# DUAL PROCESSOR SUPERVISORY CIRCUITS WITH POWER-FAIL

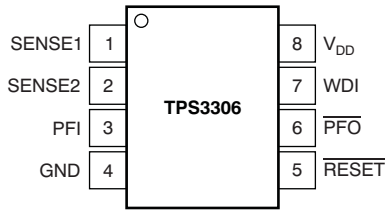
## FEATURES

- **Dual Supervisory Circuits With Power-Fail for DSP and Processor-Based Systems**
- **Voltage Monitor for Power-Fail or Low-Battery Warning**
- **Watchdog Timer With 0.8 Second Time-Out**
- **Power-On Reset Generator With Integrated 100 ms Delay Time**
- **Open-Drain Reset and Power-Fail Output**
- **Supply Current of 15 μA (Typ.)**
- **Supply Voltage Range: 7 V to 6 V**
- **Defined $\overline{\text{RESET}}$ Output From $V_{DD} \geq$ 1.1 V**
- **MSOP-8 and SO-8 Packages**
- **Temperature Range: –40°C to +85°C**

## APPLICATIONS

- **Multivoltage DSPs and Processors**
- **Portable Battery-Powered Equipment**
- **Embedded Control Systems**
- **Intelligent Instruments**
- **Automotive Systems**

**D OR DGK PACKAGE**
**(TOP VIEW)**

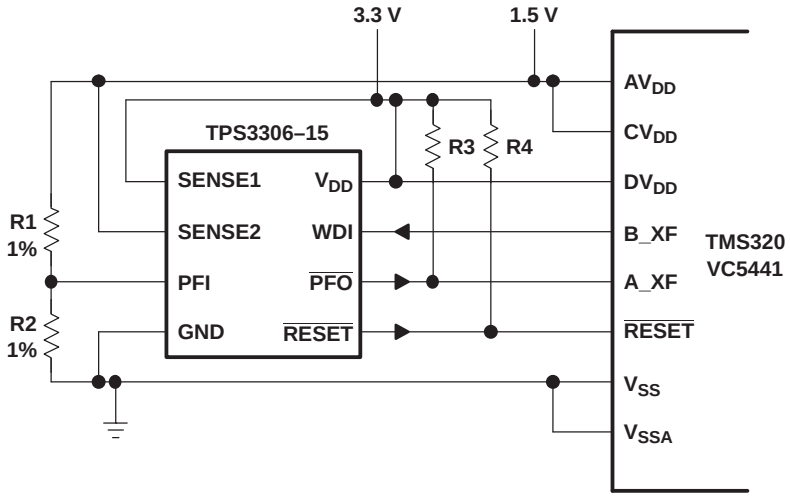



## DESCRIPTION

The TPS3306 family is a series of supervisory circuits designed for circuit initialization which require two supply voltages, primarily in DSP and processor-based systems.

The product spectrum of the TPS3306-xx is designed for monitoring two independent supply voltages of 3.3 V/1.5 V, 3.3 V/1.8 V, 3.3 V/2 V, 3.3 V/2.5 V, or 3.3 V/5 V.

**TYPICAL OPERATING CIRCUIT**



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## AVAILABLE OPTIONS

**Table 1. SUPPLY VOLTAGE MONITORING**

| DEVICE | NOMINAL SUPERVISED VOLTAGE | | THRESHOLD VOLTAGE (TYP) | |
|---|---|---|---|---|
| | SENSE1 | SENSE2 | SENSE1 | SENSE2 |
| TPS3306-15 | 3.3 V | 1.5 V | 2.93 V | 1.4 V |
| TPS3306-18 | 3.3 V | 1.8 V | 2.93 V | 1.68 V |
| TPS3306-20 | 3.3 V | 2 V | 2.93 V | 1.85 V |
| TPS3306-25 | 3.3 V | 2.5 V | 2.93 V | 2.25 V |
| TPS3306-33 | 5 V | 3.3 V | 4.55 V | 2.93 V |

For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

## DESCRIPTION (CONTINUED)

The various supervisory circuits are designed to monitor the nominal supply voltage, as shown in the Supply Voltage Monitoring table.

During power-on, $\overline{\text{RESET}}$ is asserted when the supply voltage $V_{DD}$ becomes higher than 1.1 V. Thereafter, the supervisory circuits monitor the SENSEn inputs and keep $\overline{\text{RESET}}$ active as long as SENSEn remains below the threshold voltage $V_{IT}$.

An internal timer delays the return of the $\overline{\text{RESET}}$ output to the inactive state (high) to ensure proper system reset. The delay time, $t_{d(typ)}$ = 100 ms, starts after SENSE1 and SENSE2 inputs have risen above the threshold voltage $V_{IT}$. When the voltage at SENSE1 or SENSE2 input drops below the threshold voltage $V_{IT}$, the output becomes active (low) again.

The integrated power-fail (PFI) comparator with separate open-drain ($\overline{\text{PFO}}$) output can be used for low-battery detection, power-fail warning, or for monitoring a power supply other than the main supply.

The TPS3306-xx devices integrate a watchdog timer that is periodically triggered by a positive or negative transition of WDI. When the supervising system fails to retrigger the watchdog circuit within the time-out interval, $t_{t(out)}$ = 0.50 s, $\overline{\text{RESET}}$ becomes active for the time period $t_d$. This event also reinitializes the watchdog timer. Leaving WDI unconnected disables the watchdog.

The TPS3306-xx devices are available in either 8-pin MSOP or standard 8-pin SO packages, and are characterized for operation over a temperature range of –40°C to +85°C.

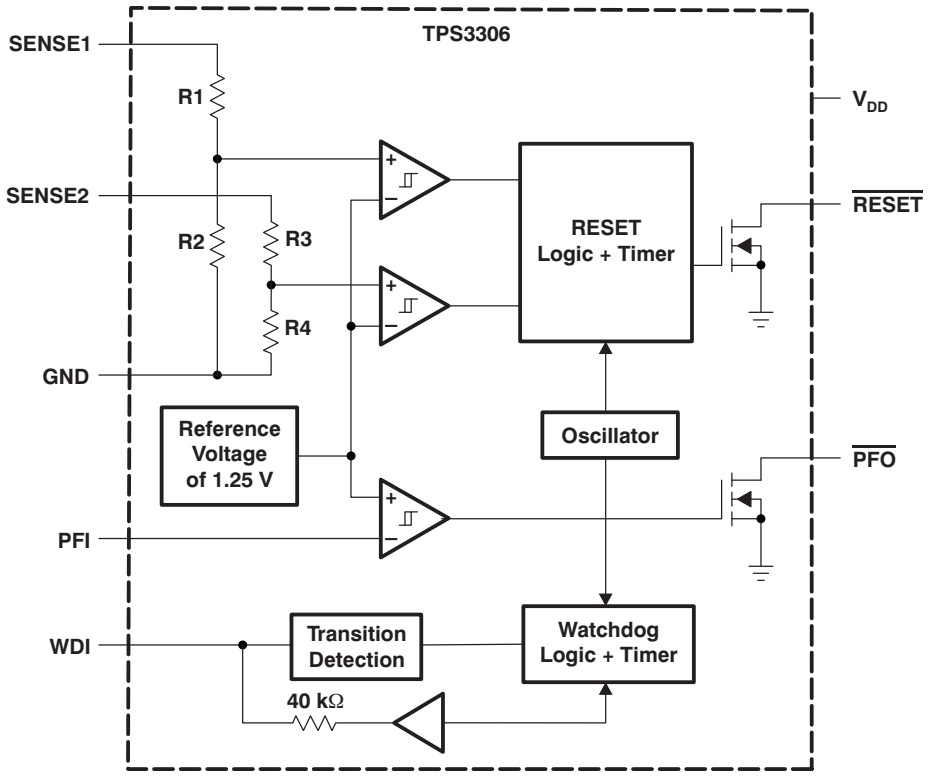
## FUNCTION/TRUTH TABLES

| SENSE1 > $V_{IT1}$ | SENSE2 > $V_{IT2}$ | $\overline{\text{RESET}}$ |
|---|---|---|
| 0 | 0 | L |
| 0 | 1 | L |
| 1 | 0 | L |
| 1 | 1 | H |

## FUNCTION/TRUTH TABLES

| PFI > $V_{IT}$ | $\overline{\text{PFO}}$ |
|---|---|
| 0 | L |
| 1 | H |

## FUNCTIONAL BLOCK DIAGRAM



### TIMING DIAGRAM

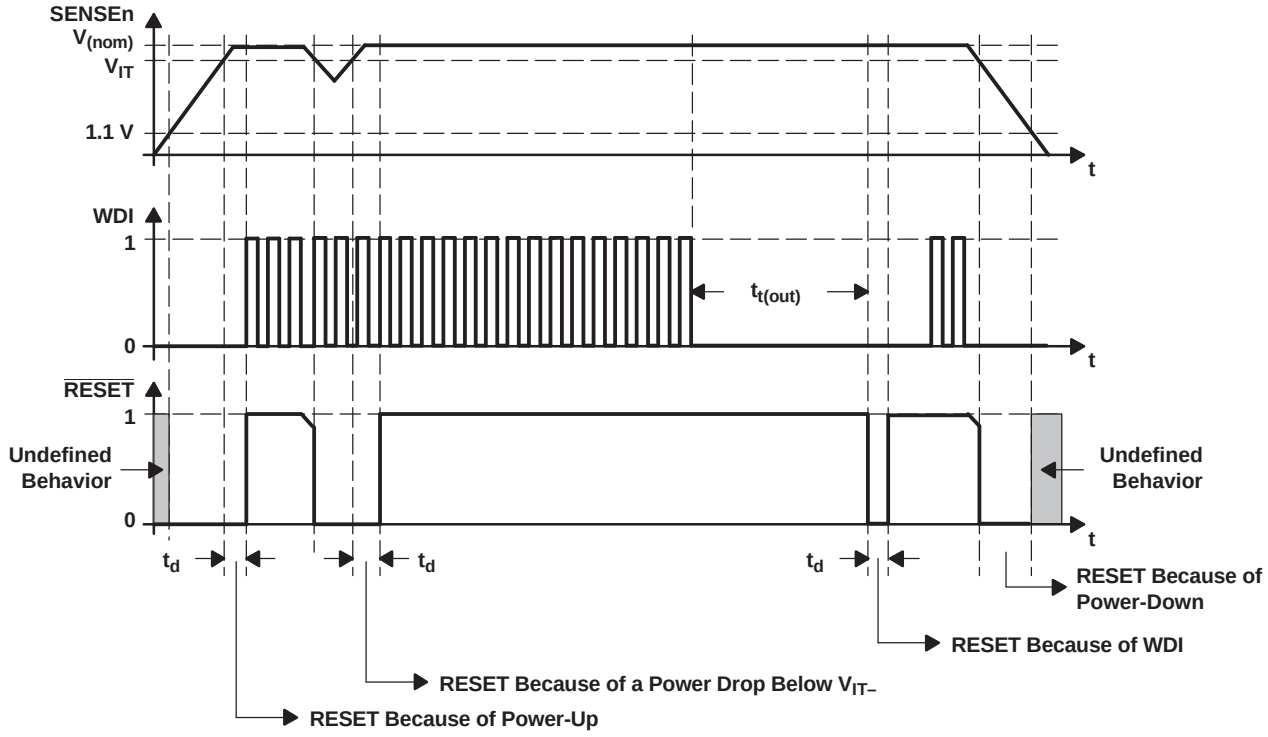



**Table 4. Terminal Functions**

| TERMINAL NAME | TERMINAL NO. | I/O | DESCRIPTION |
|---|---|---|---|
| GND | 4 | I | Ground |
| PFI | 3 | I | Power-fail comparator input |
| $\overline{PFO}$ | 6 | O | Power-fail comparator output, open-drain |
| $\overline{RESET}$ | 5 | O | Active-low reset output, open-drain |
| SENSE1 | 1 | I | Sense voltage input 1 |
| SENSE2 | 2 | I | Sense voltage input 2 |
| WDI | 7 | I | Watchdog timer input |
| $V_{DD}$ | 8 | I | Supply voltage |

## DETAILED DESCRIPTION

### Watchdog

In a microprocessor- or DSP-based system, it is not only important to supervise the supply voltage, it is also important to ensure correct program execution. The task of a watchdog is to ensure that the program is not stalled in an indefinite loop. The microprocessor, microcontroller, or DSP typically has to toggle the watchdog input within 0.8 s to avoid a time-out occurring. Either a low-to-high or a high-to-low transition resets the internal watchdog timer. If the input is unconnected or tied with a high impedance driver, the watchdog is disabled and will be retriggered internally.

## DETAILED DESCRIPTION (continued)

### Saving Current While Using the Watchdog

The watchdog input is internally driven low during the first 7/8 of the watchdog time-out period, then momentarily pulses high, resetting the watchdog counter. For minimum watchdog input current (minimum overall power consumption), leave WDI low for the majority of the watchdog time-out period, pulsing it low-high-low once within 7/8 of the watchdog time-out period to reset the watchdog timer. If instead WDI is externally driven high for the majority of the time-out period, a current of 5 V/40 kΩ = 125 µA can flow into WDI.

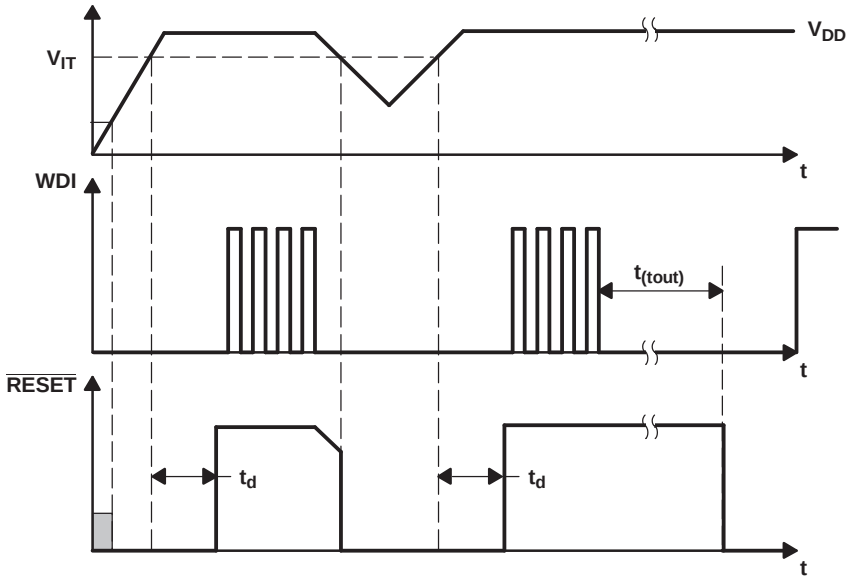
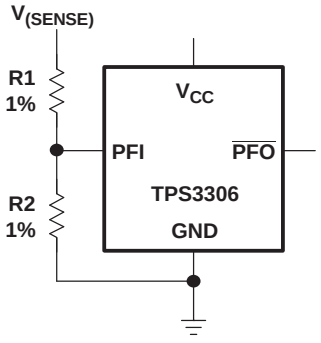



**Figure 1. Watchdog Timing**

### Power-Fail Comparator (PFI and $\overline{PFO}$)

An additional comparator is provided to monitor voltages other than the nominal supply voltage. The power-fail-input (PFI) will be compared with an internal voltage reference of 1.25 V. If the input voltage falls below the power-fail threshold ($V_{PFI}$) of typ. 1.25 V, the power-fail output ($\overline{PFO}$) goes low. If it goes above 1.25 V plus about 10 mV hysteresis, the output returns to high. By connecting two external resistors, it is possible to supervise any voltages above 1.25 V. The sum of both resistors should be about 1 MΩ, to minimize power consumption and also to assure that the current in the PFI pin can be neglected compared with the current through the resistor network. The tolerance of the external resistors should be not more than 1% to ensure minimal variation of sensed voltage. If the power-fail comparator is unused, connect PFI to ground and leave $\overline{PFO}$ unconnected.




$$V_{PFI,trip} = 1.25\ V \times \frac{R_1 + R_2}{R_2}$$

## ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range (unless otherwise noted).(1)

| | UNIT |
|---|---|
| Supply voltage, $V_{DD}$ (see (2)) | 7 V |
| PFI pin | –0.3 V to $V_{DD}$ + 0.3 V |
| All other pins (see (2)) | –0.3 V to 7 V |
| Maximum low output current, $I_{OL}$ | 5 mA |
| Maximum high output current, $I_{OH}$ | – 5 mA |
| Input clamp current, $I_{IK}$ ($V_I < 0$ or $V_I > V_{DD}$) | ±20 mA |
| Output clamp current, $I_{OK}$ ($V_O < 0$ or $V_O > V_{DD}$) | ±20 mA |
| Continuous total power dissipation | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ | –40°C to +85°C |
| Storage temperature range, $T_{stg}$ | –65°C to +150°C |
| Soldering temperature | 260°C |

(1) 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.
(2) All voltage values are with respect to GND. For reliable operation, the device must not be operated at 7 V for more than t = 1000 h continuously.

## DISSIPATION RATING TABLE

| PACKAGE | $T_A \le$ +25°C POWER RATING | DERATING FACTOR ABOVE $T_A$ = +25°C | $T_A$ = +70°C POWER RATING | $T_A$ = +85°C POWER RATING |
|---|---|---|---|---|
| DGK | 424 mW | 3.4 mW/°C | 271 mW | 220 mW |
| D | 725 mW | 5.8 mW/°C | 464 mW | 377 mW |

## RECOMMENDED OPERATING CONDITIONS

At specified temperature range.

| | MIN | MAX | UNIT |
|---|---|---|---|
| Supply voltage, $V_{DD}$ | 2.7 | 6 | V |
| Input voltage at WDI and PFI, $V_I$ | 0 | $V_{DD}$ + 0.3 | V |
| Input voltage at SENSE1 and SENSE2, $V_I$ | 0 | ($V_{DD}$ + 0.3)$V_{IT}$/1.25 V | V |
| High-level input voltage at WDI, $V_{IH}$ | 0.7 x $V_{DD}$ | | V |
| Low-level input voltage at WDI, $V_{IL}$ | | 0.3 × $V_{DD}$ | V |
| Operating free-air temperature range, $T_A$ | –40 | +85 | °C |

## ELECTRICAL CHARACTERISTICS

Over recommended operating free-air temperature range (unless otherwise noted).

| PARAMETER | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $V_{OL}$ | Low-level output voltage | $\overline{RESET}$, $\overline{PFO}$ | $V_{DD}$ = 2.7 V to 6 V, $I_{OL}$ = 20 µA | | | 0.2 | V |
| | | | $V_{DD}$ = 3.3 V, $I_{OL}$= 2 mA | | | 0.4 | |
| | | | $V_{DD}$ = 6 V, $I_{OL}$ = 3 mA | | | 0.4 | |
| | Power-up reset voltage (see (1)) | | $V_{DD} \geq$ 1.1 V, $I_{OL}$ = 20 µA | | | 0.4 | V |
| $V_{IT}$ | Negative-going input threshold voltage (see (2)) | $V_{SENSE1}$, $V_{SENSE2}$ | $V_{DD}$ = 2.7 V to 6 V<br>$T_A$ = 0°C to +85°C | 1.37 | 1.40 | 1.43 | V |
| | | | | 1.64 | 1.68 | 1.72 | |
| | | | | 1.81 | 1.85 | 1.89 | |
| | | | | 2.20 | 2.25 | 2.30 | |
| | | | | 2.86 | 2.93 | 3 | |
| | | | | 4.46 | 4.55 | 4.64 | |
| | | PFI | | 1.22 | 1.25 | 1.28 | |
| | | $V_{SENSE1}$, $V_{SENSE2}$ | $V_{DD}$ = 2.7 V to 6 V<br>$T_A$ = –40°C to +85°C | 1.37 | 1.40 | 1.44 | V |
| | | | | 1.64 | 1.68 | 1.73 | |
| | | | | 1.81 | 1.85 | 1.90 | |
| | | | | 2.20 | 2.25 | 2.32 | |
| | | | | 2.86 | 2.93 | 3.02 | |
| | | | | 4.46 | 4.55 | 4.67 | |
| | | PFI | | 1.22 | 1.25 | 1.29 | |
| $V_{hys}$ | Hysteresis | PFI | $V_{IT}$ = 1.25 V | | 10 | | mV |
| | | $V_{SENSEn}$ | $V_{IT}$ = 1.40 V | | 15 | | |
| | | | $V_{IT}$ = 1.68 V | | 15 | | |
| | | | $V_{IT}$ = 1.86 V | | 20 | | |
| | | | $V_{IT}$ = 2.25 V | | 20 | | |
| | | | $V_{IT}$ = 2.93 V | | 30 | | |
| | | | $V_{IT}$ = 4.55 V | | 40 | | |
| $I_{H(AV)}$ | Average high-level input current | WDI | WDI = $V_{DD}$ = 6 V, Time average (dc = 88%) | | 100 | 150 | µA |
| $I_{L(AV)}$ | Average low-level input current | | WDI = 0 V, $V_{DD}$ = 6 V, Time average (dc = 12%) | | –15 | –20 | |
| $I_H$ | High-level input current | WDI | WDI = $V_{DD}$ = 6 V | | 120 | 170 | µA |
| | | SENSE1 | $V_{SENSE1}$ = $V_{DD}$ = 6 V | | 5 | 8 | |
| | | SENSE2 | $V_{SENSE2}$ = $V_{DD}$ = 6 V | | 6 | 9 | |
| $I_L$ | Low-level input current | WDI | WDI = 0 V, $V_{DD,}$ = 6 V | | –120 | –170 | µA |
| $I_I$ | Input current | PFI | $V_{DD}$ = 6 V, 0 V ≤ $V_I$ ≤ $V_{DD}$ | –25 | | 25 | nA |
| $I_{DD}$ | Supply current | | | | 15 | 40 | µA |
| $C_i$ | Input capacitance | | $V_I$ = 0 V to $V_{DD}$ | | 10 | | pF |

(1) The lowest supply voltage at which $\overline{RESET}$ becomes active. $t_r$, $V_{DD} \geq$ 15 µs/V.
(2) To ensure best stability of the threshold voltage, a bypass capacitor (ceramic 0.1 µF) should be placed close to the supply terminals.

## TIMING REQUIREMENTS

at $V_{DD}$ = 2.7 V to 6 V, $R_L$= 1 MΩ, $C_L$= 50 pF, $T_A$= 25°C

| PARAMETER | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_w$ | Pulse width | SENSEn | $V_{SENSEnL} = V_{IT-}$ 0.2 V, $V_{SENSEnH} = V_{IT}$ + 0.2 V | 6 | | | µs |
| | | WDI | $V_{IH}$ = 0.7 × $V_{DD}$, $V_{IL}$= 0.3 × $V_{DD}$ | 100 | | | ns |

## SWITCHING CHARACTERISTICS

at $V_{DD}$ = 2.7 V to 6 V, $R_L$= 1 MΩ, $C_L$ = 50 pF, $T_A$= 25°C

| PARAMETER | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{t(out)}$ | Watchdog time-out | | $V_{I(SENSEn)} \geq V_{IT}$ + 0.2 V, See Timing Diagram | 0.5 | 0.8 | 1.2 | s |
| $t_d$ | Delay time | | $V_{I(SENSEn)} \geq V_{IT}$ + 0.2 V, See Timing Diagram | 70 | 100 | 140 | ms |
| $t_{PHL}$ | Propagation (delay) time, high-to-low level output | SENSEn to $\overline{RESET}$ | $V_{IH} = V_{IT}$ + 0.2 V, $V_{IL} = V_{IT-}$ 0.2 V | | 1 | 5 | µs |
| $t_{PHL}$ | Propagation (delay) time, high-to-low level output | PFI to $\overline{PFO}$ | | | 0.5 | 1 | µs |
| $t_{PLH}$ | Propagation (delay) time, low-to-high level output | | | | | | |

## TYPICAL CHARACTERISTICS

**NORMALIZED SENSE THRESHOLD VOLTAGE vs FREE-AIR TEMPERATURE AT $V_{DD}$**

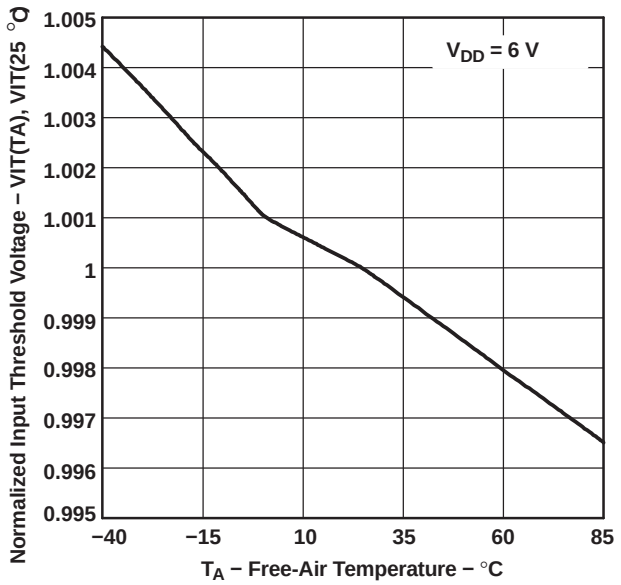



**Figure 2.**

**SUPPLY CURRENT vs SUPPLY VOLTAGE**

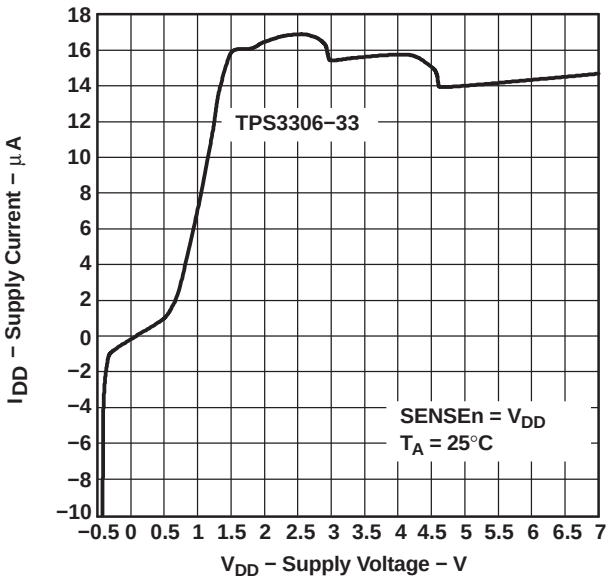



**Figure 3.**

## TYPICAL CHARACTERISTICS (continued)

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

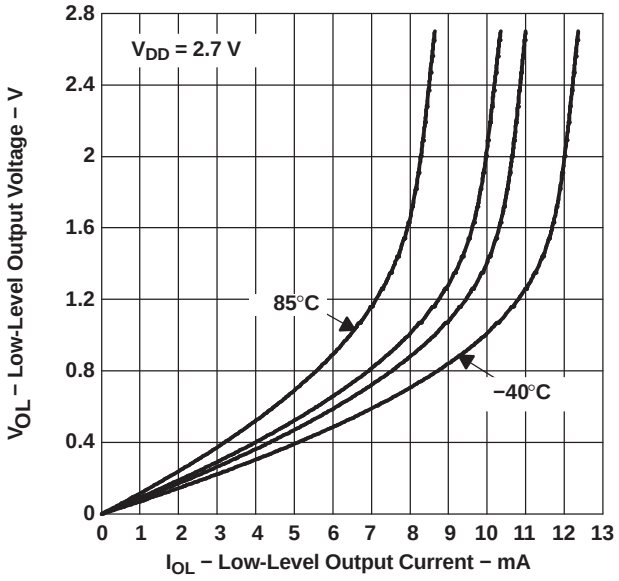



Figure 4.

LOW-LEVEL OUTPUT VOLTAGE
vs
LOW-LEVEL OUTPUT CURRENT

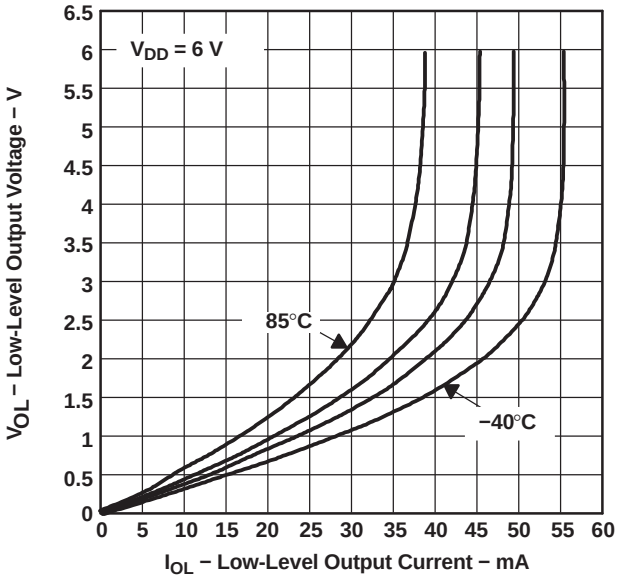



Figure 5.

MINIMUM PULSE DURATION AT SENSE
vs
THRESHOLD OVERDRIVE

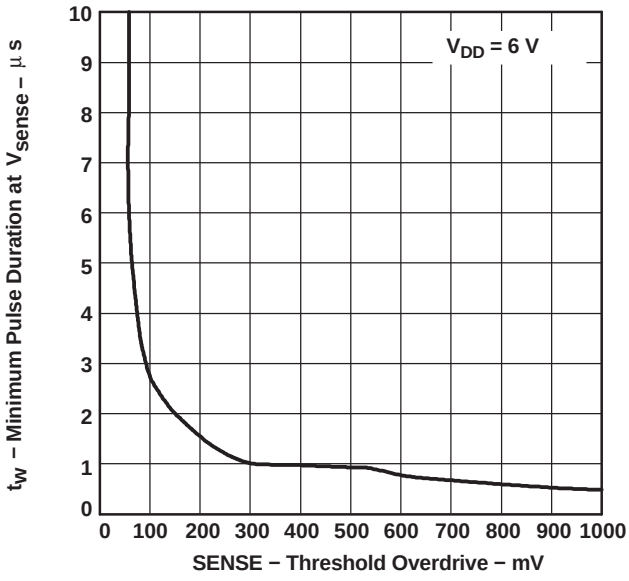



Figure 6.

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| TPS3306-15D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-15DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-15DGK | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-15DGKG4 | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-15DGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-15DGKRG4 | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-15DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-15DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18DGK | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18DGKG4 | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18DGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18DGKRG4 | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-18DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-20D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-20DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-20DGK | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-20DGKG4 | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-25D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-25DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-25DGK | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-25DGKG4 | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-25DGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

| Orderable Device | Status [1] | Package Type | Package Drawing | Pins | Package Qty | Eco Plan [2] | Lead/Ball Finish | MSL Peak Temp [3] |
|---|---|---|---|---|---|---|---|---|
| TPS3306-25DGKRG4 | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-25DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-25DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33D | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33DG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33DGK | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33DGKG4 | ACTIVE | MSOP | DGK | 8 | 80 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33DGKR | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33DGKRG4 | ACTIVE | MSOP | DGK | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33DR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |
| TPS3306-33DRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM |

[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.

**OTHER QUALIFIED VERSIONS OF TPS3306-15, TPS3306-18, TPS3306-20, TPS3306-25, TPS3306-33 :**

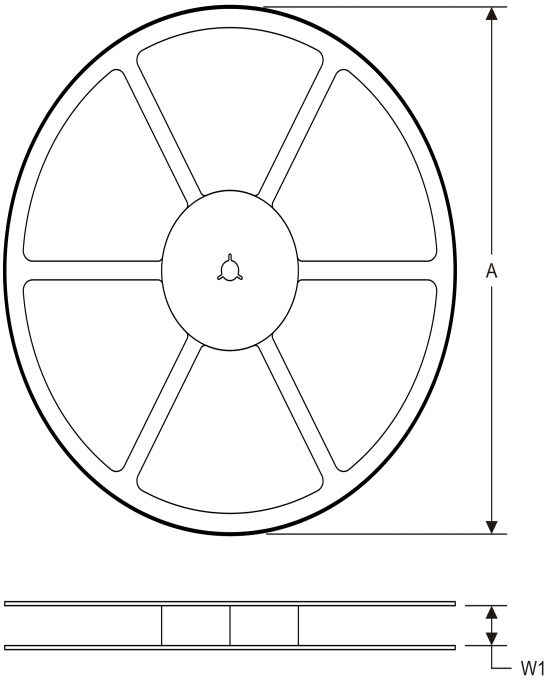
- Automotive: TPS3306-15-Q1, TPS3306-18-Q1, TPS3306-20-Q1, TPS3306-25-Q1, TPS3306-33-Q1

NOTE: Qualified Version Definitions:

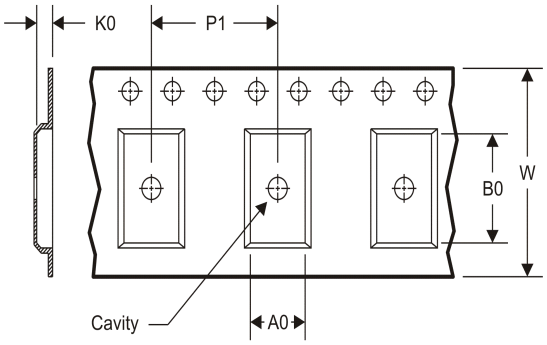
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS



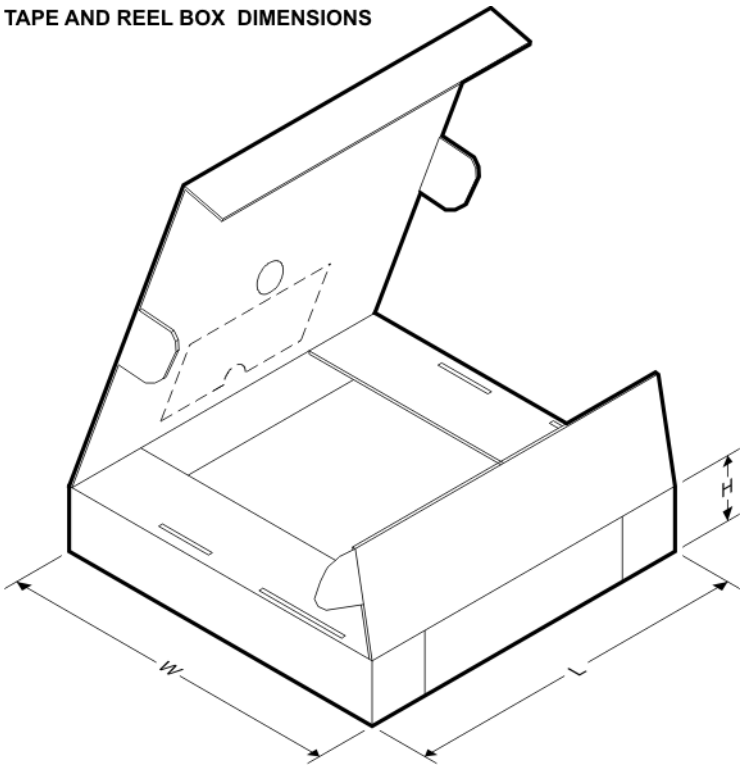

| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

### 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3306-15DGKR | MSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TPS3306-15DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TPS3306-18DGKR | MSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TPS3306-18DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TPS3306-25DGKR | MSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TPS3306-25DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TPS3306-33DGKR | MSOP | DGK | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TPS3306-33DR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

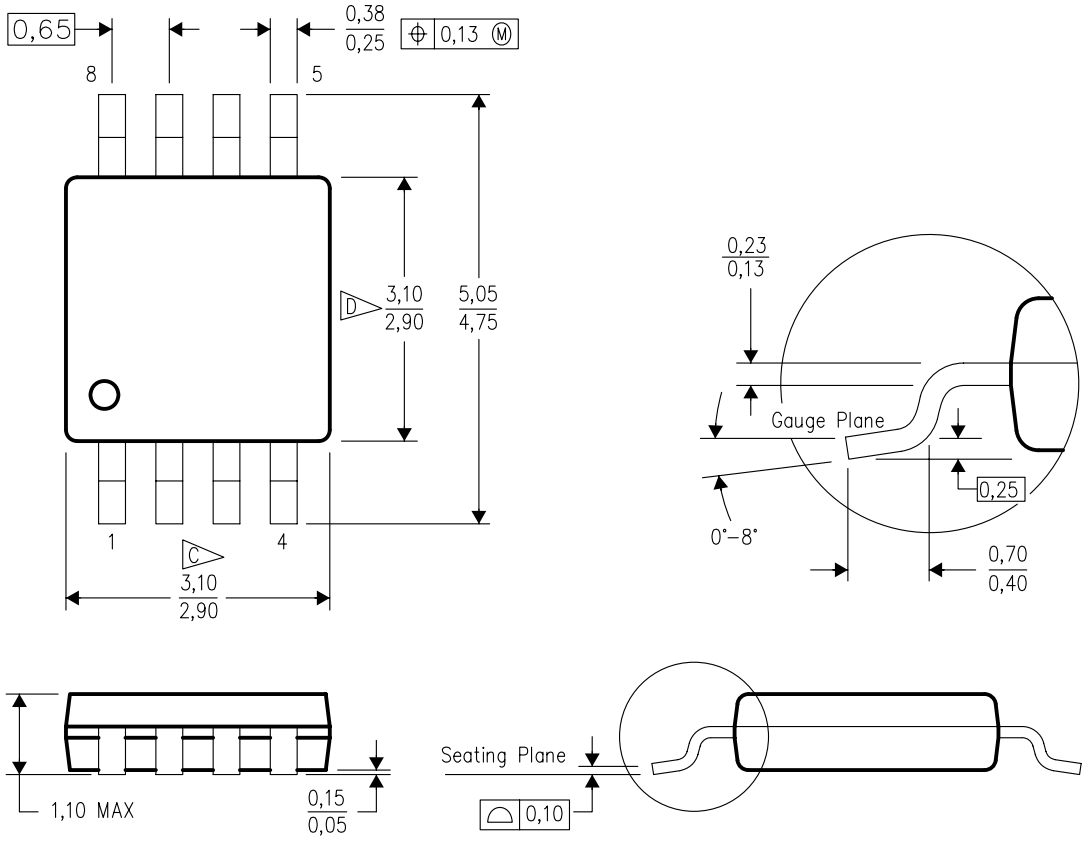
TAPE AND REEL BOX DIMENSIONS




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TPS3306-15DGKR | MSOP | DGK | 8 | 2500 | 358.0 | 335.0 | 35.0 |
| TPS3306-15DR | SOIC | D | 8 | 2500 | 346.0 | 346.0 | 29.0 |
| TPS3306-18DGKR | MSOP | DGK | 8 | 2500 | 358.0 | 335.0 | 35.0 |
| TPS3306-18DR | SOIC | D | 8 | 2500 | 346.0 | 346.0 | 29.0 |
| TPS3306-25DGKR | MSOP | DGK | 8 | 2500 | 358.0 | 335.0 | 35.0 |
| TPS3306-25DR | SOIC | D | 8 | 2500 | 346.0 | 346.0 | 29.0 |
| TPS3306-33DGKR | MSOP | DGK | 8 | 2500 | 358.0 | 335.0 | 35.0 |
| TPS3306-33DR | SOIC | D | 8 | 2500 | 346.0 | 346.0 | 29.0 |

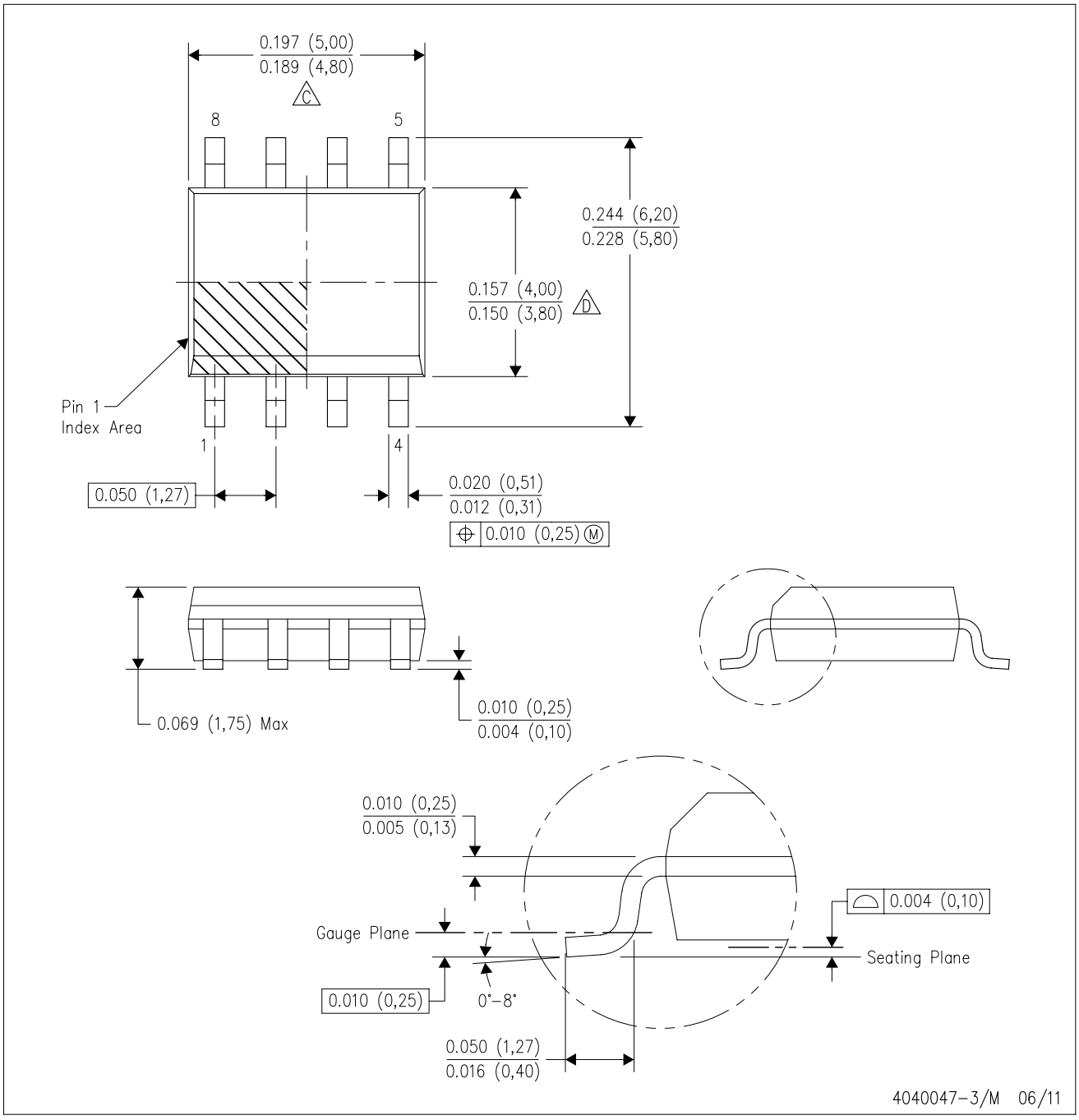
## DGK (S–PDSO–G8) PLASTIC SMALL–OUTLINE PACKAGE




4073329/E 05/06

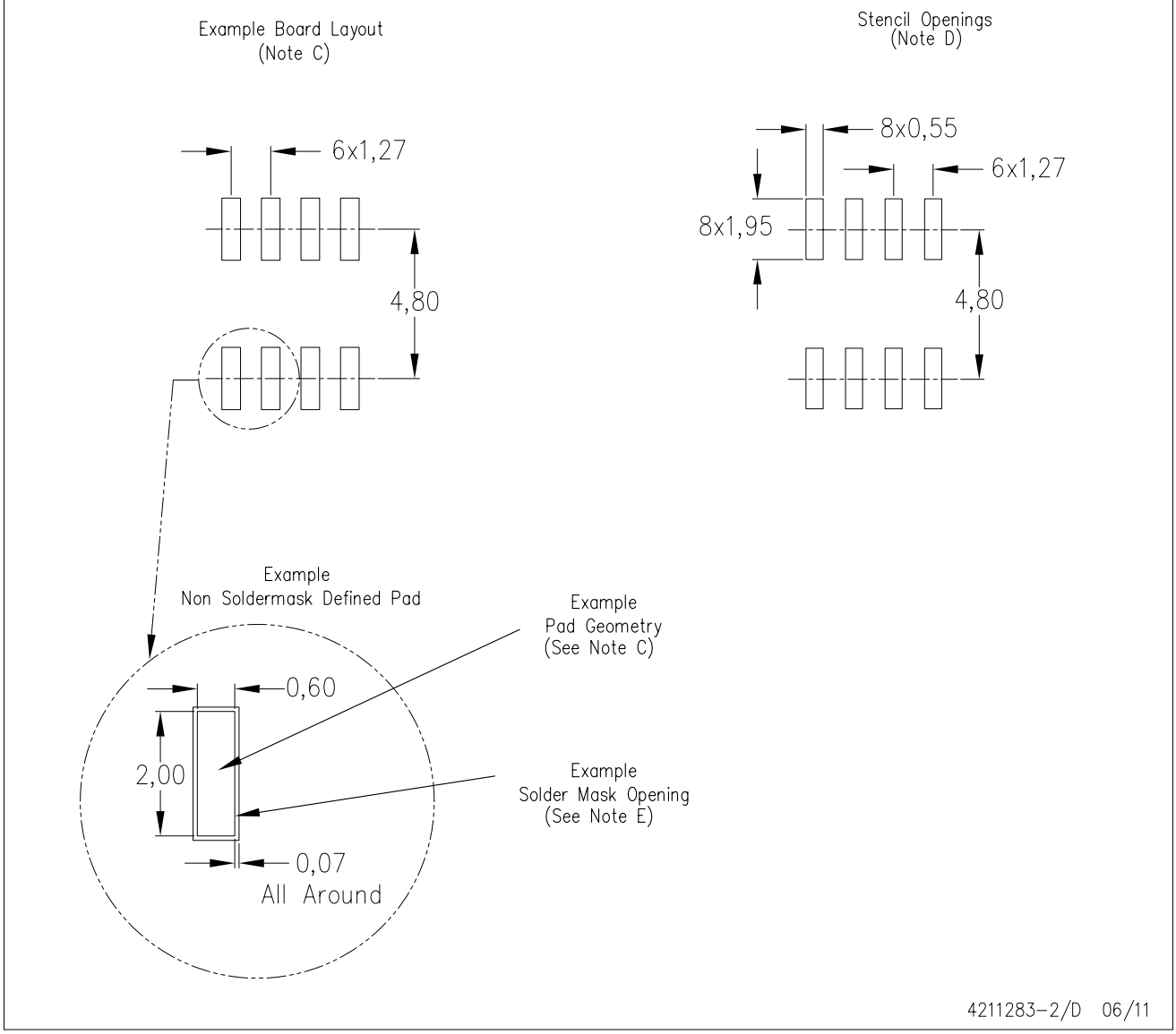
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed 0.50 per side.
E. Falls within JEDEC MO–187 variation AA, except interlead flash.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE




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 AA.

D (R–PDSO–G8) PLASTIC SMALL OUTLINE




NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
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 for other stencil recommendations.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

| **Products** | | **Applications** | |
|---|---|---|---|
| Audio | www.ti.com/audio | Automotive and Transportation | www.ti.com/automotive |
| Amplifiers | amplifier.ti.com | Communications and Telecom | www.ti.com/communications |
| Data Converters | dataconverter.ti.com | Computers and Peripherals | www.ti.com/computers |
| DLP® Products | www.dlp.com | Consumer Electronics | www.ti.com/consumer-apps |
| DSP | dsp.ti.com | Energy and Lighting | www.ti.com/energy |
| Clocks and Timers | www.ti.com/clocks | Industrial | www.ti.com/industrial |
| Interface | interface.ti.com | Medical | www.ti.com/medical |
| Logic | logic.ti.com | Security | www.ti.com/security |
| Power Mgmt | power.ti.com | Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Microcontrollers | microcontroller.ti.com | Video and Imaging | www.ti.com/video |
| RFID | www.ti-rfid.com | | |
| OMAP Mobile Processors | www.ti.com/omap | | |
| Wireless Connectivity | www.ti.com/wirelessconnectivity | | |
| | **TI E2E Community Home Page** | | e2e.ti.com |

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265