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Analog Microelectronics, Inc.

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

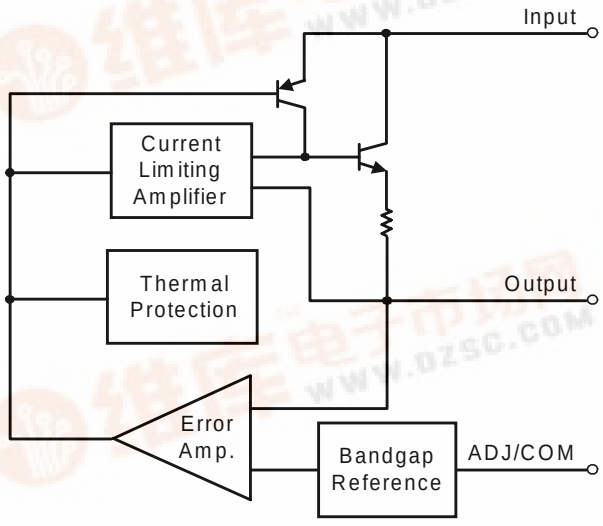
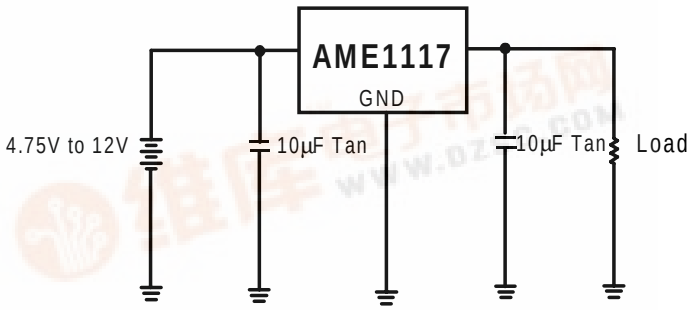


Figure 1

■ Typical Application



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

Figure 2

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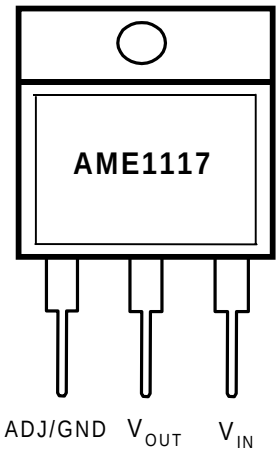
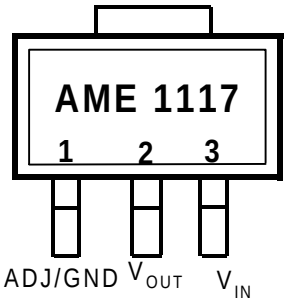
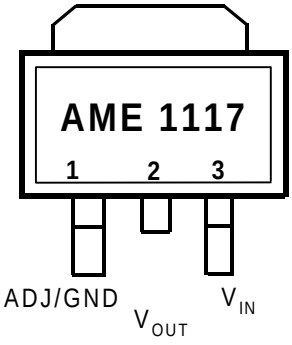
■ Pin Configuration



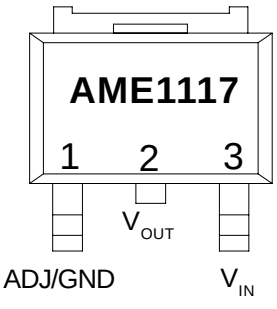
TO-220 Front View



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 ACCT yyww	ADJ	TO-252 (DPAK-2)
AME1117BCCT	AME1117 BCCT yyww	2.5	
AME1117CCCT	AME1117 CCCT yyww	3.3	
AME1117DCCT	AME1117 DCCT yyww	5.0	
AME1117ACBT	AME1117 ACBT yyww	ADJ	TO-220
AME1117BCBT	AME1117 BCBT yyww	2.5	
AME1117CCBT	AME1117 CCBT yyww	3.3	
AME1117DCBT	AME1117 DCBT yyww	5.0	

■ Absolute Maximum Ratings

Parameter		Symbol	Maximum	Unit
Input Voltage		V_{IN}	7	V
Thermal Resistance (Junction to Case)	TO-220	θ_{JC}	2.5	°C/W
	TO-252		5	
	SOT-223		15	
Thermal Resistance (Junction to Ambient)	TO-220	θ_{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, ΔVo = ±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	ΔI_{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, ΔVo = ±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, ΔVo = ±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, ΔVo = $\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

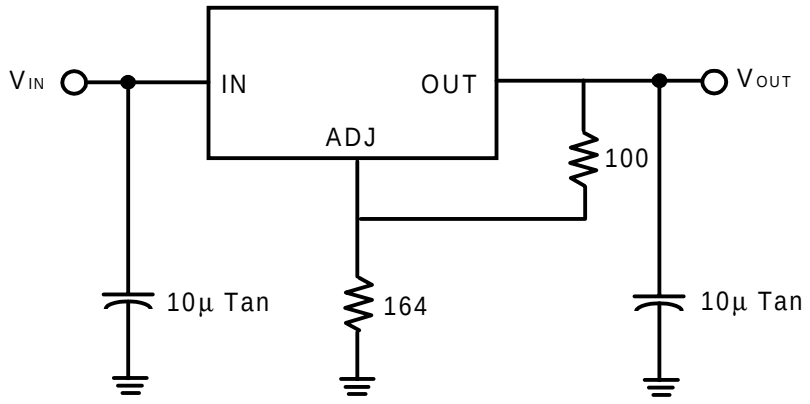
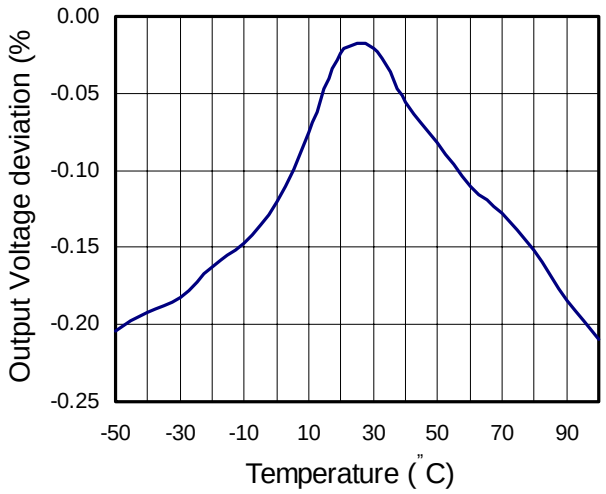


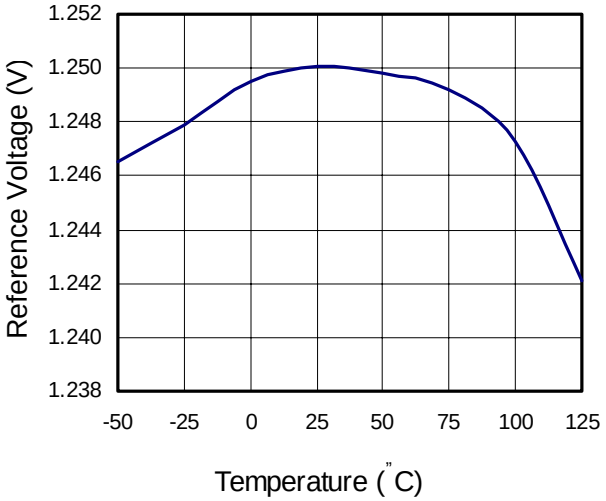
Figure 3

■ Performance Characteristics

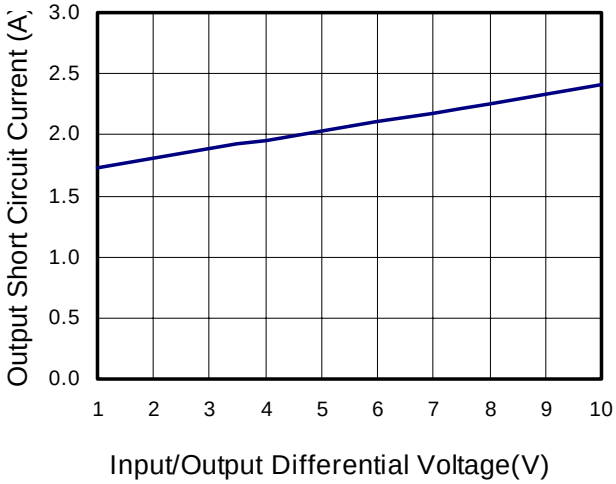
1. Load Regulation



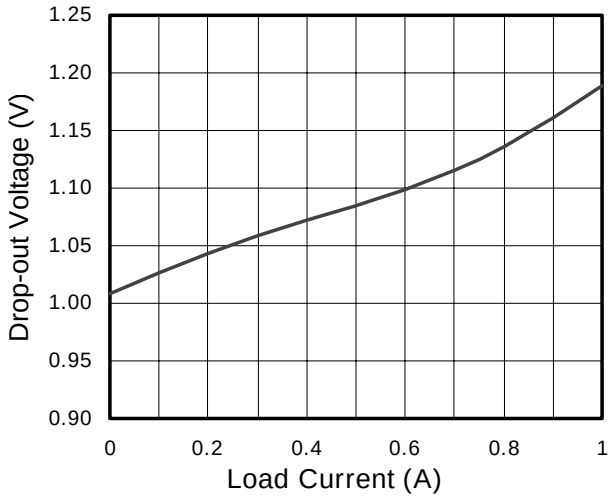
3. Temperature Stablilty



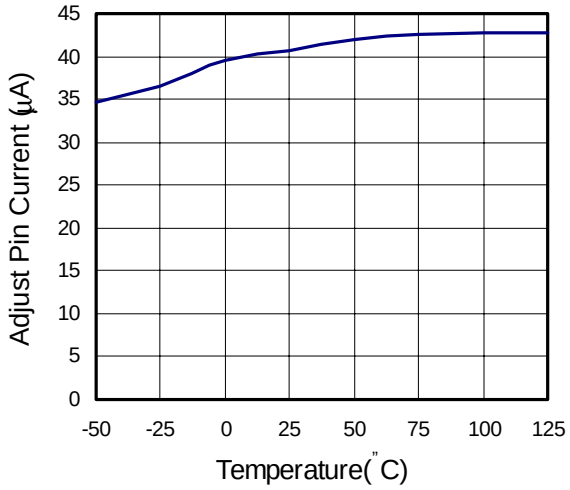
2. Short Circuit Current



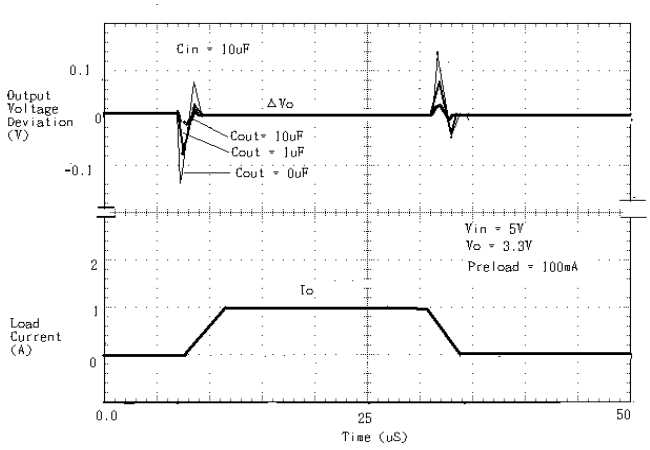
4. Dropout Voltage



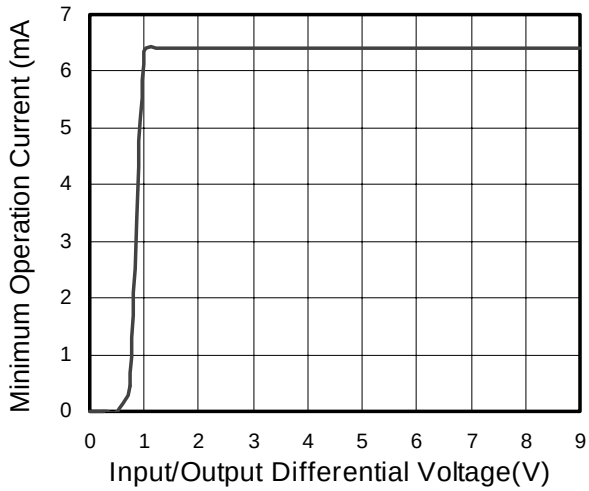
5. Adjust Pin Current



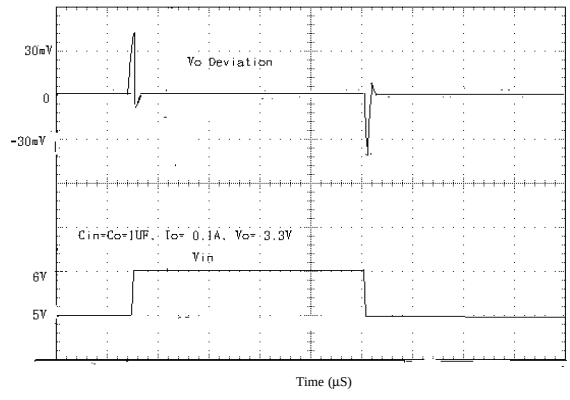
7. Load Transient Response



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.

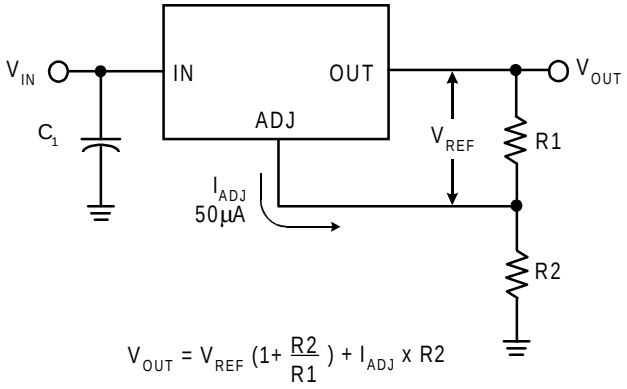


Figure 4

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.

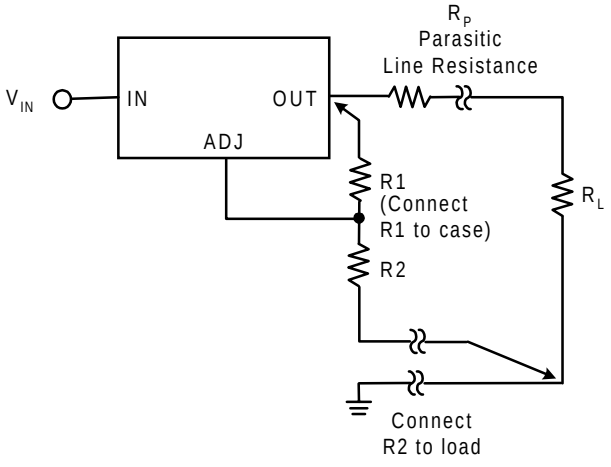


Figure 5

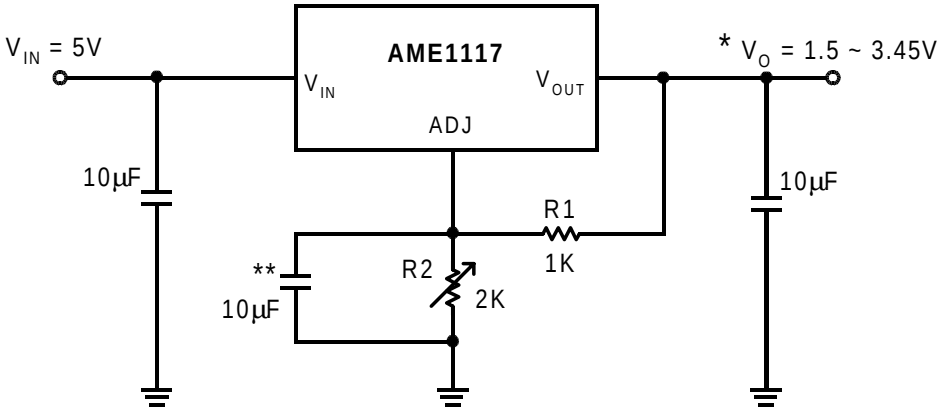
5. Thermal Consideration

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.

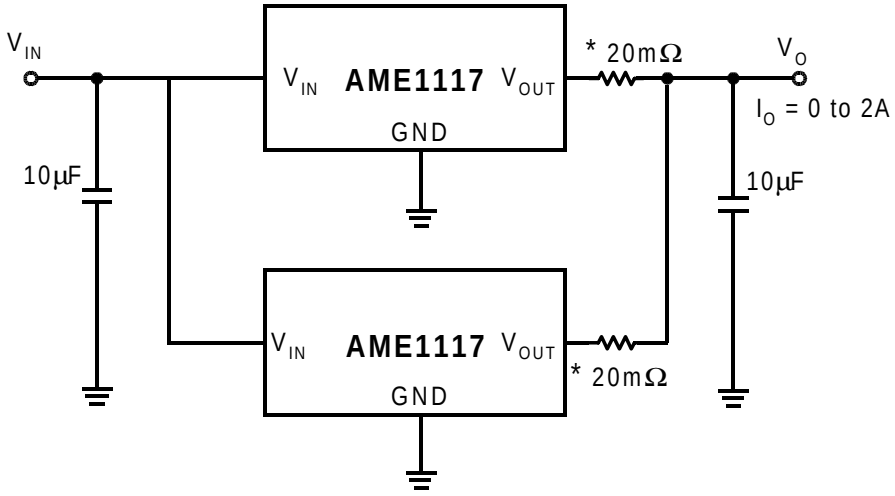
■ Advanced Applications

Adjustable Output Voltage



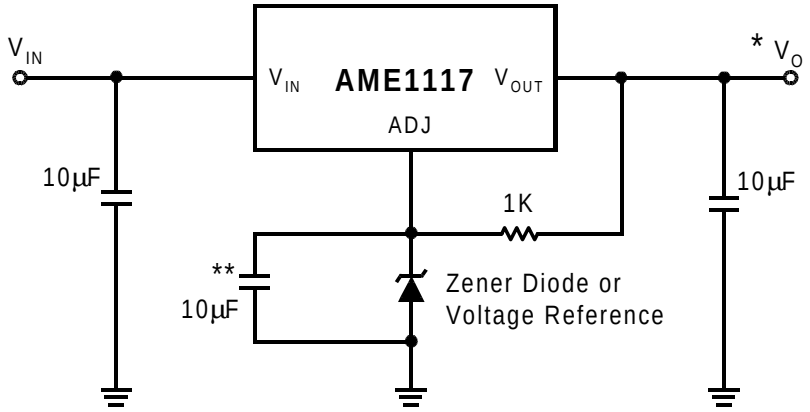
* V_O = Vref (1 + R2/R1) + Iadj X R2
** Optional for improved ripple rejection

Paralleling Regulators



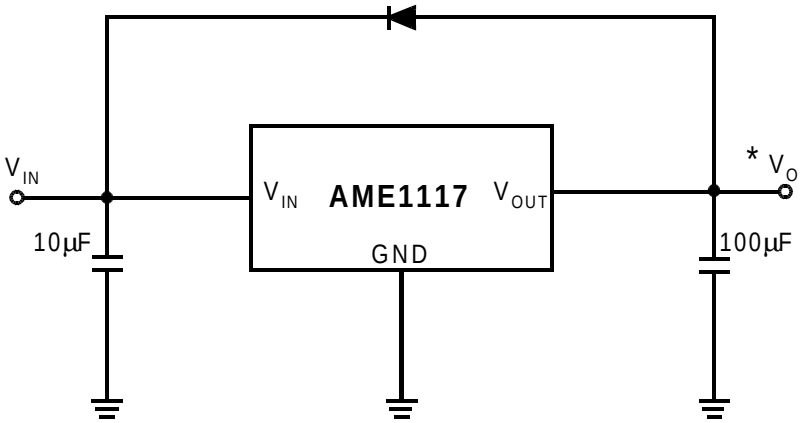
* 20mΩis ballast resistance
The inter-connection of #18 wire could act as ballast resistance.

Regulator with Reference



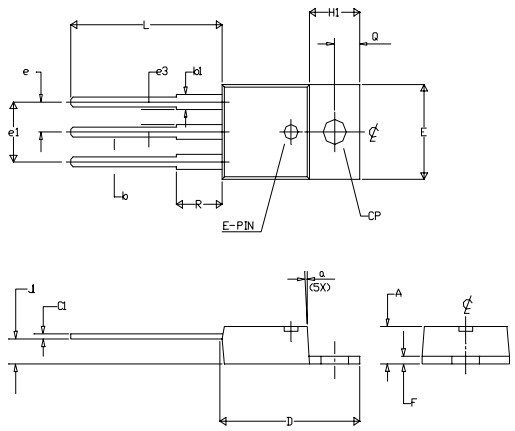
* V_O = Vref + V_Z (V_Z is breakdown voltage of Zener Diode)
** Optional for improved ripple rejection

Regulator with Reverse Diode Protection



■ Package Dimension

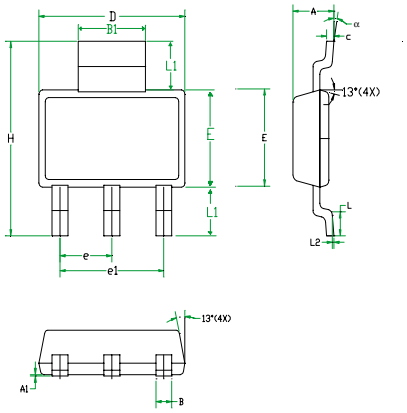
TO-220



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)

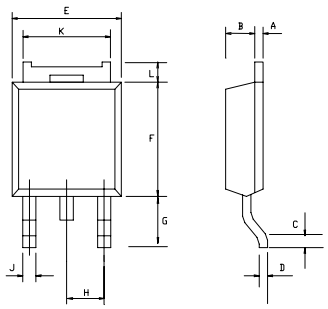
SOT-223



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°	10°	0°	10°

■ Package Dimension

TO-252 (DPAK)

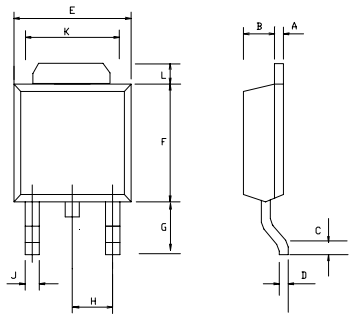


SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.45	0.58	0.0177	0.023
B	1.60	1.95	0.06	0.0768
C	0.51	-	0.02	-
D	0.45	0.60	0.0177	0.0236
E	6.40	6.80	0.252	0.2677
F	5.40	5.80	0.2126	0.2283
G	2.20	2.85	0.0866	0.1122
H	-	* 2.30	-	* 0.0906
I	-	0.90	-	0.0354
J	-	0.97	-	0.038
K	5.20	5.50	0.20	0.22
L	0.89	2.03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

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Document: 1014-DS1117-C

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