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To

Date PPM-91-614

Department Miccolis

Date Oct. 15, 1991

Code 311

Office GSFC

Department K. Sahu K. Sahu

Location 731-8954

Subject 7809

Lanham

Radiation Report on 54AC191  
SMEX Common Buy Part No. 5962-89749012A

B. Fafaul/311  
J. Denis/311  
A. Sharma/311  
M. Fowler  
A. Moor

A radiation evaluation was performed on 54AC191 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 10, 20, 30, 50, 75 and 100 krad. After 100 krad, parts were annealed at +25°C for 24 and 168 hours, and then the irradiation was continued to 200 and 300 krad (cumulative). The dose rate was between 0.1 and 5.3 krad/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 six functional tests (40 MHz) at 3.0V and 5.5V.

All parts passed all tests on irradiation up to 75 krad. However, after the 100 krad exposure, parts marginally exceeded the specification limits on some of the AC parameters. However, all parts passed all other tests on irradiation up to 100 krad. No significant recovery was observed on annealing the parts for 24 and 168 hours at 25°C. On continued irradiation to 200 and 300 krad, all parts failed functional testing. Parts also showed continuing degradation in AC parameters.

Table IV provides a summary of the functional test results, as well as 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.

TABLE I. Part Information

Generic Part Number:	54AC191
SMEX/CB Part Number:	5962-89749012A
SMEX/CB Control Number:	1398
Charge Number:	C90350
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9111A
Quantity Tested:	10
Serial Numbers of Radiation Samples:	802, 803, 804, 805, 806, 807, 808, 809
Serial Numbers of Control Samples:	800, 801
Part Function:	4-bit up/down counter
Part Technology:	CMOS
Package Style:	flat pack
Test Engineer:	A. Karygiannis

TABLE II. Radiation Schedule for 54AC191

EVENTS	DATE
1) Initial Electrical Measurements	07/16/91
2) 10 KRAD IRRADIATION (0.5 krads/hour)	07/25/91
POST-10 KRAD ELECTRICAL MEASUREMENT	07/26/91
3) 20 KRAD IRRADIATION (0.147 krads/hour)	07/26/91
POST-20 KRAD ELECTRICAL MEASUREMENT	07/29/91
4) 30 KRAD IRRADIATION (0.5 krads/hour)	08/13/91
POST-30 KRAD ELECTRICAL MEASUREMENT	07/30/91
5) 50 KRAD IRRADIATION (1.0 KRADS/HOUR)	07/30/91
POST-50 KRAD ELECTRICAL MEASUREMENT	07/31/91
6) 75 KRAD IRRADIATION (1.25 krads/hour)	07/31/91
POST-75 KRAD ELECTRICAL MEASUREMENT	08/01/91
7) 100 KRAD IRRADIATION (1.25 krads/hour)	08/01/91
POST-100 KRAD ELECTRICAL MEASUREMENT	08/02/91
8) 24 HOUR ANNEALING	08/02/91
POST-24 HOUR ANNEAL ELECTRICAL MEASUREMENT	08/03/91
9) 168 HOUR ANNEALING	08/03/91
POST-168 HOUR ANNEAL ELECTRICAL MEASUREMENT	08/09/91
10) 200 KRAD IRRADIATION (1.47 krads/hour)	08/09/91
POST-200 KRAD ELECTRICAL MEASUREMENT <sup>1</sup>	08/12/91
11) 300 KRAD IRRADIATION	08/12/91
POST-300 KRAD ELECTRICAL MEASUREMENT <sup>2</sup>	08/13/91

Table III. Electrical Characteristics of 54AC191

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VTH	CONDITIONS	PINS	-55C < Tc < +125C
FUNCT 1	2.0V	0.0V	2.0V	FREQ=1.000MHZ	ALL I/O	VOL<0.8V, VOH>0.85V
FUNCT 2	3.5V	0.0V	3.5V	FREQ=1.000MHZ	ALL I/O	VOL<2.75V, VOH>2.75V
FUNCT 3	5.5V	0.0V	5.5V	FREQ=40.000MHZ	ALL I/O	VOL<2.75V, VOH>2.75V
PARAMETER	VCC	VIL	VTH	CONDITIONS	PINS	Tc = +25C
FUNCT 4	2.0V	0.0V	2.0V	FREQ=40.000MHZ	ALL I/O	VOL<1.5V, VOH>1.5V
FUNCT 5	3.5V	0.0V	3.5V	FREQ=40.000MHZ	ALL I/O	VOL<2.75V, VOH>2.75V
FUNCT 6	5.0V	0.0V	5.0V	FREQ=40.000MHZ	ALL I/O	VOL<1.5V, VOH>1.5V

LOAD USED ← ( IGH = -6.0mA  
 ( VKFF = 1.5V  
 ( IGL = +6.0mA

  

DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VTH	CONDITIONS	PINS	-55C < Tc < +125C
VOH1	3.0V	0.0V	2.1V	LOAD=+500A	OUTS	>+2.9V / <+6.5V
VOH2	3.5V	1.35V	3.15V	LOAD=+500A	OUTS	>+4.4V / <+6.5V
VOH3	3.5V	1.65V	3.65V	LOAD=+500A	OUTS	>+5.4V / <+6.5V
VOH4	4.0V	0.0V	2.1V	LOAD=-14mA	OUTS	>+2.4V / <+6.5V
VOH5	4.5V	1.35V	3.15V	LOAD=-14mA	OUTS	>+3.7V / <+6.5V
VOH6	5.0V	1.65V	3.65V	LOAD=-14mA	OUTS	>+4.7V / <+6.5V
VOL1	3.0V	0.0V	2.1V	LOAD=+500A	OUTS	>+0.0V / <+0.1V
VOL2	3.5V	1.35V	3.15V	LOAD=+500A	OUTS	>+0.0V / <+0.1V
VOL3	3.5V	1.65V	3.65V	LOAD=+500A	OUTS	>+0.0V / <+0.1V
VOL4	4.0V	0.0V	2.1V	LOAD=+14mA	OUTS	>+0.0V / <+0.5V
VOL5	4.5V	1.35V	3.15V	LOAD=+14mA	OUTS	>+0.0V / <+0.5V
VOL6	5.0V	1.65V	3.65V	LOAD=+14mA	OUTS	>+0.0V / <+0.5V
I <sub>IH</sub>	3.5V	0.0V	3.0V	VTH = 3.0V	INS	>+0.00A / <+1.00A
I <sub>IL</sub>	3.5V	0.0V	3.0V	VTH = 3.0V	INS	>-1.00A / <+0.00A
I <sub>CC1</sub>	3.5V	0.0V	3.0V	VTH = 0.0V	VCC	>+0.00A / <+1600A
I <sub>CC2</sub>	3.5V	0.0V	3.0V	VTH = 3.0V	VCC	>+0.00A / <+1600A

Table III cont.

AC PARAMETRIC TESTS PERFORMED							
PARAMETER	VCC	VTE	VTH	CONDITIONS	PINS	Tc = + 25C	
=====	===	===	===	=====	=====	=====	=====
TPLH_CP_QN	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+13.0NS
TPLH_PL_QN	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+14.0NS
TPLH_CP_RC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+11.5NS
TPLH_UD_RC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+12.5NS
TPLH_CP_TC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+15.0NS
TPLH_UD_TC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+11.0NS
TPHL_CP_QN	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+13.0NS
TPHL_PL_QN	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+12.5NS
TPHL_CP_RC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+10.0NS
TPHL_UD_RC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+12.5NS
TPHL_CP_TC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+15.5NS
TPHL_UD_TC	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+11.0NS
TPLH_CP_QN	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+10.0NS
TPLH_PL_QN	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+10.0NS
TPLH_CP_RC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+9.0NS
TPLH_UD_RC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+9.0NS
TPLH_CP_TC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+11.0NS
TPLH_UD_TC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+8.5NS
TPHL_CP_QN	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+10.0NS
TPHL_PL_QN	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+9.5NS
TPHL_CP_RC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+8.0NS
TPHL_UD_RC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+9.0NS
TPHL_CP_TC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+11.5NS
TPHL_UD_TC	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+8.5NS
AC PARAMETRIC TESTS PERFORMED AS Go/NoGo							
PL_PW_low	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+5.0NS
PL_PW_low	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+5.0NS
PL_CP_high	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0NS	<+5.0NS
PL_CP_high	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0NS	<+5.0NS
Pn_FL_setup	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+3.5ns	
Pn_FL_setup	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+2.5ns	
Cc_CP_setup	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+7.0ns	
Cc_CP_setup	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+5.0ns	
Uu_CP_setup	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+9.0ns	
Uu_CP_setup	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+6.0ns	
Pn_FL_hold	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+1.0ns	
Pn_FL_hold	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+2.0ns	
Cc_CP_hold	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+0.3ns	
Cc_CP_hold	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+0.3ns	
Uu_CP_hold	3.0V	0.0V	3.0V	VTST=1.5V	OUTS	>+0.0ns	
Uu_CP_hold	4.5V	0.0V	4.5V	VTST=2.25V	OUTS	>+1.0ns	

Table III cont.

COMMENTS/EXCEPTIONS

- (1) VIL & VIH are tested during VOL & VOH tests as Go/NoGo.
- (2) setup time Data input to Parallel Load tested as Go/NoGo in Functional.
- (3) setup time Count Enable to Clock Pulse tested as Go/NoGo in Functional.
- (4) setup time Up/Down to Clock Pulse tested as Go/NoGo in Functional.
- (5) hold time Data input to Parallel Load tested as Go/NoGo in Functional.
- (6) hold time Count Enable to Clock Pulse tested as Go/NoGo in Functional.
- (7) Clock Pulse minimum width high tested as Go/NoGo in Functional.
- (8) Clock Pulse minimum width low not tested.
- (9) Parallel Load minimum pulse width tested as Go/NoGo in Functional.
- (10) Clock enable to ignore Carry propagation time not tested.
- (11) maximum clock frequency Tested up to 40MHz in Functional Tests.
- (12) Propagation time Qn to Qn+1 and Qn+1 not tested.

TABLE IV: Summary of Critical Measurements After Total Dose Exposures and Annealing for 54AC191 1/

Spec. Lim	Parameters	min	max	Total Dose Exposure (TDE) (krads)												Annealing				TDE (krads)					
				Initial		10		20		30		50		75		100		24 hours		168 hour		200		300	
				mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
FUNC1				P		P		P		P		P		P		P		P		P		P		P	
FUNC2				P		P		P		P		P		P		P		P		P		P		P	
FUNC3				P		P		P		P		P		P		P		P		P		P		P	
FUNC4				P		P		P		P		P		P		P		P		P		P		P	
FUNC5				P		P		P		P		P		P		P		P		P		P		P	
FUNC6				P		P		P		P		P		P		P		P		P		P		P	
VOH1	V	2.9	6.5	3.0	.00	3.0	.00	3.0	.00	3.0	.00	3.0	.00	3.0	.00	3.0	.00	3.0	.00	3.0	.00	3.0	.00	3.0	
VOH3	V	5.4	6.5	5.5	.00	5.5	.00	5.5	.00	5.5	.00	5.5	.00	5.5	.00	5.5	.00	5.5	.00	5.5	.00	5.4	0.8	3.5	2.6
VOH5	V	3.7	6.5	4.2	.01	4.2	.01	4.2	.01	4.2	.01	4.2	.01	4.2	.01	4.2	.01	4.2	.01	4.2	.01	4.2	.01	3.6	1.4
VOH7	V	3.85	6.5	4.9	.01	4.9	.02	4.9	.02	4.9	.02	4.9	.02	4.9	.02	4.9	.02	4.9	.02	4.9	.02	4.9	.02	3.3	2.3
VOL1	mV	0	100	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
VOL3	mV	0	100	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
VOL5	mV	0	500	191	3.2	192	4.3	192	4.2	191	4.2	191	3.8	191	4.2	192	4.2	193	4.1	195	6.4	195	6.3	117	392
VOL7	mV	0	1.65K	354	6.2	356	8.3	355	8.1	354	8.4	354	7.3	356	8.1	357	7.7	358	7.9	362	12.6	362	12	191	589
I <sub>IH</sub>	nA	0	1000	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A	0	N/A
ICCH 2/	uA	0	160	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A
ICCL 2/	uA	0	160	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A	<16	N/A
TPLH1_CC	nS	1	13	7.5	0.6	7.6	0.7	7.5	0.7	7.6	0.7	7.5	0.7	7.7	1.0	8.1	1.6	7.8	1.3	7.8	1.3	10.3	2.4	10.8	2.8
TPLH1_RC	nS	1	11.5	7.9	0.3	8.0	0.3	8.0	0.3	8.0	110.4	7.9	0.4	8.9	2.1	11.9	3.0	11.7	2.3	11.1	2.6	14.6	3.1	15	3.2
TPLH1_TC	nS	1	15	9.3	1.7	9.3	1.7	9.2	1.7	9.3	1.7	9.3	1.8	9.3	1.8	9.4	1.9	9.4	1.8	9.3	1.8	11.3	2.2	11.7	2.3
TPLH2_CC	nS	1	12.5	7.3	0.8	7.4	0.8	7.4	0.8	7.5	0.8	7.6	0.8	7.7	0.9	7.7	0.8	7.6	0.8	7.6	0.9	10.6	0.9	10.9	1.0
TPLH2_RC	nS	1.5	9	6.9	.07	7.0	.08	7.0	.09	7.0	0.1	7.0	0.1	7.1	0.1	8.3	2.3	7.9	1.9	7.8	1.9	11.1	2.7	11.7	3.0
TPLH2_TC	nS	1.5	11	7.7	1.2	7.7	1.2	7.5	1.2	7.6	1.2	7.6	1.2	7.7	1.3	7.6	1.2	7.5	1.3	9.4	1.5	9.6	1.6		

Note:

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/ The measurement range for ICCH and ICCL was set in the range of 16 uA to 16 mA. Therefore the actual readings at less than 16 uA were not available. However, all parts measured less than 16 uA throughout the radiation testing and annealing treatments.



