

# Total Ionizing Dose Test Report

**RDHA701FP10A8CK**

Revision 1.0  
June, 2004

International  
**IOR** Rectifier

**HI-REL PRODUCTS**

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## **INTRODUCTION**

A radiation evaluation was performed on the **RDHA701FP10A8CK 8-Channel, 1.5A, single pole, normally open, non-buffered Solid State Relay**, in a hermetic package, to determine the total dose tolerance of these parts. The irradiation was performed at the University of Massachusetts, Nuclear Research Facility using their Co<sup>60</sup> gamma ray source. During the radiation testing, four devices (sn 6,4,10,11) were irradiated under Bias condition A (On), four devices (sn 15,16,24,25) were irradiated under Bias Condition B (Off) (see Figures 5 and 6), and two devices were used as control samples. The total dose irradiation levels were 50, 100, 150, and 200Krads. The dose rate was 200rads/s(Si). Testing of the devices after irradiation was performed at the IR Leominster facility. This required the devices to be irradiated sequentially in groups of two per each radiation level, one device biased condition A and one device biased condition B. Post irradiation testing of the parts was performed within one hour after the last irradiation exposure level was completed. The graphs (figures 1 – 4) show slow degradation to the TID irradiation exposure over a range of 0 Krads to 200 Krads. Annealing was not performed on these devices since all devices passed the test conditions and specification limits listed in Table I, Appendix A.

## **TEST PLAN**

The Test Plan is included in Appendix B. In summary, the testing occurred in the following manner: Devices had to be tested after irradiation at IR's Leominster facility. Due to the 1 hour test window defined by the Mil-STD-883 (Method 1019), the 8 devices were split into 4 groups. Each sample group was irradiated as follows:

<u>Group</u>	<u>Bias (On)</u>	<u>Bias (Off)</u>	<u>TID</u>
1	#4	#15	200Krads
2	#6	#16	150Krads
3	#10	#25	100Krads
4	#11	#27	50Krads

Two devices were selected for each radiation dose step. One device was irradiated in a Bias (On) state while a second device was irradiated in an Bias (Off) state. After 4 irradiation steps, the four groups received their target radiation level and were taken back to the IR facility for electrical testing. The devices were contained in a cool (<25C) environment to minimize the effects due to annealing. Further details on the test method are explained in Appendix B.

## **RESULTS**

The pre and post radiation test results are shown graphically in Figures 1 thru 4 for bias (on) devices. As outlined in the Test Plan, four groups of two devices were exposed to 50 Krads steps. Figure 1 shows the breakdown voltages of each channel in the four bias (on) hybrids (sn# 4,6,10,11). The IRH57110 MOSFET is used as the output stage in each channel of the hybrid. The graph indicates the four radiation levels with pre and post radiation bars that represent the effects of TID. Also included in the graph is the control device, which is used as the baseline

point. Notice that there is degradation in the breakdown voltage for each channel as radiation increases, however it is negligible since each device is still within its parametric specification limits. In Figure 2, the  $R_{dson}$  was also captured for all eight channels of each hybrid. The  $R_{dson}$  increased with radiation, but was still within specifications at 200 Krads. The voltage threshold on the IRH57110 increased with radiation, coupled with the degradation of the gate drive voltage from the optocoupler, resulted in a change in  $T_{on}$  and  $T_{off}$  as shown in Figures 3 and 4.

Four additional hybrids (sn# 15,16,25,27) were also irradiated at the same time with bias (off) applied. The test results are shown graphically in Figures 5 thru 8. Note that the degradation in the breakdown voltage was greater (see Figure 5) than the bias (on) devices (see Figure 1). In addition,  $R_{dson}$ ,  $T_{on}$  and  $T_{off}$  experienced similar increases respectively as compared to the bias (on) devices. All devices did remain within their parametric specification range.

## **SUMMARY**

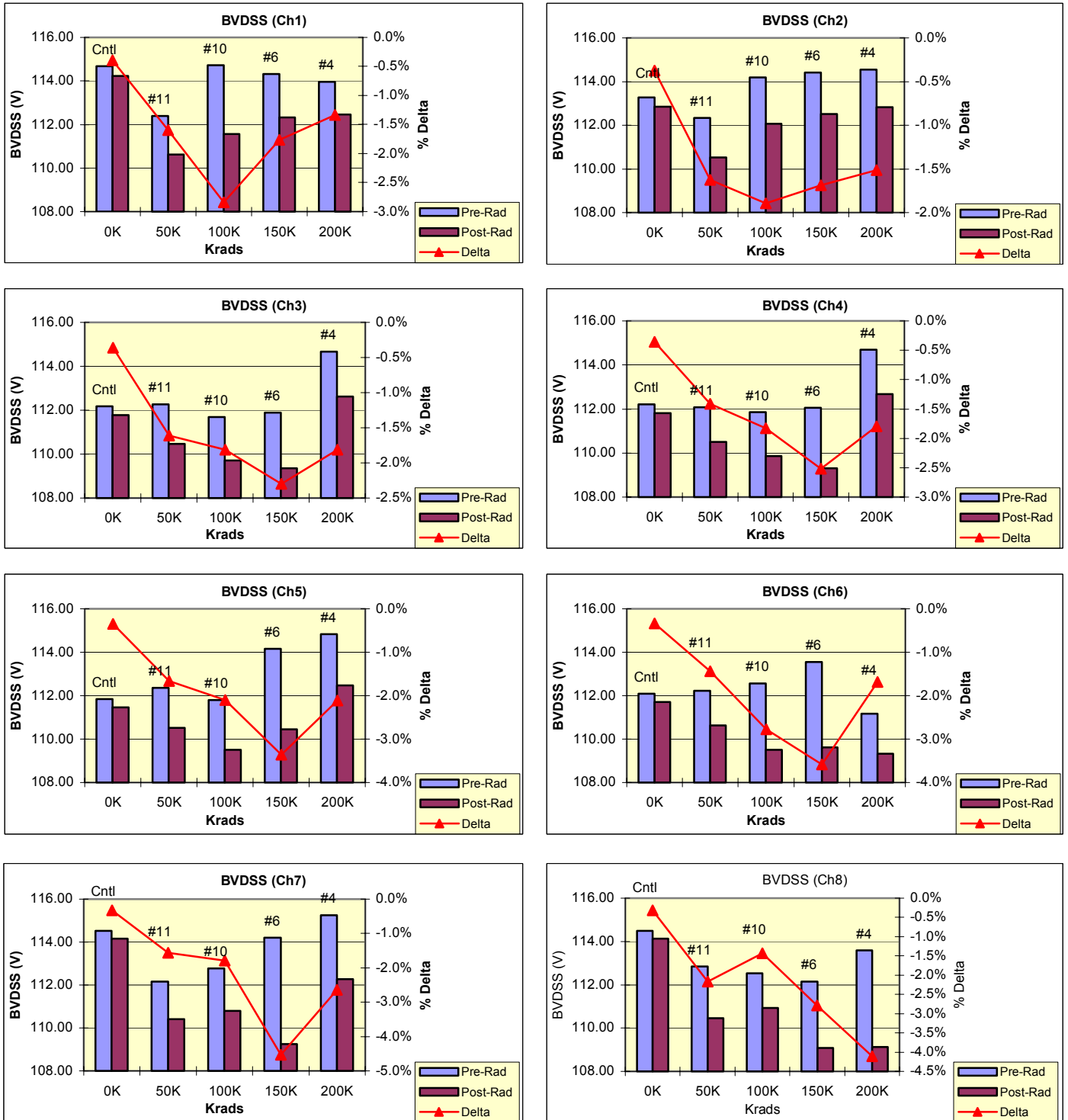
For Bias Condition A (see Appendix A), all devices passed parametric tests up to 200 Krads. Breakdown voltage (bias-on) had a maximum change of approximately 3% (see Figure 1) over the total dose spectrum while the Drain to Source resistance ( $R_{dson}$ ) increased approximately 4% (see Figure 2).  $T_{on}$  and  $T_{off}$  were affected primarily by the degradation of the optocoupler output drive voltage and the increase in the gate voltage threshold of the MOSFET.

For Bias Condition B (see Appendix A), all devices passed parametric tests up to 200 Krads, however, as noted in Figures 5 thru 8, all tests show an increase in degradation when compared to the bias-on devices. Breakdown voltage had a maximum change of approximately 8% (see Figure 5) while Drain to Source resistance ( $R_{dson}$ ) was approximately 3%.  $T_{on}$  and  $T_{off}$  (see Figures 7 & 8) show less degradation in the bias (off) state. Overall, the "worst case" performance for these devices is the Bias (Off) state.

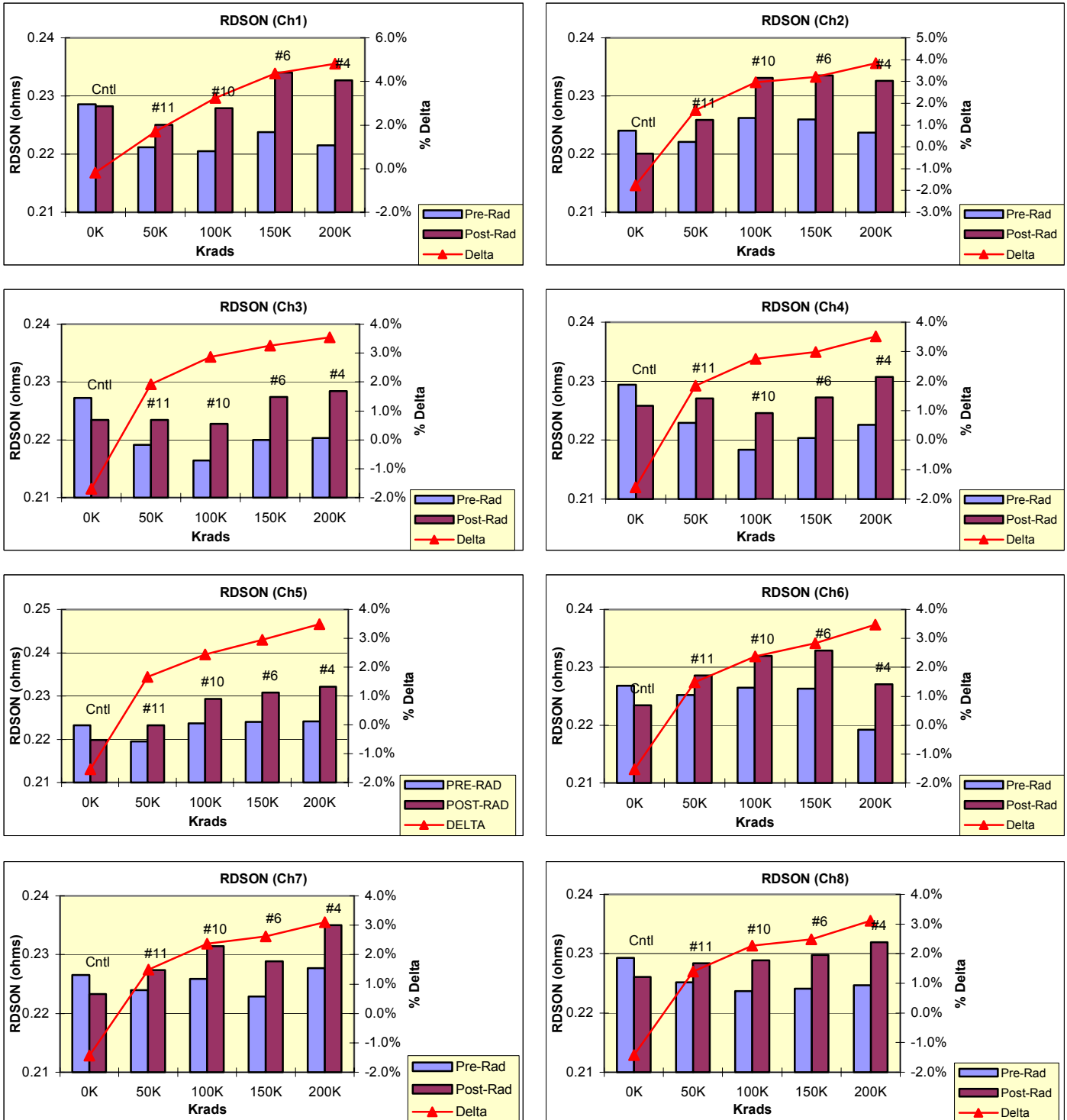
## **CONCLUSION**

The performance of IR's RDHA701FP10A8CK Solid State Relay has demonstrated a strong degree of hardness to TID radiation. Devices in an bias(off) state, when exposed ionizing irradiation, appear to have the worst-case performance. The radiation sensitive key parameters are Breakdown voltage and Output current. All parameters passed their post radiation specifications and limits.

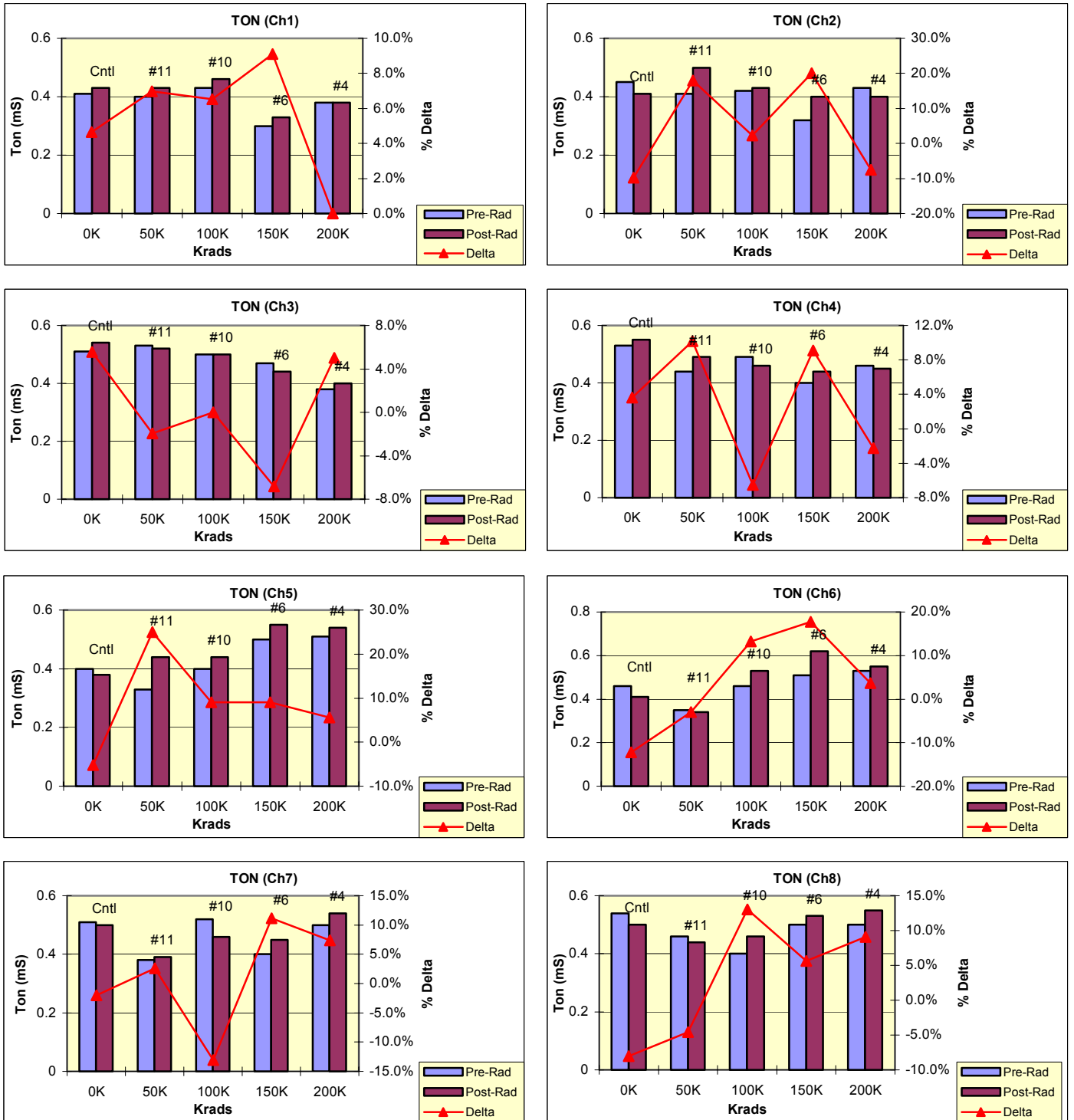
**Figure 1 (bias-on)**



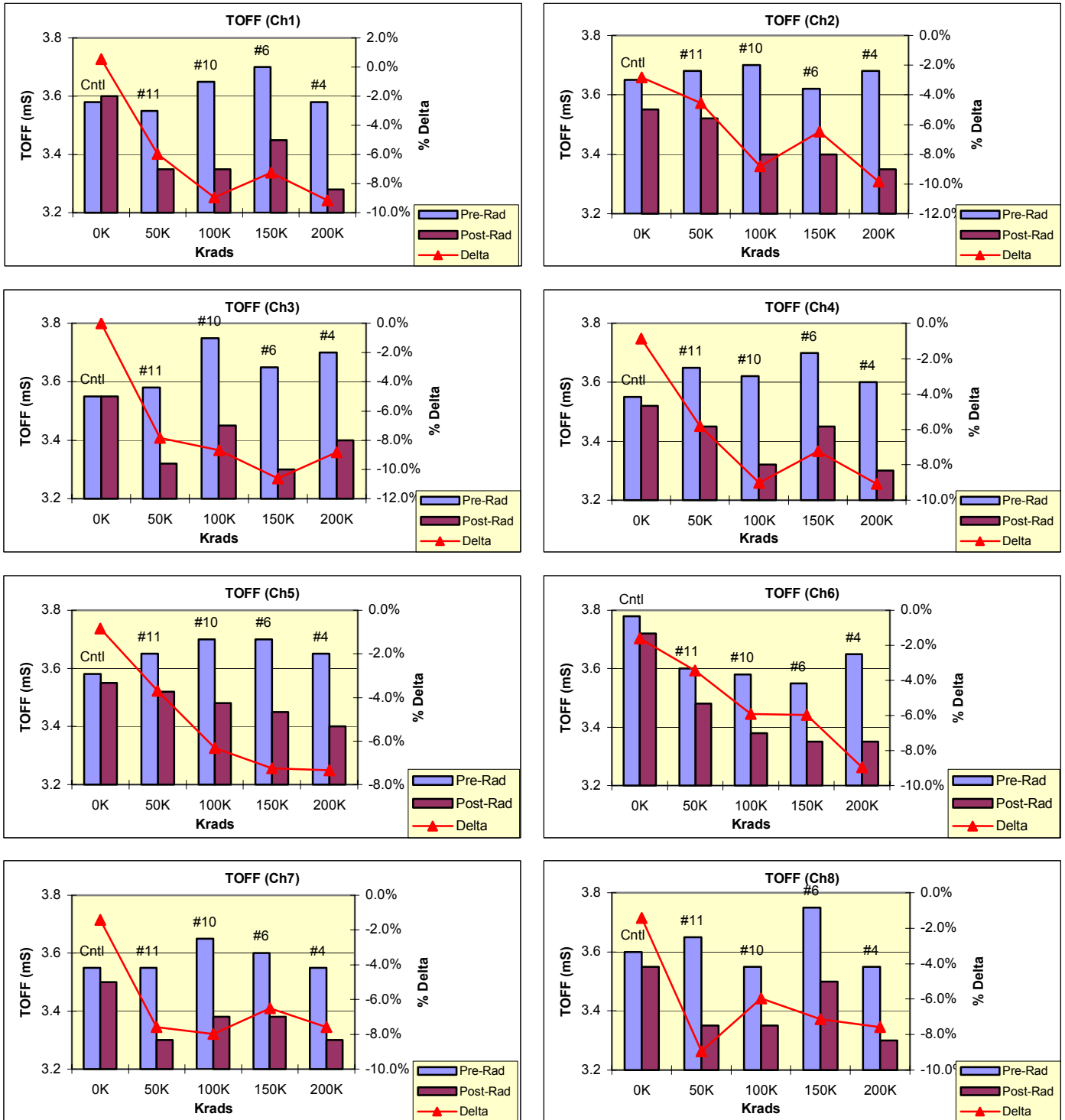
**Figure 2 (bias-on)**



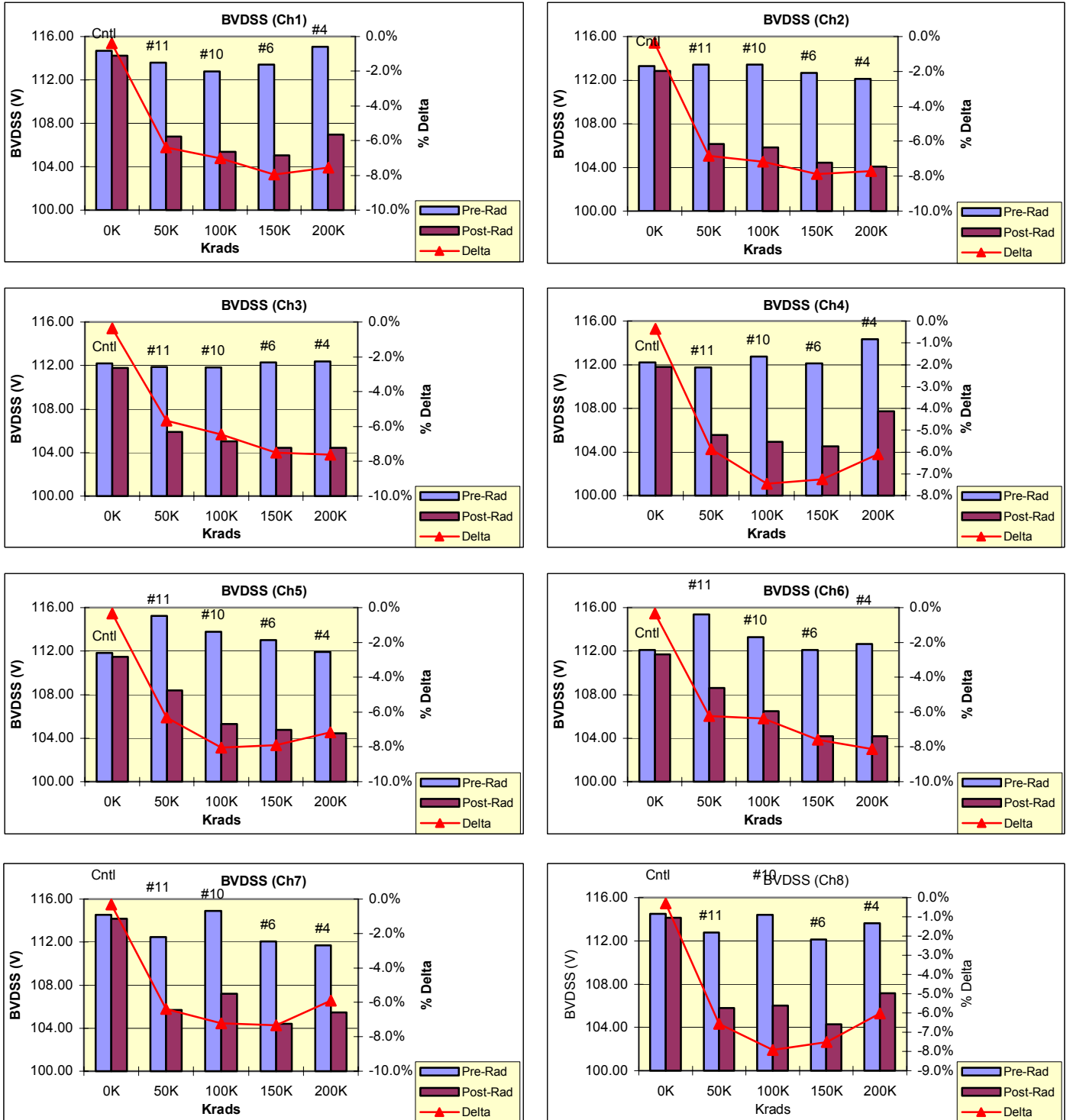
**Figure 3 (bias-on)**



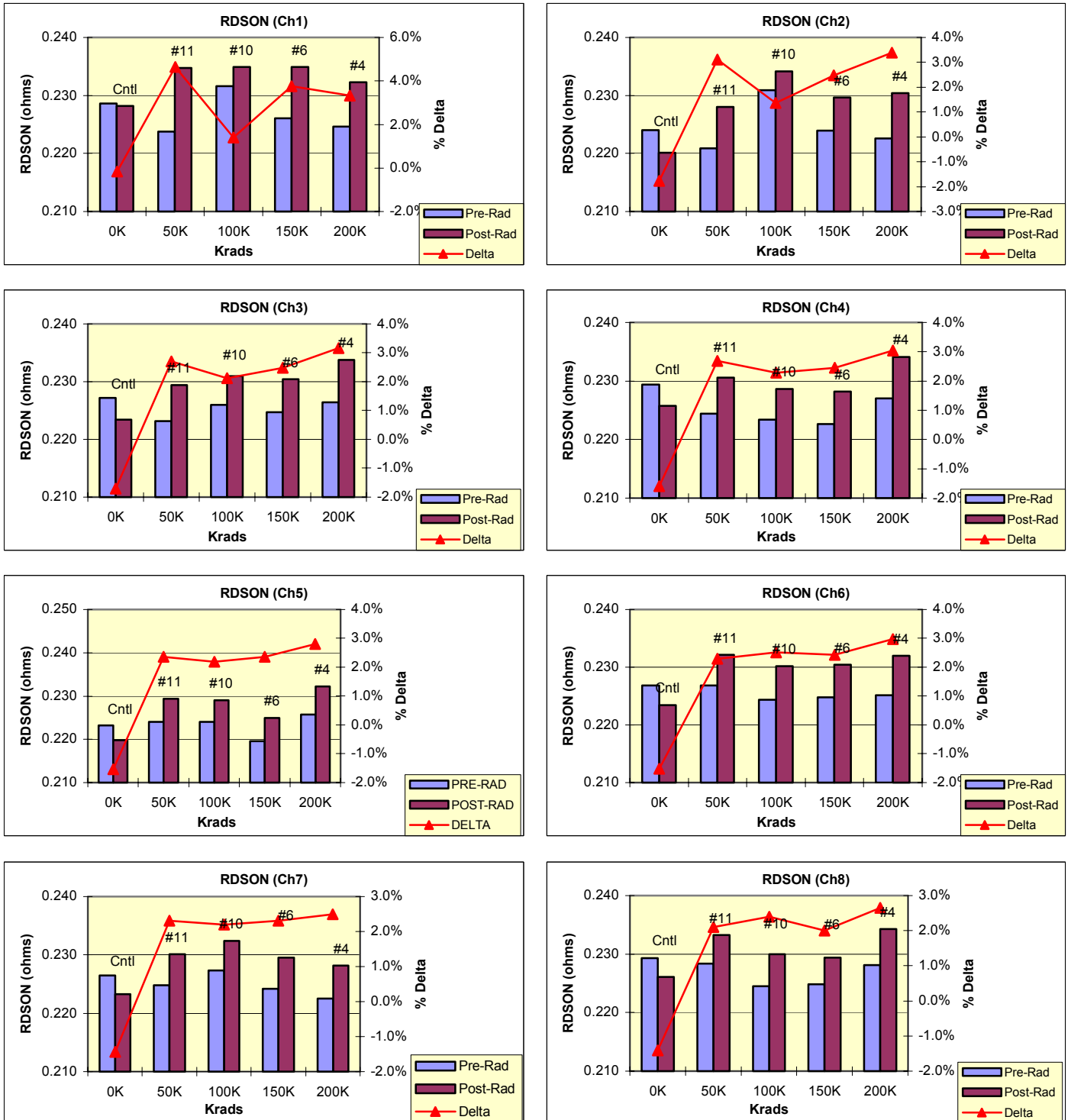
**Figure 4 (bias-on)**



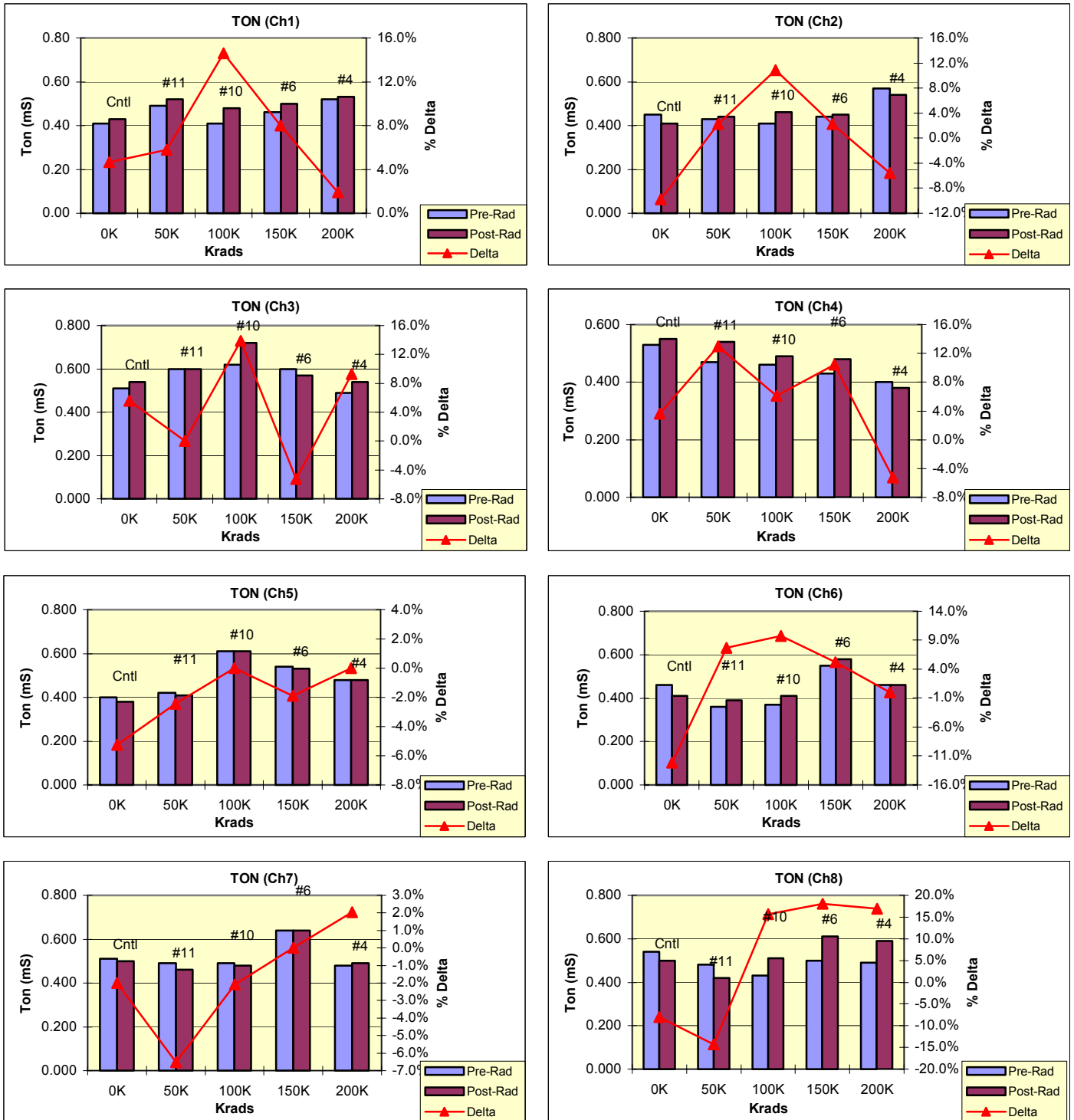
**Figure 5 (bias-off)**



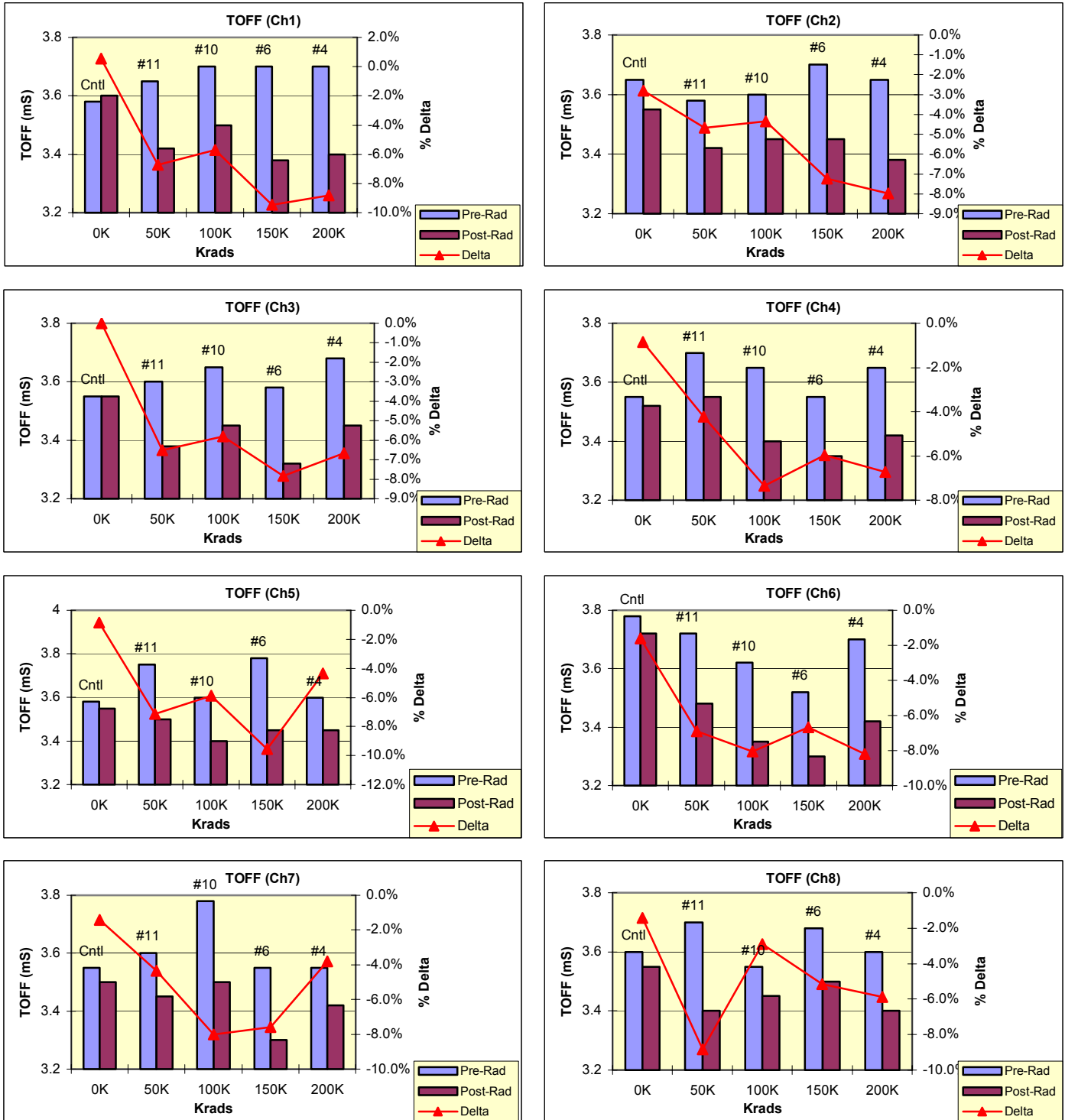
**Figure 6 (bias-off)**



**Figure 7 (bias-off)**



**Figure 8 (bias-off)**



# Appendix A

## Electrical Data

## Bias Condition A (bias-on)

### Channel 1

T#1 BVDSS (channel #1)								T#2 RDSON (channel #1)									
Condition:		ID= 1mA			Limits		U / M	% Delta	Condition:		ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max	Min			Max	Serial #	PRE	POST	KRADS	Min	Max		
CTRL	114.69	114.24	0K	100	150	V	-0.4%	CTRL	0.229	0.228	0K	0.1	0.61	ohms	-0.2%		
11	112.40	110.63	50K	100	150	V	-1.6%	11	0.221	0.225	50K	0.1	0.61	ohms	1.7%		
10	114.72	111.56	100K	100	150	V	-2.8%	10	0.221	0.228	100K	0.1	0.61	ohms	3.2%		
6	114.32	112.33	150K	100	150	V	-1.8%	6	0.224	0.234	150K	0.1	0.61	ohms	4.4%		
4	113.96	112.45	200K	100	150	V	-1.3%	4	0.222	0.233	200K	0.1	0.61	ohms	4.8%		
Min	112.40	110.63					-2.8%	Min	0.221	0.225					1.7%		
Avg	113.85	111.74					-1.9%	Avg	0.222	0.230					3.5%		
Max	114.72	112.45					-1.3%	Max	0.224	0.234					4.8%		
T#3 IOOUT OFF (channel #1)								T#4 TON (channel #1)									
Condition:		VOUT = 80V			Limits		U / M	% Delta	Condition:		PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max	Min			Max	Serial #	PRE	POST	KRADS	Min	Max		
CTRL	5.51	9.46	0K	-10	25000	nA	41.8%	CTRL	0.410	0.430	0K	0	15	mS	4.7%		
11	4.94	10.09	50K	-10	25000	nA	51.0%	11	0.400	0.430	50K	0	15	mS	7.0%		
10	4.93	10.66	100K	-10	25000	nA	53.7%	10	0.430	0.460	100K	0	15	mS	6.5%		
6	5.15	11.43	150K	-10	25000	nA	55.0%	6	0.300	0.330	150K	0	15	mS	9.1%		
4	5.28	11.84	200K	-10	25000	nA	55.4%	4	0.380	0.380	200K	0	15	mS	0.0%		
Min	4.93	10.09					51.0%	Min	0.300	0.330					0.0%		
Avg	5.08	11.01					53.8%	Avg	0.378	0.400					5.6%		
Max	5.28	11.84					55.4%	Max	0.430	0.460					9.1%		
T#5 TOFF (channel #1)								T#6 VF (channel #1)									
Condition:		Iin=0A, Iout=.8A			Limits		U / M	% Delta	Condition:		Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max	Min			Max	Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.58	3.60	0K	0.5	50	mS	0.6%	CTRL	1.316	1.321	0K	1	1.8	V	0.4%		
11	3.55	3.35	50K	0.5	50	mS	-6.0%	11	1.309	1.306	50K	1	1.8	V	-0.2%		
10	3.65	3.35	100K	0.5	50	mS	-9.0%	10	1.316	1.300	100K	1	1.8	V	-1.3%		
6	3.70	3.45	150K	0.5	50	mS	-7.2%	6	1.316	1.310	150K	1	1.8	V	-0.4%		
4	3.58	3.28	200K	0.5	50	mS	-9.1%	4	1.293	1.287	200K	1	1.8	V	-0.5%		
Min	3.55	3.28					-9.1%	Min	1.293	1.287					-1.3%		
Avg	3.62	3.36					-7.8%	Avg	1.308	1.301					-0.6%		
Max	3.70	3.45					-6.0%	Max	1.316	1.310					-0.2%		

## Channel 2

T#7 BVDSS (channel #2)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	113.27	112.84	0K	100	150	V	-0.4%
11	112.33	110.54	50K	100	150	V	-1.6%
10	114.19	112.07	100K	100	150	V	-1.9%
6	114.42	112.52	150K	100	150	V	-1.7%
4	114.55	112.84	200K	100	150	V	-1.5%
Min	112.33	110.54					-1.9%
Avg	113.87	111.99					-1.7%
Max	114.55	112.84					-1.5%
T#9 IOU OFF (channel #2)							
Condition:	VOU = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	4.87	9.03	0K	-10	25000	nA	46.0%
11	4.83	9.69	50K	-10	25000	nA	50.2%
10	4.67	10.14	100K	-10	25000	nA	54.0%
6	4.79	11.00	150K	-10	25000	nA	56.5%
4	4.69	11.39	200K	-10	25000	nA	58.8%
Min	4.67	9.69					50.2%
Avg	4.74	10.56					54.9%
Max	4.83	11.39					58.8%
T#11 TOFF (channel #2)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.65	3.55	0K	0.5	50	mS	-2.8%
11	3.68	3.52	50K	0.5	50	mS	-4.5%
10	3.7	3.4	100K	0.5	50	mS	-8.8%
6	3.62	3.4	150K	0.5	50	mS	-6.5%
4	3.68	3.35	200K	0.5	50	mS	-9.9%
Min	3.62	3.35					-9.9%
Avg	3.67	3.42					-7.4%
Max	3.70	3.52					-4.5%
T#8 RDSON (channel #2)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.224	0.220	0K	0.1	0.61	ohms	-1.8%
11	0.222	0.226	50K	0.1	0.61	ohms	1.7%
10	0.226	0.233	100K	0.1	0.61	ohms	3.0%
6	0.226	0.234	150K	0.1	0.61	ohms	3.2%
4	0.224	0.233	200K	0.1	0.61	ohms	3.8%
Min	0.222	0.226					1.7%
Avg	0.225	0.231					2.9%
Max	0.226	0.234					3.8%
T#10 TON (channel #2)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.450	0.410	0K	0	15	mS	-9.8%
11	0.410	0.500	50K	0	15	mS	18.0%
10	0.420	0.430	100K	0	15	mS	2.3%
6	0.320	0.400	150K	0	15	mS	20.0%
4	0.430	0.400	200K	0	15	mS	-7.5%
Min	0.320	0.400					-7.5%
Avg	0.395	0.433					8.2%
Max	0.430	0.500					20.0%
T#12 VF (channel #2)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.299	1.305	0K	1	1.8	V	0.4%
11	1.316	1.310	50K	1	1.8	V	-0.4%
10	1.303	1.297	100K	1	1.8	V	-0.4%
6	1.326	1.320	150K	1	1.8	V	-0.5%
4	1.287	1.282	200K	1	1.8	V	-0.4%
Min	1.287	1.282					-0.5%
Avg	1.308	1.302					-0.4%
Max	1.326	1.320					-0.4%

**(Channel 3)**

T#13 BVDSS (channel #3)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	112.18	111.78	0K	100	150	V	-0.4%
11	112.26	110.47	50K	100	150	V	-1.6%
10	111.69	109.70	100K	100	150	V	-1.8%
6	111.88	109.37	150K	100	150	V	-2.3%
4	114.66	112.62	200K	100	150	V	-1.8%
Min	111.69	109.37					-2.3%
Avg	112.62	110.54					-1.9%
Max	114.66	112.62					-1.6%
T#15 IOU OFF (channel #3)							
Condition:	VOU = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	4.03	7.90	0K	-10	25000	nA	48.9%
11	3.78	8.62	50K	-10	25000	nA	56.1%
10	3.85	9.19	100K	-10	25000	nA	58.1%
6	4.05	9.95	150K	-10	25000	nA	59.4%
4	4.12	10.39	200K	-10	25000	nA	60.3%
Min	3.78	8.62					56.1%
Avg	3.95	9.54					58.5%
Max	4.12	10.39					60.3%
T#17 TOFF (channel #3)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.55	3.55	0K	0.5	50	mS	0.0%
11	3.58	3.32	50K	0.5	50	mS	-7.8%
10	3.75	3.45	100K	0.5	50	mS	-8.7%
6	3.65	3.3	150K	0.5	50	mS	-10.6%
4	3.7	3.4	200K	0.5	50	mS	-8.8%
Min	3.58	3.30					-10.6%
Avg	3.67	3.37					-9.0%
Max	3.75	3.45					-7.8%
T#14 RDSON (channel #3)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.227	0.223	0K	0.1	0.61	ohms	-1.7%
11	0.219	0.223	50K	0.1	0.61	ohms	1.9%
10	0.216	0.223	100K	0.1	0.61	ohms	2.9%
6	0.220	0.227	150K	0.1	0.61	ohms	3.3%
4	0.220	0.228	200K	0.1	0.61	ohms	3.5%
Min	0.216	0.223					1.9%
Avg	0.219	0.226					2.9%
Max	0.220	0.228					3.5%
T#16 TON (channel #3)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.510	0.540	0K	0	15	mS	5.6%
11	0.530	0.520	50K	0	15	mS	-1.9%
10	0.500	0.500	100K	0	15	mS	0.0%
6	0.470	0.440	150K	0	15	mS	-6.8%
4	0.380	0.400	200K	0	15	mS	5.0%
Min	0.380	0.400					-6.8%
Avg	0.470	0.465					-0.9%
Max	0.530	0.520					5.0%
T#18 VF (channel #3)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.344	1.351	0K	1	1.8	V	0.5%
11	1.298	1.296	50K	1	1.8	V	-0.1%
10	1.299	1.295	100K	1	1.8	V	-0.3%
6	1.309	1.303	150K	1	1.8	V	-0.4%
4	1.295	1.291	200K	1	1.8	V	-0.4%
Min	1.295	1.291					-0.4%
Avg	1.300	1.296					-0.3%
Max	1.309	1.303					-0.1%

**(Channel 4)**

T#19		BVDSS (channel #4)						
Condition:		ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	112.21	111.81	0K	100	150	V	-0.4%	
11	112.07	110.51	50K	100	150	V	-1.4%	
10	111.86	109.85	100K	100	150	V	-1.8%	
6	112.06	109.31	150K	100	150	V	-2.5%	
4	114.69	112.67	200K	100	150	V	-1.8%	
Min	111.86	109.31					-2.5%	
Avg	112.67	110.59					-1.9%	
Max	114.69	112.67					-1.4%	
T#21		IOUT OFF (channel #4)						
Condition:		VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	3.33	6.45	0K	0.5	50	mS	48.3%	
11	3.01	7.14	50K	0.5	50	mS	57.9%	
10	3.11	7.65	100K	0.5	50	mS	59.4%	
6	3.31	8.28	150K	0.5	50	mS	60.0%	
4	3.42	8.71	200K	0.5	50	mS	60.7%	
Min	3.01	7.14					57.9%	
Avg	3.21	7.94					59.5%	
Max	3.42	8.71					60.7%	
T#23		TOFF (channel #4)						
Condition:		Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	3.55	3.52	0K	0.5	50	mS	-0.9%	
11	3.65	3.45	50K	0.5	50	mS	-5.8%	
10	3.62	3.32	100K	0.5	50	mS	-9.0%	
6	3.7	3.45	150K	0.5	50	mS	-7.2%	
4	3.6	3.3	200K	0.5	50	mS	-9.1%	
Min	3.60	3.30					-9.1%	
Avg	3.64	3.38					-7.8%	
Max	3.70	3.45					-5.8%	
T#20		RDSON (channel #4)						
Condition:		ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	0.229	0.226	0K	0.1	0.61	ohms	-1.6%	
11	0.223	0.227	50K	0.1	0.61	ohms	1.8%	
10	0.218	0.225	100K	0.1	0.61	ohms	2.8%	
6	0.220	0.227	150K	0.1	0.61	ohms	3.0%	
4	0.223	0.231	200K	0.1	0.61	ohms	3.5%	
Min	0.218	0.225					1.8%	
Avg	0.221	0.227					2.8%	
Max	0.223	0.231					3.5%	
T#22		TON (channel #4)						
Condition:		PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	0.530	0.550	0K	0	15	mS	3.6%	
11	0.440	0.490	50K	0	15	mS	10.2%	
10	0.490	0.460	100K	0	15	mS	-6.5%	
6	0.400	0.440	150K	0	15	mS	9.1%	
4	0.460	0.450	200K	0	15	mS	-2.2%	
Min	0.400	0.440					-6.5%	
Avg	0.448	0.460					2.6%	
Max	0.490	0.490					10.2%	
T#24		VF (channel #4)						
Condition:		Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	1.313	1.319	0K	1	1.8	V	0.4%	
11	1.293	1.292	50K	1	1.8	V	-0.1%	
10	1.311	1.307	100K	1	1.8	V	-0.3%	
6	1.316	1.311	150K	1	1.8	V	-0.4%	
4	1.294	1.290	200K	1	1.8	V	-0.3%	
Min	1.293	1.290					-0.4%	
Avg	1.303	1.300					-0.2%	
Max	1.316	1.311					-0.1%	

**(Channel 5)**

T#25		BVDSS (channel #5)						
Condition:		ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	111.85	111.47	0K	100	150	V	-0.3%	
11	112.35	110.51	50K	100	150	V	-1.7%	
10	111.79	109.50	100K	100	150	V	-2.1%	
6	114.16	110.46	150K	100	150	V	-3.4%	
4	114.83	112.46	200K	100	150	V	-2.1%	
Min	111.79	109.50					-3.4%	
Avg	113.29	110.73					-2.3%	
Max	114.83	112.46					-1.7%	
T#27		IOU OFF (channel #5)						
Condition:		VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	3.05	5.59	0K	-10	25000	nA	45.4%	
11	295.33	6.30	50K	-10	25000	nA	-4591.2%	
10	3.16	6.67	100K	-10	25000	nA	52.6%	
6	3.26	7.44	150K	-10	25000	nA	56.2%	
4	3.29	7.94	200K	-10	25000	nA	58.6%	
Min	3.16	6.30					-4591.2%	
Avg	76.26	7.09					-1105.9%	
Max	295.33	7.94					58.6%	
T#29		TOFF (channel #5)						
Condition:		Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	3.58	3.55	0K	0.5	50	mS	-0.8%	
11	3.65	3.52	50K	0.5	50	mS	-3.7%	
10	3.7	3.48	100K	0.5	50	mS	-6.3%	
6	3.7	3.45	150K	0.5	50	mS	-7.2%	
4	3.65	3.4	200K	0.5	50	mS	-7.4%	
Min	3.65	3.40					-7.4%	
Avg	3.68	3.46					-6.2%	
Max	3.70	3.52					-3.7%	
T#26		RDSON (channel #5)						
Condition:		ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	0.223	0.220	0K	0.1	0.61	ohms	-1.5%	
11	0.220	0.223	50K	0.1	0.61	ohms	1.7%	
10	0.224	0.229	100K	0.1	0.61	ohms	2.4%	
6	0.224	0.231	150K	0.1	0.61	ohms	2.9%	
4	0.224	0.232	200K	0.1	0.61	ohms	3.5%	
Min	0.220	0.223					1.7%	
Avg	0.223	0.229					2.6%	
Max	0.224	0.232					3.5%	
T#28		TON (channel #5)						
Condition:		PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	0.400	0.380	0K	0	15	mS	-5.3%	
11	0.330	0.440	50K	0	15	mS	25.0%	
10	0.400	0.440	100K	0	15	mS	9.1%	
6	0.500	0.550	150K	0	15	mS	9.1%	
4	0.510	0.540	200K	0	15	mS	5.6%	
Min	0.330	0.440					5.6%	
Avg	0.435	0.493					12.2%	
Max	0.510	0.550					25.0%	
T#30		VF (channel #5)						
Condition:		Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max			
CTRL	1.316	1.322	0K	1	1.8	V	0.4%	
11	1.333	1.332	50K	1	1.8	V	-0.1%	
10	1.298	1.296	100K	1	1.8	V	-0.2%	
6	1.309	1.305	150K	1	1.8	V	-0.3%	
4	1.285	1.281	200K	1	1.8	V	-0.3%	
Min	1.285	1.281					-0.3%	
Avg	1.306	1.303					-0.2%	
Max	1.333	1.332					-0.1%	

**(Channel 6)**

T#31 BVDSS (channel #6)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	112.09	111.71	0K	100	150	V	-0.3%
11	112.22	110.63	50K	100	150	V	-1.4%
10	112.56	109.52	100K	100	150	V	-2.8%
6	113.55	109.62	150K	100	150	V	-3.6%
4	111.17	109.32	200K	100	150	V	-1.7%
Min	111.17	109.32					-3.6%
Avg	112.37	109.77					-2.4%
Max	113.55	110.63					-1.4%
T#33 IOUT OFF (channel #6)							
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	2.85	5.62	0K	-10	25000	nA	49.2%
11	287.61	6.18	50K	-10	25000	nA	-4552.2%
10	3.31	6.67	100K	-10	25000	nA	50.4%
6	3.36	7.40	150K	-10	25000	nA	54.6%
4	3.42	7.81	200K	-10	25000	nA	56.3%
Min	3.31	6.18					-4552.2%
Avg	74.42	7.02					-1097.7%
Max	287.61	7.81					56.3%
T#35 TOFF (channel #6)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.78	3.72	0K	0.5	50	mS	-1.6%
11	3.6	3.48	50K	0.5	50	mS	-3.4%
10	3.58	3.38	100K	0.5	50	mS	-5.9%
6	3.55	3.35	150K	0.5	50	mS	-6.0%
4	3.65	3.35	200K	0.5	50	mS	-9.0%
Min	3.55	3.35					-9.0%
Avg	3.60	3.39					-6.1%
Max	3.65	3.48					-3.4%
T#32 RDSON (channel #6)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.227	0.223	0K	0.1	0.61	ohms	-1.5%
11	0.225	0.229	50K	0.1	0.61	ohms	1.5%
10	0.227	0.232	100K	0.1	0.61	ohms	2.4%
6	0.226	0.233	150K	0.1	0.61	ohms	2.8%
4	0.219	0.227	200K	0.1	0.61	ohms	3.5%
Min	0.219	0.227					1.5%
Avg	0.224	0.230					2.5%
Max	0.227	0.233					3.5%
T#34 TON (channel #6)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.460	0.410	0K	0	15	mS	-12.2%
11	0.350	0.340	50K	0	15	mS	-2.9%
10	0.460	0.530	100K	0	15	mS	13.2%
6	0.510	0.620	150K	0	15	mS	17.7%
4	0.530	0.550	200K	0	15	mS	3.6%
Min	0.350	0.340					-2.9%
Avg	0.463	0.510					7.9%
Max	0.530	0.620					17.7%
T#36 VF (channel #6)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.346	1.353	0K	1	1.8	V	0.5%
11	1.327	1.327	50K	1	1.8	V	0.0%
10	1.319	1.314	100K	1	1.8	V	-0.4%
6	1.333	1.329	150K	1	1.8	V	-0.3%
4	1.288	1.285	200K	1	1.8	V	-0.2%
Min	1.288	1.285					-0.4%
Avg	1.317	1.314					-0.2%
Max	1.333	1.329					0.0%

**(Channel 7)**

T#37 BVDSS (channel #7)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	114.53	114.16	0K	100	150	V	-0.3%
11	112.15	110.42	50K	100	150	V	-1.6%
10	112.76	110.79	100K	100	150	V	-1.8%
6	114.21	109.25	150K	100	150	V	-4.5%
4	115.24	112.27	200K	100	150	V	-2.6%
Min	112.15	109.25					-4.5%
Avg	113.59	110.68					-2.6%
Max	115.24	112.27					-1.6%
T#39 IOOUT OFF (channel #7)							
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	2.17	3.44	0K	-10	25000	Na	37.0%
11	17.84	4.07	50K	-10	25000	Na	-338.8%
10	2.44	4.55	100K	-10	25000	Na	46.4%
6	2.67	5.49	150K	-10	25000	Na	51.3%
4	2.46	5.85	200K	-10	25000	Na	57.9%
Min	2.44	4.07					-338.8%
Avg	6.35	4.99					-45.8%
Max	17.84	5.85					57.9%
T#41 TOFF (channel #7)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.55	3.5	0K	0.5	50	mS	-1.4%
11	3.55	3.3	50K	0.5	50	mS	-7.6%
10	3.65	3.38	100K	0.5	50	mS	-8.0%
6	3.6	3.38	150K	0.5	50	mS	-6.5%
4	3.55	3.3	200K	0.5	50	mS	-7.6%
Min	3.55	3.30					-8.0%
Avg	3.59	3.34					-7.4%
Max	3.65	3.38					-6.5%
T#38 RDSON (channel #7)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.227	0.223	0K	0.1	0.61	ohms	-1.4%
11	0.224	0.227	50K	0.1	0.61	ohms	1.5%
10	0.226	0.231	100K	0.1	0.61	ohms	2.4%
6	0.223	0.229	150K	0.1	0.61	ohms	2.6%
4	0.228	0.235	200K	0.1	0.61	ohms	3.1%
Min	0.223	0.227					1.5%
Avg	0.225	0.231					2.4%
Max	0.228	0.235					3.1%
T#40 TON (channel #7)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.510	0.500	0K	0	15	mS	-2.0%
11	0.380	0.390	50K	0	15	mS	2.6%
10	0.520	0.460	100K	0	15	mS	-13.0%
6	0.400	0.450	150K	0	15	mS	11.1%
4	0.500	0.540	200K	0	15	mS	7.4%
Min	0.380	0.390					-13.0%
Avg	0.450	0.460					2.0%
Max	0.520	0.540					11.1%
T#42 VF (channel #7)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.322	1.327	0K	1	1.8	V	0.4%
11	1.338	1.338	50K	1	1.8	V	0.0%
10	1.308	1.302	100K	1	1.8	V	-0.5%
6	1.343	1.339	150K	1	1.8	V	-0.3%
4	1.292	1.289	200K	1	1.8	V	-0.2%
Min	1.292	1.289					-0.5%
Avg	1.320	1.317					-0.3%
Max	1.343	1.339					0.0%

**(Channel 8)**

T#43 BVDSS (channel #8)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	114.50	114.14	0K	100	150	V	-0.3%
11	112.85	110.46	50K	100	150	V	-2.2%
10	112.52	110.93	100K	100	150	V	-1.4%
6	112.14	109.09	150K	100	150	V	-2.8%
4	113.60	109.12	200K	100	150	V	-4.1%
Min	112.14	109.09					-4.1%
Avg	112.78	109.90					-2.6%
Max	113.60	110.93					-1.4%
T#45 IOU OFF (channel #8)							
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	2.04	3.42	0K	-10	25000	nA	40.4%
11	13.68	4.11	50K	-10	25000	nA	-233.0%
10	2.53	4.50	100K	-10	25000	nA	43.9%
6	2.52	5.46	150K	-10	25000	nA	53.9%
4	2.57	6.03	200K	-10	25000	nA	57.3%
Min	2.52	4.11					-233.0%
Avg	5.33	5.02					-19.5%
Max	13.68	6.03					57.3%
T#44 RDSON (channel #8)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.2293	0.226	0K	0.1	0.61	ohms	-1.4%
11	0.2252	0.228	50K	0.1	0.61	ohms	1.4%
10	0.2237	0.229	100K	0.1	0.61	ohms	2.3%
6	0.2241	0.230	150K	0.1	0.61	ohms	2.5%
4	0.2247	0.232	200K	0.1	0.61	ohms	3.1%
Min	0.224	0.228					1.4%
Avg	0.224	0.230					2.3%
Max	0.225	0.232					3.1%
T#46 TON (channel #8)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.540	0.500	0K	0	15	mS	-8.0%
11	0.460	0.440	50K	0	15	mS	-4.5%
10	0.400	0.460	100K	0	15	mS	13.0%
6	0.500	0.530	150K	0	15	mS	5.7%
4	0.500	0.550	200K	0	15	mS	9.1%
Min	0.400	0.440					-4.5%
Avg	0.465	0.495					5.8%
Max	0.500	0.550					13.0%
T#47 TOFF(channel #8)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.6	3.55	0K	0.5	50	mS	-1.4%
11	3.65	3.35	50K	0.5	50	mS	-9.0%
10	3.55	3.35	100K	0.5	50	mS	-6.0%
6	3.75	3.5	150K	0.5	50	mS	-7.1%
4	3.55	3.3	200K	0.5	50	mS	-7.6%
Min	3.55	3.30					-9.0%
Avg	3.63	3.38					-7.4%
Max	3.75	3.50					-6.0%
T#48 VF (channel #8)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.286	1.289	0K	1	1.8	V	0.3%
11	1.332	1.331	50K	1	1.8	V	0.0%
10	1.329	1.322	100K	1	1.8	V	-0.5%
6	1.296	1.293	150K	1	1.8	V	-0.2%
4	1.286	1.283	200K	1	1.8	V	-0.2%
Min	1.286	1.283					-0.5%
Avg	1.311	1.307					-0.3%
Max	1.332	1.331					0.0%

## Biased Condition B (bias-off)

### (Channel 1)

T#1	BVDSS (channel #1)						
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	114.69	114.24	0K	100	150	V	-0.4%
27	113.59	106.77	50K	100	150	V	-6.4%
25	112.76	105.36	100K	100	150	V	-7.0%
16	113.39	105.03	150K	100	150	V	-8.0%
15	115.05	106.97	200K	100	150	V	-7.5%
Min	112.76	105.03					-8.0%
Avg	113.70	106.03					-7.2%
Max	115.05	106.97					-6.4%
T#3	IOOUT OFF (channel #1)						
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	5.51	9.46	0K	-10	25000	nA	41.8%
27	5.39	9.80	50K	-10	25000	nA	45.0%
25	4.98	10.11	100K	-10	25000	nA	50.7%
16	5.35	10.22	150K	-10	25000	nA	47.7%
15	5.25	10.82	200K	-10	25000	nA	51.5%
Min	4.98	9.80					45.0%
Avg	5.24	10.24					48.7%
Max	5.39	10.82					51.5%
T#5	TOFF (channel #1)						
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.58	3.6	0K	0.5	50	mS	0.6%
27	3.65	3.42	50K	0.5	50	mS	-6.7%
25	3.7	3.5	100K	0.5	50	mS	-5.7%
16	3.7	3.38	150K	0.5	50	mS	-9.5%
15	3.7	3.4	200K	0.5	50	mS	-8.8%
Min	3.65	3.38					-9.5%
Avg	3.69	3.43					-7.7%
Max	3.70	3.50					-5.7%
T#2	RDSON (channel #1)						
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.229	0.228	0K	0.1	0.61	ohms	-0.2%
27	0.224	0.235	50K	0.1	0.61	ohms	4.6%
25	0.232	0.235	100K	0.1	0.61	ohms	1.4%
16	0.226	0.235	150K	0.1	0.61	ohms	3.7%
15	0.225	0.232	200K	0.1	0.61	ohms	3.3%
Min	0.224	0.232					1.4%
Avg	0.227	0.234					3.3%
Max	0.232	0.235					4.6%
T#4	TON (channel #1)						
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.410	0.430	0K	0	15	mS	4.7%
27	0.490	0.520	50K	0	15	mS	5.8%
25	0.410	0.480	100K	0	15	mS	14.6%
16	0.460	0.500	150K	0	15	mS	8.0%
15	0.520	0.530	200K	0	15	mS	1.9%
Min	0.410	0.480					1.9%
Avg	0.470	0.508					7.6%
Max	0.520	0.530					14.6%
T#6	VF (channel #1)						
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.316	1.321	0K	1	1.8	V	0.4%
27	1.302	1.295	50K	1	1.8	V	-0.5%
25	1.305	1.305	100K	1	1.8	V	0.0%
16	1.276	1.274	150K	1	1.8	V	-0.2%
15	1.362	1.355	200K	1	1.8	V	-0.5%
Min	1.276	1.274					-0.5%
Avg	1.311	1.307					-0.3%
Max	1.362	1.355					0.0%

**(Channel 2)**

T#7	BVDSS (channel #2)						
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	113.27	112.84	0K	100	150	V	-0.4%
27	113.42	106.16	50K	100	150	V	-6.8%
25	113.44	105.84	100K	100	150	V	-7.2%
16	112.64	104.42	150K	100	150	V	-7.9%
15	112.10	104.07	200K	100	150	V	-7.7%
Min	112.10	104.07					-7.9%
Avg	112.90	105.12					-7.4%
Max	113.44	106.16					-6.8%
T#9	IOOUT OFF (channel #2)						
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	4.87	9.03	0K	-10	25000	nA	46.0%
27	4.84	9.31	50K	-10	25000	nA	48.0%
25	4.10	9.82	100K	-10	25000	nA	58.2%
16	4.71	9.89	150K	-10	25000	nA	52.4%
15	4.77	10.53	200K	-10	25000	nA	54.7%
Min	4.10	9.31					48.0%
Avg	4.61	9.89					53.3%
Max	4.84	10.53					58.2%
T#11	TOFF (channel #2)						
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.65	3.55	0K	0.5	50	mS	-2.8%
27	3.58	3.42	50K	0.5	50	mS	-4.7%
25	3.6	3.45	100K	0.5	50	mS	-4.3%
16	3.7	3.45	150K	0.5	50	mS	-7.2%
15	3.65	3.38	200K	0.5	50	mS	-8.0%
Min	3.58	3.38					-8.0%
Avg	3.63	3.43					-6.1%
Max	3.70	3.45					-4.3%

T#8	RDSON (channel #2)						
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.224	0.220	0K	0.1	0.61	ohms	-1.8%
27	0.221	0.228	50K	0.1	0.61	ohms	3.1%
25	0.231	0.234	100K	0.1	0.61	ohms	1.4%
16	0.224	0.230	150K	0.1	0.61	ohms	2.5%
15	0.223	0.230	200K	0.1	0.61	ohms	3.4%
Min	0.221	0.228					1.4%
Avg	0.225	0.231					2.6%
Max	0.231	0.234					3.4%
T#10	TON (channel #2)						
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.450	0.410	0K	0	15	mS	-9.8%
27	0.430	0.440	50K	0	15	mS	2.3%
25	0.410	0.460	100K	0	15	mS	10.9%
16	0.440	0.450	150K	0	15	mS	2.2%
15	0.570	0.540	200K	0	15	mS	-5.6%
Min	0.410	0.440					-5.6%
Avg	0.463	0.473					2.5%
Max	0.570	0.540					10.9%
T#12	VF (channel #2)						
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.299	1.305	0K	1	1.8	V	0.4%
27	1.292	1.287	50K	1	1.8	V	-0.4%
25	1.294	1.293	100K	1	1.8	V	-0.1%
16	1.335	1.332	150K	1	1.8	V	-0.2%
15	1.327	1.322	200K	1	1.8	V	-0.4%
Min	1.292	1.287					-0.4%
Avg	1.312	1.309					-0.3%
Max	1.335	1.332					-0.1%

**(Channel 3)**

T#13	BVDSS (channel #3)						
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	112.18	111.78	0K	100	150	V	-0.4%
27	111.86	105.87	50K	100	150	V	-5.7%
25	111.81	105.02	100K	100	150	V	-6.5%
16	112.26	104.43	150K	100	150	V	-7.5%
15	112.39	104.43	200K	100	150	V	-7.6%
Min	111.81	104.43					-7.6%
Avg	112.08	104.94					-6.8%
Max	112.39	105.87					-5.7%
T#15	IOU OFF (channel #3)						
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	4.03	7.90	0K	-10	25000	nA	48.9%
27	3.98	8.33	50K	-10	25000	nA	52.2%
25	3.39	8.70	100K	-10	25000	nA	61.1%
16	4.03	8.72	150K	-10	25000	nA	53.7%
15	4.03	9.58	200K	-10	25000	nA	57.9%
Min	3.39	8.33					52.2%
Avg	3.86	8.83					56.2%
Max	4.03	9.58					61.1%
T#17	TOFF (channel #3)						
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.55	3.55	0K	0.5	50	mS	0.0%
27	3.6	3.38	50K	0.5	50	mS	-6.5%
25	3.65	3.45	100K	0.5	50	mS	-5.8%
16	3.58	3.32	150K	0.5	50	mS	-7.8%
15	3.68	3.45	200K	0.5	50	mS	-6.7%
Min	3.58	3.32					-7.8%
Avg	3.63	3.40					-6.7%
Max	3.68	3.45					-5.8%

T#14	RDSON (channel #3)						
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.227	0.223	0K	0.1	0.61	ohms	-1.7%
27	0.223	0.229	50K	0.1	0.61	ohms	2.7%
25	0.226	0.231	100K	0.1	0.61	ohms	2.1%
16	0.225	0.230	150K	0.1	0.61	ohms	2.5%
15	0.226	0.234	200K	0.1	0.61	ohms	3.2%
Min	0.223	0.229					2.1%
Avg	0.225	0.231					2.6%
Max	0.226	0.234					3.2%
T#16	TON (channel #3)						
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.510	0.540	0K	0	15	mS	5.6%
27	0.600	0.600	50K	0	15	mS	0.0%
25	0.620	0.720	100K	0	15	mS	13.9%
16	0.600	0.570	150K	0	15	mS	-5.3%
15	0.490	0.540	200K	0	15	mS	9.3%
Min	0.490	0.540					-5.3%
Avg	0.578	0.608					4.5%
Max	0.620	0.720					13.9%
T#18	VF (channel #3)						
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.344	1.351	0K	1	1.8	V	0.5%
27	1.297	1.292	50K	1	1.8	V	-0.4%
25	1.296	1.294	100K	1	1.8	V	-0.1%
16	1.299	1.297	150K	1	1.8	V	-0.2%
15	1.376	1.370	200K	1	1.8	V	-0.5%
Min	1.296	1.292					-0.5%
Avg	1.317	1.313					-0.3%
Max	1.376	1.370					-0.1%

**(Channel 4)**

T#19 BVDSS (channel #4)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	112.21	111.81	0K	100	150	V	-0.4%
27	111.75	105.54	50K	100	150	V	-5.9%
25	112.76	104.94	100K	100	150	V	-7.4%
16	112.10	104.51	150K	100	150	V	-7.3%
15	114.31	107.74	200K	100	150	V	-6.1%
Min	111.75	104.51					-7.4%
Avg	112.73	105.68					-6.7%
Max	114.31	107.74					-5.9%
T#21 IOU OFF (channel #4)							
Condition:	VOU = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.33	6.45	0K	0.5	50	mS	48.3%
27	3.34	6.80	50K	0.5	50	mS	50.8%
25	2.69	7.21	100K	0.5	50	mS	62.8%
16	3.27	7.21	150K	0.5	50	mS	54.7%
15	3.45	7.92	200K	0.5	50	mS	56.4%
Min	2.69	6.80					50.8%
Avg	3.19	7.28					56.2%
Max	3.45	7.92					62.8%
T#23 TOFF (channel #4)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.55	3.52	0K	0.5	50	mS	-0.9%
27	3.7	3.55	50K	0.5	50	mS	-4.2%
25	3.65	3.4	100K	0.5	50	mS	-7.4%
16	3.55	3.35	150K	0.5	50	mS	-6.0%
15	3.65	3.42	200K	0.5	50	mS	-6.7%
Min	3.55	3.35					-7.4%
Avg	3.64	3.43					-6.1%
Max	3.70	3.55					-4.2%
T#20 RDSON (channel #4)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.229	0.226	0K	0.1	0.61	ohms	-1.6%
27	0.224	0.231	50K	0.1	0.61	ohms	2.7%
25	0.223	0.229	100K	0.1	0.61	ohms	2.3%
16	0.223	0.228	150K	0.1	0.61	ohms	2.5%
15	0.227	0.234	200K	0.1	0.61	ohms	3.0%
Min	0.223	0.228					2.3%
Avg	0.224	0.230					2.6%
Max	0.227	0.234					3.0%
T#22 TON (channel #4)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.530	0.550	0K	0	15	mS	3.6%
27	0.470	0.540	50K	0	15	mS	13.0%
25	0.460	0.490	100K	0	15	mS	6.1%
16	0.430	0.480	150K	0	15	mS	10.4%
15	0.400	0.380	200K	0	15	mS	-5.3%
Min	0.400	0.380					-5.3%
Avg	0.440	0.473					6.1%
Max	0.470	0.540					13.0%
T#24 VF (channel #4)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.313	1.319	0K	1	1.8	V	0.4%
27	1.286	1.282	50K	1	1.8	V	-0.3%
25	1.284	1.282	100K	1	1.8	V	-0.1%
16	1.302	1.300	150K	1	1.8	V	-0.1%
15	1.331	1.327	200K	1	1.8	V	-0.3%
Min	1.284	1.282					-0.3%
Avg	1.301	1.298					-0.2%
Max	1.331	1.327					-0.1%

**(Channel 5)**

T#25 BVDSS (channel #5)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	111.85	111.47	0K	100	150	V	-0.3%
27	115.23	108.38	50K	100	150	V	-6.3%
25	113.78	105.30	100K	100	150	V	-8.1%
16	113.02	104.74	150K	100	150	V	-7.9%
15	111.94	104.46	200K	100	150	V	-7.2%
Min	111.94	104.46					-8.1%
Avg	113.49	105.72					-7.4%
Max	115.23	108.38					-6.3%
T#27 IOU OFF (channel #5)							
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.05	5.59	0K	-10	25000	nA	45.4%
27	3.35	5.89	50K	-10	25000	nA	43.1%
25	305.86	6.40	100K	-10	25000	nA	-4678.8%
16	3.32	6.38	150K	-10	25000	nA	47.9%
15	3.26	7.20	200K	-10	25000	nA	54.7%
Min	3.26	5.89					-4678.8%
Avg	78.95	6.47					-1133.3%
Max	305.86	7.20					54.7%
T#29 TOFF (channel #5)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.58	3.55	0K	0.5	50	mS	-0.8%
27	3.75	3.5	50K	0.5	50	mS	-7.1%
25	3.6	3.4	100K	0.5	50	mS	-5.9%
16	3.78	3.45	150K	0.5	50	mS	-9.6%
15	3.6	3.45	200K	0.5	50	mS	-4.3%
Min	3.60	3.40					-9.6%
Avg	3.68	3.45					-6.7%
Max	3.78	3.50					-4.3%

T#26 RDS ON (channel #5)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.223	0.220	0K	0.1	0.61	ohms	-1.5%
27	0.224	0.229	50K	0.1	0.61	ohms	2.4%
25	0.224	0.229	100K	0.1	0.61	ohms	2.2%
16	0.220	0.225	150K	0.1	0.61	ohms	2.4%
15	0.226	0.232	200K	0.1	0.61	ohms	2.8%
Min	0.220	0.225					2.2%
Avg	0.223	0.229					2.4%
Max	0.226	0.232					2.8%
T#28 TON (channel #5)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.400	0.380	0K	0	15	mS	-5.3%
27	0.420	0.410	50K	0	15	mS	-2.4%
25	0.610	0.610	100K	0	15	mS	0.0%
16	0.540	0.530	150K	0	15	mS	-1.9%
15	0.480	0.480	200K	0	15	mS	0.0%
Min	0.420	0.410					-2.4%
Avg	0.513	0.508					-1.1%
Max	0.610	0.610					0.0%
T#30 VF (channel #5)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.316	1.322	0K	1	1.8	V	0.4%
27	1.303	1.299	50K	1	1.8	V	-0.3%
25	1.284	1.282	100K	1	1.8	V	-0.2%
16	1.282	1.280	150K	1	1.8	V	-0.1%
15	1.349	1.345	200K	1	1.8	V	-0.3%
Min	1.282	1.280					-0.3%
Avg	1.304	1.301					-0.2%
Max	1.349	1.345					-0.1%

**(Channel 6)**

T#31 BVDSS (channel #6)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	112.09	111.71	0K	100	150	V	-0.3%
27	115.36	108.60	50K	100	150	V	-6.2%
25	113.27	106.47	100K	100	150	V	-6.4%
16	112.09	104.18	150K	100	150	V	-7.6%
15	112.63	104.17	200K	100	150	V	-8.1%
Min	112.09	104.17					-8.1%
Avg	113.34	105.85					-7.1%
Max	115.36	108.60					-6.2%
T#33 IOOUT OFF (channel #6)							
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	2.85	5.62	0K	-10	25000	nA	49.2%
27	3.34	5.83	50K	-10	25000	nA	42.8%
25	268.00	6.33	100K	-10	25000	nA	-4134.1%
16	3.28	6.25	150K	-10	25000	nA	47.5%
15	3.26	7.06	200K	-10	25000	nA	53.9%
Min	3.26	5.83					-4134.1%
Avg	69.47	6.37					-997.5%
Max	268.00	7.06					53.9%
T#35 TOFF (channel #6)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.78	3.72	0K	0.5	50	mS	-1.6%
27	3.72	3.48	50K	0.5	50	mS	-6.9%
25	3.62	3.35	100K	0.5	50	mS	-8.1%
16	3.52	3.3	150K	0.5	50	mS	-6.7%
15	3.7	3.42	200K	0.5	50	mS	-8.2%
Min	3.52	3.30					-8.2%
Avg	3.64	3.39					-7.5%
Max	3.72	3.48					-6.7%
T#32 RDS(on) (channel #6)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.227	0.223	0K	0.1	0.61	ohms	-1.5%
27	0.227	0.232	50K	0.1	0.61	ohms	2.3%
25	0.224	0.230	100K	0.1	0.61	ohms	2.5%
16	0.225	0.230	150K	0.1	0.61	ohms	2.4%
15	0.225	0.232	200K	0.1	0.61	ohms	3.0%
Min	0.224	0.230					2.3%
Avg	0.225	0.231					2.6%
Max	0.227	0.232					3.0%
T#34 TON (channel #6)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.460	0.410	0K	0	15	mS	-12.2%
27	0.360	0.390	50K	0	15	mS	7.7%
25	0.370	0.410	100K	0	15	mS	9.8%
16	0.550	0.580	150K	0	15	mS	5.2%
15	0.460	0.460	200K	0	15	mS	0.0%
Min	0.360	0.390					0.0%
Avg	0.435	0.460					5.7%
Max	0.550	0.580					9.8%
T#36 VF (channel #6)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.346	1.353	0K	1	1.8	V	0.5%
27	1.290	1.287	50K	1	1.8	V	-0.2%
25	1.285	1.283	100K	1	1.8	V	-0.2%
16	1.321	1.320	150K	1	1.8	V	-0.1%
15	1.369	1.365	200K	1	1.8	V	-0.3%
Min	1.285	1.283					-0.3%
Avg	1.316	1.314					-0.2%
Max	1.369	1.365					-0.1%

**(Channel 7)**

T#37 BVDSS (channel #7)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	114.53	114.16	0K	100	150	V	-0.3%
27	112.45	105.68	50K	100	150	V	-6.4%
25	114.92	107.18	100K	100	150	V	-7.2%
16	112.04	104.39	150K	100	150	V	-7.3%
15	111.68	105.46	200K	100	150	V	-5.9%
Min	111.68	104.39					-7.3%
Avg	112.77	105.68					-6.7%
Max	114.92	107.18					-5.9%
T#39 IOOUT OFF (channel #7)							
Condition:	VOU = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	2.17	3.44	0K	-10	25000	Na	37.0%
27	2.48	3.90	50K	-10	25000	Na	36.5%
25	231.21	4.23	100K	-10	25000	Na	-5365.4%
16	2.48	4.32	150K	-10	25000	Na	42.5%
15	2.62	5.06	200K	-10	25000	Na	48.3%
Min	2.48	3.90					-5365.4%
Avg	59.70	4.38					-1309.6%
Max	231.21	5.06					48.3%
T#41 TOFF (channel #7)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.55	3.5	0K	0.5	50	mS	-1.4%
27	3.6	3.45	50K	0.5	50	mS	-4.3%
25	3.78	3.5	100K	0.5	50	mS	-8.0%
16	3.55	3.3	150K	0.5	50	mS	-7.6%
15	3.55	3.42	200K	0.5	50	mS	-3.8%
Min	3.55	3.30					-8.0%
Avg	3.62	3.42					-5.9%
Max	3.78	3.50					-3.8%
T#38 RDSON (channel #7)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.227	0.223	0K	0.1	0.61	ohms	-1.4%
27	0.225	0.230	50K	0.1	0.61	ohms	2.3%
25	0.227	0.232	100K	0.1	0.61	ohms	2.2%
16	0.224	0.230	150K	0.1	0.61	ohms	2.3%
15	0.223	0.228	200K	0.1	0.61	ohms	2.5%
Min	0.223	0.228					2.2%
Avg	0.225	0.230					2.3%
Max	0.227	0.232					2.5%
T#40 TON (channel #7)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.510	0.500	0K	0	15	mS	-2.0%
27	0.490	0.460	50K	0	15	mS	-6.5%
25	0.490	0.480	100K	0	15	mS	-2.1%
16	0.640	0.640	150K	0	15	mS	0.0%
15	0.480	0.490	200K	0	15	mS	2.0%
Min	0.480	0.460					-6.5%
Avg	0.525	0.518					-1.6%
Max	0.640	0.640					2.0%
T#42 VF (channel #7)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.322	1.327	0K	1	1.8	V	0.4%
27	1.300	1.296	50K	1	1.8	V	-0.2%
25	1.288	1.286	100K	1	1.8	V	-0.2%
16	1.295	1.294	150K	1	1.8	V	-0.1%
15	1.390	1.387	200K	1	1.8	V	-0.2%
Min	1.288	1.286					-0.2%
Avg	1.318	1.316					-0.2%
Max	1.390	1.387					-0.1%

**(Channel 8)**

T#43 BVDSS (channel #8)							
Condition:	ID= 1mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	114.50	114.14	0K	100	150	V	-0.3%
27	112.74	105.80	50K	100	150	V	-6.6%
25	114.39	106.00	100K	100	150	V	-7.9%
16	112.14	104.30	150K	100	150	V	-7.5%
15	113.63	107.18	200K	100	150	V	-6.0%
Min	112.14	104.30					-7.9%
Avg	113.23	105.82					-7.0%
Max	114.39	107.18					-6.0%
T#45 IOOUT OFF (channel #8)							
Condition:	VOUT = 80V			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	2.04	3.42	0K	-10	25000	nA	40.4%
27	2.47	3.86	50K	-10	25000	nA	36.0%
25	262.85	4.02	100K	-10	25000	nA	-6439.2%
16	2.59	4.25	150K	-10	25000	nA	39.0%
15	2.51	4.81	200K	-10	25000	nA	47.8%
Min	2.47	3.86					-6439.2%
Avg	67.61	4.24					-1579.1%
Max	262.85	4.81					47.8%
T#47 TOFF(channel #8)							
Condition:	Iin=0A, Iout=.8A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	3.6	3.55	0K	0.5	50	mS	-1.4%
27	3.7	3.4	50K	0.5	50	mS	-8.8%
25	3.55	3.45	100K	0.5	50	mS	-2.9%
16	3.68	3.5	150K	0.5	50	mS	-5.1%
15	3.6	3.4	200K	0.5	50	mS	-5.9%
Min	3.55	3.40					-8.8%
Avg	3.63	3.44					-5.7%
Max	3.70	3.50					-2.9%
T#44 RDSON (channel #8)							
Condition:	ID= 1.0A			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.229	0.226	0K	0.1	0.61	ohms	-1.4%
27	0.228	0.233	50K	0.1	0.61	ohms	2.1%
25	0.225	0.230	100K	0.1	0.61	ohms	2.4%
16	0.225	0.229	150K	0.1	0.61	ohms	2.0%
15	0.228	0.234	200K	0.1	0.61	ohms	2.6%
Min	0.225	0.229					2.0%
Avg	0.226	0.232					2.3%
Max	0.228	0.234					2.6%
T#46 TON (channel #8)							
Condition:	PW=50mS			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	0.540	0.500	0K	0	15	mS	-8.0%
27	0.480	0.420	50K	0	15	mS	-14.3%
25	0.430	0.510	100K	0	15	mS	15.7%
16	0.500	0.610	150K	0	15	mS	18.0%
15	0.490	0.590	200K	0	15	mS	16.9%
Min	0.430	0.420					-14.3%
Avg	0.475	0.533					9.1%
Max	0.500	0.610					18.0%
T#48 VF (channel #8)							
Condition:	Iin=10mA			Limits		U / M	% Delta
Serial #	PRE	POST	KRADS	Min	Max		
CTRL	1.286	1.289	0K	1	1.8	V	0.3%
27	1.284	1.282	50K	1	1.8	V	-0.2%
25	1.285	1.282	100K	1	1.8	V	-0.2%
16	1.297	1.296	150K	1	1.8	V	-0.1%
15	1.331	1.328	200K	1	1.8	V	-0.2%
Min	1.284	1.282					-0.2%
Avg	1.299	1.297					-0.2%
Max	1.331	1.328					-0.1%

# Appendix B

## Test Plan

## Test Plan

### 1.0 Purpose

The purpose of this test is to characterize and qualify this device for TID effects for International Rectifier's hybrid SSR devices. The data resulting from the tests may be used as qualification for Standard Military Drawings (SMD) and shall be incorporated in the IR data sheets.

### 2.0 Test Responsibility

International Rectifier shall be responsible for conducting the tests, which shall be performed at the University of Massachusetts Research Reactor facility. International Rectifier shall be responsible for the final Test Report.

### 3.0 Test Facility

#### 3.1 Nuclear Reactor

The University of Massachusetts Research Reactor shall be used to provide the source for Gamma radiation. UMRR will also provide information on dose rate, total dose, irradiation test times and dosimetry for this evaluation..

#### 3.2 Test Equipment

The necessary test equipment including interface board, cables, power supplies, measurement system, etc. shall be provided by International Rectifier.

#### 3.3 Sample Size

Sample size shall be determined based on device type, characterization parameters. As a minimum, the sample size shall meet the requirements of Mil- PRF-38534. Sample size for this TID evaluation equals ten devices (hybrids). Each device consists of eight channels.

### 4 Test Devices

4.2 The RDHA701FP10A8CK devices are planned for TID characterization and evaluation.

4.2 All devices shall be built in their respective packages (64-pin Flat Pack). Devices shall be properly sealed and packed in static-free containers.

4.3 All devices shall be verified for correct electrical performance (baseline) prior to arrival at UMRR.

### 5 Test Method

Mil- PRF-38534 shall be used to establish procedure for all testing described herein. See Appendix C Test Procedure.

### 6 Record Keeping

The Reactor facility shall provide dosimetry data for the CO<sup>60</sup>. Each exposure run shall be cataloged with the appropriate lot# and group letter in order to maintain correlation to the appropriate data set. IR will be responsible for collecting and compiling the test data.

## **7 Test Report**

The Test Report shall include the following information:

- a. Device type(s), serial numbers, wafer lot identification (per active component)
- b. Test dates and personnel names
- c. Facility, source type
- d. Schematic of test circuit
- e. Insitu bias conditions
- f. Comments and observations
- g. Pre and Post Electrical data
- h. Summary descriptive including graphs (if applicable)

# Appendix C

## Test Procedure

## **Test Procedure**

### 1.0 Preliminary Setup

- 1.01 Perform baseline testing on each device prior irradiation. Remove any device that fails pre-rad test limits and replace with known good unit.
- 1.02 Divide the ten selected units into five groups. Each group will contain two devices. One device will be used for the “on” biased state and the other for the “off” biased state. Two devices will be used for controls and will not be exposed to radiation.
- 1.03 Prepare devices for transportation to the Radiation facility. Devices must be stored in a static free container. Device pins must be shorted.

### 2.0 Test Equipment

- 2.01 Keithley model 2410 (2ea)
- 2.02 Test Board TF-xx (1ea)
- 2.03 15ft power supply cable

### 3.0 Radiation Setup (Umass – Radiation Facility)

- 3.01 Prepare the QF299 form with the appropriate information re: Part Type, Description, Part No, etc.
- 3.02 Select two devices for controls. Record their serial numbers on the QF299 form as control units.
- 3.03 Select two devices for Group 1. Record their serial numbers on the QF299 form as one biased unit and one un-biased unit. Place one device in the designated “biased on” socket on the test board TF-xx. Place the remaining device in the designated “biased off” socket.

- 3.04 Move the test board TF-xx into the Gama room and insert into the irradiation fixture.
- 3.05 In the test room connect the two Keithley 2400 sources to the appropriate connectors on the Power Supply rack. One for Voltage Input source and one for Voltage Output source.
- 3.06 Adjust the Voltage Input Keithley for “constant current” mode. Set the voltage level to 5.0 volts and the current to 80ma.
- 3.07 Adjust the Voltage Output Keithley for “constant voltage” mode. Set the voltage level to 80 volts.
- 3.08 Enable the outputs of each Keithley.
- 3.09 Measure the Voltage Input and the Voltage Output on each socket on the test board TF-xx.  
  
Note: If voltage is out of tolerance, correct the problem and retest.
- 3.10 Secure the Gama room and notify reactor personnel to place the colbat60 on the rack.  
  
Note: Record the time the cobalt 60 is in place on the QF299 form.
- 3.11 When the exposure run is complete, record the time on the QF299 form.
- 3.12 Disable the outputs of each Keithley.
- 3.13 Remove the test board TF-xx from the Gama room and return to the test room.

- 3.13 Select two devices for Group 2. Record their serial numbers on the QF299 form as one biased unit and one un-biased unit. Add one device in the designated “biased on” socket on the test board TF-xx. Add the remaining device in the designated “biased off” socket.

Note: There should be four units on the test board TF-xx.

- 3.14 Return the test board TF-xx-xx to the Gama room.

- 3.15 Enable the outputs of each Keithley.

- 3.16 Measure the Voltage Input and the Voltage Output on each socket on the test board TF-xx-xx.

Note: If voltage is out of tolerance, correct the problem and retest.

- 3.17 Secure the Gama room and notify reactor personnel to place the colbat60 on the rack.

Note: Record the time the cobalt 60 is in place on the QF299 form.

- 3.18 When the exposure run is complete, record the time on the QF299 form.

- 3.19 Disable the outputs of each Keithley.

- 3.20 Remove the test board TF-xx-xx from the Gama room and return to the test room.

- 3.21 Select two devices for Group 3. Record their serial numbers on the QF299 form as one biased unit and one un-biased unit. Add one device in the designated “biased on” socket on the test board TF-xx-xx. Add the remaining device in the designated “biased off” socket.

Note: There should be six units on the test board TF-xx-xx.

- 3.22 Return the test board TF-xx-xx to the Gama room.

- 3.23 Enable the outputs of each Keithley.
- 3.24 Measure the Voltage Input and the Voltage Output on each socket on the test board TF-xx-xx.
- Note: If voltage is out of tolerance, correct the problem and retest.
- 3.25 Secure the Gama room and notify reactor personnel to place the colbat60 on the rack.
- Note: Record the time the cobalt 60 is in place on the QF299 form.
- 3.26 When the exposure run is complete, record the time on the QF299 form.
- 3.27 Disable the outputs of each Keithley.
- 3.28 Remove the test board TF-xx-xx from the Gama room and return to the test room.
- 3.29 Select two devices for Group 4. Record their serial numbers on the QF299 form as one biased unit and one un-biased unit. Add one device in the designated "biased on" socket on the test board TF-xx-xx. Add the remaining device in the designated "biased off" socket.
- Note: There should be eight units on the test board TF-xx-xx.
- 3.30 Return the test board TF-xx-xx to the Gama room.
- 3.31 Enable the outputs of each Keithley.
- 3.32 Measure the Voltage Input and the Voltage Output on each socket on the test board TF-xx-xx.
- Note: If voltage is out of tolerance, correct the problem and retest.

3.33 Secure the Gama room and notify reactor personnel to place the colbat60 on the rack.

Note: Record the time the cobalt 60 is in place on the QF299 form.

3.34 When the exposure run is complete, record the time on the QF299 form.

3.35 Disable the outputs of each Keithley.

3.36 Remove the test board TF-xx-xx from the Gama room and return to the test room.

3.27 Radiation exposure is complete.

#### 4.0 Return to IR facility

4.01 After TID is completed, all devices will be transported back to IR Leominster for post irradiation testing. All devices were tested electrically within 1 hour of radiation.

4.02 Place devices in a static free container. Device pins must be shorted.

Note: Maintain the devices at an ambient of 25C or less.

## Appendix D

### Bias Conditions

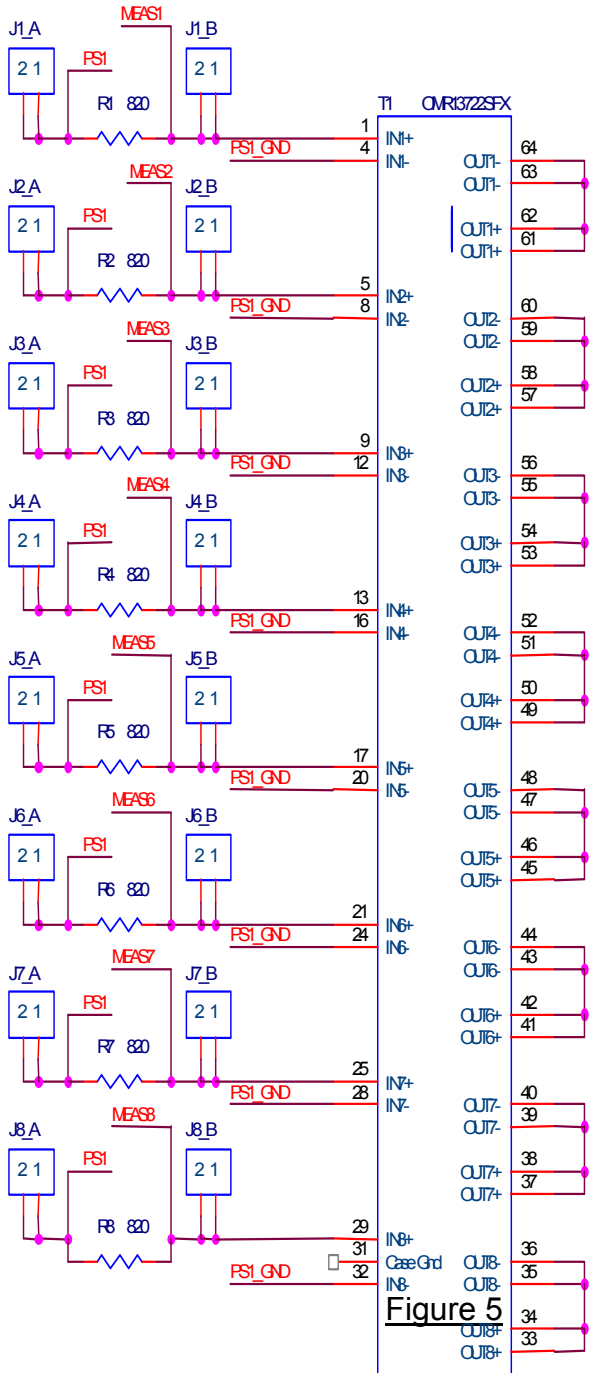
### **Condition A**

For the biased “on” state, 10ma @ 5Vdc is sourced to each individual channel input. There are 8 Solid-state relays in each package, therefore a total of 80mAmps is sourced per each hybrid. All outputs have the Drain to source shorted together without current flow. The diode drop from each optocoupler is measured, monitored, and recorded.

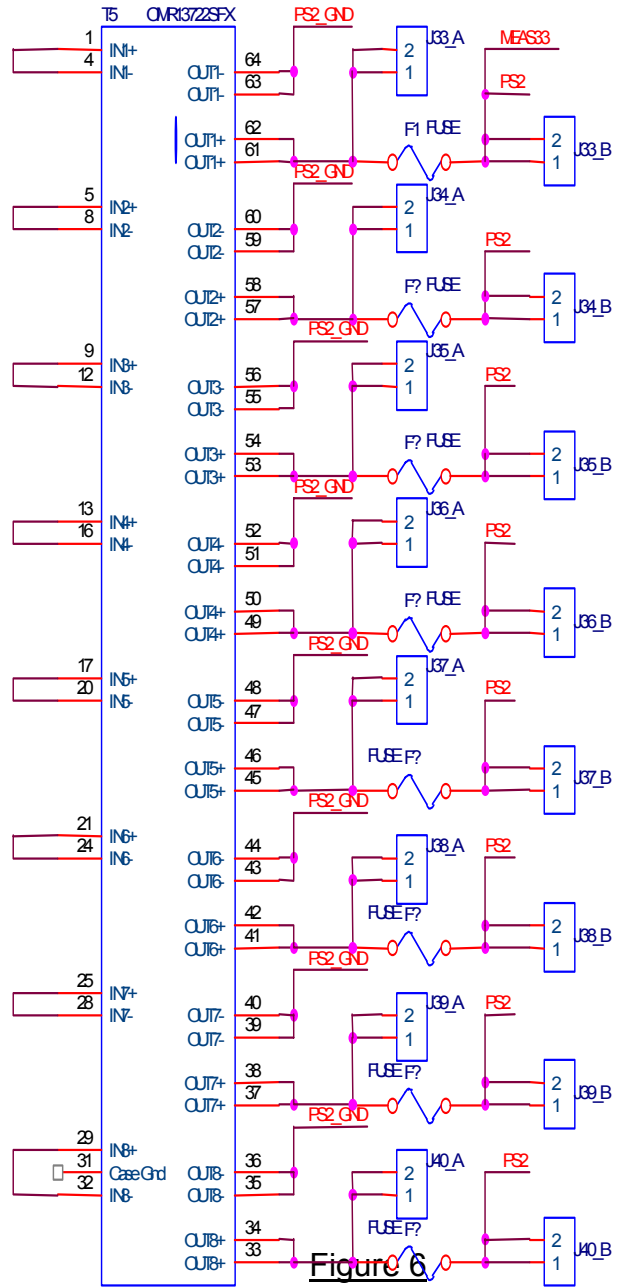
### **Condition B**

For the biased “off” state, all inputs are shorted together for 0 potential. The outputs of each device have 80 volts applied it. The leakage currents on the outputs are monitored while the devices are exposed to radiation.

## Bias A



## Bias B



TID Test Circuit for RDHA701FP10A8CK (Ch1 – Ch8)

# RDHA701FP10A8CK

## DUT Board

