REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Add device types 03 and 04. Technical and editorial changes throughout.	96-02-05	M. A. FRYE

REV																			
SHEET																			
REV																			
SHEET																			

REV STATUS OF SHEETS															
REV	A	A	A	A	A	A	A	A	A	A					
SHEET	1	2	3	4	5	6	7	8	9	10					

PMIC N/A

STANDARD MICROCIRCUIT DRAWING

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

AMSC N/A

PREPARED BY
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DRAWING APPROVAL DATE
95-07-10

REVISION LEVEL
A

DEFENSE ELECTRONICS SUPPLY CENTER
DAYTON, OHIO 45444

MICROCIRCUIT, LINEAR, DUAL/QUAD, RAIL-TO-RAIL, LOW POWER OPERATIONAL AMPLIFIER, MONOLITHIC SILICON

SIZE	CAGE CODE	
A	67268	5962-95666

SHEET 1 OF 10

DESC FORM 193
JUL 94

5962-E310-96

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

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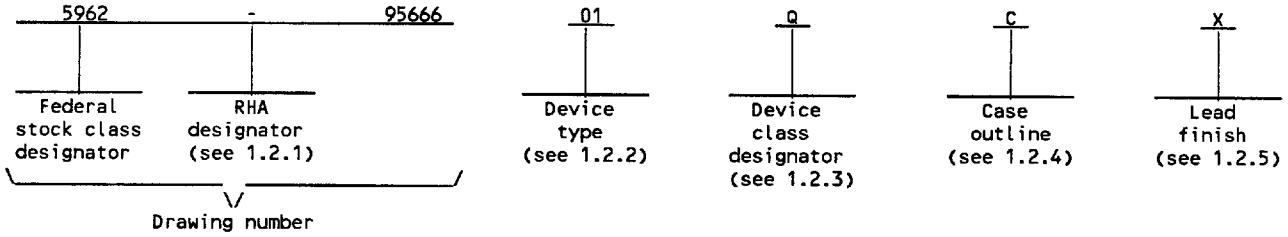
1. SCOPE

1.1 Scope. This drawing documents two product assurance class levels consisting of high reliability (device classes Q and M) and space application (device class V). A choice of case outlines and lead finishes are available and are reflected in the Part or Identifying Number (PIN). When available, a choice of Radiation Hardness Assurance (RHA) levels are reflected in the PIN.

1.2 PIN. The PIN is as shown in the following example:



1.2.1 RHA designator. Device classes Q and V RHA marked devices meet the MIL-PRF-38535 specified RHA levels and are marked with the appropriate RHA designator. Device class M RHA marked devices meet the MIL-PRF-38535, appendix A specified RHA levels and are marked with the appropriate RHA designator. A dash (-) indicates a non-RHA device.

1.2.2 Device type(s). The device type(s) identify the circuit function as follows:

Device type	Generic number	Circuit function
01	TLV2252M	Dual, rail-to-rail, low power, operational amplifiers
02	TLV2254M	Quad, rail-to-rail, low power, operational amplifiers
03	TLV2252AM	Dual, rail-to-rail, low power, operational amplifiers with enhanced V_{IO}
04	TLV2254AM	Quad, rail-to-rail, low power, operational amplifiers with enhanced V_{IO}

1.2.3 Device class designator. The device class designator is a single letter identifying the product assurance level as follows:

Device class	Device requirements documentation
M	Vendor self-certification to the requirements for MIL-STD-883 compliant, non-JAN class level B microcircuits in accordance with MIL-PRF-38535, appendix A
Q or V	Certification and qualification to MIL-PRF-38535

1.2.4 Case outline(s). The case outline(s) are as designated in MIL-STD-1835 and as follows:

Outline letter	Descriptive designator	Terminals	Package style
C	GDIP1-T14 or CDIP2-T14	14	Dual-in-line
D	GDFP1-F14 or CDFP2-F14	14	Flat pack
H	GDFP1-F10 or CDFP2-F10	10	Flat pack
P	GDIP1-T8 or CDIP2-T8	8	Dual-in-line
2	CQCC1-N20	20	Square leadless chip carrier

1.2.5 Lead finish. The lead finish is as specified in MIL-PRF-38535 for device classes Q and V or MIL-PRF-38535, appendix A for device class M.

1.3 Absolute maximum ratings. 1/

Supply voltage (V_{DD})	+8.0 V dc 2/
Differential input voltage (V_{ID})	$\pm V_{DD}$ 3/
Input voltage range (V_{IN})	$-V_{DD}$ - 0.3 V to $+V_{DD}$
Input current, each input (I_{IN})	+5.0 mA to -5.0 mA
Output current (I_{OUT})	+50.0 mA to -50.0 mA
Total current into $+V_{DD}$	+50.0 mA to -50.0 mA
Total current out of $-V_{DD}$	+50.0 mA to -50.0 mA
Duration of short-circuit current at or below +25°C	Unlimited 4/
Operating free-air temperature range (T_A)	-55°C to +125°C
Storage temperature range (T_{STG})	-65°C to +150°C
Lead temperature (soldering 10 seconds)	+260°C
Thermal resistance, junction-to-case (θ_{JC})	See MIL-STD-1835
Maximum junction temperature (T_J)	+150°C
Maximum power dissipation (P_D): 5/	
Cases C and 2	1375 mW
Cases D and H	700 mW
Case P	1050 mW

1.4 Recommended operating conditions.

Supply voltage ($\pm V_{DD}$)	2.7 V dc to 8.0 V dc
Input voltage range (V_{IN})	$-V_{DD}$ to $+V_{DD}$ - 1.3 V
Common-mode input voltage (V_{IC})	$-V_{DD}$ to $+V_{DD}$ - 1.3 V
Ambient operating temperature range (T_A)	-55°C to +125°C

2. APPLICABLE DOCUMENTS

2.1 Government specification, standards, and handbooks. The following specification, standards, and handbooks form a part of this drawing to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATION

MILITARY

MIL-PRF-38535 - Integrated Circuits, Manufacturing, General Specification for.

STANDARDS

MILITARY

MIL-STD-883 - Test Methods and Procedures for Microelectronics.
MIL-STD-973 - Configuration Management.
MIL-STD-1835 - Microcircuit Case Outlines.

HANDBOOKS

MILITARY

MIL-HDBK-103 - List of Standard Microcircuit Drawings (SMD's).
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Unless otherwise indicated, copies of the specification, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

1/ Stresses above the absolute maximum rating may cause permanent damage to the device. Extended operation at the maximum levels may degrade performance and affect reliability.
2/ All voltage values, except differential voltages, are with respect to $-V_{DD}$.
3/ Differential voltages are at the noninverting input with respect to the inverting input. Excessive current flows if the input is brought below $-V_{DD}$ - 0.3 V.
4/ The output may be shorted to either supply. Temperature and/or supply voltages must be limited to ensure that the maximum dissipation rating is not exceeded.
5/ Above T_A = +25°C, derate by the following factors; cases C and 2 at 11.0 mW/°C, cases D and H at 5.5 mW/°C, and case P at 8.4 mW/°C.

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 takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Item requirements. The individual item requirements for device classes Q and V shall be in accordance with MIL-PRF-38535 and as specified herein or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein. The individual item requirements for device class M shall be in accordance with MIL-PRF-38535, appendix A for non-JAN class level B devices and as specified herein.

3.2 Design, construction, and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38535 and herein for device classes Q and V or MIL-PRF-38535, appendix A and herein for device class M.

3.2.1 Case outline(s). The case outline(s) shall be in accordance with 1.2.4 herein.

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

3.3 Electrical performance characteristics and postirradiation parameter limits. Unless otherwise specified herein, the electrical performance characteristics and postirradiation parameter limits are as specified in table I and shall apply over the full ambient 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 defined in table I.

3.5 Marking. The part shall be marked with the PIN listed in 1.2 herein. In addition, the manufacturer's PIN may also be marked as listed in MIL-HDBK-103. For packages where marking of the entire SMD PIN number is not feasible due to space limitations, the manufacturer has the option of not marking the "5962-" on the device. For RHA product using this option, the RHA designator shall still be marked. Marking for device classes Q and V shall be in accordance with MIL-PRF-38535. Marking for device class M shall be in accordance with MIL-PRF-38535, appendix A.

3.5.1 Certification/compliance mark. The certification mark for device classes Q and V shall be a "QML" or "Q" as required in MIL-PRF-38535. The compliance mark for device class M shall be a "C" as required in MIL-PRF-38535, appendix A.

3.6 Certificate of compliance. For device classes Q and V, a certificate of compliance shall be required from a QML-38535 listed manufacturer in order to supply to the requirements of this drawing (see 6.6.1 herein). For device class M, a certificate of compliance shall be required from a manufacturer in order to be listed as an approved source of supply in MIL-HDBK-103 (see 6.6.2 herein). The certificate of compliance submitted to DESC-EC prior to listing as an approved source of supply for this drawing shall affirm that the manufacturer's product meets, for device classes Q and V, the requirements of MIL-PRF-38535 and herein or for device class M, the requirements of MIL-PRF-38535, appendix A and herein.

3.7 Certificate of conformance. A certificate of conformance as required for device classes Q and V in MIL-PRF-38535 or for device class M in MIL-PRF-38535, appendix A shall be provided with each lot of microcircuits delivered to this drawing.

3.8 Notification of change for device class M. For device class M, notification to DESC-EC of change of product (see 6.2 herein) involving devices acquired to this drawing is required for any change as defined in MIL-STD-973.

3.9 Verification and review for device class M. For device class M, 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.

3.10 Microcircuit group assignment for device class M. Device class M devices covered by this drawing shall be in microcircuit group number 49 (see MIL-PRF-38535, appendix A).

TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device Type	Limits 1/		Unit
					Min	Max	
Input offset voltage	V_{IO}	$V_{DD} = \pm 1.5$ V, $V_{IC} = 0$ V, $R_S = 50\ \Omega$, $V_{OUT} = 0$ V	1	01, 02		1500	µV
				03, 04		850	
			2, 3	01, 02		1750	
				03, 04		1000	
		$V_{DD} = \pm 2.5$ V, $V_{IC} = 0$ V, $R_S = 50\ \Omega$, $V_{OUT} = 0$ V	1	01, 02		1500	
				03, 04		850	
			2, 3	01, 02		1750	
				03, 04		1000	
Input offset current	I_{IO}	$V_{DD} = \pm 1.5$ V, $V_{IC} = 0$ V, $R_S = 50\ \Omega$, $V_{OUT} = 0$ V, $T_A = +125°C$	2	All		500	pA
		$V_{DD} = \pm 2.5$ V, $V_{IC} = 0$ V, $R_S = 50\ \Omega$, $V_{OUT} = 0$ V, $T_A = +125°C$				500	
Input bias current	I_{IB}	$V_{DD} = \pm 1.5$ V, $V_{IC} = 0$ V, $R_S = 50\ \Omega$, $V_{OUT} = 0$ V, $T_A = +125°C$	2	All		500	pA
		$V_{DD} = \pm 2.5$ V, $V_{IC} = 0$ V, $R_S = 50\ \Omega$, $V_{OUT} = 0$ V, $T_A = +125°C$				500	
Common-mode input voltage range	V_{ICR}	$V_{DD} = 3$ V, $\lvert V_{IO} \rvert \le 5$ mV, $R_S = 50\ \Omega$	1	All	0 to 2		V
			2, 3		0 to 1.7		
		$V_{DD} = 5$ V, $\lvert V_{IO} \rvert \le 5$ mV, $R_S = 50\ \Omega$	1		0 to 4		
			2, 3		0 to 3.5		
High-level output voltage	V_{OH}	$V_{DD} = 3$ V, $I_{OH} = -75$ µA	1	All	2.9		V
			2, 3		2.8		
		$V_{DD} = 3$ V, $I_{OH} = -150$ µA	1		2.8		
		$V_{DD} = 5$ V, $I_{OH} = -75$ µA	1		4.9		
			2, 3		4.8		
		$V_{DD} = 5$ V, $I_{OH} = -150$ µA	1		4.8		

See footnotes at end of table.

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device Type	Limits 1/		Unit
					Min	Max	
Low-level output voltage	V_{OL}	V_{DD} = 3 V, V_{IC} = 1.5 V, I_{OL} = 500 µA	1	All		150	mV
			2, 3			165	
		V_{DD} = 3 V, V_{IC} = 1.5 V, I_{OL} = 1 mA	1, 2, 3			300	
		V_{DD} = 5 V, V_{IC} = 2.5 V, I_{OUT} = 1 mA	1, 2, 3			150	
		V_{DD} = 5 V, V_{IC} = 2.5 V, I_{OUT} = 1 mA	1			300	
Large-signal differential voltage amplification	A_{VD}	V_{DD} = 3 V, V_{IC} = 1.5 V, V_{OUT} = 1 V to 2 V, R_L = 100 kΩ 2/	1	All	100		V/mV
			2, 3		10		
		V_{DD} = 5 V, V_{IC} = 2.5 V, V_{OUT} = 1 V to 4 V, R_L = 100 kΩ 2/	1		100		
			2, 3		10		
Common-mode rejection ratio	CMRR	V_{DD} = 3 V, V_{OUT} = 1.5 V, V_{IC} = 0 V to 1.7 V, R_S = 50 Ω	1	All	65		dB
			2, 3		60		
		V_{DD} = 5 V, V_{OUT} = 2.5 V, V_{IC} = 0 V to 2.7 V, R_S = 50 Ω	1, 2, 3		70		
Supply voltage rejection ratio ($\Delta V_{DD}/\Delta V_{IO}$)	k_{SVR}	V_{DD} = 2.7 V to 8 V, V_{IC} = V_{DD}/2, no load	1, 2, 3	All	80		dB
		V_{DD} = 4.4 V to 8 V, V_{IC} = V_{DD}/2, no load			80		
Supply current (both channels)	I_{DD}	V_{DD} = 3 V, V_{OUT} = 1.5 V, no load	1, 2, 3	01, 03		125	µA
				02, 04		250	
		V_{DD} = 5 V, V_{OUT} = 2.5 V, no load		01, 03		125	
				02, 04		250	
Slew rate at unity gain	SR	V_{DD} = 3 V, R_L = 100 kΩ, 2/ V_{OUT} = 0.8 V to 1.4 V, C_L = 100 pF	4	All	0.07		V/µs
			5, 6		0.05		
		V_{DD} = 5 V, R_L = 100 kΩ, 3/ V_{OUT} = 1.25 V to 2.75 V, C_L = 100 pF	4		0.07		
			5, 6		0.05		

1/ The algebraic convention, whereby the most negative value is a minimum and the most positive is a maximum, is used in this table. Negative current shall be defined as conventional current flow out of a device terminal.

2/ Referenced to 1.5 V.

3/ Referenced to 2.5 V.

Device types	01, 03			02, 04	
Case outlines	H	P	2	C and D	2
Terminal number	Terminal symbol				
1	NC	OUTPUT 1	NC	OUTPUT 1	NC
2	OUTPUT 1	-INPUT 1	OUTPUT 1	-INPUT 1	OUTPUT 1
3	-INPUT 1	+INPUT 1	NC	+INPUT 1	-INPUT 1
4	+INPUT 1	$-V_{DD}$/GND	NC	$+V_{DD}$	+INPUT 1
5	$-V_{DD}$/GND	+INPUT 2	-INPUT 1	+INPUT 2	NC
6	+INPUT 2	-INPUT 2	NC	-INPUT 2	$+V_{DD}$
7	-INPUT 2	OUTPUT 2	+INPUT 1	OUTPUT 2	NC
8	OUTPUT 2	$+V_{DD}$	NC	OUTPUT 3	+INPUT 2
9	$+V_{DD}$	----	NC	-INPUT 3	-INPUT 2
10	NC	----	$-V_{DD}$/GND	+INPUT 3	OUTPUT 2
11	----	----	NC	$-V_{DD}$/GND	NC
12	----	----	+INPUT 2	+INPUT 4	OUTPUT 3
13	----	----	NC	-INPUT 4	-INPUT 3
14	----	----	NC	OUTPUT 4	+INPUT 3
15	----	----	-INPUT 2	----	NC
16	----	----	NC	----	$-V_{DD}$/GND
17	----	----	OUTPUT 2	----	NC
18	----	----	NC	----	+INPUT 4
19	----	----	NC	----	-INPUT 4
20	----	----	$+V_{DD}$	----	OUTPUT 4

FIGURE 1. Terminal connections.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. For device classes Q and V, sampling and inspection procedures shall be in accordance with MIL-PRF-38535 or as modified in the device manufacturer's Quality Management (QM) plan. The modification in the QM plan shall not affect the form, fit, or function as described herein. For device class M, sampling and inspection procedures shall be in accordance with MIL-PRF-38535, appendix A.

4.2 Screening. For device classes Q and V, screening shall be in accordance with MIL-PRF-38535, and shall be conducted on all devices prior to qualification and technology conformance inspection. For device class M, screening shall be in accordance with method 5004 of MIL-STD-883, and shall be conducted on all devices prior to quality conformance inspection.

4.2.1 Additional criteria for device class M.

a. Burn-in test, method 1015 of MIL-STD-883.

(1) Test condition B or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015.

(2) T_A = +125°C, minimum.

b. Interim and final electrical test parameters shall be as specified in table II herein.

4.2.2 Additional criteria for device classes Q and V.

a. The burn-in test duration, test condition and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The burn-in test circuit shall be maintained under document revision level control of the device manufacturer's Technology Review Board (TRB) in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1015 of MIL-STD-883.

b. Interim and final electrical test parameters shall be as specified in table II herein.

c. Additional screening for device class V beyond the requirements of device class Q shall be as specified in MIL-PRF-38535, appendix B.

4.3 Qualification inspection for device classes Q and V. Qualification inspection for device classes Q and V shall be in accordance with MIL-PRF-38535. Inspections to be performed shall be those specified in MIL-PRF-38535 and herein for groups A, B, C, D, and E inspections (see 4.4.1 through 4.4.4).

4.4 Conformance inspection. Technology conformance inspection for classes Q and V shall be in accordance with MIL-PRF-38535 including groups A, B, C, D, and E inspections and as specified herein except where option 2 of MIL-PRF-38535 permits alternate in-line control testing. Quality conformance inspection for device class M shall be in accordance with MIL-PRF-38535, appendix A and as specified herein. Inspections to be performed for device class M shall be those specified in method 5005 of MIL-STD-883 and herein for groups A, B, C, D, and E inspections (see 4.4.1 through 4.4.4).

4.4.1 Group A inspection.

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

b. Subgroups 7, 8, 9, 10, and 11 in table I, method 5005 of MIL-STD-883 shall be omitted.

4.4.2 Group C inspection. The group C inspection end-point electrical parameters shall be as specified in table II herein.

TABLE II. Electrical test requirements.

Test requirements	Subgroups (in accordance with MIL-STD-883, method 5005, table I)	Subgroups (in accordance with MIL-PRF-38535, table III)	
	Device class M	Device class Q	Device class V
Interim electrical parameters (see 4.2)	----	----	----
Final electrical parameters (see 4.2)	1,2,3,4,5,6 1/	1,2,3, 4,5,6 1/	1,2,3 4,5,6 1/
Group A test requirements (see 4.4)	1,2,3,4,5,6	1,2,3, 4,5,6	1,2,3, 4,5,6
Group C end-point electrical parameters (see 4.4)	1	1	1
Group D end-point electrical parameters (see 4.4)	1	1	1
Group E end-point electrical parameters (see 4.4)	----	----	----

1/ PDA applies to subgroup 1 except for input offset voltage (V_{IO}) test.

4.4.2.1 Additional criteria for device class M. Steady-state life test conditions, method 1005 of MIL-STD-883:

a. Test condition B or D. The test circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing or acquiring activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.

b. T_A = +125°C, minimum.

c. Test duration: 1,000 hours, except as permitted by method 1005 of MIL-STD-883.

4.4.2.2 Additional criteria for device classes Q and V. The steady-state life test duration, test condition and test temperature, or approved alternatives shall be as specified in the device manufacturer's QM plan in accordance with MIL-PRF-38535. The test circuit shall be maintained under document revision level control by the device manufacturer's TRB in accordance with MIL-PRF-38535 and shall be made available to the acquiring or preparing activity upon request. The test circuit shall specify the inputs, outputs, biases, and power dissipation, as applicable, in accordance with the intent specified in test method 1005 of MIL-STD-883.

4.4.3 Group D inspection. The group D inspection end-point electrical parameters shall be as specified in table II herein.

4.4.4 Group E inspection. Group E inspection is required only for parts intended to be marked as radiation hardness assured (see 3.5 herein).

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

b. For device classes Q and V, the devices or test vehicle shall be subjected to radiation hardness assured tests as specified in MIL-PRF-38535 for the RHA level being tested. For device class M, the devices shall be subjected to radiation hardness assured tests as specified in MIL-PRF-38535, appendix A for the RHA level being tested. All device classes must meet the postirradiation end-point electrical parameter limits as defined in table I at T_A = +25°C ±5°C, after exposure, to the subgroups specified in table II herein.

c. When specified in the purchase order or contract, a copy of the RHA delta limits shall be supplied.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38535 for device classes Q and V or MIL-PRF-38535, appendix A for device class M.

6. NOTES

6.1 Intended use. Microcircuits conforming to this drawing are intended for use for Government microcircuit applications (original equipment), design applications, and logistics purposes.

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

6.1.2 Substitutability. Device class Q devices will replace device class M devices.

6.2 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-973 using DD Form 1692, Engineering Change Proposal.

6.3 Record of users. Military and industrial users should inform Defense Electronics Supply Center when a system application requires configuration control and which SMD's are applicable to that system. 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 microelectronic devices (FSC 5962) should contact DESC-EC, telephone (513) 296-6047.

6.4 Comments. Comments on this drawing should be directed to DESC-EC, Dayton, Ohio 45444-5270, or telephone (513) 296-5377.

6.5 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-PRF-38535 and MIL-HDBK-1331.

6.6 Sources of supply.

6.6.1 Sources of supply for device classes Q and V. Sources of supply for device classes Q and V are listed in QML-38535. The vendors listed in QML-38535 have submitted a certificate of compliance (see 3.6 herein) to DESC-EC and have agreed to this drawing.

6.6.2 Approved sources of supply for device class M. Approved sources of supply for class M are listed in MIL-HDBK-103. The vendors listed in MIL-HDBK-103 have agreed to this drawing and a certificate of compliance (see 3.6 herein) has been submitted to and accepted by DESC-EC.