



RDHA710SE10A2QK

Proton Test Report

July 2009

International Rectifier currently does not have a DSCC approved Radiation Hardness Assurance Program for MIL-PRF-38534.

Table of Contents

Introduction	3
Test Plan	3
Results	4
Summary	6
Conclusion.....	6

Appendix A – Electrical Data

Appendix B – Test Plan

Appendix C – Test Specification

Appendix D – Log Sheet

INTRODUCTION

This test report covers proton radiation tests performed on the RDHA710SE10A2QK Dual Solid-State-Relay in a hermetic package.

On May 27th, 2009 International Rectifier Corp. (IR) tested the RDHA710SE10A2QK for proton radiation hardness. The irradiation was performed at the Indiana University Cyclotron Facility. Four devices (Serial # 72, 79, 113, and 491) were selected to determine the proton radiation hardness while the part was toggled on and off, under a 5A load condition. The devices were exposed to a Linear Energy Transfer (LET) of 198MeV.

TEST PLAN

The complete Test Plan is included in Appendix B. In summary, the testing was conducted while the devices were being switched on and off under load. The biasing conditions were checked at both pre and post exposure prior to removal from the board. After devices were exposed to the beam they were checked for radiation levels. Once the levels were determined to be safe for handling the devices were tested at room temperature for compliance with the post radiation electrical specification.

The RDHA710SE10A2QK is a Dual SSR and contains two equivalent circuits in one package. The 7cm beam diameter was capable of covering four of these devices at one time. The distance from the end of the beam line to parts under test was approximately 12 inches which is the calibrated distance for the dosimetry measurements. All four devices (eight circuits) were exercised on and off at approximately 2 hertz. The load was set to 5A per relay.

The cyclotron facility at Indiana University utilizes this beam line for medical therapy as well. Since the medical therapy takes priority the longer beam exposures were interrupted at times. The beam was automatically diverted to the medical facility and then routed back to product by the beam operators. The bias of the devices remained on during these interruptions. This type of radiation exposure is cumulative so the interruption did not change the total fluence the devices were subjected to.

Beam Conditions

Type	Energy (MeV)	Angle (°)	Air Gap (in)	Average Flux (protons/sec cm²)	Total Fluence (protons/cm²)	Average Total Dose Rate (Krad(Si)/sec)
Proton	198	0	12	7.515e+8	1.0e+12	0.04466

RESULTS

The devices (Serial # 72, 79, 113, and 491) positioned at a 0 degree angle to the beam exhibited no evidence of any catastrophic damage at the LET of 198 MeV up to a maximum fluence of $1e+12p/cm^2$ with an average flux of $7.515e+8$ protons/sec cm^2 . All of the devices passed the post radiation electrical test specifications after exposure to the beam. No significant shifts in any device parameters were measured for fluence levels up to $1e+11p/cm^2$. However, at the fluence level of $1e+12p/cm^2$ significant shifts in parameters Ton, Trise, and Toff were measured after exposure to the beam.

The post radiation test results are shown graphically in Figures 1 thru 4. As outlined in the Test Plan, four devices (Serial # 72, 79, 113, and 491) were exposed to proton beam. The average for each selected parameter's data result is displayed in the following graphs for the exposed parts and the unexposed part (control sample).

The proton beam exposures of $1e+12p/cm^2$ caused on average a 150% increase in the turn on delay time, a 200% increase in the rise time, and a 32% decrease in the turn off delay time, but all parameters were within the post radiation limits for the device. The Tfall parameter did not show any significant shifts.

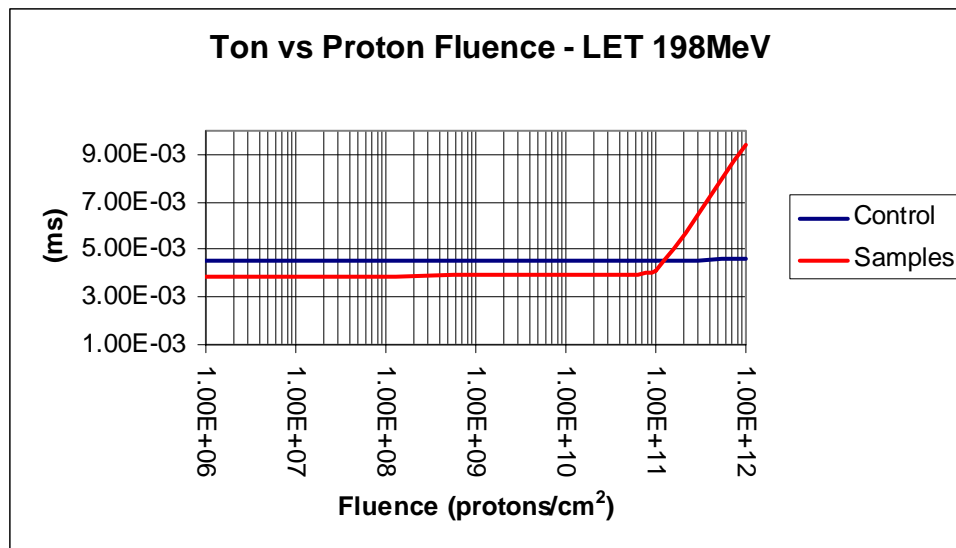


Figure 1

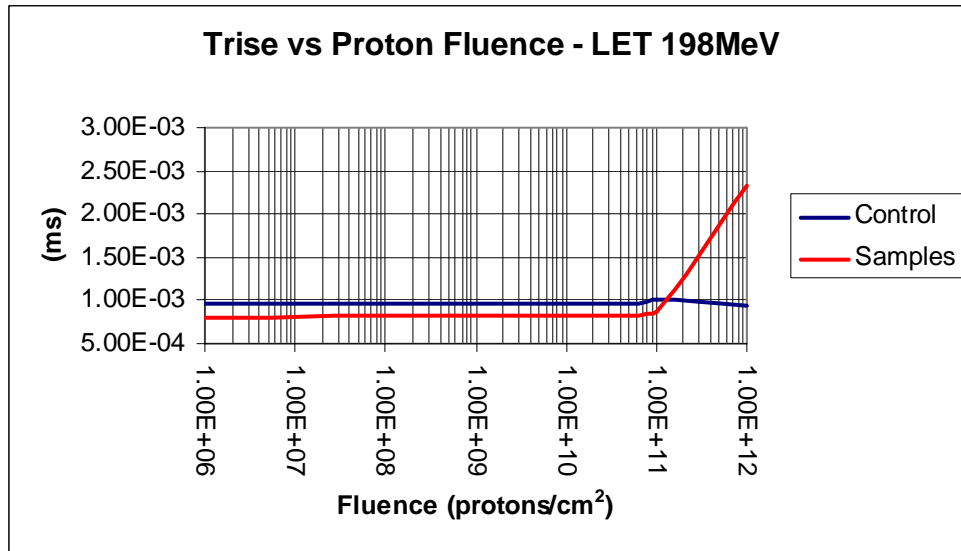


Figure 2

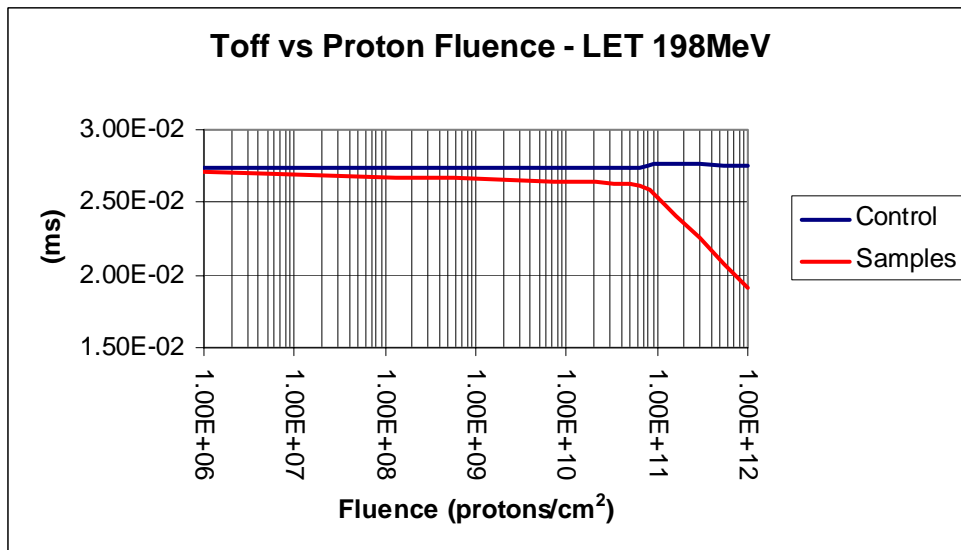


Figure 3

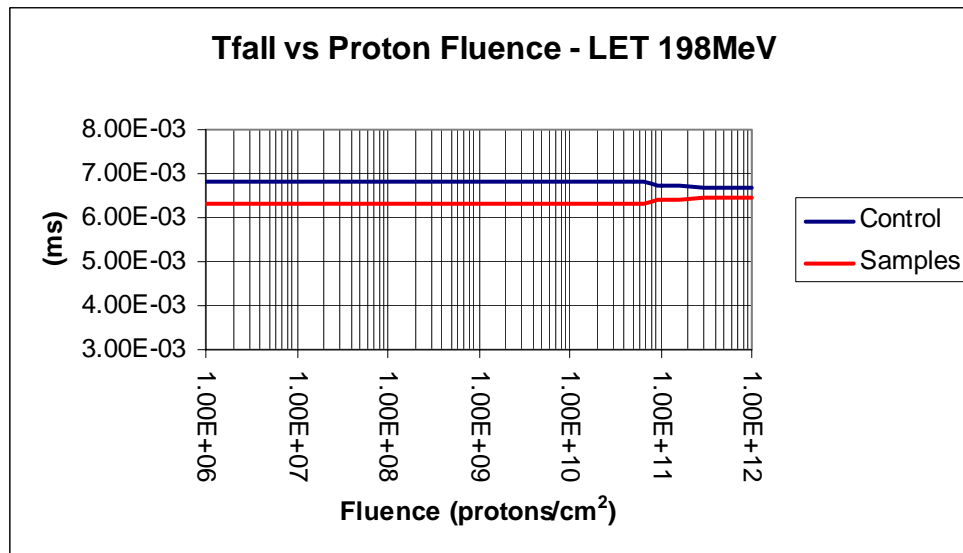


Figure 4

Due to the layout of the test facility and the nature of the test itself IR personnel were not able to stay with the equipment to monitor the results during each exposure. The devices were exposed to a fluence of $5e+10p/cm^2$ and then tested for post radiation effects. After it was confirmed that all devices passed the post radiation electrical test they were exposed to an additional $5e+10p/cm^2$ and passed the post radiation electrical test. All devices were subjected to a final exposure of $1e+12p/cm^2$ and all devices passed the post radiation electrical test. Since each exposure is cumulative for this type of radiation the total exposure for these devices was to $1.1e+12p/cm^2$.

SUMMARY

Four devices (Serial # 72, 79, 113, and 491) of part number RDHA710SE10A2QK, a Dual solid state relay were evaluated for hardness to proton radiation. International Rectifier conducted the tests on May 27th, 2009 at Indiana University. The devices were exposed in open-air. All devices exhibited no evidence of any catastrophic damage at the LET of 198 MeV up to a maximum fluence of $1e+12p/cm^2$ and passed the post radiation electrical test requirements.

CONCLUSION

The RDHA710SE10A2QK has demonstrated hardness to proton radiation for LET levels up to 198 MeV and total fluence levels of $1e+12p/cm^2$.

Appendix A

Electrical Test Data (Pre-radiation)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 8:10 AM

Lot #: EE1378901

Serial #	Test Status	Comment	IQin (A)	IDin (A)	IIHSS 1 (A)	IIHSS 2 (A)	IINPEAK 1 (A)	IINPEAK 2 (A)	IILSS 1 (A)
		Max Limit	2.00E-05	2.50E-02	1.00E-06	1.00E-06	1.00E-03	1.00E-03	1.00E-06
		Min Limit	0.00E+00	1.70E-02	-1.00E-06	-1.00E-06	-1.00E-03	-1.00E-03	-1.00E-06
		Comment	****	****	****	****	****	****	****
62	P	GS	1.10E-06	1.97E-02	6.34E-10	9.91E-10	8.41E-10	9.72E-10	-9.40E-11
113	P		1.10E-06	1.94E-02	9.74E-10	1.30E-09	1.20E-09	1.40E-09	-4.25E-11
72	P		1.10E-06	1.98E-02	1.30E-09	1.50E-09	1.60E-09	1.70E-09	-8.89E-11
79	P		1.10E-06	1.95E-02	9.77E-10	1.30E-09	1.20E-09	1.50E-09	-1.16E-10
491	P		1.10E-06	1.96E-02	1.40E-09	1.30E-09	2.20E-09	1.80E-09	-1.02E-10

Electrical Test Data (Pre-radiation continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 8:10 AM

Lot #: EE1378901

Serial #	Test Status	Comment	IILSS 2 (A)	IO [leak] 1 (A)	IO [leak] 2 (A)	Rdson 1 (Ohm)	Rdson 2 (Ohm)	Ton 1 (S)	Trise 1 (S)
		Max Limit	1.00E-06	2.50E-05	2.50E-05	1.00E-01	1.00E-01	2.50E-02	5.50E-03
		Min Limit	-1.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-04	5.00E-04
		Comment	****	****	****	****	****	****	****
62	P	GS	4.00E-12	5.24E-08	4.26E-08	5.97E-02	5.67E-02	4.10E-03	8.31E-04
113	P		1.76E-11	4.12E-07	4.29E-07	6.02E-02	5.84E-02	4.60E-03	9.52E-04
72	P		-2.33E-11	4.12E-07	4.09E-07	6.05E-02	5.72E-02	4.10E-03	8.65E-04
79	P		-3.39E-11	3.54E-07	3.48E-07	6.00E-02	5.73E-02	3.70E-03	8.02E-04
491	P		-4.95E-11	4.72E-07	5.47E-07	7.29E-02	7.36E-02	3.40E-03	6.73E-04

Electrical Test Data (Pre-radiation continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 8:10 AM

Lot #: EE1378901

Serial #	Test Status	Comment	Ton 2 (S)	Trise 2 (S)	Toff 1 (S)	Tfall 1 (S)	Toff 2 (S)	Tfall 2 (S)
		Max Limit	2.50E-02	5.50E-03	5.00E-02	1.00E-02	5.00E-02	1.00E-02
		Min Limit	1.00E-04	5.00E-04	1.00E-04	1.00E-03	1.00E-04	1.00E-03
		Comment	****	****	****	****	****	****
62	P	GS	5.10E-03	1.10E-03	2.72E-02	6.70E-03	2.77E-02	6.90E-03
113	P		3.80E-03	8.81E-04	2.83E-02	6.60E-03	2.96E-02	6.90E-03
72	P		3.00E-03	6.60E-04	2.79E-02	6.70E-03	2.90E-02	6.60E-03
79	P		3.90E-03	8.49E-04	2.73E-02	6.50E-03	2.87E-02	6.90E-03
491	P		3.70E-03	7.48E-04	2.67E-02	5.40E-03	2.65E-02	5.40E-03

¹ Serial Number 62 was used as a control Sample for this test.

Electrical Test Data (Post 5e+10p/cm² exposure)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 2:33 PM

Lot #: EE1378901

Serial #	Test Status	Comment	IQin (A)	IDin (A)	IIHSS 1 (A)	IIHSS 2 (A)	IINPEAK 1 (A)	IINPEAK 2 (A)	IILSS 1 (A)
		Max Limit	2.00E-05	2.50E-02	1.00E-06	1.00E-06	1.00E-03	1.00E-03	1.00E-06
		Min Limit	0.00E+00	1.70E-02	-1.00E-06	-1.00E-06	-1.00E-03	-1.00E-03	-1.00E-06
		GS	****	****	****	****	****	****	****
62	P		9.34E-07	1.97E-02	6.72E-10	1.10E-09	8.78E-10	1.20E-09	-3.18E-11
113	P		9.93E-07	1.94E-02	9.41E-10	1.20E-09	1.20E-09	1.40E-09	4.90E-11
72	P		9.65E-07	1.98E-02	1.00E-09	1.10E-09	1.30E-09	1.40E-09	1.92E-11
79	P		9.88E-07	1.95E-02	9.46E-10	1.20E-09	1.30E-09	1.40E-09	3.13E-11
491	P		9.98E-07	1.96E-02	1.40E-09	1.40E-09	2.20E-09	2.00E-09	-4.35E-11

Electrical Test Data (Post 5e+10p/cm² exposure continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 2:33 PM

Lot #: EE1378901

Serial #	Test Status	Comment	IILSS 2 (A)	IO [leak] 1 (A)	IO [leak] 2 (A)	Rdson 1 (Ohm)	Rdson 2 (Ohm)	Ton 1 (S)	Trise 1 (S)
		Max Limit	1.00E-06	2.50E-05	2.50E-05	1.00E-01	1.00E-01	2.50E-02	5.50E-03
		Min Limit	-1.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-04	5.00E-04
		GS	****	****	****	****	****	****	****
62	P		1.36E-10	3.80E-08	3.64E-08	5.92E-02	5.66E-02	4.10E-03	9.19E-04
113	P		8.89E-11	3.33E-07	2.49E-07	5.94E-02	5.80E-02	4.90E-03	1.10E-03
72	P		5.55E-11	3.31E-07	2.55E-07	5.98E-02	5.71E-02	4.30E-03	9.69E-04
79	P		7.47E-11	3.18E-07	2.36E-07	6.02E-02	5.70E-02	3.80E-03	8.61E-04
491	P		3.63E-11	3.76E-07	2.69E-07	7.21E-02	7.30E-02	3.50E-03	6.69E-04

Electrical Test Data (Post 5e+10p/cm² exposure continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 2:33 PM

Lot #: EE1378901

Serial #	Test Status	Comment	Ton 2 (S)	Trise 2 (S)	Toff 1 (S)	Tfall 1 (S)	Toff 2 (S)	Tfall 2 (S)
		Max Limit	2.50E-02	5.50E-03	5.00E-02	1.00E-02	5.00E-02	1.00E-02
		Min Limit	1.00E-04	5.00E-04	1.00E-04	1.00E-03	1.00E-04	1.00E-03
		GS	****	****	****	****	****	****
62	P		5.00E-03	1.00E-03	2.72E-02	6.70E-03	2.77E-02	6.90E-03
113	P		4.00E-03	8.22E-04	2.63E-02	6.70E-03	2.75E-02	6.70E-03
72	P		3.10E-03	6.78E-04	2.62E-02	6.80E-03	2.74E-02	6.70E-03
79	P		4.10E-03	8.46E-04	2.57E-02	6.50E-03	2.69E-02	6.80E-03
491	P		3.80E-03	7.07E-04	2.55E-02	5.30E-03	2.51E-02	5.00E-03

¹ Serial Number 62 was used as a control Sample for this test.

Electrical Test Data (Post 1e+11p/cm² exposure)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 3:27 PM

Lot #: EE1387901

Serial #	Test Status	Comment	IQin (A)	IDin (A)	IIHSS 1 (A)	IIHSS 2 (A)	IINPEAK 1 (A)	IINPEAK 2 (A)	IILSS 1 (A)
		Max Limit	2.00E-05	2.50E-02	1.00E-06	1.00E-06	1.00E-03	1.00E-03	1.00E-06
		Min Limit	0.00E+00	1.70E-02	-1.00E-06	-1.00E-06	-1.00E-03	-1.00E-03	-1.00E-06
		GS	****	****	****	****	****	****	****
62	P		1.00E-06	1.97E-02	6.58E-10	1.00E-09	8.63E-10	1.10E-09	-9.60E-12
113	P		1.00E-06	1.93E-02	9.70E-10	1.10E-09	1.20E-09	1.30E-09	5.50E-11
72	P		9.72E-07	1.98E-02	1.10E-09	1.20E-09	1.40E-09	1.40E-09	2.62E-11
79	P		1.00E-06	1.95E-02	9.54E-10	1.20E-09	1.30E-09	1.40E-09	2.02E-11
491	P		9.60E-07	1.96E-02	1.40E-09	1.30E-09	2.30E-09	1.80E-09	-3.19E-11

Electrical Test Data (Post 1e+11p/cm² exposure continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 3:27 PM

Lot #: EE1387901

Serial #	Test Status	Comment	IILSS 2 (A)	IO [leak] 1 (A)	IO [leak] 2 (A)	Rdson 1 (Ohm)	Rdson 2 (Ohm)	Ton 1 (S)	Trise 1 (S)
		Max Limit	1.00E-06	2.50E-05	2.50E-05	1.00E-01	1.00E-01	2.50E-02	5.50E-03
		Min Limit	-1.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-04	5.00E-04
		GS	****	****	****	****	****	****	****
62	P		9.95E-11	4.06E-08	3.97E-08	5.89E-02	5.64E-02	4.10E-03	9.26E-04
113	P		4.04E-11	3.36E-07	2.54E-07	5.92E-02	5.75E-02	5.20E-03	1.10E-03
72	P		5.86E-11	3.37E-07	2.62E-07	6.02E-02	5.69E-02	4.50E-03	9.48E-04
79	P		6.56E-11	3.21E-07	2.42E-07	5.99E-02	5.74E-02	3.90E-03	8.41E-04
491	P		3.48E-11	3.77E-07	2.83E-07	7.16E-02	7.23E-02	3.50E-03	7.04E-04

Electrical Test Data (Post 1e+11p/cm² exposure continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 3:27 PM

Lot #: EE1387901

Serial #	Test Status	Comment	Ton 2 (S)	Trise 2 (S)	Toff 1 (S)	Tfall 1 (S)	Toff 2 (S)	Tfall 2 (S)
		Max Limit	2.50E-02	5.50E-03	5.00E-02	1.00E-02	5.00E-02	1.00E-02
		Min Limit	1.00E-04	5.00E-04	1.00E-04	1.00E-03	1.00E-04	1.00E-03
		GS	****	****	****	****	****	****
62	P		5.00E-03	1.10E-03	2.73E-02	6.70E-03	2.79E-02	6.80E-03
113	P		4.20E-03	9.23E-04	2.52E-02	6.90E-03	2.64E-02	6.80E-03
72	P		3.30E-03	7.19E-04	2.52E-02	6.90E-03	2.62E-02	7.00E-03
79	P		4.20E-03	9.23E-04	2.48E-02	6.50E-03	2.59E-02	7.00E-03
491	P		4.00E-03	7.44E-04	2.47E-02	5.40E-03	2.41E-02	4.80E-03

¹ Serial Number 62 was used as a control Sample for this test.

Electrical Test Data (Post 1e+12p/cm² exposure)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 4:15 PM

Lot #: EE1387901

Serial #	Test Status	Comment	IQin (A)	IDin (A)	IIHSS 1 (A)	IIHSS 2 (A)	IINPEAK 1 (A)	IINPEAK 2 (A)	IILSS 1 (A)
		Max Limit	2.00E-05	2.50E-02	1.00E-06	1.00E-06	1.00E-03	1.00E-03	1.00E-06
		Min Limit	0.00E+00	1.70E-02	-1.00E-06	-1.00E-06	-1.00E-03	-1.00E-03	-1.00E-06
		GS	****	****	****	****	****	****	****
62	P		8.93E-07	1.97E-02	6.74E-10	1.00E-09	8.74E-10	1.10E-09	2.52E-11
113	P		8.46E-07	1.93E-02	1.30E-09	1.40E-09	1.70E-09	1.80E-09	-5.71E-11
72	P		8.01E-07	1.98E-02	1.50E-09	1.50E-09	1.90E-09	1.90E-09	-3.03E-11
79	P		8.58E-07	1.95E-02	1.30E-09	1.40E-09	1.70E-09	1.60E-09	-1.22E-11
491	P		8.21E-07	1.96E-02	2.00E-09	1.70E-09	3.10E-09	2.50E-09	-3.74E-11

Electrical Test Data (Post 1e+12p/cm² exposure continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 4:15 PM

Lot #: EE1387901

Serial #	Test Status	Comment	IILSS 2 (A)	IO [leak] 1 (A)	IO [leak] 2 (A)	Rdson 1 (Ohm)	Rdson 2 (Ohm)	Ton 1 (S)	Trise 1 (S)
		Max Limit	1.00E-06	2.50E-05	2.50E-05	1.00E-01	1.00E-01	2.50E-02	5.50E-03
		Min Limit	-1.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-04	5.00E-04
		GS	****	****	****	****	****	****	****
62	P		1.03E-10	4.17E-08	4.11E-08	5.91E-02	5.65E-02	4.10E-03	8.91E-04
			-3.94E-11						
113	P		11	3.41E-07	2.64E-07	6.15E-02	5.93E-02	1.31E-02	3.60E-03
72	P		3.68E-11	3.38E-07	2.68E-07	6.20E-02	5.88E-02	1.10E-02	2.80E-03
79	P		3.94E-11	3.18E-07	2.44E-07	6.13E-02	5.87E-02	8.50E-03	2.00E-03
491	P		4.76E-13	3.63E-07	2.70E-07	7.28E-02	7.39E-02	6.90E-03	1.40E-03

Electrical Test Data (Post 1e+12p/cm² exposure continued)¹

RDHA710SE10A2QK
PXI TESTER DATA
Wednesday, May 27, 2009, 4:15 PM

Lot #: EE1387901

Serial #	Test Status	Comment	Ton 2 (S)	Trise 2 (S)	Toff 1 (S)	Tfall 1 (S)	Toff 2 (S)	Tfall 2 (S)
		Max Limit	2.50E-02	5.50E-03	5.00E-02	1.00E-02	5.00E-02	1.00E-02
		Min Limit	1.00E-04	5.00E-04	1.00E-04	1.00E-03	1.00E-04	1.00E-03
		GS	****	****	****	****	****	****
62	P		5.10E-03	1.00E-03	2.73E-02	6.80E-03	2.78E-02	6.60E-03
113	P		9.90E-03	2.60E-03	1.84E-02	7.00E-03	1.98E-02	7.00E-03
72	P		7.70E-03	2.00E-03	1.88E-02	7.10E-03	2.02E-02	6.60E-03
79	P		9.40E-03	2.30E-03	1.90E-02	6.60E-03	1.96E-02	6.80E-03
491	P		8.90E-03	1.90E-03	1.92E-02	5.60E-03	1.78E-02	5.10E-03

¹ Serial Number 62 was used as a control Sample for this test.

Appendix B Test Plan

Test Plan Outline

1.0 Purpose

The purpose of this test is to characterize this product for hardness to proton radiation.

2.0 Test Responsibility

International Rectifier shall be responsible for conducting the tests, which shall be performed at Indiana University Cyclotron Facility. International Rectifier shall be responsible for the final Test Report.

3.0 Test Facility

3.1 Accelerator

The Indiana University Cyclotron Facility shall be used to provide the necessary proton beam conditions.

3.2 Test Equipment

The necessary test equipment including the test interface board, cables, power supplies, etc... shall be provided by IR. IR shall provide the equipment needed to handle the individual test devices.

4.0 Test Devices

4.1 The RDHA710SE10A2QK SSR devices are planned for evaluation and all test specifications are listed in Appendix C of this document.

4.2 All devices shall be built in their respective packages.

4.3 The devices shall have the lids removed, all shall be verified for correct electrical performance (baseline) prior to testing, and shall be properly packed in static-free containers.

4.4 The open samples shall be exposed to the beam and the one lidded sample shall be kept as a control to verify the test set up.

5.0 Test Method

5.1 The test board holds four samples at a time.

5.2 Four test samples shall be loaded on to the test board at the end of the beam line.

5.3 All four samples shall be exposed to the beam during the test.

5.4 Just prior to the start of the exposure the bias conditions shall be applied to the samples and it shall be confirmed the samples are operating correctly. If a problem is found it shall be corrected before starting the beam.

5.4.1 $V_{in} = 5V$ ($I_F \cong 10mA$), $V_{out} = 28V$, $I_{out} = 5A$

5.5 The beam shall be turned on for proper amount time at the specified conditions.

5.5.1 The proton energies to be used are 30 MeV, 60 MeV, 100 and 200 MeV. However, in order to minimize the number of exposures the highest LET shall be checked first and then to decrease to the next LET only if a catastrophic event is detected at that LET value.

5.5.2 The total fluence to be achieved for each energy level shall be a minimum of $5E10$ p/cm².

5.5.2 The maximum fluence a device shall be exposed to on a single run shall be $1E12$ p/cm².

5.5.3 The flux for the test shall be from $1E5$ to $1E9$ p's/sec cm².

5.6 The bias shall remain on the samples until after the beam has reached the required total fluence for the exposure.

5.7 The bias conditions shall be verified again after the beam exposure before the bias is removed.

5.8 The samples shall be removed from the test board.

5.9 The samples shall be tested for the DC parametric and switching parameters at 25C per Appendix A.

5.10 If the result of the test is acceptable the samples will be exposed per steps 5.1 through 5.9 at the next set of beam conditions.

5.11 If the result of the test is not acceptable testing shall be stopped.

6.0 Test Report

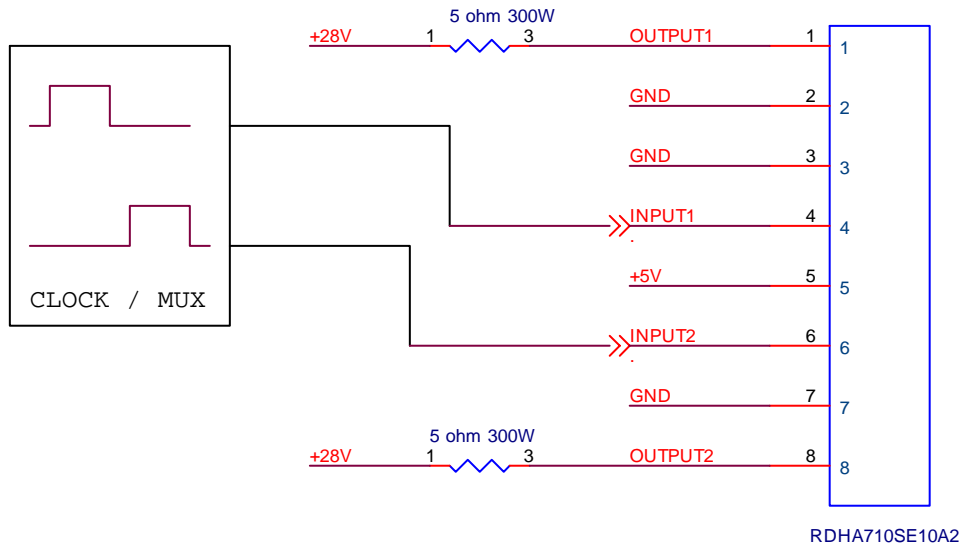
The Test Report shall include the following information:

- 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)

7.0 Record Keeping

All exposure information shall be recorded on the data file and used to correlate data from different exposure levels. The Indiana University Cyclotron Facility shall provide a copy of the summary of all exposure runs showing key parameters such as; LET, flux rate, fluence level, and time duration for exposure. International Rectifier shall provide comments regarding the tests including observations or deviations from the plan.

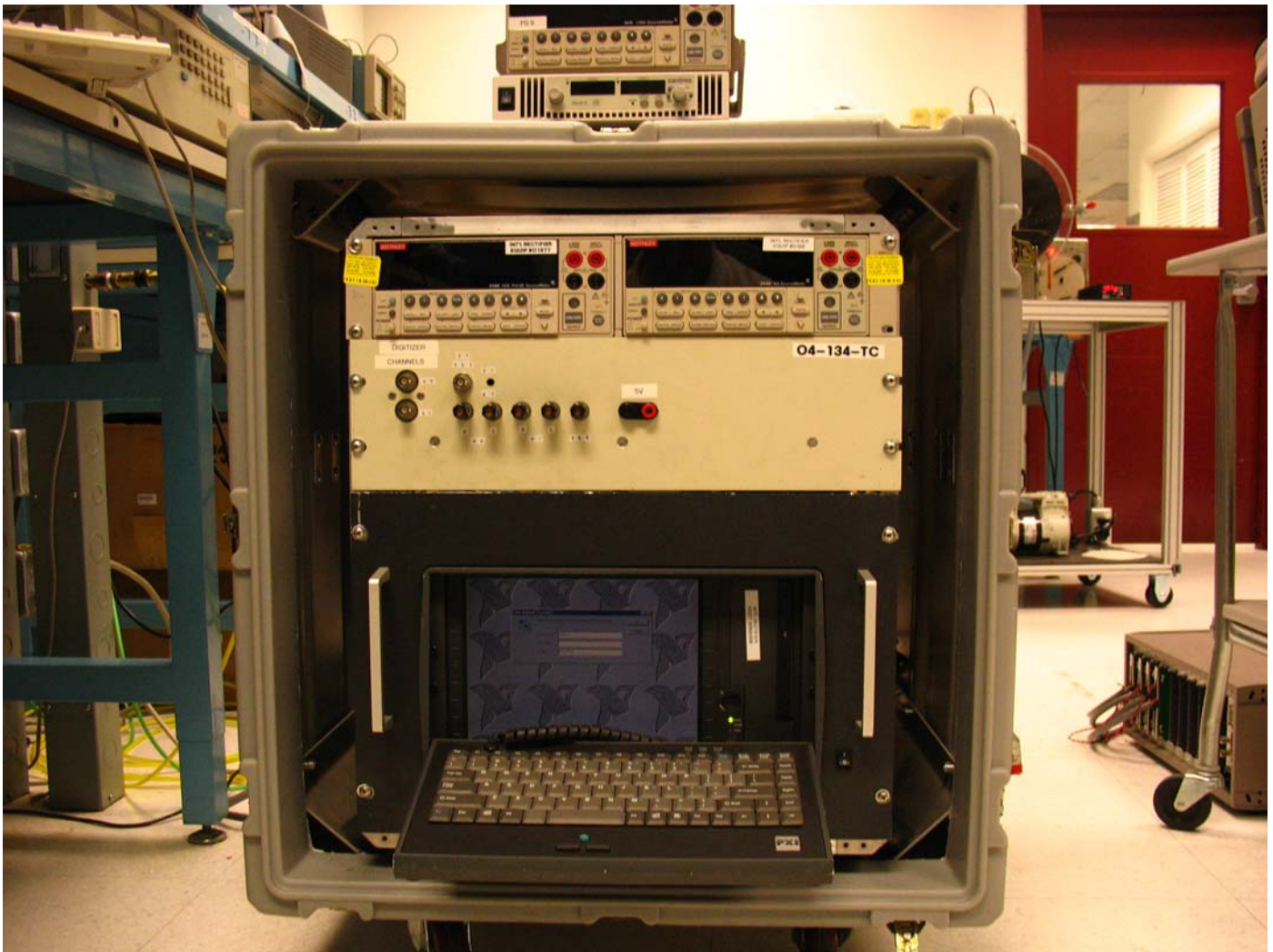
Bias Circuit Block Diagram



Bias Circuit Block Diagram for one device.

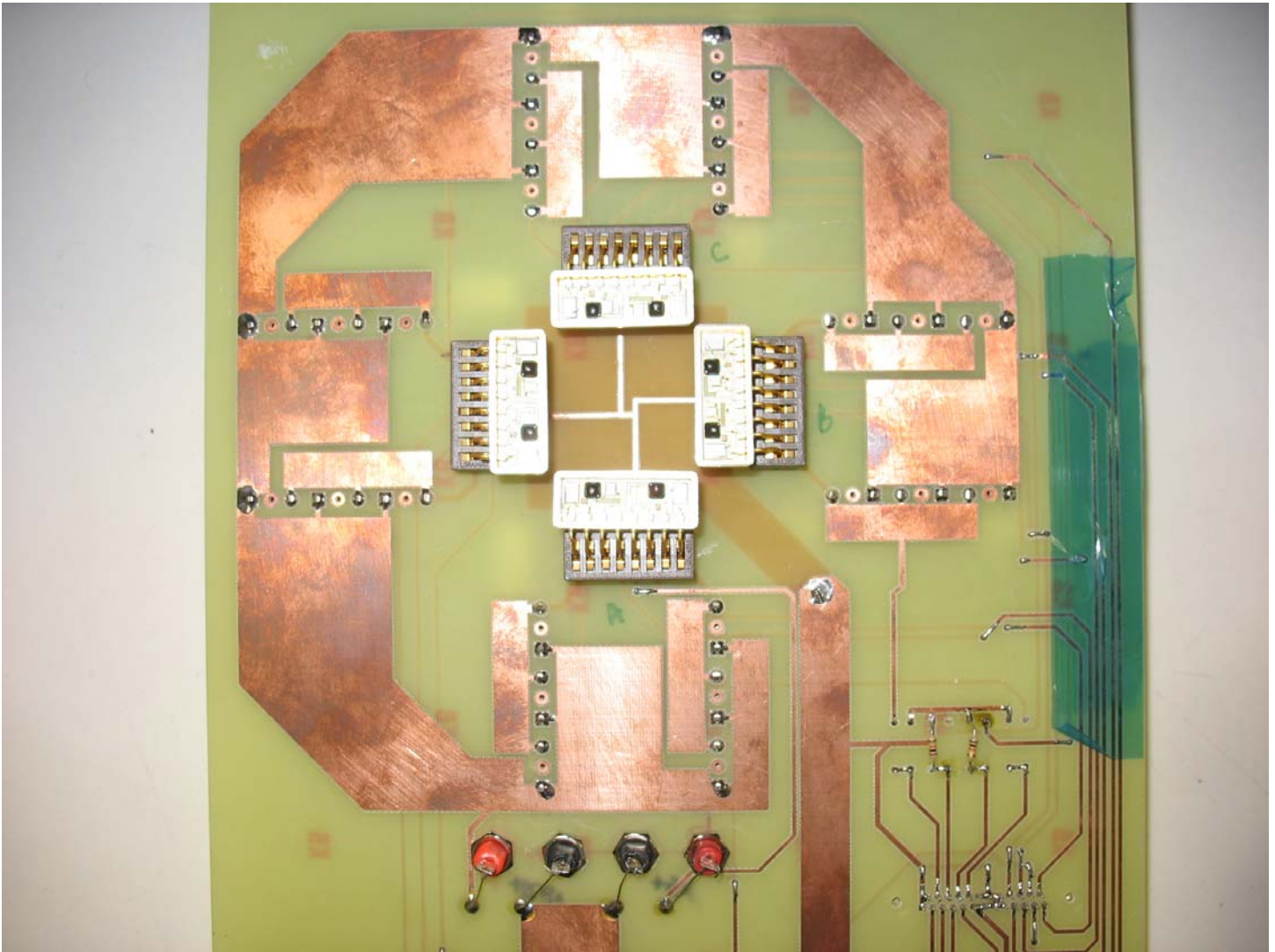
The bias circuit shall apply 28V on the output of each relay with 5A load. The switching frequency is 2Hz frequency with a duty cycle of less the 12% for each relay.

Test Rack



PXI test rack used for biasing of the devices and for the pre and post radiation electrical tests.

DUT BOARD



The test board shown with 4 devices inserted in the sockets. All active components fit inside the 7cm diameter beam.

Appendix C

Test Specification

PRODUCT DESCRIPTION: Dual Opto-MOSFET Solid State Relay								
Automatic Test				Tester: PXI-Rack				
Table 1: Pre Radiation Tests, 25C only								
Prog. Ref.	Test	Symbol	Test Conditions	Rad Level:	Notes	MIN	MAX	Units
A	Supply Current Low	IDin	Vdd=5V, two channels on	Pre Rad		1.70E-02	2.50E-02	A
A	Supply Current High	IQin	Vdd=5V, two channels off	Pre Rad		0.00E+00	2.00E-05	A
A	Input Current High	IIHSS1	VDD=5V, VIH=5.0V	Pre Rad		-1.00E-06	1.00E-06	A
A	Input Current High	IIHSS2	VDD=5V, VIH=5.0V	Pre Rad		-1.00E-06	1.00E-06	A
A	Input Current Peak	IINPEAK1	VDD=5.25V, VIH=5.25V	Pre Rad		-1.00E-03	1.00E-03	A
A	Input Current Peak	IINPEAK2	VDD=5.25V, VIH=5.25V	Pre Rad		-1.00E-03	1.00E-03	A
A	Input Current Low	IILSS1	VDD=5.0V, VIL=0.80V	Pre Rad		-1.00E-06	1.00E-06	A
A	Input Current Low	IILSS2	VDD=5.0V, VIL=0.80V	Pre Rad		-1.00E-06	1.00E-06	A
A	Leakage Current Off	IO [leak] 1	VDD=5.0V, Vin =0.8V, Vout=100V	Pre Rad		0.00	1.00E-05	A
A	Leakage Current Off	IO [leak] 2	VDD=5.0V, Vin =0.8V, Vout=100V	Pre Rad		0.00	1.00E-05	A
A	Drain to Source Resistance	Rdson 1	VDD=5.0V, Iin =10mA, Iout=1A	Pre Rad		0.00	1.00E-01	Ohm
A	Drain to Source Resistance	Rdson 2	VDD=5.0V, Iin =10mA, Iout=1A	Pre Rad		0.00	1.00E-01	Ohm
A	Time On	Ton 1	VDD=5.0V, RCL=41ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		1.00E-04	2.50E-02	S
A	Time Rise	Trise1	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		5.00E-04	5.50E-03	S
A	Time On	Ton 2	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		1.00E-04	2.50E-02	S
A	Time Rise	Trise2	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		5.00E-04	5.50E-03	S
A	Time Off	Toff 1	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		1.00E-04	5.00E-02	S
A	Time Fall	TFall1	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		1.00E-03	1.00E-02	S
A	Time Off	Toff 2	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		1.00E-04	5.00E-02	S
A	Time Fall	TFall12	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Pre Rad		1.00E-03	1.00E-02	S

Automatic Test		Tester: PXI-Rack							
Table 2: Post Radiation Tests, 25C only									
Prog.	Ref.	Test	Symbol	Test Conditions	Rad Level:	Notes	MIN	MAX	Units
B		Supply Current Low	IDin	Vdd=5V, two channels on	Post Rad		1.70E-02	2.50E-02	A
B		Supply Current High	IQin	Vdd=5V, two channels off	Post Rad		0.00E+00	2.00E-05	A
B		Input Current High	IIHSS1	VDD=5V, VIH=5.0V	Post Rad		-1.00E-06	1.00E-06	A
B		Input Current High	IIHSS2	VDD=5V, VIH=5.0V	Post Rad		-1.00E-06	1.00E-06	A
B		Input Current Peak	IINPEAK1	VDD=5.25V, VIH=5.25V	Post Rad		-1.00E-03	1.00E-03	A
B		Input Current Peak	IINPEAK2	VDD=5.25V, VIH=5.25V	Post Rad		-1.00E-03	1.00E-03	A
B		Input Current Low	IILSS1	VDD=5.0V, VIL=0.80V	Post Rad		-1.00E-06	1.00E-06	A
B		Input Current Low	IILSS2	VDD=5.0V, VIL=0.80V	Post Rad		-1.00E-06	1.00E-06	A
B		Leakage Current Off	IO [leak] 1	VDD=5.0V, Vin =0.8V, Vout=100V	Post Rad		0.00	1.00E-05	A
B		Leakage Current Off	IO [leak] 2	VDD=5.0V, Vin =0.8V, Vout=100V	Post Rad		0.00	1.00E-05	A
B		Drain to Source Resistance	Rdson 1	VDD=5.0V, Iin =10mA, Iout=1A	Post Rad		0.00	1.00E-01	Ohm
B		Drain to Source Resistance	Rdson 2	VDD=5.0V, Iin =10mA, Iout=1A	Post Rad		0.00	1.00E-01	Ohm
B		Time On	Ton 1	VDD=5.0V, RCL=41ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		1.00E-04	2.50E-02	S
B		Time Rise	Trise1	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		5.00E-04	5.50E-03	S
B		Time On	Ton 2	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		1.00E-04	2.50E-02	S
B		Time Rise	Trise2	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		5.00E-04	5.50E-03	S
B		Time Off	Toff 1	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		1.00E-04	5.00E-02	S
B		Time Fall	TFall1	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		1.00E-03	1.00E-02	S
B		Time Off	Toff 2	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		1.00E-04	5.00E-02	S
B		Time Fall	TFall12	VDD=5.0V, RCL=5ohm/100uF. Vbus=28V, Vin =4.5V	Post Rad		1.00E-03	1.00E-02	S

Appendix D

Log Sheet

DATE : 5/27/09			OPERATORS : C. DICIENZO, D. LISIEWICZ				FACILITY : IUCF			PAGE <u> 1 </u> OF <u> 1 </u>	
RUN #	Beam Type	LET MeV	AVG FLUX p's / cm ²	Fluence #/ cm ²	Distance in	Angle deg	BEAM Dia cm	PART #	S/N	TID kRad	COMMENTS
10	Proton	198	2.388E8	5.005E10	12	0	7	RDHA710SE10A2QK	72 79 113 491	2.990	No real time monitoring during the beam exposure
12	Proton	198	2.346E8	5.016E10	12	0	7	RDHA710SE10A2QK	72 79 113 491	2.997	No real time monitoring during the beam exposure
14	Proton	198	1.781E9	1.000E12	12	0	7	RDHA710SE10A2QK	72 79 113 491	62.75	No real time monitoring during the beam exposure