

# 1A Ultra Low Dropout Linear Regulator Distributeur : JBG-METAFIX **TPS1117LVxx**

## FEATURES

- Low Ground Pin Current
- Ultra Low Dropout Voltage
- Excellent Line and Load Regulation
- Guaranteed Output Current of 1.0A
- Fixed Output Voltage: 1.0V, 1.2V, 1.5V 1.8V, 2.5V, 2.8V, and 3.3V
- Over Current Protection
- Over Temperature Protection
- Available in SOT-223 Package

## APPLICATIONS

- Battery Powered Equipment
- Motherboards and Graphic Cards
- Microprocessor Power Supplies
- Peripheral Cards
- High Efficiency Linear Regulators
- Battery Chargers

## DESCRIPTION

The TPS1117LVxx series of high performance ultra low dropout linear regulators operates from 2.5V to 5.5V input supply and provides ultra low dropout voltage, high output current with low ground current. Wide range of preset output voltage options are available. These ultra low dropout linear regulators respond fast to step changes in load which makes them suitable for low voltage micro-processor applications. The TPS1117LVxx is developed on a CMOS process technology which allows low quiescent current operation independent of output load current. This CMOS process also allows the TPS1117LVxx to operate under extremely low dropout conditions.



## ORDERING INFORMATION

| Device       | Package    |
|--------------|------------|
| TPS1117LVxxS | SOT-223-3L |

xx: Output Voltage

# 1A Ultra Low Dropout Linear Regulator Distributeur : JBG-METAFIX TPS1117LVxx

## ABSOLUTE MAXIMUM RATINGS (Note 1)

| CHARACTERISTIC                       | SYMBOL     | MIN  | MAX            | UNIT |
|--------------------------------------|------------|------|----------------|------|
| Input Supply Voltage (Survival)      | $V_{IN}$   | -0.3 | 6.5            | V    |
| Output Voltage (Survival)            | $V_{OUT}$  | -0.3 | $V_{IN} + 0.3$ | V    |
| Maximum Output Current               | $I_{MAX}$  | -    | 1.0            | A    |
| ESD Rating, HBM                      |            | 2    | -              | kV   |
| Operating Junction Temperature Range | $T_{JOPR}$ | -40  | 125            | °C   |
| Storage Temperature Range            | $T_{STG}$  | -65  | 150            | °C   |

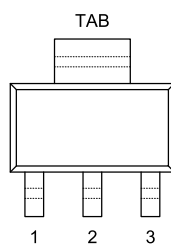
## RECOMMENDED OPERATING RATINGS (Note 2)

| CHARACTERISTIC       | SYMBOL   | MIN | MAX | UNIT |
|----------------------|----------|-----|-----|------|
| Input Supply Voltage | $V_{IN}$ | 2.5 | 5.5 | V    |

## ORDERING INFORMATION

| VOUT | Package    | Order No.    | Supplied As | Status     |
|------|------------|--------------|-------------|------------|
| 1.0V | SOT-223-3L | TPS1117LV10S | Tape & Reel | Contact Us |
| 1.2V | SOT-223-3L | TPS1117LV12S | Tape & Reel | Active     |
| 1.5V | SOT-223-3L | TPS1117LV15S | Tape & Reel | Contact Us |
| 1.8V | SOT-223-3L | TPS1117LV18S | Tape & Reel | Contact Us |
| 2.5V | SOT-223-3L | TPS1117LV25S | Tape & Reel | Contact Us |
| 2.8V | SOT-223-3L | TPS1117LV28S | Tape & Reel | Contact Us |
| 3.3V | SOT-223-3L | TPS1117LV33S | Tape & Reel | Contact Us |

### PIN CONFIGURATION

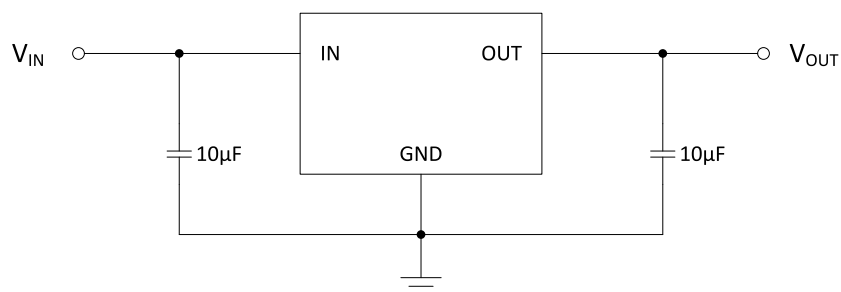
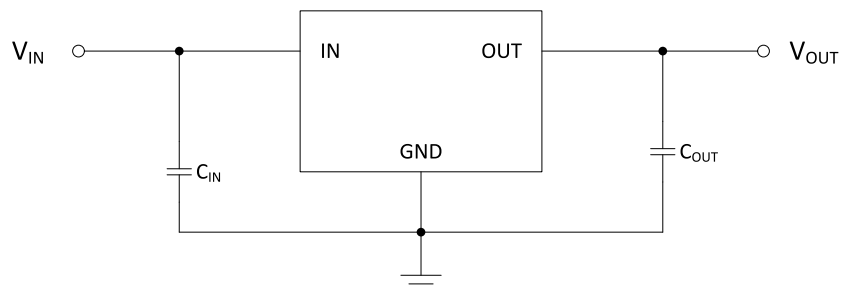


SOT-223-3L

### PIN DESCRIPTION

| Pin No. | Pin Name | Pin Function   |
|---------|----------|----------------|
| 1       | GND      | Ground         |
| 2       | OUT      | Output Voltage |
| 3       | IN       | Input Supply   |
| TAB     | TAB      | Connect to OUT |

## TYPICAL APPLICATION CIRCUIT



- \* See Application Information for the details over external capacitor.
- \*\* TPS1117LVxx can deliver a continuous current of 1.0A over the full operating temperature. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 1.0A may be still undeliverable.

## ELECTRICAL CHARACTERISTICS

Limits in standard typeface are for  $T_J = 25^\circ\text{C}$ , and limits in **boldface type** apply over the **full operating temperature range**.

$V_{IN} = V_{OUT(NOM)} + 1.0\text{ V}$  or  $V_{IN} = 2.5\text{ V}$ , whichever is greater;  $I_L = 10\text{ mA}$ ,  $C_{IN} = C_{OUT} = 10\text{ }\mu\text{F}$ , unless otherwise specified.

| PARAMETER                                    | SYMBOL                            | TEST CONDITIONS                                                                                     | MIN             | TYP  | MAX               | UNIT             |
|----------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------|-----------------|------|-------------------|------------------|
| Output Voltage Tolerance <sup>(Note 3)</sup> | $V_{OUT}$                         | $V_{OUT} + 1.0\text{ V} \leq V_{IN} \leq 5.5\text{ V}$<br>$10\text{ mA} \leq I_L \leq 1.0\text{ A}$ | -2<br><b>-3</b> | -    | 2<br><b>3</b>     | %                |
| Output Current <sup>(Note 3)</sup>           | $I_{OUT}$                         |                                                                                                     | -               | -    | 1.0               | A                |
| Line Regulation <sup>(Note 3, 4)</sup>       | $\Delta V_{OUT} / \Delta V_{IN}$  | $V_{OUT} + 1.0\text{ V} \leq V_{IN} \leq 5.5\text{ V}$                                              | -               | 0.25 | -                 | %/V              |
| Load Regulation <sup>(Note 3, 4, 5)</sup>    | $\Delta V_{OUT} / \Delta I_{OUT}$ | $10\text{ mA} \leq I_{OUT} \leq 1.0\text{ A}$                                                       | -               | 1.5  | -                 | %                |
| Dropout Voltage <sup>(Note 6)</sup>          | $V_{DROP}$                        | $I_{OUT} = 100\text{ mA}$                                                                           | -               | 40   | 50<br><b>60</b>   | mV               |
|                                              |                                   | $I_{OUT} = 500\text{ mA}$                                                                           | -               | 200  | 250<br><b>300</b> | mV               |
|                                              |                                   | $I_{OUT} = 1.0\text{ A}$                                                                            | -               | 400  | 500<br><b>600</b> | mV               |
| Ground Current <sup>(Note 7)</sup>           | $I_{GND}$                         | $I_{OUT} = 100\text{ mA}$                                                                           | -               | 130  | 200<br><b>260</b> | $\mu\text{A}$    |
|                                              |                                   | $I_{OUT} = 1.0\text{ A}$                                                                            | -               | 200  | 300<br><b>400</b> | $\mu\text{A}$    |
| Power Supply Ripple Rejection                | PSRR                              | $f = 1.0\text{ kHz}$                                                                                | -               | 45   | -                 | dB               |
| Output Current Limit                         | $I_{CL}$                          |                                                                                                     | -               | 1.6  | -                 | A                |
| Thermal Shutdown Temperature                 | $T_{SD}$                          |                                                                                                     | -               | 165  | -                 | $^\circ\text{C}$ |
| Thermal Shutdown Hysteresis                  | $\Delta T_{SD}$                   |                                                                                                     | -               | 20   | -                 | $^\circ\text{C}$ |

Note 1. Stresses listed as the absolute maximum ratings may cause permanent damage to the device. These are for stress ratings. Functional operating of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibly to affect device reliability.

Note 2. The device is not guaranteed to function outside its operating ratings. The minimum operating value for input voltage is equal to either  $(V_{OUT,NOM} + V_{DROP})$  or  $2.5\text{ V}$ , whichever is greater.

Note 3. Operating conditions are limited by maximum junction temperature. The output voltage specification does not apply to all possible combinations of input voltage and output current. When operating at maximum input voltage condition, the output current range must be limited. When operating at maximum output current condition, the input voltage range must be limited. For more information, refer to the Maximum Output Current Capability section of this data sheet.

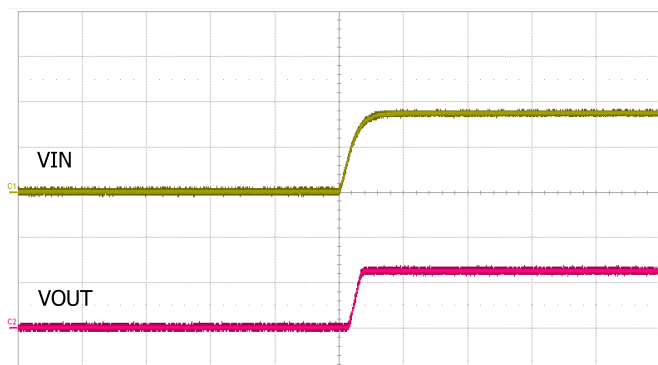
Note 4. Output voltage line regulation is defined as the change in output voltage from the nominal value due to change in the input line voltage. Output voltage load regulation is defined as the change in output voltage from the nominal value due to change in load current.

Note 5. Regulation is measured at constant junction temperature by using a 10ms current pulse. Devices are tested for load regulation in the load range from  $10\text{ mA}$  to  $1.0\text{ A}$ .

Note 6. Dropout voltage is defined as the minimum input to output differential voltage at which the output drops 2% below the nominal value. Dropout voltage specification applies only to output voltages of  $2.5\text{ V}$  and above. For output voltages below  $2.5\text{ V}$ , the dropout voltage is nothing but the input to output differential, since the minimum input voltage is  $2.5\text{ V}$ .

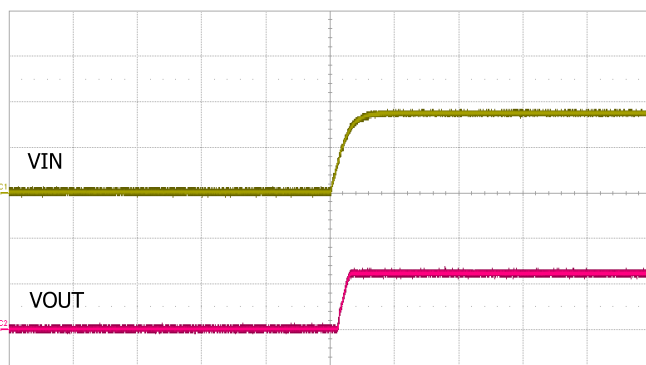
Note 7. Ground current, or quiescent current, is the difference between input and output currents. It's defined by  $I_{GND} = I_{IN} - I_{OUT}$  under the given loading condition. The total current drawn from the supply is the sum of the load current plus the ground pin current.

## TYPICAL OPERATING CHARACTERISTICS



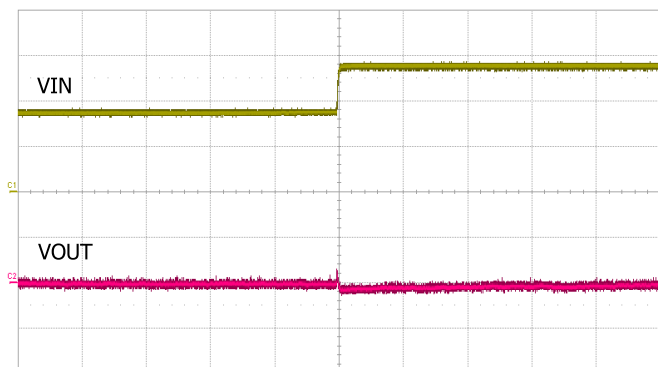
VIN: 2.0V/div, VOUT: 2.0V/div, Time: 1ms/div  
VIN=3.5V, VOUT=2.5V @ IOUT=0A

Start Up Transient Response



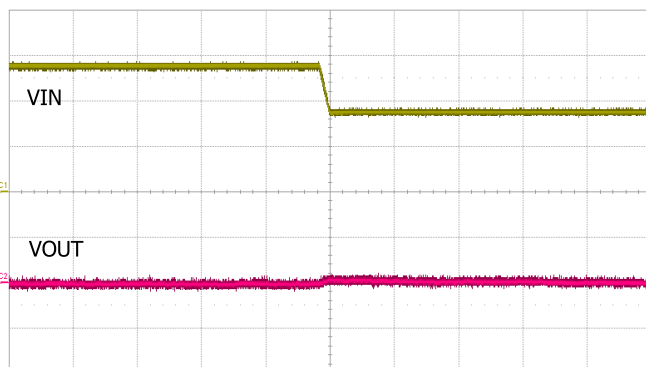
VIN: 2.0V/div, VOUT: 2.0V/div, Time: 1ms/div  
VIN=3.5V, VOUT=2.5V @ IOUT=1.0A

Start Up Transient Response



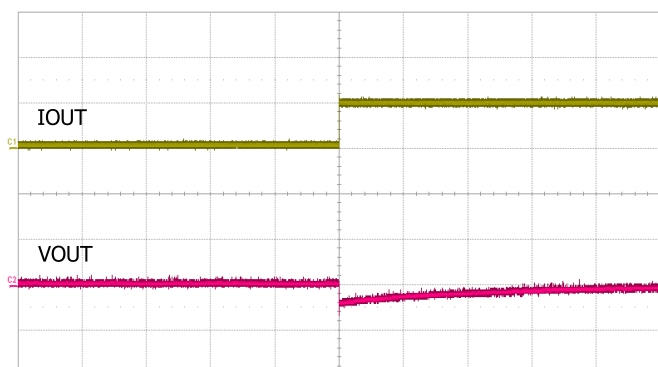
VIN: 2.0V/div, VOUT: 20mV/div, Time: 10ms/div  
VIN=3.5V to 5.5V, VOUT=2.5V @ IOUT=10mA

Line Transient Response



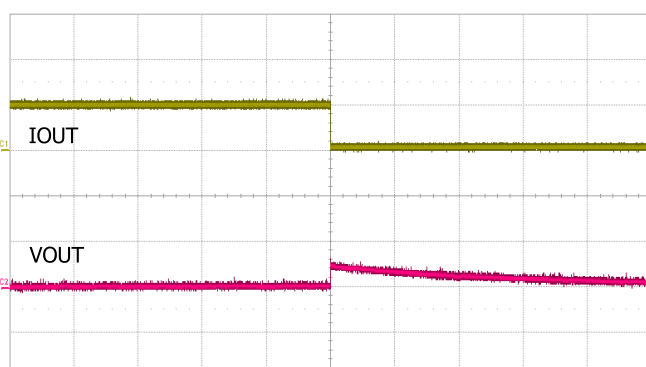
VIN: 2.0V/div, VOUT: 20mV/div, Time: 10ms/div  
VIN=5.5V to 3.5V, VOUT=2.5V @ IOUT=10mA

Line Transient Response



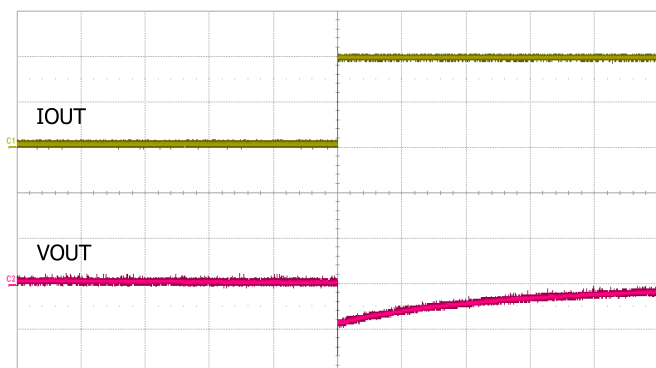
IOUT: 500mA/div, VOUT: 50mV/div, Time: 10ms/div  
VIN=3.5V, VOUT=2.5V @ IOUT=10mA to 0.5A

Load Transient Response



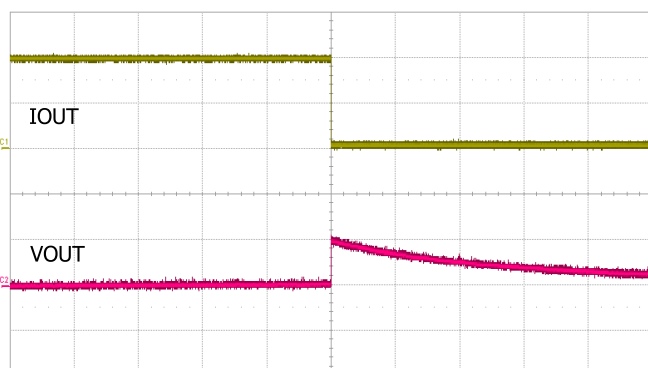
IOUT: 500mA/div, VOUT: 50mV/div, Time: 10ms/div  
VIN=3.5V, VOUT=2.5V @ IOUT=0.5A to 10mA

Load Transient Response



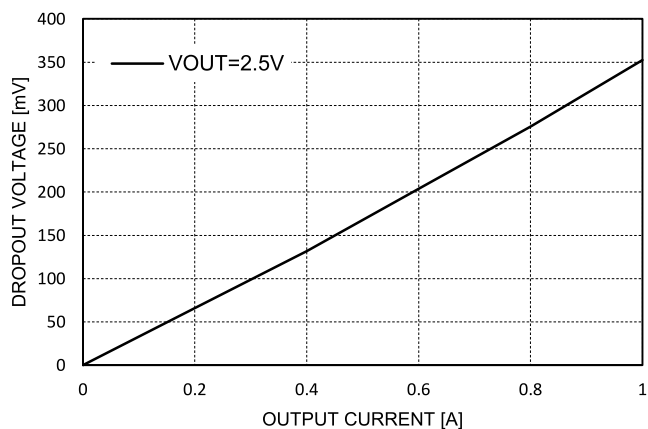
IOUT: 500mA/div, VOUT: 50mV/div, Time: 10ms/div  
VIN=3.5V, VOUT=2.5V @ IOUT=10mA to 1.0A

Load Transient Response



IOUT: 500mA/div, VOUT: 50mV/div, Time: 10ms/div  
VIN=3.5V, VOUT=2.5V @ IOUT=1.0A to 10mA

Load Transient Response



Dropout Voltage

## APPLICATION INFORMATION

The TPS1117LVxx is intended for applications where high current capability and very low dropout voltage are required. It provides a simple, low cost solution that occupies very little PCB area.

### INPUT CAPACITOR

A large bulk capacitance over than 6.8  $\mu\text{F}$  should be closely placed to the input supply pin of the TPS1117LVxx to ensure that the input supply voltage does not sag. Also a minimum of 6.8  $\mu\text{F}$  ceramic capacitor is recommended to be placed directly next to the VIN Pin. It allows for the device being some distance from any bulk capacitor on the rail. Additionally, input droop due to load transients is reduced, improving load transient response.

### OUTPUT CAPACITOR

A minimum ceramic capacitor over than 6.8  $\mu\text{F}$  should be very closely placed to the output voltage pin of the TPS1117LVxx. Increasing capacitance will improve the overall transient response and stability.

### MAXIMUM OUTPUT CURRENT CAPABILITY

The TPS1117LVxx can deliver a continuous current of 1.0 A over the full operating junction temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 1.0 A may be still undeliverable due to the restriction of the power dissipation of TPS1117LVxx. Under all possible conditions, the junction temperature must be within the range specified under operating conditions.

The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA}$$

$$T_J = T_C + P_D \times \theta_{JC}$$

$$T_J = T_A + P_D \times \theta_{JA}$$

where  $T_J$  is the junction temperature,  $T_C$  is the case temperature,  $T_A$  is the ambient temperature,  $P_D$  is the total power dissipation of the device,  $\theta_{CA}$  is the thermal resistance of case-to-ambient,  $\theta_{JC}$  is the thermal resistance of junction-to-case, and  $\theta_{JA}$  is the thermal resistance of junction to ambient.

The total power dissipation of the device is given by:

$$\begin{aligned} P_D &= P_{IN} - P_{OUT} = (V_{IN} \times I_{IN}) - (V_{OUT} \times I_{OUT}) \\ &= (V_{IN} \times (I_{OUT} + I_{GND})) - (V_{OUT} \times I_{OUT}) = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_{GND} \end{aligned}$$

where  $I_{GND}$  is the operating ground current of the device which is specified at the Electrical Characteristics. The maximum allowable temperature rise ( $T_{Rmax}$ ) depends on the maximum ambient temperature ( $T_{Amax}$ ) of the application, and the maximum allowable junction temperature ( $T_{Jmax}$ ):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

The maximum allowable value for junction-to-ambient thermal resistance,  $\theta_{JA}$ , can be calculated using the formula:

$$\theta_{JA} = T_{Rmax} / P_D$$

TPS1117LVxx is available in SOT-223 package. The thermal resistance depends on amount of copper area or heat sink, and on air flow. If the maximum allowable value of  $\theta_{JA}$  calculated above is as described in Table 1, no heat sink is needed since the package can dissipate enough heat to satisfy these requirements. If the value for allowable  $\theta_{JA}$  falls near or below these limits, a heat sink or proper area of copper plane is required

Table 1. Absolute Maximum Ratings of Thermal Resistance

| Characteristic                         | Symbol        | Rating | Unit |
|----------------------------------------|---------------|--------|------|
| Thermal Resistance Junction-To-Ambient | $\theta_{JA}$ | 140    | °C/W |

(No heat sink / No air flow / No adjacent heat source,  $T_A = 25^\circ\text{C}$ )

In case that there is no cooling solution and no heat sink / minimum copper plane area for heat sink, the maximum allowable power dissipation of each package is as follow;

| Characteristic                                                | Symbol     | Rating | Unit |
|---------------------------------------------------------------|------------|--------|------|
| Maximum Allowable Power Dissipation at $T_A=25^\circ\text{C}$ | $P_{DMax}$ | 0.714  | W    |

Please note that above maximum allowable power dissipation is based on the minimum copper plane area which does not exceed the proper footprint of the package. And the ambient temperature is  $25^\circ\text{C}$ .

If proper cooling solution such as copper plane area or air flow is applied, the maximum allowable power dissipation could be increased. However, if the ambient temperature is increased, the allowable power dissipation would be decreased.

## REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.