

TPS3700 過電圧および低電圧監視用の基準電圧を内蔵した 高電圧 (18V) ウィンドウ電圧検出器

1 特長

- 広い電源電圧範囲: 1.8V~18V
- スレッシュホールドを変更可能: 最低 400mV
- スレッシュホールドの高い精度
 - 温度範囲全体で 1.0%
 - 0.25% (標準値)
- 低い静止電流: 5.5 μ A (標準値)
- 過電圧および低電圧検出用のオープン・ドレイン出力
- 内部ヒステリシス: 5.5mV (標準値)
- 温度範囲: -40°C~+125°C
- パッケージ:
 - SOT-6
 - 1.5mm \times 1.5mm WSON-6

2 アプリケーション

- 産業用制御システム
- 車載用システム
- 組み込みコンピューティング・モジュール
- DSP、マイクロコントローラ、マイクロプロセッサのアプリケーション
- ノート PC およびデスクトップ PC
- 携帯用およびバッテリー駆動の製品
- FPGA および ASIC アプリケーション

3 概要

TPS3700 は電源電圧範囲の広いウィンドウ電圧検出器で、1.8V~18V の範囲で動作します。このデバイスには高精度コンパレータが 2 つ、内部的な 400mV の基準電圧、および過電圧と低電圧検出用の 18V 定格のオープンドレイン出力が 2 つ内蔵されています。TPS3700 はウィンドウ電圧検出器としても、2 つの独立した電圧モニタとしても使用でき、監視対象の電圧は外付け抵抗により設定できます。

OUTAは、INA+の電圧が($V_{ITP} - V_{HYS}$)より低くなるとLOWに駆動され、対応するスレッシュホールド(V_{ITP})より高い電圧に戻るとHIGHに復帰します。OUTBは、INB-の電圧が V_{ITP} より高くなるとLOWに駆動され、対応するスレッシュホールド($V_{ITP} - V_{HYS}$)より低い電圧に戻るとHIGHに復帰します。TPS3700のコンパレータは両方とも、短時間のグリッチを除去するためヒステリシスが組み込まれているので、誤ったトリガが発生せず、安定した出力動作が保証されます。

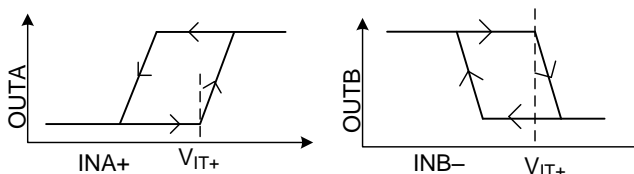
TPS3700はSOT-6および1.5mm \times 1.5mmのWSON-6パッケージで供給され、-40°C~125°Cの接合部温度範囲で動作が規定されています。

製品情報⁽¹⁾

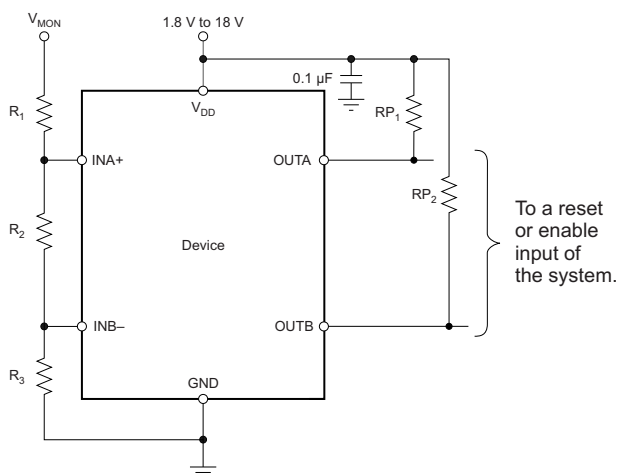
型番	パッケージ	本体サイズ(公称)
TPS3700	SOT (6)	2.90mm \times 1.60mm
	WSON (6)	1.50mm \times 1.50mm

(1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。

出力と入力のスレッシュホールドとヒステリシスの関係



概略回路図



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4 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Revision F (January 2018) から Revision G に変更 Page

- データシート全体を通してコンパレータを電圧検出器に変更 1
-

Revision E (February 2017) から Revision F に変更 Page

- データシート全体を通してコンパレータをスーパーバイザに変更 1
-

Revision D (January 2015) から Revision E に変更 Page

- Added maximum specification to *Start-up delay* parameter 6
 - Changed *at least 150 μs* to *450 μs (max)* in footnote 2 of *Electrical Characteristics* table 6
-

Revision C (May 2013) から Revision D に変更 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 5
 - Changed HBM maximum specification from 2 kV to 2.5 kV in *ESD Ratings* 5
 - Changed *Functional Block Diagram*; added hysteresis symbol 10
-

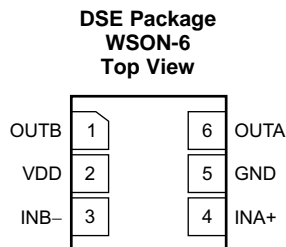
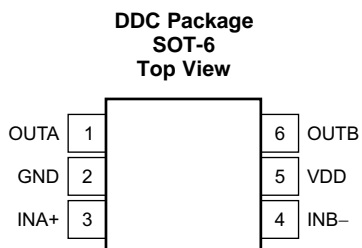
Revision B (April 2012) から Revision C に変更 Page

- 特長の箇条書きの「パッケージ」項目を変更 1
 - 「概要」セクションにSON-6パッケージ・オプションを追加 1
 - 表紙にDSEピン配置の図を追加 1
 - Added DSE pin out graphic 4
 - Added DSE package to Thermal Information table 5
-

Revision A (February 2012) から Revision B に変更 Page

- 量産データに移行 1
-

5 Pin Configuration and Functions



Pin Functions

NAME	PIN		I/O	DESCRIPTION
	DDC	DSE		
GND	2	5	—	Ground
INA+	3	4	I	This pin is connected to the voltage to be monitored with the use of an external resistor divider. When the voltage at this terminal drops below the threshold voltage ($V_{ITP} - V_{HYS}$), OUTA is driven low.
INB-	4	3	I	This pin is connected to the voltage to be monitored with the use of an external resistor divider. When the voltage at this terminal exceeds the threshold voltage (V_{ITP}), OUTB is driven low.
OUTA	1	6	O	INA+ comparator open-drain output. OUTA is driven low when the voltage at this comparator is below ($V_{ITP} - V_{HYS}$). The output goes high when the sense voltage returns above the respective threshold (V_{ITP}).
OUTB	6	1	O	INB- comparator open-drain output. OUTB is driven low when the voltage at this comparator exceeds V_{ITP} . The output goes high when the sense voltage returns below the respective threshold ($V_{ITP} - V_{HYS}$).
VDD	5	2	I	Supply voltage input. Connect a 1.8-V to 18-V supply to VDD to power the device. Good analog design practice is to place a 0.1- μ F ceramic capacitor close to this pin.

6 Specifications

6.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Voltage ⁽²⁾	V _{DD}	-0.3	20	V
	OUTA, OUTB	-0.3	20	V
	INA+, INB-	-0.3	7	V
Current	Output terminal current		40	mA
Operating junction temperature, T _J		-40	125	°C
Storage temperature, T _{stg}		-65	150	°C

- (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 voltages are with respect to network ground terminal.

6.2 ESD Ratings

		VALUE	UNIT
V _(ESD) Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins ⁽¹⁾	±2500	V
	Charged device model (CDM), per JEDEC specification JESD22-C101, all pins ⁽²⁾	±1000	

- (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.

6.3 Recommended Operating Conditions

over operating temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V _{DD}	Supply voltage	1.8		18	V
V _I	Input voltage	0		6.5	V
V _O	Output voltage	0		18	V

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		TPS3700		UNIT
		DDC (SOT)	DSE (WSON)	
		6 PINS	6 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	204.6	194.9	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	50.5	128.9	°C/W
R _{θJB}	Junction-to-board thermal resistance	54.3	153.8	°C/W
ψ _{JT}	Junction-to-top characterization parameter	0.8	11.9	°C/W
ψ _{JB}	Junction-to-board characterization parameter	52.8	157.4	°C/W
R _{θJC(bot)}	Junction-to-case (bottom) thermal resistance	N/A	N/A	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

6.5 Electrical Characteristics

Over the operating temperature range of $T_J = -40^\circ\text{C}$ to 125°C , and $1.8\text{ V} < V_{DD} < 18\text{ V}$, unless otherwise noted. Typical values are at $T_J = 25^\circ\text{C}$ and $V_{DD} = 5\text{ V}$.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{DD}	Supply voltage range		1.8		18	V
$V_{(POR)}$	Power-on reset voltage ⁽¹⁾	$V_{OLmax} = 0.2\text{ V}$, $I_{(OUTA/B)} = 15\ \mu\text{A}$			0.8	V
V_{IT+}	Positive-going input threshold voltage	$V_{DD} = 1.8\text{ V}$	396	400	404	mV
		$V_{DD} = 18\text{ V}$	396	400	404	
V_{IT-}	Negative-going input threshold voltage	$V_{DD} = 1.8\text{ V}$	387	394.5	400	mV
		$V_{DD} = 18\text{ V}$	387	394.5	400	
V_{hys}	Hysteresis voltage ($hys = V_{IT+} - V_{IT-}$)			5.5	12	
$I_{(INA+)}$	Input current (at the INA+ terminal)	$V_{DD} = 1.8\text{ V}$ and 18 V , $V_I = 6.5\text{ V}$	-25	1	25	nA
$I_{(INB-)}$	Input current (at the INB- terminal)	$V_{DD} = 1.8\text{ V}$ and 18 V , $V_I = 0.1\text{ V}$	-15	1	15	nA
V_{OL}	Low-level output voltage	$V_{DD} = 1.3\text{ V}$, $I_O = 0.4\text{ mA}$			250	mV
		$V_{DD} = 1.8\text{ V}$, $I_O = 3\text{ mA}$			250	
		$V_{DD} = 5\text{ V}$, $I_O = 5\text{ mA}$			250	
$I_{(kg(OD))}$	Open-drain output leakage-current	$V_{DD} = 1.8\text{ V}$ and 18 V , $V_O = V_{DD}$			300	nA
		$V_{DD} = 1.8\text{ V}$, $V_O = 18\text{ V}$			300	
I_{DD}	Supply current	$V_{DD} = 1.8\text{ V}$, no load		5.5	11	μA
		$V_{DD} = 5\text{ V}$		6	13	
		$V_{DD} = 12\text{ V}$		6	13	
		$V_{DD} = 18\text{ V}$		7	13	
	Start-up delay ⁽²⁾			150	450	μs
UVLO	Undervoltage lockout ⁽³⁾	V_{DD} falling	1.3		1.7	V

(1) The lowest supply voltage (V_{DD}) at which output is active; $t_{r(VDD)} > 15\ \mu\text{s/V}$. Below $V_{(POR)}$, the output cannot be determined.

(2) During power on, V_{DD} must exceed 1.8 V for $450\ \mu\text{s}$ (max) before the output is in a correct state.

(3) When V_{DD} falls below UVLO, OUTA is driven low and OUTB goes to high impedance. The outputs cannot be determined below $V_{(POR)}$.

6.6 Timing Requirements

over operating temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
t_{PHL}	High-to-low propagation delay ⁽¹⁾	$V_{DD} = 5\text{ V}$, 10-mV input overdrive, $R_P = 10\text{ k}\Omega$, $V_{OH} = 0.9 \times V_{DD}$, $V_{OL} = 400\text{ mV}$, see Figure 1		18		μs
t_{PLH}	Low-to-high propagation delay ⁽¹⁾	$V_{DD} = 5\text{ V}$, 10-mV input overdrive, $R_P = 10\text{ k}\Omega$, $V_{OH} = 0.9 \times V_{DD}$, $V_{OL} = 400\text{ mV}$, see Figure 1		29		μs

(1) High-to-low and low-to-high refers to the transition at the input terminals (INA+ and INB-).

6.7 Switching Characteristics

Over operating temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_r	Output rise time		2.2		μs
t_f	Output fall time		0.22		μs

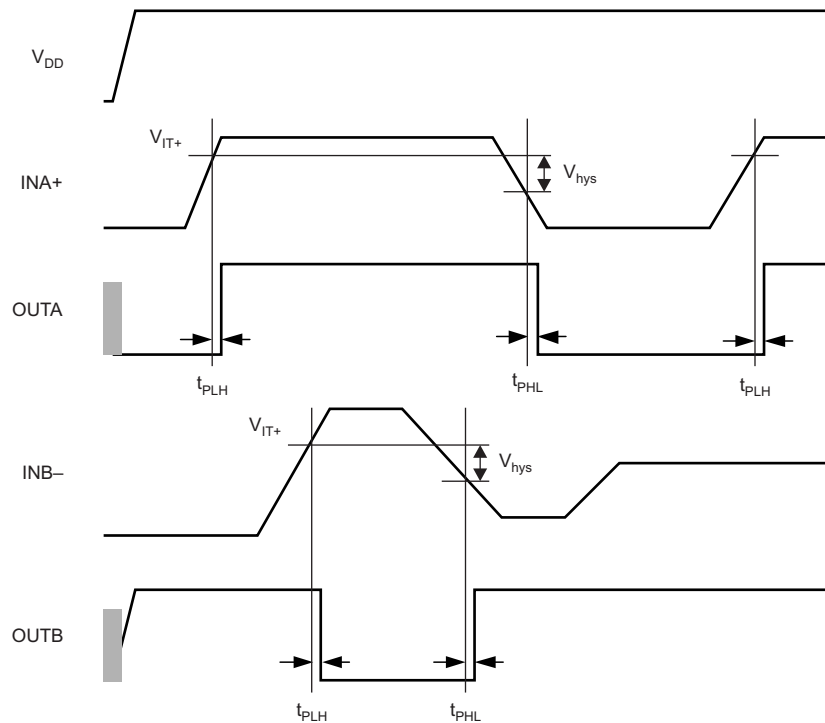


Figure 1. Timing Diagram

6.8 Typical Characteristics

at $T_J = 25^\circ\text{C}$ and $V_{DD} = 5\text{ V}$ (unless otherwise noted)

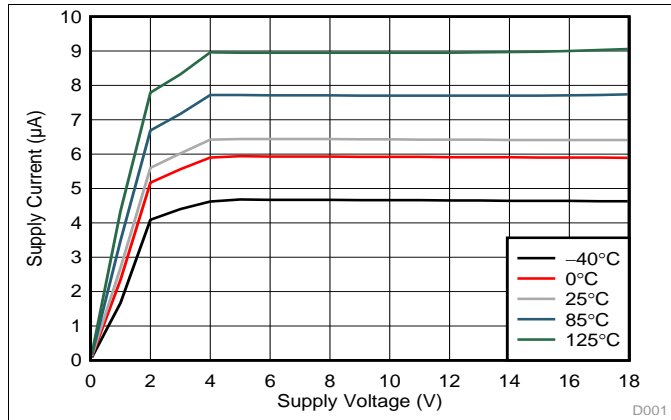


Figure 2. Supply Current (I_{DD}) vs Supply Voltage (V_{DD})

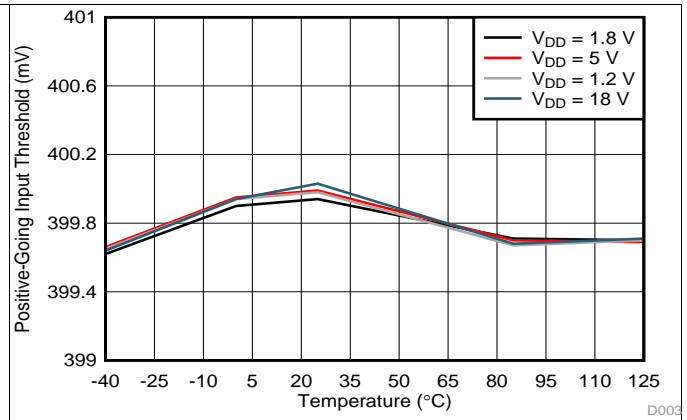


Figure 3. Rising Input Threshold Voltage (V_{IT+}) vs Temperature

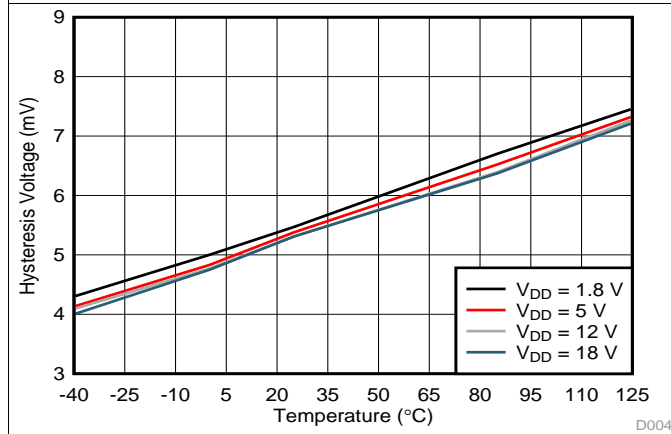


Figure 4. Hysteresis (V_{hys}) vs Temperature

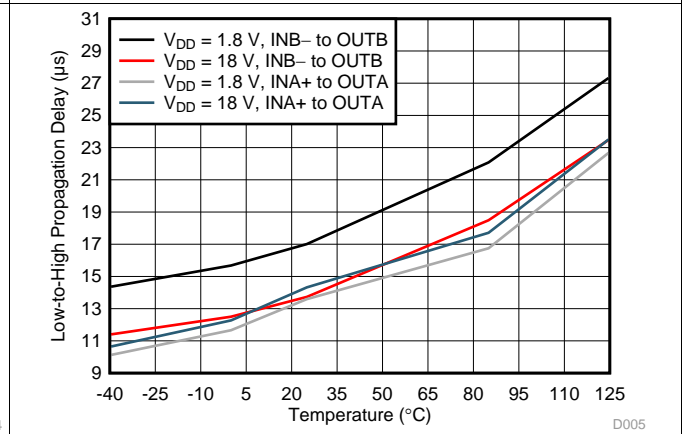


Figure 5. Propagation Delay vs Temperature (High-to-Low Transition at the Inputs)

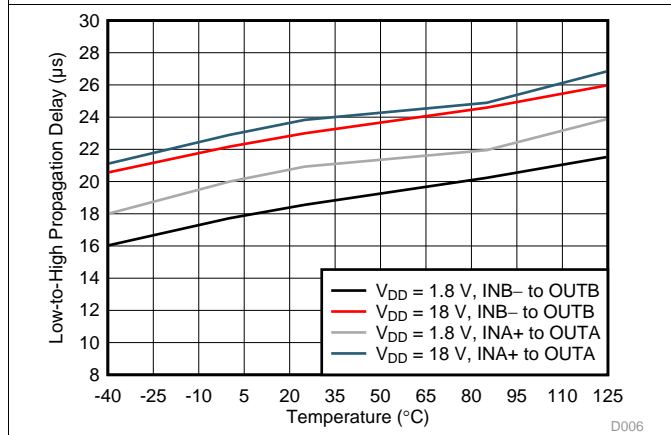
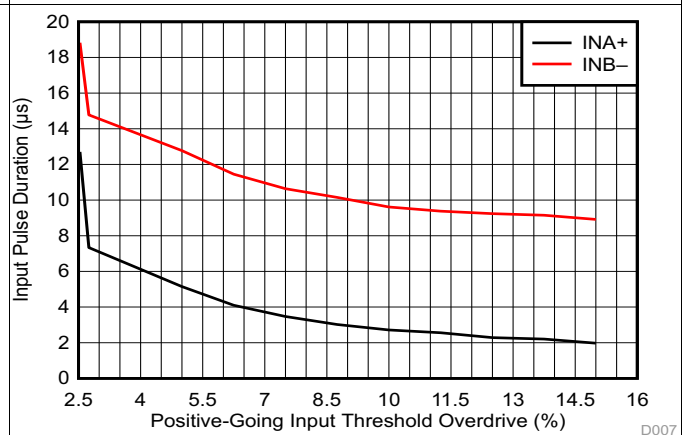


Figure 6. Propagation Delay vs Temperature (Low-to-High Transition at the Inputs)



INA+ = negative spike below V_{IT-}
 INB- = positive spike above V_{IT+}

Figure 7. Minimum Pulse Duration vs Threshold Overdrive Voltage

Typical Characteristics (continued)

at $T_J = 25^\circ\text{C}$ and $V_{DD} = 5\text{ V}$ (unless otherwise noted)

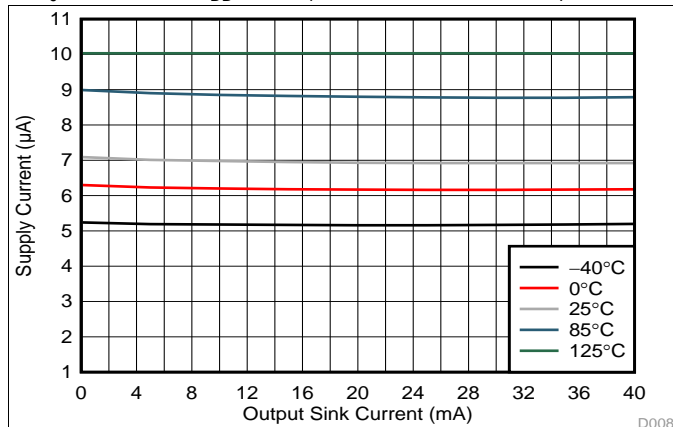


Figure 8. Supply Current (I_{DD}) vs Output Sink Current

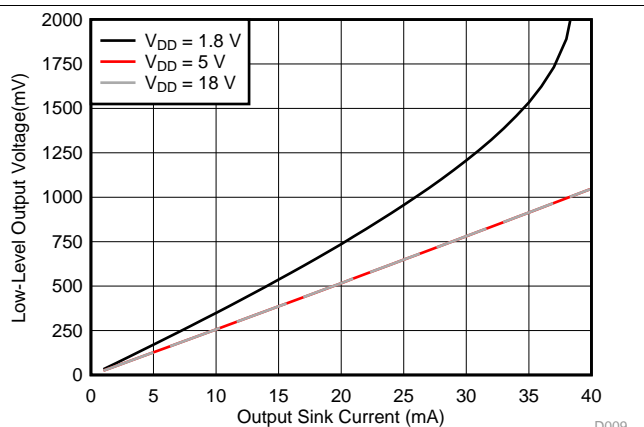


Figure 9. Output Voltage Low (V_{OL}) vs Output Sink Current (-40°C)

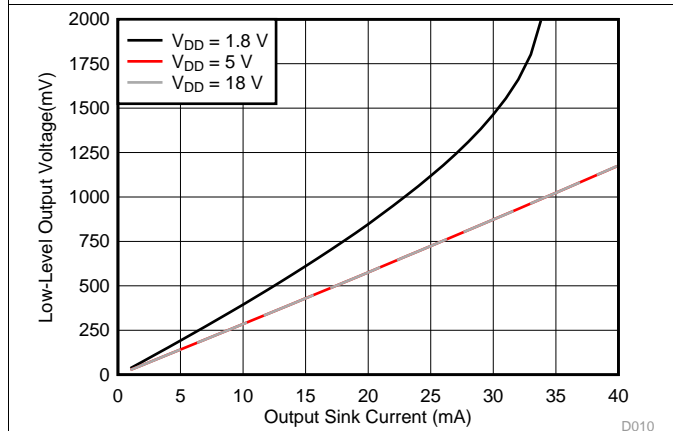


Figure 10. Output Voltage Low (V_{OL}) vs Output Sink Current (0°C)

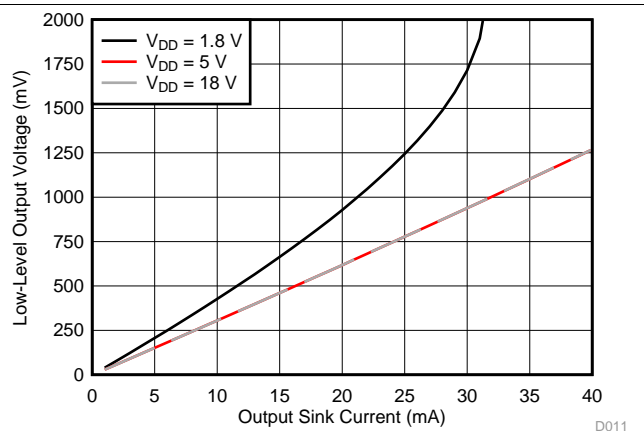


Figure 11. Output Voltage Low (V_{OL}) vs Output Sink Current (25°C)

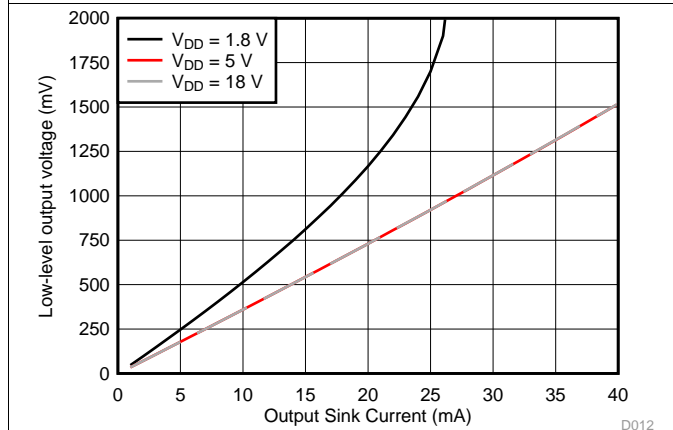


Figure 12. Output Voltage Low (V_{OL}) vs Output Sink Current (85°C)

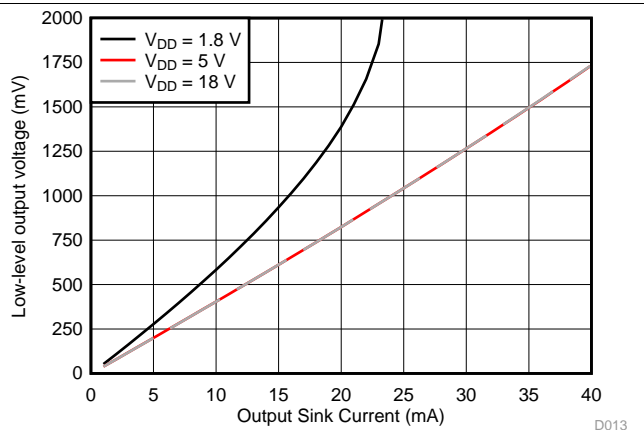


Figure 13. Output Voltage Low (V_{OL}) vs Output Sink Current (125°C)

7 Detailed Description

7.1 Overview

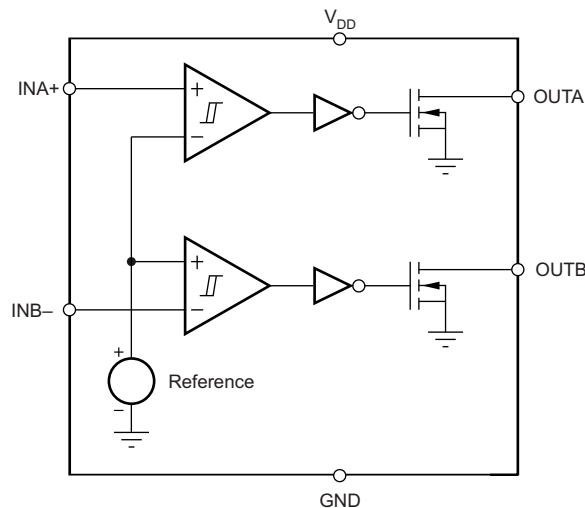
The TPS3700 device combines two voltage detectors for overvoltage and undervoltage detection. The TPS3700 device is a wide-supply voltage range (1.8 V to 18 V) device with a high-accuracy rising input threshold of 400 mV (1% over temperature) and built-in hysteresis. The outputs are also rated to 18 V and can sink up to 40 mA.

The TPS3700 device is designed to assert the output signals, as shown in [Table 1](#). Each input terminal can be set to monitor any voltage above 0.4 V using an external resistor divider network. With the use of two input terminals of different polarities, the TPS3700 device forms a window voltage detector. Broad voltage thresholds can be supported that allow the device to be used in a wide array of applications.

Table 1. TPS3700 Truth Table

CONDITION	OUTPUT	STATUS
$INA+ > V_{IT+}$	OUTA high	Output A not asserted
$INA+ < V_{IT-}$	OUTA low	Output A asserted
$INB- > V_{IT+}$	OUTB low	Output B asserted
$INB- < V_{IT-}$	OUTB high	Output B not asserted

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Inputs (INA+, INB-)

The TPS3700 device is a voltage detector that combines two comparators. Each comparator has one external input (inverting and noninverting); the other input is connected to the internal reference. The comparator rising threshold is designed and trimmed to be equal to the reference voltage (400 mV). Both comparators also have a built-in falling hysteresis that makes the device less sensitive to supply rail noise and ensures stable operation.

The INA+ and INB- inputs can swing from ground to 6.5 V, regardless of the device supply voltage used. Although not required in most cases, good analog design practice is to place a 1-nF to 10-nF bypass capacitor at the comparator input for extremely noisy applications to reduce sensitivity to transients and layout parasitics.

For comparator A, the corresponding output (OUTA) is driven to logic low when the input INA+ voltage drops below $(V_{IT+} - V_{hys})$. When the voltage exceeds V_{IT+} , the output (OUTA) goes to a high-impedance state; see [Figure 1](#).

Feature Description (continued)

For comparator B, the corresponding output (OUTB) is driven to logic low when the voltage at input INB– exceeds V_{IT+} . When the voltage drops below $V_{IT+} - V_{hys}$ the output (OUTB) goes to a high-impedance state; see [Figure 1](#). Together, these comparators form a window-detection function as discussed in the [Window Voltage Detector](#) section.

7.3.2 Outputs (OUTA, OUTB)

In a typical TPS3700 application, the outputs are connected to a reset or enable input of the processor (such as a digital signal processor [DSP], central processing unit [CPU], field-programmable gate array [FPGA], or application-specific integrated circuit [ASIC]) or the outputs are connected to the enable input of a voltage regulator (such as a DC-DC or low-dropout regulator [LDO]).

The TPS3700 device provides two open-drain outputs (OUTA and OUTB). Pullup resistors must be used to hold these lines high when the output goes to high impedance (not asserted). By connecting pullup resistors to the proper voltage rails, the outputs can be connected to other devices at the correct interface-voltage levels. The TPS3700 outputs can be pulled up to 18 V, independent of the device supply voltage. By using wired-OR logic, OUTA and OUTB can merge into one logic signal that goes low if either outputs are asserted because of a fault condition.

[Table 1](#) and the [Inputs \(INA+, INB–\)](#) section describe how the outputs are asserted or deasserted. See [Figure 1](#) for a timing diagram that describes the relationship between threshold voltages and the respective output.

7.3.3 Window Voltage Detector

The inverting and noninverting configuration of the comparators forms a window-voltage detection circuit using a resistor divider network, as illustrated in [Figure 14](#) and [Figure 15](#). The input terminals can monitor any system voltage above 400 mV with the use of a resistor divider network. The INA+ and INB– terminals monitor for undervoltage and overvoltage conditions, respectively.

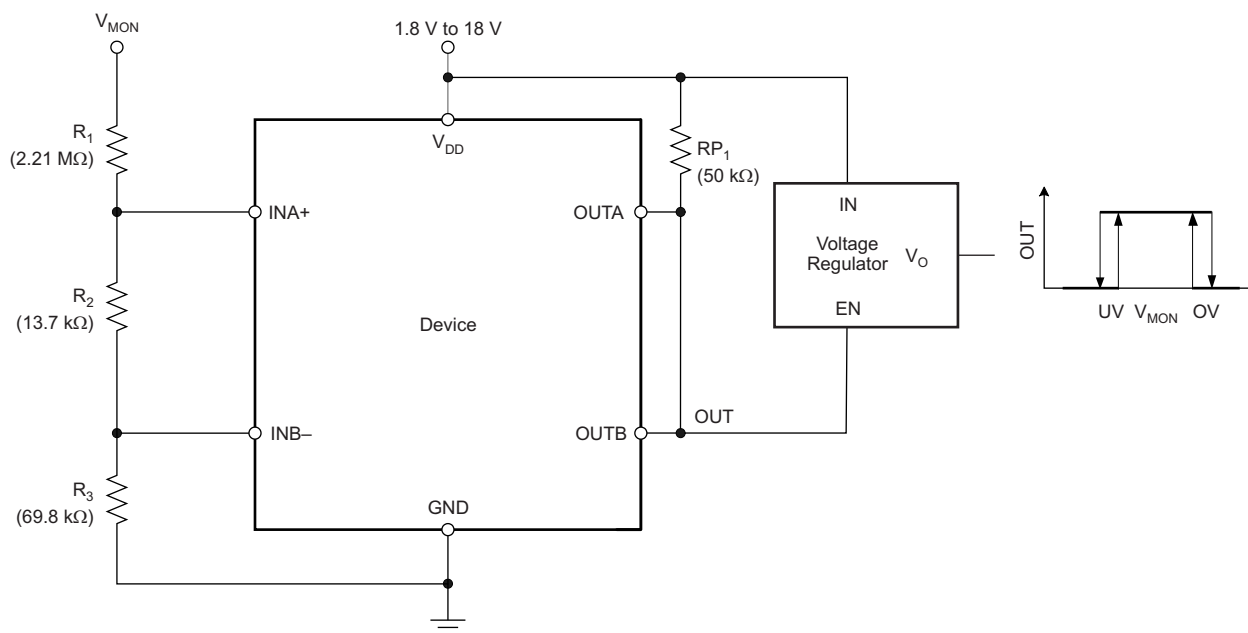


Figure 14. Window Voltage Detector Block Diagram

Feature Description (continued)

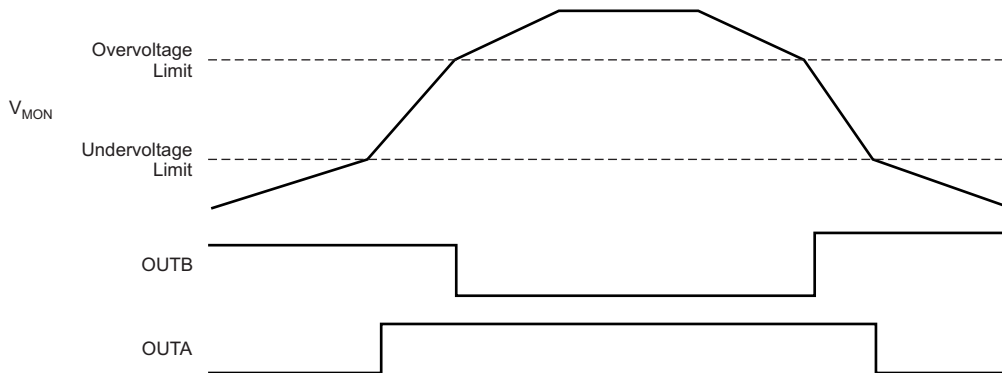


Figure 15. Window Voltage Detector Timing Diagram

7.3.4 Immunity to Input Terminal Voltage Transients

The TPS3700 device is relatively immune to short voltage transient spikes on the input terminals. Sensitivity to transients depends on both transient duration and amplitude; see the *Minimum Pulse Duration vs Threshold Overdrive Voltage* curve (Figure 7) in the *Typical Characteristics* section.

7.4 Device Functional Modes

7.4.1 Normal Operation ($V_{DD} > UVLO$)

When the voltage on V_{DD} is greater than 1.8 V for at least 150 μ s, the OUTA and OUTB signals correspond to the voltage on INA+ and INB– as listed in Table 1.

7.4.2 Undervoltage Lockout ($V_{(POR)} < V_{DD} < UVLO$)

When the voltage on V_{DD} is less than the device UVLO voltage, and greater than the power-on reset voltage, $V_{(POR)}$, the OUTA and OUTB signals are asserted and high impedance, respectively, regardless of the voltage on INA+ and INB–.

7.4.3 Power-On Reset ($V_{DD} < V_{(POR)}$)

When the voltage on V_{DD} is lower than the required voltage to internally pull the asserted output to GND ($V_{(POR)}$), both outputs are in a high-impedance state.

8 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.

8.1 Application Information

The TPS3700 device is a wide-supply window voltage detector that operates over a V_{DD} range of 1.8 V to 18 V. The device has two high-accuracy comparators with an internal 400-mV reference and two open-drain outputs rated to 18 V for overvoltage and undervoltage detection. The device can be used either as a window voltage detector or as two independent voltage monitors. The monitored voltages are set with the use of external resistors.

8.1.1 V_{PULLUP} to a Voltage Other Than V_{DD}

The outputs are often tied to V_{DD} through a resistor. However, some applications may require the outputs to be pulled up to a higher or lower voltage than V_{DD} to correctly interface with the reset and enable terminals of other devices.

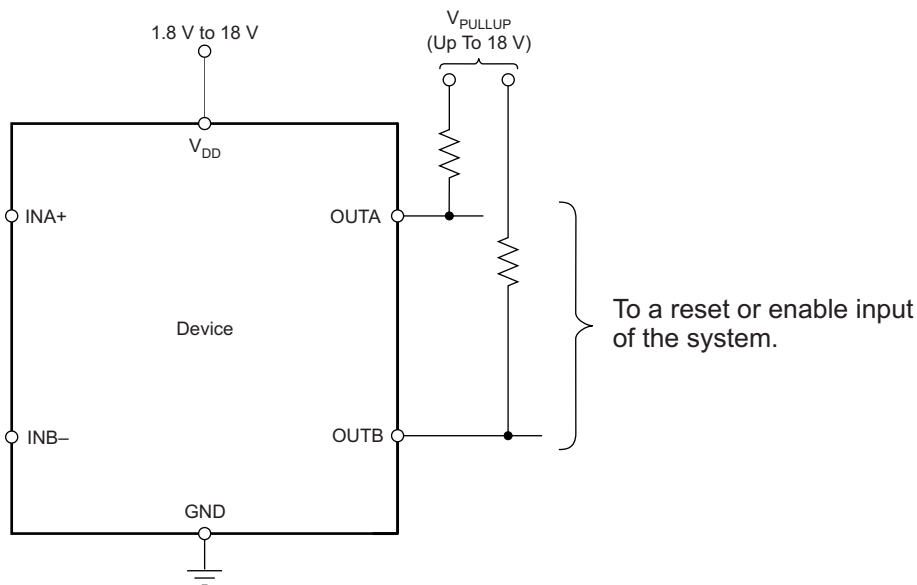


Figure 16. Interfacing to Voltages Other Than V_{DD}

Application Information (continued)

8.1.2 Monitoring V_{DD}

Many applications monitor the same rail that is powering V_{DD} . In these applications the resistor divider is simply connected to the V_{DD} rail.

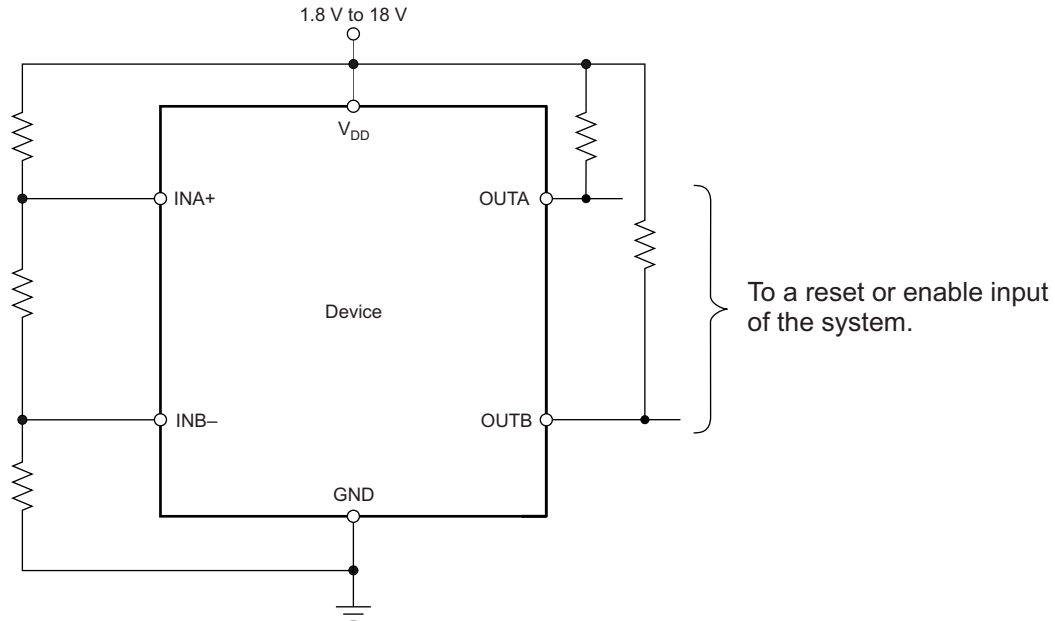
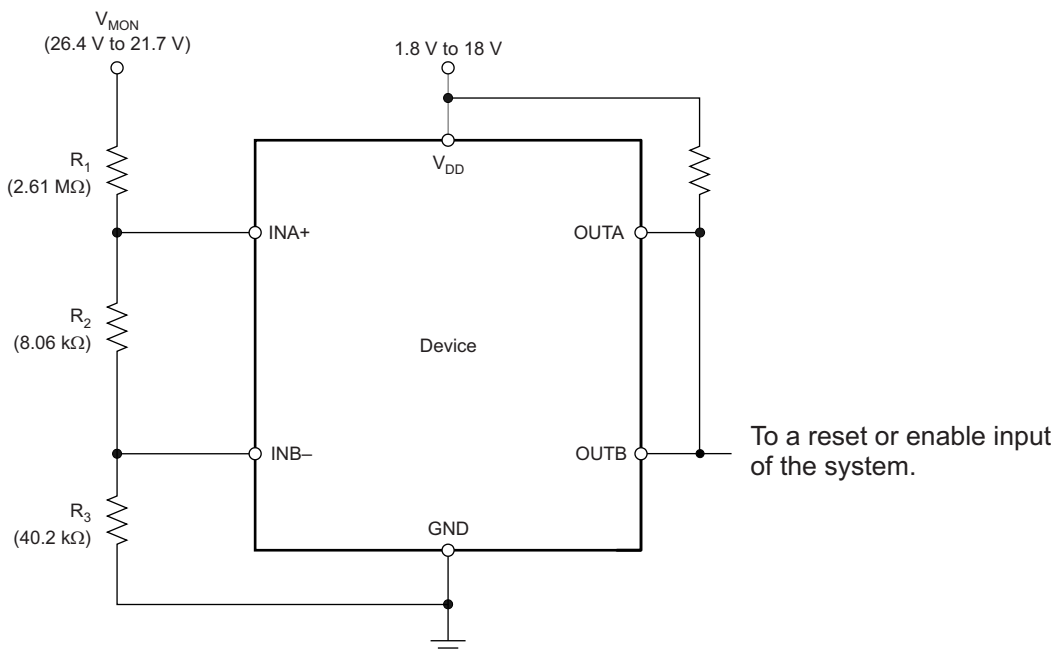


Figure 17. Monitoring the Same Voltage as V_{DD}

8.1.3 Monitoring a Voltage Other Than V_{DD}

Some applications monitor rails other than the one that is powering V_{DD} . In these types of applications the resistor divider used to set the desired thresholds is connected to the rail that is being monitored.



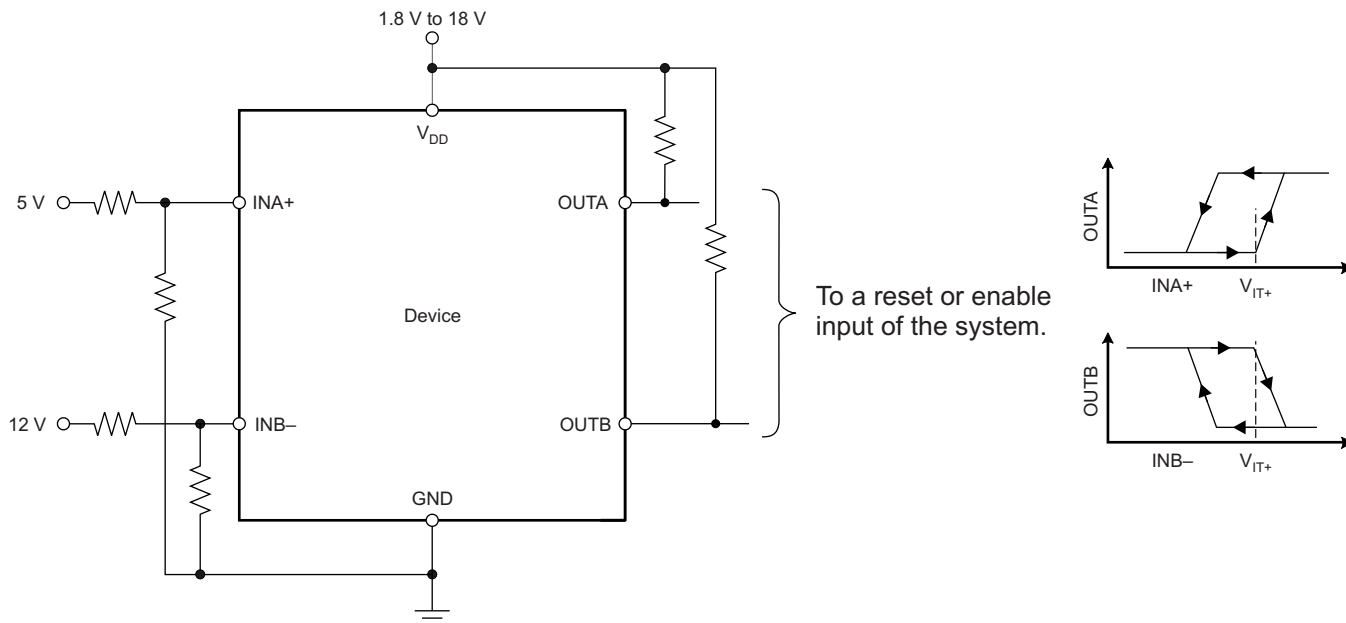
NOTE: The inputs can monitor a voltage higher than V_{DDmax} with the use of an external resistor divider network.

Figure 18. Monitoring a Voltage Other Than V_{DD}

Application Information (continued)

8.1.4 Monitoring Overvoltage and Undervoltage for Separate Rails

Some applications may want to monitor for overvoltage conditions on one rail while also monitoring for undervoltage conditions on a different rail. In these applications two independent resistor dividers must be used.



NOTE: In this case, OUTA is driven low when an undervoltage condition is detected at the 5-V rail and OUTB is driven low when an overvoltage condition is detected at the 12-V rail.

Figure 19. Monitoring Overvoltage for One Rail and Undervoltage for a Different Rail

8.2 Typical Application

The TPS3700 device is a wide-supply window voltage detector that operates over a V_{DD} range of 1.8 to 18 V. The monitored voltages are set with the use of external resistors, so the device can be used either as a window voltage detector or as two independent overvoltage and undervoltage monitors.

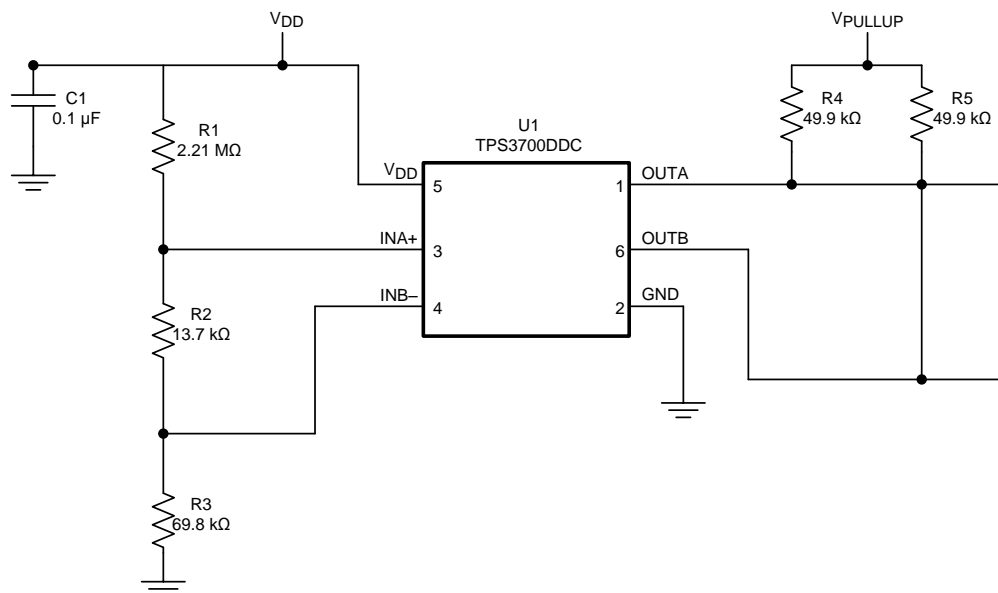


Figure 20. Typical Application Schematic

8.2.1 Design Requirements

For this design example, use the values summarized in [Table 2](#) as the input parameters.

Table 2. Design Parameters

PARAMETER	DESIGN REQUIREMENT	DESIGN RESULT
Monitored voltage	12-V nominal rail with maximum rising and falling thresholds of $\pm 10\%$	$V_{MON(UV)} = 10.99 \text{ V (8.33\%)} \pm 2.94\%$, $V_{MON(OV)} = 13.14 \text{ V (8.33\%)} \pm 2.94\%$

8.2.2 Detailed Design Procedure

8.2.2.1 Resistor Divider Selection

Use [Equation 1](#) through [Equation 4](#) to calculate the resistor divider values and target threshold voltages.

$$R_T = R_1 + R_2 + R_3 \quad (1)$$

Select a value for R_T such that the current through the divider is approximately 100 times higher than the input current at the INA+ and INB- terminals. The resistors can have high values to minimize current consumption as a result of low-input bias current without adding significant error to the resistive divider. See the application note *Optimizing Resistor Dividers at a Comparator Input (SLVA450)* for details on sizing input resistors.

Use [Equation 2](#) to calculate the value of R_3 .

$$R_3 = \frac{R_T}{V_{MON(OV)}} \times V_{IT+}$$

where:

$$V_{MON(OV)} \text{ is the target voltage at which an overvoltage condition is detected} \quad (2)$$

Use Equation 3 or Equation 4 to calculate the value of R_2 .

$$R_2 = \left[\frac{R_T}{V_{\text{MON(no UV)}}} \times V_{\text{IT+}} \right] - R_3$$

where:

$V_{\text{MON(no UV)}}$ is the target voltage at which an undervoltage condition is removed as V_{MON} rises (3)

$$R_2 = \left[\frac{R_T}{V_{\text{MON(UV)}}} \times (V_{\text{IT+}} - V_{\text{hys}}) \right] - R_3$$

where:

$V_{\text{MON(UV)}}$ is the target voltage at which an undervoltage condition is detected (4)

The worst-case tolerance can be calculated by referring to Equation 13 in application report [SLVA450, Optimizing Resistor Dividers at a Comparator Input](#) (available for download at www.ti.com). An example of the rising threshold error, $V_{\text{MON(OV)}}$, is given in Equation 5.

$$\% \text{ ACC} = \% \text{ TOL}(V_{\text{IT+(INB)}}) + 2 \times \left[1 - \frac{V_{\text{IT+(INB)}}}{V_{\text{MON(OV)}}} \right] \times \% \text{ TOL}_R = 1\% + 2 \times \left[1 - \frac{0.4}{13.2} \right] \times 1\% = 2.94\% \quad (5)$$

8.2.2.2 Pullup Resistor Selection

To ensure proper voltage levels, the pullup resistor value is selected by ensuring that the pullup voltage divided by the resistor does not exceed the sink-current capability of the device. This confirmation is calculated by verifying that the pullup voltage minus the output-leakage current ($I_{\text{kg(OD)}}$) multiplied by the resistor is greater than the desired logic-high voltage. These values are specified in the [Electrical Characteristics](#) table.

Use Equation 6 to calculate the value of the pullup resistor.

$$\frac{(V_{\text{HI}} - V_{\text{PU}})}{I_{\text{kg(OD)}}} \geq R_{\text{PU}} \geq \frac{V_{\text{PU}}}{I_{\text{O}}} \quad (6)$$

8.2.2.3 Input Supply Capacitor

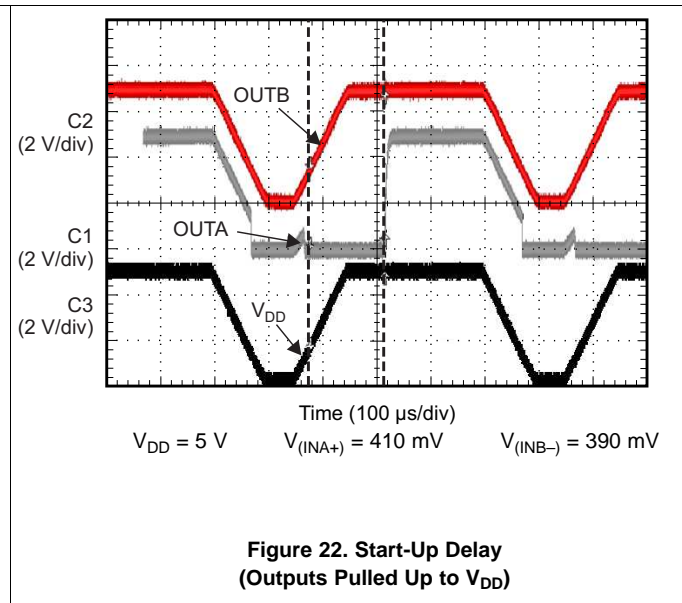
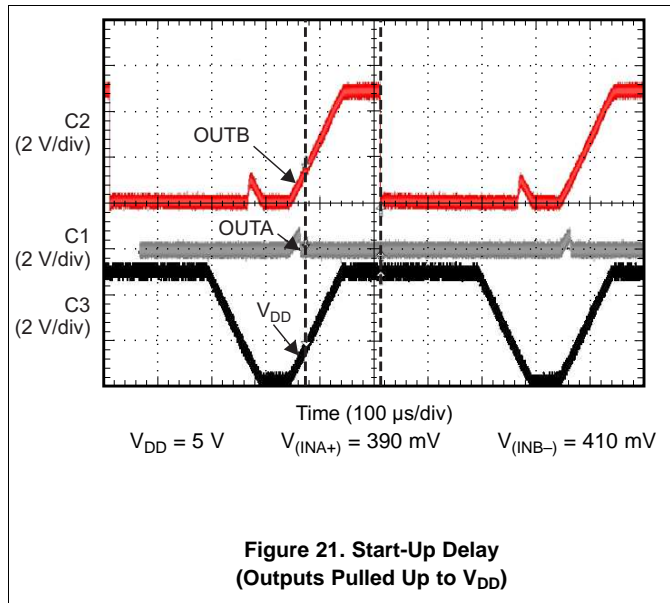
Although an input capacitor is not required for stability, connecting a 0.1- μF low equivalent series resistance (ESR) capacitor across the V_{DD} terminal and GND terminal is good analog design practice. A higher-value capacitor may be necessary if large, fast rise-time load transients are anticipated, or if the device is not located close to the power source.

8.2.2.4 Input Capacitors

Although not required in most cases, for extremely noisy applications, placing a 1-nF to 10-nF bypass capacitor from the comparator inputs (INA+, INB-) to the GND terminal is good analog design practice. This capacitor placement reduces device sensitivity to transients.

8.2.3 Application Curves

At $T_J = 25^\circ\text{C}$



8.3 Do's and Don'ts

It is good analog design practice to have a 0.1- μF decoupling capacitor from V_{DD} to GND.

If the monitored rail is noisy, connect decoupling capacitors from the comparator inputs to GND.

Do not use resistors for the voltage divider that cause the current through them to be less than 100 times the input current of the comparators without also accounting for the effect to the accuracy.

Do not use pullup resistors that are too small, because the larger current sunk by the output then exceeds the desired low-level output voltage (V_{OL}).

9 Power-Supply Recommendations

These devices are designed to operate from an input voltage supply range between 1.8 V and 18 V.

10 Layout

10.1 Layout Guidelines

Placing a 0.1- μF capacitor close to the V_{DD} terminal to reduce the input impedance to the device is good analog design practice. The pullup resistors can be separated if separate logic functions are needed (as shown in Figure 23) or both resistors can be tied to a single pullup resistor if a logical AND function is desired.

10.2 Layout Example

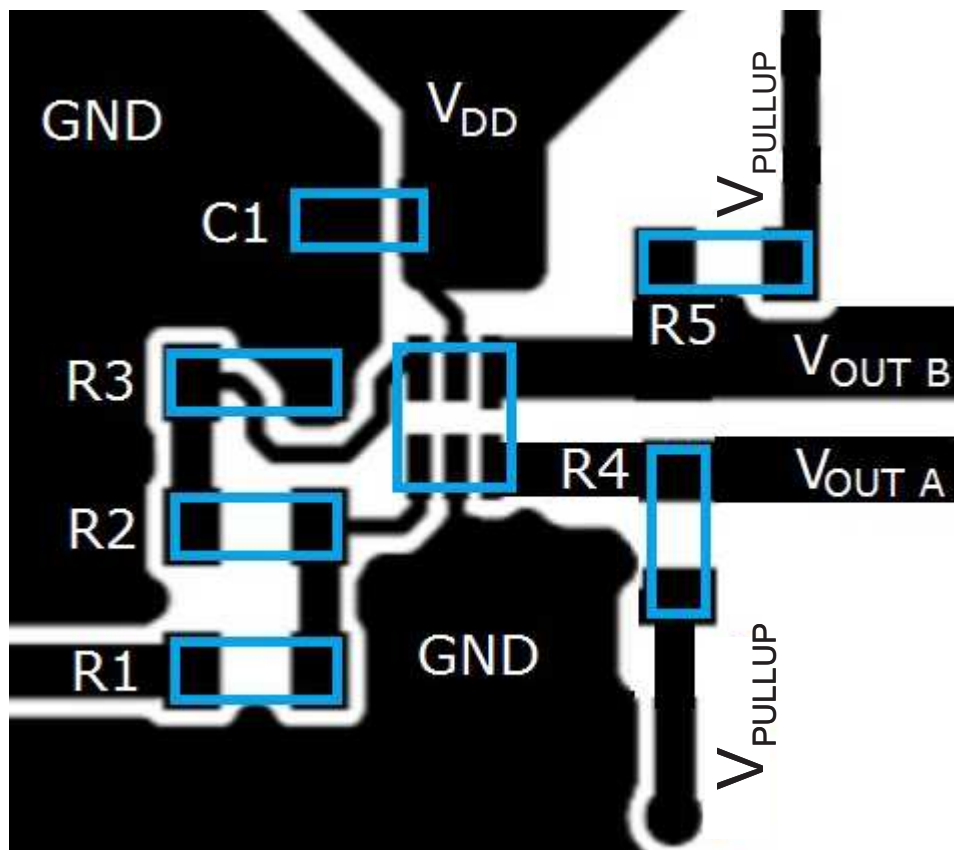


Figure 23. TPS3700 Layout Schematic

11 デバイスおよびドキュメントのサポート

11.1 デバイス・サポート

11.1.1 開発サポート

11.1.1.1 評価基板

TPS3700を使用する回路の性能の初期評価に役立てるため、2つの評価基板(EVM)を利用可能です。[TPS3700EVM-114評価基板](#)および[TPS3700EVM-202評価基板](#)(および関連するユーザー・ガイド)は、テキサス・インスツルメンツWebサイトの[TPS3700製品フォルダ](#)で請求するか、[TI eStore](#)から直接お求めになれます。

11.1.2 デバイスの項目表記

表 3. デバイスの項目表記

製品名	概要
TPS3700yyyyz	yyyはパッケージ指定子 zはパッケージ数量

11.2 ドキュメントのサポート

11.2.1 関連資料

関連資料については、以下を参照してください。

- [『負のレールの過電圧と低電圧の検出器としてTPS3700を使用』](#)
- [『コンパレータ入力の分圧抵抗の最適化』](#)
- [『TPS3700EVM-114評価基板ユーザー・ガイド』](#)
- [『TPS3700EVM-202評価基板ユーザー・ガイド』](#)

11.3 ドキュメントの更新通知を受け取る方法

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11.4 コミュニティ・リソース

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.

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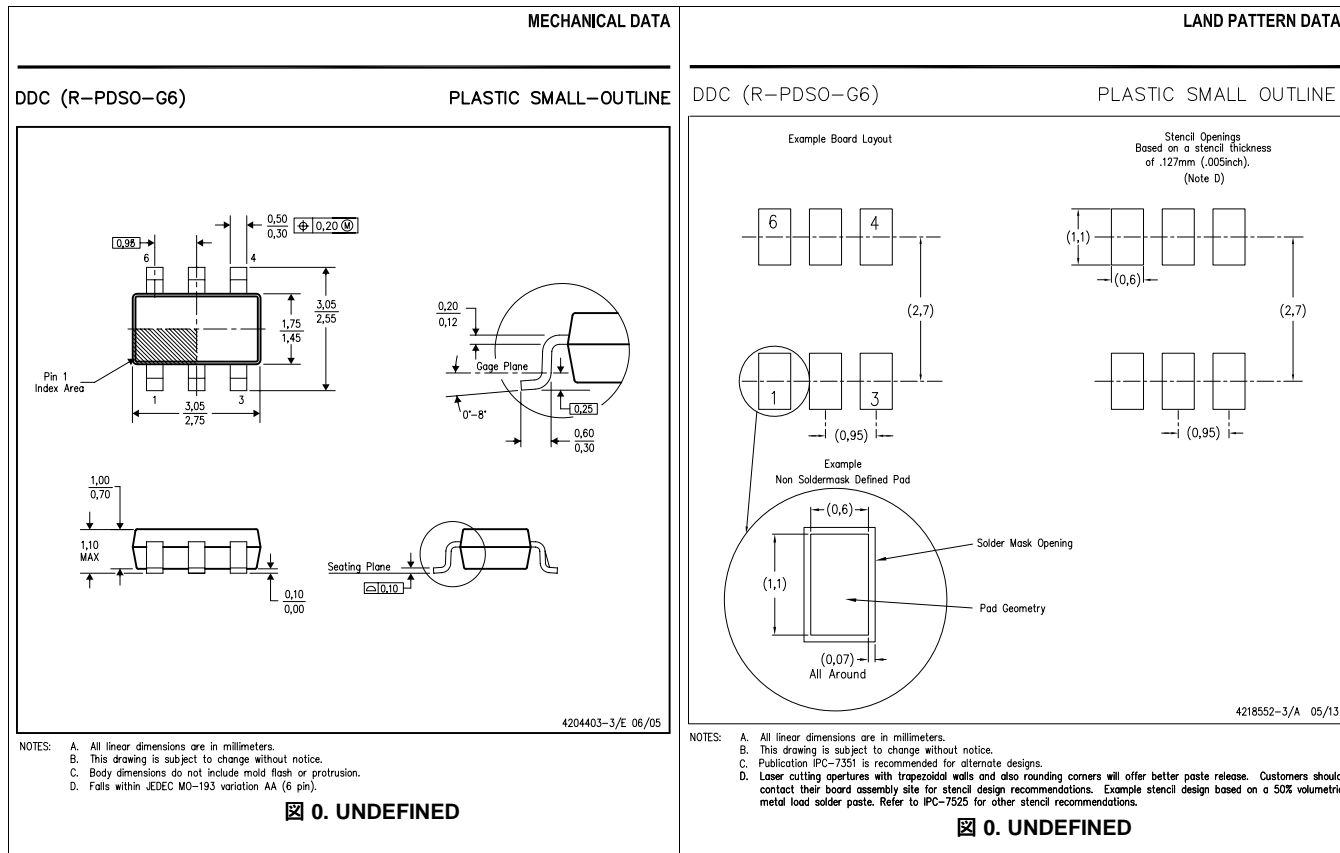
11.7 Glossary

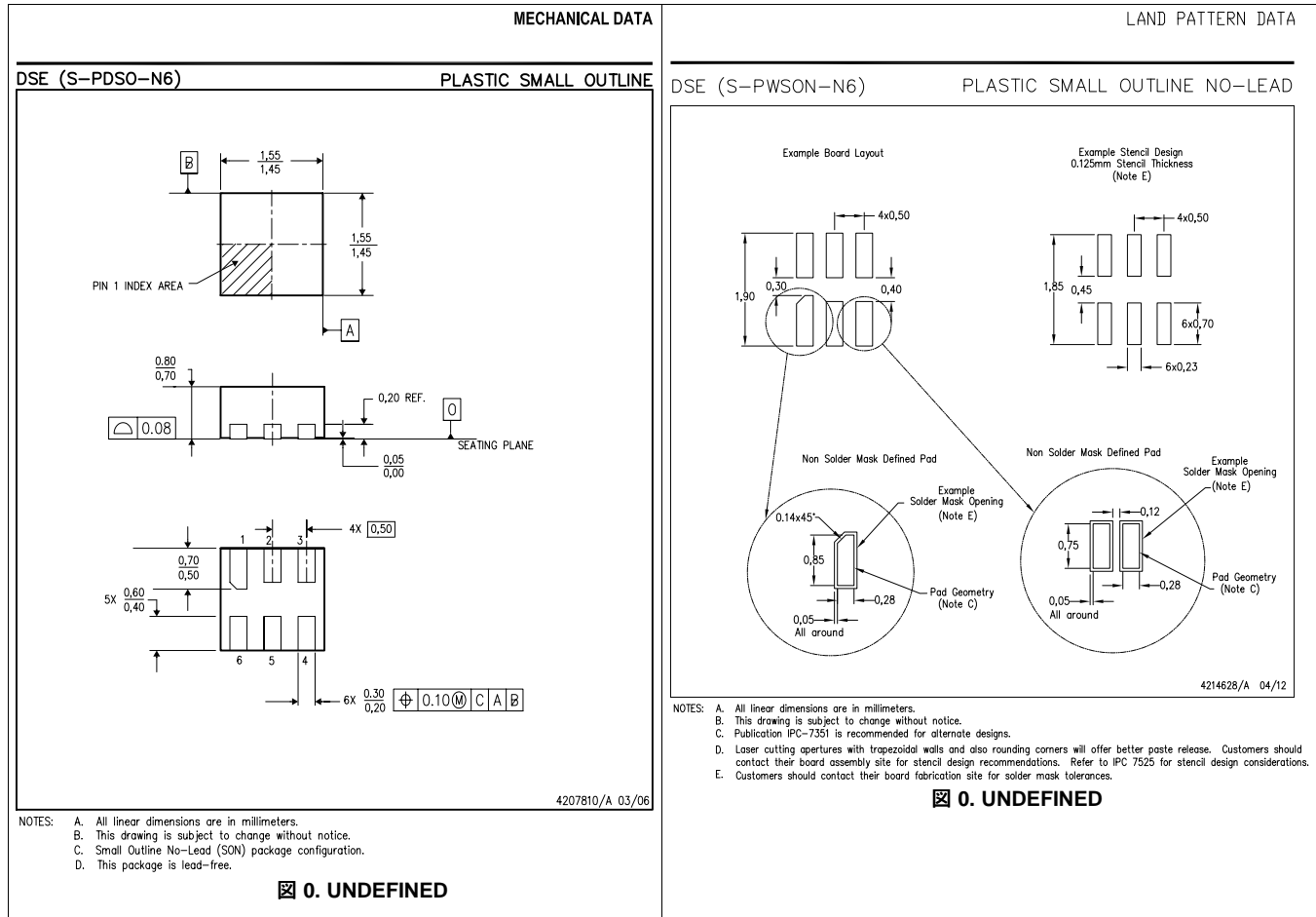
SLYZ022 — TI Glossary.

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

12 メカニカル、パッケージ、および注文情報

以降のページには、メカニカル、パッケージ、および注文に関する情報が記載されています。この情報は、そのデバイスについて利用可能な最新のデータです。このデータは予告なく変更されることがあり、ドキュメントが改訂される場合もあります。本データシートのブラウザ版を使用されている場合は、画面左側の説明をご覧ください。





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
TPS3700DDCR	ACTIVE	SOT-23-THIN	DDC	6	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	PXVQ	Samples
TPS3700DDCR2	ACTIVE	SOT-23-THIN	DDC	6	3000	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	PB4Q	Samples
TPS3700DDCT	ACTIVE	SOT-23-THIN	DDC	6	250	RoHS & Green	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	PXVQ	Samples
TPS3700DSER	ACTIVE	WSON	DSE	6	3000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(7I, BE)	Samples
TPS3700DSET	ACTIVE	WSON	DSE	6	250	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	(7I, BE)	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.

OBSELETE: 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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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
TPS3700DDCR	SOT-23-THIN	DDC	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS3700DDCR2	SOT-23-THIN	DDC	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q2
TPS3700DDCT	SOT-23-THIN	DDC	6	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS3700DSER	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3700DSET	WSON	DSE	6	250	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS3700DDCR	SOT-23-THIN	DDC	6	3000	213.0	191.0	35.0
TPS3700DDCR2	SOT-23-THIN	DDC	6	3000	213.0	191.0	35.0
TPS3700DDCT	SOT-23-THIN	DDC	6	250	213.0	191.0	35.0
TPS3700DSER	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3700DSET	WSON	DSE	6	250	205.0	200.0	33.0

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