

SN5428, SN54LS28, SN7428, SN74LS28 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers and Flat Packages, and Plastic and Ceramic DIPs
- Dependable Texas Instruments Quality and Reliability

description

These devices contain four independent 2-input NOR buffer gates.

The SN5428, and SN54LS28 are characterized for operation over the full military temperature range of -55°C to 125°C . The SN7428, and SN74LS28 are characterized for operation from 0°C to 70°C .

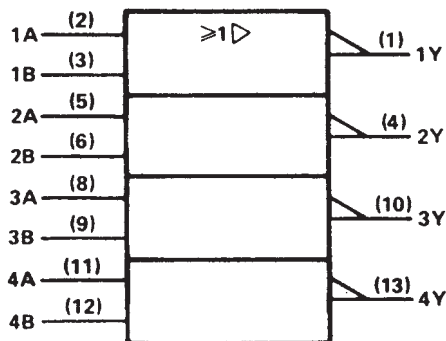
FUNCTION TABLE (each gate)

| INPUTS | | OUTPUT |
|--------|---|--------|
| A | B | Y |
| H | X | L |
| X | H | L |
| L | L | H |

positive logic

$$Y = \overline{A + B} \text{ or } Y = \overline{A} \cdot \overline{B}$$

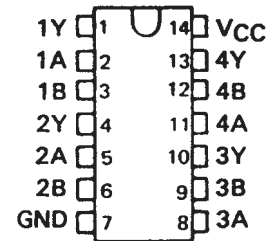
logic symbol†



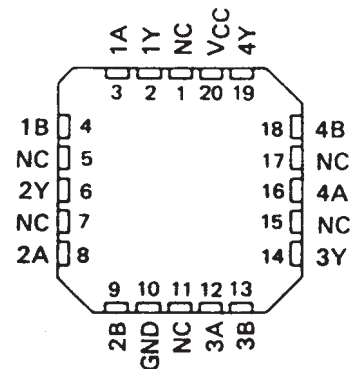
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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

SN5428, SN54LS28 . . . J OR W PACKAGE
SN7428 . . . N PACKAGE
SN74LS28 . . . D OR N PACKAGE
(TOP VIEW)

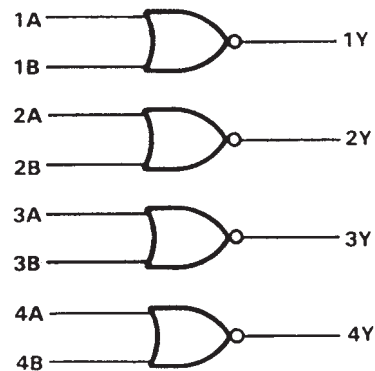


SN54LS28 . . . FK PACKAGE
(TOP VIEW)



NC - No internal connection

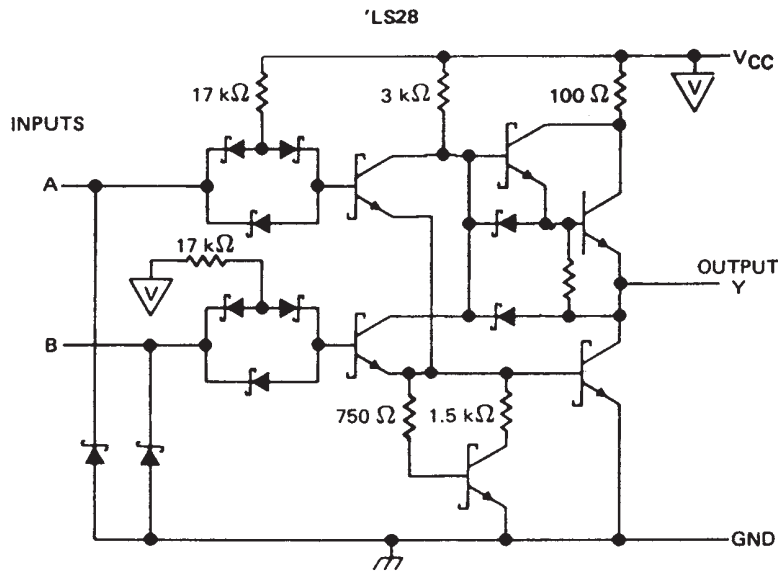
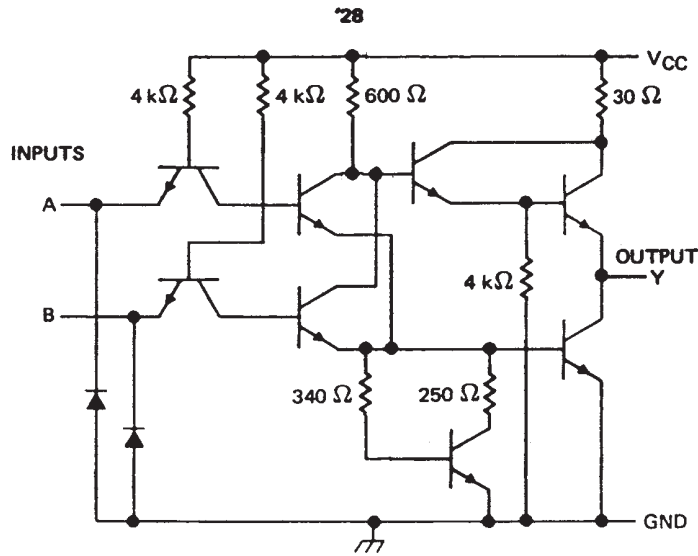
logic diagram



SN5428, SN54LS28, SN7428, SN74LS28 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

schematics (each gate)



Resistor values shown are nominal.

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

| | |
|---|----------------|
| Supply voltage, V_{CC} (see Note 1) | 7 V |
| Input voltage: '28 | 5.5 V |
| 'LS28 | 7 V |
| Operating free-air temperature: SN54' | -55°C to 125°C |
| SN74' | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN5428, SN54LS28, SN7428, SN74LS28 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

recommended operating conditions

| | SN5428 | | | SN7428 | | | UNIT |
|---|--------|-----|------|--------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | 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 | | | -2.4 | | | -2.4 | mA |
| I _{OL} Low-level output current | | | 48 | | | 48 | mA |
| T _A Operating free-air temperature | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS † | MIN | TYP ‡ | MAX | UNIT |
|-------------------|---|-----|-------|------|------|
| V _{IK} | V _{CC} = MIN, I _I = -12mA | | | -1.5 | V |
| V _{OH} | V _{CC} = MIN, V _{IL} = 0.8 V, I _{OH} = -2.4 mA | 2.4 | 3.4 | | V |
| V _{OL} | V _{CC} = MIN, V _{IH} = 2 V, I _{OL} = 48 mA | | 0.2 | 0.4 | V |
| I _I | V _{CC} = MAX, V _I = 5.5 V | | | 1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.4 V | | | 40 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.4 V | | | -1.6 | mA |
| I _{OS} § | V _{CC} = MAX | -70 | | -180 | mA |
| I _{CCH} | V _{CC} = MAX, V _I = 0 V | | 12 | 21 | mA |
| I _{CCL} | V _{CC} = MAX, See Note 2 | | 33 | 57 | mA |

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

‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.

§ Not more than one output should be shorted at a time and the duration of the short circuit should not exceed one second.

NOTE 2: One input at 4.5 V, all others at GND.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|------------------|--------------|-------------|---|-----|-----|-----|------|
| t _{PLH} | A or B | Y | R _L = 133 Ω, C _L = 50 pF | 6 | 9 | | ns |
| t _{PHL} | | | | 8 | 12 | | ns |
| t _{PLH} | | | R _L = 133 Ω, C _L = 150 pF | 10 | 15 | | ns |
| t _{PHL} | | | | 12 | 18 | | ns |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



SN5428, SN54LS28, SN7428, SN74LS28 QUADRUPLE 2-INPUT POSITIVE-NOR BUFFERS

SDLS094 – DECEMBER 1983 – REVISED MARCH 1988

recommended operating conditions

| | SN54LS28 | | | SN74LS28 | | | UNIT |
|---|----------|-----|------|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| V _{CC} Supply voltage | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| V _{IH} High-level input voltage | 2 | | | 2 | | | V |
| V _{IL} Low-level input voltage | | | 0.7 | | | 0.8 | V |
| I _{OH} High-level output current | | | -1.2 | | | -1.2 | mA |
| I _{OL} Low-level output current | | | 12 | | | 24 | mA |
| T _A Operating free-air temperature | -55 | | 125 | 0 | | 70 | °C |

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

| PARAMETER | TEST CONDITIONS † | SN54LS28 | | | SN74LS28 | | | UNIT |
|-------------------|---|----------|-------|------|----------|-------|------|------|
| | | MIN | TYP ‡ | MAX | MIN | TYP ‡ | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | | | -1.5 | | | -1.5 | V |
| V _{OH} | V _{CC} = MIN, V _{IL} = MAX, I _{OH} = -1.2 mA | 2.5 | 3.4 | | 2.7 | 3.4 | | V |
| V _{OL} | V _{CC} = MIN, V _{IH} = 2 V, I _{OL} = 12 mA | | 0.25 | 0.4 | | 0.24 | 0.4 | V |
| | V _{CC} = MIN, V _{IH} = 2 V, I _{OL} = 24 mA | | | | | 0.35 | 0.5 | |
| I _I | V _{CC} = MAX, V _I = 7 V | | | 0.1 | | | 0.1 | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | | | 20 | | | 20 | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.4 V | | | -0.4 | | | -0.4 | mA |
| I _{OS} § | V _{CC} = MAX | -30 | | -130 | -30 | | -130 | mA |
| I _{CCH} | V _{CC} = MAX, V _I = 0 V | | 1.8 | 3.6 | | 1.8 | 3.6 | mA |
| I _{CCL} | V _{CC} = MAX, See Note 2 | | 6.9 | 13.8 | | 6.9 | 13.8 | mA |

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

‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.

§ Not more than one output should be shorted at a time and the duration of the short circuit should not exceed one second.

NOTE 2: One input at 4.5 V, all others at GND.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see note 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|------------------|--------------|-------------|--|-----|-----|-----|------|
| t _{PLH} | A or B | Y | R _L = 667 Ω, C _L = 45 pF | | 12 | 24 | ns |
| t _{PHL} | | | | | 12 | 24 | |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.



PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| SN5428J | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | SN5428J | Samples |
| SN7428N | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN7428N | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN7428N3 | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN7428N3 | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28D | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28D | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28DR | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28DR | OBSOLETE | SOIC | D | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28N | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28N | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28N3 | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SN74LS28N3 | OBSOLETE | PDIP | N | 14 | | TBD | Call TI | Call TI | 0 to 70 | | |
| SNJ5428J | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | SNJ5428J | Samples |
| SNJ5428J | ACTIVE | CDIP | J | 14 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | SNJ5428J | Samples |
| SNJ5428W | ACTIVE | CFP | W | 14 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | SNJ5428W | Samples |
| SNJ5428W | ACTIVE | CFP | W | 14 | 1 | TBD | A42 | N / A for Pkg Type | -55 to 125 | SNJ5428W | Samples |

(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.

⁽⁴⁾ Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

OTHER QUALIFIED VERSIONS OF SN5428, SN7428 :

- Catalog: [SN7428](#)
- Military: [SN5428](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

J (R-GDIP-T**)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



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

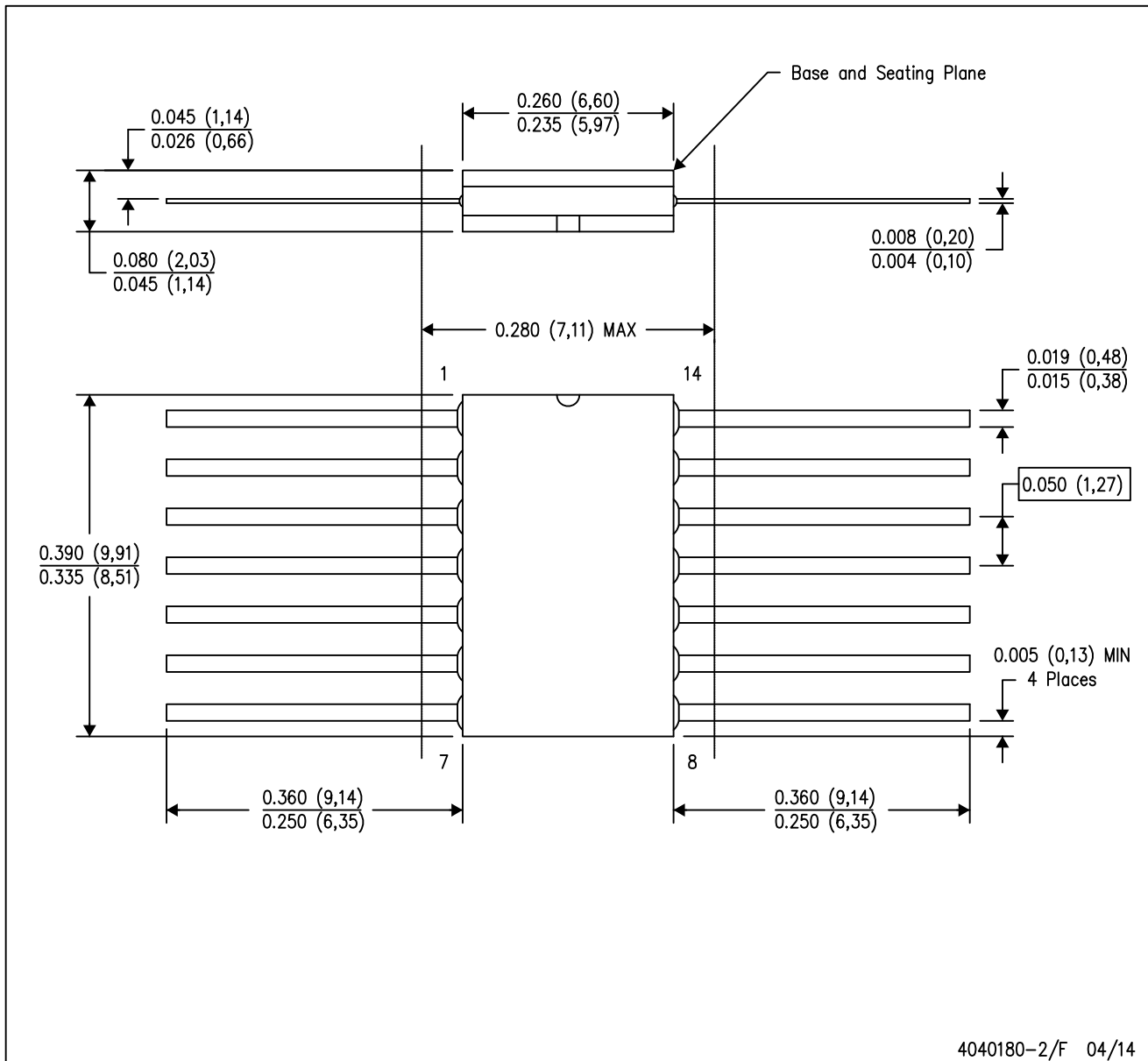


4040083/F 03/03

- 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

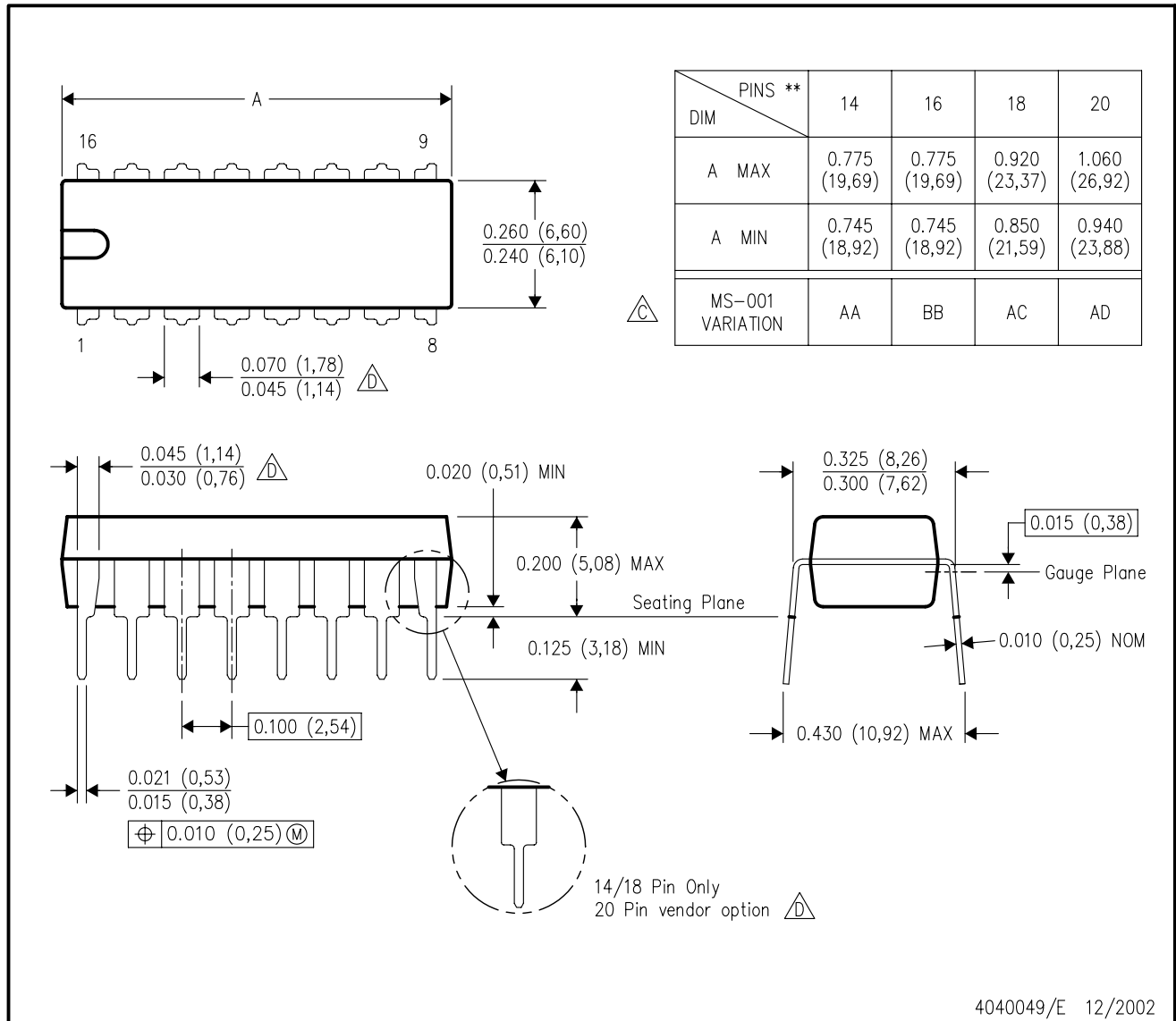


- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a ceramic lid using glass frit.
 - D. Index point is provided on cap for terminal identification only.
 - E. Falls within MIL STD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

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

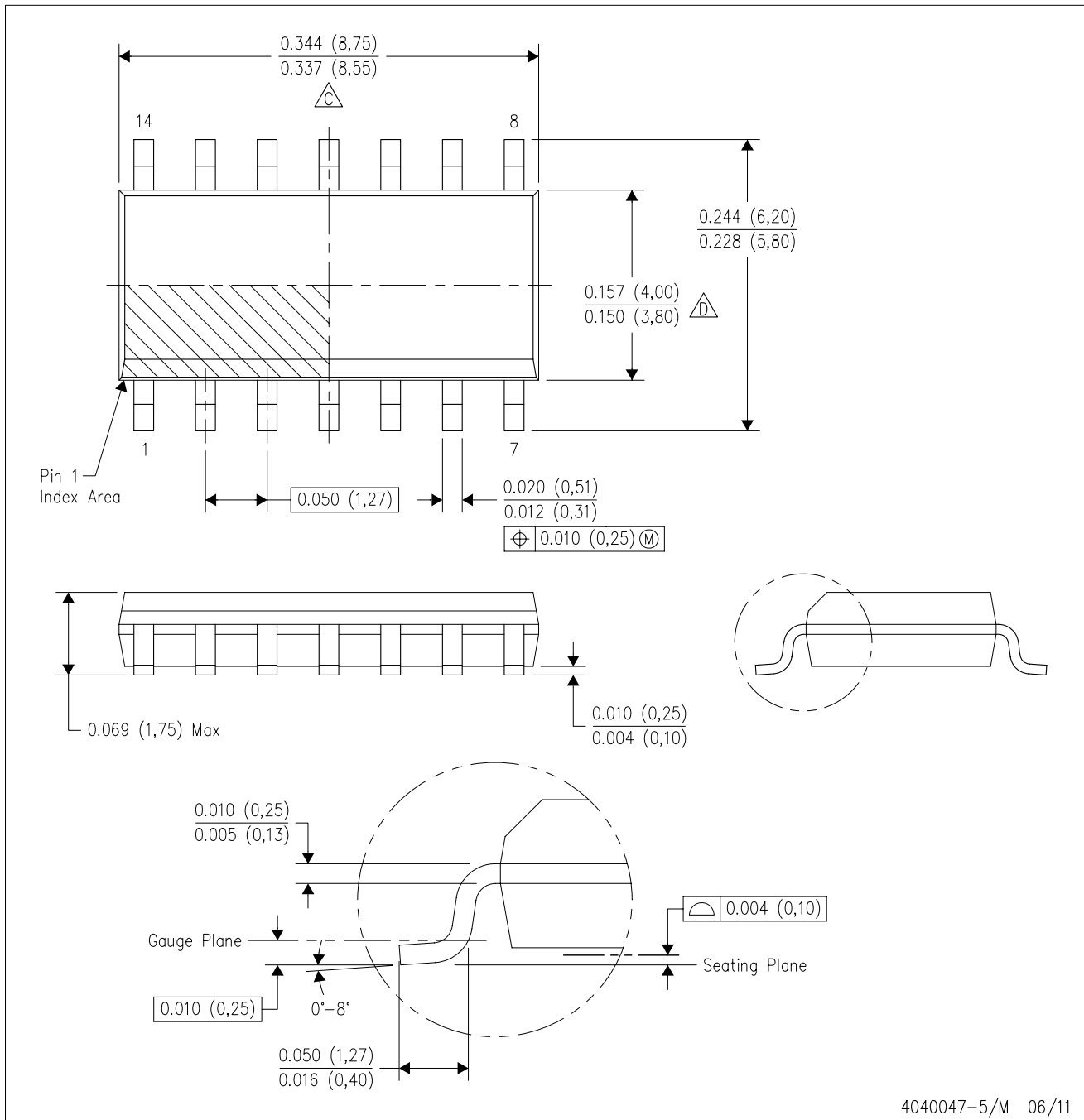
16 PINS SHOWN





- 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



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 -  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.
 -  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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

| | |
|------------------------------|--|
| Audio | www.ti.com/audio |
| Amplifiers | amplifier.ti.com |
| Data Converters | dataconverter.ti.com |
| DLP® Products | www.dlp.com |
| DSP | dsp.ti.com |
| Clocks and Timers | www.ti.com/clocks |
| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| OMAP Applications Processors | www.ti.com/omap |
| Wireless Connectivity | www.ti.com/wirelessconnectivity |

Applications

| | |
|-------------------------------|--|
| Automotive and Transportation | www.ti.com/automotive |
| Communications and Telecom | www.ti.com/communications |
| Computers and Peripherals | www.ti.com/computers |
| Consumer Electronics | www.ti.com/consumer-apps |
| Energy and Lighting | www.ti.com/energy |
| Industrial | www.ti.com/industrial |
| Medical | www.ti.com/medical |
| Security | www.ti.com/security |
| Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Video and Imaging | www.ti.com/video |

TI E2E Community

e2e.ti.com