3.21E+04 | 2.01E+04 |
| 418 | 3.20E+04 | 3.55E+04 | 2.66E+04 | 1.71E+04 | 1.89E+04 |
| 419 | 2.92E+04 | 1.92E+04 | 4.35E+04 | 2.07E+04 | 2.40E+04 |
| 420 | 3.96E+04 | 3.86E+04 | 3.34E+04 | 3.63E+04 | 1.00E+05 |
| 421 | 2.99E+04 | 4.10E+04 | 3.99E+04 | 3.04E+04 | 1.00E+05 |
| Biased Statistics | | | | | |
| Average Biased | 3.88E+04 | 2.77E+04 | 3.07E+04 | 1.89E+04 | 2.65E+04 |
| Std Dev Biased | 9.96E+03 | 5.56E+03 | 4.33E+03 | 4.53E+03 | 5.36E+03 |
| Ps90%/90% (+KTL) Biased | 6.61E+04 | 4.30E+04 | 4.26E+04 | 3.13E+04 | 4.12E+04 |
| Ps90%/90% (-KTL) Biased | 1.14E+04 | 1.25E+04 | 1.89E+04 | 6.45E+03 | 1.18E+04 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 3.19E+04 | 3.13E+04 | 2.98E+04 | 2.62E+04 | 2.26E+04 |
| Std Dev Un-Biased | 2.22E+03 | 7.11E+03 | 1.00E+04 | 6.91E+03 | 4.88E+03 |
| Ps90%/90% (+KTL) Un-Biased | 3.80E+04 | 5.08E+04 | 5.72E+04 | 4.52E+04 | 3.60E+04 |
| Ps90%/90% (-KTL) Un-Biased | 2.58E+04 | 1.18E+04 | 2.40E+03 | 7.23E+03 | 9.24E+03 |
| Specification MIN | 1.00E+03 | 1.00E+03 | 4.00E+02 | 5.00E+01 | 5.00E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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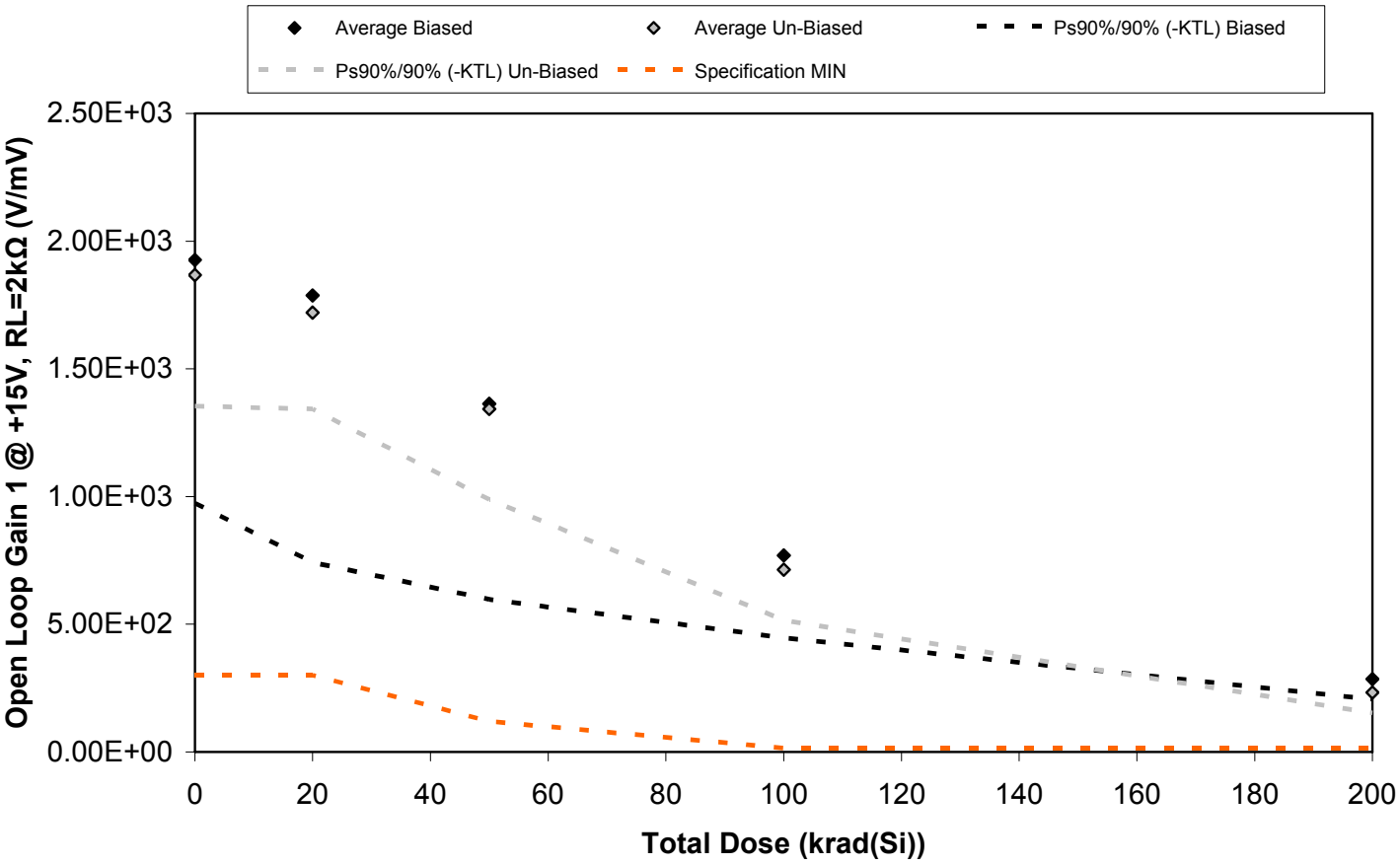


Figure 5.49. Plot of Open Loop Gain 1 @ +15V, RL=2kΩ (V/mV) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.49. Raw data for Open Loop Gain 1 @ +15V, RL=2kΩ (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 1 @ +15V, RL=2kΩ (V/mV)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.55E+03 | 1.39E+03 | 1.08E+03 | 6.64E+02 | 2.56E+02 |
| 409 | 2.12E+03 | 1.87E+03 | 1.45E+03 | 7.63E+02 | 2.83E+02 |
| 410 | 2.38E+03 | 2.37E+03 | 1.78E+03 | 9.51E+02 | 3.29E+02 |
| 411 | 1.62E+03 | 1.50E+03 | 1.15E+03 | 6.67E+02 | 2.65E+02 |
| 412 | 1.97E+03 | 1.81E+03 | 1.36E+03 | 8.02E+02 | 2.93E+02 |
| 413 | 1.99E+03 | 1.81E+03 | 1.39E+03 | 6.62E+02 | 2.12E+02 |
| 414 | 2.13E+03 | 1.90E+03 | 1.54E+03 | 7.97E+02 | 2.68E+02 |
| 415 | 1.78E+03 | 1.70E+03 | 1.30E+03 | 7.53E+02 | 2.51E+02 |
| 418 | 1.66E+03 | 1.60E+03 | 1.26E+03 | 7.41E+02 | 2.39E+02 |
| 419 | 1.78E+03 | 1.59E+03 | 1.21E+03 | 6.18E+02 | 1.95E+02 |
| 420 | 1.64E+03 | 1.66E+03 | 1.67E+03 | 1.63E+03 | 1.57E+03 |
| 421 | 1.64E+03 | 1.61E+03 | 1.63E+03 | 1.59E+03 | 1.63E+03 |
| Biased Statistics | | | | | |
| Average Biased | 1.93E+03 | 1.79E+03 | 1.36E+03 | 7.69E+02 | 2.85E+02 |
| Std Dev Biased | 3.48E+02 | 3.81E+02 | 2.79E+02 | 1.18E+02 | 2.86E+01 |
| Ps90%/90% (+KTL) Biased | 2.88E+03 | 2.83E+03 | 2.13E+03 | 1.09E+03 | 3.63E+02 |
| Ps90%/90% (-KTL) Biased | 9.73E+02 | 7.43E+02 | 5.98E+02 | 4.46E+02 | 2.07E+02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.87E+03 | 1.72E+03 | 1.34E+03 | 7.14E+02 | 2.33E+02 |
| Std Dev Un-Biased | 1.87E+02 | 1.38E+02 | 1.29E+02 | 7.27E+01 | 2.94E+01 |
| Ps90%/90% (+KTL) Un-Biased | 2.38E+03 | 2.10E+03 | 1.70E+03 | 9.14E+02 | 3.14E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.35E+03 | 1.34E+03 | 9.88E+02 | 5.15E+02 | 1.53E+02 |
| Specification MIN | 3.00E+02 | 3.00E+02 | 1.20E+02 | 1.50E+01 | 1.50E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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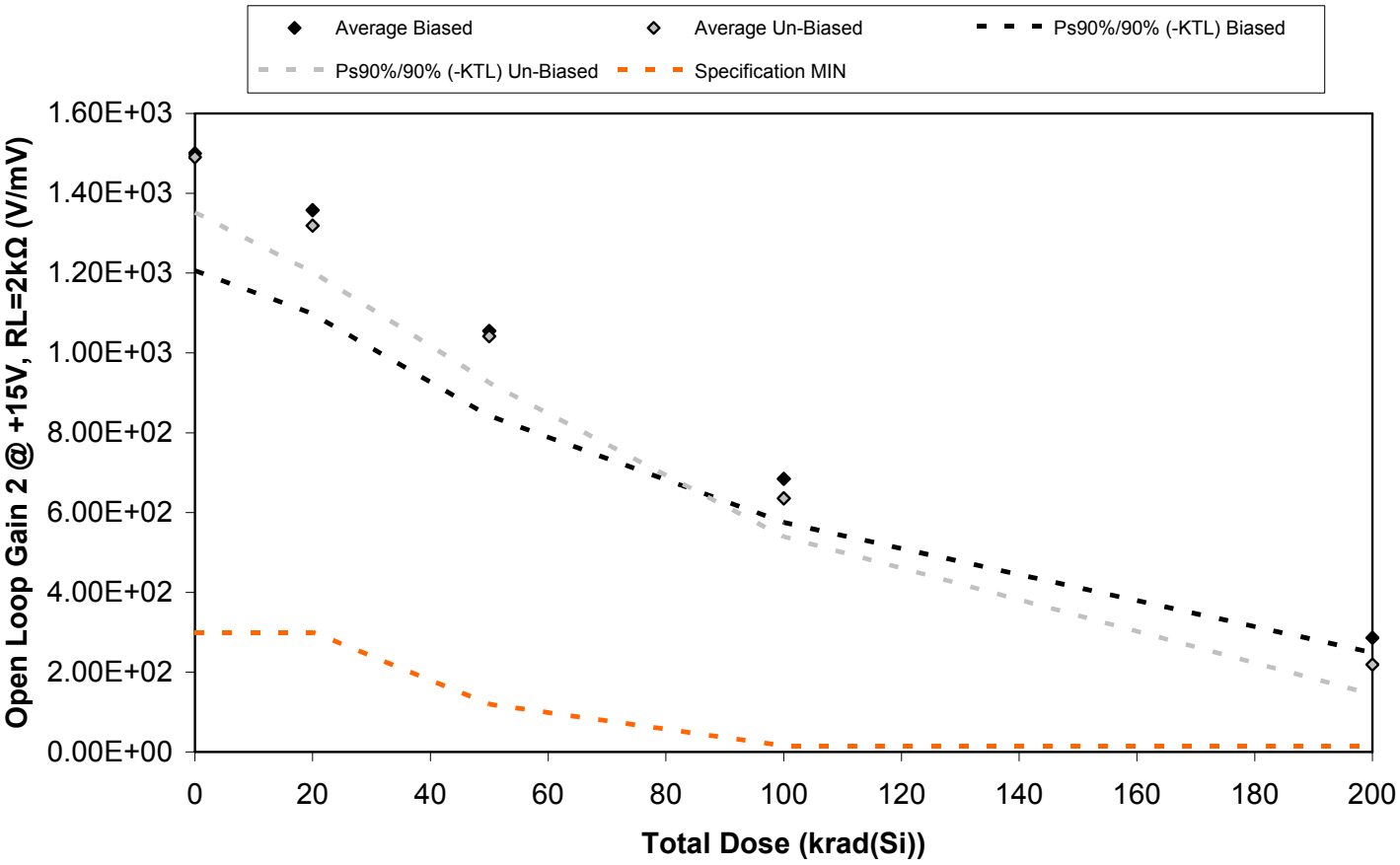


Figure 5.50. Plot of Open Loop Gain 2 @ +15V, RL=2kΩ (V/mV) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.50. Raw data for Open Loop Gain 2 @ +15V, RL=2kΩ (V/mV) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Open Loop Gain 2 @ +15V, RL=2kΩ (V/mV)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.33E+03 | 1.21E+03 | 9.40E+02 | 6.20E+02 | 2.79E+02 |
| 409 | 1.54E+03 | 1.36E+03 | 1.07E+03 | 6.99E+02 | 3.00E+02 |
| 410 | 1.61E+03 | 1.42E+03 | 1.15E+03 | 7.25E+02 | 2.94E+02 |
| 411 | 1.54E+03 | 1.45E+03 | 1.09E+03 | 7.04E+02 | 2.93E+02 |
| 412 | 1.48E+03 | 1.36E+03 | 1.03E+03 | 6.76E+02 | 2.66E+02 |
| 413 | 1.56E+03 | 1.29E+03 | 1.10E+03 | 6.04E+02 | 2.12E+02 |
| 414 | 1.47E+03 | 1.26E+03 | 1.06E+03 | 6.84E+02 | 2.58E+02 |
| 415 | 1.42E+03 | 1.35E+03 | 9.93E+02 | 6.39E+02 | 2.34E+02 |
| 418 | 1.50E+03 | 1.36E+03 | 1.05E+03 | 5.99E+02 | 1.89E+02 |
| 419 | 1.49E+03 | 1.34E+03 | 1.01E+03 | 6.50E+02 | 2.02E+02 |
| 420 | 1.50E+03 | 1.46E+03 | 1.48E+03 | 1.43E+03 | 1.48E+03 |
| 421 | 1.35E+03 | 1.26E+03 | 1.36E+03 | 1.33E+03 | 1.35E+03 |
| Biased Statistics | | | | | |
| Average Biased | 1.50E+03 | 1.36E+03 | 1.05E+03 | 6.85E+02 | 2.86E+02 |
| Std Dev Biased | 1.07E+02 | 9.48E+01 | 7.76E+01 | 4.00E+01 | 1.36E+01 |
| Ps90%/90% (+KTL) Biased | 1.79E+03 | 1.62E+03 | 1.27E+03 | 7.94E+02 | 3.23E+02 |
| Ps90%/90% (-KTL) Biased | 1.21E+03 | 1.10E+03 | 8.42E+02 | 5.75E+02 | 2.49E+02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.49E+03 | 1.32E+03 | 1.04E+03 | 6.35E+02 | 2.19E+02 |
| Std Dev Un-Biased | 5.05E+01 | 4.27E+01 | 4.27E+01 | 3.50E+01 | 2.76E+01 |
| Ps90%/90% (+KTL) Un-Biased | 1.63E+03 | 1.44E+03 | 1.16E+03 | 7.31E+02 | 2.95E+02 |
| Ps90%/90% (-KTL) Un-Biased | 1.35E+03 | 1.20E+03 | 9.25E+02 | 5.39E+02 | 1.43E+02 |
| Specification MIN | 3.00E+02 | 3.00E+02 | 1.20E+02 | 1.50E+01 | 1.50E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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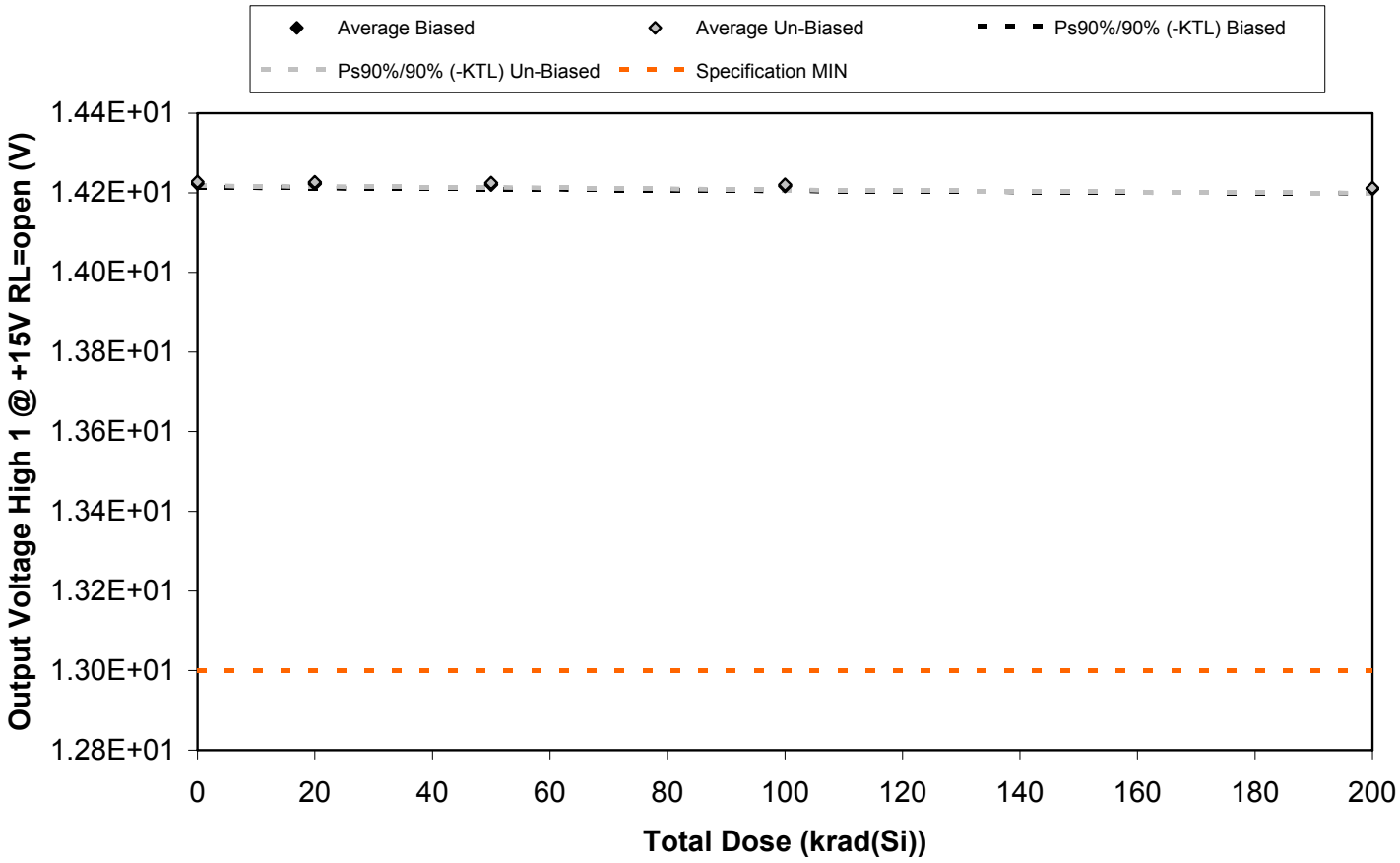


Figure 5.51. Plot of Output Voltage High 1 @ +15V RL=open (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.51. Raw data for Output Voltage High 1 @ +15V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 1 @ +15V RL=open (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 409 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 410 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 411 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 412 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 413 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 414 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 415 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 418 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 419 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 420 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 421 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Biased Statistics | | | | | |
| Average Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Std Dev Biased | 3.63E-03 | 4.09E-03 | 4.15E-03 | 4.44E-03 | 4.34E-03 |
| Ps90%/90% (+KTL) Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Ps90%/90% (-KTL) Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Std Dev Un-Biased | 3.83E-03 | 3.83E-03 | 3.83E-03 | 4.60E-03 | 5.02E-03 |
| Ps90%/90% (+KTL) Un-Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Ps90%/90% (-KTL) Un-Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Specification MIN | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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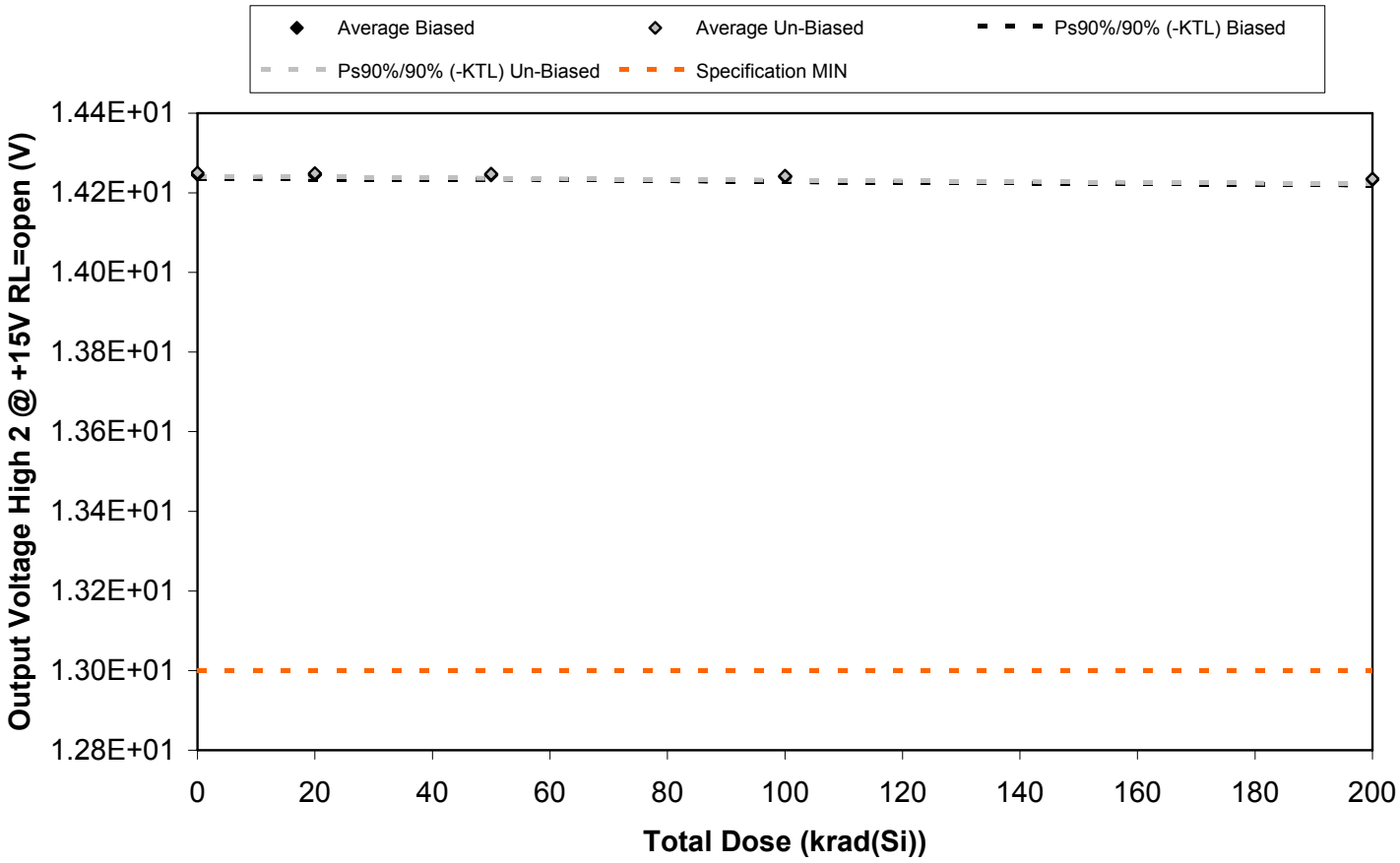


Figure 5.52. Plot of Output Voltage High 2 @ +15V RL=open (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.52. Raw data for Output Voltage High 2 @ +15V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 2 @ +15V RL=open (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.42E+01 | 1.42E+01 |
| 409 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 410 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 411 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 412 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 413 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 414 | 1.43E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 415 | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.42E+01 | 1.42E+01 |
| 418 | 1.43E+01 | 1.43E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 419 | 1.43E+01 | 1.43E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| 420 | 1.42E+01 | 1.42E+01 | 1.43E+01 | 1.42E+01 | 1.42E+01 |
| 421 | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.43E+01 |
| Biased Statistics | | | | | |
| Average Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Std Dev Biased | 3.49E-03 | 4.00E-03 | 3.71E-03 | 4.53E-03 | 4.88E-03 |
| Ps90%/90% (+KTL) Biased | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.42E+01 |
| Ps90%/90% (-KTL) Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.43E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Std Dev Un-Biased | 3.63E-03 | 3.11E-03 | 3.77E-03 | 3.85E-03 | 4.42E-03 |
| Ps90%/90% (+KTL) Un-Biased | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.43E+01 | 1.42E+01 |
| Ps90%/90% (-KTL) Un-Biased | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 | 1.42E+01 |
| Specification MIN | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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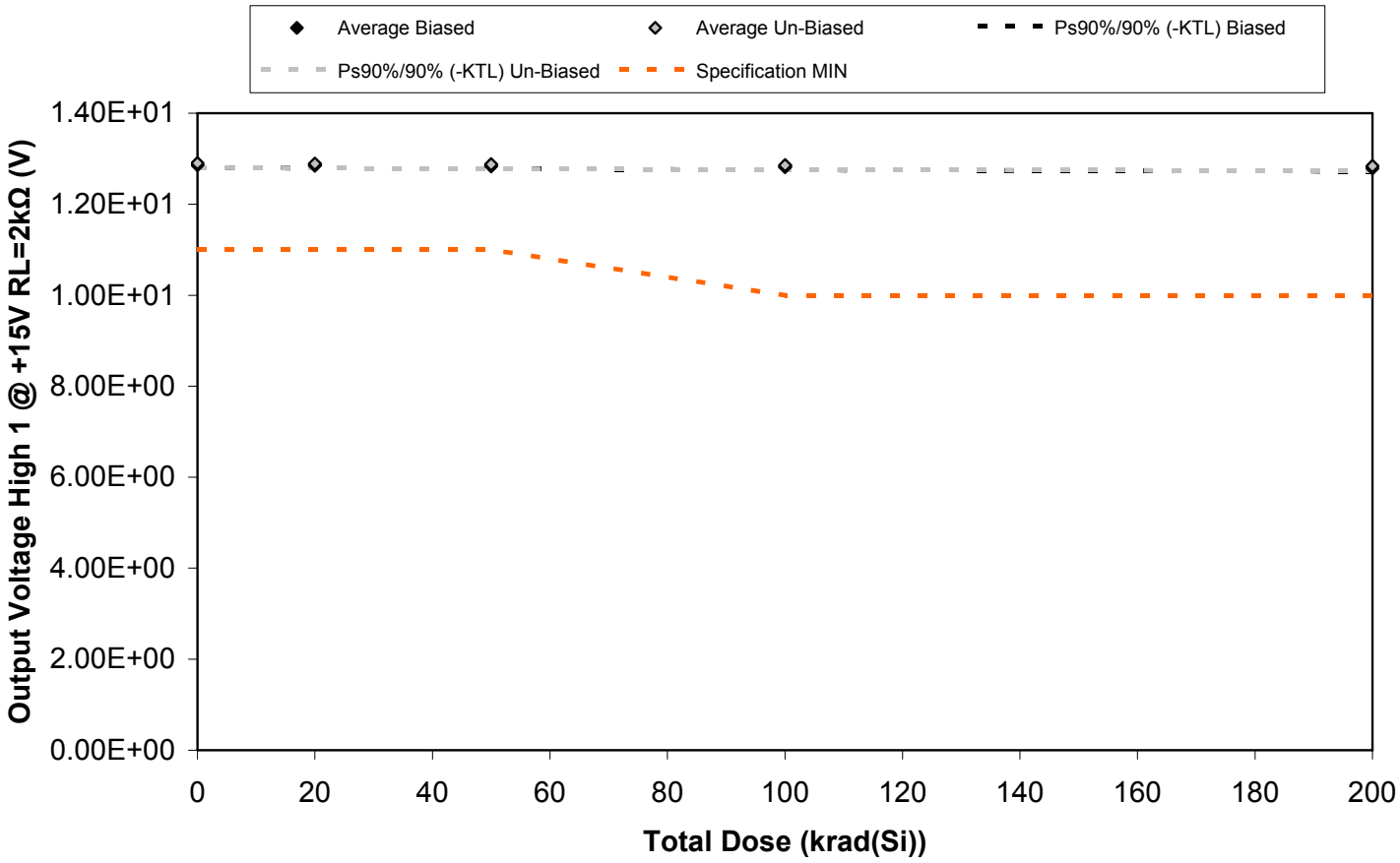


Figure 5.53. Plot of Output Voltage High 1 @ +15V RL=2kΩ (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.53. Raw data for Output Voltage High 1 @ +15V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 1 @ +15V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.28E+01 |
| 409 | 1.29E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 |
| 410 | 1.29E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 |
| 411 | 1.29E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 |
| 412 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 |
| 413 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 |
| 414 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 415 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 418 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 419 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.28E+01 |
| 420 | 1.28E+01 | 1.28E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 421 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| Biased Statistics | | | | | |
| Average Biased | 1.29E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 |
| Std Dev Biased | 2.10E-02 | 2.16E-02 | 2.14E-02 | 2.28E-02 | 2.61E-02 |
| Ps90%/90% (+KTL) Biased | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| Ps90%/90% (-KTL) Biased | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.27E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.28E+01 |
| Std Dev Un-Biased | 3.50E-02 | 3.48E-02 | 3.54E-02 | 3.65E-02 | 3.65E-02 |
| Ps90%/90% (+KTL) Un-Biased | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 |
| Ps90%/90% (-KTL) Un-Biased | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.28E+01 | 1.27E+01 |
| Specification MIN | 1.10E+01 | 1.10E+01 | 1.10E+01 | 1.00E+01 | 1.00E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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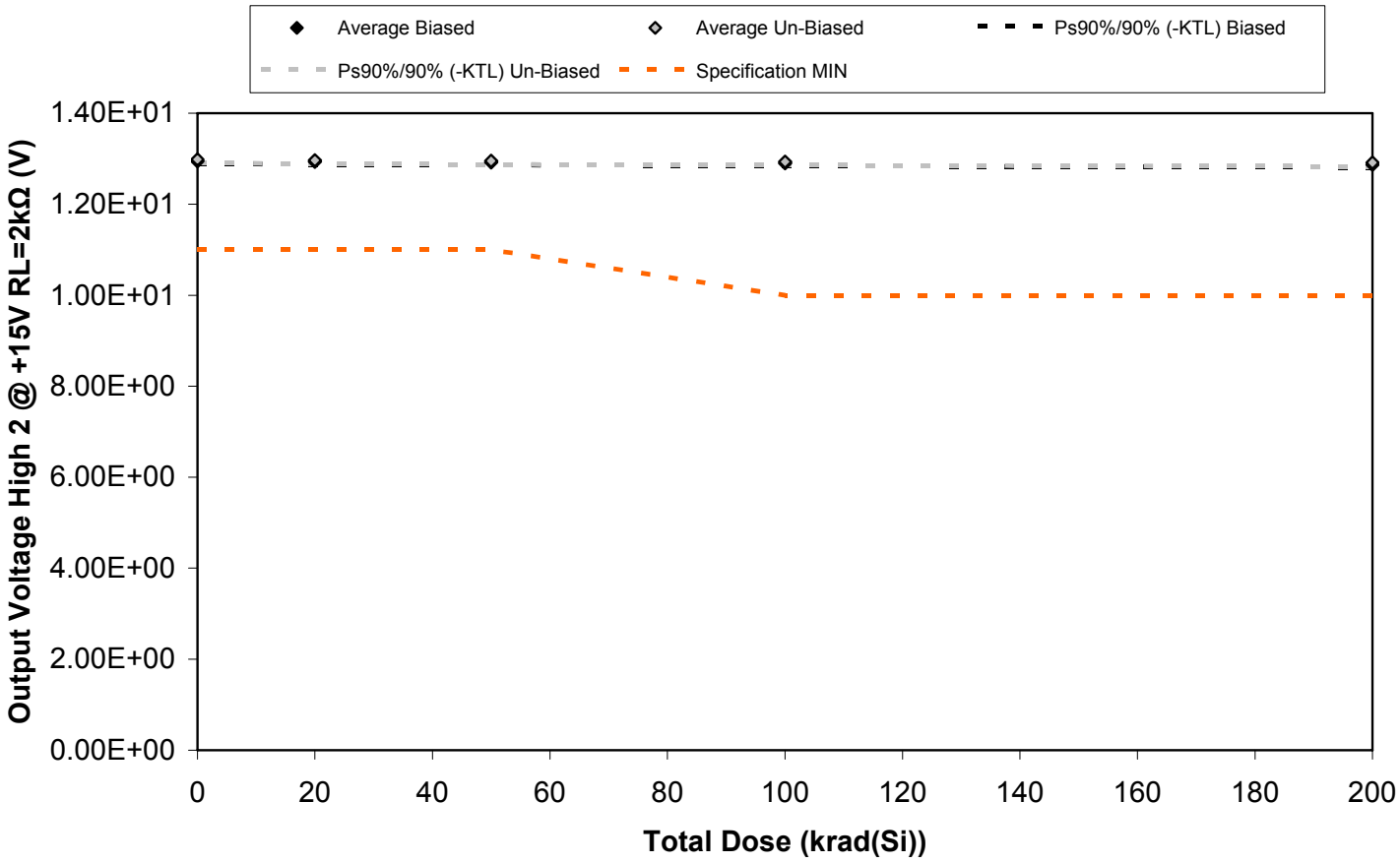


Figure 5.54. Plot of Output Voltage High 2 @ +15V RL=2kΩ (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.54. Raw data for Output Voltage High 2 @ +15V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage High 2 @ +15V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 | 1.29E+01 |
| 409 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 410 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 411 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 412 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 413 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 414 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 | 1.29E+01 |
| 415 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 |
| 418 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 |
| 419 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 | 1.29E+01 |
| 420 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| 421 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 |
| Biased Statistics | | | | | |
| Average Biased | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 |
| Std Dev Biased | 1.88E-02 | 1.98E-02 | 1.98E-02 | 2.07E-02 | 2.32E-02 |
| Ps90%/90% (+KTL) Biased | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 |
| Ps90%/90% (-KTL) Biased | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.28E+01 | 1.28E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.29E+01 | 1.29E+01 |
| Std Dev Un-Biased | 2.82E-02 | 2.84E-02 | 2.90E-02 | 2.97E-02 | 2.96E-02 |
| Ps90%/90% (+KTL) Un-Biased | 1.31E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 | 1.30E+01 |
| Ps90%/90% (-KTL) Un-Biased | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.29E+01 | 1.28E+01 |
| Specification MIN | 1.10E+01 | 1.10E+01 | 1.10E+01 | 1.00E+01 | 1.00E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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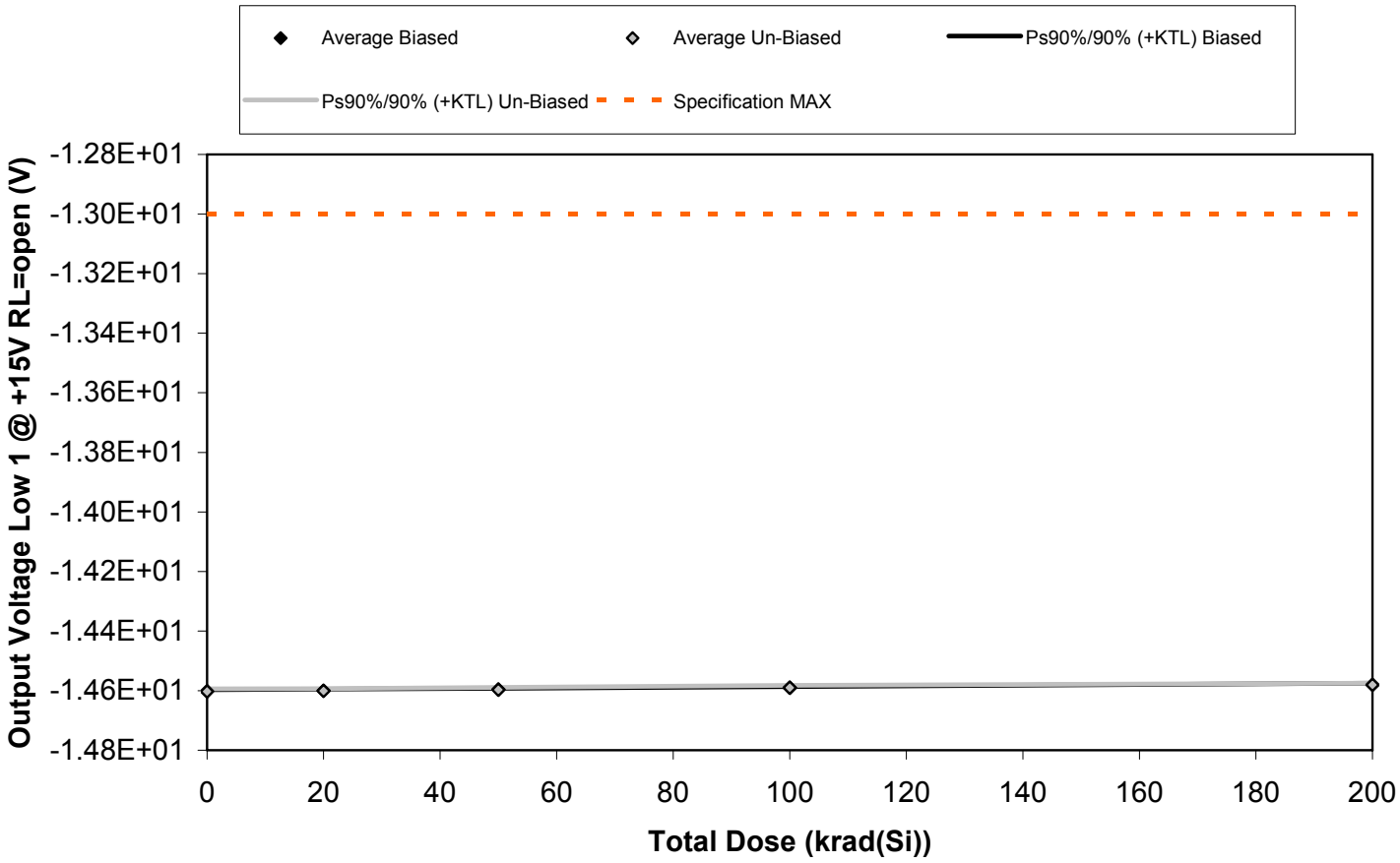


Figure 5.55. Plot of Output Voltage Low 1 @ +15V RL=open (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.55. Raw data for Output Voltage Low 1 @ +15V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 1 @ +15V RL=open (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 409 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 410 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 411 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 412 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 413 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 414 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 415 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 418 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 419 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 420 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 421 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Biased Statistics | | | | | |
| Average Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Std Dev Biased | 1.95E-03 | 1.64E-03 | 1.48E-03 | 1.52E-03 | 2.19E-03 |
| Ps90%/90% (+KTL) Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Ps90%/90% (-KTL) Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Std Dev Un-Biased | 3.11E-03 | 2.70E-03 | 2.92E-03 | 2.88E-03 | 2.07E-03 |
| Ps90%/90% (+KTL) Un-Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Ps90%/90% (-KTL) Un-Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Specification MAX | -1.30E+01 | -1.30E+01 | -1.30E+01 | -1.30E+01 | -1.30E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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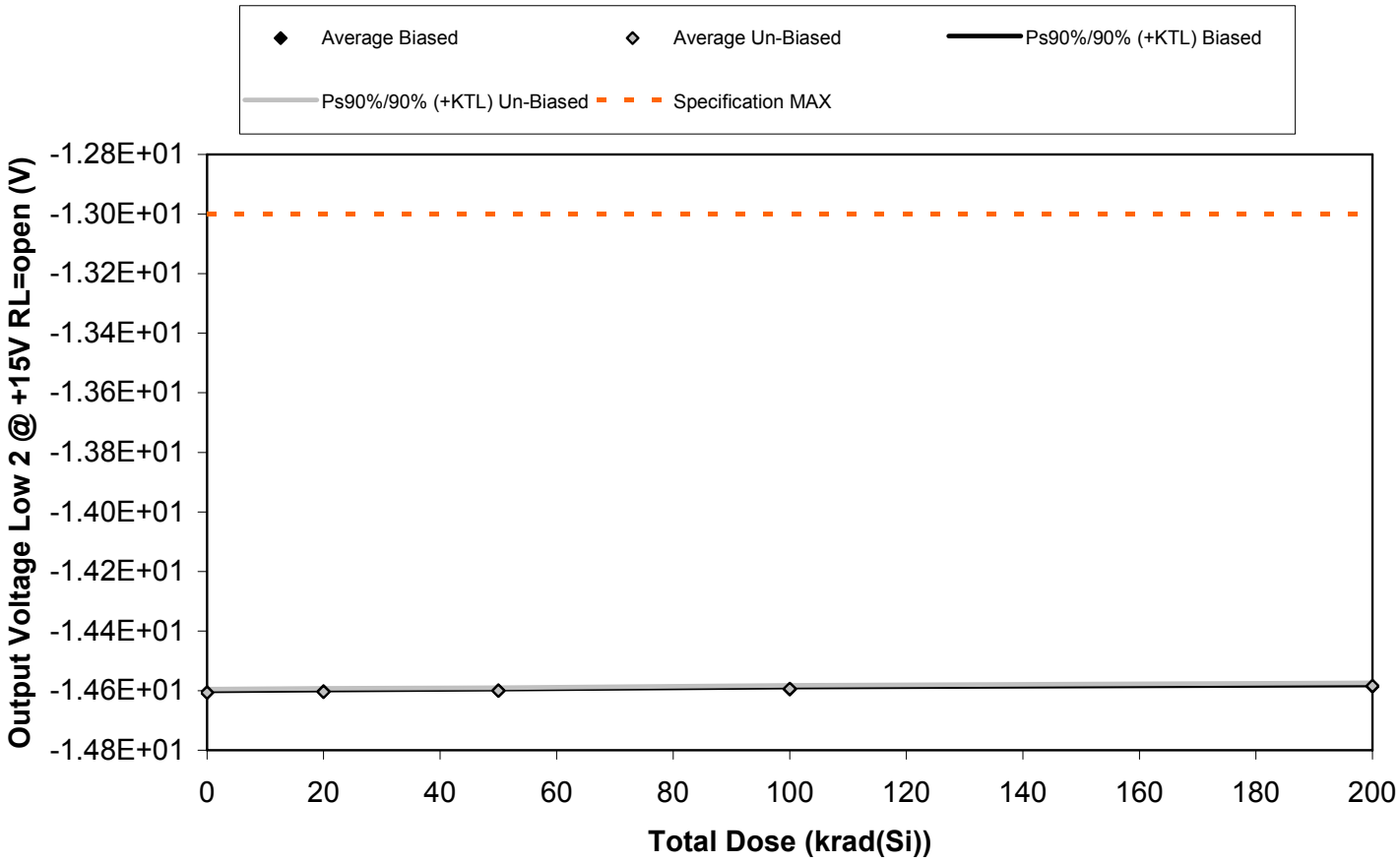


Figure 5.56. Plot of Output Voltage Low 2 @ +15V RL=open (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.56. Raw data for Output Voltage Low 2 @ +15V RL=open (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 2 @ +15V RL=open (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 409 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 410 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 411 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 412 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 413 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 414 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 415 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 418 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 419 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 420 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| 421 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Biased Statistics | | | | | |
| Average Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Std Dev Biased | 1.64E-03 | 1.73E-03 | 1.92E-03 | 2.28E-03 | 1.64E-03 |
| Ps90%/90% (+KTL) Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Ps90%/90% (-KTL) Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Std Dev Un-Biased | 4.32E-03 | 4.49E-03 | 3.78E-03 | 4.51E-03 | 4.10E-03 |
| Ps90%/90% (+KTL) Un-Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Ps90%/90% (-KTL) Un-Biased | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 | -1.46E+01 |
| Specification MAX | -1.30E+01 | -1.30E+01 | -1.30E+01 | -1.30E+01 | -1.30E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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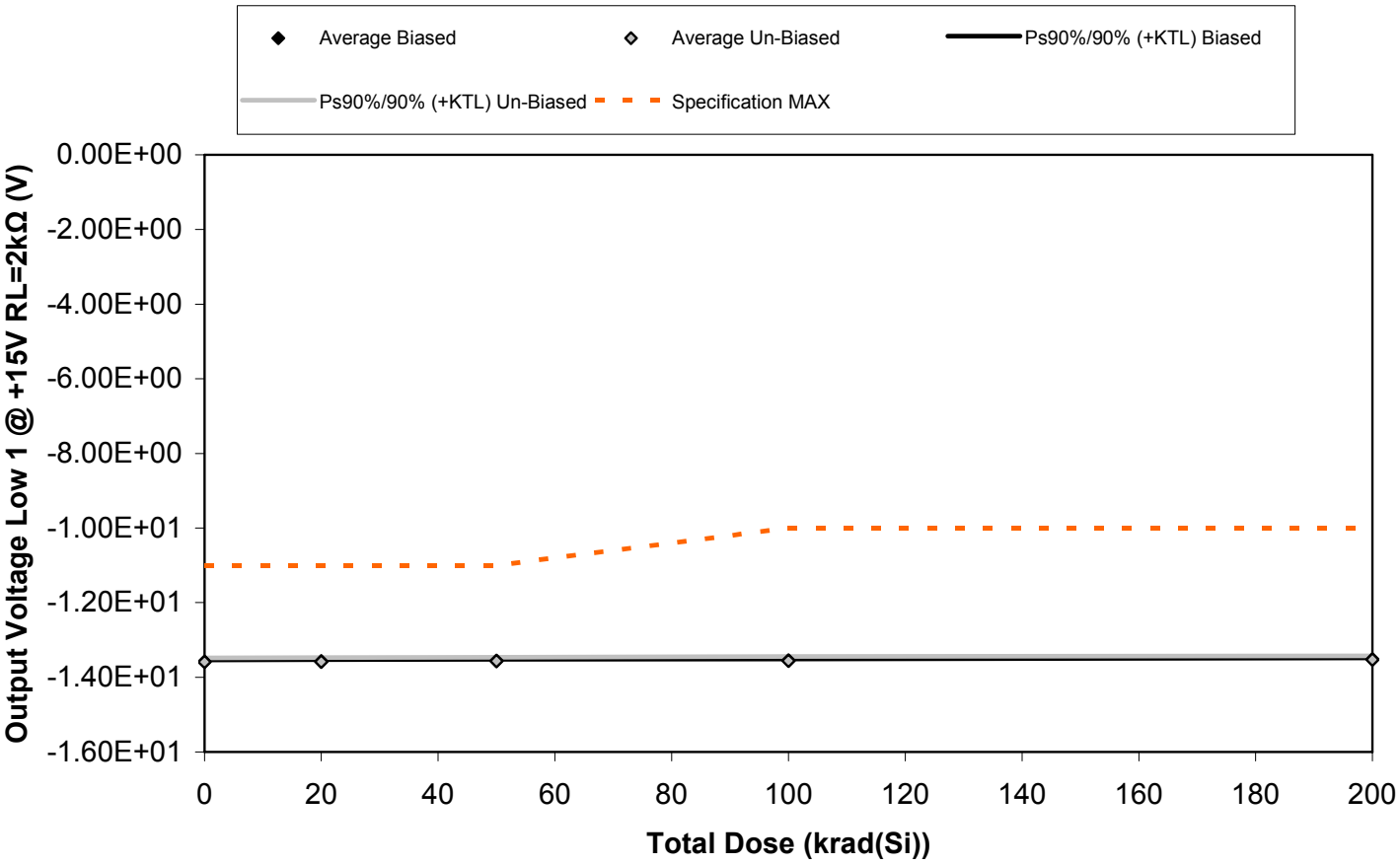


Figure 5.57. Plot of Output Voltage Low 1 @ +15V RL=2kΩ (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.57. Raw data for Output Voltage Low 1 @ +15V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 1 @ +15V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 |
| 409 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 |
| 410 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 |
| 411 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 |
| 412 | -1.36E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 |
| 413 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 |
| 414 | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 |
| 415 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 418 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 419 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 |
| 420 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 421 | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 |
| Biased Statistics | | | | | |
| Average Biased | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 |
| Std Dev Biased | 1.53E-02 | 1.51E-02 | 1.48E-02 | 1.43E-02 | 1.43E-02 |
| Ps90%/90% (+KTL) Biased | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 |
| Ps90%/90% (-KTL) Biased | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 |
| Std Dev Un-Biased | 3.94E-02 | 3.95E-02 | 3.95E-02 | 4.04E-02 | 3.93E-02 |
| Ps90%/90% (+KTL) Un-Biased | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.34E+01 | -1.34E+01 |
| Ps90%/90% (-KTL) Un-Biased | -1.37E+01 | -1.37E+01 | -1.37E+01 | -1.37E+01 | -1.36E+01 |
| Specification MAX | -1.10E+01 | -1.10E+01 | -1.10E+01 | -1.00E+01 | -1.00E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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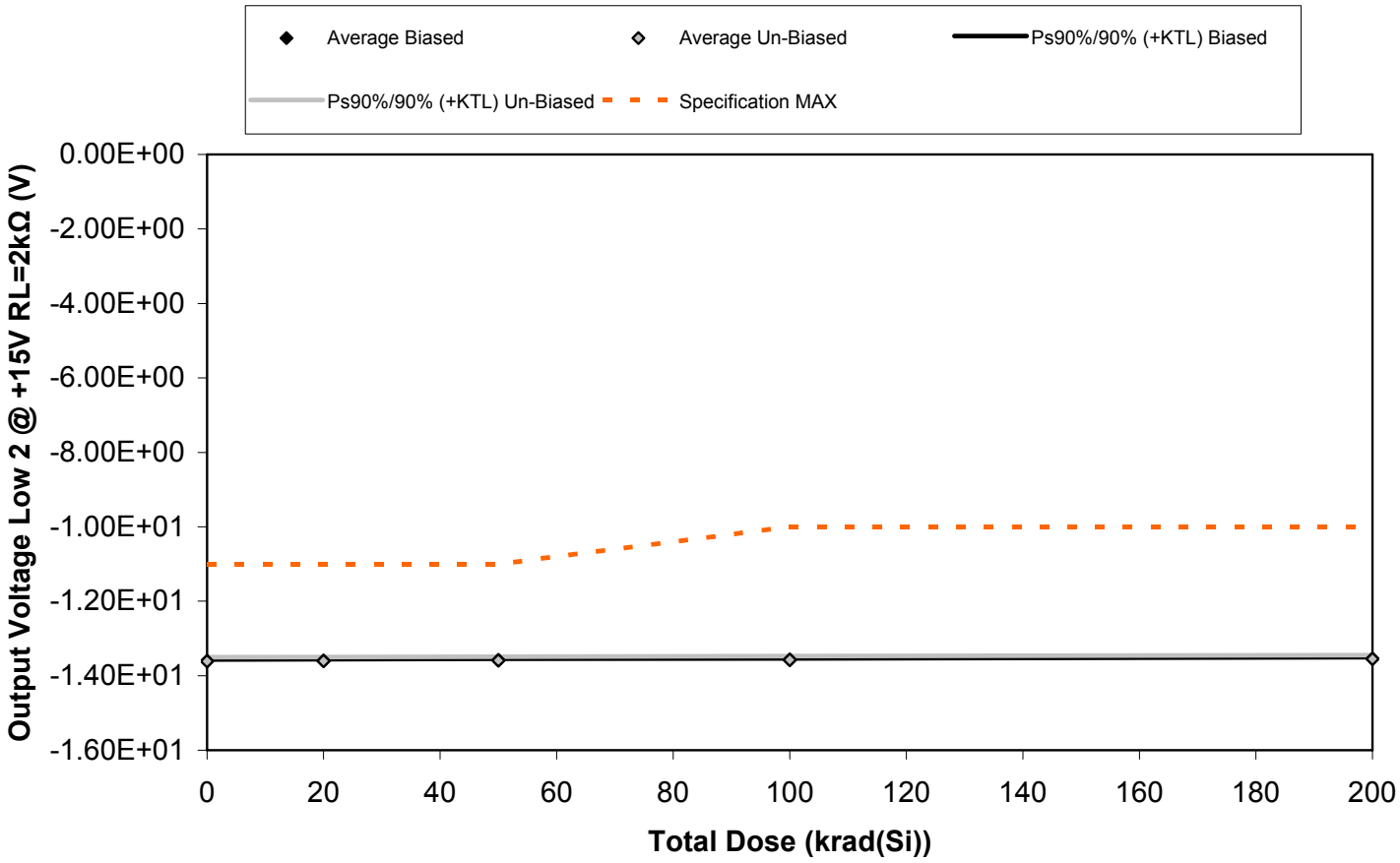


Figure 5.58. Plot of Output Voltage Low 2 @ +15V RL=2kΩ (V) versus total dose. The data show no significant change with radiation. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.58. Raw data for Output Voltage Low 2 @ +15V RL=2kΩ (V) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Output Voltage Low 2 @ +15V RL=2kΩ (V)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 409 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 410 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 |
| 411 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 412 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 |
| 413 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 |
| 414 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 |
| 415 | -1.37E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 418 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 419 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 |
| 420 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| 421 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| Biased Statistics | | | | | |
| Average Biased | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.35E+01 |
| Std Dev Biased | 1.41E-02 | 1.38E-02 | 1.39E-02 | 1.36E-02 | 1.36E-02 |
| Ps90%/90% (+KTL) Biased | -1.36E+01 | -1.36E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 |
| Ps90%/90% (-KTL) Biased | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 | -1.36E+01 |
| Std Dev Un-Biased | 3.84E-02 | 3.82E-02 | 3.79E-02 | 3.85E-02 | 3.71E-02 |
| Ps90%/90% (+KTL) Un-Biased | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.35E+01 | -1.34E+01 |
| Ps90%/90% (-KTL) Un-Biased | -1.37E+01 | -1.37E+01 | -1.37E+01 | -1.37E+01 | -1.37E+01 |
| Specification MAX | -1.10E+01 | -1.10E+01 | -1.10E+01 | -1.00E+01 | -1.00E+01 |
| Status | PASS | PASS | PASS | PASS | PASS |

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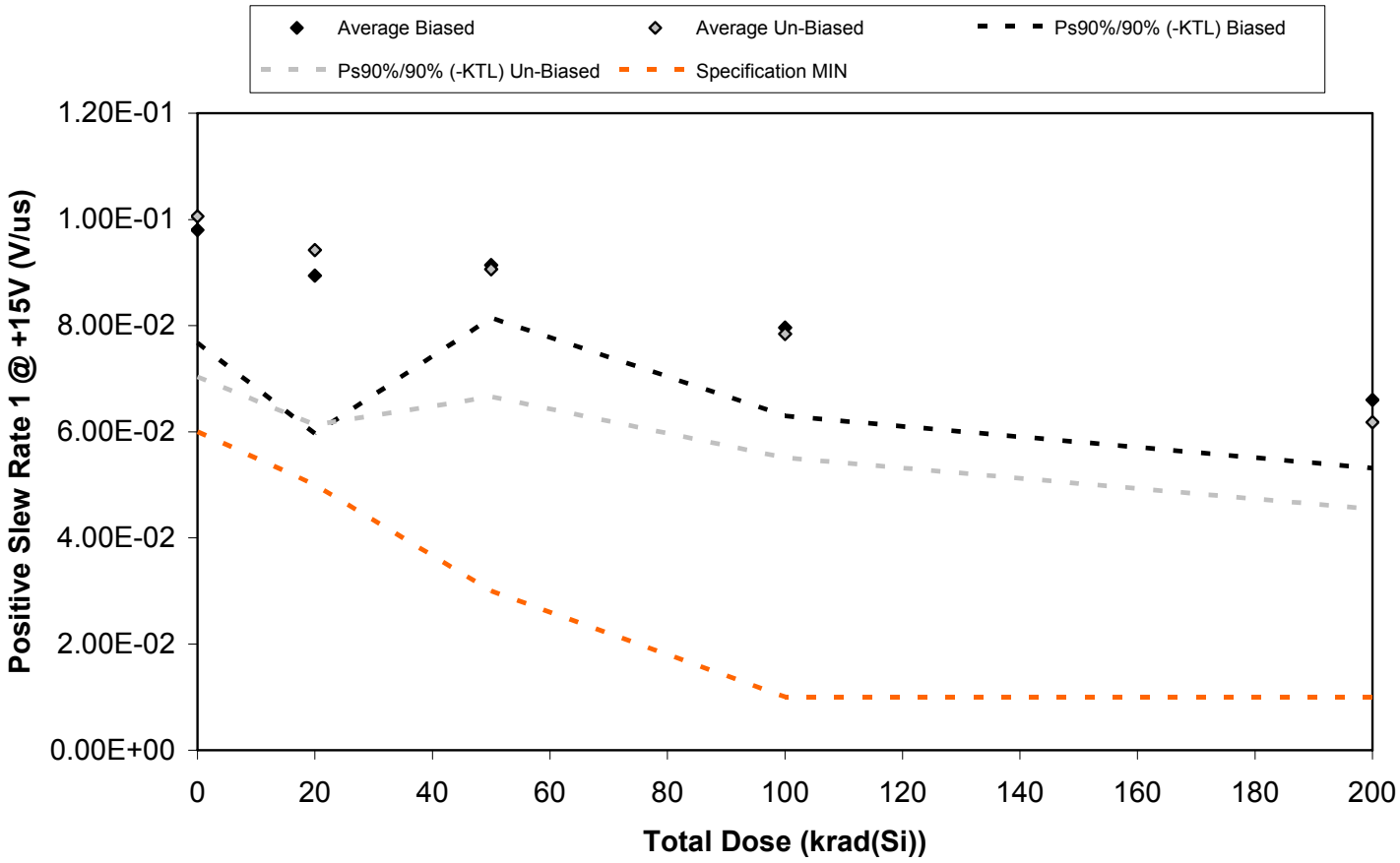


Figure 5.59. Plot of Positive Slew Rate 1 @ +15V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.59. Raw data for Positive Slew Rate 1 @ +15V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Slew Rate 1 @ +15V (V/us)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 9.10E-02 | 9.90E-02 | 9.30E-02 | 7.60E-02 | 7.10E-02 |
| 409 | 1.03E-01 | 7.40E-02 | 9.30E-02 | 8.10E-02 | 6.30E-02 |
| 410 | 1.07E-01 | 9.60E-02 | 9.40E-02 | 8.90E-02 | 7.10E-02 |
| 411 | 1.00E-01 | 9.60E-02 | 9.20E-02 | 7.30E-02 | 6.10E-02 |
| 412 | 8.90E-02 | 8.20E-02 | 8.50E-02 | 7.90E-02 | 6.40E-02 |
| 413 | 9.90E-02 | 8.20E-02 | 7.80E-02 | 7.60E-02 | 5.30E-02 |
| 414 | 9.00E-02 | 9.50E-02 | 9.40E-02 | 7.30E-02 | 6.20E-02 |
| 415 | 1.12E-01 | 1.06E-01 | 1.02E-01 | 9.00E-02 | 6.50E-02 |
| 418 | 1.12E-01 | 1.06E-01 | 8.80E-02 | 8.40E-02 | 6.90E-02 |
| 419 | 9.00E-02 | 8.20E-02 | 9.10E-02 | 6.90E-02 | 6.00E-02 |
| 420 | 1.04E-01 | 9.60E-02 | 9.50E-02 | 1.03E-01 | 9.90E-02 |
| 421 | 9.90E-02 | 9.10E-02 | 9.60E-02 | 9.80E-02 | 9.90E-02 |
| Biased Statistics | | | | | |
| Average Biased | 9.80E-02 | 8.94E-02 | 9.14E-02 | 7.96E-02 | 6.60E-02 |
| Std Dev Biased | 7.75E-03 | 1.09E-02 | 3.65E-03 | 6.07E-03 | 4.69E-03 |
| Ps90%/90% (+KTL) Biased | 1.19E-01 | 1.19E-01 | 1.01E-01 | 9.62E-02 | 7.89E-02 |
| Ps90%/90% (-KTL) Biased | 7.68E-02 | 5.96E-02 | 8.14E-02 | 6.30E-02 | 5.31E-02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.01E-01 | 9.42E-02 | 9.06E-02 | 7.84E-02 | 6.18E-02 |
| Std Dev Un-Biased | 1.10E-02 | 1.20E-02 | 8.76E-03 | 8.50E-03 | 5.97E-03 |
| Ps90%/90% (+KTL) Un-Biased | 1.31E-01 | 1.27E-01 | 1.15E-01 | 1.02E-01 | 7.82E-02 |
| Ps90%/90% (-KTL) Un-Biased | 7.03E-02 | 6.13E-02 | 6.66E-02 | 5.51E-02 | 4.54E-02 |
| Specification MIN | 6.00E-02 | 5.00E-02 | 3.00E-02 | 1.00E-02 | 1.00E-02 |
| Status | PASS | PASS | PASS | PASS | PASS |

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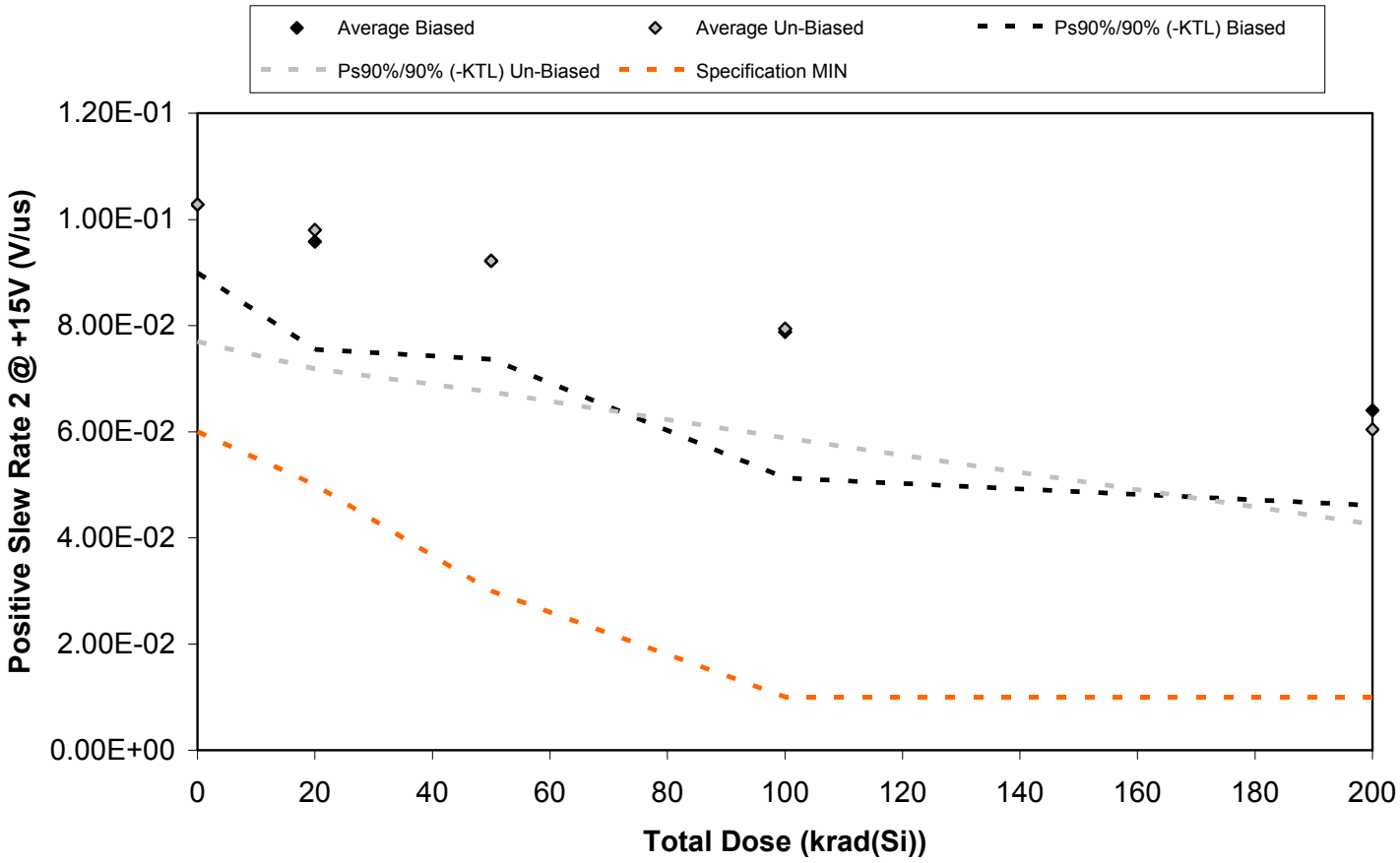


Figure 5.60. Plot of Positive Slew Rate 2 @ +15V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.60. Raw data for Positive Slew Rate 2 @ +15V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Positive Slew Rate 2 @ +15V (V/us)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | 1.03E-01 | 1.04E-01 | 9.70E-02 | 8.70E-02 | 6.60E-02 |
| 409 | 1.03E-01 | 9.70E-02 | 9.50E-02 | 8.40E-02 | 7.00E-02 |
| 410 | 1.10E-01 | 9.90E-02 | 9.90E-02 | 8.70E-02 | 6.70E-02 |
| 411 | 1.01E-01 | 9.50E-02 | 8.60E-02 | 7.00E-02 | 6.40E-02 |
| 412 | 9.70E-02 | 8.40E-02 | 8.40E-02 | 6.60E-02 | 5.30E-02 |
| 413 | 9.60E-02 | 9.30E-02 | 8.30E-02 | 7.70E-02 | 5.20E-02 |
| 414 | 1.01E-01 | 8.70E-02 | 9.30E-02 | 7.20E-02 | 6.70E-02 |
| 415 | 1.12E-01 | 1.09E-01 | 1.01E-01 | 7.70E-02 | 6.40E-02 |
| 418 | 1.13E-01 | 1.07E-01 | 1.01E-01 | 9.20E-02 | 6.40E-02 |
| 419 | 9.20E-02 | 9.40E-02 | 8.30E-02 | 7.90E-02 | 5.50E-02 |
| 420 | 1.01E-01 | 9.60E-02 | 1.03E-01 | 9.40E-02 | 8.70E-02 |
| 421 | 9.50E-02 | 9.90E-02 | 9.90E-02 | 8.20E-02 | 1.01E-01 |
| Biased Statistics | | | | | |
| Average Biased | 1.03E-01 | 9.58E-02 | 9.22E-02 | 7.88E-02 | 6.40E-02 |
| Std Dev Biased | 4.71E-03 | 7.40E-03 | 6.76E-03 | 1.00E-02 | 6.52E-03 |
| Ps90%/90% (+KTL) Biased | 1.16E-01 | 1.16E-01 | 1.11E-01 | 1.06E-01 | 8.19E-02 |
| Ps90%/90% (-KTL) Biased | 8.99E-02 | 7.55E-02 | 7.37E-02 | 5.13E-02 | 4.61E-02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | 1.03E-01 | 9.80E-02 | 9.22E-02 | 7.94E-02 | 6.04E-02 |
| Std Dev Un-Biased | 9.42E-03 | 9.54E-03 | 9.01E-03 | 7.50E-03 | 6.50E-03 |
| Ps90%/90% (+KTL) Un-Biased | 1.29E-01 | 1.24E-01 | 1.17E-01 | 1.00E-01 | 7.82E-02 |
| Ps90%/90% (-KTL) Un-Biased | 7.70E-02 | 7.18E-02 | 6.75E-02 | 5.88E-02 | 4.26E-02 |
| Specification MIN | 6.00E-02 | 5.00E-02 | 3.00E-02 | 1.00E-02 | 1.00E-02 |
| Status | PASS | PASS | PASS | PASS | PASS |

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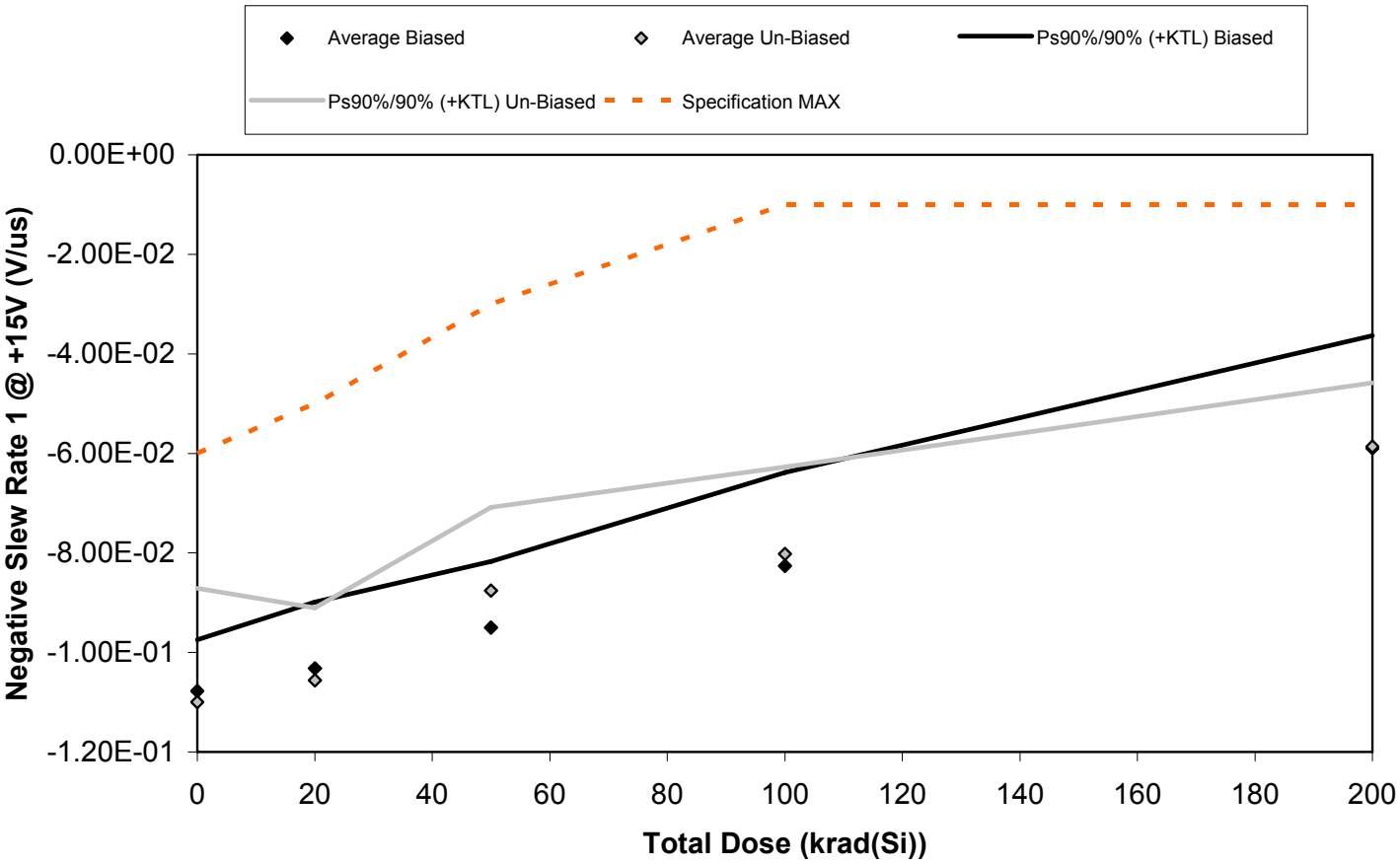


Figure 5.61. Plot of Negative Slew Rate 1 @ +15V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.61. Raw data for Negative Slew Rate 1 @ +15V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Slew Rate 1 @ +15V (V/us)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.12E-01 | -1.05E-01 | -9.60E-02 | -8.50E-02 | -7.20E-02 |
| 409 | -1.08E-01 | -1.04E-01 | -9.70E-02 | -7.90E-02 | -5.70E-02 |
| 410 | -1.10E-01 | -1.08E-01 | -1.00E-01 | -9.30E-02 | -6.10E-02 |
| 411 | -1.07E-01 | -1.04E-01 | -9.50E-02 | -8.10E-02 | -5.00E-02 |
| 412 | -1.02E-01 | -9.50E-02 | -8.70E-02 | -7.50E-02 | -5.50E-02 |
| 413 | -1.04E-01 | -1.00E-01 | -9.10E-02 | -7.10E-02 | -5.40E-02 |
| 414 | -1.04E-01 | -1.01E-01 | -8.00E-02 | -8.10E-02 | -6.50E-02 |
| 415 | -1.17E-01 | -1.12E-01 | -9.30E-02 | -8.90E-02 | -6.00E-02 |
| 418 | -1.21E-01 | -1.10E-01 | -9.20E-02 | -8.00E-02 | -6.00E-02 |
| 419 | -1.04E-01 | -1.05E-01 | -8.20E-02 | -8.00E-02 | -5.40E-02 |
| 420 | -1.01E-01 | -1.03E-01 | -1.04E-01 | -1.03E-01 | -9.30E-02 |
| 421 | -1.00E-01 | -8.80E-02 | -9.80E-02 | -1.00E-01 | -9.60E-02 |
| Biased Statistics | | | | | |
| Average Biased | -1.08E-01 | -1.03E-01 | -9.50E-02 | -8.26E-02 | -5.90E-02 |
| Std Dev Biased | 3.77E-03 | 4.87E-03 | 4.85E-03 | 6.84E-03 | 8.28E-03 |
| Ps90%/90% (+KTL) Biased | -9.75E-02 | -8.99E-02 | -8.17E-02 | -6.38E-02 | -3.63E-02 |
| Ps90%/90% (-KTL) Biased | -1.18E-01 | -1.17E-01 | -1.08E-01 | -1.01E-01 | -8.17E-02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.10E-01 | -1.06E-01 | -8.76E-02 | -8.02E-02 | -5.86E-02 |
| Std Dev Un-Biased | 8.34E-03 | 5.32E-03 | 6.11E-03 | 6.38E-03 | 4.67E-03 |
| Ps90%/90% (+KTL) Un-Biased | -8.71E-02 | -9.10E-02 | -7.09E-02 | -6.27E-02 | -4.58E-02 |
| Ps90%/90% (-KTL) Un-Biased | -1.33E-01 | -1.20E-01 | -1.04E-01 | -9.77E-02 | -7.14E-02 |
| Specification MAX | -6.00E-02 | -5.00E-02 | -3.00E-02 | -1.00E-02 | -1.00E-02 |
| Status | PASS | PASS | PASS | PASS | PASS |

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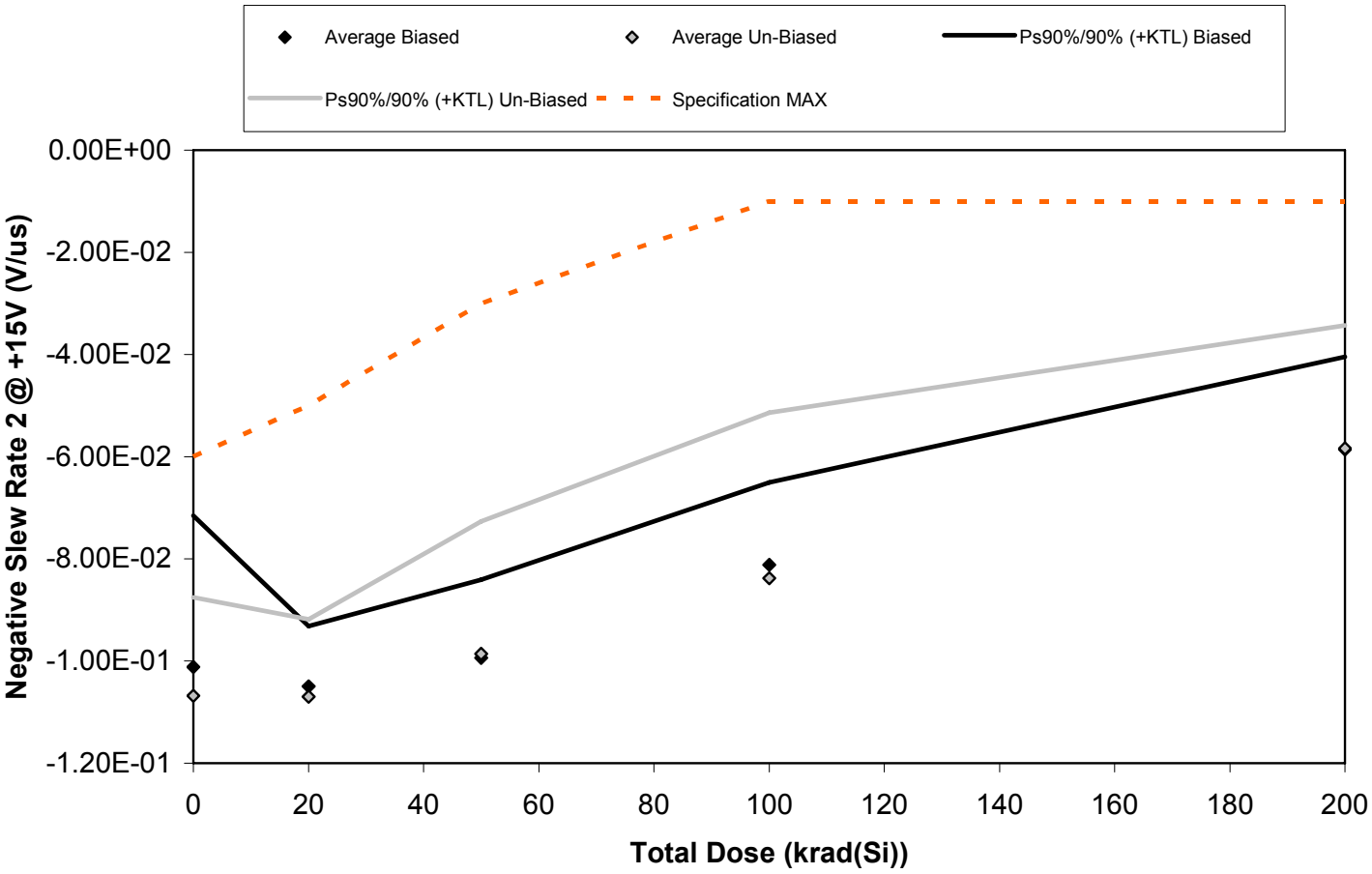


Figure 5.62. Plot of Negative Slew Rate 2 @ +15V (V/us) versus total dose. The data show significant change with radiation, however the parameter remains within specification even after application of the KTLs statistics. The solid diamonds are the average of the measured data points for the samples irradiated under electrical bias while the shaded diamonds are the average of the measured data points for the samples irradiated with all pins tied to ground. The black lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated under electrical bias while the gray lines (solid and/or dashed) are the average of the data points after application of the KTL statistics on the samples irradiated in the unbiased condition. The red dotted line(s) are the pre- and/or post-irradiation minimum and/or maximum specification value as defined in the datasheet and/or test plan.

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Table 5.62. Raw data for Negative Slew Rate 2 @ +15V (V/us) versus total dose, including the statistical analysis, specification and the status of the testing (pass/fail).

| **Negative Slew Rate 2 @ +15V (V/us)** | Total Dose (krad(Si)) | | | | |
|---|---|---|---|---|---|
| Device | 0 | 20 | 50 | 100 | 200 |
| 408 | -1.06E-01 | -1.08E-01 | -1.02E-01 | -9.10E-02 | -6.10E-02 |
| 409 | -8.30E-02 | -1.05E-01 | -9.90E-02 | -7.80E-02 | -5.80E-02 |
| 410 | -1.10E-01 | -1.09E-01 | -1.07E-01 | -7.60E-02 | -6.60E-02 |
| 411 | -1.07E-01 | -1.05E-01 | -9.70E-02 | -7.90E-02 | -4.80E-02 |
| 412 | -1.00E-01 | -9.80E-02 | -9.20E-02 | -8.20E-02 | -6.00E-02 |
| 413 | -1.03E-01 | -1.01E-01 | -9.30E-02 | -6.90E-02 | -4.50E-02 |
| 414 | -1.11E-01 | -1.06E-01 | -8.80E-02 | -8.10E-02 | -6.40E-02 |
| 415 | -1.00E-01 | -1.07E-01 | -1.10E-01 | -9.90E-02 | -6.60E-02 |
| 418 | -1.17E-01 | -1.16E-01 | -1.07E-01 | -9.20E-02 | -6.30E-02 |
| 419 | -1.03E-01 | -1.05E-01 | -9.50E-02 | -7.80E-02 | -5.40E-02 |
| 420 | -1.05E-01 | -1.03E-01 | -1.05E-01 | -1.06E-01 | -1.05E-01 |
| 421 | -1.03E-01 | -9.70E-02 | -1.02E-01 | -8.40E-02 | -1.01E-01 |
| Biased Statistics | | | | | |
| Average Biased | -1.01E-01 | -1.05E-01 | -9.94E-02 | -8.12E-02 | -5.86E-02 |
| Std Dev Biased | 1.08E-02 | 4.30E-03 | 5.59E-03 | 5.89E-03 | 6.62E-03 |
| Ps90%/90% (+KTL) Biased | -7.16E-02 | -9.32E-02 | -8.41E-02 | -6.50E-02 | -4.05E-02 |
| Ps90%/90% (-KTL) Biased | -1.31E-01 | -1.17E-01 | -1.15E-01 | -9.74E-02 | -7.67E-02 |
| Un-Biased Statistics | | | | | |
| Average Un-Biased | -1.07E-01 | -1.07E-01 | -9.86E-02 | -8.38E-02 | -5.84E-02 |
| Std Dev Un-Biased | 7.01E-03 | 5.52E-03 | 9.45E-03 | 1.18E-02 | 8.79E-03 |
| Ps90%/90% (+KTL) Un-Biased | -8.76E-02 | -9.19E-02 | -7.27E-02 | -5.14E-02 | -3.43E-02 |
| Ps90%/90% (-KTL) Un-Biased | -1.26E-01 | -1.22E-01 | -1.25E-01 | -1.16E-01 | -8.25E-02 |
| Specification MAX | -6.00E-02 | -5.00E-02 | -3.00E-02 | -1.00E-02 | -1.00E-02 |
| Status | PASS | PASS | PASS | PASS | PASS |

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## *6.0. Summary / Conclusions*

The total ionizing dose testing described in this final report was performed using the facilities at Radiation Assured Devices' Longmire Laboratories in Colorado Springs, CO. The high dose rate total ionizing dose (TID) source is a JLSA 84-21 irradiator modified to provide a panoramic exposure. The Co-60 rods are held in the base of the irradiator heavily shielded by lead, during the radiation exposures the rod is raised by an electronic timer/controller and the exposure is performed in air. The dose rate for this irradiator in this configuration ranges from <1rad(Si)/s to a maximum of approximately 120rad(Si)/s, determined by the distance from the source.

The parametric data was obtained as "read and record" and all the raw data plus an attributes summary were presented in this report. The attributes data contains the average, standard deviation and the average with the KTL values applied. The KTL value used was 2.742 per MIL HDBK 814 using one-sided tolerance limits of 99/90 and a 5-piece sample size. Note that the following criteria was used to determine the outcome of the testing: following the radiation exposure each parameter had to pass the specification value and the average value for the five-piece sample must pass the specification value when the KTL limits are applied. If these conditions were not both satisfied following the radiation exposure, then the lot would be logged as an RLAT failure.

Based on these criteria, The RH1078MW operational amplifiers passed the RLAT to the maximum tested level of 200krad(Si) (for the ±15V supply conditions) and 100krad(Si) (for the +5V and 0V supply conditions) with all measured parameters remaining within specification, including after application of the KTL statistics. The following exception should be noted, the input offset voltage for the 5V supply condition was out of specification after application of the KTL statistics intermittently due to a combination of an aggressive specification value and relative large distribution within the sample population. The input offset voltage was within specification at the 100krad(Si) read point and exhibited very little degradation with total ionizing dose.

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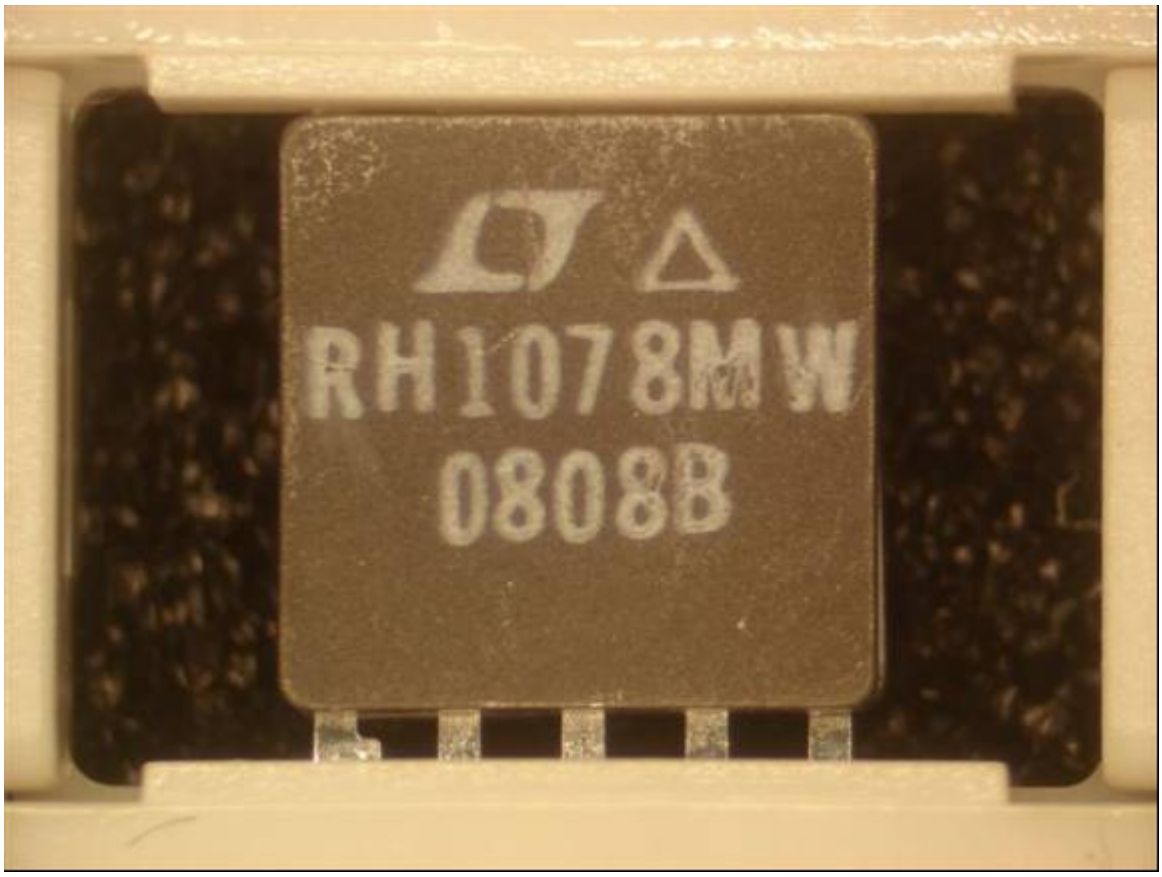
## Appendix A: Photograph of device-under-test to show part markings



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## Appendix B: TID Bias Connections

### Biased Samples:

| Pin | Function | Connection / Bias |
|---|---|---|
| 1 | OUT A | To Pin 2 via 10kΩ Resistor |
| 2 | -INPUT A | To Pin 1 via 10kΩ Resistor |
| 3 | +INPUT A | To 8V via 10kΩ Resistor |
| 4 | N/C | N/C |
| 5 | V- | To –15V using 0.1µF Decoupling |
| 6 | N/C | N/C |
| 7 | +INPUT B | To 8V via 10kΩ Resistor |
| 8 | -INPUT B | To Pin 9 via 10kΩ Resistor |
| 9 | OUT B | To Pin 8 via 10kΩ Resistor |
| 10 | V+ | To +15V using 0.1µF Decoupling |

### Unbiased Samples:

| Pin | Function | Connection / Bias |
|---|---|---|
| 1 | OUT A | GND |
| 2 | -INPUT A | GND |
| 3 | +INPUT A | GND |
| 4 | N/C | GND |
| 5 | V- | GND |
| 6 | N/C | GND |
| 7 | +INPUT B | GND |
| 8 | -INPUT B | GND |
| 9 | OUT B | GND |
| 10 | V+ | GND |

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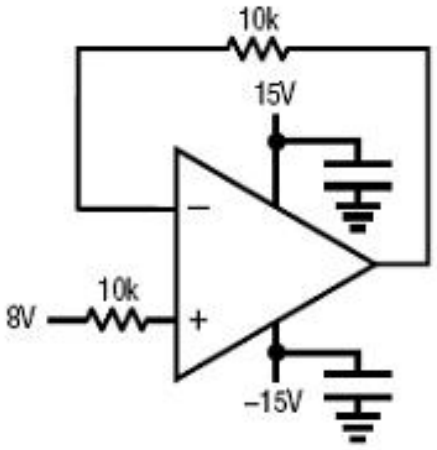


Figure B.1. Irradiation bias drawing for the units to be irradiated under electrical bias. This figure was extracted from LINEAR TECHNOLOGY CORPORATION, Drawing Number: 05-08-5020 REV. K "MICROCIRCUIT, LINEAR, MFG RH1078M, MICROPOWER, DUAL, SINGLE SUPPLY, PRECISION OP AMP".

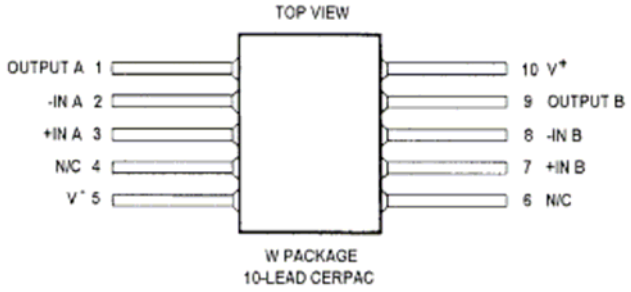


Figure B.2. W package drawing (for reference only). This figure was extracted from LINEAR TECHNOLOGY CORPORATION, Drawing Number: 05-08-5020 REV. K "MICROCIRCUIT, LINEAR, MFG RH1078M, MICROPOWER, DUAL, SINGLE SUPPLY, PRECISION OP AMP".

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## Appendix C: Electrical Test Parameters and Conditions

All electrical tests for this device are performed on one of Radiation Assured Device's LTS2020 Test Systems. The LTS2020 Test System is a programmable parametric tester that provides parameter measurements for a variety of digital, analog and mixed signal products including voltage regulators, operational amplifiers, voltage comparators, D to A and A to D converters. The LTS2020 Test System achieves accuracy and sensitivity through the use of software self-calibration and an internal relay matrix with separate family boards and custom personality adapter boards. The tester uses this relay matrix to connect the required test circuits, select the appropriate voltage / current sources and establish the needed measurement loops for all the tests performed. The measured parameters and test conditions are shown in Table C.1.

Note that test numbers 19 and 20 are modified from the datasheet condition of $V_{CM}$=100mV to $V_{CM}$=0V. This is because the LTS2020 measurement circuit has an impedance of ~333kΩ, such that at 100mV it is effectively injecting ~300nA of current. This is enough to raise the measured $V_{OL}$ by ~1mV. In our estimation, modifying the test condition as specified, plus biasing the amp not being measured to have a $V_{OUT}$ of ~100mV to make sure it's not saturated, reduces the current injected by the measurement circuit to ~30nA or less.

A listing of the measurement precision/resolution for each parameter is shown in Table C.2. The precision/resolution values were obtained either from test data or from the DAC resolution of the LTS-2020. To generate the precision/resolution shown in Table C.2, one of the units-under-test was tested repetitively (a total of 10-times with re-insertion between tests) to obtain the average test value and standard deviation. Using this test data MIL-HDBK-814 90/90 KTL statistics were applied to the measured standard deviation to generate the final measurement range. This value encompasses the precision/resolution of all aspects of the test system, including the LTS2020 mainframe, family board, socket assembly and DUT board as well as insertion error. In some cases, the measurement resolution is limited by the internal DACs, which results in a measured standard deviation of zero. In these instances the precision/resolution will be reported back as the LSB of the DAC.

Note that the testing and statistics used in this document are based on an "analysis of variables" technique, which relies on small sample sizes to qualify much larger lot sizes (see MIL-HDBK-814, p. 91 for a discussion of statistical treatments). Unfortunately, not all measured parameters are well suited to this approach due to inherent large variations. One such parameter is pre-irradiation Open Loop Gain, where the device exhibits extreme sensitivity to input conditions, resulting in a very large standard deviation and a statistical error often greater than the measured value. If necessary, larger samples sizes could be used to qualify these parameters using an "attributes" approach.

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Table C.1. Measured parameters and test conditions for the RH1078MW.

| TEST NUMBER | TEST DESCRIPTION | TEST CONDITIONS |
|---|---|---|
| | | |
| 1 | Positive Supply Current ($I_{CC2}$) | V=+5V |
| 2 | Negative Supply Current ($I_{EE2}$) | V=+5V |
| 3 & 4 | Input Offset Voltage ($V_{OS1}$ &$V_{OS2}$) | V=+5V |
| 5 & 6 | Input Offset Current ($I_{OS1}$ & $I_{OS2}$) | V=+5V |
| 7 & 8 | + Input Bias Current ($I_{B+1}$ & $I_{B+2}$) | V=+5V |
| 9 & 10 | - Input Bias Current ($I_{B-1}$ & $I_{B-2}$) | V=+5V |
| 11 & 12 | Common Mode Rejection Ratio (CMRR1 & CMRR2) | V=+5V, $V_{CM}$ = 0V to 3.5V |
| 13 & 14 | Power Supply Rejection Ratio (PSRR1 & PSRR2) | V= 2.3V to 12V |
| 15 & 16 | Large Signal Voltage Gain ($A_{VOL\,1}$ &$A_{VOL2}$) | V=+5V, $R_L$ =Open |
| 17 & 18 | Large Signal Voltage Gain ($A_{VOL3}$ &$A_{VOL4}$) | V=+5V, $R_L$ =50kΩ |
| 19 & 20 | $V_{OUT}$ Low ($V_{OUTLOW1}$ & $V_{OUTLOW2}$) | V=+5V, $R_L$ =Open, $V_{CM}$ = 0V* |
| 21 & 22 | $V_{OUT}$ Low ($V_{OUTLOW3}$ & $V_{OUTLOW4}$) | V=+5V, $R_L$ =2kΩ |
| 23 & 24 | $V_{OUT}$ Low ($V_{OUTLOW5}$ & $V_{OUTLOW6}$) | V=+5V, $I_{SINK}$=100µA |
| 25 & 26 | $V_{OUT}$ High ($V_{OUTHIGH1}$ & $V_{OUTHIGH2}$) | V=+5V, $R_L$ =Open |
| 27 & 28 | $V_{OUT}$ High ($V_{OUTHIGH3}$ & $V_{OUTHIGH4}$) | V=+5V, $R_L$ =2kΩ |
| 29 & 30 | +SR (Slew Rate 1 and Slew Rate 2) | V=+5V, $A_V$=1 |
| 31 & 32 | -SR (Slew Rate 3 and Slew Rate 4) | V=+5V, $A_V$=1 |

* This is non-datasheet condition, see above for explanation.

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| | | |
|---|---|---|
| 33 | Positive Supply Current ($I_{CC2}$) | V=±15V |
| 34 | Negative Supply Current ($I_{EE2}$) | V=±15V |
| 35 & 36 | Input Offset Voltage ($V_{OS3}$ &$V_{OS4}$) | V=±15V |
| 37 & 38 | Input Offset Current ($I_{OS3}$ & $I_{OS4}$) | V=±15V |
| 39 & 40 | + Input Bias Current ($I_{B+3}$ & $I_{B+4}$) | V=±15V |
| 41 & 42 | - Input Bias Current ($I_{B-3}$ & $I_{B-4}$) | V=±15V |
| 43 & 44 | Common Mode Rejection Ratio (CMRR3 & CMRR4) | V=±15V, $V_{CM}$ = 13.5V, –15V |
| 45 & 46 | Power Supply Rejection Ratio (PSRR3 & PSRR4) | V= 5V, 0V to ±18V |
| 47 & 48 | Large Signal Voltage Gain ($A_{VOL\,5}$ &$A_{VOL6}$) | V=±15V, $R_L$=50kΩ |
| 49 & 50 | Large Signal Voltage Gain ($A_{VOL\,7}$ &$A_{VOL8}$) | V=±15V, $R_L$=2kΩ |
| 51 & 52 | $V_{OUT}$ High ($V_{OUTHIGH5}$ & $V_{OUTHIGH6}$) | V=±15V, $R_L$=50kΩ |
| 53 & 54 | $V_{OUT}$ High ($V_{OUTHIGH7}$ & $V_{OUTHIGH8}$) | V=±15V, $R_L$=2kΩ |
| 55 & 56 | $V_{OUT}$ Low ($V_{OUTLOW7}$ & $V_{OUTLOW8}$) | V=±15V, $R_L$=50kΩ |
| 57 & 58 | $V_{OUT}$ Low ($V_{OUTLOW9}$ & $V_{OUTLOW10}$) | V=±15V, $R_L$=2kΩ |
| 59 & 60 | +SR (Slew Rate 5 and Slew Rate 6) | V=±15V, $A_V$=1 |
| 60 & 61 | -SR (Slew Rate 7 and Slew Rate 8) | V=±15V, $A_V$=1 |

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Table C.2. Measured parameters, pre-irradiation specifications and measurement resolution for the RH1078MW.

| Measured Parameter | Pre-Irradiation Specification | Measurement Resolution/Precision |
|---|---|---|
| | | |
| **Positive Supply Current ($I_{CC}$)** | 1.5E-04A | ± 1.31E-06A |
| **Negative Supply Current ($I_{EE}$)** | -1.5E-04A | ± 1.07E-06A |
| **Input Offset Voltage ($V_{OS1}$ &$V_{OS2}$)** | ±1.2E-04V | ± 3.41E-06V |
| **Input Offset Current ($I_{OS1}$ & $I_{OS2}$)** | ±8E-10A | ± 5.06E-11A |
| **+ Input Bias Current ($I_{B+1}$ & $I_{B+2}$)** | ±1.5E-08A | ± 5.88E-11A |
| **- Input Bias Current ($I_{B-1}$ & $I_{B-2}$)** | ±1.5E-08A | ± 8.03E-11A |
| **Common Mode Rejection Ratio (CMRR1 & CMRR2)** | 94dB | ± 3.12E+00 dB |
| **Power Supply Rejection Ratio (PSRR1 & PSRR2)** | 100dB | ± 5.70E+00dB |
| **Large Signal Voltage Gain ($A_{VOL\,1}$ &$A_{VOL2}$)** | 150V/mV | ± 2.69E+02V/mV |
| **Large Signal Voltage Gain ($A_{VOL3}$ &$A_{VOL4}$)** | 120V/mV | ± 7.13E+02 V/mV |
| **$V_{OUT}$ Low ($V_{OUTLOW1}$ & $V_{OUTLOW2}$)** | 6E-03V | ± 1.16E-04V |
| **$V_{OUT}$ Low ($V_{OUTLOW3}$ & $V_{OUTLOW4}$)** | 2E-03V | ± 3.43E-05V |
| **$V_{OUT}$ Low ($V_{OUTLOW5}$ & $V_{OUTLOW6}$)** | 1.3E-01V | ± 3.22E-04V |
| **$V_{OUT}$ High ($V_{OUTHIGH1}$ & $V_{OUTHIGH2}$)** | 4.2V | ± 3.11E-03V |
| **$V_{OUT}$ High ($V_{OUTHIGH3}$ & $V_{OUTHIGH4}$)** | 3.5V | ± 2.13E-03V |
| **+SR (Slew Rate 1 and Slew Rate 2)** | 4E-02V/µs | ± 1.07E-03V/µs |
| **-SR (Slew Rate 3 and Slew Rate 4)** | -4E-02V/µs | ± 1.81E-03 V/µs |

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| Measured Parameter | Pre-Irradiation Specification | Measurement Resolution/Precision |
|---|---|---|
| | | |
| **Positive Supply Current ($I_{CC2}$)** | 2E-04A | ± 1.74E-06A |
| **Negative Supply Current ($I_{EE2}$)** | -2E-04A | ± 9.73E-07A |
| **Input Offset Voltage ($V_{OS3}$ &$V_{OS4}$)** | ±3.5E-4V | ± 2.51E-06V |
| **Input Offset Current ($I_{OS3}$ & $I_{OS4}$)** | ±8E-10A | ± 3.54E-11A |
| **+ Input Bias Current ($I_{B+3}$ & $I_{B+4}$)** | ±1.5E-08A | ± 3.89E-11A |
| **- Input Bias Current ($I_{B-3}$ & $I_{B-4}$)** | ±1.5E-08A | ± 7.51E-11A |
| **Common Mode Rejection Ratio (CMRR3 & CMRR4)** | 97dB | ± 2.98E-01dB |
| **Power Supply Rejection Ratio (PSRR3 & PSRR4)** | 100dB | ± 4.20E+00dB |
| **Large Signal Voltage Gain ($A_{VOL\ 5}$ &$A_{VOL6}$)** | 1000V/mV | ± 2.34E+04V/mV |
| **Large Signal Voltage Gain ($A_{VOL\ 7}$ &$A_{VOL8}$)** | 300V/mV | ± 7.07E+01V/mV |
| **$V_{OUT}$ High ($V_{OUTHIGH5}$ & $V_{OUTHIGH6}$)** | 13V | ± 2.38E-03V |
| **$V_{OUT}$ High ($V_{OUTHIGH7}$ & $V_{OUTHIGH8}$)** | 11V | ± 1.17E-03V |
| **$V_{OUT}$ Low ($V_{OUTLOW7}$ & $V_{OUTLOW8}$)** | -13V | ± 1.75E-03V |
| **$V_{OUT}$ Low ($V_{OUTLOW9}$ & $V_{OUTLOW10}$)** | -11V | ± 4.14E-03V |
| **+SR (Slew Rate 5 and Slew Rate 6)** | 6E-02V/µs | ± 6.97E-03V/µs |
| **-SR (Slew Rate 7 and Slew Rate 8)** | -6E-02V/µs | ± 9.02E-03V/µs |

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## Appendix D: List of Figures Used in Section 5 (RLAT Test Results)

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5.40 Positive Input Bias Current 2 @ +15V (A)
5.41 Negative Input Bias Current 1 @ +15V (A)
5.42 Negative Input Bias Current 2 @ +15V (A)
5.43 Common Mode Rejection Ratio 1 @ +15V (dB)
5.44 Common Mode Rejection Ratio 2 @ +15V (dB)
5.45 Power Supply Rejection Ratio 1 @ +15V (dB)
5.46 Power Supply Rejection Ratio 2 @ +15V (dB)
5.47 Open Loop Gain 1 @ +15V, RL=50kΩ (V/mV)
5.48 Open Loop Gain 2 @ +15V, RL=50kΩ (V/mV)
5.49 Open Loop Gain 1 @ +15V, RL=2kΩ (V/mV)
5.50 Open Loop Gain 2 @ +15V, RL=2kΩ (V/mV)
5.51 Output Voltage High 1 @ +15V RL=open (V)
5.52 Output Voltage High 2 @ +15V RL=open (V)
5.53 Output Voltage High 1 @ +15V RL=2kΩ (V)
5.54 Output Voltage High 2 @ +15V RL=2kΩ (V)
5.55 Output Voltage Low 1 @ +15V RL=open (V)
5.56 Output Voltage Low 2 @ +15V RL=open (V)
5.57 Output Voltage Low 1 @ +15V RL=2kΩ (V)
5.58 Output Voltage Low 2 @ +15V RL=2kΩ (V)
5.59 Positive Slew Rate 1 @ +15V (V/us)
5.60 Positive Slew Rate 2 @ +15V (V/us)
5.61 Negative Slew Rate 1 @ +15V (V/us)
5.62 Negative Slew Rate 2 @ +15V (V/us)