REVISIONS

LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED

REV																												
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REV STATUS OF SHEETS	**REV**																									
	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

PREPARED BY

CHECKED BY

APPROVED BY

DRAWING APPROVAL DATE

8 MARCH 1990

REVISION LEVEL

DEFENSE ELECTRONICS SUPPLY CENTER DAYTON, OHIO 45444

MICROCIRCUITS, CMOS, PHASE-LOCKED-LOOP WITH VOLTAGE CONTROLLED OSCILLATOR, MONOLITHIC SILICON

SIZE	CAGE CODE	
A	67268	5962-88757

SHEET	1.

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:

```
        5962-88757              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	54HCT4046A	Phase-locked-loop with voltage-controlled oscillator

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

Outline letter	Case outline
E	D-2 (16-lead, .840" x .310" x .200"), dual-in-line 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
DC input diode current - - - - - - - - - - - - - - - -	±20 mA
DC output diode current - - - - - - - - - - - - - - -	±20 mA
DC drain current - - - - - - - - - - - - - - - - - - -	±25 mA
DC V_{CC} or GND current - - - - - - - - - - - - - - -	±50 mA
Storage temperature range- - - - - - - - - - - - - - -	-65°C to +150°C
Maximum power dissipation (P_D) - - - - - - - - - - -	500 mW 2/
Lead temperature (soldering, 10 seconds) - - - - - -	+300°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 range (V_{CC}) - - - - - - - - - - - - -	+4.5 V dc to +5.5 V dc
Case operating temperature range (T_C) - - - - - - -	-55°C to +125°C
Input voltage -	0 V to V_{CC}
Output voltage -	0 V to V_{CC}
Input rise or fall time:	
V_{CC} = 4.5 V- - - - - - - - - - - - - - - - - - - -	0 to 500 ns

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

2/ For T_C = +100°C to +125°C, derate linearly at 8 mW/°C to 300 mW.

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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 Drawings (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 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 Logic diagram. The logic diagram shall be as specified on figure 2.

3.2.3 Case outline. The case outline 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 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/ $-55°C \leq T_C \leq +125°C$ unless otherwise specified		Group A subgroups	Limits		Unit
					Min	Max	

VOLTAGE-CONTROLLED OSCILLATOR SECTION

Test	Symbol	Conditions 1/		Group A subgroups	Min	Max	Unit
High level output voltage (VCO$_{OUT}$)	V$_{OH}$	V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 20 μA, CMOS loads	V_{CC} = 4.5 V	1,2,3	4.4		V
		V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 4.0 mA, TTL loads	V_{CC} = 4.5 V		3.7		
Low level output voltage (VCO$_{OUT}$)	V$_{OL}$	V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 20 μA, CMOS loads	V_{CC} = 4.5 V	1,2,3		0.1	V
		V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 4.0 mA, TTL loads	V_{CC} = 4.5 V			0.4	
High level input voltage (INH)	V$_{IH}$	2/	V_{CC} = 4.5 V to 5.5 V	1,2,3	2.0		V
Low level input voltage (INH)	V$_{IL}$	2/	V_{CC} = 4.5 V to 5.5 V	1,2,3		0.8	V
Input leakage current (INH, VCO$_{IN}$)	I$_{IN}$	GND $\leq V_{IN} \leq V_{CC}$	V_{CC} = 5.5 V	1 / 2,3		±0.1 / ±1.0	μA
R1 and R2 range	R$_{RNG}$	3/ 4/	V_{CC} = 4.5 V	1	3.0	300	kΩ
C1 capacitance range	C$_{RNG}$	4/	V_{CC} = 4.5 V	4	0.0	5/	pF

See footnotes at end of table.

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

Test	Symbol	Conditions 1/ $-55°C \leq T_C \leq +125°C$ unless otherwise specified		Group A subgroups	Limits		Unit
					Min	Max	
VCO_{IN} operating voltage range	V_{OP}	4/ 6/	V_{CC} = 4.5 V	1	0.9	3.2	V
Frequency stability with temperature change	$\Delta f/\Delta T$	R1 = 100 kΩ, R2 = ∞, 4/ V_{CC} = 4.5 V		9		0.11	%/°C
Maximum frequency	f_{MAX}	C1 = 50 pF, R1 = 3.5 kΩ, 4/ R2 = ∞, V_{CC} = 4.5 V		9	24		MHz
		C1 = 0 pF, R1 = 9.1 kΩ, 4/ R2 = ∞, V_{CC} = 4.5 V		9	38		
Center frequency	f_{CTR}	C1 = 40 pF, R1 = 3 kΩ, V_{CC} = 4.5 V, R2 = ∞, VCO_{IN} = $V_{CC}/2$ 4/		9	17		MHz
Frequency linearity	Δf_{VCO}	R1 = 100 kΩ, R2 = ∞, C1 = 100 pF, V_{CC} = 4.5 V 4/		9		0.4	%
Offset frequency	f_{OFF}	R2 = 220 kΩ, V_{CC} = 4.5 V, 4/ C1 = 1 nF		9	400		kHz

DEMODULATOR SECTION

Test	Symbol	Conditions		Group A subgroups	Min	Max	Unit
Resistor range	R_S	At R_S > 300 kΩ leakage current can influence $V_{DEM(OUT)}$ 4/	V_{CC} = 4.5 V	1	50	300	kΩ
Offset voltage, VCO_{IN} to V_{DEM}	V_{OFF}	V_{IN} = $V_{VCO(IN)}$ = $V_{CC}/2$ Values taken over R_S range 4/	V_{CC} = 4.5 V	1		±20.0	mV
Output resistance at DEM_{OUT}	R_D	$V_{DEM(OUT)}$ = $V_{CC}/2$ 4/	V_{CC} = 4.5 V	1		25	Ω
Quiescent current	I_{CC}	V_{IN} = V_{CC} or GND	V_{CC} = 5.5 V	1 2,3		8 160	μA

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/ -55°C $\leq$ T$_C$ $\leq$ +125°C unless otherwise specified		Group A subgroups	Limits		Unit
					Min	Max	
Additional quiescent device current	ΔI_{CC}	V_{IN} = 2.4 V	V_{CC} = 4.5 V to 5.5 V	1 2,3		360 490	μA
Output voltage versus input frequency	V_{OUT}/ f_{IN}	R1 = 100 kΩ, R2 = ∞, C1 = 100 pF, R$_S$ = 10 kΩ, R3 = 100 kΩ, C2 = 100 pF	V_{CC} = 4.5 V	1		330	mV/kHz
PHASE COMPARATOR SECTION							
High level output voltage (PCP$_{OUT}$, PCn$_{OUT}$)	V_{OH}	V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 20 μA, CMOS loads	V_{CC} = 4.5 V	1,2,3	4.4		V
		V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 4.0 mA, TTL loads	V_{CC} = 4.5 V		3.7		
Low level output voltage (PCP$_{OUT}$, PCn$_{OUT}$)	V_{OL}	V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 20 μA, CMOS loads	V_{CC} = 4.5 V	1,2,3		0.1	V
		V_{IN} = V_{IH} minimum or V_{IL} maximum, $|I_O|$ = 4.0 mA, TTL loads	V_{CC} = 4.5 V			0.4	
High level input voltage (SIG$_{IN}$, COMP$_{IN}$, DC coupled)	V_{IH}	2/	V_{CC} = 4.5 V	1,2,3	2.0		V
Low level input voltage (SIG$_{IN}$, COMP$_{IN}$, DC coupled)	V_{IL}	2/	V_{CC} = 4.5 V	1,2,3		0.8	V
Input leakage current (SIG$_{IN}$, COMP$_{IN}$)	I_{IN}	GND $\leq$ V_{IN} $\leq$ V_{CC}	V_{CC} = 5.5 V	1 2,3		±30 ±45	μA

See footnotes at end of table.

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		Unit
					Min	Max	
Three-state off-state current ($PC2_{OUT}$)	I_{OZ}	$V_{IN} = V_{CC}$ or GND	$V_{CC} = 5.5$ V	1 2,3		±0.5 ±10.0	µA
Input resistance (SIG_{IN}, $COMP_{IN}$)	R_{IN}	V_1 at self-bias operating point $\Delta V_1 = 0.5$ V	$V_{CC} = 4.5$ V	1,2,3		250	kΩ
Propagation delay time, SIG_{IN}, $COMP_{IN}$ to $PC1_{OUT}$	t_{PLH1}, t_{PHL1}	$C_L = 50$ pF, see figure 3	$V_{CC} = 4.5$ V	9 10,11		45 68	ns
Propagation delay time, SIG_{IN}, $COMP_{IN}$ to PCP_{OUT}	t_{PLH2}, t_{PHL2}		$V_{CC} = 4.5$ V	9 10,11		68 102	ns
Propagation delay time, SIG_{IN}, $COMP_{IN}$ to $PC3_{OUT}$	t_{PLH3}, t_{PHL3}		$V_{CC} = 4.5$ V	9 10,11		58 87	ns
Output transition time 7/	t_{THL}, t_{TLH}		$V_{CC} = 4.5$ V	9 10,11		15 22	ns
Output enable time, SIG_{IN}, $COMP_{IN}$ to $PC2_{OUT}$	t_{PZH}, t_{PZL}		$V_{CC} = 4.5$ V	9 10,11		60 90	ns
Output disable time, SIG_{IN}, $COMP_{IN}$ to $PC2_{OUT}$	t_{PHZ}, t_{PLZ}		$V_{CC} = 4.5$ V	9 10,11		68 102	ns

See footnotes on next page.

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1/ For a power supply of 5 V ±10%, the worst case output voltages (V_{OH} and V_{OL}) occur for HCT at 4.5 V. Thus, the 4.5 V values should be used when designing with this supply. Worst cases V_{IH} and V_{IL} occur at V_{CC} = 5.5 V and 4.5 V, respectively.

2/ The V_{IH} and V_{IL} tests are not required, and shall be applied as forcing functions for the V_{OH} or V_{OL} tests.

3/ The value for R1 and R2 in parallel should exceed 2.7 kΩ.

4/ This parameter is characterization data, and is guaranteed, if not tested, to the limits specified in table I.

5/ No maximum limit for C1 capacitance range.

6/ The maximum operating voltage can be as high as V_{CC} - 0.9 V, however, this may result in an increased offset voltage.

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

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 3.6 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.

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Device type	01
Case outline	E

Terminal number	Terminal symbol
1	PCP_{OUT}
2	$PC1_{OUT}$
3	$COMP_{IN}$
4	VCO_{OUT}
5	INH
6	C1A
7	C1B
8	GND
9	VCO_{IN}
10	DEM_{OUT}
11	R1
12	R2
13	$PC2_{OUT}$
14	SIG_{IN}
15	$PC3_{OUT}$
16	V_{CC}

Terminal symbol	Symbol description
PCP_{OUT}	Phase comparator pulse output
$PC1_{OUT}$	Phase comparator 1 output
$COMP_{IN}$	Comparator input
VCO_{OUT}	VCO output
INH	Inhibit input
C1A	Capacitor C1 connection A
C1B	Capacitor C1 connection B
GND	Ground
VCO_{IN}	VCO input
DEM_{OUT}	Demodulator output
R1	Resistor R1 connection
R2	Resistor R2 connection
$PC2_{OUT}$	Phase comparator 2 output
SIG_{IN}	Signal input
$PC3_{OUT}$	Phase comparator 3 output
V_{CC}	Positive supply voltage

FIGURE 1. Terminal connections.

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FIGURE 2. Logic diagram.
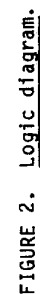
FIGURE 3. Test circuit and switching waveforms.

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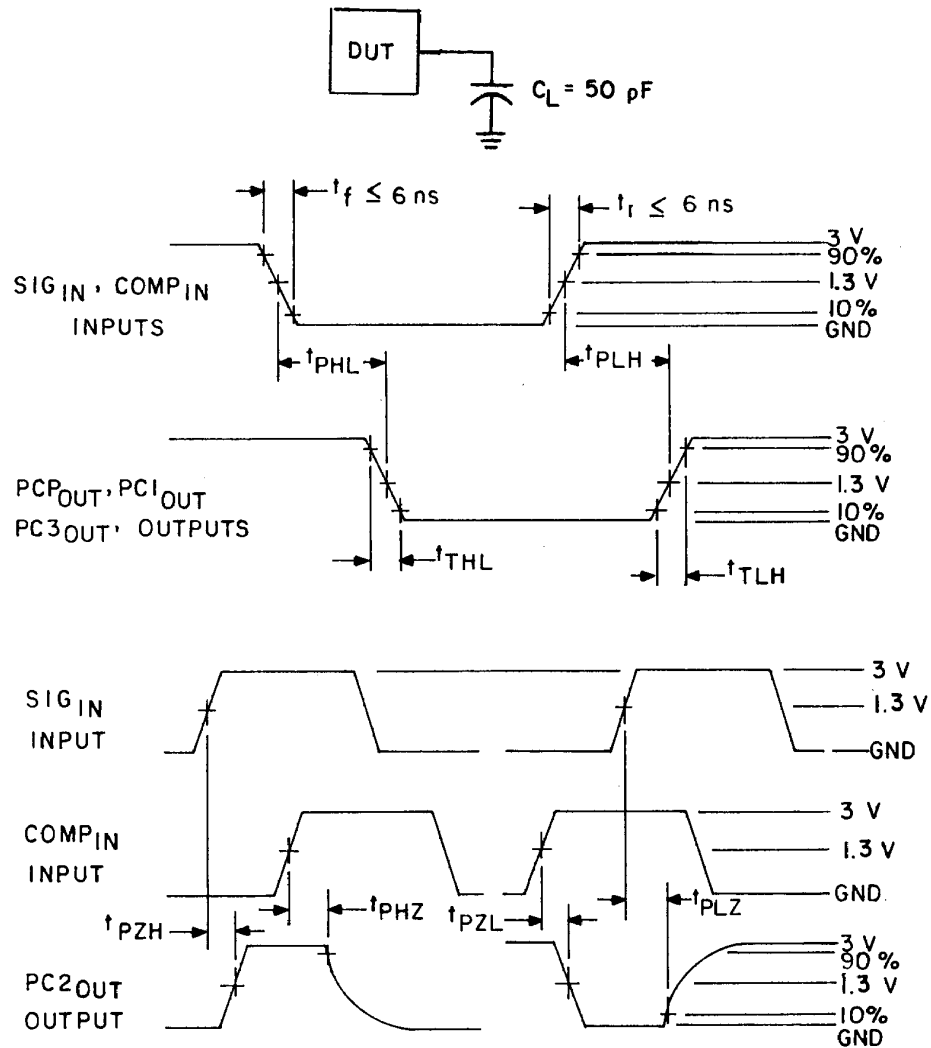4.3 Quality conformance inspection. Quality conformance inspection shall be in accordance with method 5005 of MIL-STD-883 including groups A, B, C, and D inspections. The following additional criteria shall apply.

4.3.1 Group A inspection.

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

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

c. Subgroup 4 (C_{RNG} measurement) shall be measured only for the initial test and after process or design changes which may affect capacitance. Test all applicable pins on 5 devices with zero failures.

d. Subgroups 7 and 8 tests shall consist of verifying the functionality of the device. These tests form a part of the vendors test tape and shall be maintained and available from the approved source of supply.

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 3.6 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, 3, 7, 8, 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.

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

Military drawing part number	Vendor CAGE number	Vendor 1/ similar part number
5962-8875701EX	34371	CD54HCT4046AF/3A

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
34371	Harris Semiconductor 200 Palm Bay Blvd. P.O. Box 883 Melbourne, FL 32901

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