

ADVISORY ON THE USE OF THIS DOCUMENT

The information contained in this document has been developed solely for the purpose of providing general guidance to employees of the Goddard Space Flight Center (GSFC). This document may be distributed outside GSFC only as a courtesy to other government agencies and contractors. Any distribution of this document, or application or use of the information contained herein, is expressly conditioned upon, and is subject to, the following understandings and limitations:

- (a) The information was developed for general guidance only and is subject to change at any time;
- (b) The information was developed under unique GSFC laboratory conditions which may differ substantially from outside conditions;
- (c) GSFC does not warrant the accuracy of the information when applied or used under other than unique GSFC laboratory conditions;
- (d) The information should not be construed as a representation of product performance by either GSFC or the manufacturer;
- (e) Neither the United States government nor any person acting on behalf of the United States government assumes any liability resulting from the application or use of the information.

To
A. Sharma
Department
Code 311
From
K. Sahu KS
Department
7809
Subject
Radiation Report on
GPEP Part No. 54ACTQ373
Control No. 4654

94

PPM-91-713

Date
December 6, 1991

Location
GSFC

Telephone
731-8954

Location
Lanham

cc
G. Jacobs
S. Archer-Davies
T. Perry

A radiation evaluation was performed on 54ACTQ373 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 V and Figure 1.

The total dose testing was performed using a cobalt-60 gamma ray source. During the radiation testing, ten 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 5, 10, 15, 20, 50, 80 and 100 krads*. After 100 krads, parts were annealed without bias at 25°C for 168 hours. The dose rate was between 0.5 - 5.0 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 two functional tests (1MHz, at VCC voltages of 4.5V and 5.5V) after each radiation and annealing step.

All ten parts passed initial electrical measurements at testing temperatures of -55°C, 25°C and 125°C. All parts passed functionally throughout the radiation testing to 100 krads at a testing temperature of 25°C. In addition, all parts passed all parametric tests to 50 krads. At 80 krads, one part (SN 208) exceeded the maximum specification limit of 500nA for IOZH with a reading of 792nA. At 100 krads, two parts (SNS 205 & 208) exceeded the specification limit for IOZH. SN 205 marginally failed IOZH with one output reading 543nA and SN 208 failed with a maximum IOZH output of 1.45uA. Also, SN 208 marginally exceeded the maximum specification limit of 8uA for ICCZ with a reading of 8.6uA. After 168 hours of annealing, SN 205 recovered to pass all tests and SN 208 failed IOZH only. Table IV provides the mean and standard deviation values for each parameter after different radiation exposures and annealing treatments. Table V provides this data at high/low temperature pre-irradiation electrical measurements. Tables IV & V also provide 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:	54ACTQ373
GPEP Part Number:	54ACTQ373
GPEP Control Number:	4654
Charge Number:	C14349
Manufacturer:	National Semiconductor Corp.
Lot Date Code:	9023B
Quantity Tested:	12
Serial Numbers of Radiation Samples:	202, 203, 204, 205, 206, 207, 208, 209, 210, 211
Serial Numbers of Control Samples:	201, 202
Part Function:	Octal Transparent Latch with Tri-state Outputs
Part Technology:	CMOS
Package Style:	20-Pin DIP
Test Engineer:	C. Nguyen

TABLE II. Radiation Schedule

EVENTS	DATE
1) Initial Electrical Measurements at 25°C, -55°C and 125°C	10/02/91
2) 5 krads irradiation @ 75 rads/hr Post 5 krads Electrical Measurements	10/25/91 10/28/91
3) 10 krads irradiation @ 260 rads/hr Post 10 krads Electrical Measurements	10/28/91 10/29/91
4) 15 krads irradiation @ 260 rads/hr Post 15 krads Electrical Measurements	10/29/91 10/30/91
5) 20 krads irradiation @ 260 rads/hr Post 20 krads Electrical Measurements*	10/30/91 11/01/91
6) 50 krads irradiation @ 1580 rads/hr Post 50 krads Electrical Measurements*	11/01/91 11/05/91
7) 80 krads irradiation @ 1250 rads/hr Post 80 krads Electrical Measurements*	11/05/91 11/07/91
8) 100 krads irradiation @ 1050 rads/hr Post 100 krads Electrical Measurements	11/07/91 11/08/91
9) 168 hrs annealing at 25°C Post 168 hr Electrical Measurements	11/08/91 11/15/91

* These electrical measurements were not performed according to the planned schedule because the ATE (S-50) was under repair.

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, unless otherwise noted.
- The parts were annealed without bias at 25°C.

Table III. Electrical Characteristics of 54ACTQ373

FUNCTIONAL TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS OVER TEMP.
FUNCT 1	4.5V	0.0V	4.5V	FREQ=1.000MHZ	ALL I/O	VOL<2.25V / VOH>2.25V
FUNCT 2	5.5V	0.0V	5.5V	FREQ=1.000MHZ	ALL I/O	VOL<2.75V / VOH>2.75V
LOAD USED ≤ $\begin{cases} I_{OH} = -5.0mA \\ V_{REF} = 1.5V \\ I_{OL} = +5.0mA \end{cases}$						
DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT +25C ONLY
VOH1	4.5V	0.8V	2.0V	LOAD=-50UA	OUTS	>+4.4V / <+4.5V
VOH2	4.5V	0.8V	2.0V	LOAD=-24MA	OUTS	>+3.86V / <+4.5V
VOH3	5.5V	0.8V	2.0V	LOAD=-50UA	OUTS	>+5.4V / <+5.5V
VOH4	5.5V	0.8V	2.0V	LOAD=-24MA	OUTS	>+4.86V / <+5.5V
VOH5	5.5V	0.8V	2.0V	LOAD=-50MA	OUTS	>+3.85V / <+5.5V
VOL1	4.5V	0.8V	2.0V	LOAD+=50UA	OUTS	>+0.0V / <+0.1V
VOL2	4.5V	0.8V	2.0V	LOAD+=24MA	OUTS	>+0.0V / <+0.36V
VOL3	5.5V	0.8V	2.0V	LOAD+=50UA	OUTS	>+0.0V / <+0.1V
VOL4	5.5V	0.8V	2.0V	LOAD+=24MA	OUTS	>+0.0V / <+0.36V
VOL5	5.5V	0.8V	2.0V	LOAD+=50MA	OUTS	>+0.0V / <+1.65V
I _{IH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	INS	>+0.0UA / <+0.1UA
I _{IL}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	INS	>-0.1UA / <+0.0UA
I _{DZH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	INS	>+0.0UA / <+0.5UA
I _{DZL}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	INS	>-0.5UA / <+0UA
I _{CCH}	5.5V	0.0V	5.5V	V _{IN} = 5.5V	VCC	>+0.0UA / < +8UA
I _{CCL}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	VCC	>+0.0UA / < +8UA
I _{CCZ}	5.5V	0.0V	5.5V	V _{IN} = 0.0V	VCC	>+0.0UA / < +8UA
DEL_ICC	5.5V	0.0V	5.5V	V _{IN} = 3.4V	VCC	>+0.0UA / <+1.6MA
AC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	PINS	LIMITS AT +25C ONLY	
TPHL1_DQ	5.0V	0.0V	5.0V	DN TO QN	> 2.0NS	< 7.5NS
TPLH1_DQ	5.0V	0.0V	5.0V	DN TO QN	> 2.0NS	< 7.5NS
TPHLZ_LQ	5.0V	0.0V	5.0V	LE TO QN	> 2.5NS	< 8.5NS
TPLH2_LQ	5.0V	0.0V	5.0V	LE TO QN	> 2.5NS	< 8.5NS
TPHZ_OQ	5.0V	0.0V	5.0V	OE TO QN	> 1.0NS	< 10.0NS
TPLZ_OQ	5.0V	0.0V	5.0V	OE TO QN	> 1.0NS	< 10.0NS
TPZH_OQ	5.0V	0.0V	5.0V	OE TO QN	> 2.0NS	< 9.0NS
TPZL_OQ	5.0V	0.0V	5.0V	OE TO QN	> 2.0NS	< 9.0NS

Table III. (continued)

DC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	CONDITIONS	PINS	LIMITS AT -55C AND 125C
VGH1	4.5V	0.8V	2.0V	LOAD=-50UA	OUTS	>+4.4V / <+4.5V
VGH2	4.5V	0.8V	2.0V	LOAD=-24MA	OUTS	>+3.7V / <+4.5V
VGH3	5.5V	0.8V	2.0V	LOAD=-50UA	OUTS	>+5.4V / <+5.5V
VGH4	5.5V	0.8V	2.0V	LOAD=-24MA	OUTS	>+4.7V / <+5.5V
VGH5	5.5V	0.8V	2.0V	LOAD=-50MA	OUTS	>+3.85V / <+5.5V
VOL1	4.5V	0.8V	2.0V	LOAD=+50UA	OUTS	>+0.0V / <+0.1V
VOL2	4.5V	0.8V	2.0V	LOAD=+24MA	OUTS	>+0.0V / <+0.5V
VOL3	5.5V	0.8V	2.0V	LOAD=+50UA	OUTS	>+0.0V / <+0.1V
VOL4	5.5V	0.8V	2.0V	LOAD=+24MA	OUTS	>+0.0V / <+0.5V
VOL5	5.5V	0.8V	2.0V	LOAD=+50MA	OUTS	>+0.0V / <+1.65V
I IH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	>+0.0UA / <+1.0UA
I IL	5.5V	0.0V	5.5V	VIN = 0.0V	INS	>-1.0UA / <+0.0UA
I OZH	5.5V	0.0V	5.5V	VIN = 5.5V	INS	>+0.0UA / <+10UA
I OZL	5.5V	0.0V	5.5V	VIN = 5.5V	INS	>-10UA / <+0UA
I CCH	5.5V	0.0V	5.5V	VIN = 5.5V	VCC	>+0.0UA / <+160UA
I CCL	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0UA / <+160UA
I CCZ	5.5V	0.0V	5.5V	VIN = 0.0V	VCC	>+0.0UA / <+160UA
DEL_ICC	5.5V	0.0V	5.5V	VIN = 3.4V	VCC	>+0.0UA / <+1.6MA

AC PARAMETRIC TESTS PERFORMED						
PARAMETER	VCC	VIL	VIH	PINS	LIMITS AT -55C AND 125C	
TPHL1_OQ	5.0V	0.0V	5.0V	ON TO QN	> 1.5NS	< 10.5NS
TPLH1_OQ	5.0V	0.0V	5.0V	ON TO QN	> 1.5NS	< 10.5NS
TPHL2_LQ	5.0V	0.0V	5.0V	LE TO QN	> 1.5NS	< 11.5NS
TPLH2_LQ	5.0V	0.0V	5.0V	LE TO QN	> 1.5NS	< 11.5NS
TPHZ_OQ	5.0V	0.0V	5.0V	OE TO QN	> 1.5NS	< 10.5NS
TPLZ_OQ	5.0V	0.0V	5.0V	OE TO QN	> 1.5NS	< 10.5NS
TPZH_OQ	5.0V	0.0V	5.0V	OE TO QN	> 1.5NS	< 11.0NS
TPZL_OQ	5.0V	0.0V	5.0V	OE TO QN	> 1.5NS	< 11.0NS

COMMENTS/EXCEPTIONS
(1) VIL & VIH are tested during VSL & VSH tests as Go/NoGo.
(2) IGLD & IOHD are tested during VOL5 & VDH5 tests as Go/NoGo.
(3) VILD & VIND, VOLP & VOLV are not tested per GPEP memo 9/25/91.
(4) TS, TH, TW, TOSH, TOSH are not tested due to the discrepancies between GPEP and manufacturer spec.

TABLE IV: Summary of Electrical Measurements at 25°C
after Total Dose Exposures and Annealing for 54ACT373

1/, 2/

Parameters	Spec. Limits min max		Total Dose Exposure (krads)															
			Pre-Rad		10		15		20		50		80		100		Anneal 168 hrs	
			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
Func1 @VCC=4.5V			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
Func2 @VCC=5.5V			Pass		Pass		Pass		Pass		Pass		Pass		Pass		Pass	
VOH1	V	4.4 4.5	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0	4.49	0
VOH2	V	3.86 4.5	4.17	.05	4.19	.01	4.19	.01	4.19	.01	4.18	.01	4.18	.02	4.18	.02	4.18	.01
VOH3	V	3.4 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
VOH4	V	4.86 5.5	5.20	.06	5.23	.01	5.23	.01	5.23	.01	5.23	.01	5.22	.02	5.22	.02	5.22	.01
VOH5	V	3.85 5.5	4.87	.09	4.93	.02	4.93	.02	4.93	.02	4.92	.02	4.91	.03	4.91	.05	4.91	.02
VOL1	mV	0 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL2	mV	0 360	160	39	134	5	133	4	133	4	134	5	135	12	134	15	134	5
VOL3	mV	0 100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VOL4	mV	0 360	139	38	115	4	115	4	115	3	116	4	117	12	116	14	116	4
VOL5	mV	0 1650	301	91	248	9	247	8	247	8	250	10	252	30	247	16	248	8
I _{IH}	nA	0 100	0.8	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.8
I _{IL}	nA	-100 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I _{OZH}	nA	0 500	0	0	0	0	0.2	0.9	.09	0.8	29	45	73	117	146	226	86	109
I _{OZL}	nA	-500 0	0	0	0	0	0	0	-0.4	1.7	-6.0	8	-6.5	8.2	-4.4	5.8	0	0
I _{CC1}	uA	0 8	0	0	0.2	.06	1.0	0.6	1.8	0.9	2.3	1.2	2.3	1.1	2.6	1.4	1.4	0.5
I _{CC2}	uA	0 8	0	0	0.1	.06	0.6	0.4	0.4	0.1	1.0	0.5	1.6	0.8	2.4	1.4	1.5	0.6
I _{CC3}	uA	0 8	0	0	0.1	.03	0.4	0.2	0.3	0.1	1.4	0.7	2.3	1.3	3.3	2.0	1.7	0.8
DEL ICC	mA	0 1.6	0.4	0.1	0.55	.04	0.5	.04	0.5	.04	0.5	.04	0.4	.04	0.4	.05	0.4	.05

<Table IV continued on next page>

Table IV. (continued)

Parameters		Spec. Limits		Total Dose Exposure (krads)														Anneal	
				Pre-Rad		10		15		20		50		80		100		168 hrs	
				min	max	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
TPHL1 DQ	ns	2	7.5	6.7	0.6	6.7	0.3	6.7	0.3	6.7	0.3	5.9	0.4	6.0	0.3	5.9	0.3	6.7	0.3
TPLH1 DQ	ns	2	7.5	5.4	0.5	4.8	0.3	4.7	0.3	4.8	0.3	4.5	0.3	4.5	0.3	4.4	0.3	5.2	0.4
TPEL2 LQ	ns	2.5	8.5	6.7	0.6	7.0	0.3	6.9	0.3	7.0	0.3	5.9	0.4	6.0	0.3	5.9	0.3	6.7	0.4
TPLH2 LQ	ns	2.5	8.5	5.4	0.5	4.5	0.3	4.5	0.3	4.5	0.3	4.5	0.3	4.5	0.3	4.4	0.3	5.2	0.4
TPHZ OQ	ns	1	10	5.2	0.4	5.3	0.5	5.2	0.5	5.1	0.5	4.4	0.5	4.5	0.5	4.2	0.4	4.9	0.5
TPLZ OQ	ns	1	10	7.2	0.5	6.4	0.6	6.3	0.6	6.3	0.6	6.1	0.7	6.2	0.7	6.2	0.7	7.0	0.6
TPZH OQ	ns	2	9	5.7	0.4	5.0	0.4	5.0	0.4	5.0	0.4	4.7	0.4	4.8	0.4	4.8	0.4	5.4	0.4
TPZL OQ	ns	2	9	7.7	0.3	7.7	0.3	7.7	0.3	7.6	0.3	6.9	0.2	6.9	0.3	6.9	0.2	7.7	0.3

Notes:

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

2/ Statistical data for 5 krad electrical measurements is not provided here. This data is available and can be obtained on request.

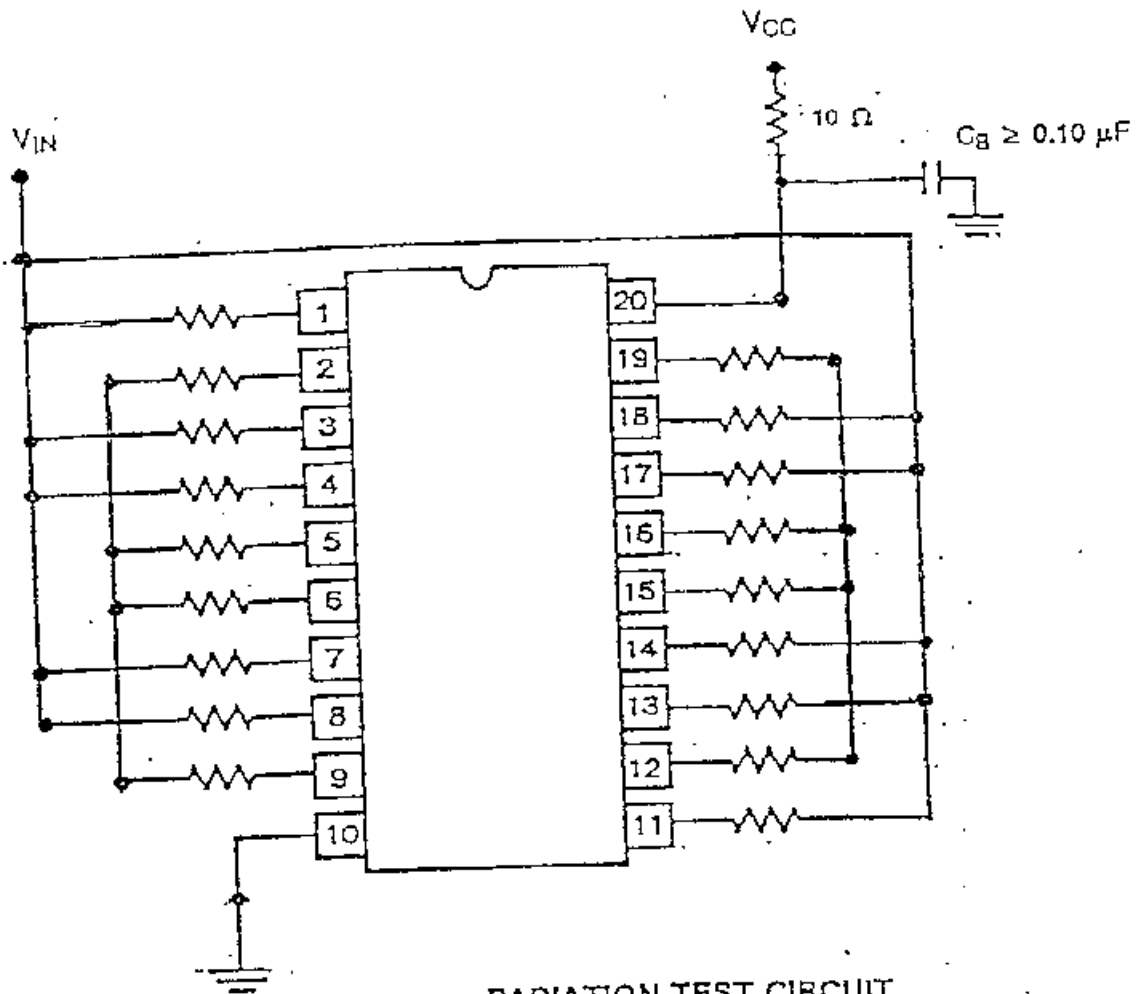
Table V. Summary of Low and High Temperature
Pre-Rad Electrical Measurements for 54ACTQ373 1/

Parameters		Spec. Limits		Low Temp. -55°C		High Temp. 125°C	
		min	max	mean	sd	mean	sd
Func1 @VCC=4.5V				Pass		Pass	
Func2 @VCC=5.5V				Pass		Pass	
VOH1	V	4.4	4.5	4.49	.01	4.49	.01
VOH2	V	3.7	4.5	4.24	.06	4.05	.05
VOH3	V	5.4	5.5	5.49	.01	5.49	.01
VOH4	V	4.7	5.5	5.26	.08	5.11	.06
VOH5	V	3.85	5.5	5.01	0.1	4.65	.15
VOL1	mV	0	100	0	0	0	0
VOL2	mV	0	500	118	36	221	34
VOL3	mV	0	100	0	0	0	0
VOL4	mV	0	500	109	45	191	37
VOL5	mV	0	1650	240	115	410	65
I _{IH}	nA	0	1000	10.2	70	8	2
I _{IL}	nA	-1000	0	-1.0	6	-10	3
I _{OZH}	uA	0	10	.01	0.1	.01	0
I _{OZL}	uA	-10	0	0	0	-.01	0
I _{CC1}	uA	0	160	0	0	0.4	.07
I _{CC2}	uA	0	160	0	0	0.5	0.1
I _{CCZ}	uA	0	160	0	0	0.5	0.1
DEL _{ICC}	mA	0	1.6	0.5	.07	0.3	0.1
T _{PHL1} DQ	ns	1.5	10.5	6.3	0.6	7.3	0.6
T _{PLH1} DQ	ns	1.5	10.5	5.0	0.6	6.0	0.5
T _{PHL2} LQ	ns	1.5	11.5	6.3	0.6	7.3	0.6
T _{PLH2} LQ	ns	1.5	11.5	5.0	0.6	6.0	0.5
T _{PHZ} OQ	ns	1.5	10.5	5.2	0.4	5.5	0.3
T _{PLZ} OQ	ns	1.5	10.5	6.9	0.5	7.6	0.4
T _{PZH} OQ	ns	1.5	11.0	5.3	0.4	6.4	0.4
T _{PZL} OQ	ns	1.5	11.0	6.9	0.3	8.8	0.3

Note:

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

Figure 1. Radiation Bias Circuit for 54ACTQ373



RADIATION TEST CIRCUIT

(Vo) OPEN	GROUND	V _{IN} = 5V
2, 5, 6, 9	10	1, 3, 4, 7
12, 15, 16, 19 Output Voltage		8, 11, 13, 14 17, 18, 20

NOTES:

V_{CC} = 5.5V ± 0.5V

*Voltage Range 5.0 is 5.0V ± 0.5V

*V_{IN} = 5.0 V

NOTE: Each pin and those designated as open shall have a resistor of 1. kΩ ± 5% except 10 and 20