# 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.

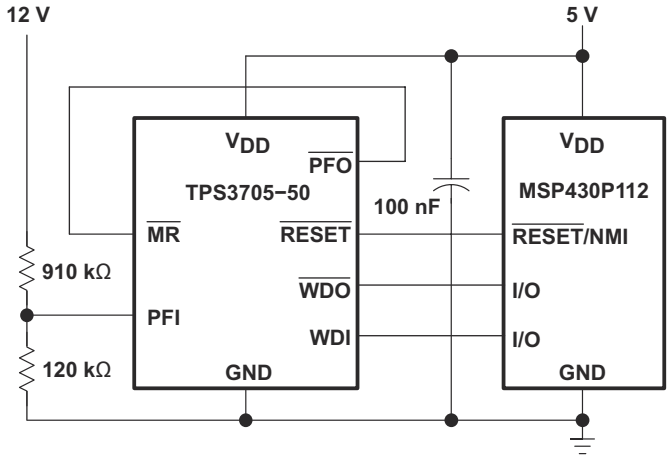
During power-on, $\overline{\text{RESET}}$ is asserted when the supply voltage $V_{DD}$ becomes higher than 1.1 V. Thereafter, the supply voltage supervisor monitors $V_{DD}$ and keeps $\overline{\text{RESET}}$ active as long as $V_{DD}$ remains below the threshold voltage $V_{IT+}$. When the supply 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.






**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 |

## 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 |

# 6 Pin Configuration and Functions

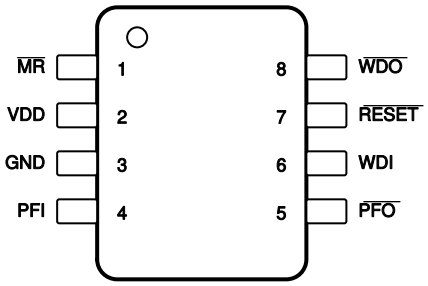



**Figure 6-1. TPS3705-xx D Package 8-Pin SOIC Top View**

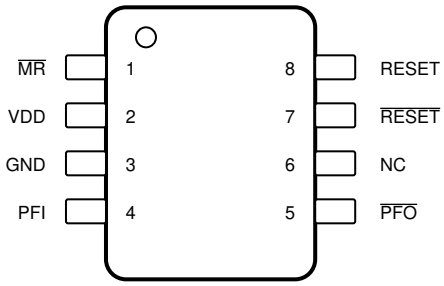



**Figure 6-2. TPS3707-xx D Package 8-Pin SOIC Top View**

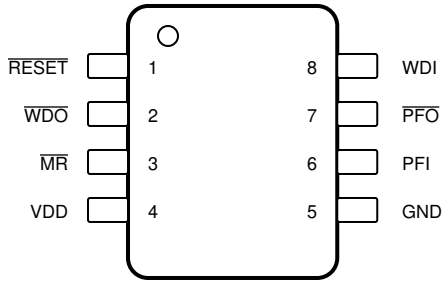



**Figure 6-3. TPS3705-xx DGN Package 8-Pin MSOP-PowerPAD Top View**

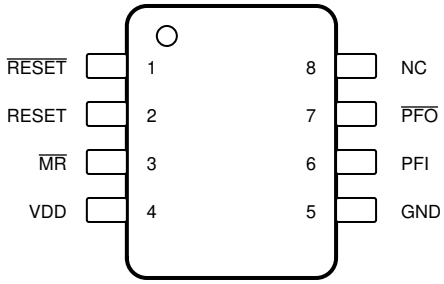



**Figure 6-4. TPS3707-xx DGN Package 8-Pin MSOP-PowerPAD Top View**

## 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 |

# 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 |

## 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 |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 15.8 | 7.6 | °C/W |
| $\psi_{JB}$ | 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.

## 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

## 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 |

## 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 |

## 7.10 Timing Diagram

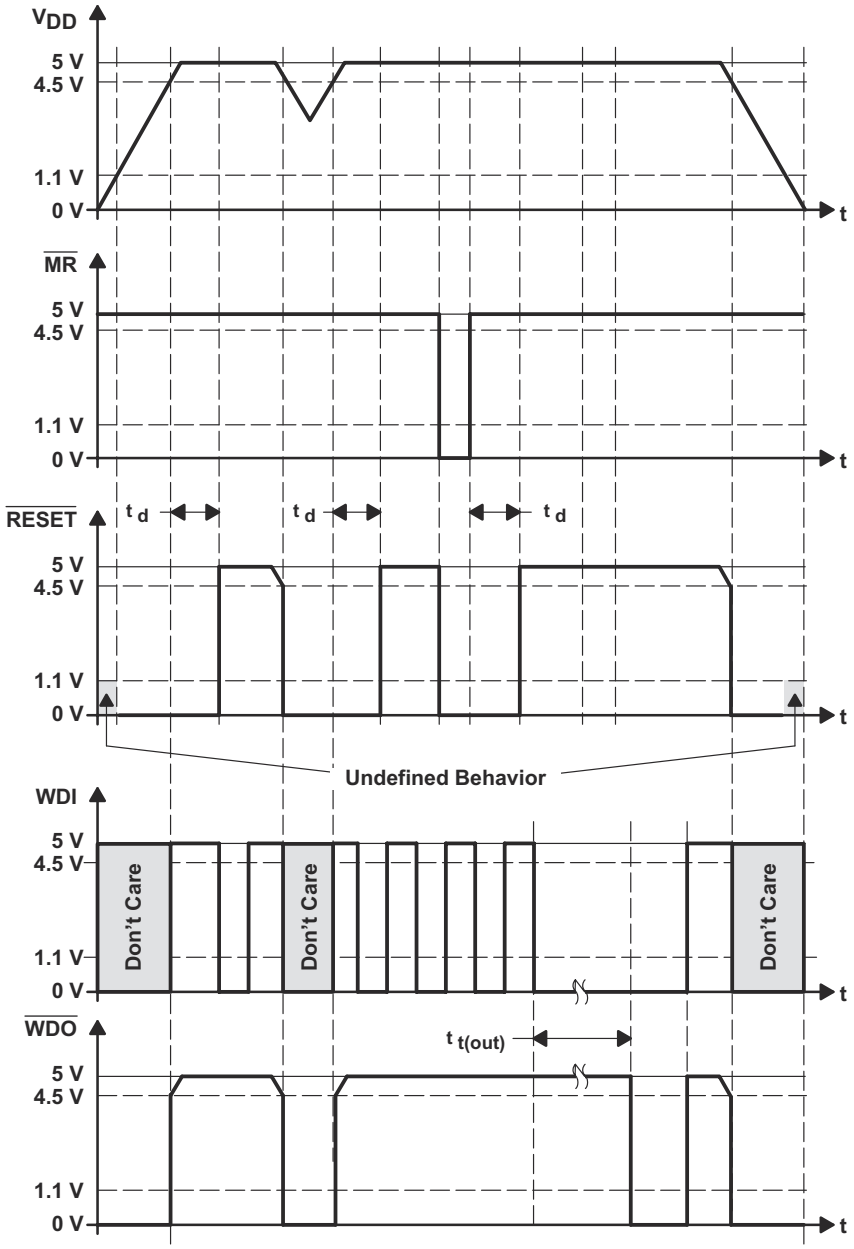



**Figure 7-1. Timing Diagrams**

## 7.11 Typical Characteristics

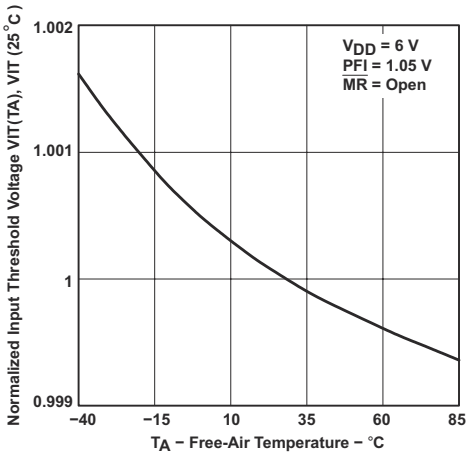



**Figure 7-2. Normalized Input Threshold Voltage vs Free-Air Temperature at $V_{DD}$**

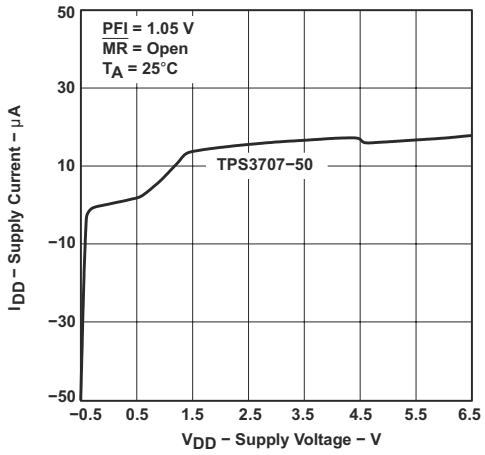



**Figure 7-3. Supply Current vs Supply Voltage**

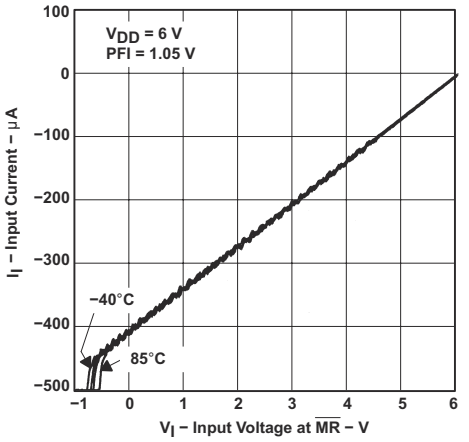



**Figure 7-4. Input Current vs Input Voltage at $\overline{MR}$**

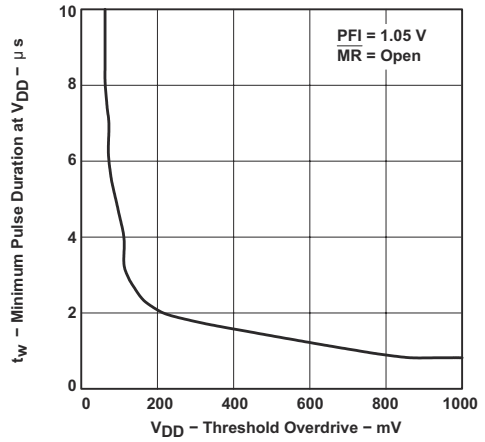



**Figure 7-5. Minimum Pulse Duration at $V_{DD}$ vs $V_{DD}$ Threshold Overdrive**

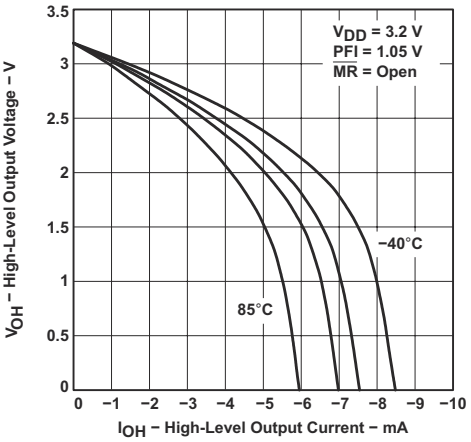



**Figure 7-6. High-Level Output Voltage vs High-Level Output Current**

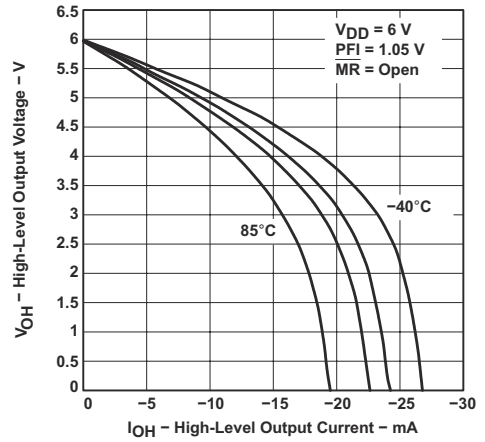



**Figure 7-7. High-Level Output Voltage vs High-Level Output Current**

## 7.11 Typical Characteristics (continued)

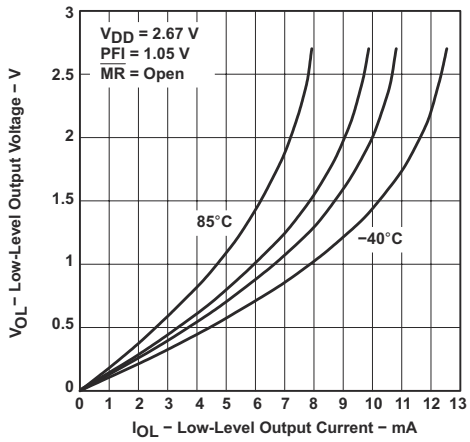



**Figure 7-8. Low-Level Output Voltage vs Low-Level Output Current**

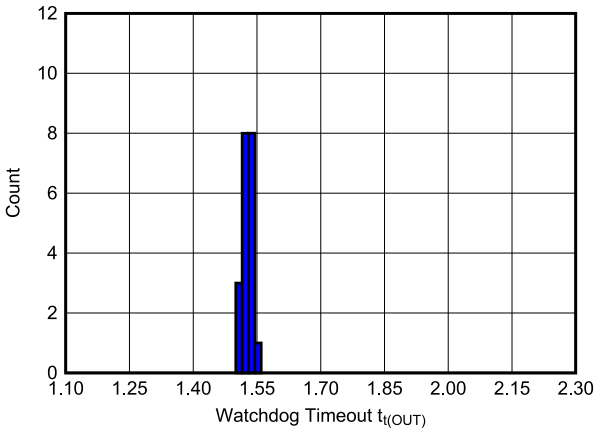



**Figure 7-9. Watchdog Timeout Histogram for TSP3705-33 Devices at -40°C (Unit Count = 20)**

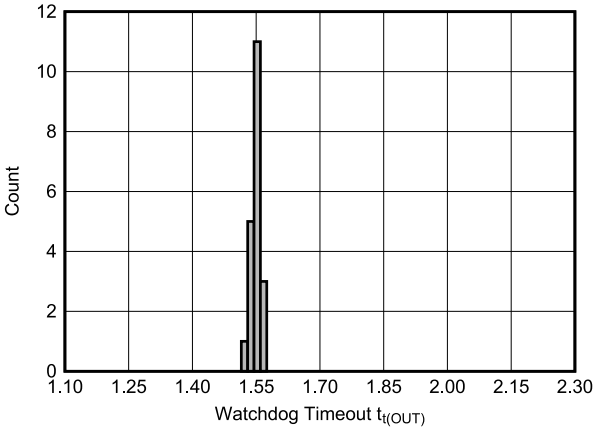



**Figure 7-10. Watchdog Timeout Histogram for TSP3705-33 Devices at 25°C (Unit Count = 20)**

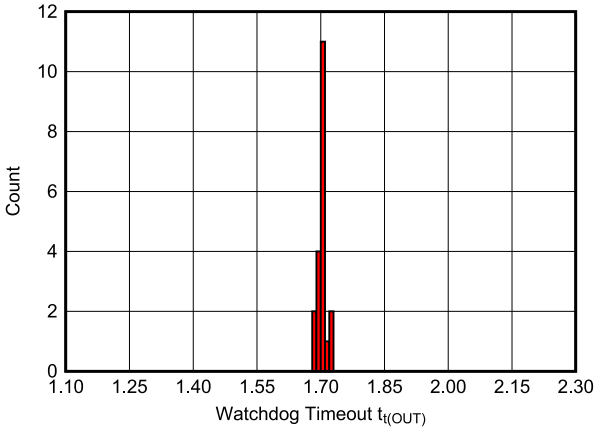



**Figure 7-11. Watchdog Timeout Histogram for TSP3705-33 Devices at 125°C (Unit Count = 20)**

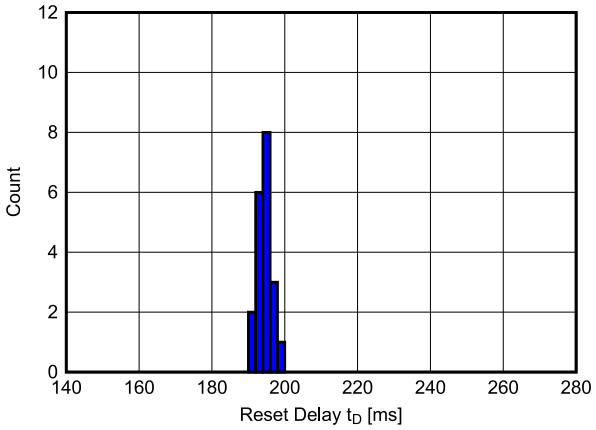



**Figure 7-12. Reset Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)**

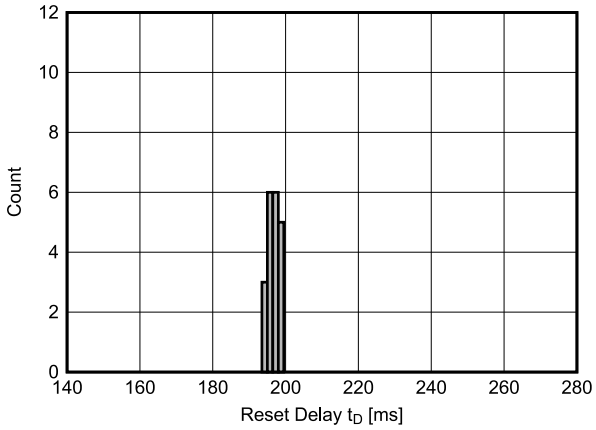



**Figure 7-13. Reset Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)**

## 7.11 Typical Characteristics (continued)

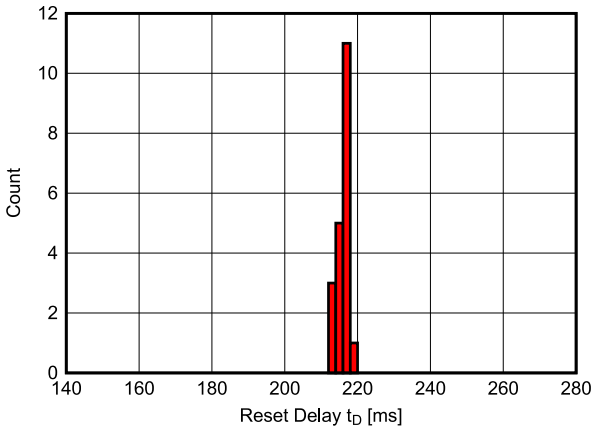



**Figure 7-14. Reset Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)**

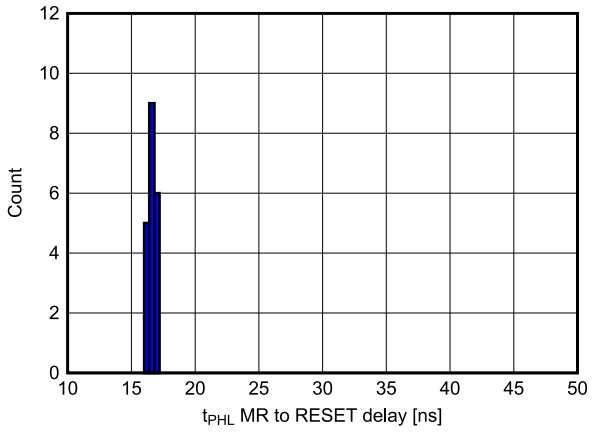



**Figure 7-15. $\overline{MR}$ to $\overline{RESET}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)**

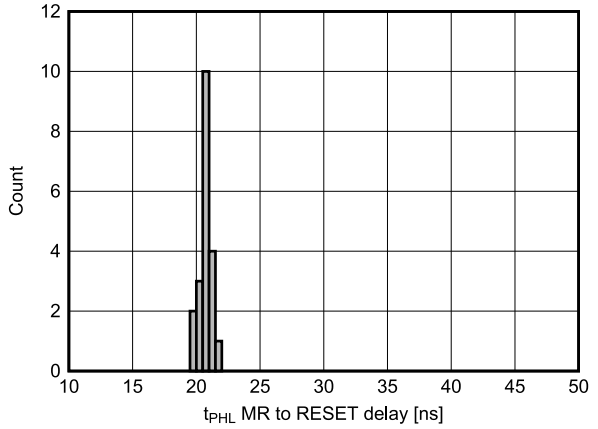



**Figure 7-16. $\overline{MR}$ to $\overline{RESET}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)**

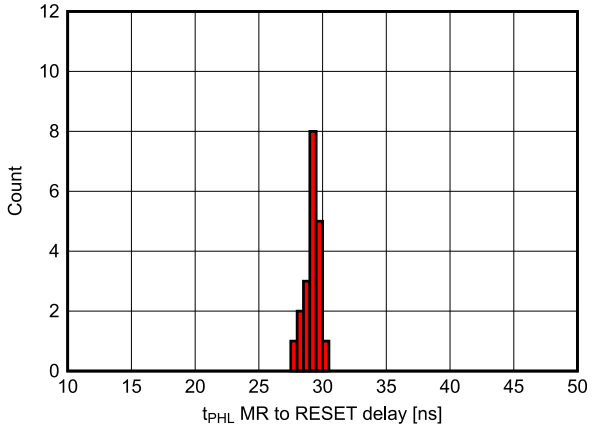



**Figure 7-17. $\overline{MR}$ to $\overline{RESET}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)**

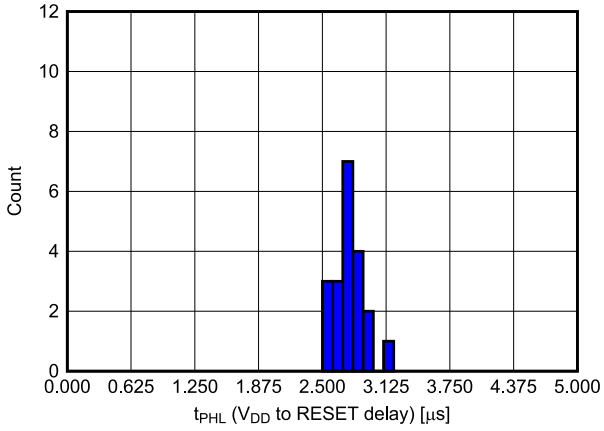



**Figure 7-18. $V_{DD}$ to $\overline{RESET}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)**

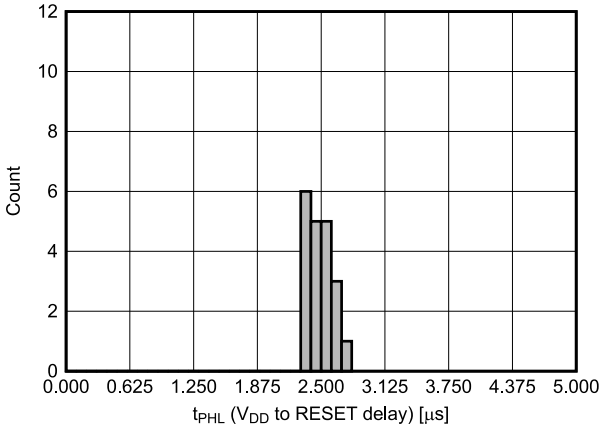



**Figure 7-19. $V_{DD}$ to $\overline{RESET}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)**

## 7.11 Typical Characteristics (continued)

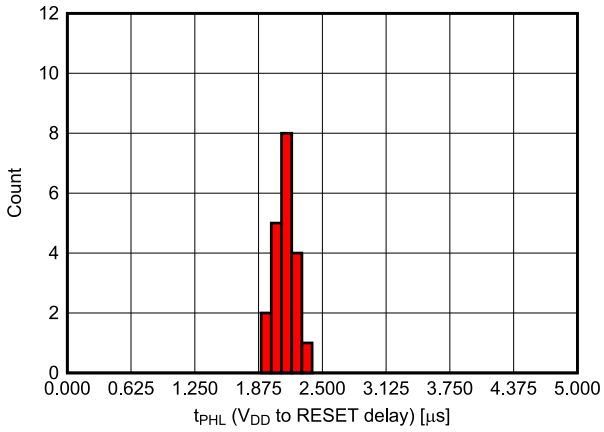



**Figure 7-20. $V_{DD}$ to $\overline{RESET}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)**

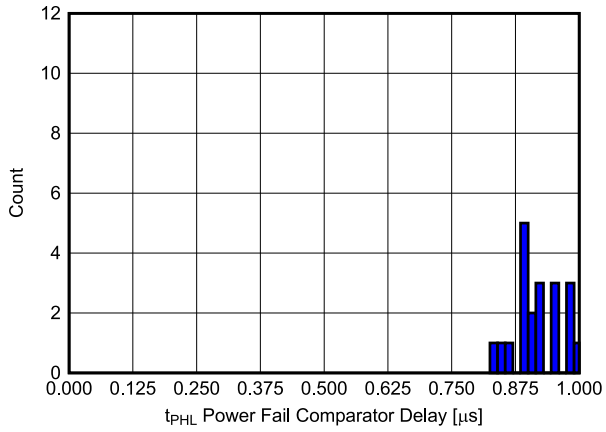



**Figure 7-21. PFI to $\overline{PFO}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)**

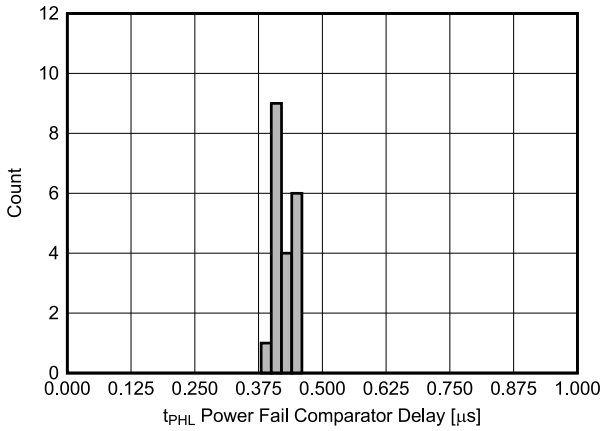



**Figure 7-22. PFI to $\overline{PFO}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)**

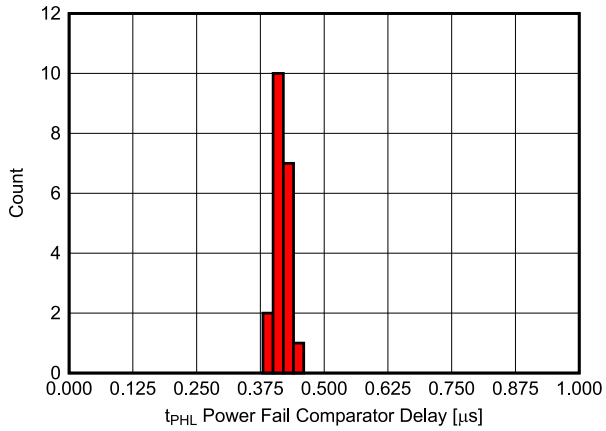



**Figure 7-23. PFI to $\overline{PFO}$ ($t_{PHL}$) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)**

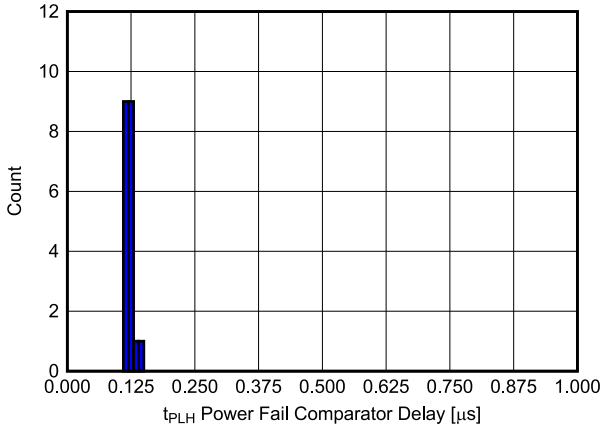



**Figure 7-24. PFI to $\overline{PFO}$ ($t_{PLH}$) Delay Histogram for TPS3705-33 Devices at -40°C (Unit Count = 20)**

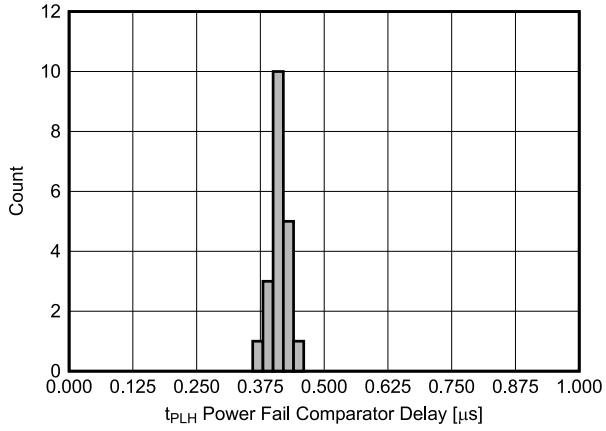



**Figure 7-25. PFI to $\overline{PFO}$ ($t_{PLH}$) Delay Histogram for TPS3705-33 Devices at 25°C (Unit Count = 20)**

## 7.11 Typical Characteristics (continued)

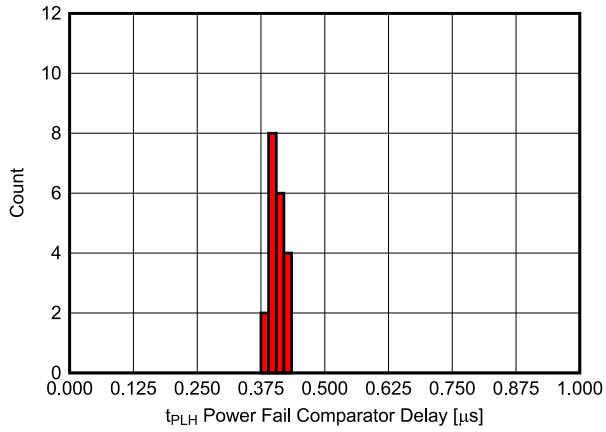


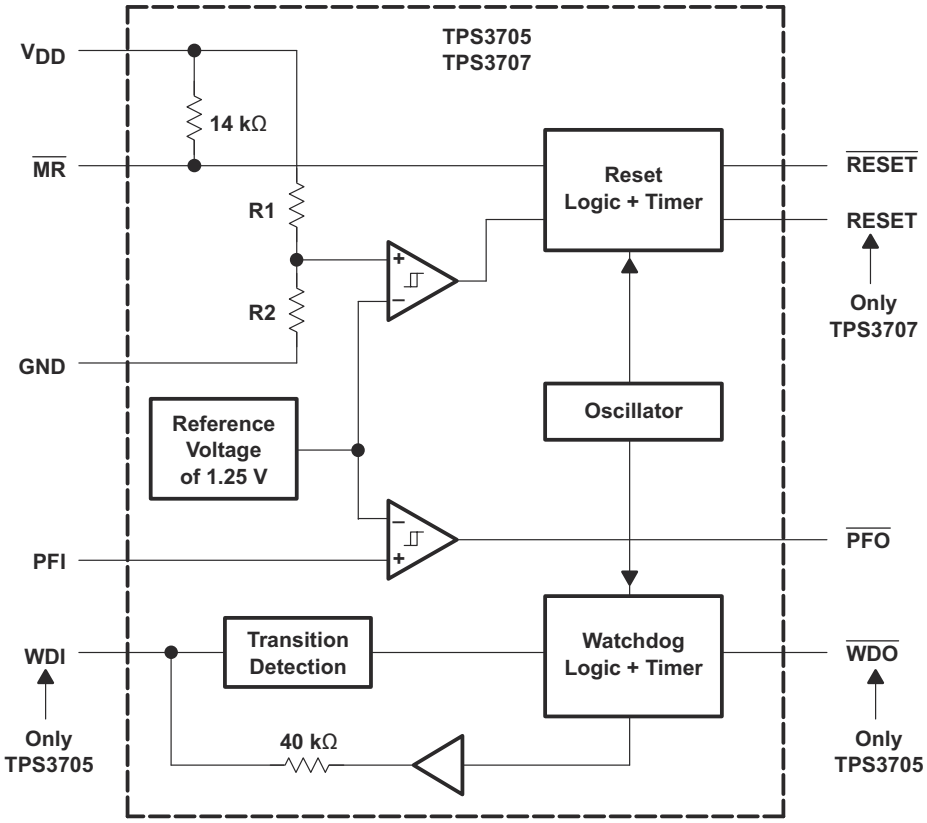

**Figure 7-26. PFI to $\overline{PFO}$ ($t_{PLH}$) Delay Histogram for TPS3705-33 Devices at 125°C (Unit Count = 20)**

# 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






## 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.

## 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 |

# 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

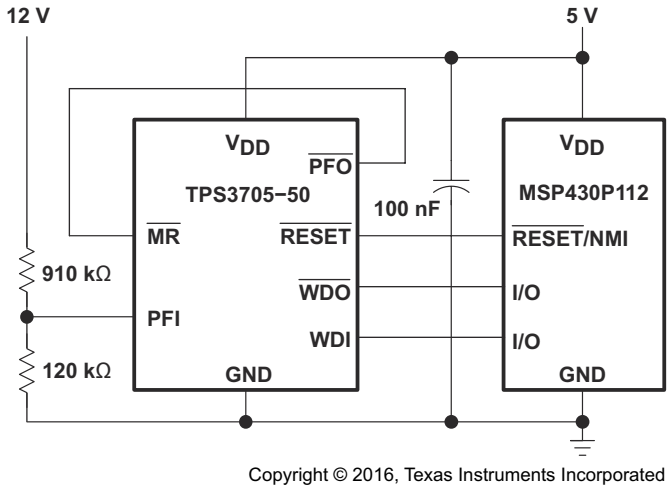





**Figure 9-1. Typical MSP430 Application**

### 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.

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

### 9.2.3 Application Curves

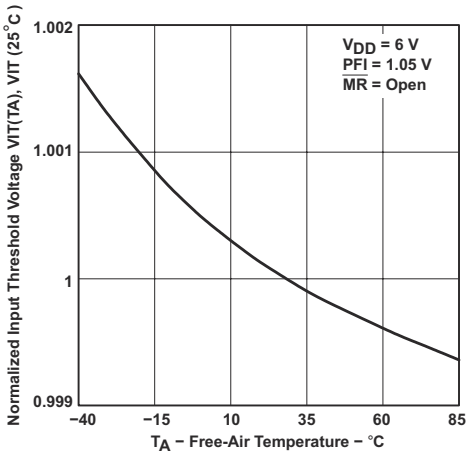



**Figure 9-2. Normalized Input Threshold Voltage vs Free-Air Temperature at $V_{DD}$**

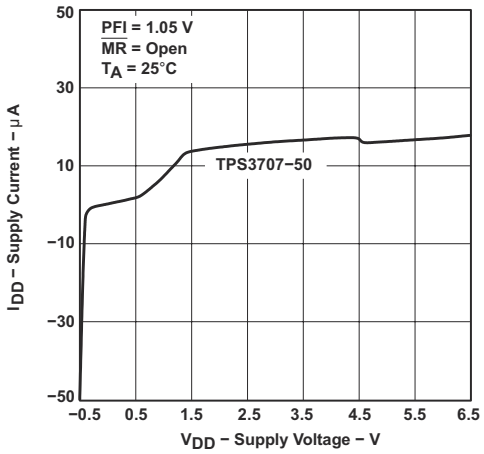



**Figure 9-3. Supply Current vs Supply Voltage**

## 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

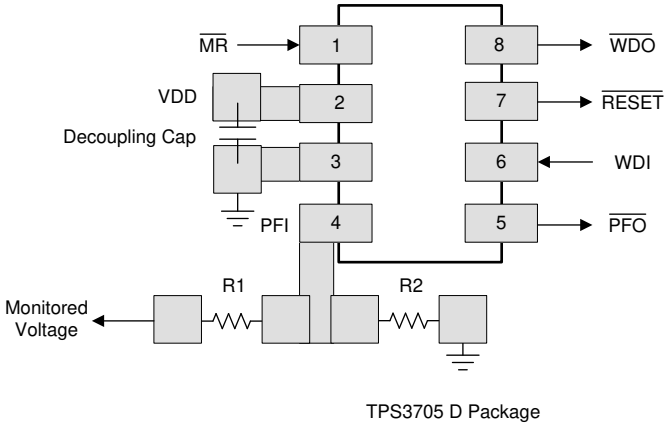



**Figure 11-1. TPS3705 Layout**

# 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

PowerPAD™ and TI E2E™ are trademarks of Texas Instruments.
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.

# PACKAGE OPTION ADDENDUM

13-Aug-2021

## 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 |
| TPS3705-33DRG4 | 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 |
| TPS3707-25DG4 | 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 |

# PACKAGE OPTION ADDENDUM

13-Aug-2021

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TPS3707-25DGNRG4 | 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 |
| TPS3707-30DG4 | ACTIVE | SOIC | D | 8 | 75 | RoHS & Green | NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 70730 | 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 |
| TPS3707-33DG4 | 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 |
| TPS3707-33DGNG4 | 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 |
| TPS3707-33DGNRG4 | 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 |
| TPS3707-50DGNG4 | 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.

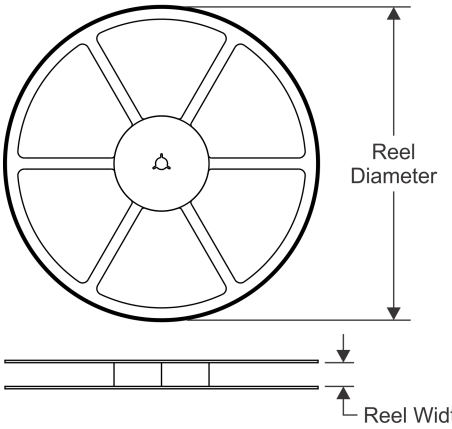
**(6)** Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

# PACKAGE MATERIALS INFORMATION

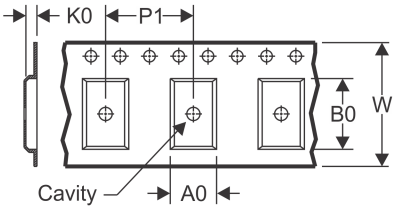
16-Oct-2020

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

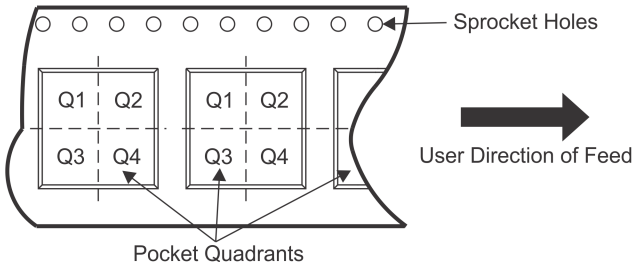



**TAPE DIMENSIONS**




| | |
|---|---|
| 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**



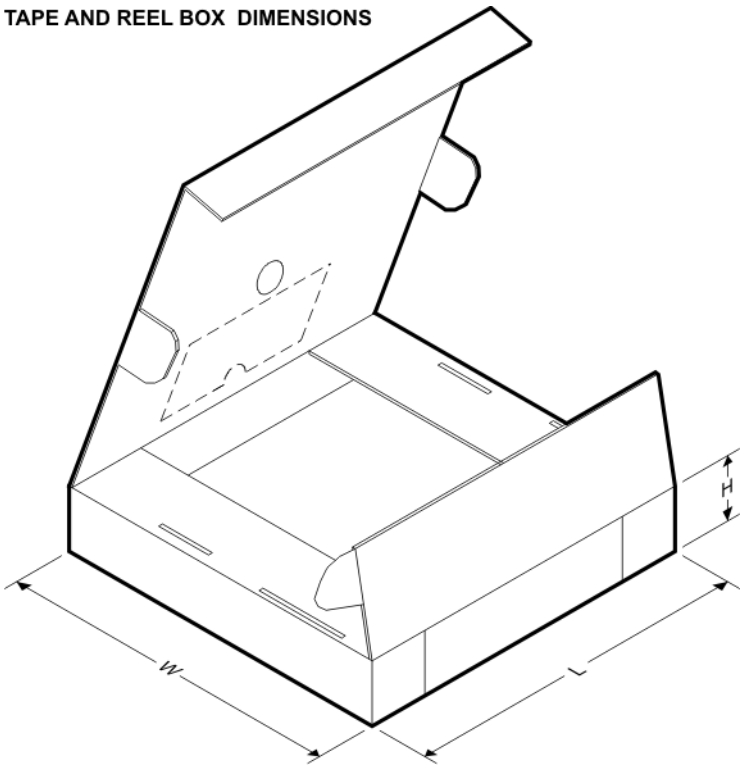

*All dimensions are nominal

| 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 |

# PACKAGE MATERIALS INFORMATION

16-Oct-2020

**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 | 853.0 | 449.0 | 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 |

# GENERIC PACKAGE VIEW

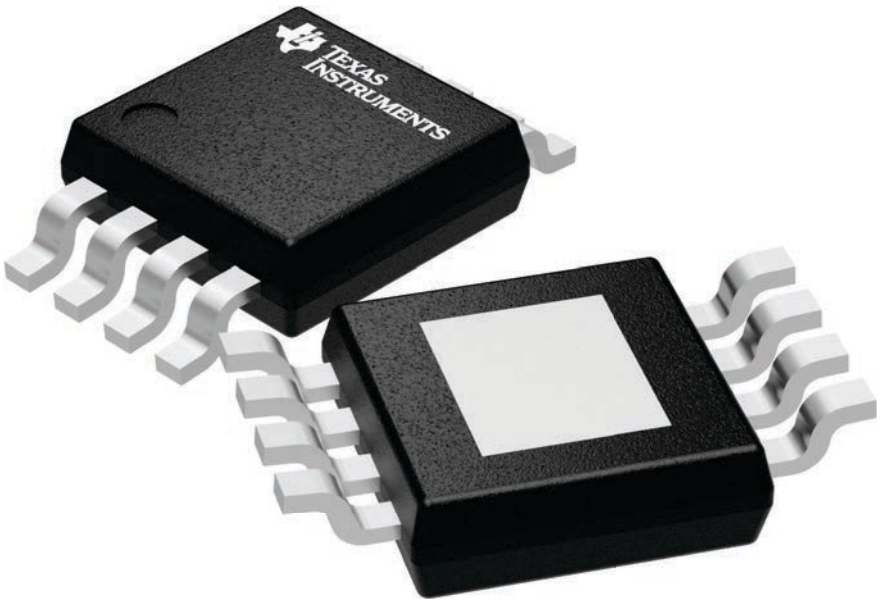
## DGN 8

## PowerPAD VSSOP - 1.1 mm max height

**3 x 3, 0.65 mm pitch**

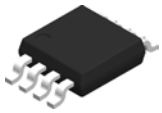
SMALL OUTLINE PACKAGE

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



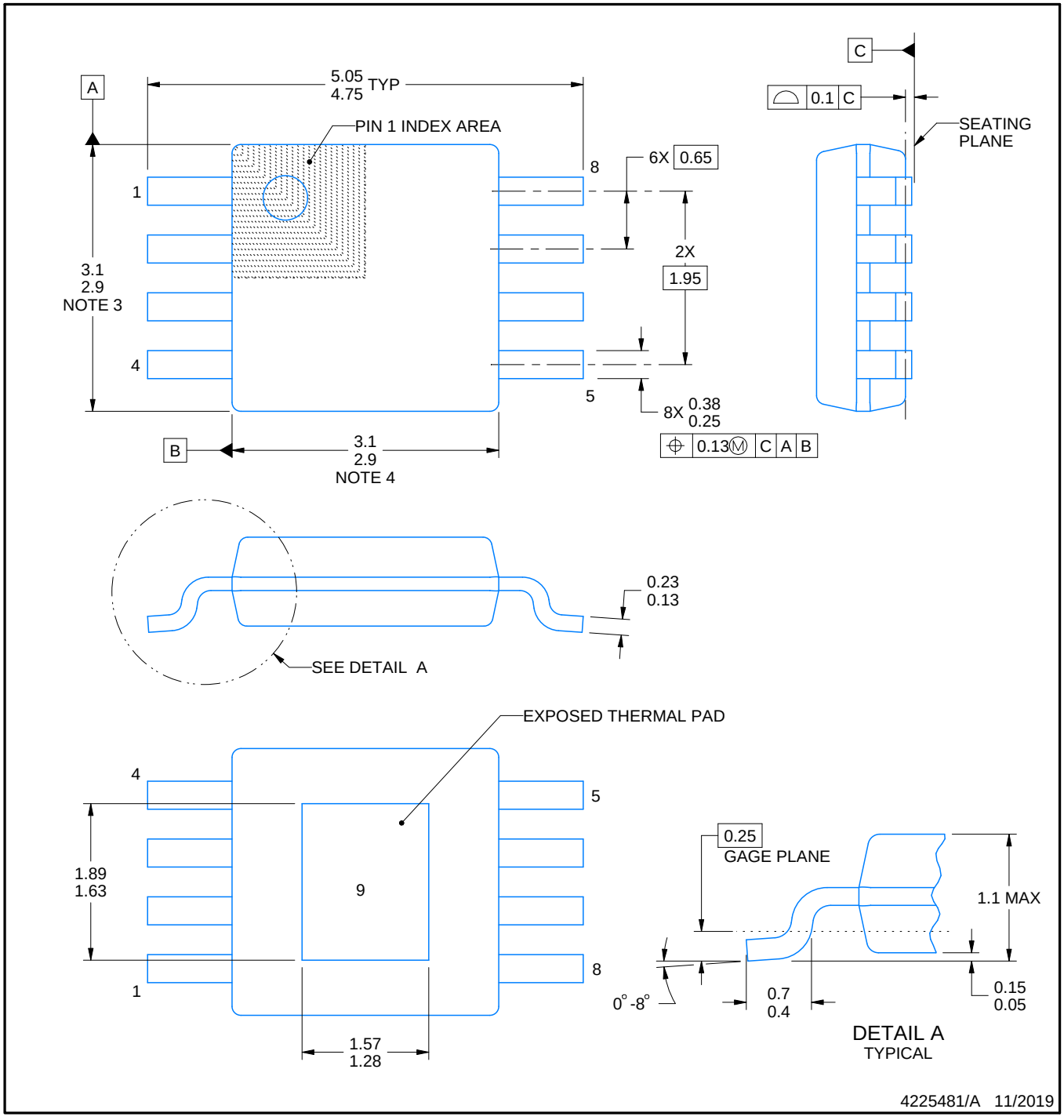
# PACKAGE OUTLINE

## DGN0008D



## PowerPAD™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE




PowerPAD is a trademark of Texas Instruments.

NOTES:

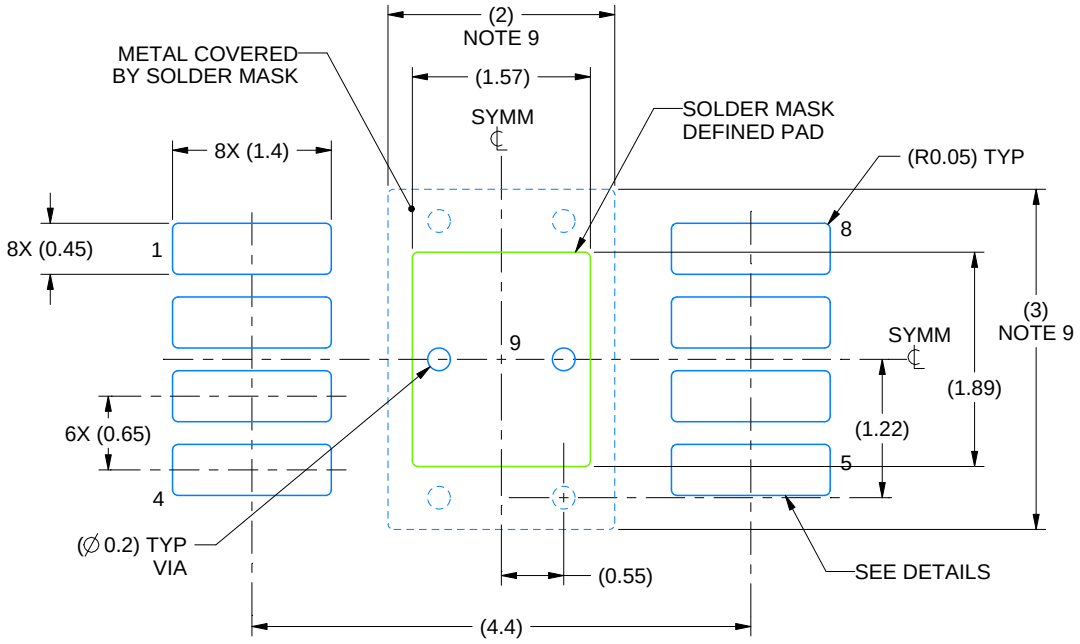
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or 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.

# EXAMPLE BOARD LAYOUT

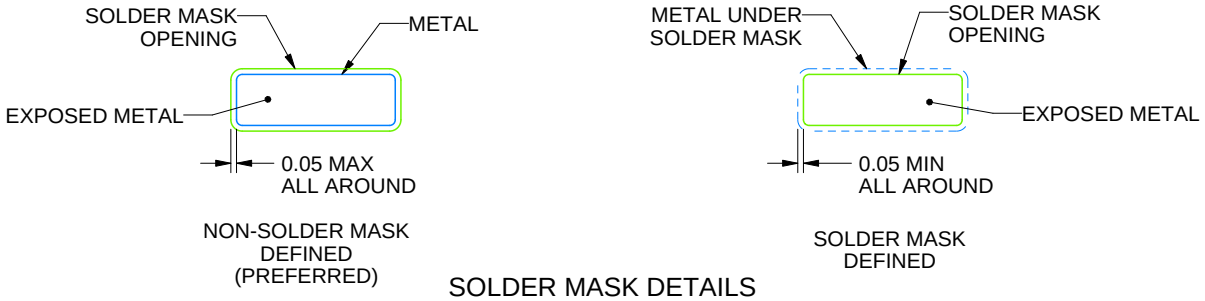
## DGN0008D

## PowerPAD™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X




SOLDER MASK DETAILS

4225481/A 11/2019

NOTES: (continued)

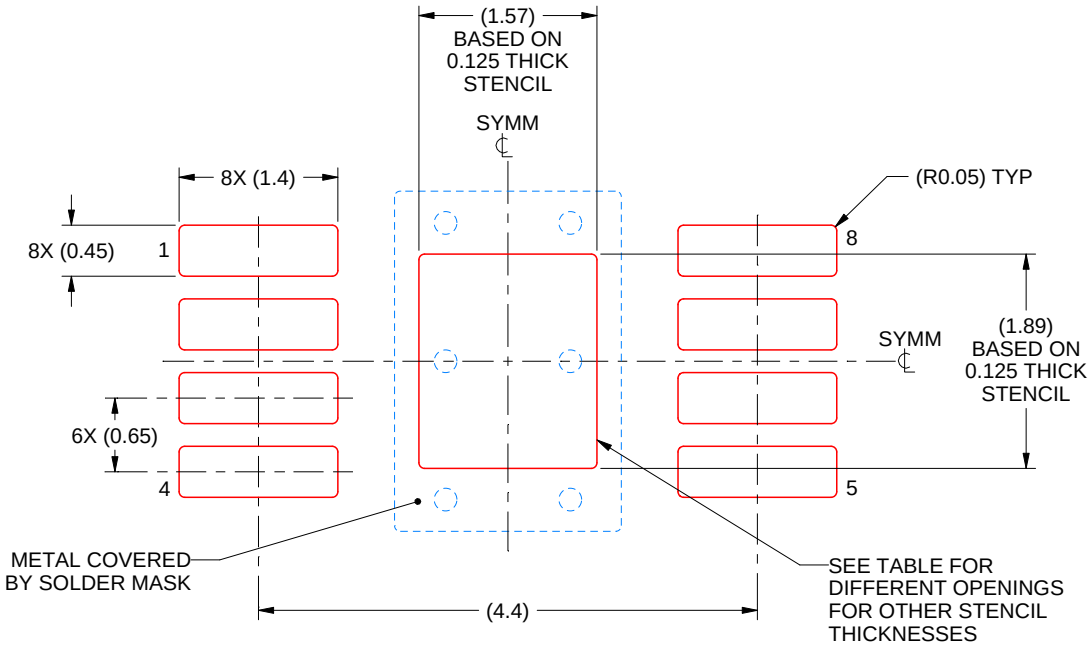
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It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

# EXAMPLE STENCIL DESIGN

## DGN0008D

## PowerPAD™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE




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)

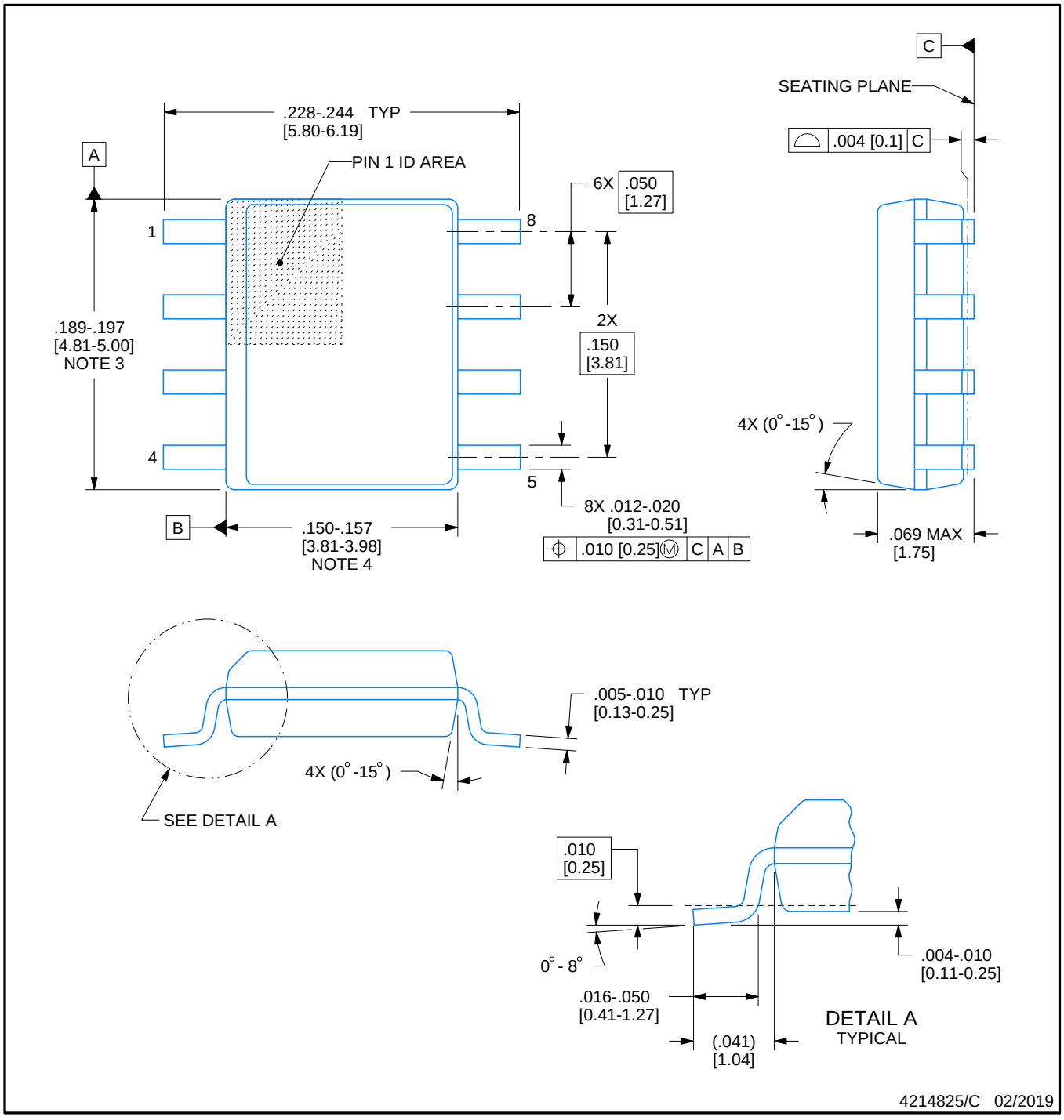
10. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
11. Board assembly site may have different recommendations for stencil design.

# PACKAGE OUTLINE

## D0008A

## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT




NOTES:

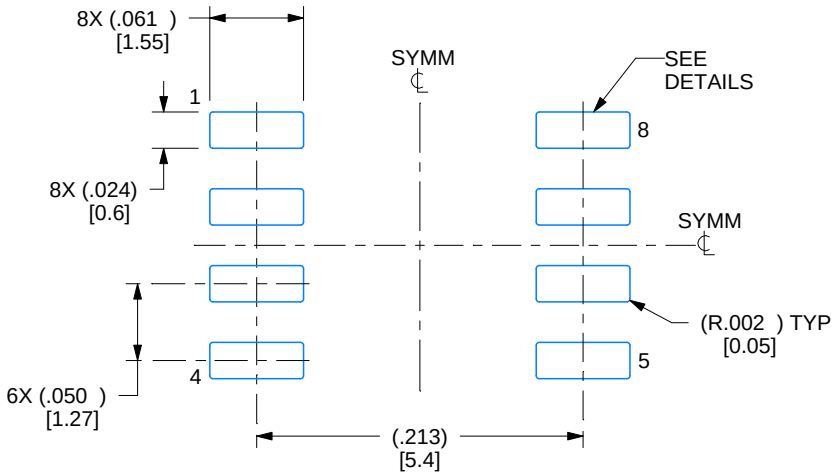
1. Linear dimensions are in inches [millimeters]. Dimensions in parenthesis are for reference only. Controlling dimensions are in inches. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate 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.

# EXAMPLE BOARD LAYOUT

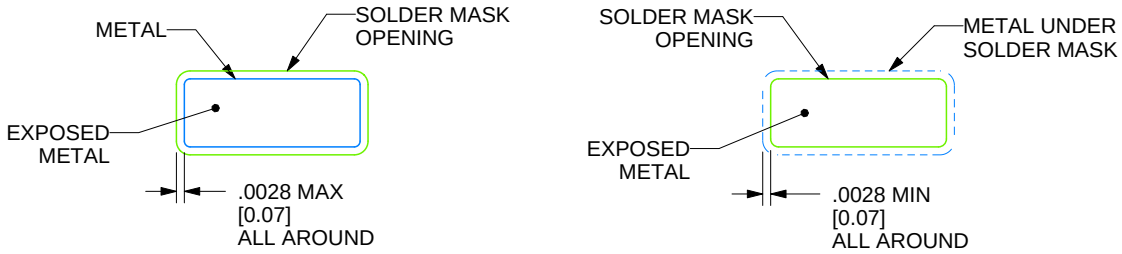
## D0008A

## SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT




LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:8X




SOLDER MASK DETAILS

4214825/C 02/2019

NOTES: (continued)

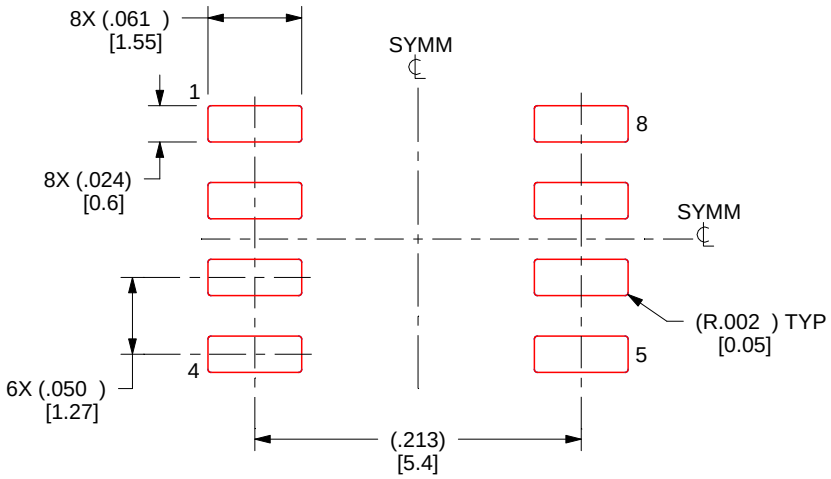
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# 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.