

REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Make change to input offset current test as specified in table I. - ro	99-10-25	R. MONNIN
B	Make change to 1.5 and add a footnote to TABLE I and TABLE IIB. - ro	00-11-16	R. MONNIN
C	Add condition " $V_{OUT} = \pm 10 V$ " to the irradiation section of the $\pm A_{VS}$ test and add " $V_{CM} = 0 V$ " to footnote 1/ as specified under table I. Make correction to table IIA. - ro	03-03-07	R. MONNIN
D	Add CAGE 60264. Delete the words "radiation hardened" from the title block and under paragraph 1.2.2. Delete the letters in the generic numbers under paragraph 1.2.2. Make change to footnote 2/ as specified under Table IIA. Delete paragraphs 4.4.4.1 and 4.4.4.2. - ro	11-10-05	C. SAFFLE
E	Delete references to device class M requirements and figure 2 radiation exposure circuit. Update document paragraphs to current MIL-PRF-38535 requirements. - ro	18-01-11	C. SAFFLE



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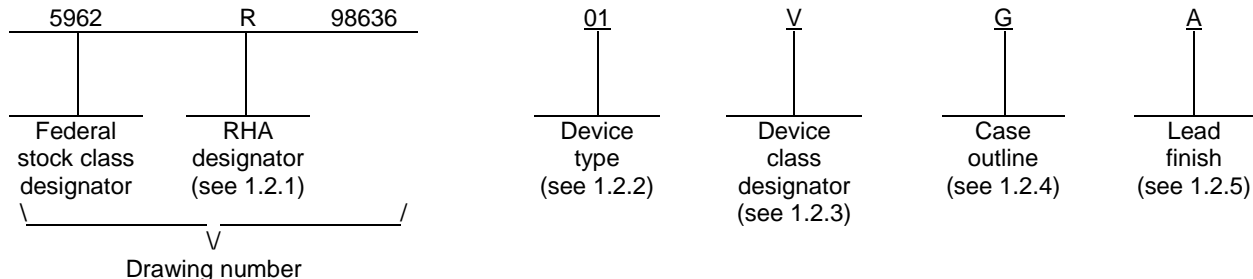
REV STATUS	REV	E	E	E	E	E	E	E	E	E	E	E	E	E						
OF SHEETS	SHEET	1	2	3	4	5	6	7	8	9	10	11								

PMIC N/A	PREPARED BY RICK OFFICER	<p align="center"> <b>DLA LAND AND MARITIME</b>  <b>COLUMBUS, OHIO 43218-3990</b>  <a href="http://www.dla.mil/landandmaritime">http://www.dla.mil/landandmaritime</a> </p> <p align="center"> <b>MICROCIRCUIT, LINEAR, JFET-INPUT</b>  <b>OPERATIONAL AMPLIFIER, MONOLITHIC</b>  <b>SILICON</b> </p>																	
<b>STANDARD</b> <b>MICROCIRCUIT</b> <b>DRAWING</b>	CHECKED BY RAJESH PITHADIA																		
	APPROVED BY RAYMOND MONNIN																		
	DRAWING APPROVAL DATE 98-10-08																		
THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE	REVISION LEVEL E	SIZE A	CAGE CODE <b>67268</b>	<b>5962-98636</b>															
AMSC N/A	SHEET		1 OF 11																

1. SCOPE

1.1 Scope. This drawing documents two product assurance class levels consisting of high reliability (device class Q) 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 is 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. A dash (-) indicates a non-RHA device.

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

<u>Device type</u>	<u>Generic number</u>	<u>Circuit function</u>
01	155A	JFET input operational amplifier
02	156A	JFET input operational amplifier

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

<u>Device class</u>	<u>Device requirements documentation</u>
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:

<u>Outline letter</u>	<u>Descriptive designator</u>	<u>Terminals</u>	<u>Package style</u>
G	MACY1-X8	8	Can
P	GDIP1-T8 or CDIP2-T8	8	Dual-in-line

1.2.5 Lead finish. The lead finish is as specified in MIL-PRF-38535 for device classes Q and V.

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1.3 Absolute maximum ratings. 1/

Supply voltage range ( $\pm V_S$ ) .....	$\pm 22$ V
Input voltage range ( $V_{IN}$ ) .....	$\pm 20$ V 2/
Differential input voltage range .....	$\pm 40$ V
Power dissipation (PD) .....	670 mW
Output short circuit duration .....	Unlimited 3/
Junction temperature ( $T_J$ ) .....	175°C 4/
Storage temperature range .....	-65°C to +150°C
Lead temperature (soldering, 60 seconds) .....	300°C
Thermal resistance, junction-to-case ( $\theta_{JC}$ ) .....	See MIL-STD-1835
Thermal resistance, junction-to-ambient ( $\theta_{JA}$ ):	
Case G .....	150°C/W
Case P .....	120°C/W

1.4 Recommended operating conditions.

Supply voltage range ( $\pm V_S$ ) .....	$\pm 5$ V dc to 20 V dc
Ambient temperature range ( $T_A$ ) .....	-55°C to +125°C

1.5 Radiation features.

Maximum total dose available (dose rate = 50 – 300 rads(Si)/s) .....	100 krad 5/
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- 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/ The absolute maximum negative input voltage is equal to the negative power supply voltage.
- 3/ Short circuit may be to ground or either supply. Rating applies to +125°C case temperature or +75°C ambient temperature.
- 4/ For short term test (in the specific burn-in and life test configuration when required and up to 168°C hours maximum),  $T_J = 275^\circ\text{C}$ .
- 5/ These parts may be dose rate sensitive in a space environment and may demonstrate enhanced low dose rate effects. Radiation end point limits for the noted parameters are guaranteed only for the conditions specified in MIL-STD-883, method 1019, condition A.

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## 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 cited in the solicitation or contract.

### DEPARTMENT OF DEFENSE SPECIFICATION

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

### DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-883 - Test Method Standard Microcircuits.  
MIL-STD-1835 - Interface Standard Electronic Component Case Outlines.

### DEPARTMENT OF DEFENSE HANDBOOKS

MIL-HDBK-103 - List of Standard Microcircuit Drawings.  
MIL-HDBK-780 - Standard Microcircuit Drawings.

(Copies of these documents are available online at <http://quicksearch.dla.mil> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

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 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.

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.

3.2.1 Case outlines. The case outlines shall be in accordance with 1.2.4 herein.

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

3.2.3 Radiation exposure circuit. The radiation exposure circuit shall be maintained by the manufacturer under document revision level control and shall be made available to the preparing and acquiring activity upon request.

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 IIA. 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. 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.

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.

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions -55°C ≤ TA ≤ +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Input offset voltage	V <sub>IO</sub>	±V <sub>S</sub> = ±5 V, V <sub>CM</sub> = 0 V	1	All	-2	2	mV
		±V <sub>S</sub> = ±20 V, V <sub>CM</sub> = ±15 V, 0 V	2,3		-2.5	2.5	
		M,D,P,L,R <u>1/ 2/</u>	1		-2	2	
Input offset voltage <u>3/</u> temperature sensitivity	ΔV <sub>IO</sub> / ΔT	±V <sub>S</sub> = ±20 V, V <sub>CM</sub> = 0 V	1,2,3	All	-10	10	μV/°C
Input offset current <u>4/ 5/ 6/</u>	I <sub>IO</sub>	±V <sub>S</sub> = ±20 V, V <sub>CM</sub> = 0 V	1	All	-20	20	pA
			2,3		-20	20	nA
		M,D,P,L,R <u>1/ 2/</u>	1		-0.3	0.3	
Input bias current <u>4/ 5/ 6/</u>	+I <sub>IB</sub> ,	±V <sub>S</sub> = ±20 V,	1	All	-100	3500	pA
	-I <sub>IB</sub>	V <sub>CM</sub> = +15 V, t ≤ 25 ms	2		-10	60	nA
		M,D,P,L,R <u>1/ 2/</u>	1		-3.0	3.0	nA
		±V <sub>S</sub> = ±15 V,	1		-100	300	pA
		V <sub>CM</sub> = +10 V, t ≤ 25 ms	2		-10	60	nA
		±V <sub>S</sub> = ±20 V, -15 V < V <sub>CM</sub> < 0 V, t ≤ 25 ms	1 2		-100 -10	100 50	pA nA
Adjustment for input <u>3/</u> offset voltage	+V <sub>IO</sub> ADJ, -V <sub>IO</sub> ADJ	±V <sub>S</sub> = ±20 V	1,2,3	All	+8	-8	mV
Output voltage swing <u>3/</u> (maximum)	V <sub>OP</sub>	±V <sub>S</sub> = ±20 V, R <sub>L</sub> = 10 kΩ	1,2,3	All	±16		V
		±V <sub>S</sub> = ±20 V, R <sub>L</sub> = 2 kΩ			±15		
Output short circuit <u>3/ 7/</u> current	+I <sub>OS</sub>	±V <sub>S</sub> = ±15 V, t ≤ 25 ms,	1,2,3	All	-50		mA
	-I <sub>OS</sub>	short circuit to ground				50	

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions -55°C ≤ TA ≤ +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Supply current	IS	±VS = ±15 V	1,2	01		4	mA
				02		7	
			3	01		6	
				02		11	
			M,D,P,L,R <u>1/ 2/</u>	01		4	
				02		7	
Open loop voltage <u>8/</u> gain (single ended)	±AVS	±VS = ±20 V, RL = 2 kΩ, VOUT = ±15 V	4	All	50		V/mV
			5,6		25		
			M,D,P,L,R <u>1/ 2/</u> VOUT = ±10 V		4	50	
Open loop voltage <u>3/ 8/</u> gain (single ended)	AVS	VS = ±5 V, RL = 2 kΩ, VOUT = ±2 V	4,5,6	All	10		V/mV
Noise (referred to input) <u>3/</u> broadband	Ni(BB)	±VS = 20V, bandwidth = 5 kHz	4	All		10	μVrms
Noise (referred to input) <u>3/</u> popcorn	Ni(PC)	±VS = 20 V, bandwidth = 5 kHz	4	All		40	μV <sub>PK</sub>
Slew rate <u>3/</u>	±SR	±VS = ±15 V, VIN = ±5 V, AV = 1	4	01	3		V/μs
				02	10		
			5,6	01	1.5		
				02	7		
Power supply rejection <u>3/</u> ratio	+PSRR	+VS = 10 V, -VS = -20 V	4,5,6	All	85		dB
	-PSRR	+VS = 20 V, -VS = -10 V			85		
Input voltage common <u>3/ 9/</u> mode rejection	CMR	±VS = ±20 V, VIN = ±15 V	4,5,6	All	85		dB

See footnotes at end of table.

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TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions -55°C ≤ TA ≤ +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Transient response rise time <u>3/</u>	TR(tr)	±VS = ±15 V, RL = 2 kΩ, CL = 100 pF, VIN = 50 mV, AV = 1	9,10,11	01		150	ns
				02		100	
Transient response overshoot <u>3/</u>	TR(os)	±VS = ±15 V, RL = 2 kΩ, CL = 100 pF, VIN = 50 mV, AV = 1	9,10,11	01,02		40	%
Settling time <u>3/</u>	+ts, -ts	±VS = ±15 V, 0.1 % error, AV = -1	9	All		1500	ns

1/ RHA devices supplied to this drawing have been characterized through all levels M, D, P, L, and R of irradiation. However, this device is only tested at the "R" level. Pre and Post irradiation values are identical unless otherwise specified in table I. When performing post irradiation electrical measurements for any RHA level, TA = +25°C.

±VS = ±15 V and VCM = 0 V.

2/ These parts may be dose rate sensitive in a space environment and may demonstrate enhanced low dose rate effects. Radiation end point limits for the noted parameters are guaranteed only for the conditions specified in MIL-STD-883, method 1019, condition A.

3/ This parameter is not tested to post irradiation.

4/ Bias and offset currents are actually junction leakage currents which double (approximately) for each 10°C increase in junction temperature (TJ). Measurement of bias and offset current is specified at TJ rather than TA, since normal warmup thermal transients will affect the bias and offset currents. The measurements for bias currents must be made within 25 ms or 5 loop time constants which ever is greater, after power is first applied to the device for test. Measurement at TA = -55°C is not necessary since expected values are too small for normal test systems.

5/ Bias current is sensitive to power supply voltage, common mode voltage and temperature.

6/ Negative I<sub>B</sub> minimum limits reflect the characteristics of devices with bias current compensation.

7/ Continuous limits shall be considerably lower. Protection for shorts to either supply exists providing that TJ(maximum) ≤ 175°C.

8/ Because of thermal feedback effects from output to input, open loop gain is not guaranteed to be linear or positive over the operating range. These requirements, if needed, should be specified by the user in additional procurement documents.

9/ CMR is calculated from V<sub>IO</sub> measurements at VCM = +15 V and -15 V.

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Device types	All
Case outlines	G and P
Terminal number	Terminal symbol
1	BALANCE
2	-INPUT
3	+INPUT
4	-Vs
5	BALANCE
6	OUTPUT
7	+Vs
8	NC

NC = no connection

FIGURE 1. Terminal connections.

<b>STANDARD MICROCIRCUIT DRAWING</b> DLA LAND AND MARITIME COLUMBUS, OHIO 43218-3990	SIZE <b>A</b>		<b>5962-98636</b>
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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). The certificate of compliance submitted to DLA Land and Maritime-VA 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.

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

4. VERIFICATION

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.

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.

4.2.1 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 method 1015 of MIL-STD-883.
- b. Interim and final electrical test parameters shall be as specified in table IIA 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.

4.4.1 Group A inspection.

- a. Tests shall be as specified in table IIA herein.
- b. Subgroups 7 and 8 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 IIA herein.

4.4.2.1 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 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 IIA herein.

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TABLE IIA. Electrical test requirements.

Test requirements	Subgroups (in accordance with MIL-PRF-38535, table III)	
	Device class Q	Device class V
Interim electrical parameters (see 4.2)	1	1
Final electrical parameters (see 4.2)	1,2,3,4,5,6 <u>1/</u>	1,2,3,4, <u>1/ 2/</u> 5,6
Group A test requirements (see 4.4)	1,2,3,4,5,6, 9,10,11	1,2,3,4,5,6 9,10,11
Group C end-point electrical parameters (see 4.4)	1	1,2,3 <u>2/</u>
Group D end-point electrical parameters (see 4.4)	1	1,2,3
Group E end-point electrical parameters (see 4.4)	---	1,4

1/ PDA applies to subgroup 1.

2/ Delta limits as specified in table IIB shall be required where specified, and the delta limits shall be computed with reference to the zero hour electrical parameters (see table I).

TABLE IIB. 240 hour burn-in and group C end point electrical parameters.

Parameter <u>1/</u>	Device type	Limits		Delta		Units
		Min	Max	Min	Max	
V <sub>IO</sub>	All	-2	2	-0.5	+0.5	mV
+I <sub>IB</sub>	All	-100	100	-50	+50	pA
-I <sub>IB</sub>	All	-100	100	-50	+50	pA

1/ T<sub>A</sub> = +25°C, ±V<sub>S</sub> = ±20 V, and V<sub>CM</sub> = 0 V for all device types.

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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 IIA 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. All device classes must meet the postirradiation end-point electrical parameter limits as defined in table I at TA = +25°C ±5°C, after exposure, to the subgroups specified in table IIA herein.

4.4.4.1 Total dose irradiation testing. Total dose irradiation testing shall be performed in accordance with MIL-STD-883 method 1019, condition A and as specified herein.

## 5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-PRF-38535 for device classes Q and V.

## 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.

6.2 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 using DD Form 1692, Engineering Change Proposal.

6.3 Record of users. Military and industrial users should inform DLA Land and Maritime when a system application requires configuration control and which SMD's are applicable to that system. DLA Land and Maritime 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 DLA Land and Maritime-VA, telephone (614) 692-8108.

6.4 Comments. Comments on this drawing should be directed to DLA Land and Maritime-VA, Columbus, Ohio 43218-3990, or telephone (614) 692-0540.

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 MIL-HDBK-103 and QML-38535. The vendors listed in MIL-HDBK-103 and QML-38535 have submitted a certificate of compliance (see 3.6 herein) to DLA Land and Maritime-VA and have agreed to this drawing.

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STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE: 18-01-11

Approved sources of supply for SMD 5962-98636 are listed below for immediate acquisition information only and shall be added to MIL-HDBK-103 and QML-38535 during the next revision. MIL-HDBK-103 and QML-38535 will be revised to include the addition or deletion of sources. The vendors listed below have agreed to this drawing and a certificate of compliance has been submitted to and accepted by DLA Land and Maritime-VA. This information bulletin is superseded by the next dated revision of MIL-HDBK-103 and QML-38535. DLA Land and Maritime maintains an online database of all current sources of supply at <https://landandmaritimeapps.dla.mil/programs/smcr/>.

Standard microcircuit drawing PIN <u>1/</u>	Vendor CAGE number	Vendor similar PIN <u>2/</u>
5962-9863601QGA	<u>3/</u>	MTLF155AQH
5962-9863601QPA	<u>3/</u>	MTLF155AQD8
5962-9863602QGA	<u>3/</u>	MTLF156AQH
5962-9863602QPA	<u>3/</u>	MTLF156AQD8
5962R9863601VGA	24355	PM155AJ/QMLR
5962R9863601VPA	24355	PM155AZ/QMLR
5962R9863602VGA	24355	PM156AJ/QMLR
5962R9863602VPA	24355	PM156AZ/QMLR

1/ The lead finish shown for each PIN representing a hermetic package is the most readily available from the manufacturer listed for that part. If the desired lead finish is not listed contact the vendor to determine its availability.

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

3/ Not available from an approved source of supply.

Vendor CAGE number

24355

Vendor name and address

Analog Devices  
 Route 1 Industrial Park  
 P.O. Box 9106  
 Norwood, MA 02062  
 Point of contact: 7910 Triad Center Drive  
 Greensboro, NC 27409-9605

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