TPS7A19

40-V, 450-mA, Wide V_{IN}, Low I_Q, Low-Dropout Voltage Regulator with Power Good

1 Features

- Wide Input Voltage Range: 4 V to 40 V
- Adjustable Output Voltage: 1.5 V to 18 V
- Output Current: 450 mA
- Low Quiescent Current (I_Q): 15 µA
- Low Dropout Voltage: 450 mV (max) at 400 mA
- Power Good with Programmable Delay
- Thermal Shutdown and Overcurrent Protection
- Stable with Ceramic Output Capacitors:
  - 10 µF to 500 µF for $V_{OUT} \geq 2.5$ V
  - 22 µF to 500 µF for $V_{OUT} < 2.5$ V
- Operating Temperature: –40°C to +125°C
- Package: 3-mm × 3-mm SON-8

2 Applications

- Smart Grid Infrastructure and Metering
- Power Tools
- Motor Drives
- Access Control Systems
- Test and Measurement

3 Description

The TPS7A19 is a low-dropout linear regulator (LDO) with a wide input voltage (V_{IN}) range up to 40 V, capable of sourcing high output current (I_{OUT}) up to 450 mA. This voltage regulator is ideal for generating a low-voltage supply from wide input-voltage rails. Not only does the TPS7A19 supply a well-regulated voltage rail, but the device also withstands and maintains regulation during voltage transients by acting as a simple surge protection circuit.

The TPS7A19 consumes only 15 µA of quiescent current (I_Q) at light loads, thereby lowering the power consumption for always-on or battery-powered applications.

The TPS7A19 features integrated thermal shutdown and overcurrent protection. The TPS7A19 also offers a power good output (PG) with a programmable delay that indicates when the output voltage is in regulation. This feature is useful for power-rail sequencing functions.

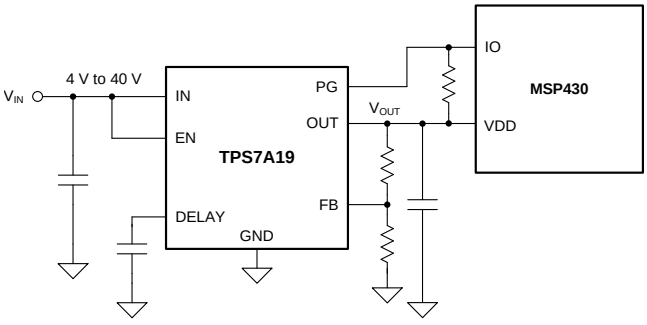
This LDO is available in a small, 3-mm × 3-mm, thermally-enhanced, 8-pin SON package.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS7A19	SON (8)	3.00 mm × 3.00 mm

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

Typical Application Schematic



Quiescent Current vs Input Voltage at V_{OUT} = 1.5 V

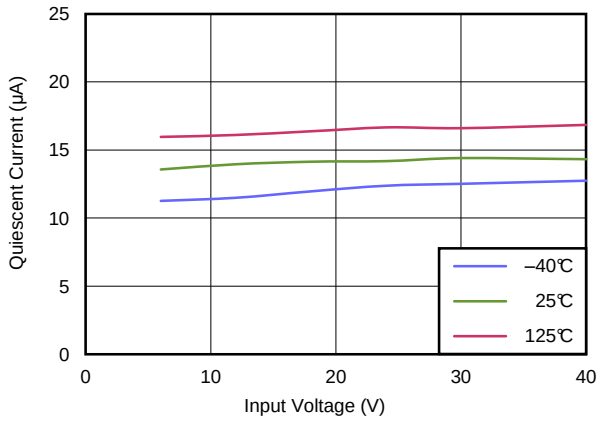


Table of Contents

1 Features ... 1
2 Applications ... 1
3 Description ... 1
4 Revision History ... 2
5 Pin Configuration and Functions ... 3
6 Specifications ... 4
6.1 Absolute Maximum Ratings ... 4
6.2 ESD Ratings ... 4
6.3 Recommended Operating Conditions ... 4
6.4 Thermal Information ... 4
6.5 Electrical Characteristics ... 5
6.6 Timing Requirements ... 5
6.7 Typical Characteristics ... 6
7 Detailed Description ... 8
7.1 Overview ... 8
7.2 Functional Block Diagram ... 8
7.3 Feature Description ... 8
7.4 Device Functional Modes ... 10
8 Application and Implementation ... 11
8.1 Application Information ... 11
8.2 Typical Application ... 11
9 Power Supply Recommendations ... 13
10 Layout ... 13
10.1 Layout Guidelines ... 13
10.2 Layout Example ... 13
11 Device and Documentation Support ... 14
11.1 Device Support ... 14
11.2 Documentation Support ... 14
11.3 Receiving Notification of Documentation Updates 14
11.4 Community Resources ... 14
11.5 Trademarks ... 14
11.6 Electrostatic Discharge Caution ... 15
11.7 Glossary ... 15
12 Mechanical, Packaging, and Orderable Information ... 15

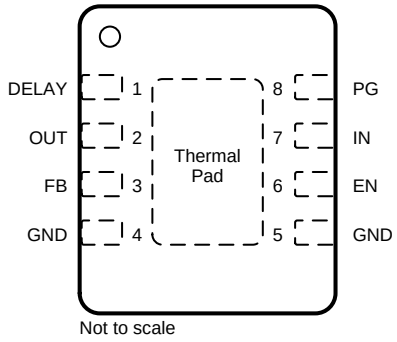
4 Revision History

Changes from Original (May 2016) to Revision A **Page**

- Changed from product preview to production data ... 1

5 Pin Configuration and Functions

DRB Package
8-Pin SON With Thermal Pad
Top View



Not to scale

Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
DELAY	1	—	Delay pin. Connect a capacitor to GND to adjust the PG delay time; leave open if the PG function is not needed.
EN	6	I	Enable pin. This pin turns the regulator on or off. If $V_{EN} \geq V_{EN\_HI}$, the regulator is enabled. If $V_{EN} \leq V_{EN\_LO}$, the regulator is disabled. If not used, the EN pin can be connected to IN.
FB	3	I	Feedback pin. The feedback pin is the input to the control-loop error amplifier.
GND	4,5	—	Ground pin.
IN	7	I	Regulator input supply pin.
OUT	2	O	Regulator output pin. When the output voltage is larger than 2.5 V, connect a 10-μF to 500-μF ceramic capacitor with an equivalent series resistance (ESR) from 0.001 to 20 Ω to assure stability. When the output voltage is from 1.5 V to 2.5 V, the minimum, stable capacitor value should be 22 μF.
PG	8	O	Power good. This open-drain pin must be connected to V_{OUT} through an external resistor. PG is pulled low when the output voltage goes below threshold.
Thermal pad		—	Solder to printed-circuit-board (PCB) to enhance thermal performance. Although the thermal pad can be left floating, connect the thermal pad to the ground plane for optimal performance.

6 Specifications

6.1 Absolute Maximum Ratings

over operating free-air temperature range –40°C to 125°C(unless otherwise noted)(1)

			MIN	MAX	UNIT
Voltage(2)	Input	IN, EN	–0.3	45	V
	Output	OUT(3)	–0.3	V_{IN} + 0.3	
		DELAY(4)	–0.3	45	
		FB, PG	–0.3	22	
Current	Peak output		Internally limited		
Temperature	Operating junction, T_J		–40	150	°C
	Storage, T_{stg}		–65	150	

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) All voltage values are with respect to GND.
(3) The absolute maximum rating is VIN + 0.3 V or 22 V, whichever is lower.
(4) The voltage at the DELAY pin must be lower than the V_{IN} voltage.

6.2 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.

6.3 Recommended Operating Conditions

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

		MIN	MAX	UNIT
V_{IN}	Input supply voltage	4	40	V
V_{OUT}	Output voltage	1.5	18	V
V_{EN}	Enable voltage	0	40	V
T_J	Operating junction temperature	–40	125	°C

6.4 Thermal Information

THERMAL METRIC(1)		TPS7A19 DRB (VSON) 8 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	48	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	56.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	22.4	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.9	°C/W
ψ_{JB}	Junction-to-board characterization parameter	22.5	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	4.6	°C/W

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

6.5 Electrical Characteristics

at T_J = –40°C to +125°C, V_{IN} = 14 V , V_{EN} = V_{IN}, I_{OUT} = 200 µA, C_{IN} = 22 µF, and C_{OUT} = 47 µF (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
SUPPLY VOLTAGE AND CURRENT							
V_{IN}	Input voltage	V_{OUT} ≤ 3.5 V , I_{OUT} = 0 mA to 450 mA		4		40	V
		V_{OUT} ≥ 3.5 V , I_{OUT} = 0 mA to 450 mA		V_{OUT} + 0.5		40	V
I_Q	Quiescent current	V_{IN} = 4 V to 40 V, V_{OUT} = 1.5 V, V_{EN} = 5 V, I_{OUT} = 0.2 mA			15	25	µA
		V_{IN} = 18.5 V to 40 V, V_{OUT} = 18 V, V_{EN} = 5 V, I_{OUT} = 0.2 mA			25	40	
I_{SHDN}	Shutdown current	V_{EN} = 0 V, I_{OUT} = 0 mA , V_{IN} = 18 V, V_{OUT} = 1.5 V				4	µA
V_{FB}	Feedback voltage	Reference voltage for FB pin		1.208	1.233	1.258	V
V_{IN_UVLO}	Undervoltage lockout	Ramp V_{IN} down until output is turned off				2.6	V
$UVLO_{Hys}$	Undervoltage detection hysteresis	V_{IN} rising			1		V
ENABLE INPUT (EN)							
V_{EN_LO}	Logic input low level			0		0.4	V
V_{EN_HI}	Logic input high level			1.7			V
I_{EN}	EN pin current	V_{EN} = 40 V , V_{IN} = 14 V				1	µA
REGULATED OUTPUT							
V_{OUT}	Regulated output(1)	V_{IN} = V_{OUT} + 1 V to 40 V and V_{IN} ≥ 4 V, I_{OUT} = 100 µA to 450 mA		–2%		2%	
$\Delta V_{O(\Delta VI)}$	Line regulation	V_{IN} = V_{OUT} + 1 V to 40 V and V_{IN} ≥ 4 V, I_{OUT} = 100 mA				10	mV
$\Delta V_{O(\Delta IL)}$	Load regulation	I_{OUT} = 1 mA to 450 mA, V_{IN} = V_{OUT} + 1 V and V_{IN} ≥ 4 V				10	mV
V_{DO}	Dropout voltage	V_{IN} – V_{OUT}, I_{OUT} = 400 mA			240	450	mV
		V_{IN} – V_{OUT}, I_{OUT} = 200 mA			160	300	
I_{OUT}	Output current	V_{OUT} in regulation		0		450	mA
I_{CL}	Output current-limit	V_{OUT} short to ground		140		360	mA
		V_{OUT} = V_{OUT} nominal × 0.9		470		850	
PSRR	Power-supply ripple rejection(2)	I_{OUT} = 100 mA, C_{OUT} = 22 µF	f = 100 Hz		60		dB
			f = 100 kHz		40		
PG							
V_{OL}	PG output low voltage	I_{OL} = 0.5 mA				0.4	V
I_{OH}	PG leakage current	PG pulled to $V_{OUT}$with 10-kΩ resistor				1	µA
$V_{T(PG)}$	Power good threshold	V_{OUT} power-up		89.6	91.6	93.6	% of V_{OUT}
V_{hys}	Hysteresis	V_{OUT} power-down			2		% of V_{OUT}
PG DELAY							
I_{Delay}	Delay capacitor charging current			5	9.5	14	µA
$V_{T(PG\_DLY)}$	Delay pin comparator threshold voltage				1		V
TEMPERATURE							
T_{sd}	Junction shutdown temperature	Temperature increasing			175		°C
T_{hys}	Hysteresis of thermal shutdown				24		°C

(1) Accuracy specification does not apply on any application condition that exceeds the power dissipation limit of the package under test. External resistor divider variation is not considered for accuracy measurement.
(2) Design information; not tested, specified by characterization.

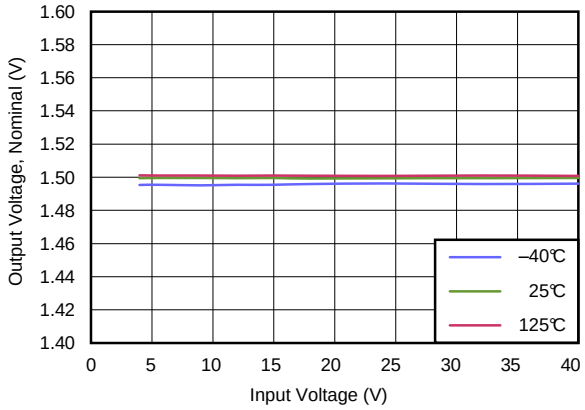
6.6 Timing Requirements

			MIN	TYP	MAX	UNIT
TIMING FOR PG						
t_{PG_DLY}	Power good delay	C = delay-capacitor value capacitance = 100 nF(1)		10.5		ms
$t_{PG\text{-}fixed}$	Power good delay	No capacitor on pin		325		µs
$t_{PG(HL)}$	PG falling propagation delay	V_{OUT} low to PG low		180		µs

(1) Information only; not tested in production. The equation is based on: (C × 1) / (9.5 × 10^{-6}) = t_{PG_DLY}, where C = delay capacitor value capacitance; range = 100 pF to 500 nF.

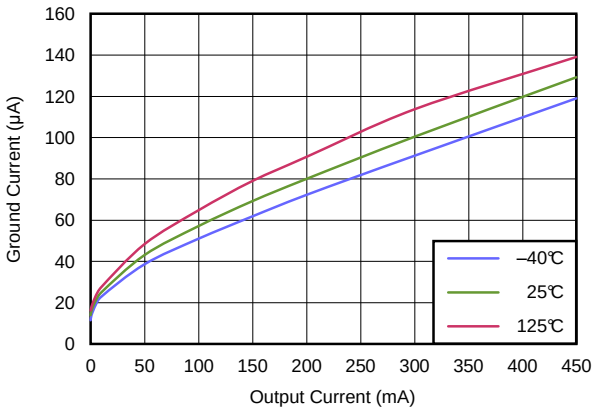
6.7 Typical Characteristics

at T_J = –40°C to +125°C, V_{IN} = 14 V , V_{EN} = V_{IN}, I_{OUT} = 200 µA, C_{IN} = 22 µF, and C_{OUT} = 47 µF (unless otherwise noted)



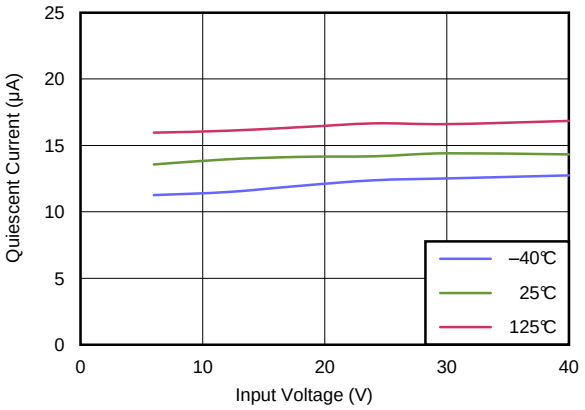
V_{OUT} = 1.5 V, I_{OUT} = 100 mA

Figure 1. Line Regulation



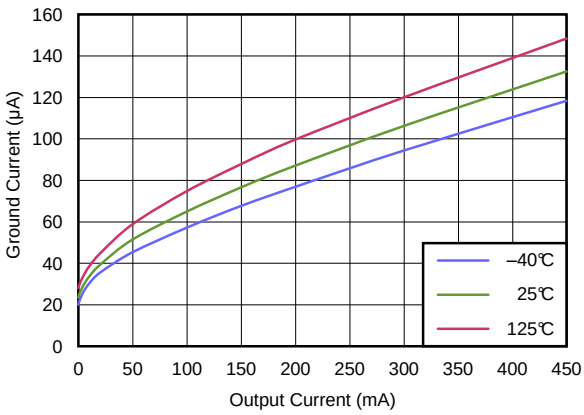
V_{IN} = 14 V, V_{OUT} = 1.5 V

Figure 2. Ground Current vs Output Current



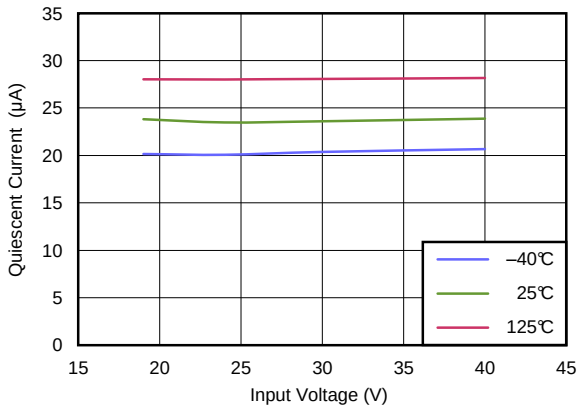
V_{OUT} = 1.5 V

Figure 3. Quiescent Current vs Input Voltage



V_{IN} = 24 V, V_{OUT} = 18 V

Figure 4. Ground Current vs Output Current



V_{OUT} = 18 V

Figure 5. Quiescent Current vs Input Voltage

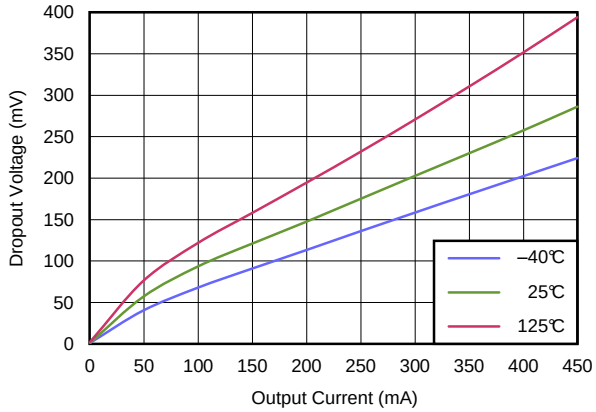
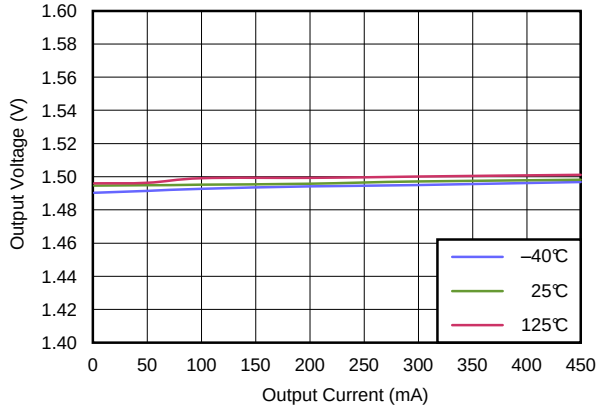


Figure 6. Dropout Voltage vs Output Current

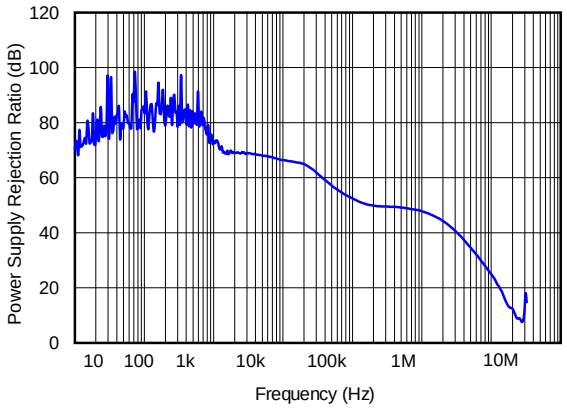
Typical Characteristics (continued)

at T_J = –40°C to +125°C, V_{IN} = 14 V , V_{EN} = V_{IN}, I_{OUT} = 200 µA, C_{IN} = 22 µF, and C_{OUT} = 47 µF (unless otherwise noted)



V_{IN} = 14 V, V_{OUT} = 1.5 V

Figure 7. Load Regulation



V_{OUT} = 5 V, C_{OUT} = 47 µF, I_{OUT} = 10 mA

Figure 8. Power-Supply Rejection Ratio vs Frequency

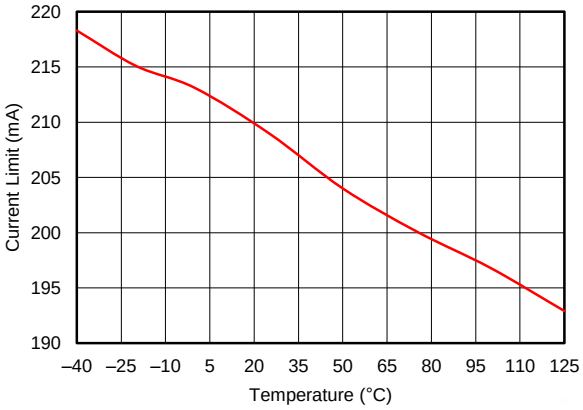


Figure 9. Short to GND Current-Limit vs Temperature

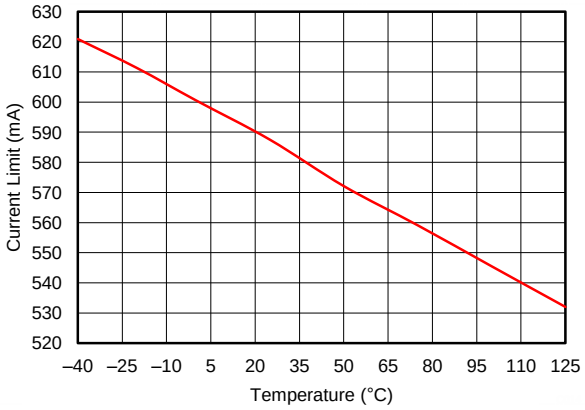


Figure 10. Current-Limit vs Temperature

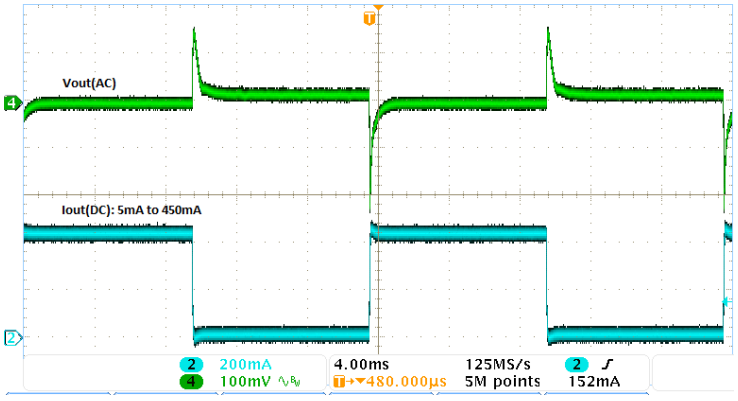


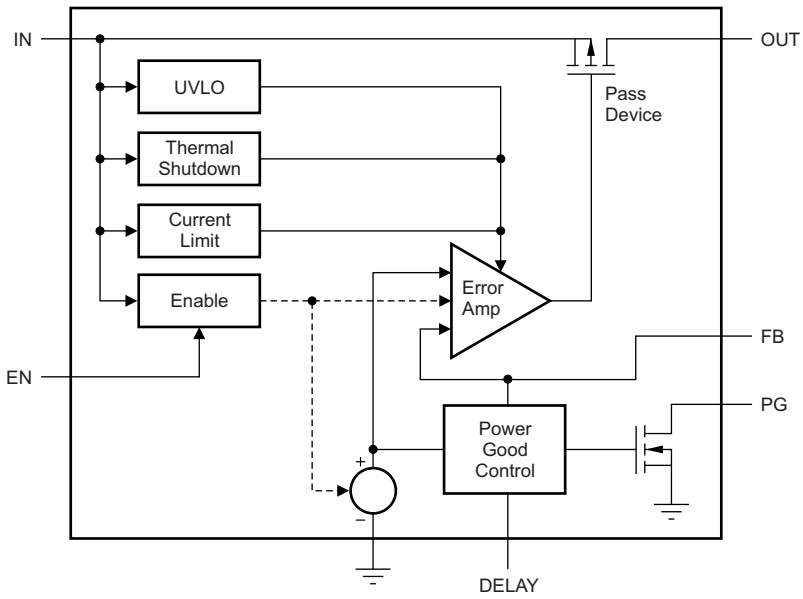
Figure 11. Load Transient
10-µF Ceramic Output Capacitor

7 Detailed Description

7.1 Overview

The TPS7A19 is a low-dropout linear regulator (LDO) combined with enable and power good functions. The power good pin initializes when the output voltage, V_{OUT}, exceeds $V_{T(PG)}$. The power good delay is a function of the value set by an external capacitor on the DELAY pin before releasing the PG pin high.

7.2 Functional Block Diagram



7.3 Feature Description

7.3.1 Enable Pin (EN)

The enable pin is a high-voltage-tolerant pin. A logic-high input on EN actives the device and turns on the LDO. For self-bias applications, connect this input to the IN pin.

7.3.2 Regulated Output Pin (OUT)

The OUT pin is the regulated output based on the required voltage. The output is protected by internal current limiting. During initial power up, the LDO has a soft start feature incorporated to control the initial current through the pass element.

In the event that the LDO drops out of regulation, the output tracks the input minus a voltage drop based on the load current. When the input voltage drops below the UVLO threshold, the LDO shuts down until the input voltage exceeds the minimum start-up level.

7.3.3 Power-Good Pin (PG)

The power good pin is an output with an external pullup resistor to the regulated supply. The output remains low until the regulated V_{OUT} exceeds approximately 91.6% of the set value, and the power good delay has expired. The regulated output falling below the 89.6% level asserts this output low after a short deglitch time of approximately 180 µs (typical).

Feature Description (continued)

7.3.4 Delay Timer Pin (DELAY)

An external capacitor on the DELAY pin sets the timer delay before the PG pin is asserted high. The constant output current charges an external capacitor until the voltage exceeds a threshold that trips an internal comparator. If this pin is open, the default delay time is 325 µs (typical).

The pulse delay time, t_{PG_DLY}, is defined with the charge time of an external capacitor DELAY, as shown in Equation 1.

$$t_{PG\_DLY} = \left(\frac{C_{DELAY} \times 1\ V}{9.5\ \mu A} \right) + 325\ \mu s \quad (1)$$

The PG pin initializes when V_{OUT} exceeds 91.6% of the programmed value. The delay is a function of the value set by an external capacitor on the DELAY pin before the PG pin is released high.

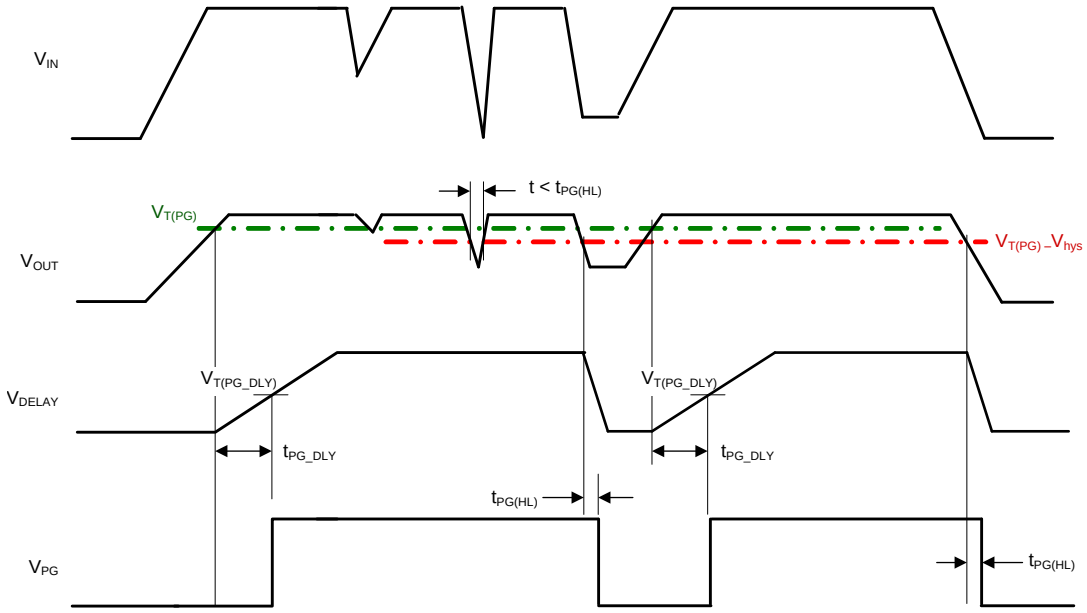


Figure 12. Conditions to Activate PG

7.3.5 Adjustable Output Voltage (ADJ for TPS7A1901)

An output voltage between 1.5 V and 18 V can be selected by using the external resistor dividers. Use Equation 2 to calculate the output voltage, where V_{FB} = 1.233 V. In order to avoid a large leakage current and to prevent a divider error, the value of (R1 + R2) must between 10 kΩ and 100 kΩ.

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2} \right) \quad (2)$$

7.3.6 Undervoltage Shutdown

The TPS7A19 family of devices has an internally-fixed, undervoltage-shutdown threshold. Undervoltage shutdown activates when the input voltage on V_{IN} drops below V_{IN_UVLO}. This activation makes sure that the regulator is not latched in an unknown state when there is a low-input supply voltage. If the input voltage has a negative transient that drops below the UVLO threshold and recovers, the regulator shuts down and powers up, similar to a typical power-up sequence when the input voltage exceeds the required levels.

Feature Description (continued)

7.3.7 Thermal Shutdown

The TPS7A19 incorporates a thermal shutdown (TSD) circuit as protection from overheating. For continuous standard operation, the junction temperature must not exceed the TSD trip point. If the junction temperature exceeds the TSD trip point, the output turns off. When the junction temperature falls below the TSD trip point minus the TSD hysteresis value, the output turns on again.

Thermal protection disables the output when the junction temperature rises to approximately 175°C, and allows the device to cool. When the junction temperature cools to approximately 150°C, the output circuitry enables. Based on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the temperature of the regulator, and protects the device from damage as a result of overheating.

Although the internal protection circuitry of the TPS7A19 device is designed to protect against overload conditions, the circuitry is not intended to replace proper heat-sink methods. Continuously running the TPS7A19 device into thermal shutdown degrades device reliability.

7.4 Device Functional Modes

7.4.1 Operation With V_{IN} < 4 V

The devices operate with input voltages above 4 V. The devices do not operate at input voltages below the actual UVLO voltage.

7.4.2 Operation With EN Control

The enable rising edge threshold voltage is 1.7 V, maximum. When the EN pin is held above 1.7 V, and the input voltage is greater than the UVLO rising voltage, the device enables.

The enable falling edge is 0.4 V, minimum. When the EN pin is held below 0.4 V, the device is disabled. The quiescent current is reduced in this state.

8 Application and Implementation

NOTE

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

8.1 Application Information

Figure 13 shows a typical application circuit for the TPS7A1901. Based on the end-application, different values of external components can be used. Some applications may require a larger output capacitor during fast load steps in order to prevent a PG low from occurring. Use a low-ESR ceramic capacitor with a dielectric of type X5R or X7R for better load transient response.

8.2 Typical Application

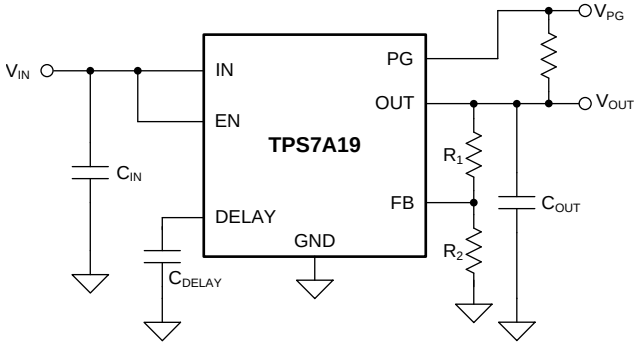


Figure 13. Adjustable Operation

8.2.1 Design Requirements

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

Table 1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
Input voltage	12 V, ±10%
Output voltage	3.3 V
Output current	50 mA (max)
PG delay time	1 ms

8.2.2 Detailed Design Procedure

To begin the design process:

1. First, make sure that the combination of maximum current, maximum ambient temperature, maximum input voltage, and minimum output voltage does not exceed the maximum operating condition of T_J = 125°C. The *Power Dissipation and Thermal Considerations* section describes how to calculate the maximum ambient temperature and power dissipation.
2. Next, set the feedback resistors to give the desired output voltage. See Equation 2 for the V_{OUT} relationship to R1 and R2. A good nominal value for R2 is 10 kΩ.
3. Then, calculate the required C_{DELAY} capacitor to achieve the desired PG delay time using Equation 1. For 1 ms of delay, the nearest standard value capacitor is 10 nF.
4. Finally, select an output capacitor with a total effective capacitance between 22 µF and 500 µF, a sufficient voltage rating, and an ESR below 20 Ω. Higher capacitance gives improved transient response, but results in higher inrush current at startup.

8.2.2.1 Power Dissipation and Thermal Considerations

Device power dissipation is calculated with Equation 3.

$$P_D = I_{OUT} \times (V_{IN} - V_{OUT}) + I_Q \times V_{IN} \quad (3)$$

where

- P_D = continuous power dissipation
- I_{OUT} = output current
- V_{IN} = input voltage
- V_{OUT} = output voltage

As $I_Q \ll I_{OUT}$, the term $I_Q \times V_{IN}$ in Equation 3 can be ignored.

For a device under operation at a given ambient air temperature (T_A), calculate the junction temperature (T_J) with Equation 4.

$$T_J = T_A + (\theta_{JA} \times P_D) \quad (4)$$

where

- θ_{JA} = junction-to-ambient air thermal impedance

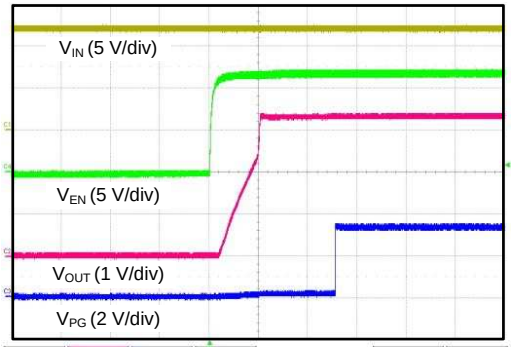
A rise in junction temperature because of power dissipation can be calculated with Equation 5.

$$\Delta T = T_J - T_A = (\theta_{JA} \times P_D) \quad (5)$$

For a given maximum junction temperature (T_{JM}), the maximum ambient air temperature (T_{AM}) at which the device can operate is calculated with Equation 6.

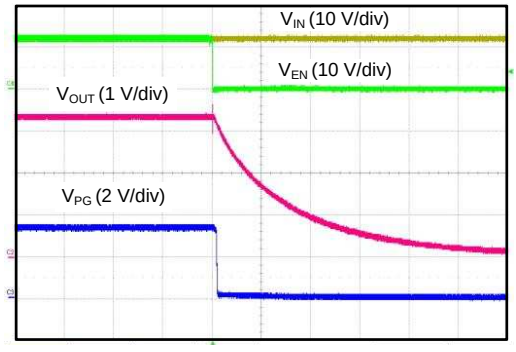
$$T_{AM} = T_{JM} - (\theta_{JA} \times P_D) \quad (6)$$

8.2.3 Application Curves



V_{IN} = 12 V, V_{EN} step from 0 V to 12 V, C_{IN} = 10 µF, C_{OUT} = 22 µF, R_{LOAD} = 66 Ω

Figure 14. Enable Startup



V_{IN} = 12 V, V_{EN} step from 12 V to 0 V, C_{IN} = 10 µF, C_{OUT} = 22 µF, R_{LOAD} = 66 Ω

Figure 15. Enable Shutdown

9 Power Supply Recommendations

The device operates from an input voltage supply range between 4 V and 40 V. This input supply must be well regulated. If the input supply is located more than a few inches from the TPS7A19 device, add an electrolytic capacitor with a value of 47 µF and a ceramic bypass capacitor at the input.

10 Layout

10.1 Layout Guidelines

- To improve ac performance such as PSRR, output noise, and transient response, design the board with separate ground planes for V_{IN} and V_{OUT}, with each ground plane connected only at the GND pin of the device. In addition, connect the ground connection for the output capacitor directly to the GND pin of the device.
- Minimize equivalent series inductance (ESL) and equivalent series resistance (ESR) in order to maximize performance and stability. Place every capacitor as close to the device as possible, and on the same side of the PCB as the regulator.
- Do not place any of the capacitors on the opposite side of the PCB from where the regulator is installed. The use of vias and long traces are strongly discouraged because of the negative impact on system performance. Vias and long traces can also cause instability.
- If possible, and to maximize the performance listed in this data sheet, use the same layout pattern used for the TPS7A19 evaluation module, TPS7A1901EVM-760 (SBVU031).

10.2 Layout Example

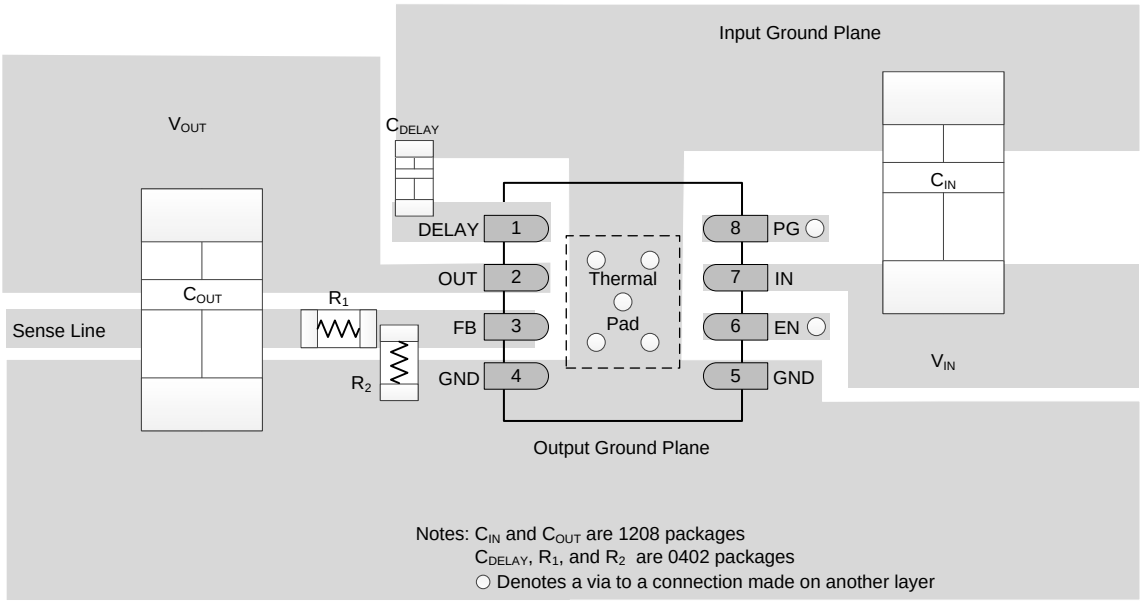


Figure 16. TPS7A19 Layout Example

11 Device and Documentation Support

11.1 Device Support

11.1.1 Development Support

11.1.1.1 Evaluation Modules

An evaluation module (EVM) is available to assist in the initial circuit performance evaluation using the TPS7A19. The summary information for this fixture is shown in Table 2.

Table 2. Evaluation Modules

NAME	EVM FOLDER
TPS7A19 40-V, 450-mA, High-Voltage, Ultra-Low IQ Low-Dropout Regulator Evaluation Module	TPS7A1901EVM-760

11.1.1.2 Spice Models

Computer simulation of circuit performance using SPICE is often useful when analyzing the performance of analog circuits and systems. A SPICE model for the TPS7A19 is available through the TPS7A19 product folder under the tools and software tab.

11.1.2 Device Nomenclature

Table 3. Ordering Information(1)

PRODUCT	DESCRIPTION
TPS7A19**XXYYYZ**	**XX** is the nominal output voltage option; 01 for adjustable. **YYY** is the package designator. **Z** is the package quantity.

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

11.2 Documentation Support

11.2.1 Related Documentation

TPS7A1901EVM-760 Evaluation Module User's Guide (SBVU031)

11.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

11.4 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

11.5 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

11.6 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

11.7 Glossary

SLYZ022 — *TI Glossary*.

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

12 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.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS7A1901DRBR	ACTIVE	SON	DRB	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	A1901	Samples
TPS7A1901DRBT	ACTIVE	SON	DRB	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 125	A1901	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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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.

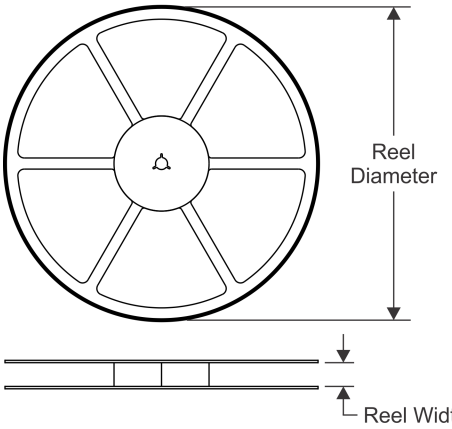
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

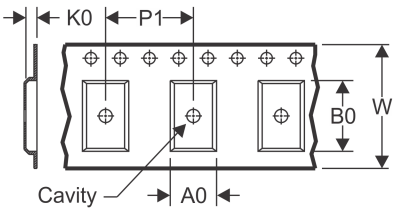
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

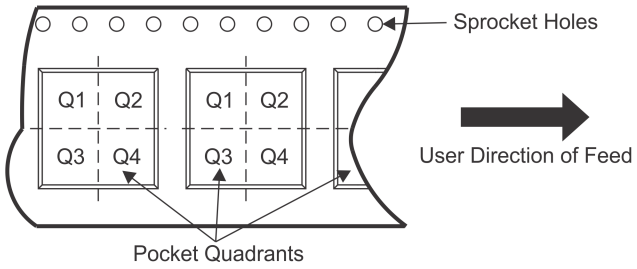


TAPE DIMENSIONS



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

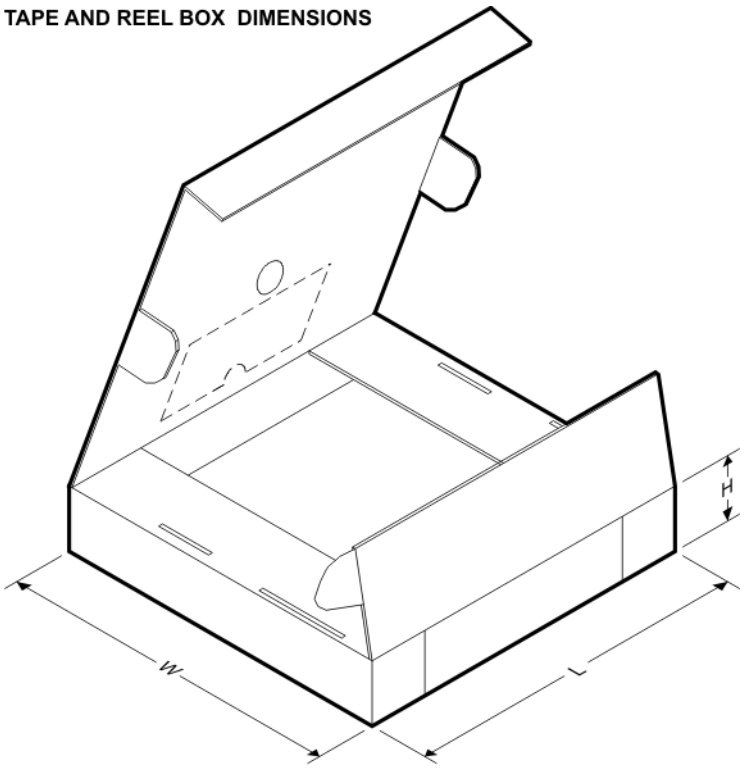
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS7A1901DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS7A1901DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS7A1901DRBR	SON	DRB	8	3000	367.0	367.0	35.0
TPS7A1901DRBT	SON	DRB	8	250	210.0	185.0	35.0

GENERIC PACKAGE VIEW

DRB 8

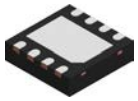
VSON - 1 mm max height

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.

4203482/L

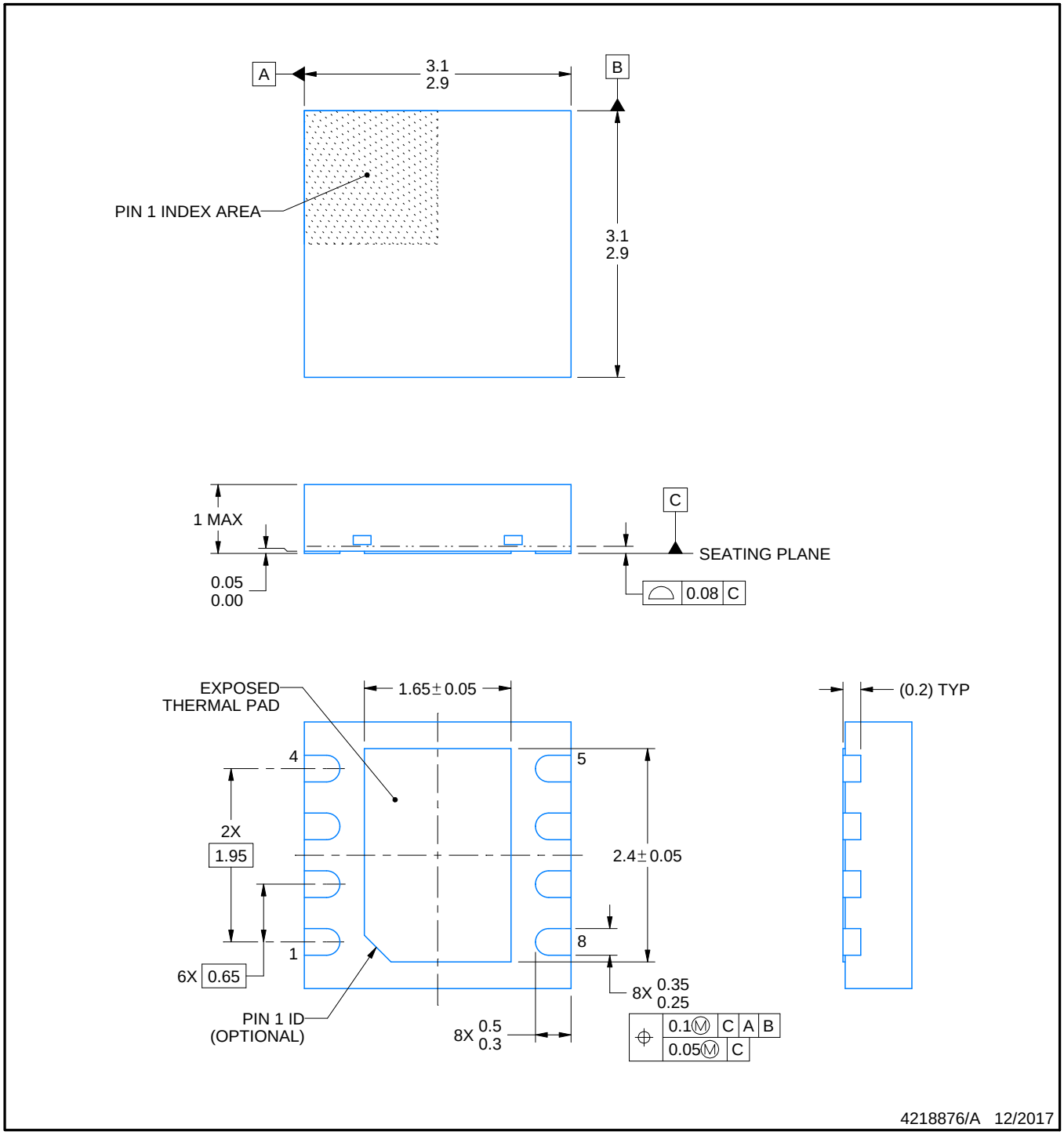
DRB0008B



PACKAGE OUTLINE

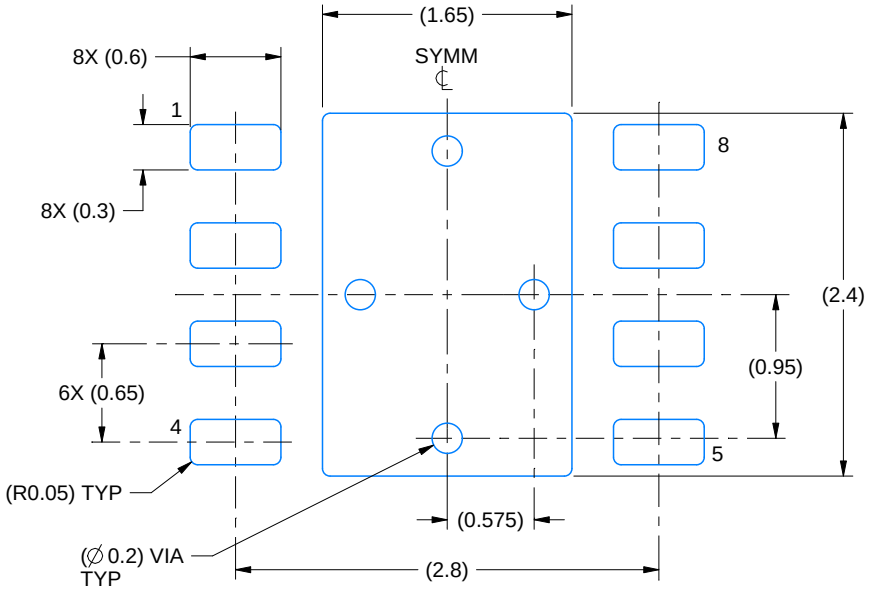
VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

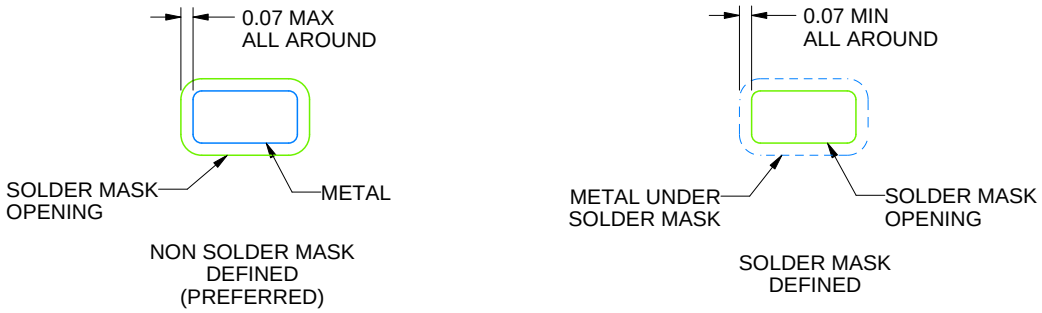


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
SCALE:20X

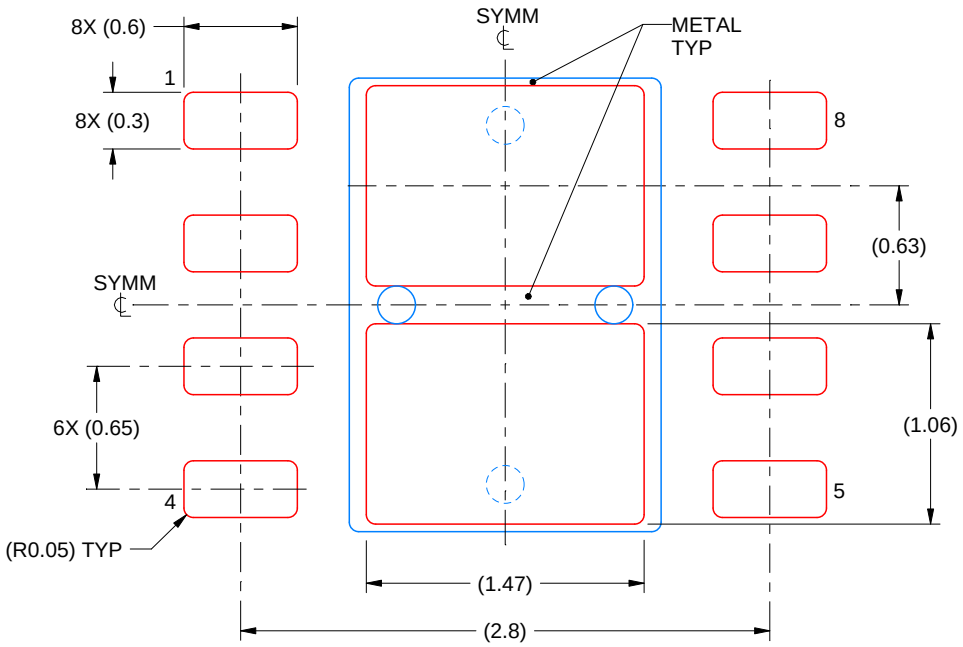


SOLDER MASK DETAILS

4218876/A 12/2017

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 any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
81% PRINTED SOLDER COVERAGE BY AREA
SCALE:25X

4218876/A 12/2017

NOTES: (continued)

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

IMPORTANT NOTICE

Texas Instruments Incorporated (TI) reserves the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

TI's published terms of sale for semiconductor products (http://www.ti.com/sc/docs/stdterms.htm) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate TI products (collectively, "Designers") understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers' applications and compliance of their applications (and of all TI products used in or for Designers' applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI's provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, "TI Resources") are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer's company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI's provision of TI Resources does not expand or otherwise alter TI's applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT OF TI OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

TI RESOURCES ARE PROVIDED "AS IS" AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designer may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers' own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer's non-compliance with the terms and provisions of this Notice.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265