



# TOTAL DOSE RADIATION TEST REPORT

## Protons Test

<p><b>Part Type : 4N49</b></p> <p><b>Package: TO-5</b></p> <p><b>Opto-Couplers</b></p> <p><b>Isolink, Micropac, Optek</b></p> <p><b>Report Reference : ESA_QCA0106T_C</b></p> <p><b>Issue : 02</b></p> <p><b>Date : February 22, 2001</b></p>
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**ESA Contract No 13528/99/NL/MV CCN No. 04 dated 22/02/2001, COO-05**

**ESTEC Technical Officer: R. Harboe Sorensen**

<p>European Space Agency Contract Report</p> <p>The work described in this report was done under ESA contract. Responsibility for the contents resides in the author or organization that prepared it</p>
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<b>Hirex reference :</b>	HRX/TID/0079	Issue : 02	Date :	February 22, 2001
<b>Written by :</b>	Hirex Engineering	-		-
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<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**DOCUMENTATION CHANGE NOTICE**

<b>ISSUE</b>	<b>DATE</b>	<b>PAGE</b>	<b>CHANGE ITEM</b>
01	February 22, 2001	All	Original issue

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**TOTAL DOSE RADIATION TEST REPORT**  
**on**  
**4N49**  
**Opto-Couplers**

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## 1 Introduction

This report details the work carried out in response to European Space Agency contract reference: 13528/99/NL/MV CCN No. 04 dated 22/02/2001, COO-05 covering "Proton Testing of 4N49 Opto-Couplers.

Displacement damage effects in 4N49 Opto-Couplers devices from three different manufacturers was investigated using 60 MeV proton. Unbiased, 2 mA and 10 mA biased devices were irradiated at the Centre de Prorionthérapie d'Orsay (CPO) up to a total fluence of about 1,5 E+11 p/cm<sup>2</sup> with the Current Transfer Ratio (CTR) degradation being the main parameter monitored.

The main purpose of these tests were to characterizing these Opto-Coupler CTR degradation due to proton displacement damage so a further mission analysis could determine their suitability for flight. All tests were conducted on samples delivered to Hirex by ESA.

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

## 2 Applicable and Reference Documents

### 2.1 Applicable Documents

- AD-1 Proton Testing of 3C91C Optocouplers For ENVISAT-1, 01ENV\_SOW\_3C91C.doc-RHS/TOS-QCA, January 2001, Issue 0, dated 18 January 2001
- AD-2 Proton test of Optocouplers at CPO, HRX/MOM/0029, dated 08 February 2001
- AD-3 ESA/SCC Basic specification N° 22900 issue 4.

### 2.2 Reference Documents

- RD-1. MIL-STD-750: test methods and procedures for discrete semiconductors..
- RD-2. The 200MeV proton beam of the Centre de Prorionthérapie d'Orsay, Radecs 99
- RD-3. Micropac datasheet

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### 3 Test Samples

A total of 21 4N49 Opto-Coupler devices were available for testing.

However, having 3 different lot/manufacturers, the number of devices allocated per biasing conditions and as reference (control samples) can be seen in Table 1a.

CPO – 60 MeV Proton Test	Reference Devices	Bias Conditions During Test		
		10 mA/5 V	2 mA/ 5 V	Unbiased
4N49 Isolink	1	2	2	2
4N49 Micropac	1	2	2	2
4N49 Optek	1	2	2	2
21 Devices	3	6	6	6

Table 1a - 4N49 devices tested

Device	Manufacturer	Device Marking	datecode
4N49	Isolink	S 4N49 0013	0013
4N49	Micropac	Logo 4N49 M9744	9744
4N49	Optek	4N49 39952	9952

Table 1b - 4N49 lot information

#### Table 1 – 4N49 test samples

Further device information and procurement references can be found in Table 1b. Table 2 provides the different serial number/date codes in respect to allocated exposure conditions.

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Serial Number	Date Code	Allocation
Iso1	DC0013	Control sample
Opt1	DC9744	Control sample
Mic1	DC9952	Ref Control sample
Iso2	DC0013	Irradiated unbiased
Iso3	DC0013	Irradiated unbiased
Opt2	DC9744	Irradiated unbiased
Opt3	DC9744	Irradiated unbiased
Mic2	DC9952	Irradiated unbiased
Mic3	DC9952	Irradiated unbiased
Iso4	DC0013	Irradiated with 2 mA bias
Iso5	DC0013	Irradiated with 2 mA bias
Opt4	DC9744	Irradiated with 2 mA bias
Opt5	DC9744	Irradiated with 2 mA bias
Mic4	DC9952	Irradiated with 2 mA bias
Mic5	DC9952	Irradiated with 2 mA bias
Iso6	DC0013	Irradiated with 10 mA bias
Iso7	DC0013	Irradiated with 10 mA bias
Opt6	DC9744	Irradiated with 10 mA bias
Opt7	DC9744	Irradiated with 10 mA bias
Mic6	DC9952	Irradiated with 10 mA bias
Mic7	DC9952	Irradiated with 10 mA bias

**Table 2 – 4N49 Test Samples allocation**

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
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## 4 Experimental Conditions

### 4.1 Radiation Source Dose Rate

The dose exposures were performed at Centre de Prorionthérapie d'Orsay (CPO). In this irradiation facility, a synchro-cyclotron SC200 is used with the possibility to vary the proton beam energy by the adjunction of degraders. (See RD-2 for details).

A mono-energetic 60MeV proton beam was used for this test with a beam diameter of 10 cm. The flux was set to 2.7 E+7 p/cm<sup>2</sup>.s.

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

Irr. Steps	Fluence	Irr. Time	Temp.
p/cm2	p/cm2	Seconds	°C
0			22
7.26E09	7.26E09	269	22
1.10E10	1.82E10	407	22
1.82E10	3.63E10	674	22
3.63E10	7.26E10	1344	22
7.26E10	1.50E11	2688	22
Flux : 2.70E07 p/cm2/sec.			

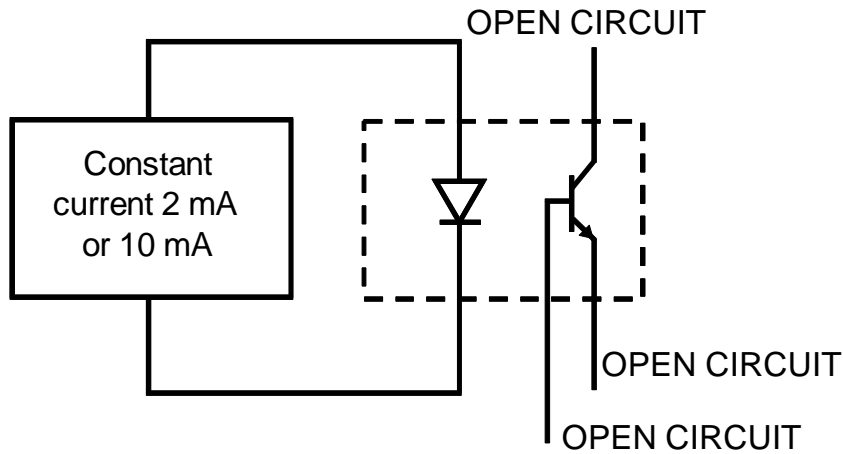
**Table 3 : Experimental Conditions**

Information on beam dosimetry and beam uniformity is provided in APPENDIX 2.

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#### 4.2 Bias condition during Dose Exposures

During exposures a dedicated test board was used mounted on a special board-holder made for irradiation. The test board allowed to bias the devices in accordance with the electrical circuit provided in Figure 1. Figure 2 shows a photo of the test board which allows the exposure of all devices with three different biasing conditions at the same time. The constant current source was supplied by Hirex internal BILT system. For unbiased devices all device terminals were connected to ground.



**Figure 1 : Bias Conditions during Irradiation Exposures and Annealing**



**Figure 2 : Photo of the Irradiation Test Board**



<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
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### 4.3 Electrical parameters test conditions and limits

Electrical parameters test conditions and limits used for performing this test are given in the following table (based on Micropac datasheet, see RD-3)

**Table 4 : Test conditions**

Symbol	Description	Conditions	Min	Max	Unit
VF	Input Diode Forward Voltage	IE=10mA	0.8	1.5	V
IC1	On State Collector Current 1	VCE=5V. IB=0. IF=1mA	0.002		A
IC2	On State Collector Current 2	VCE=5V. IB=0. IF=2mA		Note 1	A
IC5	On State Collector Current 5	VCE=5V. IB=0. IF=5mA		Note 1	A
IC10	On State Collector Current 10	VCE=5V. IB=0. IF=10mA		Note 1	A
ICOFF	Off State Collector Current	VCE=20V. IB=0. IF=0mA		1.00E-07	A
VCESAT	Collector Emitter Saturation Voltage	IC=2mA. IB=0. IF=2mA		0.3	V
CTR1 degr.	Current Transfer Ratio	CTR1=Iout/IF(1mA)		Note 1	%
CTR2 degr.	Current Transfer Ratio	CTR1=Iout/IF(2mA)		Note 1	%
CTR5 degr.	Current Transfer Ratio	CTR1=Iout/IF(5mA)		Note 1	%
CTR10 degr.	Current Transfer Ratio	CTR1=Iout/IF(10mA)		Note 1	%

Note 1: No limit specified in component specification (see RD-3). These parameters have been added to cover a wider range of potential application conditions.

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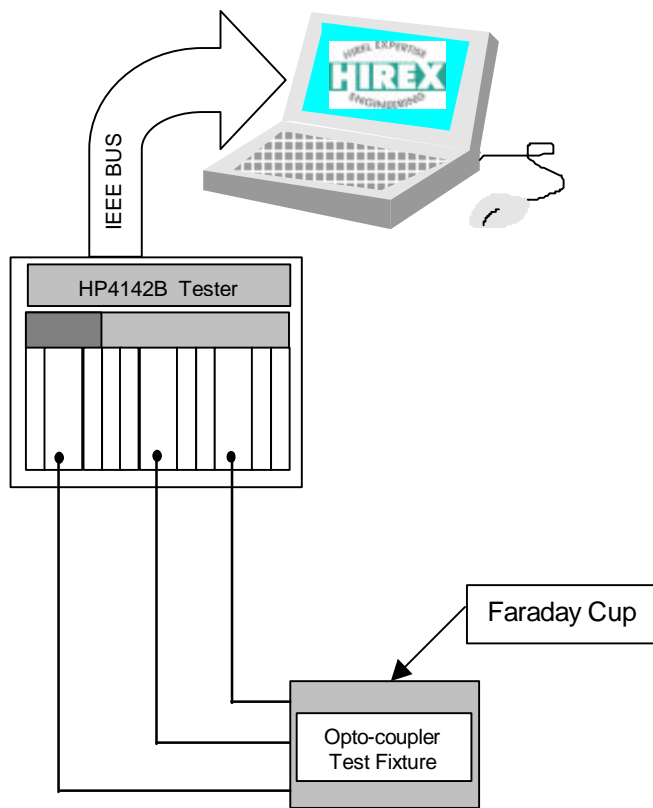
#### 4.4 Electrical Measurements

Opto-coupler test program principle is provided in Figure 3.

One instrument (DC tester HP4142B) was used to perform required measurements.

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

Test results were automatically loaded in an Excel worksheet and compared in real time to specification limits. This allowed for real time data analysis in particular when failures were recorded.



**Figure 3 : Opto-coupler test program principle**

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## 5 Test Results

The complete set of test results including the raw data and the different degradation curves versus the exposure bias condition and for the different lots are presented in APPENDIX 1.

As a general trend, CTR degradation is more important when no bias is applied to the device during the beam exposures.

Considering the three manufacturers tested, the comparison on CTR degradation, give the following manufacturer rating on this parameter:

- 1 Isolink
- 2 Optek
- 3 Micropac

This can be clearly observed when CTR degradation is computed from measurements with IF=5mA.

The following table gives the page number for each parameter drift plot versus manufacturer and bias condition. In addition, the drift trend is indicated in the last column

Symbol	Page No						Drift
	Isolink	Optek	Micropac	Unbiased	1mA	10mA	Trend
VF	24	35	46	57	68	79	—
IC1	25	36	47	58	69	80	↓
IC2	26	37	48	59	70	81	↓
IC5	27	38	49	60	71	82	↓
IC10	28	39	50	61	72	83	↓
ICOFF	29	40	51	62	73	84	—
VCESAT	30	41	52	63	74	85	↑
CTR1 degr	31	42	53	64	75	86	↓
CTR2 degr	32	43	54	65	76	87	↓
CTR5 degr	33	44	55	66	77	88	↓
CTR10 degr	34	45	56	67	78	89	↓

## 6 Conclusion

A proton test was carried out by Hirex Engineering under ESA contract on the 4N49 Opto-Couplers from three different manufacturers.

18 (3 times 6) samples plus 3 control samples were used during testing. Each device was exposed to radiation up to a total fluence of about 1.5 E+11 p/cm<sup>2</sup> using a flux of 2.7 E+07 p/cm<sup>2</sup>.s at room temperature.

CTR degradation at 4 different diode current levels versus proton fluence has been characterised for 3 different bias conditions on the 3 4N49 lots.

It can be observed that the degradation is generally more severe when the device is not biased during beam exposure.

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**APPENDIX 1 - TEST RESULTS**

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079	
				Issue : 02	
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek		

Parameter : VF

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	1.27592	1.27588	1.27504	1.27624	1.277	1.2776
Opt1_Ref	1.24596	1.2512	1.25076	1.25228	1.25304	1.24932
Mic1_Ref	1.22572	1.23192	1.2318	1.23272	1.23336	1.22496
Iso2	1.26E+00	1.26E+00	1.27E+00	1.26E+00	1.26E+00	1.25E+00
Iso3	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.24E+00	1.23E+00
Opt2	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.24E+00	1.23E+00
Opt3	1.24E+00	1.24E+00	1.24E+00	1.24E+00	1.23E+00	1.23E+00
Mic2	1.23E+00	1.22E+00	1.22E+00	1.22E+00	1.21E+00	1.21E+00
Mic3	1.22E+00	1.22E+00	1.21E+00	1.21E+00	1.20E+00	1.20E+00
Iso4	1.25E+00	1.26E+00	1.26E+00	1.25E+00	1.25E+00	1.24E+00
Iso5	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.24E+00
Opt4	1.28E+00	1.28E+00	1.28E+00	1.28E+00	1.28E+00	1.27E+00
Opt5	1.26E+00	1.26E+00	1.26E+00	1.25E+00	1.25E+00	1.25E+00
Mic4	1.23E+00	1.22E+00	1.21E+00	1.22E+00	1.21E+00	1.21E+00
Mic5	1.22E+00	1.22E+00	1.21E+00	1.21E+00	1.21E+00	1.20E+00
Iso6	1.24E+00	1.25E+00	1.24E+00	1.24E+00	1.24E+00	1.23E+00
Iso7	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.24E+00	1.24E+00
Opt6	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.24E+00
Opt7	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.34E+00
Mic6	1.22E+00	1.22E+00	1.21E+00	1.21E+00	1.21E+00	1.20E+00
Mic7	1.23E+00	1.23E+00	1.22E+00	1.23E+00	1.22E+00	1.21E+00
Max	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.35E+00	1.34E+00
Mean	1.25E+00	1.25E+00	1.25E+00	1.25E+00	1.24E+00	1.23E+00
Mean3Sig-	1.16E+00	1.16E+00	1.14E+00	1.15E+00	1.14E+00	1.14E+00
Mean3Sig+	1.34E+00	1.34E+00	1.35E+00	1.34E+00	1.34E+00	1.33E+00
Min	1.22E+00	1.22E+00	1.21E+00	1.21E+00	1.20E+00	1.20E+00
Sigma	2.99E-02	3.08E-02	3.40E-02	3.24E-02	3.45E-02	3.29E-02

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Parameter : IC1

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	0.0055158	0.0055106	0.0055082	0.0055106	0.005505	0.0055022
Opt1_Ref	0.0045188	0.0046246	0.0046192	0.004654	0.0046676	0.0045886
Mic1_Ref	0.0052588	0.0054324	0.0054126	0.0054572	0.0054746	0.005242
Iso2	6.88E-03	4.96E-03	3.12E-03	1.60E-03	5.49E-04	1.17E-04
Iso3	6.27E-03	4.67E-03	3.18E-03	1.83E-03	7.55E-04	2.08E-04
Opt2	5.41E-03	3.66E-03	2.25E-03	1.16E-03	4.24E-04	9.58E-05
Opt3	5.83E-03	3.93E-03	2.43E-03	1.27E-03	4.77E-04	1.26E-04
Mic2	3.24E-03	2.07E-03	1.28E-03	6.65E-04	2.71E-04	8.32E-05
Mic3	4.02E-03	2.53E-03	1.46E-03	7.55E-04	3.05E-04	9.17E-05
Iso4	6.25E-03	4.73E-03	3.23E-03	1.89E-03	7.91E-04	2.37E-04
Iso5	7.16E-03	5.55E-03	3.89E-03	2.36E-03	1.04E-03	3.24E-04
Opt4	5.62E-03	4.08E-03	2.72E-03	1.56E-03	6.39E-04	1.89E-04
Opt5	4.86E-03	3.44E-03	2.21E-03	1.23E-03	4.90E-04	1.42E-04
Mic4	3.83E-03	2.53E-03	1.49E-03	8.60E-04	3.56E-04	1.17E-04
Mic5	2.74E-03	1.91E-03	1.19E-03	6.88E-04	2.96E-04	1.00E-04
Iso6	6.16E-03	5.01E-03	3.76E-03	2.47E-03	1.11E-03	3.56E-04
Iso7	5.77E-03	4.73E-03	3.53E-03	2.33E-03	1.06E-03	3.40E-04
Opt6	4.47E-03	3.68E-03	2.80E-03	1.92E-03	9.18E-04	2.85E-04
Opt7	5.44E-03	4.42E-03	3.34E-03	2.28E-03	1.09E-03	3.75E-04
Mic6	3.13E-03	2.29E-03	1.56E-03	9.44E-04	4.15E-04	1.42E-04
Mic7	2.82E-03	2.07E-03	1.38E-03	8.65E-04	3.91E-04	1.36E-04
Max	7.16E-03	5.55E-03	3.89E-03	2.47E-03	1.11E-03	3.75E-04
Mean	4.99E-03	3.68E-03	2.49E-03	1.48E-03	6.32E-04	1.92E-04
Mean3Sig-	7.62E-04	1.31E-04	-2.71E-04	-4.01E-04	-2.70E-04	-1.11E-04
Mean3Sig+	9.23E-03	7.23E-03	5.25E-03	3.37E-03	1.53E-03	4.96E-04
Min	2.74E-03	1.91E-03	1.19E-03	6.65E-04	2.71E-04	8.32E-05
Sigma	1.41E-03	1.18E-03	9.20E-04	6.28E-04	3.01E-04	1.01E-04

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Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek		

Parameter : IC2

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	0.01214	0.012114	0.012126	0.01212	0.012116	0.012114
Opt1_Ref	0.011924	0.012086	0.012082	0.01215	0.012174	0.01202
Mic1_Ref	0.013424	0.013742	0.013698	0.013782	0.013814	0.013392
Iso2	1.44E-02	1.13E-02	7.76E-03	4.40E-03	1.67E-03	3.98E-04
Iso3	1.37E-02	1.09E-02	7.91E-03	4.90E-03	2.19E-03	6.60E-04
Opt2	1.62E-02	1.16E-02	7.61E-03	4.19E-03	1.69E-03	4.23E-04
Opt3	1.52E-02	1.08E-02	7.09E-03	3.93E-03	1.59E-03	4.55E-04
Mic2	9.16E-03	6.07E-03	3.77E-03	2.05E-03	8.61E-04	2.73E-04
Mic3	1.07E-02	6.98E-03	4.16E-03	2.22E-03	9.27E-04	2.92E-04
Iso4	1.35E-02	1.09E-02	8.00E-03	5.04E-03	2.30E-03	7.46E-04
Iso5	1.50E-02	1.25E-02	9.41E-03	6.16E-03	2.96E-03	1.00E-03
Opt4	1.43E-02	1.09E-02	7.63E-03	4.63E-03	2.05E-03	6.59E-04
Opt5	1.29E-02	9.61E-03	6.49E-03	3.81E-03	1.62E-03	5.04E-04
Mic4	1.07E-02	7.29E-03	4.42E-03	2.59E-03	1.10E-03	3.73E-04
Mic5	7.88E-03	5.59E-03	3.56E-03	2.09E-03	9.17E-04	3.18E-04
Iso6	1.34E-02	1.15E-02	9.20E-03	6.50E-03	3.24E-03	1.14E-03
Iso7	1.28E-02	1.10E-02	8.73E-03	6.17E-03	3.10E-03	1.09E-03
Opt6	1.18E-02	1.01E-02	7.99E-03	5.78E-03	3.03E-03	1.06E-03
Opt7	1.41E-02	1.18E-02	9.22E-03	6.53E-03	3.35E-03	1.24E-03
Mic6	8.83E-03	6.63E-03	4.62E-03	2.85E-03	1.29E-03	4.52E-04
Mic7	8.47E-03	6.37E-03	4.36E-03	2.77E-03	1.28E-03	4.58E-04
Max	1.62E-02	1.25E-02	9.41E-03	6.53E-03	3.35E-03	1.24E-03
Mean	1.24E-02	9.55E-03	6.77E-03	4.26E-03	1.95E-03	6.41E-04
Mean3Sig-	4.79E-03	2.55E-03	6.13E-04	-4.58E-04	-6.31E-04	-3.32E-04
Mean3Sig+	2.00E-02	1.65E-02	1.29E-02	8.97E-03	4.54E-03	1.61E-03
Min	7.88E-03	5.59E-03	3.56E-03	2.05E-03	8.61E-04	2.73E-04
Sigma	2.53E-03	2.33E-03	2.05E-03	1.57E-03	8.61E-04	3.24E-04

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079		
				Issue : 02		
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek			

Parameter : IC5

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	0.021912	0.0219	0.021876	0.021916	0.02194	0.021948
Opt1_Ref	0.034486	0.03483	0.034818	0.03494	0.035004	0.034678
Mic1_Ref	0.035818	0.036442	0.036372	0.036532	0.036596	0.035762
Iso2	2.38E-02	2.20E-02	1.92E-02	1.36E-02	6.47E-03	1.90E-03
Iso3	2.30E-02	2.14E-02	1.91E-02	1.45E-02	7.81E-03	2.79E-03
Opt2	4.55E-02	3.64E-02	2.69E-02	1.71E-02	8.16E-03	2.51E-03
Opt3	4.18E-02	3.28E-02	2.37E-02	1.48E-02	6.87E-03	2.27E-03
Mic2	2.82E-02	2.06E-02	1.38E-02	8.03E-03	3.64E-03	1.26E-03
Mic3	3.10E-02	2.24E-02	1.45E-02	8.32E-03	3.74E-03	1.29E-03
Iso4	2.35E-02	2.20E-02	1.94E-02	1.48E-02	8.17E-03	3.13E-03
Iso5	2.40E-02	2.25E-02	2.05E-02	1.69E-02	1.01E-02	4.10E-03
Opt4	3.89E-02	3.19E-02	2.44E-02	1.64E-02	8.31E-03	3.08E-03
Opt5	3.63E-02	2.93E-02	2.17E-02	1.41E-02	6.82E-03	2.43E-03
Mic4	3.16E-02	2.38E-02	1.57E-02	9.79E-03	4.51E-03	1.65E-03
Mic5	2.52E-02	1.91E-02	1.30E-02	8.02E-03	3.76E-03	1.39E-03
Iso6	2.22E-02	2.13E-02	1.97E-02	1.72E-02	1.10E-02	4.77E-03
Iso7	2.22E-02	2.11E-02	1.95E-02	1.68E-02	1.06E-02	4.52E-03
Opt6	3.44E-02	3.05E-02	2.57E-02	2.01E-02	1.21E-02	5.14E-03
Opt7	3.95E-02	3.46E-02	2.86E-02	2.17E-02	1.25E-02	5.30E-03
Mic6	2.73E-02	2.19E-02	1.62E-02	1.07E-02	5.18E-03	1.97E-03
Mic7	2.73E-02	2.19E-02	1.60E-02	1.08E-02	5.36E-03	2.09E-03
Max	4.55E-02	3.64E-02	2.86E-02	2.17E-02	1.25E-02	5.30E-03
Mean	3.03E-02	2.53E-02	1.99E-02	1.41E-02	7.51E-03	2.87E-03
Mean3Sig-	8.03E-03	8.63E-03	6.09E-03	1.86E-03	-1.11E-03	-1.17E-03
Mean3Sig+	5.26E-02	4.20E-02	3.36E-02	2.63E-02	1.61E-02	6.91E-03
Min	2.22E-02	1.91E-02	1.30E-02	8.02E-03	3.64E-03	1.26E-03
Sigma	7.43E-03	5.56E-03	4.59E-03	4.08E-03	2.87E-03	1.35E-03



HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079		
				Issue : 02		
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek			

Parameter : IC10

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	0.027708	0.0277	0.027672	0.027724	0.027752	0.027774
Opt1_Ref	0.06392	0.064594	0.064558	0.06477	0.064876	0.064336
Mic1_Ref	0.046972	0.047848	0.0477	0.047966	0.048064	0.046884
Iso2	2.98E-02	2.80E-02	2.58E-02	2.24E-02	1.51E-02	5.64E-03
Iso3	2.90E-02	2.73E-02	2.53E-02	2.24E-02	1.68E-02	7.54E-03
Opt2	7.13E-02	6.50E-02	5.41E-02	3.90E-02	2.19E-02	8.25E-03
Opt3	7.15E-02	6.21E-02	4.95E-02	3.44E-02	1.83E-02	7.04E-03
Mic2	4.23E-02	3.86E-02	3.15E-02	2.02E-02	1.00E-02	3.80E-03
Mic3	4.49E-02	4.11E-02	3.27E-02	2.06E-02	1.01E-02	3.80E-03
Iso4	2.95E-02	2.81E-02	2.60E-02	2.31E-02	1.74E-02	8.30E-03
Iso5	3.01E-02	2.85E-02	2.65E-02	2.38E-02	1.93E-02	1.04E-02
Opt4	6.79E-02	5.99E-02	4.94E-02	3.64E-02	2.10E-02	8.93E-03
Opt5	6.50E-02	5.63E-02	4.52E-02	3.24E-02	1.78E-02	7.24E-03
Mic4	4.35E-02	4.02E-02	3.39E-02	2.37E-02	1.20E-02	4.79E-03
Mic5	4.19E-02	3.83E-02	2.99E-02	1.99E-02	1.02E-02	4.06E-03
Iso6	2.81E-02	2.71E-02	2.55E-02	2.35E-02	1.95E-02	1.19E-02
Iso7	2.80E-02	2.70E-02	2.54E-02	2.33E-02	1.94E-02	1.14E-02
Opt6	6.43E-02	5.92E-02	5.22E-02	4.34E-02	2.92E-02	1.46E-02
Opt7	7.05E-02	6.47E-02	5.65E-02	4.58E-02	2.94E-02	1.42E-02
Mic6	4.19E-02	3.92E-02	3.47E-02	2.52E-02	1.35E-02	5.64E-03
Mic7	4.13E-02	3.89E-02	3.44E-02	2.59E-02	1.42E-02	6.05E-03
Max	7.15E-02	6.50E-02	5.65E-02	4.58E-02	2.94E-02	1.46E-02
Mean	4.67E-02	4.28E-02	3.66E-02	2.81E-02	1.75E-02	7.98E-03
Mean3Sig-	-3.99E-03	-5.42E-04	2.77E-03	3.25E-03	4.51E-04	-2.14E-03
Mean3Sig+	9.74E-02	8.60E-02	7.04E-02	5.29E-02	3.46E-02	1.81E-02
Min	2.80E-02	2.70E-02	2.53E-02	1.99E-02	1.00E-02	3.80E-03
Sigma	1.69E-02	1.44E-02	1.13E-02	8.28E-03	5.68E-03	3.37E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079	
				Issue : 02	
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek		

Parameter : ICOFF

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	4.0396E-10	1.2504E-08	1.234E-08	1.2744E-08	1.2018E-08	1.1286E-08
Opt1_Ref	7.762E-09	7.1208E-09	7.2512E-09	6.2712E-09	6.9578E-09	7.1876E-09
Mic1_Ref	5.015E-08	4.998E-08	4.657E-08	4.795E-08	4.8036E-08	5.0766E-08
Iso2	2.55E-08	2.28E-08	1.78E-08	1.57E-08	1.10E-08	4.77E-09
Iso3	2.06E-08	1.98E-08	1.71E-08	1.52E-08	1.29E-08	1.15E-08
Opt2	1.37E-08	1.15E-08	7.82E-09	6.93E-09	6.14E-09	7.38E-09
Opt3	1.70E-08	1.52E-08	1.27E-08	1.04E-08	8.97E-09	7.79E-09
Mic2	4.78E-08	5.41E-08	4.35E-08	4.35E-08	3.07E-08	2.45E-08
Mic3	5.28E-08	4.74E-08	5.11E-08	4.64E-08	3.83E-08	2.80E-08
Iso4	1.43E-08	1.44E-08	1.42E-08	1.32E-08	1.21E-08	1.20E-08
Iso5	1.43E-08	1.43E-08	1.29E-08	1.36E-08	1.27E-08	1.22E-08
Opt4	1.48E-08	1.45E-08	1.22E-08	1.12E-08	8.75E-09	1.05E-08
Opt5	2.14E-08	1.87E-08	1.69E-08	1.44E-08	1.35E-08	1.07E-08
Mic4	5.72E-08	5.77E-08	6.22E-08	5.46E-08	4.08E-08	3.20E-08
Mic5	4.95E-08	4.56E-08	4.44E-08	3.94E-08	2.98E-08	2.40E-08
Iso6	1.56E-08	1.47E-08	1.40E-08	1.21E-08	1.13E-08	1.05E-08
Iso7	7.58E-09	7.28E-09	7.20E-09	6.82E-09	7.54E-09	7.66E-09
Opt6	4.28E-09	4.00E-09	3.76E-09	3.30E-09	2.78E-09	2.80E-09
Opt7	3.18E-08	3.03E-08	2.70E-08	2.09E-08	1.62E-08	1.38E-08
Mic6	5.51E-08	5.47E-08	5.39E-08	4.55E-08	4.01E-08	1.38E-08
Mic7	5.21E-08	4.95E-08	4.83E-08	4.27E-08	3.62E-08	2.68E-08
Max	5.72E-08	5.77E-08	6.22E-08	5.46E-08	4.08E-08	3.20E-08
Mean	2.86E-08	2.76E-08	2.59E-08	2.31E-08	1.89E-08	1.45E-08
Mean3Sig-	-2.66E-08	-2.77E-08	-3.08E-08	-2.75E-08	-2.03E-08	-1.15E-08
Mean3Sig+	8.38E-08	8.29E-08	8.27E-08	7.37E-08	5.80E-08	4.04E-08
Min	4.28E-09	4.00E-09	3.76E-09	3.30E-09	2.78E-09	2.80E-09
Sigma	1.84E-08	1.84E-08	1.89E-08	1.69E-08	1.30E-08	8.65E-09

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079		
				Issue : 02		
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek			

Parameter : VCESAT

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	0.13556	0.1356	0.13592	0.13548	0.13524	0.13504
Opt1_Ref	0.12568	0.1234	0.12352	0.12284	0.12256	0.1242
Mic1_Ref	0.1432	0.13964	0.14012	0.1392	0.13892	0.1436
Iso2	1.31E-01	1.44E-01	1.63E-01	2.11E-01	1.00E+00	1.00E+00
Iso3	1.34E-01	1.46E-01	1.64E-01	2.02E-01	1.00E+00	1.00E+00
Opt2	1.29E-01	1.41E-01	1.59E-01	1.97E-01	1.00E+00	1.00E+00
Opt3	1.27E-01	1.40E-01	1.59E-01	1.96E-01	1.00E+00	1.00E+00
Mic2	1.57E-01	1.77E-01	2.10E-01	1.00E+00	1.00E+00	1.00E+00
Mic3	1.49E-01	1.67E-01	2.00E-01	3.39E-01	1.00E+00	1.00E+00
Iso4	1.32E-01	1.42E-01	1.60E-01	1.94E-01	5.23E-01	1.00E+00
Iso5	1.27E-01	1.38E-01	1.54E-01	1.83E-01	3.33E-01	1.00E+00
Opt4	1.28E-01	1.39E-01	1.54E-01	1.83E-01	1.00E+00	1.00E+00
Opt5	1.32E-01	1.43E-01	1.62E-01	1.96E-01	1.00E+00	1.00E+00
Mic4	1.51E-01	1.68E-01	2.02E-01	2.65E-01	1.00E+00	1.00E+00
Mic5	1.62E-01	1.78E-01	2.13E-01	1.00E+00	1.00E+00	1.00E+00
Iso6	1.37E-01	1.44E-01	1.57E-01	1.80E-01	2.97E-01	1.00E+00
Iso7	1.36E-01	1.44E-01	1.58E-01	1.81E-01	3.05E-01	1.00E+00
Opt6	1.25E-01	1.32E-01	1.44E-01	1.63E-01	2.23E-01	1.00E+00
Opt7	1.32E-01	1.40E-01	1.51E-01	1.68E-01	2.17E-01	1.00E+00
Mic6	1.59E-01	1.73E-01	1.95E-01	2.47E-01	1.00E+00	1.00E+00
Mic7	1.61E-01	1.74E-01	2.00E-01	2.51E-01	1.00E+00	1.00E+00
Max	1.62E-01	1.78E-01	2.13E-01	1.00E+00	1.00E+00	1.00E+00
Mean	1.39E-01	1.52E-01	1.73E-01	2.98E-01	7.72E-01	1.00E+00
Mean3Sig-	1.00E-01	1.04E-01	1.03E-01	-4.80E-01	-2.39E-01	1.00E+00
Mean3Sig+	1.79E-01	1.99E-01	2.42E-01	1.07E+00	1.78E+00	1.00E+00
Min	1.25E-01	1.32E-01	1.44E-01	1.63E-01	2.17E-01	1.00E+00
Sigma	1.31E-02	1.59E-02	2.32E-02	2.59E-01	3.37E-01	0.00E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079		
				Issue : 02		
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek			

Parameter : CTR1 degr.

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	100	99.9057254	99.862214	99.9057254	99.8041988	99.7534356
Opt1_Ref	100	102.34133	102.221829	102.991945	103.29291	101.544658
Mic1_Ref	100	103.301133	102.924622	103.772724	104.103598	99.6805355
Iso2	1.00E+02	7.20E+01	4.53E+01	2.33E+01	7.98E+00	1.70E+00
Iso3	1.00E+02	7.45E+01	5.07E+01	2.92E+01	1.20E+01	3.33E+00
Opt2	1.00E+02	6.76E+01	4.16E+01	2.14E+01	7.84E+00	1.77E+00
Opt3	1.00E+02	6.74E+01	4.17E+01	2.18E+01	8.19E+00	2.16E+00
Mic2	1.00E+02	6.39E+01	3.95E+01	2.05E+01	8.36E+00	2.57E+00
Mic3	1.00E+02	6.30E+01	3.62E+01	1.88E+01	7.59E+00	2.28E+00
Iso4	1.00E+02	7.57E+01	5.17E+01	3.02E+01	1.27E+01	3.80E+00
Iso5	1.00E+02	7.75E+01	5.43E+01	3.29E+01	1.45E+01	4.53E+00
Opt4	1.00E+02	7.25E+01	4.83E+01	2.77E+01	1.14E+01	3.36E+00
Opt5	1.00E+02	7.09E+01	4.55E+01	2.53E+01	1.01E+01	2.93E+00
Mic4	1.00E+02	6.60E+01	3.88E+01	2.24E+01	9.29E+00	3.06E+00
Mic5	1.00E+02	6.95E+01	4.33E+01	2.51E+01	1.08E+01	3.66E+00
Iso6	1.00E+02	8.14E+01	6.11E+01	4.02E+01	1.81E+01	5.78E+00
Iso7	1.00E+02	8.19E+01	6.12E+01	4.04E+01	1.84E+01	5.88E+00
Opt6	1.00E+02	8.24E+01	6.26E+01	4.31E+01	2.06E+01	6.38E+00
Opt7	1.00E+02	8.12E+01	6.13E+01	4.19E+01	2.01E+01	6.89E+00
Mic6	1.00E+02	7.30E+01	4.99E+01	3.01E+01	1.33E+01	4.52E+00
Mic7	1.00E+02	7.35E+01	4.91E+01	3.07E+01	1.39E+01	4.83E+00
Max	1.00E+02	8.24E+01	6.26E+01	4.31E+01	2.06E+01	6.89E+00
Mean	1.00E+02	7.30E+01	4.90E+01	2.92E+01	1.25E+01	3.86E+00
Mean3Sig-	1.00E+02	5.45E+01	2.38E+01	5.78E+00	-4.78E-01	-9.30E-01
Mean3Sig+	1.00E+02	9.15E+01	7.42E+01	5.26E+01	2.55E+01	8.64E+00
Min	1.00E+02	6.30E+01	3.62E+01	1.88E+01	7.59E+00	1.70E+00
Sigma	0.00E+00	6.16E+00	8.39E+00	7.80E+00	4.33E+00	1.60E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079		
				Issue : 02		
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek			

Parameter : CTR2 degr.

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	100	99.785832	99.8846787	99.8352554	99.8023064	99.785832
Opt1_Ref	100	101.358604	101.325059	101.895337	102.096612	100.805099
Mic1_Ref	100	102.368892	102.04112	102.666865	102.905244	99.761621
Iso2	1.00E+02	7.82E+01	5.38E+01	3.05E+01	1.16E+01	2.76E+00
Iso3	1.00E+02	7.96E+01	5.79E+01	3.59E+01	1.60E+01	4.83E+00
Opt2	1.00E+02	7.16E+01	4.70E+01	2.59E+01	1.04E+01	2.61E+00
Opt3	1.00E+02	7.12E+01	4.66E+01	2.58E+01	1.04E+01	2.99E+00
Mic2	1.00E+02	6.63E+01	4.12E+01	2.24E+01	9.40E+00	2.98E+00
Mic3	1.00E+02	6.55E+01	3.90E+01	2.08E+01	8.70E+00	2.74E+00
Iso4	1.00E+02	8.07E+01	5.91E+01	3.73E+01	1.70E+01	5.51E+00
Iso5	1.00E+02	8.29E+01	6.26E+01	4.10E+01	1.97E+01	6.67E+00
Opt4	1.00E+02	7.61E+01	5.33E+01	3.24E+01	1.43E+01	4.60E+00
Opt5	1.00E+02	7.45E+01	5.03E+01	2.95E+01	1.25E+01	3.91E+00
Mic4	1.00E+02	6.83E+01	4.14E+01	2.43E+01	1.04E+01	3.50E+00
Mic5	1.00E+02	7.09E+01	4.52E+01	2.65E+01	1.16E+01	4.04E+00
Iso6	1.00E+02	8.59E+01	6.85E+01	4.84E+01	2.41E+01	8.52E+00
Iso7	1.00E+02	8.59E+01	6.82E+01	4.82E+01	2.42E+01	8.50E+00
Opt6	1.00E+02	8.50E+01	6.74E+01	4.88E+01	2.56E+01	8.99E+00
Opt7	1.00E+02	8.36E+01	6.52E+01	4.62E+01	2.37E+01	8.76E+00
Mic6	1.00E+02	7.50E+01	5.23E+01	3.23E+01	1.46E+01	5.11E+00
Mic7	1.00E+02	7.52E+01	5.15E+01	3.27E+01	1.51E+01	5.41E+00
Max	1.00E+02	8.59E+01	6.85E+01	4.88E+01	2.56E+01	8.99E+00
Mean	1.00E+02	7.65E+01	5.39E+01	3.38E+01	1.55E+01	5.14E+00
Mean3Sig-	1.00E+02	5.65E+01	2.50E+01	5.92E+00	-1.43E+00	-1.62E+00
Mean3Sig+	1.00E+02	9.65E+01	8.29E+01	6.17E+01	3.25E+01	1.19E+01
Min	1.00E+02	6.55E+01	3.90E+01	2.08E+01	8.70E+00	2.61E+00
Sigma	0.00E+00	6.66E+00	9.65E+00	9.30E+00	5.65E+00	2.25E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079		
				Issue : 02		
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek			

Parameter : CTR5 degr.

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	100	99.9452355	99.8357065	100.018255	100.127784	100.164294
Opt1_Ref	100	100.997506	100.96271	101.316476	101.502059	100.556748
Mic1_Ref	100	101.742141	101.546708	101.993411	102.172092	99.843654
Iso2	1.00E+02	9.26E+01	8.07E+01	5.72E+01	2.72E+01	7.97E+00
Iso3	1.00E+02	9.29E+01	8.28E+01	6.28E+01	3.39E+01	1.21E+01
Opt2	1.00E+02	8.01E+01	5.92E+01	3.75E+01	1.79E+01	5.51E+00
Opt3	1.00E+02	7.85E+01	5.68E+01	3.54E+01	1.64E+01	5.44E+00
Mic2	1.00E+02	7.28E+01	4.88E+01	2.85E+01	1.29E+01	4.46E+00
Mic3	1.00E+02	7.22E+01	4.68E+01	2.68E+01	1.21E+01	4.16E+00
Iso4	1.00E+02	9.36E+01	8.29E+01	6.32E+01	3.48E+01	1.34E+01
Iso5	1.00E+02	9.39E+01	8.54E+01	7.05E+01	4.20E+01	1.71E+01
Opt4	1.00E+02	8.20E+01	6.26E+01	4.21E+01	2.14E+01	7.92E+00
Opt5	1.00E+02	8.07E+01	5.97E+01	3.89E+01	1.88E+01	6.70E+00
Mic4	1.00E+02	7.53E+01	4.99E+01	3.10E+01	1.43E+01	5.22E+00
Mic5	1.00E+02	7.57E+01	5.15E+01	3.18E+01	1.49E+01	5.53E+00
Iso6	1.00E+02	9.58E+01	8.87E+01	7.75E+01	4.93E+01	2.14E+01
Iso7	1.00E+02	9.53E+01	8.79E+01	7.57E+01	4.76E+01	2.04E+01
Opt6	1.00E+02	8.89E+01	7.48E+01	5.83E+01	3.52E+01	1.50E+01
Opt7	1.00E+02	8.74E+01	7.23E+01	5.48E+01	3.16E+01	1.34E+01
Mic6	1.00E+02	8.00E+01	5.94E+01	3.90E+01	1.90E+01	7.23E+00
Mic7	1.00E+02	8.01E+01	5.87E+01	3.95E+01	1.96E+01	7.65E+00
Max	1.00E+02	9.58E+01	8.87E+01	7.75E+01	4.93E+01	2.14E+01
Mean	1.00E+02	8.43E+01	6.72E+01	4.84E+01	2.61E+01	1.00E+01
Mean3Sig-	1.00E+02	5.97E+01	2.31E+01	-1.78E+00	-1.01E+01	-6.59E+00
Mean3Sig+	1.00E+02	1.09E+02	1.11E+02	9.85E+01	6.22E+01	2.67E+01
Min	1.00E+02	7.22E+01	4.68E+01	2.68E+01	1.21E+01	4.16E+00
Sigma	0.00E+00	8.21E+00	1.47E+01	1.67E+01	1.20E+01	5.54E+00

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079		
				Issue : 02		
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek			

Parameter : CTR10 degr.

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso1_Ref	100	99.9711275	99.8700736	100.057745	100.158799	100.238198
Opt1_Ref	100	101.054443	100.998123	101.329787	101.49562	100.650814
Mic1_Ref	100	101.864941	101.549859	102.116154	102.324789	99.8126543
Iso2	1.00E+02	9.40E+01	8.65E+01	7.51E+01	5.08E+01	1.89E+01
Iso3	1.00E+02	9.42E+01	8.73E+01	7.73E+01	5.80E+01	2.60E+01
Opt2	1.00E+02	9.11E+01	7.58E+01	5.47E+01	3.07E+01	1.16E+01
Opt3	1.00E+02	8.68E+01	6.92E+01	4.81E+01	2.56E+01	9.85E+00
Mic2	1.00E+02	9.11E+01	7.44E+01	4.78E+01	2.37E+01	8.98E+00
Mic3	1.00E+02	9.15E+01	7.27E+01	4.59E+01	2.25E+01	8.47E+00
Iso4	1.00E+02	9.51E+01	8.79E+01	7.83E+01	5.91E+01	2.81E+01
Iso5	1.00E+02	9.48E+01	8.81E+01	7.93E+01	6.44E+01	3.46E+01
Opt4	1.00E+02	8.81E+01	7.27E+01	5.36E+01	3.09E+01	1.31E+01
Opt5	1.00E+02	8.67E+01	6.96E+01	4.98E+01	2.74E+01	1.11E+01
Mic4	1.00E+02	9.22E+01	7.78E+01	5.45E+01	2.76E+01	1.10E+01
Mic5	1.00E+02	9.14E+01	7.14E+01	4.77E+01	2.43E+01	9.69E+00
Iso6	1.00E+02	9.65E+01	9.08E+01	8.36E+01	6.94E+01	4.24E+01
Iso7	1.00E+02	9.62E+01	9.04E+01	8.32E+01	6.92E+01	4.06E+01
Opt6	1.00E+02	9.21E+01	8.12E+01	6.75E+01	4.54E+01	2.27E+01
Opt7	1.00E+02	9.17E+01	8.01E+01	6.49E+01	4.16E+01	2.01E+01
Mic6	1.00E+02	9.35E+01	8.28E+01	6.03E+01	3.23E+01	1.35E+01
Mic7	1.00E+02	9.40E+01	8.33E+01	6.26E+01	3.42E+01	1.46E+01
Max	1.00E+02	9.65E+01	9.08E+01	8.36E+01	6.94E+01	4.24E+01
Mean	1.00E+02	9.23E+01	8.01E+01	6.30E+01	4.10E+01	1.92E+01
Mean3Sig-	1.00E+02	8.36E+01	5.80E+01	2.25E+01	-9.11E+00	-1.38E+01
Mean3Sig+	1.00E+02	1.01E+02	1.02E+02	1.04E+02	9.10E+01	5.21E+01
Min	1.00E+02	8.67E+01	6.92E+01	4.59E+01	2.25E+01	8.47E+00
Sigma	0.00E+00	2.89E+00	7.39E+00	1.35E+01	1.67E+01	1.10E+01

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink

Parameter : Input Diode Forward Voltage : VF

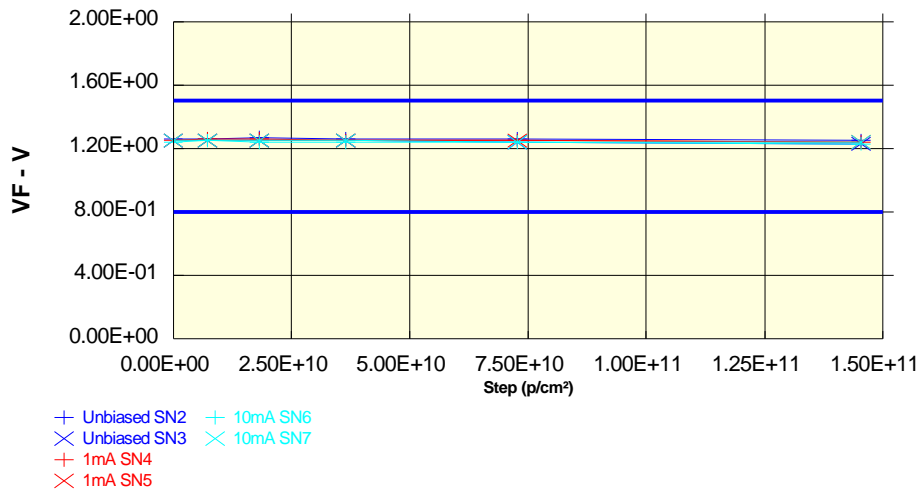
IE=10mA

Unit : V

Spec Limit Min : 8.00 E-01

Spec Limit Max : 1.50 E+00

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	1.26 E+00	1.26 E+00	1.27 E+00	1.26 E+00	1.26 E+00	1.25 E+00
Iso3	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00	1.23 E+00
Iso4	1.25 E+00	1.26 E+00	1.26 E+00	1.25 E+00	1.25 E+00	1.24 E+00
Iso5	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00
Iso6	1.24 E+00	1.25 E+00	1.24 E+00	1.24 E+00	1.24 E+00	1.23 E+00
Iso7	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00	1.24 E+00



<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink

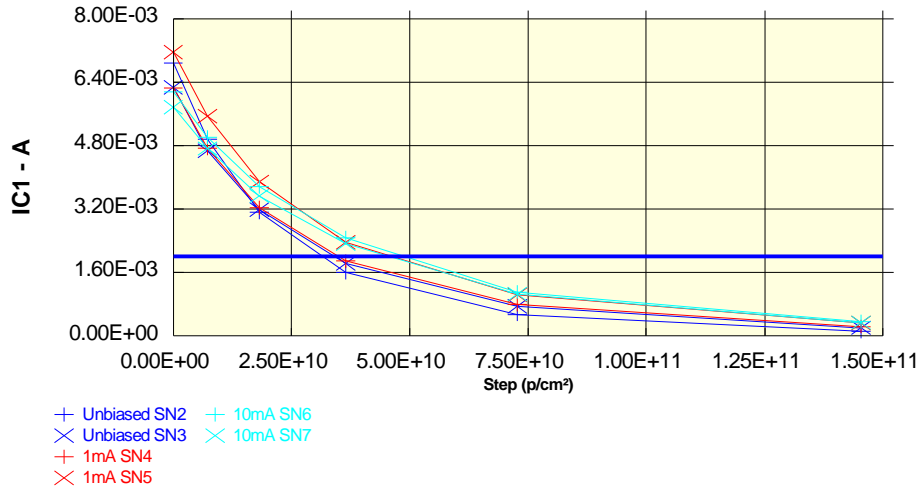
Parameter : On State Collector Current 1 : IC1

VCE=5V. IB=0. IF=1mA

Unit : A

Spec Limit Min : 2.00 E-03

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	6.88 E-03	4.96 E-03	3.12 E-03	1.60 E-03	5.49 E-04	1.17 E-04
Iso3	6.27 E-03	4.67 E-03	3.18 E-03	1.83 E-03	7.55 E-04	2.08 E-04
Iso4	6.25 E-03	4.73 E-03	3.23 E-03	1.89 E-03	7.91 E-04	2.37 E-04
Iso5	7.16 E-03	5.55 E-03	3.89 E-03	2.36 E-03	1.04 E-03	3.24 E-04
Iso6	6.16 E-03	5.01 E-03	3.76 E-03	2.47 E-03	1.11 E-03	3.56 E-04
Iso7	5.77 E-03	4.73 E-03	3.53 E-03	2.33 E-03	1.06 E-03	3.40 E-04

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

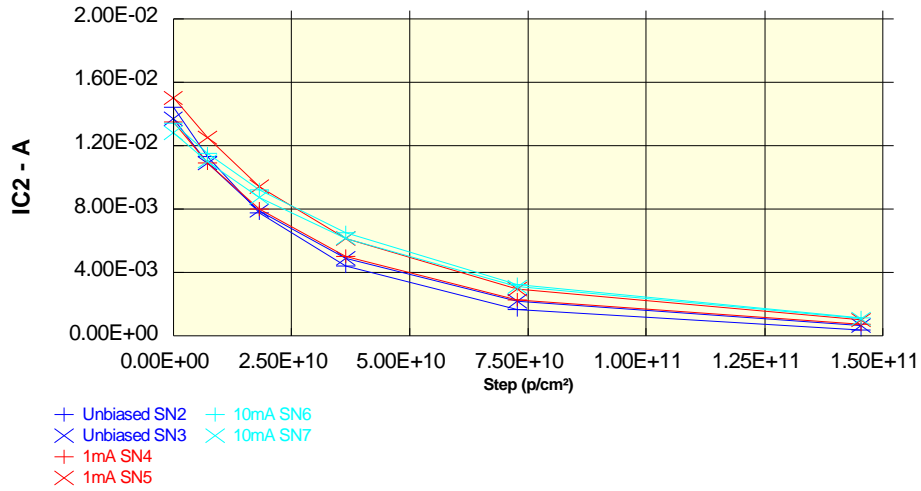
Test conditions : Isolink

Parameter : On State Collector Current 2 : IC2

VCE=5V. IB=0. IF=2mA

Unit : A

No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.44 E-02	1.13 E-02	7.76 E-03	4.40 E-03	1.67 E-03	3.98 E-04
Iso3	1.37 E-02	1.09 E-02	7.91 E-03	4.90 E-03	2.19 E-03	6.60 E-04
Iso4	1.35 E-02	1.09 E-02	8.00 E-03	5.04 E-03	2.30 E-03	7.46 E-04
Iso5	1.50 E-02	1.25 E-02	9.41 E-03	6.16 E-03	2.96 E-03	1.00 E-03
Iso6	1.34 E-02	1.15 E-02	9.20 E-03	6.50 E-03	3.24 E-03	1.14 E-03
Iso7	1.28 E-02	1.10 E-02	8.73 E-03	6.17 E-03	3.10 E-03	1.09 E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

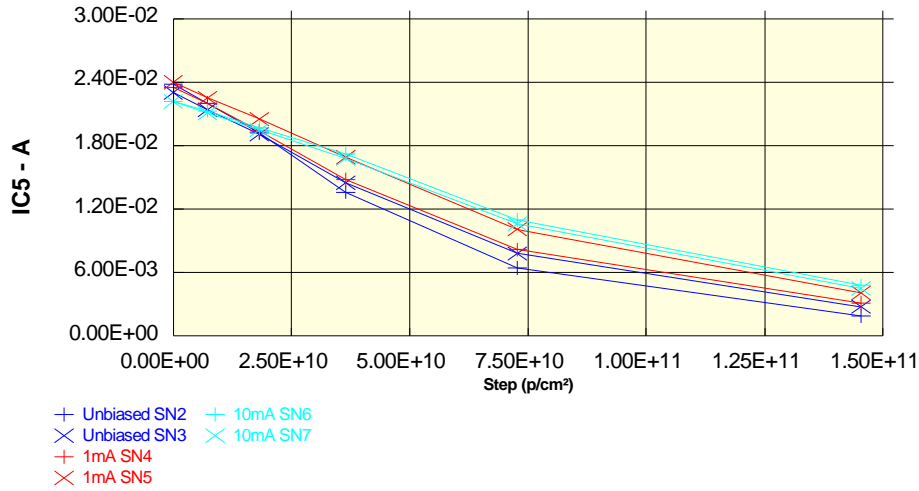
Test conditions : Isolink

Parameter : On State Collector Current 5 : IC5

VCE=5V. IB=0. IF=5mA

Unit : A

No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	2.38 E-02	2.20 E-02	1.92 E-02	1.36 E-02	6.47 E-03	1.90 E-03
Iso3	2.30 E-02	2.14 E-02	1.91 E-02	1.45 E-02	7.81 E-03	2.79 E-03
Iso4	2.35 E-02	2.20 E-02	1.94 E-02	1.48 E-02	8.17 E-03	3.13 E-03
Iso5	2.40 E-02	2.25 E-02	2.05 E-02	1.69 E-02	1.01 E-02	4.10 E-03
Iso6	2.22 E-02	2.13 E-02	1.97 E-02	1.72 E-02	1.10 E-02	4.77 E-03
Iso7	2.22 E-02	2.11 E-02	1.95 E-02	1.68 E-02	1.06 E-02	4.52 E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

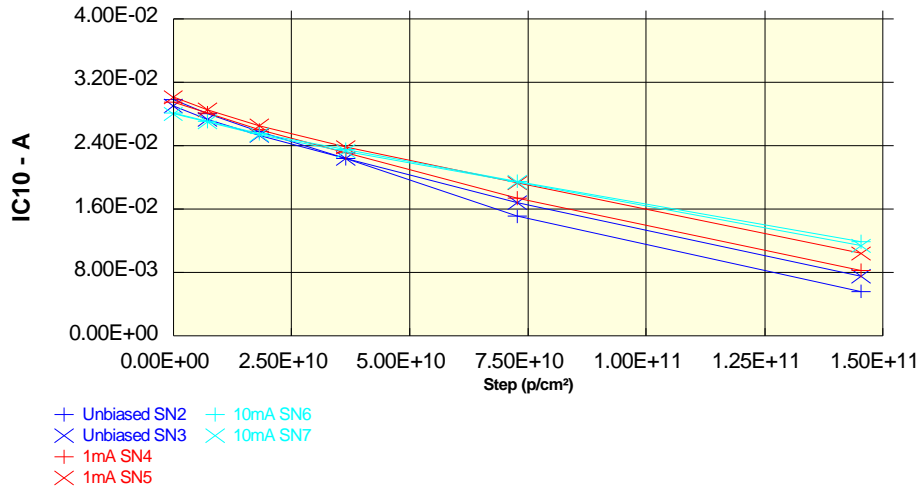
Test conditions : Isolink

Parameter : On State Collector Current 10 : IC10

VCE=5V. IB=0. IF=10mA

Unit : A

No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	2.98 E-02	2.80 E-02	2.58 E-02	2.24 E-02	1.51 E-02	5.64 E-03
Iso3	2.90 E-02	2.73 E-02	2.53 E-02	2.24 E-02	1.68 E-02	7.54 E-03
Iso4	2.95 E-02	2.81 E-02	2.60 E-02	2.31 E-02	1.74 E-02	8.30 E-03
Iso5	3.01 E-02	2.85 E-02	2.65 E-02	2.38 E-02	1.93 E-02	1.04 E-02
Iso6	2.81 E-02	2.71 E-02	2.55 E-02	2.35 E-02	1.95 E-02	1.19 E-02
Iso7	2.80 E-02	2.70 E-02	2.54 E-02	2.33 E-02	1.94 E-02	1.14 E-02

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink

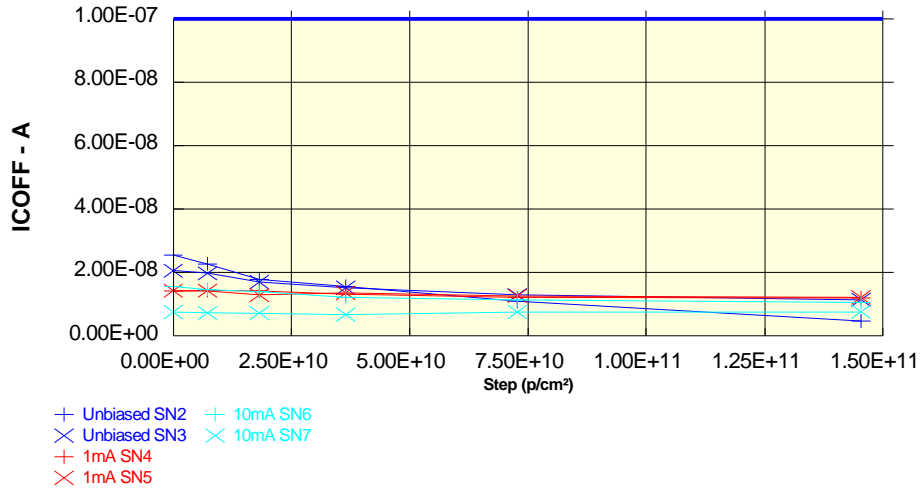
Parameter : Off State Collector Current : ICOFF

VCE=20V. IB=0. IF=0mA

Unit : A

Spec Limit Max : 1.00 E-07

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	2.55 E-08	2.28 E-08	1.78 E-08	1.57 E-08	1.10 E-08	4.77 E-09
Iso3	2.06 E-08	1.98 E-08	1.71 E-08	1.52 E-08	1.29 E-08	1.15 E-08
Iso4	1.43 E-08	1.44 E-08	1.42 E-08	1.32 E-08	1.21 E-08	1.20 E-08
Iso5	1.43 E-08	1.43 E-08	1.29 E-08	1.36 E-08	1.27 E-08	1.22 E-08
Iso6	1.56 E-08	1.47 E-08	1.40 E-08	1.21 E-08	1.13 E-08	1.05 E-08
Iso7	7.58 E-09	7.28 E-09	7.20 E-09	6.82 E-09	7.54 E-09	7.66 E-09

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink

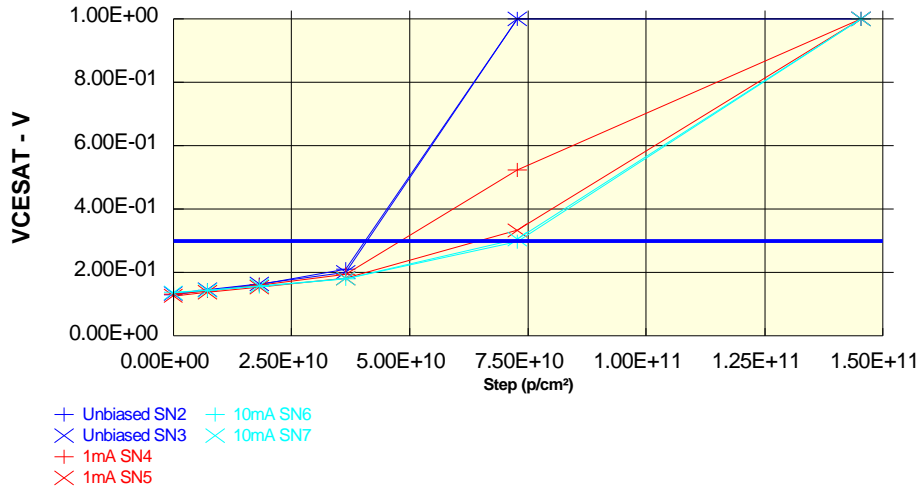
Parameter : Collector Emitter Saturation Voltage : VCESAT

IC=2mA. IB=0. IF=2mA

Unit : V

Spec Limit Max : 3.00 E-01

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.31 E-01	1.44 E-01	1.63 E-01	2.11 E-01	1.00 E+00	1.00 E+00
Iso3	1.34 E-01	1.46 E-01	1.64 E-01	2.02 E-01	1.00 E+00	1.00 E+00
Iso4	1.32 E-01	1.42 E-01	1.60 E-01	1.94 E-01	5.23 E-01	1.00 E+00
Iso5	1.27 E-01	1.38 E-01	1.54 E-01	1.83 E-01	3.33 E-01	1.00 E+00
Iso6	1.37 E-01	1.44 E-01	1.57 E-01	1.80 E-01	2.97 E-01	1.00 E+00
Iso7	1.36 E-01	1.44 E-01	1.58 E-01	1.81 E-01	3.05 E-01	1.00 E+00

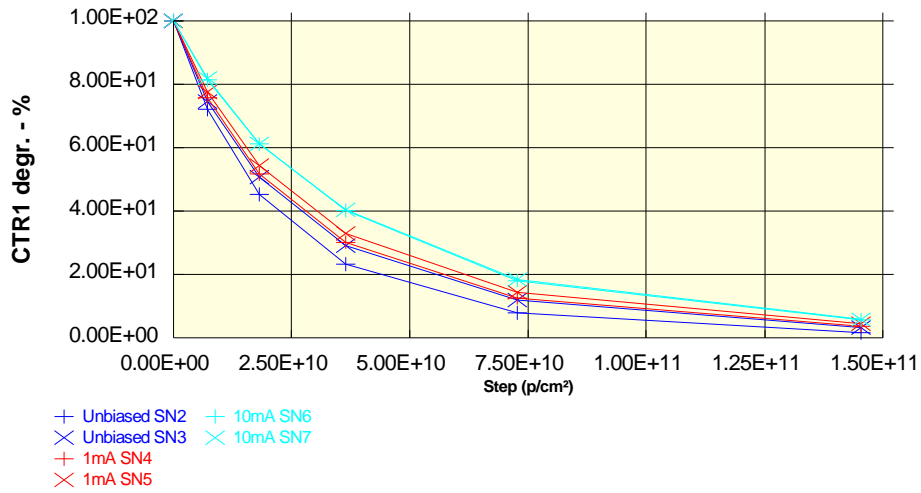
<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink

Parameter : CTR1 Degradation : CTR1 degr.

Unit : %

No spec limit specified.



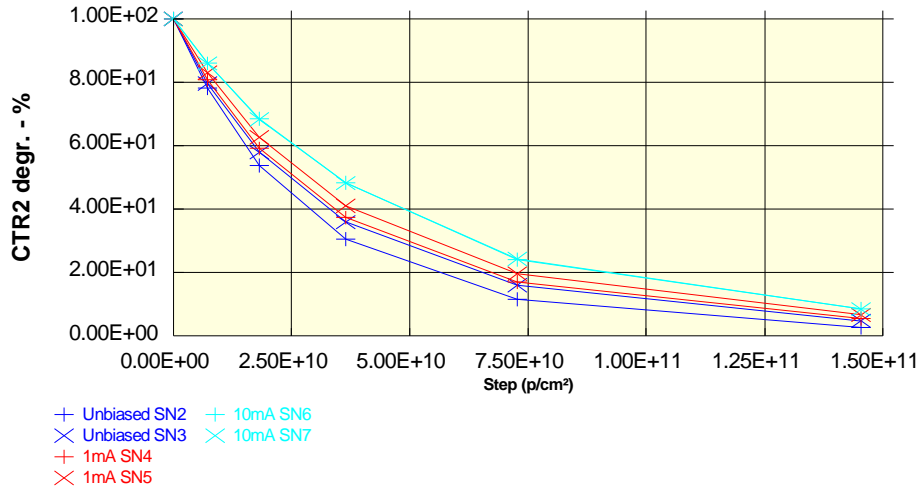
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.00 E+02	7.20 E+01	4.53 E+01	2.33 E+01	7.98 E+00	1.70 E+00
Iso3	1.00 E+02	7.45 E+01	5.07 E+01	2.92 E+01	1.20 E+01	3.33 E+00
Iso4	1.00 E+02	7.57 E+01	5.17 E+01	3.02 E+01	1.27 E+01	3.80 E+00
Iso5	1.00 E+02	7.75 E+01	5.43 E+01	3.29 E+01	1.45 E+01	4.53 E+00
Iso6	1.00 E+02	8.14 E+01	6.11 E+01	4.02 E+01	1.81 E+01	5.78 E+00
Iso7	1.00 E+02	8.19 E+01	6.12 E+01	4.04 E+01	1.84 E+01	5.88 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink  
Parameter : CTR2 Degradation : CTR2 degr.

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

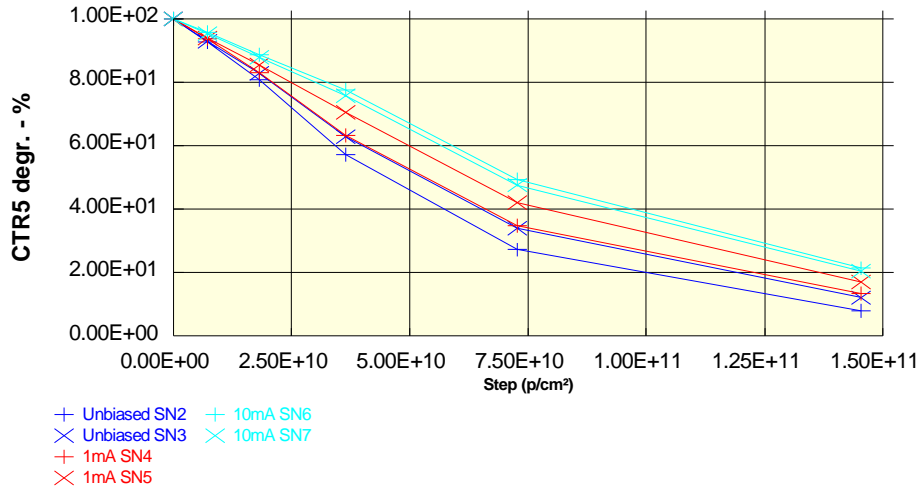
	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.00 E+02	7.82 E+01	5.38 E+01	3.05 E+01	1.16 E+01	2.76 E+00
Iso3	1.00 E+02	7.96 E+01	5.79 E+01	3.59 E+01	1.60 E+01	4.83 E+00
Iso4	1.00 E+02	8.07 E+01	5.91 E+01	3.73 E+01	1.70 E+01	5.51 E+00
Iso5	1.00 E+02	8.29 E+01	6.26 E+01	4.10 E+01	1.97 E+01	6.67 E+00
Iso6	1.00 E+02	8.59 E+01	6.85 E+01	4.84 E+01	2.41 E+01	8.52 E+00
Iso7	1.00 E+02	8.59 E+01	6.82 E+01	4.82 E+01	2.42 E+01	8.50 E+00



<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink  
Parameter : CTR5 Degradation : CTR5 degr.

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.00 E+02	9.26 E+01	8.07 E+01	5.72 E+01	2.72 E+01	7.97 E+00
Iso3	1.00 E+02	9.29 E+01	8.28 E+01	6.28 E+01	3.39 E+01	1.21 E+01
Iso4	1.00 E+02	9.36 E+01	8.29 E+01	6.32 E+01	3.48 E+01	1.34 E+01
Iso5	1.00 E+02	9.39 E+01	8.54 E+01	7.05 E+01	4.20 E+01	1.71 E+01
Iso6	1.00 E+02	9.58 E+01	8.87 E+01	7.75 E+01	4.93 E+01	2.14 E+01
Iso7	1.00 E+02	9.53 E+01	8.79 E+01	7.57 E+01	4.76 E+01	2.04 E+01

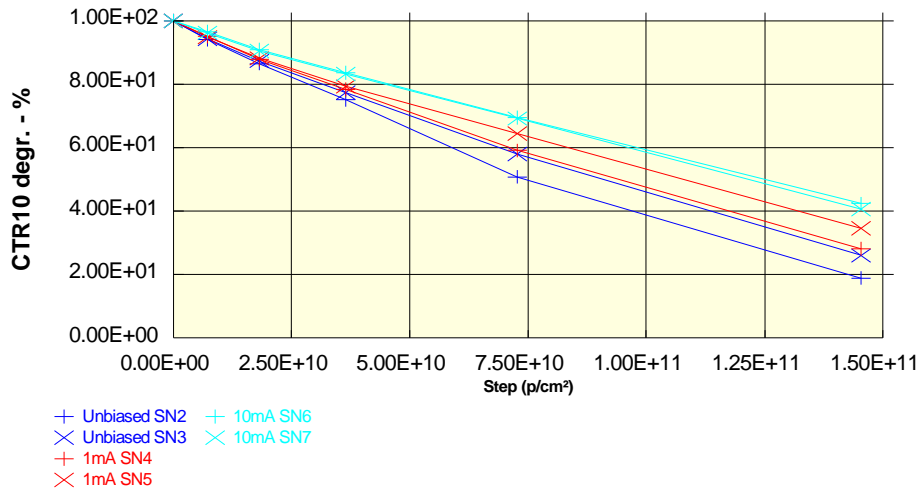
<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Test conditions : Isolink

Parameter : CTR10 Degradation : CTR10 degr.

Unit : %

No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.00 E+02	9.40 E+01	8.65 E+01	7.51 E+01	5.08 E+01	1.89 E+01
Iso3	1.00 E+02	9.42 E+01	8.73 E+01	7.73 E+01	5.80 E+01	2.60 E+01
Iso4	1.00 E+02	9.51 E+01	8.79 E+01	7.83 E+01	5.91 E+01	2.81 E+01
Iso5	1.00 E+02	9.48 E+01	8.81 E+01	7.93 E+01	6.44 E+01	3.46 E+01
Iso6	1.00 E+02	9.65 E+01	9.08 E+01	8.36 E+01	6.94 E+01	4.24 E+01
Iso7	1.00 E+02	9.62 E+01	9.04 E+01	8.32 E+01	6.92 E+01	4.06 E+01

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Optek

Parameter : Input Diode Forward Voltage : VF

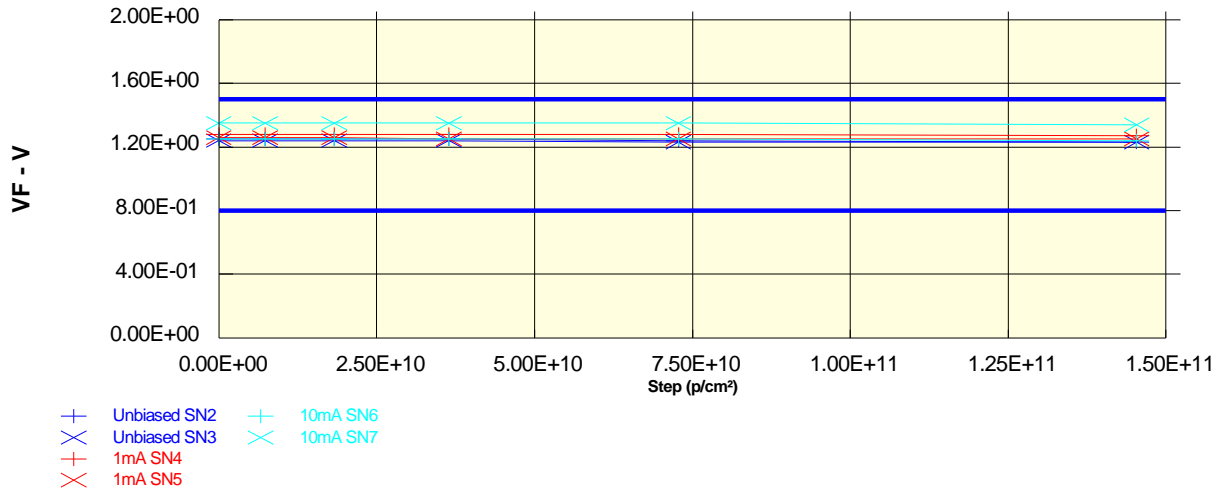
IE=10mA

Unit : V

Spec Limit Min : 8.00 E-01

Spec Limit Max : 1.50 E+00

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00	1.23 E+00
Opt3	1.24 E+00	1.24 E+00	1.24 E+00	1.24 E+00	1.23 E+00	1.23 E+00
Opt4	1.28 E+00	1.28 E+00	1.28 E+00	1.28 E+00	1.28 E+00	1.27 E+00
Opt5	1.26 E+00	1.26 E+00	1.26 E+00	1.25 E+00	1.25 E+00	1.25 E+00
Opt6	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00
Opt7	1.35 E+00	1.35 E+00	1.35 E+00	1.35 E+00	1.35 E+00	1.34 E+00

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Optek

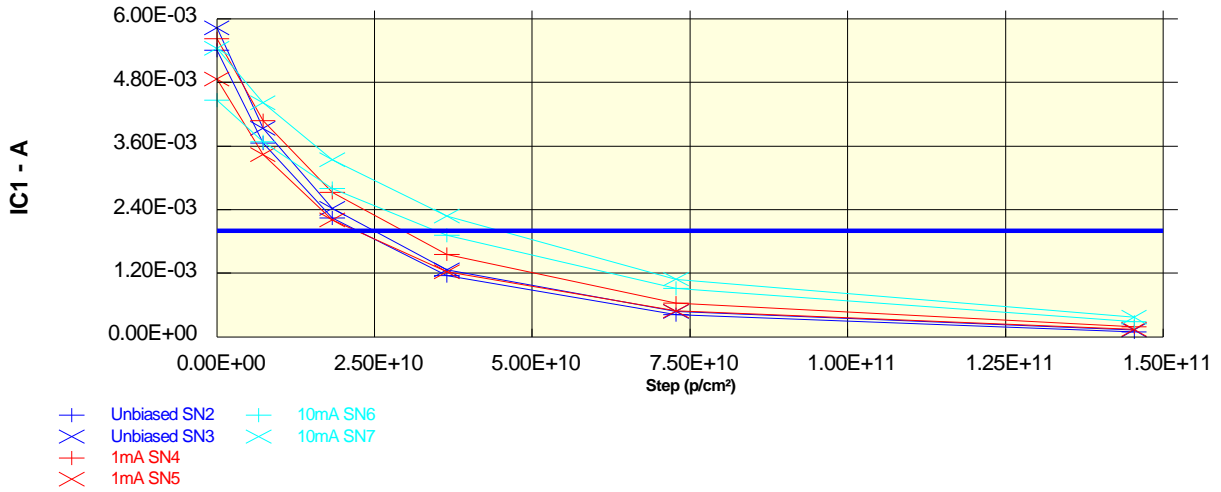
Parameter : On State Collector Current 1 : IC1

VCE=5V. IB=0. IF=1mA

Unit : A

Spec Limit Min : 2.00 E-03

Spec limits are represented in bold lines on the graphic.

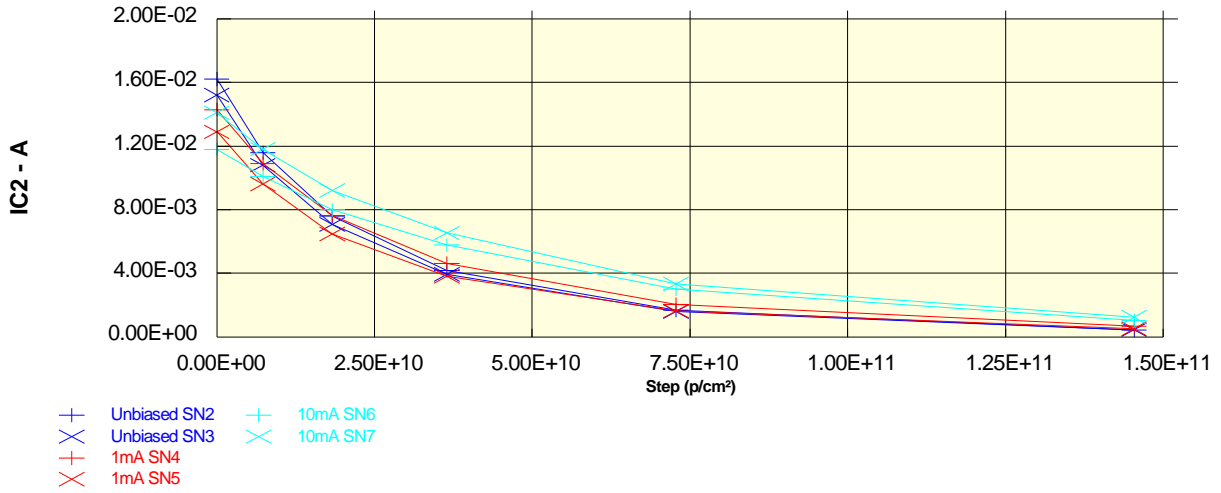


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	5.41 E-03	3.66 E-03	2.25 E-03	1.16 E-03	4.24 E-04	9.58 E-05
Opt3	5.83 E-03	3.93 E-03	2.43 E-03	1.27 E-03	4.77 E-04	1.26 E-04
Opt4	5.62 E-03	4.08 E-03	2.72 E-03	1.56 E-03	6.39 E-04	1.89 E-04
Opt5	4.86 E-03	3.44 E-03	2.21 E-03	1.23 E-03	4.90 E-04	1.42 E-04
Opt6	4.47 E-03	3.68 E-03	2.80 E-03	1.92 E-03	9.18 E-04	2.85 E-04
Opt7	5.44 E-03	4.42 E-03	3.34 E-03	2.28 E-03	1.09 E-03	3.75 E-04

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**Manufacturer : Optek**  
**Parameter : On State Collector Current 2 : IC2**  
**VCE=5V. IB=0. IF=2mA**  
 Unit : A  
 No spec limit specified.

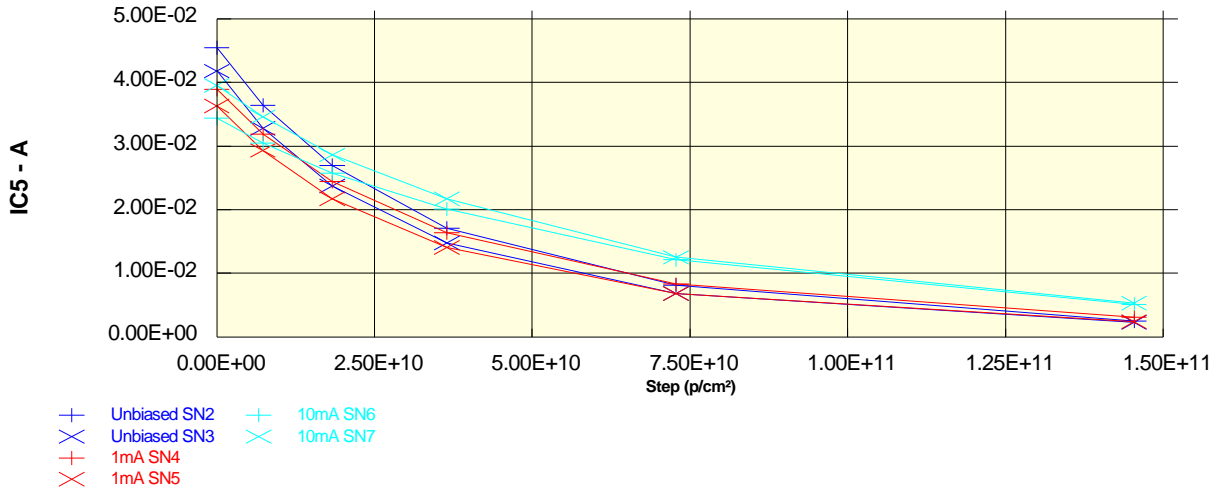


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	1.62 E-02	1.16 E-02	7.61 E-03	4.19 E-03	1.69 E-03	4.23 E-04
Opt3	1.52 E-02	1.08 E-02	7.09 E-03	3.93 E-03	1.59 E-03	4.55 E-04
Opt4	1.43 E-02	1.09 E-02	7.63 E-03	4.63 E-03	2.05 E-03	6.59 E-04
Opt5	1.29 E-02	9.61 E-03	6.49 E-03	3.81 E-03	1.62 E-03	5.04 E-04
Opt6	1.18 E-02	1.01 E-02	7.99 E-03	5.78 E-03	3.03 E-03	1.06 E-03
Opt7	1.41 E-02	1.18 E-02	9.22 E-03	6.53 E-03	3.35 E-03	1.24 E-03

HIREX Engineering	Total Dose Test Report		Réf. : HRX/TID/0079
			Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**Manufacturer : Optek**  
**Parameter : On State Collector Current 5 : IC5**  
**VCE=5V. IB=0. IF=5mA**  
 Unit : A  
 No spec limit specified.

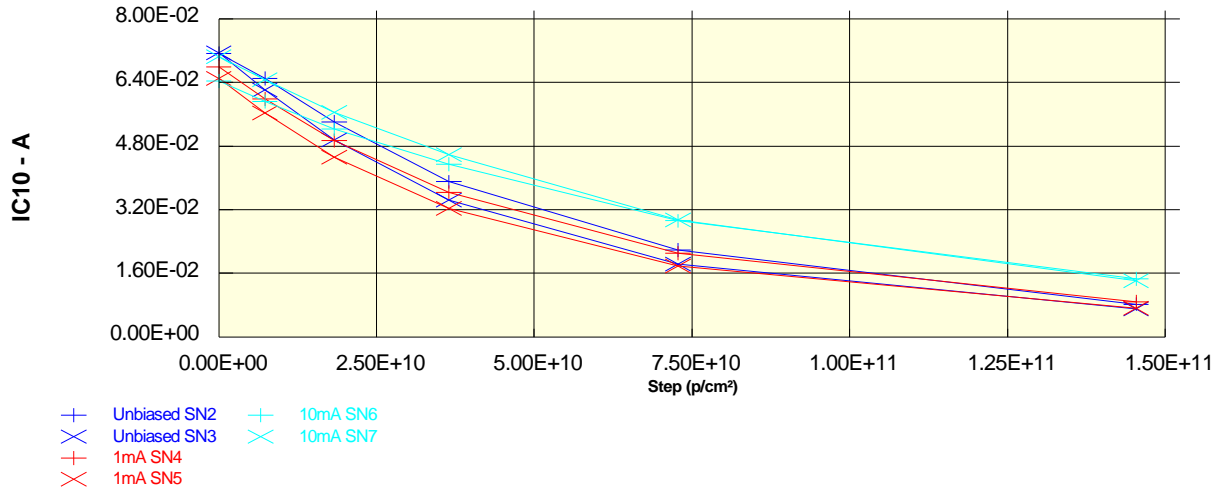


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	4.55 E-02	3.64 E-02	2.69 E-02	1.71 E-02	8.16 E-03	2.51 E-03
Opt3	4.18 E-02	3.28 E-02	2.37 E-02	1.48 E-02	6.87 E-03	2.27 E-03
Opt4	3.89 E-02	3.19 E-02	2.44 E-02	1.64 E-02	8.31 E-03	3.08 E-03
Opt5	3.63 E-02	2.93 E-02	2.17 E-02	1.41 E-02	6.82 E-03	2.43 E-03
Opt6	3.44 E-02	3.05 E-02	2.57 E-02	2.01 E-02	1.21 E-02	5.14 E-03
Opt7	3.95 E-02	3.46 E-02	2.86 E-02	2.17 E-02	1.25 E-02	5.30 E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Manufacturer : Optek**  
**Parameter : On State Collector Current 10 : IC10**  
**VCE=5V. IB=0. IF=10mA**  
 Unit : A  
 No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	7.13 E-02	6.50 E-02	5.41 E-02	3.90 E-02	2.19 E-02	8.25 E-03
Opt3	7.15 E-02	6.21 E-02	4.95 E-02	3.44 E-02	1.83 E-02	7.04 E-03
Opt4	6.79 E-02	5.99 E-02	4.94 E-02	3.64 E-02	2.10 E-02	8.93 E-03
Opt5	6.50 E-02	5.63 E-02	4.52 E-02	3.24 E-02	1.78 E-02	7.24 E-03
Opt6	6.43 E-02	5.92 E-02	5.22 E-02	4.34 E-02	2.92 E-02	1.46 E-02
Opt7	7.05 E-02	6.47 E-02	5.65 E-02	4.58 E-02	2.94 E-02	1.42 E-02

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Optek

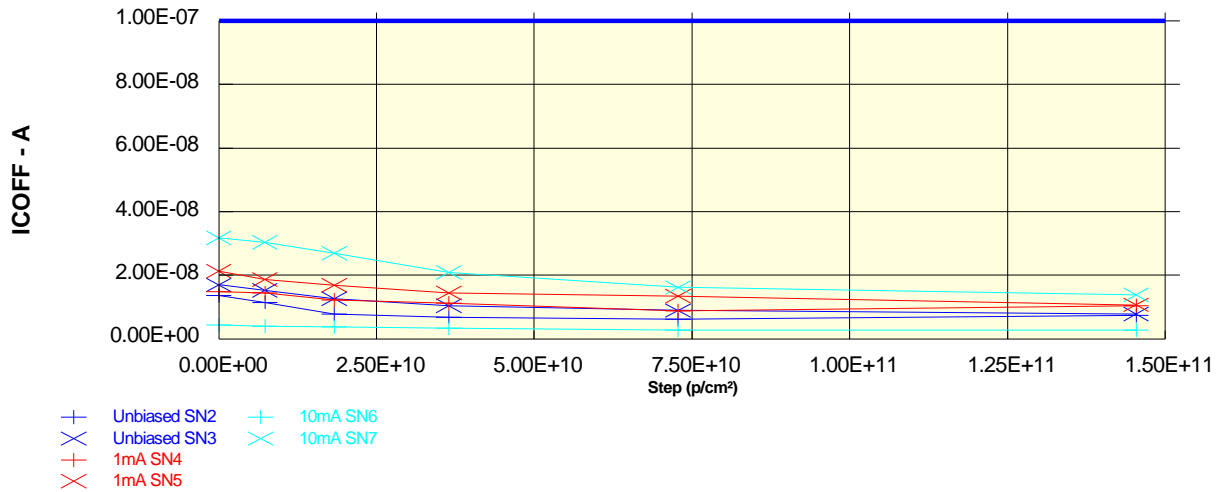
Parameter : Off State Collector Current : ICOFF

VCE=20V. IB=0. IF=0mA

Unit : A

Spec Limit Max : 1.00 E-07

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	1.37 E-08	1.15 E-08	7.82 E-09	6.93 E-09	6.14 E-09	7.38 E-09
Opt3	1.70 E-08	1.52 E-08	1.27 E-08	1.04 E-08	8.97 E-09	7.79 E-09
Opt4	1.48 E-08	1.45 E-08	1.22 E-08	1.12 E-08	8.75 E-09	1.05 E-08
Opt5	2.14 E-08	1.87 E-08	1.69 E-08	1.44 E-08	1.35 E-08	1.07 E-08
Opt6	4.28 E-09	4.00 E-09	3.76 E-09	3.30 E-09	2.78 E-09	2.80 E-09
Opt7	3.18 E-08	3.03 E-08	2.70 E-08	2.09 E-08	1.62 E-08	1.38 E-08



HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Optek

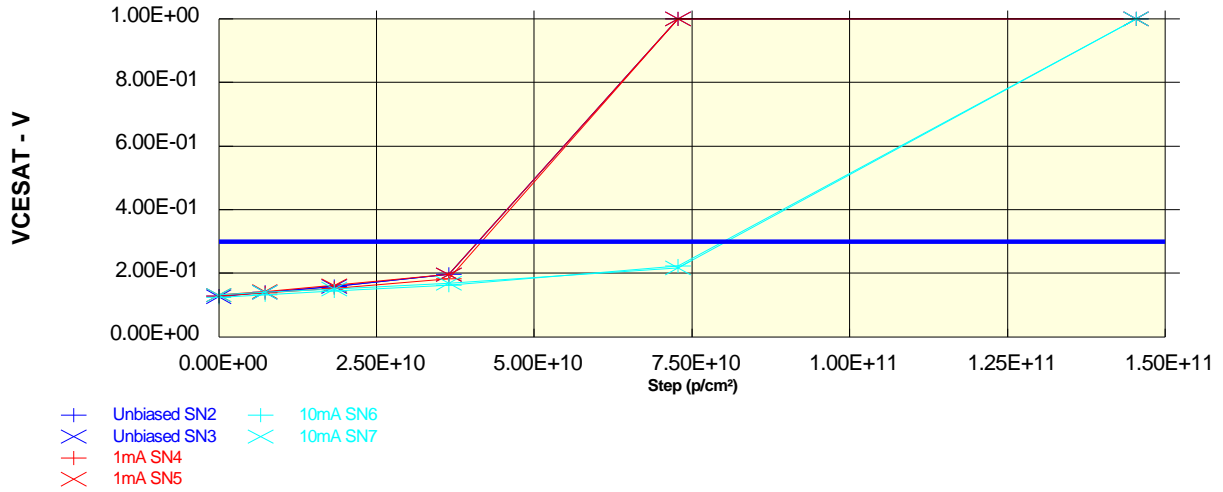
Parameter : Collector Emitter Saturation Voltage : VCESAT

IC=2mA. IB=0. IF=2mA

Unit : V

Spec Limit Max : 3.00 E-01

Spec limits are represented in bold lines on the graphic.



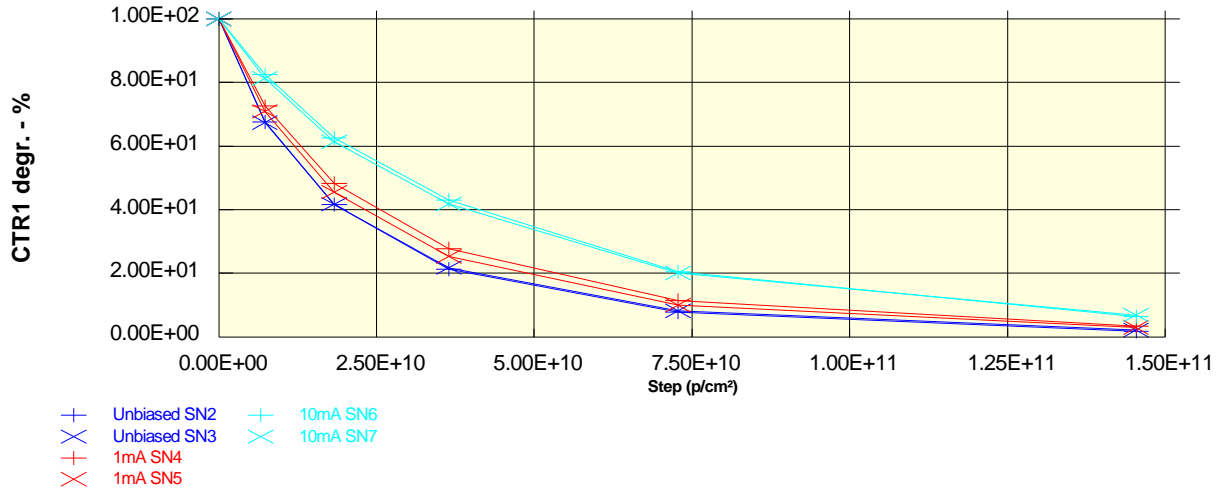
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	1.29 E-01	1.41 E-01	1.59 E-01	1.97 E-01	1.00 E+00	1.00 E+00
Opt3	1.27 E-01	1.40 E-01	1.59 E-01	1.96 E-01	1.00 E+00	1.00 E+00
Opt4	1.28 E-01	1.39 E-01	1.54 E-01	1.83 E-01	1.00 E+00	1.00 E+00
Opt5	1.32 E-01	1.43 E-01	1.62 E-01	1.96 E-01	1.00 E+00	1.00 E+00
Opt6	1.25 E-01	1.32 E-01	1.44 E-01	1.63 E-01	2.23 E-01	1.00 E+00
Opt7	1.32 E-01	1.40 E-01	1.51 E-01	1.68 E-01	2.17 E-01	1.00 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Optek  
Parameter : CTR1 Degradation : CTR1 degr.

Unit : %  
No spec limit specified.



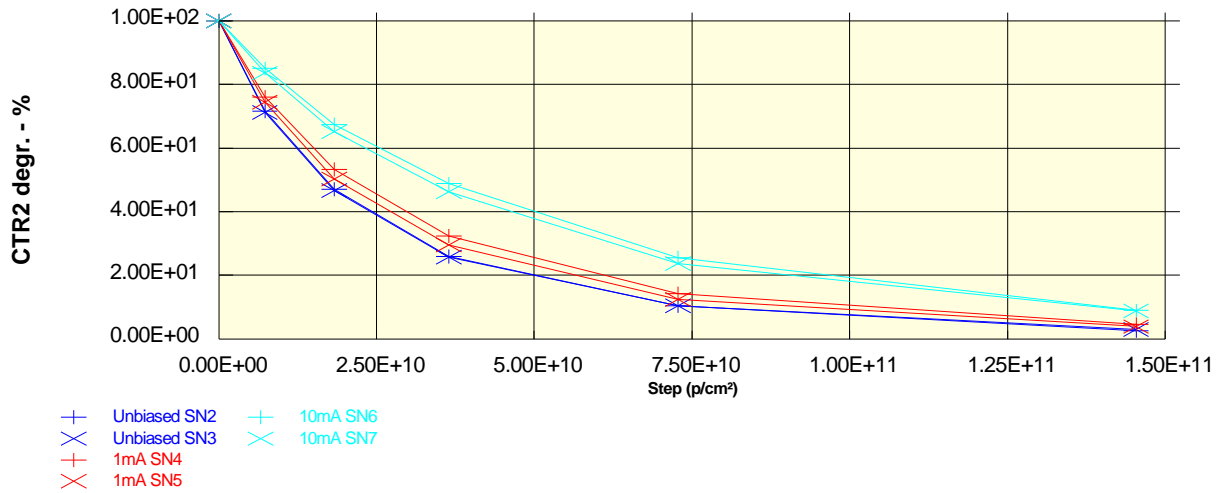
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	1.00 E+02	6.76 E+01	4.16 E+01	2.14 E+01	7.84 E+00	1.77 E+00
Opt3	1.00 E+02	6.74 E+01	4.17 E+01	2.18 E+01	8.19 E+00	2.16 E+00
Opt4	1.00 E+02	7.25 E+01	4.83 E+01	2.77 E+01	1.14 E+01	3.36 E+00
Opt5	1.00 E+02	7.09 E+01	4.55 E+01	2.53 E+01	1.01 E+01	2.93 E+00
Opt6	1.00 E+02	8.24 E+01	6.26 E+01	4.31 E+01	2.06 E+01	6.38 E+00
Opt7	1.00 E+02	8.12 E+01	6.13 E+01	4.19 E+01	2.01 E+01	6.89 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Optek  
Parameter : CTR2 Degradation : CTR2 degr.

Unit : %  
No spec limit specified.



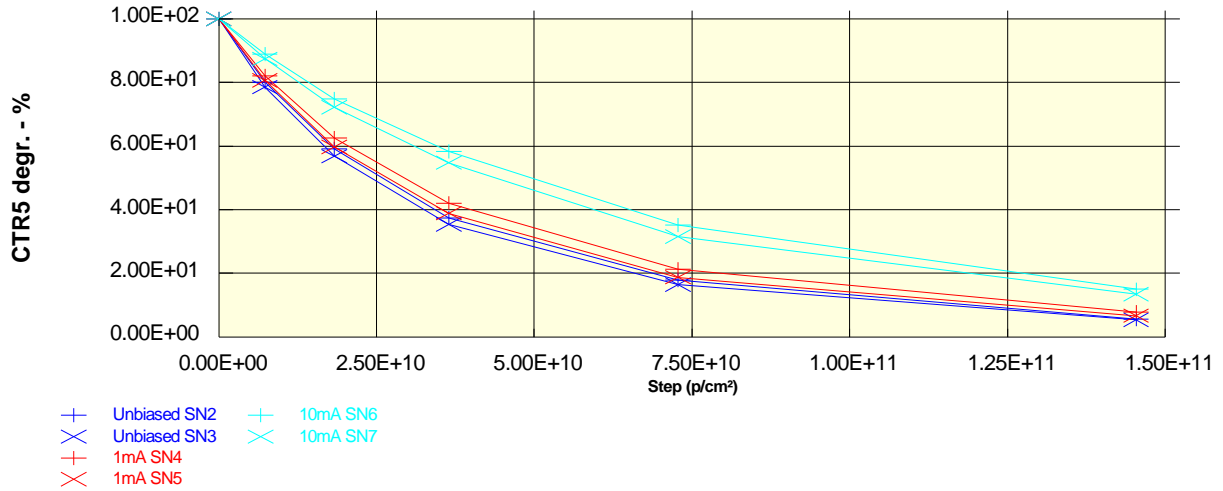
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	1.00 E+02	7.16 E+01	4.70 E+01	2.59 E+01	1.04 E+01	2.61 E+00
Opt3	1.00 E+02	7.12 E+01	4.66 E+01	2.58 E+01	1.04 E+01	2.99 E+00
Opt4	1.00 E+02	7.61 E+01	5.33 E+01	3.24 E+01	1.43 E+01	4.60 E+00
Opt5	1.00 E+02	7.45 E+01	5.03 E+01	2.95 E+01	1.25 E+01	3.91 E+00
Opt6	1.00 E+02	8.50 E+01	6.74 E+01	4.88 E+01	2.56 E+01	8.99 E+00
Opt7	1.00 E+02	8.36 E+01	6.52 E+01	4.62 E+01	2.37 E+01	8.76 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

Manufacturer : Optek  
Parameter : CTR5 Degradation : CTR5 degr.

Unit : %  
No spec limit specified.



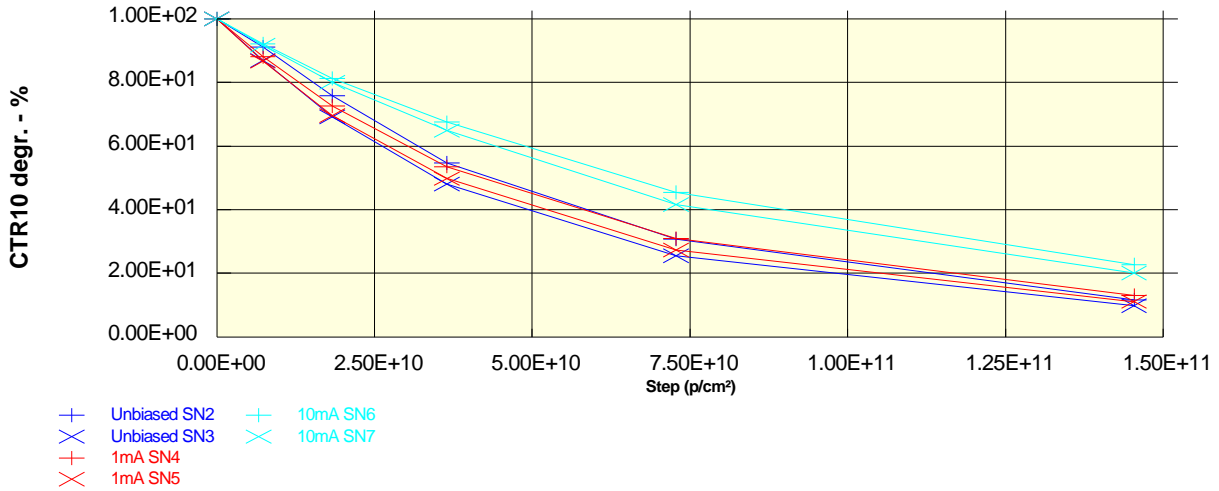
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Opt2	1.00 E+02	8.01 E+01	5.92 E+01	3.75 E+01	1.79 E+01	5.51 E+00
Opt3	1.00 E+02	7.85 E+01	5.68 E+01	3.54 E+01	1.64 E+01	5.44 E+00
Opt4	1.00 E+02	8.20 E+01	6.26 E+01	4.21 E+01	2.14 E+01	7.92 E+00
Opt5	1.00 E+02	8.07 E+01	5.97 E+01	3.89 E+01	1.88 E+01	6.70 E+00
Opt6	1.00 E+02	8.89 E+01	7.48 E+01	5.83 E+01	3.52 E+01	1.50 E+01
Opt7	1.00 E+02	8.74 E+01	7.23 E+01	5.48 E+01	3.16 E+01	1.34 E+01

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Optek  
Parameter : CTR10 Degradation : CTR10 degr.

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Opt2	1.00 E+02	9.11 E+01	7.58 E+01	5.47 E+01	3.07 E+01	1.16 E+01
Opt3	1.00 E+02	8.68 E+01	6.92 E+01	4.81 E+01	2.56 E+01	9.85 E+00
Opt4	1.00 E+02	8.81 E+01	7.27 E+01	5.36 E+01	3.09 E+01	1.31 E+01
Opt5	1.00 E+02	8.67 E+01	6.96 E+01	4.98 E+01	2.74 E+01	1.11 E+01
Opt6	1.00 E+02	9.21 E+01	8.12 E+01	6.75 E+01	4.54 E+01	2.27 E+01
Opt7	1.00 E+02	9.17 E+01	8.01 E+01	6.49 E+01	4.16 E+01	2.01 E+01

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Micropac

Parameter : Input Diode Forward Voltage : VF

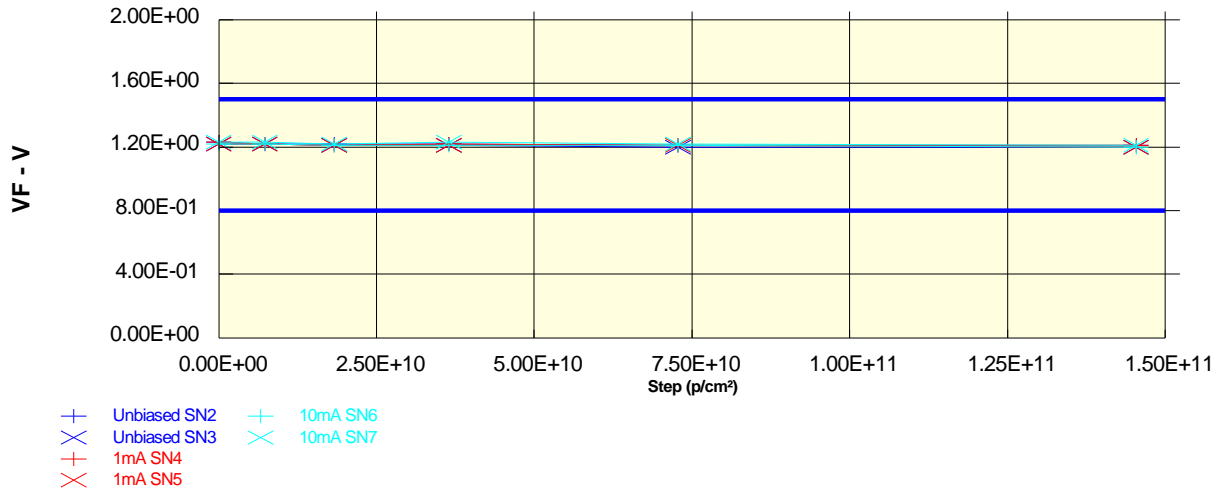
IE=10mA

Unit : V

Spec Limit Min : 8.00 E-01

Spec Limit Max : 1.50 E+00

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Mic2	1.23 E+00	1.22 E+00	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00
Mic3	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00	1.20 E+00	1.20 E+00
Mic4	1.23 E+00	1.22 E+00	1.21 E+00	1.22 E+00	1.21 E+00	1.21 E+00
Mic5	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00	1.21 E+00	1.20 E+00
Mic6	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00	1.21 E+00	1.20 E+00
Mic7	1.23 E+00	1.23 E+00	1.22 E+00	1.23 E+00	1.22 E+00	1.21 E+00

HIREX Engineering	Total Dose Test Report		Réf. : HRX/TID/0079
			Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

Manufacturer : Micropac

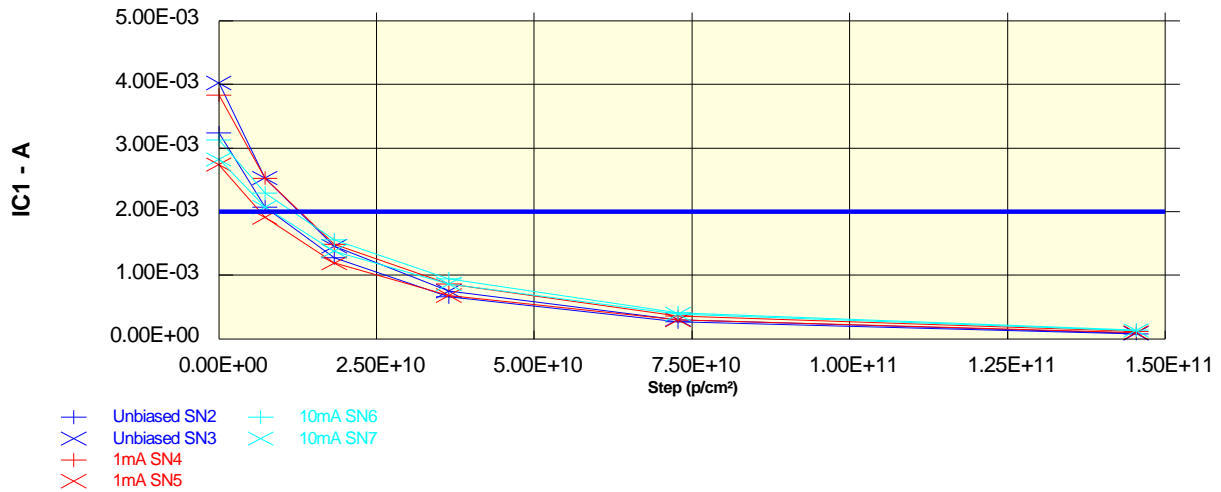
Parameter : On State Collector Current 1 : IC1

VCE=5V. IB=0. IF=1mA

Unit : A

Spec Limit Min : 2.00 E-03

Spec limits are represented in bold lines on the graphic.

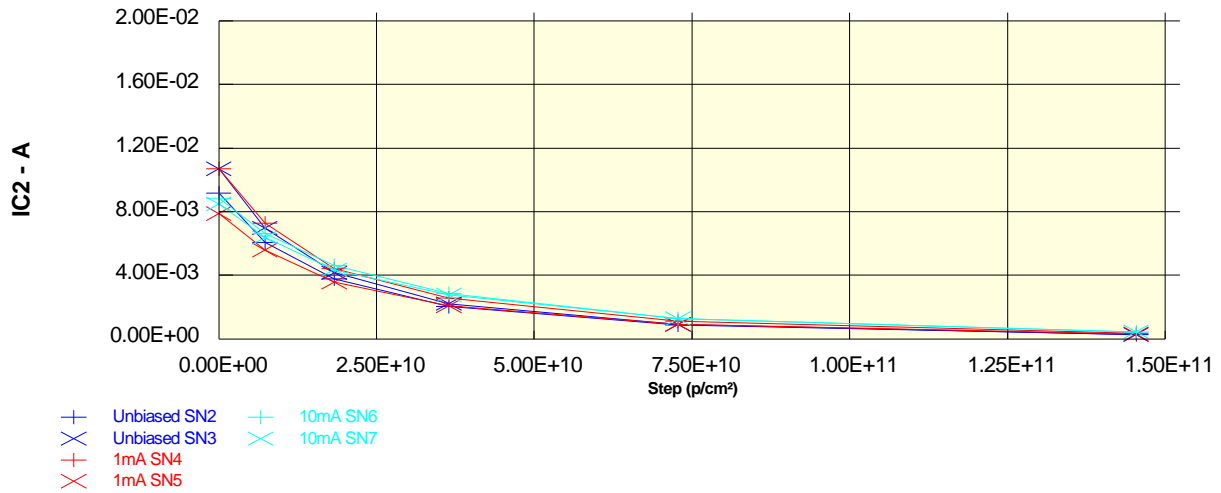


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Mic2	3.24 E-03	2.07 E-03	1.28 E-03	6.65 E-04	2.71 E-04	8.32 E-05
Mic3	4.02 E-03	2.53 E-03	1.46 E-03	7.55 E-04	3.05 E-04	9.17 E-05
Mic4	3.83 E-03	2.53 E-03	1.49 E-03	8.60 E-04	3.56 E-04	1.17 E-04
Mic5	2.74 E-03	1.91 E-03	1.19 E-03	6.88 E-04	2.96 E-04	1.00 E-04
Mic6	3.13 E-03	2.29 E-03	1.56 E-03	9.44 E-04	4.15 E-04	1.42 E-04
Mic7	2.82 E-03	2.07 E-03	1.38 E-03	8.65 E-04	3.91 E-04	1.36 E-04

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Manufacturer : Micropac**  
**Parameter : On State Collector Current 2 : IC2**  
**VCE=5V. IB=0. IF=2mA**  
 Unit : A  
 No spec limit specified.



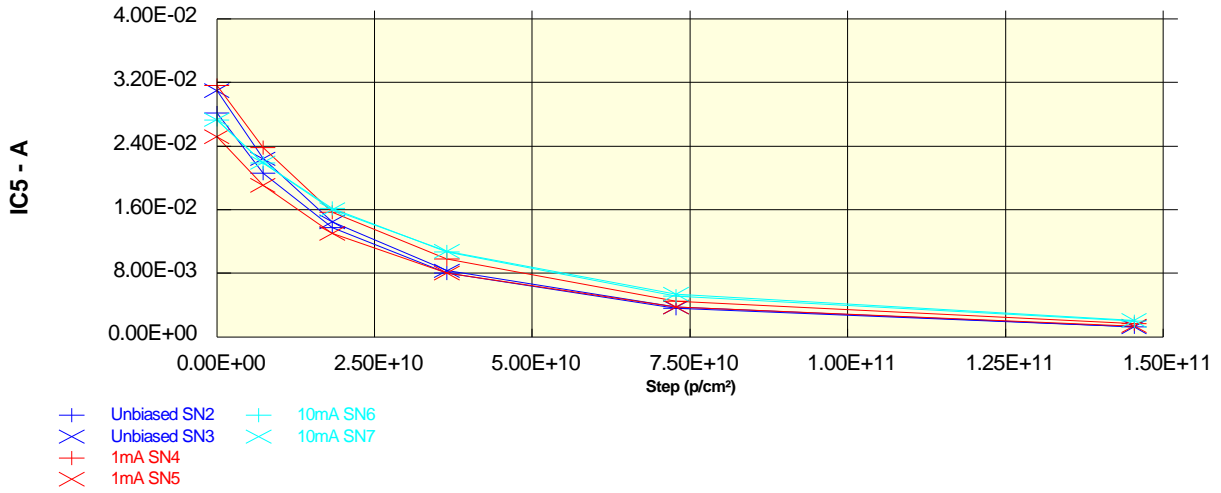
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Mic2	9.16 E-03	6.07 E-03	3.77 E-03	2.05 E-03	8.61 E-04	2.73 E-04
Mic3	1.07 E-02	6.98 E-03	4.16 E-03	2.22 E-03	9.27 E-04	2.92 E-04
Mic4	1.07 E-02	7.29 E-03	4.42 E-03	2.59 E-03	1.10 E-03	3.73 E-04
Mic5	7.88 E-03	5.59 E-03	3.56 E-03	2.09 E-03	9.17 E-04	3.18 E-04
Mic6	8.83 E-03	6.63 E-03	4.62 E-03	2.85 E-03	1.29 E-03	4.52 E-04
Mic7	8.47 E-03	6.37 E-03	4.36 E-03	2.77 E-03	1.28 E-03	4.58 E-04



<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**Manufacturer : Micropac**  
**Parameter : On State Collector Current 5 : IC5**  
**VCE=5V. IB=0. IF=5mA**  
 Unit : A  
 No spec limit specified.

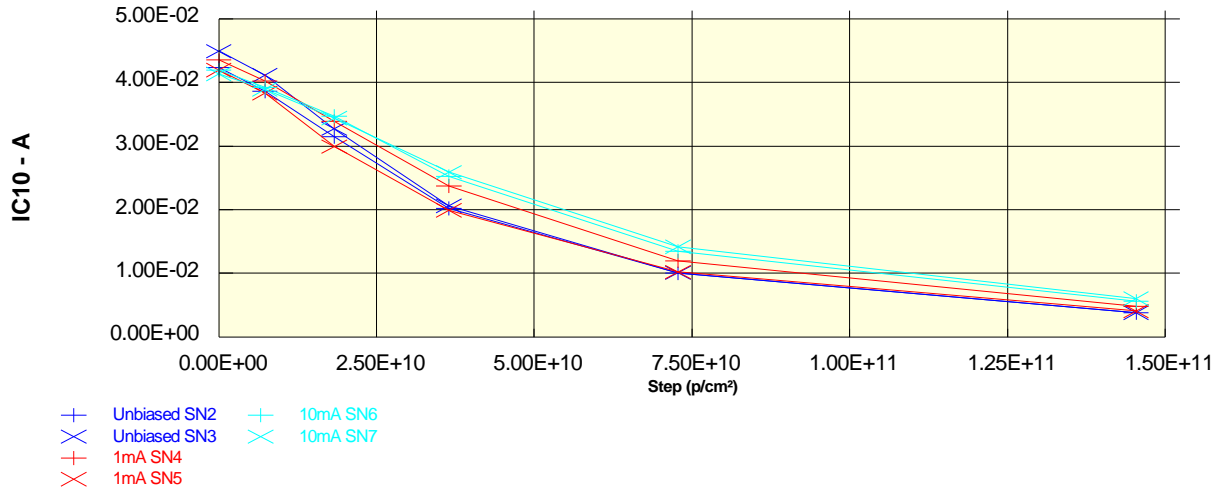


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Mic2	2.82 E-02	2.06 E-02	1.38 E-02	8.03 E-03	3.64 E-03	1.26 E-03
Mic3	3.10 E-02	2.24 E-02	1.45 E-02	8.32 E-03	3.74 E-03	1.29 E-03
Mic4	3.16 E-02	2.38 E-02	1.57 E-02	9.79 E-03	4.51 E-03	1.65 E-03
Mic5	2.52 E-02	1.91 E-02	1.30 E-02	8.02 E-03	3.76 E-03	1.39 E-03
Mic6	2.73 E-02	2.19 E-02	1.62 E-02	1.07 E-02	5.18 E-03	1.97 E-03
Mic7	2.73 E-02	2.19 E-02	1.60 E-02	1.08 E-02	5.36 E-03	2.09 E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Manufacturer : Micropac**  
**Parameter : On State Collector Current 10 : IC10**  
**VCE=5V. IB=0. IF=10mA**  
 Unit : A  
 No spec limit specified.



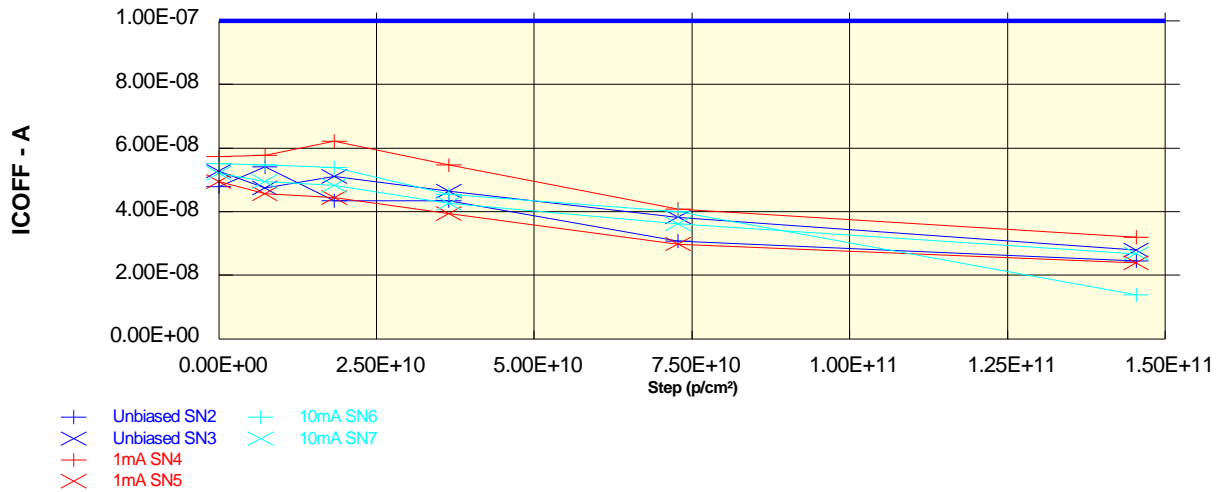
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Mic2	4.23 E-02	3.86 E-02	3.15 E-02	2.02 E-02	1.00 E-02	3.80 E-03
Mic3	4.49 E-02	4.11 E-02	3.27 E-02	2.06 E-02	1.01 E-02	3.80 E-03
Mic4	4.35 E-02	4.02 E-02	3.39 E-02	2.37 E-02	1.20 E-02	4.79 E-03
Mic5	4.19 E-02	3.83 E-02	2.99 E-02	1.99 E-02	1.02 E-02	4.06 E-03
Mic6	4.19 E-02	3.92 E-02	3.47 E-02	2.52 E-02	1.35 E-02	5.64 E-03
Mic7	4.13 E-02	3.89 E-02	3.44 E-02	2.59 E-02	1.42 E-02	6.05 E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Micropac  
Parameter : Off State Collector Current : ICOFF  
VCE=20V. IB=0. IF=0mA

Unit : A  
Spec Limit Max : 1.00 E-07  
Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Mic2	4.78 E-08	5.41 E-08	4.35 E-08	4.35 E-08	3.07 E-08	2.45 E-08
Mic3	5.28 E-08	4.74 E-08	5.11 E-08	4.64 E-08	3.83 E-08	2.80 E-08
Mic4	5.72 E-08	5.77 E-08	6.22 E-08	5.46 E-08	4.08 E-08	3.20 E-08
Mic5	4.95 E-08	4.56 E-08	4.44 E-08	3.94 E-08	2.98 E-08	2.40 E-08
Mic6	5.51 E-08	5.47 E-08	5.39 E-08	4.55 E-08	4.01 E-08	1.38 E-08
Mic7	5.21 E-08	4.95 E-08	4.83 E-08	4.27 E-08	3.62 E-08	2.68 E-08

HIREX Engineering	Total Dose Test Report		Réf. : HRX/TID/0079
			Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

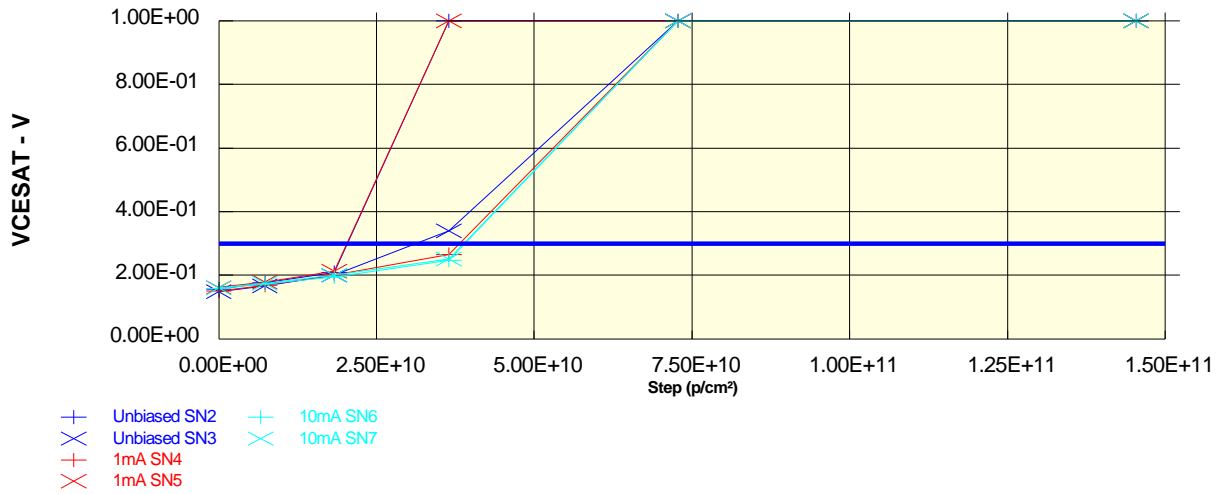
Manufacturer : Micropac

Parameter : Collector Emitter Saturation Voltage : VCESAT  
 IC=2mA. IB=0. IF=2mA

Unit : V

Spec Limit Max : 3.00 E-01

Spec limits are represented in bold lines on the graphic.



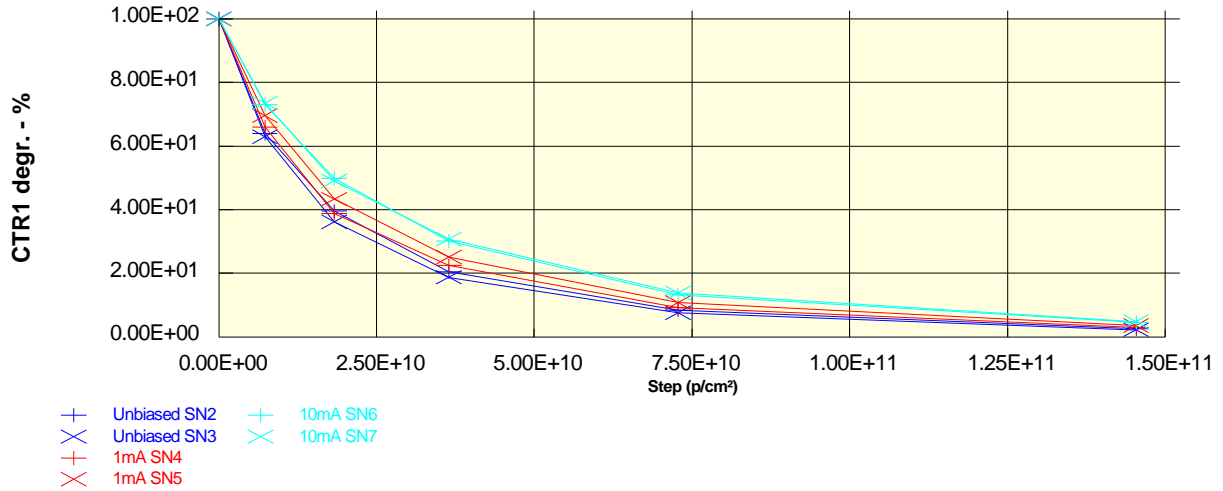
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Mic2	1.57 E-01	1.77 E-01	2.10 E-01	1.00 E+00	1.00 E+00	1.00 E+00
Mic3	1.49 E-01	1.67 E-01	2.00 E-01	3.39 E-01	1.00 E+00	1.00 E+00
Mic4	1.51 E-01	1.68 E-01	2.02 E-01	2.65 E-01	1.00 E+00	1.00 E+00
Mic5	1.62 E-01	1.78 E-01	2.13 E-01	1.00 E+00	1.00 E+00	1.00 E+00
Mic6	1.59 E-01	1.73 E-01	1.95 E-01	2.47 E-01	1.00 E+00	1.00 E+00
Mic7	1.61 E-01	1.74 E-01	2.00 E-01	2.51 E-01	1.00 E+00	1.00 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Micropac  
Parameter : CTR1 Degradation : CTR1 degr.

Unit : %  
No spec limit specified.



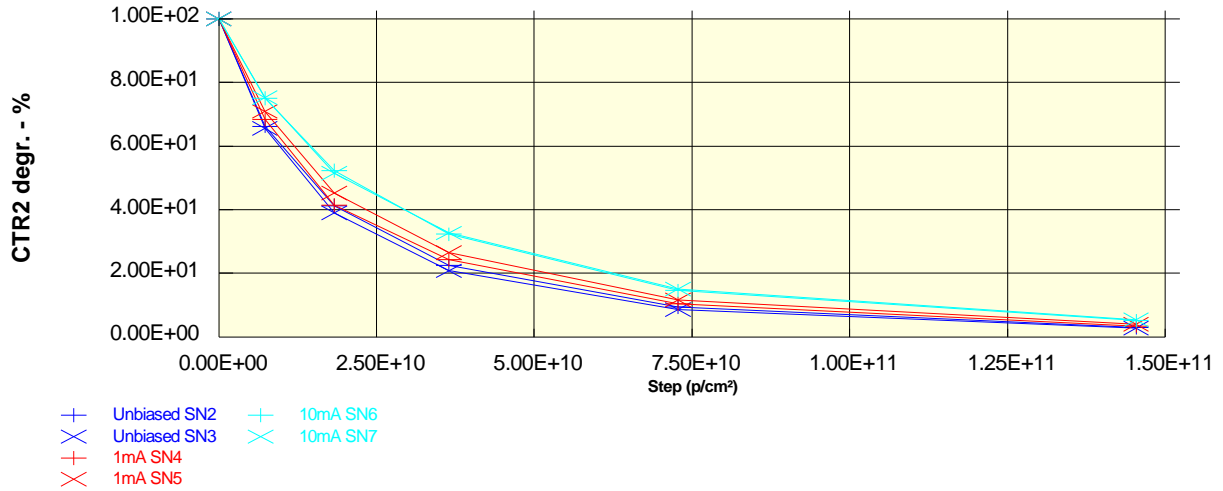
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Mic2	1.00 E+02	6.39 E+01	3.95 E+01	2.05 E+01	8.36 E+00	2.57 E+00
Mic3	1.00 E+02	6.30 E+01	3.62 E+01	1.88 E+01	7.59 E+00	2.28 E+00
Mic4	1.00 E+02	6.60 E+01	3.88 E+01	2.24 E+01	9.29 E+00	3.06 E+00
Mic5	1.00 E+02	6.95 E+01	4.33 E+01	2.51 E+01	1.08 E+01	3.66 E+00
Mic6	1.00 E+02	7.30 E+01	4.99 E+01	3.01 E+01	1.33 E+01	4.52 E+00
Mic7	1.00 E+02	7.35 E+01	4.91 E+01	3.07 E+01	1.39 E+01	4.83 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Micropac  
Parameter : CTR2 Degradation : CTR2 degr.

Unit : %  
No spec limit specified.



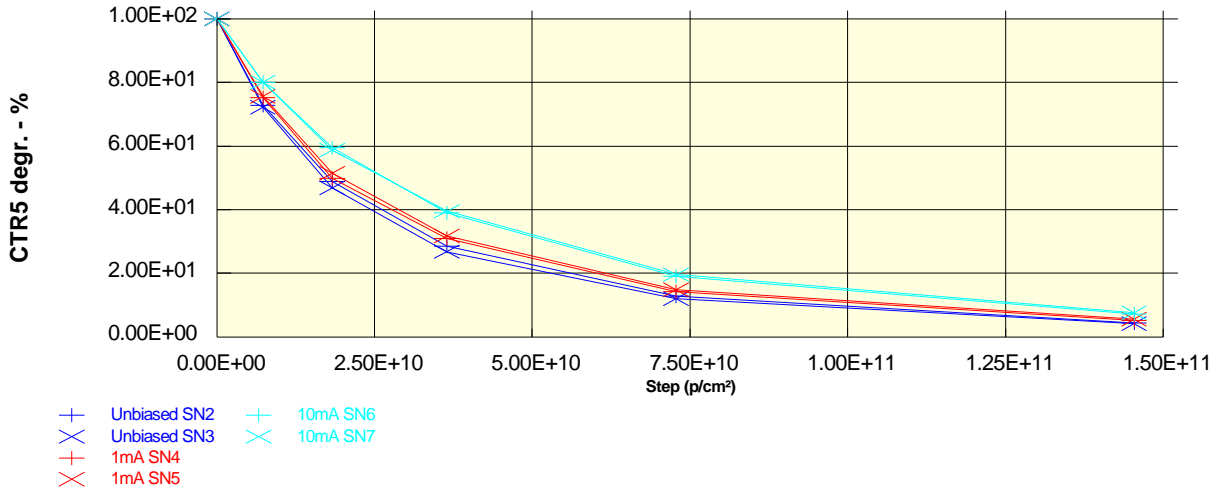
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Mic2	1.00 E+02	6.63 E+01	4.12 E+01	2.24 E+01	9.40 E+00	2.98 E+00
Mic3	1.00 E+02	6.55 E+01	3.90 E+01	2.08 E+01	8.70 E+00	2.74 E+00
Mic4	1.00 E+02	6.83 E+01	4.14 E+01	2.43 E+01	1.04 E+01	3.50 E+00
Mic5	1.00 E+02	7.09 E+01	4.52 E+01	2.65 E+01	1.16 E+01	4.04 E+00
Mic6	1.00 E+02	7.50 E+01	5.23 E+01	3.23 E+01	1.46 E+01	5.11 E+00
Mic7	1.00 E+02	7.52 E+01	5.15 E+01	3.27 E+01	1.51 E+01	5.41 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Micropac  
Parameter : CTR5 Degradation : CTR5 degr.

Unit : %  
No spec limit specified.



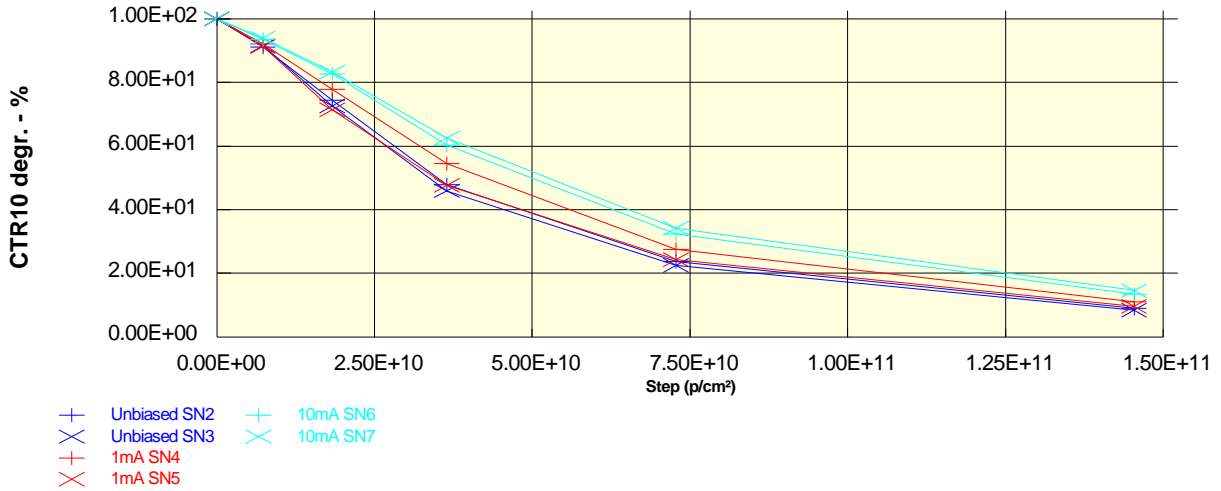
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Mic2	1.00 E+02	7.28 E+01	4.88 E+01	2.85 E+01	1.29 E+01	4.46 E+00
Mic3	1.00 E+02	7.22 E+01	4.68 E+01	2.68 E+01	1.21 E+01	4.16 E+00
Mic4	1.00 E+02	7.53 E+01	4.99 E+01	3.10 E+01	1.43 E+01	5.22 E+00
Mic5	1.00 E+02	7.57 E+01	5.15 E+01	3.18 E+01	1.49 E+01	5.53 E+00
Mic6	1.00 E+02	8.00 E+01	5.94 E+01	3.90 E+01	1.90 E+01	7.23 E+00
Mic7	1.00 E+02	8.01 E+01	5.87 E+01	3.95 E+01	1.96 E+01	7.65 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Manufacturer : Micropac  
Parameter : CTR10 Degradation : CTR10 degr.

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Mic2	1.00 E+02	9.11 E+01	7.44 E+01	4.78 E+01	2.37 E+01	8.98 E+00
Mic3	1.00 E+02	9.15 E+01	7.27 E+01	4.59 E+01	2.25 E+01	8.47 E+00
Mic4	1.00 E+02	9.22 E+01	7.78 E+01	5.45 E+01	2.76 E+01	1.10 E+01
Mic5	1.00 E+02	9.14 E+01	7.14 E+01	4.77 E+01	2.43 E+01	9.69 E+00
Mic6	1.00 E+02	9.35 E+01	8.28 E+01	6.03 E+01	3.23 E+01	1.35 E+01
Mic7	1.00 E+02	9.40 E+01	8.33 E+01	6.26 E+01	3.42 E+01	1.46 E+01



HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : Unbiased

Parameter : Input Diode Forward Voltage : VF

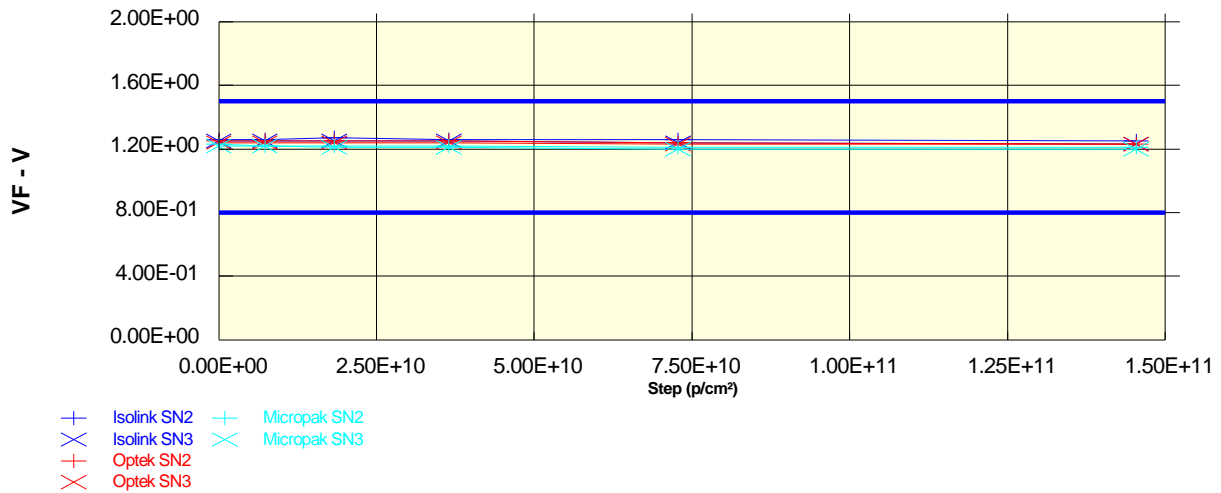
IE=10mA

Unit : V

Spec Limit Min : 8.00 E-01

Spec Limit Max : 1.50 E+00

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	1.26 E+00	1.26 E+00	1.27 E+00	1.26 E+00	1.26 E+00	1.25 E+00
Iso3	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00	1.23 E+00
Opt2	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00	1.23 E+00
Opt3	1.24 E+00	1.24 E+00	1.24 E+00	1.24 E+00	1.23 E+00	1.23 E+00
Mic2	1.23 E+00	1.22 E+00	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00
Mic3	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00	1.20 E+00	1.20 E+00

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : Unbiased

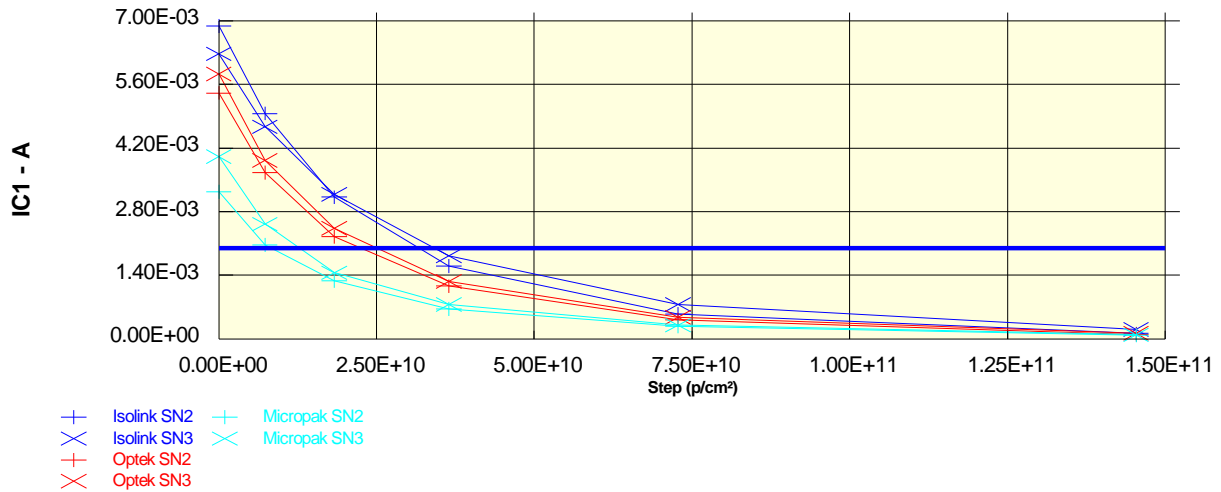
Parameter : On State Collector Current 1 : IC1

VCE=5V. IB=0. IF=1mA

Unit : A

Spec Limit Min : 2.00 E-03

Spec limits are represented in bold lines on the graphic.

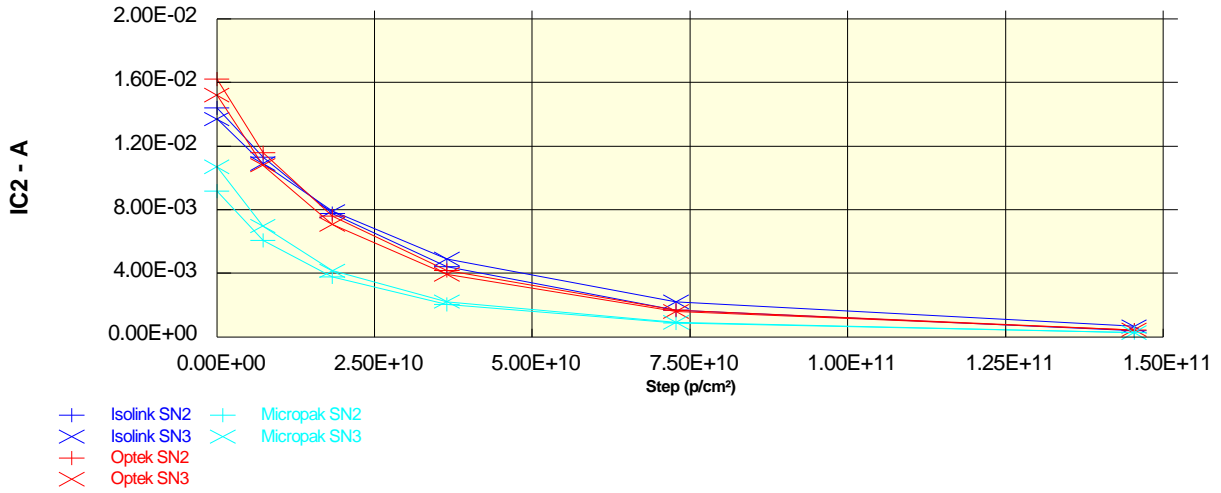


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	6.88 E-03	4.96 E-03	3.12 E-03	1.60 E-03	5.49 E-04	1.17 E-04
Iso3	6.27 E-03	4.67 E-03	3.18 E-03	1.83 E-03	7.55 E-04	2.08 E-04
Opt2	5.41 E-03	3.66 E-03	2.25 E-03	1.16 E-03	4.24 E-04	9.58 E-05
Opt3	5.83 E-03	3.93 E-03	2.43 E-03	1.27 E-03	4.77 E-04	1.26 E-04
Mic2	3.24 E-03	2.07 E-03	1.28 E-03	6.65 E-04	2.71 E-04	8.32 E-05
Mic3	4.02 E-03	2.53 E-03	1.46 E-03	7.55 E-04	3.05 E-04	9.17 E-05

HIREX Engineering	Total Dose Test Report		Réf. : HRX/TID/0079
			Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**Bias Condition : Unbiased**  
**Parameter : On State Collector Current 2 : IC2**  
**VCE=5V. IB=0. IF=2mA**  
 Unit : A  
 No spec limit specified.

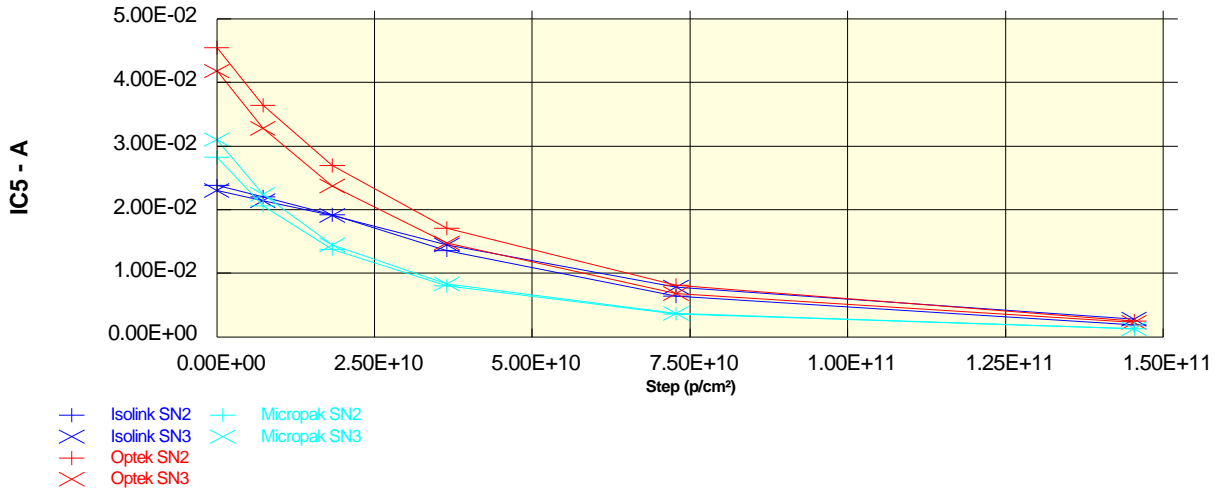


Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.44 E-02	1.13 E-02	7.76 E-03	4.40 E-03	1.67 E-03	3.98 E-04
Iso3	1.37 E-02	1.09 E-02	7.91 E-03	4.90 E-03	2.19 E-03	6.60 E-04
Opt2	1.62 E-02	1.16 E-02	7.61 E-03	4.19 E-03	1.69 E-03	4.23 E-04
Opt3	1.52 E-02	1.08 E-02	7.09 E-03	3.93 E-03	1.59 E-03	4.55 E-04
Mic2	9.16 E-03	6.07 E-03	3.77 E-03	2.05 E-03	8.61 E-04	2.73 E-04
Mic3	1.07 E-02	6.98 E-03	4.16 E-03	2.22 E-03	9.27 E-04	2.92 E-04

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : Unbiased**  
**Parameter : On State Collector Current 5 : IC5**  
**VCE=5V. IB=0. IF=5mA**  
 Unit : A  
 No spec limit specified.

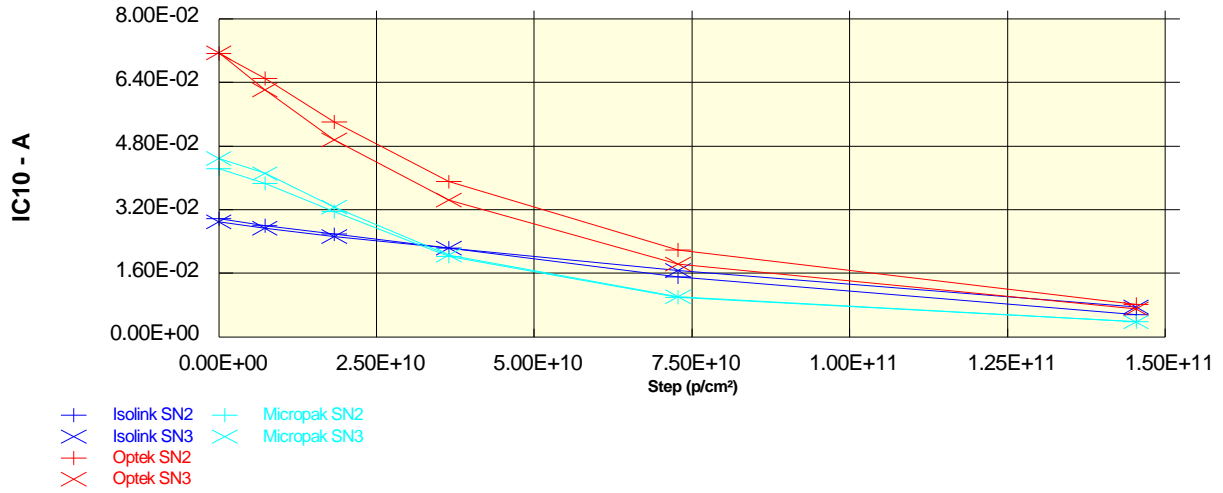


Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	2.38 E-02	2.20 E-02	1.92 E-02	1.36 E-02	6.47 E-03	1.90 E-03
Iso3	2.30 E-02	2.14 E-02	1.91 E-02	1.45 E-02	7.81 E-03	2.79 E-03
Opt2	4.55 E-02	3.64 E-02	2.69 E-02	1.71 E-02	8.16 E-03	2.51 E-03
Opt3	4.18 E-02	3.28 E-02	2.37 E-02	1.48 E-02	6.87 E-03	2.27 E-03
Mic2	2.82 E-02	2.06 E-02	1.38 E-02	8.03 E-03	3.64 E-03	1.26 E-03
Mic3	3.10 E-02	2.24 E-02	1.45 E-02	8.32 E-03	3.74 E-03	1.29 E-03

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : Unbiased**  
**Parameter : On State Collector Current 10 : IC10**  
**VCE=5V. IB=0. IF=10mA**  
 Unit : A  
 No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	2.98 E-02	2.80 E-02	2.58 E-02	2.24 E-02	1.51 E-02	5.64 E-03
Iso3	2.90 E-02	2.73 E-02	2.53 E-02	2.24 E-02	1.68 E-02	7.54 E-03
Opt2	7.13 E-02	6.50 E-02	5.41 E-02	3.90 E-02	2.19 E-02	8.25 E-03
Opt3	7.15 E-02	6.21 E-02	4.95 E-02	3.44 E-02	1.83 E-02	7.04 E-03
Mic2	4.23 E-02	3.86 E-02	3.15 E-02	2.02 E-02	1.00 E-02	3.80 E-03
Mic3	4.49 E-02	4.11 E-02	3.27 E-02	2.06 E-02	1.01 E-02	3.80 E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : Unbiased**

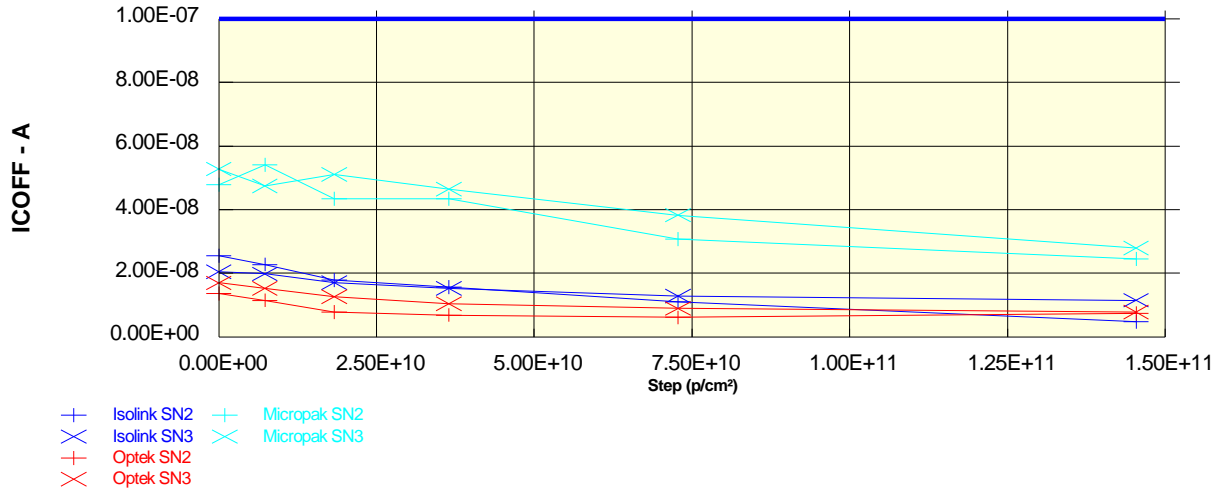
**Parameter : Off State Collector Current : ICOFF**

**VCE=20V. IB=0. IF=0mA**

Unit : A

Spec Limit Max : 1.00 E-07

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	2.55 E-08	2.28 E-08	1.78 E-08	1.57 E-08	1.10 E-08	4.77 E-09
Iso3	2.06 E-08	1.98 E-08	1.71 E-08	1.52 E-08	1.29 E-08	1.15 E-08
Opt2	1.37 E-08	1.15 E-08	7.82 E-09	6.93 E-09	6.14 E-09	7.38 E-09
Opt3	1.70 E-08	1.52 E-08	1.27 E-08	1.04 E-08	8.97 E-09	7.79 E-09
Mic2	4.78 E-08	5.41 E-08	4.35 E-08	4.35 E-08	3.07 E-08	2.45 E-08
Mic3	5.28 E-08	4.74 E-08	5.11 E-08	4.64 E-08	3.83 E-08	2.80 E-08

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : Unbiased

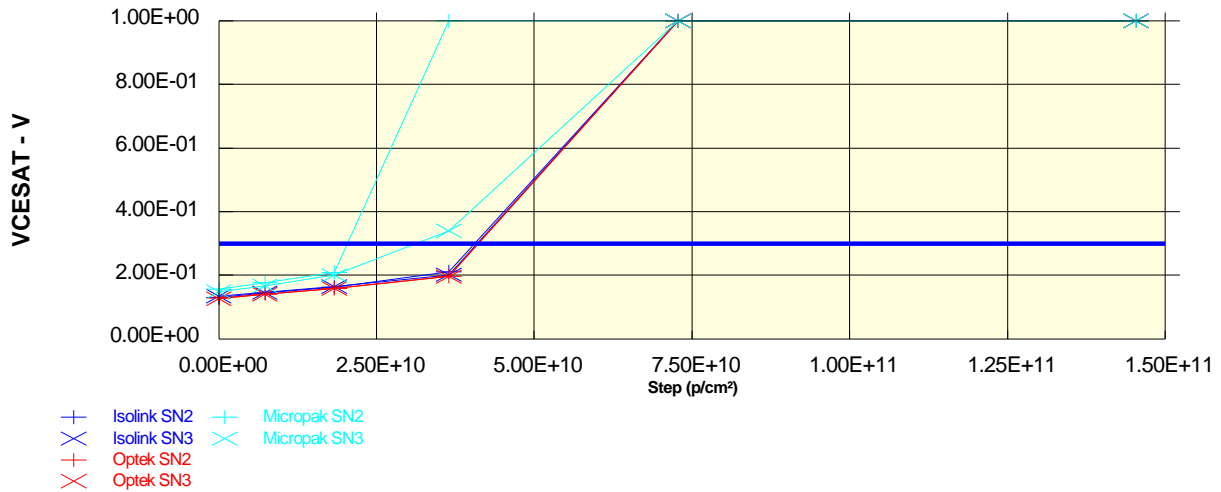
Parameter : Collector Emitter Saturation Voltage : VCESAT

IC=2mA. IB=0. IF=2mA

Unit : V

Spec Limit Max : 3.00 E-01

Spec limits are represented in bold lines on the graphic.



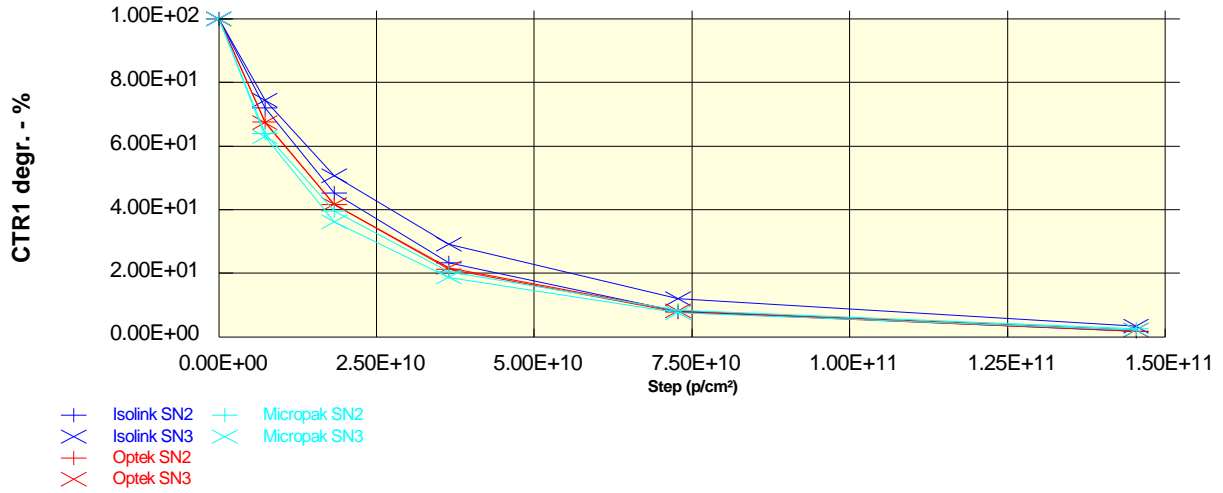
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	1.31 E-01	1.44 E-01	1.63 E-01	2.11 E-01	1.00 E+00	1.00 E+00
Iso3	1.34 E-01	1.46 E-01	1.64 E-01	2.02 E-01	1.00 E+00	1.00 E+00
Opt2	1.29 E-01	1.41 E-01	1.59 E-01	1.97 E-01	1.00 E+00	1.00 E+00
Opt3	1.27 E-01	1.40 E-01	1.59 E-01	1.96 E-01	1.00 E+00	1.00 E+00
Mic2	1.57 E-01	1.77 E-01	2.10 E-01	1.00 E+00	1.00 E+00	1.00 E+00
Mic3	1.49 E-01	1.67 E-01	2.00 E-01	3.39 E-01	1.00 E+00	1.00 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : Unbiased**  
**Parameter : CTR1 Degradation : CTR1 degr.**

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

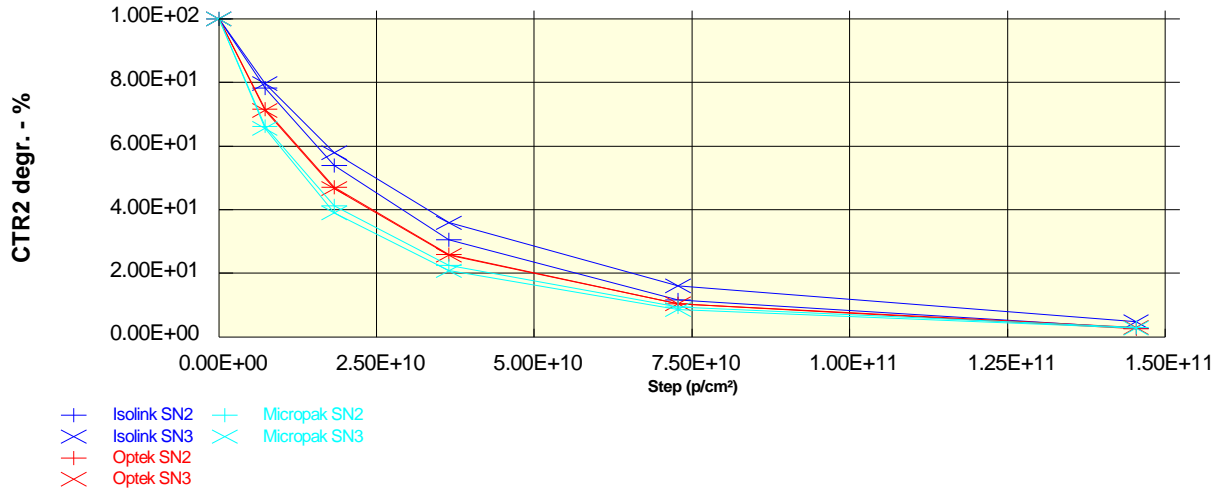
	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.00 E+02	7.20 E+01	4.53 E+01	2.33 E+01	7.98 E+00	1.70 E+00
Iso3	1.00 E+02	7.45 E+01	5.07 E+01	2.92 E+01	1.20 E+01	3.33 E+00
Opt2	1.00 E+02	6.76 E+01	4.16 E+01	2.14 E+01	7.84 E+00	1.77 E+00
Opt3	1.00 E+02	6.74 E+01	4.17 E+01	2.18 E+01	8.19 E+00	2.16 E+00
Mic2	1.00 E+02	6.39 E+01	3.95 E+01	2.05 E+01	8.36 E+00	2.57 E+00
Mic3	1.00 E+02	6.30 E+01	3.62 E+01	1.88 E+01	7.59 E+00	2.28 E+00



HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : Unbiased  
Parameter : CTR2 Degradation : CTR2 degr.

Unit : %  
No spec limit specified.



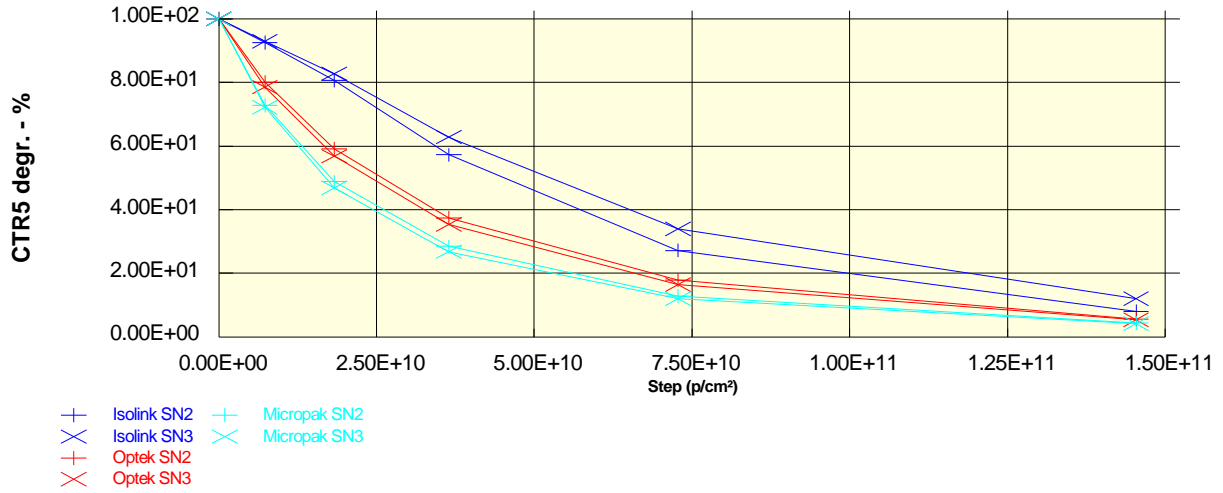
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.00 E+02	7.82 E+01	5.38 E+01	3.05 E+01	1.16 E+01	2.76 E+00
Iso3	1.00 E+02	7.96 E+01	5.79 E+01	3.59 E+01	1.60 E+01	4.83 E+00
Opt2	1.00 E+02	7.16 E+01	4.70 E+01	2.59 E+01	1.04 E+01	2.61 E+00
Opt3	1.00 E+02	7.12 E+01	4.66 E+01	2.58 E+01	1.04 E+01	2.99 E+00
Mic2	1.00 E+02	6.63 E+01	4.12 E+01	2.24 E+01	9.40 E+00	2.98 E+00
Mic3	1.00 E+02	6.55 E+01	3.90 E+01	2.08 E+01	8.70 E+00	2.74 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : Unbiased**  
**Parameter : CTR5 Degradation : CTR5 degr.**

Unit : %  
 No spec limit specified.



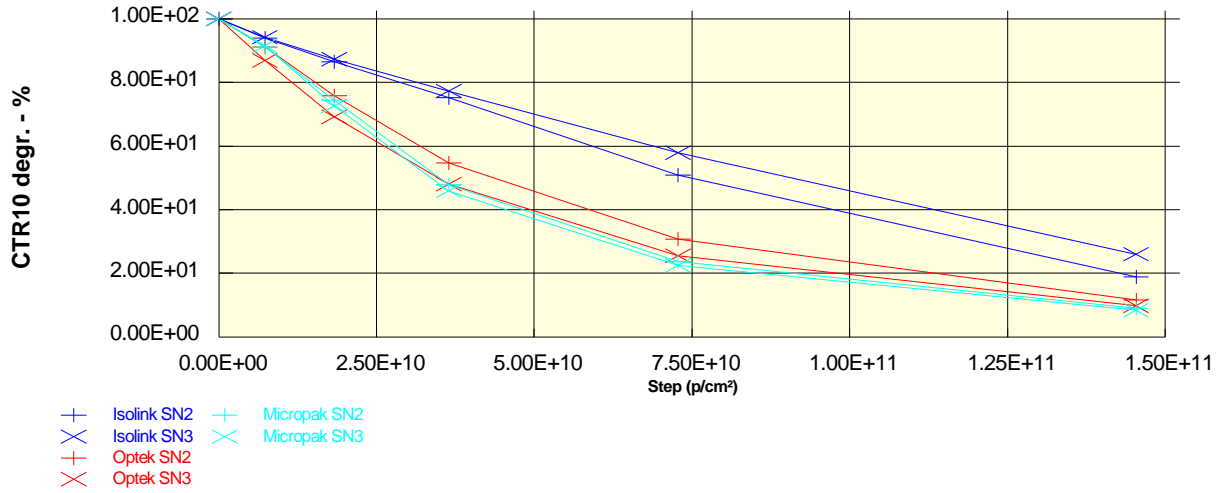
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso2	1.00 E+02	9.26 E+01	8.07 E+01	5.72 E+01	2.72 E+01	7.97 E+00
Iso3	1.00 E+02	9.29 E+01	8.28 E+01	6.28 E+01	3.39 E+01	1.21 E+01
Opt2	1.00 E+02	8.01 E+01	5.92 E+01	3.75 E+01	1.79 E+01	5.51 E+00
Opt3	1.00 E+02	7.85 E+01	5.68 E+01	3.54 E+01	1.64 E+01	5.44 E+00
Mic2	1.00 E+02	7.28 E+01	4.88 E+01	2.85 E+01	1.29 E+01	4.46 E+00
Mic3	1.00 E+02	7.22 E+01	4.68 E+01	2.68 E+01	1.21 E+01	4.16 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : Unbiased  
Parameter : CTR10 Degradation : CTR10 degr.

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso2	1.00 E+02	9.40 E+01	8.65 E+01	7.51 E+01	5.08 E+01	1.89 E+01
Iso3	1.00 E+02	9.42 E+01	8.73 E+01	7.73 E+01	5.80 E+01	2.60 E+01
Opt2	1.00 E+02	9.11 E+01	7.58 E+01	5.47 E+01	3.07 E+01	1.16 E+01
Opt3	1.00 E+02	8.68 E+01	6.92 E+01	4.81 E+01	2.56 E+01	9.85 E+00
Mic2	1.00 E+02	9.11 E+01	7.44 E+01	4.78 E+01	2.37 E+01	8.98 E+00
Mic3	1.00 E+02	9.15 E+01	7.27 E+01	4.59 E+01	2.25 E+01	8.47 E+00

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 1mA

Parameter : Input Diode Forward Voltage : VF

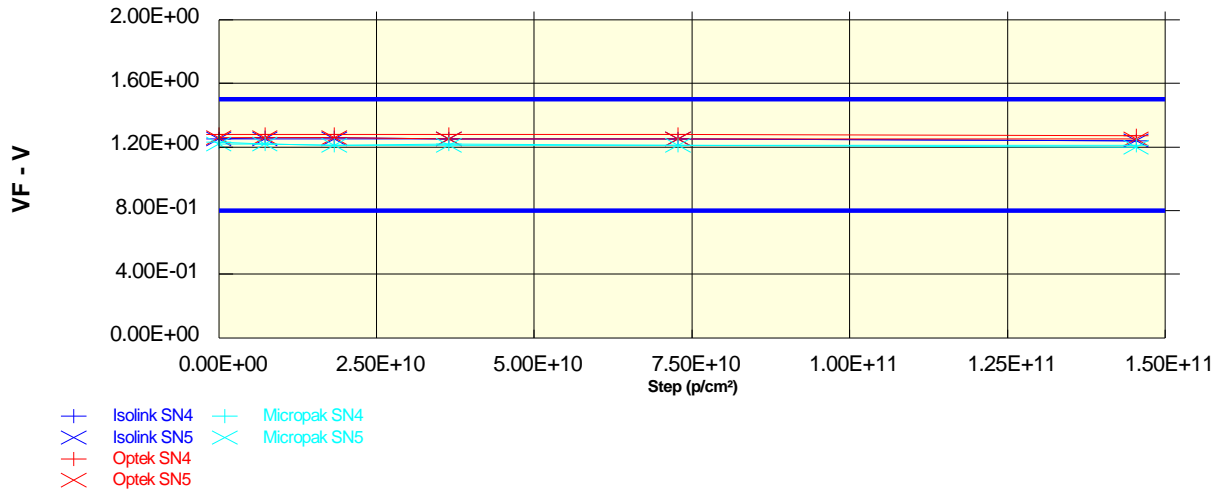
IE=10mA

Unit : V

Spec Limit Min : 8.00 E-01

Spec Limit Max : 1.50 E+00

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso4	1.25 E+00	1.26 E+00	1.26 E+00	1.25 E+00	1.25 E+00	1.24 E+00
Iso5	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00
Opt4	1.28 E+00	1.28 E+00	1.28 E+00	1.28 E+00	1.28 E+00	1.27 E+00
Opt5	1.26 E+00	1.26 E+00	1.26 E+00	1.25 E+00	1.25 E+00	1.25 E+00
Mic4	1.23 E+00	1.22 E+00	1.21 E+00	1.22 E+00	1.21 E+00	1.21 E+00
Mic5	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00	1.21 E+00	1.20 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 1mA**

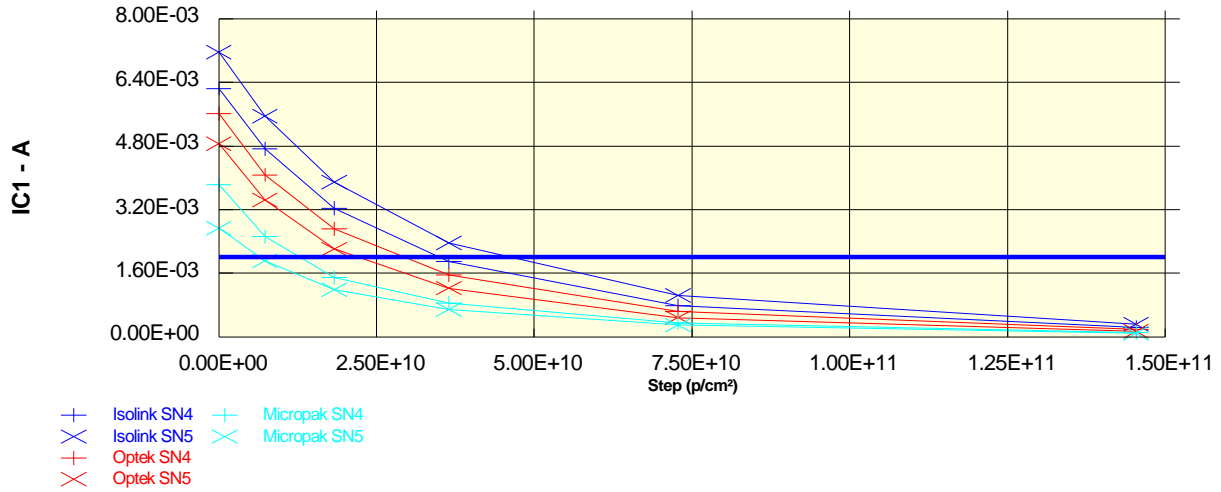
**Parameter : On State Collector Current 1 : IC1**

**VCE=5V. IB=0. IF=1mA**

Unit : A

Spec Limit Min : 2.00 E-03

Spec limits are represented in bold lines on the graphic.

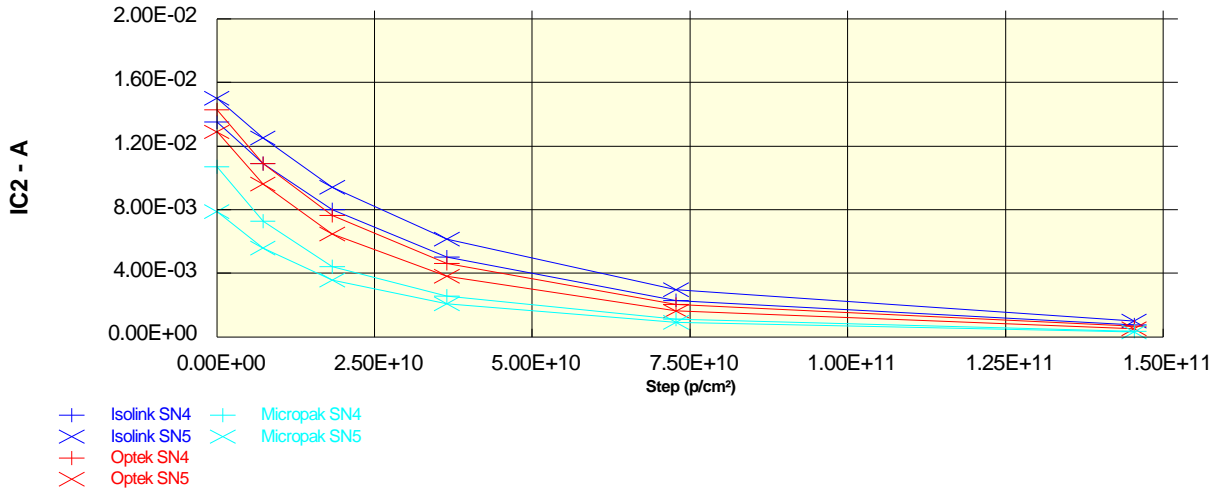


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso4	6.25 E-03	4.73 E-03	3.23 E-03	1.89 E-03	7.91 E-04	2.37 E-04
Iso5	7.16 E-03	5.55 E-03	3.89 E-03	2.36 E-03	1.04 E-03	3.24 E-04
Opt4	5.62 E-03	4.08 E-03	2.72 E-03	1.56 E-03	6.39 E-04	1.89 E-04
Opt5	4.86 E-03	3.44 E-03	2.21 E-03	1.23 E-03	4.90 E-04	1.42 E-04
Mic4	3.83 E-03	2.53 E-03	1.49 E-03	8.60 E-04	3.56 E-04	1.17 E-04
Mic5	2.74 E-03	1.91 E-03	1.19 E-03	6.88 E-04	2.96 E-04	1.00 E-04

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 1mA**  
**Parameter : On State Collector Current 2 : IC2**  
**VCE=5V. IB=0. IF=2mA**  
 Unit : A  
 No spec limit specified.

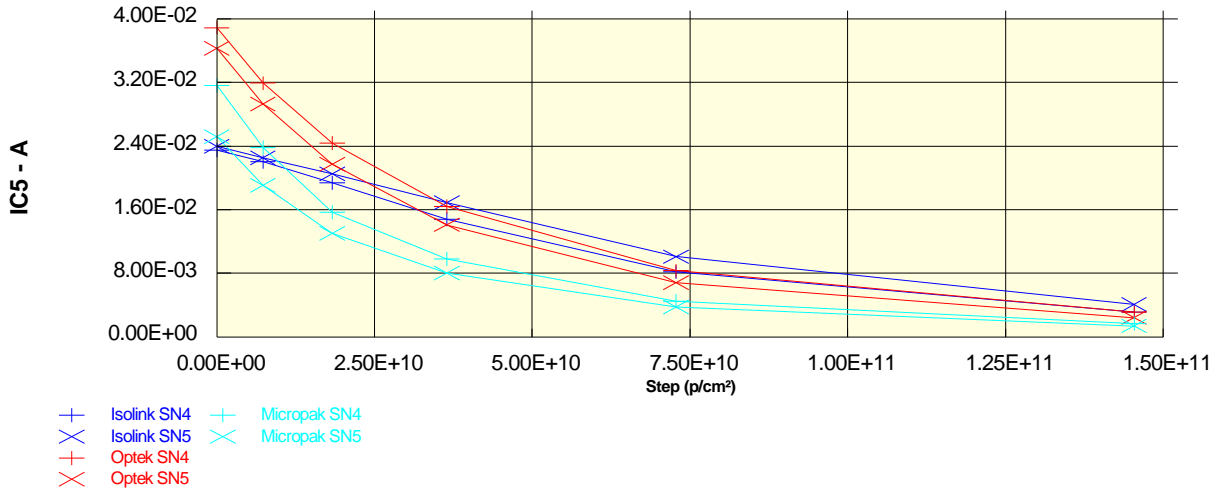


Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso4	1.35 E-02	1.09 E-02	8.00 E-03	5.04 E-03	2.30 E-03	7.46 E-04
Iso5	1.50 E-02	1.25 E-02	9.41 E-03	6.16 E-03	2.96 E-03	1.00 E-03
Opt4	1.43 E-02	1.09 E-02	7.63 E-03	4.63 E-03	2.05 E-03	6.59 E-04
Opt5	1.29 E-02	9.61 E-03	6.49 E-03	3.81 E-03	1.62 E-03	5.04 E-04
Mic4	1.07 E-02	7.29 E-03	4.42 E-03	2.59 E-03	1.10 E-03	3.73 E-04
Mic5	7.88 E-03	5.59 E-03	3.56 E-03	2.09 E-03	9.17 E-04	3.18 E-04

HIREX Engineering	Total Dose Test Report		Réf. : HRX/TID/0079
			Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**Bias Condition : 1mA**  
**Parameter : On State Collector Current 5 : IC5**  
**VCE=5V. IB=0. IF=5mA**  
 Unit : A  
 No spec limit specified.

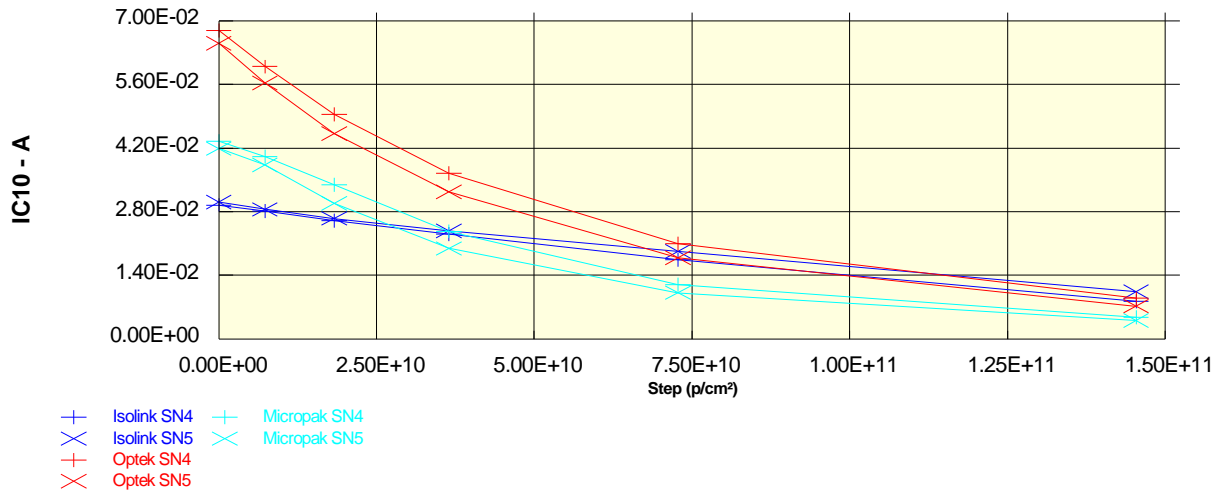


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso4	2.35 E-02	2.20 E-02	1.94 E-02	1.48 E-02	8.17 E-03	3.13 E-03
Iso5	2.40 E-02	2.25 E-02	2.05 E-02	1.69 E-02	1.01 E-02	4.10 E-03
Opt4	3.89 E-02	3.19 E-02	2.44 E-02	1.64 E-02	8.31 E-03	3.08 E-03
Opt5	3.63 E-02	2.93 E-02	2.17 E-02	1.41 E-02	6.82 E-03	2.43 E-03
Mic4	3.16 E-02	2.38 E-02	1.57 E-02	9.79 E-03	4.51 E-03	1.65 E-03
Mic5	2.52 E-02	1.91 E-02	1.30 E-02	8.02 E-03	3.76 E-03	1.39 E-03

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 1mA**  
**Parameter : On State Collector Current 10 : IC10**  
**VCE=5V. IB=0. IF=10mA**  
 Unit : A  
 No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso4	2.95 E-02	2.81 E-02	2.60 E-02	2.31 E-02	1.74 E-02	8.30 E-03
Iso5	3.01 E-02	2.85 E-02	2.65 E-02	2.38 E-02	1.93 E-02	1.04 E-02
Opt4	6.79 E-02	5.99 E-02	4.94 E-02	3.64 E-02	2.10 E-02	8.93 E-03
Opt5	6.50 E-02	5.63 E-02	4.52 E-02	3.24 E-02	1.78 E-02	7.24 E-03
Mic4	4.35 E-02	4.02 E-02	3.39 E-02	2.37 E-02	1.20 E-02	4.79 E-03
Mic5	4.19 E-02	3.83 E-02	2.99 E-02	1.99 E-02	1.02 E-02	4.06 E-03



HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 1mA

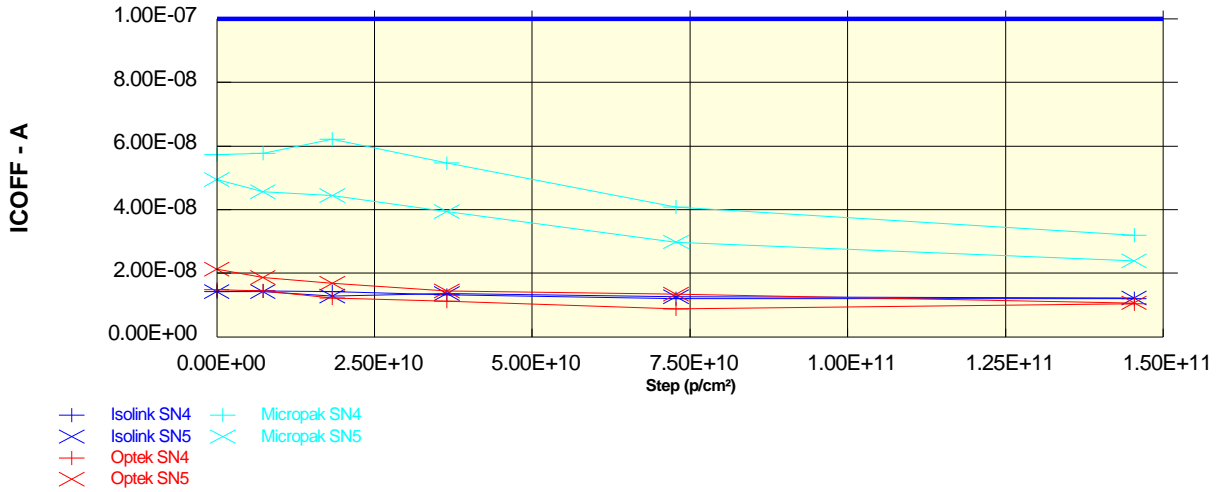
Parameter : Off State Collector Current : ICOFF

VCE=20V. IB=0. IF=0mA

Unit : A

Spec Limit Max : 1.00 E-07

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso4	1.43 E-08	1.44 E-08	1.42 E-08	1.32 E-08	1.21 E-08	1.20 E-08
Iso5	1.43 E-08	1.43 E-08	1.29 E-08	1.36 E-08	1.27 E-08	1.22 E-08
Opt4	1.48 E-08	1.45 E-08	1.22 E-08	1.12 E-08	8.75 E-09	1.05 E-08
Opt5	2.14 E-08	1.87 E-08	1.69 E-08	1.44 E-08	1.35 E-08	1.07 E-08
Mic4	5.72 E-08	5.77 E-08	6.22 E-08	5.46 E-08	4.08 E-08	3.20 E-08
Mic5	4.95 E-08	4.56 E-08	4.44 E-08	3.94 E-08	2.98 E-08	2.40 E-08

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 1mA

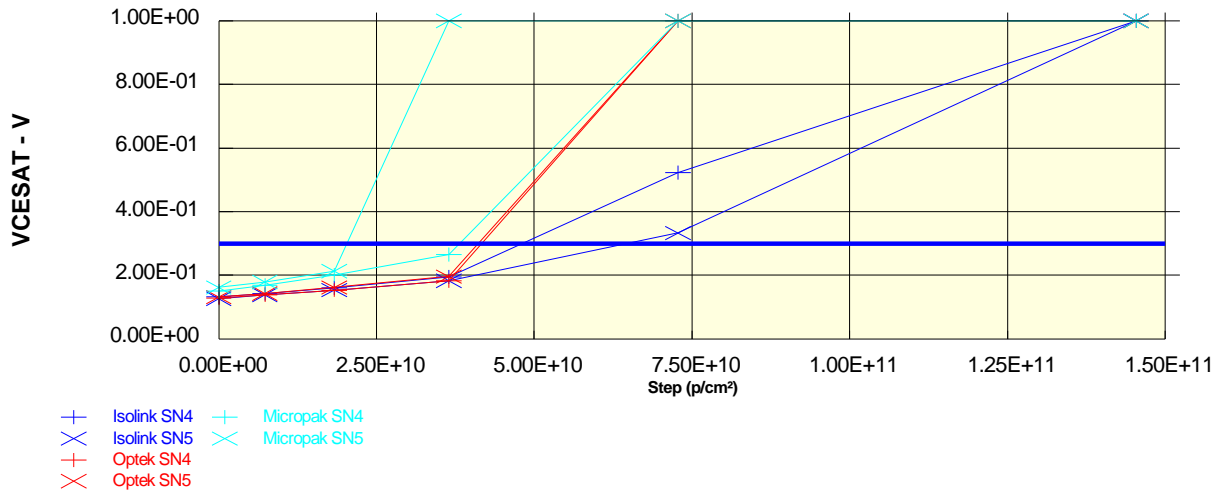
Parameter : Collector Emitter Saturation Voltage : VCESAT

IC=2mA. IB=0. IF=2mA

Unit : V

Spec Limit Max : 3.00 E-01

Spec limits are represented in bold lines on the graphic.



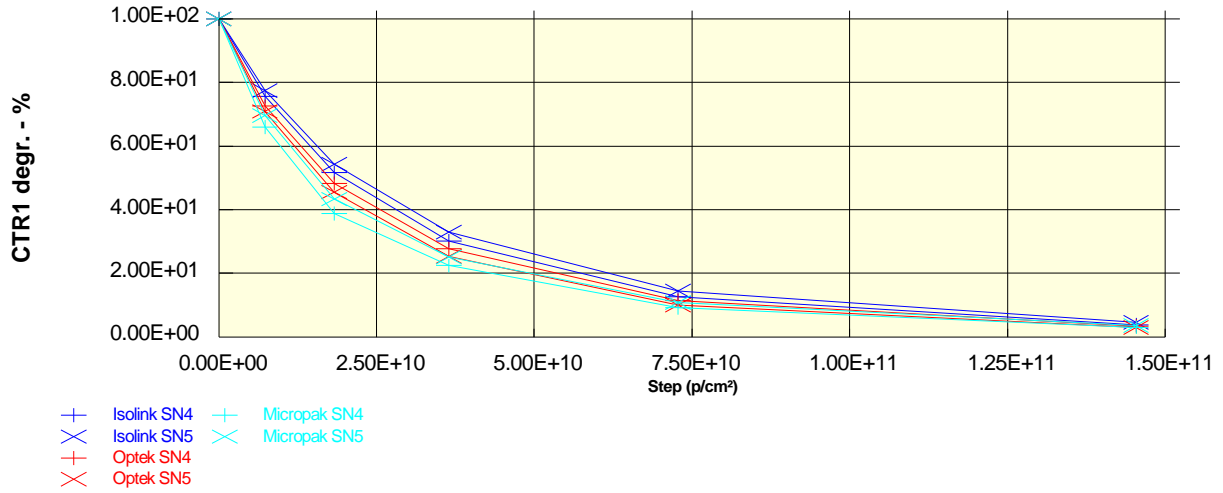
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso4	1.32 E-01	1.42 E-01	1.60 E-01	1.94 E-01	5.23 E-01	1.00 E+00
Iso5	1.27 E-01	1.38 E-01	1.54 E-01	1.83 E-01	3.33 E-01	1.00 E+00
Opt4	1.28 E-01	1.39 E-01	1.54 E-01	1.83 E-01	1.00 E+00	1.00 E+00
Opt5	1.32 E-01	1.43 E-01	1.62 E-01	1.96 E-01	1.00 E+00	1.00 E+00
Mic4	1.51 E-01	1.68 E-01	2.02 E-01	2.65 E-01	1.00 E+00	1.00 E+00
Mic5	1.62 E-01	1.78 E-01	2.13 E-01	1.00 E+00	1.00 E+00	1.00 E+00

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 1mA  
Parameter : CTR1 Degradation : CTR1 degr.

Unit : %  
No spec limit specified.



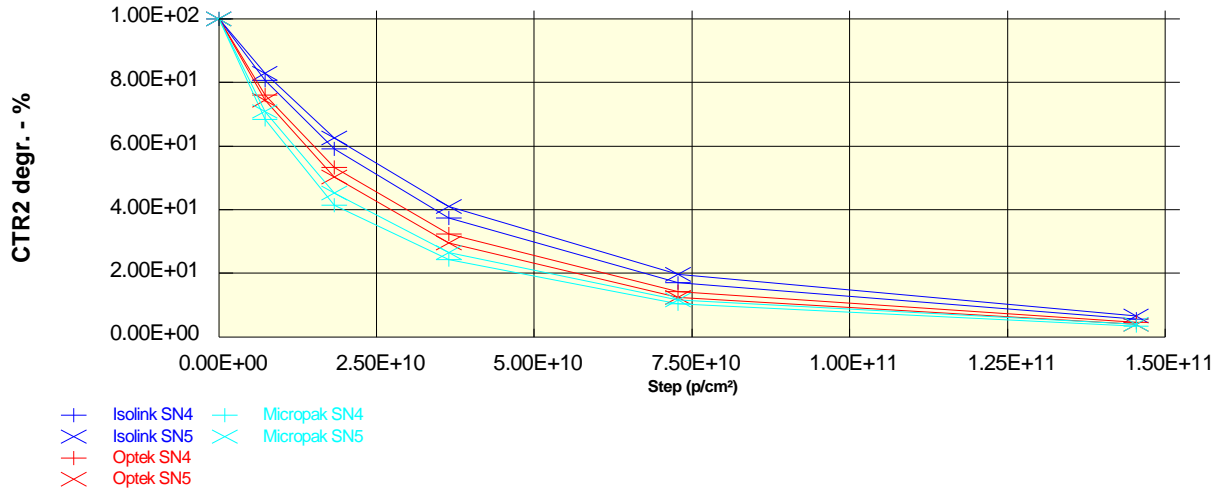
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso4	1.00 E+02	7.57 E+01	5.17 E+01	3.02 E+01	1.27 E+01	3.80 E+00
Iso5	1.00 E+02	7.75 E+01	5.43 E+01	3.29 E+01	1.45 E+01	4.53 E+00
Opt4	1.00 E+02	7.25 E+01	4.83 E+01	2.77 E+01	1.14 E+01	3.36 E+00
Opt5	1.00 E+02	7.09 E+01	4.55 E+01	2.53 E+01	1.01 E+01	2.93 E+00
Mic4	1.00 E+02	6.60 E+01	3.88 E+01	2.24 E+01	9.29 E+00	3.06 E+00
Mic5	1.00 E+02	6.95 E+01	4.33 E+01	2.51 E+01	1.08 E+01	3.66 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 1mA**  
**Parameter : CTR2 Degradation : CTR2 degr.**

Unit : %  
 No spec limit specified.



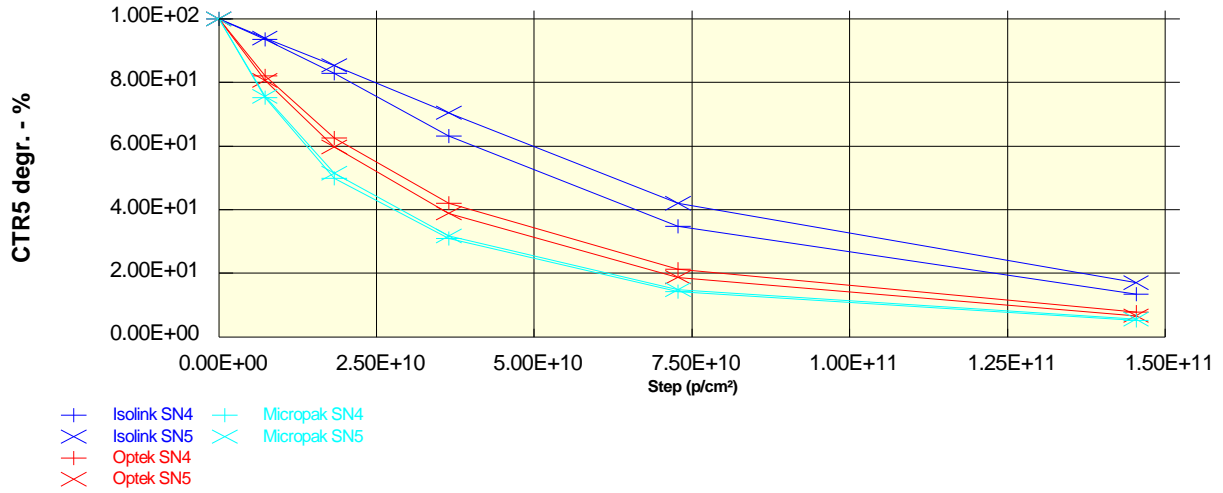
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso4	1.00 E+02	8.07 E+01	5.91 E+01	3.73 E+01	1.70 E+01	5.51 E+00
Iso5	1.00 E+02	8.29 E+01	6.26 E+01	4.10 E+01	1.97 E+01	6.67 E+00
Opt4	1.00 E+02	7.61 E+01	5.33 E+01	3.24 E+01	1.43 E+01	4.60 E+00
Opt5	1.00 E+02	7.45 E+01	5.03 E+01	2.95 E+01	1.25 E+01	3.91 E+00
Mic4	1.00 E+02	6.83 E+01	4.14 E+01	2.43 E+01	1.04 E+01	3.50 E+00
Mic5	1.00 E+02	7.09 E+01	4.52 E+01	2.65 E+01	1.16 E+01	4.04 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 1mA  
Parameter : CTR5 Degradation : CTR5 degr.

Unit : %  
No spec limit specified.



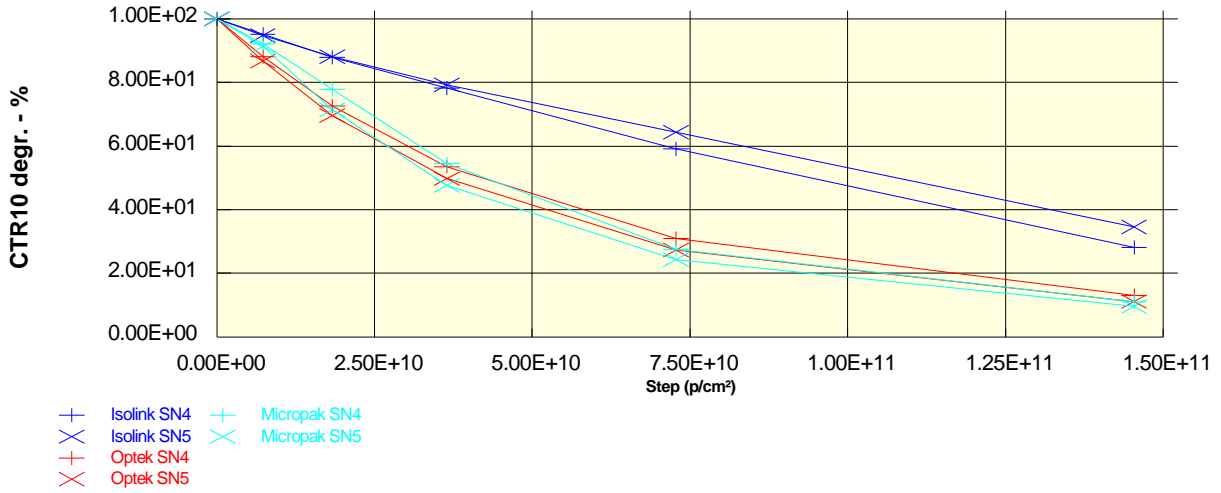
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso4	1.00 E+02	9.36 E+01	8.29 E+01	6.32 E+01	3.48 E+01	1.34 E+01
Iso5	1.00 E+02	9.39 E+01	8.54 E+01	7.05 E+01	4.20 E+01	1.71 E+01
Opt4	1.00 E+02	8.20 E+01	6.26 E+01	4.21 E+01	2.14 E+01	7.92 E+00
Opt5	1.00 E+02	8.07 E+01	5.97 E+01	3.89 E+01	1.88 E+01	6.70 E+00
Mic4	1.00 E+02	7.53 E+01	4.99 E+01	3.10 E+01	1.43 E+01	5.22 E+00
Mic5	1.00 E+02	7.57 E+01	5.15 E+01	3.18 E+01	1.49 E+01	5.53 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 1mA  
Parameter : CTR10 Degradation : CTR10 degr.

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso4	1.00 E+02	9.51 E+01	8.79 E+01	7.83 E+01	5.91 E+01	2.81 E+01
Iso5	1.00 E+02	9.48 E+01	8.81 E+01	7.93 E+01	6.44 E+01	3.46 E+01
Opt4	1.00 E+02	8.81 E+01	7.27 E+01	5.36 E+01	3.09 E+01	1.31 E+01
Opt5	1.00 E+02	8.67 E+01	6.96 E+01	4.98 E+01	2.74 E+01	1.11 E+01
Mic4	1.00 E+02	9.22 E+01	7.78 E+01	5.45 E+01	2.76 E+01	1.10 E+01
Mic5	1.00 E+02	9.14 E+01	7.14 E+01	4.77 E+01	2.43 E+01	9.69 E+00

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 10mA

Parameter : Input Diode Forward Voltage : VF

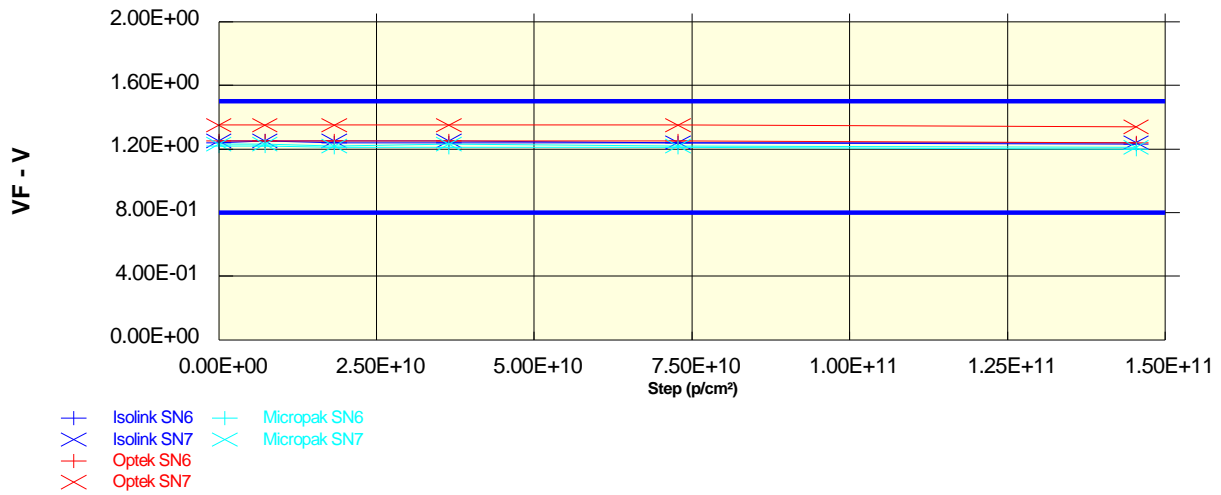
IE=10mA

Unit : V

Spec Limit Min : 8.00 E-01

Spec Limit Max : 1.50 E+00

Spec limits are represented in bold lines on the graphic.



Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso6	1.24 E+00	1.25 E+00	1.24 E+00	1.24 E+00	1.24 E+00	1.23 E+00
Iso7	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00	1.24 E+00
Opt6	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.25 E+00	1.24 E+00
Opt7	1.35 E+00	1.35 E+00	1.35 E+00	1.35 E+00	1.35 E+00	1.34 E+00
Mic6	1.22 E+00	1.22 E+00	1.21 E+00	1.21 E+00	1.21 E+00	1.20 E+00
Mic7	1.23 E+00	1.23 E+00	1.22 E+00	1.23 E+00	1.22 E+00	1.21 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 10mA**

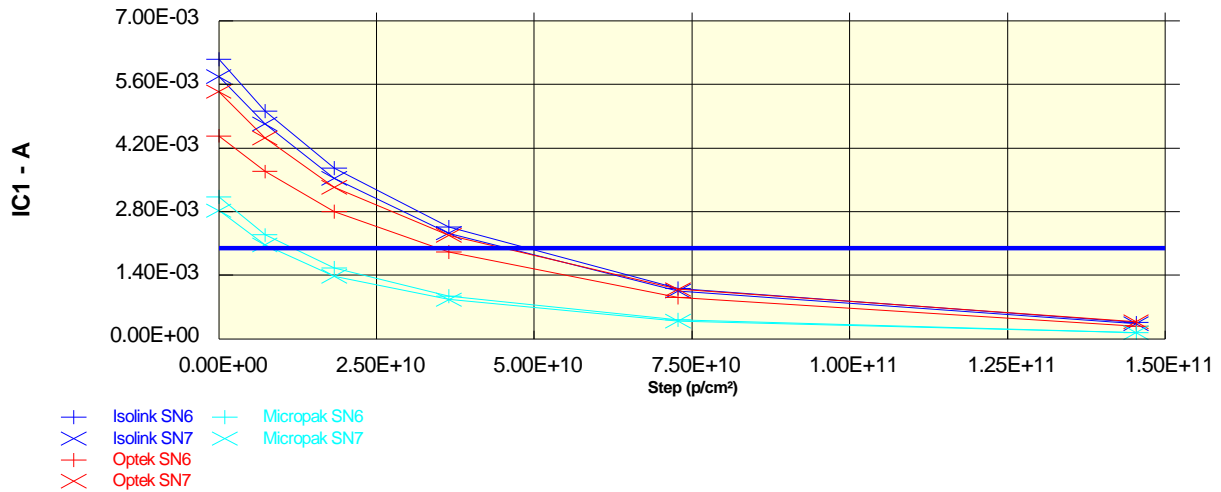
**Parameter : On State Collector Current 1 : IC1**

**VCE=5V. IB=0. IF=1mA**

Unit : A

Spec Limit Min : 2.00 E-03

Spec limits are represented in bold lines on the graphic.



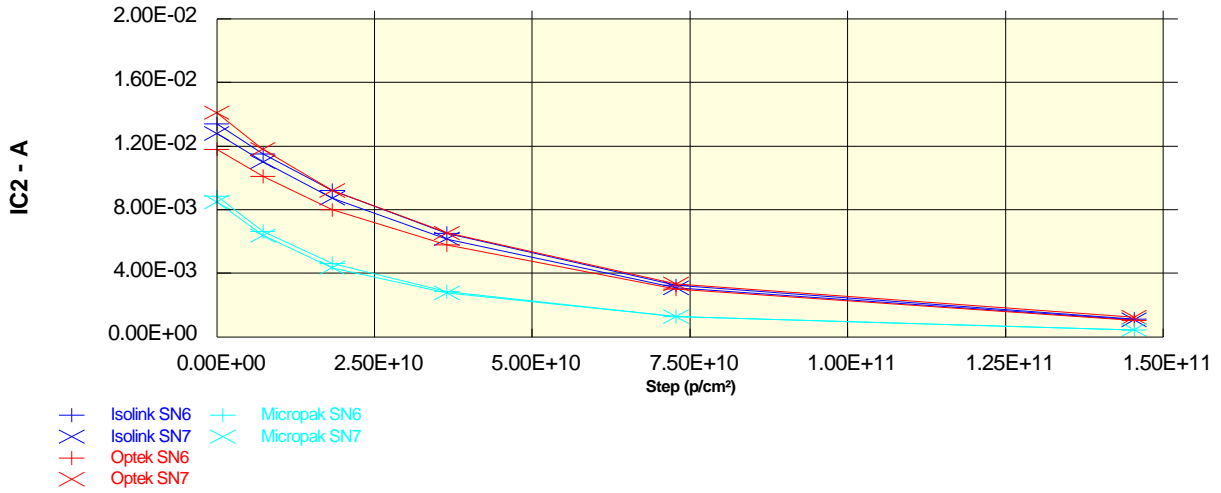
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso6	6.16 E-03	5.01 E-03	3.76 E-03	2.47 E-03	1.11 E-03	3.56 E-04
Iso7	5.77 E-03	4.73 E-03	3.53 E-03	2.33 E-03	1.06 E-03	3.40 E-04
Opt6	4.47 E-03	3.68 E-03	2.80 E-03	1.92 E-03	9.18 E-04	2.85 E-04
Opt7	5.44 E-03	4.42 E-03	3.34 E-03	2.28 E-03	1.09 E-03	3.75 E-04
Mic6	3.13 E-03	2.29 E-03	1.56 E-03	9.44 E-04	4.15 E-04	1.42 E-04
Mic7	2.82 E-03	2.07 E-03	1.38 E-03	8.65 E-04	3.91 E-04	1.36 E-04



HIREX Engineering	Total Dose Test Report		Réf. : HRX/TID/0079
			Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**Bias Condition : 10mA**  
**Parameter : On State Collector Current 2 : IC2**  
**VCE=5V. IB=0. IF=2mA**  
 Unit : A  
 No spec limit specified.

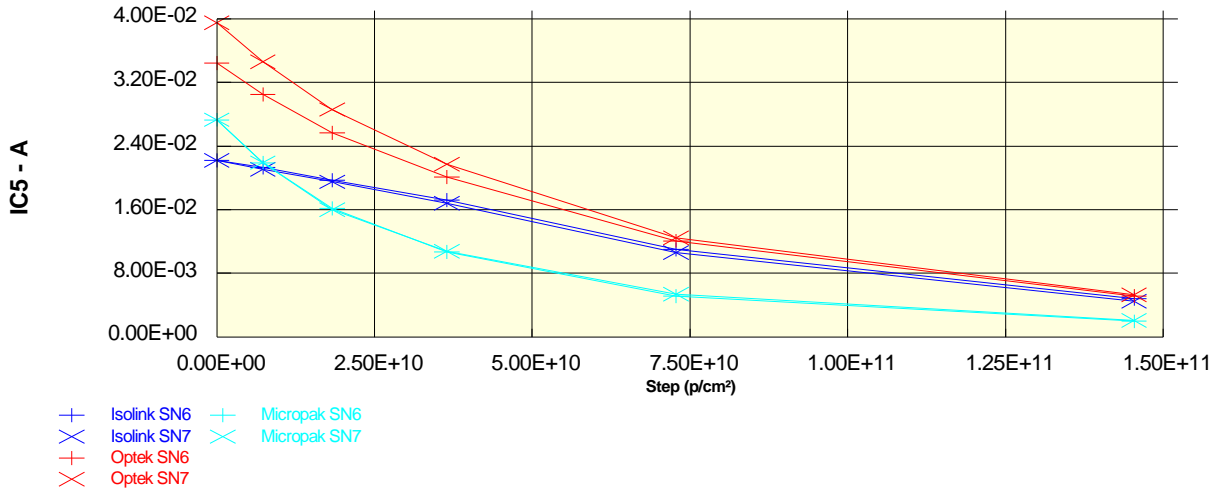


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso6	1.34 E-02	1.15 E-02	9.20 E-03	6.50 E-03	3.24 E-03	1.14 E-03
Iso7	1.28 E-02	1.10 E-02	8.73 E-03	6.17 E-03	3.10 E-03	1.09 E-03
Opt6	1.18 E-02	1.01 E-02	7.99 E-03	5.78 E-03	3.03 E-03	1.06 E-03
Opt7	1.41 E-02	1.18 E-02	9.22 E-03	6.53 E-03	3.35 E-03	1.24 E-03
Mic6	8.83 E-03	6.63 E-03	4.62 E-03	2.85 E-03	1.29 E-03	4.52 E-04
Mic7	8.47 E-03	6.37 E-03	4.36 E-03	2.77 E-03	1.28 E-03	4.58 E-04

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 10mA**  
**Parameter : On State Collector Current 5 : IC5**  
**VCE=5V. IB=0. IF=5mA**  
 Unit : A  
 No spec limit specified.

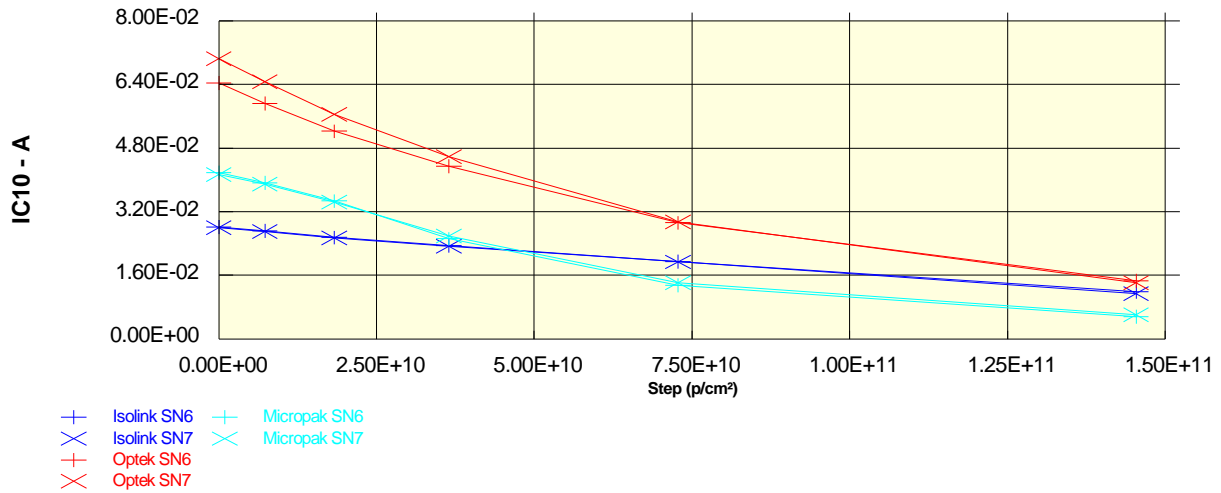


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso6	2.22 E-02	2.13 E-02	1.97 E-02	1.72 E-02	1.10 E-02	4.77 E-03
Iso7	2.22 E-02	2.11 E-02	1.95 E-02	1.68 E-02	1.06 E-02	4.52 E-03
Opt6	3.44 E-02	3.05 E-02	2.57 E-02	2.01 E-02	1.21 E-02	5.14 E-03
Opt7	3.95 E-02	3.46 E-02	2.86 E-02	2.17 E-02	1.25 E-02	5.30 E-03
Mic6	2.73 E-02	2.19 E-02	1.62 E-02	1.07 E-02	5.18 E-03	1.97 E-03
Mic7	2.73 E-02	2.19 E-02	1.60 E-02	1.08 E-02	5.36 E-03	2.09 E-03

HIREX Engineering	Total Dose Test Report		Réf. : HRX/TID/0079
			Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**Bias Condition : 10mA**  
**Parameter : On State Collector Current 10 : IC10**  
**VCE=5V. IB=0. IF=10mA**  
 Unit : A  
 No spec limit specified.



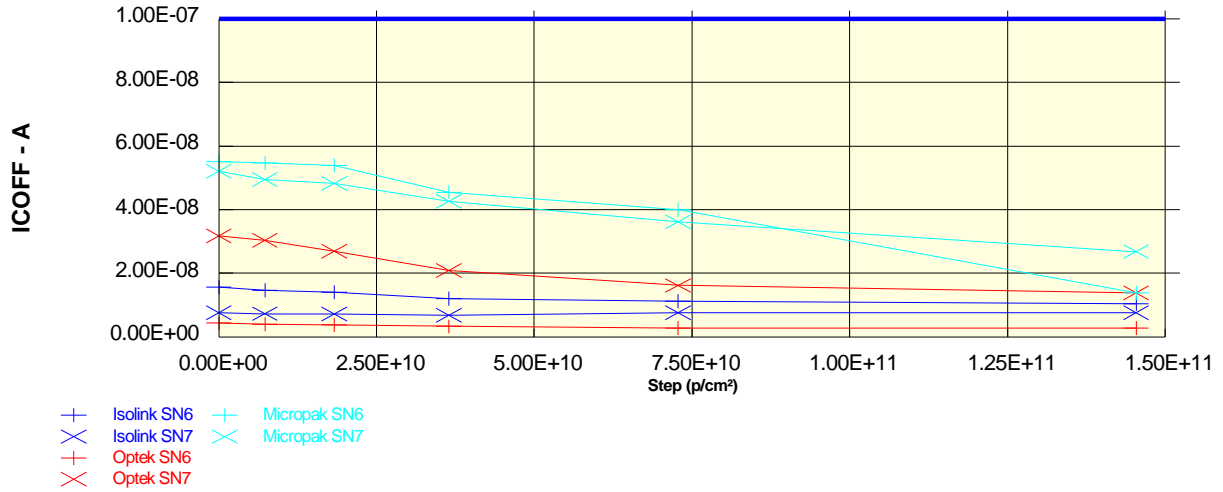
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso6	2.81 E-02	2.71 E-02	2.55 E-02	2.35 E-02	1.95 E-02	1.19 E-02
Iso7	2.80 E-02	2.70 E-02	2.54 E-02	2.33 E-02	1.94 E-02	1.14 E-02
Opt6	6.43 E-02	5.92 E-02	5.22 E-02	4.34 E-02	2.92 E-02	1.46 E-02
Opt7	7.05 E-02	6.47 E-02	5.65 E-02	4.58 E-02	2.94 E-02	1.42 E-02
Mic6	4.19 E-02	3.92 E-02	3.47 E-02	2.52 E-02	1.35 E-02	5.64 E-03
Mic7	4.13 E-02	3.89 E-02	3.44 E-02	2.59 E-02	1.42 E-02	6.05 E-03

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 10mA**  
**Parameter : Off State Collector Current : ICOFF**  
**VCE=20V. IB=0. IF=0mA**

Unit : A  
Spec Limit Max : 1.00 E-07  
Spec limits are represented in bold lines on the graphic.

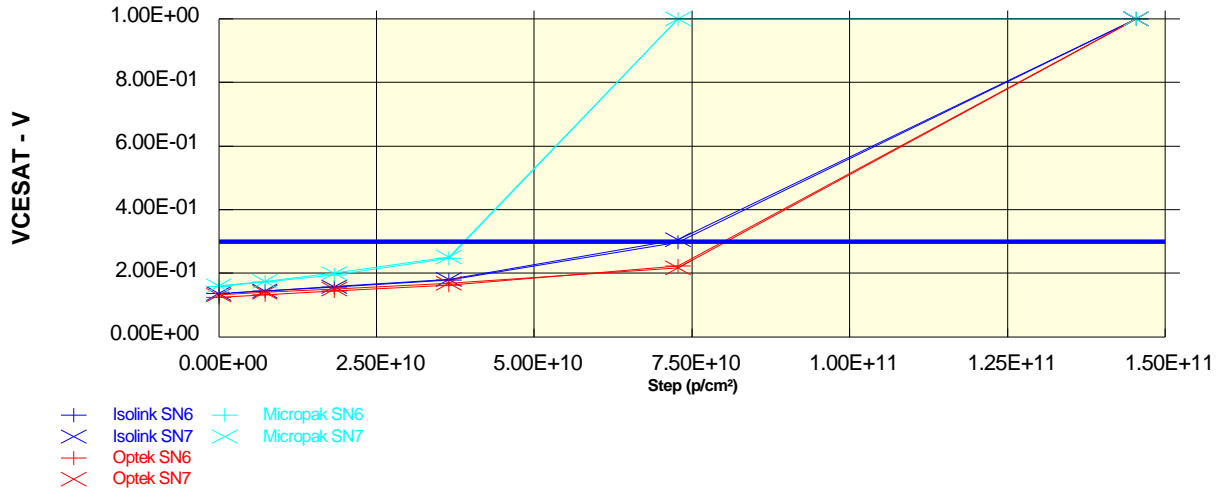


Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso6	1.56 E-08	1.47 E-08	1.40 E-08	1.21 E-08	1.13 E-08	1.05 E-08
Iso7	7.58 E-09	7.28 E-09	7.20 E-09	6.82 E-09	7.54 E-09	7.66 E-09
Opt6	4.28 E-09	4.00 E-09	3.76 E-09	3.30 E-09	2.78 E-09	2.80 E-09
Opt7	3.18 E-08	3.03 E-08	2.70 E-08	2.09 E-08	1.62 E-08	1.38 E-08
Mic6	5.51 E-08	5.47 E-08	5.39 E-08	4.55 E-08	4.01 E-08	1.38 E-08
Mic7	5.21 E-08	4.95 E-08	4.83 E-08	4.27 E-08	3.62 E-08	2.68 E-08

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 10mA**  
**Parameter : Collector Emitter Saturation Voltage : VCESAT**  
**IC=2mA. IB=0. IF=2mA**  
Unit : V  
Spec Limit Max : 3.00 E-01  
Spec limits are represented in bold lines on the graphic.



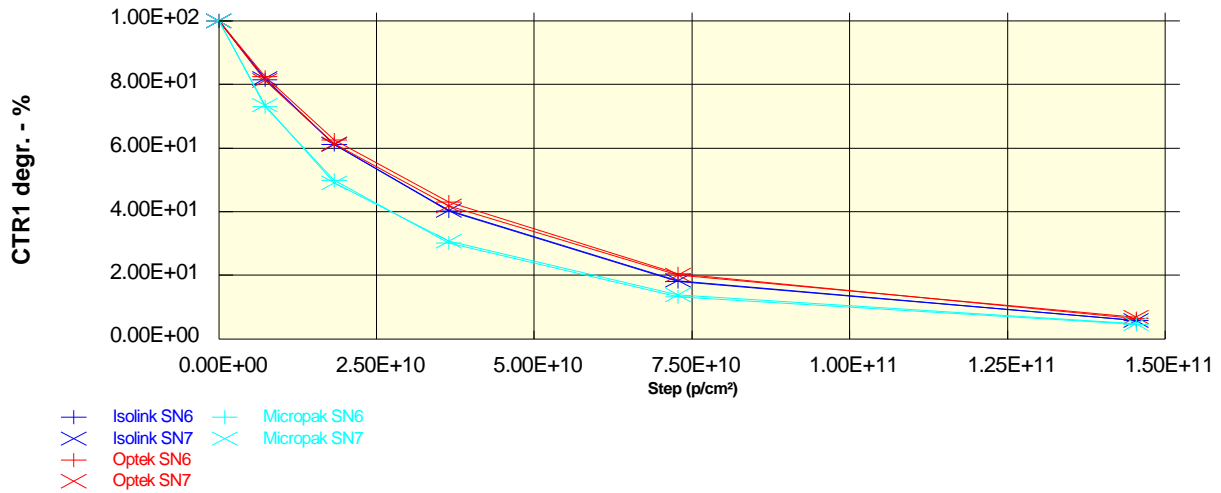
Test TST001 : 60 MeV proton

	0.00E+00 p/cm <sup>2</sup>	7.26E+09 p/cm <sup>2</sup>	1.83E+10 p/cm <sup>2</sup>	3.65E+10 p/cm <sup>2</sup>	7.28E+10 p/cm <sup>2</sup>	1.45E+11 p/cm <sup>2</sup>
Iso6	1.37 E-01	1.44 E-01	1.57 E-01	1.80 E-01	2.97 E-01	1.00 E+00
Iso7	1.36 E-01	1.44 E-01	1.58 E-01	1.81 E-01	3.05 E-01	1.00 E+00
Opt6	1.25 E-01	1.32 E-01	1.44 E-01	1.63 E-01	2.23 E-01	1.00 E+00
Opt7	1.32 E-01	1.40 E-01	1.51 E-01	1.68 E-01	2.17 E-01	1.00 E+00
Mic6	1.59 E-01	1.73 E-01	1.95 E-01	2.47 E-01	1.00 E+00	1.00 E+00
Mic7	1.61 E-01	1.74 E-01	2.00 E-01	2.51 E-01	1.00 E+00	1.00 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 10mA**  
**Parameter : CTR1 Degradation : CTR1 degr.**

Unit : %  
 No spec limit specified.



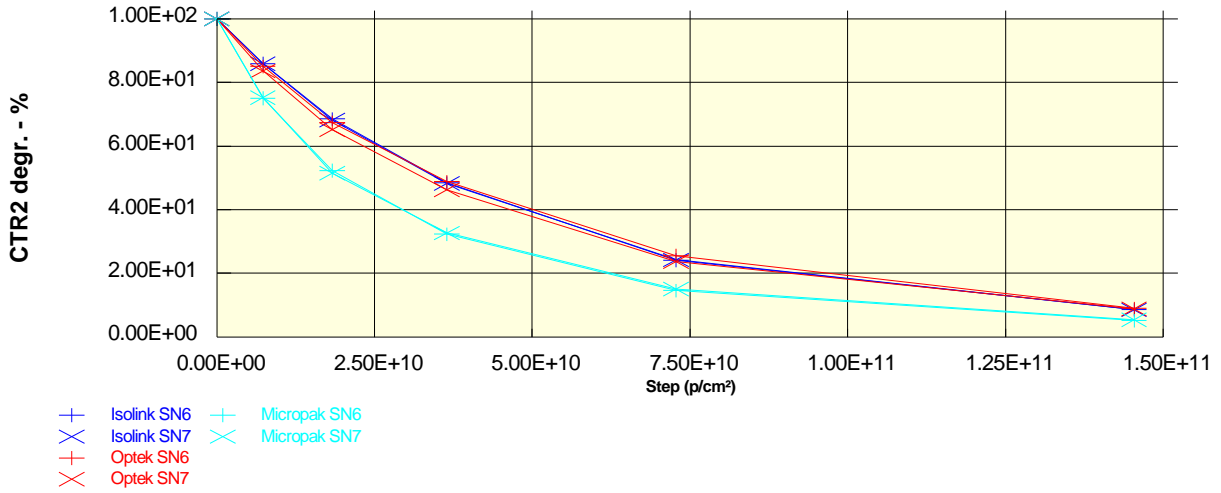
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso6	1.00 E+02	8.14 E+01	6.11 E+01	4.02 E+01	1.81 E+01	5.78 E+00
Iso7	1.00 E+02	8.19 E+01	6.12 E+01	4.04 E+01	1.84 E+01	5.88 E+00
Opt6	1.00 E+02	8.24 E+01	6.26 E+01	4.31 E+01	2.06 E+01	6.38 E+00
Opt7	1.00 E+02	8.12 E+01	6.13 E+01	4.19 E+01	2.01 E+01	6.89 E+00
Mic6	1.00 E+02	7.30 E+01	4.99 E+01	3.01 E+01	1.33 E+01	4.52 E+00
Mic7	1.00 E+02	7.35 E+01	4.91 E+01	3.07 E+01	1.39 E+01	4.83 E+00

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

**Bias Condition : 10mA**  
**Parameter : CTR2 Degradation : CTR2 degr.**

Unit : %  
 No spec limit specified.



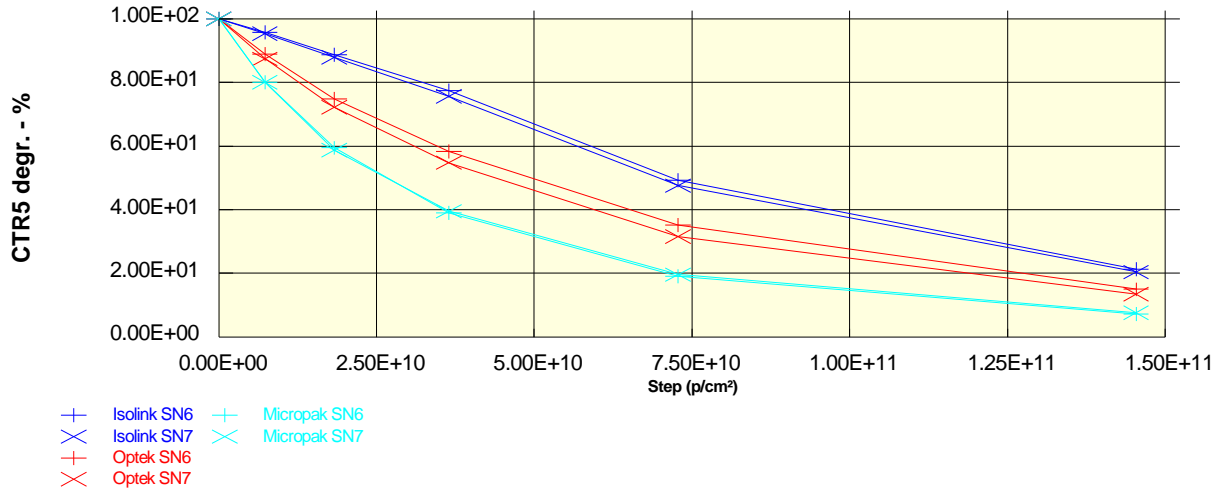
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso6	1.00 E+02	8.59 E+01	6.85 E+01	4.84 E+01	2.41 E+01	8.52 E+00
Iso7	1.00 E+02	8.59 E+01	6.82 E+01	4.82 E+01	2.42 E+01	8.50 E+00
Opt6	1.00 E+02	8.50 E+01	6.74 E+01	4.88 E+01	2.56 E+01	8.99 E+00
Opt7	1.00 E+02	8.36 E+01	6.52 E+01	4.62 E+01	2.37 E+01	8.76 E+00
Mic6	1.00 E+02	7.50 E+01	5.23 E+01	3.23 E+01	1.46 E+01	5.11 E+00
Mic7	1.00 E+02	7.52 E+01	5.15 E+01	3.27 E+01	1.51 E+01	5.41 E+00

HIREX Engineering	Total Dose Test Report			Réf. : HRX/TID/0079
				Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 10mA  
Parameter : CTR5 Degradation : CTR5 degr.

Unit : %  
No spec limit specified.



Test TST001 : 60 MeV proton

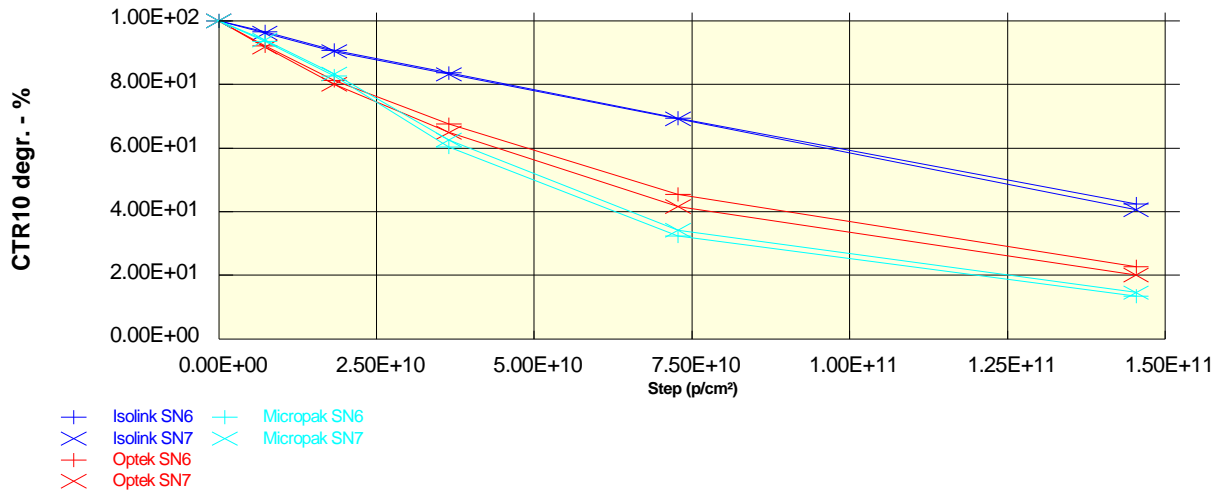
	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso6	1.00 E+02	9.58 E+01	8.87 E+01	7.75 E+01	4.93 E+01	2.14 E+01
Iso7	1.00 E+02	9.53 E+01	8.79 E+01	7.57 E+01	4.76 E+01	2.04 E+01
Opt6	1.00 E+02	8.89 E+01	7.48 E+01	5.83 E+01	3.52 E+01	1.50 E+01
Opt7	1.00 E+02	8.74 E+01	7.23 E+01	5.48 E+01	3.16 E+01	1.34 E+01
Mic6	1.00 E+02	8.00 E+01	5.94 E+01	3.90 E+01	1.90 E+01	7.23 E+00
Mic7	1.00 E+02	8.01 E+01	5.87 E+01	3.95 E+01	1.96 E+01	7.65 E+00



<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>			Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek	

Bias Condition : 10mA  
Parameter : CTR10 Degradation : CTR10 degr.

Unit : %  
No spec limit specified.



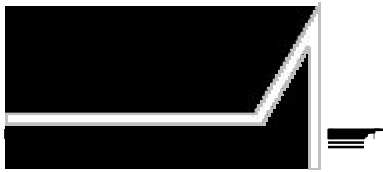
Test TST001 : 60 MeV proton

	0.00E+00 p/cm²	7.26E+09 p/cm²	1.83E+10 p/cm²	3.65E+10 p/cm²	7.28E+10 p/cm²	1.45E+11 p/cm²
Iso6	1.00 E+02	9.65 E+01	9.08 E+01	8.36 E+01	6.94 E+01	4.24 E+01
Iso7	1.00 E+02	9.62 E+01	9.04 E+01	8.32 E+01	6.92 E+01	4.06 E+01
Opt6	1.00 E+02	9.21 E+01	8.12 E+01	6.75 E+01	4.54 E+01	2.27 E+01
Opt7	1.00 E+02	9.17 E+01	8.01 E+01	6.49 E+01	4.16 E+01	2.01 E+01
Mic6	1.00 E+02	9.35 E+01	8.28 E+01	6.03 E+01	3.23 E+01	1.35 E+01
Mic7	1.00 E+02	9.40 E+01	8.33 E+01	6.26 E+01	3.42 E+01	1.46 E+01

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek

**APPENDIX 2 - CPO BEAM DOSIMETRY**

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek



**CENTRE DE PROTONTHERAPIE D'ORSAY**

End-line dosimetry instrumentation

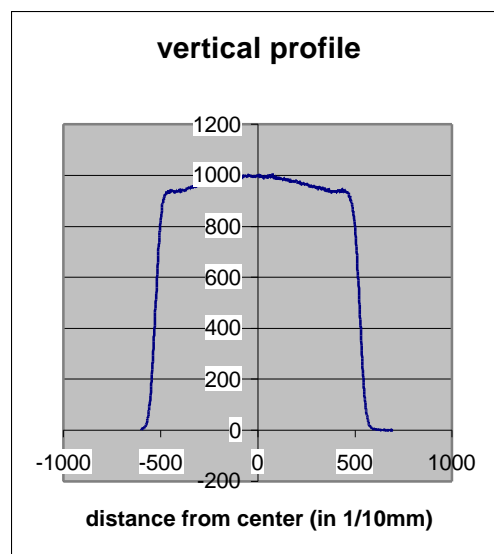
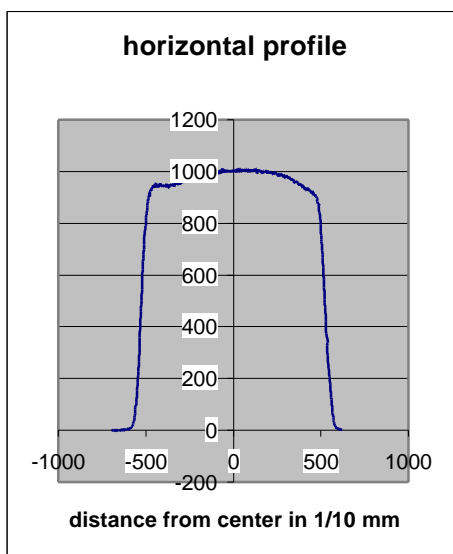
Off-line: a pencil ionization chamber (Wellhöfer IC15, vol. 0.1 cc) put in a water phantom achieves an accurate 3D dosimetry (standard system from the radiotherapy industry). The energy is calculated from the dose value.

(Code of practice for clinical proton dosimetry, Radiotherapy and Oncology 20, 1991)

On-line: the monitoring of the dose is realized with plates ionization chambers (control of the deposited dose with a resolution of 1cGy).

Beam calibration

water cm	Energy	dose	S/Ro water	coef Z5	time	Fluence rate
	MeV	Gy	MeV. g <sup>-1</sup> . cm <sup>2</sup>	.p . cm <sup>-2</sup> . U.M. <sup>-1</sup>	s	.p . cm <sup>-2</sup> .s <sup>-1</sup>
3.1	60.07	1	10.77	1.159 E06	41	2.7 E07

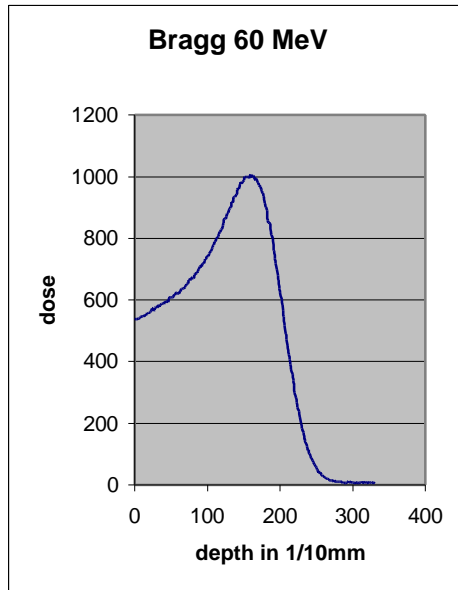


Beam profile

<b>HIREX Engineering</b>	<b>Total Dose Test Report</b>		Réf. : HRX/TID/0079 Issue : 02
Part Type :	4N49	Manufacturer :	Isolink, Micropac, Optek



**CENTRE DE PROTONTHERAPIE D'ORSAY**



Bragg peak measured behind an equivalent 1.2 cm water