

MILITARY SPECIFICATION

MICROCIRCUITS, DIGITAL, CMOS, POSITIVE LOGIC, FOUR-BIT FULL ADDER, MONOLITHIC SILICON

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic silicon, CMOS logic microcircuits. Two product assurance classes and a choice of case outline/lead finish are provided for each type and are reflected in the complete part number.

1.2 Part number. The part number shall be in accordance with MIL-M-38510.

1.2.1 Device type. The device type shall be as follows:

<u>Device type</u>	<u>Circuit</u>
01	Four-bit full adder
51	Four-bit full adder

1.2.2 Device class. The device class shall be the product assurance level as defined in MIL-M-38510.

1.2.3 Case outline. The case outline shall be designated as follows:

<u>Letter</u>	<u>Case outline (see MIL-M-38510, appendix C)</u>
E	D-2 (16-lead, 1/4" x 7/8", dual-in-line pack)
F	F-5 (16-lead, 1/4" x 3/8", flat pack)
Z	F-5 (16-lead, 1/4" x 3/8", flat pack, except A dimension = .1" (2.54 mm) max).

NOTES

1. As an exception to 3.5.6.2.3 of MIL-M-38510, for case outline Z only, the leads of bottom brazed ceramic packages (i.e. configuration 2 of case outline F-5) may have electroless nickel undercoating which shall be 50 to 200 microinches (1.27 to 5.08 μ m) thick provided the lead finish is hot solder dip (i.e. finish letter A) and provided that, after any lead forming, an additional hot solder dip coating is applied which shall extend from the outer tip of the lead to no more than 0.015 inch (0.38 mm) from the package edge.

2. For bottom or side brazed packages, case outline Z only, the S₁ dimension may go to .000 inch (.00 mm) minimum.

1.3 Absolute maximum ratings.

Supply voltage range (V_{DD} - V_{SS}):

Device type 01 - - - - - - - - - - -0.5 V to +15.5 V

Device type 51 - - - - - - - - - - -0.5 V to +18.0 V

Input current (each input) - - - - - $\pm$ 10 mA

Input voltage range- - - - - (V_{SS}-0.5 V) $\leq$ V_I $\leq$ (V_{DD} + 0.5 V)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: George C. Marshall Space Flight Center, National Aeronautics and Space Administration, ATTN: EGO2, Marshall Space Flight Center, AL 35812, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

Storage temperature range- - - - -65°C to +175°C
 Maximum power dissipation, P_D - - - 200 mW
 Lead temperature (soldering,
 10 seconds)- - - - - 300°C
 Thermal resistance, junction to case - - (See MIL-M-38510, appendix C)
 Junction temperature - - - - - $T_J = 175^\circ\text{C}$

1.4 Recommended operating conditions.

Supply voltage range ($V_{DD} - V_{SS}$):
 Device type 01- - - - - 4.5 V dc to 12.5 V dc
 Device type 51- - - - - 4.5 V dc to 15.0 V dc
 Input low (V_{IL}) voltage range:
 Device type 01- - - - - 0 to 0.85 V dc at $V_{DD} = 5$ V;
 0 to 2.1 V dc at $V_{DD} = 12.5$ V
 Device type 51- - - - - 0 to 1.5 V dc at $V_{DD} = 5.0$ V,
 $V_{OL} = 10$ percent V_{DD} ,
 $V_{OH} = 90$ percent V_{DD} ;
 0 to 4.0 V dc at $V_{DD} = 15$ V;
 0 to 2.0 V dc at $V_{DD} = 10$ V
 Input high (V_{IH}) voltage range:
 Device type 01- - - - - 3.95 to 5.0 V dc at $V_{DD} = 5$ V;
 10.0 to 12.5 V dc at $V_{DD} = 12.5$ V
 Device type 51- - - - - 3.5 to 5.0 V dc at $V_{DD} = 5.0$ V,
 $V_{OL} = 10$ percent V_{DD} ,
 $V_{OH} = 90$ percent V_{DD} ;
 11.0 to 15.0 V dc at $V_{DD} = 15$ V;
 8.0 to 10.0 V dc at $V_{DD} = 10$ V
 Load capacitance- - - - - 50 pF maximum
 Ambient operating temperature range - - -55°C to +125°C

2. APPLICABLE DOCUMENTS

2.1 Government specifications and standards. Unless otherwise specified, the following specifications and standards, of the issue listed in that issue of the Department of Defense Index of Specifications and Standards specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-M-38510 - Microcircuits, General Specification for.

STANDARD

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Detail specification. The individual item requirements shall be in accordance with MIL-M-38510, and as specified herein.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein. Although eutectic die bonding is preferred, epoxy die bonding may be performed. However, the resin used shall be Dupont 5504 Conductive Silver Paste, which is cured at $200^{\circ} \pm 10^{\circ} \text{C}$ for a minimum of 2 hours. The use of equivalent epoxies or cure cycles shall be approved by the qualifying activity. Equivalency shall be demonstrated in data submitted to the qualifying activity for verification.

3.2.1 Terminal connections. The terminal connections shall be as specified on figure 1.

3.2.2 Logic diagrams. The logic diagrams shall be as specified on figure 2.

3.2.3 Truth tables. The truth tables shall be as specified on figure 3.

3.2.4 Schematic circuits. The schematic circuits shall be submitted to the preparing activity prior to inclusion of a manufacturer's device in this specification and shall be submitted to the qualifying activity as a prerequisite for qualification. All qualified manufacturers' schematics shall be maintained and available upon request.

3.2.5 Case outlines. The case outlines shall be as specified in 1.2.3.

3.3 Lead material and finish. The lead material and finish shall be in accordance with MIL-M-38510 and 6.4 herein.

3.4 Electrical performance characteristics. The electrical performance characteristics are as specified in table I, and apply over the full recommended ambient operating temperature range, unless otherwise specified.

3.5 Electrical test requirements. The electrical test requirements for each device class shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table III. V_{IL} and V_{IH} testing requires only a summary of attributes data.

3.6 Marking. Marking shall be in accordance with MIL-M-38510.

3.6.1 Total dose radiation hardness identifier. Total dose radiation hardness identifier shall be in accordance with MIL-M-38510 and 4.5.5 herein.

3.6.2 Serialization. All class S devices shall be serialized in accordance with MIL-M-38510.

3.6.3 Correctness of indexing and markings. All devices shall be subjected to the final electrical tests specified in table II after part number marking to verify that they are correctly indexed and identified by part number. Optionally, an approved electrical test may be devised especially for this requirement.

3.7 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 39 (see MIL-M-38510, appendix E).

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-M-38510 and methods 5005 and 5007, as applicable, of MIL-STD-883, except as modified herein.

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to qualification and quality conformance inspection. The following additional criteria shall apply:

- a. Delete the sequence specified in 3.1.9 through 3.1.13 of method 5004 and substitute sequentially lines 1 through 7 of table II herein.
- b. Burn-in tests (method 1015 of MIL-STD-883).
 1. Static tests (test condition A) use circuit shown on figure 4, or equivalent. Ambient temperature (T_A) shall be 125°C minimum. Test duration for each static test shall be 24 hours minimum for class S devices and in accordance with table I method 1015 for class B devices.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $V_{SS} = 0 \text{ V}$ $-55^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$ Unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Positive clamping input to V_{DD}	$V_{IC(POS)}$	$T_A = 25^{\circ}\text{C}$, $V_{DD} = \text{GND}$, $V_{SS} = \text{Open}$, Output = Open, $I_I = 1 \text{ mA}$	ATI		1.5	V
Negative clamping input to V_{SS}	$V_{IC(NEG)}$	$T_A = 25^{\circ}\text{C}$, $V_{DD} = \text{Open}$, $V_{SS} = \text{GND}$, Output = Open, $I_I = -1 \text{ mA}$	ATI		-6	V
Quiescent supply current	I_{SS}	Any combination of inputs	$V_{DD}=15.0 \text{ V}$ 01		-5	μA
			$V_{DD}=18.0 \text{ V}$ 51			
High level output voltage	V_{OH1}	$V_{DD} = 5.0 \text{ V}$, $I_{OH} = -0.05 \text{ mA}$ (see table III)	01	4.5		V
	V_{OH2}	$V_{DD} = 5.0 \text{ V}$, $I_{OH} = 0$ (see table III)	01	4.95		V
	V_{OH3}	$V_{DD} = 12.5 \text{ V}$, $I_{OH} = 0$ (see table III)	01	11.25		V
	V_{OH4}	$V_{DD} = 15.0 \text{ V}$, $I_{OH} = 0$ (see table III)	51	14.95		V
Low level output voltage	V_{OL1}	$V_{DD} = 5.0 \text{ V}$, $I_{OL} = 0.05 \text{ mA}$ (see table III)	01		0.50	V
	V_{OL2}	$V_{DD} = 5.0 \text{ V}$, $I_{OL} = 0$ (see table III)	01		0.05	V
	V_{OL3}	$V_{DD} = 12.5 \text{ V}$, $I_{OL} = 0$ (see table III)	01		1.25	V
	V_{OL4}	$V_{DD} = 15.0 \text{ V}$, $I_{OL} = 0$ (see table III)	51		0.05	V
Input high voltage	V_{IH1}	$V_{DD} = 5.0 \text{ V}$ $V_0 = 0.5 \text{ V}$ $ I_0 \leq 1 \mu\text{A}$	51	3.5		V
	V_{IH2}	$V_{DD} = 10.0 \text{ V}$ $V_0 = 1.0 \text{ V}$ $ I_0 \leq 1 \mu\text{A}$	51	7.0		V
	V_{IH3}	$V_{DD} = 15.0 \text{ V}$ $V_0 = 1.5 \text{ V}$ $ I_0 \leq 1 \mu\text{A}$	51	11.0		V
Input low voltage	V_{IL1}	$V_{DD} = 5.0 \text{ V}$ $V_0 = 4.5 \text{ V}$ $ I_0 \leq 1 \mu\text{A}$	51		1.5	V
	V_{IL2}	$V_{DD} = 10.0 \text{ V}$ $V_0 = 9.0 \text{ V}$ $ I_0 \leq 1 \mu\text{A}$	51		3.0	V
	V_{IL3}	$V_{DD} = 15.0 \text{ V}$ $V_0 = 13.5 \text{ V}$ $ I_0 \leq 1 \mu\text{A}$	51		4.0	V
Output low (sink) current	I_{OL1}	$V_{DD} = 5.0 \text{ V}$, $V_{IN} = V_{SS}$ $V_{OL} = 0.4 \text{ V}$	51	0.36		mA

See footnotes at end of table.

TABLE I. Electrical performance characteristics -Continued.

Test	Symbol	Conditions 1/ $V_{SS} = 0 \text{ V}$ $-55^{\circ}\text{C} < T_A < 125^{\circ}\text{C}$ Unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Output low (sink) current	I_{OL2}	$V_{DD} = 15.0 \text{ V}$, $V_{IN} = V_{SS}$ $V_{OL} = 1.5 \text{ V}$	51	2.4		mA
Output high (source) current	I_{OH1}	$V_{DD} = 5.0 \text{ V}$, $V_{IN} = V_{DD}$ $V_{OH} = 4.6 \text{ V}$	51	-0.36		mA
	I_{OH2}	$V_{DD} = 15.0 \text{ V}$, $V_{IN} = V_{DD}$ $V_{OH} = 13.5 \text{ V}$	51	-2.4		mA
Input leakage current 2/ (high)	I_{IH}	Measure inputs sequentially $V_{DD} = 15.0 \text{ V}$	01		45	nA
		$V_{DD} = 18.0 \text{ V}$	51			
Input leakage current 2/ (low)	I_{IL}	Measure inputs sequentially $V_{DD} = 15.0 \text{ V}$	01		-45	nA
		$V_{DD} = 18.0 \text{ V}$	51			
Input voltage	V_{ZAP}	$C_i = 100 \text{ pF}$, $R_2 = 1.5 \text{ k}\Omega$ (see 4.5.3)	A11	400		V
Input capacitance	C_i	$V_{DD} = 0 \text{ V}$, $f = 1 \text{ MHz}$ $T_A = 25^{\circ}\text{C}$	A11		12	pF
Propagation delay high to low level - Sum input to sum output	t_{PHL1}	$V_{DD} = 5.0 \text{ V}$, $C_L = 50 \text{ pF}$ (see figure 8)	A11		3375	ns
Propagation delay high to low level - Carry input to sum output	t_{PHL2}		A11		3375	ns
Propagation delay high to low level - Sum input to carry output	t_{PHL3}		A11		1125	ns
Propagation delay high to low level - Carry input to carry output	t_{PHL4}		A11		450	ns
Propagation delay low to high level - Sum input to sum output	t_{PLH1}		A11		4350	ns
Propagation delay low to high level - Carry input to sum output	t_{PLH2}		A11		4350	ns
Propagation delay low to high level - Sum input to carry output	t_{PLH3}		A11		1125	ns
Propagation delay low to high level - Carry input to carry output	t_{PLH4}		A11	31	450	ns
Transition times at sum outputs	t_{THL} t_{TLH}		A11		15000	ns
Transition times at carry outputs	t_{THL} t_{TLH}		A11		780	ns

1/ Complete terminal conditions shall be as specified in table III.

2/ Input current at one input node.

TABLE II. Burn-in and electrical test requirements.

Line no.	Applicable tests and MIL-STD-883 test methods	Class S device 3/				Class B device 3/			
		Ref. par.	Table 2/ III sub-groups	Table 1/ IV delta limits	Test circuit figure	Ref. par.	Table 2/ III sub-groups	Table 1/ IV delta limits	Test circuit figure
1	Interim electrical parameters (method 5004)		1				1		
2	Static burn-in I (method 1015)	4.2b. 4.5.2			4				
3	Same as line 1		1	Δ					
4	Static burn-in II (method 1015)	4.2b. 4.5.2			4	4.2b. 4.5.2	4/		4
5	Same as line 1	4.2d.	1*	Δ		4.2d.	1*	Δ	
6	Dynamic burn-in (method 1015)	4.2b. 4.5.2			5				
7	Same as line 1	4.2d.	1*	Δ					
8	Final electrical parameters (method 5004)		1*,2,3,7, 9				1*,2,3,7, 9		
9	Group A end point electrical parameters (method 5005)	4.4.1	1,2,3,4, 7,8,9, 10,11			4.4.1	1,2,3, 4,7,9, 10,11		
10	Group B end point electrical parameters (method 5005)	4.4.2	1,2,3,7, 8,9,10,11	Δ					
11	Group C end-point electrical parameters (method 5005)					4.4.3c.	1,2,3	Δ	
12	Additional group C tests (method 5005)					4.4.3c.	10,11		
13	Group D end-point electrical parameters (method 5005)	4.4.4	1,2,3			4.4.4	1,2,3		

1/ (Δ) indicates delta limits shall be required on table III subgroup 1, where specified, and delta values shall be computed with reference to the previous interim electrical parameters.

2/ (*) indicates PDA applies to subgroup 1 (see 4.2.1).

3/ Blank spaces indicate tests are not applicable.

4/ The device manufacturer may, at his option, either perform delta measurements or within 24 hours after burn-in (or removal of bias) perform the final electrical parameter measurements.

Cases E, F and Z

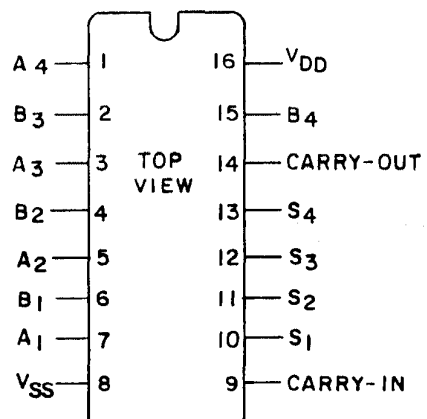
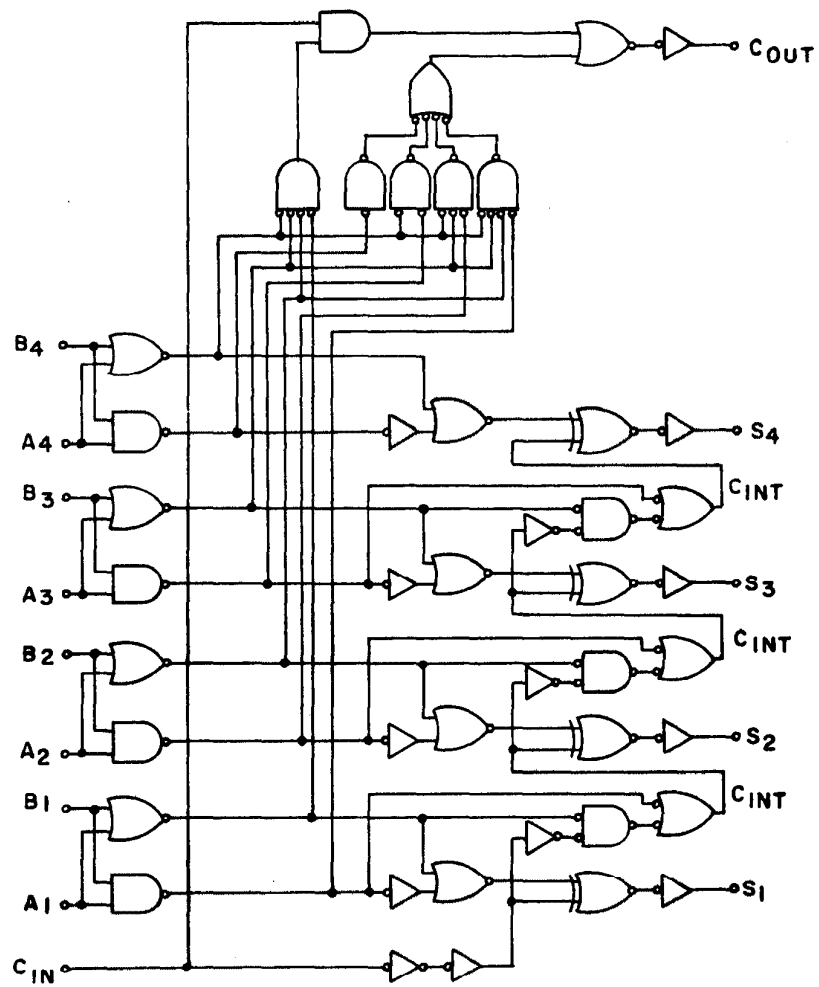


FIGURE 1. Terminal connections.

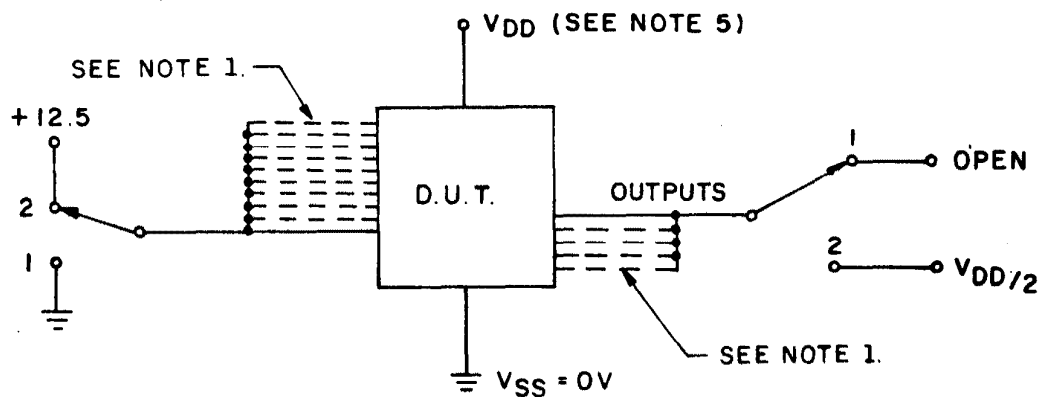
Device types 01 and 51

FIGURE 2. Logic diagram.

A_n	B_n	C_{in}	C_{int}^*	C_{OUT}	SUM
L	L	L	L	L	L
H	L	L	L	L	H
L	H	L	L	L	H
H	H	L	H	L(H**)	L
L	L	H	L	L	H
H	L	H	H	L(H**)	L
L	H	H	H	L(H**)	L
H	H	H	H	L(H**)	H
* = Internal Carry, ** $C_{OUT} = I$ when L = Low N = 4 H = High					

Positive logic one stage

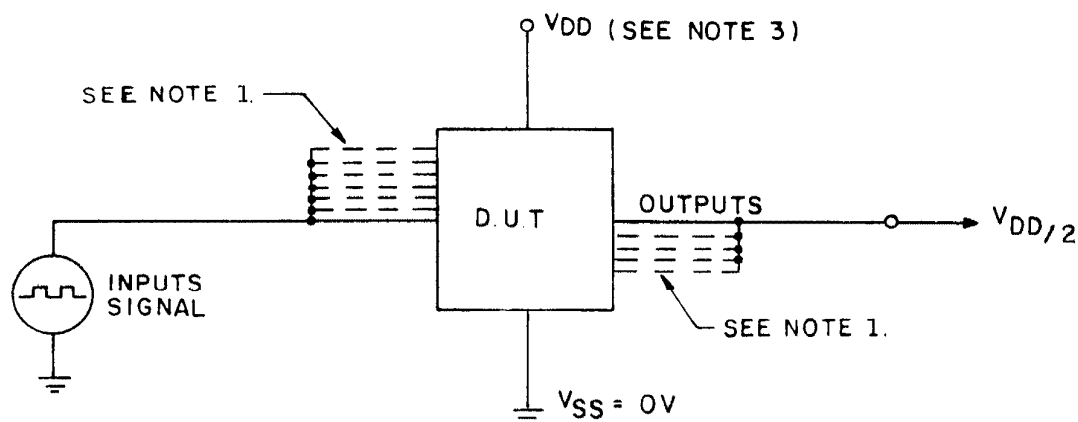
FIGURE 3. Truth table.



NOTES:

1. For static burn-in I, all inputs are connected to 0 volts, switch position 1.
2. For static burn-in II, all inputs are connected to V_{DD} , switch position 2.
3. Except for V_{DD} and V_{SS} , each terminal shall be connected through a resistor whose value is 2 k Ω to 47 k Ω . The actual measured value of the resistor selected shall not exceed $\pm 20\%$ of its branded value due to use, heat or age.
4. Output may be in switch position 1 or 2.
5. V_{DD} = 12.5 V minimum, 15.0 V maximum for device types 01.
 V_{DD} = 15.0 V minimum, 18.0 V maximum for device types 51.
 $V_{DD}/2$ = $V_{DD}/2 \pm 1.0$ V for all devices.
 V_{SS} = 0.0 V.

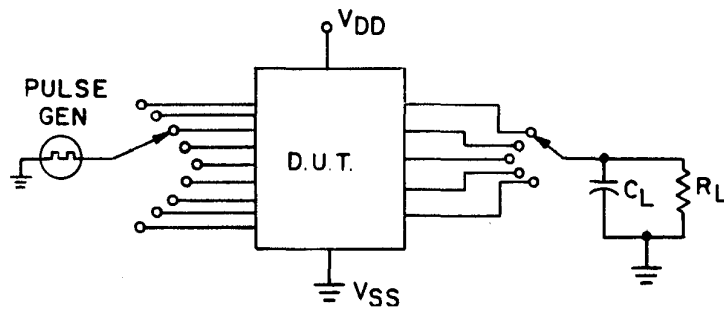
FIGURE 4. Static burn-in test circuits.



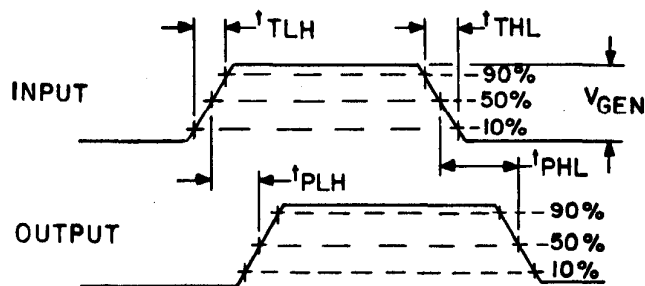
NOTES:

1. Except for V_{DD} and V_{SS} , each terminal shall be connected through a resistor whose value is $2\text{ k}\Omega$ to $47\text{ k}\Omega$. The actual measured value of the resistor selected shall not exceed $\pm 20\%$ of its branded value due to use, heat or age.
2. Input signal requirements:
 - a. Square wave, 50% duty cycle.
 - b. $25\text{ kHz} < \text{PRR} < 1\text{ MHz}$.
 - c. t_{TLH} and $t_{THL} < 1\text{ }\mu\text{s}$.
 - d. Voltage level:
 - Minimum = $V_{SS} - 0.5\text{ V}$, $+10\% V_{DD}$.
 - Maximum = $V_{DD} + 0.5\text{ V}$, $-10\% V_{DD}$.
3. $V_{DD} = 12.5\text{ V}$ minimum, 15.0 V maximum for device types 01.
 $V_{DD} = 15\text{ V}$ minimum, 18 V maximum for device types 51.
 $V_{DD/2} = V_{DD}/2 \pm 1.0\text{ V}$.
 $V_{SS} = 0.0\text{ V}$.

FIGURE 5. Dynamic burn-in and steady state life test circuit.



$R_L = 200 \text{ k}\Omega \pm 10\%$.
 $C_L = 50 \text{ pF} \pm 5.0$ (includes wiring and probe capacitance)



NOTES:

1. The pulse generator has the following characteristics: $V_{gen} = V_{DD} \pm 1\%$, duty cycle = 50%, $t_{TLH} = t_{THL} = 20 \pm 2.0 \text{ ns}$ and pulse repetition period = $50 \pm 5 \text{ }\mu\text{s}$.
2. See table III for complete terminal conditions.

FIGURE 6. Switching time test circuit and waveforms.

TABLE III. Group A inspection for device type 01 - Continued.

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See footnotes at end of device type 01.

TABLE III. Group A inspection for device type 01 - Continued.

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions and limits 1/																Measured terminal	Test limits						Units
																				Subgroup 1 T _A = 25 °C		Subgroup 2 T _A = 125 °C		Subgroup 3 T _A = -55 °C		
			Test No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		16	Min	Max	Min	Max	Min	
			A4	B3	A3	B2	A2	B1	A1	V _{SS}	C _{IN}	S1	S2	S3	S4	C _{OUT}	B4	V _{DD}								
V _{OL3}	3007	88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104	V _{IL2}	V _{IL2}	V _{IL2}	V _{IL2}	V _{IL2}	V _{IL2} V _{IL2} V _{IH2} V _{IH2} V _{IH2} V _{IL2} V																		

See footnotes at end of device type 01.

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TABLE III. Group A inspection for device type 01 - Continued.

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions and limits 1/																Measured terminal	Test limits						Units	
																					Subgroup 9 T _A = 25 °C		Subgroup 10 T _A = 125 °C		Subgroup 11 T _A = -55 °C		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16									
			Test No.	A4	B3	A3	B2	A2	B1	A1	V _{SS}	C _{IN}	S1	S2	S3	S4	C _{OUT}	B4		V _{DD}	Min	Max	Min	Max	Min		Max
^t PHL1 ↓	3003 (Fig 8)	162 163 164 165 166 167 168 169	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	IN ↓ ↓ ↓ ↓ IN IN IN GND	GND	GND	OUT OUT OUT OUT OUT OUT OUT OUT	OUT OUT OUT OUT OUT OUT OUT OUT	OUT OUT OUT OUT OUT OUT OUT OUT	OUT OUT OUT OUT OUT OUT OUT OUT	GND ↓ ↓ ↓ ↓ IN IN IN GND	5 V	A1 to S1 B1 to S1 A2 to S2 B2 to S2 A3 to S3 B3 to S3 A4 to S4 B4 to S4	2250		3375		2250	ns		
^t PHL2 ↓		170 171 172 173	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	5 V 5 V 5 V 5 V	IN	OUT	OUT	OUT	OUT	OUT	IN GND		C _{IN} to S1 C _{IN} to S2 C _{IN} to S3 C _{IN} to S4	750		1125		750		
^t PHL3 ↓		174 175	5 V ↓ IN	↓ ↓ ↓	GND ↓ GND	↓ ↓ ↓	GND ↓ GND	↓ ↓ ↓	GND ↓ GND	↓ ↓ ↓	GND	GND	GND	GND	OUT	IN	5 V	B4 to C _{OUT} A4 to C _{OUT}	750	1125	750						
^t PHL4 ↓		176 177	5 V ↓ GND	↓ ↓ 5 V	5 V ↓ GND	↓ ↓ ↓	5 V ↓ GND	↓ ↓ ↓	5 V ↓ GND	↓ ↓ ↓	IN	IN				GND ↓ 5 V	C _{IN} to C _{OUT} C _{IN} to C _{OUT}	300	450	300							
^t PLH1 ↓		178 179 180 181 182 183 184 185	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	GND ↓ ↓ ↓ ↓ IN IN IN GND	IN ↓ ↓ ↓ ↓ IN IN IN GND	GND	OUT OUT OUT OUT OUT OUT OUT OUT	OUT OUT OUT OUT OUT OUT OUT OUT	OUT OUT OUT OUT OUT OUT OUT OUT	OUT OUT OUT OUT OUT OUT OUT OUT	OUT OUT OUT OUT OUT OUT OUT OUT	GND ↓ ↓ ↓ ↓ IN IN IN GND		A1 to S1 B1 to S1 A2 to S2 B2 to S2 A3 to S3 B3 to S3 A4 to S4 B4 to S4	2900		4350		2900				
^t PLH2 ↓		186 187 188 189	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	↓ ↓ ↓ ↓	5 V 5 V 5 V 5 V	IN	OUT	OUT	OUT	OUT	OUT	IN GND		C _{IN} to S1 C _{IN} to S2 C _{IN} to S3 C _{IN} to S4	750		1125		750		
^t PLH3 ↓		190 191	5 V ↓ IN	↓ ↓ ↓	GND ↓ GND	↓ ↓ ↓	GND ↓ GND	↓ ↓ ↓	GND ↓ GND	↓ ↓ ↓	GND	GND	GND	GND	OUT	IN	5 V	B4 to C _{OUT} A4 to C _{OUT}	750	1125	750						
^t PLH4 ↓		192 193	5 V ↓ GND	↓ ↓ 5 V	5 V ↓ GND	↓ ↓ ↓	5 V ↓ GND	↓ ↓ ↓	5 V ↓ GND	↓ ↓ ↓	IN	IN				GND ↓ 5 V	C _{IN} to C _{OUT} C _{IN} to C _{OUT}	300	450	300							

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See footnotes at end of device type 01.

TABLE III. Group A inspection for device type 01 - Continued.

Symbol	MIL-STD-883 method	Cases E. F. Z	Terminal conditions and limits 1/																Measured terminal	Test limits						Units		
																						Subgroup 9 T _A = 25 °C		Subgroup 10 T _A = 125 °C			Subgroup 11 T _A = -55 °C	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		Min	Max	Min	Max	Min	Max			
		Test No.	A4	B3	A3	B2	A2	B1	A1	V _{SS}	C _{IN}	S1	S2	S3	S4	C _{OUT}	B4	V _{DD}										
t _{THL}	3004 (Fig 8)	194 195 196 197 198 199	GND ↓ IN IN 5 V	GND GND 5 V 5 V GND GND	GND GND IN 5 V GND 5 V	GND IN 5 V GND GND GND	GND 5 V 5 V GND 5 V	GND 5 V GND 5 V	IN 5 V GND 5 V	GND	GND	OUT	OUT	OUT	OUT	OUT OUT	GND ↓ 5 V 5 V GND	5 V	S1 S2 S3 S4 C _{OUT} C _{OUT}		10000 ↓ 520 520		15000 ↓ 780 780		10000 ↓ 520 520	ns		
t _{TLH}		200 201 202 203 204 205	GND ↓ IN IN 5 V	GND GND 5 V 5 V GND GND	GND GND IN 5 V GND 5 V	GND IN 5 V GND GND GND	GND 5 V 5 V GND 5 V	GND 5 V GND 5 V	IN 5 V GND 5 V	GND	GND	OUT	OUT	OUT	OUT	OUT OUT	GND ↓ 5 V 5 V GND		S1 S2 S3 S4 C _{OUT} C _{OUT}		10000 ↓ 520 520		15000 ↓ 780 780		10000 ↓ 520 520			

1/ Pins not designated can be "high" level logic, "low" level logic, or open. Exceptions are as follows:
V_{IC}(POS) tests, the V_{SS} terminal shall be open; V_{IC}(NEG) tests, the V_{DD} terminal shall be open; ISS tests, the output terminals shall be open.

2/ V_{IL1} = 1.1 V @ 25 °C; 0.85 V @ 125 °C; 1.35 V @ -55 °C.

3/ V_{IH1} = 3.8 V @ 25 °C; 3.8 V @ 125 °C; 3.95 V @ -55 °C.

4/ I_{OH1} = -0.05 mA @ 25 °C; -0.35 mA @ 125 °C; -0.08 mA @ -55 °C.

5/ I_{OH2} = -0.25 mA @ 25 °C; -0.175 mA @ 125 °C; -0.31 mA @ -55 °C.

6/ V_{IL2} = 2.8 V @ 25 °C; 2.55 V @ 125 °C; 3.05 V @ -55 °C.

7/ V_{IH2} = 9.5 V @ 25 °C; 9.25 V @ 125 °C; 9.75 V @ -55 °C.

8/ I_{OL1} = 0.05 mA @ 25 °C; 0.035 mA @ 125 °C; 0.08 mA @ -55 °C.

9/ I_{OL2} = 0.25 mA @ 25 °C; 0.175 mA @ 125 °C; 0.31 mA @ -55 °C.

10/ The device manufacturer may, at his option, measure I_{IL} and I_{IH} at 25 °C for each individual input or measure all input or measure all inputs together.

11/ See 4.4.1c.

12/ The truth table tests shall be performed in sequence.

13/ The truth table tests shall be performed at V_{IH} and V_{DD} ≤ 5.0 V and ≥ 15.0 V.

L = V_{SS} + 0.50 V maximum and H = V_{DD} - 0.50 V minimum.

TABLE III. Group A inspection for device type 51.

Symbol	MLL- STD-883 method	Cases E,F,Z Symbol Test no.	Terminal conditions 1/										Test limits										Unit		
			A ₄	B ₃	A ₃	B ₂	A ₂	B ₁	A ₁	V _{SS}	C _{IN}	S ₁	S ₂	S ₃	S ₄	C _{OUT}	A ₄	V _{DD}	Measured terminal	Subgroup 1 T _A =25°C		Subgroup 2 T _A =125°C		Subgroup 3 T _A =-55°C	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	15		Min	Max	Min	Max	Min	Max
V _{IC(POS)}		1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA	1 mA							GND		A ₄ B ₃ A ₃ B ₂ A ₂ B ₁ A ₁ C _{IN} B ₄	1.5					V _{dc}
V _{IC(NEG)}		-1 mA	-1 mA	-1 mA	-1 mA	-1 mA	-1 mA	-1 mA	-1 mA	GND									A ₄ B ₃ A ₃ B ₂ A ₂ B ₁ A ₁ C _{IN} B ₄	-0.5					
V _{SS 2/}	3005	19	GND	GND	GND	GND	GND	GND	GND	GND	GND						GND	18.0 V	V _{SS}	-0.5		-5.0			1 A
		20	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		21	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		22	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		23	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		24	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		25	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		26	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		27	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		28	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		29	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		30	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		31	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		32	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		33	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		34	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		35	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		36	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		37	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		38	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		39	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		40	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		41	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		42	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		43	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		44	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
		45	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V						18.0 V								
V _{OH4}	3006	46	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V	S ₁	14.95		14.95		14.95	V _{dc}
		48	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V	S ₂						
		49	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V	S ₃						
		50	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V	S ₄						
		51	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		52	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		53	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		54	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		55	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		56	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		57	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		58	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		59	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		60	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		61	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		62	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		63	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		64	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							
		65	GND	GND	GND	GND	GND	15.0 V	15.0 V	15.0 V	GND						GND	15.0 V							

See footnotes at end of device type 51.

TABLE 111. Group A inspection for device type 31 - Continued.

Symbol	MIL-STD-883 method	Cases E, F, Z Symbol	Terminal conditions 1/															Test limits						Unit		
			A1	B3	A3	B2	A2	B1	A1	VSS	CIN	S1	S2	S3	S4	COUT	B4	VDD	Measured terminal	Subgroup 1 TA=25°C		Subgroup 2 TA=125°C			Subgroup 3 TA=-55°C	
			Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		Min	Max	Min		Max	Min
VOL4	3007	66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82	GND ↓																							

See footnotes at end of device type 31.

TABLE III. Group A inspection for device type 51 - Continued.

Symbol	MIL-STD-883 method	Cases E, F, Z Symbol	A ₄	B ₃	A ₃	B ₂	A ₂	B ₁	A ₁	Terminal conditions 1/										C _{OUT}	B ₄	V _{DD}	Measured terminal	Test limits						Unit							
										Test no.	1	2	3	4	5	6	7	8	9					10	11	12	13	14	15		16	Subgroup 1 T _A =25°C		Subgroup 2 T _A =125°C		Subgroup 3 T _A =-55°C	
																																Min	Max	Min	Max	Min	Max
I _{ILL} 4/	3009	119	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	18.0 V	All inputs together		-9					nA												
I _{ILL} 2		120	GND	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		A ₄		-1		-45														
		121	18.0 V	GND	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		B ₃																		
		122		18.0 V	GND	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		A ₃																		
		123			18.0 V	GND	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		B ₂																		
		124				18.0 V	GND	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		A ₂																		
		125					18.0 V	GND	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		B ₁																		
		126						18.0 V	GND	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		A ₁																		
		127							18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		C _{IN}																		
		128								18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V	18.0 V		B ₄																		
																			Subgroup 4 T _A = 25°C																		
																			Min	Max																	
C ₁	3012	129	5/	5/	5/	5/	5/	5/	5/	GND							GND	A ₄		7.5					pF												
		130																B ₃																			
		131																A ₃																			
		132																B ₂																			
		133																A ₂																			
		134																B ₁																			
		135																A ₁																			
		136																C _{IN}																			
		137																B ₄																			
																			Subgroup 7 T _A = 25°C		Subgroup 8 T _A = 125°C		T _A = -55°C														
																			Min	Max	Min	Max	Min	Max													
Truth table	3014	138	GND	GND	GND	GND	GND	GND	GND	GND	GND	L	L	L	L	L	GND	5.0 V	All outputs																		
		139	5.0 V	5.0 V	5.0 V	5.0 V	5.0 V	GND	GND	GND	5.0 V	H	L	H	H	H	5.0 V																				
		140	5.0 V		GND	GND	GND	5.0 V	5.0 V	GND	5.0 V	L	L	H	L	H	GND																				
		141	5.0 V		GND	5.0 V	5.0 V	5.0 V	5.0 V	GND	5.0 V	L	L	H	L	H	GND																				
		142	GND		5.0 V		5.0 V	5.0 V	5.0 V	GND	5.0 V	L	L	H	L	H	GND																				
		143	5.0 V		GND		GND	GND	GND	GND	5.0 V	L	L	H	L	H	GND																				
		144	GND		5.0 V		GND	5.0 V	GND	5.0 V	GND	L	L	H	L	H	5.0 V																				
		145	5.0 V		GND		GND	5.0 V	5.0 V	GND	5.0 V	L	L	H	L	H	GND																				
		146	5.0 V	5.0 V	GND		GND	GND	GND	5.0 V	5.0 V	L	L	H	L	H	GND																				
		147	5.0 V	5.0 V	GND		GND	GND	5.0 V	5.0 V	5.0 V	L	L	H	L	H	GND																				
		148	GND		5.0 V	5.0 V	GND	5.0 V	GND	GND	5.0 V	L	L	H	L	H	5.0 V																				
		149	GND		GND	GND	GND	5.0 V	5.0 V	GND	5.0 V	L	L	H	L	H	5.0 V																				
		150	5.0 V	5.0 V	GND	5.0 V		GND	GND	GND	5.0 V	L	L	H	L	H	GND																				
		151			5.0 V		GND	5.0 V	5.0 V	GND	5.0 V	L	L	H	L	H	5.0 V																				
		152			5.0 V		GND	5.0 V	GND	5.0 V	5.0 V	L	L	H	L	H	GND																				
		153			5.0 V		GND	GND	5.0 V	GND	5.0 V	L	L	H	L	H	GND																				
		154			5.0 V		GND	5.0 V	GND	GND	5.0 V	L	L	H	L	H	GND																				
		155			GND		GND	5.0 V	5.0 V	GND	5.0 V	L	L	H	L	H	5.0 V																				
		156	GND		GND		5.0 V		GND	5.0 V	5.0 V	L	L	H	L	H	5.0 V																				
		157	5.0 V		GND		GND		GND	5.0 V	5.0 V	L	L	H	L	H	GND																				
		158	GND		5.0 V		GND		GND	5.0 V	5.0 V	L	L	H	L	H	5.0 V																				
		159	5.0 V		GND		GND		GND	5.0 V	5.0 V	L	L	H	L	H	GND																				
		160			GND		GND		5.0 V	5.0 V	5.0 V	L	L	H	L	H	GND																				
		161			5.0 V		GND		5.0 V	5.0 V	5.0 V	L	L	H	L	H	GND																				
		162			5.0 V		GND		5.0 V	5.0 V	5.0 V	L	L	H	L	H	GND																				
		163			5.0 V		GND		5.0 V	5.0 V	5.0 V	L	L	H	L	H	GND																				
		164	GND	5.0 V	GND		GND		5.0 V	5.0 V	5.0 V	L	L	H	L	H	5.0 V																				
		165	GND	5.0 V	GND		GND		GND	5.0 V	5.0 V	L	L	H	L	H	5.0 V																				

See footnotes at end of device type 51.

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TABLE III. Group A inspection for device type 51 -Continued.

Symbol	MIL-STD-883 method	Cases E, F, 2 Symbol	Terminal conditions 1/															Measured terminal	Test limits			Unit	
			A ₄	B ₃	A ₃	B ₂	A ₂	B ₁	A ₁	V _{SS}	C _{IN}	S ₁	S ₂	S ₃	S ₄	C _{OUT}	B ₄		V _{DD}	Subgroup 9 T _A = 25°C	Subgroup 10 T _A = 125°C		Subgroup 11 T _A = -55°C
			Test no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14		15	16	Min		Max
t _{PHL1} ↓	3003 (Fig. 8)	166	GND	GND	GND	GND	GND	GND	IN	GND	GND	OUT					GND	5.0 V	A ₁ to S ₁				
		167	GND	GND	GND	GND	GND	IN	GND		GND	OUT							B ₁ to S ₁				
		168	GND	GND	GND	GND	GND	IN	GND		GND	OUT							A ₂ to S ₂				
		169	GND	GND	GND	GND	GND	IN	GND		GND	OUT							B ₂ to S ₂				
		170	GND	GND	GND	GND	GND	IN	GND		GND	OUT							A ₃ to S ₃				
		171	GND	IN	GND	GND	GND							OUT	OUT				B ₃ to S ₃				
		172	IN	GND	GND	GND	GND									OUT	OUT		A ₄ to S ₄				
173	GND	GND	GND	GND	GND											IN	B ₄ to S ₄						
t _{PHL2} ↓		174	GND	GND	GND	GND	GND				IN	OUT					GND	C _{IN} to S ₁					
		175	GND	GND	GND	GND	GND						OUT					C _{IN} to S ₂					
		176	GND	GND	GND	GND	GND							OUT					C _{IN} to S ₃				
		177	GND	GND	GND	GND	GND								OUT				C _{IN} to S ₄				
t _{PHL3} t _{PHL3}		178	5.0 V	GND	GND	GND	GND				GND	OUT					OUT	IN	B ₄ to C _{OUT}	750	750	750	
		179	IN	GND	GND	GND	GND				GND	OUT					OUT	5.0 V	A ₄ to C _{OUT}	750	750	750	
t _{PHL4} t _{PHL4}		180	5.0 V	5.0 V	5.0 V	5.0 V	5.0 V	GND	5.0 V			OUT					OUT	GND	C _{IN} to C _{OUT}	300	450	300	
		181	GND	5.0 V	GND	5.0 V	GND	5.0 V	GND			IN	OUT					OUT	5.0 V	C _{IN} to C _{OUT}	300	450	300
t _{PLH1} ↓		182	GND	GND	GND	GND	GND	GND	IN	GND			GND	OUT				GND	A ₁ to S ₁	2900	4350	2900	
		183	GND	GND	GND	GND	GND	IN	GND			GND	OUT					GND	B ₁ to S ₁				
		184	GND	GND	GND	GND	GND	IN	GND			GND	OUT					GND	A ₂ to S ₂				
		185	GND	GND	GND	GND	GND	IN	GND			GND	OUT					GND	B ₂ to S ₂				
		186	GND	IN	GND	GND	GND					GND	OUT					GND	A ₃ to S ₃				
		187	GND	IN	GND	GND	GND					GND	OUT					GND	B ₃ to S ₃				
		188	IN	GND	GND	GND	GND					GND	OUT					GND	A ₄ to S ₄				
189	GND	GND	GND	GND	GND					IN	OUT					IN	B ₄ to S ₄						
t _{PLH2} ↓		190	GND	GND	GND	GND	GND				IN	OUT					GND	C _{IN} to S ₁					
		191	GND	GND	GND	GND	GND						OUT					C _{IN} to S ₂					
		192	GND	GND	GND	GND	GND							OUT					C _{IN} to S ₃				
		193	GND	GND	GND	GND	GND								OUT				C _{IN} to S ₄				
t _{PLH3} t _{PLH3}		194	5.0 V	GND	GND	GND	GND				GND	OUT					OUT	IN	B ₄ to C _{OUT}	750	1125	750	
		195	IN	GND	GND	GND	GND				GND	OUT					OUT	5.0 V	A ₄ to C _{OUT}	750	1125	750	
t _{PLH4} t _{PLH4}		196	5.0 V	5.0 V	5.0 V	5.0 V	5.0 V	5.0 V	5.0 V			OUT					OUT	GND	C _{IN} to C _{OUT}	300	450	300	
		197	GND	5.0 V	GND	5.0 V	GND	5.0 V	GND			IN	OUT					OUT	5.0 V	C _{IN} to C _{OUT}	300	450	300
t _{THL} ↓	3004 (Fig. 8)	198	GND	GND	GND	GND	GND	IN	5.0 V			GND	OUT					GND	S ₁	1000	15000	10000	
		199	GND	GND	GND	GND	GND	IN	5.0 V			GND	OUT					GND	S ₂				
		200	5.0 V	IN	5.0 V	5.0 V	5.0 V	GND	GND			GND	OUT					GND	S ₃				
		201	IN	5.0 V	GND	GND	GND	GND	GND			GND	OUT					5.0 V	S ₄				
		202	IN	GND	GND	GND	GND	GND	GND			GND	OUT					5.0 V	C _{OUT}	520	780	520	
		203	5.0 V	GND	5.0 V	GND	5.0 V	5.0 V	5.0 V			IN	OUT					GND	C _{OUT}	520	780	520	
		204	GND	GND	GND	GND	GND	IN	5.0 V			GND	OUT					GND	S ₁	10000	15000	10000	
t _{TLR} ↓		205	GND	GND	GND	IN	5.0 V	5.0 V	5.0 V			GND	OUT					5.0 V	S ₂				
		206	GND	5.0 V	IN	5.0 V	5.0 V	GND	GND			GND	OUT					5.0 V	S ₃				
		207	IN	5.0 V	5.0 V	GND	GND	GND	GND			GND	OUT					5.0 V	S ₄				
		208	IN	GND	GND	GND	GND	GND	GND			GND	OUT					5.0 V	C _{OUT}	520	780	520	
		209	5.0 V	GND	5.0 V	GND	5.0 V	5.0 V	5.0 V			IN	OUT					GND	C _{OUT}	520	780	520	

See footnotes at end of device type 51.

- 1/ Pins not designated may be high level logic, low level logic, or open. Exceptions are as follows: $V_{IC(POS)}$ tests, the V_{SS} terminal shall be open; $V_{IC(NEG)}$ tests, the V_{DD} terminal shall be open; I_{SS} tests, the output terminals shall be open.
- 2/ The I_{SS} test measurements shall be performed in sequence.
- 3/ The following timing sequence and input/output conditions shall apply:

Inputs				Outputs	
A_N	B_N	C_{IN}	$*C_{INT}$	C_{OUT}	Sum
L	L	L	L	L	L
H	L	L	L	L	H
L	H	L	L	L	H
H	H	L	H	L(H**)	L
L	L	H	L	L	H
H	L	H	H	L(H**)	L
L	H	H	H	L(H**)	L
H	H	H	H	L(H**)	H

*Internal carry

** C_{OUT} = H when $N = 4$

Input/output conditions

Test	V_{DD} Volts	Input levels		Output levels	
		1	0	1 Min	0 Max
V_{IH1} V_{IL1}	5.0	V_{DD} 3.5 V	1.5 V V_{SS}	4.5 V	0.5 V
V_{IH2} V_{IL2}	10.0	V_{DD} 7.0 V	3.0 V V_{SS}	9.0 V	1.0 V
V_{IH3} V_{IL3}	15.0	V_{DD} 11.0 V	4.0 V V_{SS}	13.5 V	1.5 V

- 4/ The device manufacturer may, at his option, measure I_{IL} and I_{IH} at 25°C for individual input or measure all inputs together.
- 5/ See 4.4.1c.
- 6/ The truth table tests shall be performed in sequence.
- 7/ The truth table tests shall be performed at V_{IH} and $V_{DD} \leq 5$ Vdc and ≥ 18 Vdc. $L = V_{SS} + 0.50$ V maximum and $H = V_{DD} - 0.50$ Vdc.

2. Dynamic tests (test condition D) use circuit shown on figure 7, or equivalent. T_A shall be 125°C minimum. Test duration shall be in accordance with table I method 1015.
- c. Interim and final electrical test parameters shall be as specified in table II herein.
- d. For class S devices, post dynamic burn-in, or class B devices, post static burn-in, electrical parameter measurements may, at the manufacturer's option, be performed separately or included in the final electrical parameter measurements.

4.2.1 Percent defective allowable (PDA).

- a. The class S devices PDA shall be 5 percent for static burn-in and 5 percent for dynamic burn-in, based on the exact number of devices submitted to each separate burn-in.
- b. Static burn-in I and II failures shall be cumulative for determining PDA.
- c. The class B devices PDA shall be in accordance with MIL-M-38510. Dynamic burn-in is not required.
- d. Those devices whose measured characteristics after burn-in exceed the specified delta (Δ) limits or electrical parameter limits specified in table III, subgroup 1, are defective and shall be removed to the burn-in lot. The verified failures divided by the total number of devices in the lot initially submitted to burn-in shall be used to determine the percent defective for the lot, and the lot shall be accepted or rejected based on the specified PDA.

4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, D, and E inspections (see 4.4.1 through 4.4.5).

4.3.1 Qualification extension. When authorized by the qualifying activity, for qualification inspection, if a manufacturer qualifies to a 51 device type which is manufactured identically to a 01 device type on this specification. Then the 01 device type may be part I qualified by conducting only group A electrical tests and any electricals specified as additional group C subgroups and submitting data in accordance with MIL-M-38510, appendix (i.e., groups A, B, C, D, and E tests are not required).

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-M-38510 and as specified herein. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, D, and E inspections (see 4.4.1 through 4.4.5).

4.4.1 Group A inspection. Group A inspection shall be in accordance with table I of method 5005 of MIL-STD-883 and as follows:

- a. Tests shall be as specified in table II herein.
- b. Subgroups 5 and 6 of table I of method 5005 of MIL-STD-883 shall be omitted.
- c. Subgroup 4 (C_i measurements) shall be measured only for initial qualification and after process or design changes which may affect input capacitance. Capacitance shall be measured between the designated terminal and V_{SS} at a frequency of 1 MHz.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of method 5005 of MIL-STD-883 and as follows:

- a. Class S steady state life (accelerated) test circuits shall be submitted to the qualifying activity for approval. When the alternate steady state life test is used, the circuit on figure 3, or equivalent, shall be used.
- b. A special subgroup shall be added using an LTPD of 15 for class S and B, and shall be performed on each inspection lot for device types 01, and measured only for initial qualification and after process or design changes for device types 51. This subgroup shall consist of a high voltage test of the input protection circuits, V_{ZAP} (see 4.5.3).

- c. End point electrical parameters shall be as specified in table II herein, and shall consist of those subgroups specified in table IIa of test method 5005 of MIL-STD-883, and table II herein also. Delta limits shall apply only to subgroup 5 of group B inspections, and shall consist of tests specified in table IV herein.

4.4.3 Group C inspection. Group C inspection shall be in accordance with table III of method 5005 of MIL-STD-883 and as follows:

- a. End-point electrical parameters shall be as specified in table II herein. Delta limits shall apply only to subgroup 1 of group C inspection, and shall consist of tests specified in table IV herein.
- b. Steady state life test (method 1005 of MIL-STD-883) conditions:
 1. Test condition D, as specified in 4.5.2, and as shown on figure 5, or equivalent.
 2. $T_A = 125^\circ\text{C}$, minimum.
 3. Test duration: 1,000 hours, except as permitted by appendix B of MIL-M-38510 and method 1005 of MIL-STD-883.

4.4.4 Group D inspection. Group D inspection shall be in accordance with table IV of method 5005 of MIL-STD-883. End-point electrical parameters shall be as specified in table II herein.

4.4.5 Group E inspection. Group E inspection is required only for device types intended to be marked as radiation hardened (see 3.6.1). When group E testing is performed it shall be in accordance with table V of method 5005 of MIL-STD-883 and 4.5.5 herein.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows:

4.5.1 Voltage and current. All voltages given are referenced to the microcircuit V_{SS} terminal, unless otherwise specified. Currents given are conventional current and positive when flowing into the referenced terminal.

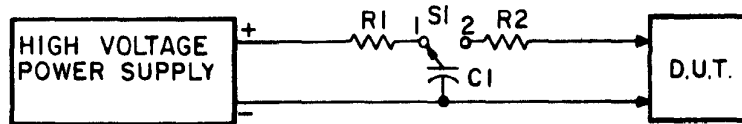
4.5.2 Burn-in and life test cooldown procedures. When these tests are completed and prior to removal of bias voltages, the devices under test (DUT) shall be cooled to a temperature of $25^\circ \pm 3^\circ\text{C}$, and the electrical parameter end-point measurements shall then be performed.

TABLE IV. Delta limits at 25°C .

Parameter	Device type	
	01	51
I_{SS}	$\pm 125\text{ nA}$	$\pm 125\text{ nA}$
V_{OL1}	$\pm .04\text{ V}$	---
V_{OH1}	$\pm .08\text{ V}$	---
I_{OL1}	---	$\pm 15\text{ percent}$
I_{OH1}	---	$\pm 15\text{ percent}$

NOTE: Each of the above parameters shall be recorded before and after the required burn-in and life tests to determine delta's (Δ).

4.5.3 High voltage (V_{ZAP}) test of input protection circuits. All input terminals (up to a maximum of four) of the DUT shall be subjected to a voltage pulse from a 100 pF source charged to 400 volts. This destructive test shall be conducted as follows using the test circuit on figure 7.



NOTES:

1. V_{ZAP} = 400 V charge on C1.
2. $1\text{ M}\Omega < R1 < 50\text{ M}\Omega$.
3. $R2 = 1.5\text{ k}\Omega$.
4. $C1 = 100\text{ pF}$.
5. S1 = Hg-wetted "bounceless" relay.

FIGURE 7. High voltage (V_{ZAP}) test circuit.

- a. Measure I_{IL} and I_{IH} at the inputs selected, as stated above, at 25°C . The test limit for each input tested shall be $\pm 10\text{ nA}$ at the specified V_{DD} . Measure I_{SS} on the DUT at 25°C . The test limit for this measurement shall be increased a maximum of 20 percent of the specified I_{SS} table III limit at the specified V_{DD} .
- b. V_{ZAP} is applied to the DUT in the following modes (see table V) by charging C1 to V_{ZAP} with S1 in position 1 and then switching to position 2.

TABLE V. Modes for high-voltage test.

Mode	+ Terminal	- Terminal
1	V_{DD}	Input
2	Input	V_{SS}
3	Input	Associated output

- c. Within 24 hours repeat the I_{SS} , I_{IH} , and I_{IL} measurements on the same terminals as performed above. If the DUT exhibits leakage currents in excess of the specified limits after the V_{ZAP} test, it shall be classified as a failure.

4.5.4 Quiescent supply current (I_{SS}) test. When performing quiescent supply current measurements (I_{SS}), the meter shall be placed so that all currents flow through the meter.

4.5.5 Radiation hardness assurance (RHA) testing. The RHA testing shall be performed in accordance with test procedures and sampling specified in table V of method 5005 of MIL-STD-883 and herein:

- a. Before irradiation, selected samples shall be assembled in qualified packages and pass the governing electrical parameters (group A subgroup 1 at 25°C) and also be subjected to the threshold-voltage test in table VIII in order to calculate the delta threshold (ΔV_T) after irradiation.
- b. The devices shall be subjected to a total radiation dose as specified in MIL-M-38510 for the radiation hardness assurance (RHA) level being tested and meet the end point electrical parameters as defined in table VI at 25°C , after exposure. The start and completion of the end point electrical parameter measurements shall not exceed 2 hours following irradiation.

- c. Threshold-voltage test circuit conditions shall be as specified in table VIII and figure 7. In situ and remote testing, the tests shall be performed with the devices biased in accordance with table VII and bias may be interrupted for up to 1 minute to remove devices to the remote bias fixture.
- d. After irradiation, the devices shall pass the truth table test as specified in subgroup 7 in table III or if subgroup 7 is not required, then an equivalent truth table test shall be performed.

TABLE VI. Radiation hardness end-point electrical parameters at 25 °C.

Parameter	Test limits (all device types)	V _{DD}	
		Device 01	Device 51
V _{TN}	0.3 V min	10 V dc	10 V dc
V _{TP}	2.8 V max	10 V dc	10 V dc
ΔV _T	1.4 V max	10 V dc	10 V dc
I _{SS}	100 x max limit	15 V dc	18 V dc
t _{PLH}	1.35 x max limit	5 V dc	5 V dc
t _{PHL}	1.35 x max limit	5 V dc	5 V dc

TABLE VII. Bias during exposure to radiation.

Device type	Pin connections 1/		
	10 V dc through a 30 kΩ to 60 kΩ resistor	V _{SS} = GND	V _{DD} = 10 V dc
01 and 51	1,2,3,4,5,6,7,9,15	8	16

1/ Pins not designated are open or connected to 10 V dc through a 30 kΩ to 60 kΩ resistor.

4.6 Data reporting. When specified in the purchase order or contract, a copy of the following data, as applicable, shall be supplied:

- a. Attributes data for all screening tests (see 4.2) and variables data for all static burn-in, dynamic burn-in, and steady state life tests.
- b. A copy of each radiograph.
- c. The quality conformance inspection data (see 4.4).
- d. Parameter distribution data on parameters evaluated during burn-in (see 3.5).
- e. Final electrical parameter data (see 4.2c).

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Intended use. Microcircuits conforming to this specification are intended for original equipment design applications and logistic support of existing equipment.

6.2 Ordering data. The acquisition document should specify the following:

- a. Complete part number (see 1.2).
- b. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- c. Requirements for certificate of compliance, if applicable.

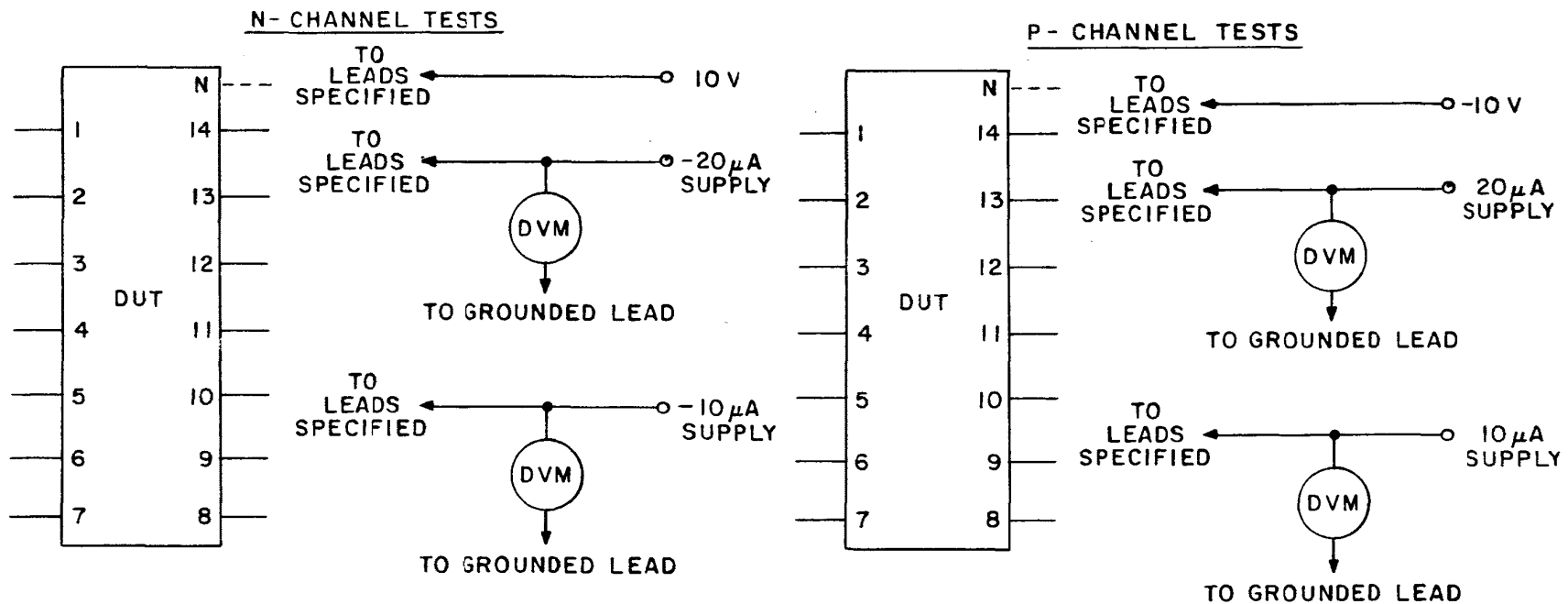


FIGURE 7. Threshold-voltage test current.

TABLE VIII. Threshold-voltage test circuit conditions.

Device type	GND	10 V	V_{IN} measured at		GND	-10 V	V_{TP} measured at	
			-20 μ A supply	-10 μ A supply			20 μ A supply	10 μ A supply
01 51	9	2, 4, 6, 15, 16	1,3,5,7,8		9	1,3,5,7,8	2, 4, 6, 15, 16	

- d. Requirements for notification of change of product or process to procuring activity in addition to notification to the qualifying activity, if applicable.
- e. Requirements for failure analysis (including required test condition of method 5003 of MIL-STD-883), corrective action, and reporting of results, if applicable.
- f. Requirements for product assurance options.
- g. Requirements for special carriers, lead lengths, or lead forming, if applicable. These requirements shall not affect the part number. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.
- h. Requirements for "JAN" marking.
- i. Requirements for total dose radiation testing (see 3.6.1 and 4.5.5), if applicable.

6.3 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-M-38510, MIL-STD-1331, and as follows:

Ci	- - - - -	Input terminal-to-V _{SS} capacitance.
C _{IN}	- - - - -	Carry-in count from preceding stage.
C _{INT}	- - - - -	Internal count carry.
C _{OUT}	- - - - -	Carry-out count to next stage.
GND	- - - - -	Ground. Zero voltage potential.
T _A	- - - - -	Free air temperature.
V _{ZAP}	- - - - -	Input test voltage.
V _{IC}	- - - - -	Input clamp voltage.
V _{DD}	- - - - -	Positive supply voltage.
V _{SS}	- - - - -	Negative supply voltage.
I _{SS}	- - - - -	Quiescent supply current.

6.4 Logistic support. Unless otherwise specified, microcircuits procured for Government logistic support shall be procured to device class S for National Aeronautics and Space Administration or class B for Department of Defense (see 1.2.2), and lead finish C (see 3.3). Longer length leads and lead forming shall not affect the part number.

6.5 Substitutability. The cross-reference information below is presented for the convenience of users. Microcircuits covered by this specification will functionally replace the listed generic-industry type. Generic-industry microcircuit types may not have equivalent operational performance characteristics across military temperature ranges or reliability factors equivalent to MIL-M-38510 device types and may have slight physical variations in relation to case size. The presence of this information shall not be deemed as permitting substitution of generic-industry types for MIL-M-38510 types or as a waiver of any of the provisions of MIL-M-38510.

<u>Military device type</u>	<u>Generic-industry type</u>
01	4008A
51	4008B

6.6 Handling. MOS devices must be handled with certain precautions to avoid damage due to accumulation of static charge. Input protection devices have been designed in the chip to minimize the effect of this static buildup. However, the following handling practices are recommended:

- a. Devices should be handled on benches with conductive and grounded surfaces.
- b. Ground test equipment and tools.
- c. Do not handle devices by the leads.
- d. Store devices in conductive foam or carriers.
- e. Avoid use of plastic, rubber, or silk in MOS areas.
- f. Maintain relative humidity above 50 percent, if practical.

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Custodians:

Army - ER
Navy - EC
Air Force - 17
NASA - NA

Preparing activity:
NASA - NA

(Project 5962-0638-4)

Review activities:

Army - MI
Air Force - 11, 19, 85, 99
DLA - ES

User activities:

Army - AR, SM
Navy - AS, OS, CG, MC, SH

Agent:

DLA - ES