

# TL317 3-TERMINAL ADJUSTABLE REGULATORS

SLVS004C – APRIL 1979 – REVISED JULY 1999

- Output Voltage Range Adjustable From 1.2 V to 32 V When Used With an External Resistor Divider
- Output Current Capability of 100 mA
- Input Regulation Typically 0.01% Per Input-Voltage Change
- Output Regulation Typically 0.5%
- Ripple Rejection Typically 80 dB

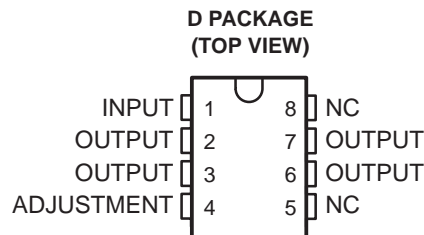
## description

The TL317 is an adjustable three-terminal positive-voltage regulator capable of supplying 100 mA over an output-voltage range of 1.2 V to 32 V. It is exceptionally easy to use and requires only two external resistors to set the output voltage.

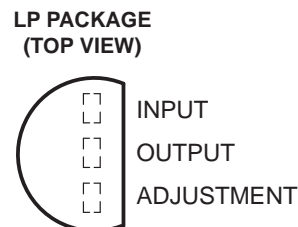
In addition to higher performance than fixed regulators, this regulator offers full overload protection available only in integrated circuits. Included on the chip are current-limiting and thermal-overload protection. All overload-protection circuitry remains fully functional, even when ADJUSTMENT is disconnected. Normally, no capacitors are needed unless the device is situated far from the input filter capacitors, in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. ADJUSTMENT can be bypassed to achieve very high ripple rejection, which is difficult to achieve with standard three-terminal regulators.

In addition to replacing fixed regulators, the TL317 regulator is useful in a wide variety of other applications. Since the regulator is floating and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input-to-output differential is not exceeded. Its primary application is that of a programmable output regulator, but by connecting a fixed resistor between ADJUSTMENT and OUTPUT, this device can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping ADJUSTMENT to ground, programming the output to 1.2 V, where most loads draw little current.

The TL317C is characterized for operation over the virtual junction temperature range of 0°C to 125°C.



NC – No internal connection  
OUTPUT terminals are all internally connected.



## AVAILABLE OPTIONS

T <sub>J</sub>	PACKAGED DEVICES		CHIP FORM (Y)
	SMALL OUTLINE (D)	PLASTIC (LP)	
0°C to 125°C	TL317CD	TL317CLP	TL317Y

The D and LP packages are available taped and reeled. Add the suffix R to device type (e.g., TL317CDR). Chip forms are tested at 25°C.



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

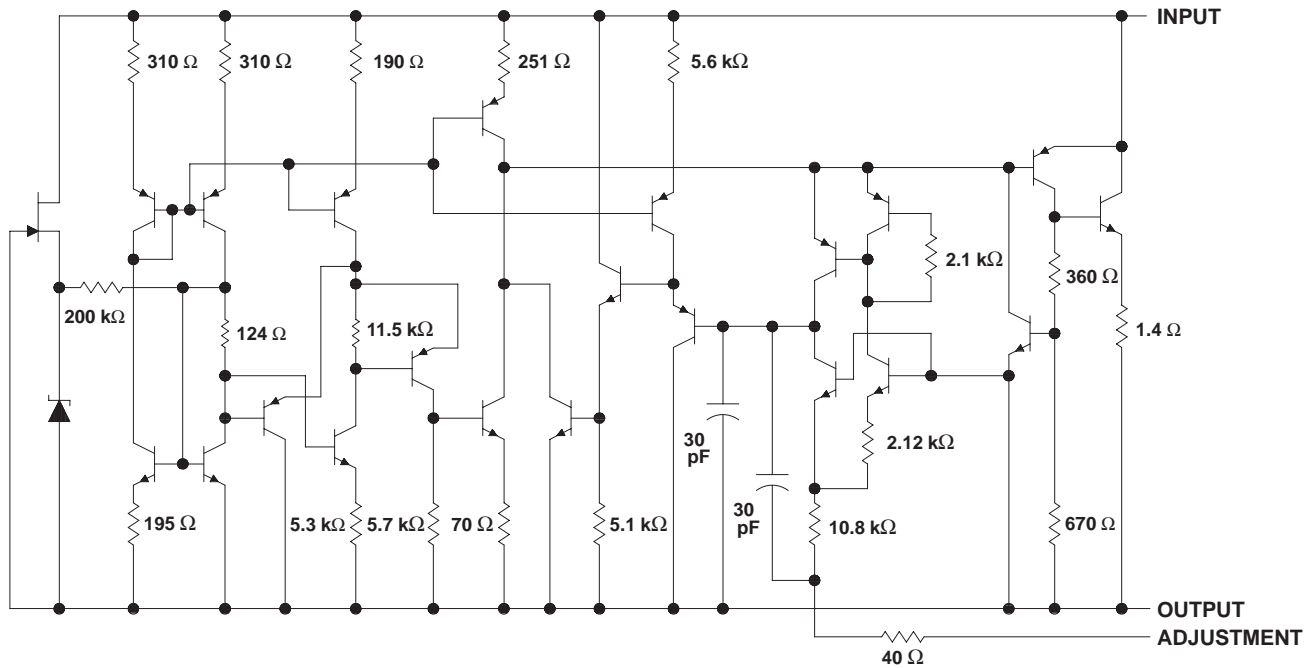
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## schematic



NOTE A: All component values shown are nominal.

## absolute maximum ratings over operating temperature range (unless otherwise noted)†

Input-to-output differential voltage, $V_I - V_O$ .....	35 V
Operating free-air, $T_A$ , case, or virtual-junction temperature range, $T_J$ : TL317C .....	0°C to 150°C
Package thermal impedance, $\theta_{JA}$ (see Notes 1 and 2): D package .....	97°C/W
LP package .....	156°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....	260°C
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C

† 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.

- NOTES: 1. Maximum power dissipation is a function of  $T_J(\max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\max) - T_A) / \theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can impact reliability.
2. The package thermal impedance is calculated in accordance with JESD 51, except for through-hole packages, which use a trace length of zero.

## recommended operating conditions

	MIN	MAX	UNIT	
Input-to-output voltage differential, $V_I - V_O$		35	V	
Output current, $I_O$	2.5	100	mA	
Operating virtual-junction temperature, $T_J$	TL317C	0	125	°C



# TL317

## 3-TERMINAL ADJUSTABLE REGULATORS

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### electrical characteristics over recommended operating virtual-junction temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONST		TL317C			UNIT
			MIN	TYP	MAX	
Input voltage regulation (see Note 3)	$V_I - V_O = 5\text{ V to }35\text{ V}$	$T_J = 25^\circ\text{C}$	0.01	0.02		%V
		$I_O = 2.5\text{ mA to }100\text{ mA}$	0.02	0.05		
Ripple regulation	$V_O = 10\text{ V},$	$f = 120\text{ Hz}$	65			dB
	$V_O = 10\text{ V},$ 10- $\mu\text{F}$ capacitor between ADJUSTMENT and ground		66	80		
Output voltage regulation	$V_I = 5\text{ V to }35\text{ V},$ $I_O = 2.5\text{ mA to }100\text{ mA},$ $T_J = 25^\circ\text{C}$	$V_O \leq 5\text{ V}$	25			mV
		$V_O \geq 5\text{ V}$	5			mV/V
	$V_I = 5\text{ V to }35\text{ V},$ $I_O = 2.5\text{ mA to }100\text{ mA}$	$V_O \leq 5\text{ V}$	50			mV
		$V_O \geq 5\text{ V}$	10			mV/V
Output voltage change with temperature	$T_J = 0^\circ\text{C to }125^\circ\text{C}$		10			mV/V
Output voltage long-term drift	After 1000 hours at $T_J = 125^\circ\text{C}$ and $V_I - V_O = 35\text{ V}$		3	10		mV/V
Output noise voltage	$f = 10\text{ Hz to }10\text{ kHz},$ $T_J = 25^\circ\text{C}$		30			$\mu\text{V/V}$
Minimum output current to maintain regulation	$V_I - V_O = 35\text{ V}$		1.5	2.5		mA
Peak output current	$V_I - V_O \leq 35\text{ V}$		100	200		mA
ADJUSTMENT current			50	100		$\mu\text{A}$
Change in ADJUSTMENT current	$V_I - V_O = 2.5\text{ V to }35\text{ V},$	$I_O = 2.5\text{ mA to }100\text{ mA}$	0.2	5		$\mu\text{A}$
Reference voltage (output to ADJUSTMENT)	$V_I - V_O = 5\text{ V to }35\text{ V},$ $P \leq \text{rated dissipation}$	$I_O = 2.5\text{ mA to }100\text{ mA},$	1.2	1.25	1.3	V

† Unless otherwise noted, these specifications apply for the following test conditions:  $V_I - V_O = 5\text{ V}$  and  $I_O = 40\text{ mA}$ . Pulse-testing techniques must be used that maintain the junction temperature as close to the ambient temperature as possible. All characteristics are measured with a 0.1- $\mu\text{F}$  capacitor across the input and a 1- $\mu\text{F}$  capacitor across the output.

NOTE 3: Input voltage regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

### electrical characteristics over recommended operating conditions, $T_J = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONST		TL317Y			UNIT
			MIN	TYP	MAX	
Input voltage regulation (see Note 3)	$V_I - V_O = 5\text{ V to }35\text{ V}$		0.01			%V
Ripple regulation	$V_O = 10\text{ V},$	$f = 120\text{ Hz}$	65			dB
	$V_O = 10\text{ V},$ 10- $\mu\text{F}$ capacitor between ADJUSTMENT and ground		80			
Output voltage regulation	$I_O = 2.5\text{ mA to }100\text{ mA}$	$V_O \leq 5\text{ V}$	25			mV
		$V_O \geq 5\text{ V}$	5			mV/V
Output noise voltage	$f = 10\text{ Hz to }10\text{ kHz}$		30			$\mu\text{V/V}$
Minimum output current to maintain regulation	$V_I - V_O = 35\text{ V}$		1.5			mA
Peak output current	$V_I - V_O \leq 35\text{ V}$		200			mA
ADJUSTMENT current			50			$\mu\text{A}$
Change in ADJUSTMENT current	$V_I - V_O = 2.5\text{ V to }35\text{ V},$	$I_O = 2.5\text{ mA to }100\text{ mA}$	0.2			$\mu\text{A}$
Reference voltage (output to ADJUSTMENT)	$V_I - V_O = 5\text{ V to }35\text{ V},$ $P \leq \text{rated dissipation}$	$I_O = 2.5\text{ mA to }100\text{ mA},$	1.25			V

† Unless otherwise noted, these specifications apply for the following test conditions:  $V_I - V_O = 5\text{ V}$  and  $I_O = 40\text{ mA}$ . Pulse-testing techniques must be used that maintain the junction temperature as close to the ambient temperature as possible. All characteristics are measured with a 0.1- $\mu\text{F}$  capacitor across the input and a 1- $\mu\text{F}$  capacitor across the output.

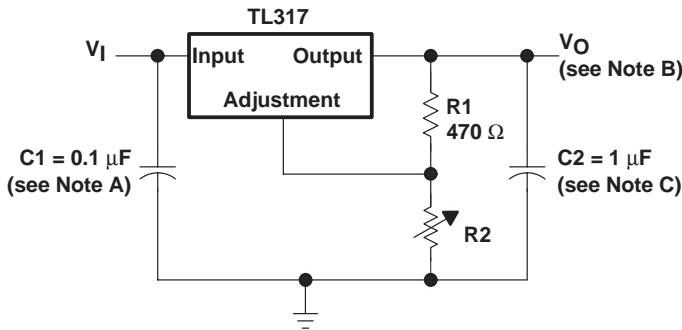
NOTE 3: Input voltage regulation is expressed here as the percentage change in output voltage per 1-V change at the input.



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## APPLICATION INFORMATION



NOTES: A. Use of an input bypass capacitor is recommended if regulator is far from the filter capacitors.

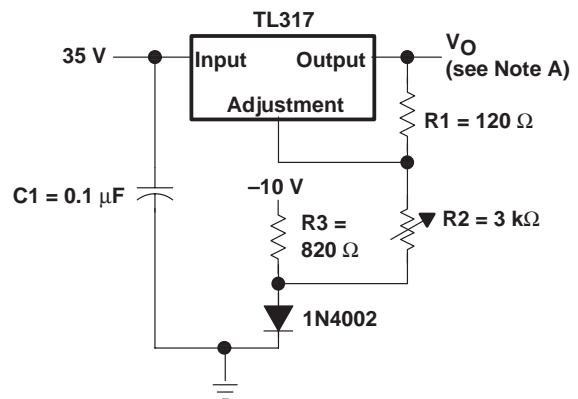
B. Output voltage is calculated from the equation:

$$V_O = V_{ref} \left( 1 + \frac{R_2}{R_1} \right)$$

where:  $V_{ref}$  equals the difference between OUTPUT and ADJUSTMENT voltages ( $\approx 1.25$  V).

C. Use of an output capacitor improves transient response but is optional.

**Figure 1. Adjustable Voltage Regulator**

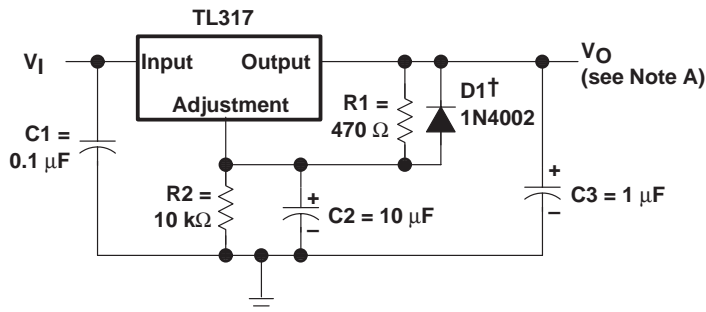


NOTE A: Output voltage is calculated from the equation:

$$V_O = V_{ref} \left( 1 + \frac{R_2 + R_3}{R_1} \right) - 10 \text{ V}$$

where:  $V_{ref}$  equals the difference between OUTPUT and ADJUSTMENT voltages ( $\approx 1.25$  V).

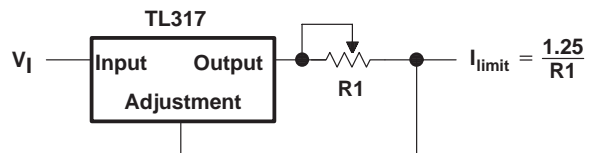
**Figure 2. 0-V to 30-V Regulator Circuit**



† D1 discharges C2 if output is shorted to ground.

NOTE A: Use of an output capacitor improves transient response but is optional.

**Figure 3. Regulator Circuit With Improved Ripple Rejection**



**Figure 4. Precision Current-Limiter Circuit**

APPLICATION INFORMATION

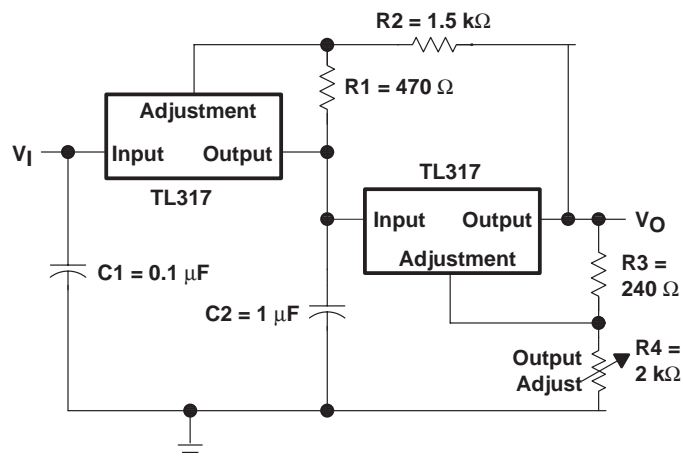


Figure 5. Tracking Preregulator Circuit

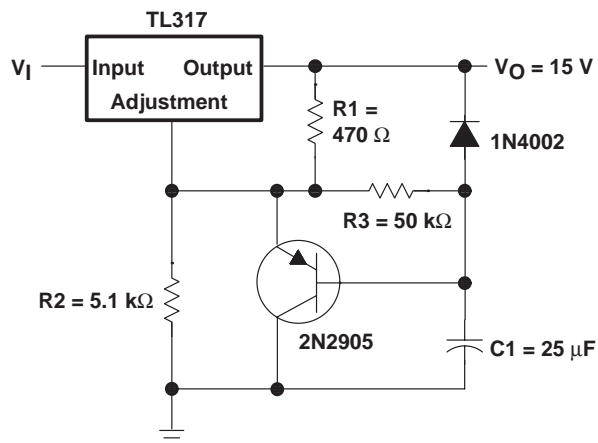


Figure 6. Slow Turnon 15-V Regulator Circuit

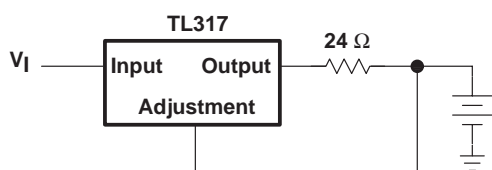


Figure 7. 50-mA Constant-Current Battery Charger Circuit

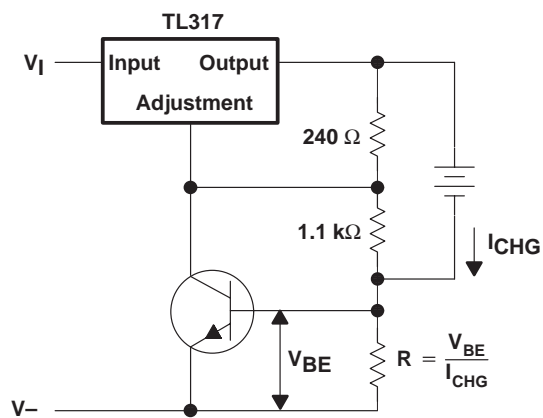
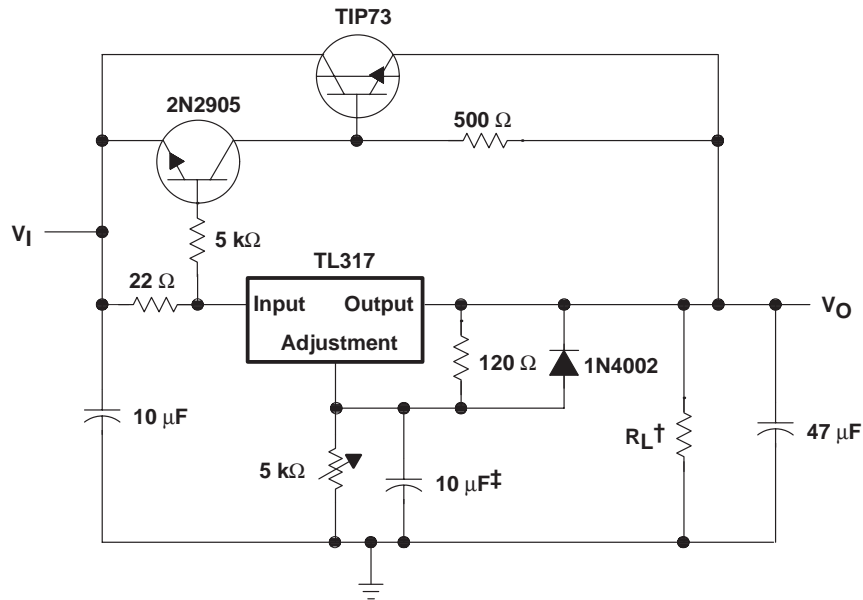


Figure 8. Current-Limited 6-V Charger

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## APPLICATION INFORMATION



† Minimum load current is 30 mA.

‡ Optional capacitor improves ripple rejection

Figure 9. High-Current Adjustable Regulator

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