

# SN54AS1004A, SN74ALS1004, SN74AS1004A HEX INVERTING DRIVERS

SDAS074B – APRIL 1982 – REVISED JANUARY 1995

- 'AS1004A Offer High Capacitive-Drive Capability
- Driver Version of 'ALS04B and 'AS04
- Package Options Include Plastic Small-Outline (D) Packages, Ceramic Chip Carriers (FK), and Standard Plastic (N) and Ceramic (J) 300-mil DIPs

## description

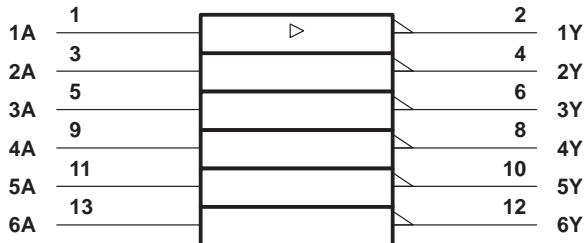
These devices contain six independent inverting drivers. They perform the Boolean function  $Y = \bar{A}$ .

The SN54AS1004A is characterized for operation over the full military temperature range of  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . The SN74ALS1004 and SN74AS1004A are characterized for operation from  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ .

**FUNCTION TABLE**  
(each inverter)

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

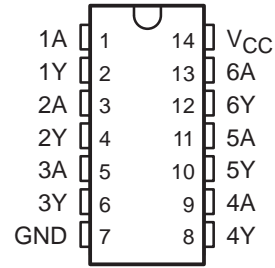
## logic symbol†



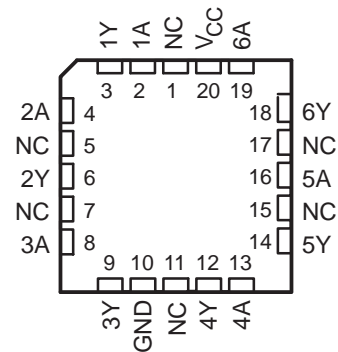
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers shown are for the D, J, and N packages.

**SN54AS1004A . . . J PACKAGE**  
**SN74ALS1004, SN74AS1004A . . . D OR N PACKAGE**  
(TOP VIEW)

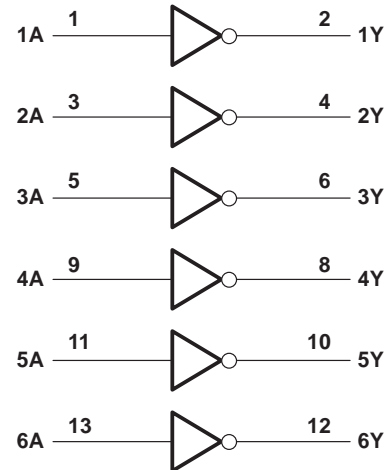


**SN54AS1004A . . . FK PACKAGE**  
(TOP VIEW)



NC – No internal connection

## logic diagram (positive logic)



# SN54AS1004A, SN74ALS1004, SN74AS1004A HEX INVERTING DRIVERS

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

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$                                  | 7 V            |
| Input voltage, $V_I$                                      | 7 V            |
| Operating free-air temperature range, $T_A$ : SN74ALS1004 | 0°C to 70°C    |
| Storage temperature range                                 | -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.

## recommended operating conditions

|          |                                | SN74ALS1004 |     |     | UNIT |
|----------|--------------------------------|-------------|-----|-----|------|
|          |                                | MIN         | NOM | MAX |      |
| $V_{CC}$ | Supply voltage                 | 4.5         | 5   | 5.5 | V    |
| $V_{IH}$ | High-level input voltage       | 2           |     |     | V    |
| $V_{IL}$ | Low-level input voltage        |             |     | 0.8 | V    |
| $I_{OH}$ | High-level output current      |             |     | -15 | mA   |
| $I_{OL}$ | Low-level output current       |             |     | 24  | mA   |
| $T_A$    | Operating free-air temperature | 0           |     | 70  | °C   |

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

| PARAMETER    | TEST CONDITIONS  | SN74ALS1004              |      |      | UNIT |
|--------------|--|--------------------------|------|------|------|
|              |  | MIN                      | TYP‡ | MAX  |      |
| $V_{IK}$     | $V_{CC} = 4.5\text{ V}$ , $I_I = -18\text{ mA}$                      |                          |      | -1.5 | V    |
| $V_{OH}$     | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ , $I_{OH} = -0.4\text{ mA}$ | $V_{CC} - 2$             |      |      | V    |
|              | $V_{CC} = 4.5\text{ V}$  | $I_{OH} = -3\text{ mA}$  | 2.4  | 3.2  |      |
|              |  | $I_{OH} = -15\text{ mA}$ | 2    |      |      |
| $V_{OL}$     | $V_{CC} = 4.5\text{ V}$  | $I_{OL} = 12\text{ mA}$  | 0.25 | 0.4  | V    |
|              |  | $I_{OL} = 24\text{ mA}$  | 0.35 | 0.5  |      |
|              |  |                          |      |      |      |
| $I_I$        | $V_{CC} = 5.5\text{ V}$ , $V_I = 7\text{ V}$                         |                          |      | 0.1  | mA   |
| $I_{IH}$     | $V_{CC} = 5.5\text{ V}$ , $V_I = 2.7\text{ V}$                       |                          |      | 20   | μA   |
| $I_{IL}$     | $V_{CC} = 5.5\text{ V}$ , $V_I = 0.4\text{ V}$                       |                          |      | -0.1 | mA   |
| $I_{O}^{\S}$ | $V_{CC} = 5.5\text{ V}$ , $V_O = 2.25\text{ V}$                      | -30                      |      | -112 | mA   |
| $I_{CCH}$    | $V_{CC} = 5.5\text{ V}$ , $V_I = 0$                                  |                          | 0.84 | 3    | mA   |
| $I_{CCL}$    | $V_{CC} = 5.5\text{ V}$ , $V_I = 4.5\text{ V}$                       |                          | 7    | 12   | mA   |

‡ All typical values are at  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

§ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

## switching characteristics (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | $V_{CC} = 4.5\text{ V to } 5.5\text{ V}$ ,<br>$C_L = 50\text{ pF}$ ,<br>$R_L = 500\ \Omega$ ,<br>$T_A = \text{MIN to MAX}^{\dagger\dagger}$ |     | UNIT |
|-----------|--------------|-------------|---|-----|------|
|           |              |             | SN74ALS1004   |     |      |
|           |              |             | MIN   | MAX |      |
| $t_{PLH}$ | A            | Y           | 1   | 7   | ns   |
| $t_{PHL}$ |              |             | 1   | 6   |      |

†† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.



# SN54AS1004A, SN74ALS1004, SN74AS1004A HEX INVERTING DRIVERS

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

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$                                  | 7 V            |
| Input voltage, $V_I$                                      | 7 V            |
| Operating free-air temperature range, $T_A$ : SN54AS1004A | -55°C to 125°C |
| SN74AS1004A   | 0°C to 70°C    |
| Storage temperature range                                 | -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.

## recommended operating conditions‡

|                                      | SN54AS1004A |     |     | SN74AS1004A |     |     | UNIT |
|--------------------------------------|-------------|-----|-----|-------------|-----|-----|------|
|                                      | MIN         | NOM | MAX | MIN         | NOM | MAX |      |
| $V_{CC}$ Supply voltage              | 4.5         | 5   | 5.5 | 4.5         | 5   | 5.5 | V    |
| $V_{IH}$ High-level input voltage    | 2           |     |     | 2           |     |     | V    |
| $V_{IL}$ Low-level input voltage     |             |     | 0.8 |             |     | 0.8 | V    |
| $I_{OH}$ High-level output current   |             |     | -40 |             |     | -48 | mA   |
| $I_{OL}$ Low-level output current    |             |     | 40  |             |     | 48  | mA   |
| $T_A$ Operating free-air temperature | -55         |     | 125 | 0           |     | 70  | °C   |

‡ These high sink- or source-current devices are not recommended for use above 40 MHz.

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

| PARAMETER           | TEST CONDITIONS                                | SN54AS1004A  |      | SN74AS1004A |              | UNIT |      |     |
|---------------------|--|--------------|------|-------------|--------------|------|------|-----|
|                     |  | MIN          | TYP§ | MAX         | MIN          |      | TYP§ | MAX |
| $V_{IK}$            | $V_{CC} = 4.5 V$ , $I_I = -18 mA$              |              |      | -1.2        |              | -1.2 | V    |     |
| $V_{OH}$            | $V_{CC} = 4.5 V$ to $5.5 V$ , $I_{OH} = -2 mA$ | $V_{CC} - 2$ |      |             | $V_{CC} - 2$ |      | V    |     |
|                     | $V_{CC} = 4.5 V$ , $I_{OH} = -3 mA$            | 2.4          | 3.2  |             | 2.4          | 3.2  |      |     |
|                     | $V_{CC} = 4.5 V$ , $I_{OH} = -40 mA$           | 2            |      |             |              |      |      |     |
| $V_{OL}$            | $V_{CC} = 4.5 V$ , $I_{OH} = -48 mA$           |              |      |             | 2            |      | V    |     |
|                     | $V_{CC} = 4.5 V$ , $I_{OL} = 40 mA$            |              | 0.25 | 0.5         |              |      |      |     |
|                     | $V_{CC} = 4.5 V$ , $I_{OL} = 48 mA$            |              |      |             | 0.35         | 0.5  |      |     |
| $I_I$               | $V_{CC} = 5.5 V$ , $V_I = 7 V$                 |              |      | 0.1         |              | 0.1  | mA   |     |
| $I_{IH}$            | $V_{CC} = 5.5 V$ , $V_I = 2.7 V$               |              |      | 20          |              | 20   | μA   |     |
| $I_{IL}$            | $V_{CC} = 5.5 V$ , $V_I = 0.4 V$               |              |      | -0.5        |              | -0.5 | mA   |     |
| $I_{O}^{\parallel}$ | $V_{CC} = 5.5 V$ , $V_O = 2.25 V$              | -50          |      | -200        | -50          | -200 | mA   |     |
| $I_{CCH}$           | $V_{CC} = 5.5 V$ , $V_I = 0$                   |              | 3.5  | 5           |              | 3.5  | 5    | mA  |
| $I_{CCL}$           | $V_{CC} = 5.5 V$ , $V_I = 4.5 V$               |              | 16   | 27          |              | 16   | 27   | mA  |

§ All typical values are at  $V_{CC} = 5 V$ ,  $T_A = 25^\circ C$ .

¶ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .



# SN54AS1004A, SN74ALS1004, SN74AS1004A HEX INVERTING DRIVERS

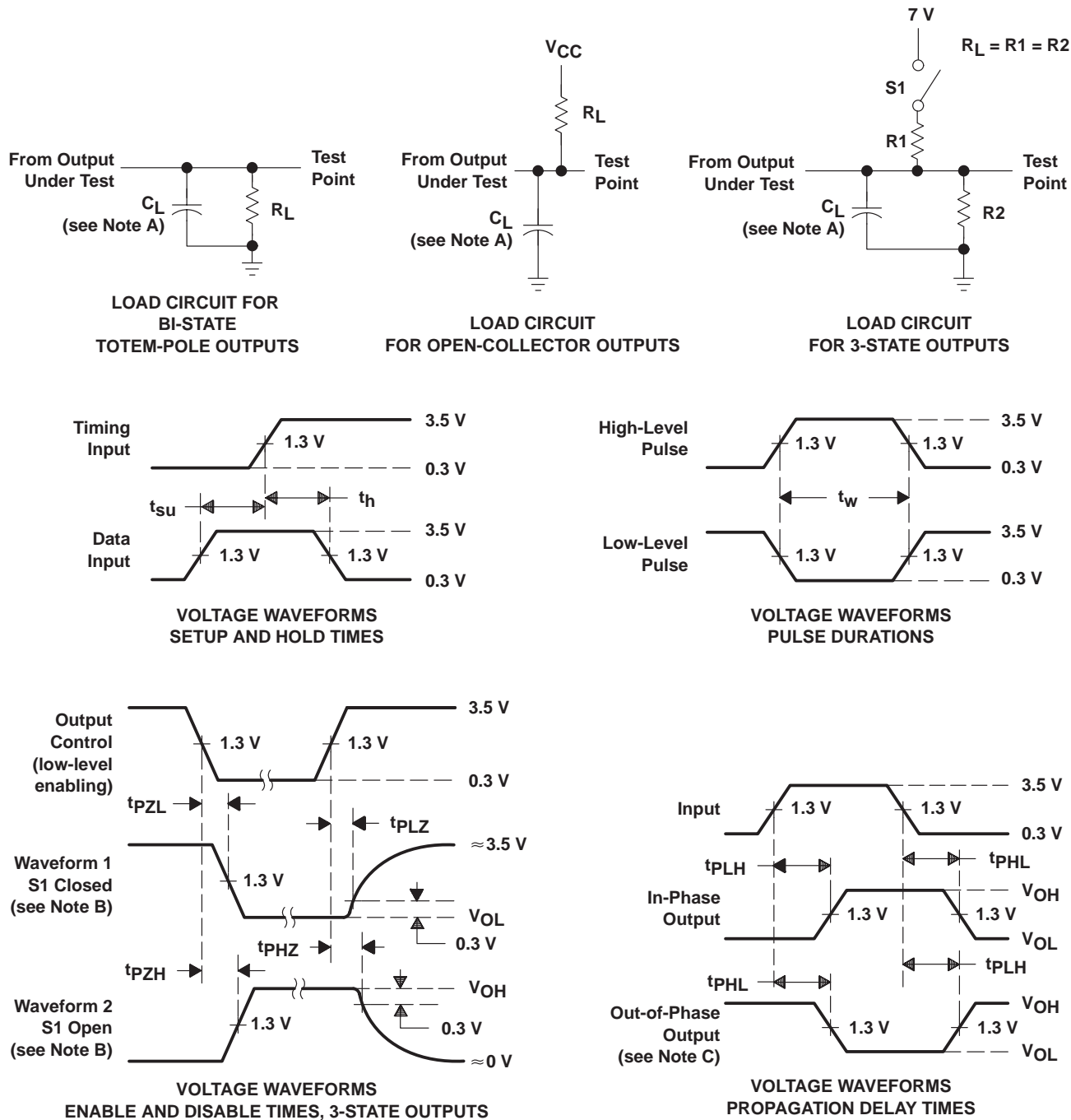
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## switching characteristics (see Figure 1)

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V},$<br>$C_L = 50 \text{ pF},$<br>$R_L = 500 \Omega,$<br>$T_A = \text{MIN to MAX}^\dagger$ |     |             |     | UNIT |
|-----------|-----------------|----------------|---|-----|-------------|-----|------|
|           |                 |                | SN54AS1004A   |     | SN74AS1004A |     |      |
|           |                 |                | MIN   | MAX | MIN         | MAX |      |
| $t_{PLH}$ | A               | Y              | 1   | 5   | 1           | 4   | ns   |
| $t_{PHL}$ |                 |                | 1   | 5   | 1           | 4   |      |

<sup>†</sup> For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

PARAMETER MEASUREMENT INFORMATION  
SERIES 54ALS/74ALS AND 54AS/74AS DEVICES



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.  
 C. When measuring propagation delay items of 3-state outputs, switch S1 is open.  
 D. All input pulses have the following characteristics:  $PRR \leq 1$  MHz,  $t_r = t_f = 2$  ns, duty cycle = 50%.  
 E. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 5962-88729012A   | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | Call TI          | Level-NC-NC-NC               |
| 5962-8872901CA   | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | Call TI          | Level-NC-NC-NC               |
| 5962-8872901DA   | ACTIVE                | CFP          | W               | 14   | 1           | TBD                     | Call TI          | Level-NC-NC-NC               |
| SN54AS1004AJ     | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | Call TI          | Level-NC-NC-NC               |
| SN74ALS1004D     | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1004DE4   | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1004DR    | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1004DRE4  | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1004N     | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC               |
| SN74ALS1004NE4   | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC               |
| SN74ALS1004NSR   | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74ALS1004NSRE4 | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS1004AD     | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS1004ADE4   | ACTIVE                | SOIC         | D               | 14   | 50          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS1004ADR    | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS1004ADRE4  | ACTIVE                | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS1004AN     | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC               |
| SN74AS1004AN3    | OBSOLETE              | PDIP         | N               | 14   |             | TBD                     | Call TI          | Call TI                      |
| SN74AS1004ANE4   | ACTIVE                | PDIP         | N               | 14   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | Level-NC-NC-NC               |
| SN74AS1004ANSR   | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SN74AS1004ANSRE4 | ACTIVE                | SO           | NS              | 14   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| SNJ54AS1004AFK   | ACTIVE                | LCCC         | FK              | 20   | 1           | TBD                     | Call TI          | Level-NC-NC-NC               |
| SNJ54AS1004AJ    | ACTIVE                | CDIP         | J               | 14   | 1           | TBD                     | Call TI          | Level-NC-NC-NC               |
| SNJ54AS1004AW    | ACTIVE                | CFP          | W               | 14   | 1           | TBD                     | Call TI          | Level-NC-NC-NC               |

<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.

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(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) 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.

**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.

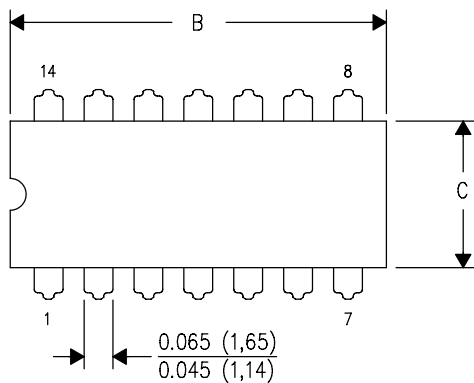
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J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



| DIM \ PINS ** | 14                     | 16                     | 18                     | 20                     |
|---------------|------------------------|------------------------|------------------------|------------------------|
| A             | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC | 0.300<br>(7,62)<br>BSC |
| B MAX         | 0.785<br>(19,94)       | .840<br>(21,34)        | 0.960<br>(24,38)       | 1.060<br>(26,92)       |
| B MIN         | —                      | —                      | —                      | —                      |
| C MAX         | 0.300<br>(7,62)        | 0.300<br>(7,62)        | 0.310<br>(7,87)        | 0.300<br>(7,62)        |
| C MIN         | 0.245<br>(6,22)        | 0.245<br>(6,22)        | 0.220<br>(5,59)        | 0.245<br>(6,22)        |



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

W (R-GDFP-F14)

CERAMIC DUAL FLATPACK



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a ceramic lid using glass frit.
  - D. Index point is provided on cap for terminal identification only.
  - E. Falls within MIL STD 1835 GDFP1-F14 and JEDEC MO-092AB

FK (S-CQCC-N\*\*)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. This package can be hermetically sealed with a metal lid.
  - D. The terminals are gold plated.
  - E. Falls within JEDEC MS-004

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

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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 PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AB.

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- 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.

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| DSP              | <a href="http://dsp.ti.com">dsp.ti.com</a>                         | Broadband           | <a href="http://www.ti.com/broadband">www.ti.com/broadband</a>           |
| Interface        | <a href="http://interface.ti.com">interface.ti.com</a>             | Digital Control     | <a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a> |
| Logic            | <a href="http://logic.ti.com">logic.ti.com</a>                     | Military            | <a href="http://www.ti.com/military">www.ti.com/military</a>             |
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