

UNISYS

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Interoffice Memorandum

To J. Solomon  
Department Code 300.1  
From K. Sahu KS  
Department 7809  
Subject Radiation Report on ISTEP/L3 (SOHO)  
Part No. DM28C256-300/B

PPM-91-610  
Date September 27, 1991  
Location Lanham  
Telephone 731-8954  
Location Lanham  
cc S. Pszcolka/311

A radiation evaluation was performed on DM28C256 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 VI and Figure 1.

The total dose testing was performed using a cobalt-60 gamma ray source. Parts were separated into two test groups of five parts each. In each group, five parts were irradiated under bias (see Figure 1 for bias circuit), and one part was used as a control sample. During the radiation testing, Test Group 1 (TG1) parts were tested functionally by writing/reading all ones, all zeros and a checkerboard pattern to the devices. However, the functional tests performed on Test Group 2 (TG2) parts were read-only, and consisted of reading the checkerboard pattern put into the parts before the first radiation exposure. The parts in TG2 were not written to during the radiation testing.

The total dose radiation steps were 5, 10, 12.5, 15, 20, 30, 40 and 50 krads. After 50 krads, parts were annealed at 25°C for 69 and 168 hours (cumulative). The dose rate was between 75 to 500 rads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, parts were electrically tested according to the test conditions and the specification limits listed in Table III. Also, nine functional tests were performed on TG1 and three functional tests were performed on TG2 after each radiation/annealing step. A description of these tests can be found in Table IIIA.

All parts from both test groups passed all tests on irradiation to 5 krads. After 10 krads of exposure, four of the five parts in TG1 failed functionally. Also, two parts from TG1 and three parts from TG2 exceeded the maximum specification limits on ICCH3 and/or ICCL3. After 12.5 krads, ICCL2 failures were observed in both test groups. At 15 krads and above, all parts in TG1 failed functionally. However, parts in TG2 continued to pass functionally to 30 krads. After 40 krads, three parts in TG2 failed functionally. After 50 krads, all parts failed functionally and six of the ten parts continued to exceed ICC specifications. Only slight recovery was observed after

annealing the parts for 69 and 168 hours. Tables IV, V and VI provide the mean and standard deviation values for each tested parameter after all radiation and annealing steps, and a summary of the functional test results.

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

TABLE I. Part Information

Generic Part Number:	DM28C256
ISTP/L3 Part Number:	DM28C256-300/B
ISTP/L3 Control Number:	3239
Charge Number:	C14188
Manufacturer:	SEEQ TECHNOLOGY INC
Lot Date Code:	9052B
Quantity Tested:	10
Serial Numbers of Radiation Samples:	21, 22, 23, 24, 25 (TG1) 26, 27, 28, 29, 30 (TG2)
Serial Numbers of Control Samples:	1 (TG1) 2 (TG2)
Part Function:	EEPROM
Part Technology:	CMOS
Package Style:	28-Pin DIP
Test Engineer:	Ted Scharer

TABLE II. Radiation Schedule for TG1 and TG2

EVENTS	DATE
1) Initial Electrical Measurements	07/09/91
2) 5 krads irradiation @ 260 rads/hr	07/22/91
Post 5 krads Electrical Measurements	07/23/91
3) 10 krads irradiation @ 290 rads/hr	07/23/91
Post 10 krads Electrical Measurements	07/24/91
4) 12.5 krads irradiation @ 130 rads/hr	07/24/91
Post 12.5 krads Electrical Measurements	07/25/91
5) 15 krads irradiation @ 125 rads/hr	07/25/91
Post 15 krads Electrical Measurements	07/26/91
6) 20 krads irradiation @ 75 rads/hr	07/26/91
Post 20 krads Electrical Measurements	07/29/91
7) 30 krads irradiation @ 500 rads/hr	07/29/91
Post 30 krads Electrical Measurements	07/31/91
8) 40 krads irradiation @ 500 rads/hr	07/31/91
Post 40 krads Electrical Measurements	08/01/91
9) 50 krads irradiation @ 500 rads/hr	08/01/91
Post 50 krads Electrical Measurements	08/02/91
10) 69 hour annealing	08/02/91
Post 69 hr Electrical Measurements	08/05/91
11) 168 hour annealing	08/02/91
Post 168 hr Electrical Measurements	08/09/91

Notes:

- All parts were radiated under bias at the cobalt-60 gamma ray facility at GSFC.
- All electrical measurements were performed off-site at 25°C.
- Annealing performed at 25°C under bias.

Table III. Electrical Characteristics of DM28C256

+25°C				
TEST NAME	TEST CONDITIONS	MIN	MAX	UNITS
VOL	VIN=0.8, 2.0 VDC; VCC=4.5 VDC IOL=2.1 mA	0	0.45	VDC
VOH	VIN=0.8, 2.0 VDC; VCC=4.5 VDC IOH=-0.4 mA	2.4	-	VDC
IIL 1/	VIN=0.1, 5.5 VDC; VCC=5.5 VDC VTEST=100 mVDC	-10	10	µA
IIH 1/	VIN=0, 5.5 VDC; VCC=5.5 VDC VTEST=5.5 VDC	-10	10	µA
IOZL	VIN=0.1, 5.5 VDC; VCC=5.5 VDC VOUT=100 mVDC; CE=VIH	-10	10	µA
IOZH	VIN=0, 5.5 VDC; VCC=5.5 VDC VOUT=5.5 VDC; CE=VIH	-10	10	µA
IOE	VIN=0, 5.5 VDC; VCC=5.5 VDC VTEST=13 VDC	-10	100	µA
ICC1 Active	VIN=0, 5.5 VDC; VCC=5.5 VDC ADDR LINES CHANGE AT 4 MHZ CE=OE=VIL; WE=VIH	0	80	mA
ICCL2 TTL Standby	VIN=0.8, 5.2 VDC; VCC=5.5 VDC CE=2.0 VDC; WE, OE, ADDR=VIL	0	3	mA
ICCH2 TTL Standby	VIN=0.8, 5.2 VDC; VCC=5.5 VDC WE, ADDR=VIH; OE=VIL; CE=2.0 VDC	0	3	mA
ICCL3 CMOS Standby	VIN=0, 5.2 VDC; VCC=5.5 VDC CE=VIH; WE, OE, ADDR=VIL	0	350	µA
ICCH3 CMOS Standby	VIN=0, 5.2 VDC; VCC=5.5 VDC CE, WE, OE, ADDR=VIH	0	350	µA
VIL 2/	VCC=4.5 VDC	-0.1	0.8	VDC
VIH 2/	VCC=4.5 VDC	2	4.8	VDC
TPHL 3/	VIN=0.4, 2.4 VDC VCC=5 VDC	0	300	ns
TPLH 3/	VIN=0.4, 2.4 VDC VCC=5 VDC	0	300	ns

Notes:

- 1/ IIL and IIH are not tested on WE since this caused data in the device to become corrupted.
- 2/ VIL and VIH are tested during VOL and VOH testing. VIL(min) and VIH(max) are not tested.
- 3/ TPHL and TPLH are performed with no loads on the outputs. No other AC tests are performed.

Table IIIA. Description of Functional Tests for DM28C256

*Group 1*

Test #	Description	VCC
1	Write/Read ONES	4.5V
2	Write/Read ONES	5.0V
3	Write/Read ONES	5.5V
4	Write/Read ZEROS	4.5V
5	Write/Read ZEROS	5.0V
6	Write/Read ZEROS	5.5V
7	Write/Read CHECKERBOARD	4.5V
8	Write/Read CHECKERBOARD	5.0V
9	Write/Read CHECKERBOARD	5.5V

*Group 2*

Test #	Description	VCC
1	Read	4.5V
2	Read	5.0V
3	Read	5.5V

TABLE IV: Summary of Elect. Measurements after  
Total Dose Exposures and Annealing for DM28C256

1/1, 2/

Group 1

Parameters	Spec. Limits min max	Initials			Total Dose Exposure (krads)											
		5		10		12.5		15		20		30				
		mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd			
VOL	mV	0	450	89	3	91	2	3E3	2E3	3E3	2E3	3E3	2E3	3E3	2E3	
VOH	V	2.4	-	3.8	.01	3.8	.01	3.8	.01	3.8	.01	3.8	.02	3.8	.02	
IIL	uA	-10	10	0	0	0	0	0	.02	0	.02	-.02	.1	-.07	.3	
IIH	uA	-10	10	0	0	0	0	0	0	0	0	.01	0	.01	.01	
IO2L	uA	-10	10	0	0	0	0	0	0	-.01	.01	-.02	.02	-.02	.02	
IO2H	uA	-10	10	0	0	0	0	0	0	0	0	0	0	0	0	
IOE	uA	-10	100	7.3	.4	6.7	.8	7.0	.8	7.2	.8	7.5	.8	7.7	.8	
ICC1	mA	0	80	7.2	.01	6.8	.5	7.3	.8	7.8	1.3	8.9	2.6	8.6	2.1	
ICCL2	mA	0	3	1.2	.02	1.1	.04	1.7	0.7	2.2	1.4	3.3	2.8	2.8	2.2	
ICCH2	mA	0	3	1.2	.02	1.1	.03	1.5	.7	2.1	1.4	3.1	2.8	2.7	2.1	
ICCL3	uA	0	350	45	2	53	26	583	705	1.1E3	1.4E3	2.2E3	2.8E3	1.7E3	2.2E3	
ICCH3	uA	0	350	45	2	53	26	585	705	1.1E3	1.4E3	2.2E3	2.8E3	1.8E3	2.1E3	
TPHL	ns	0	300	24.8	1.8	26.8	1.4	26.5	1.2	25.4	1.0	25.7	1.1	25.4	1.2	
TPLH	ns	0	300	69.5	4.3	72.1	3.9	*	*	*	*	*	*	*	*	

<Table IV continued on next page>

\* Due to functional failures at 10 krads and above, TPLH measurements could not be made for most parts.

Table IV. (continued)

Group 1

Parameters	Spec. Limits min max	Initials			TDE (krads)							
		mean	sd	3	40		50		69 hrs		168 hrs	
					mean	sd	mean	sd	mean	sd	mean	sd
VOL	0 450	89	.01	3	4E3	2E3	3E3	2E3	3E3	2E3	3E3	2E3
VOH	2.4 -	3.8	.01		3.8	0.1	2.0	1.5	2.4	1.6	3.0	1.4
IIL	-10 10	0	0		-0.3	1.3	-0.3	1.5	-0.3	1.5	-0.3	1.5
IIH	-10 10	0	0		.02	.01	.02	.01	.02	.01	.02	.01
IOZL	-10 10	0	0		-0.5	0.6	-0.5	0.9	-0.5	1.0	-0.5	1.0
IOZH	-10 10	0	0		.01	0	.02	.01	.02	.01	.02	.01
IOE	-10 100	7.3	.4		8.0	.8	8	0.8	8	0.8	7.5	0.8
ICCL1	0 80	7.2	.01		17.8	12.6	16.7	10.8	15.3	9.3	14.5	8.5
ICCL2	0 3	1.2	.02		11.4	12.2	10.6	10.2	9.4	8.7	8.6	8.6
ICCH2	0 3	1.2	.02		11.9	11.7	10.3	10.0	8.4	8.4	7.7	7.7
ICCL3	0 350	45	2		1E4	1E4	9E3	1E4	8E3	9E3	7E3	8E3
ICCH3	0 350	45	2		1E4	1E4	9E3	1E4	8E3	9E3	7E3	8E3
TPLH	0 300	24.8	1.8		25.9	1.5	25.2	2.4	25.6	2.7	25.6	2.8
TPLH	0 300	69.5	4.3		*	*	*	*	*	*	*	*

Notes:

1/ The initial electrical measurement values in Table IV were calculated only over the two control samples from both test groups. However, this data is representative of the data taken from all of the parts. The mean and standard deviation values at the radiation and annealing steps were calculated over the five parts irradiated in this test group. The control sample for Group 1 remained constant throughout the testing and is not included in this table at these steps.

2/ The VOL and TPLH output failures resulted from the location of incorrect memory contents.

\* Due to functional failures at 10 krads and above, TPLH measurements could not be made for most parts.



TABLE V: Summary of Electrical Measurements after  
Total Dose Exposures and Annealing for DM28C256  
1/, 2/

Group 2

Parameters	Spec. Limits		Total Dose Exposure (krads)																				
	min	max	Initials			5			10			12.5			15			20			30		
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd			
VOL	0	450	89	3	89	4	92	10	93	13	145	18	124	9	130	127							
VOH	2.4	-	3.8	.01	3.8	.01	3.8	0.1	3.8	0.2	3.8	0.2	3.8	.02	3.7	0.3							
IIL	-10	10	0	0	-1	0.5	-0.2	.08	-0.8	.4	-0.4	.2	-0.9	.4	-0.7	.3							
IIH	-10	10	0	0	0.1	0.6	.02	.1	.08	.4	.04	.2	.08	.4	.02	.03							
IOZL	-10	10	0	0	-0.3	.1	-0.1	.05	-0.4	.1	-0.1	.08	-0.5	.1	-0.2	.7							
IOZH	-10	10	0	0	.02	.08	.01	.04	.03	.1	.06	.2	.01	.01	0	0							
IOE	-10	100	7.3	.4	6.6	.2	7.0	.2	7.1	.2	7.2	.2	7.4	.2	7.7	.2							
ICC1	0	80	7.2	.01	6.8	.2	6.4	2.1	8.9	2.4	10.0	3.6	9.7	2.6	11.9	4.7							
ICCL2	0	3	1.2	.02	1.2	.06	1.9	.7	2.4	1.2	3.3	2.3	3.3	2.2	5.0	4.0							
ICCH2	0	3	1.2	.02	1.1	.05	1.8	.7	2.2	1.2	3.2	2.3	3.2	2.2	4.8	3.9							
ICCL3	0	350	45	2	45	4	755	707	1.3E3	1.2E3	2.2E3	2.2E3	2.2E3	2.2E3	3.9E3	3.9E3							
ICCH3	0	350	45	2	45	4	754	707	1.3E3	1.2E3	2.2E3	2.2E3	2.2E3	2.2E3	3.9E3	3.9E3							
TPHL	0	300	24.8	1.8	25.6	2.1	24.7	2.3	23.9	2.3	24.3	2.4	23.6	2.1	24.0	2.4							
TPLH	0	300	69.5	4.3	69.4	4.5	68.9	4.6	69.6	4.7	69.0	5.1	70.5	5.1	80.0	5.9							

<Table V continued on next page>

Table V. (continued)

Group 2

Parameters	min	max	Spec. Limits	Initials	TDE (krads)							
					40		50		69 hrs		168 hrs	
					mean	sd	mean	sd	mean	sd	mean	sd
VOL	0	450		89	3	347	1078	1.5E3	1.9E3	1.4E3	1.2E3	1.8E3
VOH	2.4	-		3.8	.01	3.2	1.3	1.8	1.5	2.3	1.6	1.4
IIL	uA	-10	10	0	0	-.3	1.3	-.3	1.5	-.3	1.5	1.5
IIH	uA	-10	10	0	0	.03	.05	.04	.06	.02	.01	.02
IOZL	uA	-10	10	0	0	-2.3	7.2	-3.2	8.6	-3.2	8.7	8.8
IOZH	uA	-10	10	0	0	.9	2.7	.3	.8	0.2	0.6	0.4
IOE	uA	-10	100	7.3	.4	7.9	.2	.8	1.4	7.9	0.4	0.4
ICCL1	mA	0	80	7.2	.01	24.3	16.3	22.0	14.6	20.5	13.8	18.9
ICCL2	mA	0	3	1.2	.02	16.8	15.4	14.1	13.2	12.3	11.6	11.3
ICCH2	mA	0	3	1.2	.02	16.4	15.0	13.8	12.9	11.9	11.2	11.1
ICCL3	uA	0	350	45	2	16E3	15E3	13E3	13E3	11E3	11E3	10E3
ICCH3	uA	0	350	45	2	16E3	15E3	13E3	13E3	11E3	11E3	10E3
TPHL	ns	0	300	24.8	1.8	23.0	2.7	23.1	5.1	24.6	2.8	23.9
TPLH	ns	0	300	69.5	4.3	75.0	5.6	77.8	11.7	75.9	6.0	76.1
												5.8

Notes:

- 1/ The initial electrical measurement values in Table IV were calculated only over the two control samples from both test groups. However, this data is representative of the data taken from all of the parts. The mean and standard deviation values at the radiation and annealing steps were calculated over the five parts irradiated in this test group. The control sample for Group 2 remained constant throughout the testing and is not included in this table at these steps.
- 2/ The VOL output failures resulted from the location of incorrect memory contents.

TABLE VI: Summary of Functional Test Results  
after Total Dose Exposures and Annealing for DM28C256 1/

Test Group	Functional Test	Initials	Total Dose Exposure (krads)										Annealing		
			5	10	12.5	15	20	30	40	50	69 hrs	168 hrs			
1	WR1	5/0	5/0	1/4	1/4	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5
	WR1	5/0	4/1	3/2	3/2	3/2	3/2	3/2	3/2	3/2	2/3	1/4	1/4		
	WR1	5/0	1/4	1/4	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5		
	WR0	5/0	1/4	1/4	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5		
	WR0	5/0	4/1	4/1	3/2	2/3	3/2	3/2	1/4	1/4	3/2	3/2			
	WR0	5/0	1/4	1/4	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5			
	WRCHK	5/0	1/4	1/4	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5			
	WRCHK	5/0	4/1	4/1	3/2	3/2	3/2	3/2	2/3	2/3	3/2	3/2			
	WRCHK	5/0	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5			
2	R	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	1/4	1/4			
	R	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	1/4	1/4			
	R	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	5/0	2/3	2/3			

Note:

1/ 'n/m' indicates n parts passed and m parts failed that functional test.

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