

SN54LS139A, SN54S139, SN74LS139A, SN74S139A DUAL 2-LINE TO 4-LINE DECODERS/DEMULTIPLEXERS

SDLS013

DECEMBER 1972—REVISED MARCH 1988

- Designed Specifically for High-Speed: Memory Decoders Data Transmission Systems
- Two Fully Independent 2- to 4-Line Decoders/Demultiplexers
- Schottky Clamped for High Performance

description

These Schottky-clamped TTL MSI circuits are designed to be used in high-performance memory-decoding or data-routing applications requiring very short propagation delay times. In high-performance memory systems, these decoders can be used to minimize the effects of system decoding. When employed with high-speed memories utilizing a fast-enable circuit, the delay times of these decoders and the enable time of the memory are usually less than the typical access time of the memory. This means that the effective system delay introduced by the Schottky-clamped system decoder is negligible.

The circuit comprises two individual two-line to four-line decoders in a single package. The active-low enable input can be used as a data line in demultiplexing applications.

All of these decoders/demultiplexers feature fully buffered inputs, each of which represents only one normalized load to its driving circuit. All inputs are clamped with high-performance Schottky diodes to suppress line-ringing and to simplify system design. The SN54LS139A and SN54S139 are characterized for operation range of -55°C to 125°C . The SN74LS139A and SN74S139A are characterized for operation from 0°C to 70°C .

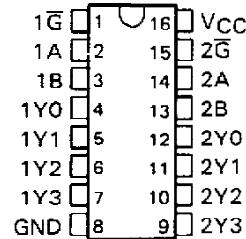
FUNCTION TABLE

| INPUTS | | | OUTPUTS | | | |
|-----------------------|--------|---|---------|----|----|----|
| ENABLE | SELECT | | Y0 | Y1 | Y2 | Y3 |
| $\overline{\text{G}}$ | B | A | | | | |
| H | X | X | H | H | H | H |
| L | L | L | L | H | H | H |
| L | L | H | H | L | H | H |
| L | H | L | H | H | L | H |
| L | H | H | H | H | H | L |

H = high level, L = low level, X = irrelevant

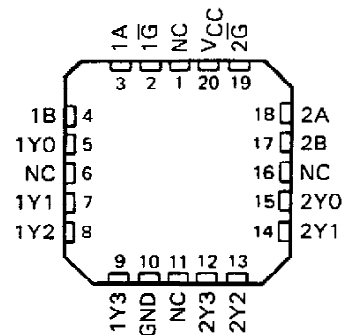
SN54LS139A, SN54S139 . . . J OR W PACKAGE
SN74LS139A, SN74S139A . . . D OR N PACKAGE

(TOP VIEW)



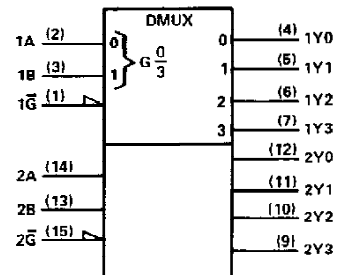
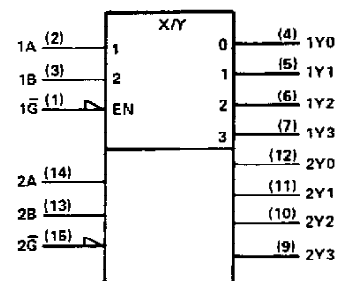
SN54LS139A, SN54S139 . . . FK PACKAGE

(TOP VIEW)



NC—No internal connection

logic symbols (alternatives)†



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12.

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

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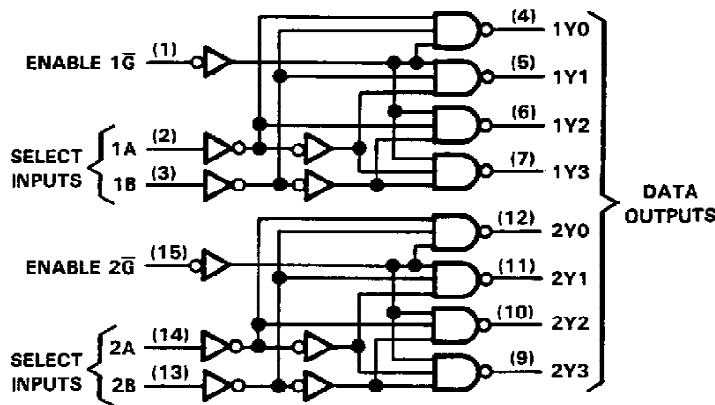
TEXAS
INSTRUMENTS

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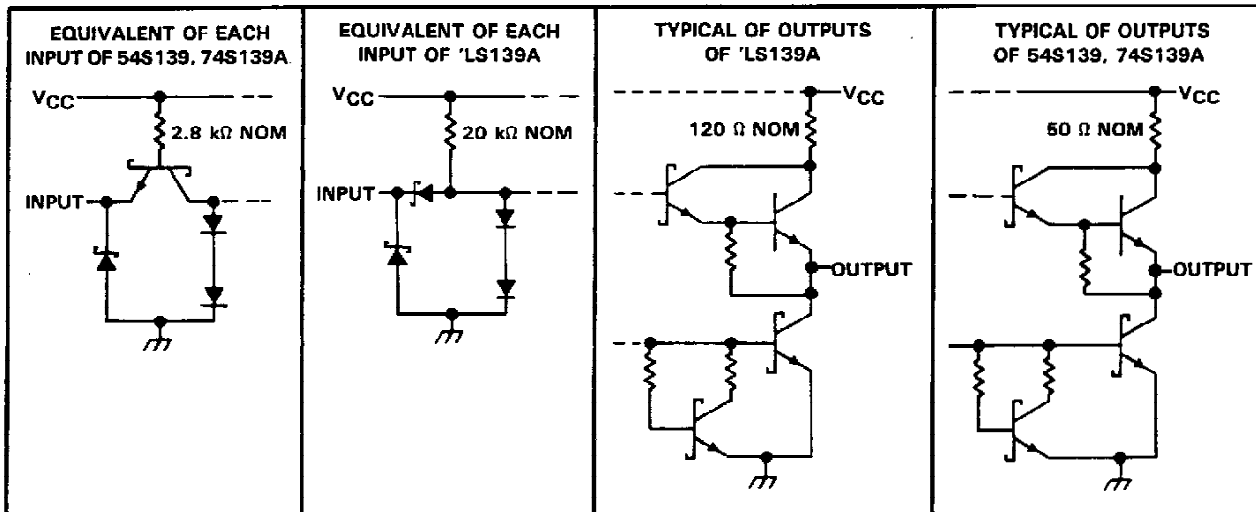
SN54LS139A, SN54S139, SN74LS139A, SN74S139A DUAL 2-LINE TO 4-LINE DECODERS/DEMULTIPLEXERS

logic diagram (positive logic)



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

schematics of inputs and outputs



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

| | |
|--|----------------|
| Supply voltage, V_{CC} (See Note 1) | 7 V |
| Input voltage: 'LS139A | 7 V |
| 54S139, 74S139A | 5.5 V |
| Operating free-air temperature range: SN54LS139A, SN54S139 | -55°C to 125°C |
| SN74LS139A, SN74S139A | 0°C to 70°C |
| Storage temperature range | -65°C to 150°C |

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

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SN54LS139A, SN74LS139A DUAL 2-LINE TO 4-LINE DECODERS/DEMULTIPLEXERS

recommended operating conditions

| | | SN54LS139A | | | SN74LS139A | | | 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 | | | -0.4 | | | -0.4 | mA |
| I _{OL} | Low-level output current | | | 4 | | | 8 | 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 [†] | SN54LS139A | | SN74LS139A | | 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 _{IH} = 2 V, V _{IL} = MAX, I _{OH} = -0.4 mA | 2.5 | 3.4 | | 2.7 | 3.4 | V | |
| V _{OL} | V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = MAX | I _{OL} = 4 mA | | 0.25 | 0.4 | 0.25 | 0.4 | V |
| | | I _{OL} = 8 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 | -20 | | -100 | -20 | | -100 | mA |
| I _{CC} | V _{CC} = MAX, Outputs enabled and open | | 6.8 | 11 | | 6.8 | 11 | 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 duration of the short circuit test should not exceed one second.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Note 2)

| PARAMETER [¶] | FROM (INPUT) | TO (OUTPUT) | LEVELS OF DELAY | TEST CONDITIONS | SN54LS139A SN74LS139A | | | UNIT |
|------------------------|---------------|-------------|-----------------|---|--------------------------|-----|-----|------|
| | | | | | MIN | TYP | MAX | |
| t _{PLH} | Binary Select | Any | 2 | R _L = 2 kΩ, C _L = 15 pF | | 13 | 20 | ns |
| t _{PHL} | | | | | | 22 | 33 | ns |
| t _{PLH} | | | 3 | | | 18 | 29 | ns |
| t _{PHL} | | | | | | 25 | 38 | ns |
| t _{PLH} | Enable | Any | 2 | | | 16 | 24 | ns |
| t _{PHL} | | | | | | 21 | 32 | ns |

[¶] t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.


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SN54S139, SN74S139A

DUAL 2-LINE TO 4-LINE DECODERS/DEMULTIPLIERS

recommended operating conditions

| | | SN54S139 | | | SN74S139A | | | 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 | | | V |
| I _{OH} | High-level output current | | | | -1 | | | mA |
| I _{OL} | Low-level output current | | | | 20 | | | mA |
| T _A | Operating free-air temperature | -55 | | | 125 | | | °C |

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

| PARAMETER | TEST CONDITIONS† | SN54S139 SN74S139A | | | UNIT |
|-------------------|--|-----------------------|------|-----|------|
| | | MIN | TYP‡ | MAX | |
| V _{IK} | V _{CC} = MIN, I _I = -18 mA | -1.2 | | | V |
| V _{OH} | V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OH} = -1 mA | SN54S* | 2.5 | 3.4 | V |
| | | SN74S* | 2.7 | 3.4 | |
| V _{OL} | V _{CC} = MIN, V _{IH} = 2 V, V _{IL} = 0.8 V, I _{OL} = 20 mA | 0.5 | | | V |
| I _I | V _{CC} = MAX, V _I = 5.5 V | 1 | | | mA |
| I _{IH} | V _{CC} = MAX, V _I = 2.7 V | 50 | | | μA |
| I _{IL} | V _{CC} = MAX, V _I = 0.5 V | -2 | | | mA |
| I _{OS} § | V _{CC} = MAX | -40 | -100 | | mA |
| I _{CC} | V _{CC} = MAX, Outputs enabled and open | 60 90 | | | 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 duration of the short circuit test should not exceed one second.

switching characteristics, V_{CC} = 5 V, T_A = 25°C (see Note 2)

| PARAMETER† | FROM (INPUT) | TO (OUTPUT) | LEVELS OF DELAY | TEST CONDITIONS | SN54S139 SN74S139A | | | UNIT |
|------------------|---------------|-------------|-----------------|--|-----------------------|-----|-----|------|
| | | | | | MIN | TYP | MAX | |
| t _{PLH} | Binary Select | Any | 2 | R _L = 280 Ω, C _L = 15 pF | 5 | 7.5 | ns | |
| t _{PHL} | | | | | 6.5 | 10 | ns | |
| t _{PLH} | | | 3 | | 7 | 12 | ns | |
| t _{PHL} | | | | | 8 | 12 | ns | |
| t _{PLH} | Enable | Any | 2 | | 5 | 8 | ns | |
| t _{PHL} | | | | | 6.5 | 10 | ns | |

† t_{PLH} = propagation delay time, low-to-high-level output

t_{PHL} = propagation delay time, high-to-low-level output

NOTE 2: Load circuits and voltage waveforms are shown in Section 1.

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PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| 76007012A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| 7600701EA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| 7600701FA | ACTIVE | CFP | W | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| 7700401EA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| 7700401FA | ACTIVE | CFP | W | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| JM38510/30702B2A | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| JM38510/30702BEA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| JM38510/30702BFA | ACTIVE | CFP | W | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| JM38510/30702SEA | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| JM38510/30702SFA | ACTIVE | CFP | W | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SN54LS139AJ | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SN54S139J | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SN74LS139AD | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139ADE4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139ADG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139ADR | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139ADRE4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139ADRG4 | ACTIVE | SOIC | D | 16 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139AN | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS139AN3 | OBSOLETE | PDIP | N | 16 | | TBD | Call TI | Call TI |
| SN74LS139ANE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74LS139ANSR | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139ANSRE4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74LS139ANSRG4 | ACTIVE | SO | NS | 16 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74S139AD | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74S139ADE4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74S139ADG4 | ACTIVE | SOIC | D | 16 | 40 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| SN74S139AN | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SN74S139AN3 | OBSOLETE | PDIP | N | 16 | | TBD | Call TI | Call TI |
| SN74S139ANE4 | ACTIVE | PDIP | N | 16 | 25 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type |
| SNJ54LS139AFK | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SNJ54LS139AJ | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SNJ54LS139AW | ACTIVE | CFP | W | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SNJ54S139FK | ACTIVE | LCCC | FK | 20 | 1 | TBD | POST-PLATE | N / A for Pkg Type |
| SNJ54S139J | ACTIVE | CDIP | J | 16 | 1 | TBD | A42 | N / A for Pkg Type |
| SNJ54S139W | ACTIVE | CFP | W | 16 | 1 | TBD | A42 | N / A for Pkg Type |

⁽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.

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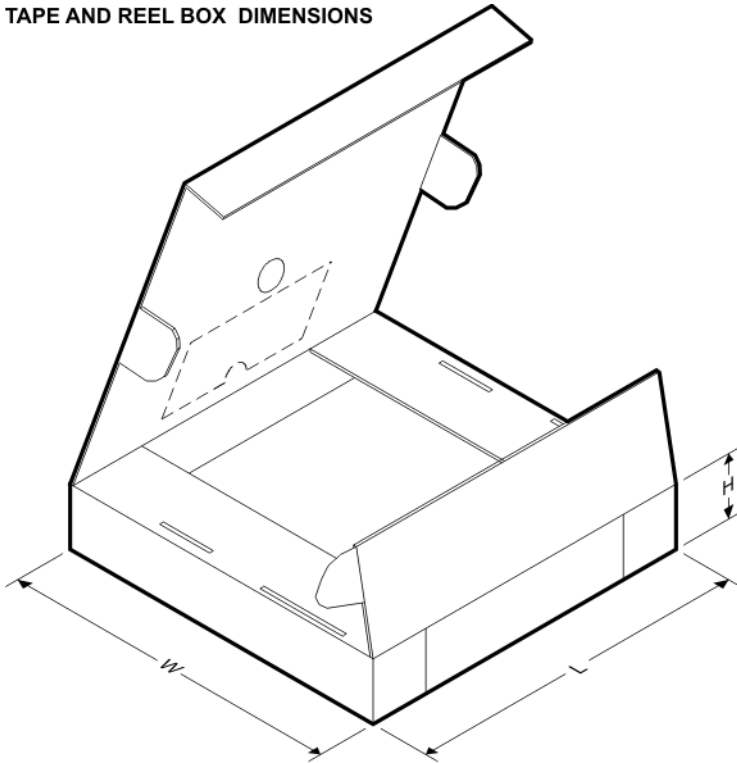
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TAPE AND REEL INFORMATION

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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LS139ADR | SOIC | D | 16 | 2500 | 330.0 | 16.4 | 6.5 | 10.3 | 2.1 | 8.0 | 16.0 | Q1 |
| SN74LS139ANSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 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) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LS139ADR | SOIC | D | 16 | 2500 | 333.2 | 345.9 | 28.6 |
| SN74LS139ANSR | SO | NS | 16 | 2000 | 346.0 | 346.0 | 33.0 |

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) |

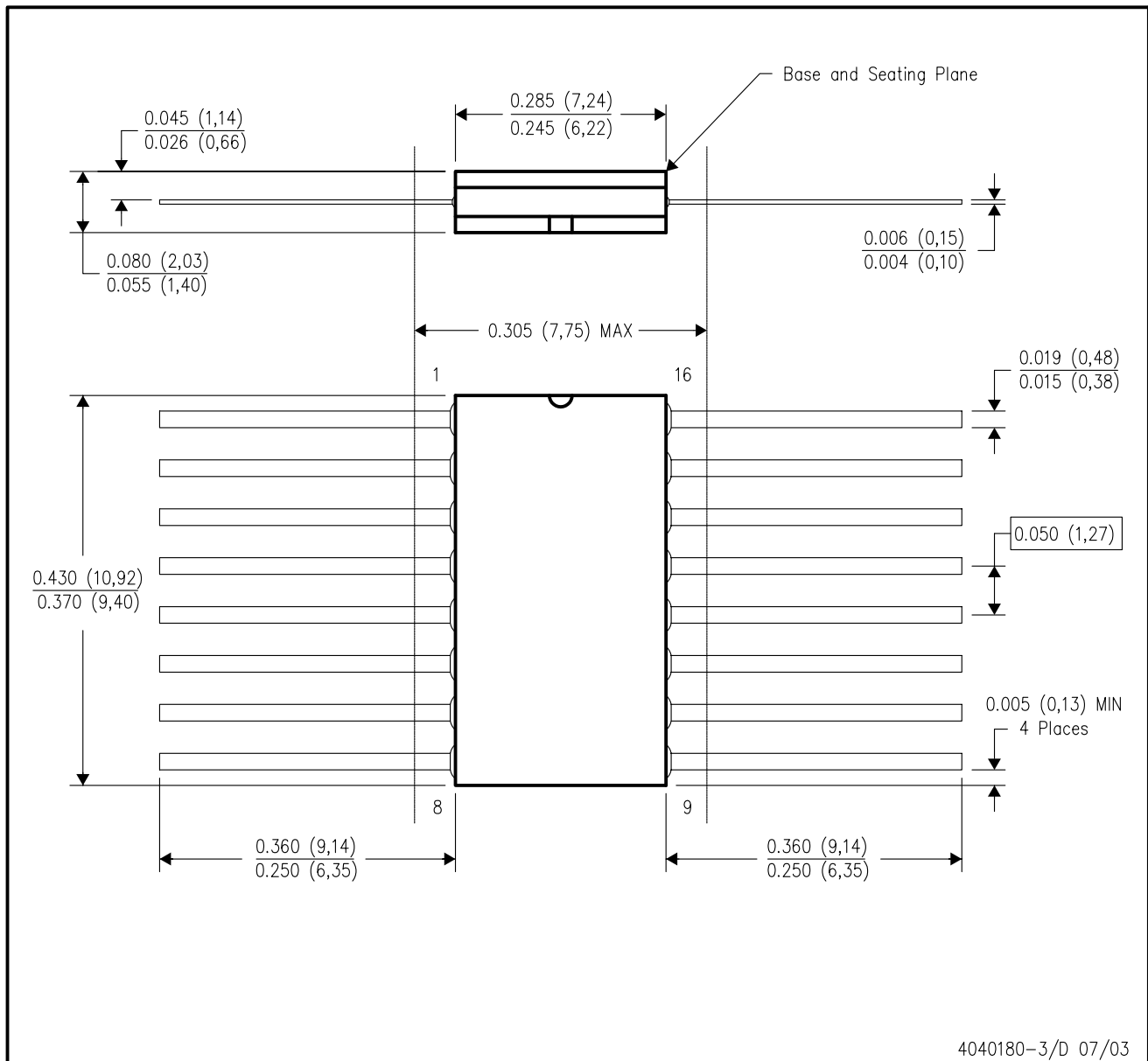


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- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - This package is hermetically sealed with a ceramic lid using glass frit.
 - Index point is provided on cap for terminal identification 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-F16)

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-F16 and JEDEC MO-092AC

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

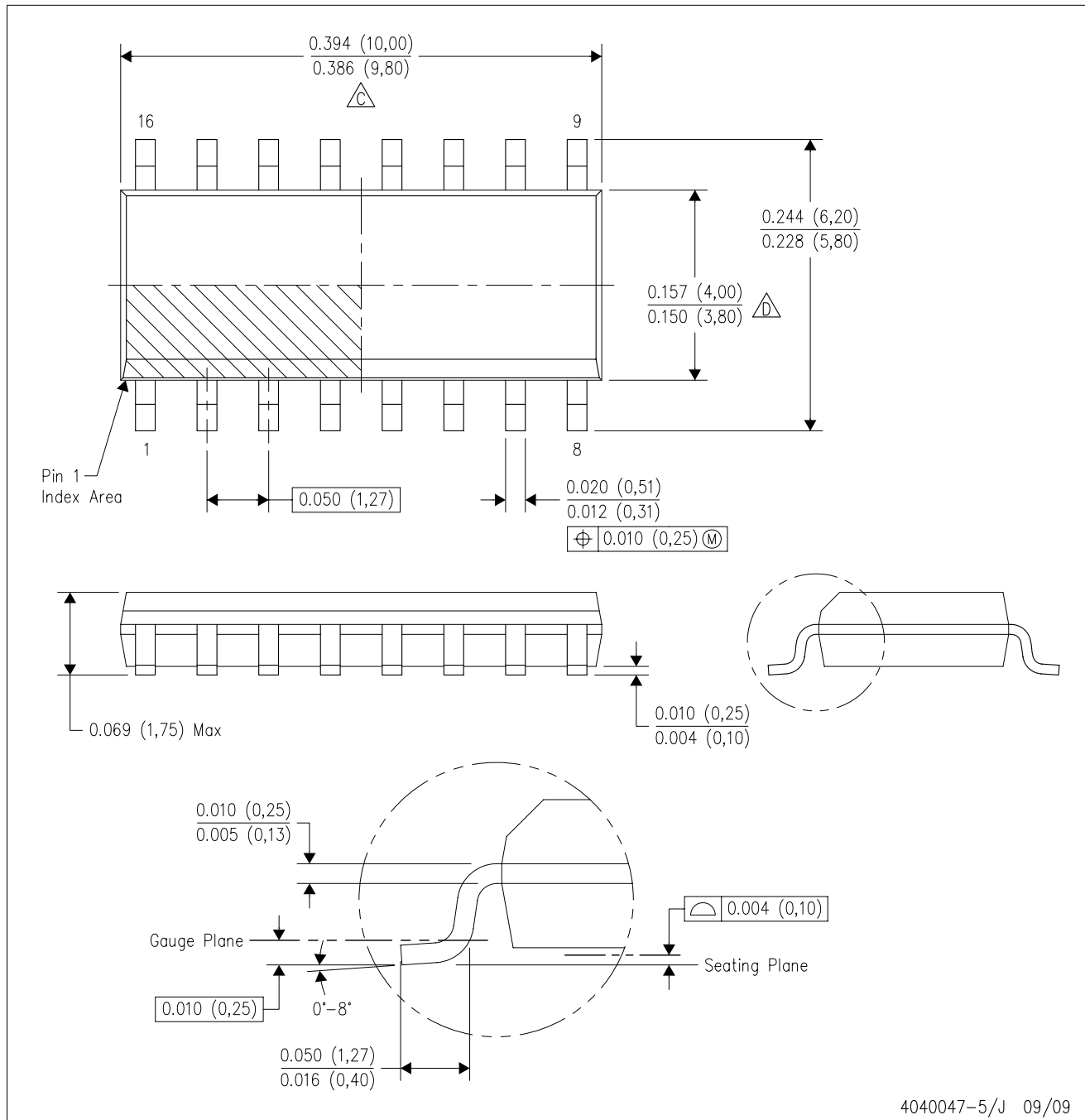
16 PINS SHOWN



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

D (R-PDSO-G16)

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 AC.

D(R-PDSO-G16)



4209373/A 03/08

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Refer to IPC7351 for alternate board design.
 - D. 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
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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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