

**REVISIONS**

LTR	DESCRIPTION	DATE (YR-MO-DA)	APPROVED
A	Add one vendor, CAGE 01295. Add case outline 2. Delete one vendor, CAGE 18324. Editorial changes throughout.	91-12-11	M. A. FRYE
B	Add device class "V" devices. Add TABLE IIB for delta limits. Delete vendor CAGE 04713.	97-09-23	R. MONNIN
C	Add radiation hardened requirements. - ro	99-01-28	R. MONNIN
D	Change total dose value for radiation requirements under 1.5. - lgt	99-03-15	R. MONNIN
E	Add case outline X. - ro	00-03-23	R. MONNIN
F	Modify paragraph 3.2.4. Remove radiation test circuit. - rrp	00-11-03	R. MONNIN
G	Drawing updated to reflect current requirements. - ro	02-10-17	R. MONNIN
H	Add RHA designator "R" level devices. Make changes to 1.5 and Table I. Delete footnote 2/ "This parameter is not tested post irradiation" under Table I. Delete 4.4.4.1.1 and 4.4.4.2. - ro	06-04-05	R. MONNIN
J	Add device type 03 tested at Low Dose Rate. Make changes to 1.2.2, 1.5, Table I, figure 1, Table IIB, and 4.4.4.1. - ro	08-10-07	R. HEBER
K	Add paragraph 3.1.1 and microcircuit die Appendix A. Make changes to I <sub>CC</sub> , V <sub>IO</sub> , CMRR, +I <sub>B</sub> , -I <sub>B</sub> , I <sub>IO</sub> , PSRR, and A <sub>VS</sub> tests as specified under Table I for device type 03. Make changes to Table IIB for device type 03. - ro	08-12-09	R. HEBER
L	Update drawing to current MIL-PRF-38535 requirements. -rrp	15-01-15	C. SAFFLE



THE ORIGINAL FIRST SHEET OF THIS DRAWING HAS BEEN REPLACED.

REV																				
SHEET																				
REV	L	L	L	L	L	L	L	L	L											
SHEET	15	16	17	18	19	20	21	22	23											

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

PMIC N/A	PREPARED BY JOSEPH H. KERBY	<p align="center"><b>DLA LAND AND MARITIME</b>  <b>COLUMBUS, OHIO 43218-3990</b>  <a href="http://www.landandmaritime.dla.mil">http://www.landandmaritime.dla.mil</a></p>																	
<p align="center"><b>STANDARD MICROCIRCUIT DRAWING</b></p> <p>THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE</p> <p align="center">AMSC N/A</p>	CHECKED BY D. A. DiCENZO																		
	APPROVED BY ROBERT P. EVANS	<p align="center">MICROCIRCUIT, LINEAR, LOW POWER DUAL OPERATIONAL AMPLIFIER, MONOLITHIC SILICON</p>																	
	DRAWING APPROVAL DATE 87-12-01																		
	REVISION LEVEL L	<table border="1"> <tr> <td>SIZE A</td> <td>CAGE CODE <b>67268</b></td> <td><b>5962-87710</b></td> </tr> </table>	SIZE A	CAGE CODE <b>67268</b>	<b>5962-87710</b>														
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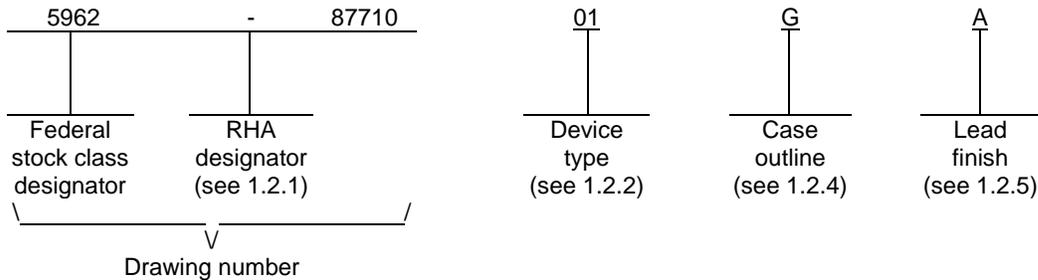
SHEET 1 OF 23

1. SCOPE

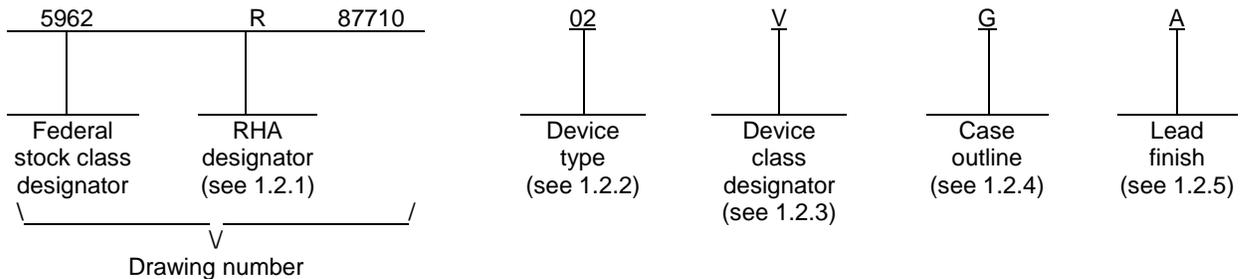
1.1 Scope. This drawing documents two product assurance class levels consisting of high reliability (device class Q and M) and space application (device class V). A choice of case outlines and lead finishes are available and are reflected in the Part or Identifying Number (PIN). When available, a choice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

1.2 PIN. The PIN is as shown in the following examples.

For device class M and Q:



For device class V:



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:

<u>Device type</u>	<u>Generic number</u>	<u>Circuit function</u>
01	LM158	Low power, dual operational amplifier
02	LM158A	Low power, dual operational amplifier
03	LM158A	Low dose rate radiation hardened low power, dual operational amplifier

1.2.3 Device class designator. The device class designator is a single letter identifying the product assurance level as listed below. Since the device class designator has been added after the original issuance of this drawing, device classes M and Q designators will not be included in the PIN and will not be marked on the device.

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

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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
X	GDFP1-G10	10	Flat pack with gull wing leads
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. <sup>1/</sup>

Supply voltage (V+) .....	32 V or $\pm 16$ V
Input voltage .....	-0.3 V to +32 V
Differential input voltage .....	32 V
Storage temperature range .....	-65°C to +150°C
Maximum power dissipation ( $P_D$ ): <sup>2/</sup>	
Cases G and P .....	830 mW
Case X .....	500 mW
Case 2 .....	1375 mW
Lead temperature (soldering, 10 seconds) .....	+300°C
Case temperature for 60 seconds .....	+260°C
Junction temperature ( $T_J$ ) .....	+150°C
Thermal resistance, junction-to-case ( $\theta_{JC}$ ):	
Class M .....	See MIL-STD-1835
Class V (case G) .....	42°C/W
Class V (case P) .....	23°C/W
Class V (case X) .....	33°C/W
Thermal resistance, junction-to-ambient ( $\theta_{JA}$ ):	
Class M (case G) .....	155°C/W
Class M (case P) .....	180°C/W
Class M (case 2) .....	65°C/W
Class V (case G) .....	155°C/W (measured in still air) 80°C/W (measured in 500 linear feet/minute air flow)
Class V (case P) .....	132°C/W (measured in still air) 81°C/W (measured in 500 linear feet/minute air flow)
Class V (case X) .....	195°C/W (measured in still air) 131°C/W (measured in 500 linear feet/minute air flow)

1.4 Recommended operating conditions.

Operating supply voltage range (V+) .....	$\pm 16$ V
Ambient operating temperature range ( $T_A$ ) .....	-55°C to +125°C

<sup>1/</sup> 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.

<sup>2/</sup> Must withstand the added  $P_D$  due to short-circuit test (e.g.,  $I_{OS}$ ).

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1.5 Radiation features.

Maximum total dose available (dose rate = 50 – 300 rads (Si)/s):

Device type 02..... ≤100 Krads (Si) 3/

Maximum total dose available (dose rate = 10 mrads (Si)/s):

Device type 03..... ≤100 Krads (Si) 4/

The manufacturer supplying device type 03 RHA parts on this drawing has performed a characterization test to demonstrate that the parts do not exhibit enhanced low dose rate sensitivity (ELDRS) according to MIL-STD-883 Method 1019 paragraph 3.13.1.1. Therefore this part may be considered ELDRS free. However, the manufacturer will continue to perform low dose rate lot acceptance testing on each wafer lot or wafer until characterization testing has been performed according to test method 1019 of MIL-STD-883. Since the redesigned part did not demonstrate ELDRS per Method 1019 and the previously tested device type 02 was not tested for ELDRS, device type 03 will be added to distinguish it from the 02 device type.

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/ For device type 02, this part 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.

4/ For device type 03, this part has been tested and does not demonstrate low dose rate sensitivity. These parts may be sensitive in a high dose environment. Radiation end point limits for the noted parameters are guaranteed for the conditions specified in MIL-STD-883, method 1019, condition D.

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### 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.

3.1.1 Microcircuit die. For the requirements of microcircuit die, see appendix A to this document.

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

3.2.4 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. 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 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 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 DLA Land and Maritime-VA of change of product (see 6.2 herein) involving devices acquired to this drawing is required for any change that affects this drawing.

3.9 Verification and review for device class M. For device class M, DLA Land and Maritime, DLA Land and Maritime '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).

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TABLE I. Electrical performance characteristics.

Test	Symbol	Conditions <u>1/ 2/</u> -55°C ≤ T <sub>A</sub> ≤ +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit	
					Min	Max		
Power supply current	I <sub>CC</sub>	V <sub>+</sub> = 5 V	1,2,3	01, 02		1.2	mA	
			M,D,P,L,R	1	02			1.5
		V <sub>+</sub> = 5 V, R <sub>L</sub> = 100 kΩ, V <sub>O</sub> = 1.4 V		1,2,3	03			1.2
		V <sub>+</sub> = 30 V		1	01, 02			3
				2,3				4
		V <sub>+</sub> = 30 V, R <sub>L</sub> = 100 kΩ, V <sub>O</sub> = 1.4 V		1	03			3
2,3				4				
Output voltage high	V <sub>OH</sub>	V <sub>+</sub> = 30 V, R <sub>L</sub> = 2 kΩ	1,2,3	All	26	V		
		V <sub>+</sub> = 30 V, R <sub>L</sub> = 10 kΩ		03	27			
Output voltage low	V <sub>OL</sub>	V <sub>+</sub> = 30 V, R <sub>L</sub> = 10 kΩ	1,2,3	01		20	mV	
			1	02, 03		40		
			2,3			100		
		V <sub>+</sub> = 30 V, I <sub>SINK</sub> = 1 μA		1,2,3	01			20
				1	02, 03			40
				2,3				100
		V <sub>+</sub> = 5 V, R <sub>L</sub> = 10 kΩ		1	03			40
				2,3				100
Output sink current	I <sub>SINK</sub>	V <sub>+</sub> = 15 V, V <sub>OUT</sub> = 200 mV	1	01, 02	12		μA	
			1		10		mA	
		V <sub>+</sub> = 15 V, V <sub>OUT</sub> = 2 V		2,3		5		
				V <sub>+</sub> = 15 V, V <sub>OUT</sub> = 200 mV, +V <sub>I</sub> = 0 V, -V <sub>I</sub> = +65 mV		1	03	12
		V <sub>+</sub> = 15 V, V <sub>OUT</sub> = 2 V, +V <sub>I</sub> = 0 V, -V <sub>I</sub> = +65 mV				1		10
				2,3		5.0		

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued.

Test	Symbol	Conditions <sup>1/2/</sup> -55°C ≤ T <sub>A</sub> ≤ +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Output source current	I <sub>SOURCE</sub>	V <sub>+</sub> = 15 V, V <sub>OUT</sub> = 2 V	1	01, 02		-20	mA
			2,3			-10	
		V <sub>+</sub> = 15 V, V <sub>OUT</sub> = 2 V, +V <sub>I</sub> = 0 V, -V <sub>I</sub> = -65 mV	1	03		-20	
			2,3			-10	
Short-circuit current	I <sub>OS</sub>	V <sub>+</sub> = 5 V, V <sub>OUT</sub> = 0 V	1	All	-60		mA
Input offset voltage	V <sub>IO</sub>	V <sub>+</sub> = 30 V, V <sub>CM</sub> = 0 V,	1	01	-5	5	mV
			2,3		-7	7	
		V <sub>+</sub> = 30 V, V <sub>CM</sub> = 28 V,	1	02	-2	2	
			2,3		-4	4	
		V <sub>+</sub> = 5 V, V <sub>CM</sub> = 0 V	M,D,P,L,R	1	-4	4	
			V <sub>+</sub> = 30 V, V <sub>CM</sub> = 0 V, R <sub>S</sub> = 50 Ω, V <sub>O</sub> = 1.4 V	1	03	-2.0	
		2,3		-4.0		4.0	
		M,D,P,L,R	1	-4.0	4.0		
			V <sub>+</sub> = 30 V, V <sub>CM</sub> = 28.5 V, R <sub>S</sub> = 50 Ω, V <sub>O</sub> = 1.4 V	1	-2.0	2.0	
		M,D,P,L,R		1	-4.0	4.0	
		V <sub>+</sub> = 30 V, V <sub>CM</sub> = 28 V, R <sub>S</sub> = 50 Ω, V <sub>O</sub> = 1.4 V	2, 3	-4.0	4.0		
			V <sub>+</sub> = 5 V, V <sub>CM</sub> = 0 V, R <sub>S</sub> = 50 Ω, V <sub>O</sub> = 1.4 V	1	-2.0	2.0	
		2,3		-4.0	4.0		
		M,D,P,L,R	1	-4.0	4.0		
Common mode rejection ratio	CMRR	V <sub>+</sub> = 30 V, V <sub>IN</sub> = 0 V to 28 V	1	01, 02	70		dB
				03	70		
		V <sub>+</sub> = 30 V, R <sub>S</sub> = 50 Ω, V <sub>IN</sub> = 0 V to 28.5 V					

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued.

Test	Symbol	Conditions <u>1/ 2/</u> -55°C ≤ T <sub>A</sub> ≤ +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Input bias current	+I <sub>B</sub> , -I <sub>B</sub>	V <sub>+</sub> = 5 V, V <sub>CM</sub> = 0 V	1	01	-150	-1	nA
			2,3		-300	-1	
			1	02	-50	-1	
			2,3		-100	-1	
			M,D,P,L,R		1	-60	
			V <sub>+</sub> = 5 V, V <sub>CM</sub> = 0 V <u>3/</u>	1	03	-50	
		2,3		-100		-1	
		M,D,P,L,R		1		-60	
		Input offset current	I <sub>IO</sub>	V <sub>+</sub> = 5 V, V <sub>CM</sub> = 0 V	1	01	
2,3	-100				100		
1	02				-10	10	
2,3					-30	30	
1	03				-10	10	
2,3					-30	30	
Power supply rejection ratio	PSRR	V <sub>+</sub> = 5 V to 30 V, V <sub>CM</sub> = 0 V	1	01, 02	65		dB
				03	65		
Common mode voltage range	V <sub>CM</sub>	V <sub>+</sub> = 30 V	1,2,3	01, 02		28	V
		V <sub>+</sub> = 30 V <u>4/ 5/</u>	1		03		
			2, 3			28	
Differential input voltage	V <sub>Diff</sub>	<u>6/</u>	1,2,3	03		32	V

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – continued.

Test	Symbol	Conditions <u>1/ 2/</u> -55°C ≤ T <sub>A</sub> ≤ +125°C unless otherwise specified	Group A subgroups	Device type	Limits		Unit
					Min	Max	
Large signal gain	A <sub>VS</sub>	V <sub>+</sub> = 15 V, <u>7/</u>  R <sub>L</sub> = 2 kΩ,  V <sub>O</sub> = 1 V to 11 V	4	01,02	50		V/mV
				03	50		
			5,6	01,02	25		
				03	25		

- 1/ RHA devices 02 and 03 supplied to this drawing have been characterized through all levels M, D, P, L, R of irradiation. Devices 02 and 03 are tested to all RHA levels (M, D, P, L, and R). Pre and Post irradiation values are identical unless otherwise specified in table I. When performing post irradiation electrical measurements for any RHA level, T<sub>A</sub> = +25°C.
- 2/ For device type 02, this part 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 as specified in the MIL-STD-883, method 1019, condition A. For device type 03, this part has been tested and does not demonstrate low dose rate sensitivity. These parts may be sensitive in a high dose environment. Radiation end point limits for the noted parameters are guaranteed for the conditions specified in MIL-STD-883, test method 1019, condition D.
- 3/ The direction of the input current is out of the device due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
- 4/ The input common mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3 V (at +25°C). The upper end of the common mode voltage range is V<sub>+</sub> - 1.5 V (at +25°C), but either or both inputs can go to +32 V without damage, independent of the magnitude of V<sub>+</sub>.
- 5/ Guaranteed by input offset voltage.
- 6/ Guaranteed parameter not tested.
- 7/ Datalog reading in K = V/mV.

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Device types	01, 02 and 03		
Case outlines	G and P	X	2
Terminal number	Terminal symbols		
1	OUTPUT A	OUTPUT A	NC
2	INVERTING INPUT A	INVERTING INPUT A	OUTPUT A
3	NON-INVERTING INPUT A	NON-INVERTING INPUT A	NC
4	GND	GND	NC
5	NON-INVERTING INPUT B	NC	INVERTING INPUT A
6	INVERTING INPUT B	NC	NC
7	OUTPUT B	NON-INVERTING INPUT B	NON-INVERTING INPUT A
8	V+	INVERTING INPUT B	NC
9	---	OUTPUT B	NC
10	---	V+	GND
11	---	---	NC
12	---	---	NON-INVERTING INPUT B
13	---	---	NC
14	---	---	NC
15	---	---	INVERTING INPUT B
16	---	---	NC
17	---	---	OUTPUT B
18	---	---	NC
19	---	---	NC
20	---	---	V+

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>5962-87710</b>
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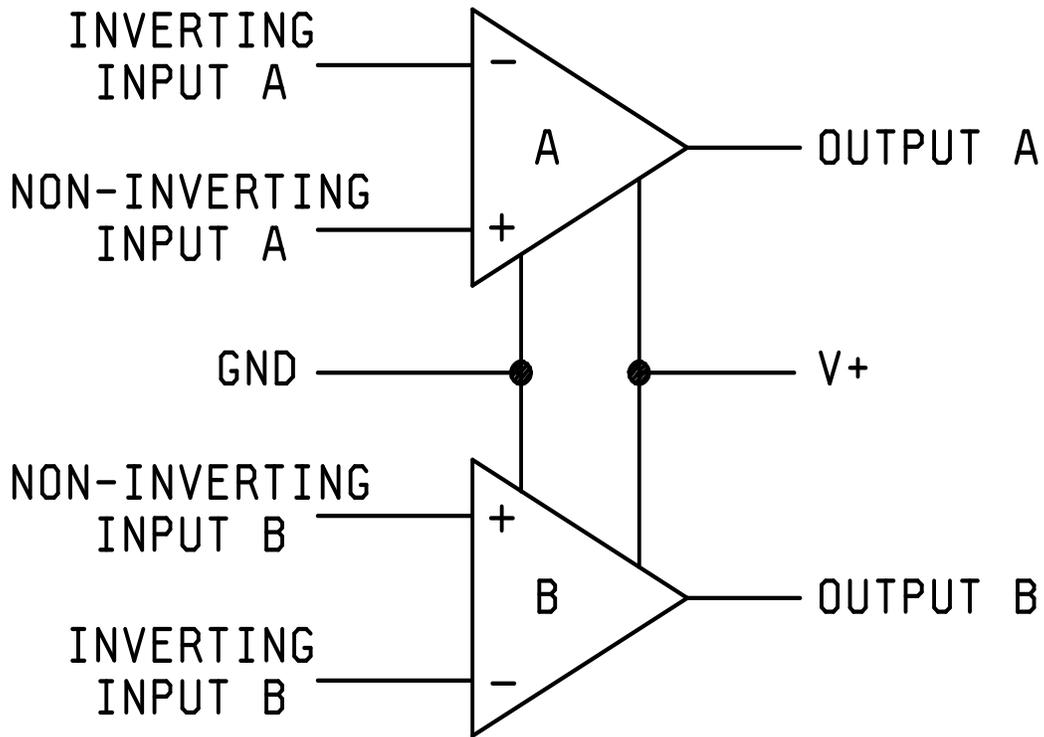


FIGURE 2. Logic diagram.

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#### 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. 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 A, B, C, 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 method 1015.
  - (2)  $T_A = +125^\circ\text{C}$ , minimum.
- b. Interim and final electrical test parameters shall be as specified in table IIA 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 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. 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 IIA herein.
- b. Subgroups 7, 8, 9, 10, and 11 in table I, method 5005 of MIL-STD-883 shall be omitted.

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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)	---	---	---
Final electrical parameters (see 4.2)	1,2,3,4,5,6 <u>1/</u>	1,2,3,4,5,6 <u>1/</u>	1,2,3,4,5,6 <u>2/</u>
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)	1,2,3	1,2,3	1,2,3 <u>2/</u>
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)	1,4	1,4	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 previous endpoint parameters.

TABLE IIB. Delta electrical characteristics at +25°C.

Test	Symbol	Conditions	Device type	Limits			Units
				Min	Max	Delta	
Input offset voltage	V <sub>IO</sub>	V <sub>+</sub> = 30 V, V <sub>CM</sub> = 0 V, R <sub>S</sub> = 50 Ω, V <sub>O</sub> = 1.4 V	02	-2	2	0.5	mV
			03	-2	2	0.5	
		V <sub>+</sub> = 30 V, V <sub>CM</sub> = 28 V, R <sub>S</sub> = 50 Ω, V <sub>O</sub> = 1.4 V	02	-2	2	0.5	mV
			03	-2	2	0.5	
		V <sub>+</sub> = 5 V, V <sub>CM</sub> = 0 V, R <sub>S</sub> = 50 Ω, V <sub>O</sub> = 1.4 V	02, 03	-2	2	0.5	mV
			03	-2	2	0.5	
Input bias current	I <sub>IB</sub>	V <sub>+</sub> = 5 V, V <sub>CM</sub> = 0 V	02	-50	-1	10	nA
			03	-50	-1	10	

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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 class M. Steady-state life test conditions, method 1005 of MIL-STD-883:

- a. Test condition A, B, C, 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 method 1005 of MIL-STD-883.
- b.  $T_A = +125^{\circ}\text{C}$ , 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 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.

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. 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  $T_A = +25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , 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 for device type 02, condition D for device type 03, 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 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.

6.2 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.

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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 QML-38535 have submitted a certificate of compliance (see 3.6 herein) to DLA Land and Maritime-VA 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 DLA Land and Maritime-VA.

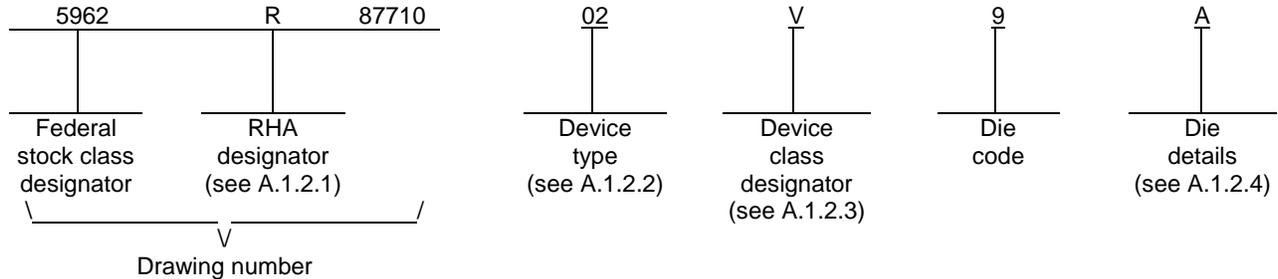
<b>STANDARD MICROCIRCUIT DRAWING</b> DLA LAND AND MARITIME COLUMBUS, OHIO 43218-3990	SIZE <b>A</b>		<b>5962-87710</b>
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APPENDIX A  
APPENDIX A FORMS A PART OF SMD 5962-87710

A.1 SCOPE

A.1.1 Scope. This appendix establishes minimum requirements for microcircuit die to be supplied under the Qualified Manufacturers List (QML) Program. QML microcircuit die meeting the requirements of MIL-PRF-38535 and the manufacturers approved QM plan for use in monolithic microcircuits, multi-chip modules (MCMs), hybrids, electronic modules, or devices using chip and wire designs in accordance with MIL-PRF-38534 are specified herein. Two product assurance classes consisting of military high reliability (device class Q) and space application (device class V) are reflected in the Part or Identification Number (PIN). When available, a choice of Radiation Hardiness Assurance (RHA) levels are reflected in the PIN.

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



A.1.2.1 RHA designator. Device classes Q and V RHA identified die meet the MIL-PRF-38535 specified RHA levels. A dash (-) indicates a non-RHA die.

A.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>
02	LM158A	Low power, dual operational amplifier
03	LM158A	Low dose rate radiation hardened low power, dual operational amplifier

A.1.2.3 Device class designator.

<u>Device class</u>	<u>Device requirements documentation</u>
Q or V	Certification and qualification to the die requirements of MIL-PRF-38535

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A.1.2.4 Die details. The die details designation is a unique letter which designates the die's physical dimensions, bonding pad location(s) and related electrical function(s), interface materials, and other assembly related information, for each product and variant supplied to this appendix.

A.1.2.4.1 Die physical dimensions.

<u>Die type</u>	<u>Figure number</u>
02 (D-step)	A-1
03 (E-step)	A-2

A.1.2.4.2 Die bonding pad locations and electrical functions.

<u>Die type</u>	<u>Figure number</u>
02	A-1
03	A-2

A.1.2.4.3 Interface materials.

<u>Die type</u>	<u>Figure number</u>
02	A-1
03	A-2

A.1.2.4.4 Assembly related information.

<u>Die type</u>	<u>Figure number</u>
02	A-1
03	A-2

A.1.3 Absolute maximum ratings. See paragraph 1.3 herein for details.

A.1.4 Recommended operating conditions. See paragraph 1.4 herein for details.

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A.2 APPLICABLE DOCUMENTS.

A.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 STANDARD

MIL-STD-883 - Test Method Standard Microcircuits.

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.)

A.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.

A.3 REQUIREMENTS

A.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.

A.3.2 Design, construction and physical dimensions. The design, construction, and physical dimensions shall be as specified in MIL-PRF-38535 and herein and the manufacturer's QM plan for device classes Q and V.

A.3.2.1 Die physical dimensions. The die physical dimensions shall be as specified in A.1.2.4.1 and on figures A-1 and A-2.

A.3.2.2 Die bonding pad locations and electrical functions. The die bonding pad locations and electrical functions shall be as specified in A.1.2.4.2 and on figures A-1 and A-2.

A.3.2.3 Interface materials. The interface materials for the die shall be as specified in A.1.2.4.3 and on figures A-1 and A-2.

A.3.2.4 Assembly related information. The assembly related information shall be as specified in A.1.2.4.4 and on figures A-1 and A-2.

A.3.2.5 Radiation exposure circuit. The radiation exposure circuit shall be as defined in paragraph 3.2.4 herein.

A.3.3 Electrical performance characteristics and post-irradiation parameter limits. Unless otherwise specified herein, the electrical performance characteristics and post-irradiation parameter limits are as specified in table I of the body of this document.

A.3.4 Electrical test requirements. The wafer probe test requirements shall include functional and parametric testing sufficient to make the packaged die capable of meeting the electrical performance requirements in table I.

A.3.5 Marking. As a minimum, each unique lot of die, loaded in single or multiple stack of carriers, for shipment to a customer, shall be identified with the wafer lot number, the certification mark, the manufacturer's identification and the PIN listed in A.1.2 herein. The certification mark shall be a "QML" or "Q" as required by MIL-PRF-38535.

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A.3.6 Certification 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 A.6.4 herein). The certificate of compliance submitted to DSCC-VA prior to listing as an approved source of supply for this appendix shall affirm that the manufacturer's product meets, for device classes Q and V, the requirements of MIL-PRF-38535 and the requirements herein.

A.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 microcircuit die delivered to this drawing.

A.4 VERIFICATION

A.4.1 Sampling and inspection. For device classes Q and V, die 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 modifications in the QM plan shall not affect the form, fit, or function as described herein.

A.4.2 Screening. For device classes Q and V, screening shall be in accordance with MIL-PRF-38535, and as defined in the manufacturer's QM plan. As a minimum, it shall consist of:

- a. Wafer lot acceptance for class V product using the criteria defined in MIL-STD-883, method 5007.
- b. 100% wafer probe (see paragraph A.3.4 herein).
- c. 100% internal visual inspection to the applicable class Q or V criteria defined in MIL-STD-883, method 2010 or the alternate procedures allowed in MIL-STD-883, method 5004.

A.4.3 Conformance inspection.

A.4.3.1 Group E inspection. Group E inspection is required only for parts intended to be identified as radiation assured (see A.3.5 herein). RHA levels for device classes Q and V shall be as specified in MIL-PRF-38535. End point electrical testing of packaged die shall be as specified in table IIA herein. Group E tests and conditions are as specified in paragraphs 4.4.4 and 4.4.4.1 herein.

A.5 DIE CARRIER

A.5.1 Die carrier requirements. The requirements for the die carrier shall be accordance with the manufacturer's QM plan or as specified in the purchase order by the acquiring activity. The die carrier shall provide adequate physical, mechanical and electrostatic protection.

A.6 NOTES

A.6.1 Intended use. Microcircuit die conforming to this drawing are intended for use in microcircuits built in accordance with MIL-PRF-38535 or MIL-PRF-38534 for government microcircuit applications (original equipment), design applications, and logistics purposes.

A.6.2 Comments. Comments on this appendix should be directed to DSCC-VA, Columbus, Ohio, 43218-3990 or telephone (614)-692-0547.

A.6.3 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-PRF-38535 and MIL-HDBK-1331.

A.6.4 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 within QML-38535 have submitted a certificate of compliance (see A.3.6 herein) to DSCC-VA and have agreed to this drawing.

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DIE LAYOUT (D-STEP)

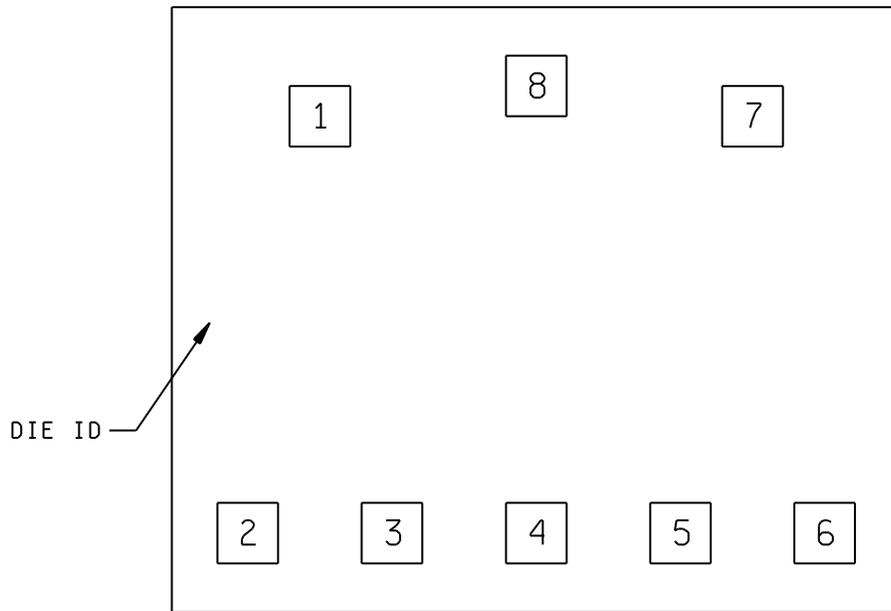


FIGURE A-1. Die bonding pad locations and electrical functions.

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Die bond pad coordinate locations (D-step)						
(Referenced to die center, coordinates in $\mu\text{m}$ ) NC = no connection, NU = not used						
Signal name	Pad number	X / Y coordinates		Pad size		
		X	Y	X	Y	Y
OUTPUT A	1	-381	320	92	x	92
INPUT A-	2	-496	-357	92	x	92
INPUT A+	3	-245	-355	92	x	92
GND	4	0	-355	92	x	92
INPUT B+	5	245	-355	92	x	92
INPUT B-	6	496	-357	92	x	92
OUTPUT B	7	381	320	92	x	92
V+	8	0	355	92	x	92

Die bonding pad locations and electrical functions

Die physical dimensions.

Die size: 1219  $\mu\text{m}$  x 940  $\mu\text{m}$   
 Die thickness: 330  $\mu\text{m}$  nominal  
 Minimum pitch: 244  $\mu\text{m}$  nominal

Interface materials.

Top metallization: Al  
 Backside metallization: Bare back

Glassivation.

Type: Vapox over metal (VOM only)  
 Thickness: 8  $\mu\text{m}$  – 12  $\mu\text{m}$

Substrate: Silicon

Assembly related information.

Substrate potential: Floating  
 Special assembly instructions: None

FIGURE A-1. Die bonding pad locations and electrical functions – continued.

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DIE LAYOUT (E-STEP)

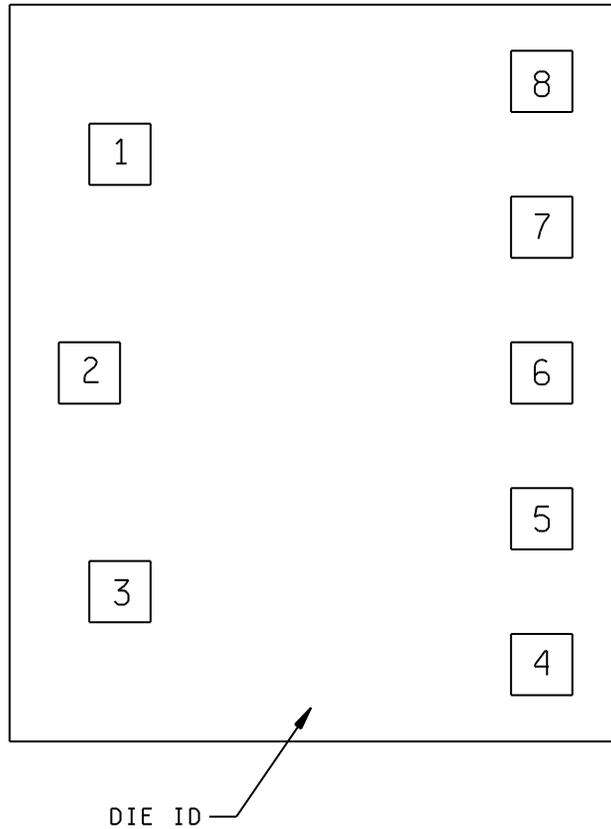


FIGURE A-2. Die bonding pad locations and electrical functions.

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Die bond pad coordinate locations (E-step)						
(Referenced to die center, coordinates in $\mu\text{m}$ ) NC = no connection, NU = not used						
Signal name	Pad number	X / Y coordinates		Pad size		
		X	Y	X	Y	Y
OUTPUT B	1	-336	400	92	x	92
V+	2	-371	-2	92	x	92
OUTPUT A	3	-336	-400	92	x	92
INPUT A-	4	372	-514	92	x	92
INPUT A+	5	371	-263	92	x	92
GND	6	371	-2	92	x	92
INPUT B+	7	371	263	92	x	92
INPUT B-	8	372	514	92	x	92

Die bonding pad locations and electrical functions

Die physical dimensions.

Die size: 990.60  $\mu\text{m}$  x 1295.40  $\mu\text{m}$

Die thickness: 304.8  $\mu\text{m}$  nominal

Minimum pitch: 261  $\mu\text{m}$  nominal

Interface materials.

Top metallization: Al 0.5% CU

Backside metallization: Bare back

Glassivation.

Type: Vapox over metal (VOM only)

Thickness: 8  $\mu\text{m}$  – 12  $\mu\text{m}$

Substrate: Silicon

Assembly related information.

Substrate potential: Floating

Special assembly instructions: None

FIGURE A-2. Die bonding pad locations and electrical functions – continued

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STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE: 15-01-15

Approved sources of supply for SMD 5962-87710 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 <u>1</u> /	Vendor CAGE number	Vendor similar PIN <u>2</u> /
5962-8771001GA	<u>3</u> /	LM158H/883
5962-8771001PA	01295	LM158JGB
	<u>3</u> /	LM158J/883
5962-87710012A	01295	LM158FKB
5962-8771002GA	27014	LM158AH/883
5962-8771002PA	01295	LM158AJGB
	27014	LM158AJ/883
5962-87710022A	01295	LM158AFKB
5962-8771002QXA	27014	LM158AWG/883
5962-8771002VGA	<u>3</u> /	LM158AH-QMLV
5962-8771002VPA	<u>3</u> /	LM158AJ-QMLV
5962-8771002VXA	<u>3</u> /	LM158AWG-QMLV
5962L8771002QGA	<u>3</u> /	LM158AHLQML
5962L8771002QPA	<u>3</u> /	LM158AJLQML
5962L8771002QXA	<u>3</u> /	LM158AWGLQML
5962L8771002VGA	<u>3</u> /	LM158AHLQMLV
5962L8771002VPA	<u>3</u> /	LM158AJLQMLV
5962L8771002VXA	<u>3</u> /	LM158AWGLQMLV

STANDARD MICROCIRCUIT DRAWING BULLETIN – Continued.

DATE: 15-01-15

Standard microcircuit drawing PIN <u>1/</u>	Vendor CAGE number	Vendor similar PIN <u>2/</u>
5962R8771002VGA	27014	LM158AHRQMLV
5962R8771002VPA	27014	LM158AJRQMLV
5962R8771002VXA	27014	LM158AWGRQMLV
5962R8771003VGA	27014	LM158AHLRQMLV
5962R8771003VPA	27014	LM158AJRLQMLV
5962R8771003VXA	27014	LM158AWGRLQMLV
5962R8771002V9A	27014	LM158A MDR
5962R8771003V9A	27014	LM158A MDE

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

Vendor name  
and address

01295

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Semiconductor Group  
8505 Forest Lane  
P.O. Box 660199  
Dallas, TX 75243  
Point of contact: U.S. Highway 75 South  
P.O. Box 84, M/S 853  
Sherman, TX 75090-9493

27014

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Santa Clara, CA 95052-8090

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