

## FEATURES

- 1.5A Output Current
- Input-Output Differential up to 40V
- Output Voltage Range Adjustable from 1.25V to 37V
- Typical 0.01%/V Line Regulation
- Typical 0.1% Load Regulation
- Current Limit Constant with Temperature
- Short-Circuit Protected Output
- Internal Short-Circuit Current Limiting
- Thermal Overload Protection

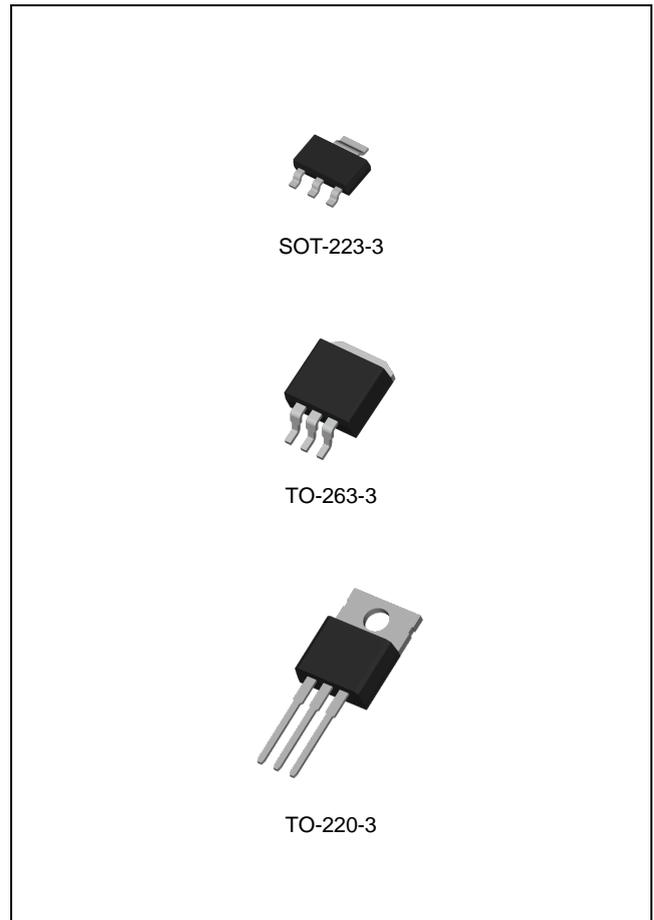
## APPLICATIONS

- Post Regulation for Switching Supplies
- Constant Current Regulator
- Digital Signage
- Ethernet Switches
- Motor Controls
- Power Line Communication Modems
- Refrigerators
- Signal or Waveform Generators
- Washing Machines

## DESCRIPTION

The LM317 device is an adjustable three-terminal positive-voltage regulator capable of supplying 1.5A over a 1.25V to 37V output range.

It requires only two external resistors to set the output voltage. The device features a typical line regulation of 0.01% and typical load regulation of 0.1%. It includes current limiting, thermal overload protection, and safe operating area protection. Overload protection circuitry remains fully functional even if the ADJ terminal is disconnected.



## DEVICE INFORMATION

Device	Package
LM317S	SOT-223-3L
LM317R	TO-263-3L
LM317T	TO-220-3L

## ABSOLUTE MAXIMUM RATINGS <sup>(Note 1)</sup>

CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Input-to-Output Differential Voltage	$V_{IN} - V_{OUT}$	-0.3	40	V
Power Dissipation	$P_D$		Limited	
Operating Virtual Junction Temperature	$T_J$	-40	125	°C
Storage Temperature	$T_{STG}$	-65	150	°C

Note 1. Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## RECOMMENDED OPERATING RATINGS <sup>(Note 2)</sup>

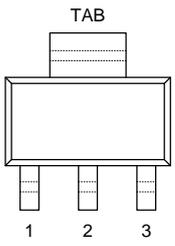
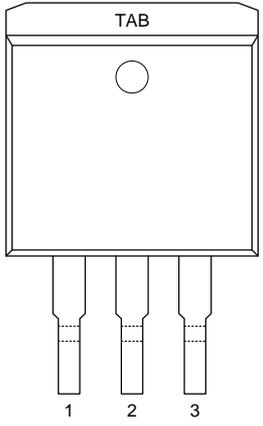
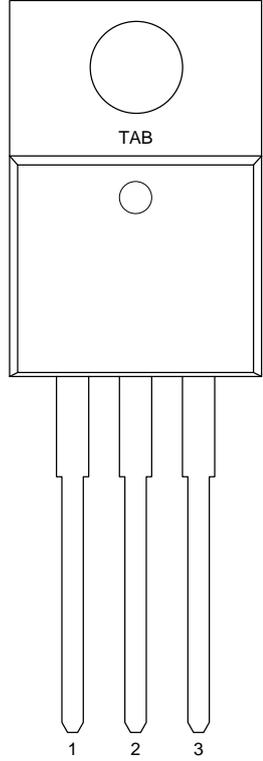
CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Supply Voltage <sup>(Note 2)</sup>	$V_{IN} - V_{OUT}$	3.0	40	V
Output Current	$I_O$	0.01	1.5	A
Operating Virtual Junction Temperature	$T_J$	-40	125	°C

Note 2. The device is not guaranteed to function outside its operating ratings.

## ORDERING INFORMATION

VOUT	Package	Order No.	Description	Supplied As	Status
ADJ	SOT-223-3L	LM317S	1.5A, Adjustable	Tape & Reel	Active
	TO-263-3L	LM317R	1.5A, Adjustable	Tape & Reel	Active
	TO-220-3L	LM317T	1.5A, Adjustable	Tube	Active

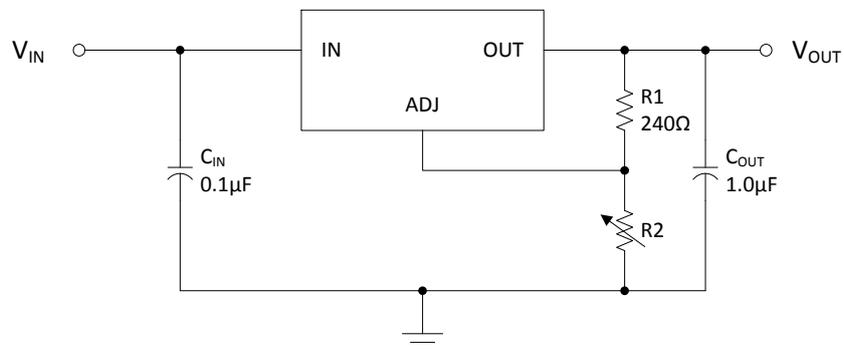
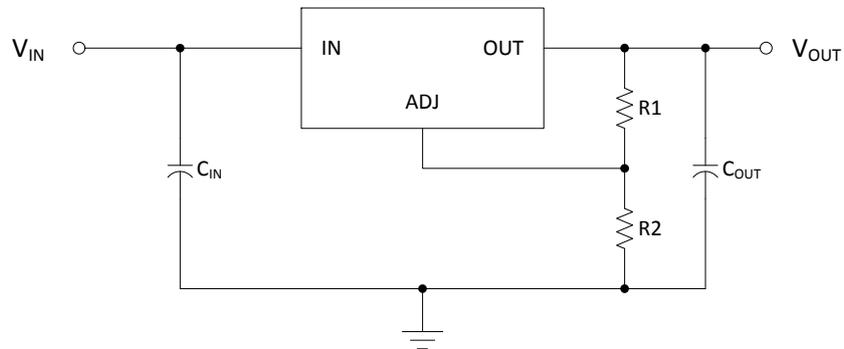
## PIN CONFIGURATIONS

		
SOT-223	TO-263	TO-220

## PIN DESCRIPTION

Pin No.			Pin Name	Pin Function
SOT-223	TO-220	TO-263		
1	1	1	ADJ	Output Voltage Adjustment.
2	2	2	OUT	Output Voltage.
3	3	3	IN	Input Voltage.
TAB	TAB	TAB	TAB	Connect to OUT. Attached to heatsink for thermal relief for TO-220 package or put a copper plane connected to this pin as a thermal relief for TO-263 package.

## TYPICAL APPLICATION CIRCUITS



$$V_{OUT} = V_{REF} (1 + R2 / R1) + (I_{ADJ} \times R2)$$

\*  $C_{IN}$  required if the device is more than 6 inches from filter capacitors. Value given may be increased.

\*\*  $C_{OUT}$  optional to improve transient response. Value given may be increased up to 1000 μF.

## ELECTRICAL CHARACTERISTICS <sup>(Note 3)</sup>

Specifications apply over full operating virtual junction temperature range as noted. Unless otherwise noted,  $V_{IN} - V_{OUT} = 5.0\text{ V}$ ,  $I_{OUT} = 10\text{ mA}$ ,  $C_{IN} = 0.1\text{ }\mu\text{F}$ ,  $C_{OUT} = 1.0\text{ }\mu\text{F}$ .

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT	
Reference Voltage	$V_{REF}$	$3.0\text{ V} \leq (V_{IN} - V_{OUT}) \leq 40\text{ V}$ , $10\text{ mA} \leq I_{OUT} \leq 1.5\text{ A}$ <sup>(Note 4)</sup>	1.20	1.25	1.30	V	
Line Regulation	LNR	$3.0\text{ V} \leq (V_{IN} - V_{OUT}) \leq 40\text{ V}$	$T_J = 25^\circ\text{C}$	-	0.01	0.04	%V
			$T_{MIN}$ to $T_{MAX}$	-	0.02	0.07	
Load Regulation	LDR	$10\text{ mA} \leq I_{OUT} \leq 1.5\text{ A}$ <sup>(Note 4)</sup> , $V_{OUT} \leq 5.0\text{ V}$	$T_J = 25^\circ\text{C}$	-	5.0	25	mV
			$T_{MIN}$ to $T_{MAX}$	-	20	70	mV
		$10\text{ mA} \leq I_{OUT} \leq 1.5\text{ A}$ <sup>(Note 4)</sup> , $V_{OUT} > 5.0\text{ V}$	$T_J = 25^\circ\text{C}$	-	0.1	0.5	%
			$T_{MIN}$ to $T_{MAX}$	-	0.3	1.5	%
ADJ Pin Current	$I_{ADJ}$		-	50	100	$\mu\text{A}$	
ADJ Pin Current Change	$\Delta I_{ADJ}$	$2.5\text{ V} \leq (V_{IN} - V_{OUT}) \leq 40\text{ V}$ , $10\text{ mA} \leq I_{OUT} \leq 1.5\text{ A}$ <sup>(Note 4)</sup>	-	0.2	5.0	$\mu\text{A}$	
Output Voltage Temperature Stability	$\Delta V_{OUT}$		-	1.0	-	%	
RMS Output Noise		$10\text{ Hz} \leq f \leq 10\text{ kHz}$ , $T_J = 25^\circ\text{C}$	-	0.003	-	% $V_{OUT}$	
Minimum Load Current	$I_{MIN}$	$(V_{IN} - V_{OUT}) = 40\text{ V}$	-	3.5	10	mA	
Maximum Output Current	$I_{O,MAX}$	$(V_{IN} - V_{OUT}) \leq 15\text{ V}$ , $P_D < P_{D,MAX}$	1.5	2.2	-	A	
		$(V_{IN} - V_{OUT}) = 40\text{ V}$ , $T_J = 25^\circ\text{C}$ , $P_D < P_{D,MAX}$	0.15	0.4	-		
Ripple Rejection Ratio	PSRR	$V_{OUT} = 10\text{ V}$ , $f = 120\text{ Hz}$	-	65	-	dB	
		$V_{OUT} = 10\text{ V}$ , $f = 120\text{ Hz}$ , $C_{ADJ} = 10\text{ }\mu\text{F}$ <sup>(Note 5)</sup>	66	80	-		
Long-term Stability <sup>(Note 6)</sup>		$T_J = 25^\circ\text{C}$ , 1000 hrs	-	0.3	1.0	%	

Note 3. Low duty cycle pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Note 4. Device power dissipation ( $P_D$ ) is limited by ambient temperature ( $T_A$ ), device maximum junction temperature ( $T_J$ ), and package thermal resistance ( $\theta_{JA}$ ). The maximum allowable power dissipation at any temperature is:  $P_{D,MAX} = ((T_{J,MAX} - T_A) / \theta_{JA})$ .

Note 5.  $C_{ADJ}$  is connected between the ADJ pin and GND.

Note 6. Since long-term stability cannot be measured on the individual devices prior to shipment, this specification is not intended to be a guarantee or warranty. It is an engineering estimate of the average drift to be expected from lot to lot.

## TYPICAL OPERATING CHARACTERISTICS

T.B.D.

## APPLICATION INFORMATION

The LM317 device is an adjustable three-terminal positive-voltage regulator capable of supplying 1.5A over a 1.25V to 37V output range.

Typically, no capacitors are needed unless the device is suited more than 6 inches from the input filter capacitors, in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The ADJ terminal can be bypassed to achieve very high ripple rejection ratios.

The primary applications of each of these regulators is that of a programmable output regulator, but by connecting a fixed resistor between adjustment terminal and the output terminal, each device can be used as a precision current regulator. Even though the regulator is floating and sees only the input-to-output differential voltage, use of these devices to regulate output voltages that would cause the maximum-rated differential voltage to be exceeded if the output became shorted to ground is not recommended.

## THERMAL PROTECTION

Device operational range is limited by the maximum junction temperature ( $T_J$ ). The junction temperature is influenced by the ambient temperature ( $T_A$ ), package selection, input voltage ( $V_{IN}$ ), and the output load current. When operating with maximum load currents the input voltage and/or ambient temperature will be limited.

Even though the LM317 is equipped with circuitry to protect itself from excessive thermal dissipation, it is not recommended that the LM317 be operated at, or near, the maximum recommended die junction temperature ( $T_J$ ) as this may impair long term device reliability.

The thermal protection circuitry monitors the temperature at the die level. When the die temperature exceeds typically 160°C the voltage regulator output will be switched off.

## MAXIMUM OUTPUT CURRENT CAPABILITY

The LM317 can deliver a continuous current of 1.0A over the full operating temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 1A may be still undeliverable due to the restriction of the power dissipation of LM317. Under all possible conditions, the junction temperature must be within the range specified under operating conditions. The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA} \quad / \quad T_J = T_C + P_D \times \theta_{JC} \quad / \quad T_J = T_A + P_D \times \theta_{JA}$$

where  $T_J$  is the junction temperature,  $T_C$  is the case temperature,  $T_A$  is the ambient temperature,  $P_D$  is the total power dissipation of the device,  $\theta_{CA}$  is the thermal resistance of case-to-ambient,  $\theta_{JC}$  is the thermal resistance of junction-to-case, and  $\theta_{JA}$  is the thermal resistance of junction to ambient. The total power dissipation of the device is given by:

$$\begin{aligned} P_D &= P_{IN} - P_{OUT} = (V_{IN} \times I_{IN}) - (V_{OUT} \times I_{OUT}) \\ &= (V_{IN} \times (I_{OUT} + I_{GND})) - (V_{OUT} \times I_{OUT}) = (V_{IN} - V_{OUT}) \times I_{OUT} + (V_{IN} \times I_{GND}) \end{aligned}$$

where  $I_{GND}$  is the operating ground current of the device which is specified at the Electrical Characteristics. The maximum allowable temperature rise ( $T_{Rmax}$ ) depends on the maximum ambient temperature ( $T_{Amax}$ ) of the application, and the maximum allowable junction temperature ( $T_{Jmax}$ ):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

The maximum allowable value for junction-to-ambient thermal resistance,  $\theta_{JA}$ , can be calculated using the formula:

$$\theta_{CA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D$$

The thermal resistance depends on amount of copper area or heat sink, and on air flow. If the maximum allowable value of  $\theta_{JA}$  calculated above is over its rating of a package, no heat sink is needed since the package can dissipate enough heat to satisfy these requirements. If the value for allowable  $\theta_{JA}$  falls near or below these limits, a heat sink or proper area of copper plane is required. The absolute maximum ratings of thermal resistances are as follow:

CHARACTERISTICS	SYMBOL	RATING	UNIT
Thermal Resistance Junction-To-Ambient / SOT-223-3L	$\theta_{JA-SOT-223-3L}$	137	°C/W
Thermal Resistance Junction-To-Ambient / TO-220-3L	$\theta_{JA-TO-220-3L}$	70	°C/W

No heat sink / No air flow / No adjacent heat source /  $T_A=25^\circ\text{C}$

## REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.