

QUALIFICATION
REQUIREMENTS
REMOVED

MIL-M-38510/442A
9 August 1983
SUPERSEDING
MIL-M-38510/442(USAF)
8 March 1979

MILITARY SPECIFICATION
MICROCIRCUITS, DIGITAL, SCHOTTKY, TTL,
D-TYPE REGISTER, WITH THREE-STATE OUTPUT, MONOLITHIC SILICON

INACTIVE FOR NEW DESIGN AFTER DATE OF THIS REVISION

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, Schottky TTL, D-Type Register with three-state output microcircuits. One product assurance class and a choice of case outlines and lead finishes are provided for each type and are reflected in the complete part number.

1.2 Part number. The part number shall be in accordance with MIL-M-38510 except that the "JAN" or "J" certification mark shall not be used.

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

<u>Device type</u>	<u>Circuit</u>
01	Quad D-type flip-flop

1.2.2 Device class. The device class shall be the product assurance level as defined in MIL-M-38510 (see 6.5).

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>
E	D-2 (16-lead, 1/4" x 7/8"), dual-in-line package
F	F-5 (16-lead, 1/4" x 3/8"), flat package

1.3 Absolute maximum ratings.

DC voltage applied to outputs for high output state - - - - -	-0.5 to V_{CC}
Supply voltage range - - - - -	-0.5 to +7.0 V dc
Input voltage range - - - - -	-0.5 to +5.5 V dc
Storage temperature range - - - - -	-65°C to +150°C
Maximum power dissipation, P_D ^{1/} :	
Device type 01 - - - - -	0.83 W
DC output current, into outputs - - - - -	30 mA
DC input current - - - - -	-30 mA to 5 mA
Lead temperature (soldering, 10 seconds) - - - - -	300°C
Thermal resistance, junction to case (θ_{JC}):	
Case E - - - - -	0.08°C/mW
Case F - - - - -	0.15°C/mW
Junction temperature (T_J) - - - - -	175°C

^{1/} Must withstand the added P_D due to short circuit test (e.g., I_{OS}).

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, (RBE-2), Griffiss AFB, NY 13441, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

1.4 Recommended operating conditions.

Supply voltage range- - - - - 4.5 V dc minimum to 5.5 V dc maximum
Minimum high level input voltage- - - - - 2.0 V dc
Maximum low level input voltage - - - - - 0.8 V dc
Case operating temperature range (T_C) - - -55°C to +125°C

2. APPLICABLE DOCUMENTS

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

SPECIFICATION

MILITARY

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

STANDARD

MILITARY

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

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

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

3. REQUIREMENTS

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

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

3.2.1 Terminal connections and logic diagrams. The terminal connections and logic diagrams shall be as specified on figures 1 and 3, respectively.

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

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

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

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

3.5 Electrical test requirements. The electrical test requirements for each device class shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table III.

3.6 Marking. Marking shall be in accordance with MIL-M-38510 and 1.2 herein. At the option of the manufacturer, the country of origin may be omitted from the body of the microcircuit, but shall be retained on the initial container. The "JAN" or "J" certification mark shall not be used.

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions	Limits		Unit
			Min	Max	
High-level output voltage	Q outputs	$V_{CC} = 4.5 \text{ V}; I_{OH} = -1 \text{ mA}$	2.5		V
	Y outputs	$V_{CC} = 4.5 \text{ V}; I_{OH} = -2 \text{ mA}$	2.4		
Low-level output voltage	V_{OL}	$V_{CC} = 4.5 \text{ V dc}; I_{OL} = 20 \text{ mA}$		0.5	V
Input clamp voltage	V_{IC}	$V_{CC} = 4.5 \text{ V}; I_{IN} = -18 \text{ mA}$		-1.2	V
Low-level input current	I_{IL1}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 0.5 \text{ V}$	-1.1	-2.0	mA
High-level input current	I_{IH1}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 2.7 \text{ V}$		50	μA
High-level input current	I_{IH2}	$V_{CC} = 5.5 \text{ V}; V_{IN} = 5.5 \text{ V}$		1.0	mA
Output leakage current low, high impedance state, Y output	$I_{OFF(L)}$	$V_{CC} = 5.5 \text{ V}; V_{OUT} = 0.4 \text{ V}$		-50	μA
Output leakage current high, high impedance state, Y output	$I_{OFF(H)}$	$V_{CC} = 5.5 \text{ V}; V_{OUT} = 2.4 \text{ V}$		50	μA
Short-circuit output current	I_{OS}	$V_{CC} = 5.5 \text{ V } \underline{1/}$	-40	-100	mA
Supply current	I_{CC}	$V_{CC} = 5.5 \text{ V}$		120	mA
Propagation delay time from clock input to Q output	t_{PHL1}	$V_{CC} = 5.0 \text{ V}$ (see load, figure 5)	2	16	ns
	t_{PLH1}		2	12	
Propagation delay time from clock input to Y output	t_{PHL2}		2	16	ns
	t_{PLH2}		2	12	
Propagation delay time to low level, from output enable to data out	t_{PZL1}	$V_{CC} = 5.0 \text{ V}$ (see load, figure 5)	2	10	ns
Propagation delay time to high level, from output enable to data out	t_{PZH1}		2	15	ns
Propagation delay time to high impedance, from output enable and data out (low)	t_{PLZ1}		2	15	ns
Propagation delay time to high impedance, from output enable and data out (high)	t_{PHZ1}	$V_{CC} = 5.0 \text{ V}$ (see load, figure 5, and 4.4.1)	2	44	ns
Set-up time, from data to clock	t_{THL}	$V_{CC} = 5.0 \text{ V}$, (see load, figure 5)	5		ns
	t_{TLH}				
Hold time, from data to clock	t_{HHL}		3		ns
	t_{HLH}				
Pulse width, clock	t_{WH}		7		ns

1/ All unspecified inputs grounded.

3.7 Manufacturer eligibility. To be eligible to supply microcircuits to this specification, a manufacturer shall have a manufacturer certification in accordance with MIL-M-38510 for at least one line, not necessarily the line producing the device type described herein.

3.8 Certification. Certification in accordance with MIL-M-38510 is not required for this device.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (see table III)
	Class B devices
Interim electrical parameters (pre burn-in) (method 5004)	1
Final electrical test parameters (method 5004)	1*,2,3,7,9,10,11
Group A test requirements (method 5005)	1,2,3,7,8,9,10,11
Group C end-point electrical parameters (method 5005)	N/A
Additional electrical subgroups for group C periodic inspections	N/A
Group D end-point electrical parameters (method 5005)	1,2,3

*PDA applies to subgroup 1 (see 4.2c).

4. QUALITY ASSURANCE PROVISIONS

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

4.2 Screening. Screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to 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.
 - (2) $T_A = +125^\circ\text{C}$ minimum.
- b. Interim and final electrical tests 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. The percent defective allowable (PDA) for class B devices shall be 10 percent based on failures from group A, subgroup 1 tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883, and with no intervening electrical measurements. If interim electrical tests are performed prior to burn-in, failures resulting from pre burn-in screening may be excluded from the PDA. If interim electrical 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.

4.3 Qualification inspection. Qualification inspection is not required.

4.4 Quality conformance inspection. Quality conformance inspection shall be in accordance with MIL-M-38510 and as specified herein. Inspections to be performed shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, and D inspections (see 4.4.1 through 4.4.4). Generic test data (see 6.6) may be used to satisfy the requirements for groups C and D inspections. Quality conformance inspection shall be completed on the specific devices covered by this specification before they are shipped.

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, and 6 of table I shall be omitted.
- c. The t_{pHZ} test in table III shall be performed with a reduced capacitance load of 5 pF.

4.4.2 Group B inspection. Group B inspection shall be in accordance with table II of method 5005 of MIL-STD-883. Electrical parameters shall be as specified in table II.

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

- a. End-point electrical test parameters shall be as specified in table II herein.
- 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. Steady-state 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) $T_A = +125^\circ\text{C}$ minimum.
 - (3) Test duration: 1,000 hours, except as permitted by appendix B of MIL-M-38510.

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

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

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

Device type 01

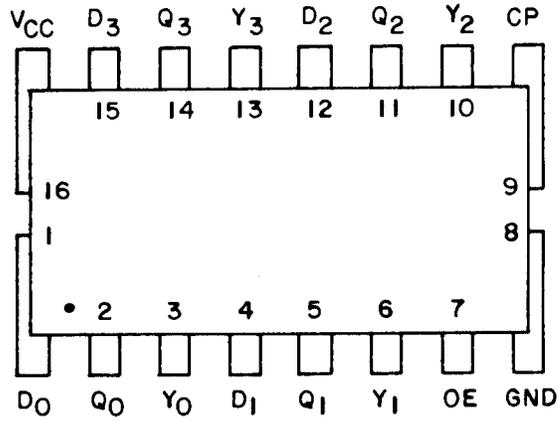


FIGURE 1. Terminal connections.

Device type 01

Inputs			Outputs	
\overline{OE}	CP	D	Q	Y
H	L	X	Q_0	Z
H	H	X	Q_0	Z
H	↑	L	L	Z
H	↑	H	H	Z
L	↑	L	L	L
L	↑	H	H	H

L = Low
 H = High
 X = Don't care
 Q_0 = Same as previous state
 Z = High impedance state
 ↑ = Low to high transition

FIGURE 2. Truth table.

Device type 01

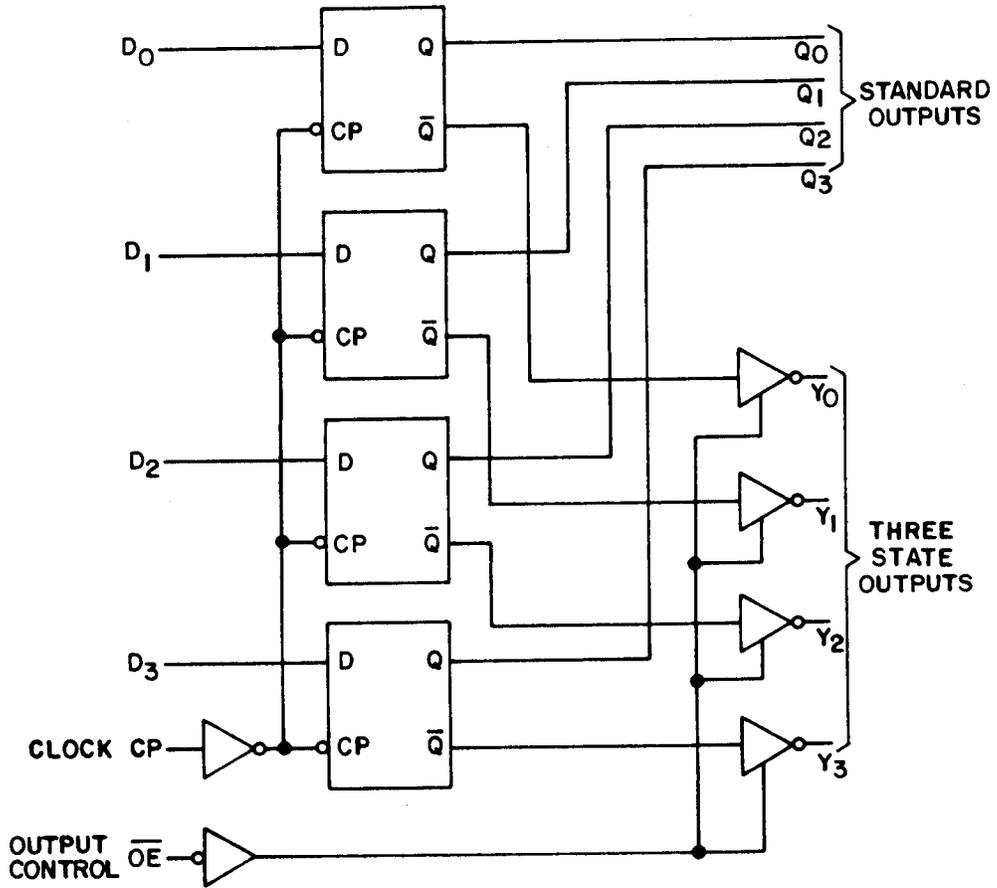
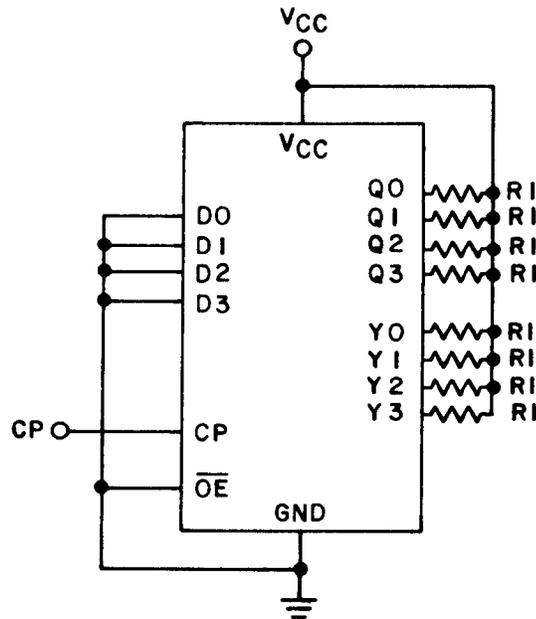


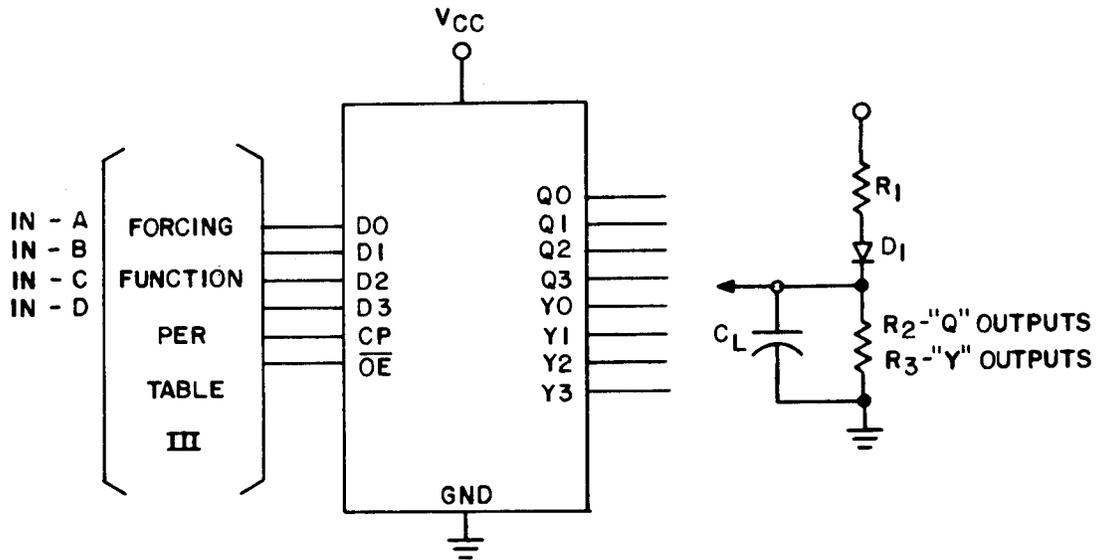
FIGURE 3. Logic diagram.

Device type 01

NOTES:

1. $V_{CC} = 5.5 \text{ V}$.
2. $R_1 = 280\Omega \pm 5\%$.
3. $CP \leq 1 \text{ MHz} \pm 50\%$ square wave; duty cycle = $50 \pm 15\%$;
 $V_{IH} = 2.0 \text{ V to } 5.5 \text{ V}$; $V_{IL} = -0.5 \text{ V to } 0.8 \text{ V}$.

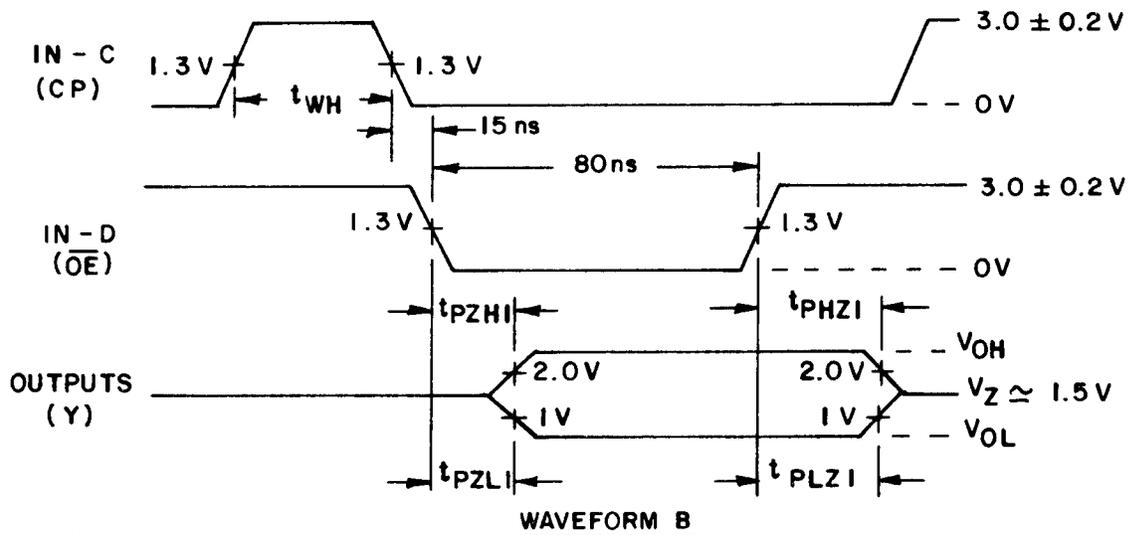
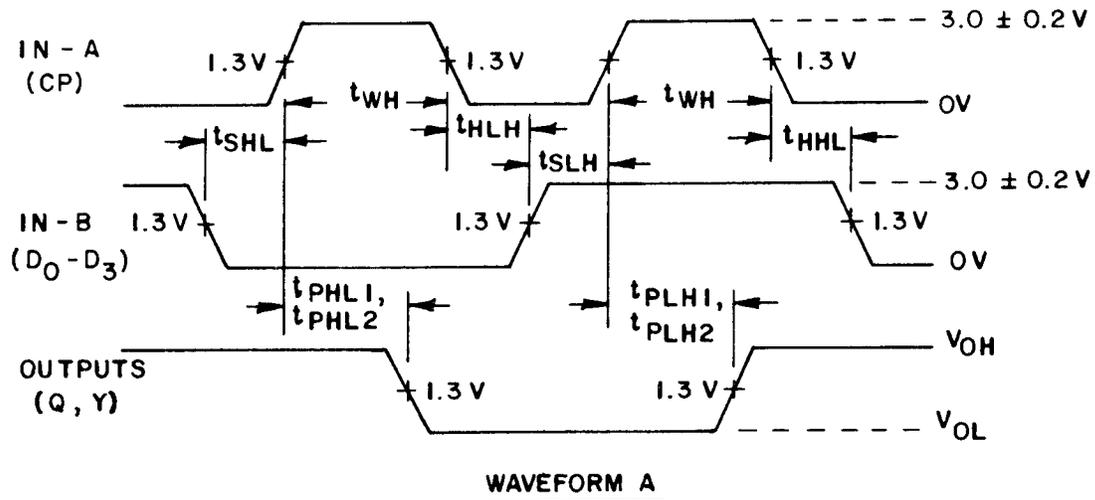
FIGURE 4. Burn-in and life test circuit.



NOTES:

1. $V_{CC} = 5.0 \text{ V.}$
2. $D_1 = 1N3064$ or equivalent.
3. $R_1 = 60.4\Omega \pm 1\%$; $R_2 = 2.49 \text{ k}\Omega \pm 1\%$; $R_3 = 1.2 \text{ k}\Omega \pm 2\%$.
4. $C_L = 50 \text{ pF.}$

FIGURE 5. Switching waveforms for device type 01.



NOTES:

1. $V_{CC} = 5.0 \text{ V}$.
2. D1 = 1N3064 or equivalent.
3. R1 = $60.4\Omega \pm 1\%$; R2 = $2.49 \text{ k}\Omega \pm 1\%$; R3 = $1.2 \text{ k}\Omega \pm 2\%$.
4. $C_L = 50 \text{ pF}$ (includes probe, fixture, wiring capacitance).
5. Setup times, hold times and pulse width (t_{SLH} , t_{SHL} , t_{HLH} , t_{HHL} and t_{WH}) are defined in table I.
6. IN-A has the following characteristics:
 $V_{gen} = 3.0 \pm 0.1 \text{ V}$.
 $PRR \leq 20 \text{ MHz}$
Rise time = fall time = 10 ns (10% to 90%).
7. IN-B has the following characteristics:
 $V_{gen} = 3.0 \pm 0.1 \text{ V}$.
 $PRR \leq 10 \text{ MHz}$.
Rise time = fall time = 10 ns (10% to 90%).
8. IN-C and IN-D have the following characteristics:
 $V_{gen} = 3.0 \pm 0.1 \text{ V}$.
 $PRR \leq 1 \text{ MHz}$.
Rise time = fall time = 10 ns (10% to 90%).

FIGURE 5. Switching waveforms for device type 01 - Continued.

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

Terminal conditions (pins not designated are open)

Subgroup	Symbol	MIL-STD-883 method	Cases E.F. Test No.	Terminal conditions (pins not designated are open)																Test limits						
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Meas. terminal	Min	Max	Unit			
1	$I_{OFF(H)}$	3010	47		D_0	Y_0	D_1	Q_1	Y_1	\overline{OE}	GND	CP	Y_2	Q_2	D_2	Y_3	Q_3	D_3	V_{CC}	Y_0			μA			
			48	4.5 V	2.4 V	4.5 V		2.4 V	4.5 V					2.4 V	4.5 V											
			49																							
			50																							
2	I_{OS}	3011	51	4.5 V	GND															Q_0				mA		
			52	4.5 V																		Y_0				
			53																			Q_1				
			54																			Y_1				
			55																			Q_2				
			56																			Y_2				
			57																			Q_3				
			58																			Y_3				
3	I_{CC}	3005	59	4.5 V																V_{CC}				mA		
			60																							
3	V_{IC}		61	-18 mA																	D_0				V	
			62																			D_1				
			63																			\overline{OE}				
			64																			CP				
			65																				D_2			
2	Same tests, terminal conditions and limits as subgroup 1 except $T_C = +125^\circ C$ and V_{IC} tests are omitted.																									
3	Same tests, terminal conditions and limits as subgroup 1 except $T_C = -55^\circ C$ and V_{IC} tests are omitted.																									

See notes at end of table.

TABLE III. Group A inspection for device type 01 - Continued.
Terminal conditions (pins not designated are open).

Subgroup	Symbol	MIL-STD-883 method	Cases E.F. Test No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Test limits			
				D ₀	Q ₀	V ₀	D ₁	Q ₁	V ₁	O _E	GND	C _P	V ₂	Q ₂	D ₂	V ₃	Q ₃	D ₃	V _{CC}	Meas. terminal	Min	Max	Unit
7				B	X 5/	X	A	X	X	B	GND	A	X	X	B	X	X	A	5.0 V	All outputs			
T _C = +25°C		3014	66	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			67	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			68	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			69	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			70	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			71	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			72	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			73	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			74	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			75	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			76	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			77	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			78	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			79	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			80	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			81	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			82	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			83	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			84	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			85	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			86	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			87	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			88	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			89	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			
			90	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→	→			

See notes 1, 2, and 3.

See notes at end of table.

TABLE III. Group A inspection for device type 01 - Continued.
Terminal conditions (pins not designated are open).

Subgroup	Symbol	MIL-STD-883 method	Cases E.F. Tests No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Test limits				
				D ₀	Q ₀	Y ₀	D ₁	Q ₁	Y ₁	DE	GND	CP	Y ₂	Q ₂	D ₂	Y ₃	Q ₃	D ₃	V _{CC}	Meas. terminal	Min	Max	Unit	
7 T _C = +25°C		3014	91	A	H	H	A	H	H	B		A	L	L	B	L	L	B	5.0 V		See notes 1, 2 and 3.			
			92	B	H	H	B	H	H	B		A	L	L	A	L	L	A						
			93	B	H	H	B	H	H	B		B	L	L	A	L	L	A						
			94	B	H	Z	B	H	Z	A		B	Z	L	A	Z	L	A						
			95	B	L	L	B	L	L	L		B	H	H	H	A	H	H	A					
			96	B	L	Z	B	L	L	Z		A	A	Z	H	A	Z	H	A					
8 Same test, terminal conditions and limits as for subgroup 7 except T _C = +125°C and -55°C.			97	IN-B	OUT		IN-B	OUT		GND	GND	IN-A		OUT	IN-B		OUT		5.0 V	2	16	ns		
		t _{PHL1}	3003																					
				98																				
				99																				
				100																				
		t _{PHL2}		101	IN-B		OUT	IN-B		OUT	GND	GND	IN-A	OUT	IN-B		OUT	IN-B		5.0 V	16	16	ns	
				102																				
				103																				
				104																				
		t _{PLH1}		105	IN-B	OUT		IN-B	OUT		GND	GND	IN-A		OUT	IN-B		OUT		5.0 V	12	12	ns	
				106																				
				107																				
			108																					
	t _{PLH2}		109	IN-B		OUT	IN-B		OUT	GND	GND	IN-A	OUT	IN-B		OUT	IN-B		5.0 V	12	12	ns		
			110																					
			111																					
			112																					

See notes at end of table.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging of microcircuits shall be 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 logistic support of existing equipment.

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

- a. Complete part number (see 1.2).
- b. Requirements for delivery of one copy of the quality conformance inspection data pertinent to the device inspection lot to be supplied with each shipment by the device manufacturer, if applicable.
- c. Requirements for certificate of compliance, if applicable.
- d. Requirements for notification of change of product or process to the contracting activity if applicable.
- e. Requirements for special carriers, lead lengths, or lead forming, if applicable. These requirements shall not affect the part number. Unless otherwise specified, these requirements shall not apply to direct purchase by or direct shipment to the Government.
- f. Requirements for "JAN" marking.

6.4 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-M-38510, 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 acquired for Government logistic support will be acquired to device class B (see 1.2.2), and lead material and finish C (see 3.3). Longer length leads and lead forming shall not affect the part number.

6.6 Generic test data. Generic test data may be used to satisfy the requirements of 4.4.3. Group C generic test data shall be on date codes no more than one year old and on a die in the same microcircuit group (see appendix E of MIL-M-38510) with the same material, design and process and from the same plant as the die represented. Group D generic data shall be on date codes no more than one year old and on the same package type (see terms, definitions, and symbols of MIL-M-38510) and from the same plant as the package represented. The vendor is required to retain the generic data for a period of not less than 36 months from the date of shipment.

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

<u>Military device type</u>	<u>Generic-industry type</u>
01	2918

6.8 Ordering guidance. Since the qualification and certification requirements have been removed from the specification, orders may be placed immediately.

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

Custodians:

Army - ER
Navy - EC
Air Force - 17

Preparing activity:

Air Force - 17

(Project 5962-0603-8)

Review activities:

Army - AR, MI
Air Force - 11, 19, 85, 99
Navy - OS, SH
DLA - ES

User activities:

Army - SM
Navy - AS, CG, MC

Agent:

DLA - ES