

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

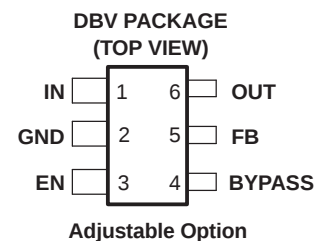
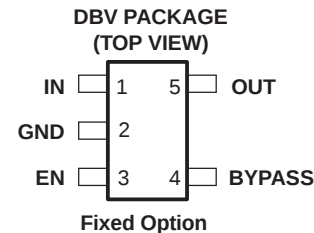
FEATURES

- Controlled Baseline
 - One Assembly/Test Site, One Fabrication Site
- Enhanced Diminishing Manufacturing Sources (DMS) Support
- Enhanced Product-Change Notification
- Qualification Pedigree ⁽¹⁾
- 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
- High PSRR (70 dB at 10 kHz)
- Ultralow Noise (32 μ V)
- Fast Start-Up Time (50 μ s)
- Stable With a 2.2- μ 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™, Wireless LAN

(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over specified temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.



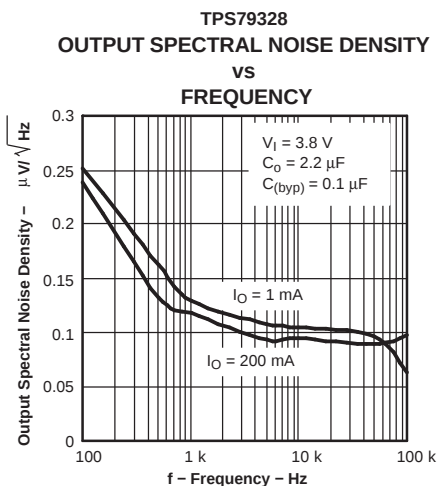
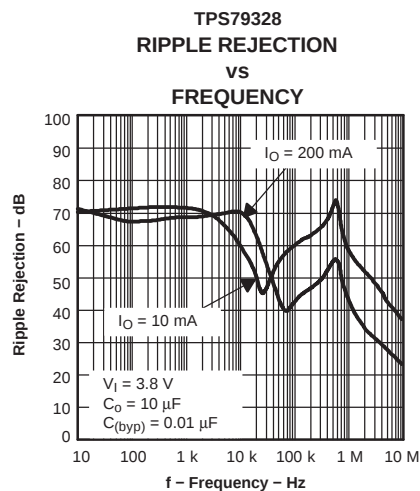
DESCRIPTION

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- μ 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 μ s with a 0.001- μ F bypass capacitor), while consuming very low quiescent current (170 μ A typical). Moreover, when the device is placed in standby mode, the supply current is reduced to less than 1 μ A. The TPS79328 exhibits approximately 32 μ V_{RMS} of output voltage noise with a 0.1- μ 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.



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AVAILABLE OPTIONS

T_J	VOLTAGE	PACKAGE	PART NUMBER	SYMBOL
-40°C to 125°C	1.2 to 5.5 V	SOT23 (DBV)	TPS79301DBVREP ⁽¹⁾	PGVE
	1.8 V		TPS79318DBVREP ⁽¹⁾	PHHE
	2.5 V		TPS79325DBVREP ⁽¹⁾	PGWE
	2.8 V		TPS79328DBVREP ⁽¹⁾⁽²⁾	PGXE
	2.85 V		TPS793285DBVREP ⁽¹⁾⁽²⁾	PHIE
	3 V		TPS79330DBVREP ⁽¹⁾⁽²⁾	PGYE
	3.3 V		TPS79333DBVREP ⁽¹⁾	PHUE
	4.75 V		TPS793475DBVREP ⁽¹⁾	PHJE
-55°C to 125°C	1.2 to 5.5 V		TPS79301MDBVREP ⁽¹⁾	PMBM

(1) The DBVR indicates tape and reel of 3000 parts.

(2) Product preview

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

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

	MIN	MAX	UNIT
Input voltage range ⁽²⁾	–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)		2 kV
	Charged-Device Model (CDM)		500 V
Continuous total power dissipation	See Dissipation Rating Table		
T_J Operating virtual junction temperature range	–55	125	°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 ⁽¹⁾	DBV	63.75°C/W	256°C/W	3.906 mW/°C	391 mW	215 mW	156 mW
High K ⁽²⁾	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 × 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 × 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, $EN = V_I$, $T_J = -55$ to 125°C and $T_J = -40$ to 125°C , $V_I = V_{O(\text{typ})} + 1\text{ V}$, $I_O = 1\text{ mA}$, $C_O = 10\text{ }\mu\text{F}$, $C_{(\text{byp})} = 0.01\text{ }\mu\text{F}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V _I	Input voltage ⁽¹⁾			2.7		5.5	V
I _O	Continuous output current ⁽²⁾			0		200	mA
T _J	Operating junction temperature			−55		125	°C
Output voltage	TPS79301	0 μA < I _O < 200 mA, 1.22 V ≤ V _O ≤ 5.2 V ⁽³⁾	T _J = −40 to 125°C,	0.98 V _O		1.02 V _O	V
		0 μA < I _O < 200 mA, 1.22 V ≤ V _O ≤ 5.2 V ⁽³⁾	T _J = −55 to 125°C,	0.97 V _O		1.025 V _O	
	TPS79318	T _J = 25°C		1.8			
		0 μA < I _O < 200 mA,	2.8 V < V _I < 5.5 V	1.764		1.836	
	TPS79325	T _J = 25°C		2.5			
		0 μA < I _O < 200 mA,	3.5 V < V _I < 5.5 V	2.45		2.55	
	TPS79328	T _J = 25°C		2.8			
		0 μA < I _O < 200 mA,	3.8 V < V _I < 5.5 V	2.744		2.856	
	TPS793285	T _J = 25°C		2.85			
		0 μA < I _O < 200 mA,	3.85 V < V _I < 5.5 V	2.793		2.907	
	TPS79330	T _J = 25°C		3			
		0 μA < I _O < 200 mA,	4 V < V _I < 5.5 V	2.94		3.06	
	TPS79333	T _J = 25°C		3.3			
		0 μA < I _O < 200 mA,	4.3 V < V _I < 5.5 V	3.234		3.366	
	TPS793475	T _J = 25°C		4.75			
		0 μA < I _O < 200 mA,	5.25 V < V _I < 5.5 V	4.655		4.845	
Quiescent current (GND current)		0 μA < I _O < 200 mA, T _J = 25°C		170		μA	
		0 μA < I _O < 200 mA		220			
Load regulation		0 μA < I _O < 200 mA, T _J = 25°C		5		mV	
Output voltage line regulation (ΔV _O /V _O) ⁽⁴⁾		V _O + 1 V < V _I ≤ 5.5 V, T _J = 25°C		0.05		%/V	
		V _O + 1 V < V _I ≤ 5.5 V		0.12			
Output noise voltage (TPS79328)		BW = 200 Hz to 100 kHz, I _O = 200 mA, T _J = 25°C	C _(byp) = 0.001 μF	55		μV _{RMS}	
			C _(byp) = 0.0047 μF	36			
			C _(byp) = 0.01 μF	33			
			C _(byp) = 0.1 μF	32			
Time, start-up (TPS79328)		R _L = 14 Ω, C _O = 1 μF, T _J = 25°C	C _(byp) = 0.001 μF	50		μs	
			C _(byp) = 0.0047 μF	70			
			C _(byp) = 0.01 μF	100			
Output current limit		V _O = 0 V ⁽³⁾		285	600	mA	
Standby current		EN = 0 V,	2.7 V < V _I < 5.5 V	0.07	1	μA	
High-level enable input voltage		2.7 V < V _I < 5.5 V		2		V	
Low-level enable input voltage		2.7 V < V _I < 5.5 V			0.7	V	
Input current (EN)		EN = 0		−1	1	μA	

- (1) To calculate the minimum input voltage for your maximum output current, use the following formula:
 $V_{I(\text{min})} = V_{O(\text{max})} + V_{DO}(\text{max load})$
- (2) 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.
- (3) The minimum I_N operating voltage is 2.7 V or $V_{O(\text{typ})} + 1\text{ V}$, whichever is greater. The maximum I_N voltage is 5.5 V . The maximum output current is 200 mA .
- (4) If $V_O \leq 2.5\text{ V}$, then $V_{I(\text{min})} = 2.7\text{ V}$, $V_{I(\text{max})} = 5.5\text{ V}$:

$$\text{Line Reg. (mV)} = (\%/\text{V}) \times \frac{V_O(V_{I(\text{max})} - 2.7\text{ V})}{100} \times 1000$$
 If $V_O \geq 2.5\text{ V}$, then $V_{I(\text{min})} = V_O + 1\text{ V}$, $V_{I(\text{max})} = 5.5\text{ V}$.

ELECTRICAL CHARACTERISTICS (continued)

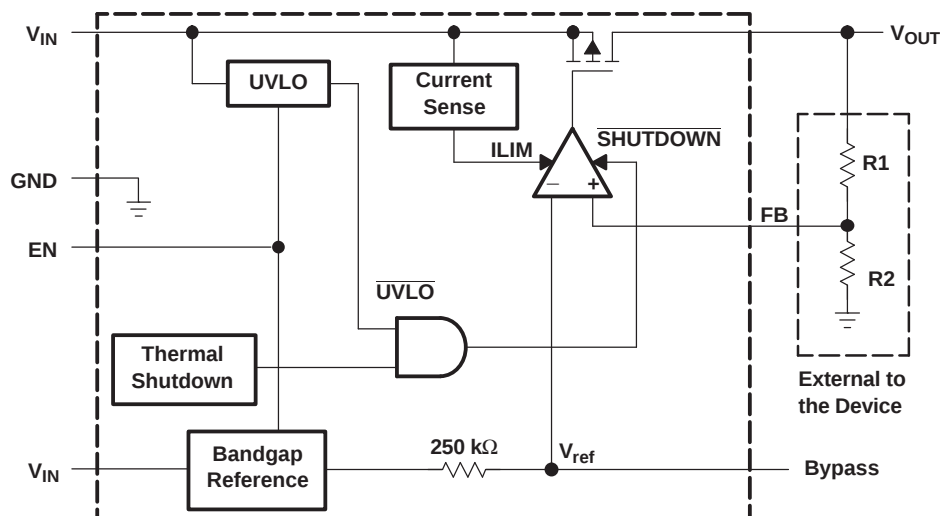
over recommended operating free-air temperature range, $EN = V_I$, $T_J = -55$ to 125°C and $T_J = -40$ to 125°C , $V_I = V_{O(\text{typ})} + 1\text{ V}$, $I_O = 1\text{ mA}$, $C_O = 10\text{ }\mu\text{F}$, $C_{(\text{byp})} = 0.01\text{ }\mu\text{F}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
Input current (FB) (TPS79301)		FB = 1.8 V				1	μA
Power-supply ripple rejection	TPS79328	f = 100 Hz, T _J = 25°C, I _O = 10 mA			70		dB
		f = 100 Hz, T _J = 25°C, I _O = 200 mA			68		
		f = 10 Hz, T _J = 25°C, I _O = 200 mA			70		
		f = 100 Hz, T _J = 25°C, I _O = 200 mA			43		
Dropout voltage ⁽⁵⁾	TPS79328	I _O = 200 mA, T _J = 25°C			120		mV
		I _O = 200 mA				200	
	TPS793285	I _O = 200 mA, T _J = 25°C			120		
		I _O = 200 mA				200	
	TPS79330	I _O = 200 mA, T _J = 25°C			112		
		I _O = 200 mA				200	
	TPS79333	I _O = 200 mA, T _J = 25°C			102		
		I _O = 200 mA				180	
TPS793475	I _O = 200 mA, T _J = 25°C			77			
	I _O = 200 mA				125		
UVLO threshold		V _{CC} rising		2.25		2.65	V
UVLO hysteresis		T _J = 25°C	V _{CC} rising		100		mV

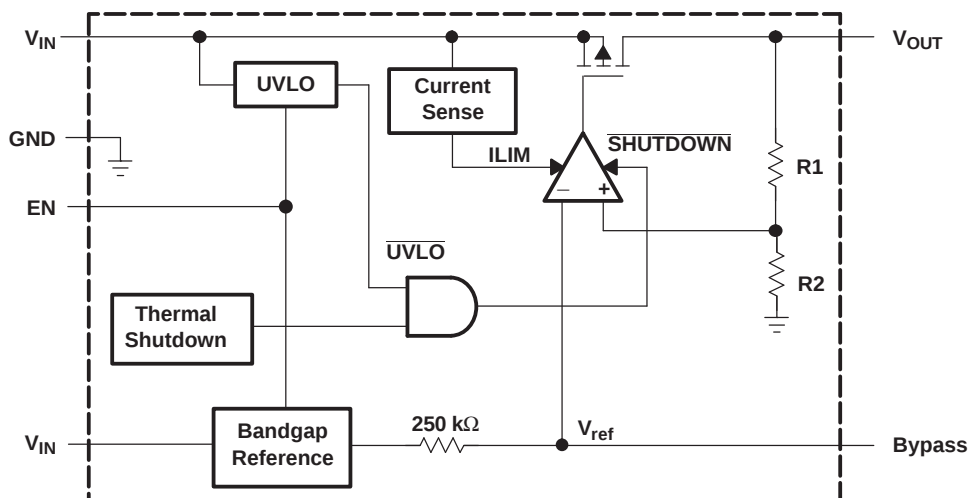
(5) I_N voltage equals $V_{O(\text{typ})} - 100\text{ mV}$; The TPS79325 dropout voltage is limited by the input voltage range limitations.

DEVICE INFORMATION

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

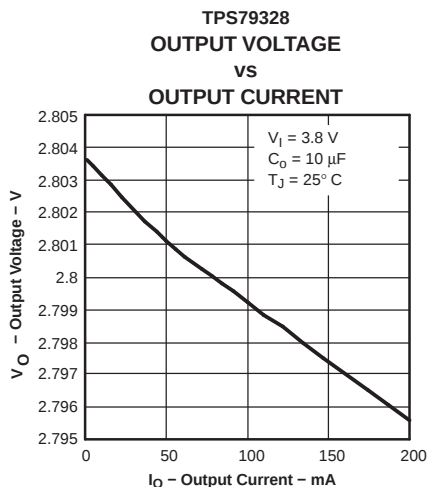


Figure 1.

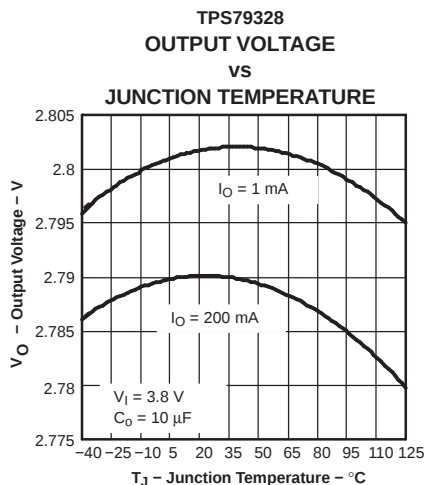


Figure 2.

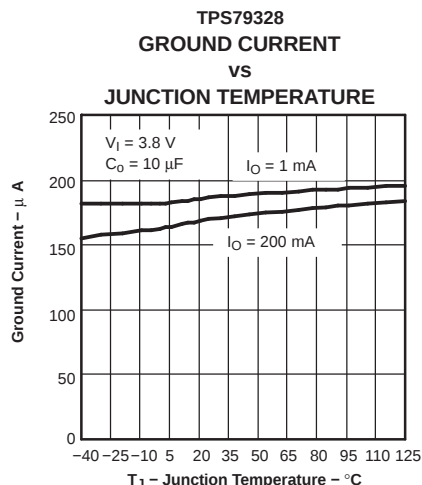


Figure 3.

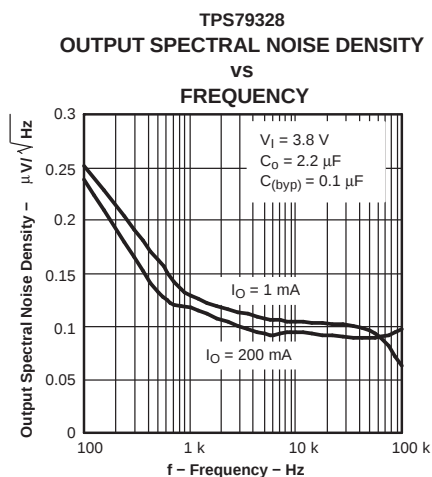


Figure 4.

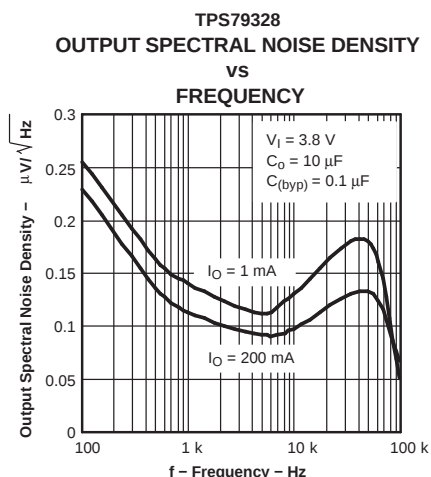


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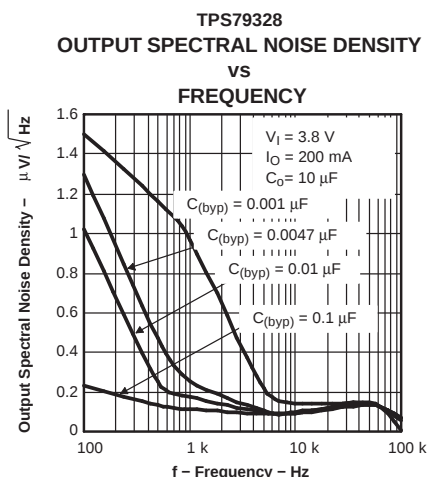


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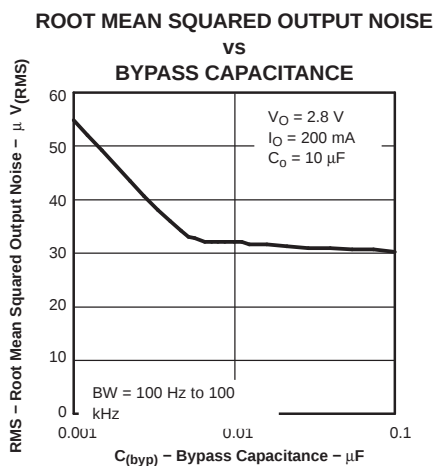


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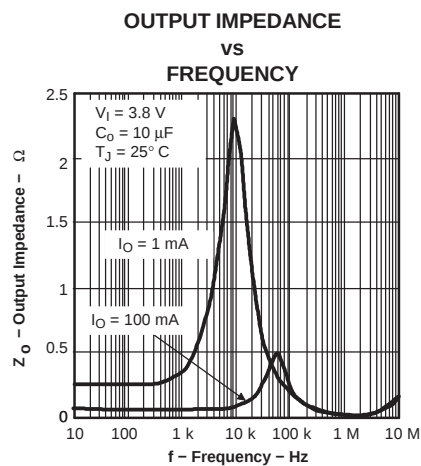


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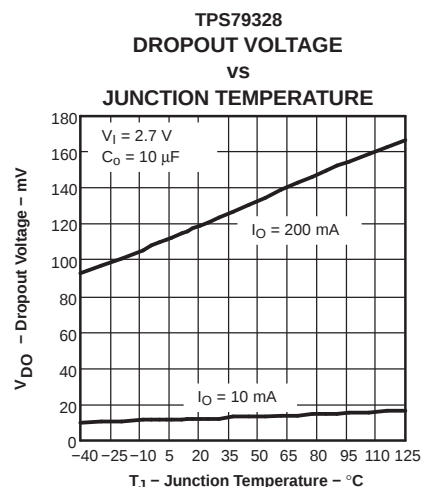


Figure 9.

TYPICAL CHARACTERISTICS (continued)

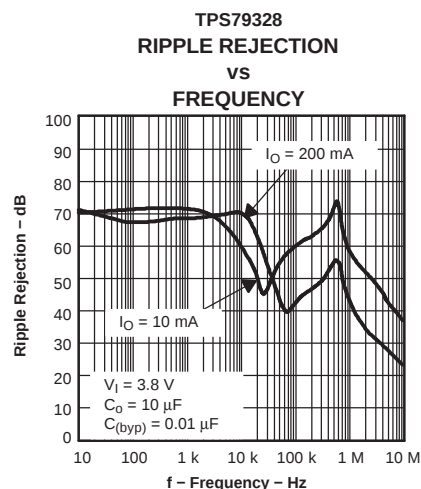


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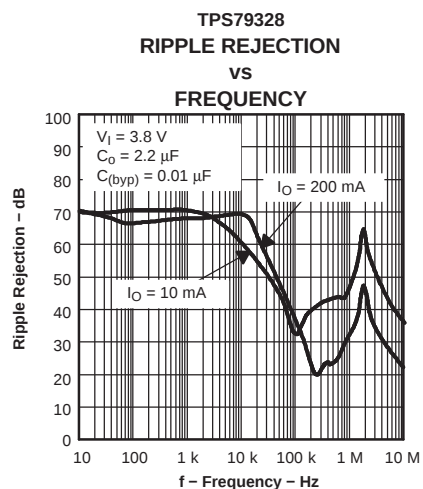


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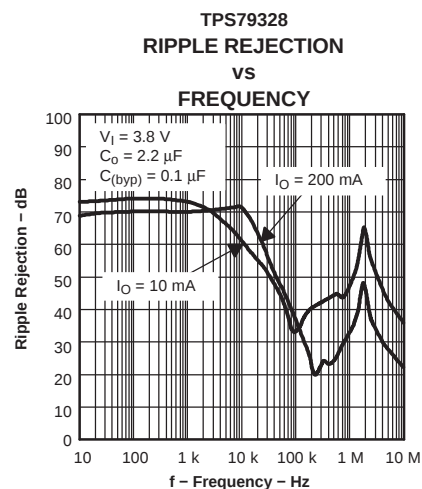


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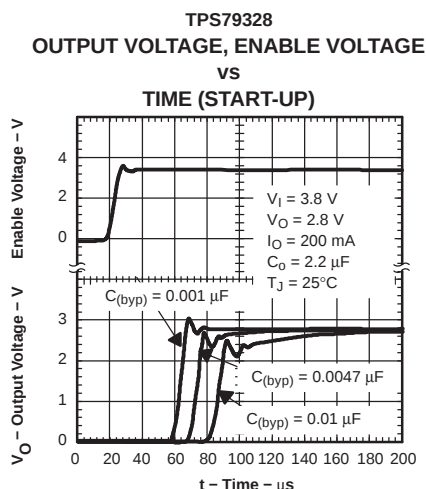


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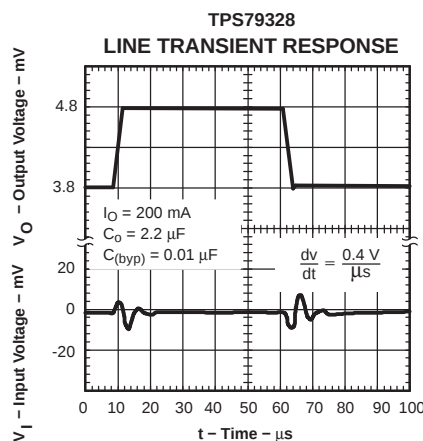


Figure 14.

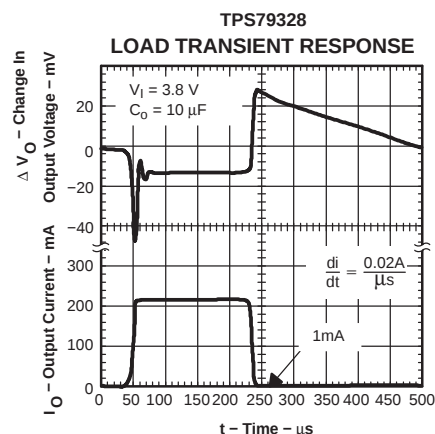


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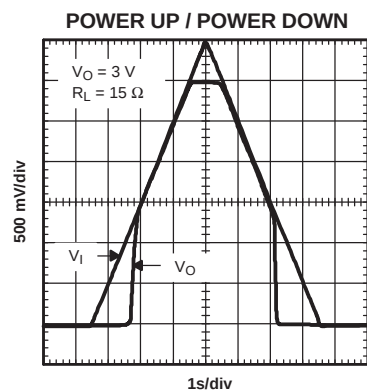


Figure 16.

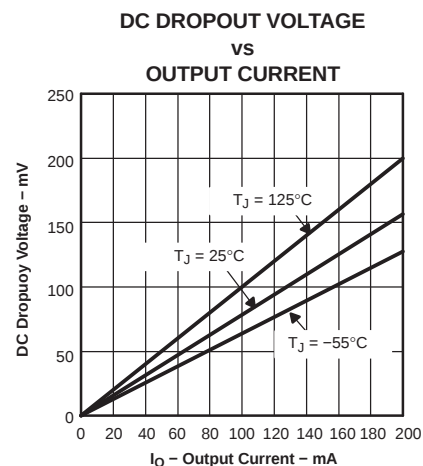


Figure 17.

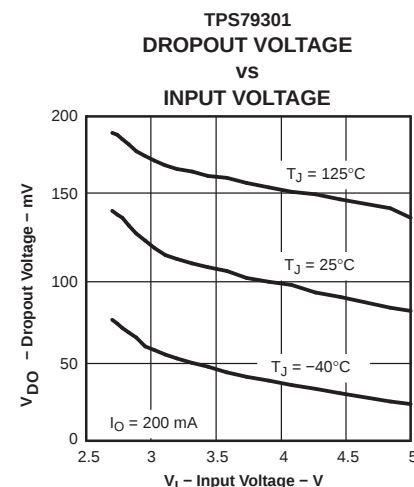


Figure 18.

TYPICAL CHARACTERISTICS (continued)

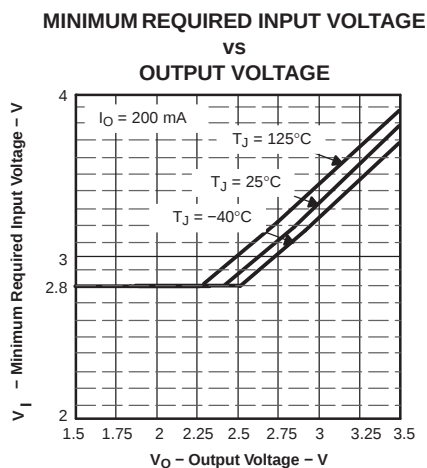


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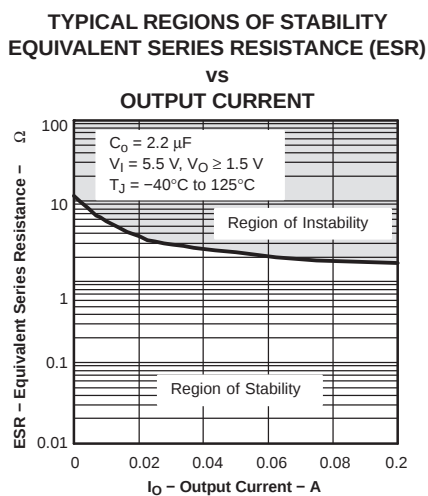


Figure 20.

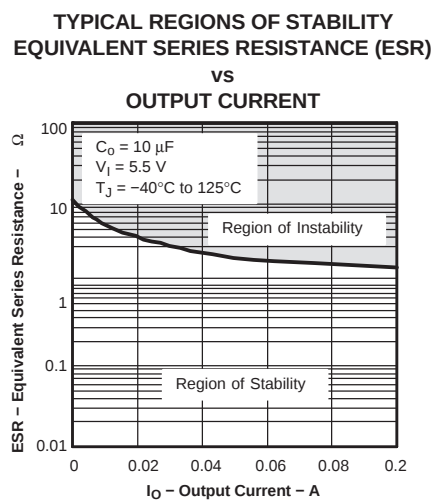


Figure 21.

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 μ A typically), and enable-input to reduce supply currents to less than 1 μ A when the regulator is turned off.

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

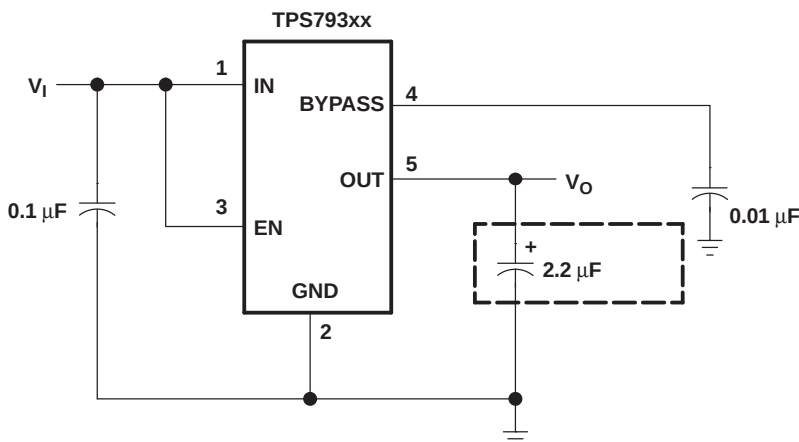


Figure 22. Typical Application Circuit

External Capacitor Requirements

A 0.1- μ 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- μ F. Any 2.2- μ 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 Ω internal resistor. The 250-k Ω 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 μ V_{RMS} of output voltage noise using a 0.1- μ F ceramic bypass capacitor and a 2.2- μ 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 Ω 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_{IN} and V_{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.

APPLICATION INFORMATION (continued)

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)

APPLICATION INFORMATION (continued)

Programming the TPS79301 Adjustable LDO Regulator (continued)

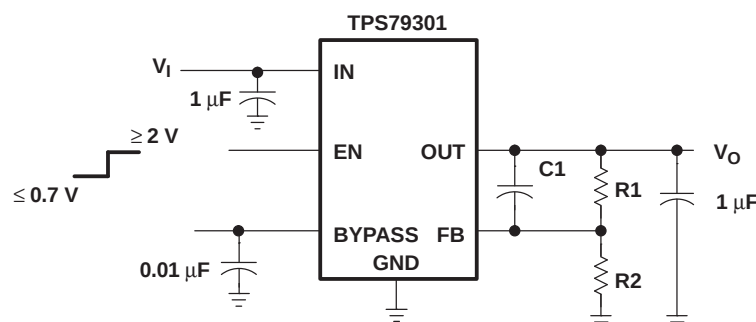
Resistors R1 and R2 should be chosen for approximately 50-μA divider current. Lower-value resistors can be used for improved noise performance, but the solution consumes more power. Higher resistor values should be avoided as leakage current into/out of FB across R1/R2 creates an offset voltage that artificially increases/decreases the feedback voltage and, thus, erroneously decreases/increases V_O . The recommended design procedure is to choose $R_2 = 30.1\text{ k}\Omega$ to set the divider current at 50 μA, $C_1 = 15\text{ pF}$ for stability, and then calculate R1 using:

$$R_1 = \left(\frac{V_O}{V_{\text{ref}}} - 1 \right) \times R_2 \quad (4)$$

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:

$$C_1 = \frac{(3 \times 10^{-7}) \times (R_1 + R_2)}{(R_1 \times R_2)} \quad (5)$$

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 μF instead of 2.2 μF.



OUTPUT VOLTAGE
PROGRAMMING GUIDE

OUTPUT VOLTAGE	R1	R2	C1
2.5 V	31.6 kΩ	30.1 kΩ	22 pF
3.3 V	51 kΩ	30.1 kΩ	15 pF
3.6 V	59 kΩ	30.1 kΩ	15 pF

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 (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS79301DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGVI	Samples
TPS79301DBVREP	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGVE	Samples
TPS79301DBVRG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGVI	Samples
TPS79301MDBVREP	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PMBM	Samples
TPS79318DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHHI	Samples
TPS79318DBVREP	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHHE	Samples
TPS79318DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHHI	Samples
TPS79318DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHHI	Samples
TPS79318DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHHI	Samples
TPS79318YEQR	OBSOLETE	DSBGA	YEQ	5		TBD	Call TI	Call TI	-40 to 125		
TPS79318YEQT	OBSOLETE	DSBGA	YEQ	5		TBD	Call TI	Call TI	-40 to 125		
TPS79318YZQR	ACTIVE	DSBGA	YZQ	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E3	Samples
TPS79318YZQT	ACTIVE	DSBGA	YZQ	5	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E3	Samples
TPS79325DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGWI	Samples
TPS79325DBVREP	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGWE	Samples
TPS79325DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGWI	Samples
TPS79325YEQR	OBSOLETE	DSBGA	YEQ	5		TBD	Call TI	Call TI	-40 to 125		
TPS79325YZQR	ACTIVE	DSBGA	YZQ	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E4	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS793285DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHII	Samples
TPS793285DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHII	Samples
TPS793285DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHII	Samples
TPS793285DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHII	Samples
TPS793285YZQR	ACTIVE	DSBGA	YZQ	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E5	Samples
TPS793285YZQT	ACTIVE	DSBGA	YZQ	5	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E5	Samples
TPS79328DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGXI	Samples
TPS79328DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGXI	Samples
TPS79328YEQR	OBSOLETE	DSBGA	YEQ	5		TBD	Call TI	Call TI	-40 to 125		
TPS79328YZQR	ACTIVE	DSBGA	YZQ	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E2	Samples
TPS79328YZQT	ACTIVE	DSBGA	YZQ	5	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E2	Samples
TPS79330DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGYI	Samples
TPS79330DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGYI	Samples
TPS79330YZQR	ACTIVE	DSBGA	YZQ	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E6	Samples
TPS79330YZQT	ACTIVE	DSBGA	YZQ	5	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 125	E6	Samples
TPS79333DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHUI	Samples
TPS79333DBVREP	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHUE	Samples
TPS79333DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHUI	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS793475DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHJI	Samples
TPS793475DBVREP	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHJE	Samples
TPS793475DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHJI	Samples
V62/03634-01YE	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGVE	Samples
V62/03634-02XE	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHHE	Samples
V62/03634-03XE	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PGWE	Samples
V62/03634-07XE	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHUE	Samples
V62/03634-08XE	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PHJE	Samples
V62/03634-09XE	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 125	PMBM	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

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

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

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

OBsolete: TI has discontinued the production of the device.

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

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

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

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

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

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

⁽⁴⁾ There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

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

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

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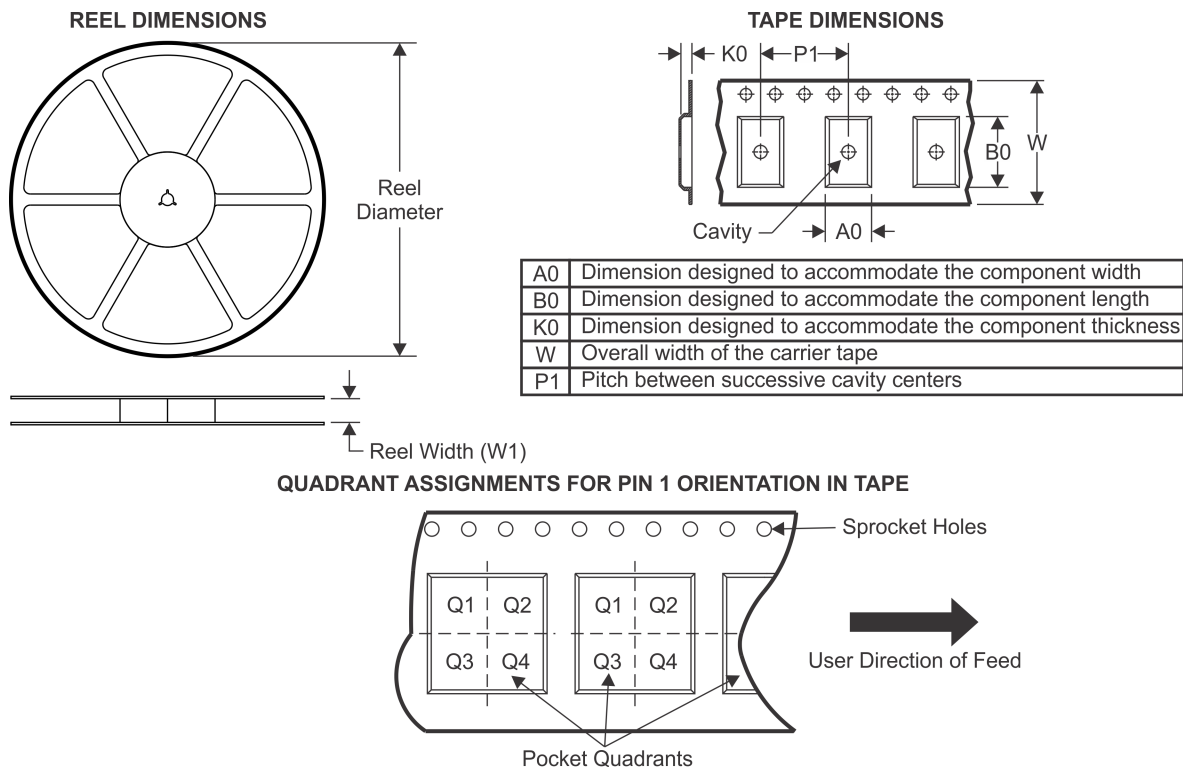
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OTHER QUALIFIED VERSIONS OF TPS793, TPS79301-EP, TPS79318-EP, TPS79325-EP, TPS79333-EP, TPS793475-EP :

- Catalog: [TPS79301](#), [TPS79318](#), [TPS79325](#), [TPS79333](#), [TPS793475](#)
- Automotive: [TPS793-Q1](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

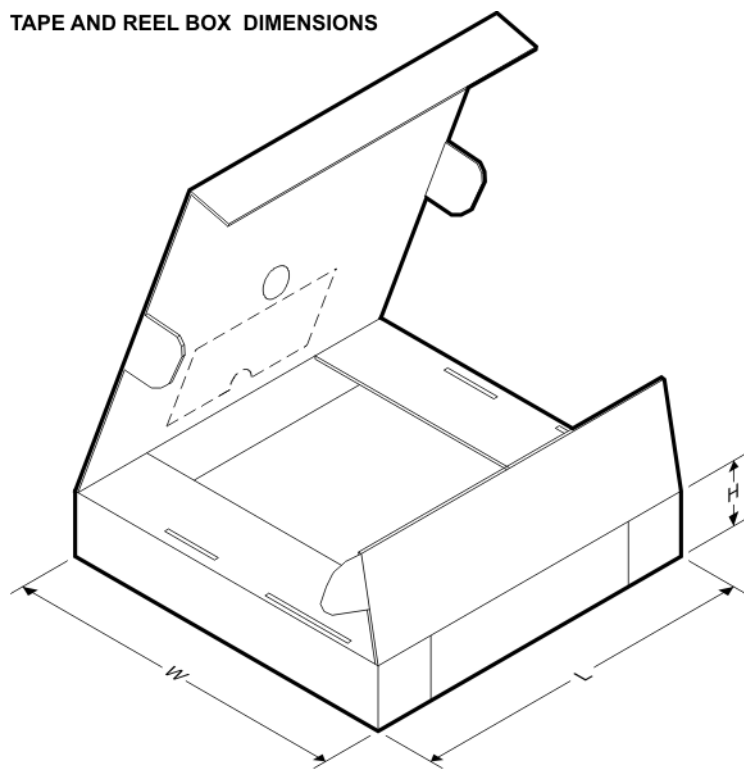
TAPE AND REEL INFORMATION


*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
TPS79301DBVR	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS79301DBVREP	SOT-23	DBV	6	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS79301MDBVREP	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS79318DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS79318DBVREP	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS79318DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS79318YZQR	DSBGA	YZQ	5	3000	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS79318YZQT	DSBGA	YZQ	5	250	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS79325DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS79325DBVREP	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS79325YZQR	DSBGA	YZQ	5	3000	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS793285DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS793285DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS793285YZQR	DSBGA	YZQ	5	3000	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS793285YZQT	DSBGA	YZQ	5	250	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS79328DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS79328YZQR	DSBGA	YZQ	5	3000	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS79328YZQT	DSBGA	YZQ	5	250	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1

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
TPS79330DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS79330YZQR	DSBGA	YZQ	5	3000	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS79330YZQT	DSBGA	YZQ	5	250	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS79333DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS79333DBVREP	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS793475DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS793475DBVR	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS793475DBVREP	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS



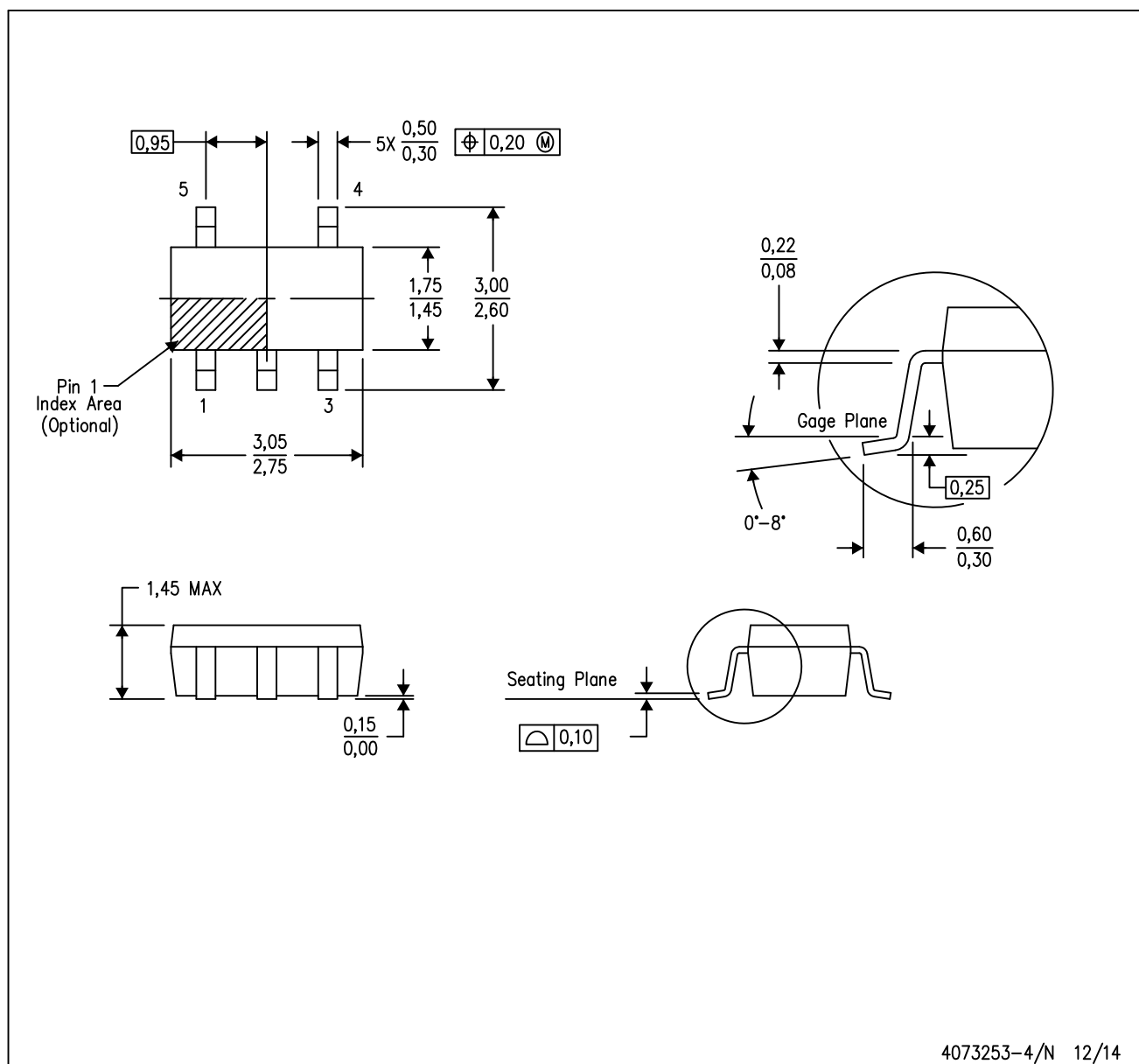
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS79301DBVR	SOT-23	DBV	6	3000	180.0	180.0	18.0
TPS79301DBVREP	SOT-23	DBV	6	3000	182.0	182.0	20.0
TPS79301MDBVREP	SOT-23	DBV	6	3000	203.0	203.0	35.0
TPS79318DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS79318DBVREP	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS79318DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS79318YZQR	DSBGA	YZQ	5	3000	217.0	193.0	35.0
TPS79318YZQT	DSBGA	YZQ	5	250	217.0	193.0	35.0
TPS79325DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS79325DBVREP	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS79325YZQR	DSBGA	YZQ	5	3000	217.0	193.0	35.0
TPS793285DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS793285DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS793285YZQR	DSBGA	YZQ	5	3000	217.0	193.0	35.0
TPS793285YZQT	DSBGA	YZQ	5	250	217.0	193.0	35.0
TPS79328DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS79328YZQR	DSBGA	YZQ	5	3000	217.0	193.0	35.0
TPS79328YZQT	DSBGA	YZQ	5	250	217.0	193.0	35.0
TPS79330DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS79330YZQR	DSBGA	YZQ	5	3000	217.0	193.0	35.0
TPS79330YZQT	DSBGA	YZQ	5	250	217.0	193.0	35.0
TPS79333DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS79333DBVREP	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS793475DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS793475DBVR	SOT-23	DBV	5	3000	203.0	203.0	35.0
TPS793475DBVREP	SOT-23	DBV	5	3000	182.0	182.0	20.0

DBV (R-PDSO-G5)

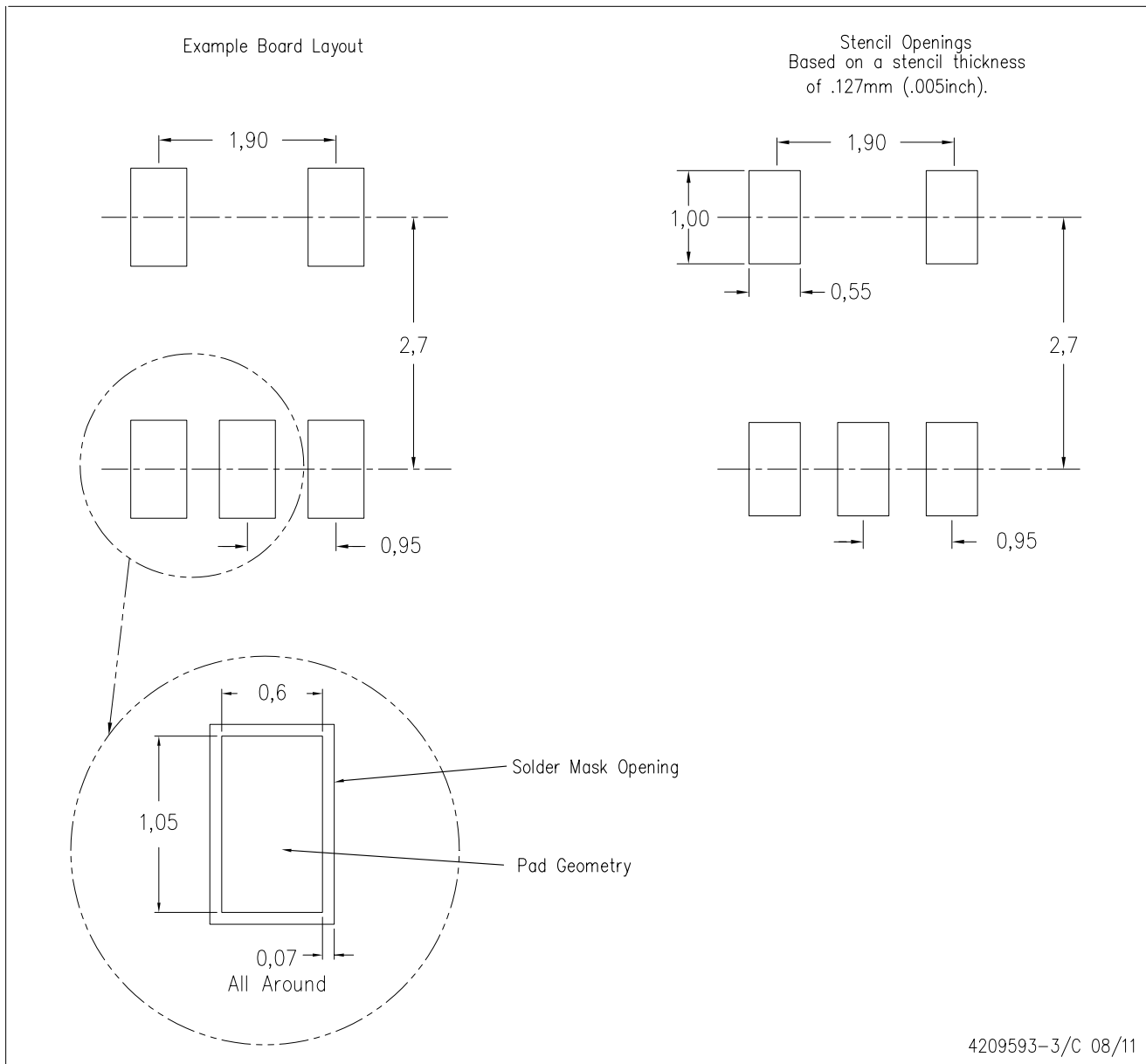
PLASTIC SMALL-OUTLINE PACKAGE



- 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-G5)

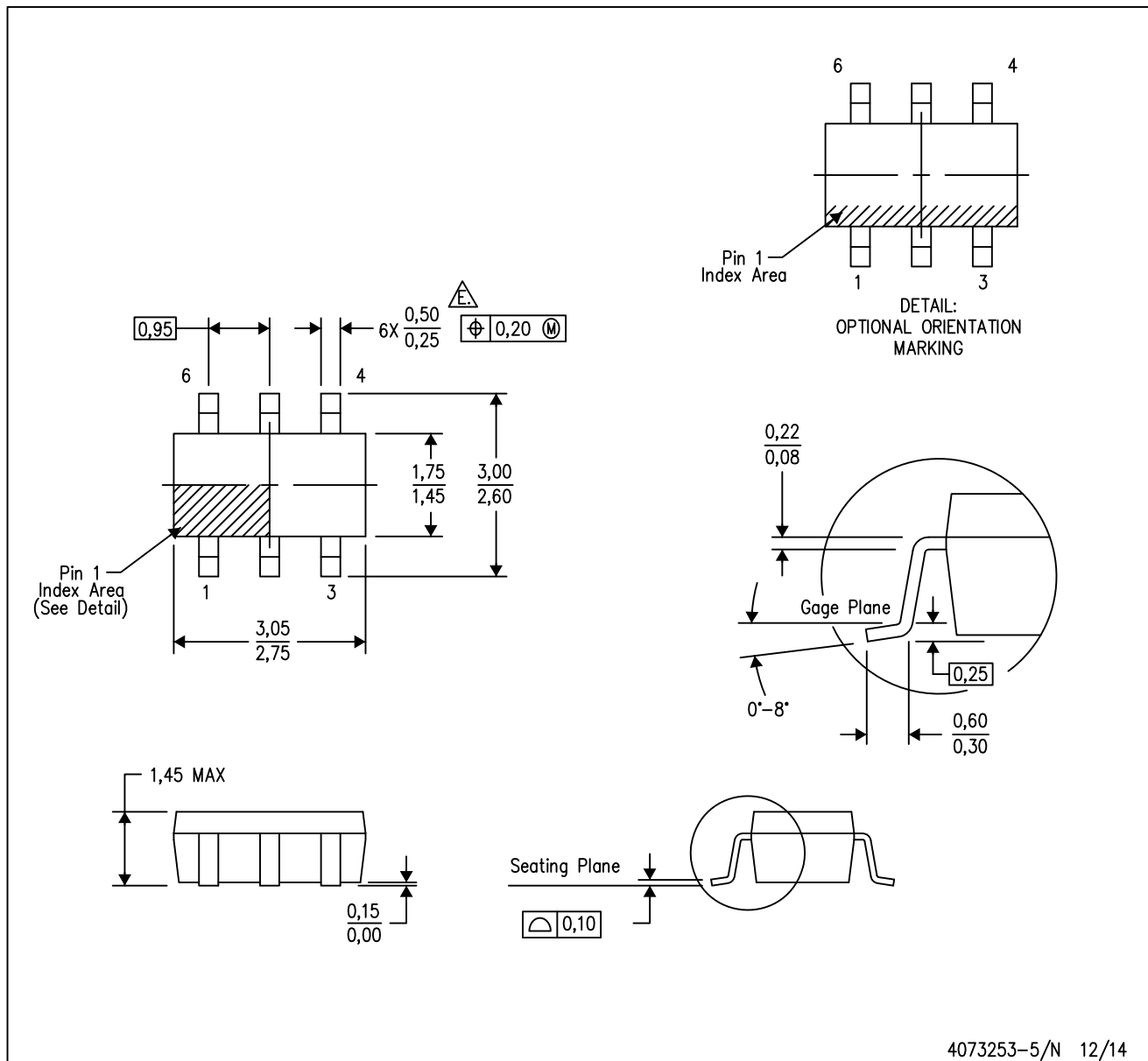
PLASTIC SMALL OUTLINE



- 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)

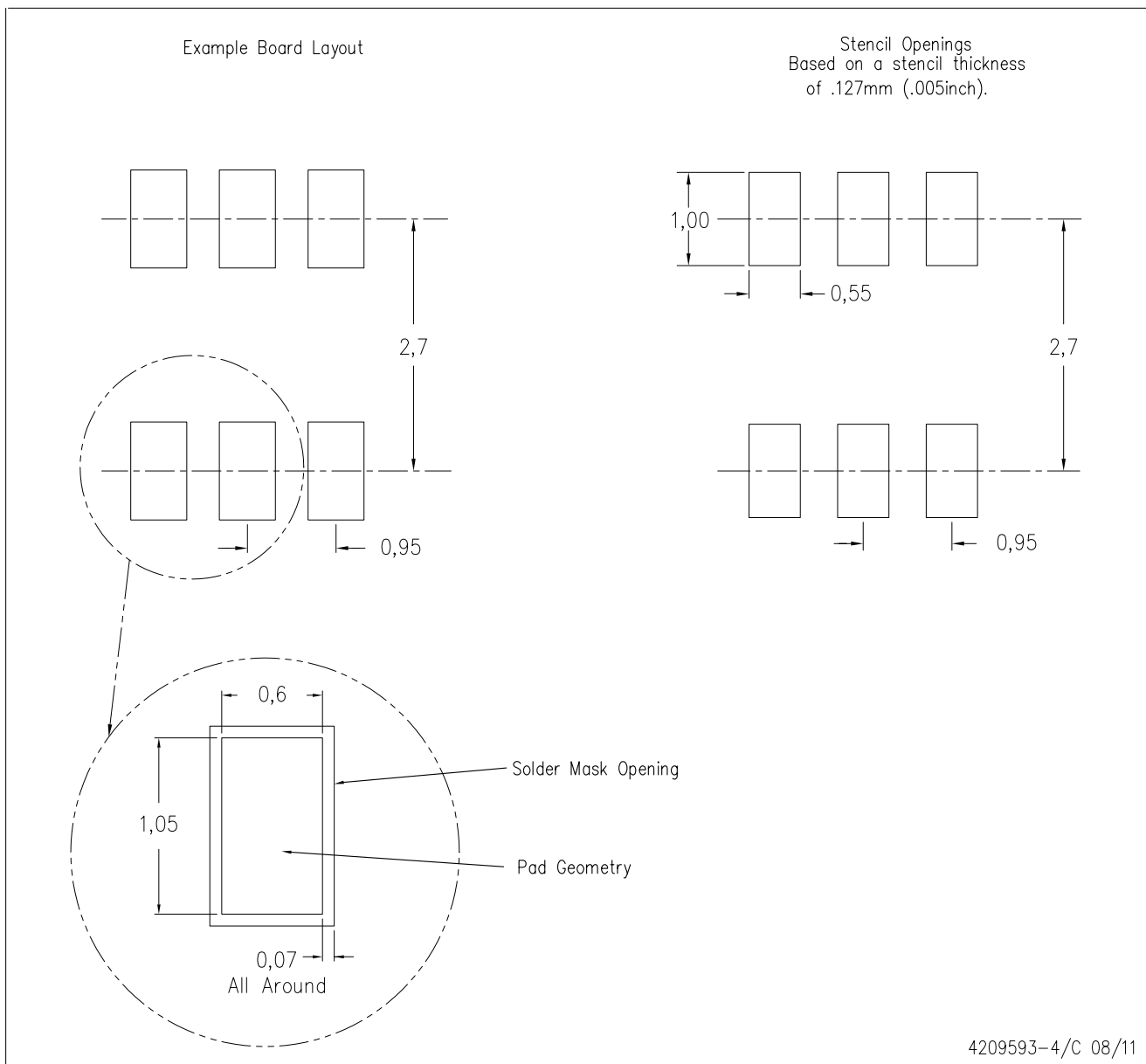
PLASTIC SMALL-OUTLINE PACKAGE



- 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.
 - E. Falls within JEDEC MO-178 Variation AB, except minimum lead width.

DBV (R-PDSO-G6)

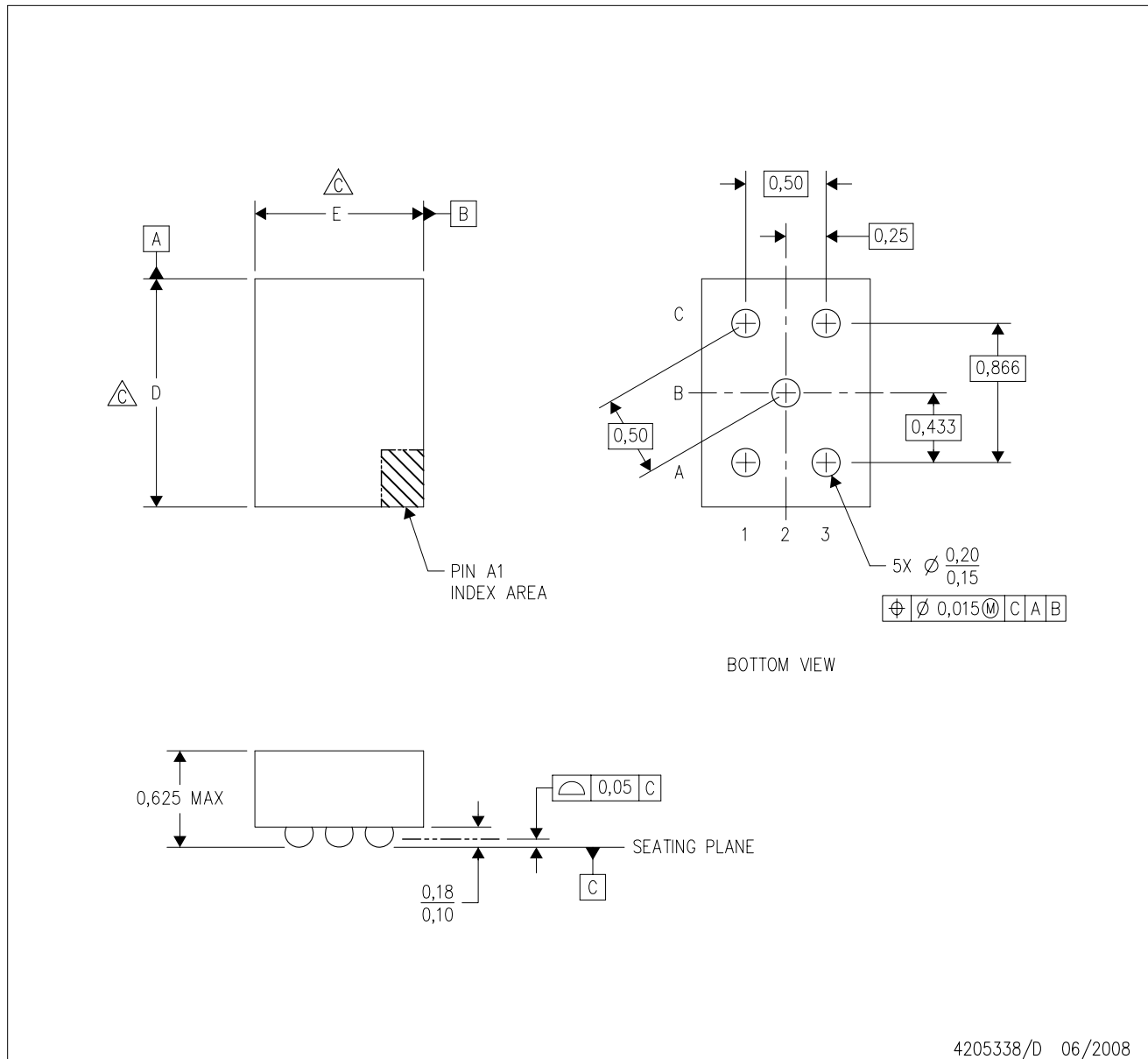
PLASTIC SMALL OUTLINE



- 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.

YEQ (R-XBGA-N5)

DIE-SIZE BALL GRID ARRAY

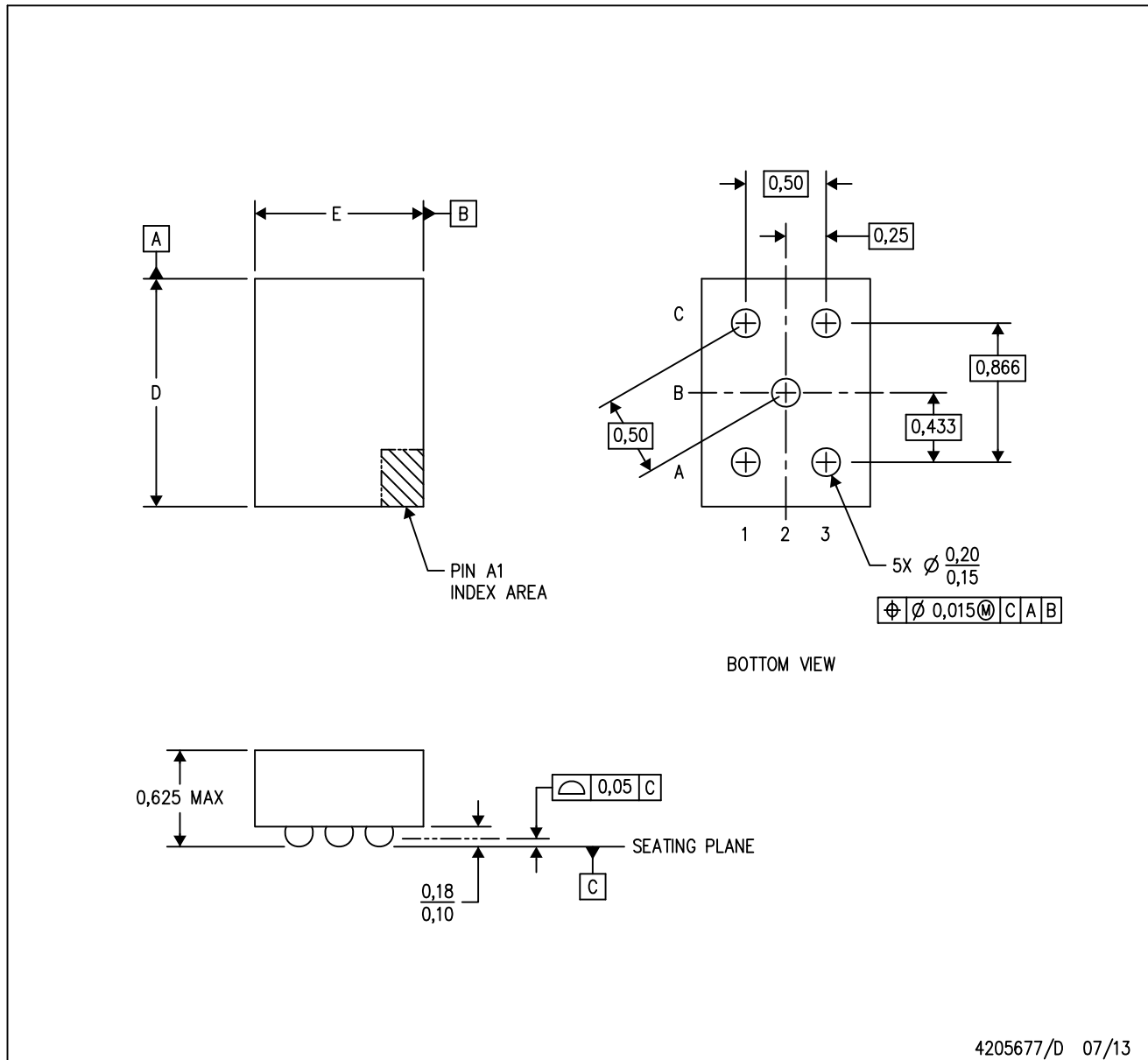


- Notes:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Devices in this YEQ package can have dimension D ranging from 1.17 to 1.67 mm and dimension E ranging from 0.80 to 1.30 mm. To determine the exact package size of a particular device, refer to the device datasheet or contact a local TI representative.
 - D. NanoStar™ package configuration.
 - E. This package contains tin-lead (SnPb) balls. Refer to the 5 YZQ package (drawing 4205677) for lead-free balls.

NanoStar is a trademark of Texas Instruments.

YZQ (R-XBGA-N5)

DIE-SIZE BALL GRID ARRAY



- Notes:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. NanoFree™ package configuration.

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