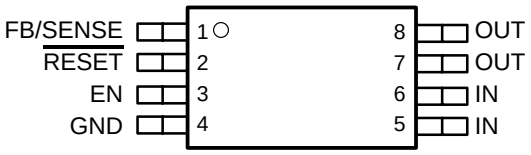
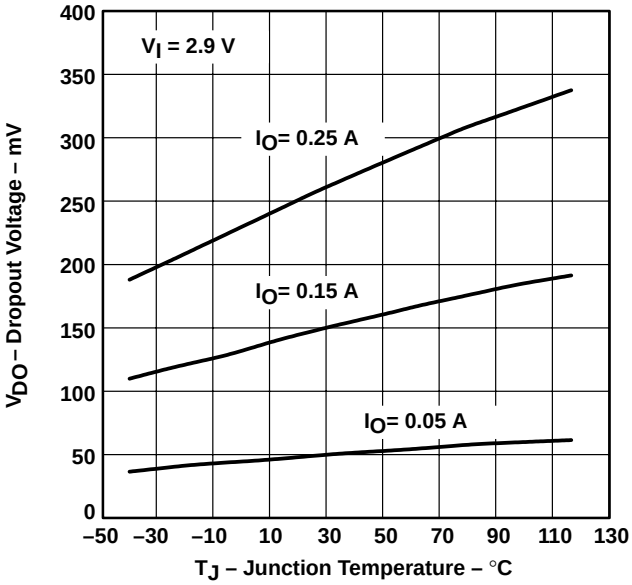
- **Open Drain Power-On Reset With 220-ms Delay**
- **250-mA Low-Dropout Voltage Regulator**
- **Available in 1.8-V, 2.5-V, 3-V, Fixed Output and Adjustable Versions**
- **Dropout Voltage Typically 200 mV at 250 mA (TPS77930)**
- **Ultralow 92-μA Quiescent Current (Typ)**
- **8-Pin MSOP (DGK) Package**
- **Low Noise (55 μV_{rms}) 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**

TPS779xx
DGK PACKAGE
(TOP VIEW)



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 μA at full load dropping down to 1 μA when the device is disabled. The device is optimized to be stable with a wide range of output capacitors including low ESR ceramic (10 μF) or low capacitance (1 μF) tantalum capacitors. The device has extremely low noise output performance (55 μV_{rms}) 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 μA 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 μA at T_J = 25°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.

Copyright © 2000, Texas Instruments Incorporated

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_J	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).

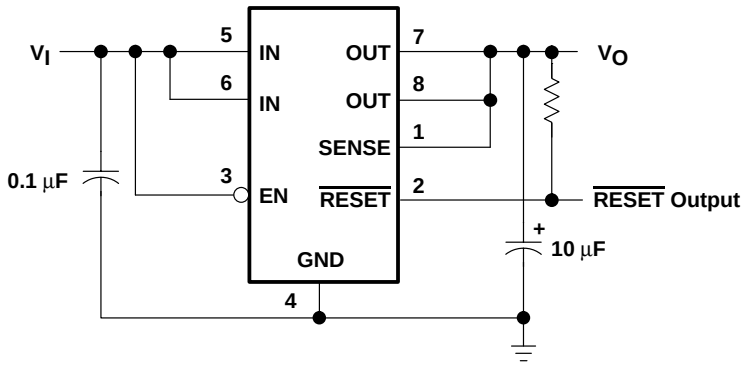
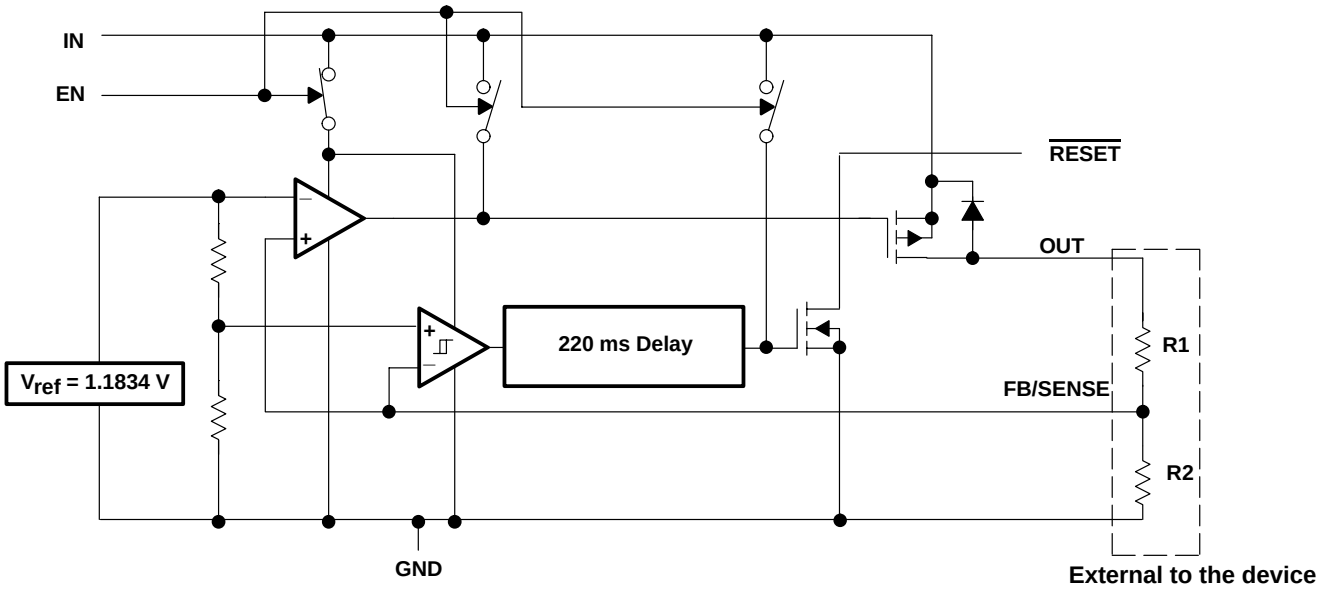
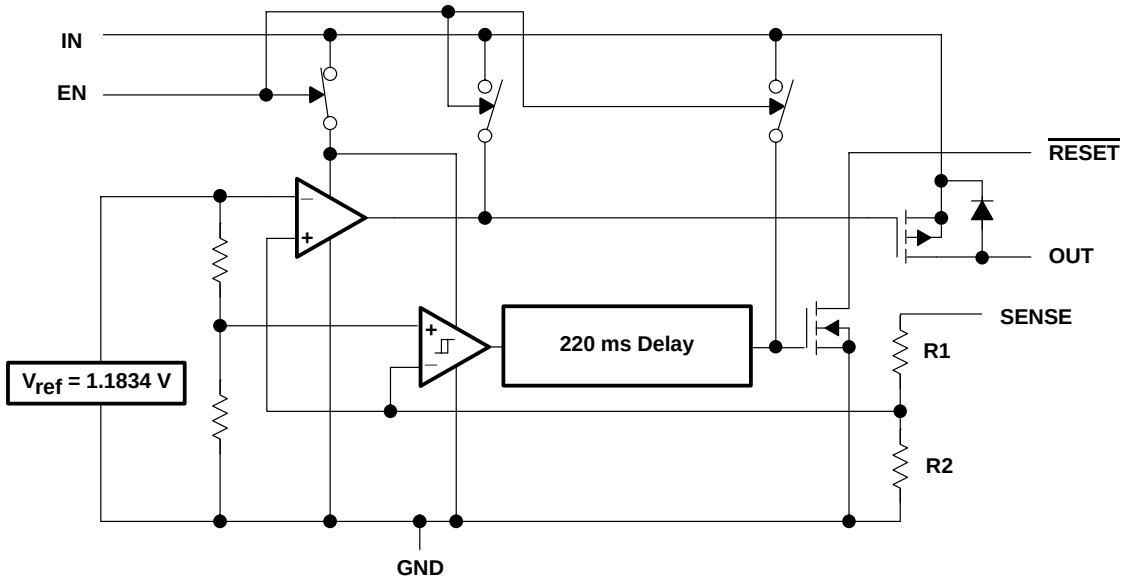


Figure 1. Typical Application Configuration (For Fixed Output Options)

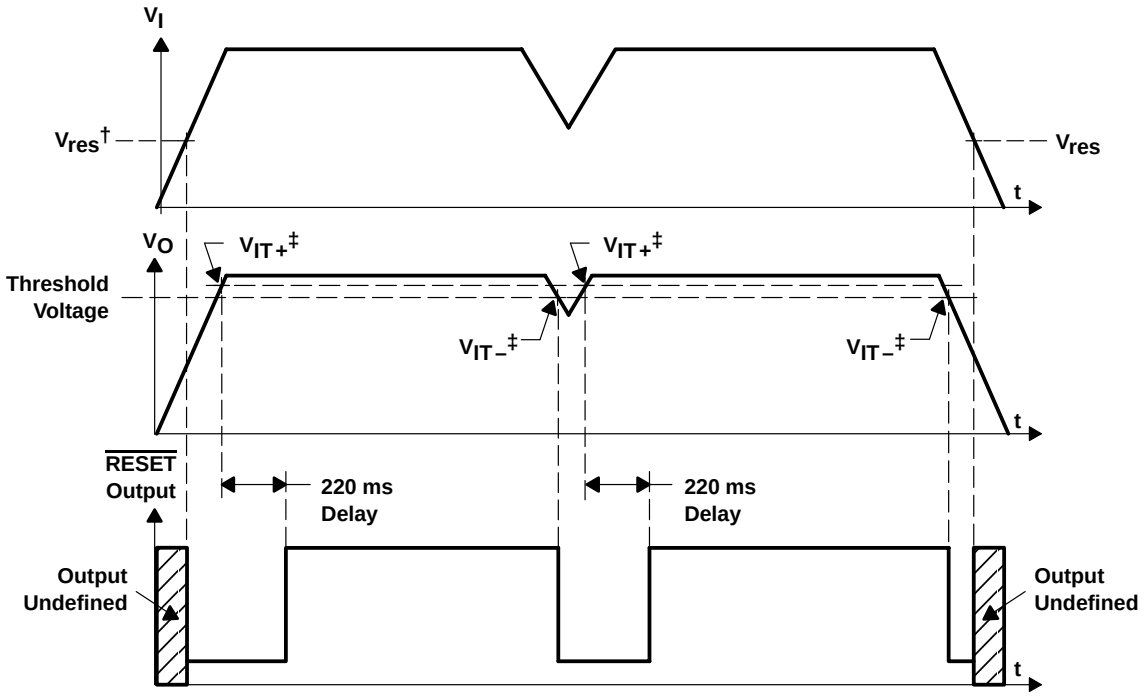
functional block diagram—adjustable version



functional block diagram—fixed-voltage version



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	TERMINAL NO.	I/O	DESCRIPTION
FB/SENSE	1	I	Feedback input voltage for adjustable device (sense input for fixed options)
$\overline{\text{RESET}}$	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

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 ($\overline{RESET}$)

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

absolute maximum ratings over operating junction temperature range (unless otherwise noted)†

Input voltage range‡, V_I . . . . . –0.3 V to 13.5 V
Voltage range at EN . . . . . –0.3 V to 16.5 V
Maximum $\overline{RESET}$ 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_{stg} . . . . . –65°C to 150°C
ESD rating, HBM . . . . . 2 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 voltage values are with respect to network terminal ground.

DISSIPATION RATING TABLE – FREE-AIR TEMPERATURES

PACKAGE	AIR FLOW (CFM)	θ_{JA} (°C/W)	θ_{JC} (°C/W)	T_A < 25°C POWER RATING	DERATING FACTOR ABOVE T_A = 25°C	T_A = 70°C POWER RATING	T_A = 85°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

recommended operating conditions

	MIN	MAX	UNIT
Input voltage, V_I†	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°C to 125°C), $V_I = V_{O(typ)}$ + 1 V, I_O = 1 mA, EN = 5 V, C_O = 10 μF (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_O	Output voltage (see Notes 2 and 4)	Adjustable voltage	1.5 V ≤ V_O ≤ 5.5 V,	T_J = 25°C		V_O		V
			1.5 V ≤ V_O ≤ 5.5 V		0.98V_O		1.02V_O	
		1.8 V Output	T_J = 25°C,	2.8 V < V_I < 10 V		1.8		
			2.8 V < V_I < 10 V		1.764		1.836	
		2.5 V Output	T_J = 25°C,	3.5 V < V_I < 10 V		2.5		
			3.5 V < V_I < 10 V		2.45		2.55	
		3.0 V Output	T_J = 25°C,	4.0 V < V_I < 10 V		3.0		
			4.0 V < V_I < 10 V		2.94		3.06	
Quiescent current (GND current) (see Notes 2 and 4)			T_J = 25°C			92		μA
							125	
Output voltage line regulation ($\Delta V_O/V_O$) (see Note 3)			V_O + 1 V < V_I ≤ 10 V,	T_J = 25°C		0.005		%/V
			V_O + 1 V < V_I ≤ 10 V				0.05	%/V
Load regulation			T_J = 25°C			1		mV
V_n	Output noise voltage	TPS77918	BW = 300 Hz to 100 kHz, T_J = 25°C,			55		μVrms
I_o	Output current limit		V_O = 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_I,	T_J = 25°C			1	μA
			EN = V_I				3	μA
FB input current		Adjustable voltage	FB = 1.5 V				1	μA
V_{IH}	High level enable input voltage				2			V
V_{IL}	Low level enable input voltage						0.7	V
Enable input current					–1		1	μA
Power supply ripple rejection (TPS77318, TPS77418)			f = 1 KHz,	T_J = 25°C		55		dB

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

3. If V_O < 1.8 V then V_{Imax} = 10 V, V_{Imin} = 2.7 V:

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

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

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

4. I_O = 1 mA to 250 mA

electrical characteristics over recommended operating junction temperature range (T_J = –40°C to 125°C), $V_I = V_{O(typ)}$ + 1 V, I_O = 1 mA, EN = 5 V, C_O = 10 μF (unless otherwise noted) (continued)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
Reset	Minimum input voltage for valid $\overline{\text{RESET}}$		$I_{(RESET)}$ = 300 μA		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 V, $I_{(RESET)}$ = 1 mA		0.15	0.4	V
	Leakage current		$V_{(RESET)}$ = 5 V			1	μA
	RESET time-out delay				220		ms
V_{DO}	Dropout voltage (see Note 5)	3 V Output	I_O = 250 mA, T_J = 25°C		250		mV
			I_O = 250 mA			475	

NOTE 5: IN voltage equals V_O(typ) – 100 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

TYPICAL CHARACTERISTICS

TPS77930
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

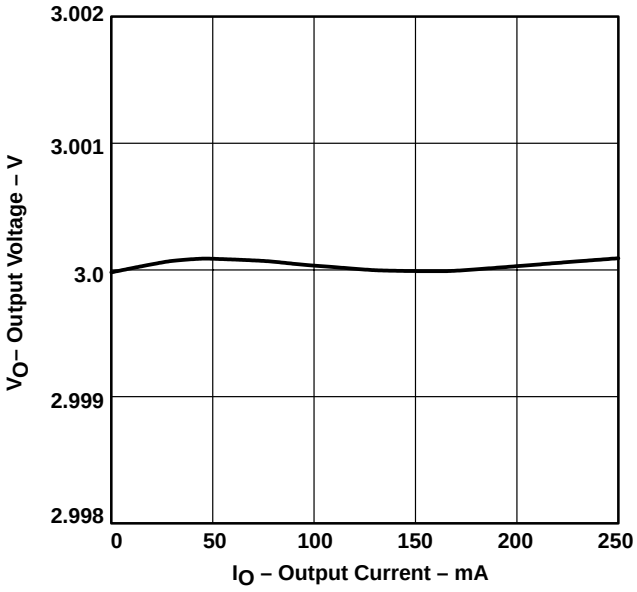


Figure 2

TPS77918
OUTPUT VOLTAGE
vs
OUTPUT CURRENT

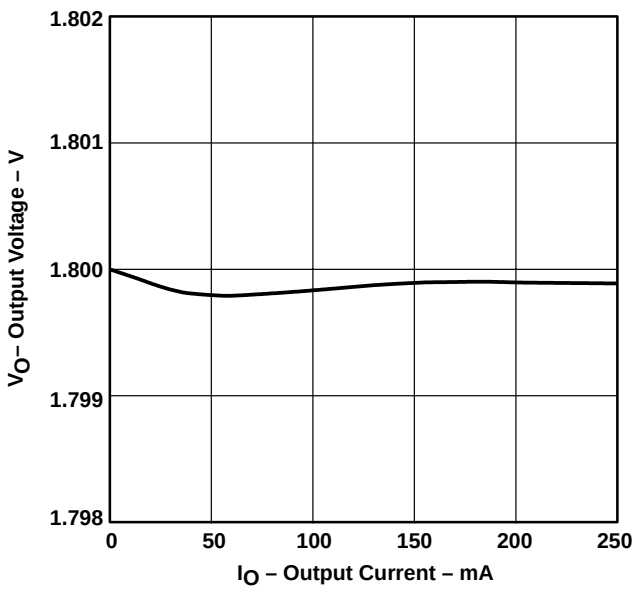


Figure 3

TPS77930
OUTPUT VOLTAGE
vs
JUNCTION TEMPERATURE

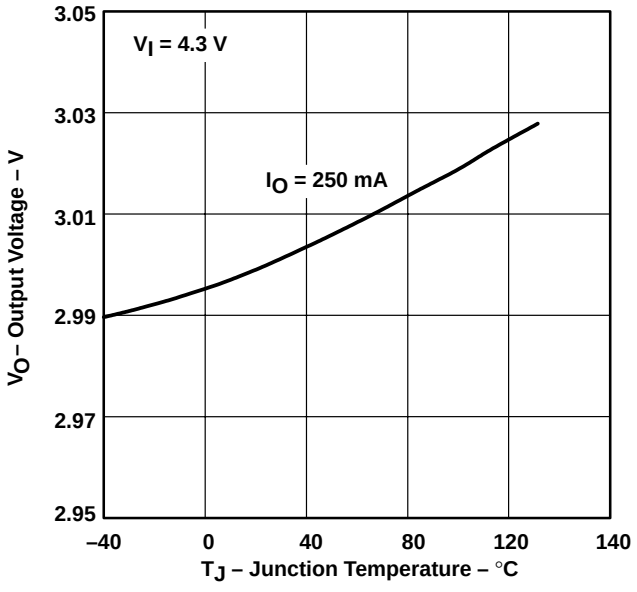


Figure 4

TPS77918
OUTPUT VOLTAGE
vs
JUNCTION TEMPERATURE

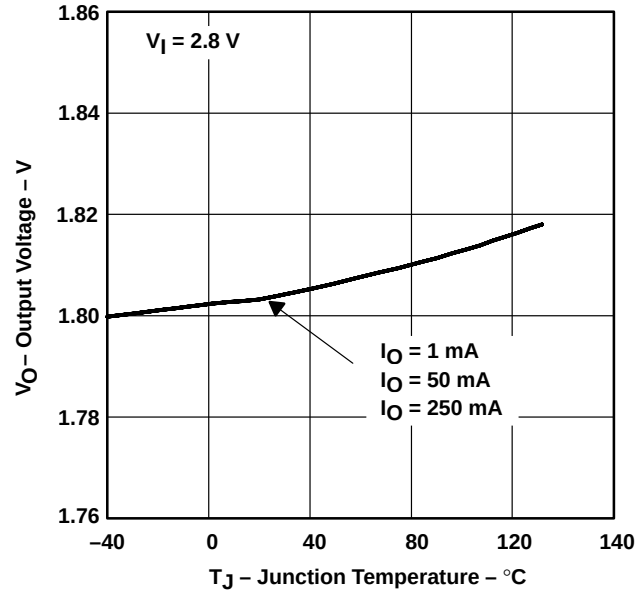


Figure 5

TYPICAL CHARACTERISTICS

TPS779xx
GROUND CURRENT
vs
JUNCTION TEMPERATURE

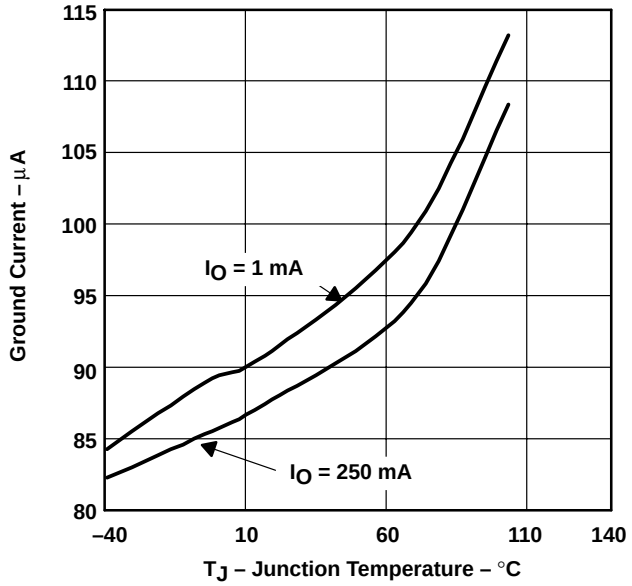


Figure 6

TPS77930
POWER SUPPLY REJECTION RATIO
vs
FREQUENCY

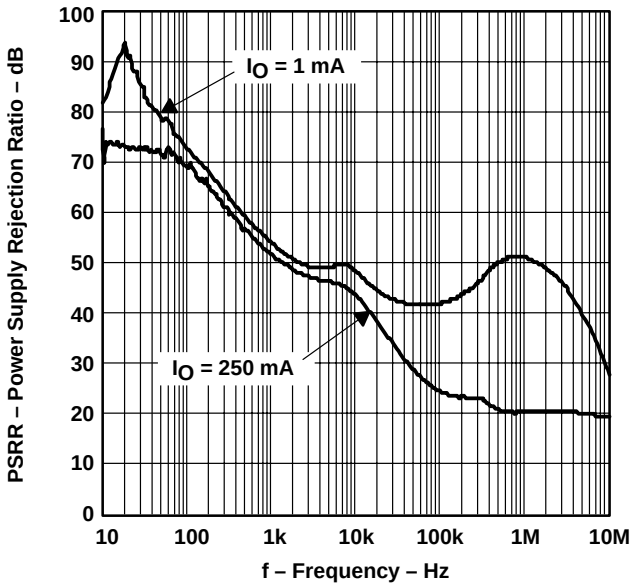


Figure 7

TPS77930
OUTPUT SPECTRAL NOISE DENSITY
vs
FREQUENCY

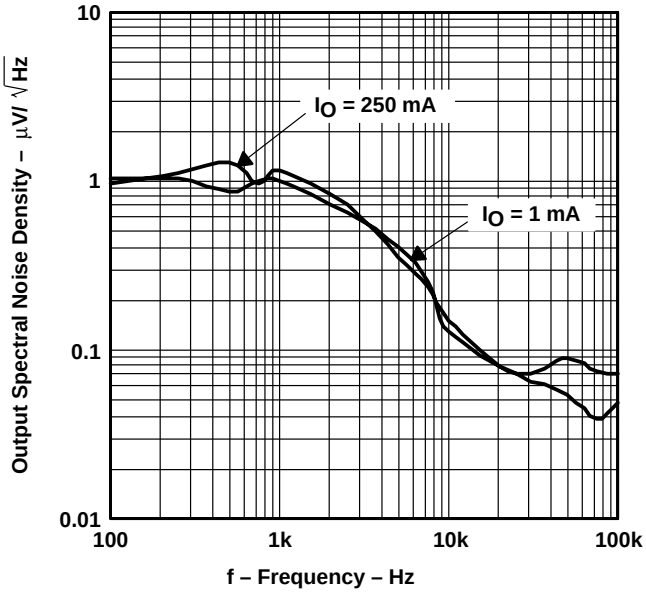


Figure 8

TYPICAL CHARACTERISTICS

TPS77930
OUTPUT IMPEDANCE
vs
FREQUENCY

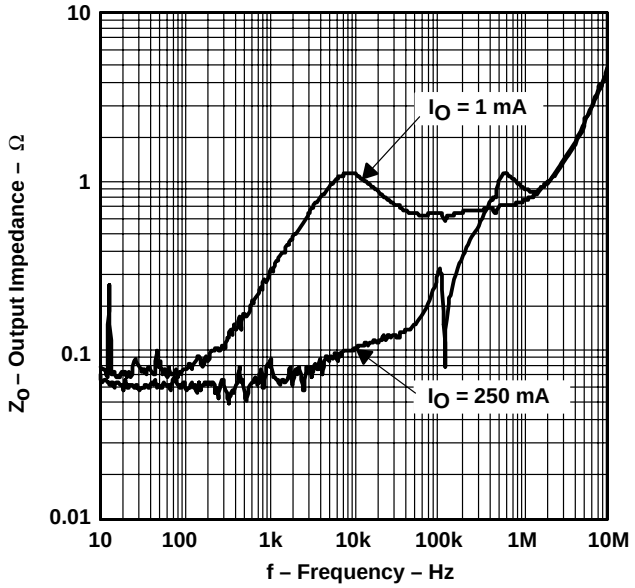


Figure 9

TPS77901
DROPOUT VOLTAGE
vs
INPUT VOLTAGE

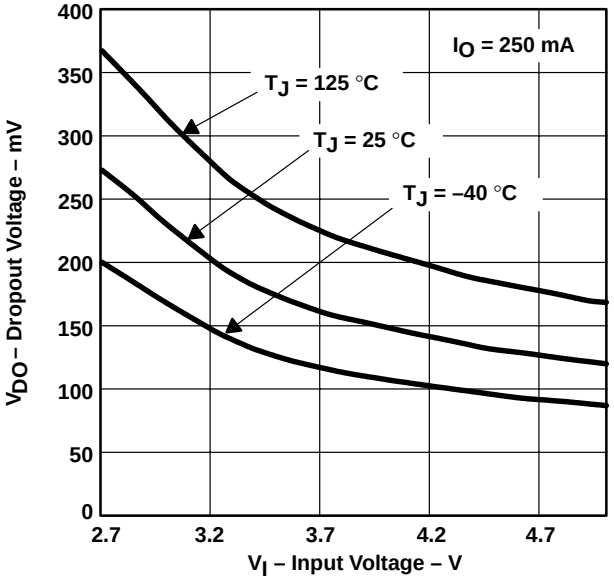


Figure 10

TPS77930
DROPOUT VOLTAGE
vs
JUNCTION TEMPERATURE

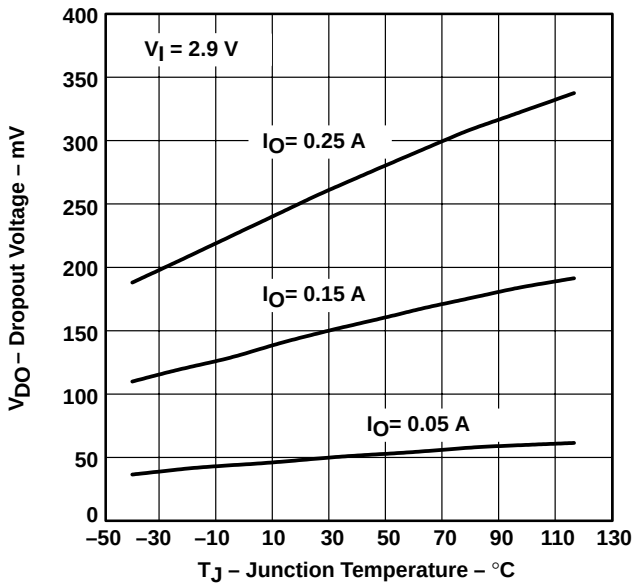


Figure 11

TYPICAL CHARACTERISTICS

TPS77918
LINE TRANSIENT RESPONSE

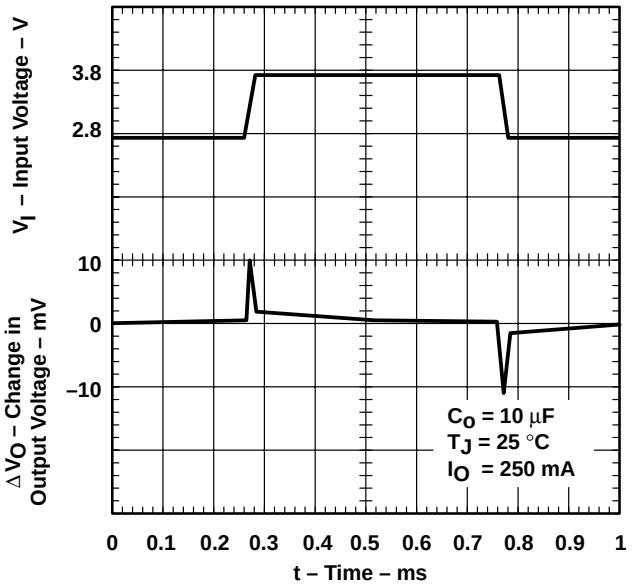


Figure 12

TPS77918
LOAD TRANSIENT RESPONSE

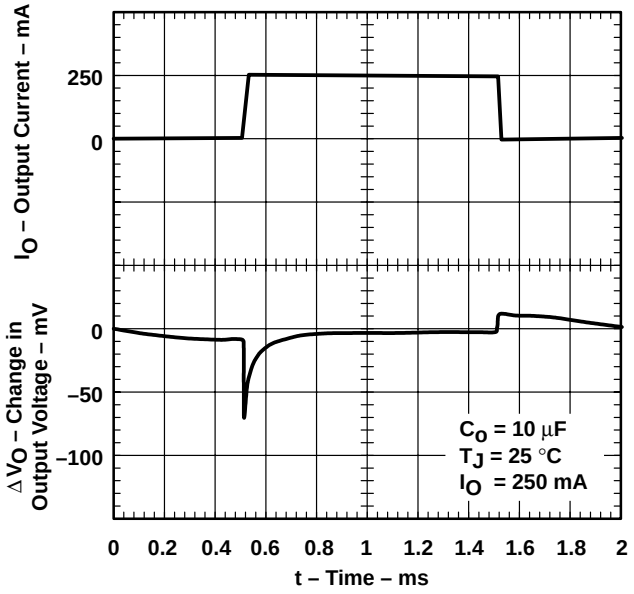


Figure 13

TPS77930
LINE TRANSIENT RESPONSE

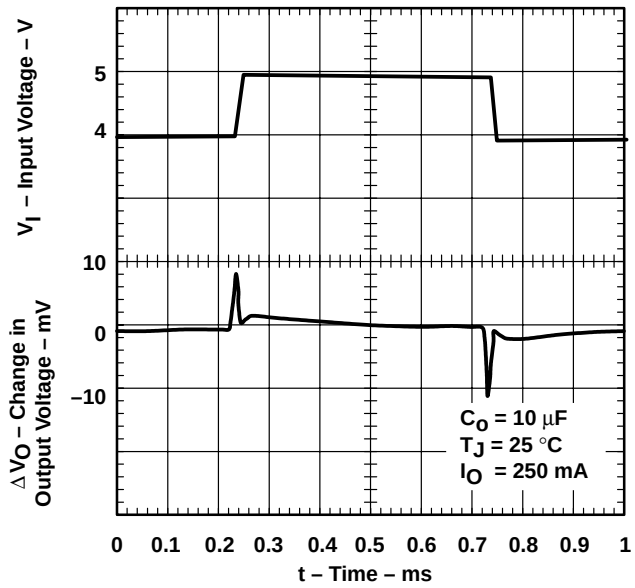


Figure 14

TPS77930
LOAD TRANSIENT RESPONSE

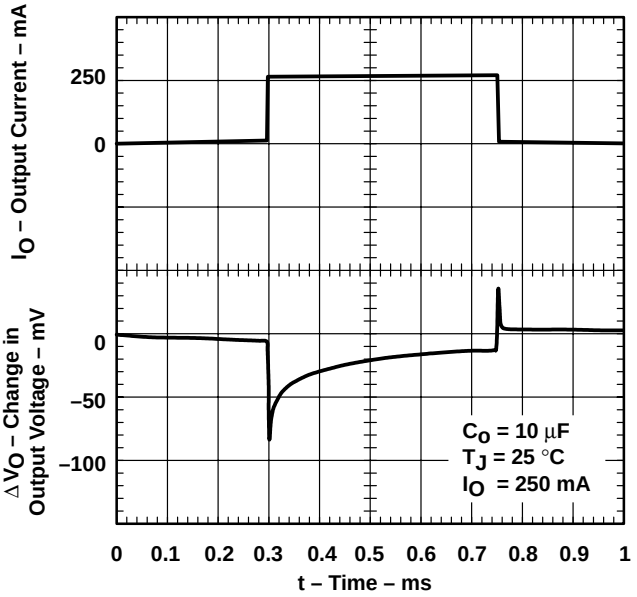


Figure 15

TYPICAL CHARACTERISTICS

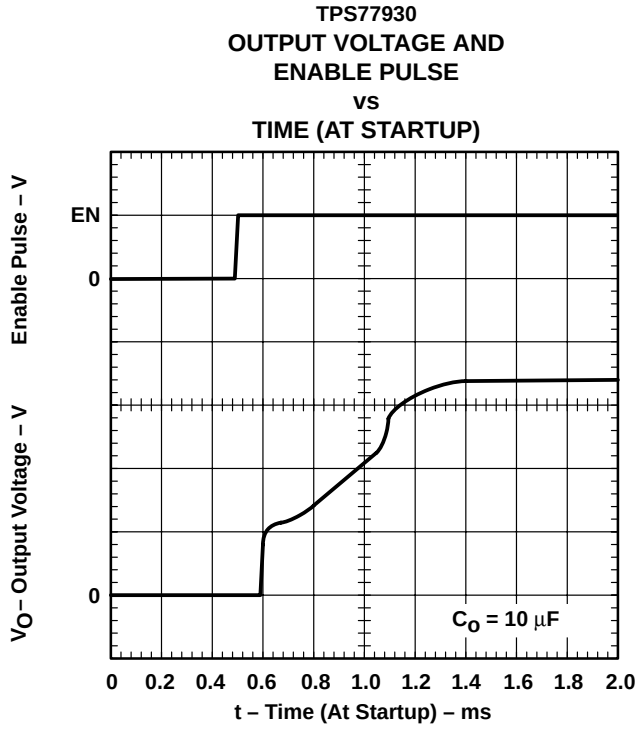


Figure 16

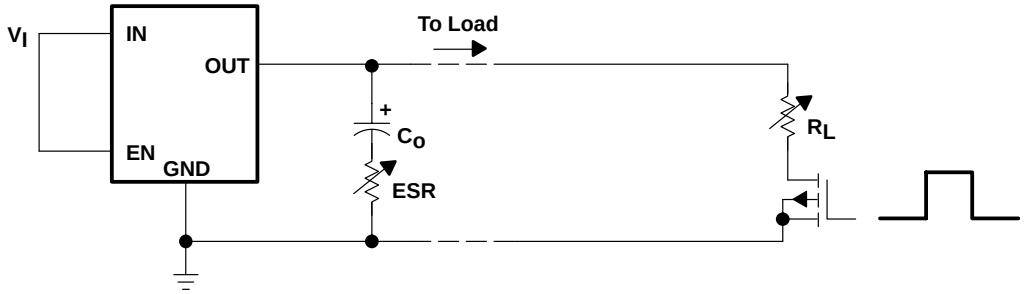


Figure 17. Test Circuit for Typical Regions of Stability (Figures 18 through 21) (Fixed Output Options)

TYPICAL CHARACTERISTICS

TYPICAL REGION OF STABILITY
EQUIVALENT SERIES RESISTANCE†
vs
OUTPUT CURRENT

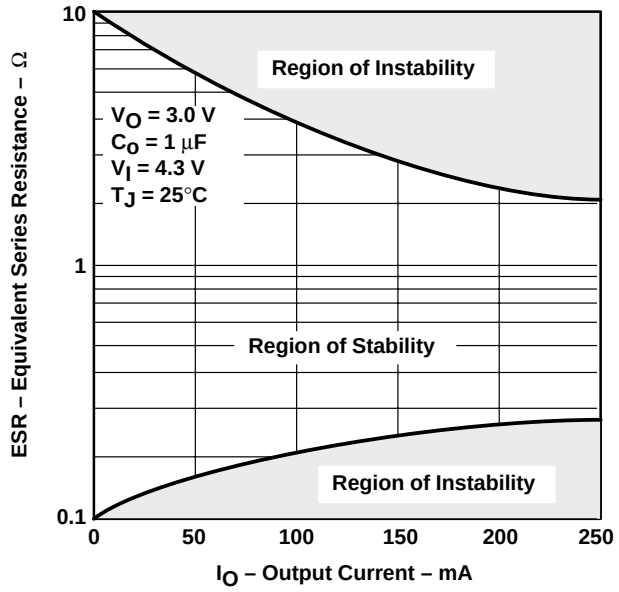


Figure 18

TYPICAL REGION OF STABILITY
EQUIVALENT SERIES RESISTANCE†
vs
OUTPUT CURRENT

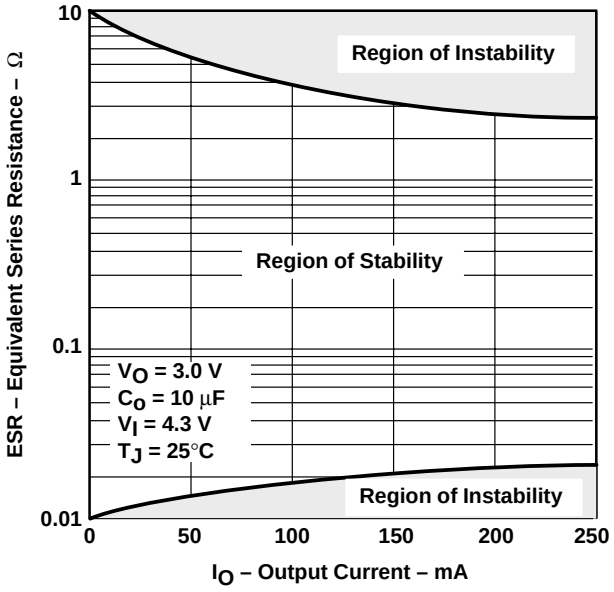


Figure 19

TYPICAL REGION OF STABILITY
EQUIVALENT SERIES RESISTANCE†
vs
OUTPUT CURRENT

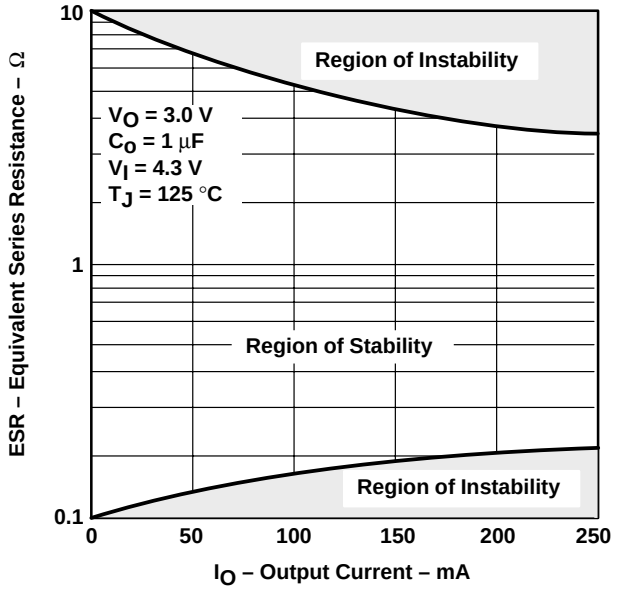


Figure 20

TYPICAL REGION OF STABILITY
EQUIVALENT SERIES RESISTANCE†
vs
OUTPUT CURRENT

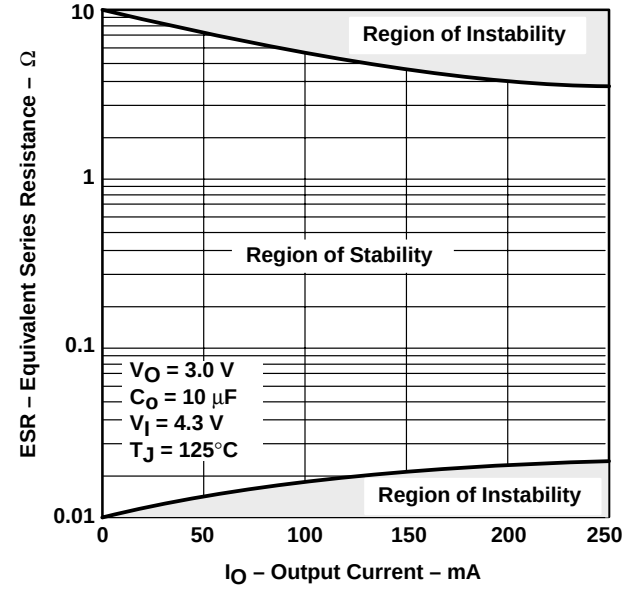


Figure 21

† 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.

APPLICATION INFORMATION

external capacitor requirements

An input capacitor is not usually required; however, a bypass capacitor (0.047 μF 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 μF 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 μF 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.

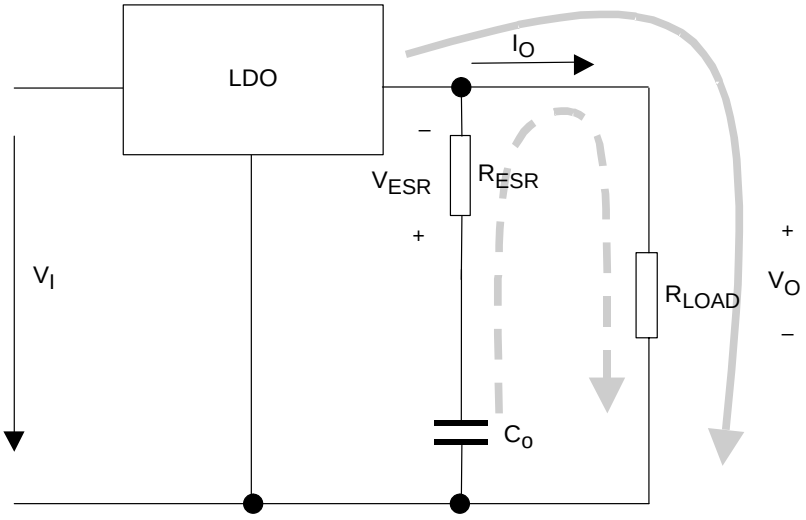


Figure 22. – LDO Output Stage With Parasitic Resistances ESR

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 ($V(C_0) = V_O$). This means no current is flowing into the C_0 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_0 provides the current for the new load condition (dashed arrow). C_0 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_0 is conducting current to the load, initial voltage at the load will be $V_O = V(C_0) – V_{ESR}$. Due to the discharge of C_0, 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.

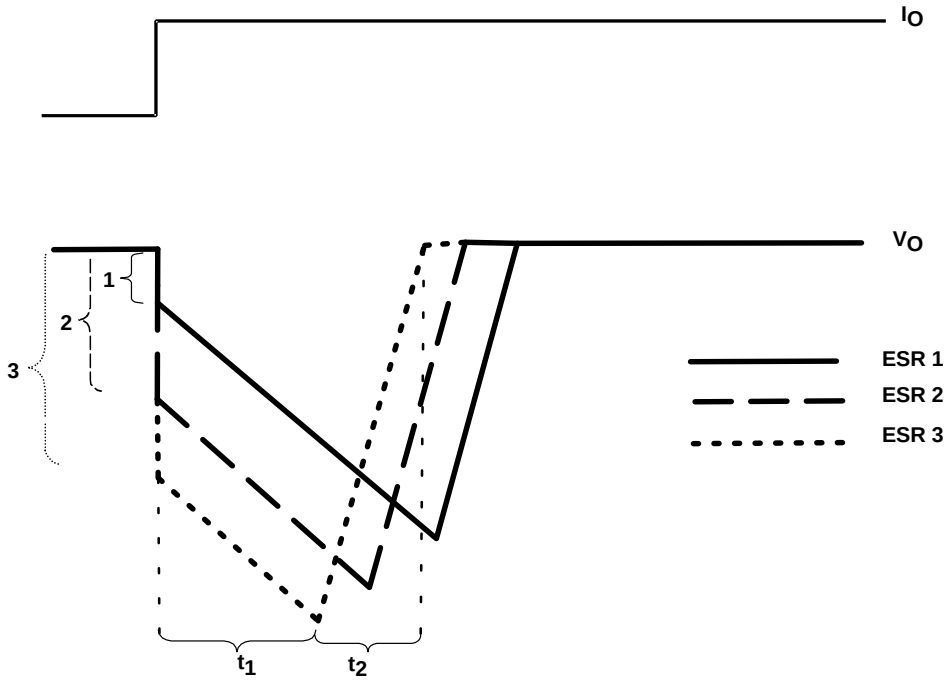


Figure 23. – Correlation of Different ESRs and Their Influence to the Regulation of V_O at a Load Step From Low-to-High Output Current

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:

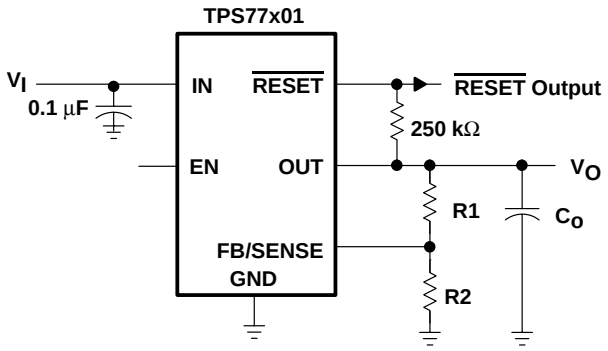
$$V_O = V_{ref} \times \left(1 + \frac{R1}{R2}\right) \quad (1)$$

Where:

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

Resistors R1 and R2 should be chosen for approximately 50-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 = 30.1 kΩ to set the divider current at 50 μA 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	kΩ
3.3 V	53.8	30.1	kΩ
3.6 V	61.5	30.1	kΩ

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:

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

Where:

$T_J max$ is the maximum allowable junction temperature.

$R_{\theta JA}$ is the thermal resistance junction-to-ambient for the package, 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:

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

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

PACKAGING INFORMATION

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

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

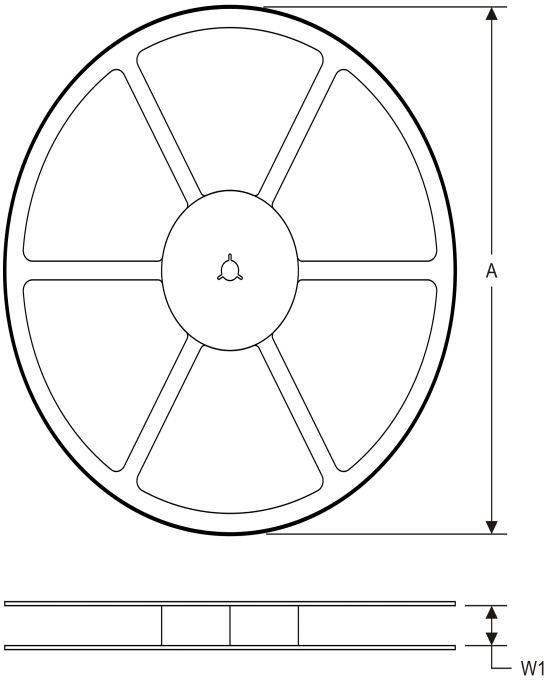
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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.

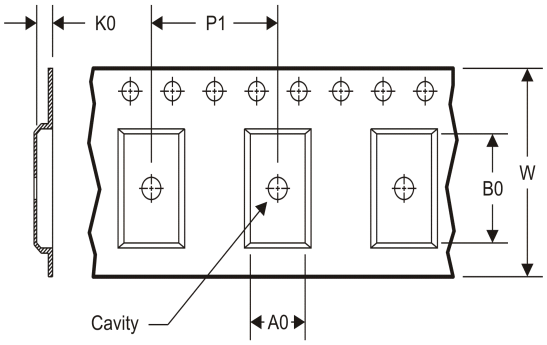
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



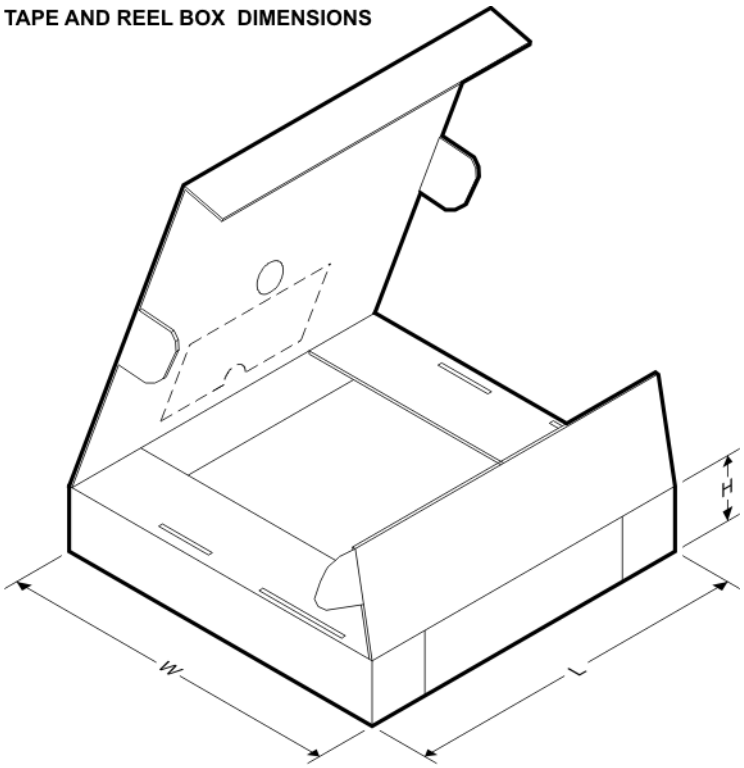
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

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	VSSOP	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	VSSOP	DGK	8	2500	358.0	335.0	35.0

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46C and to discontinue any product or service per JESD48B. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Mobile Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2012, Texas Instruments Incorporated