INCH-POUND

MIL-M-38510/59D
24 February 2006

SUPERSEDING
MIL-M-38510/59C
30 April 1984

MILITARY SPECIFICATION

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

Reactivated after 24 Feb. 2006 and may be used for new and existing designs and acquisitions.

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

The requirements for acquiring the product herein consists of this specification sheet and MIL-PRF 38535

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, lead finishes, and radiation hardness assurance (RHA) are provided and are reflected in the complete Part or Identifying Number (PIN). For this product, the requirements of MIL-M-38510 have been superseded by MIL-PRF-38535 (see 6.3).

1.2 Part or identifying number (PIN). The PIN is in accordance with MIL-PRF-38535 and as specified herein.

1.2.1 Device types. The device types are as follows:

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

1.2.2 Device class. The device class is the product assurance level as defined in MIL-PRF-38535.

1.2.3 Case outlines. The case outlines are as designated in MIL-STD-1835 and as follows:

Outline letter	Descriptive designator	Terminals	Package style
E	GDIP1-T16 or CDIP2-T16	16	Dual-in-line
F	GDFP2-F16 or CDFP3-F16	16	Flat pack
N	CDFP4-F16	16	Flat pack
Z 1/ 2/	GDFP2-F16 or CDFP3-F16	16	Flat pack, except A dimension equals 0.100” (2.54 mm) max

1.3 Absolute maximum ratings.

Supply voltage range (V_{DD} - V_{SS}):
Device type 01 ..... -0.5 V dc to +15.5 V dc
Device type 51 ..... -0.5 V dc to +18.0 V dc
Input current (I_{IN}) (each input) ..... ±10 mA
Input voltage range (V_{IN}) ..... $(V_{SS} - 0.5\ V) \leq V_I \leq (V_{DD} + 0.5\ V)$
Storage temperature range (T_{STG}) ..... -65° 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-STD-1835
Junction temperature (T_J) ..... 175°C

1/ As an exception to nickel plate or undercoating paragraph of MIL-PRF-38535, appendix A, for case outline Z only, the leads of bottom brazed ceramic packages (i.e., configuration 2 of case outline F) may have electroless nickel undercoating which is 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 extends 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 S_1 dimension may go to .000 inch (.00 mm) minimum.

Comments, suggestions, or questions on this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, or email to CMOS@dscc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

1.4 Recommended operating conditions.

Supply voltage range (V_{DD} - V_{SS}):	
Device types 01	4.5 V dc to 12.5 V dc
Device types 51	4.5 V dc to 15.0 V dc
Input low voltage range (V_{IL}):	
Device types 01	0.0 V to 0.85 V dc @ V_{DD} = 5.0 V dc 0.0 V to 2.1 V dc @ V_{DD} = 12.5 V dc
Device types 51	V_{OL} = 10% V_{DD}, V_{OH} = 90% V_{DD} 0.0 V to 1.5 V dc @ V_{DD} = 5.0 V dc 0.0 V to 2.0 V dc @ V_{DD} = 10.0 V dc 0.0 V to 4.0 V dc @ V_{DD} = 15.0 V dc
Input high voltage range (V_{IH}):	
Device types 01	3.95 V to 5.0 V dc @ V_{DD} = 5.0 V dc 10 V to 12.5 V dc @ V_{DD} = 12.5 V dc
Device types 51	V_{OL} = 10% V_{DD}, V_{OH} = 90% V_{DD} 3.5 V to 5.0 V dc @ V_{DD} = 5.0 V dc 8.0 V to 10.0 V dc @ V_{DD} = 10.0 V dc 11.0 V to 15.0 V dc @ V_{DD} = 15.0 V dc
Load capacitance	50 pF maximum
Ambient operating temperature range (T_A)	-55°C to +125°C

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and Standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATION

MIL-PRF-38535 - Integrated Circuits (Microcircuits) Manufacturing, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.
MIL-STD-1835 - Interface Standard Electronic Component Case Outlines.

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Microcircuits furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturers list before contract award (see 4.3 and 6.4).

3.2 Item requirements. The individual item requirements shall be in accordance with MIL-PRF-38535 and as specified herein or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

3.3 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38535 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°C ±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.

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

3.3.2 Truth table. The truth table shall be as specified on figure 2.

3.3.3 Logic diagram. The logic diagram shall be as specified on figure 3.

3.3.4 Switching waveforms and test circuit. The switching waveforms and test circuit shall be as specified on figure 4.

3.3.5 Schematic circuits. The schematic circuits shall be maintained by the manufacturer and made available to the qualifying activity or preparing activity upon request.

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

3.4 Lead material and finish. The lead material and finish shall be in accordance with MIL-PRF-38535 (see 6.6).

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

3.6 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.

3.7 Marking. Marking shall be in accordance with MIL-PRF-38535.

3.7.1 Radiation hardness assurance identifier. The radiation hardness assurance identifier shall be in accordance with MIL-PRF-38535 and 4.5.4 herein.

3.8 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 39 (see MIL-PRF-38535, appendix A).

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions V_{SS} = 0 V, -55°C ≤ T_A ≤ 125°C unless otherwise specified	Device type	Limits		Unit
				Min	Max	
Positive clamping input to V_{DD}	$V_{IC\ (POS)}$	T_A = 25°C, V_{DD} = GND, V_{SS} = Open, Outputs = Open, I_I = 1 mA	All		1.5	V
Negative clamping input to V_{SS}	$V_{IC\ (NEG)}$	T_A = 25°C, V_{DD} = Open, V_{SS} = GND, Outputs = Open, I_I = -1 mA	All		-6.0	V
Quiescent supply current	I_{SS}	V_{DD} = 15 V, see table III	01		-10.0	µA
		V_{DD} = 18 V, see table III	51		-10.0	µA
High level output voltage	V_{OH1}	V_{DD} = 5.0 V, no load	01	4.95		V
	V_{OH2}	V_{DD} = 10.0 V, no load	01	9.95		V
	V_{OH3}	V_{DD} = 15 V, no load	51	14.95		V
Low level output voltage	V_{OL1}	V_{DD} = 5.0 V, no load	01		50	mV
	V_{OL2}	V_{DD} = 10.0 V, no load	01		50	mV
	V_{OL3}	V_{DD} = 15 V, no load	51		50	mV
Input high voltage	V_{IH1}	V_{DD} = 5 V, V_{OUT} = 0.5 V $\lvert I_{OUT} \rvert$ ≤ 1 µA	51	3.5		V
	V_{IH2}	V_{DD} = 10 V, V_{OUT} = 1.0 V $\lvert I_{OUT} \rvert$ ≤ 1 µA	51	7.0		V
	V_{IH3}	V_{DD} = 15 V, V_{OUT} = 1.5 V $\lvert I_{OUT} \rvert$ ≤ 1 µA	51	11.0		V
Input low voltage	V_{IL1}	V_{DD} = 5 V, V_{OUT} = 4.5 V $\lvert I_{OUT} \rvert$ ≤ 1 µA	51		1.5	V
	V_{IL2}	V_{DD} = 10 V, V_{OUT} = 9.0 V $\lvert I_{OUT} \rvert$ ≤ 1 µA	51		3.0	V
	V_{IL3}	V_{DD} = 15 V, V_{OUT} = 13.5 V $\lvert I_{OUT} \rvert$ ≤ 1 µA	51		4.0	V

TABLE I. Electrical performance characteristics – Continued.

Test	Symbol	Conditions V_{SS} = 0 V, -55°C ≤ T_A ≤ 125°C unless otherwise specified		Device type	Limits		Unit
					Min	Max	
Output high (source) current	I_{OH1}	V_{DD} = 4.5 V V_{OH} = 2.5 V		01	-850		µA
	I_{OH2}	V_{DD} = 5.0 V V_{OH} = 4.5 V		01	-445		µA
	I_{OH3}	V_{DD} = 5.0 V V_{OH} = 4.6 V		51	-360		µA
	I_{OH4}	V_{DD} = 15.0 V V_{OH} = 13.5 V		51	-2.4		mA
Output low (sink) current	I_{OL1}	V_{DD} = 5.0 V V_{OL} = 0.4 V		01	700		µA
	I_{OL2}	V_{DD} = 5.5 V V_{OL} = 0.5 V		01	800		µA
	I_{OL3}	V_{DD} = 5.0 V V_{OL} = 0.4 V		51	360		µA
	I_{OL4}	V_{DD} = 15.0 V V_{OL} = 1.5 V		51	2.4		mA
Input leakage current, high	I_{IH} 1/	Measure inputs sequentially	V_{DD} = 15 V	01		45	nA
			V_{DD} = 18 V	51		45	
Input leakage current, low	I_{IL}		V_{DD} = 15 V	01		-45	nA
			V_{DD} = 18 V	51		-45	
Input capacitance	C_i	V_{DD} = 0 V, f = 1 MHz T_A = 25°C		All		12	pF
Propagation delay time	t_{PHL}	V_{DD} = 5.0 V R_L = 200 kΩ C_L = 50 pF See figure 4		All	20	740	ns
	t_{PLH}			All	20	740	ns
Transition time	t_{THL}	V_{DD} = 5.0 V R_L = 200 kΩ C_L = 50 pF See figure 4		All	13	360	ns
	t_{TLH}			All	13	360	ns

1/ Input current at one input node.

Device types	01 and 51
Case outlines	E, F, N, and Z
Terminal number	Terminal symbol
1	O4
2	O2
3	O0
4	O7
5	O9
6	O5
7	O6
8	V_{SS}
9	O8
10	A
11	D
12	C
13	B
14	O1
15	O3
16	V_{DD}

FIGURE 1. Terminal connections.

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

L = Low voltage level
H = High voltage level

FIGURE 2. Truth table.

DEVICE TYPES 01 AND 51

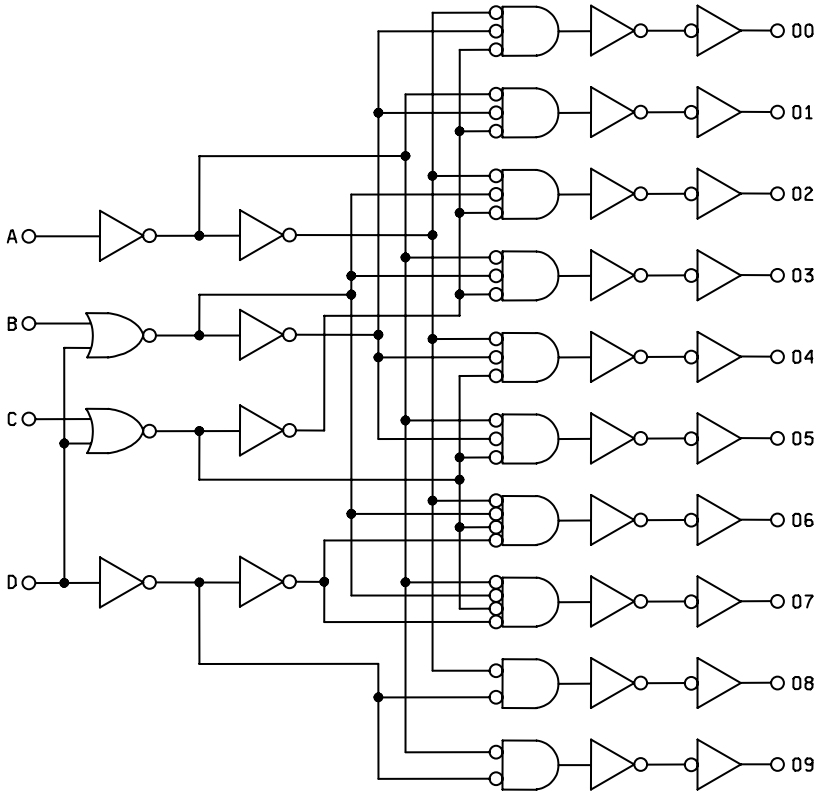
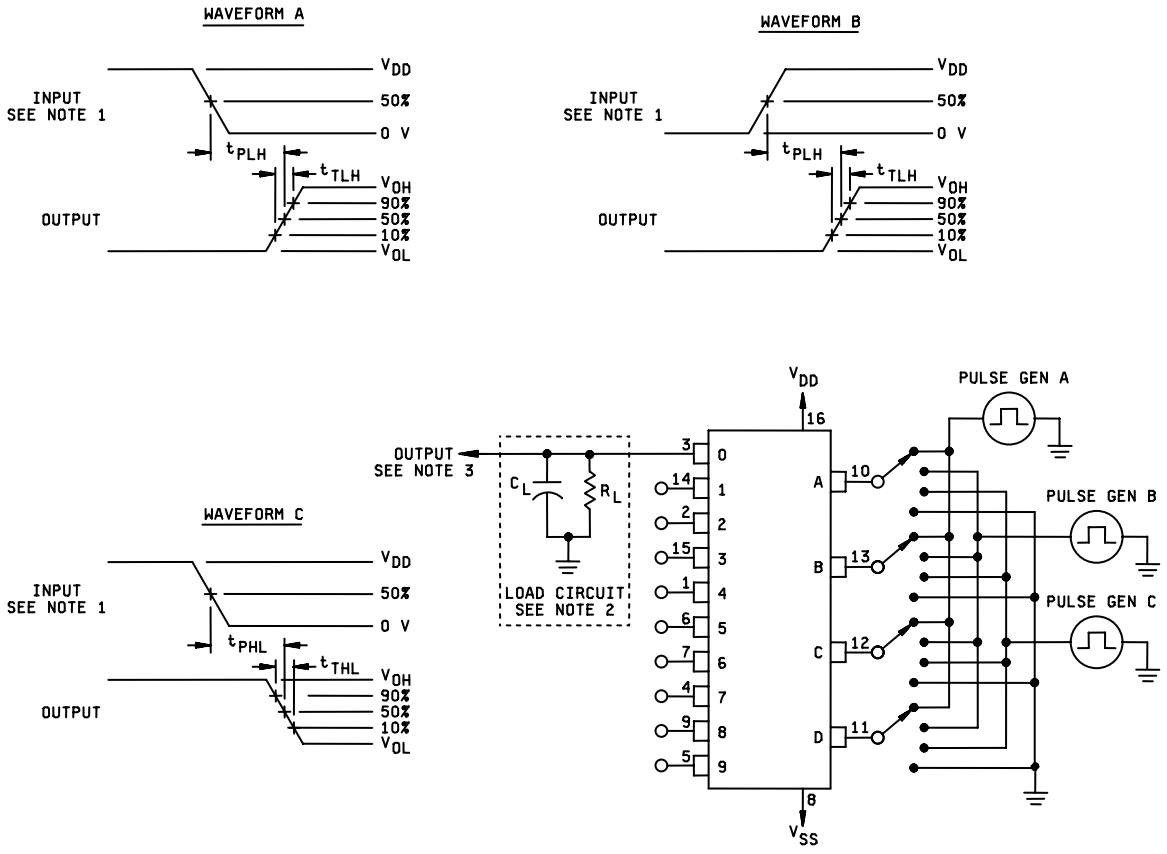


FIGURE 3. Logic diagram.



NOTES:

1. The pulse generator has 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 (includes probe and test jig capacitance).
3. Connect each output terminal to a load circuit as shown.

FIGURE 4. Switching waveforms and test circuit.

4. VERIFICATION

4.1 Sampling and inspection. Sampling and inspection procedures shall be in accordance with MIL-PRF-38535 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein.

4.2 Screening. Screening shall be in accordance with MIL-PRF-38535 and shall be conducted on all devices prior to qualification and conformance inspection. The following additional criteria shall apply:

a. The burn-in test duration, test condition, and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The burn-in test circuit shall be maintained under document control by the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.

b. Delete the sequence specified as interim (pre-burn-in) electrical parameters through interim (post-burn-in) electrical parameters of table IA of MIL-PRF-38535 and substitute lines 1 through 7 of table II herein.

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

(1) Unless otherwise specified in the manufacturers QM plan for static tests (test condition A), 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.

i. For static burn-in I, all inputs shall be connected to 0.0 V.

ii. For static burn-in II, all inputs shall be connected to V_{DD}.

iii. Except for V_{DD} and V_{SS}, the 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.

iv. Output may be open or connected to $V_{DD}/2$.

v. V_{DD} = 12.5 V minimum, 15 V maximum for device type 01.
V_{DD} = 15 V minimum, 18 V maximum for device type 51.
$V_{DD}/2 = V_{DD}/2$ ±1.0 V for all devices.
V_{SS} = 0.0 V.

(2) Unless otherwise specified in the manufacturers QM plan for dynamic test (test condition D), ambient temperature shall be +125°C minimum. Test duration shall be in accordance with table I of method 1015.

i. Except for V_{DD} and V_{SS}, the terminals 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.

ii. Input signal requirements: Square wave, 50% duty cycle; 25 kHz < PRR < 1 MHz; t_{TLH} and t_{THL} < 1 μs. Voltage level: Minimum = V_{SS} – 0.5 V, +10% V_{DD}; Maximum = V_{DD} + 0.5 V, -10% V_{DD}.

iii. V_{DD} = 12.5 V minimum, 15 V maximum for device type 01.
V_{DD} = 15 V minimum, 18 V maximum for device type 51.
$V_{DD}/2 = V_{DD}/2$ ±1.0 V.
V_{SS} = 0.0 V.

d. Interim and final electrical test parameters shall be as specified in table II.

e. 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.

TABLE II. Electrical test requirements.

Line no.	MIL-PRF-38535 test requirements	Class S device 1/			Class B device 1/		
		Ref. par.	Table III Subgroups 2/	Table IV delta limits 3/	Ref. par.	Table III subgroups 2/	Table IV delta limits 3/
1	Interim electrical parameters		1			1	
2	Static burn-in I (method 1015)	4.2c 4.5.2					
3	Same as line 1		1	Δ			
4	Static burn-in II (method 1015)	4.2c 4.5.2			4.2c 4.5.2	4/	
5	Same as line 1	4.2e	1*	Δ	4.2e	1*	Δ
6	Dynamic burn-in (method 1015)	4.2c 4.5.2					
7	Same as line 1	4.2e	1*	Δ			
8	Final electrical parameters		1*, 2, 3, 7, 9			1*, 2, 3, 7, 9	
9	Group A test requirements	4.4.1	1, 2, 3, 4, 7, 9, 10, 11		4.4.1	1, 2, 3, 4, 7, 9, 10, 11	
10	Group B test when using method 5005 QCI option	4.4.2	1, 2, 3, 7, 8, 9, 10, 11	Δ			
11	Group C end-point electrical parameters	4.4.2	1, 2, 3, 7, 8, 9, 10, 11	Δ	4.4.3	1, 2, 3	Δ
12	Group D end-point electrical parameters	4.4.4	1, 2, 3		4.4.4	1, 2, 3	

1/ Blank spaces indicate tests are not applicable.

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

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

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.

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 failure shall be cumulative for determining the PDA.

c. The PDA for class B devices shall be in accordance with MIL-PRF-38535 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 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-PRF-38535.

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 worse case group A electrical tests and any electrical tests specified as additional group C subgroups and submitting data in accordance with MIL-PRF-38535.

4.4 Technology Conformance inspection (TCI). Technology conformance inspection shall be in accordance with MIL-PRF-38535 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 III of MIL-PRF-38535 and as follows:

a. Tests shall be performed in accordance with table II herein.

b. Subgroups 5, 6, 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 that 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 sample size series of 15 (acceptance 0) and consist of 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.

f. Subgroups 9 and 11 shall be measured only for initial qualification and after process or design changes which may affect dynamic performance.

g. When device type 01 is qualified by extension (see 4.3.1), this device type will be inspected (QCI) according to the requirements for device type 51.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of MIL-PRF-38535.

4.4.3 Group C inspection. Group C inspection shall be in accordance with table IV of MIL-PRF-38535 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. The steady-state life test duration, test condition, and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The burn-in test circuit shall be maintained under document control by the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in method 1005 of MIL-STD-883.

c. When device type 01 is qualified by extension (see 4.3.1), this device type will be inspected (QCI) according to the requirements for device type 51.

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								
		Test No.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
I_{SS}	3005	1								GND		GND	GND	GND	GND			15V	V_{SS}		-1		-10			µA
“	“	2								“		15V	“	“	GND			“	“		“		“			“
“	“	3								“		GND	“	“	15V			“	“		“		“			“
“	“	4								“		15V	“	“	15V			“	“		“		“			“
“	“	5								“		GND	“	15V	GND			“	“		“		“			“
“	“	6								“		15V	“	“	GND			“	“		“		“			“
“	“	7								“		GND	“	“	15V			“	“		“		“			“
“	“	8								“		15V	“	“	15V			“	“		“		“			“
“	“	9								“		GND	15V	GND	GND			“	“		“		“			“
“	“	10								“		15V	15V	GND	GND			“	“		“		“			“
I_{IL1} 8/	3009	11								“		GND	GND	GND	GND			“	All inputs		-4.0					nA
I_{IL2}	“	12								“		GND	15V	15V	15V			“	A		-1.0		-45.0			“
“	“	13								“		15V	GND	15V	15V			“	D		“		“			“
“	“	14								“		“	15V	GND	15V			“	C		“		“			“
“	“	15								“		“	15V	15V	GND			“	B		“		“			“
I_{IH1} 8/	3010	16								“		“	15V	15V	15V			“	All inputs		4.0					“
I_{IH2}	“	17								“		“						“	A		1.0		45.0			“
“	“	18								“			15V					“	D		“		“			“
“	“	19								“				15V				“	C		“		“			“
“	“	20								“					15V			“	B		“		“			“
$V_{IC(POS)}$		21										1mA						GND	A		1.5					V
“		22											1mA					“	D		“					“
“		23												1mA				“	C		“					“
“		24													1mA			“	B		“					“
$V_{IC(NEG)}$		25								GND		-1mA							A		-6.0					“
$V_{IC(NEG)}$		26								GND			-1mA						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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
$V_{IC(NEG)}$		27								GND				-1mA					C		-6.0					V
$V_{IC(NEG)}$		28								"					-1mA				B		-6.0					"
V_{OH1}	3006 1/	29								"		V_{IL}	V_{IL}	V_{IL}	V_{IL}			5.0V	O0	4.95		4.95		4.95		"
"	"	30								"		V_{IH}	"	"	V_{IL}			"	O1	"		"		"		"
"	"	31								"		V_{IL}	"	"	V_{IH}			"	O2	"		"		"		"
"	"	32								"		V_{IH}	"	"	V_{IH}			"	O3	"		"		"		"
"	"	33								"		V_{IL}	"	V_{IH}	V_{IL}			"	O4	"		"		"		"
"	"	34								"		V_{IH}	"	"	V_{IL}			"	O5	"		"		"		"
"	"	35								"		V_{IL}	"	"	V_{IH}			"	O6	"		"		"		"
"	"	36								"		V_{IH}	"	"	V_{IH}			"	O7	"		"		"		"
"	"	37								"		V_{IL}	V_{IH}	V_{IL}	V_{IL}			"	O8	"		"		"		"
"	"	38								"		V_{IH}	V_{IH}	"	"			"	O9	"		"		"		"
V_{OL1}	3007 1/	39								"		V_{IL}	V_{IL}	V_{IL}	"			"	O1		50		50		50	mV
"	"	40								"		V_{IH}	"	"	"			"	O2		"		"		"	"
"	"	41								"		V_{IL}	"	"	V_{IH}			"	O3		"		"		"	"
"	"	42								"		V_{IH}	"	"	V_{IH}			"	O4		"		"		"	"
"	"	43								"		V_{IL}	"	V_{IH}	V_{IL}			"	O5		"		"		"	"
"	"	44								"		V_{IH}	"	"	V_{IL}			"	O6		"		"		"	"
"	"	45								"		V_{IL}	"	"	V_{IH}			"	O7		"		"		"	"
"	"	46								"		V_{IH}	"	"	V_{IH}			"	O8		"		"		"	"
"	"	47								"		V_{IL}	V_{IH}	V_{IL}	V_{IL}			"	O9		"		"		"	"
"	"	48								"		V_{IH}	V_{IH}	"	"			"	O0		"		"		"	"
V_{OH2}	3006 2/	49								"		V_{IL}	V_{IL}	"	"			10.0V	O0	9.95		9.95		9.95		V
"	"	50								"		V_{IH}	"	"	"			"	O1	"		"		"		"
"	"	51								"		V_{IL}	"	"	V_{IH}			"	O2	"		"		"		"
"	"	52								"		V_{IH}	"	"	V_{IH}			"	O3	"		"		"		"
"	"	53								"		V_{IL}	V_{IL}	V_{IH}	V_{IL}			10.0V	O4	9.95		9.95		9.95		V
"	"	54								"		V_{IH}	"	"	V_{IL}			"	O5	"		"		"		"
"	"	55								"		V_{IL}	"	"	V_{IH}			"	O6	"		"		"		"
"	"	56								"		V_{IH}	"	"	V_{IH}			"	O7	"		"		"		"
"	"	57								"		V_{IL}	V_{IH}	V_{IL}	V_{IL}			"	O8	"		"		"		"
"	"	58								"		V_{IH}	V_{IH}	"	"			"	O9	"		"		"		"

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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
V_{OL2}	3007 2/	59								GND		V_{IL}	V_{IL}	V_{IL}	V_{IL}			10V	O1		50		50		50	mV
"	"	60								"		V_{IH}	"	"	"			"	O2		"		"		"	"
"	"	61								"		V_{IL}	"	"	V_{IH}			"	O3		"		"		"	"
"	"	62								"		V_{IH}	"	"	V_{IH}			"	O4		"		"		"	"
"	"	63								"		V_{IL}	"	V_{IH}	V_{IL}			"	O5		"		"		"	"
"	"	64								"		V_{IH}	"	"	V_{IL}			"	O6		"		"		"	"
"	"	65								"		V_{IL}	"	"	V_{IH}			"	O7		"		"		"	"
"	"	66								"		V_{IH}	"	"	V_{IH}			"	O8		"		"		"	"
"	"	67								"		V_{IL}	V_{IH}	V_{IL}	V_{IL}			"	O9		"		"		"	"
"	"	68								"		V_{IH}	V_{IH}	"	"			"	O0		"		"		"	"
I_{OH1}	1/	69			2.5V					"		V_{IL}	V_{IL}	"	"			4.5V	O0	-900		-850		-900		µA
"	"	70								"		V_{IH}	"	"	"	2.5V		"	O1	"		"		"		"
"	"	71		2.5V						"		V_{IL}	"	"	V_{IH}			"	O2	"		"		"		"
"	"	72								"		V_{IH}	"	"	V_{IH}		2.5V	"	O3	"		"		"		"
"	"	73	2.5V							"		V_{IL}	"	V_{IH}	V_{IL}			"	O4	"		"		"		"
"	"	74						2.5V		"		V_{IH}	"	"	V_{IL}			"	O5	"		"		"		"
"	"	75							2.5V	"		V_{IL}	"	"	V_{IH}			"	O6	"		"		"		"
"	"	76				2.5V				"		V_{IH}	"	"	V_{IH}			"	O7	"		"		"		"
"	"	77								"	2.5V	V_{IL}	V_{IH}	V_{IL}	V_{IL}			"	O8	"		"		"		"
"	"	78					2.5V			"		V_{IH}	V_{IH}	V_{IL}	V_{IL}			"	O9	"		"		"		"
I_{OH2}	1/	79			4.5V					GND		V_{IL}	V_{IL}	V_{IL}	V_{IL}			5.0V	O0	-520		-445		-520		µA
"	"	80								"		V_{IH}	"	"	V_{IL}	4.5V		"	O1	"		"		"		"
"	"	81		4.5V						"		V_{IL}	"	"	V_{IH}			"	O2	"		"		"		"
"	"	82								"		V_{IH}	"	"	V_{IH}		4.5V	"	O3	"		"		"		"
"	"	83	4.5V							"		V_{IL}	"	V_{IH}	V_{IL}			"	O4	"		"		"		"
"	"	84						4.5V		"		V_{IH}	"	"	V_{IL}			"	O5	"		"		"		"
"	"	85							4.5V	"		V_{IL}	"	"	V_{IH}			"	O6	"		"		"		"
"	"	86				4.5V				"		V_{IH}	"	"	V_{IH}			"	O7	"		"		"		"
"	"	87								"	4.5V	V_{IL}	V_{IH}	V_{IL}	V_{IL}			"	O8	"		"		"		"
"	"	88					4.5V			"		V_{IH}	V_{IH}	"	"			"	O9	"		"		"		"

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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
I_{OL1}	1/	89								GND		V_{IL}	V_{IL}	V_{IL}	V_{IL}	0.5V		5.0V	O1	700		900		700		µA
“	“	90		0.5V						“		V_{IH}	“	“	“			“	O2	“		“		“		“
“	“	91								“		V_{IL}	“	“	V_{IH}		0.5V	“	O3	“		“		“		“
“	“	92	0.5V							“		V_{IH}	“	“	V_{IH}			“	O4	“		“		“		“
“	“	93						0.5V		“		V_{IL}	“	V_{IH}	V_{IL}			“	O5	“		“		“		“
“	“	94							0.5V	“		V_{IH}	“	“	V_{IL}			“	O6	“		“		“		“
“	“	95				0.5V				“		V_{IL}	“	“	V_{IH}			“	O7	“		“		“		“
“	“	96								“	0.5V	V_{IH}	“	“	V_{IH}			“	O8	“		“		“		“
“	“	97					0.5V			“		V_{IL}	V_{IH}	V_{IL}	V_{IL}			“	O9	“		“		“		“
“	“	98			0.5V					“		V_{IH}	V_{IH}	“	“			“	O0	“		“		“		“
I_{OL2}	“	99								“		V_{IL}	V_{IL}	“	“	0.5V		5.5V	O1	800		1000		800		“
“	“	100		0.5V						“		V_{IH}	“	“	“			“	O2	“		“		“		“
“	“	101								“		V_{IL}	“	“	V_{IH}		0.5V	“	O3	“		“		“		“
“	“	102	0.5V							“		V_{IH}	“	“	V_{IH}			“	O4	“		“		“		“
“	“	103						0.5V		“		V_{IL}	“	V_{IH}	V_{IL}			“	O5	“		“		“		“
“	“	104							0.5V	“		V_{IH}	“	V_{IH}	V_{IL}			“	O6	“		“		“		“
“	“	105				0.5V				“		V_{IL}	“	V_{IH}	V_{IH}			“	O7	“		“		“		“
“	“	106								GND	0.5V	V_{IH}	V_{IL}	V_{IH}	V_{IH}			5.5V	O8	800		1000		800		µA
“	“	107					0.5V			GND		V_{IL}	V_{IH}	V_{IL}	V_{IL}			5.5V	O9	800		1000		800		µA
“	“	108			0.5V					GND		V_{IH}	V_{IH}	V_{IL}	V_{IL}			5.5V	O0	800		1000		800		µA
																				Subgroup 4 T_A = 25°C						
																				Min	Max	Min	Max	Min	Max	
C_i	3012	109								GND		3/						GND	A		12.0					pF
“	“	110								“			3/					“	D		“					“
“	“	111								“				3/				“	C		“					“
“	“	112								“					3/			“	B		“					“

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 7 T_A = 25°C		Subgroup 8 T_A = 125°C, T_A = -55°C				
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16								
		Test No.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}								
Functional tests	3014	113	L	L	H	L	L	L	L	GND	L	GND	GND	GND	GND	L	L	5.0V	All outputs	4/ 5/						
“	“	114	“	L	L	“	“	“	“	“	“	5.0V	“	“	GND	H	L	“	“							
“	“	115	“	H	“	“	“	“	“	“	“	GND	“	“	5.0V	L	L	“	“							
“	“	116	“	L	“	“	“	“	“	“	“	5.0V	“	“	5.0V	“	H	“	“							
“	“	117	H	“	“	“	“	“	“	“	“	GND	“	5.0V	GND	“	L	“	“							
“	“	118	L	“	“	“	“	H	“	“	“	5.0V	“	“	GND	“	“	“	“							
“	“	119	“	“	“	“	“	L	H	“	“	GND	“	“	5.0V	“	“	“	“							
“	“	120	“	“	“	H	“	“	L	“	“	5.0V	“	“	5.0V	“	“	“	“							
“	“	121	“	“	“	L	“	“	L	“	H	GND	5.0V	GND	GND	“	“	“	“							
“	“	122	“	“	“	L	H	“	L	“	L	5.0V	5.0V	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_{PLH} 7/	3003 (Fig.4)	123			OUT					GND		A	GND	GND	GND			5.0V	A to O0	20	530	30	740	20	530	ns
“	“	124								“		B	“	“	GND	OUT		“	A to O1	“	“	“	“	“	“	“
“	“	125		OUT						“		GND	“	“	B			“	B to O2	“	“	“	“	“	“	“
“	“	126								“		B	“	“	B		OUT	“	B to O3	“	“	“	“	“	“	“
“	“	127	OUT							“		GND	“	B	GND			“	C to O4	“	“	“	“	“	“	“
“	“	128						OUT		“		B	“	B	GND			“	C to O5	“	“	“	“	“	“	“
“	“	129							OUT	GND		GND	GND	B	B			5.0V	B to O6	”	“	“	“	“	“	“
“	“	130				OUT				“		B	GND	B	B			“	B to O7	“	“	“	“	“	“	“
“	“	131								“	OUT	GND	B	GND	GND			“	D to O8	“	“	“	“	“	“	“
“	“	132					OUT			“		B	B	“	“			“	D to O9	“	“	“	“	“	“	“
t_{PHL} 7/	“	133			OUT					“		C	GND	“	“			“	A to O0	“	“	“	“	“	“	“
“	“	134								“		C	“	“	“	OUT		“	A to O1	“	“	“	“	“	“	“
“	“	135		OUT						“		GND	“	“	C			“	B to O2	“	“	“	“	“	“	“
“	“	136								“		C	“	“	C		OUT	“	B to O3	“	“	“	“	“	“	“
“	“	137	OUT							“		GND	“	C	GND			“	C to O4	“	“	“	“	“	“	“
“	“	138						OUT		“		C	“	“	GND			“	C to O5	“	“	“	“	“	“	“
“	“	139							OUT	“		GND	“	“	C			“	B to O6	“	“	“	“	“	“	“
“	“	140				OUT				“		C	“	“	C			“	B to O7	“	“	“	“	“	“	“
“	“	141								“	OUT	GND	C	GND	GND			“	D to O8	“	“	“	“	“	“	“
“	“	142					OUT			“		C	C	“	“			“	D to O9	“	“	“	“	“	“	“

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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
t_{TLH} 7/	3004 (Fig.4)	143			OUT					GND		A	GND	GND	GND			5.0V	A to O0	13	260	18	360	13	260	“
“	“	144								“		B	“	“	“	OUT		“	A to O1	“	“	“	“	“	“	“
“	“	145		OUT						“		GND	“	“	B			“	B to O2	“	“	“	“	“	“	“
“	“	146								“		B	“	“	B		OUT	“	B to O3	“	“	“	“	“	“	“
“	“	147	OUT							“		GND	“	B	GND			“	C to O4	“	“	“	“	“	“	“
“	“	148						OUT		“		B	“	“	GND			“	C to O5	“	“	“	“	“	“	“
“	“	149							OUT	“		GND	“	“	B			“	B to O6	“	“	“	“	“	“	“
“	“	150				OUT				“		B	“	“	B			“	B to O7	“	“	“	“	“	“	“
“	“	151								“	OUT	GND	B	GND	GND			“	D to O8	“	“	“	“	“	“	“
“	“	152					OUT			“		B	B	“	“			“	D to O9	“	“	“	“	“	“	“
t_{THL} 7/	“	153			OUT					“		C	GND	“	“			“	A to O0	“	“	“	“	“	“	“
“	“	154								“		C	GND	“	“	OUT		“	A to O1	“	“	“	“	“	“	“
“	“	155		OUT						“		GND	GND	“	C			“	B to O2	“	“	“	“	“	“	“
“	“	156								GND		C	GND	GND	C		OUT	5.0V	B to O3	“	“	“	“	“	“	ns
“	“	157	OUT							“		GND	“	C	GND			“	C to O4	“	“	“	“	“	“	“
“	“	158						OUT		“		C	“	“	GND			“	C to O5	“	“	“	“	“	“	“
“	“	159							OUT	“		GND	“	“	C			“	B to O6	“	“	“	“	“	“	“
“	“	160				OUT				“		C	“	“	C			“	B to O7	“	“	“	“	“	“	“
“	“	161								“	OUT	GND	C	GND	GND			“	D to O8	“	“	“	“	“	“	“
“	“	162					OUT			“		C	C	GND	GND			“	D to O9	“	“	“	“	“	“	“

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 $\geq$ 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 4.
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, N, 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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
$V_{IC(POS)}$		1										1mA						GND	A		1.5					Vdc
"		2											1mA					"	D		"					"
"		3												1mA				"	C		"					"
"		4													1mA			"	B		"					"
$V_{IC(NEG)}$		5								GND		-1mA							A		-6.0					"
"		6								"			-1mA						D		"					"
"		7								"				-1mA					C		"					"
"		8								"					-1mA				B		"					"
I_{SS} 2/	3005	9								"		GND	GND	GND	GND			18V	V_{SS}		-1		-10			µA
"	"	10								"		18V	"	"	GND			"	"		"		"			"
"	"	11								"		GND	"	"	18V			"	"		"		"			"
"	"	12								"		18V	"	"	18V			"	"		"		"			"
"	"	13								"		GND	"	18V	GND			"	"		"		"			"
"	"	14								"		18V	"	"	GND			"	"		"		"			"
"	"	15								"		GND	"	"	18V			"	"		"		"			"
"	"	16								"		18V	"	"	18V			"	"		"		"			"
"	"	17								"		GND	18V	GND	GND			"	"		"		"			"
"	"	18								"		18V	18V	"	"			"	"		"		"			"
V_{OH3}	3006	19								"		GND	GND	"	"			15V	O0	14.95		14.95		14.95		Vdc
"	"	20								"		15V	"	"	"			"	O1	"		"		"		"
"	"	21								"		GND	"	"	15V			"	O2	"		"		"		"
"	"	22								"		15V	"	"	15V			"	O3	"		"		"		"
"	"	23								"		GND	"	15V	GND			"	O4	"		"		"		"
"	"	24								"		15V	"	15V	GND			"	O5	"		"		"		"
V_{OH3}	3006	25								GND		GND	GND	15V	15V			15V	O6	14.95		14.95		14.95		Vdc
"	"	26								"		15V	GND	15V	15V			"	O7	"		"		"		"
"	"	27								"		GND	15V	GND	GND			"	O8	"		"		"		"
"	"	28								"		15V	15V	"	"			"	O9	"		"		"		"
V_{OL3}	3007	29								"		GND	GND	"	"			"	O1		50		50		50	mVdc
"	"	30								"		15V	"	"	"			"	O2		"		"		"	"
"	"	31								"		GND	"	"	15V			"	O3		"		"		"	"
"	"	32								"		15V	"	"	15V			"	O4		"		"		"	"
"	"	33								"		GND	"	15V	GND			"	O5		"		"		"	"
"	"	34								"		15V	"	"	GND			"	O6		"		"		"	"
"	"	35								"		GND	"	"	15V			"	O7		"		"		"	"
"	"	36								"		15V	"	"	15V			"	O8		"		"		"	"
"	"	37								"		GND	15V	GND	GND			"	O9		"		"		"	"
"	"	38								"		15V	15V	GND	GND			"	O0		"		"		"	"

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, N, 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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
V_{IH1}		39	3/	3/	3/	3/	3/	3/	3/	GND	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	0.4V		5V	O1	510		360		640		µA
"		46		0.4V						"		5V	"	"	GND			"	O2	"		"		"		"
"		47								"		GND	"	"	5V		0.4V	"	O3	"		"		"		"
"		48	0.4V							"		5V	"	"	5V			"	O4	"		"		"		"
I_{OL3}		49						0.4V		GND		GND	GND	5V	GND			5V	O5	510		360		640		µA
"		50							0.4V	"		5V	"	"	GND			"	O6	"		"		"		"
"		51				0.4V				"		GND	"	"	5V			"	O7	"		"		"		"
"		52								"	0.4V	5V	"	"	5V			"	O8	"		"		"		"
"		53					0.4V			"		GND	5V	GND	GND			"	O9	"		"		"		"
"		54			0.4V					"		5V	5V	"	"			"	O0	"		"		"		"
I_{OL4}		55								"		GND	GND	"	"	1.5V		15V	O1	3.4		2.4		4.2		mA
"		56		1.5V						"		15V	"	"	"			"	O2	"		"		"		"
"		57								"		GND	"	"	15V		1.5V	"	O3	"		"		"		"
"		58	1.5V							"		15V	"	"	15V			"	O4	"		"		"		"
"		59						1.5V		"		GND	"	15V	GND			"	O5	"		"		"		"
"		60							1.5V	"		15V	"	"	GND			"	O6	"		"		"		"
"		61				1.5V				"		GND	"	"	15V			"	O7	"		"		"		"
"		62								"	1.5V	15V	"	"	15V			"	O8	"		"		"		"
"		63					1.5V			"		GND	15V	GND	GND			"	O9	"		"		"		"
"		64			1.5V					"		15V	15V	"	"			"	O0	"		"		"		"
I_{OH3}		65			4.6V					"		GND	GND	"	"			5V	O0	-510		-360		-640		µA
"		66								"		5V	"	"	"	4.6V		"	O1	"		"		"		"
"		67		4.6V						"		GND	"	"	15V			"	O2	"		"		"		"
"		68								"		5V	"	"	15V		4.6V	"	O3	"		"		"		"
"		69	4.6V							"		GND	"	5V	GND			"	O4	"		"		"		"
"		70						4.6V		"		5V	"	"	GND			"	O5	"		"		"		"
"		71							4.6V	"		GND	"	"	15V			"	O6	"		"		"		"
"		72				4.6V				"		5V	"	"	15V			"	O7	"		"		"		"

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, N, 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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
I_{OH3}		73								GND	4.6V	GND	5V	GND	GND			5V	O8	-510		-360		-640		µA
I_{OH3}		74					4.6V			"		5V	5V	"	"			5V	O9	-510		-360		-640		µA
I_{OH4}		75			13.5V					"		GND	GND	"	"			15V	O0	-3.4		-2.4		-4.2		mA
"		76								"		15V	"	"	"	13.5V		"	O1	"		"		"		"
"		77		13.5V						"		GND	"	"	15V			"	O2	"		"		"		"
"		78								"		15V	"	"	15V		13.5V	"	O3	"		"		"		"
"		79	13.5V							"		GND	"	15V	GND			"	O4	"		"		"		"
"		80						13.5V		"		15V	"	"	GND			"	O5	"		"		"		"
"		81							13.5V	"		GND	"	"	15V			"	O6	"		"		"		"
"		82				13.5V				"		15V	"	"	15V			"	O7	"		"		"		"
"		83								"	13.5V	GND	15V	GND	GND			"	O8	"		"		"		"
"		84					13.5V			"		15V	15V	GND	GND			"	O9	"		"		"		"
I_{IH1} 4/	3010	85								"		18V	18V	18V	18V			18V	All inputs together		4.0					nA
I_{IH2}	"	86								"		18V	GND	GND	GND			"	A		1.0		45.0			"
"	"	87								"		GND	18V	GND	GND			"	D		"		"			"
"	"	88								"		"	GND	18V	GND			"	C		"		"			"
"	"	89								"		"	GND	GND	18V			"	B		"		"			"
I_{IL1} 4/	3009	90								"		"	GND	GND	GND			"	All inputs together		-4.0					"
I_{IL2}	"	91								"		"	18V	18V	18V			"	A		-1.0		-45.0			"
"	"	92								"		18V	GND	18V	18V			"	D		"		"			"
"	"	93								"		18V	18V	GND	18V			"	C		"		"			"
"	"	94								"		18V	18V	18V	GND			"	B		"		"			"

																				Subgroup 4 T_A = 25°C				Unit
																				Min	Max			
C_i	3012	95								GND		5/						GND	A		7.5			pF
"	"	96								"			5/					"	D		"			"
"	"	97								"				5/				"	C		"			"
"	"	98								"					5/			"	B		"			"

																				Subgroup 7 T_A = 25°C	Subgroup 8 T_A = 125°C, T_A = -55°C	Unit
Functional tests	3014	99	L	L	H	L	L	L	L	GND	L	GND	GND	GND	GND	L	L	5V	All outputs		6/ 7/	
"	"	100	"	L	L	"	"	"	"	"	"	5V	"	"	GND	H	L	"	"			
"	"	101	"	H	"	"	"	"	"	"	"	GND	"	"	5V	L	L	"	"			
"	"	102	"	L	"	"	"	"	"	"	"	5V	"	"	5V	"	H	"	"			
"	"	103	H	"	"	"	"	"	"	"	"	GND	"	5V	GND	"	L	"	"			
"	"	104	L	"	"	"	"	H	"	"	"	5V	"	"	GND	"	"	"	"			
"	"	105	"	"	"	"	"	L	H	"	"	GND	"	"	5V	"	"	"	"			
"	"	106	"	"	"	H	"	"	L	"	"	5V	"	"	5V	"	"	"	"			
"	"	107	"	"	"	L	"	"	L	"	H	GND	5V	GND	GND	"	"	"	"			
"	"	108	"	"	"	L	H	"	L	"	L	5V	5V	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, N, 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.	O4	O2	O0	O7	O9	O5	O6	V_{SS}	O8	A	D	C	B	O1	O3	V_{DD}		Min	Max	Min	Max	Min	Max	
t_{PLH}	3003	109			OUT					GND		A	GND	GND	GND			5V	A to O0	20	530	30	740	20	530	ns
8/	(Fig.4)	110								"		B	"	"	GND	OUT		"	A to O1	"	"	"	"	"	"	"
"	"	111		OUT						"		GND	"	"	B			"	B to O2	"	"	"	"	"	"	"
"	"	112								"		B	"	"	B		OUT	"	B to O3	"	"	"	"	"	"	"
"	"	113	OUT							"		GND	"	B	GND			"	C to O4	"	"	"	"	"	"	"
"	"	114						OUT		"		B	"	"	GND			"	C to O5	"	"	"	"	"	"	"
"	"	115							OUT	"		GND	"	"	B			"	B to O6	"	"	"	"	"	"	"
"	"	116				OUT				"		B	"	"	B			"	B to O7	"	"	"	"	"	"	"
"	"	117								"	OUT	GND	B	GND	GND			"	D to O8	"	"	"	"	"	"	"
"	"	118					OUT			"		B	B	"	"			"	D to O9	"	"	"	"	"	"	"
t_{PHL}	"	119			OUT					"		C	GND	"	"			"	A to O0	"	"	"	"	"	"	"
8/	"	120								"		C	"	"	"	OUT		"	A to O1	"	"	"	"	"	"	"
"	"	121		OUT						"		GND	"	"	C			"	B to O2	"	"	"	"	"	"	"
"	"	122								"		C	"	"	C		OUT	"	B to O3	"	"	"	"	"	"	"
"	"	123	OUT							"		GND	"	C	GND			"	C to O4	"	"	"	"	"	"	"
"	"	124						OUT		"		C	"	"	GND			"	C to O5	"	"	"	"	"	"	"
"	"	125							OUT	"		GND	"	"	C			"	B to O6	"	"	"	"	"	"	"
"	"	126				OUT				"		C	"	"	C			"	B to O7	"	"	"	"	"	"	"
"	"	127								"	OUT	GND	C	GND	GND			"	D to O8	"	"	"	"	"	"	"
"	"	128					OUT			"		C	C	GND	GND			"	D to O9	"	"	"	"	"	"	"
t_{TLH}	3004	129			OUT					GND		A	GND	GND	GND			5.0V	A to O0	13	260	18	360	13	260	ns
8/	(Fig.4)	130								"		B	"	"	GND	OUT		"	A to O1	"	"	"	"	"	"	"
"	"	131		OUT						"		GND	"	"	B			"	B to O2	"	"	"	"	"	"	"
"	"	132								"		B	"	"	B		OUT	"	B to O3	"	"	"	"	"	"	"
"	"	133	OUT							"		GND	"	B	GND			"	C to O4	"	"	"	"	"	"	"
"	"	134						OUT		"		B	"	"	GND			"	C to O5	"	"	"	"	"	"	"
"	"	135							OUT	"		GND	"	"	B			"	B to O6	"	"	"	"	"	"	"
"	"	136				OUT				"		B	"	"	B			"	B to O7	"	"	"	"	"	"	"
"	"	137								"	OUT	GND	B	GND	GND			"	D to O8	"	"	"	"	"	"	"
"	"	138					OUT			"		B	B	"	"			"	D to O9	"	"	"	"	"	"	"
t_{THL}	"	139			OUT					"		C	GND	"	"			"	A to O0	"	"	"	"	"	"	"
8/	"	140								"		C	"	"	"	OUT		"	A to O1	"	"	"	"	"	"	"
"	"	141		OUT						"		GND	"	"	C			"	B to O2	"	"	"	"	"	"	"
"	"	142								"		C	"	"	C		OUT	"	B to O3	"	"	"	"	"	"	"
"	"	143	OUT							"		GND	"	C	GND			"	C to O4	"	"	"	"	"	"	"
"	"	144						OUT		"		C	"	"	GND			"	C to O5	"	"	"	"	"	"	"
"	"	145							OUT	"		GND	"	"	C			"	B to O6	"	"	"	"	"	"	"
"	"	146				OUT				"		C	"	"	C			"	B to O7	"	"	"	"	"	"	"
"	"	147								"	OUT	GND	C	GND	GND			"	D to O8	"	"	"	"	"	"	"
"	"	148					OUT			"		C	C	GND	GND			"	D to O9	"	"	"	"	"	"	"

See footnotes on next page.

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}	Input levels		Output levels	
		H	L	H	L
V_{IH1} V_{IL1}	5.0 V	V_{DD} 3.5 V	1.5 V V_{SS}	4.5 V Min	0.5 V Max
V_{IH2} V_{IL2}	10.0 V	V_{DD} 7.0 V	3.0 v V_{SS}	9.0 V Min	1.0 V Max
V_{IH3} V_{IL3}	15.0 V	V_{DD} 11.0 V	4.0 V V_{SS}	13.5 V Min	1.5 V 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 ≥ 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 4.

4.4.4 Group D inspection. Group D inspection shall be in accordance with table V of MIL-PRF-38535. 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 parts intended to be marked as radiation hardness assured (see 3.7 herein). RHA levels for device classes B and S shall be as specified in MIL-PRF-38535 and 4.5.4 herein.

4.5 Methods of inspection. Methods of inspection shall be specified and as follows:

4.5.1 Voltage and current. Unless otherwise specified, all voltages given are referenced to the microcircuit V_{SS} terminal. 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 the burn-in and life tests are completed and prior to removal of bias voltages, the devices under test (DUT) shall be cooled to a temperature of 25°C ±3°C; then, electrical parameter end-point measurements shall be performed.

TABLE IV. Delta limits at 25°C.

Parameter 1/	Device types	
	01	51
I_{SS}	±100 nA	±100 nA
V_{OL1} 2/	±0.04 V	- - -
V_{OH1} 2/	±0.08 V	- - -
I_{OL1}	- - -	±15%
I_{OH1}	- - -	±15%

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

4.5.4 Radiation hardness assurance (RHA) testing. The RHA testing shall be performed in accordance with test procedures and sampling specified in MIL-PRF-38535 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 VII 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-PRF-38535 for the radiation hardness assurance level being tested, and meet the end-point electrical parameters as defined in table V 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 VII and on figure 5. In situ and remote testing, the tests shall be performed with the devices biased in accordance with table VI and the 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 V. Radiation hardened end-point electrical parameters at 25°C.

Parameter	Test limits (All device types)	V_{DD} Device types	
		01	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 VI. Bias during exposure to radiation.

Device type	Pin connections 1/		
	V_{DD} = 10 V dc (through a 30 kΩ to 60 kΩ resistor)	V_{SS} = GND	V_{DD} = 10 V dc
01	10, 11, 12, 13	8	16
51	10, 11, 12, 13	8	16

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

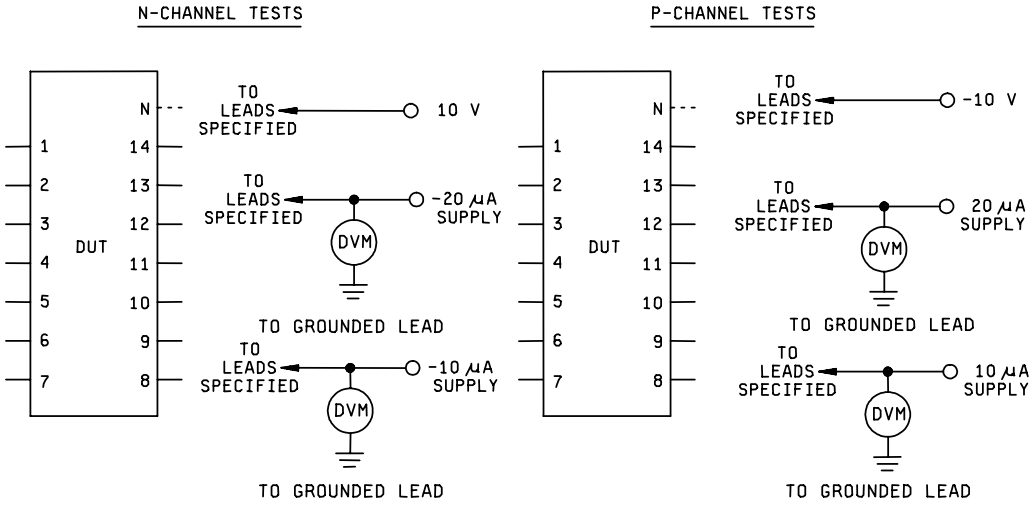


FIGURE 5. Threshold-voltage test circuit.

TABLE VII. Threshold-voltage test circuit conditions.

Device type	GND	10 V	V_{TN} measured at -20 μA supply	GND	-10 V	V_{TP} measured at 20 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

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements are as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

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

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of the specification.

b. PIN and compliance identifier, if applicable (see 1.2).

c. 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.

d. Requirements for certificate of compliance, if applicable.

e. Requirements for notification of change of product or process to contracting activity in addition to notification to the qualifying activity, if applicable.

f. Requirements for failure analysis (including required test condition of method 5003 of MIL-STD-883), corrective action, and reporting of results, if applicable.

g. Requirements for product assurance and radiation hardness assurance options.

h. Requirements for special carriers, lead lengths, or lead forming, if applicable. These requirements should not affect the part number. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.

i. Requirements for "JAN" marking.

j. Packaging requirements. (see 5.1)

6.3 Superseding information. The requirements of MIL-M-38510 have been superseded to take advantage of the available Qualified Manufacturer Listing (QML) system provided by MIL-PRF-38535. Previous references to MIL-M-38510 in this document have been replaced by appropriate references to MIL-PRF-38535. All technical requirements now consist of this specification and MIL-PRF-38535. The MIL-M-38510 specification sheet number and PIN have been retained to avoid adversely impacting existing government logistics systems and contractors parts lists.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers List QML-38535 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DSCC-VQ, P.O. Box 3990, Columbus, Ohio 43218-3990.

6.5 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-PRF-38535, MIL-HDBK-1331, and as follows:

C_I	Input terminal-to-GND 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 percent 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 percent 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_{SS}.
V_{SS}	Negative supply voltage.

6.6 Logistic support. Lead materials and finishes (see 3.4) 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 material and finish A (see 3.4). Longer length leads and lead forming should not affect the part number.

6.7 Data reporting. When specified in the purchase order or contract, a copy of the following data, as applicable, will 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 (see 3.6).

b. A copy of each radiograph.

c. The technology conformance inspection (TCI) data (see 4.4).

d. Parameter distribution data on parameters evaluated during burn-in (see 3.6).

e. Final electrical parameters data (see 4.2d).

f. RHA delta limits.

6.8 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, post irradiation performance or reliability factors equivalent to MIL-M-38510 device types and ma y have slight physical variations in relation to case size. The presence of this information should 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-PRF-38535.

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

6.9 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

(Project 5962-2006-002)

Review activities:
Army - MI, SM
Navy - AS, CG, MC, SH, TD
Air Force – 03, 19, 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using ASSIST Online database at http://assist.daps.dla.mil.