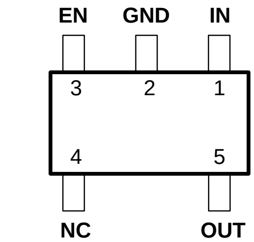
- **100-mA Low-Dropout Regulator**
- **Fixed Output Voltage Options: 5 V, 3.8 V, 3.3 V, 3.2 V, and 3 V**
- **Dropout Typically 170 mV at 100-mA**
- **Thermal Protection**
- **Less Than 1 μA Quiescent Current in Shutdown**
- **–40°C to 125°C Operating Junction Temperature Range**
- **5-Pin SOT-23 (DBV) Package**
- **ESD Protection Verified to 1.5 KV Human Body Model (HBM) per MIL-STD-883C**

DBV PACKAGE
(TOP VIEW)



NC – No internal connection

description

The TPS761xx is a 100 mA, low dropout (LDO) voltage regulator designed specifically for battery-powered applications. A proprietary BiCMOS fabrication process allows the TPS761xx to provide outstanding performance in all specifications critical to battery-powered operation.

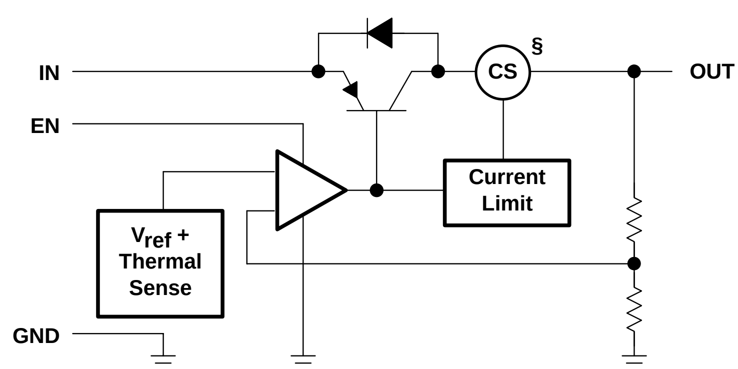
The TPS761xx is available in a space-saving SOT-23 (DBV) package and operates over a junction temperature range of –40°C to 125°C.

AVAILABLE OPTIONS

T_J	VOLTAGE	PACKAGE	PART NUMBER		SYMBOL
–40°C to 125°C	3 V	SOT-23 (DBV)	TPS76130DBVR†	TPS76130DBVT‡	PAEI
	3.2 V		TPS76132DBVR†	TPS76132DBVT‡	PAFI
	3.3 V		TPS76133DBVR†	TPS76133DBVT‡	PAII
	3.8 V		TPS76138DBVR†	TPS76138DBVT‡	PAKI
	5 V		TPS76150DBVR†	TPS76150DBVT‡	PALI

† The DBVR passive indicates tape and reel of 3000 parts.
‡ The DBVT passive indicates tape and reel of 250 parts.

functional block diagram



§ Current sense

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.

Terminal Functions

TERMINAL NAME	TERMINAL NO.	I/O	DESCRIPTION
EN	3	I	Enable input
GND	2		Ground
IN	1	I	Input voltage
NC	4		No connection
OUT	5	O	Regulated output voltage

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Input voltage range, V_I (see Note 1) . . . . –0.3 V to 16 V
Voltage range at EN . . . . –0.3 V to V_I + 0.3 V
Peak output current . . . . internally limited
Continuous total dissipation . . . . See Dissipation Rating Table
Operating junction temperature range, T_J . . . . –40°C to 150°C
Storage temperature range, T_{stg} . . . . –65°C to 150°C
ESD rating, HBM . . . . 1.5 kV

† 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.

NOTE 1: All voltages are with respect to device GND pin.

DISSIPATION RATING 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‡	DBV	65.8 °C/W	259 °C/W	3.9 mW/°C	386 mW	212 mW	154 mW
High K§	DBV	65.8 °C/W	180 °C/W	5.6 mW/°C	555 mW	305 mW	222 mW

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

recommended operating conditions

		MIN	NOM	MAX	UNIT
Input voltage, V_I	TPS76130	3.35		16	V
	TPS76132	3.58		16	
	TPS76133	3.68		16	
	TPS76138	4.18		16	
	TPS76150	5.38		16	
Continuous output current, I_O		0		100	mA
Operating junction temperature, T_J		–40		125	°C

electrical characteristics over recommended operating free-air temperature range, $V_I = V_{O(typ)} + 1$ V, $I_O = 1$ mA, EN = V_I, $C_o = 4.7$ μF (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage	TPS76130	T_J = 25°C		2.96	3	3.04	V
			T_J = 25°C,	1 mA < I_O < 100 mA	2.9		3.04	
			1 mA < I_O < 100 mA		2.89		3.07	
		TPS76132	T_J = 25°C		3.16	3.2	3.24	V
			T_J = 25°C,	1 mA < I_O < 100 mA	3.11		3.24	
			1 mA < I_O < 100 mA		3.08		3.3	
		TPS76133	T_J = 25°C		3.26	3.3	3.34	V
			T_J = 25°C,	1 mA < I_O < 100 mA	3.21		3.34	
			1 mA < I_O < 100 mA		3.18		3.4	
		TPS76138	T_J = 25°C		3.76	3.8	3.84	V
			T_J = 25°C,	1 mA < I_O < 100 mA	3.71		3.84	
			1 mA < I_O < 100 mA		3.68		3.9	
		TPS76150	T_J = 25°C		4.95	5	5.05	V
			T_J = 25°C,	1 mA < I_O < 100 mA	4.88		5.05	
			1 mA < I_O < 100 mA		4.86		5.1	
$I_{I(standby)}$	Standby current		EN = 0 V				1	μA
	Quiescent current (GND current)		I_O = 0 mA,	T_J = 25°C		90	115	μA
			I_O = 0 mA				130	
			I_O = 1 mA,	T_J = 25°C		100	130	
			I_O = 1 mA				170	
			I_O = 10 mA,	T_J = 25°C		190	220	
			I_O = 10 mA				260	
			I_O = 50 mA,	T_J = 25°C		850	1100	
			I_O = 50 mA				1200	
			I_O = 100 mA,	T_J = 25°C		2600	3600	
			I_O = 100 mA				4000	
	Input regulation	TPS76130	4 V < V_I < 16,	I_O = 1 mA		3	10	mV
		TPS76132	4.2 V < V_I < 16,	I_O = 1 mA		3	10	
		TPS76133	4.3 V < V_I < 16,	I_O = 1 mA		3	10	
		TPS76138	4.8 V < V_I < 16,	I_O = 1 mA		3	10	
		TPS76150	6 V < V_I < 16	I_O = 1 mA		3	10	
V_n	Output noise voltage		BW = 300 Hz to 50 kHz	C_o = 10 μF, T_J = 25°C		190		μVrms
	Ripple rejection		f = 1 kHz, C_o = 10 μF,	T_J = 25°C		63		dB

electrical characteristics over recommended operating free-air temperature range, $V_I = V_{O(typ)} + 1$ V, $I_O = 1$ mA, EN = V_I, $C_o = 4.7\ \mu F$ (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
	Dropout voltage	$I_O = 0$ mA,	$T_J = 25°C$		1	3	mV
		$I_O = 0$ mA				5	
		$I_O = 1$ mA,	$T_J = 25°C$		7	10	
		$I_O = 1$ mA				15	
		$I_O = 10$ mA,	$T_J = 25°C$		40	60	
		$I_O = 10$ mA				90	
		$I_O = 50$ mA,	$T_J = 25°C$		120	150	
		$I_O = 50$ mA				180	
		$I_O = 100$ mA,	$T_J = 25°C$		170	240	
		$I_O = 100$ mA				280	
	Peak output current/current limit			100	125	135	mA
	High level enable input			2			V
	Low level enable input					0.8	V
I_I	Input current (EN)	EN = 0 V		–1	0	1	μA
		EN = V_I			2.5	5	

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
V_O	Output voltage	vs Output current	1, 2, 3
		vs Free-air temperature	4, 5, 6
	Ground current	vs Free-air temperature	7, 8, 9
	Output noise	vs Frequency	10
Z_o	Output impedance	vs Frequency	11
V_{DO}	Dropout voltage	vs Free-air temperature	12
	Line transient response		13, 15
	Load transient response		14, 16

TYPICAL CHARACTERISTICS

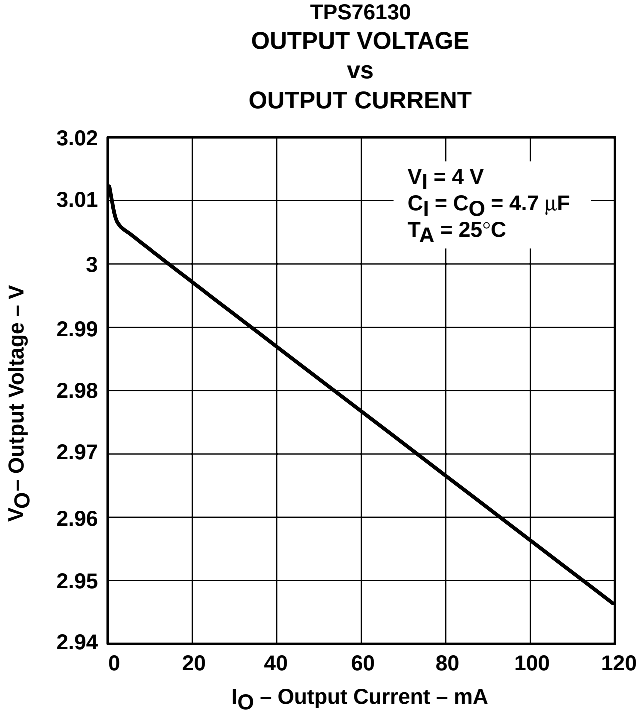


Figure 1

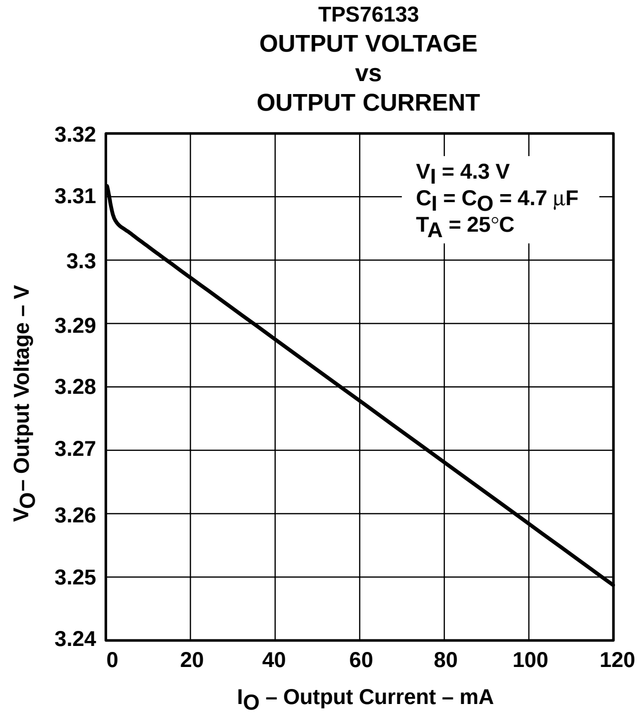


Figure 2

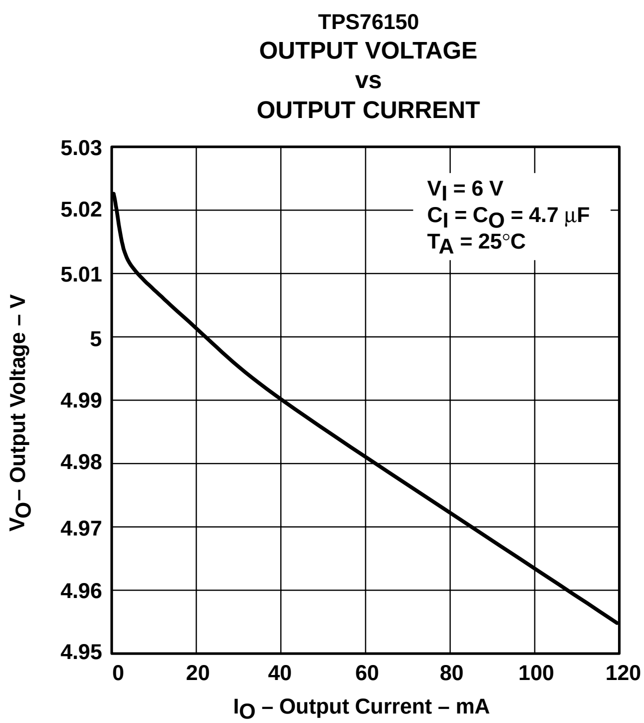


Figure 3

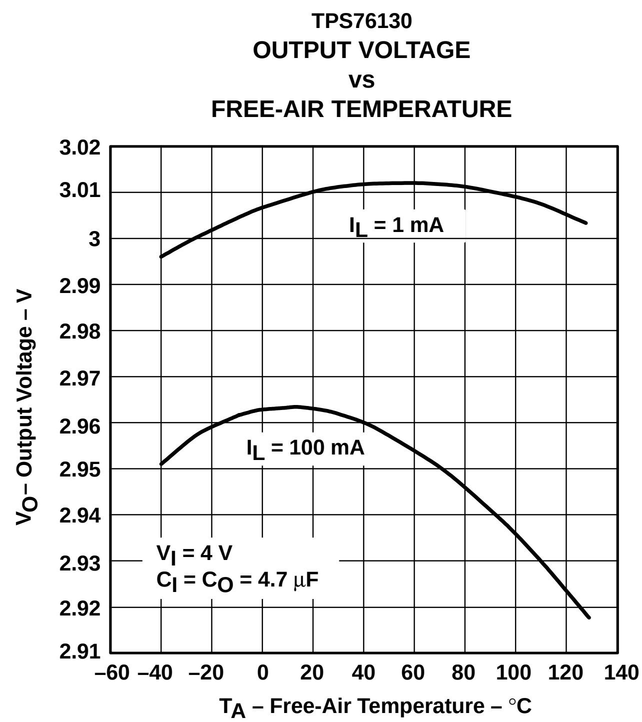


Figure 4

TYPICAL CHARACTERISTICS

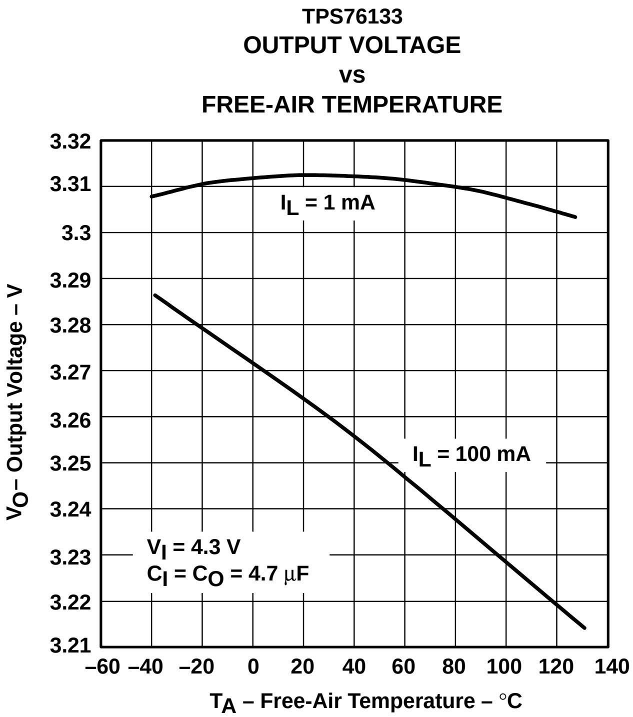


Figure 5

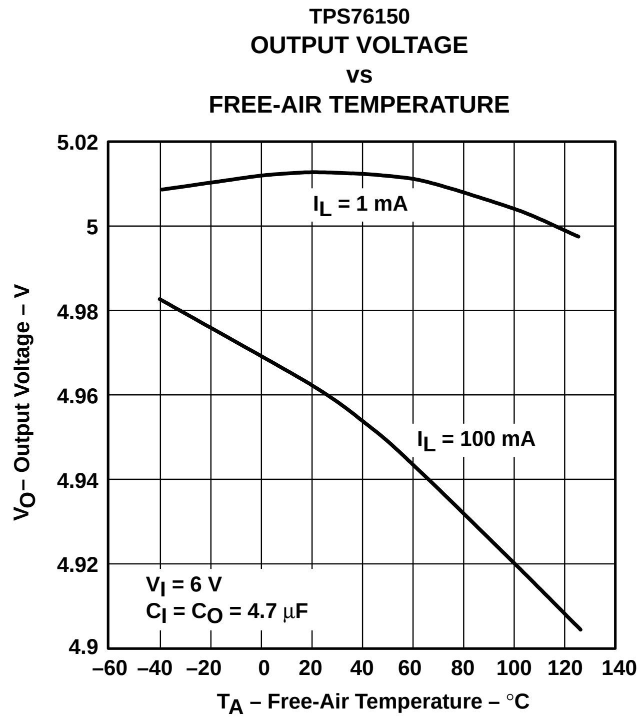


Figure 6

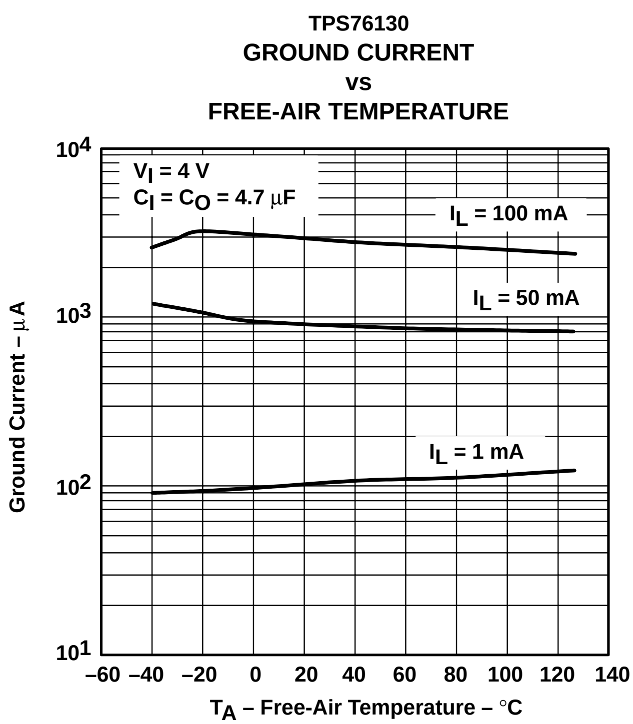


Figure 7

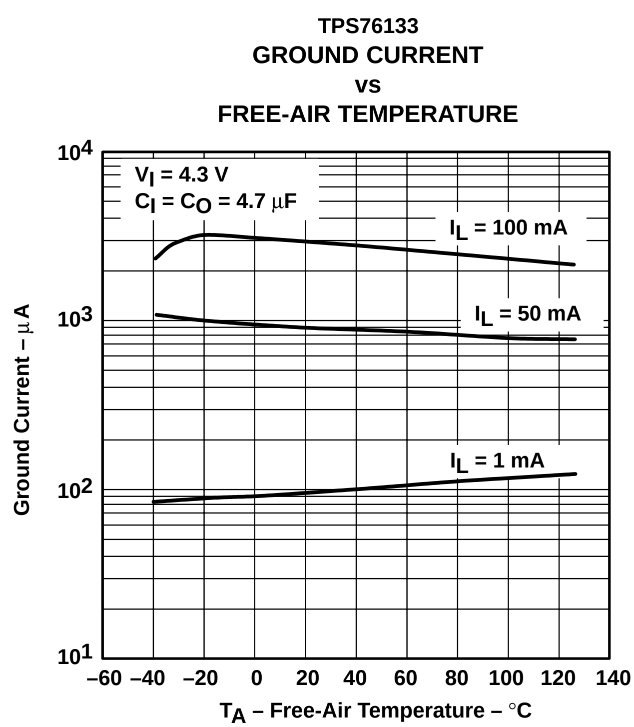


Figure 8

TYPICAL CHARACTERISTICS

TPS76150
GROUND CURRENT
vs
FREE-AIR TEMPERATURE

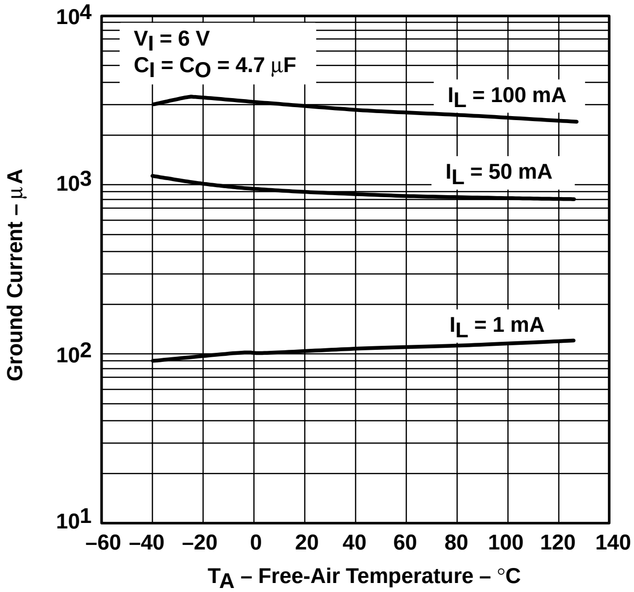


Figure 9

OUTPUT NOISE
vs
FREQUENCY

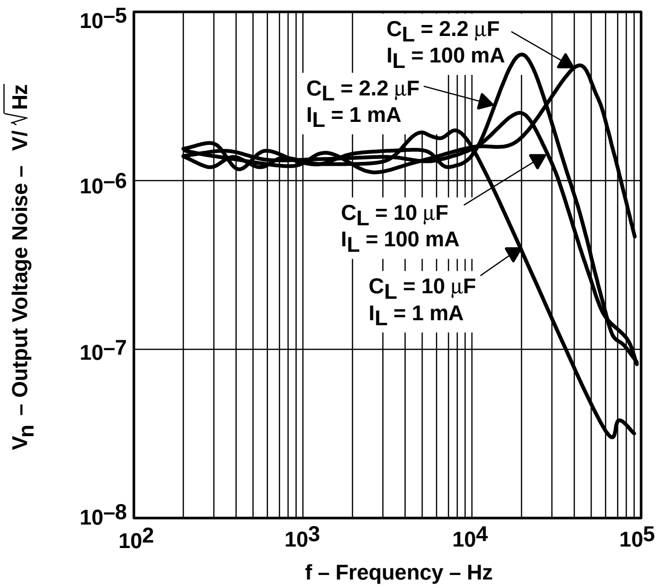


Figure 10

OUTPUT IMPEDANCE
vs
FREQUENCY

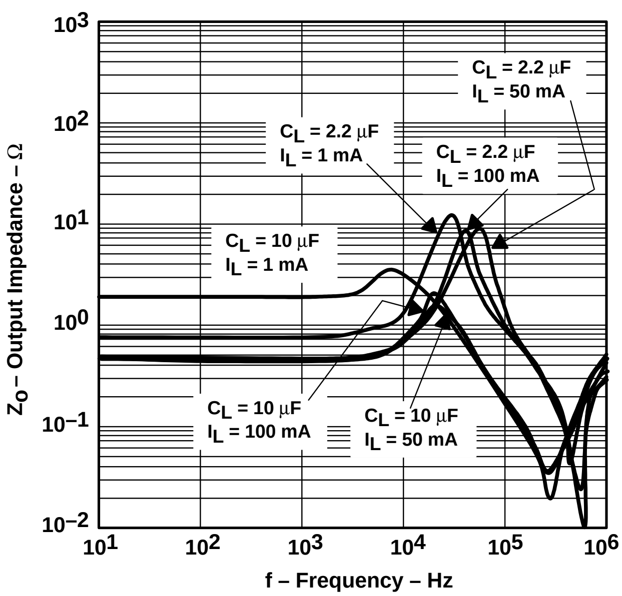


Figure 11

TPS76130
DROPOUT VOLTAGE
vs
FREE-AIR TEMPERATURE

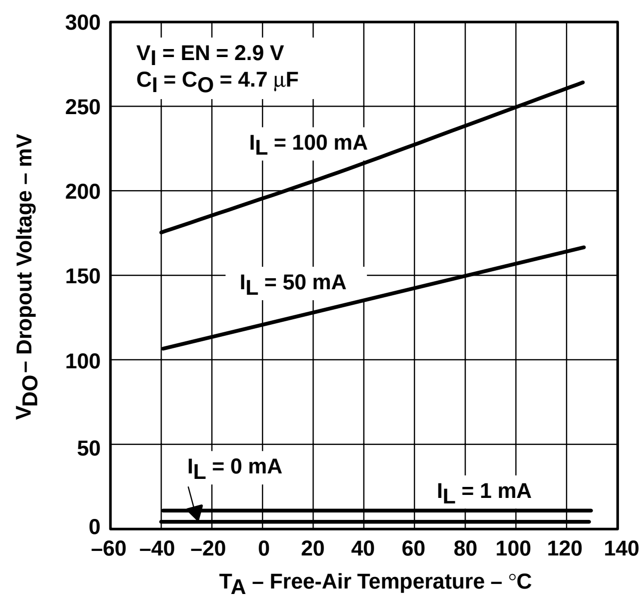


Figure 12

TYPICAL CHARACTERISTICS

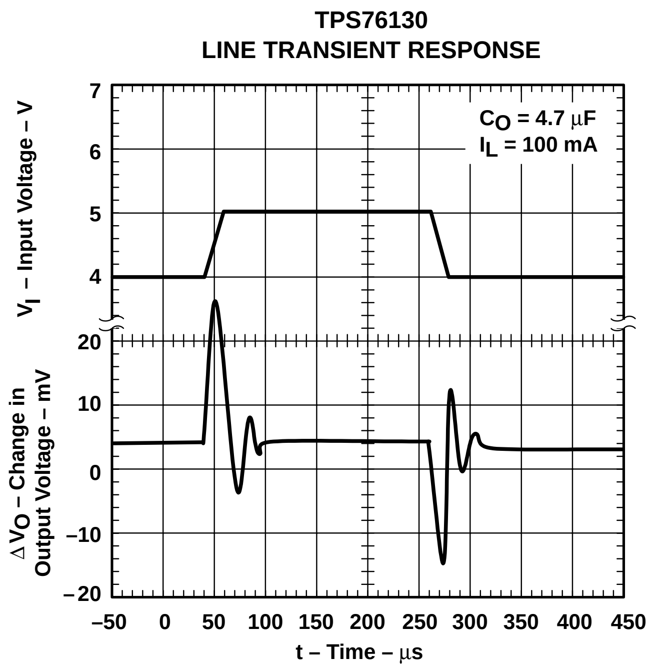


Figure 13

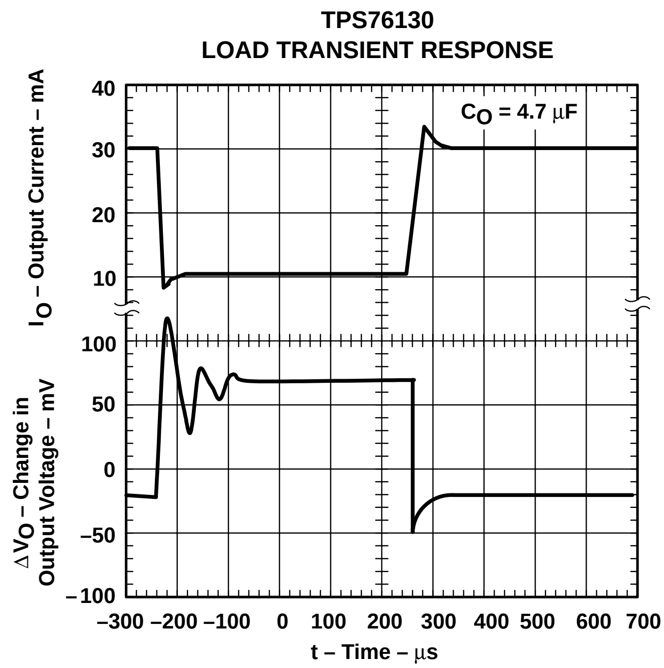


Figure 14

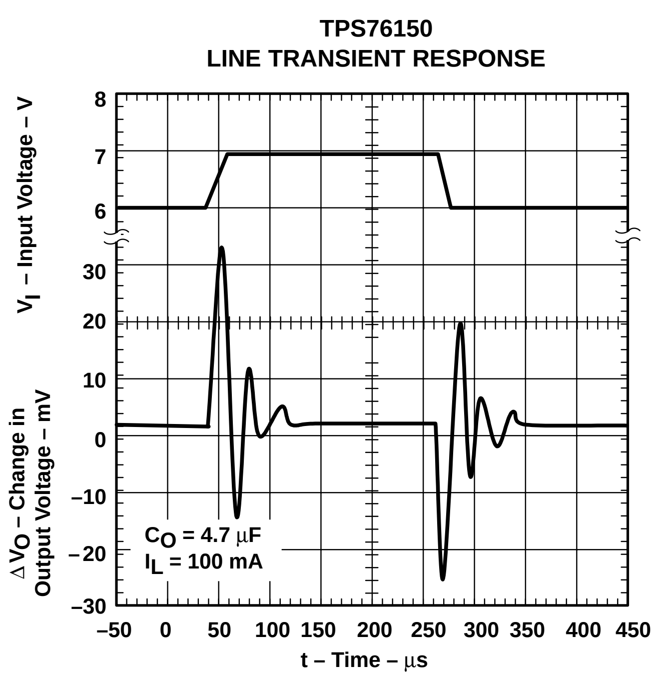


Figure 15

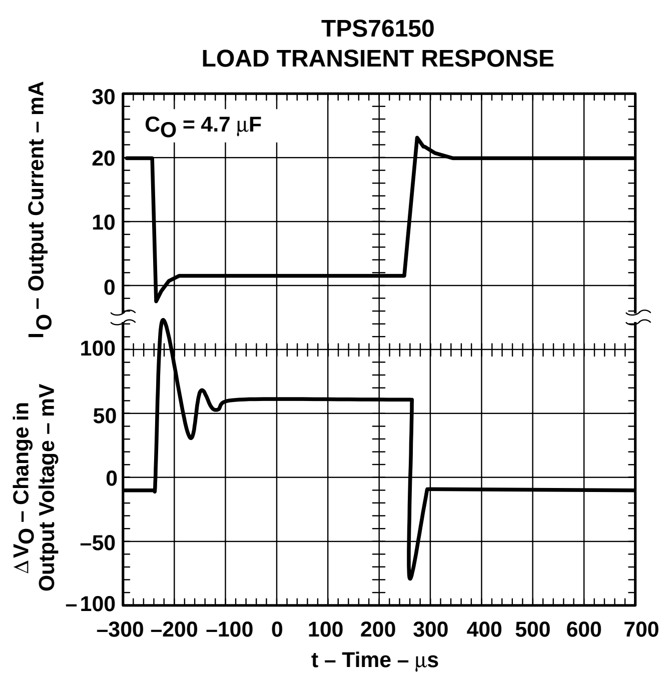


Figure 16

APPLICATION INFORMATION

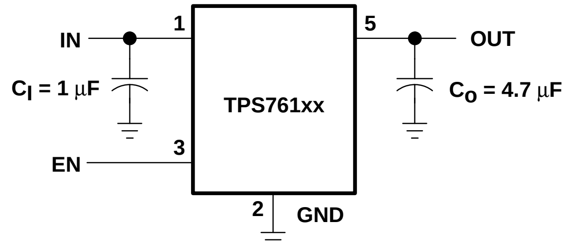


Figure 17. TPS761xx Typical Application

over current protection

The over current protection circuit forces the TPS761xx into a constant current output mode when the load is excessive or the output is shorted to ground. Normal operation resumes when the fault condition is removed.

NOTE:
An overload or short circuit may also activate the over temperature protection if the fault condition persists.

over temperature protection

The thermal protection system shuts the TPS761xx down when the junction temperature exceeds 160°C. The device recovers and operates normally when the temperature drops below 150°C.

input capacitor

A 1-µF or larger ceramic decoupling capacitor with short leads connected between IN and GND is recommended. The decoupling capacitor may be omitted if there is a 1 µF or larger electrolytic capacitor connected between IN and GND and located reasonably close to the TPS761xx. However, the small ceramic device is desirable even when the larger capacitor is present, if there is a lot of high frequency noise present in the system.

output capacitor

Like all low dropout regulators, the TPS761xx requires an output capacitor connected between OUT and GND to stabilize the internal control loop. The minimum recommended capacitance value is 4.7 µF and the ESR (equivalent series resistance) must be between 0.1 Ω and 10 Ω. Solid tantalum electrolytic, aluminum electrolytic, and multilayer ceramic capacitors are all suitable, provided they meet the requirements described above. Most of the commercially available 4.7-µF surface-mount solid-tantalum capacitors, including devices from Sprague, Kemet, and Nichicon, meet the ESR requirements stated above. Multilayer ceramic capacitors should have minimum values of 4.7 µF over the full operating temperature range of the equipment.

enable (EN)

A logic zero on the enable input shuts the TPS761xx off and reduces the supply current to less than 1 µA. Pulling the enable input high causes normal operation to resume. If the enable feature is not used, EN should be connected to IN to keep the regulator on all of the time. The EN input must not be left floating.

reverse current path

The power transistor used in the TPS761xx has an inherent diode connected between IN and OUT as shown in the functional block diagram. This diode conducts current from the OUT terminal to the IN terminal whenever IN is lower than OUT by a diode drop. This condition does not damage the TPS761xx provided the current is limited to 150 mA.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TPS76130DBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	PAEI
TPS76130DBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	PAEI
TPS76132DBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	PAFI
TPS76132DBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	PAFI
TPS76133DBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	PAII
TPS76133DBVT	Obsolete	Production	SOT-23 (DBV) | 5	-	-	Call TI	Call TI	-40 to 125	PAII
TPS76138DBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | SN | NIPDAU	Level-1-260C-UNLIM	-40 to 125	PAKI
TPS76138DBVT	Active	Production	SOT-23 (DBV) | 5	250 | SMALL T&R	Yes	NIPDAU | SN | NIPDAU	Level-1-260C-UNLIM	-40 to 125	PAKI
TPS76150DBVR	Active	Production	SOT-23 (DBV) | 5	3000 | LARGE T&R	Yes	NIPDAU | NIPDAU	Level-1-260C-UNLIM	-40 to 125	PALI
TPS76150DBVT	Obsolete	Production	SOT-23 (DBV) | 5	-	-	Call TI	Call TI	-40 to 125	PALI

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

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

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

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

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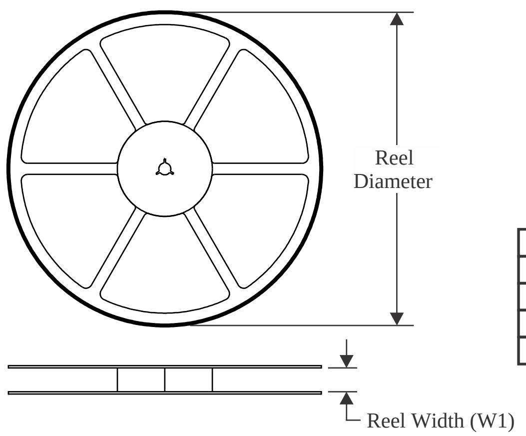
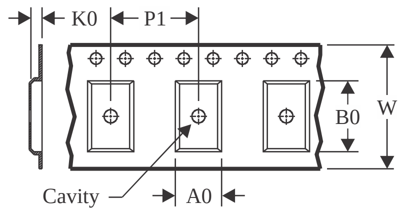
TAPE AND REEL INFORMATION

REEL DIMENSIONS

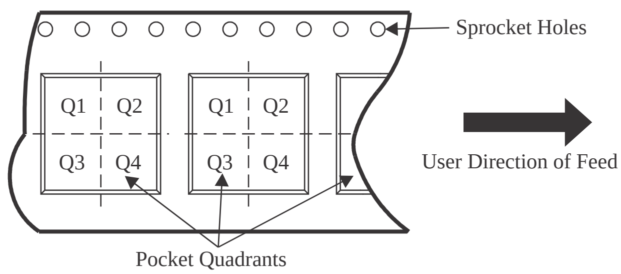


TAPE DIMENSIONS



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

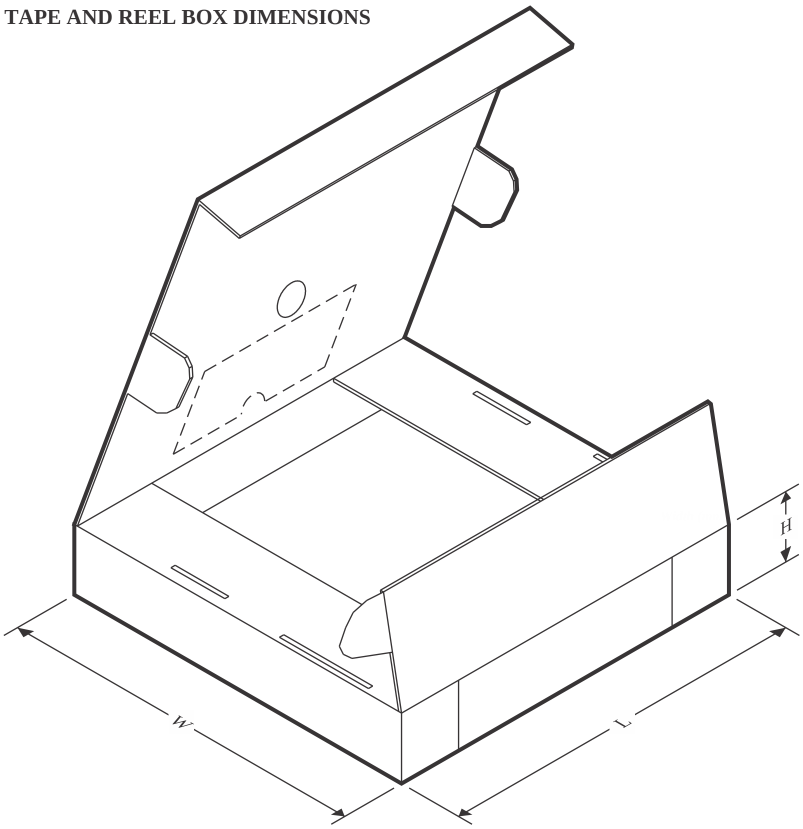
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS76130DBVR	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS76130DBVT	SOT-23	DBV	5	250	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS76132DBVR	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS76132DBVT	SOT-23	DBV	5	250	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS76133DBVR	SOT-23	DBV	5	3000	180.0	9.0	3.15	3.2	1.4	4.0	8.0	Q3
TPS76138DBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS76138DBVT	SOT-23	DBV	5	250	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS76150DBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3
TPS76150DBVR	SOT-23	DBV	5	3000	180.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

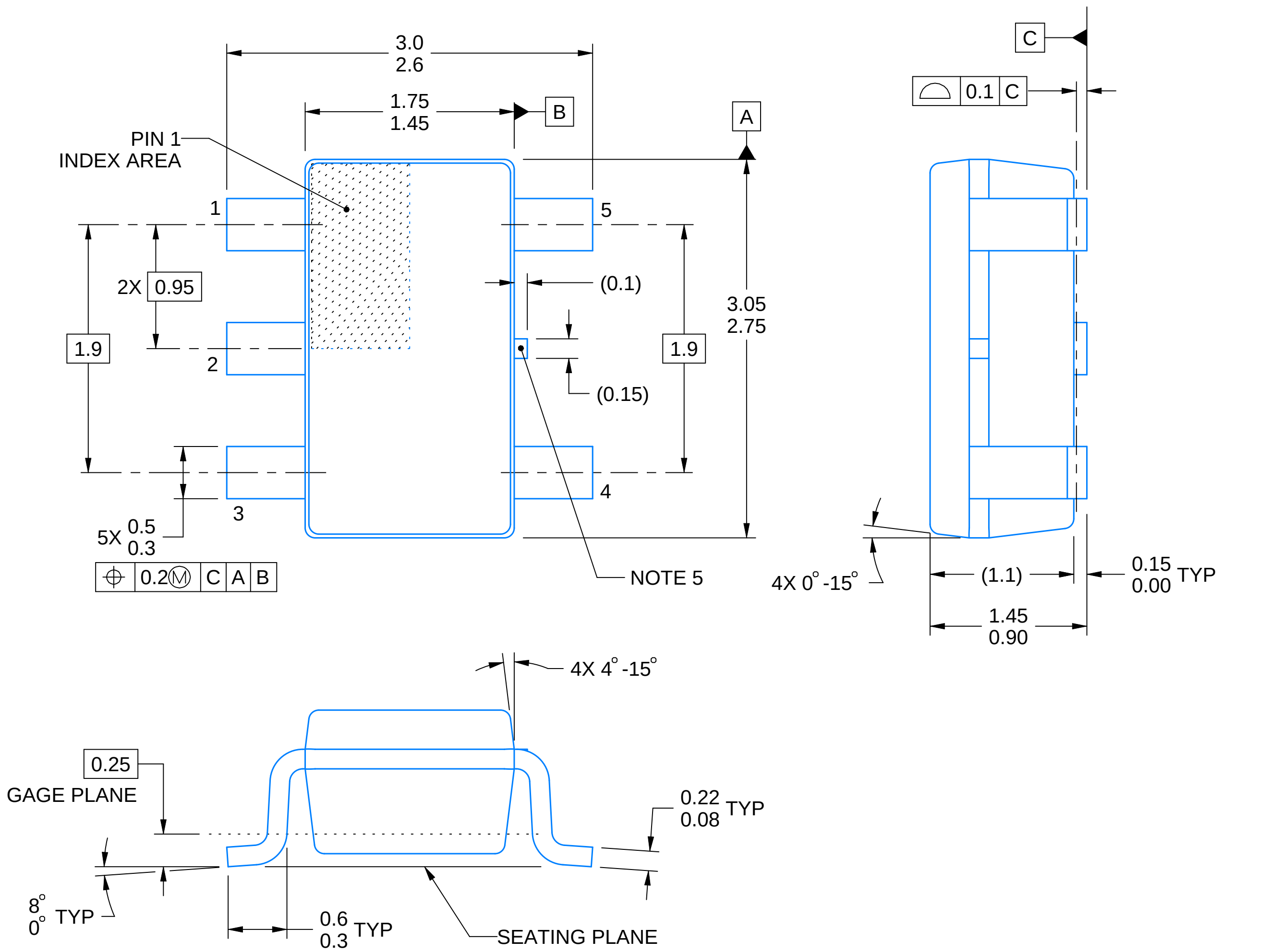
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS76130DBVR	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS76130DBVT	SOT-23	DBV	5	250	182.0	182.0	20.0
TPS76132DBVR	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS76132DBVT	SOT-23	DBV	5	250	182.0	182.0	20.0
TPS76133DBVR	SOT-23	DBV	5	3000	182.0	182.0	20.0
TPS76138DBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TPS76138DBVT	SOT-23	DBV	5	250	210.0	185.0	35.0
TPS76150DBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0
TPS76150DBVR	SOT-23	DBV	5	3000	210.0	185.0	35.0

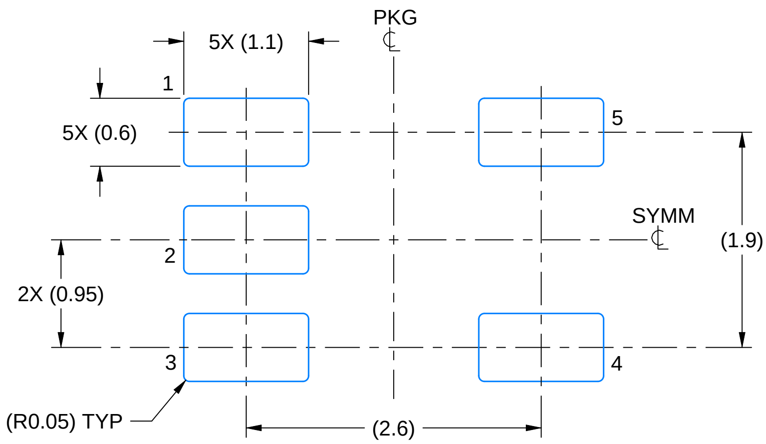
SMALL OUTLINE TRANSISTOR



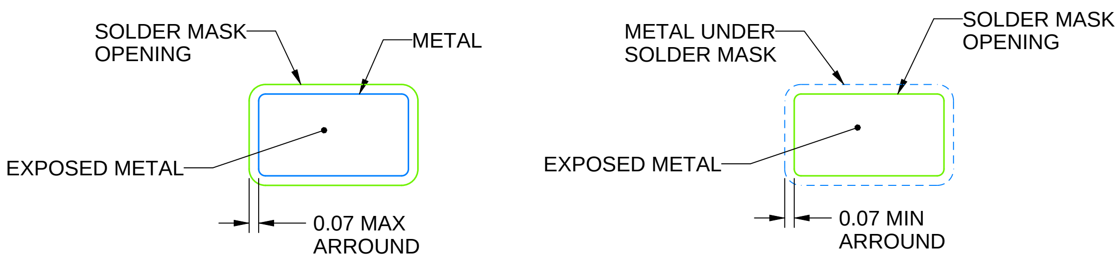
4214839/K 08/2024

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Refernce JEDEC MO-178.
4. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.
5. Support pin may differ or may not be present.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



NON SOLDER MASK DEFINED (PREFERRED)

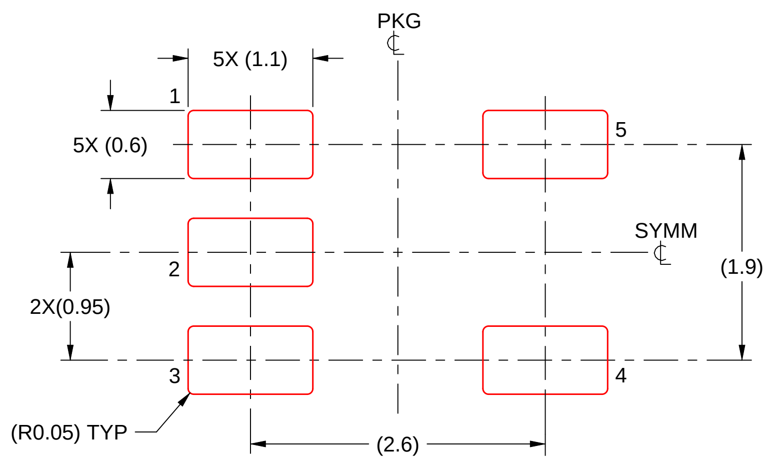
SOLDER MASK DEFINED

SOLDER MASK DETAILS

4214839/K 08/2024

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:15X

4214839/K 08/2024

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

IMPORTANT NOTICE AND DISCLAIMER

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265