

### Features

- High input voltage (up to 40V)
- Low Power Consumption: 1.4μA (Typ)
- Maximum Output Current: 250mA
- Voltage drop: 350mV@100mA
- Good Transient Response
- Output voltage accuracy: tolerance  $\pm 2\%$
- SOT23-3 and SOT89 package
- PSRR: 80dB@1KHz

### Applications

- Battery-powered equipment
- Communication equipment
- Audio/Video equipment
- Home Automation

### General Description

The HE2240 ultra-low quiescent current regulator features low dropout voltage and low current in the standby mode. With less than 1.4μA quiescent current at no load, the HE2240 is ideally suited for standby micro-control-unit systems, especially for always-on applications like E-meters, fire alarms, smoke detectors and other battery operated systems. The HE2240 retains all of the features that are common to low dropout regulators including a low dropout PMOS pass device, short circuit protection, and thermal shutdown. The device is available in fixed output voltages of 3.0, 3.3, 3.6, 4.0 and 5.0V. The device features integrated short-circuit and thermal shutdown protection. Although designed primarily as fixed voltage regulators, the device can be used with external components to obtain variable voltages.

### Selection Table

Part No.	Output Voltage	Package	Marking
HE2240Axx	3.0V	SOT89 SOT23-3L	AFxx AZxx
HE2240Axx	3.3V		
HE2240Axx	3.6V		
HE2240Axx	4.0V		
HE2240Axx	5.0V		

Note: "xx" stands for output voltages.

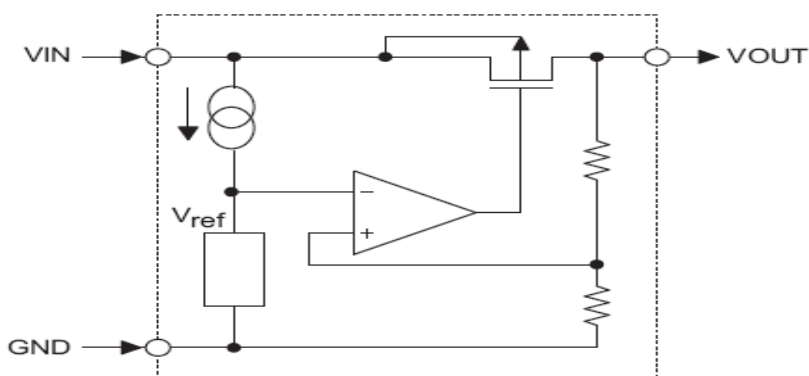
SOT23-3 & SOT89 packages will add a "B" mark at the end of the marking.

### Order Information

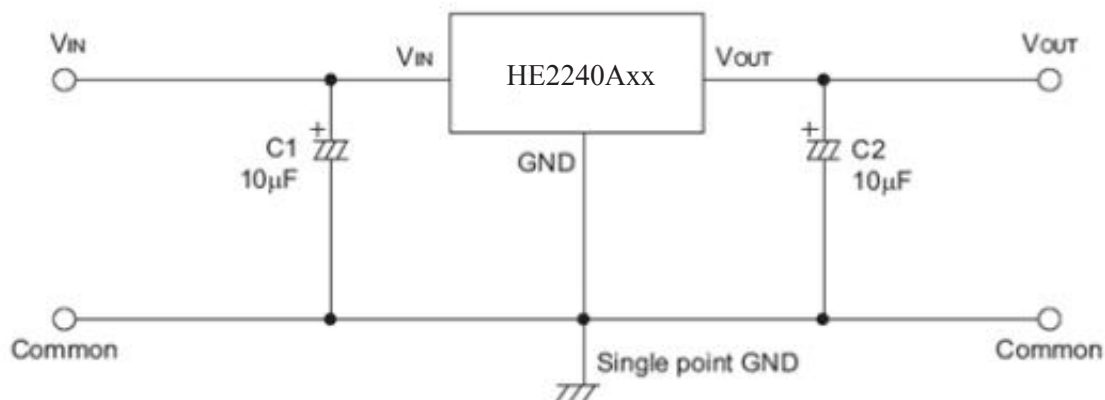
HE2240A①②③④⑤

Designator	Symbol	Description
① ②	Integer	Output Voltage(3.0~5.0V)
③	H	Standard
④	P	Package:SOT89-3
	PB	Package:SOT89B-3
	M	Package:SOT23-3
	MB	Package:SOT23B-3
⑤	R	RoHS / Pb Free
	G	Halogen Free

### Block Diagram

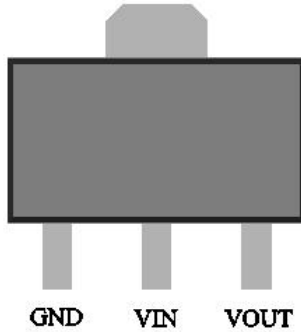


### Application Circuits

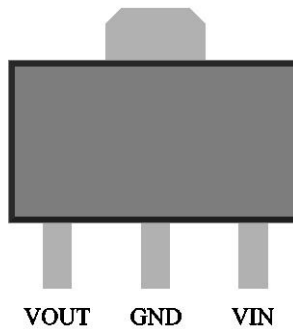


### Pin Assignment

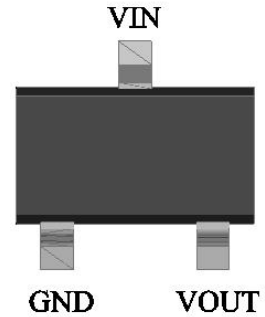
**SOT89 (Top view)**



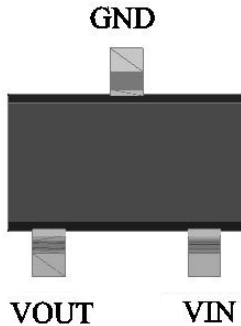
**SOT89B (TOP view)**



**SOT23-3 (Top view)**



**SOT23B-3 (TOP view)**



### Absolute Maximum Ratings

Supply Voltage .....-0.3V to 40V      Storage Temperature .....-50°C to 125°C

Operating Temperature .....-40°C to 85°C

Note: These are stress ratings only. Stresses exceeding the range specified under “Absolute Maximum Ratings” may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

### Thermal Information

Symbol	Parameter	Package	Max.	Unit
$\theta_{JA}$	Thermal Resistance (Junction to Ambient) (Assume no ambient airflow, no heat sink)	SOT23	500	°C/W
		SOT89	200	°C/W
$P_D$	Power Dissipation	SOT23	0.20	W
		SOT89	0.50	W

Note:  $P_D$  is measured at  $T_a = 25^\circ\text{C}$

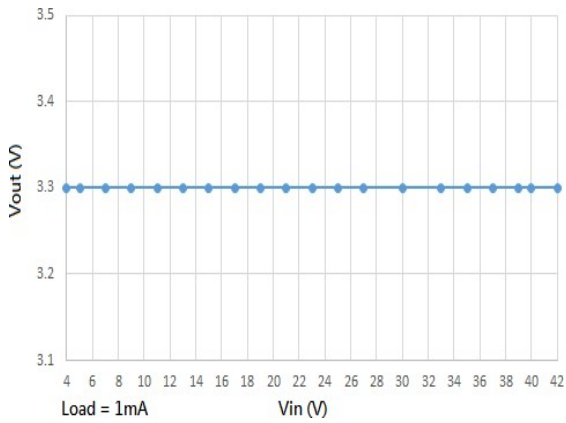
### Electrical Characteristics

(Test Conditions:  $V_{IN}=12V$ ,  $V_{OUT}=V_{set}$ ,  $C_{IN}=10\mu F$ ,  $C_{OUT}=10\mu F$ ,  $T_A=25^\circ C$ , unless otherwise specified.)

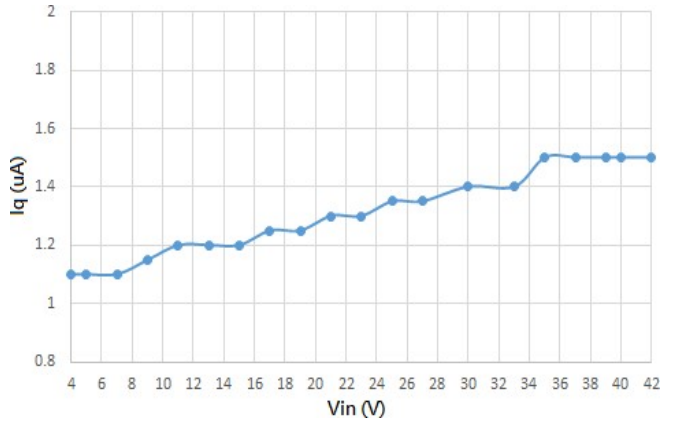
Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage	$V_{IN}$		3.0	—	40	V
Supply Current	$I_Q$	$V_{IN}=12V$ $I_{LOAD}=0mA$	—	1.4	3.0	$\mu A$
Output Voltage HE2240	$V_{OUT2}$	$V_{IN}=12V$ $I_{OUT}=10mA$	$V_{set} \cdot 0.98$	$V_{set}$	$V_{set} \cdot 1.02$	V
Maximum Output Current	$I_{OUT(Max)}$	—	250	—	—	mA
Dropout Voltage	$V_{DROP}$ $V_{OUT}=3.0V$	$I_{OUT}=250mA$	—	900	—	mV
		$I_{OUT}=100mA$	—	380	—	
	$V_{DROP}$ $V_{OUT}=3.3V$	$I_{OUT}=250mA$	—	820	—	
		$I_{OUT}=100mA$	—	350	—	
	$V_{DROP}$ $V_{OUT}=5.0V$	$I_{OUT}=250mA$	—	800	—	
		$I_{OUT}=100mA$	—	320	—	
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	$I_{OUT}=10mA$ $(V_{set}+1.0V) \leq V_{IN} \leq 38V$	—	0.1	—	%/V
Load Regulation	$\Delta V_{OUT}$	$V_{IN}=10V$ $1mA \leq I_{OUT} \leq 100mA$	—	30	—	mV
Enable pin pull high current	$I_{EN}$				0.3	$\mu A$
EN Threshold Voltage	$V_{IL}$	Shutdown	—	—	0.4	V
	$V_{IH}$	Start-Up	0.9	—	—	V
Power Supply Rejection Rate	PSRR	$V_{IN}=12V$ $V_{OUT}=3.3V$ $f=1KHz, I_{OUT}=10mA$	—	80	—	dB
		$V_{IN}=12V$ $V_{OUT}=3.3V$ $f=10KHz, I_{OUT}=10mA$	—	60	—	dB
Short Current	$I_{SHORT}$	$R_L=1\Omega$	—	42	—	mA
Output Noise Voltage	$e_{NO}$	$I_{OUT}=50mA$ $BW = 300Hz \sim 50kHz$	—	50	—	$\mu V_{RMS}$
Output Voltage Temperature Coefficient	$\frac{\Delta V_{OUT}}{\Delta T \cdot V_{OUT}}$	$I_{OUT}=10mA$	—	100	—	ppm/ $^\circ C$

## Typical Characteristics

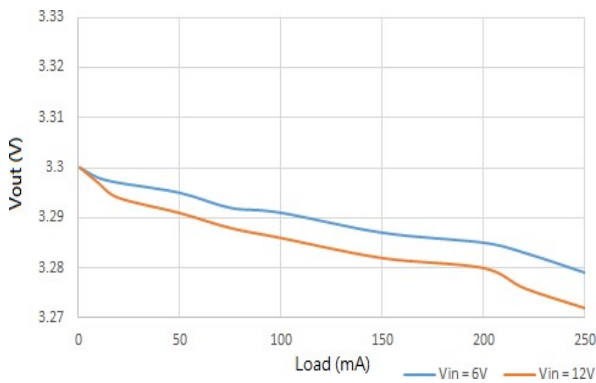
(VIN=12V, IOUT=1mA, VOUT=3.3V, CIN=COUT=1uF, TJ=25°C, unless otherwise specified)



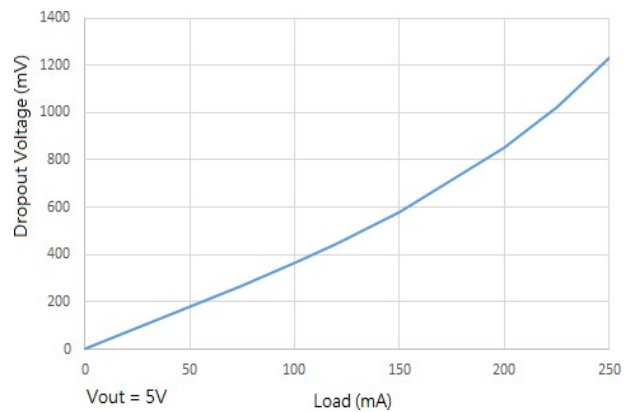
Vout vs Vin



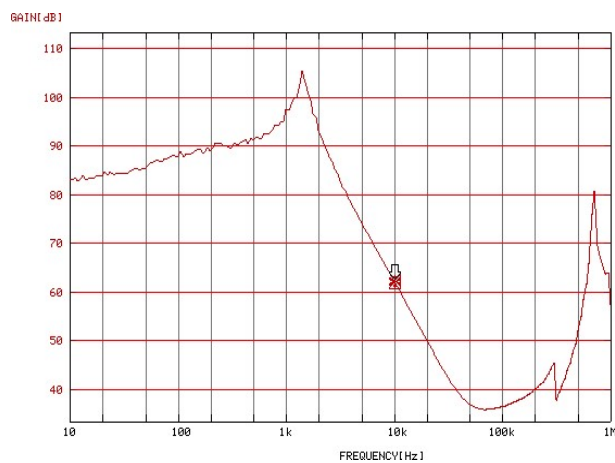
IQ vs Vin



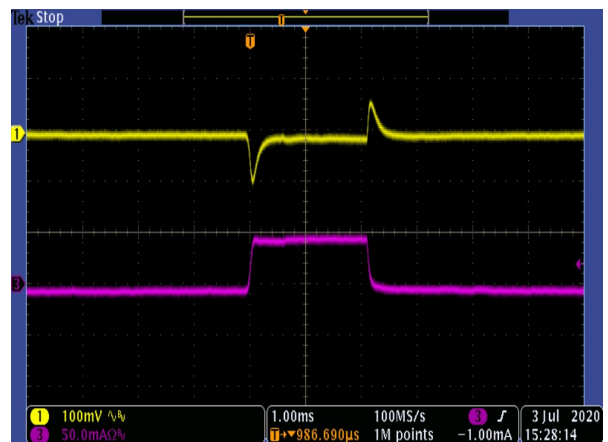
Vout vs Load



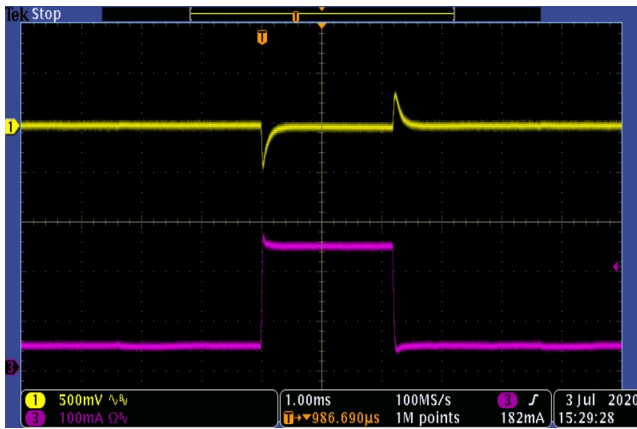
Dropout vs Load



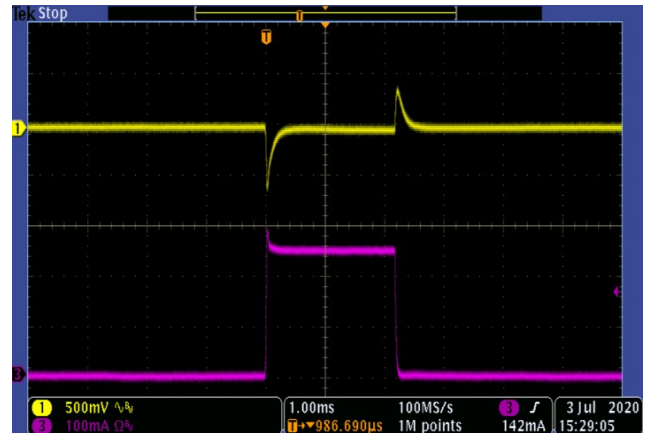
PSRR vs. Frequency (VIN=9V, VOUT=3.3V)



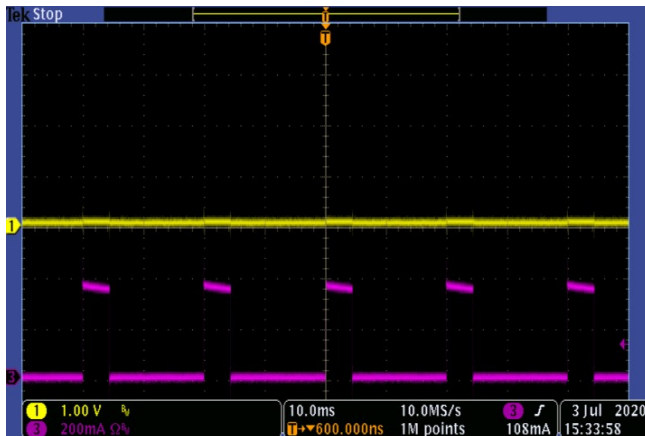
Vout Load Transient (0 to 50mA)



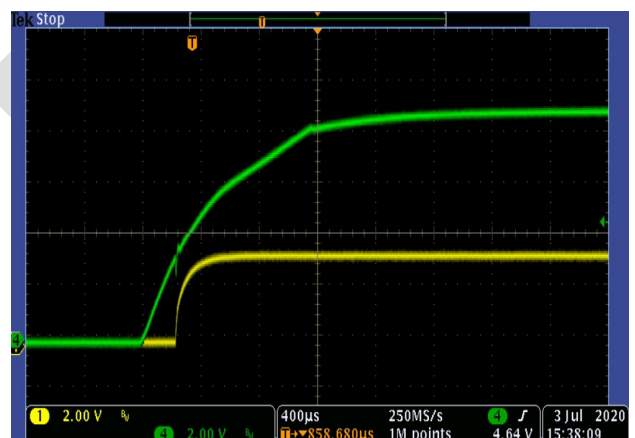
Vout Load Transient (50 to 250mA)



Vout Load Transient (1 to 250mA)



Vout Short to GND



Vin Start up

## Layout Consideration

By placing input and output capacitors on the same side of the PCB as the LDO, and placing them as close as is practical to the package can achieve the best performance. The ground connections for input and output capacitors must be back to the HE2240 ground pin using as wide and as short of a copper trace as is practical. Connections using long trace lengths, narrow trace widths, and/or connections through via must be avoided. These add parasitic inductances and resistance that results in worse performance especially during transient conditions.

## Application Guideline

### Input Capacitor

A 10 $\mu$ F ceramic capacitor is recommended to connect between V<sub>DD</sub> and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

### Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is 10 $\mu$ F, ceramic capacitor is recommended, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to VOUT and GND pins.

### Dropout Voltage

The dropout voltage refers to the voltage difference between the VIN and VOUT pins while operating at specific output current. The dropout voltage V<sub>DROP</sub> also can be expressed as the voltage drop on the pass-FET at specific output current (I<sub>RATED</sub>) while the pass-FET is fully operating at ohmic region and the pass-FET can be characterized as a resistance R<sub>DS(ON)</sub>. Thus the dropout voltage can be defined as (V<sub>DROP</sub> = V<sub>IN</sub> - V<sub>OUT</sub> = R<sub>DS(ON)</sub> x I<sub>RATED</sub>). For normal operation, the suggested LDO operating range is (V<sub>IN</sub> > V<sub>OUT</sub> + V<sub>DROP</sub>) for good transient response and PSRR ability. Vice versa, while operating at the ohmic region will degrade the performance severely.

### Thermal Application

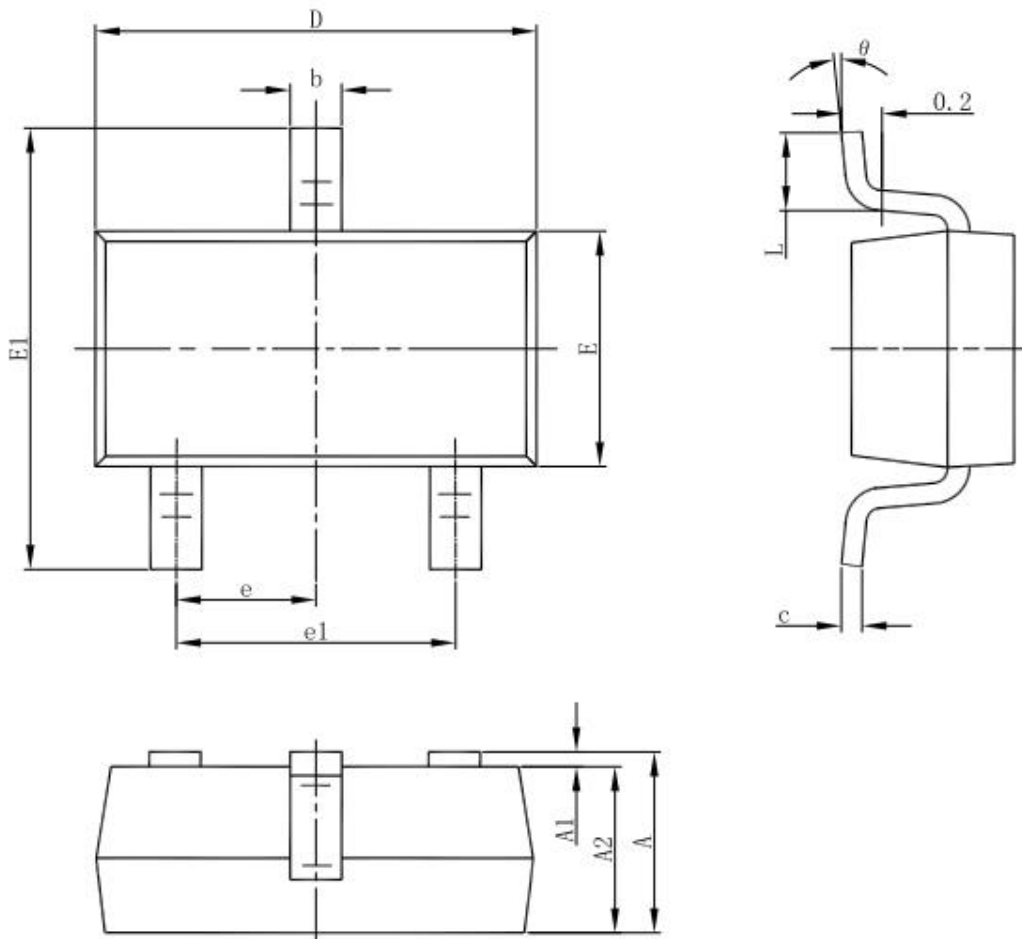
For continuous operation, do not exceed the absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated as below: TA=25°C, PCB,

The max PD= (125°C - 25°C) / (Thermal Resistance °C/W)

Power dissipation (PD) is equal to the product of the output current and the voltage drop across the output pass element, as shown in the equation below:

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

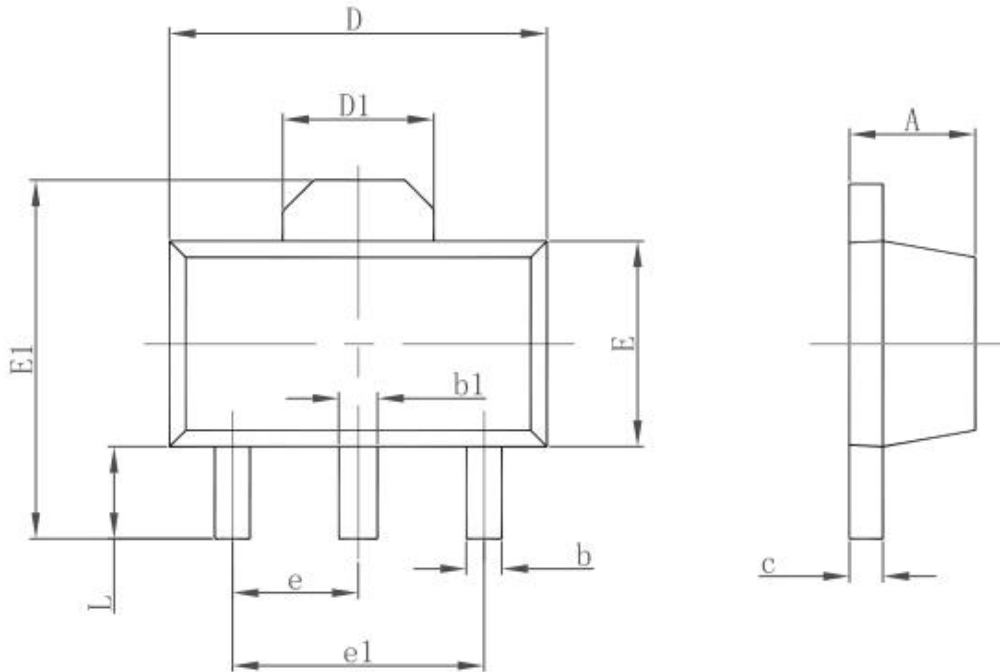
**Package Information**  
**3-pin SOT23-3 Outline Dimensions**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°



**3-pin SOT89 Outline Dimensions**



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	0.020
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	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060 TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047

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