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Code 300.1  
From  
**K. Sahu** *ks*  
Department:  
7809  
Subject:  
**Radiation Report on 54AC244DMQB**  
**SMEX Part No. 5962-8755201RA**  
**Control No. 1657**

**PPM-92-039**  
Date:  
**January 31, 1992**  
Location:  
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A radiation evaluation was performed on the 54AC244DMQB 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, the parts were annealed under bias at +25°C for 216 hours. After this annealing, the parts were irradiated to 200 and 300 krad (cumulative). Finally, the parts were annealed under bias for 168 hours at 100°C. The dose rate was between 150 and 6,250 rads/hour, depending on the total dose level (see Table II for radiation schedule). After each radiation exposure and annealing treatment, the parts were electrically tested @ +25°C according to the test conditions and the specification limits listed in Table III. These tests included three functional tests at 10 MHz after each radiation and annealing step.

All parts passed all three functional tests on irradiation up to 300 krad and on subsequent high temperature annealing for 168 hours. Also, all parts stayed within specification limits for all parameters on irradiation up to 30 krad. However, after radiation exposure to 50 krad, one device was well in excess of the specified limit of 160 uA for ICCH, ICCL, and ICCZ (ICCH = 606 uA, ICCL = 345 uA, ICCZ = 284 uA) and another device marginally exceeded the limit for ICCH. Upon continued exposure to 100 krad, the same two devices suffered further degradation in the ICCH, ICCL, and ICCZ parameters. Readings were as high as 4.2 mA for ICCH and 3 mA for ICCL and ICCZ. After annealing for 216 hours at 25°C, these two parts recovered slightly, but were still exceeding the specified limits. After 200 krad of exposure, five devices were exceeding the limits for the same parameters with readings as high as 10 mA. In addition, two of these five parts were marginally exceeding the limit for TPZH1. After 300 krad seven devices were above the limit for the ICC parameters and six devices marginally surpassed the TPZH1 limit. After the 168 hour annealing at 100°C, the devices recovered very well with only one part marginally exceeding the limits for ICCH, ICCL, and ICCZ. All of the parts continued to marginally exceed the TPZH1 limit.

Table IV provides the mean and standard deviation values for each parameter after each radiation exposure and annealing treatment. It also provides a summary of the 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.

In this report, the term rads is used as an abbreviation for rads (Si).

**TABLE I. Part Information**

Generic Part Number:	54AC244DMQB
SMEX Common Buy Part Number:	5962-8755201RA
SMEX Common Buy Control Number:	1657
Charge Number:	C90358
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9027A
Quantity Tested:	8
Serial Numbers of Radiation Samples:	603, 604, 605, 606, 607, 608, 609, 610
Serial Number of Control Sample:	601, 602
Part Function:	OCTAL BUFFER
Part Technology:	CMOS
Package Style:	20-pin DIP

TABLE II. Radiation Schedule for 54AC244DMQB

EVENTS	DATE
1) Initial (Pre-Irradiation) Electrical Measurements	07/17/91
2) 10 KRAD IRRADIATION (500 rads/hour)	12/09/91
POST 10 KRAD ELECTRICAL MEASUREMENT	12/12/91
3) 20 KRAD IRRADIATION (500 rads/hour)	12/12/91
POST 20 KRAD ELECTRICAL MEASUREMENT	12/13/91
4) 30 KRAD IRRADIATION (150 rads/hour)	12/13/91
POST 30 KRAD ELECTRICAL MEASUREMENT	12/17/91
5) 50 KRAD IRRADIATION (1,050 rads/hour)	12/17/91
POST 50 KRAD ELECTRICAL MEASUREMENT	12/18/91
6) 75 KRAD IRRADIATION (1,320 rads/hour)	12/18/91
POST 75 KRAD ELECTRICAL MEASUREMENT	12/19/91
7) 100 KRAD IRRADIATION (1,350 rads/hour)	12/19/91
POST 100 KRAD ELECTRICAL MEASUREMENT	12/20/91
8) 72 HOURS ANNEALING AT 25°C	12/20/91
POST 72 HOURS ELECTRICAL MEASUREMENT	12/23/91
9) 216 HOURS ANNEALING AT 25°C	12/20/91
POST 216 HOURS ELECTRICAL MEASUREMENT	12/30/91
10) 200 KRAD IRRADIATION (6,250 rads/hour)	12/30/91
POST 200 KRAD ELECTRICAL MEASUREMENT	12/31/91
11) 300 KRAD IRRADIATION (2,130 rads/hour)	12/31/91
POST 300 KRAD ELECTRICAL MEASUREMENT	01/02/92
12) 168 HOURS ANNEALING AT +100°C	01/02/92
POST 168 HOURS AT +100°C ELECTRICAL MEASUREMENTS	01/10/92

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.
- All Annealing steps were performed under bias.

Table III. Electrical Characteristics of 54AC244DMQB

TESTS PERFORMED							
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS: -55C TO +125C	
FUNC 1	2.0V	0.0V	2.0V	FREQ = 10KHZ	ALL I/O	VDM > 1.00V, VOL < 1.00V	
FUNC 2	4.5V	0.0V	4.5V	FREQ = 10KHZ	ALL I/O	VDM > 1.00V, VOL < 1.00V	
FUNC 3	5.5V	0.0V	5.5V	FREQ = 10KHZ	ALL I/O	VDM > 1.00V, VOL < 1.00V	
VJH1	3.0V	INPUTS AT 0.90V AND 2.10V		EACH OUTPUT AT -50UA		2.90V MIN	
VJH2	4.5V	INPUTS AT 1.55V AND 3.15V		EACH OUTPUT AT -50UA		4.40V MIN	
VJH3	5.5V	INPUTS AT 1.55V AND 3.85V		EACH OUTPUT AT -50UA		5.40V MIN	
VJL1	3.0V	INPUTS AT 0.90V AND 2.10V		EACH OUTPUT AT -24UA		2.60V MIN	
VJL2	4.5V	INPUTS AT 1.55V AND 3.15V		EACH OUTPUT AT -24UA		3.70V MIN	
VJL3	5.5V	INPUTS AT 1.55V AND 3.85V		EACH OUTPUT AT -24UA		4.70V MIN	
VJH4	3.0V	INPUTS AT 0.90V AND 2.10V		EACH OUTPUT AT -50UA		3.85V MIN	
VJH5	4.5V	INPUTS AT 1.55V AND 3.15V		EACH OUTPUT AT -50UA		0.1V MAX	
VJH7	5.5V	INPUTS AT 1.55V AND 3.85V		EACH OUTPUT AT -50UA		0.1V MAX	
VJL4	3.0V	INPUTS AT 0.90V AND 2.10V		EACH OUTPUT AT -50UA		0.1V MAX	
VJL5	4.5V	INPUTS AT 1.55V AND 3.15V		EACH OUTPUT AT -50UA		0.1V MAX	
VJL6	5.5V	INPUTS AT 1.55V AND 3.85V		EACH OUTPUT AT -50UA		0.5V MAX	
VJL8	3.0V	INPUTS AT 0.90V AND 2.10V		EACH OUTPUT AT -24UA		0.5V MAX	
VJL9	4.5V	INPUTS AT 1.55V AND 3.15V		EACH OUTPUT AT -24UA		0.5V MAX	
VJL10	5.5V	INPUTS AT 1.55V AND 3.85V		EACH OUTPUT AT -24UA		1.65V MAX	
IJL1	3.0V	EACH OUTPUT TESTED AT VIN=0.0V		-10UA TO 10UA		10UA	
IJL2	4.5V	EACH OUTPUT TESTED AT VIN=5.5V		0.0UA TO 10UA		10UA	
IJL3	5.5V	EACH OUTPUT TESTED AT VIN=5.5V		-1.0UA TO 10UA		10UA	
IIL	3.0V	EACH INPUT TESTED AT VIN=0.0V		0.0UA TO 1UA		1UA	
IIL	4.5V	EACH INPUT TESTED AT VIN=5.5V		160.0UA MAX		160.0UA MAX	
IIL	5.5V	EACH INPUT TESTED AT VIN=5.5V		160.0UA MAX		160.0UA MAX	
IOL	3.0V	INPUTS AT 0.0V		160.0UA MAX		160.0UA MAX	
IOL	4.5V	INPUTS AT 0.0V		160.0UA MAX		160.0UA MAX	
IOL	5.5V	INPUTS AT 0.0V AND 0.0V		160.0UA MAX		160.0UA MAX	
PARAMETER	VCC	CONDITIONS		PINS	LIMITS: 25C		
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 25C	
TPHL1	3.0V	0.0V	3.0V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +1.5V		>1.0NS <10.5NS	
TPHL2	4.5V	0.0V	4.5V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +2.25V		>1.0NS <8.0NS	
TPHL3	5.0V	0.0V	3.0V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +1.5V		>1.0NS <11.0NS	
TPHL2	4.5V	0.0V	4.5V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +2.25V		>1.0NS <8.5NS	
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 25C	
TPLL1	3.0V	0.0V	3.0V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = 0.3V		>1.0NS <11.0NS	
TPLL2	4.5V	0.0V	4.5V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = 0.45V		>1.0NS <9.0NS	
TPLL3	5.0V	0.0V	3.0V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +1.5V		>1.0NS <11.0NS	
TPLL2	4.5V	0.0V	4.5V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +2.25V		>1.0NS <8.5NS	
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT 25C	
TPH21	3.0V	0.0V	3.0V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = VCC-0.3V		>1.0NS <10.0NS	
TPH22	4.5V	0.0V	4.5V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = VCC-0.45V		>1.0NS <8.5NS	
TPH21	5.0V	0.0V	3.0V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +1.5V		>1.0NS <9.5NS	
TPH22	4.5V	0.0V	4.5V	IQH = -10.0MA OUTPUTS IOL = +10.0MA VCOMP = +2.25V		>1.0NS <7.5NS	

TABLE IV: Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC244DMQB 1/2/3/

Parameters	Spec Limits @ 25°C	Total Dose Exposure (TDE) (krads)												Anneal (TDE)			Anneal																	
		0			10			30			50			75			100			200			300			168 hour @ 100°C								
		(Pre-Rad)			mean sd			mean sd			mean sd			mean sd			mean sd			mean sd			mean sd			mean sd			mean sd					
		Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail			
FONC1 @ 10 MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
FONC2 @ 10 MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
FONC3 @ 10 MHz		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass		
VOH1 3.0V V	2.3	5.5	2.99	0	3.00	0	3.00	0	3.00	0.01	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0	2.99	0
VOH2 4.5V V	4.4	5.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0
VOH3 5.5V V	5.4	5.5	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0	5.49	0
VOH4 3.0V V	2.4	5.5	2.93	0.01	2.93	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0	2.92	0
VOH5 4.5V V	3.7	5.5	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01	4.18	0.01
VCH6 5.5V V	4.7	5.5	5.21	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01	5.22	0.01
VCH7 5.5V V	3.85	5.5	4.89	0.02	4.90	0.02	4.90	0.02	4.90	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02	4.89	0.02
VCL1 3.0V V	0	0.1	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
VCL2 4.5V V	0	0.1	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
VCL3 5.5V V	0	0.1	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
VOL4 3.0V V	0	0.5	0.14	0.01	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0	0.14	0
VOL5 4.5V V	0	0.5	0.21	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01	0.20	0.01
VOL6 5.5V V	0	0.5	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01
VOL7 5.5V V	0	1.65	0.39	0.02	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01	0.38	0.01
IOZL 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
IOZH 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
IIL uA	-1.0	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
IIF uA	0	1.0	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
ICCH uA	0	160	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
ICCL uA	0	160	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
ICCZ uA	0	160	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

TABLE IV (CONTINUED) : Summary of Electrical Measurements After Total Dose Exposures and Annealing for 54AC244DMQB 1/2/3/

Parameters	Spec Limits @ 25°C		Total Dose Exposure (TDE) (krads)												Anneal		Anneal					
	min	max	0 (Pre-Rad)		10		30		50		75		100		216 hour @ 25°C		200		300		168 hour @ 100°C	
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
TPHL1	1.0	10.5	4.87	0.41	6.58	0.67	7.56	0.65	7.56	0.65	7.61	0.66	7.62	0.64	7.50	0.71	7.61	0.68	7.67	0.69	7.81	0.82
TPHL2	1.0	8.0	4.58	0.36	6.29	0.71	7.23	0.71	7.29	0.71	7.35	0.74	7.36	0.74	7.21	0.77	7.33	0.77	7.40	0.81	7.56	0.91
TPHL1	1.0	11.0	5.83	0.38	6.51	1.04	7.51	1.01	7.49	1.06	7.54	1.11	7.55	1.14	7.46	1.07	7.64	1.44	7.82	1.91	7.90	1.40
TPHL2	1.0	8.5	5.26	0.37	5.91	0.85	6.89	0.78	6.84	0.82	6.85	0.82	6.83	0.82	6.71	0.75	6.70	0.79	6.68	0.86	6.76	0.77
TPHL1	1.0	11.0	6.47	0.32	7.08	0.22	8.00	0.21	8.02	0.19	7.99	0.22	7.98	0.22	7.61	0.25	7.61	0.24	7.61	0.26	7.39	0.27
TPHL2	1.0	9.0	7.05	0.34	7.78	0.24	8.72	0.23	8.67	0.24	8.65	0.25	8.68	0.25	8.31	0.29	8.28	0.29	8.26	0.31	8.06	0.26
TPHL1	1.0	11.0	7.26	0.40	9.59	0.28	10.54	0.29	10.49	0.30	10.47	0.29	10.51	0.27	10.23	0.31	10.17	0.35	10.14	0.38	10.77	0.41
TPHL2	1.0	8.5	6.14	0.32	6.09	0.20	9.05	0.20	9.02	0.22	9.04	0.21	9.09	0.20	8.76	0.24	8.73	0.24	8.75	0.23	8.84	0.23
TPHL1	1.0	10.0	3.72	0.18	4.65	0.12	5.58	0.12	5.56	0.13	5.47	0.16	5.49	0.16	5.72	0.21	5.57	0.23	5.49	0.23	5.56	0.21
TPHL2	1.0	8.5	4.87	0.21	5.87	0.14	6.78	0.13	6.73	0.14	6.70	0.15	6.72	0.13	6.96	0.18	6.83	0.19	6.74	0.18	6.86	0.17
TPHL1	1.0	9.5	7.85	0.49	8.70	0.39	9.82	0.41	9.92	0.44	10.05	0.47	10.24	0.48	10.47	0.50	10.87	0.54	11.12	0.51	11.44	0.43
TPHL2	1.0	7.5	6.42	0.46	7.03	0.29	8.07	0.30	8.10	0.32	8.16	0.33	8.29	0.33	8.52	0.38	8.78	0.40	8.89	0.41	9.03	0.35

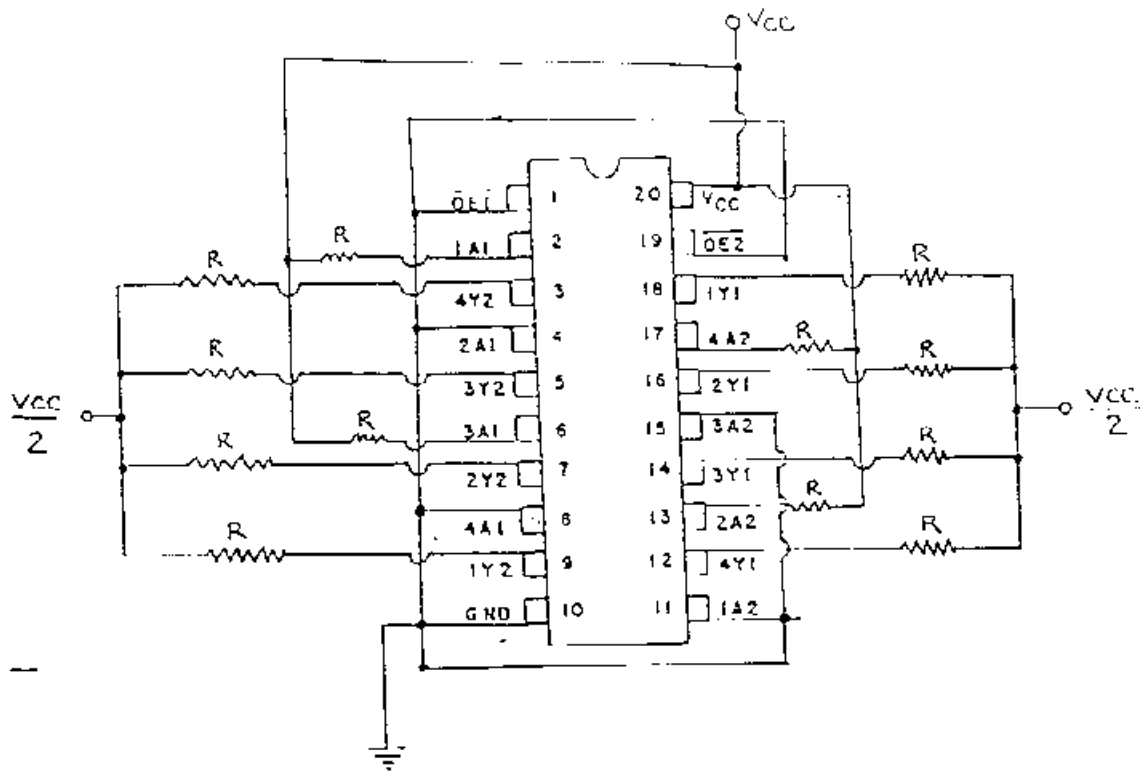
1/ These statistics do not include the control samples which remained constant throughout testing.

2/ The statistics for the post 20 krads and 72 hour annealing steps are available upon request.

3/ The statistical data for the 50 krads step does not include S/N 604 and 605 for the TPHL1 and TPHL2 parameters due to equipment related problems in gathering data for these parts. The 300 krads step does not include S/N 605 for the TPHL2 parameter for the same reason.



Figure 1. Radiation Bias Circuit for 54AC244DMQB



All RESISTORS : 1 K Ohm  $\pm 5\%$  ,  $\frac{1}{4}$  W

Vcc shall be 5.0V  $\pm 10\%$  ;  $\frac{VCC}{2} = 2.5V \pm 10\%$

$T_A = 25^\circ C$