

PARTS HISTORY LOG

Radiation Testing

PROGRAMME:- XMM

PART TYPE:- 2N4392

RADIATION REPORT:- RD 234

IGG TASK NUMBER:- 1500

SUMMARY OF TEST RESULTS

The only parameter to be affected by irradiation was I_{GSS} which was marginally within the specified minimum limit after 100KRad(Si) and failed this at the anneal measurement stage 24 hours later. The parts were measured again after 24 hours aging under bias where all samples had recovered to within the specified limit. Similar values of I_{GSS} were recorded at the end of 168 hours aging.



Radiation Report Number:- RD 234

Project:- XMM

Part Type:- 2N4392

Date Code:- 9044

Manufacturer:- SIL/U

IGG Task No:- 1500

Project Approval of Lot Traveller:-

Signed... *[Signature]*

Date... 3-7-97

Position... COMPONENT ENGINEER

Serial Number Range:-

185 through 193 (non inclusive)

I certify that the subject component has been tested in accordance with the following radiation specifications:-

Test Method - ESA/SCC22900 ISSUE- 4 DATE- Jan '95

Irradiation Test Plan- XM-PL-IGG-0052 ISSUE- 1 DATE- June '96

Closed/Approved NCR No:- N N/A

Approved Waiver No:- WAR N/A

Signed... *[Signature]*

Date... 2/7/97

Upscreening Engineer

Signed... *[Signature]*

Date... 2/7/97

Upscreening Manager



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RADIATION REPORT NUMBER:- RD 234

DATE:- 2.7.97

PROJECT:- XMM

RIR IN:- 78799

PART NUMBER:- 2N4392

MANUFACTURER:- SIL/U



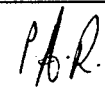

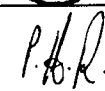
PROCUREMENT LEVEL:- ESA/SCC5205/003

DATE CODE:- 9044










TEST METHOD:- ESA/SCC22900 ISSUE- 4 DATE- Jan '95

TEST PLAN:- XM-PL-IGG-0052 ISSUE- 1 DATE- June '96

START QUANTITY:- 5

No.	Test (Sample Size)	XM-PL-IGG-0052 Test Method and Conditions	Date in	Qty in	Date out	Qty out	SIGNED Op/QA	
1	Serialisation and Selection of Control Sample (100%)	Control Sample= SN 185	23/6/97	5	23/6/97	4 + CONTROL SAMPLE	 IGG 16 CT	
2	Initial Electrical Measurements (100% read and record)	Table A Testing at IGG	Due to time constraints this test stage had to be omitted					
3	Initial Electrical Measurements (100% read and record)	Table A Testing at ERA	23/6/97	4	23/6/97	4	 IGG 16 CT	
4	Set-up and apply Bias per Figure 1	Verify Bias Circuit and conditions (in-situ) for all 4 test samples	23/6/97	4	23/6/97	4	 IGG 16 CT	
5	Irradiation 1 (4 samples)	Dose= 10kRAD(Si) Rate= 10RAD(Si) per second Time= 1000secs	23/6/97	4	23/6/97	4	 IGG 16 CT	
6	Interim 1 Electrical Measurements (100% read and record)	Table A. Bias to be maintained until testing is performed. Tdwel=10mins maximum	23/6/97	4	23/6/97	4	 IGG 16 CT	



Report No: RD 234		Part Type: 2N4392			Date: 2.7.97		
No.	Test (Sample Size)	XM-PL-IGG-0052 Test Method and Conditions	Date in	Qty in	Date out	Qty out	SIGNED Op/QA
7	Irradiation 2 (4 samples)	As Test 5	23/6/97	4	23/6/97	4	 IGG 16 CT
8	Interim 2 Electrical Measurements (100% read and record)	As Test 6	23/6/97	4	23/6/97	4	 IGG 16 CT
9	Irradiation 3 (4 samples)	As Test 5	23/6/97	4	23/6/97	4	 IGG 16 CT
10	Interim 3 Electrical Measurements (100% read and record)	As Test 6	23/6/97	4	23/6/97	4	 IGG 16 CT
11	Irradiation 4 (4 samples)	Dose= 20kRAD(Si) Rate= 10RAD(Si) per second Time=2000secs	23/6/97	4	23/6/97	4	 IGG 16 CT
12	Interim 4 Electrical Measurements (100% read and record)	As Test 6	23/6/97	4	23/6/97	4	 IGG 16 CT
13	Irradiation 5 (4 samples)	Dose= 25kRAD(Si) Rate= 10RAD(Si) per second Time=2500secs	23/6/97	4	23/6/97	4	 IGG 16 CT
14	Interim 5 Electrical Measurements (100% read and record)	As Test 6	23/6/97	4	23/6/97	4	 IGG 16 CT
15	Irradiation 6 (4 samples)	As Test 13	23/6/97	4	23/6/97	4	 IGG 16 CT



Report No: RD 234		Part Type: 2N4392			Date: 2.7.97		
No.	Test (Sample Size)	XM-PL-IGG-0052 Test Method and Conditions	Date in	Qty in	Date out	Qty out	SIGNED Op/QA
16	Final Electrical Measurements (100% read and record)	As Test 6 At ERA	23/6/97	4	23/6/97	4	<i>P.A.R.</i> IGG 16 CT
17	Annealing Test (4 samples)	Bias for 24hrs min at +25°C (record exact time)	23/6/97	4	24/6/97	4	<i>P.A.R.</i> IGG 16 CT
18	Post Annealing Electrical Measurements (100% read and record)	Table A	25/6/97	4	25/6/97	0	<i>P.A.R.</i> IGG 16 CT
19	Accelerated Aging under bias-1st Test (4 samples)	24 hours bias at +100±5°C	25/6/97	4	26/6/97	4	<i>P.A.R.</i> IGG 16 CT
20	Interim Aging Electrical Measurements (100% read and record)	Table A	26/6/97	4	26/6/97	4	<i>P.A.R.</i> IGG 16 CT
21	Accelerated Aging under bias-2nd Test (2 samples)	144 hours bias at +100±5°C	26/6/97	2	2/7/97	2	<i>P.A.R.</i> IGG 16 CT
22	Post Aging Electrical Measurements (100% read and record)	Table A	2/7/97	2	2/7/97	2	<i>P.A.R.</i> IGG 16 CT
23	Test Report Collation				2/7/97		<i>P.A.R.</i> IGG 2 CT
24	Test Report Approval				2/7/97		<i>P.A.R.</i> IGG 2 CT
25	NOTES:-						



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Report No: RD 234

Part Type: 2N4392

Date: 2.7.97

FAILURE LIST AND APPLICABLE NCR

Test No.	Serial Number (s)	Failed Parameter and Failure Mode	Applicable NCR
18	186,191,192,193	FAILED IGSS	-



RADIATION TEST SUMMARY

PART TYPE : 2N4392

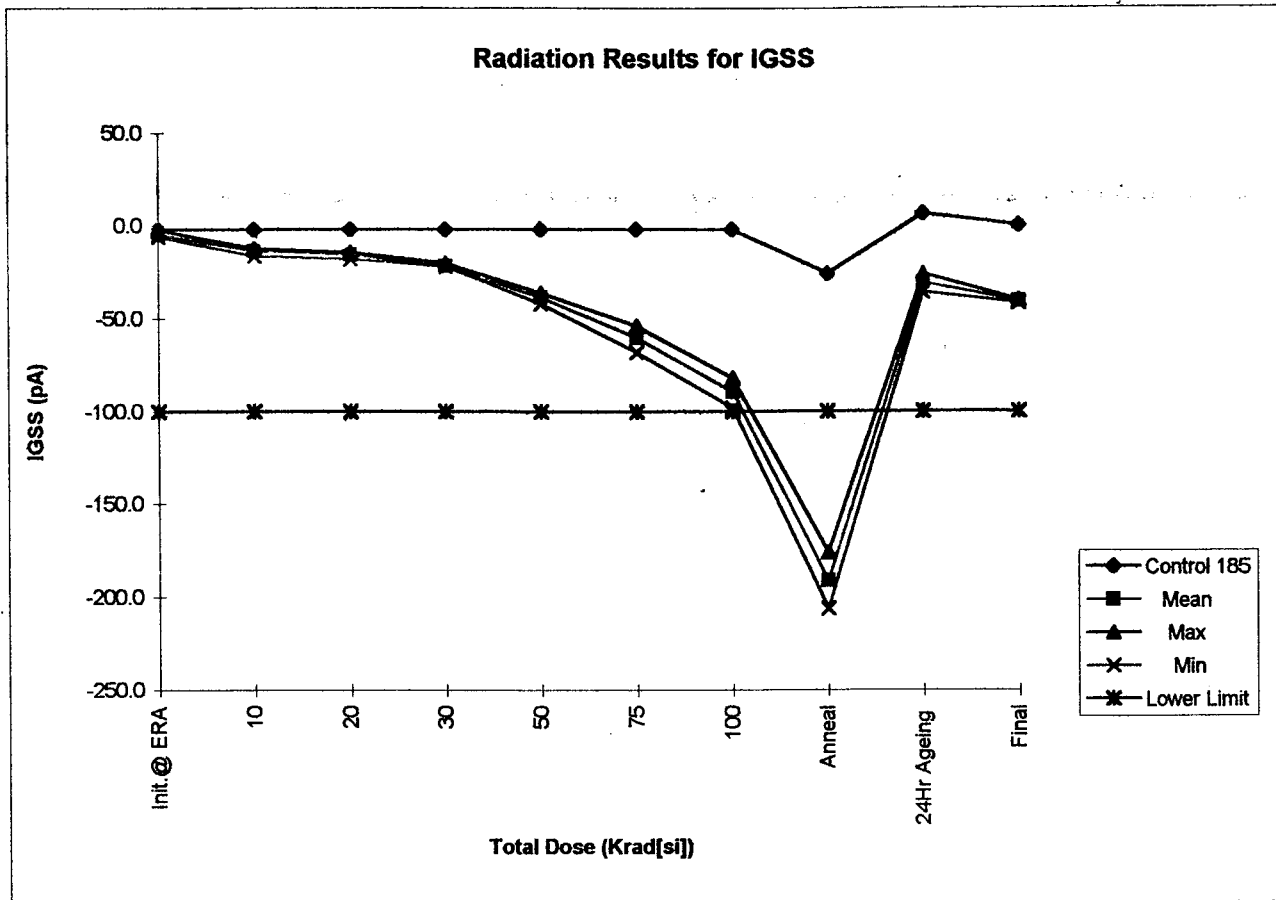
DESCRIPTION : N-CHANNEL FET

REPORT NO. : RD 234

PARAMETERS PLOTTED :

IGSS

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



Dose (kRad)	Control 185 (pA)	Mean (pA)	Max (pA)	Min (pA)	Lower Limit (pA)	Upper Limit (pA)	Std.Dev.
Init.@ ERA	-2.0	-4.5	-2.0	-6.0	-100	-	1.91
10	-2.0	-13.5	-12.0	-16.0	-100	-	1.91
20	-2.0	-15.5	-14.0	-18.0	-100	-	1.91
30	-2.0	-21.5	-20.0	-22.0	-100	-	1.00
50	-2.0	-38.5	-36.0	-42.0	-100	-	3.00
75	-2.0	-60.0	-54.0	-68.0	-100	-	7.12
100	-2.0	-89.5	-82.0	-98.0	-100	-	7.72
Anneal	-26.0	-191.0	-176.0	-206.0	-100	-	14.28
24Hr Ageing	6.0	-31.0	-26.0	-36.0	-100	-	5.66
Final	-	-41.0	-40.0	-42.0	-100	-	1.41

Note: The control sample and s/nos 186 & 191 were removed for DPA after 24 hr ageing. Hence the final points on the graph use the results from s/nos 192 & 193 only.

Lot size for statistics : 4 devices

RD 234 Date code 9044

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_INIT_EMS@_ERA / 1.0 MM 10-7-91

=====
Results file : RAD_2N4392_INIT_EMS@_ERA from: 23.06.97 / 11:12:35
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number :
Order number : D/C 9044
Vendor :
: CONTROL 185 ; RAD 186,191-193
: INITIAL EMS @ ERA
: 2N4392 SCC 5205/003 ISS 2 / 1.0 MM 10-7-91
=====

Test steps

1. IGSS (REV)	(0.0)...	1.0	nA
2. RDS on	(10.00)...	50.00	Ohm
3. VSD	0.0 ...	400.0	mV

	185	186	191	192	193
1.1 [nA]	0.1	0.0	0.1	0.0	0.0
2.1 [Ohm]	27.62	26.12	27.19	27.25	25.69
3.1 [mV]	179.0	168.5	179.6	182.1	169.8

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_EMS_@_10_KRAD / 1.0 MM 10-7-91

=====
Results file : RAD_2N4392_EMS_@_10_KRAD from: 23.06.97 / 11:33:05
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number :
Order number : D/C 9044
Vendor :
: CONTROL 185 ; RAD 186,191-193
: EMS @ 10 KRAD
:

Test steps

- | | | | |
|---------------|--------------|-------|-----|
| 1. IGSS (REV) | (0.0)... | 1.0 | nA |
| 2. RDS on | (10.00)... | 50.00 | Ohm |
| 3. VSD | 0.0 ... | 400.0 | mV |
-

	185	186	191	192	193
1.1 [nA]	0.1	0.1	0.1	0.1	0.1
2.1 [Ohm]	27.19	24.31	26.75	25.50	25.69
3.1 [mV]	179.2	167.9	178.2	181.3	168.3

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_EMS_@_20_KRAD / 1.0 MM 10-7-91

```

=====
Results file   : RAD_2N4392_EMS_@_20_KRAD   from: 23.06.97 / 11:58:23
Operator      : PAUL RUSSELL
Part number   : 2N4392
Lot number    :
Order number  : D/C 9044
Vendor       :
              : CONTROL 185 ; RAD 186,191-193
              : EMS @ 20 KRAD
              :

```

Test steps

1.	IGSS (REV)	(0.0)...	1.0	nA
2.	RDS on	(10.00)...	60.00	Ohm
3.	VSD	0.0 ...	400.0	mV

	185	186	191	192	193
1.1 [nA]	0.1	0.1	0.1	0.1	0.1
2.1 [Ohm]	27.00	26.94	29.00	26.37	25.00
3.1 [mV]	180.8	166.5	178.1	181.5	167.9

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_EMS_@_30_KRAD / 1.0 MM 10-7-91

=====
Results file : RAD_2N4392_EMS_@_30_KRAD from: 23.06.97 / 12:17:21
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number :
Order number : D/C 9044
Vendor :
: CONTROL 185 ; RAD 186,191-193
: EMS @ 30 KRAD
:

Test steps

1.	IGSS (REV)	(0.0)...	1.0	nA
2.	RDS on	(10.00)...	50.00	Ohm
3.	VSD	0.0 ...	400.0	mV

	185	186	191	192	193
1.1 [nA]	0.1	0.1	0.1	0.1	0.1
2.1 [Ohm]	27.37	22.56	25.56	27.12	24.56
3.1 [mV]	177.8	167.9	178.9	181.1	168.3

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_EMS_@_50_KRAD / 1.0 MM 10-7-91

=====
Results file : RAD_2N4392_EMS_@_50_KRAD from: 23.06.97 / 12:41:29
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number :
Order number : D/C 9044
Vendor :
: CONTROL 185 ; RAD 185,191-193
: EMS @ 50 KRAD
:

Test steps

1. IGSS (REV)	(0.0)...	1.0	nA
2. RDS on	(10.00)...	60.00	Ohm
3. VSD	0.0 ...	400.0	mV

	185	186	191	192	193
1.1 [nA]	0.1	0.1	0.1	0.1	0.1
2.1 [Ohm]	28.31	21.06	27.19	26.87	22.56
3.1 [mV]	178.8	166.1	176.7	179.9	167.9

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_EMS_@_75_KRAD / 1.0 MM 10-7-91

=====
Results file : RAD_2N4392_EMS_@_75_KRAD from: 23.06.97 / 13:24:01
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number :
Order number : D/C 9044
Vendor :
: CONTROL 185 ; RAD 186,191-193
: EMS @ 75 KRAD
:

Test steps

1. IGSS (REV)	(0.0)...	1.0	nA
2. RDS on	(10.00)...	60.00	Ohm
3. VSD	- 0.0 ...	400.0	mV

	185	186	191	192	193
1.1 [nA]	0.1	0.1	0.1	0.0	0.0
2.1 [Ohm]	26.25	24.75	27.44	29.06	23.56
3.1 [mV]	178.4	165.1	176.6	179.3	167.0

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_EMS_@_100_KRAD / 1.0 MM 10-7-91

=====
Results file : RAD_2N4392_EMS_@_100_KRAD from: 23.06.97 / 14:15:52
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number :
Order number : D/C 9044
Vendor :
: CONTROL 185 ; RAD 185,191-193
: EMS @ 100 KRAD
:

Test steps

1. IGSS (REV)	(0.0)...	1.0	nA
2. RDS on	(10.00)...	50.00	Ohm
3. VSD	0.0 ...	400.0	mV

	185	186	191	192	193
1.1 [nA]	0.1	0.0	0.0	0.1	0.0
2.1 [Ohm]	28.63	22.44	27.50	28.19	25.56
3.1 [mV]	179.1	166.2	177.9	179.8	167.5

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RAD_2N4392_POST_ANNEAL_EMS / 1.0 MM 10-7-91

=====
Results file : RAD_2N4392_POST_ANNEAL_EMS from: 25.06.97 / 11:37:41
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number : RD234
Order number : D/C 9044
Vendor : SILICONIX
: CONTROL 185 ; RAD 186,191-193
: POST ANNEAL EMS
: 2N4392 SCC 5205/003 ISS 2 / 1.0 MM 10-7-91
=====

Test steps

1. IGSS (REV)	(0.0)...	1.0	nA
2. RDS on	(10.00)...	50.00	Ohm
3. VSD	0.0 ...	400.0	mV

	185	186	191	192	193
1.1 [nA]	0.2	0.1	0.0	0.0	0.0
2.1 [Ohm]	27.44	26.87	28.00	28.69	26.31
3.1 [mV]	189.5	174.3	185.9	187.9	175.4

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RD234_2N4392_POST_24HRS_AGE_EMS / 1.0 MM 10-7-91

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=====
Results file   : RD234_2N4392_POST_24HRS_AGE_EMS   from: 26.06.97 / 10:15:55
Operator      : PAUL RUSSELL
Part number   : 2N4392
Lot number    : RD234
Order number  : D/C 9044
Vendor       : SILICONIX
               : CONTROL 195 ; RAD 186,191-193
               : EMS AFTER 24 HRS AGEING
               : 2N4392 SCC 5205/003 ISS 2 / 1.0 MM 10-7-91
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Test steps

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1. IGSS (REV)          ( 0.0 )... 1.0 nA
2. RDS on              ( 10.00 )... 50.00 Ohm
3. VSD                 .0.0 ... 400.0 mV
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	185	186	191	192	193
1.1 [nA]	0.2	0.1	0.2	0.1	0.1
2.1 [Ohm]	28.38	26.75	28.94	27.44	27.50
3.1 [mV]	186.2	174.6	185.5	193.8	175.1

SZ-TESTSYSTEME Statistics 03 Vers. 2.15 for TA07F
RD234_2N4392_FINAL_EMS / 1.0 MM 10-7-91

=====
Results file : RD234_2N4392_FINAL_EMS from: 02.07.97 / 10:51:52
Operator : PAUL RUSSELL
Part number : 2N4392
Lot number : RD234
Order number : D/C 9044
Vendor : SILICONIX
: S/NoS 192 & 193 (S/NoS 185,186 & 191 REMOVED FOR DPA)
: FINAL EMS
: 2N4392 500 5205/003 ISS 2 / 1.0 MM 10-7-91
=====

Test steps

1.	IGSS (REV)	(0.0)...	1.0	nA
2.	RDS on	(10.00)...	60.00	Ohm
3.	VSD		0.0	...	400.0	mV

192 193

1.1 [nA]	0.1		0.2	
2.1 [Ohm]	29.00		25.75	
3.1 [mV]	184.6		171.6	

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392 OPTION _____ SHEET 1 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-166-0052 Table A

Parameter Serial No's	I _{DSX} (μ A)	V _{GS OFF} (V)	I _{BSS} (μ A)				
CONTROL 185	0.021	-3.80	-2				
186	0.026	-4.40	-2				
191	0.023	-3.83	-6				
192	0.023	-3.76	-6				
193	0.019	-4.31	-4				
Limit	$\leq 0.1 \mu A$	$\geq -5V$ $\leq -2V$	$\geq -0.1 \mu A$				
Condition	V _{DS} = 20V V _{GS} = -7V	V _{DS} = 20V I _D = 1 μ A	V _{DS} = 0 V _{GS} = -20V				

Measured by P.A. Russell

Date 23/6/97

Test Equipment used:-
 EQUIPMENT: TEKTRONIX 370
CURVE TRACER
 CT NUMBER: CT217

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392 OPTION _____ SHEET 2 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-166-0052 Table A

Parameter Serial No's	I_{DSX} (nA)	$V_{GS\ OFF}$ (V)	I_{GSS} (pA)				
CONTROL 185	0.023	-3.80	-2				
186	0.024	-4.40	-12				
191	0.021	-3.83	-16				
192	0.023	-3.76	-14				
193	0.025	-4.31	-12				
Limit	$\leq 0.1\text{ nA}$	$\geq -5\text{ V}$ $\leq -2\text{ V}$	$\geq -0.1\text{ nA}$				
Condition	$V_{DS} = 20\text{ V}$ $V_{GS} = -7\text{ V}$	$V_{DS} = 20\text{ V}$ $I_D = 1\text{ nA}$	$V_{DS} = 0$ $V_{GS} = -20\text{ V}$				

Measured by P.A. Russell

Date 23/6/97

Test Equipment used:-

EQUIPMENT

CT NUMBER

TEKTRONIX 370
CURVE TRACER

CT 217

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392 OPTION _____ SHEET 3 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-166-0052 Table A

Parameter Serial No's	I _{DSX} (μ A)	V _{GS OFF} (V)	I _{GSS} (μ A)				
CONTROL 185	0.024	-3.80	-2				
186	0.025	-4.40	-18				
191	0.021	-3.83	-14				
192	0.026	-3.76	-16				
193	0.023	-4.31	-14				
Limit	$\leq 0.1 \mu A$	$\geq -5V$ $\leq -2V$	$\geq -0.1 \mu A$				
Condition	V _{DS} = 20V V _{GS} = -7V	V _{DS} = 20V I _D = 1 μ A	V _{DS} = 0 V _{GS} = -20V				

Measured by P.A. Maxwell Date 23/6/97

Test Equipment used:- EQUIPMENT CT NUMBER
 TEKTRONIX 370 CT217
 CURVE TRACER

I.G.G. COMPONENT TECHNOLOGY LTD.REPORT NO. RD234PART TYPE 2N4392

OPTION _____

SHEET 4 OF 10ELECTRICAL MEASUREMENTS w.r.t. XM-PL-16G-0052Table A

Parameter Serial No's	I_{DSX} (μA)	$V_{GS\ OFF}$ (V)	I_{GSS} (μA)				
CONTROL 185	0.023	-3.80	-2				
186	0.023	-4.40	-22				
191	0.023	-3.83	-20				
192	0.022	-3.75	-22				
193	0.020	-4.31	-22				
Limit	$\leq 0.1 \mu A$	$\geq -5V$ $\leq -2V$	$\geq -0.1 \mu A$				
Condition	$V_{DS} = 20V$ $V_{GS} = -7V$	$V_{DS} = 20V$ $I_D = 1 \mu A$	$V_{DS} = 0$ $V_{GS} = -20V$				

Measured by P. RussellDate 23/6/97Test Equipment used:-EQUIPMENTCT NUMBER

TEKTRONIX 370 CURVE TRACER

CT217

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392 OPTION _____ SHEET 5 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-166-0052 Table A

Parameter Serial No's	I_{DSX} (μA)	$V_{GS OFF}$ (V)	I_{GSS} (μA)				
CONTROL 185	0.024	-3.80	-2				
186	0.021	-4.40	-42				
191	0.017	-3.83	-36				
192	0.017	-3.76	-40				
193	0.015	-4.31	-36				
Limit	$\leq 0.1 \mu A$	$\geq -5V$ $\leq -2V$	$\geq -0.1 \mu A$				
Condition	$V_{DS} = 20V$ $V_{GS} = -7V$	$V_{DS} = 20V$ $I_D = 1 \mu A$	$V_{DS} = 0$ $V_{GS} = -20V$				

Measured by P.A. Huasell Date 23/6/97

Test Equipment used:- EQUIPMENT CT NUMBER
 TEKTRONIX 370 CURVE TRACER CT217

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392 OPTION _____ SHEET 6 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-16G-0052 Table A

Parameter Serial No's	I_{DSY} (nA)	$V_{GS\ OFF}$ (V)	I_{GSS} (pA)				
CONTROL 185	0.021	-3.80	-2				
186	0.016	-4.39	-68				
191	0.016	-3.83	-54				
192	0.012	-3.76	-64				
193	0.016	-4.31	-54				
Limit	$\leq 0.1\ \mu A$	$\geq -5V$ $\leq -2V$	$\geq -0.1\ \mu A$				
Condition	$V_{DS} = 20V$ $V_{GS} = -7V$	$V_{DS} = 20V$ $I_D = 1\ \mu A$	$V_{DS} = 0$ $V_{GS} = -20V$				

Measured by P.F. Russell Date 23/6/97

Test Equipment used:- EQUIPMENT CT NUMBER
TEKTRONIX 370 CURVE TRACER CT217

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392 OPTION _____ SHEET 7 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-166-0052 Table A

Parameter Serial No's	I_{DSX} (nA)	$V_{GS\ OFF}$ (V)	I_{GSS} (pA)				
CONTROL 185	0.018	-3.80	-2				
186	0.011	-4.39	-98				
191	0.012	-3.83	-82				
192	0.010	-3.76	-94				
193	0.011	-4.31	-84				
Limit	$\leq 0.1\ nA$	$\geq -5V$ $\leq -2V$	$\geq -0.1\ nA$				
Condition	$V_{DS} = 20V$ $V_{GS} = -7V$	$V_{DS} = 20V$ $I_D = 1\ nA$	$V_{DS} = 0$ $V_{GS} = -20V$				

Measured by P. Russell

Date 23/6/97

Test Equipment used:- EQUIPMENT CT NUMBER
 TEKTRONIX 370 CURVE TRALER CT217

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. R0234

PART TYPE 2N4392 OPTION _____ SHEET 8 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-166-0052 Table A

Parameter Serial No's	I _{DSX} (nA)	V _{GS OFF} (V)	I _{GSS} (pA)				
CONTROL 185	0.018	-3.81	-26				
186	0.015	-4.40	-200*	FAIL			
191	0.005	-3.84	-182*	FAIL			
192	0.017	-3.77	-206*	FAIL			
193	0.008	-4.32	-176*	FAIL			
Limit	≤ 0.1 nA	≥ -5V ≤ -2V	≥ -0.1 nA				
Condition	V _{DS} = 20V V _{GS} = -7V	V _{DS} = 20V I _D = 1 nA	V _{DS} = 0 V _{GS} = -20V				

Measured by P.A. Russell Date 25/6/97

Test Equipment used:- EQUIPMENT TEKTRONIX 370 CURVE TRACER CT NUMBER CT217

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392 OPTION _____ SHEET 9 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-16G-0052 Table A

Parameter Serial No's	I_{DSX} (nA)	$V_{GS\ OFF}$ (V)	I_{GSS} (pA)				
CONTROL 185	0.018	-3.81	6	USED FOR DPA			
186	0.013	-4.40	-36	——"———			
191	0.014	-3.83	-28	——"———			
192	0.015	-3.76	-34				
193	0.013	-4.32	-26				
Limit	$\leq 0.1 \mu A$	$\geq -5V$ $\leq -2V$	$\geq -0.1 \mu A$				
Condition	$V_{DS} = 20V$ $V_{GS} = -7V$	$V_{DS} = 20V$ $I_D = 1 \mu A$	$V_{DS} = 0$ $V_{GS} = -20V$				

Measured by P.A. Russell

Date 26th JUNE 1997

Test Equipment used:- TEKTRONIX 370 CURVE TRACER EQUIPMENT CT217 CT NUMBER

I.G.G. COMPONENT TECHNOLOGY LTD.

REPORT NO. RD234

PART TYPE 2N4392

OPTION _____

SHEET 10 OF 10

ELECTRICAL MEASUREMENTS w.r.t. XM-PL-166-0052

Table A

Parameter Serial No's	I_{DSX} (nA)	$V_{GS\ OFF}$ (V)	I_{GSS} (pA)				
CONTROL 185	-	-	-				
186	-	-	-				
191	-	-	-				
192	0.024	-3.75	-42				
193	0.021	-4.31	-40				
Limit	$\leq 0.1\text{ nA}$	$\geq -5\text{ V}$ $\leq -2\text{ V}$	$\geq -0.1\text{ nA}$				
Condition	$V_{DS} = 20\text{ V}$ $V_{GS} = -7\text{ V}$	$V_{DS} = 20\text{ V}$ $I_D = 1\text{ nA}$	$V_{DS} = 0$ $V_{GS} = -20\text{ V}$				

Measured by P. B. Russell

Date 2ND JULY 1997


Test Equipment used:-

EQUIPMENT

CT NUMBER

TEKTRONIX 370 CURVE TRACER

CT217

 XMM RD234	IRRADIATION TEST PLAN NO. XM-PL-IGG-0052	Issue No. 1 Date: June 1996 Page: 1/4	Rev.
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Component No. 2N4392	Component Designation: Transistor FET N Channel TYPE: 2N4392	Irradiation Spec No. N/A Iss. Rev.
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Specifications Generic ESA/SCC 5000 Iss.7D Detail ESA/SCC 5205/003 Iss.2B	Acceptance Evaluation _____ Element _____ Diffusion _____ Lot <u> X </u>	Electrical Meas In-situ _____ Remote <u> X </u>	Project/Programme XMM
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Manufacturer: Name: SEMELAB PLC Address: Coventry Road Lutterworth Leicestershire	Test Facility: Name: ERA Address: Leatherhead Surrey	Originator: IGG CT Name: M. A. PORTER Telephone: 01329 829311
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Radiation Source COBALT 60	Sample Size: 10 Control Devices: 1	Exposure Single _____ Multiple <u> X </u>	Annealing Test YES <u> X </u> NO _____	Radiation Level: 10 KRad(Si), 50 KRad(Si) 20 KRad(Si), 75 KRad(Si) 30 KRad(Si), 100 KRad(Si)
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Single Exposure Dose [KRad(Si)] Dose Rate [Rad(Si)/s] NOT APPLICABLE Exposure Time	Multiple Exposure:						
	Irradiation Steps	1	2	3	4	5	6
	Dose [KRad(Si)]	10	10	10	20	25	25
	Dose Rate [Rad(Si)/s]	10	10	10	10	10	10
	Exposure Time(s)	1000	1000	1000	2000	2500	2500

Bias Requirements: During Exposure (for in-situ elec. measure): N/A
During and after Exposure (for remote elec. measure): YES

Bias Conditions:
Test Circuits: The Electrical Bias circuit is given in Figure 1 herein.
Voltages: See Figure 1 Tolerance: See Figure 1

Shielding: Shielding is required to minimize dose enhancement effects caused by low energy, scattered radiation. The test specimens 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

Test Step	Description	Requirements
1(A)	Serialisation Goods Receiving Inspection	If parts are not serialised, serialise them (permanently) sequentially from 1 to 11 inclusive. Goods Receiving Inspection shall consist of 100% Travel Visual, Visual Inspection and Electrical Measurements per ESA/SCC 5205/003 Iss. 2B.
1(B)	Initial Electrical Measurements (at IGG)	Per Table A herein - Read and Record - 11 parts minimum at IGG.
2	Initial Electrical Measurements	Per Table A herein - Read and Record - 11 parts minimum at ERA.
3	Set-up of Test	Verify Bias circuit and Voltages (In-situ) for all 10 test samples.
4	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.



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Irradiation Test Sequence (Cont.)

Test Step	Description	Requirements
5	Intermediate Electrical Measurements	Bias to be maintained until test is performed. Test per Table A herein - Read and Record 11 parts. Test to be performed immediately upon removal from chamber (less than 10 mins interval). Upon completion of test devices to be replaced in bias circuit (10 parts) and returned to chamber. Maximum interval between two consecutive exposures to be (30 mins).
6 to 21	Repeat Set-up/Exposure/Test sequence up to Total Dose of 100 Krad(Si) as per Plan above	Repeat Step 3, 4, 5 for a total of 6 cycles up to the total dose of 100 KRad(Si) at accumulated dose of 10,20,30,50,75, and 100 KRad(Si)
22	Annealing	To be 24 hours at 25°C under Figure 1 Bias conditions.
23	Post Anneal Electrical Measurements	Per Table A herein - Read and Record - 11 parts.
24	Accelerated ageing under Bias	Bake at +100°C under Figure 1 Bias conditions for 168 hours.
25	Final Electrical Measurements	Per Table A herein - Read and Record - 11 parts.
26	Total Dose Irradiation Report	ESA/SCC 22900.

Remarks

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1. Performed for the purposes of correlation.
2. The set-up/exposure/test sequence shall be stopped for any device that exhibits repeated functional failure.
3. Electrical testing shall be performed on the same test equipment from test step 1 to step 25.



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

No.	Characteristics	Symbol	Spec. and Test Method	Test Conditions	Limits		Unit
					Min.	Max.	
1	Total gate leakage current	I_{GSS}	MIL-STD-750 Method 3411	$V_{DS} = 0$ $V_{GS} = -20V$	-	-0.1	nA
3	Drain cut-off current	I_{DSX}	MIL-STD-750 Method 3413	$V_{DS} = 20V$ $V_{GS} = -7V$	-	0.1	nA
5	Gate source cut-off voltage	V_{GSoff}	MIL-STD-750 Method 3403	$V_{DS} = 20V$ $I_D = 1nA$	-2	-5	V
6	Drain source saturation voltage	V_{DSat}	MIL-STD-750 Method 3405	$V_{GS} = 0$ $I_D = 6mA$	-	0.4	V
7	ON-state drain source resistance	r_{DSon}	MIL-STD-750 Method 3421	$V_{GS} = 0$ $I_D = 1mA$	-	60	Ω

NOTES:-

1. Pulse measurement: Pulse length $\leq 300\mu s$; Duty Cycle $\leq 2\%$.



FIGURE 1 - ELECTRICAL BIAS CIRCUIT FOR IRRADIATION

