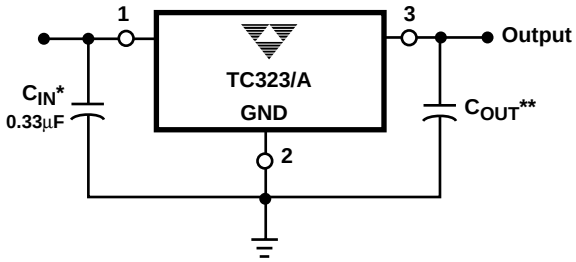
POSITIVE VOLTAGE REGULATORS

FEATURES

- **Output Current in Excess of 3.0 A**
- **Available with 2% Output Voltage Tolerance**
- **No External Components Required**
- **Internal Thermal Overload Protection**
- **Internal Short Circuit Current Limiting**
- **Output Transistor Safe–Area Compensation**
- **Thermal Regulation and Ripple Rejection Have Specified Limits**

TYPICAL OPERATING CIRCUIT



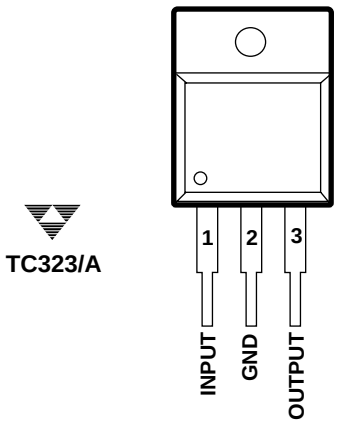
A common ground is required between the input and the ouput voltages. The input voltage must remain typically 2.5V above the voltage even during the low point on the input ripple voltage.

NOTE: *C_{IN} is required if regulator is located an appreciable distance from power supply filter. (See Applications Information for details.)

****C_{OUT} is not needed for stability; however, it does improve transient response.**

PIN CONFIGURATIONS

3-Pin TO-220B



NOTE: Heatsink surface is connected to Pin 2.

GENERAL DESCRIPTION

The TC323/A are monolithic integrated circuits which supply a fixed positive 5.0V output with a load driving capability in excess of 3.0A. These three–terminal regulators employ internal current limiting, thermal shutdown, and safe–area compensation. The A-suffix is an improved device with superior electrical characteristics and a 2% output voltage tolerance. These regulators are offered with a 0° to +125°C temperature range in a low cost plastic power package.

Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents. These devices can be used with a series pass transistor to supply up to 15A at 5.0V.

ORDERING INFORMATION

Part Number	Ouput Voltage Range	Package	Operating Junction Temp. Range
TC323VBB	4%	3-Pin TO-220B	0°C to + 125°C
TC323AVBB	2%	3-Pin TO-220B	0°C to + 125°C

TC323/A

ABSOLUTE MAXIMUM RATINGS*

Input Voltage (V_{IN} to GND) 20V
Power Dissipation ..... Internally Limited
Operating Junction Temperature Range .... 0°C to +125°C
Storage Temperature (unbiased) ..... – 65°C to +150°C
Lead Temperature (Soldering, 10 sec) ..... +300°C

*This is a stress rating only, and functional operation of the device at these or any other conditions beyond those indicated in the operation section of the specifications is not implied. Exposure to absolute maximum ratings conditions for extended periods of time may affect device reliability.

ELECTRICAL CHARACTERISTICS: $T_J = T_{LOW}$ to T_{HIGH}, (Note 1) unless otherwise specified.

			TC323A			TC323			
Symbol	**Parameter**	**Test Conditions**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Unit**
V_O	Output Voltage	V_{IN} = 7.5V, 0 ≤ I_{OUT} ≤ 3.0A, T_J = 25°C 7.5V, ≤ V_{IN} ≤ 15V, 0 ≤ I_{OUT} ≤ 3.0A, P ≤ P_{MAX}, (Note 2)	4.9 4.8	5.0 5.0	5.1 5.2	4.8 4.75	5.0 5.0	5.2 5.25	V
$R_{EG_{LINE}}$	Line Regulation	7.5V, ≤ V_{IN} ≤ 15V, T_J = 25°C, (Note 3)	—	1.0	15	—	1.0	25	mV
$R_{EG_{LOAD}}$	Load Regulation	V_{IN} = 7.5V, 0 ≤ I_{OUT} ≤ 3.0A, T_J = 25°C (Note 3)	—	10	50	—	10	100	mV
$R_{EG_{THERM}}$	Thermal Regulation	Pulse = 10msec, P = 20W, T_A = 25°C	—	0.001	0.01	—	0.002	0.03	$\%V_O/W$
I_B	Quiescent Current	7.5V, ≤ V_{IN} ≤ 15V, 0 ≤ I_{OUT} ≤ 3.0A	—	3.5	10	—	3.5	20	mA
V_{IN}	Output Noise Voltage	10Hz ≤ f ≤ 100kHz, T_J = 25°C	—	40	—	—	40	—	µVrms
RR	Ripple Rejection	8.0V ≤ V_{IN} ≤ 18V, I_{OUT} = 2.0A, f =120Hz, T_J = 25°C	66	75	—	62	75	—	dB
I_{SC}	Short Circuit Current Limit	V_{IN} =15V, T_J = 25°C V_{IN} =7.5V, T_J = 25°C	— —	4.5 5.5	— —	— —	4.5 5.5	— —	A
θ_{JC}	Thermal Resistance, Junction-to-Case (Note 4)		—	2.0	—	—	2.0	—	°C/W

NOTES: 1. T_{LOW} to T_{HIGH} = 0° to +125°C
2. Although power dissipation is internally limited, specifications apply only for P ≤ P_{MAX} = 25W.
3. Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width ≤ 1.0msec and a duty cycle ≤ 5%.
4. Without a heatsink, the thermal resistance (θ_{JA} is 65°C/W). With a heatsink, the effective thermal resistance can approach the typical values of 2.0°C/W, depending on the efficiency of the heatsink.

Voltage Regulator Performance

The performance of a voltage regulator is specified by its immunity to changes in load, input voltage, power dissipation, and temperature. Line and load regulation are tested with a pulse of short duration (<100µsec) and are strictly a function of electrical gain. However, pulse widths of longer duration (>1.0msec) are sufficient to create temperature gradients across the die. These temperature gradients can cause a change in the output voltage, in addition to changes by line and load regulation. Longer pulse widths and thermal gradients make it desirable to specify thermal regulation.

Thermal regulation is defined as the change in output voltage caused by a change in dissipated power for as pecified time, and is expressed as a percentage output voltage change per watt. The change in dissipated power can be caused by a change in either input voltage or the load current. Thermal regulation is a function of IC layout and die attach techniques, and usually occurs within 10ms of a change in power dissipation. After 10msec, additional changes in the output voltage are due to the temperature coefficient of the device.

Figure 1 shows the line and thermal regulation response of a typical TC323A to a 20W input pulse. The variation of he output voltage due to line regulation is labeled ① and the thermal regulation component is labeled ②. Figure 2 shows the load and thermal regulation response of a typical The C323A to a 20W load pulse. The output voltage variation due to load regulation is labeled ① and the thermal regulation component is labeled ②.

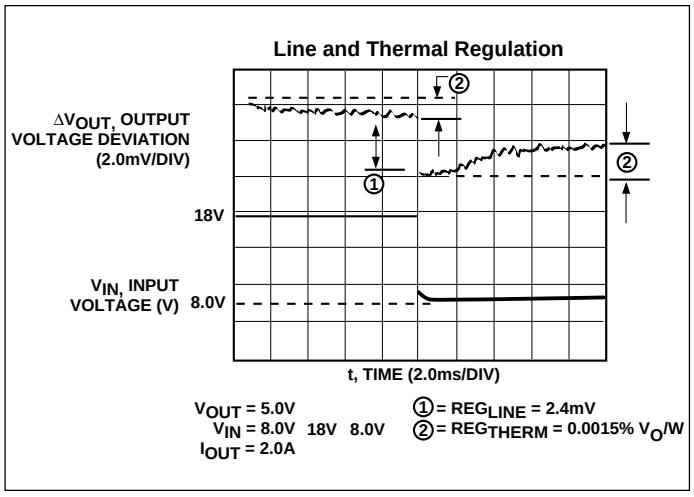


Figure 1. Line and Thermal Regulation

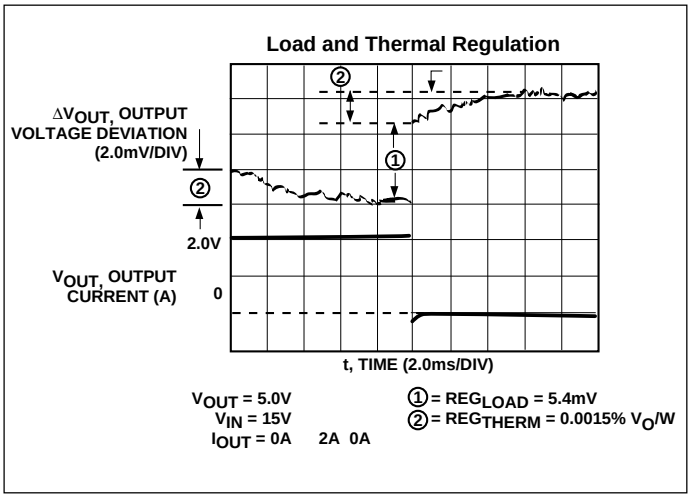


Figure 2. Load and Thermal Regulation

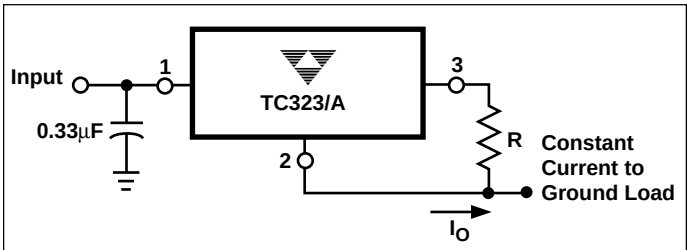
TC323/A

APPLICATIONS INFORMATION

Design Considerations

The TC323/A series of fixed voltage regulators are designed with Thermal Overload Protection that shuts down the circuit when subjected to an excessive power over load condition, Internal Short Circuit Protection that limits the maximum current the circuit will pass, and Output Transistor Safe-Area Compensation that reduces the output short circuit current as the voltage across the pass transistor is increased.

In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with a capacitor if the regulator is connected to the power supply filter with long wire lengths, or if the output load capacitance is large. An input bypass capacitor should be selected to provide good high-frequency characteristics to insure stable operation under all load conditions. A 0.33µF or larger tantalum, mylar, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with the shortest possible leads directly across the regulator's input terminals. Normally good construction techniques should be used to minimize ground loops and lead resistance drops since the regulator has no external sense lead.



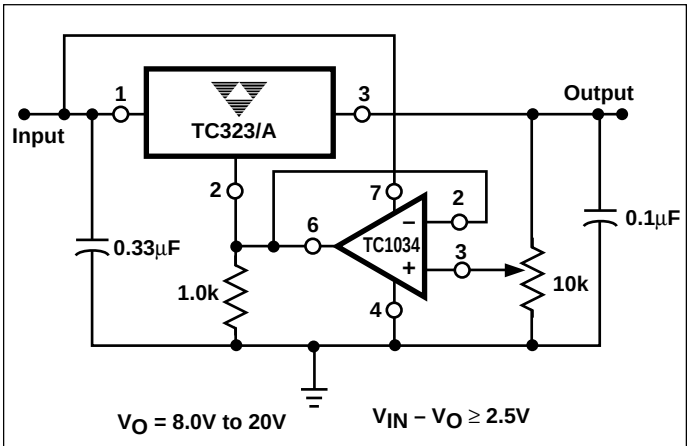
The TC323/A regulator can also be used as a current source when connected as above. Resistor R determines the current as follows:

$$I_O = \frac{5.0V}{R} + I_B$$

$\Delta I_B \cong 0.7mA$ over line, load and temperature changes
$I_B \cong 3.5mA$

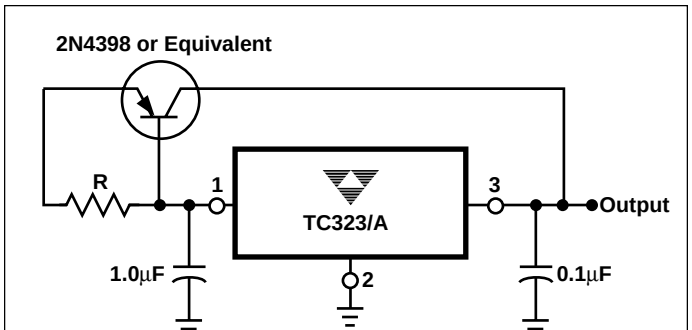
For example, a 2.0A current source would require R to be a 2.5Ω, 15W resistor and the output voltage compliance would be the input voltage less 7.5V.

Figure 3. Current Regulator



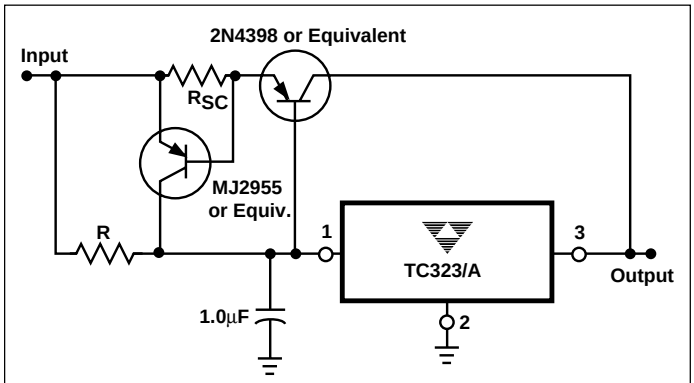
The addition of an operational amplifier allows adjustment to higher or intermediate values while retaining regulation characteristics. The minimum voltage obtainable with this arrangement is 3.0V greater than the regulator voltage.

Figure 4. Adjustable Output Regulator



The TC323/A series can be current boosted with a PNP transistor. The 2N4398 provides current to 15A. Resistor R in conjunction with the V_{BE} of the PNP determines when the pass transistor begins conducting; this circuit is not short circuit proof. Input-output differential voltage minimum is increased by the VBE of the pass transistor.

Figure 5. Current Boost Regulator

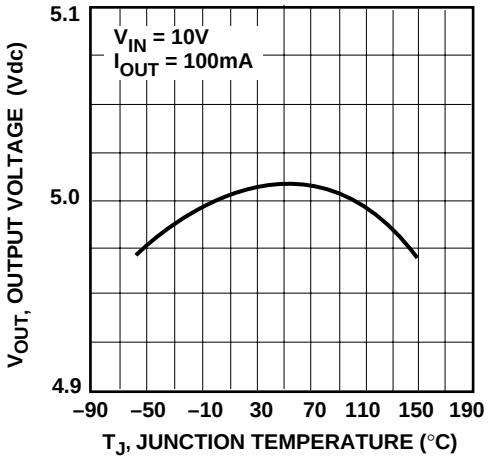


The circuit can be modified to provide supply protection against short circuits by adding a short circuit sense resistor, R_{SC}, and an additonal PNP transistor. The current sensing PNP must be able to handle the short circuit current of the three-terminal regulator. Therefore, an 8.0A power transistor is specified.

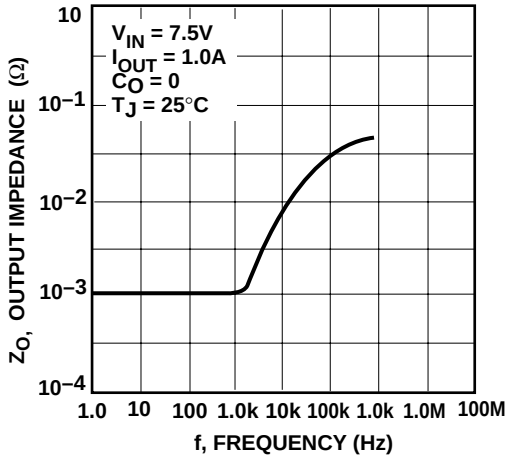
Figure 6. Current Boost Regulator with Short Circuit Protection

TYPICAL CHARACTERISTICS

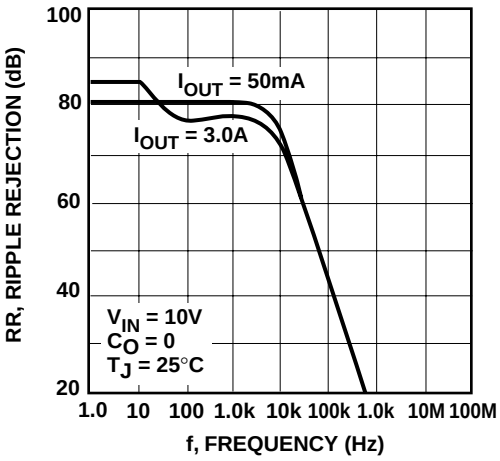
Temperature Stability



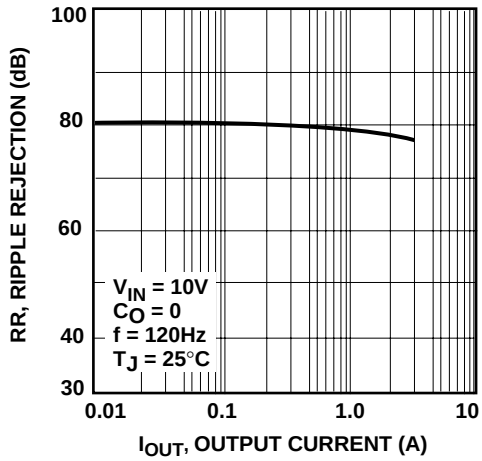
Output Impedance



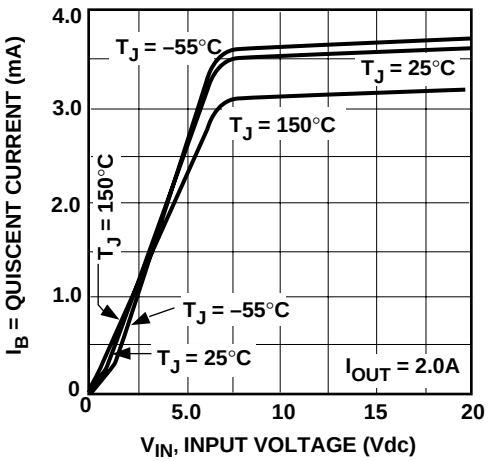
Ripple Rejection vs. Frequency



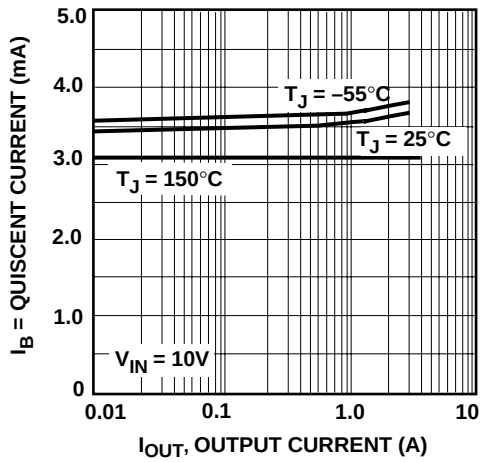
Ripple Rejection vs. Output Current



Quiescent Current vs. Input Voltage



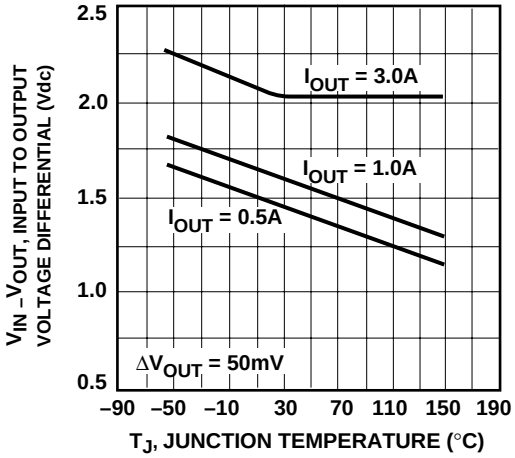
Quiescent Current vs. Output Current



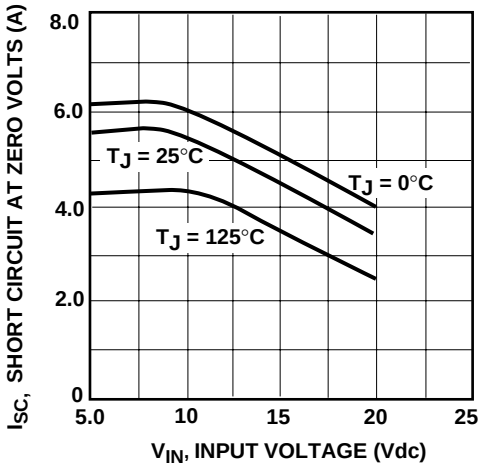
TC323/A

TYPICAL CHARACTERISTICS (Cont.)

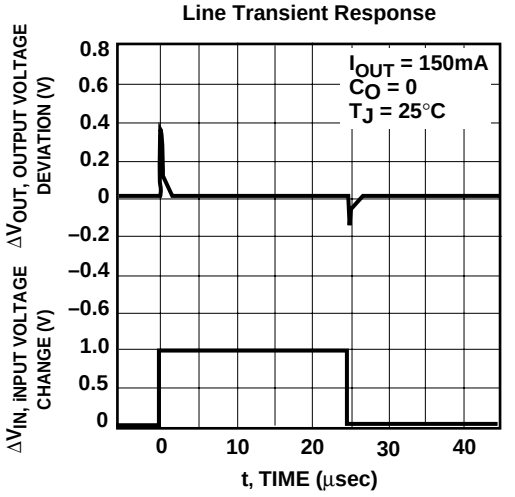
Dropout Voltage



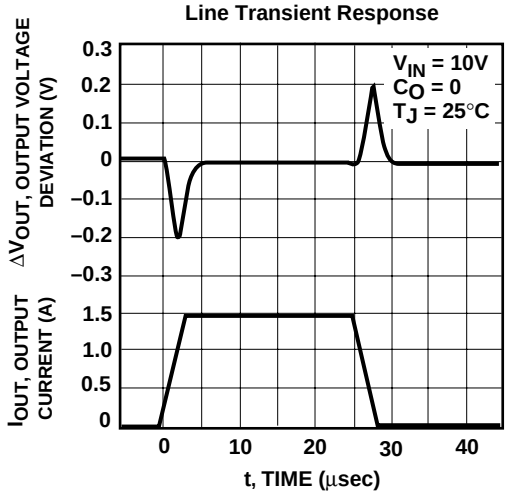
Short Circuit Current



Line Transient Response



Line Transient Response



PACKAGE DIMENSIONS

3-Pin TO-220B

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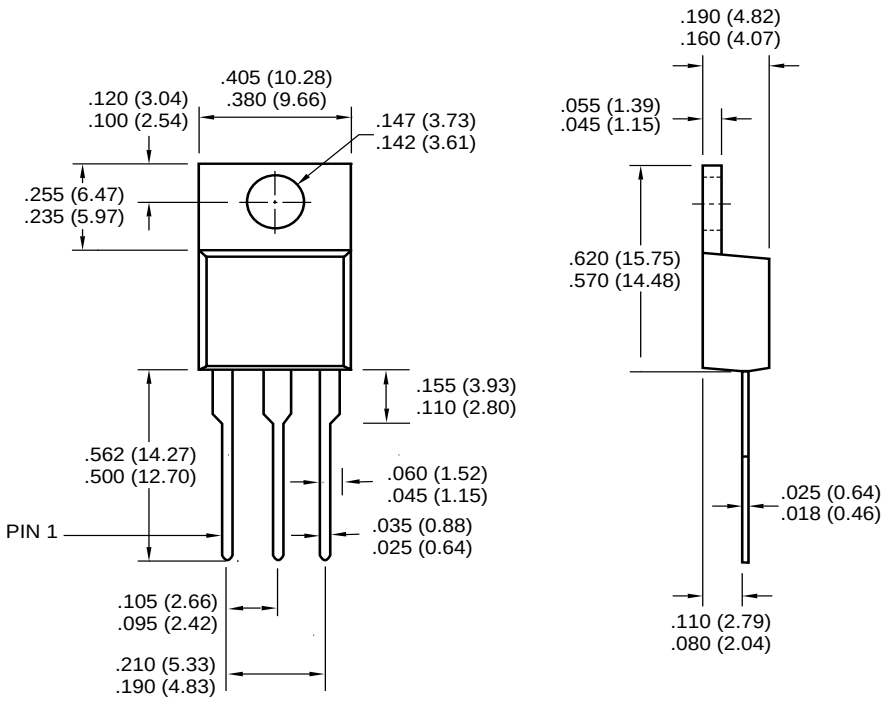

Dimensions: inches (mm)

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