

| REVISIONS |  |          |              |
|-----------|--|----------|--------------|
| LTR       | DESCRIPTION  | DATE     | APPROVED     |
| A         | Update document paragraphs to current requirements. - ro | 21-07-07 | J. ESCHMEYER |



Prepared in accordance with ASME Y14.24

Vendor item drawing

|                     |      |   |   |   |   |   |   |   |   |   |    |    |    |    |   |  |  |  |  |  |
|---------------------|------|---|---|---|---|---|---|---|---|---|----|----|----|----|---|--|--|--|--|--|
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| REV STATUS OF PAGES | REV  | A | A | A | A | A | A | A | A | A | A  | A  | A  | A  | A |  |  |  |  |  |
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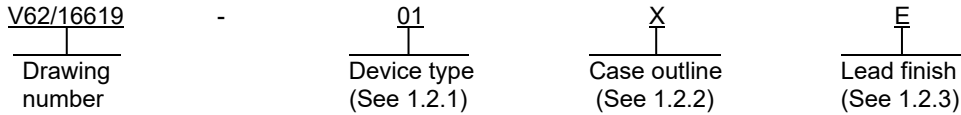
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| PMIC N/A   | PREPARED BY<br>RICK OFFICER      | DLA LAND AND MARITIME<br>COLUMBUS, OHIO 43218-3990<br><a href="https://www.dla.mil/LandandMaritime">https://www.dla.mil/LandandMaritime</a> |
| Original date of drawing<br>YY-MM-DD<br><br>16-06-03 | CHECKED BY<br>RAJESH PITHADIA    | TITLE<br>MICROCIRCUIT, LINEAR, PRECISION<br>INSTRUMENTATION AMPLIFIER, MONOLITHIC<br>SILICON  |
|  | APPROVED BY<br>CHARLES F. SAFFLE | DWG NO.<br><br><b>V62/16619</b>   |
|  | SIZE<br><b>A</b>                 | CODE IDENT. NO.<br><b>16236</b>   |
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DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

1. SCOPE

1.1 Scope. This drawing documents the general requirements of a high performance precision instrumentation amplifier microcircuit, with an operating temperature range of -55°C to +125°C.

1.2 Vendor Item Drawing Administrative Control Number. The manufacturer's PIN is the item of identification. The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation:



1.2.1 Device type(s).

| <u>Device type</u> | <u>Generic</u> | <u>Circuit function</u>             |
|--------------------|----------------|-------------------------------------|
| 01                 | AD8221-EP      | Precision instrumentation amplifier |

1.2.2 Case outline(s). The case outline(s) are as specified herein.

| <u>Outline letter</u> | <u>Number of pins</u> | <u>JEDEC PUB 95</u> | <u>Package style</u> |
|-----------------------|-----------------------|---------------------|----------------------|
| X                     | 8                     | MO-187-AA           | Micro small outline  |

1.2.3 Lead finishes. The lead finishes are as specified below or other lead finishes as provided by the device manufacturer:

| <u>Finish designator</u> | <u>Material</u>          |
|--------------------------|--------------------------|
| A                        | Hot solder dip           |
| B                        | Tin-lead plate           |
| C                        | Gold plate               |
| D                        | Palladium                |
| E                        | Gold flash palladium     |
| F                        | Tin-lead alloy (BGA/CGA) |
| Z                        | Other                    |

1.3 Absolute maximum ratings. 1/

|   |                 |
|---|-----------------|
| Supply voltage range (VS).....                      | ±18 V           |
| Internal power dissipation (PD) .....               | 200 mW          |
| Output short circuit current .....                  | Indefinite      |
| Input voltage (common mode) .....                   | ±Vs             |
| Differential input voltage .....                    | ±Vs             |
| Storage temperature range (TSTG) .....              | -65°C to +150°C |
| Junction temperature range (TJ) .....               | +150°C          |
| Thermal resistance, junction to ambient (θJA) ..... | 135°C/W         |

1/ Stresses beyond those listed under "absolute maximum rating" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

|   |                   |                                 |                              |
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1.4 Recommended operating conditions. 2/

Supply voltage range (VS) ..... ±15 V  
Operating free-air temperature range (TA) ..... -55°C to +125°C

2. APPLICABLE DOCUMENTS

JEDEC Solid State Technology Association

JEDEC PUB 95 – Registered and Standard Outlines for Semiconductor Devices

(Copies of these documents are available online at <https://www.jedec.org>.)

3. REQUIREMENTS

3.1 Marking. Parts shall be permanently and legibly marked with the manufacturer’s part number as shown in 6.3 herein and as follows:

- A. Manufacturer’s name, CAGE code, or logo
- B. Pin 1 identifier
- C. ESDS identification (optional)

3.2 Unit container. The unit container shall be marked with the manufacturer’s part number and with items A and C (if applicable) above.

3.3 Electrical characteristics. The maximum and recommended operating conditions and electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.4 Design, construction, and physical dimension. The design, construction, and physical dimensions are as specified herein.

3.5 Diagrams.

3.5.1 Case outline. The case outline shall be as shown in 1.2.2 and figure 1.

3.5.2 Terminal connections. The terminal connections shall be as shown in figure 2.

2/ Use of this product beyond the manufacturers design rules or stated parameters is done at the user’s risk. The manufacturer and/or distributor maintain no responsibility or liability for product used beyond the stated limits.

|   |                   |                                 |                              |
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TABLE I. Electrical performance characteristics. 1/

| Test   | Symbol | Conditions 2/                        | Temperature, TA | Device type | Limits       |     | Unit             |
|--|--------|--------------------------------------|-----------------|-------------|--------------|-----|------------------|
|  |        |                                      |                 |             | Min          | Max |                  |
| Common mode rejection ratio (CMRR)           |        |                                      |                 |             |              |     |                  |
| CMRR DC to 60 Hz with 1 kΩ source imbalance  |        | G = 1, VCM = -10 V to +10 V          | 25°C            | 01          | 80           |     | dB               |
|  |        | G = 10, VCM = -10 V to +10 V         |                 |             | 100          |     |                  |
|  |        | G = 100, VCM = -10 V to +10 V        |                 |             | 120          |     |                  |
|  |        | G = 1000, VCM = -10 V to +10 V       |                 |             | 130          |     |                  |
| CMRR at 10 kHz                               |        | G = 1, VCM = -10 V to +10 V          | 25°C            | 01          | 80           |     | dB               |
|  |        | G = 10, VCM = -10 V to +10 V         |                 |             | 90           |     |                  |
|  |        | G = 100, VCM = -10 V to +10 V        |                 |             | 100          |     |                  |
|  |        | G = 1000, VCM = -10 V to +10 V       |                 |             | 100          |     |                  |
| Noise  |        |                                      |                 |             |              |     |                  |
| $RTI\ noise = \sqrt{(eNI)^2 + (eNO/G)^2}$ 3/ |        |                                      |                 |             |              |     |                  |
| Voltage noise, 1 kHz                         |        |                                      |                 |             |              |     |                  |
| Input voltage noise                          | eNI    | VIN+, VIN-, VREF = 0                 | 25°C            | 01          |              | 8   | nV / $\sqrt{Hz}$ |
| Output voltage noise                         | eNO    | VIN+, VIN-, VREF = 0                 | 25°C            | 01          |              | 75  | nV / $\sqrt{Hz}$ |
| Referred to input (RTI)                      |        | G = 1, f = 0.1 Hz to 10 Hz           | 25°C            | 01          | 2 typical    |     | $\mu Vp-p$       |
|  |        | G = 10, f = 0.1 Hz to 10 Hz          |                 |             | 0.5 typical  |     |                  |
|  |        | G = 100 to 1000, f = 0.1 Hz to 10 Hz |                 |             | 0.25 typical |     |                  |
| Current noise                                |        | f = 1 kHz                            | 25°C            | 01          | 40 typical   |     | fA / $\sqrt{Hz}$ |
|  |        | f = 0.1 Hz to 10 Hz                  |                 |             | 6 typical    |     | pAp-p            |

See footnotes at end of table.

|   |                   |                                 |                              |
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TABLE I. Electrical performance characteristics – Continued. 1/

| Test   | Symbol                                     | Conditions <u>2/</u>                      | Temperature, T <sub>A</sub> | Device type | Limits      |             | Unit  |
|--|--|---|-----------------------------|-------------|-------------|-------------|-------|
|  |  |   |                             |             | Min         | Max         |       |
| Voltage offset <u>4/</u>                           |  |   |                             |             |             |             |       |
| Input offset                                       | V <sub>OSI</sub>                           | V <sub>S</sub> = ±5 V to ±15 V            | 25°C                        | 01          |             | 70          | μV    |
|  |  |   | -55°C to +125°C             |             |             | 150         |       |
| Input offset average temperature coefficient       | TC   |   | -55°C to +125°C             | 01          |             | 0.9         | μV/°C |
| Output offset                                      | V <sub>OSO</sub>                           | V <sub>S</sub> = ±5 V to ±15 V            | 25°C                        | 01          |             | 600         | μV    |
|  |  |   | -55°C to +125°C             |             |             | 1.2         |       |
| Output offset average temperature coefficient      | TC   |   | -55°C to +125°C             | 01          |             | 9           | μV/°C |
| Offset RTI versus supply (PSR)                     |  | G = 1, V <sub>S</sub> = ±2.3 V to ±18 V   | 25°C                        | 01          | 90          |             | dB    |
|  |  |   |                             |             | 100 typical |             |       |
|  |  | G = 10, V <sub>S</sub> = ±2.3 V to ±18 V  |                             |             | 100         |             |       |
|  |  |   |                             |             | 120 typical |             |       |
|  |  | G = 100, V <sub>S</sub> = ±2.3 V to ±18 V |                             |             | 120         |             |       |
|  |  |   |                             |             | 140 typical |             |       |
|  | G = 1000, V <sub>S</sub> = ±2.3 V to ±18 V | 120                                       |                             |             |             |             |       |
|  |  | 140 typical                               |                             |             |             |             |       |
| Input current                                      |  |   |                             |             |             |             |       |
| Input bias current                                 | I <sub>IB</sub>                            |   | 25°C                        | 01          |             | 2           | nA    |
|  |  |   | -55°C to +125°C             |             |             | 0.5 typical |       |
| Input bias current average temperature coefficient | TC   |   | -55°C to +125°C             | 01          | 11 typical  |             | pA/°C |

See footnotes at end of table.

|   |                   |                                 |                              |
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TABLE I. Electrical performance characteristics – Continued. 1/

| Test   | Symbol          | Conditions 2/  | Temperature, TA | Device type | Limits             |                 | Unit  |
|--|-----------------|--|-----------------|-------------|--------------------|-----------------|-------|
|  |                 |  |                 |             | Min                | Max             |       |
| Input current – continued.                           |                 |  |                 |             |                    |                 |       |
| Input offset current                                 | I <sub>IO</sub> |  | 25°C            | 01          |                    | 1               | nA    |
|  |                 |  |                 |             | 0.3 typical        |                 |       |
|  |                 |  | -55°C to +125°C |             |                    | 2.25            |       |
| Input offset current average temperature coefficient | TC              |  | -55°C to +125°C | 01          | 7 typical          |                 | pA/°C |
| Reference input                                      |                 |  |                 |             |                    |                 |       |
| Input resistance                                     | R <sub>IN</sub> |  | 25°C            | 01          | 20 typical         |                 | kΩ    |
| Input current  | I <sub>IN</sub> | V <sub>IN+</sub> , V <sub>IN-</sub> , V <sub>REF</sub> = 0 | 25°C            | 01          |                    | 60              | μA    |
|  |                 |  |                 |             | 50 typical         |                 |       |
| Voltage range  |                 |  | 25°C            | 01          | -V <sub>S</sub>    | +V <sub>S</sub> | V     |
| Gain to output                                       |                 |  | 25°C            | 01          | 1 ± 0.0001 typical |                 | V/V   |
| Power supply   |                 |  |                 |             |                    |                 |       |
| Operating range                                      |                 | V <sub>S</sub> = ±2.3 V to ±18 V                           | 25°C            | 01          | ±2.3               | ±18             | V     |
| Quiescent current                                    | I <sub>Q</sub>  |  | 25°C            | 01          |                    | 1               | mA    |
|  |                 |  |                 |             | 0.9 typical        |                 |       |
|  |                 |  | -55°C to +125°C |             |                    | 1.2             |       |
|  |                 |  |                 |             | 1 typical          |                 |       |

See footnotes at end of table.

|   |                   |                                 |                              |
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TABLE I. Electrical performance characteristics – Continued. 1/

| Test                            | Symbol                            | Conditions <u>2/</u>               | Temperature,<br>T <sub>A</sub> | Device<br>type | Limits       |      | Unit |
|---------------------------------|-----------------------------------|------------------------------------|--------------------------------|----------------|--------------|------|------|
|                                 |                                   |                                    |                                |                | Min          | Max  |      |
| Dynamic response.               |                                   |                                    |                                |                |              |      |      |
| Small signal –3 dB<br>bandwidth | SSBW                              | G = 1                              | 25°C                           | 01             | 825 typical  |      | kHz  |
|                                 |                                   | G = 10                             |                                |                | 562 typical  |      |      |
|                                 |                                   | G = 100                            |                                |                | 100 typical  |      |      |
|                                 |                                   | G = 1000                           |                                |                | 14.7 typical |      |      |
| Settling time 0.01%             | t <sub>S</sub>                    | 10 V step, G = 1 to 100            | 25°C                           | 01             | 10 typical   |      | μs   |
|                                 |                                   | 10 V step, G = 1000                |                                |                | 80 typical   |      |      |
| Settling time 0.001%            | t <sub>S</sub>                    | 10 V step, G = 1 to 100            | 25°C                           | 01             | 13 typical   |      | μs   |
|                                 |                                   | 10 V step, G = 1000                |                                |                | 110 typical  |      |      |
| Slew rate                       | SR                                | G = 1                              | 25°C                           | 01             | 1.5          |      | V/μs |
|                                 |                                   |                                    |                                |                | 2 typical    |      |      |
|                                 |                                   | G = 5 to 100                       |                                |                | 2            |      |      |
|                                 |                                   |                                    |                                |                | 2.5 typical  |      |      |
| Gain                            | G = 1 + (49.4 kΩ/R <sub>G</sub> ) |                                    |                                |                |              |      |      |
| Gain range                      |                                   |                                    | 25°C                           | 01             | 1            | 1000 | V/V  |
| Gain error                      |                                   | G = 1, V <sub>OUT</sub> = ±10 V    | 25°C                           | 01             |              | 0.1  | %    |
|                                 |                                   | G = 10, V <sub>OUT</sub> = ±10 V   |                                |                |              | 0.3  |      |
|                                 |                                   | G = 100, V <sub>OUT</sub> = ±10 V  |                                |                |              | 0.3  |      |
|                                 |                                   | G = 1000, V <sub>OUT</sub> = ±10 V |                                |                |              | 0.3  |      |

See footnotes at end of table.

|   |                   |                                 |                              |
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TABLE I. Electrical performance characteristics – Continued. 1/

| Test                                    | Symbol | Conditions <u>2/</u>  | Temperature, T <sub>A</sub> | Device type | Limits                   |                          | Unit   |
|---|--------|---|-----------------------------|-------------|--------------------------|--------------------------|--------|
|   |        |   |                             |             | Min                      | Max                      |        |
| Gain - continued.                       |        |   |                             |             |                          |                          |        |
| Gain nonlinearity                       |        | G = 1 to 10, R <sub>L</sub> = 10 kΩ,<br>V <sub>OUT</sub> = -10 V to +10 V | 25°C                        | 01          |                          | 15                       | ppm    |
|   |        |   |                             |             | 5 typical                |                          |        |
|   |        | G = 100, R <sub>L</sub> = 10 kΩ,<br>V <sub>OUT</sub> = -10 V to +10 V     |                             |             |                          | 20                       |        |
|   |        |   |                             |             | 7 typical                |                          |        |
|   |        | G = 1000, R <sub>L</sub> = 10 kΩ,<br>V <sub>OUT</sub> = -10 V to +10 V    |                             |             |                          | 50                       |        |
|   |        |   |                             |             | 10 typical               |                          |        |
|   |        | G = 1 to 100, R <sub>L</sub> = 2 kΩ,<br>V <sub>OUT</sub> = -10 V to +10 V |                             |             | 100                      |                          |        |
|   |        |   |                             |             | 15 typical               |                          |        |
| Gain versus temperature                 |        | G = 1   | 25°C                        | 01          |                          | 10                       | ppm/°C |
|   |        |   |                             |             | 3 typical                |                          |        |
|   |        | G > 1 <u>3/</u>   |                             |             |                          | -50                      |        |
| Input                                   |        |   |                             |             |                          |                          |        |
| Differential input impedance            |        | <u>5/</u>   | 25°C                        | 01          | 100  2 typical           |                          | GΩ  pF |
| Common mode input impedance             |        | <u>5/</u>   | 25°C                        | 01          | 100  2 typical           |                          | GΩ  pF |
| Input operating <u>6/</u> voltage range |        | V <sub>S</sub> = ±2.3 V to ±5 V   | 25°C                        | 01          | -V <sub>S</sub><br>+ 1.9 | +V <sub>S</sub><br>- 1.1 | V      |
|   |        |   | -55°C to +125°C             |             | -V <sub>S</sub><br>+ 2.0 | +V <sub>S</sub><br>- 1.2 |        |
| Input operating voltage range           |        | V <sub>S</sub> = ±5 V to ±18 V  | 25°C                        | 01          | -V <sub>S</sub><br>+ 1.9 | +V <sub>S</sub><br>- 1.2 | V      |
|   |        |   | -55°C to +125°C             |             | -V <sub>S</sub><br>+ 2.0 | +V <sub>S</sub><br>- 1.3 |        |

See footnotes at end of table.

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TABLE I. Electrical performance characteristics – Continued. 1/

| Test                                    | Symbol          | Conditions <u>2/</u> | Temperature, TA | Device type | Limits       |              | Unit |
|---|-----------------|----------------------|-----------------|-------------|--------------|--------------|------|
|   |                 |                      |                 |             | Min          | Max          |      |
| Output                                  |                 | RL = 10 kΩ           |                 |             |              |              |      |
| Output swing                            |                 | VS = ±2.3 V to ±5 V  | 25°C            | 01          | -VS<br>+ 1.1 | +VS<br>– 1.2 | V    |
|   |                 |                      | -55°C to +125°C |             | -VS<br>+ 1.4 | +VS<br>– 1.3 |      |
| Output swing                            |                 | VS = ±5 V to ±18 V   | 25°C            | 01          | -VS<br>+ 1.2 | +VS<br>– 1.4 | V    |
|   |                 |                      | -55°C to +125°C |             | -VS<br>+ 1.6 | +VS<br>– 1.5 |      |
| Short circuit current                   | I <sub>OS</sub> |                      | 25°C            | 01          | 18 typical   |              | mA   |
| Temperature range specified performance |                 |                      |                 | 01          | -55          | +125         | °C   |

1/ Testing and other quality control techniques are used to the extent deemed necessary to assure product performance over the specified temperature range. Product may not necessarily be tested across the full temperature range and all parameters may not necessarily be tested. In the absence of specific parametric testing, product performance is assured by characterization and/or design.

2/ Unless otherwise specified, VS = ±15 V, VREF = 0 V, G = 1, and RL = 2 kΩ.

3/ Does not include the effects of external resistor RG.

4/ Total RTI VOS = (VOSI) + (VOSO/G).

5/ The || symbolizes that the input impedance is being represented as the resistance value is in parallel with the capacitance.

6/ One input grounded. G = 1.

|   |                   |                                 |                              |
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Case X

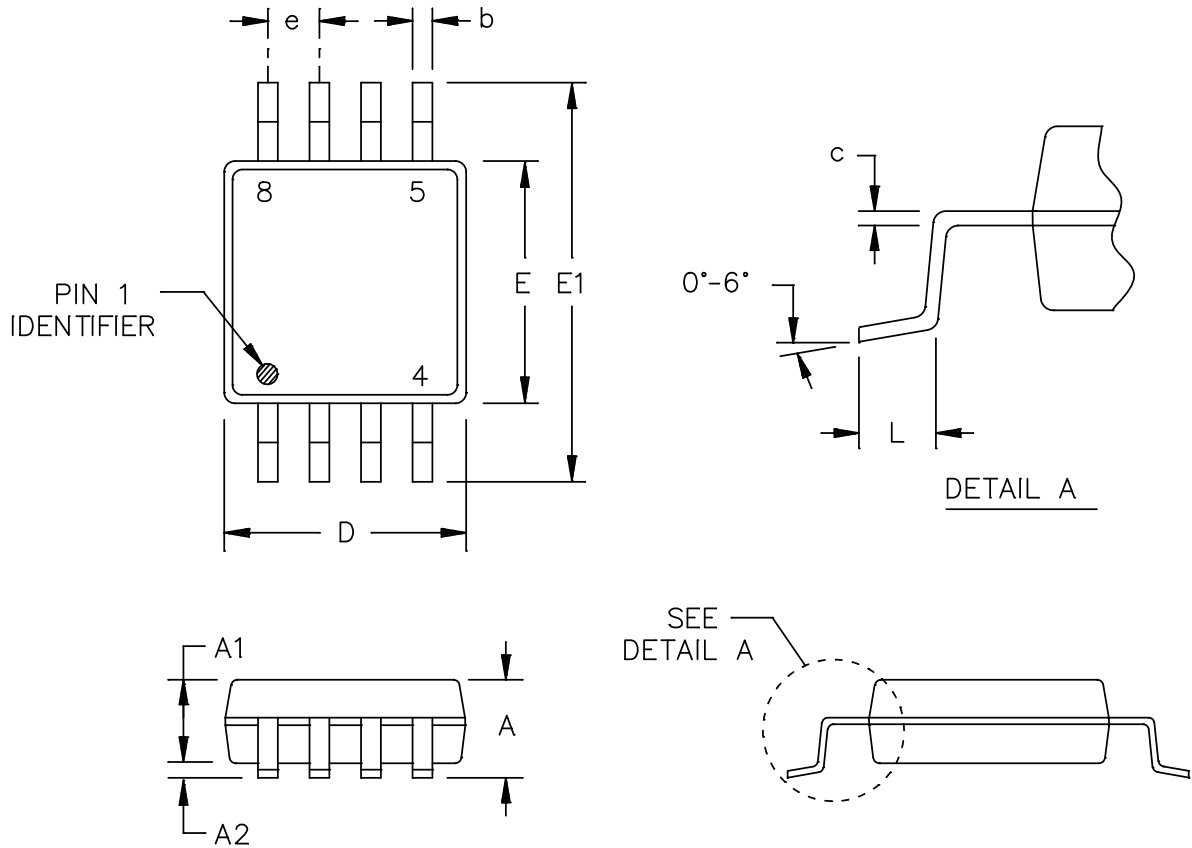


FIGURE 1. Case outline.

|  |                          |  |                                     |
|--|--------------------------|--|-------------------------------------|
| <p><b>DLA LAND AND MARITIME<br/>COLUMBUS, OHIO</b></p> | <p><b>SIZE<br/>A</b></p> | <p><b>CODE IDENT NO.<br/>16236</b></p> | <p><b>DWG NO.<br/>V62/16619</b></p> |
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Case X

| Symbol | Dimensions |         |         |             |         |         |
|--------|------------|---------|---------|-------------|---------|---------|
|        | Inches     |         |         | Millimeters |         |         |
|        | Minimum    | Nominal | Maximum | Minimum     | Nominal | Maximum |
| A      | ---        | ---     | .043    | ---         | ---     | 1.10    |
| A1     | .029       | .033    | .037    | 0.75        | 0.85    | 0.95    |
| A2     | .001       | ---     | 0.006   | 0.05        | ---     | 0.15    |
| b      | .010       | ---     | .015    | 0.25        | ---     | 0.40    |
| c      | .003       | ---     | .009    | 0.09        | ---     | 0.23    |
| D      | .110       | .118    | .125    | 2.80        | 3.00    | 3.20    |
| E      | .110       | .118    | .125    | 2.80        | 3.00    | 3.20    |
| E1     | .183       | .192    | .202    | 4.65        | 4.90    | 5.15    |
| e      | 0.026 BSC  |         |         | 0.65 BSC    |         |         |
| L      | 0.015      | .021    | .031    | 0.40        | 0.55    | 0.80    |

NOTES:

1. Controlling dimensions are millimeter, inch dimensions are given for reference only.
2. Falls with JEDEC MO-187-AA.

FIGURE 1. Case outline - Continued.

|   |                   |                                 |                              |
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| Device type     | 01              |   |
|-----------------|-----------------|---|
| Case outline    | X               |   |
| Terminal number | Terminal symbol | Description   |
| 1               | -IN             | Negative input terminal.  |
| 2               | RG              | Gain settling terminal. Place resistor across the RG pins to set the gain. $G = 1 + (49.4 \text{ k}\Omega/\text{RG})$ . |
| 3               | RG              | Gain settling terminal. Place resistor across the RG pins to set the gain. $G = 1 + (49.4 \text{ k}\Omega/\text{RG})$ . |
| 4               | +IN             | Positive input terminal.  |
| 5               | -VS             | Negative power supply terminal.   |
| 6               | REF             | Reference voltage terminal. Drive this terminal with a low impedance voltage source to level shift the output.          |
| 7               | VOUT            | Output terminal.  |
| 8               | +VS             | Positive power supply terminal.   |

FIGURE 2. Terminal connections.

|   |                   |                                 |                              |
|---|-------------------|---------------------------------|------------------------------|
| <b>DLA LAND AND MARITIME<br/>COLUMBUS, OHIO</b> | <b>SIZE<br/>A</b> | <b>CODE IDENT NO.<br/>16236</b> | <b>DWG NO.<br/>V62/16619</b> |
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4. VERIFICATION

4.1 Product assurance requirements. The manufacturer is responsible for performing all inspection and test requirements as indicated in their internal documentation. Such procedures should include proper handling of electrostatic sensitive devices, classification, packaging, and labeling of moisture sensitive devices, as applicable.

5. PREPARATION FOR DELIVERY

5.1 Packaging. Preservation, packaging, labeling, and marking shall be in accordance with the manufacturer's standard commercial practices for electrostatic discharge sensitive devices.

6. NOTES

6.1 ESDS. Devices are electrostatic discharge sensitive and are classified as ESDS class 1 minimum.

6.2 Configuration control. The data contained herein is based on the salient characteristics of the device manufacturer's data book. The device manufacturer reserves the right to make changes without notice. This drawing will be modified as changes are provided.

6.3 Suggested source(s) of supply. Identification of the suggested source(s) of supply herein is not to be construed as a guarantee of present or continued availability as a source of supply for the item. DLA Land and Maritime maintains an online database of all current sources of supply at <https://landandmaritimeapps.dla.mil/programs/smcr/>.

| Vendor item drawing administrative control number <u>1/</u> | Device manufacturer CAGE code | Mode of transportation and quantity | Vendor part number |
|---|-------------------------------|-------------------------------------|--------------------|
| V62/16619-01XE  | 24355                         | Tray, 50 units                      | AD8221TRMZ-EP      |
|   |                               | 7 inch reel, 1000 units             | AD8221TRMZ-EP-R7   |

1/ The vendor item drawing establishes an administrative control number for identifying the item on the engineering documentation.

CAGE code

24355

Source of supply

Analog Devices  
 Route 1 Industrial Park  
 P.O. Box 9106  
 Norwood, MA 02062  
 Point of contact: 20 Alpha Road  
 Chelmsford, MA 01824-4123

|   |                   |                                 |                              |
|---|-------------------|---------------------------------|------------------------------|
| <b>DLA LAND AND MARITIME<br/>COLUMBUS, OHIO</b> | <b>SIZE<br/>A</b> | <b>CODE IDENT NO.<br/>16236</b> | <b>DWG NO.<br/>V62/16619</b> |
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