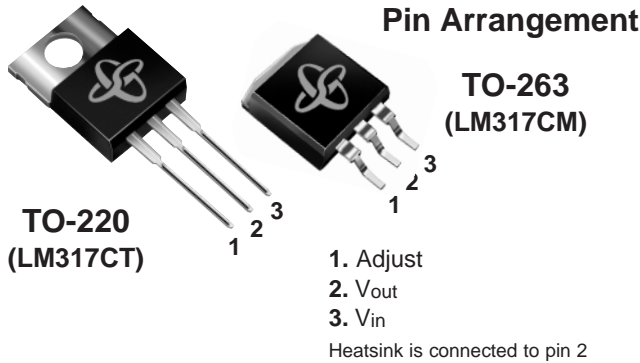


## 3-Terminal Adjustable Output Positive Voltage Regulators



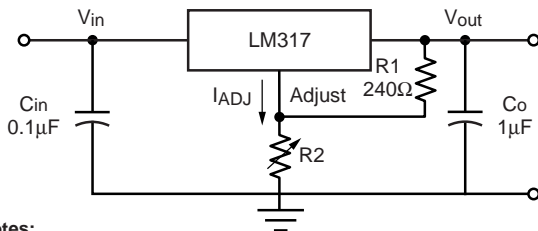
### Description

The LM317 is an adjustable 3-terminal positive voltage regulator capable of supplying in excess of 1.5A over an output voltage range of 1.2V to 37V. 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.

### Features

- Output current in excess of 1.5 ampere
- Output adjustable between 1.2V and 37V
- Internal thermal overload protection
- Internal short-circuit current limiting constant with temperature
- Output transistor safe-area compensation
- Floating operation for high voltage applications
- Eliminates stocking many fixed voltages

### Standard Application



**Notes:**

$C_{in}$  is required if regulator is located an appreciable distance from power supply filter.

$C_o$  is not needed for stability, however, it does improve transient response.

$$V_{out} = 1.25V (1 + R_2/R_1) + I_{Adj} R_2$$

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

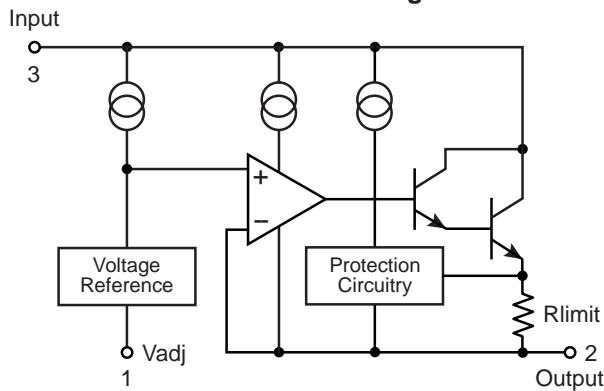
### Mechanical Data

**Case:** TO-220 and TO-263 packages

**Weight:** approx. 1.35g

Case outlines are on the back page.

### Functional Block Diagram



### Maximum Ratings Ratings at 25°C ambient temperature unless otherwise specified.

Parameter	Symbol	Value	Unit
Input-Output Voltage Differential	$V_i - V_o$	40	Vdc
Power Dissipation, 25°C Free-Air Temperature	$P_D$	2	W
Power Dissipation, 25°C Case Temperature	$P_D$	15	W
Operating Junction Temperature Range	$T_J$	0 to +125	°C
Storage Junction Temperature Range	$T_{stg}$	-65 to +150	°C

## Electrical Characteristics – LM317

$V_i - V_o = 5V$ ,  $I_o = 0.5A$ ,  $T_J = T_{low}$  to  $T_{high}$  (see Note 1),  $I_{max}$  and  $P_{max}$  per Note 2, unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Line Regulation (Fig. 1) <sup>(3)</sup> $3.0V \leq V_i - V_o \leq 40V$	REG <sub>line</sub>	$T_A = 25^\circ C$	–	0.01	0.04	%V <sub>o</sub> /V
		$T_J = 0^\circ C$ thru $125^\circ C$	–	0.02	0.07	
Load Regulation (Fig. 2) <sup>(3)</sup> $T_J = 25^\circ C$ , $10mA \leq I_o \leq 1.5A$	REG <sub>load</sub>	$V_o \leq 5.0$	–	5	25	mV
		$V_o \geq 5.0$	–	0.1	0.5	%V <sub>o</sub>
Load Regulation (Fig. 2) <sup>(3)</sup> $10mA \leq I_o \leq 1.5A$	REG <sub>load</sub>	$V_o \leq 5.0$	–	20	70	mV
		$V_o \geq 5.0$	–	0.3	1.5	%V <sub>o</sub>
Thermal Regulation	REG <sub>therm</sub>	$T_J = 25^\circ C$ , 20ms Pulse	–	0.03	0.07	%V <sub>o</sub> /W
Adjustment Pin Current (Fig. 3)	I <sub>Adj</sub>		–	50	100	μA
Adjustment Pin Current Change	ΔI <sub>Adj</sub>	$10mA \leq I_L \leq 1.5A$ $2.5V \leq V_i - V_o \leq 40V$	–	0.2	5	μA
Reference Voltage (Fig. 3) <sup>(4)</sup>	V <sub>ref</sub>	$10mA \leq I_o \leq 1.5A$ $3V \leq V_i - V_o \leq 40V$	1.225	1.25	1.275	V
Temperature Stability (Fig. 3)	T <sub>S</sub>	$T_{low} \leq T_J \leq T_{high}$	–	1	–	%V <sub>o</sub>
Min. Load Current to Maintain Regulation (Fig. 3)	I <sub>Lmin</sub>	$V_i - V_o = 40V$	–	3.5	10	mA
Maximum Output Current (Fig. 3)	I <sub>max</sub>	$V_i - V_o \leq 15V$	1.5	2.2	–	A
		$V_i - V_o = 40V$ , $T_J = 25^\circ C$	0.15	0.4	–	
RMS Noise, % of V <sub>o</sub>	N	$T_J = 25^\circ C$ , $10Hz \leq f \leq 10KHz$	–	0.003	–	%V <sub>o</sub>
Ripple Rejection (Fig. 4)	RR	$V_o = 10V$ , $f = 120Hz$ <sup>(5)</sup> $C_{Adj} = 10\mu F$	– 66	65 80	– –	dB
Long-Term Stability (after 1000 hr) Fig. 3	S	$T_J = 125^\circ C$ <sup>(6)</sup> , $T_J = 25^\circ C$ for Endpoint Measurements	–	0.3	1.0	%
Thermal Resistance Junction to Case	R <sub>θJC</sub>	$T_{low} \leq T_J \leq T_{high}$	–	5.0	–	°C/W

### Notes:

(1)  $T_{low} = 0^\circ C$   $T_{high} = 125^\circ C$

(2)  $I_{max} = 1.5A$   $P_{max}$ : TO-220 = 2W, TO-263 = 2W

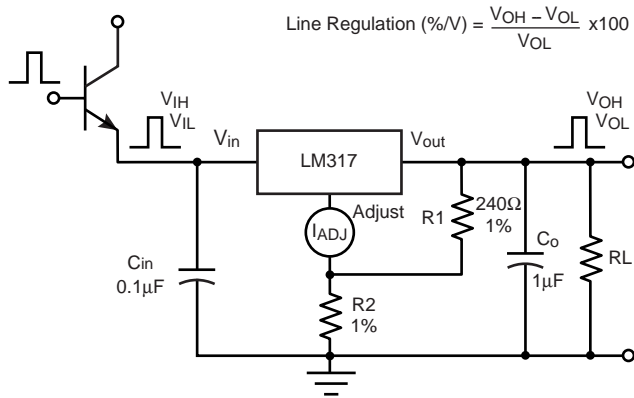
(3) Load and line regulation are specified at constant junction temperature. Changes in V<sub>o</sub> due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

(4) Selected devices with tightened tolerance reference voltage available.

(5) C<sub>Adj</sub>, when used, is connected between the adjustment pin and ground.

(6) Since Long-Term Stability cannot be measured on each device before shipment, this specification is an engineering estimate of average stability from lot to lot.

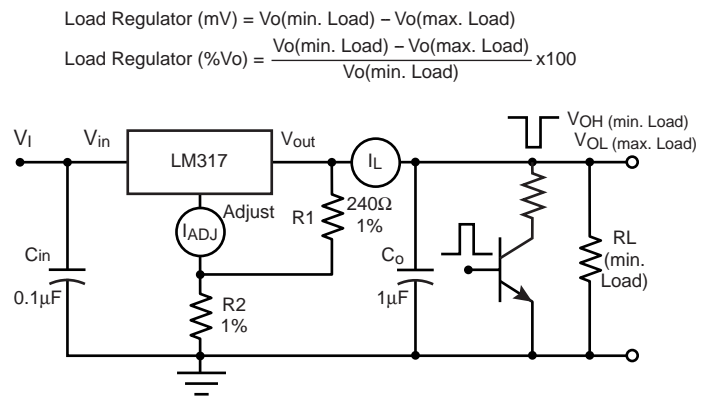
**Fig. 1 – Line Regulation Test Circuit**



$$\text{Line Regulation (\%V)} = \frac{V_{OH} - V_{OL}}{V_{OL}} \times 100$$

Pulse Testing Required:  
1% Duty Cycle is Suggested

**Fig. 2 – Load Regulation and  $\Delta I_{adj}$ /Load Test Circuit**

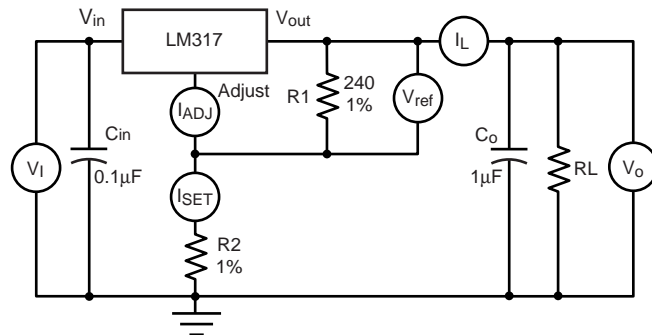


$$\text{Load Regulator (mV)} = V_{o(\text{min. Load})} - V_{o(\text{max. Load})}$$

$$\text{Load Regulator (\%V}_o) = \frac{V_{o(\text{min. Load})} - V_{o(\text{max. Load})}}{V_{o(\text{min. Load})}} \times 100$$

Pulse Testing Required:  
1% Duty Cycle is Suggested

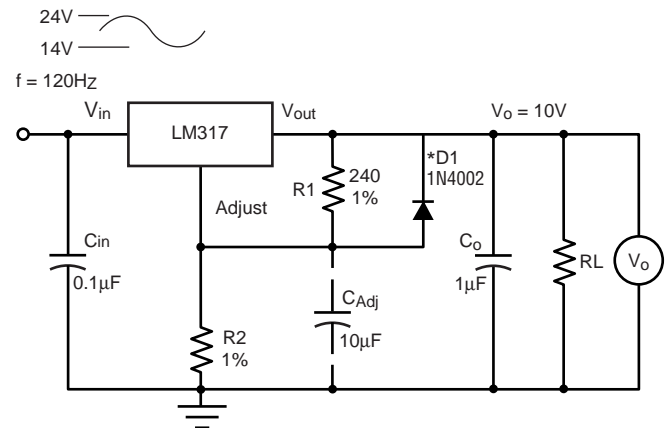
**Fig. 3 – Standard Test Circuit**



Pulse Testing Required:  
1% Duty Cycle is Suggested

To Calculate R2:  
 $V_o = I_{SET} R_2 + 1.250V$   
Assume  $I_{SET} = 5.25mA$

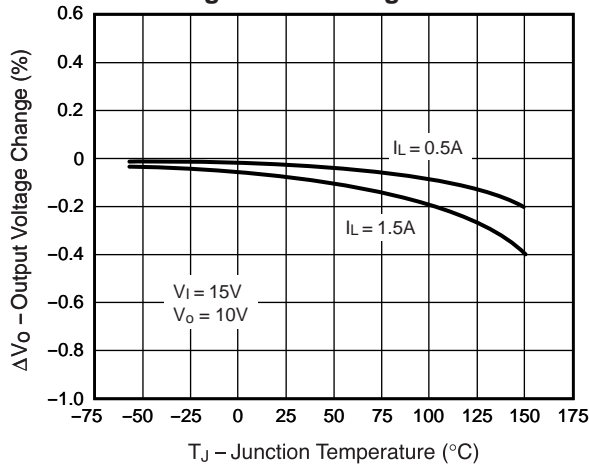
**Fig. 4 – Ripple Rejection Test Circuit**



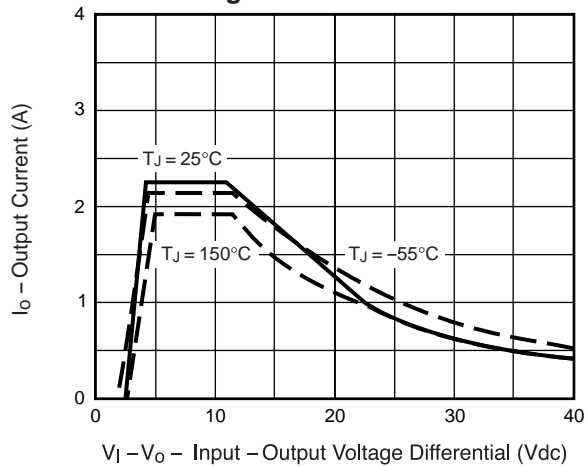
\*D1 Discharges  $C_{ADJ}$  if  
Output is Shorted to Ground

**Ratings and Characteristic Curves** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

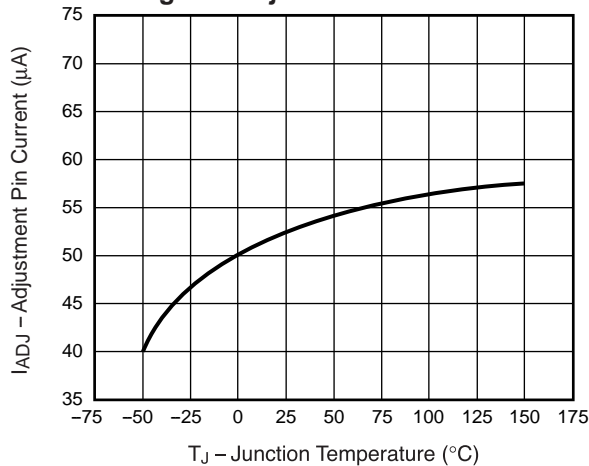
**Fig. 5 – Load Regulation**



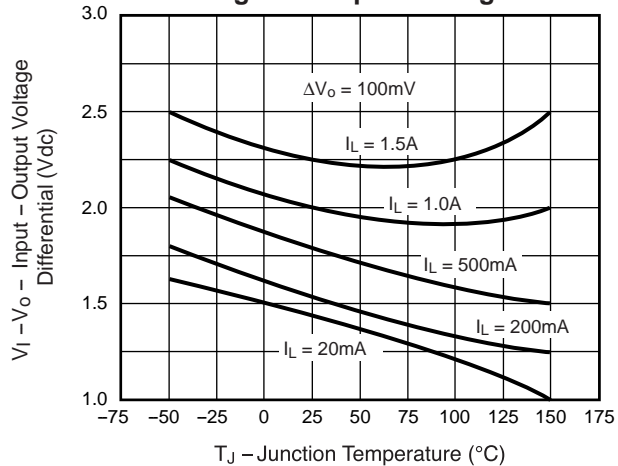
**Fig. 6 – Current Limit**



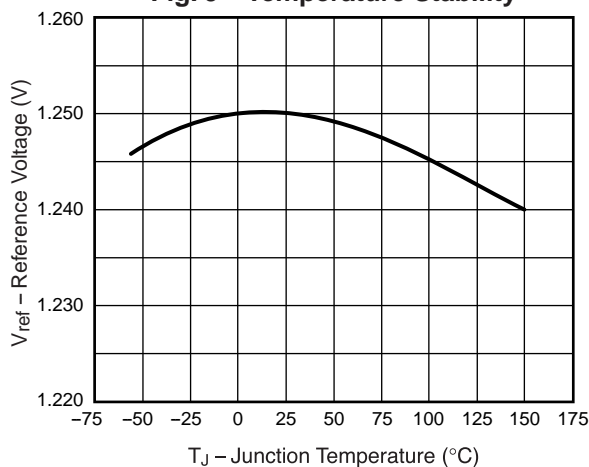
**Fig. 7 – Adjustment Pin Current**



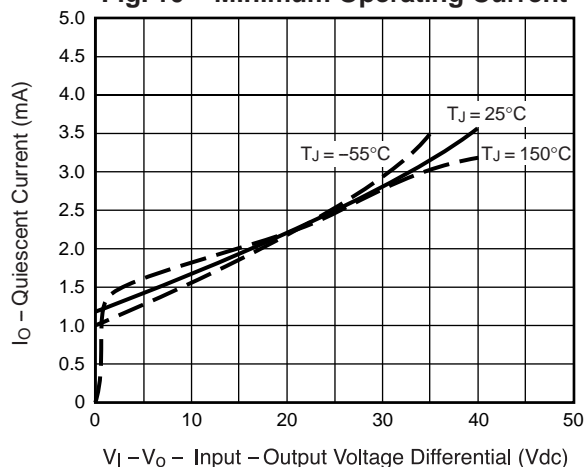
**Fig. 8 – Dropout Voltage**



**Fig. 9 – Temperature Stability**

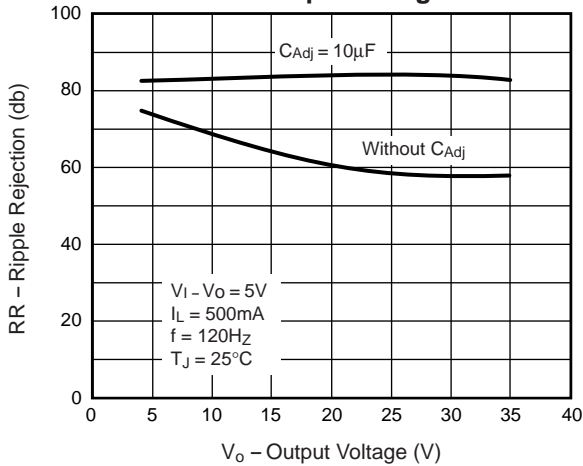


**Fig. 10 – Minimum Operating Current**

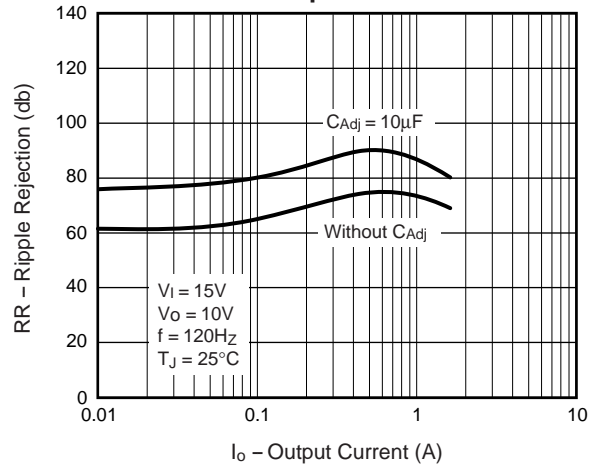


## Ratings and Characteristic Curves ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

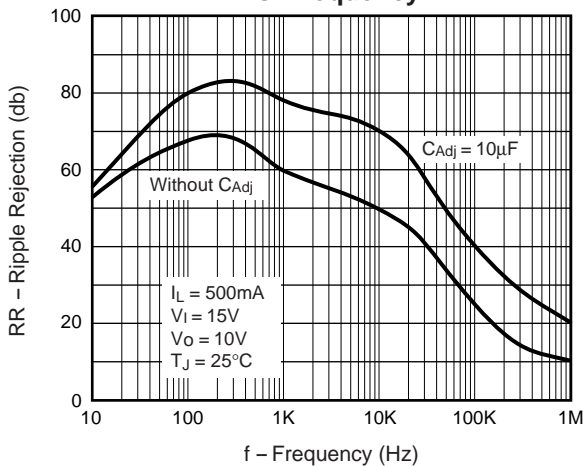
**Fig. 11 – Ripple Rejection vs. Output Voltage**



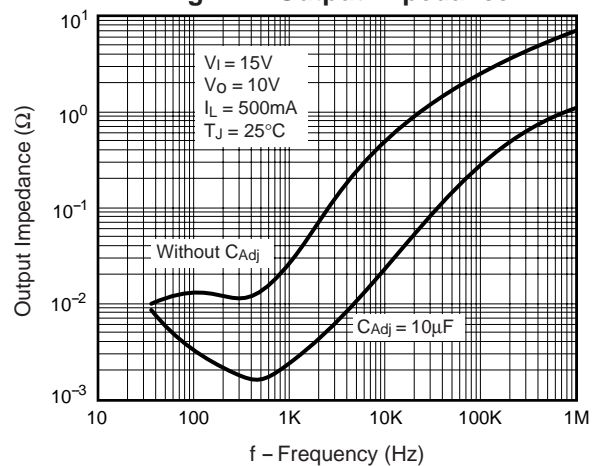
**Fig. 12 – Ripple Rejection vs. Output Current**



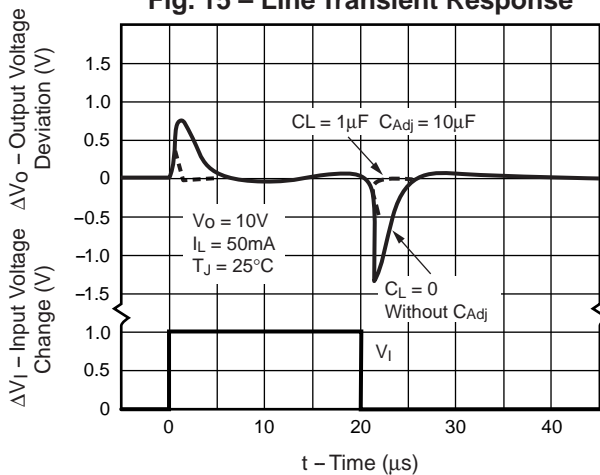
**Fig. 13 – Ripple Rejection vs. Frequency**



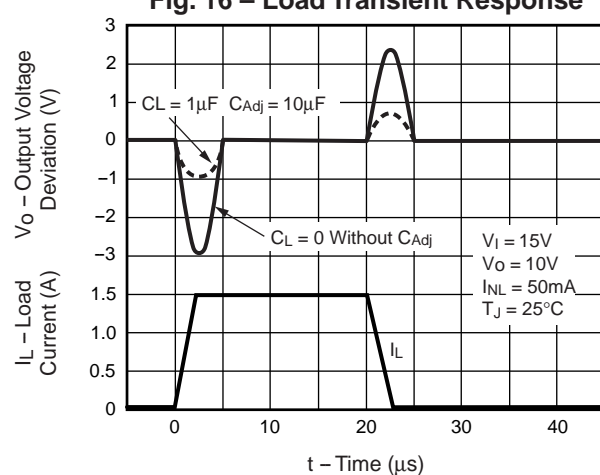
**Fig. 14 – Output Impedance**



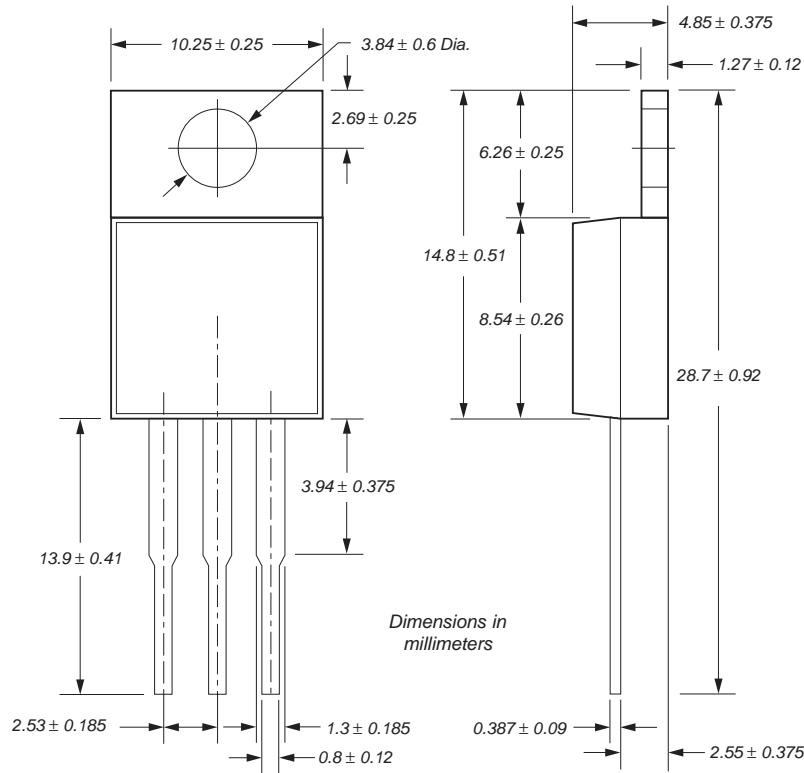
**Fig. 15 – Line Transient Response**



**Fig. 16 – Load Transient Response**



### TO-220 Case Outline



### TO-263 Case Outline

