

TPS7B82-Q1 Automotive 300-mA, High-Voltage, Ultra-Low-I_Q Low-Dropout Regulator

1 Features

- AEC-Q100 qualified for automotive applications:
 - Temperature grade 1: $-40^{\circ}\text{C} \leq T_A \leq 125^{\circ}\text{C}$
 - Temperature grade 0: $-40^{\circ}\text{C} \leq T_A \leq 150^{\circ}\text{C}$
- Extended junction temperature range:
 - Grade 1: $-40^{\circ}\text{C} \leq T_J \leq 150^{\circ}\text{C}$
 - Grade 0: $-40^{\circ}\text{C} \leq T_J \leq 165^{\circ}\text{C}$
- Low quiescent current I_Q:
 - 300nA shutdown I_Q
 - 2.7μA typical at light loads
 - 5μA maximum at light loads
- 3V to 40V wide V_{IN} input voltage range with up to 45V transient
- Maximum output current: 300mA
- 2% output-voltage accuracy
- Maximum dropout voltage: 700mV at 200mA load current for fixed 5V output version
- Stable with low-ESR (0.001Ω to 5Ω) ceramic output-stability capacitor (1μF to 200μF)
- Fixed 2.5V, 3.3V, and 5V output voltage
- Packages:
 - 8-pin HVSSOP, R_{θJA} = 63.9°C/W
 - 6-pin WSON, R_{θJA} = 72.8°C/W
 - 6-pin WSON wettable flank, R_{θJA} = 72.8°C/W
 - 5-pin TO-252, R_{θJA} = 31.1°C/W
 - 14-pin HTSSOP, R_{θJA} = 52.0°C/W

2 Applications

- [Automotive head units](#)
- [Telematics control units](#)
- [Headlights](#)
- [Body control modules](#)
- [Inverter and motor controls](#)

3 Description

In automotive battery-connected applications, low quiescent current (I_Q) is important to save power and extend battery lifetime. Ultra-low I_Q must be included for always-on systems.

The TPS7B82-Q1 is a low-dropout linear regulator designed to operate with a wide input-voltage range from 3V to 40V (45V load dump protection). Operation down to 3V allows the TPS7B82-Q1 to continue operating during cold-crank and start and stop conditions. With only 2.7μA typical quiescent current at light load, this device is an optimum design for powering microcontrollers (MCUs) and CAN/LIN transceivers in standby systems.

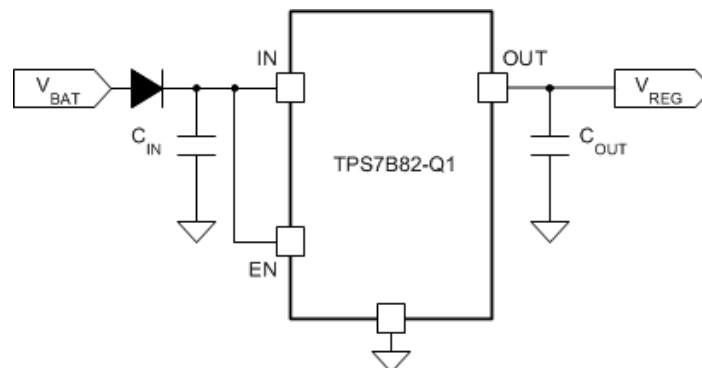
The device features integrated short-circuit and overcurrent protection. This device operates in ambient temperatures from -40°C to $+125^{\circ}\text{C}$ and with junction temperatures from -40°C to $+150^{\circ}\text{C}$. Additionally, this device uses a thermally conductive package to enable sustained operation despite significant dissipation across the device. Because of these features, the device is designed as a power supply for various automotive applications.

Package Information

| PART NUMBER | PACKAGE ⁽¹⁾ | PACKAGE SIZE ⁽²⁾ |
|-------------|------------------------------|-----------------------------|
| TPS7B82-Q1 | DGN (HVSSOP, 8) | 3mm × 4.9mm |
| | DRV (WSON, 6) | 2mm × 2mm |
| | DRV (WSON wettable flank, 6) | 2mm × 2mm |
| | KVU (TO-252, 5) | 6.6mm × 10.11mm |
| | PWP (HTSSOP, 14) | 5mm × 6.4mm |

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

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



Typical Application Schematic



Table of Contents

| | | | |
|--|----|--|----|
| 1 Features | 1 | 6.4 Device Functional Modes..... | 12 |
| 2 Applications | 1 | 7 Application and Implementation | 13 |
| 3 Description | 1 | 7.1 Application Information..... | 13 |
| 4 Pin Configuration and Functions | 3 | 7.2 Typical Application..... | 13 |
| 5 Specifications | 4 | 7.3 Power Supply Recommendations..... | 14 |
| 5.1 Absolute Maximum Ratings..... | 4 | 7.4 Layout..... | 15 |
| 5.2 ESD Ratings..... | 4 | 8 Device and Documentation Support | 16 |
| 5.3 Recommended Operating Conditions..... | 4 | 8.1 Device Nomenclature..... | 16 |
| 5.4 Thermal Information..... | 5 | 8.2 Receiving Notification of Documentation Updates.... | 16 |
| 5.5 Electrical Characteristics: Grade 1 Options..... | 5 | 8.3 Support Resources..... | 16 |
| 5.6 Electrical Characteristics: Grade 0 Options..... | 6 | 8.4 Trademarks..... | 16 |
| 5.7 Typical Characteristics..... | 8 | 8.5 Electrostatic Discharge Caution..... | 16 |
| 6 Detailed Description | 11 | 8.6 Glossary..... | 16 |
| 6.1 Overview..... | 11 | 9 Revision History | 16 |
| 6.2 Functional Block Diagram..... | 11 | 10 Mechanical, Packaging, and Orderable Information | 17 |
| 6.3 Feature Description..... | 11 | | |

4 Pin Configuration and Functions

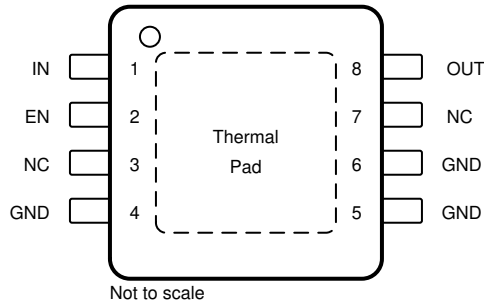


Figure 4-1. DGN Package, 8-Pin HVSSOP (Top View)

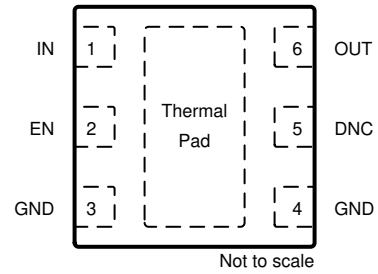


Figure 4-2. DRV Package, 6-Pin WSON (Top View)

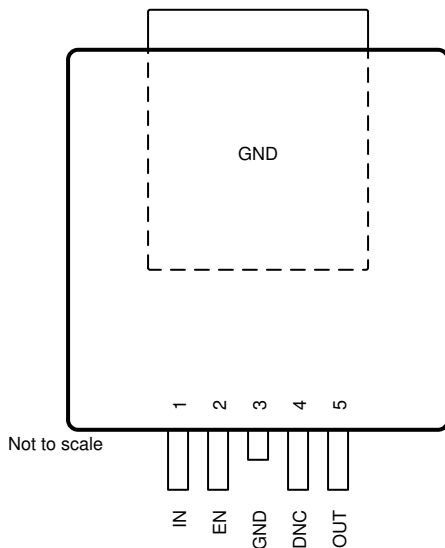


Figure 4-3. KVU Package, 5-Pin TO-252 (Top View)

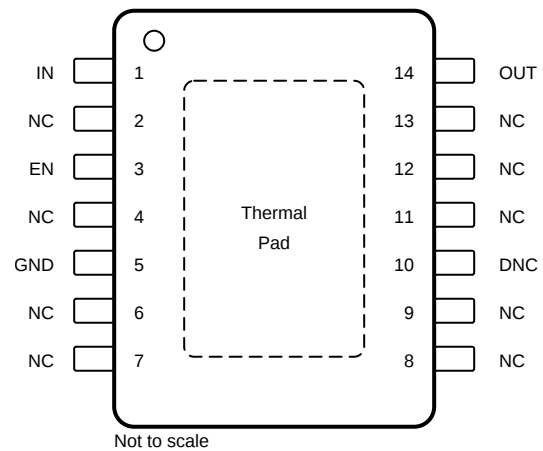


Figure 4-4. PWP Package, 14-Pin HTSSOP (Top View)

Table 4-1. Pin Functions

| NAME | PIN NO. | | | | TYPE | DESCRIPTION |
|-------------|---------|-----|--------|------------------------------|------|---|
| | DGN | DRV | KVU | PWP | | |
| DNC | — | 5 | 4 | 10 | — | Do not connect to a biased voltage. Tie this pin to ground or leave floating. |
| EN | 2 | 2 | 2 | 3 | I | Enable input pin |
| GND | 4, 5, 6 | 3,4 | 3, TAB | 5 | — | Ground reference |
| IN | 1 | 1 | 1 | 1 | I | Input power-supply pin |
| NC | 3, 7 | — | — | 2, 4, 6, 7, 8, 9, 11, 12, 13 | — | Not internally connected |
| OUT | 8 | 6 | 5 | 14 | O | Regulated output voltage pin |
| Thermal pad | | | | | — | Connect the thermal pad to a large-area GND plane for improved thermal performance. |

5 Specifications

5.1 Absolute Maximum Ratings

over operating ambient temperature range (unless otherwise noted)^{(1) (2)}

| | | MIN | MAX | UNIT |
|------------------|----------------------------------|------|-----------------|------|
| V _{IN} | Unregulated input ⁽³⁾ | -0.3 | 45 | V |
| V _{EN} | Enable input ⁽³⁾ | -0.3 | V _{IN} | V |
| V _{OUT} | Regulated output | -0.3 | 7 | V |
| T _J | Junction temperature (grade 1) | -40 | 150 | °C |
| | Junction temperature (grade 0) | -40 | 165 | |
| T _{stg} | Storage temperature range | -40 | 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.

(3) Absolute maximum voltage, withstand 45 V for 200 ms.

5.2 ESD Ratings

| | | | VALUE | UNIT | |
|--------------------|-------------------------|--|---------------------------------|------|------|
| V _(ESD) | Electrostatic discharge | Human-body model (HBM), per AEC Q100-002 ⁽¹⁾ HBM ESD classification level H2 | ±2000 | V | |
| | | Charged-device model (CDM), per AEC Q100-011 CDM ESD classification level C3B | Corner pins (1, 4, 5, and 8) | | ±750 |
| | | | Other pins | | ±500 |

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

5.3 Recommended Operating Conditions

over operating ambient temperature range (unless otherwise noted)

| | | MIN | MAX | UNIT |
|------------------|--|-------|-----------------|------|
| V _{IN} | Unregulated input voltage | 3 | 40 | V |
| V _{EN} | Enable input voltage | 0 | V _{IN} | V |
| C _{OUT} | Output capacitor requirements ⁽¹⁾ | 1 | 200 | μF |
| ESR | Output capacitor ESR requirements ⁽²⁾ | 0.001 | 5 | Ω |
| T _A | Ambient temperature (grade 1) | -40 | 125 | °C |
| | Ambient temperature (grade 0) | -40 | 150 | |
| T _J | Junction temperature (grade 1) | -40 | 150 | °C |
| | Junction temperature (grade 0) | -40 | 165 | |

(1) The output capacitance range specified in the table is the effective value.

(2) Relevant equivalent series resistance (ESR) value at f = 10 kHz.

5.4 Thermal Information

| THERMAL METRIC ⁽¹⁾ | | TPS7B82-Q1 | | | | UNIT |
|-------------------------------|--|--------------|------------|--------------|--------------|------|
| | | DGN (HVSSOP) | DRV (WSON) | KVU (TO-252) | PWP (HTSSOP) | |
| | | 8 PINS | 6 PINS | 5 PINS | 14 PINS | |
| R _{θJA} | Junction-to-ambient thermal resistance | 63.9 | 72.8 | 31.1 | 52.0 | °C/W |
| R _{θJC(top)} | Junction-to-case (top) thermal resistance | 50.2 | 85.8 | 39.9 | 48.2 | °C/W |
| R _{θJB} | Junction-to-board thermal resistance | 22.6 | 37.4 | 9.9 | 28.2 | °C/W |
| Ψ _{JT} | Junction-to-top characterization parameter | 1.8 | 2.7 | 4.2 | 2.5 | °C/W |
| Ψ _{JB} | Junction-to-board characterization parameter | 22.3 | 37.3 | 9.9 | 28.1 | °C/W |
| R _{θJC(bot)} | Junction-to-case (bottom) thermal resistance | 12.1 | 13.8 | 2.8 | 10.7 | °C/W |

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

5.5 Electrical Characteristics: Grade 1 Options

V_{IN} = 14-V, 10-μF ceramic output capacitor, grade 1 options, T_J = –40°C to +150°C, over operating ambient temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|--|--|---|--|---|-----|------|------|
| SUPPLY VOLTAGE AND CURRENT (IN) | | | | | | | |
| V _{IN} | Input voltage | | | V _{OUT(NOM)} + V _(Dropout) | | 40 | V |
| I _(SD) | Shutdown current | EN = 0 V | | | 0.3 | 1 | μA |
| I _(Q) | Quiescent current | V _{IN} = 6 V to 40 V, EN ≥ 2 V, I _{OUT} = 0 mA | DRV and KVU packages | | 1.9 | 3.5 | μA |
| | | | DGN package | | 1.9 | 5 | |
| | | V _{IN} = 6 V to 40 V, EN ≥ 2 V, I _{OUT} = 0.2 mA | DRV and KVU packages | | 2.7 | 4.5 | |
| | | | DGN package | | 2.7 | 6.5 | |
| V _(IN, UVLO) | V _{IN} undervoltage detection | Ramp V _{IN} down until the output turns OFF | | | | 2.7 | V |
| | | Hysteresis | | | 200 | | mV |
| ENABLE INPUT (EN) | | | | | | | |
| V _{IL} | Logic-input low level | | | | | 0.7 | V |
| V _{IH} | Logic-input high level | | | 2 | | | V |
| REGULATED OUTPUT (OUT) | | | | | | | |
| V _{OUT} | Regulated output | V _{IN} = V _{OUT} + V _(Dropout) to 40 V, I _{OUT} = 1 mA to 300 mA | DRV, KVU packages | –1.5% | | 1.5% | |
| | | | DGN package for V _{OUT} = 5.0 V | –1.5% | | 1.5% | |
| | | | DGN package for V _{OUT} = 2.5 V and 3.3 V | –2% | | 2% | |
| V _(Line-Reg) | Line regulation | V _{IN} = 6 V to 40 V, I _{OUT} = 10 mA | | | | 10 | mV |
| V _(Load-Reg) | Load regulation | V _{IN} = 14 V, I _{OUT} = 1 mA to 300 mA | DRV and KVU packages | | | 10 | mV |
| | | | DGN package | | | 20 | |

5.5 Electrical Characteristics: Grade 1 Options (continued)

$V_{IN} = 14\text{-V}$, 10- μF ceramic output capacitor, grade 1 options, $T_J = -40^\circ\text{C}$ to $+150^\circ\text{C}$, over operating ambient temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|------------------------------------|--------------------------------|--|----------------------------------|----------------------|-----|------------------|------|
| $V_{(\text{Dropout})}$ | Dropout voltage ⁽¹⁾ | $V_{\text{OUT(NOM)}} = 5\text{ V}$ | $I_{\text{OUT}} = 300\text{ mA}$ | DRV and KVU packages | 630 | 1170 | mV |
| | | | | DGN package | | 1000 | |
| | | | $I_{\text{OUT}} = 200\text{ mA}$ | DRV and KVU packages | 420 | 780 | |
| | | | | DGN package | 400 | 700 | |
| | | | $I_{\text{OUT}} = 100\text{ mA}$ | DRV and KVU packages | 210 | 390 | |
| | | | | DGN package | 200 | 350 | |
| | | $V_{\text{OUT}} = 3.3\text{ V}$ | $I_{\text{OUT}} = 300\text{ mA}$ | DRV and KVU packages | 730 | 1350 | |
| | | | | DGN package | | 1250 | |
| | | | $I_{\text{OUT}} = 200\text{ mA}$ | DRV and KVU packages | 475 | 900 | |
| | | | | DGN package | | 850 | |
| | | | $I_{\text{OUT}} = 100\text{ mA}$ | | | 450 | |
| | | | | | | | |
| I_{OUT} | Output current | V_{OUT} in regulation | 0 | | 300 | mA | |
| $I_{(\text{CL})}$ | Output current limit | V_{OUT} short to $90\% \times V_{\text{OUT}}$ | 310 | 510 | 690 | mA | |
| PSRR | Power-supply ripple rejection | $V_{(\text{Ripple})} = 0.5\text{ V}_{\text{PP}}$, $I_{\text{OUT}} = 10\text{ mA}$, frequency = 100 Hz, $C_{\text{OUT}} = 2.2\text{ }\mu\text{F}$ | | 60 | | dB | |
| OPERATING TEMPERATURE RANGE | | | | | | | |
| $T_{(\text{SD})}$ | Junction shutdown temperature | | | 175 | | $^\circ\text{C}$ | |
| $T_{(\text{HYST})}$ | Hysteresis of thermal shutdown | | | 20 | | $^\circ\text{C}$ | |

(1) Dropout is not valid for the 2.5-V output because of the minimum input voltage limits.

5.6 Electrical Characteristics: Grade 0 Options

$V_{IN} = 14\text{-V}$, 10- μF ceramic output capacitor, grade 0 options (PWP package), $T_J = -40^\circ\text{C}$ to $+165^\circ\text{C}$, over operating ambient temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|--|---------------------------------|---|--|--|-----|-----|---------------|
| SUPPLY VOLTAGE AND CURRENT (IN) | | | | | | | |
| V_{IN} | Input voltage | | | $V_{\text{OUT(NOM)}} + V_{(\text{Dropout})}$ | | 40 | V |
| $I_{(\text{SD})}$ | Shutdown current | $\text{EN} = 0\text{ V}$ | | | 0.3 | 1 | μA |
| $I_{(\text{Q})}$ | Quiescent current | $V_{IN} = 6\text{ V to }40\text{ V}$, $\text{EN} \geq 2\text{ V}$, $I_{\text{OUT}} = 0\text{ mA}$ | | | 1.9 | 5 | |
| | | $V_{IN} = 6\text{ V to }40\text{ V}$, $\text{EN} \geq 2\text{ V}$, $I_{\text{OUT}} = 0.2\text{ mA}$ | | | 2.7 | 6.5 | μA |
| $V_{(\text{IN, UVLO})}$ | V_{IN} undervoltage detection | Ramp V_{IN} down until the output turns OFF | | | | 2.7 | V |
| | | Hysteresis | | | 200 | | mV |
| ENABLE INPUT (EN) | | | | | | | |
| V_{IL} | Logic-input low level | | | | | 0.7 | V |
| V_{IH} | Logic-input high level | | | 2 | | | V |
| REGULATED OUTPUT (OUT) | | | | | | | |

5.6 Electrical Characteristics: Grade 0 Options (continued)

$V_{IN} = 14\text{-V}$, 10- μF ceramic output capacitor, grade 0 options (PWP package), $T_J = -40^\circ\text{C}$ to $+165^\circ\text{C}$, over operating ambient temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|------------------------------------|--------------------------------|---|---------------------------|-----|------|------------------|
| V_{OUT} | Regulated output | $V_{IN} = V_{OUT} + V_{(Dropout)}$ to 14 V, $I_{OUT} = 1\text{ mA to }300\text{ mA}$ | -1.5% | | 1.5% | |
| $V_{(Line-Reg)}$ | Line regulation | $V_{IN} = 6\text{ V to }40\text{ V}$, $I_{OUT} = 10\text{ mA}$ | | | 10 | mV |
| $V_{(Load-Reg)}$ | Load regulation | $V_{IN} = 14\text{ V}$, $I_{OUT} = 1\text{ mA to }300\text{ mA}$ | | | 20 | mV |
| $V_{(Dropout)}$ | Dropout voltage ⁽¹⁾ | $V_{OUT(NOM)} = 5\text{ V}$ | $I_{OUT} = 300\text{ mA}$ | 630 | 1170 | mV |
| | | | $I_{OUT} = 200\text{ mA}$ | 420 | 780 | |
| | | | $I_{OUT} = 100\text{ mA}$ | 210 | 390 | |
| | | $V_{OUT} = 3.3\text{ V}$ | $I_{OUT} = 300\text{ mA}$ | 730 | 1350 | |
| | | | $I_{OUT} = 200\text{ mA}$ | 475 | 900 | |
| | | | $I_{OUT} = 100\text{ mA}$ | | 450 | |
| I_{OUT} | Output current | V_{OUT} in regulation | 0 | | 300 | mA |
| $I_{(CL)}$ | Output current limit | V_{OUT} short to $90\% \times V_{OUT}$ | 310 | 510 | 690 | mA |
| PSRR | Power-supply ripple rejection | $V_{(Ripple)} = 0.5\text{ V}_{PP}$, $I_{OUT} = 10\text{ mA}$, frequency = 100 Hz, $C_{OUT} = 2.2\text{ }\mu\text{F}$ | | 60 | | dB |
| OPERATING TEMPERATURE RANGE | | | | | | |
| $T_{(SD)}$ | Junction shutdown temperature | | | 185 | | $^\circ\text{C}$ |
| $T_{(HYST)}$ | Hysteresis of thermal shutdown | | | 20 | | $^\circ\text{C}$ |

5.7 Typical Characteristics

$V_{IN} = 14\text{ V}$, $V_{EN} \geq 2\text{ V}$, $T_J = -40^\circ\text{C}$ to 150°C (unless otherwise noted)

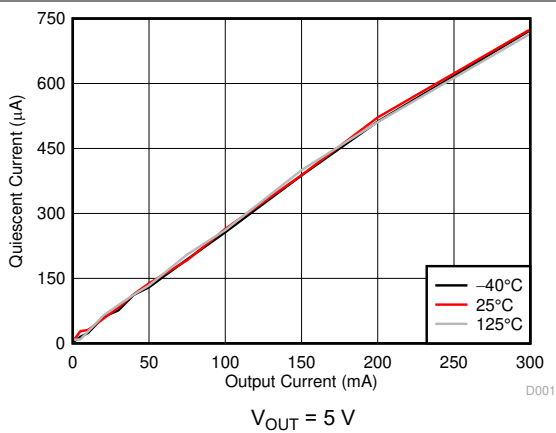


Figure 5-1. Quiescent Current vs Output Current

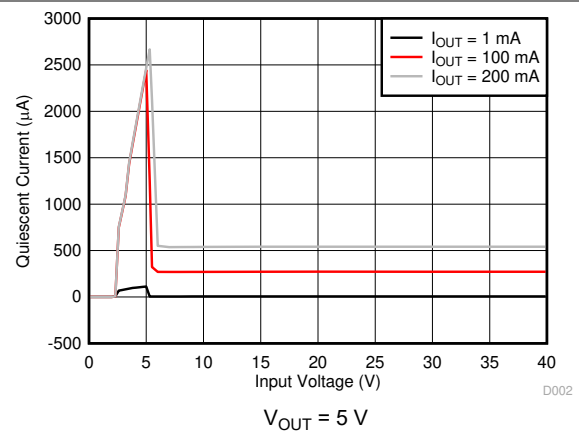


Figure 5-2. Quiescent Current vs Input Voltage

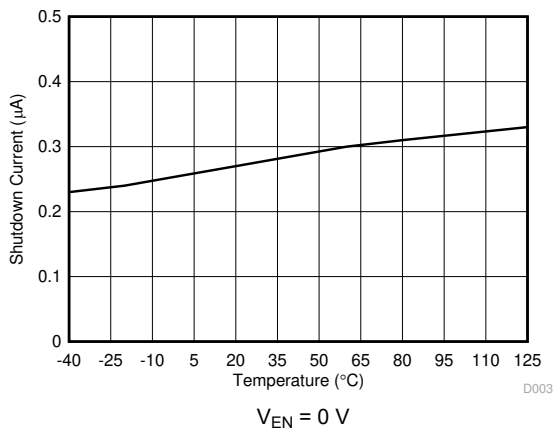


Figure 5-3. Shutdown Current vs Ambient Temperature

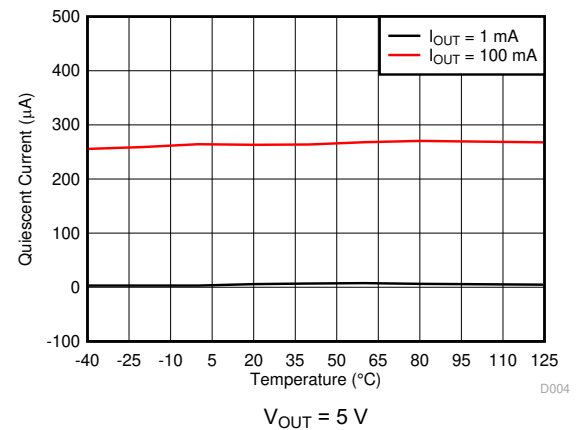


Figure 5-4. Quiescent Current vs Ambient Temperature

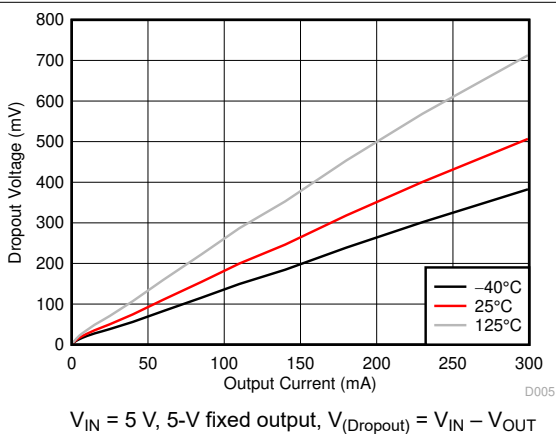


Figure 5-5. Dropout Voltage vs Output Current

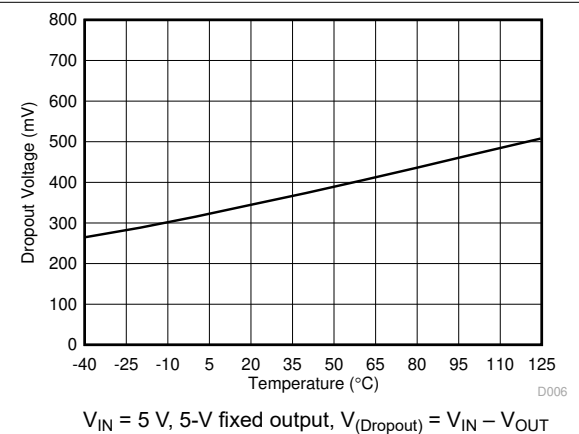


Figure 5-6. Dropout Voltage vs Ambient Temperature

5.7 Typical Characteristics (continued)

$V_{IN} = 14\text{ V}$, $V_{EN} \geq 2\text{ V}$, $T_J = -40^\circ\text{C}$ to 150°C (unless otherwise noted)

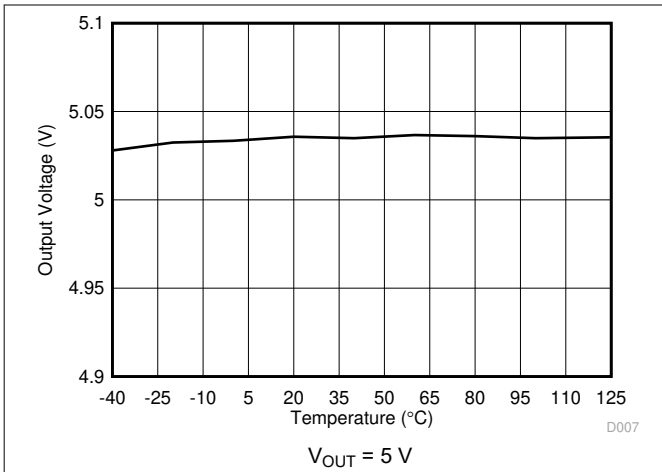


Figure 5-7. Output Voltage vs Ambient Temperature

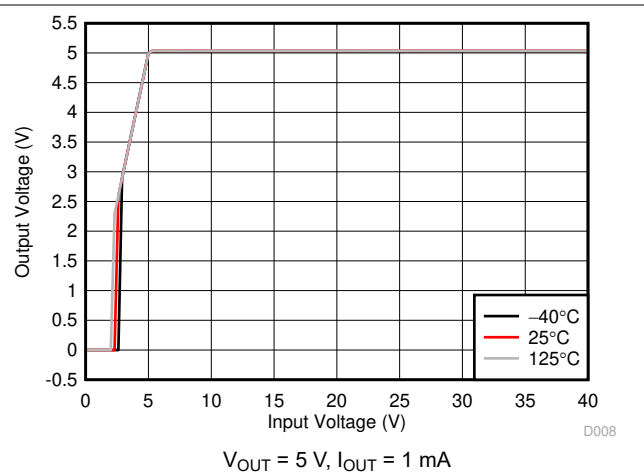


Figure 5-8. Output Voltage vs Input Voltage

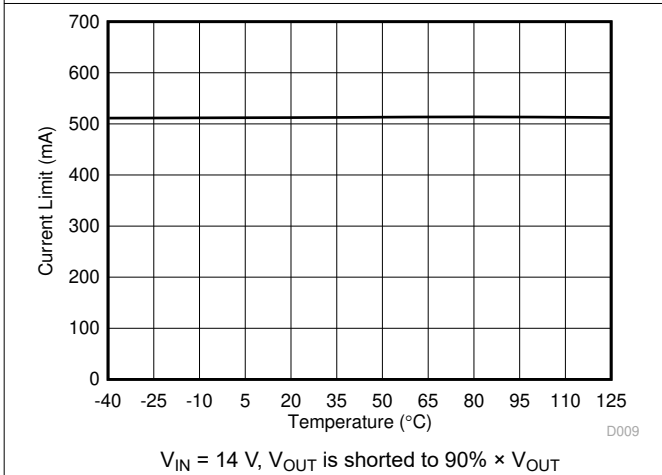


Figure 5-9. Output Current Limit vs Ambient Temperature

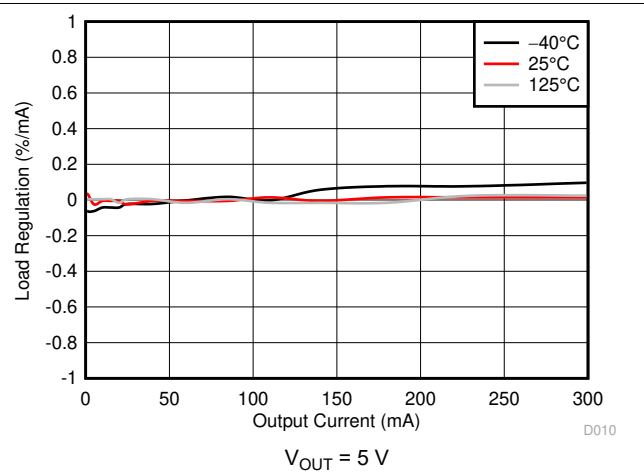


Figure 5-10. Load Regulation

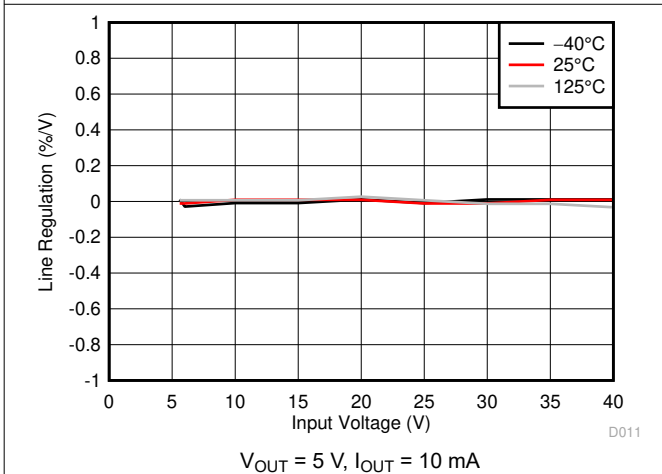


Figure 5-11. Line Regulation

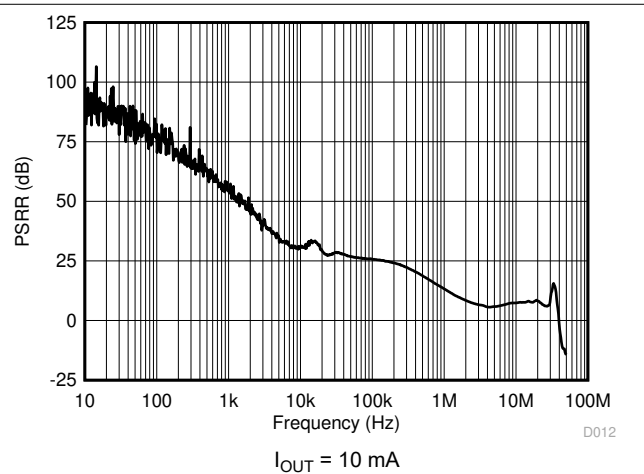
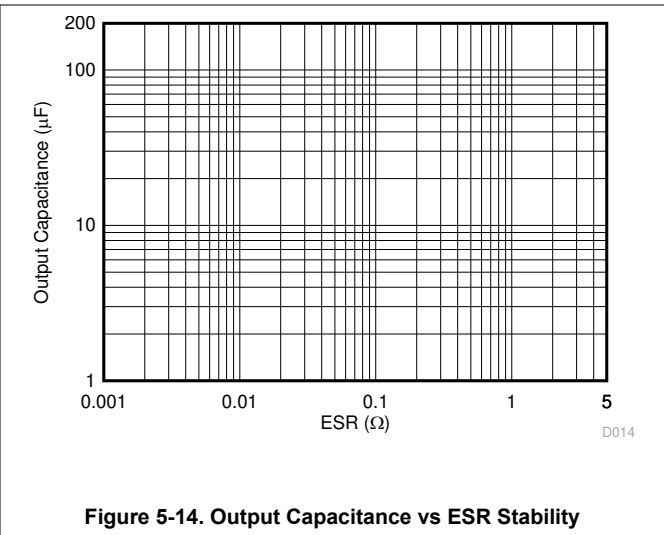
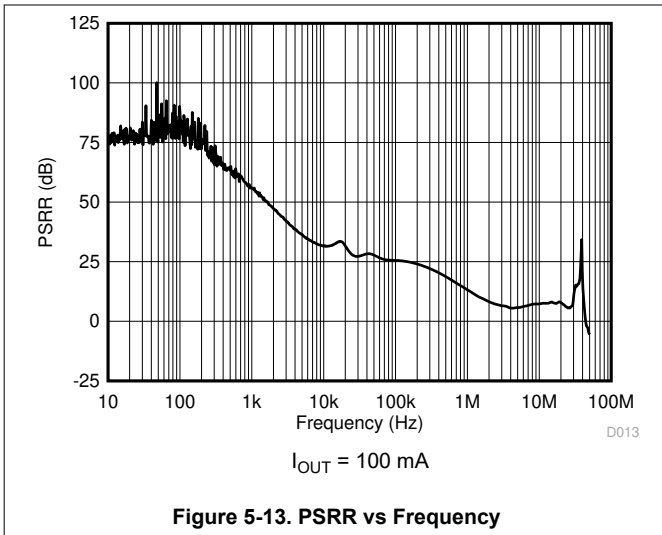


Figure 5-12. PSRR vs Frequency

5.7 Typical Characteristics (continued)

$V_{IN} = 14\text{ V}$, $V_{EN} \geq 2\text{ V}$, $T_J = -40^\circ\text{C}$ to 150°C (unless otherwise noted)

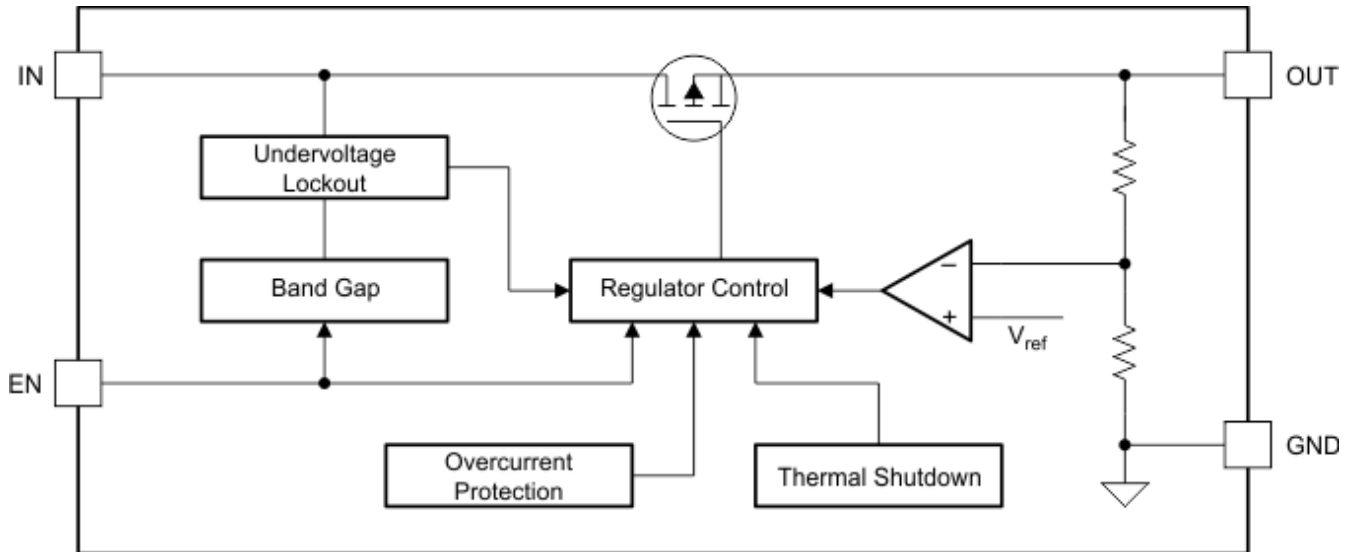


6 Detailed Description

6.1 Overview

The TPS7B82-Q1 is a 40-V, 300-mA low-dropout (LDO) linear regulator with ultra-low quiescent current. This voltage regulator consumes only 3 μA of quiescent current at light load, and is designed for the automotive always-on application.

6.2 Functional Block Diagram



6.3 Feature Description

6.3.1 Device Enable (EN)

The EN pin is a high-voltage-tolerant pin. A high input activates the device and turns the regulation ON. Connect this pin to an external microcontroller or a digital circuit to enable and disable the device, or connect to the IN pin for self-bias applications.

6.3.2 Undervoltage Shutdown

This device has an integrated undervoltage lockout (UVLO) circuit to shut down the output if the input voltage (V_{IN}) falls below an internal UVLO threshold ($V_{(UVLO)}$). This threshold limit ensures that the regulator does not latch into an unknown state during low-input-voltage conditions. If the input voltage has a negative transient that drops below the UVLO threshold and recovers, the regulator shuts down and powers up with a normal power-up sequence when the input voltage is above the required level.

6.3.3 Current Limit

This device features current-limit protection to keep the device in a safe operating area when an overload or output short-to-ground condition occurs. This limit protects the device from excessive power dissipation. For example, during a short-circuit condition on the output, fault protection limits the current through the pass element to $I_{(LIM)}$ to protect the device from excessive power dissipation.

6.3.4 Thermal Shutdown

This device incorporates a thermal shutdown (TSD) circuit as a protection from overheating. For continuous normal operation, the junction temperature must not exceed the TSD trip point. The junction temperature exceeding the TSD trip point causes the output to turn off. When the junction temperature falls below the TSD trip point minus thermal shutdown hysteresis, the output turns on again.

6.4 Device Functional Modes

6.4.1 Operation With V_{IN} Lower Than 3 V

The device normally operates with input voltages above 3 V. The device can also operate at lower input voltages; the maximum UVLO voltage is 2.7 V. At input voltages below the actual UVLO voltage, the device does not operate.

6.4.2 Operation With V_{IN} Larger Than 3 V

When V_{IN} is greater than 3 V, if V_{IN} is also higher than the output set value plus the device dropout voltage, V_{OUT} is equal to the set value. Otherwise, V_{OUT} is equal to V_{IN} minus the dropout voltage.

7 Application and Implementation

Note

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

7.1 Application Information

The TPS7B82-Q1 is a 300-mA, 40-V low-dropout linear regulator with ultra-low quiescent current. The PSpice transient model is available for download on the product folder and can be used to evaluate the basic function of the device.

7.2 Typical Application

Figure 7-1 shows a typical application circuit for the TPS7B82-Q1. Different values of external components can be used, depending on the end application. An application may require a larger output capacitor during fast load steps to prevent a large drop on the output voltage. Use a low-ESR ceramic capacitor with a dielectric of type X5R or X7R.

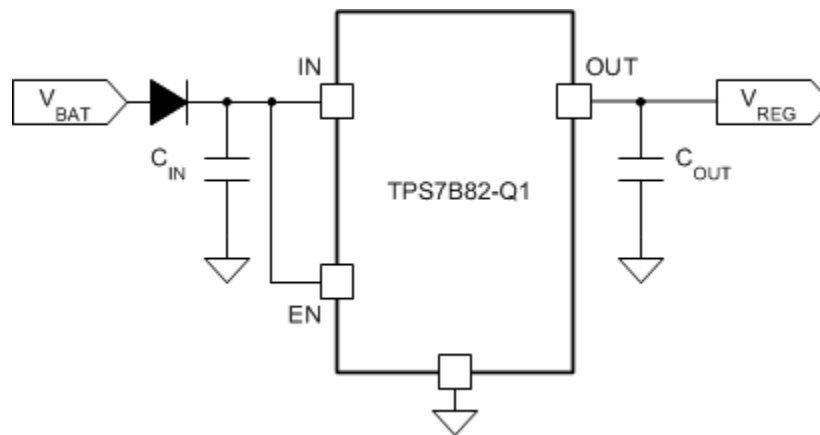


Figure 7-1. TPS7B82-Q1 Typical Application Schematic

7.2.1 Design Requirements

For this design example, use the parameters listed in Table 7-1.

Table 7-1. Design Requirements Parameters

| PARAMETER | VALUE |
|---------------------|----------------|
| Input voltage range | 3 V to 40 V |
| Output voltage | 5 V or 3.3 V |
| Output current | 300 mA maximum |

7.2.2 Detailed Design Procedure

To begin the design process, determine the following:

- Input voltage range
- Output voltage
- Output current

7.2.2.1 Input Capacitor

Although an input capacitor is not required for stability, good analog design practice is to connect a 10- μF to 22- μF capacitor from IN to GND. This capacitor counteracts reactive input sources and improves transient response, input ripple rejection, and PSRR. The voltage rating must be greater than the maximum input voltage.

7.2.2.2 Output Capacitor

To ensure the stability of the TPS7B82-Q1, the device requires an output capacitor with a value in the range from 1 μF to 200 μF and with an ESR range between 0.001 Ω and 5 Ω . Select a ceramic capacitor with low ESR to improve the load transient response.

7.2.3 Application Curve

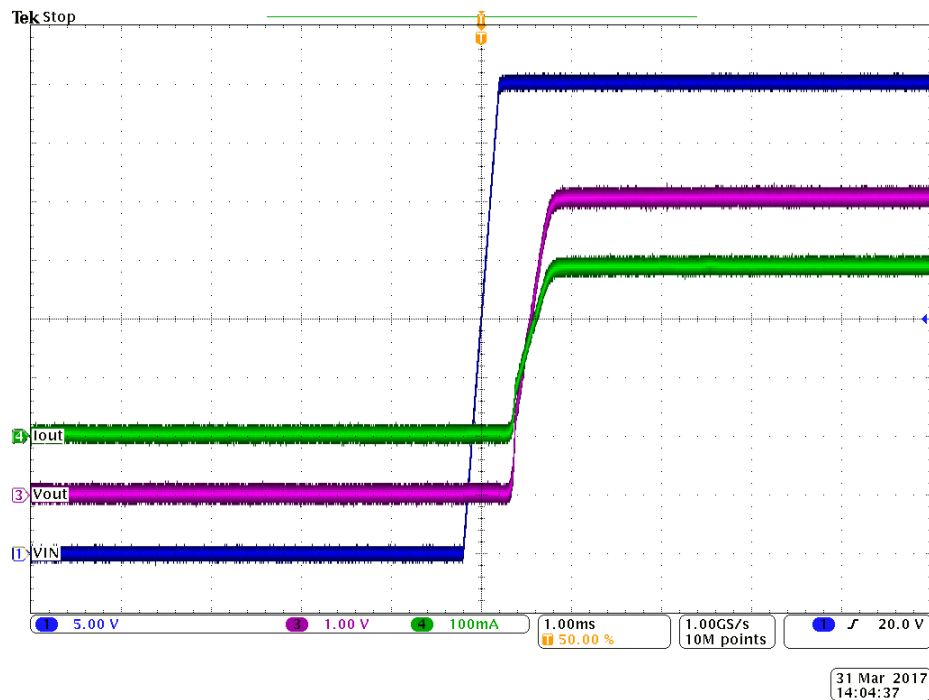


Figure 7-2. TPS7B82-Q1 Power-Up Waveform (5 V)

7.3 Power Supply Recommendations

The device is designed to operate from an input voltage supply range from 3 V to 40 V. This input supply must be well regulated. If the input supply is located more than a few inches from the TPS7B82-Q1, add a capacitor with a value greater than or equal to 10 μF with a 0.1- μF bypass capacitor in parallel at the input.

7.4 Layout

7.4.1 Layout Guidelines

For LDO power supplies, especially high-voltage and large output current supplies, layout is an important step. If layout is not carefully designed, the regulator can fail to deliver enough output current because of thermal limitation. To improve the thermal performance of the device, and to maximize the current output at high ambient temperature, spread the copper under the thermal pad as far as possible and place enough thermal vias on the copper under the thermal pad. [Figure 7-3](#) shows an example layout.

7.4.2 Layout Example

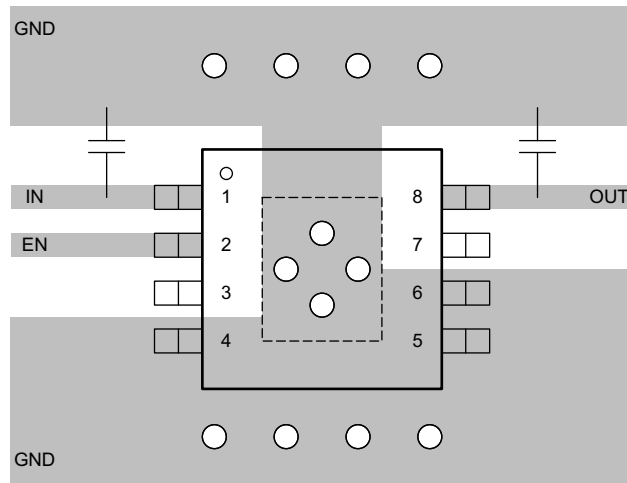


Figure 7-3. TPS7B82-Q1 Example Layout Diagram

8 Device and Documentation Support

8.1 Device Nomenclature

Table 8-1. Available Options

| PRODUCT ⁽¹⁾ | DESCRIPTION |
|------------------------|---|
| TPS7B82xxQ(W)yyyzQ1 | <p>xx is the nominal output voltage (for example, 50 = 5.0V, 33 = 3.3V).</p> <p>Q indicates that this device is a grade-1 device in accordance with the AEC-Q100 standard.</p> <p>yyy is the package designator.</p> <p>z is the reel quantity.</p> <p>Q1 indicates that this device is an automotive grade (AEC-Q100) device.</p> |
| TPS7B82xxE yyyzQ1 | <p>xx is the nominal output voltage (for example, 50 = 5.0V, 33 = 3.3V).</p> <p>E indicates that this device is a grade-0 device in accordance with the AEC-Q100 standard.</p> <p>yyy is the package designator.</p> <p>z is the reel quantity.</p> <p>Q1 indicates that this device is an automotive grade (AEC-Q100) device.</p> |

(1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or see the TI website at www.ti.com.

8.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* 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.

8.3 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](#).

8.4 Trademarks

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

8.5 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.

8.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

9 Revision History

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

| Changes from Revision J (August 2023) to Revision K (September 2025) | Page |
|---|-------------|
| • Added WSON wettable flank (DRV) package to document..... | 1 |

| Changes from Revision I (September 2017) to Revision J (August 2023) | Page |
|---|-------------|
| • Changed V_{OUT} parameter test conditions in <i>Electrical Characteristics</i> table..... | 5 |

-
- Added *Device Nomenclature* section..... 16
-

10 Mechanical, Packaging, and Orderable Information

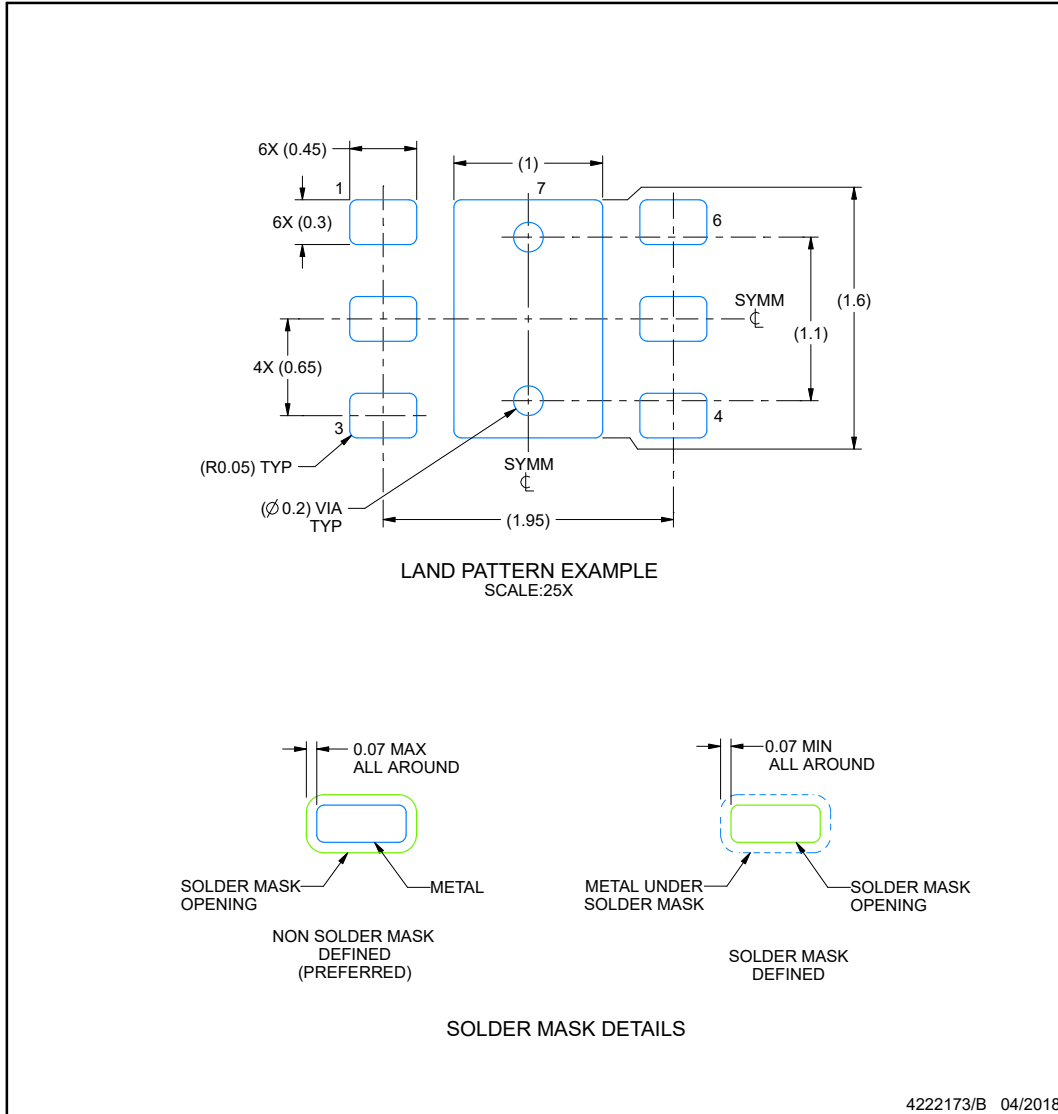
The following pages include mechanical, packaging, and orderable information. This information is the most-current data available for the designated device. This data is subject to change without notice and without revision of this document. For browser-based versions of this data sheet, see the left-hand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

EXAMPLE BOARD LAYOUT

DRV0006A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



NOTES: (continued)

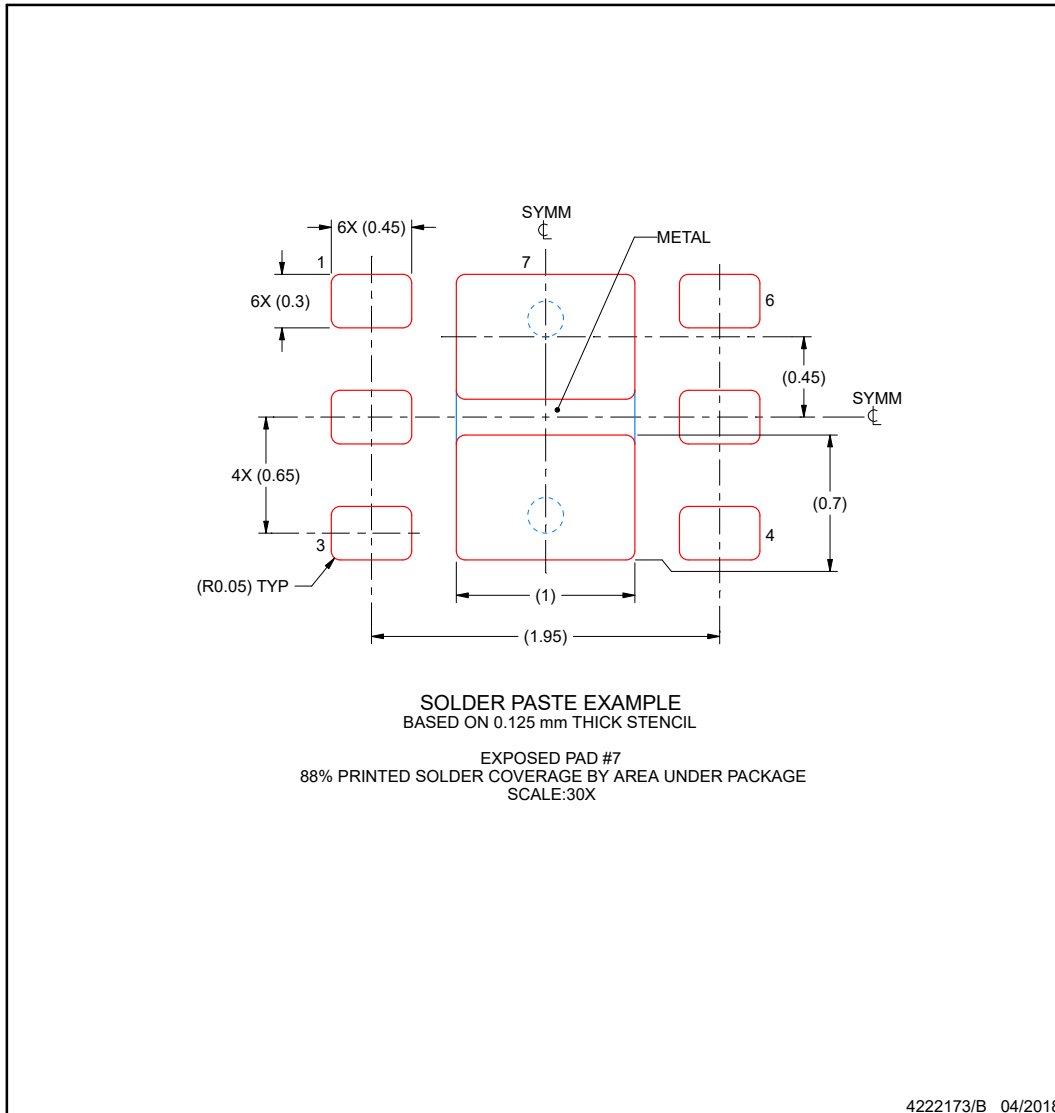
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If some or all are implemented, recommended via locations are shown.

EXAMPLE STENCIL DESIGN

DRV0006A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



NOTES: (continued)

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

PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package Pins | Package qty Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|-----------------------------------|---------------|----------------------|-------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|-------------------------|---------------------|
| TPS7B8225QDGNRQ1 | Active | Production | HVSSOP (DGN) 8 | 2500 LARGE T&R | Yes | NIPDAUAG | Level-2-260C-1 YEAR | -40 to 150 | 1QFX |
| TPS7B8225QDGNRQ1.A | Active | Production | HVSSOP (DGN) 8 | 2500 LARGE T&R | Yes | NIPDAUAG | Level-2-260C-1 YEAR | See TPS7B8225QDGNRQ1 | 1QFX |
| TPS7B8233EPWPRQ1 | Active | Production | HTSSOP (PWP) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 165 | 7B8233E |
| TPS7B8233EPWPRQ1.A | Active | Production | HTSSOP (PWP) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 165 | 7B8233E |
| TPS7B8233QDGNRQ1 | Active | Production | HVSSOP (DGN) 8 | 2500 LARGE T&R | Yes | NIPDAUAG | Level-2-260C-1 YEAR | -40 to 150 | 1GGX |
| TPS7B8233QDGNRQ1.A | Active | Production | HVSSOP (DGN) 8 | 2500 LARGE T&R | Yes | NIPDAUAG | Level-2-260C-1 YEAR | See TPS7B8233QDGNRQ1 | 1GGX |
| TPS7B8233QDRVRQ1 | Active | Production | WSON (DRV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 150 | 1ORH |
| TPS7B8233QDRVRQ1.A | Active | Production | WSON (DRV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | See TPS7B8233QDRVRQ1 | 1ORH |
| TPS7B8233QKVURQ1 | Active | Production | TO-252 (KVU) 5 | 2500 LARGE T&R | Yes | SN | Level-3-260C-168 HR | -40 to 150 | 7B8233Q1 |
| TPS7B8233QKVURQ1.A | Active | Production | TO-252 (KVU) 5 | 2500 LARGE T&R | Yes | SN | Level-3-260C-168 HR | See TPS7B8233QKVURQ1 | 7B8233Q1 |
| TPS7B8233QWDRVRQ1 | Active | Production | WSON (DRV) 6 | 3000 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 150 | 3NIH |
| TPS7B8250EPWPRQ1 | Active | Production | HTSSOP (PWP) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | -40 to 165 | 7B8250E |
| TPS7B8250EPWPRQ1.A | Active | Production | HTSSOP (PWP) 14 | 2500 LARGE T&R | Yes | NIPDAU | Level-3-260C-168 HR | See TPS7B8250EPWPRQ1 | 7B8250E |
| TPS7B8250QDGNRQ1 | Active | Production | HVSSOP (DGN) 8 | 2500 LARGE T&R | Yes | NIPDAUAG | Level-2-260C-1 YEAR | -40 to 150 | 19TX |
| TPS7B8250QDGNRQ1.A | Active | Production | HVSSOP (DGN) 8 | 2500 LARGE T&R | Yes | NIPDAUAG | Level-2-260C-1 YEAR | See TPS7B8250QDGNRQ1 | 19TX |
| TPS7B8250QDRVRQ1 | Active | Production | WSON (DRV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | -40 to 150 | 1UFH |
| TPS7B8250QDRVRQ1.A | Active | Production | WSON (DRV) 6 | 3000 LARGE T&R | Yes | NIPDAU | Level-2-260C-1 YEAR | See TPS7B8250QDRVRQ1 | 1UFH |
| TPS7B8250QKVURQ1 | Active | Production | TO-252 (KVU) 5 | 2500 LARGE T&R | Yes | SN | Level-3-260C-168 HR | -40 to 150 | 7B8250Q1 |
| TPS7B8250QKVURQ1.A | Active | Production | TO-252 (KVU) 5 | 2500 LARGE T&R | Yes | SN | Level-3-260C-168 HR | See TPS7B8250QKVURQ1 | 7B8250Q1 |
| TPS7B8250QWDRVRQ1 | Active | Production | WSON (DRV) 6 | 3000 LARGE T&R | Yes | SN | Level-1-260C-UNLIM | -40 to 150 | 3NJH |

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

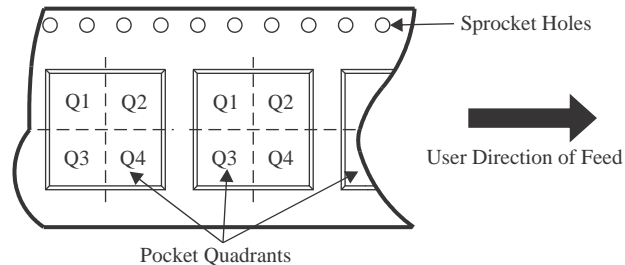
- (2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- (3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- (4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- (5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TPS7B8225QDGNRQ1 | HVSSOP | DGN | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TPS7B8233EPWPRQ1 | HTSSOP | PWP | 14 | 2500 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TPS7B8233QDGNRQ1 | HVSSOP | DGN | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TPS7B8233QDRVRQ1 | WSON | DRV | 6 | 3000 | 180.0 | 8.4 | 2.3 | 2.3 | 1.15 | 4.0 | 8.0 | Q2 |
| TPS7B8233QKVURQ1 | TO-252 | KVU | 5 | 2500 | 330.0 | 16.4 | 6.9 | 10.5 | 2.7 | 8.0 | 16.0 | Q2 |
| TPS7B8233QWDRVRQ1 | WSON | DRV | 6 | 3000 | 180.0 | 8.4 | 2.3 | 2.3 | 1.15 | 4.0 | 8.0 | Q2 |
| TPS7B8250EPWPRQ1 | HTSSOP | PWP | 14 | 2500 | 330.0 | 12.4 | 6.9 | 5.6 | 1.6 | 8.0 | 12.0 | Q1 |
| TPS7B8250QDGNRQ1 | HVSSOP | DGN | 8 | 2500 | 330.0 | 12.4 | 5.3 | 3.4 | 1.4 | 8.0 | 12.0 | Q1 |
| TPS7B8250QDRVRQ1 | WSON | DRV | 6 | 3000 | 180.0 | 8.4 | 2.3 | 2.3 | 1.15 | 4.0 | 8.0 | Q2 |
| TPS7B8250QKVURQ1 | TO-252 | KVU | 5 | 2500 | 330.0 | 16.4 | 6.9 | 10.5 | 2.7 | 8.0 | 16.0 | Q2 |
| TPS7B8250QWDRVRQ1 | WSON | DRV | 6 | 3000 | 180.0 | 8.4 | 2.3 | 2.3 | 1.15 | 4.0 | 8.0 | Q2 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TPS7B8225QDGNRQ1 | HVSSOP | DGN | 8 | 2500 | 366.0 | 364.0 | 50.0 |
| TPS7B8233EPWPRQ1 | HTSSOP | PWP | 14 | 2500 | 353.0 | 353.0 | 32.0 |
| TPS7B8233QDGNRQ1 | HVSSOP | DGN | 8 | 2500 | 366.0 | 364.0 | 50.0 |
| TPS7B8233QDRVRQ1 | WSON | DRV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| TPS7B8233QKVURQ1 | TO-252 | KVU | 5 | 2500 | 340.0 | 340.0 | 38.0 |
| TPS7B8233QWDRVRQ1 | WSON | DRV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| TPS7B8250EPWPRQ1 | HTSSOP | PWP | 14 | 2500 | 353.0 | 353.0 | 32.0 |
| TPS7B8250QDGNRQ1 | HVSSOP | DGN | 8 | 2500 | 366.0 | 364.0 | 50.0 |
| TPS7B8250QDRVRQ1 | WSON | DRV | 6 | 3000 | 210.0 | 185.0 | 35.0 |
| TPS7B8250QKVURQ1 | TO-252 | KVU | 5 | 2500 | 340.0 | 340.0 | 38.0 |
| TPS7B8250QWDRVRQ1 | WSON | DRV | 6 | 3000 | 210.0 | 185.0 | 35.0 |

GENERIC PACKAGE VIEW

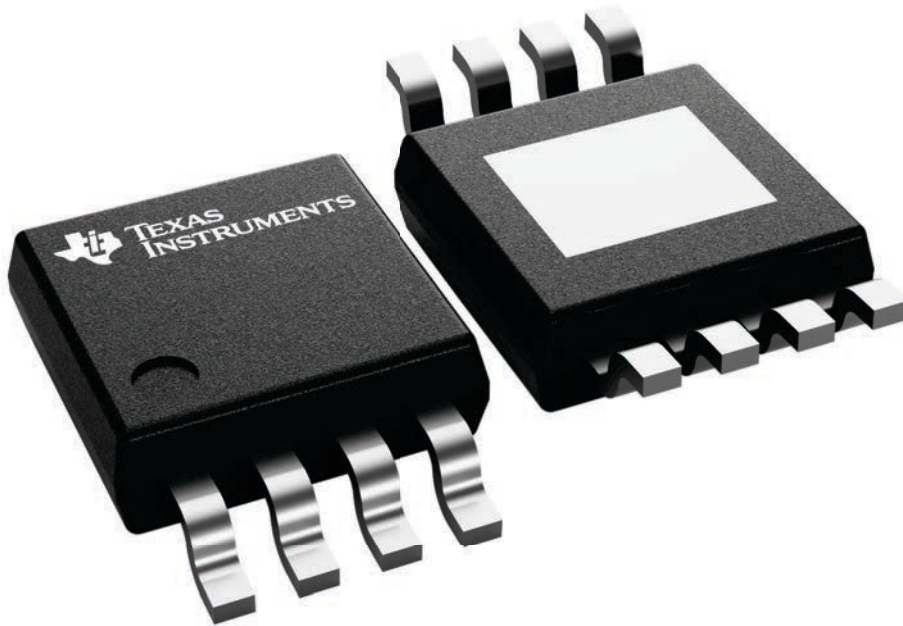
DGN 8

PowerPAD™ HVSSOP - 1.1 mm max height

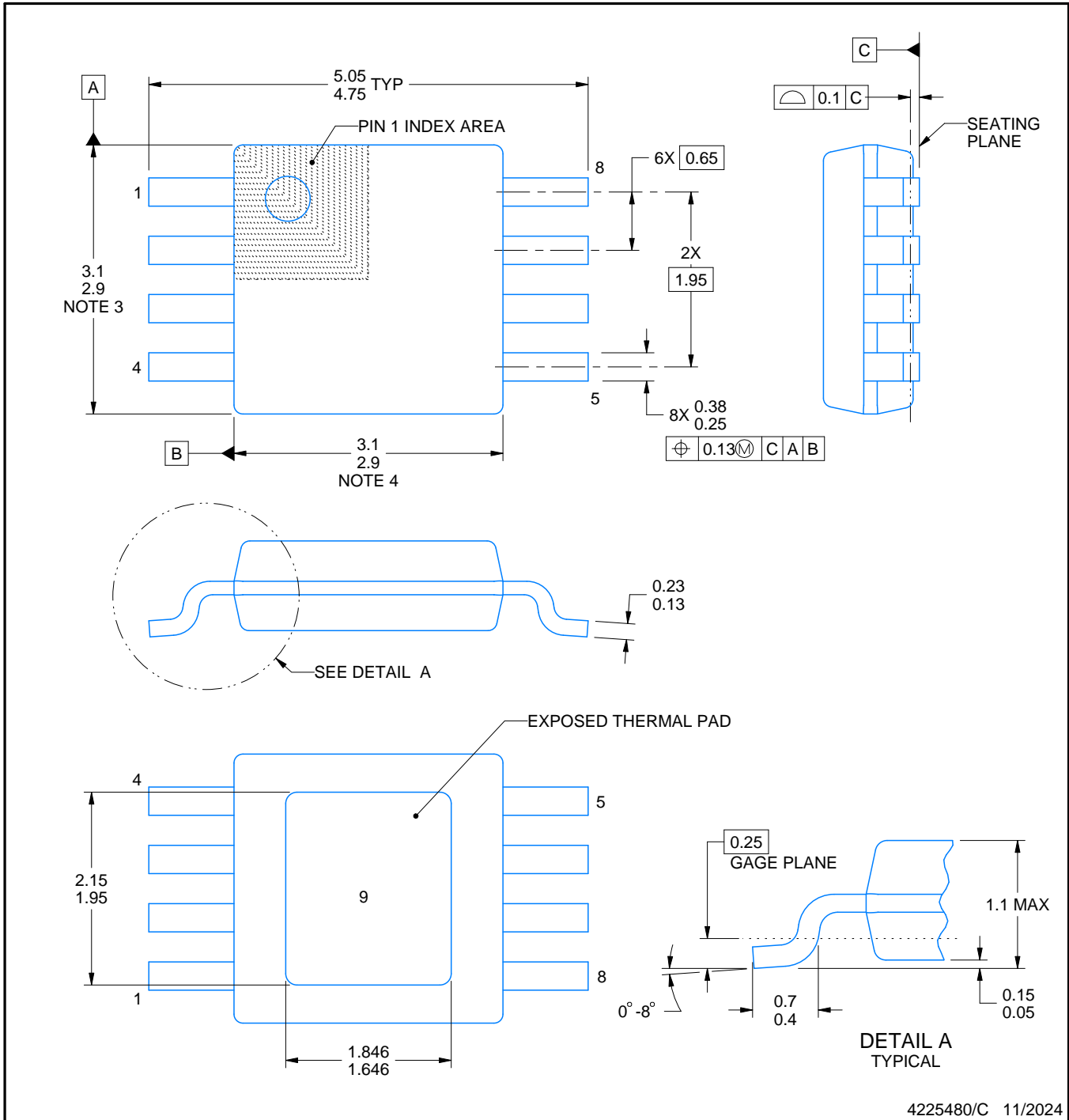
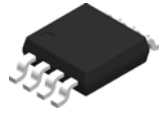
3 x 3, 0.65 mm pitch

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/B



4225480/C 11/2024

NOTES:

PowerPAD is a trademark of Texas Instruments.

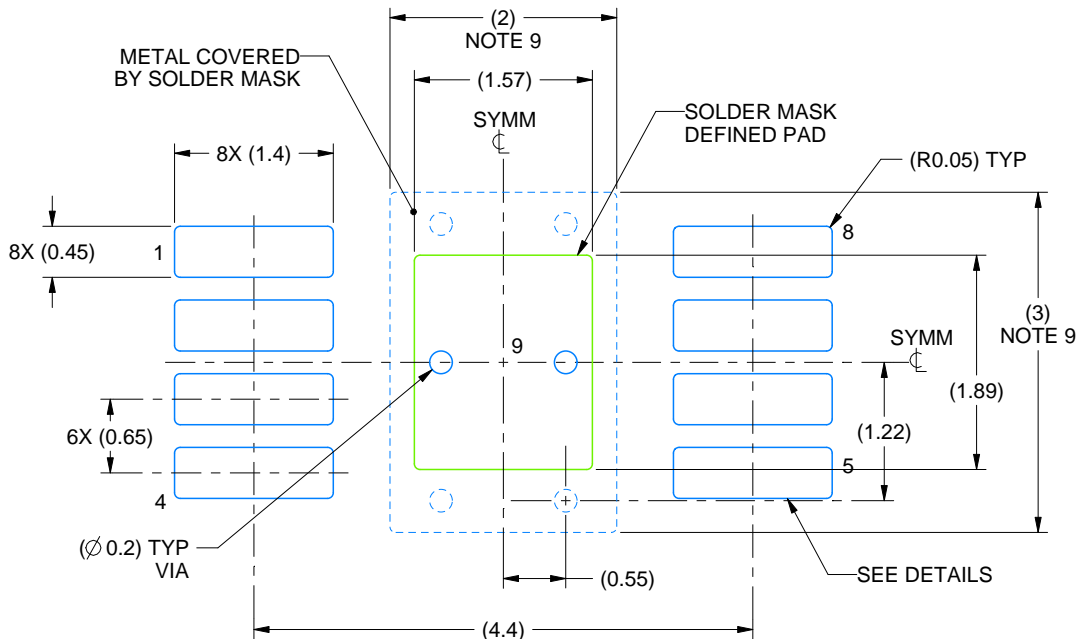
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or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

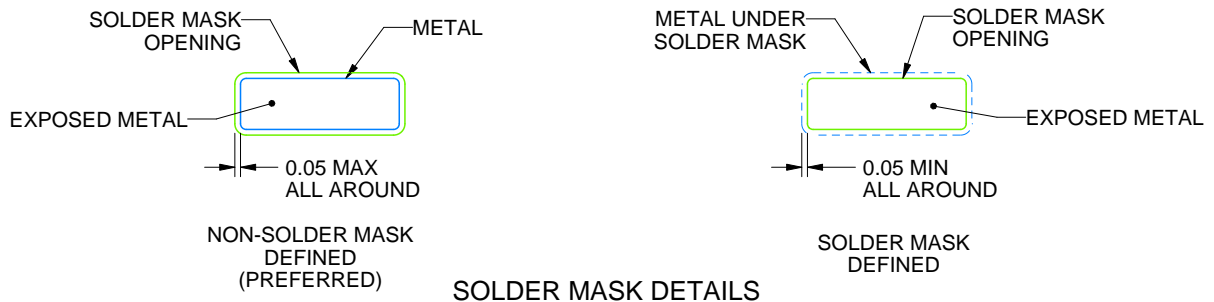
DGN0008G

PowerPAD™ HVSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



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NOTES: (continued)

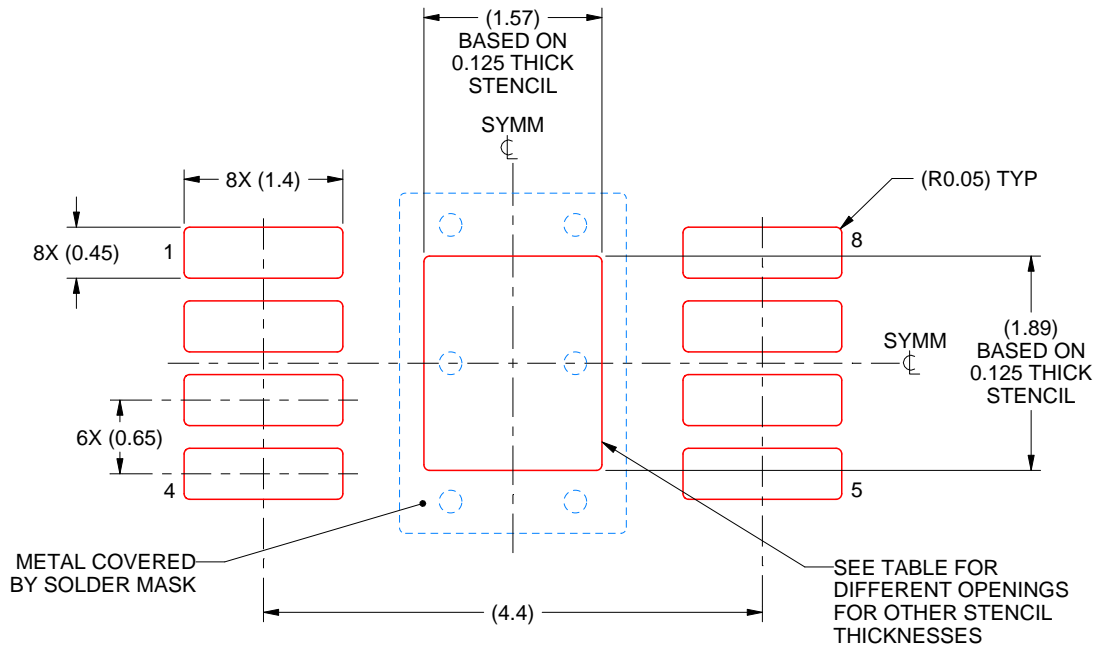
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It 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

DGN0008G

PowerPAD™ HVSSOP - 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 |

4225480/C 11/2024

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.

GENERIC PACKAGE VIEW

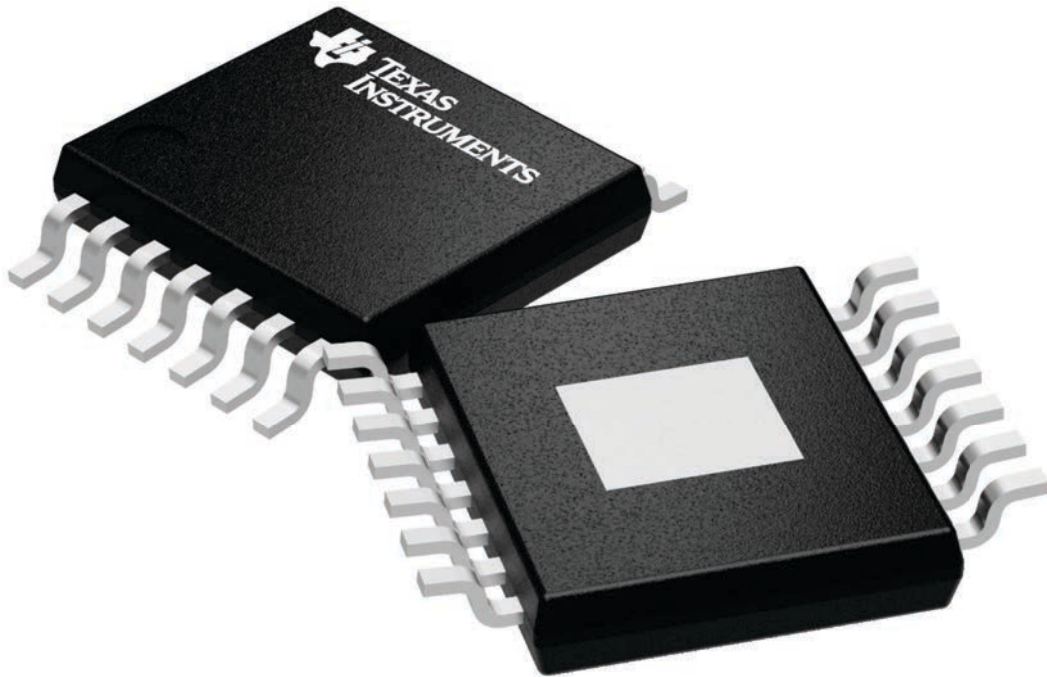
PWP 14

PowerPAD TSSOP - 1.2 mm max height

4.4 x 5.0, 0.65 mm pitch

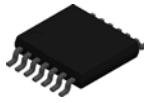
PLASTIC SMALL OUTLINE

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



4224995/A

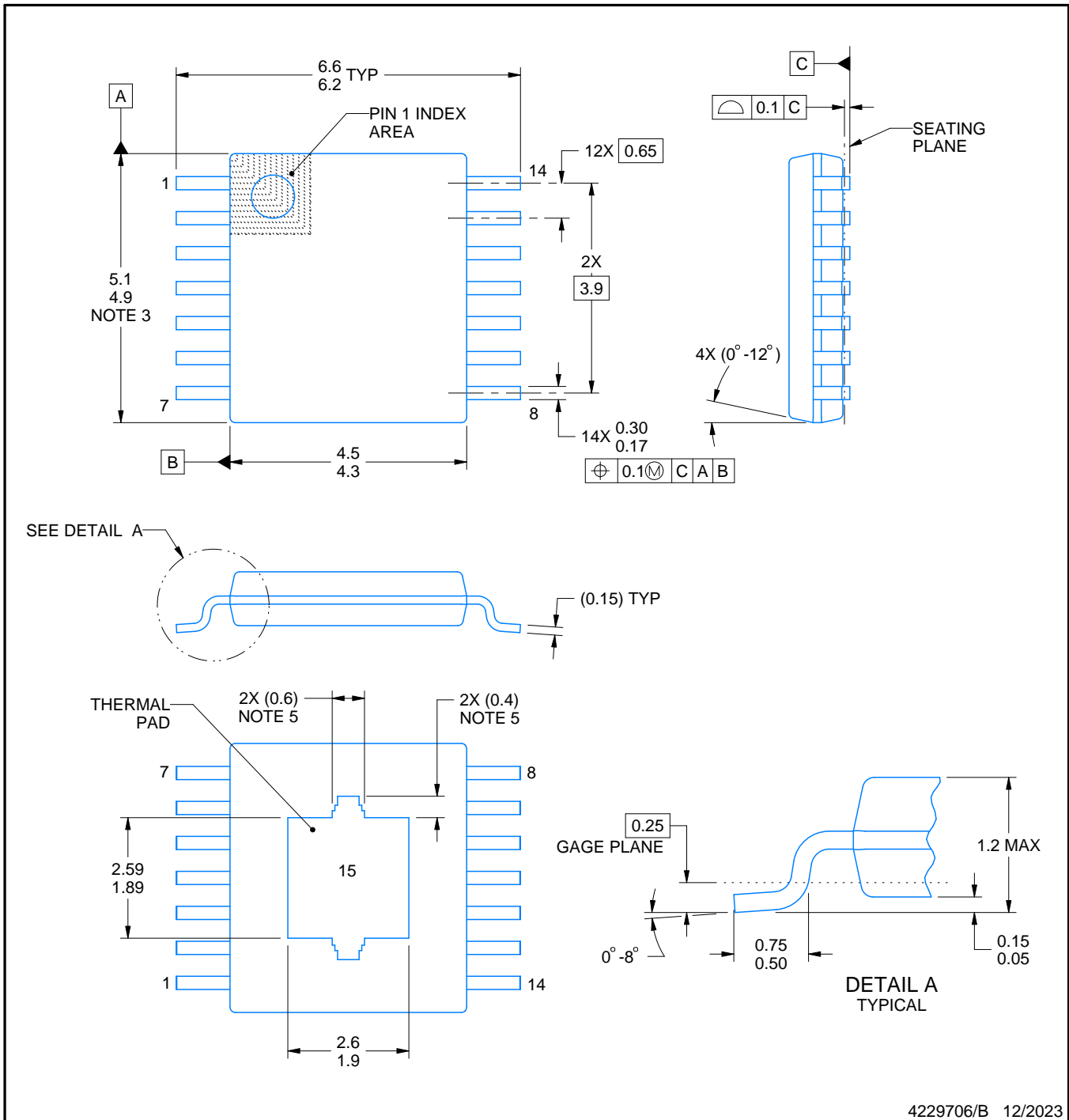
PWP0014K



PACKAGE OUTLINE

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



4229706/B 12/2023

NOTES:

PowerPAD is a trademark of Texas Instruments.

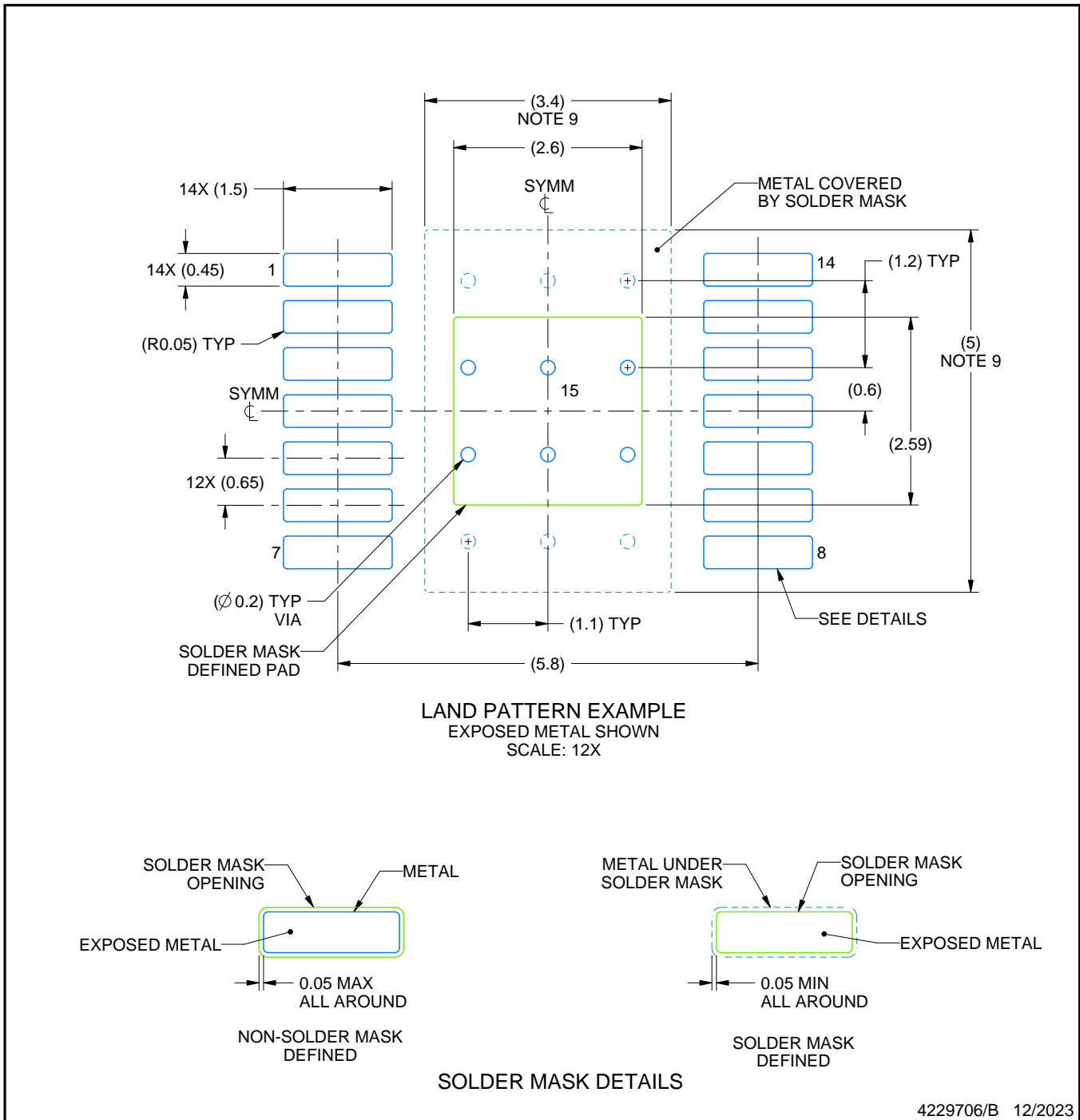
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. Reference JEDEC registration MO-153.
5. Features may differ or may not be present.

EXAMPLE BOARD LAYOUT

PWP0014K

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



NOTES: (continued)

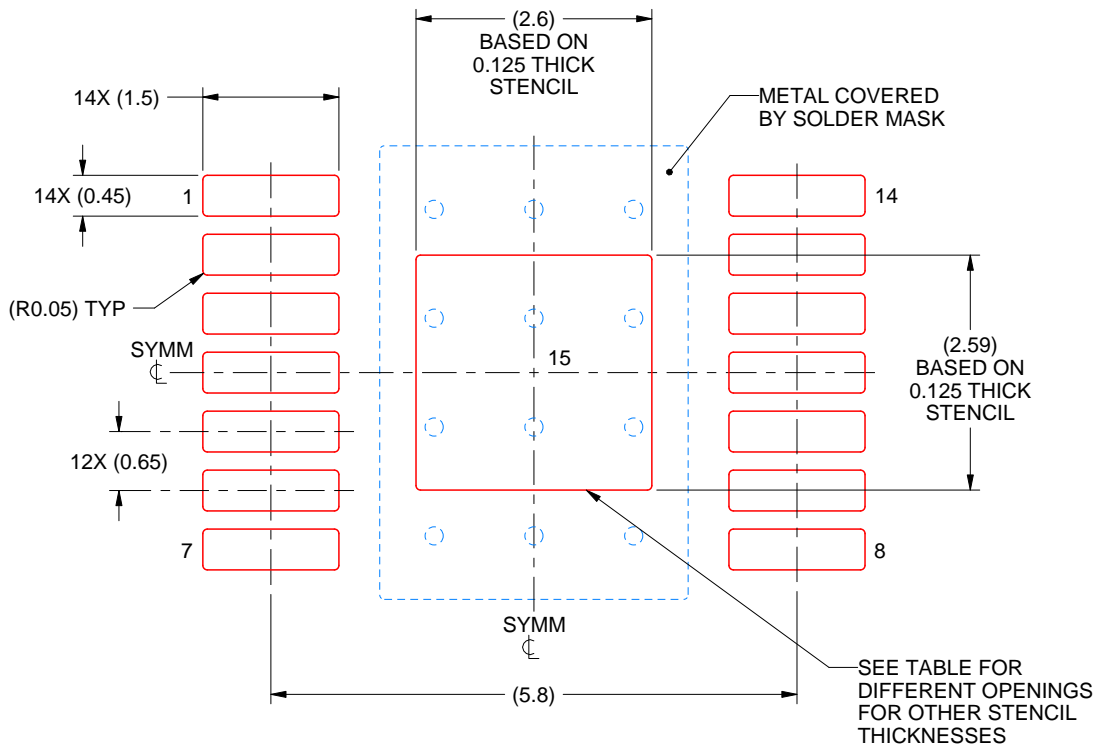
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002 (www.ti.com/lit/slma002) and SLMA004 (www.ti.com/lit/slma004).
9. Size of metal pad may vary due to creepage requirement.
10. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

PWP0014K

PowerPAD™ TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE
 BASED ON 0.125 mm THICK STENCIL
 SCALE: 12X

| STENCIL THICKNESS | SOLDER STENCIL OPENING |
|-------------------|------------------------|
| 0.1 | 2.91 X 2.90 |
| 0.125 | 2.60 X 2.59 (SHOWN) |
| 0.15 | 2.37 X 2.36 |
| 0.175 | 2.20 X 2.19 |

4229706/B 12/2023

NOTES: (continued)

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

GENERIC PACKAGE VIEW

DRV 6

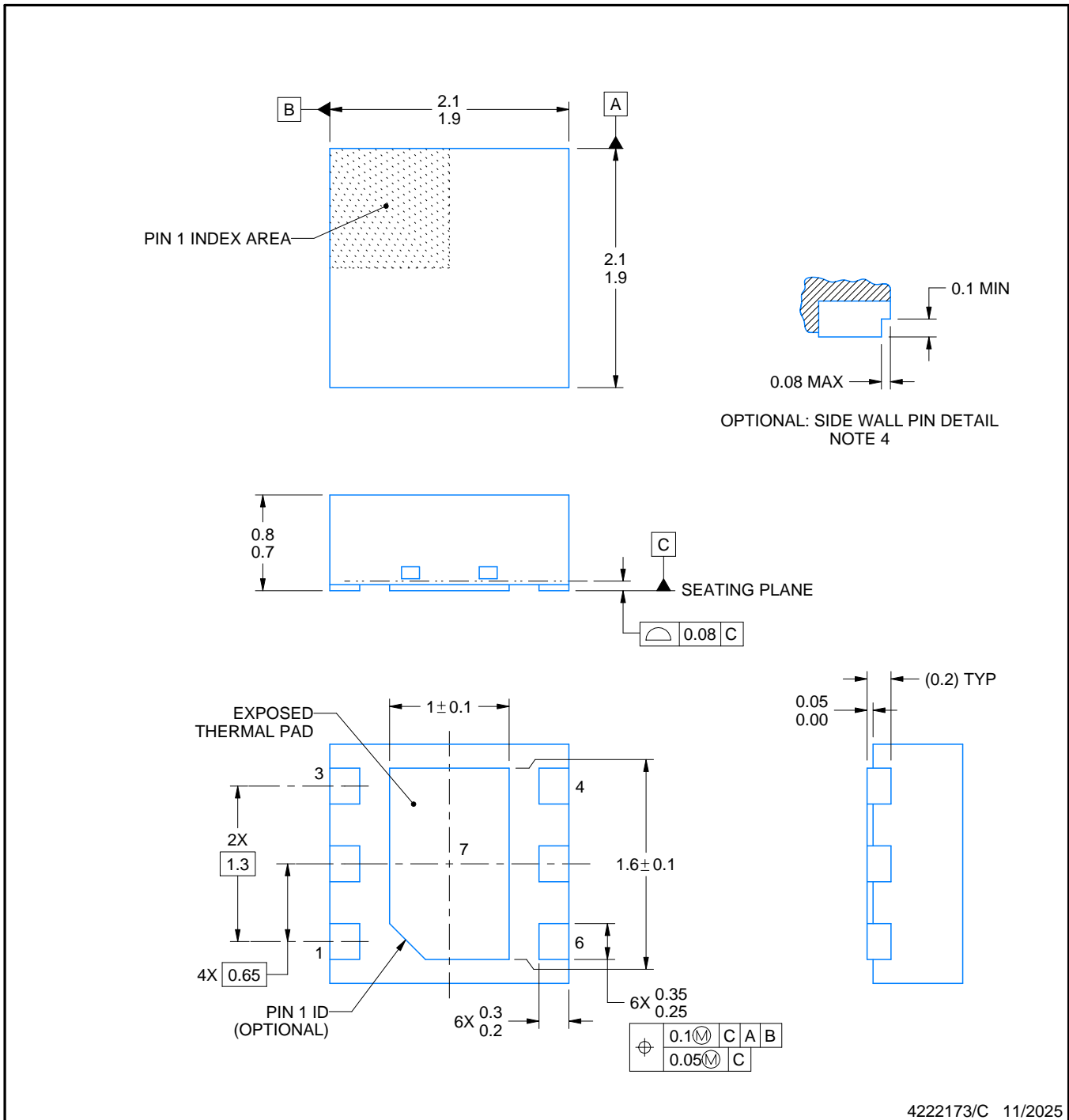
WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4206925/F



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. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Minimum 0.1 mm solder wetting on pin side wall. Available for wettable flank version only.

EXAMPLE STENCIL DESIGN

DRV0006A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD #7
88% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:30X

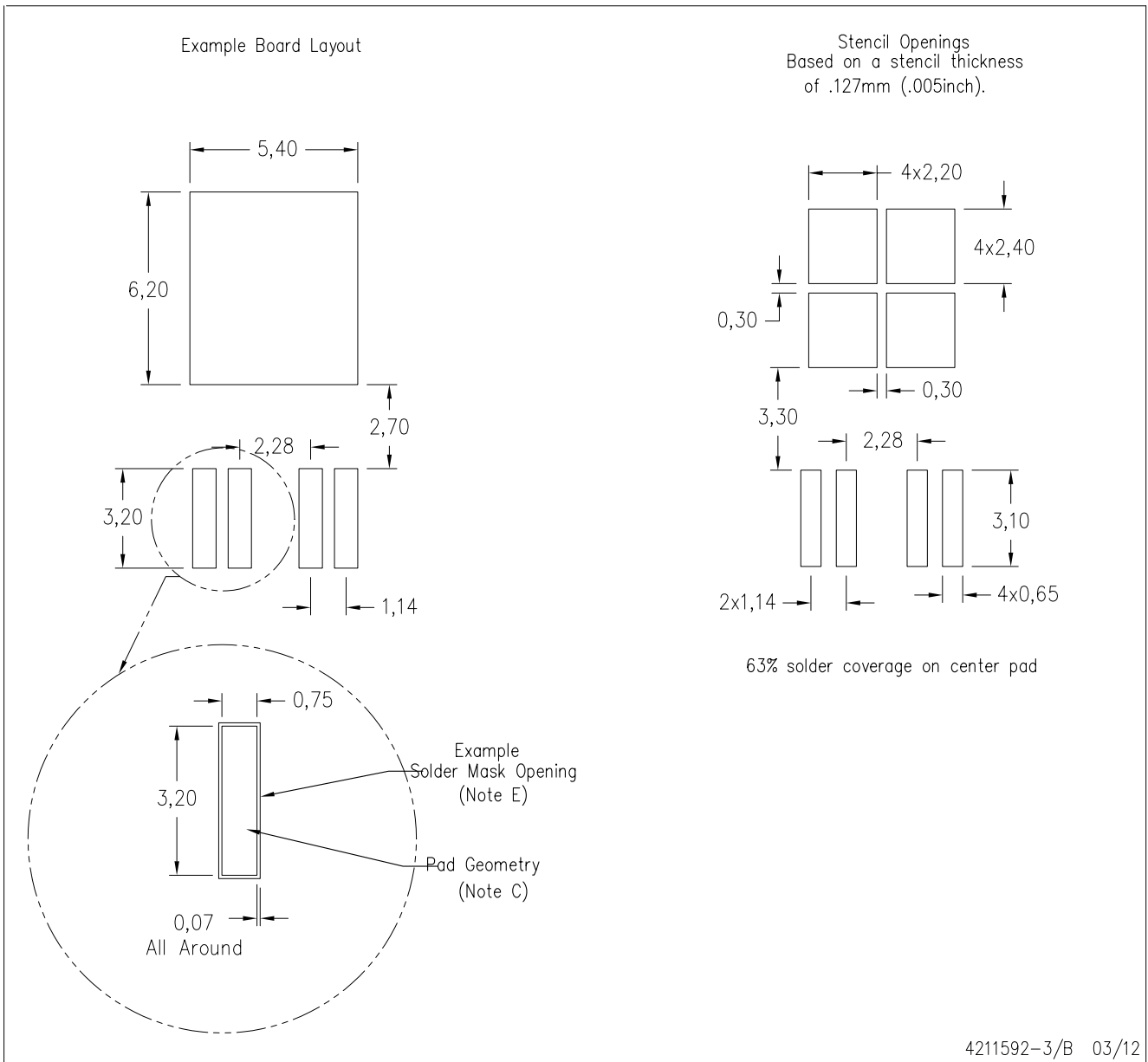
4222173/C 11/2025

NOTES: (continued)

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

KVU (R-PSFM-G5)

PLASTIC FLANGE MOUNT PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-SM-782 is an alternate information source for PCB land pattern designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in thermal pad.

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