041946

REVISIONS

| LTR	DESCRIPTION	DATE	APPROVED
A	Add vendors 04713, 27014, and 18714. Table I, propagation delay times at V_{CC} = 2.0 V and V_{CC} = 6.0 V and subgroups 10 and 11 shall be guaranteed if not tested. Changed propagation delay times for t_{PHL1}/t_{PLH1}. Convert to military drawing.	30 Sept 86	*[signature]*
B	Add vendor CAGE 27014 to case outline F and case outline 2. Editorial changes on pages 3 and 7.	10 Apr. 87	*[signature]*
C	Inactive device 01EX and 012X for new design. Use M38510 QPL device. Changed code ident. no. to 67268. Changes to figure 1, page 3, and page 9.	7 NOV 87	*[signature]* R.F.Evans

CURRENT CAGE CODE 67268

REV																														
PAGE																														

REV STATUS	REV	C	C	C	A	A	A	C	A	C	A	A	C																			
OF PAGES	PAGES	1	2	3	4	5	6	7	8	9	10	11	12																			

Defense Electronics Supply Center Dayton, Ohio	PREPARED BY *[signature] Jeffery Tunstall*	**MILITARY DRAWING** This drawing is available for use by all Departments and Agencies of the Department of Defense
	CHECKED BY *[signature]*	
Original date of drawing: 28 May 1985	APPROVED BY *[signature]*	TITLE: MICROCIRCUITS, DIGITAL, HIGH-SPEED CMOS DUAL J-K FLIP-FLOP WITH SET AND RESET, MONOLITHIC SILICON
	SIZE A	CODE IDENT. NO. **14933**	DWG NO. **84150**
AMSC N/A	REV C	PAGE 1 OF 12

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1. SCOPE

1.1 Scope. This drawing describes device requirements for class B microcircuits in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices".

1.2 Part number. The complete part number shall be as shown in the following example:

```
      84150                01                 E                    X
        |                   |                 |                    |
        |                   |                 |                    |
        |                   |                 |                    |
   Drawing number      Device type        Case outline       Lead finish per
                         (1.2.1)            (1.2.2)            MIL-M-38510
```

1.2.1 Device type. The device type shall identify the circuit function as follows:

Device type	Generic number	Circuit function
01	54HC109	Dual J-K flip-flop

1.2.2 Case outlines. The case outlines shall be as designated in appendix C of MIL-M-38510, and as follows:

Outline letter	Case outline
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
2	C-2 (20-terminal, .350" x .350"), square chip carrier package

1.3 Absolute maximum ratings. 1/

Supply voltage range - - - - - - - - - - - - - - -	-0.5 V dc to +7.0 V dc
DC input voltage - - - - - - - - - - - - - - - - -	-0.5 V dc to V_{CC} +0.5 V dc
DC output voltage- - - - - - - - - - - - - - - - -	-0.5 V dc to V_{CC} +0.5 V dc
Clamp diode current- - - - - - - - - - - - - - - -	±20 mA
DC output current (per pin)- - - - - - - - - - - -	±25 mA
DC V_{CC} or GND current (per pin)- - - - - - - - -	±50 mA
Storage temperature range- - - - - - - - - - - - -	-65°C to +150°C
Maximum power dissipation (P_D) - - - - - - - - -	500 mW 2/
Lead temperature (soldering, 10 seconds) - - - -	+260°C
Thermal resistance, junction-to-case (θ_{JC}):	
Cases E, F, and 2- - - - - - - - - - - - - - - -	(See MIL-M-38510, appendix C)
Junction temperature (T_J)- - - - - - - - - - - -	+175°C

1/ Unless otherwise specified, all voltages are referenced to ground.

2/ For T_C = +100°C to +125°C, derate linearly at 12 mW/°C.

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1.4 Recommended operating conditions.

Supply voltage -   +2.0 V dc to +6.0 V dc
Case operating temperature range (T_C) - - - - - - -   -55°C to +125°C
Input rise or fall time:
  V_{CC} = 2.0 V -   0 to 500 ns
  V_{CC} = 4.5 V -   0 to 500 ns
  V_{CC} = 6.0 V -   0 to 400 ns
Minimum recovery time, data to clock ↑ (t_{SHL1}) and (t_{SLH1}):
  Case at +25°C:
    V_{CC} = 2.0 V -   100 ns
    V_{CC} = 4.5 V -   20 ns
    V_{CC} = 6.0 V -   17 ns
  Case at -55°C, +125°C:
    V_{CC} = 2.0 V -   150 ns
    V_{CC} = 4.5 V -   30 ns
    V_{CC} = 6.0 V -   26 ns
Minimum setup time, preset or clear inactive to clock ↑ (t_{REC}):
  Case at +25°C:
    V_{CC} = 2.0 V -   100 ns
    V_{CC} = 4.5 V -   20 ns
    V_{CC} = 6.0 V -   17 ns
  Case at -55°C, +125°C:
    V_{CC} = 2.0 V -   150 ns
    V_{CC} = 4.5 V -   30 ns
    V_{CC} = 6.0 V -   26 ns
Minimum width of clock, preset or clear pulse (t_w):
  Case at +25°C:
    V_{CC} = 2.0 V -   100 ns
    V_{CC} = 4.5 V -   20 ns
    V_{CC} = 6.0 V -   17 ns
  Case at -55°C, +125°C:
    V_{CC} = 2.0 V -   150 ns
    V_{CC} = 4.5 V -   30 ns
    V_{CC} = 6.0 V -   25 ns
Minimum hold time, clock to data (t_H):
  Case at +25°C:
    V_{CC} = 2.0 V -   25 ns
    V_{CC} = 4.5 V -   5 ns
    V_{CC} = 6.0 V -   5 ns
  Case at -55°C, +125°C:
    V_{CC} = 2.0 V -   40 ns
    V_{CC} = 4.5 V -   8 ns
    V_{CC} = 6.0 V -   7 ns
Maximum clock frequency (f_{MAX}):
  Case at +25°C:
    V_{CC} = 2.0 V -   5.4 MHz
    V_{CC} = 4.5 V -   27 MHz
    V_{CC} = 6.0 V -   32 MHz
  Case at -55°C, +125°C:
    V_{CC} = 2.0 V -   3.6 MHz
    V_{CC} = 4.5 V -   18 MHz
    V_{CC} = 6.0 V -   21 MHz

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2. APPLICABLE DOCUMENTS

2.1 Government specification and standard. Unless otherwise specified, the following specification and standard, 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 drawing 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 the specification and standard required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

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

3. REQUIREMENTS

3.1 Item requirements. The individual item requirements shall be in accordance with 1.2.1 of MIL-STD-883, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices" 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. The terminal connections shall be as specified on figure 1.

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

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

3.2.4 Case outlines. The case outlines shall be in accordance with 1.2.2 herein.

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

3.4 Marking. Marking shall be in accordance with MIL-STD-883 (see 3.1 herein). The part shall be marked with the part number listed in 1.2 herein. In addition, the manufacturer's part number may also be marked as listed in 6.4 herein.

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions -55°C $\leq T_C \leq$ +125°C unless otherwise specified 1/		Group A subgroups	Limits		Unit
					Min	Max	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 20$ µA	$V_{CC} = 2.0$ V	1, 2, 3	1.9		V
			$V_{CC} = 4.5$ V		4.4		
			$V_{CC} = 6.0$ V		5.9		
		$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 4.0$ mA	$V_{CC} = 4.5$ V		3.7		
		$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 5.2$ mA	$V_{CC} = 6.0$ V		5.2		
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 20$ µA	$V_{CC} = 2.0$ V	1, 2, 3		0.1	V
			$V_{CC} = 4.5$ V			0.1	
			$V_{CC} = 6.0$ V			0.1	
		$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 4.0$ mA	$V_{CC} = 4.5$ V			0.4	
		$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 5.2$ mA	$V_{CC} = 6.0$ V			0.4	
High-level input voltage 2/	V_{IH}		$V_{CC} = 2.0$ V	1, 2, 3	1.5		V
			$V_{CC} = 4.5$ V		3.15		
			$V_{CC} = 6.0$ V		4.2		
Low-level input voltage 2/	V_{IL}		$V_{CC} = 2.0$ V	1, 2, 3		0.3	V
			$V_{CC} = 4.5$ V			0.9	
			$V_{CC} = 6.0$ V			1.2	
Input capacitance	C_{IN}	$V_{IN} = 0$ V See 4.3.1c	$T_C = +25°C$	4		10	pF
Quiescent current	I_{CC}	$V_{CC} = 6.0$, $V_{IN} = V_{CC}$ or GND		1, 2, 3		80	µA
Functional test		See 4.3.1d		7			

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions -55°C ≤ T_C ≤ +125°C unless otherwise specified 1/		Group A subgroups	Limits		Unit
					Min	Max	
Propagation delay time high to low, low to high, clock to Q or Q̄ 3/	t_PHL1, t_PLH1	T_C = +25°C C_L = 50 pF ±10% See figure 4	V_{CC} = 2.0 V	9		175	ns
			V_{CC} = 4.5 V			35	
			V_{CC} = 6.0 V			30	
		T_C = -55°C, +125°C C_L = 50 pF ±10% See figure 4	V_{CC} = 2.0 V	10, 11		265	ns
			V_{CC} = 4.5 V			53	
			V_{CC} = 6.0 V			45	
Propagation delay time high to low, low to high, preset or clear to Q or Q̄ 3/	t_PHL2, t_PLH2	T_C = +25°C C_L = 50 pF ±10% See figure 4	V_{CC} = 2.0 V	9		230	ns
			V_{CC} = 4.5 V			46	
			V_{CC} = 6.0 V			39	
		T_C = -55°C, +125°C C_L = 50 pF ±10% See figure 4	V_{CC} = 2.0 V	10, 11		345	ns
			V_{CC} = 4.5 V			69	
			V_{CC} = 6.0 V			59	
Transition time 4/	t_THL, t_TLH	T_C = +25°C C_L = 50 pF ±10% See figure 4	V_{CC} = 2.0 V	9		75	ns
			V_{CC} = 4.5 V			15	
			V_{CC} = 6.0 V			13	
		T_C = -55°C, +125°C C_L = 50 pF ±10% See figure 4	V_{CC} = 2.0 V	10, 11		110	ns
			V_{CC} = 4.5 V			22	
			V_{CC} = 6.0 V			19	

1/ For a power supply of 5.0 V ±10% the worst case output voltages (V_{OH} and V_{OL}) occur for HC at 4.5 V. Thus, the 4.5 V values should be used when designing with this supply. Worst case V_{IH} and V_{IL} occur at V_{CC} = 5.5 V and 4.5 V respectively. (The V_{IH} value at 5.5 V is 3.85 V.) The worst case leakage current (I_{IN}, I_{CC}, and I_{OZ}) occur for CMOS at the higher voltage so the 6.0 V values should be used. Power dissipation capacitance (C_{PD}), typically 80 pF, determines the no load dynamic power consumption, $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$, and the no load dynamic current consumption, $I_S = C_{PD} V_{CC} f + I_{CC}$.

2/ V_{IH} and V_{IL} tests not required if applied as a forcing function for V_{OH} and V_{OL}.

3/ AC testing at V_{CC} = 2.0 V and V_{CC} = 6.0 V shall be guaranteed, if not tested to the specified parameters.

4/ Transition times (t_{THL}, t_{TLH}), if not tested, shall be guaranteed to the specified parameters.

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Device type 01

Case 2   Cases E and F
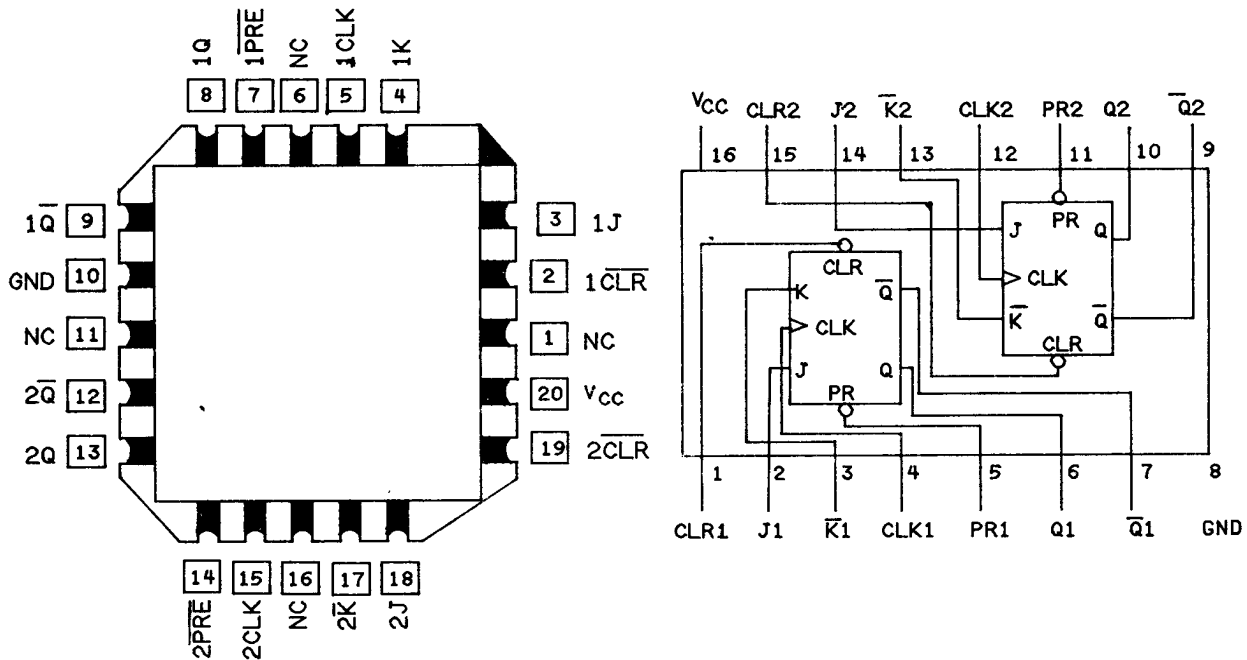
FIGURE 1.   Terminal connections (top view).

Inputs					Outputs	
PR	CLR	CLK	J	$\overline{K}$	Q	$\overline{Q}$
L	H	X	X	X	H	L
H	L	X	X	X	L	H
L	L	X	X	X	H*	H*
H	H	↑	L	L	L	H
H	H	↑	H	L	TOGGLE	
H	H	↑	L	H	Q0	$\overline{Q0}$
H	H	↑	H	H	H	L
H	H	L	X	X	Q0	$\overline{Q0}$

*This is an unstable condition and is
not guaranteed.

FIGURE 2.   Truth table.

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FIGURE 3. Logic diagram.

SET — 5, 11

J 2, 14

K̄ 3, 13

CLOCK 4, 12

6, 10 Q

7, 9 Q̄

RESET — 1, 15
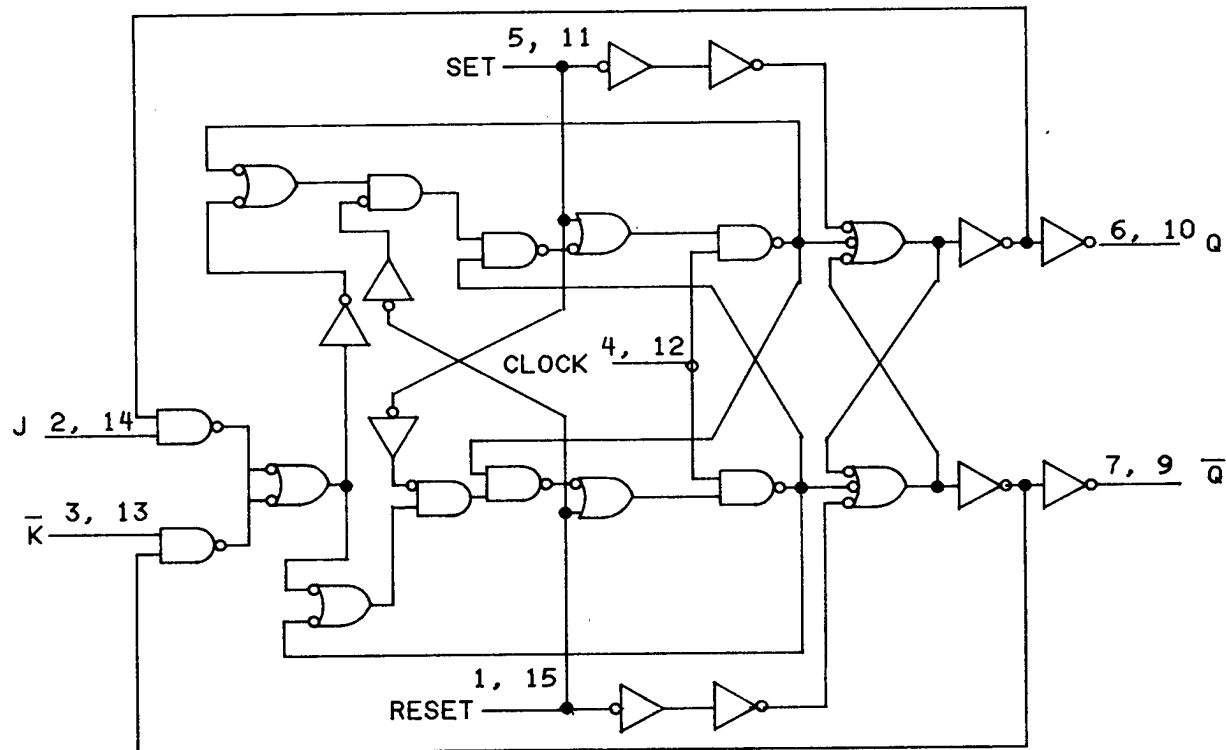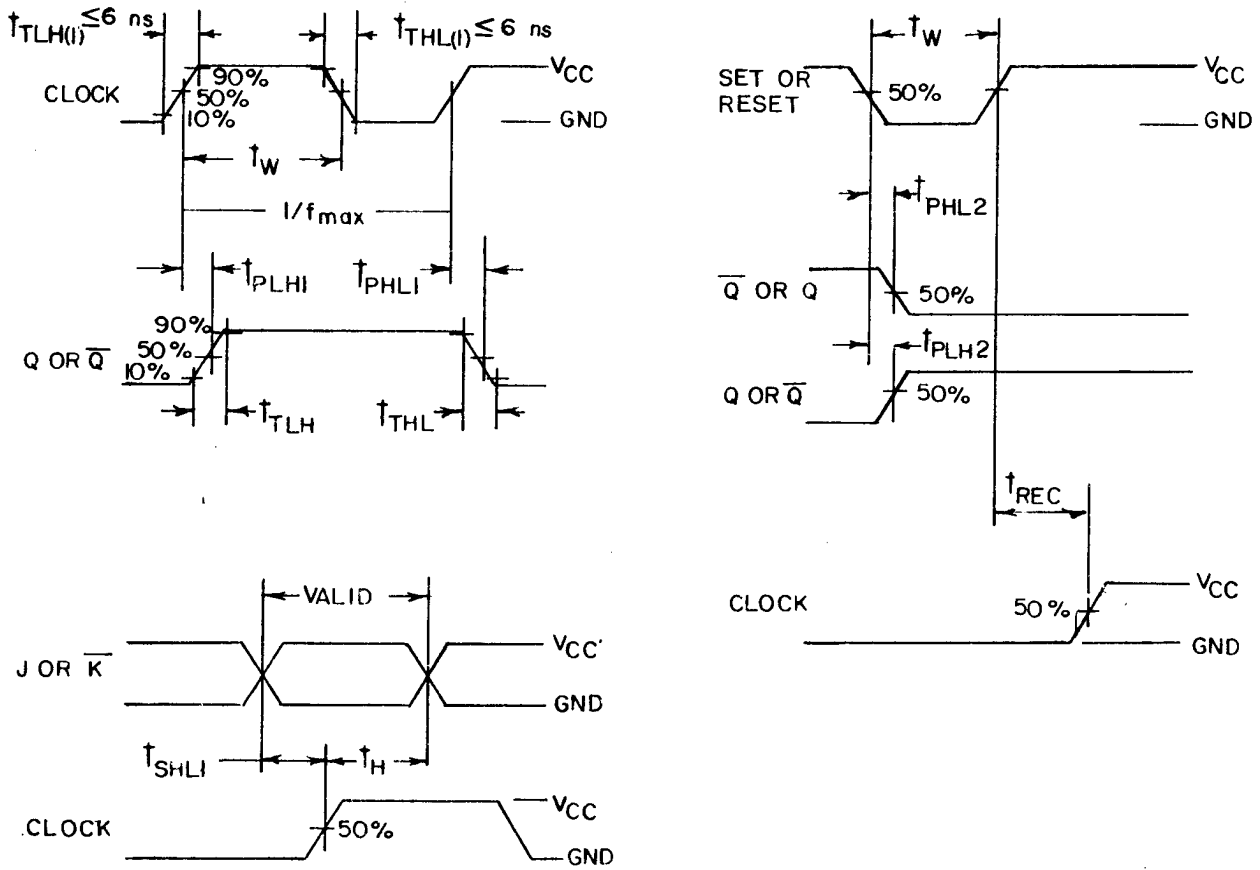
FIGURE 4. Switching waveforms.

3.5 <u>Certificate of compliance</u>. A certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in 6.4. The certificate of compliance submitted to DESC-ECS prior to listing as an approved source of supply shall state that the manufacturer's product meets the requirements of MIL-STD-883 (see 3.1 herein) and the requirements herein.

3.6 <u>Certificate of conformance</u>. A certificate of conformance as required in MIL-STD-883 (see 3.1 herein) shall be provided with each lot of microcircuits delivered to this drawing.

3.7 <u>Notification of change</u>. Notification of change to DESC-ECS shall be required in accordance with MIL-STD-883 (see 3.1 herein).

3.8 <u>Verification and review</u>. DESC, DESC's agent, and the acquiring activity retain the option to review the manufacturer's facility and applicable required documentation. Offshore documentation shall be made available onshore at the option of the reviewer.

4. QUALITY ASSURANCE PROVISIONS

4.1 <u>Sampling and inspection</u>. Sampling and inspection procedures shall be in accordance with section 4 of MIL-M-38510 to the extent specified in MIL-STD-883 (see 3.1 herein).

4.2 <u>Screening</u>. 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 A, B, C, or D using the circuit submitted with the certificate of compliance (see 3.5 herein).

        (2) $T_A = +125°C$, minimum.

    b. Interim and final electrical test parameters shall be as specified in table II herein, except interim electrical parameter tests prior to burn-in are optional at the discretion of the manufacturer.

4.3 <u>Quality conformance inspection</u>. Quality conformance inspection shall be in accordance with method 5005 of MIL-STD-883 including groups A, B, C, and D inspections. The following additional criteria shall apply.

4.3.1 <u>Group A inspection</u>.

    a. Tests shall be as specified in table II herein.

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

    c. Subgroup 4 (C_{IN} measurement) shall be measured only for the initial test and after process or design changes which may affect input capacitance.

    d. Subgroup 7 tests sufficient to verify the truth table.

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4.3.2 Groups C and D inspections.

    a. End-point electrical parameters shall be as specified in table II herein.

    b. Steady-state life test (method 1005 of MIL-STD-883) conditions:

        (1) Test condition A, B, C, or D using the circuit submitted with the certificate of compliance (see 3.5 herein).

        (2) T_A = +125°C, minimum.

        (3) Test duration: 1,000 hours, except as permitted by appendix B of MIL-M-38510 and method 1005 of MIL-STD-883.

TABLE II. Electrical test requirements.

MIL-STD-883 test requirements	Subgroups (per method 5005, table I)
Interim electrical parameters (method 5004)	---
Final electrical test parameters (method 5004)	1*, 2, 9
Group A test requirements (method 5005)	1, 2, 3, 4, 7, 9, 10, 11**
Groups C and D end-point electrical parameters (method 5005)	1, 2, 3
Additional electrical subgroups for group C periodic inspections	---

*PDA applies to subgroup 1.
**Subgroups 10 and 11, if not tested, shall be guaranteed to the specified limits in table I.

5. PACKAGING

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

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use when military specifications do not exist and qualified military devices that will perform the required function are not available for OEM application. When a military specification exists and the product covered by this drawing has been qualified for listing on QPL-38510, the device specified herein will be inactivated and will not be used for new design. The QPL-38510 product shall be the preferred item for all applications.

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6.2 Replaceability. Replaceability is determined as follows:

    a. Microcircuits covered by this drawing will replace the same generic device covered by a contractor-prepared specification or drawing.

    b. When a QPL source is established, the part numbered device specified in this drawing will be replaced by the microcircuit identified as part number M38510/65304B--.

6.3 Comments. Comments on this drawing should be directed to DESC-ECS, Dayton, Ohio 45444, or telephone 513-296-5375.

6.4 Approved sources of supply. Approved sources of supply are listed herein. Additional sources will be added as they become available. The vendors listed herein have agreed to this drawing and a certificate of compliance (see 3.5 herein) has been submitted to DESC-ECS.

Military drawing part number	Vendor CAGE number	Vendor similar part number 1/	Replacement military specification part number
8415001EX 2/	18714	CD54HC109F/3A	M38510/65304BEX
	01295	SNJ54HC109J	
	04713	54HC109/BEAJC	
	27014	MM54HC109J/883	
8415001FX	01295	SNJ54HC109W	M38510/65304BFX
	27014	MM54HC109W/883	
84150012X 3/	01295	SNJ54HC109FK	M38510/65304B2X
	04713	54HC109M/B2CJC	
	27014	MM54HC109E/883	

1/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.
2/ Inactive for new design. Use M38510/65304BEX.
3/ Inactive for new design. Use M38510/65304B2X.

Vendor CAGE number	Vendor name and address
01295	Texas Instruments, Incorporated P.O. Box 6448 Midland, TX 79701
04713	Motorola, Incorporated 7402 S. Price Road Tempe, AZ 85283
18714	RCA Corporation Solid State Division Route 202 Somerville, NJ 08876
27014	National Semiconductor P.O. Box 58090 Santa Clara, CA 95051

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