REVISIONS

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OF PAGES	**PAGES**																										

Defense Electronics Supply Center Dayton, Ohio

Original date of drawing: 17 April 1987

AMSC N/A

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SIZE	CODE IDENT. NO.
A	**14933**

REV

MILITARY DRAWING

This drawing is available for use by all Departments and Agencies of the Department of Defense

TITLE: MICROCIRCUITS, DIGITAL HIGH-SPEED CMOS UP/DOWN 4-BIT COUNTER MONOLITHIC SILICON

DWG NO. 5962-87808

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1. SCOPE

1.1 <u>Scope</u>. 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 <u>Part number</u>. The complete part number shall be as shown in the following example:

5962-87808	01	E	X
Drawing number	Device type (1.2.1)	Case outline (1.2.2)	Lead finish per MIL-M-38510

1.2.1 <u>Device type</u>. The device type shall identify the circuit function as follows:

Device type	Generic number	Circuit function
01	54HC192	Counter, decade, up/down, 4-bit synchronous with asychronous reset

1.2.2 <u>Case outlines</u>. 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
2	C-2 (20-terminal, .350" x .350"), square chip carrier package

1.3 <u>Absolute maximum ratings</u>. 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) 2/ - - - - - - -	500 mW
Lead temperature (soldering, 10 seconds) - - - -	+260°C
Thermal resistance, junction-to-case (θ_{JC}):	
Case R -	See MIL-M-38510, appendix C
Case 2 -	60°C/W 3/
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.
3/ When a thermal resistance for this case is published in MIL-M-38510, appendix C, that value shall supersede the value indicated herein.

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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 1000 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - - -	0 to 500 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - - -	0 to 400 ns	
Minimum setup time, data to load (t_S):		
T_C = +25°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	110 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	22 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	19 ns	
T_C = -55°C to +125°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	165 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	33 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	28 ns	
Minimum hold time, data to load (t_H):		
T_C = +25°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	5 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	5 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	5 ns	
T_C = -55°C to +125°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	5 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	5 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	5 ns	
Minimum clear/load pulse width (t_W):		
T_C = +25°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	260 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	52 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	45 ns	
T_C = -55°C to +125°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	390 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	78 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	68 ns	
Minimum count up/down pulse width (t_W)		
T_C = +25°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	125 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	25 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	21 ns	
T_C = -55°C to +125°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	190 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	38 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	32 ns	
Minimum recovery time, clear to clock (t_{REC})		
T_C = +25°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	50 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	10 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	9 ns	
T_C = -55°C to +125°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	75 ns	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	15 ns	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	13 ns	
Maximum frequency, count up/down (f_{MAX})		
T_C = +25°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	3 MHz	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	18 MHz	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	20 MHz	
T_C = -55°C to +125°C:		
V_{CC} = 2.0 V - - - - - - - - - - - - - - - - - -	2 MHz	
V_{CC} = 4.5 V - - - - - - - - - - - - - - - - - -	11 MHz	
V_{CC} = 6.0 V - - - - - - - - - - - - - - - - - -	12 MHz	

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2. APPLICABLE DOCUMENTS

2.1 <u>Government specification and standard</u>. 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 <u>Order of precedence</u>. 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 <u>Item requirements</u>. 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 <u>Design, construction, and physical dimensions</u>. The design, construction, and physical dimensions shall be as specified in MIL-M-38510 and herein.

3.2.1 <u>Terminal connections</u>. The terminal connections shall be as specified on figure 1.

3.2.2 <u>Truth table</u>. The truth table shall be as specified on figure 2.

3.2.3 <u>Logic diagram</u>. The logic diagram shall be as specified on figure 3.

3.2.4 <u>Case outline</u>. The case outline shall be in accordance with 1.2.2 herein.

3.3 <u>Electrical performance characteristics</u>. 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 <u>Marking</u>. 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.

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.

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions −55°C ≤ TC ≤ +125°C 1/		Group A subgroups	Limits		Unit
					Min	Max	
High level output voltage	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 20$ uA	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	1,2,3	1.9 4.4 5.9		V
		$|I_0| \leq 4.0$ mA	$V_{CC} = 4.5$ V		3.7		
		$|I_0| \leq 5.2$ mA	$V_{CC} = 6.0$ V		5.2		
Low level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL} $|I_0| \leq 20$ uA	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	1,2,3		0.1 0.1 0.1	V
		$|I_0| \leq 4.0$ mA	$V_{CC} = 4.5$ V			0.4	
		$|I_0| \leq 5.2$ mA	$V_{CC} = 6.0$ V			0.4	
High level input voltage	V_{IH}	2/	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	1,2,3	1.5 3.15 4.2		V
Low level input voltage	V_{IL}	2/	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	1,2,3		0.3 0.9 1.2	V
Input capacitance	C_{IN}	$V_{IN} = 0$ V, TC = +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		160	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			

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - continued.

Test	Symbol	Conditions $-55°C \leq T_C \leq +125°C$ 1/		Group A subgroups	Limits Min	Max	Unit
Propagation delay time clear to Q 3/	t_{PHL1}	$T_C = +25°C,$ $C_L = 50$ pF ± 10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	9		265 53 45	ns
See figure 4		$T_C = -55°C, +125°C$ $C_L = 50$ pF ±10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	10,11		398 80 68	ns
Propagation delay time load to Q 3/	$t_{PHL2},$ t_{PLH2}	$T_C = +25°C,$ $C_L = 50$ pF ± 10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	9		290 58 49	ns
See figure 4		$T_C = -55°C, +125°C$ $C_L = 50$ pF ±10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	10,11		435 87 74	ns
Propagation delay time count up/down to Q 3/	$t_{PHL3},$ t_{PLH3}	$T_C = +25°C,$ $C_L = 50$ pF ± 10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	9		275 55 47	ns
See figure 4		$T_C = -55°C, +125°C$ $C_L = 50$ pF ±10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	10,11		413 83 71	ns
Propagation delay time count down to borrow or count up to carry 3/	$t_{PHL4},$ t_{PLH4}	$T_C = +25°C,$ $C_L = 50$ pF ± 10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	9		165 33 28	ns
See figure 4		$T_C = -55°C, +125°C$ $C_L = 50$ pF ±10%	$V_{CC} = 2.0$ V $V_{CC} = 4.5$ V $V_{CC} = 6.0$ V	10,11		250 50 43	ns

See footnotes at end of table.

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TABLE I. <u>Electrical performance characteristics</u> - continued.

Test	Symbol	Conditions -55°C $\leq$ T$_C$ $\leq$ +125°C 1/		Group A subgroups	Limits Min	Max	Unit
Transition time 4/	t$_{THL}$, t$_{TLH}$	T$_C$ = +25°C, C$_L$ = 50 pF ± 10%	V$_{CC}$ = 2.0 V V$_{CC}$ = 4.5 V V$_{CC}$ = 6.0 V	9		75 15 13	ns
See figure 4		T$_C$ = -55°C, +125°C C$_L$ = 50 pF ±10%	V$_{CC}$ = 2.0 V V$_{CC}$ = 4.5 V V$_{CC}$ = 6.0 V	10,11		110 22 19	ns

1/ For a power supply of 5 V ±10 percent the worst case output voltage (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 100 pF,
  determines the no load dynamic power consumption, P$_D$ = C$_{PD}$ V$_{CC2}$ f + I$_{CC}$ V$_{CC}$, and the no
  load dynamic current consumption, I$_S$ = C$_{PD}$ V$_{CC}$ f + I$_{CC}$.
2/ Test not required if applied as a forcing functon 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
  parameters.
4/ Transition time (t$_{TLH}$, t$_{THL}$), if not tested, shall be guaranteed to the specified parameters.

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CASE E

DATA B — | 1   16 | — V_{CC}

Q_B — | 2   15 | — DATA A

Q_A — | 3   14 | — CLEAR

COUNT DOWN — | 4   13 | — BORROW

COUNT UP — | 5   12 | — CARRY

Q_C — | 6   11 | — LOAD

Q_D — | 7   10 | — DATA C

GND — | 8   9 | — DATA D

CASE 2

COUNT UP   COUNT DOWN
Q_C | NC | Q_A
8   7   6   5   4

Q_D 9   3 Q_B
GND 10   2 B
NC 11   1 NC
D 12   20 V_{CC}
C 13   19 A

14   15   16   17   18
LOAD | NC | CLEAR
CARRY   BORROW
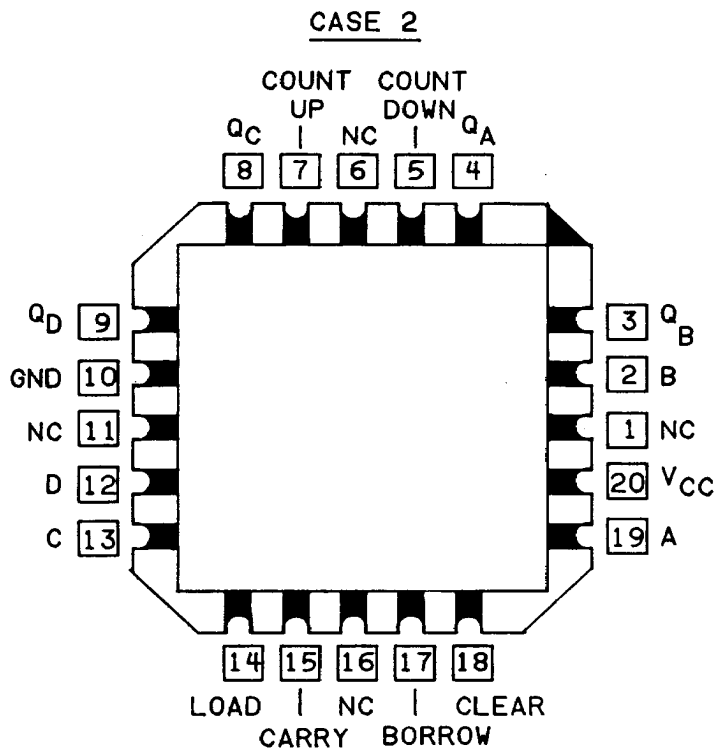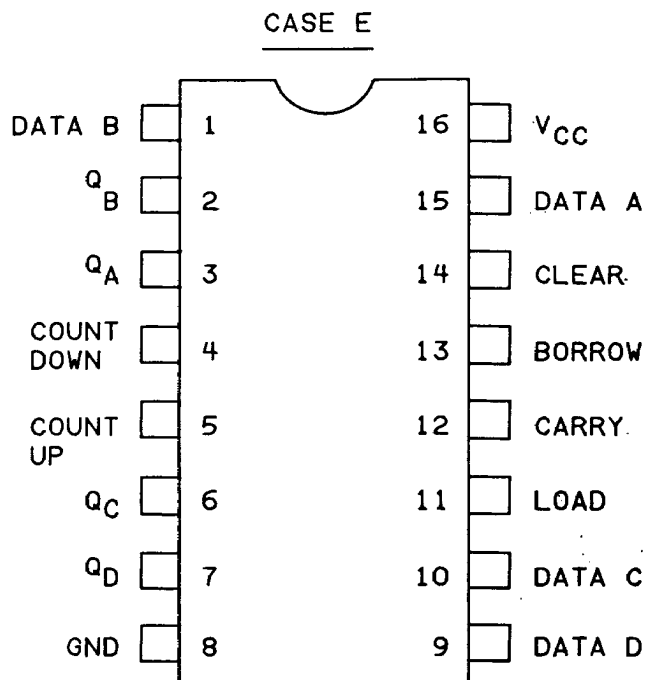
FIGURE 1. Terminal connections.

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Count				
Up	Down	Clear	Load	Function
↑	H	L	H	Count up
H	↑	L	H	Count down
X	X	H	X	Clear
X	X	L	L	Load

H = High level
L = Low level
↑ = Transition from low to high
X = Don't care

FIGURE 2. Truth table.

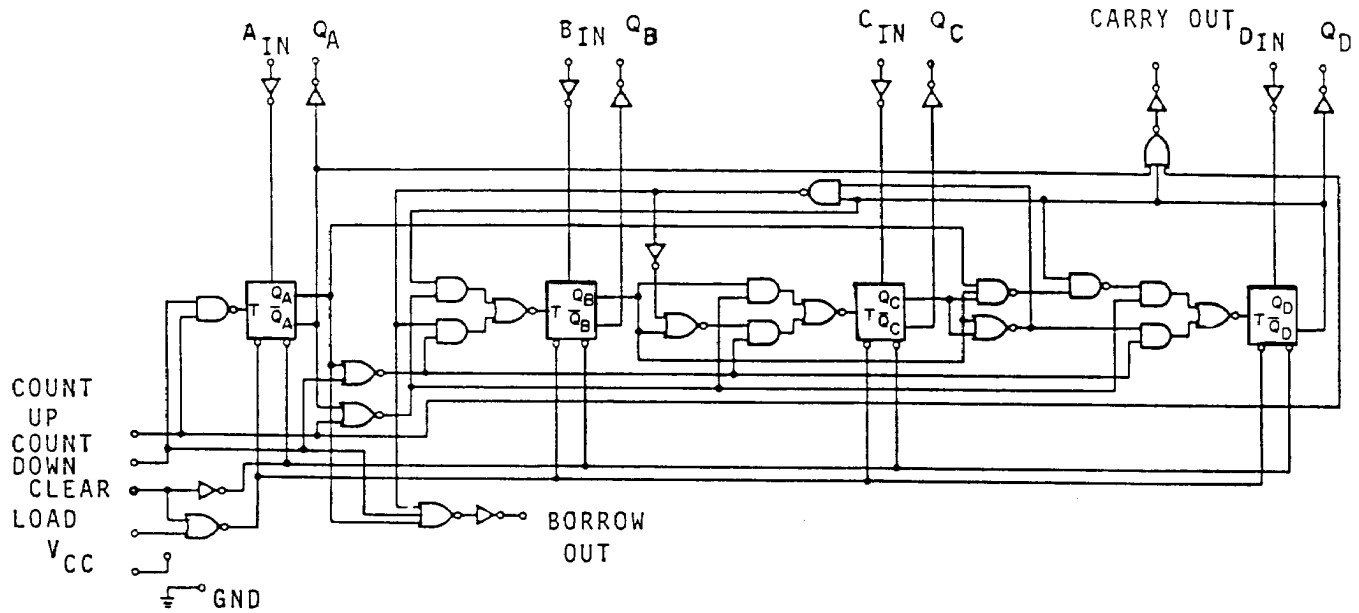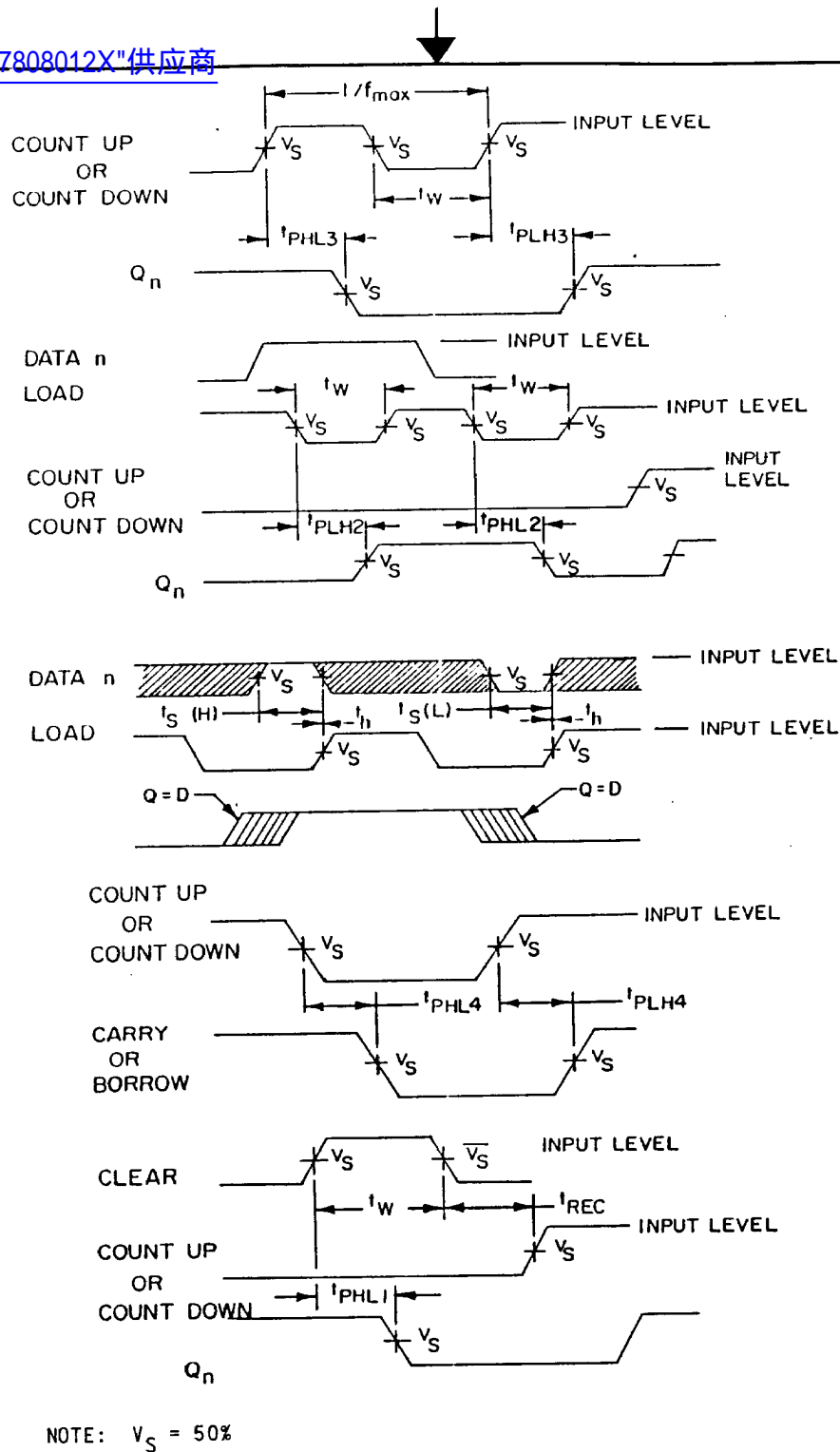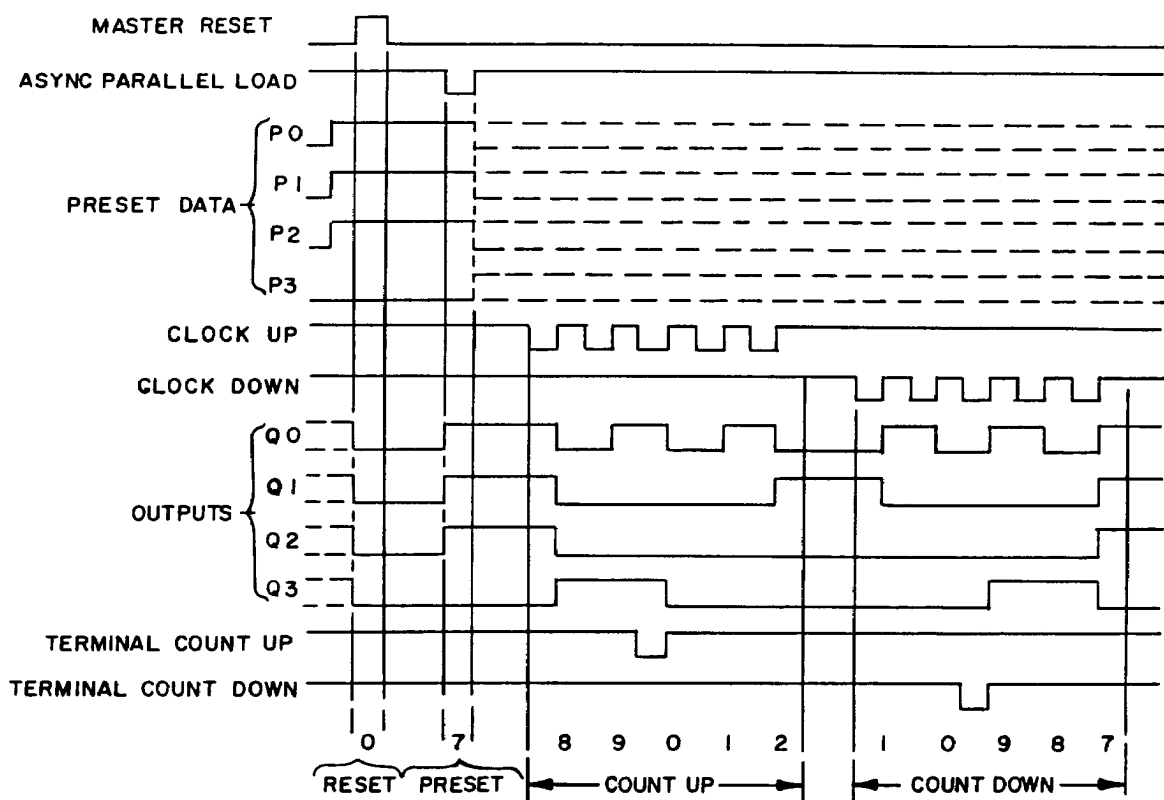| MILITARY DRAWING DEFENSE ELECTRONICS SUPPLY CENTER DAYTON, OHIO	SIZE A	CODE IDENT. NO. 14933	DWG NO. 5962-87808	
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FIGURE 3. Logic diagram.

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COUNT UP
OR
COUNT DOWN

$1/f_{max}$

INPUT LEVEL

V_S V_S V_S

t_W

t_{PHL3} t_{PLH3}

Q_n

V_S V_S

DATA n

INPUT LEVEL

LOAD

t_W t_W

INPUT LEVEL

V_S V_S V_S V_S

COUNT UP
OR
COUNT DOWN

INPUT
LEVEL

V_S

t_{PLH2} t_{PHL2}

Q_n

V_S V_S

DATA n

INPUT LEVEL

V_S V_S V_S

LOAD

$t_{S(H)}$ t_h $t_{S(L)}$ t_h

INPUT LEVEL

V_S V_S

$Q = D$ $Q = D$

COUNT UP
OR
COUNT DOWN

INPUT LEVEL

V_S V_S

t_{PHL4} t_{PLH4}

CARRY
OR
BORROW

V_S V_S

CLEAR

V_S $\overline{V_S}$

INPUT LEVEL

t_W t_{REC}

INPUT LEVEL

COUNT UP
OR
COUNT DOWN

V_S

t_{PHL1}

V_S

Q_n

NOTE: $V_S = 50\%$

FIGURE 4. Switching waveforms.

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MASTER RESET

ASYNC PARALLEL LOAD

PRESET DATA
- P0
- P1
- P2
- P3

CLOCK UP

CLOCK DOWN

OUTPUTS
- Q0
- Q1
- Q2
- Q3

TERMINAL COUNT UP

TERMINAL COUNT DOWN

| 0 | 7 | 8 9 0 1 2 | 1 0 9 8 7 |

RESET PRESET |← COUNT UP →| |← COUNT DOWN →|

FIGURE 4. Switching waveforms - Continued.

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

3.8 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.

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 input capacitance.

    d. Subgroup 7 shall be tested sufficiently to verify truth table.

  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.

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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*,2,3,9
Group A test requirements (method 5005)	1,2,3,4,7,9,10,11
Groups C and D end-point electrical parameters (method 5005)	1,2,3,9
Additional electrical subgroups for group C periodic inspections	---

*PDA applies to subgroup 1.

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. 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 M38510/66306.

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

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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
5962-8780801EX	27014 18714	MM54HC192J/883 CD54HC192F/3A	M38510/66306BEX
5962-87808012X	27014	MM54HC192E/883	M38510/66306B2X

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
27014	National Semiconductor Corp. 2900 Semiconductor Drive Santa Clara, CA 95051
18714	RCA Solid State Division Route 202 Somerville, NJ 08876

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