

MILITARY SPECIFICATION

MICROCIRCUITS, DIGITAL, TTL, COMMON OR GATES, MONOLITHIC SILICON

This specification is approved for use by Rome Air Development Center, Department of the Air Force, and is available 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, TTL, positive or logic gating microcircuits. Three product assurance classes and a choice of case outline/lead finish are provided for each type and are reflected in the complete part number.

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

1.2.1 Device type. The device type shall be as shown in the following:

<u>Device type</u>	<u>Circuit</u>
01	Quadruple 2-input positive or gate

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

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

<u>Outline letter</u>	<u>MIL-M-38510, appendix C, case outline</u>
A	F-1 (14-pin, 1/4" x 1/4", flat pack)
B	F-3 (14-pin, 3/16" x 1/4", flat pack)
C	D-1 (14-pin, 1/4" x 3/4", dual-in-line pack)
D	F-2 (14-pin, 1/4" x 3/8", flat-pack)

1.2.4 Absolute maximum ratings.

Supply voltage range - - - - -	-0.5 Vdc to 7.0 Vdc
Input voltage range- - - - -	-1.5 Vdc at -12 mA to 5.5 Vdc
Storage temperature range- - - - -	-65°C to 150°C
Maximum power dissipation, P _D - - -	210 mWdc <u>1/</u>
Lead temperature (soldering 10 seconds) - - - - -	300°C
Thermal resistance, junction to case	$\theta_{JC} - \begin{cases} 0.09^\circ\text{C}/\text{mW} \text{ for flat pack} \\ 0.08^\circ\text{C}/\text{mW} \text{ for dual-in-line pack} \end{cases}$
Junction temperature - - - - -	T _J = 175°C

1/ Must withstand the added P_D due to short circuit conditions (e.g. I_{OS}) at one output for 5 seconds.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Rome Air Development Center (RBRD), Griffis AFB, NY 13440, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.2.5 Recommended operating conditions.

Supply voltage - - - - - 4.5 Vdc minimum to 5.5 Vdc maximum
Minimum high level input voltage- 2.0 Vdc
Maximum low level input voltage - 0.8 Vdc
Normalized fanout (each output):
 High level voltage - - - - - 20
 Low level voltage- - - - - 10
Ambient operating temperature
 range- - - - - -55°C to 125°C

2. APPLICABLE DOCUMENT

2.1 The following document, of the issue in effect on date of invitation for bids or request for proposal, forms a part of this specification to the extent specified herein.

SPECIFICATION

MILITARY

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

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

3. REQUIREMENTS

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

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

3.2.1 Logic diagram and terminal connections. The logic diagram and terminal connections shall be as specified on figure 1.

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

3.2.3 Schematic circuit. The schematic circuit shall be as specified on figure 3.

3.2.4 Case outlines. The case outlines shall be in accordance with 1.2.3.

3.3 Lead material and finish. Lead material and finish shall be in accordance with MIL-M-38510 (see 6.5).

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

3.5 Rebonding. Rebonding shall be in accordance with MIL-M-38510.

3.6 Electrical test requirements. Electrical test requirements shall be as specified in table III for the applicable device type and device class. The subgroups of table III which constitute the minimum electrical test requirements for screening, qualification and quality conformance, by device class are specified in table II.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions <u>1/</u>	Limits		Units
			Min	Max	
High-level output voltage	V_{OH}	$V_{CC} = 4.5 \text{ V}$, $V_{IN} = 2.0 \text{ V}$ $I_{OH} = -800 \text{ } \mu\text{A}$	2.4	---	Volts
Low-level output voltage	V_{OL}	$V_{CC} = 4.5 \text{ V}$, $I_{OL} = 16 \text{ mA}$ $V_{IN} = 0.8 \text{ V}$	---	0.4	Volts
Input clamp voltage	V_{IC}	$V_{CC} = 4.5 \text{ V}$, $I_{IN} = -12 \text{ mA}$ $T_A = 25^\circ\text{C}$	---	-1.5	Volts
High-level input current	I_{IH1}	$V_{CC} = 5.5 \text{ V}$, $V_{IN} = 2.4 \text{ V}$	---	40	μA
High-level input current	I_{IH2}	$V_{CC} = 5.5 \text{ V}$, $V_{IN} = 5.5 \text{ V}$	---	100	μA
Low-level input current	I_{IL}	$V_{CC} = 5.5 \text{ V}$, $V_{IN} = 0.4 \text{ V}$	-0.7	-1.6	mA
Short-circuit output current	I_{OS}	$V_{CC} = 5.5 \text{ V}$ <u>2/</u>	-20	-55	mA
High-level supply current	I_{CCH}	$V_{CC} = 5.5 \text{ V}$ $V_{IN} = 5.5 \text{ V}$	---	22	mA
Low-level supply current	I_{CCL}	$V_{CC} = 5.5 \text{ V}$ $V_{IN} = 0 \text{ V}$	---	38	mA
Propagation delay time, high-to-low-level	t_{PHL}	$C_L = 50 \text{ pF}$, $R_L = 390\Omega$	3	27	ns
Propagation delay time, low-to-high-level	t_{PLH}	$C_L = 50 \text{ pF}$, $R_L = 390\Omega$	3	25	ns

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

2/ Not more than one output should be shorted at a time.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirement	Subgroups (see table III)		
	Class A devices	Class B devices	Class C devices
Interim electrical parameters (Pre Burn-In) (Method 5004)	1	1	None
Final electrical test parameters (Method 5004)	1*, 2, 3, 9, 10, 11	1*,2,3,9	1
Group A test requirements (Method 5005)	1, 2, 3, 9, 10, 11	1, 2, 3, 9	1, 2, 3, 9
Groups C and D end point electrical parameters (Method 5005)	1, 2, 3	1, 2, 3	1
Additional electrical subgroups for Group C periodic inspections	None	10, 11	None

*PDA applied to subgroup 1 (see 4.3(d)).

3.7 Marking. Marking shall be in accordance with MIL-M-38510 and 1.2. At the option of the manufacturer, the following marking may be omitted from the body of the microcircuit, but shall be retained on the initial container.

a. Country of origin.

3.8 Microcircuit group assignment. The devices covered by this specification shall be in microcircuit group number 1 (see MIL-M-38510, appendix E).

4. PRODUCT ASSURANCE PROVISIONS

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

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1, 4.4.2, and 4.4.3).

4.3 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. Burn-in test (Method 1015 of MIL-STD-883).
 1. Test condition D or E, using the circuit shown on figure 4 or equivalent.
- b. Interim and final electrical test parameters shall be as specified in table II, except interim electrical parameters test prior to burn-in is optional at the discretion of the manufacturer.

- c. Percent defective allowable (PDA) - The PDA for Class A devices shall be as specified in MIL-M-38510. The PDA for class B devices shall be 10 percent based on failures from group A, subgroup 1 test after cool down as final electrical test in accordance with method 5004 of MIL-STD-883, and with no intervening electrical measurements. If interim electrical parameter tests are performed prior to burn-in, failures resulting from pre burn-in screening may be excluded from the PDA. If interim electrical parameter tests prior to burn-in are omitted, then all screening failures shall be included in the PDA. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent defective for that lot, and the lot shall be accepted or rejected based on the PDA for the applicable device class.

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-M-38510. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1, 4.4.2, and 4.4.3).

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

- a. Tests shall be as specified in table II.
- b. Subgroups 4, 5, 6, 7, and 8 of table I of Method 5005 of MIL-STD-883 shall be omitted.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of Method 5005 of MIL-STD-883.

4.4.3 Groups C and D inspection. Groups C and D inspection shall be in accordance with tables III and IV of Method 5005 of MIL-STD-883 and as follows:

- a. End point electrical parameters shall be as specified in table II.
- b. Subgroups 3 and 4 shall be added to the group C inspection requirements for class B devices and shall consist of the tests, conditions, and limits specified for subgroups 10 and 11 of group A.
- c. Operating life test (Method 1005 of MIL-STD-883) conditions:
 1. Test condition D or E, using the circuit shown on figure 4 or equivalent.
 2. Test duration: 1,000 hours, except as permitted by appendix B of MIL-M-38510.

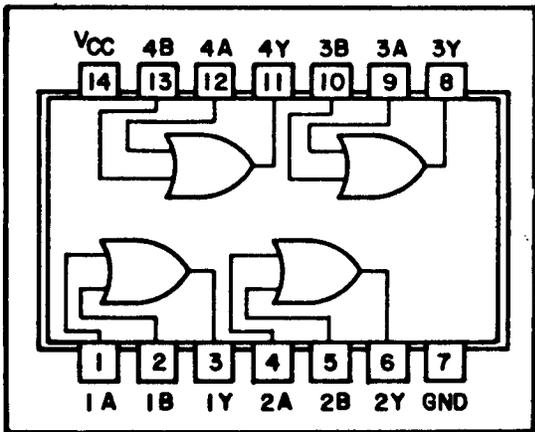
4.5 Methods of examination and test. Methods of examination and test shall be as specified in the appropriate tables and as follows:

4.5.1 Voltage and current. All voltages given are referenced to the microcircuit ground terminal. Currents given are conventional current and positive when flowing into the referenced terminal.

4.5.2 Life test cooldown procedure. When devices are measured at 25°C following application of the operating life or burn-in test condition, they shall be cooled to room temperature prior to removal of the bias. Alternately, the bias may be removed during cooling if the case temperature is reduced to room temperature within 30 minutes after removal of the test condition.

4.6 Inspection of preparation for delivery. Inspection of preparation for delivery shall be in accordance with MIL-M-38510, except that the rough handling test shall not apply.

Device type 01



CASES A, B, C AND D

FIGURE 1. Logic diagram and terminal connections.

Device type 01

Truth table (each gate)		
Inputs		Output
A	B	Y
L	L	L
H	L	H
L	H	H
H	H	H

Positive logic $Y = A + B$

FIGURE 2. Truth table and logic equations.

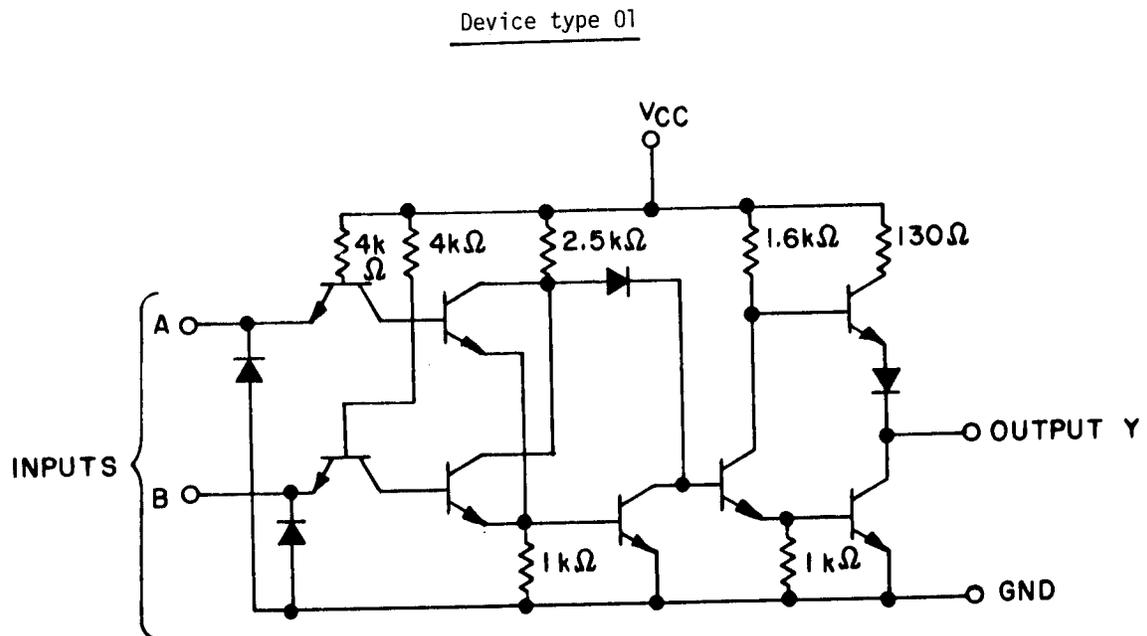
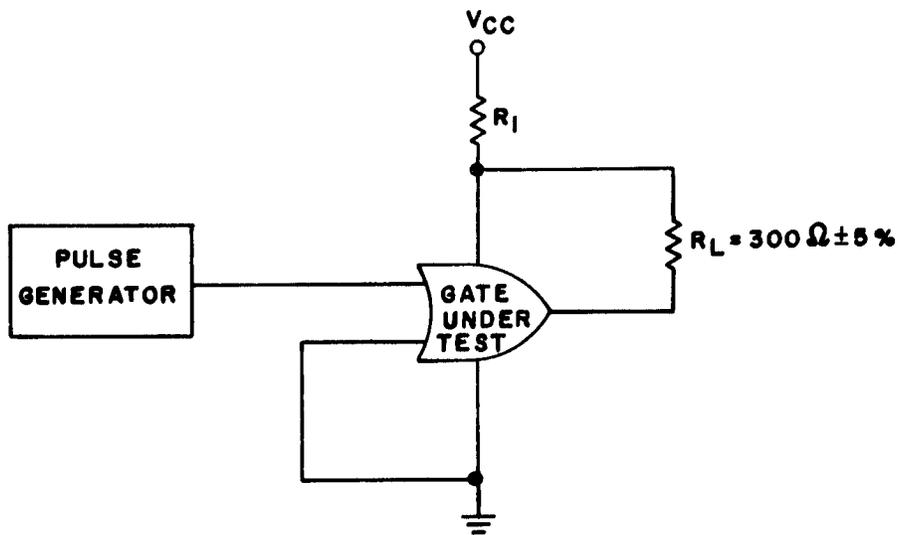


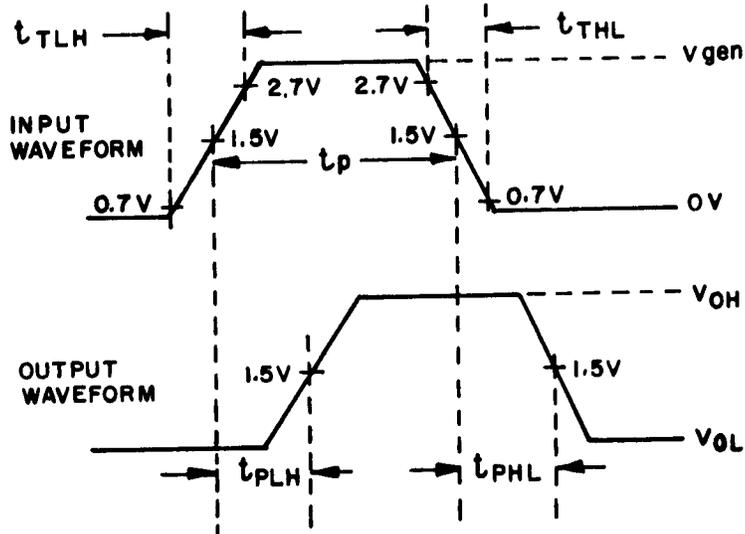
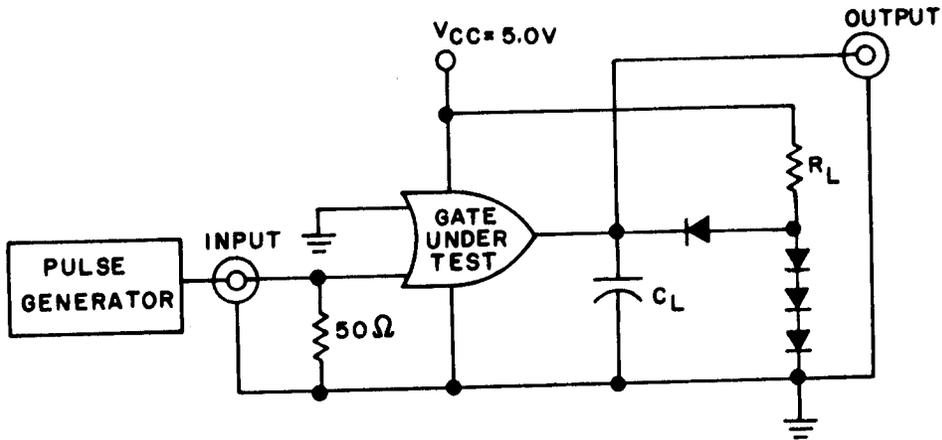
FIGURE 3. Schematic circuits (each gate).



NOTES:

1. The pulse generator has the following characteristics: PRR = 100 kHz \pm 50% square wave, duty cycle = 50 \pm 15%, V_{IL} = -0.5 V minimum to +0.7 V maximum and V_{IH} = 2.0 V minimum to 5.5 V maximum.
2. V_{CC} and R_1 are such that the minimum voltage at the device terminal is 5 volts.

FIGURE 4. Burn-in and life test circuits.



NOTES:

1. The pulse generator has the following characteristics: $V_{gen} = 3\text{ V}$, $PRR = 1\text{ MHz}$; t_{TLH} and $t_{THL} \leq 10\text{ ns}$, $t_p = 200\text{ ns}$ and $Z_{OUT} \approx 50\Omega$.
2. $C_L = 50\text{ pF}$ minimum, including scope probe, wiring, and stray capacitance.
3. $R_L = 390\Omega \pm 5\%$.
4. All diodes are 1N3064 or equivalent.

FIGURE 5. Switching time test circuit and waveforms.

TABLE III. Group A inspection for device type 01. -Continued.
Terminal conditions (pins not designated may be high ≥ 2.0 V; or low < 0.8 V; or open)

Subgroup	Symbol	MIL-STD-883 method	Cases A, B, C, D Test No.	Terminal conditions														Meas. terminal	Test limits		Unit			
				1	2	3	4	5	6	7	8	9	10	11	12	13	14		Min	Max				
1 $T_A = 25^\circ\text{C}$	t_{OS}	3011	45 46 47 48	5.5 V	1A	1B	1Y	2A	2B	2Y	GND	3Y	3A	3B	4Y	4A	4B	5.5 V	1Y	-20	-55	mA		
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	5.5 V	2Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	VCC	3Y		
2	t_{CCL}	3005	49	5.5 V	5.5 V	GND												5.5 V	4Y					
				GND	GND															GND				
2	t_{CCH}	3005	50	5.5 V	5.5 V	GND												5.5 V						
				GND	GND															GND				
3 $T_A = 25^\circ\text{C}$	t_{PHL}	3003 Fig 5	51 52 53 54 55 56 57 58	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	5.0 V	1A to 1Y	3	22	ns		
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		1B to 1Y		18	
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		2A to 2Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		2B to 2Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		3A to 3Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		3B to 3Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		4A to 4Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		4B to 4Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		1A to 1Y		27	
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		1B to 1Y			
10 $T_A = 125^\circ\text{C}$	t_{PHL}		67 68 69 70 71 72 73 74	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		1A to 1Y		25			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		1B to 1Y				
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		2A to 2Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		2B to 2Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		3A to 3Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		3B to 3Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		4A to 4Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		4B to 4Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		1A to 1Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		1B to 1Y			
11	t_{PLH}		75 76 77 78 79 80 81 82	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		1A to 1Y					
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		1B to 1Y				
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		2A to 2Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		2B to 2Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		3A to 3Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		3B to 3Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		4A to 4Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		4B to 4Y			
				IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN		1A to 1Y			
				GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND		1B to 1Y			

Same tests, terminal conditions and limits as for subgroup 10, except $T_A = -55^\circ\text{C}$.

5. PREPARATION FOR DELIVERY

5.1 Preservation-packaging and packing. Microcircuits shall be prepared for delivery in accordance with MIL-M-38510.

6. NOTES

6.1 Notes. The notes specified in MIL-M-38510 are applicable to this specification.

6.2 Intended use. Microcircuits conforming to this specification are intended for use for Government microcircuit applications (original equipment) and logistic purposes.

6.3 Ordering data. The contract or order should specify the following:

- a. Complete part number (see 1.2).
- b. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- c. Requirement for certificate of compliance, if applicable.
- d. Requirements for notification of change of product or process to procuring activity in addition to notification to the qualifying activity, if applicable.
- e. Requirements for packaging and packing.
- f. Requirements for failure analysis (including required test condition of Method 5003), corrective action and reporting of results, if applicable.
- g. Requirements for product assurance options.
- h. Requirements for carriers, special lead lengths or lead forming, if applicable. These requirements shall not affect the part number. Unless otherwise specified, these requirements will not apply to direct purchase by or direct shipment to the Government.

6.4 Abbreviations, symbols and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-STD-1313, MIL-STD-1331, and as follows:

GND	- - - - -	Electrical ground (common terminal)
V _{IN}	- - - - -	Voltage level at an input terminal
I _{IN}	- - - - -	Current-flowing into an input terminal

6.5 Logistic support. Lead materials and finishes (see 3.3) are interchangeable. Unless otherwise specified, microcircuits procured for Government logistic support will be procured to device class B (see 1.2.2), lead material and finish C (see 3.3). Longer lead lengths and lead forming shall not affect the part number.

6.6 Substitutability. Microcircuits covered by this specification will replace the following commercial device types:

<u>Device type</u>	<u>Commercial type</u>
01	5432, 7432

Custodian:
Air Force - 17

Review activities:
Air Force - 11, 17, 19, 99
DSA - ES

Preparing activity:
Air Force - 17

Agent:
DSA - ES

(Project 5962-F179)