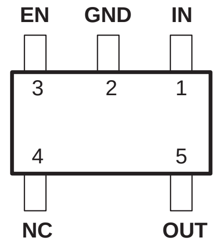
- **50-mA Low-Dropout Regulator**
- **Fixed Output Voltage Options: 5 V, 3.8 V, 3.3 V, 3.2 V, and 3 V**
- **Dropout Typically 120 mV at 50 mA**
- **Thermal Protection**
- **Less Than 1 μA Quiescent Current in Shutdown**
- **–40°C to 125°C Operating Junction Temperature Range**
- **5-Pin SOT-23 Package**
- **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 TPS760xx is a 50mA, low dropout (LDO) voltage regulator designed specifically for battery-powered applications. A proprietary BiCMOS fabrication process allows the TPS760xx to provide outstanding performance in all specifications critical to battery-powered operation.

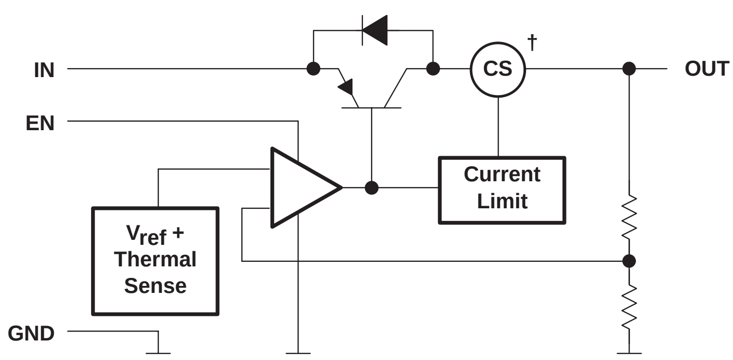
The TPS760xx is available in a space-saving SOT–23 package and operates over a junction temperature range of –40°C to 125°C.

AVAILABLE OPTIONS

T_J	VOLTAGE	PACKAGE	PART NUMBER	SYMBOL
–40°C to 125°C	3 V	SOT-23	TPS76030DBVR	PAGI
	3.2 V		TPS76032DBVR	PAOI
	3.3 V		TPS76033DBVR	PAHI
	3.8 V		TPS76038DBVR	PAJI
	5 V		TPS76050DBVR	PANI

NOTE: The DBV package is available taped and reeled only.

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
IN	1	I	Input voltage
GND	2		Ground
EN	3	I	Enable input
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‡ . . . . –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 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.
‡ All voltages are with respect to device GND pin.

DISSIPATION RATING TABLE

	PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25°C$	$T_A = 70°C$ POWER RATING	$T_A = 85°C$ POWER RATING
Recommended	DBV	350 mW	3.5 mW/°C	192 mW	140 mW
Maximum	DBV	437 mW	3.5 mW/°C	280 mW	227 mW

recommended operating conditions

		MIN	NOM	MAX	UNIT
Input voltage, V_I	TPS76030	3.2		16	V
	TPS76032	3.4		16	V
	TPS76033	3.5		16	V
	TPS76038	4		16	V
	TPS76050	5.2		16	V
Continuous output current, I_O		0		50	mA
Operating junction temperature, T_J		–40		125	°C

electrical characteristics over recommended operating free-air temperature range, $V_I = V_{O(nom)} + 1$ V, I_O = 1 mA, EN = V_I, C_o = 2.2 μF (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage	TPS76030	T_J = 25°C		2.96	3	3.04	V
			T_J = 25°C,	1 mA < I_O < 50 mA	2.92		3.04	V
			1 mA < I_O < 50 mA		2.91		3.07	V
		TPS76032	T_J = 25°C		3.16	3.2	3.24	V
			T_J = 25°C,	1 mA < I_O < 50 mA	3.13		3.24	V
			1 mA < I_O < 50 mA		3.1		3.3	V
		TPS76033	T_J = 25°C		3.26	3.3	3.34	V
			T_J = 25°C,	1 mA < I_O < 50 mA	3.23		3.34	V
			1 mA < I_O < 50 mA		3.2		3.4	V
		TPS76038	T_J = 25°C		3.76	3.8	3.84	V
			T_J = 25°C,	1 mA < I_O < 50 mA	3.73		3.84	V
			1 mA < I_O < 50 mA		3.7		3.9	V
		TPS76050	T_J = 25°C		4.95	5	5.05	V
			T_J = 25°C,	1 mA < I_O < 50 mA	4.91		5.05	V
			1 mA < I_O < 50 mA		4.89		5.1	V
$I_{I(standby)}$	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	215	
			I_O = 10 mA				460	
			I_O = 50 mA, T_J = 25°C			850	1100	
			I_O = 50 mA				1200	
	Input regulation	TPS76030	4 V < V_I < 16,	I_O = 1 mA		3	10	mV
		TPS76032	4.2 V < V_I < 16,	I_O = 1 mA		3	10	
		TPS76033	4.3 V < V_I < 16,	I_O = 1 mA		3	10	
		TPS76038	4.8 V < V_I < 16,	I_O = 1 mA		3	10	
		TPS76050	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
	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	
	Peak output current/current limit		T_J = 25°C		100	125		mA

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
	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	µA

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

TPS76030
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

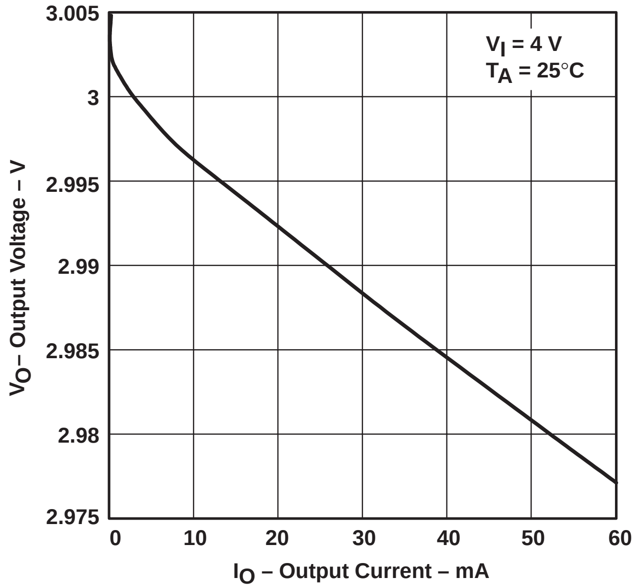


Figure 1

TPS76033
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

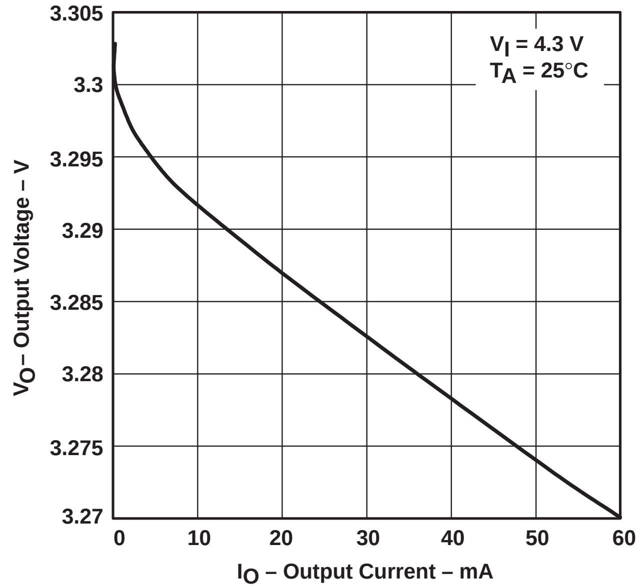


Figure 2

TPS76050
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

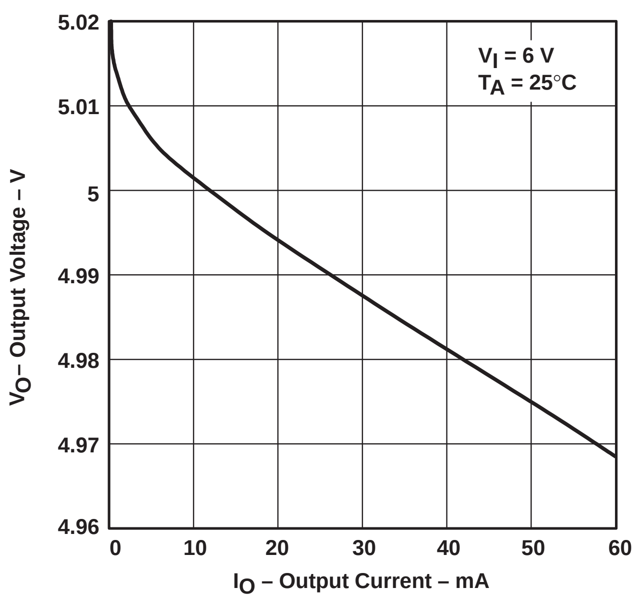


Figure 3

TPS76030
OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

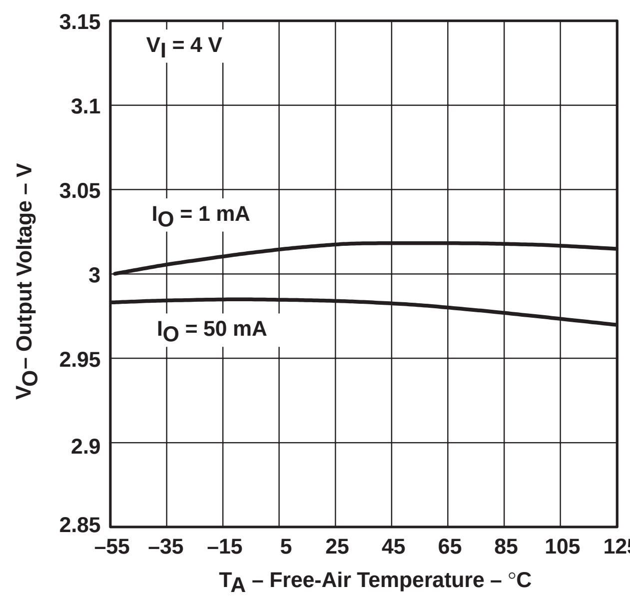


Figure 4

TYPICAL CHARACTERISTICS

TPS76033
OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

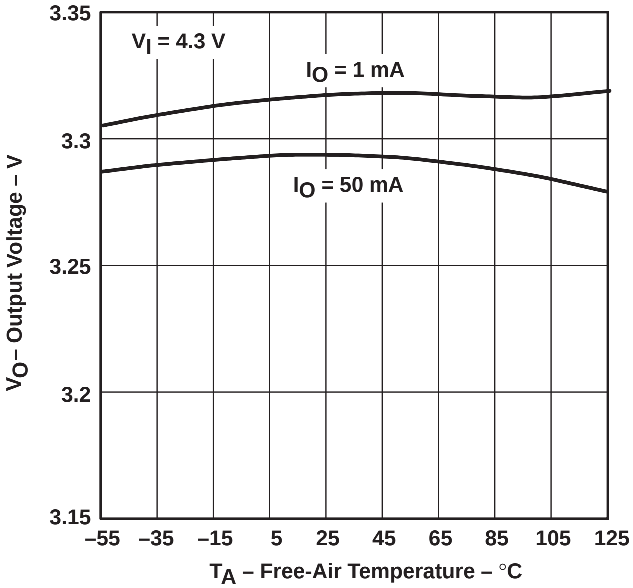


Figure 5

TPS76050
OUTPUT VOLTAGE
vs
FREE-AIR TEMPERATURE

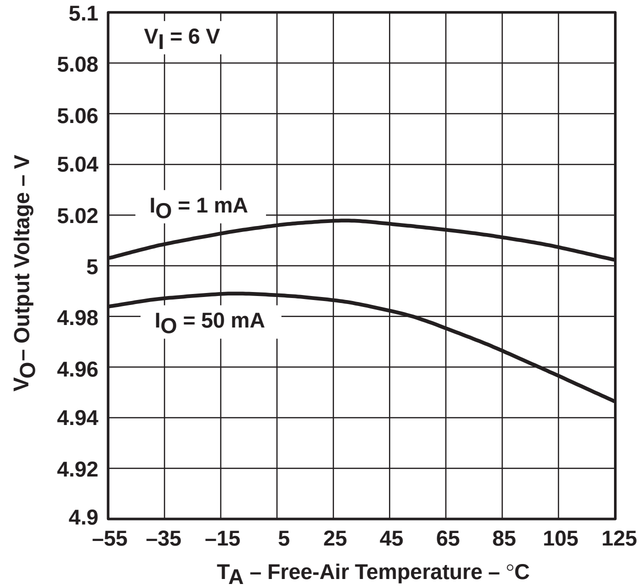


Figure 6

TPS76030
GROUND CURRENT
vs
FREE-AIR TEMPERATURE

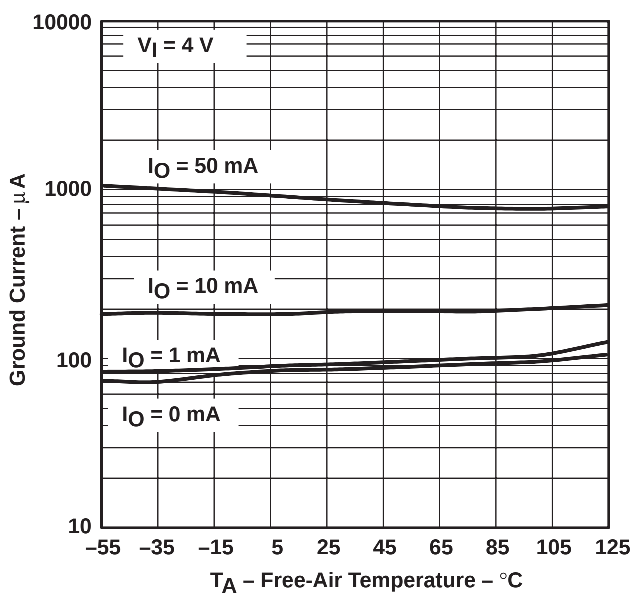


Figure 7

TPS76033
GROUND CURRENT
vs
FREE-AIR TEMPERATURE

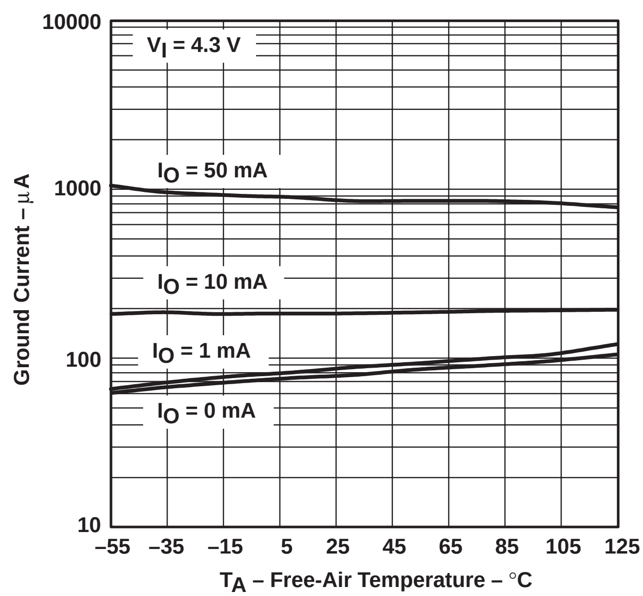


Figure 8

TYPICAL CHARACTERISTICS

TPS76050
GROUND CURRENT
vs
FREE-AIR TEMPERATURE

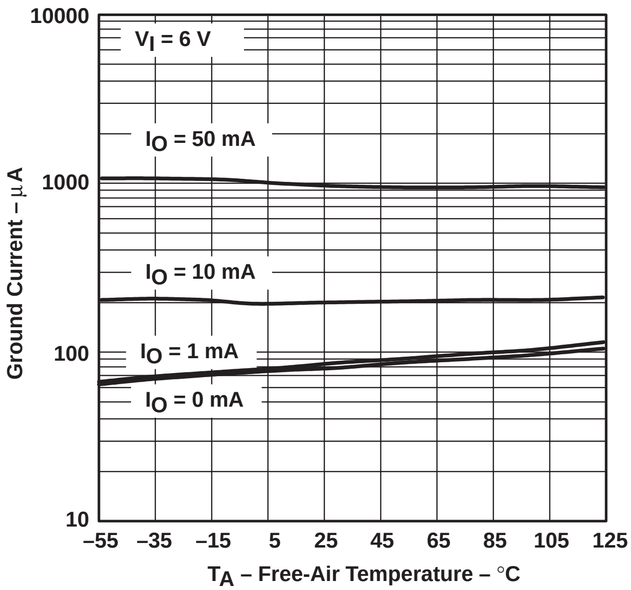


Figure 9

OUTPUT NOISE
vs
FREQUENCY

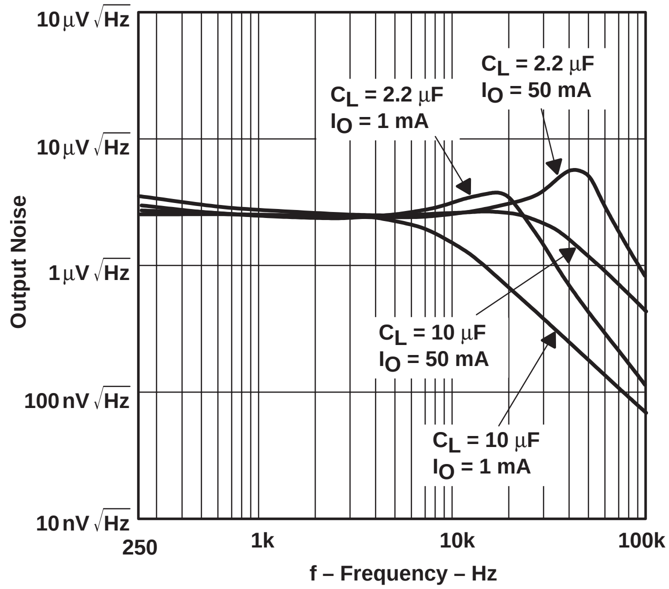


Figure 10

OUTPUT IMPEDANCE
vs
FREQUENCY

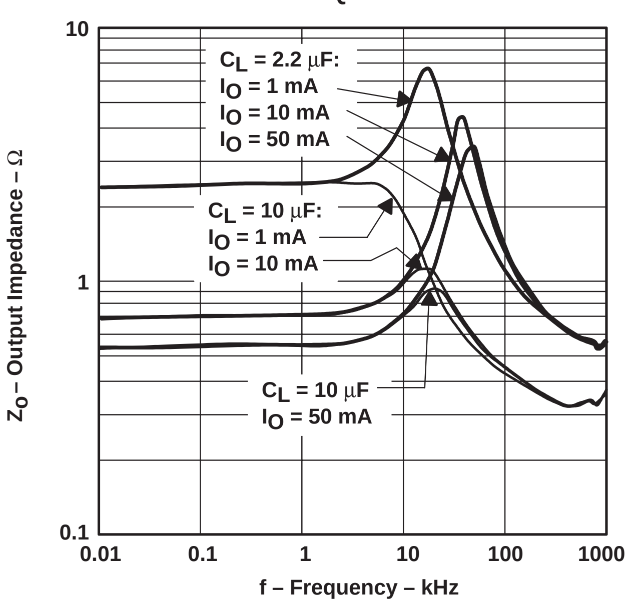


Figure 11

TPS76030
DROPOUT VOLTAGE
vs
FREE-AIR TEMPERATURE

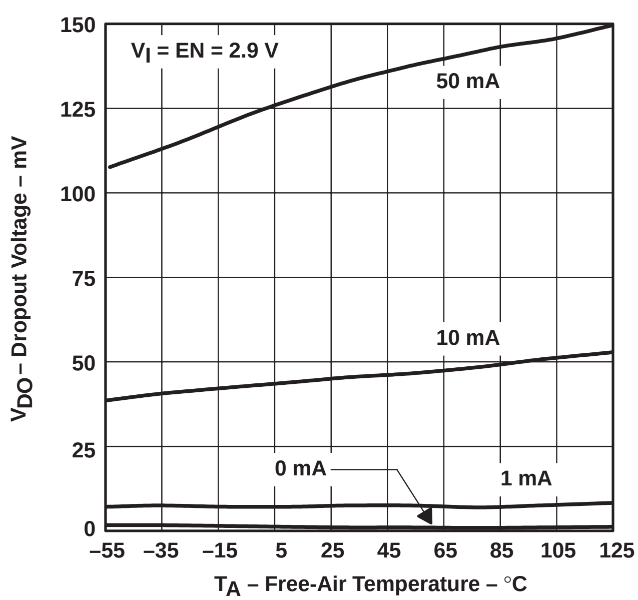


Figure 12

TYPICAL CHARACTERISTICS

TPS76033
LINE TRANSIENT RESPONSE

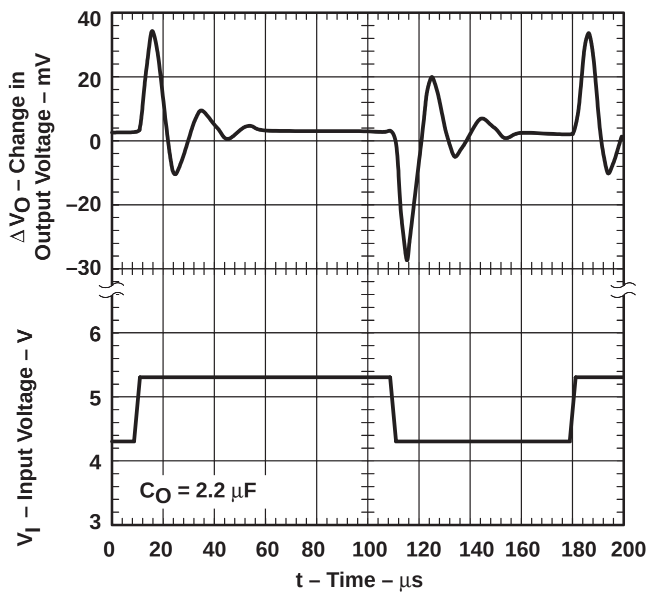


Figure 13

TPS76033
LOAD TRANSIENT RESPONSE

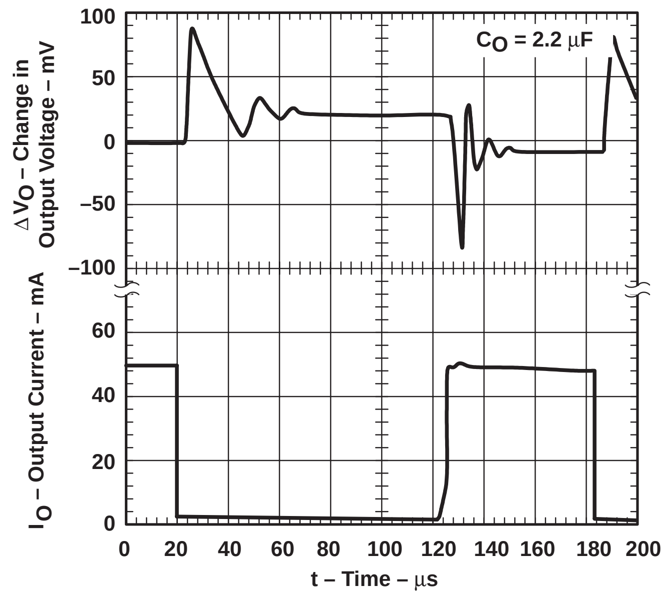


Figure 14

TPS76050
LINE TRANSIENT RESPONSE

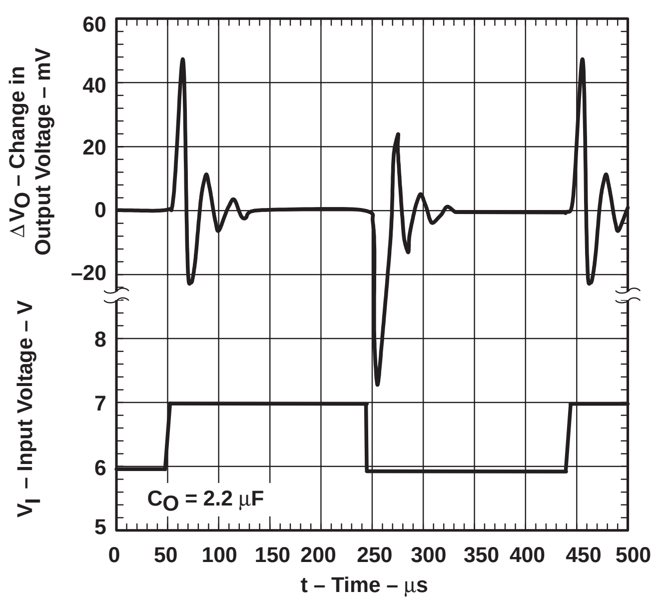


Figure 15

TPS76050
LOAD TRANSIENT RESPONSE

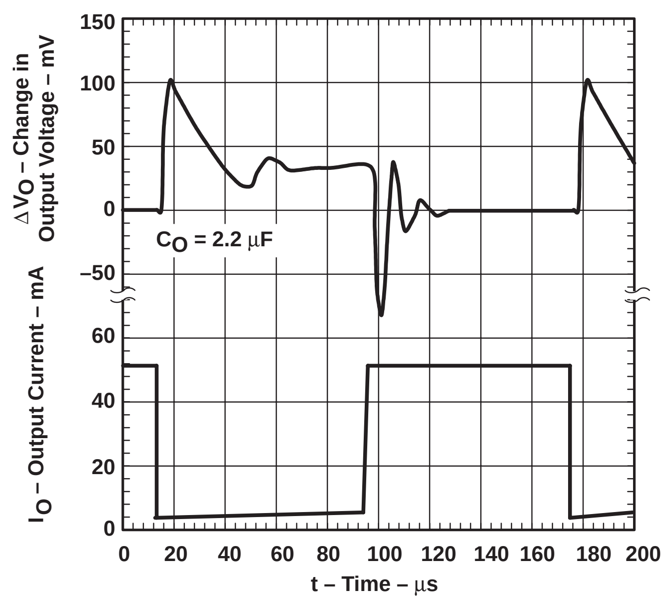


Figure 16

APPLICATION INFORMATION

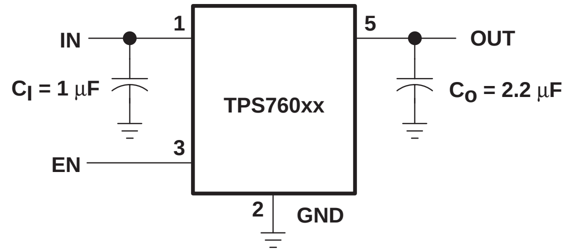


Figure 17. TPS760xx Typical Application

over current protection

The over current protection circuit forces the TPS760xx 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. 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 TPS760xx down when the junction temperature exceeds 160°C. The device recovers and operates normally when the temperature drops below 150°C.

input capacitor

A 0.047 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 TPS760xx. 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 TPS760xx requires an output capacitor connected between OUT and GND to stabilize the internal control loop. The minimum recommended capacitance value is 2.2 µF and the ESR (equivalent series resistance) must be between 0.1 Ω and 20 Ω. Capacitor values of 2.5-µF or larger are acceptable, provided the ESR is less than 20 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 2.2-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 2.5 µF over the full operating temperature range of the equipment.

enable (EN)

A logic zero on the enable input shuts the TPS760xx 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.

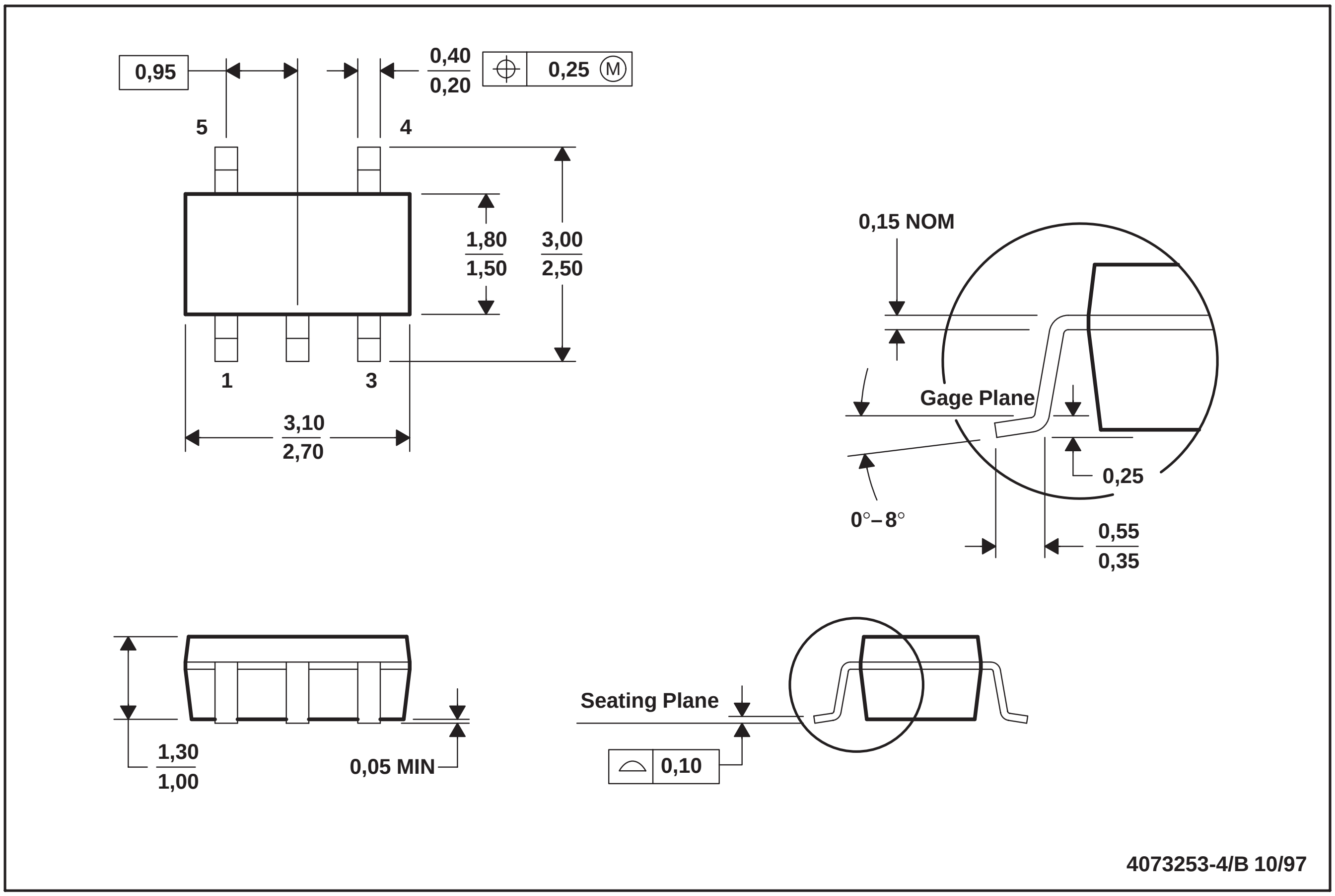
APPLICATION INFORMATION

reverse current path

The power transistor used in the TPS760xx 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 TPS760xx, provided the current is limited to 100mA.

MECHANICAL DATA

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 include mold flash or protrusion.

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