PPM-91-437

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UNISYS

(53)

Interoffice Memorandum

To
Jim Lohr
Department
Code 311
From
K. Sahu ks
Department
7809
Subject
Radiation Report on
ISTP/Geotail/EPIC Part No. 82C59A-5

PPM-91-439
Date
July 1, 1991
Location
Lanham
Telephone
731-8954
Location
Lanham
cc
V. Edson
S. Esmacher

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, two 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, 7.5, 10, 15, 20, 30, and 50 krads. After 50 krads, parts were annealed at 25°C for 96 hours. The dose rate was between 0.1-1.1 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 1.0 and 1.36 MHz) after each radiation and annealing step.

Both parts passed all functional, AC and DC electrical tests up to 2.5 krads. At the next radiation step of 5 krads, one part (SN 101) failed to meet the maximum specification limit of 10uA on ICCSBH and ICCSBL with readings of 401uA and 419uA, respectively. Both parts passed all other tests. At the next radiation step of 7.5 and 10 krads, ICCSB readings had degraded way beyond the maximum specification limit although almost no change was observed in any of the other parametric tests as both parts continued to pass these tests. After 15 krads exposure, SN 100 failed IOZH and SN 101 failed IOZH and IOZL with the magnitude of the readings varying from approximately 10uA to 45uA against the maximum specification limit of 10uA. ICCSB and IOZ continued to degrade after 20 krads. In addition, significant degradation was observed in VOL, although both parts continued to pass all tests except ICCSB and IOZ. Both parts failed functionally (SN 100 failed 2 of 5 tests and SN101 failed 4 of 5 tests) after 30 krads as VOH1 and VOH2 went to the low state, and SN 100 failed to meet the maximum specification limit of 400mV with readings ranging from 416mV to 421mV. In addition, both parts failed TIALCV1 as this timing parameter went beyond the range of the ATE. Both parts failed all functional tests after

50 krads in addition to failing several AC and DC parametric tests. No significant recovery was observed upon annealing the parts for 96 and 168 hours. 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 301-731-8954.

TABLE I. Part Information

Generic Part Number:	82C59A-5
ISTP Part Number:	82C59A-5
ISTP Control Number:	4443
Charge Number:	C14377
Manufacturer:	Harris Corp.
Quantity Procured:	2*
Lot Date Code:	9001
Quantity Tested:	4
Serial Numbers of Radiation Samples:	100, 101
Serial Numbers of Control Samples:	57, 65
Part Function:	Programmable Priority Interrupt Controller
Part Technology:	CMOS
Package Style:	28-Pin DIP

* The two control samples were procured from ISTP/CB. The two irradiated samples were supplied by ISTP/Geotail/EPIC.

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements	06/07/91
2) 2.5 krads irradiation @ 152 rads/hr	06/10/91
Post 2.5 krads Electrical Measurements	06/11/91
3) 5 krads irradiation @ 147 rads/hr	06/11/91
Post 5 krads Electrical Measurements	06/12/91
4) 7.5 krads irradiation @ 125 rads/hr	06/12/91
Post 7.5 krads Electrical Measurements	06/13/91
5) 10 krads irradiation @ 143 rads/hr	06/13/91
Post 10 krads Electrical Measurements	06/14/91
6) 15 krads irradiation @ 79 rads/hr	06/14/91
Post 15 krads Electrical Measurements	06/17/91
7) 20 krads irradiation @ 256 rads/hr	06/17/91
Post 20 krads Electrical Measurements	06/18/91
8) 30 krads irradiation @ 500 rads/hr	06/18/91
Post 30 krads Electrical Measurements	06/19/91
9) 50 krads irradiation @ 1053 rads/hr	06/19/91
Post 50 krads Electrical Measurements	06/20/91
10) 96 hrs annealing	06/20/91
Post 96 hr Electrical Measurements	06/24/91
11) 168 hrs annealing	06/20/91
Post 168 hr Electrical Measurements	06/27/91

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 82C59A-5

TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
FUNCT 1	4.5V	0.4V	2.6V	FREQ =1.36MHz	ALL I/O	VOL<1.5V , VOH>1.5V
FUNCT 2	4.5V	0.4V	2.6V	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	0.4V	2.6V	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

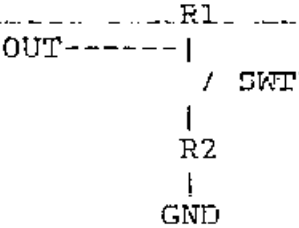
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
VOH1	4.5V	0.8V	2.2V	LOAD= 2.5MA	OUTS	>+3.0V , <+5.5V
VOH2	4.5V	0.8V	2.2V	LOAD=-100UA	OUTS	>+4.1V , <+5.5V
VOL	4.5V	0.8V	2.2V	LOAD=+2.5MA	OUTS	>+0.0V , <+0.4V
‡‡H	5.5V	0.0V	5.5V	VTST= 5.5V	INS	>+0.0A , <+1.0UA
IIH_IR	5.5V	0.0V	5.5V	VTST= 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
IOH	5.5V	0.0V	5.5V	VOUT= 5.5V	OUTS	>-10UA , <+10UA
IOL	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

Table III. (continued)

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
[illegible]VH_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
[illegible]DVL_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
TRHDLZ_1	4.5V	0.4V	2.6V	C=2,VCMP=VOL+.5V	RD/INTA->D	>10.0NS , <100.0NS
TRHDHZ_1	4.5V	0.4V	2.6V	C=2,VCMP=VOH-.5V	RD/INTA->D	>10.0NS , <100.0NS
TJHIH__1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	IR->INT	>0.0NS , <350.0NS
TIALCV_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->CAS	>0.0NS , <565.0NS
TRLELI_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <125.0NS
TRHEHI_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <60.0NS
TRLELR_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <125.0NS
TRHEHR_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <60.0NS
TAHDVH_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TAHDVL_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TCVDVH_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS
TCVDVL_1	4.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS

PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C,-55C,+125C
TRLDVH_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
TRLDVL_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD/INTA->D	>0.0NS , <160.0NS
TRHDLZ_2	5.5V	0.4V	2.6V	C=2,VCMP=VOL+.5V	RD/INTA->D	>10.0NS , <100.0NS
TRHDHZ_2	5.5V	0.4V	2.6V	C=2,VCMP=VOH-.5V	RD/INTA->D	>10.0NS , <100.0NS
TJHIH__2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	IR->INT	>0.0NS , <350.0NS
TIALCV_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->CAS	>0.0NS , <565.0NS
TRLELI_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <125.0NS
TRHEHI_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	INTA->EN	>0.0NS , <60.0NS
[illegible]ELR_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <125.0NS
[illegible]HR_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	RD->EN	>0.0NS , <60.0NS
[illegible]DVH_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TAHDVL_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CS->D	>0.0NS , <210.0NS
TCVDVH_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS
TCVDVL_2	5.5V	0.4V	2.6V	C=1,VCMP=1.5V	CAS->D	>0.0NS , <300.0NS

LOAD USED



AC PARAMETRIC TEST LOAD CONDITIONS

TEST CONDITION	V1	R1	R2	SWT1
C=1	1.7V	523	--	OPEN
C=2	VCC	1.8K	1.8K	CLOSED

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.

3) DUE TO S-50 (ATE) LIMITATIONS, ALL PROPAGATION DELAYS AND TRI-STATE MEASUREMENTS WERE MADE WITH A CAPACITIVE LOAD (CL) OF APPROXIMATELY 50pF to 60pF (STRAY CAPACITANCE OF THE TABLE).

TABLE IVA: Summary of D[illegible]ectrical Measurements after Total Dose Exposures and Annealing for 82C59A 1/, 2/

			Initials		Total Dose Exposure (krads)												Annealing	
					2.5		5		10		20		30		50		168 hrs.	
	Spec. Limits																	
Parameters	min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Func1 @1.36MHz			Pass		Pass		Pass		Pass		Pass		Fail		Fail		Fail	
Func2 @ 1MHz			Pass		Pass		Pass		Pass		Pass		Fail		Fail		Fail	
Func3 @1.36MHz			Pass		Pass		Pass		Pass		Pass		Pass		Fail		Fail	
Func4 @ 1MHz			Pass		Pass		Pass		Pass		Pass		1P/1F		Fail		Fail	
Func5 @ 1MHz			Pass		Pass		Pass		Pass		Pass		1P/1F		Fail		Fail	
VOH1 V	3.0	5.5	4.38	.02	4.37	.02	4.38	.02	4.37	.02	4.33	.02	3.29	1.8	3.23	1.77	3.25	1.78
VOH2 V	4.1	5.5	4.49	0	4.49	0	4.49	0	4.48	.01	4.44	.01	3.39	1.8	3.34	1.80	3.35	1.81
VOL mV	0	400	90	15	89	15	89	16	100	21	155	63	224	117	*		*	
IIH nA	0	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IIH IR uA	0	10	1.0	0.3	1.0	0.2	0.8	0.2	1.0	0.3	2.1	0.5	3.3	0.7	5.2	1.2	4.9	1.1
IIL nA	-1000	0	0	0	0	0	0	0	0	0	0	0	0	0	-256	43	-40	6.9
IIL IR uA	-500	0	-166	5.4	-165	5.4	-165	5.4	-162	5.3	-157	5.3	-152	5.4	-141	5.4	-145	5.3
IOZH uA	-10	10	0	0	0	0	0	0	0.4	1.1	37.6	46	123	134	279	288	259	273
IOZL uA	-10	10	0	0	0	0	0	0	-.07	0.1	-19.7	30	-119	118	-795	832	-611	612
ICCSBH uA	0	10	0.3	.01	0.4	1.0	203	198	4.8E3	3.1E3	32E3	4.7E3	65E3	1.8E3	1E5	755	1E5	966
ICCSBL uA	0	10	2.0	0	0.4	1.0	213	206	5.1E3	3.2E3	34E3	3.9E3	66E3	2.0E3	1E5	515	1E5	726

Notes:

1/ The mean and standard deviation values were calculated over the two parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

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

* No reliable VOL measurements were made at the noted radiation/annealing steps.

TABLE IVB: Summary of Ac ectrical Measurements after Total Dose Exposures and Annealing for 82C59A 1/, 2/, 3/

Parameters		Spec. Limits min	Spec. Limits max	Initials mean	Initials sd	Total Dose Exposure (krads) 2.5 mean	2.5 sd	5 mean	5 sd	10 mean	10 sd	20 mean	20 sd	30 mean	30 sd	50 mean	50 sd	Annealing 168 hrs. mean	Annealing 168 hrs. sd
TRLDVH 1	ns	0	160	44.9	3.7	42.4	3.7	42.4	3.7	42.5	3.8	43.7	3.8	45.6	3.9	47.7	4.1	47.0	4.0
TRLDVL 1	ns	0	160	45.1	2.5	42.6	2.5	42.5	2.6	42.7	2.6	43.3	2.5	43.8	2.4	44.7	2.6	44.1	2.5
TRHDLZ 1	ns	10	100	54.5	2.6	50.8	2.6	50.6	2.6	50.8	2.4	51.7	2.3	53.0	2.3	55.9	2.2	55.0	2.2
TRHDHZ 1	ns	10	100	54.9	5.3	51.4	5.3	51.5	5.4	52.0	5.5	54.3	6.1	57.1	6.9	63.0	9.4	61.8	9.0
TJHIH 1	ns	0	350	60.6	1.0	57.1	1.0	56.8	1.0	57.3	0.7	60.8	1.1	68.1	1.9	548	452	544	456
TIALCV 1	ns	0	565	37.0	0.5	34.6	0.5	34.6	0.5	34.8	0.4	35.5	0.4	>1E3	-	>1E3	-	>1E3	-
TRLELI 1	ns	0	125	45.4	0.6	43.2	0.6	43.1	0.6	43.3	0.6	44.3	0.7	45.6	0.9	47.9	0.8	47.2	0.7
TRHEHI 1	ns	0	60	32.1	0.4	28.8	0.4	28.8	0.4	28.7	0.4	29.4	0.5	30.0	0.6	31.9	0.5	31.1	0.6
TRLELR 1	ns	0	125	36.8	0.5	34.5	0.5	34.5	0.5	34.7	0.4	35.4	0.5	36.4	0.7	38.3	0.5	37.7	0.6
TRHEHR 1	ns	0	60	35.6	0.4	32.3	0.5	32.2	0.4	32.3	0.4	33.2	0.5	34.3	0.6	36.4	0.5	35.5	0.6
TAHDVH 1	ns	0	210	51.7	2.2	49.2	2.3	49.1	2.3	49.3	2.4	50.8	3.1	52.6	3.7	54.0	3.9	53.6	3.9
TAHDVL 1	ns	0	210	50.4	1.7	47.8	1.7	47.7	1.7	47.9	1.7	48.3	1.8	48.9	1.8	49.6	1.6	49.3	1.7
TCVDVH 1	ns	0	300	70.2	10	67.8	10	67.6	10.2	68.1	10.3	68.4	10.1	69.5	10.1	>1E3	-	>1E3	-
TCVDVL 1	ns	0	300	49.5	12	47.1	13	47.0	12.5	47.3	12.7	48.2	13.4	49.5	14.3	403	462	223	372
TRLDVH 2	ns	0	160	38.9	3.1	36.4	3.1	36.4	3.1	36.5	3.1	37.5	3.1	38.9	3.2	40.6	3.3	40.0	3.3
TRLDVL 2	ns	0	160	39.5	2.4	37.0	2.4	36.9	2.4	37.1	2.4	38.1	2.4	37.9	2.2	38.1	2.4	37.8	2.4
TRHDLZ 2	ns	10	100	50.9	3.1	47.2	3.1	47.1	3.1	47.3	2.9	47.7	3.0	49.3	2.8	51.8	2.7	50.8	2.9
TRHDHZ 2	ns	10	100	51.2	5.4	47.6	5.5	47.7	5.5	48.5	5.7	51.1	6.4	53.8	7.2	59.2	9.7	58.2	9.2
TJHIH 2	ns	0	350	51.7	0.8	48.2	0.8	47.9	0.8	48.3	0.6	51.1	1.2	55.1	1.3	66.6	1.0	63.6	1.2
TIALCV 2	ns	0	565	31.9	0.4	29.7	0.4	29.5	0.4	29.6	0.4	30.2	0.3	30.9	0.4	>1E3	-	>1E3	-
TRLELI 2	ns	0	125	40.5	0.5	38.1	0.5	38.2	0.5	38.4	0.4	39.1	0.5	40.1	0.6	41.9	0.5	41.3	0.6
TRHEHI 2	ns	0	60	29.0	0.3	25.7	0.3	25.6	0.4	25.6	0.3	26.2	0.3	26.7	0.4	28.0	0.3	27.4	0.4
TRLELR 2	ns	0	125	33.4	0.4	31.1	0.4	31.1	0.4	31.2	0.3	31.9	0.4	32.5	0.5	33.9	0.4	33.5	0.4
TRHEHR 2	ns	0	60	32.2	0.3	28.9	0.4	28.9	0.3	28.9	0.3	29.6	0.3	30.5	0.5	32.2	0.4	31.5	0.4

TABLE IVB: (continued)

Parameters		Spec. Limits min	Spec. Limits max	Initials mean	Initials sd	Total Dose Exposure (krads) 2.5 mean	2.5 sd	5 mean	5 sd	10 mean	10 sd	20 mean	20 sd	30 mean	30 sd	50 mean	50 sd	Annealing 168 hrs. mean	Annealing 168 hrs. sd
TAHDVH 2	ns	0	210	47.2	1.9	44.8	1.9	44.7	2.0	44.9	2.0	46.1	2.7	47.5	3.2	48.7	3.4	48.3	3.3
TAHDVL 2	ns	0	210	46.2	1.6	43.6	1.6	43.5	1.6	43.7	1.6	43.9	1.6	44.4	1.6	44.9	1.5	44.7	1.5
TCVDVH 2	ns	0	300	61.1	9.0	58.7	9.0	58.5	9.0	58.9	9.0	59.1	8.8	60.1	8.9	62.4	9.3	62.8	9.3
TCVDVL 2	ns	0	300	43.6	12.0	41.1	12	41.1	12.0	41.4	12.2	42.0	12.8	43.2	13.6	222	374	44.1	14.5

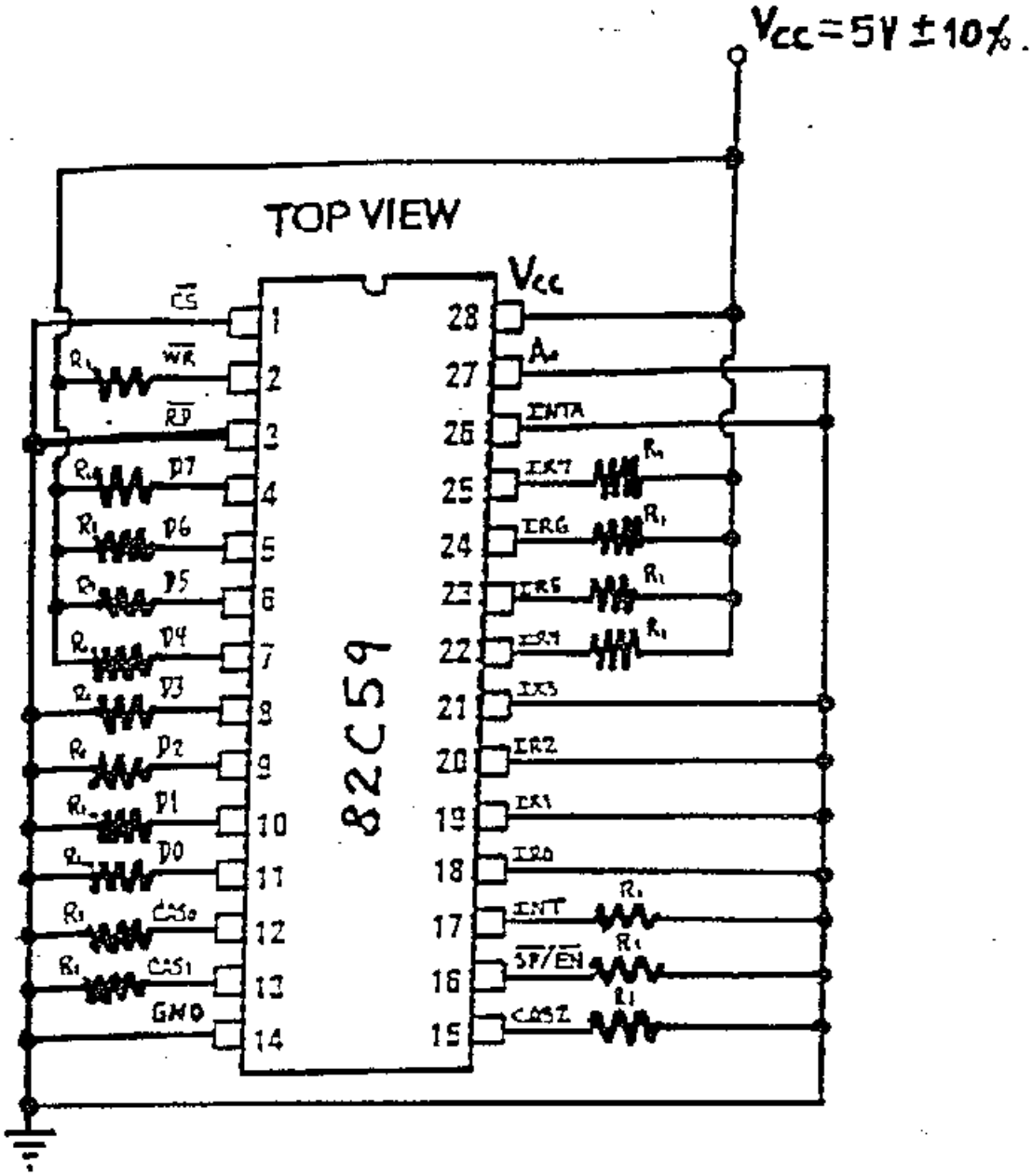
Notes:

1/ The mean and standard deviation values were calculated over the two parts irradiated in this testing. The control samples remained constant throughout the testing and are not included in this table.

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

3/ Some of the timing parameters could not be measured due to the range of the testing equipment, which is indicated by '>1E3' (ie. 1us) in Table IVB.

Figure 1. Radiation Bias Circuit for 82C59A-5



R1 = 2KΩ, 1/4W, 5%