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Interoffice Memorandum

PPM-91-075

To
T. Miccolis

Department
Code 311

From
K. Sahu

Department
7809

Subject
Radiation Report on 82C59A-5
SMEX Common Buy Part No. 5962-85016023A

Date
February 11, 1991

Location
GSFC

Telephone
731-8954

Location
Lanham

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A radiation evaluation was performed on 82C59A-5 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 cobalt-60 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 steps were 2.5, 5, 10, 15, 20, 30, 50, 75 and 100 krads. After 100 krads, parts were annealed at 25°C for 24 and 168 hours. The dose rate was between 0.07 - 1.25 krads/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. These tests included a total of five functional tests (at 1 and 1.36 MHz) after each radiation and annealing step.

All parts passed all tests on irradiation up to 15 krads. At 20 krads*, three parts exceeded specification limits on ICCSBH/L (these readings were in the range of 17uA to 12mA against the specification limit of 10uA). At 30 krads, all parts exceeded the specification limits on ICCSBH/L, but passed all other tests. At 50 krads, parts exceeded the specification limits on IOZH also. However, all parts passed all functional tests on irradiation up to 50 krads.

The first functional failures occurred at the radiation step of 75 krads when six parts failed functional test #1, which was performed at VCC = 4.5V with VIL = 0.4V and VIH = 2.6V. However, all parts passed functional tests #2, #3, #4 and #5 at 75 krads (see Table III for details of functional test conditions). At 100 krads, all parts failed functional test #1, while three parts also failed functional test #3. However, all parts continued to

pass functional tests #2, #4 and #5 on irradiation up to 100 krads. On annealing the parts for 24 and 168 hours at 25°C, parts showed some recovery in ICCSBH/L and IOZH, and in functional test performance. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. It also provides a summary of functional test results after each radiation/annealing step.

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

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* At 20 krads and above, the Automatic Tester began recording invalid VOH and VOL readings (~~i.e. 0V~~) for some of the irradiated parts, although the control samples were showing valid readings. The test procedure for VOH and VOL tests was therefore modified, and the invalid VOH and VOL test results were ignored in the remaining report. See Note 1/ following Table III for more details.

TABLE I. Part Information

Generic Part Number:	82C59A
SMEX Common Buy Part Number:	5962-85016023A
SMEX Common Buy Control Number:	1400
Manufacturer:	Harris Semiconductor
Quantity Procured:	58
Lot Date Code:	8934
Quantity Tested:	10
Serial Numbers of Radiation Samples:	3,4,5,6,7,8,9,10
Serial Numbers of Control Samples:	1,2
Part Function:	Programmable Priority Interrupt Controller
Part Technology:	CMOS
Package Style:	28-Pin LCC

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	12/11/90
2) 2.5 krads irradiation @ 125 rads/hr Post 2.5 krads Electrical Measurements 1/	12/11/90 12/14/90
3) 5.0 krads irradiation @ 125 rads/hr Post 5.0 krads Electrical Measurements	12/17/90 12/18/90
4) 10 krads irradiation @ 250 rads/hr Post 10 krads Electrical Measurements 1/	12/18/90 12/21/90
5) 15 krads irradiation @ 250 rads/hr Post 15 krads Electrical Measurements 1/	12/21/90 12/28/90
6) 20 krads irradiation @ 73 rads/hr Post 20 krads Electrical Measurements	12/28/90 12/31/90
7) 30 krads irradiation @ 225 rads/hr Post 30 krads Electrical Measurements	12/31/90 01/02/91
8) 50 krads irradiation @ 1 krad/hr Post 50 krads Electrical Measurements	01/02/91 01/03/91
9) 75 krads irradiation @ 1250 rads/hr Post 75 krads Electrical Measurements	01/03/91 01/04/91
10) 100 krads irradiation @ 367 rads/hr Post 100 krads Electrical Measurements	01/04/91 01/07/91
11) 24 hrs annealing Post 24 hr Electrical Measurements	01/07/91 01/08/91
12) 168 hrs annealing Post 168 hr Electrical Measurements	01/08/91 01/15/91

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 was performed at 25°C under bias.

Anomalous Events:
1/ The S-50 was down when the devices were originally scheduled (12/12/90, 12/19/90, and 12/24/90 for Post 2.5, 10, and 15 krads electrical measurements, respectively) to be tested. The devices were kept under bias until the actual measurements were made, on the dates shown above.

TABLE III. Electrical Characteristics of 82C59A

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
FUNCT # 1	4.5V	0.4V	2.6V	FREQ =1.36MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 2	4.5V	0.0V	4.5V	FREQ =1.00MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 3	5.5V	0.4V	2.6V	FREQ =1.36MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT # 4	5.5V	0.0V	5.5V	FREQ =1.00MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT #-5	5.5V	0.0V	5.5V	FREQ =1.00MHz	ALL I/O	VOL<0.4V , VOH>3.0V

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C
VOH1	4.5V	0.8V	2.2V	LOAD=-2.5MA	OUTS	>+3.0V , <+5.5V
VOH2	4.5V	0.8V	2.2V	LOAD=-100UA	OUTS	>+4.1V , <+5.5V
VOL	4.5V	0.8V	2.2V	LOAD=+2.5MA	OUTS	>+0.0V , <+0.4V
IIH	5.5V	0.0V	5.5V	VTST= 5.5V	INS	>+0.0A , <+1.0UA
IIH_IR	5.5V	0.0V	5.5V	VTST= 5.5V	IR INS	>+0.0A , <+10UA
IIL	5.5V	0.0V	5.5V	VTST= 0.0V	INS	>-1.0UA , <+0.0A
IIL_IR	5.5V	0.0V	5.5V	VTST= 0.0V	IR INS	>-500UA , <+0.0A
IC	5.5V	0.0V	5.5V	VOUT= 5.5V	OUTS	>-10UA , <+10UA
IC	5.5V	0.0V	5.5V	VOUT= 0.0V	OUTS	>-10UA , <+10UA
ICCSBH	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>+0.0A , <+10UA
ICCSBL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0A , <+10UA

COMMENTS/EXCEPTIONS

(1) THESE PARAMETERS WERE TESTED DURING FUNCTIONAL # 1 AND #3 AS GO/NOGO :
- tAHRL, tRHAX, tRLRH, tAHWL, tWHAX, tWLWH,
  tDVWH, tWHDX, tJLJH, tCVIAL, tRHRL, tWHWL & tCHCL

(2) VIL & VIH WERE TESTED DURING VOL & VOH TESTS AS GO/NOGO.

1/ Functional Test #5 was added at the radiation step of 50 krads to verify VOH and VOL levels under dynamic conditions. This test was needed because at 20 and 30 krads, the Automatic Tester, S-50, began recording invalid* VOH and VOL readings for some of the irradiated parts. This was attributed to the limitation of the S-50 equipment rather than the parts' failure, as the parts were passing VOH and VOL tests under functional tests #1, #2, #3 and #4. It should be noted that the S-50 does not have a high speed parametric measurement unit, which would be needed to perform VOH and VOL tests under static conditions. In order to bring each pin to the high state so that the Output High Voltage (VOH) measurement can be performed statically, a lengthy portion of the functional pattern must be executed. The pattern is then halted and the output voltage on that pin is measured. Although this technique was successful for parts that had not been irradiated, it did not work for the irradiated parts. This cannot be deemed as a device failure because the measurement was not being performed correctly. The ATE program was modified to perform the VOH and VOL tests as Go/NoGo in the functional tests in addition to the parametric VOH and VOL tests. While, the previous functional tests (#1, #2, #3 and #4) consider anything above 1.5V as a passing logic "1" and anything below 1.5V a passing logic "0", the additional functional test (#5) considers anything below 0.4V a passing logic "0" and anything above 3.0V a passing logic "1". The original functional tests, which compare values at 1.5V, were kept in the program to distinguish between functional failures and VOH and VOL Go/NoGo failures.

* The invalid VOH readings were : 0.00V.
The invalid VOL readings were : -1.0V, +1.0V.

Table IV. Summary of Electri Measurements after Total Dose Exposures and Annealing for 82C59A 1/,2/

Parameters		Spec. Limits min	Spec. Limits max	Initials mean	Initials sd	15 mean	15 sd	20 mean	20 sd	30 mean	30 sd	50 mean	50 sd	75 mean	75 sd	100 mean	100 sd	Annealing 168 hrs. mean	Annealing 168 hrs. sd
						Total Dose Exposure (krads)													
Func1, 1.4MHz				Pass		Pass		Pass		Pass		Pass		2P/6F		8 Fail		3P/5F	
Func2, 1MHz				Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func3, 1.4MHz				Pass		Pass		Pass		Pass		Pass		Pass		5P/3P		Pass	
Func4, 1MHz				Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func5, 3/ 1MHz				-		-		-		-		Pass		Pass		Pass		Pass	
VOH1	V	3.0	5.5	4.38	.01	4.37	.01	4.24	0.73			>3.0		>3.0		>3.0		>3.0	
VOH2	V	4.1	5.5	4.49	0	4.49	0	4.36	1.75	3.97									
VOL	mV	0	400	85.7	15.9	87.3	16.8	87.7	17.3	118		<400		<400		<400		<400	
IIH1	nA	0	1E3	0.9	2.4	0	-	0	-	0	-	0	-	0	-	0	-	0	-
IIH2	nA	0	10	1.02	0.37	0.8	0.3	0.8	0.3	0.7	0.4	0.2	0.2	0.15	0.22	0.35	0.41	0.4	0.3
IIL	nA	-1E3	0	-0.5	1.7	0	-	0	-	0	-	0	-	0	-	0	-	0	-
IOZH	uA	-10	10	0	0	0	0	0	0	.06	.09	3.6	6.1	73.4	102	223	284	50.0	72.6
IOZL	uA	-10	10	0	-	0	-	0	0	0	.01	0	.02	-0.9	4.2	-7.1	23.2	-0.4	1.9
ICCSBH	uA	0	10	0	-	0	-	4.3	7.3	21.5	4.5	77.1	44.0	500	513	2E3	1E3	604	337
ICCSBL	uA	0	10	0	-	0	-	1E3	4E3	5E3	7E3	4E3	6E3	4E3	7E3	6E3	6E3	4E3	6E3

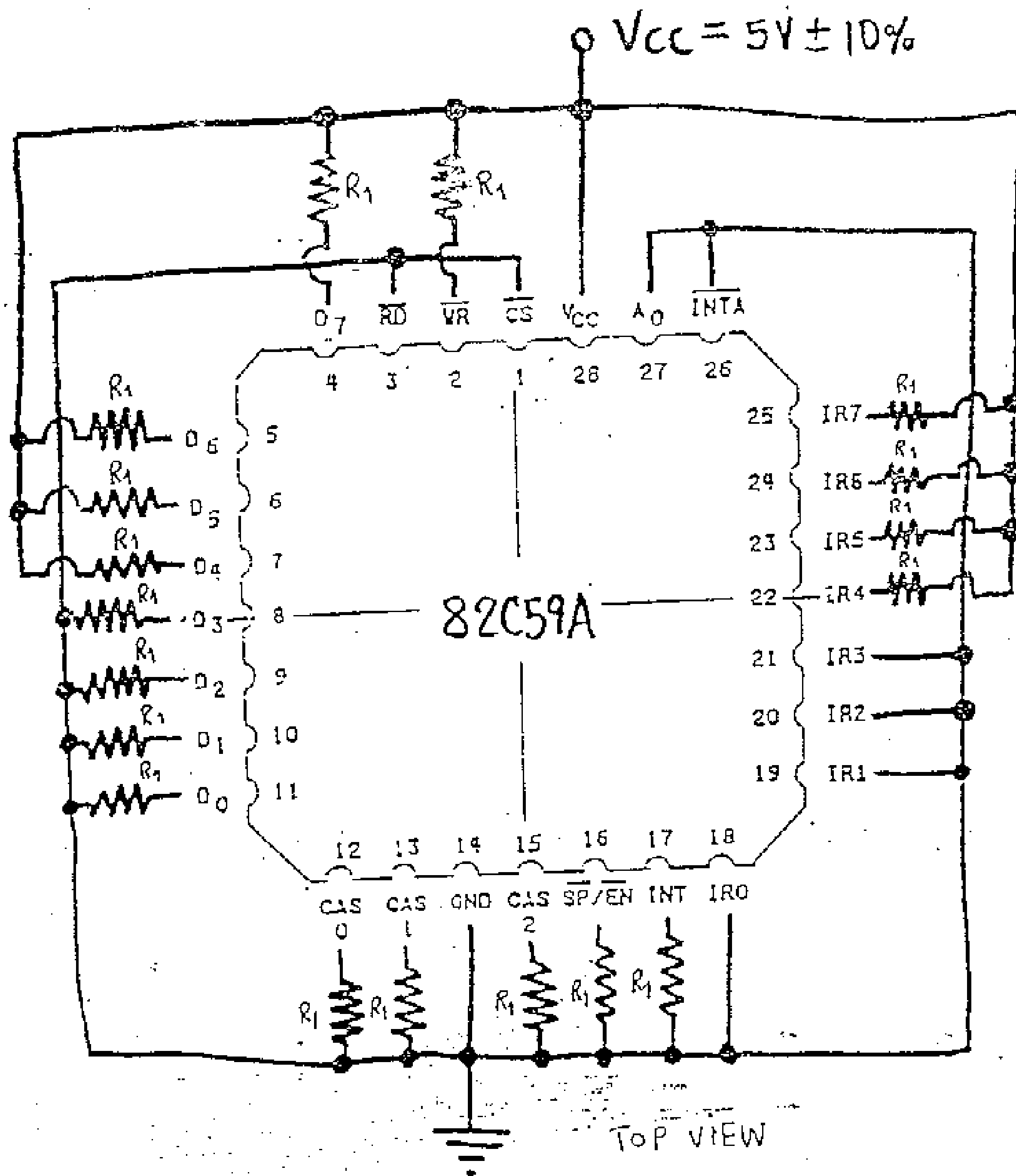
Notes:

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/ Table IV provides radiation characteristics of parts at selected total dose exposures. The data at other radiation exposures is available and can be obtained upon request.

3/ At 20 krads and above, VOH and VOL measurements could not be reliably made under static conditions. Therefore, at the radiation step of 50 krads, functional test #5 was added to characterize the VOH level under dynamic functional test conditions, by comparing a valid logic 1 to 3.0V. The VOL level was tested by considering any value below 0.4V as a passing logic 0, and any value above 0.4V as a failing logic 0.

Figure 1. Radiation Bias Circuit for 82C59A



R1 = 2K ohms, 1/4 W, 5% Tol.
Vcc = 5V ± 10%, TA = +25°C.