

REVISIONS

LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Add radiation hardened requirements. Make correction to both PSRR tests by moving the limits from the min column to the max column as specified under Table I. Add Static burn-in test to Table IIA. - ro	18-07-10	C. SAFFLE
B	Drawing updated to reflect current MIL-PRF-38535 requirements. - rrp	24-01-11	J. ESCHMEYER



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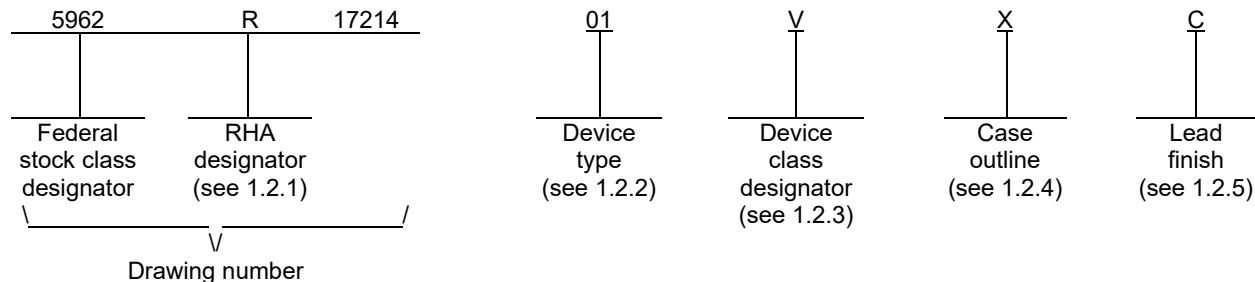
REV STATUS	REV	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
OF SHEETS	SHEET	1	2	3	4	5	6	7	8	9	10	11	12	13	14			

PMIC N/A	PREPARED BY RAJESH PITHADIA	<p align="center">DLA LAND AND MARITIME COLUMBUS, OHIO 43218-3990 https://www.dla.mil/landandmaritime</p> <p align="center">MICROCIRCUIT, LINEAR, FULLY DIFFERENTIAL AMPLIFIER, MONOLITHIC SILICON</p>																	
<p align="center">STANDARD MICROCIRCUIT DRAWING</p> <p align="center">THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE</p>	CHECKED BY RAJESH PITHADIA																		
	APPROVED BY CHARLES F. SAFFLE																		
	DRAWING APPROVAL DATE 18-04-05																		
AMSC N/A	REVISION LEVEL B	SIZE A	CAGE CODE 67268	5962-17214															
		SHEET		1 OF 14															

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 types. The device types identify the circuit function as follows:

<u>Device type</u>	<u>Generic number</u>	<u>Circuit function</u>
01	LMH5401-SP	BiCMOS, 6.5 GHz, gain-configurable, fully differential 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. The case outline is as designated in MIL-STD-1835 and as follows:

<u>Outline letter</u>	<u>Descriptive designator</u>	<u>Terminals</u>	<u>Package style</u>
X	See figure 1	14	Leadless chip carrier

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/

Power supply voltage (VS)	5.5 V
Input voltage range	(-VS) – 0.7 V to (+VS) + 0.7 V
Input current	10 mA
Output current sourcing	100 mA
Output current sinking	100 mA
Maximum junction temperature (T _J)	+150°C
Maximum power dissipation (P _D)	550 mW
Storage temperature range	-65°C to +150°C
Thermal resistance, junction-to-case (top) (θ _{JC})	106.2°C/W
Thermal resistance, junction-to-case (bottom) (θ _{JC})	63.8°C/W
Thermal resistance, junction-to-ambient (θ _{JA})	92.1°C/W

1.4 Recommended operating conditions.

Power supply voltage (-V _S - +V _S)	+3.15 V to +5.25 V
Operating temperature range (T _A = T _J)	-55°C to +125°C

1.5 Radiation features.

Maximum total ionizing dose available (high dose rate = 50 - 300 rad(Si)/s)	100 krad(Si) 2/
Maximum total ionizing dose available (low dose rate ≤ 10 mrad(Si)/s)	100 krad(Si) 2/

The manufacturer supplying RHA device type 01 on this drawing has performed characterization test to demonstrate that the parts do not exhibit enhanced low dose rate sensitivity (ELDRS) in accordance with MIL-STD-883, method 1019, paragraph 3.13.1.1 at a dose level of 100 krad(Si).

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 manufacturer supplying device type 01 has performed characterization testing in accordance with MIL-STD-883 method 1019 paragraph 3.13.1.1 and the parts exhibited no enhanced low dose rate sensitivity (ELDRS) at a dose level of 100 krad(Si). The radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, method 1019, condition A and condition D to a maximum total dose of 100 krad(Si).

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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 <https://quicksearch.dla.mil>).

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 outline. The case outline shall be in accordance with 1.2.4 herein and figure 1.

3.2.2 Terminal connections. The terminal connections shall be as specified on figure 2.

3.2.5 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 <u>1/ 2/ 3/</u> -55°C ≤ T _A ≤ +125°C T _A = T _J V _S = 4.75 V to 5.25 V unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
AC performance							
Output impedance	Z _O	At dc, differential	1, 2, 3	01	13	25	Ω
Input							
Input offset voltage	V _{IO}		1, 2, 3	01		±5	mV
Input bias current	I _{IB}		1, 2, 3	01		150	μA
Input offset current	I _{IO}		1, 2, 3	01		±20	μA
Input common mode low voltage	V _{ICL}		1, 2, 3	01		-V _S + 0.41	V
Input common mode high voltage	V _{ICH}		1, 2, 3	01	+V _S - 1.41		V
Output							
Output voltage range, high	V _{OCHR}	Measured single ended	1, 2, 3	01	+V _S - 1.30		V
Output voltage range, low	V _{OCLR}	Measured single ended	1, 2, 3	01	-V _S + 1.30		V
Differential output current	I _{OD}	V _{OUT} = 0 V <u>4/</u>	1, 2, 3	01	40		mA
Power supply							
Supply voltage	V _S		1, 2, 3	01	3.15	5.25	V
Power supply rejection ratio	PSRR	-V _S	1, 2, 3	01		-44	dB
		+V _S	1, 2, 3			-48	
Quiescent current	I _Q	Power down pin = 0	1, 2, 3	01	46	78	mA
		Power down pin = 1	1, 2, 3		1	6	

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued.

Test	Symbol	Conditions <u>1/ 2/ 3/</u> -55°C ≤ T _A ≤ +125°C T _A = T _J V _S = 4.75 V to 5.25 V unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Output common mode control pin (VCM)							
VCM voltage range low		Differential gain shift < 1 dB	1, 2, 3	01		-V _S + 2.0	V
VCM voltage range high		Differential gain shift < 1 dB	1, 2, 3	01	+V _S - 2.0		V
VCM gain		VCM = 0 V	1, 2, 3	01	0.98	1.01	V/V
Power down (PD pin)							
Enable or disable voltage threshold	V _T	Device powers on below 0.8 V, device powers down above 1.2 V	1, 2, 3	01	0.9	1.2	V
Power down quiescent current			1, 2, 3	01	1	6	mA
Power down bias current		PD = 2.5 V	1, 2, 3	01		±100	μA

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued.

Test	Symbol	Conditions <u>2/ 3/ 5/</u> -55°C ≤ T _A ≤ +125°C T _A = T _J V _S = 3.15 V to 3.45 V unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
AC performance							
Output impedance	Z _O	At dc	1, 2, 3	01	13	25	Ω
Input							
Input offset voltage	V _{IO}		1, 2, 3	01		±5	mV
Input bias current	I _{IB}		1, 2, 3	01		150	μA
Input offset current	I _{IO}		1, 2, 3	01		±20	μA
Input common mode low voltage	V _{ICL}		1, 2, 3	01		-V _S + 0.41	V
Input common mode high voltage	V _{ICH}		1, 2, 3	01	+V _S - 1.41		V
Output							
Output voltage range, high	V _{OCHR}	Measured single ended	1, 2, 3	01	+V _S - 1.30		V
Output voltage range, low	V _{OCLR}	Measured single ended	1, 2, 3	01	-V _S + 1.30		V
Differential output current	I _{OD}	V _{OUT} = 0 V <u>4/</u>	1, 2, 3	01	30		mA
Power supply							
Supply voltage	V _S		1, 2, 3	01	3.15	5.25	V
Power supply rejection ratio	PSRR	-V _S	1, 2, 3	01		-44	dB
		+V _S	1, 2, 3			-48	
Quiescent current	I _Q	Power down pin = 0	1, 2, 3	01	44	63	mA
		Power down pin = 1	1, 2, 3		1	5	

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued.

Test	Symbol	Conditions <u>2/ 3/ 5/</u> -55°C ≤ TA ≤ +125°C TA = TJ VS = 3.15 V to 3.45 V unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Output common mode control pin (VCM)							
VCM voltage range low		Differential gain shift < 1 dB	1, 2, 3	01		-VS + 1.55	V
VCM voltage range high		Differential gain shift < 1 dB	1, 2, 3	01	+VS - 1.55		V
VCM gain		VCM = 0 V	1, 2, 3	01	0.98	1.01	V/V
Power down (PD pin)							
Enable or disable voltage threshold	VT	Device powers on below 0.8 V, device powers down above 1.2 V	1, 2, 3	01	0.9	1.2	V
Power down quiescent current			1, 2, 3	01	1	6	mA
Power down bias current		PD = 2.5 V	1, 2, 3	01		±100	µA

1/ Unless otherwise specified, TA = 25°C, +VS = 5.0 V, -VS = 0 V, VCM = 2.5 V, RL = 200 Ω differential, G = 8 dB, single-ended input, differential output, and RS = 50 Ω. The input resistance and corresponding gain are obtained with the external resistance added.

2/ For production testing of these parameters to the limits in table I herein, Ambient temperature (TA) equals Junction temperature (TJ).

3/ Device type 01 supplied to this drawing has been characterized through all levels M, D, P, L, and R of irradiation. However, these devices are 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 (see 1.5 herein).

The manufacturer supplying device type 01 has performed characterization testing in accordance with MIL-STD-883 method 1019 paragraph 3.13.1.1 and the parts exhibited no enhanced low dose rate sensitivity (ELDRS) at a dose level of 100 krad(Si). The radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, method 1019, condition A and condition D to a maximum total dose of 100 krad(Si).

4/ This test shorts the outputs to ground (mid supply) then sources or sinks 60 mA and measures the deviation from the initial condition.

5/ Unless otherwise specified, TA = 25°C, +VS = 3.3 V, -VS = 0 V, VCM = 0 V, RL = 200 Ω differential, G = 8 dB, single-ended input, differential output, and input and output referenced to midsupply.

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Case X

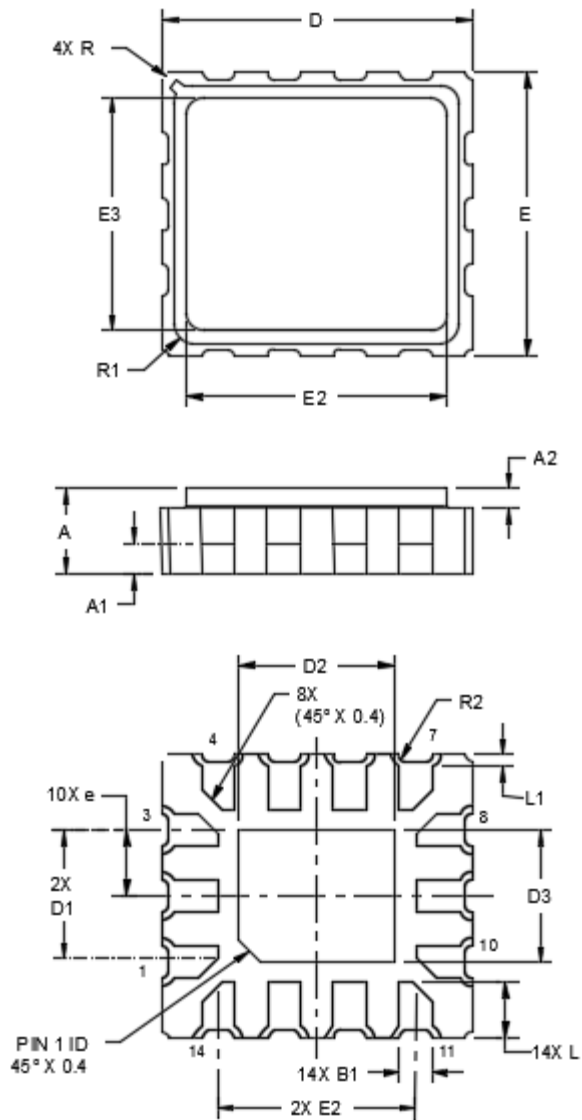


FIGURE 1. Case outline.

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Case X – continued.

Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	---	1.87	---	.074
A1	.600 REF		.024 REF	
A2	.364	---	.014	---
B1	.570	.710	.022	.028
D	5.75	6.25	.226	.246
D1	2.53	2.55	.099	.100
D2	2.80	3.20	.110	.126
D3	2.30	2.70	.091	.106
E	5.25	5.75	.207	.226
E1	3.71	3.91	.146	.154
E2	4.75	5.25	.187	.207
E3	4.25	4.75	.167	.187
e	1.17	1.37	.046	.054
L	.980	1.22	.039	.048
L1	.150 REF		.006 REF	
R	.150 REF		.006 REF	
R1	.400 REF		.016 REF	
R2	.150 REF		.006 REF	

NOTE:

Controlling dimensions are millimeter, inch dimensions are given for reference only.

FIGURE 1. Case outline - Continued.

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Device type	01		
Case outline	X		
Terminal number	Terminal symbol	I/O	Description
1	+VS	Power supply	Positive supply voltage
2	CM	Input	Input pin to set amplifier output common mode voltage.
3	-VS	Power supply	Negative supply voltage
4	+FB	Output	Positive output feedback component connection.
5	-IN	Input	Negative input pin
6	+IN	Input	Positive input pin
7	-FB	Output	Negative output feedback component connection.
8	-VS	Power supply	Negative supply voltage
9	PD	Input	Power down (logic 1 = power down)
10	+VS	Power supply	Positive supply voltage
11	GND	Ground	Printed circuit board ground
12	-OUT	Output	Negative output pin
13	+OUT	Output	Positive output pin
14	GND	Ground	Printed circuit board ground

FIGURE 2. Terminal connections.

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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 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.

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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, 2, 3	1, 2, 3
Static burn-in test	Not required	Required
Final electrical parameters (see 4.2)	1, 2, 3 <u>1/</u>	1, 2, 3 <u>1/ 2/</u>
Group A test requirements (see 4.4)	1, 2, 3	1, 2, 3
Group C end-point electrical parameters (see 4.4)	1, 2, 3	1, 2, 3 <u>2/</u>
Group D end-point electrical parameters (see 4.4)	1	1
Group E end-point electrical parameters (see 4.4)	1	1

1/ PDA applies to subgroups 1.

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

TABLE IIB. Burn-in and operating life test delta parameters. 1/

Parameters	Symbol	Delta limits	Units
Output voltage range, high	VOCRH	± 0.108	V
Output voltage range, low	VOCRL	± 0.108	V
Power down pin = 0	IQ	± 6.39	mA
VCM gain	VCMg	± 0.17	V/V

1/ 240 hour burn in and group C end point electrical parameters.

Deltas are performed at T_A = +25°C.

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4.4.3 Group D inspection. The group D inspection end-point electrical parameters shall be as specified in table IIA 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 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 $T_A = +25^{\circ}\text{C} \pm 5^{\circ}\text{C}$, 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 condition D as specified herein (see 1.5).

4.4.4.1.1 Accelerated annealing test. Accelerated annealing testing shall be performed on all devices requiring a RHA level greater than 5 krad(Si). The post-anneal end-point electrical parameter limits shall be as specified in table I herein and shall be the pre-irradiation end-point electrical parameter limits at $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$. Testing shall be performed at initial qualification and after any design or process changes which may affect the RHA response of the device.

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) 692-0591.

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: 24-01-11

Approved sources of supply for SMD 5962-17214 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>
5962-1721401VXC	01295	LMH5401-SP
5962R1721401VXC	01295	LMH5401-RHA

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

01295

Vendor name
and address

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