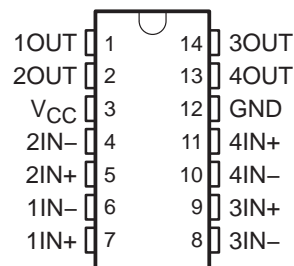


# LM3302 QUADRUPLE DIFFERENTIAL COMPARATOR

SLCS014A –OCTOBER 1977 –REVISED AUGUST 2003

- Single Supply or Dual Supplies
- Wide Range of Supply Voltage . . . 2 V to 28 V
- Low Supply-Current Drain Independent of Supply Voltage . . . 0.8 mA Typ
- Low Input Bias Current . . . 25 nA Typ
- Low Input Offset Current . . . 3 nA Typ
- Low Input Offset Voltage . . . 3 mV Typ
- Common-Mode Input Voltage Range Includes Ground
- Differential Input Voltage Range Equal to Maximum-Rated Supply Voltage . . .  $\pm 28$  V
- Low Output Saturation Voltage
- Output Compatible With TTL, MOS, and CMOS

D OR N PACKAGE  
(TOP VIEW)



## description/ordering information

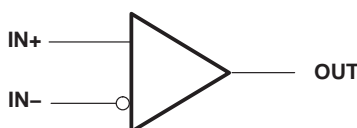
This device consists of four independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies also is possible as long as the difference between the two supplies is 2 V to 28 V and  $V_{CC}$  is a least 1.5 V more positive 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.

## ORDERING INFORMATION

| $T_A$         | $V_{IOmax}$<br>AT 25°C | PACKAGE† |              | ORDERABLE<br>PART NUMBER | TOP-SIDE<br>MARKING |
|---------------|------------------------|----------|--------------|--------------------------|---------------------|
| -40°C to 85°C | 20 mV                  | PDIP (N) | Tube of 25   | LM3302N                  | LM3302N             |
|               |                        | SOIC (D) | Tube of 50   | LM3302D                  | LM3302              |
|               |                        |          | Reel of 2500 | LM3302DR                 |                     |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

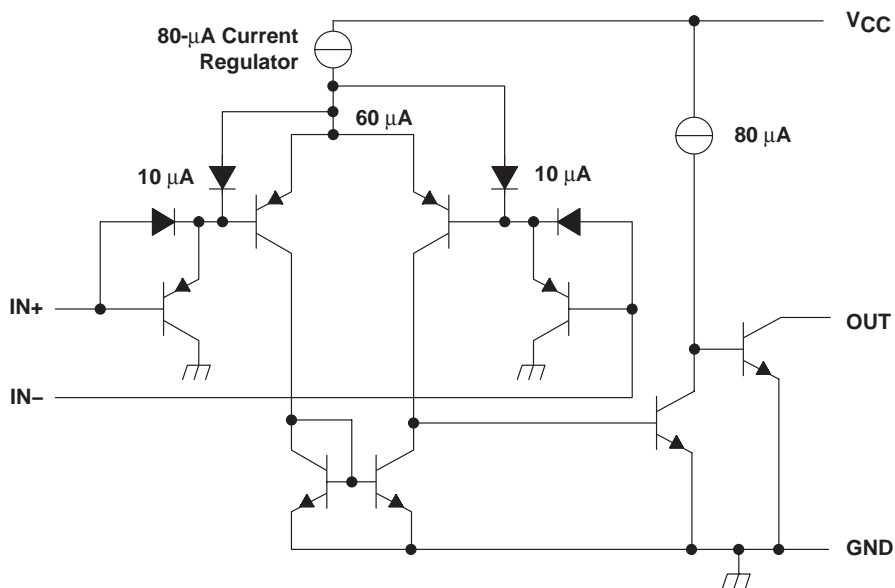
## symbol (each comparator)



# LM3302 QUADRUPLE DIFFERENTIAL COMPARATOR

SLCS014A –OCTOBER 1977 –REVISED AUGUST 2003

## schematic



Current values shown are nominal.

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

|  |                |
|--|----------------|
| Supply voltage, $V_{CC}$ (see Note 1)  | 28 V           |
| Differential input voltage, $V_{ID}$ (see Note 2)                            | $\pm 28$ V     |
| Input voltage range, $V_I$ (either input)                                    | -0.3 V to 28 V |
| Output voltage, $V_O$  | 28 V           |
| Output current, $I_O$  | 20 mA          |
| Duration of output short-circuit to ground (see Note 3)                      | Unlimited      |
| Package thermal impedance, $\theta_{JA}$ (see Notes 4 and 5): D package      | 86°C/W         |
| N package  | 80°C/W         |
| Operating virtual junction temperature, $T_J$                                | 150°C          |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or N package | 260°C          |
| Storage temperature range, $T_{stg}$   | -65°C to 150°C |

<sup>†</sup> Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. There are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the recommended operating conditions section of this specification 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 the network ground.
  2. Differential voltages are at  $IN+$  with respect to  $IN-$ .
  3. Short circuits from the output to  $V_{CC}$  can cause excessive heating and eventual destruction.
  4. Maximum power dissipation is a function of  $T_J(max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(max) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can affect reliability.
  5. The package thermal impedance is calculated in accordance with JESD 51-7.

# LM3302 QUADRUPLE DIFFERENTIAL COMPARATOR

SLCS014A –OCTOBER 1977 –REVISED AUGUST 2003

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

| PARAMETER |   | TEST CONDITION†  | $T_A$         | MIN | TYP               | MAX   | UNIT |               |
|-----------|---|--|---------------|-----|-------------------|-------|------|---------------|
| $V_{IO}$  | Input offset voltage                            | $V_{CC} = 5\text{ V to }28\text{ V}, V_{IC} = V_{ICRmin}, V_O = 1.4\text{ V}$                    | 25°C          |     | 3                 | 20    | mV   |               |
|           |   |  | -40°C to 85°C |     |                   | 40    |      |               |
| $I_{IO}$  | Input offset voltage                            | $V_O = 1.4\text{ V}$   | 25°C          |     | 3                 | 100   | nA   |               |
|           |   |  | -40°C to 85°C |     |                   | 300   |      |               |
| $I_{IB}$  | Input bias current                              |  | 25°C          |     | -25               | -500  | nA   |               |
|           |   |  | -40°C to 85°C |     |                   | -1000 |      |               |
| $V_{ICR}$ | Common-mode input voltage range                 |  | 25°C          |     | 0 to $V_{CC}-1.5$ |       | V    |               |
|           |   |  | -40°C to 85°C |     | 0 to $V_{CC}-2$   |       |      |               |
| $A_{VD}$  | Large-signal differential voltage amplification | $V_{CC} = 15\text{ V}, R_L = 15\ \Omega \text{ to } V_{CC}, V_O = 1.4\text{ V to }11.4\text{ V}$ | 25°C          |     | 2                 | 30    | V/mV |               |
| $I_{OH}$  | High-level output current                       | $V_{ID} = 1\text{ V}, V_{OH} = 5\text{ V}$   | 25°C          |     |                   | 0.1   | nA   |               |
|           |   |  | -40°C to 85°C |     |                   |       | 1    | $\mu\text{A}$ |
| $V_{OL}$  | Low-level output voltage                        | $V_{ID} = -1\text{ V}, I_{OL} = 4\text{ mA}$   | 25°C          |     |                   | 150   | 500  | mV            |
|           |   |  | -40°C to 85°C |     |                   |       | 700  |               |
| $I_{OL}$  | Low-level output current                        | $V_{ID} = 1\text{ V}, V_{OL} = 1.5\text{ V}$   | 25°C          |     | 6                 | 16    | mA   |               |
| $I_{CC}$  | Supply current (four comparators)               | $V_O = 2.5\text{ V}, \text{ No load}$  | 25°C          |     |                   | 0.8   | mA   |               |

† All characteristics are measured with zero common-mode input voltage unless otherwise specified.

**switching characteristics,  $V_{CC} = 5\text{ V}, T_A = 25^\circ\text{C}$**

| PARAMETER     | TEST CONDITIONS  | TYP                                   | UNIT |
|---------------|--|---------------------------------------|------|
| Response time | $R_L = 5.1\text{ k}\Omega \text{ to } 5\text{ V}, C_L = 15\text{ pF}^\ddagger, \text{ See Note 6}$ | 100-mV input step with 5-mV overdrive | 1.3  |
|               |  | TTL-level input step                  | 0.3  |

‡  $C_L$  includes probe and jig capacitance.

NOTE 6: 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 <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| LM3302D          | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| LM3302DE4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| LM3302DG4        | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| LM3302DR         | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| LM3302DRE4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| LM3302DRG4       | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| LM3302N          | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| LM3302NE4        | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

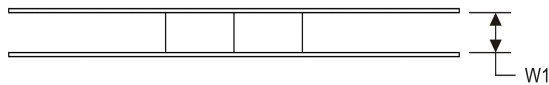
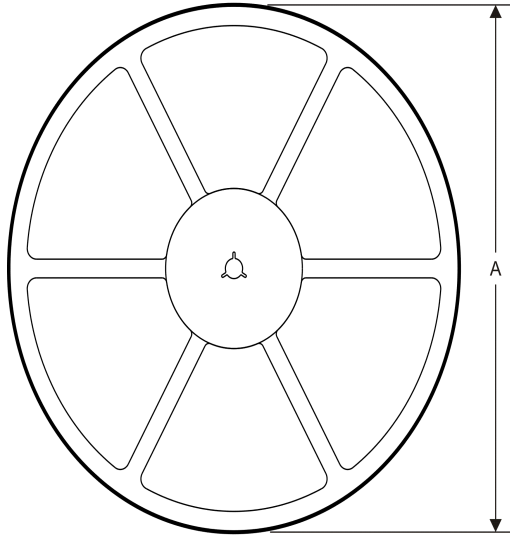
<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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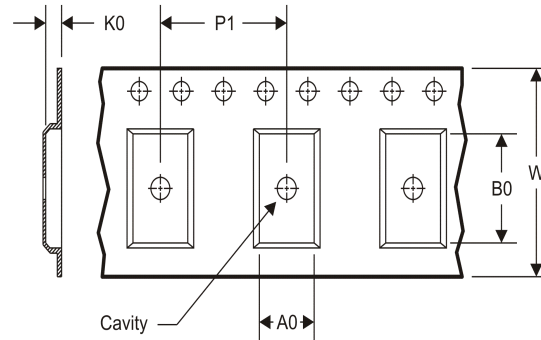
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**TAPE AND REEL INFORMATION**

**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                   |

**TAPE AND REEL INFORMATION**

\*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 |
|----------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM3302DR | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.0     | 2.1     | 8.0     | 16.0   | Q1            |
| LM3302DR | 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) |
|----------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM3302DR | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 38.0        |
| LM3302DR | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



4040049/E 12/2002

- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  - $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.



D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4211283-3/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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