

1. SCOPE

1.1 Scope. This drawing documents the general requirements of a high performance CMOS operational 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:

| | | | | |
|------------------|---|----------------------------|-----------------------------|----------------------------|
| <u>V62/06641</u> | - | <u>01</u> | <u>X</u> | <u>E</u> |
| Drawing number | | Device type (See 1.2.1) | Case outline (See 1.2.2) | Lead finish (See 1.2.3) |

1.2.1 Device type(s).

| <u>Device type</u> | <u>Generic</u> | <u>Circuit function</u> |
|--------------------|----------------|----------------------------|
| 01 | OPA336-EP | CMOS operational 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 | 5 | MO-178-AA | Plastic small outline |

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

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

| | | | |
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1.3 Absolute maximum ratings. 1/

| | |
|---|---|
| Supply voltage (V _S) | 7.5 V |
| Signal input terminals: | |
| Voltage range | -V _S – 0.3 V to +V _S + 0.3 V 2/ |
| Current | 10 mA 2/ |
| Output short circuit | Continuous 3/ |
| Storage temperature range (T _{STG}) | -55°C to +125°C |
| Junction temperature (T _J) | +150°C |
| Lead temperature (soldering, 10 seconds) | +300°C |
| Electrostatic discharge rating: | |
| Charged device model (CDM) | 1000 V |
| Human body model (HBM) | 500 V |
| Machine model (MM) | 100 V |
| Package thermal impedance (θ _{JA}) | 200°C/W |

1.4 Recommended operating conditions. 4/

| | |
|--|-----------------|
| Supply voltage range (V _S) | 2.3 V to 5.5 V |
| Operating free-air temperature range (T _A) | -55°C to +125°C |

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- 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.
- 2/ Input terminals are diode clamped to the power supply rails. Input signals that can swing more than 0.3 V beyond the supply rails should be current limited to 10 mA or less.
- 3/ Short circuit to ground, one amplifier per package.
- 4/ 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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2. APPLICABLE DOCUMENTS

JEDEC Solid State Technology Association

JEDEC PUB 95 – Registered and Standard Outlines for Semiconductor Devices

(Applications for copies should be addressed to the JEDEC Office, 3103 North 10th Street, Suite 240-S, Arlington, VA 22201-2107 or online at <http://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.

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TABLE I. Electrical performance characteristics. 1/

| Test | Symbol | Conditions 2/ | Temperature, T _A | Device type | Limits | | Unit |
|---|-----------------|---|--------------------------------|----------------|-------------------------------|------------------------|-------------|
| | | | | | Min | Max | |
| Offset voltage section | | | | | | | |
| Input offset voltage | V _{OS} | | +25°C | 01 | | ±500 | μV |
| | | | -55°C to +125°C | | | ±950 | |
| Input offset voltage versus power supply | PSRR | V _S = 2.3 V to 5.5 V | +25°C | 01 | | 100 | μV/V |
| | | | -55°C to +125°C | | | 150 | |
| Channel separation, dc | | | +25°C | 01 | 0.1 typical | | |
| Input bias current section | | | | | | | |
| Input bias current | | | +25°C | 01 | | ±10 | pA |
| | | | -55°C to +125°C | | | ±200 | |
| Input offset current | I _{OS} | | +25°C | 01 | | ±60 | pA |
| Noise section | | | | | | | |
| Input voltage noise | | f = 0.1 Hz to 10 Hz | +25°C | 01 | 3 typical | | μVp-p |
| Input voltage noise density | e _n | f = 1 kHz | +25°C | 01 | 40 typical | | nV / √Hz |
| Current noise density | i _n | f = 1 kHz | +25°C | 01 | 30 typical | | fA / √Hz |
| Input voltage range section | | | | | | | |
| Common mode voltage range | V _{CM} | | +25°C | 01 | -0.2 | +V _S - 1 | V |
| Common mode rejection ratio | CMRR | -0.2 V < V _{CM} < (+V _S) - 1 V | +25°C | 01 | 76 | | dB |
| | | | -55°C to +125°C | | 72 | | |
| Input impedance section | | | | | | | |
| Differential input impedance | | 3/ | +25°C | 01 | 10 ¹³ 2 typical | | Ω pF |
| Common mode input impedance | | 3/ | +25°C | 01 | 10 ¹³ 4 typical | | Ω pF |

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 _A | Device type | Limits | | Unit |
|--|-----------------|--|--------------------------------|----------------|--------------|-----|------|
| | | | | | Min | Max | |
| Open loop gain section | | | | | | | |
| Open loop voltage gain | A _{OL} | 100 mV < V _O < (+V _S) – 100 mV, R _L = 25 kΩ | +25°C | 01 | 90 | | dB |
| | | 500 mV < V _O < (+V _S) – 500 mV, R _L = 5 kΩ | | | 90 | | |
| | | 100 mV < V _O < (+V _S) – 100 mV, R _L = 25 kΩ | -55°C to +125°C | | 82 | | |
| | | 500 mV < V _O < (+V _S) – 500 mV, R _L = 5 kΩ | | | 89 | | |
| Frequency response section | | | | | | | |
| Gain bandwidth product | GBW | V _S = 5 V, G = 1 | +25°C | 01 | 100 typical | | kHz |
| Slew rate | SR | V _S = 5 V, G = 1 | +25°C | 01 | 0.03 typical | | V/μs |
| Overload recovery time | | V _{IN} x G = V _S | +25°C | 01 | 100 typical | | μs |
| Output section | | | | | | | |
| Voltage output swing from rail <u>4/</u> | | R _L = 100 kΩ, A _{OL} ≥ 70 dB | +25°C | 01 | 3 typical | | mV |
| | | R _L = 25 kΩ, A _{OL} ≥ 90 dB | | | | 100 | |
| | | R _L = 5 kΩ, A _{OL} ≥ 90 dB | | | 500 | | |
| | | R _L = 25 kΩ, A _{OL} ≥ 82 dB | -55°C to +125°C | | 100 | | |
| | | R _L = 5 kΩ, A _{OL} ≥ 89 dB | | | 500 | | |
| Short circuit current | | | +25°C | 01 | ±5 typical | | mA |

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 _A | Device type | Limits | | Unit |
|--------------------------------------|----------------|----------------------|--------------------------------|----------------|-------------|-----|------|
| | | | | | Min | Max | |
| Power supply section | | | | | | | |
| Specified voltage range | V _S | | +25°C | 01 | 2.3 | 5.5 | V |
| Minimum operating voltage | | | +25°C | 01 | 2.1 typical | | V |
| Quiescent current (per amplifier) | I _Q | I _O = 0 | +25°C | 01 | | 35 | μA |
| | | | -55°C to +125°C | | | 38 | |

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, V_S = 2.3 V to 5.5 V, R_L = 25 kΩ connected to V_S / 2.

3/ The || symbols represent that the values and symbols are in parallel to each other.

4/ Output voltage swings are measured between the output and positive and negative power supply rails.

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Case X

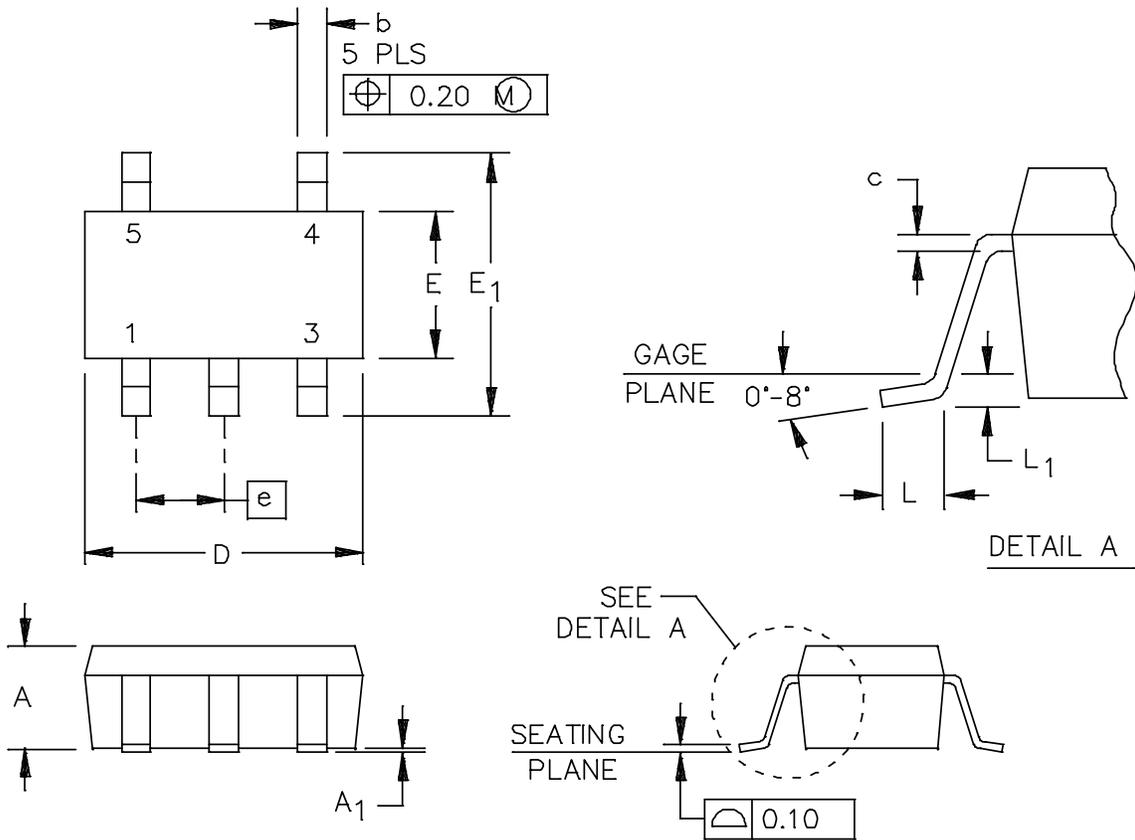


FIGURE 1. Case outline.

| | | | |
|--|--------------------------|--|-------------------------------------|
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Case X

| Symbol | Dimensions | | | |
|--------|------------|------|-------------|------|
| | Inch | | Millimeters | |
| | Min | Max | Min | Max |
| A | --- | .057 | --- | 1.45 |
| A1 | .000 | .005 | 0.00 | 0.15 |
| b | .011 | .019 | 0.30 | 0.50 |
| c | .003 | .008 | 0.08 | 0.22 |
| D | .108 | .120 | 2.75 | 3.05 |
| E | .057 | .068 | 1.45 | 1.75 |
| E1 | .102 | .118 | 2.60 | 3.00 |
| e | .037 BSC | | 0.95 BSC | |
| L | .011 | .021 | 0.30 | 0.55 |
| L1 | .009 BSC | | 0.25 BSC | |
| n | 5 leads | | 5 leads | |

NOTES:

1. Controlling dimensions are millimeter, inch dimensions are given for reference only.
2. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 mm (0.006 inch) per side.
3. Falls with JEDEC MO-178-AA.

FIGURE 1. Case outline – Continued.

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| | |
|-----------------|-----------------|
| Device type | 01 |
| Case outline | X |
| Terminal number | Terminal symbol |
| 1 | OUTPUT |
| 2 | -V _S |
| 3 | +INPUT |
| 4 | -INPUT |
| 5 | +V _S |

FIGURE 2. Terminal connections.

| | | | |
|---|-------------------|---------------------------------|------------------------------|
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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 <http://www.landandmaritime.dla.mil/Programs/Smcr/>.

| | | | |
|---|-------------------------------|------------------|--------------------|
| Vendor item drawing administrative control number <u>1/</u> | Device manufacturer CAGE code | Top side marking | Vendor part number |
| V62/06641-01XE | 01295 | OAYM | OPA336MDBVREP |

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

CAGE code

01295

Source of supply

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

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