

## LOW INPUT VOLTAGE, CAP FREE 150 mA LOW-DROPOUT (LDO) LINEAR REGULATOR

### FEATURES

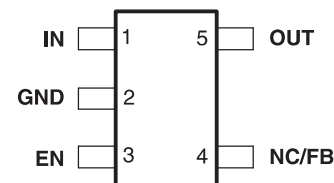
- **Controlled Baseline**
  - One Assembly Site
  - One Test Site
  - One Fabrication Site
- **Extended Temperature Performance of –55°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product-Change Notification**
- **Qualification Pedigree <sup>(1)</sup>**
- **150 mA Low-Dropout (LDO)**
- **Available in 1.8 V Fixed-Output Version**
- **Low Input Voltage Requirement (Down to 1.8 V)**
- **Small Output Capacitor, 0.1  $\mu$ F**
- **Dropout Voltage Typically 200 mV at 150 mA**
- **Less Than 3  $\mu$ A Quiescent Current in Shutdown Mode**
- **Thermal Protection**
- **Over Current Limitation**
- **5-Pin SOT-23 (DBV) Package**

(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

### APPLICATIONS

- **Portable Communication Devices**
- **Battery-Powered Equipment**
- **PCMCIA Cards**
- **Personal Digital Assistants**
- **Modems**
- **Bar Code Scanners**
- **Backup Power Supplies**
- **SMPS Post Regulation**
- **Internet Audio**

DBV PACKAGE  
(TOP VIEW)



### DESCRIPTION/ORDERING INFORMATION

The TPS72118 family of LDO regulators is available in fixed voltage options that are commonly used to power the latest DSPs and microcontrollers with a fixed output to 1.8 V. These regulators can be used in a wide variety of applications ranging from portable, battery-powered equipment to PC peripherals. The family features operation over a wide range of input voltages (1.8 V to 5.5 V) and low dropout voltage (150 mV at full load). Therefore, compared to many other regulators that require 2.5 V or higher input voltages for operation, these regulators can be operated directly from two AAA batteries. Also, the typical quiescent current (ground pin current) is low, starting at 85  $\mu$ A during normal operation and 3  $\mu$ A in shutdown mode. These regulators can be operated very efficiently and, in a battery-powered application, help extend the longevity of the device.

Similar LDO regulators require 1  $\mu$ F or larger output capacitors for stability. However, this regulator uses an internal compensation scheme that stabilizes the feedback loop over the full range of input voltages and load currents with output capacitances as low as 0.1  $\mu$ F. Ceramic capacitors of this size are relatively inexpensive and available in small footprints.



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This family of regulators is particularly suited as a portable power supply solution due to its minimal board space requirement and 1.8 V minimum input voltage. Being able to use two off-the-shelf AAA batteries makes system design easier and also reduces component cost. Moreover, the solution is more efficient than if a regulator with a higher input voltage is used.



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### ORDERING INFORMATION<sup>(1)</sup>

T <sub>J</sub>	VOLTAGE	PACKAGE <sup>(2)</sup>	PART NUMBER	SYMBOL
–55°C to 125°C	1.8 V	DBV	TPS72118MDBVREP <sup>(3)</sup>	CKZ

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI website at [www.ti.com](http://www.ti.com).
- (2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).
- (3) The DBVR indicates tape and reel of 3000 parts.

### ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range unless otherwise noted<sup>(1)(2)</sup>

	TPS72118
Voltage range at IN	–0.3 V to 7 V
Voltage range at EN	–0.3 V to 7 V
Voltage on OUT, FB, NC	–0.3 V to V <sub>I</sub> + 0.3 V
Peak output current	Internally limited
ESD rating, HBM	3 kV
Continuous total power dissipation	See Dissipation Rating Table
Operating junction temperature range, T <sub>J</sub>	–55°C to 150°C
Storage temperature range, T <sub>stg</sub>	–65°C to 150°C

- (1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. All voltage values are with respect to network ground terminal.
- (2) All voltage values are with respect to network ground terminal.

### PACKAGE DISSIPATION RATING

BOARD	PACKAGE	R <sub>θJC</sub>	R <sub>θJA</sub>	DERATING FACTOR ABOVE T <sub>A</sub> = 25°C	T <sub>A</sub> ≤ 25°C POWER RATING	T <sub>A</sub> = 70°C POWER RATING	T <sub>A</sub> = 85°C POWER RATING
Low-K <sup>(1)</sup>	DBV	65.8 °C/W	259 °C/W	3.9 mW/°C	386 mW	212 mW	154 mW
High-K <sup>(2)</sup>	DBV	65.8 °C/W	180 °C/W	5.6 mW/°C	555 mW	305 mW	222 mW

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

## ELECTRICAL CHARACTERISTICS

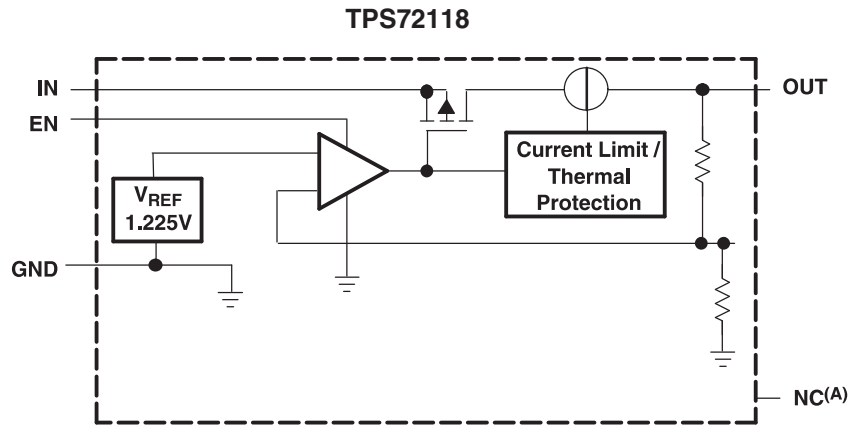
over recommended operating junction temperature range  $V_{IN} = V_{OUT(Nom)} + 1\text{ V}$ ,  $I_{OUT} = 1\text{ mA}$ ,  $EN = V_{IN}$ ,  $C_{OUT} = 1\text{ }\mu\text{F}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{IN}$	Input voltage <sup>(1)</sup>			1.8		5.5	V
$I_{OUT}$	Continuous output current			0		150	mA
$T_J$	Operating junction temperature			-55		125	°C
$V_{OUT}$	Output voltage	$T_J = 25^\circ\text{C}$	$1\text{ mA} < I_{OUT} < 150\text{ mA}$ $2.8\text{ V} \leq V_{IN} \leq 5.5\text{ V}$	1.8			V
		$T_J = \text{Full Temp}$		1.728	1.872		
$I_{(Q)}$	Quiescent current (GND current)	$I_{OUT} = 1\text{ mA}$	$T_J = 25^\circ\text{C}$	85			$\mu\text{A}$
		$I_{OUT} = 1\text{ mA}$	$T_J = \text{Full Temp}$			125	
		$I_{OUT} = 150\text{ mA}$	$T_J = 25^\circ\text{C}$	570			
		$I_{OUT} = 150\text{ mA}$	$T_J = \text{Full Temp}$			850	
	Standby current	$EN < 0.5\text{ V}$	$T_J = 25^\circ\text{C}$	0.01			$\mu\text{A}$
		$EN < 0.5\text{ V}$	$T_J = \text{Full Temp}$			3	
$V_{ref}$	Reference voltage	$T_J = 25^\circ\text{C}$		1.22	5		V
PSRR	Ripple rejection	$f = 100\text{ Hz}$ , $C_O = 10\text{ }\mu\text{F}$ , $I_{OUT} = 150\text{ mA}$	$T_J = 25^\circ\text{C}$ <sup>(1)</sup>	48			dB
	Current limit	See <sup>(2)</sup>		120		525	mA
	Output voltage line regulation ( $\Delta V_{OUT}/V_{OUT}$ ) <sup>(1)</sup>	$V_O + 1\text{ V} < V_{IN} \leq 5.5\text{ V}$ , $I_{OUT} = 150\text{ mA}$	$T_J = 25^\circ\text{C}$	0.03	0.20		%V
			$T_J = \text{Full Temp}$	0.35			
	Output voltage load regulation	$0 < I_{OUT} < 150\text{ mA}$	$T_J = 25^\circ\text{C}$	1.5			mV
$V_{IH}$	EN high level input			1.4			V
$V_{IL}$	EN low level input			0.4			
$I_i$	EN input current	$EN = 0\text{ V}$		-0.0	1		$\mu\text{A}$
		$EN = IN$		-0.0	1		
$V_{DO}$	Dropout voltage <sup>(3)</sup>	$I_{OUT} = 150\text{ mA}$	$T_J = 25^\circ\text{C}$	150			mV
	Thermal shutdown temperature			170			°C
	Thermal shutdown hysteresis			20			°C

(1) Minimum IN operating voltage is 1.8 V or  $V_{OUT} + V_{DO}$ , whichever is greater.

(2) Test condition includes output voltage  $V_O = 1\text{ V}$  and pulse duration = 10 ms.

(3) Dropout voltage is defined as the differential voltage between  $V_O$  and  $V_I$  when  $V_O$  drops 100 mV below the value measured with  $V_{IN} = V_{OUT} + V_{DO}$ .



A. This pin must be left floating and not connected to GND.

Figure 1. Functional Block Diagram—Fixed Version

Terminal Functions

TERMINAL NAME	NO.	DESCRIPTION
GND	2	Ground
EN	3	Enable input
IN	1	Input supply voltage
NC/FB	4	NC = Not connected (see (A)); FB = Feedback (adjustable option TPS72101)
OUT	5	Regulated output voltage

TYPICAL CHARACTERISTICS

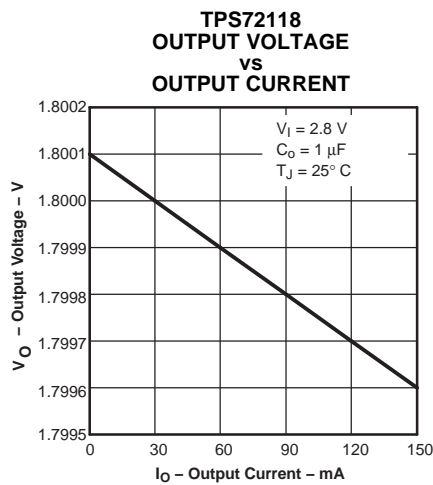


Figure 2.

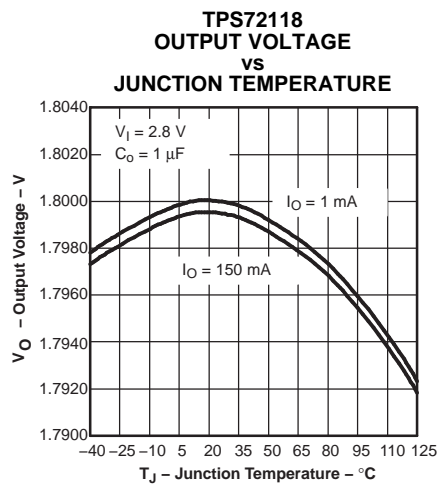


Figure 3.

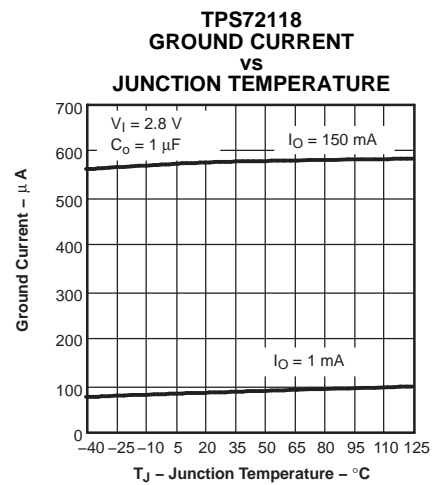


Figure 4.

**TYPICAL CHARACTERISTICS (continued)**

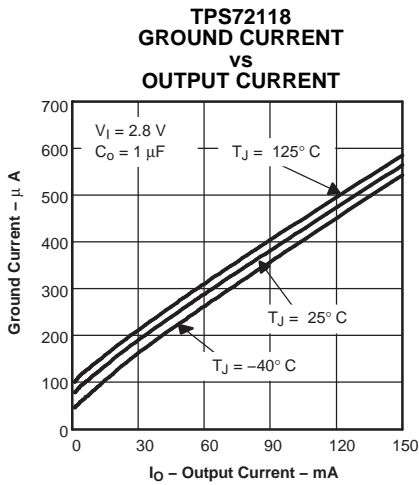


Figure 5.

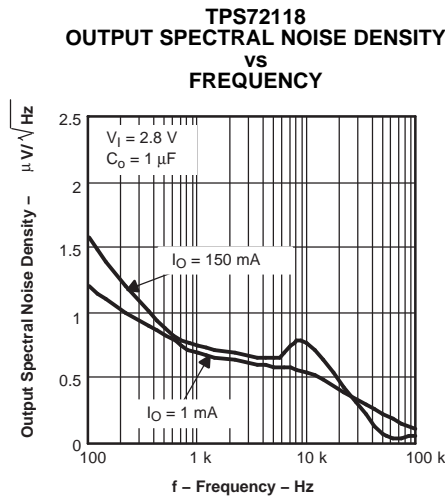


Figure 6.

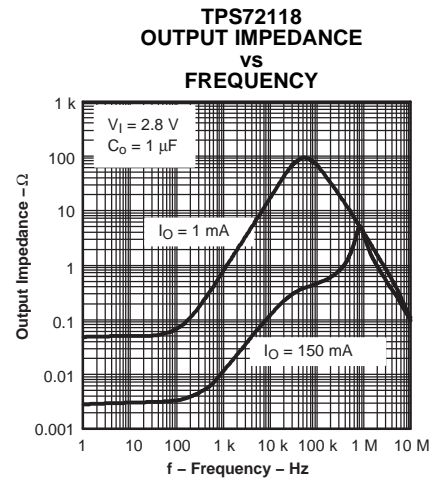


Figure 7.

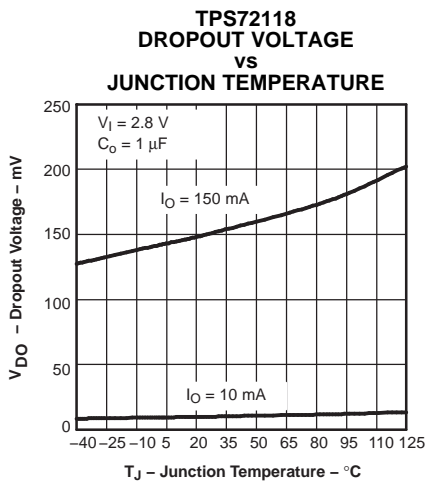


Figure 8.

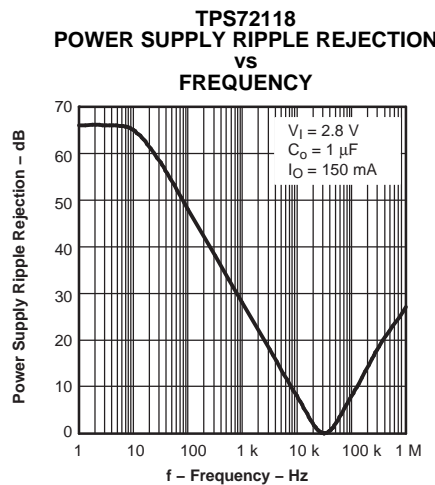


Figure 9.

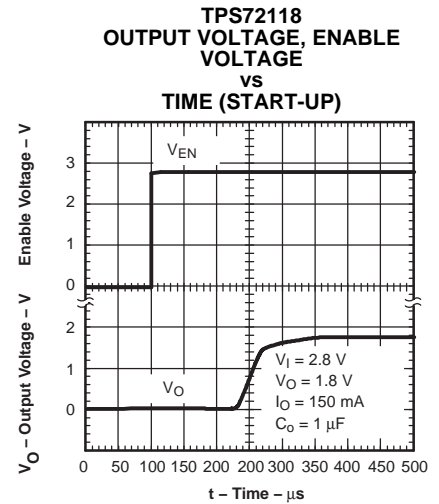


Figure 10.

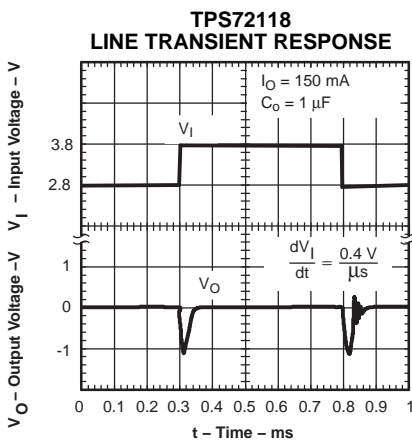


Figure 11.

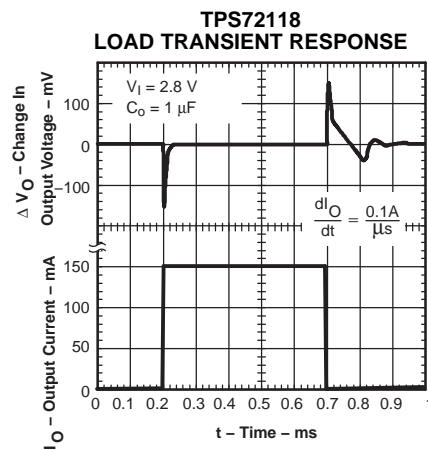


Figure 12.

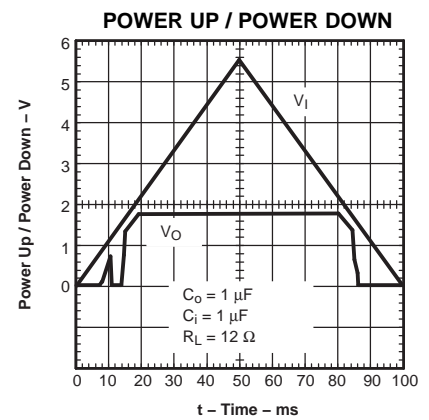
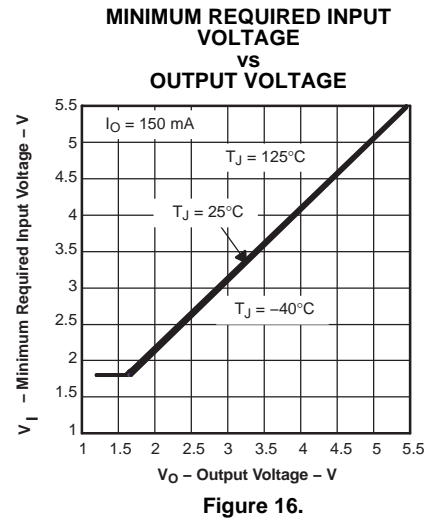
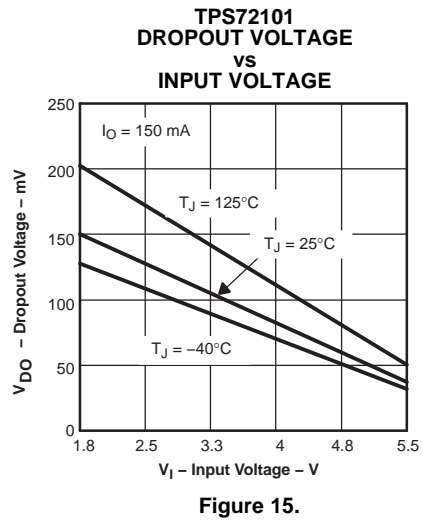
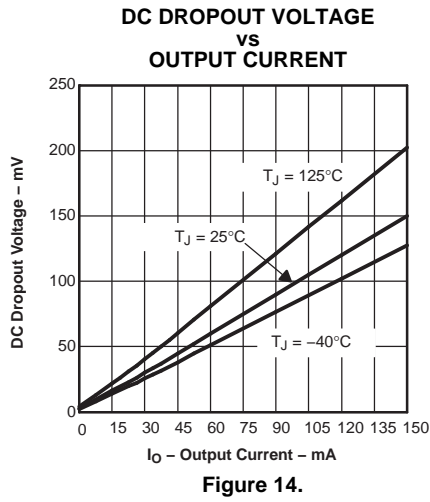


Figure 13.

TYPICAL CHARACTERISTICS (continued)



## APPLICATION INFORMATION

The TPS72118 family of low-dropout (LDO) regulators functions with a very low input voltage ( $>1.8$  V). The dropout voltage is typically 150 mV at full load. Typical quiescent current (ground pin current) is only 85  $\mu$ A and drops to 3  $\mu$ A in the shutdown mode.

## DEVICE OPERATION

The TPS72118 family can be operated at low input voltages due to low voltage circuit design techniques and a PMOS pass element that exhibits low dropout.

A logic low on the enable input, EN, shuts off the output and reduces the supply current to less than 3  $\mu$ A. EN may be tied to  $V_{IN}$  in applications where the shutdown feature is not used.

Current limiting and thermal protection prevent damage by excessive output current and/or power dissipation. The device switches into a constant-current mode at approximately 350 mA; further load reduces the output voltage instead of increasing the output current. The thermal protection shuts the regulator off if the junction temperature rises above 170°C. Recovery is automatic when the junction temperature drops approximately 20°C below the high temperature trip point. The PMOS pass element includes a back diode that safely conducts reverse current when the input voltage level drops below the output voltage level.

A typical application circuit is shown in [Figure 17](#).

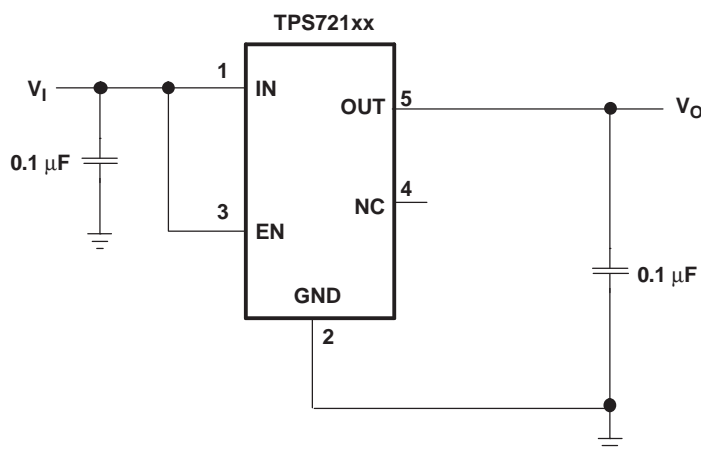


Figure 17. Typical Application Circuit

## DUAL SUPPLY APPLICATION

In portable, battery-powered electronics, separate power rails for the DSP or microcontroller core voltage,  $V_{(CORE)}$ , and I/O peripherals ( $V_{IO}$ ) are usually necessary. The TPS72118 family of LDO linear regulators is ideal for providing  $V_{(CORE)}$  for the DSP or microcontroller. As shown in [Figure 18](#), two AAA batteries provide an input voltage to a boost converter. The batteries combine input voltage ranges from 3.0 V down to 1.8 V near the end of their useful lives. Therefore, a boost converter is necessary to provide the typical 3.3 V needed for  $V_{IO}$ . Although there is no explicit circuitry to perform power-up sequencing of first  $V_{(CORE)}$  then  $V_{IO}$ , the output of the linear regulator reaches its regulated voltage much faster ( $< 400$   $\mu$ s) than the output of any switching type boost converter due to the inherent slow start up of those types of converters. Assuming a boost converter with minimum  $V_I$  of 1.8 V is appropriately chosen, this power supply solution can be used over the entire life of the two off-the-shelf AAA batteries. Thus, this solution is very efficient and the design time and overall cost of the solution is minimized.

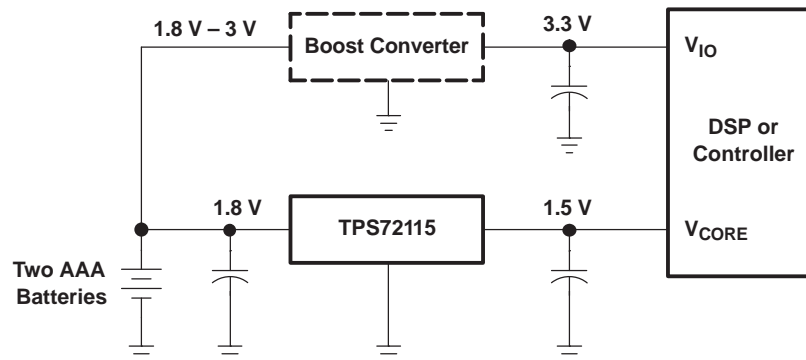


Figure 18. Dual Supply Application Circuit

## EXTERNAL CAPACITOR REQUIREMENTS

A 0.1- $\mu\text{F}$  ceramic bypass capacitor is required on both the input and output for stability. Larger capacitors improve transient response, noise rejection, and ripple rejection. A higher value electrolytic input capacitor may be necessary if large, fast rise time load transient are anticipated, and/or there is significant input resistance from the device to the input power supply.

## POWER DISSIPATION AND JUNCTION TEMPERATURE

Specified regulator operation is ensured to a junction temperature of 125°C; the maximum junction temperature allowable without damaging the device is 150°C. This restriction limits the power dissipation the regulator can handle in any given application. To ensure the junction temperature is within acceptable limits, calculate the maximum allowable dissipation,  $P_{D(\text{max})}$ , and the actual dissipation,  $P_D$ , which must be less than or equal to  $P_{D(\text{max})}$ .

The maximum power dissipation limit is determined using [Equation 1](#) :

$$P_{D(\text{max})} = \frac{T_{J\text{max}} - T_A}{R_{\theta\text{JA}}} \quad (1)$$

Where:

- $T_{J\text{max}}$  is the maximum allowable junction temperature.
- $R_{\theta\text{JA}}$  is the thermal resistance junction-to-ambient for the package; see the package dissipation rating table.
- $T_A$  is the ambient temperature.

The regulator dissipation is calculated using [Equation 2](#):

$$P_D = (V_I - V_O) \times I_O \quad (2)$$

Power dissipation resulting from quiescent current is negligible.

## REGULATOR PROTECTION

The TPS72118 pass element has a built-in back diode that safely conducts reverse current when the input voltage drops below the output voltage (for example, during power down). Current is conducted from the output to the input and is not internally limited. If extended reverse voltage is anticipated, external limiting might be appropriate.

The TPS72118 also features internal current limiting and thermal protection. During normal operation, the TPS72118 limits output current to approximately 350 mA. When current limiting engages, the output voltage scales back linearly until the overcurrent condition ends. While current limiting is designed to prevent gross device failure, care should be taken not to exceed the power dissipation ratings of the package. If the temperature of the device exceeds 170°C, thermal-protection circuitry shuts it down. Once the device has cooled down to below 150°C, regulator operation resumes.



**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>
TPS72118MDBVREP	ACTIVE	SOT-23	DBV	5	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
V62/07636-01XE	ACTIVE	SOT-23	DBV	5	3000	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.

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**OTHER QUALIFIED VERSIONS OF TPS72118-EP :**

- Catalog: [TPS72118](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product

**TAPE AND REEL INFORMATION**



**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS72118MDBVREP	SOT-23	DBV	5	3000	179.0	8.4	3.2	3.2	1.4	4.0	8.0	Q3

**TAPE AND REEL BOX DIMENSIONS**

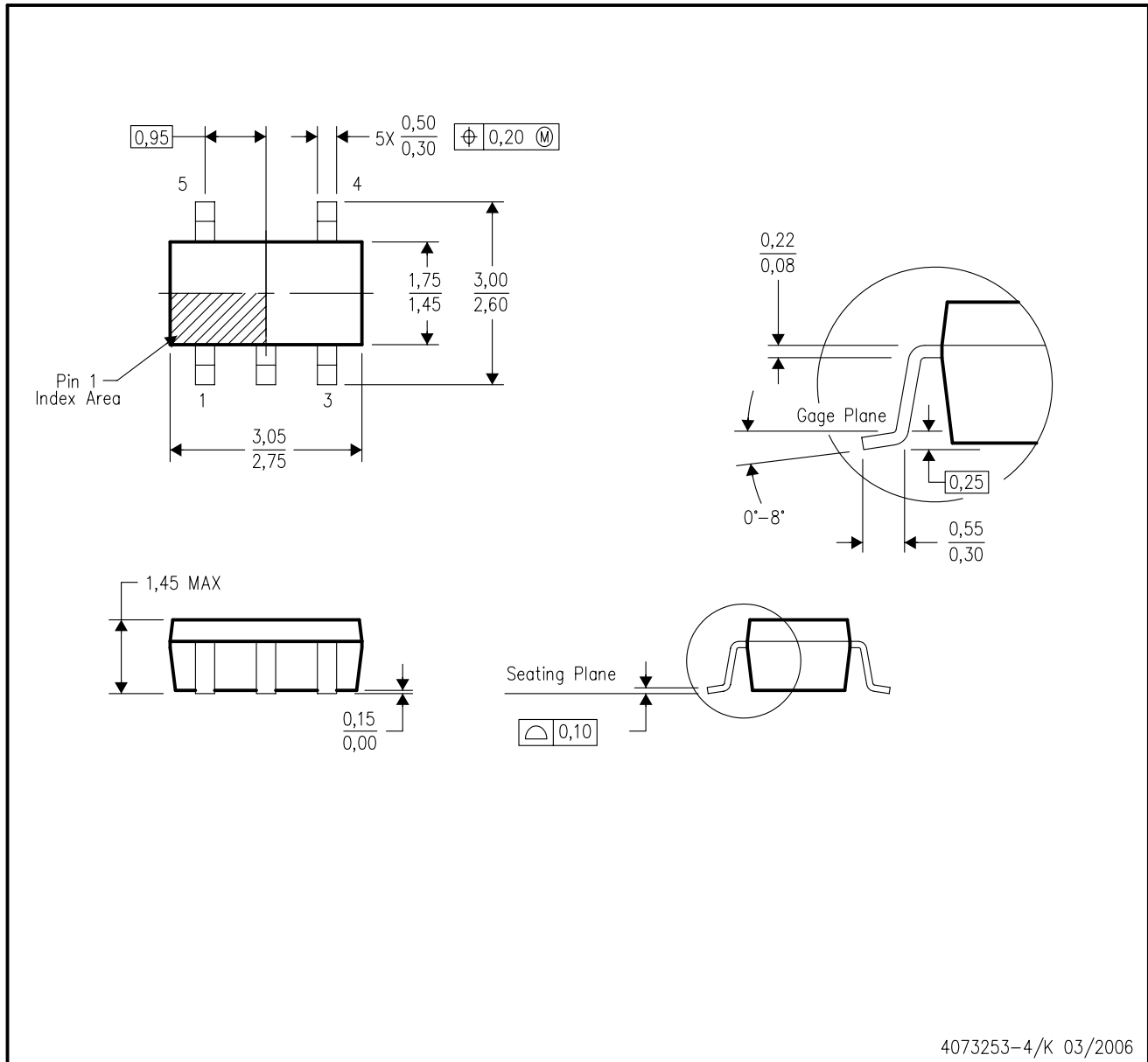


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS72118MDBVREP	SOT-23	DBV	5	3000	195.0	200.0	45.0

DBV (R-PDSO-G5)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
  - Falls within JEDEC MO-178 Variation AA.

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

### Products

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Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.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>
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