

PROTONS TEST REPORT

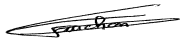


ESA study: "Survey of Critical Components for 150 kRad Power Systems"

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

<p>Part Type : IS9-2100ARH</p> <p>Package : FP-16</p> <p>Description : Rad Hard High Frequency Half Bridge Driver</p> <p>Manufacturer: Intersil</p>

Alter Technology Group Spain Purchase Order N° ATGSP-TL-09-JC-CO-9 dated 11/27/2009

Alter Technology Group Spain Project Manager: David NUNEZ

Hirex reference :	HRX/TID/0877	Issue : 01	Date :	June 3 rd , 2011
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Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

PROTONS TEST REPORT
on
IS9-2100ARH
Rad Hard High Frequency Half Bridge Driver
From Intersil

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1 Introduction

In the scope of the ESA study: "Survey of Critical Components for 150 kRad Power Systems", a protons test of the Intersil IS9-2100ARH, Rad Hard High Frequency Half Bridge Driver has been performed up to a total fluence of about $2E11$ p/cm², in response to Alter Technology Group Spain purchase order reference ATGSP-TL-09-JC-CO-9 that refers to ESTEC contract N° 22831/09/NL/AF.

Displacement damage effects were investigated using 60 MeV protons energy. Devices were irradiated at UCL in Louvain - Belgium.

The purpose of this test was to characterize degradation due to protons induced displacement damage so further mission analysis could determine their suitability for flight use. This test was conducted on samples provided by Alter Technology Group Spain.

Test has been performed in accordance with Hirex Engineering Radiation Test Plan HRX/SPE/0232 issue 2 dated 09/08/2010.

A complete set of electrical measurements together with graphical representation of measured parameters with respect to Fluence levels received are also provided.

2 Applicable and Reference Documents

2.1 Applicable Documents

- Hirex Engineering Radiation Test Plan: HRX/SPE/0232 issue 2 dated 09/08/2010
- Alter Technology Group Proposal: ATGSP-OF-648/2009 Issue 1
- Minutes of Meeting: MM-SRP-ATG-0001 dated 29/10/2009
- Hirex specification: Total Ionizing dose test general procedure.
- SMD detail specification: 5962-99536

2.2 Reference Documents

- Intersil datasheet: FN9037.1, April 2003

3 Test Samples

7 samples of the IS9-2100ARH devices were tested (6 + 1 control sample).

Allocation of samples used for testing is provided in the following table. Serial numbers were arbitrarily defined by Hirex.

Serial Numbers	Samples allocation
1	Control sample
2	Biased OFF
3	Biased OFF
4	Biased OFF
5	Biased OFF
6	Biased OFF
7	Biased OFF

Identification of the IS9-2100ARH is given below:

Part Number: IS9-2100ARH

Top Marking: logo IS9-2100ARH delta /PROTO

Bottom Marking: -

Date Code: -

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4 Experimental Conditions

4.1 Radiation Source Description

The protons exposures were performed at the UCL facility in Louvain-la-Neuve - Belgium. The Proton Irradiation facility (Light Ion irradiation Facility or LIF) was used for this experiment. The corresponding experimental set-up is shown in Figure 1.

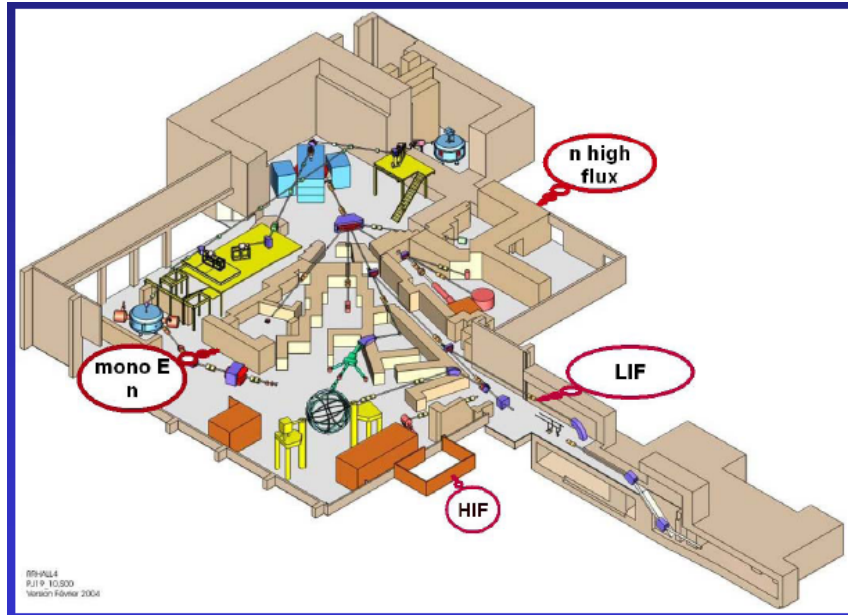


Figure 1 : LIF layout and typical experimental set-up

Light Ion irradiation Facility is characterized by the following beam parameters:

- Initial Proton Energies: 65 MeV;
- Energy Range: 9.3 – 62 MeV using energy degraders (See Figure 2)
- Beam Flux at 62 MeV is between 10^7 p/cm²/sec to 5×10^8 p/cm²/sec
- Irradiation Area: 8 cm diameter maximum

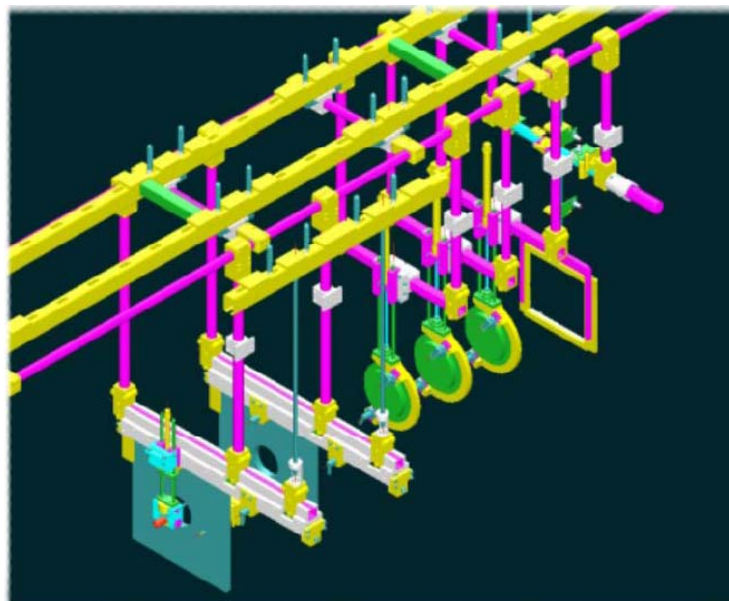


Figure 2: LIF Energy degraders

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The irradiation conditions used for this test are provided in the following table:

Fluence Steps	Total Fluence	Flux	Equivalent Total Dose	Temperature
p/cm ² @60MeV	p/cm ² @60MeV	p/cm ² /s	Rad (Si)	°C
0	0		0	
2E+11	2E+11	5.00E+08	27.5E+3	25

Table 1: Irradiation conditions

4.2 Bias during Dose Exposures and Measurements conditions

4.2.1 Bias conditions

During exposures all samples were biased OFF with all pins connected to ground.

4.2.2 Electrical Measurements

Electrical parameters test program principle for IS9-2100ARH is provided in Figure 3.

A HP4142 DC tester, a HP54831B Scope and a HP33120 waveform generator were used to perform required measurements.

A dedicated test fixture and a test board were designed to ensure proper measurement conditions.

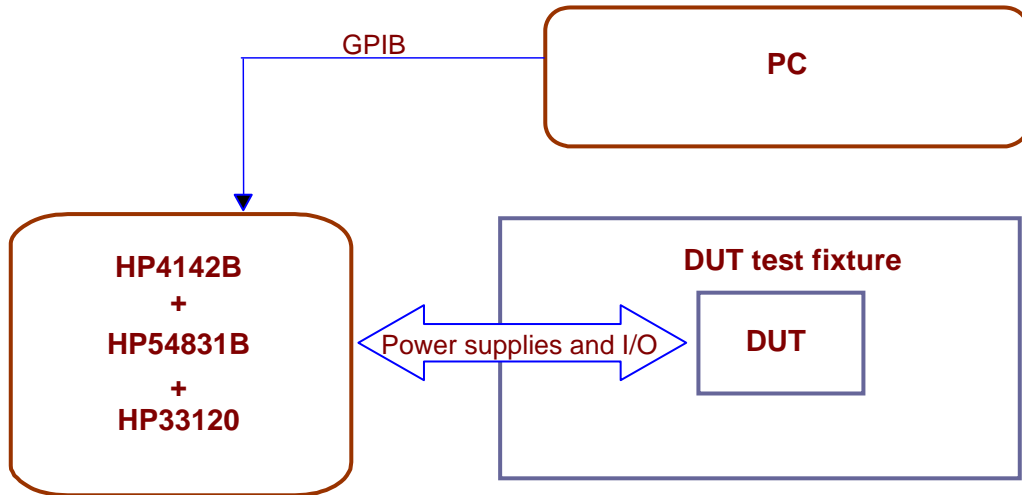


Figure 3 : IS9-2100ARH test program principle

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Electrical parameters test conditions and limits used for performing this test are given in Table 2.

Parameter	Description	Conditions	Spec		Unit
			Min	Max	
VOH(HO)	High level output voltage	VIN = VIH VOH = VB - VHO	-	0.1	V
VOH(LO)	High level output voltage	VIN = VIH VOH = VCC - VLO	-	0.1	V
VOL(HO)	Low level output voltage	VIN = VIL	-	0.1	V
VOL(LO)	Low level output voltage	VIN = VIL	-	0.1	V
IQB_H	Quiescent VB supply current	VIN = 15V	-	500	μA
IQB_L	Quiescent VB supply current	VIN = 0V	-	500	μA
IQCC_H	Quiescent VCC supply current	VIN = 15V	-	50	μA
IQCC_L	Quiescent VCC supply current	VIN = 0V	-	50	μA
IQDD	Quiescent VDD supply current	VIN = 0V	-	2.9	mA
IIN+(HIN)	Logic "1" input bias current	VIN = 15V	-	75	μA
IIN+(SD)	Logic "1" input bias current	SD = 15V	-	75	μA
IIN+(LIN)	Logic "1" input bias current	VIN = 15V	-	75	μA
IIN-(HIN)	Logic "0" input bias current	VIN = 0V	-10	-	μA
IIN-(SD)	Logic "0" input bias current	SD = 0V	-10	-	μA
IIN-(LIN)	Logic "0" input bias current	VIN = 0V	-10	-	μA
VTHUV+	VDD / VSS under-voltage lockout threshold		8	12	V
VTHUV-	VDD / VSS under-voltage lockout threshold		8	12	V
VTHUVS	VDD / VSS under-voltage lockout threshold Hystersis	VTHUVS = (VTHUV+) - (VTHUV-)	0.25	2	V
TL_{OFF}	Low side turn-off propagation delay	CL = 1000pF	-	360	ns
TH_{OFF}	High side turn-off propagation delay	CL = 1000pF	-	360	ns
TL_{ON}	Low side turn-on propagation delay	CL = 1000pF	-	425	ns
TH_{ON}	High side turn-on propagation delay	CL = 1000pF	-	425	ns
TL_{SD}	Low side shutdown propagation delay	CL = 1000pF	-	400	ns
TH_{SD}	High side shutdown propagation delay	CL = 1000pF	-	400	ns
TR_{HO}	HO rise time	CL = 1000pF	-	40	ns
TR_{LO}	LO rise time	CL = 1000pF	-	40	ns
TF_{HO}	HO fall time	CL = 1000pF	-	40	ns
TF_{LO}	LO fall time	CL = 1000pF	-	40	ns
Mt_{ON}	Turn-on propagation delay matching	TL _{ON} - TH _{ON}	-20	60	ns
Mt_{OFF}	Turn-off propagation delay matching	TL _{OFF} - TH _{OFF}	-20	60	ns

Unless otherwise specified: VDD = VB = VCC = 15V; COM = VSS = VS = SD = 0V

Table 2 : Measured electrical parameters

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5 Conclusion

A proton displacement damage test was carried out by Hirex Engineering under Alter Technology Group Spain contract on the Intersil IS9-2100ARH Rad Hard High Frequency Half Bridge Driver in FP-16 package.

Each device was exposed at room temperature to a protons flux of 60 MeV incident energy up to a total fluence of $2E+11p/cm^2$.

All parameters remained within specification limits all along testing.

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6 Test Results

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

Parameter measurements values are plotted versus Equivalent Fluence levels for 60 MeV incident energy protons. Fluences are expressed in protons/cm² in Silicon.

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

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

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Test conditions : Protons

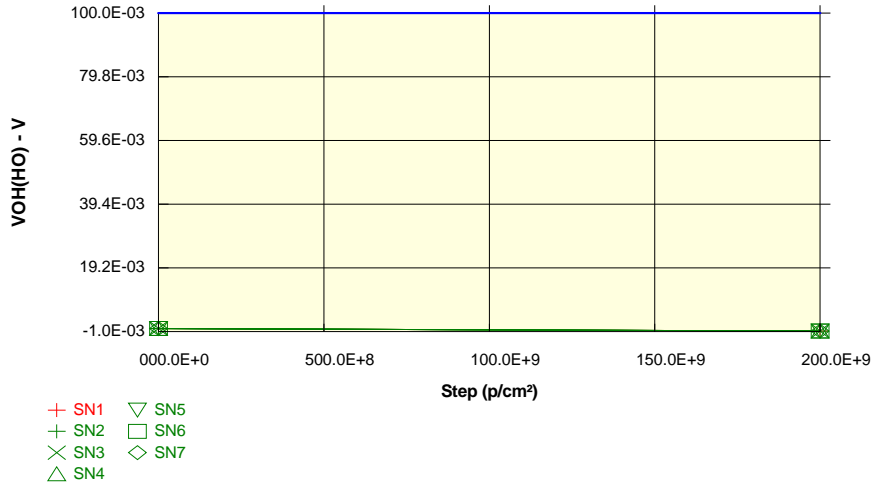
Parameter : High Level Output Voltage : VOH(HO)

VIN=VIH. VOH=VB-VHO

Unit : V

Spec Limit Max : 100.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VOH(HO)	0 p/cm ²	2E+11 p/cm ²
SN1_REF	0.0E+00	-800.1E-06
OFF samples		
SN2	0.0E+00	-800.1E-06
SN3	0.0E+00	-800.1E-06
SN4	0.0E+00	-800.1E-06
SN5	0.0E+00	-800.1E-06
SN6	0.0E+00	-800.1E-06
SN7	0.0E+00	-800.1E-06
Statistics		
Min	0.0E+00	-800.1E-06
Max	0.0E+00	-800.1E-06
Average	0.0E+00	-800.1E-06
Sigma	0.0E+00	8.4E-12

Drift Calculation

VOH(HO)	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-800.13E-06
SN3	-	-800.13E-06
SN4	-	-800.13E-06
SN5	-	-800.13E-06
SN6	-	-800.13E-06
SN7	-	-800.13E-06
Average	-	-800.13E-06
Sigma	-	8.40E-12

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Test conditions : Protons

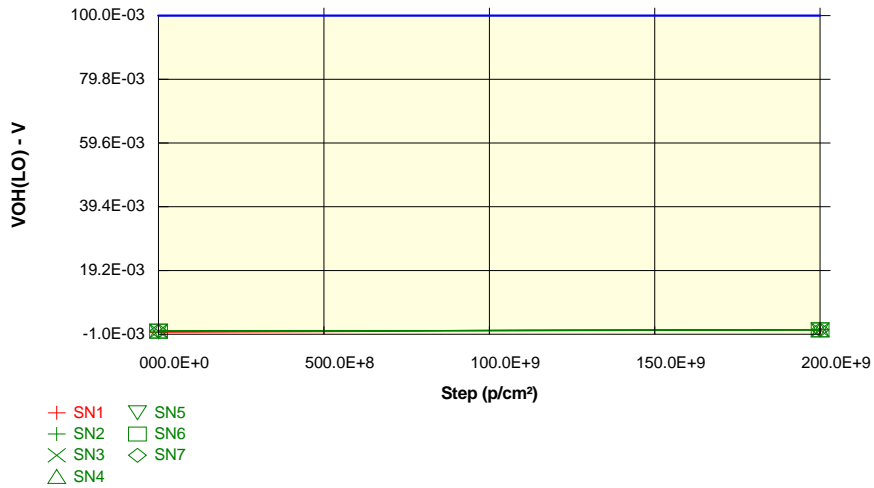
Parameter : High Level Output Voltage : VOH(LO)

VIN=VIH. VOH=VCC-VLO

Unit : V

Spec Limit Max : 100.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VOH(LO)	0 p/cm²	2E+11 p/cm²
SN1_REF	-399.6E-06	399.6E-06
OFF samples		
SN2	0.0E+00	399.6E-06
SN3	0.0E+00	399.6E-06
SN4	0.0E+00	399.6E-06
SN5	0.0E+00	399.6E-06
SN6	0.0E+00	399.6E-06
SN7	0.0E+00	399.6E-06
Statistics		
Min	0.0E+00	399.6E-06
Max	0.0E+00	399.6E-06
Average	0.0E+00	399.6E-06
Sigma	0.0E+00	0.0E+00

Drift Calculation

VOH(LO)	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	399.59E-06
SN3	-	399.59E-06
SN4	-	399.59E-06
SN5	-	399.59E-06
SN6	-	399.59E-06
SN7	-	399.59E-06
Average	-	399.59E-06
Sigma	-	0.00E+00

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Test conditions : Protons

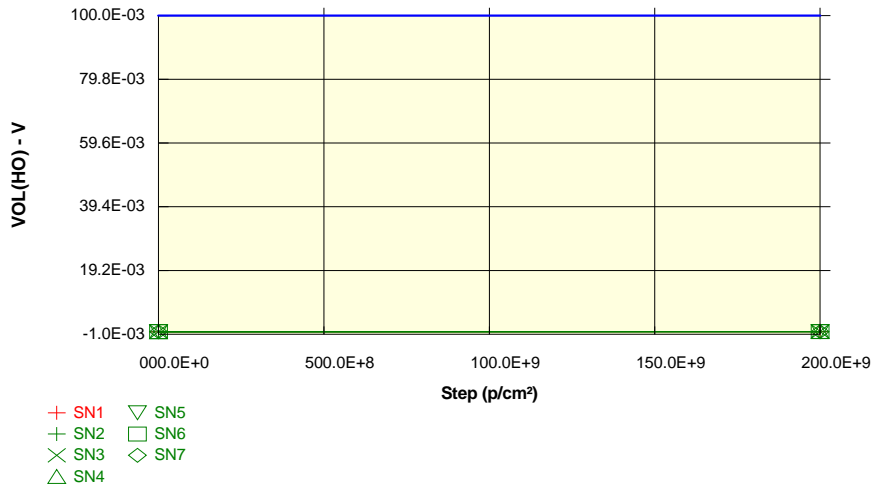
Parameter : Low level output voltage : VOL(HO)

VIN=VIL

Unit : V

Spec Limit Max : 100.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VOL(HO)	0 p/cm²	2E+11 p/cm²
SN1_REF	-240.0E-06	-160.0E-06
OFF samples		
SN2	-240.0E-06	-160.0E-06
SN3	-200.0E-06	-120.0E-06
SN4	-240.0E-06	-120.0E-06
SN5	-200.0E-06	-160.0E-06
SN6	-200.0E-06	-160.0E-06
SN7	-200.0E-06	-160.0E-06
Statistics		
Min	-240.0E-06	-160.0E-06
Max	-200.0E-06	-120.0E-06
Average	-213.3E-06	-146.7E-06
Sigma	18.9E-06	18.9E-06

Drift Calculation

VOL(HO)	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	80.00E-06
SN3	-	80.00E-06
SN4	-	120.00E-06
SN5	-	40.00E-06
SN6	-	40.00E-06
SN7	-	40.00E-06
Average	-	66.67E-06
Sigma	-	29.81E-06

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Test conditions : Protons

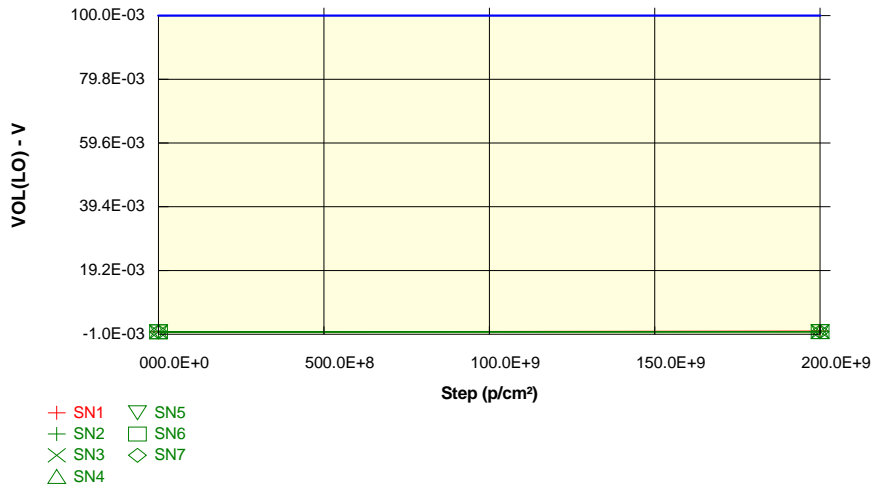
Parameter : Low level output voltage : VOL(LO)

VIN=VIL

Unit : V

Spec Limit Max : 100.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VOL(LO)	0 p/cm²	2E+11 p/cm²
SN1_REF	-240.0E-06	0.0E+00
OFF samples		
SN2	-240.0E-06	-160.0E-06
SN3	-240.0E-06	-160.0E-06
SN4	-240.0E-06	-160.0E-06
SN5	-240.0E-06	-200.0E-06
SN6	-240.0E-06	-160.0E-06
SN7	-240.0E-06	-200.0E-06
Statistics		
Min	-240.0E-06	-200.0E-06
Max	-240.0E-06	-160.0E-06
Average	-240.0E-06	-173.3E-06
Sigma	2.1E-12	18.9E-06

Drift Calculation

VOL(LO)	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	80.00E-06
SN3	-	80.00E-06
SN4	-	80.00E-06
SN5	-	40.00E-06
SN6	-	80.00E-06
SN7	-	40.00E-06
Average	-	66.67E-06
Sigma	-	18.86E-06

Test conditions : Protons

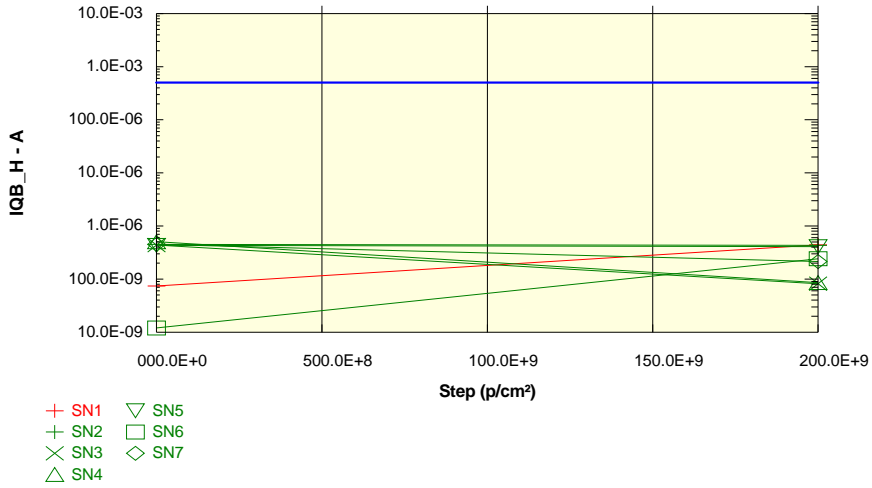
Parameter : Quiescent VB supply current : IQB_H

VIN=15V

Unit : A

Spec Limit Max : 500.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IQB_H	0 p/cm ²	2E+11 p/cm ²
SN1_REF	74.0E-09	440.0E-09
OFF samples		
SN2	454.0E-09	432.0E-09
SN3	438.0E-09	82.0E-09
SN4	506.0E-09	86.0E-09
SN5	432.0E-09	408.0E-09
SN6	12.0E-09	242.0E-09
SN7	452.0E-09	214.0E-09
Statistics		
Min	12.0E-09	82.0E-09
Max	506.0E-09	432.0E-09
Average	382.3E-09	244.0E-09
Sigma	167.3E-09	138.1E-09

Drift Calculation

IQB_H	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-22.00E-09
SN3	-	-356.00E-09
SN4	-	-420.00E-09
SN5	-	-24.00E-09
SN6	-	230.00E-09
SN7	-	-238.00E-09
Average	-	-138.33E-09
Sigma	-	223.21E-09

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Test conditions : Protons

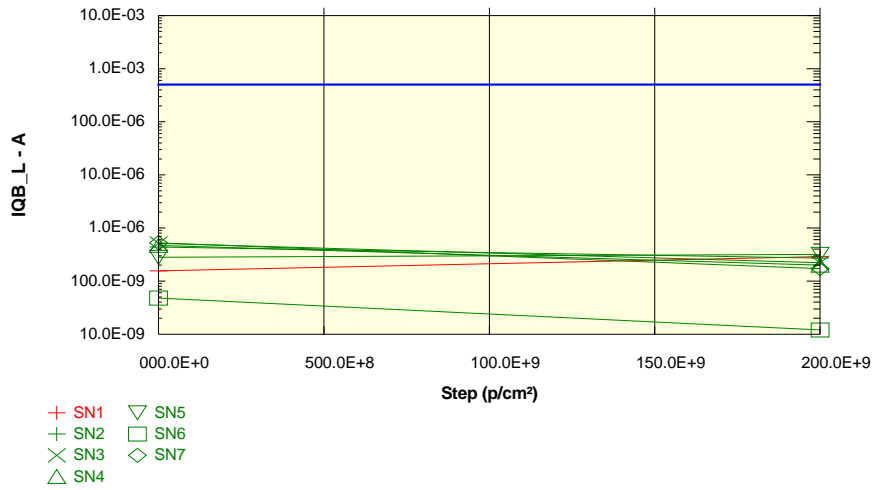
Parameter : Quiescent VB supply current : IQB_L

VIN=0V

Unit : A

Spec Limit Max : 500.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IQB_L	0 p/cm²	2E+11 p/cm²
SN1_REF	156.0E-09	290.0E-09
OFF samples		
SN2	438.0E-09	272.0E-09
SN3	512.0E-09	222.0E-09
SN4	472.0E-09	199.8E-09
SN5	280.0E-09	318.0E-09
SN6	48.0E-09	12.0E-09
SN7	524.0E-09	172.0E-09
Statistics		
Min	48.0E-09	12.0E-09
Max	524.0E-09	318.0E-09
Average	379.0E-09	199.3E-09
Sigma	168.4E-09	96.4E-09

Drift Calculation

IQB_L	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-166.00E-09
SN3	-	-290.00E-09
SN4	-	-272.20E-09
SN5	-	38.00E-09
SN6	-	-36.00E-09
SN7	-	-352.00E-09
Average	-	-179.70E-09
Sigma	-	140.62E-09

Test conditions : Protons

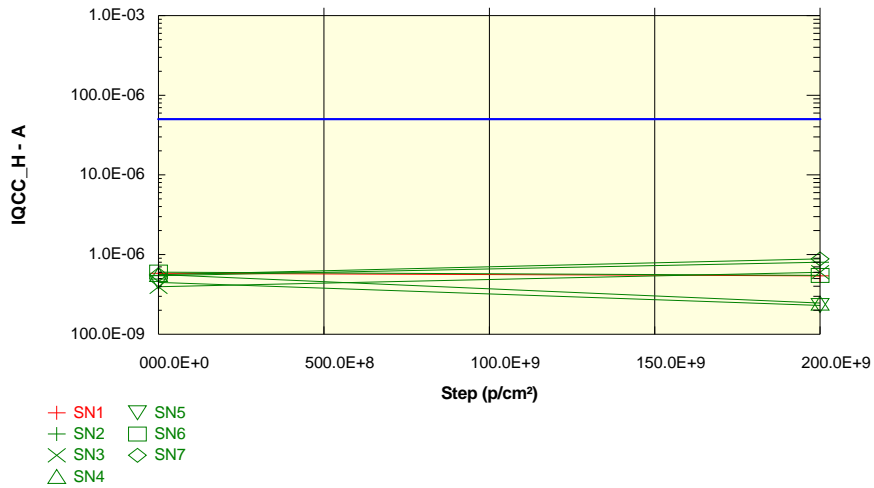
Parameter : Quiescent VCC supply current : IQCC_H

VIN = 15V

Unit : A

Spec Limit Max : 50.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements		
IQCC_H	0 p/cm²	2E+11 p/cm²
SN1_REF	582.0E-09	540.0E-09
OFF samples		
SN2	544.0E-09	800.0E-09
SN3	394.0E-09	600.0E-09
SN4	562.0E-09	246.0E-09
SN5	448.0E-09	230.0E-09
SN6	602.0E-09	548.0E-09
SN7	560.0E-09	882.0E-09
Statistics		
Min	394.0E-09	230.0E-09
Max	602.0E-09	882.0E-09
Average	518.3E-09	551.0E-09
Sigma	72.7E-09	248.3E-09

Drift Calculation		
IQCC_H	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	256.00E-09
SN3	-	206.00E-09
SN4	-	-316.00E-09
SN5	-	-218.00E-09
SN6	-	-54.00E-09
SN7	-	322.00E-09
Average	-	32.67E-09
Sigma	-	243.43E-09

Test conditions : Protons

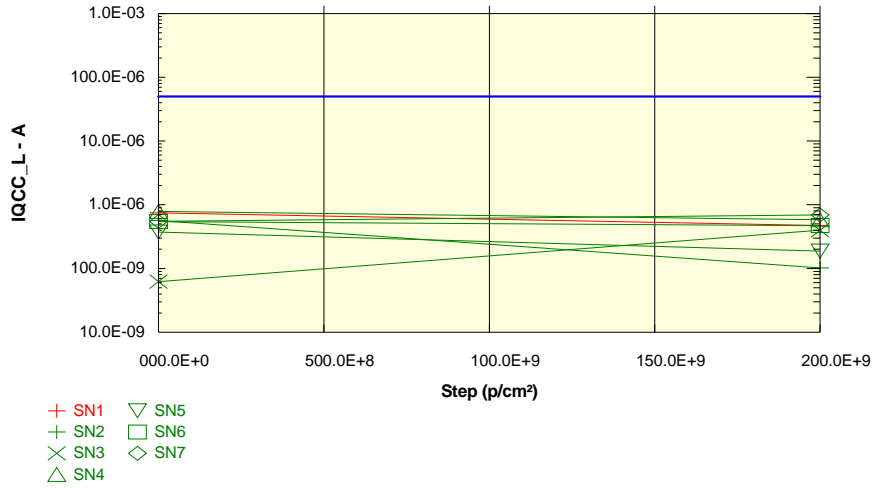
Parameter : Quiescent VCC supply current : IQCC_L

VIN = 0V

Unit : A

Spec Limit Max : 50.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IQCC L	0 p/cm ²	2E+11 p/cm ²
SN1_REF	750.0E-09	474.0E-09
OFF samples		
SN2	568.0E-09	102.0E-09
SN3	62.0E-09	398.0E-09
SN4	786.0E-09	580.0E-09
SN5	374.0E-09	188.0E-09
SN6	546.0E-09	472.0E-09
SN7	548.0E-09	690.0E-09
Statistics		
Min	62.0E-09	102.0E-09
Max	786.0E-09	690.0E-09
Average	480.7E-09	405.0E-09
Sigma	222.2E-09	206.3E-09

Drift Calculation

IQCC L	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-466.00E-09
SN3	-	336.00E-09
SN4	-	-206.00E-09
SN5	-	-186.00E-09
SN6	-	-74.00E-09
SN7	-	142.00E-09
Average	-	-75.67E-09
Sigma	-	257.67E-09

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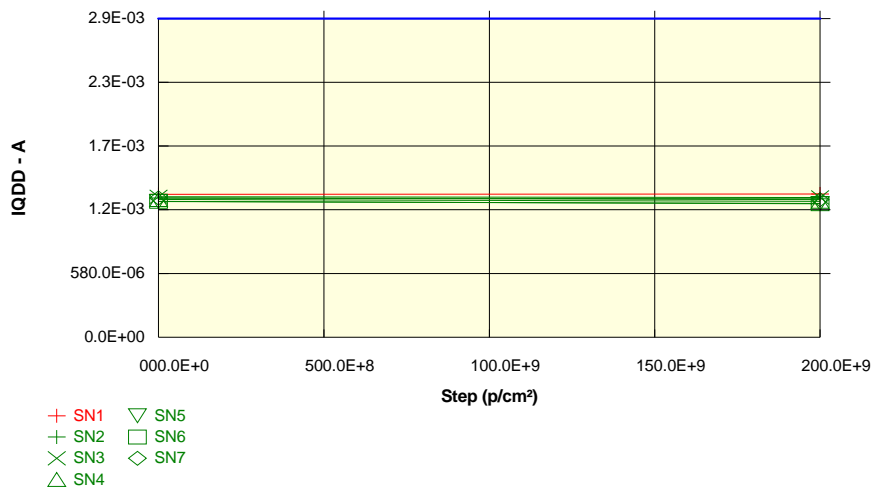
Parameter : Quiescent VDD supply current : IQDD

VIN = 0V

Unit : A

Spec Limit Max : 2.9E-03

Spec limits are represented in bold lines on the graphic.



Measurements

IQDD	0 p/cm ²	2E+11 p/cm ²
SN1_REF	1.3E-03	1.3E-03
OFF samples		
SN2	1.3E-03	1.3E-03
SN3	1.3E-03	1.3E-03
SN4	1.3E-03	1.2E-03
SN5	1.2E-03	1.2E-03
SN6	1.2E-03	1.2E-03
SN7	1.3E-03	1.3E-03
Statistics		
Min	1.2E-03	1.2E-03
Max	1.3E-03	1.3E-03
Average	1.3E-03	1.2E-03
Sigma	15.9E-06	21.2E-06

Drift Calculation

IQDD	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-6.80E-06
SN3	-	-6.80E-06
SN4	-	-17.20E-06
SN5	-	-19.00E-06
SN6	-	-22.60E-06
SN7	-	-16.60E-06
Average	-	-14.83E-06
Sigma	-	5.99E-06

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

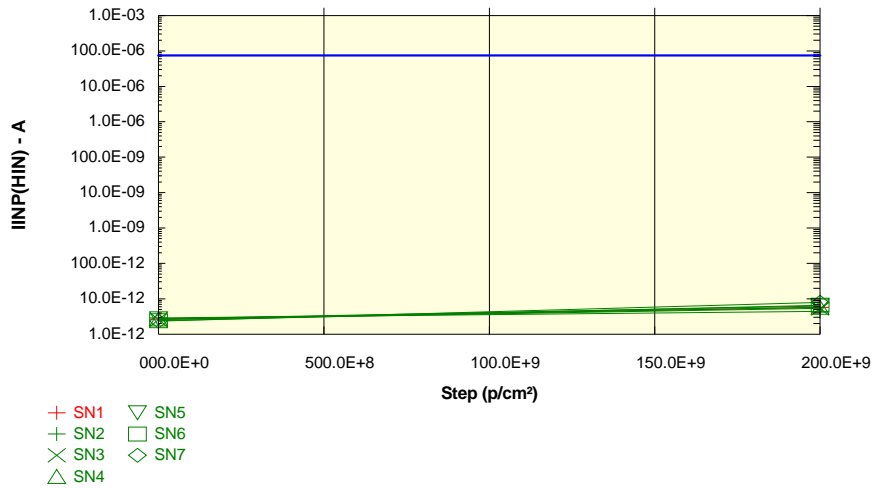
Parameter : Logic "1" input bias current : IINP(HIN)

VIN = 15V

Unit : A

Spec Limit Max : 75.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IINP(HIN)	0 p/cm²	2E+11 p/cm²
SN1_REF	2.7E-12	5.8E-12
OFF samples		
SN2	2.9E-12	4.5E-12
SN3	2.6E-12	5.3E-12
SN4	2.7E-12	5.8E-12
SN5	2.7E-12	6.3E-12
SN6	2.4E-12	6.6E-12
SN7	2.3E-12	8.0E-12
Statistics		
Min	2.3E-12	4.5E-12
Max	2.9E-12	8.0E-12
Average	2.6E-12	6.1E-12
Sigma	193.8E-15	1.1E-12

Drift Calculation

IINP(HIN)	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	1.56E-12
SN3	-	2.76E-12
SN4	-	3.06E-12
SN5	-	3.56E-12
SN6	-	4.14E-12
SN7	-	5.66E-12
Average	-	3.46E-12
Sigma	-	1.26E-12

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

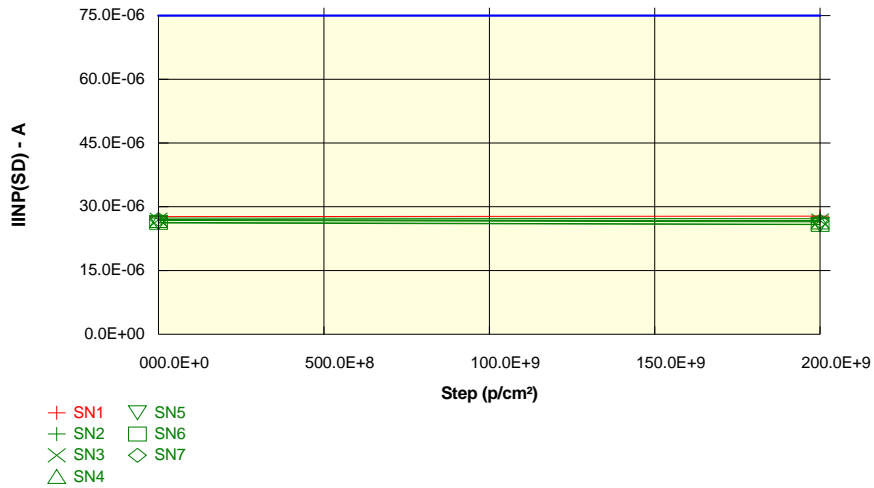
Parameter : Logic "1" input bias current : IINP(SD)

SD = 15V

Unit : A

Spec Limit Max : 75.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements		
IINP(SD)	0 p/cm ²	2E+11 p/cm ²
SN1_REF	27.7E-06	27.8E-06
OFF samples		
SN2	27.3E-06	27.2E-06
SN3	27.0E-06	26.8E-06
SN4	26.8E-06	26.4E-06
SN5	26.2E-06	25.8E-06
SN6	26.3E-06	25.8E-06
SN7	27.0E-06	26.6E-06
Statistics		
Min	26.2E-06	25.8E-06
Max	27.3E-06	27.2E-06
Average	26.8E-06	26.5E-06
Sigma	389.9E-09	503.1E-09

Drift Calculation		
IINP(SD)	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-90.00E-09
SN3	-	-172.00E-09
SN4	-	-336.00E-09
SN5	-	-388.00E-09
SN6	-	-482.00E-09
SN7	-	-382.00E-09
Average	-	-308.33E-09
Sigma	-	134.76E-09

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

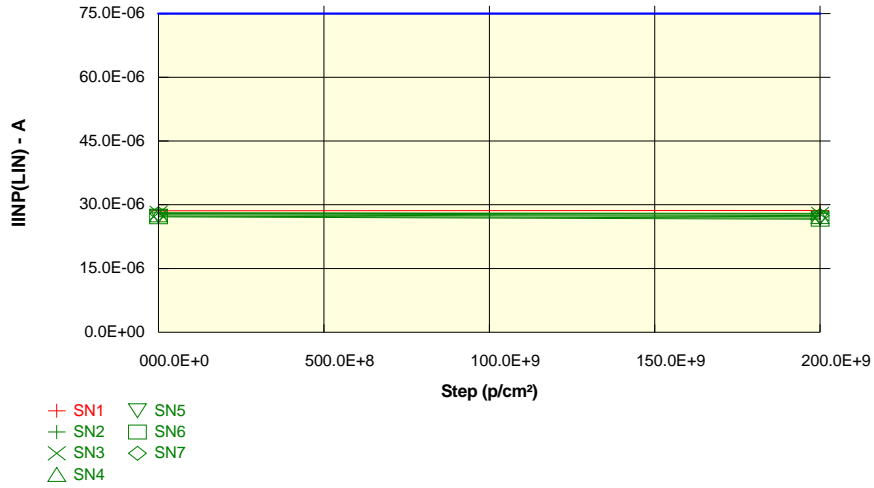
Parameter : Logic "1" input bias current : IINP(LIN)

VIN = 15V

Unit : A

Spec Limit Max : 75.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements		
IINP(LIN)	0 p/cm ²	2E+11 p/cm ²
SN1_REF	28.6E-06	28.7E-06
OFF samples		
SN2	28.1E-06	28.0E-06
SN3	28.1E-06	27.8E-06
SN4	27.6E-06	27.2E-06
SN5	27.3E-06	26.9E-06
SN6	27.2E-06	26.6E-06
SN7	27.9E-06	27.5E-06
Statistics		
Min	27.2E-06	26.6E-06
Max	28.1E-06	28.0E-06
Average	27.7E-06	27.3E-06
Sigma	364.6E-09	489.6E-09

Drift Calculation		
IINP(LIN)	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-132.00E-09
SN3	-	-256.00E-09
SN4	-	-406.00E-09
SN5	-	-470.00E-09
SN6	-	-544.00E-09
SN7	-	-448.00E-09
Average	-	-376.00E-09
Sigma	-	139.69E-09

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

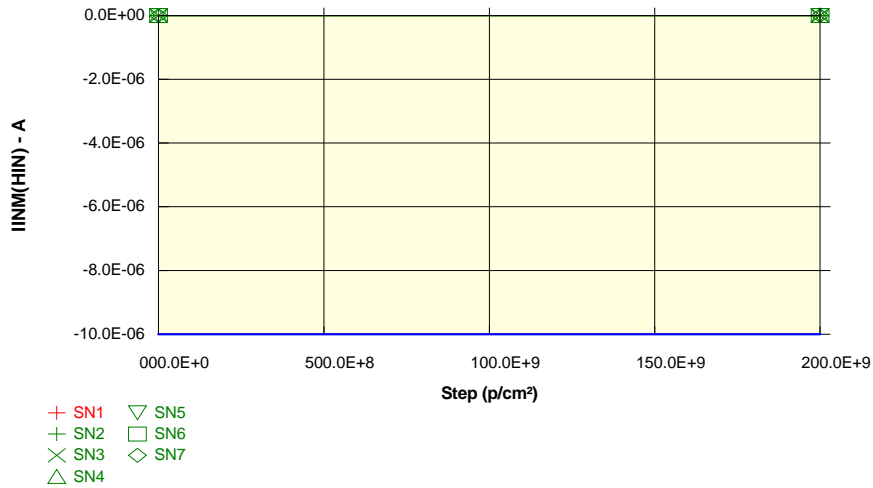
Parameter : Logic "0" input bias current : IINM(HIN)

VIN = 0V

Unit : A

Spec Limit Min : -10.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IINM(HIN)	0 p/cm²	2E+11 p/cm²
SN1_REF	-3.2E-12	-4.4E-12
OFF samples		
SN2	-3.4E-12	-4.4E-12
SN3	-3.6E-12	-6.0E-12
SN4	-3.7E-12	-5.5E-12
SN5	-3.9E-12	-6.1E-12
SN6	-3.6E-12	-8.4E-12
SN7	-3.5E-12	-8.6E-12
Statistics		
Min	-3.9E-12	-8.6E-12
Max	-3.4E-12	-4.4E-12
Average	-3.6E-12	-6.5E-12
Sigma	157.0E-15	1.5E-12

Drift Calculation

IINM(HIN)	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-940.00E-15
SN3	-	-2.42E-12
SN4	-	-1.76E-12
SN5	-	-2.22E-12
SN6	-	-4.78E-12
SN7	-	-5.14E-12
Average	-	-2.88E-12
Sigma	-	1.55E-12

Test conditions : Protons

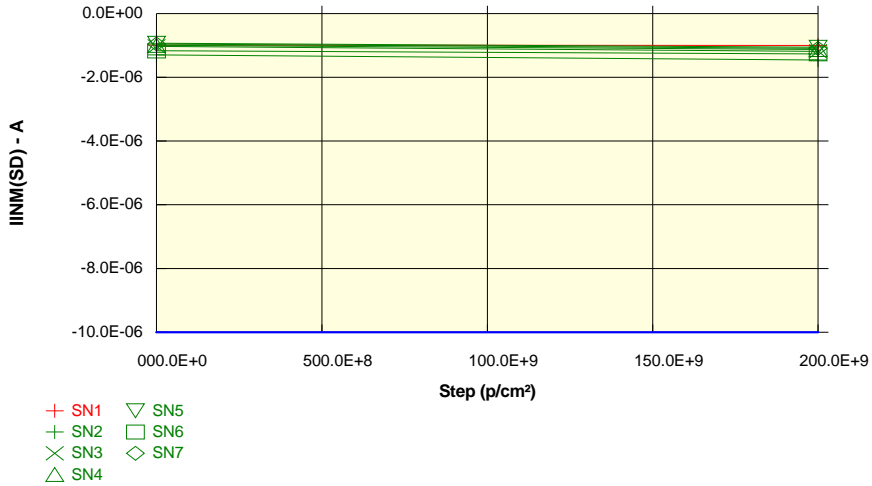
Parameter : Logic "0" input bias current : IINM(SD)

SD = 0V

Unit : A

Spec Limit Min : -10.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IINM(SD)	0 p/cm ²	2E+11 p/cm ²
SN1_REF	-990.5E-09	-998.3E-09
OFF samples		
SN2	-1.3E-06	-1.5E-06
SN3	-1.0E-06	-1.2E-06
SN4	-996.2E-09	-1.1E-06
SN5	-931.1E-09	-1.1E-06
SN6	-1.2E-06	-1.3E-06
SN7	-953.4E-09	-1.1E-06
Statistics		
Min	-1.3E-06	-1.5E-06
Max	-931.1E-09	-1.1E-06
Average	-1.1E-06	-1.2E-06
Sigma	129.3E-09	135.1E-09

Drift Calculation

IINM(SD)	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-163.80E-09
SN3	-	-154.40E-09
SN4	-	-129.04E-09
SN5	-	-126.48E-09
SN6	-	-94.40E-09
SN7	-	-136.82E-09
Average	-	-134.16E-09
Sigma	-	22.22E-09

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

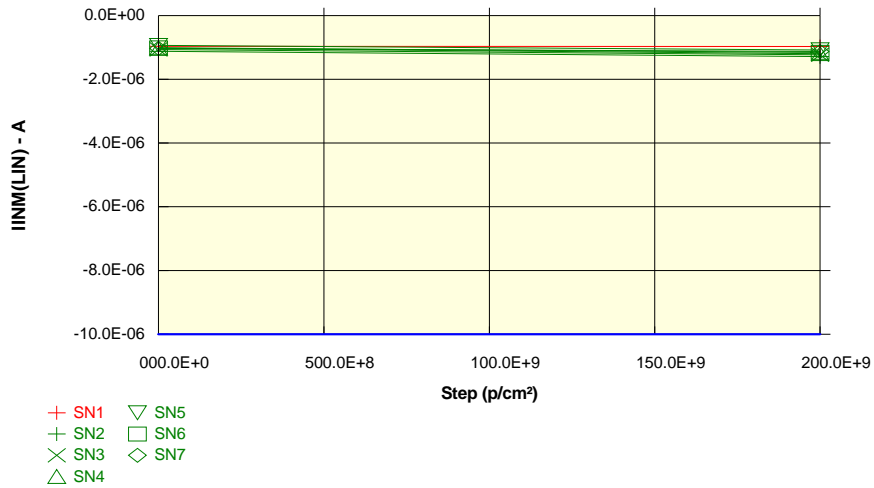
Parameter : Logic "0" input bias current : IINM(LIN)

VIN = 0V

Unit : A

Spec Limit Min : -10.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IINM(LIN)	0 p/cm ²	2E+11 p/cm ²
SN1_REF	-963.5E-09	-971.0E-09
OFF samples		
SN2	-1.1E-06	-1.3E-06
SN3	-1.1E-06	-1.2E-06
SN4	-1.0E-06	-1.2E-06
SN5	-936.2E-09	-1.1E-06
SN6	-1.0E-06	-1.2E-06
SN7	-1.0E-06	-1.1E-06
Statistics		
Min	-1.1E-06	-1.3E-06
Max	-936.2E-09	-1.1E-06
Average	-1.0E-06	-1.2E-06
Sigma	55.1E-09	69.5E-09

Drift Calculation

IINM(LIN)	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-169.40E-09
SN3	-	-172.00E-09
SN4	-	-169.00E-09
SN5	-	-140.76E-09
SN6	-	-147.20E-09
SN7	-	-94.80E-09
Average	-	-148.86E-09
Sigma	-	26.94E-09

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

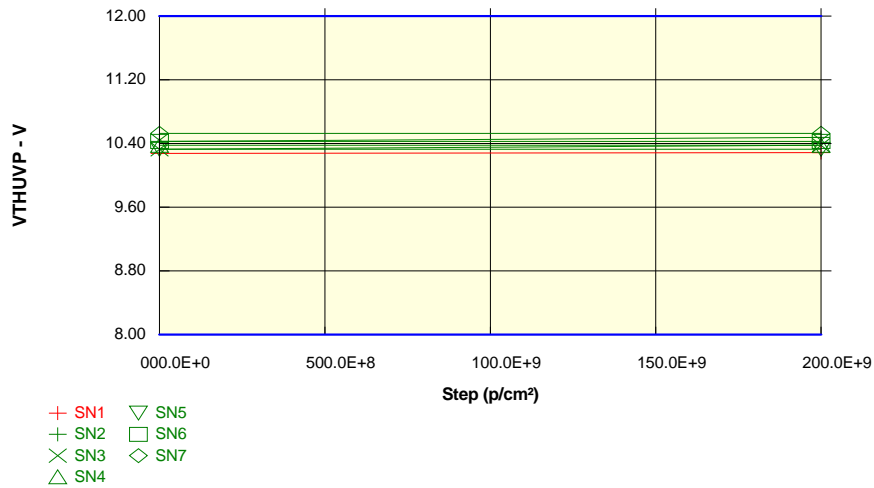
Parameter : VDD / VSS under-voltage lockout threshold : VTHUVP

Unit : V

Spec Limit Min : 8.00

Spec Limit Max : 12.00

Spec limits are represented in bold lines on the graphic.



Measurements

VTHUVP	0 p/cm ²	2E+11 p/cm ²
SN1_REF	10.28	10.29
OFF samples		
SN2	10.43	10.48
SN3	10.33	10.38
SN4	10.38	10.38
SN5	10.33	10.33
SN6	10.43	10.43
SN7	10.53	10.53
Statistics		
Min	10.33	10.33
Max	10.53	10.53
Average	10.40	10.42
Sigma	0.07	0.07

Drift Calculation

VTHUVP	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	50.00E-03
SN3	-	50.00E-03
SN4	-	-953.67E-09
SN5	-	-953.67E-09
SN6	-	-953.67E-09
SN7	-	-953.67E-09
Average	-	16.67E-03
Sigma	-	23.57E-03

Test conditions : Protons

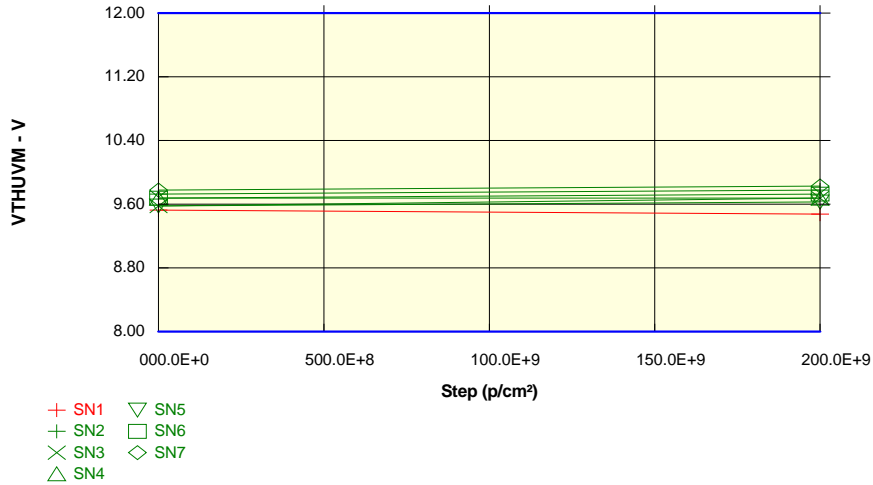
Parameter : VDD / VSS under-voltage lockout threshold : VTHUVM

Unit : V

Spec Limit Min : 8.00

Spec Limit Max : 12.00

Spec limits are represented in bold lines on the graphic.



Measurements		
VTHUVM	0 p/cm ²	2E+11 p/cm ²
SN1_REF	9.53	9.48
OFF samples		
SN2	9.73	9.78
SN3	9.58	9.68
SN4	9.68	9.68
SN5	9.58	9.63
SN6	9.68	9.73
SN7	9.78	9.83
Statistics		
Min	9.58	9.63
Max	9.78	9.83
Average	9.67	9.72
Sigma	0.07	0.07

Drift Calculation		
VTHUVM	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	50.00E-03
SN3	-	100.00E-03
SN4	-	0.00E+00
SN5	-	50.00E-03
SN6	-	50.00E-03
SN7	-	50.00E-03
Average	-	50.00E-03
Sigma	-	28.87E-03

Test conditions : Protons

Parameter : VDD / VSS under-voltage lockout threshold : VTHUVS

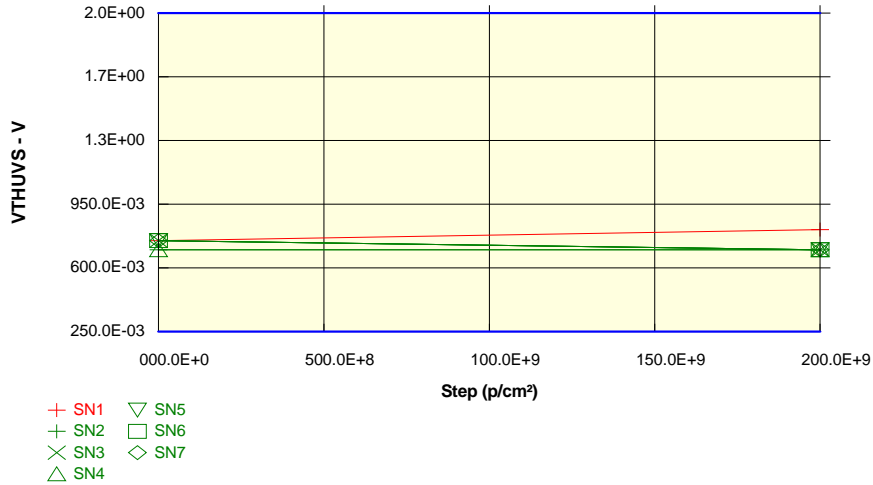
VTHUVS = (VTHUV+) - (VTHUV-)

Unit : V

Spec Limit Min : 250.0E-03

Spec Limit Max : 2.0E+00

Spec limits are represented in bold lines on the graphic.



Measurements

VTHUVS	0 p/cm ²	2E+11 p/cm ²
SN1_REF	750.0E-03	810.0E-03
OFF samples		
SN2	700.0E-03	700.0E-03
SN3	750.0E-03	700.0E-03
SN4	700.0E-03	700.0E-03
SN5	750.0E-03	700.0E-03
SN6	750.0E-03	700.0E-03
SN7	750.0E-03	700.0E-03
Statistics		
Min	700.0E-03	700.0E-03
Max	750.0E-03	700.0E-03
Average	733.3E-03	700.0E-03
Sigma	23.6E-03	355.6E-09

Drift Calculation

VTHUVS	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-953.67E-09
SN3	-	-50.00E-03
SN4	-	-953.67E-09
SN5	-	-50.00E-03
SN6	-	-50.00E-03
SN7	-	-50.00E-03
Average	-	-33.33E-03
Sigma	-	23.57E-03

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

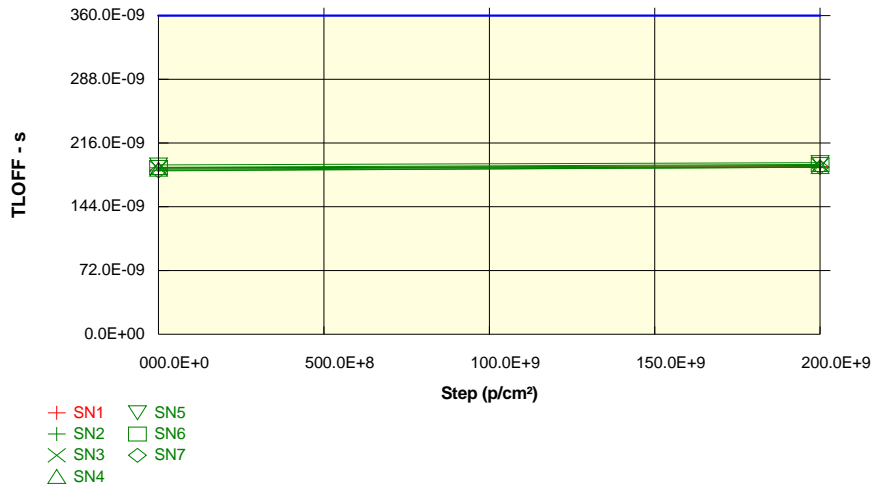
Parameter : Low side turn-off propagation delay : TLOFF

CL = 1000pF

Unit : s

Spec Limit Max : 360.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

TLOFF	0 p/cm ²	2E+11 p/cm ²
SN1_REF	188.2E-09	189.3E-09
OFF samples		
SN2	185.4E-09	188.4E-09
SN3	187.8E-09	190.7E-09
SN4	186.5E-09	189.4E-09
SN5	191.1E-09	194.0E-09
SN6	188.4E-09	191.8E-09
SN7	184.6E-09	188.8E-09
Statistics		
Min	184.6E-09	188.4E-09
Max	191.1E-09	194.0E-09
Average	187.3E-09	190.5E-09
Sigma	2.1E-09	1.9E-09

Drift Calculation

TLOFF	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	3.09E-09
SN3	-	2.92E-09
SN4	-	2.85E-09
SN5	-	2.86E-09
SN6	-	3.40E-09
SN7	-	4.18E-09
Average	-	3.22E-09
Sigma	-	469.67E-12

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

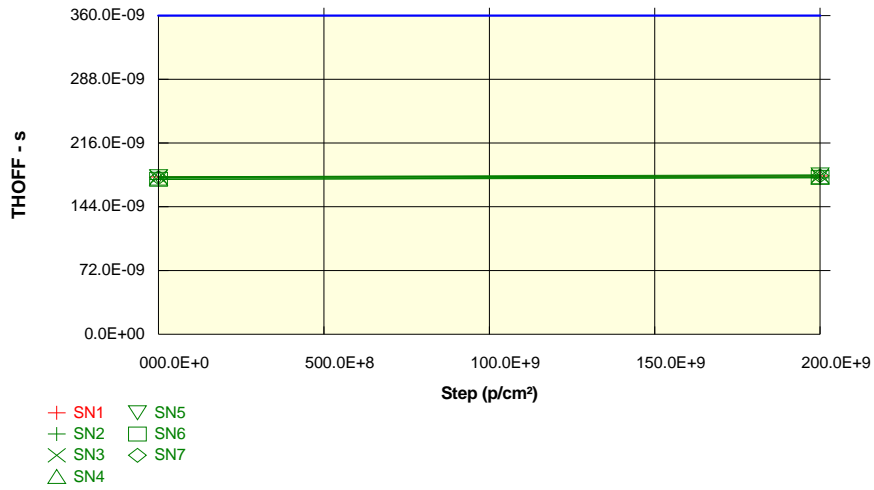
Parameter : High side turn-off propagation delay : THOFF

CL = 1000pF

Unit : s

Spec Limit Max : 360.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

THOFF	0 p/cm²	2E+11 p/cm²
SN1_REF	177.8E-09	178.8E-09
OFF samples		
SN2	174.7E-09	176.6E-09
SN3	177.6E-09	178.9E-09
SN4	176.3E-09	177.7E-09
SN5	178.0E-09	180.0E-09
SN6	175.0E-09	177.3E-09
SN7	176.9E-09	179.0E-09
Statistics		
Min	174.7E-09	176.6E-09
Max	178.0E-09	180.0E-09
Average	176.4E-09	178.3E-09
Sigma	1.2E-09	1.2E-09

Drift Calculation

THOFF	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	1.86E-09
SN3	-	1.34E-09
SN4	-	1.35E-09
SN5	-	1.96E-09
SN6	-	2.26E-09
SN7	-	2.11E-09
Average	-	1.81E-09
Sigma	-	352.45E-12

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

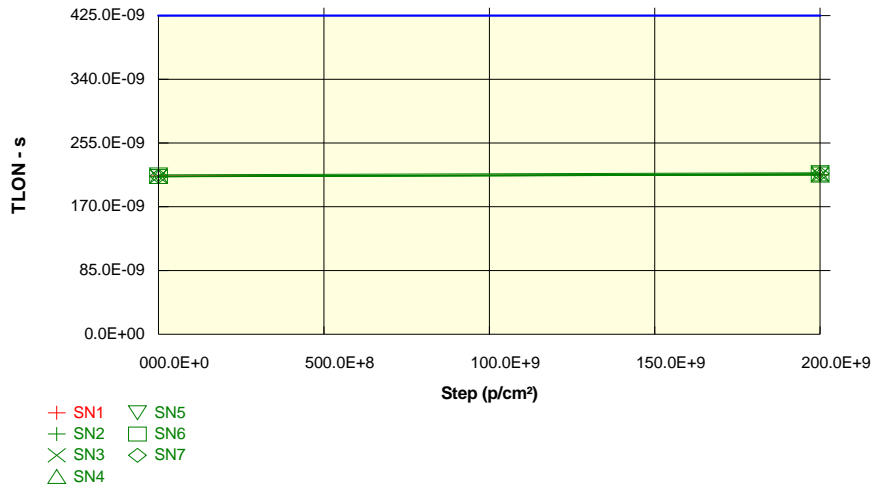
Parameter : Low side turn-on propagation delay : TLON

CL = 1000pF

Unit : s

Spec Limit Max : 425.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

TLON	0 p/cm ²	2E+11 p/cm ²
SN1_REF	211.0E-09	212.8E-09
OFF samples		
SN2	210.0E-09	212.6E-09
SN3	210.3E-09	212.8E-09
SN4	210.2E-09	212.3E-09
SN5	212.6E-09	215.4E-09
SN6	210.3E-09	213.8E-09
SN7	210.8E-09	214.0E-09
Statistics		
Min	210.0E-09	212.3E-09
Max	212.6E-09	215.4E-09
Average	210.7E-09	213.5E-09
Sigma	891.9E-12	1.1E-09

Drift Calculation

TLON	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	2.58E-09
SN3	-	2.53E-09
SN4	-	2.04E-09
SN5	-	2.80E-09
SN6	-	3.59E-09
SN7	-	3.15E-09
Average	-	2.78E-09
Sigma	-	490.31E-12

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

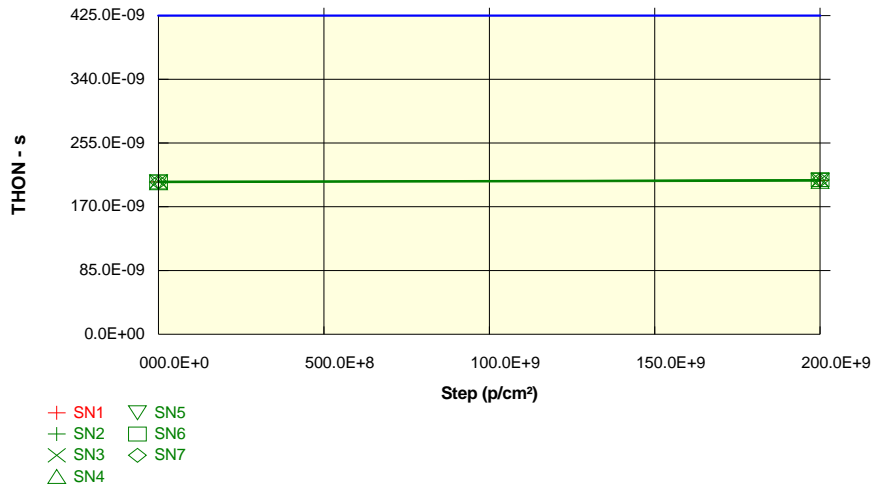
Parameter : High side turn-on propagation delay : THON

CL = 1000pF

Unit : s

Spec Limit Max : 425.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

THON	0 p/cm ²	2E+11 p/cm ²
SN1_REF	203.3E-09	205.3E-09
OFF samples		
SN2	202.9E-09	205.4E-09
SN3	204.2E-09	206.1E-09
SN4	202.0E-09	203.9E-09
SN5	202.9E-09	205.2E-09
SN6	203.0E-09	206.1E-09
SN7	202.9E-09	205.7E-09
Statistics		
Min	202.0E-09	203.9E-09
Max	204.2E-09	206.1E-09
Average	203.0E-09	205.4E-09
Sigma	641.5E-12	733.0E-12

Drift Calculation

THON	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	2.46E-09
SN3	-	1.87E-09
SN4	-	1.94E-09
SN5	-	2.34E-09
SN6	-	3.14E-09
SN7	-	2.77E-09
Average	-	2.42E-09
Sigma	-	441.81E-12

Test conditions : Protons

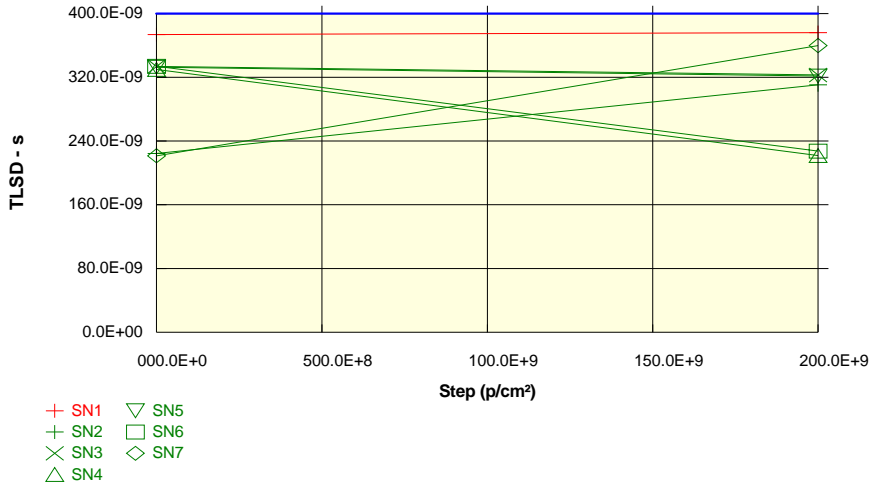
Parameter : Low side shutdown propagation delay : TLSD

CL = 1000pF

Unit : s

Spec Limit Max : 400.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

TLSD	0 p/cm ²	2E+11 p/cm ²
SN1_REF	373.7E-09	376.1E-09
OFF samples		
SN2	224.4E-09	310.7E-09
SN3	333.7E-09	322.9E-09
SN4	329.9E-09	221.9E-09
SN5	332.7E-09	321.6E-09
SN6	333.9E-09	227.5E-09
SN7	221.5E-09	359.9E-09
Statistics		
Min	221.5E-09	221.9E-09
Max	333.9E-09	359.9E-09
Average	296.0E-09	294.1E-09
Sigma	51.7E-09	51.4E-09

Drift Calculation

TLSD	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	86.29E-09
SN3	-	-10.78E-09
SN4	-	-107.96E-09
SN5	-	-11.12E-09
SN6	-	-106.37E-09
SN7	-	138.40E-09
Average	-	-1.92E-09
Sigma	-	91.09E-09

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

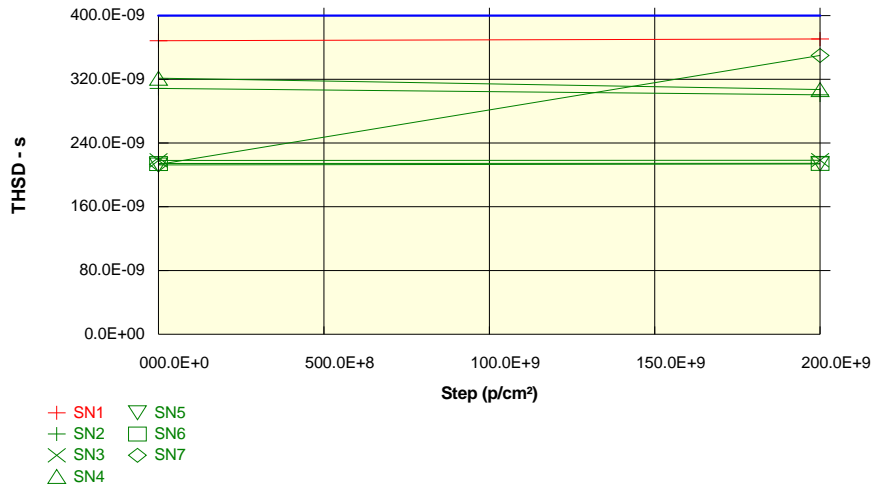
Parameter : High side shutdown propagation delay : THSD

CL = 1000pF

Unit : s

Spec Limit Max : 400.0E-09

Spec limits are represented in bold lines on the graphic.



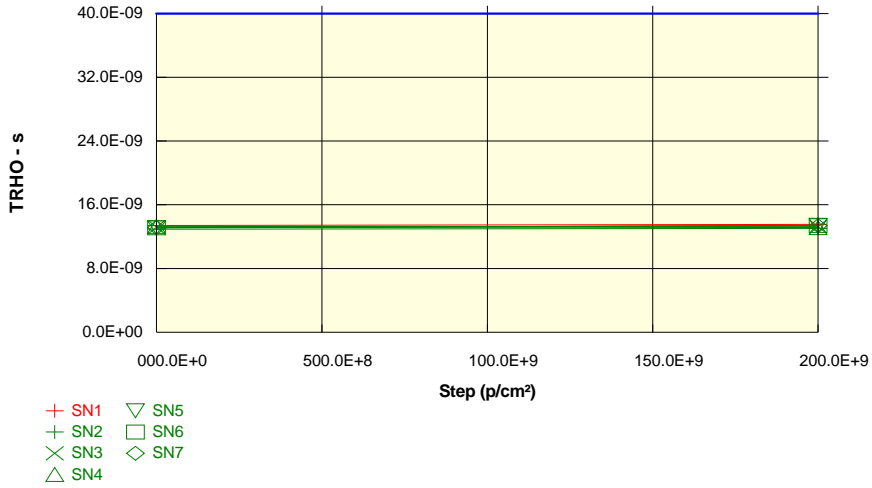
Measurements		
THSD	0 p/cm ²	2E+11 p/cm ²
SN1_REF	368.5E-09	370.6E-09
OFF samples		
SN2	308.6E-09	300.4E-09
SN3	218.2E-09	218.5E-09
SN4	321.5E-09	307.2E-09
SN5	212.3E-09	213.8E-09
SN6	214.3E-09	214.6E-09
SN7	213.0E-09	349.9E-09
Statistics		
Min	212.3E-09	213.8E-09
Max	321.5E-09	349.9E-09
Average	248.0E-09	267.4E-09
Sigma	47.6E-09	54.1E-09

Drift Calculation		
THSD	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-8.24E-09
SN3	-	220.99E-12
SN4	-	-14.29E-09
SN5	-	1.50E-09
SN6	-	296.00E-12
SN7	-	136.86E-09
Average	-	19.39E-09
Sigma	-	52.83E-09

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons
Parameter : HO rise time : TRHO
CL = 1000pF

Unit : s
Spec Limit Max : 40.0E-09
Spec limits are represented in bold lines on the graphic.



Measurements

TRHO	0 p/cm ²	2E+11 p/cm ²
SN1_REF	13.4E-09	13.5E-09
OFF samples		
SN2	13.0E-09	13.0E-09
SN3	13.2E-09	13.2E-09
SN4	13.3E-09	13.1E-09
SN5	13.1E-09	13.3E-09
SN6	13.1E-09	13.4E-09
SN7	13.1E-09	13.4E-09
Statistics		
Min	13.0E-09	13.0E-09
Max	13.3E-09	13.4E-09
Average	13.1E-09	13.3E-09
Sigma	100.8E-12	137.9E-12

Drift Calculation

TRHO	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	74.00E-12
SN3	-	53.00E-12
SN4	-	-173.00E-12
SN5	-	210.00E-12
SN6	-	302.00E-12
SN7	-	216.00E-12
Average	-	113.67E-12
Sigma	-	154.19E-12

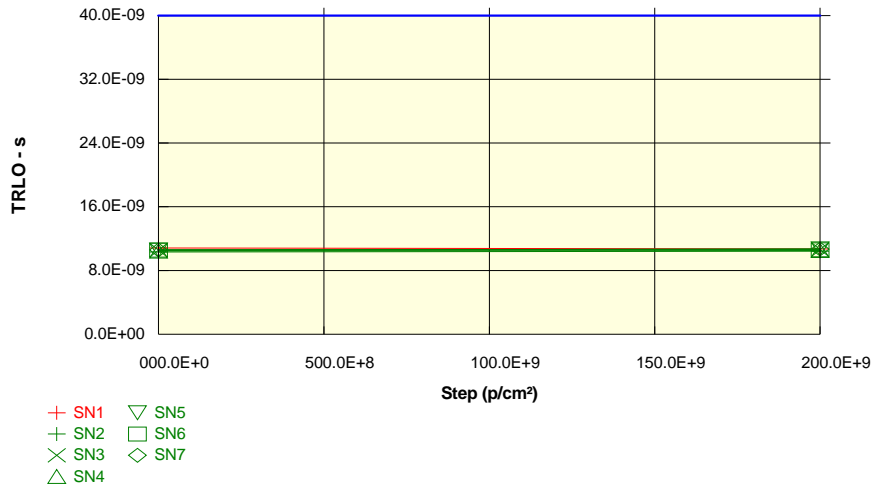
Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons
Parameter : LO rise time : TRLO
CL = 1000pF

Unit : s

Spec Limit Max : 40.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

TRLO	0 p/cm ²	2E+11 p/cm ²
SN1_REF	10.8E-09	10.7E-09
OFF samples		
SN2	10.3E-09	10.4E-09
SN3	10.5E-09	10.6E-09
SN4	10.4E-09	10.5E-09
SN5	10.5E-09	10.7E-09
SN6	10.6E-09	10.6E-09
SN7	10.6E-09	10.7E-09
Statistics		
Min	10.3E-09	10.4E-09
Max	10.6E-09	10.7E-09
Average	10.5E-09	10.6E-09
Sigma	93.3E-12	102.9E-12

Drift Calculation

TRLO	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	99.00E-12
SN3	-	84.00E-12
SN4	-	80.00E-12
SN5	-	159.00E-12
SN6	-	31.00E-12
SN7	-	126.00E-12
Average	-	96.50E-12
Sigma	-	39.79E-12

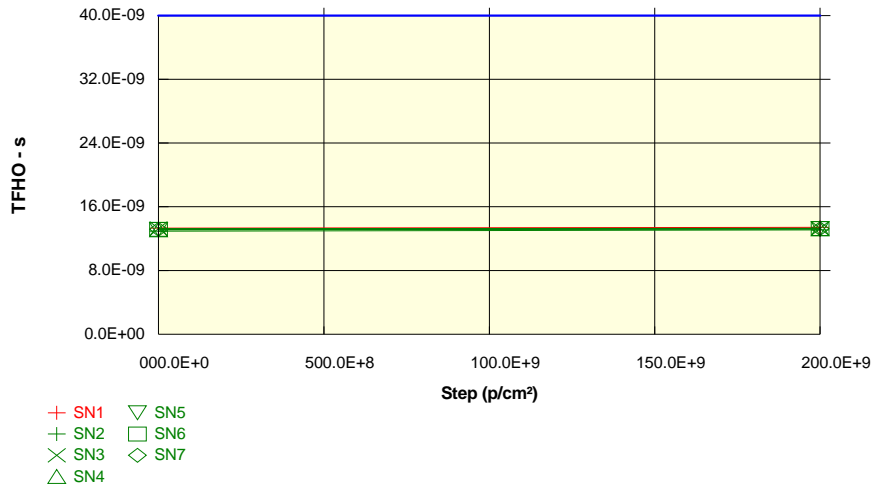
Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons
Parameter : HO fall time : TFHO
CL = 1000pF

Unit : s

Spec Limit Max : 40.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

TFHO	0 p/cm ²	2E+11 p/cm ²
SN1_REF	13.3E-09	13.4E-09
OFF samples		
SN2	13.0E-09	13.1E-09
SN3	13.3E-09	13.3E-09
SN4	13.1E-09	13.2E-09
SN5	13.2E-09	13.3E-09
SN6	13.2E-09	13.3E-09
SN7	13.2E-09	13.2E-09
Statistics		
Min	13.0E-09	13.1E-09
Max	13.3E-09	13.3E-09
Average	13.1E-09	13.2E-09
Sigma	93.7E-12	61.5E-12

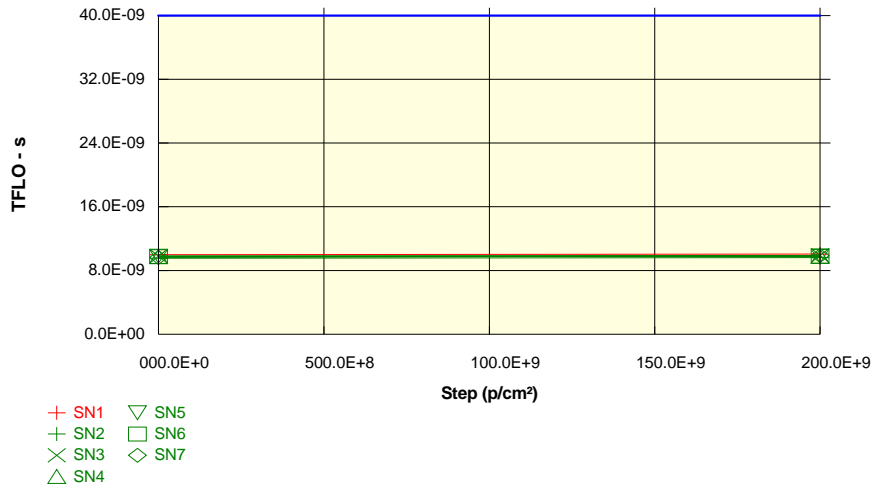
Drift Calculation

TFHO	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	148.00E-12
SN3	-	26.00E-12
SN4	-	106.00E-12
SN5	-	98.00E-12
SN6	-	96.00E-12
SN7	-	74.00E-12
Average	-	91.33E-12
Sigma	-	36.65E-12

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons
Parameter : LO fall time : TFLO
CL = 1000pF

Unit : s
Spec Limit Max : 40.0E-09
Spec limits are represented in bold lines on the graphic.



Measurements

TFLO	0 p/cm ²	2E+11 p/cm ²
SN1_REF	10.0E-09	10.1E-09
OFF samples		
SN2	9.5E-09	9.6E-09
SN3	9.8E-09	9.9E-09
SN4	9.7E-09	9.8E-09
SN5	9.8E-09	9.8E-09
SN6	9.7E-09	9.8E-09
SN7	9.6E-09	9.9E-09
Statistics		
Min	9.5E-09	9.6E-09
Max	9.8E-09	9.9E-09
Average	9.7E-09	9.8E-09
Sigma	94.2E-12	89.3E-12

Drift Calculation

TFLO	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	72.00E-12
SN3	-	84.00E-12
SN4	-	62.00E-12
SN5	-	24.00E-12
SN6	-	57.00E-12
SN7	-	227.00E-12
Average	-	87.67E-12
Sigma	-	64.97E-12

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

Parameter : Turn-on propagation delay matching : MTON

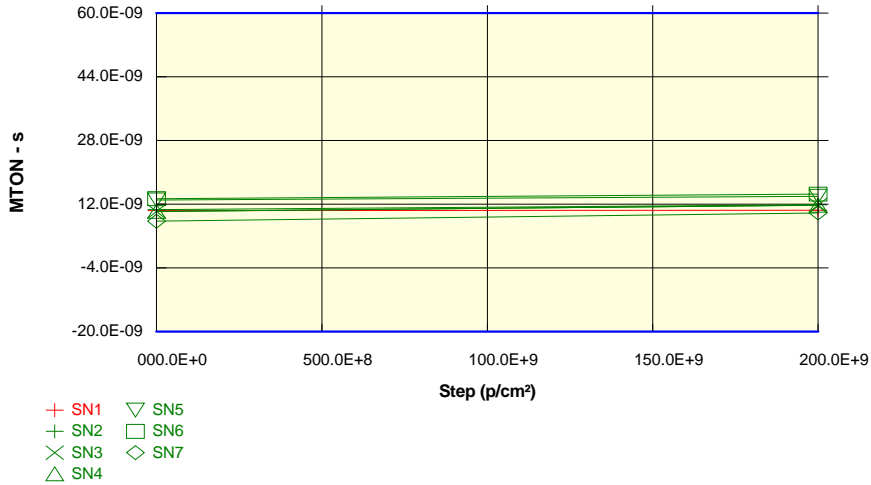
TLON – THON

Unit : s

Spec Limit Min : -20.0E-09

Spec Limit Max : 60.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

MTON	0 p/cm ²	2E+11 p/cm ²
SN1_REF	10.4E-09	10.5E-09
OFF samples		
SN2	10.6E-09	11.8E-09
SN3	10.2E-09	11.8E-09
SN4	10.2E-09	11.7E-09
SN5	13.1E-09	14.0E-09
SN6	13.4E-09	14.5E-09
SN7	7.7E-09	9.8E-09
Statistics		
Min	7.7E-09	9.8E-09
Max	13.4E-09	14.5E-09
Average	10.9E-09	12.3E-09
Sigma	1.9E-09	1.6E-09

Drift Calculation

MTON	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	1.22E-09
SN3	-	1.58E-09
SN4	-	1.50E-09
SN5	-	895.40E-12
SN6	-	1.15E-09
SN7	-	2.07E-09
Average	-	1.40E-09
Sigma	-	374.73E-12

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0877
	IS9-2100ARH	Intersil	Issue:	01

Test conditions : Protons

Parameter : Turn-off propagation delay matching : MTOFF

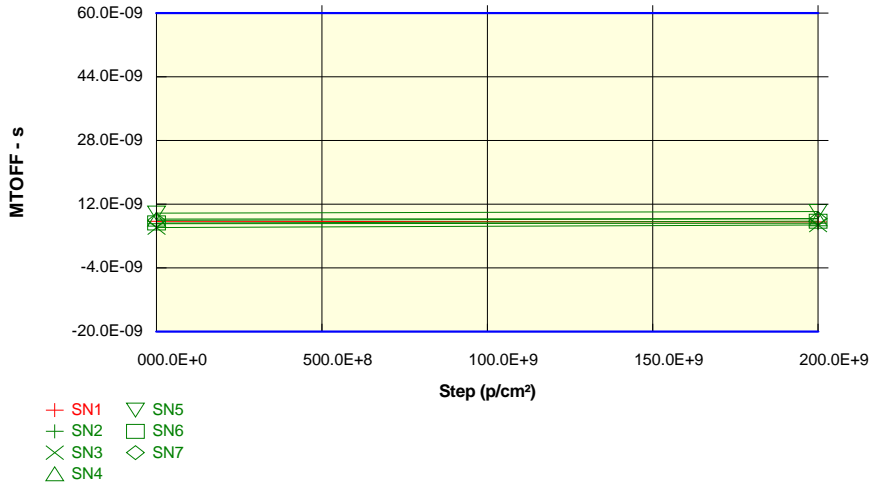
TLOFF – THOFF

Unit : s

Spec Limit Min : -20.0E-09

Spec Limit Max : 60.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

MTOFF	0 p/cm ²	2E+11 p/cm ²
SN1_REF	7.7E-09	7.5E-09
OFF samples		
SN2	7.1E-09	7.2E-09
SN3	6.1E-09	6.8E-09
SN4	8.3E-09	8.4E-09
SN5	9.7E-09	10.2E-09
SN6	7.3E-09	7.7E-09
SN7	7.9E-09	8.3E-09
Statistics		
Min	6.1E-09	6.8E-09
Max	9.7E-09	10.2E-09
Average	7.7E-09	8.1E-09
Sigma	1.1E-09	1.1E-09

Drift Calculation

MTOFF	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	122.31E-12
SN3	-	654.20E-12
SN4	-	93.29E-12
SN5	-	451.39E-12
SN6	-	447.50E-12
SN7	-	382.51E-12
Average	-	358.54E-12
Sigma	-	196.08E-12