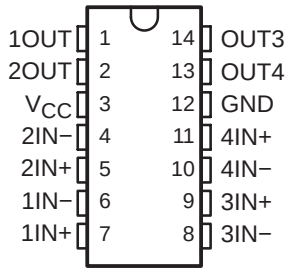
- **Controlled Baseline**
  - **One Assembly**
  - **Test Site**
  - **One Fabrication Site**
- **Extended Temperature Performance of −55°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree†**
- **Single Supply or Dual Supplies**
- **Wide Range of Supply Voltage . . . 2 V to 36 V**
- **Low Supply-Current Drain Independent of Supply Voltage . . . 0.8 mA Typ**
- **Low Input Bias Current . . . 25 nA Typ**
- **Low Input Offset Current . . . 5 nA Typ**
- **Low Input Offset Voltage . . . 2 mV Typ**
- **Common-Mode Input Voltage Range Includes Ground**
- **Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . . ±36 V**
- **Low Output Saturation Voltage**
- **Output Compatible With TTL, MOS, and CMOS**

† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

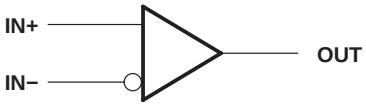
**D or PW PACKAGE**
**(TOP VIEW)**




## description

This device consists of four independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies also is possible as long as the difference between the two supplies is 2 V to 36 V and $V_{CC}$ is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships.

## symbol (each comparator)



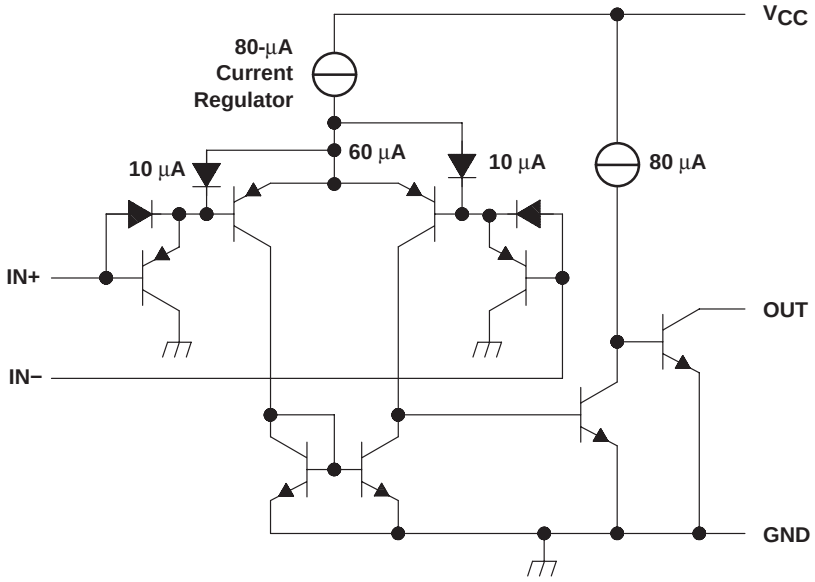

**ORDERING INFORMATION†**

| $T_A$ | PACKAGE‡ | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---|---|---|---|---|
| −40°C to 125°C | SOP − D | Tape and reel | LM239AQDREP | LM239AEP |
| −55°C to 125°C | SOP − D | Tape and reel | LM239AMDREP | LM239AME |
| | TSSOP − PW | Tape and reel | LM239AMPWREP | LM239AE |

† For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

‡ Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/packaging.

## schematic (each comparator)




All current values shown are nominal.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

| | |
|---|---|
| Supply voltage, $V_{CC}$ (see Note 1) | 36 V |
| Differential input voltage, $V_{ID}$ (see Note 2) | ±36 V |
| Input voltage range, $V_I$ (either input) | −0.3 V to 36 V |
| Output voltage, $V_O$ | 36 V |
| Output current, $I_O$ | 20 mA |
| Duration of output short circuit to ground (see Note 3) | Unlimited |
| Package thermal impedance, $\theta_{JA}$ (see Note 4) | 86°C/W |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C |
| Maximum operating junction temperature, $T_J$ | 136°C |
| Storage temperature range, $T_{stg}$ (see Note 5) | −65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” 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.

NOTES:
1. All voltage values, except differential voltages, are with respect to network ground.
2. Differential voltages are at IN+ with respect to IN−.
3. Short circuits from outputs to $V_{CC}$ can cause excessive heating and eventual destruction.
4. The package thermal impedance is calculated in accordance with JESD 51-7.
5. Long term high−temperature storage and/or extended use at maximum recommended operating conditions may result in a reduction of overall device life. See http://www.ti.com/ep_quality for additional information on enhanced plastic packaging.

## electrical characteristics at specified free-air temperature, $V_{CC}$ = 5 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS† | | $T_A$‡ | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | $V_{CC}$ = 5 V to 30 V, $V_{IC}$ = $V_{ICR}$(min), $V_O$ = 1.4 V | | 25°C | | 1 | 2.5 | mV |
| | | | | Full range | | | 5.5 | |
| $I_{IO}$ | Input offset current | $V_O$ = 1.4 V | | 25°C | | 5 | 50 | nA |
| | | | | Full range | | | 150 | |
| $I_{IB}$ | Input bias current | $V_O$ = 1.4 V | | 25°C | | −25 | −250 | nA |
| | | | | Full range | | | −400 | |
| $V_{ICR}$ | Common-mode input-voltage range | | | 25°C | 0 to $V_{CC}$−1.5 | | | V |
| | | | | Full range | 0 to $V_{CC}$−2 | | | |
| $A_{VD}$ | Large-signal differential-voltage amplification | $V_{CC}$ = 15 V, $V_O$ = 1.4 V to 11.4 V, $R_L$ ≥ 15 kΩ to $V_{CC}$ | | 25°C | 50 | 200 | | V/mV |
| $I_{OH}$ | High-level output current | $V_{ID}$= 1 V | $V_{OH}$ = 5 V | 25°C | | 0.1 | 50 | nA |
| | | | $V_{OH}$ = 30 V | Full range | | | 1 | µA |
| $V_{OL}$ | Low-level output voltage | $V_{ID}$ = −1 V, | $I_{OL}$ = 4 mA | 25°C | | 150 | 400 | mV |
| | | | | Full range | | | 700 | |
| $I_{OL}$ | Low-level output current | $V_{ID}$ = −1 V, | $V_{OL}$ = 1.5 V | 25°C | 6 | 16 | | mA |
| $I_{CC}$ | Supply current (four comparators) | $V_O$ = 2.5 V, | No load | 25°C | | 0.8 | 2 | mA |

† All characteristics are measured with zero common-mode input voltage, unless otherwise specified.
‡ Full range (MIN to MAX) for LM239AQ is −40°C to 125°C. All characteristics are measured with zero common-mode input voltage, unless otherwise specified.

## switching characteristics, $V_{CC}$ = 5 V, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Response time | $R_L$ connected to 5 V through 5.1 kΩ, $C_L$ = 15 pF§, See Note 5 | 100 mV input step with 5 mV overdrive | | 1.3 | | µs |
| | | TTL-level input step | | 0.3 | | |

§ $C_L$ includes probe and jig capacitance.
NOTE 5: The response time specified is the interval between the input step function and the instant when the output crosses 1.4 V.

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| LM239AMDREP | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM239AMPWREP | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| LM239AQDREP | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| V62/03672-01XE | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| V62/03672-02XE | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| V62/03672-02YE | ACTIVE | TSSOP | PW | 14 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

(1) The marketing status values are defined as follows:
**ACTIVE:** Product device recommended for new designs.
**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
**TBD:** The Pb-Free/Green conversion plan has not been defined.
**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

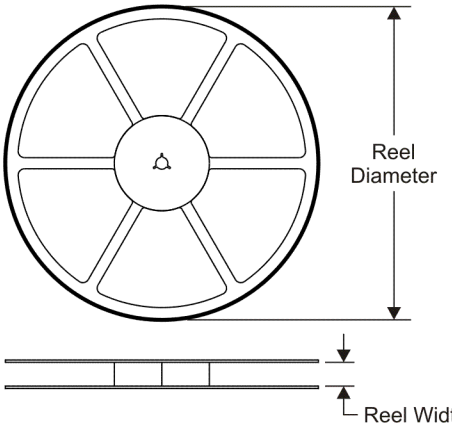


**OTHER QUALIFIED VERSIONS OF LM239A-EP :**
- Catalog: LM239A
- Automotive: LM239A-Q1

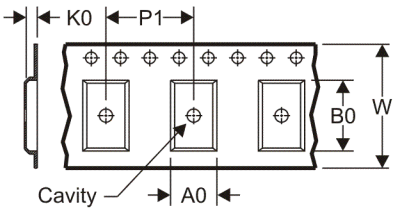
NOTE: Qualified Version Definitions:
- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

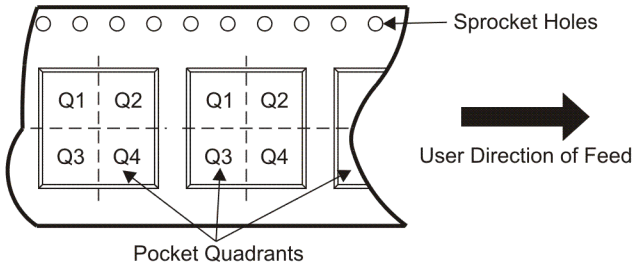



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

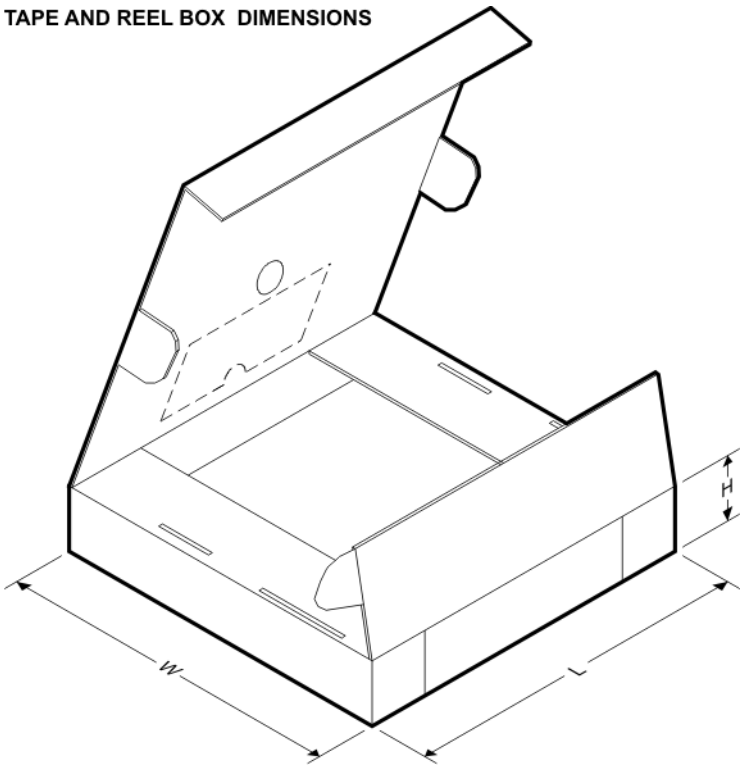
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LM239AMDREP | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |
| LM239AMPWREP | TSSOP | PW | 14 | 2000 | 330.0 | 12.4 | 7.0 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| LM239AQDREP | SOIC | D | 14 | 2500 | 330.0 | 16.4 | 6.5 | 9.0 | 2.1 | 8.0 | 16.0 | Q1 |

**TAPE AND REEL BOX DIMENSIONS**

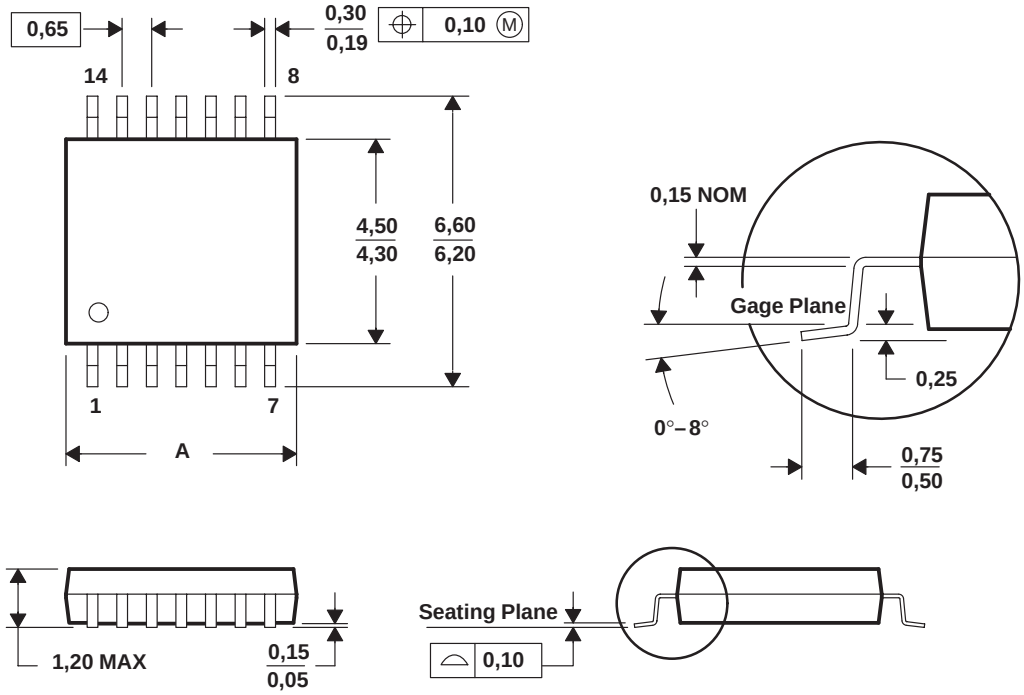



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| LM239AMDREP | SOIC | D | 14 | 2500 | 333.2 | 345.9 | 28.6 |
| LM239AMPWREP | TSSOP | PW | 14 | 2000 | 346.0 | 346.0 | 29.0 |
| LM239AQDREP | SOIC | D | 14 | 2500 | 333.2 | 345.9 | 28.6 |

**PW (R-PDSO-G**)** **PLASTIC SMALL-OUTLINE PACKAGE**

**14 PINS SHOWN**

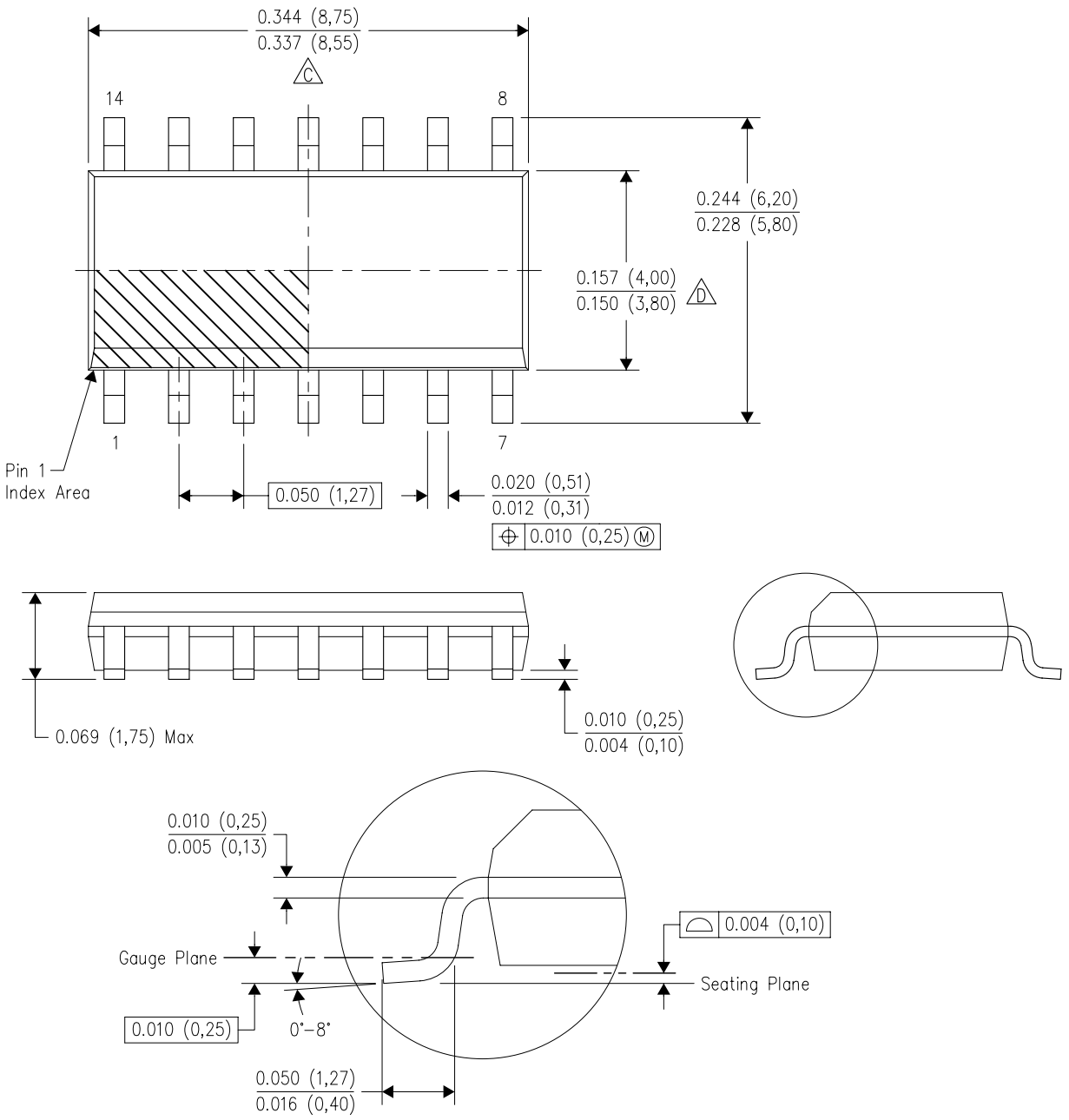



| DIM \ PINS ** | 8 | 14 | 16 | 20 | 24 | 28 |
|---|---|---|---|---|---|---|
| A MAX | 3,10 | 5,10 | 5,10 | 6,60 | 7,90 | 9,80 |
| A MIN | 2,90 | 4,90 | 4,90 | 6,40 | 7,70 | 9,60 |

**4040064/F 01/97**

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-153

D (R–PDSO–G14) PLASTIC SMALL–OUTLINE PACKAGE




NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS–012 variation AB.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

| **Products** | | **Applications** | |
|---|---|---|---|
| Amplifiers | amplifier.ti.com | Audio | www.ti.com/audio |
| Data Converters | dataconverter.ti.com | Automotive | www.ti.com/automotive |
| DSP | dsp.ti.com | Broadband | www.ti.com/broadband |
| Clocks and Timers | www.ti.com/clocks | Digital Control | www.ti.com/digitalcontrol |
| Interface | interface.ti.com | Medical | www.ti.com/medical |
| Logic | logic.ti.com | Military | www.ti.com/military |
| Power Mgmt | power.ti.com | Optical Networking | www.ti.com/opticalnetwork |
| Microcontrollers | microcontroller.ti.com | Security | www.ti.com/security |
| RFID | www.ti-rfid.com | Telephony | www.ti.com/telephony |
| RF/IF and ZigBee® Solutions | www.ti.com/lprf | Video & Imaging | www.ti.com/video |
| | | Wireless | www.ti.com/wireless |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265