



**THE DATASHEET OF  
XB1117K12BFR-G**



## 1A Low Dropout Positive Voltage Regulator

## ■ GENERAL DESCRIPTION

The XB1117 series is 1A Bi-polar transistor LDO voltage regulator. Output voltage of the XB1117P series is fixed to 1.8V, 2.5V, 3.3V, and 5.0V. The XB1117K series output voltage is adjustable by the external resistors. Please refer to the absolute maximum ratings for the difference between the rated input voltage of the XB1117P50 ( $V_{OUT}=5.0V$ ) and XB1117P18, 25, 31, K12B. With the dropout voltage 1.2V (TYP.), output current can be generated up to 1A. The built-in overcurrent circuit and thermal protection circuit start to operate when either one of output current reaches the current limit level or junction temperature reaches the temperature limit. The XB1117 series provide stable line and load regulation by using an input capacitor and an output capacitor ( $10\mu F$ , tantalum). Package is available in SOT-223.

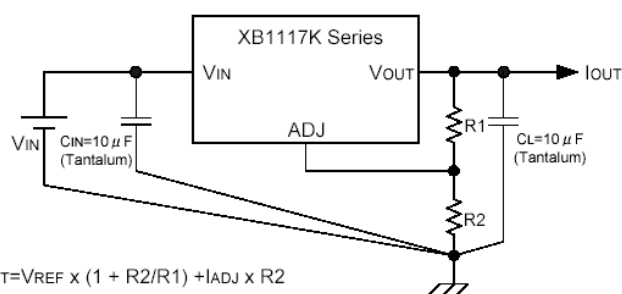
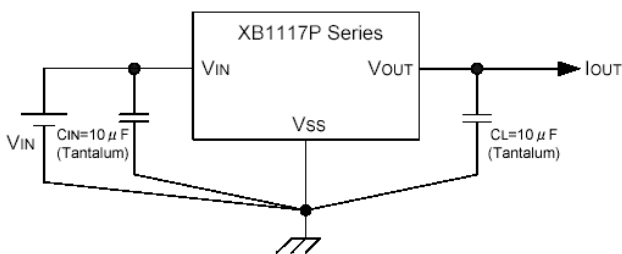
## ■ APPLICATIONS

- Highly efficient linear regulators
- 5V ~ 3.3V DC / DC converter
- Battery charger
- Local power supply inside equipment
- Battery powered equipment

## ■ FEATURES

|                          |   |
|--------------------------|---|
| Maximum Output Current   | : 1A  |
| Output Voltages          | : 1.8V, 2.5V, 3.3V, 5.0V, ADJ                   |
| Output Voltage Accuracy  | : $\pm 1\%$                                     |
| Low Dropout Voltage      | : 1.2V @ $I_{OUT}=1A$                           |
| Line Regulation (TYP.)   | : 0.04% (ADJ)                                   |
| Load Regulation (TYP.)   | : 0.1% (ADJ)                                    |
| Adjust Pin Current       | : Less than $120\mu A$ (ADJ)                    |
| Protection Circuit       | : Over-current protection<br>Thermal protection |
| Package                  | : SOT-223                                       |
| Environmentally Friendly | : EU RoHS Compliant, Pb Free                    |

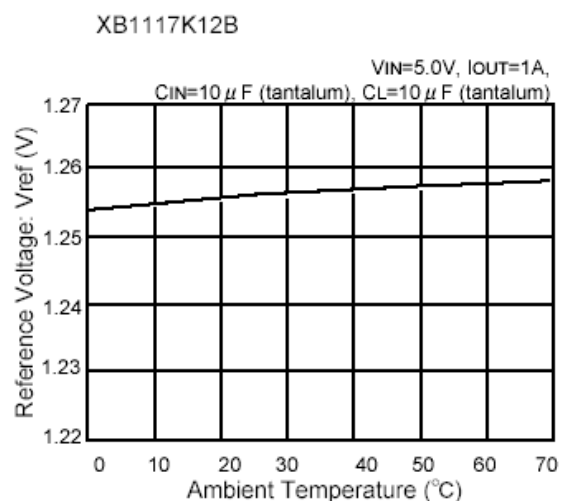
## ■ TYPICAL APPLICATION CIRCUIT



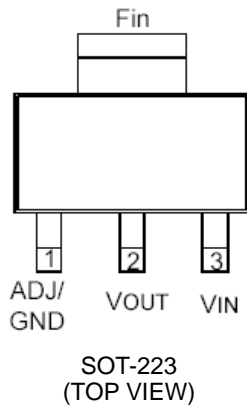
$$V_{OUT} = V_{REF} \times (1 + R2/R1) + I_{ADJ} \times R2$$

## ■ TYPICAL PERFORMANCE CHARACTERISTICS

- Reference Voltage vs. Ambient Temperature



## ■ PIN CONFIGURATION



## ■ PIN ASSIGNMENT

| PIN NUMBER | PIN NAME | FUNCTIONS  |
|------------|----------|------------|
| 1          | ADJ/GND  | ADJ/Ground |
| 2          | VOUT     | Output     |
| 3          | VIN      | Input      |

\* The electrical potential of the package fin is the same as the VOUT pin.

## ■ PRODUCT CLASSIFICATION

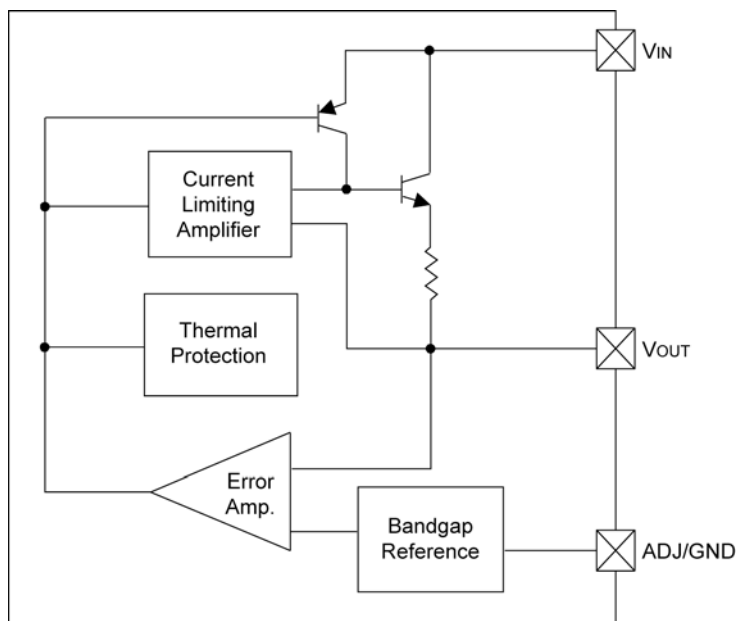
### ● Ordering Information

XB1117①②③④⑤⑥-⑦

| DESIGNATOR          | ITEM                      | SYMBOL | DESCRIPTION                 |
|---------------------|---------------------------|--------|-----------------------------|
| ①                   | Type of Regulators        | P      | Fixed VOUT type             |
|                     |                           | K      | Adjustable VOUT type        |
| ②③④                 | Output Voltage & Accuracy | 181    | Fixed VOUT 1.80V (±1%)      |
|                     |                           | 251    | Fixed VOUT 2.50V (±1%)      |
|                     |                           | 331    | Fixed VOUT 3.30V (±1%)      |
|                     |                           | 501    | Fixed VOUT 5.00V (±1%)      |
|                     |                           | 12B    | Adjustable VOUT 1.25V (±1%) |
| ⑤⑥-⑦ <sup>(*)</sup> | Package (Order Unit)      | FR-G   | SOT-223(1,000/Reel)         |

<sup>(\*)</sup> The "-G" suffix denotes Halogen and Antimony free as well as being fully EU RoHS compliant.

■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

XB1117P501

| PARAMETER   | SYMBOL            | RATINGS     | UNITS |
|---|-------------------|-------------|-------|
| Input Voltage   | V <sub>IN</sub>   | 10.0        | V     |
| Thermal Resistance<br>(Junction to Case)                | $\theta_{JC}$     | 15          | °C/W  |
| Thermal Resistance<br>(Junction to Ambient)             | $\theta_{JA}$     | 160         |       |
| Power Dissipation<br>( $\Delta T=100^{\circ}\text{C}$ ) | P <sub>D</sub>    | 625         | mW    |
| Operating Ambient Temperature                           | T <sub>opr</sub>  | 0 ~ +70     | °C    |
| Operating Junction Temperature Range                    | T <sub>j</sub>    | 0 ~ +125    |       |
| Storage Temperature Range                               | T <sub>stg</sub>  | - 65 ~ +150 |       |
| Lead Temperature  | T <sub>lead</sub> | 260         |       |

\*Stress above the listed absolute maximum rating may cause permanent damage to the device.

\*\* The rated values of the XB1117P18 / 25 / 30 (V<sub>OUT</sub>=1.8V, 2.5V and 3.0V) and XB1117K type are different from that of the XB1117P50 (V<sub>OUT</sub>=5.0V).

## ■ ELECTRICAL CHARACTERISTICS

XB1117P501

T<sub>a</sub>=25°C

| PARAMETER               | SYMBOL            | CONDITIONS   | MIN.  | TYP.  | MAX.  | UNITS  |
|-------------------------|-------------------|--|-------|-------|-------|--------|
| Output Voltage          | V <sub>OUT</sub>  | V <sub>IN</sub> =7.0V<br>I <sub>OUT</sub> =0A                  | 4.950 | 5.000 | 5.050 | V      |
|                         |                   | *Over Temp.  | 4.900 | 5.000 | 5.100 |        |
| Line Regulation         | $\Delta V_{OUT1}$ | 7.0V ≤ V <sub>IN</sub> ≤ 9.0V<br>I <sub>OUT</sub> =0A          | -     | 1     | 6     | mV     |
| Load Regulation         | $\Delta V_{OUT2}$ | V <sub>IN</sub> =7.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A          | -     | 5.0   | 15.2  |        |
| Dropout Voltage         | V <sub>dif</sub>  | $\Delta V_{OUT} = \pm 1\%$<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A     | -     | 1.2   | 1.4   | V      |
|                         |                   | *Over Temp.  | -     | 1.3   | -     |        |
| Current Limit           | I <sub>LIM</sub>  | 7.0V ≤ V <sub>IN</sub> ≤ 10.0V                                 | 1.0   | 1.5   | -     | A      |
| Supply Current          | I <sub>SS</sub>   | V <sub>IN</sub> =7.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A          | -     | 6     | 13    | mA     |
| Temperature Coefficient | T <sub>C</sub>    | 7.0V ≤ V <sub>IN</sub> ≤ 10.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A | -     | 50    | -     | ppm/°C |
| Temperature Stability   | T <sub>S</sub>    | V <sub>IN</sub> =7.0V<br>I <sub>OUT</sub> =100mA               | -     | 0.5   | -     | %      |

\*Over Temp. = Over Temperature (0 ~ +70°C)

## ■ ABSOLUTE MAXIMUM RATINGS

XB1117P181, P251, P331, K12B

| PARAMETER  | SYMBOL            | RATINGS   | UNITS |
|--|-------------------|-----------|-------|
| Input Voltage  | V <sub>IN</sub>   | 7.0       | V     |
| Thermal Resistance<br>(Junction to Case)             | $\theta_{JC}$     | 15        | °C/W  |
| Thermal Resistance<br>(Junction to Ambient)          | $\theta_{JA}$     | 160       |       |
| Power Dissipation ( $\Delta T=100^{\circ}\text{C}$ ) | P <sub>D</sub>    | 625       | mW    |
| Operating Ambient Temperature                        | T <sub>OPR</sub>  | 0 ~ 70    | °C    |
| Operating Temperature Range                          | T <sub>J</sub>    | 0 ~ 125   |       |
| Storage Temperature Range                            | T <sub>STG</sub>  | -65 ~ 150 |       |
| Lead Temperature                                     | T <sub>LEAD</sub> | 260       |       |

\*Stress above the listed absolute maximum rating may cause permanent damage to the device.

## ■ ELECTRICAL CHARACTERISTICS

XB1117P181

 T<sub>J</sub>=25°C

| PARAMETER               | SYMBOL            | CONDITIONS  | MIN.  | TYP.         | MAX.         | UNITS      |
|-------------------------|-------------------|---|-------|--------------|--------------|------------|
| Output Voltage          | V <sub>OUT</sub>  | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =0A<br>*Over Temp.              | 1.782 | 1.800        | 1.818        | V          |
| Line Regulation         | $\Delta V_{OUT1}$ | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>I <sub>OUT</sub> = 0A                   | -     | 1.0          | 5.5          | mV         |
| Load Regulation         | $\Delta V_{OUT2}$ | V <sub>IN</sub> =5.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A<br>*Over Temp.      | -     | 1.80<br>3.70 | 18.2<br>22.0 | mV         |
| Dropout Voltage         | V <sub>dif</sub>  | $\Delta V_{OUT} = \pm 1\%$<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A<br>*Over Temp. | -     | 1.2<br>1.3   | 1.4<br>-     | V          |
| Current Limit           | I <sub>LIM</sub>  | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>*Over Temp.                             | 1.0   | 1.5          | -            | A          |
| Supply Current          | I <sub>SS</sub>   | V <sub>IN</sub> =5.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A<br>*Over Temp.      | -     | 6            | 13           | mA         |
| Temperature Coefficient | T <sub>C</sub>    | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A            | -     | 50           | -            | ppm/<br>°C |
| Temperature Stability   | T <sub>S</sub>    | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =100mA<br>*Over Temp.           | -     | 0.5          | -            | %          |

\*Over Temp. = Over Temperature (0~+70°C)

XB1117P251

 T<sub>J</sub>=25°C

| PARAMETER               | SYMBOL            | CONDITIONS  | STANDARD VALUE |            |                | UNITS      |
|-------------------------|-------------------|---|----------------|------------|----------------|------------|
|                         |                   |   | MIN.           | TYP.       | MAX.           |            |
| Output Voltage          | V <sub>OUT</sub>  | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =0A<br>*Over Temp.              | 2.475<br>2.450 | 2.500      | 2.525<br>2.550 | V          |
| Line Regulation         | $\Delta V_{OUT1}$ | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>I <sub>OUT</sub> =0A                    | -              | 1.0        | 6.8            | mV         |
| Load Regulation         | $\Delta V_{OUT2}$ | V <sub>IN</sub> =5.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A<br>*Over Temp.      | -              | 2.5<br>5.1 | 25.3<br>30.3   | mV         |
| Dropout Voltage         | V <sub>dif</sub>  | $\Delta V_{OUT} = \pm 1\%$<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A<br>*Over Temp. | -              | 1.2<br>1.3 | 1.4<br>-       | V          |
| Current Limit           | I <sub>LIM</sub>  | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>*Over Temp.                             | 1.0            | 1.5        | -              | A          |
| Supply Current          | I <sub>SS</sub>   | V <sub>IN</sub> =5.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A<br>*Over Temp.      | -              | 6          | 13             | mA         |
| Temperature Coefficient | T <sub>C</sub>    | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A            | -              | 50         | -              | ppm/<br>°C |
| Temperature Stability   | T <sub>S</sub>    | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =100mA<br>*Over Temp.           | -              | 0.5        | -              | %          |

\*Over Temp. = Over Temperature (0~+70°C)

## ELECTRICAL CHARACTERISTICS (Continued)

XB1117P331

T<sub>J</sub>=25°C

| PARAMETER               | SYMBOL             | CONDITIONS   | MIN.        | TYP.  | MAX.  | UNITS  |    |
|-------------------------|--------------------|--|-------------|-------|-------|--------|----|
| Output Voltage          | V <sub>OUT</sub>   | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =0A                  | 3.267       | 3.300 | 3.333 | V      |    |
|                         |                    | *Over Temp.  | 3.234       | 3.300 | 3.366 |        |    |
| Line Regulation         | ΔV <sub>OUT1</sub> | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>I <sub>OUT</sub> =0A         | -           | 1.0   | 4.5   | mV     |    |
| Load Regulation         | ΔV <sub>OUT2</sub> | V <sub>IN</sub> =5.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0V          | -           | 3.4   | 10.0  |        |    |
| Dropout Voltage         | V <sub>dif</sub>   | ΔV <sub>OUT</sub> =±1%   | -           | 1.2   | 1.4   | V      |    |
|                         |                    | 0A ≤ I <sub>OUT</sub> ≤ 1.0A                                   | *Over Temp. | -     | 1.3   |        | -  |
| Current Limit           | I <sub>LIM</sub>   | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V                                 | *Over Temp. | 1.0   | 1.5   | A      |    |
| Supply Current          | I <sub>SS</sub>    | V <sub>IN</sub> =5.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A          | *Over Temp. | -     | 6     | 13     | mA |
| Temperature Coefficient | T <sub>C</sub>     | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>0A ≤ I <sub>OUT</sub> ≤ 1.0A | -           | 50    | -     | ppm/°C |    |
| Temperature Stability   | T <sub>S</sub>     | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =100mA               | *Over Temp. | -     | 0.5   | -      | %  |

\*Over Temp. = Over Temperature (0~+70°C)

XB1117K12B

T<sub>J</sub>=25°C

| PARAMETER                 | SYMBOL             | CONDITIONS   | MIN.        | TYP.  | MAX.  | UNITS  |    |
|---------------------------|--------------------|--|-------------|-------|-------|--------|----|
| Reference voltage         | V <sub>ref</sub>   | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =10mA                  | 1.238       | 1.250 | 1.262 | V      |    |
|                           |                    | *Over Temp.  | 1.225       | 1.250 | 1.275 |        |    |
| Line Regulation           | ΔV <sub>OUT1</sub> | 4.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>I <sub>OUT</sub> =0A           | -           | 0.04  | 0.20  | %      |    |
| Load Regulation           | ΔV <sub>OUT2</sub> | V <sub>IN</sub> =5.0V<br>10mA ≤ I <sub>OUT</sub> ≤ 1.0A          | -           | 0.1   | 0.3   | %      |    |
|                           |                    | *Over Temp.  | -           | 0.2   | 0.4   |        |    |
| Dropout Voltage           | V <sub>dif</sub>   | ΔV <sub>OUT</sub> =±1%   | -           | 1.2   | 1.4   | V      |    |
|                           |                    | 10mA ≤ I <sub>OUT</sub> ≤ 1.0A                                   | *Over Temp. | -     | 1.3   |        | -  |
| Current Limit             | I <sub>LIM</sub>   | 2.75A ≤ V <sub>IN</sub> ≤ 7.0V                                   | *Over Temp. | 1.0   | 1.5   | A      |    |
| Temperature Coefficient   | T <sub>C</sub>     | 2.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>10mA ≤ I <sub>OUT</sub> ≤ 1.0A | -           | 50    | -     | ppm/°C |    |
| Adjust Pin Current        | I <sub>ADJ</sub>   | 2.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>10mA ≤ I <sub>OUT</sub> ≤ 1.0A | -           | 55    | -     | μA     |    |
|                           |                    | *Over Temp.  | -           | -     | 120   |        |    |
| Adjust Pin Current Change | ΔI <sub>ADJ</sub>  | 2.75V ≤ V <sub>IN</sub> ≤ 7.0V<br>10mA ≤ I <sub>OUT</sub> ≤ 1.0A | *Over Temp. | -     | 0.2   | 5.0    | μA |
| Temperature Stability     | T <sub>S</sub>     | V <sub>IN</sub> =5.0V<br>I <sub>OUT</sub> =100mA                 | *Over Temp. | -     | 0.5   | -      | %  |
| Minimum Load Current      | I <sub>OUT</sub>   | V <sub>OUT</sub> =5.0V   | -           | -     | 10    | mA     |    |

\*Over Temp. = Over Temperature (0~+70°C)

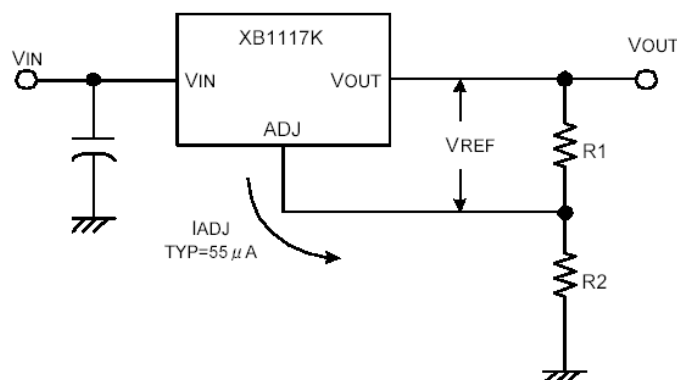
## ■ OPERATIONAL EXPLANATION

### 1. Output voltage adjustment

The XB1117 series provide a stable output by comparing the output voltage to an internal reference voltage. With the adjustable XB1117K type, a 1.25V reference voltage ( $V_{REF}$ ) is fixed between the  $V_{OUT}$  pin and the ADJ pin and the external resistors R1 and R2 are used to set the output voltage. The resistance values of R1 and R2 should be set so as to provide a minimum load current of 10mA. The output voltage is given by the following equation.

$$V_{OUT} = V_{REF}(1 + R2/R1) + I_{ADJ} \times R2$$

The output voltage of the XB1117P type is internally fixed to 1.8V, 2.5V, 3.3V, and 5.0V so external resistors are not necessary.



### 2. Stability and load regulation

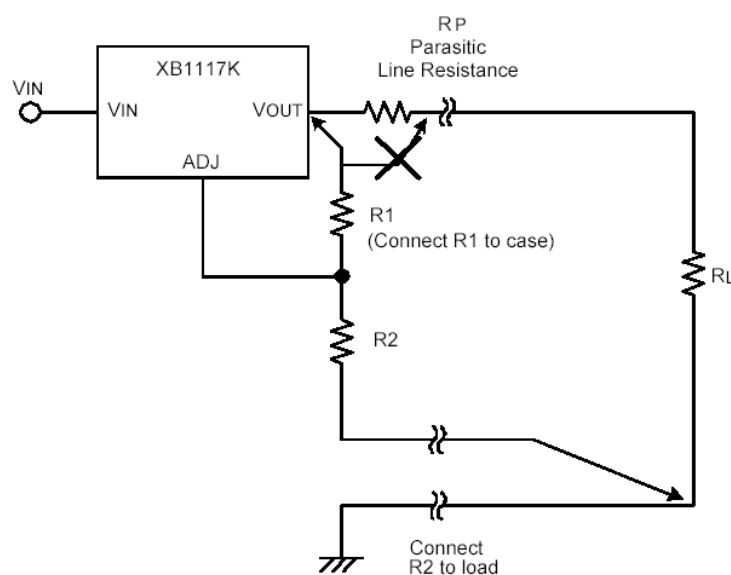
The XB1117 series requires a load capacitor between the  $V_{OUT}$  pin and the GND pin to provide phase compensation thereby ensuring stability of the output voltage. Either a tantalum capacitor of more than  $10 \mu F$  (TYP.) or an aluminum electrolytic capacitor of more than  $50 \mu F$  (TYP.) should be connected.

(Note : The capacitor's ESR value should not exceed  $0.5 \Omega$ .)

The output capacitor does not have a theoretical upper limit so increasing its value will increase stability.  $C_L = 100 \mu F$  or more is typical for high current regulator design.

In order to avoid any reductions in output voltage accuracy with the XB1117K type, we recommend not to place a parasitic resistor ( $R_p$ ) between the  $V_{OUT}$  pin and the divider resistor R1. The parasitic resistor ( $R_p$ ) does not influence the output however if the divider resistor R1 is directly connected to the  $V_{OUT}$  pin.

With the XB1117P type, although external resistor (R1) is internally connected to the  $V_{OUT}$  pin, stability can be maintained by not wiring a parasitic resistor to the GND pin.



## OPERATIONAL EXPLANATION (Continued)

### 3. Thermal protection

XB1117 series has thermal protection which limits junction temperature to 150°C. However, device functionally is only guaranteed to a maximum junction temperature of + 125°C. The power dissipation and junction temperature for the XB1117 series are given by;

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

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

NOTE : T<sub>J</sub> must not exceed 125°C.

### 4. Current limit protection

XB1117 series is protected against overload conditions. Current protection is triggered at 1.5A (TYP.).

### 5. Thermal consideration

The XB1117 series contain thermal limiting circuitry designed to protect itself from over-temperature conditions. Even for normal load conditions, maximum junction temperature ratings must not be exceeded. As mentioned in thermal protection section, we need to consider all sources of thermal resistance between junction and ambient. It includes junction-to-case, case-to-heat-sink interface and heat sink thermal resistance itself.

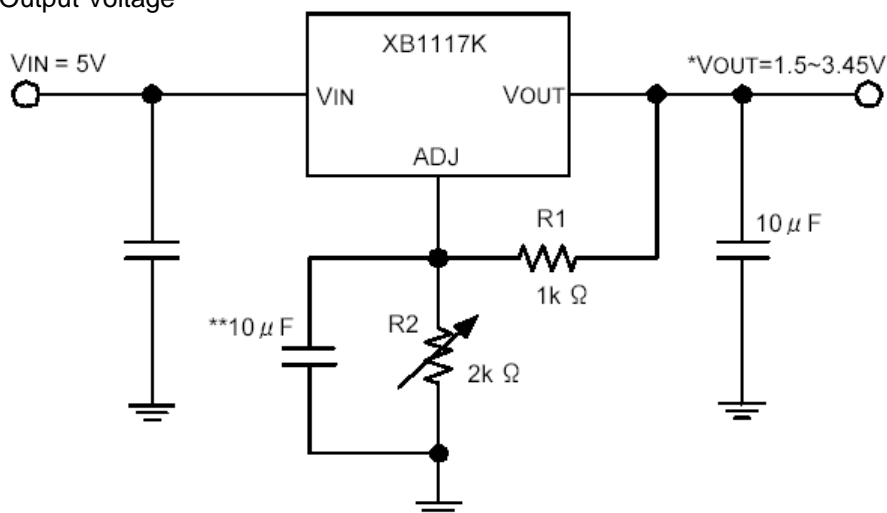
Junction-to-case thermal resistance is specified from the IC junction to the bottom of the case directly below the die. Proper mounting is required to ensure the best possible thermal flow from this area of the package to the heat sink. The case of all devices in this product series is electrically connected to the output. Therefore, if the case of the device is not electrically isolated, a thermally conductive spacer is recommended.

## NOTES ON USE

- For the phenomenon of temporal and transitional voltage decrease or voltage increase, the IC may be damaged or deteriorated if IC is used beyond the absolute MAX. specifications.
- Torex places an importance on improving our products and their reliability. We request that users incorporate fail-safe designs and post-aging protection treatment when using Torex products in their systems.

## APPLICATION CIRCUITS

### ● Adjustable Output Voltage

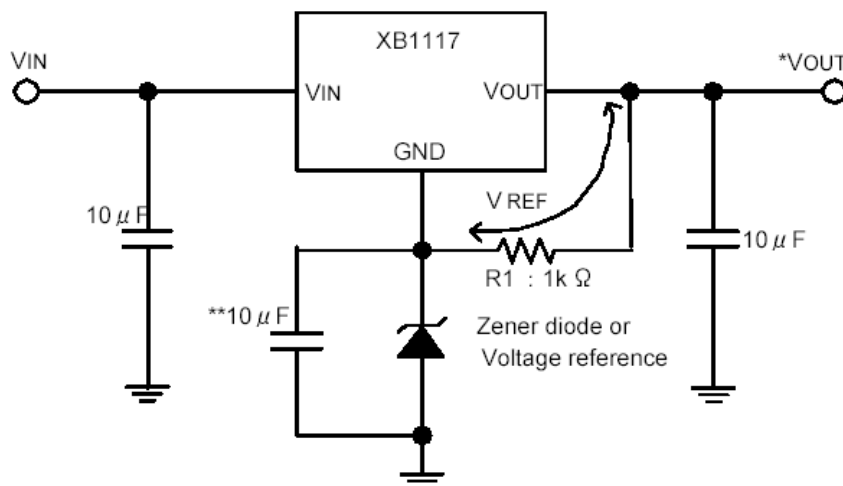


$$NOTE: *V_{OUT} = V_{REF} \left( 1 + \frac{R_2}{R_1} \right) + I_{ADJ} \times R_2$$

\*\* Optional for improved ripple rejection.

## ■ APPLICATION CIRCUITS (Continued)

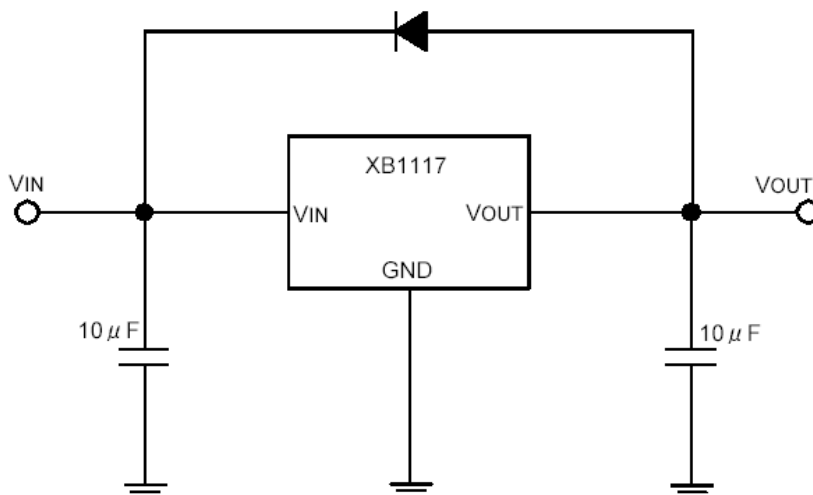
### ● Regulator with reference voltage



NOTE:  $*V_{OUT} = V_{REF} + V_Z$  ( $V_Z$ : Zener diode)

\*\* Optional for improved ripple rejection.

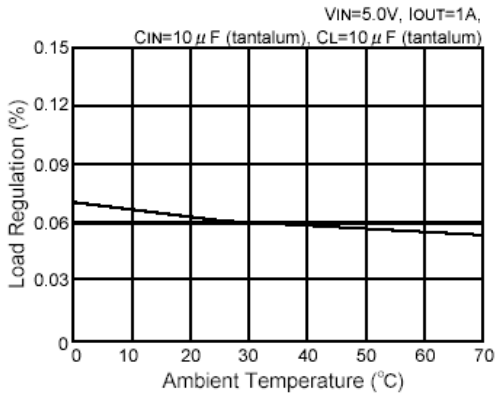
### ● Regulator with reverse diode protection



## TYPICAL PERFORMANCE CHARACTERISTICS

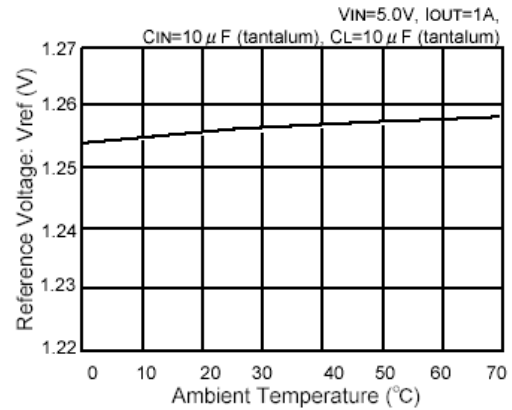
(1) Load Regulation vs. Ambient Temperature

XB1117K12B



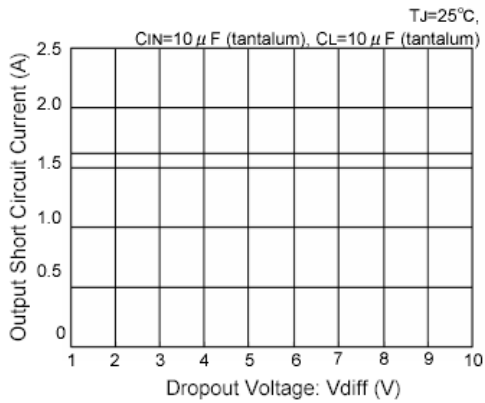
(2) Reference Voltage vs. Ambient Temperature

XB1117K12B



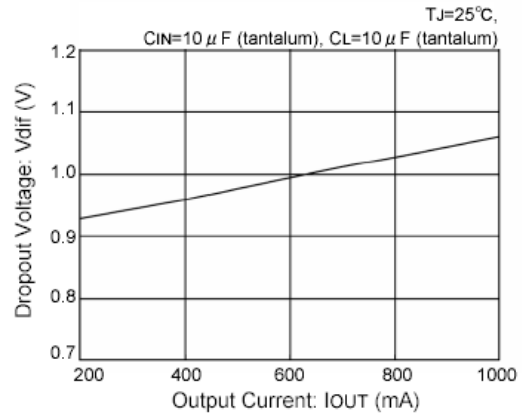
(3) Output Short Circuit Current vs. Dropout Voltage

XB1117P331



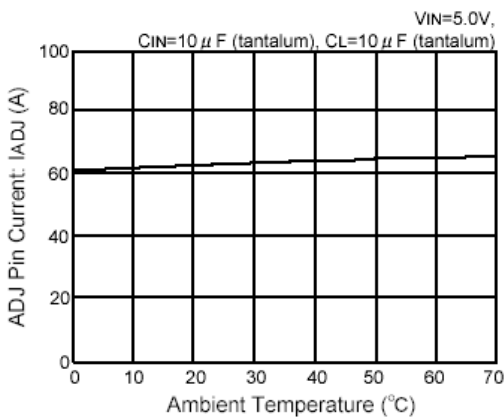
(4) Dropout Voltage vs. Output Current

XB1117P331



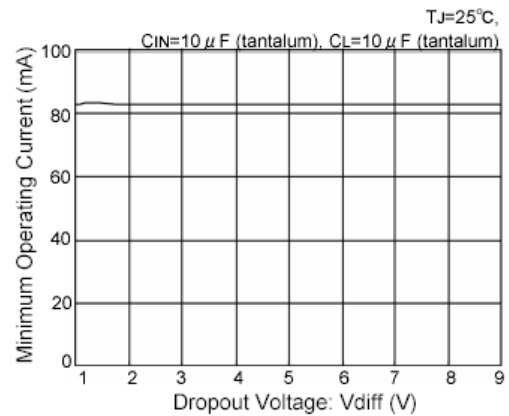
(5) Adjust Pin Current vs. Ambient Temperature

XB1117K12B



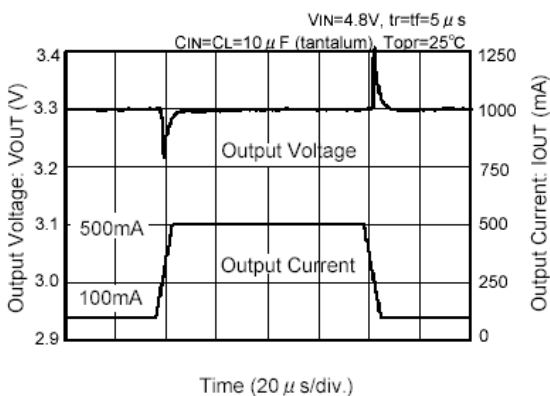
(6) Supply Current vs. Dropout Voltage

XB1117P331



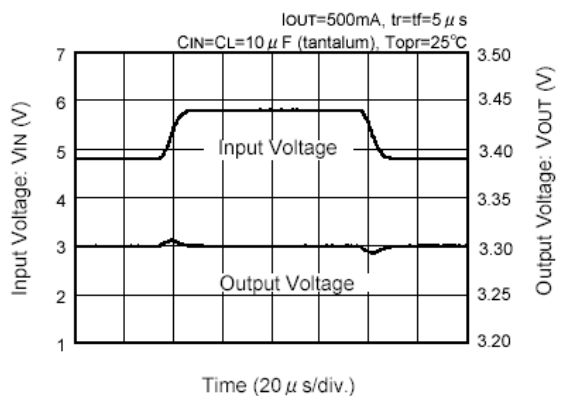
(7) Load Transient Response

XB1117P331



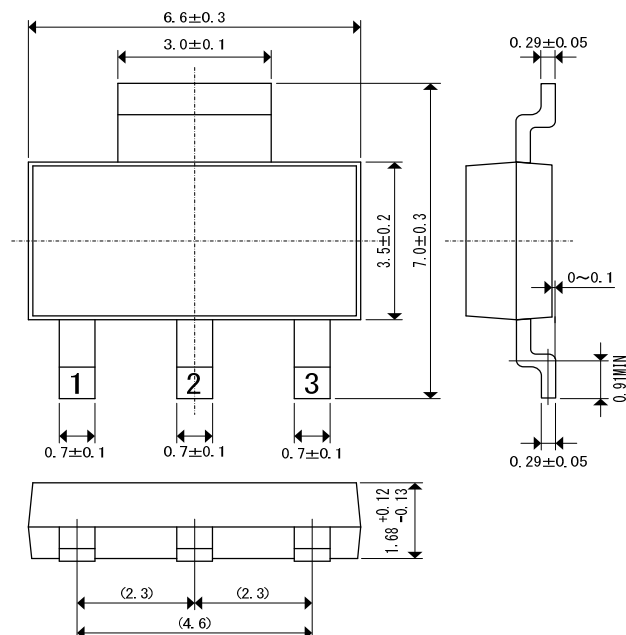
(8) Line Transient Response

XB1117P331



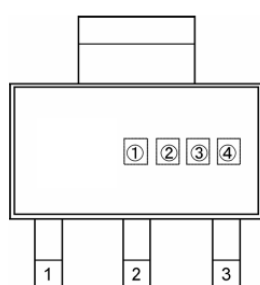
## ■ PACKAGING INFORMATION

### ● SOT-223



## ■ MARKING RULE

### ● SOT-223



SOT-223  
(TOP VIEW)

① represents product series

| MARK | PRODUCT SERIES |
|------|----------------|
| B    | XB1117xxxxFx   |

② represents fixed or adjustable output voltage

| MARK | PRODUCT SERIES |
|------|----------------|
| K    | XB1117KxxxxFx  |
| P    | XB1117PxxxxFx  |

③ represents output voltage

| MARK | OUTPUT VOLTAGE (V) | PRODUCT SERIES |
|------|--------------------|----------------|
| B    | ADJ                | XB1117K12BFx   |
| K    | 1.8                | XB1117P181Fx   |
| T    | 2.5                | XB1117P251Fx   |
| 2    | 3.3                | XB1117P331Fx   |
| M    | 5.0                | XB1117P501Fx   |

④ represents production lot number

0 to 9, A to Z repeated. (G, I, J, O, Q, W are excepted.)

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