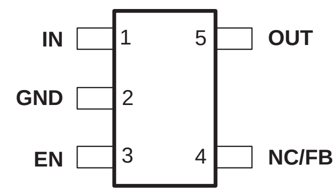
TPS76301, TPS76316, TPS76318, TPS76325, TPS76327 TPS76328, TPS76330, TPS76333, TPS76338, TPS76350 LOW-POWER 150-mA LOW-DROPOUT LINEAR REGULATORS

SLVS181H − DECEMBER 1998 − REVISED JANUARY 2004

- **150-mA Low-Dropout Regulator**
- **Output Voltage: 5 V, 3.8 V, 3.3 V, 3.0 V, 2.8 V, 2.7 V, 2.5 V, 1.8 V, 1.6 V and Variable**
- **Dropout Voltage, Typically 300 mV at 150 mA**
- **Thermal Protection**
- **Over Current Limitation**
- **Less Than 2-μA Quiescent Current in Shutdown Mode**
- **−40°C to 125°C Operating Junction Temperature Range**
- **5-Pin SOT-23 (DBV) Package**

DBV PACKAGE
(TOP VIEW)



description

The TPS763xx family of low-dropout (LDO) voltage regulators offers the benefits of low-dropout voltage, low-power operation, and miniaturized packaging. These regulators feature low dropout voltages and quiescent currents compared to conventional LDO regulators. Offered in a 5-terminal, small outline integrated-circuit SOT-23 package, the TPS763xx series devices are ideal for cost-sensitive designs and for applications where board space is at a premium.

A combination of new circuit design and process innovation has enabled the usual pnp pass transistor to be replaced by a PMOS pass element. Because the PMOS pass element behaves as a low-value resistor, the dropout voltage is very low—typically 300 mV at 150 mA of load current (TPS76333)—and is directly proportional to the load current. Since the PMOS pass element is a voltage-driven device, the quiescent current is very low (140 μA maximum) and is stable over the entire range of output load current (0 mA to 150 mA). Intended for use in portable systems such as laptops and cellular phones, the low-dropout voltage feature and low-power operation result in a significant increase in system battery operating life.

The TPS763xx also features a logic-enabled sleep mode to shut down the regulator, reducing quiescent current to 1 μA maximum at T_J = 25°C.The TPS763xx is offered in 1.6-V,1.8-V, 2.5-V, 2.7-V, 2.8-V, 3.0-V, 3.3-V, 3.8-V, and 5-V fixed-voltage versions and in a variable version (programmable over the range of 1.5 V to 6.5 V.

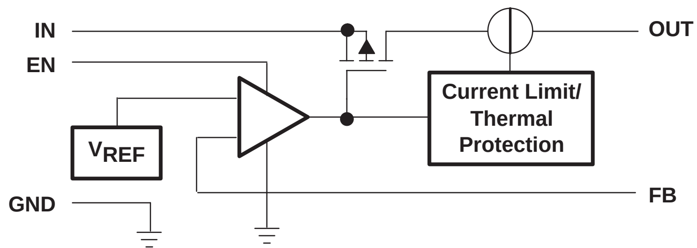
AVAILABLE OPTIONS

T_J	VOLTAGE	PACKAGE	PART NUMBER		SYMBOL
−40°C to 125°C	Variable	SOT-23 (DBV)	TPS76301DBVT(1)	TPS76301DBVR(2)	PAZI
	1.6 V		TPS76316DBVT	TPS76316DBVR	PBHI
	1.8 V		TPS76318DBVT	TPS76318DBVR	PBAI
	2.5 V		TPS76325DBVT	TPS76325DBVR	PBBI
	2.7 V		TPS76327DBVT	TPS76327DBVR	PBCI
	2.8 V		TPS76328DBVT	TPS76328DBVR	PBDI
	3.0 V		TPS76330DBVT	TPS76330DBVR	PBII
	3.3 V		TPS76333DBVT	TPS76333DBVR	PBEI
	3.8 V		TPS76338DBVT	TPS76338DBVR	PBFI
	5.0 V		TPS76350DBVT	TPS76350DBVR	PBGI

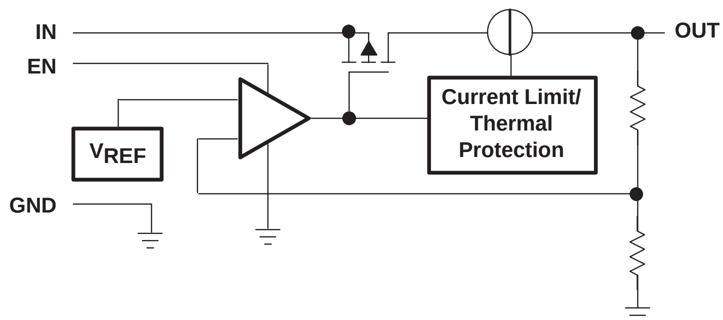
(1) The DBVT passive indicates tape and reel of 250 parts.
(2) The DBVR passive indicates tape and reel of 3000 parts.

FUNCTIONAL BLOCK DIAGRAM

TPS76301



TPS76316/ 18/ 25/ 27/ 28/ 30/ 33/ 38/ 50



Terminal Functions

TERMINAL NAME	DESCRIPTION
GND	Ground
EN	Enable input
FB	Feedback voltage (TPS76301 only)
IN	Input supply voltage
NC	No connection (fixed-voltage option only)
OUT	Regulated output voltage

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[1]

Input voltage range[2]	−0.3 V to 10 V
Voltage range at EN	−0.3 V to V_I + 0.3 V
Voltage on OUT, FB	7 V
Peak output current	Internally limited
ESD rating, HBM	2 kV
Continuous total power dissipation	See Dissipation Rating Tables
Operating junction temperature range, T_J	−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.
(2) All voltage values are with respect to network ground terminal.

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[1]	DBV	65.8 °C/W	259 °C/W	3.9 mW/°C	386 mW	212 mW	154 mW
High K[2]	DBV	65.8 °C/W	180 °C/W	5.6 mW/°C	555 mW	305 mW	222 mW

(1) 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.
(2) 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[1]	2.7		10	V
Continuous output current, I_O	0		150	mA
Operating junction temperature, T_J	−40		125	°C

(1) To calculate the minimum input voltage for your maximum output current, use the following equation:

$$V_{I(min)} = V_{O(max)} + V_{DO(max\ load)}$$

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

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage	TPS76301	3.25 V > V_I ≥ 2.7 V, 2.5 V ≥ V_O ≥ 1.5 V,	I_O = 1 mA to 75 mA, T_J = 25°C	0.98 V_O	V_O	1.02 V_O	V
			3.25 V > V_I ≥ 2.7 V, 2.5 V ≥ V_O ≥ 1.5 V	I_O = 1 mA to 75 mA,	0.97 V_O	V_O	1.03 V_O	
			V_I ≥ 3.25 V, 5 V ≥ V_O ≥ 1.5 V	I_O = 1 mA to 100 mA, T_J = 25°C	0.98 V_O	V_O	1.02 V_O	
			V_I ≥ 3.25 V, 5 V ≥ V_O ≥ 1.5 V	I_O = 1 mA to 100 mA,	0.97 V_O	V_O	1.03 V_O	
			V_I ≥ 3.25 V, 5 V ≥ V_O ≥ 1.5 V	I_O = 1 mA to 150 mA, T_J = 25°C	0.975 V_O	V_O	1.025 V_O	
			V_I ≥ 3.25 V, 5 V ≥ V_O ≥ 1.5 V	I_O = 1 mA to 150 mA,	0.9625 V_O	V_O	1.0375 V_O	
		TPS76316	V_I = 2.7 V,	1 mA< I_O < 75 mA, T_J = 25°C	1.568	1.6	1.632	V
			V_I = 2.7 V,	1 mA< I_O < 75 mA	1.552	1.6	1.648	
			V_I = 3.25 V,	1 mA < I_O < 100 mA, T_J = 25°C	1.568	1.6	1.632	
			V_I = 3.25 V,	1 mA < I_O < 100 mA	1.552	1.6	1.648	
			V_I = 3.25 V,	1 mA < I_O < 150 mA, T_J = 25°C	1.560	1.6	1.640	
			V_I = 3.25 V,	1 mA < I_O < 150 mA	1.536	1.6	1.664	
		TPS76318	V_I = 2.7 V,	1 mA< I_O < 75 mA, T_J = 25°C	1.764	1.8	1.836	V
			V_I = 2.7 V,	1 mA< I_O < 75 mA	1.746	1.8	1.854	
			V_I = 3.25 V,	1 mA < I_O < 100 mA, T_J = 25°C	1.764	1.8	1.836	
			V_I = 3.25 V,	1 mA < I_O < 100 mA	1.746	1.8	1.854	
			V_I = 3.25 V,	1 mA < I_O < 150 mA, T_J = 25°C	1.755	1.8	1.845	
			V_I = 3.25 V,	1 mA < I_O < 150 mA	1.733	1.8	1.867	
		TPS76325	I_O = 1 mA to 100 mA,	T_J = 25°C	2.45	2.5	2.55	V
			I_O = 1 mA to 100 mA		2.425	2.5	2.575	
			I_O = 1 mA to 150 mA,	T_J = 25°C	2.438	2.5	2.562	
			I_O = 1 mA to 150 mA		2.407	2.5	2.593	
		TPS76327	I_O = 1 mA to 100 mA,	T_J = 25°C	2.646	2.7	2.754	V
			I_O = 1 mA to 100 mA		2.619	2.7	2.781	
			I_O = 1 mA to 150 mA,	T_J = 25°C	2.632	2.7	2.767	
			I_O = 1 mA to 150 mA		2.599	2.7	2.801	
		TPS76328	I_O = 1 mA to 100 mA,	T_J = 25°C	2.744	2.8	2.856	V
			I_O = 1 mA to 100 mA		2.716	2.8	2.884	
			I_O = 1 mA to 150 mA,	T_J = 25°C	2.73	2.8	2.87	
			I_O = 1 mA to 150 mA		2.695	2.8	2.905	
		TPS76330	I_O = 1 mA to 100 mA,	T_J = 25°C	2.94	3.0	3.06	V
			I_O = 1 mA to 100 mA		2.91	3.0	3.09	
			I_O = 1 mA to 150 mA,	T_J = 25°C	2.925	3.0	3.075	
			I_O = 1 mA to 150 mA		2.888	3.0	3.112	

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

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage	TPS76333	I_O = 1 mA to 100 mA,	T_J = 25°C	3.234	3.3	3.366	V
			I_O = 1 mA to 100 mA		3.201	3.3	3.399	
			I_O = 1 mA to 150 mA,	T_J = 25°C	3.218	3.3	3.382	
			I_O = 1 mA to 150 mA		3.177	3.3	3.423	
		TPS76338	I_O = 1 mA to 100 mA,	T_J = 25°C	3.724	3.8	3.876	V
			I_O = 1 mA to 100 mA		3.705	3.8	3.895	
			I_O = 1 mA to 150 mA,	T_J = 25°C	3.686	3.8	3.914	
			I_O = 1 mA to 150 mA		3.667	3.8	3.933	
		TPS76350	I_O = 1 mA to 100 mA,	T_J = 25°C	4.875	5	5.125	V
			I_O = 1 mA to 100 mA		4.825	5	5.175	
			I_O = 1 mA to 150 mA,	T_J = 25°C	4.750	5	5.15	
			I_O = 1 mA to 150 mA		4.80	5	5.20	
$I_{(Q)}$	Quiescent current (GND terminal current)		I_O = 0 to 150 mA,	T_J = 25°C (1)		85	100	µA
			I_O = 0 to 150 mA	(2)			140	
	Standby current		EN < 0.5 V,	T_J = 25°C		0.5	1	
			EN < 0.5 V				2	
V_n	Output noise voltage		BW = 300 Hz to 50 kHz, T_J = 25°C,	C_o = 10 µF (2)		140		µV
PSRR	Ripple rejection		f = 1 kHz, C_o = 10 µF,	T_J = 25°C (2)		60		dB
	Current limit		T_J = 25°C	(3)	0.5	0.8	1.5	A
	Output voltage line regulation ($\Delta V_O/V_O$) (see Note 3)		V_O + 1 V < V_I ≤ 10 V,	V_I ≥ 3.5 V, T_J = 25°C		0.04	0.07	%/V
			V_O + 1 V < V_I ≤ 10 V,	V_I ≥ 3.5 V			0.1	
V_{IH}	EN high level input		(2)			1.4	2	V
V_{IL}	EN low level input		(2)		0.5	1.2		
I_I	EN input current		EN = 0 V			−0.01	−0.5	µA
			EN = IN			−0.01	−0.5	

(1) Minimum IN operating voltage is 2.7 V or $V_{O(typ)}$ + 1 V, whichever is greater.
(2) Test condition includes, output voltage V_O=0 volts (for variable device FB is shorted to V_O), and pulse duration = 10 mS.
(3) If V_O < 2.5 V and V_{Imax} = 10 V, V_{Imin} = 3.5 V:

$$\text{Line Reg. (mV)} = (\%/V) \times \frac{V_O\left(V_{Imax} - 3.5\ V\right)}{100} \times 1000$$

If V_O > 2.5 V and V_{Imax} = 10 V, V_{Imin} = V_O + 1 V:

$$\text{Line Reg. (mV)} = (\%/V) \times \frac{V_O\left(V_{Imax} - \left(V_O + 1\right)\right)}{100} \times 1000$$

TEXAS INSTRUMENTS
www.ti.com

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

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{DO}	Dropout voltage	TPS76325	I_O = 0 mA,	T_J = 25°C		0.2		mV
			I_O = 1 mA,	T_J = 25°C		3		
			I_O = 50 mA,	T_J = 25°C		120	150	
			I_O = 50 mA				200	
			I_O = 75 mA,	T_J = 25°C		180	225	
			I_O = 75 mA				300	
			I_O = 100 mA,	T_J = 25°C		240	300	
			I_O = 100 mA				400	
			I_O = 150 mA,	T_J = 25°C		360	450	
			I_O = 150 mA				600	
		TPS76333	I_O = 0 mA,	T_J = 25°C		0.2		mV
			I_O = 1 mA,	T_J = 25°C		3		
			I_O = 50 mA,	T_J = 25°C		100	125	
			I_O = 50 mA				166	
			I_O = 75 mA,	T_J = 25°C		150	188	
			I_O = 75 mA				250	
			I_O = 100 mA,	T_J = 25°C		200	250	
			I_O = 100 mA				333	
			I_O = 150 mA,	T_J = 25°C		300	375	
			I_O = 150 mA				500	
		TPS76350	I_O = 0 mA,	T_J = 25°C		0.2		mV
			I_O = 1 mA,	T_J = 25°C		2		
			I_O = 50 mA,	T_J = 25°C		60	75	
			I_O = 50 mA				100	
			I_O = 75 mA,	T_J = 25°C		90	113	
			I_O = 75 mA				150	
			I_O = 100 mA,	T_J = 25°C		120	150	
			I_O = 100 mA				200	
			I_O = 150 mA,	T_J = 25°C		180	225	
			I_O = 150 mA				300	

TYPICAL CHARACTERISTICS

TPS76325
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

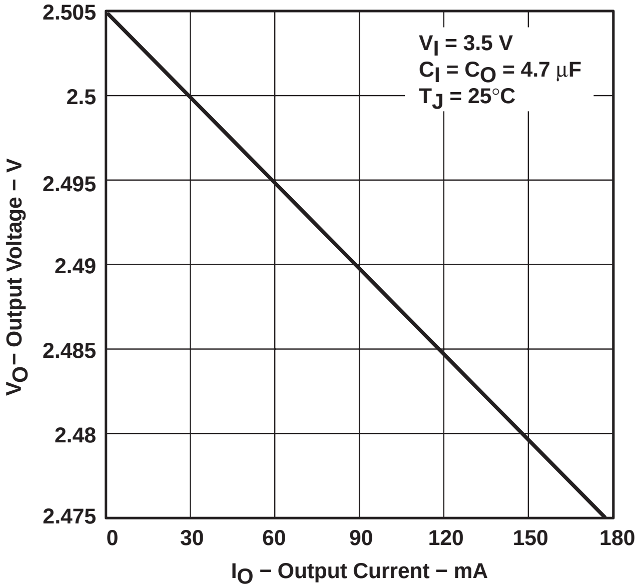


Figure 1

TPS76318
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

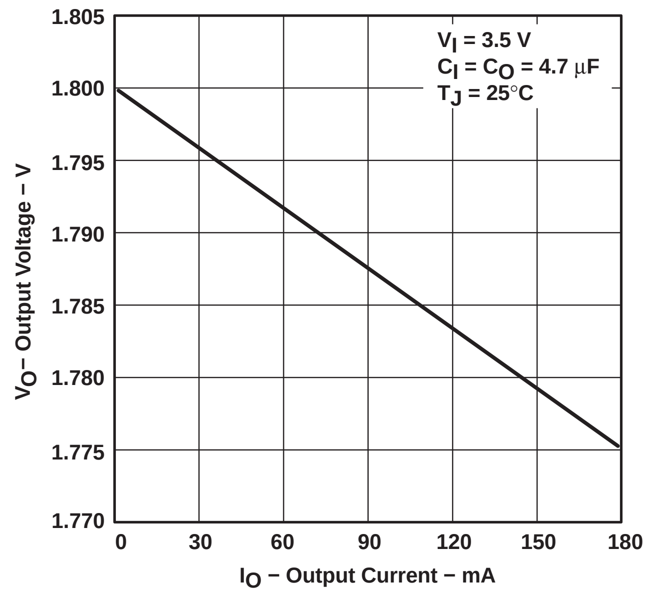


Figure 2

TPS76350
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

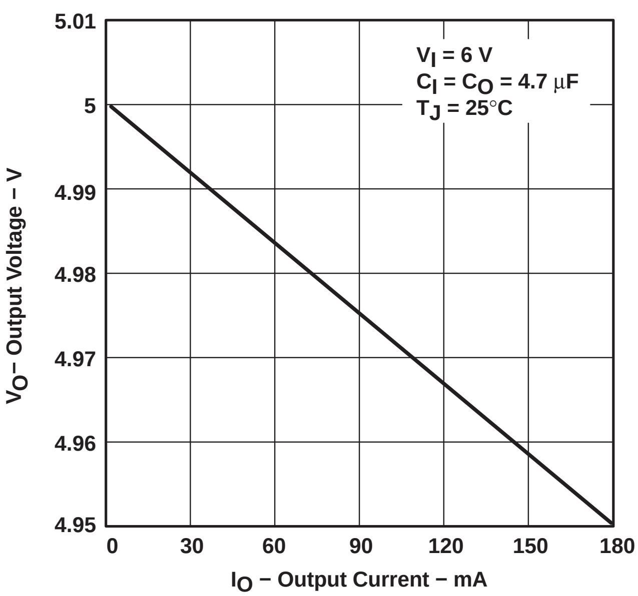


Figure 3

TPS76325
OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

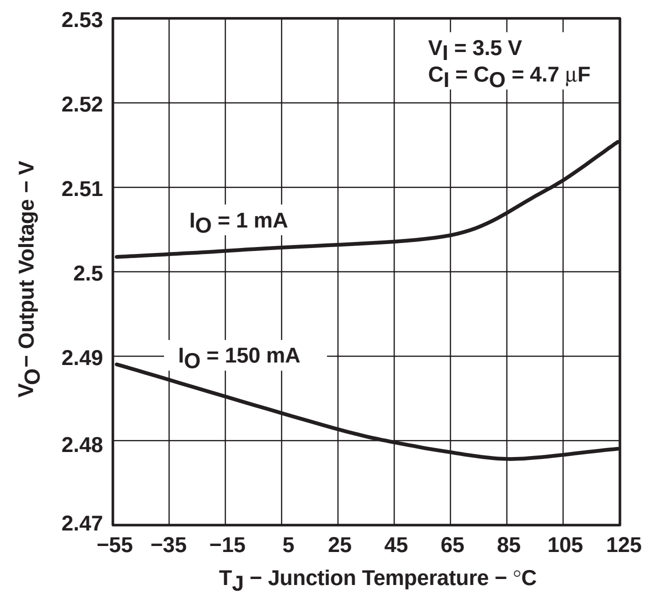


Figure 4

TYPICAL CHARACTERISTICS

TPS76318
OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

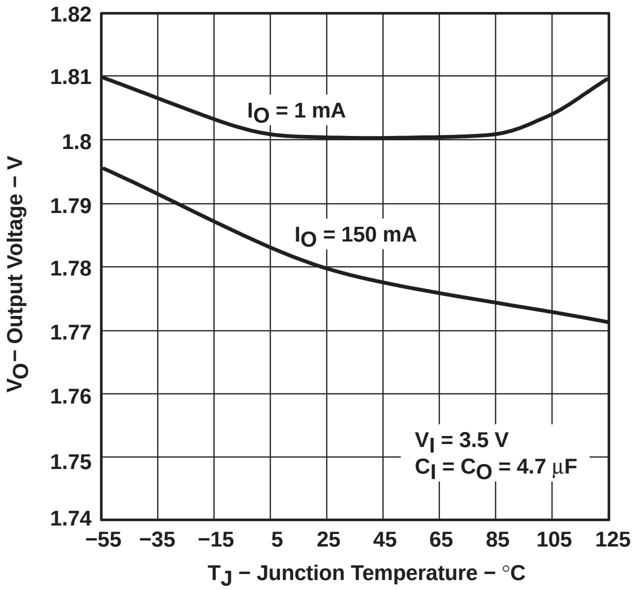


Figure 5

TPS76350
OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

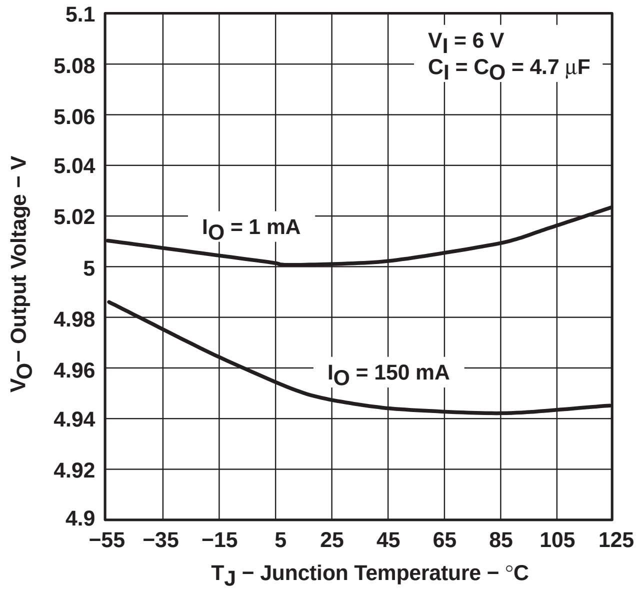


Figure 6

TPS76350
GROUND CURRENT
vs
FREE-AIR TEMPERATURE

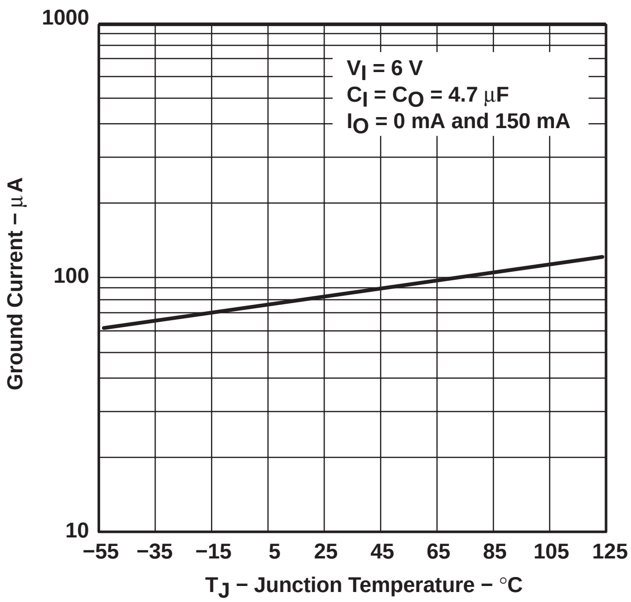


Figure 7

OUTPUT NOISE
vs
FREQUENCY

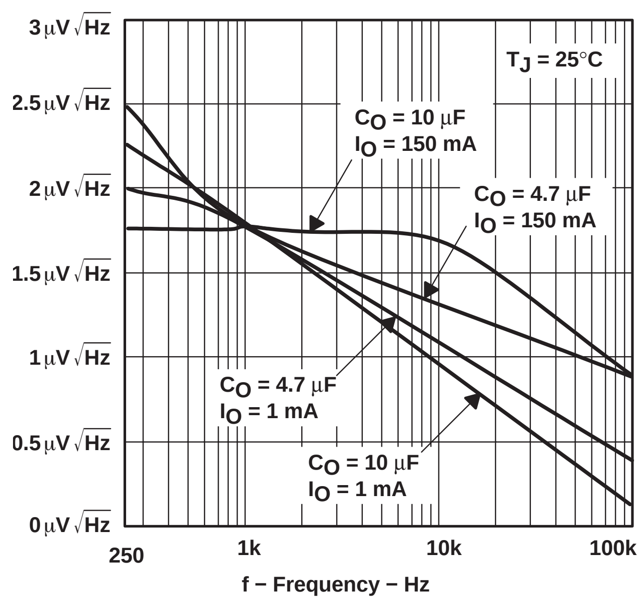


Figure 8

TYPICAL CHARACTERISTICS

OUTPUT IMPEDANCE
vs
FREQUENCY

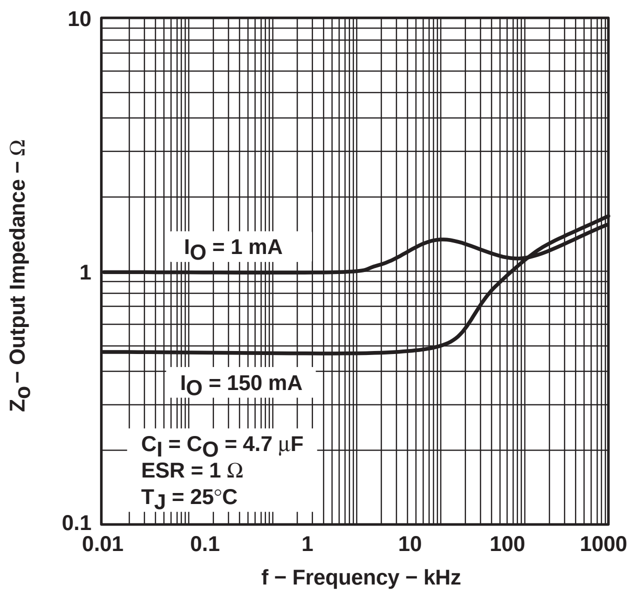


Figure 9

TPS76325
DROPOUT VOLTAGE
vs
FREE-AIR TEMPERATURE

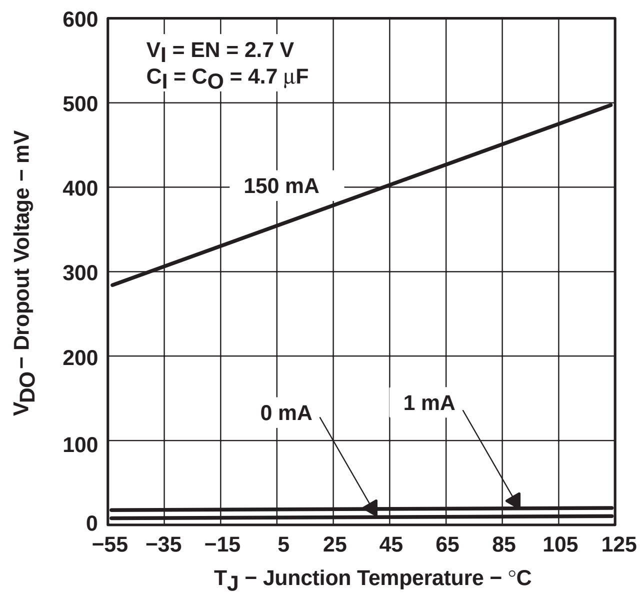


Figure 10

TPS76325
RIPPLE REJECTION
vs
FREQUENCY

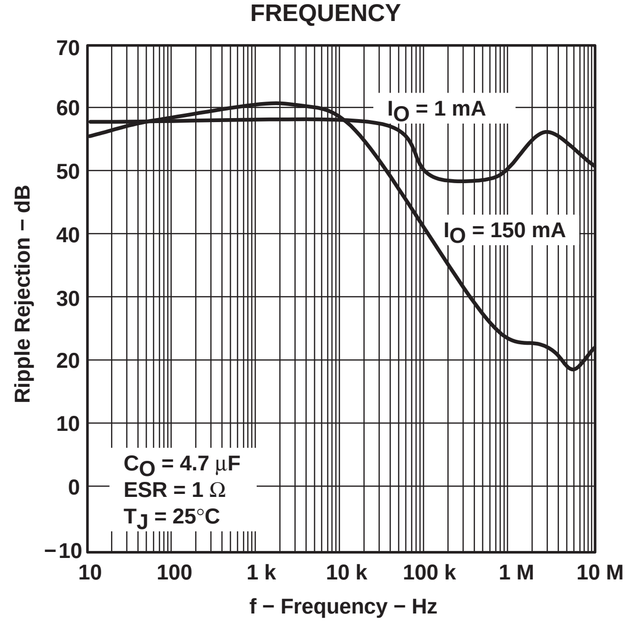


Figure 11

TYPICAL CHARACTERISTICS

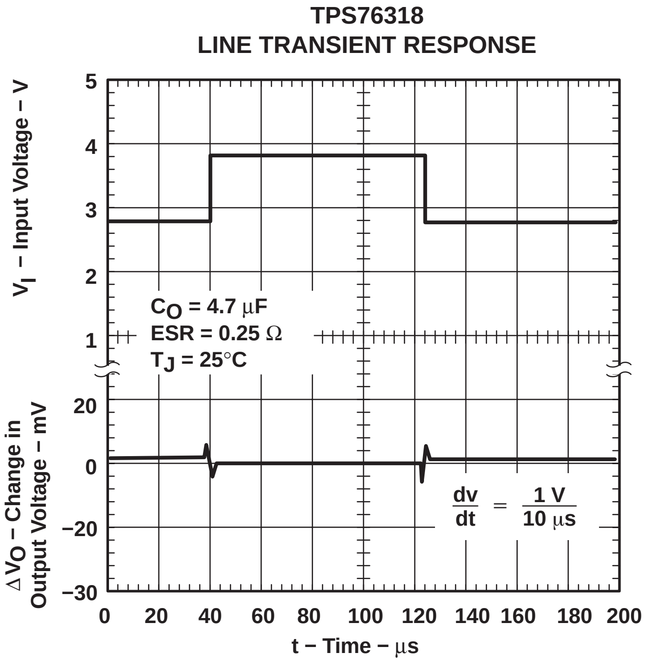


Figure 12

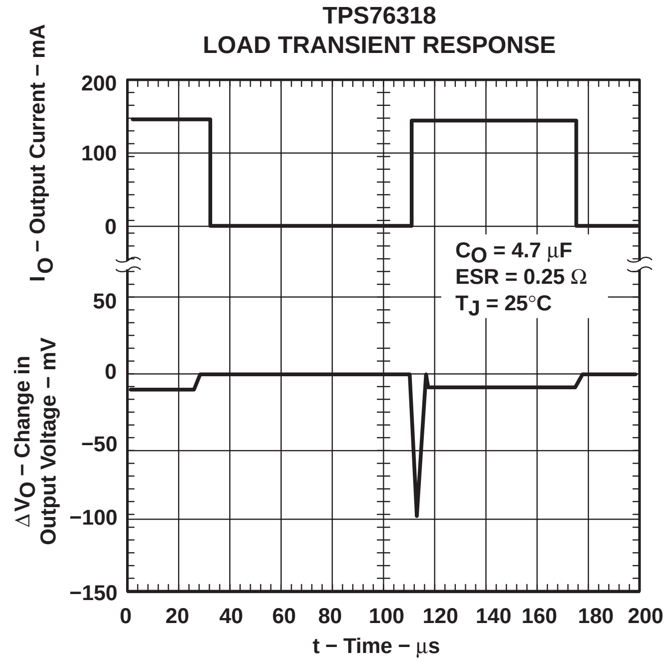


Figure 13

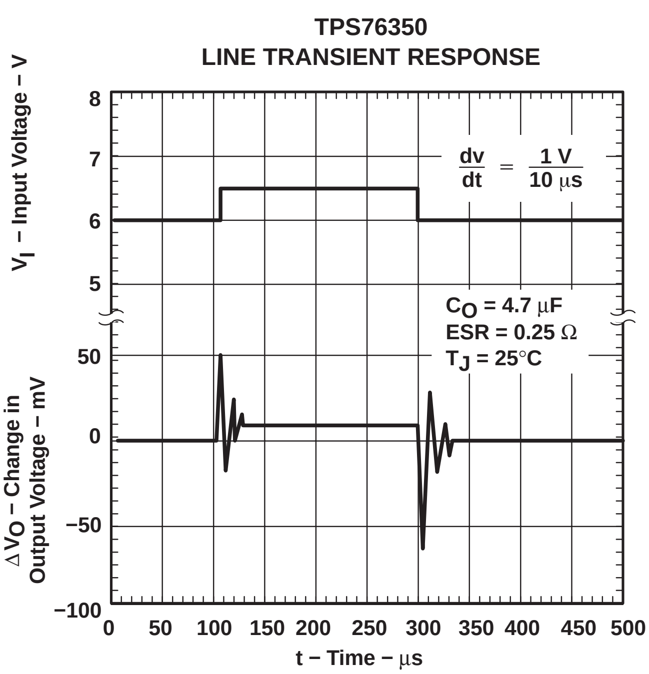


Figure 14

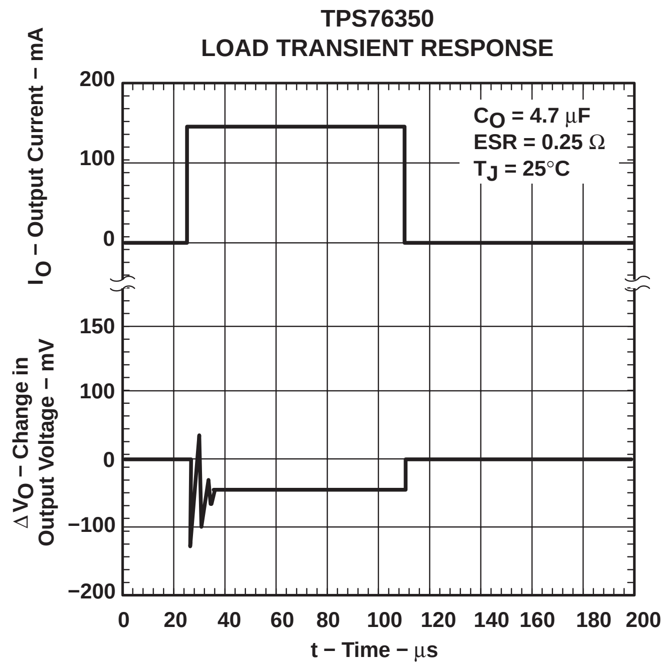


Figure 15

TYPICAL CHARACTERISTICS

TYPICAL REGIONS OF STABILITY
COMPENSATION SERIES RESISTANCE (CSR)(1)
vs
OUTPUT CURRENT

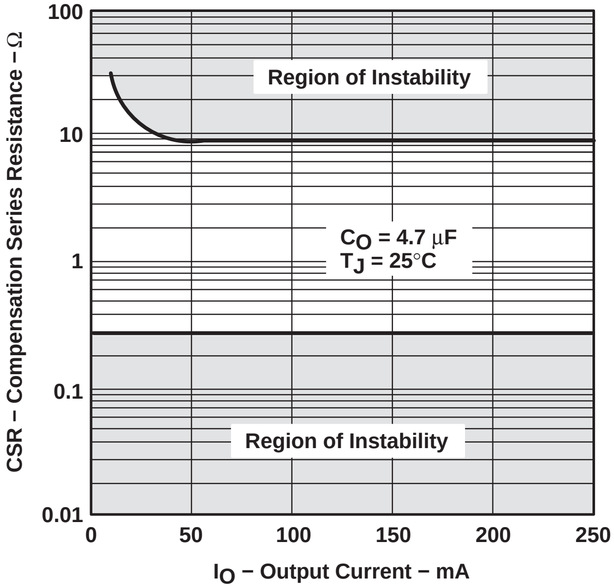


Figure 16

TYPICAL REGIONS OF STABILITY
COMPENSATION SERIES RESISTANCE (CSR)(1)
vs
ADDED CERAMIC CAPACITANCE

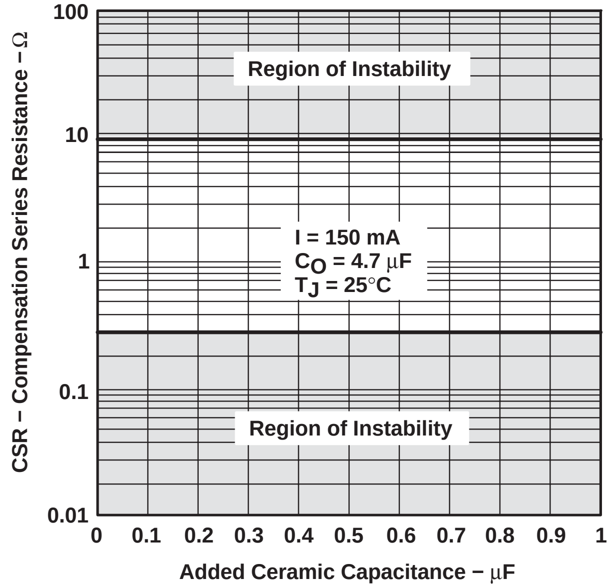


Figure 17

TYPICAL REGIONS OF STABILITY
COMPENSATION SERIES RESISTANCE (CSR)(1)
vs
OUTPUT CURRENT

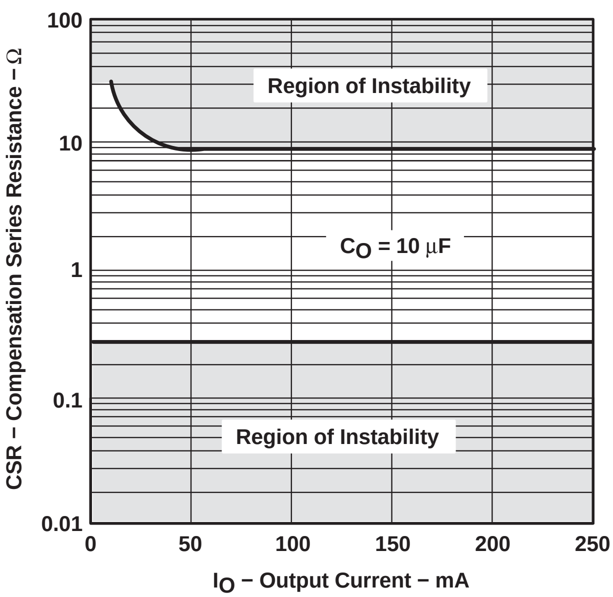


Figure 18

TYPICAL REGIONS OF STABILITY
COMPENSATION SERIES RESISTANCE (CSR)(1)
vs
ADDED CERAMIC CAPACITANCE

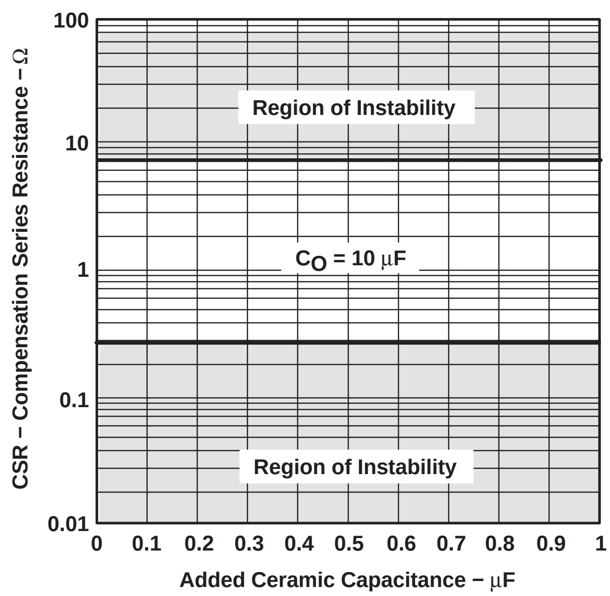


Figure 19

(1) CSR refers to the total series resistance, including the ESR of the capacitor, any series resistance added externally, and PWB trace resistance to C_O.

APPLICATION INFORMATION

The TPS763xx low-dropout (LDO) regulators are new families of regulators which have been optimized for use in battery-operated equipment and feature extremely low dropout voltages, low quiescent current (140 μA), and an enable input to reduce supply currents to less than 2 μA when the regulator is turned off.

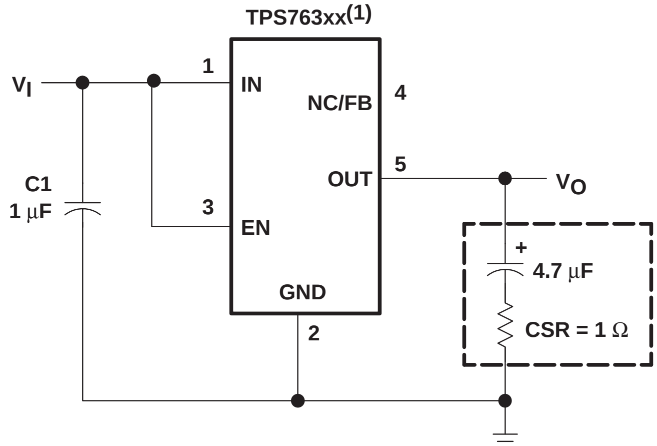
device operation

The TPS763xx uses a PMOS pass element to dramatically reduce both dropout voltage and supply current over more conventional PNP pass element LDO designs. The PMOS pass element is a voltage-controlled device that, unlike a PNP transistor, does not require increased drive current as output current increases. Supply current in the TPS763xx is essentially constant from no-load to maximum load.

Current limiting and thermal protection prevent damage by excessive output current and/or power dissipation. The device switches into a constant-current mode at approximately 1 A; further load reduces the output voltage instead of increasing the output current. The thermal protection shuts the regulator off if the junction temperature rises above 165°C. Recovery is automatic when the junction temperature drops approximately 25°C below the high temperature trip point. The PMOS pass element includes a back diode that safely conducts reverse current when the input voltage level drops below the output voltage level.

A logic low on the enable input, EN shuts off the output and reduces the supply current to less than 2 μA. EN should be tied high in applications where the shutdown feature is not used.

A typical application circuit is shown in Figure 20.



(1) TPS76316, TPS76318, TPS76325, TPS76327, TPS76328, TPS7630 TPS76333, TPS76338, TPS76350 (fixed-voltage options).

Figure 20. Typical Application Circuit

APPLICATION INFORMATION

external capacitor requirements

Although not required, a 0.047 µF or larger ceramic bypass input capacitor, connected between IN and GND and located close to the TPS763xx, is recommended to improve transient response and noise 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 low dropout regulators, the TPS763xx requires an output capacitor connected between OUT and GND to stabilize the internal loop control. The minimum recommended capacitance value is 4.7 µF and the ESR (equivalent series resistance) must be between 0.3 Ω and 10 Ω. Capacitor values 4.7 µF or larger are acceptable, provided the ESR is less than 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 Nichico, meet the ESR requirements stated above.

CAPACITOR SELECTION

PART NO.	MFR.	VALUE	MAX ESR(1)	SIZE (H × L × W)†
T494B475K016AS	KEMET	4.7 µF	1.5 Ω	1.9 × 3.5 × 2.8
195D106x0016x2T	SPRAGUE	10 µF	1.5 Ω	1.3 × 7.0 × 2.7
695D106x003562T	SPRAGUE	10 µF	1.3 Ω	2.5 × 7.6 × 2.5
TPSC475K035R0600	AVX	4.7 µF	0.6 Ω	2.6 × 6.0 × 3.2

(1) Size is in mm. ESR is maximum resistance in ohms at 100 kHz and T_A = 25°C. Listings are sorted by height.

output voltage programming

The output voltage of the TPS76301 adjustable regulator is programmed using an external resistor divider as shown in Figure 21. The output voltage is calculated using:

$$V_O = 0.995 \times V_{ref} \times \left(1 + \frac{R1}{R2}\right) \tag{1}$$

Where:

V_{ref} = 1.192 V typ (the internal reference voltage)

0.995 is a constant used to center the load regulator (1%)

Resistors R1 and R2 should be chosen for approximately 7-µA divider current. Lower value resistors can be used but offer no inherent advantage and waste more power. Higher values should be avoided as leakage currents at FB increase the output voltage error. The recommended design procedure is to choose R2 = 169 kΩ to set the divider current at 7 µA and then calculate R1 using:

$$R1 = \left(\frac{V_O}{0.995 \times V_{ref}} - 1\right) \times R2 \tag{2}$$

APPLICATION INFORMATION

OUTPUT VOLTAGE PROGRAMMING GUIDE

OUTPUT VOLTAGE (V)	DIVIDER RESISTANCE (kΩ)(1)	
	R1	R2
2.5	187	169
3.3	301	169
3.6	348	169
4	402	169
5	549	169
6.45	750	169

(1) 1% values shown.

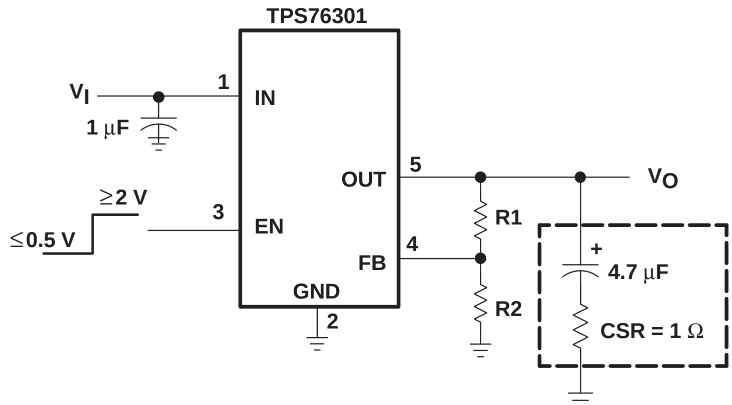


Figure 21. TPS76301 Adjustable LDO Regulator Programming

power dissipation and junction temperature

Specified regulator operation is assured to a junction temperature of 125°C; the maximum junction temperature allowable to avoid damaging the device is 150°C. 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:

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

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 rating table.

T_A is the ambient temperature.

The regulator dissipation is calculated using:

$$P_D = \left(V_I - V_O\right) \times I_O$$

Power dissipation resulting from quiescent current is negligible.

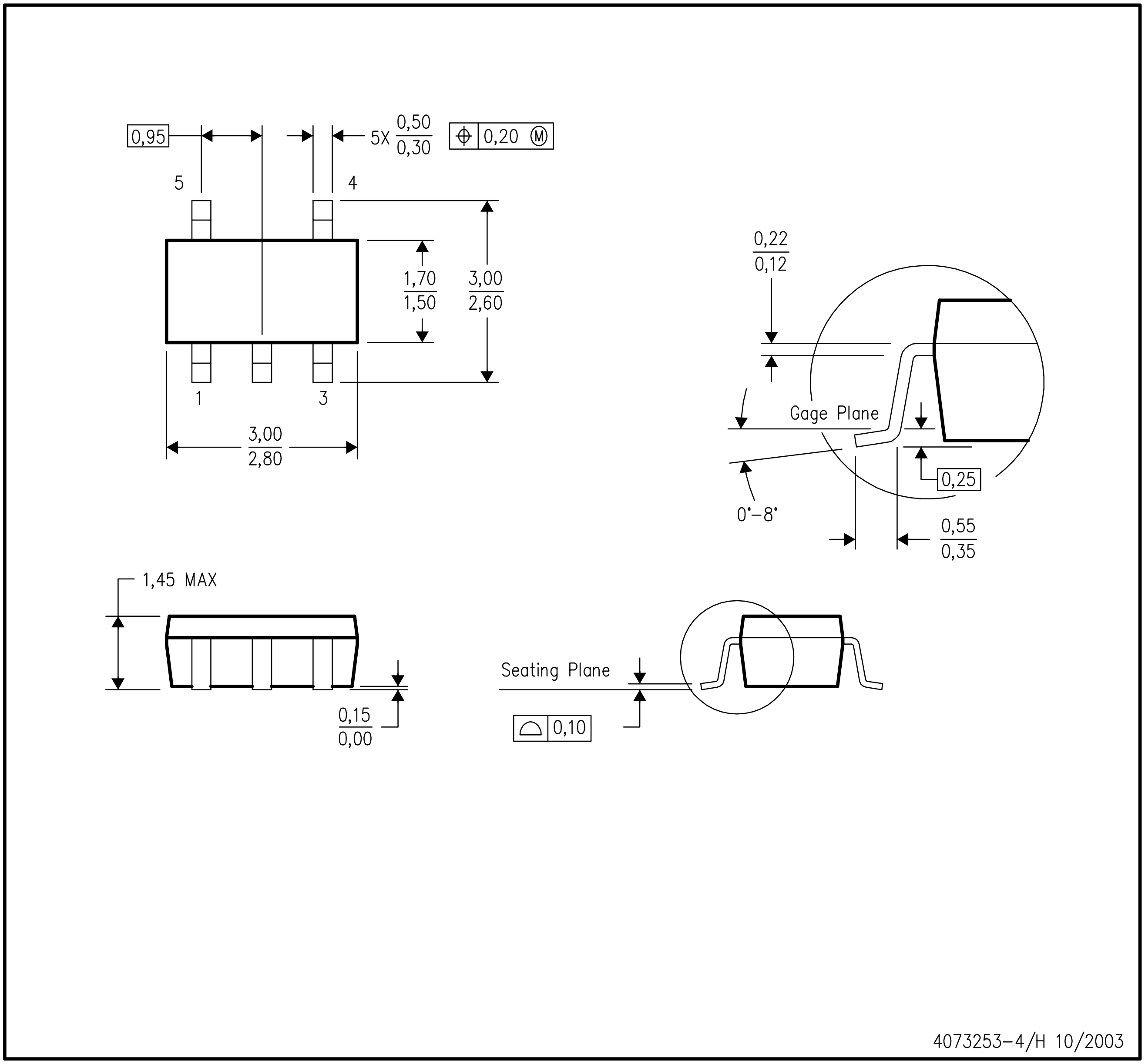
APPLICATION INFORMATION

regulator protection

The TPS763xx pass element has a built-in back diode that safely conducts reverse currents when the input voltage drops below the output voltage (e.g., during power down). Current is conducted from the output to the input and is not internally limited. If extended reverse voltage is anticipated, external limiting might be appropriate.

The TPS763xx also features internal current limiting and thermal protection. During normal operation, the TPS763xx limits output current to approximately 800 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. If the temperature of the device exceeds 165°C, thermal-protection circuitry shuts it down. Once the device has cooled down to below 140°C, regulator operation resumes.

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.
- D. Falls within JEDEC MO-178 Variation AA.

IMPORTANT NOTICE

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

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

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