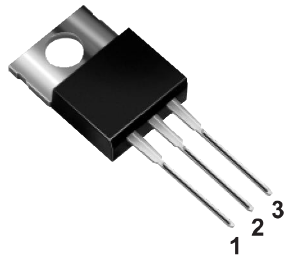
3-Terminal Adjustable Output Positive Voltage Regulators

■ DESCRIPTION

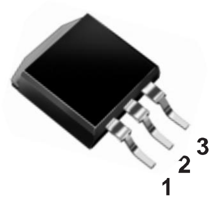
The LM317 is an adjustable 3-terminal positive voltage regulator capable of supplying in excess of 1.5A over an output voltage range of 1.2V to 37V. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage. Further, it employs internal current limiting, thermal shutdown and safe area compensation, making it essentially blow-out proof.



TO-220

■ FEATURES

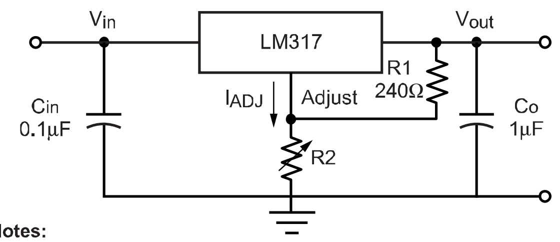
- Output current in excess of 1.5 ampere
- Output adjustable between 1.2V and 37V
- Internal thermal overload protection
- Internal short-circuit current limiting constant with temperature
- Output transistor safe-area compensation
- Floating operation for high voltage applications
- Eliminates stocking many fixed voltages
- TO-220 and TO-263 packages



TO-263

1. Adjust
2. V_{out}
3. V_{in}
Heatsink is connected to pin 2

Standard Application



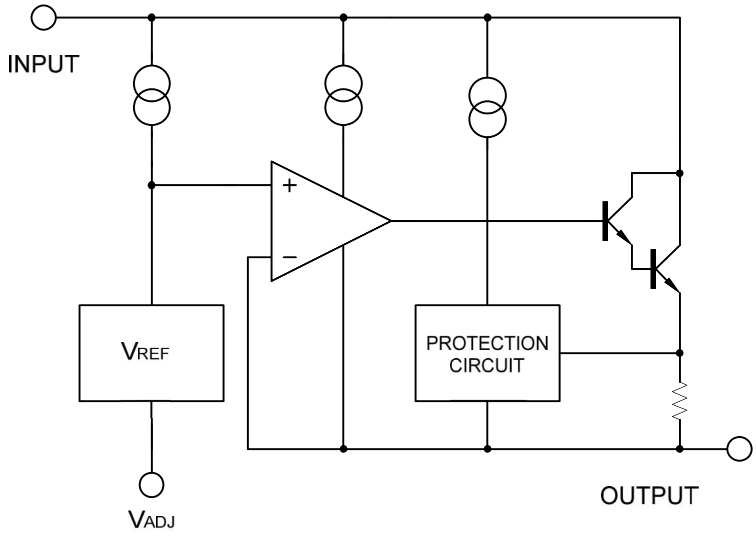
Notes:
Cin is required if regulator is located an appreciable distance from power supply filter.

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

$V_{out} = 1.25V\ (1 + R_2/R_1) + I_{Adj}\ R2$

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

■ 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 TO-220 TO-263	$R_{\theta JC}$	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

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) $3.0V \le V_I - V_O \le 40V$	REG_{line}	T_A = 25°C	–	0.01	0.04	%V_O/V
		T_J = 0°C thru 125°C	–	0.02	0.07	
Load Regulation (Fig. 2)(3) T_J = 25°C, $10mA \le I_O \le 1.5A$	REG_{load}	$V_O \le 5.0$	–	5	25	mV
		$V_O \ge 5.0$	–	0.1	0.5	%V_O
Load Regulation (Fig. 2)(3) $10mA \le I_O \le 1.5A$	REG_{load}	$V_O \le 5.0$	–	20	70	mV
		$V_O \ge 5.0$	–	0.3	1.5	%V_O
Thermal Regulation	REG_{therm}	T_J = 25°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}	$10mA \le I_L \le 1.5A$ $2.5V \le V_I - V_O \le 40V$	–	0.2	5	μA
Reference Voltage (Fig. 3)(4)	V_{ref}	$10mA \le I_O \le 1.5A$ $3V \le V_I - V_O \le 40V$	1.225	1.25	1.275	V
Temperature Stability (Fig. 3)	T_S	$T_{low} \le T_J \le T_{high}$	–	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}	$V_I - V_O \le 15V$	1.5	2.2	–	A
		$V_I - V_O$ = 40V, T_J = 25°C	0.15	0.4	–	
RMS Noise, % of V_O	N	T_J = 25°C, 10Hz ≤ f ≤ 10KHz	—	0.003	–	%V_O
Ripple Rejection (Fig. 4)	RR	V_O = 10V, f = 120Hz(5)	—	65	–	dB
		C_{Adj} = 10μF	66	80	–	
Long-Term Stability (after 1000 hr) Fig. 3	S	T_J = 125°C(6), T_J = 25°C for Endpoint Measurements	–	0.3	1.0	%
Thermal Resistance Junction to Case	$R_{\theta JC}$	$T_{low} \le T_J \le T_{high}$	–	5.0	–	°C/W

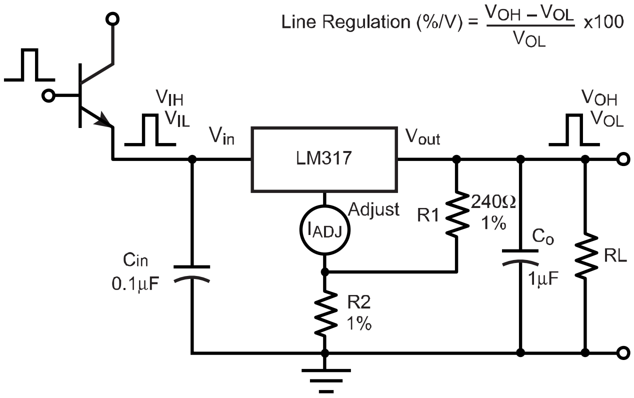
Notes:

(1) T_{low} = 0°C T_{high} = 125°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 addjustment 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.

APPLICATION CIRCUITS

Fig. 1 – Line Regulation Test Circuit

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

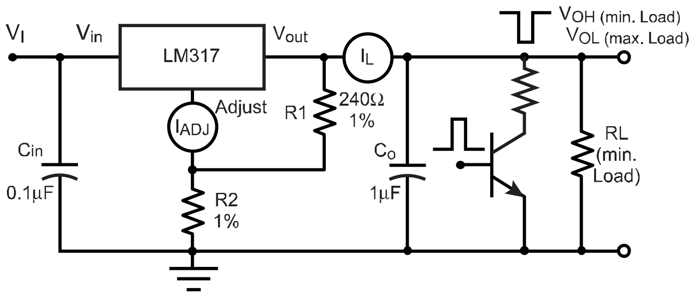


Pulse Testing Required:
1% Duty Cycle is Suggested

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

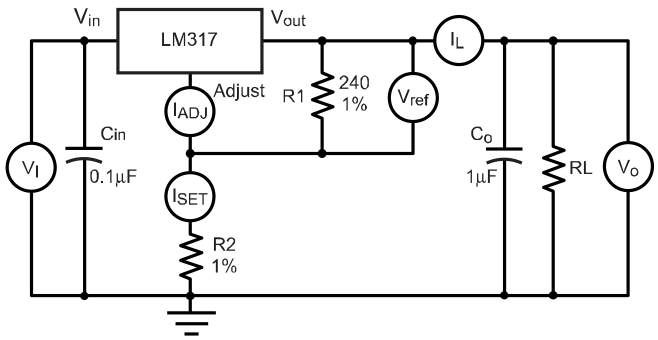
$$\text{Load Regulator (mV)} = V_o(\text{min. Load}) - V_o(\text{max. Load})$$

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



Pulse Testing Required:
1% Duty Cycle is Suggested

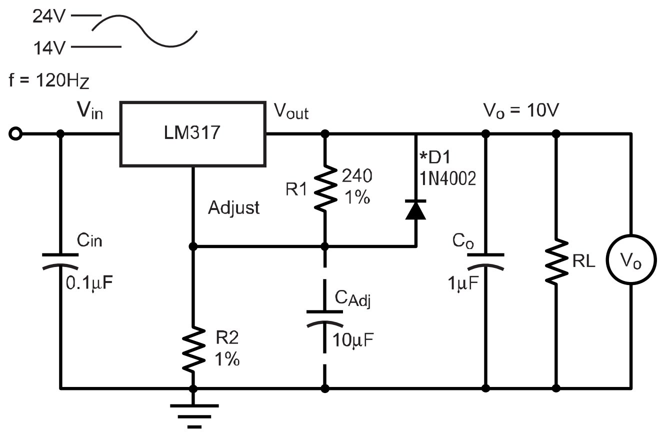
Fig. 3 – Standard Test Circuit



Pulse Testing Required:
1% Duty Cycle is Suggested

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

Fig. 4 – Ripple Rejection Test Circuit



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

TYPICAL CHARACTERISTICS

Fig. 5 – Load Regulation

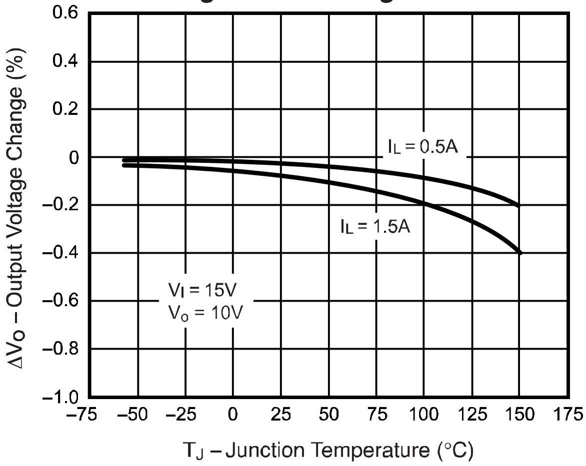


Fig. 6 – Current Limit

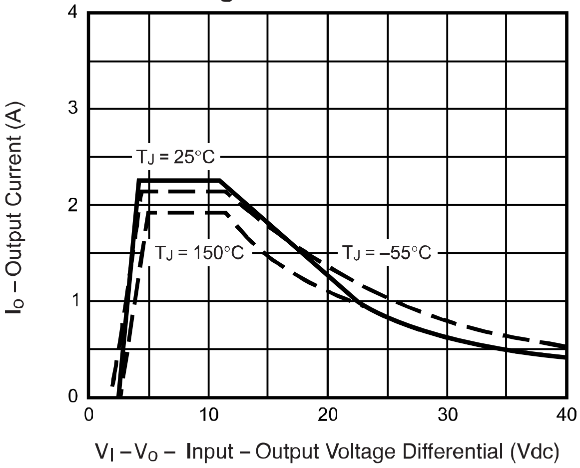


Fig. 7 – Adjustment Pin Current

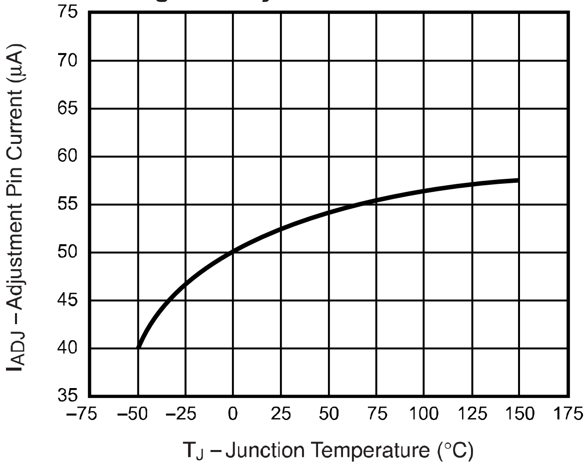


Fig. 8 – Dropout Voltage

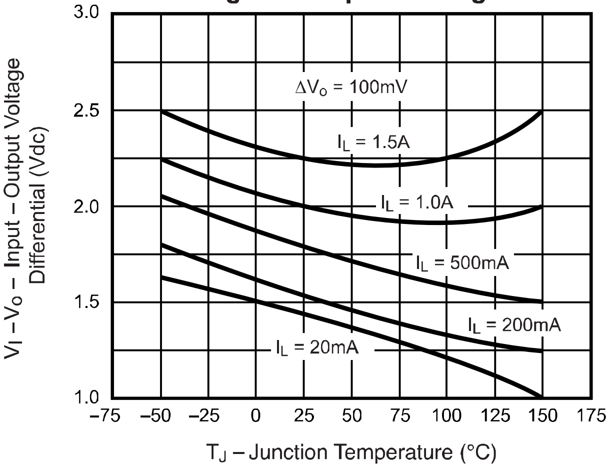


Fig. 9 – Temperature Stability

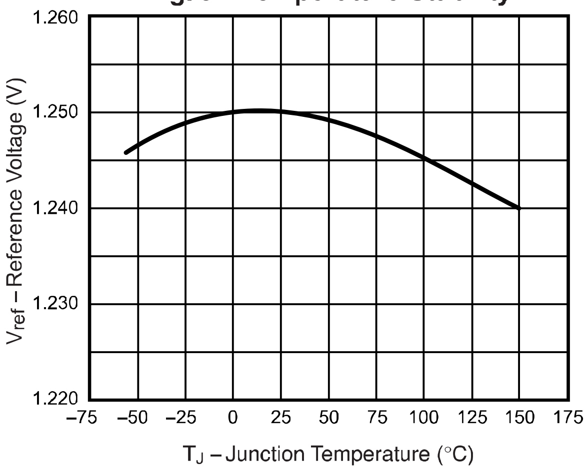
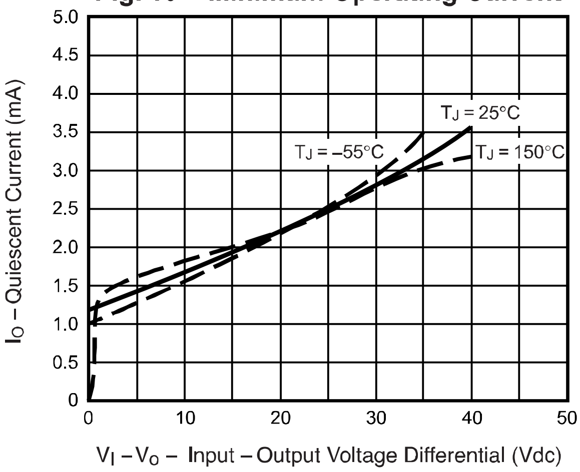


Fig. 10 – Minimum Operating Current



■ TYPICAL CHARACTERISTICS

Fig. 11 – Ripple Rejection vs. Output Voltage

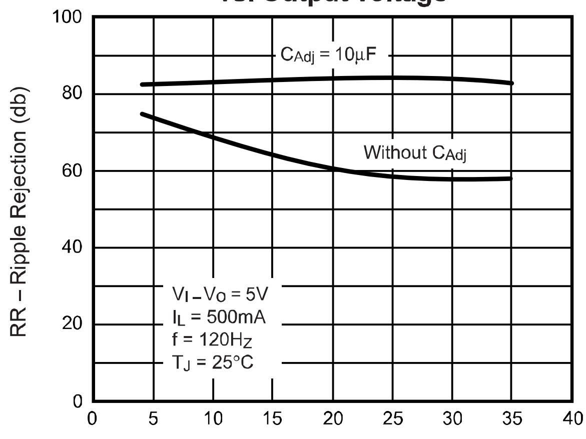


Fig. 12 – Ripple Rejection vs. Output Current

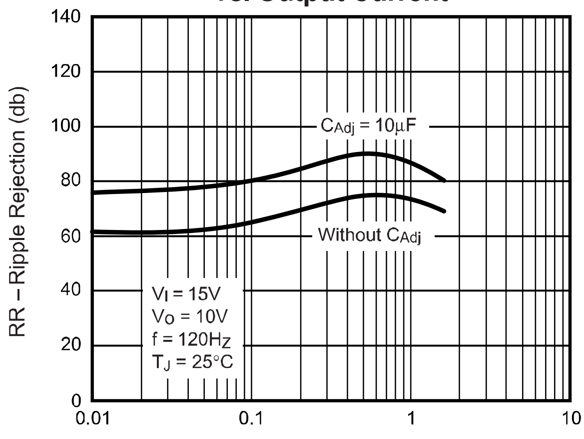


Fig. 13 – Ripple Rejection vs. Frequency

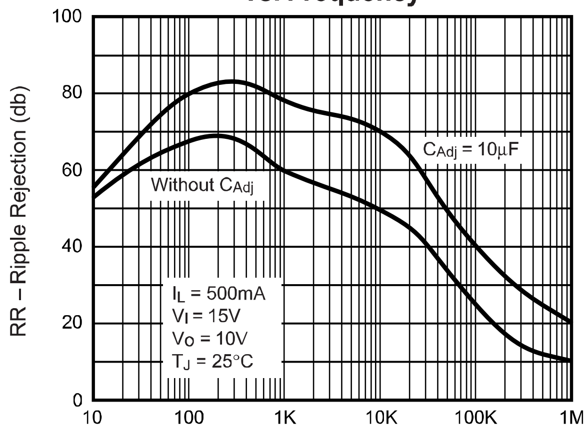


Fig. 14 – Output Impedance

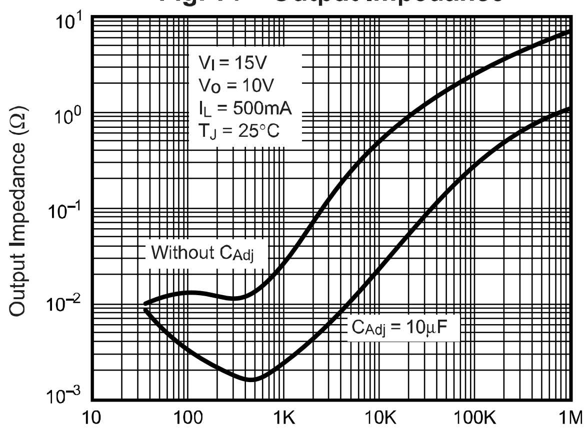


Fig. 15 – Line Transient Response

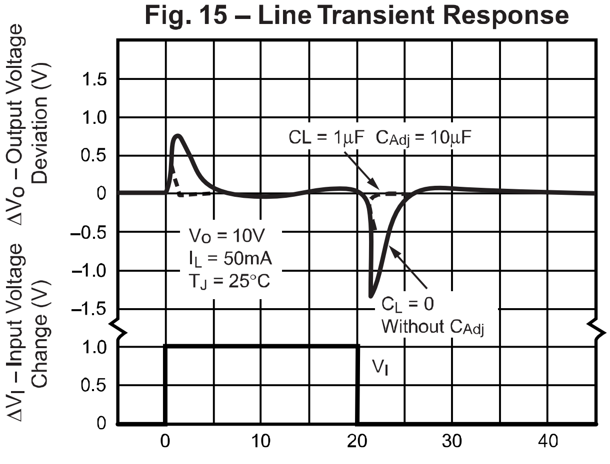
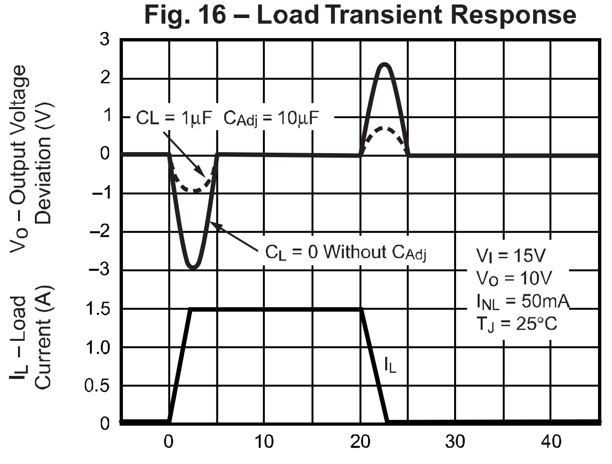
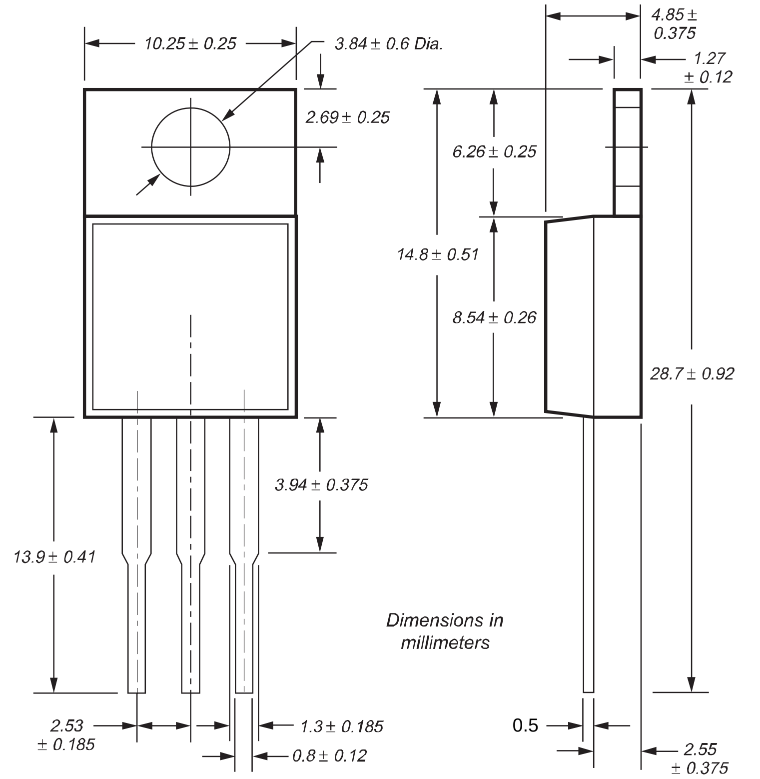


Fig. 16 – Load Transient Response



TO-220 Case Outline



TO-263 Case Outline