TOTAL DOSE IRRADIATION TEST REPORT

OP27AZ(DC9811A)

SINGLE OPERATIONAL AMPLIFIER

FROM

Analog Devices

Reference : RA13-1998	*Montpellier, September 30 , 1998*

TRAD

Tests et radiations

P.I.T de la Pompignane. Rue de la vieille poste- Bat. T4
34055 MONTPELLIER CEDEX 1 FRANCE
☎ : 04 99 52 68 99 : Fax 04 99 52 68 98.
EMAIL: atrad@ibm.net

To :
MATRA MARCONI SPACE
Mme DESENCLOS

Verified by :
M. Fabrice HEYER

Approved by :
M. Christian CHATRY

CONTENTS

1. Introduction

This report presents the total dose irradiation test results of Single Operational Amplifier OP27AZ (DC9811A) from Analog Devices.

This tests were conducted in respect of MIL-M-38510/13503SPA specification.

2. Parts References

REFERENCES	
Type :	OP27AZ
Manufacturer :	ANALOG DEVICES
Packaging :	DIL8
TECHNOLOGY	
Bipolar	
PARTS PROCUREMENT	
Origin :	MATRA MARCONI SPACE
Level :	QML V
Date Code :	9811A
Wafer Lot :	F31043.1
F.R :	95360-1
Number of Parts :	10 irradiated + 1 reference
DETAIL SPECIFICATION	
MIL-M-38510/13503SPA rev B ,amend 2	

3. Dosimetry and irradiation facilities

IRRADIATION FACILITY	
Source :	^{60}Co
Localisation :	Montpellier.
Dose rate :	350cGy(Si) per hour (0.35 krad(Si)/h).
Irradiation box :	(20 x 20 x 2 cm^3), Pb (1,5 mm)/Al (1 mm)
Dosimetry :	TLD (CaF_2), with Harshaw 2000.
IRRADIATION TIMING	
Total dose limit :	200 kcGy(Si) (1kcGy(Si)=1krad(Si))
Level for measurement :	0, 8, 13, 22, 30, 54, 77, 100,130,200, kcGy(Si) (or krad(Si))

4. Electrical parameters

See appendix 2, the MATRA MARCONI SPACE test plan for the list of electrical parameter.

5. Bias conditions

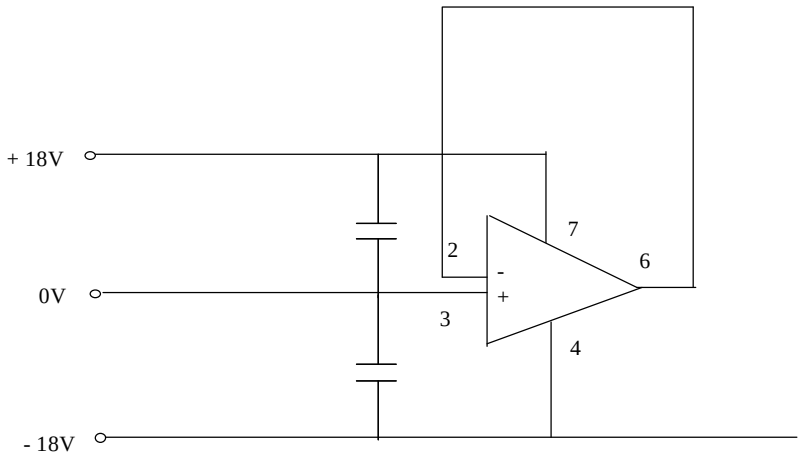
All components are biased following biasing condition figure in MATRA MARCONI SPACE test plan.

PARTS IDENTIFICATION

Manufacturer : Analog Devices
Marking :

Serial Numbers	Sample Devices										Control
Manufacturer	292	293	294	295	298	299	300	301	297	303	288
Irr. Marking	1	2	3	4	6	7	8	9	5	10	Ref
Biasing Mode	On	On	On	On	On	On	On	On	Off	Off	Unbiased

BIASING CONDITIONS



COMMENTS

8 parts are biased in static on mode ; 2 parts are biased in static off mode with all pins connected to ground.

6. Results

Comments:

-For parts biased on :

The parameter Vio is out of specification at 3 krad(Si) by interpolation
The parameter Iib+ is out of specification at 27 krad(Si) by interpolation.
The parameter Iib- is out of specification at 25 krad(Si) by interpolation.
The parameter Sr+ is out of specification at 110 krad(Si) by interpolation.

-For parts biased off :

The parameter Vio is out of specification at 26 krad(Si) by interpolation
The parameter Iib+ is out of specification at 21 krad(Si) by interpolation.
The parameter Iib- is out of specification at 21 krad(Si) by interpolation.
The parameter Sr+ is out of specification at 66 krad(Si) by interpolation.
The parameter Sr- is out of specification at 131 krad(Si) by interpolation.

7. Conclusions

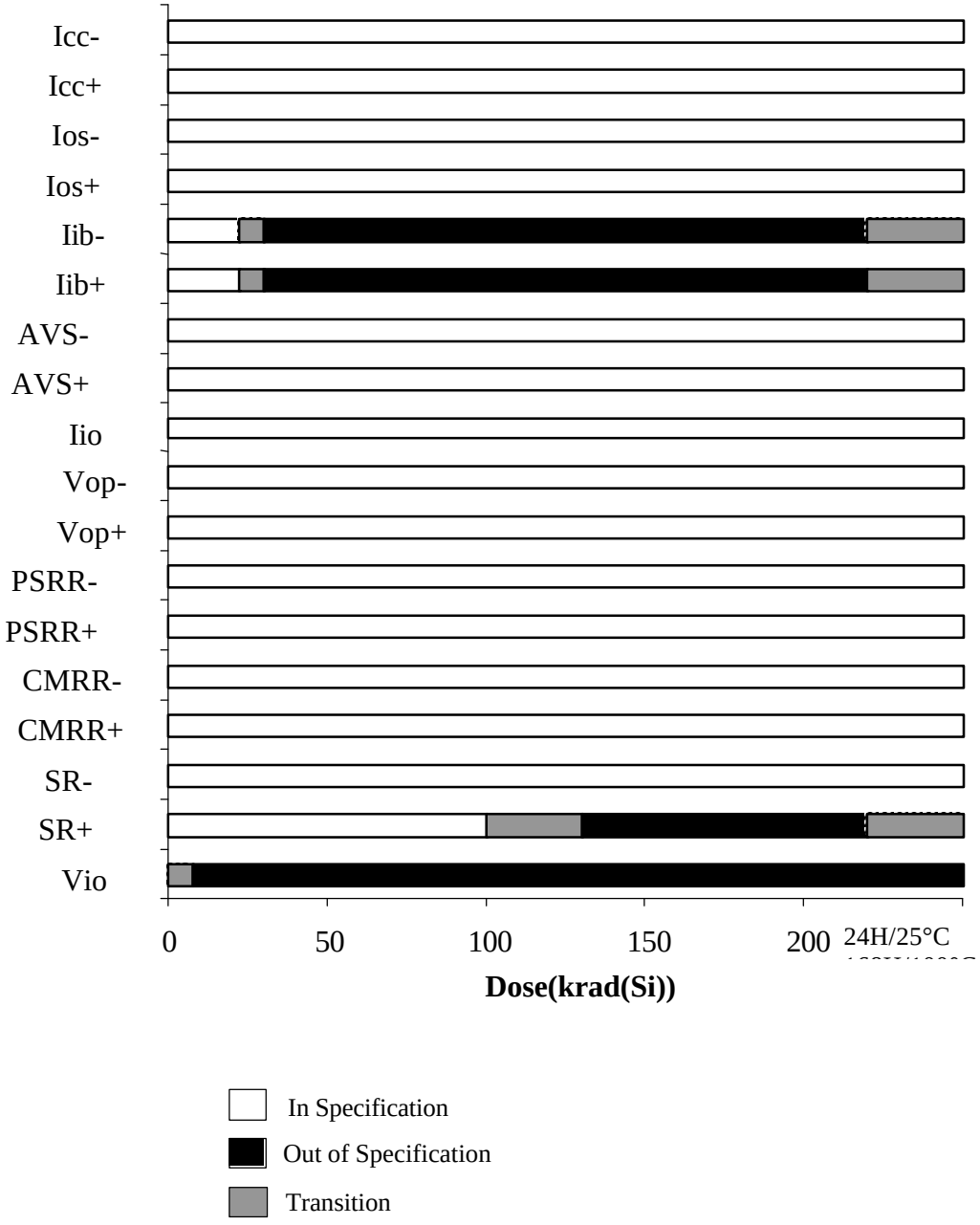
Total dose steady-state irradiation test using gamma rays from Cobalt 60 has been carried out on 10 (8 Static On and 2 Static Off) **Single Operational Amplifier OP27AZ (DC9811A)** from **Analog Devices** at low dose rate (≤ 0.35 krad(Si)/h) up to 200 krad(Si).

The results indicate that:

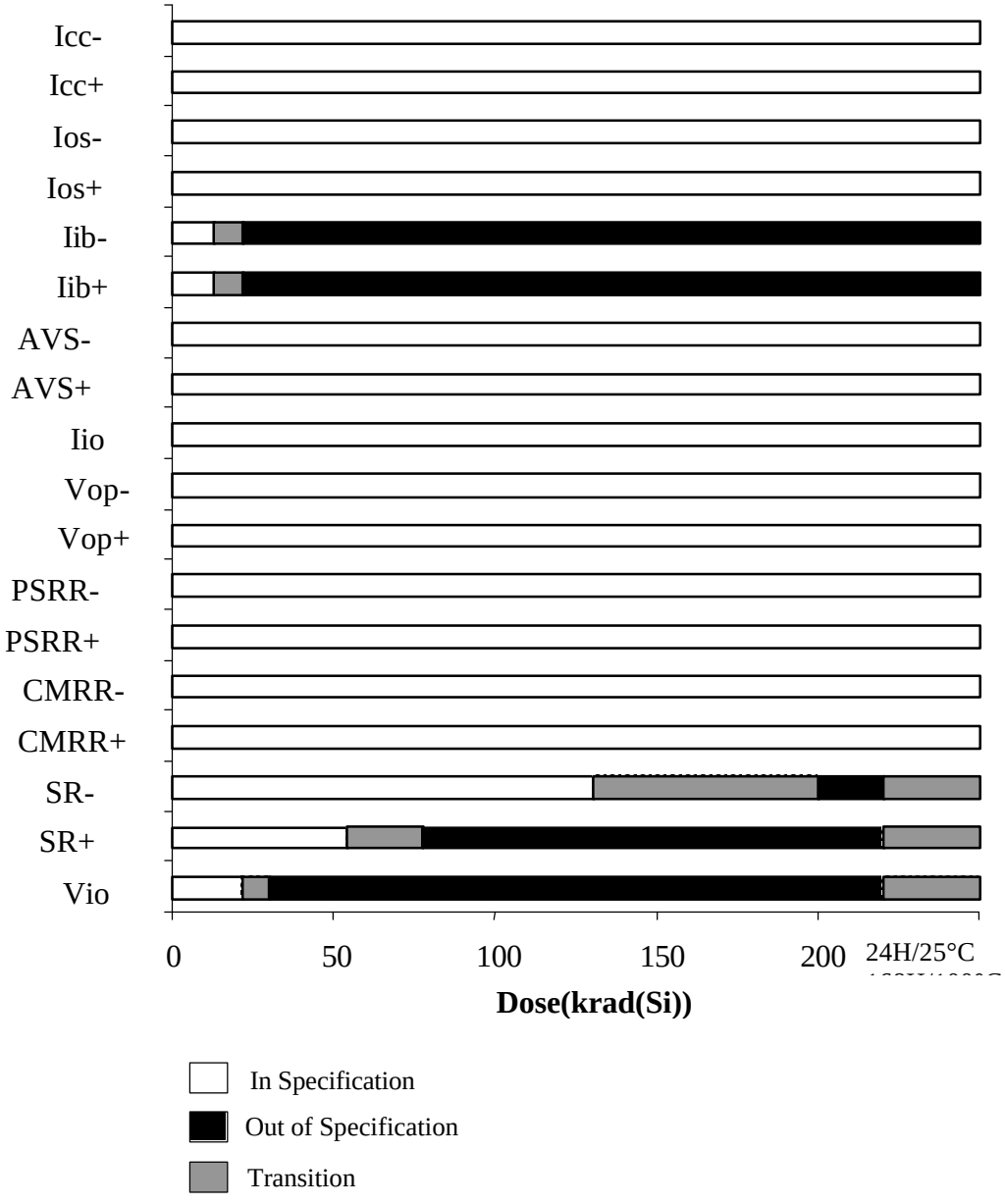
The first parameter which overstep specification is Vio at 3 krad(Si) on part biased ON.

Influence of biasing condition : worst case is biased OFF.

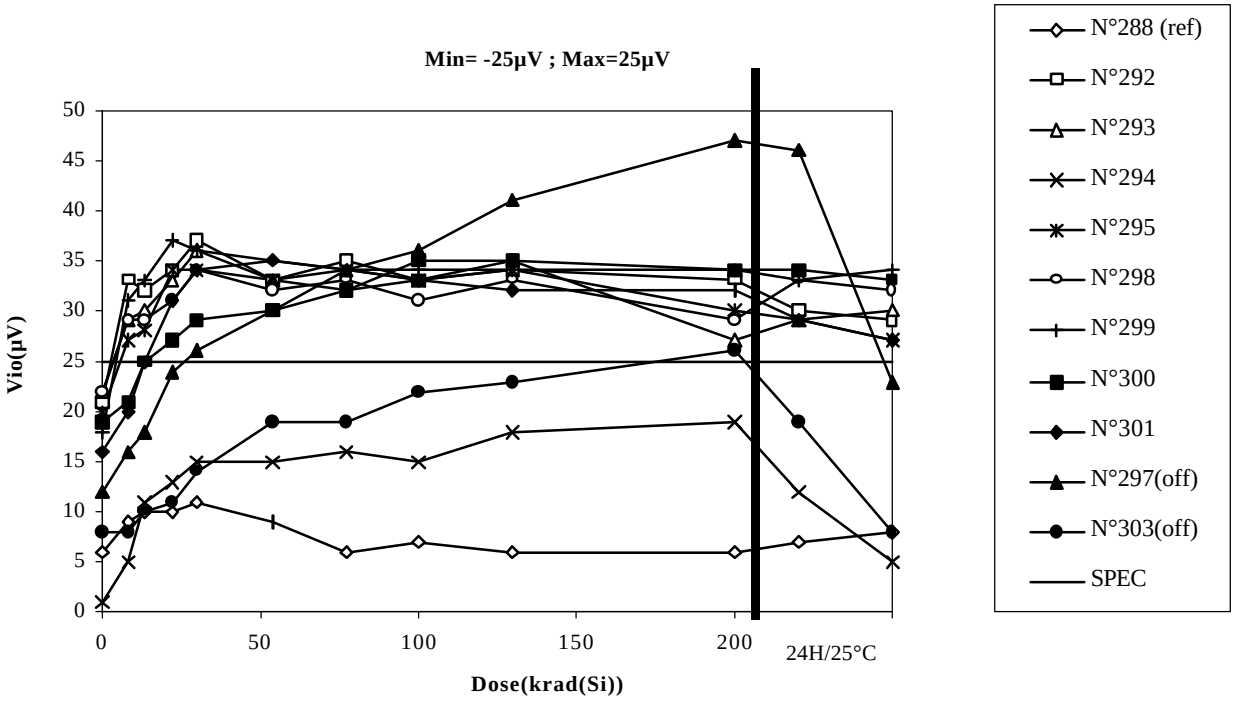
7.1. ELECTRICAL PARAMETERS FOR PARTS BIASED ON



7.2. ELECTRICAL PARAMETERS FOR PARTS BIASED OFF

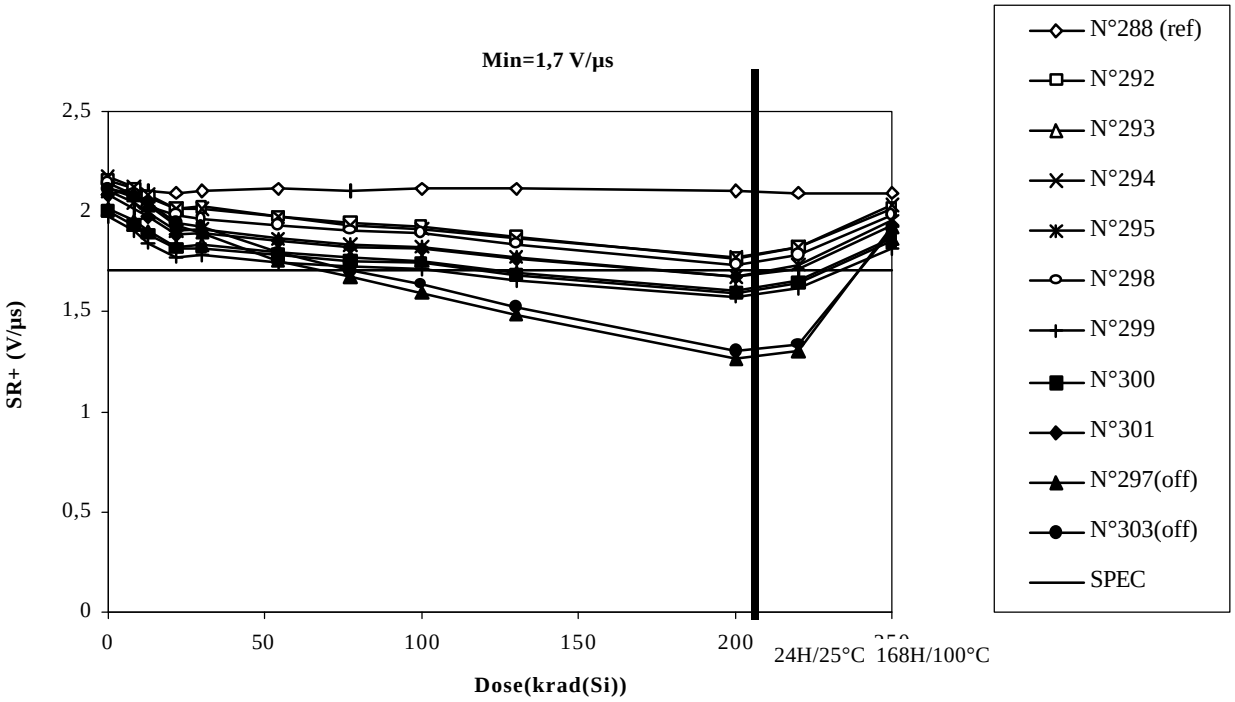


7.3. Vio (µV)



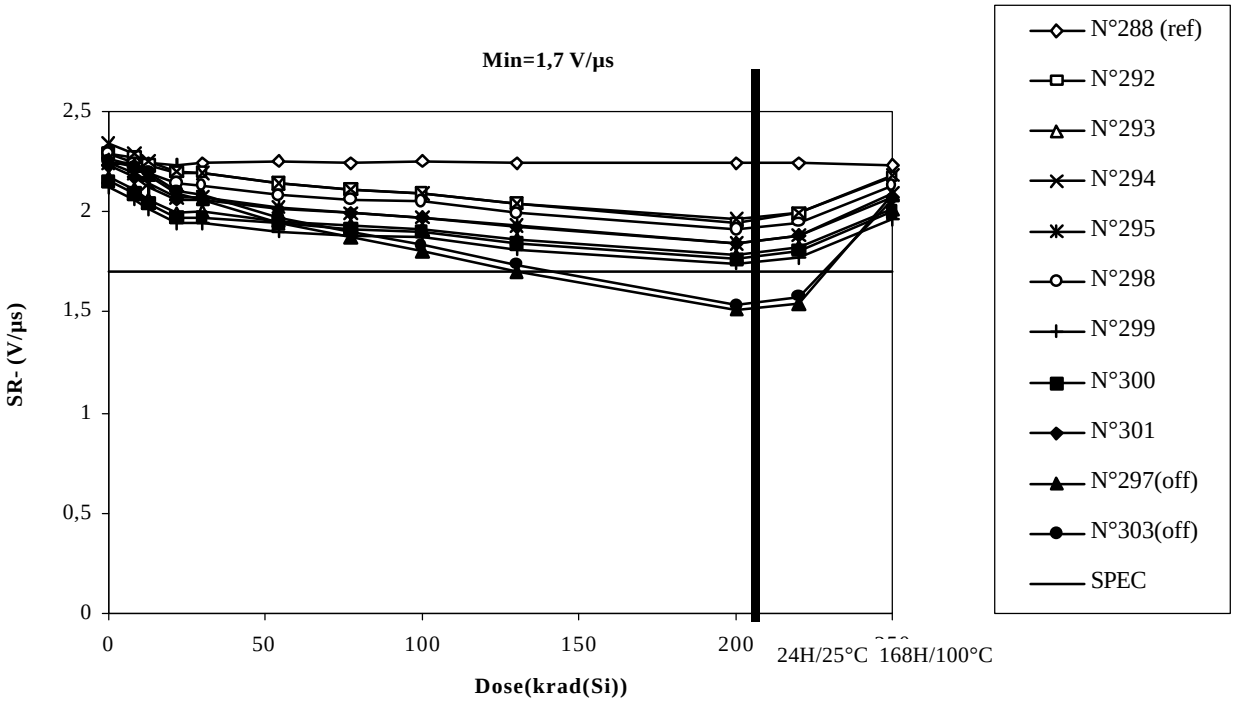
Vio(µV)	Vcc+ =15V ; Vcc- = -15V ;Min= -25µV ; Max=25µV											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	6	9	10	10	11	9	6	7	6	6	7	8
N°292	21	33	32	34	37	33	35	33	34	33	30	29
N°293	22	29	30	33	36	33	32	33	35	27	29	30
N°294	1	5	11	13	15	15	16	15	18	19	12	5
N°295	20	27	28	34	34	33	34	33	34	30	29	27
N°298	22	29	29	31	34	32	33	31	33	29	33	32
N°299	18	31	33	37	36	35	34	34	34	34	33	34
N°300	19	21	25	27	29	30	32	35	35	34	34	33
N°301	16	20	25	31	34	35	34	33	32	32	29	27
N°297(off)	12	16	18	24	26	30	34	36	41	47	46	23
N°303(off)	8	8	10	11	14	19	19	22	23	26	19	8
Average	17	24	27	30	32	31	31	31	32	30	29	27
s	7	9	7	7	7	7	6	7	6	5	7	9
Avg+3*s	38	52	47	52	54	50	50	50	49	45	50	55
Avg-3*s	-3	-3	6	8	10	11	12	11	15	15	8	-1

7.4. SR+ (V/µs)



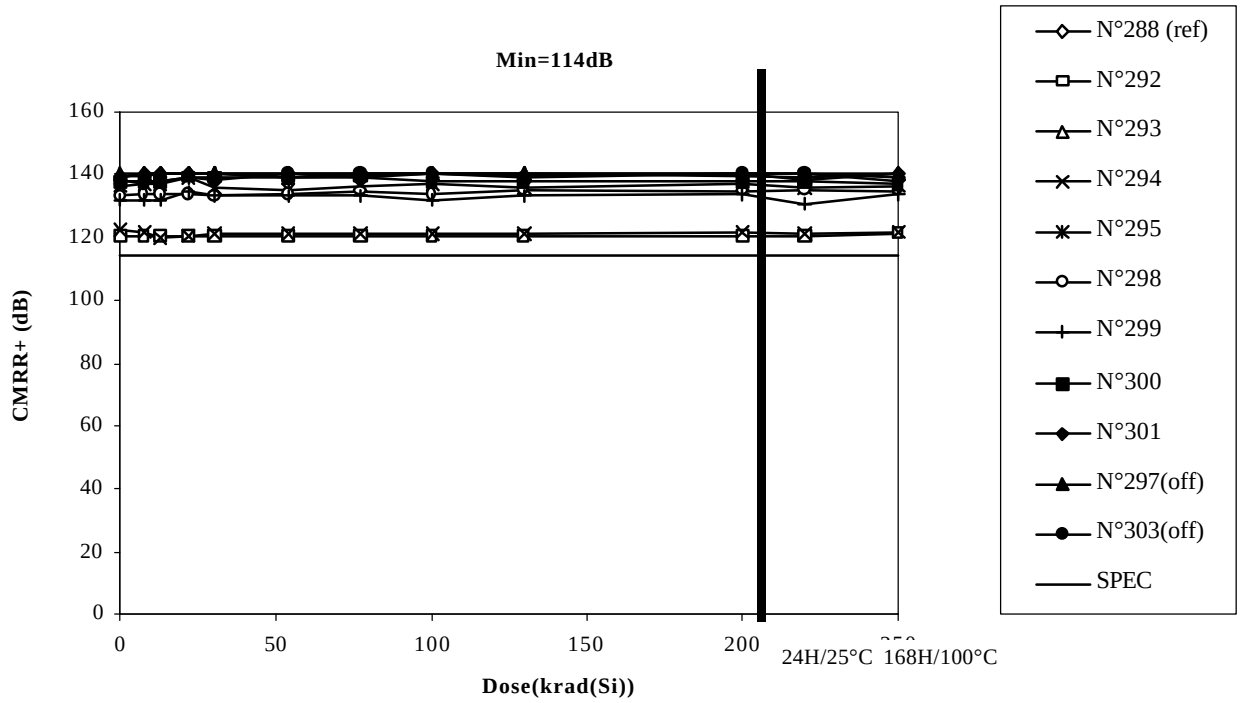
SR+ (V/µs)	Vcc+ =15V ; Vcc- = -15V ; AV=1 ; Min=1,7 V/µs											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	2,079	2,11	2,103	2,088	2,103	2,107	2,105	2,107	2,107	2,103	2,096	2,088
N°292	2,148	2,11	2,073	2,014	2,018	1,974	1,947	1,921	1,871	1,764	1,821	2,012
N°293	2,016	1,957	1,898	1,821	1,83	1,791	1,77	1,754	1,696	1,603	1,656	1,862
N°294	2,174	2,121	2,077	2,014	2,016	1,969	1,936	1,916	1,866	1,775	1,823	2,03
N°295	2,103	2,043	1,988	1,907	1,914	1,862	1,832	1,818	1,768	1,678	1,73	1,951
N°298	2,137	2,083	2,024	1,982	1,967	1,929	1,898	1,889	1,828	1,735	1,779	1,986
N°299	1,97	1,903	1,845	1,776	1,778	1,747	1,723	1,717	1,656	1,571	1,612	1,815
N°300	2,006	1,936	1,881	1,808	1,813	1,778	1,753	1,742	1,686	1,597	1,645	1,857
N°301	2,077	2,016	1,969	1,887	1,894	1,855	1,826	1,813	1,761	1,675	1,718	1,929
N°297(off)	2,116	2,083	2,03	1,929	1,889	1,756	1,675	1,596	1,489	1,267	1,309	1,918
N°303(off)	2,11	2,075	2,039	1,946	1,918	1,789	1,704	1,63	1,528	1,301	1,338	1,905
Average	2,079	2,021	1,969	1,901	1,904	1,863	1,836	1,821	1,767	1,675	1,723	1,930
s	0,075	0,082	0,088	0,095	0,092	0,088	0,085	0,080	0,083	0,079	0,081	0,079
Avg+3*s	2,303	2,268	2,233	2,186	2,180	2,126	2,090	2,062	2,016	1,912	1,965	2,167
Avg-3*s	1,855	1,774	1,706	1,617	1,628	1,600	1,581	1,580	1,517	1,438	1,481	1,694

7.5. SR- (V/µs)



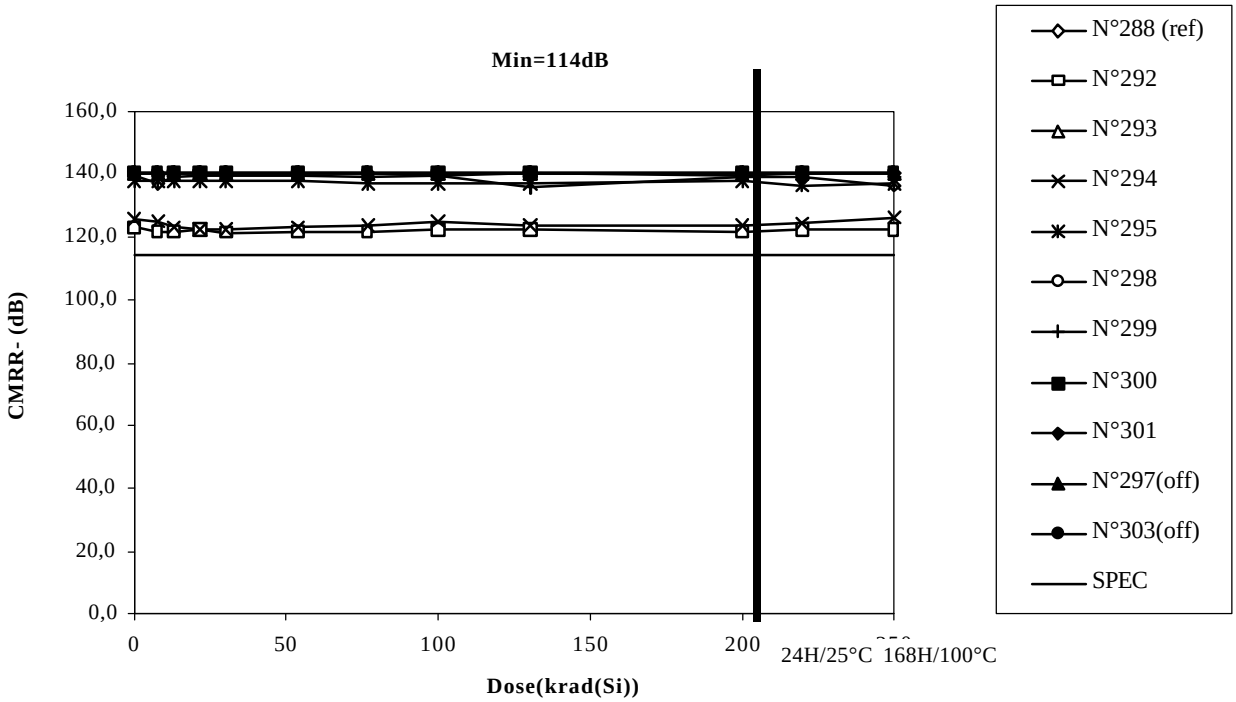
SR- (V/µs)	Vcc+ =15V ; Vcc- = -15V ; AV=1 ; Min=1,7 V/µs											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	2,23	2,247	2,242	2,235	2,24	2,25	2,24	2,25	2,242	2,242	2,237	2,232
N°292	2,286	2,268	2,235	2,191	2,193	2,141	2,114	2,088	2,041	1,944	1,99	2,167
N°293	2,174	2,114	2,06	1,996	2,002	1,955	1,934	1,916	1,862	1,783	1,825	2,014
N°294	2,339	2,286	2,25	2,2	2,195	2,146	2,11	2,088	2,041	1,963	1,996	2,186
N°295	2,242	2,188	2,141	2,07	2,073	2,02	1,992	1,97	1,929	1,845	1,885	2,092
N°298	2,291	2,237	2,193	2,146	2,134	2,086	2,066	2,049	1,992	1,912	1,946	2,134
N°299	2,119	2,06	2,008	1,942	1,944	1,905	1,885	1,873	1,815	1,739	1,771	1,965
N°300	2,155	2,092	2,043	1,976	1,976	1,942	1,914	1,899	1,845	1,767	1,803	1,998
N°301	2,227	2,169	2,123	2,058	2,06	2,01	1,99	1,972	1,918	1,845	1,878	2,075
N°297(off)	2,262	2,232	2,186	2,094	2,062	1,944	1,871	1,802	1,708	1,512	1,544	2,081
N°303(off)	2,247	2,22	2,188	2,105	2,083	1,97	1,899	1,828	1,738	1,538	1,57	2,066
Average	2,229	2,177	2,132	2,072	2,072	2,026	2,001	1,982	1,930	1,850	1,887	2,079
s	0,076	0,084	0,090	0,099	0,096	0,091	0,088	0,085	0,088	0,084	0,085	0,081
Avg+3*s	2,456	2,427	2,402	2,368	2,360	2,299	2,266	2,236	2,193	2,101	2,141	2,323
Avg-3*s	2,002	1,926	1,861	1,776	1,785	1,752	1,736	1,727	1,668	1,598	1,632	1,835

7.6. CMRR+ (dB)



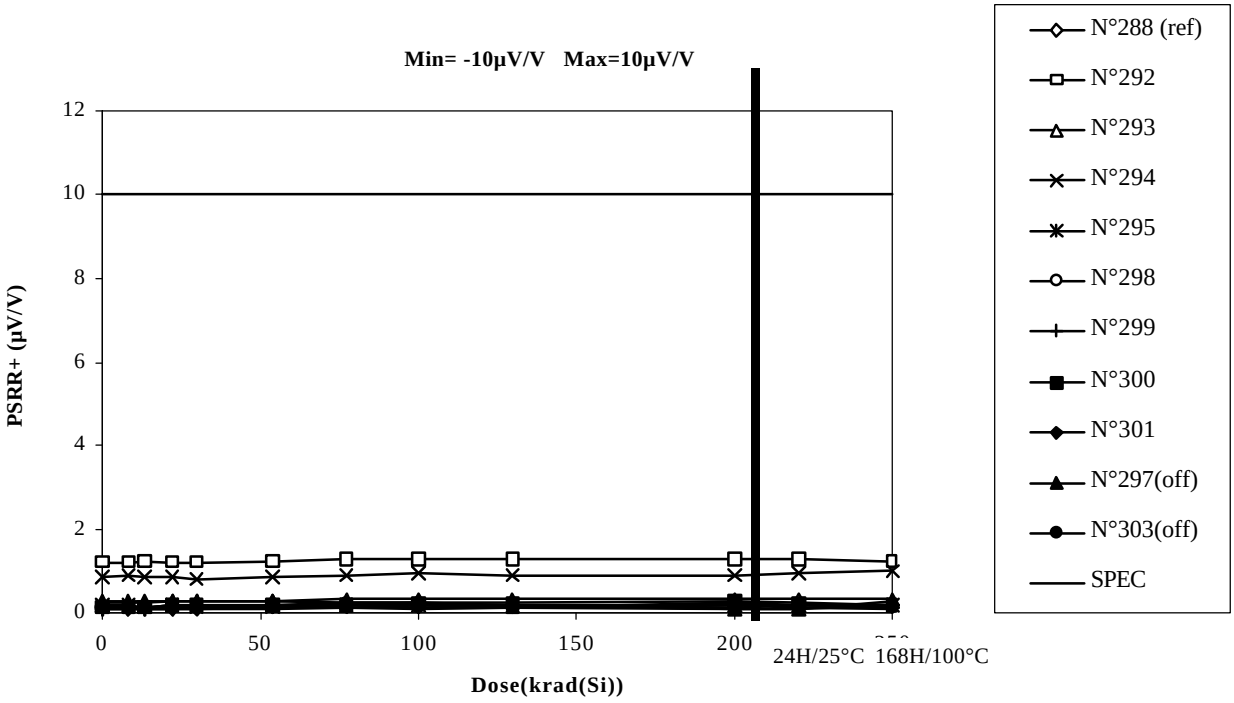
CMRR+ (dB)	Vcc+= 26V to 4V ; Vcm=11V ; Min=114dB											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	139,5	139,6	140,0	140,0	140,0	140,0	138,8	140,0	140,0	140,0	140,0	138,8
N°292	120,3	120,3	120,4	120,5	120,3	120,3	120,2	120,4	120,3	120,6	120,5	120,8
N°293	139,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0
N°294	122,2	122,0	120,1	120,6	120,9	121,0	121,1	121,1	121,3	121,9	121,0	121,9
N°295	136,6	137,0	136,8	138,8	135,8	135,4	136,4	137,1	135,8	137,1	136,0	136,1
N°298	133,0	133,9	134,0	134,2	133,5	134,1	134,2	133,9	135,2	134,5	134,9	134,2
N°299	131,8	132,1	132,1	134,8	133,2	133,2	133,3	131,6	133,4	133,6	130,6	133,7
N°300	138,0	138,0	138,0	139,0	139,0	139,0	139,0	138,0	138,0	138,0	138,0	137,3
N°301	139,0	140,0	140,0	140,0	140,0	139,0	139,6	140,0	139,9	140,0	138,6	140,0
N°297(off)	140,0	140,0	140,0	140,0	140,0	139,0	140,0	140,0	140,0	139,9	139,0	140,0
N°303(off)	138,2	136,9	137,7	138,8	138,4	140,0	140,0	140,0	139,0	140,0	140,0	137,5
Average	132,5	132,9	132,7	133,5	132,8	132,7	133,0	132,8	133,0	133,2	132,4	133,0
s	7,4	7,8	8,1	8,3	8,0	7,9	8,0	8,0	7,9	7,7	7,8	7,5
Avg+3*s	154,8	156,2	157,1	158,3	156,9	156,3	156,9	156,6	156,6	156,4	155,7	155,7
Avg-3*s	110,2	109,6	108,3	108,6	108,8	109,2	109,0	108,9	109,4	110,0	109,2	110,4

7.7. CMRR- (dB)



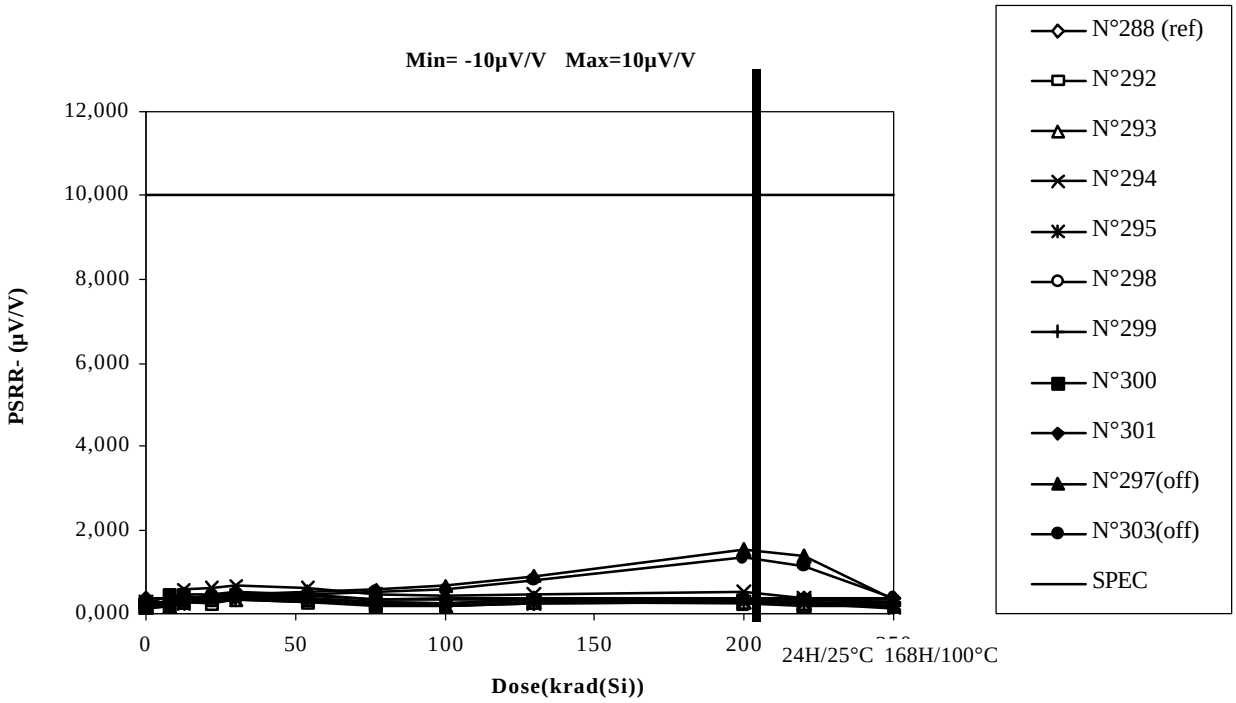
CMRR- (dB)	Vcc-= -4V to -26V ; Vcm= -11V ; Min=114dB											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	139,7	137,2	139,3	139,4	139,5	139,5	138,7	139,9	135,5	139,3	138,9	136,6
N°292	122,7	121,9	121,7	122,6	121,2	121,4	121,9	122,3	122,2	121,8	122,7	122,6
N°293	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0
N°294	125,4	125,1	123,0	122,6	122,3	123,2	123,8	124,8	123,7	123,7	124,5	126,0
N°295	137,4	137,9	137,5	137,4	137,8	137,6	137,2	137,3	137,1	137,5	136,7	137,1
N°298	140,0	140,0	140,0	140,0	140,0	140,0	140,0	139,9	140,0	140,0	140,0	140,0
N°299	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0
N°300	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0
N°301	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0
N°297(off)	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	139,6	140,0	140,0
N°303(off)	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0	140,0
Average	135,7	135,6	135,3	135,3	135,2	135,3	135,4	135,5	135,4	135,4	135,5	135,7
s	7,3	7,6	8,0	7,9	8,3	8,1	7,8	7,5	7,7	7,8	7,4	7,2
Avg+3*s	157,5	158,3	159,4	159,0	160,1	159,5	158,7	158,0	158,6	158,9	157,8	157,2
Avg-3*s	113,8	112,9	111,2	111,6	110,2	111,1	112,0	113,1	112,1	111,9	113,1	114,2

7.8. PSRR+ (µV/V)



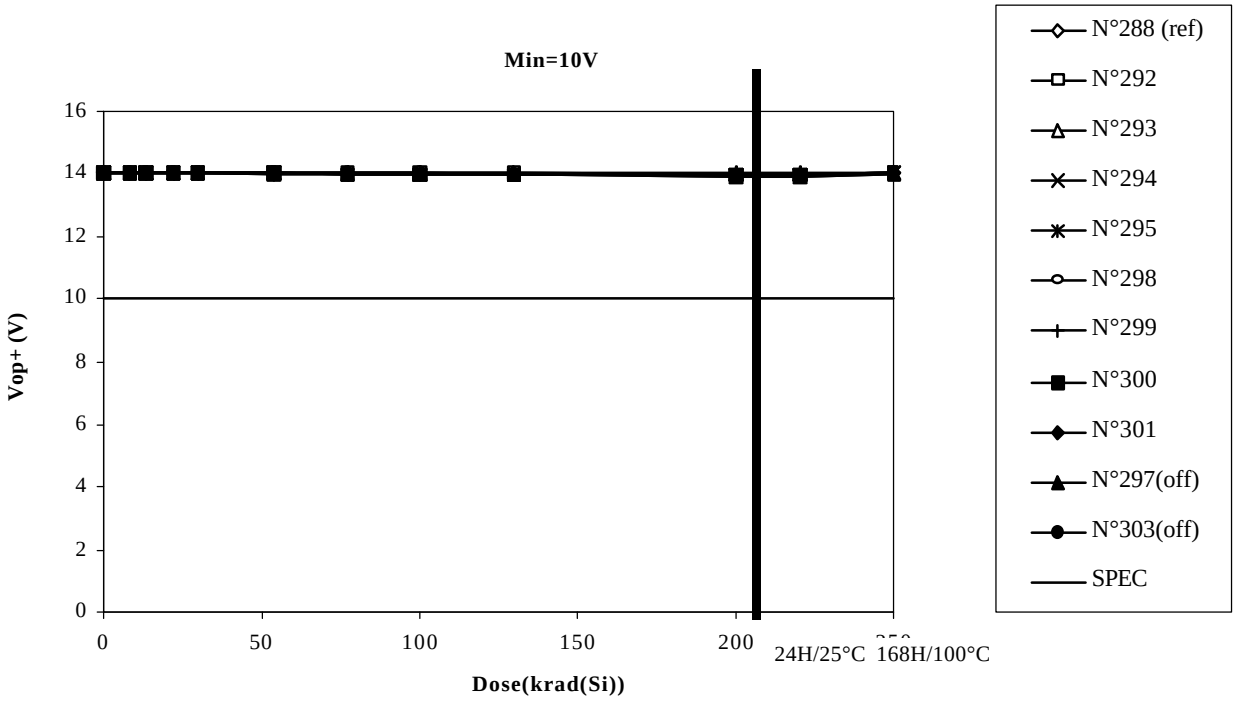
PSRR+ (µV/V)	Vcc+ =4,5V to 18V ; Vcc- = -15V ;Min= -10µV/V Max=10µV/V											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	0,173	0,137	0,146	0,147	0,161	0,139	0,177	0,167	0,183	0,146	0,192	0,188
N°292	1,187	1,210	1,221	1,209	1,178	1,248	1,281	1,287	1,299	1,284	1,296	1,242
N°293	0,245	0,257	0,246	0,265	0,288	0,287	0,316	0,321	0,329	0,341	0,356	0,319
N°294	0,870	0,888	0,876	0,862	0,831	0,865	0,909	0,932	0,924	0,889	0,974	0,994
N°295	0,170	0,170	0,145	0,170	0,137	0,154	0,197	0,206	0,196	0,205	0,209	0,204
N°298	0,100	0,100	0,100	0,100	0,100	0,100	0,129	0,116	0,125	0,172	0,141	0,100
N°299	0,100	0,100	0,100	0,108	0,140	0,133	0,144	0,153	0,158	0,219	0,196	0,167
N°300	0,135	0,104	0,128	0,191	0,203	0,203	0,210	0,242	0,242	0,273	0,245	0,199
N°301	0,100	0,100	0,110	0,104	0,111	0,164	0,140	0,163	0,165	0,213	0,203	0,144
N°297(off)	0,288	0,293	0,263	0,309	0,303	0,268	0,248	0,249	0,151	0,100	0,100	0,283
N°303(off)	0,123	0,119	0,132	0,187	0,161	0,205	0,236	0,238	0,179	0,100	0,100	0,193
Average	0,363	0,366	0,366	0,376	0,374	0,394	0,416	0,427	0,430	0,449	0,452	0,421
s	0,422	0,434	0,434	0,421	0,405	0,425	0,435	0,436	0,437	0,410	0,434	0,440
Avg+3*s	1,629	1,668	1,668	1,639	1,588	1,669	1,721	1,736	1,741	1,681	1,755	1,740
Avg-3*s	-0,902	-0,935	-0,936	-0,887	-0,841	-0,881	-0,889	-0,881	-0,881	-0,782	-0,850	-0,898

7.9. PSRR- (µV/V)



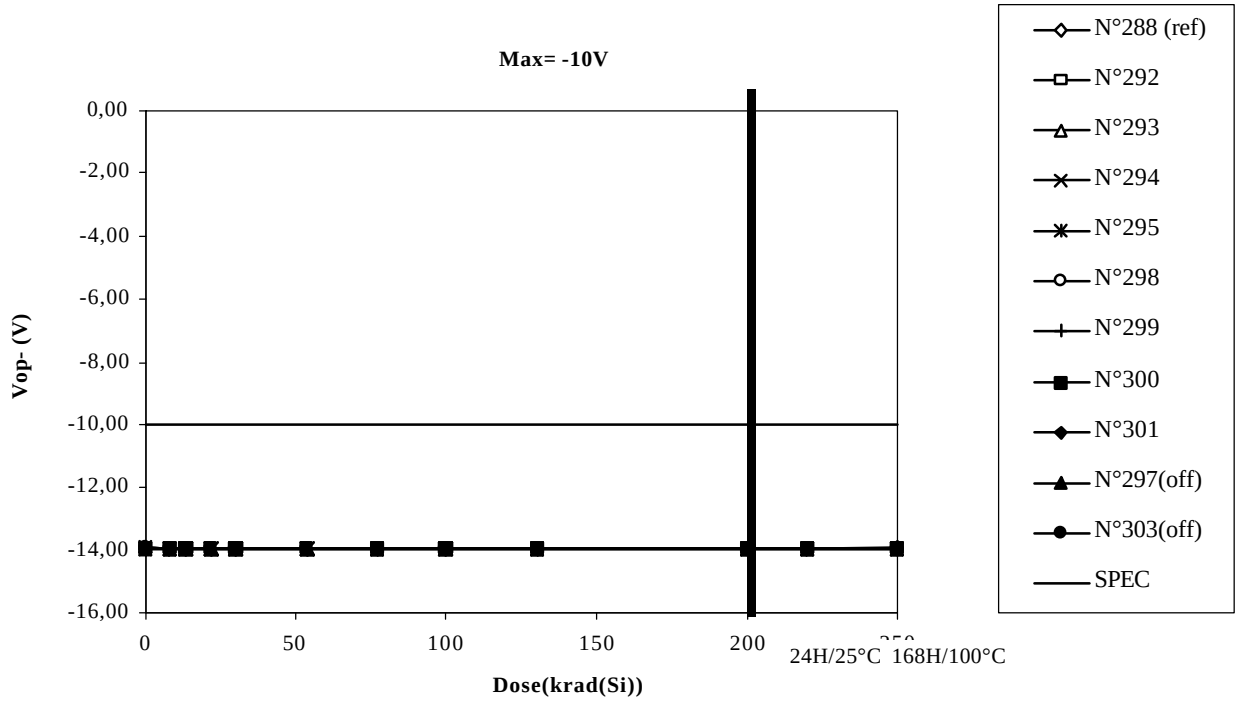
PSRR- (µV/V)	Vcc+ = 15V ; Vcc- = -4,5V to -18V ; Min= -10µV/V Max=10µV/V											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	0,231	0,262	0,283	0,293	0,313	0,291	0,226	0,200	0,216	0,283	0,263	0,249
N°292	0,199	0,236	0,269	0,257	0,332	0,302	0,212	0,215	0,277	0,249	0,195	0,198
N°293	0,172	0,208	0,302	0,349	0,350	0,333	0,253	0,209	0,274	0,271	0,249	0,181
N°294	0,267	0,255	0,550	0,623	0,654	0,614	0,493	0,409	0,498	0,508	0,394	0,257
N°295	0,147	0,181	0,235	0,321	0,350	0,324	0,226	0,195	0,258	0,289	0,224	0,158
N°298	0,266	0,286	0,359	0,425	0,437	0,410	0,313	0,311	0,351	0,327	0,338	0,323
N°299	0,242	0,262	0,378	0,357	0,375	0,370	0,285	0,254	0,311	0,330	0,236	0,246
N°300	0,263	0,417	0,407	0,353	0,424	0,393	0,290	0,250	0,324	0,345	0,313	0,286
N°301	0,380	0,399	0,472	0,497	0,529	0,481	0,344	0,360	0,377	0,403	0,370	0,359
N°297(off)	0,159	0,213	0,334	0,408	0,456	0,540	0,580	0,675	0,928	1,547	1,373	0,356
N°303(off)	0,229	0,282	0,360	0,406	0,455	0,497	0,527	0,582	0,807	1,360	1,157	0,404
Average	0,242	0,280	0,372	0,398	0,431	0,403	0,302	0,276	0,334	0,340	0,290	0,251
s	0,072	0,085	0,105	0,115	0,110	0,102	0,089	0,077	0,078	0,083	0,074	0,070
Avg+3*s	0,459	0,536	0,687	0,744	0,763	0,710	0,568	0,508	0,567	0,589	0,511	0,462
Avg-3*s	0,025	0,025	0,056	0,051	0,100	0,096	0,036	0,043	0,101	0,092	0,068	0,040

7.10. Vop+ (V)



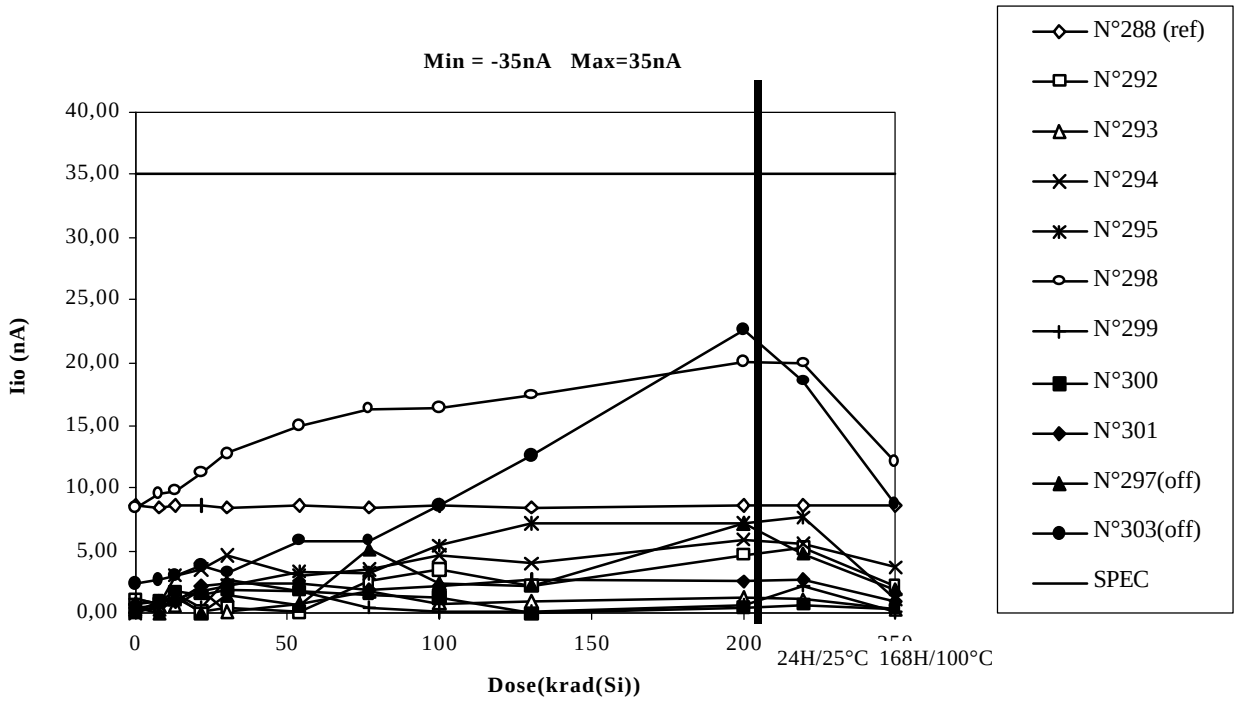
Vop+ (V)	Vcc+ =15V ; Vcc- = -15V ; R1=2k ; Min=10V											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	14,023	14,026	14,025	14,023	14,025	14,025	14,026	14,026	14,026	14,025	14,024	14,022
N°292	14,028	14,031	14,027	14,02	14,021	14,015	14,012	14,007	14,001	13,981	13,989	14,013
N°293	14,024	14,025	14,02	14,013	14,013	14,005	14,001	13,996	13,989	13,972	13,98	14,007
N°294	14,015	14,016	14,011	14,004	14,005	13,997	13,992	13,988	13,981	13,963	13,97	13,997
N°295	14,016	14,017	14,012	14,003	14,004	13,995	13,989	13,985	13,978	13,96	13,968	13,998
N°298	14,021	14,02	14,016	14,013	14,009	14,002	13,998	13,994	13,988	13,973	13,977	14,004
N°299	14,013	14,012	14,007	14	13,998	13,99	13,986	13,982	13,974	13,959	13,963	13,994
N°300	14,019	14,016	14,012	14,005	14,004	13,997	13,992	13,989	13,982	13,966	13,972	14,001
N°301	14,029	14,03	14,025	14,018	14,017	14,009	14,004	14,001	13,994	13,979	13,984	14,012
N°297(off)	14,016	14,016	14,01	14,001	13,998	13,987	13,979	13,968	13,951	13,892	13,905	13,976
N°303(off)	14,023	14,021	14,016	14,007	14,006	13,996	13,988	13,979	13,965	13,919	13,927	13,986
Average	14,021	14,021	14,016	14,010	14,009	14,001	13,997	13,993	13,986	13,969	13,975	14,003
s	0,006	0,007	0,007	0,007	0,008	0,008	0,009	0,008	0,009	0,008	0,009	0,007
Avg+3*s	14,039	14,042	14,038	14,032	14,032	14,026	14,023	14,018	14,012	13,994	14,002	14,024
Avg-3*s	14,003	14,000	13,995	13,987	13,986	13,977	13,971	13,968	13,959	13,944	13,949	13,982

7.11. Vop- (V)



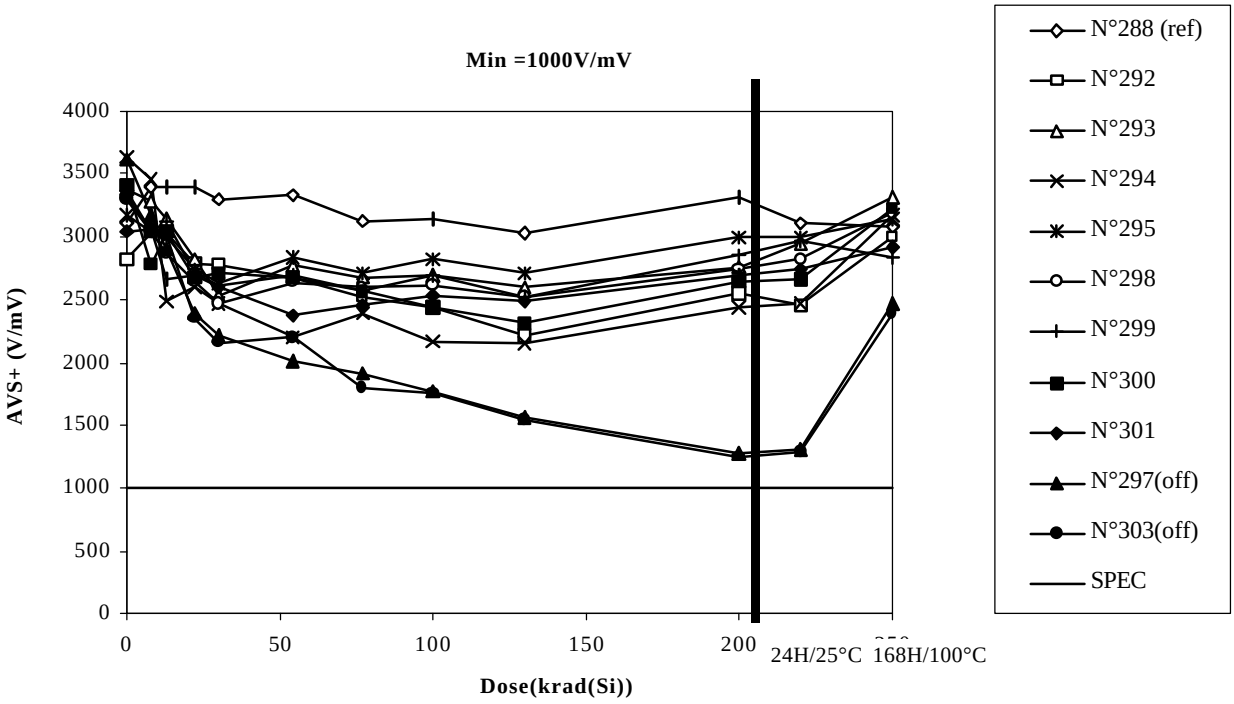
Vop- (V)	Vcc+ =15V ; Vcc- = -15V ; R1=2k ; Max= -10V											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	-13,93	-13,93	-13,93	-13,93	-13,93	-13,93	-13,93	-13,93	-13,93	-13,93	-13,93	-13,93
N°292	-13,94	-13,95	-13,95	-13,96	-13,96	-13,97	-13,97	-13,97	-13,98	-13,98	-13,99	-13,95
N°293	-13,94	-13,96	-13,96	-13,97	-13,97	-13,98	-13,98	-13,98	-13,99	-13,99	-13,99	-13,96
N°294	-13,92	-13,93	-13,94	-13,94	-13,95	-13,95	-13,96	-13,96	-13,97	-13,97	-13,97	-13,94
N°295	-13,93	-13,94	-13,95	-13,96	-13,96	-13,97	-13,97	-13,97	-13,97	-13,97	-13,98	-13,94
N°298	-13,93	-13,94	-13,95	-13,96	-13,96	-13,96	-13,96	-13,96	-13,97	-13,97	-13,97	-13,94
N°299	-13,94	-13,95	-13,96	-13,97	-13,97	-13,97	-13,97	-13,98	-13,98	-13,98	-13,98	-13,95
N°300	-13,94	-13,96	-13,97	-13,97	-13,98	-13,98	-13,98	-13,98	-13,99	-13,99	-13,99	-13,96
N°301	-13,93	-13,95	-13,95	-13,96	-13,96	-13,97	-13,97	-13,97	-13,98	-13,98	-13,98	-13,95
N°297(off)	-13,92	-13,93	-13,94	-13,96	-13,96	-13,98	-13,98	-13,99	-13,99	-13,98	-13,99	-13,95
N°303(off)	-13,93	-13,94	-13,94	-13,95	-13,96	-13,98	-13,98	-13,99	-13,99	-13,98	-13,99	-13,95
Average	-13,935	-13,947	-13,953	-13,960	-13,962	-13,969	-13,969	-13,972	-13,977	-13,978	-13,980	-13,948
s	0,007	0,008	0,010	0,011	0,010	0,009	0,008	0,008	0,008	0,007	0,007	0,007
Avg+3*s	-13,914	-13,923	-13,923	-13,928	-13,933	-13,943	-13,946	-13,950	-13,954	-13,956	-13,957	-13,926
Avg-3*s	-13,956	-13,971	-13,983	-13,993	-13,992	-13,995	-13,993	-13,995	-14,000	-14,000	-14,002	-13,970

7.12. Iio (nA)



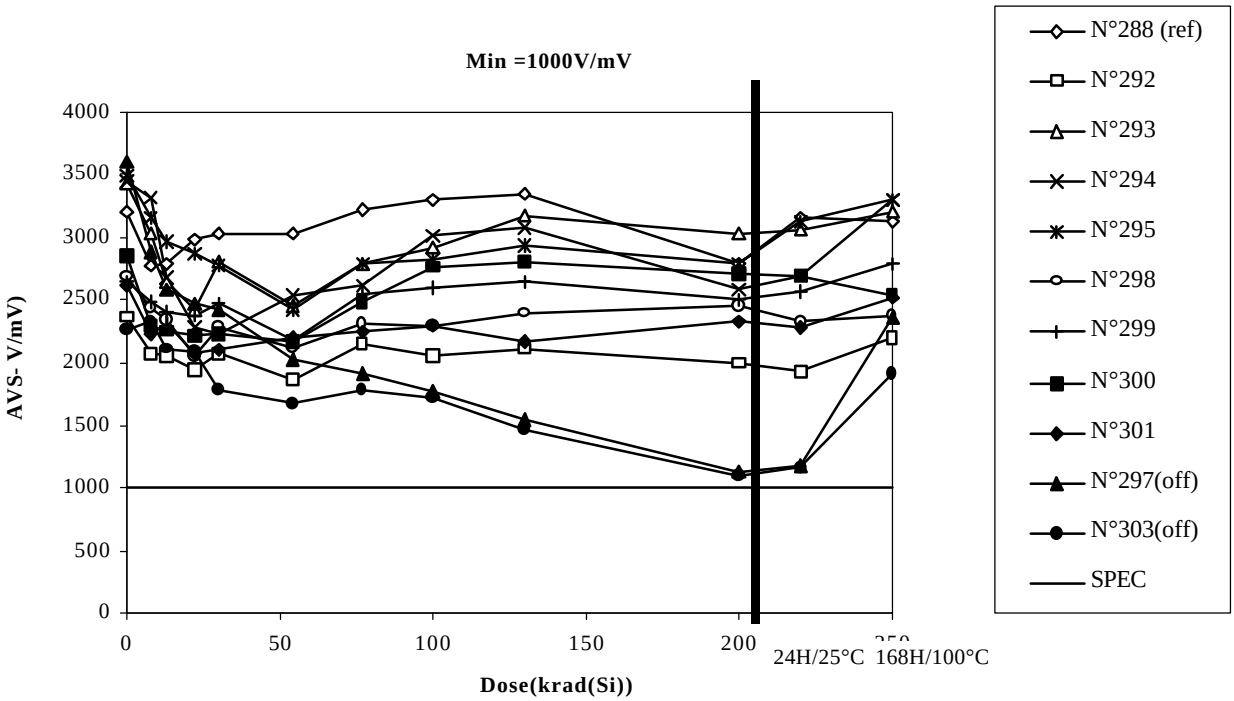
Iio (nA)	Vcc+ =15V ; Vcc- = -15V ; Min = -35nA Max=35nA											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	8,606	8,494	8,535	8,598	8,492	8,526	8,445	8,531	8,473	8,535	8,564	8,593
N°292	1,111	0,863	1,230	0,106	0,400	0,128	2,551	3,447	2,169	4,566	5,248	2,156
N°293	0,499	0,685	0,611	1,871	0,080	0,856	1,754	0,860	0,957	1,225	1,081	0,247
N°294	0,067	0,636	3,017	3,469	4,655	3,072	3,438	4,563	3,989	5,900	5,642	3,700
N°295	0,344	0,281	1,085	1,825	2,277	3,408	3,194	5,484	7,181	7,127	7,572	1,183
N°298	8,491	9,488	9,722	11,089	12,793	15,010	16,307	16,354	17,403	20,025	19,892	12,083
N°299	1,037	0,724	1,585	0,428	2,774	1,803	0,492	0,180	0,101	0,671	2,260	0,148
N°300	0,135	0,971	1,738	1,388	1,945	1,754	1,417	1,278	0,054	0,519	0,715	0,277
N°301	0,854	0,987	0,881	2,153	2,333	2,412	1,895	2,175	2,737	2,609	2,764	1,016
N°297(off)	0,482	0,013	1,434	0,070	1,373	0,585	5,025	2,349	2,165	7,217	4,705	1,890
N°303(off)	2,360	2,679	3,035	3,877	3,243	5,738	5,726	8,557	12,639	22,678	18,484	8,838
Average	1,567	1,829	2,484	2,791	3,407	3,555	3,881	4,293	4,324	5,330	5,647	2,601
s	2,825	3,103	3,015	3,510	4,049	4,753	5,111	5,209	5,781	6,427	6,231	4,014
Avg+3*s	10,043	11,138	11,530	13,323	15,553	17,814	19,214	19,920	21,665	24,613	24,339	14,644
Avg-3*s	-6,909	-7,479	-6,562	-7,740	-8,738	-10,703	-11,452	-11,335	-13,018	-13,952	-13,045	-9,441

7.13. Avs+ (V/mV)



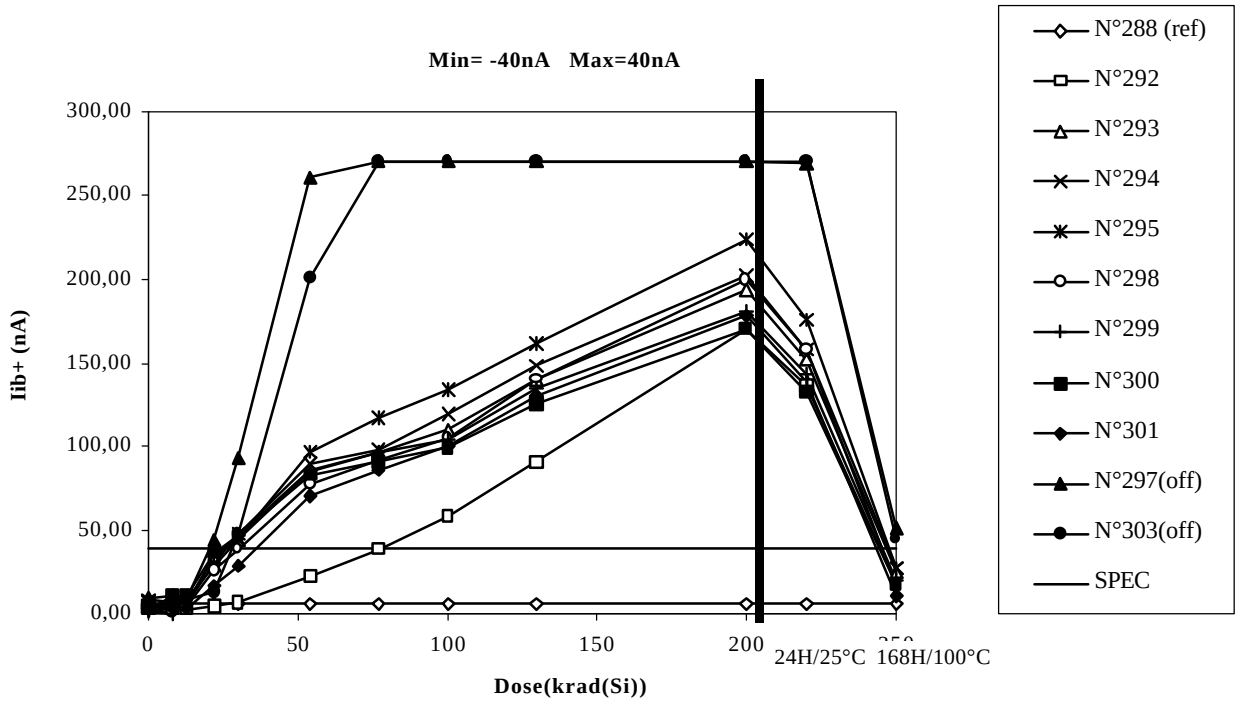
AVS+ (V/mV)	Vcc+ =15V ; Vcc- = -15V ; R1=2k ; Min =1000V/mV											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	3100	3393	3400	3400	3300	3337	3120	3146	3030	3309	3101	3071
N°292	2814	3024	3034	2786	2773	2678	2523	2438	2214	2552	2457	2991
N°293	3381	3278	3137	2823	2527	2776	2676	2700	2597	2755	2955	3311
N°294	3632	3462	2489	2595	2462	2197	2396	2160	2152	2442	2477	3167
N°295	3165	3044	2991	2749	2622	2835	2703	2826	2715	2998	2996	3145
N°298	3303	3047	2864	2653	2470	2636	2595	2614	2518	2737	2827	3191
N°299	3355	3040	3122	2714	2607	2692	2569	2698	2522	2846	2957	2829
N°300	3416	2777	3031	2683	2712	2676	2565	2434	2306	2646	2656	3214
N°301	3051	3065	2655	2693	2603	2375	2456	2533	2488	2696	2748	2916
N°297(off)	3622	3165	2895	2391	2218	2011	1916	1771	1560	1268	1305	2469
N°303(off)	3312	3055	3012	2342	2155	2199	1800	1760	1548	1249	1293	2384
Average	3265	3092	2915	2712	2597	2608	2560	2550	2439	2709	2759	3095
s	251	201	232	73	110	214	103	208	195	171	214	165
Avg+3*s	4016	3695	3612	2932	2926	3249	2870	3175	3025	3223	3401	3591
Avg-3*s	2513	2490	2219	2493	2268	1967	2251	1926	1852	2196	2118	2599

7.14. Avs- (V/mV)



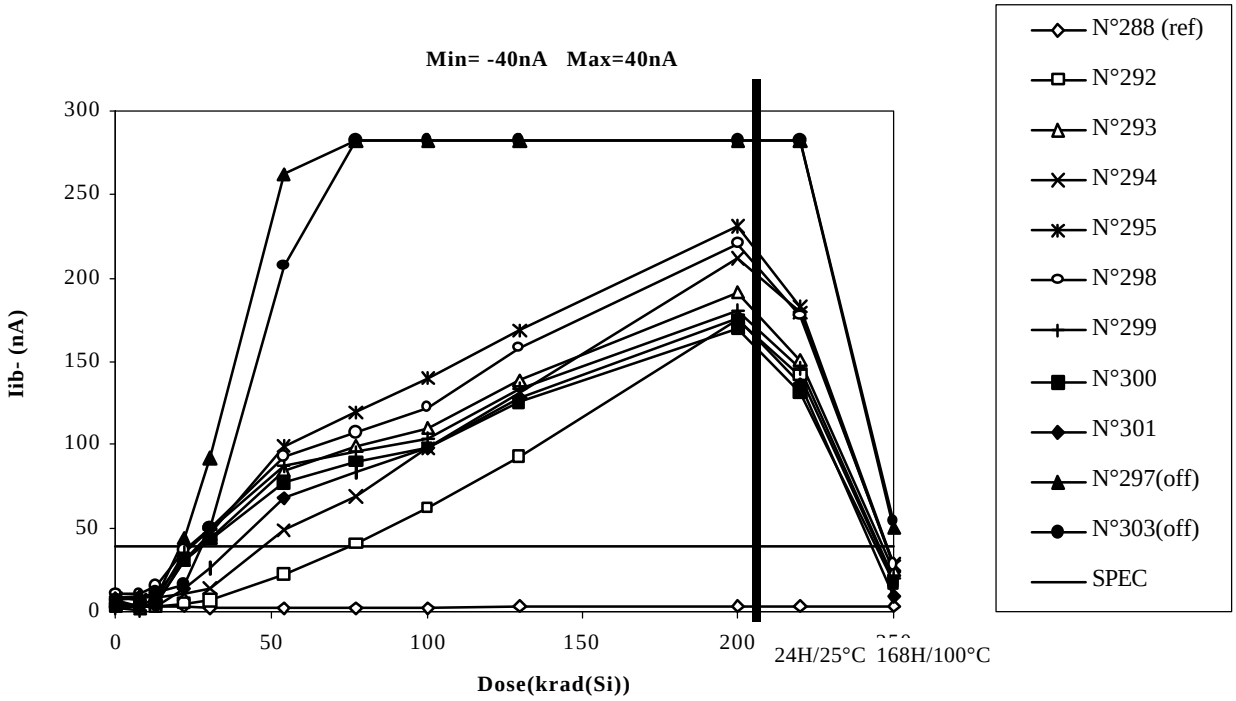
AVS- V/mV)	Vcc+ =15V ; Vcc- = -15V ; R1=2k ;Min =1000V/mV											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	3203	2768	2781	2974	3024	3030	3220	3300	3350	2781	3151	3122
N°292	2352	2074	2054	1950	2065	1871	2144	2055	2099	1999	1936	2201
N°293	3433	3028	2650	2424	2799	2450	2783	2917	3170	3022	3059	3205
N°294	3442	3310	2674	2276	2230	2536	2617	3008	3075	2576	2686	3296
N°295	3486	3160	2967	2875	2772	2429	2794	2822	2938	2783	3121	3301
N°298	2683	2438	2346	2050	2277	2112	2313	2301	2391	2448	2319	2372
N°299	2648	2493	2406	2367	2477	2187	2550	2600	2646	2507	2560	2791
N°300	2857	2291	2254	2223	2239	2166	2483	2750	2811	2715	2696	2530
N°301	2619	2230	2314	2076	2107	2192	2251	2298	2169	2326	2273	2519
N°297(off)	3599	2883	2574	2469	2430	2031	1909	1765	1550	1132	1184	2355
N°303(off)	2268	2319	2110	2084	1778	1672	1779	1719	1469	1102	1157	1916
Average	2940	2628	2458	2280	2371	2243	2492	2594	2662	2547	2581	2777
s	447	469	289	290	284	217	241	341	407	310	401	439
Avg+3*s	4282	4036	3324	3150	3223	2895	3214	3618	3884	3476	3783	4094
Avg-3*s	1598	1220	1592	1410	1518	1591	1769	1570	1441	1618	1379	1459

7.15. Iib+ (nA)



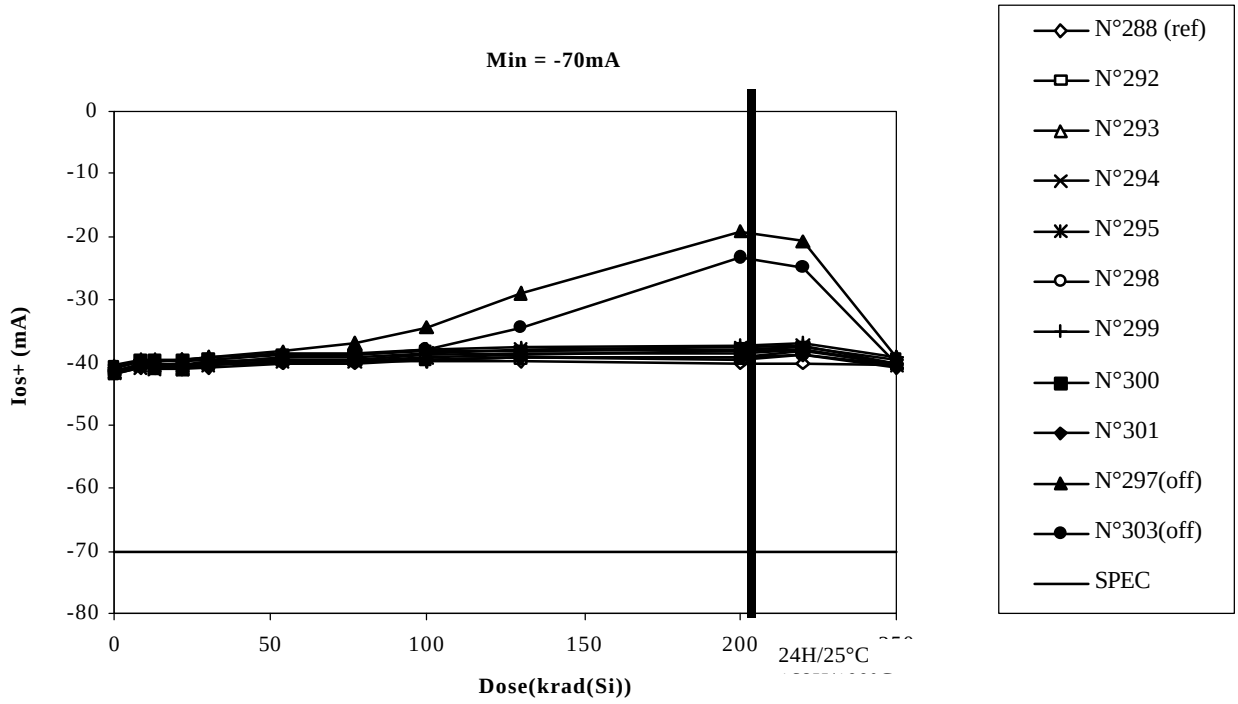
Iib+ (nA)	Vcc+ =15V ; Vcc- = -15V ; Min= -40nA Max=40nA											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	5,38	5,44	5,52	5,47	5,49	5,53	5,48	5,55	5,45	5,52	5,45	5,40
N°292	4,62	2,92	2,33	4,46	7,27	22,66	38,05	59,15	90,59	169,63	136,43	17,65
N°293	4,92	3,28	6,42	33,08	44,01	84,65	96,72	109,46	140,02	193,05	151,64	25,46
N°294	7,09	3,68	6,03	29,49	47,67	89,96	97,65	119,79	147,87	202,54	157,56	27,45
N°295	7,92	7,48	9,29	28,85	44,18	96,26	116,65	133,96	161,63	223,37	175,38	27,23
N°298	2,73	0,87	5,32	25,91	37,95	77,57	91,70	105,66	140,20	200,01	157,19	16,56
N°299	1,22	0,33	5,73	35,06	46,45	85,79	96,46	104,29	134,66	179,92	142,89	20,75
N°300	2,66	10,18	10,96	35,90	46,59	82,74	90,48	99,22	125,51	169,69	132,65	18,23
N°301	2,84	4,16	3,24	16,14	28,16	70,38	85,57	100,54	130,36	178,40	138,38	10,81
N°297(off)	9,08	10,33	9,68	44,55	93,09	260,89	269,66	269,76	269,81	269,57	269,51	51,58
N°303(off)	4,71	5,99	8,37	13,24	47,28	200,62	269,67	269,76	269,85	269,55	269,57	44,42
Average	4,25	4,11	6,16	26,11	37,78	76,25	89,16	104,01	133,85	189,58	149,02	20,52
s	2,33	3,28	2,85	10,77	13,91	22,99	22,59	21,47	20,70	18,68	14,24	5,87
Avg+3*s	11,25	13,95	14,73	58,41	79,50	145,22	156,92	168,41	195,97	245,61	191,73	38,12
Avg-3*s	-2,75	-5,72	-2,40	-6,19	-3,94	7,28	21,40	39,61	71,74	133,54	106,30	2,91

7.16. Iib- (nA)



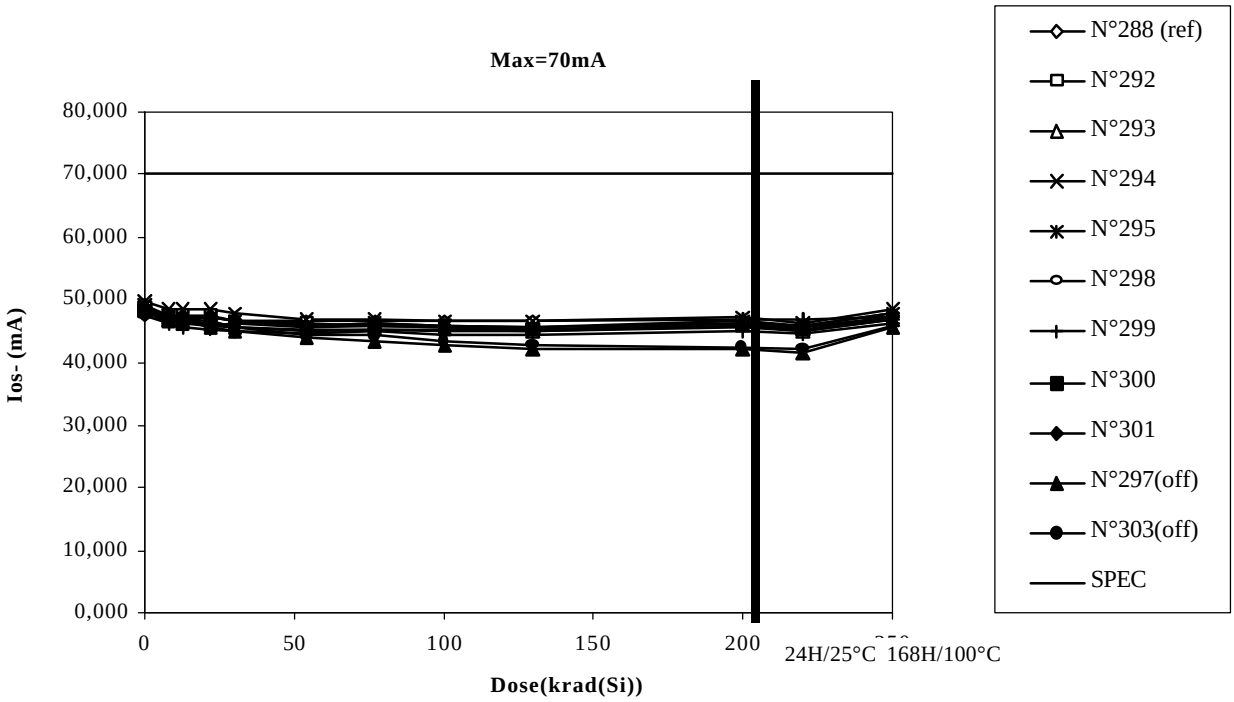
Iib- (nA)	Vcc+ =15V ; Vcc- = -15V ; Min= -40nA Max=40nA											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	3,19	3,01	2,99	3,08	2,96	2,98	2,98	2,96	3,01	2,99	3,09	3,18
N°292	5,70	3,72	3,46	4,49	6,87	22,79	40,35	62,71	92,83	174,15	141,49	19,72
N°293	5,39	2,58	5,87	31,14	43,89	85,38	98,67	110,17	138,97	191,73	150,53	25,68
N°294	7,13	3,09	8,51	11,08	14,86	49,20	69,12	97,81	131,45	211,21	179,20	27,07
N°295	8,25	7,29	10,28	30,64	46,54	99,76	119,91	139,50	168,60	230,09	183,07	28,42
N°298	11,23	10,39	15,10	36,95	50,64	92,67	107,86	121,94	157,79	220,30	176,87	28,62
N°299	2,22	1,07	7,24	35,46	49,38	87,60	95,96	103,92	134,38	180,64	145,42	20,85
N°300	2,49	3,78	4,24	31,60	42,59	77,93	89,16	97,97	125,58	169,23	131,97	17,90
N°301	3,74	5,19	4,13	13,99	25,76	67,91	83,64	98,12	127,69	176,08	135,96	9,77
N°297(off)	8,63	9,97	8,36	44,00	91,56	262,25	282,09	282,18	282,34	282,06	282,04	49,78
N°303(off)	7,08	8,70	11,42	17,32	50,70	206,54	282,08	282,17	282,32	282,06	282,00	53,60
Average	5,77	4,64	7,35	24,42	35,07	72,91	88,08	104,02	134,66	194,18	155,56	22,25
s	3,06	2,96	3,92	12,53	16,92	25,65	24,60	22,15	22,67	23,31	20,83	6,51
Avg+3*s	14,94	13,52	19,10	61,99	85,82	149,87	161,89	170,46	202,66	264,10	218,05	41,78
Avg-3*s	-3,40	-4,25	-4,39	-13,16	-15,68	-4,06	14,28	37,57	66,66	124,26	93,08	2,73

7.17. Ios+ (mA)



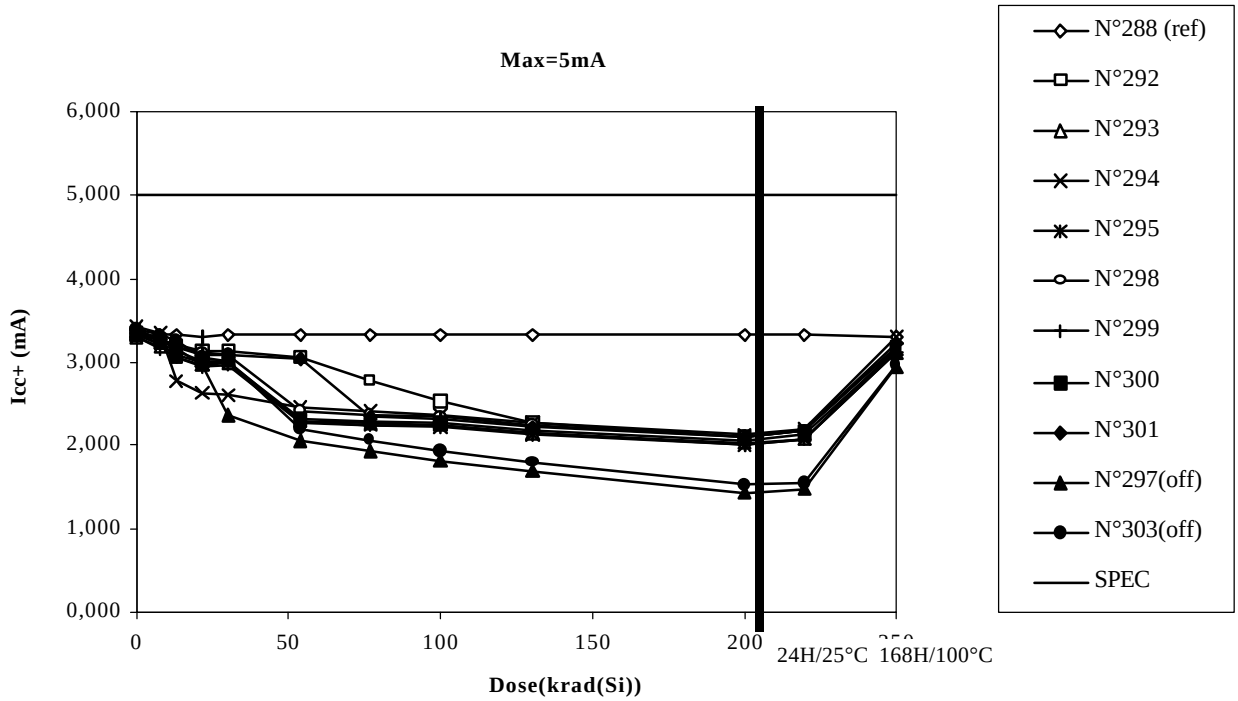
Ios+ (mA)	Vcc+ =15V ; Vcc- = -15V Min = -70mA											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	-40,733	-39,853	-40,103	-40,553	-40,053	-40,010	-39,950	-39,883	-39,960	-40,103	-40,207	-40,533
N°292	-41,677	-40,637	-40,760	-41,130	-40,393	-39,997	-39,793	-39,443	-39,057	-39,223	-38,370	-40,273
N°293	-41,377	-40,303	-40,337	-40,567	-39,957	-39,477	-39,387	-38,933	-38,597	-38,567	-37,813	-40,013
N°294	-41,793	-40,863	-40,963	-41,260	-40,583	-39,970	-39,823	-39,220	-38,773	-38,323	-37,850	-40,510
N°295	-41,457	-40,400	-40,453	-40,710	-40,003	-39,310	-39,197	-38,577	-38,047	-37,487	-37,160	-40,183
N°298	-41,540	-40,503	-40,580	-40,007	-40,350	-39,887	-39,927	-39,420	-39,223	-39,370	-38,873	-40,437
N°299	-40,423	-39,463	-39,460	-39,503	-39,170	-38,613	-38,623	-37,987	-37,677	-37,337	-37,033	-39,217
N°300	-40,827	-39,733	-39,740	-39,953	-39,500	-38,913	-38,973	-38,343	-38,097	-37,927	-37,557	-39,620
N°301	-41,890	-40,870	-40,897	-41,217	-40,670	-40,050	-40,083	-39,573	-39,290	-39,203	-38,900	-40,813
N°297(off)	-41,017	-39,867	-39,837	-39,650	-39,293	-38,180	-37,033	-34,287	-29,010	-19,080	-20,580	-39,253
N°303(off)	-41,310	-40,457	-40,420	-40,747	-40,103	-39,353	-39,043	-37,783	-34,490	-23,333	-24,803	-40,077
Average	-41,373	-40,347	-40,399	-40,543	-40,078	-39,527	-39,476	-38,937	-38,595	-38,430	-37,945	-40,133
s	0,503	0,509	0,541	0,661	0,529	0,545	0,515	0,581	0,599	0,800	0,715	0,512
Avg+3*s	-39,864	-38,820	-38,774	-38,560	-38,492	-37,891	-37,930	-37,195	-36,797	-36,030	-35,799	-38,597
Avg-3*s	-42,882	-41,873	-42,023	-42,526	-41,665	-41,163	-41,022	-40,679	-40,393	-40,829	-40,090	-41,670

7.18. Ios- (mA)



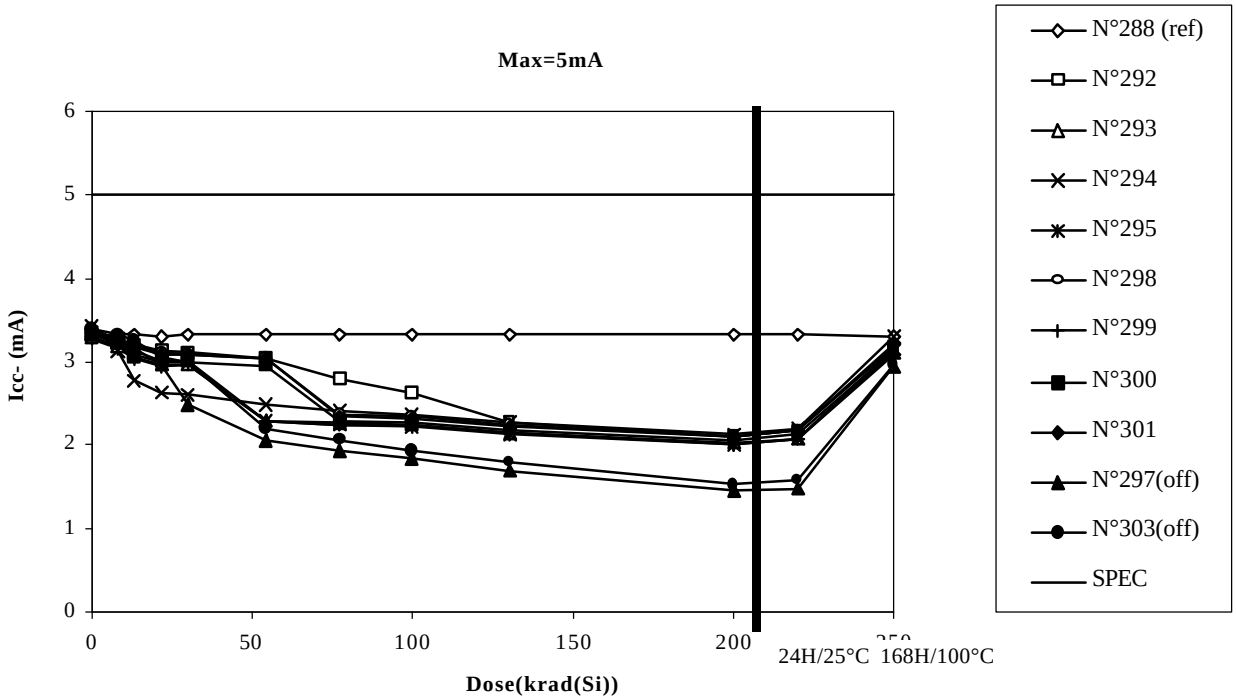
Ios- (mA)	Vcc+ =15V ; Vcc- = -15V ; Max=70mA											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	47,340	46,487	46,727	47,157	46,673	46,623	46,583	46,510	46,587	46,727	46,820	47,143
N°292	48,637	47,443	47,417	47,530	46,667	46,110	45,910	45,653	45,403	46,217	45,247	47,183
N°293	48,320	46,827	46,423	46,263	45,673	45,303	45,413	45,207	45,067	45,883	44,993	46,970
N°294	49,687	48,537	48,447	48,503	47,680	47,007	47,003	46,610	46,470	47,107	46,350	48,403
N°295	49,027	47,603	47,330	47,230	46,487	45,920	46,110	45,813	45,660	46,400	45,743	47,850
N°298	48,560	47,193	46,867	45,850	46,180	45,703	45,840	45,473	45,343	45,910	45,450	47,330
N°299	47,533	46,057	45,560	45,253	44,990	44,600	44,827	44,450	44,343	44,860	44,487	46,317
N°300	48,030	46,457	46,063	45,903	45,470	44,997	45,273	44,897	44,833	45,443	45,043	46,833
N°301	48,893	47,510	47,173	47,030	46,480	45,893	46,113	45,817	45,703	46,287	45,977	47,790
N°297(off)	48,427	46,907	46,430	45,590	44,997	43,827	43,333	42,693	42,200	41,913	41,550	45,607
N°303(off)	48,447	47,313	46,973	46,667	45,650	44,443	44,187	43,430	42,753	42,340	42,153	45,903
Average	48,586	47,203	46,910	46,695	46,203	45,692	45,811	45,490	45,353	46,013	45,411	47,335
s	0,654	0,766	0,898	1,067	0,832	0,739	0,658	0,655	0,637	0,670	0,598	0,661
Avg+3*s	50,548	49,500	49,604	49,897	48,699	47,909	47,784	47,456	47,263	48,024	47,206	49,317
Avg-3*s	46,624	44,907	44,216	43,494	43,708	43,475	43,838	43,524	43,442	44,002	43,617	45,352

7.19. Icc+ (mA)



Icc+ (mA)	Vcc+ =15V ; Vcc- = -15V ; Max=5mA											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25°C**	**168H/100°C**
N°288 (ref)	3,299	3,328	3,320	3,306	3,322	3,324	3,324	3,328	3,324	3,320	3,317	3,307
N°292	3,344	3,277	3,212	3,128	3,121	3,049	2,770	2,530	2,275	2,115	2,171	3,173
N°293	3,291	3,172	3,068	2,967	2,977	2,301	2,271	2,247	2,154	2,023	2,089	3,108
N°294	3,427	3,338	2,768	2,640	2,604	2,473	2,414	2,363	2,275	2,136	2,192	3,307
N°295	3,329	3,219	3,129	3,016	3,022	2,289	2,249	2,217	2,137	2,013	2,076	3,155
N°298	3,364	3,266	3,172	3,099	3,088	2,403	2,365	2,342	2,246	2,111	2,168	3,185
N°299	3,287	3,155	3,048	2,952	2,962	2,282	2,255	2,240	2,142	2,019	2,077	3,098
N°300	3,315	3,198	3,090	2,980	2,989	2,314	2,288	2,271	2,178	2,057	2,118	3,128
N°301	3,398	3,282	3,190	3,078	3,082	3,040	2,348	2,321	2,233	2,110	2,171	3,217
N°297(off)	3,347	3,261	3,150	2,965	2,370	2,053	1,935	1,825	1,691	1,438	1,482	2,945
N°303(off)	3,396	3,315	3,241	3,056	3,001	2,190	2,058	1,941	1,797	1,521	1,559	2,969
Average	3,344	3,238	3,085	2,983	2,981	2,519	2,370	2,316	2,205	2,073	2,133	3,171
s	0,050	0,063	0,141	0,153	0,163	0,331	0,172	0,101	0,059	0,050	0,048	0,068
Avg+3*s	3,494	3,426	3,507	3,441	3,469	3,512	2,886	2,619	2,381	2,224	2,277	3,375
Avg-3*s	3,195	3,051	2,662	2,524	2,492	1,526	1,854	2,014	2,029	1,922	1,989	2,968

7.20. Icc- (mA)



Icc- (mA)	Vcc+ =15V ; Vcc- = -15V ; Max=5mA											
Dose(krad(Si))	**0**	**8**	**13**	**22**	**30**	**54**	**77**	**100**	**130**	**200**	**24H/25° C**	**168H/100°C**
N°288 (ref)	3,299	3,326	3,319	3,305	3,320	3,323	3,323	3,325	3,323	3,319	3,316	3,305
N°292	3,341	3,276	3,211	3,126	3,119	3,047	2,800	2,630	2,274	2,115	2,171	3,170
N°293	3,290	3,171	3,067	2,964	2,974	2,302	2,270	2,246	2,153	2,022	2,089	3,105
N°294	3,424	3,136	2,769	2,641	2,605	2,475	2,413	2,363	2,275	2,136	2,192	3,306
N°295	3,326	3,218	3,127	3,014	3,018	2,290	2,249	2,217	2,136	2,013	2,076	3,151
N°298	3,362	3,265	3,172	3,097	3,085	3,038	2,364	2,341	2,246	2,111	2,168	3,183
N°299	3,286	3,155	3,047	2,949	2,959	2,289	2,254	2,240	2,142	2,019	2,077	3,095
N°300	3,313	3,196	3,089	2,978	2,986	2,947	2,288	2,271	2,178	2,057	2,118	3,125
N°301	3,398	3,283	3,190	3,076	3,079	3,037	2,349	2,320	2,233	2,110	2,171	3,215
N°297(off)	3,344	3,259	3,148	2,962	2,481	2,058	1,940	1,832	1,700	1,449	1,490	2,940
N°303(off)	3,393	3,313	3,240	3,054	2,999	2,194	2,062	1,946	1,803	1,530	1,566	2,965
Average	3,343	3,213	3,084	2,981	2,978	2,678	2,373	2,329	2,205	2,073	2,133	3,169
s	0,050	0,057	0,140	0,152	0,162	0,369	0,182	0,132	0,059	0,051	0,048	0,069
Avg+3*s	3,491	3,384	3,505	3,436	3,463	3,784	2,919	2,726	2,381	2,225	2,277	3,374
Avg-3*s	3,194	3,041	2,663	2,525	2,493	1,572	1,827	1,931	2,028	1,921	1,989	2,963

8. APPENDIX 1.
MANUFACTURER DATA SHEET

N°	*Parameters*	*Symbol*	*Test Conditions*	*Limit*		*Unit*
				Min	*Max*	
1	Input Offset Current	Vio	Vcc+ =15V ; Vcc- = -15V	-25	25	µV
2	Slew Rate	SR+	Vcc+ =15V ; Vcc- = -15V ; AV=1	1,7	-	V/µs
3	Slew Rate	SR-	Vcc+ =15V ; Vcc- = -15V ; AV=1	1,7	-	V/µs
4	Common Mode Rejection Ratio	CMRR+	Vcc+= 26Vto 4V ; Vcm=11V	114	-	dB
5	Common Mode Rejection Ratio	CMRR-	Vcc-= -4Vto -26V ; Vcm= -11V	114	-	dB
6	Power Supply Rejection Ratio	PSRR+	Vcc+ =4,5V to 18V ; Vcc- = -15V	-10	10	µV/V
7	Power Supply Rejection Ratio	PSRR-	Vcc+ = 15V ; Vcc- = -4,5V to -18V	-10	10	µV/V
8	Maximum Output Voltage Swing	Vop +	Vcc+ =15V ; Vcc- = -15V ; R1=2k	10	-	V
9	Maximum Output Voltage Swing	Vop -	Vcc+ =15V ; Vcc- = -15V ; R1=2k	-	-10	V
10	Input Offset Current	Iio	Vcc+ =15V ; Vcc- = -15V	-35	35	nA
11	Single Ended Open Loop Voltage Gain	Avs+	Vcc+ =15V ; Vcc- = -15V ; R1=2k	1000	-	V/mV
12	Single Ended Open Loop Voltage Gain	Avs-	Vcc+ =15V ; Vcc- = -15V ; R1=2k	1000	-	V/mV
13	Input Bias Current	Iib+	Vcc+ =15V ; Vcc- = -15V	-40	40	nA
14	Input Bias Current	Iib-	Vcc+ =15V ; Vcc- = -15V	-40	40	nA
15	Output Short Circuit Current	Iio+	Vcc+ =15V ; Vcc- = -15V	-70	-	mA
16	Output Short Circuit Current	Iio-	Vcc+ =15V ; Vcc- = -15V	-	70	mA
17	Power Supply Current	Icc+	Vcc+ =15V ; Vcc- = -15V	-	5	mA
18	Power Supply Current	Icc-	Vcc+ =15V ; Vcc- = -15V	-	5	mA

9. APPENDIX 2.
MATRA MARCONI SPACE TEST PLAN