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

Check for Samples: TPS730xx

FEATURES

- **200-mA RF Low-Dropout Regulator With Enable**
- **Available in Fixed Voltages from 1.8V to 3.3V and Adjustable (1.22V to 5.5V)**
- **High PSRR (68dB at 100Hz)**
- **Ultralow-Noise (33μV_{RMS}, TPS73018)**
- **Fast Start-Up Time (50μs)**
- **Stable With a 2.2μF Ceramic Capacitor**
- **Excellent Load/Line Transient Response**
- **Very Low Dropout Voltage (120mV at 200mA)**
- **5- and 6-Pin SOT23 (DBV), and Wafer Chip Scale (YZQ) Packages**

APPLICATIONS

- **RF: VCOs, Receivers, ADCs**
- **Audio**
- **Cellular and Cordless Telephones**
- **Bluetooth®, Wireless LAN**
- **Handheld Organizers, PDAs**

DESCRIPTION

The TPS730xx 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 a small SOT23 package. NanoStar™ packaging gives an ultrasmall footprint as well as an ultralow profile and package weight, making it ideal for portable applications such as handsets and PDAs. Each device in the family is stable, with a small 2.2μF ceramic capacitor on the output. The TPS730xx family uses an advanced, proprietary BiCMOS fabrication process to yield low dropout voltages (e.g., 120mV at 200mA, TPS73030). Each device achieves fast start-up times (approximately 50μs with a 0.001μF bypass capacitor) while consuming low quiescent current (170μA typical). Moreover, when the device is placed in standby mode, the supply current is reduced to less than 1μA. The TPS73018 exhibits approximately 33μV_{RMS} of output voltage noise at 1.8V output with a 0.01μF 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.

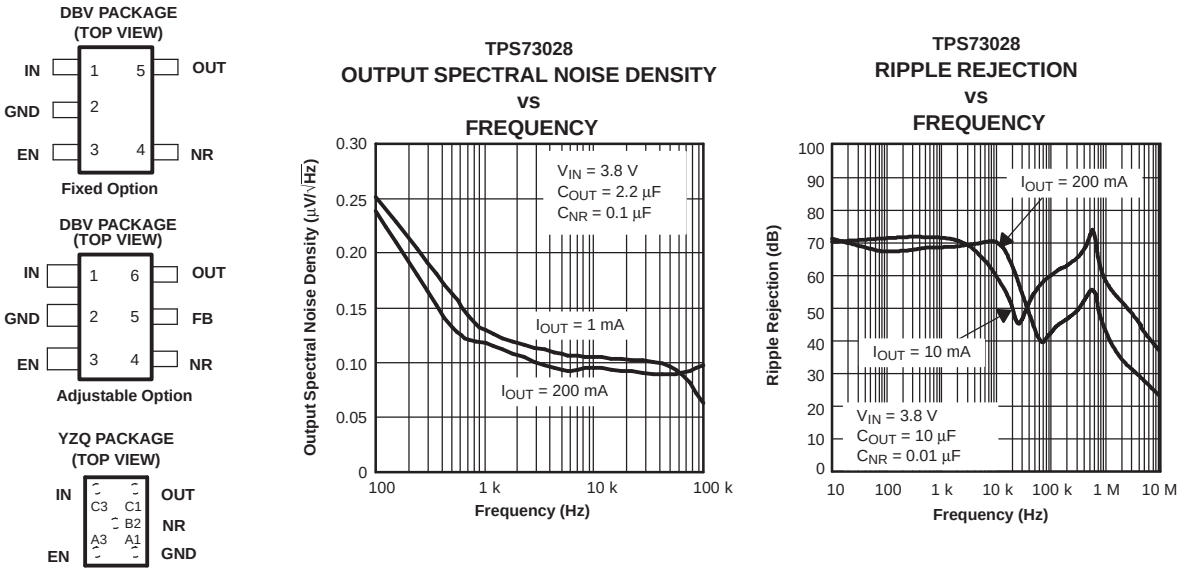


Figure 1.

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)

PRODUCT	V_{OUT}
TPS730**xx** ***yy yz***	**XX** is nominal output voltage (for example, 28 = 2.8V, 01 = Adjustable). **YYY** is package designator. **Z** is package quantity.

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

ABSOLUTE MAXIMUM RATINGS

Over operating temperature range (unless otherwise noted).(1)

	UNIT
V_{IN} range	–0.3V to +6V
V_{EN} range	–0.3V to +6V
V_{OUT} range	–0.3V to V_{IN} + 0.3V
Peak output current	Internally limited
ESD rating, HBM	2kV
ESD rating, CDM	500V
Continuous total power dissipation	See Dissipation Ratings Table
Junction temperature range	–40°C to +150°C
Storage temperature range, T_{stg}	–65°C to +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.

DISSIPATION RATINGS TABLE

BOARD	PACKAGE	$R_{\theta JC}$	$R_{\theta JA}$	DERATING FACTOR ABOVE T_A = +25°C	$T_A \le$ +25°C POWER RATING	T_A = +70°C POWER RATING	T_A = +85°C POWER RATING
Low-K(1)	DBV	65°C/W	255°C/W	3.9mW/°C	390mW	215mW	155mW
High-K(2)	DBV	65°C/W	180°C/W	5.6mW/°C	560mW	310mW	225mW
Low-K(1)	YZQ	27°C/W	255°C/W	3.9mW/°C	390mW	215mW	155mW
High-K(2)	YZQ	27°C/W	190°C/W	5.3mW/°C	530mW	296mW	216mW

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

ELECTRICAL CHARACTERISTICS

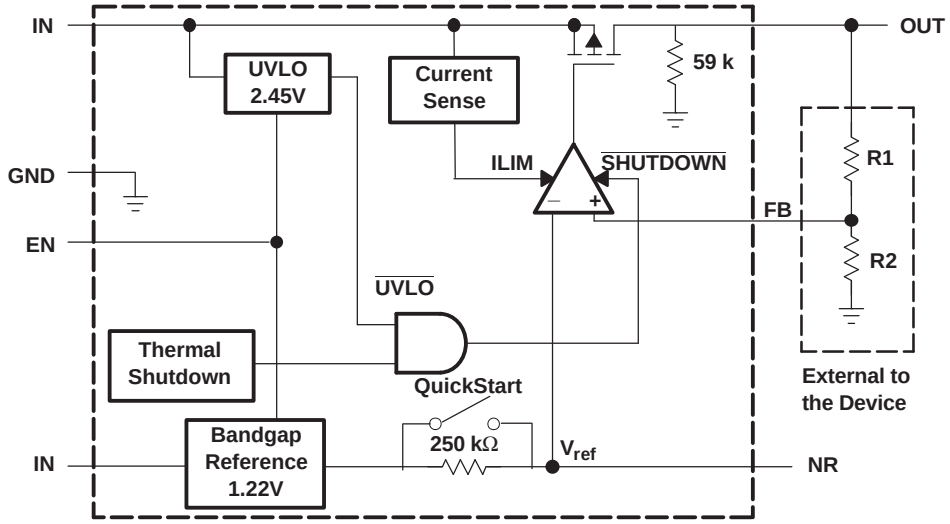
Over recommended operating temperature range T_J = –40 to +125°C, $V_{EN} = V_{IN}$, $V_{IN} = V_{OUT(nom)}$ + 1 V(1), I_{OUT} = 1mA, C_{OUT} = 10µF, C_{NR} = 0.01µF (unless otherwise noted). Typical values are at +25°C.

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{IN} Input voltage(1)				2.7		5.5	V
I_{OUT} Continuous output current				0		200	mA
V_{FB} Internal reference (TPS73001)				1.201	1.225	1.250	V
Output voltage range (TPS73001)				V_{FB}		5.5 – V_{DO}	V
Output voltage accuracy		0µA ≤ I_{OUT} ≤ 200mA, 2.75V ≤ V_{IN} < 5.5V		–2%	$V_{OUT(nom)}$	+2%	V
Line regulation ($\Delta V_{OUT}\%/\Delta V_{IN}$) (1)		V_{OUT} + 1V ≤ V_{IN} ≤ 5.5V			0.05		%/V
Load regulation ($\Delta V_{OUT}\%/\Delta I_{OUT}$)		0µA ≤ I_{OUT} ≤ 200mA, T_J = +25°C			5		mV
Dropout voltage(2)($V_{IN} = V_{OUT(nom)} – 0.1V$)		I_{OUT} = 200mA			120	210	mV
Output current limit		V_{OUT} = 0V		285		600	mA
GND pin current		0µA ≤ I_{OUT} ≤ 200mA			170	250	µA
Shutdown current(3)		V_{EN} = 0V, 2.7V ≤ V_{IN} ≤ 5.5V			0.07	1	µA
FB pin current		V_{FB} = 1.8V				1	µA
Power-supply ripple rejection	TPS73028	f = 100Hz, T_J = +25°C, I_{OUT} = 200mA			68		dB
Output noise voltage (TPS73018)		BW = 200Hz to 100kHz, I_{OUT} = 200mA	C_{NR} = 0.01µF		33		μV_{RMS}
Time, start-up (TPS73018)		R_L = 14Ω, C_{OUT} = 1µF	C_{NR} = 0.001µF		50		µs
High level enable input voltage		2.7V ≤ V_{IN} ≤ 5.5V		1.7		V_{IN}	V
Low level enable input voltage		2.7V ≤ V_{IN} ≤ 5.5V		0		0.7	V
EN pin current		V_{EN} = 0		–1		1	µA
UVLO threshold		V_{CC} rising		2.25		2.65	V
UVLO hysteresis					100		mV

(1) Minimum V_{IN} is 2.7V or V_{OUT} + V_{DO}, whichever is greater.
(2) Dropout is not measured for the TPS73018 and TPS73025 since minimum V_{IN} = 2.7V.
(3) For adjustable versions, this applies only after V_{IN} is applied; then V_{EN} transitions high to low.

FUNCTIONAL BLOCK DIAGRAMS

ADJUSTABLE VERSION



FIXED VERSION

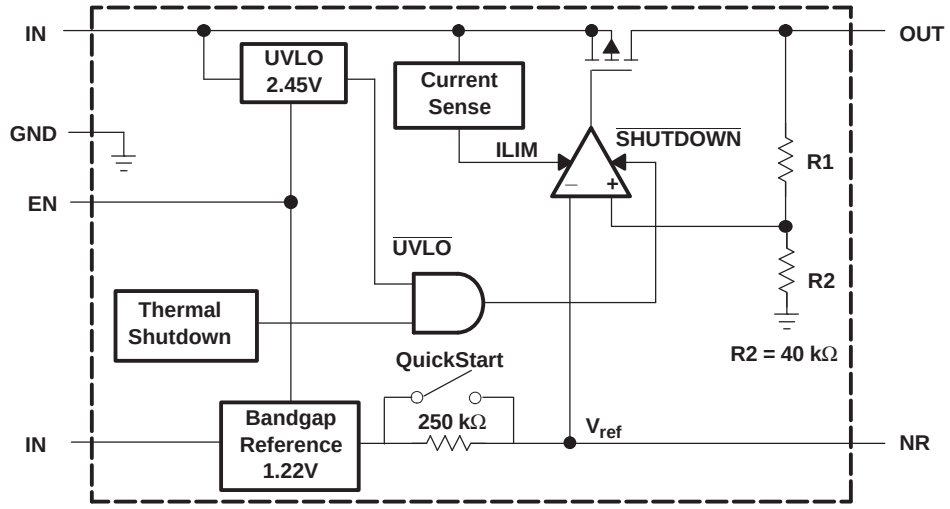


Table 1. Terminal Functions

TERMINAL				DESCRIPTION
NAME	SOT23 ADJ	SOT23 FIXED	WCSP FIXED	
NR	4	4	B2	Connecting an external capacitor to this pin bypasses noise generated by the internal bandgap. This improves power-supply rejection and reduces output noise.
EN	3	3	A3	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.
FB	5	N/A	N/A	This terminal is the feedback input voltage for the adjustable device.
GND	2	2	A1	Regulator ground
IN	1	1	C3	Input to the device.
OUT	6	5	C1	Output of the regulator.

TYPICAL CHARACTERISTICS (SOT23 PACKAGE)

TPS73028 OUTPUT VOLTAGE vs OUTPUT CURRENT

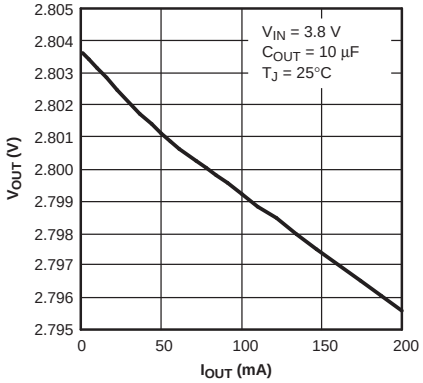


Figure 2.

TPS73028 OUTPUT VOLTAGE vs JUNCTION TEMPERATURE

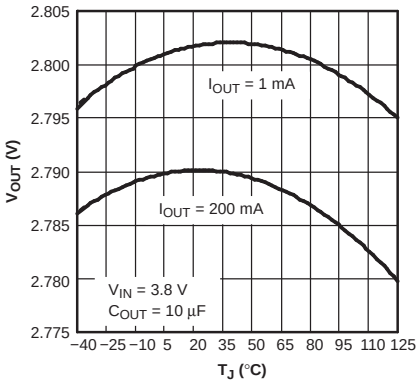


Figure 3.

TPS73028 GROUND CURRENT vs JUNCTION TEMPERATURE

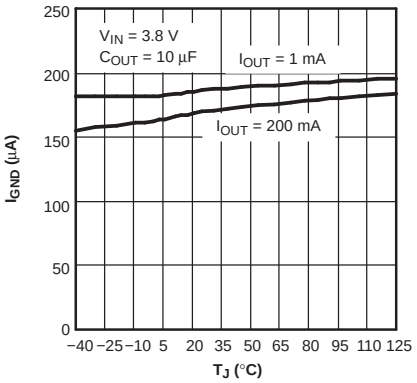


Figure 4.

TPS73028 OUTPUT SPECTRAL NOISE DENSITY vs FREQUENCY

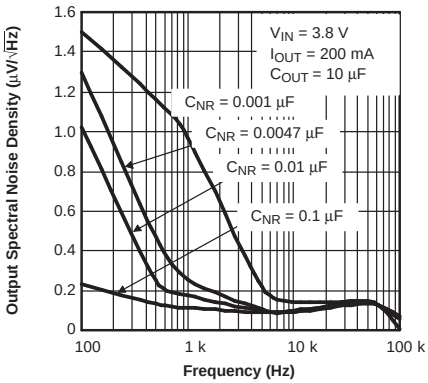


Figure 5.

ROOT MEAN SQUARE OUTPUT NOISE vs C_{NR}

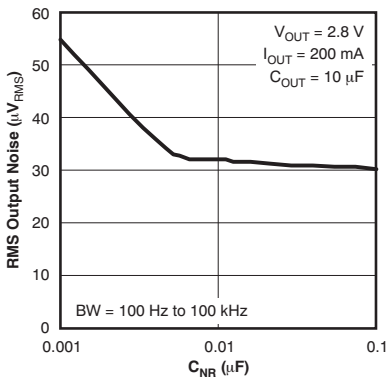


Figure 6.

TPS73028 DROPOUT VOLTAGE vs JUNCTION TEMPERATURE

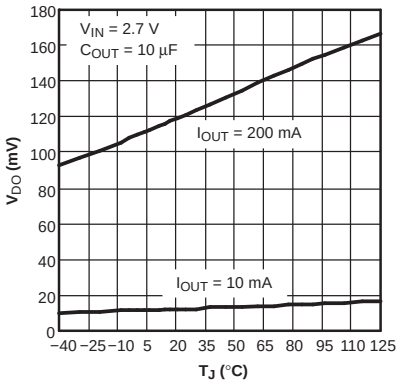


Figure 7.

TPS73028 RIPPLE REJECTION vs FREQUENCY

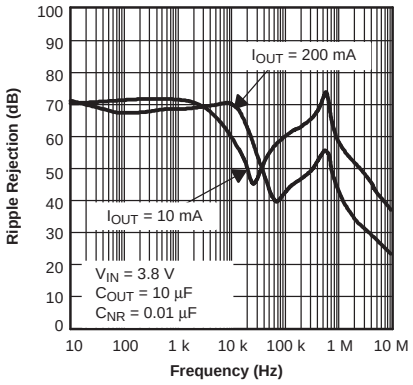


Figure 8.

TPS73028 OUTPUT VOLTAGE, ENABLE VOLTAGE vs TIME (START-UP)

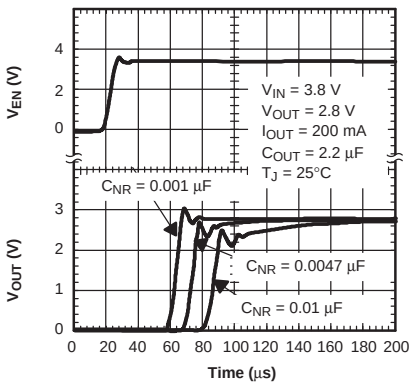


Figure 9.

TPS73028 LINE TRANSIENT RESPONSE

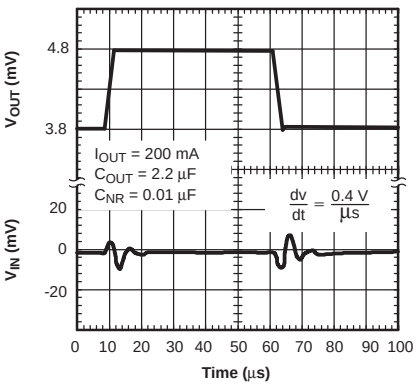


Figure 10.

TYPICAL CHARACTERISTICS (SOT23 PACKAGE) (continued)

TPS73028
LOAD TRANSIENT RESPONSE

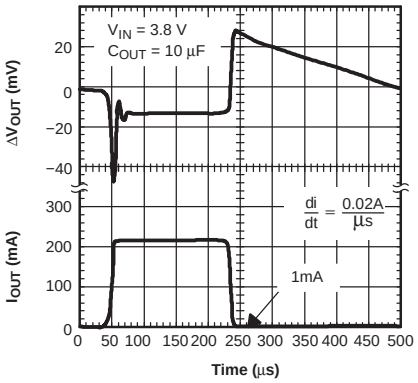


Figure 11.

POWER-UP/POWER-DOWN

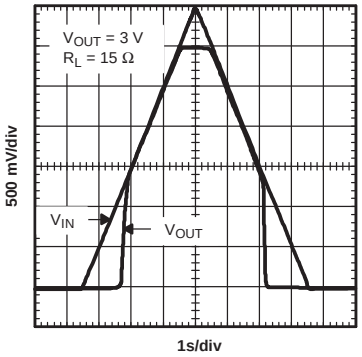


Figure 12.

DROPOUT VOLTAGE
vs
OUTPUT CURRENT

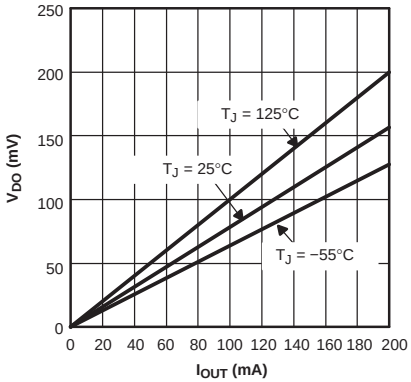


Figure 13.

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

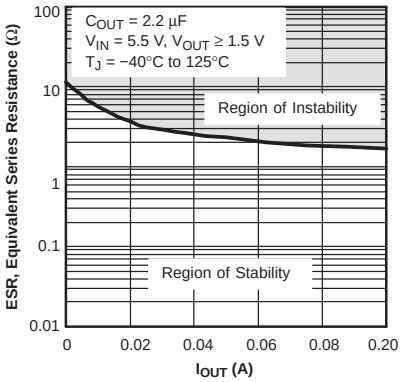


Figure 14.

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

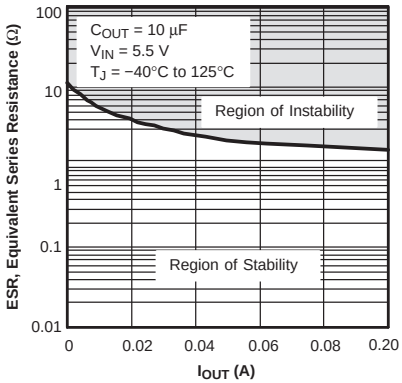


Figure 15.

APPLICATION INFORMATION

The TPS730xx 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 (170µA typically), and enable-input to reduce supply currents to less than 1µA when the regulator is turned off.

A typical application circuit is shown in Figure 16.

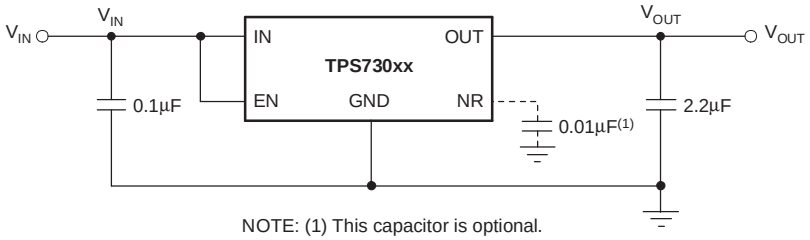


Figure 16. Typical Application Circuit

External Capacitor Requirements

A 0.1µF or larger ceramic input bypass capacitor, connected between IN and GND and located close to the TPS730xx, is required for stability and improves transient response, noise rejection, and ripple rejection. A higher-value input capacitor may be necessary if large, fast-rise-time load transients are anticipated or the device is located several inches from the power source.

Like most low dropout regulators, the TPS730xx requires an output capacitor connected between OUT and GND to stabilize the internal control loop. The minimum recommended capacitance is 2.2µF. Any 2.2µF or larger ceramic capacitor is suitable, provided the capacitance does not vary significantly over temperature. If load current is not expected to exceed 100mA, a 1.0µF ceramic capacitor can be used.

The internal voltage reference is a key source of noise in an LDO regulator. The TPS730xx has an NR pin which is connected to the voltage reference through a 250kΩ internal resistor. The 250kΩ 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 0.1µF to ensure that it is fully charged during the quickstart time provided by the internal switch shown in the Functional Block Diagrams.

As an example, the TPS73018 exhibits only 33µV_{RMS} of output voltage noise using a 0.01µF ceramic bypass capacitor and a 2.2µF ceramic output capacitor. Note that the output starts up slower as the bypass capacitance increases due to the RC time constant at the NR pin that is created by the internal 250kΩ 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.

Power Dissipation and Junction Temperature

Specified regulator operation is assured 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 Equation 1:

$$P_{D(max)} = \frac{T_J max - T_A}{R_{\Theta JA}} \quad (1)$$

Where:

- $T_J$max is the maximum allowable junction temperature.
- $R_{\theta JA}$ is the thermal resistance junction-to-ambient for the package (see the Dissipation Ratings Table).
- T_A is the ambient temperature.

The regulator dissipation is calculated using Equation 2:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} \quad (2)$$

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

Programming the TPS73001 Adjustable LDO Regulator

The output voltage of the TPS73001 adjustable regulator is programmed using an external resistor divider as shown in Figure 17. The output voltage is calculated using Equation 3:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_1}{R_2}\right) \quad (3)$$

Where:

- V_{REF} = 1.225V typ (the internal reference voltage)

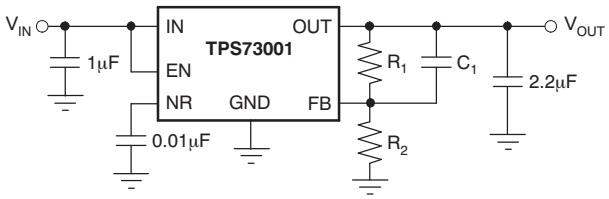
Resistors R_1 and R_2 should be chosen for approximately 50µA divider current. Lower value resistors can be used for improved noise performance, but the solution consumes more power. Higher resistor values should be avoided as leakage current into/out of FB across R_1/R_2 creates an offset voltage that artificially increases/decreases the feedback voltage and thus erroneously decreases/increases V_{OUT}. The recommended design procedure is to choose R_2 = 30.1kΩ to set the divider current at 50µA, C_1 = 15pF for stability, and then calculate R_1 using Equation 4:

$$R_1 = \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \times R_2 \quad (4)$$

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 < 1.8V, the value of this capacitor should be 100pF. For voltages > 1.8V, the approximate value of this capacitor can be calculated as shown in Equation 5:

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

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 < 1.8V is chosen, then the minimum recommended output capacitor is 4.7µF instead of 2.2µF.



OUTPUT VOLTAGE PROGRAMMING GUIDE

OUTPUT VOLTAGE	R_1	R_2	C_1
1.22V	short	open	0pF
2.5V	31.6kΩ	30.1kΩ	22pF
3.3V	51kΩ	30.1kΩ	15pF
3.6V	59kΩ	30.1kΩ	15pF

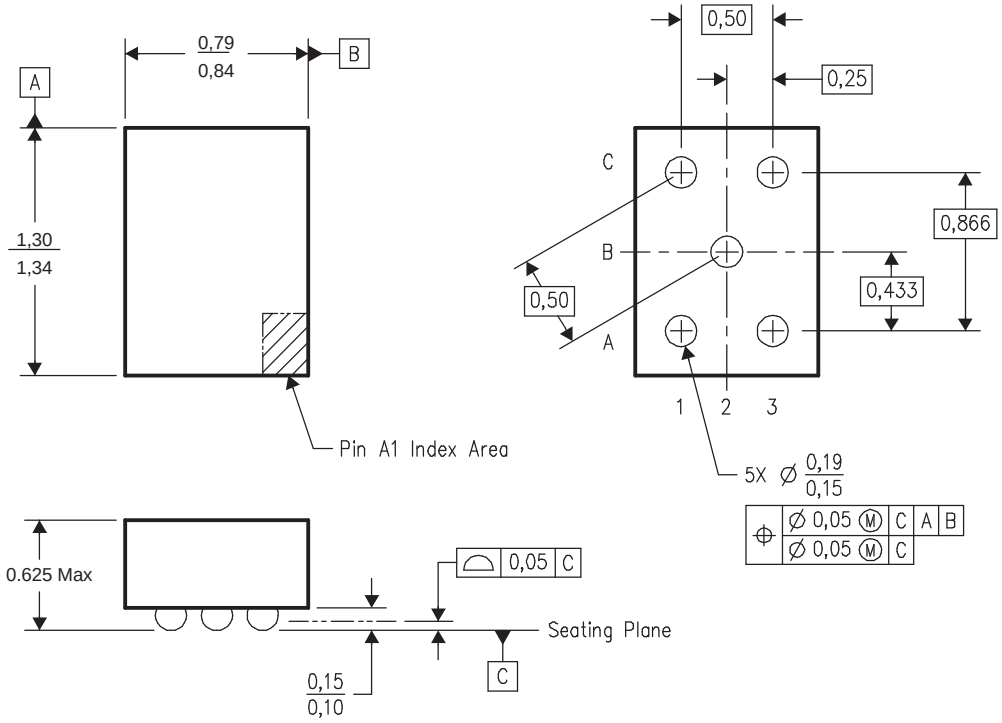
Figure 17. TPS73001 Adjustable LDO Regulator Programming

Regulator Protection

The TPS730xx 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 TPS730xx features internal current limiting and thermal protection. During normal operation, the TPS730xx limits output current to approximately 400mA. 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.

TPS730xxYZQ NanoStar™ Wafer Chip Scale Information



NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. NanoStar™ package configuration.
D. This package is tin-lead (SnPb); consult the factory for availability of lead-free material.

NanoStar is a trademark of Texas Instruments.

Figure 18. NanoStar™ Wafer Chip Scale Package

REVISION HISTORY

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision H (October, 2007) to Revision I	Page
• Corrected units in y-axis of Figure 6	5

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
TPS73001DBVR	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGVI	Samples
TPS73001DBVRG4	ACTIVE	SOT-23	DBV	6	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGVI	Samples
TPS73001DBVT	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGVI	Samples
TPS73001DBVTG4	ACTIVE	SOT-23	DBV	6	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGVI	Samples
TPS73018DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHHI	Samples
TPS73018DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHHI	Samples
TPS73018DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHHI	Samples
TPS73018DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHHI	Samples
TPS73018YZQR	OBSOLETE	DSBGA	YZQ	5		TBD	Call TI	Call TI	-40 to 85	E3	
TPS73025DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGWI	Samples
TPS73025DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGWI	Samples
TPS73025DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGWI	Samples
TPS73025DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGWI	Samples
TPS73025YZQR	ACTIVE	DSBGA	YZQ	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	E4	Samples
TPS73025YZQT	ACTIVE	DSBGA	YZQ	5	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	E4	Samples
TPS730285DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHII	Samples
TPS730285DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHII	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
TPS730285DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHII	Samples
TPS73028DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGXI	Samples
TPS73028DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGXI	Samples
TPS73028DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGXI	Samples
TPS73028DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGXI	Samples
TPS73028YZQR	ACTIVE	DSBGA	YZQ	5	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	E2	Samples
TPS73028YZQT	ACTIVE	DSBGA	YZQ	5	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	E2	Samples
TPS73030DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGYI	Samples
TPS73030DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGYI	Samples
TPS73030DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGYI	Samples
TPS73030DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PGYI	Samples
TPS73030YZQR	OBSOLETE	DSBGA	YZQ	5		TBD	Call TI	Call TI	-40 to 85		
TPS73030YZQT	OBSOLETE	DSBGA	YZQ	5		TBD	Call TI	Call TI	-40 to 85		
TPS73033DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHUI	Samples
TPS73033DBVRG4	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHUI	Samples
TPS73033DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHUI	Samples
TPS73033DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PHUI	Samples
TPS73047DBVR	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PETI	Samples
TPS73047DBVT	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PETI	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
TPS73047DBVTG4	ACTIVE	SOT-23	DBV	5	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PETI	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.

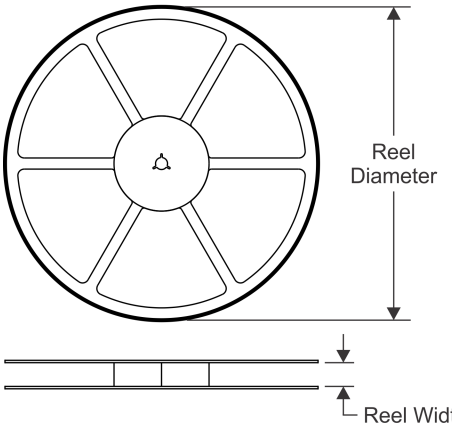
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

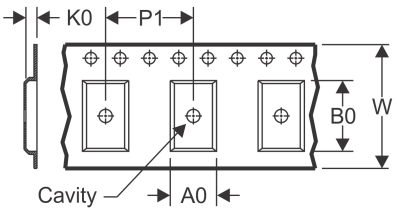
(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

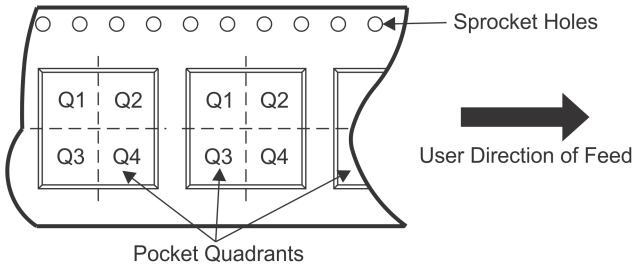


TAPE DIMENSIONS



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

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

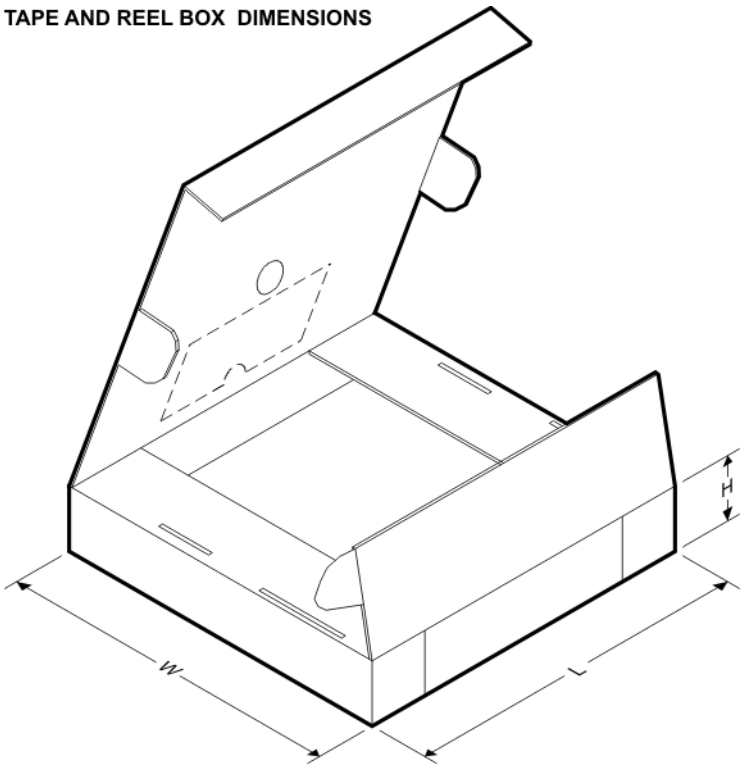


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS73001DBVR	SOT-23	DBV	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73001DBVR	SOT-23	DBV	6	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS73001DBVT	SOT-23	DBV	6	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73018DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73018DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73025DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73025DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73025YZQR	DSBGA	YZQ	5	3000	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS73025YZQT	DSBGA	YZQ	5	250	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS730285DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS730285DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73028DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73028DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73028YZQR	DSBGA	YZQ	5	3000	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS73028YZQT	DSBGA	YZQ	5	250	178.0	8.4	0.98	1.46	0.69	4.0	8.0	Q1
TPS73030DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73030DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73033DBVR	SOT-23	DBV	5	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3

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
TPS73033DBVT	SOT-23	DBV	5	250	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
TPS73047DBVR	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS73047DBVT	SOT-23	DBV	5	250	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

TAPE AND REEL BOX DIMENSIONS

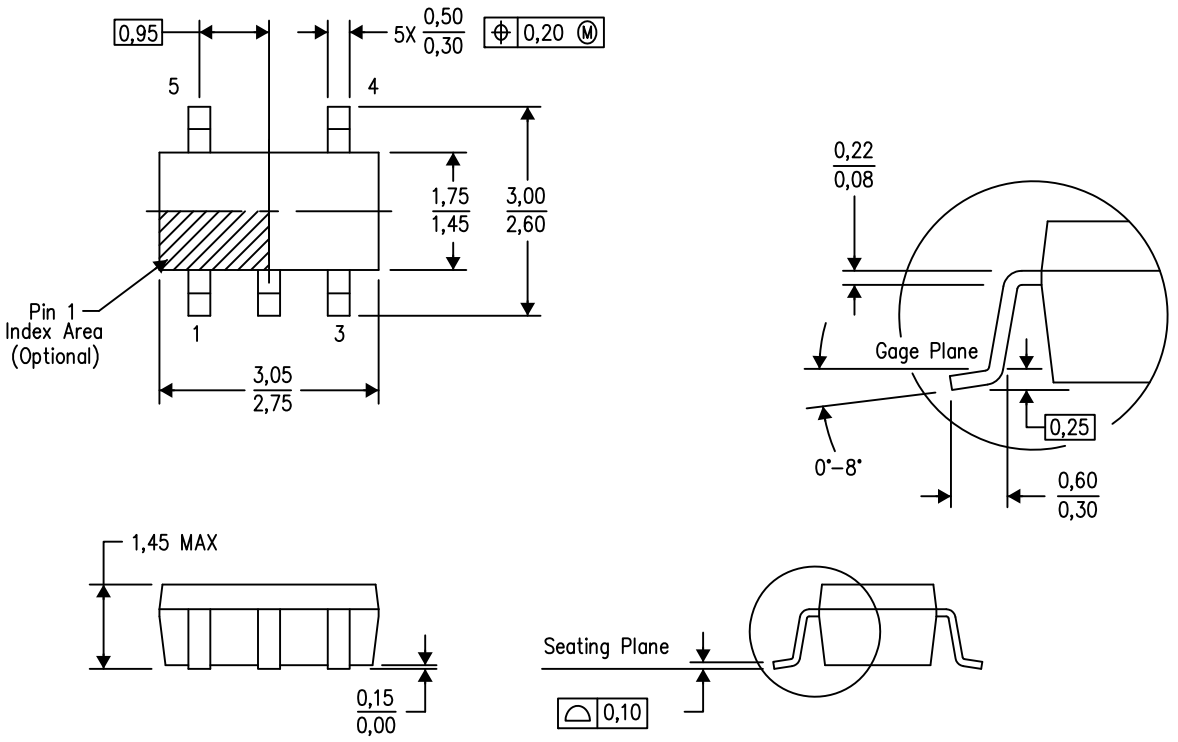


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS73001DBVR	SOT-23	DBV	6	3000	180.0	180.0	18.0
TPS73001DBVR	SOT-23	DBV	6	3000	203.0	203.0	35.0
TPS73001DBVT	SOT-23	DBV	6	250	180.0	180.0	18.0
TPS73018DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS73018DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS73025DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS73025DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS73025YZQR	DSBGA	YZQ	5	3000	217.0	193.0	35.0
TPS73025YZQT	DSBGA	YZQ	5	250	217.0	193.0	35.0
TPS730285DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS730285DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS73028DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS73028DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS73028YZQR	DSBGA	YZQ	5	3000	217.0	193.0	35.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS73028YZQT	DSBGA	YZQ	5	250	217.0	193.0	35.0
TPS73030DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS73030DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS73033DBVR	SOT-23	DBV	5	3000	180.0	180.0	18.0
TPS73033DBVT	SOT-23	DBV	5	250	180.0	180.0	18.0
TPS73047DBVR	SOT-23	DBV	5	3000	203.0	203.0	35.0
TPS73047DBVT	SOT-23	DBV	5	250	203.0	203.0	35.0

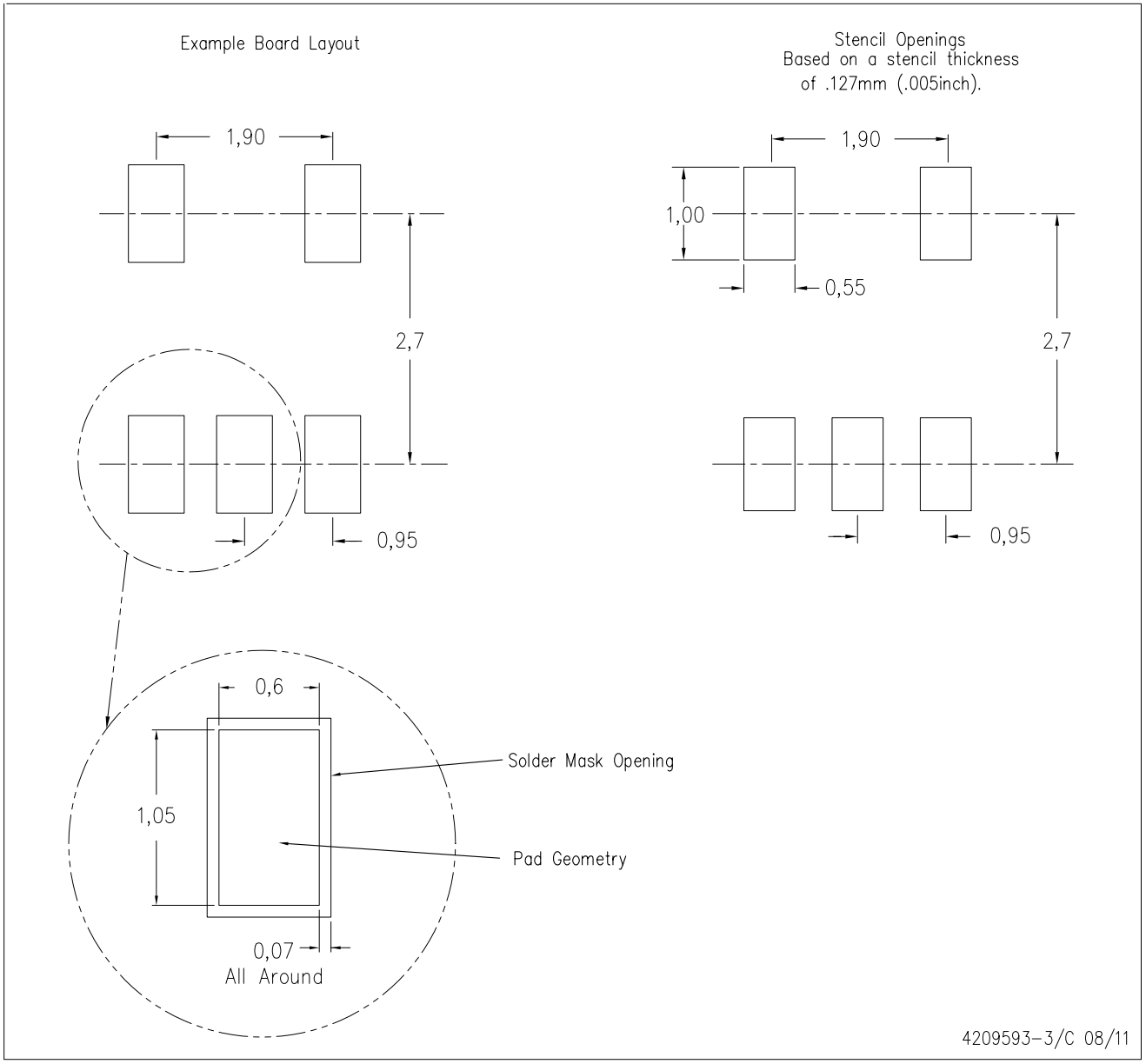
DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE



4073253–4/N 12/14

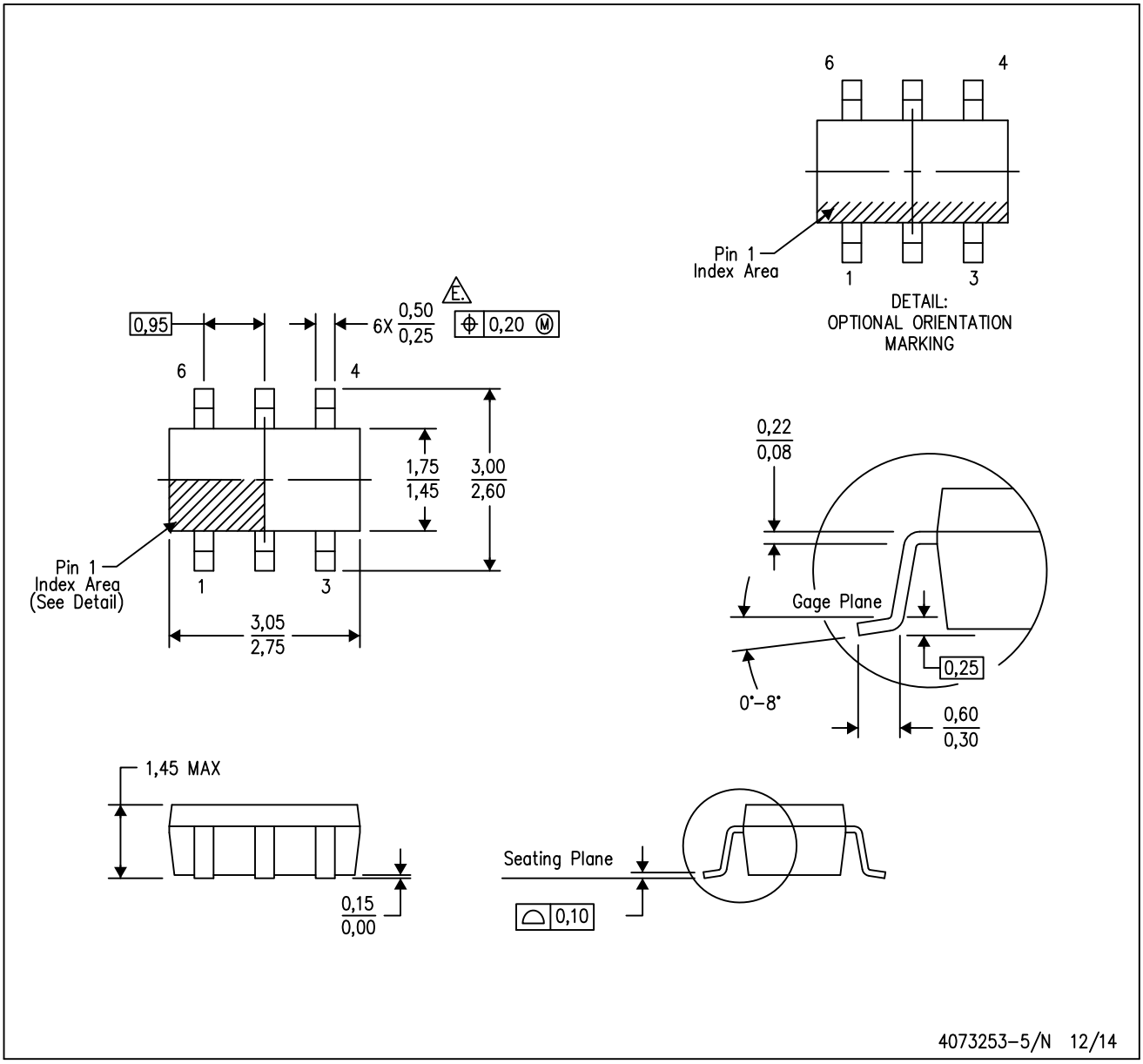
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

DBV (R–PDSO–G5) PLASTIC SMALL OUTLINE



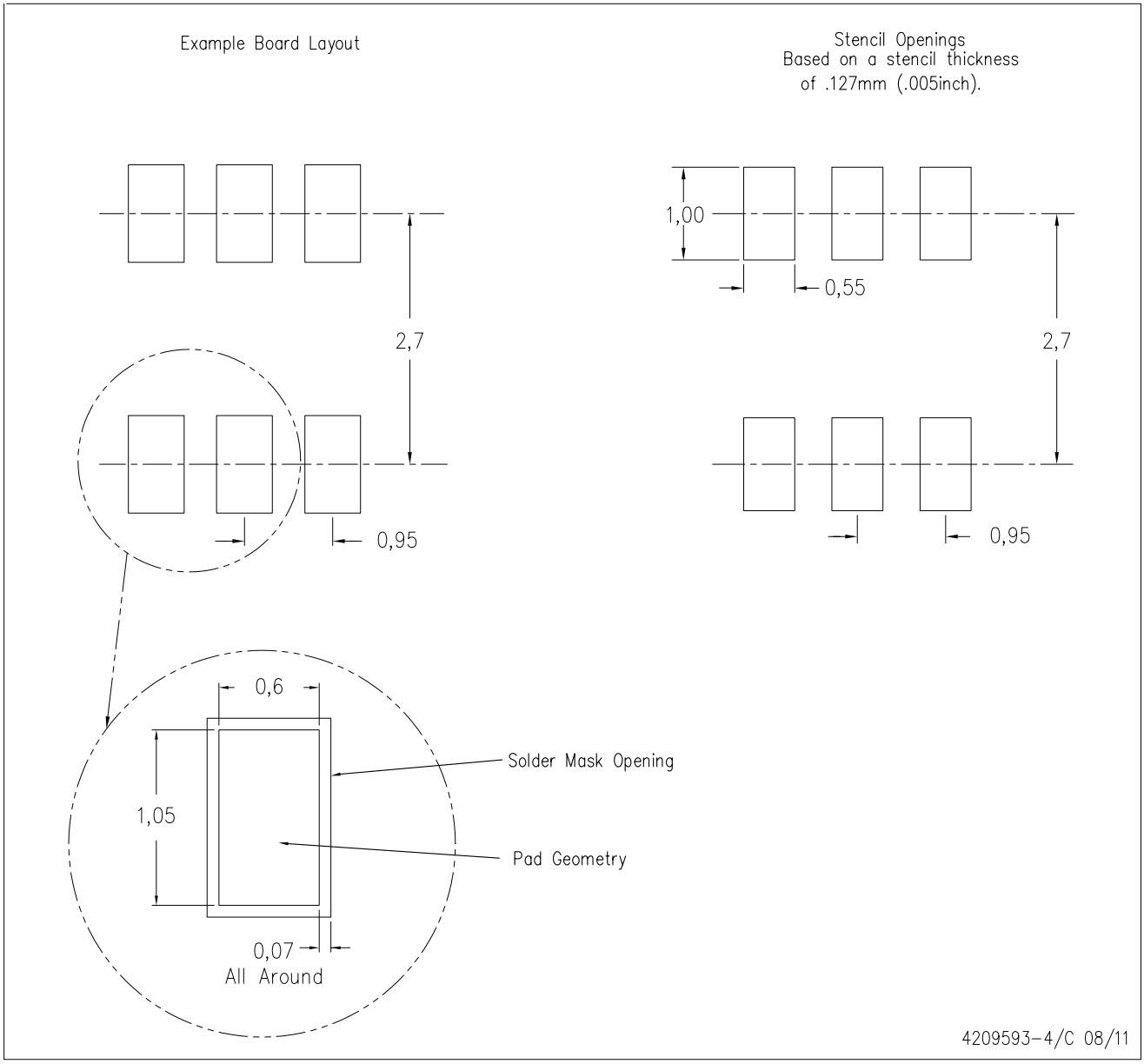
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting 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



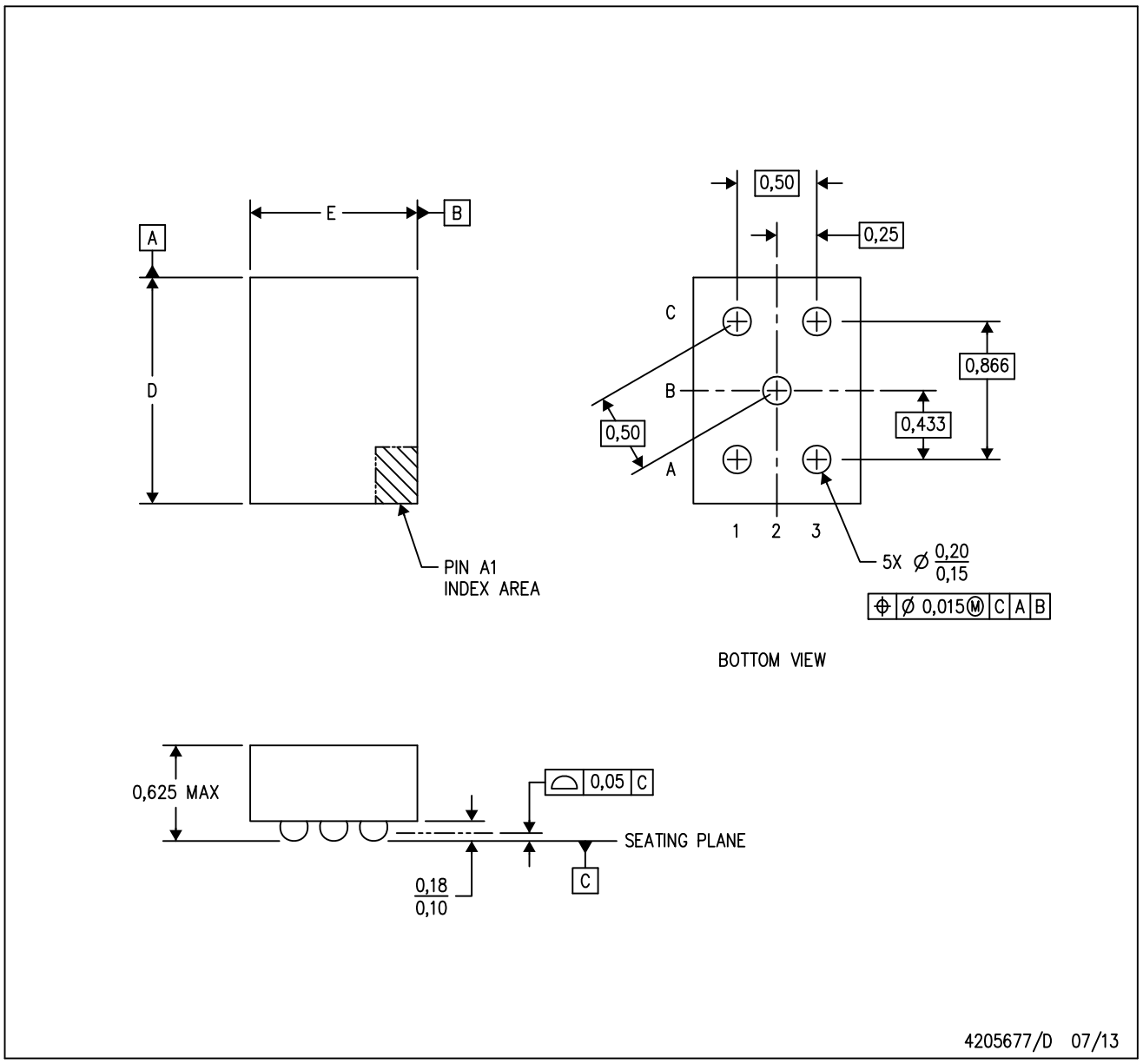
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Leads 1,2,3 may be wider than leads 4,5,6 for package orientation.
E. Falls 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.

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.

NanoFree is a trademark of Texas Instruments.

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