REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

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	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13											

PMIC N/A

STANDARDIZED MILITARY DRAWING

THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE

AMSC N/A

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DRAWING APPROVAL DATE: 9 APRIL 1990

REVISION LEVEL:

DEFENSE ELECTRONICS SUPPLY CENTER
DAYTON, OHIO 45444

MICROCIRCUITS, DIGITAL, HIGH SPEED CMOS, DUAL J-K FLIP FLOP, MONOLITHIC SILICON

SIZE	CAGE CODE	5962-89695
A	67268	

SHEET 1

DESC FORM 193
SEP 87

* U.S. GOVERNMENT PRINTING OFFICE: 1987 — 748-129/60913

5962-E1347

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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:

5962-89695	01	C	X
Drawing number	Device type (1.2.1)	Case outline (1.2.2)	Lead finish per MIL-M-38510

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

Device type	Generic number	Circuit
01	54HC113	Dual, negative edge triggered J-K flip-flop with asynchronous preset

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
C	D-1 (14-lead, .785" x .310" x .200"), dual-in-line package
2	C-2 (20 terminal, .358" x .358" x .100"), 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 range	-0.5 V dc to V_{CC} + 0.5 V dc
DC output voltage range	-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})	See MIL-M-38510, appendix C
Junction temperature (T_J)	+175°C

1.4 Recommended operating conditions.

Supply voltage (V_{CC})	+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
Input voltage (V_{IN})	0 V dc to V_{CC}
Output voltage (V_{OUT})	0 V dc to V_{CC}

1/ Unless otherwise specified, all voltages are referenced to ground.
2/ For T_C = +100 to +125°C, derate linearly at 12 mW/°C.

Minimum setup time, J or K to clock (t_s):		
T_C = +25°C,	V_{CC} = 2.0 V	100 ns
	V_{CC} = 4.5 V	20 ns
	V_{CC} = 6.0 V	17 ns
T_C = -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 recovery time, set inactive to clock (t_{rec}):		
T_C = +25°C,	V_{CC} = 2.0 V	100 ns
	V_{CC} = 4.5 V	20 ns
	V_{CC} = 6.0 V	17 ns
T_C = -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 clock pulse width (t_w1):		
T_C = +25°C,	V_{CC} = 2.0 V	80 ns
	V_{CC} = 4.5 V	16 ns
	V_{CC} = 6.0 V	14 ns
T_C = -55°C/+125°C,	V_{CC} = 2.0 V	120 ns
	V_{CC} = 4.5 V	24 ns
	V_{CC} = 6.0 V	20 ns
Minimum set pulse width (t_w2):		
T_C = +25°C,	V_{CC} = 2.0 V	100 ns
	V_{CC} = 4.5 V	20 ns
	V_{CC} = 6.0 V	17 ns
T_C = -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 hold time, clock to J or K (t_h):		
T_C = +25°C,	V_{CC} = 2.0 V	25 ns
	V_{CC} = 4.5 V	5 ns
	V_{CC} = 6.0 V	5 ns
T_C = -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}):		
T_C = +25°C,	V_{CC} = 2.0 V	5.4 MHz
	V_{CC} = 4.5 V	27 MHz
	V_{CC} = 6.0 V	32 MHz
T_C = -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

2. APPLICABLE DOCUMENTS

2.1 Government specification, standard, and bulletin. Unless otherwise specified, the following specification, standard, and bulletin 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.

BULLETIN

MILITARY

MIL-BUL-103 - List of Standardized Military Drawing (SMD's).

(Copies of the specification, standard, and bulletin 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-M-38510, "Provisions for the use of MIL-STD-883 in conjunction with compliant non-JAN devices" and as specified herein.

3.2 1 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

3.2 2 Terminal connections. The terminal connections shall be as specified on figure 1.

3.2 3 Truth table. The truth table shall be as specified on figure 2.

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 herein, the electrical performance characteristics are as specified in table I and shall apply over the full case operating temperature range.

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table II. The electrical tests for each subgroup are described in table I.

3.5 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 MIL-BUL-103 (see 6.6 herein).

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +125°C$ unless otherwise specified		Group A subgroups	Limits		Unit
					Min	Max	
High level output voltage	V_{OH}	$V_{IN} = V_{IH}$ minimum or V_{IL} maximum $\lvert I_O \rvert \le 20\ \mu A$	$V_{CC} = 2.0$ V	1, 2, 3	1.9		V
			$V_{CC} = 4.5$ V		4.4		
			$V_{CC} = 6.0$ V		5.9		
		$V_{IN} = V_{IH}$ minimum or V_{IL} maximum $\lvert I_O \rvert \le 4.0$ mA	$V_{CC} = 4.5$ V		3.7		
		$V_{IN} = V_{IH}$ minimum or V_{IL} maximum $\lvert I_O \rvert \le 5.2$ mA	$V_{CC} = 6.0$ V		5.2		
Low level output voltage	V_{OL}	$V_{IN} = V_{IH}$ minimum or V_{IL} maximum $\lvert I_O \rvert \le 20\ \mu A$	$V_{CC} = 2.0$ V	1, 2, 3		0.1	V
			$V_{CC} = 4.5$ V			0.1	
			$V_{CC} = 6.0$ V			0.1	
		$V_{IN} = V_{IH}$ minmum or V_{IL} maximum $\lvert I_O \rvert \le 4.0$ mA	$V_{CC} = 4.5$ V			0.4	
		$V_{IN} = V_{IH}$ minimum or V_{IL} maximum $\lvert I_O \rvert \le 5.2$ mA	$V_{CC} = 6.0$ V			0.4	
High level input voltage	V_{IH}	2/	$V_{CC} = 2.0$ V	1, 2, 3	1.5		V
			$V_{CC} = 4.5$ V		3.15		
			$V_{CC} = 6.0$ V		4.2		

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ $-55°C \le T_C \le +125°C$ unless otherwise specified		Group A subgroups	Limits Min	Limits Max	Unit
Low level input voltage	V_{IL}	2/	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_{CC} = GND, T_C = +25°C See 4.3.1c		4		10	pF
Quiescent current	I_{CC}	V_{CC} = 6.0 V, V_{IN} = V_{CC} or GND		1, 2, 3		80	µA
Input leakage current	I_{IN}	V_{CC} = 6.0 V, V_{IN} = V_{CC} or GND		1, 2, 3		±1	µA
Functional tests		See 4.3.1d		7			
Propagation delay time; clock to Q or $\overline{Q}$	t_{PHL1}, t_{PLH1}	C_L = 50 pF See figure 3 3/	V_{CC} = 2.0 V	9 10,11		170 225	ns
			V_{CC} = 4.5 V	9 10,11		30 45	
			V_{CC} = 6.0 V	9 10,11		26 38	
Propagation delay time; set to Q or $\overline{Q}$	t_{PHL2}, t_{PLH2}	C_L = 50 pF See figure 3 3/	V_{CC} = 2.0 V	9 10,11		165 250	ns
			V_{CC} = 4.5 V	9 10,11		33 50	
			V_{CC} = 6.0 V	9 10,11		28 43	
Transition time, any output	t_{THL}, t_{TLH}	C_L = 50 pF See figure 3 4/	VCC = 2.0 V	9 10,11		75 110	ns
			VCC = 4.5 V	9 10,11		15 22	
			VCC = 6.0 V	9 10,11		13 19	

See footnotes at end of table.

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1/ For a power supply of 5 V ±10%, the worse 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 and so the 6.0 V values should be used. Power dissipation capacitance (C_{PD}), typically 40 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 are not required and shall be applied as forcing functions for V_{OH} or 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 limits.

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

3.6 Certificate of compliance. A certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in MIL-BUL-103 (see 6.6 herein). The certificate of compliance submitted to DESC-ECS prior to listing as an approved source of supply shall affirm that the manufacturer's product meets the requirements of MIL-STD-883 (see 3.1 herein) and the requirements herein.

3.7 Certificate of conformance. 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.

3.8 Notification of change. Notification of change to DESC-ECS shall be required in accordance with MIL-STD-883 (see 3.1 herein).

3.9 Verification and review. 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 Sampling and inspection. 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 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 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.

Device type	01	
Case outlines	C	2
Terminal number	Terminal symbol	
1	Clock 1	NC
2	K1	Clock 1
3	J1	K1
4	Set 1	J1
5	Q1	NC
6	$\overline{Q1}$	Set 1
7	GND	NC
8	$\overline{Q2}$	Q1
9	Q2	$\overline{Q1}$
10	Set 2	GND
11	J2	NC
12	K2	$\overline{Q2}$
13	Clock 2	Q2
14	V_{CC}	Set 2
15	---	NC
16	---	J2
17	---	NC
18	---	K2
19	---	Clock 2
20	---	V_{CC}

FIGURE 1. Terminal connections.

Inputs				Outputs	
Set	Clock	J	K	Q	$\overline{Q}$
L	X	X	X	H	L
H	↓	L	L	No change	
H	↓	L	H	L	H
H	↓	H	L	H	L
H	↓	H	H	Toggle	
H	H	X	X	No change	
H	L	X	X	No change	
H	↑	X	X	No change	

H = High level voltage
L = Low level voltage
X = Irrelevant
↓ = High to low transition
↑ = Low to high transition

FIGURE 2. Truth table

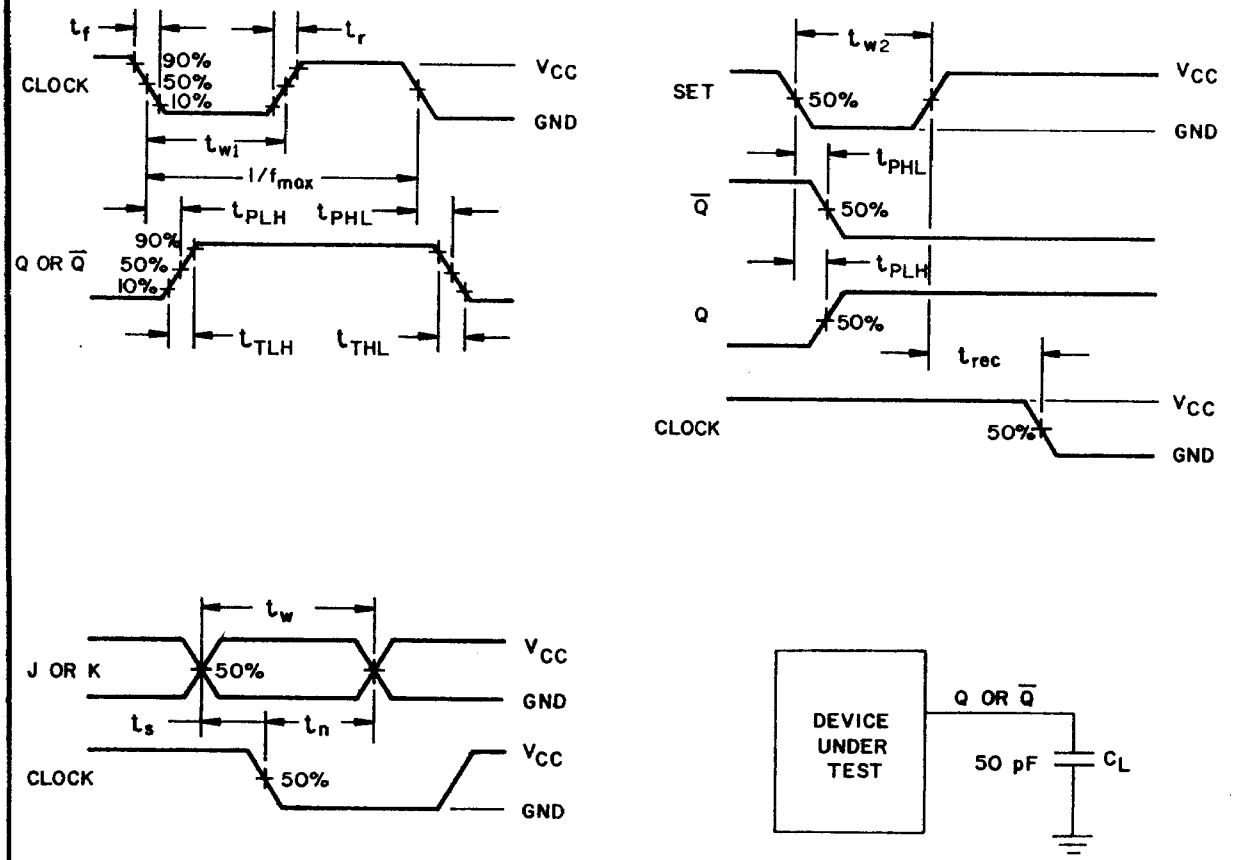

FIGURE 3. Test circuit and switching waveforms.

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4.3 Quality conformance inspection. 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 Group A inspection.

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 capacitance. C_{IN} shall be measured between the designated terminals and GND at a frequency of 1 MHz. Test all applicable pins on 5 devices with zero failures.

d. Subgroup 7 tests shall verify the truth table as specified on figure 2 herein.

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 conditions, method 1005 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.

(3) Test duration: 1,000 hours, except as permitted by 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, 7, 8A, 9
Group A test requirements (method 5005)	1, 2, 3, 4, 7, 8, 9, 10**, 11**
Groups C and D end-point electrical parameters (method 5005)	1, 2, 3

* 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.

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

6.3 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated with the users of record for the individual documents. This coordination will be accomplished in accordance with MIL-STD-481 using DD form 1693, Engineering Change Proposal (Short Form).

6.4 Record of users. Military and industrial users shall inform Defense Electronics Supply Center when a system application requires configuration control and the applicable SMD. DESC will maintain a record of users and this list will be used for coordination and distribution of changes to the drawings. Users of drawings covering microelectronics devices (FSC 5962) should contact DESC-ECS, telephone (513) 296-6022.

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

6.6 Approved sources of supply. Approved sources of supply are listed in MIL-BUL-103. Additional sources will be added to MIL-BUL-103 as they become available. The vendors listed in MIL-BUL-103 have agreed to this drawing and a certificate of compliance (see 3.6 herein) has been submitted to and accepted by DESC-ECS. The approved sources of supply listed below are for information purposes only and are current only to the date of the last action of this document.

Military drawing part number	Vendor CAGE number	Vendor similar part number 1/
5962-8969501CX	04713 27014 01295	54HC113/BCAJ MM54HC113J/883 SNJ54HC113J
5962-89695012X	04713 27014 01295	54HC113M/B2CJC MM54HC113E/883 SNJ54HC113FK

1/ Caution. Do not use this number for item acquisition. Items acquired to this number may not satisfy the performance requirements of this drawing.

Vendor CAGE number	Vendor name and address
01295	Texas Instuments, Incorporated 13500 N. Central Expressway P.O. Box 655303 Dallas, TX 75265 Point of contact: I-20 at FM 1788 Midland, TX 79711-0448
04713	Motorola, Incorporated 5005 E. McDowell Road Phoenix, AZ 85008 Point of contact: 7402 S. Price Road Tempe, AZ 85283
27014	National Semiconductor 2900 Semiconductor Drive P.O. Box 58090 Santa Clara, CA 95052-8090 Point of contact: 333 Western Avenue South Portland, ME 04106