Unisys

DATE: January 15, 1999 PPM-99-007
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SUBJECT: Radiation Report on **DG403 (Maxim) (LDC 9810)**
PROJECT: IRAC

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A radiation evaluation was performed on **DG403 (5962/8976301MEA) Low Power, High Speed, CMOS Analog Switch (Maxim)** to determine the total ionizing dose (TID) tolerance of these parts. The TID testing was performed using a Co^{60} gamma ray source. During the radiation testing, five parts were irradiated under bias at 0.060kRads/hour (0.02Rads/s), four parts were irradiated under bias at 0.011kRads/hour (0.003Rads/s) (see Figure 1 for bias configuration), and one part was used as a control sample. The total dose radiation levels were 2.5 and 5.0kRads for the higher dose rate and 2.5, 5.0, 7.5, and 10.0kRads for the lower dose rate.[1] See Table II for the radiation schedule and effective dose rate calculation. At the higher dose rate, the parts were annealed under bias at 25°C and tested after 24 hours following the 2.5kRad irradiation and after 96 hours following the 15.0kRad irradiation.[2] At the lower dose rate, the parts were annealed under bias at 25°C for 168 hours after 5.0kRads, 72 hours after 7.5kRads and 168 hours after 10.0kRads. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits[3] listed in Table III.

An executive summary of the test results is provided below in bold, followed by a detailed summary of the test results after each radiation level and annealing step. For detailed information, refer to Tables I through IV and Figure 1.

At the higher dose rate, all parts passed the Functional Test up to 5kRads. All parts failed the Functional Test from 10 to 20kRads. All parts showed significant degradation in IDD, ISS, IN1_iih, IN2_iih, from 2.5 to 20kRads. All parts showed significant degradation in Idoff_1, Idoff_2, Isoff_1, and Isoff_2 from 5.0 to 20kRads. All parts showed significant degradation in Rds_±10mA from 10 to 20kRads. The parts showed no significant recovery after any annealing step at 25°C.

At the lower dose rate, all parts passed the Functional Test up to 5kRads. All parts failed the Functional Test from 7.5 to 10kRads. All parts showed significant degradation in IDD, ISS, IN1_iih, and IN2_iih from 2.5 to 10kRads. All parts showed significant degradation in Idoff_1, Idoff_2, Isoff_1, Isoff_2, Rds3_±10mA, and Rds4_±10mA from 7.5 to 10kRads. The parts showed no significant recovery after any annealing step at 25°C.

It should be noted that for several parameters, the specification limits are less than the natural noise of the test circuit. By virtue of the fact that the values did not change during testing, these tests were considered as passing when reviewing the data.

Initial electrical measurements were made on 10 samples. Eight samples (SN's 8, 9, 10, 11, 12, 13, 14, and 15) were used as radiation samples at the higher dose rate, four samples (SN's 30, 31, 32, and 33) were used as radiation samples at the lower dose rate, while SN's 6 and 7 were used as control samples.

Higher Dose Rate (0.02R/s)

[1] The term Rads, as used in this document, means Rads (silicon). All radiation levels cited are cumulative.
[2] The temperature 25°C as used in this document implies room temperature.
[3] These are manufacturer's pre-irradiation data specification limits. The manufacturer provided no post-irradiation limits at the time these tests were performed.

After the 2.5kRad irradiation, all parts passed the Functional Test and all parts showed significant degradation in several parameters. All parts exceeded the specification limit of 1µA for IDD_vih, IN1_iih and IN2_iih all with readings >5µA. All parts fell below the specification limit of -1µA for ISS_iih all with readings <-5µA. **All parts passed all other tests.**

After annealing the parts for 24 hours at 25°C, the parts showed no recovery in the above parameters and showed some degradation in IDD_vil with four parts exceeding the specification limit of 1µA with readings >5µA. Four parts fell below the specification limit of -1000nA for ISS_vil with readings <-5µA. Readings for IDD_vih and ISS_vih remained at >5µA.

After the 5.0kRad irradiation, all parts passed the Functional Test and all parts showed continued degradation in other parameters. Six parts exceeded the specification limit for IDD_vil with readings >5µA and six parts fell below the specification limit for ISS_vil with readings <-5µA. All parts continued to exceed/fall below the specification limits for IDD_vih and ISS_vih with readings >5µA/<-5µA. Readings for IN1_iih and IN2_iih reverted to >5µA for both. All parts marginally exceeded the specification limit of 0.25nA for Idoff_1, Idoff_2, Isoff_1 and Isoff_2 with readings in the range of 1 to 12nA. **All parts passed all other tests.**

After the 10.0kRad irradiation, all parts showed significant degradation in numerous parameters. All parts failed the Functional Test. All parts passed IDD_vil and ISS_vih. Seven parts exceeded the specification limit for IDD_vil with readings >5µA and seven parts fell below the specification limit for ISS_vil with readings <-5µA. All parts continued to exceed/fall below the specification limits for IDD_vih and ISS_vih with readings >5µA/<-5µA. All parts exceeded the specification limit of 0.25nA for Idoff_1 and Isoff_1 with readings >5µA. All parts fell below the specification limit of -0.25nA for Idoff_2 and Isoff_2 with readings in the range of -80 to -142nA. One part for Rds1_10mA, two parts for Rds2_10mA, seven parts for Rds3_10mA, six parts for Rds4_10mA, one part for Rds1_-10mA, two parts for Rds2_-10mA, seven parts for Rds3_-10mA, and six parts for Rds4_-10mA exceeded the specification limit of 35Ω with readings >940Ω. **All parts passed all other tests.**

After the 15.0kRad irradiation, all parts showed very different results from those at 10kRads. All parts continued to fail the Functional Test. All parts had readings >5µA for Idoff_1 and Isoff_2. All parts fell below the specification limits for Idoff_2 and Isoff_2 with readings in the range of -80 to -142nA. All parts had readings >940Ω for Rds1_10mA, Rds2_10mA, Rds1_-10mA, and Rds2_-10mA. **All parts passed all other tests.**

After annealing the parts for 96 hours at 25°C, the parts showed no significant recovery in any parameter with readings very similar to those at 15kRads.

After the 20.0kRad irradiation, all parts showed no significant change with readings very similar to those at 15kRads. **All parts passed all other tests.**

Lower Dose Rate (0.003R/s)

After the 2.5kRad irradiation, all parts passed the Functional Test. All parts exceeded the specification limit of 1µA for IDD_vil with readings in the range of 14 to 29µA. All parts fell below the specification limit of -1µA for ISS_vil with readings in the range of -22 to -42µA. One part exceeded the specification limit of 1µA for IN1_iih and IN2_iih with readings >41µA. **All parts passed all other tests.**

After the 5.0kRad irradiation, all parts passed the Functional Test. One part fell below the specification limit for ISS_vil with a reading of -1.3µA. All parts exceeded the specification limit of 1µA for IDD_vih with readings in the range of 59 to 100µA. All parts fell below the specification limit for ISS_vih with readings in the range of -73 to -100µA. All parts exceeded the specification limit for IN1_iih and IN2_iih with readings >41µA. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts showed no significant change in any parameter.

After the 7.5kRad irradiation, all parts failed the functional test. All parts exceeded the specification limit for IDD_vih with readings >100µA. All parts fell below the specification limit for ISS_vih with readings <-100µA. All parts exceeded the specification limit for IN1_Iih and IN2_Iih with readings >41µA. All parts exceeded the specification limit of 0.25nA for Idoff_1 and Isoff_1 with readings >5µA. All parts fell below the specification limit of -0.25nA for Idoff_2 with readings in the range of -84 to -85nA. All parts exceeded the specification limit of 0.25nA of fell below the specification limit of -0.25nA for Isoff_2 with readings in the range of -90 to 1011nA. Two parts exceeded the specification limit of 45Ω for Rds3_+10mA, Rds3_-10mA, Rds4_+10mA, Rds4_-10mA with readings >944Ω. **All parts passed all other tests.**

After annealing the parts for 72 hours at 25°C, the parts showed no recovery in any parameter. Several parameters showed different readings due to a programming change to allow the ATE to measure higher values for some parameters. IDD_vil and IDD_vih both show readings >100µA. ISS_vil had readings <-3mA and ISS_vih had readings <-5mA. IN1_Iih and IN2_Iih now show readings >328µA. Idoff_1 and Isoff_1 both had readings >48µA. Idoff_2 had readings in the range of -600 to -700nA. For Isoff_2, two parts fell below the specification limit with readings of -730 and -800nA.

After the 10.0kRad irradiation, all parts failed the functional test. All parts exceeded the specification limit for IDD_vil and IDD_vih with readings >100µA. All parts fell below the specification limit for ISS_vil with readings <-2.7mA. All parts fell below the specification limit for ISS_vih with readings <-4.1mA. All parts exceeded the specification limit for IN1_Iih and IN2_Iih with readings >328µA. All parts exceeded the specification limit for Idoff_1 and Isoff_1 with readings >47µA. All parts fell below the specification limit for Idoff_2 with readings in the range of -680 to -720nA. All parts exceeded the specification limit for Isoff_2 with readings in the range of 220 to 3450nA. An increase of 16nA was noted in Ison_1 implying that these parts have degraded to a level outside the specification limit. All parts exceeded the specification limit of 45Ω for Rds3_+10mA, Rds3_-10mA, Rds4_+10mA, Rds4_-10mA with readings >944Ω. **All parts passed all other tests.**

After annealing the parts for 168 hours at 25°C, the parts showed no significant recovery in any parameter.

Table IV provides a summary of the test results with the mean and standard deviation values for each parameter after each irradiation exposure and annealing step.

Any further details about this evaluation can be obtained upon request. If you have any questions, please call us at (301) 731-8954.

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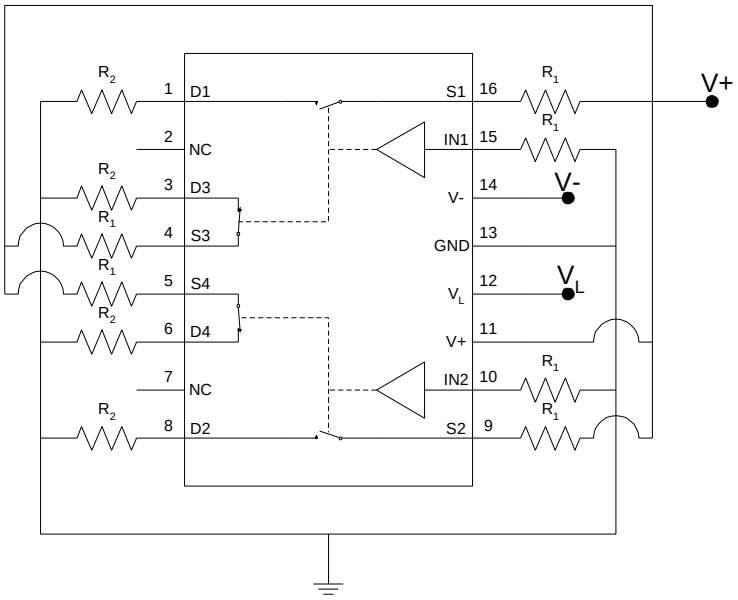
Figure 1. Radiation Bias Circuit for DG403



Notes:
1. V+ = +15V ±0.5V, V- = -15V ±0.5V, V_L = +5.0V, ±0.5V.
2. R_1 = 2kΩ ±10%, ¼W.
3. R_2 = 10kΩ ±10%, ¼W.

TABLE I. Part Information

Generic Part Number:	DG403
IRAC Part Number:	DG403 (5962/8976301MEA)
Charge Number:	M88563
Manufacturer:	Maxim
Lot Date Code (LDC):	9810
Quantity Tested:	14
Serial Number of Control Samples:	6, 7
Serial Numbers of Radiation Samples:	8, 9, 10, 11, 12, 13, 14, 15 (HDR), 30, 31, 32, 33 (LDR)
Part Function:	Low Power, High Speed, CMOS Analog Switch
Part Technology:	CMOS
Package Style:	16 Pin Dip
Test Equipment:	A540
Test Engineer:	A. Duvalsaint

- The manufacturer for this part guaranteed no radiation tolerance/hardness.

TABLE IIa. Radiation Schedule for DG403

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	10/07/98
2) 2.5 KRAD IRRADIATION (0.038 KRADS/HOUR)	10/16/98
POST-2.5 KRAD ELECTRICAL MEASUREMENT	10/19/98
3) 24 HOUR ANNEALING @25°C	10/19/98
POST-24 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/20/98
4) 5.0 KRAD IRRADIATION (0.147 KRADS/HOUR)	10/20/98
POST-5.0 KRAD ELECTRICAL MEASUREMENT	10/21/98
5) 10.0 KRAD IRRADIATION (0.149 KRADS/HOUR)	10/21/98
POST-10.0 KRAD ELECTRICAL MEASUREMENT	10/23/98
6) 15.0 KRAD IRRADIATION (0.077 KRADS/HOUR)	10/23/98
POST-15.0 KRAD ELECTRICAL MEASUREMENT	10/26/98
7) 96 HOUR ANNEALING @25°C	10/26/98
POST-96 HOUR ANNEAL ELECTRICAL MEASUREMENT	10/30/98
8) 20.0 KRAD IRRADIATION (0.079 KRADS/HOUR)	10/30/98
POST-20.0 KRAD ELECTRICAL MEASUREMENT	11/02/98

Effective Dose Rate = 20,000 RADS/14 DAYS=59.5 RADS/HOUR=0.02 RADS/SEC
The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim annealing step and time needed to test the parts.

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS, SEE FIGURE 1.

TABLE IIb. Radiation Schedule for DG403

EVENT	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	11/04/98
2) 2.5 KRAD IRRADIATION (0.022 KRADS/HOUR)	11/04/98
POST-2.5 KRAD ELECTRICAL MEASUREMENT	11/09/98
3) 5.0 KRAD IRRADIATION (0.015 KRADS/HOUR)	11/09/98
POST-5.0 KRAD ELECTRICAL MEASUREMENT	11/16/98
4) 168 HOUR ANNEALING @25°C	11/16/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	11/23/98
5) 7.5 KRAD IRRADIATION (0.015 KRADS/HOUR)	11/23/98
POST-7.5 KRAD ELECTRICAL MEASUREMENT	11/30/98
6) 72 HOUR ANNEALING @25°C	11/30/98
POST-72 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/04/98
7) 10.0 KRAD IRRADIATION (0.015 KRADS/HOUR)	12/04/98
POST-10.0 KRAD ELECTRICAL MEASUREMENT	12/11/98
8) 168 HOUR ANNEALING @25°C	12/11/98
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/18/98

Effective Dose Rate = 10,000 RADS/37 DAYS=11.3 RADS/HOUR=0.003 RADS/SEC
The effective dose rate is lower than that of the individual radiation steps as it takes into account the interim annealing steps and time needed to test the parts.

PARTS WERE IRRADIATED AND ANNEALED UNDER BIAS, SEE FIGURE 1.

Table III. Electrical Characteristics of DG403 /1

Test #	Parameter	Units	Test Conditions /2 /3 /4	Spec. Lim. min	Spec. Lim. max
1	functional_100kHz	P/F	f = 100kHz, V_{IL} = 0.8V, V_{IH} = 2.4V, Load = ±10mA	V_{OH}>3.0V	V_{OL}<1.0V
10	IDD_vil	nA	V_{IN} = 0.0V	-1000	1000
11	ISS_vil	nA	V_{IN} = 0.0V	-1000	1000
12	IDD_vih	nA	V_{IN} = 5.0V	-1000	1000
13	ISS_vih	nA	V_{IN} = 5.0V	-1000	1000
20	IN1_Iil	nA	V_{IN1} = 0.8V, V_{DD} = 15V, V_{SS} = -15V	-1000	1000
21	IN2_Iil	nA	V_{IN2} = 0.8V, V_{DD} = 15V, V_{SS} = -15V	-1000	1000
22	IN1_Iih	nA	V_{IN1} = 2.4V, V_{DD} = 15V, V_{SS} = -15V	-1000	1000
23	IN2_Iih	nA	V_{IN2} = 2.4V, V_{DD} = 15V, V_{SS} = -15V	-1000	1000
30	D1_Idoff_1	nA	V_{IN1} = 0.8V, V_{DD} = 15V, V_{SS} = -15V	-0.25	0.25
31	D2_Idoff_1	nA	V_{IN2} = 0.8V, V_{DD} = 15V, V_{SS} = -15V	-0.25	0.25
32	D3_Idoff_1	nA	V_{IN1} = 2.4V, V_{DD} = 15V, V_{SS} = -15V	-0.25	0.25
33	D4_Idoff_1	nA	V_{IN2} = 2.4V, V_{DD} = 15V, V_{SS} = -15V	-0.25	0.25
34	D1_Idoff_2	nA	V_{IN1} = 0.8V, V_{DD} = -5V, V_{SS} = 15V	-0.25	0.25
35	D2_Idoff_2	nA	V_{IN2} = 0.8V, V_{DD} = -5V, V_{SS} = 15V	-0.25	0.25
36	D3_Idoff_2	nA	V_{IN1} = 2.4V, V_{DD} = -5V, V_{SS} = 15V	-0.25	0.25
37	D4_Idoff_2	nA	V_{IN2} = 2.4V, V_{DD} = -5V, V_{SS} = 15V	-0.25	0.25
40	S1_Isoff_1	nA	V_{IN1} = 0.8V, V_{DD} = -15V, V_{SS} = 15V	-0.25	0.25
41	S2_Isoff_1	nA	V_{IN2} = 0.8V, V_{DD} = -15V, V_{SS} = 15V	-0.25	0.25
42	S3_Isoff_1	nA	V_{IN1} = 2.4V, V_{DD} = -15V, V_{SS} = 15V	-0.25	0.25
43	S4_Isoff_1	nA	V_{IN2} = 2.4V, V_{DD} = -15V, V_{SS} = 15V	-0.25	0.25
44	S1_Isoff_2	nA	V_{IN1} = 0.8V, V_{DD} = 15V, V_{SS} = -5V	-0.25	0.25
45	S2_Isoff_2	nA	V_{IN2} = 0.8V, V_{DD} = 15V, V_{SS} = -5V	-0.25	0.25
46	S3_Isoff_2	nA	V_{IN1} = 2.4V, V_{DD} = 15V, V_{SS} = -5V	-0.25	0.25
47	S4_Isoff_2	nA	V_{IN2} = 2.4V, V_{DD} = 15V, V_{SS} = -5V	-0.25	0.25
50	S1_Ison_1	nA	V_{IN1} = 2.4V, V_{SS} = 15V	-0.4	0.4
51	S2_Ison_1	nA	V_{IN2} = 2.4V, V_{SS} = 15V	-0.4	0.4
52	S3_Ison_1	nA	V_{IN1} = 0.8V, V_{SS} = 15V	-0.4	0.4
53	S4_Ison_1	nA	V_{IN2} = 0.8V, V_{SS} = -5V	-0.4	0.4
54	S1_Ison_2	nA	V_{IN1} = 2.4V, V_{SS} = -5V	-0.4	0.4
55	S2_Ison_2	nA	V_{IN2} = 2.4V, V_{SS} = -5V	-0.4	0.4
56	S3_Ison_2	nA	V_{IN1} = 0.8V, V_{SS} = -5V	-0.4	0.4
57	S4_Ison_2	nA	V_{IN2} = 0.8V, V_{SS} = -5V	-0.4	0.4
60	D1_Idon_1	nA	V_{IN1} = 2.4V, V_{DD} = 15V	-0.4	0.4
61	D2_Idon_1	nA	V_{IN2} = 2.4V, V_{DD} = 15V	-0.4	0.4
62	D3_Idon_1	nA	V_{IN1} = 0.8V, V_{DD} = 15V	-0.4	0.4
63	D4_Idon_1	nA	V_{IN2} = 0.8V, V_{DD} = -5V	-0.4	0.4
64	D1_Idon_2	nA	V_{IN1} = 2.4V, V_{DD} = -5V	-0.4	0.4
65	D2_Idon_2	nA	V_{IN2} = 2.4V, V_{DD} = -5V	-0.4	0.4
66	D3_Idon_2	nA	V_{IN1} = 0.8V, V_{DD} = -5V	-0.4	0.4
67	D4_Idon_2	nA	V_{IN2} = 0.8V, V_{DD} = -5V	-0.4	0.4
70	Rds1_10mA	W	V_{IN1} = 2.4V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0
71	Rds2_10mA	W	V_{IN2} = 2.4V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0
72	Rds3_10mA	W	V_{IN1} = 0.8V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0
73	Rds4_10mA	W	V_{IN2} = 0.8V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0
74	Rds1_-10mA	W	V_{IN1} = 2.4V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0
75	Rds2_-10mA	W	V_{IN2} = 2.4V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0
76	Rds3_-10mA	W	V_{IN1} = 0.8V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0
77	Rds4_-10mA	W	V_{IN2} = 0.8V, V_{DD} = 0.0V, V_{SS} = 10V	0.0	45.0

Notes:

1/ These are the manufacturer's non-irradiated data sheet specification limits. The manufacturer provided no post-irradiation limits at the time the tests were performed.

2/ The Digital Voltage Level range of the Drivers is from -5.2V to 15.0V. Because of this limitation, Isoff, Idoff and Idon2 are performed as V_{SS} and V_{DD} = -5V instead of -15V and 15V instead of 15.5V. In addition, the test limits for Isoff and Idoff are changed from 250pA to ±1µA and the test limits for Idon and Ison are changed from ±1nA to ±1µA because the "open socket leakage current" for these tests is greater than ±1nA.

3/ For Rds tests, V_{DD} = +13.5V, V_{SS} = -13.5V, I_S = ±10mA. The Rds test routine contains a correction factor that was derived from bench test data taken on some of the switches.

TABLE IVa: Summary of Electrical Measurements after Total Dose Exposures and Annealing for DG403 /1

Dose Rate = 0.02R/s

							TDE (kRads Si)		Annealing		Total Dose Exposure (kRads Si)						Annealing		TDE (kRads Si)	
					Initial		2.5		24 hours @25°C		5.0		10.0		15.0		96 hours @25°C		20.0	
Test #	Parameters	Units	Spec. Lim. /2 min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Functional_100kHz /3	P/F			P		P		P		P		F		F		F		F	
10	IDD_vil	mA	-1.0	1.0	0	0	0	0	2.5	2.7	3.8	2.3	0	0	0.04	0.02	0.03	0.01	0.26	0.14
11	ISS_vil	mA	-1.0	1.0	1	0	0	0	-2.5	2.7	-3.8	2.3	0	0	-0.05	0.01	-0.04	0.01	-0.21	0.12
12	IDD_vih	mA	-1.0	1.0	0	0	>5		>5		>5		4.4	1.6	0.15	0.05	0.12	0.05	0.26	0.14
13	ISS_vih	mA	-1.0	1.0	0	0	<-5		<-5		<-5		-4.4	1.8	-0.05	0.02	-0.04	0.01	-0.21	0.12
20	IN1_Iil	mA	-1.0	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	IN2_Iil	mA	-1.0	1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	IN1_Iih	mA	-1.0	1.0	0	0	>5		14.1	16.6	>5		4.5	1.8	0	0	0	0	0	0
23	IN2_Iih	mA	-1.0	1.0	0	0	>5		14.1	16.6	>5		4.5	1.8	0	0	0	0	0	0
30-33	Idoff_1	nA	-0.25	0.25	0	0	0	0	0	0	1	1	4409	2683	>5000		>5000		>5000	
34-37	Idoff_2	nA	-0.25	0.25	0	0	0	0	0	0	1	0	-80	0	-80	0	-80	0	-71	27
40-43	Isoff_1	nA	-0.25	0.25	0	0	0	0	0	0	3	2	5110	1643	>5000		>5000		>5000	
44-47	Isoff_2	nA	-0.25	0.25	0	0	0	0	0	0	5	7	-142	0	-142	0	-142	0	-127	47
50-53	Ison_1	nA	-0.4	0.4	19	0	19	1	19	0	19	0	22	6	19	0	19	0	17	7
54-57	Ison_2	nA	-0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60-63	Idon_1	nA	-0.4	0.4	18	0	19	0	18	0	18	0	17	2	18	0	18	1	16	6
64-67	Idon_2	nA	-0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	Rds1_10mA	?	0.0	35.0	18.3	0.2	18.5	0.2	18.3	0.1	18.5	0.2	136	329	950	0	950	0	950	0
71	Rds2_10mA	?	0.0	35.0	18.4	0.1	18.5	0.2	18.4	0.1	18.6	0.2	253	430	950	0.2	950	0	950	0
72	Rds3_10mA	?	0.0	35.0	18.3	0.2	18.6	0.2	18.5	0.1	18.6	0.2	834	329	19.5	0.3	19.6	0.3	123	310
73	Rds4_10mA	?	0.0	35.0	18.5	0.2	18.7	0.2	18.7	0.1	18.9	0.1	717	431	19.7	0.3	19.8	0.3	21	0.5
74	Rds1_-10mA	?	0.0	35.0	17.9	0.2	18.2	0.2	18.0	0.1	18.3	0.2	136	326	944	0.1	944	0.3	944	0.3
75	Rds2_-10mA	?	0.0	35.0	18.1	0.2	18.3	0.2	18.1	0.1	18.5	0.2	252	427	944	0.3	944	0.4	944	0.5
76	Rds3_-10mA	?	0.0	35.0	18.0	0.2	18.3	0.1	18.2	0.1	18.4	0.2	828	327	19.4	0.3	19.6	0.3	20.4	0.4
77	Rds4_-10mA	?	0.0	35.0	18.1	0.2	18.4	0.2	18.4	0.1	18.6	0.1	713	428	19.6	0.3	19.7	0.3	20.6	0.5

Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout testing and are not included in this table.

2/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

3/ For this test, a "P" ("F") implies that all parts passed (failed) this functional test at this level.

Radiation sensitive parameters: Functional_100kHz, IDD, ISS, IN1_Iih, In2_Iih, Idoff_1, Idoff_2, Isoff_1, Isoff_2, Rds_10mA, Rds_-10mA.

TABLE IVb: Summary of Electrical Measurements after Total Dose Exposures and Annealing for DG403 /1

Dose Rate = 0.003R/s

					Initial		Total Dose Exposure (kRads Si) 2.5		5.0		Annealing 168 hours @25°C		TDE (kRads Si) 7.5		Annealing 72 hours @25°C		TDE (kRads Si) 10.0		Annealing 168 hours @25°C	
Test #	Parameters	Units	Spec. Lim. /2 min	Spec. Lim. /2 max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
1	Functional_100kHz /3	P/F			P		P		P		P		F		F		F		F	
10	IDD_vil	mA	-1.0	1.0	-0.009	0.007	16	10	0.1	0.3	0	0.2	0	0.2	>100		>100		75	50
11	ISS_vil	mA	-1.0	1.0	-0.004	0.013	-24	14	-0.7	0.4	-0.6	0.3	-0.6	0.3	-3300	225	-2716	334	-2052	1380
12	IDD_vih	mA	-1.0	1.0	-0.007	0.005	-0.2	0	79	17	36	30	>100		>100		>100		>100	
13	ISS_vih	mA	-1.0	1.0	-0.001	0.002	-0.3	0	-93	14	-45	37	<-100		-5525	449	-4115	1710	-3551	1897
20	IN1_Iil	mA	-1.0	1.0	0.001	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	IN2_Iil	mA	-1.0	1.0	0.000	0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	IN1_Iih	mA	-1.0	1.0	0.000	0.000	10	21	41	0	31	21	>41		>328		>328		>328	
23	IN2_Iih	mA	-1.0	1.0	0.000	0.000	10	21	41	0	31	21	>41		>328		>328		>328	
30-33	Idoff_1	nA	-0.25	0.25	1	0	1	0	1	0	1	0	5808	45	48273	331	47636	102	47772	193
34-37	Idoff_2	nA	-0.25	0.25	0	1	0	0	0	0	0	0	-87	4	-692	11	-713	9	-700	7
40-43	Isoff_1	nA	-0.25	0.25	0	0	0	0	0	0	0	0	5800	44	48183	315	47602	105	47720	187
44-47	Isoff_2	nA	-0.25	0.25	0	1	0	0	0	1	0	1	299	475	-728	93	1040	1608	1410	2344
50-53	Ison_1	nA	-0.4	0.4	16	7	19	1	19	0	19	0	19	0	18	0	34	1	33	4
54-57	Ison_2	nA	-0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60-63	Idon_1	nA	-0.4	0.4	16	7	19	1	18	1	18	0	19	0	18	0	19	0	19	0
64-67	Idon_2	nA	-0.4	0.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
70	Rds1_10mA	?	0.0	45.0	18.1	0	18.5	0.1	18.5	0.1	18.4	0.1	19.0	0.1	18.9	0.1	19.6	0.3	19.6	0.4
71	Rds2_10mA	?	0.0	45.0	18.6	0.2	20.6	1.5	21.1	1.3	23.5	3.8	20.6	1.0	21.1	0.5	23.8	0.7	22.8	0.3
72	Rds3_10mA	?	0.0	45.0	18.1	0	18.2	0.1	18.6	0.2	18.6	0.2	484	537	484	537	950	0.3	950	0.2
73	Rds4_10mA	?	0.0	45.0	18.4	0.1	18.2	0.1	18.5	0.2	18.6	0.2	484	537	484	537	950	0.3	950	0.3
74	Rds1_-10mA	?	0.0	45.0	17.7	0	18.1	0.1	18.2	0.1	18.1	0.1	18.9	0.2	18.7	0.2	20.1	0.7	20.0	0.7
75	Rds2_-10mA	?	0.0	45.0	20.6	2.3	20.1	0.7	21.7	3.8	23.1	2.4	21.1	1.0	21.3	0.5	24.7	0.8	23.5	1.0
76	Rds3_-10mA	?	0.0	45.0	17.8	0	18.0	0.1	18.3	0.2	18.4	0.2	482	534	482	534	>944		>944	
77	Rds4_-10mA	?	0.0	45.0	18.0	0.1	17.9	0.1	18.2	0.2	18.3	0.2	481	534	481	534	>944		>944	

Notes:

1/ The mean and standard deviation values were calculated over the four parts irradiated in this testing. The control samples remained constant throughout testing and are not included in this table.

2/ These are manufacturer's pre-irradiation data sheet specification limits. No post-irradiation limits were provided by the manufacturer at the time the tests were performed.

3/ For this test, a "P" ("F") implies that all parts passed (failed) this functional test at this level.

Radiation sensitive parameters: Functional_100kHz, IDD, ISS, IN1_Iih, In2_Iih, Idoff_1, Idoff_2, Isoff_1, Isoff_2, Ison_1, Rds_10mA, Rds_-10mA.