



RADIATION TEST SUMMARY

PART TYPE : IRFY044

DESCRIPTION : N-CHANNEL POWER MOSFET

REPORT NO. : RD 246

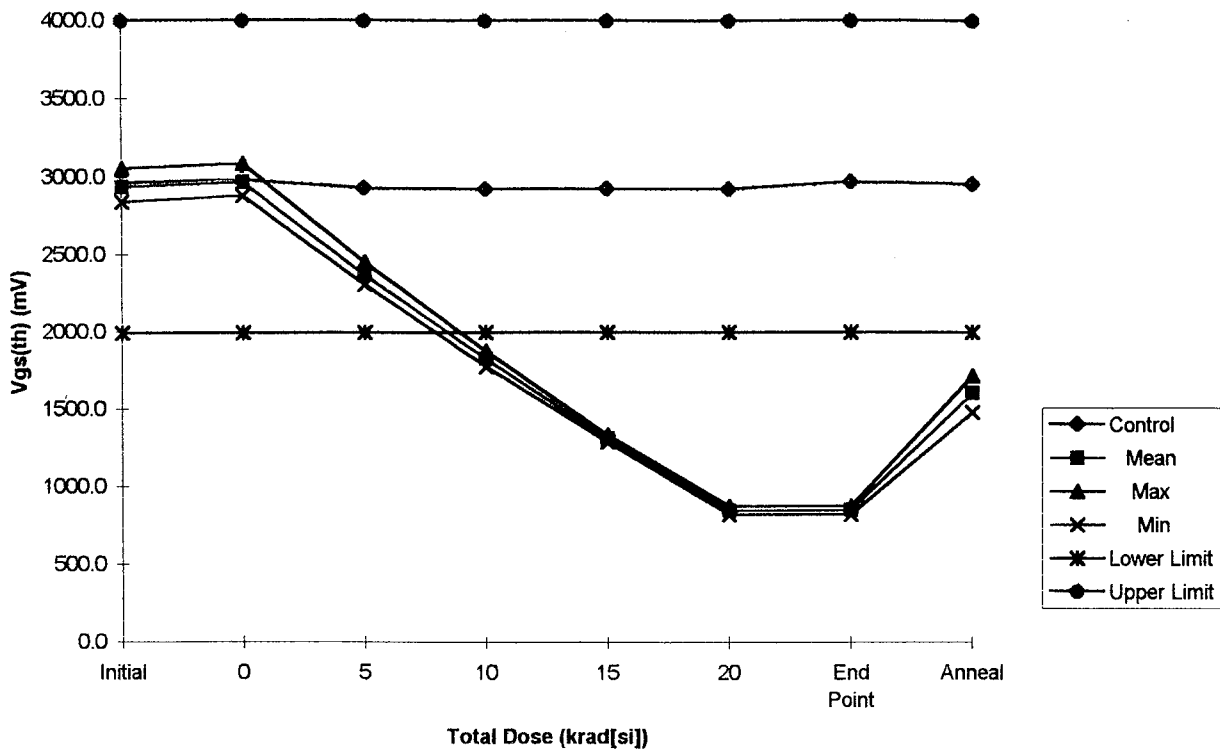
PARAMETERS PLOTTED :

VGS(th)
IDSS

NOTE : The results for the remaining parameters showed no significant change and hence plots were not considered necessary.



Radiation Results for Vgs(th)

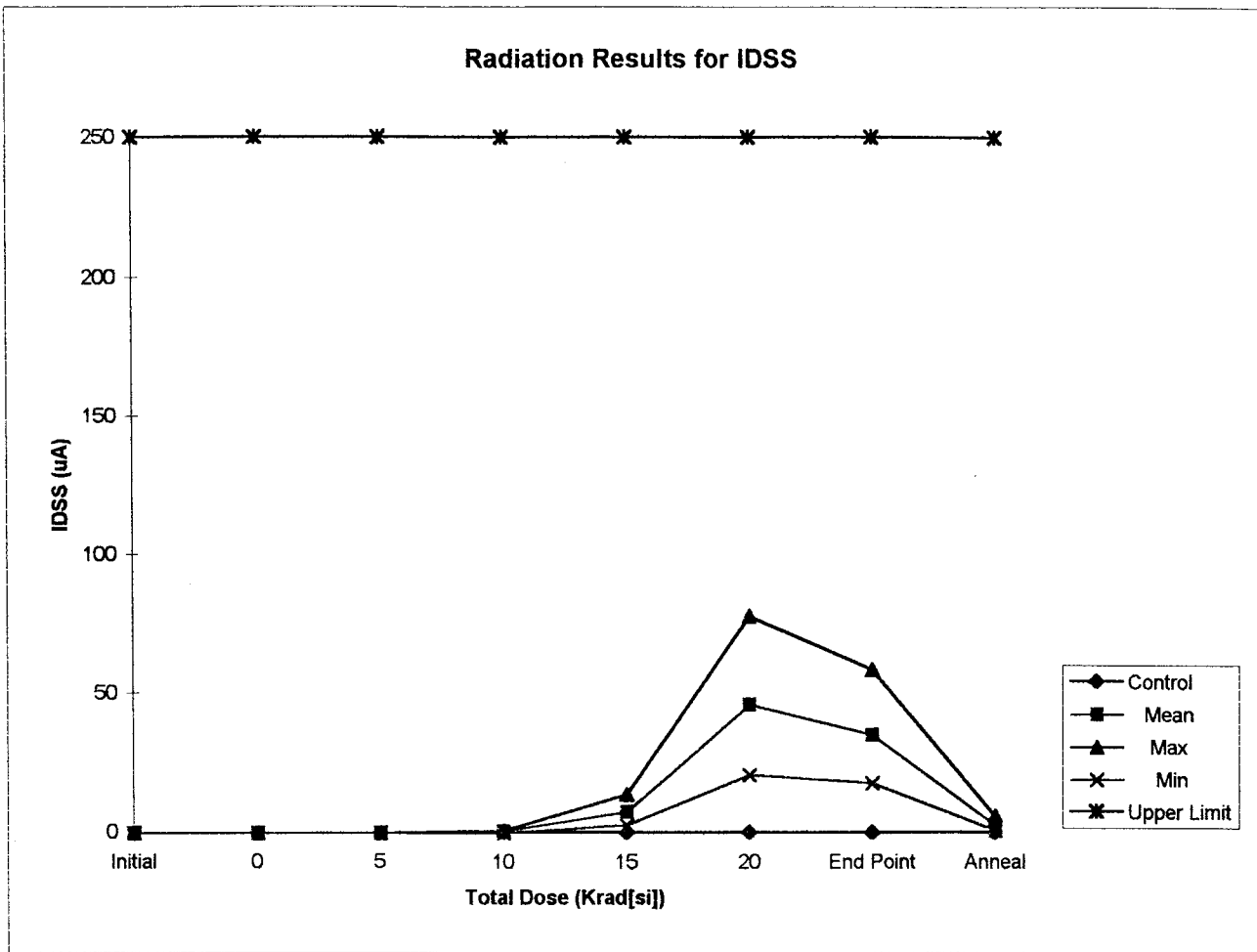


Dose (kRad)	Control (mV)	Mean (mV)	Max (mV)	Min (mV)	Lower Limit (mV)	Upper Limit (mV)	Std.Dev.
Initial	2962.0	2940.5	3061.3	2847.3	2000	4000	104.12
0	2980.7	2972.5	3091.4	2882.6	2000	4000	101.93
5	2924.0	2372.5	2455.9	2307.9	2000	4000	71.33
10	2918.7	1829.4	1880.1	1781.4	2000	4000	44.82
15	2920.3	1314.3	1340.3	1292.4	2000	4000	19.81
20	2917.0	853.0	879.4	828.2	2000	4000	21.89
End Point	2966.3	855.9	881.3	826.4	2000	4000	22.86
Anneal	2955.8	1606.1	1718.9	1481.6	2000	4000	112.09

Note : Results for both control samples (biased and unbiased) similar therefore average plotted.

Lot size for statistics : 4 devices

RD 246 Date code 9731



Dose (kRad)	Control (uA)	Mean (uA)	Max (uA)	Min (uA)	Upper Limit (uA)	Lower Limit (uA)	Std.Dev.
Initial	0	0	0	0	250	-	0.00
0	0	0	0	0	250	-	0.00
5	0	0	0	0	250	-	0.00
10	0	1	1	0	250	-	0.50
15	0	8	14	3	250	-	5.19
20	0	46	78	21	250	-	28.67
End Point	0	36	59	18	250	-	20.34
Anneal	0	3	6	1	250	-	2.22

Note : Results for both control samples (biased and unbiased) similar therefore average plotted.

Lot size for statistics : 4 devices

RD 246 Date code 9731

ENVISAT-1 RIR 79602 RD 246	IRRADIATION TEST PLAN NO. PO-PL-IGG-PL-0015	Issue No. 2 Date: OCTOBER 1995 Page: 1/4	Rev. NA Date: NA
	1	2	2

Component No. POIG003101B	Component Designation: TRANSISTOR, MOSFET, N-CHANNEL, POWER TYPE IRFY044	Irradiation Spec No. NA Iss. Rev.
3	4	5

Specifications Generic ESA/SCC 5000 Iss. 7 Rev. B Detail PO-PS-IGG-PL-0031 Iss. 3	Acceptance Evaluation Element — Diffusion — Lot <u>X</u>	Electrical Measurements In-situ — Remote <u>X</u>	Project/Programme ENVISAT-1
6	7	8	9

Manufacturer: Name: Int. Rectifier Address: Hurst Green, Oxted Surrey, England	Test Facility: Name: ERA Address: LEATHERHEAD, SURREY ENGLAND	Originator: IGG CT Name: S THACKER
10	11	12

Radiation Source COBALT 60	Sample Size: 4 Control Device: 1 (Each Test)	Exposure Single — Multiple <u>X</u>	Annealing Test YES <u>X</u> NO —	Radiation Level: See Below
13	14	15	16	17

Single Exposure Dose [Krad(Si)] Dose Rate [rad(Si)/s] Exposure Time Not applicable	Multiple Exposure: Irradiation Steps Dose [Krad(Si)] Dose Rate [rad(Si)/s] Exposure Time(s)	In accordance with the applicable Appendix to this Plan for each test.
18	19	19

Bias Requirements: During and after Exposure (for remote Electrical Measurements): YES

Bias Conditions:
 Test Circuits: The Electrical Bias circuit is given in Figure 1 in the applicable Appendix to this Plan.

Shielding: Shielding is required to minimize dose enhancement effects caused by low energy, scattered radiation. The test units shall be enclosed in a Pb/Al container of Pb 1.5mm minimum, surrounding on inner shield of 0.7 to 1.0mm Al.

Irradiation Test Sequence(applied for each radiation test per the applicable Appendix to this plan). 21

Test Step	Description	Requirements
1	Irradiation Test Samples Selection	Quantity 5 devices shall be selected from the lot delivered to IGG.
2	Serialisation	Serialisation - (if the devices are not already serialised) Test units shall be serialised 1 to 4 and the control unit shall be 5.
3	Initial Electrical Measurements (at IGG)	Per Table A herein - (Read-and-Record) - on all 5 parts at IGG. (See Remarks 1 and 2).
4	Initial Electrical Measurements (at ERA)	Per Table A herein - (Read-and-Record) - on all 5 parts at ERA. (See Remarks 1 and 2).
5	Set-up of Test	Verify Bias Circuit and Voltages (In-situ) for 4 test units.

Irradiation Test Sequence (Cont.)

Test Step	Description	Requirements
6	Irradiation Exposure	Verify radiation dose rate and position in the chamber to achieve required dose. Verify and witness duration of exposure to achieve required dose.
7	Intermediate Electrical Measurement (at ERA)	Bias to be maintained until test is performed. Test per Table A herein - (Read-and-Record) - on all 5 parts. Test to be performed immediately upon removal from chamber (less than 10 mins interval). Upon completion of test 4 test units shall be replaced in bias circuit and returned to chamber. Maximum interval between two consecutive exposures to be 30 mins. (See Remark 2).
8 to 7 + 3n	Repeat Set-up/Exposure/Test sequence upto a Final Total Dose as per the applicable Appendix	Repeat Steps 5, 6, 7 for a total of n cycles (see applicable Appendix). (See Remark 3)
8 + 3n	End Point Electrical Measurements (at IGG)	Per Table A herein - (Read-and-Record) - on all 5 parts at IGG. (See Remarks 2 and 4).
9 + 3n	Annealing	Bias shall be maintained during Annealing for 4 test units. Annealing shall be at room temperature for 168 hours.
10 + 3n	Final Electrical Measurements (at IGG)	Per Table A herein - (Read-and-Record) - on all 5 parts at IGG (See Remark 2).
11 + 3n	Total Dose Irradiation Test Report	ESA/SCC No. 22900

Remarks

1. The initial electrical measurements performed at IGG (Test Step 3) shall be performed within 24 hours of the initial electrical measurements at ERA (Test Step 4).
2. All electrical testing shall be performed on the same set of equipment in order to achieve correlation of results both at IGG and ERA. All results plus details of any failures shall be advised to Project.
3. The set-up/exposure/test sequence shall be stopped for any device that exhibits repeated functional failure.
4. The End Point electrical measurements (Test Step 8 + 3n) performed at IGG shall be performed within 24 hours of the last electrical measurement at ERA (Test Step 7 + 3n).

TABLE A - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE - $T_{amb} = +25 \pm 5^{\circ}\text{C}$ BEFORE, AT INTERMEDIATE POINTS, AND ON COMPLETION OF IRRADIATION.

NO.	CHARACTERISTICS	SYMBOL	MIL-STD-750 TEST METHOD	TEST CONDITIONS	LIMITS		UNIT
					MIN.	MAX.	
1	Breakdown Voltage Drain to Source	BV_{DSS}	3407 Bias Cond. C	$I_D = 0.25\text{mA dc}$ $V_{GS} = 0$	60	-	Vdc
2	Gate Threshold Voltage	$V_{GS(th)}$	3403	$V_{DS} = V_{GS}$ $I_D = 1.0\text{mA dc}$	2.0	4.0	Vdc
3	Gate Current	I_{GSS}	3411 Bias Cond. C	$V_{GS} = 20\text{Vdc}$ $V_{DS} = 0$	-	100	nA dc
4	Drain Current	I_{DSS}	3413 Bias Cond C	$V_{DS} = 60\text{Vdc}$ $V_{GS} = 0$	-	0.25	mA dc
5	Drain Source ON Resistance	$r_{DS(ON)}$	3421	$V_{GS} = 10\text{Vdc}$ $I_D = 20\text{A dc}$ (Notes 2 and 3)	-	0.035	Ω

NOTES

- The limits specified in this Table only apply to the first intermediate electrical measurements at dose 5Krad(Si). For all other intermediate, end point and final electrical measurements, these limits shall not apply but the tests shall be performed and the result recorded for information and characterisation purposes.

Parametric failures to the limits given in this Table could possibly occur at any irradiation level greater than 5Krad(Si).
- Pulsed: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.
- Measured within 2mm of case.

ENVISAT-1

IRRADIATION TEST PLAN NO.

PO-PL-IGG-PL-0015

Issue No. 2

Date: OCTOBER 1995

Page: 4/4

Rev. NA

Date: NA

APPENDIX: 1

COMPONENT TYPE: IRFY044

This appendix defines the specific radiation test requirements applicable to the following ENVISAT-1 user(s):-

USER CODE	USER COMMENT
MEICSA, SRDSSA	N/A

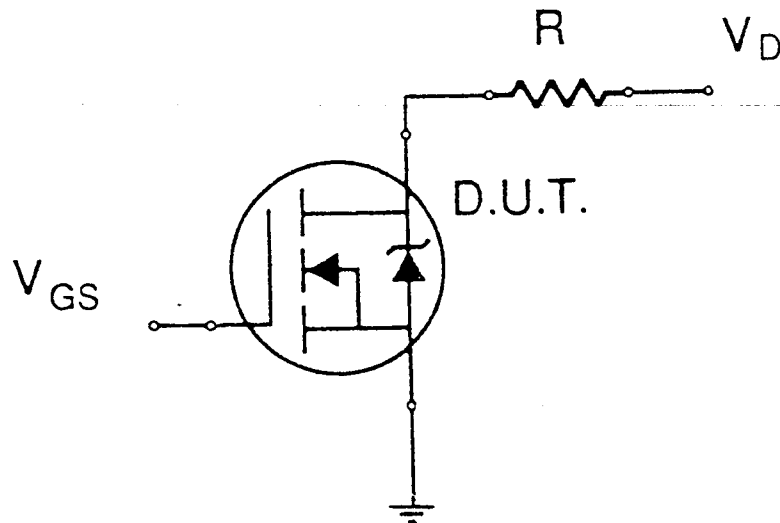
The following specific requirements shall apply:-

a) MULTIPLE EXPOSURE/IRRADIATION STEPS:

Irradiation Steps (n)	1	2	3	4
Dose [Krad(Si)]	5	5	5	5
Accumulated Dose[Krad(Si)]	5	10	15	20
Dose Rate [rad(Si)/s] (See note)	3	3	3	3
Exposure Time(s) (See note)	1667	1667	1667	1667

Note: The dose rates and exposure times given are nominal conditions and may be adjusted during irradiation testing to achieve convenient test points. The actual dose rate shall not exceed 3rad(Si)/s. The dose rates and exposure times used during the testing shall be recorded for each test step.

b) ELECTRICAL BIAS CIRCUIT FOR IRRADIATION TESTING:-



- NOTES:**
- i) Bias conditions $V_{GS} = 10V_{dc}$, $V_D = 30V_{dc}$
 - ii) $R = 300\Omega \pm 1\%$ to give $I_D = 100mA_{dc}$

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Results file : RD246_IRFY044_INIT_EMS_@_IG6 from: 14.10.97 / 15:47:09
Operator : PAUL RUSSELL
Part number : IRFY044
Lot number : RD246
Order number : D/C 9731
Vendor : IR
: CONTROLS 55 (BIASED),76 (UNBIASED) ; RAD 107,124,152,155
: INITIAL EMS @ IG6
: IRFY044 PO-PL-IG6-PL-0015 ISS 2 / 1.0 SMR 24/10/95
=====

Test steps

1.	V(BR)DSS	50.0	...	700.0	V
2.	VGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)...		100.0	nA
4.	IDSS	(0)...		250	uA
5.	RDS on	(0.001)...		0.035	Ohm

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	55	76	107	124	152	155
1.1 [V]	55.3	55.5	55.3	55.2	55.4	55.3
2.1 [mV]	3012.9	2911.1	2947.3	2650.1	3061.3	2993.2
3.1 [nA]	1.8	1.7	1.8	1.8	1.7	1.6
4.1 [uA]	0	0	0	0	0	0
5.1 [Ohm]	0.025	0.027	0.025	0.027	0.029	0.025

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Results file : RD246__IRFY044_INIT_EMS @_ERA from: 15.10.97 / 10:54:36
Operator : PAUL RUSSELL
Part number : IRFY044
Lot number : RD246
Order number : D/C 9731
Vendor : IR
: CONTROL 55 (BIASED), 76 (UNBIASED) ; RAD 107,124,152,155
: INITIAL EMS @ ERA
: IRFY044 PO-PL-IG6-PL-0015 ISS 2 / 1.0 SMR 24/10/95
=====

Test steps

1.	V(BR)DSS	50.0	...	700.0	V
2.	VGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)	...	100.0	nA
4.	IDSS	(0)	...	250	uA
5.	RDS on	(0.001)	...	0.035	Ohm

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	55	76	107	124	152	155
1.1 [V]	66.3	66.2	66.2	66.2	65.9	66.0
2.1 [mV]	3024.0	2937.3	2882.6	2892.7	3091.4	3023.3
3.1 [nA]	91.7	75.7	75.2	77.7	81.0	82.8
4.1 [uA]	0	0	0	0	0	0
5.1 [Ohm]	0.026	0.026	0.025	0.026	0.026	0.026

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RD246_IRFY044_EMS_@_5_KRAD / 1.0 SMR 24/10/95

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Results file   : RD246_IRFY044_EMS_@_5_KRAD   from: 15.10.97 / 11:17:24
Operator      : PAUL RUSSELL
Part number   : IRFY044
Lot number    : RD246
Order number  : D/C 9731
Vendor       : IR
              : CONTROL 55 (BIASED), 76 (UNBIASED) ; RAD 107,124,152,155
              : EMS @ 5 KRAD
              : IRFY044 PO-PL-IG6-PL-0015 ISS 2 / 1.0 SMR 24/10/95
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Test steps

1.	V(BR)DSS	60.0	...	700.0	V
2.	VGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)	...	100.0	nA
4.	IDSS	(0)	...	250	uA
5.	RDS on	(0.001)	...	0.035	Ohm

	55	76	107	124	152	185
1.1 [V]	67.5	66.3	66.3	66.3	66.0	66.2
2.1 [mV]	2916.8	2931.1	2307.9	2318.6	2455.9	2407.6
3.1 [nA]	5.2	5.0	3.3	3.3	3.1	3.3
4.1 [uA]	0	0	0	0	0	0
5.1 [Ohm]	0.029	0.026	0.025	0.026	0.026	0.025

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RD246_IRFY044_EMS_@_10_KRAD / 1.0 SMR 24/10/95

Results file : RD246_IRFY044_EMS_@_10_KRAD from: 15.10.97 / 11:55:09
Operator : PAUL RUSSELL
Part number : IRFY044
Lot number : RD246
Order number : D/C 9731
Vendor : IR
: CONTROL 55 (BIASED), 76 (UNBIASED) ; RAD 107,124,152,155
: EMS @ 10 KRAD
: IRFY044 PO-PL-IGG-PL-0015 ISS 2 / 1.0 SMR 24/10/95

Test steps

1.	V(BR)DSS	60.0	...	700.0	V
2.	VGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)	...	100.0	nA
4.	IDSS	(0)	...	250	uA
5.	RDS on	(0.001)	...	0.035	Ohm

	55	75	107	124	152	155
1.1 [V]	67.4	66.2	66.2	66.2	66.1	66.0
2.1 [mV]	2910.8	2926.5	1781.4	1804.1	1880.1	1852.0
3.1 [nA]	2.6	2.5	2.3	2.3	2.3	2.3
4.1 [uA]	0	0	1	1	1	0
5.1 [Ohm]	0.033	0.029	0.025	0.029	0.027	0.025

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RD246_IRFY044_EMS_@_15_KRAD / 1.0 SMR 24/10/95

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Results file : RD246_IRFY044_EMS_@_15_KRAD from: 15.10.97 / 12:19:55
Operator : PAUL RUSSELL
Part number : IRFY044
Lot number : RD246
Order number : D/C 9731
Vendor : IR
: CONTROL 55 (BIASED), 76 (UNBIASED) ; RAD 107,124,152,155
: EMS @ 15 KRAD
: IRFY044 PO-PL-IGG-PL-0015 ISS 2 / 1.0 SMR 24/10/95

Test steps

1.	V(BR)DSS	60.0	...	700.0	V
2.	VGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)	...	100.0	nA
4.	IDSS	(0)	...	250	uA
5.	RDS on	(0.001)	...	0.035	Ohm

	55	76	107	124	152	155
1.1 [V]	67.2	66.1	65.9	66.1	66.0	66.2
2.1 [mV]	2912.4	2928.1	1292.4 F	1309.6 F	1340.3 F	1314.7 F
3.1 [nA]	2.5	2.5	2.4	2.3	2.3	2.3
4.1 [uA]	0	0	14	10	4	3
5.1 [Ohm]	0.028	0.026	0.034	0.026	0.032	0.025

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RD246_IRFY044_EMS_@_20_KRAD / 1.0 SMR 24/10/95

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Results file : RD246_IRFY044_EMS_@_20_KRAD from: 15.10.97 / 12:46:44
Operator : PAUL RUSSELL
Part number : IRFY044
Lot number : RD246
Order number : D/C 9731
Vendor : IR
: CONTROL 55 (BIASED), 76 (UNBIASED) ; RAD 107,124,152,155
: EMS @ 20 KRAD
: IRFY044 PO-PL-166-PL-0015 ISS 2 / 1.0 SMR 24/10/95

Test steps

1.	V(BR)DSS	50.0	...	700.0	V
2.	UGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)	...	100.0	nA
4.	IDSS	(0)	...	250	uA
5.	RDS on	(0.001)	...	0.035	Ohm

	55	76	107	124	152	155
1.1 [V]	57.3	55.3	55.1	55.2	55.9	56.0
2.1 [mV]	2910.9	2923.0	828.2 F	850.1 F	879.4 F	844.3 F
3.1 [nA]	2.4	2.3	2.2	2.2	2.2	2.2
4.1 [uA]	0	0	78	63	21	23
5.1 [Ohm]	0.029	0.026	0.025	0.027	0.026	0.025

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RD246_IRFY044_END_POINT_EMS / 1.0 SMR 24/10/95

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Results file : RD246_IRFY044_END_POINT_EMS from: 16.10.97 / 11:48:45
Operator : PAUL RUSSELL
Part number : IRFY044
Lot number : RD246
Order number : D/C 9731
Vendor : IR
: CONTROL 55 (BIASED), 76 (UNBIASED) ; RAD 107,124,152,155
: END POINT EMS
: IRFY044 PO-PL-IG6-PL-0015 ISS 2 / 1.0 SMR 24/10/95

Test steps

1.	V(BR)DSS	50.0	...	700.0	V
2.	VGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)	...	100.0	nA
4.	IDSS	(0)	...	250	uA
5.	RDS on	(0.001)	...	0.035	Ohm

	55	76	107	124	152	155
1.1 [V]	66.4	66.4	66.5	66.3	66.2	66.
2.1 [mV]	3015.0	2917.6	826.4 F	862.6 F	881.3 F	853. F
3.1 [nA]	2.2	2.3	2.2	2.2	2.3	2.3
4.1 [uA]	0	0	59	46	19	19
5.1 [Ohm]	0.026	0.026	0.025	0.027	0.026	0.025

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Results file   : RD246_IRFY044_FINAL_EMS   from: 24.10.97 / 11:13:44
Operator      : PAUL RUSSELL
Part number   : IRFY044
Lot number    : RD246
Order number  : D/C 9731
Vendor       : IR
              : CONTROL 55 (BIASED), 76 (UNBIASED) ; RAD 107,124,152,155
              : FINAL EMS
              : IRFY044 PO-PL-160-PL-0015 ISS 2 / 1.0 SMR 24/10/95
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Test steps

1.	V(BR)DSS	50.0	...	700.0	V
2.	VGS	2000.0	...	4000.0	mV
3.	IGSS (FWD)	(0.0)	...	100.0	nA
4.	IDSS	(0)	...	250	uA
5.	RDS on	(0.001)	...	0.035	Ohm

	55	75	107	124	152	155
1.1 [V]	55.2	55.5	55.5	55.3	55.2	55.2
2.1 [mV]	3005.3	2905.3	1481.5 FI	1580.5 FI	1543.4 FI	1718.9 FI
3.1 [nA]	1.8	1.8	1.8	1.8	1.8	1.6
4.1 [uA]	0	0	6	2	2	1
5.1 [Ohm]	0.026	0.026	0.026	0.027	0.027	0.027

Section 1 Goods Inwards

Date	15Sep1997	Priority	19971231
Supplier	INR/G INTERNATIONAL RECTIFIER G.B. Ltd.	Manu	INR/U INTERNATIONAL RECTIFIER
Doc			
Part Type	TRANSISTOR IRFY044	Value	IRFY044CSCS
Spec No/Option	MIL-PRF-19500 IRFY044CSCS	Issue	K - - 01
Date			
PO No	CT12520 item 1	PO Qty	113 FLIGHT
Adv Qty			8

Section 2 Project Authorisation

Project/PLIN	000800 / 109904
SAR No	N/A
Part Family	TRANSISTOR

Section 3 Results

WAR No		Date Codes	9731	Act Qty	8
Related RIR Nos		Qty Pass	8	Qty Rej	
				N C R	
Action	Reference				LOT QTY
Travel Visual	100%				18-9-97 8
Visual Inspection	100%				
Solderability	-				
Data Review	100%				
Electrical Measurements	100%				
D P A	→				
Radiation	3.4+2 RD 246	6	-	-	
i.a.w. Test Plan PO-PL-106-PL-0015/2 App. 1					



Section 4 Disposition

Reference	Qty	Authorisation	Date
Project Store			
Reject-Credit/Replacement			
Scrap Store			
D P A (Report No)			
VOQ/Lot Acceptance			
Quarantine (Category)			
RADIATION TEST	RD 246	6	RFQ 24/9/97

Section 6 Stores

Signed..... Date.....