1A Low Dropout Voltage Regulator

GENERAL DESCRIPTION

The ME1117 series of adjustable and fixed voltage regulators are designed to provide 1A output current and to operate down to 1A input-to-output differential.

The dropout voltage of the device is guaranteed maximum 1.3V at maximum output current, decreasing at lower load currents.

On-Chip trimming adjusts the reference voltage to 1%. Current limit is also trimmed, minimizing the stress under overload conditions on both the regulator and power source circuitry.

The ME1117 device are pin compatible with other three-triminal SCSI regulators and are offered in the low profile surface mount SOT-223 package and in the TO-252(DPAK) and TO-263 plastic package.

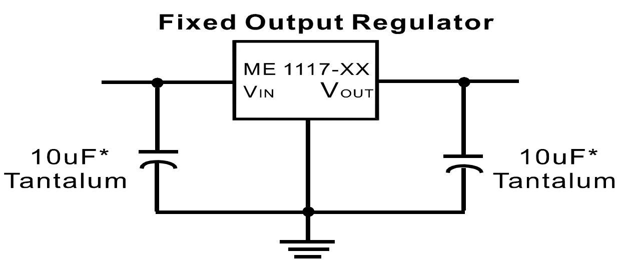
FEATURES

1. 1.8V, 2.5V, 3.3V, 5.0V, and Adjustable Output
2. Output Current of 1A
3. Operates Down to 1V Dropout
4. Line Regulation : 0.2% Max
5. Output Voltage Tolerance:2% max
6. SOT-223, TO-252 and TO-263 package available.

APPLICATIONS

1. High Efficiency linear Regulators.
2. Post Regulators for Switching Supplies
3. 5V to 3.3V Linear Regulator.
4. Battery Chargers
5. Active SCSI Terminators
6. Power Management for Laptop
7. Battery Powerec Instrumentation

TYPICAL APPLICATION



Absolute Maximum Ratings (T_A=25℃ Unless Otherwise Noted)

Parameter		Symbol	Limit	Unit
Power Dissipation		Pd	Internally	W
Input Voltage		Vin	15	V
Operating Junction Temperature			-40 to 125	℃
Storage Temperature			-65 to150	℃
Soldering information Lead Temperature(10 sec)			4	Sec
Thermal Resistance	SOT-223	θ_{JA}	90	℃/W
	TO-252		80	℃/W
	TO-263			℃/W
Thermal Resistance	SOT-223	θ_{JC}	15 to 20	℃/W
	TO-252		10 to 15	℃/W

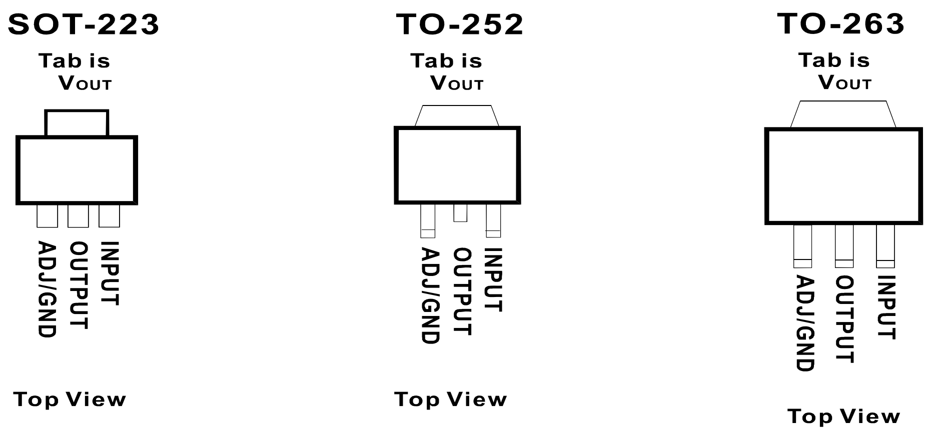
Electrical Characteristics: Operating conditions:Ta=25°C unless specified**.**

Parameter	Conditions	Min	Typ	Max	Unit
Output Voltage ± 2%	Tj=0 to+125				
ME1117(Adjustable)	Io=10mA to 1A, Vin-Vo=1.5V to 13.75V	1.225	1.250	1.280	
ME1117-1.8	Io=0 to 1A, Vin=3.3V to 12V	1.764	1.800	1.836	
ME1117-2.5	Io=0 to 1A, Vin=4.0V to 12V	2.450	2.500	2.550	V
ME1117-3.3	Io=0 to 1A, Vin=4.8V to 12V	3.240	3.300	3.360	
ME1117-5.0	Io=0 to 1A, Vin=6.5V to 15V	4.900	5.00	5.100	
LINE REGULATION					
ME1117(Adjustable)	Io=10mA to 1A, Vin-Vo=1.5V to 13.75V		0.1	0.2	%
ME1117-1.8	Io=0, Vin=3.3V to 12V		2	7	mV
ME1117-2.5	Io=0, Vin=4.0V to 12V		2	7	mV
ME1117-3.3	Io=0, Vin=4.8V to 12V		3	7	mV
ME1117-5.0	Io=0, Vin=6.5V to 15V		4	10	mV
LOAD REGULATION					
ME1117(Adjustable)1	Io=10mA to 1A, Vin-Vo=1.5V to 13.75V		0.2	0.4	%
ME1117-1.8	Io=0 to 1A, Vin=3.8V		3	10	mV
ME1117-2.5	Io=0 to 1A, Vin=4.5V		3	10	mV
ME1117-3.3	Io=0 to 1A, Vin=5.3V		4	12	mV
ME1117-5.0	Io=0 to 1A, Vin=7.0V		5	15	mV
DROPOUT VOLTAGE2	Io=800mA		1.10	1..20	
ALL Models	Io=1A		1.20	1.30	V
	Io=1A(Tj=0 to +125)		1.20	1.55	
CURRENT LIMIT	Vin-Vo = 5V	1000	1250	1600	mA
Quiescent Current	Vin –Vo= 5V		5.2	10	mA
MINIMUM LOAD CURRENT					
Adjustable Models	Vin-Vo=12V			5	mA
Adjust Pin Current vs Load Current,	Io=10mA, Vin-Vo=1.4V to 10V		50	120	uA
ME1117A	Io=10mA to 1A, Vin-Vo=1.4V to 10V		0.5	5	
TEMPERATURE DRIFT	Tj=0 to +125		0.5		ppm/℃

NOTES: 1.ME1117 adjustable versions requires a minimum load for ±3% regulation.

2.Dropout voltage is the input voltage minus output voltage that produces a 1% decrease in output voltage

PIN CONNECTIONS



ORDERING INFORMATION

PACKAGE	OUTPUT VOLTAGE					QUALITY
	ADJ	1.8V	2.5V	3.3V	5V	
SOT-223	ME1117STA	ME1117ST18	ME1117ST25	ME1117ST33	ME1117ST50	2500/REEL
TO-252	ME1117DTA	ME1117DT18	ME1117DT25	ME1117DT33	ME1117DT50	2500/REEL
TO-263	ME1117D2TA	ME1117D2T18	ME1117D2T25	ME1117D2T33	ME1117D2T50	1000/REEL

APPLICATION HINTS

The **ME1117** series of adjustable and fixed regulators are easy to use and are protected against short circuit and thermal overloads. Thermal protection circuitry will shut-down the regulators should the junction temperature exceed 165℃ at the sense point.
Pin compatible with older three terminal adjustable regulators, these devices offer the advantage of a lower dropout voltage, more precise reference tolerance and improved reference stability with temperature.

Stability

The circuit design used in the **ME1117** series requires the use of an output capacitor as part of the device frequency compensation. The addition of 22uF solid tantalum on the output will ensure stability for all operating conditions.
When the adjustment terminal is bypassed with a capacitor to improve the ripple rejection, the requirement for an output capacitor increases. The value of 22uF tantalum covers all cases of bypassing the adjustment terminal. Without bypassing the adjustment terminal smaller capacitors can used with eq1ually good results. To further improve stability and transient response of these devices larger values of output capacitor can be used.

Protection Diodes

Unlike older regulators, the **ME1117** family does not need any protection diodes between the adjustment pin and the output and form the output to the input to prevent over-stressing the die. Internal resistors are limiting the internal current paths on the **ME1117** adjustment pin, therefore, even with capacitors on the adjustment pin no protection diode is needed to ensure device safety under short-circuit conditions.
Diodes between the input and output are not usually needed. Microsecond surge currents of 50A to 100A can be handled by the internal diode between the input and output pins of the device. In normal operations, it is difficult to get those values of surge currents even with the use of large output capacitances. If high value output capacitors are used, such as 1000uF to 5000uF and the input pin is instantaneously shouted to ground, damage can occur. A diode from output to input is recommended, when a crowbar circuit at the input of the **ME1117** is used (Figure1).

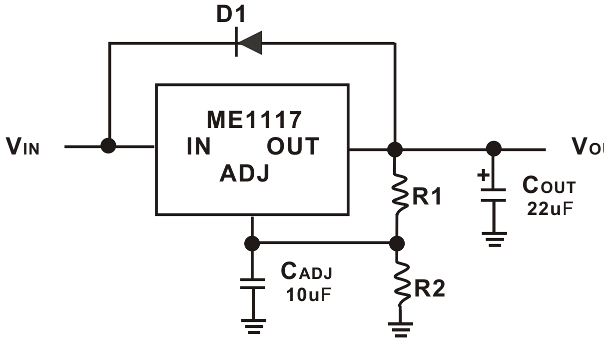
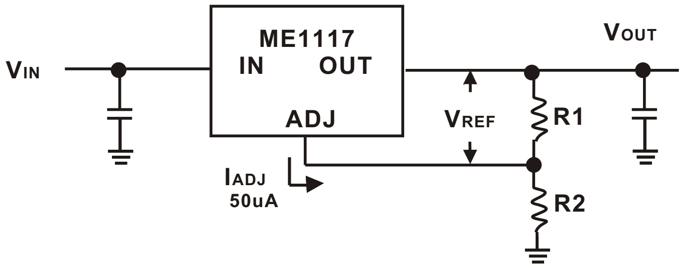


Figure 1.

Output Voltage

The **ME1117** series develops a 1.25V reference voltage between the output and the adjust terminal. Placing a resistor between these two terminals causes a constant current to flow through R1 and down through R2 to set the overall output voltage. This current is normally the specified minimum load current of 10mA. Because I_{ADJ} is very small and constant it represents a small error and it can usually be ignored.



$V_{OUT}=V_{REF}(1+R2/R1)+I_{ADJ})*R2$

Figure 2. Basic Adjustable Regulator

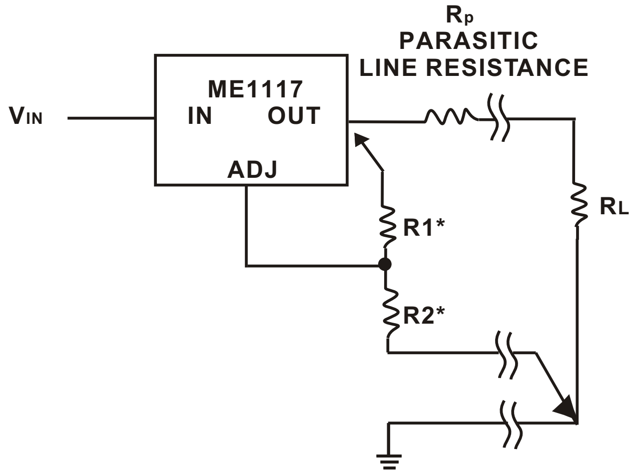
Load Regulation

True remote load sensing it is not possible to provide, because the **ME1117** is a three terminal device. The resistance of the wire connecting the regulator to the load will limit the load regulation. The data sheet specification for load regulation is measured at the bottom of the package. Negative side sensing is a true Kelvin connection, with the bottom of the output divider returned to the negative side of the load.
The best load regulation is obtained when the top of the resistor divider R1 is connected directly to the case not to the load. If R1 were connected to the regulator and the load would be:

$$R_p \times \left(\frac{R2+R1}{R1}\right)$$, Rp= Parasitic Line Resistance

APPLICATION HINTS

Connected as shown, Rp is not multiplied by the divider ratio



*CONNECT R1 TO CASE
CONNECT R2 TO CASE

Figure3. Connections for Best Load Regulation

In the case of fixed voltage devices the top of R1 is connected Kelvin internally, and the ground pin can be used for negative side sensing.

Thermal Considerations

The **ME1117** series have internal power and thermal limiting circuitry designed to protect the device under overload conditions. However maximum junction temperature ratings of 125℃ should not be exceeded under continuous normal load conditions.

Careful consideration must be given to all sources of thermal resistance from junction to ambient. For the surface mount package SOT-223 additional heat sources mounted near the device must be considered. The heat dissipation capability of the PC board and its copper traces is used as a heat sink for the device. The thermal resistance from the junction to the tab for the **ME1117** is 15℃ /W. Thermal resistance from tab to ambient can be as low as 30℃/W.

The total thermal resistance from junction to ambient can be as low as 45℃ /W. This requires a reasonable sized PC board with at least on layer of copper to spread the heat across the board and couple it into the surrounding air.Experiments have shown that the heat spreading copper layer does not need to be electrically connected to the tab of the device. The PC material can be very effective at transmitting heat between the pad area, attached to the pad of the device, and a ground plane layer either inside or on the opposite side of the board. Although the actual thermal resistance fo the PC material is high, the Length/Area ratio of the thermal resistance between layers is small. For each application the thermal resistance will be affected by thermal interactions with other components on the board. To determine the actual value some experimentation will be necessary.

The power dissipation of the **ME1117** is equal to :

$$P_D=(V_{IN}-V_{OUT})(I_{OUT})$$

Maximum junction temperature will be equal to: $T_J=T_{A(MAX)}+P_D$(Thermal Resistance(Junction-to-ambient))

Maximum junction temperature must not exceed 125℃.

Ripple Rejection

The ripple rejection values are measured with the adjustment pin bypassed. The impedance of the adjust pin capacitor at the ripple frequency should be less than the value of R1(normally 100Ω to 200Ω for a proper bypassing and ripple rejection approaching the values shown. The size of the required adjust pin capacitor is a function of the input ripple frequency. If R1=100Ω at 120Hz,the adjust pin capacitor should be>13uF. At 10kHz only 0.16uF is needed.

The ripple rejection will be a function of output voltage, in circuits without an adjust pin bypass capacitor. The output ripple will increase directly as a ratio of the output voltage to the reference voltage (V_{OUT}/V_{REF}).

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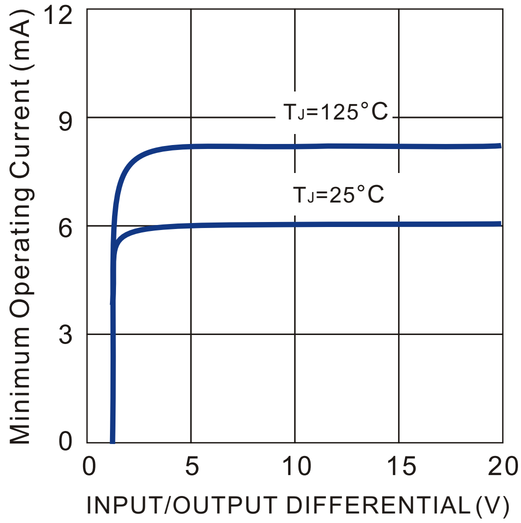
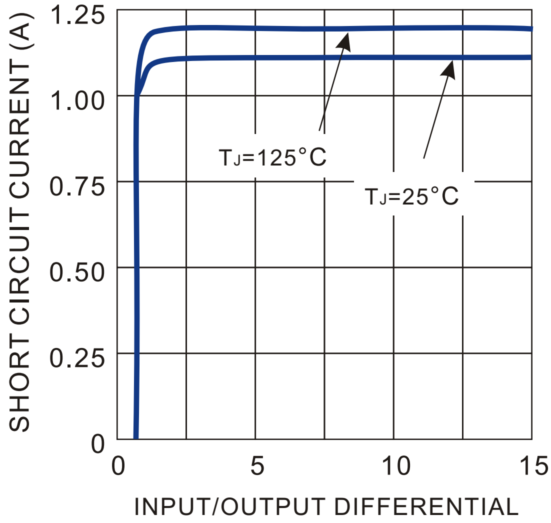
TYPICAL PERFORMANCE CHARACTERISTICS

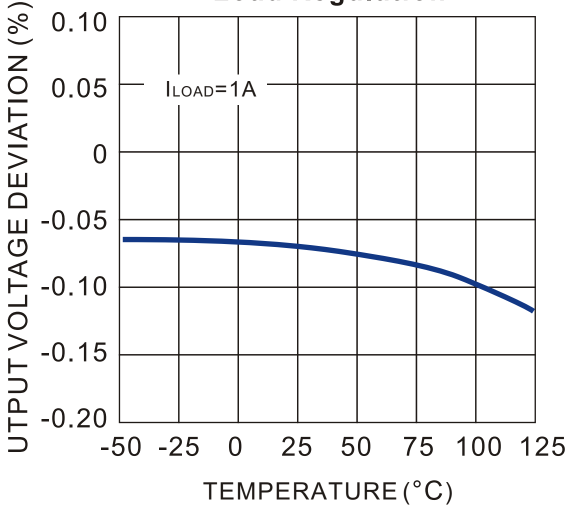
Minimum Operating Current(Adjustable Device)



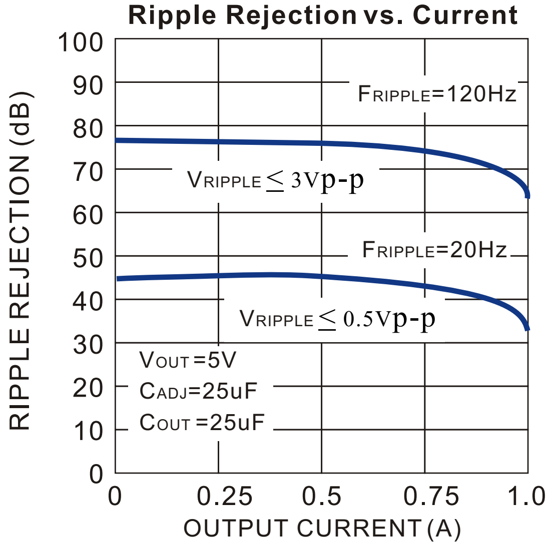
Short-Circuit Current



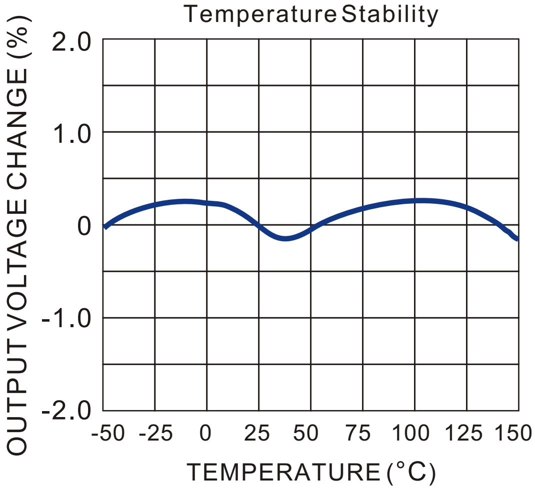
Load Regulation



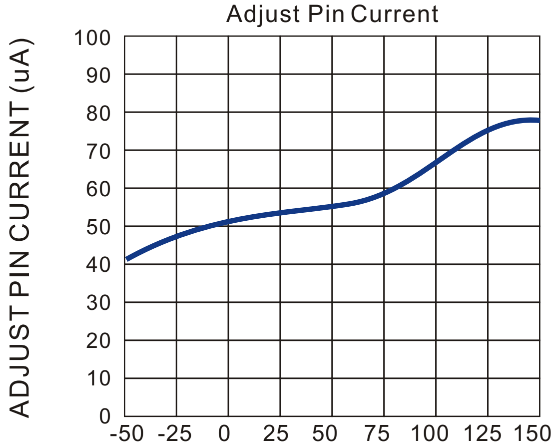
Ripple Rejection vs. Current



Temperature Stability

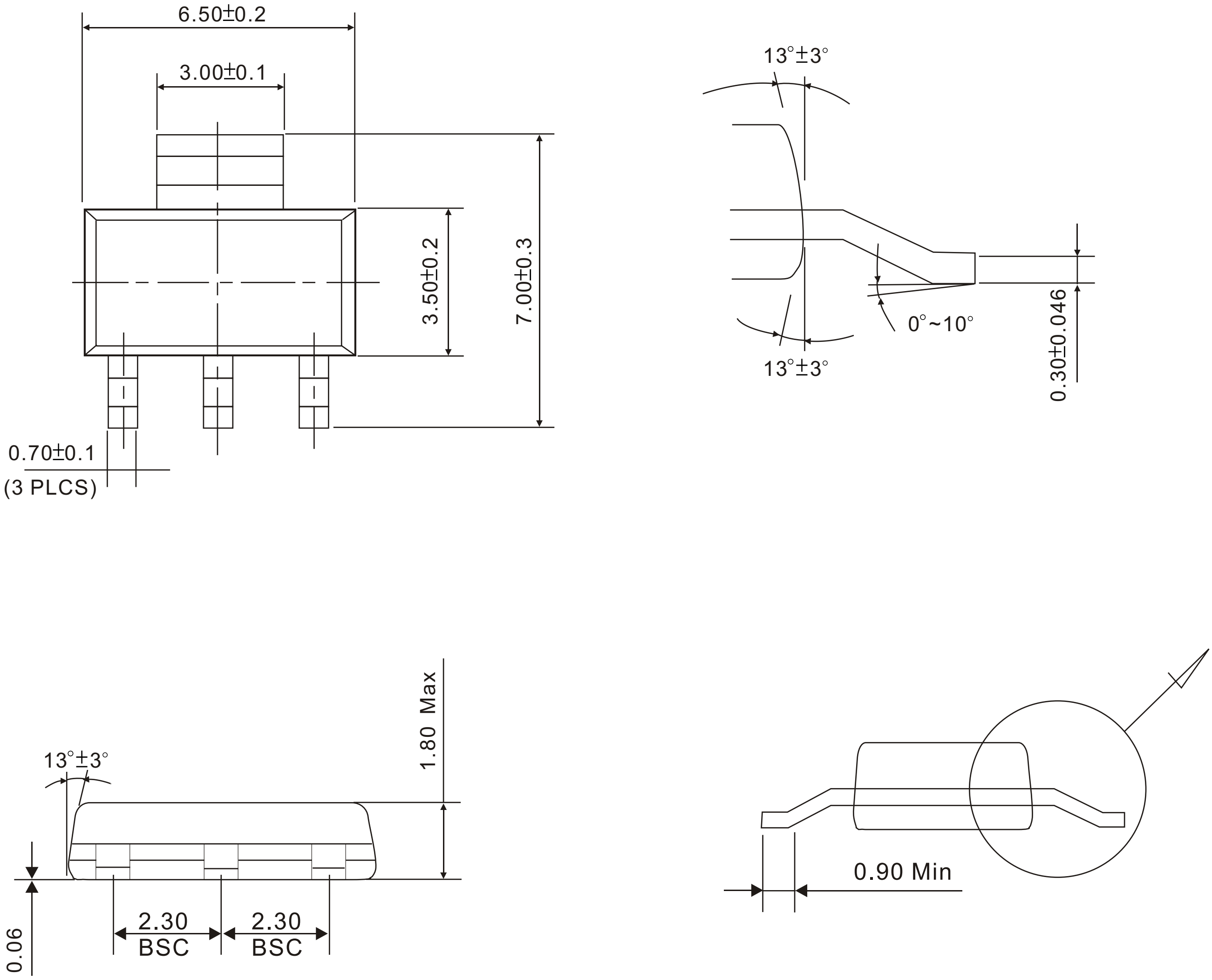


Adjust Pin Current



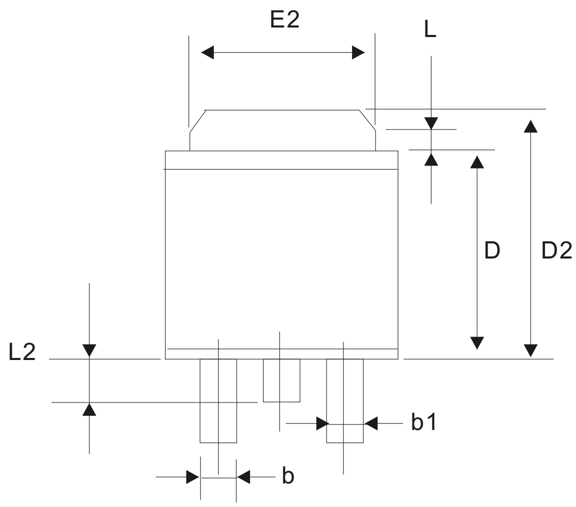
Physical Dimensions **inches**(millimeters) unless otherwise noted

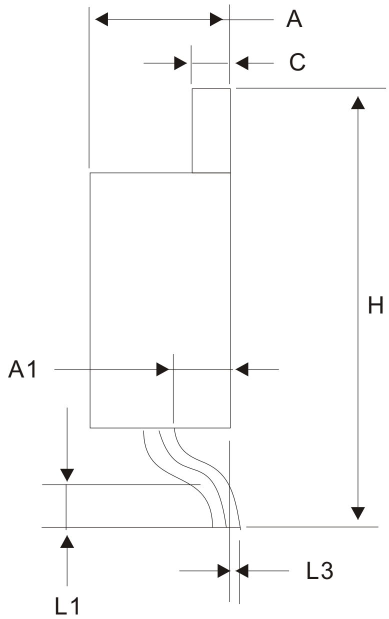
SOT-223

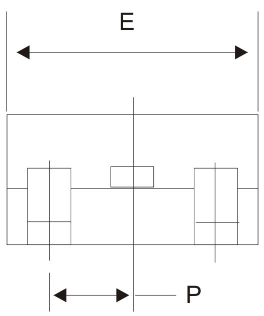


Physical Dimensions inches(millimeters) unless otherwise noted

TO-252







SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.250	2.350	0.089	0.093
A1	0.950	1.050	0.037	0.041
C	0.490	0.530	0.019	0.021
E	6.400	6.600	0.252	0.260
E2	5.300	5.450	0.209	0.215
D	6.000	6.200	0.236	0.244
D2	7.100	7.300	0.280	0.287
H	9.700	10.100	0.382	0.398
L	0.600	Ref	0.024	Ref
L1	1.425	1.625	0.056	0.064
L2	0.650	0.850	0.026	0.033
L3	0.020	0.120	0.001	0.005
b	0.770	0.850	0.030	0.033
b1	0.840	0.940	0.033	0.037
P	2.290	BSC	0.090	BSC

Physical Dimensions **inches**(millimeters) unless otherwise noted

TO-263