1A Low Dropout Regulator

FEATURES

- Guaranteed Output Voltage Accuracy within 2%
- Fast Transient Response
- Load Regulation : 0.1% Typ.
- Line Regulation : 0.03% Typ.
- Low Dropout Voltage : 1.1V Typ. at I_{OUT} =1A
- Current Limit : 1A Typ. at T_J=25°C
- On-chip Thermal Limiting : 150°C Typ.
- Adjustable Output : 1.25~10.7V
- Standard 3-pin SOT-223 Power Packages

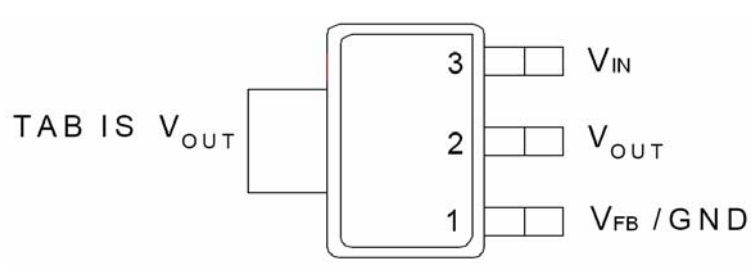
APPLICATIONS

- PC peripheral
- Low Voltage Logic Supplies
- Post Regulator for Switching Power Supply

DESCRIPTION

The EP1117 is a low dropout three-terminal adjustable or fixed-voltage regulator with 1A output current capability. The EP1117 is available in an adjustable version, with output ranging from 1.25V to 10.7V and fixed output voltages of 1.8V, 2.5V and 3.3V. Dropout voltage is guaranteed at a maximum of 1.3V at 1A. On-chip thermal limiting provides protection against any combination of overload that would create excessive junction temperatures. The EP1117 is available in the industry standard 3-pin the low profile surface mount SOT-223 power packages which can be used in applications where space is limited.

Package Information



Absolute Maximum Rating (Note1)

Symbol	Parameter	Rating (Note2)	Unit
V_I	Input Voltage EP1117-adj, EP1117-33 EP1117-25, EP1117-18	15 9	V
T_J	Operating Junction Temperature Range Control Section Power Transistor	 0 to 125 0 to 150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_L	Lead Temperature (Soldering, 10 second)	260	°C

Note: 1. Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note: 2.The values here show the absolute maximum rating, and for normal usage please refer the test condition in Electrical Characteristics Table.

Electrical Characteristics (Note3):

Unless otherwise noted, these specifications apply over C_{IN} = 10μF, C_{OUT} = 10μF, and T_A=0 to 70°C. Typical values refer to T_A=25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{REF}	Reference Voltage	T_J = 0~125°C, 10mA≤ I_{OUT} ≤1A, 1.4V≤ (V_{IN} -V_{OUT}) ≤10.75V	1.225	1.250	1.275	V
V_{OUT}	Output Voltage EP1117-18 EP1117-25 EP1117-33	 T_J = 0~125°C, 0≤I_{OUT}≤1.5A, 3.25V≤ V_{IN} ≤9V, T_J = 0~125°C, 0≤ I_{OUT}≤ 1A, 3.95V≤ V_{IN}≤9V T_J = 0~125°C, 0≤I_{OUT}≤1A, 4.75V≤V_{IN} ≤12V	 1.764 2.450 3.235	 1.800 2.500 3.300	 1.836 2.550 3.365	V
REG_{LINE}	Line Regulation EP1117-adj EP1117-18 EP1117-25 EP1117-33	 I_{OUT} =10mA, 1.5V≤(V_{IN} -V_{OUT})≤10.75V (Note4) I_{OUT} = 0A, 3.25V≤V_{IN} ≤9V (Note4) I_{OUT} = 0A, 3.95V≤ V_{IN} ≤9V (Note4) I_{OUT} = 0A, 4.75V≤V_{IN} ≤12V (Note4)		 0.03 1 1 1	 0.2 6 6 6	 % mV
REG_{LOAD}	Load Regulation EP1117 EP1117-18 EP1117-25 EP1117-33	 (V_{IN} -V_{OUT})=3V, 0≤ I_{OUT} ≤1A (Note4) V_{IN} = 3.25V, 0≤ I_{OUT} ≤1A (Note4) V_{IN} = 3.95V, 0≤ I_{OUT} ≤1A (Note4) V_{IN} = 4.75V, 0≤ I_{OUT} ≤1A (Note4)		 0.1 1 1 1	 0.4 10 10 10	 % mV

V_D	Dropout Voltage	I_{OUT} = 100mA (Note5) I_{OUT} = 500mA (Note5) I_{OUT} = 1A (Note5)		1 1.05 1.1	1.1 1.2 1.3	V
I_{LIMIT}	Current Limit	(V_{IN} -V_{OUT}) = 5V, T_J = 25°C	1000			mA
I_{ADJ}	Adjust Pin Current	(V_{IN} -V_{OUT}) = 3V, I_{OUT} = 10mA		60	120	μA
ΔI_{ADJ}	Adjust Pin Current Change	10mA≤ I_{OUT} ≤1A, 1.4V≤ (V_{IN} -V_{OUT}) ≤10.75V		0.2	5	μA
I_O	Minimum Load Current	(V_{IN} -V_{OUT}) = 10.75V (Note6)		1.7		mA
PSRR	Ripple Rejection	f_{RIPPLE} =120Hz, V_{RIPPLE} = 1VP-P, (V_{IN} -V_{OUT}) = 3V	60	75		dB
T_R	Thermal Regulation	T_J = 25°C, 30ms Pulse		0.01	0.02	%/ W
T_S	Temperature Stability			0.5		%
L_S	Long -Term Stability	T_J = 125°C, 1000Hrs.		0.3		%
V_N	RMS Output Noise	T_J = 25°C, 10Hz≤F≤10kHz, (% of V_{OUT})		0.003		%
θ_{th}	Thermal Resistance	Junction to Case, at Tab Junction to Ambient		15		°C/ W
OT	Over Temperature Point			150		°C
I_Q	Quiescent Current EP1117-18 EP1117-25 EP1117-33	 V_{IN}≤9V V_{IN}≤9V V_{IN}≤12V		 5.5 5.5 5.5	 10 10 10	mA

Note 3. 100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

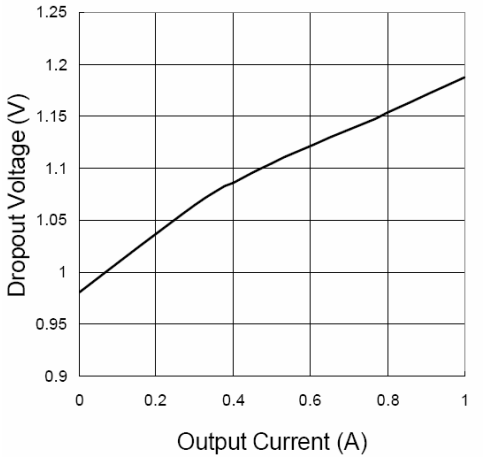
Note 4: See thermal regulation specifications for changes in output voltage due to heating effects. Load line regulations are measured at a constant junction temperature by low duty cycle pulse testing.

Note 5: Dropout voltage is specified over the full output current range of the device. Dropout voltage is defined as the minimum input/output differential measured at the specified output current. Test points and limits are also shown on the Dropout Voltage curve.

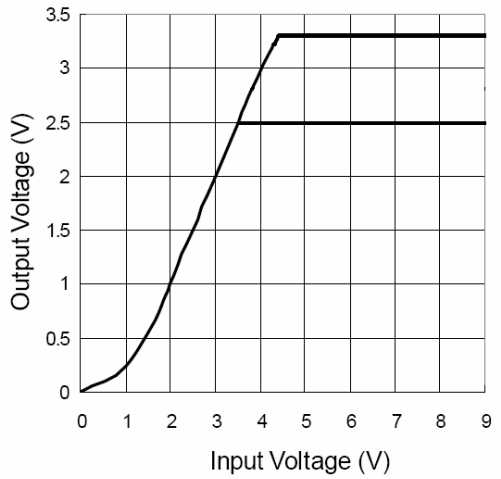
Note 6: Minimum load current is defined as the minimum output current required to maintain regulation.

Typical Performance Characteristics

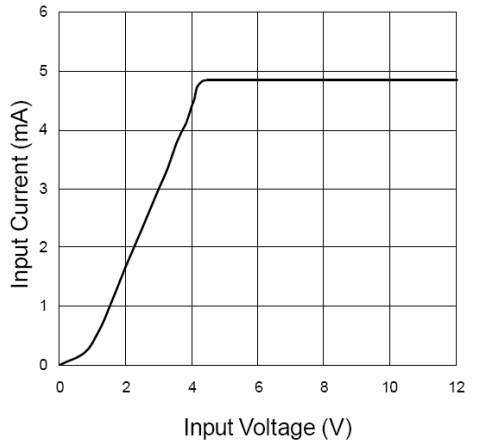
Dropout Voltage vs. Output Current



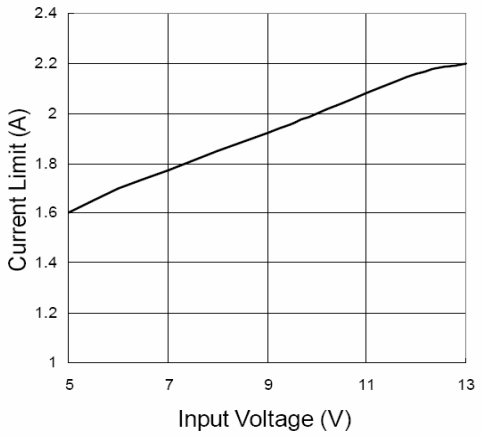
Output Voltage vs. Input Voltage



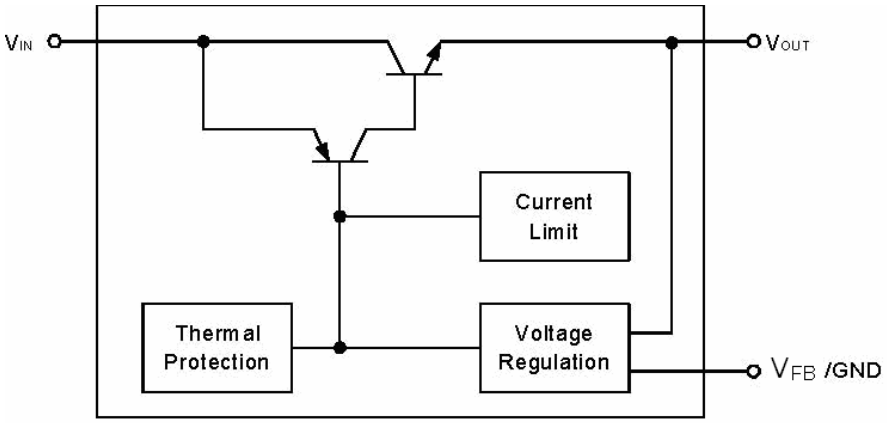
Input Current vs. Input Voltage



Current Limit vs. Input Voltage

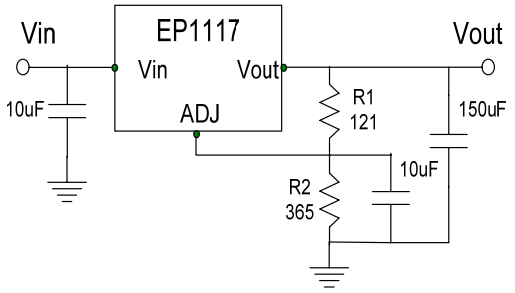


Functional Block Diagram

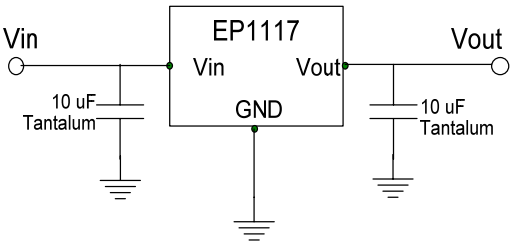


APPLICATIONS INFORMATION

1.25V to 10.7V Adjustable Regulator



Fixed Voltage Model—Basic Connections.



* Needed if device is far from filter capacitors

$$V_{out} = 1.250V \times \frac{R1 + R2}{R1}$$

Output Voltage

The EP1117 develops a 1.25V reference voltage between the output and the adjust terminal. By placing a resistor between these two terminals, a constant Current is caused to flow through R1 and down through R2 to set the overall output voltage. Normally this current is chosen to be the specified minimum load current of 10mA. For fixed voltage devices R1 and R2 are included in the device.

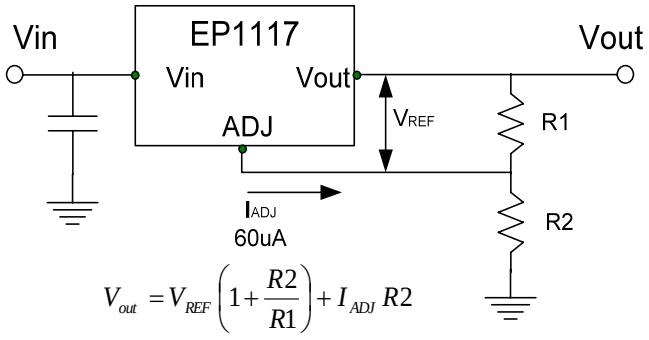


Figure 1. Basic Adjustable Regulator

Load Regulation

When the adjustable regulator is used, load regulation will be limited by the resistance of the wire connecting the regulator to the load. The datasheet specification for load regulation is measured at the output pin of the EP1117. Best load regulation is obtained when the top of the resistor divider (R1) is tied directly to the output pin of the device, not to the load. For fixed voltage devices, the top of R1 is internally connected to the output, and the ground pin can be connected to low side of the load. If R1 were connected to the load, RP is multiplied by the divider ratio, the effective resistance between the regulator and the load would be: Rp X (1+ R2/R1), where Rp is Parasitic Line Resistance.

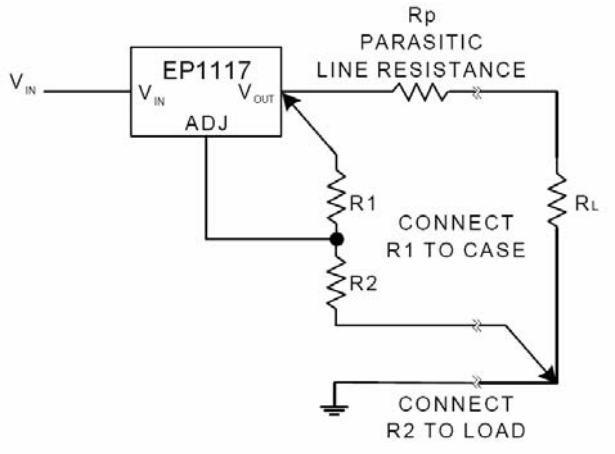


Figure 2. Connections for Best Load Regulation

Input Capacitor

An input capacitor of 10μF or greater is recommended. Tantalum or aluminum electrolytic capacitors can be used for bypassing. Larger Values will improve ripple rejection by bypassing the input to the regulator.

Output Capacitor

The EP1117 requires an output capacitor to maintain stability and improve transient response. The EP1117 output capacitor selection is dependent upon the ESR (equivalent series resistance) of the output capacitor to maintain stability. When the output capacitor is 10μF or greater, the output capacitor should have an ESR less than 1Ω. This will improve transient response as well as promote stability. A low-ESR solid Tantalum capacitor works extremely well and provides good transient response and stability over temperature.

Aluminum electrolytes can also be used, as long as the ESR of the capacitor is less than 1Ω. The value of the output capacitor can be increased without limit. Higher capacitance values help to improve transient response and ripple rejection and reduce output noise.

Ripple Rejection

The curves for Ripple Rejection were generated using an adjustable device with the adjust pin bypassed. With a 22μF bypassing capacitor 75dB ripple rejection is obtainable at any output level. The impedance of the adjust pin capacitor, at the ripple frequency, should be < R1. R1 is normally in the range of 100Ω-200Ω. The size of the required adjust pin capacitor is a function of the input ripple frequency. At 120Hz, with R1=100Ω, the adjust pin capacitor should be 13mF. For fixed voltage devices, and adjustable devices without an adjust pin capacitor, the output ripple will increase as the ratio of the output voltage to the reference voltage (V_{OUT} /V_{REF}).

Thermal Considerations

The EP1117 regulators have thermal protection to limit junction temperature to 150ºC. However, device functionality is only guaranteed to a maximum junction temperature of +125ºC. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of the application. Figure 3 show for the SOT-223 the measured values $\theta_{(JA)}$ for different copper area sizes using a 2 layers, 1.6mm, and 6Sq. cm FR-4 PCB with 2oz. copper and a ground plane layer on the backside area used for heat sinking. It can be used as a rough guideline in estimating thermal resistance. The SOT-223 packages use a copper plane on the PCB and the PCB itself as a heat sink. To optimize the heat sinking ability of the plane and PCB, solder the tab of the package to the plane.

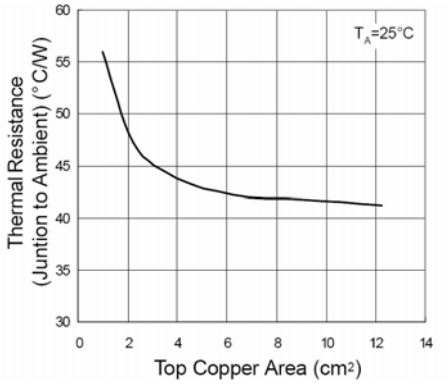


Figure 3. $\theta_{(JA)}$ vs. copper area for SOT-223 package

The thermal resistance for each application will be affected by thermal interactions with other components on the board. Some experimentation will be necessary to determine the actual value.

The power dissipation of EP1117 is equal to : PD = $(V_{IN} - V_{OUT}) \times I_{OUT}$

Maximum junction temperature is equal to : $T_{JUNCTION} = T_{AMBIENT} + (P_D \times \theta_{(JA)})$

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

Safe Operation Area

Using the experiment result of previous Thermal Consideration (choose the one with 1.5cm * 1.5cm polygene area) and $\theta_{(JA)}$ = 50°C/W spec, the safe operation area of EP1117 in SOT-223 packages can be obtained as Figure 4.

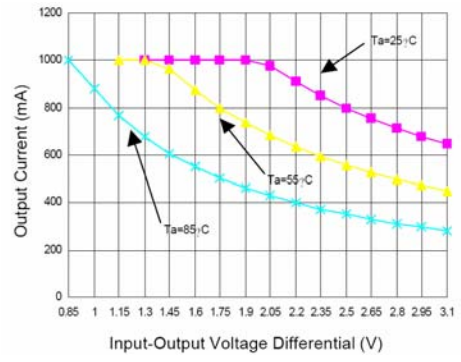
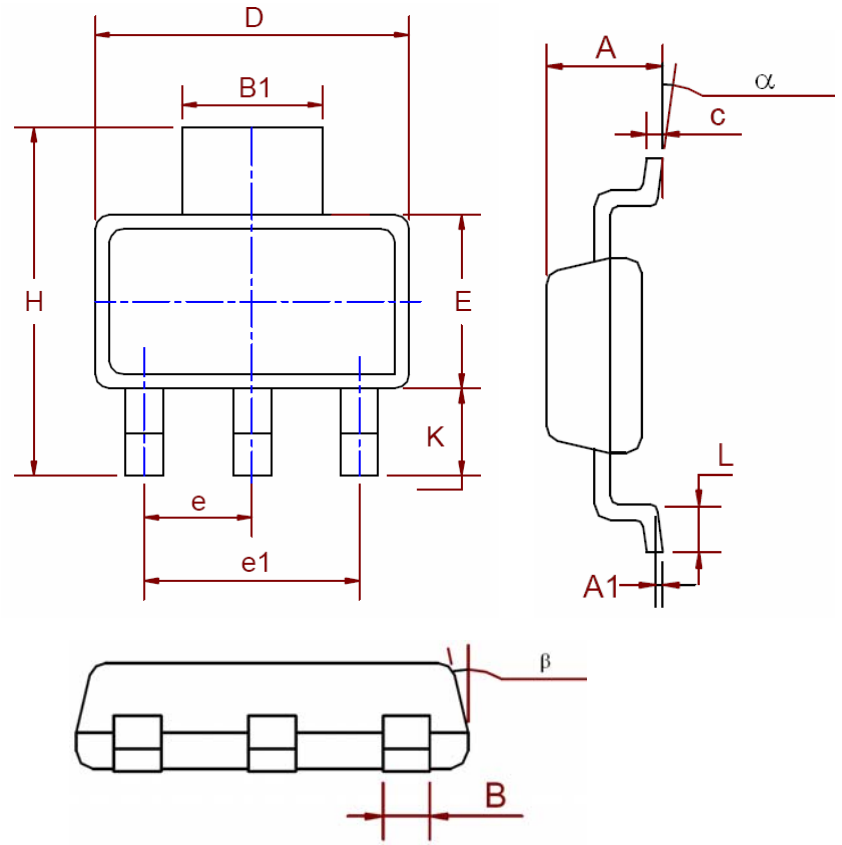


Figure 4. Safe Operation Area of EP1117 in SOT-223 packages

(Limited by Power Dissipation with $T_{JUNCTION}$ < 125°C)

Package Description

SOT-223(ReferenceJEDECRegistrationSOT-223)



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.50	1.80	0.059	0.070
A1	0.02	0.08	0.001	0.003
B	0.60	0.80	0.023	0.031
B1	2.90	3.10	0.113	0.121
c	0.28	0.32	0.011	0.012
D	6.30	6.70	0.246	0.261
E	3.30	3.70	0.129	0.144
e	2.3 BSC		0.090 BSC	
E1	4.6 BSC		0.179 BSC	
H	6.70	7.30	0.261	0.285
L	0.91	1.10	0.035	0.043
K	1.50	2.00	0.059	0.078
α	0°	10°	0°	10°
β	13°		13°	