Government Systems Group

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DATE: January 13, 1995

PPM-95-119

TO: B. Fafaul/311
FROM: K. Sahu/300.1 KS
SUBJECT: Radiation Report on HST/BASE
Part No. IDT49C460
Control No. 10625

cc: A. Sharma/311.0
R. Williams/300.1
OFA Library/300.1

A radiation evaluation was performed on IDT49C460 (32-Bit CMOS Error detection and Correction Unit) to determine the total dose tolerance of these parts. A brief summary of the test results is provided below. For detailed information, refer to Tables I through IV and Figure 1.

The total dose testing was performed using a ^{60}Co gamma ray source. During the radiation testing, eight parts were irradiated under bias (see Figure 1 for bias configuration), and two parts were used as control samples. The total dose radiation levels were 2.5, 5, 7.5, 10, 15, 20 and 30 krads*. The dose rate was between 0.04 and 0.6 krads/hour, depending on the total dose level (see Table II for radiation schedule). After the 30 krad irradiation, parts were annealed at 25°C for 168 hours, after which the parts were annealed at 100°C for 168 hours. After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits** listed in Table III. These tests included nine functional tests, six at 1.0MHz and three at 10MHz.

All parts passed initial electrical measurements. All irradiated parts passed all electrical and functional tests up to and including the 30 krad level.

After annealing for 168 hours at 25°C, all parts passed all electrical and functional tests.

After annealing for 168 hours at 100°C, no rebound effects were observed in the parts.

Table IV provides a summary of the mean and standard deviation values for each parameter after different irradiation exposures and annealing steps.

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

*The term rads, as used in this document, means rads(silicon). All radiation levels cited are cumulative.
**These are manufacturer's unirradiated data specification limits. No post-irradiation limits were provided by the manufacturer at the time these tests were performed.

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TABLE I. Part Information

Generic Part Number:	IDT49C460
HST/BASE Part Number:	IDT49C460DGB
HST/BASE Control Number:	10625
Charge Number:	ES44618
Manufacturer:	Integrated Device Technology
Lot Date Code:	9424
Quantity Tested:	10
Serial Number of Control Samples:	60, 63
Serial Numbers of Radiation Samples:	61, 62, 64, 65, 66, 67, 68, 69
Part Function:	32-Bit Error Detection and Correction unit
Part Technology:	CMOS
Package Style:	PGA
Test Equipment:	S-50
Test Engineer:	T. Scharer

No radiation tolerance/hardness was guaranteed by the manufacturer for this part.

TABLE II. Radiation Schedule for IDT49C460

EVENTS	DATE
1) INITIAL ELECTRICAL MEASUREMENTS	12/08/94
2) 2.5 KRAD IRRADIATION (0.04 KRADS/HOUR)	12/11/94
POST-2.5 KRAD ELECTRICAL MEASUREMENT	12/12/94
3) 5 KRAD IRRADIATION (0.15 KRADS/HOUR)	12/12/94
POST-5 KRAD ELECTRICAL MEASUREMENT	12/13/94
4) 7.5 KRAD IRRADIATION (0.15 KRADS/HOUR)	12/14/94
POST-7.5 KRAD ELECTRICAL MEASUREMENT	12/15/94
5) 10 KRAD IRRADIATION (0.15 KRADS/HOUR)	12/15/94
POST-10 KRAD ELECTRICAL MEASUREMENT	12/16/94
6) 15 KRAD IRRADIATION (0.08 KRADS/HOUR)	12/16/94
POST-15 KRAD ELECTRICAL MEASUREMENT	12/19/94
7) 20 KRAD IRRADIATION (0.29 KRADS/HOUR)	12/19/94
POST-20 KRAD ELECTRICAL MEASUREMENT	12/20/94
8) 30 KRAD IRRADIATION (0.59 KRADS/HOUR)	12/20/94
POST-30 KRAD ELECTRICAL MEASUREMENT	12/21/94
9) 168-HOUR ANNEALING @25°C	12/21/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	12/28/94
10) 168-HOUR ANNEALING @100°C*	12/28/94
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	01/10/95
(The test equipment was down until 1/10/95)	

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

*High temperature annealing is performed to accelerate long term time dependent effects (TDE), namely, the "rebound" effect due to the growth of interface states after the radiation exposure. For more information on the need to perform this test, refer to MIL-STD-883D, Method 1019, Para. 3.10.1.

Table III. Electrical Characteristics of IDT49C460

FUNCTIONAL TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 3 TEMPS
FUNCT 1	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 2	5.0V	0.0V	5.0V	FREQ=1.000MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 3	5.5V	0.0V	5.5V	FREQ=1.000MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 4	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 5	5.0V	0.0V	5.0V	FREQ=1.000MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 6	5.5V	0.0V	5.5V	FREQ=1.000MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 7	4.5V	0.0V	4.5V	FREQ=10.00MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 8	5.0V	0.0V	5.0V	FREQ=10.00MHZ	ALL I/O	VOL<1.50V , VOH>1.50V
FUNCT 9	5.5V	0.0V	5.5V	FREQ=10.00MHZ	ALL I/O	VOL<1.50V , VOH>1.50V

LOADS FOR ALL FUNCTIONAL TESTS ARE +/-3MA

DC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 3 TEMPS
VOH1	4.5V	0.80V	2.00V	LOAD= -300UA	OUTS	>+4.49V , <+4.50V
VOH2	4.5V	0.80V	2.00V	LOAD= -12MA	OUTS	>+2.40V , <+4.50V
VOL1	4.5V	0.80V	2.00V	LOAD= +300UA	OUTS	>-0.10V , <+0.00V
VOL2	4.5V	0.80V	2.00V	LOAD= +12MA	OUTS	>0.00V , <+0.50V
IIH	5.5V	0.00V	5.5V	VIN = 5.5V	INS	>0UA , <+10UA
IIL	5.5V	0.00V	5.5V	VIN = 0.0V	INS	>-10UA , <0UA
IOS	5.5V	0.00V	5.5V	VOUT= 0.0V	OUTS	>-120MA , <-30MA
IOZL	5.5V	0.00V	5.5V	VOUT= 0.0V	DATA,SC	>-20UA , <0UA
IOZH	5.5V	0.00V	5.5V	VOUT= 5.5V	DATA,SC	>0UA , <+20UA
ICCQH	5.5V	0.0V	5.5V	VOUT= OPEN	VCC	>+0.0MA , <+10MA
ICCT	5.5V	0.0V	3.4V	INS=VIH	VCC	>+0.0MA , <+39MA
ICCD	5.5V	0.0V	5.5V	F=10MHZ,OE_=LO	VCC	>+0.0MA , <+100MA
ICC1	5.5V	0.0V	5.5V	F=10MHZ,OE_=LO	VCC	>+0.0MA , <+110MA
ICC2	5.5V	0.4V	3.4V	F=10MHZ,OE_=LO	VCC	>+0.0MA , <+125MA

AC PARAMETRIC TESTS PERFORMED

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
TPLHC_SC	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+13NS
TPLHC_E	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+12NS
TPLHC_M	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+14NS
TPLHD_SC	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+17NS
TPHLC_SC	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+13NS
TPHLC_E	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+12NS
TPHLC_M	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+14NS
TPHLD_SC	4.5V	0.00V	3.00V	VTEST= 1.5V	OUTS	>+1.0NS , <+17NS

COMMENTS/EXCEPTIONS

(1) THE MAXIMUM LIMIT FOR ICCT IS (53 INPUTS)*(0.75MA/INPUT) OR 39.75MA. A ROUNDED LIMIT OF 39MA IS USED WHICH IS LESS THAN THE ACTUAL MAXIMUM.
(2) VIH AND VIL ARE TESTED GO/NOGO DURING THE VOH AND VOL TESTS. VIL FOR THE ENABLE PINS ARE TESTED GO/NOGO DURING THE IOZ TESTS.
(3) ONLY THE AC'S LISTED ARE TESTED. ALL OTHER AC PARAMETERS LISTED IN THE DATA SHEET ARE NOT TESTED. THIS INCLUDES SETUP AND HOLD TIMES.
(4) THE VOH1 LOWER LIMIT IS 4.49V AND NOT THE 4.5V (VCC) LISTED IN THE DATA SHEET. THE ACCURACY OF THE PMU ON THE 8V RANGE IS 12.098MV. ALL RESULTS USING THE 8V RANGE ARE TRUNCATED TO TWO DECIMAL PLACES. THEREFORE ALL READINGS OF 4.49X V ARE LISTED AS 4.49V. THE PMU ACCURACY PREVENTS A LOWER LIMIT OF 4.5V FROM BEING USED.
(5) THE VOL1 RESULTS FORCE ANY READING OF 1MV OR LESS TO 0V.
(6) THE MAXIMUM LIMIT FOR ICCD IS (10MHZ)*(10MA/MHZ) OR 100MA.

TABLE IV: Summary of Electrical Measurements after Total Dose Exposures and Annealing for IDT49C460 /1

Test #	Parameters	Units	Spec. Lim./2 min	Spec. Lim./2 max	Initial mean	Initial sd	2.5 mean	2.5 sd	5 mean	5 sd	7.5 mean	7.5 sd	10 mean	10 sd	15 mean	15 sd	20 mean	20 sd	30 mean	30 sd	Annealing 168 hrs @25°C mean	Annealing 168 hrs @25°C sd	Annealing 168 hrs @100°C mean	Annealing 168 hrs @100°C sd
							Total Dose Exposure (krads)																	
1	VOH1	V	4.49	4.5	4.49	1.44	4.49	1.44	4.49	1.44	4.49	1.44	4.49	1.44	4.49	1.44	4.49	1.44	4.49	1.44	4.49	1.44	4.49	1.44
2	VOH2	V	2.4	4.5	4.15	0.01	4.15	0.01	4.15	0.01	4.16	0.01	4.15	0.01	4.15	0.01	4.15	0.01	4.15	0.01	4.15	0.01	4.15	0.01
3	VOL1	mV	-100	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	VOL2	mV	0	500	129	5.9	128	5.8	128	5.9	128	5.9	127	5.9	126	5.7	127	5.64	125	5.4	126	6.19	127	5.82
5	IIH	uA	0	10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	IIL	uA	-10	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	IOS	mA	-120	-30	-94	2.75	-94	2.74	-93	2.78	-93	2.79	-93	2.87	-93	2.85	-93	2.95	-92	2.98	-92	2.96	-92	2.98
8	IOZL	nA	-20000	0	-0.02	0.45	-0.02	0.39	-0.02	0.45	-0.02	0.39	-0.02	0.45	-0.03	0.50	-0.03	0.50	-0.01	0.45	-28.3	0.50	-0.01	0.45
9	IOZH	nA	0	20000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	84.2	14.2	51.7	0.0	0.0
10	ICCQH	mA	0	10	1.11	1.57	1.34	1.42	1.27	1.38	1.51	1.29	1.49	1.29	1.59	1.16	1.79	1.29	0.69	1.15	1.23	1.20	1.58	1.09
11	ICCT	mA	0	39	10.5	1.11	10.5	1.13	10.5	1.13	10.6	1.13	10.5	1.13	10.6	1.13	10.3	1.11	7.98	1.45	8.40	1.55	10.2	1.04
12	ICCD	mA	0	100	25.7	1.10	27.0	1.11	27.0	1.15	28.0	1.09	27.4	1.37	27.0	1.12	27.9	1.21	25.9	1.77	24.7	1.09	25.3	1.34
13	ICC1	mA	0	110	25.6	1.15	27.2	1.19	27.1	1.17	28.1	1.19	27.5	1.34	27.2	1.15	28	1.28	25.9	1.64	24.7	1.14	25.3	1.42
14	ICC2	mA	0	125	25.8	1.09	27.1	1.16	27.1	1.16	28.0	1.23	27.5	1.32	27.2	1.15	27.9	1.29	25.8	1.65	24.8	1.11	25.1	1.44
15	TPLHC_SC	ns	1	13	4.95	0.48	4.89	0.49	4.89	0.46	4.91	0.48	4.88	0.48	4.88	0.46	4.93	0.47	4.92	0.46	4.87	0.46	5.53	0.47
16	TPLHC_E	ns	1	12	5.21	0.14	5.05	0.14	5.12	0.13	5.12	0.13	5.11	0.13	6.01	0.14	5.14	0.14	5.13	0.13	5.01	0.13	4.80	0.14
17	TPLHC_M	ns	1	14	6.32	0.13	6.30	0.14	6.31	0.15	6.26	0.14	6.24	0.15	6.16	0.15	6.15	0.15	6.25	0.14	6.23	0.14	5.97	0.15
18	TPLHD_SC	ns	1	17	7.26	0.54	7.62	0.50	7.63	0.50	7.73	0.51	7.68	0.54	7.65	0.55	7.71	0.54	7.66	0.53	7.57	0.49	8.13	0.47
19	TPHLC_SC	ns	1	13	5.57	0.52	5.44	0.39	5.45	0.36	5.54	0.53	5.62	0.53	5.47	0.53	5.54	0.51	5.51	0.49	5.39	0.37	5.04	0.51
20	TPHLC_E	ns	1	12	6.91	0.17	6.76	0.16	6.79	0.17	6.85	0.16	6.83	0.17	6.78	0.16	6.86	0.16	6.84	0.15	6.75	0.15	7.30	0.17
21	TPHLC_M	ns	1	14	5.65	0.17	5.79	0.54	5.57	0.18	5.60	0.17	5.58	0.18	5.54	0.17	5.63	0.17	5.62	0.16	5.51	0.17	6.08	0.15
22	TPHLD_SC		1	17	8.23	0.53	8.06	0.55	8.04	0.54	8.19	0.52	8.15	0.52	8.09	0.49	8.15	0.48	8.09	0.48	7.94	0.48	7.55	0.35
23	FUNC1, VCC=4.5V, VIL=0.4V, VIH=4.5V, 1MHZ				P		P		P		P		P		P		P		P		P		P	
24	FUNC2, VCC=5.0V, VIL=0.0V, VIH=5.0V, 1MHZ				P		P		P		P		P		P		P		P		P		P	
25	FUNC3, VCC=5.5V, VIL=0.0V, VIH=5.5V, 1MHZ				P		P		P		P		P		P		P		P		P		P	
26	FUNC4, VCC=4.5V, VIL=0.0V, VIH=4.5V, [illegible]MHZ				P		P		P		P		P		P		P		P		P		P	
27	FUNC5, VCC=5.0V, VIL=0.0V, VIH=5.0V, 1MHZ				P		P		P		P		P		P		P		P		P		P	
28	FUNC6, VCC=5.5V, VIL=0.0V, VIH=5.5V, 1MHZ				P		P		P		P		P		P		P		P		P		P	
29	FUNC7, VCC=4.5V, VIL=0.0V, VIH=4.5V, 10MHZ				P		P		P		P		P		P		P		P		P		P	
30	FUNC8, VCC=5.0V, VIL=0.0V, VIH=5.0V, 10MHZ				P		P		P		P		P		P		P		P		P		P	
31	FUNC9, VCC=5.5V, VIL=0.0V, VIH=5.5V, 10MHZ				P		P		P		P		P		P		P		P		P		P	

Notes:

1/ The mean and standard deviation values were calculated over the eight parts irradiated in this testing. The control samples remained constant throughout the 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/ In the functional Tests, "P" means that all parts passed this test at this irradiation or annealing level, "F" means that all parts failed this test at this irradiation or annealing level and "nPmF" means that n parts passed at this level and m parts failed at this level.

Radiation-sensitive parameters: None.

Figure 1. Radiation Bias Circuit for IDT49C460

PIN LOC	BURN IN CONNECT	SIGNAL NAME
B2	+5.0V	VCC
B1	0.0V	D[2]
C2	+5.0V	D[3]
C1	0.0V	D[4]
D2	+5.0V	D[5]
D1	0.0V	D[6]
E2	+5.0V	D[7]
E1	0.0V	D[8]
F2	GROUND	GND
F1	+5.0V	D[9]
G2	0.0V	D[10]
G1	+5.0V	D[11]
H2	0.0V	D[12]
H1	+5.0V	D[13]
J2	0.0V	D[14]
J1	+5.0V	D[15]
K1	+5.0V	OE_[1]
K2	0.0V	CB[7]
L2	0.0V	CB[6]
K3	0.0V	CB[5]
L3	0.0V	CB[4]
K4	+5.0V	CB[3]
L4	+5.0V	CB[2]
K5	0.0V	CB[1]
L5	0.0V	CB[0]
K6	VCC/2	SC[0]
L6	VCC/2	SC[1]
K7	VCC/2	SC[2]
L7	VCC/2	SC[3]
K8	VCC/2	SC[4]
L8	VCC/2	SC[5]
K9	VCC/2	SC[6]
L9	VCC/2	SC[7]
L10	0.0V	OESC_

SIGNAL NAME	BURN IN CONNECT	PIN LOC
D[1]	+5.0V	A2
D[0]	0.0V	A3
OE_[0]	+5.0V	B3
LEIN	+5.0V	A4
DIAG_MODE[1]	0.0V	B4
DIAG_MODE[0]	0.0V	A5
CODE_ID[1]	+5.0V	B5
CODE_ID[0]	0.0V	A6
OE_[3]	+5.0V	B6
D[31]	+5.0V	A7
D[30]	0.0V	B7
D[29]	+5.0V	A8
D[28]	0.0V	B8
D[27]	+5.0V	A9
D[26]	0.0V	B9
D[25]	+5.0V	A10
GND	GROUND	B10
D[24]	0.0V	B11
D[23]	+5.0V	C11
D[22]	0.0V	C10
D[21]	+5.0V	D11
D[20]	0.0V	D10
D[19]	+5.0V	E11
D[18]	0.0V	E10
D[17]	+5.0V	F11
VCC	+5.0V	F10
D[16]	0.0V	G11
OE_[2]	+5.0V	G10
LEOUT/GEN_	+5.0V	H11
CORRECT	0.0V	H10
LEDIAG	+5.0V	J11
ERROR	VCC/2	J10
MULTERROR_	VCC/2	K11
GND	GROUND	K10

VCC = +5 V +/- 0.5 V

VCC/2 = +2.5 V +/- 0.25 V

TA = +25 AND +100C