| REVISIONS | | | |
|---|---|---|---|
| LTR | DESCRIPTION | DATE (YR-MO-DA) | APPROVED |
| A | Update drawing to current MIL-PRF-38535 requirements. Remove class M references. -rrp | 17-05-09 | C. SAFFLE |
| B | Drawing updated to reflect current MIL-PRF-38535 requirements. -rrp | 23-02-24 | J. ESCHMEYER |

Revision Status of Sheets

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REV | | | | | | | | | | | | | | | | | | | | | | |
| SHEET | | | | | | | | | | | | | | | | | | | | | | |
| REV | B | B | B | B | B | B | B | B | B | B | B | B | B | | | | | | | | | |
| SHEET | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | | | | | | | | | |

PMIC N/A

| | | |
|---|---|---|
| **STANDARD MICROCIRCUIT DRAWING** | PREPARED BY RICK OFFICER | **DLA LAND AND MARITIME COLUMBUS, OHIO 43218-3990 https://www.dla.mil/LandandMaritime** |
| | CHECKED BY RAJESH PITHADIA | |
| THIS DRAWING IS AVAILABLE FOR USE BY ALL DEPARTMENTS AND AGENCIES OF THE DEPARTMENT OF DEFENSE | APPROVED BY CHARLES F. SAFFLE | MICROCIRCUIT, LINEAR, PRECISION LOW NOISE, LOW INPUT BIAS CURRENT OPERATIONAL AMPLIFIER, MONOLITHIC SILICON |
| | DRAWING APPROVAL DATE 11-01-11 | |
| AMSC N/A | REVISION LEVEL B | SIZE A · CAGE CODE **67268** · **5962-09223** |
| | | SHEET 1 OF 13 |

DSCC FORM 2233
APR 97

5962-E165-23

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

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:

| 5962 | L | 09223 | 01 | V | H | A |
|---|---|---|---|---|---|---|
| Federal supply class | RHA designator (see 1.2.1) | | Device type (see 1.2.2) | Device class designator (see 1.2.3) | Case outline (see 1.2.4) | Lead finish (see 1.2.5) |
| \ Drawing number / | | | | | | |

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 |
|---|---|---|
| 01 | AD8671 | Precision low noise, low input bias current operational amplifier |

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 outlines. The case outlines are as designated in MIL-STD-1835 and as follows:

| Outline letter | Descriptive designator | Terminals | Package style |
|---|---|---|---|
| H | GDFP1-F10 | 10 | Flat pack |

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/

| | |
|---|---|
| Supply voltage ($+V_S$ to $-V_S$) | 36 V |
| Input voltage ($V_{IN}$) | $-V_S$ to $+V_S$ |
| Differential input voltage | ±0.7 V |
| Output short circuit duration | Indefinite |
| Power dissipation ($P_D$) | 2/ |
| Junction temperature ($T_J$) | +150°C |
| Lead temperature (soldering, 10 seconds) | +300°C |
| Storage temperature range | -65°C to +150°C |
| Thermal resistance, junction-to-case ($\theta_{JC}$) | 66°C/W |
| Thermal resistance, junction-to-ambient ($\theta_{JA}$) | 370°C/W 3/ |

1.4 Recommended operating conditions.

| | |
|---|---|
| Supply voltage ($\pm V_S$) : | |
| $\pm V_S$ dual supply mode | ±5 V to ±15 V |
| 0 V / $+V_S$ single supply mode | 0 V / +10 V to 0 V / +30 V |
| Ambient operating temperature range ($T_A$) | -55°C to +125°C |

1.4.1 Operating performance characteristics. 4/

| | |
|---|---|
| Common mode input capacitance ($C_{INCM}$) | 6.25 pF |
| Differential mode input capacitance ($C_{INDM}$) | 7.5 pF |
| Input resistance ($R_{IN}$) | 3.5 GΩ |
| Differential mode input resistance ($R_{INDM}$) | 15 MΩ |
| Settling time ($t_S$): | |
| $V_S = \pm 5$ V: | |
| To 0.1%, 4 V step, gain (G) = 1 | 1.4 µs |
| To 0.01%, 4 V step, gain (G) = 1 | 5.1 µs |
| $V_S = \pm 15$ V: | |
| To 0.1%, 10 V step, gain (G) = 1 | 2.2 µs |
| To 0.01%, 10 V step, gain (G) = 1 | 6.3 µs |
| Current noise density ($i_n$) (f = 1 kHz) | 0.3 pA / $\sqrt{Hz}$ |
| Output current ($V_S = \pm 5$ V) | ±10 mA |
| Output current ($V_S = \pm 15$ V) | ±20 mA |
| Short circuit current ($V_S = \pm 15$ V) | ±30 mA |

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/ Absolute maximum power dissipation is limited by ensuring in the application of the absolute maximum junction temperature ($T_J$) of 150°C is not exceed. Actual application power dissipation (including what is required for output drive current) and case to ambient thermal resistance ($\theta_{CA}$) will determine the maximum $T_J$ as described in section 6.7.1.

3/ Measurement taken under absolute worst case conditions of still air chamber while mounted above the printed circuit board (PCB) to minimize PCB mounting heat sinking effects.

4/ Unless otherwise specified, $V_S = \pm 5$ V to ±15 V, $V_{CM} = 0.0$ V, $T_A = +25$°C.

1.5 Radiation features.

Maximum total dose available (dose rate = 50 – 300 rads(Si)/s) ..... 50 krads(Si) 5/

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

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

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

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

3.4 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table IIA. The electrical tests for each subgroup are defined in table I.

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

TABLE I. Electrical performance characteristics.

| Test | Symbol | Conditions 1/ 2/ $-55°C \leq T_A \leq +125°C$ $\pm V_S = \pm 5$ V, $V_{CM} = 0$ V unless otherwise specified | Group A subgroups | Device type | Limits | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| Input characteristics section | | | | | | | |
| Offset voltage | $V_{OS}$ | | 1 | 01 | -75 | +75 | µV |
| | | | 2,3 | | -125 | +125 | |
| | | M,D,P,L | 1 | | -200 | +200 | |
| Offset voltage drift | $\Delta V_{OS} / \Delta T$ | 3/ | 2,3 | 01 | | 0.5 | µV/°C |
| Input bias current | $I_B$ | | 1 | 01 | -12 | +12 | nA |
| | | | 2,3 | | -40 | +40 | |
| | | M,D,P,L | 1 | | -200 | +200 | |
| Input offset current | $I_{OS}$ | | 1 | 01 | -12 | +12 | nA |
| | | | 2,3 | | -40 | +40 | |
| | | M,D,P,L | 1 | | -40 | +40 | |
| Input voltage range | IVR | | 1,3 | 01 | -2.5 | +2.5 | V |
| | | | 2 | | -2.25 | +2.25 | |
| | | M,D,P,L | 1 | | -2.5 | +2.5 | |
| Common mode rejection ratio | CMRR | $V_{CM}$ = IVR max to IVR min | 1,2,3 | 01 | 100 | | dB |
| | | $V_{CM}$ = IVR max to IVR min, M,D,P,L | 1 | | 100 | | |
| Large signal voltage gain | $A_{VO}$ | $V_O$ = -3 V to +3 V, $R_L$ = 2 kΩ | 1,2,3 | 01 | 1000 | | V/mV |
| | | $V_O$ = -3 V to +3 V, $R_L$ = 2 kΩ, M,D,P,L | 1 | | 1000 | | |

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

| Test | Symbol | Conditions 1/ 2/ -55°C ≤ $T_A$ ≤ +125°C ±$V_S$ = ±5 V, $V_{CM}$ = 0 V unless otherwise specified | Group A subgroups | Device type | Limits | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| Output characteristics section | | | | | | | |
| Output low voltage | $V_{OL}$ | $R_L$ = 600 Ω | 1,2,3 | 01 | | -3.7 | V |
| | | $R_L$ = 600 Ω, M,D,P,L | 1 | | | -3.7 | |
| | | $R_L$ = 2 kΩ | 1,2,3 | | | -3.8 | |
| | | $R_L$ = 2 kΩ, M,D,P,L | 1 | | | -3.8 | |
| Output high voltage | $V_{OH}$ | $R_L$ = 600 Ω | 1,2,3 | 01 | +3.7 | | V |
| | | $R_L$ = 600 Ω, M,D,P,L | 1 | | +3.7 | | |
| | | $R_L$ = 2 kΩ | 1,2,3 | | +3.8 | | |
| | | $R_L$ = 2 kΩ, M,D,P,L | 1 | | +3.8 | | |
| Power supply section | | | | | | | |
| Power supply rejection ratio | PSRR | $V_S$ = ±4 V to ±18 V | 1,2,3 | 01 | 110 | | dB |
| | | $V_S$ = ±4 V to ±18 V, M,D,P,L | 1 | | 110 | | |
| Supply current | $I_S$ | $V_O$ = 0 V | 1 | 01 | | 3.5 | mA |
| | | | 2,3 | | | 4.2 | |
| | | $V_O$ = 0 V, M,D,P,L | 1 | | | 4.2 | |
| Dynamic performance section | | | | | | | |
| Gain bandwidth product | GBP | 3/ 4/ | 4,5,6 | 01 | 10 | | MHz |
| Slew rate | SR | 3/ 4/ | 4 | 01 | 4.0 | | V/µs |
| | | | 5 | | 5.0 | | |
| | | | 6 | | 3.0 | | |
| Noise performance section | | | | | | | |
| Peak to peak noise | $e_{np-p}$ | 0.1 Hz to 10 Hz 3/ 4/ | 4 | 01 | | 100 | nVpp |
| Voltage noise density | $e_n$ | f = 1 kHz 3/ 4/ | 4 | 01 | | 3.8 | nV / $\sqrt{Hz}$ |

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

| Test | Symbol | Conditions 1/ 2/ -55°C ≤ $T_A$ ≤ +125°C ±$V_S$ = ±15 V, $V_{CM}$ = 0 V unless otherwise specified | Group A subgroups | Device type | Limits | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| Input characteristics section | | | | | | | |
| Offset voltage | $V_{OS}$ | | 1 | 01 | -75 | +75 | µV |
| | | | 2,3 | | -125 | +125 | |
| | | M,D,P,L | 1 | | -200 | +200 | |
| Offset voltage drift | $\Delta V_{OS} / \Delta T$ | 3/ | 2,3 | 01 | | 0.5 | µV/°C |
| Input bias current | $I_B$ | | 1 | 01 | -12 | +12 | nA |
| | | | 2,3 | | -40 | +40 | |
| | | M,D,P,L | 1 | | -200 | +200 | |
| Input offset current | $I_{OS}$ | | 1 | 01 | -12 | +12 | nA |
| | | | 2,3 | | -40 | +40 | |
| | | M,D,P,L | 1 | | -40 | +40 | |
| Input voltage range | IVR | | 1,2,3 | 01 | -12 | +12 | V |
| | | M,D,P,L | 1 | | -12 | +12 | |
| Common mode rejection ratio | CMRR | $V_{CM}$ = IVR max to IVR min | 1,2,3 | 01 | 100 | | dB |
| | | $V_{CM}$ = IVR max to IVR min, M,D,P,L | 1 | | 100 | | |
| Large signal voltage gain | $A_{VO}$ | $V_O$ = -10 V to +10 V, $R_L$ = 2 kΩ | 1,2,3 | 01 | 1000 | | V/mV |
| | | $V_O$ = -10 V to +10 V, $R_L$ = 2 kΩ, M,D,P,L | 1 | | 1000 | | |

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

| Test | Symbol | Conditions 1/ 2/ -55°C ≤ $T_A$ ≤ +125°C ±$V_S$ = ±15 V, $V_{CM}$ = 0 V unless otherwise specified | Group A subgroups | Device type | Limits | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| Output characteristics section | | | | | | | |
| Output low voltage | $V_{OL}$ | $R_L$ = 600 Ω | 1,3 | 01 | | -11 | V |
| | | | 2 | | | -10.4 | |
| | | $R_L$ = 600 Ω, M,D,P,L | 1 | | | -11 | |
| | | $R_L$ = 2 kΩ | 1,2,3 | | | -13.2 | |
| | | $R_L$ = 2 kΩ, M,D,P,L | 1 | | | -13.2 | |
| Output high voltage | $V_{OH}$ | $R_L$ = 600 Ω | 1,3 | 01 | +11 | | V |
| | | | 2 | | +10.4 | | |
| | | $R_L$ = 600 Ω, M,D,P,L | 1 | | +11 | | |
| | | $R_L$ = 2 kΩ | 1,2,3 | | +13.2 | | |
| | | $R_L$ = 2 kΩ, M,D,P,L | 1 | | +13.2 | | |
| Power supply section | | | | | | | |
| Power supply rejection ratio | PSRR | $V_S$ = ±4 V to ±18 V | 1,2,3 | 01 | 110 | | dB |
| | | $V_S$ = ±4 V to ±18 V, M,D,P,L | 1 | | 110 | | |
| Supply current | $I_S$ | $V_O$ = 0 V | 1 | 01 | | 3.5 | mA |
| | | | 2,3 | | | 4.2 | |
| | | $V_O$ = 0 V, M,D,P,L | 1 | | | 4.2 | |
| Dynamic performance section | | | | | | | |
| Gain bandwidth product | GBP | 3/ 4/ | 4,5,6 | 01 | 10 | | MHz |
| Slew rate | SR | 3/ 4/ | 4 | 01 | 3.5 | | V/µs |
| | | | 5 | | 5.0 | | |
| | | | 6 | | 3.0 | | |
| Noise performance section | | | | | | | |
| Peak to peak noise | $e_{np-p}$ | 0.1 Hz to 10 Hz 3/ | 4 | 01 | | 100 | nVpp |
| Voltage noise density | $e_n$ | f = 1 kHz 3/ 4/ | 4 | 01 | | 3.8 | nV / √Hz |

See footnotes at end of table.

TABLE I. Electrical performance characteristics – Continued.

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

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

3/ Parameter not tested post irradiation.

4/ Tested initially and after any design or process changes which may affect that parameter, and therefore shall be guaranteed to the limits specified in table I herein.

| Device type | 01 |
|---|---|
| Case outline | H |
| Terminal number | Terminal symbol |
| 1 | NC |
| 2 | NC |
| 3 | -INPUT |
| 4 | +INPUT |
| 5 | $-V_S$ |
| 6 | NC |
| 7 | OUTPUT |
| 8 | $+V_S$ |
| 9 | NC |
| 10 | NC |

NC = No connection

FIGURE 1. Terminal connections.

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.

3.6 Certificate of compliance. For device classes Q and V, a certificate of compliance shall be required from a QML-38535 listed manufacturer in order to supply to the requirements of this drawing (see 6.6.1 herein). The certificate of compliance submitted to DLA Land and Maritime-VA prior to listing as an approved source of supply for this drawing shall affirm that the manufacturer's product meets, for device classes Q and V, the requirements of MIL-PRF-38535 and herein.

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

4. VERIFICATION

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

4.2 Screening. For device classes Q and V, screening shall be in accordance with MIL-PRF-38535, and shall be conducted on all devices prior to qualification and technology conformance inspection.

4.2.1 Additional criteria for device classes Q and V.

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

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

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

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

4.4 Conformance inspection. Technology conformance inspection for classes Q and V shall be in accordance with MIL-PRF-38535 including groups A, B, C, D, and E inspections, and as specified herein.

4.4.1 Group A inspection.

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

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

c. Subgroups 5 and 6 are tested as part of device initial characterization and after design and process changes.

TABLE IIA. Electrical test requirements.

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

1/ PDA applies to subgroup 1.
2/ Subgroups 5 and 6 are tested as part of device initial characterization and after design and process changes.
3/ Delta limits as specified in table IIB shall be required where specified, and the delta limits shall be computed with reference to the zero hour electrical parameters (see table I).

TABLE IIB. Burn-in and operating life test delta parameters. $T_A$ = +25°C. 1/ 2/

| Parameters | Symbol | Condition | Delta limits | | Units |
|---|---|---|---|---|---|
| | | | Min | Max | |
| Offset voltage | $V_{OS}$ | $V_S$ = ±5 V, $V_{CM}$ = 0 V | -15 | 15 | µV |
| Input bias current | $I_B$ | $V_S$ = ±5 V | -3 | 3 | nA |
| Supply current | $I_S$ | $V_S$ = ±5 V | -100 | 100 | µA |
| Offset voltage | $V_{OS}$ | $V_S$ = ±15 V, $V_{CM}$ = 0 V | -15 | 15 | µV |
| Input bias current | $I_B$ | $V_S$ = ±15 V | -3 | 3 | nA |
| Supply current | $I_S$ | $V_S$ = ±15 V | -100 | 100 | µA |

1/ Deltas are performed at room temperature.
2/ 240 hour burn-in and 1,000 hour operating group C life test.

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.

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°C ±5°C, after exposure, to the subgroups specified in table II herein.

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

5. PACKAGING

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

6. NOTES

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

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

6.2 Configuration control of SMD's. All proposed changes to existing SMD's will be coordinated with the users of record for the individual documents. This coordination will be accomplished using DD Form 1692, Engineering Change Proposal, or email communication.

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.

6.7 Application notes.

6.7.1 Power dissipation calculations. To achieve low voltage noise in a bipolar operational amplifier, the current must be increased. The emitter-base theoretical voltage noise is approximately

$$e_n = 10^9 kT \times (\sqrt{2} / qIC) \text{ measured in limits of } nV / \sqrt{Hz}$$

To achieve the low voltage noise of 2.8 nV / $\sqrt{Hz}$ , the input stage current is higher than most operational amplifiers with an equivalent gain bandwidth product. The thermal noise of a 1 kΩ resistor is 4 nV / $\sqrt{Hz}$ , which is higher than the voltage noise of the device. Low voltage noise requires using low values of resistors, so low voltage noise operational amplifiers should have good drive capability, such as a 600 Ω load. This means that the second stage and output stage are also biased at higher currents. As a result, the supply current of the device is higher than a normal amplifier. This means that thermal power management must be considered in device application.

Use the following equation to determine the die junction temperature: $T_J = T_A + P_D * ( \theta_{JC}+\theta_{CA} )$ where $P_D$ is power dissipation, $T_A$ is ambient temperature, $\theta_{JC}$ as specified for device, and $\theta_{CA}$ is how efficiently heat is taken away from the package. For device systems application, the worse case $\theta_{CA}$, $T_A$, and $P_D$ must be known to determine the worse case $T_J$.
Note the worse case $P_D$ must include additional power caused by the output current load. This $T_J$ cannot exceed the absolute maximum specification +150°C. Note that $\theta_{CA}$ can be improved by system level considerations such as heat pipes to draw away the device thermal power. Design considerations could also include using lower supply voltages to lower $P_D$.

6.7.2 Unity-gain follower applications. When large transient pulses ( >1 V ) are applied at the positive terminal of amplifiers with back-to-back diodes at the input stage, the use of a resistor in the feedback loop is recommended to avoid having the amplifier load the signal generator. The feedback resistor ($R_F$), should be at least 500 Ω. However, if large values must be used for $R_F$, a small feedback capacitor ($C_F$), should be inserted in parallel with $R_F$ to compensate for the pole introduced by the input capacitance and $R_F$.

6.7.3 Driving capacitive loads. The device can drive large capacitive loads without causing instability. However, when configured in unity gain, driving very large loads can cause unwanted ringing or instability. If heavier loads are used in low closed-loop gain or unity-gain configurations, it is recommended to use a small feedback capacitor ($C_F$) of 220pF, between $V_{OUT}$ and $-V_{IN}$. This technique reduces the overshoot and prevents the operational amplifier from oscillation. The trade-off of this circuit is a reduction in output swing. However, a great added benefit stems from the fact that the input signal and the operational amplifier's noise are filtered, and thus the overall output noise is kept to a minimum.

STANDARD MICROCIRCUIT DRAWING BULLETIN

DATE: 23-02-24

Approved sources of supply for SMD 5962-09223 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 1/ | Vendor CAGE number | Vendor similar PIN 2/ |
|---|---|---|
| 5962L0922301VHA | 24355 | AD8671AL/QMLL |

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 |
|---|---|
| 24355 | Analog Devices<br>Route 1 Industrial Park<br>P.O. Box 9106<br>Norwood, MA 02062<br>Point of contact: 7910 Triad Center Drive<br>Greensboro, NC 27409-9605 |

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