



## Description

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

The LM317 serves a wide variety of applications including local, on card regulation. This device can also be used to make a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM317 can be used as a precision current regulator.

## Features

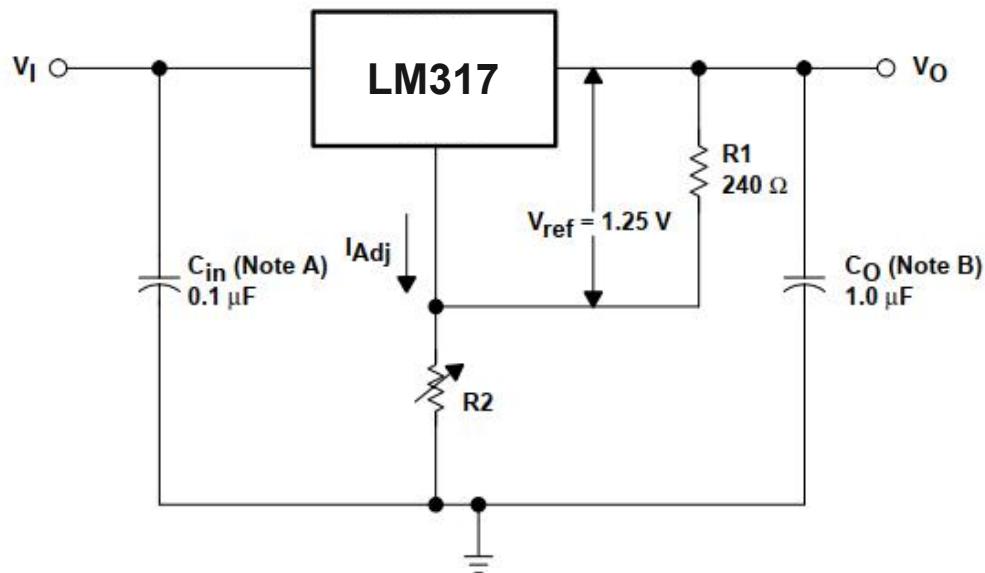
- Output Current in Excess of 1.5 A
- Output Adjustable Between 1.2 V and 37 V
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting Constant with Temperature
- Output Transistor Safe-Area Compensation
- Eliminates Stocking many Fixed Voltages
- Available Packages: SOT-223 and TO-220

## Applications

- Electronic Points of Sale
- Medical, Health, and Fitness Applications
- Appliances and White Goods
- TV Set-Top Boxes



## Typical Applications

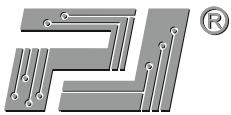


### Note:

$C_{in}$  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.

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

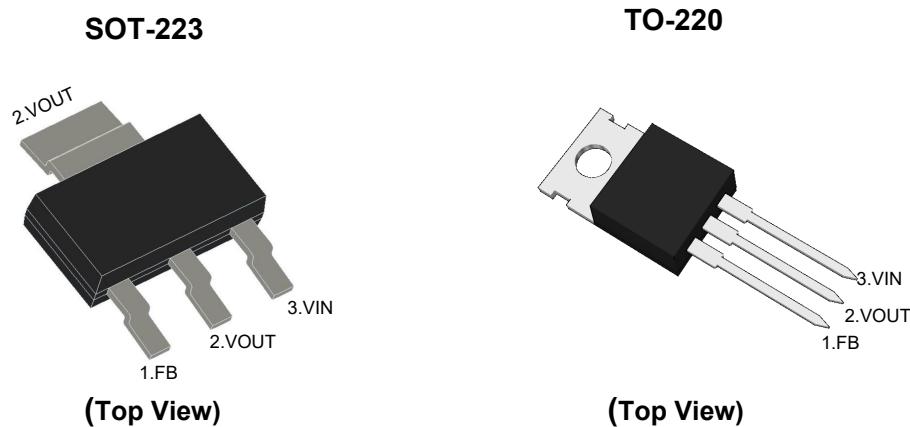
Since  $I_{Adj}$  is controlled to less than 50  $\mu$ A, the error associated with this term is negligible in most applications.



# LM317L

## 3-Terminal Adjustable Voltage Regulators

### Pin Distribution



### Functional Pin Description

| Pin Name | Pin Function            |
|----------|-------------------------|
| FB       | Output Feedback Voltage |
| VOUT     | Output Voltage          |
| VIN      | Power Input Voltage     |

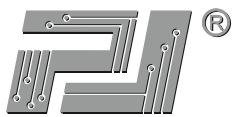
### Ordering Information Continue

| Orderable Device | Package | Package Qty (PCS) | Eco Plan <small>Note</small> | MSL Level | Marking Code |
|------------------|---------|-------------------|------------------------------|-----------|--------------|
| LM317ST          | SOT-223 | 4000/Reel         | RoHS & Green                 | MSL3      |              |
| LM317TO          | TO-220  | 50/Rail           | RoHS & Green                 | MSL3      |              |

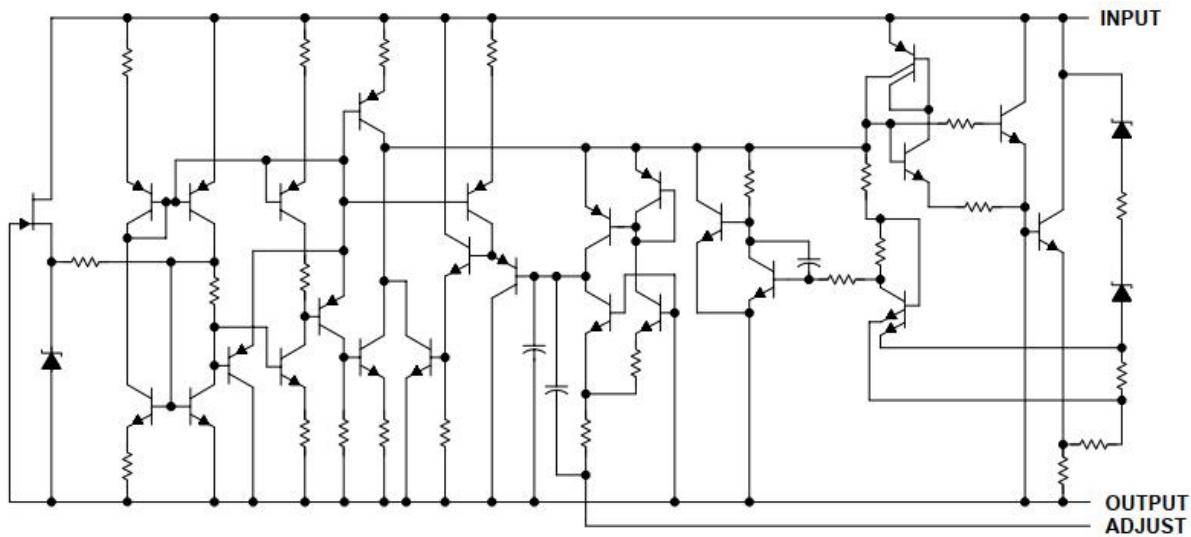
#### Note:

RoHS: PJ defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials.

Green: PJ defines "Green" to mean Halogen-Free and Antimony-Free.



## Function Block Diagram



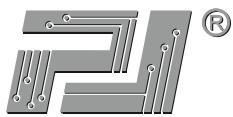
## Absolute Maximum Ratings

Ratings at 25°C ambient temperature unless otherwise specified.

| Parameter                               | Value              | Unit |
|---|--------------------|------|
| Input-Output Voltage Differential       | -0.3 ~ +40         | V    |
| Output Current                          | Internally limited | --   |
| Power Dissipation                       | SOT-223            | 1.5  |
|   | TO-220             | 2.5  |
| Thermal Resistance, Junction-to-Ambient | SOT-223            | 67   |
|   | TO-220             | 40   |
| Junction temperature                    | 150                | °C   |
| Storage temperature range               | -40 ~ +150         | °C   |

## Recommended Operating Conditions

| Parameter                         | Min. | Max. | Unit |
|-----------------------------------|------|------|------|
| Input–Output Voltage Differential | 3    | 37   | V    |
| Output Current                    | --   | 1.5  | A    |
| Operating Ambient Temperature     | 0    | 125  | °C   |



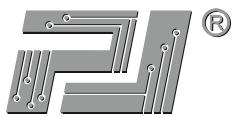
LM317

## 3-Terminal Adjustable Voltage Regulators

## Electrical Characteristics

(V<sub>I</sub>-V<sub>O</sub>=5V, I<sub>O</sub>=500mA, T<sub>J</sub>=0~125°C , unless otherwise noted.)

| Parameter                                   | Symbol             | Test Conditions  | Min. | Typ.  | Max. | Unit             |
|---|--------------------|--|------|-------|------|------------------|
| Line Regulation                             | ΔV <sub>LINE</sub> | V <sub>I</sub> -V <sub>O</sub> =3V~40V                                   | --   | 0.01  | 0.04 | %/V              |
| Load Regulation                             | ΔV <sub>LOAD</sub> | V <sub>O</sub> ≤ 5V, I <sub>O</sub> =10mA~1500mA                         | --   | 5     | 25   | mV               |
|   |                    | V <sub>O</sub> ≥ 5V, I <sub>O</sub> =10mA~1500mA                         | --   | 0.1   | 0.5  | % V <sub>O</sub> |
| Adjustment Pin Current                      | I <sub>adj</sub>   |  | --   | --    | 100  | μA               |
| Adjustment Pin Current Change               | ΔI <sub>adj</sub>  | V <sub>I</sub> -V <sub>O</sub> =2.5V~40V,<br>I <sub>O</sub> =10mA~1500mA | --   | 0.2   | 5    | μA               |
| Reference Voltage                           | V <sub>ref</sub>   | V <sub>I</sub> -V <sub>O</sub> =3V~40V,<br>I <sub>O</sub> =10mA~1500mA   | 1.2  | --    | 1.3  | V                |
| Reference Line Regulation                   | ΔV <sub>LINE</sub> | V <sub>I</sub> -V <sub>O</sub> =3V~40V                                   | --   | 0.02  | 0.07 | %V               |
| Reference Load Regulation                   | ΔV <sub>LOAD</sub> | V <sub>O</sub> ≤ 5V, I <sub>O</sub> =10mA~1500mA                         | --   | 20    | 70   | mV               |
|   |                    | V <sub>O</sub> ≥ 5V, I <sub>O</sub> =10mA~1500mA                         | --   | 0.3   | 1.5  | % V <sub>O</sub> |
| Temperature Stability                       | T <sub>S</sub>     |  | --   | 1     | --   | %                |
| Minimum Load Current to Maintain Regulation | I <sub>O_min</sub> | V <sub>I</sub> -V <sub>O</sub> =40V                                      | --   | --    | 10   | mA               |
| Maximum Load Current to Maintain Regulation | I <sub>O_max</sub> | V <sub>I</sub> -V <sub>O</sub> ≤ 15V, P <sub>D</sub> <20W                | 1.5  | --    | --   | A                |
|   |                    | V <sub>I</sub> -V <sub>O</sub> =40V, P <sub>D</sub> <20W                 | 0.15 | --    | --   | A                |
| RMS Noise, % of V <sub>O</sub>              | N                  | T <sub>A</sub> =25°C, 10Hz<f<10KHz                                       | --   | 0.003 | --   | % V <sub>O</sub> |
| Rejection Ratio                             | RR                 | T <sub>A</sub> =25°C, f=120Hz, C <sub>adj</sub> =0                       | --   | 65    | --   | dB               |
|   |                    | T <sub>A</sub> =25°C, f=120Hz, C <sub>adj</sub> =10μF                    | 66   | 80    | --   | dB               |



## Typical Characteristic Curves

图 5. 负载调整率

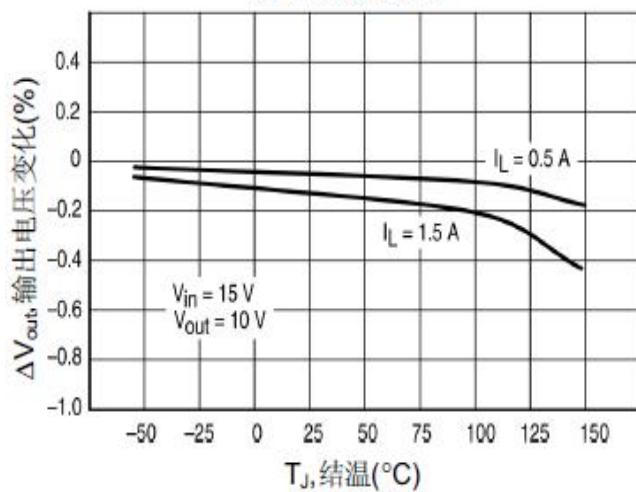


图 6. 电流限度

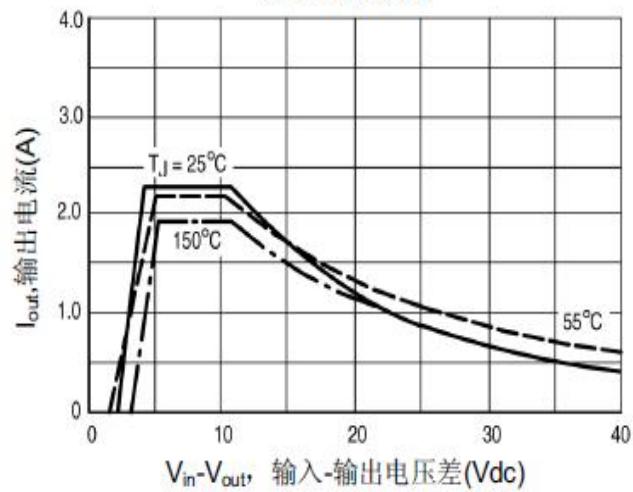


图 7. 调节管脚电流

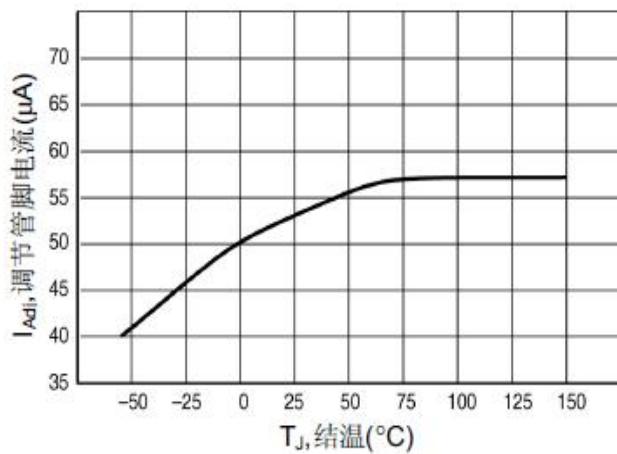


图 8. 压降电压

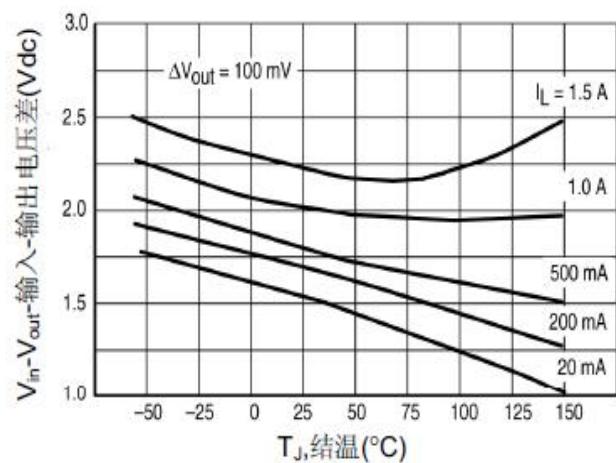


图 9. 温度稳定性

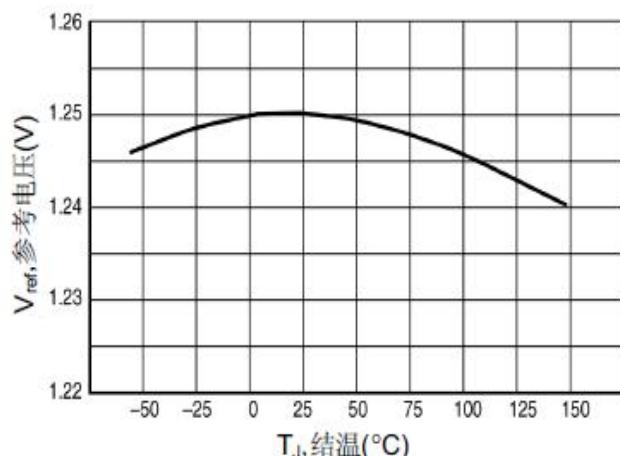
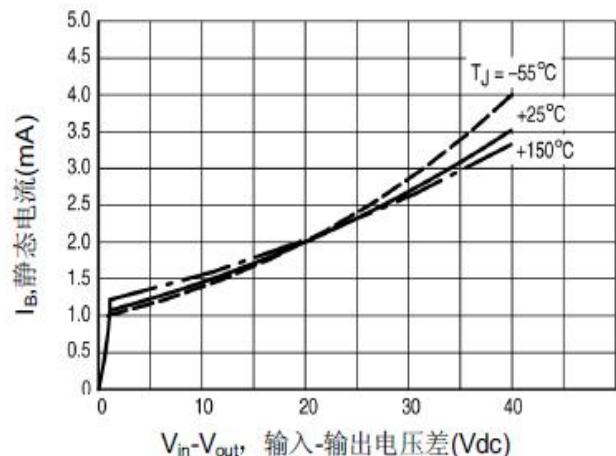


图 10. 最小工作电流





LM317

## 3-Terminal Adjustable Voltage Regulators

图 11. 纹波抑制与输出电压关系曲线

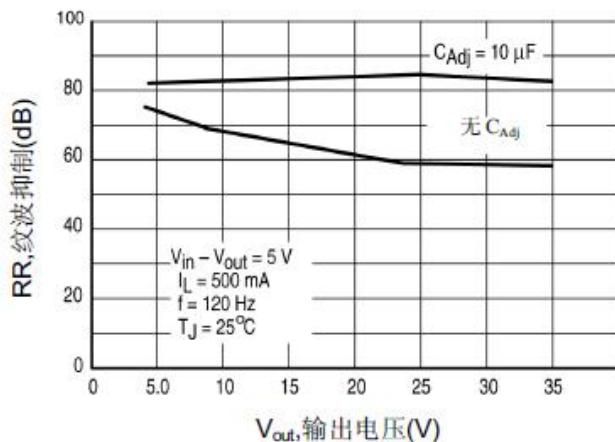


图 12. 纹波抑制与输出电流关系曲线

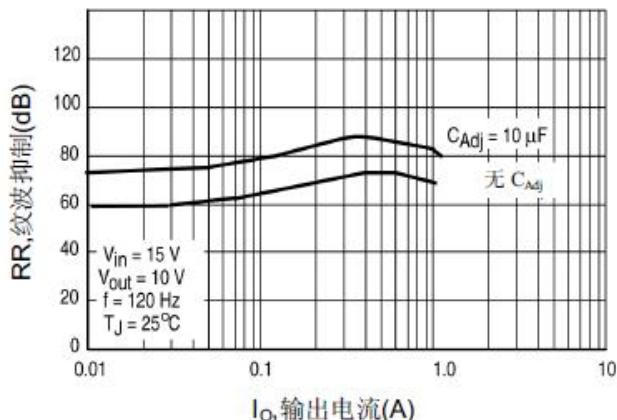


图 13. 纹波抑制与频率关系曲线

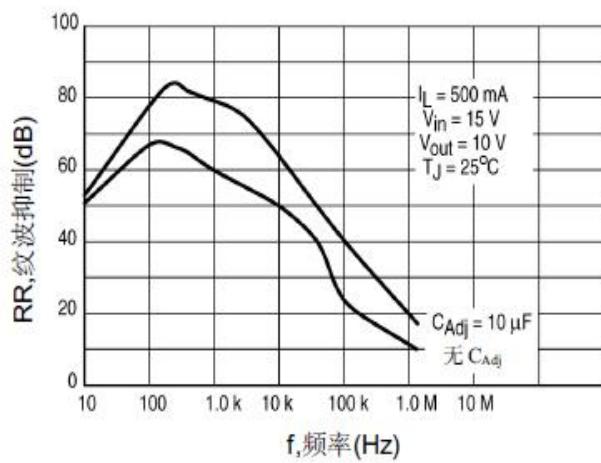


图 14. 输出阻抗

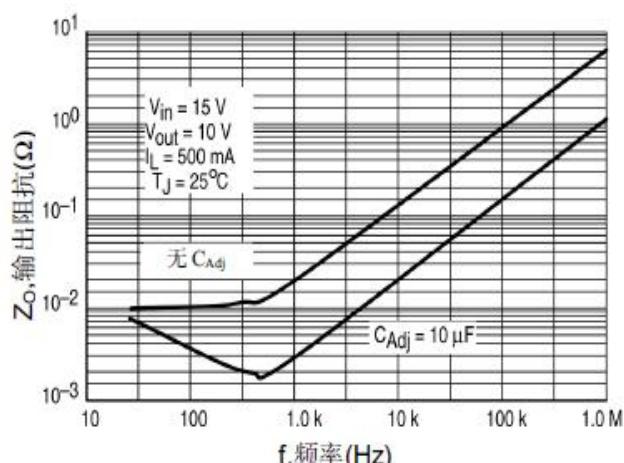


图 15. 电源瞬态响应

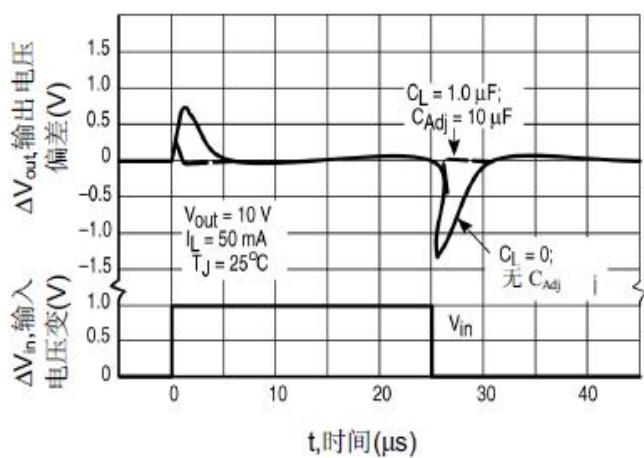
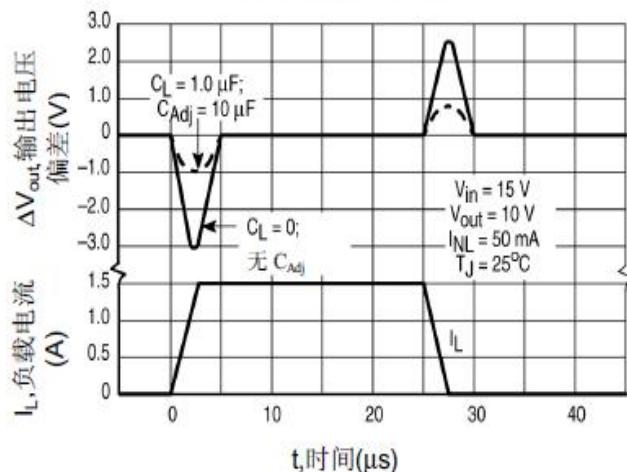


图 16. 负载瞬态响应





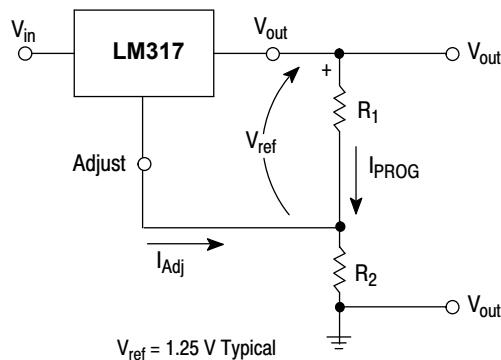
## Applications Information

### Basic Circuit Operation

The LM317 is a 3-terminal floating regulator. In operation, the LM317 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 ( $I_{PROG}$ ) by  $R_1$  (see the following figure), and this constant current flows through  $R_2$  to ground.

The regulated output voltage is given by:

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



### Basic Circuit Configuration

Since the current from the adjustment terminal ( $I_{Adj}$ ) represents an error term in the equation, the LM317 was designed to control  $I_{Adj}$  to less than 100  $\mu$ A 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 LM317 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 LM317 is capable of providing extremely good load regulation, but a few precautions are needed to obtain maximum performance. For best performance, the programming resistor ( $R_1$ ) 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  $R_2$  can be returned near the load ground to provide remote ground sensing and improve load regulation.

### External Capacitors

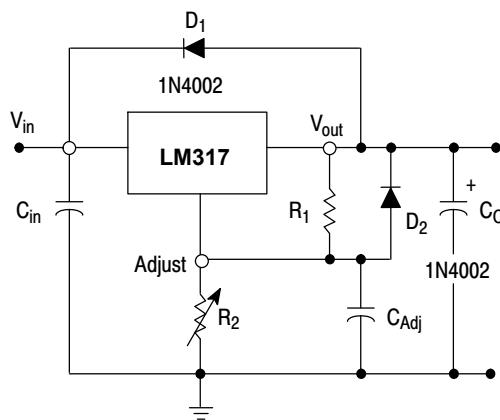
A 0.1  $\mu$ F disc or 1.0  $\mu$ F tantalum input bypass capacitor ( $C_{in}$ ) is recommended to reduce the sensitivity to input line impedance. The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor ( $C_{Adj}$ ) prevents ripple from being amplified as the output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

Although the LM317 is stable with no output capacitance, like any feedback circuit, certain values of external capacitance can cause excessive ringing. An output capacitance ( $C_2$ ) in the form of a 1.0 $\mu$ F tantalum or 25 $\mu$ F 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 following figure shows the LM317 with the recommended protection diodes for output voltages in excess of 25 V or high capacitance values ( $C_o > 25\mu F$ ,  $C_{Adj} > 10\mu F$ ). Diode D1 prevents  $C_o$  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.

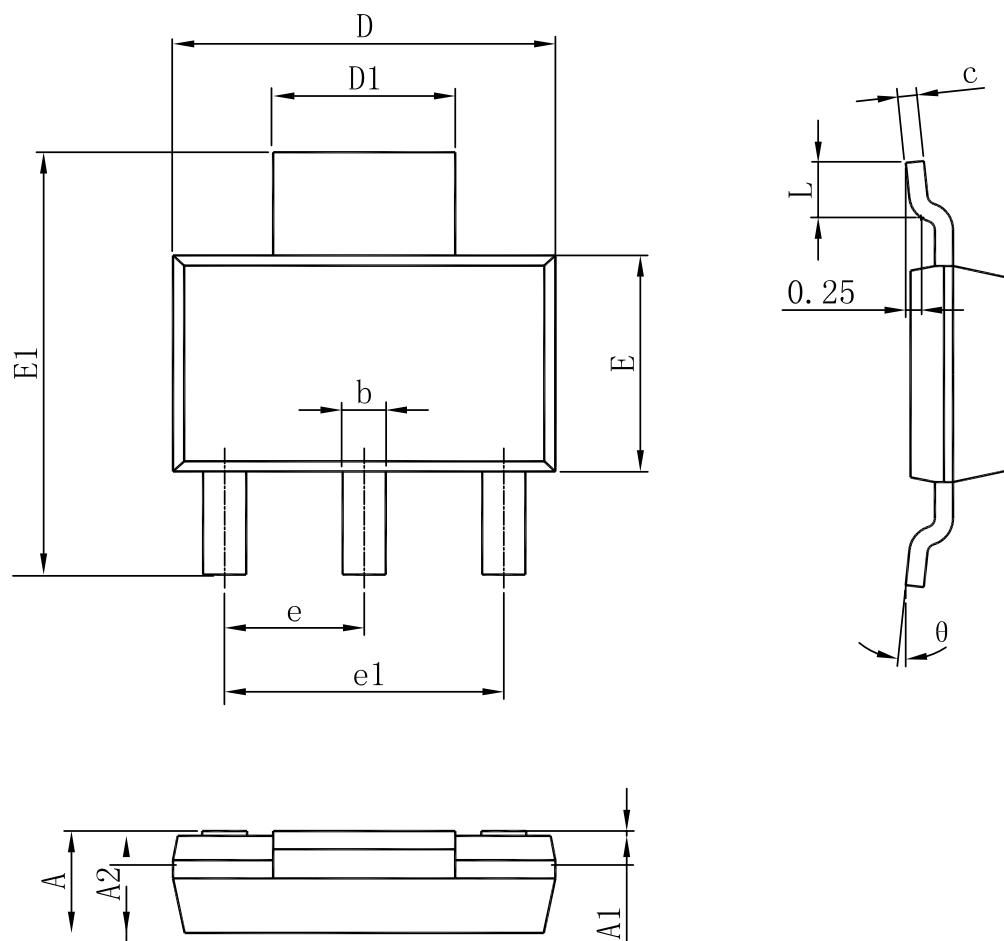


Voltage Regulator with Protection Diodes

## Package Outline

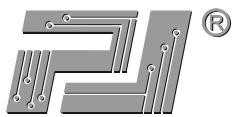
SOT-223

Dimensions in mm



1. 塑脂体无缺损、缩孔、气泡、裂纹等缺陷；
2. 树脂体上下部XY方向偏差、树脂体中心与引线框中心错位 $\pm 0.035$ ；
3. 粗糙度Ra为0.4--0.6。

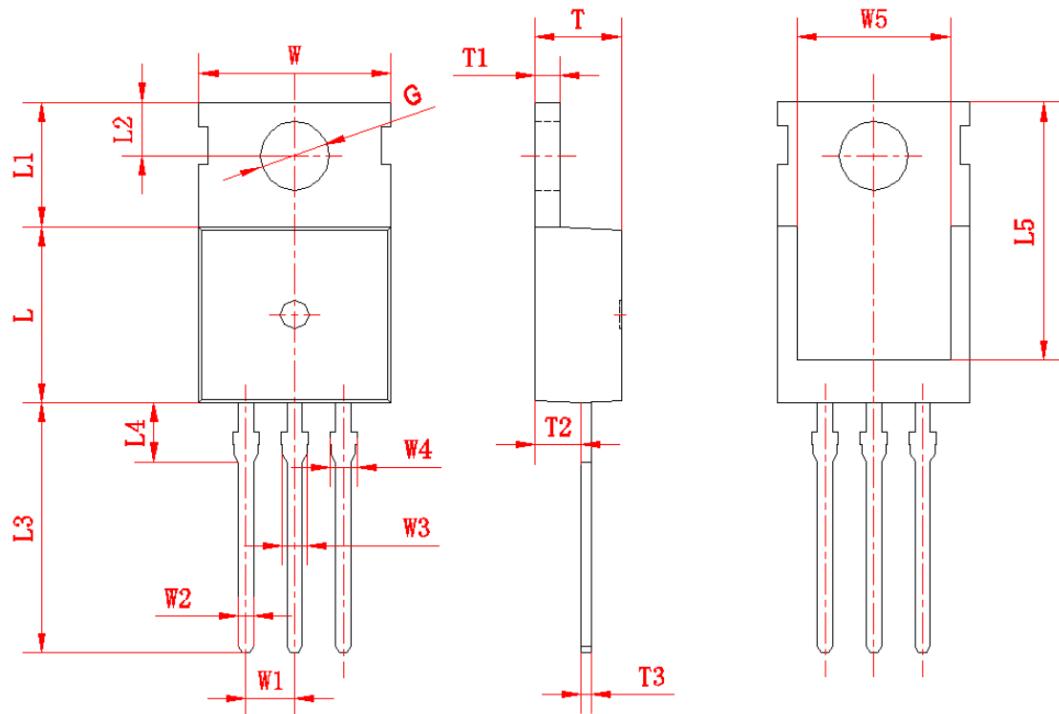
| Symbol | Dimensions In Millimeters |      |      |
|--------|---------------------------|------|------|
|        | MIN                       | NOM  | MAX  |
| A      | /                         | /    | 1.80 |
| A1     | 0.02                      | /    | 0.10 |
| A2     | 1.50                      | 1.60 | 1.70 |
| b      | 0.66                      | 0.71 | 0.84 |
| c      | 0.23                      | 0.30 | 0.35 |
| D      | 6.30                      | 6.50 | 6.70 |
| D1     | 2.90                      | 3.00 | 3.10 |
| E      | 3.30                      | 3.50 | 3.70 |
| E1     | 6.70                      | 7.00 | 7.30 |
| e      | 2.30 BASIC                |      |      |
| e1     | 4.60 BASIC                |      |      |
| L      | 0.75                      | /    | /    |
| θ      | 0°                        | /    | 10°  |



## Package Outline

TO-220

Dimensions in mm



### 2.1.2 尺寸标准

(单位: mm)

| 符号 | 尺寸     |       | 符号 | 尺寸     |       | 符号 | 尺寸   |      |
|----|--------|-------|----|--------|-------|----|------|------|
|    | Min    | Max   |    | Min    | Max   |    | Min  | Max  |
| W  | 9.80   | 10.20 | L  | 9.00   | 9.40  | T  | 4.30 | 4.70 |
| W1 | (2.54) |       | L1 | 6.30   | 6.70  | T1 | 1.20 | 1.40 |
| W2 | 0.70   | 0.90  | L2 | 2.70   | 2.90  | T2 | 2.20 | 2.60 |
| W3 | 1.17   | 1.37  | L3 | 12.88  | 13.28 | T3 | 0.45 | 0.60 |
| W4 | 1.17   | 1.62  | L4 | (3.10) |       | G  | 3.50 | 3.70 |
| W5 | (8.00) |       | L5 | (13.5) |       |    |      |      |

注: () 内数值为参考值; 尺寸不包含毛刺及模具溢料。