General Description

The EM317 is an adjustable 3-terminal positive voltage regulator capable of supplying in excess of 1.5 A over an output voltage range of 1.2 V to 37 V. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage. Further, it employs internal current limiting, thermal shutdown and safe area compensation, making it essentially blow out proof.

EM317 offers full overload protection. Included on the chip current limit, thermal overload protection, and safe-area protection. Normally, no capacitors is needed unless the device is situated far from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can added to improve transient response.

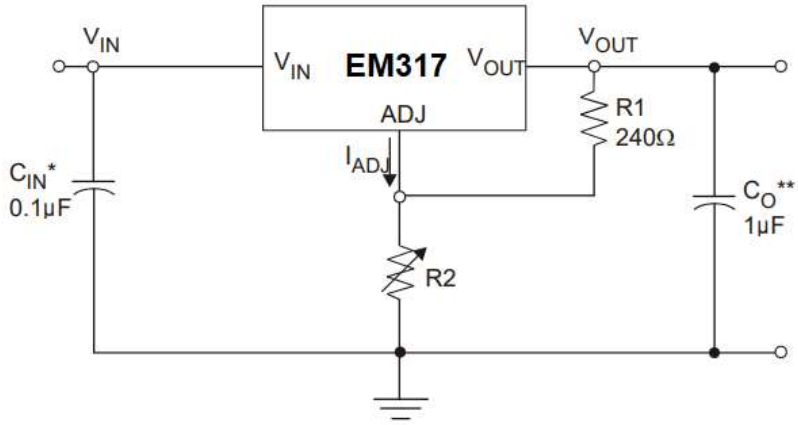
Features

- Output current up to 1.5A
- Output Voltages 1.2V to 37V
- Input Regulation typ. 0.01%
- Output Regulation typ. 0.1%
- Peak Output Current Constant over Temperature Range of Regulator
- Available in TO-220, TO-263, TO252 and SOT223 Packages
- Ripple Rejection Typically 80dB
- Direct replacements for EM317

Applications

- Voltage Regulators
- Power Supplies
- Current Regulators
- Switching Regulators
- Current Limiter
- Constant Current Battery Charger
- Current Limited Charger

Typical Application Circuit



* C_{IN} is required if regulator is located an appreciable distance from power supply filter.
**C_{OUT} is not needed for stability, however, it improve transient response.

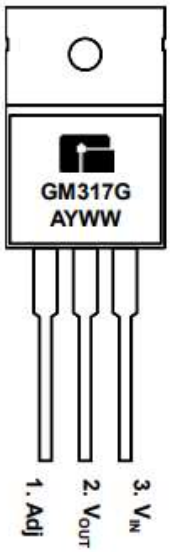
$$V_{OUT} = 1.25V\left(1+\frac{R2}{R1}\right) + I_{ADJ}R2$$

Since I_{ADJ} is controlled to less than 100µA, the error associated with this term is negligible in most applications.

Marking Information and Pin Configurations (Top View) – Green Product

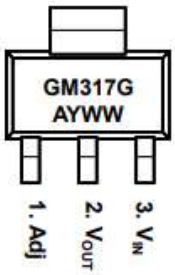
TO 252 (D-PAK)

TO 220



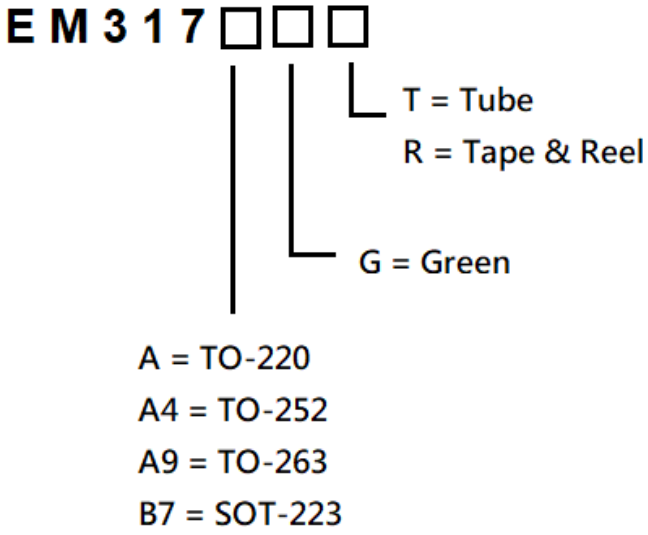
TO 263 (D^2-PAK)

SOT223



G: Green Product
A: Assembly / Test site code
Y: Year
WW: Week

Ordering Information



Ordering Number	V_{OUT}	Package	Shipping
EM317A9GT	Adj	TO-263	50 Units/Tube
EM317A9GR		TO-263	800 Units / Tape & Reel
EM317AGT		TO-220	50 Units/Tube
EM317A4GT		TO-252	80 Units/Tube
EM317A4GR		TO-252	2,500 Units / Tape & Reel
EM317B7GT		SOT-223	80 Units/Tube
EM317B7GR		SOT-223	2,500 Units / Tape & Reel

Note:
Green products:

- Lead-free (RoHS compliant)
- Halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight)

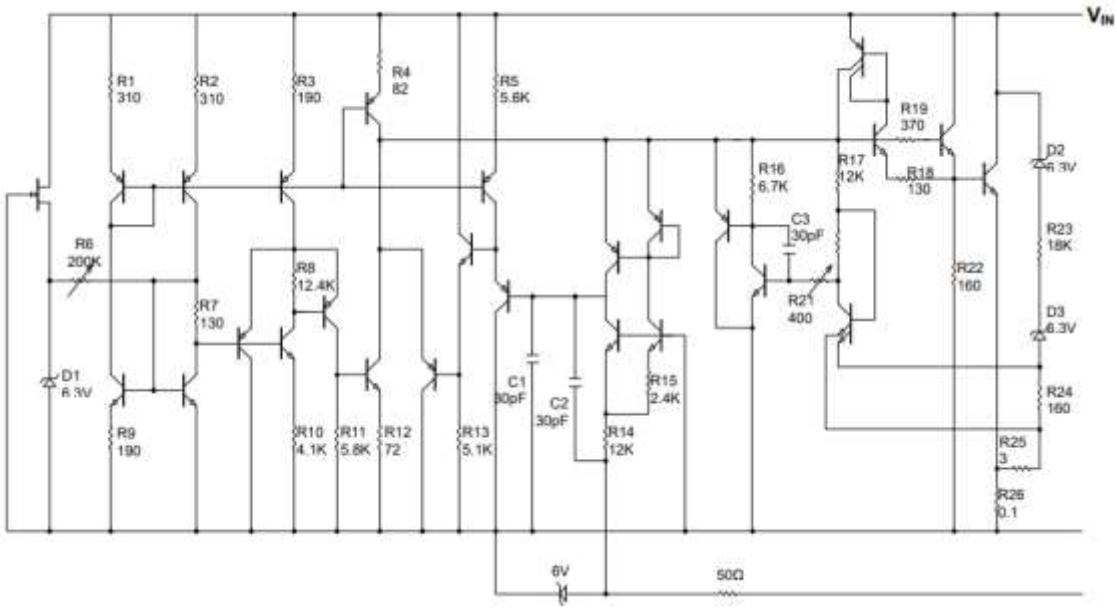
Absolute Maximum Ratings

PARAMETER		RATINGS	UNITS
Input Voltage, V_I		41	V
Input to Output Differential Voltage, $V_I - V_O$		40	V
Continuous Total Dissipation at 25°C Free-air Temperature		2	W
Continuous Total Dissipation at (or bellow) 25°C Cast Temperature		15	
Operating Junction Temperature	T_J	0 to 125	°C
Storage Temperature	T_{stg}	- 60 to 150	°C
Lead Temperature 1.6mm (1/6 inch) from case for 10 seconds		260	°C

Recommended Operating Conditions

PARAMETER	Min	Max	Unit
Output Current, I_O	10	1500	mA
Operating Virtual Junction Temperature, T_J	0	125	°C

Block Diagram



Electrical Characteristics ((Unless otherwise noted, VI - VO = 5V and IO= 0.5A. TJ = Full Range)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
Line Regulation (note 2)	ΔV_{OI}	$3V \le V_{IN} - V_{OUT} \le 40V$, $T_J = 25°C$			0.01	0.04	%/V
		$3V \le V_{IN} - V_{OUT} \le 40V$,			0.02	0.07	
Ripple Rejection Ratio		V_{OUT} = 10V, f = 120Hz			65		dB
		V_{OUT} = 10V, f = 120Hz, 10µF capacitor between ADJ and GND		66	80		
Load regulation (note 3)	ΔV_{OL}	$10mA \le I_{OUT} \le 1.5A$, $T_J = 25°C$	$V_O \le 5V$		5	25	mV
			$V_O > 5V$		0.1	0.5	%
		$10mA \le I_{OUT} \le 1.2A$	$V_O \le 5V$		20	70	mV
			$V_O > 5V$		0.3	1.5	%
Output Voltage Change with Temperature	ΔV_{OT}	Full Temperature Range					%
Long Term Stability (Note 4)		$T_J = 125°C$, $V_{IN} - V_{OUT} = 40V$, after 1000hr			0.3	1	%
Output Noise Voltage		$10Hz \le f \le 10KHz$, $T_J = 25°C$			0.003		%
Minimum Load Current		$V_{IN} - V_{OUT} \le 40V$			3.5	10	mA
Output Current Limit	I_{CL}	$V_{IN} - V_{OUT} \le 15V$		1.5	2.2		A
		$V_{IN} - V_{OUT} \le 40V$, $T_J = 25°C$		0.15	0.4		
Adjustment Pin Current	I_{ADJ}				50	100	µA
Adjustment Pin Current Change	ΔI_{ADJ}	$3V \le V_{IN} - V_{OUT} \le 40V$ $10mA \le I_{OUT} \le 1.2A$			0.2	5.0	µA
Reference Voltage		$3V \le V_{IN} - V_{OUT} \le 40V$, $10mA \le I_{OUT} \le 1.5A$, $P \le 15W$		1.2	1.25	1.3	V

Note 1: All characteristics are measured with a 0.1µF capacitor across the input and a 1µF capacitor across the output.

Note 2: Input regulation is expressed here as the percentage change in output voltage per 1V change at the input.

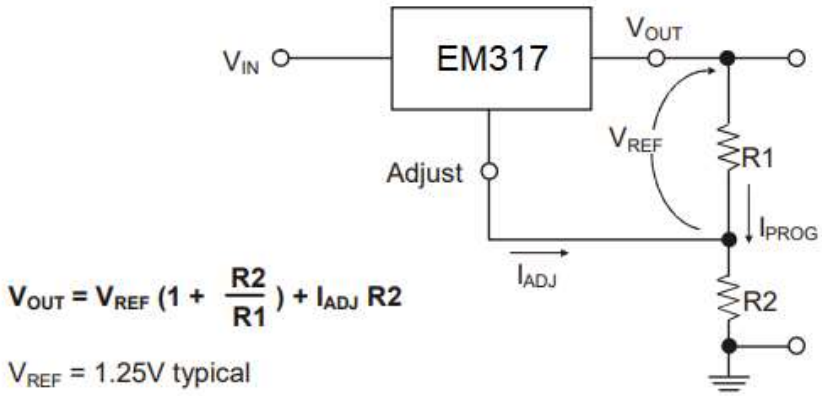
Note 3: Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

Note 4: Since long-term drift cannot be measured on the individual devices prior to shipment, this specification is not intended to be a guarantee or warranty. It is an engineering estimate of the average drift to be expected from lot to lot.

Application Information

■ Basic Circuit Operation

The EM317 is a 3- terminal floating regulator. In operation, the EM317 develops and maintains a nominal 1.25V reference (V_{REF}) between its output and adjustment terminals. This reference voltage is converted to a programming current flow through R2 to ground.
The regulated output voltage is given by:



Basic Circuit Configuration

Since the current from the adjustment terminal (I_{ADJ}) represents an error term in the equation, the EM317was designed to control I_{ADJ} to less than 100μA and keep it constant. To do this, all quiescent operating current is returned to the output terminal. This imposes the requirement for a minimum load current. If the load current is less than this minimum, the output voltage will rise.
Since the EM317 is a floating regulator, it is only the voltage differential across the circuit which is important to performance, and operation at high voltages with respect to ground is possible.

■ Load Regulation

The EM317 is capable of providing extremely good load regulation, but a few precautions are needed to obtain maximum performance. For best performance, the programming resistor R1 should be connected as close to the regulator as possible to minimize line drops which effectively appear in series with the reference, thereby degrading regulation. The ground end of R2 can be returned near the load ground to provide remote ground sensing and improve load regulation.

External Capacitors

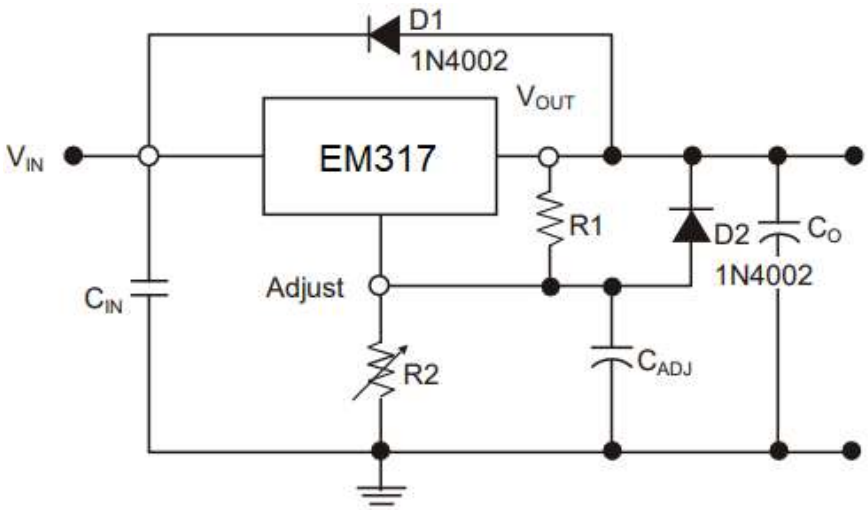
A 0.1µF disc or 1.0µF tantalum input bypass capacitor C_{IN} is recommended to reduce the sensitivity to input line impedance. The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor CADJ prevents ripple from being amplified as the output voltage is increased. A 10µF capacitor should improve ripple rejection about 15 dB at 120Hz in a 10V application.

Although the EM317 is stable with no output capacitance, like any feedback circuit, certain values of external capacitance can cause excessive ringing. An output capacitance CO in the form of a 1.0µF tantalum or 25µF aluminum electrolytic capacitor on the output swamps this effect and insures stability.

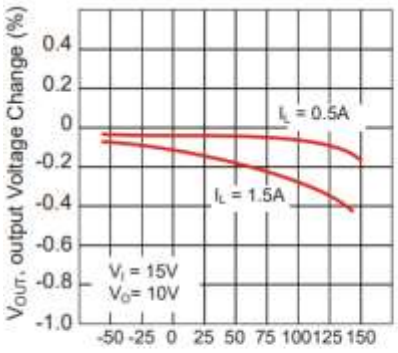
Protection Diodes

When external capacitors are used with any IC regulator, it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator.

The figure below shows the EM317 with the recommended protection diodes for output for output voltage in excess of 25V or high capacitance values (C_O > 25µF, C_{ADJ} > 10µF). Diode D1 prevents CO from discharging thru the IC during an input short circuit. Diode D2 protects against capacitor C_{ADJ} discharging through the IC during an output short circuit. The combination of diodes D1 and D2 prevents C_{ADJ} from discharging through the IC during an input short circuit.

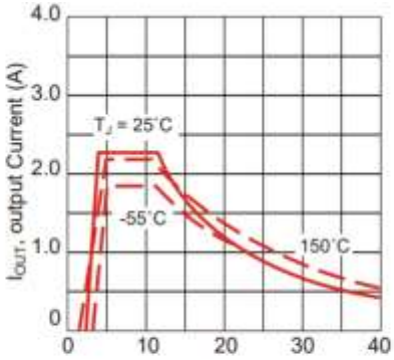


Typical Performance Characteristics



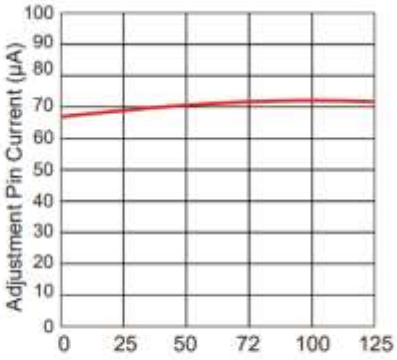
T_J, Junction Temperature (°C)

Figure 1. Load Regulation



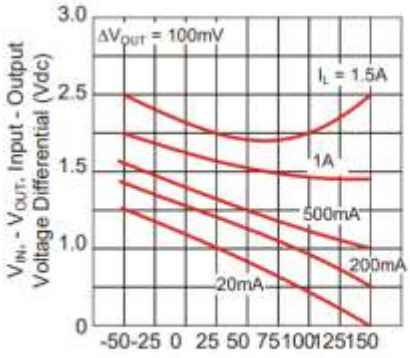
$V_{IN} - V_{OUT}$, Input – Output Voltage differential (Vdc)

Figure 2. Current Limit



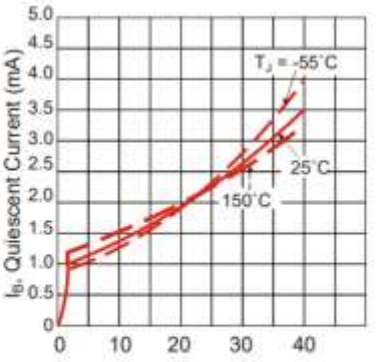
Ambient Temperature (°C)

Figure 3. Adjustment Pin Current vs. Temperature



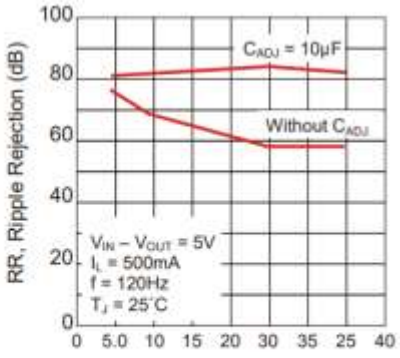
T_J, Junction Temperature (°C)

Figure 4. Dropout Voltage



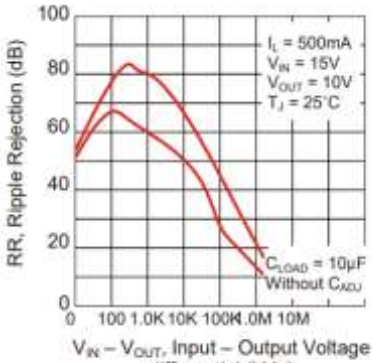
$V_{IN} - V_{OUT}$, Input – Output Voltage differential (Vdc)

Figure 5. Minimum Operating current



V_{OUT}, Output Voltage

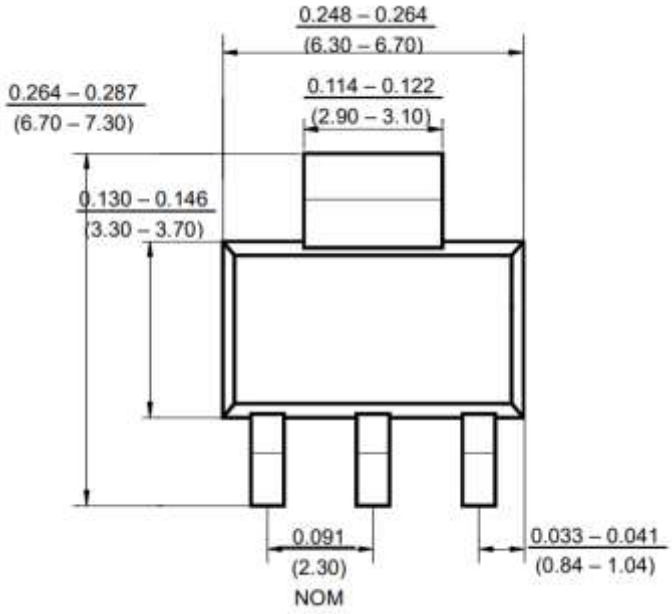
Figure 6. Ripple Rejection vs. Output Voltage

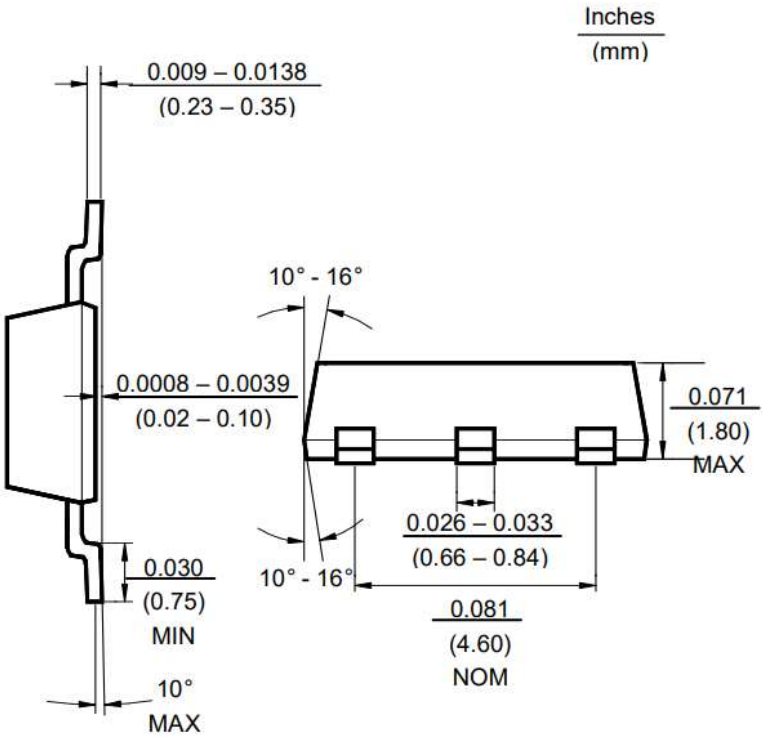


$V_{IN} - V_{OUT}$, Input – Output Voltage differential (Vdc)

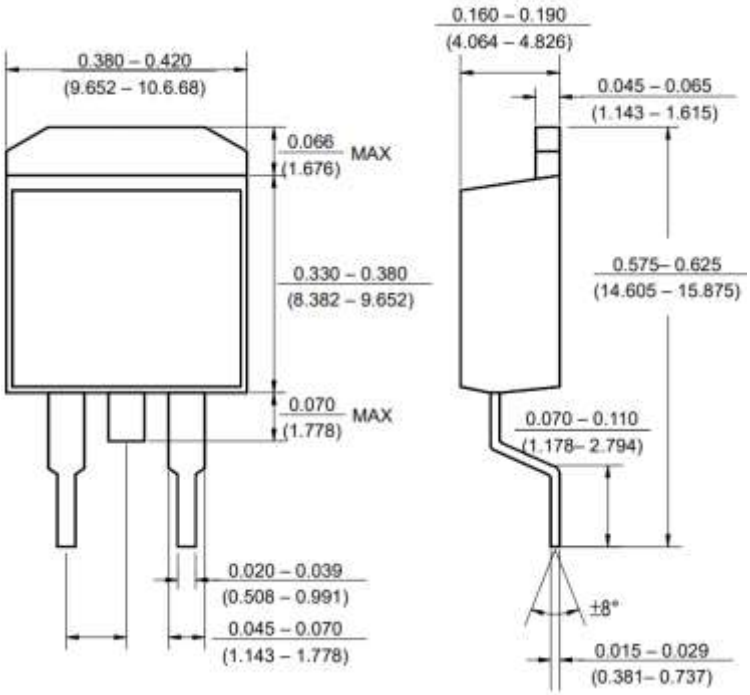
Figure 7. Ripple Rejection vs. Frequency

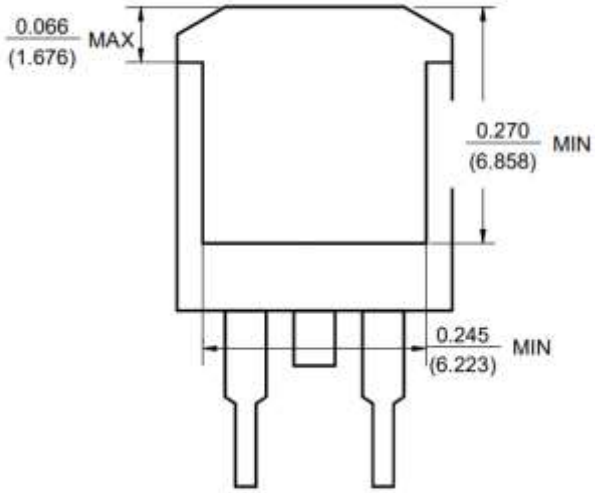
Package Outline Dimensions – SOT223





Package Outline Dimensions – TO263

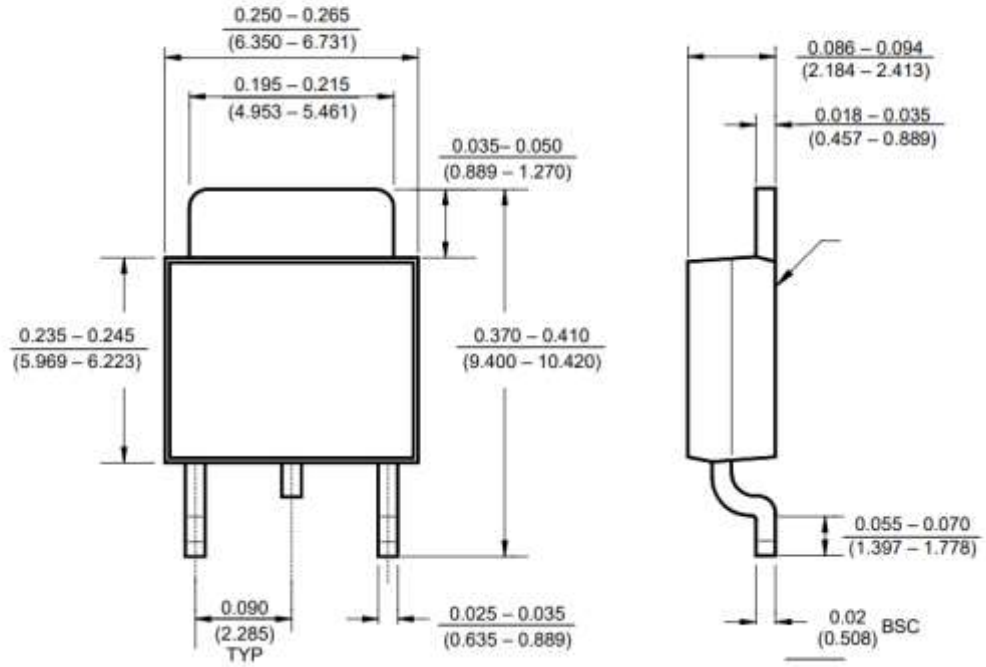


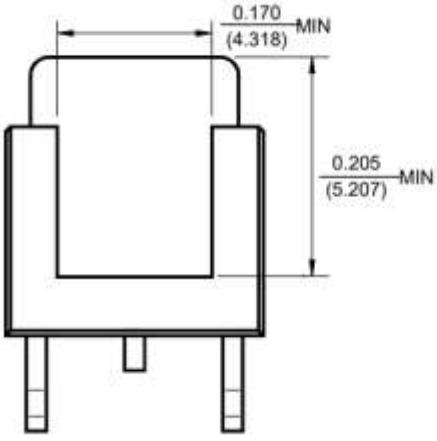


Note: All dimensions for TO263 package are subject to change due to manufacturing concerns. However, they will be in full compliance with JEDEC TO263E standard.

Package Outline Dimensions – TO252

Note: All dimensions for TO252 package are subject to change due to manufacturing concerns. However, they will be in full compliance with JEDEC TO-252E standard.





Inch
(mm)