TOTAL DOSE STEADY-STATE IRRADIATION

OF

3C91C (DC 9806)

OPTOELECTRONIC COMPONENT

from

MITTEL

Written by	Verified by	Approved by
Name: I. DESENCLOS	Name: J.F OLIVE	Name: T. CARRIERE
Date: 23/10/98	Date:	Date:
Visa:	Visa:	Visa:

CONTENTS

I. DOCUMENTATION

I.1 APPLICABLE DOCUMENTS:

PRO2. 001.....	MATRA Procedure for Total Dose Steady-State Irradiation on Active Devices.

I.2 REFERENCE DOCUMENTS:

MIL STD 883 D, Method 1019-4	Steady State Irradiation Procedure
ESA/SCC 22900-3.....	ESA Basic Specification For Total Dose Steady-State Irradiation
MA 5000 AJQ issue 1	Detail Specification

II. TEST PLAN

II.1 PARTS REFERENCES

REFERENCES		
TYPE	:	3C91C
MANUFACTURER	:	MITTEL
PLACE	:	SWEDEN
FUNCTION		
OPTOELECTRONIC COMPONENT		
TECHNOLOGY		
BIPOLAR		
PARTS PROCUREMENT		
ORIGIN	:	CPPA (AGLIGNE)
LEVEL	:	B
PACKAGING	:	TO 72
DATE CODE	:	9806
F.R. NUMBER	:	42436
WAFER LOT NUMBER	:	diode 826-5 ; transistor 403231-33
NUMBER OF PARTS	:	11
DETAIL SPECIFICATION		
MA 5000 AJQ issue 1		

II.2 ELECTRICAL MEASUREMENTS

TEST TYPE		
TYPE	:	Remote elcctrical measurements done at room temperature
TEST FACILITY		
PLACE	:	MMS Vélizy
MATERIAL	:	HP4155A, TLS216
CALIBRATION DATE	:	04/98, 01/98

TESTED PARAMETERS

Parameter Name	Fig n°	Symbol	Test Conditions	Min	Max	Unit
Breakdown Voltage	1	Vbr	Ir= -100µA	7		V
Forward Voltage 1	2	Vf1	If= 2mA		1,3	V
Forward Voltage 2	3	Vf2	If= 50mA		1,8	V
Dark Current	4	Ice0	Vce= 5V / If= 0 mA		50	nA
Output Current	5	Ic	Vce= 5V / If= 10mA	4		mA
Collector-Emitter Breakdown Voltage	6	V(br)ce0	Ic= 10mA / If= 0mA	50		V
Collector-Emitter Saturation Voltage	7	Vce(sat)	Ic= 2mA / If= 50mA		0,4	V
Rise Time	8	tr	Ic= 2 mA : Vce= 5V		5,0	µs
Fall Time	9	tf	Ic= 2 mA : Vce= 5V		5,0	µs

Notes:

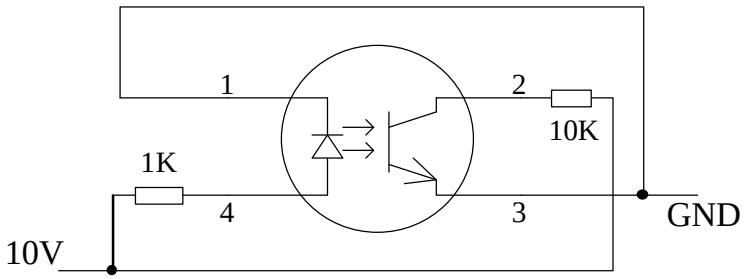
- All electrical measurements were made within one hour of termination of the irradiation step.
- Figure numbers refer to the figures showing variation and values of each parameter with total dose and annealings at the end of this document.

II.3 EXPERIMENTAL CONDITIONS

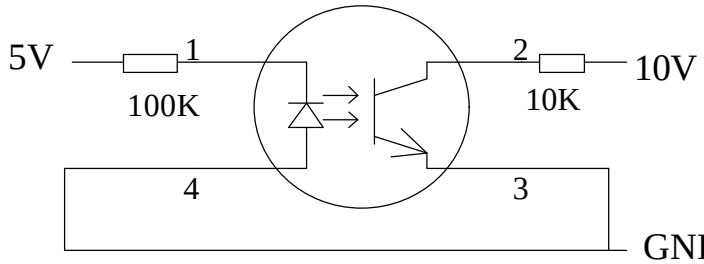
IRRADIATION FACILITY		
PLACE	:	MATRA MARCONI Space (VELIZY, France)
TYPE	:	COBALT60, SHEPHERD 484
ACTIVITY	:	< 9 Curies
CALIBRATION DATE	:	20/01/98

IRRADIATION FACILITY		
TYPE	:	Multiple Exposure
STEPS	:	5 / 9 / 15 / 33 /54 / 83 / 113 kRad (Si)

BIASING CONDITIONS



Mode 1 (Sn 1 to 4)



Mode 2 (Sn 5 to 8)

COMMENTS

8 parts were biased in Static On mode 1 and 2, 2 parts in Static Off mode with all pins connected to the ground.

III TEST REPORT

III.1 EXPERIMENTAL CONDITIONS

PARTS IDENTIFICATION			
MANUFACTURER MARKING : MITEL MAAJQ02B 9806			
SAMPLES DESCRIPTION			
SN Manuf.	**SN Irrad.**	**Biasing Mode**	**Comments**
001	0	REF	
002	1	ON	Mode 1
003	2	ON	Mode 1
004	3	ON	Mode 1
005	4	ON	Mode 1
007	5	ON	Mode 2
008	6	ON	Mode 2
009	7	ON	Mode 2
010	8	ON	Mode 2
011	9	OFF	
012	10	OFF	

IRRADIATION SCHEDULE

Step N°	Date In / Out	Description	DOSE RATE [kRad(Si) / H]	IRRAD. TIME [H]	DOSE [kRad(Si)]	TOTAL DOSE [kRad(Si)]
0	29/06/98	Initial Measurements				
1	29/06/98 30/06/98	Irradiation & Measurements	0,210	24,05	5,1	5
2	30/06/98 01/07/98	Irradiation & Measurements	0,210	20,22	4,2	9
3	01/07/98 02/07/98	Irradiation & Measurements	0,210	26	5,46	15
4	02/07/98 06/07/98	Irradiation & Measurements	0,210	86,33	18,12	33
5	06/07/98 10/07/98	Irradiation & Measurements	0,210	101,23	21,25	54
6	10/07/98 16/07/98	Irradiation & Measurements	0,210	136,92	28,75	83
7	16/07/98 22/07/98	Irradiation & Measurements	0,210	142,08	29,84	113
8	22/07/98 23/07/98	Annealing Amb.		24		
9	23/07/98 30/07/98	Annealing 100°C		168		

III.2 EXPERIMENTAL RESULTS

III.2.1.Parametric tests:

The evolution of each parameter as a function of the total dose and annealings is plotted at the end of the report.

The following tables summarize the evolution of the measured parameters with irradiation and annealings (See next page) for each biasing conditions

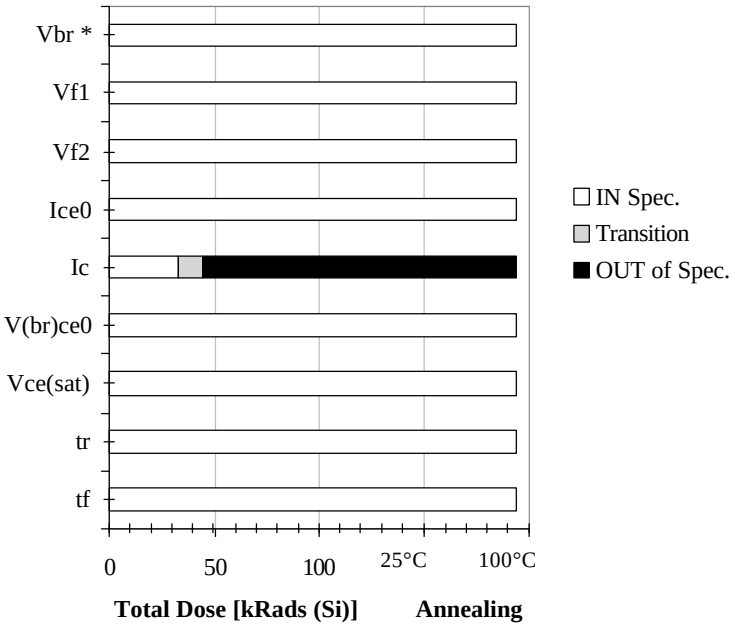
In the construction of these charts ,

1/ A parameter is considered to be out of specification if the parameter is measured out of specification on one or more devices.

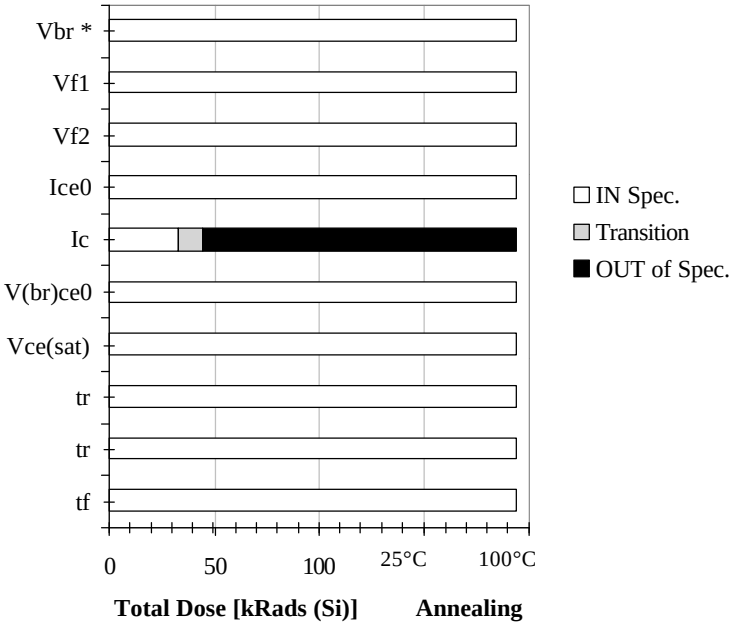
2/ A parameter is considered to be in specification only up to the last step for which all irradiated devices remain inside the parameter specification.

3/ The step during which a parameter goes out of specification (or recovers) is called transition step.

Bias Condition: ON



Bias Condition: OFF



* For breakdown voltage (Vbr), all measurements are close to the specification limit and are considered acceptable due to the accuracy of the tester.

III.2.2.Post irradiation effects.

Step 1.

Temperature : Room Temperature.
Duration : 24
Biasing : Parts biased as during irradiation.

Step 2.

Temperature : 100°C.
Duration : 168
Biasing : Parts biased as during irradiation.

Important remark : 100°C annealing results shall not be taken into account in an attempt to predict the space dose rate behavior of parts * .

III.2.3 Problems encountered / Discussion

- For breakdown voltage (Vbr), all measurements are close to the specification limit and are considered acceptable due to the accuracy of the tester.

- Increase of V(br)ce0 has been observed during irradiation. Due to the limitation of hte tester, measurements of this parameter were saturated at 70V.

* "Hardness-Assurance and Testing Issues for Bipolar/BiCMOS Devices"
R. Nathan Nowlin, D.M. Fleetwood, R.D. Schrimpf, R.L. Pease, W.E. Combs
IEEE Transactions on Nuclear Science, Vol.40, N°6, p1686, December 1993

IV CONCLUSION

Total dose steady-state irradiation test using gamma rays from Cobalt 60 has been carried out on 11 parts (8 parts biased in Static On mode and 2 Off) OPTOELECTRONIC COMPONENT 3C91C (9806) from MITTEL up to 113 kRAD test at low dose rate (≤ 360 Rad/h).

The results indicate that :

- All the parameters stay within specification up to 37 kRAD

The following table shows the tolerance in kRad of parameters affected by irradiation (by interpolation from the figures) :

	Tolerance	
Parameter	**Static On**	**Static Off**
Output current (Ic)	37 kRAD	45 kRAD

- Biasing mode effect : no significant difference between biasing modes has been observed.

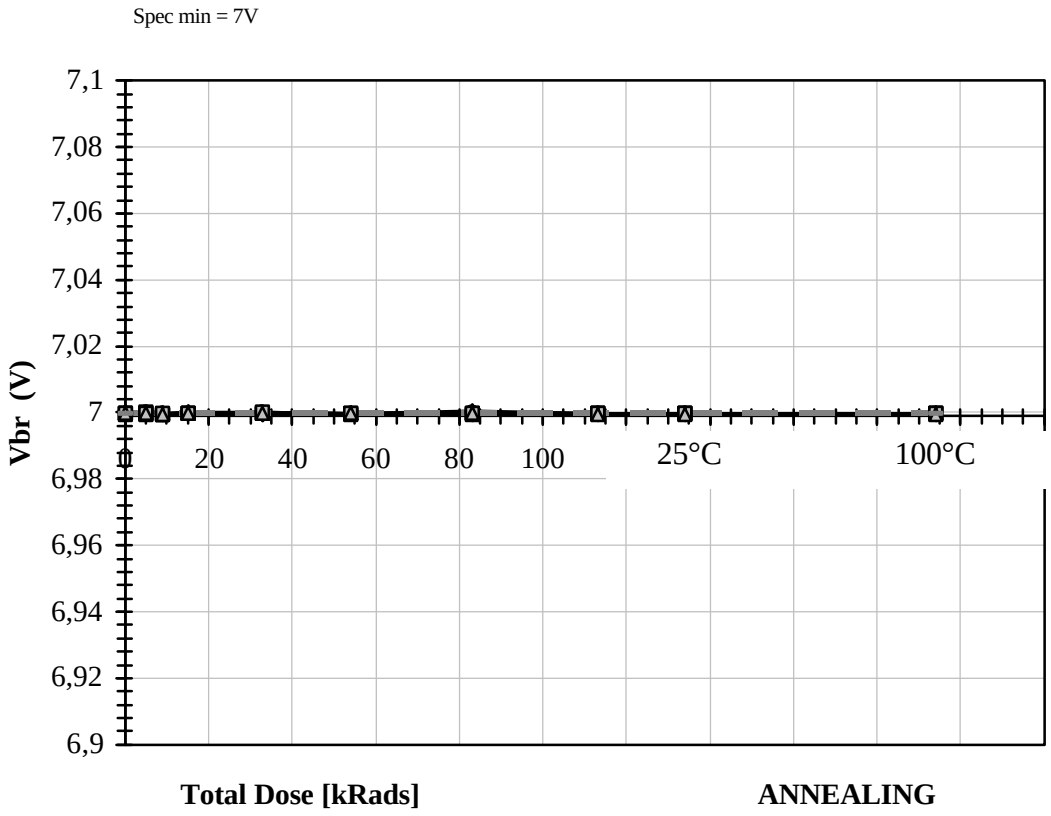
- Annealing effect : no significant effect.

In the following table, a comparison is made with other date codes from the same manufacturer, already tested :

Date code	**Diffusion lot**	**Tolerance (in kRad)**	**Report ref.**
9631	822-8 (diode) 90493-18 (transistor)	47	DOF/DEC/RP8.011
9441	817-6 (diode) 90492-8 (transistor)	15	DOF/DEC/RP8.010

Date : 30/07/98	Device Type :	3C91C	Figure 1

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	OFF / ON / REF
Test	Parameter :	**Vbr**	Conditions :	Ir= 100µA

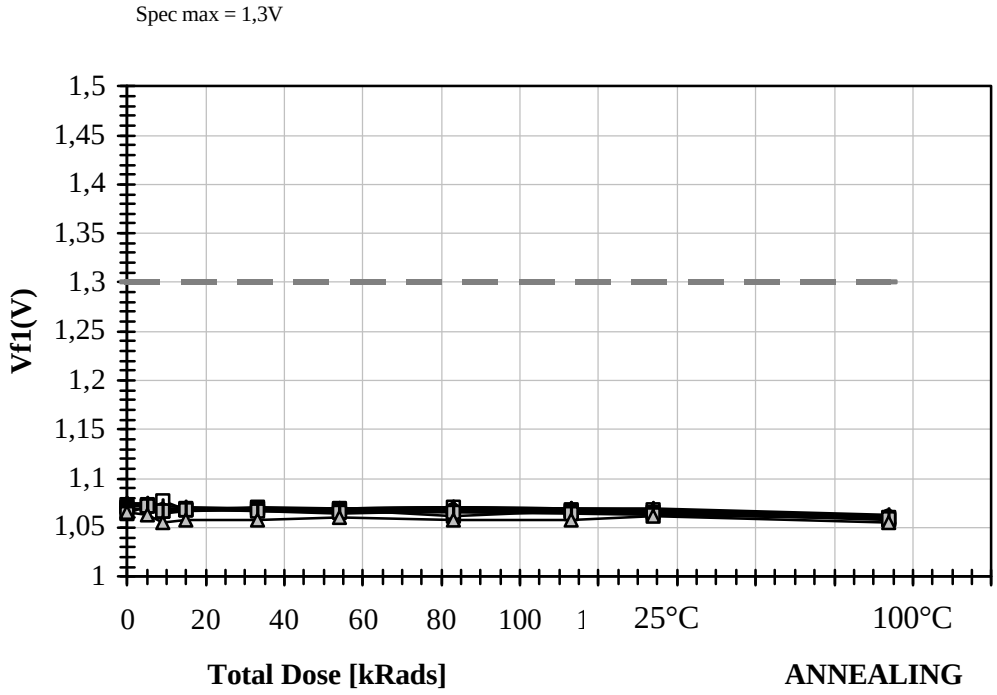


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON	□	**6,9998**	7,000067	**6,9994**	**6,9998**	**6,999933**	**6,9998**	**6,999733**	**6,999867**	**6,999867**	**6,999867**
2	ON	◇	7,0002	7	**6,999667**	7,000067	**6,9998**	**6,9998**	7,000133	**6,999667**	**6,999667**	**6,999667**
3	ON	△	**6,999867**	**6,9996**	**6,999733**	**6,999733**	**6,9998**	**6,9998**	7,000267	**6,999733**	**6,999733**	**6,999733**
4	ON	○	7	7,000333	**6,9998**	**6,999933**	**6,999867**	**6,999533**	7,000067	**6,999467**	**6,999467**	**6,999467**
5	ON	■	**6,999733**	7	**6,999533**	**6,999933**	**6,999867**	**6,999533**	**6,9996**	**6,999667**	**6,999667**	**6,999667**
6	ON	◆	**6,999867**	7,0002	**6,999733**	7	**6,9996**	**6,9998**	**6,999933**	**6,999467**	**6,999467**	**6,999467**
7	ON	▲	**6,9996**	**6,999867**	7	7,000267	7,000133	**6,999867**	7,0006	**6,9998**	**6,9998**	**6,9998**
8	ON	●	7	**6,9998**	**6,999867**	**6,999933**	7,000267	**6,999867**	**6,9998**	**6,999933**	**6,999933**	**6,999933**
9	OFF	□	**6,9998**	**6,999667**	**6,999667**	**6,999867**	7,000067	**6,999733**	**6,9998**	**6,999867**	**6,999867**	**6,999867**
10	OFF	◇	**6,999533**	**6,999733**	**6,999533**	**6,9998**	**6,9996**	**6,999867**	**6,9996**	**6,9998**	**6,9998**	**6,9998**
0	REF	△	**6,9998**	**6,9998**	**6,999467**	**6,9998**	**6,9998**	**6,999933**	**6,999933**	**6,9996**	**6,9996**	**6,9996**

Date : 30/07/98	Device Type :	3C91C	Figure 2

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	OFF / ON / REF
Test	Parameter :	**Vf1**	Conditions :	If= 2mA

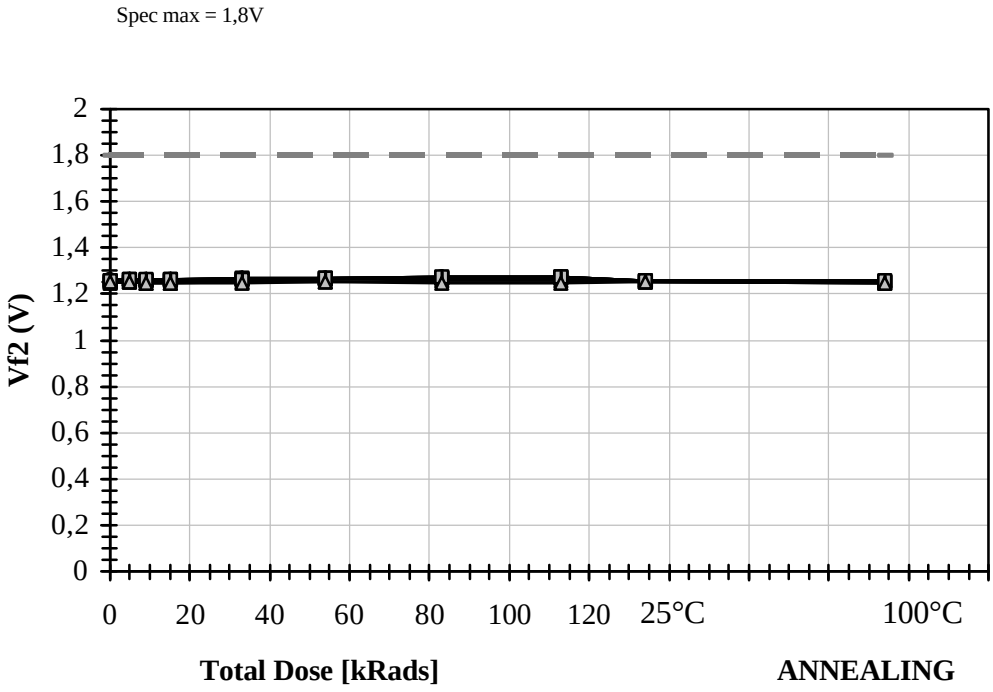


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		1,07253	1,07212	1,07728	1,06875	1,07058	1,06969	1,0708	1,06773	1,068	1,06
2	ON		1,07298	1,07182	1,06594	1,06634	1,06936	1,07014	1,07052	1,06981	1,069	1,06
3	ON		1,07226	1,07162	1,06736	1,06849	1,06965	1,06981	1,07085	1,06964	1,069	1,06
4	ON		1,06974	1,06838	1,06424	1,06676	1,06789	1,0687	1,06868	1,06697	1,066	1,06
5	ON		1,07144	1,07384	1,06626	1,06984	1,06932	1,06786	1,06176	1,06717	1,065	1,06
6	ON		1,07457	1,07538	1,0726	1,07037	1,06906	1,06879	1,06892	1,06524	1,067	1,06
7	ON		1,07445	1,07322	1,06977	1,06982	1,06847	1,06781	1,06903	1,06674	1,068	1,06
8	ON		1,07338	1,0713	1,0679	1,06864	1,06978	1,06567	1,06638	1,0668	1,066	1,06
9	OFF		1,06368	1,07245	1,06742	1,06828	1,06637	1,06605	1,06588	1,06491	1,063	1,06
10	OFF		1,07259	1,07396	1,06778	1,06976	1,06671	1,0637	1,0666	1,06537	1,064	1,06
0	REF		1,06537	1,06325	1,05561	1,05806	1,05803	1,06015	1,05807	1,05798	1,062	1,06

Date : 30/07/98	Device Type :	3C91C	Figure 3

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	ON / OFF / REF
Test	Parameter :	**Vf2**	Conditions :	If= 50mA

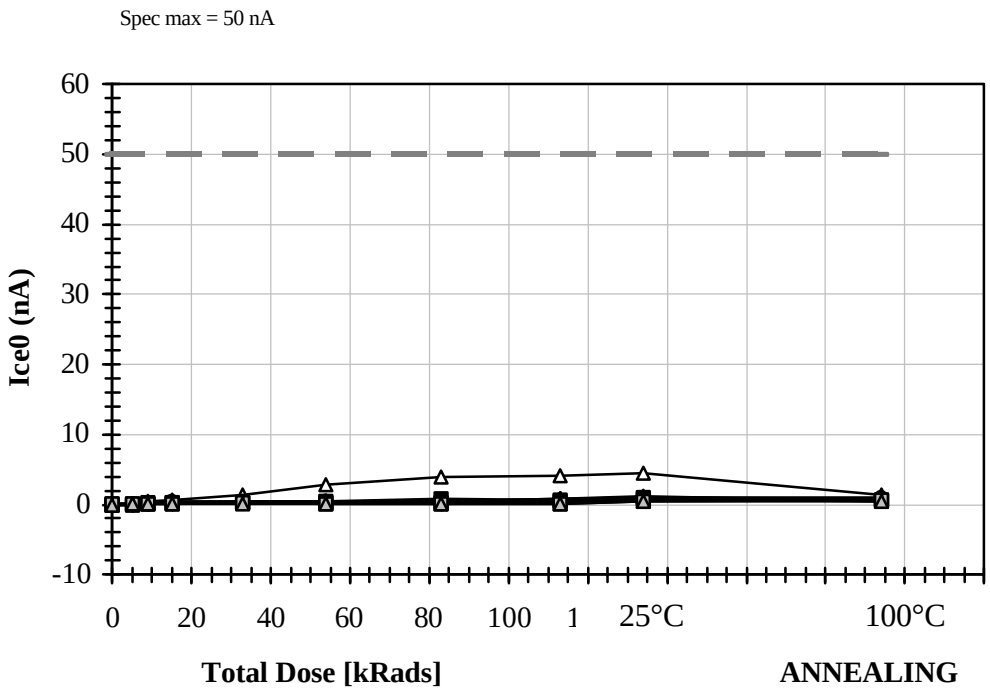


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		1,25162	1,25415	1,25926	1,25566	1,26049	1,26352	1,26668	1,26559	1,252	1,249
2	ON		1,26498	1,26547	1,26246	1,26351	1,26762	1,27104	1,2738	1,27454	1,258	1,257
3	ON		1,24884	1,24932	1,24711	1,24806	1,2507	1,25305	1,25572	1,25627	1,25	1,246
4	ON		1,2478	1,24928	1,2482	1,25192	1,25653	1,26102	1,26361	1,26367	1,251	1,248
5	ON		1,25996	1,26374	1,25898	1,26279	1,26612	1,26902	1,26794	1,27322	1,257	1,254
6	ON		1,26257	1,26456	1,2632	1,26297	1,26498	1,26874	1,27264	1,2722	1,259	1,26
7	ON		1,26006	1,2625	1,2616	1,26387	1,26712	1,27079	1,27467	1,27456	1,258	1,255
8	ON		1,26184	1,26204	1,26042	1,26248	1,26684	1,2683	1,27252	1,275	1,259	1,258
9	OFF		1,25722	1,26453	1,26138	1,26293	1,26505	1,26878	1,27227	1,27338	1,257	1,259
10	OFF		1,25848	1,26101	1,2574	1,26034	1,26183	1,26354	1,26863	1,26944	1,255	1,251
0	REF		1,25284	1,2519	1,24645	1,24811	1,24802	1,24962	1,24823	1,24803	1,25	1,244

Date : 30/07/98	Device Type :	3C91C	Figure 4

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	ON / OFF / REF
Test	Parameter :	**Ice0**	Conditions :	Vce= 5V / If= 0 mA

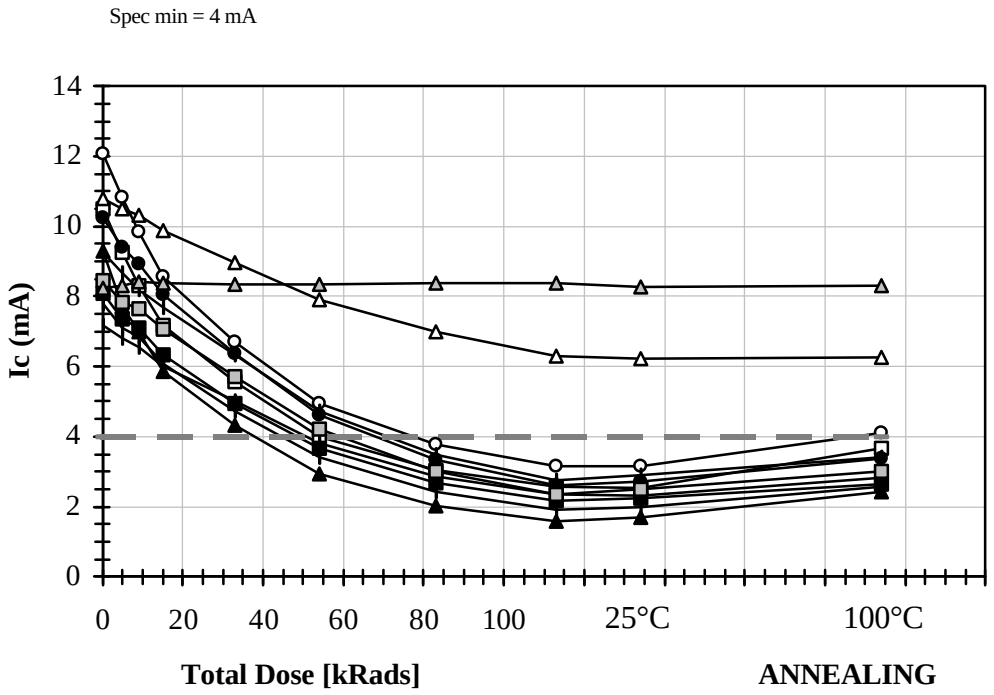


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		0,03733333	0,1071233	0,05004333	0,276525	0,2542883	0,314095	0,2980883	0,43703	0,8	0,7
2	ON		-0,03950667	0,02239333	0,1523633	0,2562317	0,2886233	0,37223	0,3408017	0,34804	0,8	0,5
3	ON		0,039315	0,14064	0,4311267	0,72952	1,325297	2,783467	3,974633	4,198683	4,4	1,4
4	ON		0,02251333	0,115085	0,327795	0,39512	0,3998517	0,4345683	0,4069217	0,4971183	1,1	1
5	ON		-0,03417833	0,00652	0,2495817	0,26354	0,32218	0,3905117	0,84248	0,700185	1,1	0,6
6	ON		0,00844667	0,04101167	0,1617167	0,267775	0,3978567	0,4026333	0,4528183	0,7643517	1	0,6
7	ON		-0,0273	0,05674333	0,2086283	0,267345	0,2430733	0,2769067	0,445595	0,7537917	1,2	0,5
8	ON		-0,00559667	0,09804333	0,277535	0,36942	0,3623517	0,4753533	0,5371367	0,62803	1	0,9
9	OFF		0,07622167	0,01989333	0,1007783	0,1320117	0,2221867	0,1610367	0,1207533	0,1428233	0,5	0,6
10	OFF		-0,03092333	0,00354833	0,119965	0,1527117	0,2478467	0,233025	0,1660383	0,208655	0,6	0,6
0	REF		-4,42E-04	0,02467333	0,1369033	0,09228	0,1027117	0,07767333	0,1121317	0,09723167	0,5	0,5

Date : 30/07/98	Device Type :	3C91C	Figure 5

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	ON / OFF / REF
Test	Parameter :	**Ic**	Conditions :	Vce= 5V / If= 10mA

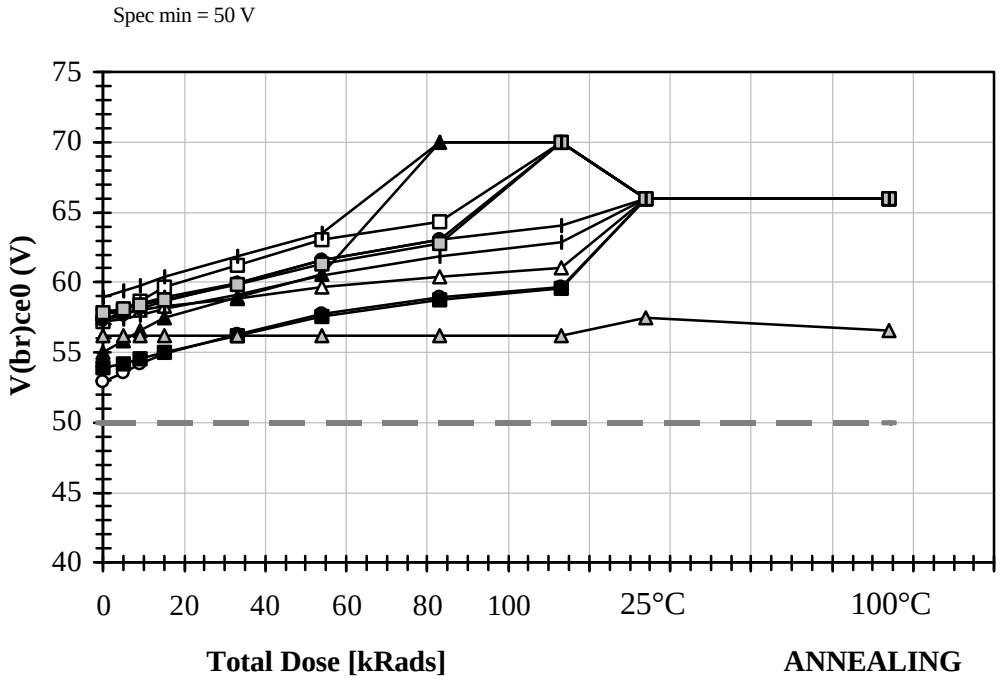


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		10,5015	9,2737	8,3228	7,1576	5,559	4,0022	**3,0437**	**2,562**	**2,54**	**3,65**
2	ON		7,1654	6,8199	6,5342	5,9935	5,0336	**3,7938**	**2,8553**	**2,3448**	**2,32**	**2,81**
3	ON		10,787	10,5102	10,2997	9,8824	8,9726	7,9044	6,9742	6,2879	6,21	6,26
4	ON		12,09	10,825	9,8476	8,5579	6,7038	4,935	**3,784**	**3,1709**	**3,14**	4,12
5	ON		8,0955	7,3464	7,091	6,3384	4,9561	**3,6503**	**2,666**	**2,1614**	**2,23**	**2,65**
6	ON		9,2541	8,6607	8,1948	7,6904	6,3283	4,7247	**3,4844**	**2,7521**	**2,9**	**3,42**
7	ON		9,2861	7,7401	6,9882	5,8618	4,3048	**2,9177**	**2,0245**	**1,5769**	**1,68**	**2,41**
8	ON		10,2301	9,4203	8,9441	8,0576	6,3754	4,6186	**3,3325**	**2,6101**	**2,72**	**3,37**
9	OFF		8,4395	7,8455	7,6546	7,063	5,7238	4,2045	**3,0005**	**2,3526**	**2,48**	**3,02**
10	OFF		7,7947	7,0959	6,8344	6,0886	4,7367	**3,4041**	**2,4385**	**1,901**	**1,99**	**2,58**
0	REF		8,2492	8,2929	8,4044	8,3658	8,3584	8,3335	8,3685	8,3692	8,26	8,3

Date : 30/07/98	Device Type :	3C91C	Figure 6

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	ON / OFF / REF
Test	Parameter :	**V(br)ce0**	Conditions :	Ic= 10mA / If= 0mA

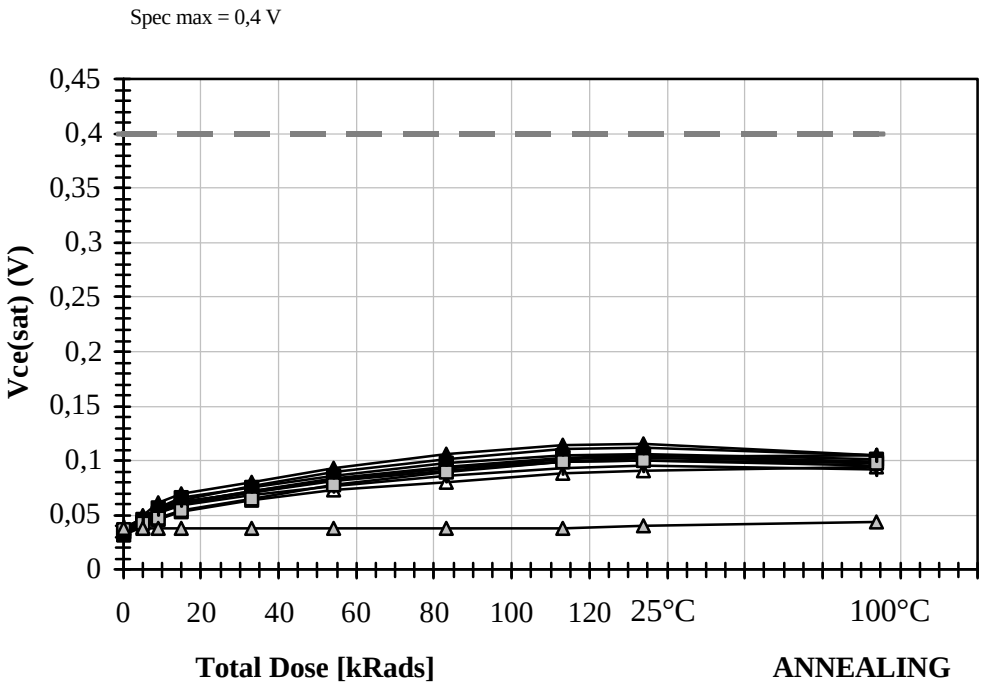


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		57,18	58	58,66	59,71	61,21	63,02	64,34	70	66	66
2	ON		57,83	58,13	58,47	58,96	59,96	61,58	63,08	64,06	66	66
3	ON		57,77	57,92	58,07	58,29	58,88	59,68	60,42	61,05	66	66
4	ON		52,92	53,57	54,17	54,94	56,27	57,77	58,95	59,7	66	66
5	ON		53,9	54,23	54,54	55,05	56,17	57,53	58,78	59,6	66	66
6	ON		57,17	57,4	57,69	58,11	59,08	60,5	61,85	62,85	66	66
7	ON		54,99	55,83	56,57	57,51	58,96	60,61	70	70	66	66
8	ON		57,3	57,68	58,08	58,69	59,93	61,62	63,09	70	66	66
9	OFF		57,87	58,09	58,35	58,79	59,86	61,35	62,76	70	66	66
10	OFF		58,95	59,38	59,8	60,44	61,82	63,47	70	70	66	66
0	REF		56,22	56,21	56,23	56,23	56,24	56,23	56,23	56,23	57,46	56,6

Date : 30/07/98	Device Type :	3C91C	Figure 7

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	OFF / ON / REF
Test	Parameter :	**Vce(sat)**	Conditions :	Ic= 2mA / If= 50mA

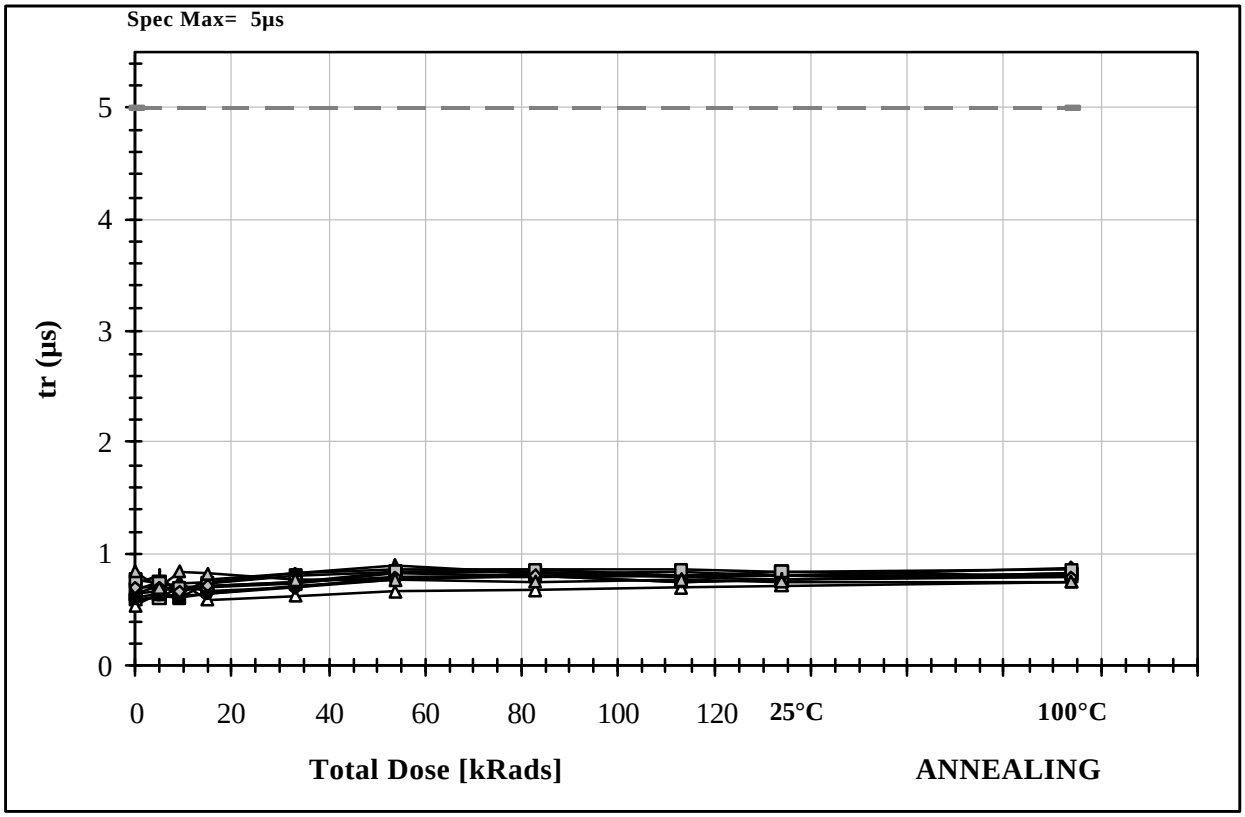


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		0,033194	0,043364	0,051744	0,061336	0,071866	0,083976	0,094826	0,102258	0,1049	0,0993
2	ON		0,039056	0,046414	0,053404	0,06131	0,07203	0,082826	0,093068	0,10094	0,1036	0,1044
3	ON		0,03256	0,039062	0,045646	0,05323	0,06396	0,073216	0,080762	0,087842	0,0905	0,0938
4	ON		0,03173	0,042838	0,052086	0,060668	0,071056	0,082298	0,092724	0,099534	0,1022	0,0987
5	ON		0,033792	0,046578	0,057254	0,065856	0,075584	0,086512	0,097698	0,104774	0,1066	0,1018
6	ON		0,036476	0,044128	0,052046	0,059324	0,06796	0,076988	0,085956	0,093592	0,0949	0,0921
7	ON		0,032458	0,049552	0,06125	0,069744	0,079808	0,093304	0,105656	0,114498	0,1155	0,1045
8	ON		0,034896	0,045436	0,054734	0,062672	0,071016	0,081398	0,091048	0,098804	0,1004	0,0954
9	OFF		0,03672	0,042022	0,04763	0,054342	0,065484	0,078128	0,08978	0,09846	0,0998	0,0982
10	OFF		0,037592	0,047072	0,055372	0,063882	0,076158	0,089564	0,101898	0,110462	0,1119	0,1053
0	REF		0,03802	0,037874	0,038148	0,038044	0,03835	0,038144	0,03815	0,038166	0,0405	0,0437

Date : 30/07/98	Device Type :	3C91C	Figure 8

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	ON / OFF / REF
Test	Parameter :	**tr**	Conditions :	Ic= 2 mA : Vce= 5V

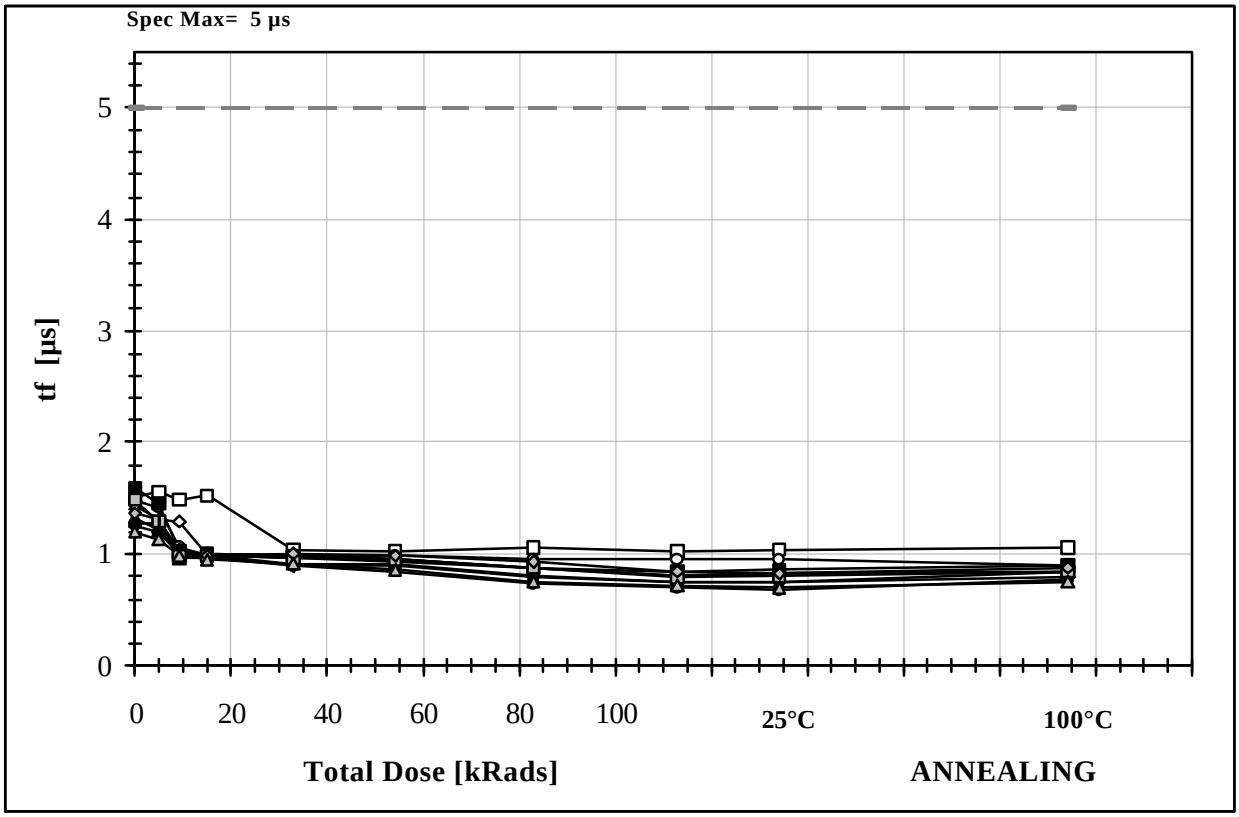


Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		0,6	0,61	0,7	0,691	0,738	0,82	0,8	0,76	0,765	0,82
2	ON		0,73	0,812	0,649	0,772	0,83	0,86	0,86	0,8	0,8	0,87
3	ON		0,533	0,651	0,752	0,595	0,62	0,67	0,686	0,69	0,708	0,75
4	ON		0,583	0,632	0,613	0,653	0,7	0,787	0,795	0,805	0,804	0,81
5	ON		0,682	0,756	0,608	0,736	0,806	0,842	0,848	0,805	0,84	0,8
6	ON		0,636	0,665	0,714	0,655	0,69	0,764	0,81	0,811	0,804	0,806
7	ON		0,651	0,716	0,736	0,761	0,831	0,9	0,828	0,784	0,764	0,82
8	ON		0,613	0,653	0,629	0,649	0,719	0,77	0,818	0,84	0,811	0,814
9	OFF		0,764	0,74	0,693	0,713	0,75	0,84	0,86	0,852	0,845	0,86
10	OFF		0,705	0,695	0,662	0,711	0,748	0,787	0,8	0,75	0,764	0,79
0	REF		0,845	0,705	0,85	0,827	0,769	0,765	0,751	0,763	0,755	0,76

Date : 30/07/98	Device Type :	3C91C	Figure 9

Component	Date Code :	**9806**	Manufacturer :	MITTEL
Irradiation	Dose Rate :	<= 0.36 kRad / h	Conditions :	OFF / ON / REF
Test	Parameter :	**tf**	Conditions :	Ic= 2 mA : Vce= 5V



Comments : *The last 2 steps correspond to the post annealing measurements*

Total Dose [kRad(Si)]			0	5	9	15	33	54	83	113	25°C	100°C
1	ON		1,51	1,55	1,5	1,52	1,05	1,02	1,06	1,03	1,04	1,06
2	ON		1,43	1,31	1,28	0,98	0,9	0,9	0,79	0,75	0,76	0,84
3	ON		1,29	1,25	0,96	1,01	0,98	0,96	0,87	0,81	0,83	0,841
4	ON		1,49	1,42	1,06	0,99	0,96	0,98	0,95	0,95	0,95	0,9
5	ON		1,6	1,45	1,02	1	0,98	0,96	0,88	0,84	0,86	0,89
6	ON		1,25	1,19	1,01	0,99	0,92	0,91	0,81	0,75	0,75	0,78
7	ON		1,33	1,21	1,04	0,98	0,97	0,93	0,87	0,81	0,83	0,84
8	ON		1,28	1,27	0,97	0,97	0,9	0,85	0,73	0,71	0,69	0,77
9	OFF		1,48	1,28	0,99	0,99	0,97	0,95	0,89	0,79	0,82	0,85
10	OFF		1,37	1,3	1,02	0,99	1,01	0,98	0,92	0,85	0,82	0,88
0	REF		1,19	1,13	0,98	0,94	0,92	0,86	0,75	0,71	0,7	0,75