

## ULTRALOW-NOISE, HIGH-PSRR, FAST RF 200-mA LOW-DROPOUT LINEAR REGULATORS

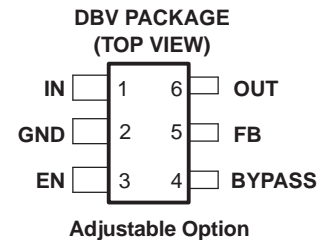
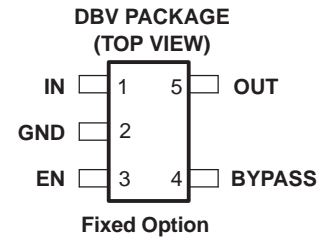
Check for Samples: [TPS79301-Q1](#), [TPS79318-Q1](#), [TPS79325-Q1](#), [TPS79328-Q1](#), [TPS793285-Q1](#), [TPS79330-Q1](#), [TPS79333-Q1](#)

### FEATURES

- Qualified For Automotive Applications
- 200-mA Low-Dropout Regulator With EN
- Available in 1.8-V, 2.5-V, 2.8-V, 2.85-V, 3-V, 3.3-V, 4.75-V, and Adjustable Options
- High PSRR (70 dB at 10 kHz)
- Ultralow Noise (32  $\mu$ V)
- Fast Start-Up Time (50  $\mu$ s)
- Stable With a 2.2- $\mu$ F Ceramic Capacitor
- Excellent Load/Line Transient
- Very Low Dropout Voltage (112 mV at Full Load, TPS79330)
- 5-Pin SOT23 (DBV) Package

### APPLICATIONS

- VCOs
- RF
- Bluetooth™



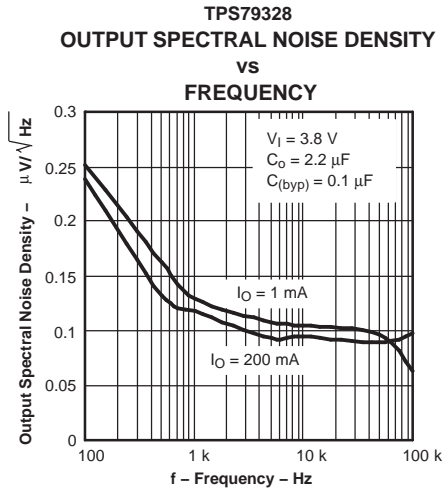
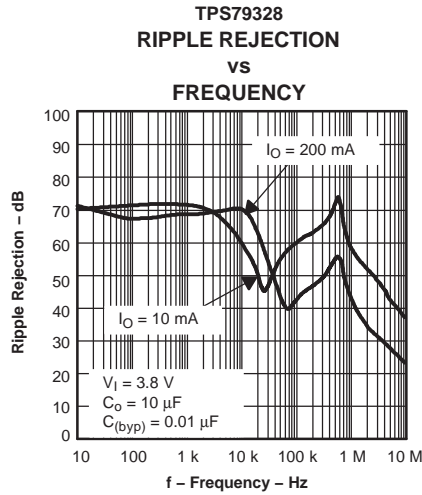
### DESCRIPTION

The TPS793xx family of low-dropout (LDO) low-power linear voltage regulators features high power-supply rejection ratio (PSRR), ultralow noise, fast start-up, and excellent line and load transient responses in a small-outline SOT23 package. Each device in the family is stable, with a small 2.2- $\mu$ F ceramic capacitor on the output. The TPS793xx family uses an advanced, proprietary, BiCMOS fabrication process to yield extremely low dropout voltages (e.g., 112 mV at 200 mA, TPS79330). Each device achieves fast start-up times (approximately 50  $\mu$ s with a 0.001- $\mu$ F bypass capacitor), while consuming very low quiescent current (170  $\mu$ A typical). Moreover, when the device is placed in standby mode, the supply current is reduced to less than 1  $\mu$ A. The TPS79328 exhibits approximately 32  $\mu$ V<sub>RMS</sub> of output voltage noise with a 0.1- $\mu$ F 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 the fast response time.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

Bluetooth is a trademark of Bluetooth SIG, Inc.



**ORDERING INFORMATION<sup>(1)</sup>**

T <sub>J</sub>	OUTPUT VOLTAGE	PACKAGE <sup>(2)</sup>		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	1.2 to 5.5 V	SOT23 – DBV	Reel of 3000	TPS79301DBVRQ1	PGV1
	1.8 V			TPS79318DBVRQ1	PHH1
	2.5 V			TPS79325DBVRQ1	PGW1
	2.8 V			TPS79328DBVRQ1	PGX1
	2.85 V			TPS793285QDBVRQ1	PHI1
	3 V			TPS79330QDBVRQ1	PGY1
	3.3 V			TPS79333QDBVRQ1	PHU1
	4.75 V			TPS793475QDBVRQ1 <sup>(3)</sup>	PHJ1

- (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](http://www.ti.com).  
 (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).  
 (3) Product preview

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

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

	MIN	MAX	UNIT
Input voltage range <sup>(2)</sup>	-0.3	6	V
Voltage range at EN	-0.3	$V_I + 0.3$	V
Voltage on OUT	-0.3	6	V
Peak output current	Internally limited		
ESD rating	Human-Body Model (HBM)		2000 V
	Charged-Device Model (CDM)		250
Continuous total power dissipation	See Dissipation Rating Table		
$T_J$ Operating virtual junction temperature range	-40	150	°C
$T_{stg}$ Storage temperature range	-65	150	°C

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values are with respect to network ground terminal

## DISSIPATION RATINGS

BOARD	PACKAGE	$R_{\theta JC}$	$R_{\theta JA}$	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A \leq 25^\circ\text{C}$ POWER RATING	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
Low K <sup>(1)</sup>	DBV	63.75°C/W	256°C/W	3.906 mW/°C	391 mW	215 mW	156 mW
High K <sup>(2)</sup>	DBV	63.75°C/W	178.3°C/W	5.609 mW/°C	561 mW	308 mW	224 mW

- (1) The JEDEC low K (1s) board design used to derive this data was a 3-in x 3-in, two layer board with 2-oz copper traces on top of the board.
- (2) The JEDEC high K (2s2p) board design used to derive this data was a 3-in x 3-in, multilayer board with 1-oz internal power and ground planes and 2-oz copper traces on top and bottom of the board.

## ELECTRICAL CHARACTERISTICS

over recommended operating free-air temperature range, EN = V<sub>I</sub>, T<sub>J</sub> = –40 to 125°C, V<sub>I</sub> = V<sub>O(typ)</sub> + 1 V, I<sub>O</sub> = 1 mA, C<sub>O</sub> = 10 μF, C<sub>(byp)</sub> = 0.01 μF (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT	
V <sub>I</sub>	Input voltage <sup>(1)</sup>			2.7		5.5	V	
I <sub>O</sub>	Continuous output current <sup>(2)</sup>			0		200	mA	
T <sub>J</sub>	Operating junction temperature			–40		125	°C	
Output voltage	TPS79301	0 μA < I <sub>O</sub> < 200 mA,	1.22 V ≤ V <sub>O</sub> ≤ 5.2 V <sup>(3)</sup>	0.98 V <sub>O</sub>		1.02 V <sub>O</sub>	V	
	TPS79318	T <sub>J</sub> = 25°C		1.8				
		0 μA < I <sub>O</sub> < 200 mA,	2.8 V < V <sub>I</sub> < 5.5 V	1.764		1.836		
	TPS79325	T <sub>J</sub> = 25°C		2.5				
		0 μA < I <sub>O</sub> < 200 mA,	3.5 V < V <sub>I</sub> < 5.5 V	2.45		2.55		
	TPS79328	T <sub>J</sub> = 25°C		2.8				
		0 μA < I <sub>O</sub> < 200 mA,	3.8 V < V <sub>I</sub> < 5.5 V	2.744		2.856		
	TPS793285	T <sub>J</sub> = 25°C		2.85				
		0 μA < I <sub>O</sub> < 200 mA,	3.85 V < V <sub>I</sub> < 5.5 V	2.793		2.907		
	TPS79330	T <sub>J</sub> = 25°C		3				
0 μA < I <sub>O</sub> < 200 mA,		4 V < V <sub>I</sub> < 5.5 V	2.94		3.06			
TPS79333	T <sub>J</sub> = 25°C		3.3					
	0 μA < I <sub>O</sub> < 200 mA,	4.3 V < V <sub>I</sub> < 5.5 V	3.234		3.366			
TPS793475	T <sub>J</sub> = 25°C		4.75					
	0 μA < I <sub>O</sub> < 200 mA,	5.25 V < V <sub>I</sub> < 5.5 V	4.655		4.845			
Quiescent current (GND current)	0 μA < I <sub>O</sub> < 200 mA,		T <sub>J</sub> = 25°C		170		μA	
	0 μA < I <sub>O</sub> < 200 mA				220			
Load regulation	0 μA < I <sub>O</sub> < 200 mA,		T <sub>J</sub> = 25°C		5		mV	
Output voltage line regulation (ΔV <sub>O</sub> /V <sub>O</sub> ) <sup>(4)</sup>	V <sub>O</sub> + 1 V < V <sub>I</sub> ≤ 5.5 V,		T <sub>J</sub> = 25°C		0.05		%V	
	V <sub>O</sub> + 1 V < V <sub>I</sub> ≤ 5.5 V				0.12			
Output noise voltage (TPS79328)	BW = 200 Hz to 100 kHz, I <sub>O</sub> = 200 mA, T <sub>J</sub> = 25°C	C <sub>(byp)</sub> = 0.001 μF		55		μV <sub>RMS</sub>		
		C <sub>(byp)</sub> = 0.0047 μF		36				
		C <sub>(byp)</sub> = 0.01 μF		33				
		C <sub>(byp)</sub> = 0.1 μF		32				
Time, start-up (TPS79328)	R <sub>L</sub> = 14 Ω, C <sub>O</sub> = 1 μF, T <sub>J</sub> = 25°C	C <sub>(byp)</sub> = 0.001 μF		50		μs		
		C <sub>(byp)</sub> = 0.0047 μF		70				
		C <sub>(byp)</sub> = 0.01 μF		100				
Output current limit	V <sub>O</sub> = 0 V <sup>(3)</sup>		285		600		mA	
Standby current	EN = 0 V,		2.7 V < V <sub>I</sub> < 5.5 V		0.07		1	μA
High-level enable input voltage	2.7 V < V <sub>I</sub> < 5.5 V		2				V	
Low-level enable input voltage	2.7 V < V <sub>I</sub> < 5.5 V				0.7		V	
Input current (EN)	EN = 0		–1		1		μA	
Input current (FB) (TPS79301)	FB = 1.8 V				1		μA	

- To calculate the minimum input voltage for your maximum output current, use the following formula:  

$$V_{I(\min)} = V_{O(\max)} + V_{DO}(\text{max load})$$
- Continuous output current and operating junction temperature are limited by internal protection circuitry, but it is not recommended that the device operate under conditions beyond those specified in this table for extended periods of time.
- The minimum IN operating voltage is 2.7 V or V<sub>O(typ)</sub> + 1 V, whichever is greater. The maximum IN voltage is 5.5 V. The maximum output current is 200 mA.
- If V<sub>O</sub> ≤ 2.5 V, then V<sub>Imin</sub> = 2.7 V, V<sub>Imax</sub> = 5.5 V:  

$$\text{Line Reg. (mV)} = (\%/V) \times \frac{V_O(V_{I\max} - 2.7 V)}{100} \times 1000$$
 If V<sub>O</sub> ≥ 2.5 V, then V<sub>Imin</sub> = V<sub>O</sub> + 1 V, V<sub>Imax</sub> = 5.5 V.

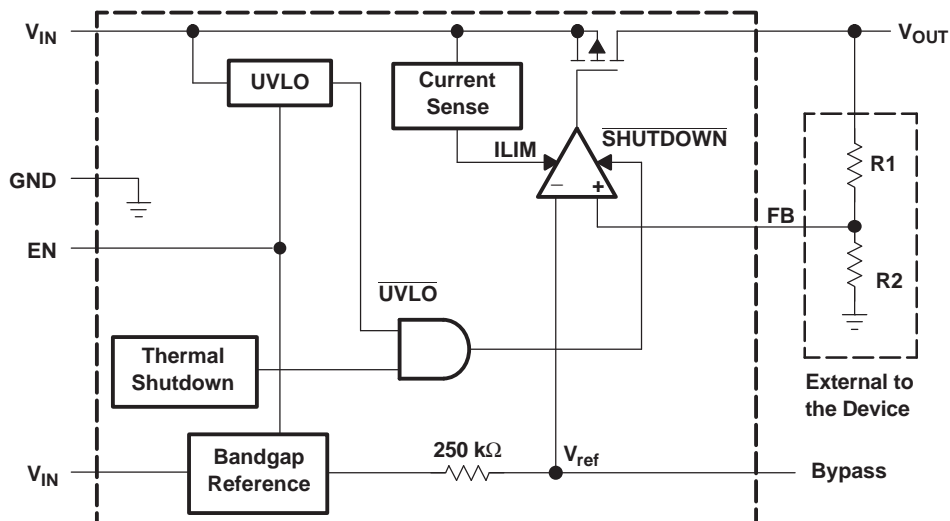
**ELECTRICAL CHARACTERISTICS (continued)**

over recommended operating free-air temperature range,  $EN = V_I$ ,  $T_J = -40$  to  $125^\circ\text{C}$ ,  $V_I = V_{O(\text{typ})} + 1\text{ V}$ ,  $I_O = 1\text{ mA}$ ,  $C_O = 10\ \mu\text{F}$ ,  $C_{(\text{byp})} = 0.01\ \mu\text{F}$  (unless otherwise noted)

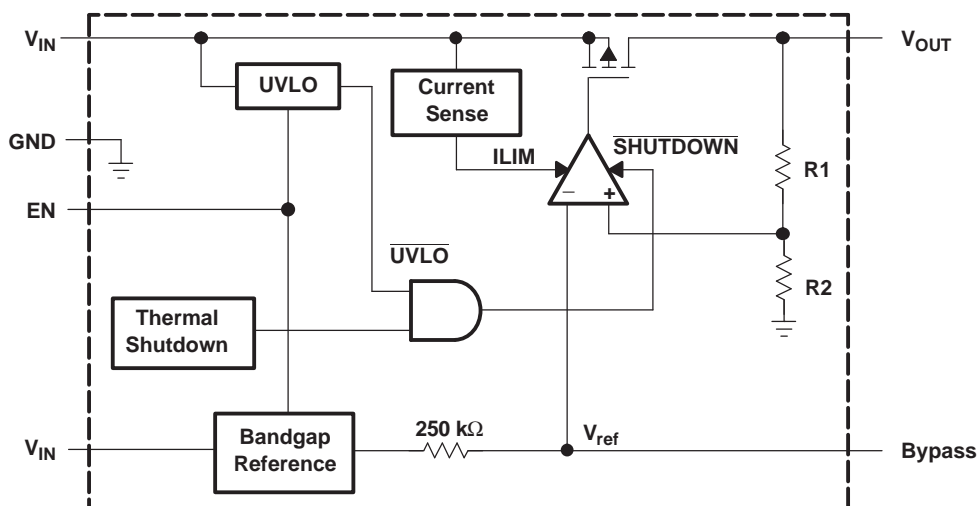
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Power-supply ripple rejection	TPS79328	$f = 100\text{ Hz}$ , $T_J = 25^\circ\text{C}$ , $I_O = 10\text{ mA}$		70		dB
		$f = 100\text{ Hz}$ , $T_J = 25^\circ\text{C}$ , $I_O = 200\text{ mA}$		68		
		$f = 10\text{ Hz}$ , $T_J = 25^\circ\text{C}$ , $I_O = 200\text{ mA}$		70		
		$f = 100\text{ Hz}$ , $T_J = 25^\circ\text{C}$ , $I_O = 200\text{ mA}$		43		
Dropout voltage <sup>(5)</sup>	TPS79328	$I_O = 200\text{ mA}$ , $T_J = 25^\circ\text{C}$		120		mV
		$I_O = 200\text{ mA}$			200	
	TPS793285	$I_O = 200\text{ mA}$ , $T_J = 25^\circ\text{C}$		120		
		$I_O = 200\text{ mA}$			200	
	TPS79330	$I_O = 200\text{ mA}$ , $T_J = 25^\circ\text{C}$		112		
		$I_O = 200\text{ mA}$			200	
	TPS79333	$I_O = 200\text{ mA}$ , $T_J = 25^\circ\text{C}$		102		
		$I_O = 200\text{ mA}$			180	
TPS793475	$I_O = 200\text{ mA}$ , $T_J = 25^\circ\text{C}$		77			
	$I_O = 200\text{ mA}$			125		
UVLO threshold		$V_{CC}$ rising	2.25		2.65	V
UVLO hysteresis		$T_J = 25^\circ\text{C}$ $V_{CC}$ rising		100		mV

(5)  $I_N$  voltage equals  $V_{O(\text{typ})} - 100\text{ mV}$ ; The TPS79325 dropout voltage is limited by the input voltage range limitations.

**FUNCTIONAL BLOCK DIAGRAM – ADJUSTABLE VERSION**



**FUNCTIONAL BLOCK DIAGRAM – FIXED VERSION**



**TERMINAL FUNCTIONS**

TERMINAL			I/O	DESCRIPTION
NAME	ADJ	FIXED		
BYPASS	4	4		An external bypass capacitor, connected to this terminal, in conjunction with an internal resistor, creates a low-pass filter to further reduce regulator noise.
EN	3	3	I	Enable input that enables or shuts down the device. When EN goes to a logic high, the device is enabled. When the device goes to a logic low, the device is in shutdown mode.
FB	5	N/A	I	Feedback input voltage for the adjustable device
GND	2	2		Regulator ground
IN	1	1	I	Input to the device
OUT	6	5	O	Regulated output of the device

TYPICAL CHARACTERISTICS

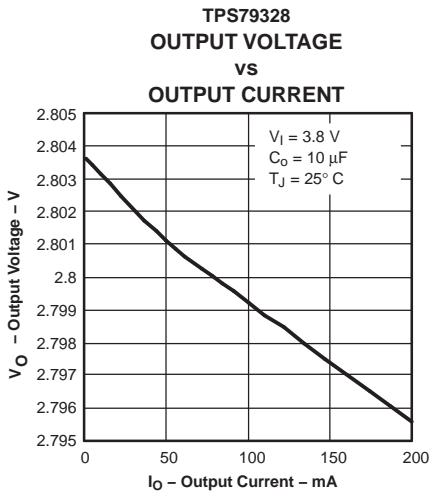


Figure 1.

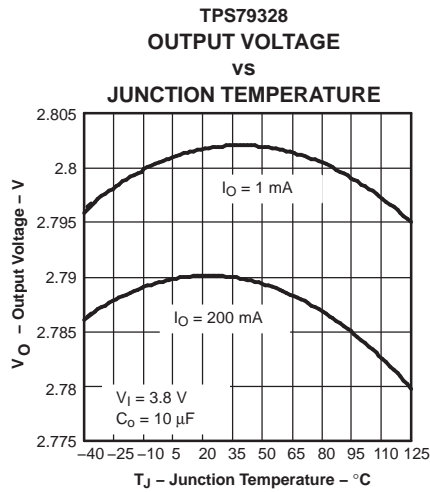


Figure 2.

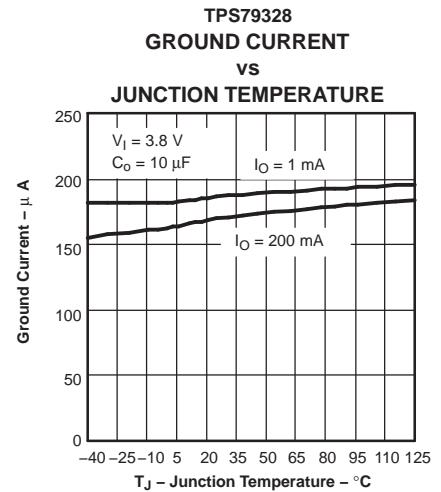


Figure 3.

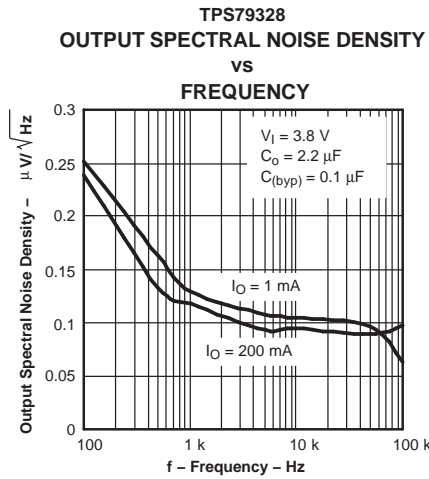


Figure 4.

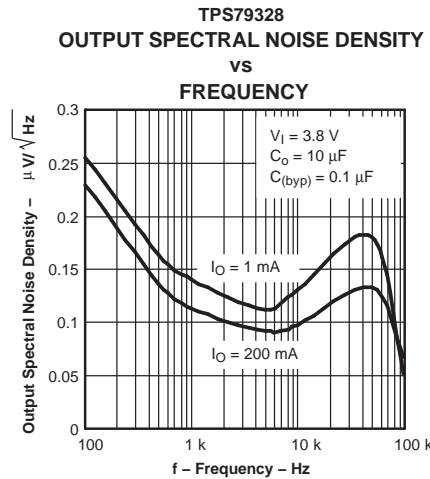


Figure 5.

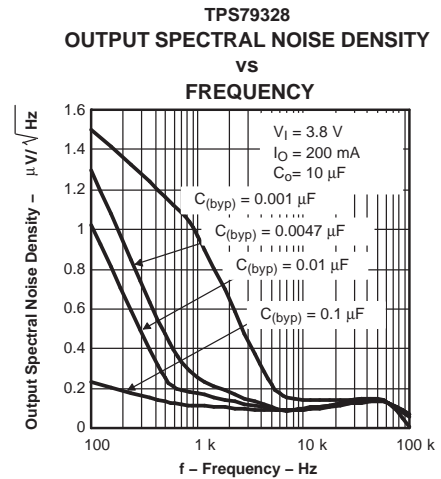


Figure 6.

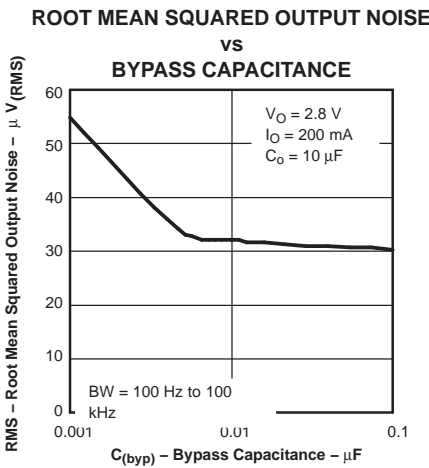


Figure 7.

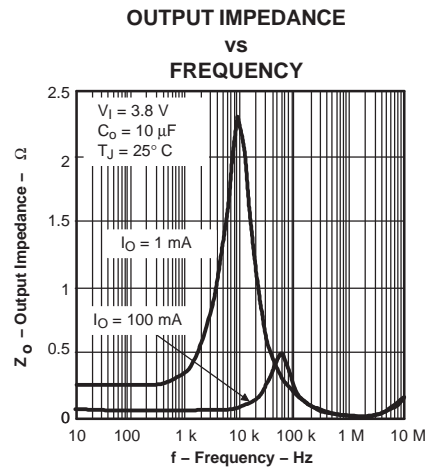


Figure 8.

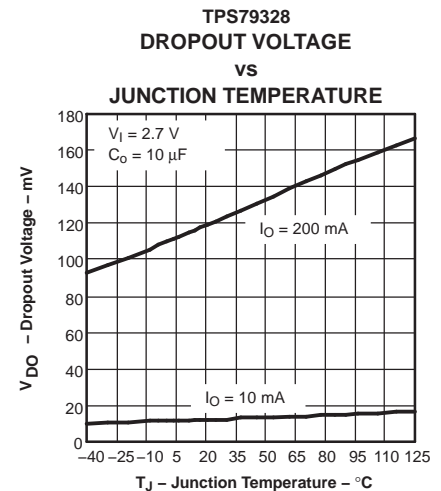


Figure 9.

**TYPICAL CHARACTERISTICS (continued)**

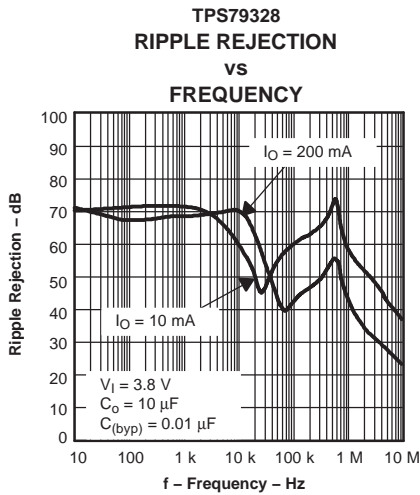


Figure 10.

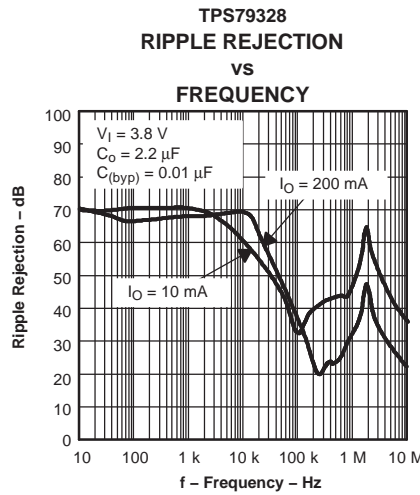


Figure 11.

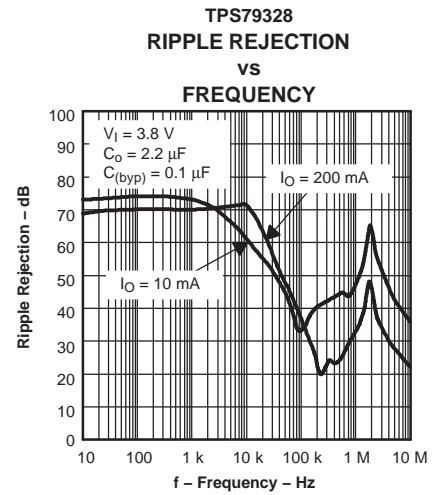


Figure 12.

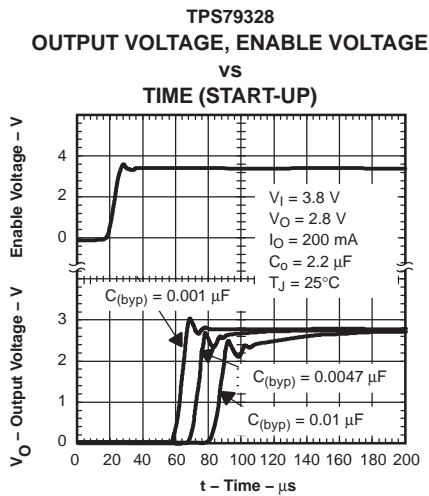


Figure 13.

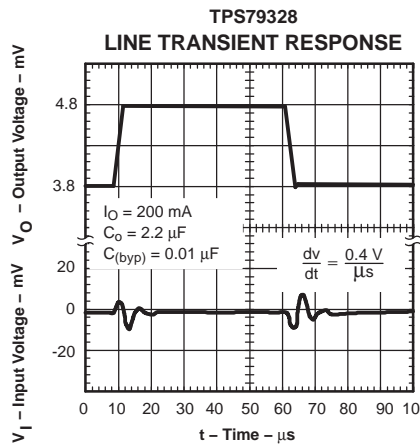


Figure 14.

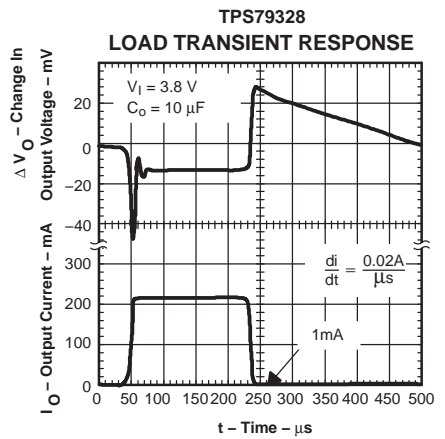


Figure 15.

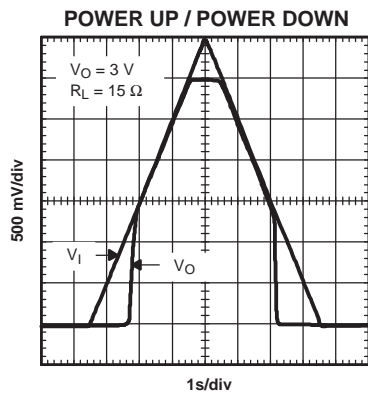


Figure 16.

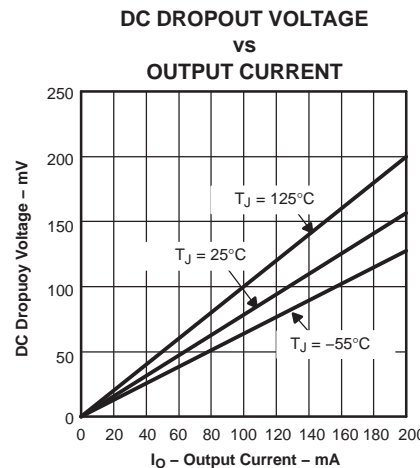


Figure 17.

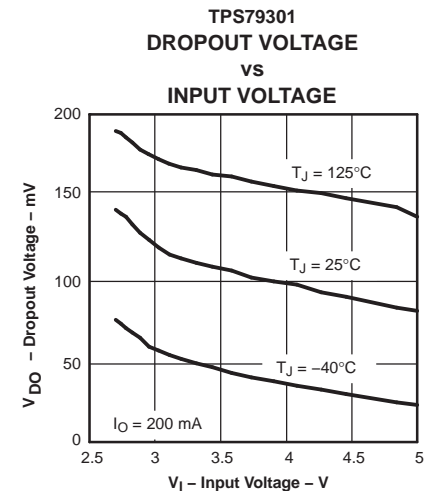


Figure 18.



TYPICAL CHARACTERISTICS (continued)

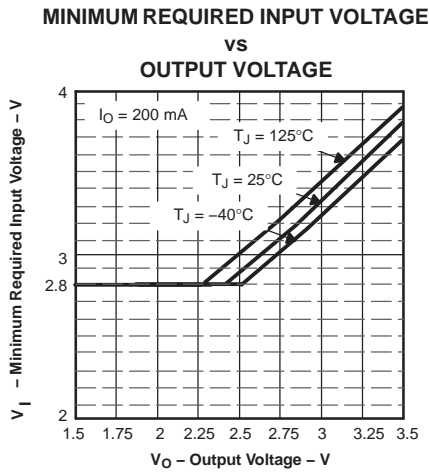


Figure 19.

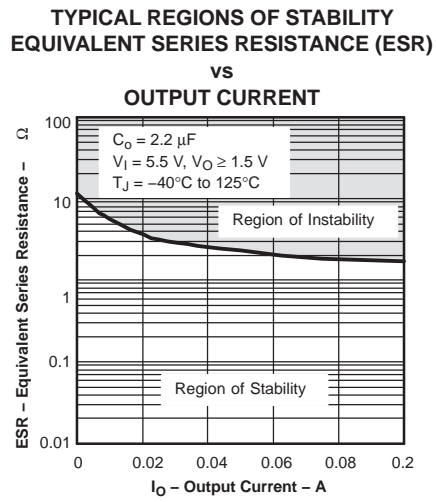


Figure 20.

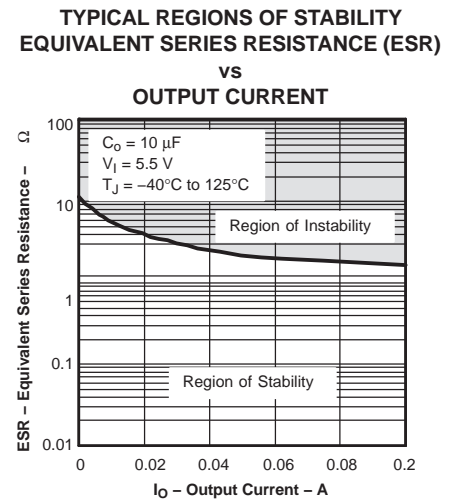
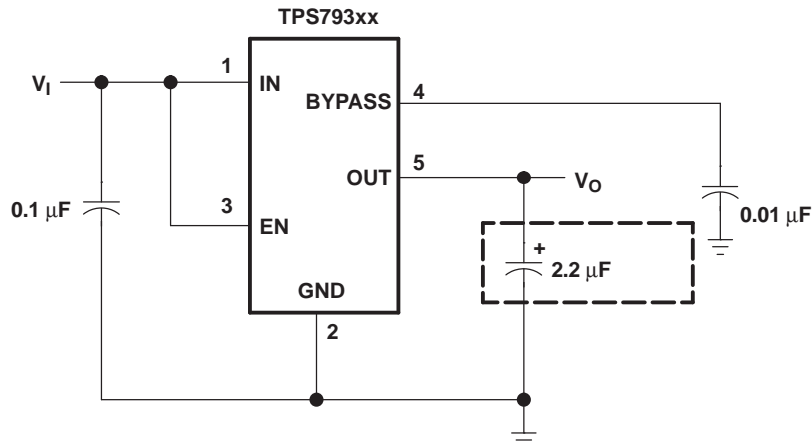


Figure 21.

## APPLICATION INFORMATION

The TPS793xx family of low-dropout (LDO) regulators has been optimized for use in noise-sensitive battery-operated equipment. The device features extremely low dropout voltages, high PSRR, ultralow output noise, low quiescent current (170  $\mu\text{A}$  typically), and enable-input to reduce supply currents to less than 1  $\mu\text{A}$  when the regulator is turned off.

A typical application circuit is shown in [Figure 22](#).



**Figure 22. Typical Application Circuit**

### External Capacitor Requirements

A 0.1- $\mu\text{F}$  or larger ceramic input bypass capacitor, connected between IN and GND and located close to the TPS793xx, is required for stability and improves transient response, noise rejection, and ripple rejection. A higher-value electrolytic 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 all LDOs, the TPS793xx requires an output capacitor connected between OUT and GND to stabilize the internal control loop. The minimum recommended capacitance is 2.2- $\mu\text{F}$ . Any 2.2- $\mu\text{F}$  or larger ceramic capacitor is suitable, provided the capacitance does not vary significantly over temperature.

The internal voltage reference is a key source of noise in an LDO regulator. The TPS793xx has a BYPASS pin that is connected to the voltage reference through a 250-k $\Omega$  internal resistor. The 250-k $\Omega$  internal resistor, in conjunction with an external bypass capacitor connected to the BYPASS 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 BYPASS 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.

For example, the TPS79328 exhibits only 32  $\mu\text{V}_{\text{RMS}}$  of output voltage noise using a 0.1- $\mu\text{F}$  ceramic bypass capacitor and a 2.2- $\mu\text{F}$  ceramic output capacitor. Note that the output starts up slower as the bypass capacitance increases due to the RC time constant at the BYPASS pin that is created by the internal 250-k $\Omega$  resistor and external capacitor.

### Board Layout Recommendation to Improve PSRR and Noise Performance

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

## Power Dissipation and Junction Temperature

Specified regulator operation is ensured to a junction temperature of 125°C; the maximum junction temperature should be restricted to 125°C under normal operating conditions. This restriction limits the power dissipation the regulator can handle in any given application. To ensure 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 the following equation:

$$P_{D(max)} = \frac{T_{Jmax} - T_A}{R_{\theta JA}} \quad (1)$$

Where:

$T_{Jmax}$  = Maximum allowable junction temperature

$R_{\theta JA}$  = Thermal resistance, junction to ambient, for the package, see the dissipation rating table

$T_A$  = Ambient temperature

The regulator dissipation is calculated using:

$$P_D = (V_I - V_O) \times I_O \quad (2)$$

Power dissipation resulting from quiescent current is negligible. Excessive power dissipation triggers the thermal protection circuit.

## Programming the TPS79301 Adjustable LDO Regulator

The output voltage of the TPS79301 adjustable regulator is programmed using an external resistor divider as shown in [Figure 23](#). The output voltage is calculated using:

$$V_O = V_{ref} \times \left(1 + \frac{R1}{R2}\right) \quad (3)$$

Where:

$V_{ref}$  = 1.2246 V typical (the internal reference voltage)

Resistors R1 and R2 should be chosen for approximately 50- $\mu$ A divider current. Lower-value resistors can be used for improved noise performance, but the solution consumes more power. Higher resistor values should be avoided as leakage current into/out of FB across R1/R2 creates an offset voltage that artificially increases/decreases the feedback voltage and, thus, erroneously decreases/increases  $V_O$ . The recommended design procedure is to choose  $R2 = 30.1 \text{ k}\Omega$  to set the divider current at 50  $\mu$ A,  $C1 = 15 \text{ pF}$  for stability, and then calculate R1 using:

$$R1 = \left(\frac{V_O}{V_{ref}} - 1\right) \times R2 \quad (4)$$

In order to improve the stability of the adjustable version, it is suggested that a small compensation capacitor be placed between OUT and FB. For voltages <1.8 V, the value of this capacitor should be 100 pF. For voltages >1.8 V, the approximate value of this capacitor can be calculated as:

$$C1 = \frac{(3 \times 10^{-7}) \times (R1 + R2)}{(R1 \times R2)} \quad (5)$$

The suggested value of this capacitor for several resistor ratios is shown in the table below. If this capacitor is not used (such as in a unity-gain configuration) or if an output voltage <1.8 V is chosen, then the minimum recommended output capacitor is 4.7  $\mu$ F instead of 2.2  $\mu$ F.

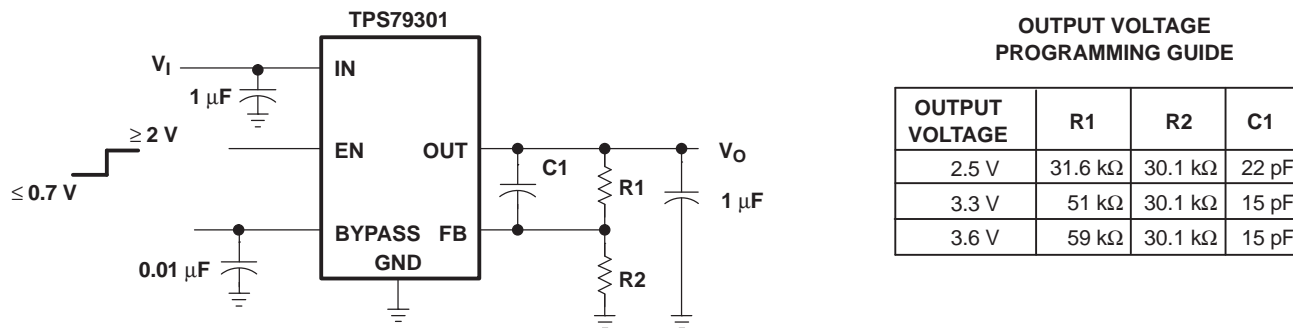


Figure 23. TPS79301 Adjustable LDO Regulator Programming

### Regulator Protection

The TPS793xx features internal current limiting and thermal protection. During normal operation, the TPS793xx limits output current to approximately 400 mA. 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 or the absolute maximum voltage ratings of the device. 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.

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
TPS79301DBVRG4Q1	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Purchase Samples</a>
TPS79301DBVRQ1	ACTIVE	SOT-23	DBV	6	3000	TBD	CU NIPDAU	Level-1-220C-UNLIM	<a href="#">Request Free Samples</a>
TPS79318DBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
TPS79318DBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
TPS79325DBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Purchase Samples</a>
TPS79325DBVRQ1	ACTIVE	SOT-23	DBV	5	3000	TBD	CU NIPDAU	Level-1-220C-UNLIM	<a href="#">Request Free Samples</a>
TPS793285QDBVRQ1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
TPS79333DBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Request Free Samples</a>
TPS79333DBVRQ1	ACTIVE	SOT-23	DBV	5	3000	TBD	CU NIPDAU	Level-1-220C-UNLIM	<a href="#">Request Free Samples</a>
TPS793475DBVRG4Q1	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	<a href="#">Purchase Samples</a>
TPS793475DBVRQ1	ACTIVE	SOT-23	DBV	5	3000	TBD	CU NIPDAU	Level-1-220C-UNLIM	<a href="#">Purchase Samples</a>

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

**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.

**OTHER QUALIFIED VERSIONS OF TPS79301-Q1, TPS79318-Q1, TPS79325-Q1, TPS793285-Q1, TPS79333-Q1, TPS793475-Q1 :**

- Catalog: [TPS79301](#), [TPS79318](#), [TPS79325](#), [TPS793285](#), [TPS79333](#), [TPS793475](#)
- Enhanced Product: [TPS79301-EP](#), [TPS79318-EP](#), [TPS79325-EP](#), [TPS79333-EP](#), [TPS793475-EP](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

DBV (R-PDSO-G5)

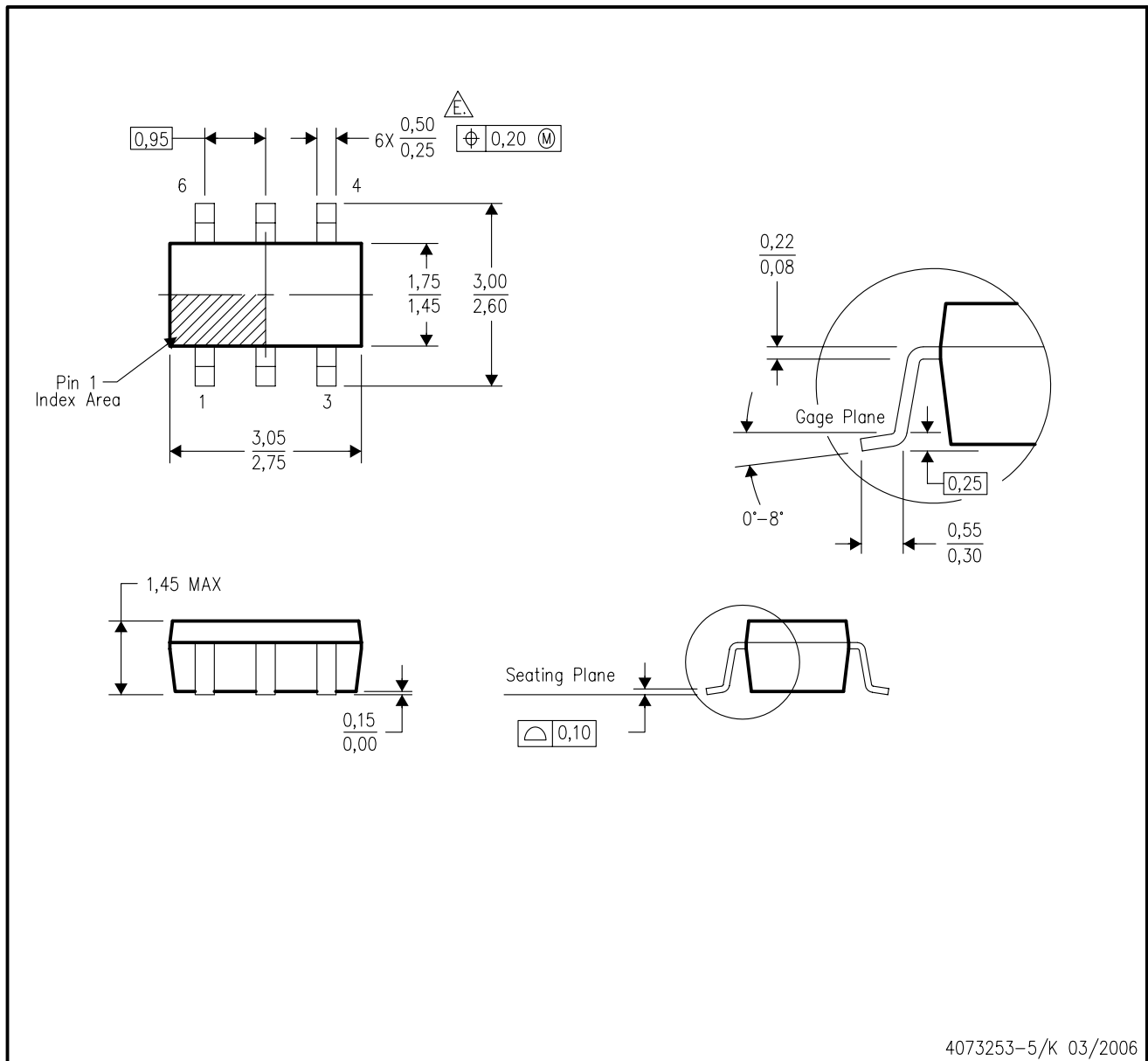
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Falls within JEDEC MO-178 Variation AA.

DBV (R-PDSO-G6)

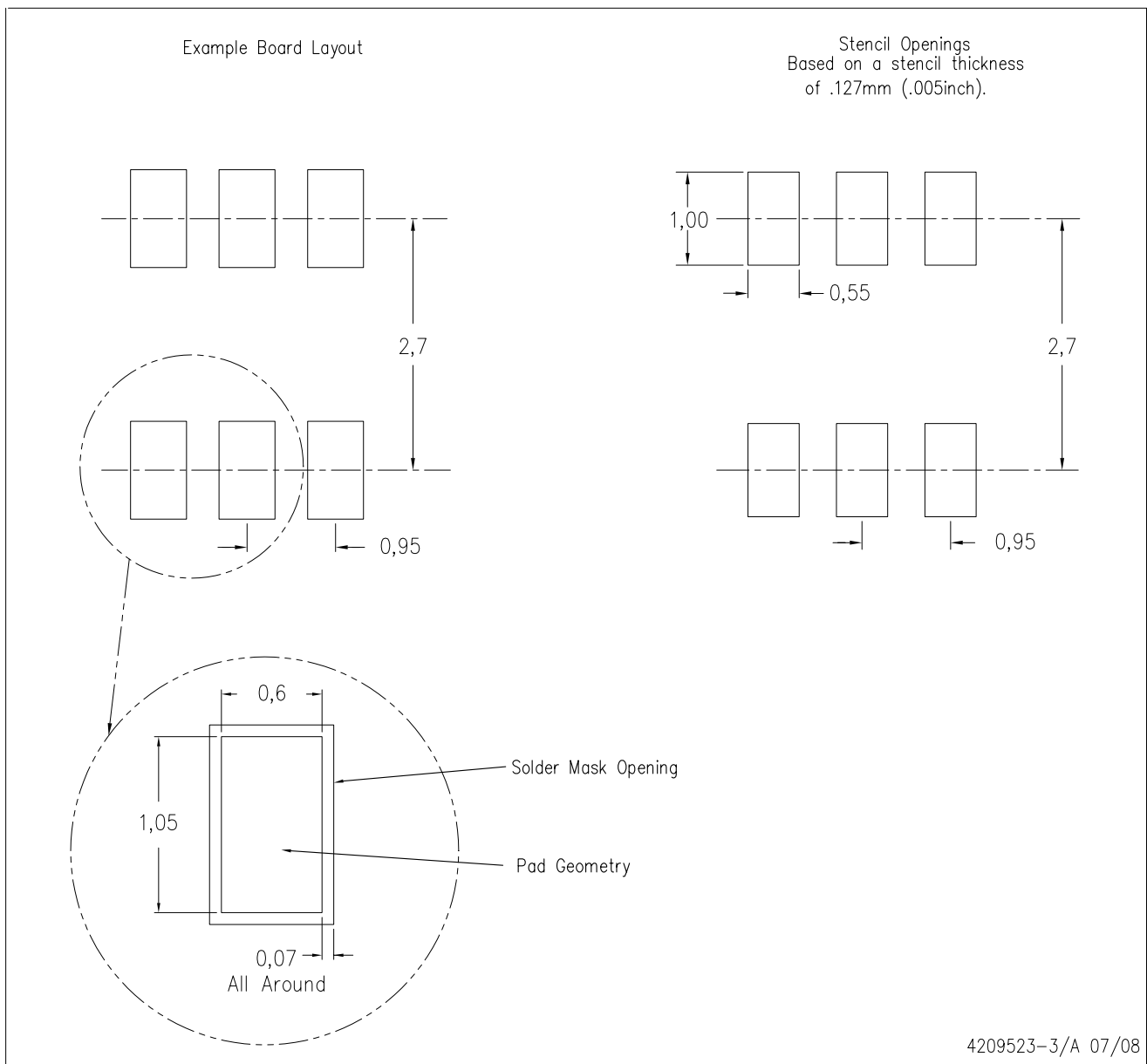
PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
- $\triangle E$  Falls within JEDEC MO-178 Variation AB, except minimum lead width.

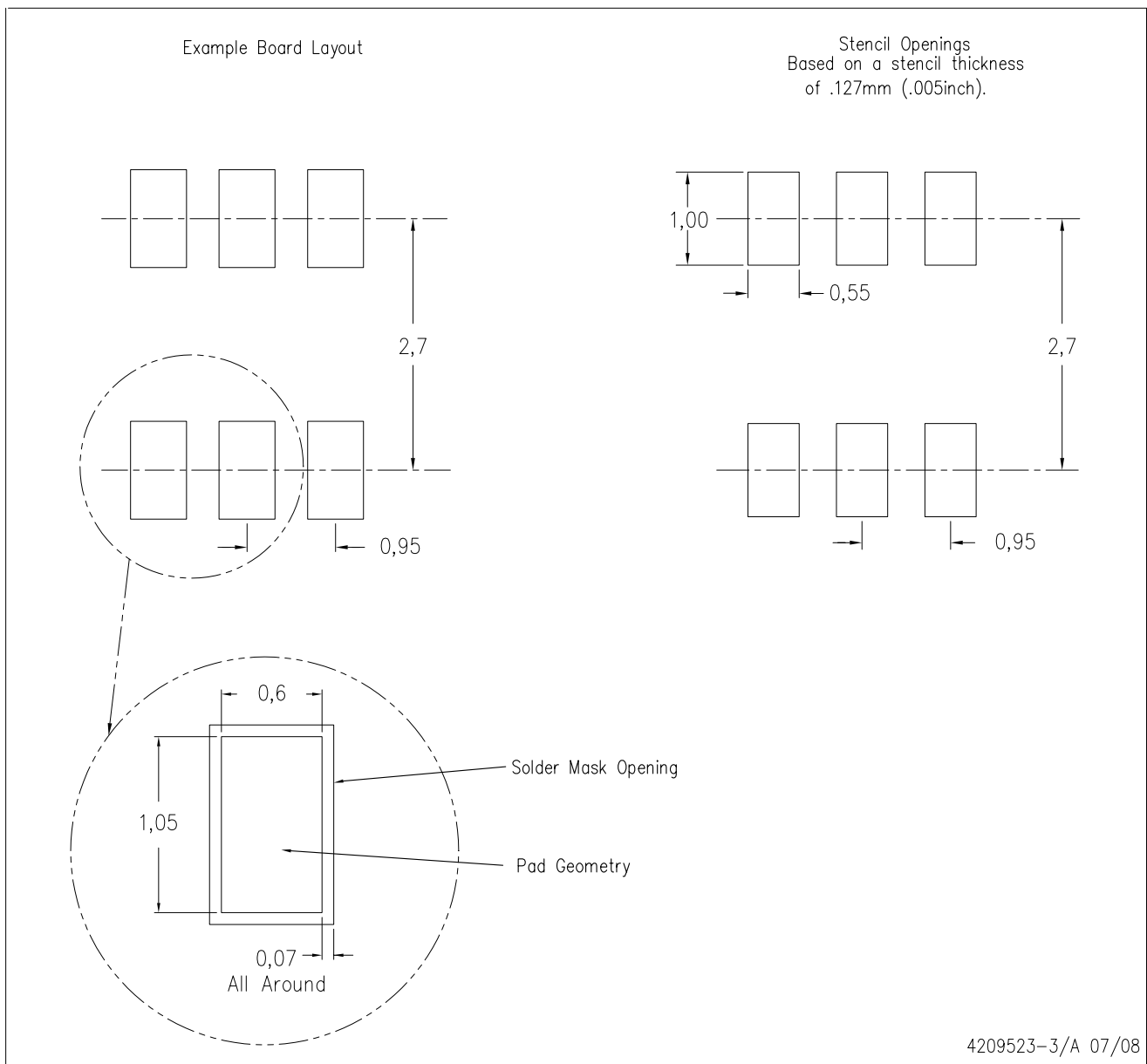


DBV (R-PDSO-G6)



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

DBV (R-PDSO-G6)



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
  - D. Publication IPC-7351 is recommended for alternate designs.
  - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC-7525 for other stencil recommendations.

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

<b>Products</b>		<b>Applications</b>	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>	Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>	Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Energy	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>	Space, Avionics & Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>	Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2010, Texas Instruments Incorporated