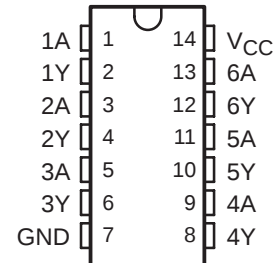


- **Controlled Baseline**
  - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of –55°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree<sup>†</sup>**
- **2-V to 6-V  $V_{CC}$  Operation**
- **Inputs Accept Voltages to 6 V**
- **Max  $t_{pd}$  of 7 ns at 5 V**

**D PACKAGE  
(TOP VIEW)**



<sup>†</sup> 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.

## description/ordering information

The SN74AC04 contains six independent inverters. The device performs the Boolean function  $Y = \bar{A}$ .

### ORDERING INFORMATION

| $T_A$          | PACKAGE <sup>‡</sup> |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|----------------------|---------------|-----------------------|------------------|
| –55°C to 125°C | SOIC – D             | Tape and reel | SN74AC04MDREP         | SAC04MEP         |

<sup>‡</sup> 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).

**FUNCTION TABLE  
(each inverter)**

| INPUT<br>A | OUTPUT<br>Y |
|------------|-------------|
| H          | L           |
| L          | H           |

## logic diagram, each inverter (positive logic)



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

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# SN74AC04-EP HEX INVERTER

SCAS717 – OCTOBER 2003

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

|                                                                |                            |
|----------------------------------------------------------------|----------------------------|
| Supply voltage range, $V_{CC}$                                 | –0.5 V to 7 V              |
| Input voltage range, $V_I$ (see Note 1)                        | –0.5 V to $V_{CC} + 0.5$ V |
| Output voltage range, $V_O$ (see Note 1)                       | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )  | ±20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) | ±20 mA                     |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ )     | ±50 mA                     |
| Continuous current through $V_{CC}$ or GND                     | ±200 mA                    |
| Package thermal impedance, $\theta_{JA}$ (see Note 2)          | 86°C/W                     |
| Storage temperature range, $T_{stg}$ (see Note 3)              | –65°C to 150°C             |

<sup>†</sup> 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. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

2. The package thermal impedance is calculated in accordance with JESD 51-7.

3. 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](http://www.ti.com/ep_quality) for additional information on enhanced plastic packaging.

## recommended operating conditions (see Note 4)

|                     |                                    | MIN              | MAX      | UNIT |
|---------------------|------------------------------------|------------------|----------|------|
| $V_{CC}$            | Supply voltage                     | 2                | 6        | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 3$ V   | 2.1      | V    |
|                     |                                    | $V_{CC} = 4.5$ V | 3.15     |      |
|                     |                                    | $V_{CC} = 5.5$ V | 3.85     |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 3$ V   | 0.9      | V    |
|                     |                                    | $V_{CC} = 4.5$ V | 1.35     |      |
|                     |                                    | $V_{CC} = 5.5$ V | 1.65     |      |
| $V_I$               | Input voltage                      | 0                | $V_{CC}$ | V    |
| $V_O$               | Output voltage                     | 0                | $V_{CC}$ | V    |
| $I_{OH}$            | High-level output current          | $V_{CC} = 3$ V   | –12      | mA   |
|                     |                                    | $V_{CC} = 4.5$ V | –24      |      |
|                     |                                    | $V_{CC} = 5.5$ V | –24      |      |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 3$ V   | 12       | mA   |
|                     |                                    | $V_{CC} = 4.5$ V | 24       |      |
|                     |                                    | $V_{CC} = 5.5$ V | 24       |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate |                  | 8        | ns/V |
| $T_A$               | Operating free-air temperature     | –55              | 125      | °C   |

NOTE 4: All unused inputs of the device must be held at  $V_{CC}$  or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER       | TEST CONDITIONS                                             | V <sub>CC</sub> | T <sub>A</sub> = 25°C |       |      | MIN | MAX | UNIT |
|-----------------|-------------------------------------------------------------|-----------------|-----------------------|-------|------|-----|-----|------|
|                 |                                                             |                 | MIN                   | TYP   | MAX  |     |     |      |
| V <sub>OH</sub> | I <sub>OH</sub> = -50 µA                                    | 3 V             | 2.9                   | 2.99  |      | 2.9 |     | V    |
|                 |                                                             | 4.5 V           | 4.4                   | 4.49  |      | 4.4 |     |      |
|                 |                                                             | 5.5 V           | 5.4                   | 5.49  |      | 5.4 |     |      |
|                 | I <sub>OH</sub> = -12 mA                                    | 3 V             | 2.56                  |       |      | 2.4 |     |      |
|                 |                                                             | 4.5 V           | 3.86                  |       |      | 3.7 |     |      |
|                 |                                                             | 5.5 V           | 4.86                  |       |      | 4.7 |     |      |
| V <sub>OL</sub> | I <sub>OL</sub> = 50 µA                                     | 3 V             |                       | 0.002 | 0.1  |     | 0.1 | V    |
|                 |                                                             | 4.5 V           |                       | 0.001 | 0.1  |     | 0.1 |      |
|                 |                                                             | 5.5 V           |                       | 0.001 | 0.1  |     | 0.1 |      |
|                 | I <sub>OL</sub> = 12 mA                                     | 3 V             |                       |       | 0.36 |     | 0.5 |      |
|                 |                                                             | 4.5 V           |                       |       | 0.36 |     | 0.5 |      |
|                 |                                                             | 5.5 V           |                       |       | 0.36 |     | 0.5 |      |
| I <sub>I</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND                     | 5.5 V           |                       |       | ±0.1 |     | ±1  | µA   |
| I <sub>CC</sub> | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0 | 5.5 V           |                       |       | 2    |     | 40  | µA   |
| C <sub>i</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND                     |                 |                       | 2.8   |      |     |     | pF   |

switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | T <sub>A</sub> = 25°C |     |     | MIN | MAX | UNIT |
|------------------|--------------|-------------|-----------------------|-----|-----|-----|-----|------|
|                  |              |             | MIN                   | TYP | MAX |     |     |      |
| t <sub>PLH</sub> | A            | Y           | 1.5                   | 4.5 | 9   | 1   | 11  | ns   |
| t <sub>PHL</sub> |              |             | 1.5                   | 4.5 | 8.5 | 1   | 10  |      |

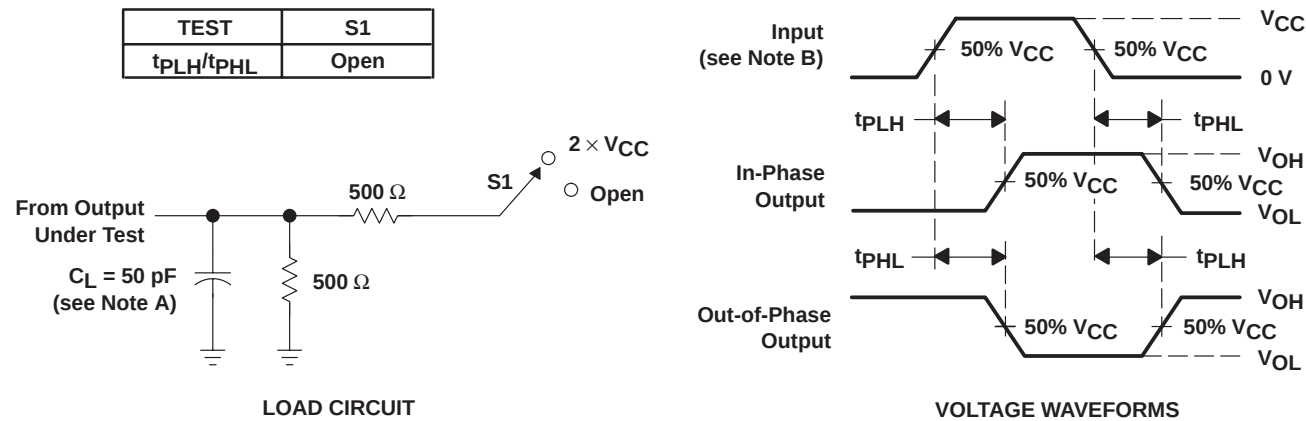
switching characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)

| PARAMETER        | FROM (INPUT) | TO (OUTPUT) | T <sub>A</sub> = 25°C |     |     | MIN | MAX | UNIT |
|------------------|--------------|-------------|-----------------------|-----|-----|-----|-----|------|
|                  |              |             | MIN                   | TYP | MAX |     |     |      |
| t <sub>PLH</sub> | A            | Y           | 1.5                   | 4   | 7   | 1   | 8.5 | ns   |
| t <sub>PHL</sub> |              |             | 1.5                   | 3.5 | 6.5 | 1   | 7.5 |      |

operating characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C

| PARAMETER                                     | TEST CONDITIONS                   | TYP | UNIT |
|-----------------------------------------------|-----------------------------------|-----|------|
| C <sub>pd</sub> Power dissipation capacitance | C <sub>L</sub> = 50 pF, f = 1 MHz | 45  | pF   |

PARAMETER MEASUREMENT INFORMATION



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1\ \text{MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r \leq 2.5\ \text{ns}$ ,  $t_f \leq 2.5\ \text{ns}$ .  
C. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

## 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74AC04MDREP    | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| V62/04614-01XE   | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |

<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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### OTHER QUALIFIED VERSIONS OF SN74AC04-EP :

- Catalog: [SN74AC04](#)
- Automotive: [SN74AC04-Q1](#)
- Military: [SN54AC04](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

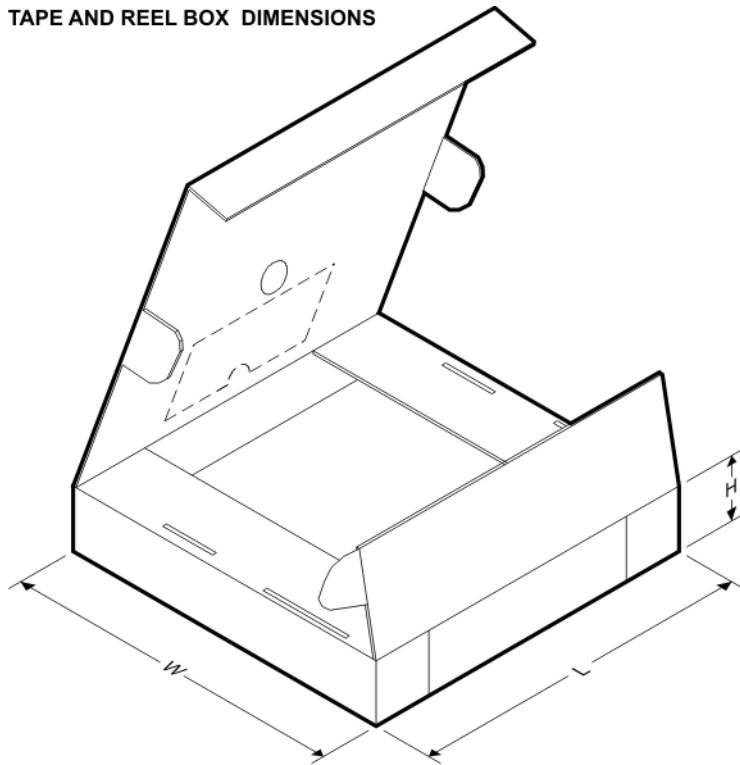
**TAPE AND REEL INFORMATION**



\*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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AC04MDREP | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AC04MDREP | SOIC         | D               | 14   | 2500 | 333.2       | 345.9      | 28.6        |

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