REVISIONS			
LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Add conditions of I_R = 15 mA for subgroups 2, 3 and make limit changes to the ΔV_R / ΔT test as specified under Table I. - ro	11-03-24	C. SAFFLE
B	Add device type 62. Make change to title block on first sheet. Make change to Table IB title description and footnote 1/. - ro	12-05-10	C. SAFFLE
C	Make limit changes to Reverse breakdown voltage tolerance test as specified under Table IB. Delete device class M references. - ro	13-10-02	C. SAFFLE

REV																				
SHEET																				
REV	C																			
SHEET	15																			

REV STATUS	REV	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
OF SHEETS	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14	

PMIC N/A

PREPARED BY
RICK OFFICER

CHECKED BY
RAJESH PITHADIA

APPROVED BY
CHARLES F. SAFFLE

DRAWING APPROVAL DATE
10-08-18

REVISION LEVEL
C

DLA LAND AND MARITIME
COLUMBUS, OHIO 43218-3990
http://www.landandmaritime.dla.mil

STANDARD MICROCIRCUIT DRAWING

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

AMSC N/A

MICROCIRCUIT, LINEAR, 2.5 V AND 5.0 V PRECISION MICROPOWER SHUNT VOLTAGE REFERENCE, MONOLITHIC SILICON

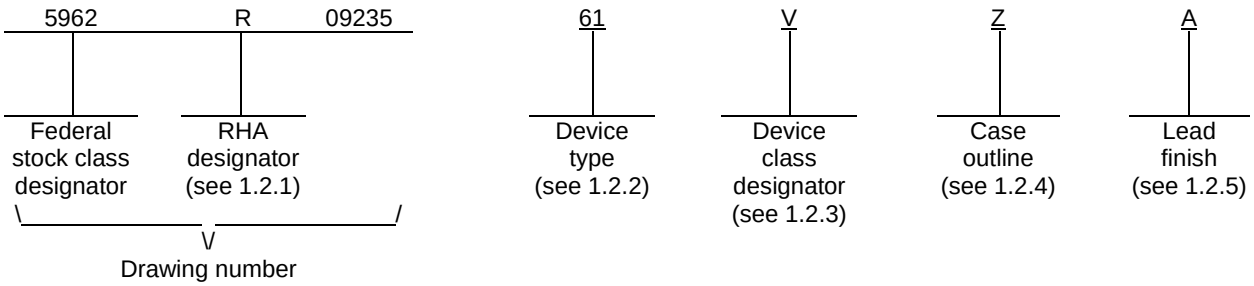
SIZE	CAGE CODE	
A	**67268**	**5962-09235**

SHEET 1 OF 15

1. SCOPE

1.1 Scope. This drawing documents two product assurance class levels consisting of high reliability (device classes 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:

Device type	Generic number	Circuit function
61	LM4050	Radiation hardened, 2.5 V precision micropower shunt voltage reference
62	LM4050	Radiation hardened, 5.0 V precision micropower shunt voltage reference

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
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
Z	GDFP1-G10	10	Flat pack with gullwing leads

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

1.3 Absolute maximum ratings. 1/

Reverse current ..... 20 mA
Forward current ..... 10 mA
Power dissipation (P_D) (T_A = +25°C) ..... 467 mW 2/
Junction temperature (T_J) ..... +150°C
Lead temperature (soldering, 10 seconds) ..... +260°C
Storage temperature ..... -65°C to +150°C
Electrostatic discharge (ESD) tolerance ..... 2, 000 V 3/
Thermal resistance, junction-to-case (θ_{JC}) ..... 20.87°C/W
Thermal resistance, junction-to-ambient (θ_{JA}) ..... 214°C/W (still air)
147°C/W (500 linear feet /minute air flow)

1.4 Recommended operating conditions.

Reverse current :
Device type 61 ..... 60 μA to 15 mA
Device type 62 ..... 74 μA to 15 mA
Ambient operating temperature range (T_A) ..... -55°C to +125°C

1.5 Radiation features.

Maximum total dose available (dose rate = .010 rads(Si)/s) ..... 100 krads(Si) 4/

The manufacturer supplying RHA parts on this drawing has performed a characterization test to demonstrate if the parts exhibit enhanced low dose rate sensitivity (ELDRS) according to MIL-STD-883 method 1019 paragraph 3.13.11. These parts have been characterized and observed to be enhanced low dose rate sensitive. However, the characterization test demonstrated the parts did pass the radiation end point parameter limits under low dose rate conditions according to MIL-STD-883 method 1019 paragraph 3.13.3.b. The manufacturer will continue to perform low dose rate lot acceptance testing on each wafer lot or wafer according to method 1019 of MIL-STD-883.

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/ Maximum power dissipation must be de-rated at elevated temperatures and is dictated by T_J (maximum junction temperature), θ_{JA} (junction to ambient thermal resistance), and T_A (ambient temperature). The maximum allowable power dissipation at any temperature is $P_{Dmax} = (T_J(max) – T_A) / \theta_{JA}$ or the number given in absolute maximum ratings paragraph 1.3 herein, which ever is lower.

3/ The human body model is 100 pF capacitor discharged through a 1.5 kΩ resistor into each pin.

4/ For device types 61 and 62, these part have been tested and do demonstrate enhanced low dose rate effects. Radiation end point limits for the noted parameters are guaranteed for the conditions specified in MIL-STD-883, method 1019, condition D and paragraph 3.13.3.b.

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 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.

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 outline. The case outline 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 IA 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 IA.

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.

TABLE IA. Electrical performance characteristics. 1/ 2/

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Reverse breakdown voltage tolerance	V_R	I_R = 60 µA	1	61		±2.5	mV
		I_R = 100 µA				±2.5	
		I_R = 1 mA				±3.75	
		I_R = 10 mA				±10	
		I_R = 15 mA				±13	
		I_R = 60 µA	2			±5	
		I_R = 100 µA				±5	
		I_R = 1 mA				±6.25	
		I_R = 10 mA				±12.5	
		I_R = 15 mA				±14	
		I_R = 60 µA	3			±4.5	
		I_R = 100 µA				±4.5	
		I_R = 1 mA				±5.75	
		I_R = 10 mA				±13	
		I_R = 15 mA				±17.5	
Minimum operating current	I_{RMIN}		1	61		60	µA
			2,3			65	

See footnotes at end of table.

TABLE IA. Electrical performance characteristics - continued. 1/ 2/

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Average reverse breakdown voltage temperature coefficient 3/	$\Delta V_R / \Delta T$	I_R = 60 µA, $25°C \le T_A \le 125°C$	2	61		±15	ppm/°C
		I_R = 100 µA, $25°C \le T_A \le 125°C$				±16	
		I_R = 1 mA, $25°C \le T_A \le 125°C$				±18	
		I_R = 10 mA, $25°C \le T_A \le 125°C$				±20	
		I_R = 15 mA, $25°C \le T_A \le 125°C$				±22	
		I_R = 60 µA, $-55°C \le T_A \le 25°C$	3			±18	
		I_R = 100 µA, $-55°C \le T_A \le 25°C$				±19	
		I_R = 1 mA, $-55°C \le T_A \le 25°C$				±22	
		I_R = 10 mA, $-55°C \le T_A \le 25°C$				±32	
		I_R = 15 mA, $-55°C \le T_A \le 25°C$				±45	

See footnotes at end of table.

TABLE IA. Electrical performance characteristics - continued. 1/ 2/

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Reverse breakdown voltage tolerance	V_R	I_R = 74 µA	1	62		±5.0	mV
		I_R = 100 µA				±5.0	
		I_R = 1 mA				±8	
		I_R = 10 mA				±18	
		I_R = 15 mA				±20	
		I_R = 74 µA	2			±10	
		I_R = 100 µA				±10	
		I_R = 1 mA				±12	
		I_R = 10 mA				±22.5	
		I_R = 15 mA				±28	
		I_R = 74 µA	3			±9	
		I_R = 100 µA				±9	
		I_R = 1 mA				±11.5	
		I_R = 10 mA				±29	
		I_R = 15 mA				±37	
Minimum operating current	I_{RMIN}		1	62		70	µA
			2,3			74	

See footnotes at end of table.

TABLE IA. Electrical performance characteristics - continued. 1/ 2/

Test	Symbol	Conditions $-55°C \le T_A \le +125°C$ unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Average reverse breakdown voltage temperature coefficient 3/	$\Delta V_R / \Delta T$	I_R = 74 µA, $25°C \le T_A \le 125°C$	2	62		±23	ppm/°C
		I_R = 100 µA, $25°C \le T_A \le 125°C$				±25	
		I_R = 1 mA, $25°C \le T_A \le 125°C$				±28	
		I_R = 10 mA, $25°C \le T_A \le 125°C$				±35	
		I_R = 15 mA, $25°C \le T_A \le 125°C$				±40	
		I_R = 74 µA, $-55°C \le T_A \le 25°C$	3			±25	
		I_R = 100 µA, $-55°C \le T_A \le 25°C$				±29	
		I_R = 1 mA, $-55°C \le T_A \le 25°C$				±34	
		I_R = 10 mA, $-55°C \le T_A \le 25°C$				±45	
		I_R = 15 mA, $-55°C \le T_A \le 25°C$				±60	

1/ RHA devices supplied to this drawing are characterized and tested through all levels M, D, P, L, and R of irradiation. Pre and Post irradiation values are identical unless otherwise specified in Table IB. When performing post irradiation electrical measurements for any RHA level, T_A = +25°C.

2/ These parts have been tested and do demonstrate enhanced low dose rate effects. Radiation end point limits for the noted parameters are guaranteed for the conditions specified in MIL-STD-883, method 1019, condition D and paragraph 3.13.3.b with an overtest factor of 1.5X. For 100 krad, units are tested to 150 krad and still meet the radiation end point limits.

3/ This parameter not tested post irradiation.

TABLE IB. Post irradiation (low dose rate) reference voltage drift limits.

Test	Symbol	Conditions Device type 61	RHA level designators	Group A subgroups	Limits	
					Min	Max
Reverse breakdown voltage tolerance 1/	V_R	I_R = 60 μA	P	1		+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 100 μA	P			+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 1 mA	P			+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 10 mA	P			+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 15 mA	P			+0.42%
			L			+0.67%
			R			+1.75%

See footnote at end of table.

TABLE IB. Post irradiation (low dose rate) reference voltage drift limits – continued.

Test	Symbol	Conditions Device type 62	RHA level designators	Group A subgroups	Limits	
					Min	Max
Reverse breakdown voltage tolerance 1/	V_R	I_R = 74 μA	P	1		+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 100 μA	P			+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 1 mA	P			+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 10 mA	P			+0.42%
			L			+0.67%
			R			+1.75%
		I_R = 15 mA	P			+0.42%
			L			+0.67%
			R			+1.75%

1/ Post irradiation reference voltage tolerance limit is the maximum allowable change from the pre irradiation measured value.

Device types	61 and 62	
Case outline	Z	
Terminal number	Terminal symbol	Description
1	GND / NC	Ground or no connect
2	GND / NC	Ground or no connect
3	GND / NC	Ground or no connect
4	GND / NC	Ground or no connect
5	GND	Ground
6	GND / NC	Ground or no connect
7	GND / NC	Ground or no connect
8	GND / NC	Ground or no connect
9	GND / NC	Ground or no connect
10	V_{REF}	Reference voltage

FIGURE 1. Terminal connections.

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.

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 4, 5, 6, 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 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.

TABLE IIA. 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)	1	1	1
Final electrical parameters (see 4.2)	1,2,3 1/	1,2,3 1/	1,2,3 1/
Group A test requirements (see 4.4)	1,2,3	1,2,3	1,2,3
Group C end-point electrical parameters (see 4.4)	1,2,3	1,2,3	1,2,3 2/
Group D end-point electrical parameters (see 4.4)	1,2,3	1,2,3	1,2,3
Group E end-point electrical parameters (see 4.4)	1	1	1

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 IA).

TABLE IIB. Operating life test delta parameters. T_A = +25°C. 1/

Parameters	Symbol	Condition	Delta limits		Units
		Device type 61	Min	Max	
Reverse breakdown voltage tolerance	V_R	I_R = 60 μA	-0.873	0.873	mV
		I_R = 100 μA	-0.873	0.873	
		I_R = 1 mA	-0.998	0.998	
		I_R = 10 mA	-3.93	3.93	
		I_R = 15 mA	-5	5	
Minimum operating current	I_{RMIN}		-0.623	0.623	μA

See footnote at end of table.

TABLE IIB. Operating life test delta parameters – continued. T_A = +25°C. 1/

Parameters	Symbol	Condition	Delta limits		Units
		Device type 62	Min	Max	
Reverse breakdown voltage tolerance	V_R	I_R = 74 μA	-0.8	0.8	mV
		I_R = 100 μA	-0.8	0.8	
		I_R = 1 mA	-0.84	0.84	
		I_R = 10 mA	-1.6	1.6	
		I_R = 15 mA	-2.6	2.6	
Minimum operating current	I_{RMIN}		-0.623	0.623	μA

1/ This table represents the drift seen from initial measurements post 1,000 hour operational life burn in. All units will remain within the electrical characteristics limits post 1, 000 hour operational life burn-in. Deltas required for device class V product at group B, subgroup 5. Deltas are performed at room temperature.

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 post irradiation end-point electrical parameter limits as defined in table IA at T_A = +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 D and paragraph 3.13.3.b, 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.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE: 13-10-02

Approved sources of supply for SMD 5962-09235 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 http://www.landandmaritime.dla.mil/Programs/Smcr/.

Standard microcircuit drawing PIN 1/	Vendor CAGE number	Vendor similar PIN 2/
5962R0923561VZA	27014	LM4050WG2.5RLQV
5962R0923562VZA	27014	LM4050WG5.0RLQV

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.

Vendor CAGE number	Vendor name and address
27014	National Semiconductor 2900 Semiconductor Drive P.O. Box 58090 Santa Clara, CA 95052-8090