

1A Low Dropout Positive Voltage Regulator

GENERAL DESCRIPTION

The EC50117B Series are available in fixed and adjustable output voltage versions. Over current and thermal overload protection are integrated onto the chip. Output current will decrease while it reaches the preset current or temperature limit. The dropout voltage is specified at 1.2V Maximum at full rated output current. EC50117B Series provide excellent regulation over variations due to changes in line, load and temperature. EC50117B Series are three terminal regulators and available in popular packages.

FEATURES

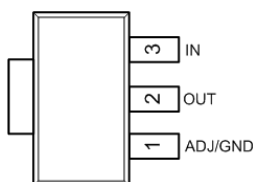
- Low Dropout Voltage 1.2V at 1A
- Adjustable or Fixed Voltage (1.8V, 2.5V, 3.3V, 5V)
- Over Current Protection
- Thermal Overload Protection
- Maximum Line Regulation 0.45%
- Maximum Load Regulation 0.4%
- Adjust Pin Current Less Than 90 uA

Applications

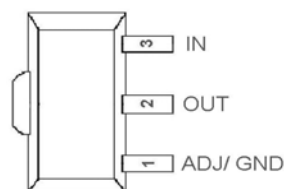
- SCSI-2 Active Termination
- High Efficiency Linear Regulators
- 5V to 3.3V Voltage Converter
- Battery Charger
- Battery Management Circuits For Notebook And Palmtop PCs
- Core Voltage Supply: FPGA, PLD, DSP, CPU

PIN ASSIGNMENT

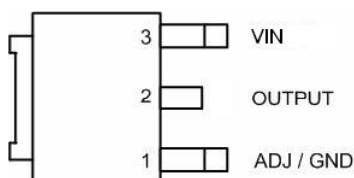
Package: SOT223-3L



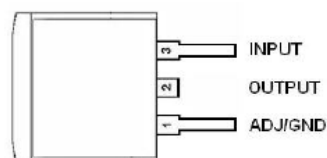
Package: SOT-89-3L



Package: TO252-3L



Package: TO-263-2L

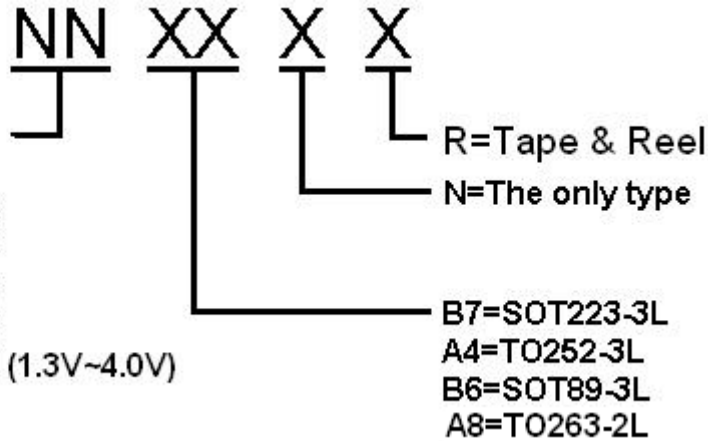




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Ordering Information

EC50117B



18=1.8V
25=2.5V
33=3.3V
50=5.0V
AJ=ADJ (1.3V~4.0V)

Part Number	Package	Marking	Marking Information
EC50117BXXA4NR	TO252-3L	117B-XX YWLLLLL	1. XX is the output voltage of production. 18=1.8V 25=2.5V;33=3.3V;50=5V;AJ=ADJ 2. YWLLLLL: Lot No & Date Code 3. N is Only Type
EC50117BXXB6NR	SOT89-3L	117B-XX YWLLLLL	
EC50117BXXB7NR	SOT223-3L	117B-XX YWLLLLL	
EC50117BXXA8NR	TO263-2L	117B-XX YWLLLLL	

ABSOLUTE MAXIMUM RATINGS

Characteristics		Symbol	Maximum	Unit
DC Supply Voltage		V_{IN}	20V	V
Operating Junction Temperature Range		T_{OPR}	0 to +125	°C
Storage Temperature Range		T_{STG}	-65 to 150	°C
Lead Temperature (Soldering) 5 Sec		T_{LEAD}	260	°C
Electrostatic Discharge Sensitivity			2	KV/Min
Thermal Resistance Junction to Ambient	SOT89-3L	θ_{JA}	175	°C/W
	SOT223-3L		135	
	TO252-3L		100	
	TO263-2L		60	
Thermal Resistance Junction to Case	SOT89-3L	θ_{JC}	58	°C/W
	SOT223-3L		15	
	TO252-3L		12	
	TO263-2L		4	
Internal Power Dissipation	SOT89-3L	P_D	0.57	W
	SOT223-3L		0.74	
	TO252-3L		1	
	TO263-2L		1.67	



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ELECTRICAL CHARACTERISTICS

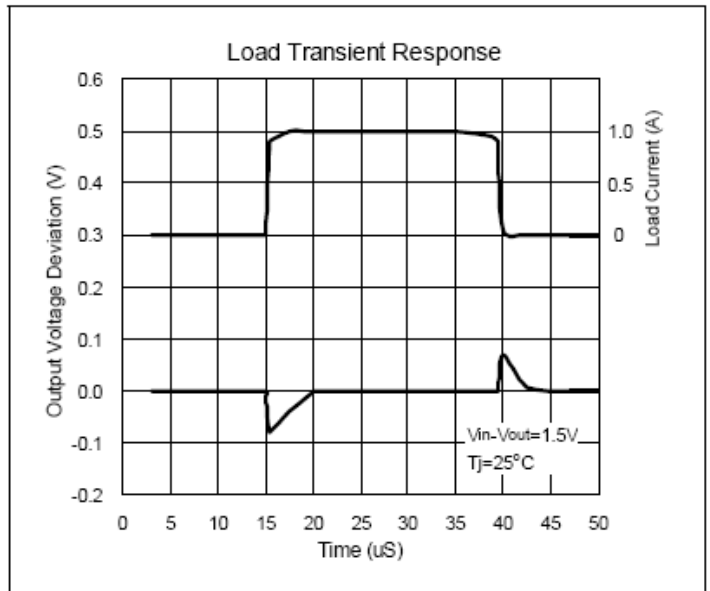
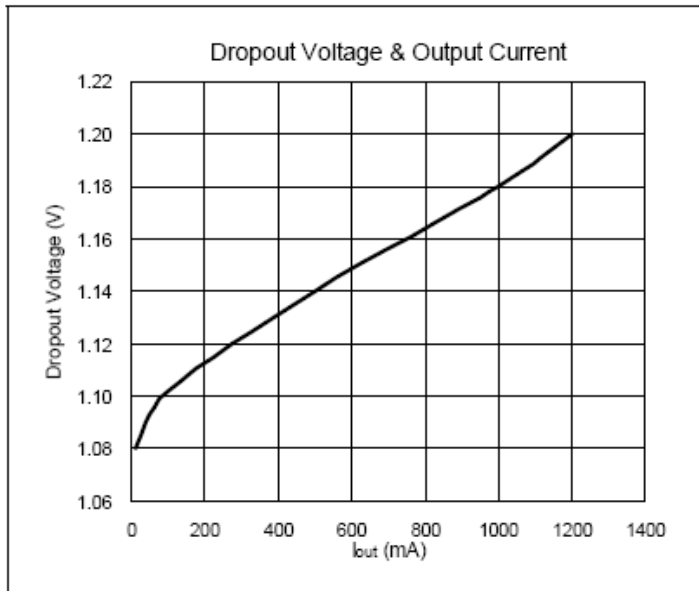
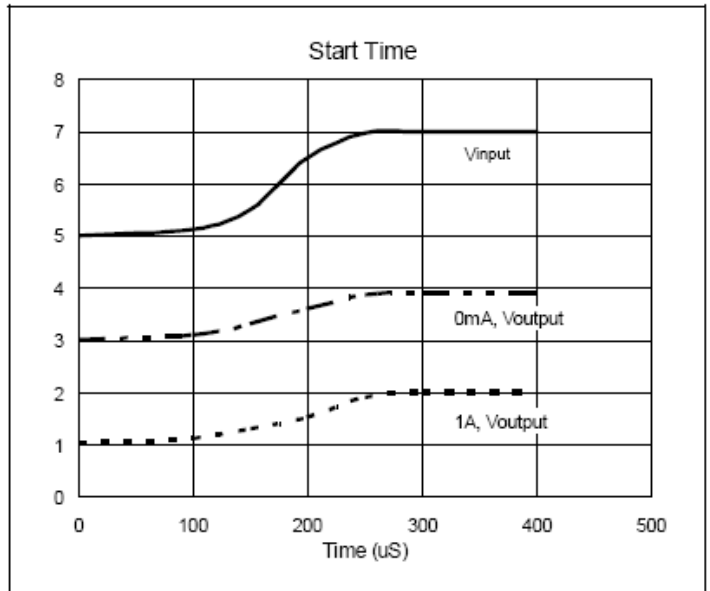
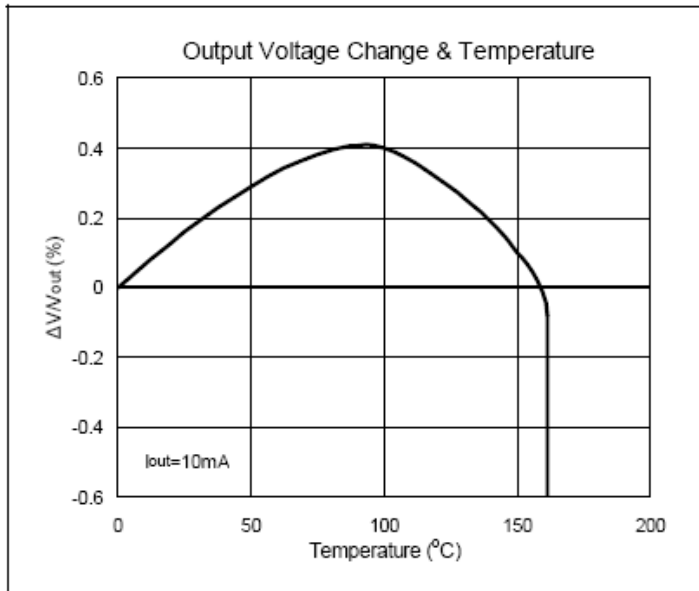
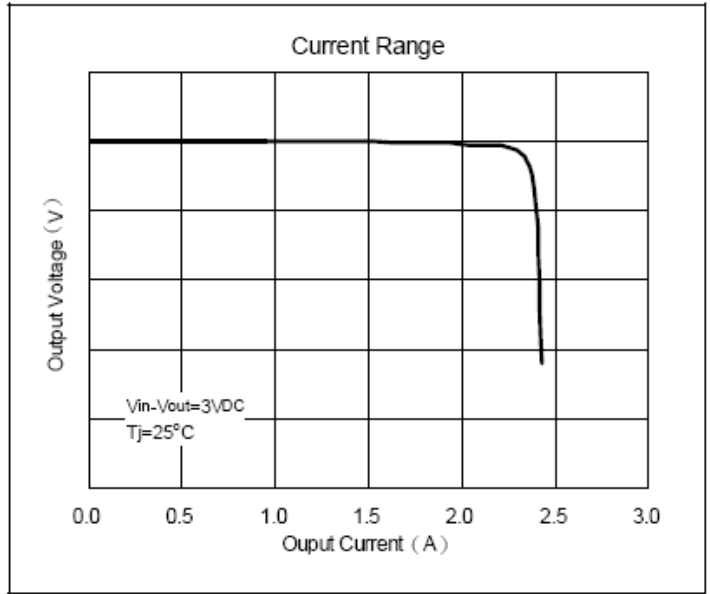
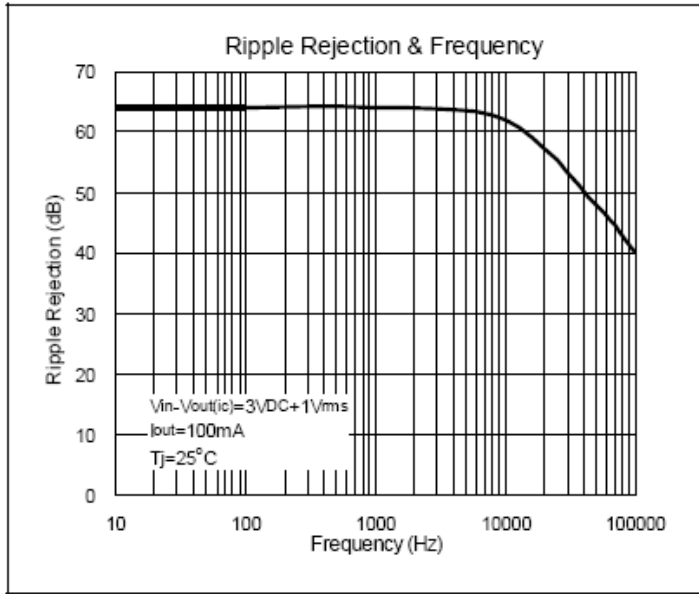
(C_i=10uF, C_o=100uF, unless otherwise noted.)

Parameter	Test Conditions		Min	Typ	Max	Units
Output Voltage	EC50117B-1.8V	I _o = 0mA, V _{IN} =3.3V	1.782	1.800	1.818	V
	EC50117B-2.5V	I _o = 0mA, V _{IN} =4V	2.475	2.500	2.525	V
	EC50117B-3.3V	I _o = 0mA, V _{IN} =4.8V	3.27	3.300	3.33	V
	EC50117B-5.0V	I _o = 0mA, V _{IN} =6.5V	4.950	5.000	5.05	V
Reference Voltage	EC50117B-ADJ	I _o =10mA, V _{IN} -V _o =3V	1.238	1.25	1.262	
Line Regulation	EC50117B-1.8V	I _o = 0mA, V _{IN} =3.3~10V	---	1	6	mV
	EC50117B-2.5V	I _o = 0mA, V _{IN} =4~10V	---	1	7	mV
	EC50117B-3.3V	I _o = 0mA, V _{IN} =4.8~10V	---	2	7	mV
	EC50117B-5.0V	I _o = 0mA, V _{IN} =6.5~10V	---	3	10	mV
	EC50117B-ADJ	I _o = 10mA, V _{IN} -V _o =1.5~10V	---	0.1	0.4	%
Load Regulation	EC50117B-1.8V	I _o =0~800mA, V _{IN} =3.3V, T _J =25°C	---	---	0.4	%
		I _o =0~1000mA, V _{IN} =3.3V, ^{NOTE1}	---	---	1	
	EC50117B-2.5V	I _o =0~800mA, V _{IN} =4V, T _J =25°C	---	---	0.4	%
		I _o =0~1000mA, V _{IN} =4V, ^{NOTE1}	---	---	1	
	EC50117B-3.3V	I _o =0~800mA, V _{IN} =4.8V, T _J =25°C	---	---	0.4	%
		I _o =0~1000mA, V _{IN} =4.8V, ^{NOTE1}	---	---	1	
	EC50117B-5.0V	I _o =0~800mA, V _{IN} =6.5V, T _J =25°C	---	---	0.4	%
		I _o =0~1000mA, V _{IN} =6.5V, ^{NOTE1}	---	---	1	
	EC50117B-ADJ	I _o =0~800mA, V _{IN} =2.75V, T _J =25°C	---	---	0.4	%
		I _o =0~1000mA, V _{IN} =2.75V, ^{NOTE1}	---	---	1	
Dropout Voltage ^(NOTE3)	EC50117B-ADJ /1.8/2.5/3.3/5.0	I _o =100mA, T _J =25°C	---	1.05	1.15	V
		I _o =500mA, T _J =25°C	---	1.1	1.15	
		I _o =1000mA, T _J =25°C	---	1.2	1.3	
		I _o =1000mA,	---	1.2	1.55	
Current Limit	EC50117B-ADJ /1.8/2.5/3.3/5.0	V _{IN} -V _O = 1.5V	2000	2600	3200	mA
Minimum Load Current	EC50117B-ADJ ^(NOTE1&NOTE2)	V _{IN} -V _O = 13.75V ^{NOTE1&NOTE2}	---	1.7	5	mA
Quiescent Current	EC50117B-1.8/2.5/ 3.3/5.0 ^(NOTE1)	V _{IN} -V _O = 5V ^{NOTE1}	---	6	10	mA
Adjust pin current ^(NOTE1&NOTE2)	---	I _o =10mA, V _{IN} -V _O = 1.5V ^{NOTE1&NOTE2}	---	50	120	μA
Adjust pin current change	---	I _o =10mA, V _{IN} -V _O = 1.4~10V	---	0.5	5	uA
Ripple Rejection	EC50117B-ADJ /1.8/2.5/3.3/5.0	f=120MHz, V _{IN} -V _O =3V+1.5Vpp, Co=22uF	---	62	---	dB
Temperature Drift	EC50117B-1.8/2.5 /3.3/5.0	T _J =0~25°C	---	0.5	---	%
	EC50117B-ADJ	T _J =0~25°C	---	2	---	%

- Note: 1. Specification applies over the full operating junction temperature range, 0~125°C
 2. EC50117B-ADJ require a minimum load current for ±3% regulation
 3. Dropout voltage is the input voltage minus output voltage that produces a 1% decrease in output voltage.

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Characteristics Curve



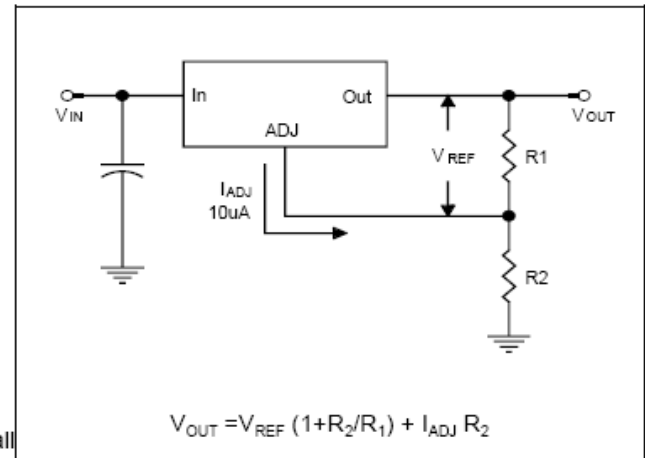
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Applications Description

- Output Voltage Adjustment

Like most regulators, EC50117B series regulate 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 R_1 and R_2 should be set to conduct 10mA (minimum output load). The output voltage is given by the following equation: $V_{OUT} = V_{REF} (1 + R_2/R_1) + I_{ADJ} R_2$

On fixed versions of EC50117B series, the voltage divider is provided internally.



- Thermal Protection

EC50117B series have 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 EC50117B in all packages given by

$$P_D = (V_{IN} - V_{OUT}) I_{OUT}, T_{JUNCTION} = T_{AMBIENT} + (P_D \times \theta_{JA}), \text{ Note: } T_{JUNCTION} \text{ must not exceed } 125^\circ\text{C}$$

- Current Limit Protection

EC50117B series are protected against overload conditions. Current protection is triggered at typically 1.5A.

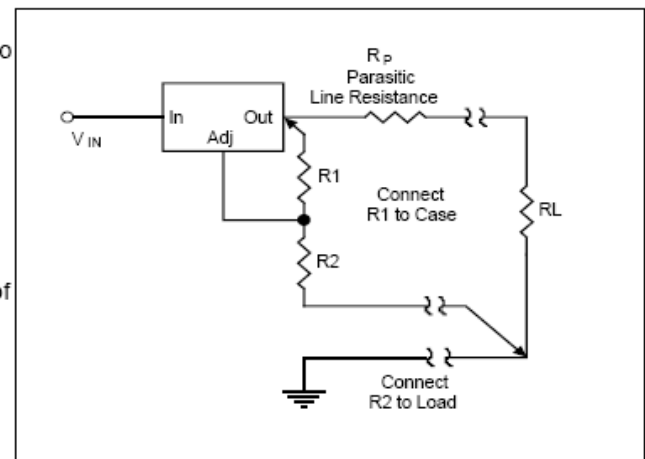
- Stability And Load Regulation

EC50117B series require 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 10uF tantalum or 50uF 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. $C_{OUT} = 100 \mu\text{F}$ or more is typical for high current regulator design.

EC50117B series load regulation are limited by the resistance of the wire connecting it to the load (R_p). For the adjustable version, the best load regulation is accomplished when the top of the resistor divider (R_1) is connected directly to the output pin of the EC50117B series. When so connected, R_p is not multiplied by the divider ratio. For fixed output versions, the top of R_1 is internally connected to the output and ground pin can be connected to low side of the load as a negative side sense if, so desired.



- Thermal Consideration

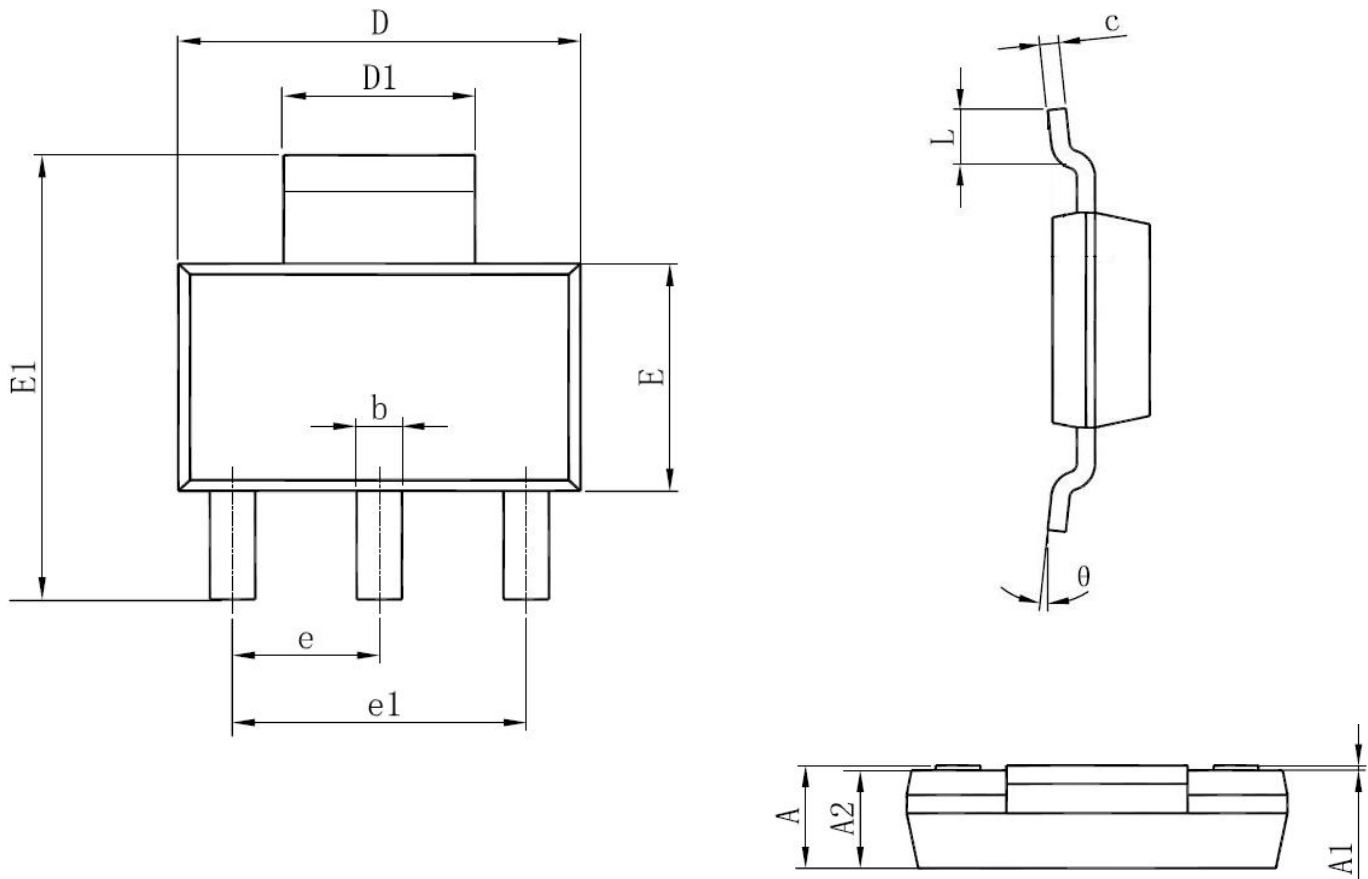
The EC50117B series contain thermal limiting circuitry designed to protect itself for over-temperature conditions. Even for normal load conditions, maximum junction temperature ratings must not be exceeded. As mention in thermal protection section, we need to consider all sources of thermal resistance between junction and ambient. It contains junction-to-case, case-to-heat-sink interface and heat sink resistance itself. An additional heat sink is applied externally sometimes. It can increase the maximum power dissipation. For example, the equivalent junction temperature of 300mA output current is 115°C without external heat sink. Under the same junction temperature IC can operates 500mA with an adequate heat sink. Therefore, to attach an extra heat sink is recommended.

Junction-to-case thermal resistance is specified from the IC junction to the bottom of the case directly below the die. The bonding wires are appending paths. The former is the lowest resistance path. Proper mounting is required to ensure the best possible thermal flow this area of the package to the heat sink. Thermal compound at the case-to-heat-sink interface is strongly recommended. The case of all devices in this series is electrically connected to the output. Therefore, if the case of the device must be electrically isolated, a thermally conductive spacer can be used, as long its thermal resistance is considered.

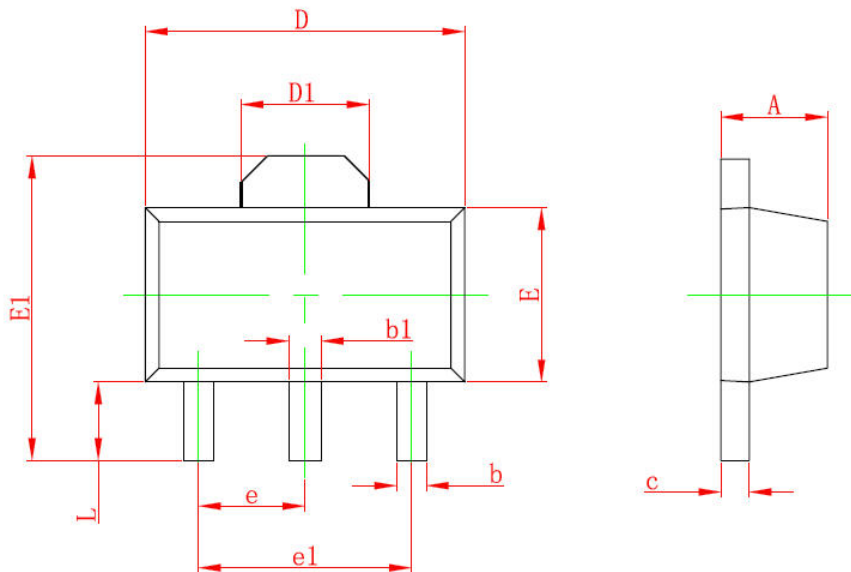
- Protection Diode

(The figure is shown as Regulator with Reverse Diode Protection in advanced applications)

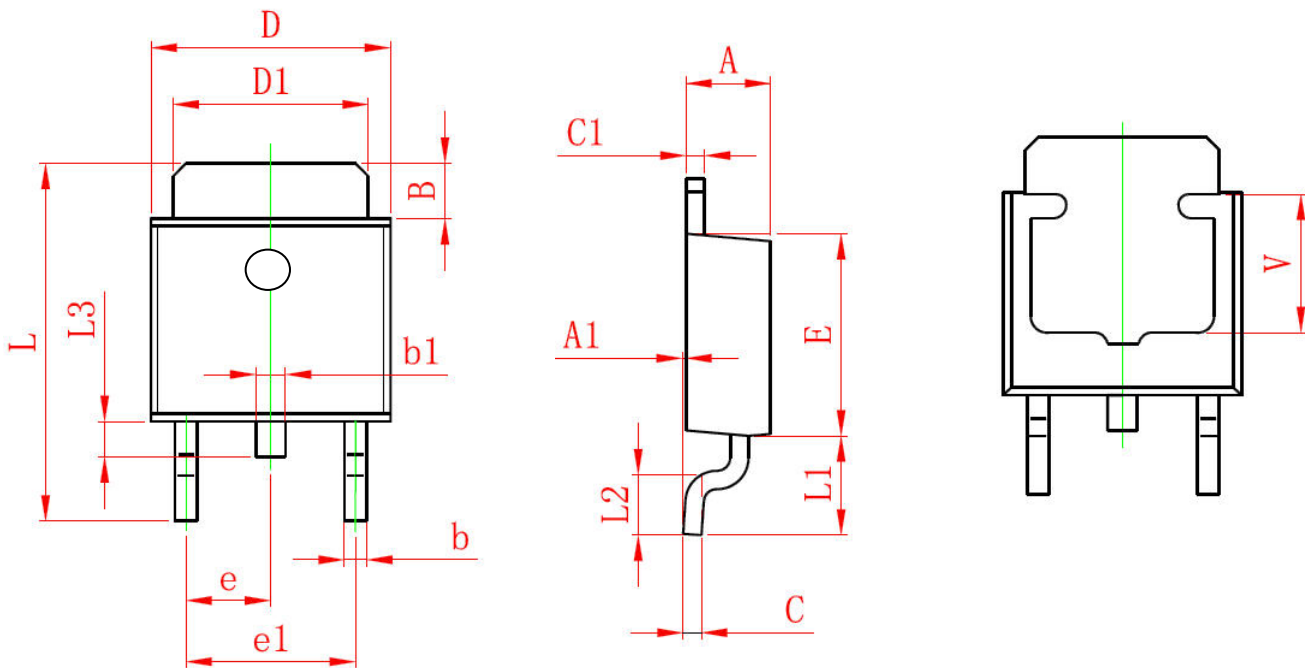
In general operation, EC50117B series don't need any protection diodes. From the cross-section structure of EC50117B series, the output pin is connected to P+ substrate, and the input pin is connected to N- well. There is a parasitic reverse diode between them. It can handle microsecond surge currents of 5A to 10A. Even with large output capacitance, it is very difficult to get those values of surge currents in normal operation. Only with high value output capacitors, such as 1000uF. And with the input pin instantaneously shorted to ground. can damage occur. A crowbar circuit at the input of the EC50117B series can generate those kinds of currents, and a diode from output to input is recommended. Normal power supply cycling or even plugging and unplugging in the system will not generate currents large enough to do any damage.

1A Low Dropout Positive Voltage Regulator
**Mechanical Dimensions
OUTLINE DRAWING SOT223-3L**


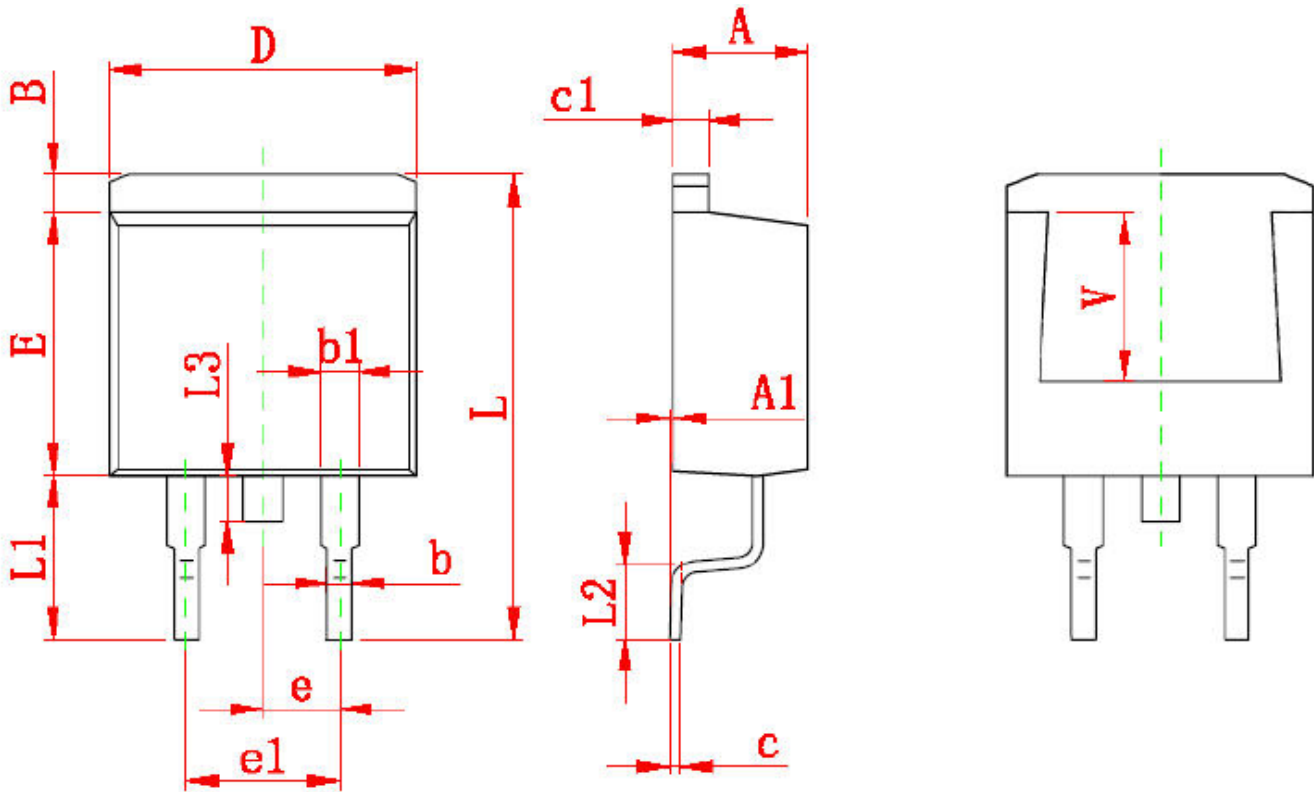
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.450	1.800	0.0571	0.071
A1	0.020	0.100	0.0008	0.004
A2	1.430	1.750	0.056	0.069
b	0.610	0.820	0.024	0.032
c	0.230	0.350	0.009	0.014
D	6.300	6.710	0.248	0.264
D1	2.900	3.150	0.114	0.124
E	3.300	3.710	0.130	0.148
E1	6.710	7.290	0.264	0.287
e	2.150	2.450	0.085	0.097
e1	4.450	4.750	0.175	0.187
L	0.900	1.150	0.035	0.045
θ	0°	10°	0°	10°

1A Low Dropout Positive Voltage Regulator
Mechanical Dimensions (Continued)
OUTLINE DRAWING SOT89-3L


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.197
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.445	1.775	0.057	0.069
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.350	1.650	0.053	0.065
e1	2.850	3.150	0.112	0.124
L	0.900	1.200	0.035	0.047

1A Low Dropout Positive Voltage Regulator
Mechanical Dimensions (Continued)
OUTLINE DRAWING TO252-3L


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
B	1.350	1.650	0.053	0.065
b	0.450	0.750	0.018	0.030
b1	0.600	1.000	0.024	0.040
c	0.430	0.580	0.017	0.023
c1	0.430	0.580	0.017	0.023
D	6.300	6.700	0.249	0.264
D1	5.100	5.500	0.201	0.217
E	5.400	5.700	0.213	0.224
e	2.150	2.450	0.085	0.097
e1	4.450	4.750	0.175	0.187
L	9.500	9.900	0.374	0.390
L1	2.550	2.900	0.100	0.114
L2	1.400	1.780	0.055	0.070
L3	0.600	1.000	0.024	0.040
V	3.400	3.800	0.134	0.150

1A Low Dropout Positive Voltage Regulator
Mechanical Dimensions (Continued)
OUTLINE DRAWING TO263-2L


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.470	4.670	0.176	0.184
A1	0.000	0.150	0.000	0.006
B	1.170	1.370	0.046	0.054
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	0.335	0.350
e	2.540 TYP		0.100 TYP	
e1	4.980	5.180	0.196	0.204
L	15.050	15.450	0.593	0.608
L1	5.080	5.480	0.200	0.216
L2	2.340	2.740	0.092	0.108
L3	1.300	1.700	0.051	0.067
V	5.600 REF		0.220 REF	