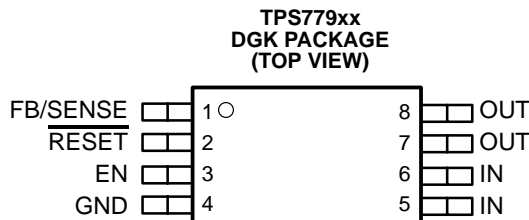


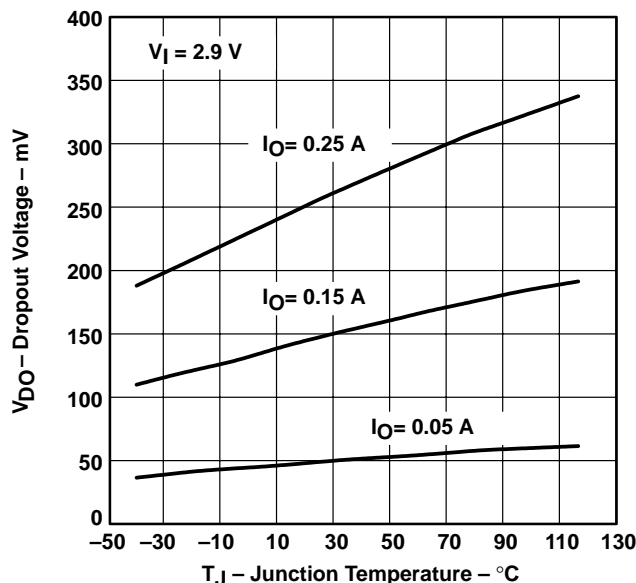
# TPS77901, TPS77918, TPS77925, TPS77930 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

- Open Drain Power-On Reset With 220-ms Delay
- 250-mA Low-Dropout Voltage Regulator
- Available in 1.8-V, 2.5-V, 3-V, Fixed Output and Adjustable Versions
- Dropout Voltage Typically 200 mV at 250 mA (TPS77930)
- Ultralow 92- $\mu$ A Quiescent Current (Typ)
- 8-Pin MSOP (DGK) Package
- Low Noise (55  $\mu$ V<sub>rms</sub>) With No Bypass Capacitor (TPS77918)
- 2% Tolerance Over Specified Conditions For Fixed-Output Versions
- Fast Transient Response
- Thermal Shutdown Protection
- See the TPS773xx and TPS774xx Family of Devices for Active Low Enable



TPS77930  
DROPOUT VOLTAGE  
vs  
JUNCTION TEMPERATURE



## description

The TPS779xx is a low-dropout regulator with integrated power-on reset. The device is capable of supplying 250 mA of output current with a dropout of 200 mV (TPS77930). Quiescent current is 92  $\mu$ A at full load dropping down to 1  $\mu$ A when the device is disabled. The device is optimized to be stable with a wide range of output capacitors including low ESR ceramic (10  $\mu$ F) or low capacitance (1  $\mu$ F) tantalum capacitors. The device has extremely low noise output performance (55  $\mu$ V<sub>rms</sub>) without using any added filter capacitors. TPS779xx is designed to have a fast transient response for larger load current changes.

The TPS779xx is offered in 1.8-V, 2.5-V, and 3-V fixed-voltage versions and in an adjustable version (programmable over the range of 1.5 V to 5.5 V). Output voltage tolerance is 2% over line, load, and temperature ranges. The TPS779xx family is available in 8-pin MSOP (DGK) packages.

Because the PMOS device behaves as a low-value resistor, the dropout voltage is very low (typically 200 mV at an output current of 250 mA for 3.3 volt option) and is directly proportional to the output current. Additionally, since the PMOS pass element is a voltage-driven device, the quiescent current is very low and independent of output loading (typically 92  $\mu$ A over the full range of output current, 0 mA to 250 mA). These two key specifications yield a significant improvement in operating life for battery-powered systems.

The device is enabled when the EN pin is connected to a high-level input voltage. This LDO family also features a sleep mode; applying a TTL low signal to EN (enable) shuts down the regulator, reducing the quiescent current to less than 1  $\mu$ A at  $T_J = 25^\circ\text{C}$ .



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



TEXAS  
INSTRUMENTS

[www.BDITIC.com/TI](http://www.BDITIC.com/TI)

POST OFFICE BOX 655003 • DALLAS, TEXAS 75266

Copyright © 2000, Texas Instruments Incorporated

# TPS77901, TPS77918, TPS77925, TPS77930

## 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

### description (continued)

The TPS779xx features an integrated power-on reset, commonly used as a supply voltage supervisor (SVS), or reset output voltage. The  $\overline{\text{RESET}}$  output of the TPS779xx initiates a reset in DSP, microcomputer, or microprocessor systems at power-up and in the event of an undervoltage condition. An internal comparator in the TPS779xx monitors the output voltage of the regulator to detect an undervoltage condition on the regulated output voltage. When OUT reaches 95% of its regulated voltage,  $\overline{\text{RESET}}$  will go to a high-impedance state after a 220 ms delay.  $\overline{\text{RESET}}$  will go to low-impedance state when OUT is pulled below 95% (i.e. over load condition) of its regulated voltage.

AVAILABLE OPTIONS			
T <sub>J</sub>	OUTPUT VOLTAGE (V)	PACKAGED DEVICES	
	TYP	MSOP (DGK)	SYMBOL
–40°C to 125°C	3.0	TPS77930DGK	AHY
	2.5	TPS77925DGK	AHX
	1.8	TPS77918DGK	AHW
	Adjustable 1.5 V to 5.5 V	TPS77901DGK†	AHV

† The TPS77901 is programmable using an external resistor divider (see application information). The DGK package is available taped and reeled. Add an R suffix to the device type (e.g., TPS77901DGKR).

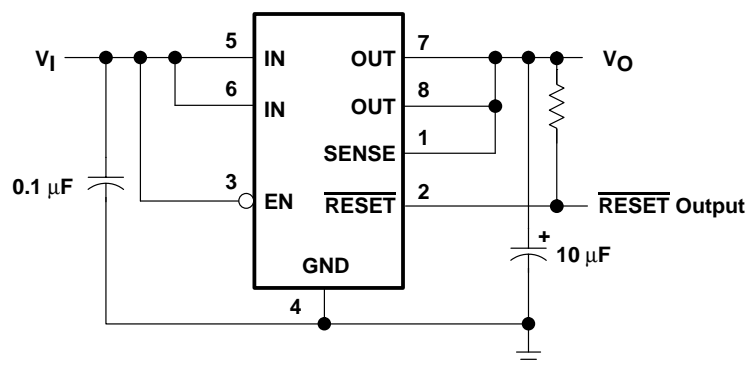
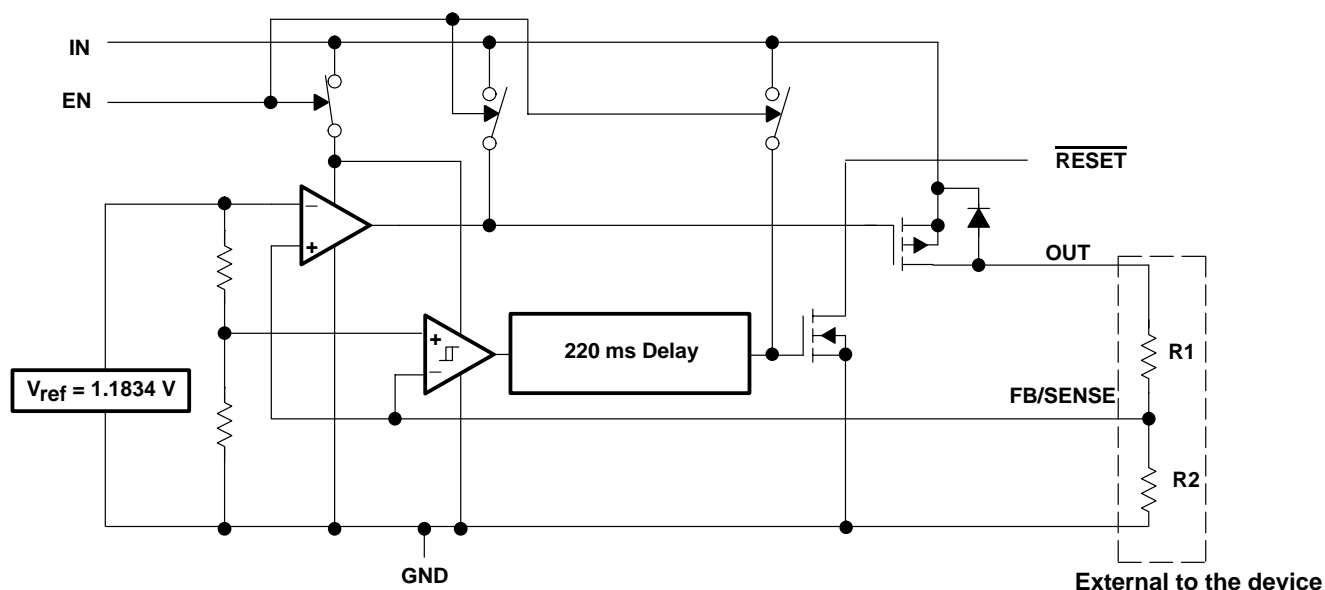


Figure 1. Typical Application Configuration (For Fixed Output Options)

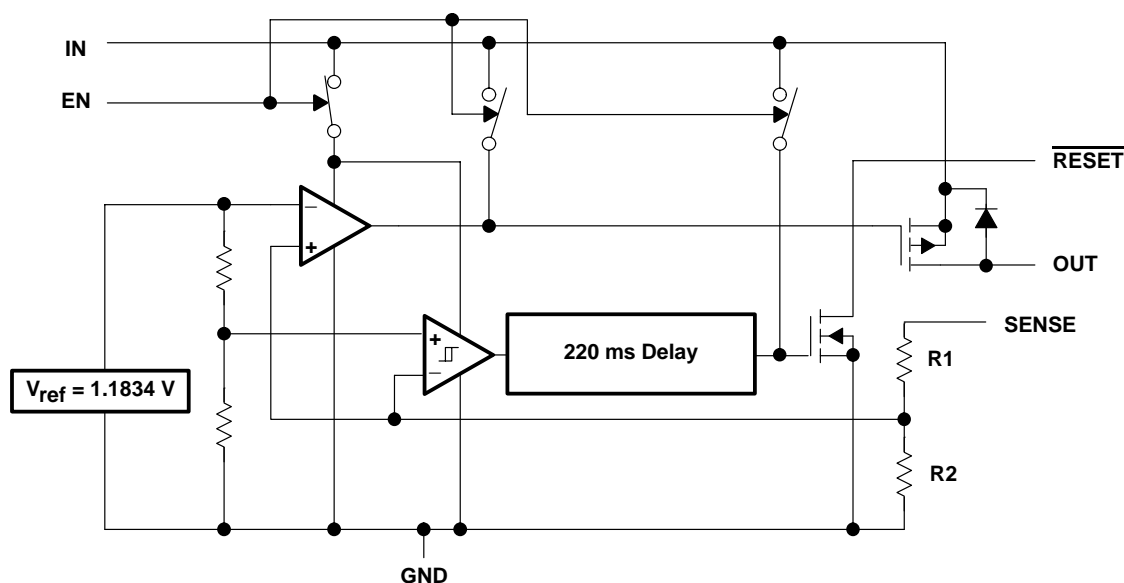
# TPS77901, TPS77918, TPS77925, TPS77930 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

functional block diagram—adjustable version



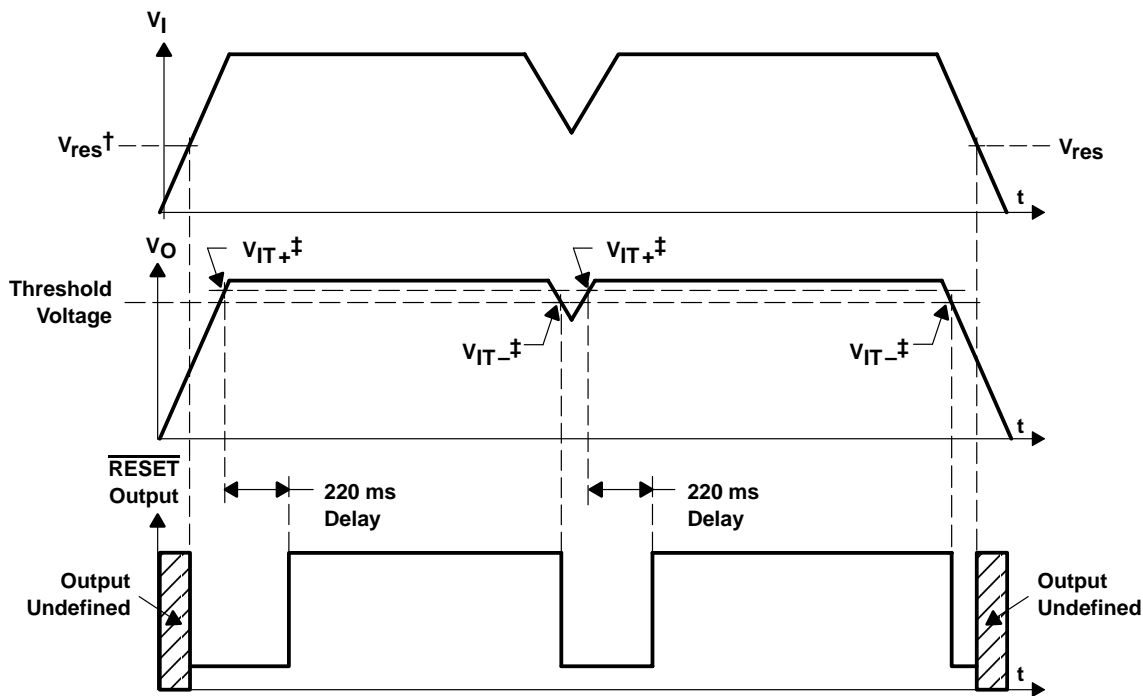
functional block diagram—fixed-voltage version



TPS77901, TPS77918, TPS77925, TPS77930  
250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

TPS779xx  $\overline{\text{RESET}}$  timing diagram



†  $V_{res}$  is the minimum input voltage for a valid  $\overline{\text{RESET}}$ . The symbol  $V_{res}$  is not currently listed within EIA or JEDEC standards for semiconductor symbology.

‡  $V_{IT-}$  – Trip voltage is typically 5% lower than the output voltage (95%  $V_O$ ).  $V_{IT-}$  to  $V_{IT+}$  is the hysteresis voltage.

Terminal Functions (TPS779xx)

TERMINAL NAME	NO.	I/O	DESCRIPTION
FB/SENSE	1	I	Feedback input voltage for adjustable device (sense input for fixed options)
RESET	2	O	Reset output
EN	3	I	Enable input
GND	4		Regulator ground
IN	5, 6	I	Input voltage
OUT	7, 8	O	Regulated output voltage

# TPS77901, TPS77918, TPS77925, TPS77930

## 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

### detailed description

#### pin functions

##### enable (EN)

The EN terminal is an input which enables or shuts down the device. If EN is a logic low, the device will be in shutdown mode. When EN goes to logic high, then the device will be enabled.

##### sense (SENSE)

The SENSE terminal of the fixed-output options must be connected to the regulator output, and the connection should be as short as possible. Internally, SENSE connects to a high-impedance wide-bandwidth amplifier through a resistor-divider network and noise pickup feeds through to the regulator output. It is essential to route the SENSE connection in such a way to minimize/avoid noise pickup. Adding RC networks between the SENSE terminal and  $V_O$  to filter noise is not recommended because it can cause the regulator to oscillate.

##### feedback (FB)

FB is an input terminal used for the adjustable-output options and must be connected to an external feedback resistor divider. The FB connection should be as short as possible. It is essential to route it in such a way to minimize/avoid noise pickup. Adding RC networks between FB terminal and  $V_O$  to filter noise is not recommended because it can cause the regulator to oscillate.

##### reset (RESET)

The  $\overline{\text{RESET}}$  terminal is an open drain, active low output that indicates the status of  $V_O$ . When  $V_O$  reaches 95% of the regulated voltage,  $\overline{\text{RESET}}$  will go to a high-impedance state after a 220-ms delay.  $\overline{\text{RESET}}$  will go to a low-impedance state when  $V_{\text{out}}$  is below 95% of the regulated voltage. The open-drain output of the RESET terminal requires a pullup resistor.

### absolute maximum ratings over operating junction temperature range (unless otherwise noted)<sup>†</sup>

Input voltage range <sup>‡</sup> , $V_I$	–0.3 V to 13.5 V
Voltage range at EN	–0.3 V to 16.5 V
Maximum $\overline{\text{RESET}}$ voltage	16.5 V
Peak output current	Internally limited
Continuous total power dissipation	See Dissipation Rating Table
Output voltage, $V_O$ (OUT, FB)	5.5 V
Operating virtual junction temperature range, $T_J$	–40°C to 125°C
Storage temperature range, $T_{\text{stg}}$	–65°C to 150°C
ESD rating, HBM	2 kV

<sup>†</sup> 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.

<sup>‡</sup> All voltage values are with respect to network terminal ground.

DISSIPATION RATING TABLE – FREE-AIR TEMPERATURES

PACKAGE	AIR FLOW (CFM)	$\theta_{JA}$ (°C/W)	$\theta_{JC}$ (°C/W)	$T_A < 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
DGK	0	266.2	3.84	376 mW	3.76 mW/°C	207 mW	150 mW
	150	255.2	3.92	392 mW	3.92 mW/°C	216 mW	157 mW
	250	242.8	4.21	412 mW	4.12 mW/°C	227 mW	165 mW

# TPS77901, TPS77918, TPS77925, TPS77930

## 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

### recommended operating conditions

	MIN	MAX	UNIT
Input voltage, $V_{I\uparrow}$	2.7	10	V
Output voltage range, $V_O$	1.5	5.5	V
Output current, $I_O$ (see Note 1)	0	250	mA
Operating virtual junction temperature, $T_J$ (see Note 1)	-40	125	°C

† To calculate the minimum input voltage for your maximum output current, use the following equation:  $V_{I(min)} = V_{O(max)} + V_{DO(max\ load)}$ .  
 NOTE 1: Continuous current and operating junction temperature are limited by internal protection circuitry, but it is not recommended that the device operate under conditions beyond those specified in this table for extended periods of time.

### electrical characteristics over recommended operating junction temperature range ( $T_J = -40^\circ\text{C}$ to $125^\circ\text{C}$ ), $V_I = V_{O(typ)} + 1\text{ V}$ , $I_O = 1\text{ mA}$ , $EN = 5\text{ V}$ , $C_O = 10\text{ }\mu\text{F}$ (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V <sub>O</sub> Output voltage (see Notes 2 and 4)	Adjustable voltage	1.5 V ≤ V <sub>O</sub> ≤ 5.5 V, T <sub>J</sub> = 25°C		V <sub>O</sub>				V
		1.5 V ≤ V <sub>O</sub> ≤ 5.5 V		0.98V <sub>O</sub>		1.02V <sub>O</sub>		
	1.8 V Output	T <sub>J</sub> = 25°C, 2.8 V < V <sub>I</sub> < 10 V		1.8				
		2.8 V < V <sub>I</sub> < 10 V		1.764		1.836		
	2.5 V Output	T <sub>J</sub> = 25°C, 3.5 V < V <sub>I</sub> < 10 V		2.5				
		3.5 V < V <sub>I</sub> < 10 V		2.45		2.55		
	3.0 V Output	T <sub>J</sub> = 25°C, 4.0 V < V <sub>I</sub> < 10 V		3.0				
		4.0 V < V <sub>I</sub> < 10 V		2.94		3.06		
Quiescent current (GND current) (see Notes 2 and 4)			T <sub>J</sub> = 25°C		92			μA
					125			
Output voltage line regulation (ΔV <sub>O</sub> /V <sub>O</sub> ) (see Note 3)			V <sub>O</sub> + 1 V < V <sub>I</sub> ≤ 10 V, T <sub>J</sub> = 25°C		0.005			%/V
			V <sub>O</sub> + 1 V < V <sub>I</sub> ≤ 10 V		0.05			%/V
Load regulation			T <sub>J</sub> = 25°C		1			mV
V <sub>n</sub> Output noise voltage	TPS77918		BW = 300 Hz to 100 kHz, T <sub>J</sub> = 25°C,		55			μVrms
I <sub>O</sub> Output current limit			V <sub>O</sub> = 0 V		0.9		1.3	A
Peak output current			2 ms pulse width, 50% duty cycle		400			mA
Thermal shutdown junction temperature					144			°C
Standby current			EN = V <sub>I</sub> , T <sub>J</sub> = 25°C		1			μA
			EN = V <sub>I</sub>		3			μA
FB input current	Adjustable voltage		FB = 1.5 V		1			μA
V <sub>IH</sub> High level enable input voltage					2			V
V <sub>IL</sub> Low level enable input voltage					0.7			V
Enable input current					−1		1	μA
Power supply ripple rejection (TPS77318, TPS77418)			f = 1 KHz, T <sub>J</sub> = 25°C		55			dB

NOTES: 2. Minimum input operating voltage is 2.7 V or  $V_{O(typ)} + 1\text{ V}$ , whichever is greater. Maximum input voltage = 10 V, minimum output current 1 mA.

3. If  $V_O < 1.8\text{ V}$  then  $V_{I\max} = 10\text{ V}$ ,  $V_{I\min} = 2.7\text{ V}$ :

$$\text{Line Regulation (mV)} = (\%/V) \times \frac{V_O(V_{I\max} - 2.7\text{ V})}{100} \times 1000$$

If  $V_O > 2.5\text{ V}$  then  $V_{I\max} = 10\text{ V}$ ,  $V_{I\min} = V_O + 1\text{ V}$ :

$$\text{Line Regulation (mV)} = (\%/V) \times \frac{V_O(V_{I\max} - (V_O + 1))}{100} \times 1000$$

4.  $I_O = 1\text{ mA to }250\text{ mA}$

# TPS77901, TPS77918, TPS77925, TPS77930

## 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

electrical characteristics over recommended operating junction temperature range ( $T_J = -40^\circ\text{C}$  to  $125^\circ\text{C}$ ),  $V_I = V_O(\text{typ}) + 1\text{ V}$ ,  $I_O = 1\text{ mA}$ ,  $EN = 5\text{ V}$ ,  $C_O = 10\text{ }\mu\text{F}$  (unless otherwise noted) (continued)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reset	Minimum input voltage for valid RESET	$I(\text{RESET}) = 300\text{ }\mu\text{A}$		1.1		V
	Trip threshold voltage	$V_O$ decreasing	92%		98%	$V_O$
	Hysteresis voltage	Measured at $V_O$		0.5%		$V_O$
	Output low voltage	$V_I = 2.7\text{ V}$ , $I(\text{RESET}) = 1\text{ mA}$		0.15	0.4	V
	Leakage current	$V(\text{RESET}) = 5\text{ V}$			1	$\mu\text{A}$
	RESET time-out delay			220		ms
$V_{DO}$	Dropout voltage (see Note 5)	3 V Output $I_O = 250\text{ mA}$ , $T_J = 25^\circ\text{C}$		250		mV
					475	

NOTE 5:  $I_N$  voltage equals  $V_O(\text{typ}) - 100\text{ mV}$ ; 1.8 V, and 2.5 V dropout voltage limited by input voltage range limitations (i.e., 3.3 V input voltage needs to drop to 3.2 V for purpose of this test).

### TYPICAL CHARACTERISTICS

#### Table of Graphs

			FIGURE
$V_O$	Output voltage	vs Output current	2, 3
		vs Junction temperature	4, 5
	Ground current	vs Junction temperature	6
	Power supply rejection ratio	vs Frequency	7
	Output spectral noise density	vs Frequency	8
$Z_O$	Output impedance	vs Frequency	9
$V_{DO}$	Dropout voltage	vs Input voltage	10
		vs Junction temperature	11
	Line transient response		12, 14
	Load transient response		13, 15
	Output voltage and enable pulse	vs Time (at startup)	16
	Equivalent series resistance	vs Output current	18 – 21

# TPS77901, TPS77918, TPS77925, TPS77930

## 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

### TYPICAL CHARACTERISTICS

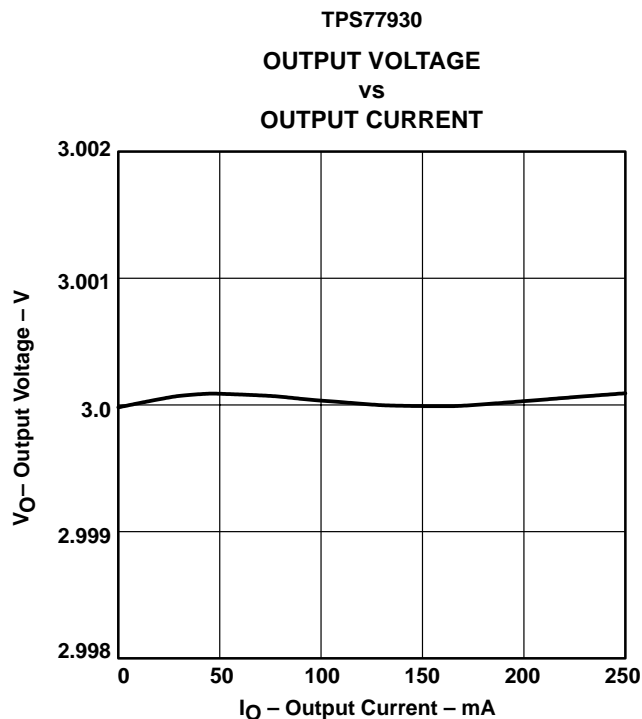


Figure 2

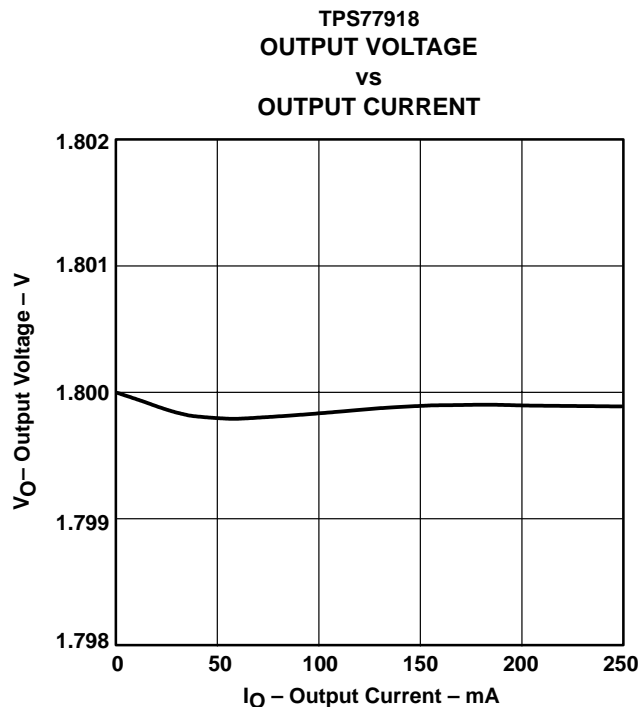


Figure 3

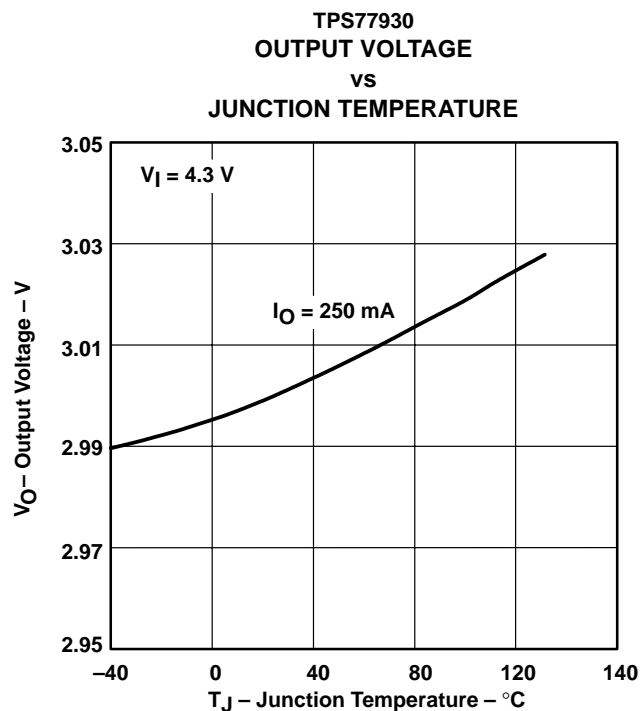


Figure 4

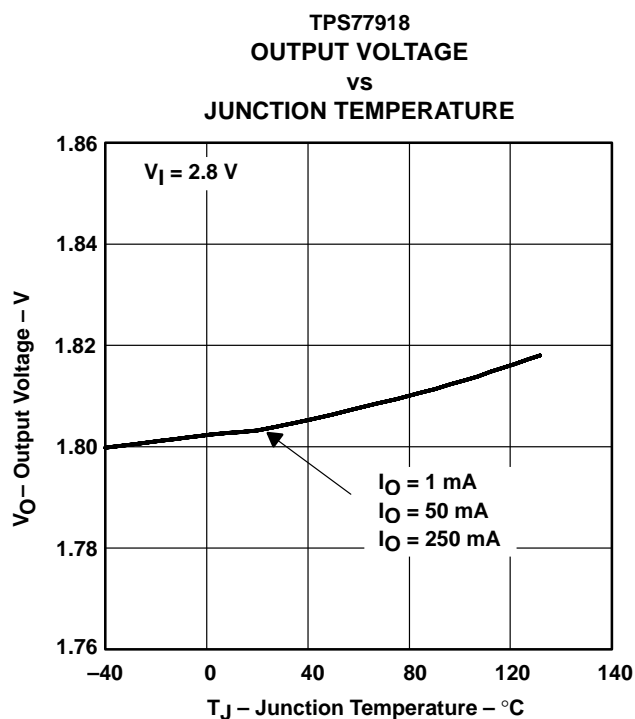


Figure 5



# TPS77901, TPS77918, TPS77925, TPS77930 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

## TYPICAL CHARACTERISTICS

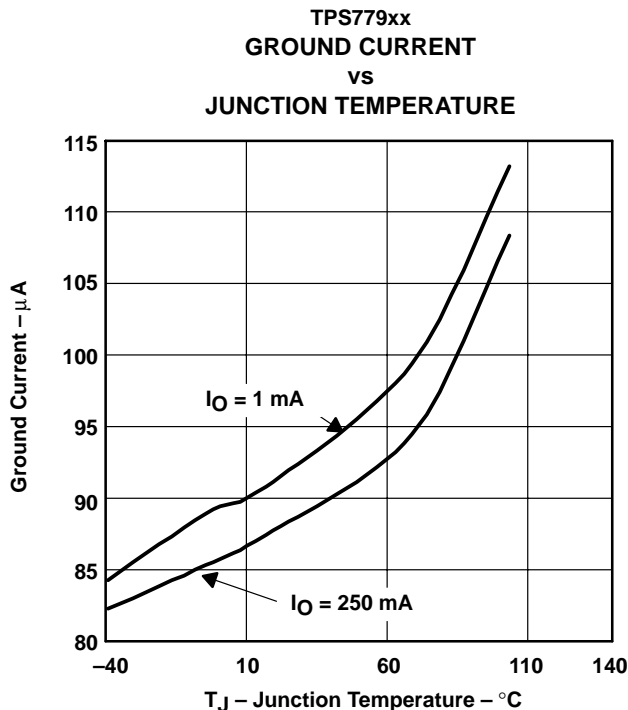


Figure 6

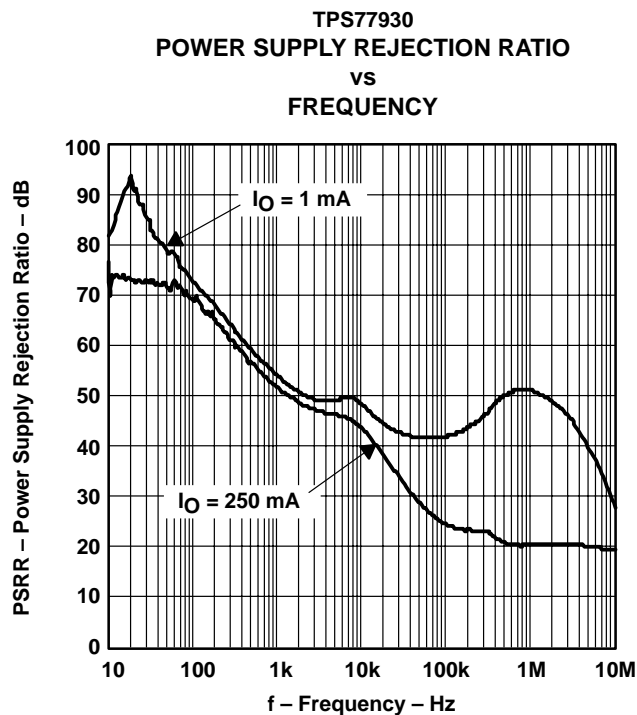


Figure 7

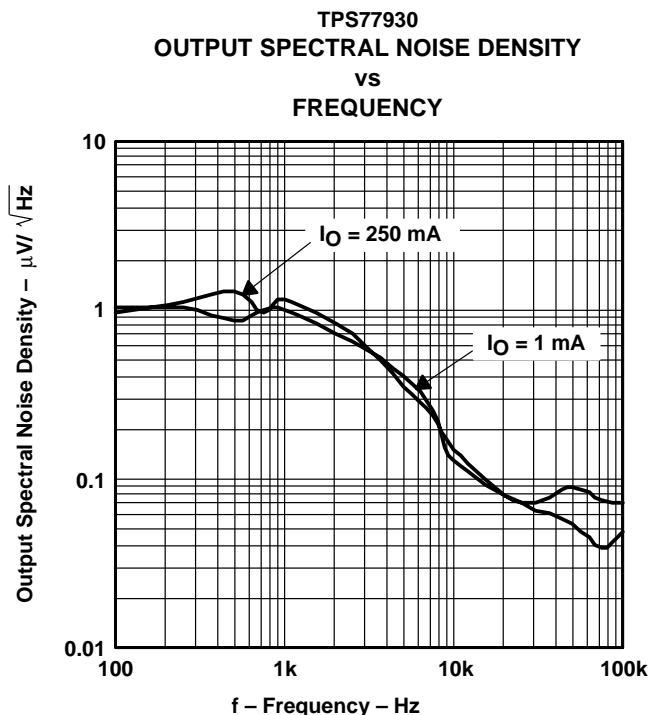
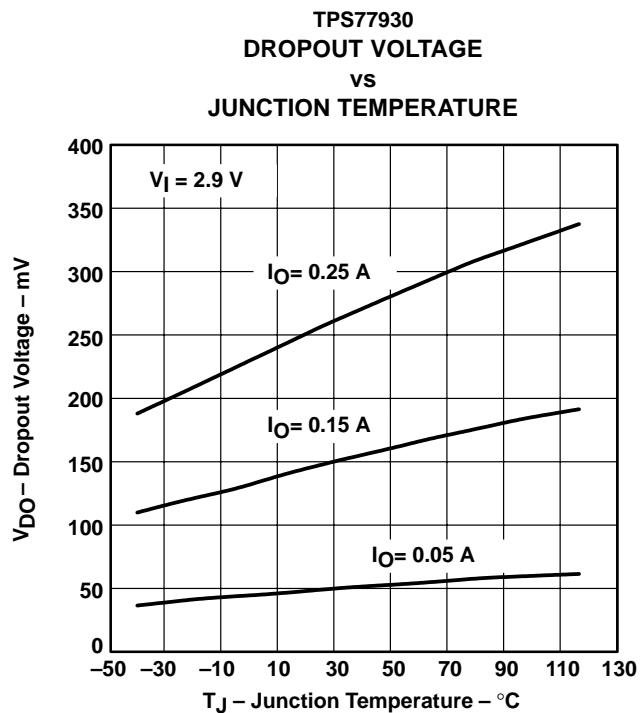
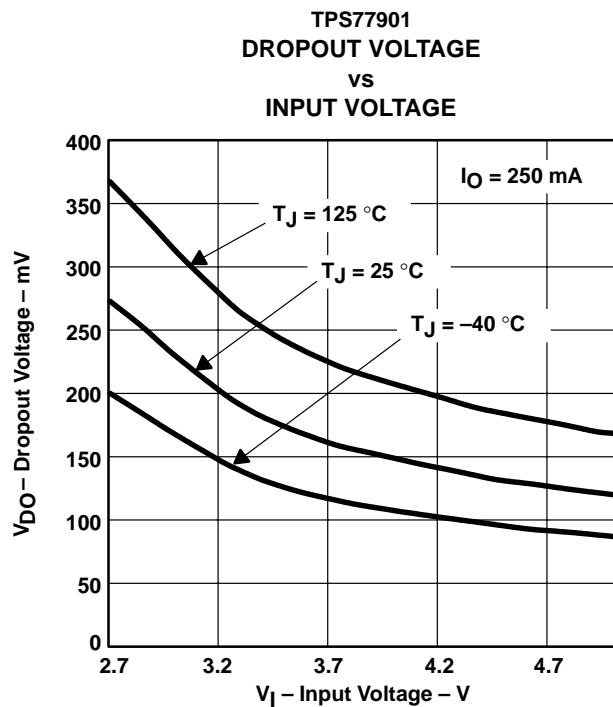
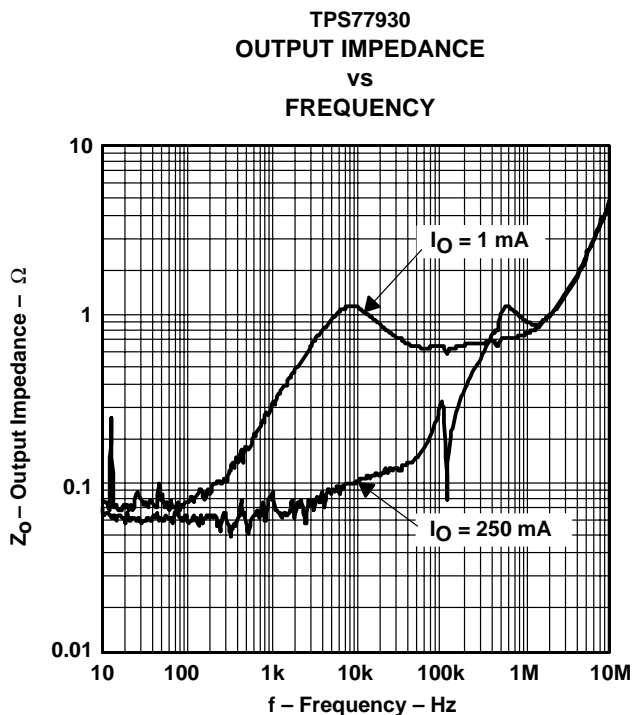


Figure 8

# TPS77901, TPS77918, TPS77925, TPS77930 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

## TYPICAL CHARACTERISTICS



# TPS77901, TPS77918, TPS77925, TPS77930 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

## TYPICAL CHARACTERISTICS

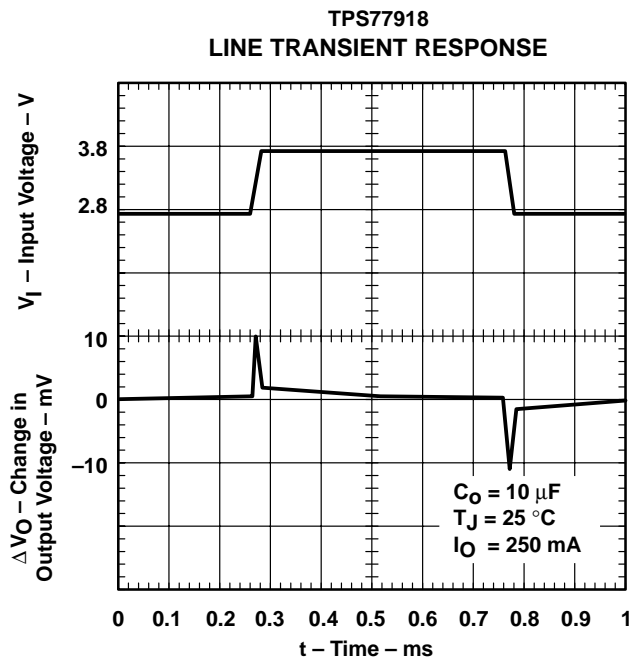


Figure 12

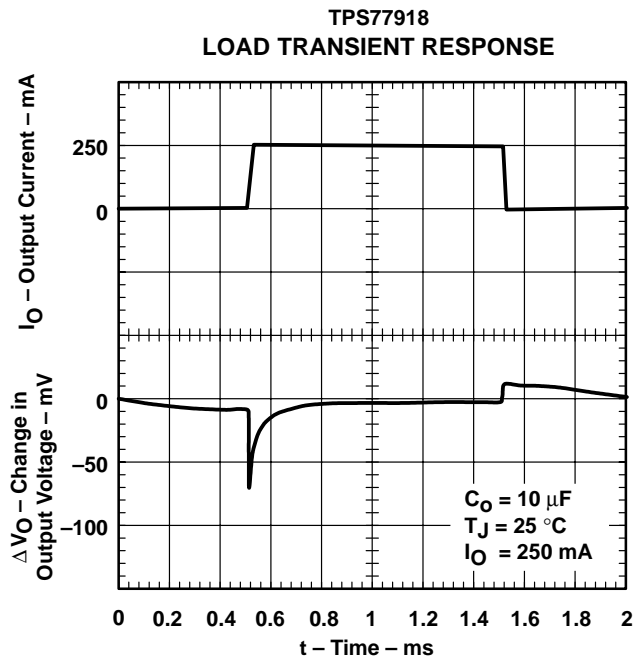


Figure 13

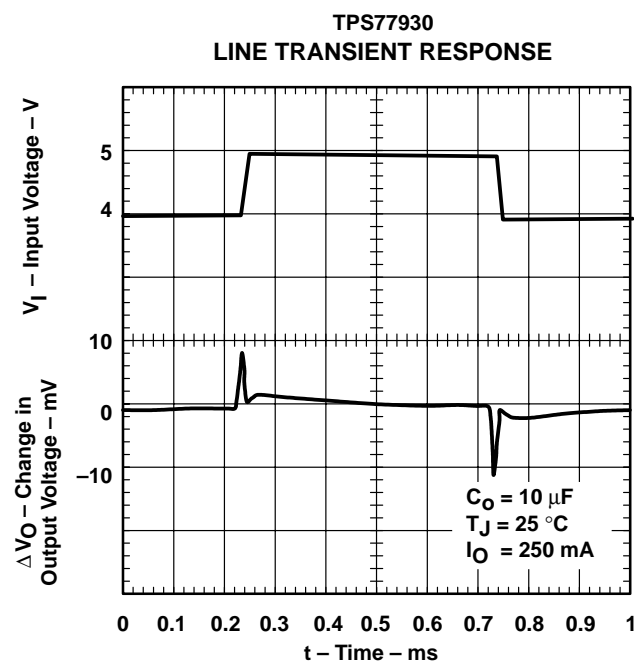


Figure 14

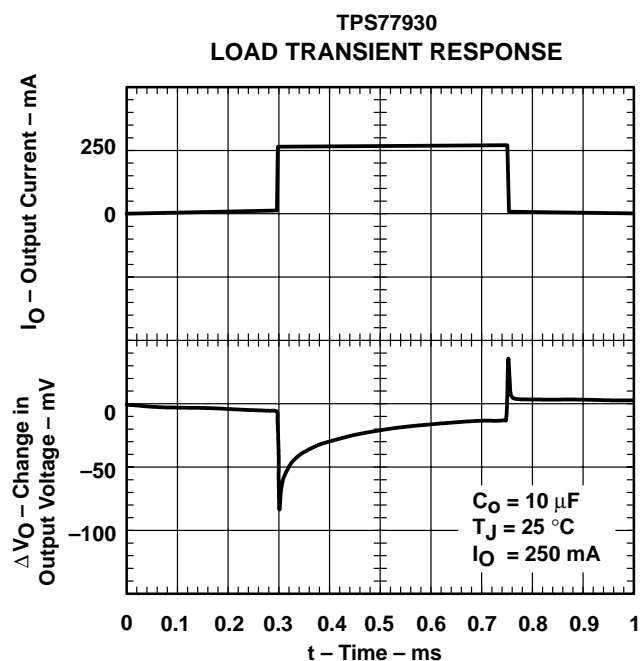


Figure 15

# TPS77901, TPS77918, TPS77925, TPS77930 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

## TYPICAL CHARACTERISTICS

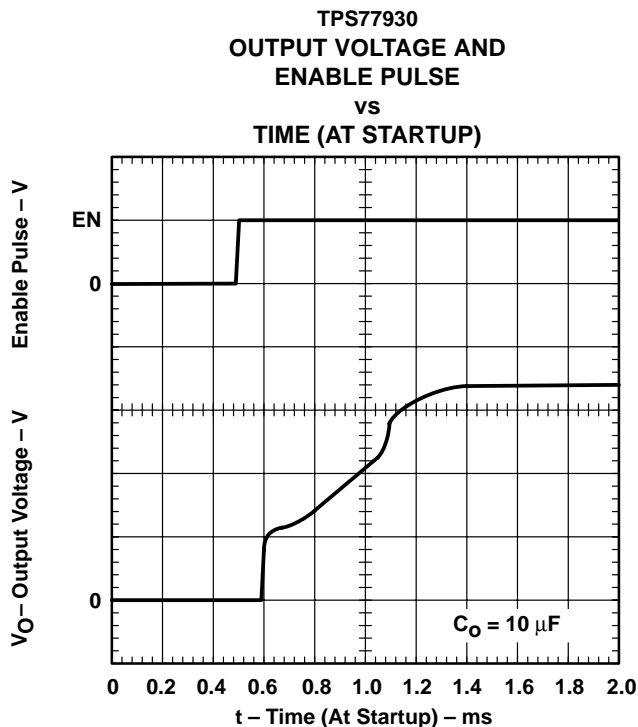


Figure 16

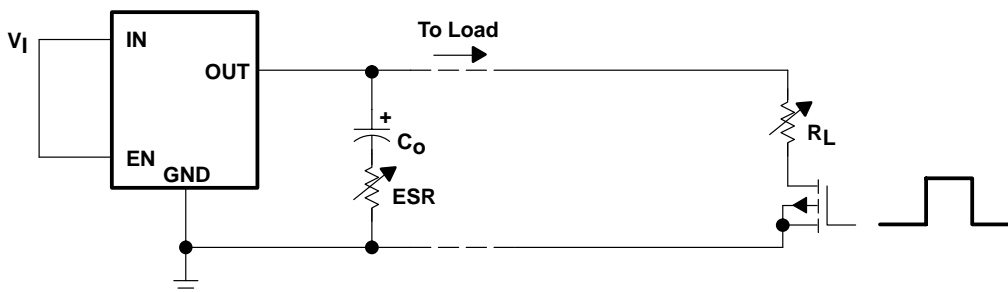


Figure 17. Test Circuit for Typical Regions of Stability (Figures 18 through 21) (Fixed Output Options)

# TPS77901, TPS77918, TPS77925, TPS77930 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

## TYPICAL CHARACTERISTICS

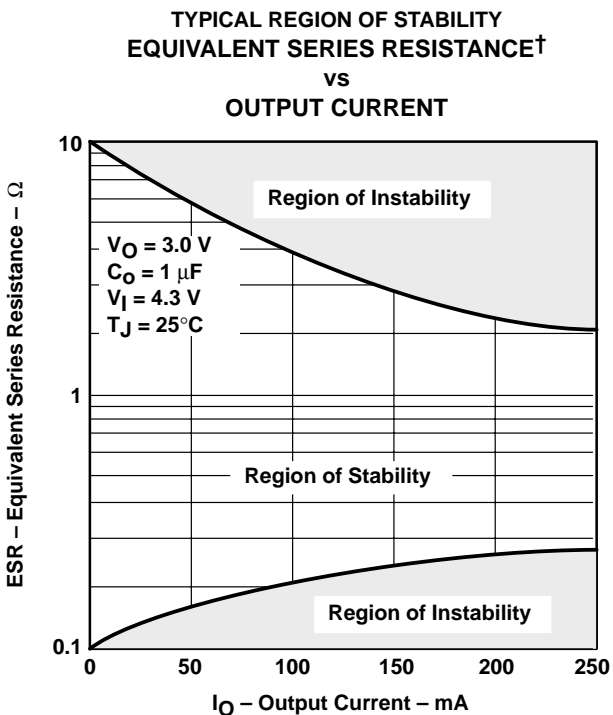


Figure 18

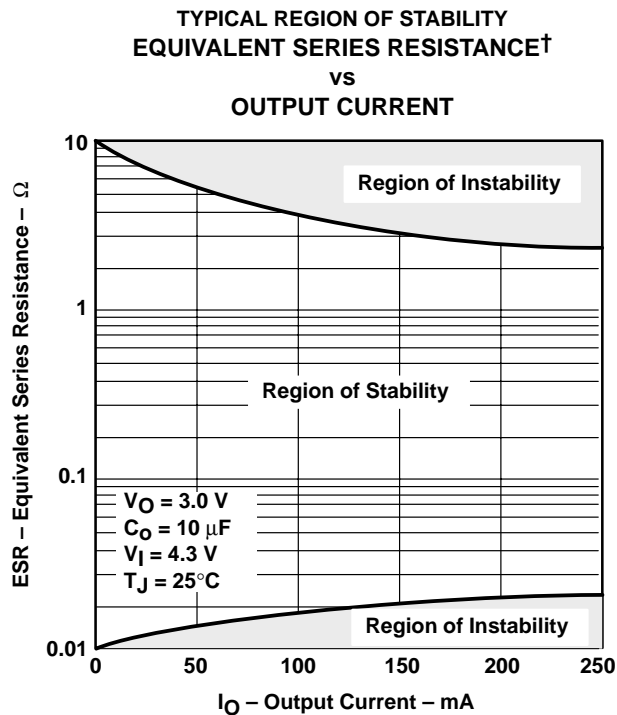


Figure 19

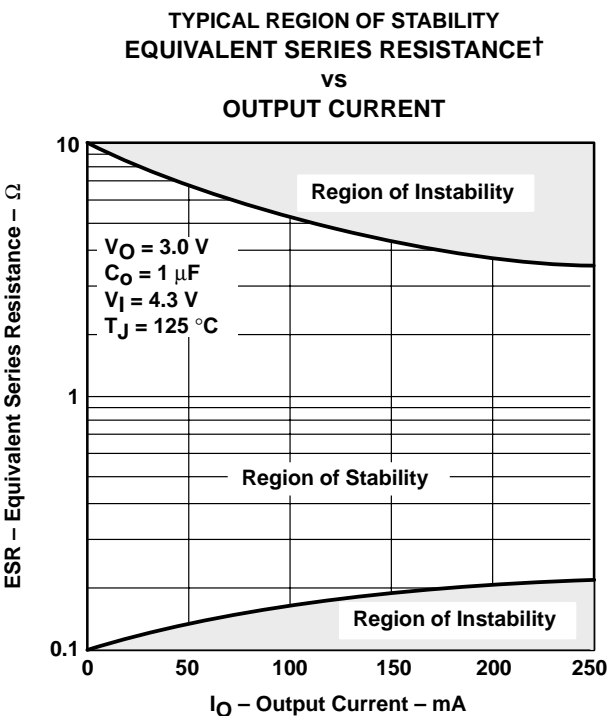


Figure 20

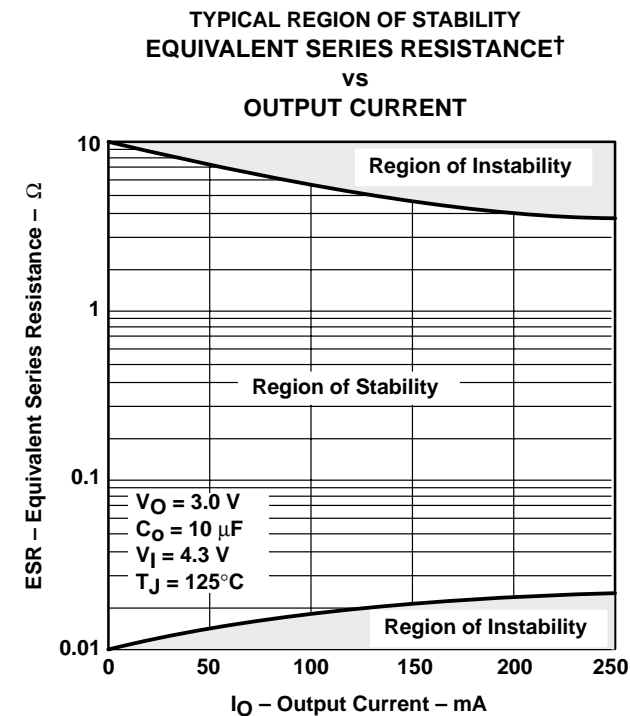


Figure 21

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

# TPS77901, TPS77918, TPS77925, TPS77930

## 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

### APPLICATION INFORMATION

#### external capacitor requirements

An input capacitor is not usually required; however, a bypass capacitor (0.047  $\mu\text{F}$  or larger) improves load transient response and noise rejection if the TPS779xx is located more than a few inches from the power supply. A higher-capacitance capacitor may be necessary if large (hundreds of milliamps) load transients with fast rise times are anticipated.

Most low noise LDOs require an external capacitor to further reduce noise. This will impact the cost and board space. The TPS779xx has a very low noise specification requirement without using any external component.

Like all low dropout regulators, the TPS779xx requires an output capacitor connected between OUT (output of the LDO) and GND (signal ground) to stabilize the internal control loop. The minimum recommended capacitance value is 1  $\mu\text{F}$  provided the ESR meets the requirement in Figures 19 and 21. In addition, a low-ESR capacitor can be used if the capacitance is at least 10  $\mu\text{F}$  and the ESR meets the requirements in Figures 18 and 20. Solid tantalum electrolytic, aluminum electrolytic, and multilayer ceramic capacitors are all suitable, provided they meet the requirements described previously.

Ceramic capacitors have different types of dielectric material with each exhibiting different temperature and voltage variation. The most common types are X5R, X7R, Y5U, Z5U, and NPO. The NPO type ceramic type capacitors are generally the most stable over temperature. However, the X5R and X7R are also relatively stable over temperature (with the X7R being the more stable of the two) and are therefore acceptable to use. The Y5U and Z5U types provide high capacitance in a small geometry, but exhibit large variations over temperature; therefore, the Y5U and Z5U are not generally recommended for use on this LDO. Independent of which type of capacitor is used, one must make certain that at the worst case condition the capacitance/ESR meets the requirement specified in Figures 18 through 21.

Figure 22 shows the output capacitor and its parasitic impedances in a typical LDO output stage.

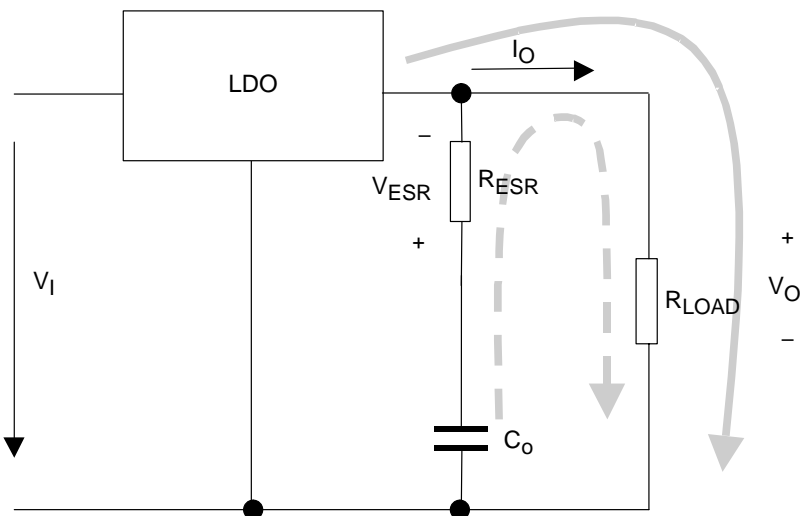


Figure 22. – LDO Output Stage With Parasitic Resistances ESR

## APPLICATION INFORMATION

### external capacitor requirements (continued)

In steady state (dc state condition), the load current is supplied by the LDO (solid arrow) and the voltage across the capacitor is the same as the output voltage ( $V(C_O) = V_O$ ). This means no current is flowing into the  $C_O$  branch. If  $I_O$  suddenly increases (transient condition), the following occurs:

- The LDO is not able to supply the sudden current need due to its response time ( $t_1$  in Figure 23). Therefore, capacitor  $C_O$  provides the current for the new load condition (dashed arrow).  $C_O$  now acts like a battery with an internal resistance, ESR. Depending on the current demand at the output, a voltage drop will occur at  $R_{ESR}$ . This voltage is shown as  $V_{ESR}$  in Figure 22.
- When  $C_O$  is conducting current to the load, initial voltage at the load will be  $V_O = V(C_O) - V_{ESR}$ . Due to the discharge of  $C_O$ , the output voltage  $V_O$  will drop continuously until the response time  $t_1$  of the LDO is reached and the LDO will resume supplying the load. From this point, the output voltage starts rising again until it reaches the regulated voltage. This period is shown as  $t_2$  in Figure 23.

The figure also shows the impact of different ESRs on the output voltage. The left brackets show different levels of ESRs where number 1 displays the lowest and number 3 displays the highest ESR.

From above, the following conclusions can be drawn:

- The higher the ESR, the larger the droop at the beginning of load transient.
- The smaller the output capacitor, the faster the discharge time and the bigger the voltage droop during the LDO response period.

### conclusion

To minimize the transient output droop, capacitors must have a low ESR and be large enough to support the minimum output voltage requirement.

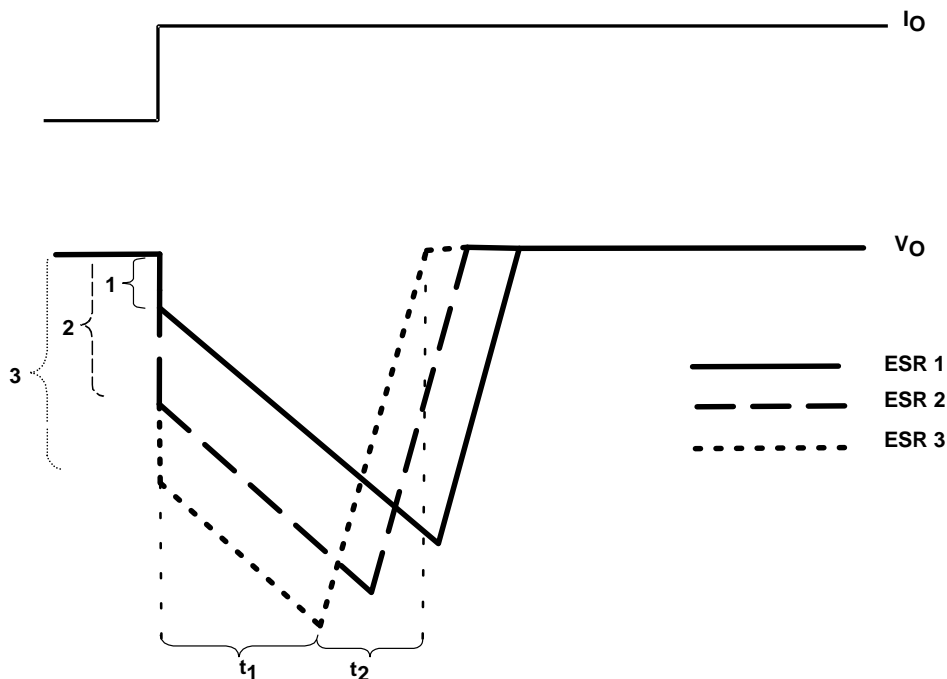


Figure 23. – Correlation of Different ESRs and Their Influence to the Regulation of  $V_O$  at a Load Step From Low-to-High Output Current

# TPS77901, TPS77918, TPS77925, TPS77930

## 250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

### APPLICATION INFORMATION

#### programming the TPS77901 adjustable LDO regulator

The output voltage of the TPS77901 adjustable regulator is programmed using an external resistor divider as shown in Figure 24. The output voltage is calculated using:

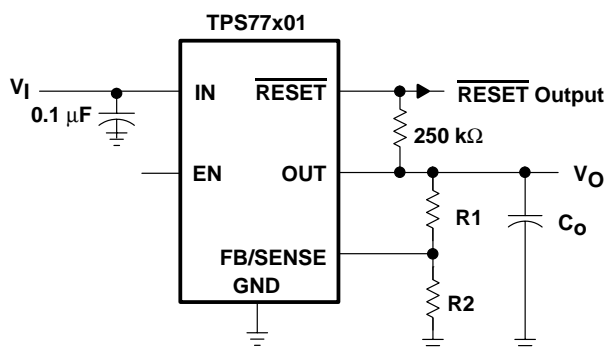
$$V_O = V_{ref} \times \left(1 + \frac{R1}{R2}\right) \quad (1)$$

Where:

$V_{ref} = 1.1834 \text{ V typ}$  (the internal reference voltage)

Resistors R1 and R2 should be chosen for approximately 50- $\mu\text{A}$  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  $R2 = 30.1 \text{ k}\Omega$  to set the divider current at 50  $\mu\text{A}$  and then calculate R1 using:

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



OUTPUT VOLTAGE  
PROGRAMMING GUIDE

OUTPUT VOLTAGE	R1	R2	UNIT
2.5 V	33.5	30.1	k $\Omega$
3.3 V	53.8	30.1	k $\Omega$
3.6 V	61.5	30.1	k $\Omega$

NOTE: To reduce noise and prevent oscillation, R1 and R2 need to be as close as possible to the FB/SENSE terminal.

Figure 24. TPS77901 Adjustable LDO Regulator Programming

#### regulator protection

The TPS779xx PMOS-pass transistor has a built-in back diode that 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. When extended reverse voltage is anticipated, external limiting may be appropriate.

The TPS779xx also features internal current limiting and thermal protection. During normal operation, the TPS779xx limits output current to approximately 0.9 A. 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 150°C(typ), thermal-protection circuitry shuts it down. Once the device has cooled below 130°C(typ), regulator operation resumes.



## APPLICATION INFORMATION

### 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 the following equation:

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

Where:

$T_{Jmax}$  is the maximum allowable junction temperature.

$R_{\theta JA}$  is the thermal resistance junction-to-ambient for the package, i.e., 266.2°C/W for the 8-terminal MSOP with no airflow.

$T_A$  is the ambient temperature.

The regulator dissipation is calculated using:

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

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

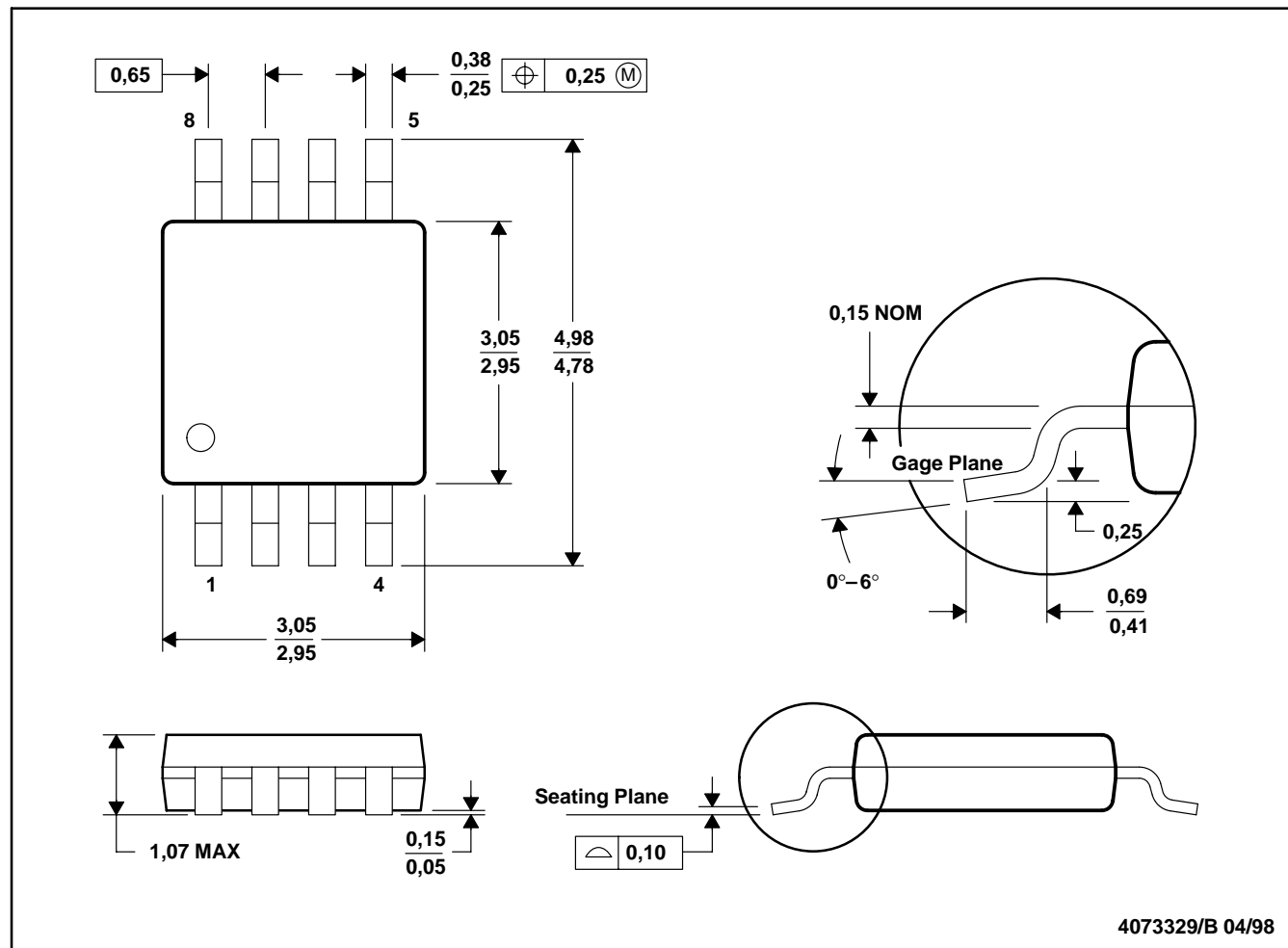
**TPS77901, TPS77918, TPS77925, TPS77930**  
**250-mA LDO REGULATOR WITH INTEGRATED RESET IN A MSOP8 PACKAGE**

SLVS283D – MARCH 2000 – REVISED OCTOBER 2000

**MECHANICAL DATA**

**DGK (R-PDSO-G8)**

**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-187



**www.BDTC.com/TI**

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TPS77901DGK	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77901DGKG4	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77901DGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77901DGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77918DGK	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77918DGKG4	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77918DGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77918DGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77925DGK	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77925DGKG4	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77930DGK	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77930DGKG4	ACTIVE	MSOP	DGK	8	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77930DGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TPS77930DGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is

provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS77901DGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS77918DGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1
TPS77930DGKR	MSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS77901DGKR	MSOP	DGK	8	2500	358.0	335.0	35.0
TPS77918DGKR	MSOP	DGK	8	2500	358.0	335.0	35.0
TPS77930DGKR	MSOP	DGK	8	2500	358.0	335.0	35.0

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

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

### Products

Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2009, Texas Instruments Incorporated