# TPS382x Voltage Monitor With Watchdog Timer

## 1 Features

- Power-On Reset Generator With Fixed Delay Time of 200 ms (TPS3823/4/5/8) or 25 ms (TPS3820)
- Manual Reset Input (TPS3820/3/5/8)
- Reset Output Available in Active-Low (TPS3820/3/4/5), Active-High (TPS3824/5), and Open Drain (TPS3828)
- Supply Voltage Supervision Range: 2.5 V, 3 V, 3.3 V, 5 V
- Watchdog Timer (TPS3820/3/4/8)
- Supply Current of 15 µA (Typical)
- 5-Pin SOT-23 Package
- Temperature Range: −40°C to 85°C

## 2 Applications

- DSPs, Microcontrollers, or Microprocessors
- Industrial Equipment
- Programmable Controls
- Automotive Systems
- Portable and Battery-Powered Equipment
- Intelligent Instruments
- Wireless Communications Systems
- Notebook and Desktop Computers

## 3 Description

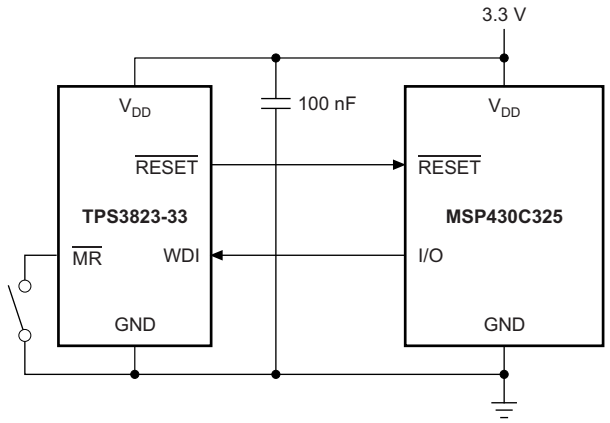
The TPS382x family of supervisors provide circuit initialization and timing supervision, primarily for DSP and processor-based systems. During power on, $\overline{\text{RESET}}$ asserts when the supply voltage $V_{DD}$ becomes greater than 1.1 V. Thereafter, the supply voltage supervisor monitors $V_{DD}$ and keeps $\overline{\text{RESET}}$ active low as long as $V_{DD}$ remains less than 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, $t_d$, starts after $V_{DD}$ has risen above the threshold voltage ($V_{IT-}$ + $V_{HYS}$). 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 TPS382x family also offers watchdog time out options of 200 ms (TPS3820) and 1.6 s (TPS3823/4/8).

**Device Information**[1]

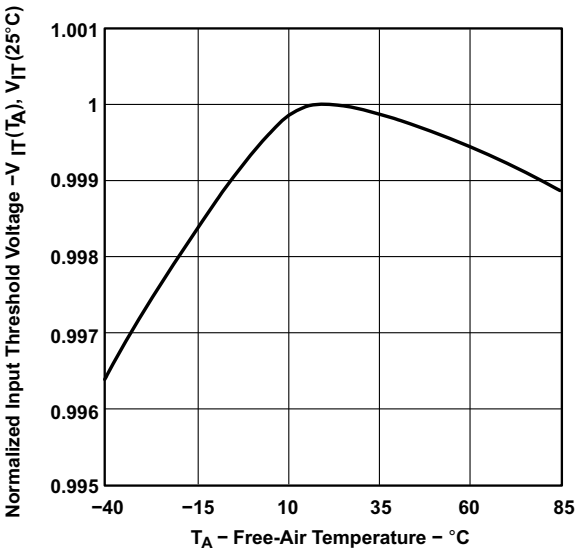
| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| TPS382x | SOT-23 (5) | 2.90 mm × 1.60 mm |

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

**Typical Application Schematic**




**Normalized Input Threshold Voltage vs Free-Air Temperature**



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## 4 Revision History

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

**Changes from Revision J (April 2013) to Revision K** — **Page**

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1
- Changed front-page figure ... 1
- Changed *Pin Configuration and Functions* section; updated table format ... 4
- Changed "free-air temperature" to "junction temperature" in *Absolute Maximum Ratings* condition statement ... 5
- Deleted *Soldering temperature* specification from *Absolute Maximum Ratings* table ... 5
- Changed *clamp current* to *current* specifications in *Absolute Maximum Ratings* table ... 5
- Changed Removed $V_I$ from *Absolute Maximum Ratings* table ... 5
- Changed Removed $V_{SENSE}$ from *Recommended Operating Conditions* table ... 5
- Changed free-air temperature to junction temperature in *Electrical Characteristics* condition statement ... 6
- Changed "$T_A$" to "$T_J$" in *Timing Requirements* condition statement ... 7
- Changed "$T_A$" to "$T_J$" in *Switching Characteristics* condition statement ... 7
- Added footnote (3) to *Functional Block Diagram* ... 10
- Changed part number shown in Figure 9 ... 12
- Changed Figure 11 ... 14

**Changes from Revision I (February 2013) to Revision J** — **Page**

- Added *TPS382xA-33* to second $\overline{\text{RESET}}$ row of $V_{OH}$ parameter in *Electrical Characteristics* table ... 6
- Added *TPS382xA-33* to third $\overline{\text{RESET}}$ row of $V_{OL}$ parameter in *Electrical Characteristics* table ... 6
- Corrected typo in $V_{OL}$ $\overline{\text{RESET}}$ parameter test conditions ... 6
- Added *TPS382xA-33* to third and seventh rows of $V_{IT-}$ parameter in *Electrical Characteristics* table ... 6
- Added *TPS382xA-33* to third row of $V_{hys}$ parameter in *Electrical Characteristics* table ... 6
- Added *TPS382xA-33* to third row of $I_{OS}$ parameter in *Electrical Characteristics* table ... 7

- Added *TPS3823A* to second row of $t_{tout}$ parameter in *Switching Characteristics* table ... 7
- Added *TPS3823A* to second row of $t_d$ parameter in *Switching Characteristics* table ... 7
- Added *TPS3823A* to first row of $t_{PHL}$ parameter in *Switching Characteristics* table ... 7

**Changes from Revision H (July 2012) to Revision I** **Page**

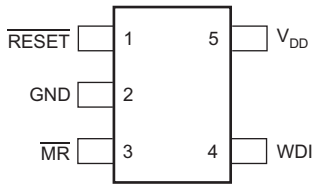
- Added last row of *Terminal Functions* table to Package Information table ... 4

## 5 Device Comparison Table

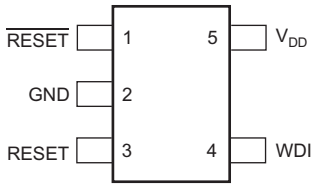
| DEVICE | RESET | $\overline{\text{RESET}}$ | WDI | $\overline{\text{MR}}$ |
|---|---|---|---|---|
| TPS3820 | | Push-pull | X | X |
| TPS3823 | | Push-pull | X | X |
| TPS3823A | | Push-pull | X | X |
| TPS3824 | Push-pull | | X | |
| TPS3825 | Push-pull | Push-pull | | X |
| TPS3828 | Open-drain | Push-pull | X | X |

## 6 Pin Configuration and Functions

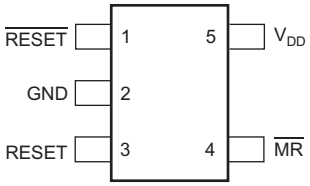
**TPS3820, TPS3823, TPS3823A, TPS3828: DBV PACKAGE**
**5-Pin SOT-23**
**Top View**




**TPS3824: DBV PACKAGE**
**5-Pin SOT-23**
**Top View**




**TPS3825: DBV PACKAGE**
**5-Pin SOT-23**
**Top View**




**Pin Functions**

| PIN | | | | I/O | DESCRIPTION |
|---|---|---|---|---|---|
| NAME | TPS3820, TPS3823, TPS3823A, TPS3828 | TPS3824 | TPS3825 | | |
| GND | 2 | 2 | 2 | — | Ground connection |
| $\overline{\text{MR}}$ | 3 | — | 4 | I | Manual-reset input. Pull low to force a reset. RESET remains low as long as $\overline{\text{MR}}$ is low and for the time-out period after $\overline{\text{MR}}$ goes high. Leave unconnected or connect to $V_{DD}$ when unused. |
| RESET | — | 3 | 3 | O | Active-high reset output. Either push-pull or open-drain output stage. |
| $\overline{\text{RESET}}$ | 1 | 1 | 1 | O | Active-low reset output. Either push-pull or open-drain output stage. |
| $V_{DD}$ | 5 | 5 | 5 | I | Supply voltage. Powers the device and monitors its own voltage. |
| WDI | 4 | 4 | — | I | Watchdog timer input. If WDI remains high or low longer than the time-out period, then reset is triggered. The timer clears when reset is asserted or when WDI sees a rising edge or a falling edge. If unused, the WDI connection must be high impedance to prevent it from causing a reset event. |

# 7 Specifications

## 7.1 Absolute Maximum Ratings

over operating junction temperature range (unless otherwise noted)(1) (2)

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| Voltage | $V_{DD}$ | –0.3 | 6 | V |
| | RESET, $\overline{\text{RESET}}$, MR, WDI | –0.3 | ($V_{DD}$ + 0.3) | |
| Current | Maximum low output, $I_{OL}$ | –5 | 5 | mA |
| | Maximum high output, $I_{OH}$ | –5 | 5 | |
| | Output range ($V_O$ < 0 or $V_O$ > $V_{DD}$), $I_{OK}$ | –10 | 10 | |
| | Continuous total power dissipation | See *Thermal Information* | | |
| Temperature | Operating free-air, $T_A$ | –40 | 85 | °C |
| | Storage, $T_{stg}$ | –65 | 150 | |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values are with respect to GND.

## 7.2 ESD Ratings

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1) | ±2000 | V |
| | | Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(2) | ±500 | |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

## 7.3 Recommended Operating Conditions

over operating junction temperature range (unless otherwise noted).

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| $V_{DD}$ | Supply voltage | 1.1 | | 5.5 | V |
| $V_{IH}$ | High-level input voltage at $\overline{\text{MR}}$ and WDI | 0.7 × $V_{DD}$ | | | V |
| $V_{IL}$ | Low-level input voltage | | | 0.3 × $V_{DD}$ | V |
| Δt/ΔV | Input transition rise and fall rate at $\overline{\text{MR}}$ or WDI | | | 100 | ns/V |
| $T_A$ | Operating free-air temperature range | –40 | | 85 | °C |

## 7.4 Thermal Information

| THERMAL METRIC(1) | | TPS382x DBV (SOT-23) 5 PINS | UNIT |
|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 209.1 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 72.8 | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 36.7 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 2.1 | °C/W |
| $\psi_{JB}$ | Junction-to-board characterization parameter | 35.8 | °C/W |

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

## 7.5 Electrical Characteristics

over operating junction temperature range (unless otherwise noted)

| PARAMETER | | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | $\overline{RESET}$ | TPS382x-25 | $V_{DD} = V_{IT-} + 0.2$ V, $I_{OH} = -20$ µA | 0.8 × $V_{DD}$ | | | V |
| | | | TPS382x-30<br>TPS382x-33<br>TPS382xA-33 | $V_{DD} = V_{IT-} + 0.2$ V, $I_{OH} = -30$ µA | | | | |
| | | | TPS382x-50 | $V_{DD} = V_{IT-} + 0.2$ V $I_{OH} = -120$ µA | $V_{DD}$ – 1.5 V | | | |
| | | RESET | TPS3824-25<br>TPS3825-25 | $V_{DD} \geq 1.8$ V, $I_{OH} = -100$ µA | 0.8 × $V_{DD}$ | | | |
| | | | TPS3824-30<br>TPS3825-30 | $V_{DD} \geq 1.8$ V, $I_{OH} = -150$ µA | | | | |
| | | | TPS3824-33<br>TPS3825-33 | | | | | |
| | | | TPS3824-50<br>TPS3825-50 | | | | | |
| $V_{OL}$ | Low-level output voltage | RESET | TPS3824-25<br>TPS3825-25 | $V_{DD} = V_{IT-} + 0.2$ V, $I_{OL} = 1$ mA | | | 0.4 | V |
| | | | TPS3824-30<br>TPS3825-30 | $V_{DD} = V_{IT-} + 0.2$ V, $I_{OL} = 1.2$ mA | | | | |
| | | | TPS3824-33<br>TPS3825-33 | | | | | |
| | | | TPS3824-50<br>TPS3825-50 | $V_{DD} = V_{IT-} + 0.2$ V, $I_{OL} = 3$ mA | | | | |
| | | $\overline{RESET}$ | TPS382x-25 | $V_{DD} = V_{IT-} - 0.2$ V, $I_{OL} = 1$ mA | | | 0.4 | |
| | | | TPS382x-30 | $V_{DD} = V_{IT-} - 0.2$ V, $I_{OL} = 1.2$ mA | | | | |
| | | | TPS382x-33<br>TPS382xA-33 | | | | | |
| | | | TPS382x-50 | $V_{DD} = V_{IT-} - 0.2$ V, $I_{OL} = 3$ mA | | | | |
| | Power-up reset voltage (1) | | | $V_{DD} \geq 1.1$ V, $I_{OL} = 20$ µA | | | 0.4 | V |
| $V_{IT-}$ | Negative-going input threshold voltage (2) | | TPS382x-25 | $T_A$ = 0°C to 85°C | 2.21 | 2.25 | 2.30 | V |
| | | | TPS382x-30 | | 2.59 | 2.63 | 2.69 | |
| | | | TPS382x-33<br>TPS382xA-33 | | 2.88 | 2.93 | 3 | |
| | | | TPS382x-50 | | 4.49 | 4.55 | 4.64 | |
| | | | TPS382x-25 | $T_A$ = –40°C to 85°C | 2.20 | 2.25 | 2.30 | |
| | | | TPS382x-30 | | 2.57 | 2.63 | 2.69 | |
| | | | TPS382x-33<br>TPS382xA-33 | | 2.86 | 2.93 | 3 | |
| | | | TPS382x-50 | | 4.46 | 4.55 | 4.64 | |
| $V_{hys}$ | Hysteresis at $V_{DD}$ input | | TPS382x-25 | | | 30 | | mV |
| | | | TPS382x-30 | | | | | |
| | | | TPS382x-33<br>TPS382xA-33 | | | | | |
| | | | TPS382x-50 | | | 50 | | |
| $I_{IH(AV)}$ | Average high-level input current | WDI | | WDI = $V_{DD}$, time average (DC = 88%) | | 120 | | µA |
| $I_{IL(AV)}$ | Average low-level input current | | | WDI = 0.3 V, $V_{DD}$ = 5.5 V time average (DC = 12%) | | –15 | | |
| $I_{IH}$ | High-level input current | WDI | | WDI = $V_{DD}$ | | 140 | 190 | µA |
| | | $\overline{MR}$ | | $\overline{MR}$ = $V_{DD}$ × 0.7, $V_{DD}$ = 5.5 V | | –40 | –60 | |
| $I_{IL}$ | Low-level input current | WDI | | WDI = 0.3 V, $V_{DD}$ = 5.5 V | | 140 | 190 | µA |
| | | $\overline{MR}$ | | $\overline{MR}$ = 0.3 V, $V_{DD}$ = 5.5 V | | –110 | –160 | |

(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 near the supply terminals.

## Electrical Characteristics (continued)

over operating junction temperature range (unless otherwise noted)

| PARAMETER | | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $I_{OS}$ | Output short-circuit current(3) | $\overline{RESET}$ | TPS382x-25 | $V_{DD} = V_{IT,\ max} + 0.2$ V, $V_O = 0$ V | | | –400 | µA |
| | | | TPS382x-30 | | | | | |
| | | | TPS382x-33<br>TPS382xA-33 | | | | | |
| | | | TPS382x-50 | | | | –800 | |
| $I_{DD}$ | Supply current | | | WDI, $\overline{MR}$, and outputs unconnected | | 15 | 25 | µA |
| | Internal pullup resistor at $\overline{MR}$ | | | | | 52 | | kΩ |
| $C_i$ | Input capacitance at $\overline{MR}$, WDI | | | $V_I = 0$ V to 5.5 V | | 5 | | pF |

(3) The $\overline{RESET}$ short-circuit current is the maximum pullup current when $\overline{RESET}$ is driven low by a microprocessor bidirectional reset pin.

## 7.6 Timing Requirements

At $R_L = 1$ MΩ, $C_L = 50$ pF, and $T_J = 25°C$, unless otherwise noted.

| | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $t_w$ | Pulse width at $V_{DD}$ | $V_{DD} = V_{IT-} + 0.2$ V, $V_{DD} = V_{IT-} – 0.2$ V | 6 | | | µs |
| | Pulse width at $\overline{MR}$ | $V_{DD} \geq V_{IT-} + 0.2$ V, $V_{IL} = 0.3 \times V_{DD}$, $V_{IH} = 0.7 \times V_{DD}$ | 1 | | | µs |
| | Pulse width at WDI | $V_{DD} \geq V_{IT-} + 0.2$ V, $V_{IL} = 0.3 \times V_{DD}$, $V_{IH} = 0.7 \times V_{DD}$ | 100 | | | ns |

## 7.7 Switching Characteristics

At $R_L = 1$ MΩ, $C_L = 50$ pF, and $T_J = 25°C$, unless otherwise noted.

| PARAMETER | | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{tout}$ | Watchdog time out | TPS3820 | $V_{DD} \geq V_{IT-} + 0.2$ V<br>See Figure 1 | 112 | 200 | 300 | ms |
| | | TPS3823/4/8, TPS3823A | | 0.9 | 1.6 | 2.5 | s |
| $t_d$ | Delay time | TPS3820 | $V_{DD} \geq V_{IT-} + 0.2$ V<br>See Figure 1 | 15 | 25 | 37 | ms |
| | | TPS3823/4/5/8, TPS3823A | | 120 | 200 | 300 | |
| $t_{PHL}$ | Propagation (delay) time, high-to-low-level output | $\overline{MR}$ to $\overline{RESET}$ delay (TPS3820/3/5/8, TPS3823A) | $V_{DD} \geq V_{IT-} + 0.2$ V,<br>$V_{IL} = 0.3 \times V_{DD}$,<br>$V_{IH} = 0.7 \times V_{DD}$ | | | 0.1 | µs |
| | | $V_{DD}$ to $\overline{RESET}$ delay | $V_{IL} = V_{IT-} – 0.2$ V,<br>$V_{IH} = V_{IT-} + 0.2$ V | | | 25 | |
| $t_{PLH}$ | Propagation (delay) time, low-to-high-level output | $\overline{MR}$ to RESET delay (TPS3824/5) | $V_{DD} \geq V_{IT-} + 0.2$ V,<br>$V_{IL} = 0.3 \times V_{DD}$,<br>$V_{IH} = 0.7 \times V_{DD}$ | | | 0.1 | µs |
| | | $V_{DD}$ to RESET delay (TPS3824/5) | $V_{IL} = V_{IT-} – 0.2$ V,<br>$V_{IH} = V_{IT-} + 0.2$ V | | | 25 | |

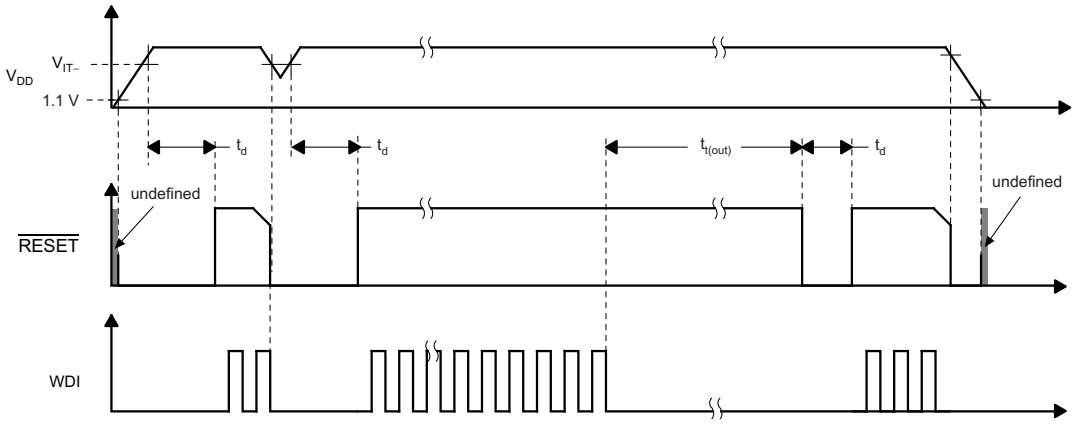



**Figure 1. Timing Diagram**

## 7.8 Typical Characteristics

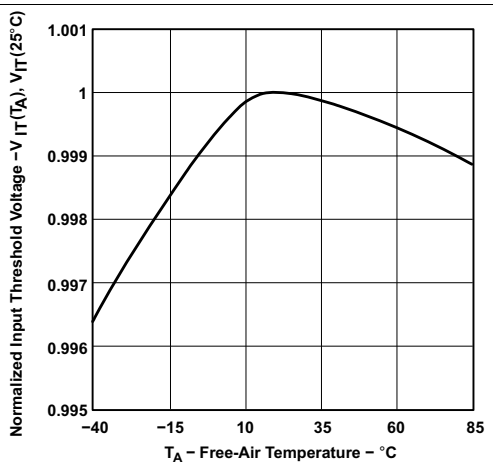



**Figure 2. Normalized Input Threshold Voltage vs Free-Air Temperature at $V_{DD}$**

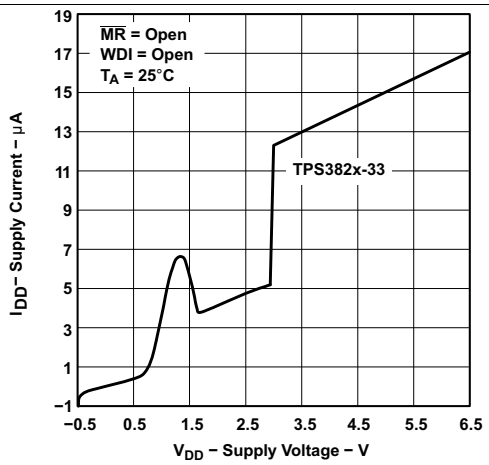



**Figure 3. Supply Current vs Supply Voltage**

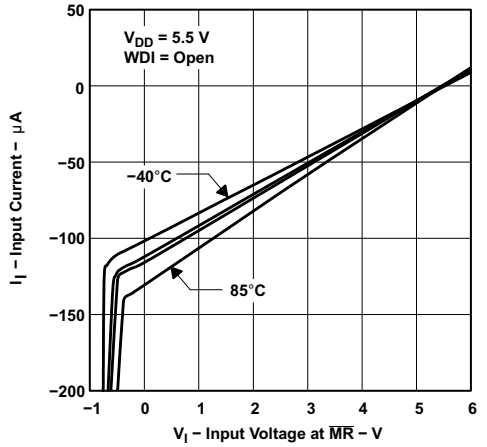



**Figure 4. Input Current vs Input Voltage at $\overline{MR}$**

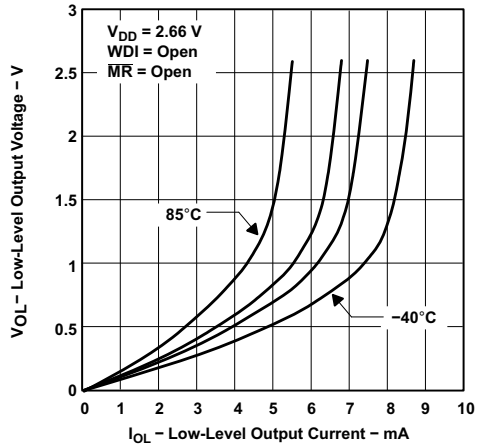



**Figure 5. Low-Level Output Voltage vs Low-Level Output Current**

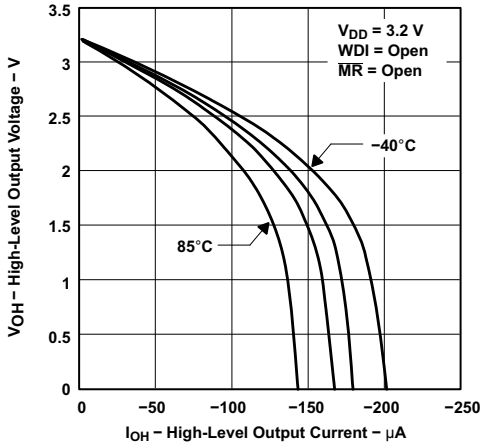



**Figure 6. High-Level Output Voltage vs High-Level Output Current**

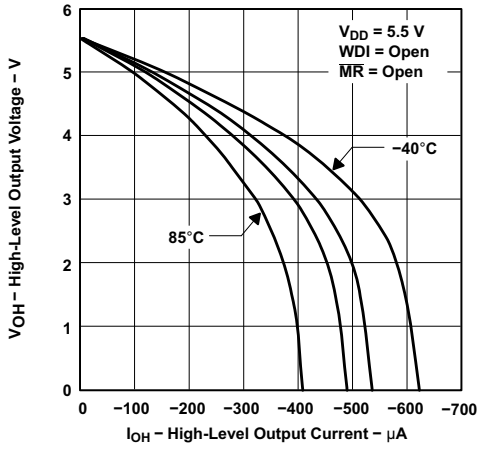



**Figure 7. High-Level Output Voltage vs High-Level Output Current**

## Typical Characteristics (continued)

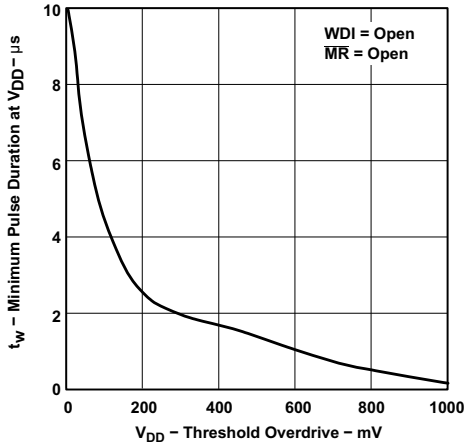



**Figure 8. Minimum Pulse Duration at $V_{DD}$ vs $V_{DD}$ Threshold Overdrive**

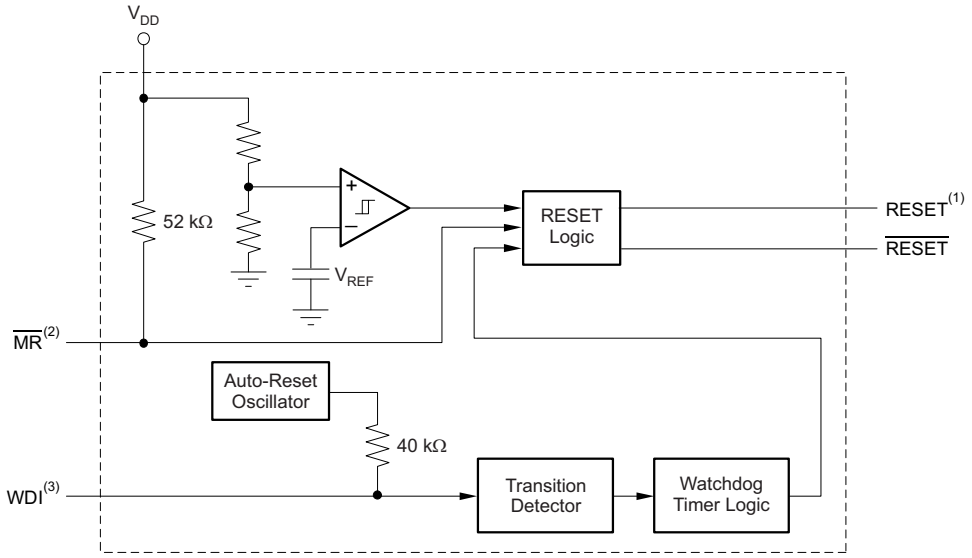
# 8 Detailed Description

## 8.1 Overview

The TPS382x family of supervisors provide circuit initialization and timing supervision. Optional configurations include devices with active-high and active-low output signals (TPS3824/5), devices with a watchdog timer (TPS3820/3/4/8), and devices with manual reset ($\overline{MR}$) pins (TPS3820/3/5/8). $\overline{RESET}$ asserts when the supply voltage, $V_{DD}$, rises above 1.1 V. For devices with active-low output logic, the device monitors $V_{DD}$ and keeps $\overline{RESET}$ low as long as $V_{DD}$ remains below the negative threshold voltage, $V_{IT-}$. For devices with active-high output logic, RESET remains high as long as $V_{DD}$ remains below $V_{IT-}$. An internal timer delays the return of the output to the inactive state (high) to ensure proper system reset. The delay time, $t_d$, starts after $V_{DD}$ rises above the positive threshold voltage ($V_{IT-} + V_{HYS}$). When the supply voltage drops below $V_{IT-}$, the output becomes active (low) again. All the devices of this family have a fixed-sense threshold voltage, $V_{IT-}$, set by an internal voltage divider, so no external components are required.

The TPS382x family is designed to monitor supply voltages of 2.5 V, 3 V, 3.3 V, and 5 V. The devices are available in a 5-pin SOT-23 package and are characterized for operation over a temperature range of −40°C to 85°C.

## 8.2 Functional Block Diagram




(1) TPS3824/5
(2) TPS3820/3/5/8
(3) TPS3820/3/4/8

## 8.3 Feature Description

### 8.3.1 Manual Reset ($\overline{MR}$)

The $\overline{MR}$ input allows an external logic signal from processors, logic circuits, and/or discrete sensors to force a reset signal regardless of $V_{DD}$ with respect to $V_{IT-}$ or the state of the watchdog timer. A low level at $\overline{MR}$ causes the reset signals to become active.

### 8.3.2 Active High or Active Low Output

All TPS382x devices have an active-low logic output ($\overline{RESET}$), while the TPS3824/5 devices also include an active-high logic output (RESET).

### 8.3.3 Push-Pull or Open-Drain Output

All TPS382x devices, except for TPS3828, have push-pull outputs. TPS3828 devices have an open-drain output.

## Feature Description (continued)

### 8.3.4 Watchdog Timer (WDI)

TPS3820/3/4/8 devices have a watchdog timer that must be periodically triggered by either a positive or negative transition at WDI to avoid a reset signal being issued. When the supervising system fails to retrigger the watchdog circuit within the time-out interval, $t_{tout}$, $\overline{RESET}$ becomes active for the time period $t_d$. This event also reinitializes the watchdog timer.

The watchdog timer can be disabled by disconnecting the WDI pin from the system. If the WDI pin detects that it is in a high-impedance state the TPS3820/3/4/8 will generate its own WDI pulse to ensure that $\overline{RESET}$ does not assert. If this behavior is not desired place a 1kΩ resistor from WDI to ground. This resistor will help ensure that the TPS3820/3/4/8 detects that WDI is not in a high-impedance state.

In applications where the input to the WDI pin is active (transitioning high and low) when the TPS3820/3/4/8 is asserting $\overline{RESET}$, $\overline{RESET}$ will be stuck at a logic low after the input voltage returns above $V_{IT-}$. If the application requires that input to WDI be active when the reset signal is asserted, then either the **A** version of the device should be used or a FET to decouple the WDI signal. The **A** version does not latch the reset signal to the asserted state if a WDI pulse is received while RESET is asserted. An external FET decouples the WDI signal by disconnecting the WDI input when $\overline{RESET}$ is asserted. For more details on this, see *Decoupling WDI During Reset Event* for more details. The **A** version of the device does not need this FET but does operate in circuits that have it. Therefore, the **A** version is backwards-compatible with the non-**A** versions.

## 8.4 Device Functional Modes

**Table 1. Function Table**

| INPUTS | | OUTPUTS | |
|---|---|---|---|
| $\overline{MR}$ (1) | $V_{DD} > V_{IT}$ | $\overline{RESET}$ | RESET (2) |
| L | 0 | L | H |
| L | 1 | L | H |
| H | 0 | L | H |
| H | 1 | H | L |

(1) TPS3820/3/5/8
(2) TPS3824/5

# 9 Application and Implementation

**NOTE**

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

## 9.1 Application Information

The TPS382x family of devices are very small supervisory circuits that monitor fixed supply voltages of 2.5 V, 3 V, 3.3 V, and 5 V. The TPS382x family operates from 1.1 V to 5.5 V. Orderable options include versions with either push-pull or open-drain outputs, versions that use active-high or active-low logic for output signals, versions with a manual reset pin, and versions with a watchdog timer. See the *Device Comparison Table* for an overview of device options.

## 9.2 Typical Applications

### 9.2.1 Supply Rail Monitoring with Watchdog Time-out and 200-ms Delay

The TPS3823A can be used to monitor the supply rail for devices such as microcontrollers. The downstream device is enabled by the TPS3823A once the voltage on the supply pin ($V_{DD}$) is above the internal threshold voltage ($V_{IT-} + V_{HYS}$). The downstream device is disabled by the TPS3823A when $V_{DD}$ falls below the threshold voltage minus the hysteresis voltage ($V_{IT-}$). The TPS3823A also issues a reset signal if the WDI input is not periodically triggered by a positive or negative transition at WDI. When the supervising system fails to retrigger the watchdog circuit within the time-out interval, $t_{tout}$, $\overline{\text{RESET}}$ becomes active for the time period $t_d$.

Some applications require a shorter reset signal than the 200 ms that most of the TPS382x family provide. In these cases, the TPS3820 is a good choice because it has a delay time of only 25 ms. If an open-drain output is needed, replace the TPS3823A with the TPS3828 (if the WDI input must be active while $\overline{\text{RESET}}$ is low, see *Decoupling WDI During Reset Event* ). Figure 9 shows the TPS3823A in a typical application.

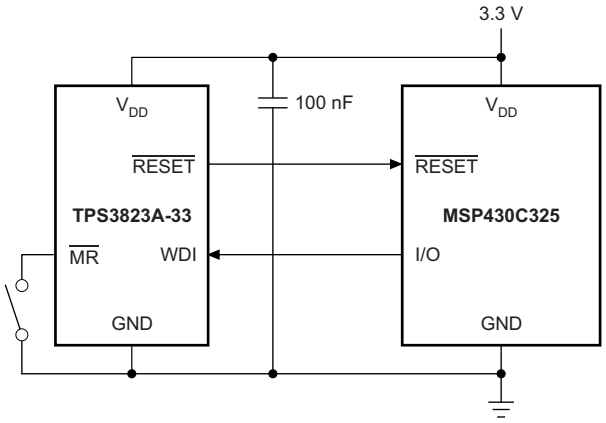



**Figure 9. Supply Rail Monitoring With Watchdog Time-out**

#### *9.2.1.1 Design Requirements*

The TPS3823A must drive the enable pin of a MSP430C325 using a logic-high signal to signify that the supply voltage is above the minimum operating voltage of the device and monitor the I/O pin to determine if the microcontroller is operating correctly.

## Typical Applications (continued)

### 9.2.1.2 Detailed Design Procedure

Determine which version of the TPS382x family best suits the functional performance required.

If the input supply is noisy, include an input capacitor to help avoid unwanted changes to the reset signal.

### 9.2.1.3 Application Curve

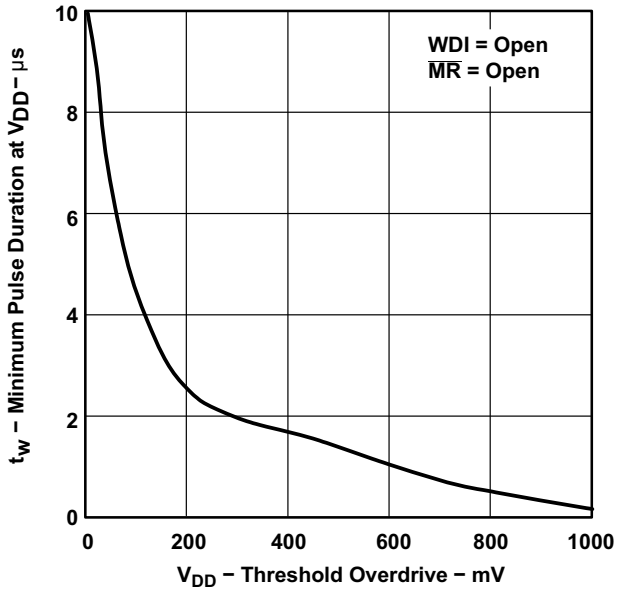



**Figure 10. Minimum Pulse Duration at $V_{DD}$ vs $V_{DD}$ Threshold Overdrive**

## Typical Applications (continued)

### 9.2.2 Decoupling WDI During Reset Event

If the application requires that the input to WDI is active when the reset signal is asserted and the **A** version of the device cannot be used, Figure 11 shows how to decouple WDI from the active signal using an N-channel FET. The N-channel FET is placed in series with the WDI pin, with the gate of the FET connected to the $\overline{\text{RESET}}$ output.

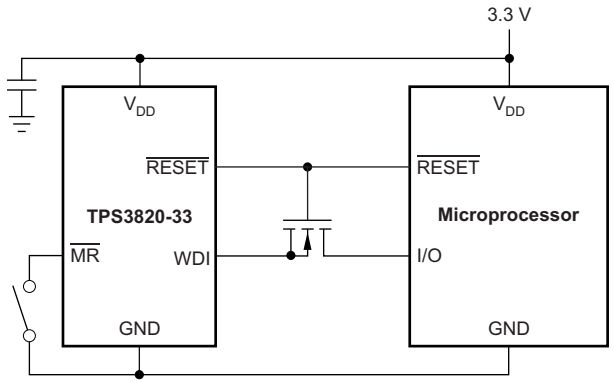



**Figure 11. WDI Example**

#### *9.2.2.1 Design Requirements*

The TPS3820 must drive the enable pin of a microprocessor using a logic-high signal to signify that the supply voltage is above the minimum operating voltage of the device and monitor the I/O pin to determine if the microcontroller is operating correctly. The reset signal delay time should be greater than 10 ms but less than 50 ms to achieve the desired behavior.

#### *9.2.2.2 Detailed Design Procedure*

Determine which version of the TPS3820 is best suited for monitoring the supply voltage.

If the input supply is noisy, include an input capacitor to help avoid unwanted changes to the reset signal.

#### *9.2.2.3 Application Curve*

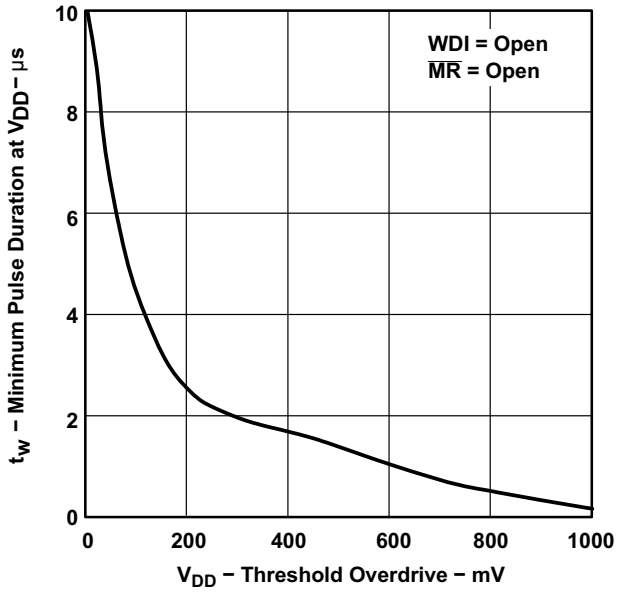



**Figure 12. Minimum Pulse Duration at $V_{DD}$ vs $V_{DD}$ Threshold Overdrive**

# 10 Power Supply Recommendations

These devices are designed to operate from an input supply with a voltage range from 1.1 V to 5.5 V. Though not required, it is good analog design practice to place a 0.1-µF ceramic capacitor close to the $V_{DD}$ pin if the input supply is noisy.

# 11 Layout

## 11.1 Layout Guidelines

Follow these guidelines to lay out the printed-circuit-board (PCB) that is used for the TPS382x family of devices.

- Place the $V_{DD}$ decoupling capacitor ($C_{VDD}$) close to the device.
- Avoid using long traces for the $V_{DD}$ supply node. The $V_{DD}$ capacitor ($C_{VDD}$), along with parasitic inductance from the supply to the capacitor, can form an LC tank and create ringing with peak voltages above the maximum $V_{DD}$ voltage.

## 11.2 Layout Example

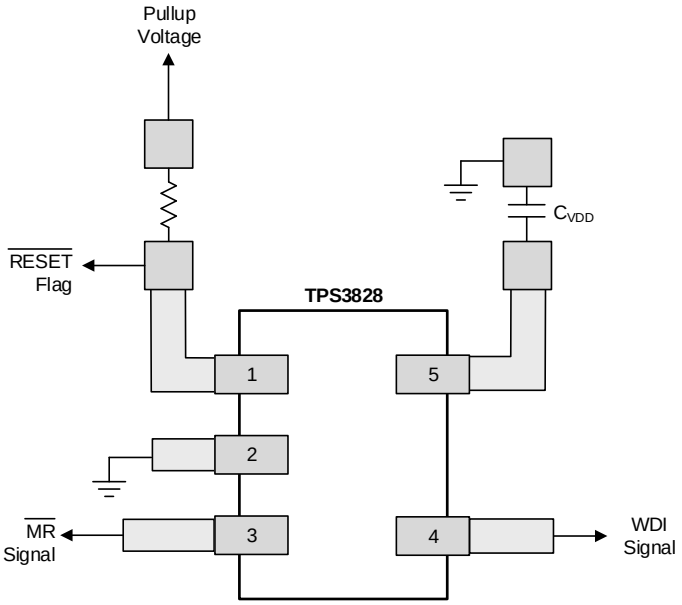



**Figure 13. Example Layout (DBV Package)**

# 12 Device and Documentation Support

## 12.1 Device Support

### 12.1.1 Development Support

#### *12.1.1.1 Spice Models*

Computer simulation of circuit performance using SPICE is often useful when analyzing the performance of analog circuits and systems. A SPICE model for the TPS382x is available through the product folders under *Tools & Software*.

### 12.1.2 Device Nomenclature

**Table 2. Ordering Information(1)**

| ORDERABLE DEVICE NAME(2) (3) | | THRESHOLD VOLTAGE(4) | MARKING |
|---|---|---|---|
| TPS3820-33DBVT | TPS3820-33DBVR | 2.93 V | PDEI |
| TPS3820-50DBVT | TPS3820-50DBVR | 4.55 V | PDDI |
| TPS3823-25DBVT | TPS3823-25DBVR | 2.25 V | PAPI |
| TPS3823-30DBVT | TPS3823-30DBVR | 2.63 V | PAQI |
| TPS3823-33DBVT | TPS3823-33DBVR | 2.93 V | PARI |
| TPS3823-50DBVT | TPS3823-50DBVR | 4.55 V | PASI |
| TPS3824-25DBVT | TPS3824-25DBVR | 2.25 V | PATI |
| TPS3824-30DBVT | TPS3824-30DBVR | 2.63 V | PAUI |
| TPS3824-33DBVT | TPS3824-33DBVR | 2.93 V | PAVI |
| TPS3824-50DBVT | TPS3824-50DBVR | 4.55 V | PAWI |
| TPS3825-33DBVT | TPS3825-33DBVR | 2.93 V | PDGI |
| TPS3825-50DBVT | TPS3825-50DBVR | 4.55 V | PDFI |
| TPS3828-33DBVT | TPS3828-33DBVR | 2.93 V | PDII |
| TPS3828-50DBVT | TPS3828-50DBVR | 4.55 V | PDHI |
| TPS3823A-33DBVT | TPS3823A-33DBVR | 2.93 V | PYPI |

(1) 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.
(2) The DBVT package indicates tape and reel of 250 parts.
(3) The DBVR package indicates tape and reel of 3000 parts.
(4) For other threshold voltage versions, contact the local TI sales office.

## 12.2 Documentation Support

### 12.2.1 Related Documentation

For related documentation see the following:

- *Disabling the Watchdog Timer for TI's Family of Supervisors*, SLVA145

## 12.3 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 3. Related Links**

| PARTS | PRODUCT FOLDER | SAMPLE & BUY | TECHNICAL DOCUMENTS | TOOLS & SOFTWARE | SUPPORT & COMMUNITY |
|---|---|---|---|---|---|
| TPS3820 | Click here | Click here | Click here | Click here | Click here |
| TPS3823 | Click here | Click here | Click here | Click here | Click here |
| TPS3824 | Click here | Click here | Click here | Click here | Click here |
| TPS3825 | Click here | Click here | Click here | Click here | Click here |
| TPS3828 | Click here | Click here | Click here | Click here | Click here |

## 12.4 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

**TI E2E™ Online Community** ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

## 12.5 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

## 12.6 Electrostatic Discharge Caution

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.

## 12.7 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

# 13 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3820-33DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDEI | Samples |
| TPS3820-33DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDEI | Samples |
| TPS3820-33DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDEI | Samples |
| TPS3820-33DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDEI | Samples |
| TPS3820-50DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDDI | Samples |
| TPS3820-50DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDDI | Samples |
| TPS3820-50DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDDI | Samples |
| TPS3820-50DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDDI | Samples |
| TPS3823-25DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAPI | Samples |
| TPS3823-25DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAPI | Samples |
| TPS3823-25DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAPI | Samples |
| TPS3823-25DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAPI | Samples |
| TPS3823-30DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAQI | Samples |
| TPS3823-30DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAQI | Samples |
| TPS3823-30DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAQI | Samples |
| TPS3823-30DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAQI | Samples |
| TPS3823-33DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PARI | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3823-33DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PARI | Samples |
| TPS3823-33DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PARI | Samples |
| TPS3823-33DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PARI | Samples |
| TPS3823-50DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PASI | Samples |
| TPS3823-50DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PASI | Samples |
| TPS3823-50DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PASI | Samples |
| TPS3823-50DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PASI | Samples |
| TPS3823A-33DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PYPI | Samples |
| TPS3823A-33DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PYPI | Samples |
| TPS3824-25DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PATI | Samples |
| TPS3824-25DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PATI | Samples |
| TPS3824-25DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PATI | Samples |
| TPS3824-25DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PATI | Samples |
| TPS3824-30DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAUI | Samples |
| TPS3824-30DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAUI | Samples |
| TPS3824-30DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAUI | Samples |
| TPS3824-30DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAUI | Samples |
| TPS3824-33DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAVI | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3824-33DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAVI | Samples |
| TPS3824-33DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAVI | Samples |
| TPS3824-33DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAVI | Samples |
| TPS3824-50DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAWI | Samples |
| TPS3824-50DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PAWI | Samples |
| TPS3824-50DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAWI | Samples |
| TPS3824-50DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | PAWI | Samples |
| TPS3825-33DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDGI | Samples |
| TPS3825-33DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDGI | Samples |
| TPS3825-33DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDGI | Samples |
| TPS3825-33DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDGI | Samples |
| TPS3825-50DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDFI | Samples |
| TPS3825-50DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDFI | Samples |
| TPS3825-50DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDFI | Samples |
| TPS3825-50DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDFI | Samples |
| TPS3828-33DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDII | Samples |
| TPS3828-33DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDII | Samples |
| TPS3828-33DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDII | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3828-33DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDII | Samples |
| TPS3828-50DBVR | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDHI | Samples |
| TPS3828-50DBVRG4 | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDHI | Samples |
| TPS3828-50DBVT | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDHI | Samples |
| TPS3828-50DBVTG4 | ACTIVE | SOT-23 | DBV | 5 | 250 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | PDHI | 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) 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.

(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.

**OTHER QUALIFIED VERSIONS OF TPS3820, TPS3820-33, TPS3820-50, TPS3823-25, TPS3823-30, TPS3823-33, TPS3823-50, TPS3824-25, TPS3824-30, TPS3824-33, TPS3824-50, TPS3825-33, TPS3825-50, TPS3828-33, TPS3828-50 :**

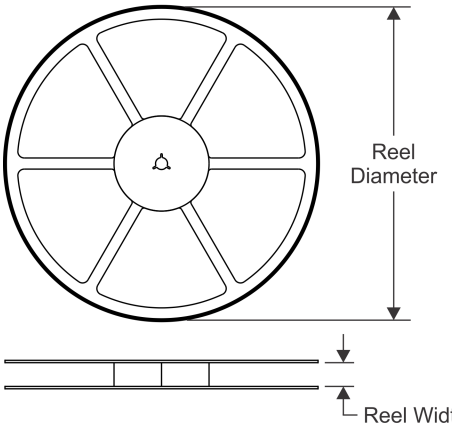
- Automotive: TPS3820-Q1, TPS3820-33-Q1, TPS3820-50-Q1, TPS3823-25-Q1, TPS3823-30-Q1, TPS3823-33-Q1, TPS3823-50-Q1, TPS3824-25-Q1, TPS3824-30-Q1, TPS3824-33-Q1, TPS3824-50-Q1, TPS3825-33-Q1, TPS3825-50-Q1, TPS3828-33-Q1, TPS3828-50-Q1

NOTE: Qualified Version Definitions:

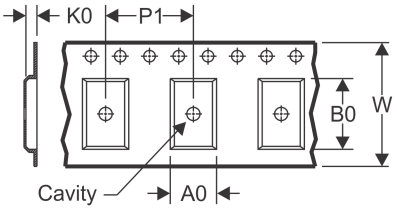
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

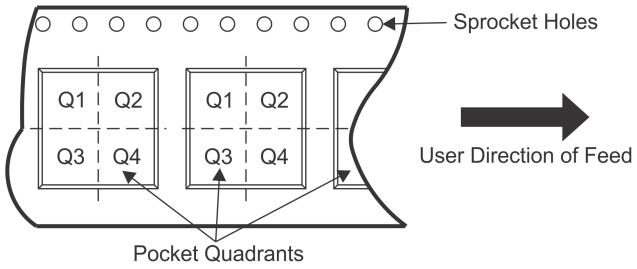



**TAPE DIMENSIONS**




| | |
|---|---|
| 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 |

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**

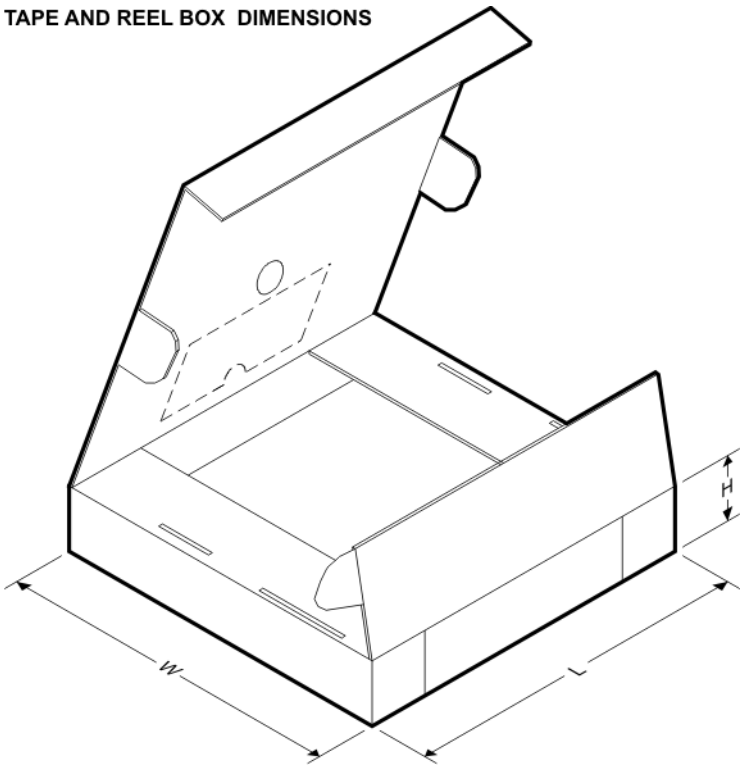



*All dimensions are nominal

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3820-33DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3820-33DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3820-50DBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3820-50DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3820-50DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3820-50DBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3823-25DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3823-25DBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3823-25DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3823-25DBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3823-30DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3823-30DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3823-33DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3823-33DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3823-50DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3823-50DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3823A-33DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3823A-33DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3824-25DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3824-25DBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3824-25DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3824-25DBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3824-30DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3824-30DBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3824-30DBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3824-30DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3824-33DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3824-33DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3824-50DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3824-50DBVT | SOT-23 | DBV | 5 | 250 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3824-50DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3825-33DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3825-33DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 8.4 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3825-50DBVR | SOT-23 | DBV | 5 | 3000 | 179.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3825-50DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3825-50DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| TPS3828-33DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3828-33DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3828-50DBVR | SOT-23 | DBV | 5 | 3000 | 178.0 | 9.0 | 3.23 | 3.17 | 1.37 | 4.0 | 8.0 | Q3 |
| TPS3828-50DBVT | SOT-23 | DBV | 5 | 250 | 178.0 | 9.0 | 3.3 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |

**TAPE AND REEL BOX DIMENSIONS**

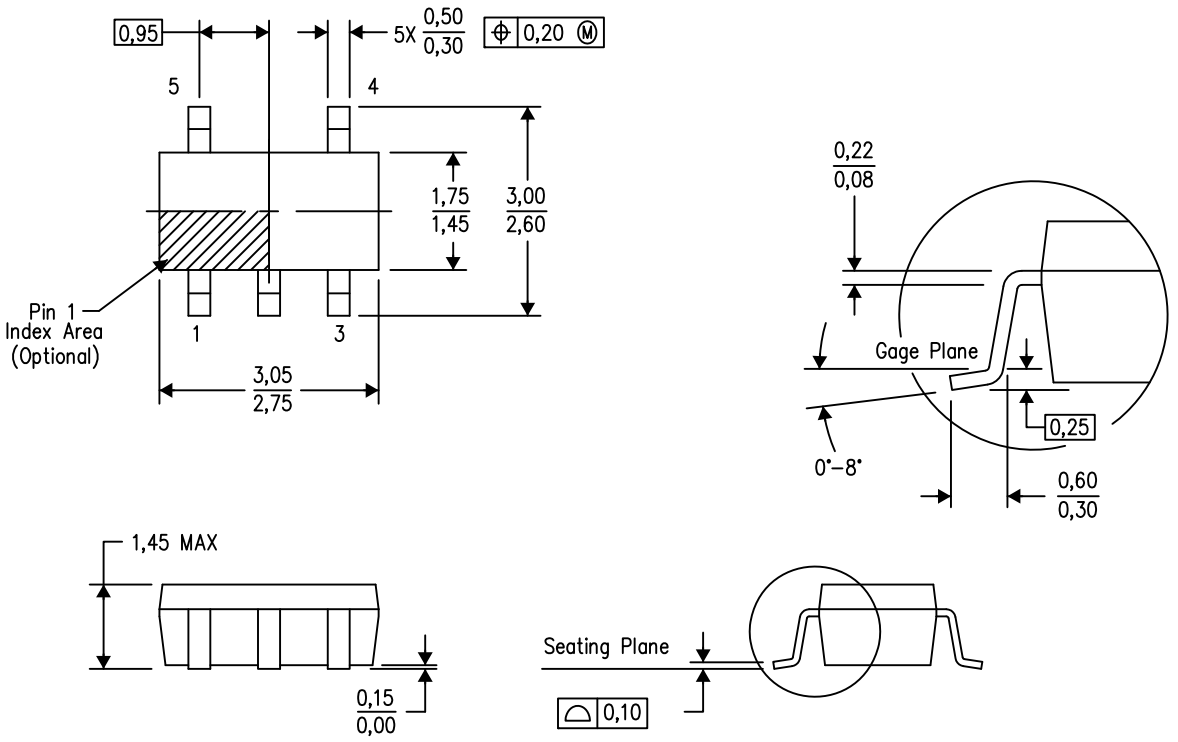



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TPS3820-33DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3820-33DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3820-50DBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TPS3820-50DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3820-50DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3820-50DBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TPS3823-25DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3823-25DBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TPS3823-25DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3823-25DBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TPS3823-30DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3823-30DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3823-33DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3823-33DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3823-50DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3823-50DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3823A-33DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3823A-33DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3824-25DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3824-25DBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| TPS3824-25DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3824-25DBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TPS3824-30DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3824-30DBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TPS3824-30DBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TPS3824-30DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3824-33DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3824-33DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3824-50DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3824-50DBVT | SOT-23 | DBV | 5 | 250 | 203.0 | 203.0 | 35.0 |
| TPS3824-50DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3825-33DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3825-33DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3825-50DBVR | SOT-23 | DBV | 5 | 3000 | 203.0 | 203.0 | 35.0 |
| TPS3825-50DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3825-50DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3828-33DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3828-33DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |
| TPS3828-50DBVR | SOT-23 | DBV | 5 | 3000 | 180.0 | 180.0 | 18.0 |
| TPS3828-50DBVT | SOT-23 | DBV | 5 | 250 | 180.0 | 180.0 | 18.0 |

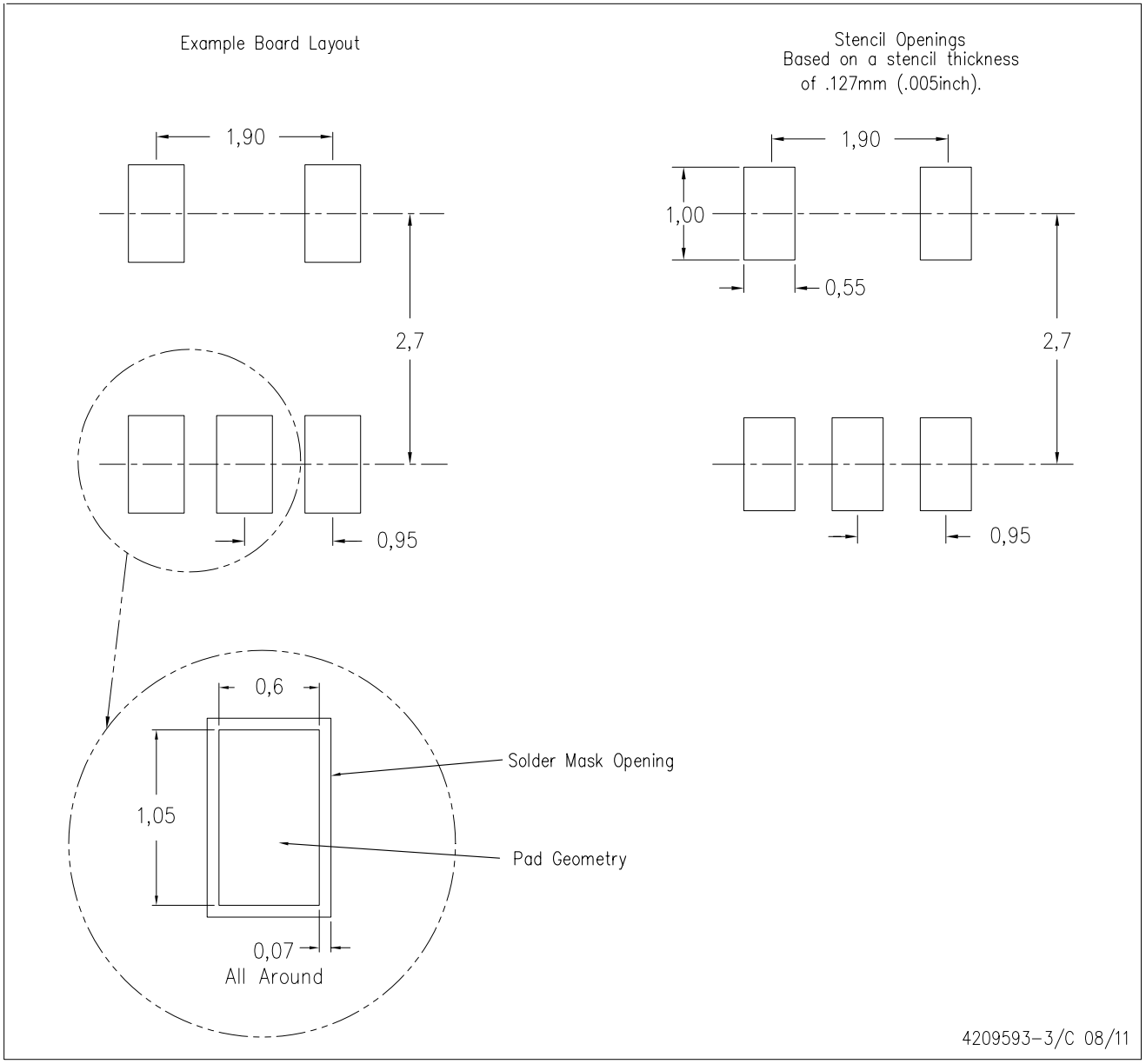
DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE




4073253–4/N 12/14

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. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

DBV (R–PDSO–G5) 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.

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