

Component No OLH449		Component Designation: OLH449	Irradiation Spec. No.: ESCC 22900 Issue 4
Gen. Spec.: -- Det. Spec.: MFR Datasheet Amend.: --		Evaluation: X Acceptance Wafer: - Acceptance Lot: -	Project/Programme: LDT (ESA) AO / 1-6172 / 09 / F / WE
Family: 18	Group: 01	Functional Assignment: Radiation Tolerant Phototransistor Hermetic Optocoupler	Package: TO-5
Manuf.Name: ISOLINK Address: USA		Test House: ATN Address: SEVILLA (SPAIN)	Orig.house: ATN Address: SEVILLA (SPAIN)
Radiation Test Plan No.: ATGSP-RP-76 Iss1		Sample Size: 22 Irradiation Devices: 20 Control Devices: 2	Date Code: 0942 Diffusion Lot: See summary. Diffusion Run: See summary. Wafer Lot: See summary.
Radiation Source: Cobalt-60 Facility Name: ESA (ESTEC) Address: NOORDWIJK (HOLLAND)		Energy: 1.33/1.17 MeV Dose Rate: 35.4 & 323.7 rad(Si)/h	Interest level: 100krad(Si) Maximum Test Level: 100krad(Si)
Irradiation Conditions: Biased: X (10 samples) Unbiased: X (10 samples) Test Circuit: Figure 1		Irradiation Measurements Interval: Remote test: X In situ Test: --	Annealing Tests: 24h@25°C, 168h@100°C Biased: X (10 samples) Unbiased: X (10 samples) Test Circuit: Figure 1

Electrical Measurements. Parameters Tested:

$I_{C(ON)}$, $V_{CE(sat)}$, $I_{C(OFF)}$, V_F , I_R , CTR1, CTR2, CTR3, CTR4, CTR5, CTR6, CTR7.

Prepared by.: Antonio Romero Mallén
Date: 2012/11/12
Signature:



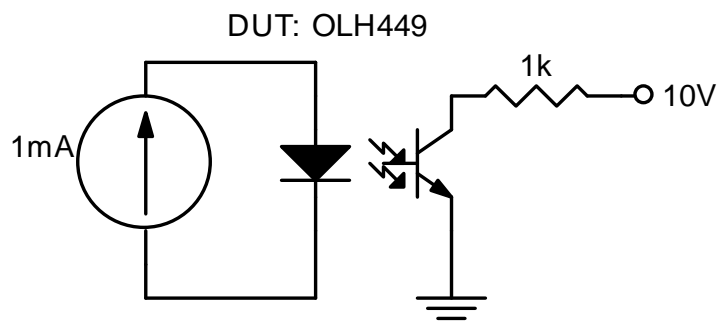
Approved by.: Eugenio Muñoz Plaza
Date: 2012/11/12
Signature:



DOCUMENT CHANGE CONTROL

Edition / Revision	Date	Affected Edition / Revision	Affected Paragraph / Modification
ATN-RR-003/2012 Iss.1	2012/07/10	--	First edition of this document.
ATN-RR-003/2012 Iss.2	2012/11/12	ATN-RR-003/2012 Iss.1	Footer on the pages updated with new issue of document format. Company's logo updated. Test house name updated. Electrical measurements at room temperature conditions included as ANNEX III.

FIGURE 1.-RADIATION BIAS CIRCUITS



Notes:

1. Ten parts (5 ELDR+5 LDR) were irradiated biased ON, in accordance with the radiation bias circuit shown in Figure 1.
2. Ten parts (5 ELDR+ 5 LDR) were irradiated biased OFF: the pins are short circuited and connected to ground.

SUMMARY

In order to evaluate the behaviour of the samples between ELDR, LDR, ON and OFF biased, a total dose steady-state irradiation test has been carried out on a Radiation Tolerant Phototransistor Hermetic Optocoupler OLH449, manufactured by ISOLINK, USA. The test was performed using two dose rate (35.4 rad(Si)/h and 323.7rad (Si)/h) until a total accumulated dose of 100krad(Si). The irradiated parts were labelled as follows:

Serial Number	Bias condition	Dose rate
R1	Control device	ELDR
R2	ON	
R3		
R4		
R5		
R6		
R7	OFF	
R8		
R9		
R10		
R11		
R1	Control device	LDR
R2	ON	
R3		
R4		
R5		
R6		
R7	OFF	
R8		
R9		
R10		
R11		

WAFER LOT NUMBER

LED: DXA350, WAFER LOT# 65187, WAFER# 28
DET: OI1527, WAFER LOT# V003/2, WAFER# 17

RESULTS

The next table shows a resume of the irradiation test results.

ELDR									
	0Krad	6Krad	13Krad	20Krad	30Krad	50Krad	100Krad	ANN24	ANN168
I _{C(ON)}	PASS	PASS	PASS	PASS	(1)	(1)	(1)	(1)	PASS
V _{CE(SAT)}	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
I _{CE(OFF)}	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
V _F	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
I _R	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR1	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR2	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR3	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR4	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR5	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR6	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR7	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
LDR									
	0Krad	6Krad	13Krad	20Krad	30Krad	50Krad	100Krad	ANN24	ANN168
I _{C(ON)}	PASS	PASS	PASS	PASS	(1)	(1)	(1)	(1)	PASS
V _{CE(SAT)}	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
I _{CE(OFF)}	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
V _F	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
I _R	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR1	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR2	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR3	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR4	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR5	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR6	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
CTR7	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

(1) Values out of limits.

The values measured and graphs with the evolution of the previous parameters during the irradiation test and annealing sequence are available in ANNEX I.

CONCLUSION

The results obtained during the irradiation test, show that this lot is sensitive to the cumulative radiation dose when tested at dose rates of 35.4 rad(Si)/h and 323.7 rad(Si)/h up to a cumulative dose of 100krad(Si).

The most affected parameters are the IC(ON), VCE(SAT) and the CTR's. The IC(ON) parameter starts to be out of limits at the 35krad step. The other parameters remain within specification limits. The samples tend to recover their initial values during the annealing process.

-IC(ON): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 50krad onwards.

-VCE(SAT): The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 100krad onwards.

CTR's: The results show a higher degradation in the samples biased OFF than the biased ON. A slight difference between LDR and ELDR in the samples biased On is observed from 50krad onwards.

For the rest of the parameters, it is not observed a clear differentiate behaviour between ELDR, LDR, On and Off biased parts

SCHEDULE

ELDR Average Dose Rate (1) rad(Si)/h	LDR Average Dose Rate (2) rad(Si)/h	Cummulative ELDR Total Dose krad(Si)	ELDR Measurement date	Cummulative LDR Total Dose krad(Si)	LDR Measurement date	Step Deviation ELDR vs LDR (%)
--	--	0	2012/02/15	0	2012/06/04	--
35.41	323.7	5240	2012/02/21	5707	2012/06/05	8.9
		12168	2012/02/29	13362	2012/06/06	9.8
		19201	2012/03/08	20644	2012/06/07	7.5
		28612	2012/03/19	28167	2012/06/08	-1.5
		48417	2012/04/11	48498	2012/06/11	0.1
		106074	2012/06/18	102360	2012/06/18	-3.7
Annealing						
ann24h @25°C	24	--	2012/06/19	--	2012/06/19	
ann168h @100°C	168	--	2012/06/26	--	2012/06/26	

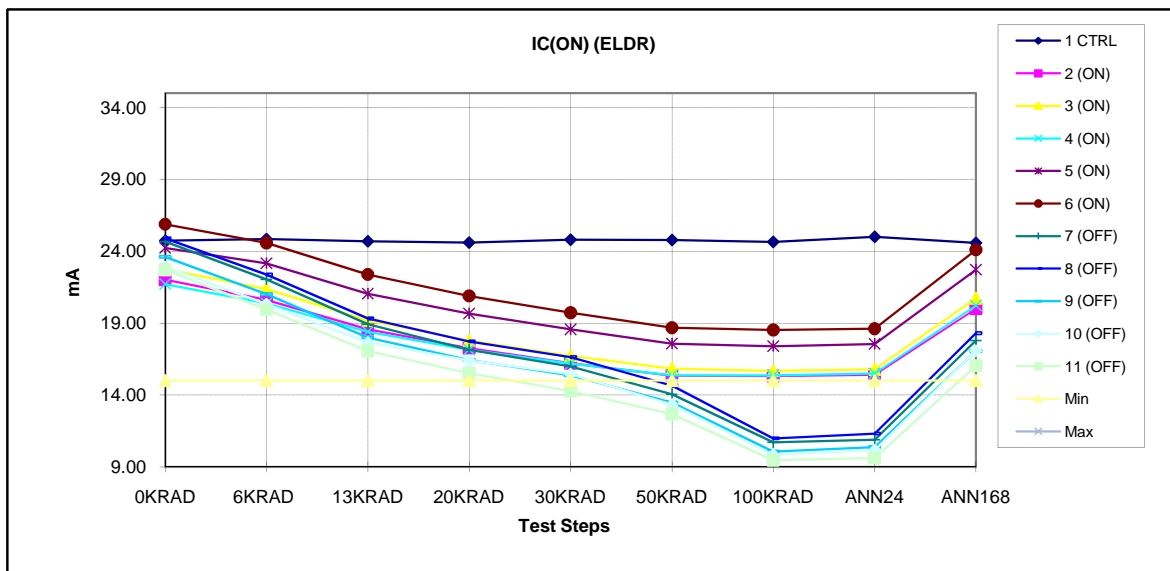
(1) The minimum and maximum dose rate registered were 18.6rad (Si)/h and 38.9rad (Si)/h respectively.

(2) The minimum and maximum dose rate registered were 271.2 rad(Si)/h and 360.6 rad(Si)/h respectively.

ELECTRICAL MEASUREMENTS EQUIPMENT LIST

REF INVENT	DESCRIPTION	MFR	MODEL	CALIBRATION DUE	USAGE
LE0304.000	UNIVERSAL TEST SYSTEM	SZ	M-3000	2012/08/15	0,6,13,20,35,50,100Krad, ANN24, ANN168
LE0393.003	TEST ADAPTER	SZ	UNIVERSAL FRONT ADAPTER	--	0,6,13,20,35,50,100Krad, ANN24, ANN168
LE080.008	TEST ADAPTER	SZ	TA06B	--	0,6,13,20,35,50,100Krad, ANN24, ANN168
LE0400.000	HIGH RESISTANCE METER	AGILENT	4339B	2012/09/21	0,6,13,20,35,50,100Krad, ANN24, ANN168

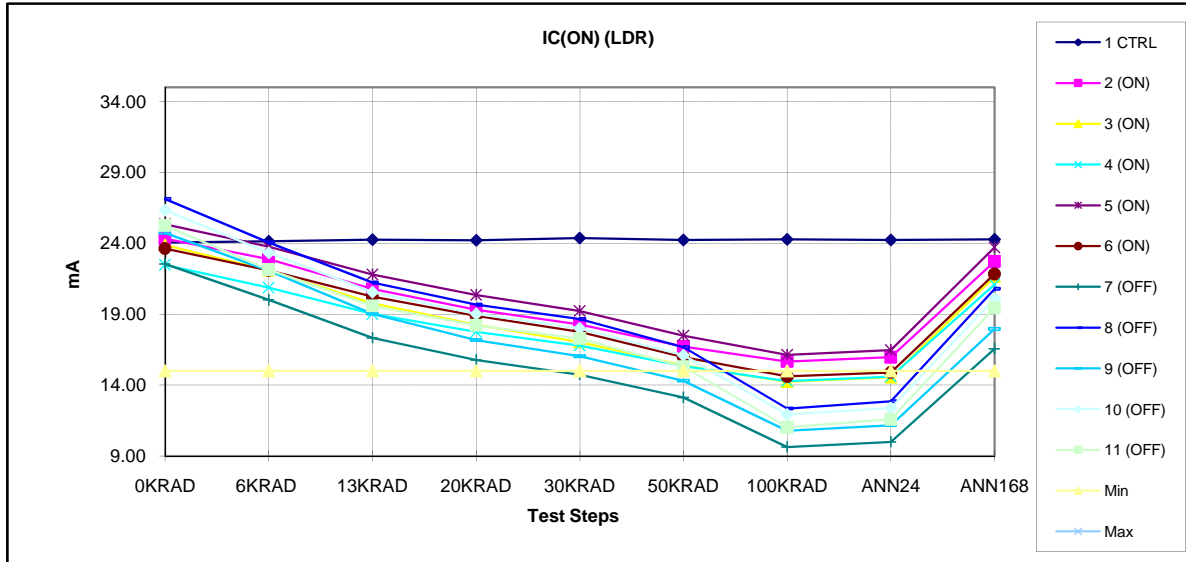
ANNEX I ELECTRICAL MEASUREMENTS GRAPHS



IC(ON) (ELDR)	0KRAD	6KRAD	13KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	15	15	15	15	15	15	15	15	15
Max	40	40	40	40	40	40	40	40	40
Unit	mA	mA	mA	mA	mA	mA	mA	mA	mA
Control Results									
1 CTRL	24.7	24.9	24.7	24.6	24.8	24.8	24.7	25.0	24.6

Bias on results									
2 (ON)	22.0	20.6	18.6	17.3	16.2	15.3	15.3	15.4	20.0
3 (ON)	22.8	21.4	19.2	17.8	16.7	15.8	15.7	15.8	20.7
4 (ON)	21.7	20.4	18.4	17.2	16.2	15.4	15.4	15.5	20.2
5 (ON)	24.2	23.2	21.0	19.7	18.6	17.6	17.4	17.5	22.7
6 (ON)	25.9	24.6	22.4	20.9	19.7	18.7	18.5	18.6	24.1
Statistics bias on									
min result	21.7	20.4	18.4	17.2	16.2	15.3	15.3	15.4	20.0
max result	25.9	24.6	22.4	20.9	19.7	18.7	18.5	18.6	24.1
average	23.3	22.0	19.9	18.6	17.5	16.6	16.5	16.6	21.6
sigma	1.7	1.8	1.7	1.7	1.6	1.5	1.4	1.4	1.8

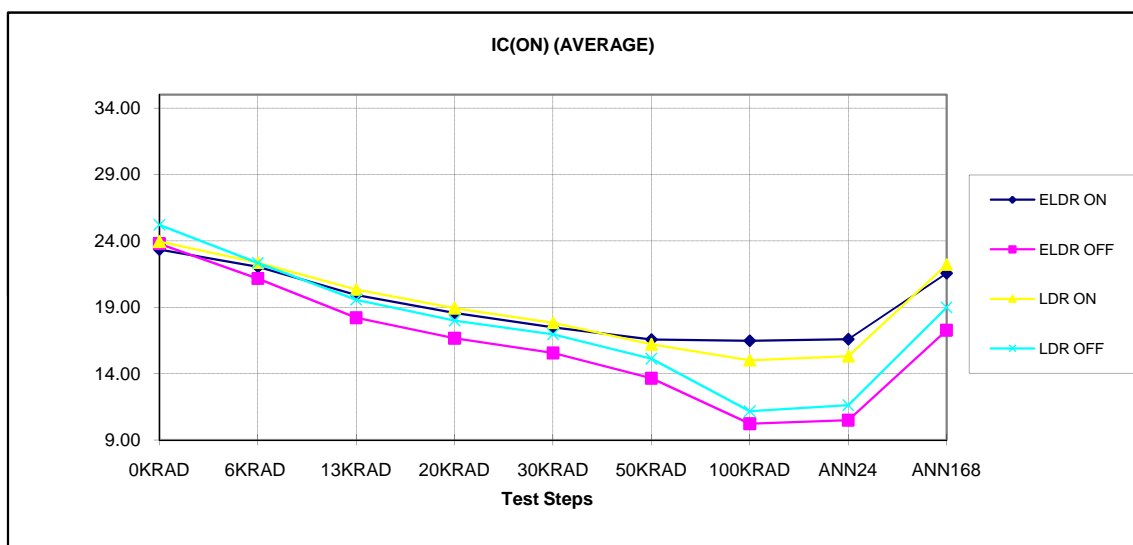
Bias off results									
7 (OFF)	24.7	22.0	18.9	17.1	16.0	14.1	10.7	10.9	17.8
8 (OFF)	24.9	22.4	19.3	17.7	16.6	14.6	11.0	11.3	18.3
9 (OFF)	23.6	21.0	18.0	16.4	15.4	13.5	10.1	10.4	17.1
10 (OFF)	22.9	20.3	17.7	16.4	15.5	13.3	9.8	10.2	17.1
11 (OFF)	22.7	20.0	17.1	15.5	14.3	12.7	9.5	9.6	16.0
Statistics bias off									
min result	22.7	20.0	17.1	15.5	14.3	12.7	9.5	9.6	16.0
max result	24.9	22.4	19.3	17.7	16.6	14.6	11.0	11.3	18.3
average	23.8	21.1	18.2	16.7	15.5	13.6	10.2	10.5	17.2
sigma	1.0	1.1	0.9	0.8	0.9	0.7	0.6	0.7	0.9



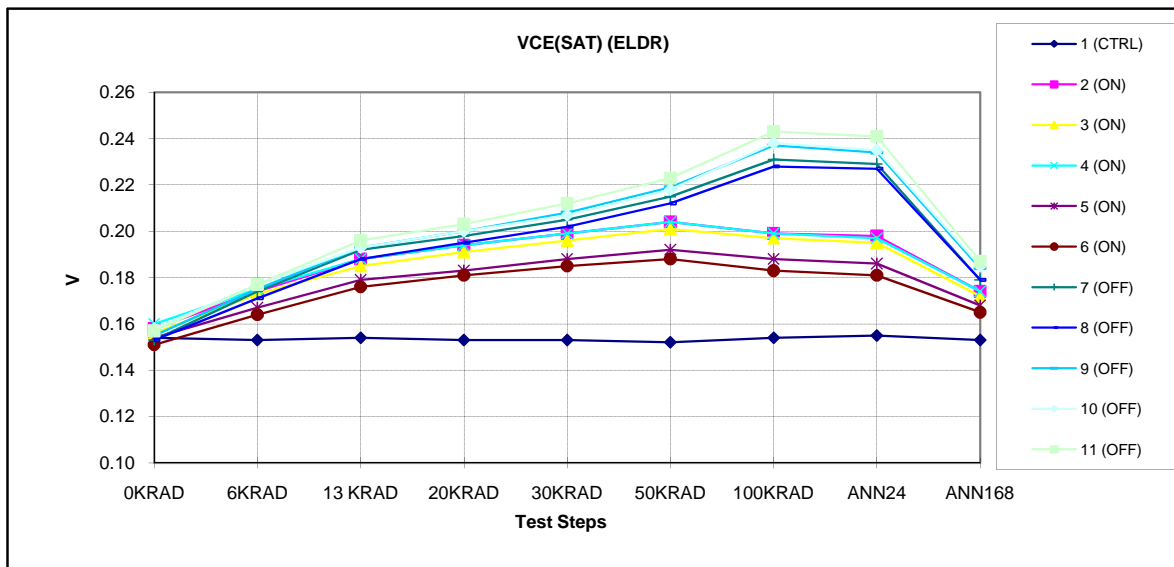
IC(ON) (LDR)	0KRAD	6KRAD	13KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	15	15	15	15	15	15	15	15	15
Max	40	40	40	40	40	40	40	40	40
Unit	mA	mA	mA	mA	mA	mA	mA	mA	mA
Control Results									
1 CTRL	24.1	24.2	24.3	24.2	24.4	24.2	24.3	24.2	24.3

Bias on results									
2 (ON)	24.3	22.9	20.8	19.3	18.3	16.7	15.7	16.0	22.7
3 (ON)	23.9	22.1	19.8	18.3	17.1	15.4	14.3	14.6	21.6
4 (ON)	22.5	20.9	19.0	17.8	16.8	15.3	14.3	14.6	21.1
5 (ON)	25.3	23.8	21.8	20.4	19.2	17.5	16.1	16.5	23.7
6 (ON)	23.6	22.1	20.3	18.9	17.8	16.0	14.6	14.9	21.8
Statistics bias on									
min result	22.5	20.9	19.0	17.8	16.8	15.3	14.3	14.6	21.1
max result	25.3	23.8	21.8	20.4	19.2	17.5	16.1	16.5	23.7
average	23.9	22.3	20.3	18.9	17.8	16.2	15.0	15.3	22.2
sigma	1.0	1.1	1.1	1.0	1.0	0.9	0.9	0.9	1.0

Bias off results									
7 (OFF)	22.5	20.0	17.3	15.8	14.7	13.1	9.6	10.0	16.6
8 (OFF)	27.1	24.1	21.2	19.7	18.7	16.7	12.4	12.9	20.8
9 (OFF)	24.7	22.1	19.0	17.2	16.0	14.3	10.8	11.2	18.0
10 (OFF)	26.3	23.3	20.6	19.0	18.0	16.1	11.9	12.4	20.1
11 (OFF)	25.3	22.1	19.6	18.2	17.3	15.3	11.0	11.6	19.4
Statistics bias off									
min result	22.5	20.0	17.3	15.8	14.7	13.1	9.6	10.0	16.6
max result	27.1	24.1	21.2	19.7	18.7	16.7	12.4	12.9	20.8
average	25.2	22.3	19.6	18.0	16.9	15.1	11.2	11.6	19.0
sigma	1.7	1.5	1.5	1.5	1.6	1.4	1.1	1.1	1.7



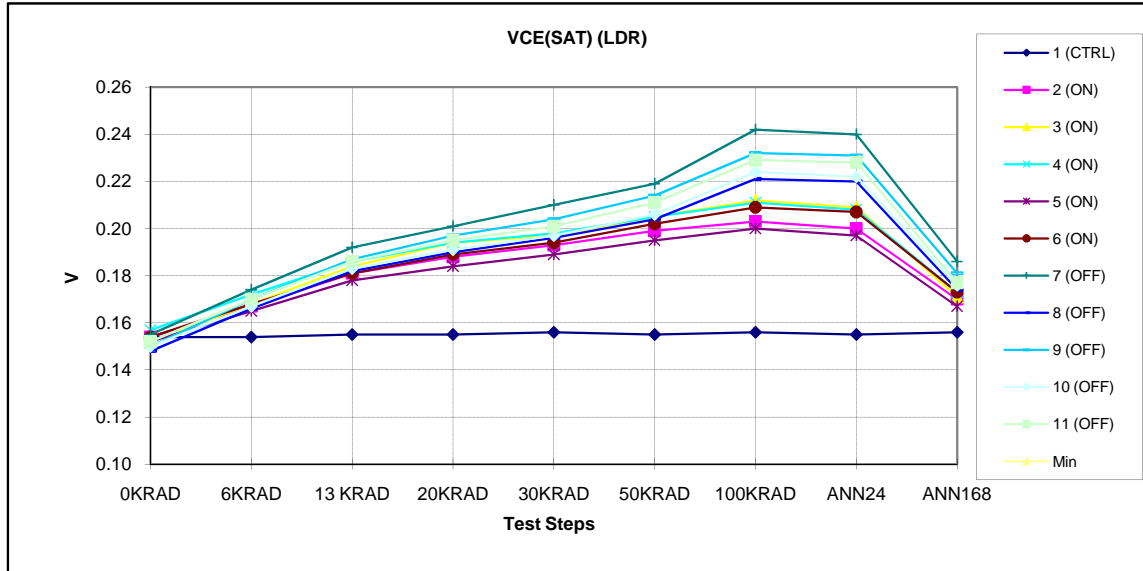
IC(ON) (AVERAGE)	0KRAD	6KRAD	13KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	23.3	22.0	19.9	18.6	17.5	16.6	16.5	16.6	21.6
ELDR OFF	23.8	21.1	18.2	16.7	15.5	13.6	10.2	10.5	17.2
LDR ON	23.9	22.3	20.3	18.9	17.8	16.2	15.0	15.3	22.2
LDR OFF	25.2	22.3	19.6	18.0	16.9	15.1	11.2	11.6	19.0



VCE(SAT) (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Unit	V	V	V	V	V	V	V	V	V
Control Results									
1 (CTRL)	0.154	0.153	0.154	0.153	0.153	0.152	0.154	0.155	0.153

Bias on results									
2 (ON)	0.158	0.174	0.188	0.194	0.199	0.204	0.199	0.198	0.174
3 (ON)	0.156	0.173	0.185	0.191	0.196	0.201	0.197	0.195	0.172
4 (ON)	0.160	0.175	0.188	0.194	0.199	0.204	0.199	0.197	0.174
5 (ON)	0.154	0.167	0.179	0.183	0.188	0.192	0.188	0.186	0.168
6 (ON)	0.151	0.164	0.176	0.181	0.185	0.188	0.183	0.181	0.165
Statistics bias on									
min result	0.151	0.164	0.176	0.181	0.185	0.188	0.183	0.181	0.165
max result	0.160	0.175	0.188	0.194	0.199	0.204	0.199	0.198	0.174
average	0.156	0.171	0.183	0.189	0.193	0.198	0.193	0.191	0.171
sigma	0.003	0.005	0.005	0.006	0.007	0.007	0.007	0.008	0.004

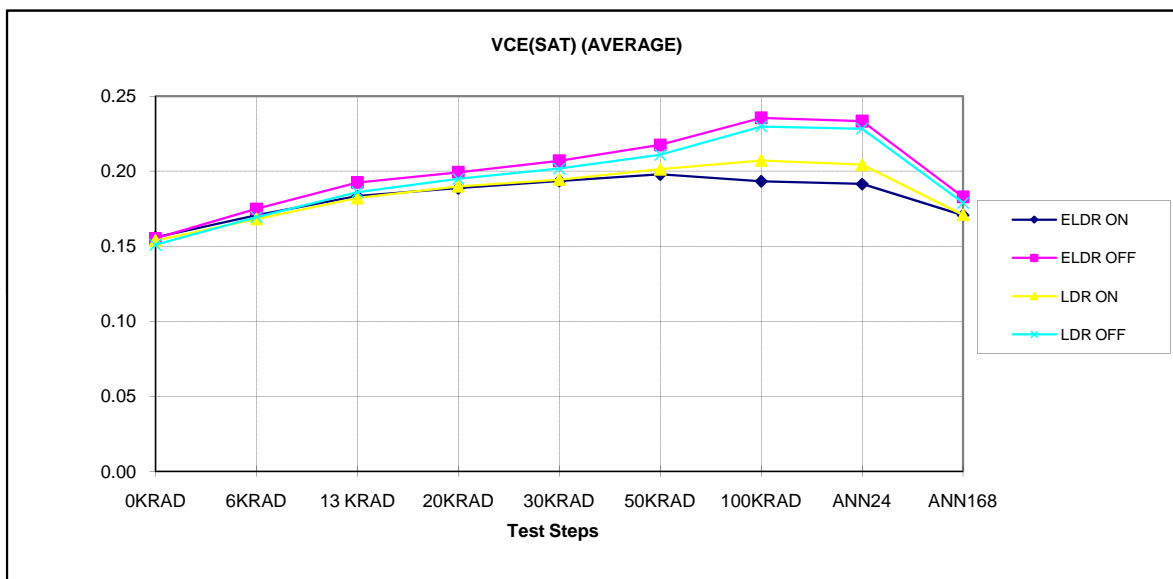
Bias off results									
7 (OFF)	0.153	0.174	0.192	0.198	0.205	0.215	0.231	0.229	0.179
8 (OFF)	0.153	0.171	0.188	0.195	0.202	0.212	0.228	0.227	0.179
9 (OFF)	0.155	0.175	0.193	0.200	0.208	0.219	0.237	0.234	0.184
10 (OFF)	0.158	0.177	0.193	0.200	0.207	0.218	0.238	0.235	0.185
11 (OFF)	0.157	0.177	0.196	0.203	0.212	0.223	0.243	0.241	0.187
Statistics bias off									
min result	0.153	0.171	0.188	0.195	0.202	0.212	0.228	0.227	0.179
max result	0.158	0.177	0.196	0.203	0.212	0.223	0.243	0.241	0.187
average	0.155	0.175	0.192	0.199	0.207	0.217	0.235	0.233	0.183
sigma	0.002	0.002	0.003	0.003	0.004	0.004	0.006	0.005	0.004



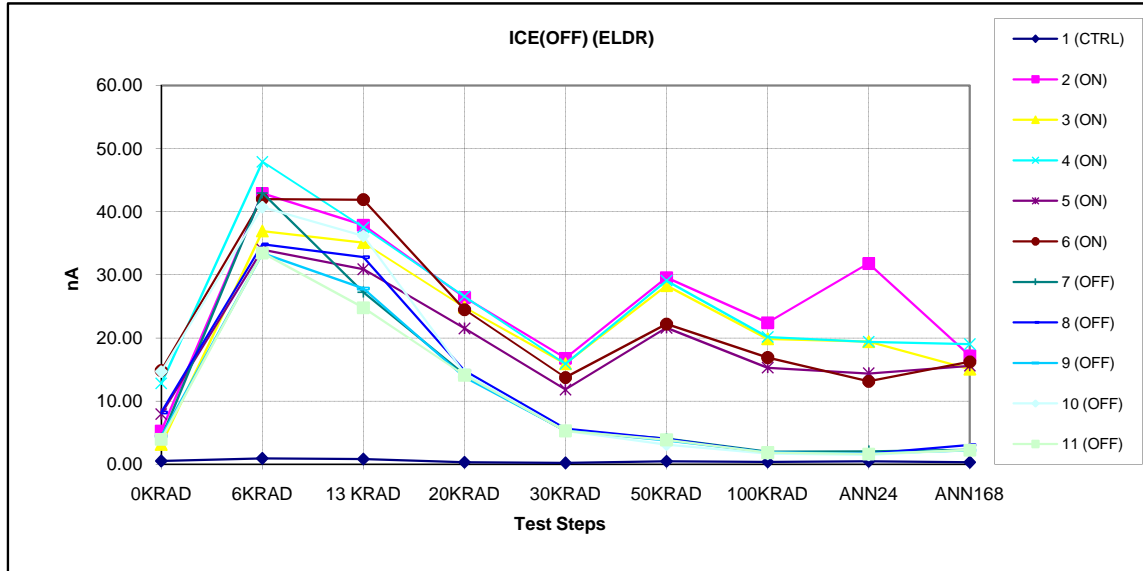
VCE(SAT) (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Unit	V	V	V	V	V	V	V	V	V
Control Results									
1 (CTRL)	0.154	0.154	0.155	0.155	0.156	0.155	0.156	0.155	0.156

Bias on results									
2 (ON)	0.154	0.167	0.181	0.188	0.193	0.199	0.203	0.200	0.170
3 (ON)	0.152	0.168	0.184	0.194	0.197	0.205	0.212	0.209	0.171
4 (ON)	0.157	0.172	0.186	0.194	0.198	0.205	0.211	0.208	0.173
5 (ON)	0.152	0.165	0.178	0.184	0.189	0.195	0.200	0.197	0.167
6 (ON)	0.154	0.168	0.181	0.189	0.194	0.202	0.209	0.207	0.173
Statistics bias on									
min result	0.152	0.165	0.178	0.184	0.189	0.195	0.200	0.197	0.167
max result	0.157	0.172	0.186	0.194	0.198	0.205	0.212	0.209	0.173
average	0.154	0.168	0.182	0.190	0.194	0.201	0.207	0.204	0.171
sigma	0.002	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.002

Bias off results									
7 (OFF)	0.155	0.174	0.192	0.201	0.210	0.219	0.242	0.240	0.186
8 (OFF)	0.148	0.166	0.182	0.190	0.196	0.204	0.221	0.220	0.174
9 (OFF)	0.150	0.170	0.187	0.197	0.204	0.214	0.232	0.231	0.181
10 (OFF)	0.150	0.167	0.183	0.191	0.197	0.206	0.224	0.222	0.176
11 (OFF)	0.152	0.170	0.186	0.195	0.201	0.211	0.229	0.228	0.177
Statistics bias off									
min result	0.148	0.166	0.182	0.190	0.196	0.204	0.221	0.220	0.174
max result	0.155	0.174	0.192	0.201	0.210	0.219	0.242	0.240	0.186
average	0.151	0.169	0.186	0.195	0.202	0.211	0.230	0.228	0.179
sigma	0.003	0.003	0.004	0.004	0.006	0.006	0.008	0.008	0.005



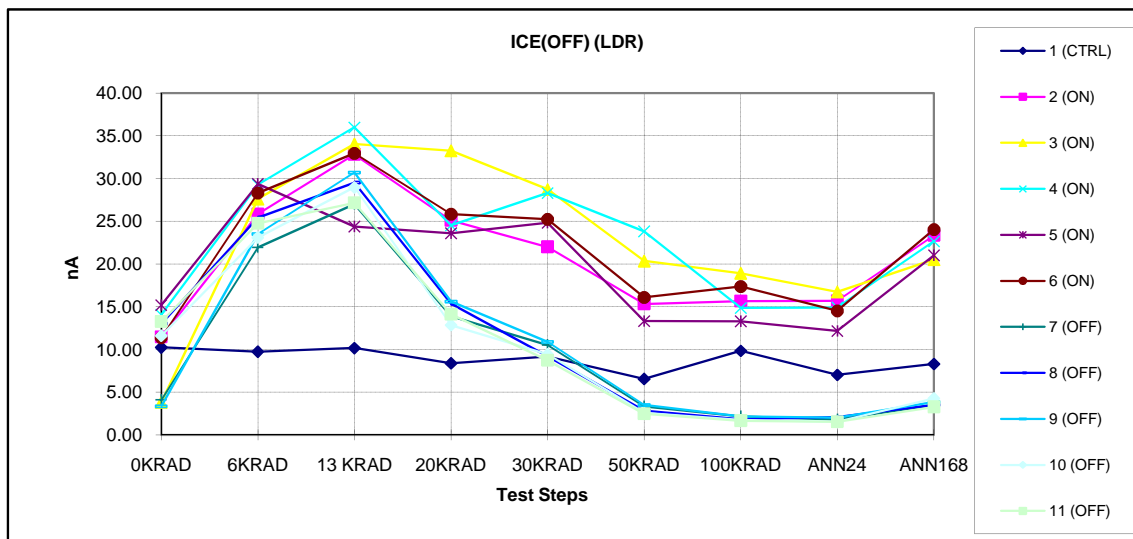
VCE(SAT) (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	0.156	0.171	0.183	0.189	0.193	0.198	0.193	0.191	0.171
ELDR OFF	0.155	0.175	0.192	0.199	0.207	0.217	0.235	0.233	0.183
LDR ON	0.154	0.168	0.182	0.190	0.194	0.201	0.207	0.204	0.171
LDR OFF	0.151	0.169	0.186	0.195	0.202	0.211	0.230	0.228	0.179



ICE(OFF) (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	100	100	100	100	100	100	100	100	100
Unit	nA	nA	nA	nA	nA	nA	nA	nA	nA
Control Results									
1 (CTRL)	0.50	0.92	0.81	0.32	0.20	0.47	0.36	0.46	0.32

Bias on results									
2 (ON)	5.26	42.90	37.87	26.40	16.78	29.57	22.41	31.79	17.19
3 (ON)	3.14	36.95	35.13	24.89	15.93	28.32	19.86	19.43	15.08
4 (ON)	12.81	47.92	37.52	26.60	15.89	29.09	20.15	19.40	19.02
5 (ON)	7.94	33.99	30.89	21.50	11.82	21.60	15.27	14.39	15.61
6 (ON)	14.85	42.02	41.93	24.50	13.76	22.22	16.91	13.15	16.23
Statistics bias on									
min result	3.14	33.99	30.89	21.50	11.82	21.60	15.27	13.15	15.08
max result	14.85	47.92	41.93	26.60	16.78	29.57	22.41	31.79	19.02
average	8.80	40.76	36.67	24.78	14.84	26.16	18.92	19.63	16.63
sigma	4.95	5.43	4.05	2.05	2.02	3.91	2.83	7.37	1.55

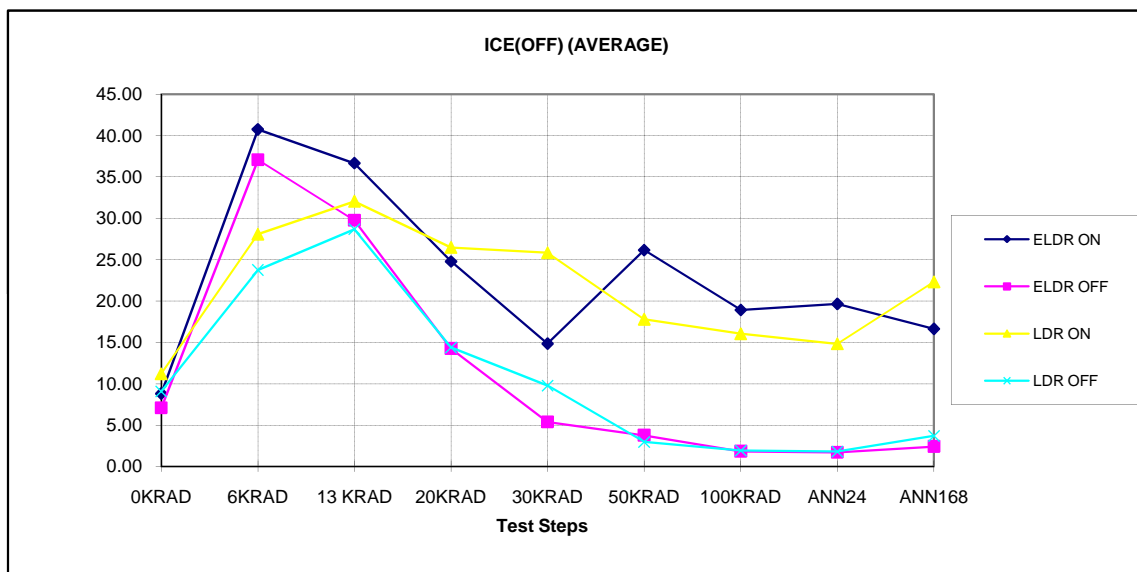
Bias off results									
7 (OFF)	4.11	42.98	27.27	14.20	5.30	4.04	1.98	2.05	2.26
8 (OFF)	8.22	34.84	32.83	14.80	5.62	4.03	1.84	1.68	3.06
9 (OFF)	4.41	33.42	27.85	13.80	5.33	3.76	1.86	1.67	2.20
10 (OFF)	14.69	40.73	36.15	14.40	5.30	3.12	1.66	1.48	2.31
11 (OFF)	3.94	33.46	24.80	14.10	5.28	3.85	1.82	1.61	2.21
Statistics bias off									
min result	3.94	33.42	24.80	13.80	5.28	3.12	1.66	1.48	2.20
max result	14.69	42.98	36.15	14.80	5.62	4.04	1.98	2.05	3.06
average	7.07	37.09	29.78	14.26	5.37	3.76	1.83	1.70	2.41
sigma	4.61	4.46	4.60	0.37	0.14	0.38	0.11	0.21	0.37



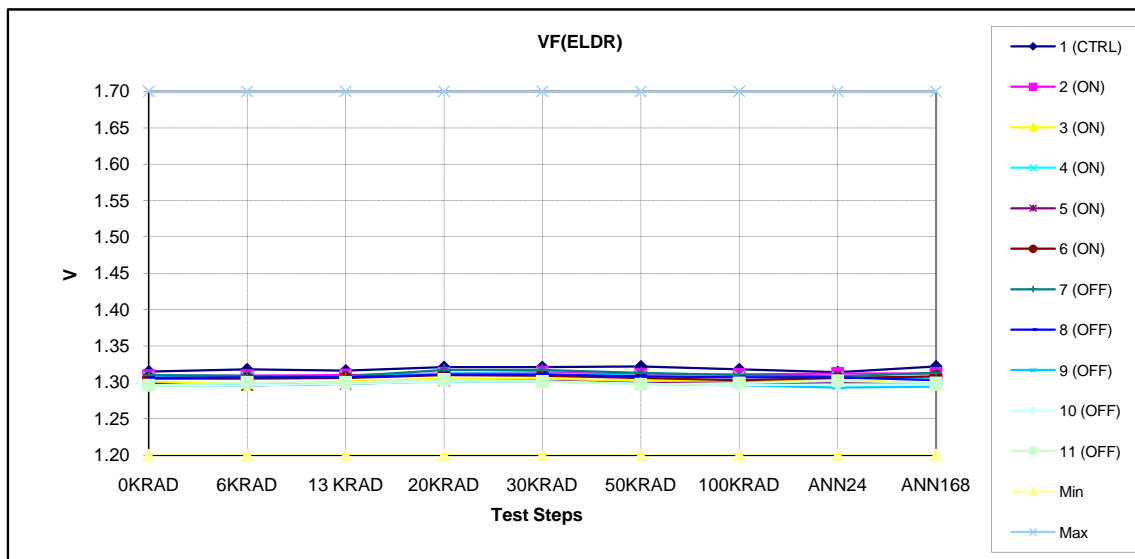
ICE(OFF) (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	100	100	100	100	100	100	100	100	100
Unit	nA	nA	nA	nA	nA	nA	nA	nA	nA
Control Results									
1 (CTRL)	10.26	9.75	10.18	8.39	9.18	6.55	9.85	7.03	8.31

Bias on results									
2 (ON)	11.48	25.85	32.83	25.11	22.02	15.33	15.66	15.70	23.36
3 (ON)	3.82	27.62	34.04	33.25	28.75	20.36	18.93	16.75	20.52
4 (ON)	14.10	29.29	35.99	24.54	28.32	23.84	14.88	14.94	22.66
5 (ON)	15.21	29.37	24.39	23.60	24.82	13.33	13.31	12.18	21.02
6 (ON)	11.40	28.32	32.96	25.84	25.26	16.11	17.39	14.53	24.05
Statistics bias on									
min result	3.82	25.85	24.39	23.60	22.02	13.33	13.31	12.18	20.52
max result	15.21	29.37	35.99	33.25	28.75	23.84	18.93	16.75	24.05
average	11.20	28.09	32.04	26.47	25.83	17.79	16.03	14.82	22.32
sigma	4.45	1.45	4.46	3.88	2.77	4.24	2.19	1.70	1.51

Bias off results									
7 (OFF)	4.10	21.97	27.03	13.91	10.53	3.36	2.18	1.82	3.53
8 (OFF)	13.01	25.45	29.54	15.36	9.21	2.86	1.83	2.10	3.52
9 (OFF)	3.38	23.53	30.72	15.61	10.91	3.53	2.18	2.02	3.86
10 (OFF)	11.62	23.12	28.99	12.86	9.45	2.57	1.75	1.54	4.29
11 (OFF)	13.28	24.77	27.17	14.15	8.75	2.50	1.69	1.56	3.30
Statistics bias off									
min result	3.38	21.97	27.03	12.86	8.75	2.50	1.69	1.54	3.30
max result	13.28	25.45	30.72	15.61	10.91	3.53	2.18	2.10	4.29
average	9.08	23.77	28.69	14.38	9.77	2.96	1.93	1.81	3.70
sigma	4.92	1.37	1.58	1.12	0.91	0.46	0.24	0.26	0.39



CE(OFF) (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	8.80	40.76	36.67	24.78	14.84	26.16	18.92	19.63	16.63
ELDR OFF	7.07	37.09	29.78	14.26	5.37	3.76	1.83	1.70	2.41
LDR ON	11.20	28.09	32.04	26.47	25.83	17.79	16.03	14.82	22.32
LDR OFF	9.08	23.77	28.69	14.38	9.77	2.96	1.93	1.81	3.70



VF(ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Max	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Unit	V	V	V	V	V	V	V	V	V

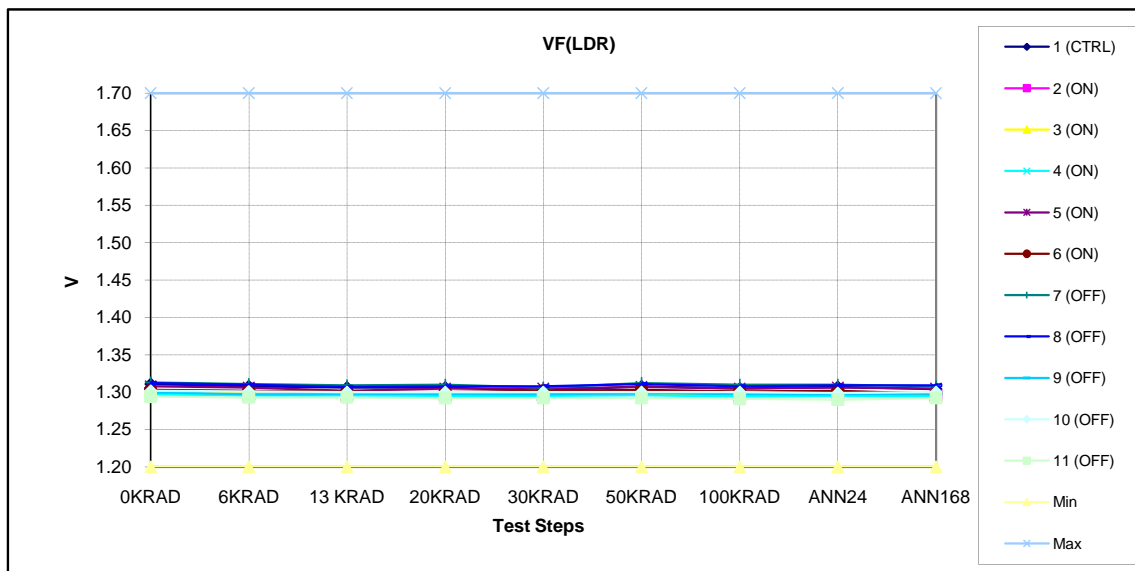
Control Results									
1 (CTRL)	1.315	1.318	1.316	1.321	1.321	1.322	1.318	1.314	1.322

Bias on results									
2 (ON)	1.309	1.309	1.310	1.312	1.314	1.311	1.311	1.312	1.312
3 (ON)	1.301	1.297	1.301	1.305	1.305	1.302	1.303	1.304	1.298
4 (ON)	1.307	1.307	1.308	1.312	1.312	1.309	1.308	1.307	1.306
5 (ON)	1.298	1.296	1.298	1.302	1.302	1.299	1.300	1.299	1.299
6 (ON)	1.305	1.305	1.306	1.310	1.309	1.306	1.303	1.306	1.308

Statistics bias on									
min result	1.298	1.296	1.298	1.302	1.302	1.299	1.300	1.299	1.298
max result	1.309	1.309	1.310	1.312	1.314	1.311	1.311	1.312	1.312
average	1.304	1.303	1.305	1.308	1.308	1.305	1.305	1.306	1.305
sigma	0.004	0.006	0.005	0.004	0.005	0.005	0.004	0.005	0.006

Bias off results									
7 (OFF)	1.310	1.309	1.308	1.317	1.317	1.313	1.310	1.308	1.313
8 (OFF)	1.306	1.307	1.307	1.311	1.311	1.308	1.307	1.307	1.303
9 (OFF)	1.296	1.296	1.298	1.301	1.301	1.298	1.296	1.293	1.294
10 (OFF)	1.296	1.296	1.298	1.301	1.301	1.298	1.296	1.297	1.297
11 (OFF)	1.296	1.300	1.300	1.304	1.301	1.297	1.299	1.302	1.299

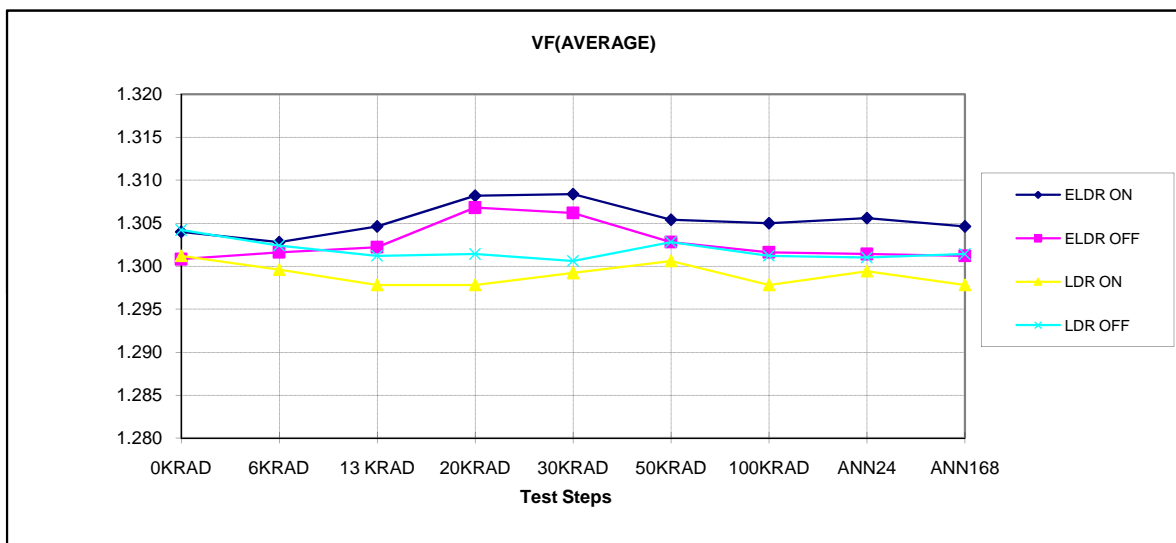
Statistics bias off									
min result	1.296	1.296	1.298	1.301	1.301	1.297	1.296	1.293	1.294
max result	1.310	1.309	1.308	1.317	1.317	1.313	1.310	1.308	1.313
average	1.301	1.302	1.302	1.307	1.306	1.303	1.302	1.301	1.301
sigma	0.007	0.006	0.005	0.007	0.007	0.007	0.007	0.006	0.007



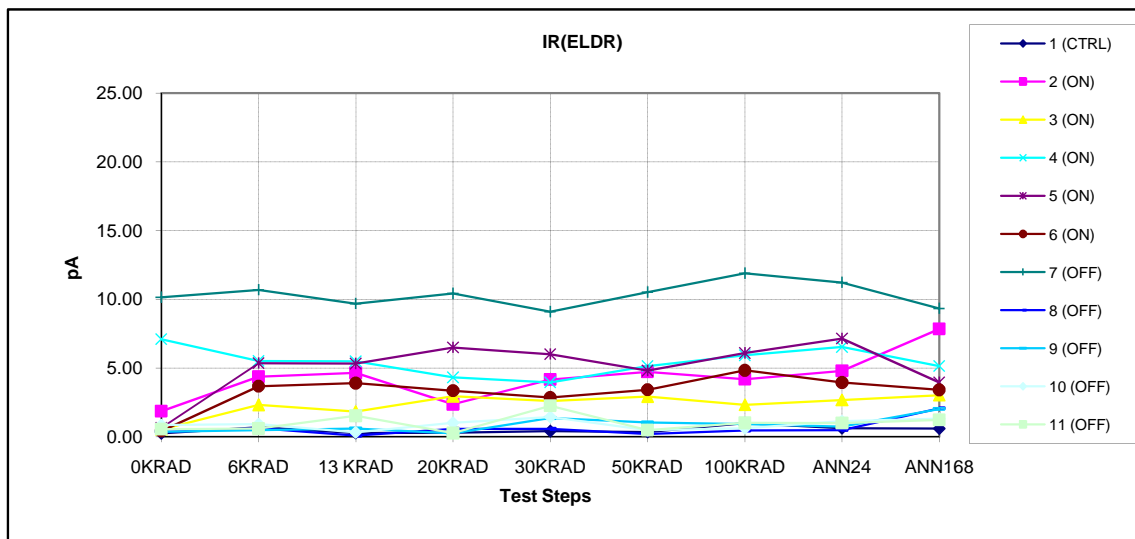
VF(LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Max	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
Unit	V	V	V	V	V	V	V	V	V
Control Results									
1 (CTRL)	1.311	1.308	1.306	1.306	1.302	1.308	1.305	1.307	1.304

Bias on results									
2 (ON)	1.298	1.297	1.296	1.296	1.296	1.298	1.295	1.297	1.295
3 (ON)	1.300	1.298	1.296	1.294	1.298	1.299	1.294	1.297	1.297
4 (ON)	1.297	1.295	1.294	1.294	1.295	1.296	1.294	1.295	1.294
5 (ON)	1.308	1.306	1.302	1.305	1.305	1.307	1.305	1.306	1.305
6 (ON)	1.303	1.302	1.301	1.300	1.302	1.303	1.301	1.302	1.298
Statistics bias on									
min result	1.297	1.295	1.294	1.294	1.295	1.296	1.294	1.295	1.294
max result	1.308	1.306	1.302	1.305	1.305	1.307	1.305	1.306	1.305
average	1.301	1.300	1.298	1.298	1.299	1.301	1.298	1.299	1.298
sigma	0.004	0.004	0.003	0.005	0.004	0.004	0.005	0.005	0.004

Bias off results									
7 (OFF)	1.313	1.311	1.309	1.310	1.306	1.312	1.310	1.310	1.308
8 (OFF)	1.312	1.310	1.307	1.308	1.308	1.311	1.308	1.309	1.309
9 (OFF)	1.300	1.297	1.297	1.297	1.297	1.299	1.297	1.297	1.298
10 (OFF)	1.302	1.301	1.300	1.300	1.300	1.300	1.300	1.299	1.300
11 (OFF)	1.294	1.293	1.293	1.292	1.292	1.292	1.291	1.290	1.292
Statistics bias off									
min result	1.294	1.293	1.293	1.292	1.292	1.292	1.291	1.290	1.292
max result	1.313	1.311	1.309	1.310	1.308	1.312	1.310	1.310	1.309
average	1.304	1.302	1.301	1.301	1.301	1.303	1.301	1.301	1.301
sigma	0.008	0.008	0.007	0.008	0.007	0.009	0.008	0.008	0.007



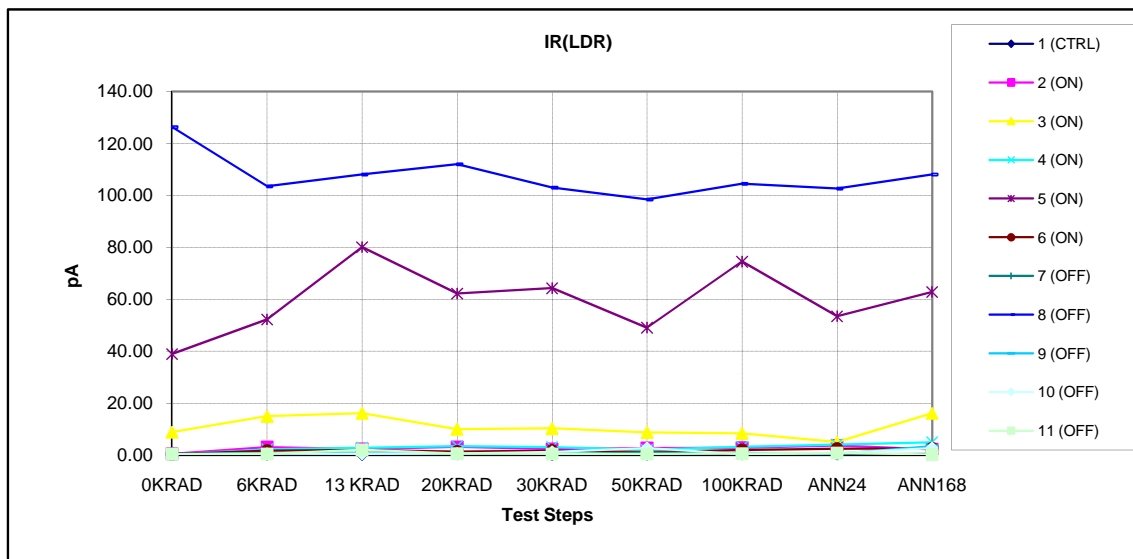
VF(AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	1.304	1.303	1.305	1.308	1.308	1.305	1.305	1.306	1.305
ELDR OFF	1.301	1.302	1.302	1.307	1.306	1.303	1.302	1.301	1.301
LDR ON	1.301	1.300	1.298	1.298	1.299	1.301	1.298	1.299	1.298
LDR OFF	1.304	1.302	1.301	1.301	1.301	1.303	1.301	1.301	1.301



IR(ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06
Unit	pA	pA	pA	pA	pA	pA	pA	pA	pA
Control Results									
1 (CTRL)	0.2	0.7	0.3	0.3	0.4	0.4	1.0	0.6	0.6

Bias on results									
2 (ON)	1.9	4.4	4.6	2.4	4.2	4.7	4.2	4.8	7.8
3 (ON)	0.5	2.3	1.8	2.9	2.6	2.9	2.3	2.7	3.0
4 (ON)	7.1	5.5	5.5	4.3	4.0	5.1	5.9	6.5	5.1
5 (ON)	0.6	5.4	5.3	6.5	6.0	4.8	6.1	7.1	4.0
6 (ON)	0.4	3.7	3.9	3.4	2.9	3.4	4.8	3.9	3.4
Statistics bias on									
min result	0.4	2.3	1.8	2.4	2.6	2.9	2.3	2.7	3.0
max result	7.1	5.5	5.5	6.5	6.0	5.1	6.1	7.1	7.8
average	2.1	4.2	4.2	3.9	3.9	4.2	4.7	5.0	4.7
sigma	2.8	1.3	1.5	1.6	1.4	1.0	1.5	1.8	1.9

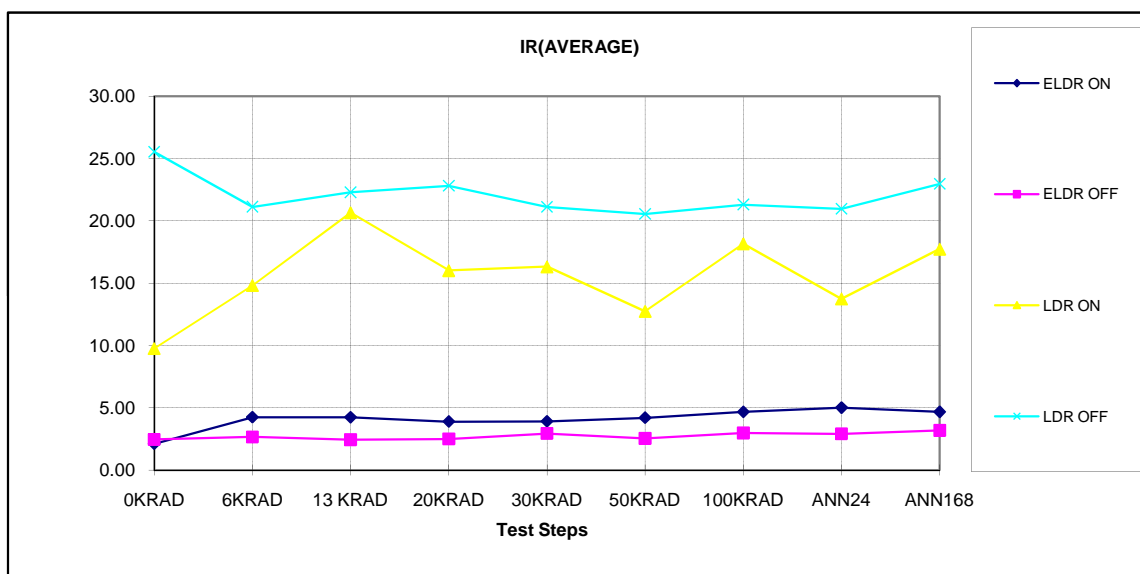
Bias off results									
7 (OFF)	10.1	10.7	9.7	10.4	9.1	10.5	11.9	11.2	9.3
8 (OFF)	0.3	0.6	0.1	0.6	0.6	0.2	0.5	0.5	2.1
9 (OFF)	0.4	0.5	0.6	0.2	1.4	1.0	0.9	0.7	2.0
10 (OFF)	0.9	0.9	0.3	1.0	1.4	0.5	0.6	1.1	1.3
11 (OFF)	0.6	0.6	1.5	0.3	2.3	0.5	1.0	1.0	1.2
Statistics bias off									
min result	0.3	0.5	0.1	0.2	0.6	0.2	0.5	0.5	1.2
max result	10.1	10.7	9.7	10.4	9.1	10.5	11.9	11.2	9.3
average	2.5	2.7	2.4	2.5	2.9	2.5	3.0	2.9	3.2
sigma	4.3	4.5	4.1	4.4	3.5	4.5	5.0	4.7	3.5



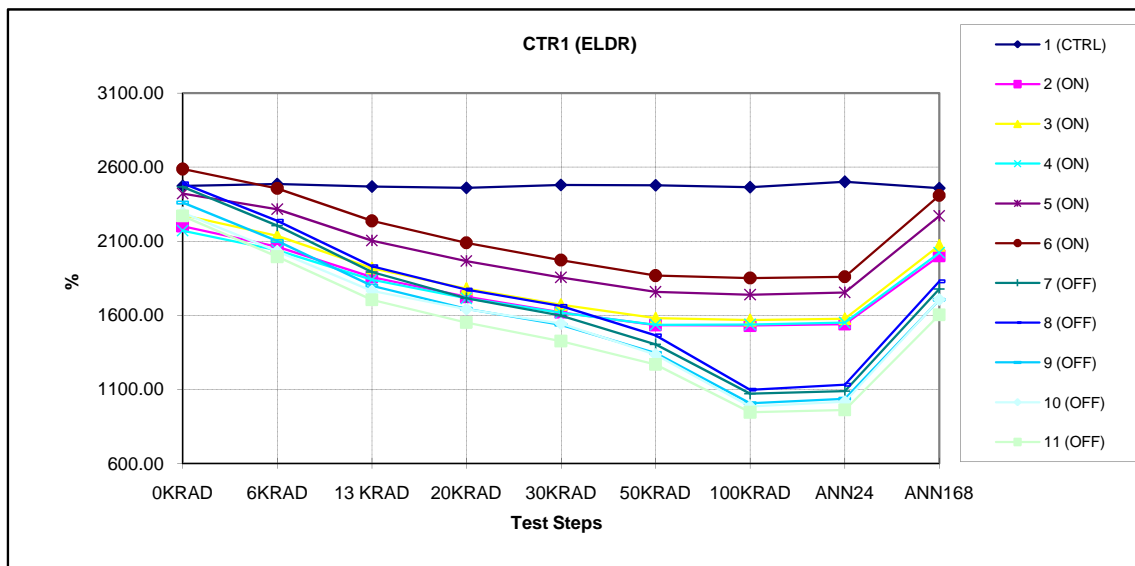
IR(LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06	100E+06
Unit	pA	pA	pA	pA	pA	pA	pA	pA	pA
Control Results									
1 (CTRL)	0.1	0.3	0.2	0.5	0.2	0.3	0.4	0.4	0.3

Bias on results									
2 (ON)	0.5	3.1	2.4	3.2	2.4	2.7	2.8	3.7	2.3
3 (ON)	8.8	14.9	16.1	9.9	10.2	8.7	8.3	5.0	16.1
4 (ON)	0.2	2.2	2.8	3.5	3.1	2.0	3.2	4.2	5.0
5 (ON)	38.9	52.2	80.0	62.2	64.2	49.1	74.5	53.4	62.8
6 (ON)	0.4	1.7	1.9	1.3	1.7	1.2	2.0	2.4	2.6
Statistics bias on									
min result	0.2	1.7	1.9	1.3	1.7	1.2	2.0	2.4	2.3
max result	38.9	52.2	80.0	62.2	64.2	49.1	74.5	53.4	62.8
average	9.8	14.8	20.6	16.0	16.3	12.7	18.2	13.7	17.7
sigma	16.7	21.6	33.7	26.0	27.0	20.5	31.6	22.2	25.8

Bias off results									
7 (OFF)	0.5	0.8	0.5	0.5	0.3	1.0	0.5	0.3	0.5
8 (OFF)	126.3	103.5	108.0	112.0	103.0	98.4	104.4	102.6	108.1
9 (OFF)	0.2	0.4	0.5	0.5	0.6	0.2	0.7	0.5	3.4
10 (OFF)	0.3	0.5	0.5	0.6	1.3	2.7	0.4	0.7	2.7
11 (OFF)	0.4	0.4	2.0	0.5	0.4	0.5	0.5	0.8	0.2
Statistics bias off									
min result	0.2	0.4	0.5	0.5	0.3	0.2	0.4	0.3	0.2
max result	126.3	103.5	108.0	112.0	103.0	98.4	104.4	102.6	108.1
average	25.5	21.1	22.3	22.8	21.1	20.6	21.3	21.0	23.0
sigma	56.3	46.0	47.9	49.9	45.8	43.5	46.5	45.6	47.6



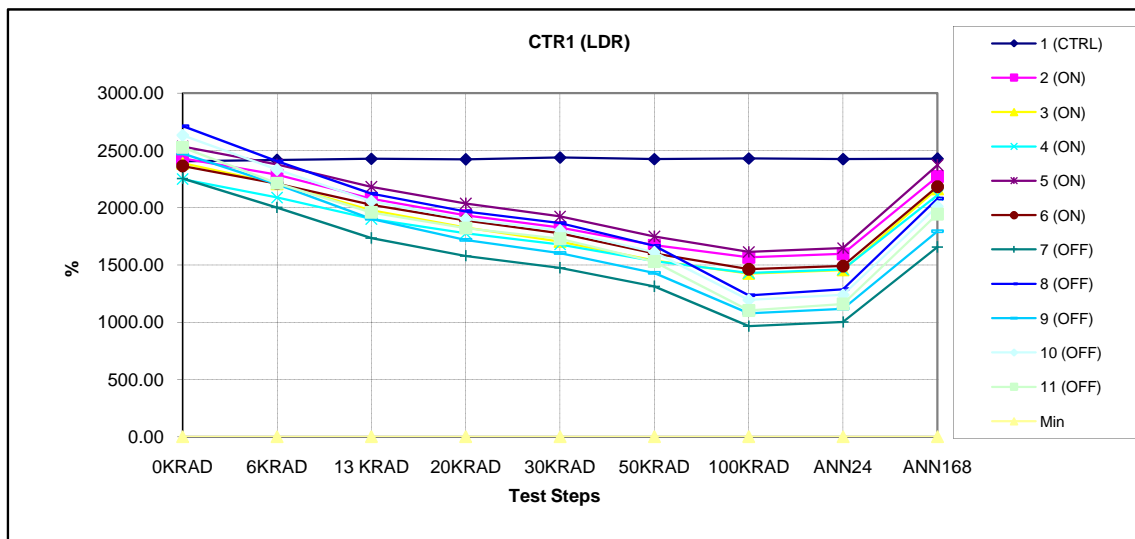
IR(AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	2.1	4.2	4.2	3.9	3.9	4.2	4.7	5.0	4.7
ELDR OFF	2.5	2.7	2.4	2.5	2.9	2.5	3.0	2.9	3.2
LDR ON	9.8	14.8	20.6	16.0	16.3	12.7	18.2	13.7	17.7
LDR OFF	25.5	21.1	22.3	22.8	21.1	20.6	21.3	21.0	23.0



CTR1 (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	2473.8	2485.9	2470.6	2461.6	2481.1	2478.7	2466.2	2501.5	2458.9

Bias on results									
2 (ON)	2201.9	2063.1	1858.3	1725.8	1620.9	1534.9	1531.5	1541.5	2000.6
3 (ON)	2276.9	2137.4	1918.8	1780.0	1672.9	1582.4	1568.2	1578.1	2072.7
4 (ON)	2171.3	2038.6	1840.5	1715.1	1618.3	1537.0	1537.7	1550.7	2022.5
5 (ON)	2423.1	2316.4	2104.8	1966.7	1856.2	1758.0	1740.0	1754.9	2271.6
6 (ON)	2587.8	2457.4	2238.1	2089.6	1972.5	1868.1	1852.3	1861.3	2409.3
Statistics bias on									
min result	2171.3	2038.6	1840.5	1715.1	1618.3	1534.9	1531.5	1541.5	2000.6
max result	2587.8	2457.4	2238.1	2089.6	1972.5	1868.1	1852.3	1861.3	2409.3
average	2332.2	2202.6	1992.1	1855.4	1748.2	1656.1	1645.9	1657.3	2155.4
sigma	172.9	179.2	172.8	165.4	158.7	149.7	143.4	143.3	177.8

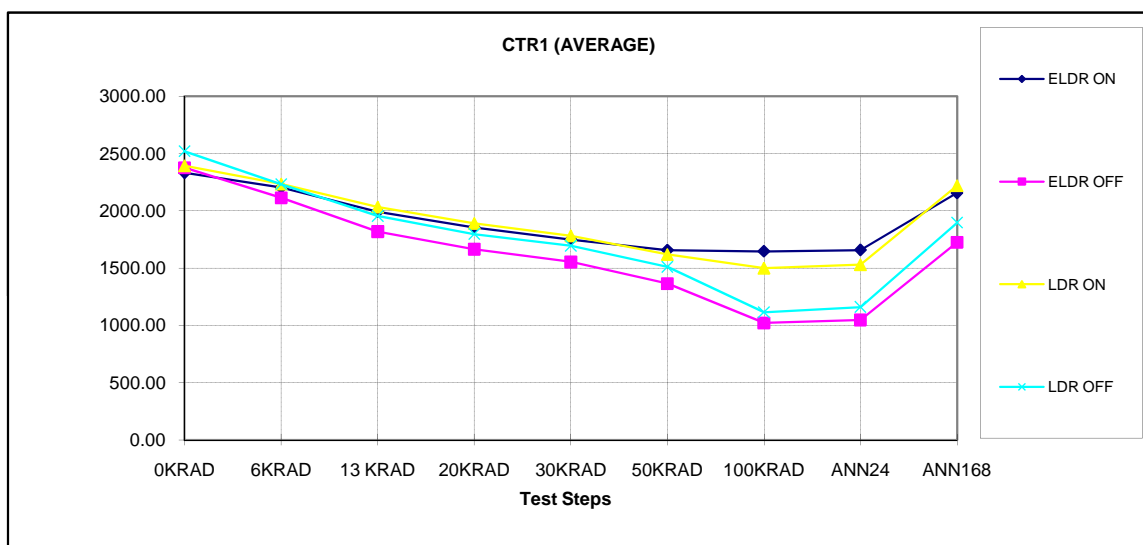
Bias off results									
7 (OFF)	2468.5	2205.0	1891.9	1714.8	1597.9	1405.2	1070.8	1089.7	1778.5
8 (OFF)	2490.7	2237.6	1932.6	1773.4	1662.6	1464.6	1097.8	1131.3	1829.8
9 (OFF)	2361.0	2101.9	1799.3	1644.5	1536.5	1347.0	1007.6	1036.8	1705.1
10 (OFF)	2291.7	2032.3	1765.6	1642.0	1545.3	1334.8	984.6	1018.6	1707.0
11 (OFF)	2270.8	1995.4	1705.2	1551.7	1426.3	1268.2	945.5	961.6	1604.2
Statistics bias off									
min result	2270.8	1995.4	1705.2	1551.7	1426.3	1268.2	945.5	961.6	1604.2
max result	2490.7	2237.6	1932.6	1773.4	1662.6	1464.6	1097.8	1131.3	1829.8
average	2376.5	2114.4	1818.9	1665.3	1553.7	1364.0	1021.3	1047.6	1724.9
sigma	100.1	105.4	92.8	83.7	87.2	74.4	62.4	65.5	85.4



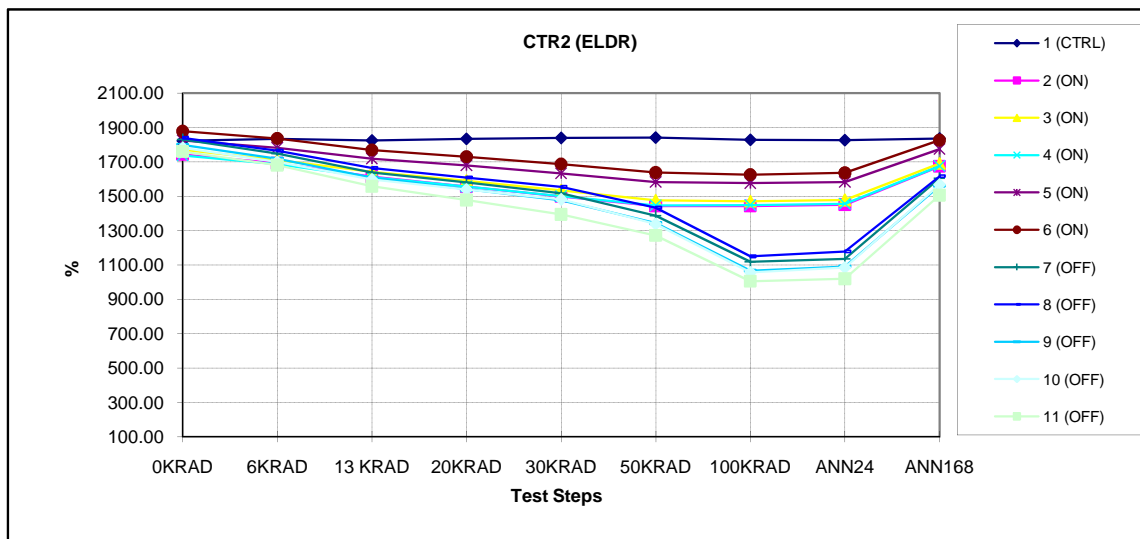
CTR1 (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	2406.6	2415.7	2426.1	2422.5	2437.7	2424.1	2429.2	2424.0	2428.1

Bias on results									
2 (ON)	2431.8	2287.7	2079.6	1932.0	1828.3	1672.4	1566.5	1596.9	2271.6
3 (ON)	2387.7	2210.4	1977.7	1826.9	1705.1	1540.0	1425.1	1456.8	2164.9
4 (ON)	2248.7	2088.1	1902.3	1775.2	1679.3	1533.7	1429.5	1460.2	2109.4
5 (ON)	2533.7	2376.6	2181.2	2036.1	1923.6	1749.5	1614.9	1647.4	2371.0
6 (ON)	2363.9	2210.0	2025.0	1888.5	1775.6	1598.6	1462.3	1489.5	2183.5
Statistics bias on									
min result	2248.7	2088.1	1902.3	1775.2	1679.3	1533.7	1425.1	1456.8	2109.4
max result	2533.7	2376.6	2181.2	2036.1	1923.6	1749.5	1614.9	1647.4	2371.0
average	2393.2	2234.6	2033.2	1891.8	1782.4	1618.8	1499.7	1530.2	2220.1
sigma	103.7	106.8	105.3	100.3	98.4	91.9	86.0	86.8	102.5

Bias off results									
7 (OFF)	2254.9	2001.6	1733.8	1578.5	1474.1	1312.7	964.9	1001.1	1656.4
8 (OFF)	2712.0	2405.5	2123.1	1967.7	1865.6	1667.1	1235.4	1287.7	2078.7
9 (OFF)	2473.6	2206.4	1902.4	1717.5	1604.0	1431.5	1078.4	1118.4	1795.5
10 (OFF)	2633.0	2333.9	2056.7	1902.0	1801.5	1611.8	1194.2	1238.3	2011.1
11 (OFF)	2525.5	2213.9	1959.1	1822.2	1729.8	1529.2	1103.3	1160.0	1944.4
Statistics bias off									
min result	2254.9	2001.6	1733.8	1578.5	1474.1	1312.7	964.9	1001.1	1656.4
max result	2712.0	2405.5	2123.1	1967.7	1865.6	1667.1	1235.4	1287.7	2078.7
average	2519.8	2232.3	1955.0	1797.6	1695.0	1510.4	1115.2	1161.1	1897.2
sigma	174.7	153.8	150.3	154.0	157.1	141.9	105.8	111.1	170.6



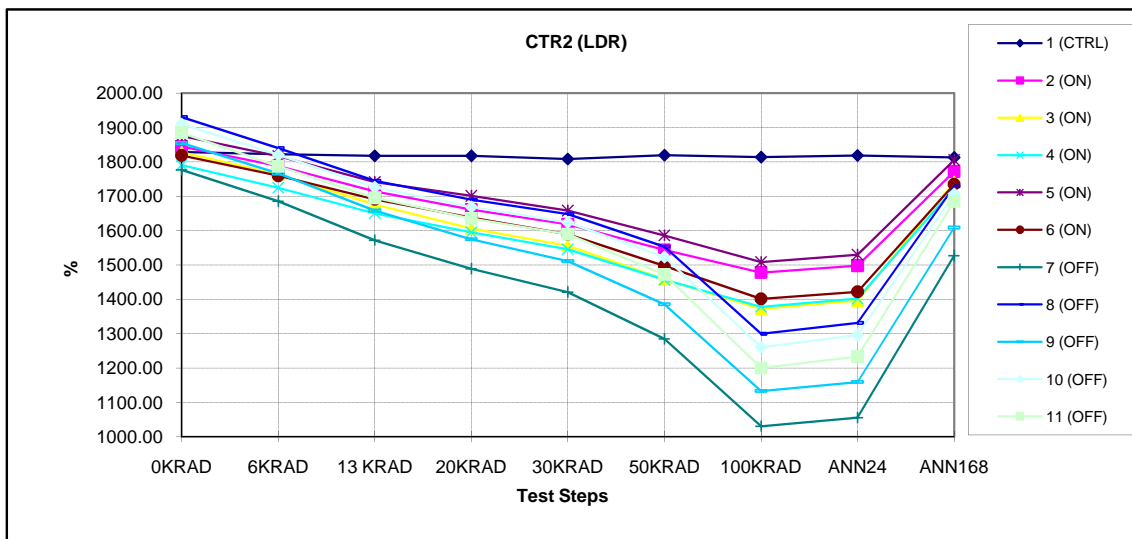
CTR1(AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	2332.2	2202.6	1992.1	1855.4	1748.2	1656.1	1645.9	1657.3	2155.4
ELDR OFF	2376.5	2114.4	1818.9	1665.3	1553.7	1364.0	1021.3	1047.6	1724.9
LDR ON	2393.2	2234.6	2033.2	1891.8	1782.4	1618.8	1499.7	1530.2	2220.1
LDR OFF	2519.8	2232.3	1955.0	1797.6	1695.0	1510.4	1115.2	1161.1	1897.2



CTR2 (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	1823.2	1834.0	1825.5	1834.0	1838.9	1840.8	1828.7	1826.6	1835.6

Bias on results									
2 (ON)	1742.9	1691.8	1613.6	1555.6	1499.5	1443.1	1443.6	1450.6	1674.0
3 (ON)	1771.3	1710.6	1642.3	1589.4	1533.5	1476.7	1470.8	1477.9	1691.3
4 (ON)	1737.0	1686.0	1610.0	1555.9	1501.2	1447.2	1448.6	1456.4	1676.5
5 (ON)	1825.3	1781.0	1719.0	1679.5	1633.3	1583.2	1576.6	1583.1	1774.8
6 (ON)	1878.6	1835.9	1769.1	1730.2	1687.3	1637.8	1626.0	1635.7	1825.7
Statistics bias on									
min result	1737.0	1686.0	1610.0	1555.6	1499.5	1443.1	1443.6	1450.6	1674.0
max result	1878.6	1835.9	1769.1	1730.2	1687.3	1637.8	1626.0	1635.7	1825.7
average	1791.0	1741.1	1670.8	1622.1	1571.0	1517.6	1513.1	1520.7	1728.5
sigma	60.1	65.1	70.3	78.8	84.9	87.9	83.0	83.7	68.3

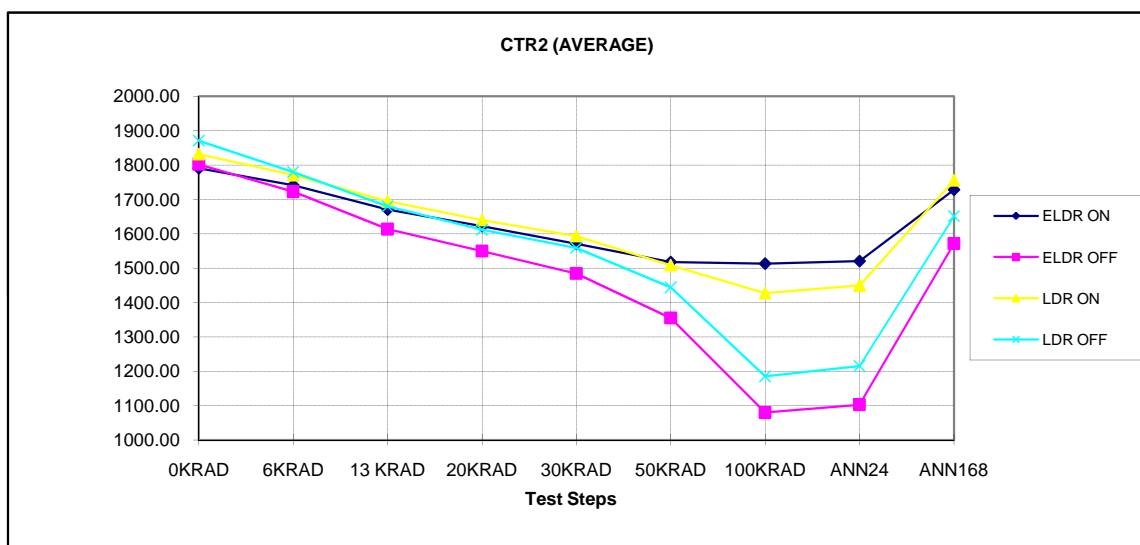
Bias off results									
7 (OFF)	1829.9	1748.0	1638.7	1579.8	1516.9	1387.3	1119.2	1135.7	1604.3
8 (OFF)	1839.7	1765.2	1663.9	1608.5	1553.6	1433.6	1149.3	1178.3	1616.7
9 (OFF)	1798.4	1718.8	1609.0	1540.7	1476.6	1343.1	1066.1	1091.4	1560.8
10 (OFF)	1781.1	1699.0	1596.5	1540.0	1481.1	1337.8	1057.8	1085.8	1566.7
11 (OFF)	1759.8	1680.9	1557.7	1477.9	1393.8	1271.7	1005.3	1019.4	1505.2
Statistics bias off									
min result	1759.8	1680.9	1557.7	1477.9	1393.8	1271.7	1005.3	1019.4	1505.2
max result	1839.7	1765.2	1663.9	1608.5	1553.6	1433.6	1149.3	1178.3	1616.7
average	1801.8	1722.4	1613.2	1549.4	1484.4	1354.7	1079.5	1102.1	1570.7
sigma	33.3	34.5	40.6	49.2	59.4	60.4	56.2	59.5	43.8



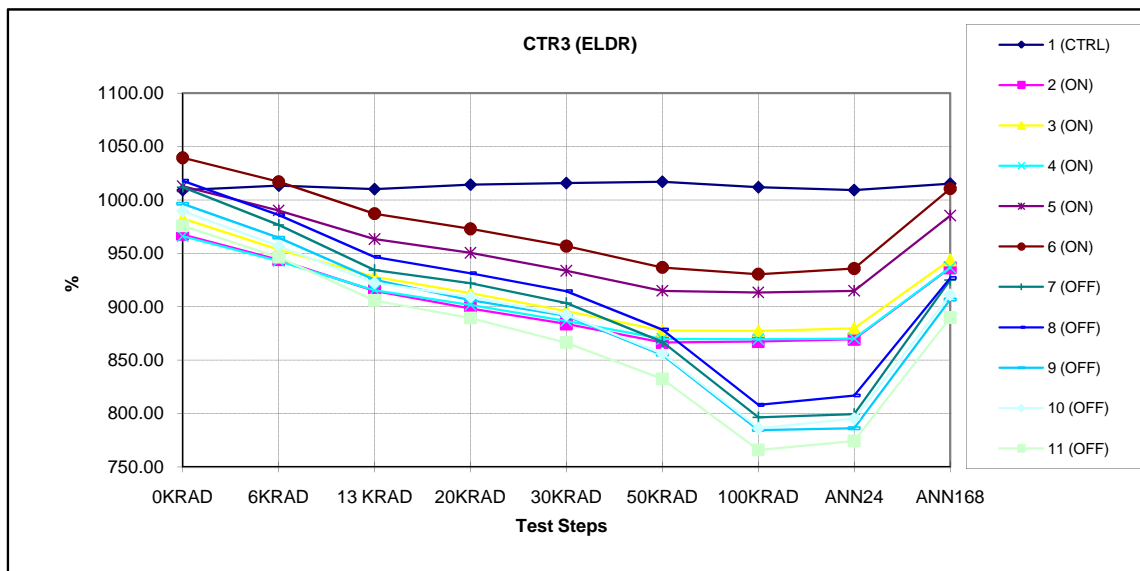
CTR2 (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	1828.4	1822.0	1817.4	1817.5	1808.3	1819.9	1813.8	1818.2	1813.1

Bias on results									
2 (ON)	1844.6	1788.2	1713.8	1661.2	1618.0	1543.8	1477.7	1497.8	1771.7
3 (ON)	1828.1	1763.7	1675.6	1606.2	1556.1	1458.1	1372.5	1396.0	1741.3
4 (ON)	1790.9	1724.8	1650.2	1594.5	1545.9	1456.8	1378.3	1401.8	1723.5
5 (ON)	1875.5	1816.8	1741.1	1701.0	1658.0	1585.8	1508.7	1529.5	1805.3
6 (ON)	1818.8	1759.7	1690.9	1637.4	1589.6	1497.4	1401.2	1421.8	1735.0
Statistics bias on									
min result	1790.9	1724.8	1650.2	1594.5	1545.9	1456.8	1372.5	1396.0	1723.5
max result	1875.5	1816.8	1741.1	1701.0	1658.0	1585.8	1508.7	1529.5	1805.3
average	1831.6	1770.6	1694.3	1640.0	1593.5	1508.4	1427.7	1449.4	1755.4
sigma	31.3	34.3	34.9	43.0	45.9	56.1	61.8	60.5	33.1

Bias off results									
7 (OFF)	1776.5	1685.2	1571.7	1488.5	1420.3	1284.3	1030.3	1055.1	1526.6
8 (OFF)	1930.0	1839.8	1744.8	1690.2	1648.5	1553.1	1299.3	1331.0	1728.4
9 (OFF)	1854.5	1766.2	1658.0	1574.8	1511.3	1385.8	1133.2	1159.0	1608.8
10 (OFF)	1910.0	1820.5	1726.7	1668.3	1624.1	1522.8	1260.9	1296.2	1706.9
11 (OFF)	1885.0	1787.2	1695.5	1635.0	1589.8	1472.3	1200.1	1233.0	1684.6
Statistics bias off									
min result	1776.5	1685.2	1571.7	1488.5	1420.3	1284.3	1030.3	1055.1	1526.6
max result	1930.0	1839.8	1744.8	1690.2	1648.5	1553.1	1299.3	1331.0	1728.4
average	1871.2	1779.8	1679.3	1611.4	1558.8	1443.6	1184.7	1214.9	1651.1
sigma	60.0	60.1	68.6	81.3	93.1	109.3	106.9	110.8	82.9



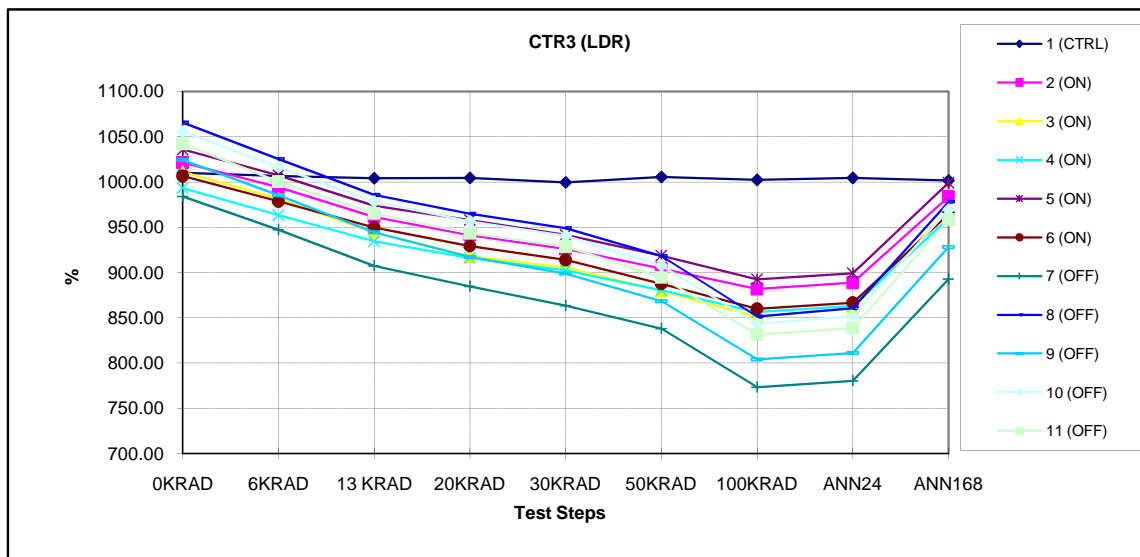
CTR2 (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	1791.0	1741.1	1670.8	1622.1	1571.0	1517.6	1513.1	1520.7	1728.5
ELDR OFF	1801.8	1722.4	1613.2	1549.4	1484.4	1354.7	1079.5	1102.1	1570.7
LDR ON	1831.6	1770.6	1694.3	1640.0	1593.5	1508.4	1427.7	1449.4	1755.4
LDR OFF	1871.2	1779.8	1679.3	1611.4	1558.8	1443.6	1184.7	1214.9	1651.1



CTR3 (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	1009.2	1013.6	1010.2	1014.5	1015.9	1017.0	1011.9	1009.2	1015.2

Bias on results									
2 (ON)	967.7	944.0	914.8	898.4	883.9	866.5	867.4	869.5	936.4
3 (ON)	982.7	953.5	928.1	912.9	895.9	877.7	877.5	879.8	943.8
4 (ON)	966.0	942.8	915.5	901.7	886.8	869.8	869.4	870.2	936.6
5 (ON)	1012.8	990.1	963.3	950.4	933.6	914.8	913.3	914.9	985.3
6 (ON)	1039.4	1017.0	987.2	972.9	956.7	936.8	930.5	935.7	1010.4
Statistics bias on									
min result	966.0	942.8	914.8	898.4	883.9	866.5	867.4	869.5	936.4
max result	1039.4	1017.0	987.2	972.9	956.7	936.8	930.5	935.7	1010.4
average	993.7	969.5	941.8	927.3	911.4	893.1	891.6	894.0	962.5
sigma	31.7	32.8	32.2	32.8	32.2	31.1	28.5	29.8	33.6

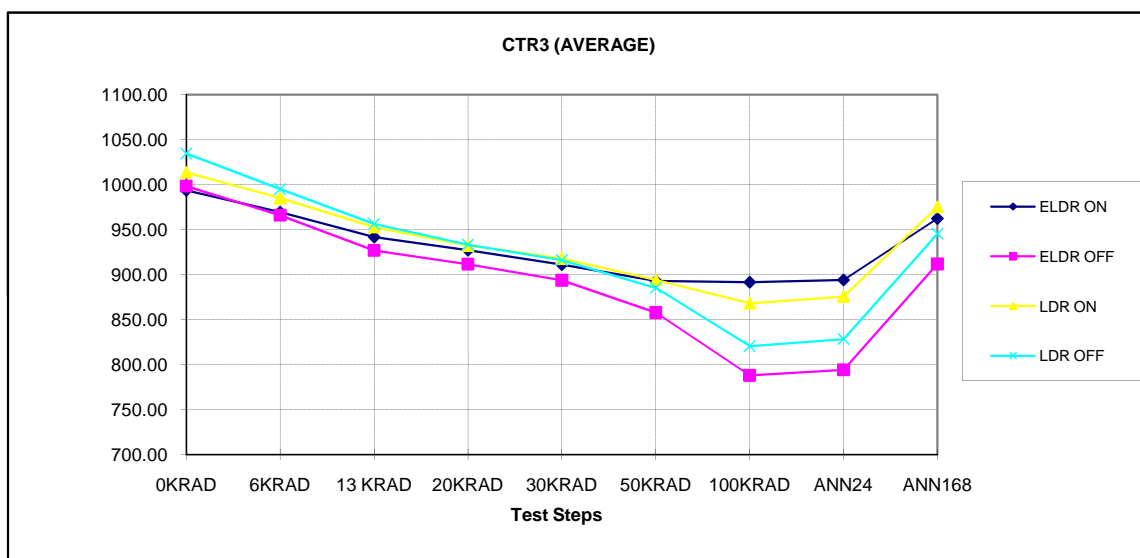
Bias off results									
7 (OFF)	1012.0	976.5	934.2	922.0	903.6	867.0	796.3	799.3	925.1
8 (OFF)	1017.9	985.8	946.8	931.4	914.5	878.6	808.0	816.8	926.7
9 (OFF)	996.4	964.7	925.3	906.2	891.6	855.0	784.5	786.2	906.7
10 (OFF)	989.4	956.8	922.4	909.2	892.3	855.9	786.1	795.1	911.1
11 (OFF)	975.8	946.3	905.9	889.3	866.4	832.5	765.8	774.3	889.7
Statistics bias off									
min result	975.8	946.3	905.9	889.3	866.4	832.5	765.8	774.3	889.7
max result	1017.9	985.8	946.8	931.4	914.5	878.6	808.0	816.8	926.7
average	998.3	966.1	926.9	911.6	893.7	857.8	788.1	794.4	911.9
sigma	17.0	15.6	15.1	16.1	17.9	17.1	15.6	15.8	15.1



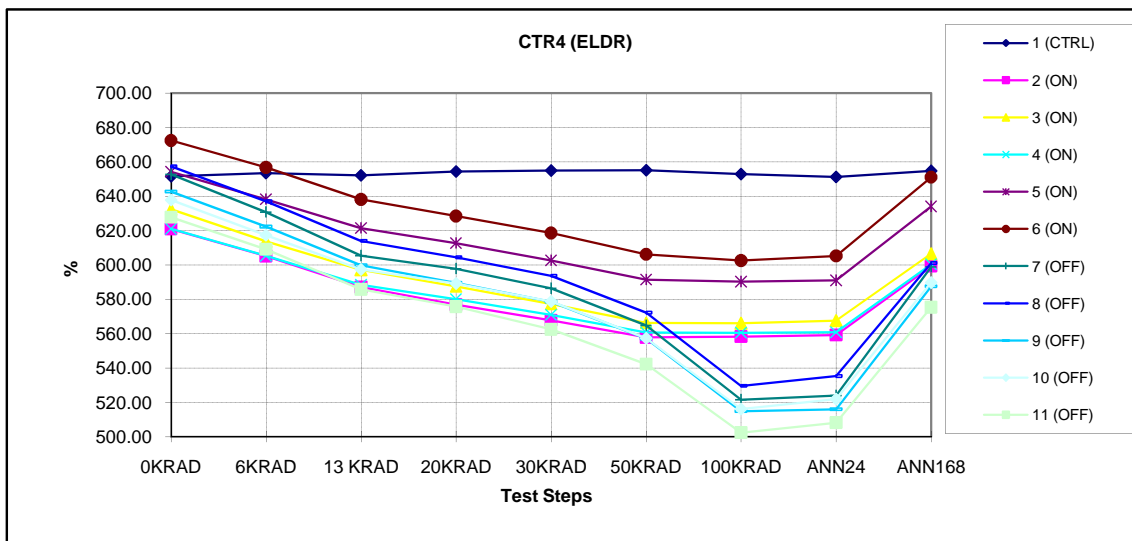
CTR3 (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	1010.4	1006.7	1004.4	1004.6	999.7	1005.7	1002.5	1004.4	1001.9

Bias on results									
2 (ON)	1021.5	994.2	961.5	941.4	926.1	904.4	881.8	888.9	983.7
3 (ON)	1011.4	981.4	944.6	917.8	905.4	879.7	850.9	860.4	969.2
4 (ON)	993.4	963.5	934.5	916.2	902.2	880.5	856.5	863.1	959.7
5 (ON)	1036.0	1007.3	973.9	957.9	941.6	918.8	892.5	899.3	999.2
6 (ON)	1006.5	978.6	949.7	929.3	914.0	887.7	859.9	866.7	964.5
Statistics bias on									
min result	993.4	963.5	934.5	916.2	902.2	879.7	850.9	860.4	959.7
max result	1036.0	1007.3	973.9	957.9	941.6	918.8	892.5	899.3	999.2
average	1013.8	985.0	952.8	932.5	917.9	894.2	868.3	875.7	975.3
sigma	16.0	16.6	15.3	17.4	16.2	17.0	17.9	17.4	16.1

Bias off results									
7 (OFF)	984.1	947.4	907.5	884.8	863.5	838.2	773.4	780.5	893.0
8 (OFF)	1065.9	1025.3	985.7	964.9	949.1	918.3	851.4	860.5	978.2
9 (OFF)	1024.5	985.4	944.3	917.1	898.9	868.3	804.0	811.1	928.1
10 (OFF)	1056.0	1016.6	978.3	956.4	940.6	907.6	843.5	851.7	969.5
11 (OFF)	1042.3	1000.4	965.3	943.5	928.8	894.7	831.3	838.8	958.7
Statistics bias off									
min result	984.1	947.4	907.5	884.8	863.5	838.2	773.4	780.5	893.0
max result	1065.9	1025.3	985.7	964.9	949.1	918.3	851.4	860.5	978.2
average	1034.5	995.0	956.2	933.3	916.2	885.4	820.7	828.5	945.5
sigma	32.2	30.7	31.4	32.6	35.0	32.4	32.0	32.7	34.9



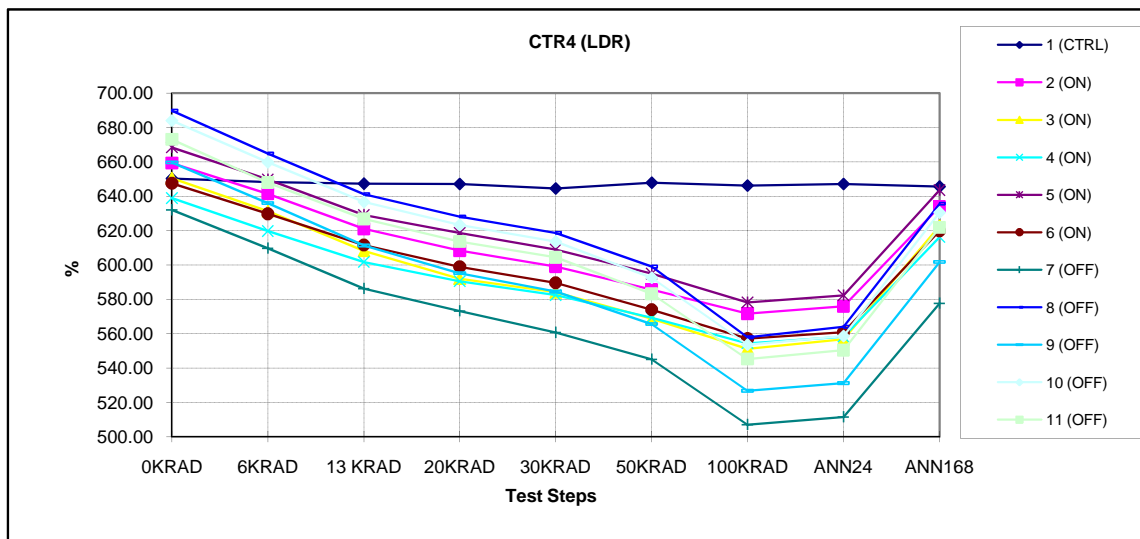
CTR3 (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	993.7	969.5	941.8	927.3	911.4	893.1	891.6	894.0	962.5
ELDR OFF	998.3	966.1	926.9	911.6	893.7	857.8	788.1	794.4	911.9
LDR ON	1013.8	985.0	952.8	932.5	917.9	894.2	868.3	875.7	975.3
LDR OFF	1034.5	995.0	956.2	933.3	916.2	885.4	820.7	828.5	945.5



CTR4 (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	651.6	653.4	652.1	654.4	654.9	655.2	652.9	651.2	654.7

Bias on results									
2 (ON)	620.8	605.2	587.1	576.9	567.8	557.8	558.3	559.3	599.3
3 (ON)	632.4	613.7	597.2	587.6	577.3	566.3	566.0	567.5	606.5
4 (ON)	621.0	605.3	588.3	580.1	571.0	560.7	560.5	560.8	600.4
5 (ON)	654.2	638.2	621.5	612.7	602.6	591.5	590.2	591.0	634.1
6 (ON)	672.4	656.8	638.2	628.4	618.5	606.2	602.5	605.3	651.1
Statistics bias on									
min result	620.8	605.2	587.1	576.9	567.8	557.8	558.3	559.3	599.3
max result	672.4	656.8	638.2	628.4	618.5	606.2	602.5	605.3	651.1
average	640.2	623.8	606.4	597.1	587.5	576.5	575.5	576.8	618.3
sigma	22.6	22.8	22.5	22.4	22.1	21.3	19.7	20.4	23.2

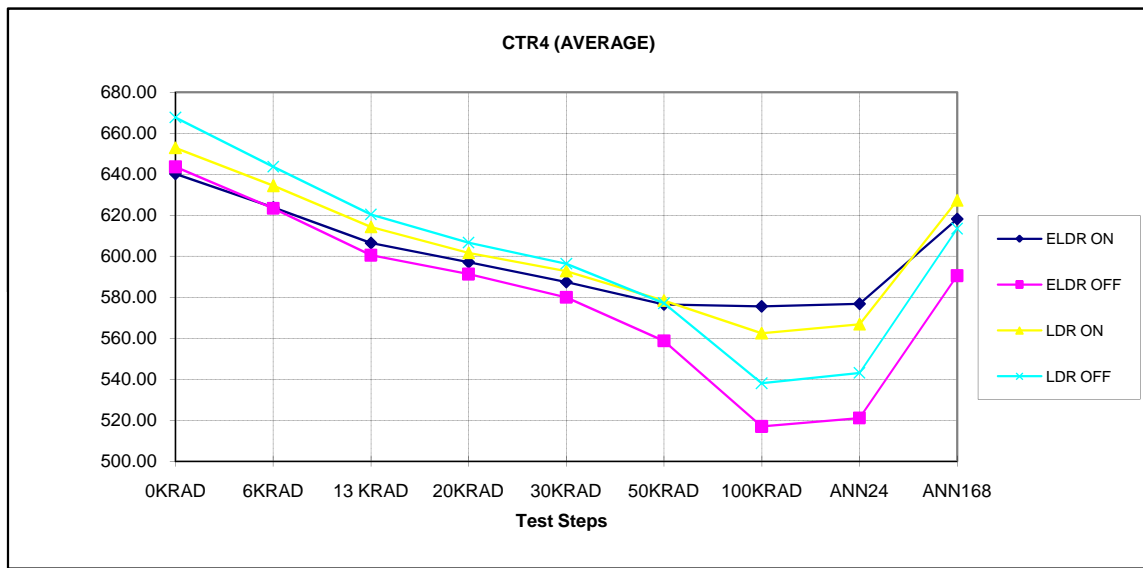
Bias off results									
7 (OFF)	652.6	630.8	605.4	597.8	586.4	564.8	521.5	524.0	598.9
8 (OFF)	657.3	637.0	614.0	604.4	593.6	572.2	529.6	535.3	601.1
9 (OFF)	642.7	622.3	599.8	589.6	578.6	557.1	514.9	516.0	587.6
10 (OFF)	637.9	617.4	597.5	589.1	578.7	557.2	516.2	521.8	589.7
11 (OFF)	627.8	609.2	585.7	575.7	562.4	542.2	502.4	508.2	575.4
Statistics bias off									
min result	627.8	609.2	585.7	575.7	562.4	542.2	502.4	508.2	575.4
max result	657.3	637.0	614.0	604.4	593.6	572.2	529.6	535.3	601.1
average	643.6	623.4	600.5	591.3	580.0	558.7	516.9	521.0	590.5
sigma	11.8	11.0	10.4	10.8	11.6	11.1	10.0	10.0	10.3



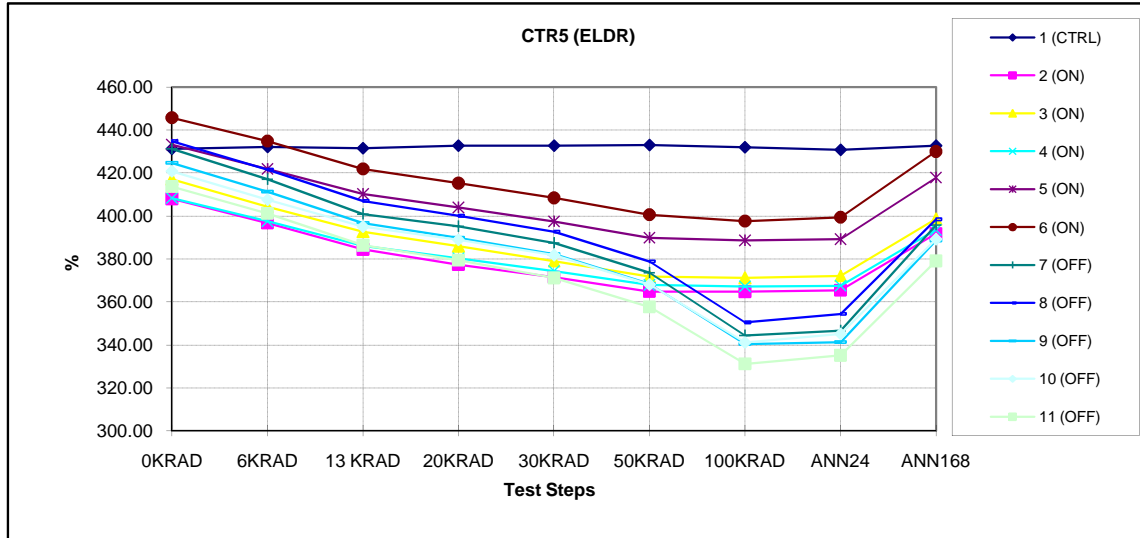
CTR4 (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	650.3	648.3	647.2	647.1	644.6	647.9	646.1	647.2	645.7

Bias on results									
2 (ON)	659.3	641.4	621.0	608.4	599.0	585.6	571.6	575.9	633.9
3 (ON)	650.5	631.4	608.2	592.0	584.1	568.7	551.2	556.8	622.7
4 (ON)	638.9	619.7	601.7	590.6	582.4	569.2	554.3	558.3	616.2
5 (ON)	668.4	649.7	629.0	618.7	608.9	594.9	578.3	582.3	643.5
6 (ON)	647.6	629.8	611.6	598.9	589.6	573.9	557.1	560.8	619.9
Statistics bias on									
min result	638.9	619.7	601.7	590.6	582.4	568.7	551.2	556.8	616.2
max result	668.4	649.7	629.0	618.7	608.9	594.9	578.3	582.3	643.5
average	652.9	634.4	614.3	601.7	592.8	578.4	562.5	566.8	627.3
sigma	11.3	11.5	10.8	11.8	11.1	11.4	11.8	11.5	11.3

Bias off results									
7 (OFF)	632.0	609.7	586.2	573.2	560.6	545.0	507.0	511.5	577.6
8 (OFF)	689.9	664.9	641.1	628.2	618.7	599.0	557.8	563.9	635.7
9 (OFF)	659.6	636.0	611.3	595.1	584.4	565.6	526.7	531.1	601.7
10 (OFF)	684.1	659.8	636.7	623.4	613.5	592.6	553.6	558.7	630.5
11 (OFF)	673.1	648.0	626.8	613.6	604.4	583.2	545.2	550.4	621.8
Statistics bias off									
min result	632.0	609.7	586.2	573.2	560.6	545.0	507.0	511.5	577.6
max result	689.9	664.9	641.1	628.2	618.7	599.0	557.8	563.9	635.7
average	667.7	643.7	620.4	606.7	596.3	577.1	538.0	543.1	613.5
sigma	23.1	22.0	22.3	22.6	23.9	21.9	21.1	21.6	23.8



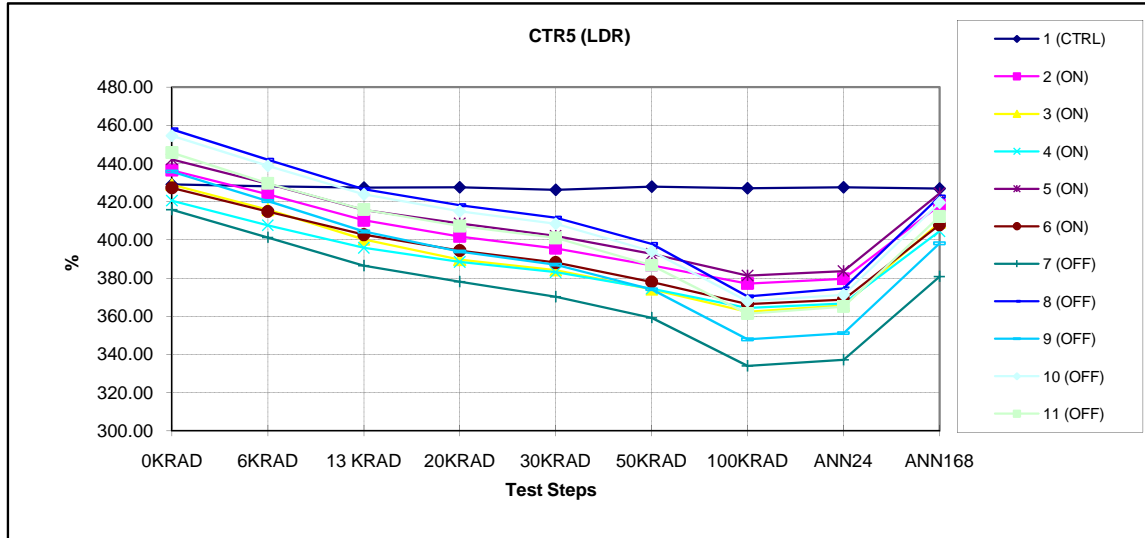
CTR4 (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	640.2	623.8	606.4	597.1	587.5	576.5	575.5	576.8	618.3
ELDR OFF	643.6	623.4	600.5	591.3	580.0	558.7	516.9	521.0	590.5
LDR ON	652.9	634.4	614.3	601.7	592.8	578.4	562.5	566.8	627.3
LDR OFF	667.7	643.7	620.4	606.7	596.3	577.1	538.0	543.1	613.5



CTR5 (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	431.3	432.2	431.6	432.7	432.8	433.1	432.0	430.9	432.8

Bias on results									
2 (ON)	408.0	396.7	384.4	377.4	371.5	364.8	364.7	365.4	391.7
3 (ON)	417.2	404.4	392.7	385.9	379.0	371.8	371.2	372.1	398.6
4 (ON)	408.3	397.5	386.1	380.3	374.4	367.9	367.2	367.5	393.5
5 (ON)	433.3	421.9	410.2	403.9	397.5	389.9	388.6	389.2	417.9
6 (ON)	445.8	434.9	421.9	415.3	408.4	400.6	397.6	399.4	430.1
Statistics bias on									
min result	408.0	396.7	384.4	377.4	371.5	364.8	364.7	365.4	391.7
max result	445.8	434.9	421.9	415.3	408.4	400.6	397.6	399.4	430.1
average	422.5	411.1	399.1	392.6	386.1	379.0	377.9	378.7	406.3
sigma	16.6	16.7	16.4	16.4	16.0	15.5	14.5	14.9	16.8

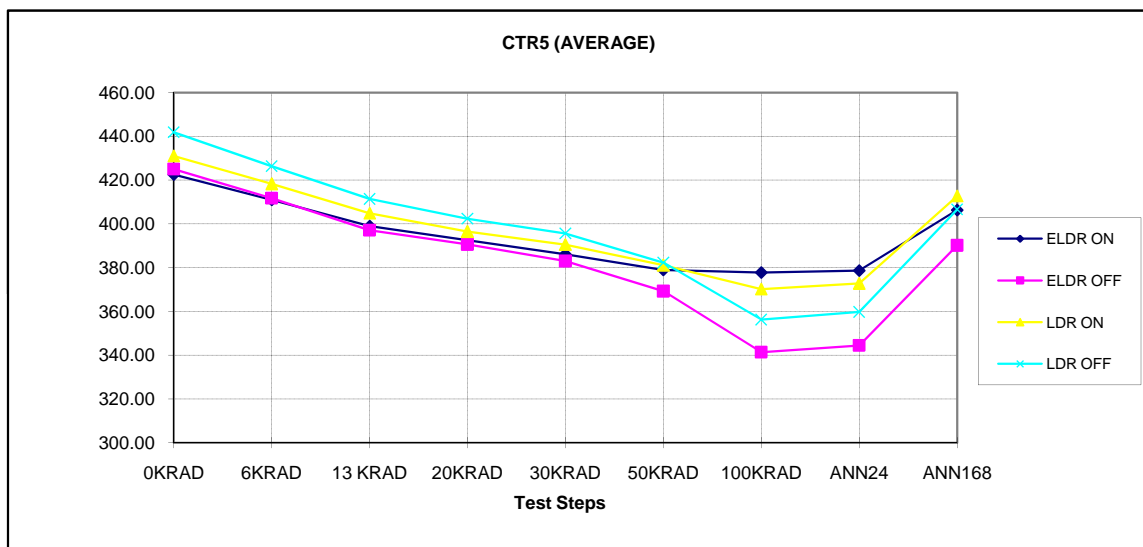
Bias off results									
7 (OFF)	431.3	417.1	400.9	395.2	387.5	373.6	344.4	346.5	395.8
8 (OFF)	434.9	421.6	407.0	400.1	392.7	378.8	350.5	354.4	398.5
9 (OFF)	424.7	411.3	396.7	389.8	382.2	368.3	340.3	341.3	388.6
10 (OFF)	420.8	407.6	395.0	388.9	381.8	368.1	341.0	345.1	389.2
11 (OFF)	413.7	401.2	386.3	379.5	371.2	357.6	331.1	335.1	379.1
Statistics bias off									
min result	413.7	401.2	386.3	379.5	371.2	357.6	331.1	335.1	379.1
max result	434.9	421.6	407.0	400.1	392.7	378.8	350.5	354.4	398.5
average	425.1	411.8	397.2	390.7	383.1	369.3	341.5	344.5	390.2
sigma	8.4	8.0	7.6	7.7	8.0	7.9	7.0	7.1	7.5



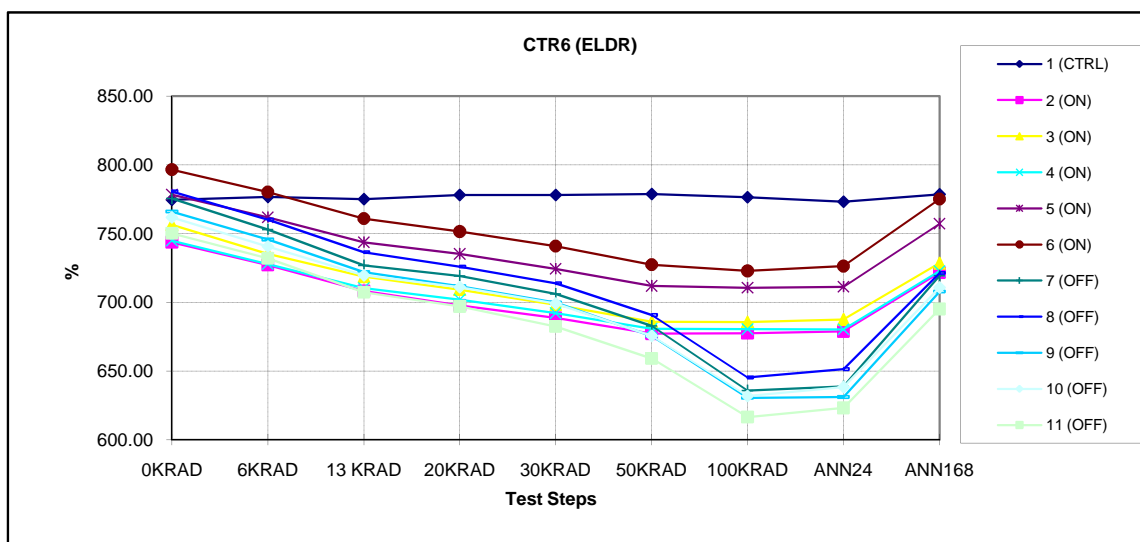
CTR5 (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	429.1	428.1	427.4	427.5	426.2	427.9	427.0	427.6	426.8

Bias on results									
2 (ON)	436.4	423.9	410.2	401.7	395.5	386.6	377.1	379.6	418.1
3 (ON)	429.0	415.8	400.3	389.6	384.2	374.1	362.4	365.7	409.2
4 (ON)	420.6	407.6	395.8	388.4	383.1	374.4	364.3	366.6	404.5
5 (ON)	442.2	429.3	415.7	408.6	402.1	392.6	381.3	383.7	424.4
6 (ON)	427.3	414.9	402.7	394.3	388.1	377.9	366.4	368.6	407.9
Statistics bias on									
min result	420.6	407.6	395.8	388.4	383.1	374.1	362.4	365.7	404.5
max result	442.2	429.3	415.7	408.6	402.1	392.6	381.3	383.7	424.4
average	431.1	418.3	404.9	396.5	390.6	381.1	370.3	372.8	412.8
sigma	8.4	8.4	8.0	8.5	8.1	8.2	8.4	8.2	8.2

Bias off results									
7 (OFF)	415.8	401.3	386.4	378.0	370.2	359.2	333.9	337.1	380.8
8 (OFF)	458.0	442.0	426.6	418.1	411.7	397.8	370.3	374.6	422.6
9 (OFF)	435.8	420.3	404.4	393.9	387.0	374.1	347.9	351.1	398.2
10 (OFF)	454.5	438.9	423.9	415.0	408.4	394.0	367.9	371.3	419.5
11 (OFF)	445.7	429.6	415.9	407.2	401.0	386.7	361.3	365.1	412.3
Statistics bias off									
min result	415.8	401.3	386.4	378.0	370.2	359.2	333.9	337.1	380.8
max result	458.0	442.0	426.6	418.1	411.7	397.8	370.3	374.6	422.6
average	441.9	426.4	411.4	402.5	395.7	382.3	356.3	359.8	406.7
sigma	17.0	16.4	16.4	16.5	17.1	15.8	15.2	15.6	17.3



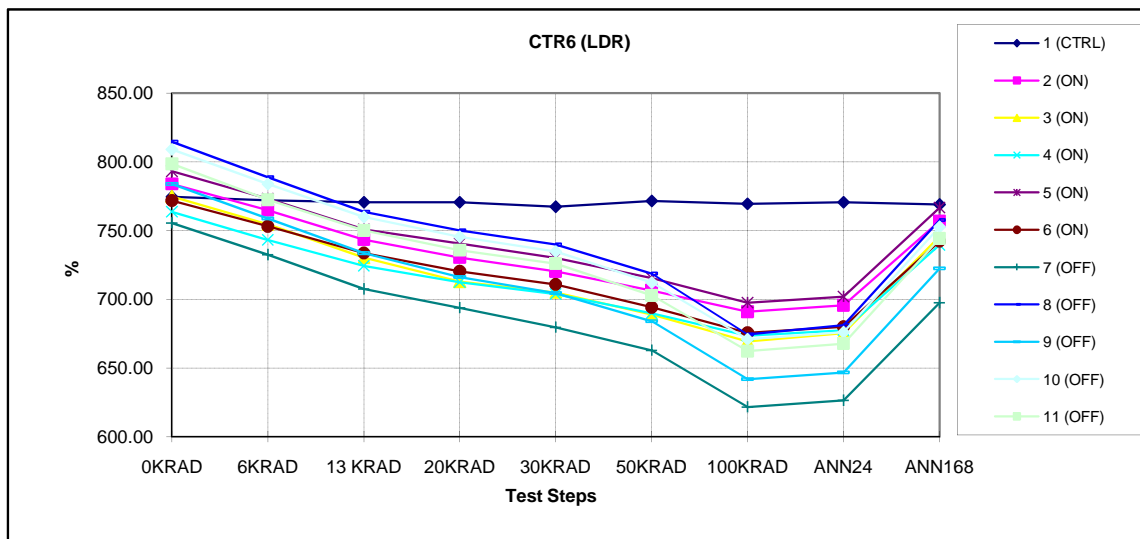
CTR5 (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	422.5	411.1	399.1	392.6	386.1	379.0	377.9	378.7	406.3
ELDR OFF	425.1	411.8	397.2	390.7	383.1	369.3	341.5	344.5	390.2
LDR ON	431.1	418.3	404.9	396.5	390.6	381.1	370.3	372.8	412.8
LDR OFF	441.9	426.4	411.4	402.5	395.7	382.3	356.3	359.8	406.7



CTR6 (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	774.5	776.7	775.1	778.1	778.1	778.9	776.4	773.3	778.4

Bias on results									
2 (ON)	743.7	727.2	708.2	697.7	688.7	677.2	677.5	678.8	721.5
3 (ON)	756.4	735.2	718.7	709.2	698.3	686.0	685.7	687.4	728.5
4 (ON)	744.8	727.8	710.2	702.0	692.1	680.8	680.4	680.3	722.7
5 (ON)	778.4	761.8	743.6	735.2	724.3	711.9	710.6	711.3	757.2
6 (ON)	796.5	780.3	760.8	751.5	740.9	727.3	722.9	726.3	775.2
Statistics bias on									
min result	743.7	727.2	708.2	697.7	688.7	677.2	677.5	678.8	721.5
max result	796.5	780.3	760.8	751.5	740.9	727.3	722.9	726.3	775.2
average	764.0	746.4	728.3	719.1	708.8	696.6	695.4	696.9	741.0
sigma	22.9	23.6	23.0	23.2	22.7	21.9	20.2	21.0	24.0

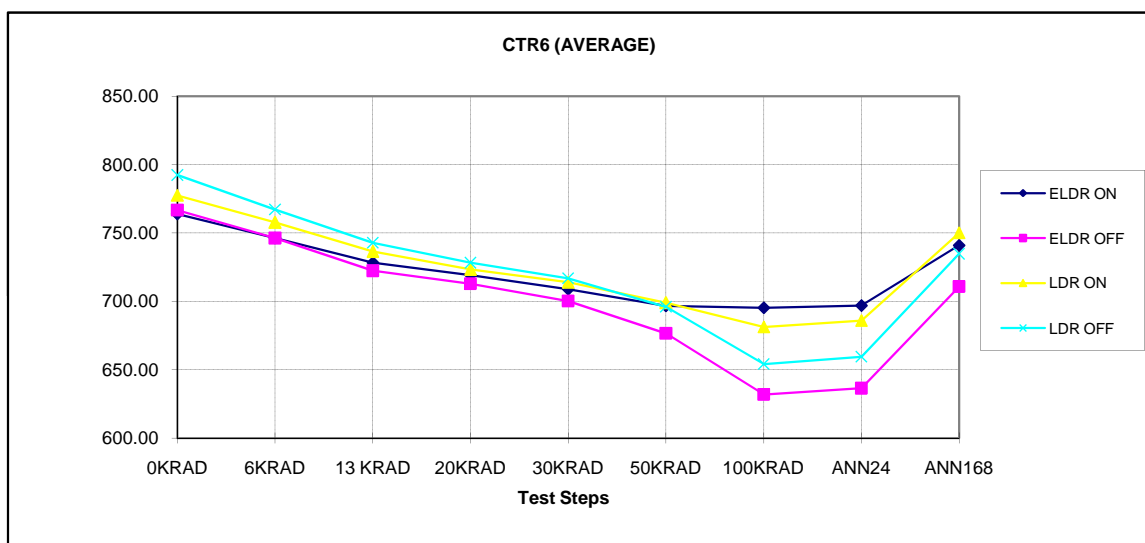
Bias off results									
7 (OFF)	775.4	753.0	726.8	719.2	706.2	682.7	635.8	638.8	719.3
8 (OFF)	780.7	760.1	736.4	726.0	713.8	690.7	645.2	651.3	721.3
9 (OFF)	766.1	745.6	722.0	711.7	699.7	675.4	630.4	631.0	707.8
10 (OFF)	761.7	740.7	719.7	710.9	699.2	675.7	631.7	638.3	710.8
11 (OFF)	750.2	732.0	707.4	696.9	682.4	659.0	616.4	623.1	695.1
Statistics bias off									
min result	750.2	732.0	707.4	696.9	682.4	659.0	616.4	623.1	695.1
max result	780.7	760.1	736.4	726.0	713.8	690.7	645.2	651.3	721.3
average	766.8	746.3	722.5	712.9	700.3	676.7	631.9	636.5	710.9
sigma	11.9	10.9	10.6	10.8	11.6	11.7	10.4	10.5	10.5



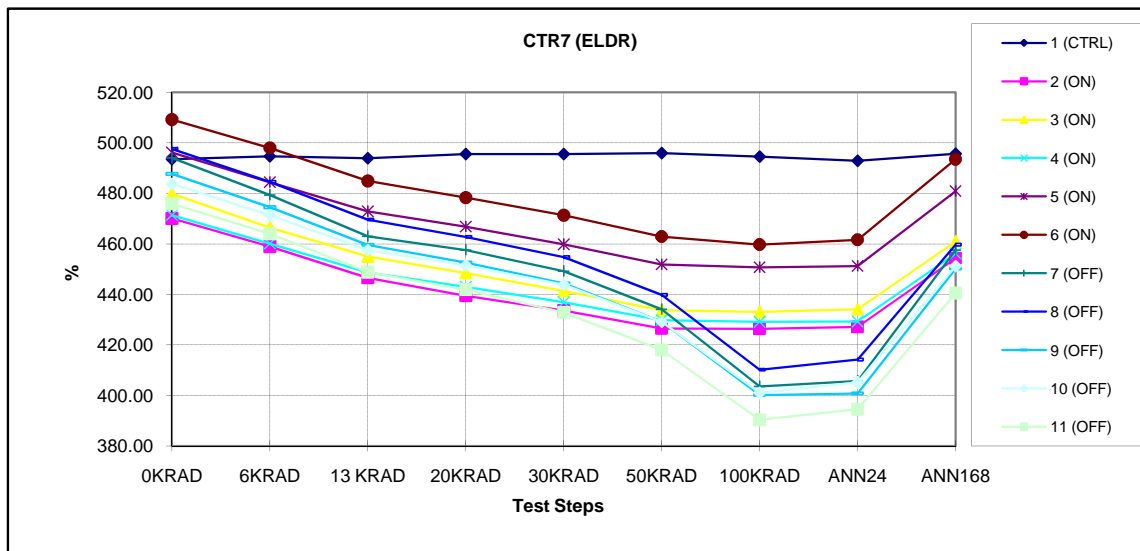
CTR6 (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	774.6	772.1	770.6	770.7	767.3	771.7	769.6	770.7	768.9

Bias on results									
2 (ON)	784.0	764.9	743.4	730.4	720.3	706.4	690.9	695.5	756.8
3 (ON)	774.8	754.5	730.3	712.8	705.0	688.9	669.4	675.3	745.7
4 (ON)	763.7	743.2	724.3	712.5	703.8	689.9	673.6	677.5	739.6
5 (ON)	793.1	773.2	750.9	740.6	730.1	715.5	697.5	702.0	766.7
6 (ON)	771.9	753.1	733.7	720.3	710.9	694.2	675.6	680.0	742.3
Statistics bias on									
min result	763.7	743.2	724.3	712.5	703.8	688.9	669.4	675.3	739.6
max result	793.1	773.2	750.9	740.6	730.1	715.5	697.5	702.0	766.7
average	777.5	757.8	736.5	723.3	714.0	699.0	681.4	686.1	750.2
sigma	11.3	11.5	10.6	12.1	11.1	11.6	12.2	11.9	11.3

Bias off results									
7 (OFF)	755.6	732.3	707.5	693.8	679.6	662.9	621.6	626.4	697.4
8 (OFF)	814.7	788.8	763.7	750.2	739.9	718.6	674.5	681.1	757.6
9 (OFF)	783.9	758.9	733.5	716.2	704.5	684.0	641.9	646.8	722.5
10 (OFF)	809.1	784.0	759.9	745.5	734.9	712.2	671.0	676.0	752.6
11 (OFF)	798.5	772.4	750.1	735.8	725.9	702.8	662.2	667.7	744.2
Statistics bias off									
min result	755.6	732.3	707.5	693.8	679.6	662.9	621.6	626.4	697.4
max result	814.7	788.8	763.7	750.2	739.9	718.6	674.5	681.1	757.6
average	792.4	767.3	742.9	728.3	717.0	696.1	654.2	659.6	734.9
sigma	23.7	22.7	23.0	23.3	24.9	22.7	22.2	22.7	24.9



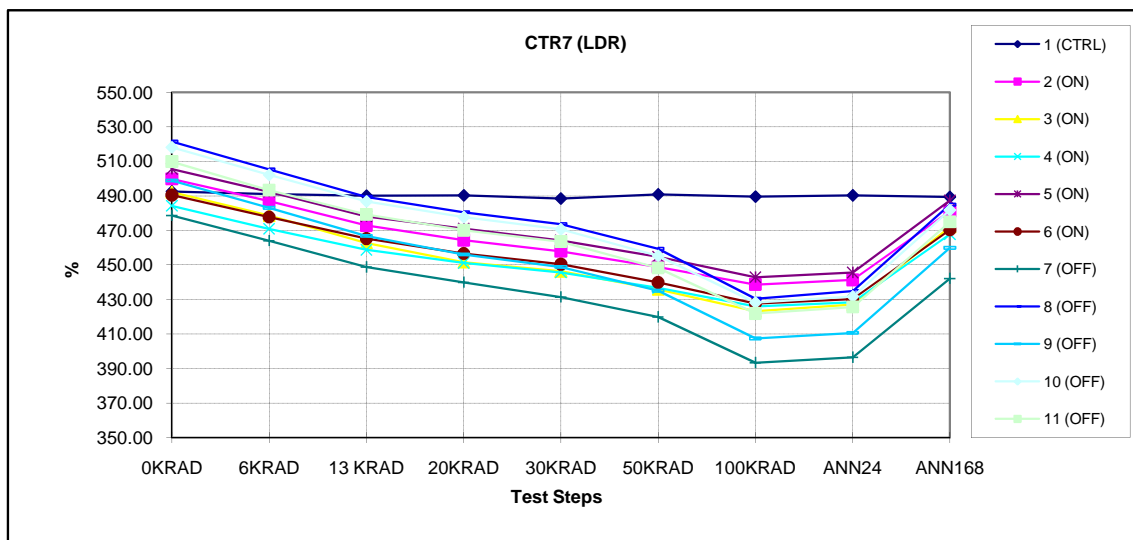
CTR6 (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	764.0	746.4	728.3	719.1	708.8	696.6	695.4	696.9	741.0
ELDR OFF	766.8	746.3	722.5	712.9	700.3	676.7	631.9	636.5	710.9
LDR ON	777.5	757.8	736.5	723.3	714.0	699.0	681.4	686.1	750.2
LDR OFF	792.4	767.3	742.9	728.3	717.0	696.1	654.2	659.6	734.9



CTR7 (ELDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	493.5	494.7	494.0	495.6	495.6	495.9	494.6	492.9	495.8

Bias on results									
2 (ON)	470.1	458.9	446.6	439.5	433.6	426.5	426.5	427.2	454.3
3 (ON)	479.9	466.4	455.0	448.5	441.4	433.7	433.1	434.1	461.0
4 (ON)	471.4	460.2	448.7	443.1	436.9	429.9	429.1	429.3	456.2
5 (ON)	496.2	484.4	472.9	466.8	459.8	451.9	450.7	451.3	480.9
6 (ON)	509.2	498.0	484.9	478.3	471.3	462.9	459.7	461.7	493.5
Statistics bias on									
min result	470.1	458.9	446.6	439.5	433.6	426.5	426.5	427.2	454.3
max result	509.2	498.0	484.9	478.3	471.3	462.9	459.7	461.7	493.5
average	485.4	473.6	461.6	455.2	448.6	441.0	439.8	440.7	469.2
sigma	16.9	17.0	16.6	16.6	16.3	15.7	14.6	15.1	17.2

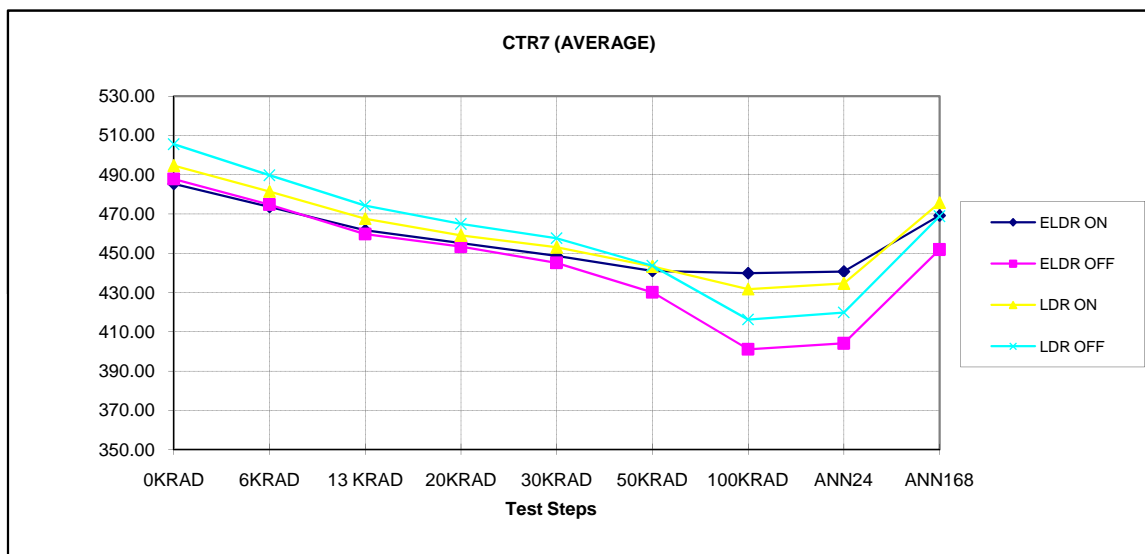
Bias off results									
7 (OFF)	494.0	479.4	463.1	457.6	449.3	434.2	403.6	405.8	457.5
8 (OFF)	497.6	484.5	469.6	462.8	454.7	439.8	410.2	414.2	459.7
9 (OFF)	487.7	474.5	459.6	452.6	444.4	429.2	400.2	400.8	450.2
10 (OFF)	483.8	471.3	457.6	451.5	443.9	429.2	401.0	405.2	451.2
11 (OFF)	475.9	464.0	448.8	441.9	432.9	418.0	390.4	394.6	440.5
Statistics bias off									
min result	475.9	464.0	448.8	441.9	432.9	418.0	390.4	394.6	440.5
max result	497.6	484.5	469.6	462.8	454.7	439.8	410.2	414.2	459.7
average	487.8	474.7	459.7	453.3	445.0	430.1	401.1	404.1	451.8
sigma	8.6	7.8	7.6	7.8	8.1	8.0	7.2	7.2	7.5



CTR7 (LDR)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
Min	--	--	--	--	--	--	--	--	--
Max	--	--	--	--	--	--	--	--	--
Unit	%	%	%	%	%	%	%	%	%
Control Results									
1 (CTRL)	492.5	491.1	490.2	490.4	488.5	490.9	489.6	490.3	489.3

Bias on results									
2 (ON)	499.9	487.0	472.9	464.4	458.0	448.9	438.6	441.4	481.0
3 (ON)	492.2	478.7	462.7	451.6	446.4	435.9	423.3	427.0	472.0
4 (ON)	484.3	470.9	458.7	451.2	445.7	436.7	426.0	428.5	467.8
5 (ON)	505.6	492.4	478.2	471.1	464.3	454.8	443.0	445.6	487.3
6 (ON)	490.5	477.8	465.3	456.7	450.5	439.9	427.7	430.3	470.4
Statistics bias on									
min result	484.3	470.9	458.7	451.2	445.7	435.9	423.3	427.0	467.8
max result	505.6	492.4	478.2	471.1	464.3	454.8	443.0	445.6	487.3
average	494.5	481.4	467.6	459.0	453.0	443.2	431.7	434.6	475.7
sigma	8.3	8.4	7.9	8.6	8.0	8.3	8.6	8.4	8.2

Bias off results									
7 (OFF)	478.7	464.0	448.7	439.9	431.4	419.9	393.4	396.4	442.2
8 (OFF)	521.6	505.3	489.4	480.6	473.7	459.3	430.4	434.9	484.9
9 (OFF)	498.9	483.1	466.9	456.1	448.8	435.1	407.4	410.7	459.9
10 (OFF)	518.2	502.3	486.9	477.7	470.7	455.4	428.2	431.7	481.9
11 (OFF)	509.9	493.4	479.2	470.1	463.6	448.3	421.9	425.6	475.0
Statistics bias off									
min result	478.7	464.0	448.7	439.9	431.4	419.9	393.4	396.4	442.2
max result	521.6	505.3	489.4	480.6	473.7	459.3	430.4	434.9	484.9
average	505.5	489.6	474.2	464.9	457.6	443.6	416.3	419.9	468.8
sigma	17.3	16.7	16.7	16.9	17.5	16.2	15.6	16.1	17.7



CTR7 (AVERAGE)	0KRAD	6KRAD	13 KRAD	20KRAD	30KRAD	50KRAD	100KRAD	ANN24	ANN168
ELDR ON	485.4	473.6	461.6	455.2	448.6	441.0	439.8	440.7	469.2
ELDR OFF	487.8	474.7	459.7	453.3	445.0	430.1	401.1	404.1	451.8
LDR ON	494.5	481.4	467.6	459.0	453.0	443.2	431.7	434.6	475.7
LDR OFF	505.5	489.6	474.2	464.9	457.6	443.6	416.3	419.9	468.8



**TOTAL DOSE RADIATION
TEST REPORT
No. ATN-RR-003/2012**

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ANNEX II DOSIMETRY

5	17/02/2012 13:33	17/02/2012 15:33	0.82	0.41
6	17/02/2012 15:42	20/02/2012 09:08	27.02	0.41
7	20/02/2012 09:18	20/02/2012 11:11	0.78	0.41
8	20/02/2012 11:23	20/02/2012 13:49	1.00	0.41
9	20/02/2012 13:55	20/02/2012 15:16	0.55	0.41
10	20/02/2012 15:21	21/02/2012 09:36	7.47	0.41
11	21/02/2012 09:43	21/02/2012 10:58	0.52	0.41
12	21/02/2012 11:02	21/02/2012 14:00	1.22	0.41
13	21/02/2012 14:16	21/02/2012 16:14		
14	21/02/2012 16:35	22/02/2012 13:18	8.54	0.41
15	22/02/2012 13:28	22/02/2012 15:09	0.69	0.41
16	22/02/2012 15:17	23/02/2012 09:18	7.43	0.41
17	23/02/2012 09:25	23/02/2012 10:20	0.38	0.41
18	23/02/2012 11:09	24/02/2012 18:31	12.94	0.41
19	24/02/2012 18:33	27/02/2012 08:33	25.58	0.41
20	27/02/2012 08:47	27/02/2012 10:06	0.49	0.37
21	27/02/2012 10:12	27/02/2012 11:09	0.36	0.38
22	27/02/2012 11:11	27/02/2012 13:07	0.73	0.38
23	27/02/2012 13:10	27/02/2012 15:12	0.77	0.38
24	27/02/2012 15:16	27/02/2012 16:28	0.46	0.38
25	27/02/2012 16:31	28/02/2012 13:00	8.44	0.41
26	28/02/2012 13:10	28/02/2012 16:33	1.33	0.39
27	28/02/2012 16:36	28/02/2012 19:40	1.21	0.39
28	28/02/2012 19:42	29/02/2012 08:44	5.13	0.39
29	29/02/2012 08:48	29/02/2012 13:16	1.83	0.41
30	29/02/2012 13:18	29/02/2012 14:53	0.65	0.41
31	29/02/2012 15:06	29/02/2012 16:50		
32	29/02/2012 17:10	01/03/2012 08:36	6.30	0.41
33	01/03/2012 09:08	01/03/2012 14:03	2.01	0.41
34	01/03/2012 14:15	01/03/2012 16:29	0.92	0.41
35	01/03/2012 16:32	02/03/2012 08:50	6.70	0.41
36	02/03/2012 08:58	02/03/2012 17:29	3.53	0.41
37	02/03/2012 17:47	06/03/2012 09:02	37.75	0.43
38	06/03/2012 09:14	06/03/2012 09:15	0.00	0.31
39	06/03/2012 09:18	06/03/2012 10:36	0.51	0.39
40	06/03/2012 10:39	06/03/2012 11:44	0.43	0.40
41	06/03/2012 11:47	06/03/2012 13:56	0.85	0.39
42	06/03/2012 13:59	06/03/2012 14:49	0.33	0.39

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43	06/03/2012 14:52	06/03/2012 16:29	0.64	0.39
44	06/03/2012 16:35	06/03/2012 18:30	0.76	0.40
45	06/03/2012 18:33	07/03/2012 08:57	5.68	0.39
46	07/03/2012 09:01	07/03/2012 10:16	0.51	0.41
47	07/03/2012 10:23	08/03/2012 08:56	9.23	0.41
48	08/03/2012 09:06	08/03/2012 14:16	2.00	0.39
49	08/03/2012 14:29	08/03/2012 16:10		
50	08/03/2012 16:27	09/03/2012 09:19	6.90	0.41
51	09/03/2012 09:22	09/03/2012 11:40	0.94	0.41
52	09/03/2012 11:42	12/03/2012 13:22	30.14	0.41
53	12/03/2012 13:25	12/03/2012 15:53	1.01	0.41
54	12/03/2012 15:55	13/03/2012 09:04	7.00	0.41
55	13/03/2012 09:14	14/03/2012 08:49	9.23	0.39
56	14/03/2012 08:56	14/03/2012 11:37	1.05	0.39
57	14/03/2012 11:43	14/03/2012 17:04	2.09	0.39
58	14/03/2012 17:09	15/03/2012 09:02	6.48	0.41
59	15/03/2012 09:08	15/03/2012 09:37	0.19	0.39
60	15/03/2012 09:42	15/03/2012 15:00	2.07	0.39
61	15/03/2012 15:05	15/03/2012 17:14	0.88	0.41
62	15/03/2012 17:21	16/03/2012 10:24	6.68	0.39
63	16/03/2012 10:31	16/03/2012 16:01	2.15	0.39
64	16/03/2012 16:15	19/03/2012 09:08	26.46	0.41
65	19/03/2012 09:33	19/03/2012 09:35	0.01	0.40
66	19/03/2012 09:37	19/03/2012 10:23	0.31	0.41
67*	19/03/2012 11:22	19/03/2012 13:44	0.96	0.41
68	19/03/2012 14:02	19/03/2012 15:39		
69	19/03/2012 15:58	20/03/2012 10:19	7.32	0.41
70	20/03/2012 10:27	20/03/2012 10:47	0.14	0.40
71	20/03/2012 10:50	20/03/2012 11:09	0.13	0.41
72	20/03/2012 11:12	20/03/2012 12:45	0.62	0.40
73	20/03/2012 12:47	20/03/2012 13:39	0.35	0.41
74	20/03/2012 13:42	20/03/2012 16:29	1.10	0.40
75	20/03/2012 16:31	20/03/2012 17:40	0.47	0.41
76	20/03/2012 17:43	21/03/2012 09:08	6.13	0.40
77	21/03/2012 09:11	21/03/2012 10:22	0.49	0.41
78	21/03/2012 10:28	21/03/2012 10:45	0.12	0.40
79	21/03/2012 10:47	21/03/2012 11:27	0.27	0.41
80	21/03/2012 11:30	21/03/2012 11:52	0.15	0.40

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81	21/03/2012 11:54	21/03/2012 12:44	0.34	0.41
82	21/03/2012 12:47	21/03/2012 13:40	0.35	0.40
83	21/03/2012 13:42	21/03/2012 14:36	0.37	0.41
84	21/03/2012 14:38	21/03/2012 15:42	0.42	0.40
85	21/03/2012 15:44	21/03/2012 16:19	0.24	0.41
86	21/03/2012 16:21	21/03/2012 17:01	0.26	0.40
87	21/03/2012 17:05	30/03/2012 09:14	84.22	0.41
88	30/03/2012 09:24	30/03/2012 11:16	0.76	0.41
89	30/03/2012 11:20	30/03/2012 11:22	0.01	0.40
90	30/03/2012 11:26	30/03/2012 14:01	1.05	0.41
91	30/03/2012 14:05	30/03/2012 15:52	0.72	0.41
92	30/03/2012 15:56	30/03/2012 19:24	1.42	0.41
93	30/03/2012 20:03	30/03/2012 20:06	0.02	0.39
94	30/03/2012 20:09	30/03/2012 20:24	0.11	0.41
95	30/03/2012 20:27	30/03/2012 20:30	0.03	0.40
96	30/03/2012 20:32	30/03/2012 20:45	0.09	0.41
97	30/03/2012 20:49	30/03/2012 20:57	0.05	0.40
98	30/03/2012 21:21	02/04/2012 08:58	24.41	0.41
99	02/04/2012 09:01	03/04/2012 14:04	11.87	0.41
100	03/04/2012 14:22	03/04/2012 19:59	2.30	0.41
101	03/04/2012 20:05	03/04/2012 20:51	0.32	0.41
102	03/04/2012 20:57	04/04/2012 11:04	5.77	0.41
103	04/04/2012 11:07	04/04/2012 11:57	0.34	0.41
104	04/04/2012 12:02	05/04/2012 10:31	9.19	0.41
105	05/04/2012 10:37	05/04/2012 13:51	1.32	0.41
106	05/04/2012 14:11	05/04/2012 16:02	0.76	0.41
107	05/04/2012 16:04	10/04/2012 16:04	48.96	0.41
108	10/04/2012 17:38	11/04/2012 11:00	7.08	0.41
109	11/04/2012 13:32	11/04/2012 15:31	0.81	0.41
110	11/04/2012 15:34	12/04/2012 09:45	7.40	0.41
111	12/04/2012 11:06	12/04/2012 13:07	0.82	0.41
112	12/04/2012 13:35	12/04/2012 15:36	0.82	0.41
113	12/04/2012 15:52	12/04/2012 17:53	0.82	0.41
114	12/04/2012 18:08	13/04/2012 08:30	5.84	0.41
115	13/04/2012 08:45	13/04/2012 10:45	0.81	0.41
116	13/04/2012 10:57	13/04/2012 12:57	0.81	0.41
117	13/04/2012 13:10	13/04/2012 15:10	0.81	0.41
118	13/04/2012 15:24	13/04/2012 17:27	0.83	0.41

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119	13/04/2012 17:40	16/04/2012 08:39	25.59	0.41
120	16/04/2012 08:50	17/04/2012 15:26	12.41	0.41
121	17/04/2012 15:45	20/04/2012 10:10	26.90	0.40
122	20/04/2012 10:23	20/04/2012 10:24	0.01	0.38
123	20/04/2012 10:27	20/04/2012 10:37	0.07	0.39
124	20/04/2012 10:40	20/04/2012 10:41	0.01	0.39
125	20/04/2012 10:45	24/04/2012 11:20	39.04	0.40
126	24/04/2012 11:41	24/04/2012 13:39	0.80	0.40
127	24/04/2012 13:42	27/04/2012 11:00	28.03	0.40
128	27/04/2012 11:06	03/05/2012 11:36	58.37	0.40
129	03/05/2012 11:56	03/05/2012 13:20	0.55	0.40
130	03/05/2012 13:27	04/05/2012 10:15	8.38	0.40
131	04/05/2012 10:24	07/05/2012 13:22	30.16	0.40
132	07/05/2012 13:35	07/05/2012 17:30	1.57	0.40
133	07/05/2012 17:53	07/05/2012 18:50	0.38	0.40
134	07/05/2012 18:53	08/05/2012 10:58	6.46	0.40
135	08/05/2012 11:26	08/05/2012 12:46	0.54	0.40
136	08/05/2012 12:50	08/05/2012 17:00	1.67	0.40
137	08/05/2012 17:19	08/05/2012 18:25	0.44	0.40
138	08/05/2012 18:47	09/05/2012 10:51	6.47	0.40
139	09/05/2012 10:53	09/05/2012 12:02	0.46	0.40
140	09/05/2012 12:07	10/05/2012 14:36	10.62	0.40
141	10/05/2012 14:41	10/05/2012 16:12	0.60	0.40
142	10/05/2012 16:15	11/05/2012 14:19	8.86	0.40
143	11/05/2012 14:46	14/05/2012 15:41	29.25	0.40
144	14/05/2012 15:51	14/05/2012 16:15	0.16	0.40
145	14/05/2012 16:19	21/05/2012 12:34	65.65	0.40
146	21/05/2012 12:37	21/05/2012 15:36	1.20	0.40
147*	21/05/2012 16:11	21/05/2012 18:34	0.96	0.40
148	21/05/2012 19:39	23/05/2012 16:53	18.15	0.40
149	23/05/2012 17:14	25/05/2012 11:55	17.18	0.40
150	25/05/2012 11:57	29/05/2012 10:35	38.04	0.40
151	29/05/2012 10:38	29/05/2012 13:27	1.13	0.40
152	29/05/2012 13:34	29/05/2012 14:32	0.39	0.40
153	29/05/2012 14:35	31/05/2012 08:20	16.77	0.40
154	31/05/2012 08:23	04/06/2012 10:18	40.48	0.41
155	04/06/2012 10:31	04/06/2012 11:05	0.19	0.33
156	04/06/2012 11:08	04/06/2012 13:43	2.87	0.40

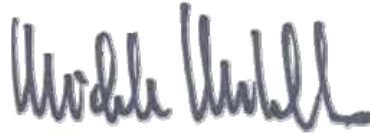
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157	04/06/2012 13:48	04/06/2012 15:27	1.14	0.33
158	04/06/2012 17:08	05/06/2012 08:58	6.04	0.40
159	05/06/2012 09:12	05/06/2012 11:04	0.41	0.40
160	05/06/2012 11:23	05/06/2012 13:45	0.54	0.33
161	05/06/2012 13:47	05/06/2012 17:24	1.04	0.29
162	05/06/2012 17:30	06/06/2012 08:45	3.83	0.25
163	06/06/2012 09:00	06/06/2012 10:06	0.24	0.22
164	06/06/2012 10:09	06/06/2012 11:12	0.24	0.23
165	06/06/2012 11:34	06/06/2012 14:16	0.59	0.22
166	06/06/2012 14:26	07/06/2012 08:44	3.73	0.21
167	07/06/2012 09:01	07/06/2012 11:04	0.78	0.38
168	07/06/2012 11:28	07/06/2012 16:33	1.93	0.38
169	07/06/2012 16:43	07/06/2012 18:23	0.70	0.42
170	07/06/2012 18:29	08/06/2012 11:03	6.40	0.39
171	08/06/2012 11:16	08/06/2012 13:01	0.67	0.38
172	08/06/2012 13:23	08/06/2012 17:54	1.72	0.38
173	08/06/2012 17:59	11/06/2012 08:54	27.18	0.43
174	11/06/2012 09:10	11/06/2012 11:09	0.80	0.40
175	11/06/2012 11:31	11/06/2012 13:21	0.73	0.40
176	11/06/2012 13:24	11/06/2012 14:21	0.38	0.40
177	11/06/2012 14:30	11/06/2012 14:55	0.15	0.37
178	11/06/2012 14:58	12/06/2012 08:45	6.70	0.38
179	12/06/2012 08:49	12/06/2012 09:30	0.25	0.37
180	12/06/2012 09:32	12/06/2012 11:11	0.62	0.38
181	12/06/2012 11:13	12/06/2012 11:53	0.25	0.37
182	12/06/2012 11:55	12/06/2012 13:50	0.72	0.38
183	12/06/2012 13:53	12/06/2012 14:51	0.37	0.38
184	12/06/2012 14:54	12/06/2012 16:40	0.67	0.38
185	12/06/2012 16:43	12/06/2012 17:32	0.32	0.39
186	12/06/2012 17:37	13/06/2012 13:55	8.06	0.40
187	13/06/2012 14:28	14/06/2012 10:15	7.89	0.40
188	14/06/2012 10:23	14/06/2012 11:20	0.38	0.40
189	14/06/2012 11:38	15/06/2012 09:55	8.89	0.40
190	15/06/2012 10:03	15/06/2012 10:53	0.33	0.40
191	15/06/2012 11:06	18/06/2012 09:24	28.04	0.40

Note: The uncertainty budgets (according to TEC-QEC/PR001 section 12) are: 4.2 % ($k=2$) for absorbed dose to water and 4.4% ($k=2$) for absorbed dose rate to water

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Notes: * Runs 67 & 147 without dosimetry. Dose rate taken from previous run with dosimetry.
Runs 13,31,49 & 68 – no dosimetry – devices out for measurements



Bob Nickson/Michele Muschitiello
(TEC-QEC Radiation Test Engineer)



Ali Zadeh
(TEC-QEC Section Head)

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RADIATION TEST SUMMARY

 Irradiation Test Report Number : **20139b**

 Date : **18 June 2012**

Test Requester :	Name	Alter Technology
	Address	Avd. Tomas Alba Edison, 4 41092 Seville (SPAIN)
	Personnel present :	E Munoz Plaza, J Jimenez Carreira, E Bernabeu Torres
	Project/Cost Code :	TRP
	Devices/Components irradiated :	Linear Devices AD565AT,OP470,AD584,PM139X,REF02,OP27,UC1843
	Device/Component details :	AD565AT,OP470,OP27,AD565AT,OLH249,OLH449 66183-105,AD565AT,PM139X,PM139X,SOC5551,UC1846

(conditions and identification)

Dosimetry Chain used :	A
Dosimeter :	Farmer model 2680 – s/n 390
Gas Ionisation Chamber :	NE Type 2571 – s/n 2915
Measured Dosimetry :	Total Ionising Dose in [Gy] (water)

Dosimetry Procedure :	ESCC 22900 section 4.1.1 TEC-QEC/PR001 - Appendix D <i>(Total Ionising Dose accredited by RvA according to ISO/IEC 17025.2005 Certificate No. L517)</i>
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(With the exception of the above specified dosimetry equipment, ESTEC ⁶⁰Co Facility does not assume any liability for the calibration status of any other equipment lent to the requester)

Irradiation Test Campaign Details

Source Activity : 76.7 TBq

on date : 4 June 2012

	units	Min.	Max.	Time-weighted Average
Temperature	°C	25.00	25.60	25.43
Pressure	mbar	996.40	1019.10	1008.25
Relative Humidity	%	31.20	40.50	35.64

Dosimeter position relative to ⁶⁰ Co source		
X	cm	-10
Y	cm	231
Z	cm	0

Run	Start Date & Time (CET)	End Date & Time (CET)	Total Ionising Dose [Gy] (water)	Dose Rate [mGy/h] (water)
1	04/06/2012 17:08	05/06/2012 08:58	63.56	4.02
2	05/06/2012 09:12	05/06/2012 11:04		
3	05/06/2012 11:23	05/06/2012 13:45	9.47	4.01
4	05/06/2012 13:47	05/06/2012 17:24	14.52	4.02

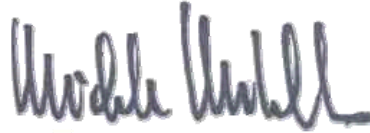
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5	05/06/2012 17:30	06/06/2012 08:45	61.25	4.02
6	06/06/2012 09:00	06/06/2012 10:06		
7	06/06/2012 10:09	06/06/2012 11:12		
8	06/06/2012 11:34	06/06/2012 14:16	9.51	3.52
9	06/06/2012 14:26	07/06/2012 08:44	71.58	3.97
10	07/06/2012 09:01	07/06/2012 11:04		
11	07/06/2012 11:28	07/06/2012 16:33	18.63	3.67
12	07/06/2012 16:43	07/06/2012 18:23	6.15	3.68
13	07/06/2012 18:29	08/06/2012 11:03	59.00	3.56
14	08/06/2012 11:16	08/06/2012 13:01		
15	08/06/2012 13:23	08/06/2012 17:54	13.66	3.02
16	08/06/2012 17:59	11/06/2012 08:54	212.74	3.38
17	11/06/2012 09:10	11/06/2012 11:09		
18	11/06/2012 11:31	11/06/2012 13:21	6.15	3.35
19	11/06/2012 13:24	11/06/2012 14:21	3.42	3.63
20	11/06/2012 14:30	11/06/2012 14:55	1.35	3.29
21	11/06/2012 14:58	12/06/2012 08:45	64.80	3.64
22	12/06/2012 08:49	12/06/2012 09:30	2.27	3.35
23	12/06/2012 09:32	12/06/2012 11:11	5.96	3.64
24	12/06/2012 11:13	12/06/2012 11:53	2.12	3.24
25	12/06/2012 11:55	12/06/2012 13:50	6.95	3.64
26	12/06/2012 13:53	12/06/2012 14:51	3.23	3.33
27	12/06/2012 14:54	12/06/2012 16:40	6.40	3.64
28	12/06/2012 16:43	12/06/2012 17:32	2.74	3.34
29	12/06/2012 17:37	13/06/2012 13:55	73.87	3.64
30	13/06/2012 14:28	14/06/2012 10:15	72.86	3.68
31	14/06/2012 10:23	14/06/2012 11:20	3.48	3.66
32	14/06/2012 11:38	15/06/2012 09:55	81.99	3.68
33	15/06/2012 10:03	15/06/2012 10:53	3.07	3.66
34	15/06/2012 11:06	18/06/2012 09:24	259.13	3.69

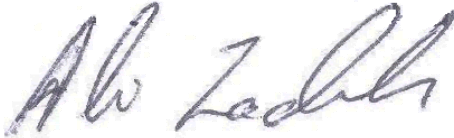
Note: The uncertainty budgets (according to TEC-QEC/PR001 section 12) are: 4.2 % (k=2) for absorbed dose to water and 4.4% (k=2) for absorbed dose rate to water

Notes: Runs 2,6,7,10,14 & 17 – no dosimetry – devices out for measurements

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ANNEX III ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE CONDITIONS

ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

Nº	SYMBOL	CONDITIONS (T _A =25°C)	LIMITS		UNIT
			MIN.	MAX.	
1	I _{C(ON)}	V _{CE} =5V, I _F =1mA, I _B =0.	15	40	mA
2	V _{CE(SAT)}	I _F =1mA, I _C =5.0mA.	--	0.3	V
3	I _{CE(OFF)}	V _{CE} =20V, I _F =0, I _B =0.	--	100	nA
4	V _F	I _F =10mA.	1.2	1.7	V
5	I _R	V _R =2.0V.	--	100	µA
6	CTR1	I _F =1mA, V _{CE} =5V, I _B =0. Note 4.	--	--	--
7	CTR2	I _F =2mA, V _{CE} =5V, I _B =0. Note 4.	--	--	--
8	CTR3	I _F =5mA, V _{CE} =5V, I _B =0. Note 4.	--	--	--
9	CTR4	I _F =10mA, V _{CE} =5V, I _B =0. Note 4.	--	--	--
10	CTR5	I _F =20mA, V _{CE} =5V, I _B =0. Note 4.	--	--	--
11	CTR6	I _F =10mA, V _{CE} =10V, I _B =0. Note 4.	--	--	--
12	CTR7	I _F =20mA, V _{CE} =10V, I _B =0. Note 4.	--	--	--

Notes:

1. The limits included above are included herein for reference purposes only.
2. The standard microcircuit drawing also specifies post irradiation limits. They are not applicable to this characterization because the specified dose rate is out of range, but they will be considered in the final assessment, together with the limits included above.
3. ATN reserves the right to solder the parts to a substrate for the purposes of testing.
4. This parameter is not specified in the manufacturer datasheet, but is has been added according to customer requirements.