Enhanced Low Dose Rate Sensitivity (ELDRS) Radiation Testing of the Microsemi AAHS298B 8-Channel High Side Driver

Date: 5/2/13

Summary: ELDRS testing was performed on 10 AAHS298B parts. All parts sent for ELDRS testing were found to be within the pre-irradiation electrical specification limits after being irradiated to a total dose of 100krad(Si) at a dose rate of 10mrad(Si)/s.

ELDRS Report: Microsemi.xls

Report Date: 03/25/13

Test completion Date: 03/25/13

Test Lab: Survivability Vulnerability Assessment Directorate (SVAD), White Sands Missile Range, NM 88002

Customer: Microsemi Corp.

Part Type Tested: AAHS298B, 8-Channel High Side Driver, Part Package: 20 Pin Ceramic SOIC

Traceability Information: All parts serialized at assembly house. Wafer Lot #E09722.

Quantity of Units: 10 units of which 5 units for biased irradiation (Group B) and 5 units for unbiased irradiation (Group A).
Group A: S/N's 373-377
Group B: S/N's 378-382

Radiation and Electrical Test Increments: 10mrad(Si)/s ionizing radiation with electrical test increments: pre-irradiation, 50krad(Si) and 100krad(Si).

Pre-Irradiation Burn-In: Performed at Microsemi AMSG as part of the standard flow.

Overtest and Post-Irradiation Anneal: No overtest. No extended post-irradiation anneal conducted.

Radiation Test Standard: MIL-STD-883H TM1019

Test Hardware and Software: Credence ASL-1000 Automated Tester, Entity ID: TMT7(50krad(Si)), TMT8(100krad(Si)) , Tester Calibration performed monthly, Test Board: AAHSS298B-Part_SN01, Test Program:AAHS298B_QA02

Facility and Radiation Source: El Dorado Irradiator Facility of the SVAD White Sands Missile Range in New Mexico. Gamma rays provided by Co60 (Eldorado irradiator) low dose rate source. The lab is ISO 9001-2000 Laboratory Suitability Certified.

Irradiation: Exposure record can be found in appendix E, sheet: "microsemi.xls-Rad_Report_SVAD."

Pass/Fail Criteria: Pass if irradiated part falls within part specification as well as the electrical test specification. Part Specification see: http://www.microsemi.com/existing-parts/parts/35#docs-specs
Electrical Test Specification Ref: AAHS298B_Test.Plan_RevD-01-1.pdf.

Test Result: All parts pass post ELDRs electrical testing at 50krad(Si) and 100krad(Si) dose levels. Every electrical test's mean fell within test specification post ELDRs. Additionally biased and unbiased parts had Mean ±3σ values that fell within the specification limits. See appendix E for detailed results.

1.0. Overview and Background

Some bipolar devices have been shown to exhibit an Enhanced Low Dose Rate Sensitivity (ELDRS) effect. Parameters in these susceptible devices drift more with low dose rate testing than with higher dose rate testing at the same total dose levels. Total Ionizing Dose (TID) testing is traditionally done at higher dose rates (typically 50rad(Si)/s) which is convenient due to commercial test lab capabilities and the rapid speed at which the testing can be conducted (in the order of minutes for doses up to 100krad(Si).) This higher dose rate testing is outlined in MIL-STD-883 TM 1019 Section 3.6.1 (Condition A.) The AAHS298B contains bipolar devices in its design and has an application in the low dose rate environment of space. Condition A is therefore not sufficient in determining the worst case radiation response of this device. Condition D, which prescribes a dose rate of <= 10mrad(Si)/s, was the method of choice for this testing in order to determine the worst case radiation response of this device.

2.0. Radiation Test Apparatus

The low dose rate testing described in this report was performed at the El Dorado Irradiator Facility on the White Sands Missile Range in New Mexico. The El Dorado's irradiator device is called the Eldorado. Dose rates between 20 and .01rad(Si)/s can be controlled on the Eldorado by placing the DUT at the appropriate distance from the exposure aperture. Lower dose rates can be achieved by doing off axis exposures or by adding inline aluminum attenuators.

Figure 2.1. The "Eldorado" low-dose irradiator at the El Dorado Irradiator Facility of the SVAD White Sands Missile Range in New Mexico provided the Co60 gamma rays for this testing.

3.0. Radiation Test Conditions

The 10 AAHS298B parts were loaded onto two AAHS298B_TID boards. Each board held five parts. One board contained the five parts to be irradiated with 0V bias. On this board all inputs, VS and ground were grounded. The other board with five parts was irradiated with bias. Vs was set at 50V, and the odd inputs (e.g CH1, CH3, etc.) were set to 2V as the "ON" condition. The even channels were grounded to determine if any radiation effects differed between the "ON" or "OFF" states.

4.0. Tested Parameters

During the enhanced low dose rate sensitivity testing the following electrical parameters were measured pre- and post-irradiation:

ICC1	OUTPUT5 LEAKAGE	CH1 FALL TIME
ICC2	OUTPUT6 LEAKAGE	CH2 TURN ON
ICC3	OUTPUT7 LEAKAGE	CH2 TURN OFF
INPUT1 OFF CUR	OUTPUT8 LEAKAGE	CH2 RISE TIME
INPUT2 OFF CUR	OUT1_LEAKAGE_VS	CH2 FALL TIME
INPUT3 OFF CUR	OUT2_LEAKAGE_VS	CH3 TURN ON
INPUT4 OFF CUR	OUT3_LEAKAGE_VS	CH3 TURN OFF
INPUT5 OFF CUR	OUT4_LEAKAGE_VS	CH3 RISE TIME
INPUT6 OFF CUR	OUT5_LEAKAGE_VS	CH3 FALL TIME
INPUT7 OFF CUR	OUT6_LEAKAGE_VS	CH4 TURN ON
INPUT8 OFF CUR	OUT7_LEAKAGE_VS	CH4 TURN OFF
INPUT1 ON CUR	OUT8_LEAKAGE_VS	CH4 RISE TIME
INPUT2 ON CUR	OUTPUT1 SAT	CH4 FALL TIME
INPUT3 ON CUR	OUTPUT2 SAT	CH5 TURN ON
INPUT4 ON CUR	OUTPUT3 SAT	CH5 TURN OFF
INPUT5 ON CUR	OUTPUT4 SAT	CH5 RISE TIME
INPUT6 ON CUR	OUTPUT5 SAT	CH5 FALL TIME
INPUT7 ON CUR	OUTPUT6 SAT	CH6 TURN ON
INPUT8 ON CUR	OUTPUT7 SAT	CH6 TURN OFF
IN1 VIH	OUTPUT8 SAT	CH6 RISE TIME
IN1 VIL	OUTPUT1 SAT	CH6 FALL TIME
IN2 VIH	OUTPUT2 SAT	CH7 TURN ON
IN2 VIL	OUTPUT3 SAT	CH7 TURN OFF
IN3 VIH	OUTPUT4 SAT	CH7 RISE TIME
IN3 VIL	OUTPUT5 SAT	CH7 FALL TIME
IN4 VIH	OUTPUT6 SAT	CH8 TURN ON
IN4 VIL	OUTPUT7 SAT	CH8 TURN OFF
IN5 VIH	OUTPUT8 SAT	CH8 RISE TIME
IN5 VIL	OUTPUT1 SAT	CH8 FALL TIME
IN6 VIH	OUTPUT2 SAT	CLAMP1 LEAKAGE
IN6 VIL	OUTPUT3 SAT	CLAMP2 LEAKAGE
IN7 VIH	OUTPUT4 SAT	CLAMP3 LEAKAGE
IN7 VIL	OUTPUT5 SAT	CLAMP4 LEAKAGE
IN8 VIH	OUTPUT6 SAT	CLAMP5 LEAKAGE
IN8 VIL	OUTPUT7 SAT	CLAMP6 LEAKAGE
OUTPUT1 LEAKAGE	OUTPUT8 SAT	CLAMP7 LEAKAGE
OUTPUT2 LEAKAGE	CH1 TURN ON	CLAMP8 LEAKAGE
OUTPUT3 LEAKAGE	CH1 TURN OFF	CLAMP1 VF@200MA
OUTPUT4 LEAKAGE	CH1 RISE TIME	CLAMP2 VF@200MA

CLAMP3 VF@200MA	CLAMP5 VF@700MA	OUT4_OFF
CLAMP4 VF@200MA	CLAMP6 VF@700MA	OUT4_SAT_LOW_VS
CLAMP5 VF@200MA	CLAMP7 VF@700MA	OUT5_OFF
CLAMP6 VF@200MA	CLAMP8 VF@700MA	OUT5_SAT_LOW_VS
CLAMP7 VF@200MA	OUT1_OFF	OUT6_OFF
CLAMP8 VF@200MA	OUT1_SAT_LOW_VS	OUT6_SAT_LOW_VS
CLAMP1 VF@700MA	OUT2_OFF	OUT7_OFF
CLAMP2 VF@700MA	OUT2_SAT_LOW_VS	OUT7_SAT_LOW_VS
CLAMP3 VF@700MA	OUT3_OFF	OUT8_OFF
CLAMP4 VF@200MA	OUT3_SAT_LOW_VS	OUT8_SAT_LOW_VS

Appendix C details the measured parameters, test conditions, pre-irradiation specification and measurement resolution for each of the measurements. The raw data can be found in Appendix E.

5.0. ELDRS Test Results

The following table summarizes all tested electrical parameters.

Parameter	UNIT	SPEC MIN	SPEC MAX	ALL VALUES IN SPEC [krad(Si)]	M ±3σ IN SPEC [krad(Si)]
ICC1	uA	-0.2	20	100	100
ICC2	mA	0	25	100	100
ICC3	mA	0	25	100	100
INPUT1 OFF CUR	uA	-10	10	100	100
INPUT2 OFF CUR	uA	-10	10	100	100
INPUT3 OFF CUR	uA	-10	10	100	100
INPUT4 OFF CUR	uA	-10	10	100	100
INPUT5 OFF CUR	uA	-10	10	100	100
INPUT6 OFF CUR	uA	-10	10	100	100
INPUT7 OFF CUR	uA	-10	10	100	100
INPUT8 OFF CUR	uA	-10	10	100	100
INPUT1 ON CUR	uA	0	100	100	100
INPUT2 ON CUR	uA	0	100	100	100
INPUT3 ON CUR	uA	0	100	100	100
INPUT4 ON CUR	uA	0	100	100	100
INPUT5 ON CUR	uA	0	100	100	100
INPUT6 ON CUR	uA	0	100	100	100
INPUT7 ON CUR	uA	0	100	100	100
INPUT8 ON CUR	uA	0	100	100	100
IN1 VIH	V	0.8	2.5	100	100
IN1 VIL	V	0.8	2.5	100	100
IN2 VIH	V	0.8	2.5	100	100
IN2 VIL	V	0.8	2.5	100	100
IN3 VIH	V	0.8	2.5	100	100
IN3 VIL	V	0.8	2.5	100	100
IN4 VIH	V	0.8	2.5	100	100
IN4 VIL	V	0.8	2.5	100	100
IN5 VIH	V	0.8	2.5	100	100
IN5 VIL	V	0.8	2.5	100	100

IN6 VIH	V	0.8	2.5	100	100
IN6 VIL	V	0.8	2.5	100	100
IN7 VIH	V	0.8	2.5	100	100
IN7 VIL	V	0.8	2.5	100	100
IN8 VIH	V	0.8	2.5	100	100
IN8 VIL	V	0.8	2.5	100	100
OUTPUT1 LEAKAGE	uA	-50	50	100	100
OUTPUT2 LEAKAGE	uA	-50	50	100	100
OUTPUT3 LEAKAGE	uA	-50	50	100	100
OUTPUT4 LEAKAGE	uA	-50	50	100	100
OUTPUT5 LEAKAGE	uA	-50	50	100	100
OUTPUT6 LEAKAGE	uA	-50	50	100	100
OUTPUT7 LEAKAGE	uA	-50	50	100	100
OUTPUT8 LEAKAGE	uA	-50	50	100	100
OUT1_LEAKAGE_VS	uA	-10	10	100	100
OUT2_LEAKAGE_VS	uA	-10	10	100	100
OUT3_LEAKAGE_VS	uA	-10	10	100	100
OUT4_LEAKAGE_VS	uA	-10	10	100	100
OUT5_LEAKAGE_VS	uA	-10	10	100	100
OUT6_LEAKAGE_VS	uA	-10	10	100	100
OUT7_LEAKAGE_VS	uA	-10	10	100	100
OUT8_LEAKAGE_VS	uA	-10	10	100	100
OUTPUT1 SAT	V	0	2.2	100	100
OUTPUT2 SAT	V	0	2.2	100	100
OUTPUT3 SAT	V	0	2.2	100	100
OUTPUT4 SAT	V	0	2.2	100	100
OUTPUT5 SAT	V	0	2.2	100	100
OUTPUT6 SAT	V	0	2.2	100	100
OUTPUT7 SAT	V	0	2.2	100	100
OUTPUT8 SAT	V	0	2.2	100	100
OUTPUT1 SAT	V	0	2.3	100	100
OUTPUT2 SAT	V	0	2.3	100	100
OUTPUT3 SAT	V	0	2.3	100	100
OUTPUT4 SAT	V	0	2.3	100	100
OUTPUT5 SAT	V	0	2.3	100	100
OUTPUT6 SAT	V	0	2.3	100	100
OUTPUT7 SAT	V	0	2.3	100	100
OUTPUT8 SAT	V	0	2.3	100	100
OUTPUT1 SAT	V	0	2.7	100	100
OUTPUT2 SAT	V	0	2.7	100	100
OUTPUT3 SAT	V	0	2.7	100	100
OUTPUT4 SAT	V	0	2.7	100	100
OUTPUT5 SAT	V	0	2.7	100	100
OUTPUT6 SAT	V	0	2.7	100	100
OUTPUT7 SAT	V	0	2.7	100	100

OUTPUT8 SAT	V	0	2.7	100	100
CH1 TURN ON	uS	0	2	100	100
CH1 TURN OFF	uS	0	10	100	100
CH1 RISE TIME	uS	0	2	100	100
CH1 FALL TIME	uS	0	10	100	100
CH2 TURN ON	uS	0	2	100	100
CH2 TURN OFF	uS	0	10	100	100
CH2 RISE TIME	uS	0	2	100	100
CH2 FALL TIME	uS	0	10	100	100
CH3 TURN ON	uS	0	2	100	100
CH3 TURN OFF	uS	0	10	100	100
CH3 RISE TIME	uS	0	2	100	100
CH3 FALL TIME	uS	0	10	100	100
CH4 TURN ON	uS	0	2	100	100
CH4 TURN OFF	uS	0	10	100	100
CH4 RISE TIME	uS	0	2	100	100
CH4 FALL TIME	uS	0	10	100	100
CH5 TURN ON	uS	0	2	100	100
CH5 TURN OFF	uS	0	10	100	100
CH5 RISE TIME	uS	0	2	100	100
CH5 FALL TIME	uS	0	10	100	100
CH6 TURN ON	uS	0	2	100	100
CH6 TURN OFF	uS	0	10	100	100
CH6 RISE TIME	uS	0	2	100	100
CH6 FALL TIME	uS	0	10	100	100
CH7 TURN ON	uS	0	2	100	100
CH7 TURN OFF	uS	0	10	100	100
CH7 RISE TIME	uS	0	2	100	100
CH7 FALL TIME	uS	0	10	100	100
CH8 TURN ON	uS	0	2	100	100
CH8 TURN OFF	uS	0	10	100	100
CH8 RISE TIME	uS	0	2	100	100
CH8 FALL TIME	uS	0	10	100	100
CLAMP1 LEAKAGE	uA	-50	50	100	100
CLAMP2 LEAKAGE	uA	-50	50	100	100
CLAMP3 LEAKAGE	uA	-50	50	100	100
CLAMP4 LEAKAGE	uA	-50	50	100	100
CLAMP5 LEAKAGE	uA	-50	50	100	100
CLAMP6 LEAKAGE	uA	-50	50	100	100
CLAMP7 LEAKAGE	uA	-50	50	100	100
CLAMP8 LEAKAGE	uA	-50	50	100	100
CLAMP1 VF@200MA	V	-2.5	0	100	100
CLAMP2 VF@200MA	V	-2.5	0	100	100
CLAMP3 VF@200MA	V	-2.5	0	100	100
CLAMP4 VF@200MA	V	-2.5	0	100	100

CLAMP5 VF@200MA	V	-2.5	0	100	100
CLAMP6 VF@200MA	V	-2.5	0	100	100
CLAMP7 VF@200MA	V	-2.5	0	100	100
CLAMP8 VF@200MA	V	-2.5	0	100	100
CLAMP1 VF@700MA	V	-3	0	100	100
CLAMP2 VF@700MA	V	-3	0	100	100
CLAMP3 VF@700MA	V	-3	0	100	100
CLAMP4 VF@200MA	V	-3	0	100	100
CLAMP5 VF@700MA	V	-3	0	100	100
CLAMP6 VF@700MA	V	-3	0	100	100
CLAMP7 VF@700MA	V	-3	0	100	100
CLAMP8 VF@700MA	V	-3	0	100	100
OUT1_OFF	V	-0.15	0.3	100	100
OUT1_SAT_LOW_VS	V	0	2.7	100	100
OUT2_OFF	V	-0.15	0.3	100	100
OUT2_SAT_LOW_VS	V	0	2.7	100	100
OUT3_OFF	V	-0.15	0.3	100	100
OUT3_SAT_LOW_VS	V	0	2.7	100	100
OUT4_OFF	V	-0.15	0.3	100	100
OUT4_SAT_LOW_VS	V	0	2.7	100	100
OUT5_OFF	V	-0.15	0.3	100	100
OUT5_SAT_LOW_VS	V	0	2.7	100	100
OUT6_OFF	V	-0.15	0.3	100	100
OUT6_SAT_LOW_VS	V	0	2.7	100	100
OUT7_OFF	V	-0.15	0.3	100	100
OUT7_SAT_LOW_VS	V	0	2.7	100	100
OUT8_OFF	V	-0.15	0.3	100	100
OUT8_SAT_LOW_VS	V	0	2.7	100	100

Figures 5.1-5.5 are a sampling of ELDRs parameter shifts. Plots and data of all tested parameters can be found in appendix E.

Fig 5.1 Channel 1 Output Sat @ 750mA. Channel is "ON" for Biased Parts

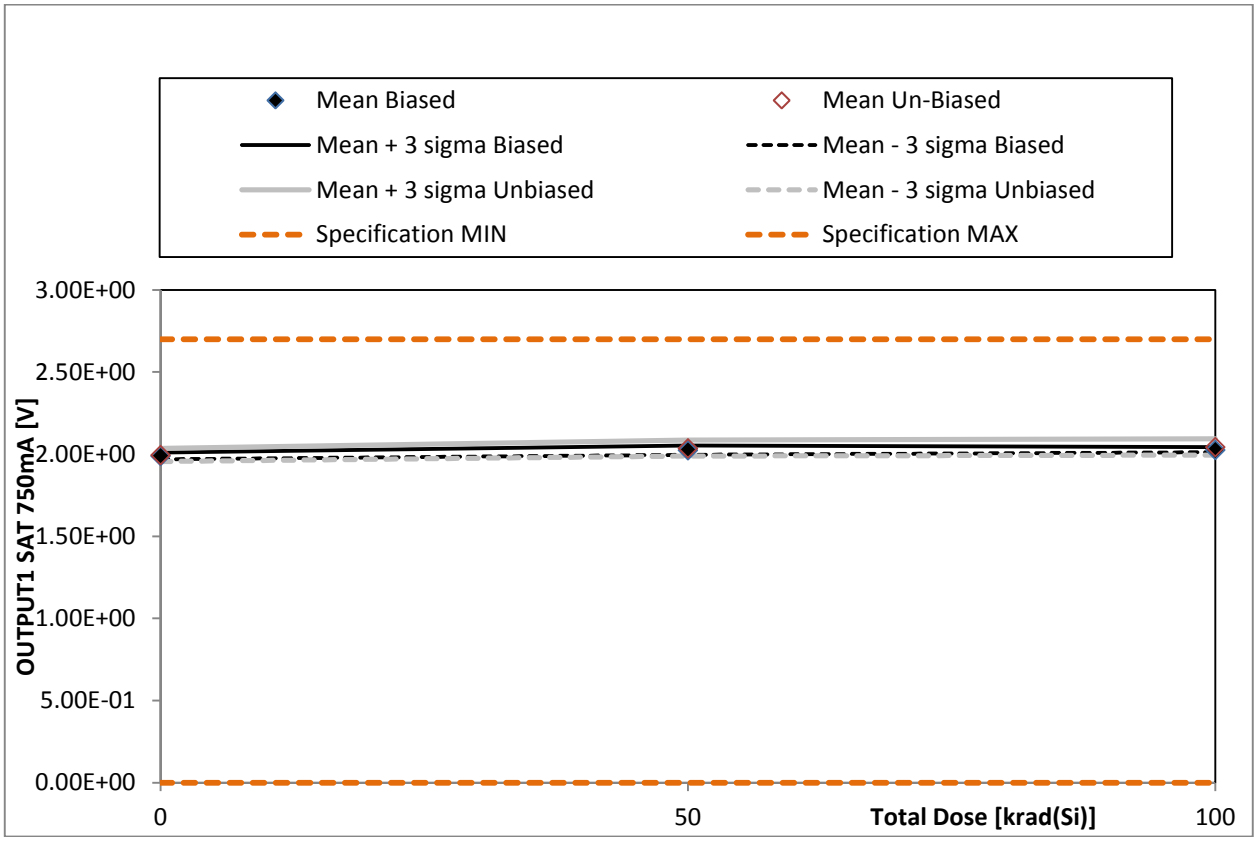


Fig 5.2 Channel 2 Output Sat @ 750mA. Channel is "OFF" for Biased Parts

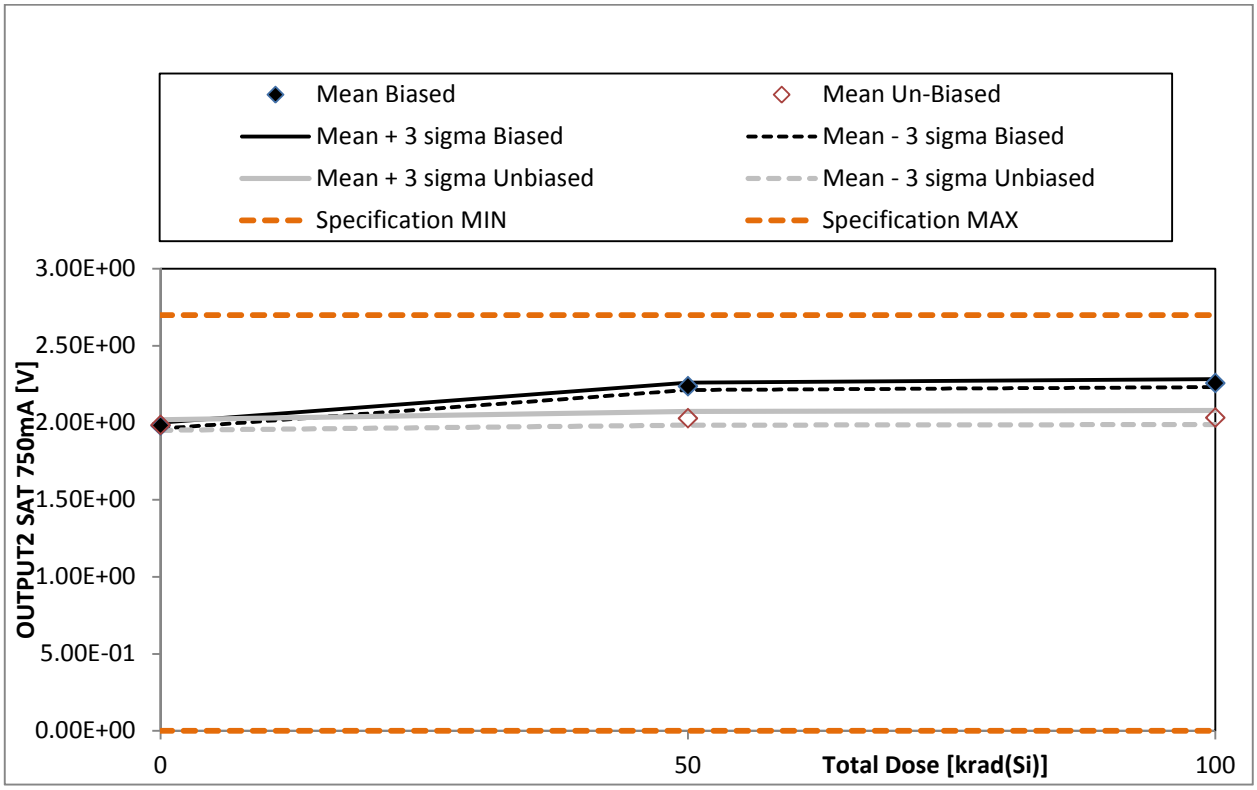


Fig 5.3 Channel 1 Turn-On Delay. Channel is "ON" for Biased Parts

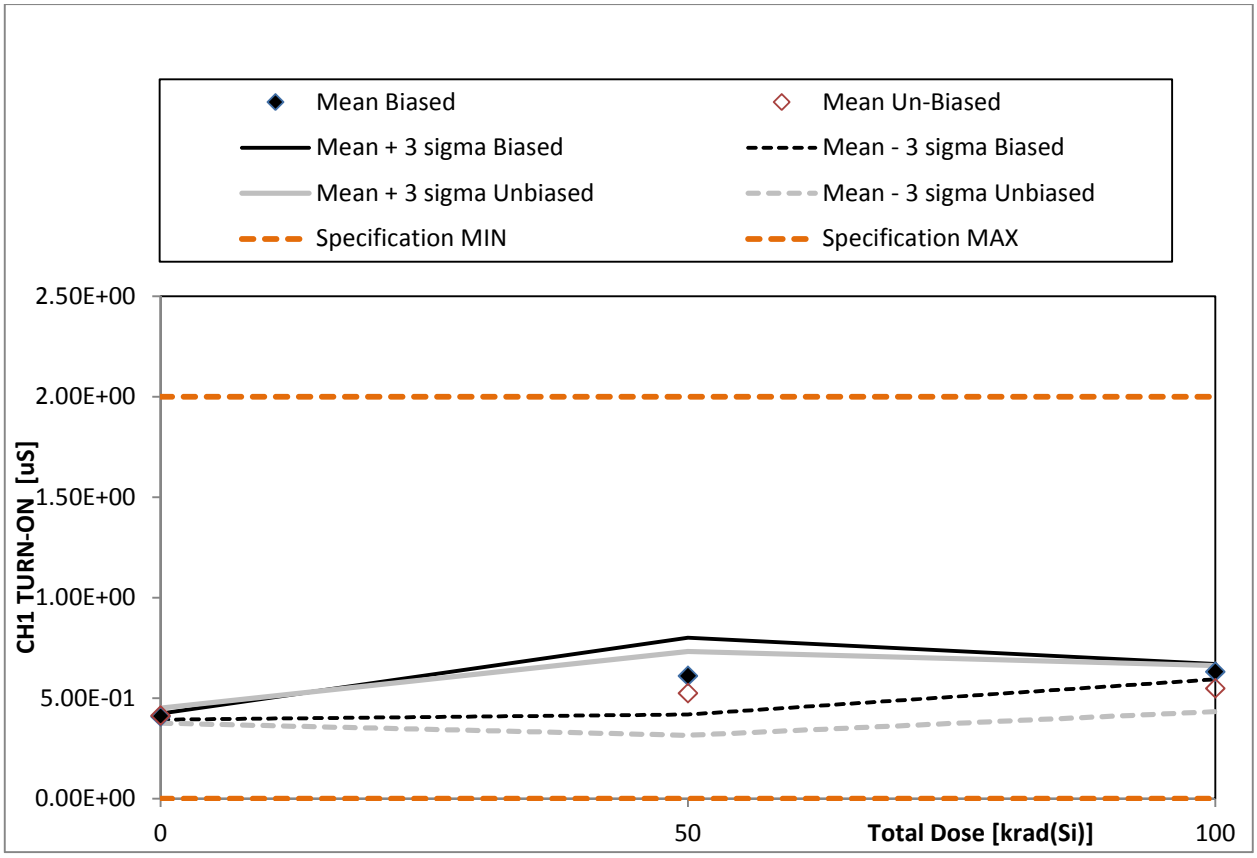


Fig 5.4 Channel 2 Turn-On Delay. Channel is "OFF" for Biased Parts

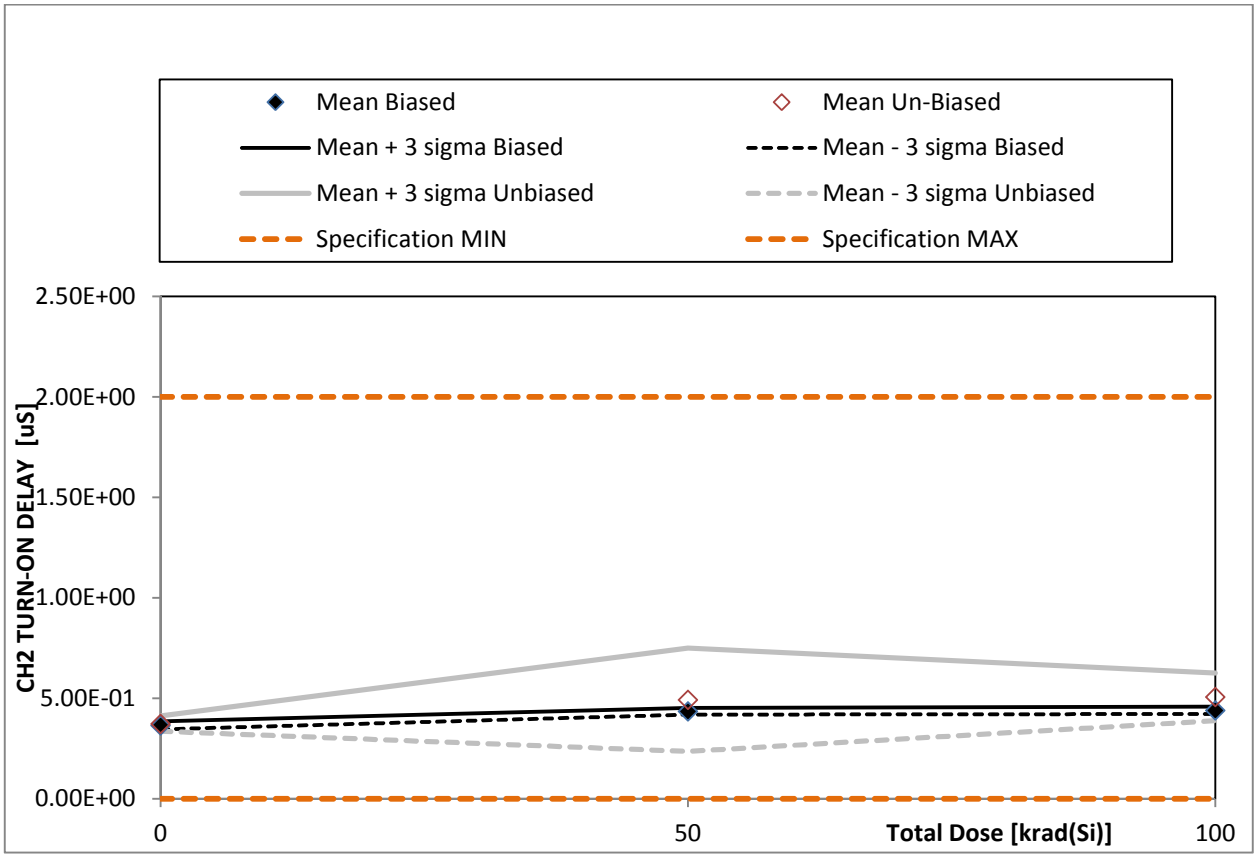


Fig 5.5 ICC2, Active Supply Current, All inputs at 2.5V

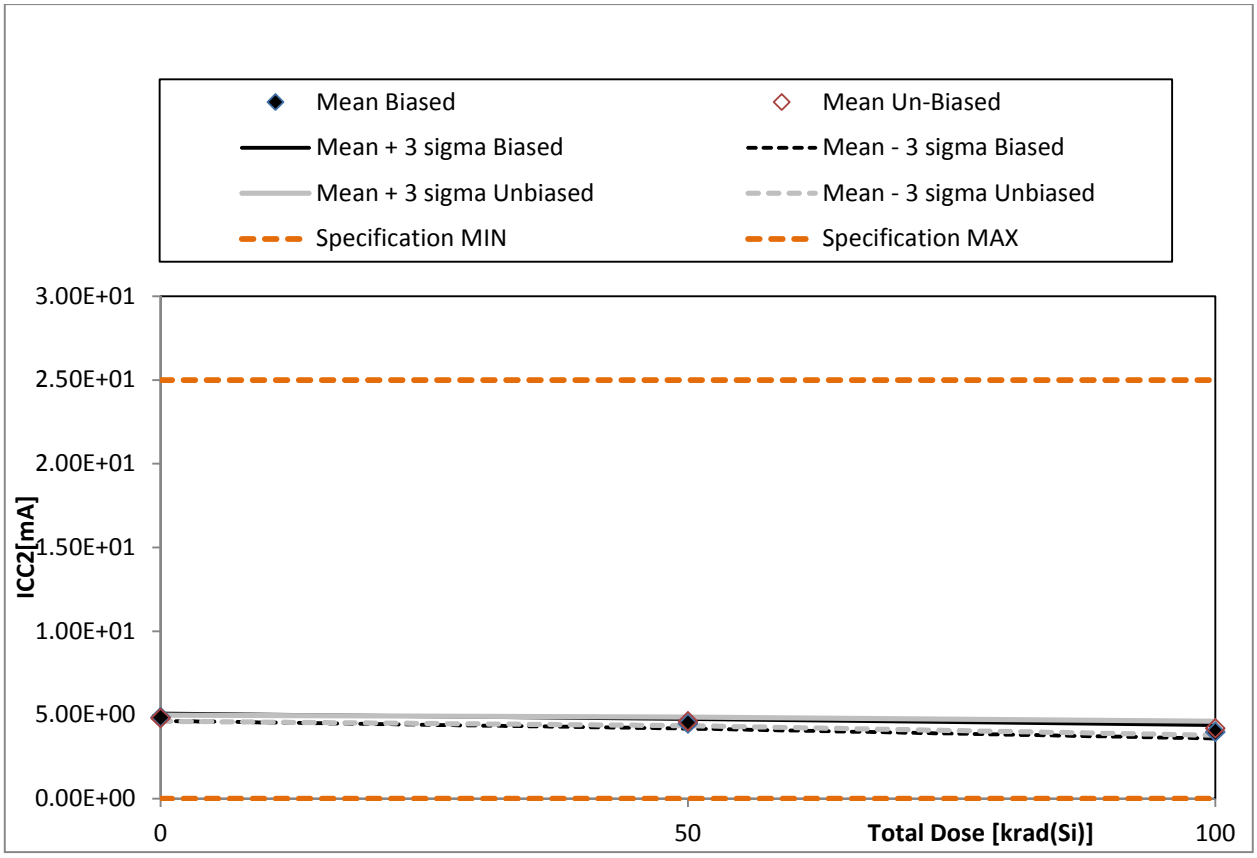
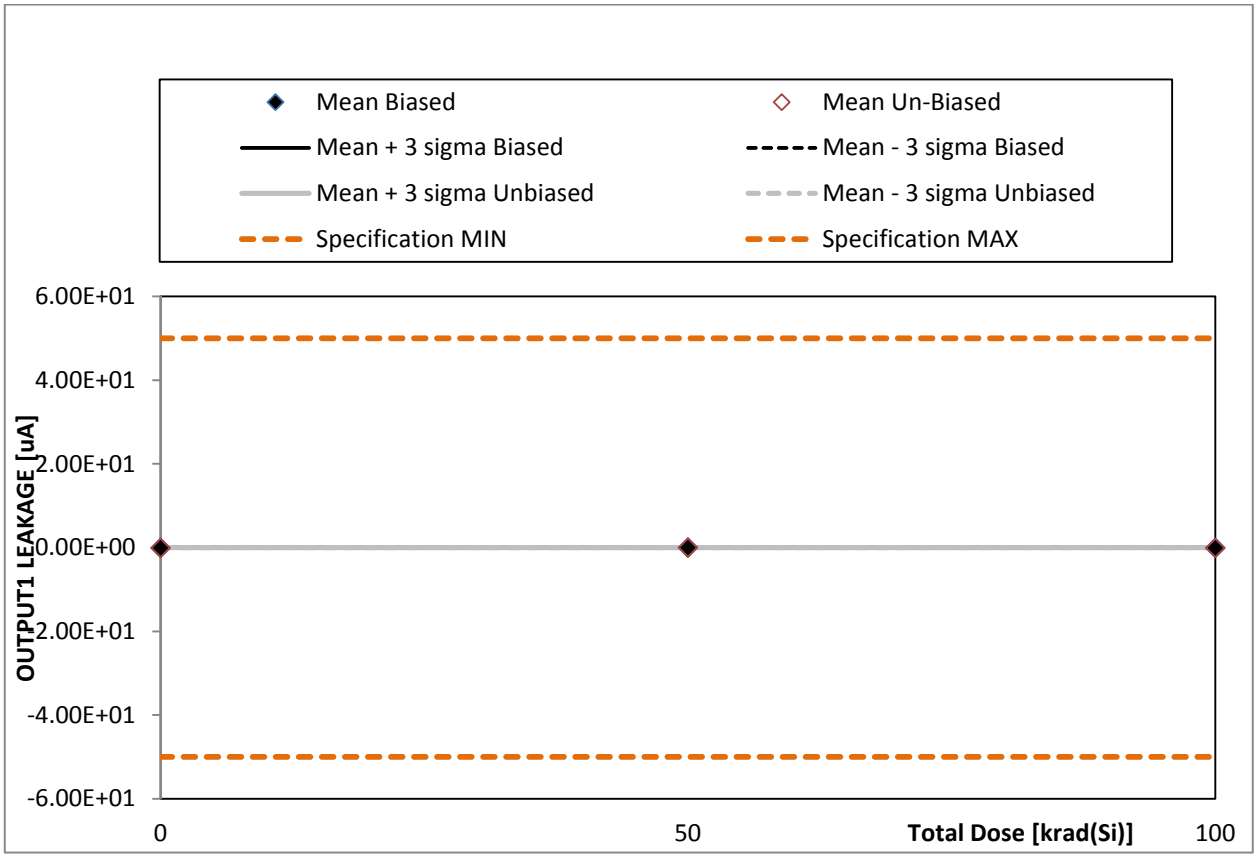
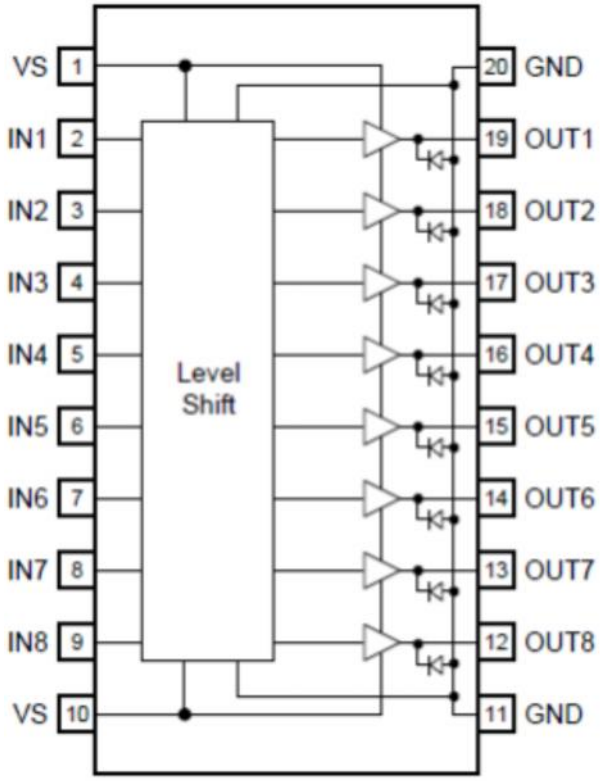


Fig 5.6 Output Leakage Channel 1



Appendix A: AAHS298B Functional Block Diagram

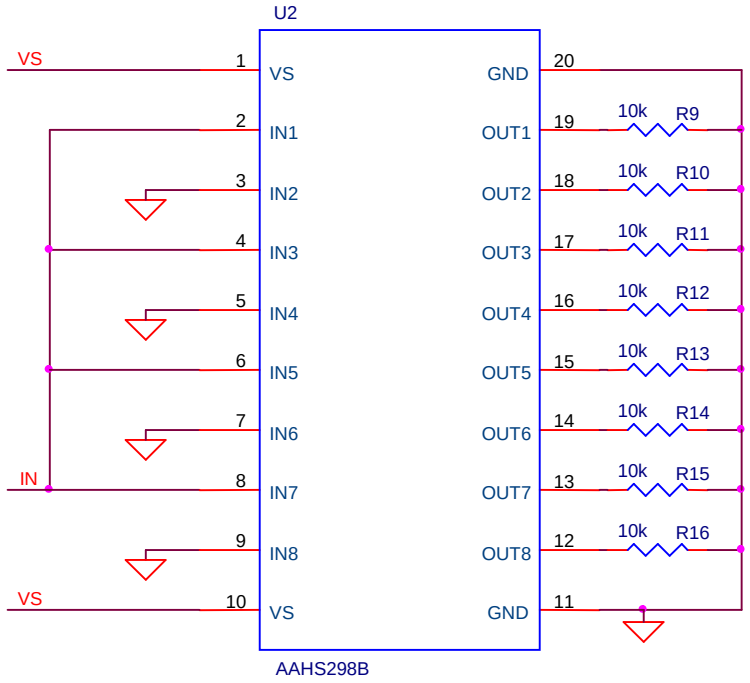


Appendix B: Radiation Bias Connections and Absolute Maximum Ratings

ELDRS Radiation Biased Conditions

Pin	Function	Connection / Bias
1	VS	50V
2	IN1	2V
3	IN2	0V
4	IN2	2V
5	IN2	0V
6	IN5	2V
7	IN6	0V
8	IN7	2V
9	IN8	0V
10	VS	50V
11	GND	0V
12	OUT8	10k to Ground
13	OUT7	10k to Ground
14	OUT6	10k to Ground
15	OUT5	10k to Ground
16	OUT4	10k to Ground
17	OUT3	10k to Ground
18	OUT2	10k to Ground
19	OUT1	10k to Ground
20	GND	0V

Figure B.1. Irradiation bias circuit



ELDRS Radiation Unbiased Conditions: All pins to GROUND except outputs. Outputs tied to GROUND through 10k resistors.

Absolute Maximum Ratings:

Parameter	**Max Rating**
Supply Voltage (+VS)	75V
Max Voltage between Input and Ground	15V
Max Voltage between Output and Ground	75V
Single Output Continuous Current	-700mA
Multiple Output Simultaneously Continuous Current	-2800mA

Appendix C: Electrical Test Parameters and Conditions

The expected ranges of values as well as the measurement conditions are taken from Microsemi AAHS298B Datasheet Revision 1.1 published 6/26/2012. See: http://www.microsemi.com/existing-parts/parts/35#docs-specs. All electrical tests for this device were performed on the Credence ASL1000 tester. Data was taken pre-Rad, at 50krad(Si) and at 100krad(Si) at Microsemi. Dry Ice was used for transit between the El Dorado facility and Microsemi to freeze annealing effects during transit. The measured parameters and test conditions are shown in Table C.1.

A listing of the measurement precision/resolution for each parameter is shown in Table C.2. The precision/resolution values were obtained from test data or from the resolution of the ASL-1000 tester for the particular test shown. A single unit was tested 255 times and the standard deviation for the repeatability of each measurement was calculated. This number was used to calculate the precision of the measurement unless it was determined that the resolution of the tester was worse than this statistical value. This is particularly clear when the standard deviation of the measurement is 0.

Table C.1. Measured parameters and test conditions for the AAHS298B 8 Channel High Side Driver.

Test Name	Test Description
ICC1	ICC at 50V, Vin = 0V
ICC2	ICC at 50V, Vin = 2.5V on all 8 inputs.
ICC3	ICC at 50V, Vin = 5V
INPUT1 OFF CUR	Measure current on Input 1 at 0V
INPUT2 OFF CUR	Measure current on Input 2 at 0V
INPUT3 OFF CUR	Measure current on Input 3 at 0V
INPUT4 OFF CUR	Measure current on Input 4 at 0V
INPUT5 OFF CUR	Measure current on Input 5 at 0V
INPUT6 OFF CUR	Measure current on Input 6 at 0V
INPUT7 OFF CUR	Measure current on Input 7 at 0V
INPUT8 OFF CUR	Measure current on Input 8 at 0V
INPUT1 ON CUR	Measure current on Input 1 at 5V
INPUT2 ON CUR	Measure current on Input 2 at 5V
INPUT3 ON CUR	Measure current on Input 3 at 5V
INPUT4 ON CUR	Measure current on Input 4 at 5V
INPUT5 ON CUR	Measure current on Input 5 at 5V
INPUT6 ON CUR	Measure current on Input 6 at 5V
INPUT7 ON CUR	Measure current on Input 7 at 5V
INPUT8 ON CUR	Measure current on Input 8 at 5V
IN1 VIH	Ramp up voltage on Input1 until output turns on
IN1 VIL	Ramp down voltage on Input1 until output turns off.
IN2 VIH	Ramp up voltage on Input2 until output turns on
IN2 VIL	Ramp down voltage on Input2 until output turns off.
IN3 VIH	Ramp up voltage on Input3 until output turns on
IN3 VIL	Ramp down voltage on Input3 until output turns off.
IN4 VIH	Ramp up voltage on Input4 until output turns on
IN4 VIL	Ramp down voltage on Input4 until output turns off.

IN5 VIH	Ramp up voltage on Input5 until output turns on
IN5 VIL	Ramp down voltage on Input5 until output turns off.
IN6 VIH	Ramp up voltage on Input6 until output turns on
IN6 VIL	Ramp down voltage on Input6 until output turns off.
IN7 VIH	Ramp up voltage on Input7 until output turns on
IN7 VIL	Ramp down voltage on Input7 until output turns off.
IN8 VIH	Ramp up voltage on Input8 until output turns on
IN8 VIL	Ramp down voltage on Input8 until output turns off.
OUTPUT1 LEAKAGE	Force 0V on Output1, measure current
OUTPUT2 LEAKAGE	Force 0V on Output2, measure current
OUTPUT3 LEAKAGE	Force 0V on Output3, measure current
OUTPUT4 LEAKAGE	Force 0V on Output4, measure current
OUTPUT5 LEAKAGE	Force 0V on Output5, measure current
OUTPUT6 LEAKAGE	Force 0V on Output6, measure current
OUTPUT7 LEAKAGE	Force 0V on Output7, measure current
OUTPUT8 LEAKAGE	Force 0V on Output8, measure current
OUTPUT1 SAT	Force 350mA on Output1, measure voltage, subtract from 50V.
OUTPUT2 SAT	Force 350mA on Output2, measure voltage, subtract from 50V.
OUTPUT3 SAT	Force 350mA on Output3, measure voltage, subtract from 50V.
OUTPUT4 SAT	Force 350mA on Output4, measure voltage, subtract from 50V.
OUTPUT5 SAT	Force 350mA on Output5, measure voltage, subtract from 50V.
OUTPUT6 SAT	Force 350mA on Output6, measure voltage, subtract from 50V.
OUTPUT7 SAT	Force 350mA on Output7, measure voltage, subtract from 50V.
OUTPUT8 SAT	Force 350mA on Output8, measure voltage, subtract from 50V.
OUTPUT1 SAT	Force 500mA on Output1, measure voltage, subtract from 50V.
OUTPUT2 SAT	Force 500mA on Output2, measure voltage, subtract from 50V.
OUTPUT3 SAT	Force 500mA on Output3, measure voltage, subtract from 50V.
OUTPUT4 SAT	Force 500mA on Output4, measure voltage, subtract from 50V.
OUTPUT5 SAT	Force 500mA on Output5, measure voltage, subtract from 50V.
OUTPUT6 SAT	Force 500mA on Output6, measure voltage, subtract from 50V.
OUTPUT7 SAT	Force 500mA on Output7, measure voltage, subtract from 50V.
OUTPUT8 SAT	Force 500mA on Output8, measure voltage, subtract from 50V.
OUTPUT1 SAT	Force 700mA on Output1, measure voltage, subtract from 50V.
OUTPUT2 SAT	Force 700mA on Output2, measure voltage, subtract from 50V.
OUTPUT3 SAT	Force 700mA on Output3, measure voltage, subtract from 50V.
OUTPUT4 SAT	Force 700mA on Output4, measure voltage, subtract from 50V.
OUTPUT5 SAT	Force 700mA on Output5, measure voltage, subtract from 50V.
OUTPUT6 SAT	Force 700mA on Output6, measure voltage, subtract from 50V.
OUTPUT7 SAT	Force 700mA on Output7, measure voltage, subtract from 50V.
OUTPUT8 SAT	Force 700mA on Output8, measure voltage, subtract from 50V.
CH1 TURN ON	Measure prop delay Input 1 rising to Output1 rising

CH1 TURN OFF	Measure prop delay Input 1 falling to Output1 falling
CH1 OUTPUT RISE	Measure Output1 rise time
CH1 OUTPUT FALL	Measure Output1 fall time
CH2 TURN ON	Measure prop delay Input2 rising to Output2 rising
CH2 TURN OFF	Measure prop delay Input2 falling to Output2 falling
CH2 OUTPUT RISE	Measure Output2 rise time
CH2 OUTPUT FALL	Measure Output2 fall time
CH3 TURN ON	Measure prop delay Input3 rising to Output3 rising
CH3 TURN OFF	Measure prop delay Input3 falling to Output3 falling
CH3 OUTPUT RISE	Measure Output3 rise time
CH3 OUTPUT FALL	Measure Output3 fall time
CH4 TURN ON	Measure prop delay Input4 rising to Output4 rising
CH4 TURN OFF	Measure prop delay Input4 falling to Output4 falling
CH4 OUTPUT RISE	Measure Output4 rise time
CH4 OUTPUT FALL	Measure Output4 fall time
CH5 TURN ON	Measure prop delay Input5 rising to Output5 rising
CH5 TURN OFF	Measure prop delay Input5 falling to Output5 falling
CH5 OUTPUT RISE	Measure Output5 rise time
CH5 OUTPUT FALL	Measure Output5 fall time
CH6 TURN ON	Measure prop delay Input6 rising to Output6 rising
CH6 TURN OFF	Measure prop delay Input6 falling to Output6 falling
CH6 OUTPUT RISE	Measure Output6 rise time
CH6 OUTPUT FALL	Measure Output6 fall time
CH7 TURN ON	Measure prop delay Input7 rising to Output7 rising
CH7 TURN OFF	Measure prop delay Input7 falling to Output7 falling
CH7 OUTPUT RISE	Measure Output7 rise time
CH7 OUTPUT FALL	Measure Output7 fall time
CH8 TURN ON	Measure prop delay Input8 rising to Output8 rising
CH8 TURN OFF	Measure prop delay Input8 falling to Output8 falling
CH8 OUTPUT RISE	Measure Output8 rise time
CH8 OUTPUT FALL	Measure Output8 fall time
CLAMP1 LEAKAGE	Force Output1 to 50V, Measure Current
CLAMP2 LEAKAGE	Force Output2 to 50V, Measure Current
CLAMP3 LEAKAGE	Force Output3 to 50V, Measure Current
CLAMP4 LEAKAGE	Force Output4 to 50V, Measure Current
CLAMP5 LEAKAGE	Force Output5 to 50V, Measure Current
CLAMP6 LEAKAGE	Force Output6 to 50V, Measure Current
CLAMP7 LEAKAGE	Force Output7 to 50V, Measure Current
CLAMP8 LEAKAGE	Force Output8 to 50V, Measure Current
CLAMP1 VF@200MA	Force -200mA on Output1, measure voltage
CLAMP2 VF@200MA	Force -200mA on Output2, measure voltage

CLAMP3 VF@200MA	Force -200mA on Output3, measure voltage
CLAMP4 VF@200MA	Force -200mA on Output4, measure voltage
CLAMP5 VF@200MA	Force -200mA on Output5, measure voltage
CLAMP6 VF@200MA	Force -200mA on Output6, measure voltage
CLAMP7 VF@200MA	Force -200mA on Output7, measure voltage
CLAMP8 VF@200MA	Force -200mA on Output8, measure voltage
CLAMP1 VF@700MA	Force -700mA on Output1, measure voltage
CLAMP2 VF@700MA	Force -700mA on Output2, measure voltage
CLAMP3 VF@700MA	Force -700mA on Output3, measure voltage
CLAMP4 VF@700MA	Force -700mA on Output4, measure voltage
CLAMP5 VF@700MA	Force -700mA on Output5, measure voltage
CLAMP6 VF@700MA	Force -700mA on Output6, measure voltage
CLAMP7 VF@700MA	Force -700mA on Output7, measure voltage
CLAMP8 VF@700MA	Force -700mA on Output8, measure voltage
OUT1_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT1_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.
OUT2_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT2_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.
OUT3_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT3_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.
OUT4_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT4_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.
OUT5_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT5_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.
OUT6_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT6_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.
OUT7_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT7_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.
OUT8_OFF	Set Vs=10V, Vin=0.8V, measure output voltage
OUT8_SAT_LOW_VS	Force 700mA on Output1, measure voltage, subtract from 10V.

Table C.2. Measured parameters, pre-irradiation specifications and measurement precision for the AAHS298B

Test Name	Unit	Min Limit	Max Limit	Measurement Resolution
ICC1	uA	-1.00E-01	2.00E+01	2.40E-02
ICC2	mA	0.00E+00	2.50E+01	1.20E-02
ICC3	mA	0.00E+00	2.50E+01	1.20E-02
INPUT1 OFF CUR	uA	-1.00E+01	1.00E+01	1.20E-02
INPUT2 OFF CUR	uA	-1.00E+01	1.00E+01	1.80E-02
INPUT3 OFF CUR	uA	-1.00E+01	1.00E+01	1.80E-02
INPUT4 OFF CUR	uA	-1.00E+01	1.00E+01	1.80E-02
INPUT5 OFF CUR	uA	-1.00E+01	1.00E+01	1.20E-02
INPUT6 OFF CUR	uA	-1.00E+01	1.00E+01	1.20E-02
INPUT7 OFF CUR	uA	-1.00E+01	1.00E+01	1.80E-02
INPUT8 OFF CUR	uA	-1.00E+01	1.00E+01	1.80E-02
INPUT1 ON CUR	uA	0.00E+00	1.00E+02	1.08E-01
INPUT2 ON CUR	uA	0.00E+00	1.00E+02	1.08E-01
INPUT3 ON CUR	uA	0.00E+00	1.00E+02	1.08E-01
INPUT4 ON CUR	uA	0.00E+00	1.00E+02	1.08E-01
INPUT5 ON CUR	uA	0.00E+00	1.00E+02	1.02E-01
INPUT6 ON CUR	uA	0.00E+00	1.00E+02	9.60E-02
INPUT7 ON CUR	uA	0.00E+00	1.00E+02	1.08E-01
INPUT8 ON CUR	uA	0.00E+00	1.00E+02	1.08E-01
IN1 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN1 VIL	V	8.00E-01	2.50E+00	2.50E-02
IN2 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN2 VIL	V	8.00E-01	2.50E+00	2.50E-02
IN3 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN3 VIL	V	8.00E-01	2.50E+00	2.50E-02
IN4 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN4 VIL	V	8.00E-01	2.50E+00	2.50E-02
IN5 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN5 VIL	V	8.00E-01	2.50E+00	2.50E-02
IN6 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN6 VIL	V	8.00E-01	2.50E+00	2.50E-02
IN7 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN7 VIL	V	8.00E-01	2.50E+00	3.60E-02
IN8 VIH	V	8.00E-01	2.50E+00	2.50E-02
IN8 VIL	V	8.00E-01	2.50E+00	2.50E-02
OUTPUT1 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03
OUTPUT2 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03
OUTPUT3 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03
OUTPUT4 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03
OUTPUT5 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03
OUTPUT6 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03
OUTPUT7 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03

OUTPUT8 LEAKAGE	uA	-5.00E+01	5.00E+01	6.00E-03
OUT1_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	1.80E-02
OUT2_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	1.80E-02
OUT3_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	1.80E-02
OUT4_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	1.80E-02
OUT5_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	1.80E-02
OUT6_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	1.80E-02
OUT7_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	1.80E-02
OUT8_LEAKAGE_VS	uA	-1.00E+01	1.00E+01	6.00E-03
OUTPUT1 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT2 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT3 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT4 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT5 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT6 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT7 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT8 SAT	V	0.00E+00	2.20E+00	6.00E-03
OUTPUT1 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT2 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT3 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT4 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT5 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT6 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT7 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT8 SAT	V	0.00E+00	2.30E+00	6.00E-03
OUTPUT1 SAT	V	0.00E+00	2.70E+00	6.00E-03
OUTPUT2 SAT	V	0.00E+00	2.70E+00	6.00E-03
OUTPUT3 SAT	V	0.00E+00	2.70E+00	6.00E-03
OUTPUT4 SAT	V	0.00E+00	2.70E+00	6.00E-03
OUTPUT5 SAT	V	0.00E+00	2.70E+00	6.00E-03
OUTPUT6 SAT	V	0.00E+00	2.70E+00	6.00E-03
OUTPUT7 SAT	V	0.00E+00	2.70E+00	6.00E-03
OUTPUT8 SAT	V	0.00E+00	2.70E+00	6.00E-03
CH1 TURN ON	uS	0.00E+00	2.00E+00	6.00E-03
CH1 TURN OFF	uS	0.00E+00	1.00E+01	3.00E-02
CH1 RISE TIME	uS	0.00E+00	2.00E+00	1.20E-02
CH1 FALL TIME	uS	0.00E+00	1.00E+01	4.20E-02
CH2 TURN ON	uS	0.00E+00	2.00E+00	6.00E-03
CH2 TURN OFF	uS	0.00E+00	1.00E+01	2.40E-02
CH2 RISE TIME	uS	0.00E+00	2.00E+00	1.20E-02
CH2 FALL TIME	uS	0.00E+00	1.00E+01	4.20E-02
CH3 TURN ON	uS	0.00E+00	2.00E+00	6.00E-03
CH3 TURN OFF	uS	0.00E+00	1.00E+01	2.40E-02
CH3 RISE TIME	uS	0.00E+00	2.00E+00	1.20E-02
CH3 FALL TIME	uS	0.00E+00	1.00E+01	5.40E-02

CH4 TURN ON	uS	0.00E+00	2.00E+00	6.00E-03
CH4 TURN OFF	uS	0.00E+00	1.00E+01	3.60E-02
CH4 RISE TIME	uS	0.00E+00	2.00E+00	1.20E-02
CH4 FALL TIME	uS	0.00E+00	1.00E+01	4.80E-02
CH5 TURN ON	uS	0.00E+00	2.00E+00	2.40E-02
CH5 TURN OFF	uS	0.00E+00	1.00E+01	2.40E-02
CH5 RISE TIME	uS	0.00E+00	2.00E+00	1.20E-02
CH5 FALL TIME	uS	0.00E+00	1.00E+01	4.20E-02
CH6 TURN ON	uS	0.00E+00	2.00E+00	3.60E-02
CH6 TURN OFF	uS	0.00E+00	1.00E+01	3.00E-02
CH6 RISE TIME	uS	0.00E+00	2.00E+00	4.80E-02
CH6 FALL TIME	uS	0.00E+00	1.00E+01	5.40E-02
CH7 TURN ON	uS	0.00E+00	2.00E+00	1.80E-02
CH7 TURN OFF	uS	0.00E+00	1.00E+01	4.80E-02
CH7 RISE TIME	uS	0.00E+00	2.00E+00	2.40E-02
CH7 FALL TIME	uS	0.00E+00	1.00E+01	6.00E-02
CH8 TURN ON	uS	0.00E+00	2.00E+00	1.20E-02
CH8 TURN OFF	uS	0.00E+00	1.00E+01	4.80E-02
CH8 RISE TIME	uS	0.00E+00	2.00E+00	2.40E-02
CH8 FALL TIME	uS	0.00E+00	1.00E+01	1.02E-01
CLAMP1 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP2 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP3 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP4 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP5 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP6 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP7 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP8 LEAKAGE	uA	-5.00E+01	5.00E+01	1.20E-02
CLAMP1 VF@200MA	V	-2.50E+00	0.00E+00	-1.71E-03
CLAMP2 VF@200MA	V	-2.50E+00	0.00E+00	-1.71E-03
CLAMP3 VF@200MA	V	-2.50E+00	0.00E+00	-1.70E-03
CLAMP4 VF@200MA	V	-2.50E+00	0.00E+00	-1.71E-03
CLAMP5 VF@200MA	V	-2.50E+00	0.00E+00	-1.71E-03
CLAMP6 VF@200MA	V	-2.50E+00	0.00E+00	-1.70E-03
CLAMP7 VF@200MA	V	-2.50E+00	0.00E+00	-1.69E-03
CLAMP8 VF@200MA	V	-2.50E+00	0.00E+00	-1.69E-03
CLAMP1 VF@700MA	V	-3.00E+00	0.00E+00	-1.28E-03
CLAMP2 VF@700MA	V	-3.00E+00	0.00E+00	-1.27E-03
CLAMP3 VF@700MA	V	-3.00E+00	0.00E+00	-1.27E-03
CLAMP4 VF@200MA	V	-3.00E+00	0.00E+00	-1.29E-03
CLAMP5 VF@700MA	V	-3.00E+00	0.00E+00	-1.27E-03
CLAMP6 VF@700MA	V	-3.00E+00	0.00E+00	-1.26E-03
CLAMP7 VF@700MA	V	-3.00E+00	0.00E+00	-1.25E-03
CLAMP8 VF@700MA	V	-3.00E+00	0.00E+00	-1.24E-03

Appendix D: List of Figures Used in the Results Section (Section 5)

Fig 5.1 Channel 1 Output Sat @ 750mA, Channel is “ON” for Biased Parts

Fig 5.2 Channel 2 Output Sat @ 750mA, Channel is “OFF” for Biased Parts

Fig 5.3 Channel 1 Turn-On Delay, Channel is “ON” for Biased Parts

Fig 5.4 Channel 2 Turn-On Delay, Channel is “OFF” for Biased Parts

Fig 5.5 ICC2, Active Supply Current, All inputs at 2.5V

Fig 5.6 Output Leakage Channel 1, Channel is “ON” for Biased Parts

Appendix E: Raw Data, Analysis and Plot File

AAHS298B_ELDRS_DATA.xlsx