NEUTRONS DISPLACEMENT DAMAGE TEST REPORT

OLH7000-0010

(DC0721)

Linear Optocoupler From ISOLINK

TRAD/TN/OLH7000/XXX1/ESA/YP/1104		Labège, March 7th, 2012
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Issue : 0		
To: Marc POIZAT	Project/Program:	ESA Contract N°4000102571/10/NL/AF-Radiation Characterization of Laplace RH optocouplers, sensors and detectors

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1 INTRODUCTION

This report includes the test results of OLH7000-0010, an hermetic linear Optocoupler from ISOLINK to evaluate displacement damage effects under neutron irradiation. On November, week 45, 2011, TRAD characterized this device for neutron sensitivity at the SCK-CEN Facility, Belgium using their BR1 Neutron Irradiator.
The objectives of the test are:

- to detect and measure the degradation of device parameters as a function of neutron fluence,
- to determine if device parameters are within specified limits after exposure to final level of neutron fluence.

2 DOCUMENTS

2.1 Applicable Documents

AD	1.	ESA contract	N°4000102571/10/NL/AF-Radiation Characterization of Laplace RH optocouplers, sensors and detectors
AD	2.	Irradiation Test Plan	ITP-TN-OLH7000-ISO-ESA-1119 Iss.2, dated 28/06/2011

2.2 Reference Documents

RD	1.	Datasheet OLH7000	Hermetic Linear Optocoupler

3 DEVICE INFORMATION

3.1 Device description

The OLH7000 is a hermetic linear Optocoupler which consists of two LED in series coupled to two PIN photodiode detectors. The photodiode on the input side acts as a feedback device permitting an external feedback loop to ensure constant LED light output. A similar matching photodiode on the output side is used to drive an output circuit that is electrically isolated from the input. A fixed relationship is thus maintained between input and output. This technique compensates for the LED's nonlinear time and temperature characteristics. Each OLH7000 is mounted and coupled in a hermetic 8-pin ceramic DIP providing 1000 Vdc electrical isolation between input and output.

Type	OLH7000-0010
Manufacturer	ISOLINK
Function	Optocoupler
Package	DIP8
Date Code	0721
Sample size	4 parts (3 test parts + 1 control sample)

3.2 Procurement information

75 parts OLH7000-0010 were delivered by ISOLINK through the French representative EUROMIP.

3.3 External view

Figure 1: package marking

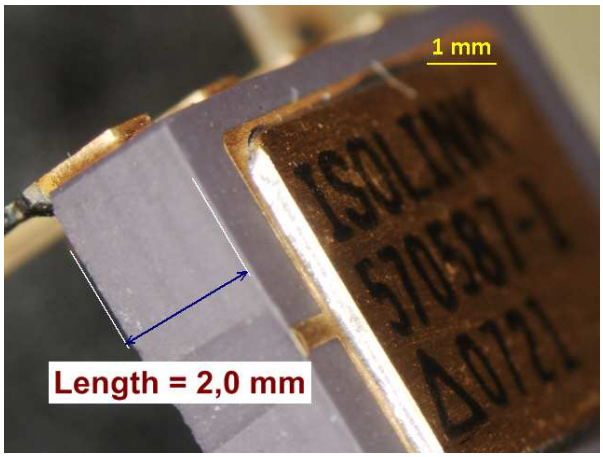


Figure 2: package view

3.4 Internal view

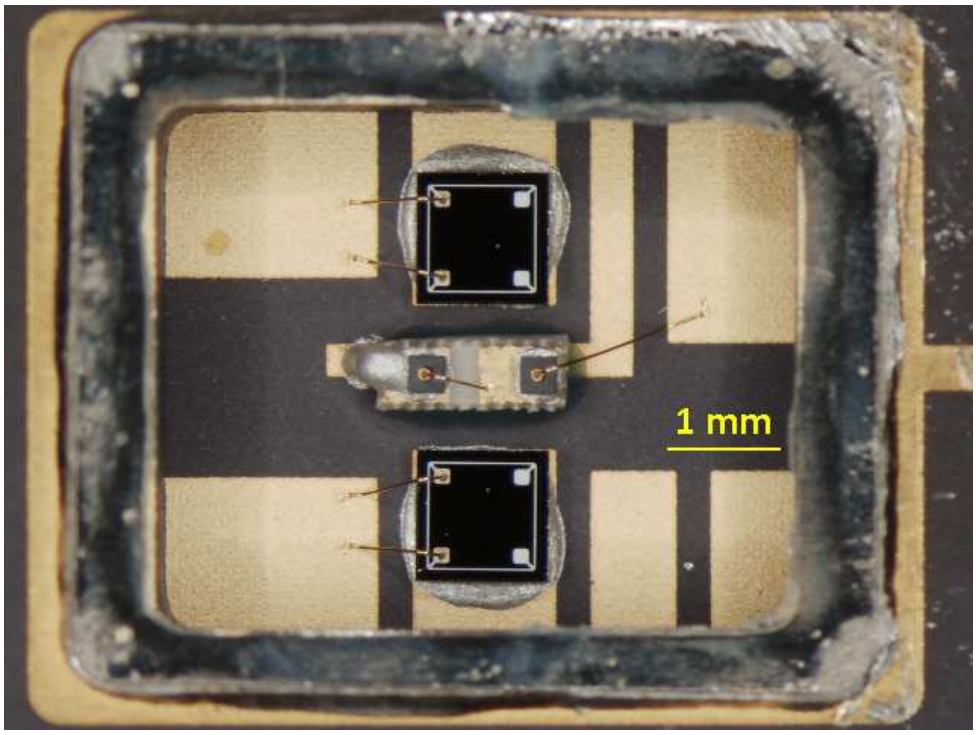


Figure 3: Internal overall view

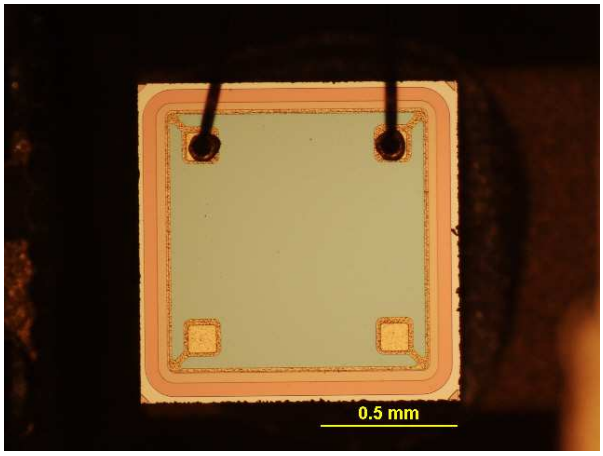


Figure 4: view of photodiode detector

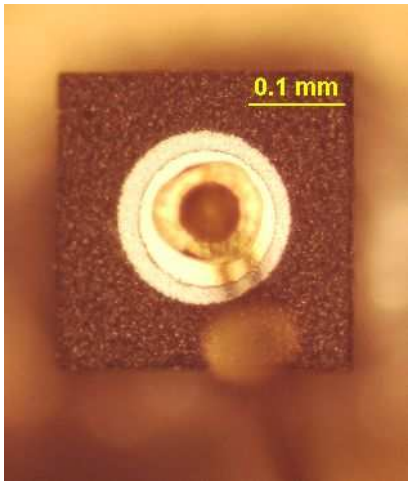


Figure 5: view of LED

3.5 Serialization

Each part is serialized to enable pre and post test identification and comparison.

Serial Number	Control sample	Test samples		
Serialization	1	2	3	4

4 IRRADIATION MEANS AND CONDITIONS

4.1 BR1 irradiation facility (Belgium)

The Reactor BR1 is a versatile neutron / gamma irradiation tool.
The large cavity is used for this test. To obtain the required neutron flux, a 6cm Uranium shell is used. This spherical converter provides a 1 MeV equivalent neutron flux of 2.86E+08n/cm^2.s, with a low ionizing dose rate of 2,5Gy/h.
All exposures are made at 20°C ±10°C.

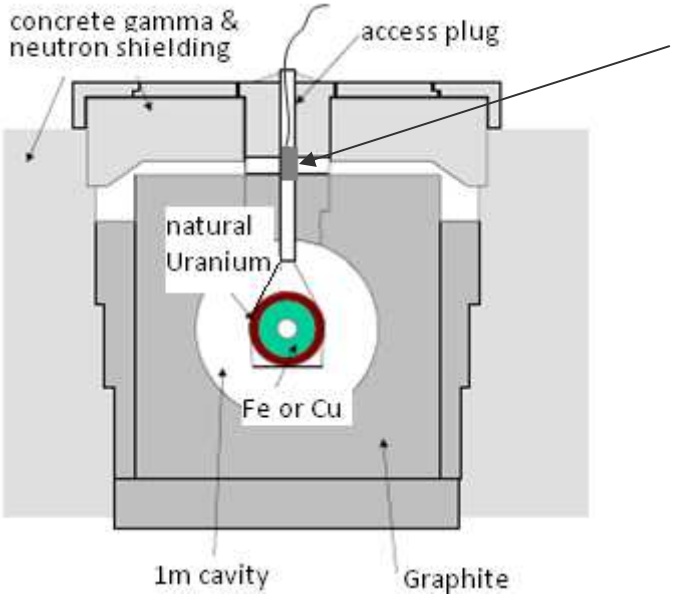


Figure 6: schematical view of the large cavity and its spherical drivers

The sample holder is a cylinder, dimensions of which are 3.5 cm diameter and 5.5 cm length made of high-density polyethylene.

Figure 7: view of the sample holder

4.2 Dose measurement

The SCK•CEN reactor dosimetry service is accredited by BELAC (Ministry of Economic Affairs) under the accreditation number 015-TEST. The accreditation towards norms NBN EN ISO/IEC 17025 for the Standard Practice for Determining Neutron Fluence Rate, Fluence, and Spectra by Radioactivation Techniques (ASTM261 & ASTM262) is on progress.

4.3 Experimental conditions

An Equivalent total fluence of 1E12 #/cm² of 10 MeV protons is required [AD2] for this TNID (Total Non Ionizing Dose) evaluation test. Considering NIEL (Non Ionizing Energy Loss) value for 1 MeV neutron (1.14E-03 MeV cm2 g^{-1}), it corresponds to a total fluence of 6.89E+12 #/cm² for 1 MeV neutron.
Five steps are defined to determine the component degradation under 1 MeV neutron irradiation.
The test devices have been exposed to the following neutron fluence levels:

	Step1	Step2	Step3	Step4	Step5
Fluence n/cm^2	5,00E+10	1,00E+11	5,00E+11	1,00E+12	7,00E+12
Flux n/cm^2.s	2,86E+08	2,86E+08	2,86E+08	2,86E+08	2,86E+08

4.4 Exposure set-up

The samples were exposed to neutron irradiation in an un-biased state and had all their terminal leads open.

5 ELECTRICAL TESTS

Electrical parameters to be measured in pre and post exposure tests are described in the following table. Electrical tests are performed on each part using the test set-up hereunder. All required data are recorded for each device. Test conditions and limits are given in the applicable irradiation test plan [AD2] and shown hereafter.

5.1 Test set-up

TEST BOARD	TRAD/CT1/N/OPTO/ZIP14/BR/1109
TEST PROGRAM	TRAD/CT1/P/OLH7000/DIL8/BR/1109

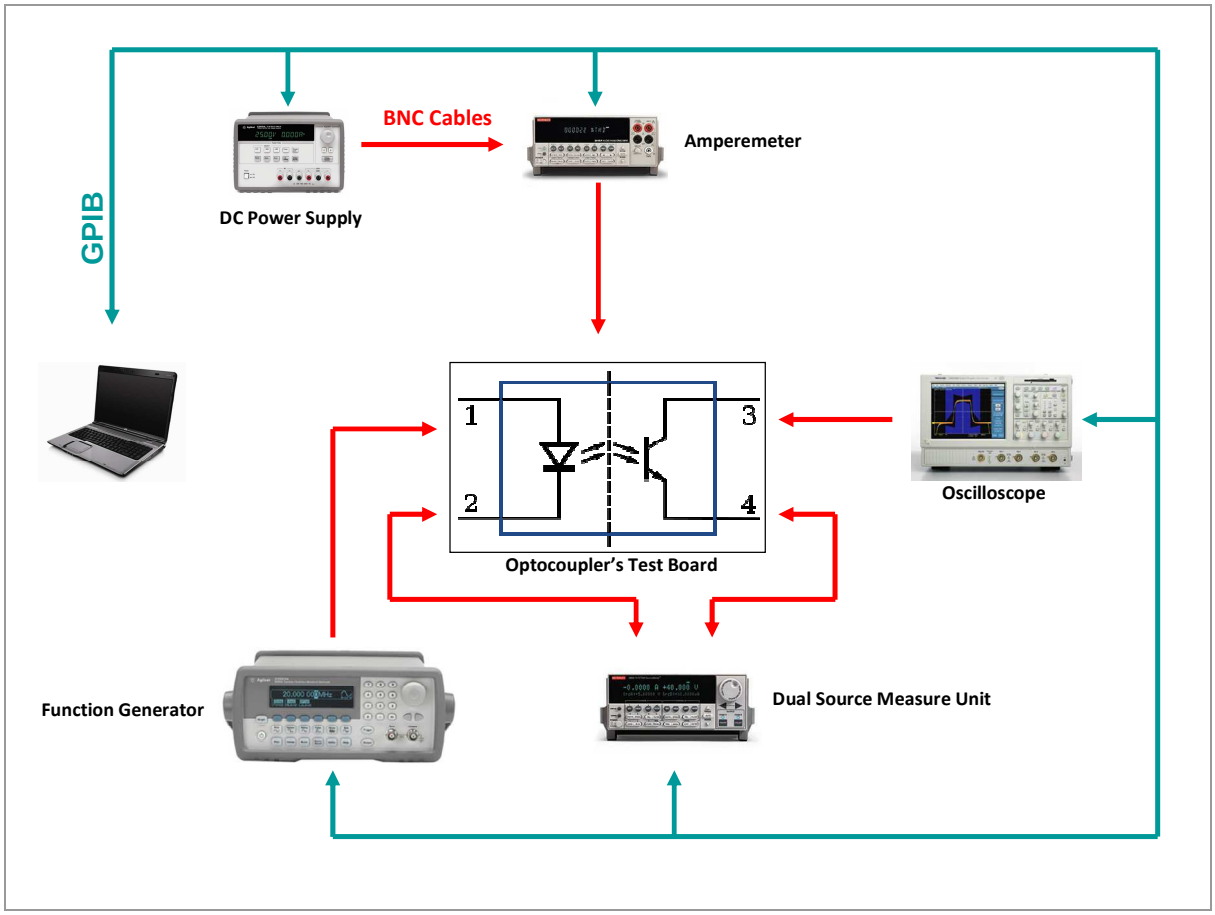


Figure 8: test principle

5.2 Electrical parameters

PARAMETER	SYMBOL	TEST CONDITION	MIN	MAX	UNIT	Typical value
Forward Voltage	V_F	I_F = 10 mA		3,3	V	
Reverse Voltage	V_R	I_R = 100µA	5		V	
Dark Current	I_D	V_R = 15 V, I_F = 0 mA		25	nA	
Open Circuit Voltage	V_{OC}	I_F = 10 mA			mV	500
Servo Current Gain	K1	I_F = 10 mA, Vdet = -15 V	0,0035	0,0065		
Servo Current	I_{P1}	I_F = 10 mA, Vdet = -15 V			µA	50
Forward Current Gain	K2-1	I_F = 10 mA, Vdet = -15 V	0,0035	0,0065		
	K2-2	I_F = 1 mA, Vdet = -15 V				
	K2-3	I_F = 2 mA, Vdet = -15 V				
	K2-4	I_F = 60 mA, Vdet = -15 V				
	K2-5	I_F = 10 mA, Vdet = -30 V				
Forward Current	I_{P2}	I_F = 10 mA, Vdet = -15 V			µA	50
Transfer Gain	K3	I_F = 10 mA, Vdet = -15 V	0,75	1,25		K1/K2
Frequency Response (-3db)	BW	I_F = 10 mA ± 4 mA, R_L = 50Ω			KHz	200
Rise Time	tr	I_F = 10 mA ± 4 mA, R_L = 50Ω			µs	2
Fall Time	tf	I_F = 10 mA ± 4 mA, R_L = 50Ω			µs	2

Min/ Max values are those specified in the reference data-sheet [RD1] applicable to OLH7000 type.
Test measurements are performed at 20°C ± 10°C.

See extracts from mails from ISOLINK here after concerning the OLH7000.0010 type:

"*The OLH7000.0010 is different from the standard OLH7000. The standard OLH7000's LED cannot withstand displacement damage*
radiation.
The OLH7000.0010 (570587-1) uses a different LED that is more displacement damage tolerant and this LED had higher light output and thus higher Ip1 and Ip2.
We have been supplying the OLH7000.00XX for several years to many space customers"

"*The marking 570587-1 is for the ITT OLH7000.0010. The '570587-1' is the ITT Drawing# for the SCD. The parts are tested to ensure that they meet the minimum Ip1 of 35uA and Ip2 of 35uA. The typical is around 50uA and it could be higher.*
Regardless of the initial value of K1 (Ip1) and K2 (Ip2), the most important parameter is K3 (Transfer Gain)."

6 TEST HISTORY

PARAMETERS	SYMBOLS	TEST CONDITIONS	APPLICABLE DETAIL SPECIFICATION or DATA-SHEET			
Ta = 25°C, unless otherwise specified						
			Min	Typ. Value	Max	Unit
Servo Current	I_{P1}	I_F = 10 mA, Vdet = -15 V		50		µA
Forward Current	I_{P2}	I_F = 10 mA, Vdet = -15 V		50		µA
Servo Current Gain	K1	I_F = 10 mA, Vdet = -15 V	0.0035	0.005	0.0065	
Forward Current Gain	K2-1	I_F = 10 mA, Vdet = -15 V	0.0035	0.005	0.0065	

Previous table summarizes applicable specification for IP1, IP2, K1 and K2-1 parameters.
The typical value of IP1 and IP2 should be 50 µA.
But during test, as shown in the next figure, IP1 and IP2 current on the un-irradiated device is around 100 µA.

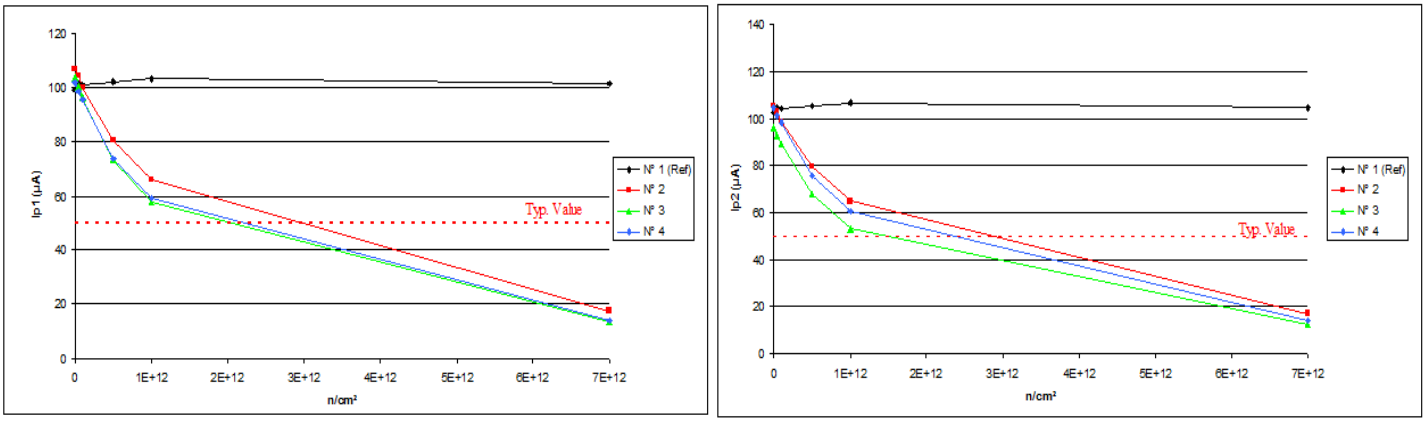


Figure 9: IP1 and IP2 parameters function of neutron fluence

Moreover,

Servo Current Gain: $K1 = \frac{IP1}{IF}$

Forward Current Gain: $K2\_1 = \frac{IP2}{IF}$

With IF=10mA

Then K1 and K2_1 (for the device OLH7000-0010) have a typical value of 0.01 instead of 0.005 as specified in the applicable datasheet [RD1].

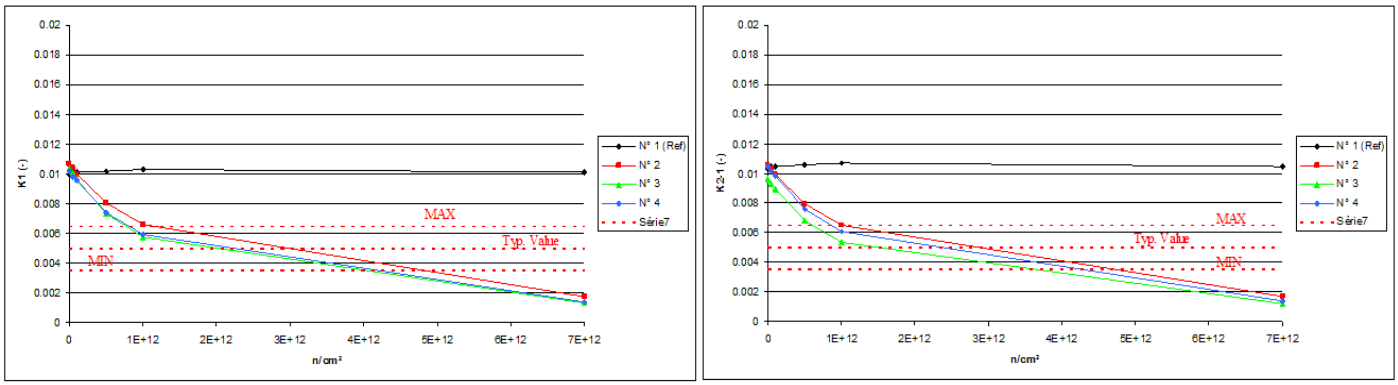


Figure 10: K1 and K2_1 parameters function of neutron fluence

As shown in Figure 8, un-irradiated devices are out of specification due to the difference between IP1 and IP2 requirement and measurement. According to information provided by ISOLINK, this is explained by the difference between OLH7000.0010 that was delivered instead of OLH7000 initially requested by TRAD.
The OLH7000.0010 (570587-1) uses a different LED that is more displacement damage tolerant. This LED had higher light output and thus higher Ip1 and Ip2.
However , no dedicated specification (or datasheet) is available.

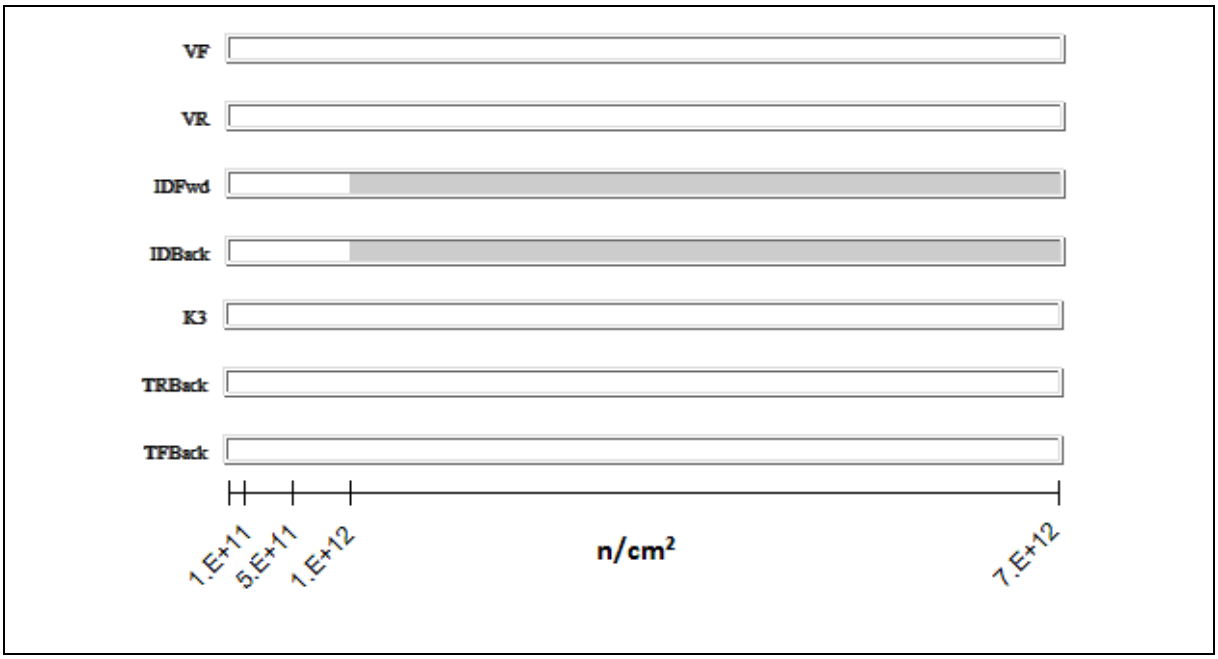
If 100 µA is considered as the typical value for IP1 and IP2, then the typical value for K1 and K2_1 is 0.01.
If the minimum and maximum value for K1 and K2_1 is evaluated as a difference of 0.0015 from the typical value, then specified values are described in the table below:

PARAMETERS	SYMBOLS	TEST CONDITIONS	APPLICABLE DETAIL SPECIFICATION or DATA-SHEET			
Ta = 25°C, unless otherwise specified						
			Min	Typ. Value	Max	Unit
Servo Current	I_{P1}	I_F = 10 mA, Vdet = -15 V		100		µA
Forward Current	I_{P2}	I_F = 10 mA, Vdet = -15 V		100		µA
Servo Current Gain	K1	I_F = 10 mA, Vdet = -15 V	0.0085	0.01	0.0115	
Forward Current Gain	K2-1	I_F = 10 mA, Vdet = -15 V	0.0085	0.01	0.0115	

Results are calculated considering the applicable datasheet [RD1] and the re-evaluated values for the concerned part type.

7 SUMMARY RESULTS

Only parameters with applicable test limits are shown hereunder.



Within specification

Transition

Out of specification or parameter not measurable

- In the worst case, the parameter IDBack is out of specification at 3.18 E12.n/cm² by interpolation.
- In the worst case, the parameter IDFwd is out of specification at 3.22 E12.n/cm² by interpolation.

Due to the important gap between the 1E12n/cm² and the 7E12n/cm² step, interpolations are indicative information.

Next table shows measurement results on the three components tested and which are out of specification at step 7E12n/cm².

	Device N°2	Device N°3	Device N°4	Applicable specification
IDFwd at step 7E12n/cm²	50.71 nA	54.85 nA	56.05 nA	MAX : 25 nA
IDBack at step 7E12n/cm²	50.49 nA	54.87 nA	56.99 nA	MAX : 25 nA

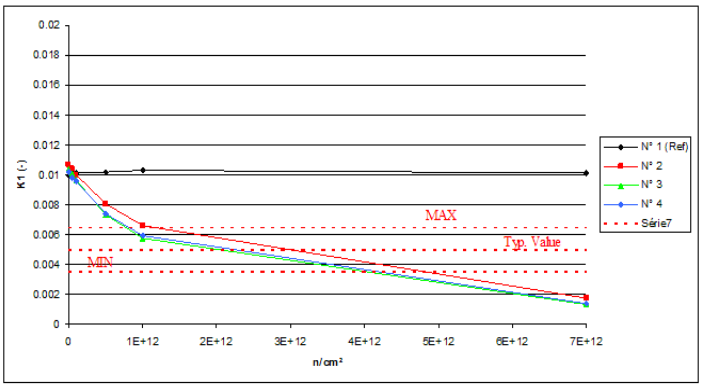
7.1 K1 and K2_1 case

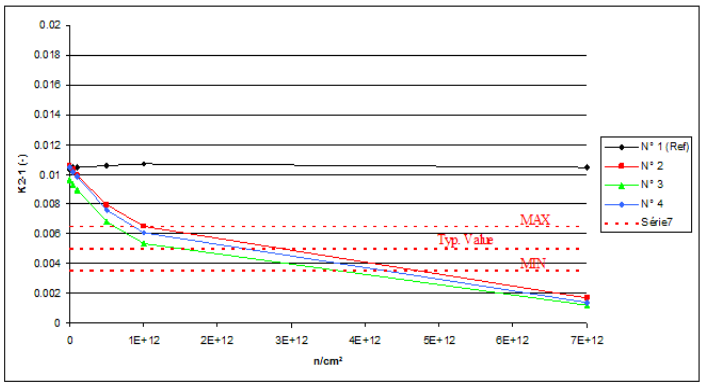
7.1.1 Considering the applicable datasheet

The table below describes the applicable value mentioned the applicable datasheet [RD1]

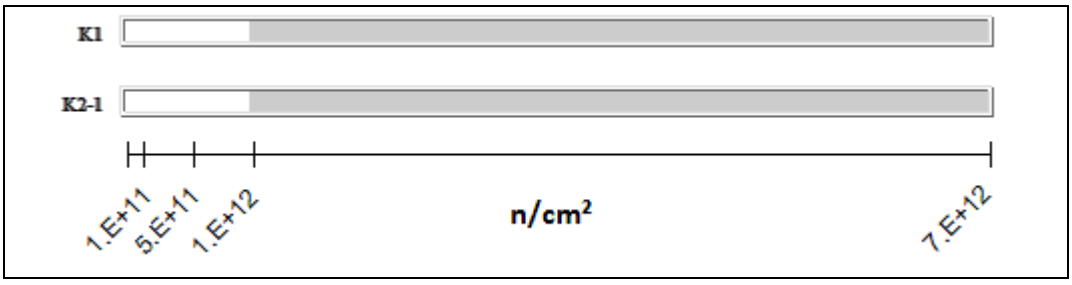
PARAMETERS	SYMBOLS	TEST CONDITIONS	APPLICABLE DETAIL SPECIFICATION or DATA-SHEET			
Ta = 25°C, unless otherwise specified						
			Min	Typ. Value	Max	Unit
Servo Current Gain	K1	I_F = 10 mA, Vdet = -15 V	0.0035	0.005	0.0065	
Forward Current Gain	K2-1	I_F = 10 mA, Vdet = -15 V	0.0035	0.005	0.0065	

Results are illustrates in the following graphs.





With these conditions (MIN : 0.0035), the evolution of K1 and K2_1 parameter versus accumulated total fluence is registered in the following diagram.



Within specification

Transition

Out of specification or parameter not measurable

- In the worst case, the parameter K2-1 is out of specification at 3.69 E12.n/cm² by interpolation.
- In the worst case, the parameter K1 is out of specification at 4.09 E12.n/cm² by interpolation.

Next table show parameters results on the three components tested which are out of specification at step 7E12n/cm².

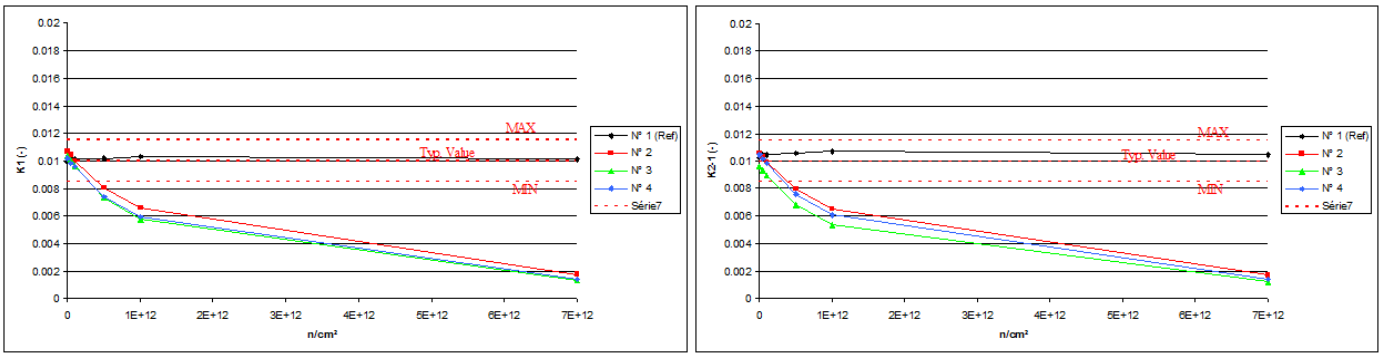
	Device N°2	Device N°3	Device N°4	Applicable specification
K1 at step 7E12n/cm²	0.001757	0.001354	0.001381	MIN : 0.0035
K2-1 at step 7E12n/cm²	0.001731	0.001246	0.001416	MIN : 0.0035

7.1.2 Considering re-evaluated specification

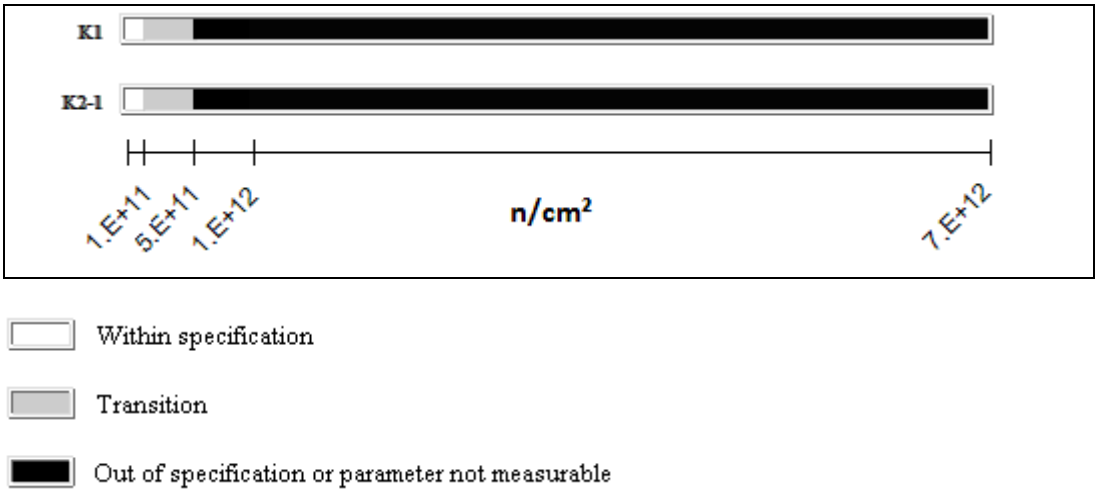
The table below describes the re-evaluated value:

PARAMETERS	SYMBOLS	TEST CONDITIONS	APPLICABLE DETAIL SPECIFICATION or DATA-SHEET			
Ta = 25°C, unless otherwise specified						
			Min	Typ. Value	Max	Unit
Servo Current Gain	K1	I_F = 10 mA, Vdet = -15 V	0.0085	0.01	0.0115	
Forward Current Gain	K2-1	I_F = 10 mA, Vdet = -15 V	0.0085	0.01	0.0115	

Results are illustrated in the following graph:



With these conditions (MIN : 0.0085), the evolution of K1 and K2_1 parameter versus accumulated total fluence are registered in the following diagram.

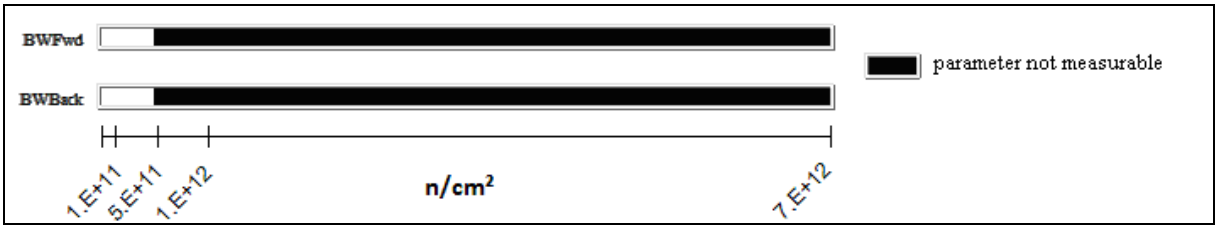


- In the worst case, the parameter K2-1 is out of specification at 1.82E11.n/cm² by interpolation.
- In the worst case, the parameter K1 is out of specification at 2.43E11.n/cm² by interpolation.

Next table show parameters results on the three components tested which are out of specification at step 5E11n/cm².

	Device N°2	Device N°3	Device N°4	Applicable specification
K1 at step 5E11n/cm²	0.008052	0.007342	0.007375	MIN : 0.0085
K2-1 at step 5E11n/cm²	0.007954	0.006789	0.007584	MIN : 0.0085

7.2 BWFwd and BWBack case



- The parameter BWFwd is not measurable at step 1E12.n/cm²
- The parameter BWBack is not measurable at step 1E12.n/cm²

Indeed Frequency Response measured at step 1 E12.n/cm² is higher than 1E3kHz (test equipment limit).

8 CONCLUSION

Total fluence steady-state irradiation test using neutrons has been carried out on three devices from OLH7000.0010 type, a Hermetic Linear Optocoupler from ISOLINK up to 7E12 neutrons/cm² and with an energy of 1 MeV.

Final test results are:

- Considering the applicable datasheet [RD1]:

For the three components tested, IDFwd, IDBack, K1 and K2-1 are out of specification at step 7E12n/cm².

PARAMETERS	SYMBOLS	TEST CONDITIONS	Applicable specification			Worst Measurement at step 7E12 n/cm²
			Min	Max	Unit	
Dark Current Forward	I_{DFwd}	V_R = 15 V, I_F = 0 mA		25	nA	56.05 nA
Dark Current Back	I_{DBack}	V_R = 15 V, I_F = 0 mA		25	nA	56.993 nA
Servo Current Gain	K1	I_F = 10 mA, Vdet = -15 V	0.0035	0.0065		0.001354
Forward Current Gain	K2-1	I_F = 10 mA, Vdet = -15 V	0.0035	0.0065		0.001246

However, all devices are functional up to 1 E+12 neutrons/cm² total fluence level.

- Considering re-evaluated specification (according to information provided by ISOLINK)

For the three components tested, IDFwd, IDBack, are out of specification at step 7E12n/cm² and K1 and K2-1 are out of specification at step 5E11n/cm².

PARAMETERS	SYMBOLS	TEST CONDITIONS	Applicable specification			Worst Measurement
			Min	Max	Unit	
Dark Current Forward	I_{DFwd}	V_R = 15 V, I_F = 0 mA		25	nA	at step 7E12 n/cm² 56.05 nA
Dark Current Back	I_{DBack}	V_R = 15 V, I_F = 0 mA		25	nA	at step 7E12 n/cm² 56.993 nA
Servo Current Gain	K1	I_F = 10 mA, Vdet = -15 V	0.0035	0.0065		at step 5E11 n/cm² 0.007342
Forward Current Gain	K2-1	I_F = 10 mA, Vdet = -15 V	0.0035	0.0065		at step 5E11 n/cm² 0.006789

However, all devices are functional up to 1 E+11 neutrons/cm² total fluence level.

9 DETAILED TESTS RESULTS

The pre and post radiation test results are shown graphically in the following pages (9-2 to 9-22). The data is displayed in the following tables and graphs.

These graphs show parameter's shifts observed during the neutron testing sequence. The Control sample results are shown on each graph (black curve).

When available in the device data-sheet/specification, the maximum/minimum/typical values are also shown (red dotted line).

The tables include drift calculation between each measurement step and the "0" neutrons/cm² step.

For CTR values, the formula used is:

$$\text{Drift} = \frac{1}{\text{measurement } (X \text{ neutrons/cm}^2)} - \frac{1}{\text{measurement } (0 \text{ neutrons/cm}^2)}$$

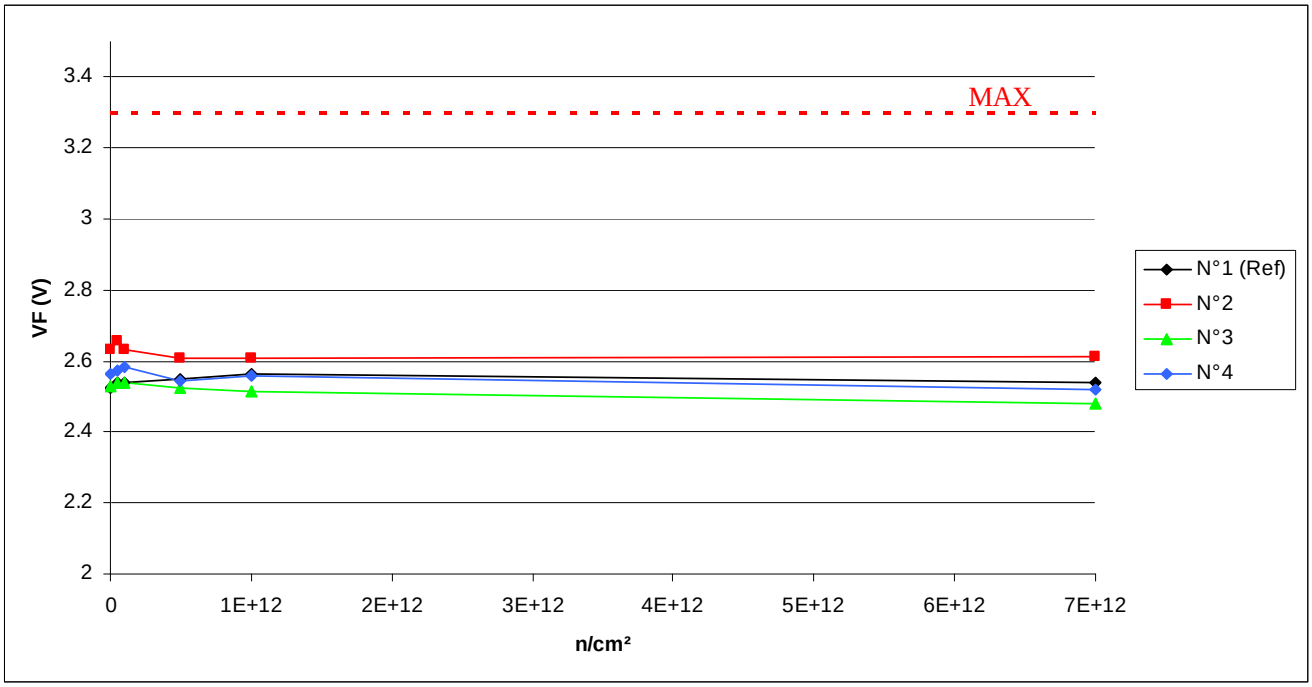
For other parameters, the formula used is:

Drift value= measurement (X neutrons/cm²) - measurement (0 neutrons/cm²)

CONTENTS

1. VF

Ta = 25°C ; IF = 10mA



VF. (V) **Max = 3.3**

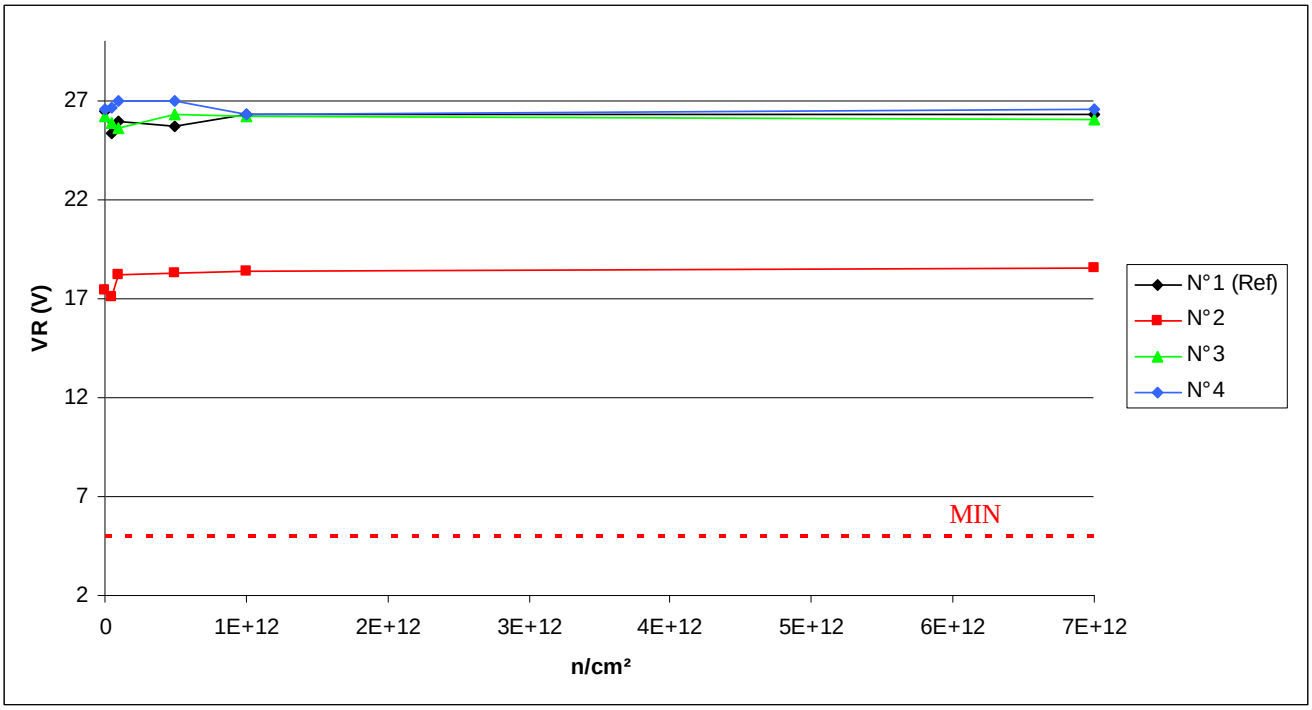
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	2.525	2.540	2.538	2.550	2.562	2.540
N° 2	2.631	2.655	2.634	2.609	2.608	2.615
N° 3	2.528	2.539	2.537	2.524	2.516	2.480
N° 4	2.563	2.573	2.581	2.544	2.560	2.521

Delta [VF]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	1.528E-2	1.344E-2	2.466E-2	3.714E-2	1.466E-2
N° 2	---	2.383E-2	2.189E-3	-2.255E-2	-2.310E-2	-1.691E-2
N° 3	---	1.050E-2	8.430E-3	-4.777E-3	-1.208E-2	-4.814E-2
N° 4	---	9.989E-3	1.847E-2	-1.910E-2	-2.927E-3	-4.162E-2
Average	---	1.477E-2	9.696E-3	-1.548E-2	-1.270E-2	-3.556E-2
σ	---	7.849E-3	8.214E-3	9.424E-3	1.010E-2	1.647E-2
Average+3σ	---	3.832E-2	3.434E-2	1.280E-2	1.760E-2	1.386E-2
Average-3σ	---	-8.771E-3	-1.494E-2	-4.375E-2	-4.301E-2	-8.498E-2

2. VR

Ta = 25°C ; IR = 100µA



VR. (V) **Min = 5.0**

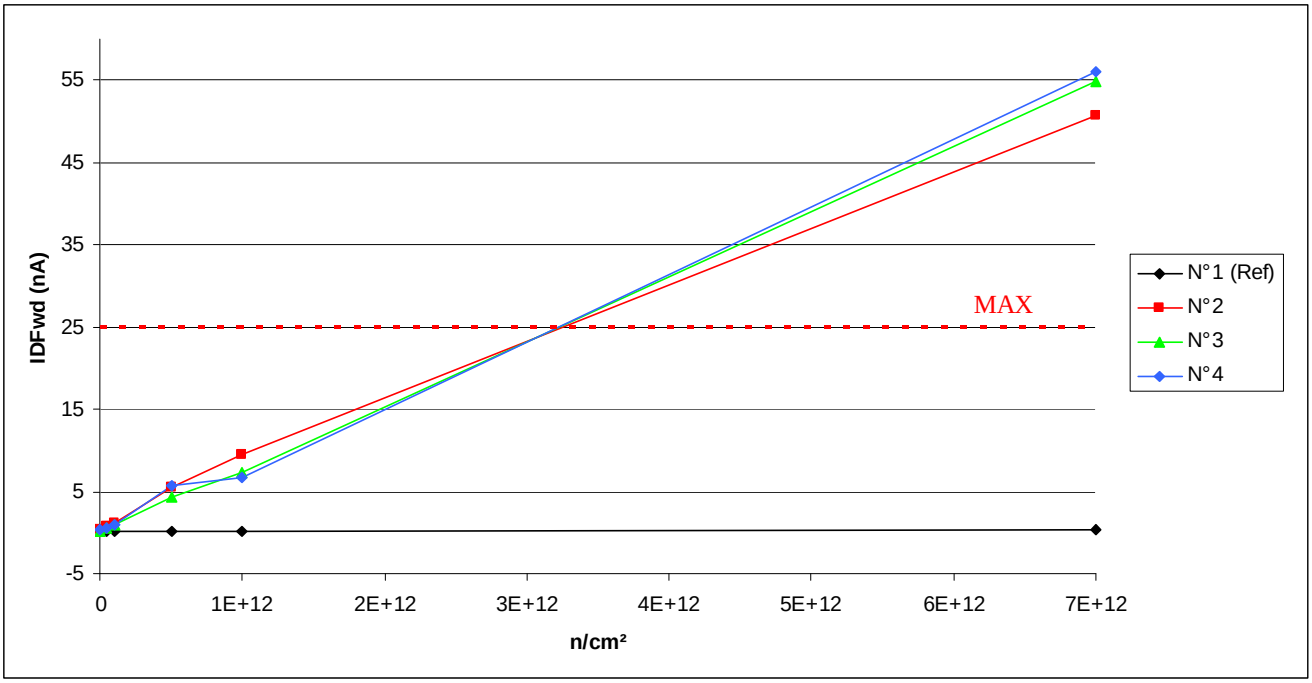
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	26.44	25.38	25.91	25.70	26.29	26.33
N° 2	17.42	17.10	18.23	18.26	18.34	18.54
N° 3	26.22	25.88	25.63	26.31	26.23	26.05
N° 4	26.55	26.64	26.96	26.99	26.26	26.55

Delta [VR]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	-1.055E+0	-5.282E-1	-7.359E-1	-1.503E-1	-1.050E-1
N° 2	---	-3.243E-1	8.120E-1	8.379E-1	9.129E-1	1.122E+0
N° 3	---	-3.334E-1	-5.860E-1	9.262E-2	1.681E-2	-1.666E-1
N° 4	---	8.909E-2	4.152E-1	4.411E-1	-2.899E-1	-1.180E-3
Average	---	-1.896E-1	2.137E-1	4.572E-1	2.133E-1	3.179E-1
σ	---	2.414E-1	7.204E-1	3.729E-1	6.250E-1	7.009E-1
Average+3σ	---	5.345E-1	2.375E+0	1.576E+0	2.088E+0	2.421E+0
Average-3σ	---	-9.136E-1	-1.948E+0	-6.615E-1	-1.662E+0	-1.785E+0

3. IDFwd

Ta = 25°C ; VR = 15V ; IF = 0mA



IDFwd . (nA) **Max = 25.0**

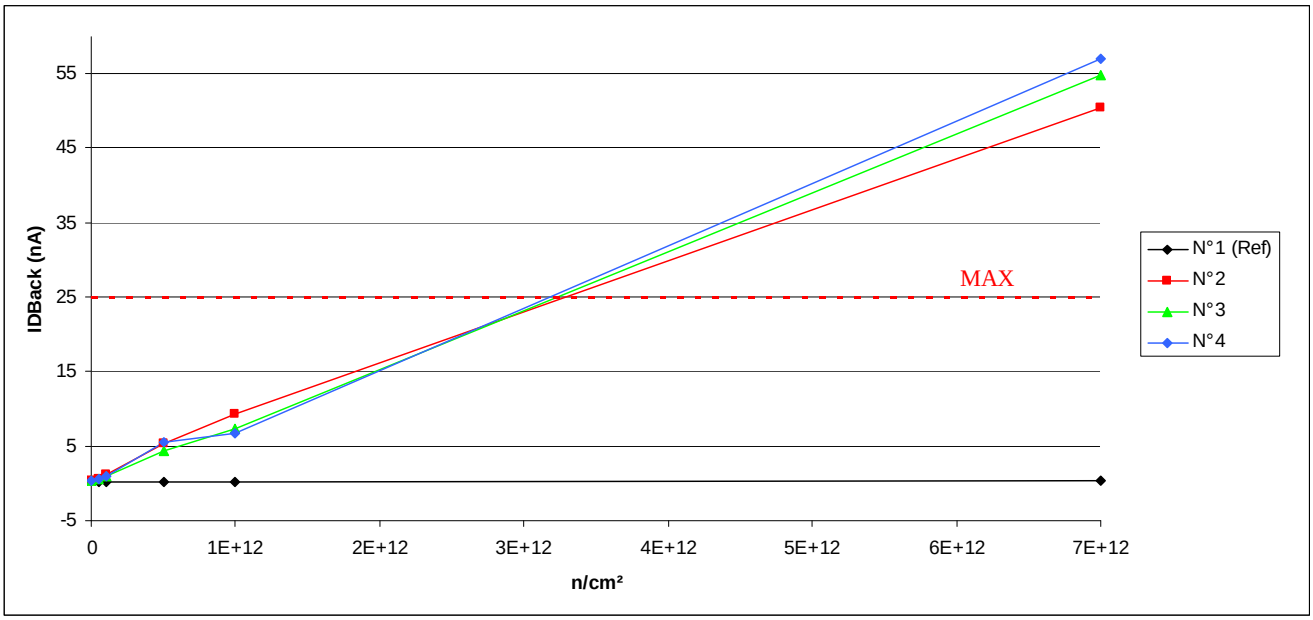
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	0.285	0.202	0.143	0.148	0.123	0.363
N° 2	0.387	0.721	1.212	5.524	9.527	50.712
N° 3	0.232	0.490	0.940	4.229	7.363	54.804
N° 4	0.270	0.508	0.861	5.704	6.711	56.054

Delta [IDFwd]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	-8.314E-2	-1.419E-1	-1.373E-1	-1.616E-1	7.850E-2
N° 2	---	3.345E-1	8.256E-1	5.137E+0	9.141E+0	5.033E+1
N° 3	---	2.579E-1	7.086E-1	3.997E+0	7.131E+0	5.457E+1
N° 4	---	2.386E-1	5.911E-1	5.435E+0	6.441E+0	5.578E+1
Average	---	2.770E-1	7.084E-1	4.856E+0	7.571E+0	5.356E+1
σ	---	5.073E-2	1.172E-1	7.589E-1	1.402E+0	2.867E+0
Average+3σ	---	4.292E-1	1.060E+0	7.133E+0	1.178E+1	6.216E+1
Average-3σ	---	1.248E-1	3.568E-1	2.580E+0	3.364E+0	4.496E+1

4. IDBack

Ta = 25°C ; VR = 15V ; IF = 0mA



IDBack . (nA) **Max = 25.0**

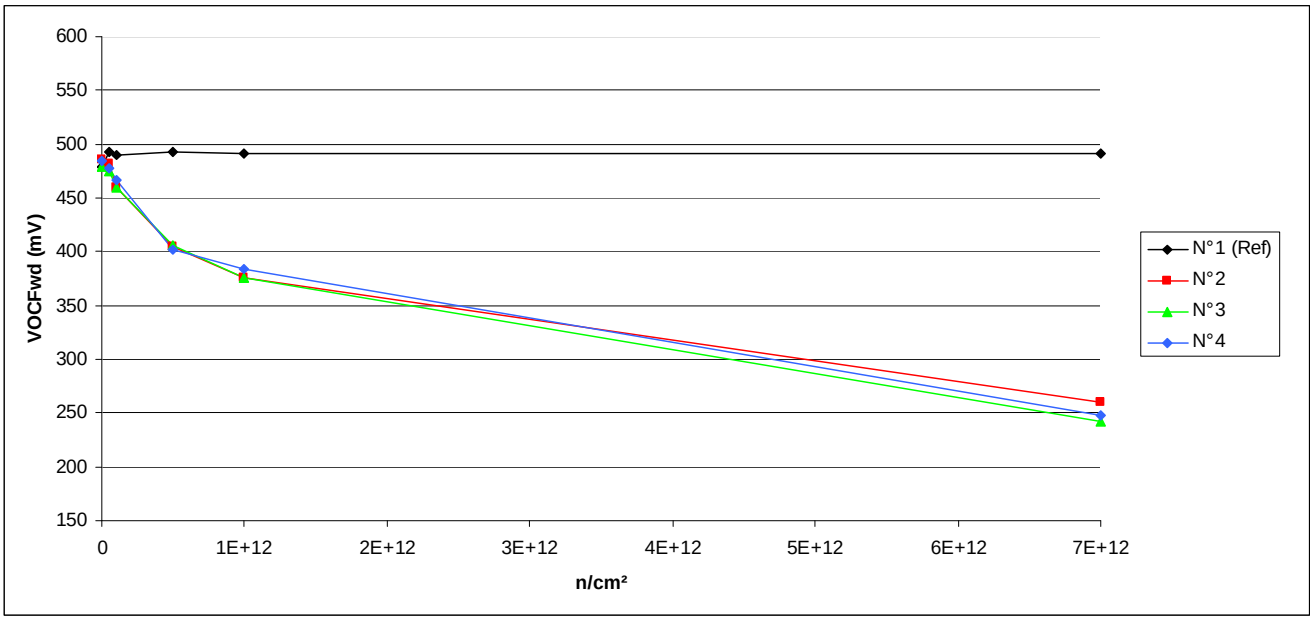
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	0.302	0.230	0.190	0.198	0.180	0.280
N° 2	0.346	0.637	1.185	5.282	9.313	50.498
N° 3	0.335	0.538	0.987	4.290	7.411	54.869
N° 4	0.298	0.556	0.912	5.513	6.802	56.993

Delta [IDBack]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	-7.111E-2	-1.118E-1	-1.038E-1	-1.220E-1	-2.206E-2
N° 2	---	2.916E-1	8.390E-1	4.936E+0	8.967E+0	5.015E+1
N° 3	---	2.034E-1	6.520E-1	3.955E+0	7.076E+0	5.453E+1
N° 4	---	2.580E-1	6.137E-1	5.215E+0	6.504E+0	5.670E+1
Average	---	2.510E-1	7.016E-1	4.702E+0	7.516E+0	5.379E+1
σ	---	4.451E-2	1.206E-1	6.614E-1	1.289E+0	3.334E+0
Average+3σ	---	3.845E-1	1.063E+0	6.686E+0	1.138E+1	6.380E+1
Average-3σ	---	1.175E-1	3.398E-1	2.718E+0	3.648E+0	4.379E+1

5. VOCFwd

Ta = 25°C ; IF = 10mA



VOCFwd . (mV)

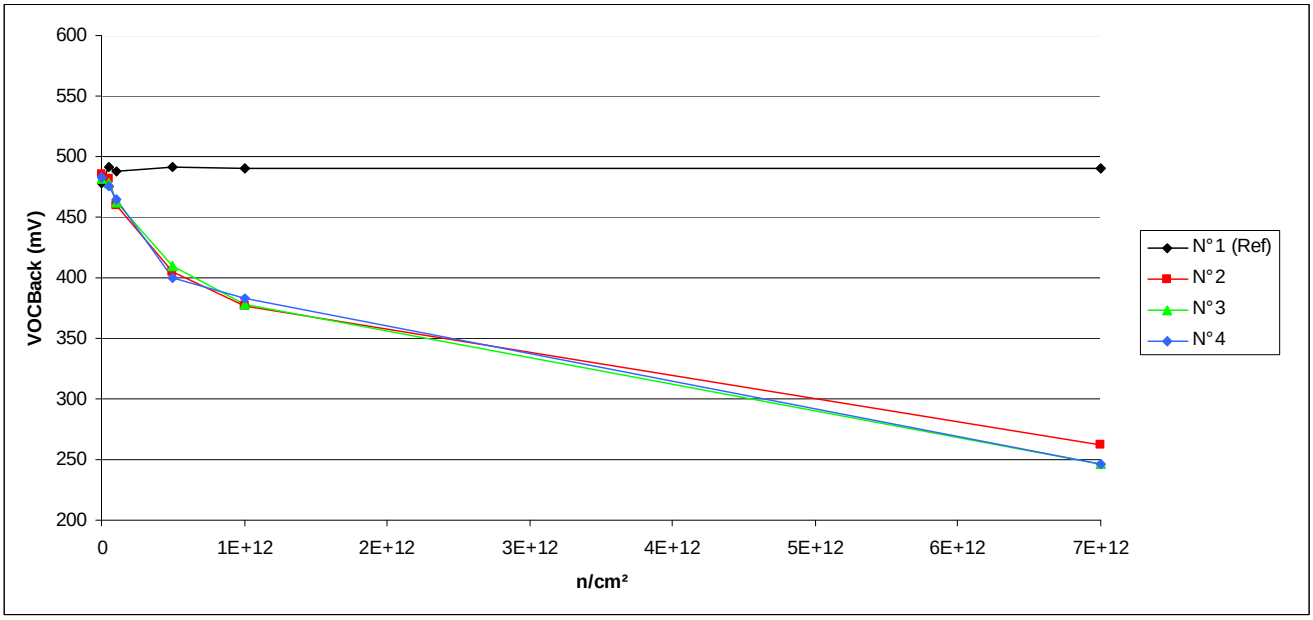
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	478.80	492.41	489.33	492.51	490.98	490.92
N° 2	485.41	481.28	459.87	404.46	376.26	260.68
N° 3	478.44	474.43	459.24	406.30	375.31	242.71
N° 4	483.74	477.15	466.05	401.49	383.95	247.71

Delta [VOCFwd]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	1.360E+1	1.052E+1	1.370E+1	1.217E+1	1.212E+1
N° 2	---	-4.132E+0	-2.554E+1	-8.094E+1	-1.091E+2	-2.247E+2
N° 3	---	-4.011E+0	-1.921E+1	-7.214E+1	-1.031E+2	-2.357E+2
N° 4	---	-6.595E+0	-1.769E+1	-8.225E+1	-9.979E+1	-2.360E+2
Average	---	-4.913E+0	-2.081E+1	-7.844E+1	-1.040E+2	-2.322E+2
σ	---	1.458E+0	4.163E+0	5.498E+0	4.740E+0	6.442E+0
Average+3σ	---	-5.385E-1	-8.322E+0	-6.195E+1	-8.981E+1	-2.128E+2
Average-3σ	---	-9.286E+0	-3.330E+1	-9.494E+1	-1.182E+2	-2.515E+2

6. VOCBack

Ta = 25°C ; IF = 10mA



VOCBack . (mV)

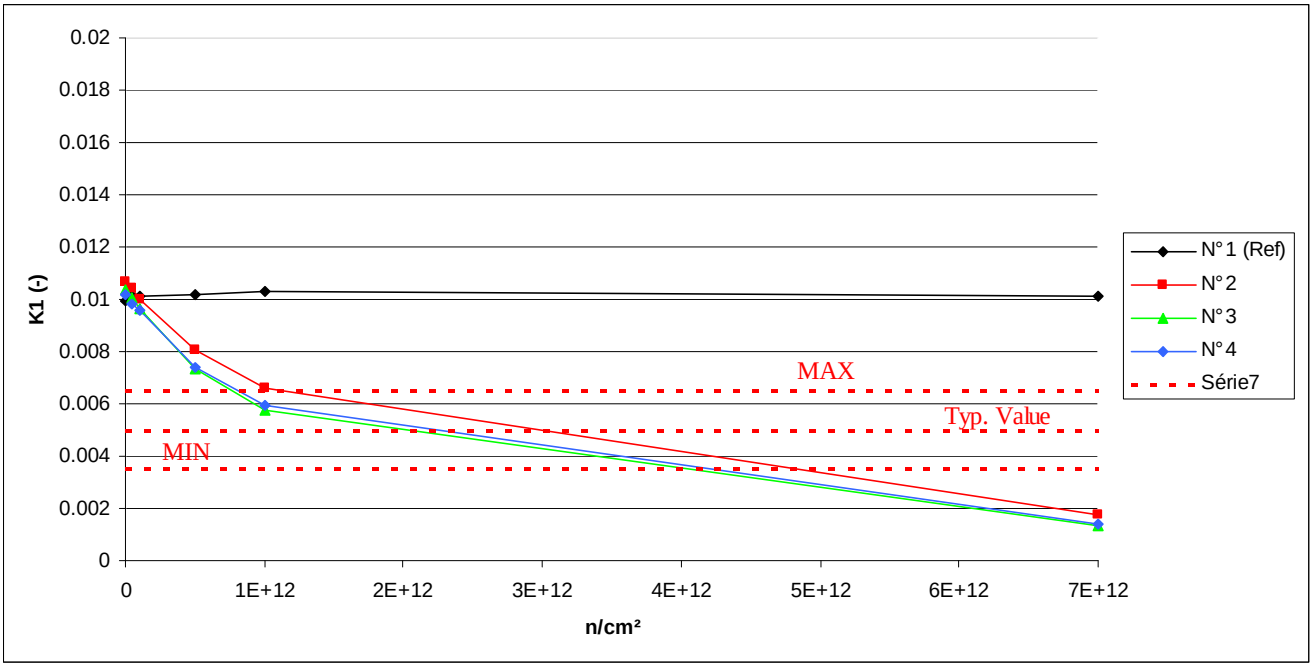
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	477.91	491.63	488.40	491.70	490.16	490.04
N° 2	485.25	481.35	460.15	405.31	377.01	261.58
N° 3	481.36	477.44	462.31	409.53	378.58	246.24
N° 4	482.40	475.84	464.66	400.49	382.52	246.01

Delta [VOCBack]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	1.372E+1	1.049E+1	1.379E+1	1.225E+1	1.214E+1
N° 2	---	-3.898E+0	-2.510E+1	-7.994E+1	-1.082E+2	-2.237E+2
N° 3	---	-3.925E+0	-1.905E+1	-7.183E+1	-1.028E+2	-2.351E+2
N° 4	---	-6.555E+0	-1.773E+1	-8.191E+1	-9.988E+1	-2.364E+2
Average	---	-4.793E+0	-2.063E+1	-7.789E+1	-1.036E+2	-2.317E+2
σ	---	1.526E+0	3.928E+0	5.339E+0	4.244E+0	7.014E+0
Average+3σ	---	-2.148E-1	-8.845E+0	-6.188E+1	-9.090E+1	-2.107E+2
Average-3σ	---	-9.371E+0	-3.241E+1	-9.391E+1	-1.164E+2	-2.528E+2

7. K1

Ta = 25°C ; IF = 10mA ; Vdet = -15V



K1 . (-) **Min = 0.0065**

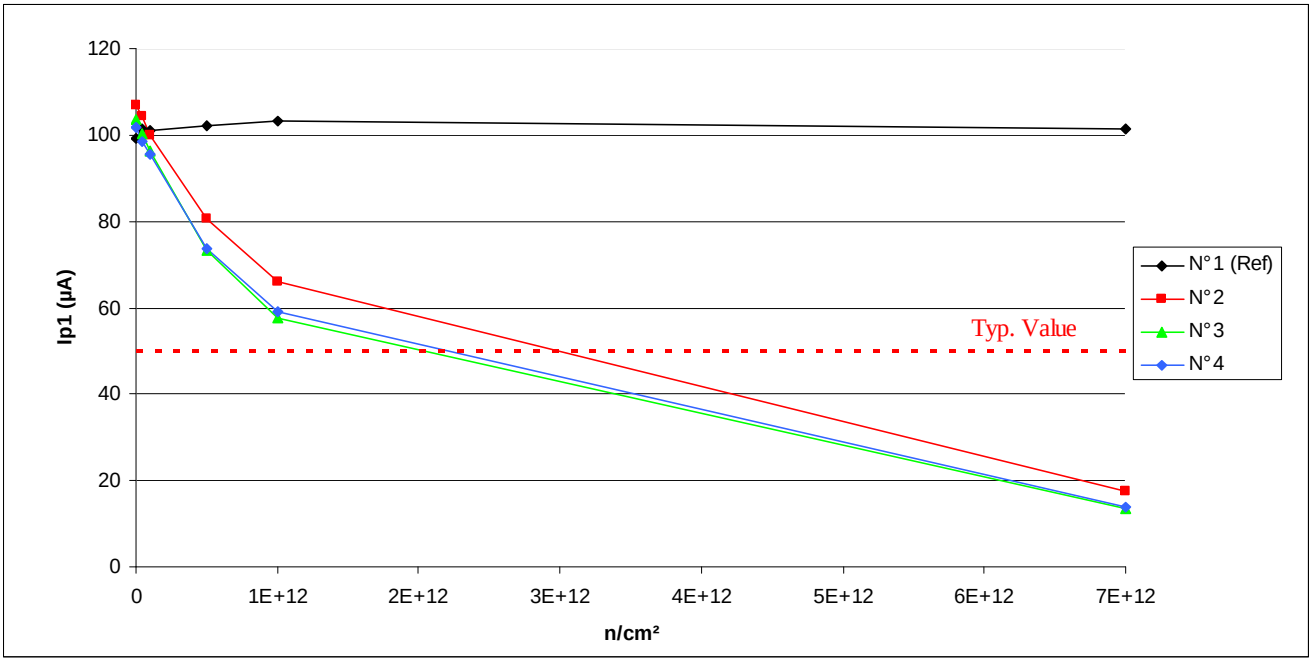
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	9.920E-3	1.015E-2	1.010E-2	1.021E-2	1.033E-2	1.014E-2
N° 2	1.068E-2	1.044E-2	9.998E-3	8.052E-3	6.593E-3	1.757E-3
N° 3	1.034E-2	1.003E-2	9.638E-3	7.342E-3	5.774E-3	1.354E-3
N° 4	1.017E-2	9.842E-3	9.564E-3	7.375E-3	5.926E-3	1.381E-3

Delta [K1]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	2.251E-4	1.821E-4	2.908E-4	4.089E-4	2.204E-4
N° 2	---	-2.395E-4	-6.839E-4	-2.630E-3	-4.089E-3	-8.926E-3
N° 3	---	-3.105E-4	-7.071E-4	-3.003E-3	-4.571E-3	-8.991E-3
N° 4	---	-3.290E-4	-6.077E-4	-2.797E-3	-4.245E-3	-8.791E-3
Average	---	-2.930E-4	-6.662E-4	-2.810E-3	-4.302E-3	-8.902E-3
σ	---	4.726E-5	5.202E-5	1.869E-4	2.457E-4	1.020E-4
Average+3σ	---	-1.512E-4	-5.102E-4	-2.249E-3	-3.564E-3	-8.596E-3
Average-3σ	---	-4.348E-4	-8.223E-4	-3.371E-3	-5.039E-3	-9.208E-3

8. Ip1

Ta = 25°C ; IF = 10mA ; Vdet = -15V



Ip1 . (uA)

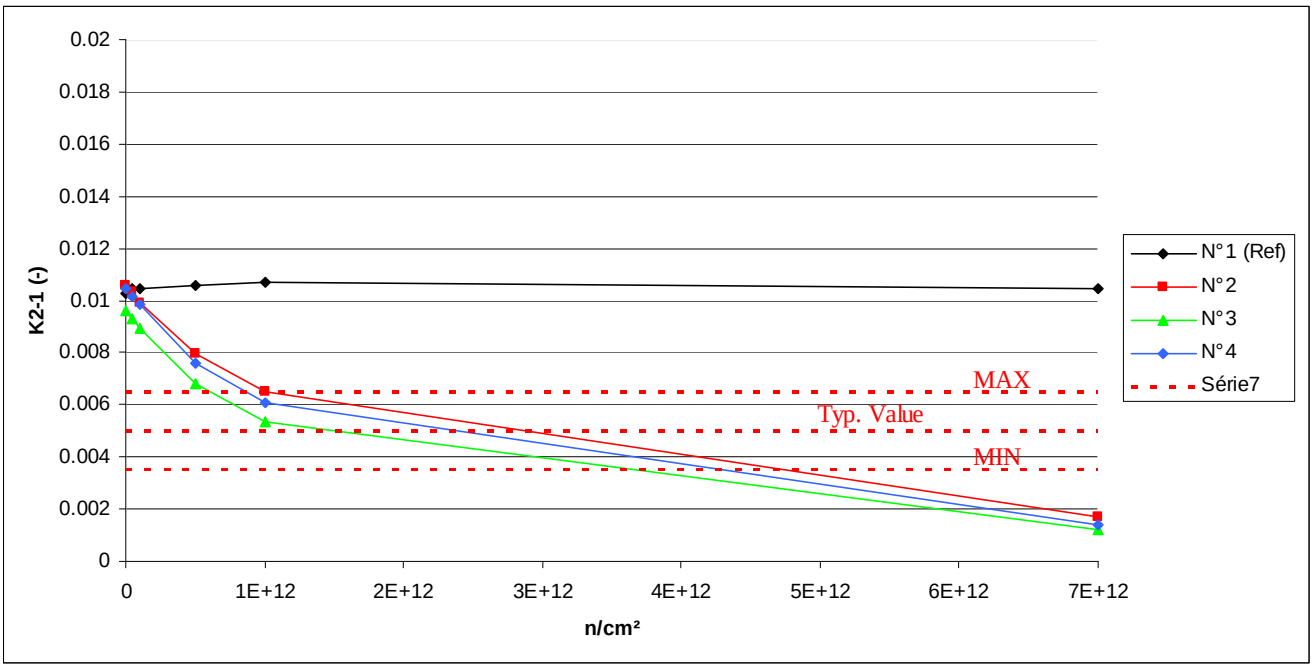
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	99.204	101.455	101.025	102.112	103.292	101.407
N° 2	106.823	104.428	99.984	80.523	65.932	17.565
N° 3	103.446	100.341	96.376	73.416	57.739	13.540
N° 4	101.713	98.423	95.636	73.745	59.260	13.806

Delta [Ip1]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	2.251E+0	1.821E+0	2.908E+0	4.089E+0	2.204E+0
N° 2	---	-2.395E+0	-6.839E+0	-2.630E+1	-4.089E+1	-8.926E+1
N° 3	---	-3.105E+0	-7.071E+0	-3.003E+1	-4.571E+1	-8.991E+1
N° 4	---	-3.290E+0	-6.077E+0	-2.797E+1	-4.245E+1	-8.791E+1
Average	---	-2.930E+0	-6.662E+0	-2.810E+1	-4.302E+1	-8.902E+1
σ	---	4.726E-1	5.202E-1	1.869E+0	2.457E+0	1.020E+0
Average+3σ	---	-1.512E+0	-5.102E+0	-2.249E+1	-3.564E+1	-8.596E+1
Average-3σ	---	-4.348E+0	-8.223E+0	-3.371E+1	-5.039E+1	-9.208E+1

9. K2-1

Ta = 25°C ; IF = 10mA ; Vdet = -15V



K2-1 . (-) **Min = 0.0065**

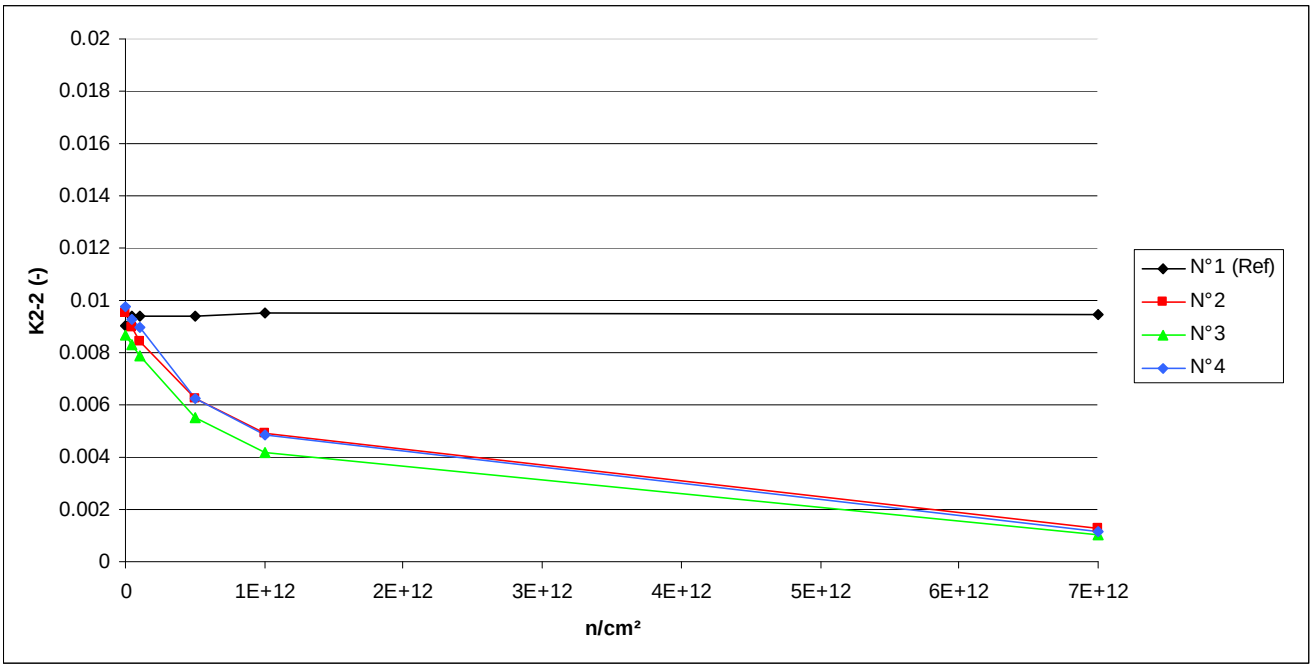
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.025E-2	1.048E-2	1.044E-2	1.055E-2	1.067E-2	1.048E-2
N° 2	1.057E-2	1.033E-2	9.886E-3	7.954E-3	6.513E-3	1.731E-3
N° 3	9.621E-3	9.321E-3	8.944E-3	6.789E-3	5.328E-3	1.246E-3
N° 4	1.047E-2	1.013E-2	9.846E-3	7.584E-3	6.093E-3	1.416E-3

Delta [K2-1]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	2.316E-4	1.867E-4	2.978E-4	4.201E-4	2.262E-4
N° 2	---	-2.417E-4	-6.840E-4	-2.617E-3	-4.058E-3	-8.840E-3
N° 3	---	-3.005E-4	-6.770E-4	-2.832E-3	-4.294E-3	-8.375E-3
N° 4	---	-3.375E-4	-6.245E-4	-2.886E-3	-4.378E-3	-9.054E-3
Average	---	-2.932E-4	-6.618E-4	-2.779E-3	-4.243E-3	-8.756E-3
σ	---	4.831E-5	3.251E-5	1.425E-4	1.659E-4	3.472E-4
Average+3σ	---	-1.483E-4	-5.643E-4	-2.351E-3	-3.745E-3	-7.715E-3
Average-3σ	---	-4.381E-4	-7.594E-4	-3.206E-3	-4.741E-3	-9.798E-3

10.K2-2

Ta = 25°C ; IF = 1mA ; Vdet = -15V



K2-2 . (-)

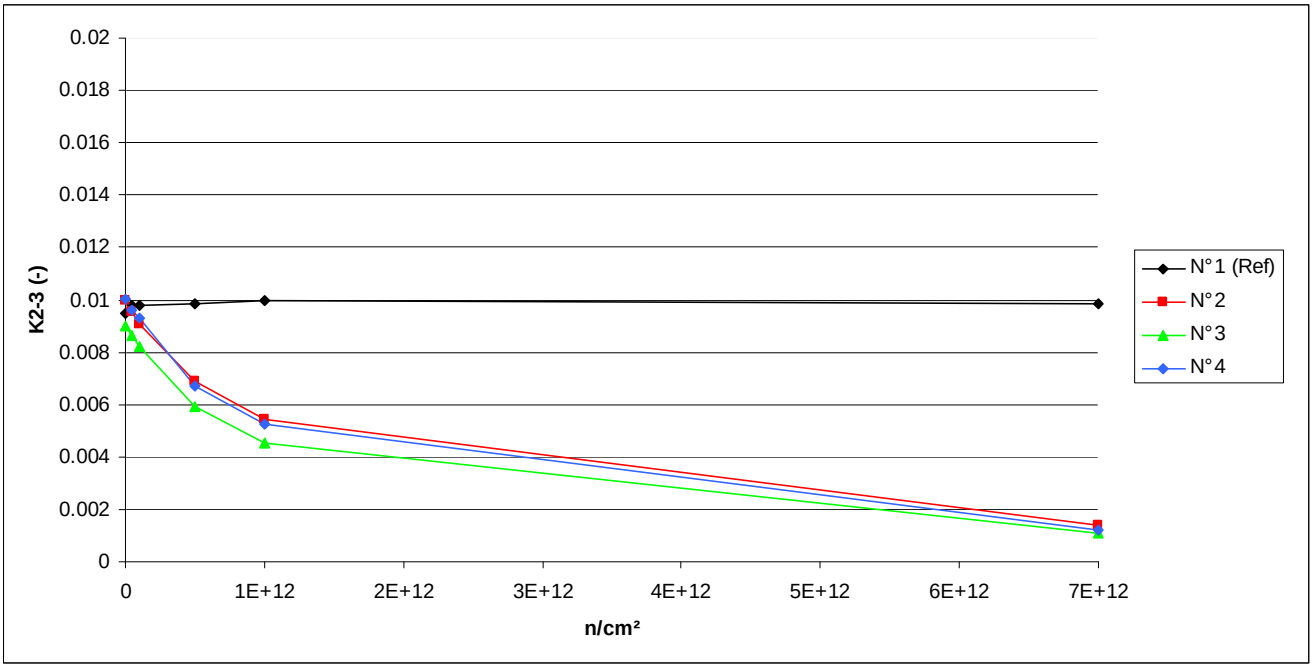
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	9.010E-3	9.416E-3	9.367E-3	9.397E-3	9.508E-3	9.460E-3
N° 2	9.506E-3	8.982E-3	8.415E-3	6.243E-3	4.885E-3	1.279E-3
N° 3	8.672E-3	8.291E-3	7.867E-3	5.519E-3	4.197E-3	1.036E-3
N° 4	9.729E-3	9.293E-3	8.951E-3	6.262E-3	4.875E-3	1.155E-3

Delta [K2-2]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	4.057E-4	3.574E-4	3.866E-4	4.981E-4	4.496E-4
N° 2	---	-5.241E-4	-1.091E-3	-3.263E-3	-4.622E-3	-8.227E-3
N° 3	---	-3.814E-4	-8.055E-4	-3.154E-3	-4.476E-3	-7.637E-3
N° 4	---	-4.362E-4	-7.777E-4	-3.467E-3	-4.854E-3	-8.574E-3
Average	---	-4.472E-4	-8.915E-4	-3.295E-3	-4.651E-3	-8.146E-3
σ	---	7.198E-5	1.736E-4	1.591E-4	1.910E-4	4.738E-4
Average+3σ	---	-2.313E-4	-3.706E-4	-2.818E-3	-4.077E-3	-6.725E-3
Average-3σ	---	-6.631E-4	-1.412E-3	-3.772E-3	-5.224E-3	-9.568E-3

11.K2-3

Ta = 25°C ; IF = 2mA ; Vdet = -15V



K2-3 . (-)

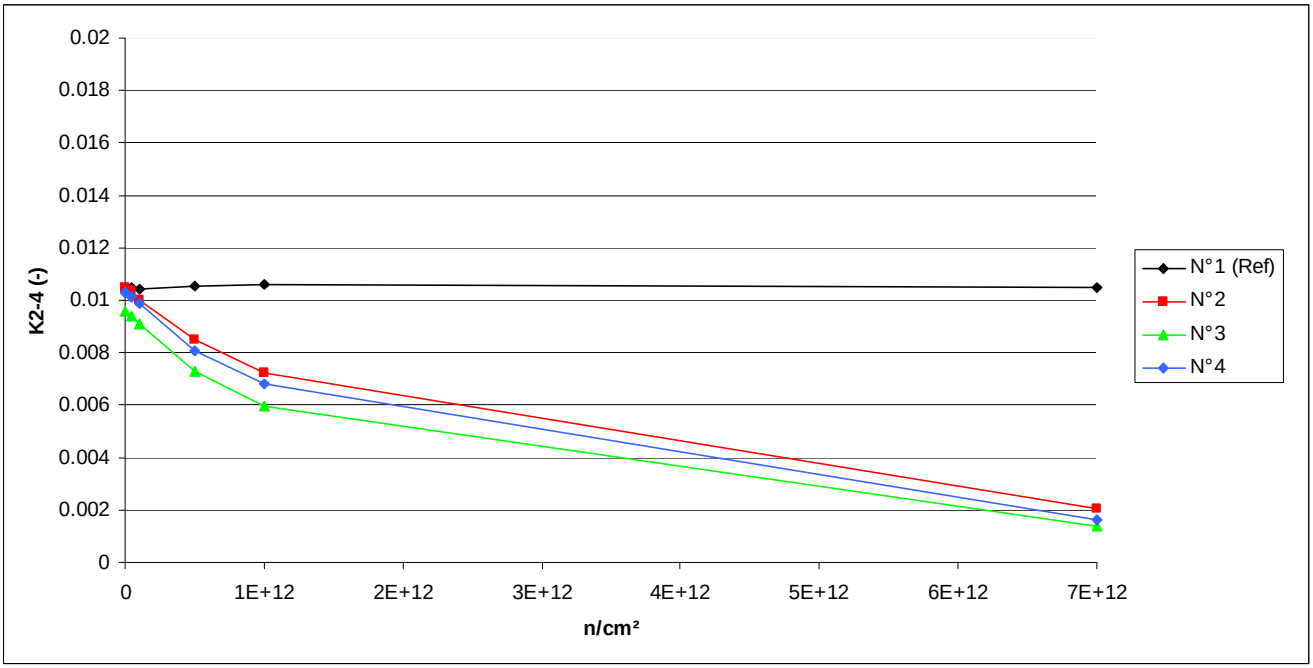
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	0.009	0.010	0.010	0.010	0.010	0.010
N° 2	0.010	0.010	0.009	0.007	0.005	0.001
N° 3	0.009	0.009	0.008	0.006	0.005	0.001
N° 4	0.010	0.010	0.009	0.007	0.005	0.001

Delta [K2-3]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	3.396E-4	2.900E-4	3.578E-4	4.678E-4	3.641E-4
N° 2	---	-3.844E-4	-9.251E-4	-3.084E-3	-4.526E-3	-8.559E-3
N° 3	---	-3.589E-4	-7.836E-4	-3.106E-3	-4.499E-3	-7.950E-3
N° 4	---	-4.102E-4	-7.547E-4	-3.335E-3	-4.802E-3	-8.825E-3
Average	---	-3.845E-4	-8.211E-4	-3.175E-3	-4.609E-3	-8.444E-3
σ	---	2.568E-5	9.120E-5	1.390E-4	1.675E-4	4.486E-4
Average+3σ	---	-3.075E-4	-5.475E-4	-2.758E-3	-4.106E-3	-7.099E-3
Average-3σ	---	-4.615E-4	-1.095E-3	-3.592E-3	-5.111E-3	-9.790E-3

12.K2-4

Ta = 25°C ; IF = 60mA ; Vdet = -15V



K2-4 . (-)

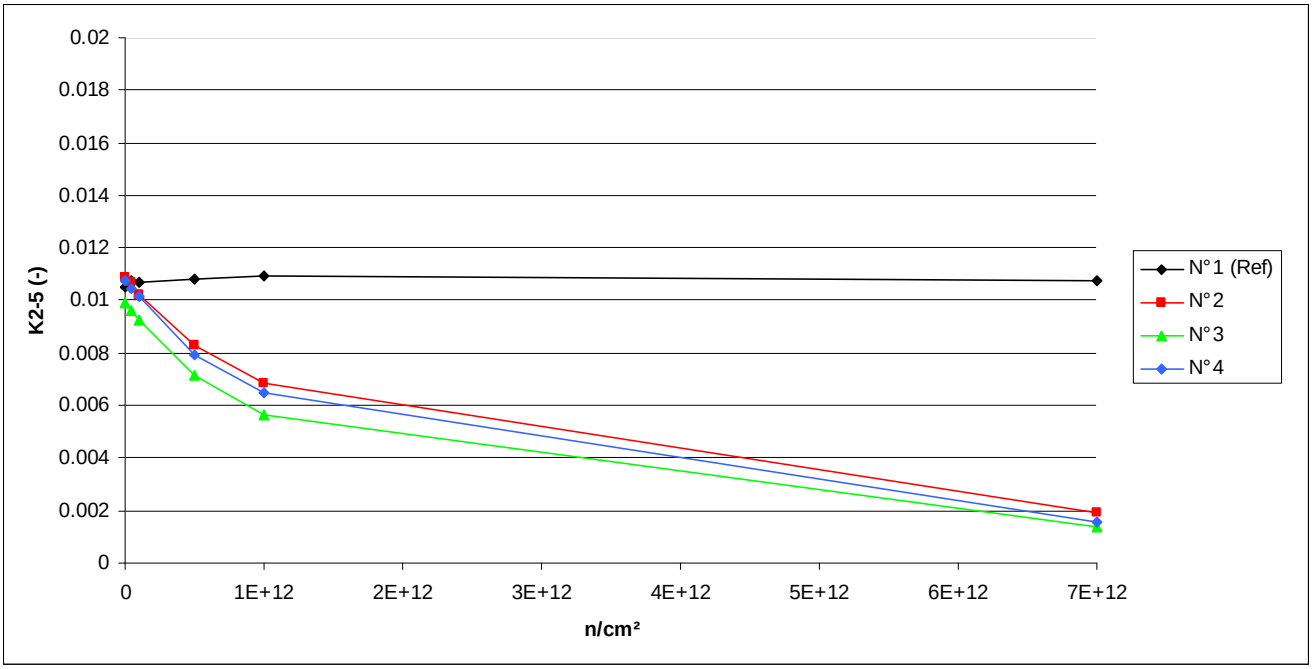
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.027E-2	1.047E-2	1.042E-2	1.054E-2	1.061E-2	1.045E-2
N° 2	1.047E-2	1.036E-2	1.001E-2	8.477E-3	7.244E-3	2.070E-3
N° 3	9.575E-3	9.374E-3	9.074E-3	7.303E-3	5.937E-3	1.403E-3
N° 4	1.032E-2	1.010E-2	9.894E-3	8.079E-3	6.792E-3	1.643E-3

Delta [K2-4]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	1.934E-4	1.454E-4	2.629E-4	3.408E-4	1.790E-4
N° 2	---	-1.115E-4	-4.688E-4	-1.998E-3	-3.231E-3	-8.405E-3
N° 3	---	-2.008E-4	-5.008E-4	-2.272E-3	-3.638E-3	-8.172E-3
N° 4	---	-2.192E-4	-4.246E-4	-2.240E-3	-3.527E-3	-8.675E-3
Average	---	-1.771E-4	-4.647E-4	-2.170E-3	-3.465E-3	-8.417E-3
σ	---	5.759E-5	3.831E-5	1.500E-4	2.100E-4	2.517E-4
Average+3σ	---	-4.373E-6	-3.498E-4	-1.720E-3	-2.835E-3	-7.662E-3
Average-3σ	---	-3.499E-4	-5.796E-4	-2.620E-3	-4.095E-3	-9.172E-3

13.K2-5

Ta = 25°C ; IF = 10mA ; Vdet = -30V



K2-5 . (-)

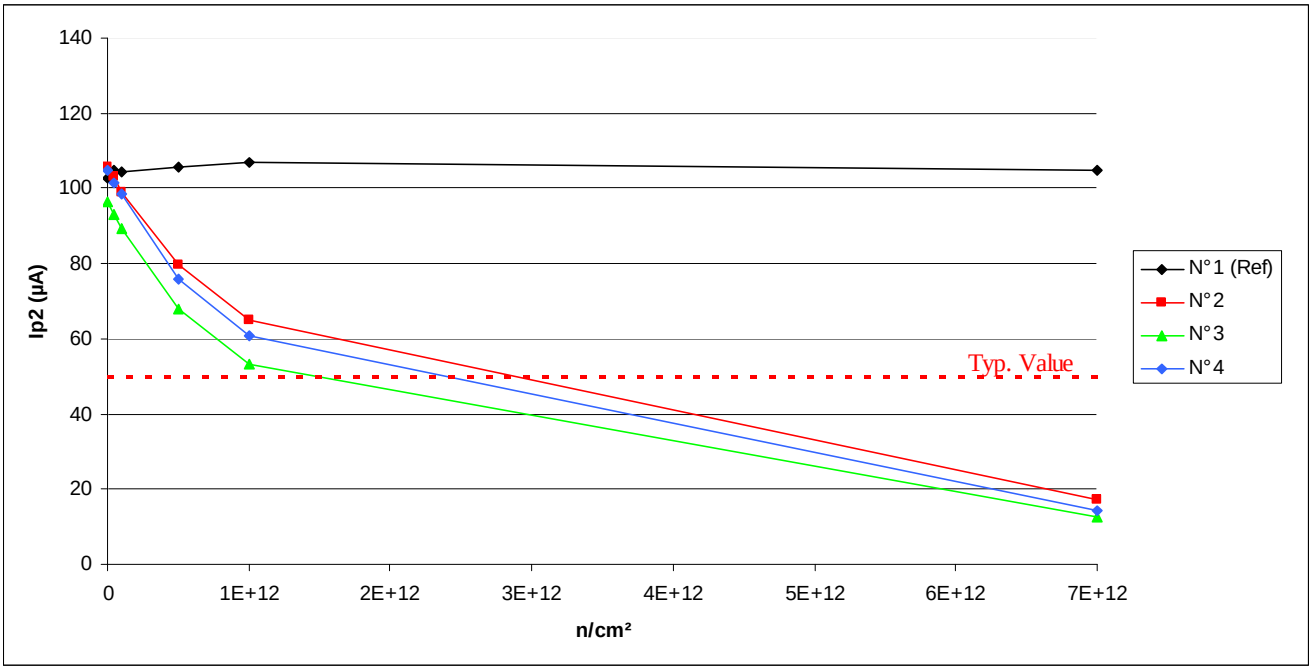
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.053E-2	1.077E-2	1.072E-2	1.084E-2	1.096E-2	1.076E-2
N° 2	1.088E-2	1.066E-2	1.022E-2	8.308E-3	6.868E-3	1.899E-3
N° 3	9.886E-3	9.607E-3	9.233E-3	7.131E-3	5.655E-3	1.366E-3
N° 4	1.075E-2	1.044E-2	1.016E-2	7.915E-3	6.462E-3	1.554E-3

Delta [K2-5]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	2.407E-4	1.917E-4	3.098E-4	4.336E-4	2.346E-4
N° 2	---	-2.199E-4	-6.605E-4	-2.575E-3	-4.014E-3	-8.984E-3
N° 3	---	-2.790E-4	-6.525E-4	-2.755E-3	-4.231E-3	-8.520E-3
N° 4	---	-3.156E-4	-5.929E-4	-2.838E-3	-4.291E-3	-9.199E-3
Average	---	-2.715E-4	-6.353E-4	-2.722E-3	-4.179E-3	-8.901E-3
σ	---	4.828E-5	3.697E-5	1.348E-4	1.457E-4	3.471E-4
Average+3σ	---	-1.266E-4	-5.244E-4	-2.318E-3	-3.742E-3	-7.860E-3
Average-3σ	---	-4.163E-4	-7.462E-4	-3.127E-3	-4.616E-3	-9.942E-3

14.Ip2

Ta = 25°C ; IF = 10mA ; Vdet = -15V



Ip2. (uA)

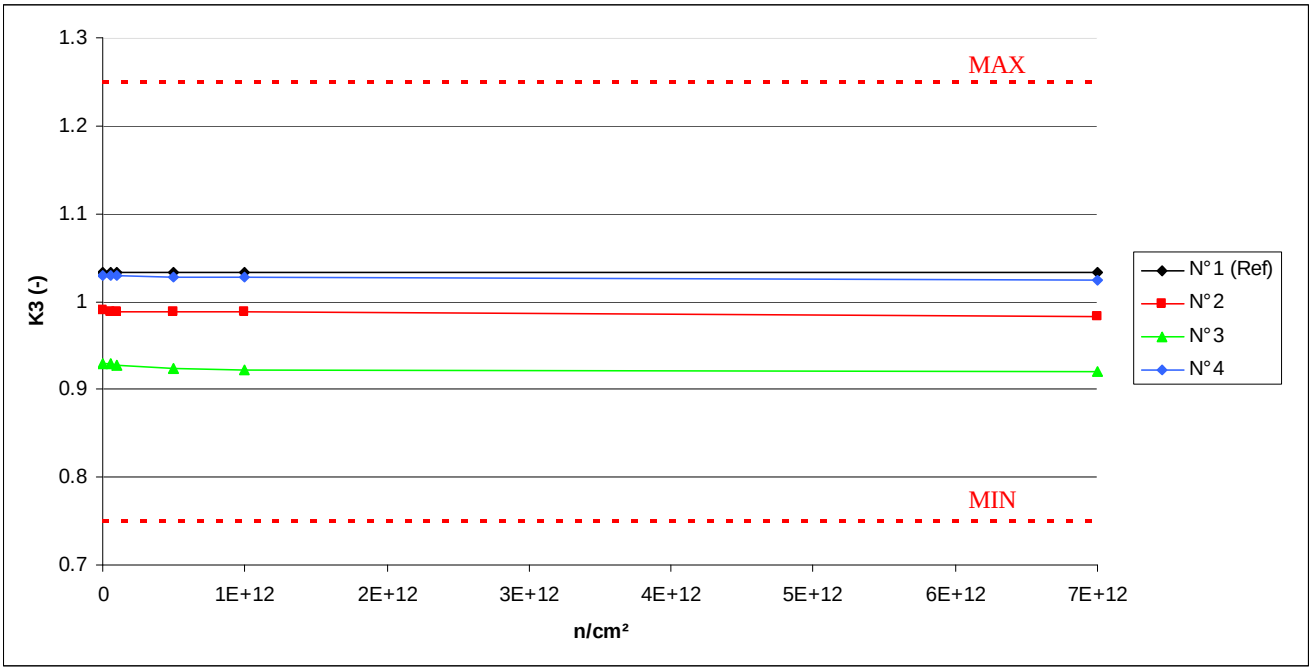
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	102.500	104.816	104.367	105.478	106.701	104.762
N° 2	105.705	103.288	98.865	79.536	65.126	17.307
N° 3	96.212	93.207	89.442	67.888	53.277	12.463
N° 4	104.705	101.331	98.460	75.843	60.925	14.164

Delta [Ip2]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	2.316E+0	1.867E+0	2.978E+0	4.201E+0	2.262E+0
N° 2	---	-2.417E+0	-6.840E+0	-2.617E+1	-4.058E+1	-8.840E+1
N° 3	---	-3.005E+0	-6.770E+0	-2.832E+1	-4.294E+1	-8.375E+1
N° 4	---	-3.375E+0	-6.245E+0	-2.886E+1	-4.378E+1	-9.054E+1
Average	---	-2.932E+0	-6.618E+0	-2.779E+1	-4.243E+1	-8.756E+1
σ	---	4.831E-1	3.251E-1	1.425E+0	1.659E+0	3.472E+0
Average+3σ	---	-1.483E+0	-5.643E+0	-2.351E+1	-3.745E+1	-7.715E+1
Average-3σ	---	-4.381E+0	-7.594E+0	-3.206E+1	-4.741E+1	-9.798E+1

15.K3

Ta = 25°C ; IF = 10mA ; Vdet = -15V



K3. (-) **Min = 0.75 Max = 1.25**

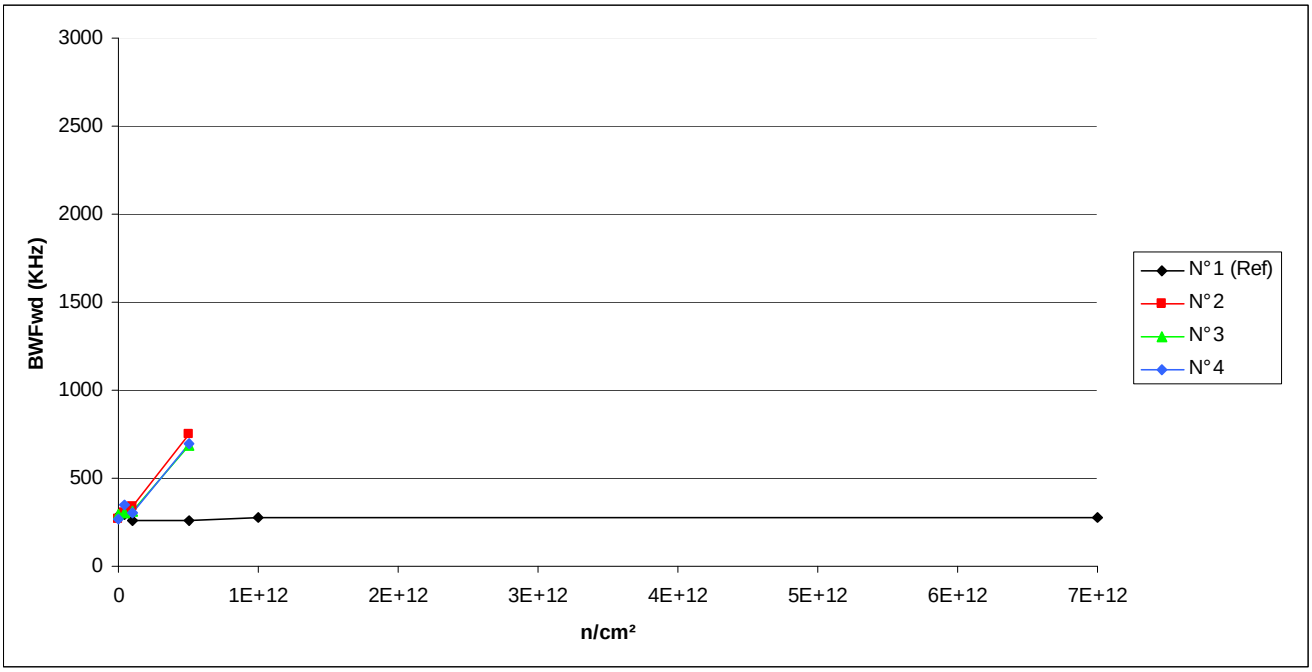
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.033	1.033	1.033	1.033	1.033	1.033
N° 2	0.989	0.989	0.988	0.987	0.988	0.983
N° 3	0.930	0.929	0.928	0.925	0.923	0.920
N° 4	1.029	1.029	1.029	1.028	1.028	1.024

Delta [K3]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	-9.300E-5	9.000E-6	1.770E-4	2.570E-4	-4.100E-5
N° 2	---	-7.161E-4	-1.059E-3	-2.002E-3	-1.976E-3	-6.022E-3
N° 3	---	-1.156E-3	-1.899E-3	-5.456E-3	-7.421E-3	-1.060E-2
N° 4	---	1.500E-4	1.330E-4	-8.290E-4	-1.499E-3	-4.976E-3
Average	---	-5.741E-4	-9.415E-4	-2.762E-3	-3.632E-3	-7.198E-3
σ	---	6.646E-4	1.021E-3	2.405E-3	3.290E-3	2.989E-3
Average+3σ	---	1.420E-3	2.121E-3	4.454E-3	6.237E-3	1.769E-3
Average-3σ	---	-2.568E-3	-4.004E-3	-9.978E-3	-1.350E-2	-1.617E-2

16.BWFwd

Ta = 25°C ; IF = 10mA +/- 4mA ; RL = 50 Ohms



BWFwd . (Khz)

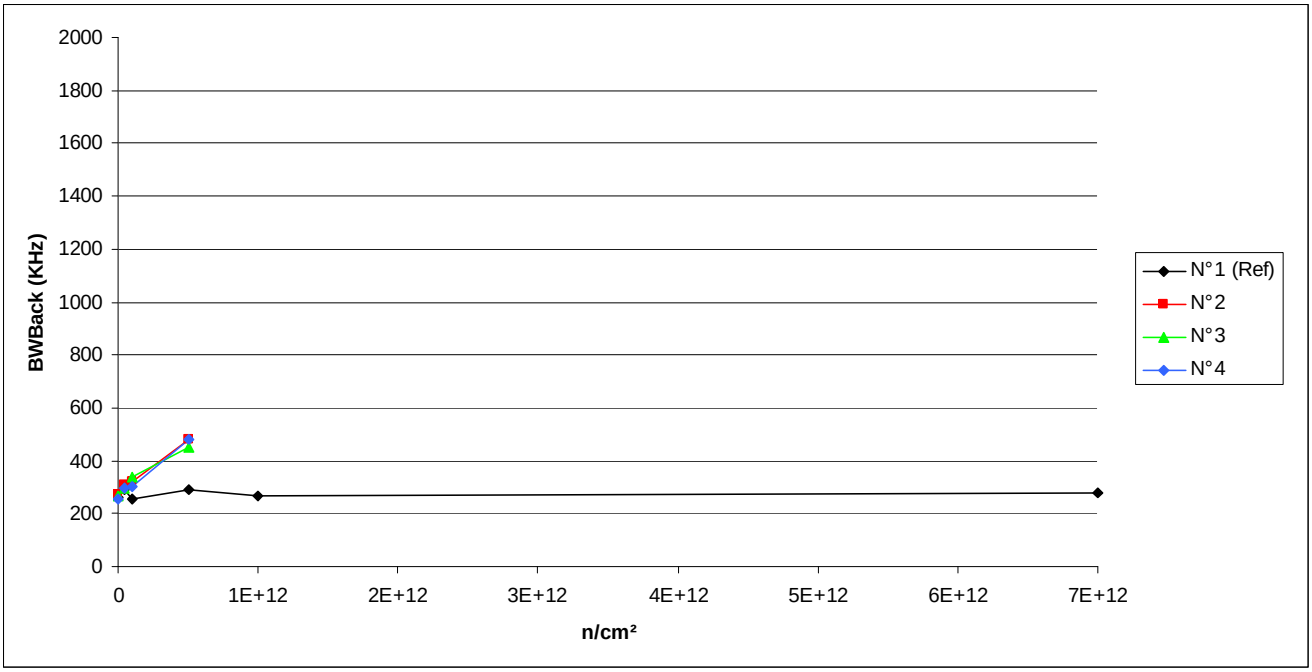
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	284	298	258	262	280	278
N° 2	268	308	342	748	Not Measurable	Not Measurable
N° 3	294	304	316	690	Not Measurable	Not Measurable
N° 4	272	348	308	698	Not Measurable	Not Measurable

Delta [BWFwd]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	1.400E+1	-2.600E+1	-2.200E+1	-4.000E+0	-6.000E+0
N° 2	---	4.000E+1	7.400E+1	4.800E+2	NaN	NaN
N° 3	---	1.000E+1	2.200E+1	3.960E+2	NaN	NaN
N° 4	---	7.600E+1	3.600E+1	4.260E+2	NaN	NaN
Average	---	4.200E+1	4.400E+1	4.340E+2	NaN	NaN
σ	---	3.305E+1	2.691E+1	4.257E+1	0.000E+0	0.000E+0
Average+3σ	---	1.411E+2	1.247E+2	5.617E+2	NaN	NaN
Average-3σ	---	-5.714E+1	-3.672E+1	3.063E+2	NaN	NaN

17.BWBack

Ta = 25°C ; IF = 10mA +/- 4mA ; RL = 50 Ohms



BWBack . (Khz)

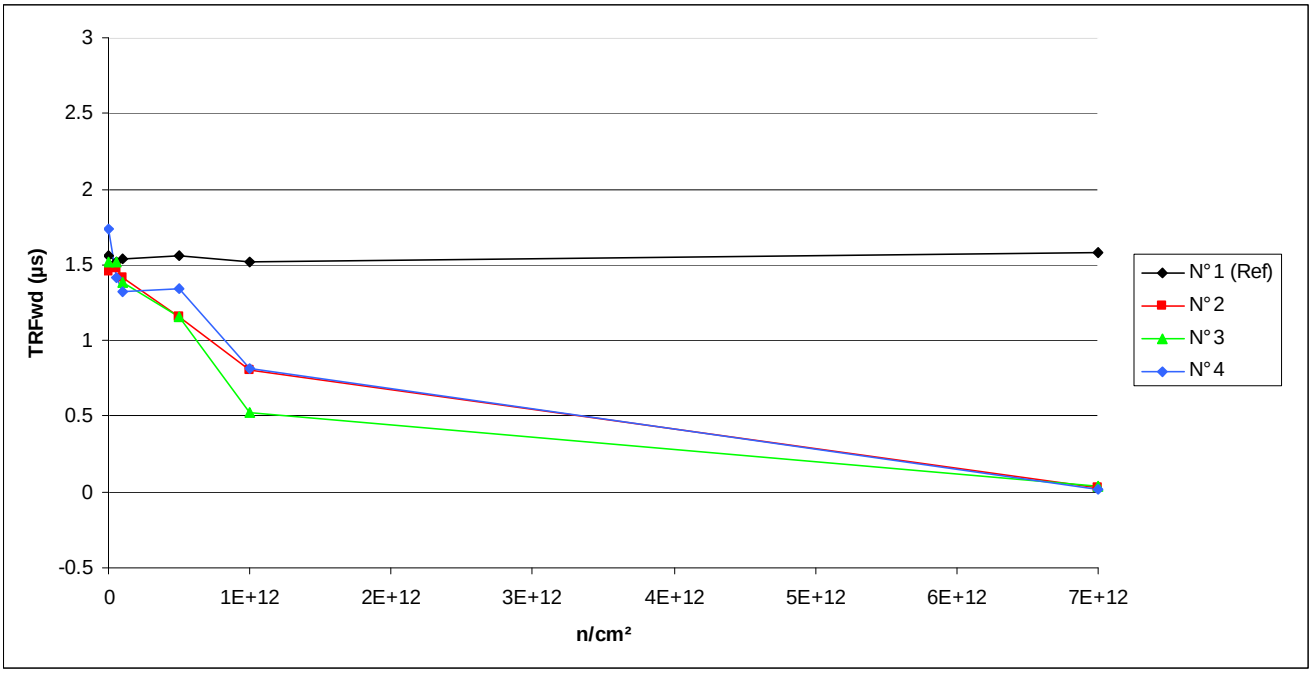
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	264	290	256	288	270	278
N° 2	272	308	318	478	Not Measurable	Not Measurable
N° 3	268	296	338	452	Not Measurable	Not Measurable
N° 4	258	298	302	478	Not Measurable	Not Measurable

Delta [BWBack]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	2.600E+1	-8.000E+0	2.400E+1	6.000E+0	1.400E+1
N° 2	---	3.600E+1	4.600E+1	2.060E+2	NaN	NaN
N° 3	---	2.800E+1	7.000E+1	1.840E+2	NaN	NaN
N° 4	---	4.000E+1	4.400E+1	2.200E+2	NaN	NaN
Average	---	3.467E+1	5.333E+1	2.033E+2	NaN	NaN
σ	---	6.110E+0	1.447E+1	1.815E+1	0.000E+0	0.000E+0
Average+3σ	---	5.300E+1	9.674E+1	2.578E+2	NaN	NaN
Average-3σ	---	1.634E+1	9.928E+0	1.489E+2	NaN	NaN

18.TRFwd

Ta = 25°C ; IF = 10mA +/- 4mA ; RL = 50 Ohms



TRFwd . (us)

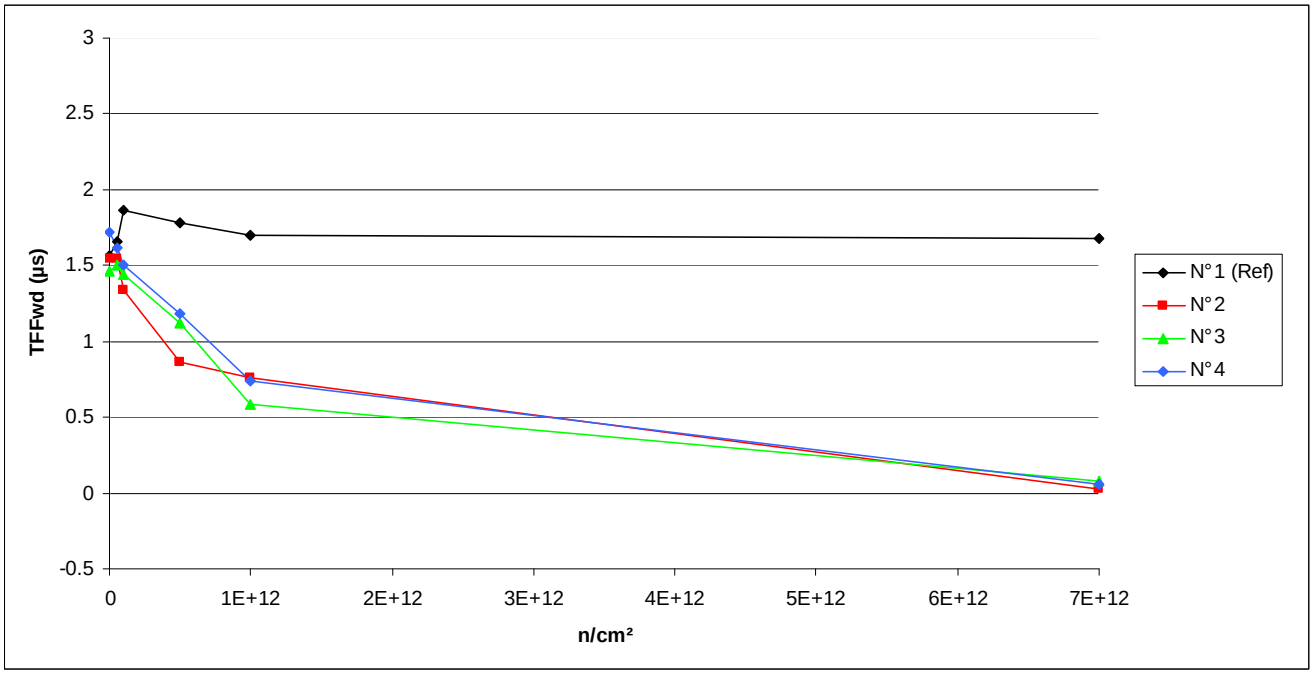
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.56	1.52	1.54	1.56	1.52	1.58
N° 2	1.46	1.48	1.42	1.16	0.80	0.02
N° 3	1.52	1.52	1.38	1.16	0.52	0.04
N° 4	1.74	1.42	1.32	1.34	0.82	0.02

Delta [TRFwd]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	-4.000E-2	-2.000E-2	0.000E+0	-4.000E-2	2.000E-2
N° 2	---	2.000E-2	-4.000E-2	-3.000E-1	-6.600E-1	-1.436E+0
N° 3	---	0.000E+0	-1.400E-1	-3.600E-1	-1.000E+0	-1.480E+0
N° 4	---	-3.200E-1	-4.200E-1	-4.000E-1	-9.200E-1	-1.720E+0
Average	---	-1.000E-1	-2.000E-1	-3.533E-1	-8.600E-1	-1.545E+0
σ	---	1.908E-1	1.970E-1	5.033E-2	1.778E-1	1.529E-1
Average+3σ	---	4.724E-1	3.909E-1	-2.023E-1	-3.267E-1	-1.087E+0
Average-3σ	---	-6.724E-1	-7.909E-1	-5.043E-1	-1.393E+0	-2.004E+0

19.TFFwd

Ta = 25°C ; IF = 10mA +/- 4mA ; RL = 50 Ohms



TFFwd . (us)

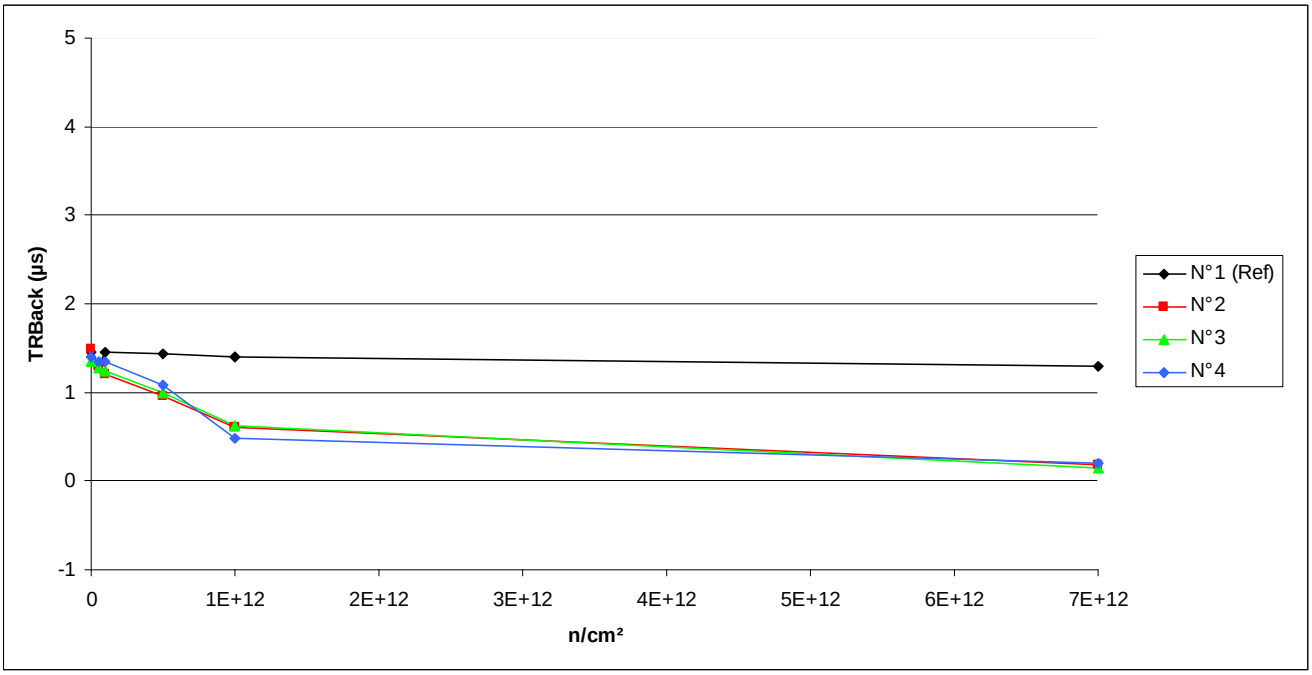
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.56	1.66	1.86	1.78	1.70	1.68
N° 2	1.54	1.54	1.34	0.86	0.76	0.03
N° 3	1.46	1.50	1.44	1.12	0.58	0.08
N° 4	1.72	1.62	1.50	1.18	0.74	0.06

Delta [TFFwd]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	1.000E-1	3.000E-1	2.200E-1	1.400E-1	1.200E-1
N° 2	---	0.000E+0	-2.000E-1	-6.800E-1	-7.800E-1	-1.510E+0
N° 3	---	4.000E-2	-2.000E-2	-3.400E-1	-8.800E-1	-1.380E+0
N° 4	---	-1.000E-1	-2.200E-1	-5.400E-1	-9.800E-1	-1.660E+0
Average	---	-2.000E-2	-1.467E-1	-5.200E-1	-8.800E-1	-1.517E+0
σ	---	7.211E-2	1.102E-1	1.709E-1	1.000E-1	1.401E-1
Average+3σ	---	1.963E-1	1.838E-1	-7.360E-3	-5.800E-1	-1.096E+0
Average-3σ	---	-2.363E-1	-4.771E-1	-1.033E+0	-1.180E+0	-1.937E+0

20.TRBack

Ta = 25°C ; IF = 10mA +/- 4mA ; RL = 50 Ohms



TRBack . (us)

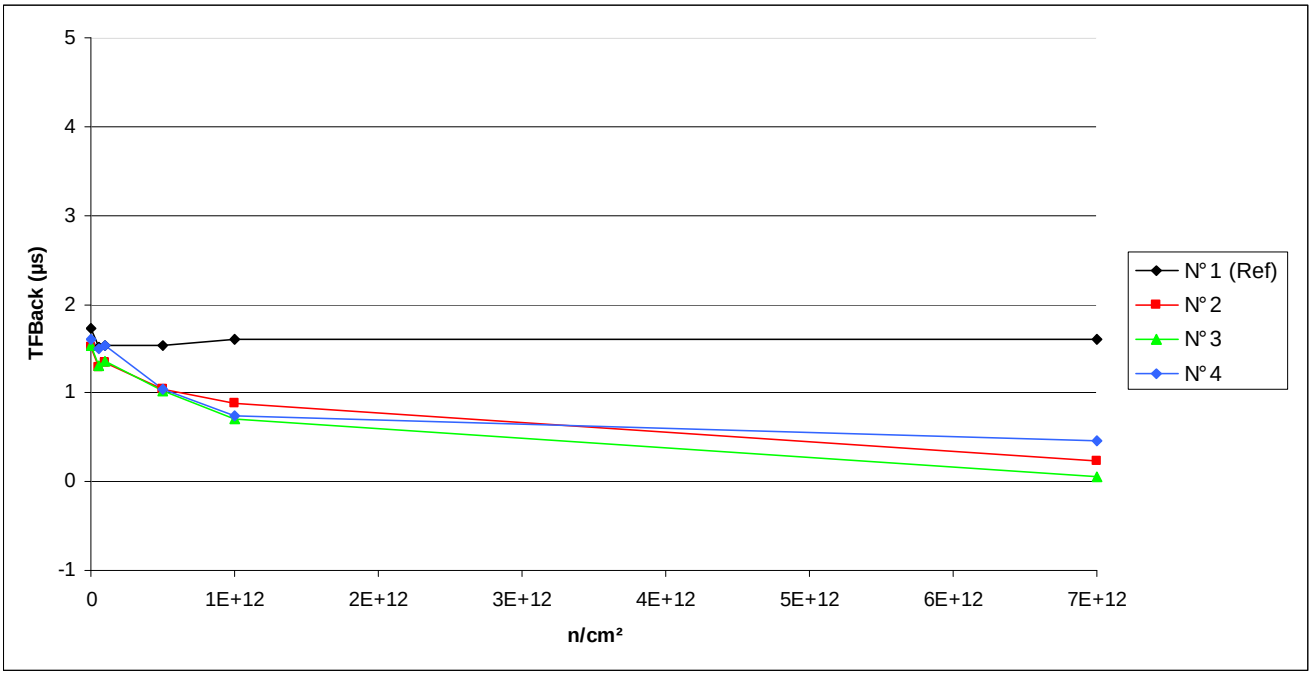
	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.46	1.32	1.46	1.44	1.40	1.30
N° 2	1.48	1.30	1.20	0.96	0.60	0.18
N° 3	1.34	1.28	1.24	1.00	0.62	0.14
N° 4	1.40	1.34	1.34	1.08	0.48	0.20

Delta [TRBack]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	-1.400E-1	0.000E+0	-2.000E-2	-6.000E-2	-1.600E-1
N° 2	---	-1.800E-1	-2.800E-1	-5.200E-1	-8.800E-1	-1.300E+0
N° 3	---	-6.000E-2	-1.000E-1	-3.400E-1	-7.200E-1	-1.200E+0
N° 4	---	-6.000E-2	-6.000E-2	-3.200E-1	-9.200E-1	-1.200E+0
Average	---	-1.000E-1	-1.467E-1	-3.933E-1	-8.400E-1	-1.233E+0
σ	---	6.928E-2	1.172E-1	1.102E-1	1.058E-1	5.774E-2
Average+3σ	---	1.078E-1	2.049E-1	-6.288E-2	-5.225E-1	-1.060E+0
Average-3σ	---	-3.078E-1	-4.982E-1	-7.238E-1	-1.157E+0	-1.407E+0

21.TFBack

Ta = 25°C ; IF = 10mA +/- 4mA ; RL = 50 Ohms



TFBack . (us)

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	1.72	1.52	1.54	1.54	1.60	1.60
N° 2	1.52	1.28	1.34	1.04	0.88	0.24
N° 3	1.54	1.30	1.36	1.02	0.70	0.06
N° 4	1.60	1.50	1.54	1.04	0.74	0.46

Delta [TFBack]

	0.n/cm²	5E10.n/cm²	1E11.n/cm²	5E11.n/cm²	1E12.n/cm²	7E12.n/cm²
N° 1 (Ref)	---	-2.000E-1	-1.800E-1	-1.800E-1	-1.200E-1	-1.200E-1
N° 2	---	-2.400E-1	-1.800E-1	-4.800E-1	-6.400E-1	-1.280E+0
N° 3	---	-2.400E-1	-1.800E-1	-5.200E-1	-8.400E-1	-1.480E+0
N° 4	---	-1.000E-1	-6.000E-2	-5.600E-1	-8.600E-1	-1.140E+0
Average	---	-1.933E-1	-1.400E-1	-5.200E-1	-7.800E-1	-1.300E+0
σ	---	8.083E-2	6.928E-2	4.000E-2	1.217E-1	1.709E-1
Average+3σ	---	4.915E-2	6.785E-2	-4.000E-1	-4.150E-1	-7.874E-1
Average-3σ	---	-4.358E-1	-3.478E-1	-6.400E-1	-1.145E+0	-1.813E+0