ULTRALOW-NOISE, HIGH-PSRR, FAST, RF, 500-mA LOW-DROPOUT LINEAR REGULATORS

Check for Samples: TPS79501-Q1

FEATURES

- **Qualified for Automotive Applications**
- **500-mA Low-Dropout Regulator With Enable**
- **High PSRR (50 dB at 10 kHz)**
- **Ultralow Noise (33 μV_{RMS}, TPS79501-Q1)**
- **Fast Start-Up Time (50 μs)**
- **Stable With a 1-μF Ceramic Capacitor**
- **Excellent Load/Line Transient Response**
- **Low Dropout Voltage (110 mV at Full Load, TPS79501-Q1)**

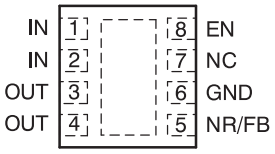
APPLICATIONS

- **RF: VCOs, Receivers, ADCs**
- **Audio**
- **Bluetooth®, Wireless LAN**

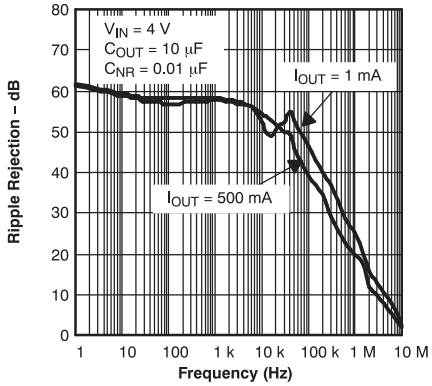
DESCRIPTION

The TPS79501-Q1 low-dropout (LDO), low-power linear voltage regulator features high power-supply rejection ratio (PSRR), ultralow noise, fast start-up, and excellent line and load transient responses in a small outline SON package. The device is stable with a small 1-μF ceramic capacitor on the output. The TPS79501-Q1 uses an advanced, proprietary BiCMOS fabrication process to yield extremely low dropout voltages (for example, 110 mV at 500 mA). The device achieves fast start-up times (approximately 50 μs with a 0.001-μF bypass capacitor) while consuming very low quiescent current (265 μA, typical). Moreover, when the device is placed in standby mode, the supply current is reduced to less than 1 μA. The TPS79501-Q1 exhibits approximately 33 μV_{RMS} of output voltage noise at 3-V output with a 0.1-μF bypass capacitor. Applications with analog components that are noise-sensitive, such as portable RF electronics, benefit from the high-PSRR and low-noise features, as well as from the fast response time.

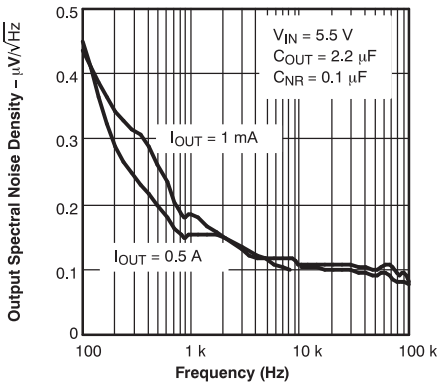
DRB PACKAGE
3mm x 3mm SON
(TOP VIEW)



RIPPLE REJECTION vs FREQUENCY



OUTPUT SPECTRAL NOISE DENSITY vs FREQUENCY



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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.

ORDERING INFORMATION(1)

T_A	PACKAGE		ORDERABLE	TOP-SIDE MARKING
-40°C to 125°C	SON – DRB	Tape and reel	TPS79501QDRBRQ1	QVE

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

ABSOLUTE MAXIMUM RATINGS

over operating temperature (unless otherwise noted)(1)

	VALUE
V_{IN} range	–0.3 V to 6 V
V_{EN} range	–0.3 V to V_{IN} + 0.3 V
V_{OUT} range	6 V
Peak output current	Internally limited
Continuous total power dissipation	See the Thermal Information Table
Junction temperature range, T_J	–40°C to 150°C
Storage temperature range, T_{stg}	–65°C to 150°C

(1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum conditions for extended periods may degrade device reliability. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.

THERMAL INFORMATION

THERMAL METRIC(1)(2)		TPS795xx(3) DRB (8 PINS)	UNITS
θ_{JA}	Junction-to-ambient thermal resistance(4)	47.8	°C/W
θ_{JCtop}	Junction-to-case (top) thermal resistance(5)	83	
θ_{JB}	Junction-to-board thermal resistance(6)	n/a	
ψ_{JT}	Junction-to-top characterization parameter(7)	2.1	
ψ_{JB}	Junction-to-board characterization parameter(8)	17.8	
θ_{JCbot}	Junction-to-case (bottom) thermal resistance(9)	12.1	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953A.
(2) For thermal estimates of this device based on PCB copper area, see the TI PCB Thermal Calculator.
(3) Thermal data for the RGW and DRC packages are derived by thermal simulations based on JEDEC-standard methodology as specified in the JESD51 series. The following assumptions are used in the simulations:
  (a) DRB: The exposed pad is connected to the PCB ground layer through a 2x2 thermal via array.
  (b) DRB: The top and bottom copper layers are assumed to have a 20% thermal conductivity of copper representing a 20% copper coverage.
  (c) These data were generated with only a single device at the center of a JEDEC high-K (2s2p) board with 3in × 3in copper area. To understand the effects of the copper area on thermal performance, see the *Power Dissipation* and *Estimating Junction Temperature* sections of this data sheet.
(4) The junction-to-ambient thermal resistance under natural convection is obtained in a simulation on a JEDEC-standard, high-K board, as specified in JESD51-7, in an environment described in JESD51-2a.
(5) The junction-to-case (top) thermal resistance is obtained by simulating a cold plate test on the top of the package. No specific JEDEC-standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.
(6) The junction-to-board thermal resistance is obtained by simulating in an environment with a ring cold plate fixture to control the PCB temperature, as described in JESD51-8.
(7) The junction-to-top characterization parameter, ψ_{JT}, estimates the junction temperature of a device in a real system and is extracted from the simulation data to obtain θ_{JA} using a procedure described in JESD51-2a (sections 6 and 7).
(8) The junction-to-board characterization parameter, ψ_{JB}, estimates the junction temperature of a device in a real system and is extracted from the simulation data to obtain θ_{JA} using a procedure described in JESD51-2a (sections 6 and 7).
(9) The junction-to-case (bottom) thermal resistance is obtained by simulating a cold plate test on the exposed (power) pad. No specific JEDEC standard test exists, but a close description can be found in the ANSI SEMI standard G30-88.

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ELECTRICAL CHARACTERISTICS

Over recommended operating temperature range (T_J = –40°C to 125°C), $V_{EN} = V_{IN}$, $V_{IN} = V_{OUT(nom)}$ + 1 V(1), I_{OUT} = 1 mA, C_{OUT} = 10 µF, C_{NR} = 0.01 µF, unless otherwise noted. Typical values are at +25°C.

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
Input voltage, V_{IN} (1)				2.7		5.5	V
Internal reference, V_{FB}				1.200	1.225	1.250	V
Continuous output current, I_{OUT}				0		500	mA
Output voltage	Output voltage range			1.225		5.5 – V_{DO}	V
	Accuracy, see Note (2)	0 µA ≤ I_{OUT} ≤ 500 mA, V_{OUT} + 1 V ≤ V_{IN} ≤ 5.5 V(1)		0.98(V_{OUT})	V_{OUT}	1.02(V_{OUT})	V
Output voltage line regulation ($\Delta V_{OUT}\%/\Delta V_{IN}$)(1)		V_{OUT} + 1 V ≤ V_{IN} ≤ 5.5 V			0.05	0.12	%/V
Load regulation ($\Delta V_{OUT}\%/\Delta I_{OUT}$)		0 µA ≤ I_{OUT} ≤ 500 mA,			3		mV
Dropout voltage(3) V_{IN} = $V_{OUT(nom)}$ - 0.1 V		I_{OUT} = 500 mA			110	170	mV
Output current limit		V_{OUT} = 0 V		2.4	2.8	4.2	A
Ground pin current		0 µA ≤ I_{OUT} ≤ 500 mA			265	385	µA
Shutdown current(4)		V_{EN} = 0 V, 2.7 V ≤ V_{IN} ≤ 5.5 V			0.07	1	µA
FB pin current		V_{FB} = 1.225 V				1	µA
Power-supply ripple rejection		f = 100 Hz, I_{OUT} = 10 mA			59		dB
		f = 100 Hz, I_{OUT} = 500 mA			58		
		f = 10 kHz, I_{OUT} = 500 mA			50		
		f = 100 kHz, I_{OUT} = 500 mA			39		
Output noise voltage		BW = 100 Hz to 100 kHz, I_{OUT} = 500 mA	C_{NR} = 0.001 µF		46		μV_{RMS}
			C_{NR} = 0.0047 µF		41		
			C_{NR} = 0.01 µF		35		
			C_{NR} = 0.1 µF		33		
Time, start-up		R_L = 6 Ω, C_{OUT} = 1 µF	C_{NR} = 0.001 µF		50		µs
			C_{NR} = 0.0047 µF		75		
			C_{NR} = 0.01 µF		110		
High-level enable input voltage		2.7 V ≤ V_{IN} ≤ 5.5 V		1.7		V_{IN}	V
Low-level enable input voltage		2.7 V ≤ V_{IN} ≤ 5.5 V				0.7	V
EN pin current		V_{EN} = 0 V		1		1	µA
UVLO threshold		V_{CC} rising		2.25		2.65	V
UVLO hysteresis					100		mV

(1) Minimum V_{IN} is 2.7 V or V_{OUT} + V_{DO}, whichever is greater.
(2) Tolerance of external resistors not included in this specification.
(3) Dropout is not measured since minimum V_{IN} = 2.7 V.
(4) For adjustable version, this applies only after V_{IN} is applied; then V_{EN} transitions high to low.

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FUNCTIONAL BLOCK DIAGRAM—ADJUSTABLE VERSION

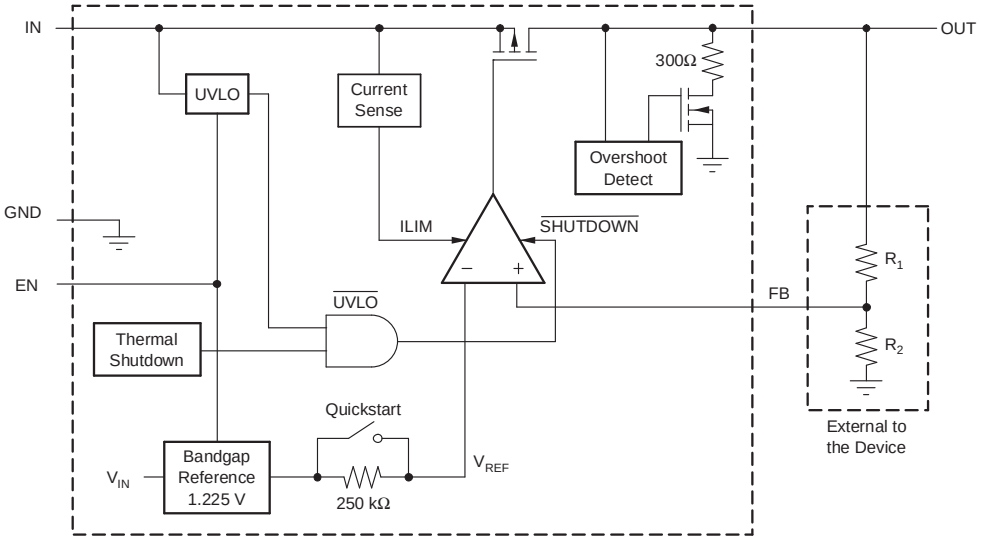

Table 1. Terminal Functions

NAME	3x3 SON (DRB) PIN NO.	DESCRIPTION
IN	1, 2	Unregulated input to the device
GND	6	Regulator ground
EN	8	Driving the enable pin (EN) high turns on the regulator. Driving this pin low puts the regulator into shutdown mode. EN can be connected to IN if not used.
NR	5	Noise-reduction pin for fixed versions only. Connecting an external capacitor to this pin bypasses noise generated by the internal bandgap, which improves power-supply rejection and reduces output noise.
FB	5	Feedback input voltage for the adjustable device.
OUT	3, 4	Regulator output.
NC	7	Not connected

TYPICAL CHARACTERISTICS

OUTPUT VOLTAGE vs OUTPUT CURRENT

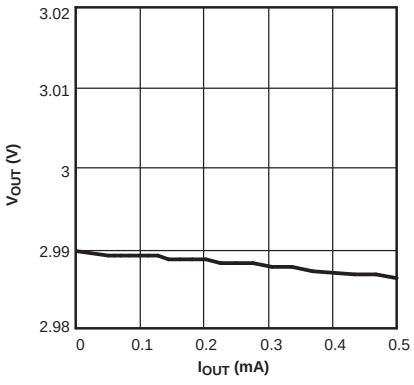

Figure 1.

OUTPUT VOLTAGE vs JUNCTION TEMPERATURE

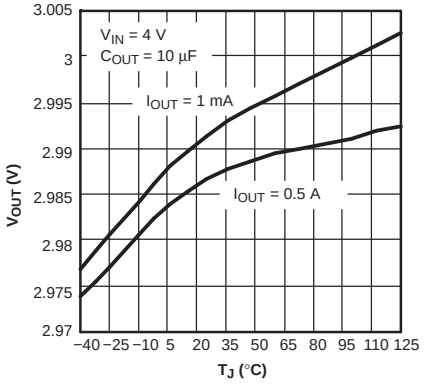

Figure 2.

GROUND CURRENT vs JUNCTION TEMPERATURE

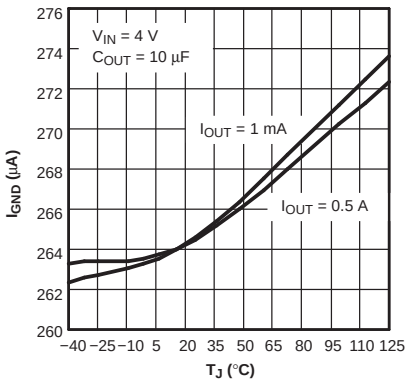

Figure 3.

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TYPICAL CHARACTERISTICS (continued)

OUTPUT SPECTRAL NOISE DENSITY vs FREQUENCY

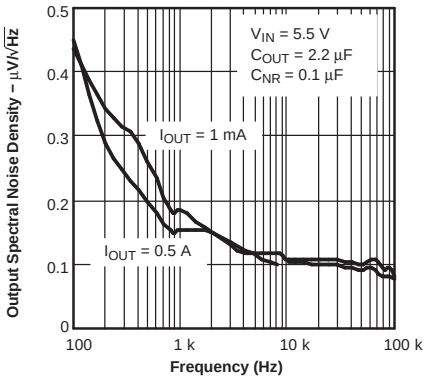

Figure 4.

OUTPUT SPECTRAL NOISE DENSITY vs FREQUENCY

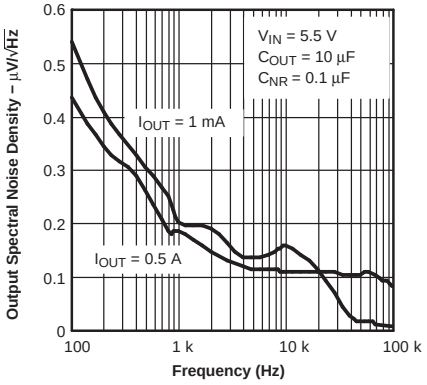

Figure 5.

OUTPUT SPECTRAL NOISE DENSITY vs FREQUENCY

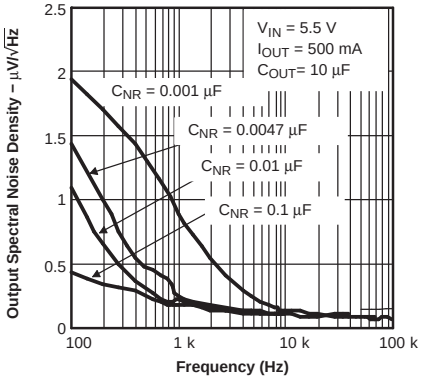

Figure 6.

ROOT MEAN SQUARED OUTPUT NOISE vs C_{NR}

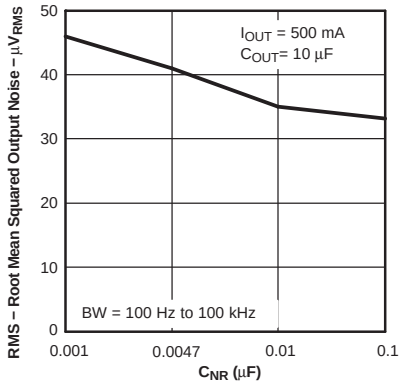

Figure 7.

DROPOUT VOLTAGE vs JUNCTION TEMPERATURE

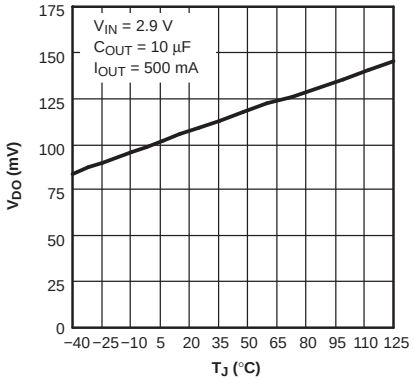

Figure 8.

RIPPLE REJECTION vs FREQUENCY

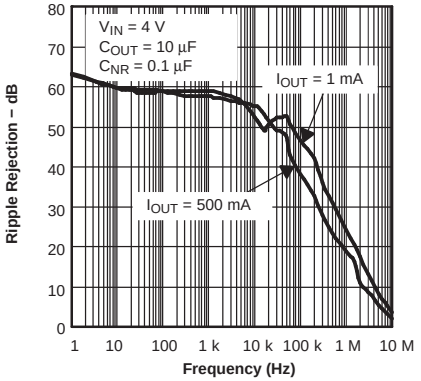

Figure 9.

RIPPLE REJECTION vs FREQUENCY

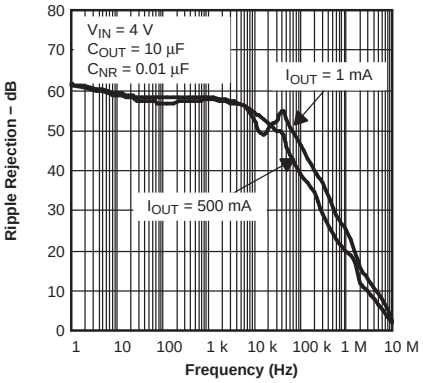

Figure 10.

RIPPLE REJECTION vs FREQUENCY

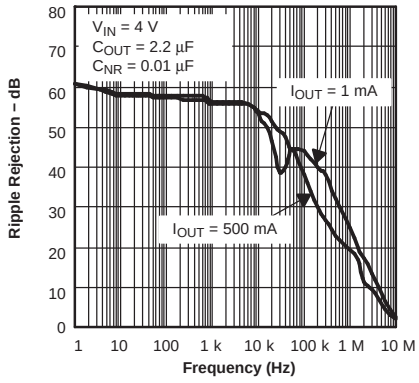

Figure 11.

RIPPLE REJECTION vs FREQUENCY

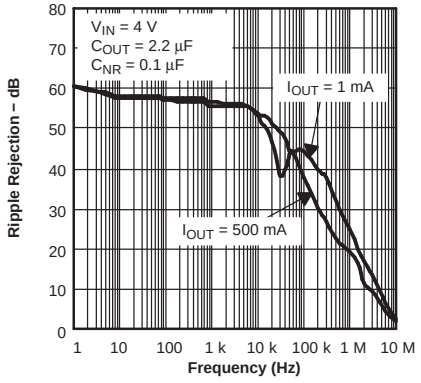

Figure 12.

TYPICAL CHARACTERISTICS (continued)

START-UP TIME

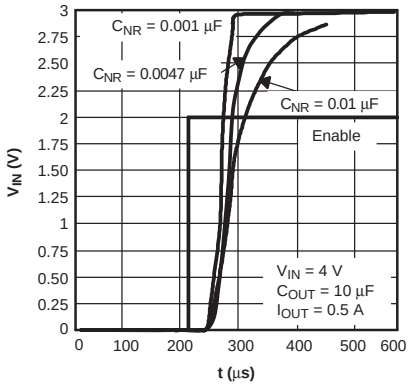

Figure 13.

LINE TRANSIENT RESPONSE

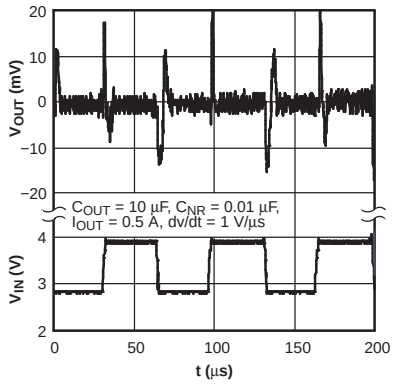

Figure 14.

LINE TRANSIENT RESPONSE

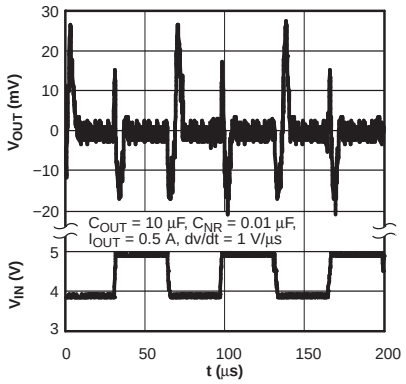

Figure 15.

LOAD TRANSIENT RESPONSE

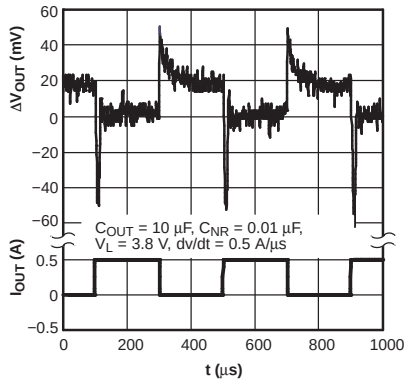

Figure 16.

POWER UP/POWER DOWN

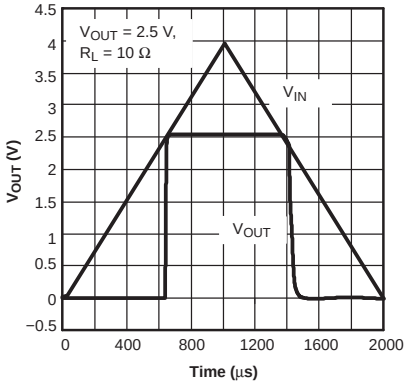

Figure 17.

DROPOUT VOLTAGE vs OUTPUT CURRENT

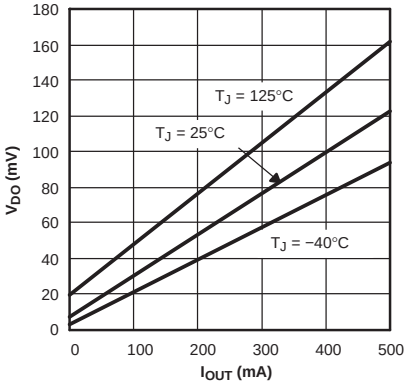

Figure 18.

DROPOUT VOLTAGE vs INPUT VOLTAGE

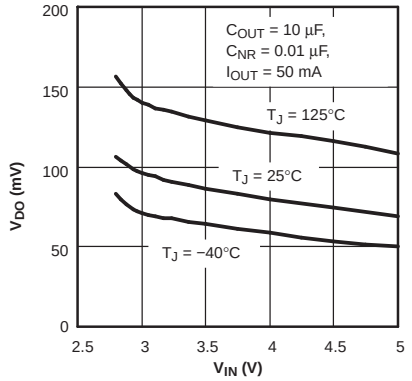

Figure 19.

TYPICAL REGIONS OF STABILITY EQUIVALENT SERIES RESISTANCE (ESR) vs OUTPUT CURRENT

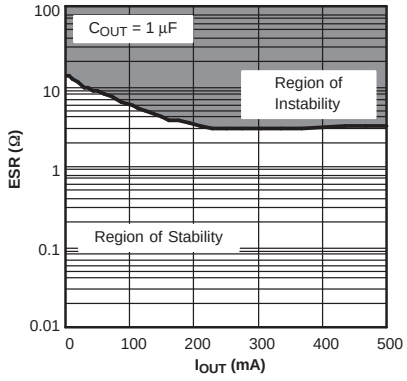

Figure 20.

TYPICAL REGIONS OF STABILITY EQUIVALENT SERIES RESISTANCE (ESR) vs OUTPUT CURRENT

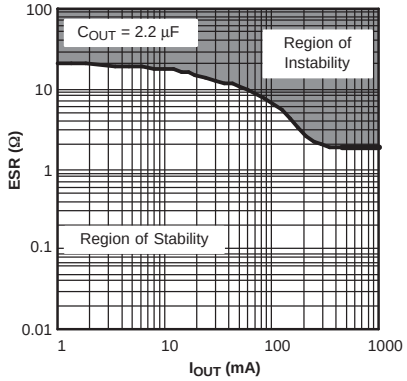

Figure 21.

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TYPICAL CHARACTERISTICS (continued)

TYPICAL REGIONS OF STABILITY EQUIVALENT SERIES RESISTANCE (ESR) VS OUTPUT CURRENT

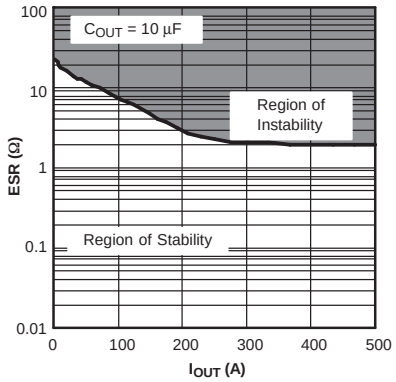

Figure 22.

APPLICATION INFORMATION

The TPS79501-Q1 low-dropout (LDO) regulator has been optimized for use in noise-sensitive equipment. The device features extremely low dropout voltages, high PSRR, ultralow output noise, low quiescent current (265 μA typical), and an enable input to reduce supply currents to less than 1 μA when the regulator is turned off.

A typical application circuit is shown in Figure 23.

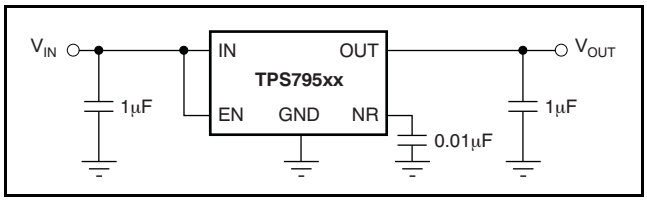

Figure 23. Typical Application Circuit

EXTERNAL CAPACITOR REQUIREMENTS

Although not required, it is good analog design practice to place a 0.1μF to 2.2μF capacitor near the input of the regulator to counteract reactive input sources. A higher-value input capacitor may be necessary if large, fast-rise-time load transients are anticipated and the device is located several inches from the power source.

Like most low-dropout regulators, the TPS79501-Q1 requires an output capacitor connected between OUT and GND to stabilize the internal control loop. The minimum recommended capacitor is 1 μF. Any 1 μF or larger ceramic capacitor is suitable.

The internal voltage reference is a key source of noise in an LDO regulator. The TPS79501-Q1 has an NR pin which is connected to the voltage reference through a 250-kΩ internal resistor. The 250-kΩ internal resistor, in conjunction with an external bypass capacitor connected to the NR pin, creates a low-pass filter to reduce the voltage reference noise and, therefore, the noise at the regulator output. In order for the regulator to operate properly, the current flow out of the NR pin must be at a minimum, because any leakage current creates an IR drop across the internal resistor, thus creating an output error. Therefore, the bypass capacitor must have minimal leakage current. The bypass capacitor should be no more than 0.1-μF in order to ensure that it is fully charged during the quickstart time provided by the internal switch shown in the Functional Block Diagram.

For example, the TPS79501-Q1 exhibits only 33 μV_{RMS} of output voltage noise using a 0.1-μF ceramic bypass capacitor and a 10-μF ceramic output capacitor. Note that the output starts up slower as the bypass capacitance increases because of the RC time constant at the bypass pin that is created by the internal 250-kΩ resistor and external capacitor.

BOARD LAYOUT RECOMMENDATION TO IMPROVE PSRR AND NOISE PERFORMANCE

To improve ac measurements such as PSRR, output noise, and transient response, it is recommended that the board be designed with separate ground planes for V_{IN} and V_{OUT}, with each ground plane connected only at the ground pin of the device. In addition, the ground connection for the bypass capacitor should connect directly to the ground pin of the device.

REGULATOR MOUNTING

The tab of the SOT223-6 package is electrically connected to ground. For best thermal performance, the tab of the surface-mount version should be soldered directly to a circuit-board copper area. Increasing the copper area improves heat dissipation.

Solder pad footprint recommendations for the devices are presented in application report SBFA015, *Solder Pad Recommendations for Surface-Mount Devices*, available from the TI web site (www.ti.com).

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PROGRAMMING THE TPS79501-Q1 ADJUSTABLE LDO REGULATOR

The output voltage of the TPS79501-Q1 adjustable regulator is programmed using an external resistor divider as shown in Figure 24. The output voltage is calculated using Equation 1:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_1}{R_2}\right) \quad (1)$$

where:

- V_{REF} = 1.2246 V typ (the internal reference voltage)

Resistors R_1 and R_2 should be chosen for approximately 40-μA divider current. Lower value resistors can be used for improved noise performance, but the device wastes more power. Higher values should be avoided, as leakage current at FB increases the output voltage error.

The recommended design procedure is to choose R_2 = 30.1 kΩ to set the divider current at 40 μA, C_1 = 15 pF for stability, and then calculate R_1 using Equation 2:

$$R_1 = \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \times R_2 \quad (2)$$

In order to improve the stability of the adjustable version, it is suggested that a small compensation capacitor be placed between OUT and FB.

The approximate value of this capacitor can be calculated as Equation 3:

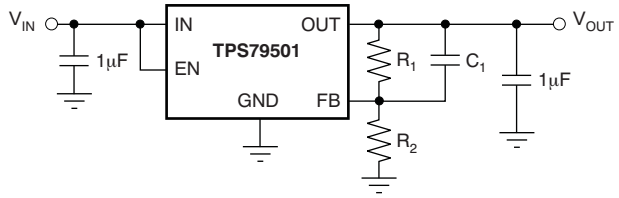
$$C_1 = \frac{(3 \times 10^{-7}) \times (R_1 + R_2)}{(R_1 \times R_2)} \quad (3)$$

The suggested value of this capacitor for several resistor ratios is shown in the table within Figure 24. If this capacitor is not used (such as in a unity-gain configuration), then the minimum recommended output capacitor is 2.2 μF instead of 1 μF.

REGULATOR PROTECTION

The TPS79501-Q1 PMOS-pass transistor has a built-in back diode that conducts reverse current when the input voltage drops below the output voltage (for example, during power down). Current is conducted from the output to the input and is not internally limited. If extended reverse voltage operation is anticipated, external limiting might be appropriate.

The TPS79501-Q1 features internal current limiting and thermal protection. During normal operation, the TPS79501-Q1 limits output current to approximately 2.8 A. When current limiting engages, the output voltage scales back linearly until the overcurrent condition ends. While current limiting is designed to prevent gross device failure, care should be taken not to exceed the power dissipation ratings of the package. If the temperature of the device exceeds approximately +165°C, thermal protection circuitry shuts it down. Once the device has cooled down to below approximately 140°C, regulator operation resumes.



OUTPUT VOLTAGE PROGRAMMING GUIDE

OUTPUT VOLTAGE	R_1	R_2	C_1
1.8 V	14.0 kΩ	30.1 kΩ	33 pF
3.6 V	57.9 kΩ	30.1 kΩ	15 pF

Figure 24. TPS79501-Q1 Adjustable LDO Regulator Programming

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THERMAL INFORMATION

Power Dissipation

Knowing the device power dissipation and proper sizing of the thermal plane that is connected to the tab or pad is critical to avoiding thermal shutdown and ensuring reliable operation.

Power dissipation of the device depends on input voltage and load conditions and can be calculated using Equation 4:

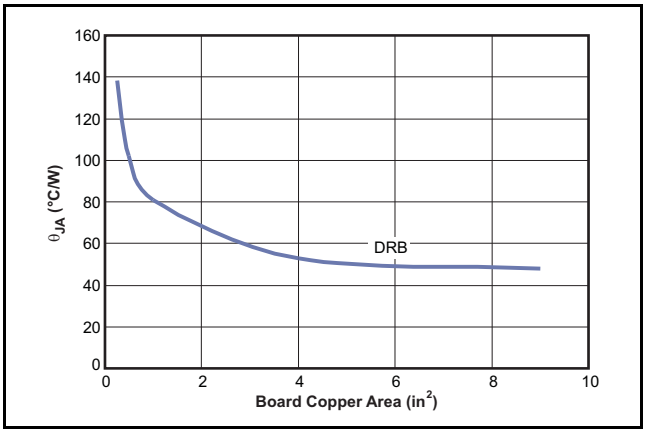
$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} \quad (4)$$

Power dissipation can be minimized and greater efficiency can be achieved by using the lowest possible input voltage necessary to achieve the required output voltage regulation.

On the SON (DRB) package, the primary conduction path for heat is through the exposed pad to the printed circuit board (PCB). The pad can be connected to ground or be left floating; however, it should be attached to an appropriate amount of copper PCB area to ensure the device does not overheat. The tab should be connected to ground. The maximum junction-to-ambient thermal resistance depends on the maximum ambient temperature, maximum device junction temperature, and power dissipation of the device and can be calculated using Equation 5:

$$R_{\theta JA} = \frac{(+125^{o}C - T_A)}{P_D} \quad (5)$$

Knowing the maximum $R_{\theta JA}$, the minimum amount of PCB copper area needed for appropriate heatsinking can be estimated using Figure 25.



Note: θ_{JA} value at board size of 9 in^2 (that is, 3 in × 3 in) is a JEDEC standard.

Figure 25. θ_{JA} vs Board Size

Figure 25 shows the variation of θ_{JA} as a function of ground plane copper area in the board. It is intended only as a guideline to demonstrate the effect of heat spreading in the ground plane and should not be used to estimate the thermal performance in real application environments.

NOTE: When the device is mounted on an application PCB, it is strongly recommended to use Ψ_{JT} and Ψ_{JB}, as explained in the *Estimating Junction Temperature* section.

ESTIMATING JUNCTION TEMPERATURE

Using the thermal metrics Ψ_{JT} and Ψ_{JB}, as shown in the Thermal Information table, the junction temperature can be estimated with corresponding formulas (given in Equation 6). For backwards compatibility, an older θ_{JC},Top parameter is also listed.

$$\Psi_{JT}: \quad T_J = T_T + \Psi_{JT} \bullet P_D$$

$$\Psi_{JB}: \quad T_J = T_B + \Psi_{JB} \bullet P_D \quad (6)$$

Where P_D is the power dissipation shown by Equation 5, T_T is the temperature at the center-top of the IC package, and T_B is the PCB temperature measured 1 mm away from the IC package *on the PCB surface* (as Figure 27 shows).

NOTE: Both T_T and T_B can be measured on actual application boards using a thermo-gun (an infrared thermometer).

For more information about measuring T_T and T_B, see the application note SBVA025, *Using New Thermal Metrics*, available for download at www.ti.com.

By looking at Figure 26, the new thermal metrics (Ψ_{JT} and Ψ_{JB}) have little dependency on board size. That is, using Ψ_{JT} or Ψ_{JB} with Equation 6 is a good way to estimate T_J by simply measuring T_T or T_B, regardless of the application board size.

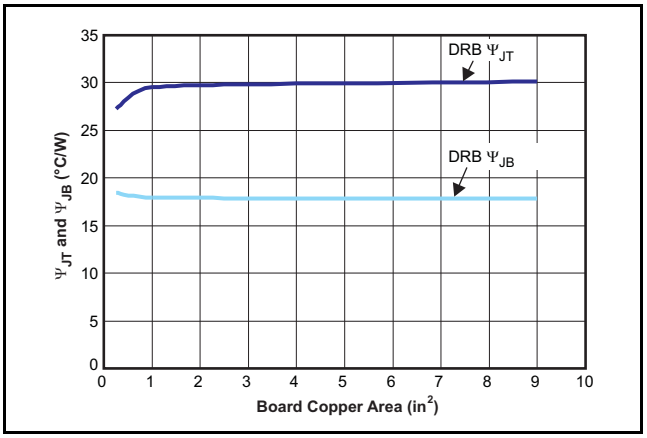


Figure 26. Ψ_{JT} and Ψ_{JB} vs Board Size

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For a more detailed discussion of why TI does not recommend using $\theta_{JC(top)}$ to determine thermal characteristics, see the application report SBVA025, *Using New Thermal Metrics*, available for download at www.ti.com.

For further information, see the application report SPRA953, *IC Package Thermal Metrics*, also available on the TI website.

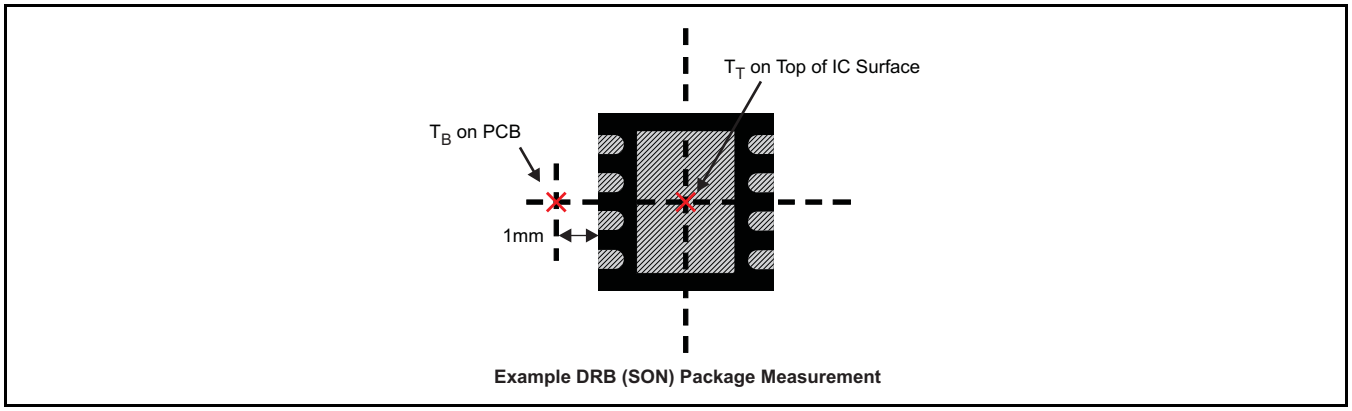

Figure 27. Measuring Point for T_T and T_B

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)
TPS79501QDRBRQ1	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	QVE
TPS79501QDRBRQ1.A	Active	Production	SON (DRB) | 8	3000 | LARGE T&R	Yes	NIPDAU	Level-3-260C-168 HR	-40 to 125	QVE

(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.

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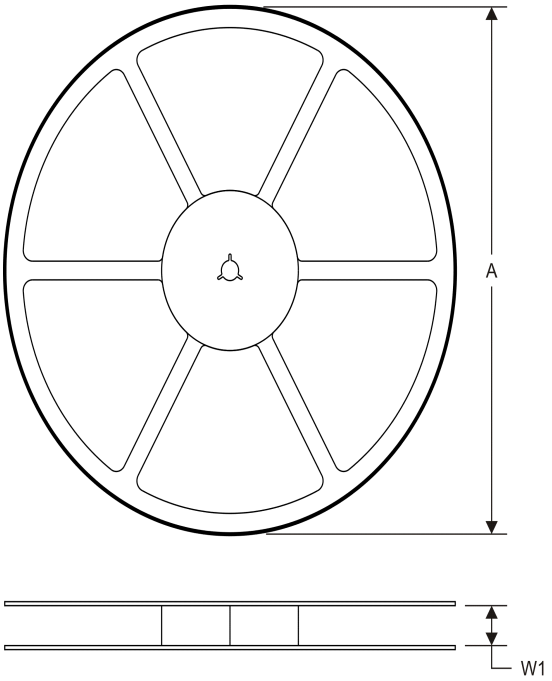
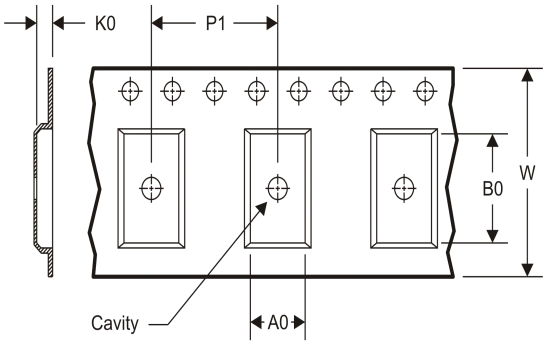
TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



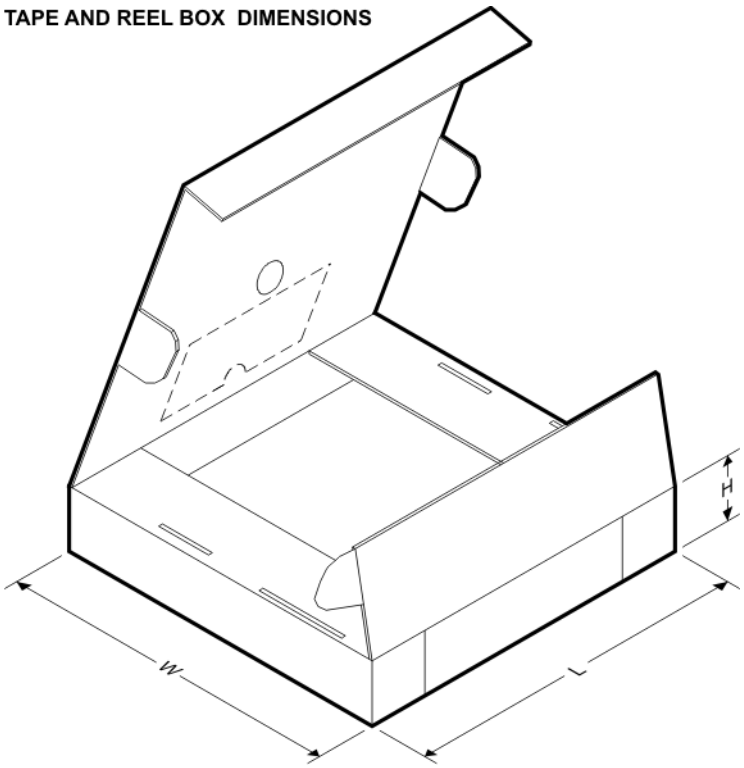
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*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
TPS79501QDRBRQ1	SON	DRB	8	3000	330.0	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)
TPS79501QDRBRQ1	SON	DRB	8	3000	367.0	367.0	35.0

GENERIC PACKAGE VIEW

DRB 8 VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

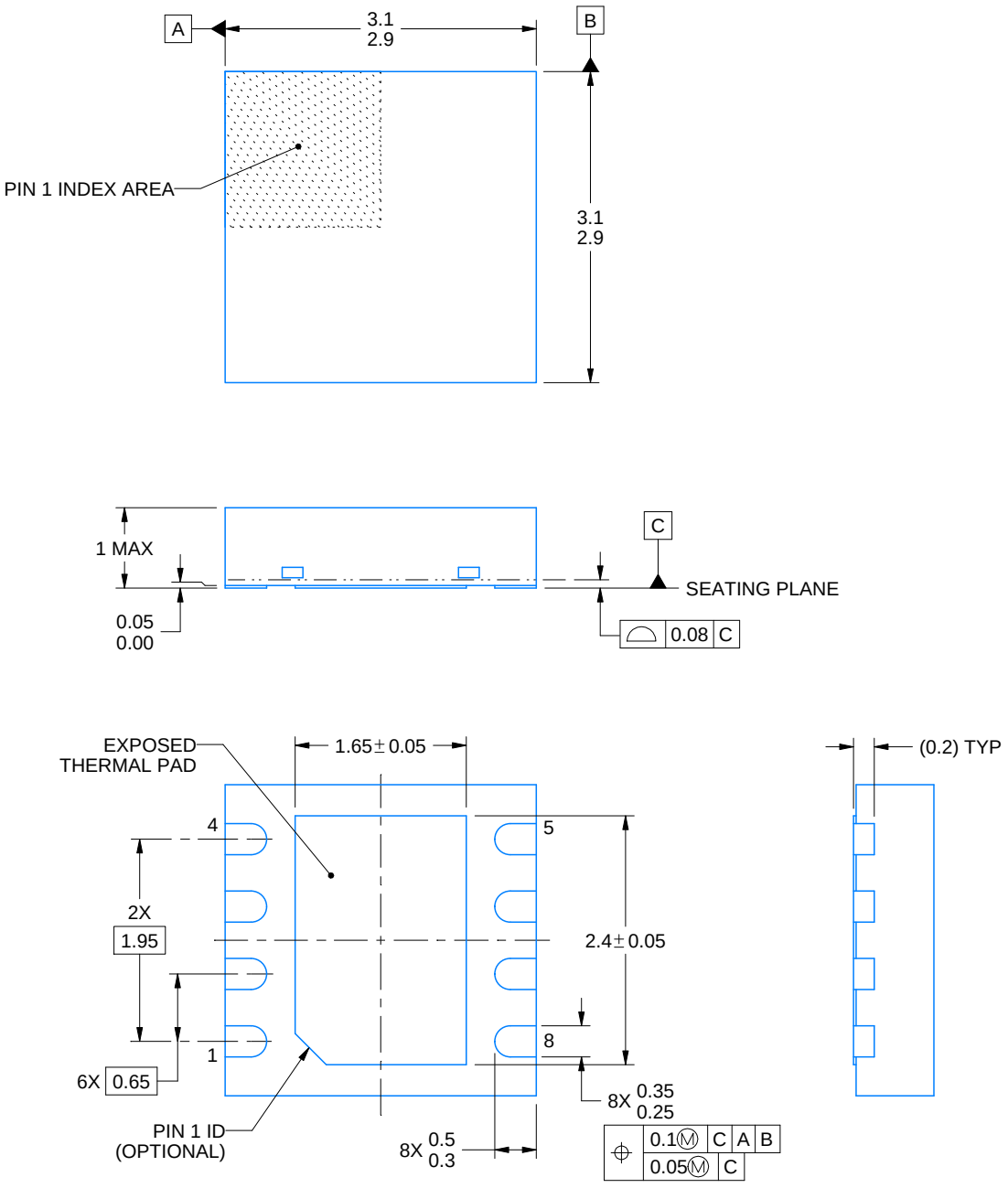
Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

DRB0008B

PACKAGE OUTLINE

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



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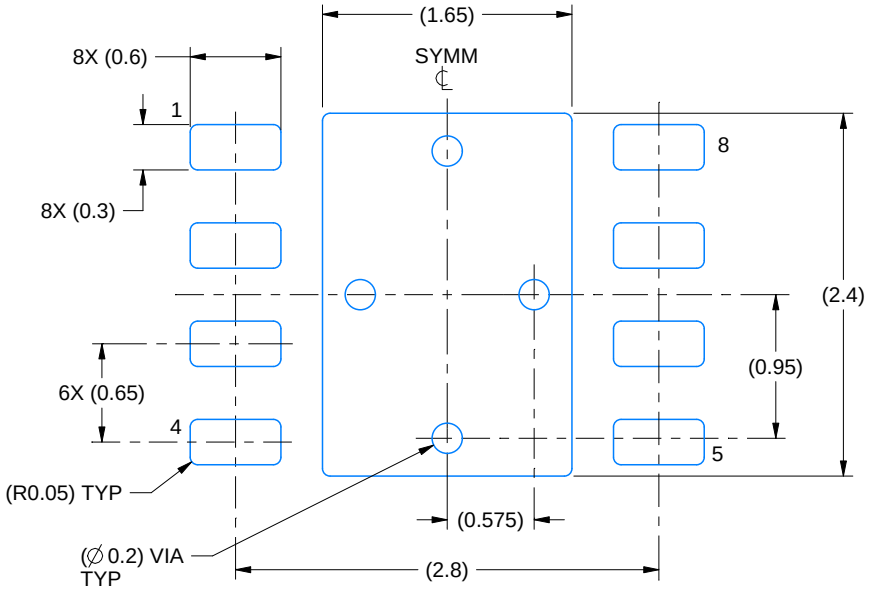
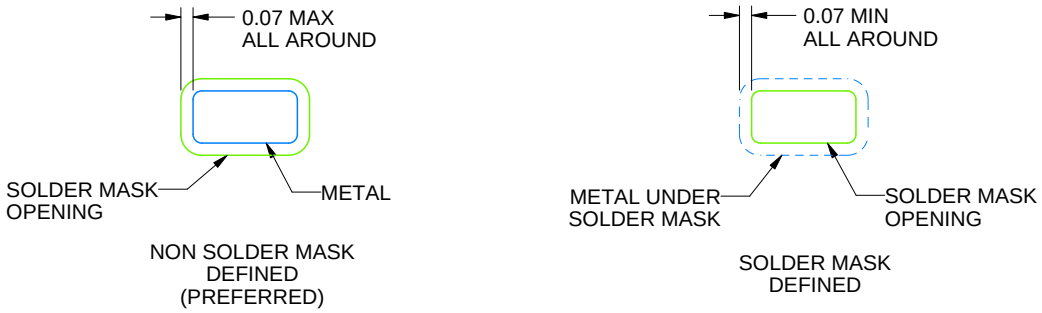
NOTES:

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

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NOTES: (continued)

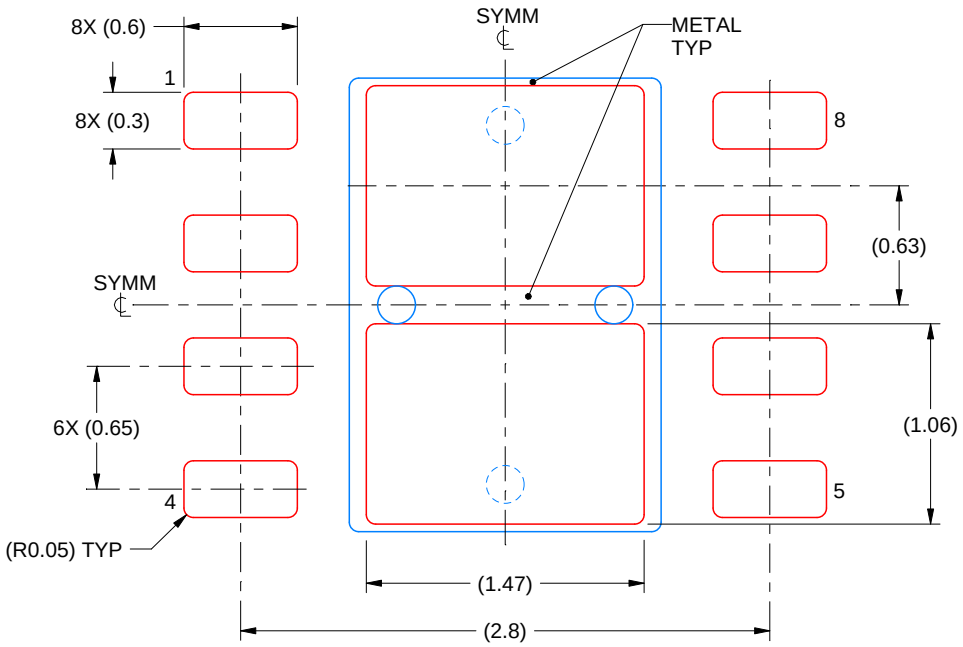
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DRB0008B

VSON - 1 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

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

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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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