

# TOTAL DOSE RADIATION TEST REPORT

ESA study: "Survey of Critical Components for 150 kRad Power Systems"

ESTEC Contract N° 22831/09/NL/AF refers

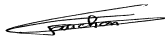


Contract extension up to 400 kRad as per CCN: ATGSP-CN-0004 IS. 3

## Final Report

<p><b>Part Type : IS2-1009RH</b></p> <p><b>Package : TO-206AB</b></p> <p><b>Description : Rad Hard 2.5V Voltage Reference</b></p> <p><b>Manufacturer : Intersil</b></p>
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Alter Technology Purchase Order N° ATGSP-TL-09-JC-CO-9 dated 11/27/2009

Alter Technology Project Manager: David NUNEZ

<b>Hirex reference :</b>	HRX/TID/1014	Issue : 01	Date :	January 12 <sup>th</sup> 2012
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Hirex Engineering	Total Dose Radiation Test Report		Ref.:	HRX/TID/1014
	IS2-1009RH	Intersil	Issue:	01

**CHANGE RECORD**

ISSUE	DATE	PAGE	DESCRIPTION OF CHANGES
01	January 12 <sup>th</sup> 2012	All	Original Issue

Hirex Engineering	Total Dose Radiation Test Report		Ref.:	HRX/TID/1014
	IS2-1009RH	Intersil	Issue:	01

**TOTAL DOSE RADIATION TEST REPORT**  
**on**  
**Intersil**  
**IS2-1009RH**  
**Rad Hard 2.5V Voltage Reference**

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## 1 Introduction

In the scope of the ESA study: "Survey of Critical Components for 150 kRad Power Systems", a total dose characterization test of the Intersil IS2-1009RH, Rad Hard 2.5V Voltage Reference has been performed with an accumulated dose of about 426 Krad(Si) at different dose rates of 36, 100 & 300 rad(Si)/hour, in response to Alter Technology purchase order reference ATGSP-TL-09-JC-CO-9.

An Interim report, HRX/TID/0929 Issue 01, corresponding to the irradiation up to 163 Krad(Si) has been already provided.

The purpose of this test was to evaluate total dose withstanding of this component, to investigate its suitability for being used in space applications. This test was conducted on samples provided by Alter Technology.

Test has been performed in accordance with Hirex Engineering Radiation Test Plan HRX/ SPE/0235 issue 3 dated 09/21/2010.

A complete set of electrical measurements together with graphical representation of measured parameters with respect to total dose received, are provided for all samples.

## 2 Applicable and Reference Documents

### 2.1 Applicable Documents

- Hirex Engineering Radiation Test Plan: HRX/ SPE/0235 issue 3 dated 09/21/2010
- Alter Technology Proposal: ATGSP-OF-648/2009 Issue 1
- Minutes of Meeting: MM-SRP-ATG-0001 dated 29/10/2009
- Hirex internal specification: Total Ionizing Dose Test General Procedure.
- SMD detail specification: 5962-00523

### 2.2 Reference Documents

- Intersil datasheet: ID FN4780.4 dated January 27, 2006

## 3 Test Samples

13 samples of the IS2-1009RH device were tested (6 ON + 6 OFF + 1 control sample).

12 samples (including the 6 samples already submitted to protons test: see report HRX/TID/0881) have been biased according to the flow diagram given in Figure 1.

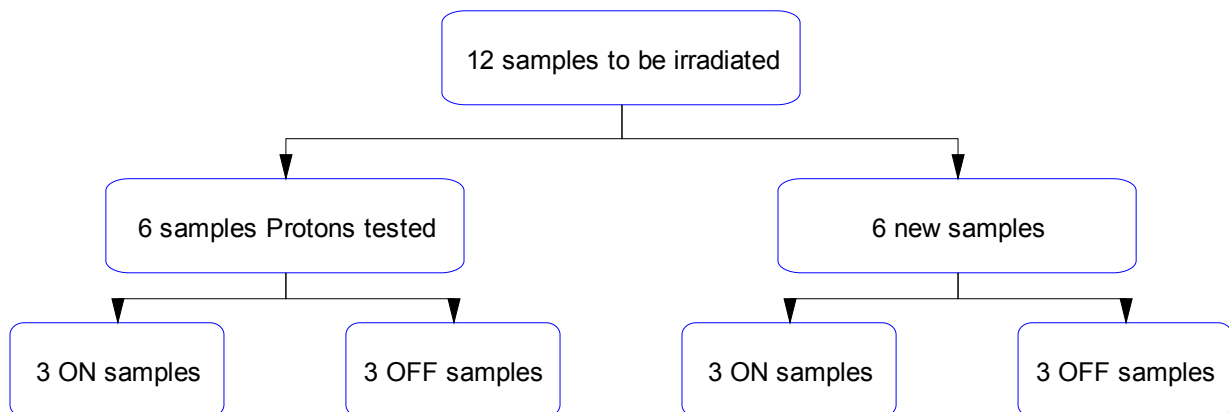


Figure 1 : Samples bias flow diagram

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Samples were allocated into the bias conditions during exposures and annealing as provided in the following table. The different samples groups are also identified for an easier plots reading.

SN attributed by Hirex	Samples Allocation	Samples Group Naming
1	Control sample	REF
2	Biased ON	ON_PROTON
3	Biased ON	ON_PROTON
4	Biased ON	ON_PROTON
5	Biased OFF	OFF_PROTON
6	Biased OFF	OFF_PROTON
7	Biased OFF	OFF_PROTON
8	Biased ON	ON_TID
9	Biased ON	ON_TID
10	Biased ON	ON_TID
11	Biased OFF	OFF_TID
12	Biased OFF	OFF_TID
13	Biased OFF	OFF_TID

Identification of the IS2-1009RH is given below:

**Part Number:** IS2-1009RH/PROTO

**Top Marking:** logo IS2-1009RH /PROTO

**Bottom Marking:** -

**Date Code:** -

## 4 Experimental Conditions

### 4.1 Radiation Source Dose Rate and Annealing

The dose exposures were performed at UCL in Louvain (Belgium). In this irradiation facility, a Cobalt 60 source is used with the possibility to vary the dose rate by simply adjusting the distance to the source. During the dose exposures, devices under test have been irradiated in an ambient temperature of 24°C ±6°C.

The dose received by the devices has been controlled by the measurement of one Alanine pellet dosimeter placed onto the bias board.

Resulting test conditions are provided below.

Irradiation Steps requested	Pellet dosimetry data	Dose rate	Annealing steps	Temperature
kRad	kRad	Rad/h	Hours	°C
0	0			
10	11.7	36		Room
20	22.5	36		Room
50	53.1	36		Room
100	104.4	36		Room
150	159.3	100 [1]		Room
200	207	300 [1]		Room
250	245.7	300 [1]		Room
300	291.2	300 [1]		Room
350	333	300 [1]		Room
400	426.6	300 [1]		Room
			24	Room
			168	100

Note [1]: Due to the maintenance period planned at UCL at the end of December and in order to perform subsequent requested exposures steps up to 400 Krad(Si), the dose rates of several steps have been changed, in agreement with ESA, from 36 rad(Si)/h to 100 rad(Si)/h and from 100 rad(Si)/h to 300 rad(Si)/h as indicated.

### 4.2 Bias during Dose Exposures and Measurements conditions

#### 4.2.1 Bias conditions

During exposures and annealing test board allowed to bias 6 samples in accordance with the electrical circuit provided in Figure 2.

6 other samples were biased OFF with all pins connected to ground.

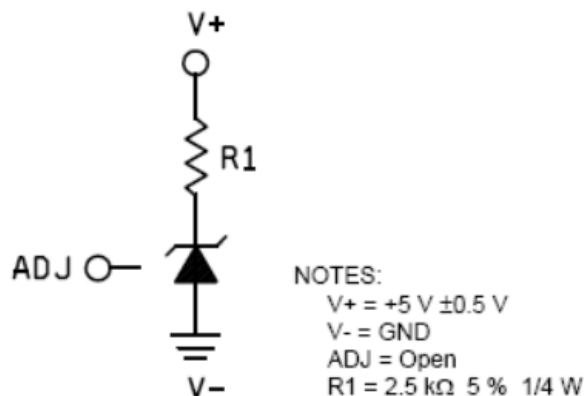


Figure 2 : Bias Conditions during Irradiation Exposures

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4.2.2 Electrical Measurements

Electrical parameters test program principle for IS2-1009RH is provided in Figure 3.

A HP4142 DC tester and a HP3458A multimeter were used to perform required measurements.

A dedicated test fixture was designed to ensure proper measurement conditions. In addition a faraday cage was used to ensure optimum conditions for low level measurements.

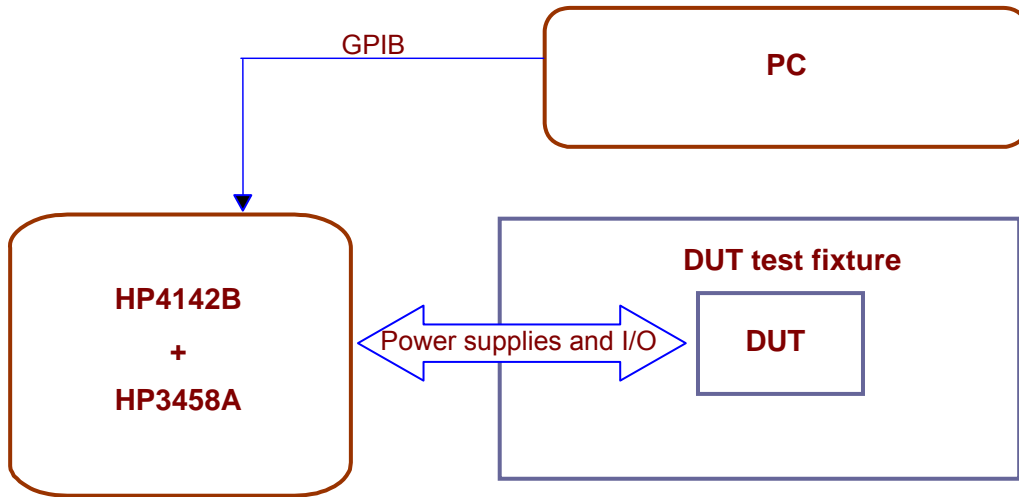


Figure 3 : IS2-1009RH test program principle

Hirex Engineering	Total Dose Radiation Test Report		Ref.:	HRX/TID/1014
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Electrical parameters test conditions and limits used for performing this test are given in Table 1.

Parameter	Description	Conditions Note 1	Spec			Unit
			Min	Typ	Max	
<a href="#">VREF</a>	Reference voltage	IL = 1 mA	2.495	-	2.505	V
<a href="#">DVZ/DIZ</a>	Zener voltage versus zener current	400µA ≤ IR ≤ 8mA	-6	-	6	mV
<a href="#">Rz1</a>	Shunt Resistance	IZ1 = 400µA, Note 2	-	-	-	Ω
<a href="#">Rz2</a>	Shunt Resistance	IZ2 = 1mA, Note 3	0	-	0.6	Ω
<a href="#">Rz3</a>	Shunt Resistance	IZ3 = 8mA, Note 4	-	-	-	Ω

Note 1: Pulsed measurement Width ≤ 1ms, Duty cycle = 1%

Note 2:  $Rz1 = |(Vz1 - Vz3)/(Iz1 - Iz3)|$

Note 3:  $Rz2 = |(Vz2 - Vz1)/(Iz2 - Iz1)|$

Note 4:  $Rz3 = |(Vz2 - Vz3)/(Iz2 - Iz3)|$

**Table 1 : Measured electrical parameters**



Hirex Engineering	Total Dose Radiation Test Report		Ref.:	HRX/TID/1014
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### 5 Conclusion

A Total Ionizing Dose verification test was carried out by Hirex Engineering under Alter Technology contract on the Intersil IS2-1009RH Rad Hard 2.5V Voltage Reference in TO-206AB package.

12 samples plus one control sample were used during testing. They were exposed to radiation using different dose rates of 36, 100 & 300 rad(Si)/hour at room temperature.

A summary of the failed parameters is provided in the following table. The behavior of each parameter is recorded for both biased On and biased Off samples of each group. Parameters not listed remained within specification limits all along testing or had no limits specified. Detail test results are presented in next section.

Parameters	Failure Level between :		Annealing Recovery [Note 1]					Comments
			NA	No	Partial	Complete	Rebound	
VREF	ON_PROTON	[Note 2]				X		
	ON_TID	207 & 245.7 kRad(Si)				X		
	OFF_PROTON	[Note 2]		X				
	OFF_TID	0 & 11.7 kRad(Si)			X			
DVZ/DIZ	ON_PROTON	No Failure	X					
	ON_TID	No Failure	X					
	OFF_PROTON	104.4 & 159.3 kRad(Si)				X		
	OFF_TID	159.3 & 207 kRad(Si)				X		
Rz2	ON_PROTON	No Failure	X					
	ON_TID	No Failure	X					
	OFF_PROTON	53.1 & 104.4 kRad(Si)				X		
	OFF_TID	104.4 & 159.3 kRad(Si)				X		

[Note 1]: **NA** = Not applicable, **No**: means no sample has recovered, **Partial**: means at least one sample has recovered, **Complete**: means all samples have recovered, **Rebound**: means rebound has been observed on at least one sample.

[Note 2]: Most of samples failed after protons exposures were still failed at initial measurements of TID testing.

**Table 2 : Summary of parameters failure levels**

Hirex Engineering	Total Dose Radiation Test Report		Ref.:	HRX/TID/1014
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## 6 Test Results

Test results including tables and graphics are provided in this section for each measured parameter.

Statistics are provided separately for biased ON & biased OFF samples of each group.

For each parameter, a drift calculation table is provided computing the drift between a given exposure step with respect to initial readings:

$$\Delta(\text{Parameter value}) = (\text{Parameter value}_{\text{POSTRAD}}) - (\text{Parameter value}_{\text{PRERAD}})$$

Parameter : Reference Voltage : VREF

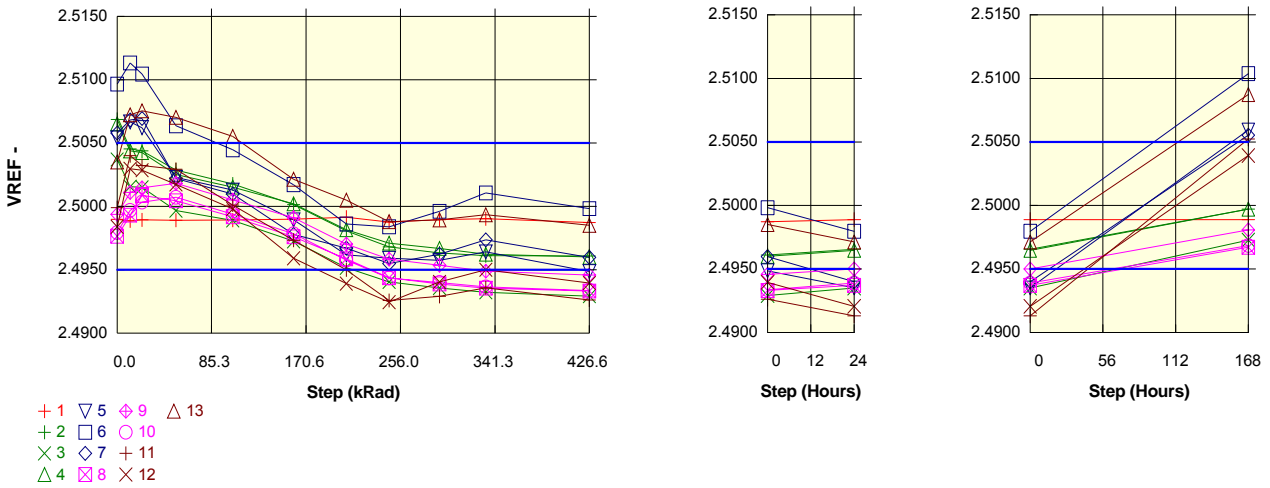
Test conditions : IL=1mA

Unit :

Spec Limit Min : 2.4950

Spec Limit Max : 2.5050

Spec limits are represented in bold lines on the graphic.



Measurements

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	2.4990	2.4989	2.4989	2.4989	2.4989	2.4990	2.4991	2.4988	2.4990	2.4990	2.4987	2.4989	2.4989
ON_PROTON samples													
2	<b>2.5069</b>	2.5045	2.5044	2.5029	2.5018	2.5001	2.4981	2.4968	2.4963	2.4961	2.4961	2.4966	2.4997
3	2.5037	2.5015	2.5015	2.4997	2.4989	2.4973	2.4952	<b>2.4940</b>	<b>2.4936</b>	<b>2.4932</b>	<b>2.4929</b>	<b>2.4935</b>	2.4973
4	<b>2.5065</b>	2.5044	2.5043	2.5025	2.5015	2.5002	2.4982	2.4971	2.4967	2.4962	2.4960	2.4965	2.4997
Statistics													
Min	2.5037	2.5015	2.5015	2.4997	2.4989	2.4973	2.4952	2.4940	2.4936	2.4932	2.4929	2.4935	2.4973
Max	2.5069	2.5045	2.5044	2.5029	2.5018	2.5002	2.4982	2.4971	2.4967	2.4962	2.4961	2.4966	2.4997
Average	2.5057	2.5035	2.5034	2.5017	2.5007	2.4992	2.4971	2.4960	2.4955	2.4952	2.4950	2.4955	2.4989
Sigma	0.0014	0.0014	0.0013	0.0014	0.0013	0.0014	0.0014	0.0014	0.0014	0.0014	0.0015	0.0014	0.0012

Drift Calculation

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON_PROTON samples													
2	-	-2.3E-03	-2.5E-03	-4.0E-03	-5.1E-03	-6.7E-03	-8.8E-03	-10.1E-03	-10.5E-03	-10.8E-03	-10.8E-03	-10.3E-03	-7.2E-03
3	-	-2.2E-03	-2.2E-03	-4.0E-03	-4.8E-03	-6.5E-03	-8.5E-03	-9.7E-03	-10.1E-03	-10.5E-03	-10.8E-03	-10.2E-03	-6.4E-03
4	-	-2.1E-03	-2.3E-03	-4.0E-03	-5.0E-03	-6.3E-03	-8.4E-03	-9.4E-03	-9.8E-03	-10.3E-03	-10.5E-03	-10.1E-03	-6.8E-03
Average	-	-2.2E-03	-2.3E-03	-4.0E-03	-5.0E-03	-6.5E-03	-8.6E-03	-9.7E-03	-10.2E-03	-10.5E-03	-10.7E-03	-10.2E-03	-6.8E-03
Sigma	-	85.4E-06	125.3E-06	18.8E-06	118.9E-06	167.6E-06	177.6E-06	258.0E-06	285.0E-06	184.6E-06	119.5E-06	103.9E-06	294.2E-06

Measurements

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	2.4990	2.4989	2.4989	2.4989	2.4989	2.4990	2.4991	2.4988	2.4990	2.4990	2.4987	2.4989	2.4989
ON_TID samples													
8	2.4976	2.4993	2.5009	2.5004	2.4992	2.4976	2.4959	<b>2.4944</b>	<b>2.4939</b>	<b>2.4936</b>	<b>2.4933</b>	<b>2.4937</b>	2.4967
9	2.4994	2.5011	2.5015	2.5018	2.5005	2.4991	2.4970	2.4958	2.4954	<b>2.4949</b>	<b>2.4946</b>	2.4950	2.4981
10	2.4979	2.4997	2.5003	2.5007	2.4994	2.4978	2.4958	<b>2.4943</b>	<b>2.4940</b>	<b>2.4936</b>	<b>2.4934</b>	<b>2.4939</b>	2.4969
Statistics													
Min	2.4976	2.4993	2.5003	2.5004	2.4992	2.4976	2.4958	2.4943	2.4939	2.4936	2.4933	2.4937	2.4967
Max	2.4994	2.5011	2.5015	2.5018	2.5005	2.4991	2.4970	2.4958	2.4954	2.4949	2.4946	2.4950	2.4981
Average	2.4983	2.5000	2.5009	2.5010	2.4997	2.4982	2.4962	2.4949	2.4944	2.4940	2.4938	2.4942	2.4972
Sigma	0.0008	0.0008	0.0005	0.0006	0.0006	0.0007	0.0006	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006

Drift Calculation

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON_TID samples													
8	-	1.7E-03	3.2E-03	2.8E-03	1.5E-03	-45.1E-06	-1.8E-03	-3.3E-03	-3.8E-03	-4.1E-03	-4.3E-03	-3.9E-03	-938.9E-06
9	-	1.7E-03	2.1E-03	2.5E-03	1.1E-03	-248.9E-06	-2.3E-03	-3.5E-03	-4.0E-03	-4.5E-03	-4.8E-03	-4.4E-03	-1.3E-03
10	-	1.7E-03	2.4E-03	2.8E-03	1.4E-03	-92.0E-06	-2.2E-03	-3.6E-03	-3.9E-03	-4.3E-03	-4.6E-03	-4.0E-03	-1.1E-03
Average	-	1.7E-03	2.6E-03	2.7E-03	1.4E-03	-128.7E-06	-2.1E-03	-3.5E-03	-3.9E-03	-4.3E-03	-4.6E-03	-4.1E-03	-1.1E-03
Sigma	-	41.2E-06	474.1E-06	156.0E-06	167.4E-06	87.2E-06	228.5E-06	135.5E-06	96.3E-06	154.7E-06	182.0E-06	184.4E-06	140.2E-06

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**Measurements**

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	2.4990	2.4989	2.4989	2.4989	2.4989	2.4990	2.4991	2.4988	2.4990	2.4990	2.4987	2.4989	2.4989
OFF PROTON samples													
5	2.5054	2.5067	2.5062	2.5023	2.5013	2.4989	2.4962	2.4959	2.4958	2.4964	2.4949	2.4935	2.5059
6	2.5097	2.5113	2.5104	2.5064	2.5045	2.5017	2.4986	2.4984	2.4996	2.5011	2.4998	2.4980	2.5104
7	2.5058	2.5068	2.5069	2.5022	2.5010	2.4978	2.4967	2.4955	2.4962	2.4974	2.4960	2.4940	2.5055
Statistics													
Min	2.5054	2.5067	2.5062	2.5022	2.5010	2.4978	2.4962	2.4955	2.4958	2.4964	2.4949	2.4935	2.5055
Max	2.5097	2.5113	2.5104	2.5064	2.5045	2.5017	2.4986	2.4984	2.4996	2.5011	2.4998	2.4980	2.5104
Average	2.5070	2.5083	2.5079	2.5036	2.5022	2.4995	2.4972	2.4966	2.4972	2.4983	2.4969	2.4952	2.5073
Sigma	0.0019	0.0022	0.0018	0.0019	0.0016	0.0017	0.0010	0.0013	0.0017	0.0020	0.0021	0.0020	0.0022

**Drift Calculation**

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF PROTON samples													
5	-	1.3E-03	808.0E-06	-3.1E-03	-4.1E-03	-6.5E-03	-9.2E-03	-9.5E-03	-9.7E-03	-9.0E-03	-10.5E-03	-11.9E-03	521.9E-06
6	-	1.7E-03	779.9E-06	-3.3E-03	-5.2E-03	-7.9E-03	-11.1E-03	-11.3E-03	-10.0E-03	-8.6E-03	-9.8E-03	-11.7E-03	710.0E-06
7	-	1.0E-03	1.1E-03	-3.6E-03	-4.8E-03	-8.0E-03	-9.1E-03	-10.3E-03	-9.6E-03	-8.4E-03	-9.8E-03	-11.8E-03	-265.8E-06
Average	-	1.3E-03	910.0E-06	-3.3E-03	-4.7E-03	-7.5E-03	-9.8E-03	-10.4E-03	-9.8E-03	-8.7E-03	-10.1E-03	-11.8E-03	322.0E-06
Sigma	-	259.1E-06	164.5E-06	198.3E-06	447.4E-06	710.1E-06	901.0E-06	721.9E-06	204.3E-06	234.3E-06	339.3E-06	81.7E-06	422.7E-06

**Measurements**

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	2.4990	2.4989	2.4989	2.4989	2.4989	2.4990	2.4991	2.4988	2.4990	2.4990	2.4987	2.4989	2.4989
OFF TID samples													
11	2.4999	2.5040	2.5032	2.5029	2.5001	2.4973	2.4950	2.4926	2.4929	2.4936	2.4926	2.4913	2.5052
12	2.4984	2.5030	2.5029	2.5017	2.4998	2.4959	2.4939	2.4924	2.4940	2.4950	2.4939	2.4921	2.5039
13	2.5035	2.5072	2.5075	2.5070	2.5055	2.5021	2.5005	2.4988	2.4989	2.4993	2.4985	2.4971	2.5087
Statistics													
Min	2.4984	2.5030	2.5029	2.5017	2.4998	2.4959	2.4939	2.4924	2.4929	2.4936	2.4926	2.4913	2.5039
Max	2.5035	2.5072	2.5075	2.5070	2.5055	2.5021	2.5005	2.4988	2.4989	2.4993	2.4985	2.4971	2.5087
Average	2.5006	2.5047	2.5045	2.5039	2.5018	2.4985	2.4965	2.4946	2.4953	2.4960	2.4950	2.4935	2.5060
Sigma	0.0021	0.0018	0.0021	0.0023	0.0026	0.0027	0.0029	0.0030	0.0026	0.0025	0.0025	0.0026	0.0020

**Drift Calculation**

VREF	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF TID samples													
11	-	4.1E-03	3.3E-03	3.0E-03	201.9E-06	-2.6E-03	-4.9E-03	-7.3E-03	-7.0E-03	-6.3E-03	-7.3E-03	-8.6E-03	5.3E-03
12	-	4.6E-03	4.5E-03	3.3E-03	1.4E-03	-2.5E-03	-4.5E-03	-6.0E-03	-4.4E-03	-3.4E-03	-4.4E-03	-6.3E-03	5.5E-03
13	-	3.7E-03	4.0E-03	3.5E-03	2.0E-03	-1.4E-03	-3.0E-03	-4.7E-03	-4.6E-03	-4.2E-03	-5.0E-03	-6.4E-03	5.2E-03
Average	-	4.1E-03	3.9E-03	3.3E-03	1.2E-03	-2.1E-03	-4.1E-03	-6.0E-03	-5.3E-03	-4.6E-03	-5.6E-03	-7.1E-03	5.4E-03
Sigma	-	347.8E-06	475.2E-06	201.5E-06	753.3E-06	551.6E-06	807.1E-06	1.1E-03	1.2E-03	1.2E-03	1.2E-03	1.1E-03	132.1E-06

Parameter : Zener Voltage Versus Zener Current : DVZ/DIZ

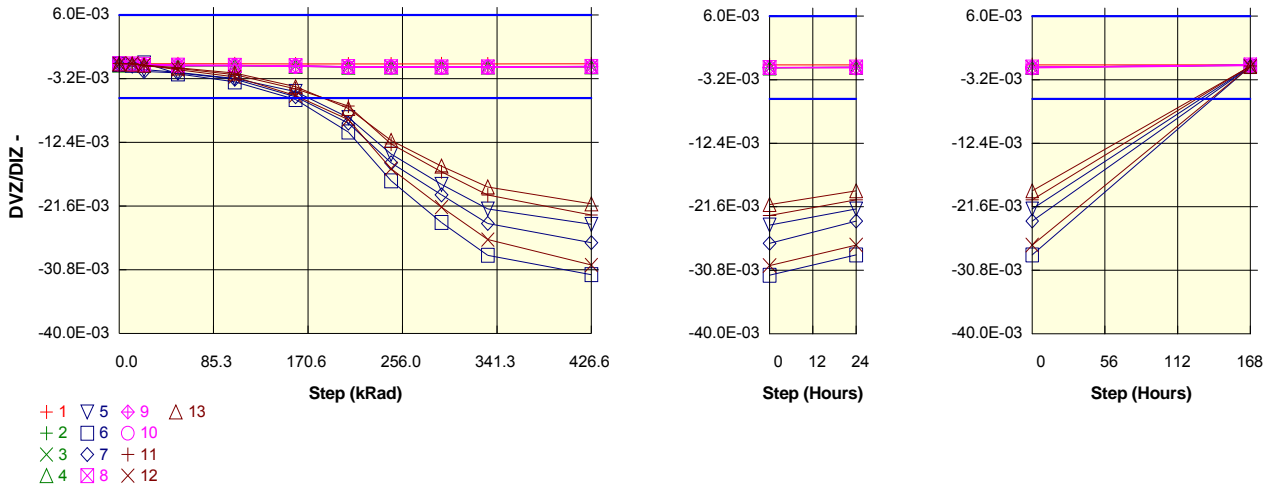
Test conditions : 400µA<=IR<=8mA

Unit :

Spec Limit Min : -6.0E-03

Spec Limit Max : 6.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03
ON PROTON samples													
2	-1.2E-03	-1.2E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.1E-03
3	-1.1E-03	-1.2E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.1E-03
4	-1.2E-03	-1.2E-03	-1.3E-03	-1.4E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.1E-03
Statistics													
Min	-1.2E-03	-1.2E-03	-1.3E-03	-1.4E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.1E-03
Max	-1.1E-03	-1.2E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.1E-03
Average	-1.2E-03	-1.2E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.1E-03
Sigma	46.2E-06	18.0E-06	32.4E-06	19.9E-06	18.8E-06	27.8E-06	21.6E-06	11.9E-06	19.0E-06	17.2E-06	24.2E-06	17.1E-06	19.7E-06

Drift Calculation

DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON PROTON samples													
2	-	47.9E-06	-14.8E-06	-104.0E-06	-88.0E-06	-157.8E-06	-299.0E-06	-319.0E-06	-308.0E-06	-268.9E-06	-252.0E-06	-191.9E-06	134.0E-06
3	-	-39.1E-06	-80.8E-06	-189.1E-06	-178.8E-06	-230.1E-06	-354.1E-06	-373.1E-06	-352.1E-06	-347.1E-06	-322.1E-06	-267.0E-06	43.2E-06
4	-	35.0E-06	-47.0E-06	-120.2E-06	-104.0E-06	-184.1E-06	-298.0E-06	-287.1E-06	-286.1E-06	-276.1E-06	-269.2E-06	-196.9E-06	116.1E-06
Average	-	14.6E-06	-47.5E-06	-137.7E-06	-123.6E-06	-190.7E-06	-317.0E-06	-326.4E-06	-315.4E-06	-297.4E-06	-281.1E-06	-218.6E-06	97.8E-06
Sigma	-	38.4E-06	27.0E-06	36.9E-06	39.6E-06	29.9E-06	26.2E-06	35.5E-06	27.5E-06	35.3E-06	29.8E-06	34.3E-06	39.3E-06

Measurements

DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03
ON TID samples													
8	-1.0E-03	-1.1E-03	-1.1E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.4E-03	-1.1E-03
9	-1.0E-03	-1.1E-03	-1.1E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.4E-03	-1.1E-03
10	-1.1E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.4E-03	-1.6E-03	-1.6E-03	-1.6E-03	-1.6E-03	-1.5E-03	-1.5E-03	-1.2E-03
Statistics													
Min	-1.1E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.4E-03	-1.6E-03	-1.6E-03	-1.6E-03	-1.6E-03	-1.5E-03	-1.5E-03	-1.2E-03
Max	-1.0E-03	-1.1E-03	-1.1E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.4E-03	-1.1E-03
Average	-1.1E-03	-1.1E-03	-1.2E-03	-1.3E-03	-1.3E-03	-1.4E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.5E-03	-1.4E-03	-1.1E-03
Sigma	47.1E-06	52.0E-06	67.5E-06	45.9E-06	38.9E-06	41.6E-06	53.9E-06	47.5E-06	34.1E-06	33.9E-06	41.3E-06	52.5E-06	49.2E-06

Drift Calculation

DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON TID samples													
8	-	-24.1E-06	-93.2E-06	-208.4E-06	-242.0E-06	-301.4E-06	-429.2E-06	-448.2E-06	-476.1E-06	-472.3E-06	-398.2E-06	-359.1E-06	-39.1E-06
9	-	-39.1E-06	-116.8E-06	-224.8E-06	-250.1E-06	-319.0E-06	-438.9E-06	-475.9E-06	-477.1E-06	-452.0E-06	-401.0E-06	-369.1E-06	-37.9E-06
10	-	-41.0E-06	-146.7E-06	-212.9E-06	-228.2E-06	-297.1E-06	-448.0E-06	-459.9E-06	-448.9E-06	-432.0E-06	-387.2E-06	-375.0E-06	-42.9E-06
Average	-	-34.7E-06	-118.9E-06	-215.4E-06	-240.1E-06	-305.8E-06	-438.7E-06	-461.3E-06	-467.4E-06	-452.1E-06	-395.5E-06	-367.7E-06	-40.0E-06
Sigma	-	7.6E-06	21.9E-06	6.9E-06	9.1E-06	9.5E-06	7.7E-06	11.3E-06	13.0E-06	16.4E-06	6.0E-06	6.6E-06	2.1E-06

Hirex Engineering	Total Dose Radiation Test Report									Ref.:	HRX/TID/1014
	IS2-1009RH					Intersil				Issue:	01

**Measurements**

DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03
<b>OFF_PROTON samples</b>													
5	-1.1E-03	-1.3E-03	-1.9E-03	-2.3E-03	-3.2E-03	-5.1E-03	-8.8E-03	-14.1E-03	-18.5E-03	-22.0E-03	-24.3E-03	-21.9E-03	-1.3E-03
6	-1.1E-03	-1.3E-03	-932.9E-06	-2.5E-03	-3.7E-03	-6.2E-03	-10.9E-03	-17.9E-03	-24.0E-03	-28.7E-03	-31.5E-03	-28.6E-03	-1.3E-03
7	-1.2E-03	-1.3E-03	-2.2E-03	-2.4E-03	-3.3E-03	-5.8E-03	-9.6E-03	-15.4E-03	-20.0E-03	-24.1E-03	-26.9E-03	-23.7E-03	-1.3E-03
<b>Statistics</b>													
Min	-1.2E-03	-1.3E-03	-2.2E-03	-2.5E-03	-3.7E-03	-6.2E-03	-10.9E-03	-17.9E-03	-24.0E-03	-28.7E-03	-31.5E-03	-28.6E-03	-1.3E-03
Max	-1.1E-03	-1.3E-03	-932.9E-06	-2.3E-03	-3.2E-03	-5.1E-03	-8.8E-03	-14.1E-03	-18.5E-03	-22.0E-03	-24.3E-03	-21.9E-03	-1.3E-03
Average	-1.1E-03	-1.3E-03	-1.7E-03	-2.4E-03	-3.4E-03	-5.7E-03	-9.8E-03	-15.8E-03	-20.8E-03	-24.9E-03	-27.6E-03	-24.7E-03	-1.3E-03
Sigma	49.2E-06	32.2E-06	529.7E-06	91.7E-06	219.4E-06	476.3E-06	853.0E-06	1.6E-03	2.3E-03	2.8E-03	3.0E-03	2.8E-03	12.3E-06

**Drift Calculation**

DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
<b>OFF_PROTON samples</b>													
5	-	-265.1E-06	-808.2E-06	-1.2E-03	-2.1E-03	-4.0E-03	-7.8E-03	-13.0E-03	-17.4E-03	-20.9E-03	-23.2E-03	-20.8E-03	-229.1E-06
6	-	-123.0E-06	214.1E-06	-1.4E-03	-2.5E-03	-5.1E-03	-9.8E-03	-16.8E-03	-22.8E-03	-27.6E-03	-30.4E-03	-27.4E-03	-159.0E-06
7	-	-132.1E-06	-972.4E-06	-1.2E-03	-2.1E-03	-4.6E-03	-8.4E-03	-14.2E-03	-18.8E-03	-22.9E-03	-25.7E-03	-22.5E-03	-134.0E-06
Average	-	-173.4E-06	-522.2E-06	-1.2E-03	-2.2E-03	-4.6E-03	-8.6E-03	-14.7E-03	-19.7E-03	-23.8E-03	-26.4E-03	-23.6E-03	-174.0E-06
Sigma	-	65.0E-06	524.9E-06	83.3E-06	211.8E-06	442.9E-06	832.0E-06	1.6E-03	2.3E-03	2.8E-03	3.0E-03	2.8E-03	40.3E-06

**Measurements**

DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03	-1.1E-03
<b>OFF_TID samples</b>													
11	-997.1E-06	-1.0E-03	-1.3E-03	-1.7E-03	-2.6E-03	-4.7E-03	-7.2E-03	-12.6E-03	-16.6E-03	-20.0E-03	-22.9E-03	-20.6E-03	-1.2E-03
12	-1.1E-03	-1.0E-03	-1.2E-03	-1.9E-03	-3.0E-03	-5.6E-03	-9.1E-03	-16.2E-03	-21.8E-03	-26.4E-03	-30.1E-03	-27.1E-03	-1.3E-03
13	-1.1E-03	-1.1E-03	-1.2E-03	-1.6E-03	-2.4E-03	-4.4E-03	-7.5E-03	-12.1E-03	-15.8E-03	-18.9E-03	-21.3E-03	-19.3E-03	-1.3E-03
<b>Statistics</b>													
Min	-1.1E-03	-1.1E-03	-1.3E-03	-1.9E-03	-3.0E-03	-5.6E-03	-9.1E-03	-16.2E-03	-21.8E-03	-26.4E-03	-30.1E-03	-27.1E-03	-1.3E-03
Max	-997.1E-06	-1.0E-03	-1.2E-03	-1.6E-03	-2.4E-03	-4.4E-03	-7.2E-03	-12.1E-03	-15.8E-03	-18.9E-03	-21.3E-03	-19.3E-03	-1.2E-03
Average	-1.0E-03	-1.0E-03	-1.3E-03	-1.8E-03	-2.7E-03	-4.9E-03	-7.9E-03	-13.7E-03	-18.1E-03	-21.8E-03	-24.8E-03	-22.4E-03	-1.3E-03
Sigma	31.2E-06	46.6E-06	45.1E-06	100.1E-06	229.9E-06	549.7E-06	858.5E-06	1.8E-03	2.6E-03	3.3E-03	3.8E-03	3.4E-03	36.6E-06

**Drift Calculation**

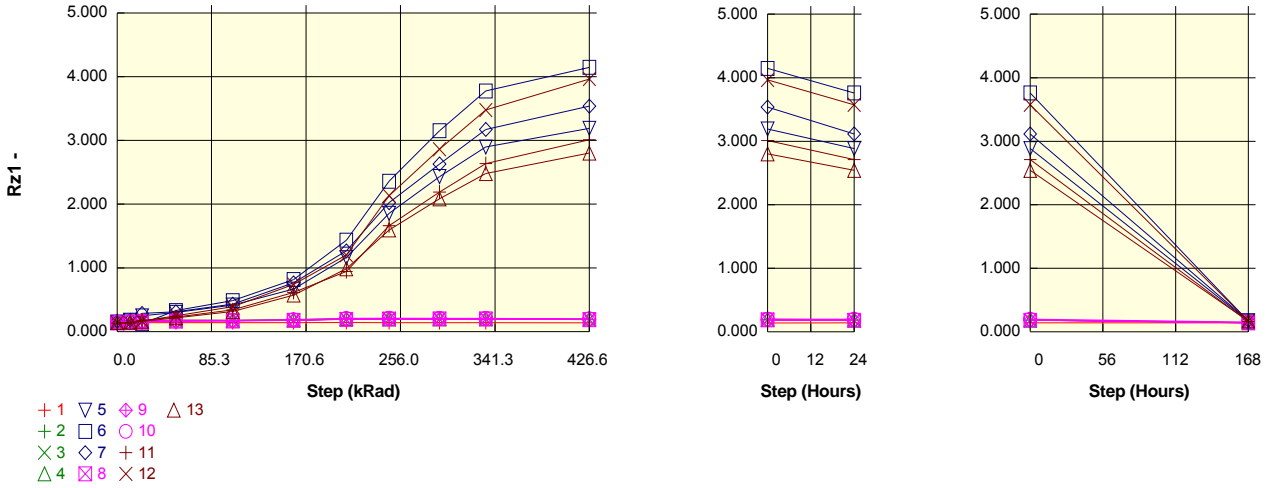
DVZ/DIZ	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
<b>OFF_TID samples</b>													
11	-	-23.8E-06	-338.0E-06	-724.8E-06	-1.6E-03	-3.7E-03	-6.2E-03	-11.6E-03	-15.6E-03	-19.0E-03	-21.9E-03	-19.6E-03	-222.9E-06
12	-	48.2E-06	-190.9E-06	-833.0E-06	-1.9E-03	-4.6E-03	-8.1E-03	-15.2E-03	-20.7E-03	-25.4E-03	-29.1E-03	-26.1E-03	-251.1E-06
13	-	-42.9E-06	-164.9E-06	-579.8E-06	-1.3E-03	-3.3E-03	-6.4E-03	-11.1E-03	-14.8E-03	-17.8E-03	-20.2E-03	-18.2E-03	-216.0E-06
Average	-	-6.2E-06	-231.3E-06	-712.6E-06	-1.6E-03	-3.8E-03	-6.9E-03	-12.6E-03	-17.0E-03	-20.7E-03	-23.7E-03	-21.3E-03	-230.0E-06
Sigma	-	39.2E-06	76.2E-06	103.7E-06	232.4E-06	547.4E-06	844.0E-06	1.8E-03	2.6E-03	3.3E-03	3.8E-03	3.4E-03	15.2E-06

Parameter : Shunt Resistance : Rz1

Test conditions : IR=400µA

Unit :

No spec limit specified.



Measurements

Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	0.141	0.141	0.140	0.141	0.140	0.141	0.143	0.141	0.141	0.141	0.139	0.141	0.141
ON_PROTON samples													
2	0.160	0.154	0.162	0.174	0.172	0.181	0.200	0.202	0.201	0.196	0.193	0.186	0.143
3	0.150	0.155	0.160	0.174	0.173	0.180	0.196	0.199	0.196	0.195	0.192	0.185	0.144
4	0.164	0.159	0.170	0.180	0.178	0.188	0.203	0.202	0.202	0.200	0.199	0.190	0.149
Statistics													
Min	0.150	0.154	0.160	0.174	0.172	0.180	0.196	0.199	0.196	0.195	0.192	0.185	0.143
Max	0.164	0.159	0.170	0.180	0.178	0.188	0.203	0.202	0.202	0.200	0.199	0.190	0.149
Average	0.158	0.156	0.164	0.176	0.174	0.183	0.200	0.201	0.199	0.197	0.195	0.187	0.145
Sigma	0.006	0.002	0.004	0.003	0.002	0.004	0.003	0.002	0.002	0.002	0.003	0.002	0.003

Drift Calculation

Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON_PROTON samples													
2	-	-6.3E-03	1.9E-03	13.7E-03	11.6E-03	20.8E-03	39.3E-03	42.0E-03	40.5E-03	35.4E-03	33.2E-03	25.3E-03	-17.6E-03
3	-	5.1E-03	10.6E-03	24.9E-03	23.5E-03	30.3E-03	46.6E-03	49.1E-03	46.3E-03	45.7E-03	42.4E-03	35.1E-03	-5.7E-03
4	-	-4.6E-03	6.2E-03	15.8E-03	13.7E-03	24.2E-03	39.2E-03	37.8E-03	37.6E-03	36.3E-03	35.4E-03	25.9E-03	-15.3E-03
Average	-	-1.9E-03	6.3E-03	18.1E-03	16.3E-03	25.1E-03	41.7E-03	42.9E-03	41.5E-03	39.1E-03	37.0E-03	28.8E-03	-12.9E-03
Sigma	-	5.0E-03	3.5E-03	4.9E-03	5.2E-03	3.9E-03	3.4E-03	4.7E-03	3.6E-03	4.6E-03	3.9E-03	4.5E-03	5.2E-03

Measurements

Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	0.141	0.141	0.140	0.141	0.140	0.141	0.143	0.141	0.141	0.141	0.139	0.141	0.141
ON_TID samples													
8	0.136	0.139	0.148	0.163	0.168	0.176	0.192	0.195	0.199	0.198	0.188	0.183	0.141
9	0.136	0.141	0.151	0.166	0.169	0.178	0.194	0.199	0.199	0.195	0.189	0.184	0.141
10	0.149	0.154	0.168	0.177	0.179	0.188	0.208	0.210	0.208	0.206	0.200	0.198	0.155
Statistics													
Min	0.136	0.139	0.148	0.163	0.168	0.176	0.192	0.195	0.199	0.195	0.188	0.183	0.141
Max	0.149	0.154	0.168	0.177	0.179	0.188	0.208	0.210	0.208	0.206	0.200	0.198	0.155
Average	0.140	0.145	0.156	0.169	0.172	0.181	0.198	0.201	0.202	0.200	0.192	0.189	0.146
Sigma	0.006	0.007	0.009	0.006	0.005	0.005	0.007	0.006	0.004	0.004	0.005	0.007	0.006

Drift Calculation

Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON_TID samples													
8	-	3.2E-03	12.3E-03	27.4E-03	31.8E-03	39.7E-03	56.5E-03	59.0E-03	62.6E-03	62.1E-03	52.4E-03	47.2E-03	5.1E-03
9	-	5.1E-03	15.4E-03	29.6E-03	32.9E-03	42.0E-03	57.8E-03	62.6E-03	62.8E-03	59.5E-03	52.8E-03	48.6E-03	5.0E-03
10	-	5.4E-03	19.3E-03	28.0E-03	30.0E-03	39.1E-03	58.9E-03	60.5E-03	59.1E-03	56.8E-03	50.9E-03	49.3E-03	5.6E-03
Average	-	4.6E-03	15.6E-03	28.3E-03	31.6E-03	40.2E-03	57.7E-03	60.7E-03	61.5E-03	59.5E-03	52.0E-03	48.4E-03	5.3E-03
Sigma	-	996.1E-06	2.9E-03	912.9E-06	1.2E-03	1.2E-03	1.0E-03	1.5E-03	1.7E-03	2.2E-03	784.2E-06	867.2E-06	281.0E-06

Measurements

Hirex Engineering	Total Dose Radiation Test Report									Ref.:	HRX/TID/1014
	IS2-1009RH				Intersil				Issue:	01	

Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.141	0.141	0.140	0.141	0.140	0.141	0.143	0.141	0.141	0.141	0.139	0.141	0.141
OFF PROTON samples													
5	0.142	0.177	0.248	0.301	0.418	0.666	1.162	1.856	2.433	2.897	3.191	2.884	0.172
6	0.151	0.167	0.123	0.330	0.485	0.817	1.435	2.360	3.153	3.777	4.146	3.760	0.172
7	0.158	0.175	0.286	0.311	0.431	0.766	1.267	2.022	2.631	3.172	3.538	3.113	0.175
Statistics													
Min	0.142	0.167	0.123	0.301	0.418	0.666	1.162	1.856	2.433	2.897	3.191	2.884	0.172
Max	0.158	0.177	0.286	0.330	0.485	0.817	1.435	2.360	3.153	3.777	4.146	3.760	0.175
Average	0.150	0.173	0.219	0.314	0.445	0.750	1.288	2.079	2.739	3.282	3.625	3.252	0.173
Sigma	0.006	0.004	0.070	0.012	0.029	0.063	0.112	0.210	0.304	0.368	0.395	0.371	0.002

**Drift Calculation**

Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF PROTON samples													
5	-	34.9E-03	106.3E-03	158.8E-03	275.8E-03	524.0E-03	1.0E+00	1.7E+00	2.3E+00	2.8E+00	3.0E+00	2.7E+00	30.1E-03
6	-	16.2E-03	-28.2E-03	179.1E-03	333.7E-03	665.9E-03	1.3E+00	2.2E+00	3.0E+00	3.6E+00	4.0E+00	3.6E+00	20.9E-03
7	-	17.4E-03	128.0E-03	153.7E-03	273.4E-03	608.0E-03	1.1E+00	1.9E+00	2.5E+00	3.0E+00	3.4E+00	3.0E+00	17.6E-03
Average	-	22.8E-03	68.7E-03	163.9E-03	294.3E-03	599.3E-03	1.1E+00	1.9E+00	2.6E+00	3.1E+00	3.5E+00	3.1E+00	22.9E-03
Sigma	-	8.5E-03	69.1E-03	11.0E-03	27.9E-03	58.3E-03	109.5E-03	207.5E-03	301.9E-03	365.4E-03	392.0E-03	368.7E-03	5.3E-03

**Measurements**

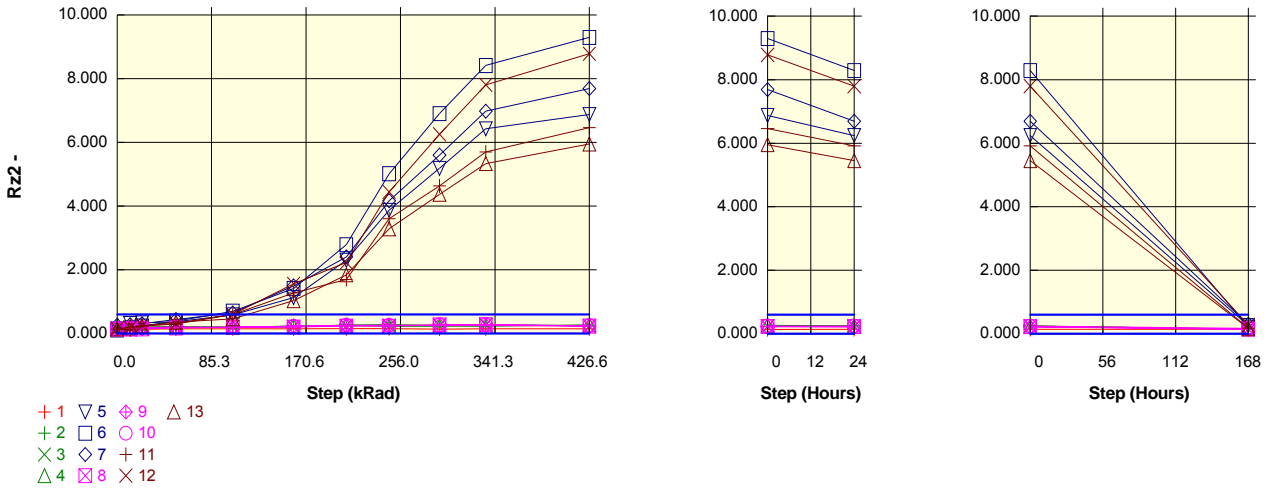
Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.141	0.141	0.140	0.141	0.140	0.141	0.143	0.141	0.141	0.141	0.139	0.141	0.141
OFF TID samples													
11	0.131	0.134	0.176	0.227	0.342	0.614	0.943	1.662	2.190	2.635	3.011	2.711	0.161
12	0.139	0.132	0.164	0.248	0.390	0.743	1.201	2.133	2.863	3.477	3.963	3.572	0.172
13	0.141	0.146	0.162	0.217	0.317	0.573	0.987	1.595	2.083	2.481	2.801	2.540	0.169
Statistics													
Min	0.131	0.132	0.162	0.217	0.317	0.573	0.943	1.595	2.083	2.481	2.801	2.540	0.161
Max	0.141	0.146	0.176	0.248	0.390	0.743	1.201	2.133	2.863	3.477	3.963	3.572	0.172
Average	0.137	0.138	0.167	0.231	0.350	0.643	1.044	1.797	2.379	2.864	3.259	2.941	0.167
Sigma	0.004	0.006	0.006	0.013	0.030	0.072	0.113	0.239	0.345	0.438	0.506	0.451	0.005

**Drift Calculation**

Rz1	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF TID samples													
11	-	3.1E-03	44.5E-03	95.4E-03	211.3E-03	483.3E-03	811.4E-03	1.5E+00	2.1E+00	2.5E+00	2.9E+00	2.6E+00	29.3E-03
12	-	-6.3E-03	25.1E-03	109.6E-03	251.2E-03	603.8E-03	1.1E+00	2.0E+00	2.7E+00	3.3E+00	3.8E+00	3.4E+00	33.0E-03
13	-	5.6E-03	21.7E-03	76.3E-03	176.3E-03	432.0E-03	846.3E-03	1.5E+00	1.9E+00	2.3E+00	2.7E+00	2.4E+00	28.4E-03
Average	-	815.6E-06	30.4E-03	93.8E-03	212.9E-03	506.4E-03	906.7E-03	1.7E+00	2.2E+00	2.7E+00	3.1E+00	2.8E+00	30.3E-03
Sigma	-	5.2E-03	10.0E-03	13.6E-03	30.6E-03	72.0E-03	111.1E-03	238.4E-03	344.2E-03	437.3E-03	504.9E-03	450.8E-03	2.0E-03



Parameter : Shunt Resistance : Rz2  
 Test conditions : IR=1mA  
 Unit :  
 Spec Limit Min : 0.000  
 Spec Limit Max : 0.600  
 Spec limits are represented in bold lines on the graphic.



**Measurements**

Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.145	0.152	0.134	0.145	0.142	0.145	0.152	0.152	0.138	0.145	0.142	0.145	0.143
ON PROTON samples													
2	0.185	0.172	0.183	0.190	0.185	0.210	0.262	0.273	0.257	0.273	0.240	0.248	0.149
3	0.148	0.167	0.178	0.207	0.200	0.215	0.242	0.245	0.237	0.267	0.238	0.242	0.153
4	0.220	0.162	0.207	0.220	0.190	0.233	0.257	0.222	0.230	0.222	0.270	0.242	0.153
Statistics													
Min	0.148	0.162	0.178	0.190	0.185	0.210	0.242	0.222	0.230	0.222	0.238	0.242	0.149
Max	0.220	0.172	0.207	0.220	0.200	0.233	0.262	0.273	0.257	0.273	0.270	0.248	0.153
Average	0.184	0.167	0.189	0.206	0.192	0.219	0.253	0.247	0.241	0.254	0.250	0.244	0.152
Sigma	0.029	0.004	0.012	0.012	0.006	0.010	0.009	0.021	0.011	0.023	0.015	0.003	0.002

**Drift Calculation**

Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON PROTON samples													
2	-	-13.1E-03	-2.0E-03	4.8E-03	0.0E+00	25.0E-03	76.7E-03	88.2E-03	71.5E-03	88.2E-03	54.8E-03	63.2E-03	-36.6E-03
3	-	18.7E-03	30.2E-03	58.4E-03	51.7E-03	66.8E-03	93.4E-03	97.0E-03	88.6E-03	118.4E-03	90.2E-03	93.8E-03	5.2E-03
4	-	-58.0E-03	-13.2E-03	397.4E-06	-29.8E-03	13.5E-03	37.0E-03	2.0E-03	10.3E-03	2.0E-03	50.5E-03	21.9E-03	-66.4E-03
Average	-	-17.5E-03	5.0E-03	21.2E-03	7.3E-03	35.1E-03	69.0E-03	62.4E-03	56.8E-03	69.5E-03	65.2E-03	59.6E-03	-32.6E-03
Sigma	-	31.5E-03	18.4E-03	26.4E-03	33.7E-03	22.9E-03	23.7E-03	42.9E-03	33.6E-03	49.3E-03	17.8E-03	29.5E-03	29.3E-03

**Measurements**

Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.145	0.152	0.134	0.145	0.142	0.145	0.152	0.152	0.138	0.145	0.142	0.145	0.143
ON TID samples													
8	0.138	0.137	0.142	0.174	0.203	0.202	0.232	0.222	0.270	0.275	0.233	0.226	0.153
9	0.141	0.159	0.165	0.185	0.187	0.230	0.247	0.258	0.252	0.252	0.227	0.222	0.140
10	0.152	0.167	0.185	0.207	0.190	0.217	0.258	0.252	0.261	0.268	0.242	0.242	0.175
Statistics													
Min	0.138	0.137	0.142	0.174	0.187	0.202	0.232	0.222	0.252	0.252	0.227	0.222	0.140
Max	0.152	0.167	0.185	0.207	0.203	0.230	0.258	0.258	0.270	0.275	0.242	0.242	0.175
Average	0.144	0.154	0.164	0.188	0.193	0.216	0.246	0.244	0.261	0.265	0.234	0.230	0.156
Sigma	0.006	0.013	0.018	0.014	0.007	0.012	0.011	0.016	0.007	0.010	0.006	0.008	0.014

**Drift Calculation**

Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON TID samples													
8	-	-1.6E-03	3.6E-03	35.4E-03	64.8E-03	63.6E-03	93.4E-03	83.4E-03	131.5E-03	136.7E-03	95.0E-03	88.2E-03	15.1E-03
9	-	17.1E-03	23.3E-03	43.3E-03	45.3E-03	88.6E-03	105.3E-03	116.8E-03	110.5E-03	110.1E-03	85.4E-03	80.3E-03	-1.2E-03
10	-	15.1E-03	33.1E-03	54.8E-03	38.1E-03	65.2E-03	106.5E-03	99.7E-03	109.7E-03	116.4E-03	90.2E-03	89.8E-03	23.0E-03
Average	-	10.2E-03	20.0E-03	44.5E-03	49.4E-03	72.5E-03	101.7E-03	100.0E-03	117.2E-03	121.1E-03	90.2E-03	86.1E-03	12.3E-03
Sigma	-	8.4E-03	12.3E-03	8.0E-03	11.3E-03	11.4E-03	5.9E-03	13.6E-03	10.1E-03	11.4E-03	3.9E-03	4.2E-03	10.1E-03

Hirex Engineering	Total Dose Radiation Test Report								Ref.:	HRX/TID/1014
	IS2-1009RH				Intersil				Issue:	01

**Measurements**

Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.145	0.152	0.134	0.145	0.142	0.145	0.152	0.152	0.138	0.145	0.142	0.145	0.143
OFF PROTON samples													
5	0.135	0.318	0.335	0.370	0.583	1.125	2.297	3.868	5.187	6.428	6.874	6.243	0.258
6	0.112	0.175	0.238	0.388	0.699	1.417	2.790	5.015	6.901	8.412	9.292	8.283	0.213
7	0.258	0.273	0.303	0.438	0.647	1.495	2.403	4.168	5.597	6.980	7.688	6.690	0.303
Statistics													
Min	0.112	0.175	0.238	0.370	0.583	1.125	2.297	3.868	5.187	6.428	6.874	6.243	0.213
Max	0.258	0.318	0.335	0.438	0.699	1.495	2.790	5.015	6.901	8.412	9.292	8.283	0.303
Average	0.168	0.256	0.292	0.399	0.643	1.346	2.497	4.350	5.895	7.273	7.951	7.072	0.258
Sigma	0.064	0.060	0.040	0.029	0.047	0.159	0.212	0.485	0.731	0.836	1.005	0.876	0.037

**Drift Calculation**

Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF PROTON samples													
5	-	183.2E-03	200.0E-03	234.8E-03	448.2E-03	990.2E-03	2.2E+00	3.7E+00	5.1E+00	6.3E+00	6.7E+00	6.1E+00	123.2E-03
6	-	63.2E-03	126.4E-03	276.6E-03	586.9E-03	1.3E+00	2.7E+00	4.9E+00	6.8E+00	8.3E+00	9.2E+00	8.2E+00	101.7E-03
7	-	15.1E-03	45.1E-03	180.0E-03	388.2E-03	1.2E+00	2.1E+00	3.9E+00	5.3E+00	6.7E+00	7.4E+00	6.4E+00	44.9E-03
Average	-	87.2E-03	123.8E-03	230.5E-03	474.5E-03	1.2E+00	2.3E+00	4.2E+00	5.7E+00	7.1E+00	7.8E+00	6.9E+00	89.9E-03
Sigma	-	70.7E-03	63.3E-03	39.5E-03	83.2E-03	135.2E-03	247.5E-03	514.9E-03	760.8E-03	863.0E-03	1.0E+00	906.2E-03	33.0E-03

**Measurements**

Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.145	0.152	0.134	0.145	0.142	0.145	0.152	0.152	0.138	0.145	0.142	0.145	0.143
OFF TID samples													
11	0.137	0.110	0.230	0.302	0.590	1.273	1.695	3.602	4.633	5.697	6.460	5.915	0.177
12	0.147	0.177	0.242	0.317	0.596	1.558	2.230	4.445	6.253	7.805	8.781	7.797	0.277
13	0.147	0.213	0.235	0.355	0.460	1.032	1.842	3.285	4.370	5.335	5.952	5.450	0.172
Statistics													
Min	0.137	0.110	0.230	0.302	0.460	1.032	1.695	3.285	4.370	5.335	5.952	5.450	0.172
Max	0.147	0.213	0.242	0.355	0.596	1.558	2.230	4.445	6.253	7.805	8.781	7.797	0.277
Average	0.143	0.167	0.236	0.324	0.549	1.288	1.922	3.777	5.085	6.279	7.064	6.387	0.208
Sigma	0.005	0.043	0.005	0.022	0.063	0.215	0.226	0.490	0.833	1.089	1.232	1.015	0.048

**Drift Calculation**

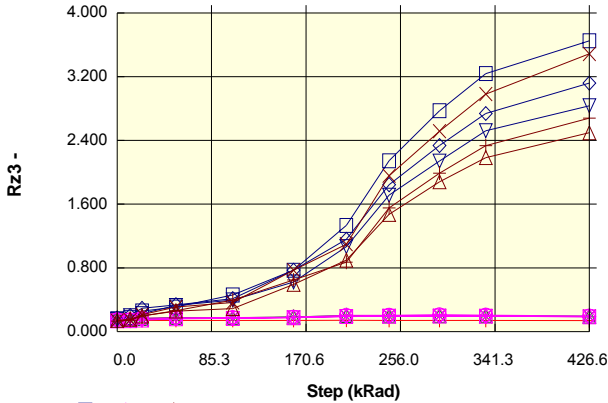
Rz2	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF TID samples													
11	-	-26.6E-03	93.5E-03	164.9E-03	453.0E-03	1.1E+00	1.6E+00	3.5E+00	4.5E+00	5.6E+00	6.3E+00	5.8E+00	40.1E-03
12	-	30.1E-03	95.0E-03	170.1E-03	449.8E-03	1.4E+00	2.1E+00	4.3E+00	6.1E+00	7.7E+00	8.6E+00	7.7E+00	129.9E-03
13	-	66.4E-03	88.2E-03	208.2E-03	313.5E-03	884.9E-03	1.7E+00	3.1E+00	4.2E+00	5.2E+00	5.8E+00	5.3E+00	25.0E-03
Average	-	23.3E-03	92.2E-03	181.1E-03	405.4E-03	1.1E+00	1.8E+00	3.6E+00	4.9E+00	6.1E+00	6.9E+00	6.2E+00	65.0E-03
Sigma	-	38.3E-03	2.9E-03	19.3E-03	65.0E-03	215.2E-03	222.5E-03	488.4E-03	831.0E-03	1.1E+00	1.2E+00	1.0E+00	46.3E-03

Parameter : Shunt Resistance : Rz3

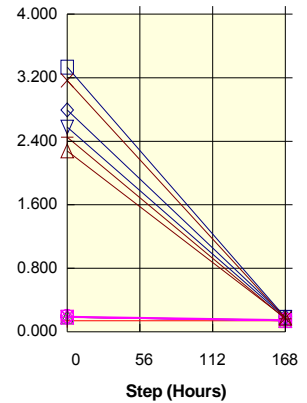
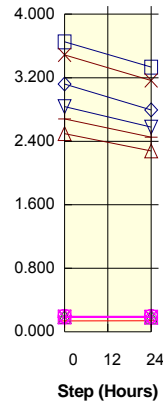
Test conditions : IR=8mA

Unit :

No spec limit specified.



+ 1 ∇ 5 ◆ 9 △ 13  
 + 2 □ 6 ○ 10  
 × 3 ◇ 7 + 11  
 △ 4 ⊗ 8 × 12



Measurements

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	0.141	0.142	0.140	0.140	0.140	0.141	0.144	0.141	0.141	0.141	0.139	0.141	0.141
ON_PROTON samples													
2	0.171	0.149	0.159	0.173	0.169	0.180	0.196	0.201	0.201	0.194	0.189	0.184	0.140
3	0.158	0.151	0.156	0.174	0.171	0.179	0.194	0.197	0.198	0.194	0.190	0.184	0.144
4	0.170	0.155	0.166	0.177	0.176	0.184	0.203	0.197	0.200	0.201	0.194	0.189	0.147
Statistics													
Min	0.158	0.149	0.156	0.173	0.169	0.179	0.194	0.197	0.198	0.194	0.189	0.184	0.140
Max	0.171	0.155	0.166	0.177	0.176	0.184	0.203	0.201	0.201	0.201	0.194	0.189	0.147
Average	0.166	0.152	0.160	0.174	0.172	0.181	0.198	0.198	0.200	0.196	0.191	0.186	0.144
Sigma	0.006	0.002	0.004	0.002	0.003	0.002	0.004	0.002	0.002	0.003	0.002	0.002	0.003

Drift Calculation

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON_PROTON samples													
2	-	-21.8E-03	-11.4E-03	1.9E-03	-1.3E-03	9.1E-03	25.0E-03	30.0E-03	30.7E-03	23.0E-03	18.6E-03	13.3E-03	-30.4E-03
3	-	-7.3E-03	-2.6E-03	15.7E-03	12.8E-03	21.2E-03	36.0E-03	39.3E-03	39.4E-03	36.3E-03	32.2E-03	26.3E-03	-14.4E-03
4	-	-14.7E-03	-3.4E-03	7.0E-03	6.0E-03	14.7E-03	33.3E-03	27.6E-03	30.4E-03	31.4E-03	24.6E-03	19.1E-03	-22.2E-03
Average	-	-14.6E-03	-5.8E-03	8.2E-03	5.9E-03	15.0E-03	31.4E-03	32.3E-03	33.5E-03	30.2E-03	25.1E-03	19.6E-03	-22.3E-03
Sigma	-	5.9E-03	4.0E-03	5.7E-03	5.8E-03	4.9E-03	4.7E-03	5.1E-03	4.2E-03	5.5E-03	5.5E-03	5.3E-03	6.5E-03

Measurements

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1_REF	0.141	0.142	0.140	0.140	0.140	0.141	0.144	0.141	0.141	0.141	0.139	0.141	0.141
ON_TID samples													
8	0.136	0.137	0.145	0.162	0.166	0.174	0.189	0.194	0.195	0.193	0.186	0.184	0.142
9	0.136	0.138	0.150	0.164	0.166	0.177	0.191	0.194	0.195	0.193	0.185	0.182	0.140
10	0.149	0.150	0.169	0.174	0.177	0.182	0.205	0.205	0.211	0.206	0.196	0.196	0.154
Statistics													
Min	0.136	0.137	0.145	0.162	0.166	0.174	0.189	0.194	0.195	0.193	0.185	0.182	0.140
Max	0.149	0.150	0.169	0.174	0.177	0.182	0.205	0.205	0.211	0.206	0.196	0.196	0.154
Average	0.141	0.142	0.154	0.167	0.170	0.178	0.195	0.198	0.201	0.197	0.189	0.188	0.145
Sigma	0.006	0.006	0.011	0.005	0.005	0.004	0.007	0.005	0.007	0.006	0.005	0.006	0.006

Drift Calculation

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
ON_TID samples													
8	-	1.2E-03	8.3E-03	25.7E-03	30.0E-03	37.5E-03	52.7E-03	57.4E-03	59.2E-03	56.3E-03	49.9E-03	47.9E-03	5.4E-03
9	-	2.0E-03	13.4E-03	27.8E-03	29.8E-03	40.7E-03	55.0E-03	57.8E-03	59.1E-03	57.3E-03	49.3E-03	46.3E-03	4.1E-03
10	-	272.5E-06	19.6E-03	24.4E-03	28.0E-03	32.9E-03	55.6E-03	55.4E-03	61.4E-03	57.0E-03	46.2E-03	46.9E-03	4.3E-03
Average	-	1.1E-03	13.8E-03	26.0E-03	29.3E-03	37.0E-03	54.4E-03	56.9E-03	59.9E-03	56.9E-03	48.4E-03	47.0E-03	4.6E-03
Sigma	-	695.4E-06	4.6E-03	1.4E-03	893.8E-06	3.2E-03	1.2E-03	1.1E-03	1.1E-03	405.2E-06	1.6E-03	659.5E-06	584.0E-06

Measurements

Hirex Engineering	Total Dose Radiation Test Report									Ref.:	HRX/TID/1014		
	IS2-1009RH					Intersil				Issue:	01		

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.141	0.142	0.140	0.140	0.140	0.141	0.144	0.141	0.141	0.141	0.139	0.141	0.141
OFF PROTON samples													
5	0.154	0.199	0.224	0.329	0.397	0.624	1.067	1.714	2.140	2.523	2.835	2.577	0.180
6	0.161	0.174	0.259	0.307	0.459	0.770	1.333	2.146	2.773	3.239	3.652	3.333	0.183
7	0.171	0.203	0.291	0.337	0.413	0.770	1.160	1.845	2.336	2.739	3.120	2.793	0.188
Statistics													
Min	0.154	0.174	0.224	0.307	0.397	0.624	1.067	1.714	2.140	2.523	2.835	2.577	0.180
Max	0.171	0.203	0.291	0.337	0.459	0.770	1.333	2.146	2.773	3.239	3.652	3.333	0.188
Average	0.162	0.192	0.258	0.324	0.423	0.721	1.187	1.902	2.416	2.833	3.202	2.901	0.184
Sigma	0.007	0.013	0.027	0.013	0.026	0.069	0.110	0.181	0.264	0.300	0.338	0.318	0.004

**Drift Calculation**

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF PROTON samples													
5	-	44.8E-03	70.0E-03	174.9E-03	242.3E-03	469.8E-03	913.0E-03	1.6E+00	2.0E+00	2.4E+00	2.7E+00	2.4E+00	25.3E-03
6	-	13.6E-03	97.9E-03	146.5E-03	298.0E-03	609.5E-03	1.2E+00	2.0E+00	2.6E+00	3.1E+00	3.5E+00	3.2E+00	21.7E-03
7	-	32.3E-03	120.4E-03	166.0E-03	242.6E-03	599.2E-03	988.7E-03	1.7E+00	2.2E+00	2.6E+00	2.9E+00	2.6E+00	17.5E-03
Average	-	30.2E-03	96.1E-03	162.4E-03	261.0E-03	559.5E-03	1.0E+00	1.7E+00	2.3E+00	2.7E+00	3.0E+00	2.7E+00	21.5E-03
Sigma	-	12.8E-03	20.6E-03	11.9E-03	26.2E-03	63.6E-03	108.8E-03	179.9E-03	263.2E-03	298.6E-03	337.0E-03	316.8E-03	3.2E-03

**Measurements**

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
1 REF	0.141	0.142	0.140	0.140	0.140	0.141	0.144	0.141	0.141	0.141	0.139	0.141	0.141
OFF TID samples													
11	0.132	0.142	0.196	0.262	0.395	0.649	0.871	1.552	1.990	2.333	2.680	2.451	0.164
12	0.139	0.146	0.211	0.307	0.365	0.769	1.097	1.956	2.515	2.982	3.487	3.166	0.174
13	0.141	0.156	0.196	0.259	0.291	0.593	0.897	1.472	1.881	2.185	2.497	2.278	0.174
Statistics													
Min	0.132	0.142	0.196	0.259	0.291	0.593	0.871	1.472	1.881	2.185	2.497	2.278	0.164
Max	0.141	0.156	0.211	0.307	0.395	0.769	1.097	1.956	2.515	2.982	3.487	3.166	0.174
Average	0.137	0.148	0.201	0.276	0.350	0.670	0.955	1.660	2.129	2.500	2.888	2.632	0.171
Sigma	0.004	0.006	0.007	0.022	0.044	0.073	0.101	0.212	0.277	0.346	0.430	0.384	0.004

**Drift Calculation**

Rz3	0 kRad	11.7 kRad	22.5 kRad	53.1 kRad	104.4 kRad	159.3 kRad	207 kRad	245.7 kRad	291.2 kRad	333 kRad	426.6 kRad	24 Hours	168 Hours
OFF TID samples													
11	-	10.6E-03	64.7E-03	130.6E-03	263.3E-03	517.0E-03	739.3E-03	1.4E+00	1.9E+00	2.2E+00	2.5E+00	2.3E+00	32.7E-03
12	-	7.4E-03	72.4E-03	168.8E-03	226.5E-03	630.7E-03	958.5E-03	1.8E+00	2.4E+00	2.8E+00	3.3E+00	3.0E+00	35.6E-03
13	-	15.0E-03	55.1E-03	117.7E-03	149.7E-03	452.4E-03	755.5E-03	1.3E+00	1.7E+00	2.0E+00	2.4E+00	2.1E+00	32.7E-03
Average	-	11.0E-03	64.1E-03	139.0E-03	213.2E-03	533.4E-03	817.8E-03	1.5E+00	2.0E+00	2.4E+00	2.8E+00	2.5E+00	33.7E-03
Sigma	-	3.1E-03	7.1E-03	21.7E-03	47.3E-03	73.7E-03	99.7E-03	211.5E-03	276.4E-03	345.8E-03	429.4E-03	383.8E-03	1.3E-03