

INCH-POUND

MIL-M-38510/751A
29 June 1992

SUPERSEDING
MIL-M-38510/751
11 SEPTEMBER 1990

MILITARY SPECIFICATION

MICROCIRCUITS, DIGITAL, ADVANCED CMOS, NOR GATES, MONOLITHIC SILICON

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

1. SCOPE

1.1 Scope. This specification covers the detail requirements for monolithic silicon, advanced, 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). The PIN shall be formulated in accordance with MIL-M-38510.

1.2 Classification.

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

<u>Device type</u>	<u>Circuit</u>
01	Quad 2-input NOR gate
02	To be included at a later date
03	To be included at a later date

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

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

<u>Outline letter</u>	<u>Case outline (see MIL-M-38510, appendix C)</u>
C	D-1 (14-lead, .785" x .310" x .200"), dual-in-line package
D	F-2 (14-lead, .390" x .260" x .085"), flat package
2	C-2 (20 terminal, .358" x .358" x .100"), square chip carrier package

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Laboratory (RL/ERDS), Griffiss AFB, NY 13441-5700, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.3 Absolute maximum ratings. 1/ 2/

Supply voltage range (V_{CC})	- - - - -	-0.5 V dc to +6.0 V dc
DC input voltage range (V_{IN})	- - - - -	-0.5 V dc to $V_{CC} + 0.5$ V dc
DC output voltage range (V_{OUT})	- - - - -	-0.5 V dc to $V_{CC} + 0.5$ V dc
Clamp diode current (I_{IK}, I_{OK})	- - - - -	± 20 mA
DC output current (I_{OUT})	- - - - -	± 50 mA
DC V_{CC} or GND current (I_{CC}, I_{GND})	- - - - -	± 100 mA
Storage temperature range (T_{STG})	- - - - -	-65°C to +150°C
Maximum power dissipation (P_D)	- - - - -	500 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
Case operating temperature (T_C)	- - - - -	-55°C to +125°C

1.4 Recommended operating conditions. 2/ 3/ 4/

Supply voltage range (V_{CC})	- - - - -	+3.0 V dc to +5.5 V dc
Input voltage range (V_{IN})	- - - - -	+0.0 V dc to V_{CC}
Output voltage range (V_{OUT})	- - - - -	+0.0 V dc to V_{CC}
Case operating temperature range (T_C)	- - - - -	-55°C to +125°C
Input low (V_{IL}) maximum voltage	- - - - -	0.90 V dc at $V_{CC} = 3.0$ V dc 1.35 V dc at $V_{CC} = 4.5$ V dc 1.65 V dc at $V_{CC} = 5.5$ V dc
Input high (V_{IH}) minimum voltage	- - - - -	2.10 V dc at $V_{CC} = 3.0$ V dc 3.15 V dc at $V_{CC} = 4.5$ V dc 3.85 V dc at $V_{CC} = 5.5$ V dc
Input rise and fall rate (t_r, t_f) maximum: $V_{CC} = 3.6$ V, $V_{CC} = 5.5$ V	- - - - -	8 ns/V

1/ Stresses above the absolute maximum rating may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability. The maximum junction temperature may be exceeded for allowable short duration burn-in screening conditions in accordance with method 5004 of MIL-STD-883.

2/ Unless otherwise specified, all voltages are referenced to GND.

3/ Operation from 2.0 V dc to 3.0 V dc is provided for compatibility with data retention and battery back up systems. Data retention implies no input transitions and no stored data loss with the following conditions: $V_{IH} \geq 70$ percent of V_{CC} , $V_{IL} \leq 30$ percent of V_{CC} , $V_{OH} \geq 70$ percent of V_{CC} at $-20 \mu A$, $V_{OL} \leq 30$ percent of V_{CC} at $20 \mu A$.

4/ Unless otherwise specified, the values listed above shall apply over the full V_{CC} and T_C recommended operating range.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

MILITARY

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

STANDARD

MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

ELECTRONICS INDUSTRIES ASSOCIATION (EIA)

JEDEC Standard No. 20 - Standard for description of 54/74ACXXXX and 54/74ACTXXXX Advanced High-Speed CMOS Devices.

JEDEC Standard No. 17 - A Standardized Test Procedure for the characterization of LATCH-UP in CMOS Integrated Circuits.

(Applications for copies should be addressed to the Electronics Industries Association, 2001 Eye Street, N.W., Washington, DC 20006.)

(Non-Government standards and other publications are normally available from the organizations which prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

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 shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

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

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

3.1.3 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.

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3.2 Electrical performance characteristics and postirradiation end-point electrical parameter limits. Unless otherwise specified, the electrical performance characteristics, and postirradiation end-point electrical parameter limits are as specified in table I, and apply over the case operating temperature range specified. Test conditions for these specified characteristics and limits are as specified in table I. A pin for pin conditions and testing sequence for table I parameters shall be maintained and available upon request from the qualifying activity, on qualified devices.

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 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 I. RHA level designators M, D, and R (see MIL-M-38510) in table I are postirradiation end-point electrical parameters.

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

3.5.1 RHA identifier. The RHA identifier shall be in accordance with MIL-M-38510 and herein (see 3.4).

3.6 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 36 (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 of MIL-STD-883, except as modified herein.

4.1.1 Burn-in and life test circuits. Burn-in and life test circuits shall be constructed so that the devices are stressed at the maximum operating conditions stated 4.2b or 4.2c as applicable or equivalent as approved by the qualifying activity.

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 3.1.10 through 3.1.14 of method 5004 and substitute lines 1 through 7 of table II herein.
- b. Static burn-in, test condition A, method 1015 of MIL-STD-883. 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.
 1. For static burn-in I, all inputs shall be connected to GND. Outputs may be open or connected to $V_{CC}/2 \pm 0.5$ V. Resistors R1 are optional on both inputs and open outputs, and required on outputs connected to $V_{CC}/2 \pm 0.5$ V. $R1 = 220\Omega$ to 47 k Ω .
 2. For static burn-in II, all inputs shall be connected through the R1 resistors to V_{CC} . Outputs may be open or connected to $V_{CC}/2 \pm 0.5$ V. Resistors are optional on open outputs, and required on outputs connected to $V_{CC}/2 \pm 0.5$ V. $R1 = 220\Omega$ to 47 k Ω .
 3. $V_{CC} = 5.5$ V ± 0.5 V.
- c. Dynamic burn-in, test condition D, method 1015 of MIL-STD-883.
 1. Input resistors = 220Ω to 2 k Ω ± 20 percent.
 2. Output resistors = 220Ω ± 20 percent.
 3. $V_{CC} = 5.5$ V ± 0.5 V.
 4. One input shall be connected through the resistor to a CP and all other inputs shall be connected through the resistors in parallel to V_{CC} or GND as applicable. Outputs shall be connected to $V_{CC}/2 \pm 0.5$ V through the resistors.
 5. CP = 25 kHz to 100 kHz square wave; duty cycle = 50 ± 15 percent; $V_{IH} = 4.5$ V to V_{CC} , $V_{IL} = 0$ V ± 0.5 V; t_r , $t_f \leq 100$ ns.
- d. Interim and final electrical parameters shall be as specified in table II herein.
- 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.

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TABLE I. Electrical performance characteristics.

Test and MIL-STD-883 test method	Symbol	Test conditions 1/ -55°C ≤ T _c ≤ +125°C 3.0 V ≤ V _{CC} ≤ 5.5 V unless otherwise specified	Device type 2/	V _{CC}	Group A subgroups	Limits 1/		Unit
						Min	Max	
High level output voltage 3006	V _{OH1} 3/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 2.10 V V _{IL} = 0.90 V For all other inputs V _{IN} = V _{CC} or GND I _{OH} = -50 μA	ALL	3.0 V	1,2,3	2.9		V
	V _{OH2} 3/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.15 V V _{IL} = 1.35 V For all other inputs V _{IN} = V _{CC} or GND I _{OH} = -50 μA	ALL	4.5 V	1,2,3	4.4		V
	V _{OH3} 4/ 5/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.85 V V _{IL} = 1.65 V For all other inputs V _{IN} = V _{CC} or GND I _{OH} = -50 μA	ALL	5.5 V	1,2,3	5.4		V
			M D R	01	1	5.4		
						5.4		
						5.4		
	V _{OH4} 3/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 2.10 V V _{IL} = 0.90 V For all other inputs V _{IN} = V _{CC} or GND I _{OH} = -4 mA	ALL	3.0 V	1,2,3	2.4		V
V _{OH5} 4/ 5/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.15 V V _{IL} = 1.35 V For all other inputs V _{IN} = V _{CC} or GND I _{OH} = -24 mA	ALL	4.5 V	1,2,3	3.7		V	
		M D R	01	1	3.7			
					3.7			
					3.7			
V _{OH6} 3/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.85 V V _{IL} = 1.65 V For all other inputs V _{IN} = V _{CC} or GND I _{OH} = -24 mA	ALL	5.5 V	1,2,3	4.7		V	

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test and MIL-STD-883 test method	Symbol	Test conditions ^{1/} -55°C ≤ T _C ≤ +125°C 3.0 V ≤ V _{CC} ≤ 5.5 V unless otherwise specified	Device type ^{2/}	V _{CC}	Group A subgroups	Limits ^{1/}		Unit				
						Min	Max					
High level output voltage 3006	V _{OH7} 4/ 5/ 6/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.85 V V _{IL} = 1.65 V For all other inputs V _{IN} = V _{CC} or GND I _{OH} = -50 mA	ALL	5.5 V	1,2,3	3.85		V				
									M	01	1	3.85
									D			3.85
			R				3.85					
Low level output voltage 3007	V _{OL1}	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 2.70 V V _{IL} = 0.90 V For all other inputs V _{IN} = V _{CC} or GND I _{OL} = 50 μA	ALL	3.0 V	1,2,3		0.1	V				
	3/											
	V _{OL2}	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.15 V V _{IL} = 1.35 V For all other inputs V _{IN} = V _{CC} or GND I _{OL} = 50 μA	ALL	4.5 V	1,2,3		0.1	V				
	3/											
	V _{OL3} 4/ 5/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.85 V V _{IL} = 1.65 V For all other inputs V _{IN} = V _{CC} or GND I _{OL} = 50 μA	ALL	5.5 V	1,2,3		0.1	V				
									M	01	1	0.1
									D			0.1
			R				0.1					
	V _{OL4} 3/	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 2.70 V V _{IL} = 0.90 V For all other inputs V _{IN} = V _{CC} or GND I _{OL} = 12 mA	ALL	3.0 V	1,3		0.4	V				
											2	0.5

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test and MIL-STD-883 test method	Symbol	Test conditions -55°C ≤ T _c ≤ +125°C 3.0 V ≤ V _{CC} ≤ 5.5 V unless otherwise specified	Device type 2/	V _{CC}	Group A subgroups	Limits 1/		Unit		
						Min	Max			
Low level output voltage 3007	V _{OL5} <u>4/ 5/</u>	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.15 V V _{IL} = 1.35 V For all other inputs V _{IN} = V _{CC} or GND I _{OL} = 24 mA	ALL	4.5 V	1,3		0.4	V		
					2		0.5			
					M D R	01	1			0.4
		0.4								
		0.4								
V _{OL6} <u>3/</u>	For all inputs affecting output under test V _{IN} = V _{IH} or V _{IL} V _{IH} = 3.85 V V _{IL} = 1.65 V For all other inputs V _{IN} = V _{CC} or GND I _{OL} = 24 mA	ALL	5.5 V	1,3		0.4	V			
				2		0.5				
				M D R	01	1			1.65	
		1.65								
		1.65								
Positive input clamp voltage 3022	V _{IC+} <u>4/ 5/</u>	V _{CC} = GND For input under test I _{IN} = 1 mA	ALL		1	0.4	1.5	V		
					M D R	01	1		0.4	1.5
									0.4	1.5
	0.4	1.5								
Negative input clamp voltage 3022	V _{IC-} <u>4/ 5/</u>	V _{CC} = Open For input under test I _{IN} = -1 mA	ALL		1	-0.4	-1.5	V		
					M D R	01	1		-0.4	-1.5
									-0.4	-1.5
	-0.4	-1.5								
Input current high 3010	I _{IH} <u>4/ 5/</u>	For input under test V _{IN} = V _{CC} For all other inputs V _{IN} = V _{CC} or GND	ALL	5.5 V	1		0.1	μA		
					2		1.0			
					M D R	01	1			0.1
		0.1								
		0.1								

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test and MIL-STD-883 test method	Symbol	Test conditions ^{1/} -55°C ≤ T _C ≤ +125°C 3.0 V ≤ V _{CC} ≤ 5.5 V unless otherwise specified	Device type ^{2/}	V _{CC}	Group A subgroups	Limits ^{1/}		Unit
						Min	Max	
Input current low 3009	I _{IL} 4/ 5/	For input under test V _{IN} = GND For all other inputs V _{IN} = V _{CC} or GND	ALL	5.5 V	1		-0.1	μA
						2		
					1			
Input capacitance 3012	C _{IN}	See 4.4.1c T _C = +25°C	ALL	GND	4		8.0	pF
Power dissipation capacitance	C _{PD} 7/	See 4.4.1c T _C = +25°C	ALL	5.0 V	4		75	pF
Quiescent supply current output high 3005	I _{CCH} 4/ 5/	For all inputs V _{IN} = V _{CC} or GND	ALL	5.5 V	1		1.0	μA
						2		
					1			
		700						
Quiescent supply current output low 3005	I _{CCL} 4/ 5/	For all other inputs V _{IN} = V _{CC} or GND	ALL	5.5 V	1		1.0	μA
						2		
					1			
		700						
Low level ground bounce noise	V _{GBL} 8/	V _{LD} = 2.5 V I _{OL} = +24 mA V _I = 4.5 V or 0.0 V See figure 3	ALL	4.5 V	4	0.0	1000	mV
High level ground bounce noise	V _{GBH} 8/	V _{LD} = 2.5 V I _{OH} = -24 mA V _I = 4.5 V or 0.0 V See figure 3	ALL	4.5 V	4	0.0	1000	mV

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test and MIL-STD-883 test method	Symbol	Test conditions ^{1/} -55°C ≤ T _C ≤ +125°C 3.0 V ≤ V _{CC} ≤ 5.5 V unless otherwise specified	Device type ^{2/}	V _{CC}	Group A subgroups	Limits ^{1/}		Unit	
						Min	Max		
Latch-up input/output over-voltage	I _{CC} (0/V1) 2/	t _w ≥ 100 μs t _{cool} ≥ t _w 5 μs ≤ t _r ≤ 5 ms 5 μs ≤ t _f ≤ 5 ms V _{test} = 6.0 V V _{CCQ} = 5.5 V V _{over} = 10.5 V	ALL	5.5 V	2		200	mA	
Latch-up input/output positive over-current	I _{CC} (0/I1+) 2/	t _w ≥ 100 μs t _{cool} ≥ t _w 5 μs ≤ t _r ≤ 5 ms 5 μs ≤ t _f ≤ 5 ms V _{test} = 6.0 V V _{CCQ} = 5.5 V I _{trigger} = +120 mA	ALL	5.5 V	2		200	mA	
Latch-up input/output negative over-current	I _{CC} (0/I1-) 2/	t _w ≥ 100 μs t _{cool} ≥ t _w 5 μs ≤ t _r ≤ 5 ms 5 μs ≤ t _f ≤ 5 ms V _{test} = 6.0 V V _{CCQ} = 5.5 V I _{trigger} = -120 mA	ALL	5.5 V	2		200	mA	
Latch-up supply over-voltage	I _{CC} (0/V2) 2/	t _w ≥ 100 μs t _{cool} ≥ t _w 5 μs ≤ t _r ≤ 5 ms 5 μs ≤ t _f ≤ 5 ms V _{test} = 6.0 V V _{CCQ} = 5.5 V V _{over} = 9.0 V	ALL	5.5 V	2		100	mA	
Truth table test output voltage 3014	4/ 5/ 10/	V _{IL} = 0.45 V V _{IH} = 2.50 V Verify output V _O	M D R	01	3.0 V	7	L L L	H H H	V
		V _{IL} = 0.60 V V _{IH} = 3.70 V Verify output V _O		ALL	4.5 V	7,8	L	H	

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test and MIL-STD-883 test method	Symbol	Test conditions ^{1/} -55°C ≤ T _C ≤ +125°C 3.0 V ≤ V _{CC} ≤ 5.5 V unless otherwise specified	Device type ^{2/}	V _{CC}	Group A subgroups	Limits ^{1/}		Unit	
						Min	Max		
Propagation delay time, A, B to Y 3003	t _{PHL} / t _{PLH} 4/ 5/ 11/ 12/	C _L = 50 pF minimum R _L = 500Ω See figure 4	ALL	3.0 V	9,11	1.0	9.0	ns	
						10	1.0		12.0
					9		1.0		9.0
						D	1.0		9.0
						R	1.0		9.0
					M 01, 02, 03	4.5 V	9,11		1.0
			10	1.0				8.0	
				9			1.0	6.0	
			D				1.0	6.0	
			R				1.0	6.0	

^{1/} Each input/output, as applicable shall be tested at the specified temperature for the specified limits. Output terminals not designated shall be high level logic, low level logic, or open, except as follows:

- a. V_{IC} (pos) tests, the GND terminal can be open. T_C = +25°C.
- b. V_{IC} (neg) tests, the V_{CC} terminal shall be open. T_C = +25°C.
- c. All I_{CC} tests, the output terminal shall be open. When performing these tests, the current meter shall be placed in the circuit such that all current flows through the meter.

Additional detailed information on qualified devices (i.e., pin for pin conditions and testing sequence) is available from the qualifying activity (DESC-EQM) upon request. For negative and positive voltage and current values: The sign designates the potential difference in reference to GND and the direction of current flow respectively; and the absolute value of the magnitude, not the sign, is relative to the minimum and maximum limits, as applicable, listed herein.

- ^{2/} The word "All" in the device type column, means non-RHA limits for all device types. Where M, D and R in the conditions column are postirradiation limits for those device types specified in the device type column.
- ^{3/} This test is guaranteed, if not tested, to the limits specified in table I.
- ^{4/} RHA samples do not have to be tested at -55°C and +125°C prior to irradiation.

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- 5/ When performing postirradiation electrical measurements for RHA level, $T_A = +25^\circ\text{C}$. Limits shown are guaranteed at $T_A = +25^\circ\text{C} \pm 5^\circ\text{C}$.
- 6/ Transmission driving tests are performed at $V_{CC} = 5.5$ V dc with a 2 ns duration maximum.
- 7/ Power dissipation capacitance (C_{PD}) determines the no load dynamic power consumption, $P_D = (C_{PD} + C_L) (V_{CC} \times V_{CC})f + (I_{CC} \times V_{CC})$. The dynamic current consumption, $I_S = (C_{PD} + C_L) V_{CC}f + I_{CC}$. For both P_D and I_S , f is the frequency of the input signal.
- 8/ This test is for qualification only. Ground bounce tests are performed on a nonswitching (quiescent) output and are used to measure the magnitude of induced noise caused by other simultaneously switching outputs. The test is performed on a low noise bench test fixture with all outputs fully dc loaded (I_{OL} maximum and I_{OH} maximum = i.e., ± 24 mA) and 50 pF of load capacitance (see figure 3). The loads must be located as close as possible to the device output. Inputs are then conditioned with 1 MHz pulse ($t_r = t_f = 3.5 \pm 1.5$ ns) switching simultaneously and in phase such that one output is forced low and all others (possible) are switched. The low level ground bounce noise is measured at the quiet output using a F. E. T. oscilloscope probe with at least 1 M Ω impedance. Measurement is taken from the peak of the largest positive pulse with respect to the nominal low level output voltage (see figure 3). The device inputs are then conditioned such that the output under test is at a high nominal V_{OH} level. The high level ground bounce measurement is then measured from nominal V_{OH} level to the largest negative peak. This procedure is repeated such that all outputs are tested at a high and low level with a maximum number of outputs switching.
- 9/ See JEDEC STD. 17 for electrically induced latch-up test methods and procedures. The values listed for $V_{trigger}$, $I_{trigger}$ and V_{over} are to be accurate within ± 5 percent.
- 10/ Tests shall be performed in sequence, attributes data only. Functional tests shall include the truth table and other logic patterns used for fault detection. Functional tests shall be performed in sequence as approved by the qualifying activity on qualified devices. $H \geq 2.5$ V, $L < 2.5$ V; high inputs = 3.7 V and low inputs = 0.6 V for $V_{CC} = 4.5$ V and $H \geq 1.5$ V, $L < 1.5$ V; high inputs = 2.5 V and low inputs = 0.45 V for $V_{CC} = 3.0$ V. Tests at $V_{CC} = 3.0$ V are for RHA specified devices only ($T_A = +25^\circ\text{C} \pm 5^\circ\text{C}$). Functional tests at $V_{CC} = 3.0$ V are worst case for RHA specified devices.
- 11/ Devices are tested at $V_{CC} = 3.0$ V and $V_{CC} = 4.5$ V at $T_C = +125^\circ\text{C}$ for sample testing and at $V_{CC} = 3.0$ V and $V_{CC} = 4.5$ V at $T_C = +25^\circ\text{C}$ for screening. Other voltages of V_{CC} and temperatures are guaranteed, if not tested, see 4.4.1d.
- 12/ AC limits at $V_{CC} = 5.5$ V are equal to the limits at $V_{CC} = 4.5$ V and guaranteed by testing at $V_{CC} = 4.5$ V. Minimum ac limits for $V_{CC} = 5.5$ V are 1.0 ns and guaranteed by guardbanding the $V_{CC} = 4.5$ V minimum limits to 1.5 ns. For propagation delay tests, all paths must be tested.

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Device type	01	
Case outlines	C,D	2
Terminal number	Terminal symbol	
1	1Y	NC
2	1A	1Y
3	1B	1A
4	2Y	1B
5	2A	NC
6	2B	2Y
7	GND	NC
8	3A	2A
9	3B	2B
10	3Y	GND
11	4A	NC
12	4B	3A
13	4Y	3B
14	V _{CC}	3Y
15	---	NC
16	---	4A
17	---	NC
18	---	4B
19	---	4Y
20	---	V _{CC}

NC = No connection

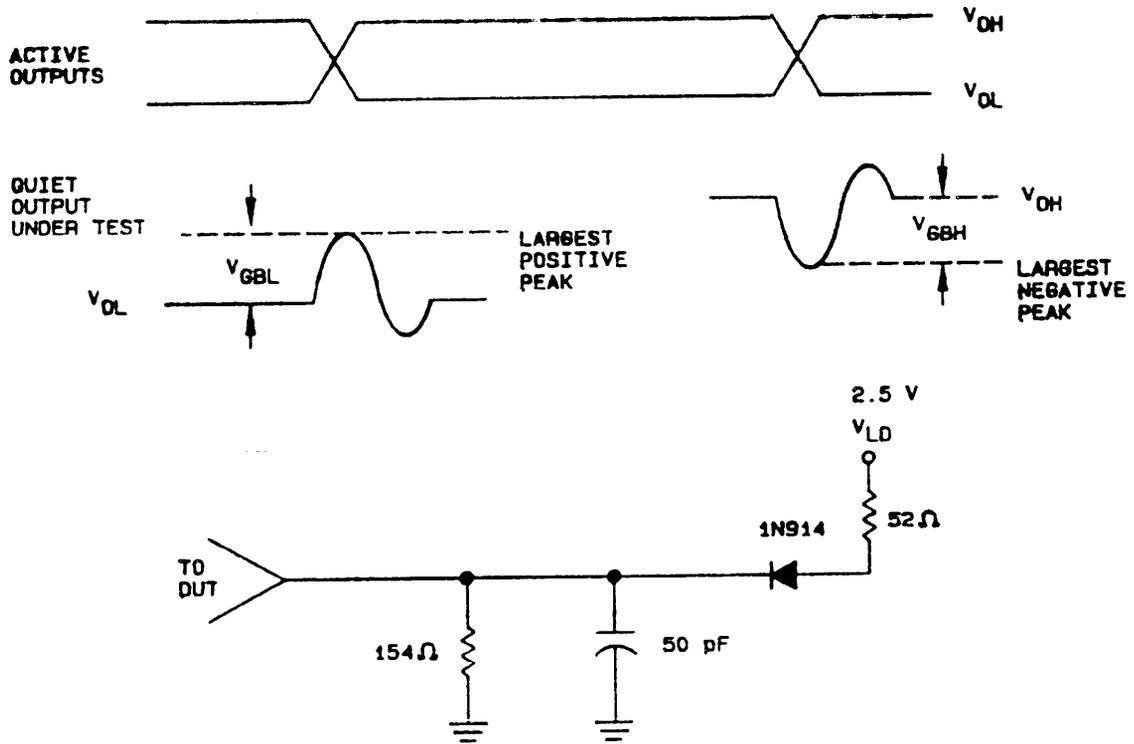
FIGURE 1. Terminal connections.

Device type 01

Inputs		Output
A	B	Y
L	L	H
L	H	L
H	L	L
H	H	L

H = High voltage level
L = Low voltage level
X = Irrelevant

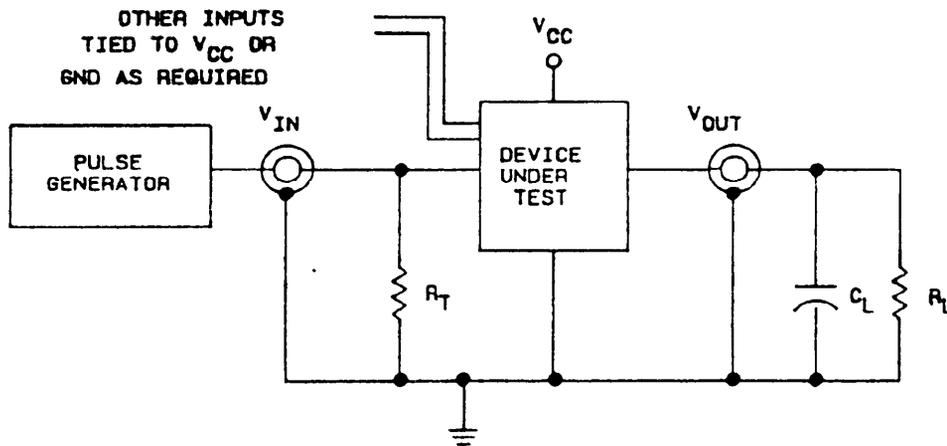
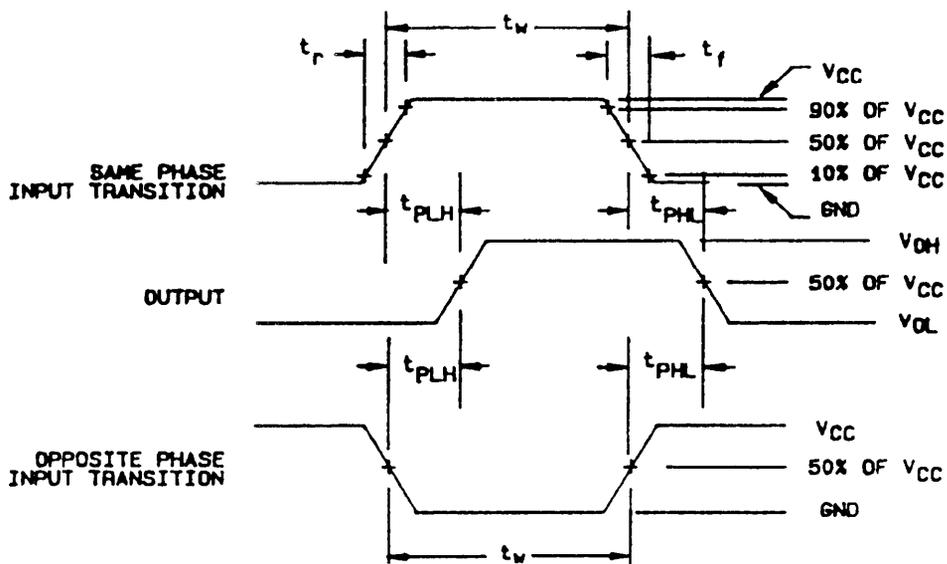
FIGURE 2. Truth table.



NOTE: Resistor and capacitor tolerances = $\pm 10\%$

FIGURE 3. Voltage levels for ground bounce.

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NOTES:

1. $C_L = 50$ pF minimum or equivalent (includes test jig and probe capacitance).
2. $R_L = 500\Omega$ or equivalent
3. $R_T = 50\Omega$ or equivalent.
4. Input signal from pulse generator: $V_{IN} = 0.0$ V to V_{CC} ; PRR ≤ 10 MHz;
 $t_r \leq 3$ ns; $t_f \leq 3$ ns; duty cycle = 50 percent.
5. Timing parameters shall be tested at a minimum input frequency of 1 MHz.

FIGURE 4. Switching waveforms and test circuit.

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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 the PDA.
- c. The PDA for class B devices 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 I, subgroup 1, are defective and shall be removed from the lot. The verified devices times 100 divided by the total number of devices in the lot initially submitted to burn-in shall be used to determine the percent defective for the lot and the lot shall be accepted or rejected based on the specified PDA.

4.3 Qualification inspection. Qualification inspection shall be in accordance with MIL-M-38510, and 4.3.1 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).

4.3.1 Electrostatic discharge sensitivity qualification inspection. Electrostatic discharge sensitivity (ESDS) testing shall be performed in accordance with MIL-STD-883, method 3015. Only those device types that pass ESDS testing at 2,000 volts or greater shall be considered as conforming to the requirements of this specification. ESDS testing shall be measured only for initial qualification and after process or design changes which may affect ESDS classification.

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. O/V, O/I (latch-up) tests and $V_{GBL/H}$ (ground bounce) tests shall be measured only for initial qualification and after process or design changes which may affect the performance of the device. Latch-up test shall be considered destructive. Test all applicable pins on 5 devices with no failures.
- c. C_{IN} and C_{PD} shall be measured only for initial qualification and after process or design changes which may affect capacitance. Capacitance shall be measured between the designated terminal and GND at a frequency of 1 MHz. C_{PD} shall be tested in accordance with the latest revision of JEDEC Standard No. 20 and table I herein. Test all applicable pins on 5 devices with no failures.
- d. Subgroups 9 and 11 shall be measured only for initial qualification and after process or design changes which may affect dynamic performance.
- e. Subgroups 7 and 8 tests shall be sufficient to verify truth table.

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

- a. Class S steady-state life (accelerated) shall be conducted using test condition D, method 1005 of MIL-STD-883 and the circuit described in 4.2c herein, or equivalent as approved by the qualifying activity.
- b. End-point electrical parameters shall be as specified in table II herein. Delta limits shall apply only to subgroup 5 of group B inspections and shall consist of tests specified in table III herein.

TABLE II. Burn-in and electrical test requirements.

Line no.	Applicable tests and MIL-STD-883 test method	Class S device ^{1/}			Class B device ^{1/}		
		Reference paragraph	TABLE I sub-groups ^{2/}	TABLE III delta limits ^{3/}	Reference paragraph	TABLE I sub-groups ^{2/}	TABLE III delta limits ^{3/}
1	Interim electrical parameters (method 5004)		1			1	
2	Static burn-in I (method 1015)	4.2b 4.5.2	Required ^{4/}			Not required	
3	Same as line 1		1	Δ			
4	Static burn-in II (method 1015)	4.2b 4.5.2	Required ^{4/}		4.2b 4.5.2	Required ^{5/}	
5	Same as line 1	4.2d	1*	Δ	4.2d	1*	Δ
6	Dynamic burn-in (method 1015)	4.2c 4.5.2	Required ^{4/}			Not required	
7	Same as line 1	4.2d	1	Δ			
8	Final electrical parameters (method 5004)		1*,2,7*,9			1*,2,7,9 ^{5/}	
9	Group A test requirements (method 5005)	4.4.1	1,2,3,4, 7,8,9,10, 11		4.4.1	1,2,3,4, 7,8,9,10, 11	
10	Group B end-point electrical parameters (method 5005)	4.4.2	1,2,3,7, 8,9,10,11	Δ			
11	Group C end-point electrical parameters (method 5005)				4.4.3	1,2	Δ
12	Group D end-point electrical parameters (method 5005)	4.4.4	1,2,3		4.4.4	1,2	
13	Group E end-point electrical parameters (method 5005)	4.4.5	1,7,9		4.4.5	1,7,9	

1/ Blank spaces indicate tests are not applicable.

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

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

4/ On all class S lots, the device manufacturer shall maintain read-and-record data (as a minimum on disk) for burn-in electrical parameters (group A, subgroup 1), in accordance with test method 5004 of MIL-STD-883. For preburn-in and interim electrical parameters the read-and-record requirements are for delta measurements only.

5/ The device manufacturer may at his option either complete subgroup 1 electrical parameter measurements, including delta measurements, within 96 hours after burn-in completion (removal of bias) or may complete subgroup 1 electrical measurements without delta measurements within 24 hours after burn-in completion (removal of bias). When the manufacturer elects to perform the subgroup 1 electrical parameter measurements without delta measurements, there is no requirement to perform the pre-burn-in electrical tests (first interim electrical parameters test in table II).

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TABLE III. Delta limits at 25°C.

Parameter	Device type	Limits
I_{cch} , I_{ccl} 1/	All	± 100 nA

1/ The above parameters shall be recorded before and after the required burn-in and life tests to determine deltas (Δ).

4.4.3 Group C inspection. Group C inspection shall be in accordance with table III, 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 III herein.
- b. Steady-state life test (method 1005 of MIL-STD-883) shall be conducted using test condition D and as specified in 4.5.2 herein using a circuit as described in 4.2c herein, or equivalent as approved by the qualifying activity.

4.4.4 Group D inspection. Group D inspection shall be in accordance with table IV, 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 hardness assured (see 3.5.1). RHA testing shall be performed in accordance with table V, method 5005 of MIL-STD-883 and electrical tests in table I herein. RHA quality conformance inspection sample tests shall be performed at the level specified in the purchase order.

- a. RHA test for levels M, D, and R shall be performed through each level to determine at what levels the devices meet the RHA requirements. These RHA tests shall be performed for initial qualification and after design or process changes which may affect the RHA performance of the device.
- b. End-point electrical parameters shall be as specified in table I herein.
- c. Prior to total dose irradiation, each selected sample shall be assembled in its qualified package. It shall pass the specified group A electrical parameters for subgroups specified in table II herein.
- d. The devices shall be subjected to RHA tests as specified in MIL-M-38510 for the RHA level being tested, and meet the post irradiation end-point electrical parameter limits as defined in table I at $T_A = 25^\circ\text{C} \pm 5^\circ\text{C}$, after exposure.
- e. Prior to and during total dose irradiation characterization and testing, the devices for characterization shall be biased as so that 50 percent of the devices are tested at input(s) high and 50 percent are at input(s) low, and the devices for testing shall be biased to the worst case condition established during characterization. Devices shall be biased as follows:
 1. Inputs tested high, $V_{CC} = 5.5$ V dc +5%, $R_{CC} = 10\Omega \pm 20$ percent, $V_{IN} = 5.0$ V dc +5%, $R_{IN} = 1$ k $\Omega \pm 20$ percent, and all outputs are open.
 2. Inputs tested low, $V_{CC} = 5.5$ V dc +5%, $R_{CC} = 10\Omega \pm 20$ percent, $V_{IN} = 0.0$ V dc, $R_{IN} = 1$ k $\Omega \pm 20$ percent, and all outputs are open.
- f. Subgroups 1 and 2 of table V (method 5005) of MIL-STD-883 shall be tested as appropriate for device construction.

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

4.5.1 Voltage and current. Unless otherwise specified, all voltages given are referenced to the microcircuit GND terminal. Currents given are conventional current and positive when flowing into the referenced terminal.

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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 within 10°C of their power stable condition at room temperature; then, electrical parameter end-point measurements shall be performed.

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

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, RHA tests and steady-state life tests (see 3.4).
- 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 3.4).
- e. Final electrical parameters data (see 4.2d).
- f. RHA delta limits.

5. PACKAGING

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

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 application and logistic support of existing equipment.

6.2 Acquisition requirements. The acquisition documents must specify the following:

- a. Title, number, and date of the specification.
- b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.2).
- c. Complete PIN.
- d. 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.
- e. Requirements for certificate of compliance, if applicable.
- f. Requirements for notification of change of product or process to the contracting activity in addition to notification to the qualifying activity, if applicable.
- g. Requirements for failure analysis (including required test condition of method 5003 of MIL-STD-883), corrective action and reporting of results, if applicable.
- h. Requirements for product assurance and RHA options.
- i. Requirements for special carriers, lead lengths, or lead forming, if applicable. These requirements shall not affect the PIN. Unless otherwise specified, these requirements shall not apply to direct purchase by, or direct shipment to the Government.
- j. Requirements for "JAN" marking.

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 _{IN}	-----	Input terminal-to-GND capacitance
GND	-----	Ground zero voltage potential
I _{CC} H	-----	Quiescent supply current, outputs high
I _{CC} L	-----	Quiescent supply current, outputs low
I _{IL}	-----	Input current low
I _{IH}	-----	Input current high
T _C	-----	Case temperature
T _A	-----	Ambient temperature
V _{CC}	-----	Positive supply voltage
C _{PD}	-----	Power dissipation capacitance
V _{IC}	-----	Positive input clamp voltage
V _{GB}	-----	Ground bounce voltage
O/V	-----	Latch-up over-voltage
O/I	-----	Latch-up over-current
t _w	-----	Trigger duration (width)

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 PIN.

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, postirradiation performance or reliability factors equivalent to MIL-M-38510 device types and may have slight physical variations in relation to case size. The presence of this information shall not be deemed as permitting substitution of generic-industry types for MIL-M-38510 types or as a waiver of any of the provisions of MIL-M-38510.

<u>Military device type</u>	<u>Generic-industry type</u>
01	54AC02
02*	54AC27
03*	54AC266

* These device types to be included in a later revision of this specification.

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. Avoid use of plastic, rubber, or silk in MOS areas.
- e. Maintain relative humidity above 50 percent, if practical.

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

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CONCLUDING MATERIAL

Custodians:

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

Review activities:

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

User activities:

Army - SM
Navy - AS, CG, MC, OC, SH

Preparing activity:

Air Force - 17

Agent:

DLA - ES

(Project 5962-1280)