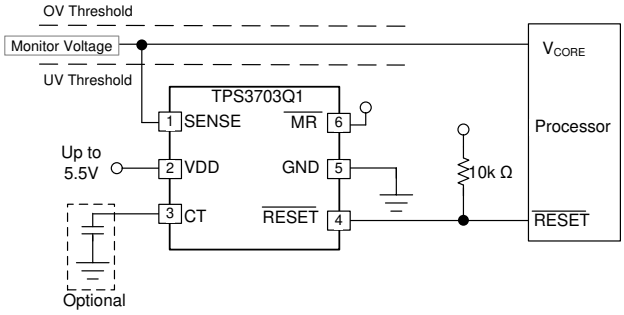
TPS3703-Q1
Overvoltage and Undervoltage Reset IC With Time Delay and Manual Reset

1 Features

- AEC-Q100 qualified for automotive applications:
  - Temperature grade 1: –40°C to +125°C, T_A
  - Device HBM ESD classification level 2
  - Device CDM ESD classification level C7B
- Functional Safety-Capable
  - Documentation available to aid functional safety system design
- Input voltage range: 1.7 V to 5.5 V
- Undervoltage lockout (UVLO): 1.7 V
- Low quiescent current: 7 µA (Max)
- High threshold accuracy:
  - ± 0.25% (typical)
  - ± 0.7% (–40°C to +125°C)
- Fixed window threshold levels
  - 50-mV steps from 500 mV to 1.3 V
  - 1.5 V, 1.8 V, 2.5 V, 2.8 V, 2.9 V 3.3 V, 5 V
  - Available in UV threshold only
  - Window tolerance available from ±3% to ±7%
- User adjustable voltage threshold levels
- Internal glitch immunity and hysteresis
- Fixed time delay options: 50 µs, 1 ms, 5 ms, 10 ms, 20 ms, 100 ms, 200 ms
- Programmable time delay option with a single external capacitor
- Open-drain active low UV and OV monitor
- $\overline{\text{RESET}}$ voltage latching output mode

2 Applications

- Advanced driver assistance system (ADAS)
- ADAS domain controller
- Automotive infotainment and cluster
- Digital cockpit
- HEV/EV



Integrated Overvoltage and Undervoltage Detection

3 Description

The TPS3703-Q1 device is an integrated overvoltage (OV) and undervoltage (UV) monitor or reset IC in industry's smallest 6-pin DSE package. This highly accurate voltage supervisor is ideal for systems that operate on low-voltage supply rails and have narrow margin supply tolerances. Low threshold hysteresis prevent false reset signals when the monitored voltage supply is in its normal range of operation. Internal glitch immunity and noise filters further eliminate false resets resulting from erroneous signals.

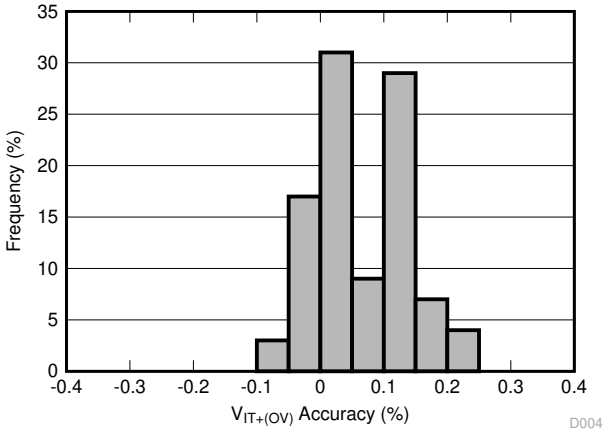
The TPS3703-Q1 does not require any external resistors for setting overvoltage and undervoltage reset thresholds, which further optimizes overall accuracy, cost, solution size, and improves reliability for safety systems. The Capacitor Time (CT) pin is used to select between the two available reset time delays designed into each device and also to adjust the reset time delay by connecting a capacitor. A separate SENSE input pin and VDD pin allow for the redundancy sought by high-reliability systems.

This device has a low typical quiescent current specification of 4.5 µA (typical). The TPS3703-Q1 is suitable for automotive applications and is qualified for AEC-Q100 Grade 1.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS3703-Q1	WSON (6)	1.50 mm × 1.50 mm

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



Typical Overvoltage Accuracy Distribution

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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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 C (February 2020) to Revision D (March 2021)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1
• Included Functional Safety bullets	1
• Replaced *Device Comparison Table* with device nomenclature legend	3

Changes from Revision B (September 2019) to Revision C (February 2020)	Page
• Changed reset time delay nomenclature (t_D): J to M by A to H	7

Changes from Revision A (May 2019) to Revision B (September 2019)	Page
• Deleted OV only throughout document.	1
• Changed from threshold tolerance to window tolerance throughout document.	1
• Added new voltage variants for window and UV only.	3
• Added pinout description for package.	4
• Changed functional block diagram for clarity between variants.	14
• Added UV only normal operation condition.	16
• Changed equation to correctly reflect resistor divider.	20
• Changed to R_1 from R_{SENSE}	20

Changes from Revision * (November 2018) to Revision A (May 2019)	Page
• Changed from Advance Information to Production Data release	1

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5 Device Comparison

Figure 5-1 shows the device nomenclature of the TPS3703-Q1. For all possible voltages, window tolerance, time delays, and UV threshold options, see Table 12-1. Contact TI sales representatives or on TI's E2E forum for details and availability of other options; minimum order quantities apply.

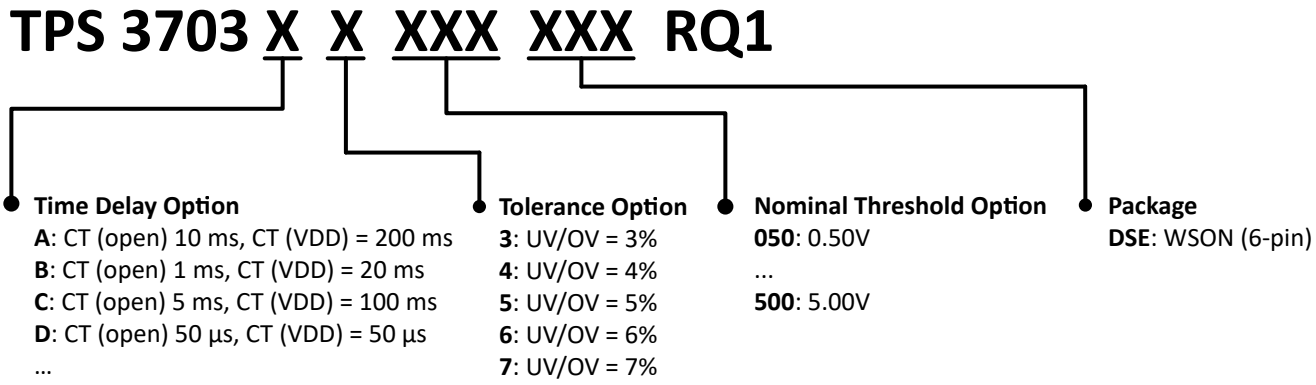


Figure 5-1. Device Nomenclature Legend

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6 Pin Configuration and Functions

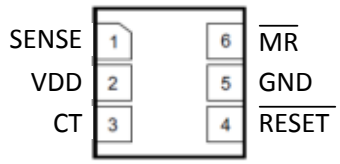


Figure 6-1. DSE Package, 6-Pin WSON, Top View

Table 6-1. Pin Functions

PIN		I/O	DESCRIPTION
NO.	NAME		
1	SENSE	I	Input for the monitored supply voltage rail. When the SENSE voltage goes above the overvoltage threshold or below the undervoltage threshold, the $\overline{\text{RESET}}$ pin is driven low. Connect to VDD pin if monitoring VDD supply voltage.
2	VDD	I	Supply voltage input pin. Good analog design practice is to place a 0.1-µF ceramic capacitor close to this pin.
3	CT	I	Capacitor time delay pin. The CT pin offers two fixed time delays by connecting CT pin to VDD or leaving it floating. Delay time can be programmed by connecting an external capacitor reference to ground.
4	$\overline{\text{RESET}}$	O	Active-low, open-drain output. This pin goes low when the SENSE voltage rises above the internally overvoltage threshold (V_{IT+}) or below the undervoltage threshold (V_{IT-}). See the timing diagram in Figure 8-2 for more details. Connect this pin to a pull-up resistor terminated to the desired pull-up voltage.
5	GND	—	Ground
6	$\overline{\text{MR}}$	I	Manual reset (MR), pull this pin to a logic low ($V_{\overline{MR}_L}$) to assert a reset signal . After the $\overline{\text{MR}}$ pin is deasserted the output goes high after the reset delay time(t_D) expires. $\overline{\text{MR}}$ can be left floating when not in use.

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7 Specifications

7.1 Absolute Maximum Ratings

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

		MIN	MAX	UNIT
Voltage	V_{DD}	–0.3	6	V
	$V_{\overline{RESET}}$	–0.3	6	
	V_{CT}	–0.3	6	
	V_{SENSE}	–0.3	6	
	$V_{\overline{MR}}$	–0.3	6	
Current	$I_{\overline{RESET}}$		±40	mA
Temperature (2)	Continuous total power dissipation	See the Thermal Information		
	Operating junction temperature, T_J	–40	150	°C
	Operating free-air temperature, T_A	–40	150	
	Storage temperature, T_{stg}	–65	150	

(1) Stresses beyond values 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) As a result of the low dissipated power in this device, it is assumed that $T_J = T_A$.

7.2 ESD Ratings

				VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)		±2000	V
		Charged-device model (CDM), per AEC Q100-011	All pins	±500	
			Corner pins	±750	

(1) AEC Q100-002 indicates that HBM stressing shall be in accordance with the ANSI/ESDA/JEDEC JS-001 specification

7.3 Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
V_{DD}	Supply pin voltage	1.7		5.5	V
V_{SENSE}	Input pin voltage	0		5.5	V
V_{CT}	CT pin voltage(1) (3)			V_{DD}	V
$V_{\overline{RESET}}$	Output pin voltage	0		5.5	V
$V_{\overline{MR}}$	$\overline{MR}$ pin voltage(2)	0		5.5	V
$I_{\overline{RESET}}$	Output pin current	0.3		10	mA
T_J	Junction temperature (free-air temperature)	–40		125	℃

(1) CT pin connected to VDD pin requires a pullup resistor; 10 kΩ is recommended.

(2) If the logic signal driving $\overline{MR}$ is less than V_{DD}, then additional current flows into V_{DD} and out of $\overline{MR}$.

(3) The maximum rating is V_{DD} or 5.5 V, whichever is smaller.

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7.4 Thermal Information

THERMAL METRIC[1]		TPS3703-Q1 DSE (WSON) PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	184.2	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	30.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	86.4	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	13.4	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	86.1	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	N/A	°C/W

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

7.5 Electrical Characteristics

At 1.7 V ≤ V_{DD} ≤ 5.5 V, CT = $\overline{MR}$ = Open, $\overline{RESET}$ Voltage ($V_{\overline{RESET}}$) = 10 kΩ to V_{DD}, $\overline{RESET}$ load = 10 pF, and over the operating free-air temperature range of – 40°C to 125°C, unless otherwise noted. Typical values are at T_J = 25°C, typical conditions at V_{DD} = 3.3 V.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{DD}	Supply voltage		1.7		5.5	V
UVLO	Under voltage lockout[3]	V_{DD} falling below 1.7 V	1.2		1.7	V
V_{POR}	Power on reset voltage[2]	V_{OL}(max) = 0.25 V, I_{OUT} = 15 µA			1	V
$V_{IT+(OV)}$	Positive- going threshold accuracy		–0.7	±0.25	0.7	%
$V_{IT-(UV)}$	Negative-going threshold accuracy		–0.7	±0.25	0.7	%
V_{HYS}	Hysteresis voltage[1]		0.3	0.55	0.8	%
I_{DD}	Supply current	V_{DD} ≤ 5.5 V		4.5	7	µA
I_{SENSE}	Input current, SENSE pin	V_{SENSE} = 5 V		1	1.5	µA
V_{OL}	Low level output voltage	V_{DD} = 1.7 V, I_{OUT} = 0.4 mA			250	mV
		V_{DD} = 2 V, I_{OUT} = 3 mA			250	mV
		V_{DD} = 5 V, I_{OUT} = 5 mA			250	mV
I_{LKG}	Open drain output leakage current	V_{DD} = $V_{\overline{RESET}}$ = 5.5 V			300	nA
$V_{\overline{MR}_L}$	$\overline{MR}$ logic low input				0.3	V
$V_{\overline{MR}_H}$	$\overline{MR}$ logic high input		1.4			V
V_{CT_H}	High level CT pin voltage		1.4			V
$R_{\overline{MR}}$	Manual reset Internal pullup resistance			100		KΩ
I_{CT}	CT pin charge current		337	375	413	nA
V_{CT}	CT pin comparator threshold voltage[4]		1.133	1.15	1.167	V

(1) Hysteresis is with respect of the tripoint ($V_{IT-(UV)}$, $V_{IT+(OV)}$).

(2) V_{POR} is the minimum V_{DD} voltage level for a controlled output state.

(3) $\overline{RESET}$ pin is driven low when V_{DD} falls below UVLO.

(4) V_{CT} voltage refers to the comparator threshold voltage that measures the voltage level of the external capacitor at CT pin.

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7.6 Timing Requirements

At 1.7 V ≤ V_{DD} ≤ 5.5 V, CT = $\overline{MR}$ = Open, $\overline{RESET}$ Voltage ($V_{\overline{RESET}}$) = 10 kΩ to V_{DD}, $\overline{RESET}$ load = 10 pF, and over the operating free-air temperature range of – 40°C to 125°C, unless otherwise noted. Typical values are at T_J = 25°C, typical conditions at V_{DD} = 3.3 V.

			MIN	NOM	MAX	UNIT
t_D	Reset time delay, TPS3703A, TPS3703E	CT = Open	7	10	13	ms
	Reset time delay, TPS3703A, TPS3703E	CT = 10 kΩ to V_{DD}	140	200	260	
	Reset time delay, TPS3703B, TPS3703F	CT = Open	0.7	1	1.3	
	Reset time delay, TPS3703B, TPS3703F	CT = 10 kΩ to V_{DD}	14	20	26	
	Reset time delay, TPS3703C, TPS3703G	CT = Open	3.5	5	6.5	
	Reset time delay, TPS3703C, TPS3703G	CT = 10 kΩ to V_{DD}	70	100	130	
	Reset time delay, TPS3703D, TPS3703H	CT = 10 kΩ to V_{DD} CT = Open		50		µs
t_{PD}	Propagation detect delay(1) (2)			15	30	µs
t_R	Output rise time(1) (3)			2.2		µs
t_F	Output fall time(1) (3)			0.2		µs
t_{SD}	Startup delay(4)			300		µs
$t_{GI\ (VIT-)}$	Glitch Immunity undervoltage $V_{IT-(UV)}$, 5% Overdrive(1)			3.5		µs
$t_{GI\ (VIT+)}$	Glitch Immunity overvoltage $V_{IT+(OV)}$, 5% Overdrive(1)			3.5		µs
$t_{GI\ (\overline{MR})}$	Glitch Immunity $\overline{MR}$ pin				25	ns
$t_{PD\ (\overline{MR})}$	Propagation delay from $\overline{MR}$ low to assert $\overline{RESET}$			500		ns
$t_{\overline{MR}_W}$	$\overline{MR}$ pin pulse width duration to assert $\overline{RESET}$		1			µs
$t_{D\ (\overline{MR})}$	$\overline{MR}$ reset time delay			t_D		ms

(1) 5% Overdrive from threshold. Overdrive % = [V_{SENSE} - V_{IT}] / V_{IT}; Where V_{IT} stands for $V_{IT-(UV)}$ or $V_{IT+(OV)}$

(2) t_{PD} measured from threhold trip point ($V_{IT-(UV)}$ or $V_{IT+(OV)}$) to $\overline{RESET}$ V_{OL} voltage

(3) Output transitions from V_{OL} to 90% for rise times and 90% to V_{OL} for fall times.

(4) During the power-on sequence, V_{DD} must be at or above $V_{DD\ (MIN)}$ for at least t_{SD} + t_D before the output is in the correct state.

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7.7 Timing Diagrams

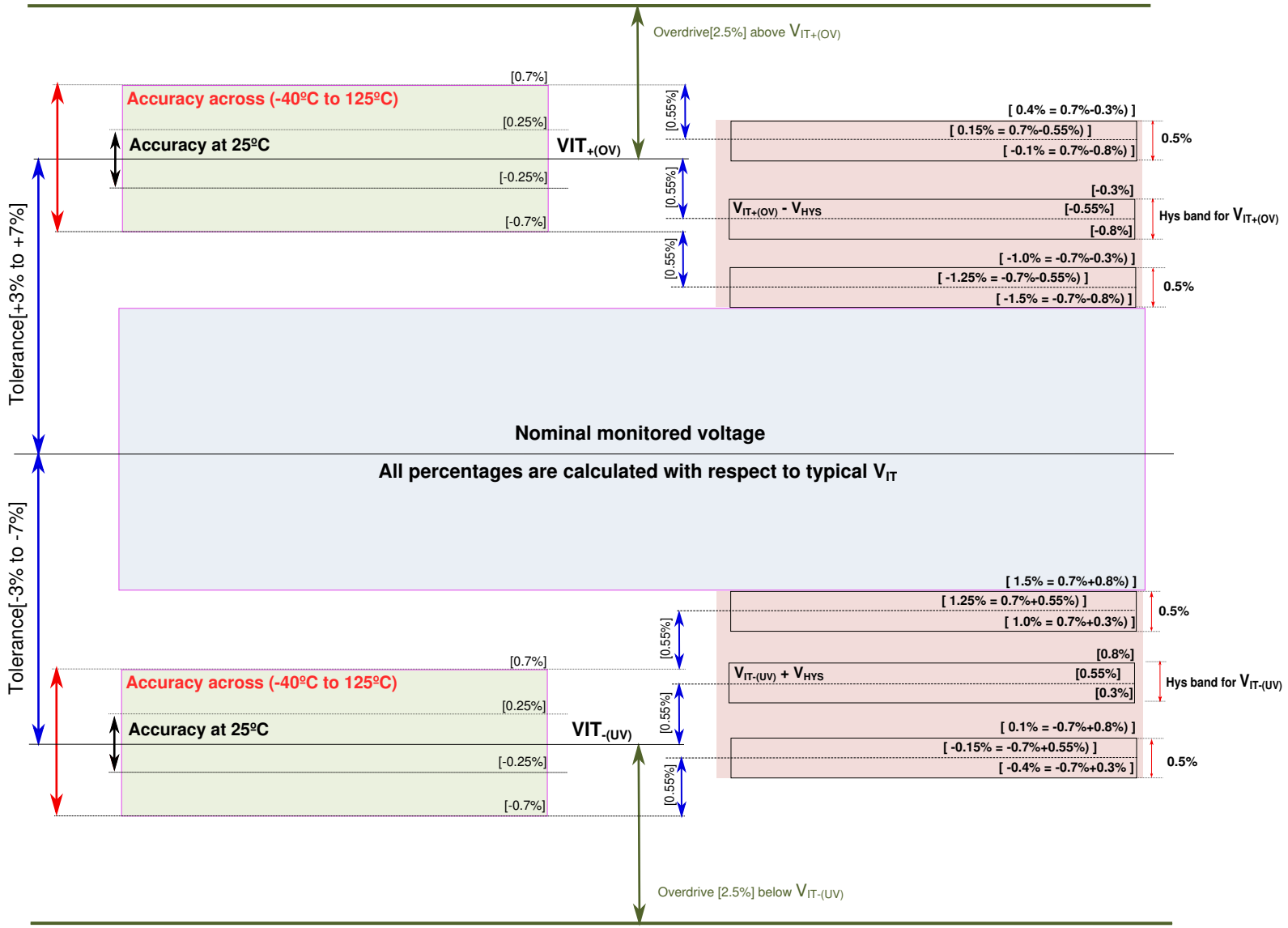
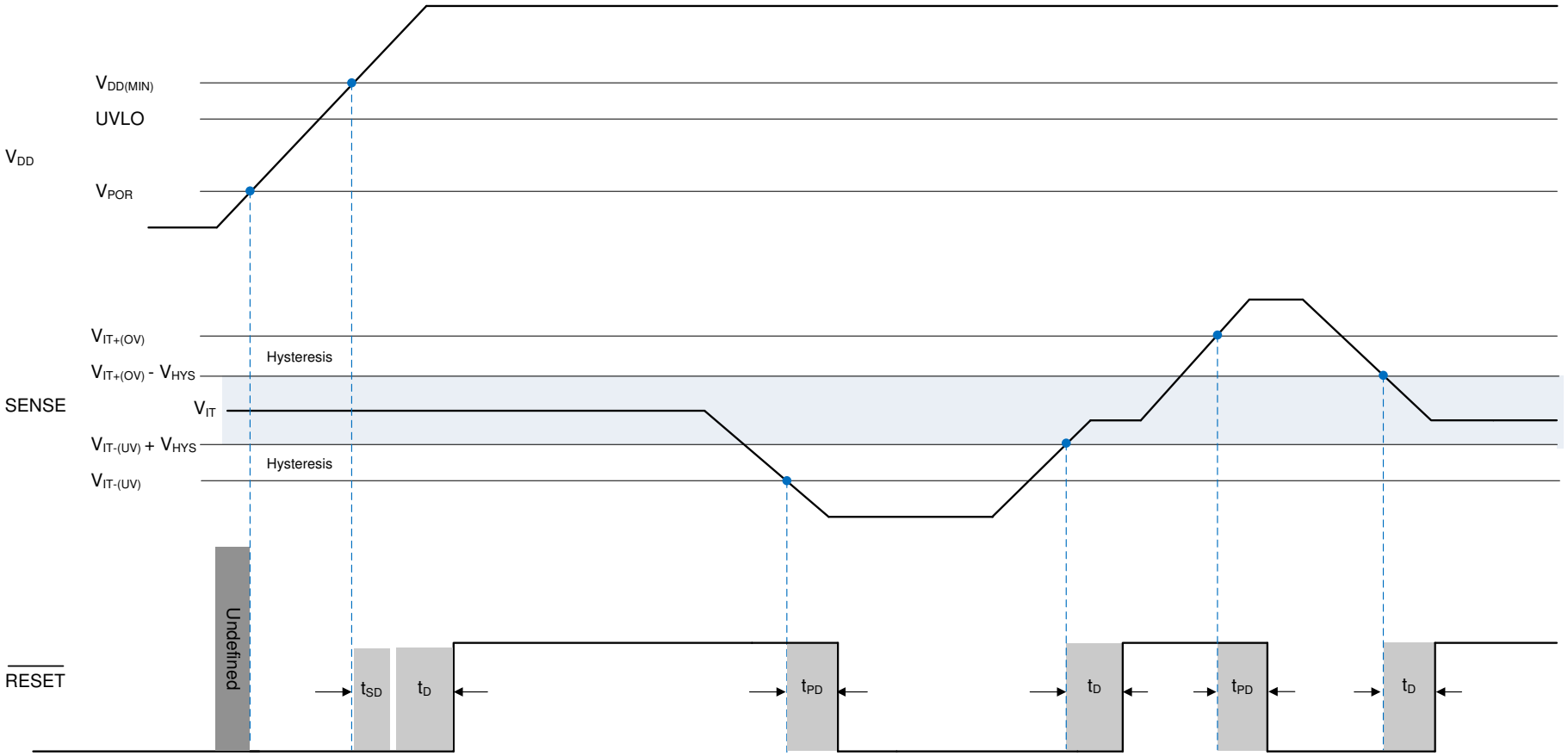


Figure 7-1. Voltage Threshold and Hysteresis Accuracy

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A. V_{DD} = 2 V, R_{PU} = 10 kΩ to V_{DD}.

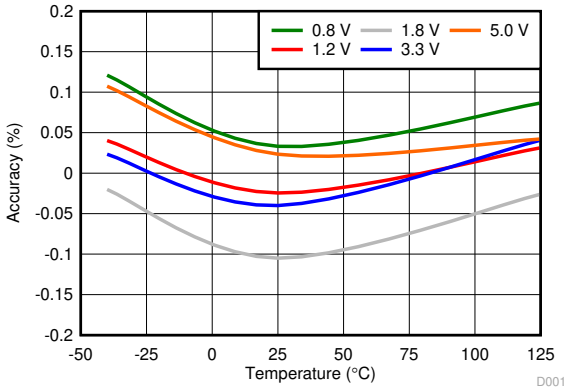
B. Variant D (time delay bypass) has a ~40 µs pulse at $\overline{\text{RESET}}$ pin during power up window, this is present only when the power cycle off time is longer than 10 seconds, this behavior will not occur if the SENSE pin is within window of operation during V_{DD} power up.

Figure 7-2. SENSE Timing Diagram

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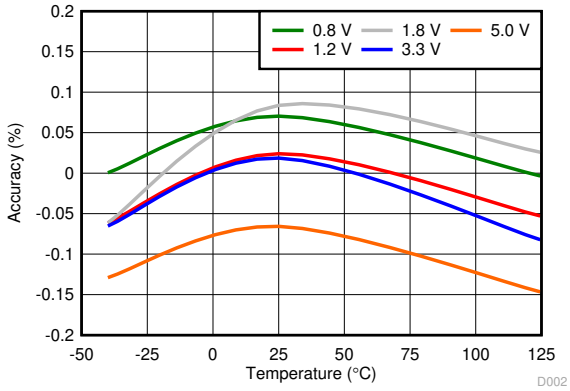
7.8 Typical Characteristics

at T_J = 25°C, V_{DD} = 3.3 V, and R_{PU} = 10 kΩ (unless otherwise noted)



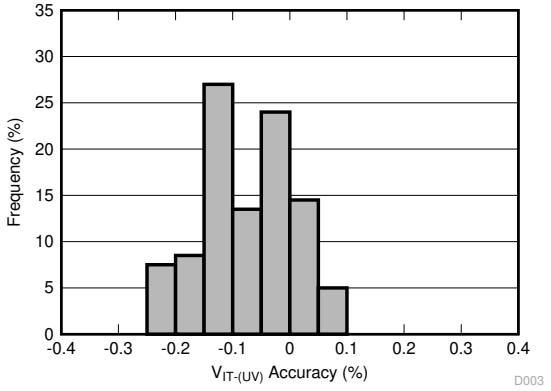
Tested across multiple voltage options

Figure 7-3. Undervoltage Accuracy vs Temperature



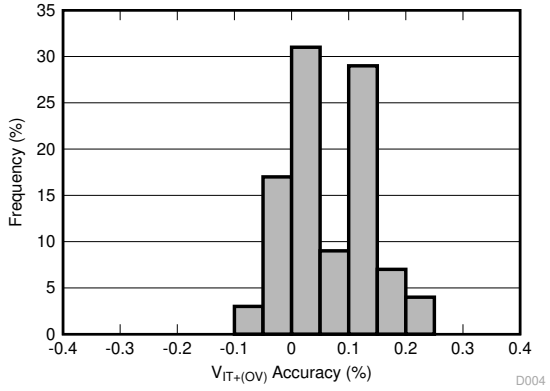
Tested across multiple voltage options

Figure 7-4. Overvoltage Accuracy vs Temperature



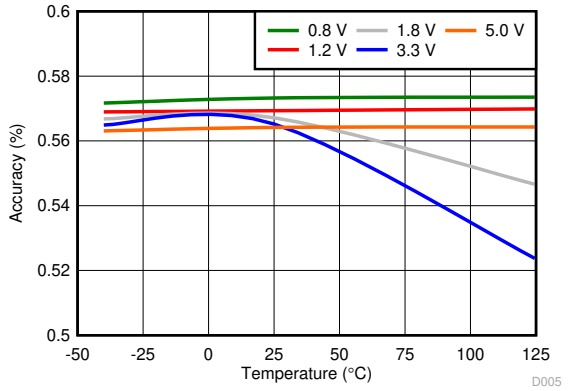
Sample Size of 100 TPS3703A7125 units

Figure 7-5. Undervoltage Accuracy Distribution



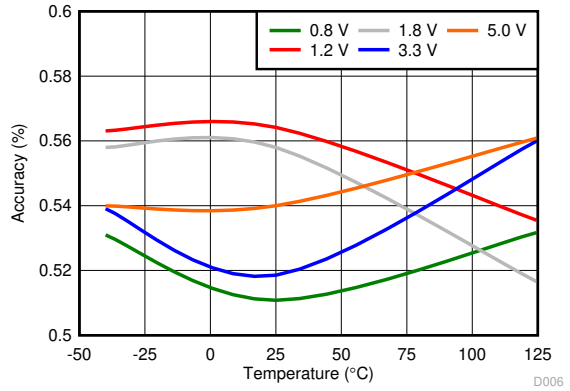
Sample Size of 100 TPS3703A7125 units

Figure 7-6. Overvoltage Accuracy Distribution



Tested across multiple voltage options

Figure 7-7. Undervoltage Hysteresis Voltage Accuracy vs Temperature



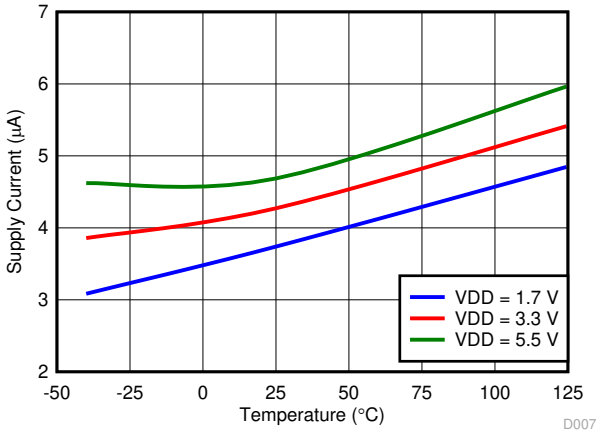
Tested across multiple voltage options

Figure 7-8. Overvoltage Hysteresis Voltage Accuracy vs Temperature

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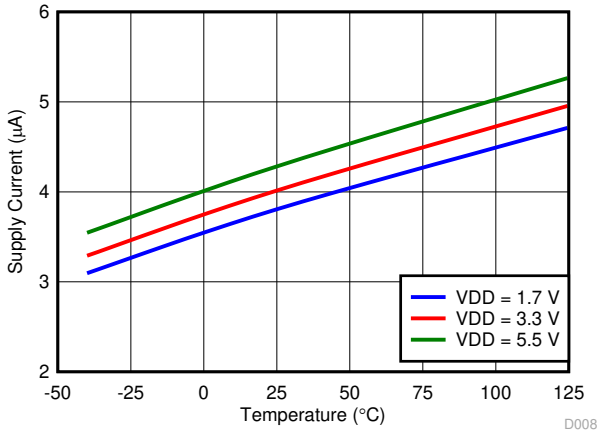
7.8 Typical Characteristics (continued)

at T_J = 25°C, V_{DD} = 3.3 V, and R_{PU} = 10 kΩ (unless otherwise noted)



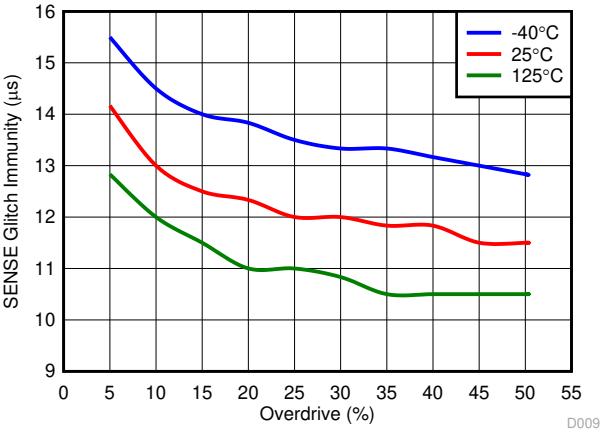
Output ($\overline{\text{RESET}}$ Pin) = High

Figure 7-9. Supply Current vs Temperature



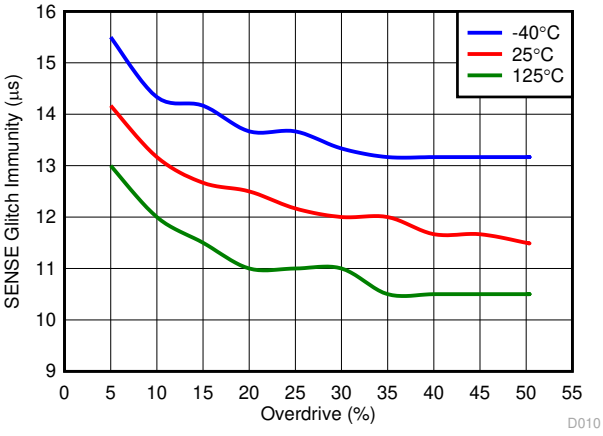
Output ($\overline{\text{RESET}}$ Pin) = Low

Figure 7-10. Supply Current vs Temperature



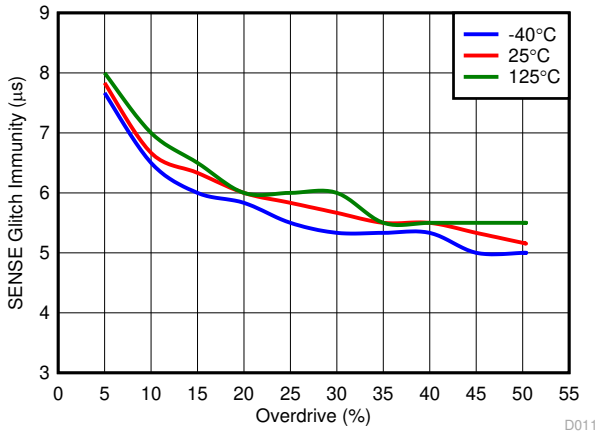
VDD = 1.7 V

Figure 7-11. SENSE Glitch Immunity (VIT-) vs Overdrive



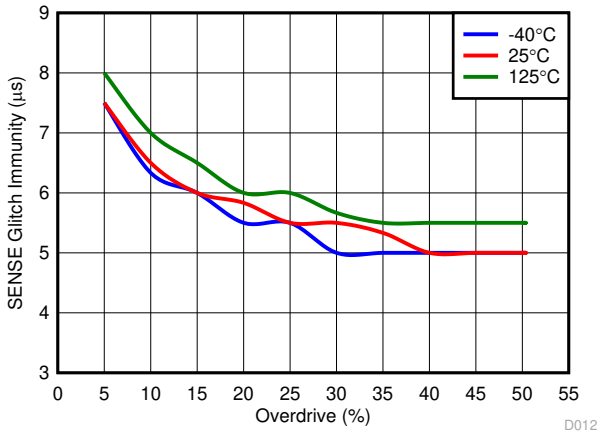
VDD = 1.7 V

Figure 7-12. SENSE Glitch Immunity (VIT+) vs Overdrive



VDD = 5.5 V

Figure 7-13. SENSE Glitch Immunity (VIT-) vs Overdrive



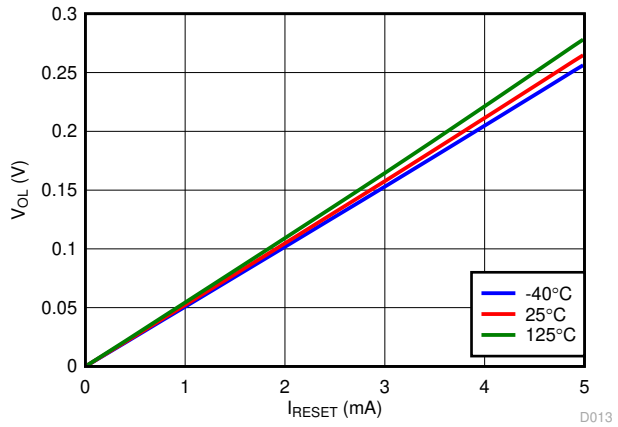
VDD = 5.5 V

Figure 7-14. SENSE Glitch Immunity (VIT+) vs Overdrive

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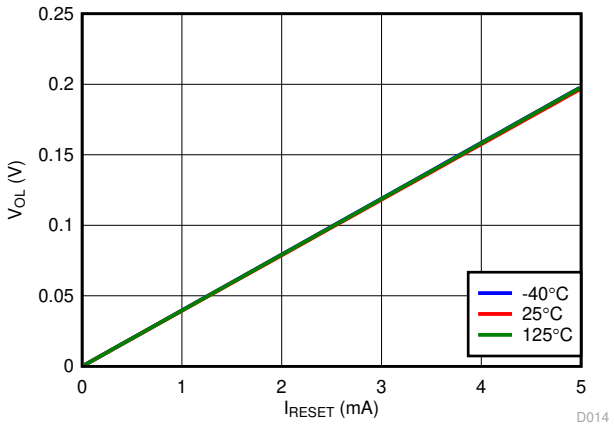
7.8 Typical Characteristics (continued)

at T_J = 25°C, V_{DD} = 3.3 V, and R_{PU} = 10 kΩ (unless otherwise noted)



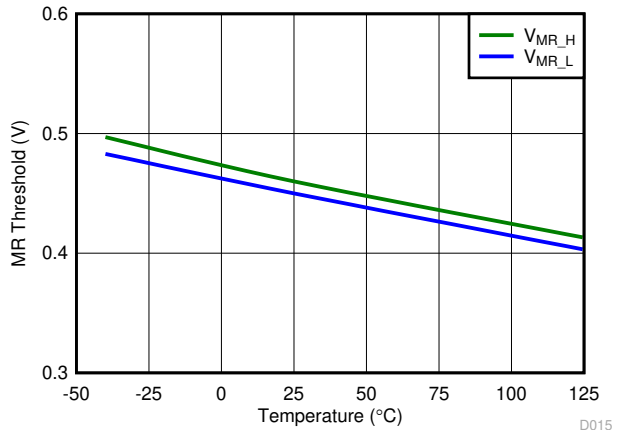
VDD = 1.7 V

Figure 7-15. Low-Level Output Voltage vs RESET current



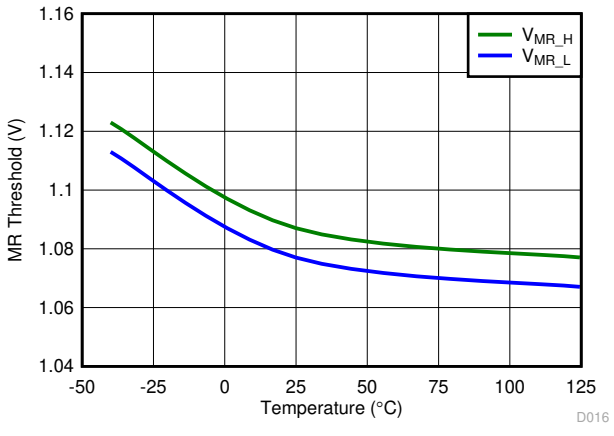
VDD = 5.5 V

Figure 7-16. Low-Level Output Voltage vs RESET current



VDD = 1.7 V

Figure 7-17. SET Threshold vs Temperature



VDD = 5.5 V

Figure 7-18. SET Threshold vs Temperature

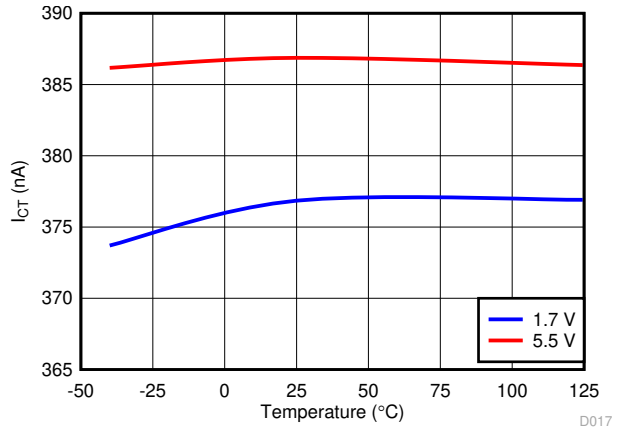


Figure 7-19. CT Current vs CT value

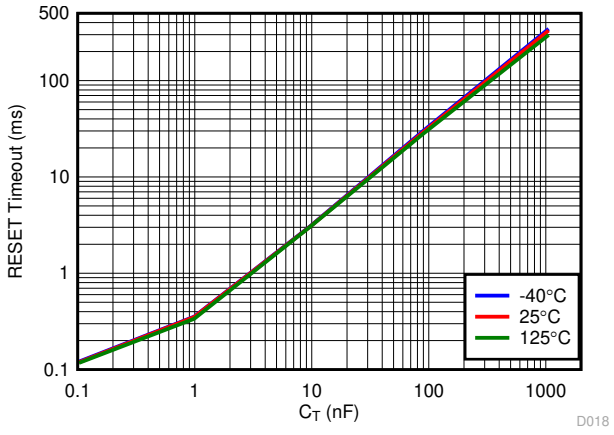


Figure 7-20. $\overline{\text{RESET}}$ Timeout vs CT Capacitor

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7.8 Typical Characteristics (continued)

at T_J = 25°C, V_{DD} = 3.3 V, and R_{PU} = 10 kΩ (unless otherwise noted)

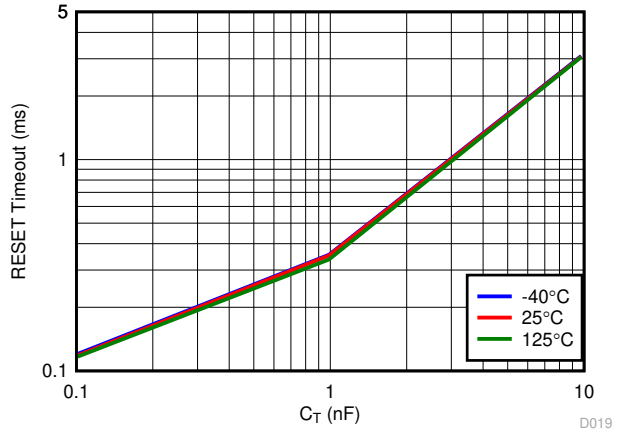


Figure 7-21. Timeout vs CT Capacitor (0.1 to 10 nF)

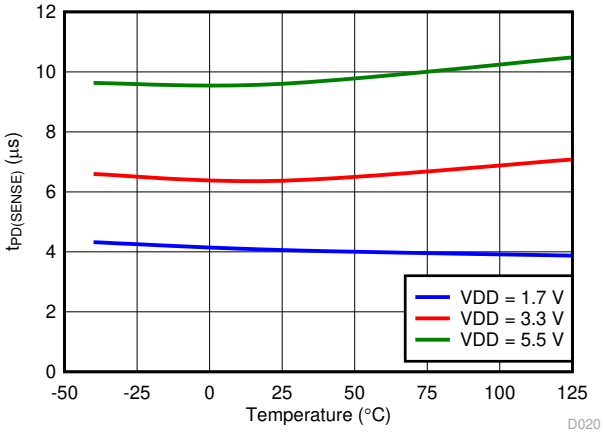


Figure 7-22. Detect Propagation Delay vs Temperature

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8 Detailed Description

8.1 Overview

The TPS3703-Q1 family of devices combines two voltage comparators and a precision voltage reference for overvoltage and undervoltage detection. The TPS3703-Q1 features a highly accurate window threshold voltages (±0.7% over temperature) and a variety voltage threshold variants.

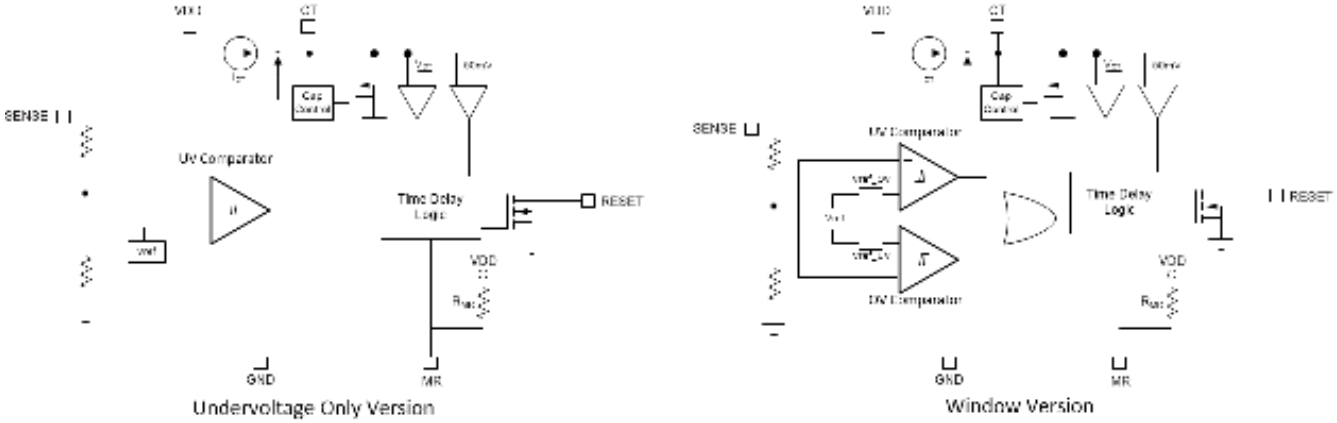
The TPS3703-Q1 includes the resistors used to set the overvoltage and undervoltage thresholds internal to the device. These internal resistors allow for lower component counts and greatly simplifies the design because no additional margins are needed to account for the accuracy of external resistors.

TPS3703-Q1 version A, B and C has three time delay settings, two fixed by connecting CT pin to VDD through a resistor and leaving CT floating and a programmable time delay setting that only requires a single capacitor connected from CT pin to ground.

Manual Reset ($\overline{MR}$) allows for sequencing or hard reset by driving the $\overline{MR}$ pin below $V_{\overline{MR}_L}$.

The TPS3703-Q1 is designed to assert active low output signals when the monitored voltage is outside the safe window. The relationship between the monitored voltage and the states of the outputs is shown in Table 8-1.

8.2 Functional Block Diagram



*For all possible voltages, window tolerance, time delays, and UV threshold options, see Table 12-1.

8.3 Feature Description

8.3.1 VDD

The TPS3703-Q1 is designed to operate from an input voltage supply range between 1.7 V to 5.5 V. An input supply capacitor is not required for this device; however, if the input supply is noisy good analog practice is to place a 1-µF capacitor between the VDD pin and the GND pin.

V_{DD} needs to be at or above $V_{DD(MIN)}$ for at least the start-up delay (t_{SD}+ t_D) for the device to be fully functional.

8.3.2 SENSE

The TPS3703-Q1 combines two comparators with a precision reference voltage and a trimmed resistor divider. This configuration optimizes device accuracy because all resistor tolerances are accounted for in the accuracy and performance specifications. Both comparators also include built-in hysteresis that provides noise immunity and ensures stable operation.

Although not required in most cases, for noisy applications good analog design practice is to place a 1-nF to 10-nF bypass capacitor at the SENSE input in order to reduce sensitivity to transient voltages on the monitored signal.

When monitoring VDD supply voltage, the SENSE pin can be connected directly to VDD. The output ($\overline{RESET}$) is high impedance when voltage at the SENSE pin is between upper and lower boundary of threshold.

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8.3.3 $\overline{\text{RESET}}$

In a typical TPS3703-Q1 application, the $\overline{\text{RESET}}$ output is connected to a reset or enable input of a processor [such as a digital signal processor (DSP), application-specific integrated circuit (ASIC), or other processor type] or the enable input of a voltage regulator [such as a DC-DC converter or low-dropout regulator (LDO)].

The TPS3703-Q1 has an open drain active low output that requires a pull-up resistor to hold these lines high to the required voltage logic. Connect the pull-up resistor to the proper voltage rail to enable the output to be connected to other devices at the correct interface voltage levels. To ensure proper voltage levels, give some consideration when choosing the pull-up resistor values. The pull-up resistor value is determined by V_{OL}, output capacitive loading, and output leakage current. These values are specified in *Section 7*. The open drain output can be connected as a wired-OR logic with other open drain signals such as another TPS3703-Q1 $\overline{\text{RESET}}$ pin.

Table 8-1 describes the scenarios when the output ($\overline{\text{RESET}}$) is either asserted low or high impedance.

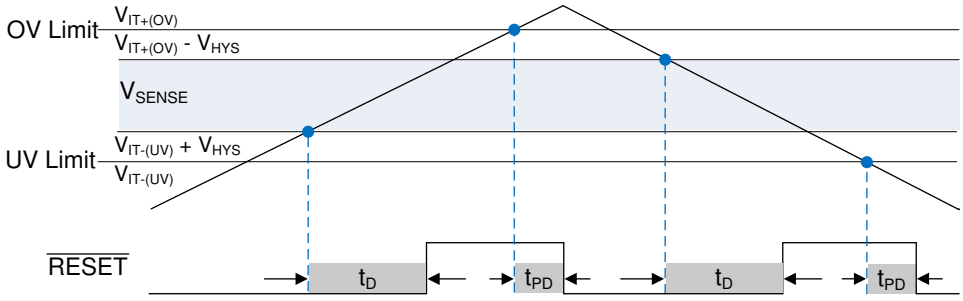


Figure 8-1. RESET output

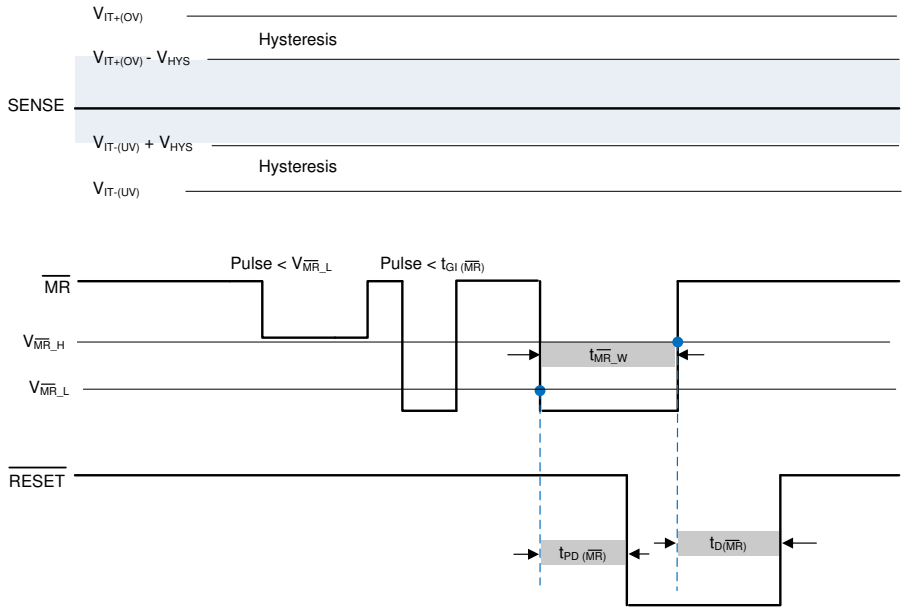
8.3.4 Capacitor Time (CT)

The CT pin provides the user the functionality of both high-precision, factory-programmed, reset delay timing options and user-programmable, reset delay timing. The CT pin can be pulled up to V_{DD} through a resistor, have an external capacitor to ground, or can be left unconnected. The configuration of the CT pin is re-evaluated by the device every time the voltage on the SENSE line enters the valid window ($V_{IT-(UV)} < V_{SENSE} < V_{IT+(OV)}$). The pin evaluation is controlled by an internal state machine that determines which option is connected to the CT pin. The sequence of events takes 450 µs to determine if the CT pin is left unconnected, pulled up through a resistor, or connected to a capacitor. If the CT pin is being pulled up to V_{DD}, then a pull-up resistor is required, 10 kΩ is recommended.

8.3.5 Manual Reset ($\overline{\text{MR}}$)

The manual reset ($\overline{\text{MR}}$) input allows a processor or other logic circuits to initiate a reset. A logic low on $\overline{\text{MR}}$ causes $\overline{\text{RESET}}$ to assert. After $\overline{\text{MR}}$ returns to a logic high and the SENSE pin voltage is within a valid window ($(V_{IT-(UV)} < V_{SENSE} < V_{IT+(OV)})$, $\overline{\text{RESET}}$ is deasserted after the reset delay time (t_D). If $\overline{\text{MR}}$ is not controlled externally, then $\overline{\text{MR}}$ can either be connected to V_{DD} or left floating because the $\overline{\text{MR}}$ pin is internally pulled up to V_{DD}. Figure Figure 8-2 shows the relation between $\overline{\text{MR}}$ and $\overline{\text{RESET}}$.

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A. $\overline{RESET}$ pulls up to VDD with 10 kΩ.

B. To initiate and continue time reset counter both conditions must be met $\overline{MR}$ pin above $V_{\overline{MR}_H}$ or floating and V_{SENSE} between $V_{IT-(UV)}$ + V_{HYS} and $V_{IT+(OV)}$ - V_{HYS}

C. $\overline{MR}$ is ignored during output $\overline{RESET}$ low event

Figure 8-2. Manual Reset Timing Diagram

8.4 Device Functional Modes

Table 8-1. Functional Mode Truth Table

DESCRIPTION	CONDITION	$\overline{MR}$ PIN	VDD PIN	OUTPUT ($\overline{RESET}$ PIN)
Normal Operation	$V_{IT-(UV)}$ < SENSE < $V_{IT+(OV)}$	Open or above $V_{\overline{MR}_H}$	V_{DD} > $V_{DD(MIN)}$	High
Normal Operation (UV Only)	SENSE > $V_{IT-(UV)}$	Open or above $V_{\overline{MR}_H}$	V_{DD} > $V_{DD(MIN)}$	High
Over Voltage detection	SENSE > $V_{IT+(OV)}$	Open or above $V_{\overline{MR}_H}$	V_{DD} > $V_{DD(MIN)}$	Low
Under Voltage detection	SENSE < $V_{IT-(UV)}$	Open or above $V_{\overline{MR}_H}$	V_{DD} > $V_{DD(MIN)}$	Low
Manual reset	$V_{IT-(UV)}$ < SENSE < $V_{IT+(OV)}$	Below $V_{\overline{MR}_L}$	V_{DD} > $V_{DD(MIN)}$	Low
UVLO engaged	$V_{IT-(UV)}$ < SENSE < $V_{IT+(OV)}$	Open or above $V_{\overline{MR}_H}$	V_{POR} < V_{DD} < UVLO	Low

8.4.1 Normal Operation (V_{DD} > $V_{DD(MIN)}$)

When the voltage on V_{DD} is greater than $V_{DD(MIN)}$ for approximately (t_{SD}+ t_D), the $\overline{RESET}$ output state will correspond to the SENSE pin voltage with respect to the threshold limits, when SENSE voltage is outside of threshold limits the $\overline{RESET}$ voltage will be low (V_{OL}).

8.4.2 Undervoltage Lockout (V_{POR} < V_{DD} < UVLO)

When the voltage on V_{DD} is less than the device UVLO voltage but greater than the power-on reset voltage (V_{POR}), the $\overline{RESET}$ pin will be held low , regardless of the voltage on SENSE pin.

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

When the voltage on V_{DD} is lower than the required voltage (V_{POR}) to internally pull the asserted output to GND, $\overline{RESET}$ signal is undefined and is not to be relied upon for proper device function.

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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, as well as validating and testing their design implementation to confirm system functionality.

9.1 Application Information

9.1.1 Voltage Threshold Accuracy

Voltage monitoring requirements vary depending on the voltage supply tolerance of the device being powered. Due to the high precision of the TPS3703-Q1 (±0.7% Max), the device allows for a wider supply voltage margins and threshold headroom for tight tolerance applications.

For example, take a DC/DC regulator providing power to a core voltage rail of an MCU. The MCU has a tolerance of ±5% of the nominal output voltage of the DC/DC. The user sets an ideal voltage threshold of ±4% which allows for ±1% of threshold accuracy. Since the TPS3703-Q1 threshold accuracy is higher than ±1%, the user has more supply voltage margin which can allow for a relaxed power supply design. This gives flexibility to the DC/DC to use a smaller output capacitor or inductor because of a larger voltage window for voltage ripple and transients. There is also headroom between the minimum system voltage and voltage tolerance of the MCU to ensure that the voltage supply will never be in the region of potential failure of malfunction without the TPS3703-Q1 asserting a reset signal.

Figure 9-1 illustrates the supply undervoltage margin and accuracy of the TPS3703-Q1 for the example explained above. Using a low accuracy supervisor will eat into the available budget for the power supply ripple and transient response. This gives less flexibility to the user and a more stringent DC/DC converter design.

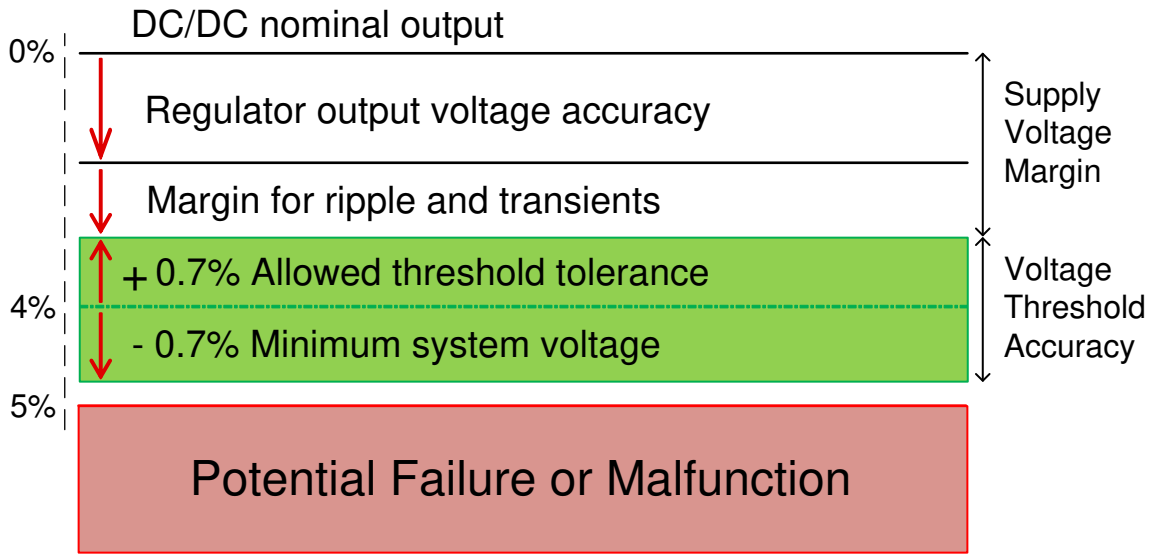


Figure 9-1. TPS3703-Q1 Voltage Threshold Accuracy

9.1.2 CT Reset Time Delay

The TPS3703-Q1 features three options for setting the reset delay (t_D): connecting a capacitor to the CT pin, connecting a pull-up resistor to VDD, and leaving the CT pin unconnected. Figure 9-2 shows a schematic drawing of all three options. To determine which option is connected to the CT pin, an internal state machine controls the internal pulldown device and measures the pin voltage. This sequence of events takes 450 µs to determine which timing option is used. Every time the voltage on the SENSE line enters the valid window ($V_{IT-(UV)} + V_{HYS} < V_{SENSE} < V_{IT+(OV)} - V_{HYS}$, the state machine determines the CT option.

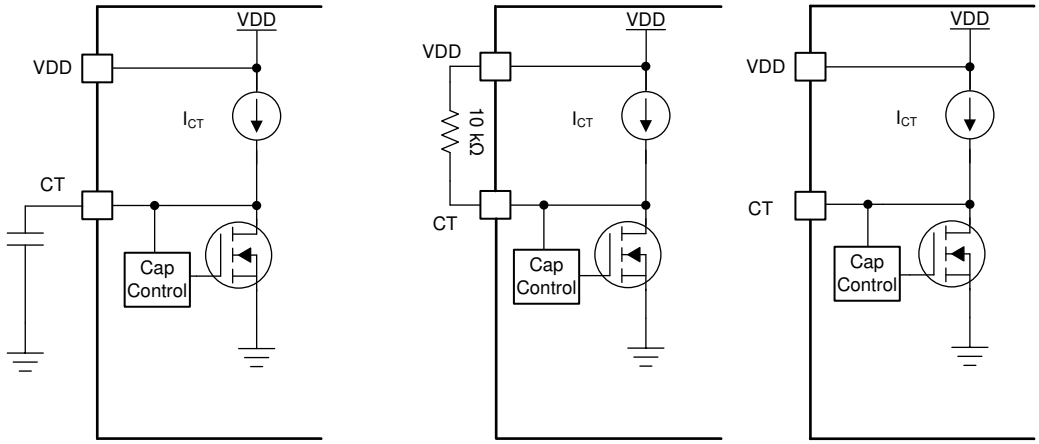


Figure 9-2. CT Charging Circuit

9.1.2.1 Factory-Programmed Reset Delay Timing

To use the factory-programmed timing options, the CT pin must either be left unconnected or pulled up to VDD through a 10 kΩ pull-up resistor. Using these options enables a high-precision reset delay timing, as shown in Table 9-1.

Table 9-1. Reset Delay Time for Factory-Programmed Reset Delay Timing

VARIANT	RESET DELAY TIME (t_D)			VALUE
	CT = Capacitor to GND	CT = Floating	CT = 10 kΩ to VDD	
TPS3703A	Programmable t_D	10	200	ms
TPS3703B	Programmable t_D	1	20	ms
TPS3703C	Programmable t_D	5	100	ms
TPS3703D	N/A	50	50	µs

9.1.2.2 Programmable Reset Delay-Timing

The TPS3703 reset time delay is based on internal current source (I_{CT}) to charge external capacitor (C_{CT}) and read capacitor voltage with internal comparator. The minium value capacitor is 250 pF. There is no limitation on maximum capacitor the only constrain is imposed by the initial voltage of the capacitor, if CT cap is zero or near to zero then ideally there is no other constraint on the max capacitor. The typical ideal capacitor value needed for a given delay time can be calculated using Equation 1, where C_{CT} is in nanofarads (nF) and t_D is in ms:

$$t_D = 3.066 \times C_{CT} + 0.5 \text{ ms} \quad (1)$$

To calculate the minimum and maximum-reset delay time use Equation 2 and Equation 3, respectively.

$$t_{D(min)} = 2.7427 \times C_{CT} + 0.3 \text{ ms} \quad (2)$$

$$t_{D(max)} = 3.4636 \times C_{CT} + 0.7 \text{ ms} \quad (3)$$

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The slope of the equation is determined by the time the CT charging current (I_{CT}) takes to charge the external capacitor up to the CT comparator threshold voltage (V_{CT}). When $\overline{\text{RESET}}$ is asserted, the capacitor is discharged through the internal CT pulldown resistor. When the $\overline{\text{RESET}}$ conditions are cleared, the internal precision current source is enabled and begins to charge the external capacitor; when V_{CT} = 1.15 V, $\overline{\text{RESET}}$ is unasserted. Note that in order to minimize the difference between the calculated $\overline{\text{RESET}}$ delay time and the actual $\overline{\text{RESET}}$ delay time, use a use a high-quality ceramic dielectric COG, X5R, or X7R capacitor and minimize parasitic board capacitance around this pin. Table 9-2 lists the reset delay time ideal capacitor values for C_{CT}.

Table 9-2. Reset Delay Time for Ideal Capacitor Values

C_{CT}	$\overline{\text{RESET}}$ DELAY TIME (t_D), TYPICAL
250 pF	1.27 ms
1 nF	3.57 ms
3.26 nF	10.5 ms
32.6 nF	100.45 ms
65.2 nF	200.40 ms
1uF	3066.50 ms

9.1.3 $\overline{\text{RESET}}$ Latch Mode

The TPS3703-Q1 features a voltage latch mode on the $\overline{\text{RESET}}$ pin when connecting the CT pin to common ground . A pull-down resistor is recommended to limit current consumption of the system. In latch mode, if the $\overline{\text{RESET}}$ pin is low or triggers low, the pin will stay low regardless if V_{SENSE} is within the acceptable voltage boundaries ($V_{IT-(UV)}$ < V_{SENSE} < $V_{IT+(OV)}$). To unlatch the device provide a voltage to the CT pin that is greater than the CT pin comparator threshold voltage, V_{CT}. The $\overline{\text{RESET}}$ pin will trigger high instantaneously without any reset delay. A voltage greater than 1.2 V to recommended to ensure a proper unlatch. Use a series resistance to limit current when an unlatch voltage is applied. For more information, Section 9.2.2 gives an example of a typical latch application.

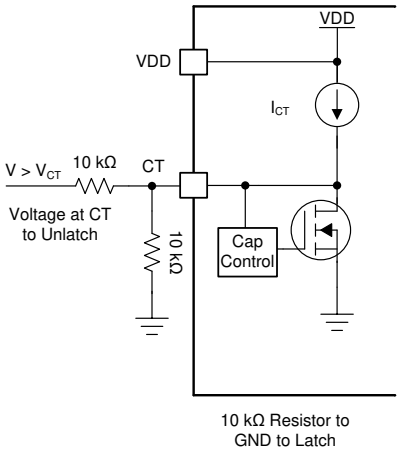


Figure 9-3. $\overline{\text{RESET}}$ Latch Circuit

9.1.4 Adjustable Voltage Thresholds

The TPS3703-Q1 0.7% maximum accuracy allows for adjustable voltage thresholds using external resistors without adding major inaccuracies to the device. In case that the desired monitored voltage is not available, external resistor dividers can be used to set the desired voltage thresholds. Figure 9-4 illustrates an example of how to adjust the voltage threshold with external resistor dividers. The resistors can be calculated depending on the desired voltage threshold and device part number. TI recommends using the 0.8V voltage threshold device such as the TPS3703B3080 because of the bypass mode of internal resistor ladder.

For example, consider a 2.0 V rail being monitored (V_{MON}) using the TPS3703B3080 variant. Using Equation 4, R1 = 15 kΩ given that R2 = 10 kΩ, V_{MON} = 2 V , and V_{SENSE} = 0.8 V. This device is typically meant to monitor a 0.8 V rail with ±3% voltage thresholds. This means that the device undervoltage threshold ($V_{IT-(UV)}$) and overvoltage threshold ($V_{IT-(OV)}$) is 0.776 V and 0.824 V respectively. Using Equation 4 , V_{MON} = 1.94 V when V_{SENSE} = $V_{IT-(UV)}$. This can be denoted as V_{MON-}, the monitored undervoltage threshold where the device will assert a reset signal. Using Equation 4 again, the monitored overvoltage threshold (V_{MON+}) = 2.06 V when V_{SENSE} = $V_{IT+(OV)}$. If a wider tolerance or UV only threshold is desired, use a device variant shown on Table 7 to determine what device part number matches your application.

$$V_{SENSE} = V_{MON} \times (R_2 \div (R_1 + R_2)) \quad (4)$$

There are inaccuracies that must be taken into consideration while adjusting voltage thresholds. Aside from the tolerance of the resistor divider, there is an internal resistance of the SENSE pin that may affect the accuracy of the resistor divider. Although expected to be very high impedance, users are recommended to calculate the values for design specifications. The internal sense resistance (R_{SENSE}) can be calculated by the sense voltage (V_{SENSE}) divided by the sense current (I_{SENSE}) as shown in Equation 6. V_{SENSE} can be calculated using Equation 4 depending on the resistor divider and monitored voltage. I_{SENSE} can be calculated using Equation 5.

$$I_{SENSE} = (V_{MON} – V_{SENSE}) \div R_1 – (V_{SENSE} \div R_2) \quad (5)$$

$$R_{SENSE} = V_{SENSE} \div I_{SENSE} \quad (6)$$

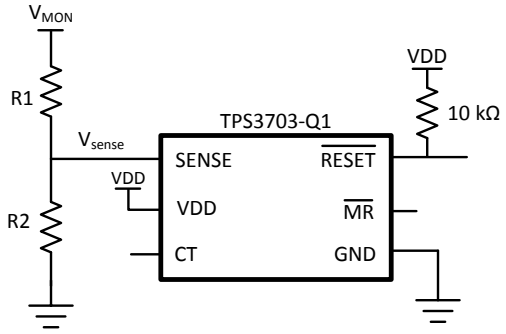


Figure 9-4. Adjustable Voltage Threshold with External Resistor Dividers

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9.1.5 Immunity to SENSE Pin Voltage Transients

The TPS3703-Q1 is immune to short voltage transient spikes on the input pins. Sensitivity to transients depends on both transient duration and overdrive (amplitude) of the transient.

Overdrive is defined by how much the V_{SENSE} exceeds the specified threshold, and is important to know because the smaller the overdrive, the slower the response of the outputs ($\overline{RESET}$). Threshold overdrive is calculated as a percent of the threshold in question, as shown in Equation 7:

$$\text{Overdrive \%} = | (V_{SENSE} - (V_{IT-(UV)} \text{ or } V_{IT+(OV)})) / V_{IT} \text{ (Nominal)} \times 100\% | \quad (7)$$

where:

- V_{SENSE} is the voltage at the SENSE pin
- V_{IT} (Nominal) is the nominal threshold voltage
- $V_{IT-(UV)}$ and $V_{IT+(OV)}$ represent the actual undervoltage or overvoltage tripping voltage

9.1.5.1 Hysteresis

Overvoltage and undervoltage comparators include built-in hysteresis that provides noise immunity and ensures stable operation. For example if the voltage on the SENSE pin falls below $V_{IT-(UV)}$ or above $V_{IT+(OV)}$, then $\overline{RESET}$ is asserted (driven low), then when the voltage on the SENSE pin is between the positive and negative threshold voltages, $\overline{RESET}$ deasserts after the user-defined $\overline{RESET}$ delay time. Figure Figure 9-5 shows the relation between $V_{IT-(UV)}$,$V_{IT+(OV)}$ and hysteresis voltage (V_{HYS}).

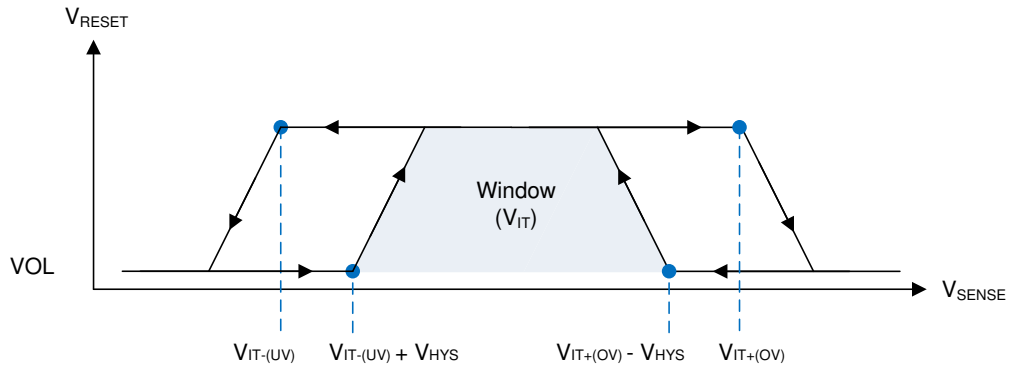


Figure 9-5. SENSE Pin Hysteresis

9.2 Typical Applications

9.2.1 Design 1: Multi-Rail Window Monitoring for Microcontroller Power Rails

A typical application for the TPS3703-Q1 is shown in Figure 9-6. The TPS3703-Q1 is used to monitor two PMIC voltage rails that powers the core and I/O voltage of the microcontroller that requires accurate reset delay and voltage supervision. Reference design TIDA-050008 is an ADAS power reference that focuses on improved voltage supervision. It utilizes the TPS3703-Q1 to monitor the core voltage rail of a MCU similar to the circuit below.

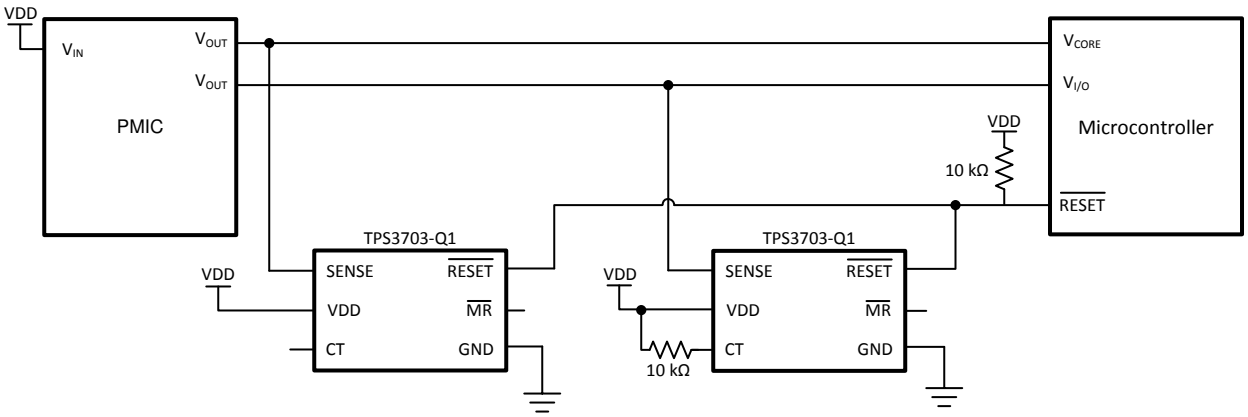


Figure 9-6. Two TPS3703-Q1 Monitoring Two Microcontroller Power Rails

9.2.1.1 Design Requirements

Table 9-3. Design Parameters

PARAMETER	DESIGN REQUIREMENT	DESIGN RESULT
Monitored rails	3.3-$V_{I/O}$ nominal, with alerts if outside of ±8% of 3.3 V (including device accuracy), 200 ms reset delay	Worst case $V_{IT+(OV)}$ = 3.554 V (7.7%), Worst case $V_{IT–(UV)}$ = 3.046 V (-7.7%)
	1.2-V_{CORE} nominal, with alerts if outside of ±5% of 1.2 V (including device accuracy), 10 ms reset delay	Worst case $V_{IT+(OV)}$ = 1.256 V (4.7%), Worst case $V_{IT–(UV)}$ = 1.144 V (-4.7%)
Output logic voltage	5-V CMOS	5-V CMOS
Maximum system supervision current consumption	50 µA	14 µA (7 µA Max each)

9.2.1.2 Detailed Design Procedure

Determine which version of the TPS3703-Q1 best suits the monitored rail (V_{MON}) and window tolerances found on Table 7. The TPS3703-Q1 allows overvoltage and undervoltage monitoring for precise voltage supervision of common rails between 0.5 V and 5.0 V. This application calls for very tight monitoring of the rail with only ±5% of variation allowed on the 1.2V core rail. To ensure this requirement is met, the TPS3703-Q1 was chosen for its ±4% thresholds. The 3.3V I/O is more flexible and can operate up to 8% variance. Since the TPS3703-Q1 comes in various tolerance options, the ±7% thresholds can be chosen for this voltage rail. To calculate the worst-case for $V_{IT+(OV)}$ and $V_{IT-(UV)}$, the accuracy must also be taken into account. The worst-case for $V_{IT+(OV)}$ and $V_{IT-(UV)}$ can be calculated shown in Equation 8 and Equation 9 respectively:

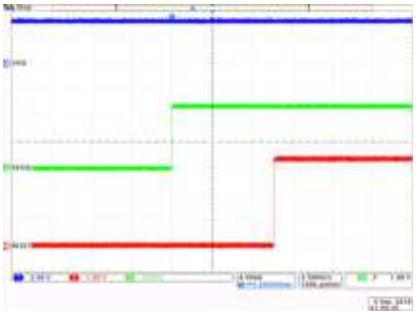
$$V_{IT+(OV\text{-}Worst\ Case)} = V_{MON} \times (\%Threshold + 0.7\%) = 1.2 \times (+4.7\%) = 1.256\ V \quad (8)$$

$$V_{IT-(UV\text{-}Worst\ Case)} = V_{MON} \times (\%Threshold - 0.7\%) = 1.2 \times (-4.7\%) = 1.144V \quad (9)$$

When the outputs switch to a high impedance state, the rise time of the $\overline{RESET}$ pin depends on the pull-up resistance and the capacitance on that node. Choose pull-up resistors that satisfy both the downstream timing requirements and the sink current required to have a V_{OL} low enough for the application; 10 kΩ to 1 MΩ resistors are a good choice for low-capacitive loads.

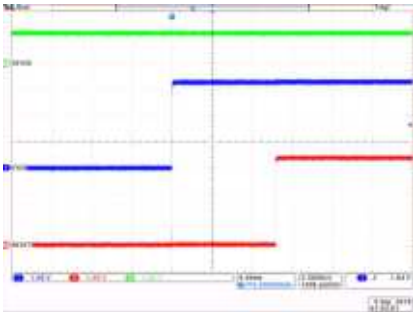
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9.2.1.3 Application Curves



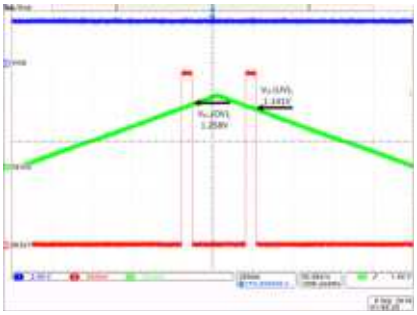
V_{SENSE} Start up from 0 V to 1.2 V, V_{DD} = 3.3 V, CT = OPEN
$V_{\overline{RESET}}$ = VDD = 3.3 V, TPS3703A4120

Figure 9-7. TPS3703-Q1 SENSE Start Up Function



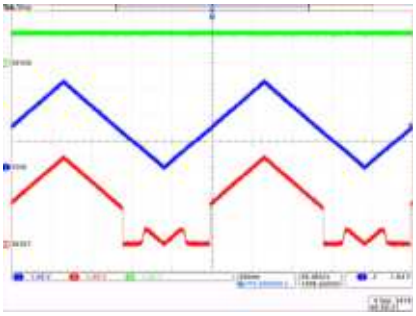
V_{DD} Start up from 0 V to 3.3 V, V_{SENSE} = 1.2 V, CT = OPEN
$V_{\overline{RESET}}$ = VDD = 3.3 V, TPS3703A4120

Figure 9-8. TPS3703-Q1 VDD Start Up Function



V_{SENSE} ramp from 0 V to 1.4 V, V_{DD} = 3.3 V, CT = OPEN
$V_{\overline{RESET}}$ = VDD = 3.3 V, TPS3703A4120

Figure 9-9. TPS3703-Q1 Overvoltage and Undervoltage Function



V_{DD} ramp from 0 V to 3.3 V, V_{SENSE} = 1.2 V, CT = OPEN
$V_{\overline{RESET}}$ = VDD = 3.3 V,TPS3703A4120

Figure 9-10. TPS3703-Q1 VDD Ramp Up Function

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9.2.2 Design 2: $\overline{\text{RESET}}$ Latch Mode

Another typical application for the TPS3703-Q1 is shown in Figure 9-6. The TPS3703-Q1 is used in a $\overline{\text{RESET}}$ latch output mode. In latch mode, once $\overline{\text{RESET}}$ driven logic low, it will stay low regardless of the sense voltage. If the $\overline{\text{RESET}}$ pin is low on start up, it will also stay low regardless of sense voltage.

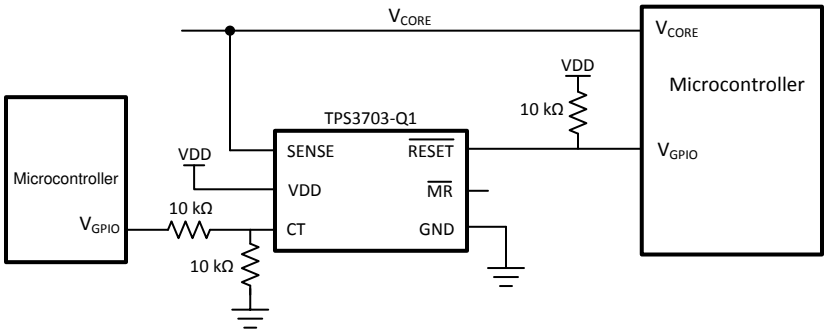


Figure 9-11. Window Voltage Monitoring with $\overline{\text{RESET}}$ Latch

9.2.2.1 Design Requirements

Table 9-4. Design Parameters

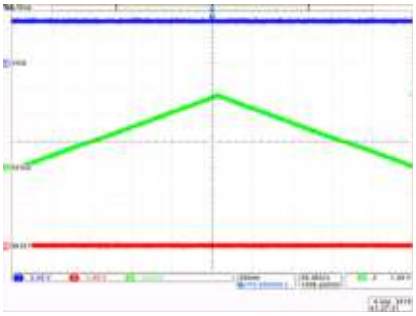
PARAMETER	DESIGN REQUIREMENT	DESIGN RESULT
Monitored Rail	1.2-V_{CORE} nominal, with alerts if outside of ±5% of 1.2 V (including device accuracy), Latch when $\overline{\text{RESET}}$ is low, until voltage is applied on CT pin.	Worst case $V_{IT+(OV)}$ = 1.256 V (4.7%), Worst case $V_{IT–(UV)}$ = 1.144 V (-4.7%)
Output logic voltage	5-V CMOS	5-V CMOS
Maximum device current consumption	15 µA	4.5 µA (Typ), 7 µA (Max)

9.2.2.2 Detailed Design Procedure

The $\overline{\text{RESET}}$ pin can be latched when the CT pin is connected to a common ground with a pull-down resistor. A 10 kΩ resistors is recommended to limit current consumption. To unlatch the device provide a voltage to the CT pin that is greater than the CT pin comparator threshold voltage, V_{CT}. A voltage greater than 1.15 V to recommended to ensure a proper unlatch. Use a series resistance to limit current when an unlatch voltage is applied. To go back into latch operation, disconnect the voltage on the CT pin. The $\overline{\text{RESET}}$ pin will trigger high instanously without any reset delay.

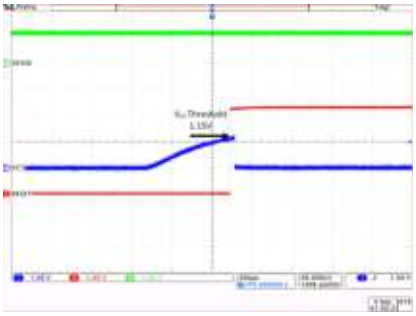
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9.2.2.3 Application Curves



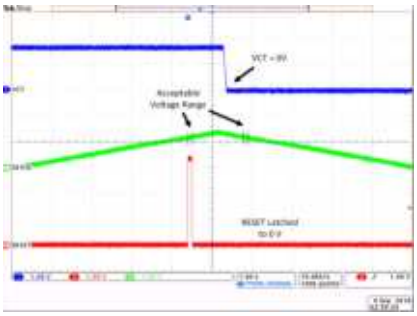
V_{SENSE} ramp from 0 V to 1.4V, V_{DD} = 3.3 V, V_{CT} = 0 V $V_{\overline{RESET}}$ = VDD = 3.3 V, TPS3703A4120

Figure 9-12. TPS3703-Q1 SENSE Ramp Latch Function



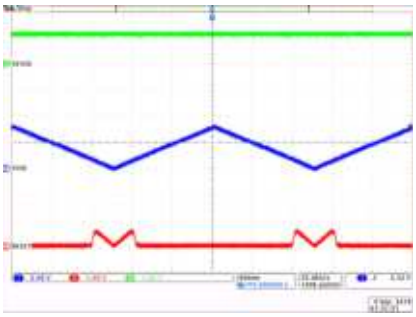
V_{CT} biased at least to 1.15 V , V_{SENSE} = 1.2 V $V_{\overline{RESET}}$ = VDD = 3.3 V, TPS3703A4120

Figure 9-13. TPS3703-Q1 CT Bias Unlatch Function



V_{Sense} ramp from 0 V to 1.4 V , V_{DD} = 3.3 V, $V_{\overline{RESET}}$ = VDD CT is pulled down after RESET is low, RESET becomes latched TPS3703A4120

Figure 9-14. TPS3703-Q1 Overvoltage and Undervoltage Latch Function



V_{DD} ramp up from 0 V to 3.3 V , V_{SENSE} = 1.2 V, CT = 0 V $V_{\overline{RESET}}$ = VDD = 3.3 V, TPS3703A4120

Figure 9-15. TPS3703-Q1 VDD Ramp Latch Function

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10 Power Supply Recommendations

10.1 Power Supply Guidelines

This device is designed to operate from an input supply with a voltage range between 1.7 V to 5.5 V. It has a 6-V absolute maximum rating on the VDD pin. It is good analog practice to place a 0.1-µF to 1-µF capacitor between the VDD pin and the GND pin depending on the input voltage supply noise. If the voltage supply providing power to VDD is susceptible to any large voltage transient that exceed maximum specifications, additional precautions must be taken. See SNVA849 for more information.

11 Layout

11.1 Layout Guidelines

- Place the external components as close to the device as possible. This configuration prevents parasitic errors from occurring.
- Avoid using long traces for the VDD supply node. The VDD capacitor, along with parasitic inductance from the supply to the capacitor, can form an LC circuit and create ringing with peak voltages above the maximum VDD voltage.
- Avoid using long traces of voltage to the sense pin. Long traces increase parasitic inductance and cause inaccurate monitoring and diagnostics.
- Do not run sensitive analog traces in parallel with digital traces. Avoid crossing digital and analog traces if possible, and only make perpendicular crossings when absolutely necessary.

11.2 Layout Example

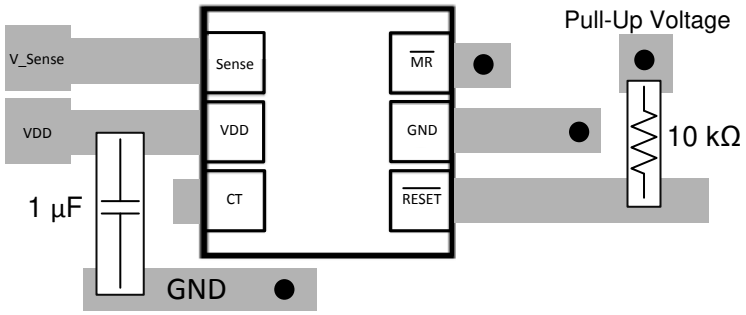


Figure 11-1. Recommended Layout

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12 Device and Documentation Support

12.1 Device Support

12.1.1 Device Nomenclature

Table 12-1 shows how to decode the function of the device based on its part number.

Table 12-1. Device Naming Convention

DESCRIPTION		NOMENCLATURE	VALUE
		TPS3703	TPS3703
Time delay options: Every part has two fixed time delay and adjustable delay option via external capacitor Part number	Window (OV & UV)	A	CT pin open = 10 ms, CT pin tied to VDD = 200 ms CT programable with external capacitor
		B	CT pin open = 1 ms, CT pin tied to VDD = 20 ms CT programable with external capacitor
		C	CT pin open = 5 ms, CT pin tied to VDD = 100 ms CT programable with external capacitor
		D	CT pin open = 50 µs, CT pin tied to VDD = 50 µs CT not programable
	UV only	E	CT pin open = 10 ms, CT pin tied to VDD = 200 ms CT programable with external capacitor
		F	CT pin open = 1 ms, CT pin tied to VDD = 20 ms CT programable with external capacitor
		G	CT pin open = 5 ms, CT pin tied to VDD = 100 ms CT programable with external capacitor
		H	CT pin open = 50 µs, CT pin tied to VDD = 50 µs CT not programable
Tolerance options: Trigger or threshold voltage as a percentage of the monitored threshold voltage		3	Window threshold from nominal value = OV : 3%; UV: –3%
		4	Window threshold from nominal value = OV : 4%; UV: –4%
		5	Window threshold from nominal value = OV : 5%; UV: –5%
		6	Window threshold from nominal value = OV : 6%; UV: –6%
		7	Window threshold from nominal value = OV : 7%; UV: –7%

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Table 12-1. Device Naming Convention (continued)

DESCRIPTION	NOMENCLATURE	VALUE
Nominal monitor threshold voltage option	050	0.50 V
	055	0.55 V
	060	0.60 V
	065	0.65 V
	070	0.70 V
	075	0.75 V
	080	0.80 V
	085	0.85 V
	090	0.90 V
	095	0.95 V
	100	1.00 V
	105	1.05 V
	110	1.10 V
	115	1.15 V
	120	1.20 V
	125	1.25 V
	130	1.30 V
	150	1.50 V
	180	1.80 V
	250	2.50 V
	280	2.80 V
	290	2.90 V
	330	3.30 V
	500	5.00 V
Package	DSE	WSON - 6 pin (1.5 mm × 1.5 mm)
Reel	R	Large reel
Automotive version	Q1	Q100 AEC

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12.2 Documentation Support

12.2.1 Evaluation Module

An evaluation module (EVM) is available to assist in the initial circuit performance evaluation using the TPS3703-Q1. The *TPS3703-Q1 evaluation module* (and *related user guide*) can be requested at the Texas Instruments website through the product folders or purchased directly from the TI eStore .

12.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

12.4 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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12.5 Trademarks

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12.6 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.

12.7 Glossary

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.

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PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TPS3703A4085DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	L8
TPS3703A4085DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	L8
TPS3703A4120DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AB
TPS3703A4120DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AB
TPS3703A4180DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AD
TPS3703A4180DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AD
TPS3703A4280DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H8
TPS3703A4280DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H8
TPS3703A4330DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AE
TPS3703A4330DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AE
TPS3703A5090DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GW
TPS3703A5090DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GW
TPS3703A5180DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GZ
TPS3703A5180DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GZ
TPS3703A5290DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GT
TPS3703A5290DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GT
TPS3703A7080DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	LD
TPS3703A7080DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	LD
TPS3703A7100DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	LA
TPS3703A7100DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	LA
TPS3703A7110DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GX
TPS3703A7110DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GX
TPS3703A7120DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H1
TPS3703A7120DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H1
TPS3703A7125DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AC
TPS3703A7125DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	AC
TPS3703A7180DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H2
TPS3703A7180DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H2
TPS3703A7250DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	L9

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TPS3703A7250DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	L9
TPS3703A7280DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H3
TPS3703A7280DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H3
TPS3703A7330DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GV
TPS3703A7330DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GV
TPS3703B3080DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	BA
TPS3703B3080DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	BA
TPS3703B4250DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H6
TPS3703B4250DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H6
TPS3703B5180DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GU
TPS3703B5180DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	GU
TPS3703C7115DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	N9
TPS3703C7115DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	N9
TPS3703C7500DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	CF
TPS3703C7500DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	CF
TPS3703E4080DSERQ1	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H7
TPS3703E4080DSERQ1.A	Active	Production	WSON (DSE) | 6	3000 | LARGE T&R	Yes	NIPDAUAG	Level-1-260C-UNLIM	-40 to 125	H7

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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OTHER QUALIFIED VERSIONS OF TPS3703-Q1 :

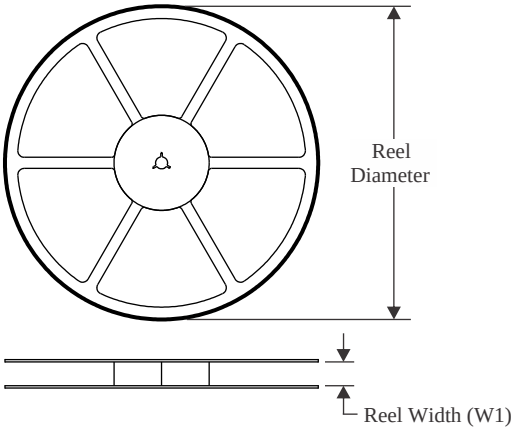
- Catalog : TPS3703

NOTE: Qualified Version Definitions:

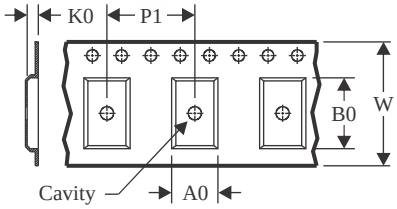
- Catalog - TI's standard catalog product

TAPE AND REEL INFORMATION

REEL DIMENSIONS

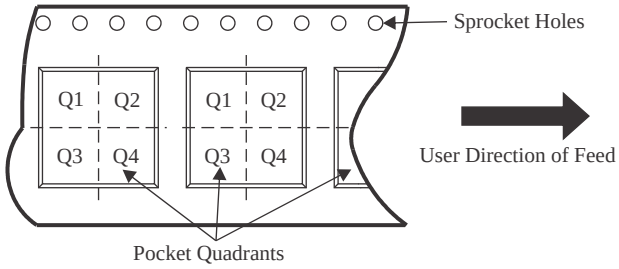


TAPE DIMENSIONS



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

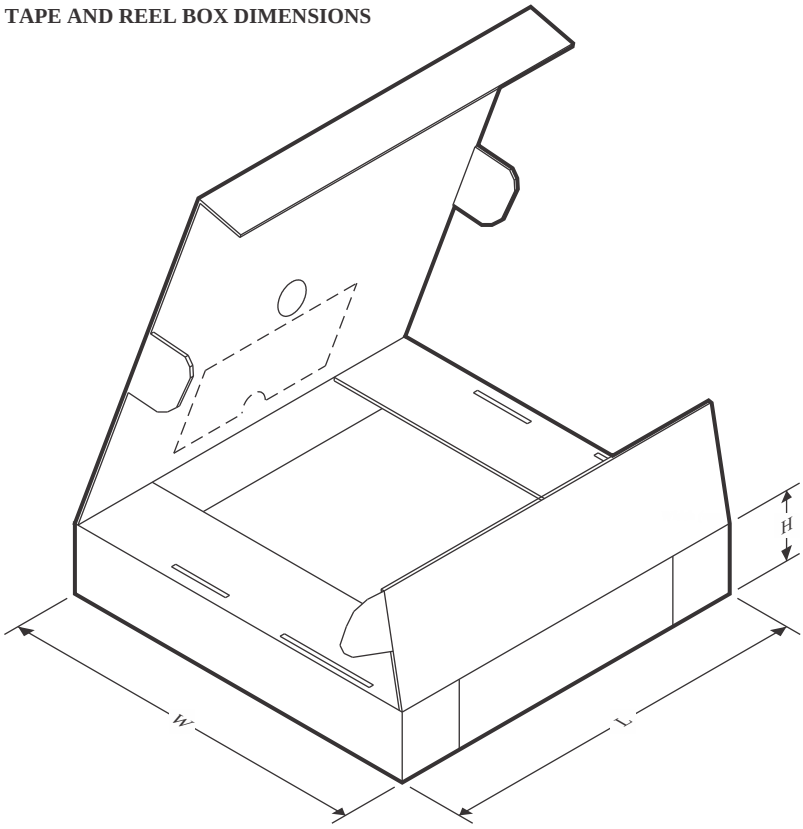


*All dimensions are nominal

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
TPS3703A4085DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A4120DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A4180DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A4280DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A4330DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A5090DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A5180DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A5290DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7080DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7100DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7110DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7120DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7125DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7180DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7250DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703A7280DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2

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
TPS3703A7330DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703B3080DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703B4250DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703B5180DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703C7115DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703C7500DSERQ1	WSON	DSE	6	3000	178.0	8.4	1.7	1.7	0.95	4.0	8.0	Q2
TPS3703E4080DSERQ1	WSON	DSE	6	3000	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)
TPS3703A4085DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A4120DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A4180DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A4280DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A4330DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A5090DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A5180DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A5290DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7080DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7100DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7110DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7120DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7125DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7180DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7250DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7280DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703A7330DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703B3080DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0

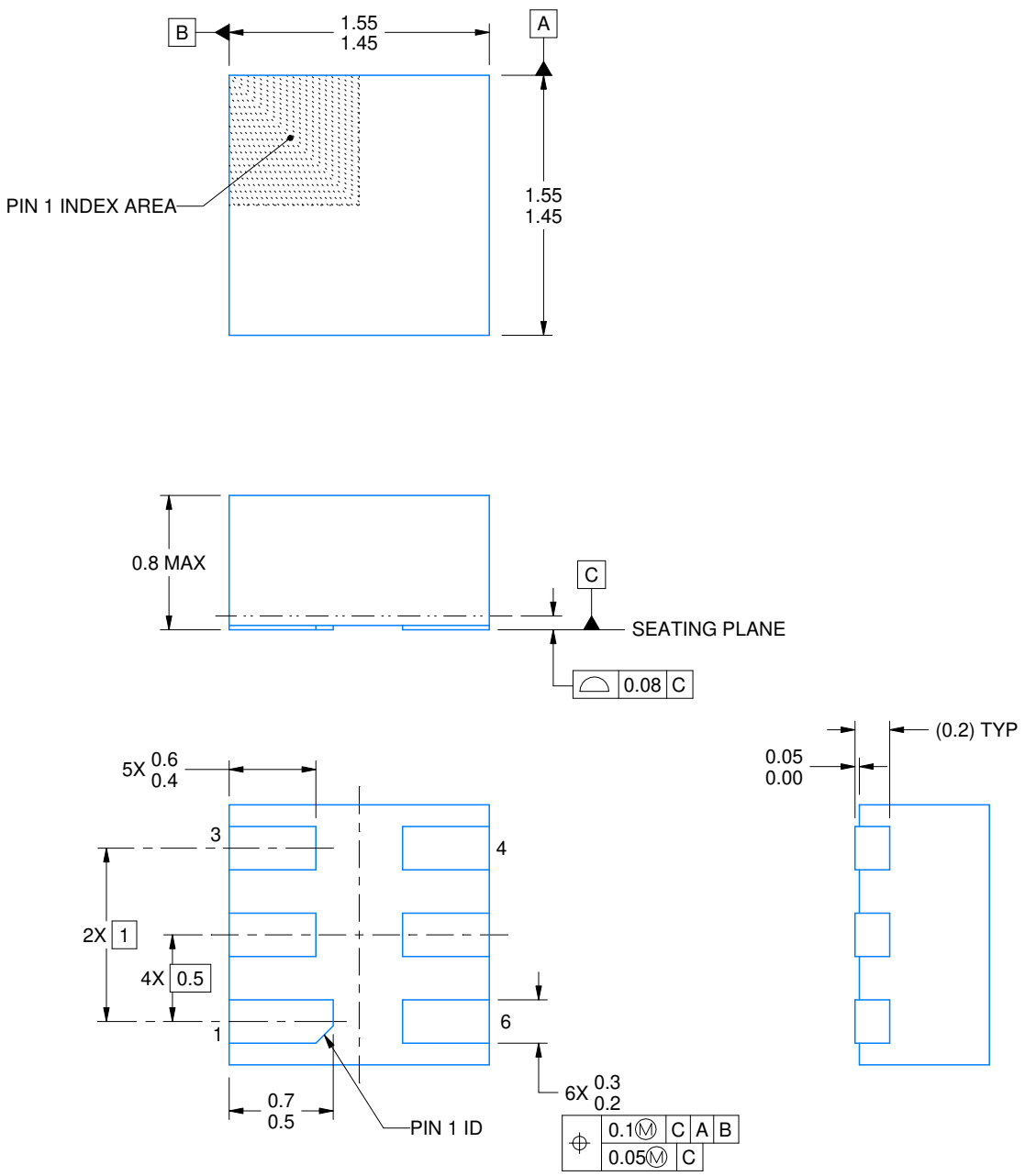
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS3703B4250DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703B5180DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703C7115DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703C7500DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0
TPS3703E4080DSERQ1	WSON	DSE	6	3000	205.0	200.0	33.0

PACKAGE OUTLINE

DSE0006A

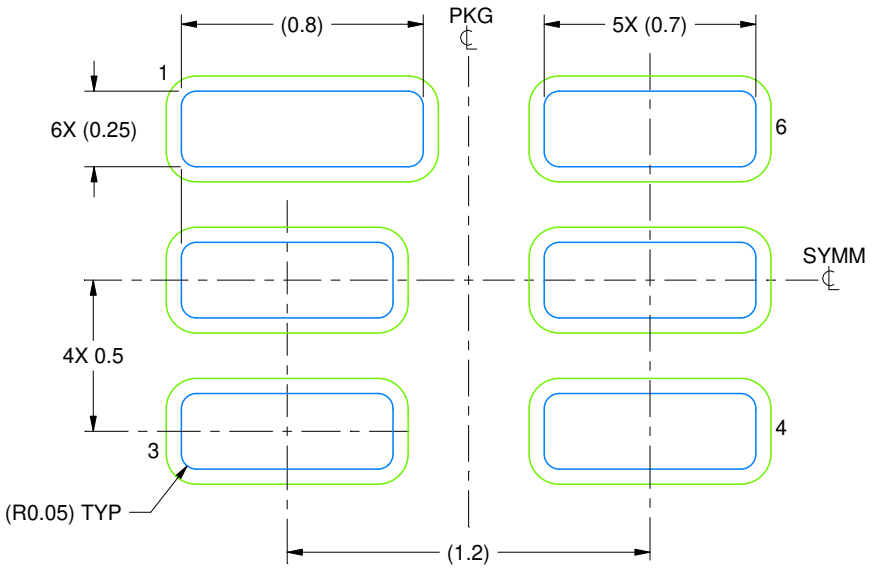
WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

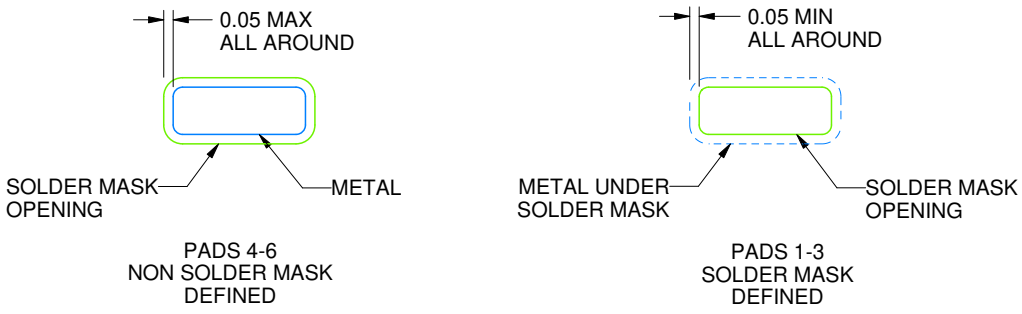


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
SCALE:40X

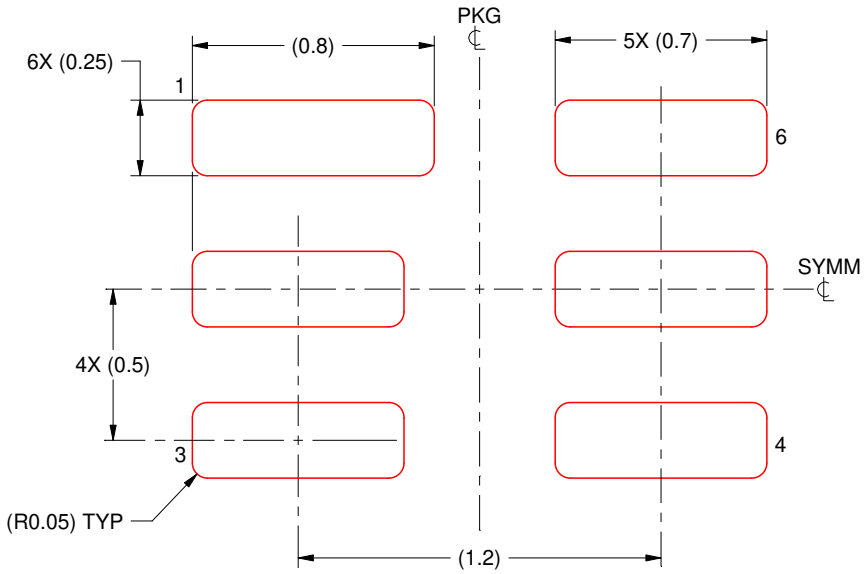


SOLDER MASK DETAILS

4220552/B 01/2024

NOTES: (continued)

3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:40X

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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