

PROTONS TEST REPORT

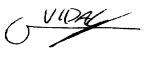


ESA study: "Survey of Critical Components for 150 kRad Power Systems"

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

<p>Part Type : 2N3637</p> <p>Package : TO-39</p> <p>Description : PNP Medium Power Transistors</p> <p>Manufacturer: Microsemi Corporation</p>

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

Alter Technology Group Spain Project Manager: David NUNEZ

Hirex reference :	HRX/TID/0923	Issue : 01	Date :	June 03 rd , 2011
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Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

CHANGE RECORD

ISSUE	DATE	PAGE	DESCRIPTION OF CHANGES
01	June 03rd, 2011	All	Original Issue

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

PROTONS TEST REPORT
on
2N3637
PNP Medium Power Transistors
From Microsemi Corporation

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1 Introduction

In the scope of the ESA study: "Survey of Critical Components for 150 kRad Power Systems", a protons test of the Microsemi Corporation 2N3637, PNP Medium Power Transistors has been performed up to a total fluence of about $2E11$ p/cm², in response to Alter Technology Group Spain purchase order reference ATGSP-TL-09-JC-CO-9 that refers to ESTEC contract N° 22831/09/NL/AF.

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

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

Test has been performed in accordance with Hirex Engineering Radiation Test Plan HRX/SPE/0228 issue 2 dated 09/08/2010.

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

2 Applicable and Reference Documents

2.1 Applicable Documents

- Hirex Engineering Radiation Test Plan: HRX/SPE/0228 issue 2 dated 09/08/2010
- Alter Technology Group Proposal: ATGSP-OF-648/2009 Issue 1
- Minutes of Meeting: MM-SRP-ATG-0001 dated 29/10/2009
- Hirex specification: Total Ionizing dose test general procedure.
- MIL detail specification: MIL-PRF-19500/357K

2.2 Reference Documents

- Microsemi Corporation datasheet: T4-LDS-0065 Rev.2 (100377)

3 Test Samples

7 samples of the 2N3637 devices were tested (6 + 1 control sample).

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

Serial Number	Samples Allocation
1	Control sample
2	Biased OFF
3	Biased OFF
4	Biased OFF
5	Biased OFF
6	Biased OFF
7	Biased OFF

Identification of the 2N3637 is given below:

Part Number: F2N3637

Top Marking: MSC MSF2N3637 SAMPLE serial

Inspection lot: -

Date Code: -

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4 Experimental Conditions

4.1 Radiation Source Description

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

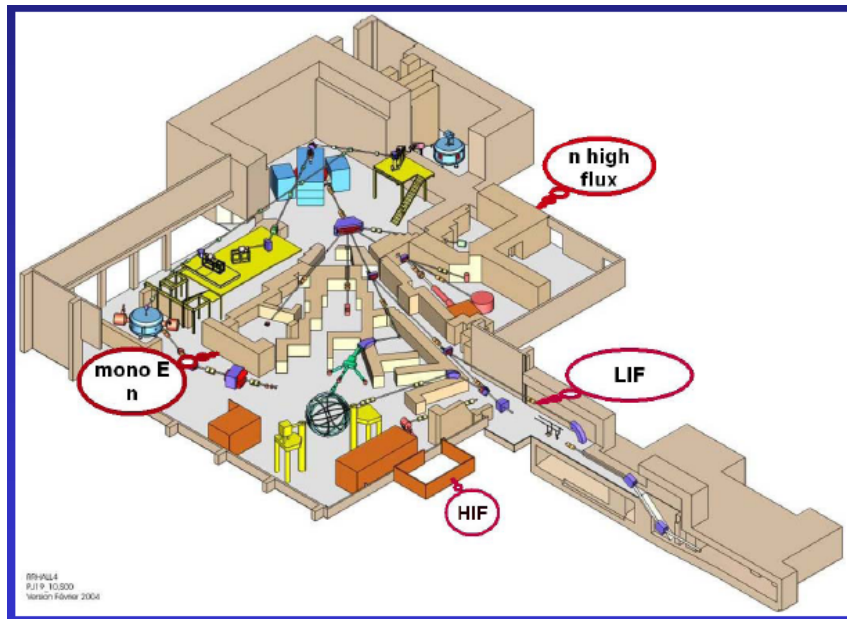


Figure 1 : LIF layout and typical experimental set-up

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

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

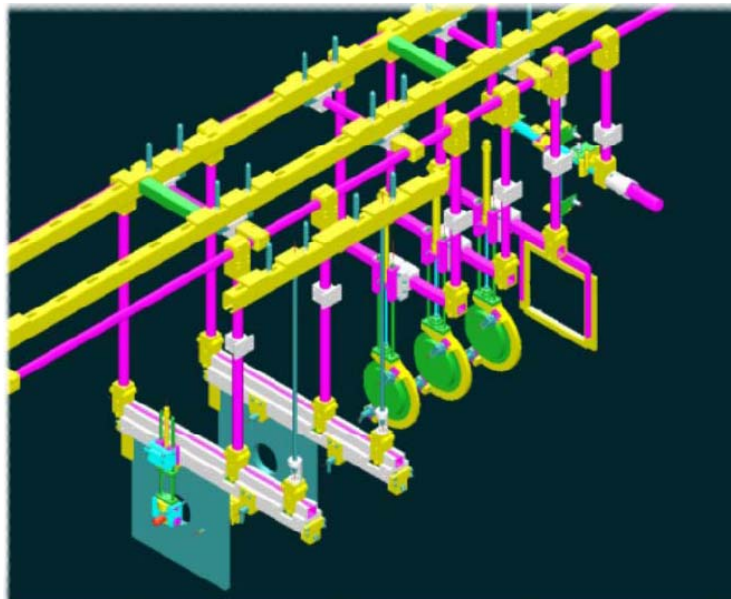


Figure 2: LIF Energy degraders

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

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

4.2 Bias during Dose Exposures and Measurements conditions

4.2.1 Bias conditions

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

4.2.2 Electrical Measurements

Electrical parameters test program principle for 2N3637 is provided in Figure 3.

A HP4142 DC tester and a network analyzer HP8714ES were used to perform required measurements.

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

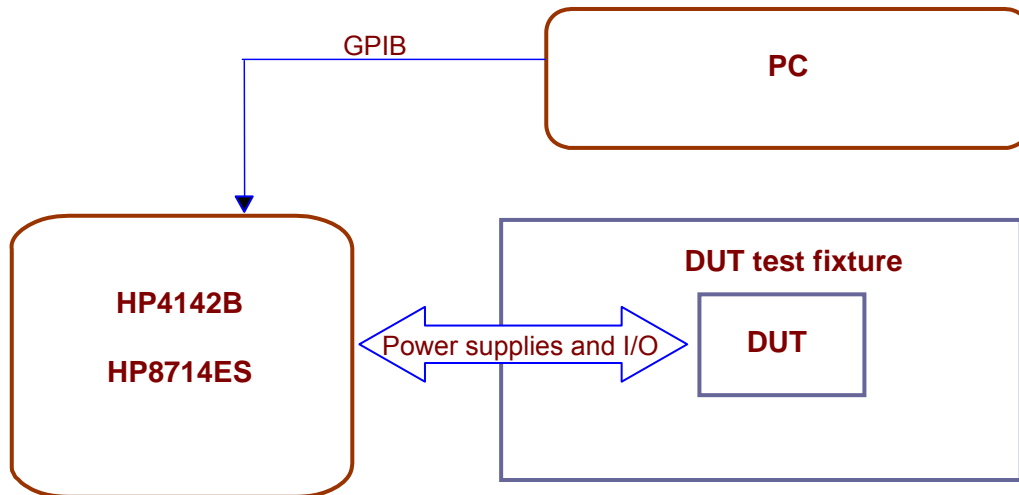


Figure 3 : 2N3637 test program principle

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Electrical parameters test conditions and limits used for performing this test are given in Table 1.

Parameter	Description	Conditions	Limits		Unit
			Min	Max	
I_{CBO1}	Collector-Base cut-off current	$V_{CB} = -175V$	-10	-	μA
I_{CBO2}	Collector-Base cut-off current	$V_{CB} = -100V$	-100	-	nA
I_{EBO1}	Emitter-Base cut-off current	$V_{EB} = -5V$	-10	-	μA
I_{EBO2}	Emitter-Base cut-off current	$V_{EB} = -3V$	-50	-	nA
I_{CEO}	Collector-Emitter cut-off current	$V_{CE} = -100V$	-10	-	μA
$V_{(BR)CEO}$	Collector-Emitter breakdown voltage	$I_C = -10mA$, Note 1	-	-175	V
$V_{CE(SAT)1}$	Collector-Emitter saturation voltage	$I_C = -10mA$, $I_B = -1mA$, Note 1	-0.3	-	V
$V_{CE(SAT)2}$	Collector-Emitter saturation voltage	$I_C = -50mA$, $I_B = -5mA$, Note 1	-0.6	-	V
$V_{BE(SAT)1}$	Base-Emitter saturation voltage	$I_C = -10mA$, $I_B = -1mA$, Note 1	-0.8	-	V
$V_{BE(SAT)2}$	Base-Emitter saturation voltage	$I_C = -50mA$, $I_B = -5mA$, Note 1	-0.9	-0.65	V
H_{FE1}	Forward-current transfer ratio	$I_C = -100\mu A$, $V_{CE} = -10V$, Note 1	55	-	-
H_{FE2}	Forward-current transfer ratio	$I_C = -1mA$, $V_{CE} = -10V$, Note 1	90	-	-
H_{FE3}	Forward-current transfer ratio	$I_C = -10mA$, $V_{CE} = -10V$, Note 1	100	-	-
H_{FE4}	Forward-current transfer ratio	$I_C = -50mA$, $V_{CE} = -10V$, Note 1	100	300	-
H_{FE5}	Forward-current transfer ratio	$I_C = -150mA$, $V_{CE} = -10V$, Note 1	60	-	-
F_T	Gain Bandwidth Product	$I_C = -30mA$, $V_{CE} = -30V$	200	850	MHz

Note 1: Pulse measurement: Pulse Width $\leq 300\mu s$, duty cycle 1%.

Table 1 : Measured electrical parameters

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5 Conclusion

A proton displacement damage test was carried out by Hirex Engineering under Alter Technology Group Spain contract on the Microsemi Corporation 2N3637 PNP Medium Power Transistors in TO-39 package.

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

A summary of failed parameters is provided in the following table. Parameters not listed remained within specification limits all along testing. Detail test results are presented in the following section.

Parameters	Failure Level between :	Comments
HFE2	0 and $2E+11p/cm^2$.	
HFE3	0 and $2E+11p/cm^2$.	

Table 2 : Summary of failed parameters

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6 Test Results

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

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

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

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

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Test conditions : PROTONS

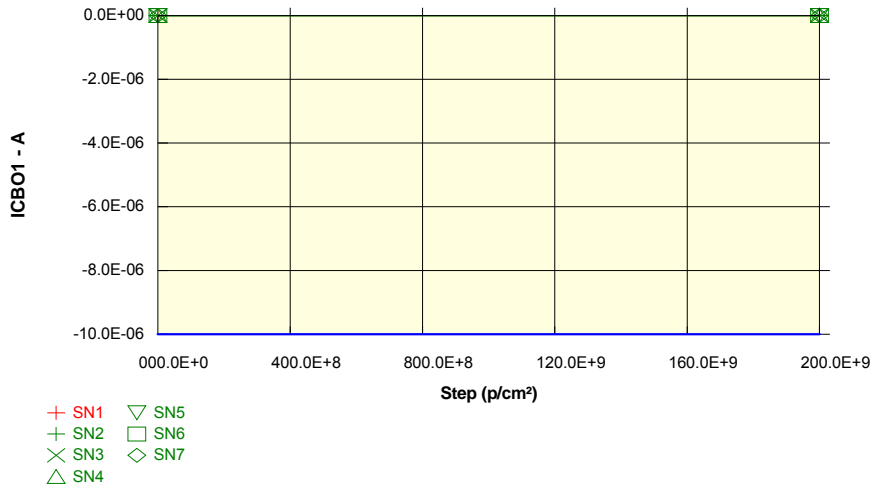
Parameter : Collector-Base cut-off current : ICBO1

Vcb = -175V

Unit : A

Spec Limit Min : -10.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements		
ICBO1	0 p/cm²	2E+11 p/cm²
SN1_REF	-1.1E-09	-571.3E-12
OFF samples		
SN2	-1.1E-09	-1.3E-09
SN3	-1.3E-09	-1.5E-09
SN4	-1.1E-09	-1.3E-09
SN5	-1.1E-09	-1.4E-09
SN6	-1.2E-09	-1.4E-09
SN7	-930.4E-12	-1.6E-09
Statistics		
Min	-1.3E-09	-1.6E-09
Max	-930.4E-12	-1.3E-09
Average	-1.1E-09	-1.4E-09
Sigma	119.4E-12	109.9E-12

Drift Calculation		
ICBO1	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-270.00E-12
SN3	-	-208.00E-12
SN4	-	-176.20E-12
SN5	-	-309.60E-12
SN6	-	-141.80E-12
SN7	-	-688.80E-12
Average	-	-299.07E-12
Sigma	-	183.02E-12

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Test conditions : PROTONS

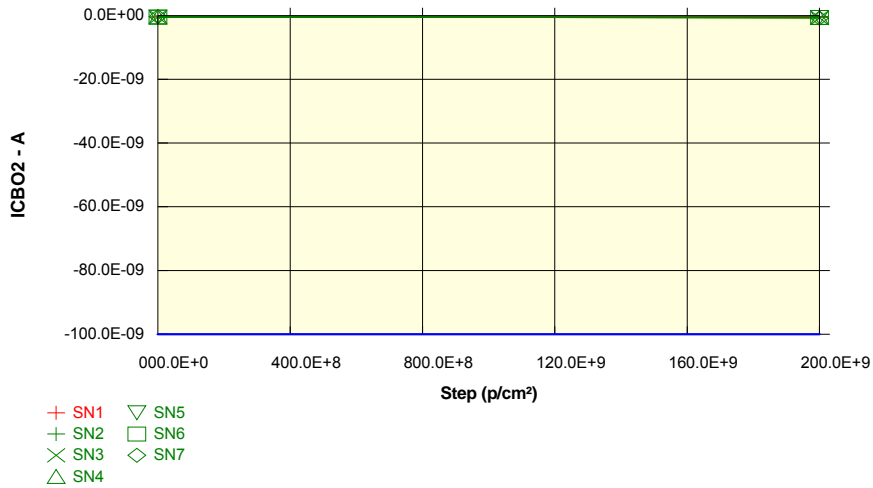
Parameter : Collector-Base cut-off current : ICBO2

Vcb = -100

Unit : A

Spec Limit Min : -100.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

ICBO2	0 p/cm²	2E+11 p/cm²
SN1_REF	-454.1E-12	-250.4E-12
OFF samples		
SN2	-394.8E-12	-555.2E-12
SN3	-469.6E-12	-708.4E-12
SN4	-413.3E-12	-556.2E-12
SN5	-428.8E-12	-585.9E-12
SN6	-478.5E-12	-564.7E-12
SN7	-306.8E-12	-823.0E-12
Statistics		
Min	-478.5E-12	-823.0E-12
Max	-306.8E-12	-555.2E-12
Average	-415.3E-12	-632.2E-12
Sigma	56.7E-12	100.5E-12

Drift Calculation

ICBO2	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-160.36E-12
SN3	-	-238.80E-12
SN4	-	-142.94E-12
SN5	-	-157.14E-12
SN6	-	-86.24E-12
SN7	-	-516.18E-12
Average	-	-216.94E-12
Sigma	-	141.04E-12

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Test conditions : PROTONS

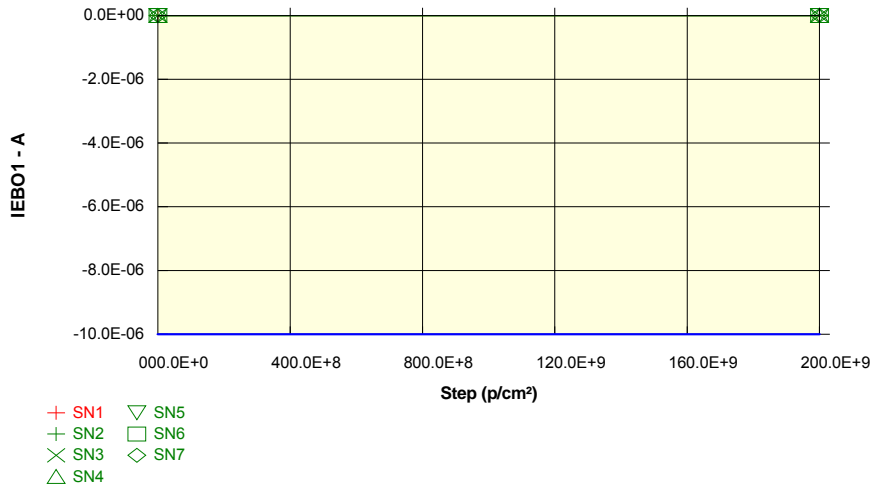
Parameter : Emitter-Base cut-off current : IEBO1

Veb = -5V

Unit : A

Spec Limit Min : -10.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

IEBO1	0 p/cm²	2E+11 p/cm²
SN1_REF	-47.2E-12	-41.5E-12
OFF samples		
SN2	-44.7E-12	-66.7E-12
SN3	-52.2E-12	-81.0E-12
SN4	-50.5E-12	-75.2E-12
SN5	-61.2E-12	-73.8E-12
SN6	-63.6E-12	-76.4E-12
SN7	-50.3E-12	-82.1E-12
Statistics		
Min	-63.6E-12	-82.1E-12
Max	-44.7E-12	-66.7E-12
Average	-53.8E-12	-75.9E-12
Sigma	6.6E-12	5.0E-12

Drift Calculation

IEBO1	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-22.00E-12
SN3	-	-28.82E-12
SN4	-	-24.62E-12
SN5	-	-12.60E-12
SN6	-	-12.76E-12
SN7	-	-31.78E-12
Average	-	-22.10E-12
Sigma	-	7.33E-12

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Test conditions : PROTONS

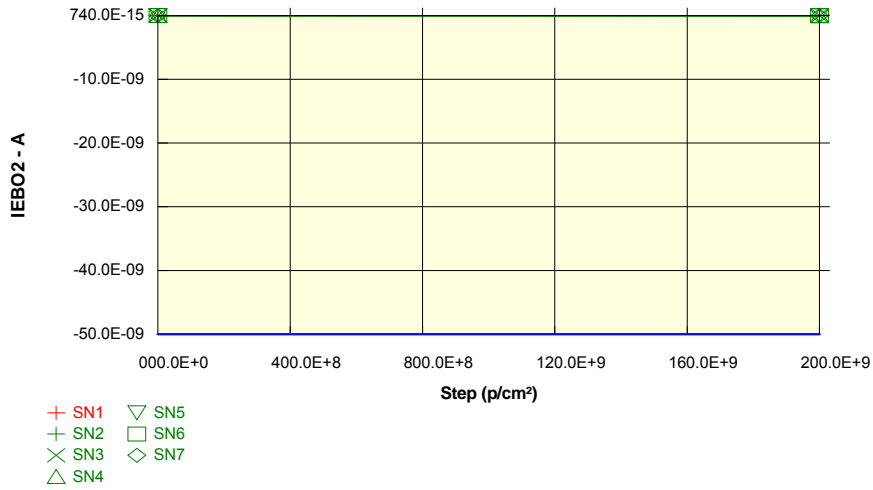
Parameter : Emitter-Base cut-off current : IEBO2

V_{eb} = -3V

Unit : A

Spec Limit Min : -50.0E-09

Spec limits are represented in bold lines on the graphic.



Measurements

IEBO2	0 p/cm ²	2E+11 p/cm ²
SN1_REF	-20.1E-12	-5.9E-12
OFF samples		
SN2	-24.5E-12	-10.2E-12
SN3	740.0E-15	-17.0E-12
SN4	-1.2E-12	-12.6E-12
SN5	-11.8E-12	-12.2E-12
SN6	-1.9E-12	-12.2E-12
SN7	-10.3E-12	-17.4E-12
Statistics		
Min	-24.5E-12	-17.4E-12
Max	740.0E-15	-10.2E-12
Average	-8.2E-12	-13.6E-12
Sigma	8.7E-12	2.7E-12

Drift Calculation

IEBO2	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	14.24E-12
SN3	-	-17.72E-12
SN4	-	-11.40E-12
SN5	-	-400.00E-15
SN6	-	-10.32E-12
SN7	-	-7.16E-12
Average	-	-5.46E-12
Sigma	-	10.21E-12

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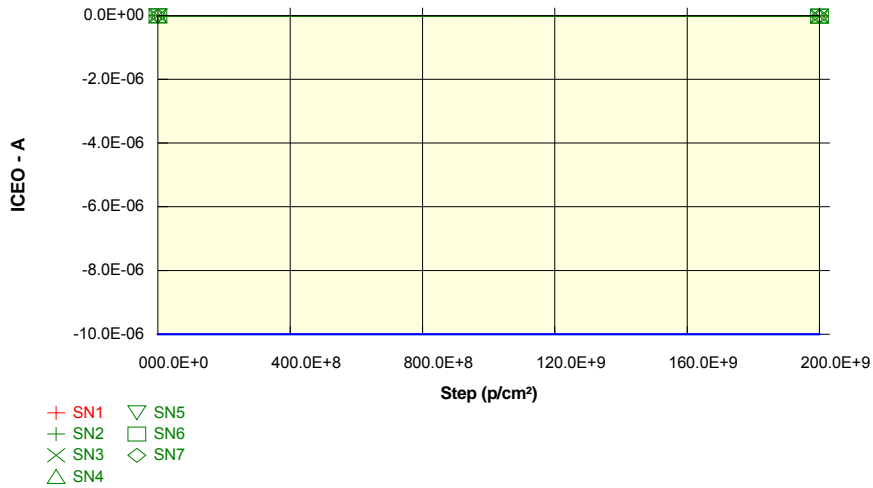
Parameter : Collector-Emitter cut-off current : ICEO

Vce = -100V

Unit : A

Spec Limit Min : -10.0E-06

Spec limits are represented in bold lines on the graphic.



Measurements

ICEO	0 p/cm²	2E+11 p/cm²
SN1_REF	-6.5E-09	-11.4E-09
OFF samples		
SN2	-7.6E-09	-11.7E-09
SN3	-7.4E-09	-20.1E-09
SN4	-7.3E-09	-12.9E-09
SN5	-7.6E-09	-14.1E-09
SN6	-8.2E-09	-13.2E-09
SN7	-6.2E-09	-24.0E-09
Statistics		
Min	-8.2E-09	-24.0E-09
Max	-6.2E-09	-11.7E-09
Average	-7.4E-09	-16.0E-09
Sigma	618.5E-12	4.5E-09

Drift Calculation

ICEO	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-4.15E-09
SN3	-	-12.69E-09
SN4	-	-5.58E-09
SN5	-	-6.54E-09
SN6	-	-4.99E-09
SN7	-	-17.88E-09
Average	-	-8.64E-09
Sigma	-	4.98E-09

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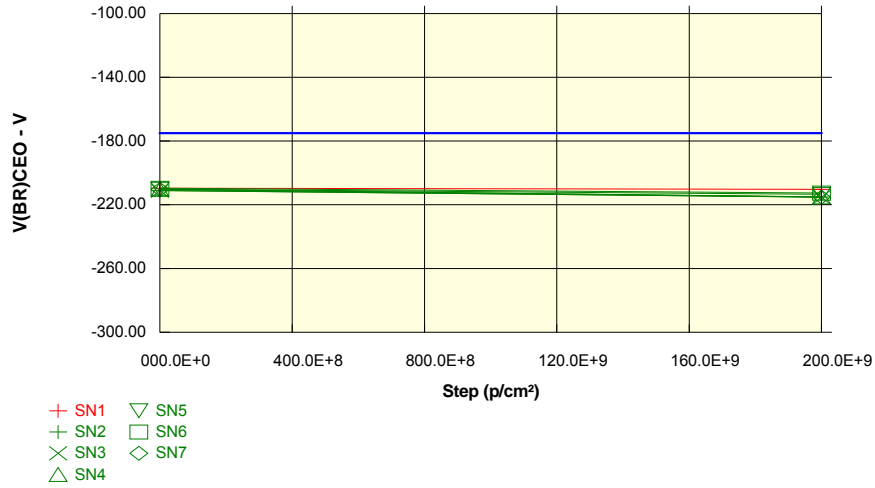
Parameter : Collector-Emitter breakdown voltage : V(BR)CEO

Ic = -10mA

Unit : V

Spec Limit Max : -175.00

Spec limits are represented in bold lines on the graphic.



Measurements

V(BR)CEO	0 p/cm²	2E+11 p/cm²
SN1_REF	-209.59	-210.29
OFF samples		
SN2	-211.09	-215.19
SN3	-211.08	-215.23
SN4	-210.35	-215.05
SN5	-210.22	-213.45
SN6	-209.64	-212.69
SN7	-210.38	-215.20
Statistics		
Min	-211.09	-215.23
Max	-209.64	-212.69
Average	-210.46	-214.47
Sigma	0.50	1.01

Drift Calculation

V(BR)CEO	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-4.10E+00
SN3	-	-4.15E+00
SN4	-	-4.70E+00
SN5	-	-3.23E+00
SN6	-	-3.05E+00
SN7	-	-4.82E+00
Average	-	-4.01E+00
Sigma	-	669.56E-03

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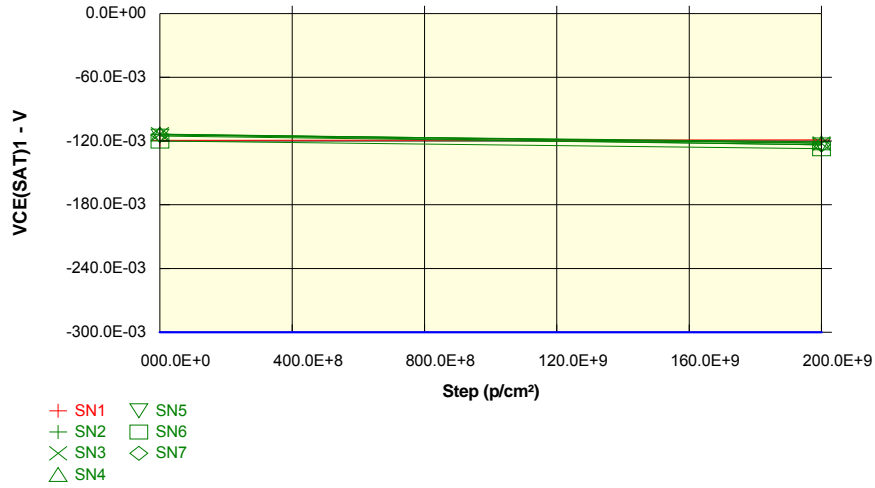
Parameter : Collector-Emitter saturation voltage : VCE(SAT)1

Ic = -10mA ; Ib = -1mA

Unit : V

Spec Limit Min : -300.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VCE(SAT)1	0 p/cm²	2E+11 p/cm²
SN1_REF	-119.3E-03	-118.9E-03
OFF samples		
SN2	-114.1E-03	-120.7E-03
SN3	-113.6E-03	-122.2E-03
SN4	-113.4E-03	-121.6E-03
SN5	-115.3E-03	-123.6E-03
SN6	-120.0E-03	-127.3E-03
SN7	-114.2E-03	-123.6E-03
Statistics		
Min	-120.0E-03	-127.3E-03
Max	-113.4E-03	-120.7E-03
Average	-115.1E-03	-123.2E-03
Sigma	2.3E-03	2.1E-03

Drift Calculation

VCE(SAT)1	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-6.60E-03
SN3	-	-8.60E-03
SN4	-	-8.20E-03
SN5	-	-8.24E-03
SN6	-	-7.28E-03
SN7	-	-9.40E-03
Average	-	-8.05E-03
Sigma	-	901.75E-06

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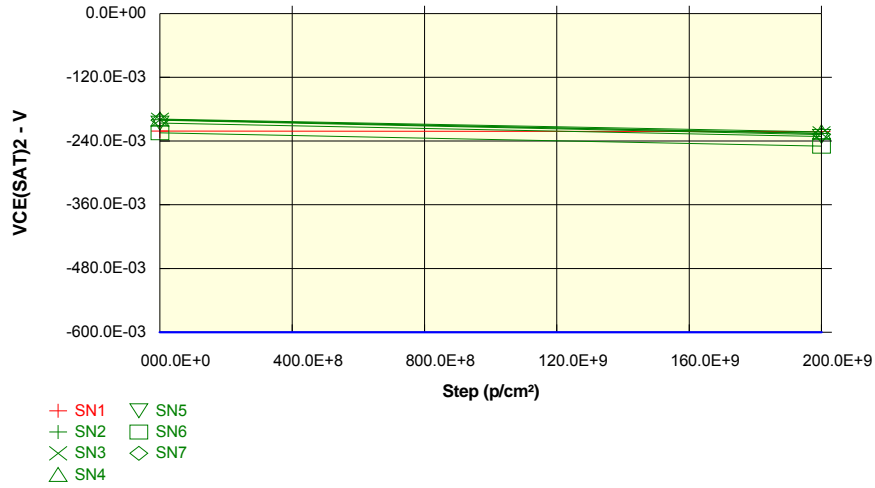
Parameter : Collector-Emitter saturation voltage : VCE(SAT)2

Ic = -50mA ; Ib = -5mA

Unit : V

Spec Limit Min : -600.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VCE(SAT)2	0 p/cm²	2E+11 p/cm²
SN1_REF	-221.4E-03	-221.9E-03
OFF samples		
SN2	-200.0E-03	-225.9E-03
SN3	-200.0E-03	-225.4E-03
SN4	-198.6E-03	-222.7E-03
SN5	-206.3E-03	-231.3E-03
SN6	-224.4E-03	-249.8E-03
SN7	-200.8E-03	-227.8E-03
Statistics		
Min	-224.4E-03	-249.8E-03
Max	-198.6E-03	-222.7E-03
Average	-205.0E-03	-230.5E-03
Sigma	9.0E-03	9.0E-03

Drift Calculation

VCE(SAT)2	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	-25.92E-03
SN3	-	-25.44E-03
SN4	-	-24.08E-03
SN5	-	-25.00E-03
SN6	-	-25.32E-03
SN7	-	-26.96E-03
Average	-	-25.45E-03
Sigma	-	875.34E-06

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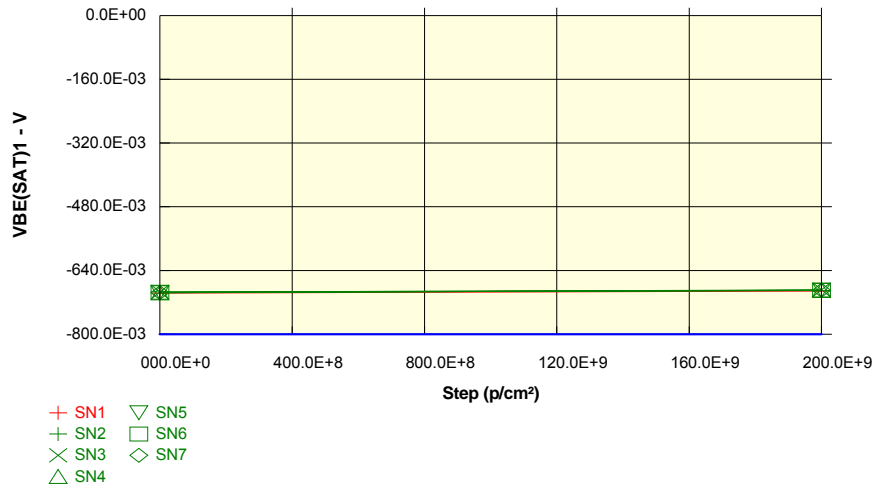
Parameter : Base-Emitter saturation voltage : VBE(SAT)1

Ic = -10mA ; Ib = -1mA

Unit : V

Spec Limit Min : -800.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VBE(SAT)1	0 p/cm²	2E+11 p/cm²
SN1_REF	-697.0E-03	-691.3E-03
OFF samples		
SN2	-693.9E-03	-690.6E-03
SN3	-694.0E-03	-688.5E-03
SN4	-696.0E-03	-689.1E-03
SN5	-695.7E-03	-689.4E-03
SN6	-694.8E-03	-690.1E-03
SN7	-695.6E-03	-689.4E-03
Statistics		
Min	-696.0E-03	-690.6E-03
Max	-693.9E-03	-688.5E-03
Average	-695.0E-03	-689.5E-03
Sigma	842.0E-06	686.8E-06

Drift Calculation

VBE(SAT)1	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	3.28E-03
SN3	-	5.52E-03
SN4	-	6.96E-03
SN5	-	6.32E-03
SN6	-	4.68E-03
SN7	-	6.20E-03
Average	-	5.49E-03
Sigma	-	1.22E-03

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

Test conditions : PROTONS

Parameter : Base-Emitter saturation voltage : VBE(SAT)2

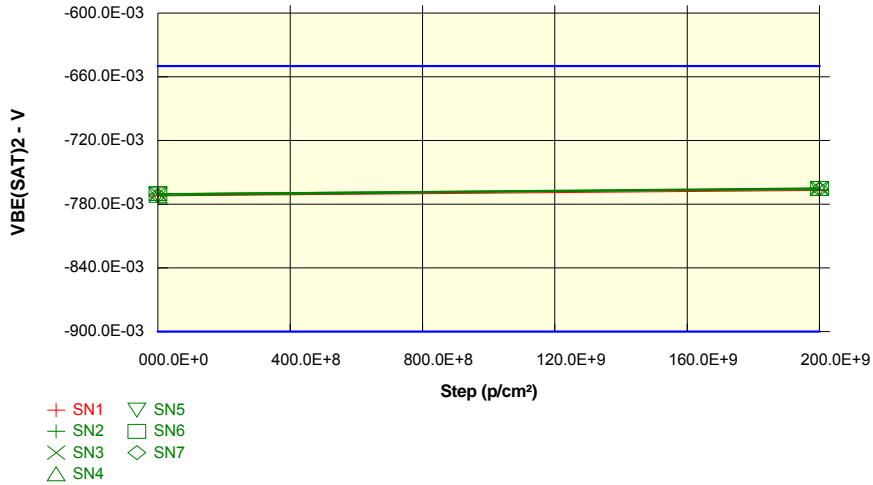
Ic = -50mA ; Ib = -5mA

Unit : V

Spec Limit Min : -900.0E-03

Spec Limit Max : -650.0E-03

Spec limits are represented in bold lines on the graphic.



Measurements

VBE(SAT)2	0 p/cm²	2E+11 p/cm²
SN1_REF	-772.2E-03	-767.0E-03
OFF samples		
SN2	-770.1E-03	-766.4E-03
SN3	-770.2E-03	-764.6E-03
SN4	-771.6E-03	-765.0E-03
SN5	-771.2E-03	-765.2E-03
SN6	-770.0E-03	-765.3E-03
SN7	-771.8E-03	-765.7E-03
Statistics		
Min	-771.8E-03	-766.4E-03
Max	-770.0E-03	-764.6E-03
Average	-770.8E-03	-765.3E-03
Sigma	743.6E-06	564.6E-06

Drift Calculation

VBE(SAT)2	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	3.72E-03
SN3	-	5.60E-03
SN4	-	6.68E-03
SN5	-	6.04E-03
SN6	-	4.76E-03
SN7	-	6.08E-03
Average	-	5.48E-03
Sigma	-	978.44E-06

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

Test conditions : PROTONS

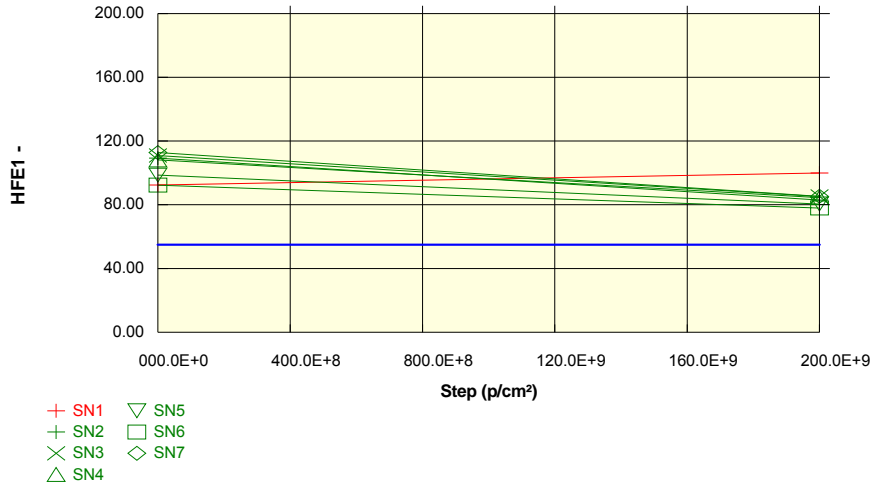
Parameter : Forward-current transfer ratio : HFE1

Ic = -100µA ; Vce = -10V

Unit :

Spec Limit Min : 55.00

Spec limits are represented in bold lines on the graphic.



Measurements

HFE1	0 p/cm²	2E+11 p/cm²
SN1_REF	92.39	99.91
OFF samples		
SN2	109.34	82.96
SN3	110.93	85.14
SN4	108.19	84.53
SN5	98.68	80.48
SN6	92.32	77.96
SN7	112.72	85.25
Statistics		
Min	92.32	77.96
Max	112.72	85.25
Average	105.36	82.72
Sigma	7.35	2.68

Drift Calculation

HFE1	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	2.91E-03
SN3	-	2.73E-03
SN4	-	2.59E-03
SN5	-	2.29E-03
SN6	-	2.00E-03
SN7	-	2.86E-03
Average	-	2.56E-03
Sigma	-	324.59E-06

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

Test conditions : PROTONS

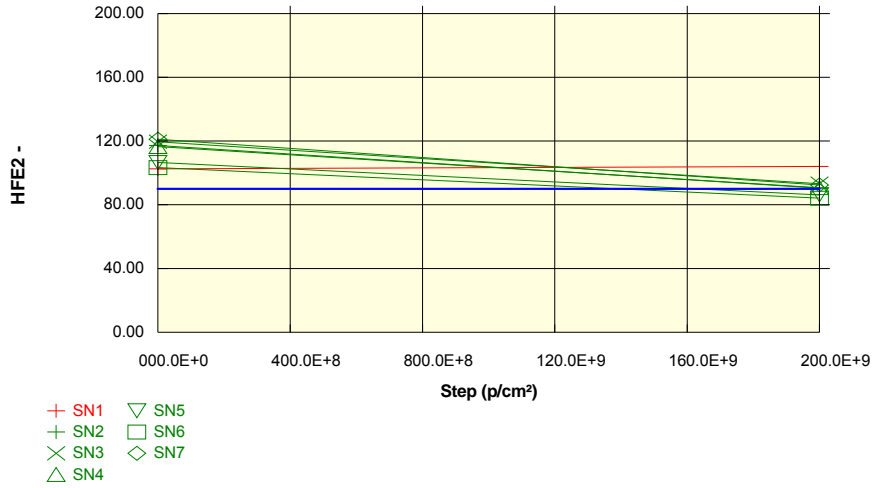
Parameter : Forward-current transfer ratio : HFE2

Ic = -1mA ; Vce = -10V

Unit :

Spec Limit Min : 90.00

Spec limits are represented in bold lines on the graphic.



Measurements

HFE2	0 p/cm²	2E+11 p/cm²
SN1_REF	102.52	104.02
OFF samples		
SN2	117.29	90.39
SN3	119.56	93.25
SN4	116.52	90.70
SN5	106.60	86.27
SN6	103.33	84.14
SN7	121.17	92.39
Statistics		
Min	103.33	84.14
Max	121.17	93.25
Average	114.08	89.52
Sigma	6.68	3.26

Drift Calculation

HFE2	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	2.54E-03
SN3	-	2.36E-03
SN4	-	2.44E-03
SN5	-	2.21E-03
SN6	-	2.21E-03
SN7	-	2.57E-03
Average	-	2.39E-03
Sigma	-	143.37E-06

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

Test conditions : PROTONS

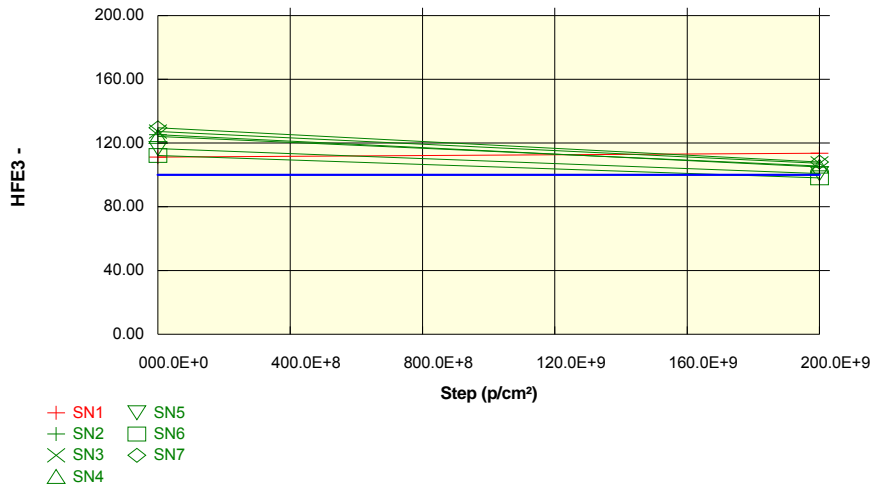
Parameter : Forward-current transfer ratio : HFE3

Ic = -10mA ; Vce = -10V

Unit :

Spec Limit Min : 100.00

Spec limits are represented in bold lines on the graphic.



Measurements		
HFE3	0 p/cm²	2E+11 p/cm²
SN1_REF	111.19	113.55
OFF samples		
SN2	125.33	104.97
SN3	127.21	107.23
SN4	124.12	105.56
SN5	116.58	100.81
SN6	112.18	98.12
SN7	129.55	108.04
Statistics		
Min	112.18	98.12
Max	129.55	108.04
Average	122.49	104.12
Sigma	6.11	3.53

Drift Calculation		
HFE3	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	1.55E-03
SN3	-	1.46E-03
SN4	-	1.42E-03
SN5	-	1.34E-03
SN6	-	1.28E-03
SN7	-	1.54E-03
Average	-	1.43E-03
Sigma	-	98.10E-06

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

Test conditions : PROTONS

Parameter : Forward-current transfer ratio : HFE4

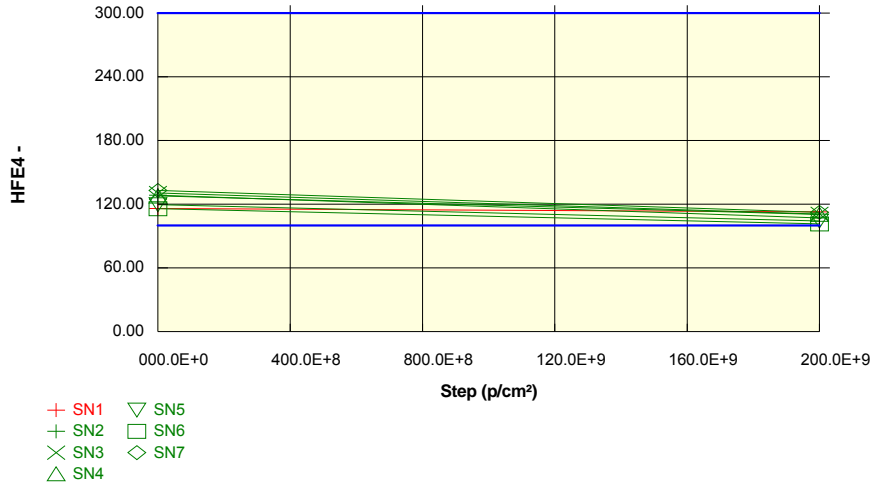
Ic = -50mA ; Vce = -10V

Unit :

Spec Limit Min : 100.00

Spec Limit Max : 300.00

Spec limits are represented in bold lines on the graphic.



Measurements

HFE4	0 p/cm²	2E+11 p/cm²
SN1_REF	115.81	112.86
OFF samples		
SN2	128.48	107.13
SN3	130.52	110.79
SN4	127.70	110.44
SN5	119.51	104.09
SN6	115.64	101.34
SN7	132.91	112.26
Statistics		
Min	115.64	101.34
Max	132.91	112.26
Average	125.79	107.68
Sigma	6.14	3.91

Drift Calculation

HFE4	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	1.55E-03
SN3	-	1.36E-03
SN4	-	1.22E-03
SN5	-	1.24E-03
SN6	-	1.22E-03
SN7	-	1.38E-03
Average	-	1.33E-03
Sigma	-	118.59E-06

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

Test conditions : PROTONS

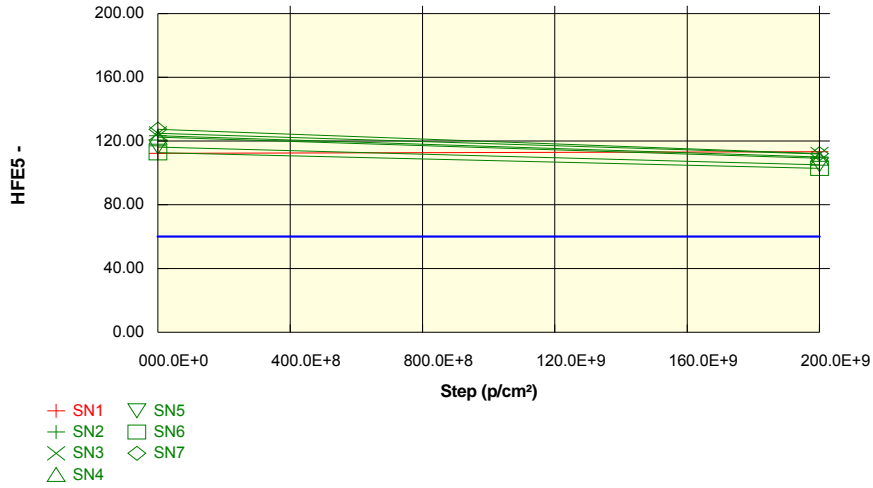
Parameter : Forward-current transfer ratio : HFE5

Ic = -150mA ; Vce = -10V

Unit :

Spec Limit Min : 60.00

Spec limits are represented in bold lines on the graphic.



Measurements

HFE5	0 p/cm²	2E+11 p/cm²
SN1_REF	112.36	113.37
OFF samples		
SN2	123.31	110.07
SN3	124.80	111.83
SN4	122.47	109.20
SN5	116.18	105.04
SN6	112.60	102.83
SN7	127.42	112.06
Statistics		
Min	112.60	102.83
Max	127.42	112.06
Average	121.13	108.50
Sigma	5.11	3.44

Drift Calculation

HFE5	0 p/cm²	2E+11 p/cm²
OFF samples		
SN2	-	976.01E-06
SN3	-	929.39E-06
SN4	-	991.89E-06
SN5	-	913.33E-06
SN6	-	843.81E-06
SN7	-	1.08E-03
Average	-	955.03E-06
Sigma	-	72.03E-06

Hirex Engineering	Protons Test Report		Ref.:	HRX/TID/0923
	2N3637	Microsemi Corporation	Issue:	01

Test conditions : PROTONS

Parameter : Gain bandwidth product : FT

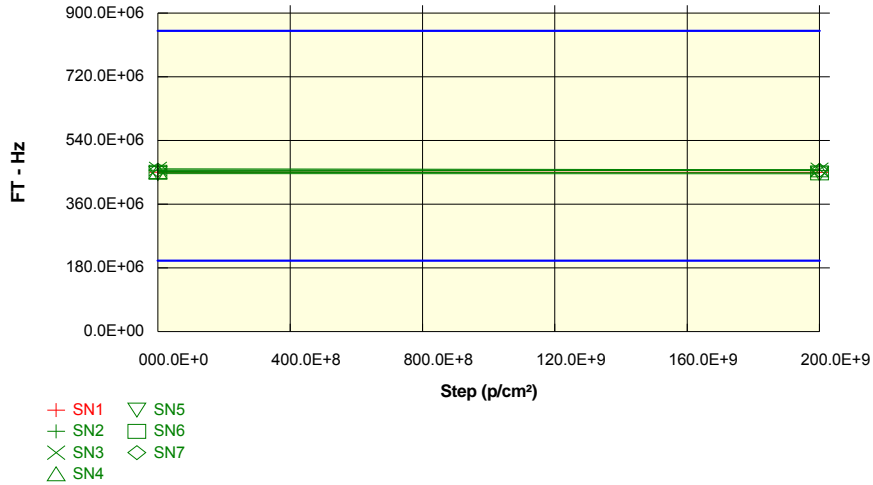
Ic = -30mA ; Vce = -30V

Unit : Hz

Spec Limit Min : 200.0E+06

Spec Limit Max : 850.0E+06

Spec limits are represented in bold lines on the graphic.



Measurements

FT	0 p/cm ²	2E+11 p/cm ²
SN1_REF	450.5E+06	450.3E+06
OFF samples		
SN2	455.6E+06	455.1E+06
SN3	459.7E+06	457.2E+06
SN4	452.4E+06	456.7E+06
SN5	446.3E+06	446.1E+06
SN6	450.1E+06	448.3E+06
SN7	456.0E+06	455.7E+06
Statistics		
Min	446.3E+06	446.1E+06
Max	459.7E+06	457.2E+06
Average	453.4E+06	453.2E+06
Sigma	4.4E+06	4.3E+06

Drift Calculation

FT	0 p/cm ²	2E+11 p/cm ²
OFF samples		
SN2	-	-524.26E+03
SN3	-	-2.53E+06
SN4	-	4.29E+06
SN5	-	-205.44E+03
SN6	-	-1.76E+06
SN7	-	-314.94E+03
Average	-	-174.27E+03
Sigma	-	2.17E+06