

TPS3809x 3-Pin Supply Voltage Supervisors

1 Features

- 3-pin SOT-23 package
- Supply current of 9 μA (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°C to $+85^{\circ}\text{C}$

2 Applications

- [Factory automation](#)
- [Wireless speakers](#)
- [Motor drives](#)
- [Servers](#)
- [Appliances](#)
- [Electricity meters](#)
- [Building automation](#)

3 Description

The TPS3809 family of supervisory circuits provides circuit initialization and timing supervision, primarily for DSPs and processor-based systems. The newer [TLV809E](#) device is an alternative with the same pins, functions and electrical parameters.

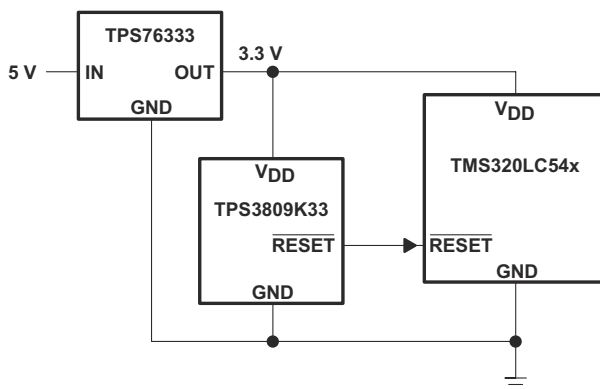
During power-on, $\overline{\text{RESET}}$ is asserted when the supply voltage V_{DD} becomes higher than 1.1 V. Thereafter, the supervisory circuit monitors V_{DD} and keeps $\overline{\text{RESET}}$ active as long as V_{DD} remains below the threshold voltage V_{IT} . An internal timer delays the return of the output to the inactive state (high) to ensure proper system reset. The delay time, $t_{\text{d(typ)}} = 200 \text{ ms}$, starts after V_{DD} has risen above the threshold voltage V_{IT} . When the supply voltage drops below the threshold voltage V_{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_{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°C to 85°C .

Device Information

| PART NUMBER | PACKAGE ⁽¹⁾ | BODY SIZE (NOM) |
|-------------|------------------------|--------------------------|
| TPS3809 | SOT-23 (3), DBV | 2.90 mm \times 1.60 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.



Typical Application



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4 Revision History

| | |
|--|-------------|
| Changes from Revision C (October 2013) to Revision D (January 2021) | Page |
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1 |
| • Added new sentence regarding the new TLV809E to the <i>Description</i> section..... | 1 |
| • Added the pinout and pin function table..... | 4 |
| • Changed VDD from 7 to 6.5 in <i>Absolute Maximum Ratings</i> | 5 |
| • Changed V _{OL} @ 500μA from 0.2 to 0.3V and corrected header of the table from TPS3800-xx, TPS3801-xx, TPS3802-xx to TPS3809xx in <i>Electrical Characteristics</i> | 5 |
| • Changed t _w pulse duration from 3 to 10μs in <i>Timing Requirements</i> | 6 |
| • Changed t _{PHL} from 1 to 10μs in <i>Switching Characteristics</i> | 6 |
| Changes from Revision B (July 2012) to Revision C (October 2013) | 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 <i>Absolute Maximum Ratings</i> (typo)..... | 5 |
| Changes from Revision A (October 2010) to Revision B (July 2012) | Page |
| • Changed the Pull-up resistor value, $\overline{\text{RESET}}$ To: $\overline{\text{RESET}}$ current sink during startup in the Recommended Operating Conditions Table..... | 5 |
| Changes from Revision * (August 1999) to Revision A (October 2010) | Page |
| • Added Pull-up resistor value, $\overline{\text{RESET}}$ to the Recommended Operating Conditions Table..... | 5 |

5 Device Comparison

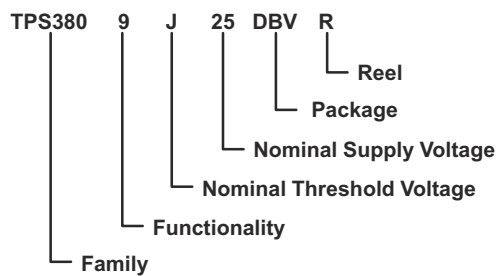
Table 5-1. Device Comparison Table

| T _A | 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 |

FUNCTION/TRUTH TABLE, TPS3809

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

ORDERING INFORMATION



6 Pin Configuration and Functions

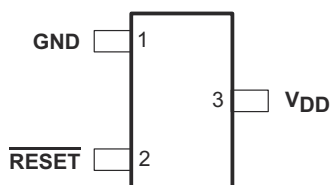


Figure 6-1. Pin configuration

Table 6-1. Pin Functions

| PIN | | I/O ⁽¹⁾ | DESCRIPTION |
|-------|-----|--------------------|---|
| NAME | NO. | | |
| GND | 1 | - | This pin should be connected to ground with a low-impedance connection. |
| RESET | 2 | O | RESET is an active low signal, asserting when V _{DD} is below the threshold voltage. When V _{DD} rises above V _{IT} , there is a delay time (t _d) until RESET deasserts. RESET is a push-pull output stage. |
| VDD | 3 | - | Supply voltage pin. A 0.1-μF ceramic capacitor from this pin to ground is recommended to improve stability of the threshold voltage |

7 Specifications

7.1 Absolute Maximum Ratings ⁽¹⁾ ⁽²⁾

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

| | UNIT |
|--|------------------------------|
| Supply voltage, V_{DD} | 6.5 V |
| All other pins | –0.3 V to 6.5 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 |

- (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 should not be operated at 6.5 V for more than $t = 1000h$ continuously.

7.2 Recommended Operating Conditions

| | MIN | MAX | UNIT |
|---|-----|-----|------|
| Supply voltage, V_{DD} | 2 | 6 | V |
| RESET current sink during startup | | 50 | μA |
| Operating free-air temperature range, T_A | –40 | +85 | °C |

7.3 Dissipation Ratings

| PACKAGE | $T_A < 25^\circ\text{C}$ POWER RATING | DERATING FACTOR ABOVE $T_A < 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$ POWER RATING | $T_A = 85^\circ\text{C}$ POWER RATING |
|---------|--|---|--|--|
| DBV | 437 mW | 3.5 mW/°C | 280 mW | 227 mW |

7.4 Electrical Characteristics

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

| PARAMETER | | TEST CONDITIONS | TPS3809xx | | | UNIT |
|--|------------|--|----------------------|------|------|------|
| | | | MIN | TYP | MAX | |
| V _{OH} High-level output voltage | | V _{DD} = 2.5 V to 6 V I _{OH} = −500 μA | V _{DD} −0.2 | | | V |
| | | V _{DD} = 3.3 V I _{OH} = −2 mA | V _{DD} −0.4 | | | |
| | | V _{DD} = 6 V I _{OH} = −4 mA | V _{DD} −0.4 | | | |
| V _{OL} Low-level output voltage | | V _{DD} = 2 V to 6 V, I _{OL} = 500 μA | 0.3 | | | V |
| | | V _{DD} = 3.3 V, I _{OL} = 2 mA | 0.4 | | | |
| | | V _{DD} = 6 V, I _{OL} = 4 mA | 0.4 | | | |
| Power-up reset voltage ⁽¹⁾ | | V _{DD} ≥ 1.1 V, I _{OL} = 50 μA | 0.2 | | | V |
| V _{IT−} Negative-going input threshold voltage ⁽²⁾ | TPS3809J25 | T _A = −40°C to 85°C | 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 _{hys} Threshold hysteresis | TPS3809J25 | | 30 | | | mV |
| | TPS3809L30 | | 35 | | | |
| | TPS3809K33 | | 40 | | | |
| | TPS3809I50 | | 60 | | | |

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

| PARAMETER | | TEST CONDITIONS | TPS3809xx | | | UNIT |
|-------------------------|--|--|-----------|-----|-----|---------------|
| | | | MIN | TYP | MAX | |
| I_{DD} Supply current | | $V_{DD} = 2\text{ V}$, output unconnected | | 9 | 12 | μA |
| | | $V_{DD} = 6\text{ V}$, output unconnected | | 20 | 25 | |
| C_i Input capacitance | | $V_i = 0\text{ V}$ to V_{DD} | | 5 | | pF |

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

7.5 Timing Requirements

at $R_L = 1\text{ M}\Omega$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$

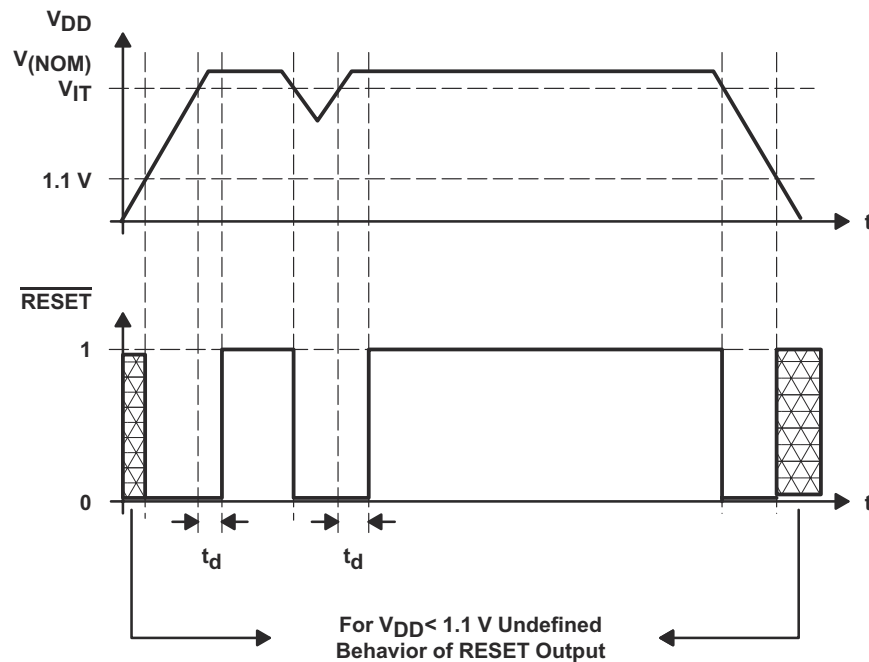
| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------|-------------|---|-----|-----|-----|---------------|
| t_w Pulse width | at V_{DD} | $V_{DD} = V_{IT-} + 0.2\text{ V}$, $V_{DD} = V_{IT-} - 0.2\text{ V}$ | 10 | | | μs |

7.6 Switching Characteristics

at $R_L = 1\text{ M}\Omega$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|---|--|-----|-----|-----|---------------|
| t_d Delay time | | $V_{DD} \geq V_{IT-} + 0.2\text{ V}$, See timing diagram | 120 | 200 | 280 | ms |
| t_{PHL} Propagation (delay) time, high-to-low-level output | V_{DD} to $\overline{\text{RESET}}$ delay | $V_{IL} = V_{IT-} - 0.2\text{ V}$, $V_{IH} = V_{IT-} + 0.2\text{ V}$ | | 10 | | μs |

7.7 Timing Diagram



7.8 Typical Characteristics

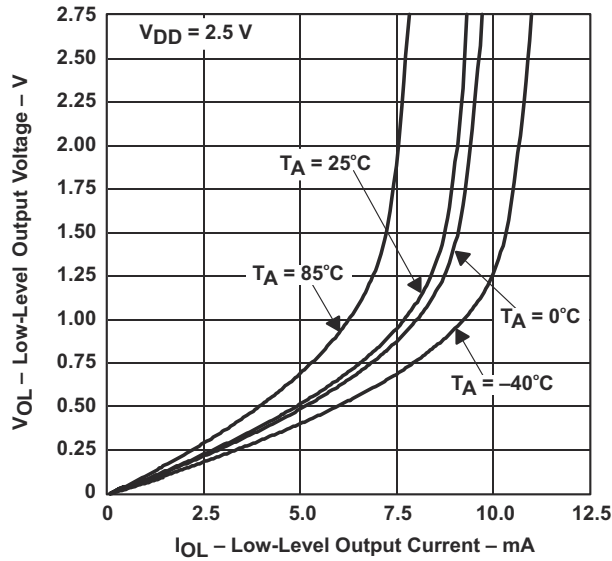


Figure 7-1. LOW-LEVEL OUTPUT VOLTAGE vs LOW-LEVEL OUTPUT CURRENT

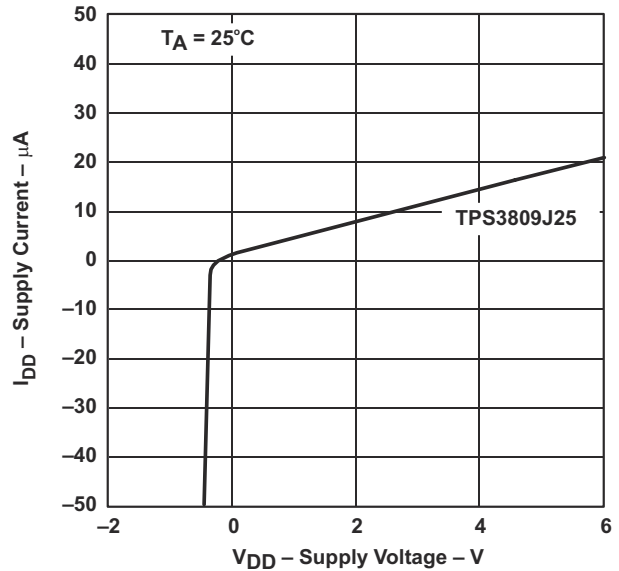


Figure 7-2. SUPPLY CURRENT vs SUPPLY VOLTAGE

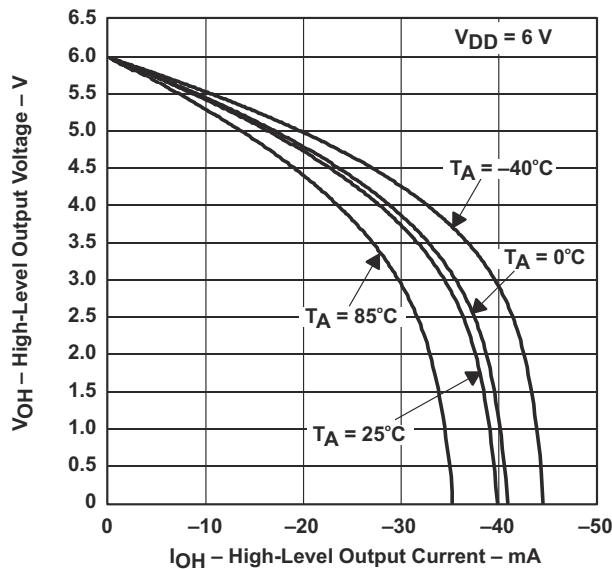


Figure 7-3. HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT at $V_{DD}=6V$

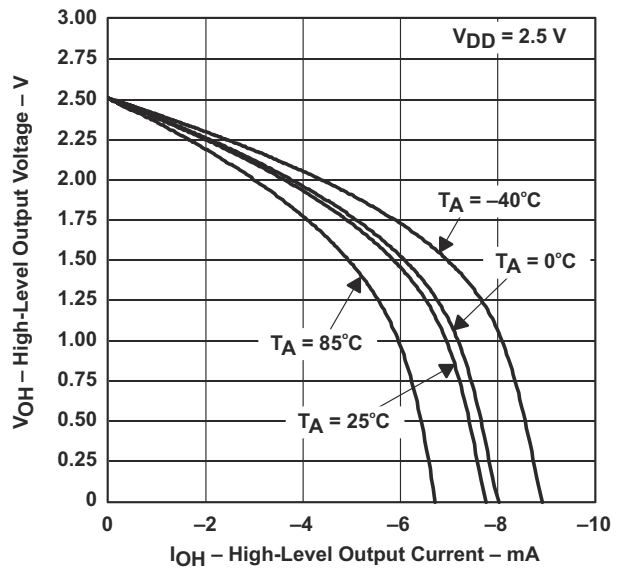


Figure 7-4. HIGH-LEVEL OUTPUT VOLTAGE vs HIGH-LEVEL OUTPUT CURRENT at $V_{DD}=2.5V$

7.8 Typical Characteristics (continued)

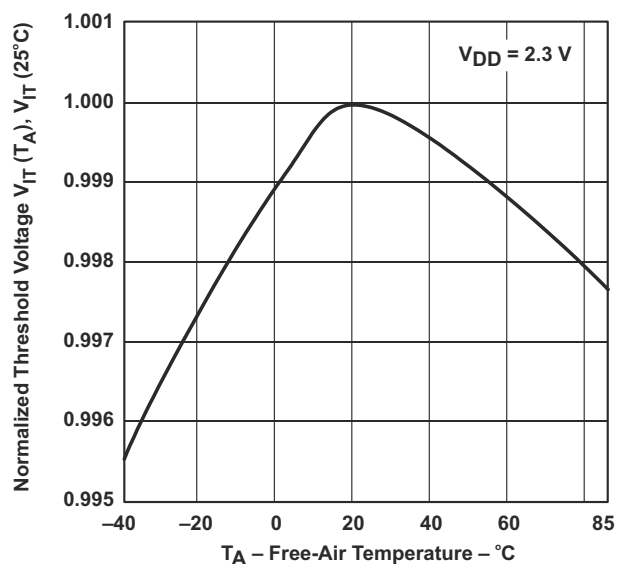
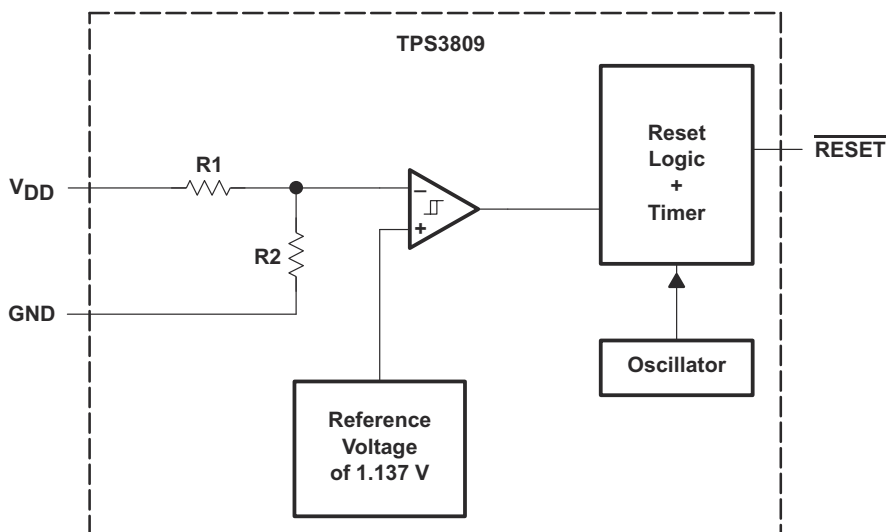


Figure 7-5. NORMALIZED INPUT THRESHOLD VOLTAGE vs FREE-AIR TEMPERATURE AT $V_{DD}=2.3\text{V}$

8 Detailed Description



9 Electrostatic Discharge Caution



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.

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead finish/ Ball material (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| TPS3809I50DBVR | ACTIVE | SOT-23 | DBV | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDCI | Samples |
| TPS3809I50DBVRG4 | ACTIVE | SOT-23 | DBV | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDCI | Samples |
| TPS3809I50DBVT | ACTIVE | SOT-23 | DBV | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDCI | Samples |
| TPS3809J25DBVR | ACTIVE | SOT-23 | DBV | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PCZI | Samples |
| TPS3809J25DBVT | ACTIVE | SOT-23 | DBV | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PCZI | Samples |
| TPS3809J25DBVTG4 | ACTIVE | SOT-23 | DBV | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PCZI | Samples |
| TPS3809K33DBVR | ACTIVE | SOT-23 | DBV | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDBI | Samples |
| TPS3809K33DBVRG4 | ACTIVE | SOT-23 | DBV | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDBI | Samples |
| TPS3809K33DBVT | ACTIVE | SOT-23 | DBV | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDBI | Samples |
| TPS3809K33DBVTG4 | ACTIVE | SOT-23 | DBV | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDBI | Samples |
| TPS3809L30DBVR | ACTIVE | SOT-23 | DBV | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDAI | Samples |
| TPS3809L30DBVRG4 | ACTIVE | SOT-23 | DBV | 3 | 3000 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDAI | Samples |
| TPS3809L30DBVT | ACTIVE | SOT-23 | DBV | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDAI | Samples |
| TPS3809L30DBVTG4 | ACTIVE | SOT-23 | DBV | 3 | 250 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDAI | Samples |

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **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 <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm 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 finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material 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


*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

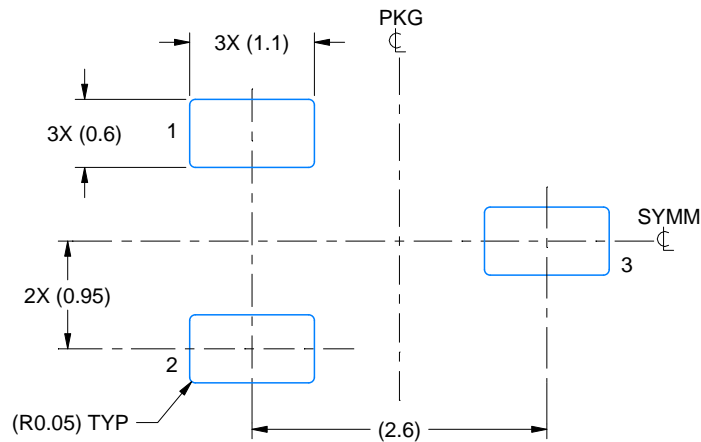
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS3809I50DBVR | SOT-23 | DBV | 3 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3809I50DBVT | SOT-23 | 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 |

EXAMPLE BOARD LAYOUT

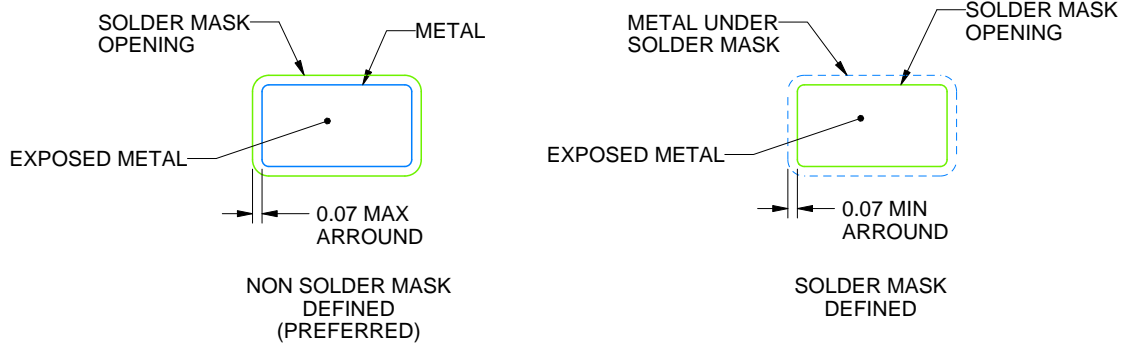
DBV0003A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

4220743/A 06/2021

NOTES: (continued)

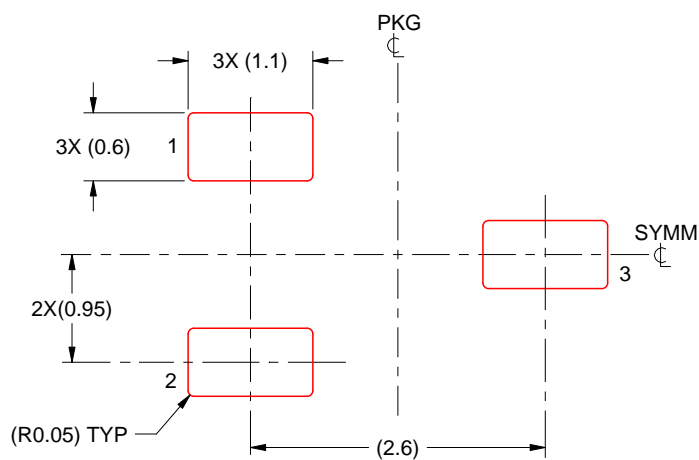
5. Publication IPC-7351 may have alternate designs.
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

DBV0003A

SOT-23 - 1.45 mm max height

SMALL OUTLINE TRANSISTOR



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4220743/A 06/2021

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

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