THE DATASHEET OF

TPS3707-33DG4

www.win-source.net 0086-755-83957316

TPS370x-xx Processor Supervisory Circuits With Power-Fail

1 Features

- Power-on reset generator with fixed delay time of 200 ms (no external capacitor needed)
- Precision supply voltage monitor: 2.5 V, 3 V, 3.3 V, and 5 V
- Pin-for-pin compatible with the MAX705 through MAX708 Series
- Integrated watchdog time (TPS3705-xx Only)
- Voltage monitor for power-fail or low-battery warning
- Maximum supply current of 50 µA
- 8-Pin MSOP and 8-Pin SOIC packages
- Temperature range: –40°C to 85°C (–40°C to 125°C for TPS3705-33)

2 Applications

- Designs using DSPs, microcontrollers, or microprocessors
- Industrial equipment
- Programmable controls
- Automotive systems
- Portable or battery powered equipment
- Intelligent instruments
- Wireless communication systems
- Notebook or desktop computers

3 Description

The TPS370x-xx family of microprocessor supply-voltage supervisors provide circuit initialization and timing supervision, primarily for DSP and processor-based systems.

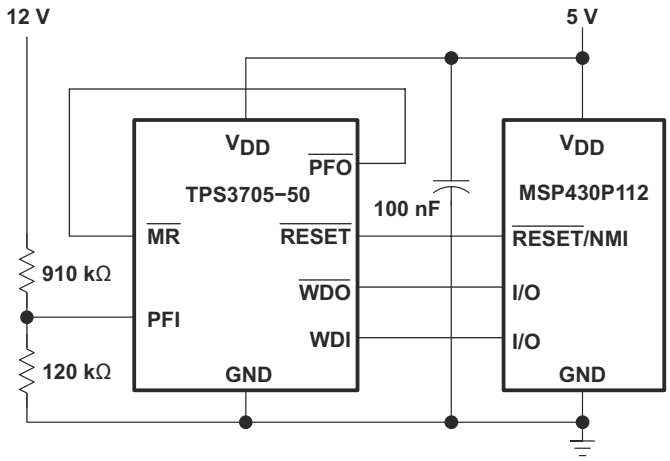
During power-on, $\overline{\text{RESET}}$ is asserted when the supply voltage V_{DD} becomes higher than 1.1 V. Thereafter, the supply voltage supervisor monitors V_{DD} and keeps $\overline{\text{RESET}}$ active as long as V_{DD} remains below the threshold voltage V_{IT+}. When the supply voltage drops below the threshold voltage V_{IT-}, the output becomes active (low) again. No external components are required. All the devices of this family have a fixed-sense threshold voltage V_{IT-} set by an internal voltage divider.

The product spectrum is designed for supply voltages of 2.5 V, 3 V, 3.3 V, and 5 V. The circuits are available in either 8-pin MSOP or standard SOIC packages. The TPS370x-xx devices are characterized for operation over a temperature range of −40°C to 85°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS3705-xx, TPS3707-xx	MSOP-PowerPAD™ (8)	3.00 mm × 3.00 mm
	SOIC (8)	3.90 mm × 4.90 mm

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



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Typical MSP430 Application

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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 E (July 2017) to Revision F (October 2020)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1
• Updated Device Comparison Table by adding -40°C to 125°C for TPS3705-33D	3
• Updated Absolute Maximum Ratings table to include Operating Temperature of -40°C to 125°C for TPS3705-33D	5
• Added TPS3705-33 Electrical Table	8
• Added histograms	11

Changes from Revision D (May 2016) to Revision E (July 2017)	Page
• Updated package body sizes in the *Device Information* table	1

Changes from Revision C (December 2005) to Revision D (May 2016)	Page
• Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section	1

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5 Device Comparison Table

T_A	THRESHOLD VOLTAGE	PACKAGED DEVICES		MARKING DGN PACKAGE	CHIP FORM (Y)
		SMALL OUTLINE (D)	POWER-PAD µ-SMALL OUTLINE (DGN)		
–40°C to 85°C	2.63 V	TPS3705−30D	TPS3705−30DGN	TIAAT	TPS3705-30Y
	4.55 V	TPS3705−50D	TPS3705−50DGN	TIAAV	TPS3705−50Y
	2.25 V	TPS3707−25D	TPS3707−25DGN	TIAAW	TPS3707−25Y
	2.63 V	TPS3707−30D	TPS3707−30DGN	TIAAX	TPS3707−30Y
	2.93 V	TPS3707−33D	TPS3707−33DGN	TIAAY	TPS3707−33Y
	4.55 V	TPS3707−50D	TPS3707−50DGN	TIAAZ	TPS3707−50Y
–40°C to 125°C	2.93 V	TPS3705−33D	TPS3705−33DGN	TIAAU	TPS3705−33Y

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6 Pin Configuration and Functions

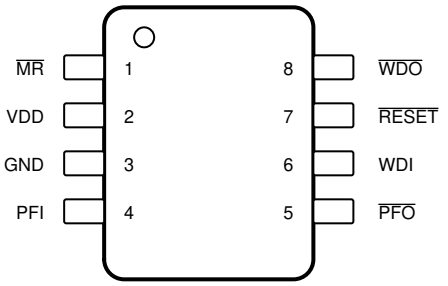

Figure 6-1. TPS3705-xx D Package 8-Pin SOIC Top View

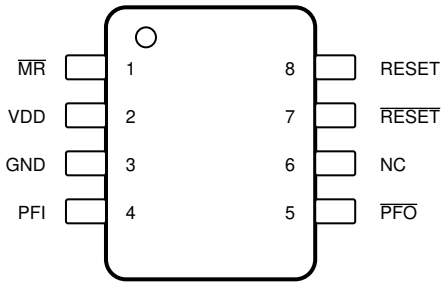

Figure 6-2. TPS3707-xx D Package 8-Pin SOIC Top View

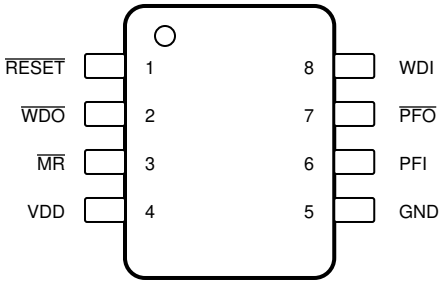

Figure 6-3. TPS3705-xx DGN Package 8-Pin MSOP-PowerPAD Top View

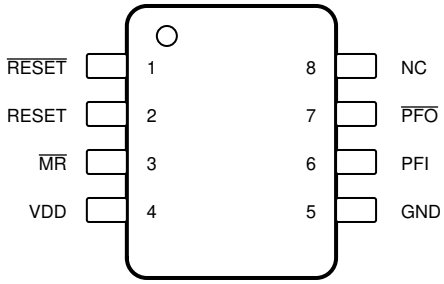

Figure 6-4. TPS3707-xx DGN Package 8-Pin MSOP-PowerPAD Top View

6.1 Pin Functions

PIN					I/O	DESCRIPTION
NAME	TPS3705-xx		TPS3707-xx			
	SOIC	MSOP-PowerPAD	SOIC	MSOP-PowerPAD		
GND	3	5	3	5	—	Ground
$\overline{MR}$	1	3	1	3	I	Manual reset
NC	—	—	6	8	—	No internal connection
PFI	4	6	4	6	I	Power-fail comparator input
$\overline{PFO}$	5	7	5	7	O	Power-fail comparator output
$\overline{RESET}$	7	1	7	1	O	Active-low reset output
RESET	—	—	8	2	O	Active-high reset output
V_{DD}	2	4	2	4	—	Supply voltage
WDI	6	8	—	—	I	Watchdog timer input
$\overline{WDO}$	8	2	—	—	O	Watchdog timer output

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7 Specifications

7.1 Absolute Maximum Ratings

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

	MIN	MAX	UNIT
Supply voltage, V_{DD} (2)		7	V
PFI voltage range, V_{PFI}	–0.3	V_{DD} + 0.3	V
All other pins(2)	–0.3	7	V
Maximum low output current, I_{OL}		5	mA
Maximum high output current, I_{OH}		–5	mA
Input clamp current, I_{IK} (V_I < 0 or V_I > V_{DD})		±20	mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{DD})		±20	mA
Continuous total power dissipation	See *Section 7.9*		
Soldering temperature		260	°C
Operating temperature, T_A	–40	85	°C
Operating temperature, T_A for TPS3705-33 only	–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 voltage values are with respect to GND. For reliable operation the device must not be operated at 7 V for more than t = 1000h continuously.

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 JEDEC specification JESD22-C101(2)	±500	

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

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

7.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
V_{DD}	Supply voltage	2		6	V
V_I	Input voltage	0		V_{DD} + 0.3	V
V_{IH}	High-level input voltage	0.7 × V_{DD}			V
V_{IL}	Low-level input voltage			0.3 × V_{DD}	V
Δt/ΔV	Input transition rise and fall rate at $\overline{MR}$ or WDI			100	ns/V
T_A	Operating free-air temperature	–40		85	°C
T_A	Operating free-air temperature for TPS3705-33 only	–40		125	°C

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7.4 Thermal Information

THERMAL METRIC[1]		TPS3705-xx	TPS3707-xx	UNIT
		D (SOIC)	DGN (MSOP-PowerPAD)	
		8 PINS	8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	118.2	66.1	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	64.4	62.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	58.5	45.1	°C/W
ψ_{JT}	Junction-to-top characterization parameter	15.8	7.6	°C/W
ψ_{JB}	Junction-to-board characterization parameter	57.9	44.8	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	18.5	°C/W

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

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7.5 Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	TPS370x-xx, V_{DD} = 1.1 V, I_{OH} = –4 µA	0.8			V
		TPS3707-25, TPS370x-30, TPS370x-33, $V_{DD} = V_{IT+} + 0.2$ V, I_{OH} = –500 µA	0.7 × V_{DD}			
		TPS370x-50, $V_{DD} = V_{IT+} + 0.2$ V, I_{OH} = –800 µA	V_{DD} – 1.5			
		TPS370x-xx, V_{DD} = 6 V, I_{OH} = –800 µA	V_{DD} – 1.5			
V_{OL}	Low-level output voltage	TPS3707-25, TPS370x-30, TPS370x-33, $V_{DD} = V_{IT+} + 0.2$ V, I_{OL} = 1 mA			0.3	V
		TPS370x-50, $V_{DD} = V_{IT+} + 0.2$ V, I_{OL} = 2.5 mA			0.4	
		TPS370x-xx, V_{DD} = 6 V, I_{OL} = 3 mA			0.4	
	Power-up reset voltage(1)	$V_{DD} \geq 1.1$ V, I_{OL} = 50 µA			0.3	V
$V_{IT–}$	Negative-going input threshold voltage(2)	TPS3707-25, T_A = 0°C to 85°C	2.2	2.25	2.3	V
		TPS370x-30, T_A = 0°C to 85°C	2.57	2.63	2.68	
		TPS370x-33, T_A = 0°C to 85°C	2.87	2.93	2.98	
		TPS370x-50, T_A = 0°C to 85°C	4.45	4.55	4.63	
		TPS3707-25, T_A = –40°C to 85°C	2.2	2.25	2.32	
		TPS370x-30, T_A = –40°C to 85°C	2.57	2.63	2.7	
		TPS370x-33, T_A = –40°C to 85°C	2.87	2.93	3	
		TPS370x-50, T_A = –40°C to 85°C	4.45	4.55	4.65	
	Negative-going input threshold voltage, PFI(2)	TPS370x-xx, $V_{DD} \geq 2$ V, T_A = –40°C to 85°C	1.2	1.25	1.3	
V_{hys}	Hysteresis, V_{DD}	TPS3707-25		40		mV
		TPS370x-30		50		
		TPS370x-33		50		
		TPS370x-50		70		
	Hysteresis, PFI	TPS370x-xx		10		
$I_{IH(AV)}$	Average high-level input current, WDI	WDI = V_{DD} = 6 V, time average (dc = 88%)		100	150	µA
$I_{IL(AV)}$	Average low-level input current, WDI	WDI = 0 V, V_{DD} = 6 V, time average (dc = 12%)		–15	–20	µA
I_{IH}	High-level input current, WDI	WDI = V_{DD} = 6 V		120	170	µA
	High-level input current, $\overline{MR}$	$\overline{MR}$ = 0.7 × V_{DD}, V_{DD} = 6 V		–130	–180	
I_{IL}	Low-level input current, WDI	WDI = 0 V, V_{DD} = 6 V		–120	–170	µA
	Low-level input current, $\overline{MR}$	$\overline{MR}$ = 0 V, V_{DD} = 6 V		–430	–600	
I_I	Input current, PFI	V_{DD} = 6 V, 0 V ≤ V_I ≤ V_{DD}	–1	0	1	µA
I_{DD}	Supply current	TPS3705-xx, V_{DD} = 2 V to 6 V, $\overline{MR}$ = V_{DD}, $\overline{MR}$, WDI and outputs unconnected		30	50	µA
		TPS3707-xx, V_{DD} = 2 V to 6 V, $\overline{MR}$ = V_{DD}, $\overline{MR}$, WDI and outputs unconnected		20	50	
C_i	Input capacitance	V_I = 0 V to V_{DD}		5		pF

(1) The lowest supply voltage at which $\overline{RESET}$ becomes active, $t_{r,VDD} \geq 15$ µs/V

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

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7.6 Electrical Characteristics for TPS3705-33 Only

over operating free-air temperature range -40 to 125C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OH}	High-level output voltage	V_{DD} = 1.1 V, I_{OH} = –4 µA	0.8			V
		V_{DD} = V_{IT+} + 0.2 V, I_{OH} = –500 µA	0.7 × V_{DD}			
		V_{DD} = 6 V, I_{OH} = –800 µA	V_{DD} – 1.5			
V_{OL}	Low-level output voltage	V_{DD} = V_{IT+} + 0.2 V, I_{OL} = 1 mA			0.3	V
		V_{DD} = 6 V, I_{OL} = 3 mA			0.4	
	Power-up reset voltage(1)	V_{DD} ≥ 1.1 V, I_{OL} = 50 µA			0.3	V
$V_{IT–}$	Negative-going input threshold voltag	T_A = 0°C to 125°C	2.87	2.93	3	V
		T_A = –40°C to 125°C	2.87	2.93	3.02	
	Negative-going input threshold voltage, PFI(2)	V_{DD} ≥ 2 V	1.2	1.25	1.3	
V_{hys}	Hysteresis, V_{DD}			50		mV
	Hysteresis, PFI			10		
$I_{IH(AV)}$	Average high-level input current, WDI	WDI = V_{DD} = 6 V, time average (dc = 88%)		100	150	µA
$I_{IL(AV)}$	Average low-level input current, WDI	WDI = 0 V, V_{DD} = 6 V, time average (dc = 12%)		–15	–20	µA
I_{IH}	High-level input current, WDI	WDI = V_{DD} = 6 V		120	170	µA
	High-level input current, $\overline{MR}$	$\overline{MR}$ = 0.7 × V_{DD}, V_{DD} = 6 V		–130	–180	
I_{IL}	Low-level input current, WDI	WDI = 0 V, V_{DD} = 6 V		–120	–170	µA
	Low-level input current, $\overline{MR}$	$\overline{MR}$ = 0 V, V_{DD} = 6 V		–430	–600	
I_I	Input current, PFI	V_{DD} = 6 V, 0 V ≤ V_I ≤ V_{DD}	–1	0	1	µA
I_{DD}	Supply current	V_{DD} = 2 V to 6 V, $\overline{MR}$ = V_{DD}, $\overline{MR}$, WDI and outputs unconnected		30	50	µA
C_i	Input capacitance	V_I = 0 V to V_{DD}		5		pF

7.7 Timing Requirements

at R_L = 1 MΩ, C_L = 50 pF, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	NOM	MAX	UNIT
t_w	Pulse width	At V_{DD}, V_{DD} = V_{IT+} + 0.2 V, V_{DD} = $V_{IT–}$ – 0.2 V	6			µs
		At $\overline{MR}$ and WDI, V_{DD} ≥ V_{IT+} + 0.2 V, V_{IL} = 0.3 × V_{DD}, V_{IH} = 0.7 × V_{DD}	100			ns

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7.8 Switching Characteristics

at R_L = 1 MΩ, C_L = 50 pF, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{t(out)}$	Watchdog time out	$V_{DD} \geq V_{IT+}$ + 0.2 V, see Figure 7-1	1.1	1.6	2.3	s
t_d	Delay time	$V_{DD} \geq V_{IT+}$ + 0.2 V, see Figure 7-1	140	200	280	ms
t_{PHL}	Propagation (delay) time, high-to-low-level output	$\overline{MR}$ to $\overline{RESET}$ delay, $V_{DD} \geq V_{IT+}$ + 0.2 V, V_{IL} = 0.3 × V_{DD}, V_{IH} = 0.7 × V_{DD}		50	250	ns
t_{PLH}	Propagation (delay) time, low-to-high-level output	$\overline{MR}$ to RESET delay (TPS3707-xx only) $V_{DD} \geq V_{IT+}$ + 0.2 V, V_{IL} = 0.3 × V_{DD}, V_{IH} = 0.7 × V_{DD}		50	250	ns
t_{PHL}	Propagation (delay) time, high-to-low-level output	V_{DD} to $\overline{RESET}$ delay		3	5	µs
t_{PLH}	Propagation (delay) time, low-to-high-level output	V_{DD} to RESET delay (TPS3707-xx only)		3	5	µs
t_{PHL}	Propagation (delay) time, high-to-low-level output	PFI to $\overline{PFO}$ delay, V_{DD} = 2 V to 6 V		0.5	1	µs
t_{PLH}	Propagation (delay) time, low-to-high-level output	PFI to $\overline{PFO}$ delay, V_{DD} = 2 V to 6 V		0.5	1	µs

7.9 Dissipation Ratings

PACKAGE	T_A < 25°C POWER RATING	DERATING FACTOR ABOVE T_A = 25°C	T_A = 70°C POWER RATING	T_A = 85°C POWER RATING
DGN	2.14 W	17.1 mW/°C	1.37 W	1.11 W
D	725 mW	5.8 mW/°C	464 mW	377 mW

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7.10 Timing Diagram

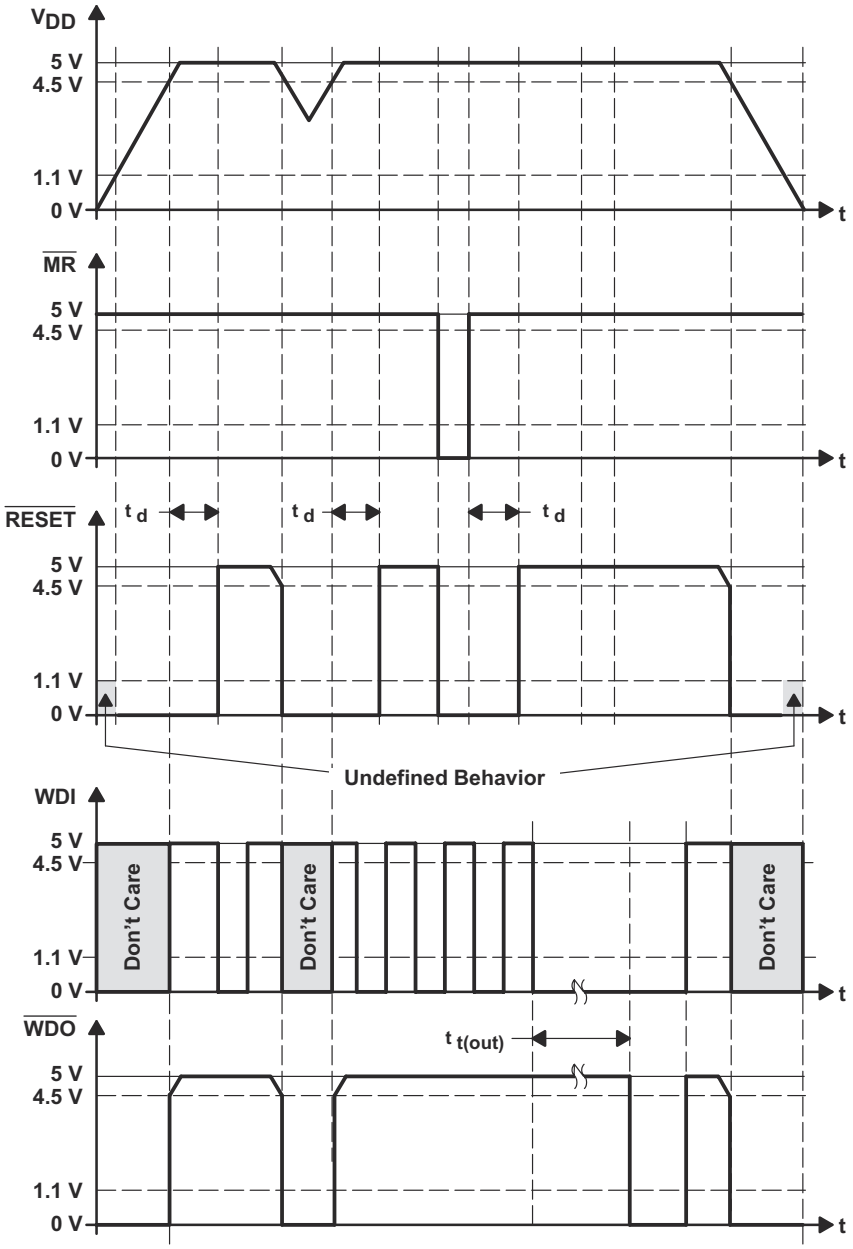

Figure 7-1. Timing Diagrams

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7.11 Typical Characteristics

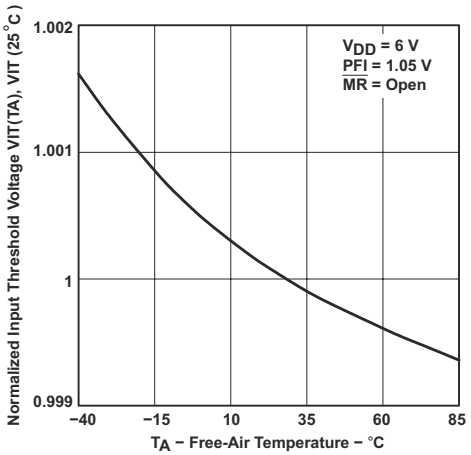

Figure 7-2. Normalized Input Threshold Voltage vs Free-Air Temperature at V_{DD}

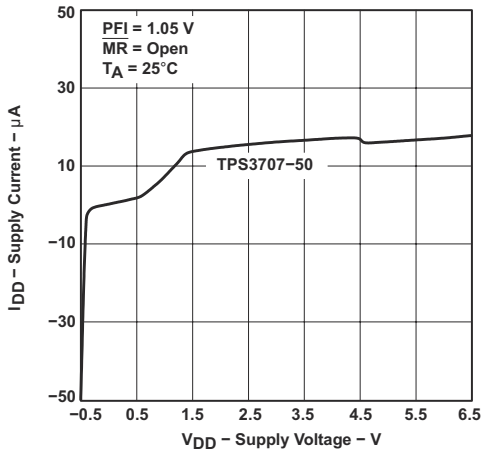

Figure 7-3. Supply Current vs Supply Voltage

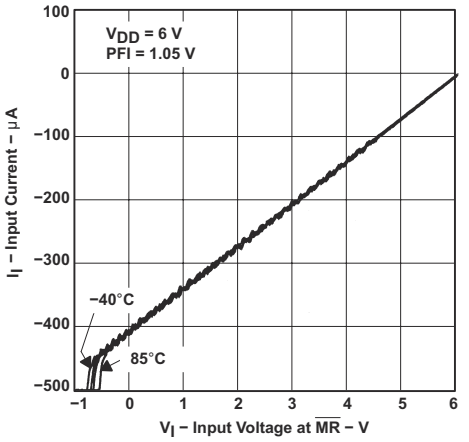

Figure 7-4. Input Current vs Input Voltage at $\overline{MR}$

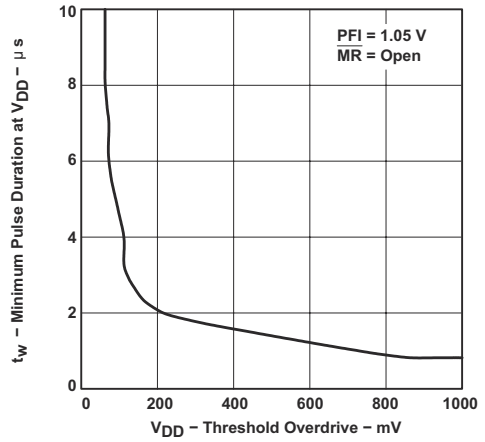

Figure 7-5. Minimum Pulse Duration at V_{DD} vs V_{DD} Threshold Overdrive

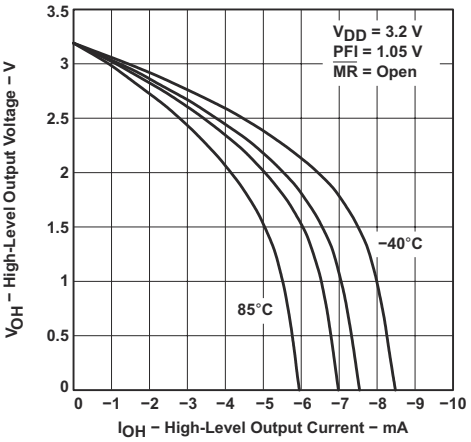

Figure 7-6. High-Level Output Voltage vs High-Level Output Current

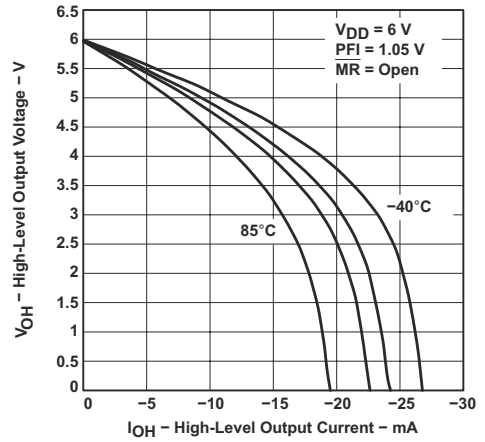

Figure 7-7. High-Level Output Voltage vs High-Level Output Current

7.11 Typical Characteristics (continued)

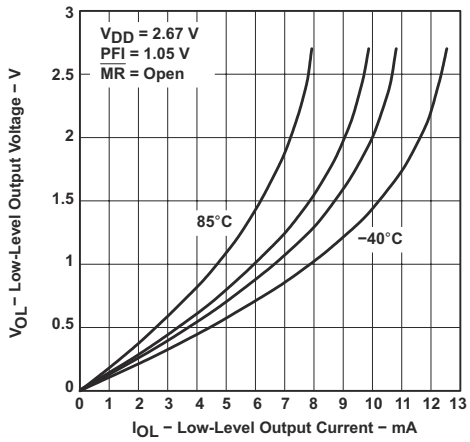

Figure 7-8. Low-Level Output Voltage vs Low-Level Output Current

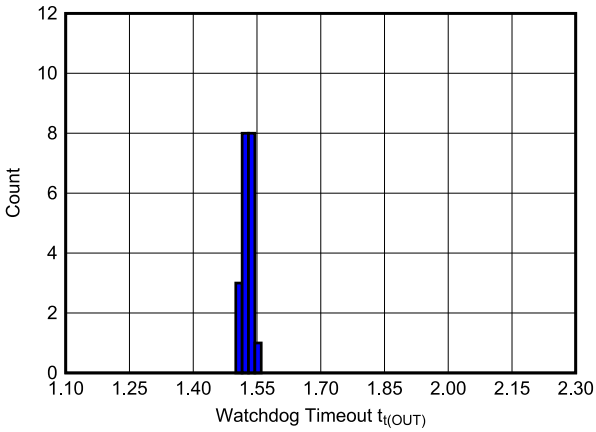

Figure 7-9. Watchdog Timeout Histogram for TSP3705-33 Devices at -40°C (Unit Count = 20)

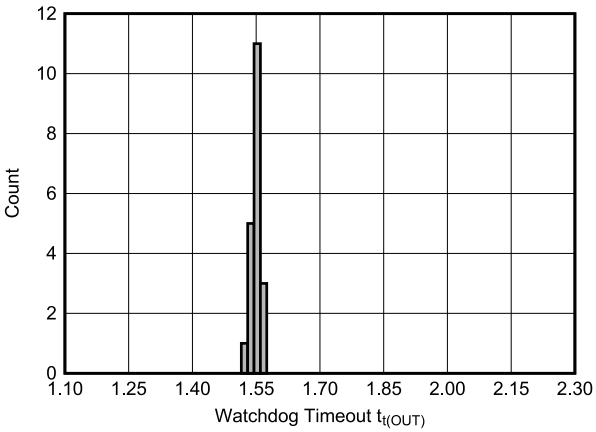

Figure 7-10. Watchdog Timeout Histogram for TSP3705-33 Devices at 25°C (Unit Count = 20)

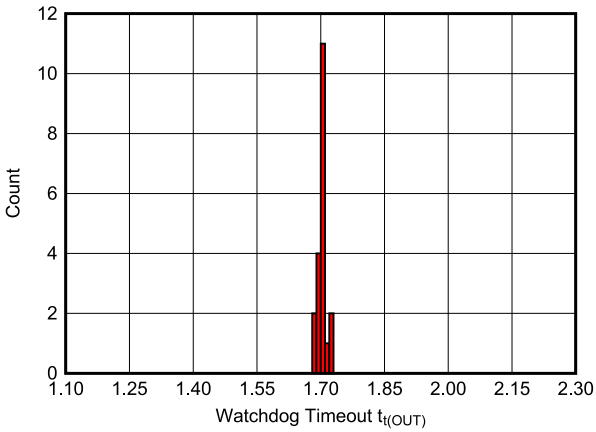

Figure 7-11. Watchdog Timeout Histogram for TSP3705-33 Devices at 125°C (Unit Count = 20)

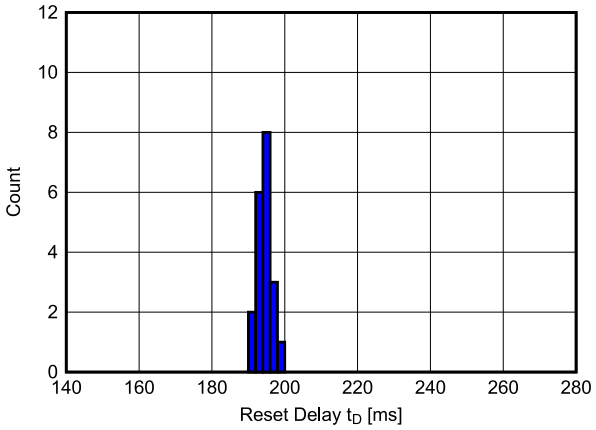

Figure 7-12. Reset Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)

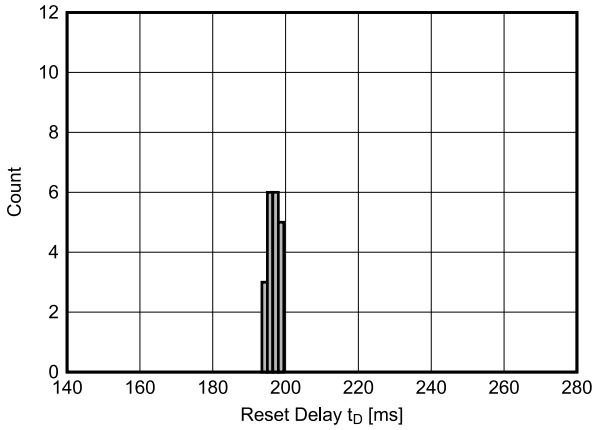

Figure 7-13. Reset Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)

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7.11 Typical Characteristics (continued)

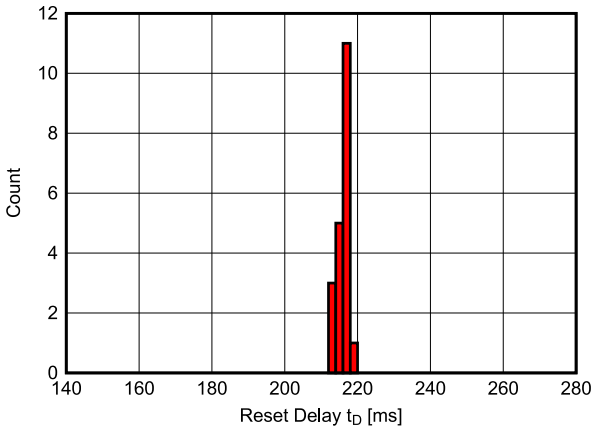

Figure 7-14. Reset Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)

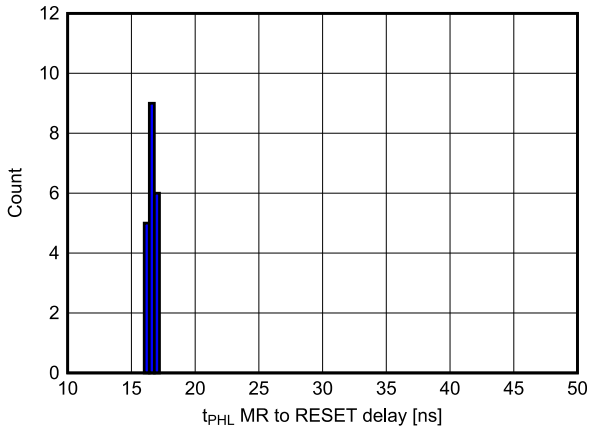

Figure 7-15. $\overline{MR}$ to $\overline{RESET}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)

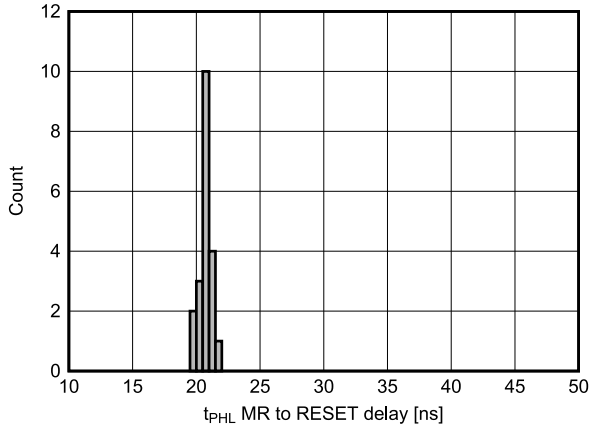

Figure 7-16. $\overline{MR}$ to $\overline{RESET}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)

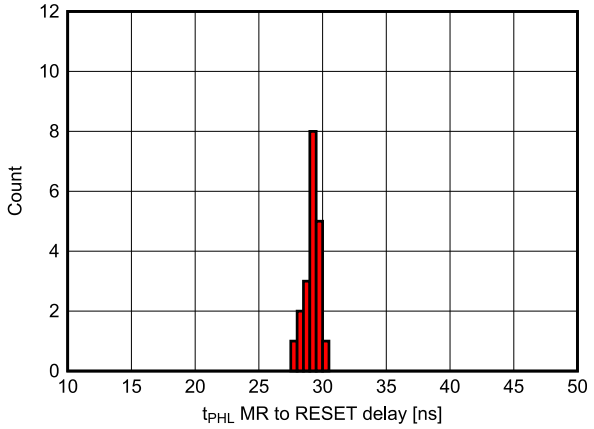

Figure 7-17. $\overline{MR}$ to $\overline{RESET}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)

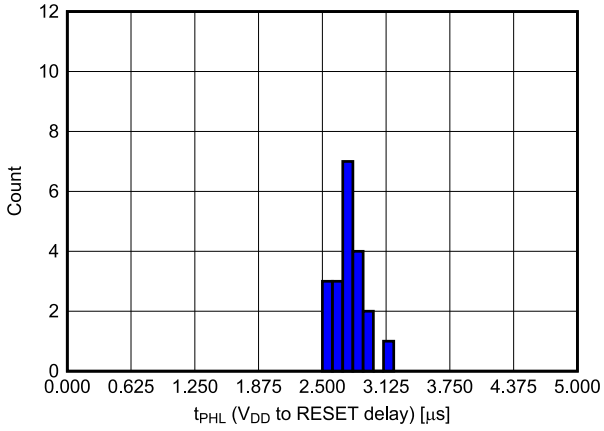

Figure 7-18. V_{DD} to $\overline{RESET}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)

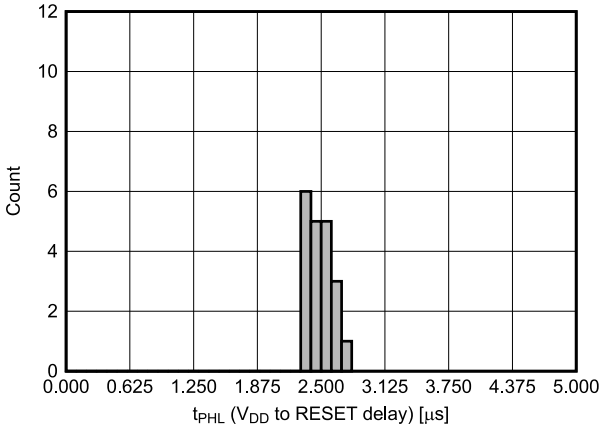

Figure 7-19. V_{DD} to $\overline{RESET}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)

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7.11 Typical Characteristics (continued)

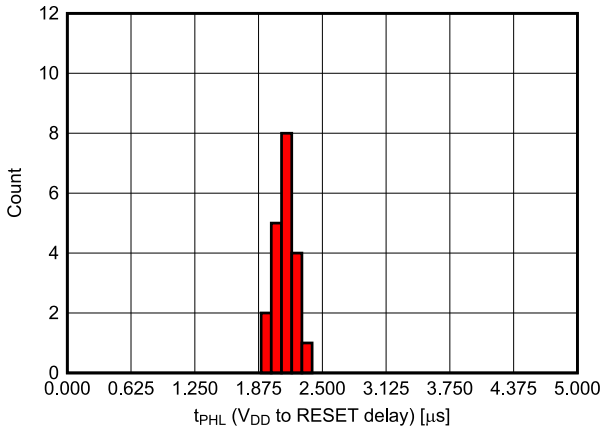

Figure 7-20. V_{DD} to $\overline{RESET}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)

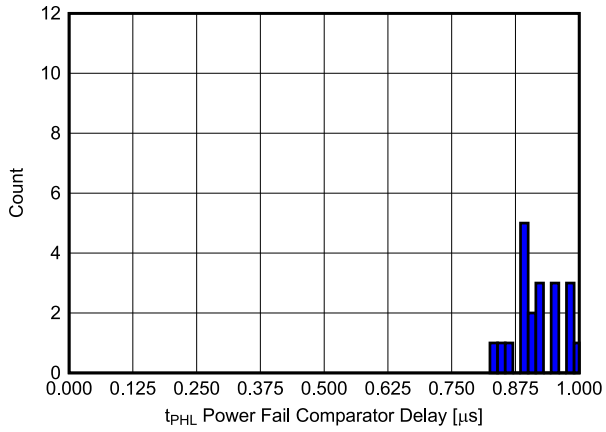

Figure 7-21. PFI to $\overline{PFO}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)

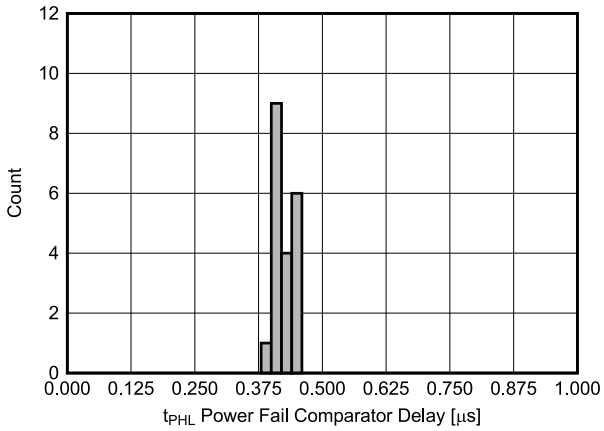

Figure 7-22. PFI to $\overline{PFO}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)

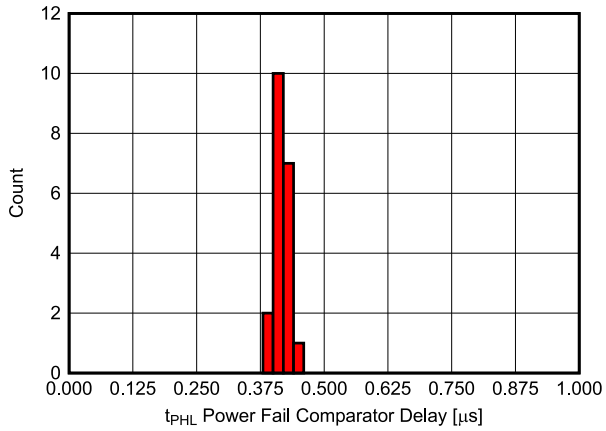

Figure 7-23. PFI to $\overline{PFO}$ (t_{PHL}) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)

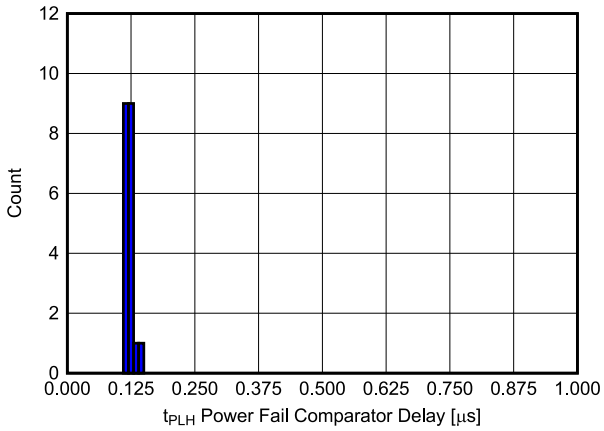

Figure 7-24. PFI to $\overline{PFO}$ (t_{PLH}) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)

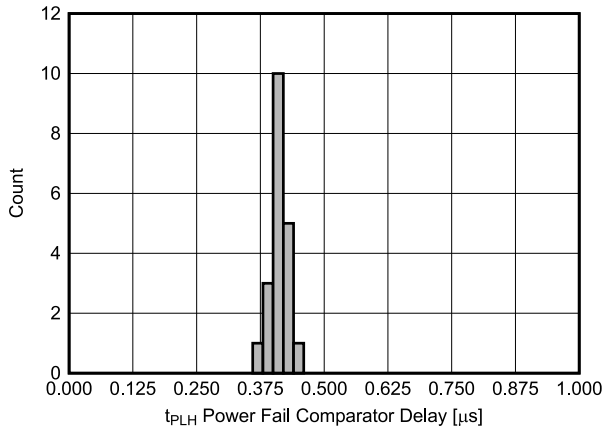

Figure 7-25. PFI to $\overline{PFO}$ (t_{PLH}) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)

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7.11 Typical Characteristics (continued)

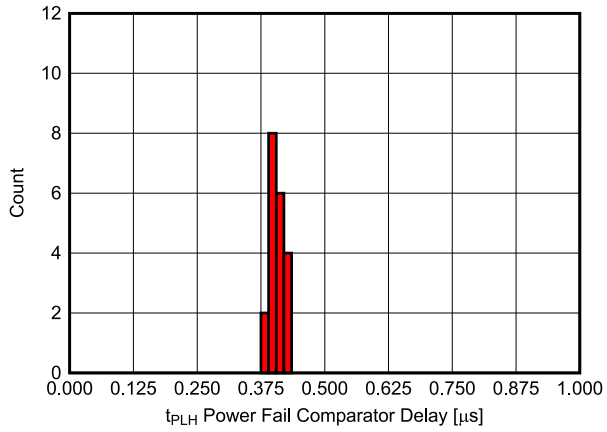


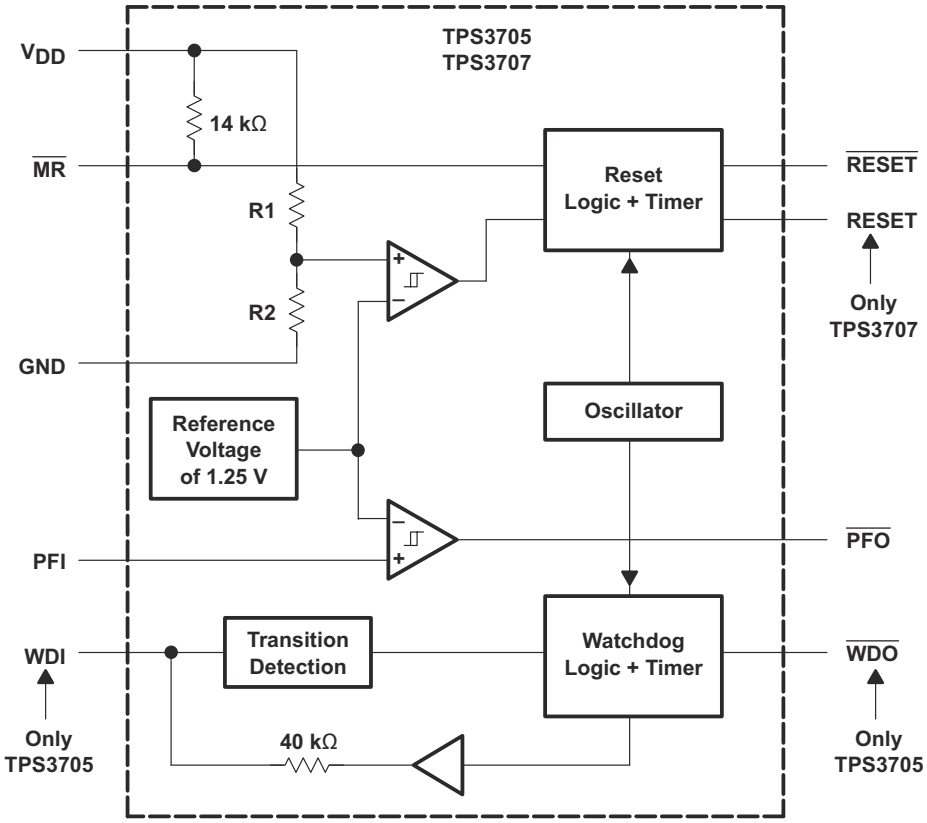
Figure 7-26. PFI to $\overline{PFO}$ (t_{PLH}) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)

8 Detailed Description

8.1 Overview

The TPS370x-xx family of supervisors feature an integrated reference and comparator for V_{DD} supervision, an additional power-fail supervisor, and a manual reset input. The TPS3705-xx devices feature a watchdog timer, where the TPS3707-xx devices feature a complimentary RESET output.

8.2 Functional Block Diagram



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8.3 Feature Description

8.3.1 Manual Reset Input

The TPS370x-xx devices incorporate a manual reset input, $\overline{MR}$. A low level at $\overline{MR}$ causes $\overline{RESET}$ to become active.

8.3.2 Power-Fail Comparator

The TPS370x-xx family integrates a power-fail comparator which can be used for low-battery detection, power-fail warning, or for monitoring a power supply other than the main supply.

8.3.3 Watchdog Timer

The TPS3705-xx devices have a watchdog timer that is periodically triggered by a positive or negative transition at WDI. When the supervising system fails to retrigger the watchdog circuit within the timeout interval, $t_{t(out)}$ = 1.6 s, $\overline{WDO}$ becomes active. This event also reinitializes the watchdog timer. Leaving WDI unconnected disables the watchdog.

The TPS3707-xx devices do not have the watchdog function, but include a high-level output RESET.

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8.4 Device Functional Modes

8.4.1 V_{DD} < 1.1 V

When V_{DD} is less than 1.1 V, the status of the outputs cannot be determined.

8.4.2 1.1 V < V_{DD} ≤ 2 V

When V_{DD} is greater than 1.1 V but less than 2 V, the output states are valid. However, the specifications in *Section 7.5* do not apply.

8.4.3 2 V < V_{DD} < 6 V

When V_{DD} is greater than 2 V but less than 6 V, the device is within the recommended operating conditions (see *Section 7.3*). See Table 8-1, Table 8-2, and Table 8-3 for corresponding truth tables.

Table 8-1. TPS3705 Truth Table

$\overline{MR}$	$V_{DD} > V_{IT}$	$\overline{RESET}$	TYPICAL DELAY
H → L	1	H → L	30 ns
L → H	1	L → H	200 ms
H	1 → 0	H → L	3 µs
H	0 → 1	L → H	200 ms

Table 8-2. TPS3707 Truth Table

$\overline{MR}$	$V_{DD} > V_{IT}$	$\overline{RESET}$	RESET	TYPICAL DELAY
H → L	1	H → L	L → H	30 ns
L → H	1	L → H	H → L	200 ms
H	1 → 0	H → L	L → H	3 µs
H	0 → 1	L → H	H → L	200 ms

Table 8-3. TPS370x Truth Table

PFI > V_{IT}	$\overline{PFO}$	TYPICAL DELAY
0 → 1	L → H	0.5 µs
1 → 0	H → L	0.5 µs

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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. Customers should validate and test their design implementation to confirm system functionality.

9.1 Application Information

The TPS370x-xx family of devices offers several options for power monitoring. The TPS3705-xx offers a watchdog supervisor, V_{DD} rail monitoring, and a power-fail interrupt monitor. The TPS3707-xx offers V_{DD} rail monitoring with complimentary outputs and a power-fail interrupt monitor.

9.2 Typical Application

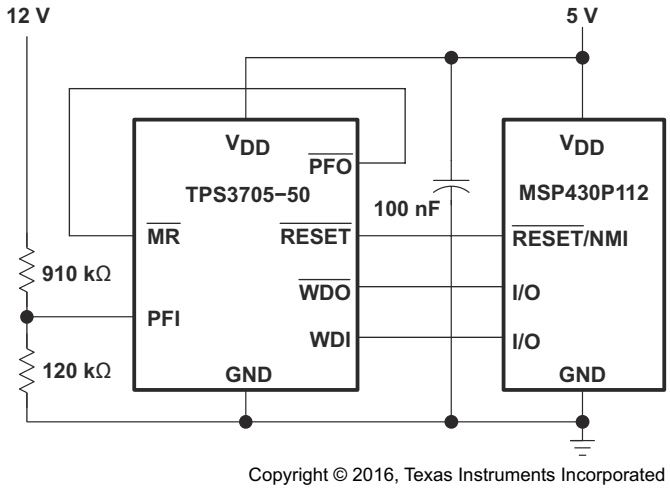

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Figure 9-1. Typical MSP430 Application

9.2.1 Design Requirements

Table 9-1 lists the required design parameters for Figure 9-1.

Table 9-1. Application Parameters

DESIGN PARAMETER	VALUE
Monitored voltage 1	5 V
Monitored voltage 2	12 V

9.2.2 Detailed Design Procedure

To create two voltage monitoring rails, the PFI input can be used along with the MR pin to create a single output. The 5-V monitor is created by selecting a 5-V device option, giving threshold of 4.55 V. The PFI input is configured to any adjustable rail with a voltage divider. Use Equation 1 to select resistors.

$$V_{TH} = \frac{R_1 + R_2}{R_2} \times V_{IT-} = \frac{910\,k + 120\,k}{120\,k} \times 1.25 = 10.73\ V \quad (1)$$

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9.2.3 Application Curves

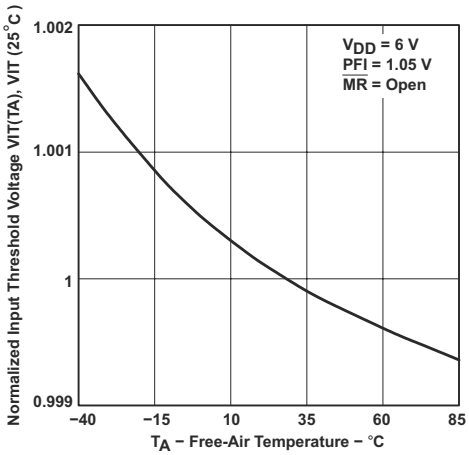

Figure 9-2. Normalized Input Threshold Voltage vs Free-Air Temperature at V_{DD}

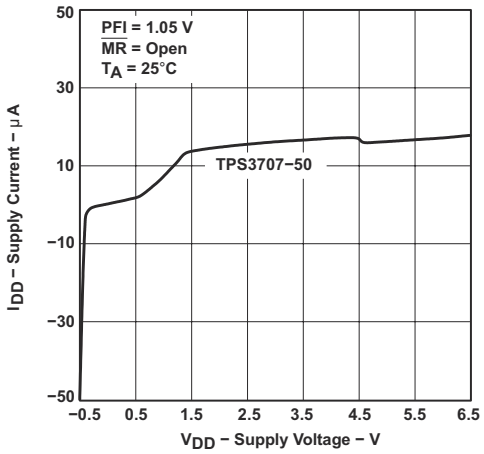

Figure 9-3. Supply Current vs Supply Voltage

10 Power Supply Recommendations

These devices are designed to operate from an input supply with a voltage range from 2 V to 6 V.

11 Layout

11.1 Layout Guidelines

Place a 0.1-µF decoupling capacitor as close to the device as possible.

If a resistor divider is used, place the resistors as close to the device as possible to minimize noise coupling.

11.2 Layout Example

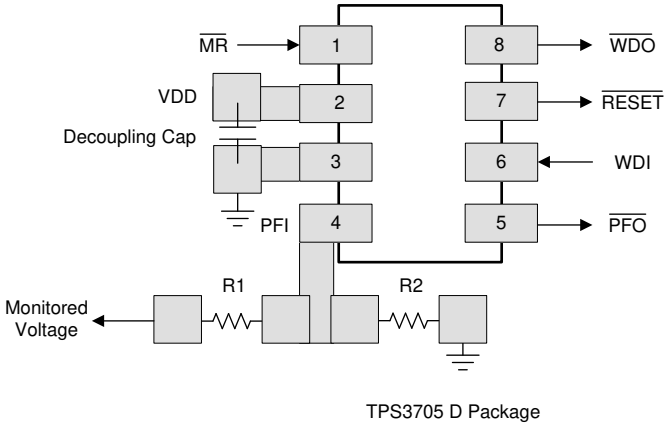

Figure 11-1. TPS3705 Layout

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12 Device and Documentation Support

12.1 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.

12.2 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.

Linked content is 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.

12.3 Trademarks

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All other trademarks are the property of their respective owners.

12.4 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.

12.5 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 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
TPS3705-30D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70530	Samples
TPS3705-30DGN	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAT	Samples
TPS3705-30DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70530	Samples
TPS3705-33D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	70533	Samples
TPS3705-33DG4	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	70533	Samples
TPS3705-33DGN	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAU	Samples
TPS3705-33DGNR	ACTIVE	HVSSOP	DGN	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAU	Samples
TPS3705-33DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 125	70533	Samples
TPS3705-50D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70550	Samples
TPS3705-50DG4	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70550	Samples
TPS3705-50DGN	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAV	Samples
TPS3705-50DGNG4	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAV	Samples
TPS3705-50DGNR	ACTIVE	HVSSOP	DGN	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAV	Samples
TPS3705-50DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70550	Samples
TPS3705-50DRG4	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70550	Samples
TPS3707-25D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70725	Samples
TPS3707-25DGN	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAW	Samples
TPS3707-25DGNR	ACTIVE	HVSSOP	DGN	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAW	Samples
TPS3707-25DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70725	Samples
TPS3707-30D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70730	Samples

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
TPS3707-30DGN	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAX	Samples
TPS3707-30DGNR	ACTIVE	HVSSOP	DGN	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAX	Samples
TPS3707-30DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70730	Samples
TPS3707-33D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70733	Samples
TPS3707-33DGN	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAY	Samples
TPS3707-33DGNR	ACTIVE	HVSSOP	DGN	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAY	Samples
TPS3707-33DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70733	Samples
TPS3707-50D	ACTIVE	SOIC	D	8	75	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70750	Samples
TPS3707-50DGN	ACTIVE	HVSSOP	DGN	8	80	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAZ	Samples
TPS3707-50DGNR	ACTIVE	HVSSOP	DGN	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	AAZ	Samples
TPS3707-50DR	ACTIVE	SOIC	D	8	2500	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-40 to 85	70750	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

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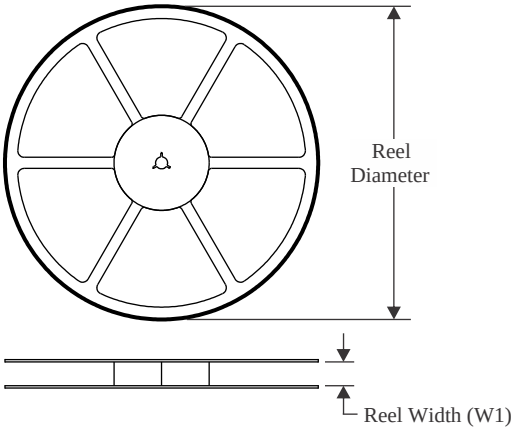
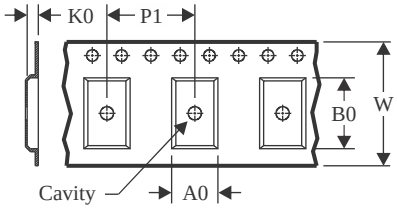
TAPE AND REEL INFORMATION

REEL DIMENSIONS

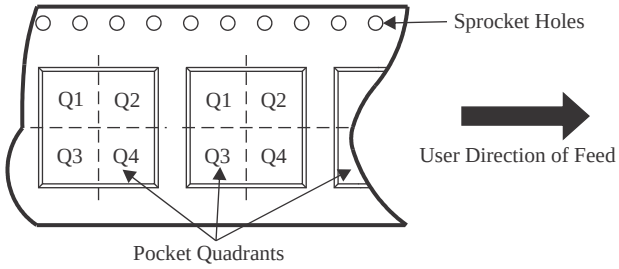


TAPE DIMENSIONS



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

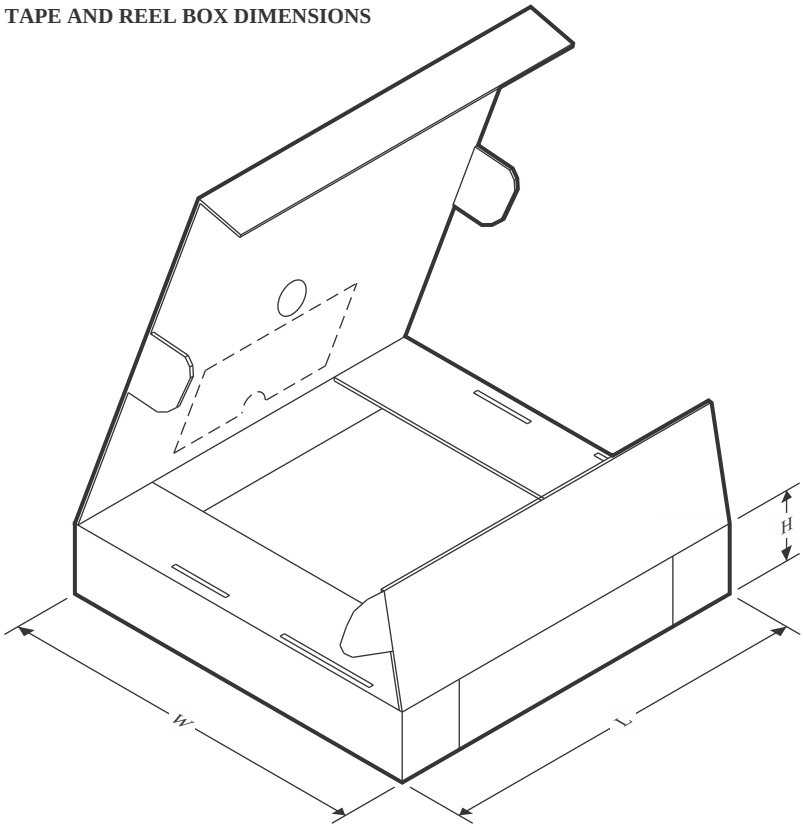
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS3705-30DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TPS3705-33DGNR	HVSSOP	DGN	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS3705-33DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TPS3705-50DGNR	HVSSOP	DGN	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS3705-50DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TPS3707-25DGNR	HVSSOP	DGN	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS3707-25DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TPS3707-30DGNR	HVSSOP	DGN	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS3707-30DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TPS3707-33DGNR	HVSSOP	DGN	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS3707-33DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1
TPS3707-50DGNR	HVSSOP	DGN	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS3707-50DR	SOIC	D	8	2500	330.0	12.4	6.4	5.2	2.1	8.0	12.0	Q1

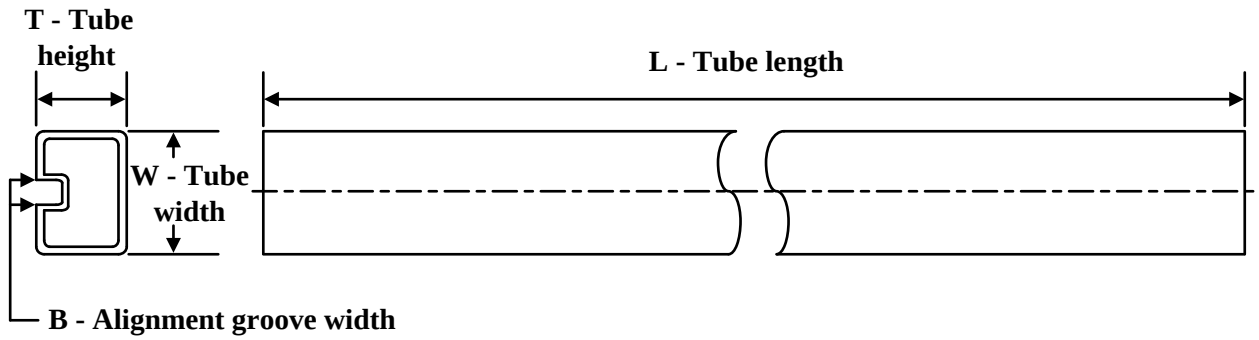
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS3705-30DR	SOIC	D	8	2500	350.0	350.0	43.0
TPS3705-33DGNR	HVSSOP	DGN	8	2500	358.0	335.0	35.0
TPS3705-33DR	SOIC	D	8	2500	350.0	350.0	43.0
TPS3705-50DGNR	HVSSOP	DGN	8	2500	358.0	335.0	35.0
TPS3705-50DR	SOIC	D	8	2500	350.0	350.0	43.0
TPS3707-25DGNR	HVSSOP	DGN	8	2500	358.0	335.0	35.0
TPS3707-25DR	SOIC	D	8	2500	350.0	350.0	43.0
TPS3707-30DGNR	HVSSOP	DGN	8	2500	358.0	335.0	35.0
TPS3707-30DR	SOIC	D	8	2500	356.0	356.0	35.0
TPS3707-33DGNR	HVSSOP	DGN	8	2500	358.0	335.0	35.0
TPS3707-33DR	SOIC	D	8	2500	350.0	350.0	43.0
TPS3707-50DGNR	HVSSOP	DGN	8	2500	358.0	335.0	35.0
TPS3707-50DR	SOIC	D	8	2500	350.0	350.0	43.0

TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
TPS3705-30D	D	SOIC	8	75	505.46	6.76	3810	4
TPS3705-30D	D	SOIC	8	75	506.6	8	3940	4.32
TPS3705-33D	D	SOIC	8	75	505.46	6.76	3810	4
TPS3705-33DG4	D	SOIC	8	75	505.46	6.76	3810	4
TPS3705-50D	D	SOIC	8	75	505.46	6.76	3810	4
TPS3705-50DG4	D	SOIC	8	75	505.46	6.76	3810	4
TPS3707-25D	D	SOIC	8	75	505.46	6.76	3810	4
TPS3707-30D	D	SOIC	8	75	506.6	8	3940	4.32
TPS3707-30D	D	SOIC	8	75	505.46	6.76	3810	4
TPS3707-33D	D	SOIC	8	75	505.46	6.76	3810	4
TPS3707-50D	D	SOIC	8	75	505.46	6.76	3810	4

GENERIC PACKAGE VIEW

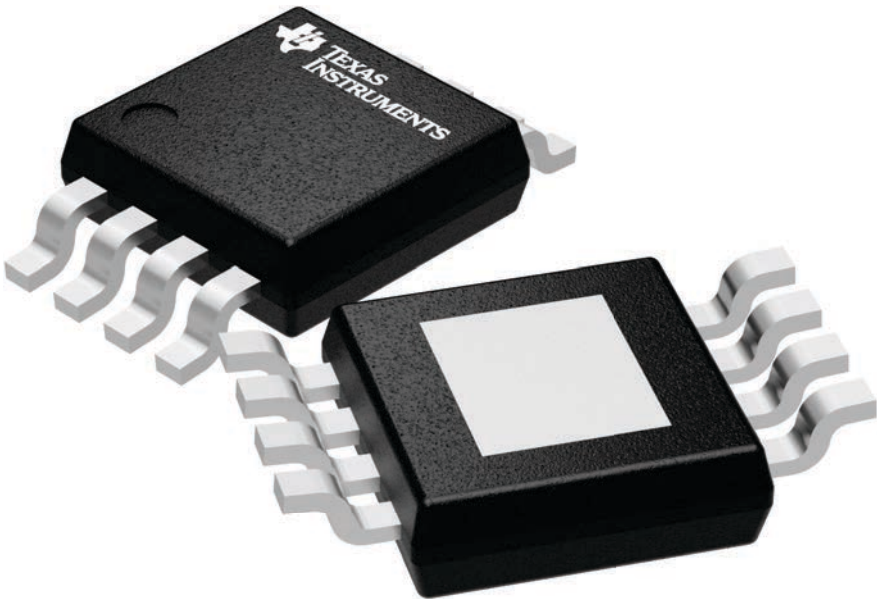
DGN 8

PowerPAD VSSOP - 1.1 mm max height

3 x 3, 0.65 mm pitch

SMALL OUTLINE PACKAGE

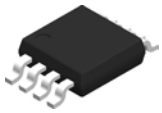
This image is a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.



4225482/A

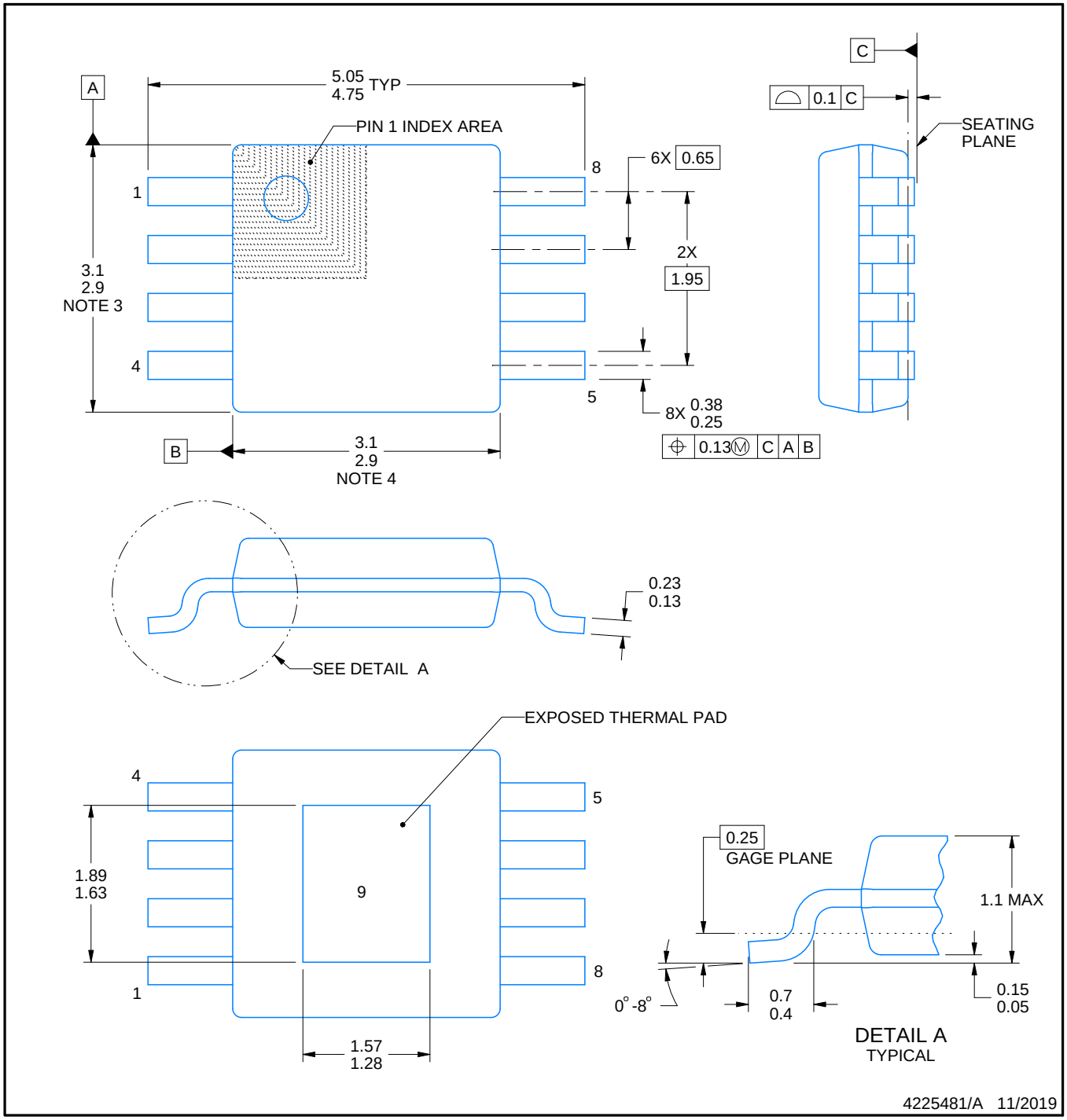
PACKAGE OUTLINE

DGN0008D



PowerPAD™ VSSOP - 1.1 mm max height

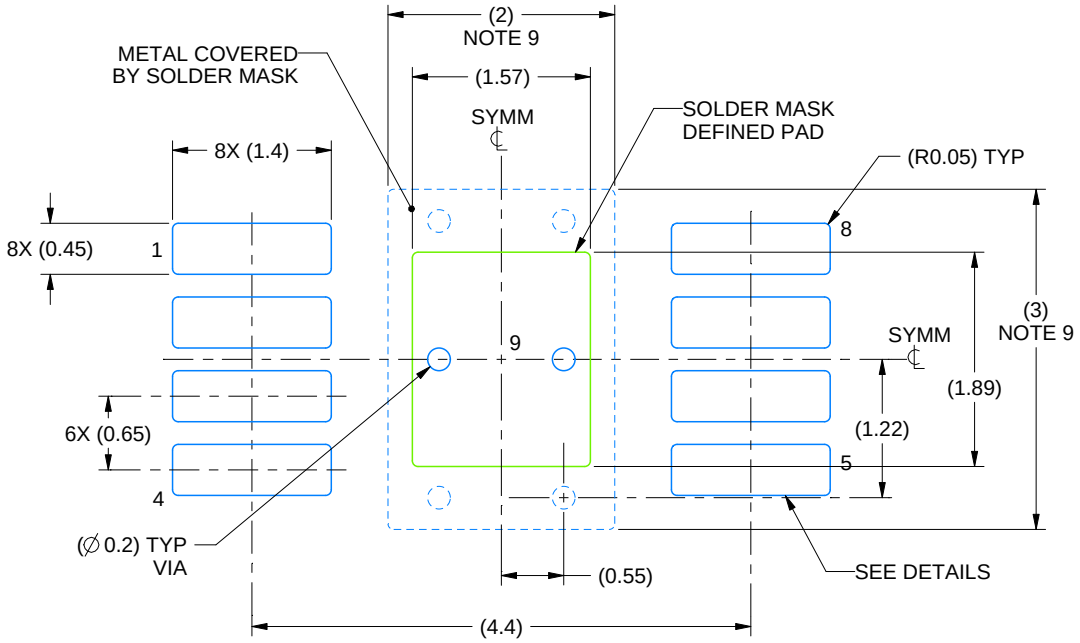
SMALL OUTLINE PACKAGE



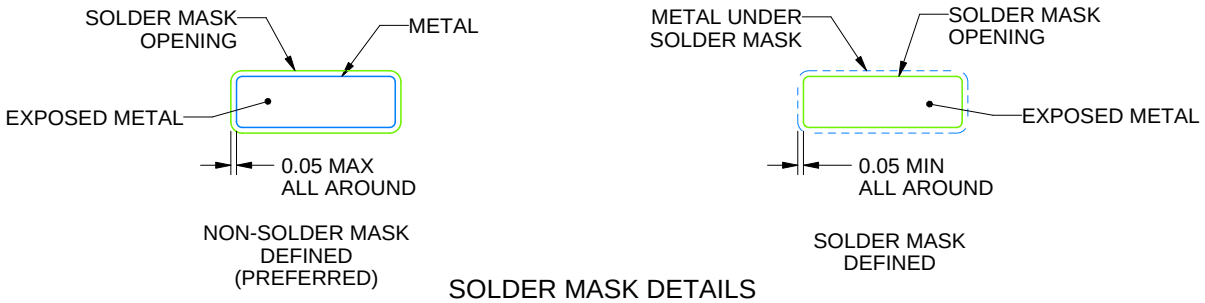
PowerPAD is a trademark of Texas Instruments.

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.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X

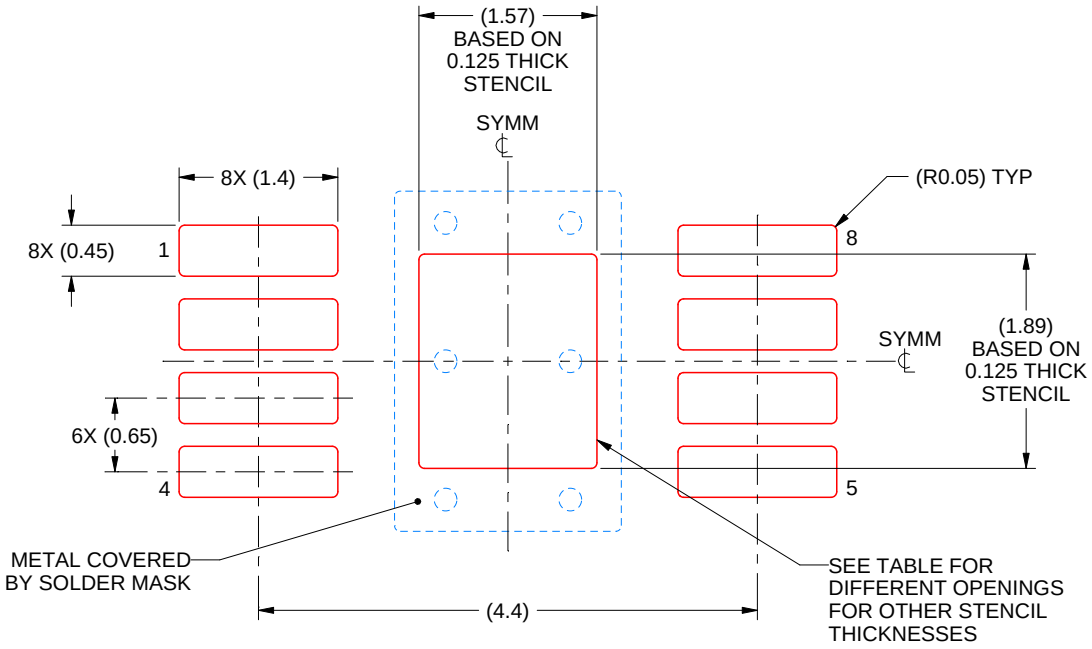


SOLDER MASK DETAILS

4225481/A 11/2019

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.



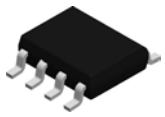
SOLDER PASTE EXAMPLE
EXPOSED PAD 9:
100% PRINTED SOLDER COVERAGE BY AREA
SCALE: 15X

STENCIL THICKNESS	SOLDER STENCIL OPENING
0.1	1.76 X 2.11
0.125	1.57 X 1.89 (SHOWN)
0.15	1.43 X 1.73
0.175	1.33 X 1.60

4225481/A 11/2019

NOTES: (continued)

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

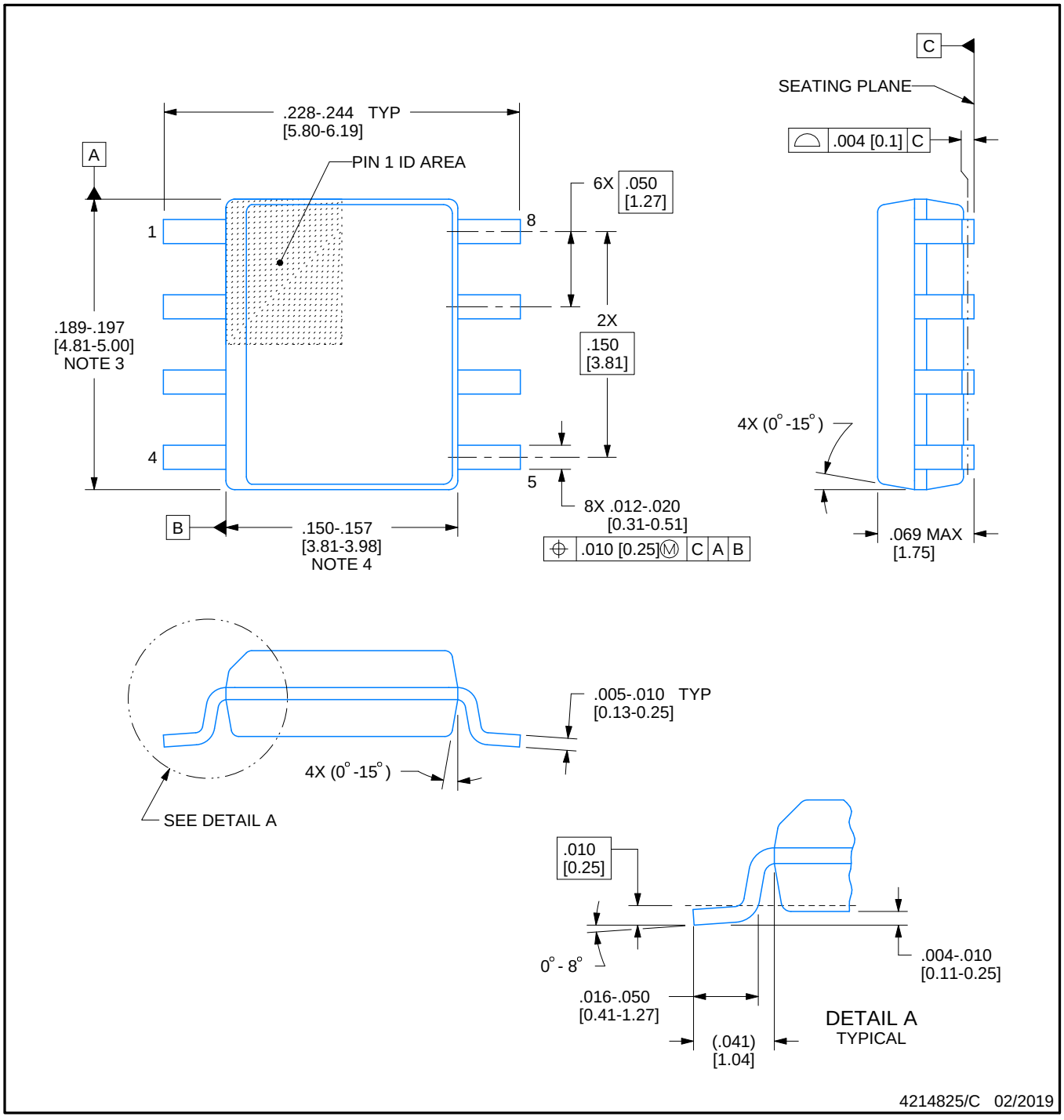


PACKAGE OUTLINE

D0008A

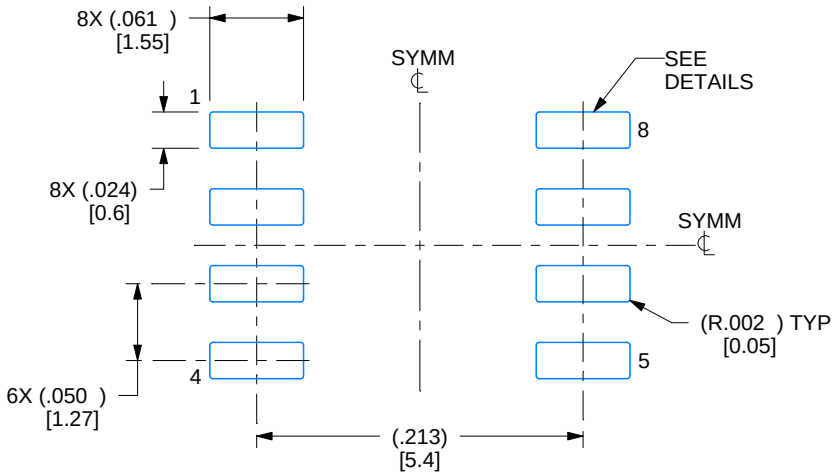
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

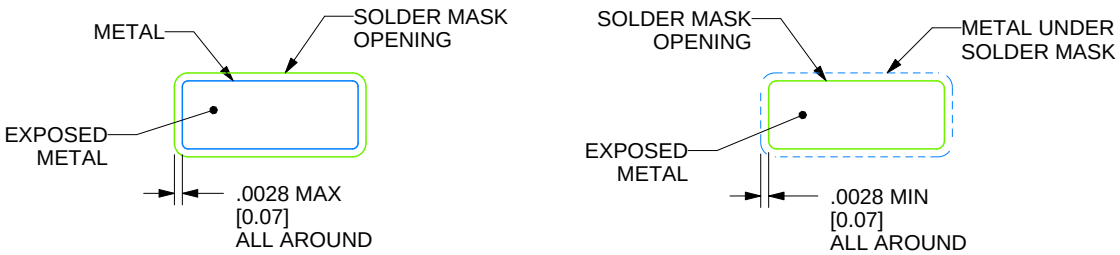


NOTES:

1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 [0.15] per side.
4. This dimension does not include interlead flash.
5. Reference JEDEC registration MS-012, variation AA.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X



SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

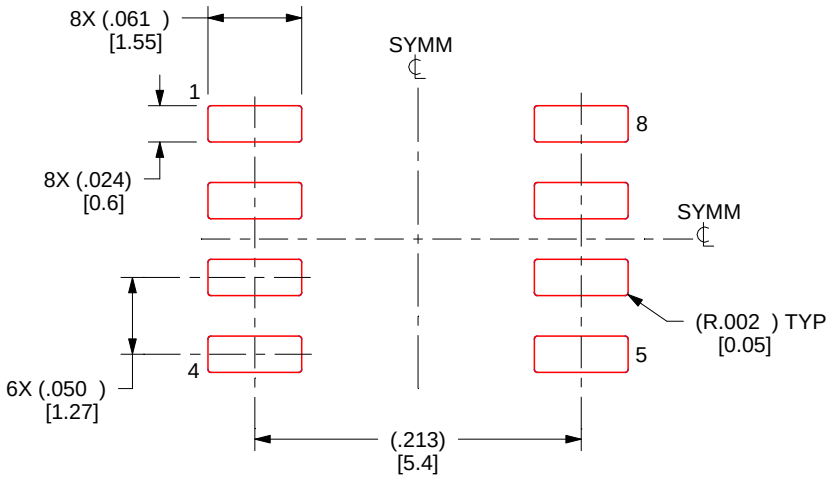
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

EXAMPLE STENCIL DESIGN

D0008A

SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT



SOLDER PASTE EXAMPLE
BASED ON .005 INCH [0.125 MM] THICK STENCIL
SCALE:8X

4214825/C 02/2019

NOTES: (continued)

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

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