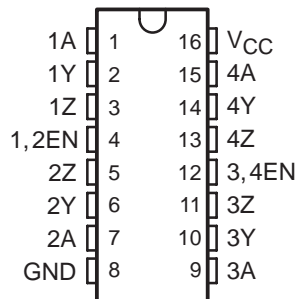


# MC3487 QUADRUPLE DIFFERENTIAL LINE DRIVER

SLLS098C – MAY 1980 – REVISED FEBRUARY 2004

- Meets or Exceeds Requirements of ANSI TIA/EIA-422-B and ITU Recommendation V.11
- 3-State, TTL-Compatible Outputs
- Fast Transition Times
- High-Impedance Inputs
- Single 5-V Supply
- Power-Up and Power-Down Protection

D, N, OR NS PACKAGE  
(TOP VIEW)



## description/ordering information

The MC3487 offers four independent differential line drivers designed to meet the specifications of ANSI TIA/EIA-422-B and ITU Recommendation V.11. Each driver has a TTL-compatible input buffered to reduce current and minimize loading.

The driver outputs utilize 3-state circuitry to provide high-impedance states at any pair of differential outputs when the appropriate output enable is at a low logic level. Internal circuitry is provided to ensure the high-impedance state at the differential outputs during power-up and power-down transition times, provided the output enable is low.

The MC3487 is designed for optimum performance when used with the MC3486 quadruple line receiver. It is supplied in a 16-pin dual-in-line package and operates from a single 5-V supply.

## ORDERING INFORMATION

| TA          | PACKAGE† |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|-------------|----------|---------------|-----------------------|------------------|
| 0°C to 70°C | PDIP – N | Tube          | MC3487N               | MC3487N          |
|             | SOIC – D | Tube          | MC3487D               | MC3487           |
|             |          | Tape and reel | MC3487DR              |                  |
|             | SOP – NS | Tape and reel | MC3487NSR             | MC3487           |

† 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 driver)

| INPUT | OUTPUT ENABLE | OUTPUTS |   |
|-------|---------------|---------|---|
|       |               | Y       | Z |
| H     | H             | H       | L |
| L     | H             | L       | H |
| X     | L             | Z       | Z |

H = TTL high level, L = TTL low level,  
X = irrelevant, Z = High impedance



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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**

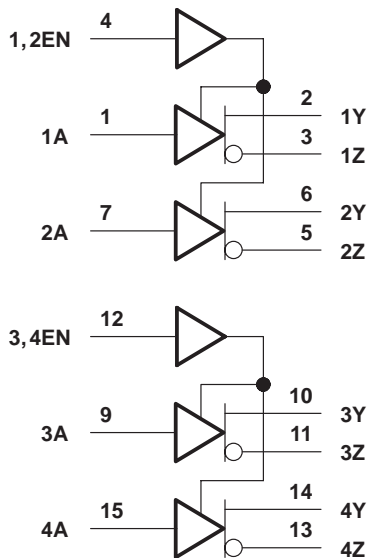
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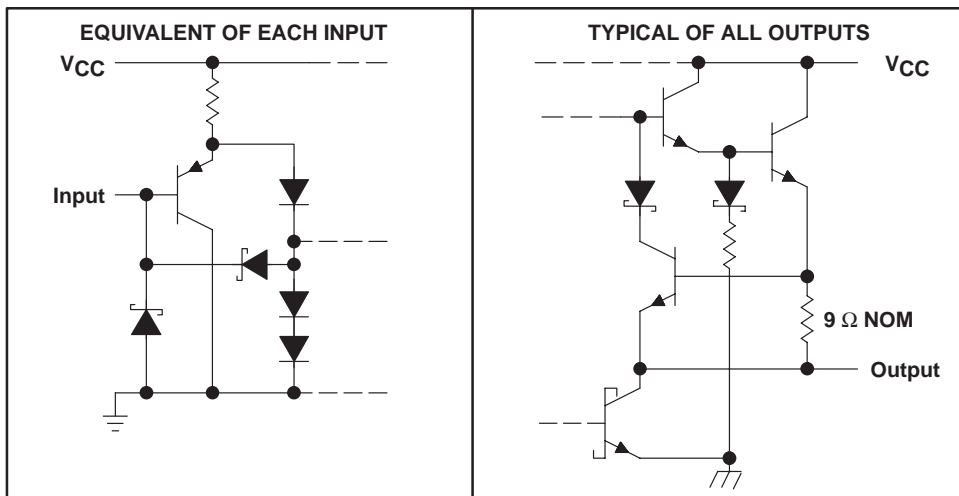
# MC3487 QUADRUPLE DIFFERENTIAL LINE DRIVER

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## logic diagram (positive logic)



## schematics of inputs and outputs



# MC3487 QUADRUPLE DIFFERENTIAL LINE DRIVER

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

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$ (see Note 1) .....                                   | 8 V            |
| Input voltage, $V_I$ .....  | 5.5 V          |
| Output voltage, $V_O$ .....   | 7 V            |
| Package thermal impedance, $\theta_{JA}$ (see Notes 2 and 3): D package ..... | 73°C/W         |
| N package .....   | 67°C/W         |
| NS package .....  | 64°C/W         |
| Operating virtual junction temperature, $T_J$ .....                           | 150°C          |
| Storage temperature range, $T_{Stg}$ .....                                    | –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.

- NOTES: 1. All voltage values, except differential output voltage,  $V_{OD}$ , are with respect to the network ground terminal.  
 2. 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.  
 3. The package thermal impedance is calculated in accordance with JESD 51-7.

## recommended operating conditions

|                                      | MIN  | NOM | MAX  | UNIT |
|--------------------------------------|------|-----|------|------|
| $V_{CC}$ Supply voltage              | 4.75 | 5   | 5.25 | V    |
| $V_{IH}$ High-level input voltage    | 2    |     |      | V    |
| $V_{IL}$ Low-level input voltage     |      |     | 0.8  | V    |
| $T_A$ Operating free-air temperature | 0    |     | 70   | °C   |



# MC3487

## QUADRUPLE DIFFERENTIAL LINE DRIVER

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electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

| PARAMETER        |   | TEST CONDITIONS                   |                          |                           | MIN  | MAX       | UNIT          |
|------------------|---|-----------------------------------|--------------------------|---------------------------|------|-----------|---------------|
| $V_{IK}$         | Input clamp voltage                                 | $I_I = -18 \text{ mA}$            |                          |                           |      | -1.5      | V             |
| $V_{OH}$         | High-level output voltage                           | $V_{IL} = 0.8 \text{ V}$ ,        | $V_{IH} = 2 \text{ V}$ , | $I_{OH} = -20 \text{ mA}$ | 2.5  |           | V             |
| $V_{OL}$         | Low-level output voltage                            | $V_{IL} = 0.8 \text{ V}$ ,        | $V_{IH} = 2 \text{ V}$ , | $I_{OL} = 48 \text{ mA}$  |      | 0.5       | V             |
| $ V_{OD} $       | Differential output voltage                         | $R_L = 100 \Omega$ ,              | See Figure 1             |                           | 2    |           |               |
| $\Delta V_{OD} $ | Change in magnitude of differential output voltage† | $R_L = 100 \Omega$ ,              | See Figure 1             |                           |      | $\pm 0.4$ | V             |
| $V_{OC}$         | Common-mode output voltage‡                         | $R_L = 100 \Omega$ ,              | See Figure 1             |                           |      | 3         | V             |
| $\Delta V_{OC} $ | Change in magnitude of common-mode output voltage‡  | $R_L = 100 \Omega$ ,              | See Figure 1             |                           |      | $\pm 0.4$ | V             |
| $I_O$            | Output current with power off                       | $V_{CC} = 0$                      | $V_O = 6 \text{ V}$      |                           | 100  |           | $\mu\text{A}$ |
|                  |   |                                   | $V_O = -0.25 \text{ V}$  |                           | -100 |           |               |
| $I_{OZ}$         | High-impedance-state output current                 | Output enables at $0.8 \text{ V}$ | $V_O = 2.7 \text{ V}$    |                           | 100  |           | $\mu\text{A}$ |
|                  |   |                                   | $V_O = 0.5 \text{ V}$    |                           | -100 |           |               |
| $I_I$            | Input current at maximum input voltage              | $V_I = 5.5 \text{ V}$             |                          |                           |      | 100       | $\mu\text{A}$ |
| $I_{IH}$         | High-level input current                            | $V_I = 2.7 \text{ V}$             |                          |                           |      | 50        | $\mu\text{A}$ |
| $I_{IL}$         | Low-level input current                             | $V_I = 0.5 \text{ V}$             |                          |                           |      | -400      | $\mu\text{A}$ |
| $I_{OS}$         | Short-circuit output current§                       | $V_I = 2 \text{ V}$               |                          |                           | -40  | -140      | mA            |
| $I_{CC}$         | Supply current (all drivers)                        | Outputs disabled                  |                          |                           |      | 105       | mA            |
|                  |   | Outputs enabled, No load          |                          |                           |      | 85        |               |

†  $\Delta|V_{OD}|$  and  $\Delta|V_{OC}|$  are the changes in magnitude of  $V_{OD}$  and  $V_{OC}$ , respectively, that occur when the input is changed from a high level to a low level.

‡ In ANSI Standard TIA/EIA-422-B,  $V_{OC}$ , which is the average of the two output voltages with respect to ground, is called output offset voltage,  $V_{OS}$ .

§ Only one output at a time should be shorted, and duration of the short circuit should not exceed one second.

switching characteristics over recommended operating free-air temperature range,  $V_{CC} = 5 \text{ V}$

| PARAMETER |   | TEST CONDITIONS         |              |  | MIN | MAX | UNIT |
|-----------|---|-------------------------|--------------|--|-----|-----|------|
| $t_{PLH}$ | Propagation delay time, low- to high-level output | $C_L = 15 \text{ pF}$ , | See Figure 2 |  | 20  |     | ns   |
| $t_{PHL}$ | Propagation delay time, high- to low-level output |                         |              |  | 20  |     |      |
| $t_{sk}$  | Skew time   | $C_L = 15 \text{ pF}$ , | See Figure 2 |  | 6   |     | ns   |
| $t_t(OD)$ | Differential-output transition time               | $C_L = 15 \text{ pF}$ , | See Figure 3 |  | 20  |     | ns   |
| $t_{PZH}$ | Output enable time to high level                  | $C_L = 50 \text{ pF}$ , | See Figure 4 |  | 30  |     | ns   |
| $t_{PZL}$ | Output enable time to low level                   |                         |              |  | 30  |     |      |
| $t_{PHZ}$ | Output disable time from high level               | $C_L = 50 \text{ pF}$ , | See Figure 4 |  | 25  |     | ns   |
| $t_{PLZ}$ | Output disable time from low level                |                         |              |  | 30  |     |      |



PARAMETER MEASUREMENT INFORMATION

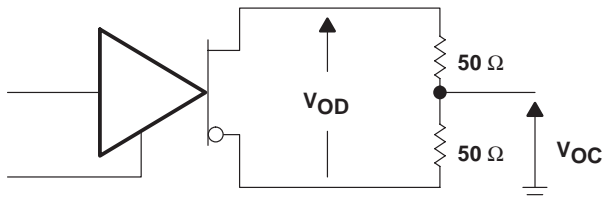
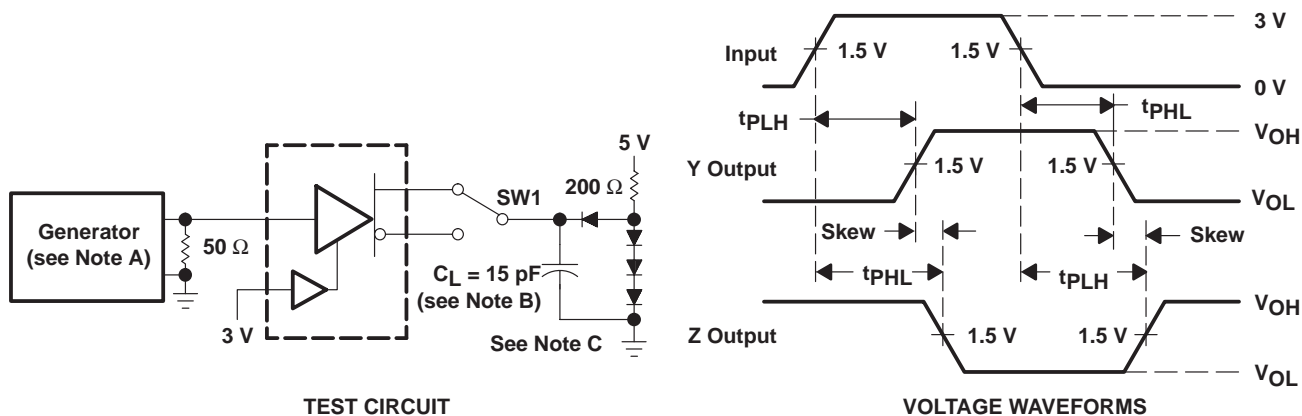
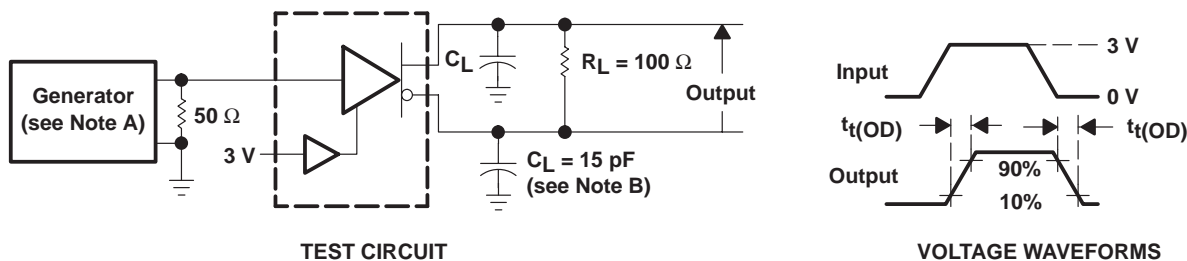


Figure 1. Differential and Common-Mode Output Voltages



- NOTES: A. The input pulse is supplied by a generator having the following characteristics:  $t_r \leq 5$  ns,  $t_f \leq 5$  ns, PRR  $\leq 1$  MHz, duty cycle = 50%,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.  
 C. All diodes are 1N916 or 1N3064.

Figure 2. Test Circuit and Voltage Waveforms



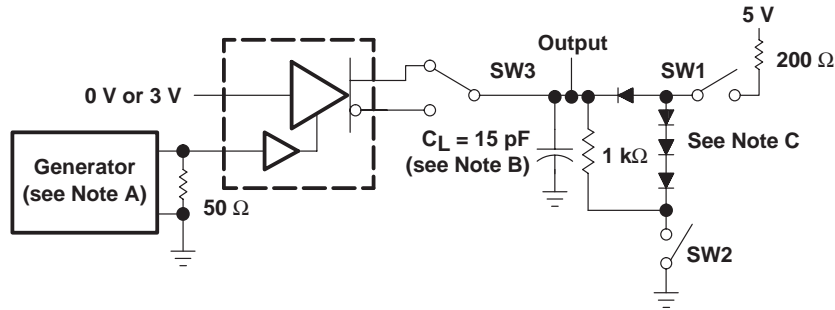
- NOTES: A. The input pulse is supplied by a generator having the following characteristics:  $t_r \leq 5$  ns,  $t_f \leq 5$  ns, PRR  $\leq 1$  MHz, duty cycle = 50%,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.

Figure 3. Test Circuit and Voltage Waveforms

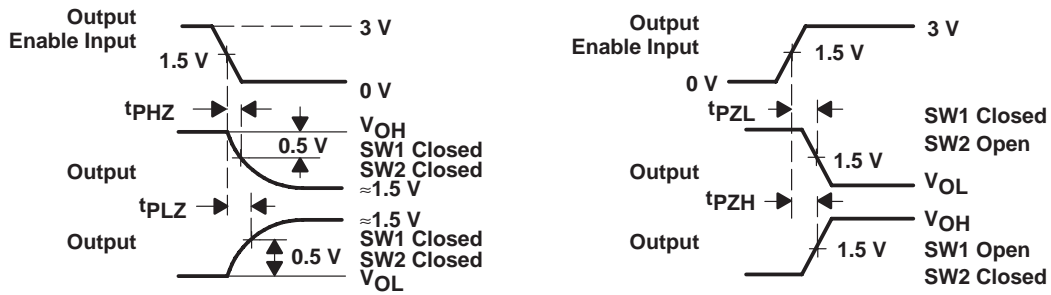
# MC3487 QUADRUPLE DIFFERENTIAL LINE DRIVER

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## PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

- NOTES: A. The input pulse is supplied by a generator having the following characteristics:  $t_r \leq 5 \text{ ns}$ ,  $t_f \leq 5 \text{ ns}$ ,  $\text{PRR} \leq 1 \text{ MHz}$ , duty cycle = 50%,  $Z_O = 50 \Omega$ .  
 B.  $C_L$  includes probe and stray capacitance.  
 C. All diodes are 1N916 or 1N3064.

Figure 4. Driver Test 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> |
|------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| MC3487D          | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487DE4        | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487DG4        | ACTIVE                | SOIC         | D               | 16   | 40          | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487DR         | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487DRE4       | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487DRG4       | ACTIVE                | SOIC         | D               | 16   | 2500        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487J          | OBSOLETE              | CDIP         | J               | 16   |             | TBD                     | Call TI          | Call TI                      |
| MC3487N          | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| MC3487NE4        | ACTIVE                | PDIP         | N               | 16   | 25          | Pb-Free (RoHS)          | CU NIPDAU        | N / A for Pkg Type           |
| MC3487NSR        | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487NSRE4      | ACTIVE                | SO           | NS              | 16   | 2000        | Green (RoHS & no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM           |
| MC3487NSRG4      | ACTIVE                | SO           | NS              | 16   | 2000        | 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.

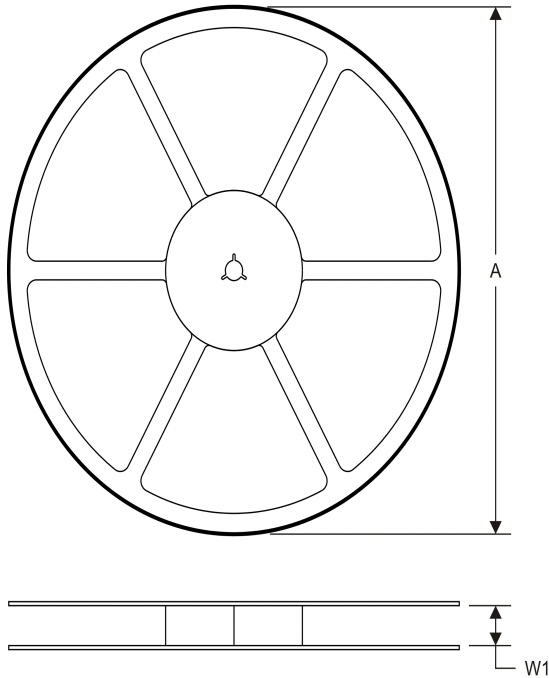
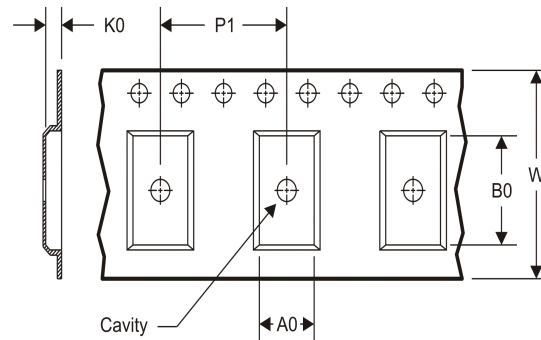
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<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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**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 |
|-----------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| MC3487DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| MC3487DR  | SOIC         | D               | 16   | 2500 | 330.0              | 16.4               | 6.5     | 10.3    | 2.1     | 8.0     | 16.0   | Q1            |
| MC3487NSR | 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) |
|-----------|--------------|-----------------|------|------|-------------|------------|-------------|
| MC3487DR  | SOIC         | D               | 16   | 2500 | 333.2       | 345.9      | 28.6        |
| MC3487DR  | SOIC         | D               | 16   | 2500 | 367.0       | 367.0      | 38.0        |
| MC3487NSR | SO           | NS              | 16   | 2000 | 367.0       | 367.0      | 38.0        |

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.

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.
  - $\triangle C$  Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
  - $\triangle D$  The 20 pin end lead shoulder width is a vendor option, either half or full width.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



4040047-6/M 06/11

- 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 0.006 (0,15) each side.
  -  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 AC.

D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- 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.

# 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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### Products

|                        |  |
|------------------------|--|
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| Amplifiers             | <a href="http://amplifier.ti.com">amplifier.ti.com</a>                               |
| Data Converters        | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products          | <a href="http://www.dlp.com">www.dlp.com</a>   |
| DSP                    | <a href="http://dsp.ti.com">dsp.ti.com</a>   |
| Clocks and Timers      | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>                             |
| Interface              | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                  | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt             | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers       | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                   | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Mobile Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity  | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

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| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
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