**AME1117**

**1A Low Dropout Positive Voltage Regulator**

## ■General Descriptions

The AME1117 is a 1A low-dropout positive voltage regulator. It is available in fixed and adjustable output voltage versions. Overcurrent and thermal protection are integrated onto the chip. Output current will limit as while it reaches the pre-set current or temperature limit. The dropout voltage is specified at 1.4V Maximum at full rated output current. The AME1117 series provides excellent regulation over line, load and temperature variations.

## ■Key Features

- Low dropout voltage .....1.2V at 1A
- Adjustable or fixed voltages 2.5V, 3.3V, 5.0V
- Typical line regulation ..... 0.2%
- Typical load regulation ..... 0.15%
- Adjust pin current less than 90µA
- Overcurrent protection
- Thermal protection
- Available in TO-220, TO-252, SOT-223

## ■Applications

- High Efficiency Linear Regulators
- 5V to 3.3V Voltage Converter
- Battery Charger
- Post Regulators for Switching Supplies

## ■Functional Block Diagram

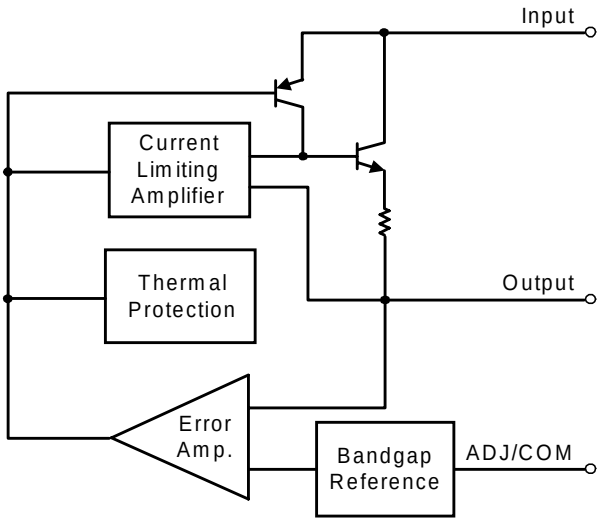
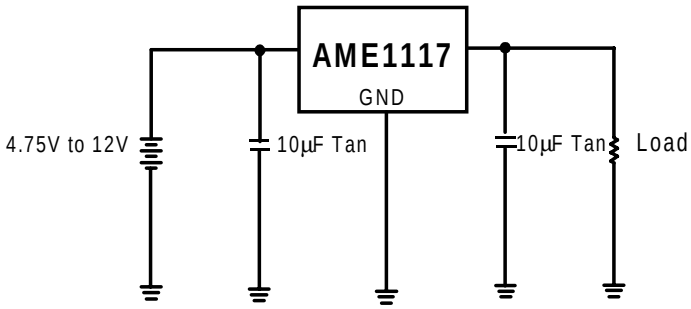



**Figure 1**

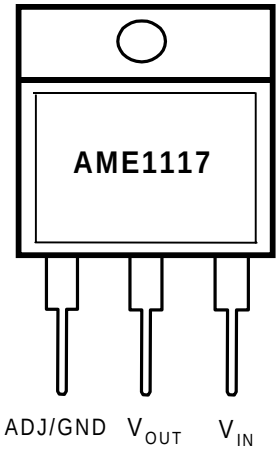
## ■ Typical Application



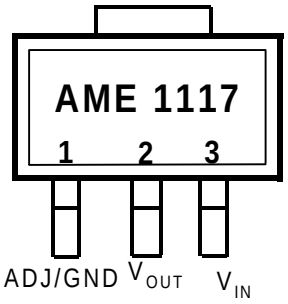

Input range depends on $V_{OUT}$
Please refer to electrical characteristics.

**Figure 2**

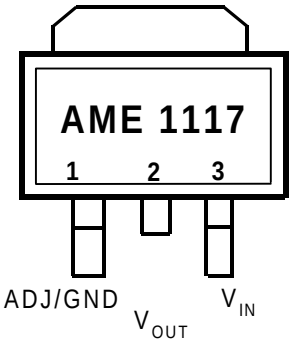
## ■ Pin Configuration



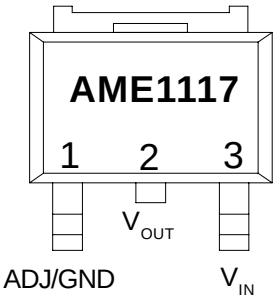

TO-220 Front View




SOT-223 Front View




TO-252 ( DPAK-2)
Front View




TO-252 ( DPAK-2)
Front View

## ■ Ordering Information

| Part Number | Marking | Output Voltage | Package |
|---|---|---|---|
| AME1117ACGT | ABEyww | ADJ | SOT-223 |
| AME1117BCGT | AKEyww | 2.5 | |
| AME1117CCGT | ABFyww | 3.3 | |
| AME1117DCGT | AKFyww | 5.0 | |
| AME1117ACCT | AME1117<br>ACCT<br>yyww | ADJ | TO-252<br>(DPAK-2) |
| AME1117BCCT | AME1117<br>BCCT<br>yyww | 2.5 | |
| AME1117CCCT | AME1117<br>CCCT<br>yyww | 3.3 | |
| AME1117DCCT | AME1117<br>DCCT<br>yyww | 5.0 | |
| AME1117ACBT | AME1117<br>ACBT<br>yyww | ADJ | TO-220 |
| AME1117BCBT | AME1117<br>BCBT<br>yyww | 2.5 | |
| AME1117CCBT | AME1117<br>CCBT<br>yyww | 3.3 | |
| AME1117DCBT | AME1117<br>DCBT<br>yyww | 5.0 | |

## ■ Absolute Maximum Ratings

| Parameter | | Symbol | Maximum | Unit |
|---|---|---|---|---|
| Input Voltage | | $V_{IN}$ | 7 | V |
| Thermal Resistance (Junction to Case) | TO-220 | $\theta_{JC}$ | 2.5 | °C/W |
| | TO-252 | | 5 | |
| | SOT-223 | | 15 | |
| Thermal Resistance (Junction to Ambient) | TO-220 | $\theta_{JA}$ | 50 | |
| | TO-252 | | 90 | |
| | SOT-223 | | 160 | |
| Operating Junction Temperature Range | | $T_J$ | 0 to 125 | °C |
| Storage Temperature Range | | $T_{STG}$ | -65 to 150 | |
| Lead Temperature (10 sec) | | $T_{LEAD}$ | 260 | |

## ■ Electrical Characteristics

**AME1117AXXX**

| Parameter | Symbol | Test conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Reference voltage | $V_{REF}$ | $V_{IN}$ = 5V, $I_O$ = 10mA | $T_J$ = 25°C | 1.238 | 1.250 | 1.262 | V |
| | | | Over Temp. | 1.225 | 1.250 | 1.275 | |
| Line regulation * | $Reg_{LINE}$ | $V_{IN}$ = 4.75~7V, $I_O$ = 10mA | $T_J$ = 25°C | - | - | 0.2 | % |
| Load regulation | $Reg_{LOAD}$ | $V_{IN}$ = 5V, $I_O$ = 10mA~1A | $T_J$ = 25°C | - | 0.05 | 0.3 | |
| | | | Over Temp. | - | 0.2 | 0.4 | |
| Dropout voltage | $V_D$ | $I_O$ = 10mA~1A, $\Delta$Vo = ±1% | $T_J$ = 25°C | - | 1.2 | 1.4 | V |
| | | | Over Temp. | - | 1.3 | - | |
| Current limit | $I_S$ | $V_{IN}$ = 2.75~7V | Over Temp. | 1.0 | - | - | A |
| Temp. coefficient | $T_C$ | $V_{IN}$ = 2.75~7V, $I_O$ = 10mA~1A | | - | 0.005 | - | %/"C |
| Adjust pin current | $I_{ADJ}$ | $V_{IN}$ = 2.75~7V, $I_O$ = 10mA~1A | $T_J$ = 25°C | - | 55 | - | μA |
| | | | Over Temp. | - | | 90 | |
| Adjust pin current change | $\Delta I_{ADJ}$ | $V_{IN}$ = 2.75~7V, $I_O$ = 10mA~1A, Over Temp. | | - | 0.2 | 5 | |
| Temperature stability | $T_S$ | $V_{IN}$ = 5V, $I_O$ = 100mA, Over Temp. | | - | 0.5 | | % |
| Minimum load current | $I_O$ | $V_{IN}$ = 5V | | - | 5 | 10 | mA |
| RMS output noise | $V_N$ | $T_J$ = 25°C | | - | 0.003 | - | %$V_O$ |
| Ripple rejection ratio | $R_A$ | $V_{IN}$ = 5V, $I_O$ = 1A, Over Temp. | | 60 | 72 | - | dB |

**AME1117BXXX**

| Parameter | Symbol | Test conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Output voltage | $V_O$ | $V_{IN}$ = 5V, $I_O$ = 0A | $T_J$ = 25°C | 2.475 | 2.500 | 2.525 | V |
| | | | Over Temp. | 2.450 | 2.500 | 2.550 | |
| Line regulation | $Reg_{LINE}$ | $V_{IN}$ = 4.75~7V, $I_O$ = 0A | $T_J$ = 25°C | - | - | 0.2 | % |
| Load regulation | $Reg_{LOAD}$ | $V_{IN}$ = 5V, $I_O$ = 0A~1A | $T_J$ = 25°C | - | 0.05 | 0.3 | |
| | | | Over Temp. | - | 0.2 | 0.4 | |
| Dropout voltage | $V_D$ | $I_O$ = 0A~1A, $\Delta$Vo = ±1% | $T_J$ = 25°C | - | 1.2 | 1.4 | V |
| | | | Over Temp. | - | 1.3 | - | |
| Current limit | $I_S$ | $V_{IN}$ = 4.75~7V, Over Temp. | | 1.0 | - | - | A |
| Quiescent Current | $I_Q$ | $V_{IN}$ = 5V, $I_O$ = 0A~1A, Over Temp. | | - | 6 | 13 | mA |
| Temp. Coefficient | $T_C$ | $V_{IN}$ = 4.75~7V, $I_O$ = 0A~1A | | - | 0.005 | - | %/"C |
| Temperature stability | $T_S$ | $V_{IN}$ = 5V, $I_O$ = 100mA, Over Temp. | | - | 0.5 | - | % |
| RMS output noise | $V_N$ | $T_J$ = 25°C | | - | 0.003 | - | $\%V_O$ |
| Ripple rejection ratio | $R_A$ | $V_{IN}$ = 5V, $I_O$ = 1A, Over Temp. | | 60 | 72 | - | dB |

**AME1117CXXX**

| Parameter | Symbol | Test conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Output voltage | $V_O$ | $V_{IN}$ = 5V, $I_O$ = 0A | $T_J$ = 25°C | 3.270 | 3.300 | 3.330 | V |
| | | | Over Temp. | 3.234 | 3.300 | 3.366 | |
| Line regulation | $Reg_{LINE}$ | $V_{IN}$ = 4.75~7V, $I_O$ = 0A | $T_J$ = 25°C | - | - | 0.2 | % |
| Load regulation | $Reg_{LOAD}$ | $V_{IN}$ = 5V, $I_O$ = 0A~1A | $T_J$ = 25°C | - | 0.05 | 0.3 | |
| | | | Over Temp. | - | 0.2 | 0.4 | |
| Dropout voltage | $V_D$ | $I_O$ = 0A~1A, $\Delta$Vo = ±1% | $T_J$ = 25°C | - | 1.2 | 1.4 | V |
| | | | Over Temp. | - | 1.3 | - | |
| Current limit | $I_S$ | $V_{IN}$ = 4.75~7V, Over Temp. | | 1.0 | - | - | A |
| Quiescent Current | $I_Q$ | $V_{IN}$ = 5V, $I_O$ = 0A~1A, Over Temp. | | - | 6 | 13 | mA |
| Temp. coefficient | $T_C$ | $V_{IN}$ = 4.75~7V, $I_O$ = 0A~1A | | - | 0.005 | - | %/"C |
| Temperature stability | $T_S$ | $V_{IN}$ = 5V, $I_O$ = 100mA, Over Temp. | | - | 0.5 | - | % |
| RMS output noise | $V_N$ | $T_J$ = 25°C | | - | 0.003 | - | $\%V_O$ |
| Ripple rejection ratio | $R_A$ | $V_{IN}$ = 5V, $I_O$ = 1A, Over Temp. | | 60 | 72 | - | dB |

*Line regulation test circuit

**AME1117DXXX**

| Parament | Symbol | Test conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Output voltage | $V_O$ | $V_{IN}$ = 7V, $I_O$ = 0A | $T_J$ = 25°C | 4.950 | 5.000 | 5.050 | V |
| | | | Over Temp. | 4.900 | 5.000 | 5.100 | |
| Line regulation | $Reg_{LINE}$ | $V_{IN}$ = 7~9V, $I_O$ = 0A | $T_J$ = 25°C | - | - | 0.3 | % |
| | | | Over Temp. | - | - | 0.4 | |
| Load regulation | $Reg_{LOAD}$ | $V_{IN}$ = 7V, $I_O$ = 0A~1A | $T_J$ = 25°C | - | 0.05 | 0.3 | |
| | | | Over Temp. | - | 0.2 | 0.4 | |
| Dropout voltage | $V_D$ | $I_O$ = 0A~1A, $\Delta$Vo = $\pm$1% | $T_J$ = 25°C | - | 1.2 | 1.4 | V |
| | | | Over Temp. | - | 1.3 | - | |
| Current limit | $I_S$ | $V_{IN}$ = 7~10V, Over Temp. | | 1.0 | - | - | A |
| Quiescent Current | $I_Q$ | $V_{IN}$ = 7V, $I_O$ = 0A~1A, Over Temp. | | - | 6 | 13 | mA |
| Temp. coefficient | $T_C$ | $V_{IN}$ = 7~10V, $I_O$ = 0A~1A | | - | 0.005 | - | %/"C |
| Temperature stability | $T_S$ | $V_{IN}$ = 7V, $I_O$ = 100mA, Over Temp. | | - | 0.5 | - | % |
| RMS output noise | $V_N$ | $T_J$ = 25°C | | - | 0.003 | - | $\%V_O$ |
| Ripple rejection ratio | $R_A$ | $V_{IN}$ = 7V, $I_O$ = 1A, Over Temp. | | 60 | 72 | - | dB |

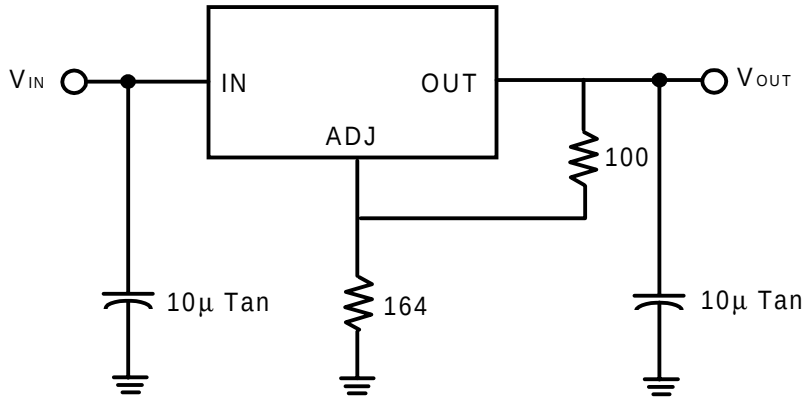
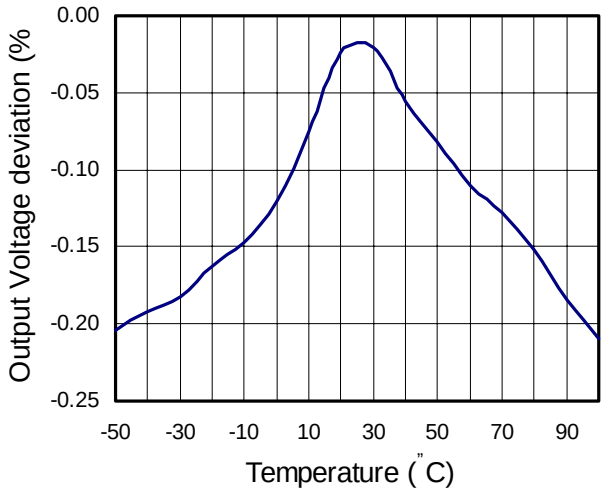


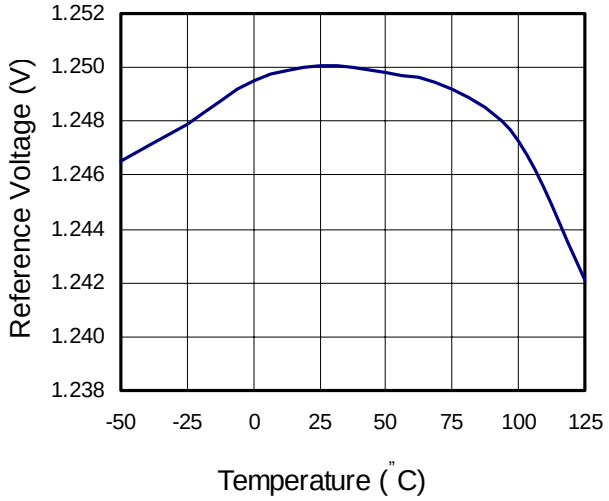

**Figure 3**

## ■ Performance Characteristics

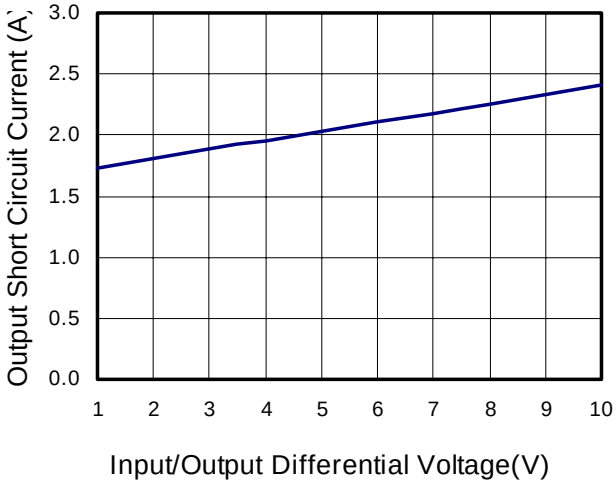
**1. Load Regulation**



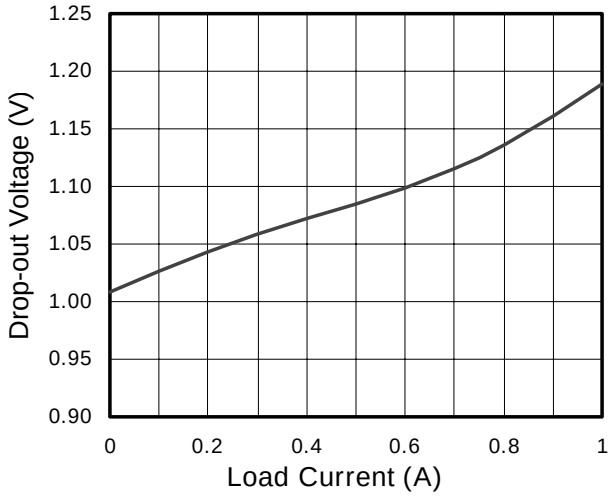

**3. Temperature Stablilty**



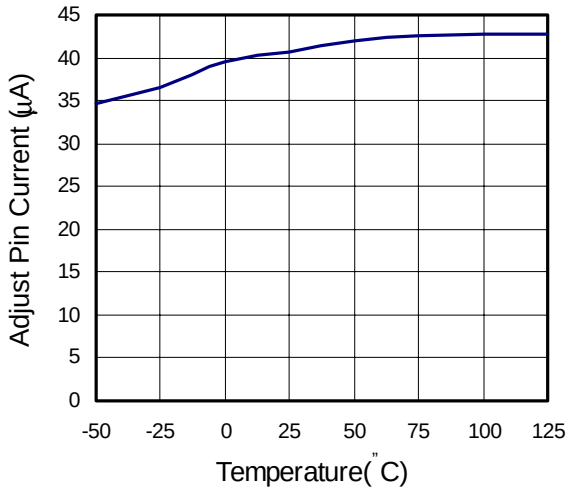

**2. Short Circuit Current**



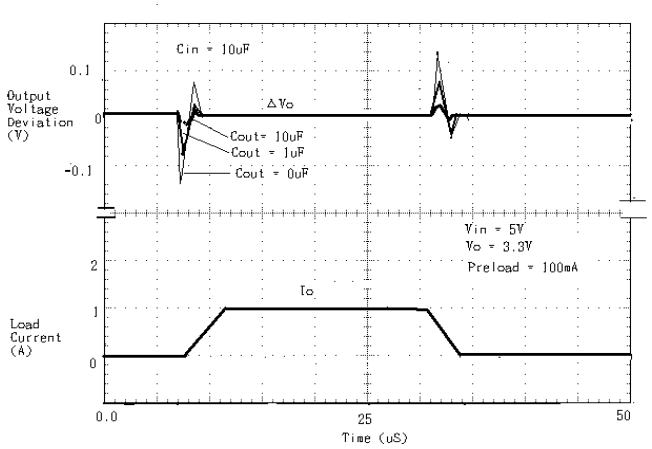

**4. Dropout Voltage**



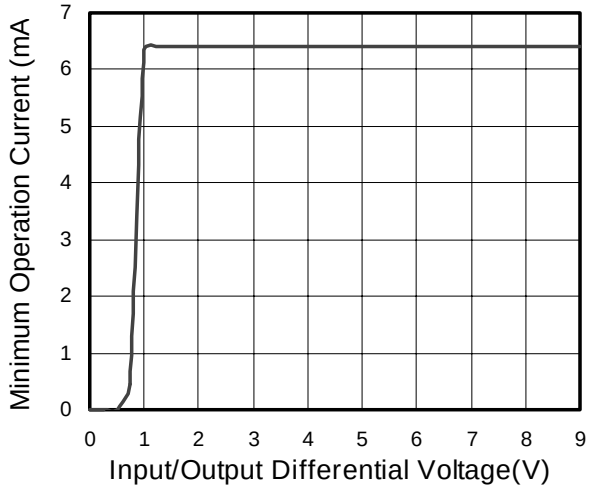
**5. Adjust Pin Current**



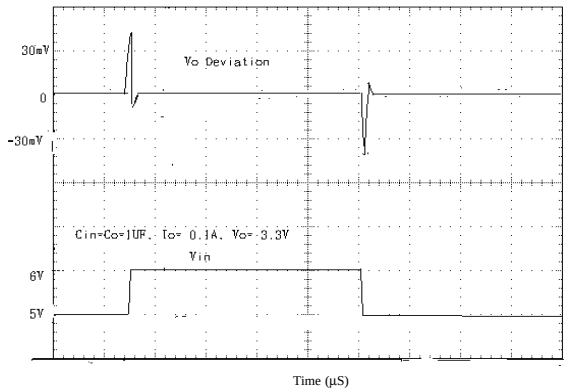

**7. Load Transient Response**




**6. Minimum Operating Current**




**8. Line Transient Response**



## ■ Application Descriptions

**1. Output voltage adjustment**

Like most regulators, the AME1117 regulates the output by comparing the output voltage to an internally generated reference voltage. On the adjustable version, the $V_{REF}$ is available externally as 1.25V between $V_{OUT}$ and ADJ. The voltage ratio formed by R1 and R2 should be set to conduct 10mA (minimum output load). The output voltage is given by the following equation:

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

On fixed versions of AME1117, the voltage divider is provided internally.

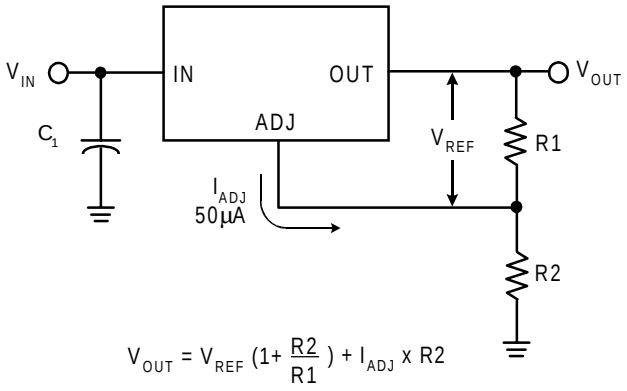



**Figure 4**

**2. Thermal protection**

AME1117 has thermal protection which limits junction temperature to 150°C. However, device functionality is only guaranteed to a maximum junction temperature of +125°C.
The power dissipation and junction temperature for AME1117 in DPAK package are given by

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$
$$T_{JUNCTION} = T_{AMBIENT} + (P_D \times \theta_{JA})$$

Note: $T_{JUNCTION}$ must not exceed 125°C

**3. Current Limit Protection**

AME1117 is protected against overload conditions. Current protection is triggered at typically 1.5A.

**4. Stability and Load Regulation**

AME1117 requires a capacitor from $V_{OUT}$ to GND to provide compensation feedback to the internal gain stage. This is to ensure stability at the output terminal. Typically, a 10µF tantalum or 50µF aluminum electrolytic is sufficient.

Note: It is important that the ESR for this capacitor does not exceed 0.5Ω.

The output capacitor does not have a theoretical upper limit and increasing its value will increase stability. $C_{OUT}$ = 100µF or more is typical for high current regulator design.

For the adjustable version, the best load regulation is accomplished when the top of the resistor divider (R1) is connected directly to the output pin of the AME1117. When so connected, $R_P$ is not multiplied by the divider ratio.
For fixed output versions, the top of R1 is internally connected to the output. The ground pin can be connected to the low side of the load in order to eliminate ground loop errors.

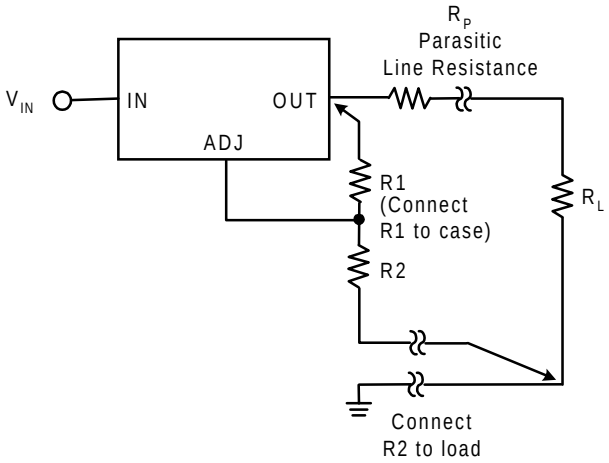



**Figure 5**

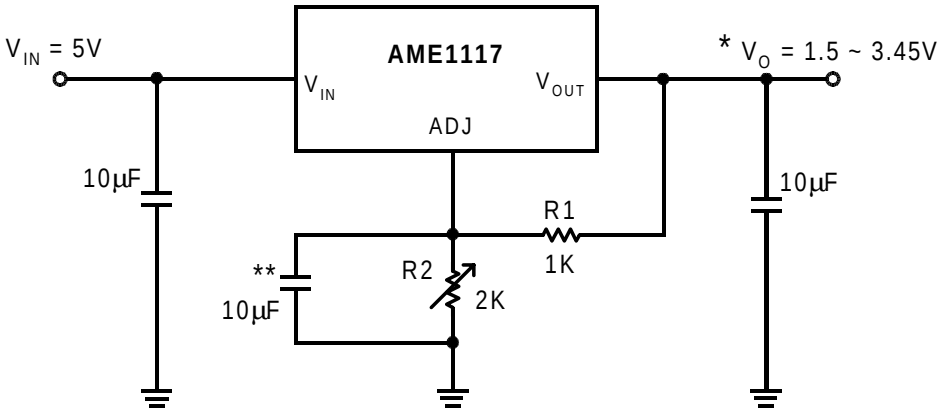
**5. Thermal Consideration**

The AME1117 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 must be electrically isolated, a thermally conductive spacer is recommended.

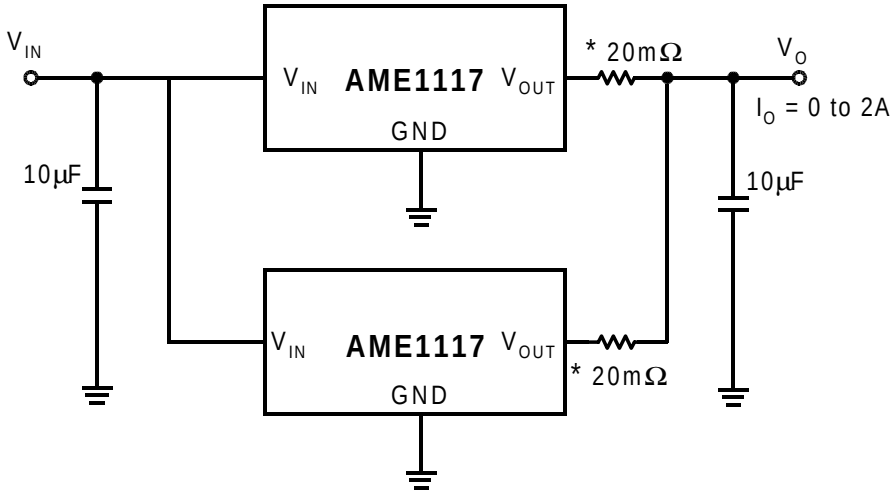
## ■ Advanced Applications

### Adjustable Output Voltage



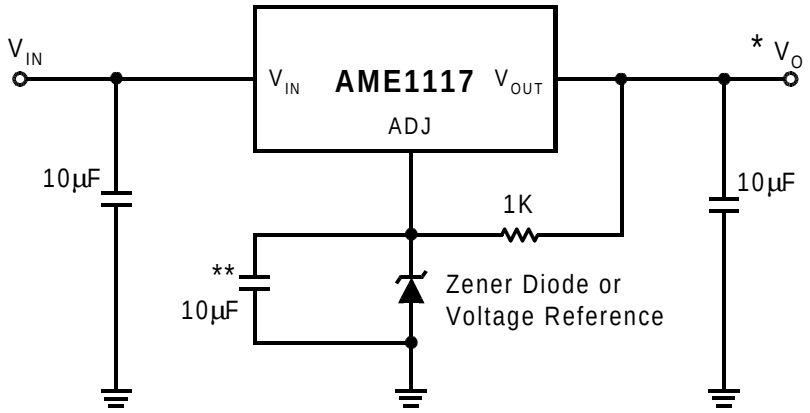

* $V_O$ = Vref (1 + R2/R1) + Iadj X R2
** Optional for improved ripple rejection

### Paralleling Regulators



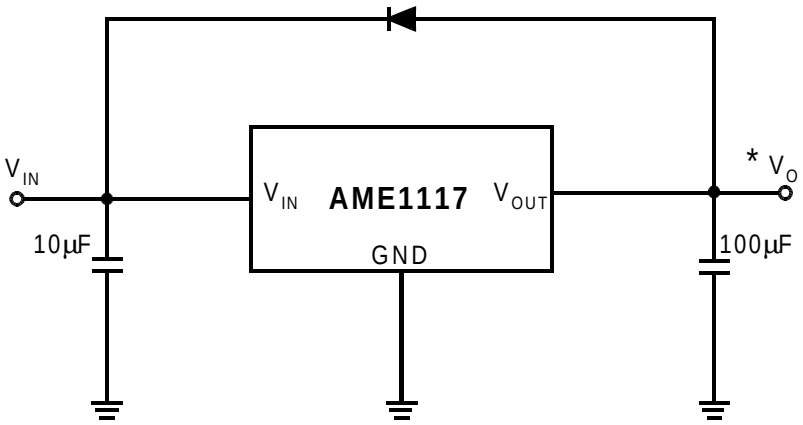

* 20mΩis ballast resistance
The inter-connection of #18 wire could act as ballast resistance.

### Regulator with Reference



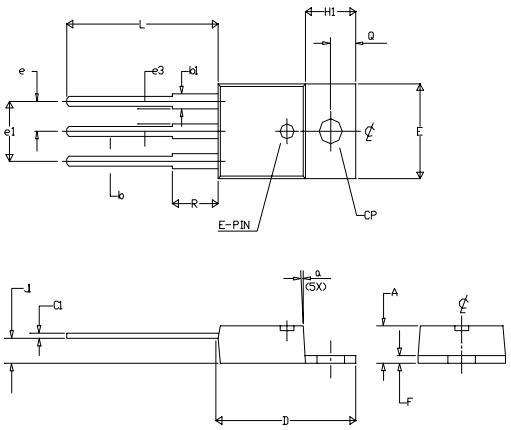

* $V_O$ = Vref + $V_Z$ ($V_Z$ is breakdown voltage of Zener Diode)
** Optional for improved ripple rejection

### Regulator with Reverse Diode Protection



## ■ Package Dimension

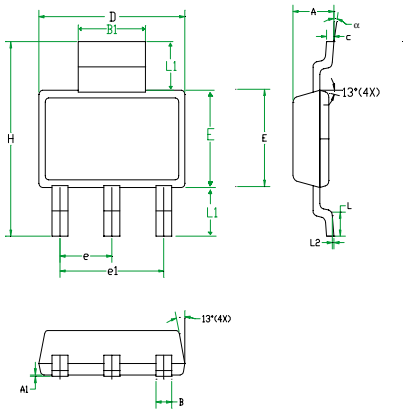
### TO-220




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 4.06 | 4.83 | 0.160 | 0.190 |
| b | 0.63 | 1.02 | 0.025 | 0.040 |
| C1 | 0.35 | 0.60 | 0.0138 | 0.0236 |
| D | 14.22 | 14.99 | 0.056 | 0.590 |
| E | 9.66 | 10.54 | 0.385 | 0.415 |
| e | - | 2.79 | - | 0.110 |
| e1 | 4.83 | 5.33 | 0.190 | 0.210 |
| e3 | 1.14 | 1.40 | 0.045 | 0.055 |
| f | 1.14 | 1.40 | 0.045 | 0.055 |
| H1 | 5.94 | 6.55 | 0.234 | 0.258 |
| K | 2.29 | 2.92 | 0.090 | 0.115 |
| CP | 3.71 | 3.96 | 0.146 | 0.156 |
| Q | 2.62 | 2.87 | 0.103 | 0.113 |
| L | 12.70 | 14.27 | 0.500 | 0.5618 |
| a | 3D | 7D | 3D | 7D |
| b1 | 1.14 | 1.52 | 0.0449 | 0.06 |
| R | 6.17 REF. | | 0.243 REF. | |

**Notes :**
1. Dimension C1 apply for tin plate finish.
2. For solder dip lead finish dimension C1 should be 0.015"-0.027" (0.38-0.69)

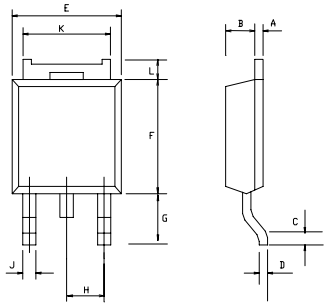
### SOT-223




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.50 | 1.80 | 0.0591 | 0.0709 |
| $A_1$ | 0.02 | 0.10 | 0.0008 | 0.0039 |
| B | 0.60 | 0.838 | 0.0236 | 0.033 |
| $B_1$ | 2.895 | 3.15 | 0.1140 | 0.1240 |
| C | 0.24 | 0.381 | 0.0094 | 0.0150 |
| D | 6.299 | 6.706 | 0.2480 | 0.2640 |
| E | 3.30 | 3.708 | 0.1299 | 0.1460 |
| e | 2.30 BSC | | 0.090 BSC | |
| $e_1$ | 4.60 BSC | | 0.181 BSC | |
| H | 6.70 | 7.30 | 0.2638 | 0.2874 |
| L | 0.91 MIN | | 0.0360 MIN | |
| $L_1$ | 2.00 MAX | | 0.0787 MAX | |
| $L_2$ | 0.06 BSC | | 0.0024 BSC | |
| a | $0^\circ$ | $10^\circ$ | $0^\circ$ | $10^\circ$ |

## ■ Package Dimension

### TO-252 (DPAK)

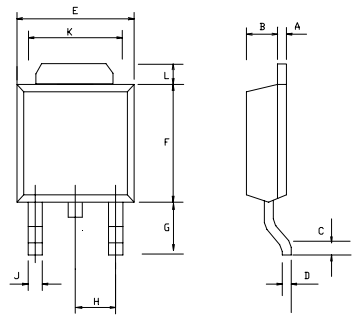



| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.45 | 0.58 | 0.0177 | 0.023 |
| B | 1.60 | 1.95 | 0.06 | 0.0768 |
| C | 0.51 | - | 0.02 | - |
| D | 0.45 | 0.60 | 0.0177 | 0.0236 |
| E | 6.40 | 6.80 | 0.252 | 0.2677 |
| F | 5.40 | 5.80 | 0.2126 | 0.2283 |
| G | 2.20 | 2.85 | 0.0866 | 0.1122 |
| H | - | * 2.30 | - | * 0.0906 |
| I | - | 0.90 | - | 0.0354 |
| J | - | 0.97 | - | 0.038 |
| K | 5.20 | 5.50 | 0.20 | 0.22 |
| L | 0.89 | 2.03 | 0.035 | 0.08 |

* : Typical value

NOTES :
1. CONTROLLING DIMENSION : MILLIMETERS.
2. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

### TO-252 (DPAK)




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.45 | 0.58 | 0.0177 | 0.023 |
| B | 1.60 | 1.95 | 0.06 | 0.0768 |
| C | 0.51 | - | 0.02 | - |
| D | 0.45 | 0.60 | 0.0177 | 0.0236 |
| E | 6.40 | 6.80 | 0.252 | 0.2677 |
| F | 5.40 | 5.80 | 0.2126 | 0.2283 |
| G | 2.20 | 2.85 | 0.0866 | 0.1122 |
| H | - | * 2.30 | - | * 0.0906 |
| I | - | 0.90 | - | 0.0354 |
| J | - | 0.97 | - | 0.038 |
| K | 5.20 | 5.50 | 0.20 | 0.22 |
| L | 0.89 | 2.03 | 0.035 | 0.08 |

* : Typical value

NOTES :
1. CONTROLLING DIMENSION : MILLIMETERS.
2. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

**www.analogmicro.com**
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## Corporate Headquarters
**Analog Microelectronics, Inc.**
3100 De La Cruz Blvd. Suite 201
Santa Clara, CA. 95054-2046
Tel : (408) 988-2388
Fax: (408) 988-2489

## Asia Pacific Headquarters
**AME, Inc.**
2F, 187 Kang-Chien Road, Nei-Hu Dist.,
Taipei 114 Taiwan, R.O.C.
Tel : 886 2 2627-8687
Fax: 886 2 2659-2989