TPS715A 80mA、24V、3.2µA 静态电流、低压降线性稳压器

1 特性

- 输入电压范围：
  - 2.5V 至 24V
- 可配置的输出电压选项：
  - 固定：1.8V 至 5V
  - 可调节：1.205V 至 15V
- 输出电流：高达 80mA
- 超低 I_Q：80mA 负载电流下为 3.2 µ A
- 过流保护
- 封装：
  - 3mm × 3mm VSON (DRB)
  - 2mm × 2mm WSON (DRV)
- 工作结温：–40°C 至 +125°C
- 有关 MSP430 特定的输出电压，请参见 TPS715

2 应用

- 家庭和楼宇自动化
- 零售自动化和支付
- 电网基础设施
- 医疗应用
- 照明应用

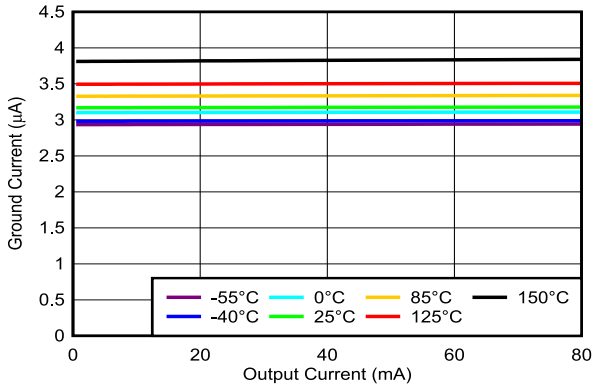


图 3-1. TPS715A 的静态电流与负载电流之间的关系（新芯片）

3 说明

TPS715A 低压降 (LDO) 线性稳压器是低静态电流器件，可提供采用微型封装、具有宽输入电压范围和实现低功耗运行的优势。因此，TPS715A 专为电池供电型应用而设计，可用作低功耗微控制器的电源管理附件。

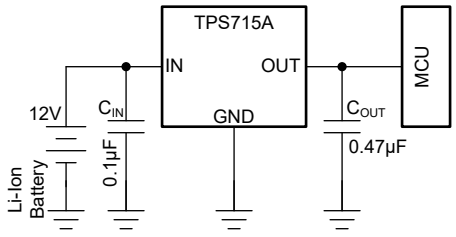
TPS715A 有固定电压和可调节电压两种版本可供选用。为了获得更大的灵活性或更高的输出电压，可调节电压版本使用外部反馈电阻器将输出电压设置为 1.205V 至 15V。TPS715A LDO 在负载电流为 80mA 时支持 650mV（典型值）的低压降。低静态电流（典型值为 3.2µA）在整个输出负载电流（0mA 至 80mA）范围内都是稳定的。TPS715A（新芯片）还具有内部软启动功能，可降低浪涌电流。内置过流限制有助于在发生负载短路或故障时保护稳压器。

TPS715A 可采用适用于高功率耗散应用的 3mm × 3mm 封装，也可以采用适用于手持和超便携式应用的 2mm × 2mm 小型封装。该器件还针对医疗成像应用提供了一种非磁性封装，即 3mm × 3mm 封装。

封装信息

器件型号	封装(1)	封装尺寸(2)
TPS715A	DRB（VSON，8）	3mm × 3mm
	DRV（WSON，6）	2mm × 2mm

(1) 如需更多信息，请参阅*机械、封装和可订购信息*。
(2) 封装尺寸（长 × 宽）为标称值，并包括引脚（如适用）。



典型应用原理图

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4 Pin Configuration and Functions

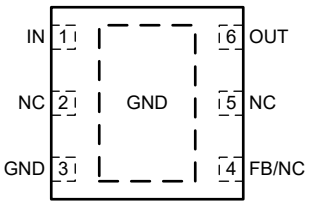


图 4-1. DRV Package, 6-Pin WSON (Top View)

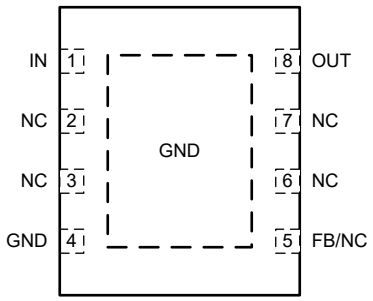


图 4-2. DRB Package, 8-Pin VSON (Top View)

表 4-1. Pin Functions

NAME	VSON		WSON		I/O	DESCRIPTION
	FIXED	ADJ.	FIXED	ADJ.		
FB	—	5	—	4	I	In the adjustable configuration, this pin sets the output voltage with the help of the external feedback divider.
GND	4, Pad	4, Pad	3, Pad	3, Pad	—	Ground pin.
IN	1	1	1	1	I	Input supply pin. Use a capacitor with a value of 0.1 µF or larger from this pin to ground. See the *Input and Output Capacitor Requirements* section for more information.
NC	2, 3, 5, 6, 7	2, 3, 6, 7	2, 4, 5	2, 5	—	No connect pin. This pin is not connected internally. Connect this pin to ground for best thermal performance, or leave floating.
OUT	8	8	6	6	O	Output of the regulator. For the new chip, a capacitor with a value of 1 µF or larger is required from this pin to ground.(1) See the *Input and Output Capacitor Requirements* section for more information.

(1) The nominal output capacitance must be greater than 0.47 µF. Throughout this document, the nominal derating on these capacitors is 50%. Make sure that the effective capacitance at the pin is greater than 0.47 µF. The legacy chip is stable for any capacitor value ≥ 0.47 µF.

5 Specifications

5.1 Absolute Maximum Ratings

over operating temperature range (unless otherwise noted)(1) (2)

		MIN	MAX	UNIT
Voltage	V_{IN} (for legacy chip only)	– 0.3	24	V
	V_{IN} (for new chip only)	– 0.3	30	
	V_{OUT} (for fixed output new chip only)	– 0.3	2 × $V_{OUT(typ)}$ or V_{IN} + 0.3 or 5.5 (whichever is lower)	
Voltage	V_{OUT} (for legacy chip only)	– 0.3	16.5	V
Voltage	V_{OUT} (for adjustable output new chip only)	– 0.3	V_{IN} + 0.3	V
	V_{FB} (for adjustable output new chip only)		2.4	
	V_{FB} (for adjustable output legacy chip only)	– 0.3	4.5	
Current	Peak output current	Internally limited		
Temperature	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, 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 network ground terminal.

5.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	±2000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(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.

5.3 Recommended Operating Conditions

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

		MIN	NOM	MAX	UNIT
V_{IN}	Input supply voltage	2.5		24	V
V_{OUT}	Output voltage	1.205		15	V
I_{OUT}	Output current	0		80	mA
C_{IN}	Input capacitor(2)	0	0.047		µF
C_{OUT}	Output capacitor (for legacy chip only)	0.47	1		
	Output capacitor (for new chip only) (3)	1			
T_J	Operating junction temperature	-40		125	°C

(1) All voltages are with respect to GND.
(2) An input capacitor is not required for LDO stability. However, an input capacitor with an effective value of 0.047 µF is recommended to counteract the effect of source resistance and inductance, which may in some cases cause symptoms of system level instability such as ringing or oscillation, especially in the presence of load transients.
(3) All capacitor values are assumed to derate to 50% of the nominal capacitor value. Maintain an effective output capacitance of 0.47 µF minimum for the stability.

5.4 Thermal Information

THERMAL METRIC (1)		TPS715A (2)				UNIT
		DRV (WSON) 6 Pins		DRB (VSON) 8 Pins		
		Legacy chip	New chip	Legacy chip	New chip	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	79.5	69.5	69	55.8	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	110.5	108.0	76.8	82.3	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	48.9	35.4	44.6	29.2	°C/W
ψ_{JT}	Junction-to-top characterization parameter	5.2	5.9	8.1	6.4	°C/W
ψ_{JB}	Junction-to-board characterization parameter	49.3	35.4	44.8	29.1	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	18.3	7.2	27.5	8.7	°C/W

(1) For more information about traditional and new thermal metrics, see the Semiconductor and IC package thermal metrics application note.

(2) Thermal performance results are based on the JEDEC standard of 2s2p PCB configuration. These thermal metric parameters can be further improved by 35-55% based on thermally optimized PCB layout designs. See the analysis of the Impact of board layout on LDO thermal performance application note.

5.5 Electrical Characteristics

over operating junction temperature range (T_J = –40°C to 125°C), V_{IN} = $V_{OUT(nom)}$ + 1 V, I_{OUT} = 1 mA, and C_{OUT} = 1 µF (unless otherwise noted); typical values are at T_J = 25°C

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}	Input voltage (1)		I_O = 10 mA	2.5		24	V
			I_O = 80mA	3		24	
V_{OUT}	Output voltage range (TPS715A01) [legacy chip]			1.2		15	V
	Output voltage range (TPS715A01) [new chip]			1.205		15	
V_{OUT}	Output voltage accuracy (1)	TPS715A01 (legacy chip)	V_{OUT} + 1 V ≤ V_{IN} ≤ 24 V, 1.2 V ≤ V_{OUT} ≤ 15 V, 0 ≤ I_{OUT} ≤ 80 mA	–4		4	%
		TPS715A01 (new chip)	V_{OUT} + 1 V ≤ V_{IN} ≤ 24 V, 1.205 V ≤ V_{OUT} ≤ 15 V, 0 ≤ I_{OUT} ≤ 80 mA	–4		4	
		TPS715A33 (legacy chip)	4.3 V ≤ V_{IN} ≤ 24 V, 0 ≤ I_{OUT} ≤ 80 mA	3.135	3.3	3.465	V
		TPS715A33 (new chip)	4.3 V ≤ V_{IN} ≤ 24 V, 0 ≤ I_{OUT} ≤ 80 mA	3.168	3.3	3.432	
I_{GND}	Ground pin current (legacy chip) (3)		0 ≤ I_{OUT} ≤ 80mA, T_J = –40°C to 85°C		3.2	4.1	µA
			0 mA ≤ I_{OUT} ≤ 80mA		3.2	4.3	
			0 mA ≤ I_{OUT} ≤ 80mA, V_{IN} = 24 V			4.5	
	Ground pin current (new chip) (3)		0 ≤ I_{OUT} ≤ 80mA, T_J = –40°C to 85°C		3.2	4.2	
			0 mA ≤ I_{OUT} ≤ 80mA		3.2	4.8	
			0 mA ≤ I_{OUT} ≤ 80mA, V_{IN} = 24 V			5.8	
ΔV_{OUT} (ΔIOUT)	Load regulation		I_{OUT} = 100 µA to 80 mA		35		mV
ΔV_{OUT} (ΔVIN)	Output voltage line regulation (legacy chip) (1)		$V_{OUT(NOM)}$ + 1 V ≤ V_{IN} ≤ 24 V		20	60	mV
	Output voltage line regulation (new chip) (1)		$V_{OUT(NOM)}$ + 1 V ≤ V_{IN} ≤ 24 V		20	22	
V_n	Output noise voltage (legacy chip) (4)		BW = 200 Hz to 100 kHz, C_{OUT} = 10 µF, I_{OUT} = 50 mA		575		µVrms
	Output noise voltage (new chip)(4)		BW = 200 Hz to 100 kHz, C_{OUT} = 10 µF, I_{OUT} = 50 mA		425		
I_{CL}	Output current limit (legacy chip)		V_{OUT} = 0 V	160		1100	mA
	Output current limit (new chip)		V_{OUT} = 0 V, V_{IN} ≥ 3.5 V	160		500	
	Output current limit (new chip)		V_{OUT} = 0 V, V_{IN} < 3.5 V	90		500	
PSRR	Power-supply ripple rejection (legacy chip)		f = 100 kHz, C_{OUT} = 10 µF		60		dB
	Power-supply ripple rejection (new chip)				60		
V_{DO}	Dropout voltage (legacy chip)		V_{IN} = $V_{OUT(nom)}$ – 0.1 V, I_{OUT} = 80 mA		670	1120	mV
	Dropout voltage (new chip)				650	900	

(1) Minimum V_{IN} = V_{OUT} + V_{DO} or the value shown for *Input voltage* in this table, whichever is greater.
(2) This device employs a leakage null control circuit. This circuit is active only if output current is less than pass transistor leakage current. The circuit is typically active when output load is less than 5 µA, V_{IN} is greater than 18 V, and die temperature is greater than 100°C.
(3) See the *Device Nomenclature*section for details about new and legacy chip descriptions.

5.6 Typical Characteristics

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

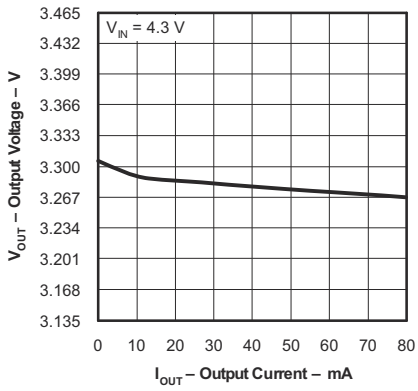


图 5-1. TPS715A33 Output Voltage vs Output Current (Legacy Chip)

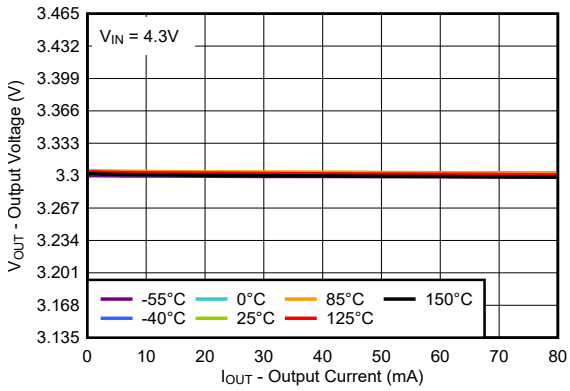


图 5-2. TPS715A33 Output Voltage vs Output Current (New Chip)

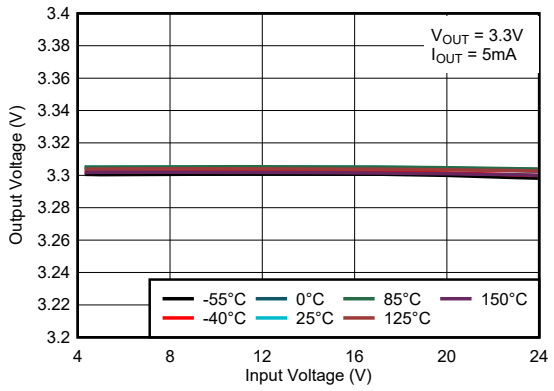


图 5-3. TPS715A33 Output Voltage vs Input Voltage (New Chip)

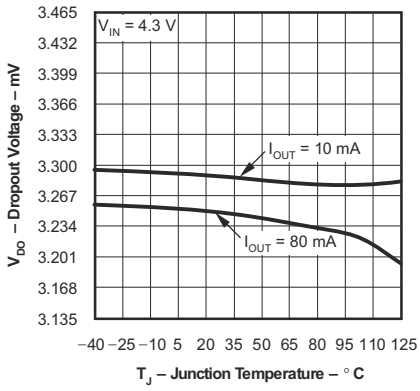


图 5-4. Output Voltage vs Junction Temperature (Legacy Chip)

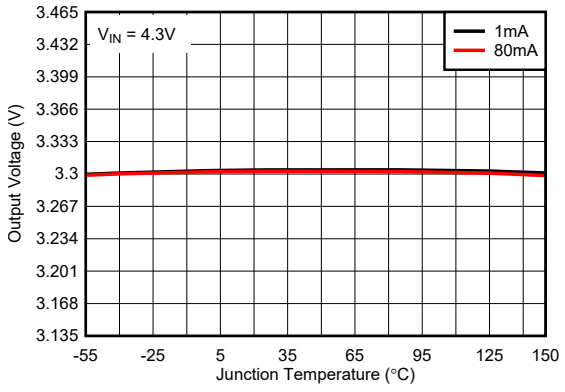


图 5-5. Output Voltage vs Junction Temperature (New Chip)

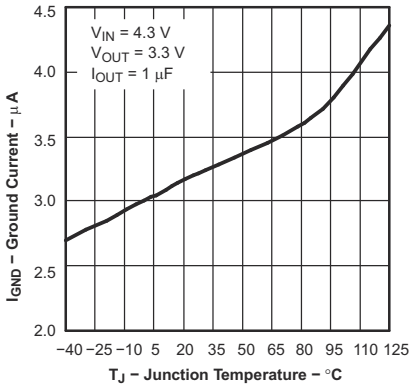


图 5-6. Ground Current vs Junction Temperature (Legacy Chip)

5.6 Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

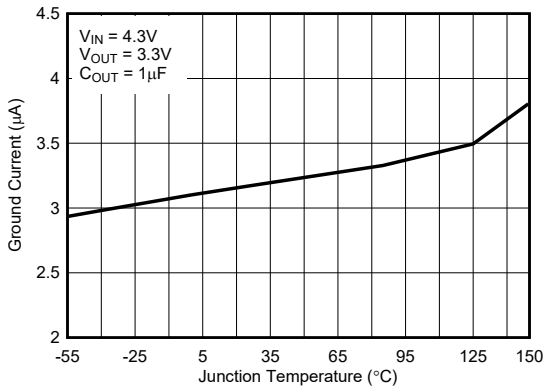


图 5-7. Ground Current vs Junction Temperature (New Chip)

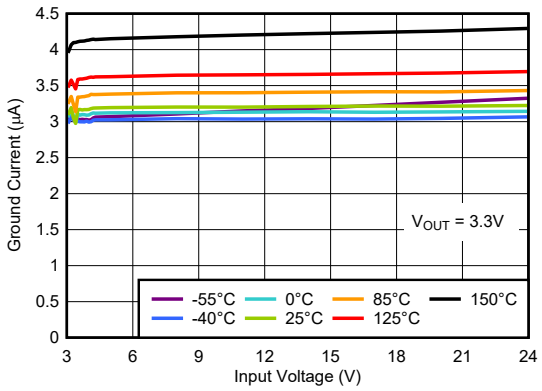


图 5-8. Ground Pin Current vs Input Voltage (New Chip)

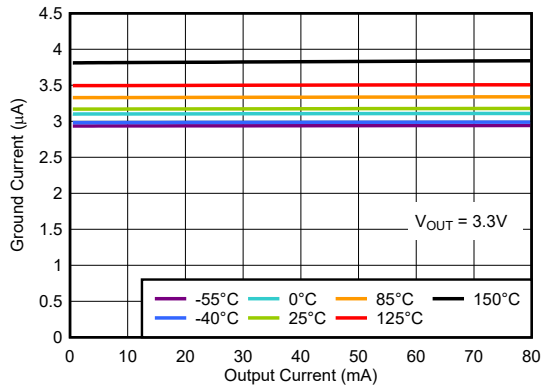


图 5-9. Ground Pin Current vs Load Current (New Chip)

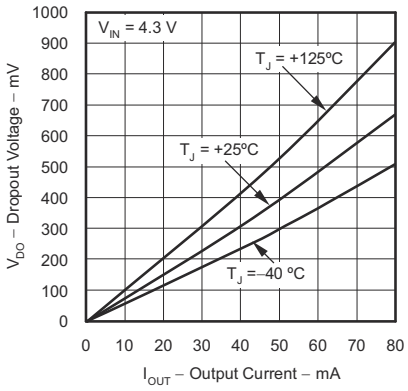


图 5-10. TPS715A33 Dropout Voltage vs Output Current (Legacy Chip)

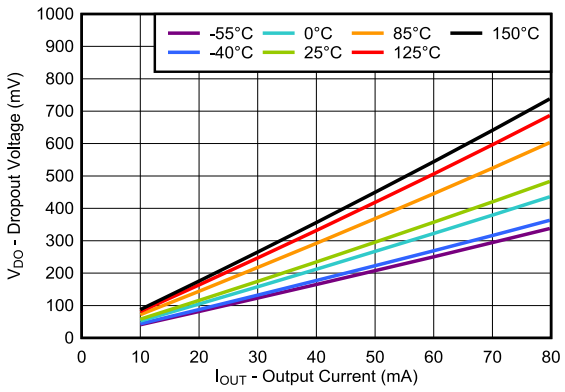


图 5-11. TPS715A33 Dropout Voltage vs Output Current (New Chip)

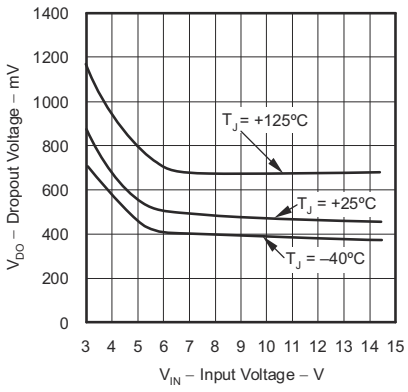


图 5-12. TPS715A01 Dropout Voltage vs Input Voltage (Legacy Chip)

5.6 Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

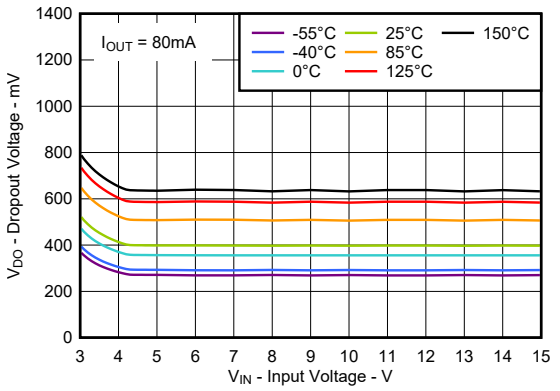


图 5-13. TPS715A01 Dropout Voltage vs Input Voltage (New Chip)

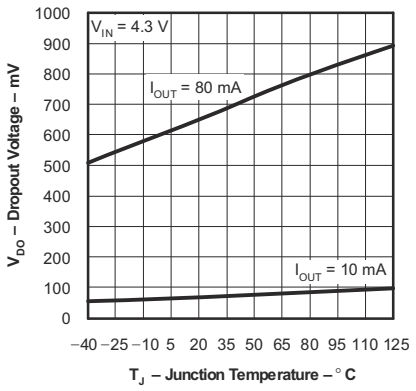


图 5-14. TPS715A33 Dropout Voltage vs Junction Temperature (Legacy Chip)

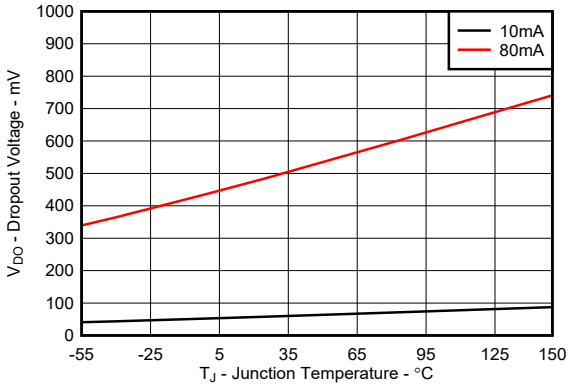


图 5-15. TPS715A33 Dropout Voltage vs Junction Temperature (New Chip)

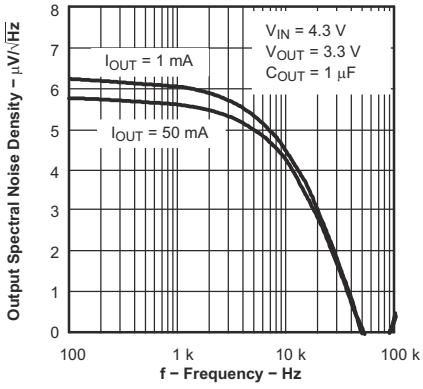


图 5-16. Output Spectral Noise Density vs Frequency (Legacy Chip)

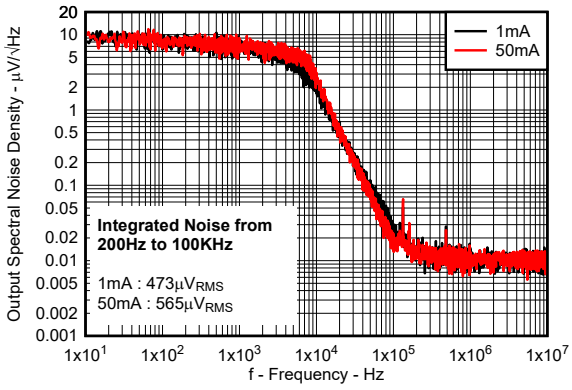


图 5-17. Output Spectral Noise Density vs Frequency (New Chip)

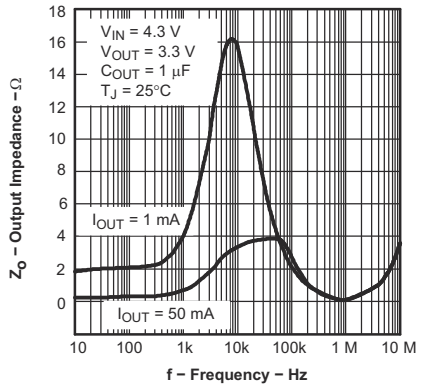


图 5-18. Output Impedance vs Frequency (Legacy Chip)

5.6 Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

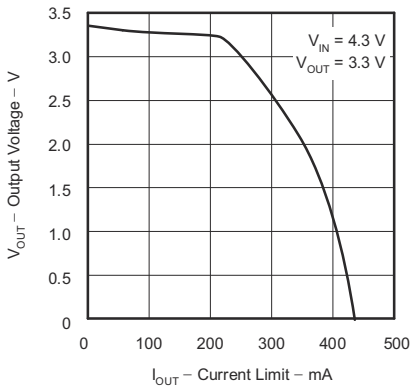


图 5-19. Output Voltage vs Current Limit (Legacy Chip)

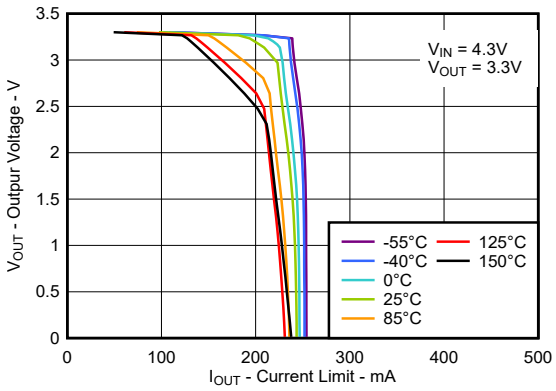


图 5-20. Output Voltage vs Current Limit (New Chip)

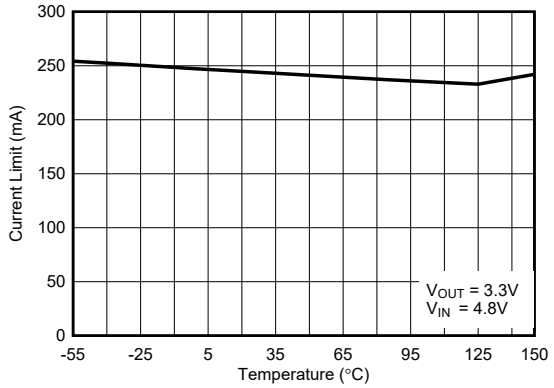


图 5-21. Current Limit vs Junction Temperature (New Chip)

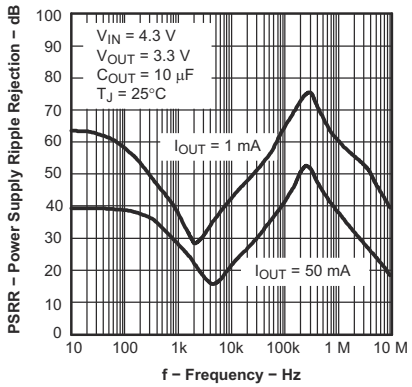


图 5-22. Power-Supply Ripple Rejection vs Frequency (Legacy Chip)

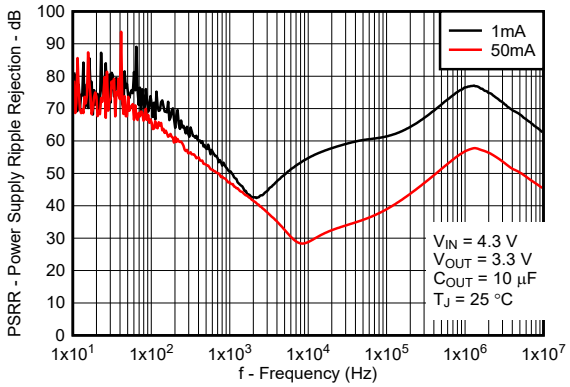


图 5-23. Power-Supply Ripple Rejection vs Frequency (New Chip)

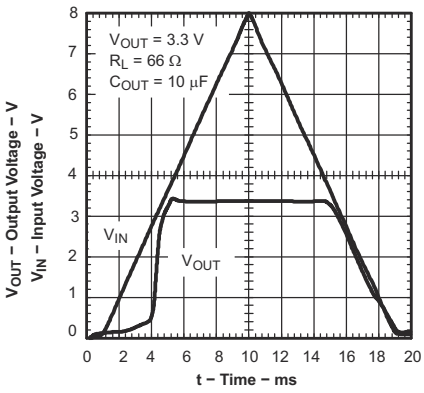


图 5-24. Power-Up and Power-Down (Legacy Chip)

5.6 Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

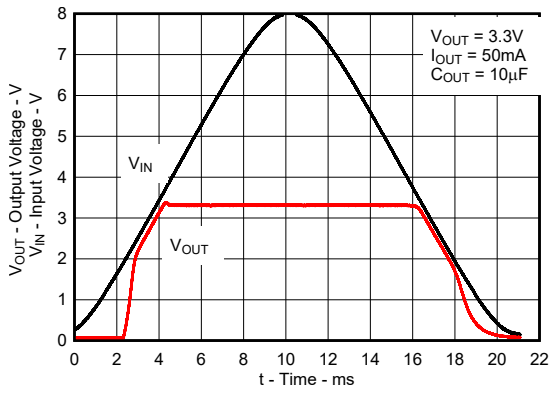


图 5-25. Power-Up, Power-Down (New Chip)

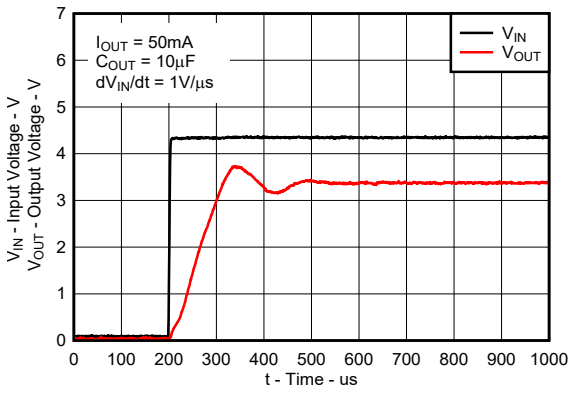


图 5-26. Fast Power-Up (Legacy Chip)

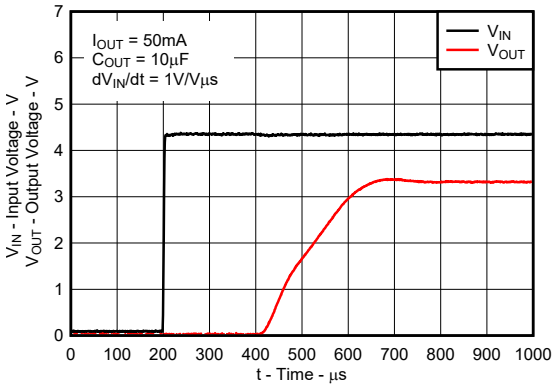


图 5-27. Fast Power-Up (New Chip)

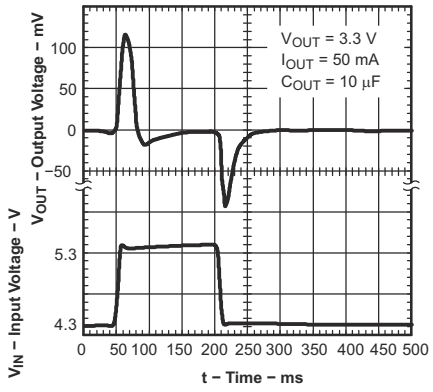


图 5-28. Line Transient Response (Legacy Chip)

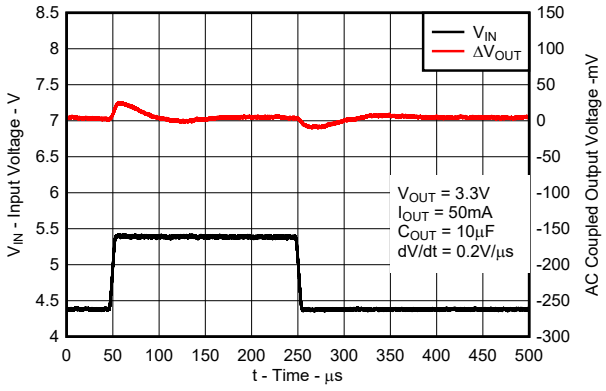


图 5-29. Line Transient Response (New Chip)

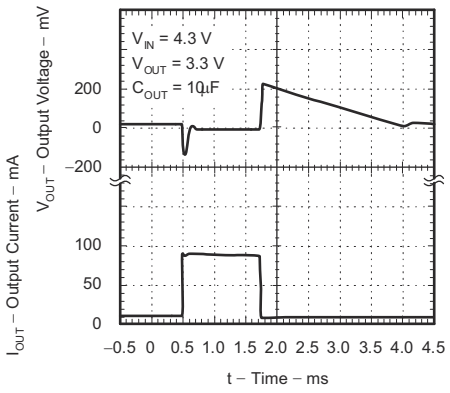


图 5-30. Load Transient Response (Legacy Chip)

5.6 Typical Characteristics (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

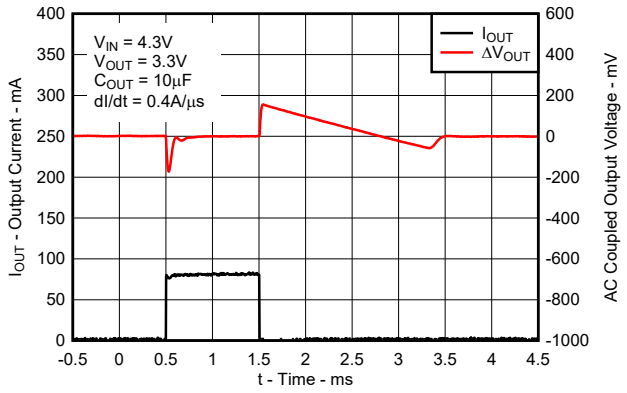


图 5-31. Load Transient Response (New Chip)

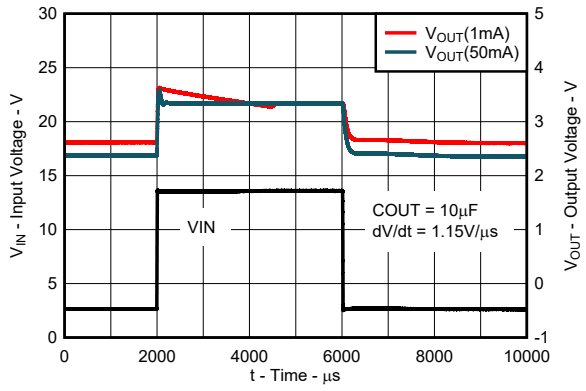


图 5-32. Line Transient Response (New Chip)

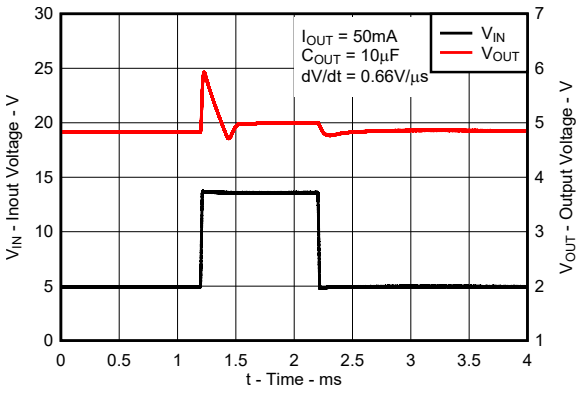


图 5-33. Dropout Exit Transient Response (New Chip)

6 Detailed Description

6.1 Overview

The TPS715A low-dropout regulator (LDO) consumes only 3.2 μA (typ) of quiescent current across the entire output current range, while offering a wide input voltage range and low-dropout voltage in small packaging. The device, which operates over an input range of 2.5 V to 24 V, is stable with any output capacitance greater than or equal to 0.47 μF. The low quiescent current across the complete load current range makes the TPS715A optimal for powering battery-operated applications. The TPS715A has internal soft-start to control inrush current into the output capacitor. This LDO also has overcurrent protection during a load-short or fault condition on the output.

6.2 Functional Block Diagrams

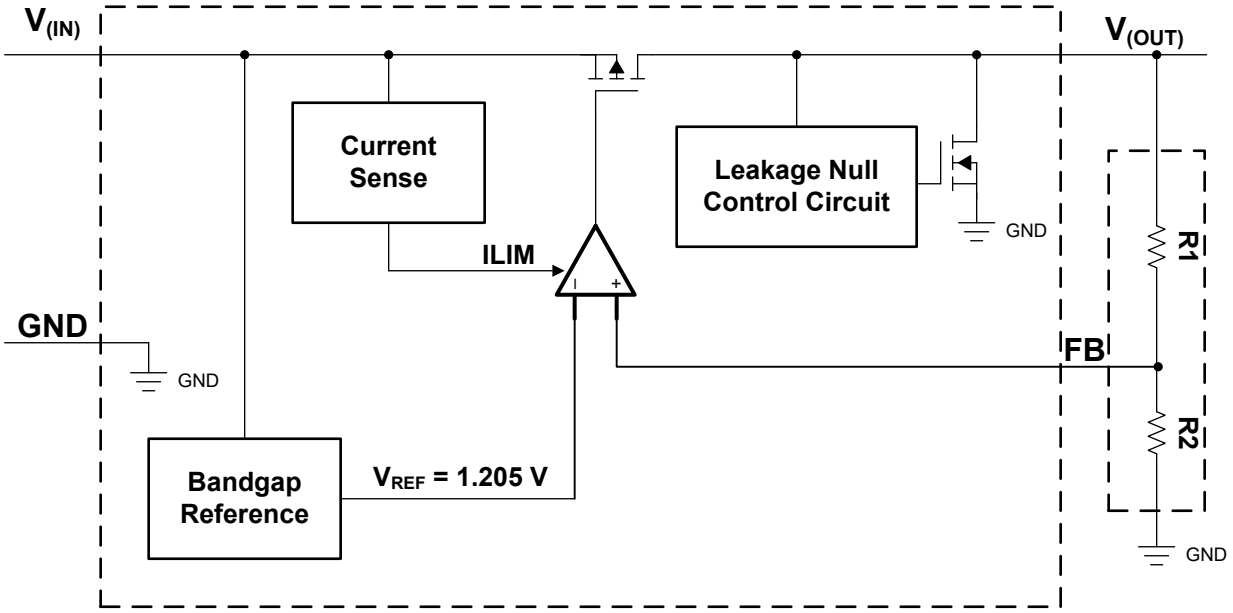


图 6-1. Functional Block Diagram: Adjustable Version

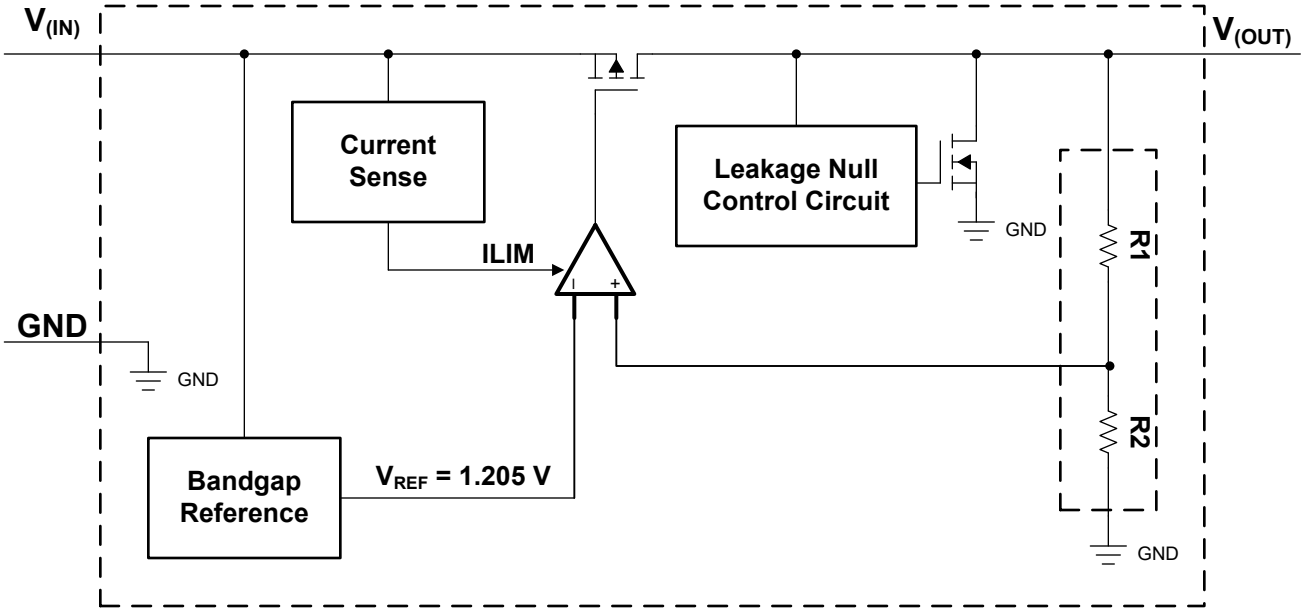


图 6-2. Functional Block Diagram: Fixed Version

6.3 Feature Description

6.3.1 Wide Supply Range

This device has an operational input supply range of 2.5 V to 24 V, allowing for a wide range of applications. This wide supply range is optimal for applications that have either large transients or high dc voltage supplies.

6.3.2 Low Supply Current

This device only requires 3.2 μA (typical) of quiescent current across the complete load current range (0 mA to 80 mA) and has a maximum current consumption of 4.8 μA (for the new device only) at –40°C to +125°C.

6.3.3 Current Limit

The device has an internal current limit circuit that protects the regulator during transient high-load current faults or shorting events. The current limit is a brick-wall scheme. In a high-load current fault, the brick-wall scheme limits the output current to the current limit (I_{CL}). I_{CL} is listed in the *Electrical Characteristics* table.

The output voltage is not regulated when the device is in current limit. When a current limit event occurs, the device begins to heat up because of the increase in power dissipation. When the device is in brick-wall current limit, the pass transistor dissipates power [(V_{IN} – V_{OUT}) × I_{CL}]. For more information on current limits, see the *Know Your Limits* application note. The LDO is not designed to operate in a steady-state current limit.

图 6-3 shows a diagram of the current limit.

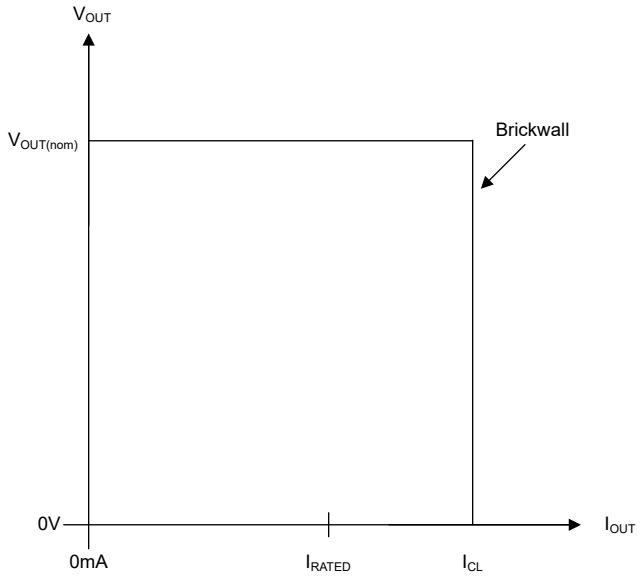


图 6-3. Current Limit

6.3.4 Dropout Voltage (V_{DO})

Dropout voltage (V_{DO}) is defined as the input voltage minus the output voltage (V_{IN} – V_{OUT}) at the rated output current (I_{RATED}), where the pass transistor is fully on. I_{RATED} is the maximum I_{OUT} listed in the *Recommended Operating Conditions* table. In dropout operation, the pass transistor is in the ohmic or triode region of operation, and acts as a switch. The dropout voltage indirectly specifies a minimum input voltage greater than the nominal programmed output voltage at which the output voltage is expected to stay in regulation. If the input voltage falls to less than the value required to maintain output regulation, the output voltage falls as well.

For a CMOS regulator, the dropout voltage is determined by the drain-source, on-state resistance ($R_{DS(ON)}$) of the pass transistor. Therefore, if the linear regulator operates at less than the rated current, the dropout voltage for that current scales accordingly. Use 方程式 1 to calculate the $R_{DS(ON)}$ of the device.

$$R_{DS(ON)} = \frac{V_{DO}}{I_{RATED}} \quad (1)$$

6.4 Device Functional Modes

表 6-1 provides a quick comparison between the normal and dropout modes of operation.

表 6-1. Device Functional Mode Comparison

OPERATING MODE	PARAMETER	
	V_{IN}	I_{OUT}
Normal	$V_{IN} > V_{OUT(nom)} + V_{DO}$	$I_{OUT} < I_{CL}$
Dropout	$V_{IN} < V_{OUT(nom)} + V_{DO}$	$I_{OUT} < I_{CL}$

6.4.1 Normal Operation

The device regulates to the nominal output voltage under the following conditions:

- The input voltage is greater than the nominal output voltage plus the dropout voltage ($V_{OUT(nom)} + V_{DO}$)
- The output current is less than the current limit ($I_{OUT} < I_{CL}$)
- The device junction temperature is greater than –40°C and less than +125°C

6.4.2 Dropout Operation

If the input voltage is lower than the nominal output voltage plus the specified dropout voltage, but all other conditions are met for normal operation, the device operates in dropout mode. In this mode, the output voltage tracks the input voltage. During this mode, the transient performance of the device becomes significantly degraded because the pass transistor is in the ohmic or triode region, and acts as a switch. Line or load transients in dropout can result in large output voltage deviations.

When the device is in a steady dropout state (defined as when the device is in dropout, $V_{IN} < V_{OUT(NOM)} + V_{DO}$, directly after being in a normal regulation state, but *not* during start up), the pass transistor is driven into the ohmic or triode region. When the input voltage returns to a value greater than or equal to the nominal output voltage plus the dropout voltage ($V_{OUT(NOM)} + V_{DO}$), the output voltage can overshoot for a short period of time while the device pulls the pass transistor back into the linear region.

7 Application and Implementation

备注

以下应用部分中的信息不属于 TI 器件规格的范围，TI 不担保其准确性和完整性。TI 的客 户应负责确定器件是否适用于其应用。客户应验证并测试其设计，以确保系统功能。

7.1 Application Information

The TPS715A LDO regulator is designed for battery-powered applications and is a good supply for low-power microcontrollers (such as the MSP430) because of the device low I_Q performance across load current range. The ultra-low-supply current of the TPS715A maximizes efficiency at light loads, and the high input voltage range and flexibility of output voltage selection in the adjustable configuration and fixed output levels makes the device an optimal supply for building automation and power tools.

7.2 Typical Applications

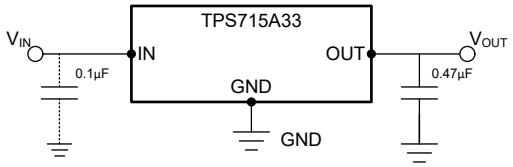
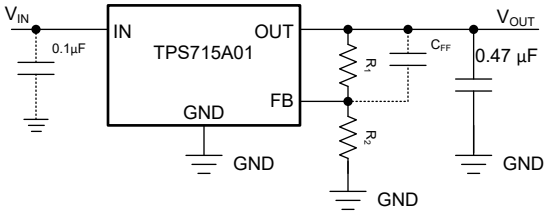


图 7-1. Typical Application Circuit (Fixed-Voltage Version)



Output Voltage	R1	R2
1.8V	0.499 MΩ	1MΩ
2.8V	1.33 MΩ	1MΩ
5.0V	3.16 MΩ	1MΩ

图 7-2. TPS715A01 Adjustable LDO Regulator Programming

7.2.1 Design Requirements

Minimum output capacitor (C_{OUT}) value for stability is needed as suggested in the *Recommended Operating Conditions* table.

表 7-1 summarizes the design requirements for this application.

表 7-1. Design Parameters

PARAMETER	VALUE
Input voltage	4.3 V
Output voltage	3.3 V
Output current	50 mA

7.2.2 Detailed Design Procedure

7.2.2.1 Setting V_{OUT} for the TPS715A01 Adjustable LDO

The TPS715A contains an adjustable version, the TPS715A01, which sets the output voltage using an external resistor divider as shown in 图 7-2. The output voltage operating range is 1.205 V to 15 V, and is calculated using:

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

where:

- V_{REF} = 1.205 V (typical)

Choosing resistors R1 and R2 allows approximately 1.5 μA of current through the resistor divider. Lower value resistors can be used for improved noise performance, but consume more power. Avoid higher resistor values because leakage current into or out of FB across R1 / R2 creates an offset voltage that is proportional to V_{OUT} divided by V_{REF}. The recommended design procedure is to choose R2 = 1 MΩ to set the divider current at 1.5 μA, and then calculate R1 using 方程式 3:

$$R1 = \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \times R2 \quad (3)$$

图 7-2 depicts this configuration.

7.2.2.2 External Capacitor Requirements

The device is designed to be stable using low equivalent series resistance (ESR) ceramic capacitors at the input and output. Multilayer ceramic capacitors have become the industry standard for these types of applications and are recommended, but must be used with good judgment. Ceramic capacitors that employ X7R-, X5R-, and C0G-rated dielectric materials provide relatively good capacitive stability across temperature, whereas the use of Y5V-rated capacitors is discouraged because of large variations in capacitance.

Regardless of the ceramic capacitor type selected, the effective capacitance varies with operating voltage and temperature. Generally, expect the effective capacitance to decrease by as much as 50%. The input and output capacitors recommended in the *Recommended Operating Conditions* table account for an effective capacitance of approximately 50% of the nominal value.

Although not required, use a 0.1-μF or larger input bypass capacitor, connected between IN and GND and located close to the device, to improve transient response and noise rejection of the power supply as a whole. A higher-value input capacitor can be necessary if large, fast-rise-time load transients are anticipated and the device is located several inches from the power source.

7.2.2.3 Input and Output Capacitor Requirements

Although an input capacitor is not required for stability, good analog design practice is to connect a capacitor from IN to GND. This capacitor counteracts reactive input sources and improves transient response, input ripple, and PSRR. Use an input capacitor if the source impedance is more than 0.5 Ω. A higher value capacitor can be necessary if large, fast rise-time load or line transients are anticipated or if the device is located several inches from the input power source.

Dynamic performance of the device is improved with the use of a large output capacitor. Use an output capacitor within the range specified in the *Recommended Operating Conditions* table for stability.

7.2.2.4 Reverse Current

Excessive reverse current can damage this device. Reverse current flows through the intrinsic body diode of the PMOS pass transistor instead of the normal conducting channel. At high magnitudes, this current flow degrades the long-term reliability of the device.

Conditions where reverse current can occur are outlined in this section, all of which can exceed the absolute maximum rating of $V_{OUT} \leqslant V_{IN}$ + 0.3 V. These conditions are:

- If the device has a large C_{OUT} and the input supply collapses with little or no load current
- The output is biased when the input supply is not established
- The output is biased above the input supply

If reverse current flow is expected in the application, external protection is recommended to protect the device. Reverse current is not limited in the device, so external limiting is required if extended reverse voltage operation is anticipated. Limit reverse current to 5% or less of the rated output current of the device in the event this current cannot be avoided.

图 7-3 shows one approach for protecting the device.

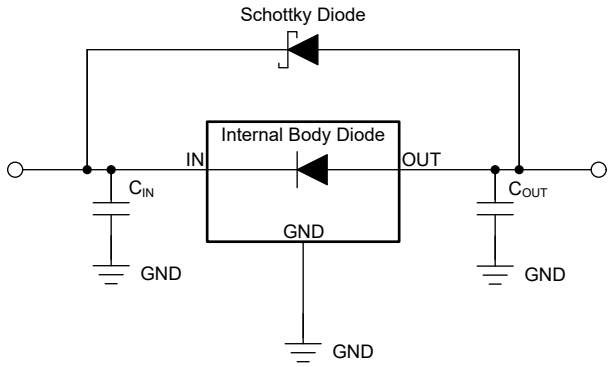


图 7-3. Example Circuit for Reverse Current Protection Using a Schottky Diode

7.2.2.5 Feed-Forward Capacitor (C_{FF})

For the adjustable-voltage version device, a feed-forward capacitor (C_{FF}) can be connected from the OUT pin to the FB pin. C_{FF} improves transient, noise, and PSRR performance, but is not required for regulator stability. Recommended C_{FF} values are listed in the *Recommended Operating Conditions* table. A higher capacitance C_{FF} can be used; however, the start-up time increases. For a detailed description of C_{FF} tradeoffs, see the *Pros and Cons of Using a Feedforward Capacitor with a Low-Dropout Regulator* application note.

C_{FF} and R_1 form a zero in the loop gain at frequency f_Z, while C_{FF}, R_1, and R_2 form a pole in the loop gain at frequency f_P. C_{FF} zero and pole frequencies can be calculated from the following equations:

$$f_Z = 1 / (2 \times \pi \times C_{FF} \times R_1) \quad (4)$$

$$f_P = 1 / (2 \times \pi \times C_{FF} \times (R_1 \parallel R_2)) \quad (5)$$

$C_{FF} \geqslant 10$ pF is required for stability if the feedback divider current is less than 5 μA. 方程式 6 calculates the feedback divider current.

$$I_{FB\_Divider} = V_{OUT} / (R_1 + R_2) \quad (6)$$

To avoid start-up time increases from C_{FF}, limit the product $C_{FF} \times R_1 < 50$ μs.

For an output voltage of 1.205 V with the FB pin tied to the OUT pin, no C_{FF} is used.

7.2.2.6 Power Dissipation (P_D)

Circuit reliability requires consideration of the device power dissipation, location of the circuit on the printed circuit board (PCB), and correct sizing of the thermal plane. The PCB area around the regulator must have few or no other heat-generating devices that cause added thermal stress.

To first-order approximation, power dissipation in the regulator depends on the input-to-output voltage difference and load conditions. The following equation calculates power dissipation (P_D).

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} \quad (7)$$

备注

Power dissipation can be minimized, and therefore greater efficiency can be achieved, by correct selection of the system voltage rails. For the lowest power dissipation, use the minimum input voltage required for correct output regulation.

For devices with a thermal pad, the primary heat conduction path for the device package is through the thermal pad to the PCB. Solder the thermal pad to a copper pad area under the device. This pad area must contain an array of plated vias that conduct heat to additional copper planes for increased heat dissipation.

The maximum power dissipation determines the maximum allowable ambient temperature (T_A) for the device. According to the following equation, power dissipation and junction temperature are most often related by the junction-to-ambient thermal resistance ($R_{\theta JA}$) of the combined PCB and device package and the temperature of the ambient air (T_A).

$$T_J = T_A + (R_{\theta JA} \times P_D) \quad (8)$$

Thermal resistance ($R_{\theta JA}$) is highly dependent on the heat-spreading capability built into the particular PCB design, and therefore varies according to the total copper area, copper weight, and location of the planes. The junction-to-ambient thermal resistance listed in the *Thermal Information* table is determined by the JEDEC standard PCB and copper-spreading area, and is used as a relative measure of package thermal performance.

7.2.2.7 Estimating Junction Temperature

The JEDEC standard now recommends the use of psi (Ψ) thermal metrics to estimate the junction temperatures of the linear regulator when in-circuit on a typical PCB board application. These metrics are not thermal resistance parameters and instead offer a practical and relative way to estimate junction temperature. These psi metrics are determined to be significantly independent of the copper area available for heat-spreading. The *Thermal Information* table lists the primary thermal metrics, which are the junction-to-top characterization parameter (ψ_{JT}) and junction-to-board characterization parameter (ψ_{JB}). These parameters provide two methods for calculating the junction temperature (T_J), as described in the following equations. Use the junction-to-top characterization parameter (ψ_{JT}) with the temperature at the center-top of device package (T_T) to calculate the junction temperature. Use the junction-to-board characterization parameter (ψ_{JB}) with the PCB surface temperature 1 mm from the device package (T_B) to calculate the junction temperature.

$$T_J = T_T + \psi_{JT} \times P_D \quad (9)$$

where:

- P_D is the dissipated power
- T_T is the temperature at the center-top of the device package

$$T_J = T_B + \psi_{JB} \times P_D \quad (10)$$

where:

- T_B is the PCB surface temperature measured 1 mm from the device package and centered on the package edge

For detailed information on the thermal metrics and how to use them, see the *Semiconductor and IC Package Thermal Metrics* application note.

7.2.3 Application Curves

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

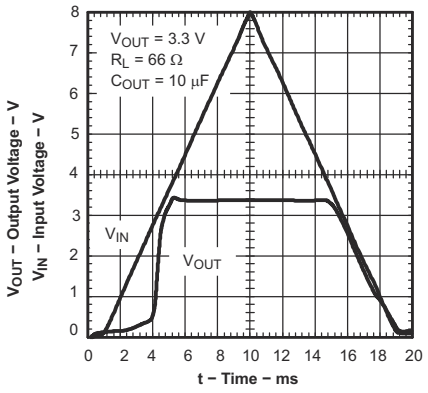


图 7-4. Power-Up and Power-Down (Legacy Chip)

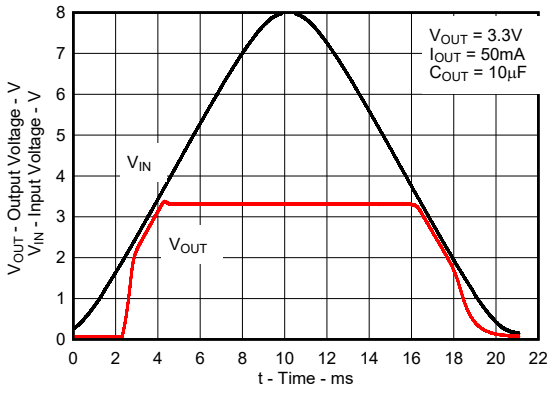


图 7-5. Power-Up, Power-Down (New Chip)

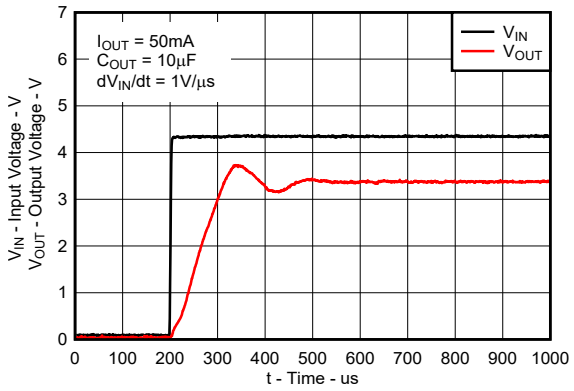


图 7-6. Fast Power-Up (Legacy Chip)

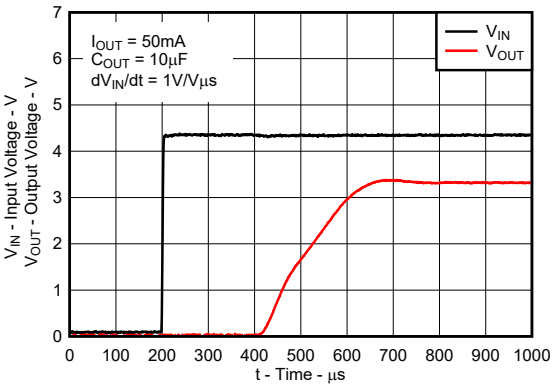


图 7-7. Fast Power-Up (New Chip)

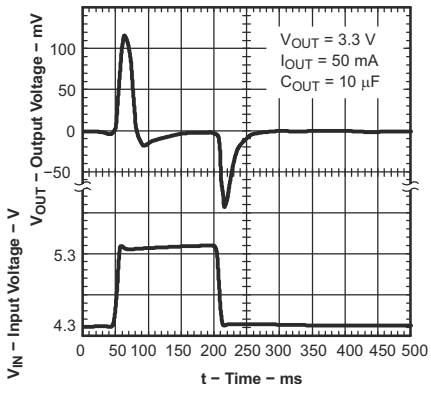


图 7-8. Line Transient Response (Legacy Chip)

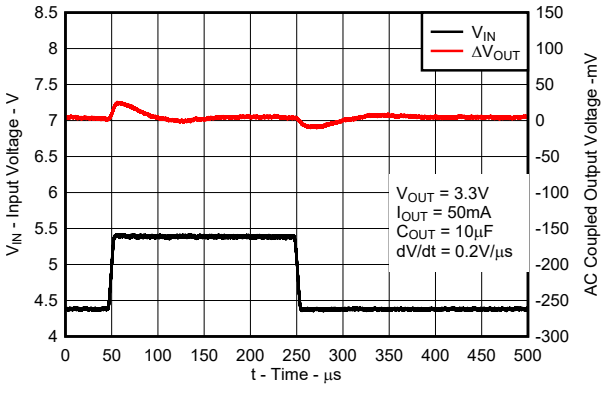


图 7-9. Line Transient Response (New Chip)

7.2.3 Application Curves (continued)

at operating temperature T_J = 25°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V or 2.5 V (whichever is greater), I_{OUT} = 1 mA, C_{IN} = 1 µF, and C_{OUT} = 1 µF (unless otherwise noted)

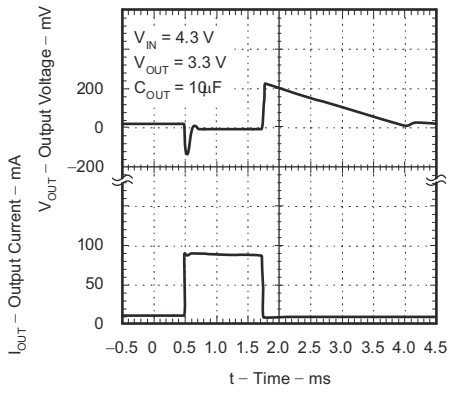


图 7-10. Load Transient Response (Legacy Chip)

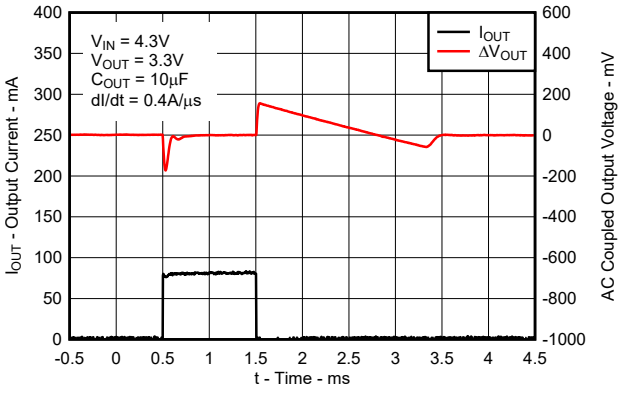


图 7-11. Load Transient Response (New Chip)

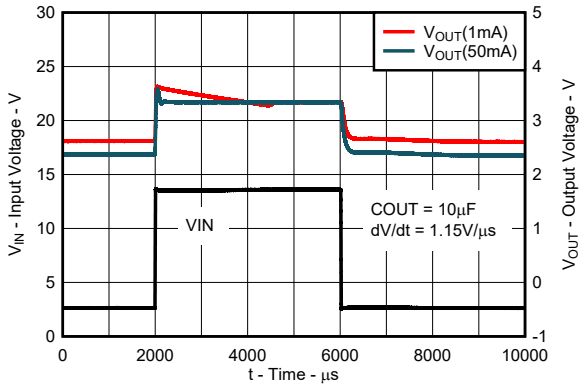


图 7-12. Line Transient Response (New Chip)

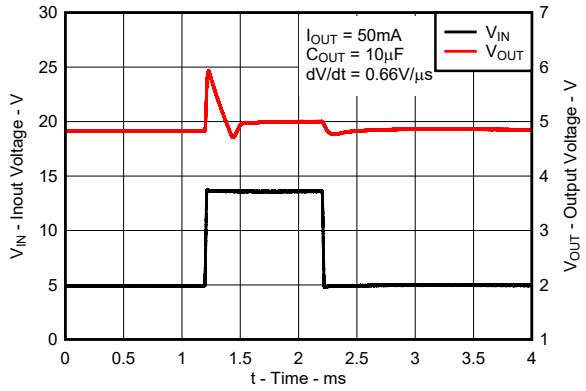


图 7-13. Dropout Exit Transient Response (New Chip)

7.3 Best Design Practices

Place at least one 0.47-µF capacitor as close as possible to the OUT and GND pins of the regulator.

Do not connect the output capacitor to the regulator using a long, thin trace.

Connect an input capacitor of 0.047 µF as close as possible to the IN and GND pins of the regulator for best performance.

Do not exceed the absolute maximum ratings.

7.4 Power Supply Recommendations

The TPS715A is designed to operate with an input voltage supply range from 2.5 V to 24 V. The input voltage range provides adequate headroom in order for the device to have a regulated output. This input supply must be well regulated. If the input supply is noisy, additional input capacitors with low ESR can help improve the output noise performance.

7.5 Layout

7.5.1 Layout Guidelines

For best overall performance, place all circuit components on the same side of the printed circuit board (PCB) and as near as practical to the respective LDO pin connections. Place ground return connections for the input and output capacitors as close to the GND pin as possible, using wide, component-side, copper planes. Avoid using vias and long traces to create LDO circuit connections to the input capacitor, output capacitor, or the resistor divider because doing so negatively affects system performance. This grounding and layout scheme minimizes inductive parasitics, and thereby reduces load-current transients, minimizes noise, and increases circuit stability. A ground reference plane is recommended to be embedded either in the PCB or located on the bottom side of the PCB opposite the components. This reference plane provides accuracy of the output voltage and shields the LDO from noise.

7.5.1.1 Power Dissipation

To provide reliable operation, worst-case junction temperature must not exceed 125°C. This restriction limits the power dissipation the regulator can handle in any given application. To make sure the junction temperature is within acceptable limits, calculate the maximum allowable dissipation, $P_{D(max)}$, and the actual dissipation, P_D, which must be less than or equal to $P_{D(max)}$.

The maximum-power-dissipation limit is determined using 方程式 11.

$$P_{D(max)} = \frac{T_J max - T_A}{R_{\theta JA}} \tag{11}$$

where:

- $T_J$max is the maximum allowable junction temperature
- $R_{\theta JA}$ is the thermal resistance junction-to-ambient for the package (see the *Thermal Information* table)
- T_A is the ambient temperature

The regulator power dissipation is calculated using 方程式 12.

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} \tag{12}$$

For a higher power package version of the TPS715A, see the TPS715A.

7.5.2 Layout Example

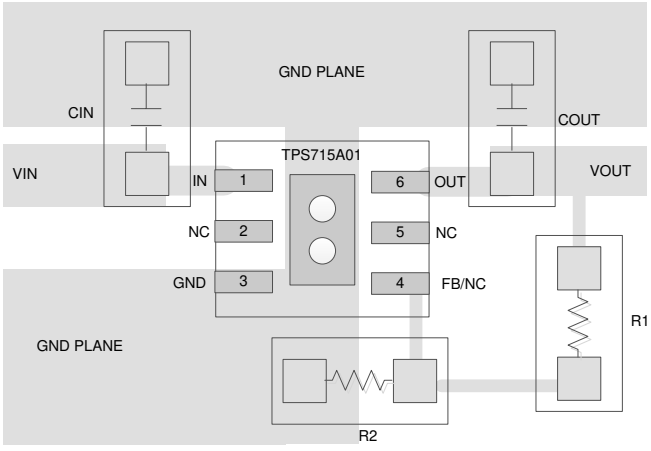


图 7-14. Example Layout for the TPS715A01DRV

8 Device and Documentation Support

8.1 Device Support

8.1.1 Development Support

8.1.1.1 Evaluation Module

An evaluation module (EVM) is available to assist in the initial circuit performance evaluation using the TPS715A. The TPS715AXXEVM-065 evaluation module (and related user's guide) can be requested at the TI web site through the product folders or purchased directly from the TI eStore.

8.1.1.2 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 TPS715A is available through the product folders under *Tools & Software*.

8.1.2 Device Nomenclature

表 8-1. Device Nomenclature(1)

PRODUCT	V_{OUT}
TPS715A**xxyyyz** Legacy chip	**xx** is the nominal output voltage (for example, 33 = 3.3V, 01 = adjustable) **yyy** is the package designator **z** is the package quantity
TPS715A**xxyyyz M3** New chip	**xx** is the nominal output voltage (for example, 33 = 3.3V, 01 = adjustable) **yyy** is the package designator **z** is the package quantity **M3** is a suffix designator for new chip redesigns on the latest TI process technology.

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

8.2 Documentation Support

8.2.1 Related Documentation

For related documentation see the following:

- Texas Instruments, *TPS715AxxEVM* user guide
- Texas Instruments, *LDO Noise Demystified* application note
- Texas Instruments, *LDO PSRR Measurement Simplified* application note
- Texas Instruments, *A Topical Index of TI LDO Application Notes* application note

8.3 接收文档更新通知

要接收文档更新通知，请导航至 ti.com 上的器件产品文件夹。点击*通知* 进行注册，即可每周接收产品信息更改摘要。有关更改的详细信息，请查看任何已修订文档中包含的修订历史记录。

8.4 支持资源

TI E2E™ 中文支持论坛是工程师的重要参考资料，可直接从专家处获得快速、经过验证的解答和设计帮助。搜索现有解答或提出自己的问题，获得所需的快速设计帮助。

链接的内容由各个贡献者“按原样”提供。这些内容并不构成 TI 技术规范，并且不一定反映 TI 的观点；请参阅 TI 的使用条款。

8.5 Trademarks

TI E2E™ is a trademark of Texas Instruments.
所有商标均为其各自所有者的财产。

8.6 静电放电警告

静电放电 (ESD) 会损坏这个集成电路。德州仪器 (TI) 建议通过适当的预防措施处理所有集成电路。如果不遵守正确的处理和安装程序，可能会损坏集成电路。

ESD 的损坏小至导致微小的性能降级，大至整个器件故障。精密的集成电路可能更容易受到损坏，这是因为非常细微的参数更改都可能会导致器件与其发布的规格不相符。

8.7 术语表

TI 术语表　　本术语表列出并解释了术语、首字母缩略词和定义。

9 Revision History

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision H (March 2016) to Revision I (August 2021)	Page
• 更新了整个文档中的表格、图和交叉参考的编号格式	1
• 更改了整个文档，以便与当前系列格式保持一致	1
• 通篇将 SON 更改为 WSON（对于 DRV）或 VSON（对于 DRB）	1

Changes from Revision G (May 2015) to Revision H (March 2016)	Page
• 更改了第三个*应用*要点	1
• 为了清晰起见，在*器件信息*表中添加了封装标识符	1
• Changed pin numbers in *Pin Functions* table to align with pin out configurations	2
• Added last three items to *Related Documentation*	23

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 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 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)
TPS715A01DRBR	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU | NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANO
TPS715A01DRBR.A	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANO
TPS715A01DRBRG4	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANO
TPS715A01DRBRM3	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANO
TPS715A01DRBRM3.A	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANO
TPS715A01DRBT	Obsolete	Production	SON (DRB) | 8	-	-	Call TI	Call TI	-40 to 125	ANO
TPS715A01DRVR	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU | NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SBE
TPS715A01DRVR.A	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SBE
TPS715A01DRVRM3	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SBE
TPS715A01DRVRM3.A	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	SBE
TPS715A01DRVT	Obsolete	Production	WSON (DRV) | 6	-	-	Call TI	Call TI	-40 to 125	SBE
TPS715A30DRVR	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SAV
TPS715A30DRVR.A	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SAV
TPS715A30DRVT	Active	Production	WSON (DRV) | 6	250 | SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SAV
TPS715A30DRVT.A	Active	Production	WSON (DRV) | 6	250 | SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	SAV
TPS715A33DRBR	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU | NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANN
TPS715A33DRBR.A	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANN
TPS715A33DRBRG4	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANN
TPS715A33DRBRG4.A	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANN
TPS715A33DRBRM3	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANN
TPS715A33DRBRM3.A	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANN
TPS715A33DRBT	Active	Production	SON (DRB) | 8	250 | SMALL T&R	Yes	NIPDAU | NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANN
TPS715A33DRBT.A	Active	Production	SON (DRB) | 8	250 | SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANN
TPS715A33DRVR	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU | NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANN
TPS715A33DRVR.A	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	-40 to 125	ANN
TPS715A33DRVRM3	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANN
TPS715A33DRVRM3.A	Active	Production	WSON (DRV) | 6	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	ANN
TPS715A33DRVT	Obsolete	Production	WSON (DRV) | 6	-	-	Call TI	Call TI	-40 to 125	ANN

(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.

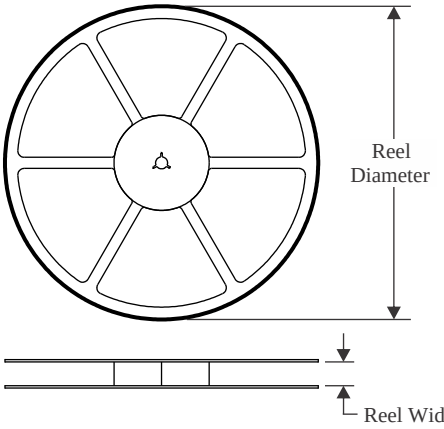
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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.

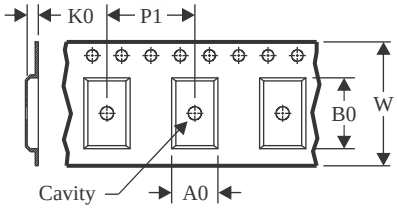
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

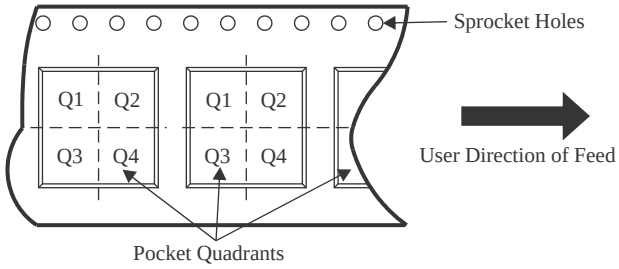


TAPE DIMENSIONS



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

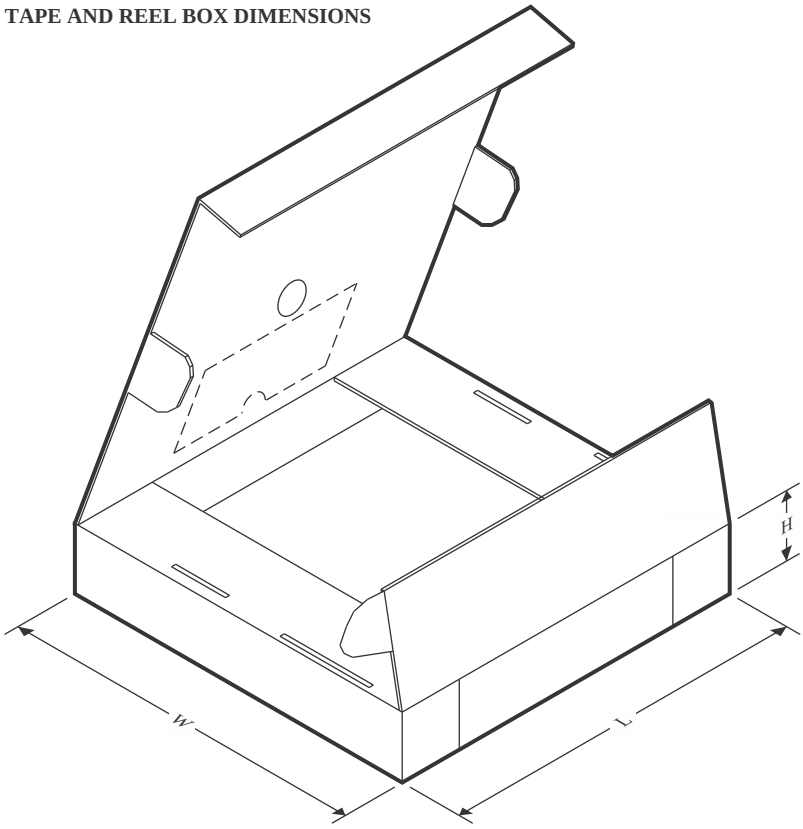
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS715A01DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS715A01DRBRM3	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS715A01DRVR	WSON	DRV	6	3000	179.0	8.4	2.2	2.2	1.2	4.0	8.0	Q2
TPS715A01DRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TPS715A01DRVRM3	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TPS715A30DRVR	WSON	DRV	6	3000	179.0	8.4	2.2	2.2	1.2	4.0	8.0	Q2
TPS715A30DRVT	WSON	DRV	6	250	179.0	8.4	2.2	2.2	1.2	4.0	8.0	Q2
TPS715A33DRBR	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS715A33DRBRG4	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS715A33DRBRM3	SON	DRB	8	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS715A33DRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS715A33DRVR	WSON	DRV	6	3000	179.0	8.4	2.2	2.2	1.2	4.0	8.0	Q2
TPS715A33DRVR	WSON	DRV	6	3000	180.0	8.4	2.3	2.3	1.15	4.0	8.0	Q2
TPS715A33DRVRM3	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)
TPS715A01DRBR	SON	DRB	8	3000	367.0	367.0	35.0
TPS715A01DRBRM3	SON	DRB	8	3000	367.0	367.0	35.0
TPS715A01DRVR	WSON	DRV	6	3000	213.0	191.0	35.0
TPS715A01DRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TPS715A01DRVRM3	WSON	DRV	6	3000	210.0	185.0	35.0
TPS715A30DRVR	WSON	DRV	6	3000	195.0	200.0	45.0
TPS715A30DRVT	WSON	DRV	6	250	213.0	191.0	35.0
TPS715A33DRBR	SON	DRB	8	3000	367.0	367.0	35.0
TPS715A33DRBRG4	SON	DRB	8	3000	367.0	367.0	35.0
TPS715A33DRBRM3	SON	DRB	8	3000	367.0	367.0	35.0
TPS715A33DRBT	SON	DRB	8	250	210.0	185.0	35.0
TPS715A33DRVR	WSON	DRV	6	3000	213.0	191.0	35.0
TPS715A33DRVR	WSON	DRV	6	3000	210.0	185.0	35.0
TPS715A33DRVRM3	WSON	DRV	6	3000	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.

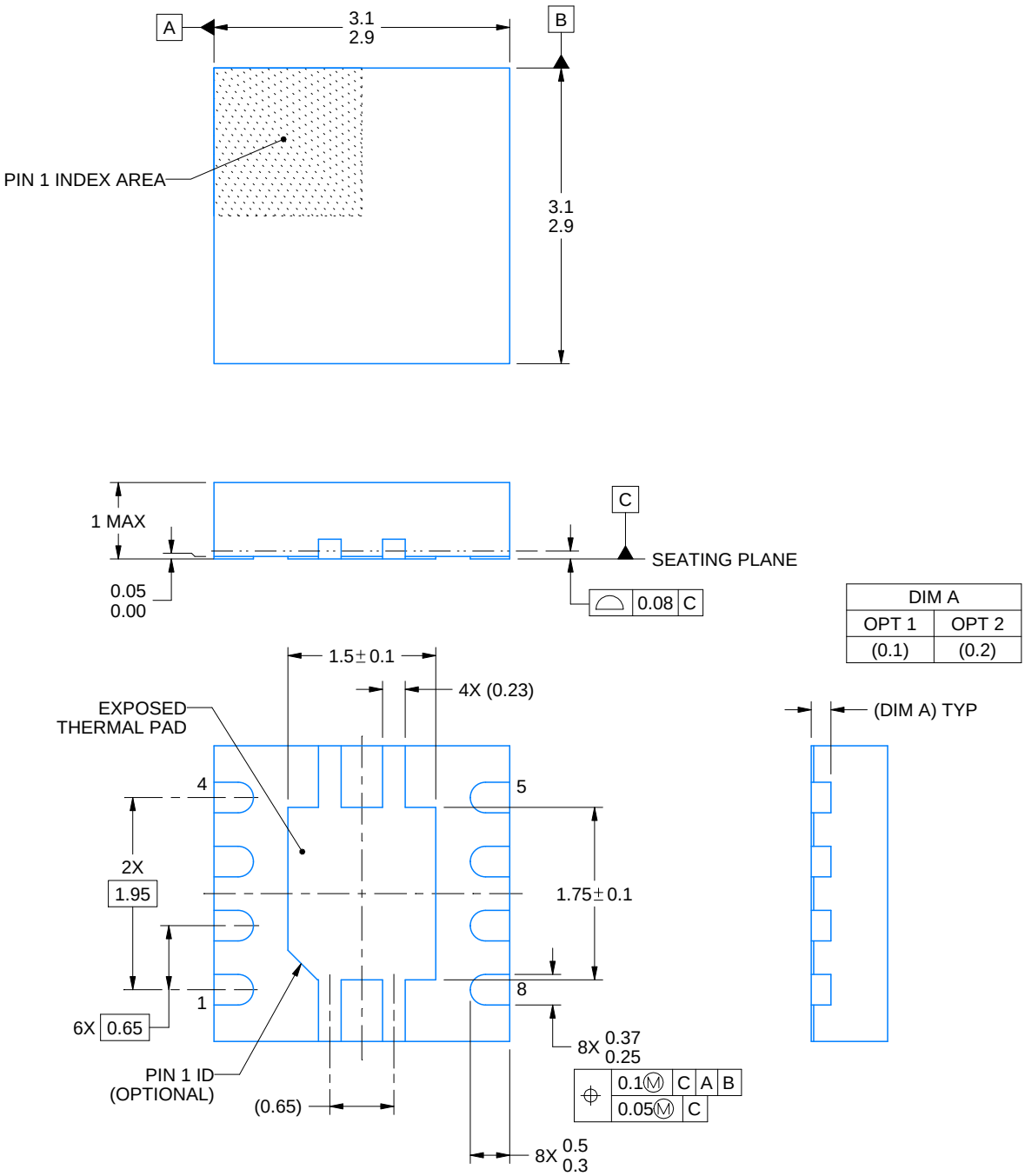
4203482/L

PACKAGE OUTLINE

DRB0008A

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



NOTES:

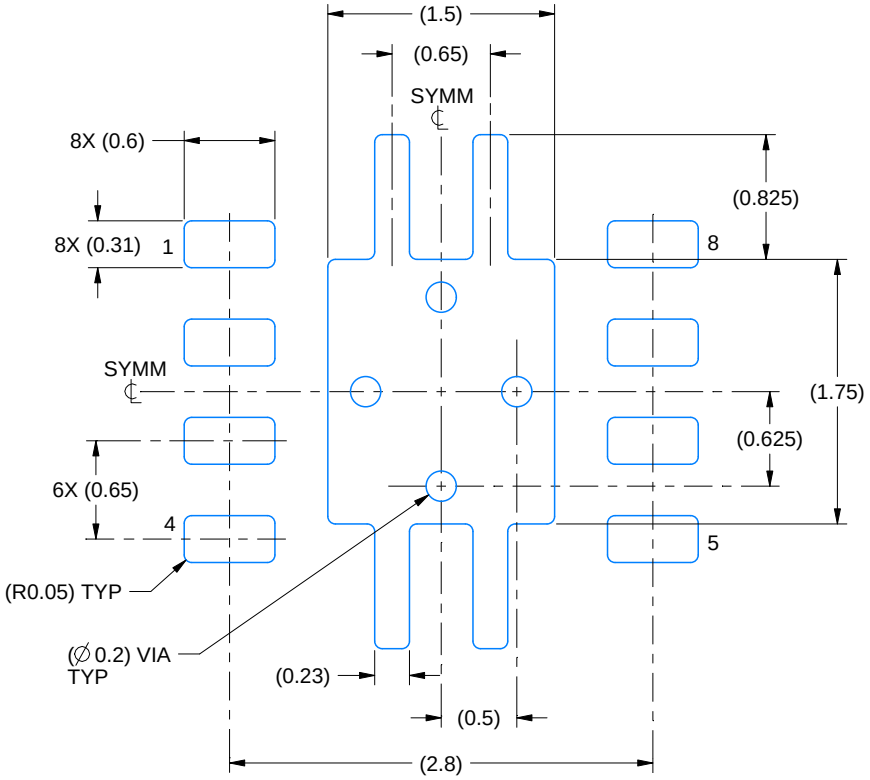
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

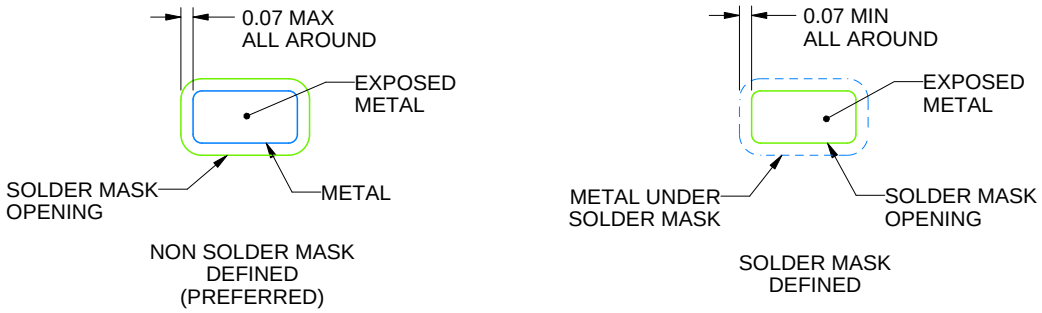
DRB0008A

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:20X

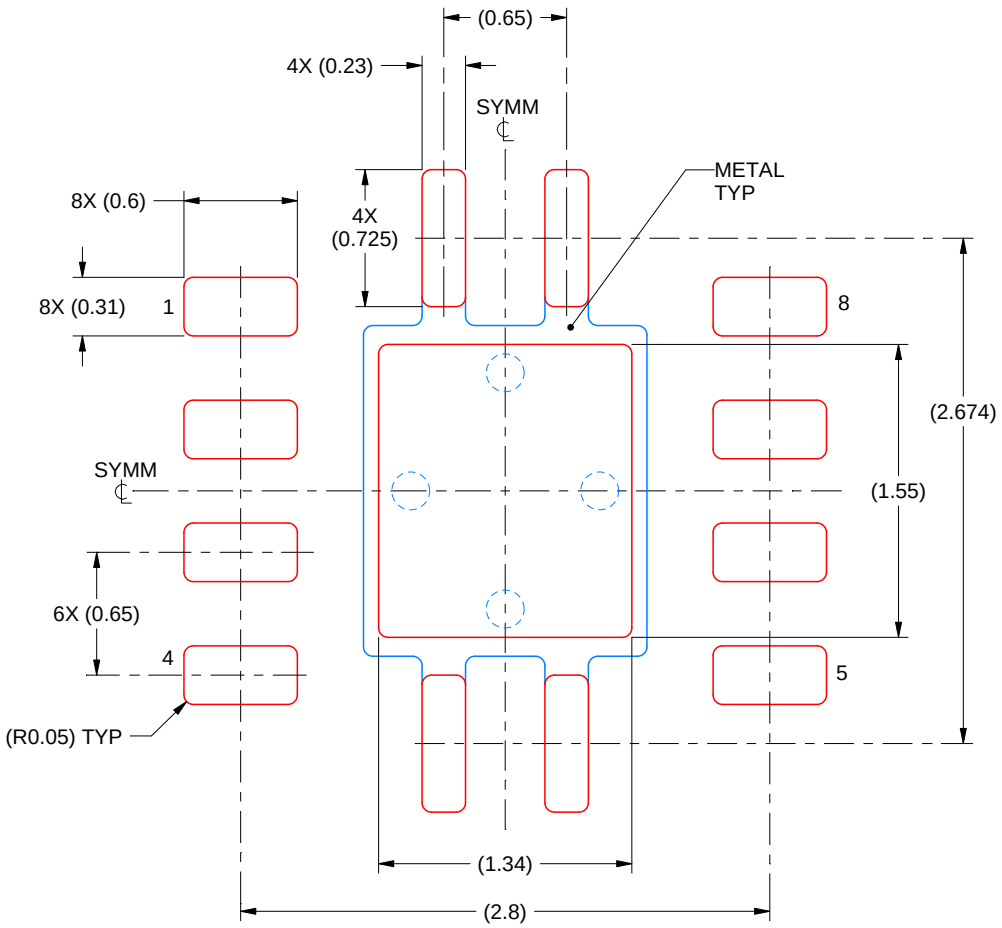


SOLDER MASK DETAILS

4218875/A 01/2018

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
84% PRINTED SOLDER COVERAGE BY AREA
SCALE:25X

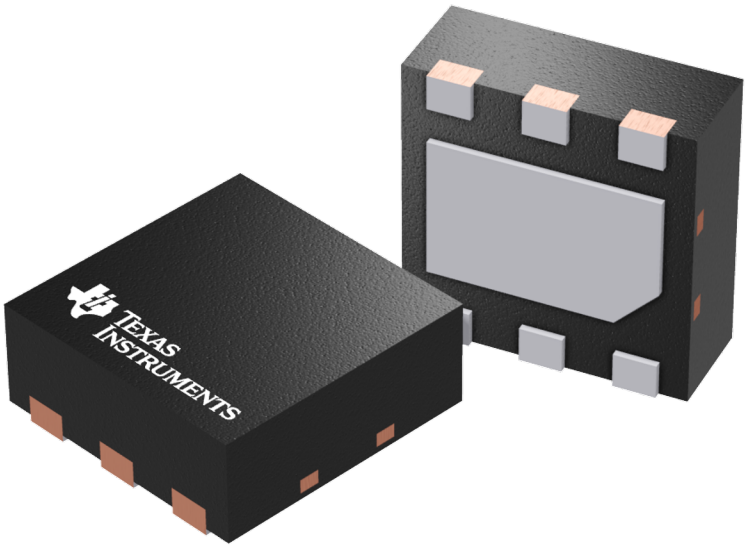
4218875/A 01/2018

NOTES: (continued)

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

DRV 6 WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



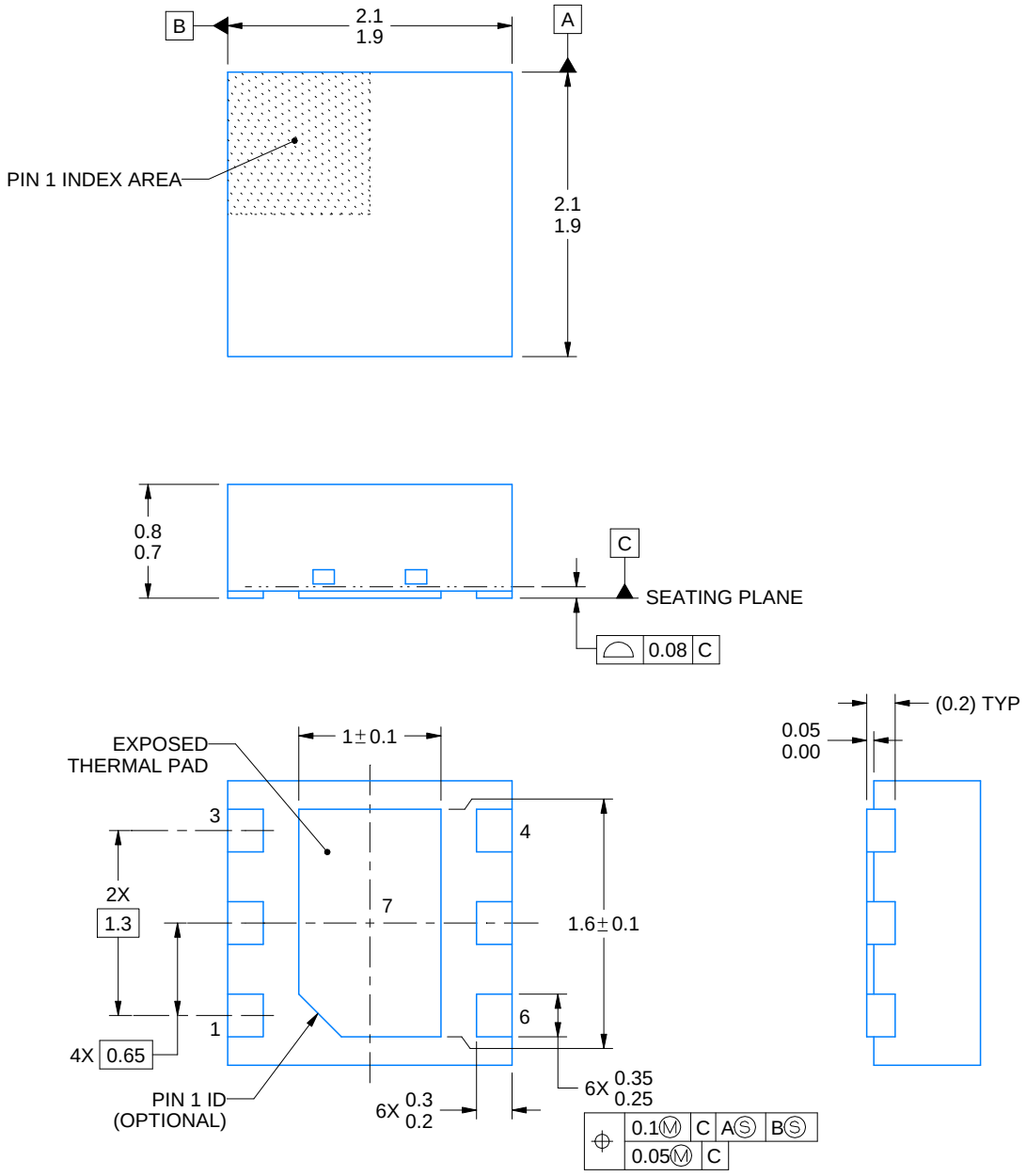
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

PACKAGE OUTLINE

DRV0006A

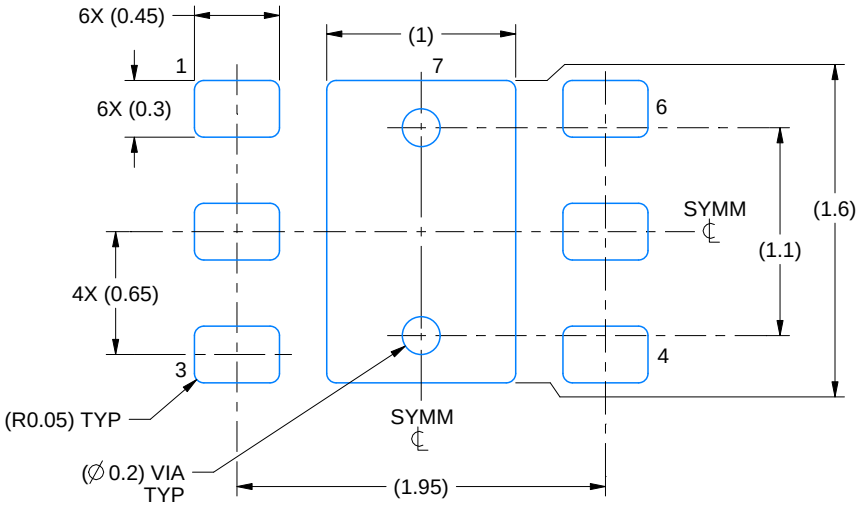
WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

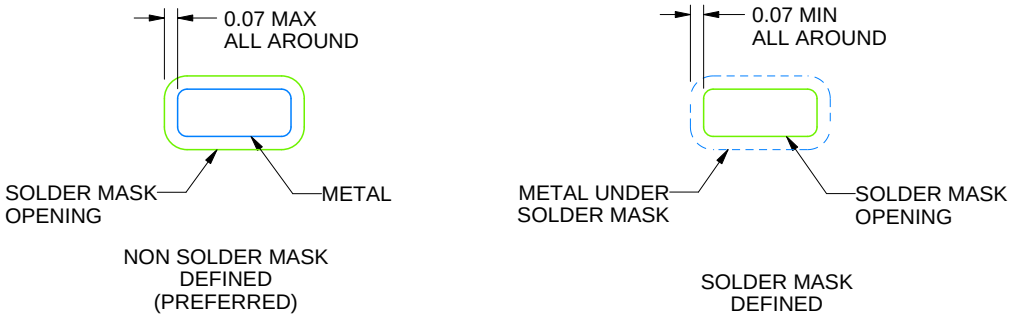


NOTES:

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



LAND PATTERN EXAMPLE
SCALE:25X



SOLDER MASK DETAILS

4222173/B 04/2018

NOTES: (continued)

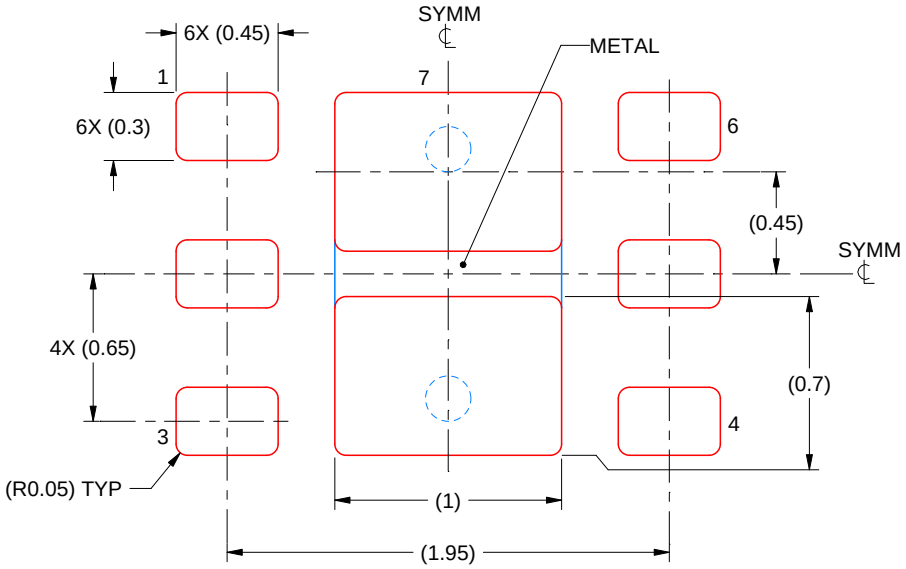
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If some or all are implemented, recommended via locations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

EXAMPLE STENCIL DESIGN

DRV0006A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

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

4222173/B 04/2018

NOTES: (continued)

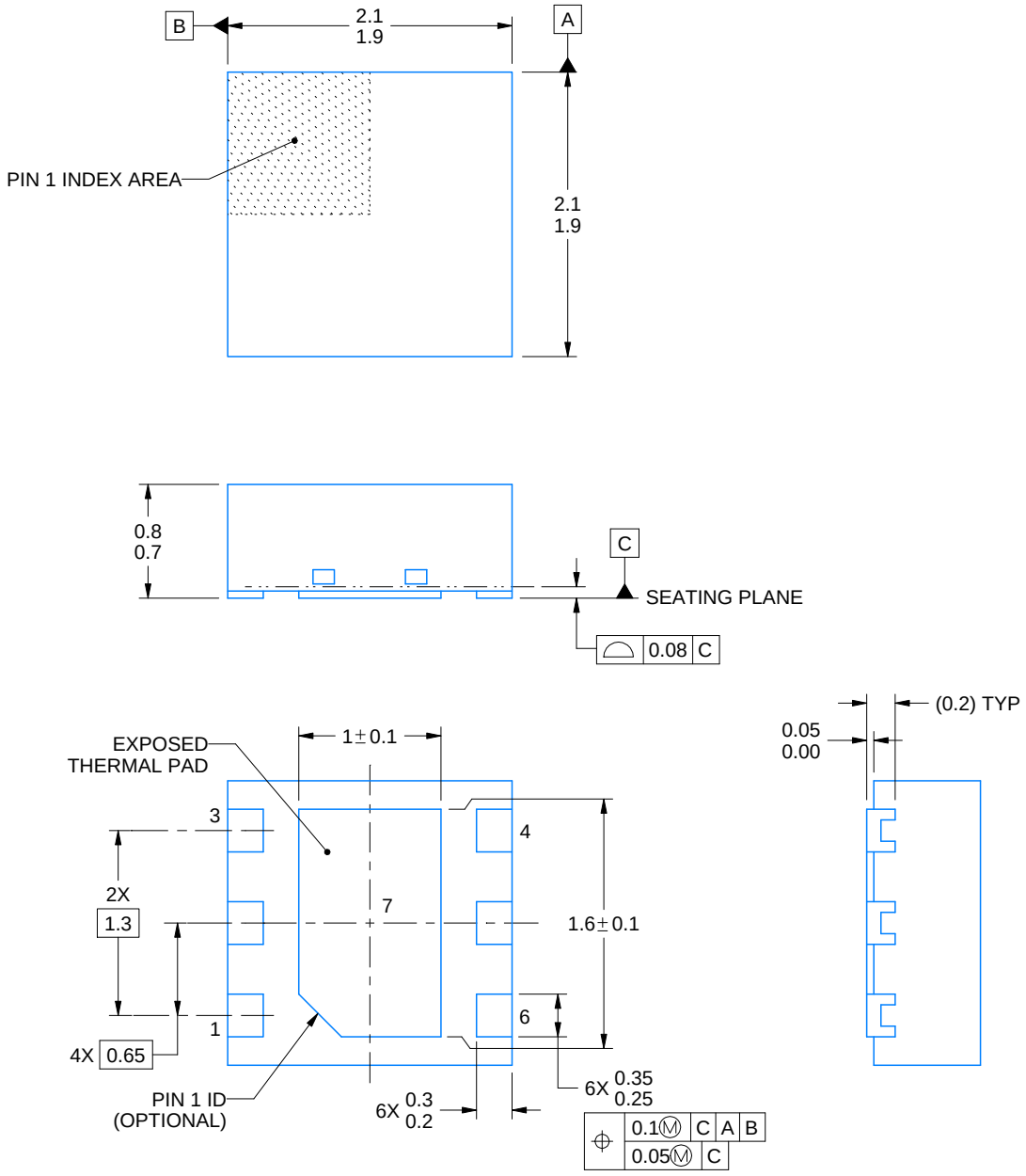
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

DRV0006D

PACKAGE OUTLINE

WSON - 0.8 mm max height

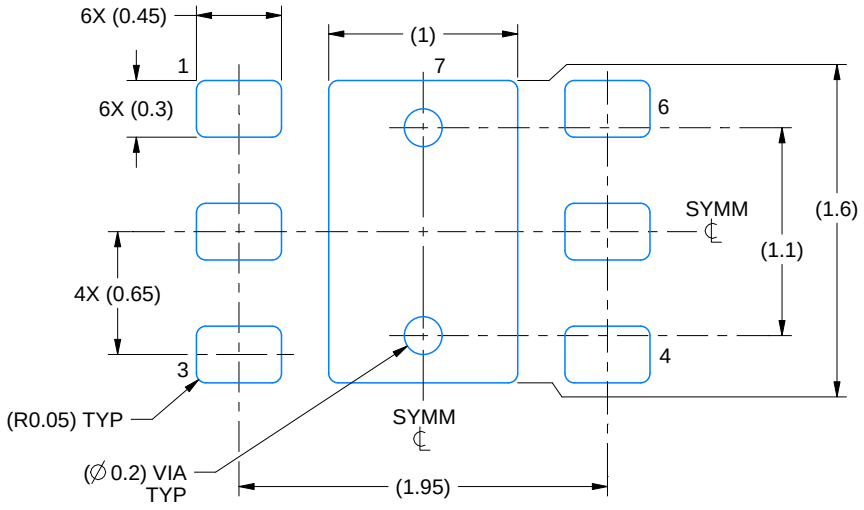
PLASTIC SMALL OUTLINE - NO LEAD



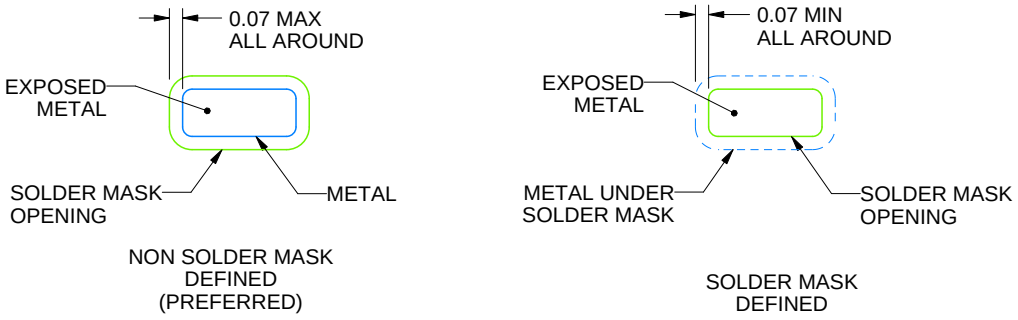
4225563/A 12/2019

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
EXPOSED METAL SHOWN
SCALE:25X

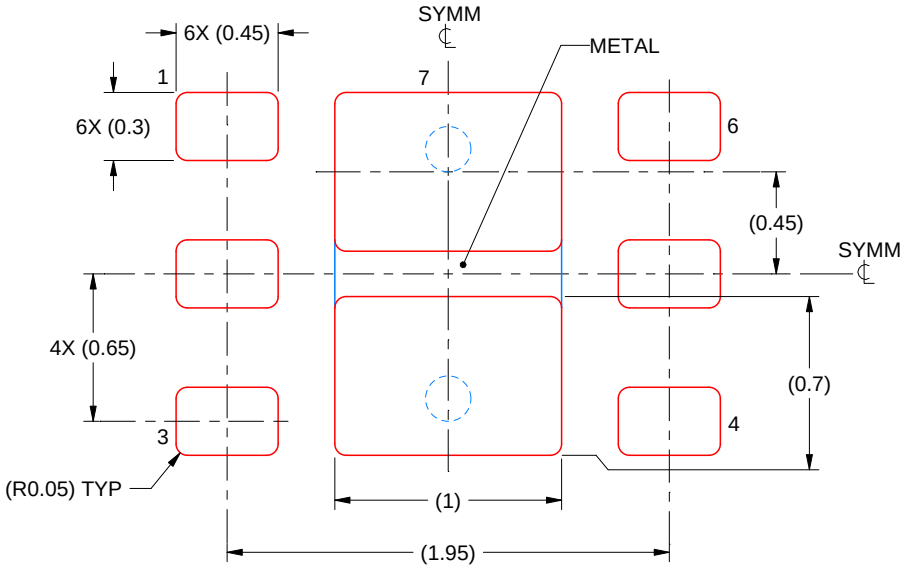


SOLDER MASK DETAILS

4225563/A 12/2019

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.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

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

4225563/A 12/2019

NOTES: (continued)

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

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