MILITARY SPECIFICATION

MICROCIRCUITS, DIGITAL, CMOS, DECODER, MONOLITHIC SILICON, POSITIVE LOGIC

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 outlines and lead finishes are provided 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:

Device type	Circuit
01	BCD to decimal decoder
51	BCD to decimal decoder

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:

Outline letter	Case outline (see MIL-M-38510, appendix C)
E	D-2 (16-lead, 1/4" x 7/8"), dual-in-line package
F	F-5 (16-lead, 1/4" x 3/8"), flat package
Z	F-5 (16-lead, 1/4" x 3/8"), flat package, except A dimensions = 0.1 (2.54 mm) max.

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 inut)	±10 mA
Input voltage range	V_{SS} = -0.5 V $\leq V_I \leq V_{DD}$ +0.5 V
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 (θ_{JC}):	(See MIL-M-38510, appendix C)
Junction temperature (T_J)	+175°C

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 outlines F-5 or F-6) may have electroless nickel undercoating which shall be 50 to 200 microinches (1.27 to 5.08 µm) 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 braded packages, case outline Z only, the S_1 dimension may go to .000 inch (.00 mm) mimimum.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: National Aeronautics and Space Administration, George C, Marshall Space Flight Center, ATTN: EG02, Marshall Space Flight Center, Alabama 35812 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Recommended operating conditions.

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

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, or equivalent which is cured at 200° ±10°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 Logic diagrams and terminal connections. The logic diagrams and terminal connections shall be as specified on figure 1.

3.2.2 Truth tables and logic equations. The truth tables and logic equations shall be as specified on figure 2.

3.2.3 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.

3.2.4 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 lines 1 through 7 of table II herein.

b. Burn-in (method 1015 of MIL-STD-883).

(1) Static tests (test condition A) using 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 of method 1015 for class B devices.

(2) Dynamic test (test condition D) using circuit shown on figure 5 or equivalent. Ambient temperature (T_A) shall be 125°C minimum. Test duration shall be in accordance with table I of method 1015.

c. Interim and final electrical 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 requirements.

4.2.1 Percent defective allowable (PDA).

a. The PDA for class S devices 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 for static burn-in. 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 from the lot. The verified failures divided by the total number of devices in 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, 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 D (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 performed in accordance with table II herein.

b. Subgroups 5, 6, 7, and 8 of table I of method 5005 of MIL-STD-883 shall be omitted.

c. Subgroup 4 (C_i measurement) 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.

d. Subgroup 12 shall be added to the group A inspection requirements for class S devices using an LTPD of 15 and consist of the procedures, test conditions, and limits specified in table III.

e. At the manufacturer's option, test tapes may be programmed simultaneously for each identical section provided that each output is measured and each specified input combination is tested.

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 5, or equivalent, shall be used.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions V_{SS}= 0 V, -55°C ≤ T_A ≤ 125°C, Unless otherwise specified	Device type	Limits Min	Limits Max	Unit
Positive clamping input to V_{DD}	V_{IC}(pos)	T_A=25°C, I_I=1 mA; V_{DD}=GND, V_{SS}=Open, Outputs = Open	All		1.5	Vdc
Negative clamping input to V_{DD}	V_{IC}(neg)	T_A=25°C, I_I= -1 mA; V_{DD}= Open, V_{SS}= GND, Outputs = Open	All		-6	Vdc
Quiescent supply current	I_{SS}	See table III; V_{DD}= 15 V	01		-10	µA
		V_{DD}= 18 V	51		-10	µA
High level output voltage	V_{OH1}	V_{DD}=5.0 Vdc, No load	01	4.95		Vdc
	V_{OH2}	V_{DD}=10 Vdc, No load	01	9.95		Vdc
	V_{OH3}	V_{DD}= 15 Vdc, No load	51	14.95		Vdc
Low level output voltage	V_{OL1}	V_{DD}= 5.0 Vdc, No load	01		50	mVdc
	V_{OL2}	V_{DD}= 10 Vdc, No load	01		50	mVdc
	V_{OL3}	V_{DD}= 15 Vdc, No load	51		50	mVdc
Input high voltage	V_{IH1}	V_{DD}= 5.0 Vdc, V_O = 0.5 V, $\lvert I_O \rvert \leq 1$ µA	51	3.5		Vdc
	V_{IH2}	V_{DD}= 10 Vdc, V_O= 1.0 V, $\lvert I_O \rvert \leq 1$ µA	51	7.0		Vdc
	V_{IH3}	V_{DD}= 15 Vdc, V_O = 1.5 V, $\lvert I_O \rvert \leq 1$ µA	51	11.0		Vdc
Input low voltage	V_{IL1}	V_{DD} = 5.0 Vdc, V_O = 4.5 V, $\lvert I_O \rvert \leq 1$ µA	51		1.5	Vdc
	V_{IL2}	V_{DD}= 10 Vdc, V_O = 9 Vdc, $\lvert I_O \rvert \leq 1$ µA	51		3.0	Vdc
	V_{IL3}	V_{DD}= 15 Vdc, V_O = 13.5 V, $\lvert I_O \rvert \leq 1$ µA	51		4.0	Vdc
Output low (sink) current	I_{OL1}	V_{DD} = 5.0 Vdc, V_{OL} = 0.5 Vdc	01	700		µAdc
	I_{OL2}	V_{DD} = 5.5 Vdc, V_{OL} = 0.5 Vdc	01	800		µAdc
	I_{OL3}	V_{DD} = 5.0 Vdc, V_{OL} = 0.4 Vdc	51	360		µAdc
	I_{OL4}	V_{DD} = 15 Vdc, V_{OL} = 1.5 Vdc	51	2.4		mAdc

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions V_{SS} = 0 V $-55°C \leq T_A \leq 125°C$, Unless otherwise specified		Device type	Limits Min	Limits Max	Unit
Output high (source) current	I_{OH1}	V_{DD} = 4.5 Vdc V_{OH} = 2.5 Vdc		01	-850		µAdc
	I_{OH2}	V_{DD} = 5.0 Vdc V_{OH} = 4.5 Vdc		01	-445		µAdc
	I_{OH3}	V_{DD} = 5.0 Vdc V_{OH} = 4.6 Vdc		51	-360		µAdc
	I_{OH4}	V_{DD} = 15.0 Vdc V_{OH} = 13.5 Vdc		51	-2.4		mAdc
Input leakage 1/ current (high)	I_{IH}	Measure inputs sequentially	V_{DD} = 15 V	01		45	nA
			V_{DD} = 18 V	51		45	nA
Input leakage current (low)	I_{IL}	Measure inputs sequentially	V_{DD} = 15 V	01		-45	nA
			V_{DD} = 18 V	51		-45	nA
Input voltage test	V_{ZAP}	C_L = 100 pF R_2 = 1.5 KΩ (see 4.5.3)		All	400		V
Input capacitance test	C_i	V_{DD} = 0 Vdc f = 1 MHz T_A = 25°C		All		12	pF
Propagation delay time	t_{PHL1}	V_{DD} = 5.0 Vdc R_L = 200 KΩ C_L = 50 pF (see figure 6)		All	27	740	ns
	t_{PLH1}			All	27	740	ns
Transition time	t_{THL1}	V_{DD} = 5.0 Vdc R_L = 200 KΩ C_L = 50 pF		All	13	360	ns
	t_{TLH1}			All	13	360	ns

1/ Input current of 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		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	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					4.4.3	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		

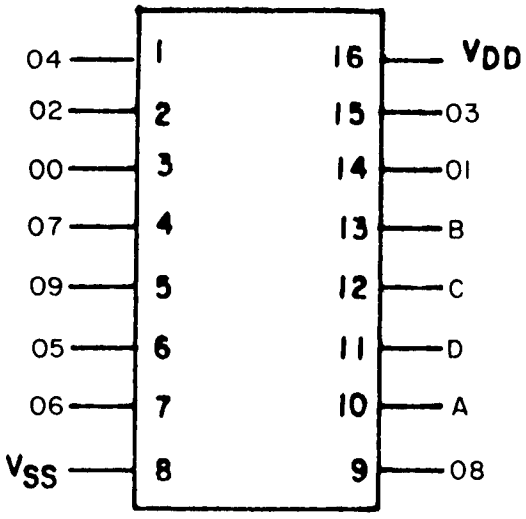
1/ (Δ) indicates delta limit shall be required on table III subgroup 1 where specified, and delta values shall be computed with reference to the previous interim electrical parameters.

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.

Device types 01 and 51



Cases E, F and Z

FIGURE 1. Terminal connections.

Device types 01 and 51

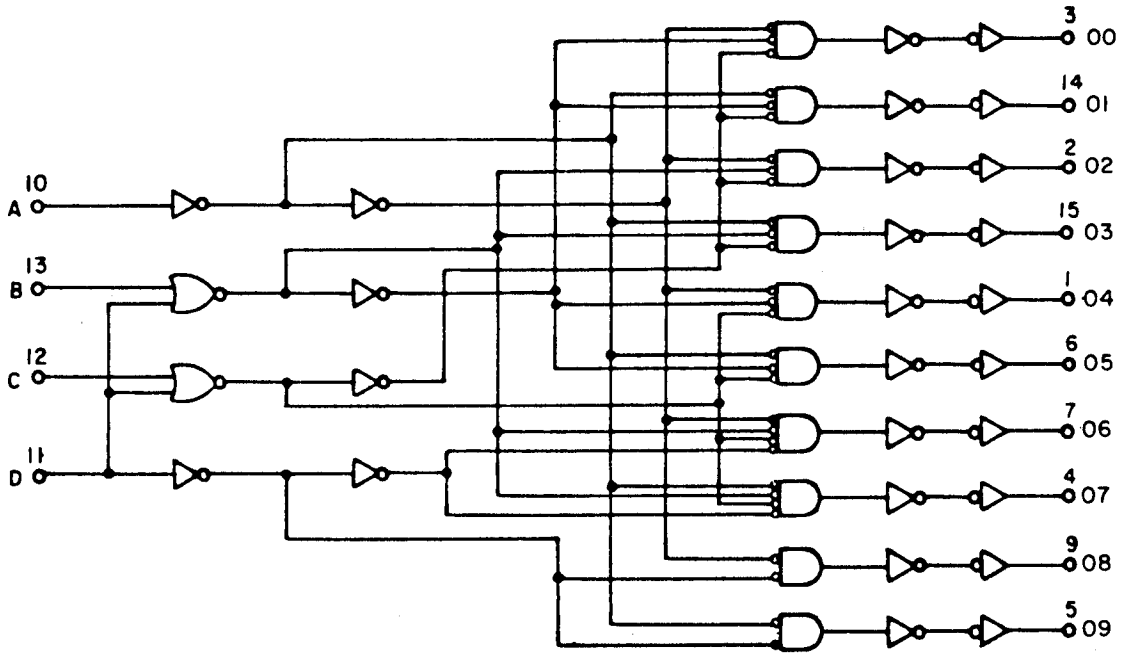
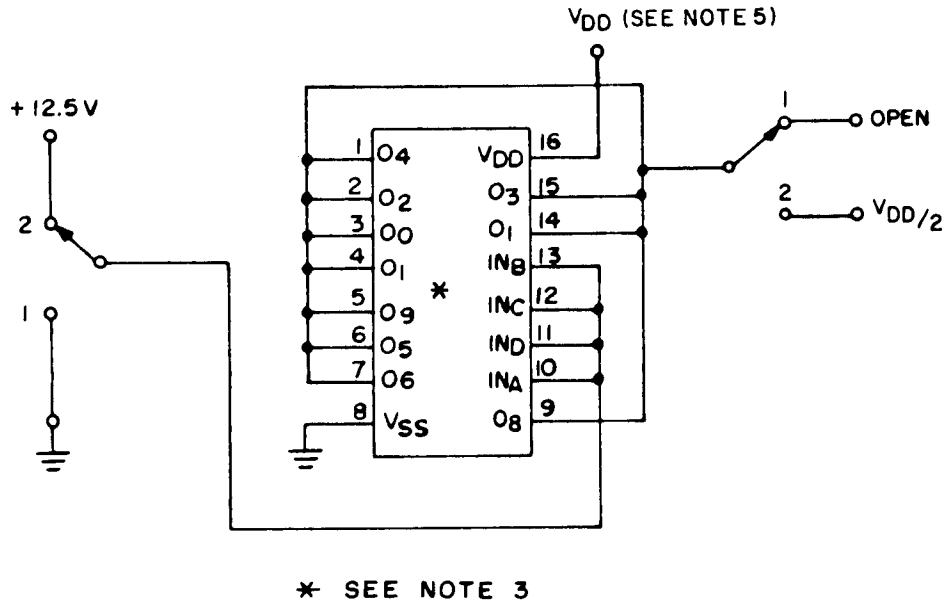


FIGURE 2. Logic diagram.

Device types 01 and 51

INPUTS				OUTPUTS									
D	C	B	A	0	1	2	3	4	5	6	7	8	9
L	L	L	L	H	L	L	L	L	L	L	L	L	L
L	L	L	H	L	H	L	L	L	L	L	L	L	L
L	L	H	L	L	L	H	L	L	L	L	L	L	L
L	L	H	H	L	L	L	H	L	L	L	L	L	L
L	H	L	L	L	L	L	L	H	L	L	L	L	L
L	H	L	H	L	L	L	L	L	H	L	L	L	L
L	H	H	L	L	L	L	L	L	L	H	L	L	L
L	H	H	H	L	L	L	L	L	L	L	H	L	L
H	L	L	L	L	L	L	L	L	L	L	L	H	L
H	L	L	H	L	L	L	L	L	L	L	L	L	H
H	L	H	L	L	L	L	L	L	L	L	L	L	L
H	L	H	H	L	L	L	L	L	L	L	L	L	L
H	H	L	L	L	L	L	L	L	L	L	L	L	L
H	H	L	H	L	L	L	L	L	L	L	L	L	L
H	H	H	L	L	L	L	L	L	L	L	L	L	L
H	H	H	H	L	L	L	L	L	L	L	L	L	L

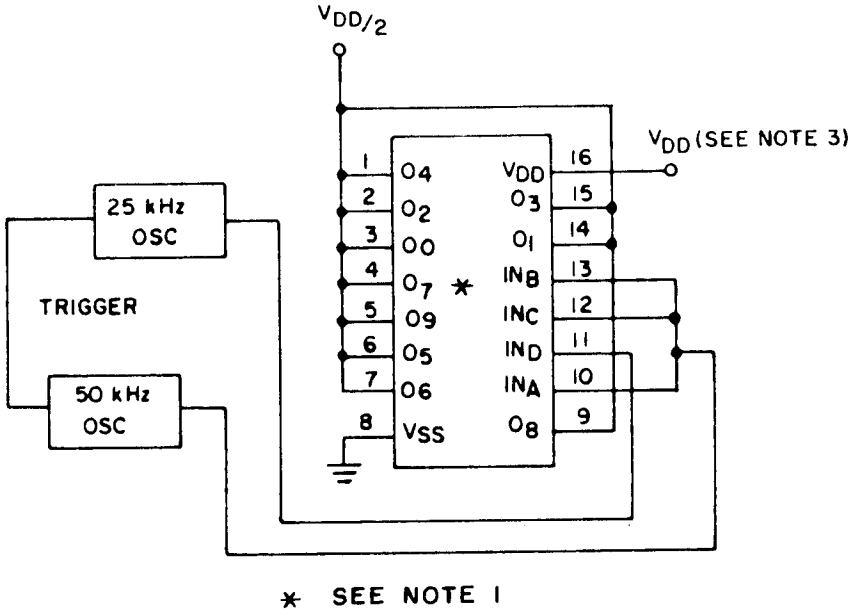
FIGURE 3. Truth table.



* SEE NOTE 3

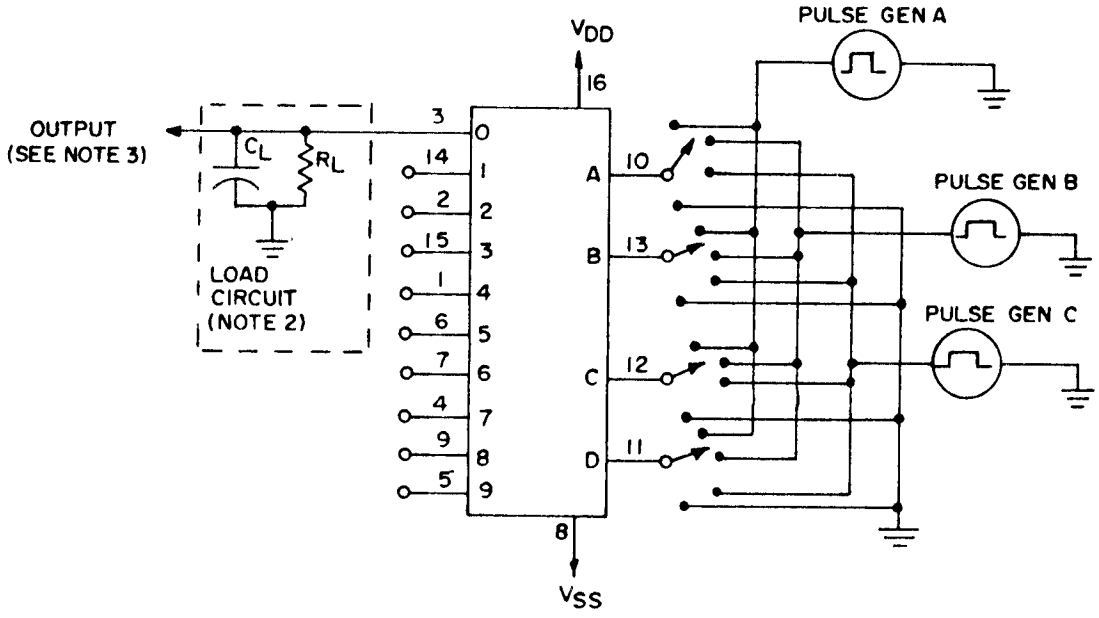
NOTES:
1. For static burn-in I, all inputs are connected to 0 volts, switch position 1.
2. For static burn-in II, all inputs are connected to V_{DD}, switch position 2.
3. Except for V_{DD} and V_{SS}, each terminal shall be connected through a resistor whose value is 2 kΩ to 47 kΩ. The actual measured value of the resistor selected shall not exeed ±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.
   $V_{DD/2}$ = $V_{DD/2}$ ±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 kΩ to 47 kΩ. The actual measured value of the resistor selected shall not exceed ±20% of its branded value due to use, heat or age.
2. Input signal requirements:
   a. Square wave, 50% duty cycle.
   b. 25 kHz < PRR < 1 MHz.
   c. t_{TLH} and t_{THL} < 1 µs.
   d. Voltage level:
      Minimum = V_{SS} -0.5 V, +10% V_{DD}.
      Maximum = V_{DD} +0.5, -10% V_{DD}.
3. V_{DD} = 12.5 V minimum, 15.0 V maximum for device types 01.
   V_{DD} = 15 V minimum, 18 V maximum for device types 51.
   $V_{DD/2}$ = $V_{DD}/2$ ±1.0 V.
   V_{SS} = 0.0 V.

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



NOTES:
1. The pulse generator shall have the following characteristics: $V_{gen} = V_{DD} \pm 1\%$; $t_r = t_f = \leq 20$ ns, f = 100 kHz; 50% duty cycle.
2. Load conditions: R_L = 200 kΩ ±10%, C_L = 50 pF (including probe and jig).
3. Connect each output terminal to a load circuit as shown.

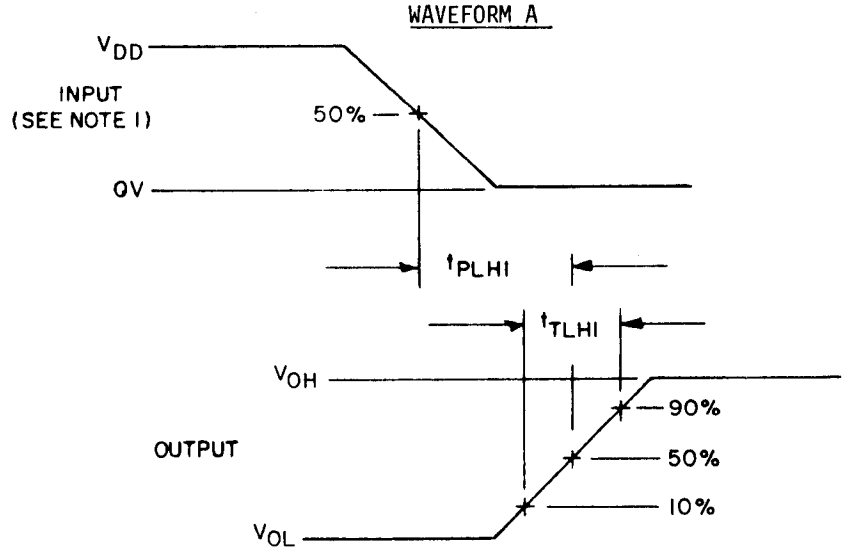
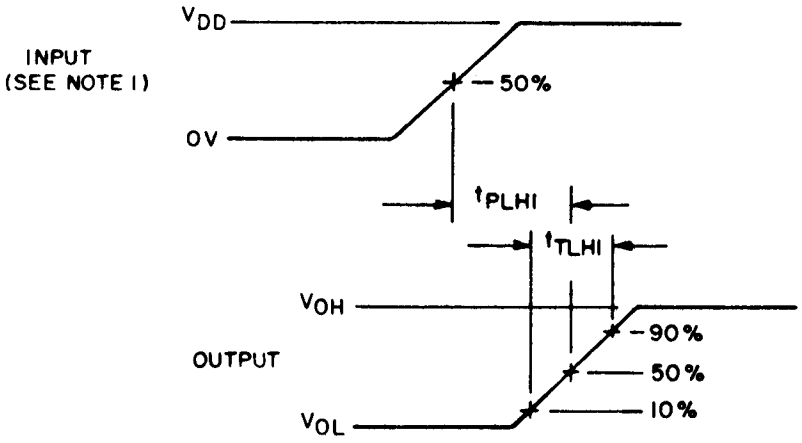


FIGURE 6. Transition/propagation delay time test circuit and waveforms.

WAVEFORM B



WAVEFORM C

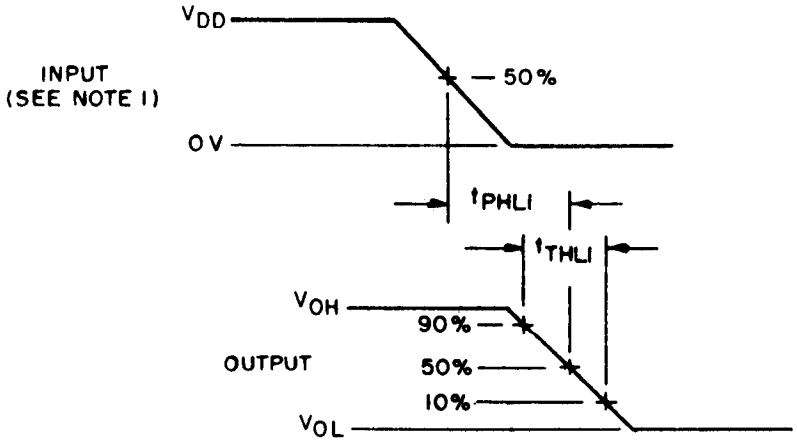


FIGURE 6. Transition/propagation delay time test circuit and waveforms - Continued.

TABLE III. Group A inspection for device type 01.

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 6/																Measured terminal	Test limits						Unit
																				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	16		Min	Max	Min	Max	Min	Max	
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}								
I_{SS}	3005	1								GND		GND	GND	GND	GND			15 V	V_{SS}		-1		-10			µA
		2										15 V			GND											
		3										GND			15 V											
		4										15 V			15 V											
		5										GND		15 V	GND											
		6										15 V			GND											
		7										GND			15 V											
		8										15 V			15 V											
		9										GND	15 V	GND	GND											
		10										15 V	15 V	GND	GND											
I_{IL1} 8/	3009	11										GND	GND	GND	GND				All inputs		-4.0					nA
I_{IL2}		12										GND	15 V	15 V	15 V				IN_A		-1.0		-45.0			
		13										15 V	GND	15 V	15 V				IN_D							
		14											15 V	GND	15 V				IN_C							
		15											15 V	15 V	GND				IN_B							
I_{IH1} 8/	3010	16											15 V	15 V	15 V				All inputs		4.0					
I_{IH2}		17																	IN_A		1.0		45.0			
		18											15 V						IN_D							
		19												15 V					IN_C							
		20													15 V				IN_B							
$V_{IC(POS)}$		21										1 mA						GND	IN_A		1.5					V
		22											1 mA						IN_D							
		23												1 mA					IN_C							
		24													1 mA				IN_B							
$V_{IC(NEG)}$		25								GND		-1 mA							IN_A		-6.0					
$V_{IC(NEG)}$		26								GND			-1 mA						IN_D		-6.0					

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 6/															Measured terminal	Test limits						Unit
																			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	16							
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
$V_{IC(NEG)}$	3010	27								GND				-1 mA					IN_C		-6.0					V
$V_{IC(NEG)}$	3010	28													-1 mA				IN_B		-6.0					
V_{OH1}	3006 1/	29										V_{IL}	V_{IL}	V_{IL}	V_{IL}			5.0 V	O_0	4.95		4.95		4.95		
		30										V_{IH}			V_{IL}				O_1							
		31										V_{IL}			V_{IH}				O_2							
		32										V_{IH}		V_{IH}	V_{IH}				O_3							
		33										V_{IL}		V_{IH}	V_{IL}				O_4							
		34										V_{IH}			V_{IL}				O_5							
		35										V_{IL}			V_{IH}				O_6							
		36										V_{IH}		V_{IH}	V_{IH}				O_7							
		37										V_{IL}	V_{IH}	V_{IL}	V_{IL}				O_8							
		38										V_{IH}	V_{IH}						O_9							
V_{OL1}	3007 1/	39										V_{IL}	V_{IL}						O_1		50		50		50	mV
		40										V_{IH}			V_{IH}				O_2							
		41										V_{IL}			V_{IH}				O_3							
		42										V_{IH}		V_{IH}	V_{IH}				O_4							
		43										V_{IL}		V_{IH}	V_{IL}				O_5							
		44										V_{IH}			V_{IL}				O_6							
		45										V_{IL}			V_{IH}				O_7							
		46										V_{IH}		V_{IH}	V_{IH}				O_8							
		47										V_{IL}	V_{IH}	V_{IL}	V_{IL}				O_9							
		48										V_{IH}	V_{IH}						O_0							
V_{OH2}	3006 2/	49										V_{IL}	V_{IL}					10.0 V	O_0	9.95		9.95		9.95		V
		50										V_{IH}			V_{IH}				O_1							
		51										V_{IL}			V_{IH}				O_2							
		52										V_{IH}			V_{IH}				O_3							

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 6/															Measured terminal	Test limits						Unit
																			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	16							
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
V_{OH2}	3006 2/	53								GND		V_{IL}	V_{IL}	V_{IH}	V_{IL}			10.0 V	O_4	9.95		9.95		9.95		V
		54										V_{IH}			V_{IL}				O_5							
		55										V_{IL}			V_{IH}				O_6							
		56										V_{IH}			V_{IH}				O_7							
		57										V_{IL}	V_{IH}	V_{IL}	V_{IL}				O_8							
		58										V_{IH}	V_{IH}						O_9							
V_{OL2}	3007 2/	59										V_{IL}	V_{IL}						O_1		50		50		50	mV
		60										V_{IH}							O_2							
		61										V_{IL}			V_{IH}				O_3							
		62										V_{IH}			V_{IH}				O_4							
		63										V_{IL}		V_{IH}	V_{IL}				O_5							
		64										V_{IH}			V_{IL}				O_6							
		65										V_{IL}			V_{IH}				O_7							
		66										V_{IH}			V_{IH}				O_8							
		67										V_{IL}	V_{IH}	V_{IL}	V_{IL}				O_9							
		68										V_{IH}	V_{IH}						O_0							
I_{OH1}	1/	69			2.5 V							V_{IL}	V_{IL}					4.5 V	O_0	-900		-850		-900		µA
		70										V_{IH}				2.5 V			O_1							
		71		2.5 V								V_{IL}			V_{IH}				O_2							
		72										V_{IH}			V_{IH}		2.5 V		O_3							
		73	2.5 V									V_{IL}		V_{IH}	V_{IL}				O_4							
		74						2.5 V				V_{IH}			V_{IL}				O_5							
		75							2.5 V			V_{IL}			V_{IH}				O_6							
		76				2.5 V						V_{IH}			V_{IH}				O_7							
		77									2.5 V	V_{IL}	V_{IH}	V_{IL}	V_{IL}				O_8							
		78					2.5 V					V_{IH}	V_{IH}	V_{IL}	V_{IL}				O_9							

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 6/															Measured terminal	Test limits						Unit
																			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	16							
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
I_{OH2}	1/	79			4.5 V					GND		V_{IL}	V_{IL}	V_{IL}	V_{IL}			5.0 V	O_0	-520		-445		-520		µA
		80										V_{IH}			V_{IL}	4.5 V			O_1							
		81		4.5 V								V_{IL}			V_{IH}				O_2							
		82										V_{IH}			V_{IH}		4.5 V		O_3							
		83	4.5 V									V_{IL}		V_{IH}	V_{IL}				O_4							
		84						4.5 V				V_{IH}			V_{IL}				O_5							
		85							4.5 V			V_{IL}			V_{IH}				O_6							
		86				4.5 V						V_{IH}			V_{IH}				O_7							
		87									4.5 V	V_{IL}	V_{IH}	V_{IL}	V_{IL}				O_8							
		88					4.5 V					V_{IH}	V_{IH}						O_9							
I_{OL1}		89										V_{IL}	V_{IL}			0.5 V			O_1	700		900		700		
		90		0.5 V								V_{IH}							O_2							
		91										V_{IL}			V_{IH}		0.5 V		O_3							
		92	0.5 V									V_{IH}			V_{IH}				O_4							
		93						0.5 V				V_{IL}		V_{IH}	V_{IL}				O_5							
		94							0.5 V			V_{IH}			V_{IL}				O_6							
		95				0.5 V						V_{IL}			V_{IH}				O_7							
		96									0.5 V	V_{IH}			V_{IH}				O_8							
		97					0.5 V					V_{IL}	V_{IH}	V_{IL}	V_{IL}				O_9							
		98			0.5 V							V_{IH}	V_{IH}						O_0							
I_{OL2}		99										V_{IL}	V_{IL}			0.5 V		5.5 V	O_1	800		1000		800		
		100		0.5 V								V_{IH}							O_2							
		101										V_{IL}			V_{IH}		0.5 V		O_3							
		102	0.5 V									V_{IH}			V_{IH}				O_4							
		103						0.5 V				V_{IL}		V_{IH}	V_{IL}				O_5							
		104							0.5 V			V_{IH}		V_{IH}	V_{IL}				O_6							
		105				0.5 V						V_{IL}		V_{IH}	V_{IH}				O_7							

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 6/															Measured terminal	Test limits						Unit
			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		
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
I_{OL2}	1/	106								GND	0.5 V	V_{IH}	V_{IL}	V_{IH}	V_{IH}			5.5 V	O_8	800		1000		800		µA
I_{OL2}	1/	107					0.5 V			GND		V_{IL}	V_{IH}	V_{IL}	V_{IL}			5.5 V	O_9	800		1000		800		µA
I_{OL2}	1/	108			0.5 V					GND		V_{IH}	V_{IH}	V_{IL}	V_{IL}			5.5 V	O_0	800		1000		800		µA
																				Subgroup 4 T_A = 25°C						
																				Min	Max					
C_i	3012	109								GND		3/						GND	IN_A		12.0					pF
		110											3/						IN_D							
		111												3/					IN_C							
		112													3/				IN_B							
																				Subgroup 7 T_A = 25°C		Subgroup 8 T_A = 125°C T_A = -55°C				
Functional tests	3014	113	L	L	H	L	L	L	L	GND	L	GND	GND	GND	GND	L	L	5.0 V	All outputs	4/ 5/						
		114		L	L							5.0 V			GND	H	L									
		115		H								GND			5.0 V	L	L									
		116		L								5.0 V			5.0 V		H									
		117	H					L				GND		5.0 V	GND		L									
		118	L					H				5.0 V			GND											
		119						L	H			GND			5.0 V											
		120				H			L			5.0 V		5.0 V	5.0 V											
		121				L			L			GND	5.0 V	GND	GND											
		122				L	H		L			5.0 V	5.0 V	GND	GND											
																				Subgroup 9 T_A = 25°C		Subgroup 10 T_A = 125°C		Subgroup 11 T_A = -55°C		
																				Min	Max	Min	Max	Min	Max	
t_{PLH1} 7/	3003 (Fig. 6)	123			OUT					GND		A	GND	GND	GND			5.0 V	IN_A to O_0	27	530	37	740	27	530	ns
		124										B			GND	OUT			IN_A to O_1							
		125		OUT								GND			B				IN_B to O_2							
		126										B			B		OUT		IN_B to O_3							
		127	OUT									GND			B	GND			IN_C to O_4							
		128						OUT				B			B	GND			IN_C to O_5							

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 6/																Measured terminal	Test limits						Unit
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		Subgroup 9 T_A = 25°C		Subgroup 10 T_A = 125°C		Subgroup 11 T_A = -55°C		
		Test No.	O_1	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
t_{PLH1} 7/	3003 (Fig. 6)	129							OUT	GND		GND	GND	B	B			5.0 V	IN_B to O_6	27	530	37	740	27	530	ns
		130				OUT						B	GND	B	B				IN_B to O_7							
		131									OUT	GND	B	GND	GND				IN_D to O_8							
		132					OUT					B	B						IN_D to O_9							
t_{PHL1} 7/		133			OUT							C	GND						IN_A to O_0							
		134										C				OUT			IN_A to O_1							
		135		OUT								GND			C				IN_B to O_2							
		136										C			C		OUT		IN_B to O_3							
		137	OUT									GND		C	GND				IN_C to O_4							
		138						OUT				C			GND				IN_C to O_5							
		139							OUT			GND			C				IN_B to O_6							
		140				OUT						C			C				IN_B to O_7							
		141									OUT	GND	C	GND	GND				IN_D to O_8							
		142					OUT					C	C						IN_D to O_9							
t_{TLH1} 7/	3004 (Fig. 6)	143			OUT							A	GND						IN_A to O_0	13	260	18	360	13	260	
		144										B				OUT			IN_A to O_1							
		145		OUT								GND			B				IN_B to O_2							
		146										B			B		OUT		IN_B to O_3							
		147	OUT									GND		B	GND				IN_C to O_4							
		148						OUT				B			GND				IN_C to O_5							
		149							OUT			GND			B				IN_B to O_6							
		150				OUT						B			B				IN_B to O_7							
		151									OUT	GND	B	GND	GND				IN_D to O_8							
		152					OUT					B	B						IN_D to O_9							
t_{THL1} 7/		153			OUT							C	GND						IN_A to O_0							
t_{THL1}		154										C	GND			OUT			IN_A to O_1							
t_{THL1}		155		OUT								GND	GND		C				IN_B to O_2							

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 6/																Measured terminal	Test limits						Unit
																				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.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
t_{THL1} 7/	3004 (Fig. 6)	156								GND		C	GND	GND	C		OUT	5.0 V	IN_B to O_3	13	260	18	360	13	260	ns
		157	OUT									GND		C	GND				IN_C to O_4							
		158						OUT				C			GND				IN_C to O_5							
		159							OUT			GND			C				IN_B to O_6							
		160				OUT						C			C				IN_B to O_7							
		161									OUT	GND	C	GND	GND				IN_D to O_8							
		162					OUT					C	C	GND	GND				IN_D to O_9							

1/ The input conditions: V_{IH} = 3.8 V, V_{IL} = 1.1 V at 25°C; V_{IH} = 3.6 V, V_{IL} = 0.85 V at 125°C; V_{IH} = 3.95 V, V_{IL} = 1.35 V at -55°C.

2/ The input conditions: V_{IH} = 9.5 V, V_{IL} = 2.8 V at 25°C; V_{IH} = 9.25 V, V_{IL} = 2.55 V at 125°C; V_{IH} = 9.75 V, V_{IL} = 3.05 V at -55°C.

3/ See 4.4.1c.

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

5/ The truth table tests shall be performed with V_{IH} and $V_{DD} \leq 5.0$ V and ≥ 15.0 V. L = V_{SS} + 0.5 V maximum and H = V_{DD} -0.5 V minimum.

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

7/ Input conditions A, B, and C refer to the waveforms of figure 6.

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

TABLE III. Group A inspection for device type 51.

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 1/															Measured terminal	Test limits						Unit
																			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	16							
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
$V_{IC(POS)}$		1										1 mA						GND	IN_A		1.5					Vdc
		2											1 mA						IN_D							
		3												1 mA					IN_C							
		4													1 mA				IN_B							
$V_{IC(NEG)}$		5								GND		-1 mA							IN_A		-6.0					
		6											-1 mA						IN_D							
		7												-1 mA					IN_C							
		8													-1 mA				IN_B							
I_{SS} 2/	3005	9										GND	GND	GND	GND			18 V	V_{SS}		-1		-10			µA
		10										18 V			GND											
		11										GND			18 V											
		12										18 V			18 V											
		13										GND		18 V	GND											
		14										18 V			GND											
		15										GND			18 V											
		16										18 V			18 V											
		17										GND	18 V	GND	GND											
		18										18 V	18 V													
V_{OH3}	3006	19										GND	GND					15 V	O_0	14.95		14.95		14.95		Vdc
		20										15 V							O_1							
		21										GND			15 V				O_2							
		22										15 V			15 V				O_3							
		23										GND		15 V	GND				O_4							
		24										15 V		15 V	GND				O_5							

See footnotes at end of device type 51.

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

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 1/																Measured terminal	Test limits						Unit
																				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	16								
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
V_{OH3}	3006	25								GND		GND	GND	15 V	15 B			15 V	O_6	14.95		14.95		14.95		Vdc
		26										15 V	GND	15 V	15 V				O_7							
		27										GND	15 V	GND	GND				O_8							
		28										15 V	15 V						O_9							
V_{OL3}	3007	29										GND	GND						O_1		50		50		50	mVdc
		30										15 V			15 V				O_2							
		31										GND			15 V				O_3							
		32										15 V		15 V					O_4							
		33										GND		15 V	GND				O_5							
		34										15 V			GND				O_6							
		35										GND			15 V				O_7							
		36										15 V		15 V	15 V				O_8							
		37										GND	15 V	GND	GND				O_9							
		38										15 V	15 V	GND	GND				O_0							
V_{IH1}		39	3/	3/	3/	3/	3/	3/	3/			3/	3/	3/	3/	3/	3/	3/	All outputs	3/	3/	3/	3/	3/	3/	3/
V_{IH2}		40																								
V_{IH3}		41																								
V_{IL1}		42																								
V_{IL2}		43																								
V_{IL3}		44																								
I_{OL3}		45										GND	GND	GND	GND	0.4 V		5 V	O_1	510		360		640		uA
		46		0.4 V								5 V			GND				O_2							
		47										GND			5 V		0.4 V		O_3							
		48	0.4 V									5 V			5 V				O_4							

See footnotes at end of device type 51.

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

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 1/															Measured terminal	Test limits						Unit
																			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	16							
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
I_{OL3}		49						0.4 V		GND		GND	GND	5 V	GND			5 V	O_5	510		360		640		µA
		50							0.4 V			5 V			GND				O_6							
		51				0.4 V						GND			5 V				O_7							
		52									0.4 V	5 V			5 V				O_8							
		53					0.4 V					GND	5 V	GND	GND				O_9							
		54			0.4 V							5 V	5 V						O_0							
I_{OL4}		55										GND	GND			1.5 V		15 V	O_1	3.4		2.4		4.2		mA
		56		1.5 V								15 V							O_2							
		57										GND			15 V		1.5 V		O_3							
		58	1.5 V									15 V			15 V				O_4							
		59						1.5 V				GND		15 V	GND				O_5							
		60							1.5 V			15 V			GND				O_6							
		61				1.5 V						GND			15 V				O_7							
		62									1.5 V	15 V			15 V				O_8							
		63					1.5 V					GND	15 V	GND	GND				O_9							
		64			1.5 V							15 V	15 V						O_0							
I_{OH3}		65			4.6 V							GND	GND					5 V	O_0	-510		-360		-640		µA
		66										5 V				4.6 V			O_1							
		67		4.6 V								GND			15 V				O_2							
		68										5 V			15 V		4.6 V		O_3							
		69	4.6 V									GND		5 V	GND				O_4							
		70						4.6 V				5 V			GND				O_5							
		71							4.6 V			GND			15 V				O_6							
		72				4.6 V						5 V			15 V				O_7							

See footnotes at end of device type 51.

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

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 1/																Measured terminal	Test limits						Unit
																				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	16								
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
I_{OH3}		73								GND	4.6 V	GND	5 V	GND	GND			5 V	O_8	-510		-360		-640		µA
I_{OH3}		74					4.6 V			↓		5 V	5 V	↓	↓			5 V	O_9	-510		-360		-640		µA
I_{OH4}		75			13.5 V							GND	GND					15 V	O_0	-3.4		-2.4		-4.2		mA
↓		76										15 V	↓		↓	13.5 V		↓	O_1	↓		↓		↓		↓
		77		13.5 V								GND			15 V				O_2							
		78										15 V		↓	15 V		13.5 V		O_3							
		79	13.5 V									GND		15 V	GND				O_4							
		80						13.5 V				15 V		↓	GND				O_5							
		81							13.5 V			GND			15 V				O_6							
		82				13.5 V						15 V	↓	↓	15 V				O_7							
		83									13.5 V	GND	15 V	GND	GND				O_8							
		84					13.5 V					15 V	15 V	GND	GND			↓	O_9	↓		↓		↓		↓
I_{IH1} 4/	3010	85										18 V	18 V	18 V	18 V			18 V	All inputs together		4.0					nA
I_{IH2}	↓	86										18 V	GND	GND	GND				IN_A		1.0		45.0			↓
↓		87										GND	18 V	GND	GND				IN_D		↓		↓			
		88										↓	GND	18 V	GND				IN_C							
		89											GND	GND	18 V				IN_B							
I_{IL1} 4/	3009	90											GND	GND	GND				All inputs together		-4.0					
I_{IL2}	↓	91										↓	18 V	18 V	18 V				IN_A		-1.0		-45.0			↓
↓		92										18 V	GND	18 V	18 V				IN_D		↓		↓			
		93										18 V	18 V	GND	18 V				IN_C							
		94								↓		18 V	18 V	18 V	GND			↓	IN_B	↓		↓		↓		↓

See footnotes at end of device type 51.

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

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 1/															Measured terminal	Test limits			Unit
																			Subgroup 4 T_A = 25°C			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				
		Test No.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max		
C_i	3012	95								GND		5/						GND	IN_A		7.5		pF
		96											5/						IN_D				
		97												5/					IN_C				
		98													5/				IN_B				
																				Subgroup 7 T_A = 25°C	Subgroup 8 T_A = 125°C T_A = -55°C		
Function-al tests	3014	99	L	L	H	L	L	L	L	GND	L	GND	GND	GND	GND	L	L	5 V	All out-puts	6/ 7/			
		100		L	L							5 V			GND	H	L						
		101		H								GND			5 V	L	L						
		102		L								5 V			5 V		H						
		103	H									GND		5 V	GND		L						
		104	L					H				5 V			GND								
		105						L	H			GND			5 V								
		106				H			L			5 V			5 V								
		107				L			L		H	GND	5 V	GND	GND								
		108				L	H		L		L	5 V	5 V	GND	GND								

See footnotes at end of device type 51.

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

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 1/																Measured terminal	Test limits						Unit
																				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.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
t_{PLH1} 8/	3003 (Fig. 6)	109			OUT					GND		A	GND	GND	GND			5 V	IN_A to O_0	27	530	37	740	27	530	ns
		110										B			GND	OUT			IN_A to O_1							
		111		OUT								GND			B				IN_B to O_2							
		112										B			B		OUT		IN_B to O_3							
		113	OUT									GND		B	GND				IN_C to O_4							
		114						OUT				B			GND				IN_C to O_5							
		115							OUT			GND			B				IN_B to O_6							
		116				OUT						B			B				IN_B to O_7							
		117									OUT	GND	B	GND	GND				IN_D to O_8							
		118					OUT					B	B						IN_D to O_9							
t_{PHL1} 8/		119			OUT							C	GND						IN_A to O_0							
		120										C				OUT			IN_A to O_1							
		121		OUT								GND			C				IN_B to O_2							
		122										C			C		OUT		IN_B to O_3							
		123	OUT									GND		C	GND				IN_C to O_4							
		124						OUT				C			GND				IN_C to O_5							
		125							OUT			GND			C				IN_B to O_6							
		126				OUT						C			C				IN_B to O_7							
		127									OUT	GND	C	GND	GND				IN_D to O_8							
		128					OUT					C	C	GND	GND				IN_D to O_9							

See footnotes at end of device type 51.

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

Symbol	MIL-STD-883 method	Cases E, F, Z	Terminal conditions 1/															Measured terminal	Test limits						Unit
																			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.	O_4	O_2	O_0	O_7	O_9	O_5	O_6	V_{SS}	O_8	IN_A	IN_D	IN_C	IN_B	O_1	O_3	V_{DD}		Min	Max	Min	Max	Min	Max	
t_{TLH1} 8/	3004 (Fig. 6)	129			OUT					GND		A	GND	GND	GND			5.0 V	IN_A to O_0	13	260	18	360	13	260	ns
		130										B			GND	OUT			IN_A to O_1							
		131		OUT								GND			B				IN_B to O_2							
		132										B			B		OUT		IN_B to O_3							
		133	OUT									GND		B	GND				IN_C to O_4							
		134						OUT				B			GND				IN_C to O_5							
		135							OUT			GND			B				IN_B to O_6							
		136				OUT						B			B				IN_B to O_7							
		137									OUT	GND	B	GND	GND				IN_D to O_8							
		138					OUT					B	B						IN_D to O_9							
t_{THL1} 8/		139			OUT							C	GND						IN_A to O_0							
		140										C				OUT			IN_A to O_1							
		141		OUT								GND			C				IN_B to O_2							
		142										C			C		OUT		IN_B to O_3							
		143	OUT									GND		G	GND				IN_C to O_4							
		144						OUT				C			GND				IN_C to O_5							
		145							OUT			GND			C				IN_B to O_6							
		146				OUT						C			C				IN_B to O_7							
		147									OUT	GND	C	GND	GND				IN_D to O_8							
		148					OUT					C	C	GND	GND				IN_D to O_9							

See footnotes at end of device type 51.

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

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

2/ The I_{SS} tests shall be performed in sequence.

3/ The following sequence and input/output conditions shall apply:

INPUTS				OUTPUTS									
D	C	B	A	0	1	2	3	4	5	6	7	8	9
L	L	L	L	H	L	L	L	L	L	L	L	L	L
L	L	L	H	L	H	L	L	L	L	L	L	L	L
L	L	H	L	L	L	H	L	L	L	L	L	L	L
L	L	H	H	L	L	L	H	L	L	L	L	L	L
L	H	L	L	L	L	L	L	H	L	L	L	L	L
L	H	L	H	L	L	L	L	L	H	L	L	L	L
L	H	H	L	L	L	L	L	L	L	H	L	L	L
L	H	H	H	L	L	L	L	L	L	L	H	L	L
H	L	L	L	L	L	L	L	L	L	L	L	H	L
H	L	L	H	L	L	L	L	L	L	L	L	L	H
H	L	H	L	L	L	L	L	L	L	L	L	L	L
H	L	H	H	L	L	L	L	L	L	L	L	L	L
H	H	L	L	L	L	L	L	L	L	L	L	L	L
H	H	L	H	L	L	L	L	L	L	L	L	L	L
H	H	H	L	L	L	L	L	L	L	L	L	L	L
H	H	H	H	L	L	L	L	L	L	L	L	L	L

Truth table

Test	V_{DD} volts	Input levels		Output levels	
		H	L	H	L
V_{IH1} V_{IL1}	5.0V	V_{DD} 3.5V	1.5V V_{SS}	4.5V min	0.5V max
V_{IH2} V_{IL2}	10.0V	V_{DD} 7.0V	3.0V V_{SS}	9.0V min	1.0V max
V_{IH3} V_{IL3}	15.0V	V_{DD} 11.0V	4.0V V_{SS}	13.5V min	1.5V max

INPUT/OUTPUT conditions

4/ The device manufacturer may, at his option, measure I_{IL} and I_{IH} at 25°C for each 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 $\geq$ 18 Vdc. L = V_{SS} +0.50 V maximum, and H = V_{DD} -0.50 Vdc minimum.

8/ Input conditions A, B, and C refer to waveforms of figure 6.

b. A special subgroup shall be added using an LTPD of 15 for classes S and B, and shall be performed on each inspection lot for initially qualified device types 01, and measured only for initial qualification and after process or design changes for initially qualified 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 only 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 and as specified in 4.5.2 and as shown on figure 5, or equivalent.

(2) T_A = +125°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.

c. Subgroups 3 and 4 shall be added to the group C inspection requirements for class B devices, and shall consist of the tests, conditions, and limits as specified for subgroups 10 and 11 of group A.

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 specified 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 cool down 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° ±3°C; then, electrical parameter end-point measurements shall be performed.

TABLE IV. Delta limits @25°C.

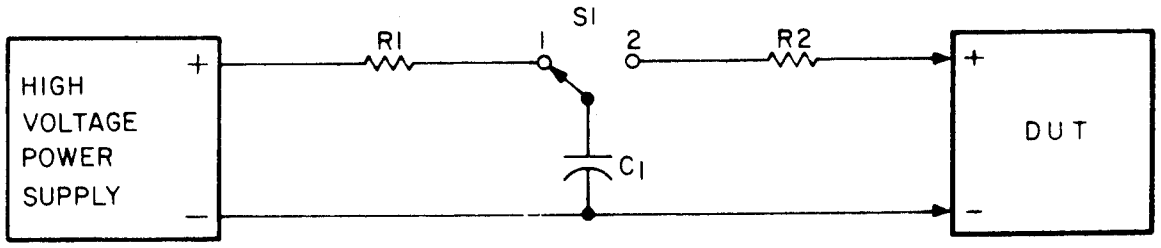
Parameter 1/	Device types	
	01	51
I_{SS}	±100 nA	±100 nA
V_{OL1} 2/	±.04 V	---
V_{OH1} 2/	±.08 V	---
I_{OL1}	---	±15%
I_{OH1}	---	±15%

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

2/ V_{OH} and V_{OL} delta measurements shall be calculated using one output for each input sequence of the truth table.

4.5.3 High voltage (V_{ZAP}) test or input protection circuits. All input terminals (up to a maximum of 4) of the DUT shall be subjected to a voltage pulse from a 100 pF source charged to 400 V. This destructive test shall be conducted as follows using the test circuit on figure 7.

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 ±10 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}.



R1 = 1 MΩ to 50 MΩ.
R2 = 1.5 kΩ.
C1 = 100 pF.
V_{ZAP} = 400 V minimum charge on C1.
S1 = Hg-wetted "bounceless" relay.

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

b. V_{ZAP} is applied to DUT in the following modes (see table V) by changing 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_{IL}, and I_{IH} measurements on the same terminals as performed above. If a 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 8. 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 limit all device types	V_{DD}	
		Device types 01	Device types 51
V_{TN}	0.3 V min.	10 V	10 V
V_{TP}	2.8 V max.	10 V	10 V
ΔV_T	1.4 V max	10 V	10 V
I_{SS}	100 x max limit	15 V	18 V
t_{PLH}	1.35 x max limit	5 V	5 V
t_{PHL}	1.35 x max limit	5 V	5 V

TABLE VII. Bias during exposure to radiation.

Device type	Pin connections		
	V_{DD} = 10 V dc (through a 30 k to 60 k resistor)	V_{SS} = GND	V_{DD} = 10 V dc
01	10, 11, 12, 13	8	16
51	10, 11, 12, 13	8	16

Pins not designated are open or connected to 10 V dc through a 30 kΩ to 60 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 parmeters data (see 4.2c).

5. PACKAGING

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

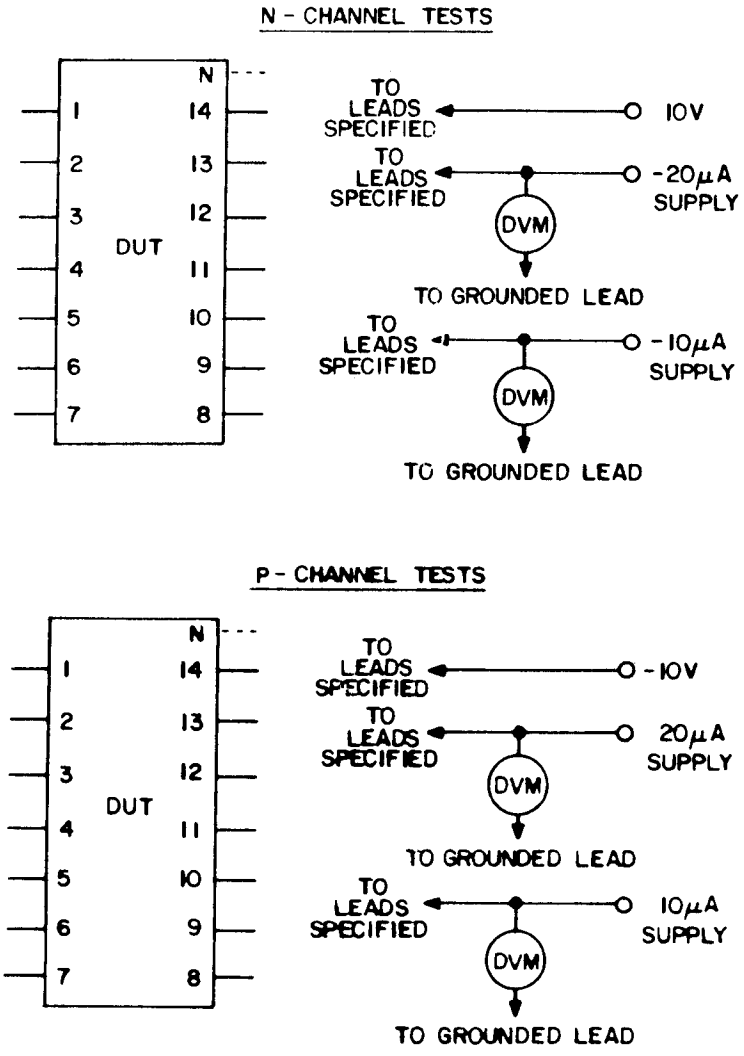


TABLE VIII. Threshold - voltage test circuit conditions.

Device type	GND	10 V	V_{TN} measured at		GND	-10 V	V_{TP} measured at	
			-20 μA supply	-10 μA supply			20 μA supply	10 μA supply
01	10	16	8, 11, 12, 13		10	8, 11, 12, 13	16	
51	10	16	8, 11, 12, 13		10	8, 11, 12, 13	16	

FIGURE 8. Threshold voltage test circuit.

6. NOTES

6.1 Intended use. Microcircuits conforming to this specification are intended for original equipment design applications and logisitic 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.

d. Requirements for notification of change of product or process to the contracting 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 shall 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:

C_i	Input terminal-to-V_{SS} capacitance.
GND	Ground zero voltage potential.
I_{SS}	Quiescent supply current.
T_A	Free air temperature.
t_{THL}	Fall time. Time duration during which the amplitude of the trailing edge of the input forcing condition or waveform is decreasing from 90 to 10 percent of the maximum amplitude.
t_{TLH}	Rise time. Time duration during which the amplitude of the leading edge of the input forcing condition or waveform is increasing from 10 to 90 percent of the maximum amplitude.
V_{DD}	Positive supply voltage.
$V_{IC(pos)}$	Positive clamping input to V_{DD}.
$V_{IC(neg)}$	Negative clamping input to V_{DD}.
V_{SS}	Negative supply voltage.
V_{ZAP}	Input test voltage.

6.4 Logistic support. Lead materials and finishes (see 3.3) are interchangeable. Unless otherwise specified, microcircuits acquired for Government logistic support will be acquired to device class S for National Aeronautics and Space Administration or class B for Department of Defense (see 1.2.2), 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.

Military device type	Generic-industry type
01	4028A
51	4028B

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

a. Devices should be handled on benches with conductive and grounded surface.

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

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

User activities:
Army - AR, SM
Navy - AS, CG, OS, MC, SH

Agent:
DLA - ES

Preparing activity:
NASA - NA

(Project 5962-0638-9)