

## 3-Pin Supply Voltage Supervisors

Check for Samples: [TPS3809J25](#), [TPS3809L30](#), [TPS3809K33](#), [TPS3809I50](#)

### FEATURES

- 3-Pin SOT-23 Package
- Supply Current of 9  $\mu$ A (Typical)
- Precision Supply Voltage Monitor  
2.5 V, 3 V, 3.3 V, 5 V
- Pin-For-Pin Compatible With MAX 809
- Temperature Range:  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

### APPLICATIONS

- Applications Using DSPs, Microcontrollers, or Microprocessors
- Wireless Communication Systems
- Portable/Battery-Powered Equipment
- Programmable Controls
- Intelligent Instruments
- Industrial Equipment
- Notebook/Desktop Computers
- Automotive Systems

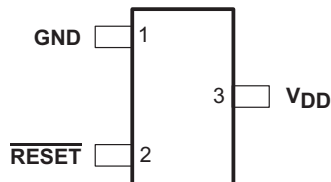
### DESCRIPTION

The TPS3809 family of supervisory circuits provides circuit initialization and timing supervision, primarily for DSPs and processor-based systems.

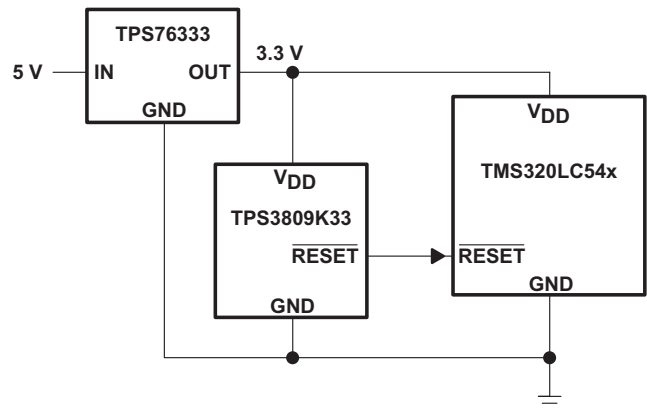
During power-on,  $\overline{\text{RESET}}$  is asserted when the supply voltage  $V_{\text{DD}}$  becomes higher than 1.1 V. Thereafter, the supervisory circuit monitors  $V_{\text{DD}}$  and keeps  $\overline{\text{RESET}}$  active as long as  $V_{\text{DD}}$  remains below the threshold voltage  $V_{\text{IT}}$ . An internal timer delays the return of the output to the inactive state (high) to ensure proper system reset. The delay time,  $t_{\text{d(typ)}}$  = 200 ms, starts after  $V_{\text{DD}}$  has risen above the threshold voltage  $V_{\text{IT}}$ . When the supply voltage drops below the threshold voltage  $V_{\text{IT}}$ , the output becomes active (low) again. No external components are required. All the devices of this family have a fixed sense-threshold voltage  $V_{\text{IT}}$  set by an internal voltage divider.

The product spectrum is designed for supply voltages of 2.5 V, 3 V, 3.3 V, and 5 V. The circuits are available in a 3-pin SOT-23. The TPS3809 devices are characterized for operation over a temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

DBV PACKAGE  
TOP VIEW)



TYPICAL APPLICATION



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.

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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### AVAILABLE OPTIONS<sup>(1)</sup>

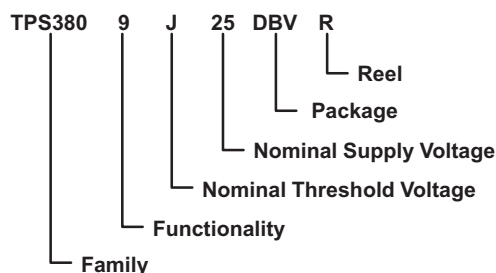
| T <sub>A</sub> | DEVICE NAME    |                | THRESHOLD VOLTAGE | MARKING |
|----------------|----------------|----------------|-------------------|---------|
| –40°C to 85°C  | TPS3809J25DBVR | TPS3809J25DBVT | 2.25 V            | PCZI    |
|                | TPS3809L30DBVR | TPS3809L30DBVT | 2.64 V            | PDAI    |
|                | TPS3809K33DBVR | TPS3809K33DBVT | 2.93 V            | PDBI    |
|                | TPS3809I50DBVR | TPS3809I50DBVT | 4.55 V            | PDCI    |

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this data sheet, or visit the device product folder at [www.ti.com](http://www.ti.com).

### FUNCTION/TRUTH TABLE, TPS3809

| V <sub>DD</sub> >V <sub>IT</sub> | $\overline{\text{RESET}}$ |
|----------------------------------|---------------------------|
| 0                                | L                         |
| 1                                | H                         |

### ORDERING INFORMATION



### ABSOLUTE MAXIMUM RATINGS<sup>(1)(2)</sup>

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

|   | UNIT                         |
|---|------------------------------|
| Supply voltage, V <sub>DD</sub>   | 7 V                          |
| All other pins  | –0.3 V to 7 V                |
| Maximum low-output current, I <sub>OL</sub>   | 5 mA                         |
| Maximum high-output current, I <sub>OH</sub>  | –5 mA                        |
| Input-clamp current, I <sub>IK</sub> (V <sub>I</sub> < 0 or V <sub>I</sub> > V <sub>DD</sub> )  | ±20 mA                       |
| Output-clamp current, I <sub>OK</sub> (V <sub>O</sub> < 0 or V <sub>O</sub> > V <sub>DD</sub> ) | ±20 mA                       |
| Continuous total power dissipation  | See Dissipation Rating Table |
| Operating free-air temperature range, T <sub>A</sub>  | –40°C to 85°C                |
| Storage temperature range, T <sub>stg</sub>   | –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.
- All voltage values are with respect to GND. For reliable operation, the device should not be operated at 7 V for more than t = 1000h continuously.

### DISSIPATION RATINGS

| PACKAGE | T <sub>A</sub> < 25°C<br>POWER RATING | DERATING FACTOR<br>ABOVE T <sub>A</sub> < 25°C | T <sub>A</sub> = 70°C<br>POWER RATING | T <sub>A</sub> = 85°C<br>POWER RATING |
|---------|---------------------------------------|--|---------------------------------------|---------------------------------------|
| DBV     | 437 mW                                | 3.5 mW/°C                                      | 280 mW                                | 227 mW                                |

### RECOMMENDED OPERATING CONDITIONS

|   | MIN | MAX | UNIT |
|---|-----|-----|------|
| Supply voltage, V <sub>DD</sub>                       | 2   | 6   | V    |
| $\overline{\text{RESET}}$ current sink during startup |     | 50  | μA   |
| Operating free-air temperature range, T <sub>A</sub>  | –40 | +85 | °C   |

## ELECTRICAL CHARACTERISTICS

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

| PARAMETER                             |   | TEST CONDITIONS  | TPS3800-xx, TPS3801-xx, TPS3802-xx |      |      | UNIT |   |
|---------------------------------------|---|--|------------------------------------|------|------|------|---|
|                                       |   |  | MIN                                | TYP  | MAX  |      |   |
| V <sub>OH</sub>                       | High-level output voltage                             | V <sub>DD</sub> = 2.5 V to 6 V I <sub>OH</sub> = -500 μA | V <sub>DD</sub> - 0.2              |      |      | V    |   |
|                                       |   | V <sub>DD</sub> = 3.3 V I <sub>OH</sub> = -2 mA          | V <sub>DD</sub> - 0.4              |      |      |      |   |
|                                       |   | V <sub>DD</sub> = 6 V I <sub>OH</sub> = -4 mA            | V <sub>DD</sub> - 0.4              |      |      |      |   |
| V <sub>OL</sub>                       | Low-level output voltage                              | V <sub>DD</sub> = 2 V to 6 V, I <sub>OL</sub> = 500 μA   | 0.2                                |      |      | V    |   |
|                                       |   | V <sub>DD</sub> = 3.3 V, I <sub>OL</sub> = 2 mA          | 0.4                                |      |      |      |   |
|                                       |   | V <sub>DD</sub> = 6 V, I <sub>OL</sub> = 4 mA            | 0.4                                |      |      |      |   |
| Power-up reset voltage <sup>(1)</sup> |   | V <sub>DD</sub> ≥ 1.1 V, I <sub>OL</sub> = 50 μA         | 0.2                                |      |      | V    |   |
| V <sub>IT-</sub>                      | Negative-going input threshold voltage <sup>(2)</sup> | T <sub>A</sub> = -40°C to 85°C                           | TPS3809J25                         | 2.2  | 2.25 | 2.3  | V |
|                                       |   |  | TPS3809L30                         | 2.58 | 2.64 | 2.7  |   |
|                                       |   |  | TPS3809K33                         | 2.87 | 2.93 | 2.99 |   |
|                                       |   |  | TPS3809I50                         | 4.45 | 4.55 | 4.65 |   |
| V <sub>hys</sub>                      | Threshold hysteresis                                  |  | TPS3809J25                         | 30   |      | mV   |   |
|                                       |   |  | TPS3809L30                         | 35   |      |      |   |
|                                       |   |  | TPS3809K33                         | 40   |      |      |   |
|                                       |   |  | TPS3809I50                         | 60   |      |      |   |
| I <sub>DD</sub>                       | Supply current  | V <sub>DD</sub> = 2 V, output unconnected                | 9                                  |      | 12   | μA   |   |
|                                       |   | V <sub>DD</sub> = 6 V, output unconnected                | 20                                 |      | 25   |      |   |
| C <sub>i</sub>                        | Input capacitance                                     | V <sub>I</sub> = 0 V to V <sub>DD</sub>                  | 5                                  |      |      | pF   |   |

(1) The lowest supply voltage at which  $\overline{\text{RESET}}$  becomes active.  $t_r, V_{DD} \geq 15 \mu\text{s/V}$ .

(2) To ensure the best stability of the threshold voltage, a bypass capacitor (0.1-μF ceramic) should be placed near the supply terminals.

## TIMING REQUIREMENTS

at R<sub>L</sub> = 1 MΩ, C<sub>L</sub> = 50 pF, T<sub>A</sub> = 25°C

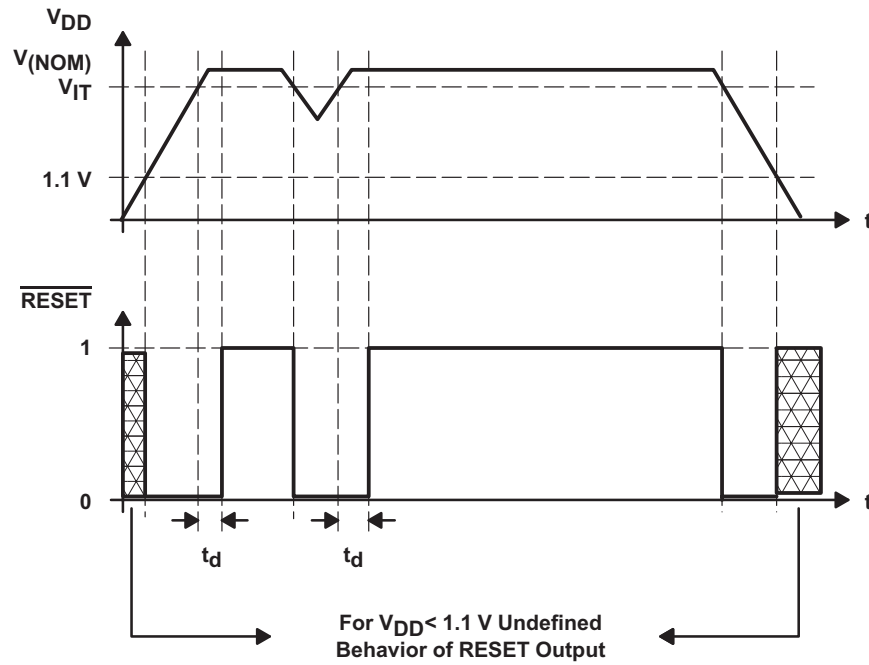
| PARAMETER      |             | TEST CONDITIONS    | MIN  | TYP | MAX | UNIT |    |
|----------------|-------------|--------------------|--|-----|-----|------|----|
| t <sub>w</sub> | Pulse width | at V <sub>DD</sub> | V <sub>DD</sub> = V <sub>IT-</sub> + 0.2 V, V <sub>DD</sub> = V <sub>IT-</sub> - 0.2 V |     |     | 3    | μs |

## SWITCHING CHARACTERISTICS

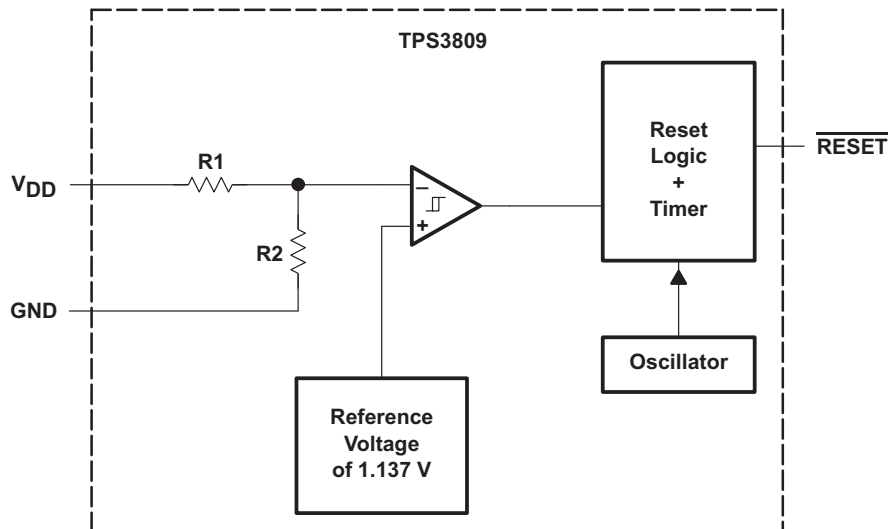
at R<sub>L</sub> = 1 MΩ, C<sub>L</sub> = 50 pF, T<sub>A</sub> = 25°C

| PARAMETER        |  | TEST CONDITIONS   | MIN | TYP | MAX | UNIT |
|------------------|--|---|-----|-----|-----|------|
| t <sub>d</sub>   | Delay time   | V <sub>DD</sub> ≥ V <sub>IT-</sub> + 0.2 V,<br>See <a href="#">timing diagram</a>   | 120 | 200 | 280 | ms   |
| t <sub>PHL</sub> | Propagation (delay) time, high-to-low-level output | V <sub>DD</sub> to $\overline{\text{RESET}}$ delay<br>V <sub>IL</sub> = V <sub>IT-</sub> - 0.2 V,<br>V <sub>IH</sub> = V <sub>IT-</sub> + 0.2 V | 1   |     |     | μs   |

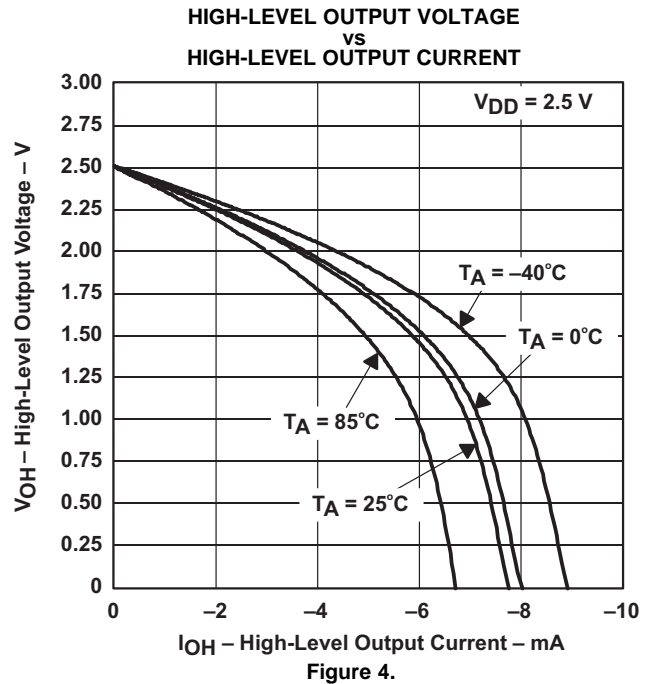
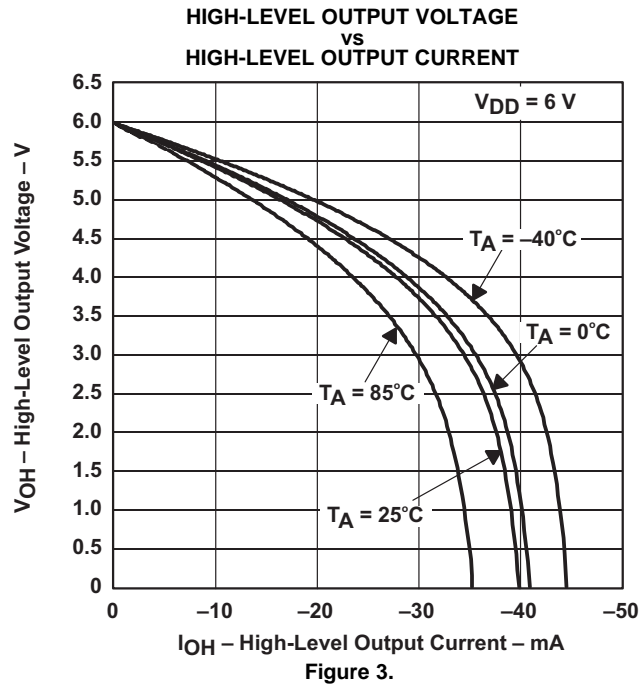
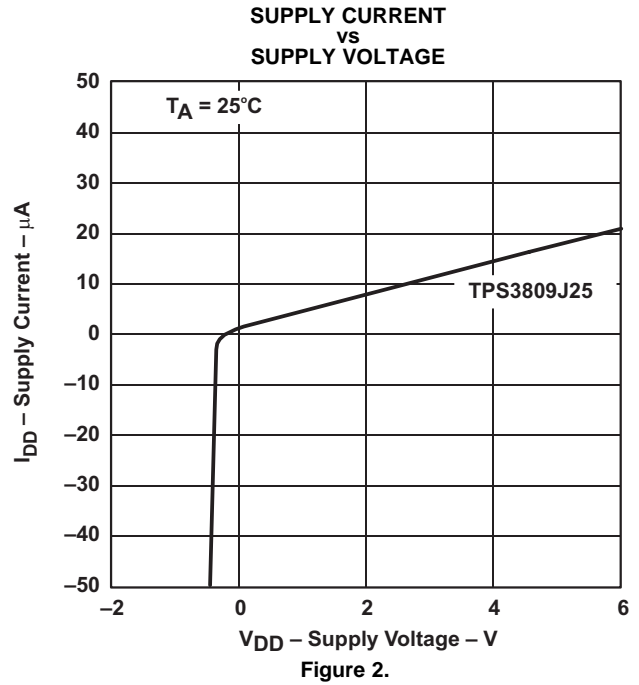
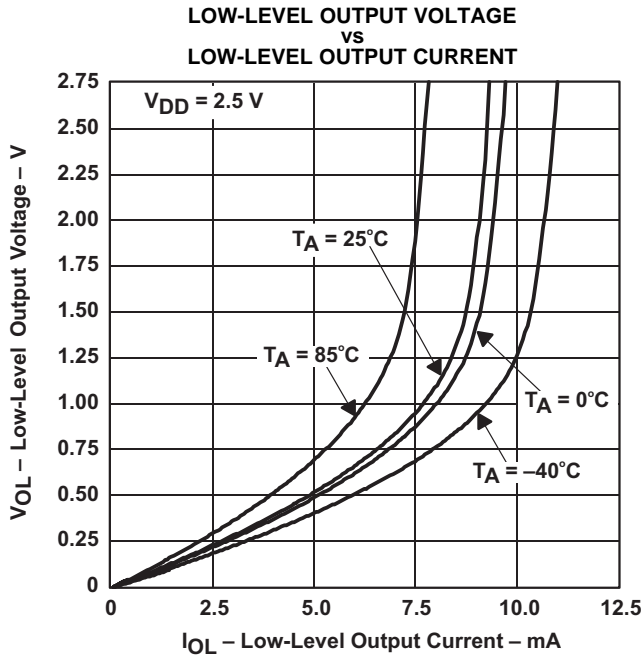
**TIMING DIAGRAM**



**FUNCTIONAL BLOCK DIAGRAM**



TYPICAL CHARACTERISTICS



**TYPICAL CHARACTERISTICS (continued)**

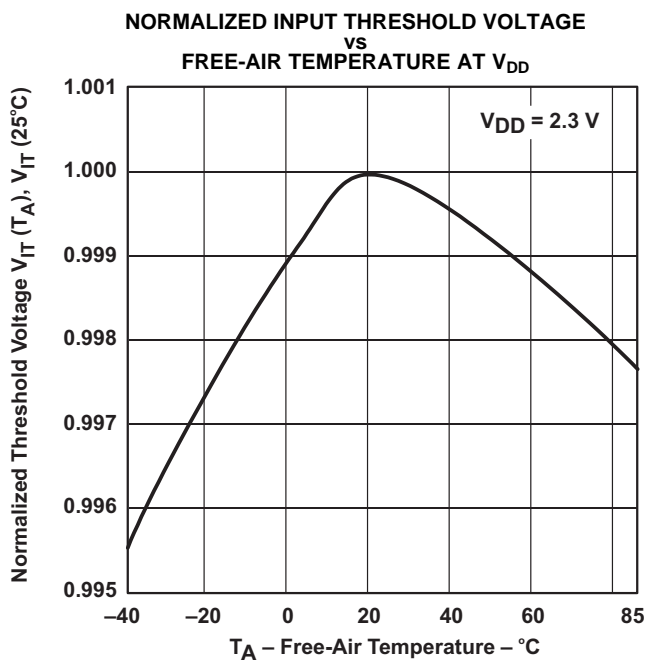


Figure 5.

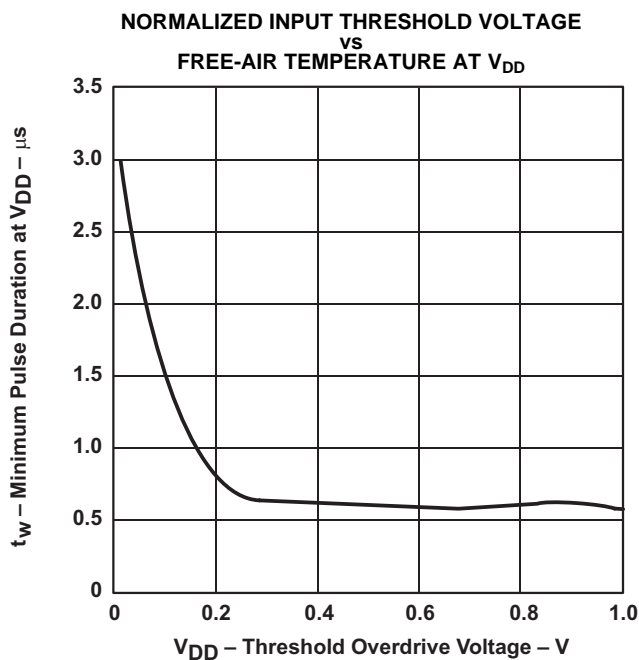


Figure 6.

**REVISION HISTORY**

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

**Changes from Revision B (July 2012) to Revision C** **Page**

- Changed front page and page flow to match current standard look and feel ..... 1
- Changed "Operating junction temperature range" to "Operating free-air temperature range" in Absolute Maximum Ratings (typo) ..... 2

**Changes from Revision A (October 2010) to Revision B** **Page**

- Changed the Pull-up resistor value,  $\overline{\text{RESET}}$  To:  $\overline{\text{RESET}}$  current sink during startup in the Recommended Operating Conditions Table ..... 2

**Changes from Original (August 1999) to Revision A** **Page**

- Added Pull-up resistor value,  $\overline{\text{RESET}}$  to the Recommended Operating Conditions Table ..... 2

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| TPS3809I50DBVR   | ACTIVE        | SOT-23       | DBV                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   Call TI     | Level-1-260C-UNLIM   | -40 to 85    | PDCI                    | <a href="#">Samples</a> |
| TPS3809I50DBVRG4 | ACTIVE        | SOT-23       | DBV                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDCI                    | <a href="#">Samples</a> |
| TPS3809I50DBVT   | ACTIVE        | SOT-23       | DBV                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   Call TI     | Level-1-260C-UNLIM   | -40 to 85    | PDCI                    | <a href="#">Samples</a> |
| TPS3809J25DBVR   | ACTIVE        | SOT-23       | DBV                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PCZI                    | <a href="#">Samples</a> |
| TPS3809J25DBVT   | ACTIVE        | SOT-23       | DBV                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PCZI                    | <a href="#">Samples</a> |
| TPS3809J25DBVTG4 | ACTIVE        | SOT-23       | DBV                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PCZI                    | <a href="#">Samples</a> |
| TPS3809K33DBVR   | ACTIVE        | SOT-23       | DBV                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDBI                    | <a href="#">Samples</a> |
| TPS3809K33DBVRG4 | ACTIVE        | SOT-23       | DBV                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDBI                    | <a href="#">Samples</a> |
| TPS3809K33DBVT   | ACTIVE        | SOT-23       | DBV                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDBI                    | <a href="#">Samples</a> |
| TPS3809K33DBVTG4 | ACTIVE        | SOT-23       | DBV                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDBI                    | <a href="#">Samples</a> |
| TPS3809L30DBVR   | ACTIVE        | SOT-23       | DBV                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDAI                    | <a href="#">Samples</a> |
| TPS3809L30DBVRG4 | ACTIVE        | SOT-23       | DBV                | 3    | 3000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDAI                    | <a href="#">Samples</a> |
| TPS3809L30DBVT   | ACTIVE        | SOT-23       | DBV                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDAI                    | <a href="#">Samples</a> |
| TPS3809L30DBVTG4 | ACTIVE        | SOT-23       | DBV                | 3    | 250            | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 85    | PDAI                    | <a href="#">Samples</a> |

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm threshold requirement.

(3) **MSL, Peak Temp.** - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

(6) **Lead/Ball Finish** - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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#### **OTHER QUALIFIED VERSIONS OF TPS3809 :**

- Automotive: [TPS3809-Q1](#)
- Enhanced Product: [TPS3809-EP](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Enhanced Product - Supports Defense, Aerospace and Medical Applications



**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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS3809I50DBVR | SOT-23       | DBV             | 3    | 3000 | 178.0              | 9.0                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |
| TPS3809I50DBVT | SOT-23       | DBV             | 3    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |
| TPS3809J25DBVR | SOT-23       | DBV             | 3    | 3000 | 178.0              | 9.0                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |
| TPS3809J25DBVT | SOT-23       | DBV             | 3    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |
| TPS3809K33DBVR | SOT-23       | DBV             | 3    | 3000 | 178.0              | 9.0                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |
| TPS3809K33DBVT | SOT-23       | DBV             | 3    | 250  | 178.0              | 9.0                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |
| TPS3809L30DBVR | SOT-23       | DBV             | 3    | 3000 | 178.0              | 9.0                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |
| TPS3809L30DBVT | SOT-23       | DBV             | 3    | 250  | 178.0              | 8.4                | 3.3     | 3.2     | 1.47    | 4.0     | 8.0    | Q3            |

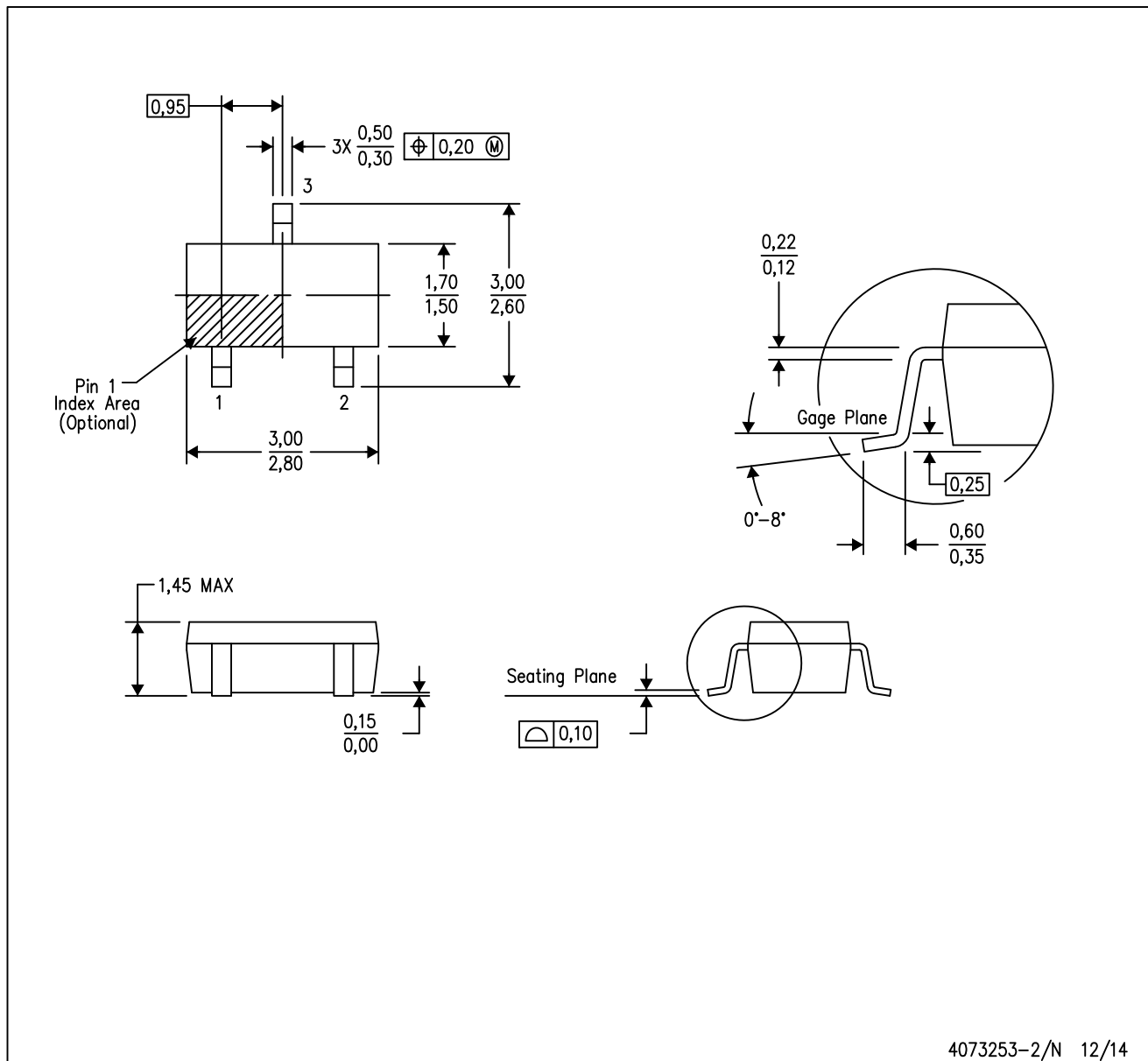
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS3809I50DBVR | SOT-23       | DBV             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS3809I50DBVT | SOT-23       | DBV             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TPS3809J25DBVR | SOT-23       | DBV             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS3809J25DBVT | SOT-23       | DBV             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TPS3809K33DBVR | SOT-23       | DBV             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS3809K33DBVT | SOT-23       | DBV             | 3    | 250  | 180.0       | 180.0      | 18.0        |
| TPS3809L30DBVR | SOT-23       | DBV             | 3    | 3000 | 180.0       | 180.0      | 18.0        |
| TPS3809L30DBVT | SOT-23       | DBV             | 3    | 250  | 180.0       | 180.0      | 18.0        |

DBV (R-PDSO-G3)

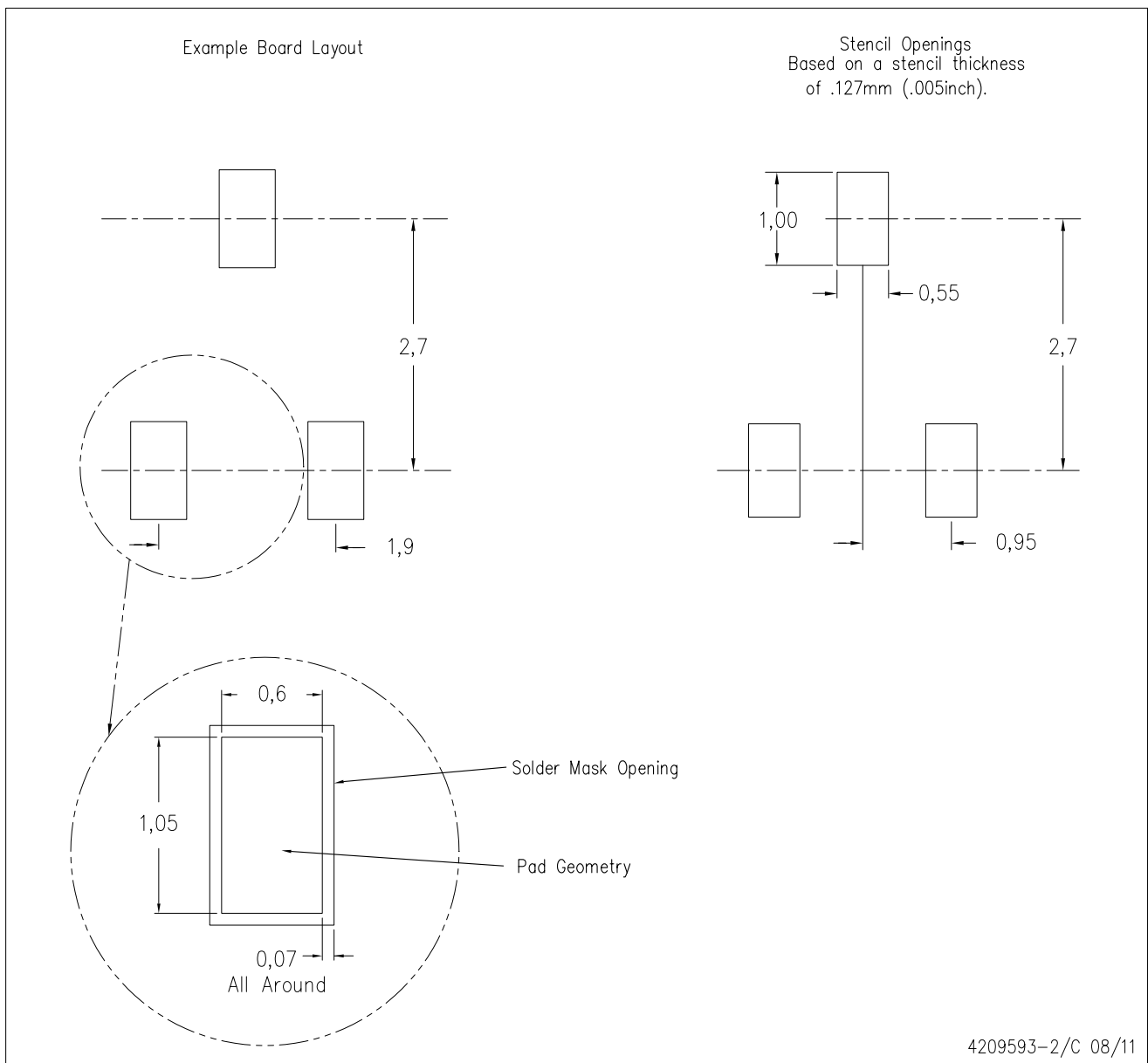
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.

DBV (R-PDSO-G3)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. 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. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

## IMPORTANT NOTICE

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