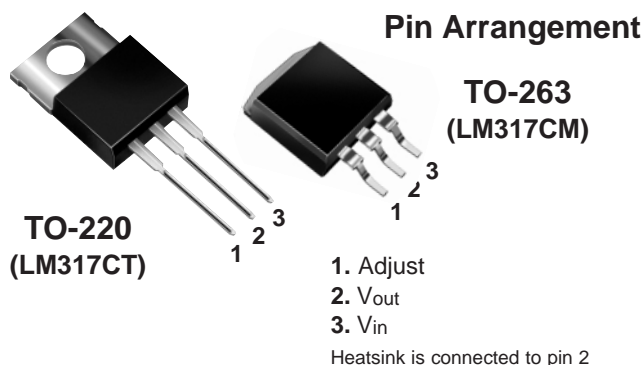


3-Terminal Adjustable Output Positive Voltage Regulators



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

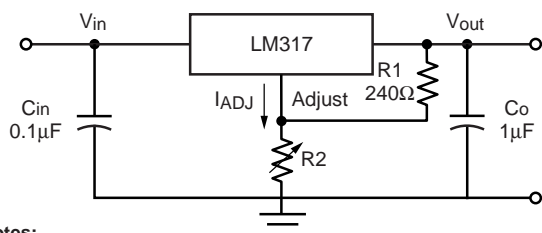
Mechanical Data

Case: TO-220 and TO-263 packages

Weight: approx. 1.35g

Case outlines are on the back page.

Standard Application



Notes:

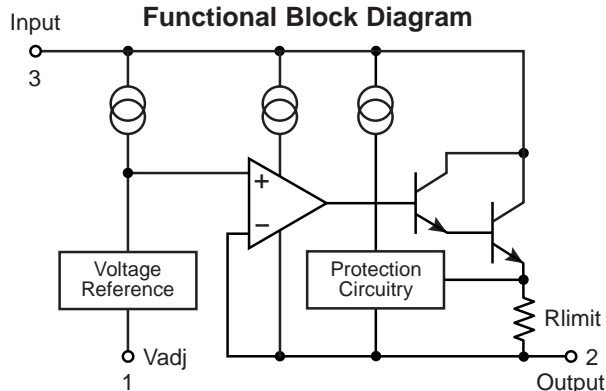
C_{in} is required if regulator is located an appreciable distance from power supply filter.

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

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

Notes:

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

(2) $I_{max} = 1.5A$ P_{max} is internally limited

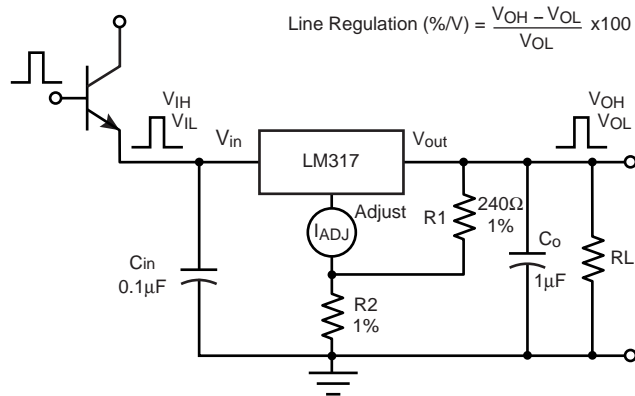
(3) Load and line regulation are specified at constant junction temperature. Changes in V_o due to heating effects must be taken into account separately.
Pulse testing with low duty cycle is used.

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

(5) C_{Adj}, 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.

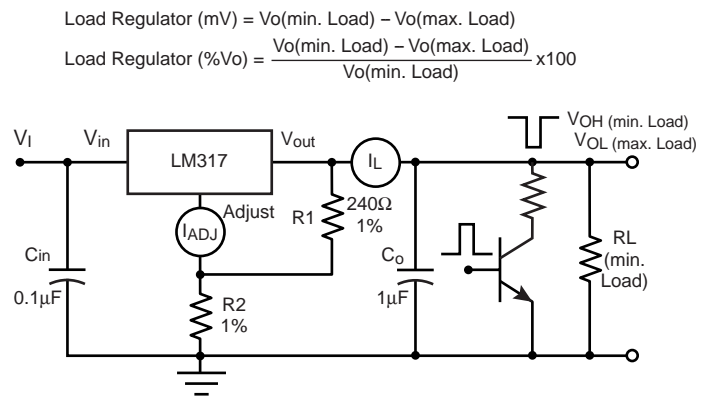
Fig. 1 – Line Regulation Test Circuit



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

Pulse Testing Required:
1% Duty Cycle is Suggested

Fig. 2 – Load Regulation and ΔI_{adj} /Load Test Circuit

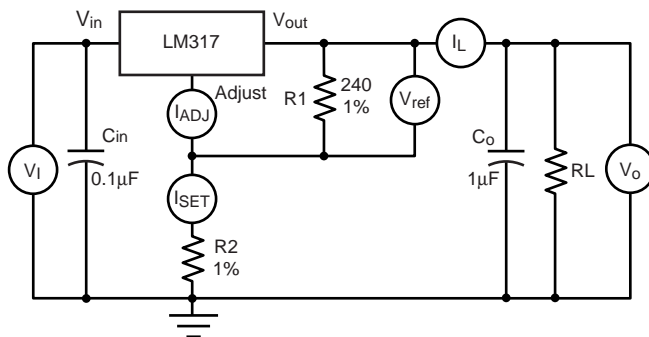


$$\text{Load Regulator (mV)} = V_{O(\text{min. Load})} - V_{O(\text{max. Load})}$$

$$\text{Load Regulator (\% } V_O) = \frac{V_{O(\text{min. Load})} - V_{O(\text{max. Load})}}{V_{O(\text{min. Load})}} \times 100$$

Pulse Testing Required:
1% Duty Cycle is Suggested

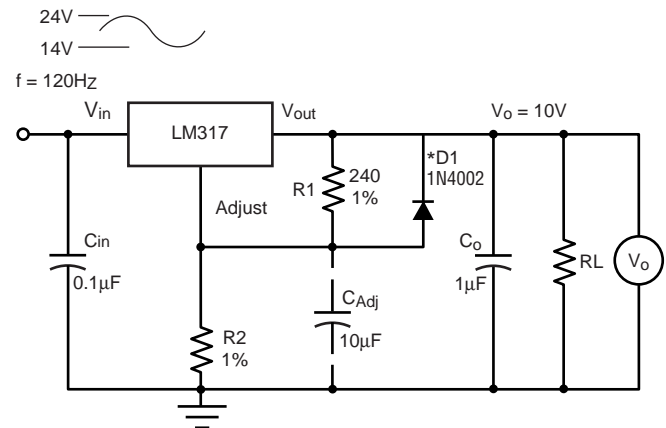
Fig. 3 – Standard Test Circuit



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

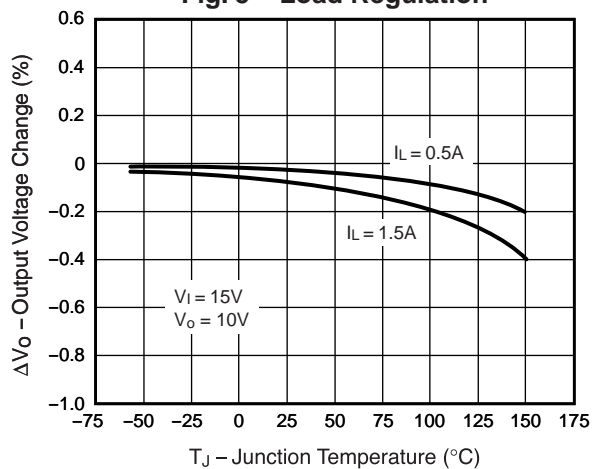


Fig. 6 – Current Limit

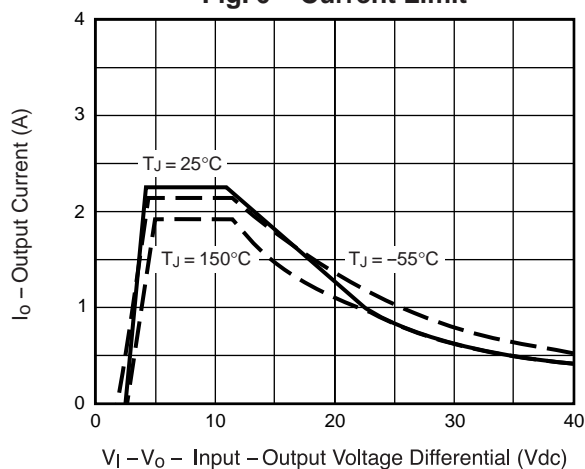


Fig. 7 – Adjustment Pin Current

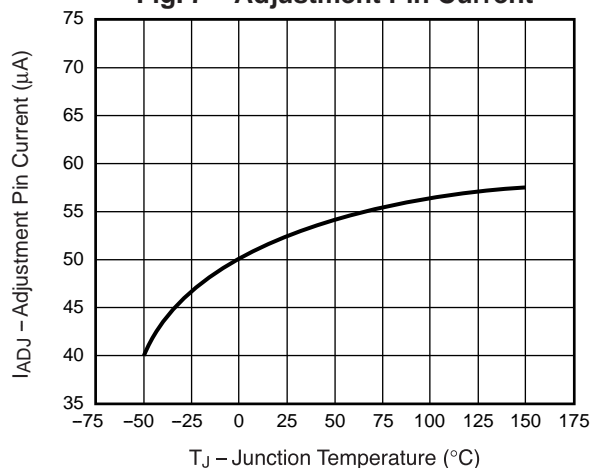


Fig. 8 – Dropout Voltage

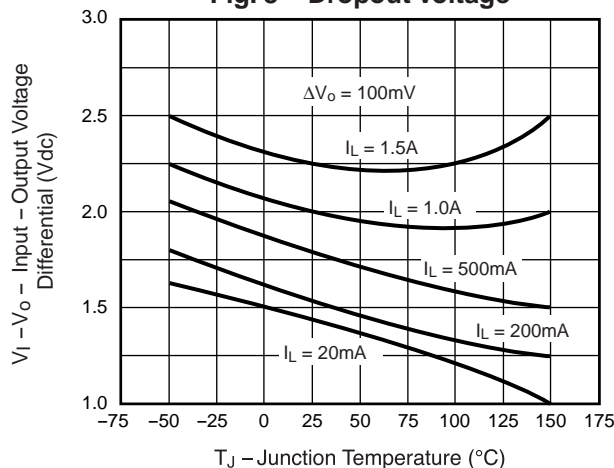


Fig. 9 – Temperature Stability

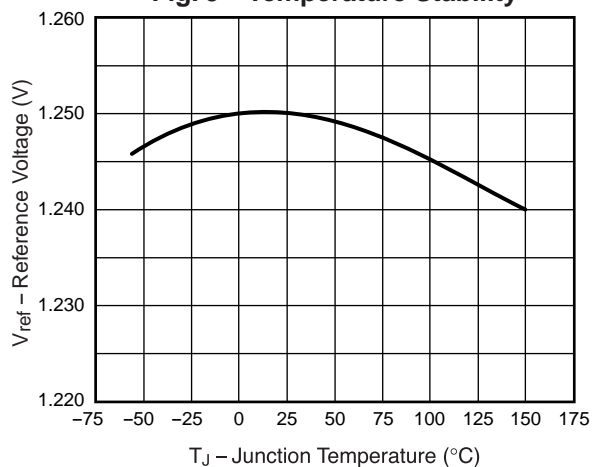
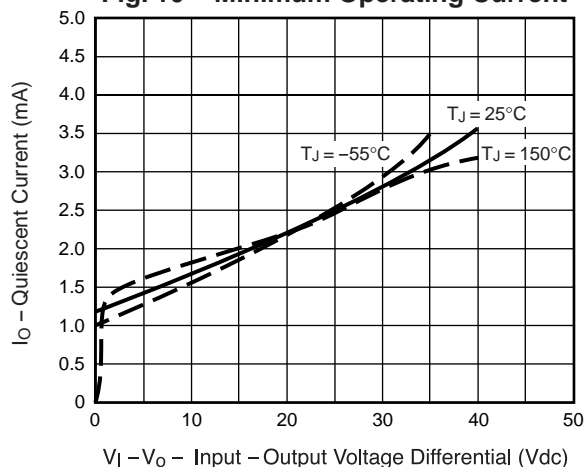


Fig. 10 – Minimum Operating Current



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

Fig. 11 – Ripple Rejection vs. Output Voltage

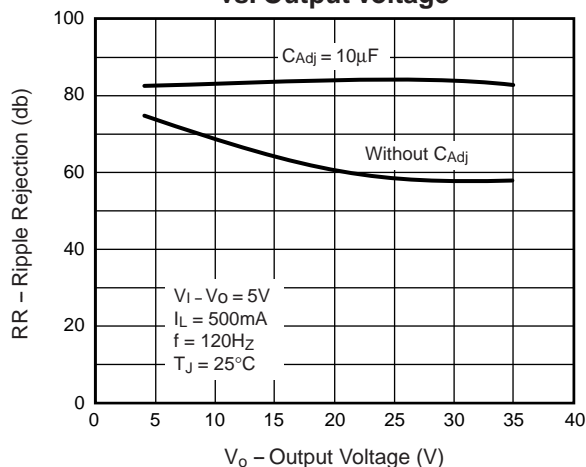


Fig. 12 – Ripple Rejection vs. Output Current

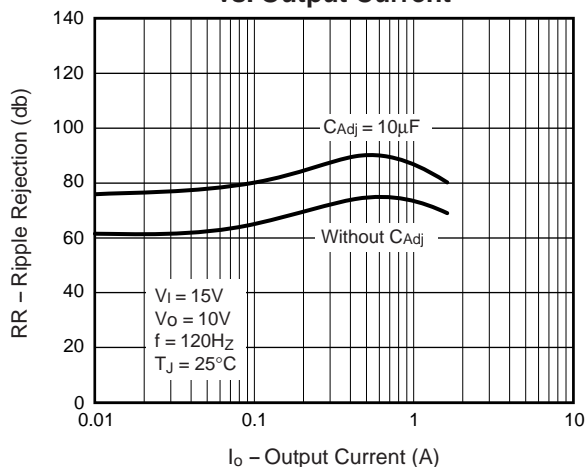


Fig. 13 – Ripple Rejection vs. Frequency

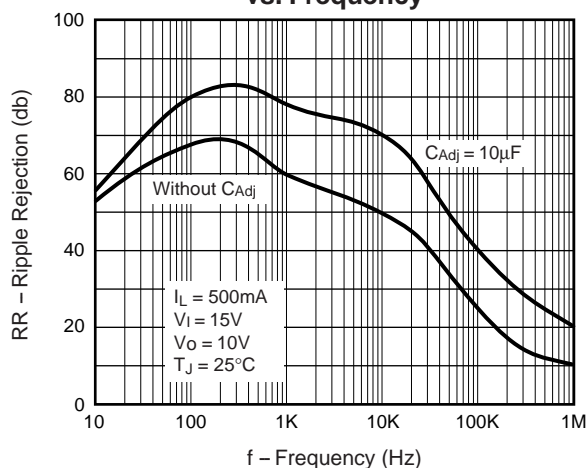


Fig. 14 – Output Impedance

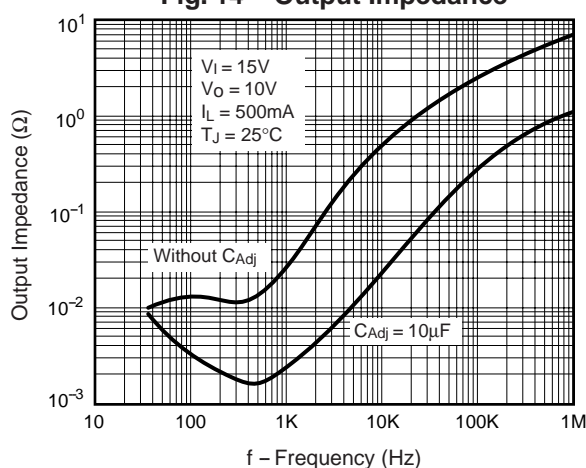


Fig. 15 – Line Transient Response

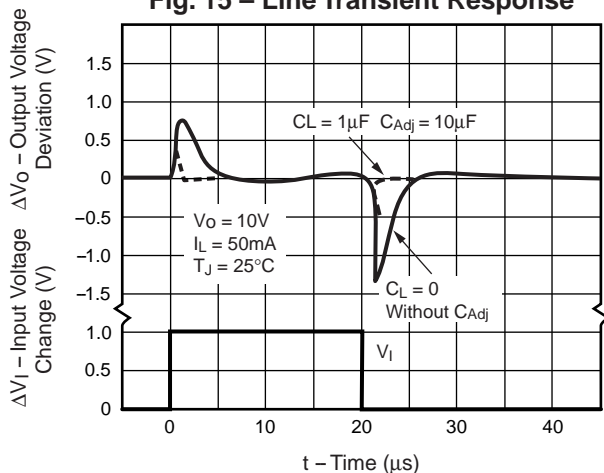
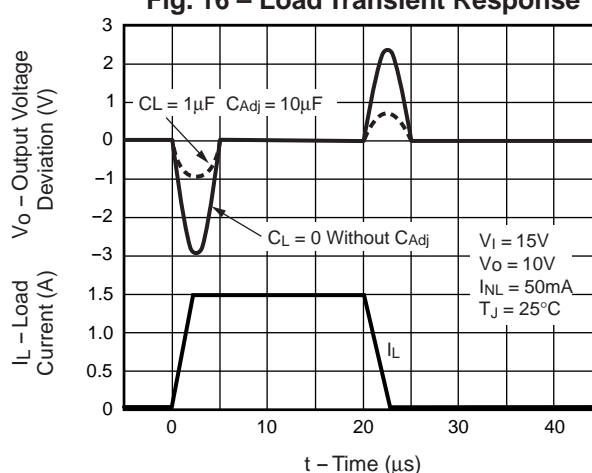
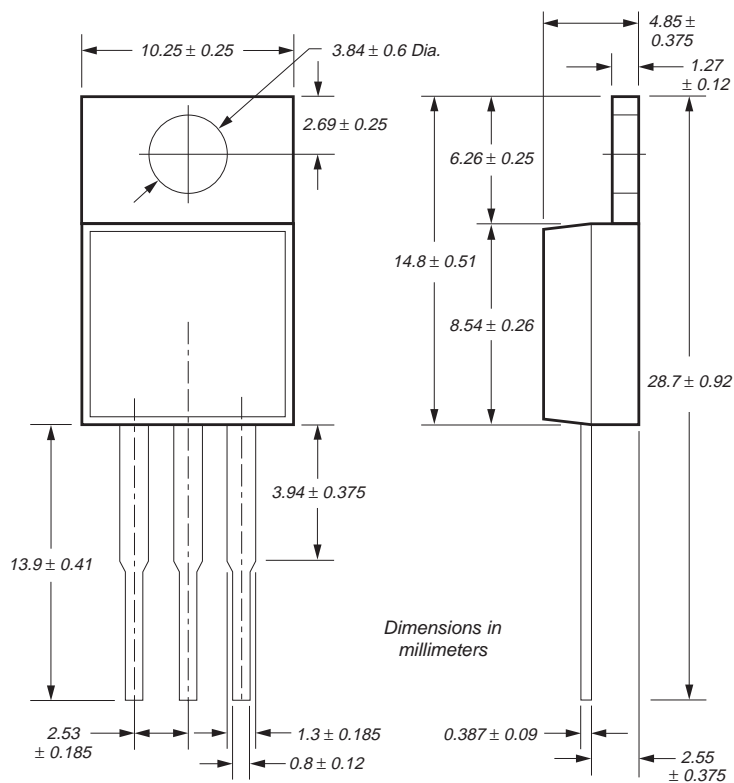


Fig. 16 – Load Transient Response



TO-220 Case Outline**TO-263 Case Outline**