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ORIGINAL EN ROUGE

PROJECT : ENVISAT

RUT : IRFC250
(MOT) LM 108A
(MOT) LM 139

ASAR-PSU

IRRADIATION REPORTS

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1. INTRODUCTION

This document reports the results of the irradiation tests which have been performed on some components items used in die form in hybrids manufactured by ETCA for ENVISAT ASAR-PSU and on which a Radiation Verification Test was to be done.

A summary of the different tests is given in the text, the complete results are given in Appendix.

2. REFERENCE DOCUMENTS

Ref.	Document number	Issue date	Document title
RD1	PO-TN-ETC-SR-2059	2, Rev.0 26.04.95	ENVISAT 1 -ASAR-PSU : IRRADIATION PLANS

3. LIST OF COMPONENTS COVERED BY THIS REPORT

- IRFC250, manufactured by International Rectifier
- LM108A, manufactured by MOTOROLA
- LM139, manufactured by MOTOROLA.

4. RVT ON IRFC 250

4.1. Component identification

- MOSFET, N channel;V_{DS} = 200V; size 5
- Manufacturer : International Rectifier
- Diffusion lot : IR 221927 (ASAR-PSU Flight Model Lot)
- ETCA internal lot Number : N14
- Irradiation Test Plan : according to requirements of the ETCA internal doc EVAL-RAD-230, appended to RD1
- Irradiation Test Report : Nucletudes Ref n° 5424/1, App. D dated 26/04/1995.

4.2. Test Results - Summary

Eight components from the lot destinated to be mounted in ASAR-PSU Flight Model Hybrids were encapsulated in T03 packages by HCM.

The Irradiation tests were performed by NUCLETUDES S.A., with a Co^{60} source from their SAND facility.

Six devices were subjected to the complete sequence of Irradiation; two devices were kept as references.

The dose rate was 0,44 Rad (Si)/sec. Four irradiation steps of 5 kRad (Si) were performed, followed by a last step of 10 kRad (Si).

Five parameters (BV_{DSS}, I_{GSS}, I_{DSS}, $V_{GS\,(th)}$ and $R_{DS\,(ON)}$ were measured after each irradiation step.

The results show that BV_{DSS} and I_{GSS} stay within their limit (> 200 V and < 100 nA, respectively) and $R_{DS,ON}$ stay < 85 mohm up to 30 krads.

At 20 krads, however, the mean value of $V_{GS(th)}$ is equal to 0,35 V (limit fixed to 0,5 V). But $V_{GS\,(th)}$ is still equal to 0,97 V at 15 krads. In relation with this shift of $V_{GS(th)}$, I_{DSS} goes out its limit of 250 µA at 30 krad.

The annealing effect (ambient temperature) is negligible (50 mV on $V_{GS(TH)}$.

The plot of $V_{GS(th)}$ is given in fig 4.2.

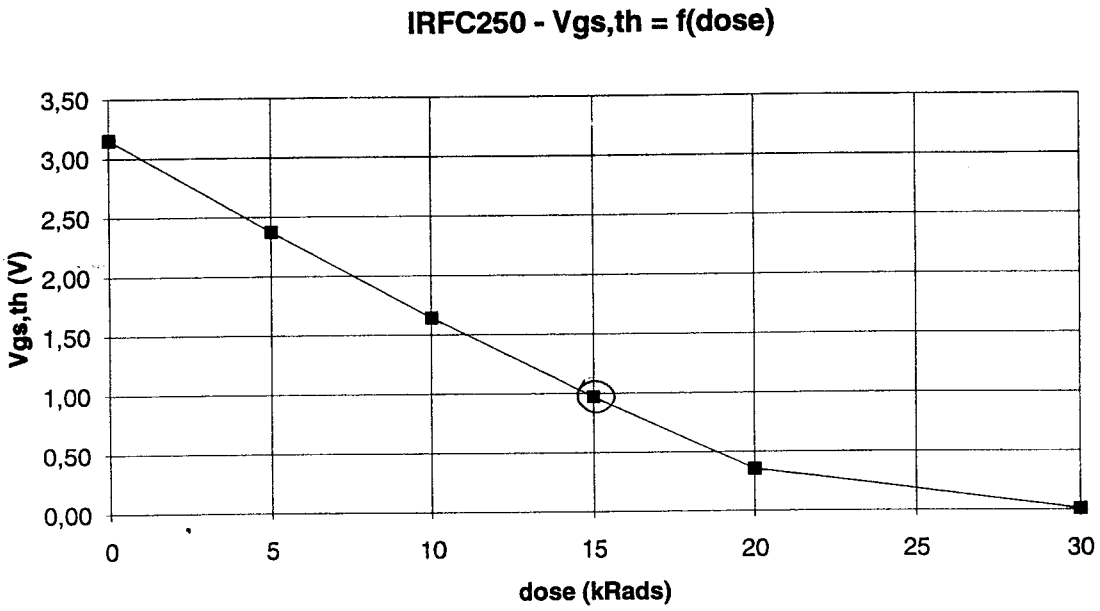

Fig 4.2

4.3. Conclusion

The initial value of $V_{GS(TH)}$ is about 3,15 V. At 15 krad (which is sufficient for ASAR-PSU), $V_{GS(th)}$ is equal to 1 V and still largely compatible with the drive capability of ASAR/PSU design. The mean shift of $V_{GS(th)}$ is equal to 0,145 V by krad up to 15 krad, which is a "know good" value.

This lot of IRFC 250 (IR 221927) is thus compatible with the ASAR/PSU application.

5. RVT ON LM 108 A

5.1. Component Identification

- Operational amplifier
- Manufacturer : MOTOROLA
- Diffusion lot : 1A 220929 (ASAR-PSU FM lot)
- ETCA internal lot number : N15
- Irradiation Test Plan : according to the requirements of ETCA internal doc EVAL-RAD-224, appended to RD1.
- Irradiation Test Report : MOT/RAD.0042.

5.2. Test Results - Summary

Eleven components from the lot destinated to be mounted in ASA-PSU Flight Model hybrids were encapsulated in T0-99 packages by MOTOROLA.

The irradiation tests were performed under the control of MOTOROLA Toulouse, with a Co^{60} source of the DERTS facility.

Ten devices were subjected to the complete sequence of Irradiation : one device was kept as a reference.

The dose rate was 5,7 krad/h. Three irradiation steps of 10 krad (Si) were performed, followed by a last step of 20 krad (Si).

All the parameters listed in the SCC table 2 were measured. All these parameters remain within the limits of the SCC specification up to 20 krads, which is enough for the ASAR-PSU application.

As an information, at 30 krad, there is an increase of the input parameters values, which go out the SCC specifications limits but remain compatible with the extended values agreed between CNES, ESA and MOTOROLA. These degradations decrease during the remaining irradiation phases and during the annealing phase.

5.3. Conclusion

The LM108A parts from the lot dedicated to ASAR-PSU FM models show a good behaviour up to 20 krads, which is compatible with the ASAR-PSU application requirements.

6. RVT ON LM139

6.1. Component identification

- Comparator, quad
- Manufacturer : MOTOROLA
- Diffusion lot : 012021 (ASAR-PSU FM lot)
- ETCA internal lot number : I56
- Irradiation Test Plan : according to the requirements of ETCA internal doc. EVAL-RAD-225, appended to RD1
- Irradiation Test Report : MOT/RAD.0041.

6.2. Test Results - Summary

Eleven components from the lot destinated to be mounted in ASAR-PSU Flight Model hybrids were encapsulated in DIL-14 packages by MOTOROLA Toulouse.

The irradiation tests were performed under the control of MOTOROLA Toulouse, with a Co^{60} source of the DERTS facility.

Ten devices were submitted to the complete irradiation sequence; one device was kept as a reference.

The dose rate, was 5,7 krad/h. Three irradiation steps of 10 krad (Si) were performed, followed by a last step of 20 krad (Si).

The parameters listed in the table 2 of ESA/SCC specification were measured after each step of irradiation.

After 20 krad, drifts are found an IIB and IIO parameters.

However, these drifts are rather limited. For IIB, a worst case value of 230 nA is found, which is over the ESA/SCC table 2 limit of 100 nA, but which would be accepted by the future table 7 that proposes an extended limit of ± 250 nA.

For IIO, the worst case is 29 nA, which is over the ESA/SCC limit of 25 nA, but which would be accepted by the extended value of ± 250 nA proposed by future table 7.

These extended values, which were in principle agreed between MOTOROLA, CNES and ESA in the end of 94 are anyway fully accepted by the ETCA usage of the LM139 in ASAR-PSU application design.

6.3. Conclusion

The LM139 parts from the lot dedicated to ASAR-PSU FM behaviour show a good behaviour up to 20 krads, with limited drifts of the input parameters IIO and IIB which are, in any case acceptable and compatible with the ASAR-PSU requirements.

APPENDIX D

Results for IRFC 250

TYPE	IRFC 250

PARAMETER	BV_{DSS}

Measurement conditions	at Id = 1 mA	
Acceptance limits		> 200 V

		0	5 krad	10 krad	15 krad	20 krad	30 krad
	1	231	229	227	227	226	226 *
	2	230	230	230	230	229	
	3	232	229	228	227	226	
	4	233	230	230	229	228	
	5	234	232	231	229	230	228 *
	6	232	229	228	228	227	227 *
CONTROL PARTS	7	232	232	232	232	233	232
	8	234	233	233	233	233	233

* With Vgs=-2 V

TYPE	IRFC 250

PARAMETER	I_{GSS}

Measurement conditions	at Vgs = 20 V Vds = 0 V
Acceptance limits	< 100 nA

		0	5 krad	10 krad	15 krad	20 krad	30 krad
	1	454 p	555 p	614 p	418 p	360 p	352 p
	2	192 p	5.85 n	2.44 n	1.73 n	909 p	653 p
	3	273 p	571 p	639 p	510 p	337 p	224 p
	4	122 p	145 p	138 p	105 p	95 p	88 p
	5	221 p	501 p	570 p	518 p	425 p	241 p
	6	140 p	160 p	132 p	140 p	122 p	160 p
CONTROL PARTS	7	126 p	248 p	364 p	281 p	261 p	235 p
	8	125 p	134 p	139 p	141 p	133 p	128 p

TYPE	IRFC 250

PARAMETER	I_{DSS}

Measurement conditions	at Vds = 200 V Vgs = 0 V
Acceptance limits	< 250 µA

		0	5 krad	10 krad	15 krad	20 krad	30 krad
	1	2.5 µ	3.8 µ	6 µ	9 µ	180 µ	100 n
	2	2 n	18 n	100 n	700 n	155 µ	100 n
	3	4 n	8 n	18 n	460 n	100 µ	100 n
	4	1 n	3 n	8 n	580 n	132 µ	100 n
	5	1.3 µ	1.4 µ	1.5 µ	2 µ	126 µ	100 n
	6	5 n	20 n	42 n	570 n	166 µ	120 n
CONTROL PARTS	7	12 n	10 n	35 n	18 n	15 n	22 n
	8	14 n	13 n	40 n	24 n	14 n	23 n

TYPE	IRFC 250

PARAMETER	$V_{GS(th)}$

Measurement conditions	at Id = 1 mA Vds = Vgs
Acceptance limits	> 0.5 V

		0	5 krad	10 krad	15 krad	20 krad	30 krad
	1	3.17	2.39	1.65	0.98	0.35	10.5 n
	2	3.13	2.35	1.62	0.95	0.34	11.9 n
	3	3.18	2.40	1.67	0.99	0.38	11.5 n
	4	3.15	2.37	1.64	0.96	0.35	11.8 n
	5	3.13	2.36	1.64	0.97	0.36	11.4 n
	6	3.16	2.38	1.65	0.98	0.35	11.8 n
CONTROL PARTS	7	3.12	3.12	3.13	3.12	3.13	3.13
	8	3.17	3.17	3.18	3.17	3.17	3.18

TYPE	IRFC 250

PARAMETER	$R_{DS(ON)}$

Measurement conditions	at Id = 20 A Vgs = 10 V
Acceptance limits	< 0.085 ohm

Vds < 1.70 V <---

	Vds	0	5 krad	10 krad	15 krad	20 krad	30 krad
	1	1.65	1.62	1.59	1.60	1.60	1.58
	2	1.62	1.58	1.56	1.57	1.57	1.56
	3	1.62	1.62	1.59	1.60	1.59	1.60
	4	1.63	1.61	1.59	1.60	1.60	1.60
	5	1.62	1.61	1.59	1.58	1.58	1.58
	6	1.62	1.62	1.58	1.58	1.59	1.59
CONTROL PARTS	7	1.62	1.62	1.60	1.62	1.62	1.62
	8	1.62	1.63	1.62	1.62	1.63	1.64