



September 2014

# LM350

## 3-Terminal 3 A Positive Adjustable Regulator

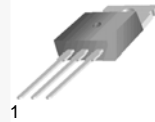
### Features

- Output Adjustable Between 1.2 V and 33 V
- Guaranteed 3 A Output Current
- Internal Thermal Overload Protection
- Load Regulation (Typical: 0.1%)
- Line Regulation (Typical: 0.015%/V)
- Internal Short-Circuit Current Limit
- Output Transistor Safe-Area Compensation

### Description

The LM350 is an adjustable 3-terminal positive voltage regulator capable of supplying in excess of 3.0 A over an output voltage range of 1.2 V to 33 V.

TO-220 (Single Gauge)



1. Adj 2. Output 3. Input

### Ordering Information

Product Number	Marking	Package	Packing Method	Operating Temperature
LM350T	LM350	TO-220 3L (Single Gauge)	Rail	0 to +125°C

LM350 — 3-Terminal 3 A Positive Adjustable Regulator

## Block Diagram

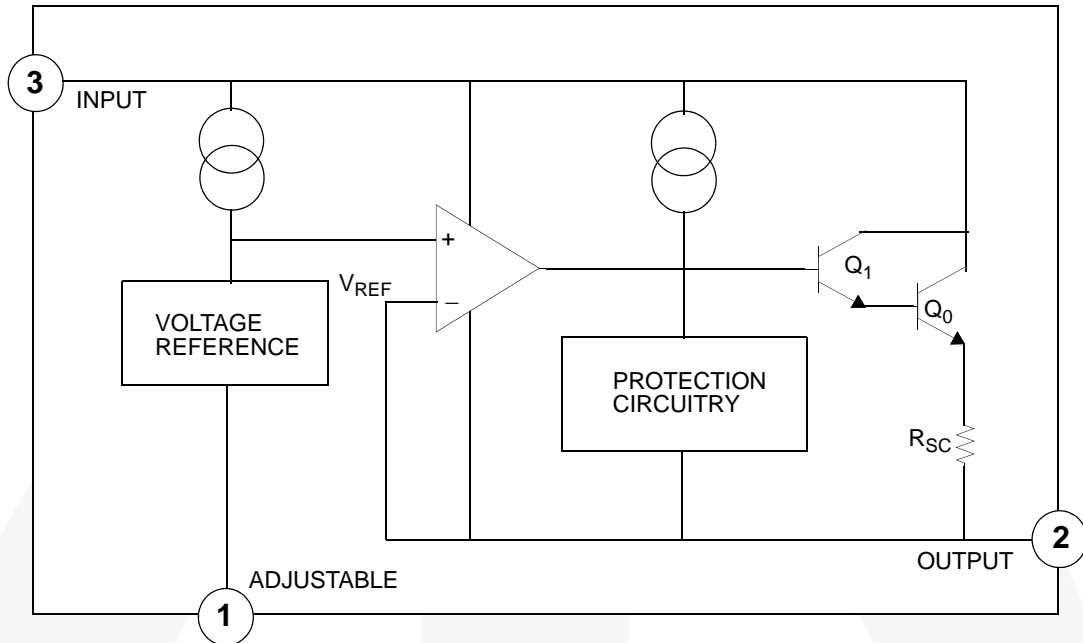


Figure 1. Block Diagram

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$V_I - V_O$	Input-Output Voltage Differential	35	V
$T_{\text{LEAD}}$	Lead Temperature (Soldering, 10 sec)	300	$^\circ\text{C}$
$T_{\text{OPR}}$	Operating Temperature Range	0 to +125	$^\circ\text{C}$
$T_{\text{STG}}$	Storage Temperature Range	-65 to +150	$^\circ\text{C}$

## Thermal Characteristics

Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter	Value	Unit
$P_D$	Power Dissipation	Internally Limited	W

## Electrical Characteristics

$V_I - V_O = 5\text{ V}$ ,  $I_O = 1.5\text{ A}$ ,  $0^\circ\text{C} \leq T_J \leq +125^\circ\text{C}$ ,  $P_D \leq P_{D\text{MAX}}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Rline	Line Regulation <sup>(1)</sup>	$T_A = +25^\circ\text{C}$ , $3\text{ V} \leq V_I - V_O \leq 35\text{ V}$		0.015	0.030	%/V
Rload	Load Regulation <sup>(1)</sup>	$T_A = +25^\circ\text{C}$ , $3\text{ V} \leq V_I - V_O \leq 35\text{ V}$ , $V_O \leq 5\text{ V}$		5	25	mV
		$T_A = +25^\circ\text{C}$ , $3\text{ V} \leq V_I - V_O \leq 35\text{ V}$ , $V_O \geq 5\text{ V}$		0.1	0.5	%
$I_{\text{ADJ}}$	Adjustment Pin Current	-		50	100	$\mu\text{A}$
$\Delta I_{\text{ADJ}}$	Adjustment Pin Current Change	$3\text{ V} \leq V_I - V_O \leq 35\text{ V}$ , $10\text{ mA} \leq I_O \leq 3\text{ A}$ , $P_D \leq P_{\text{MAX}}$		0.2	5.0	$\mu\text{A}$
REG <sub>T</sub>	Thermal Regulation	Pulse = 20 ms, $T_A = +25^\circ\text{C}$		0.002		%/W
$V_{\text{REF}}$	Reference Voltage	$3\text{ V} \leq V_I - V_O \leq 35\text{ V}$ , $10\text{ mA} \leq I_O \leq 3\text{ A}$ , $P_D \leq 30\text{ W}$	1.20	1.25	1.30	V
Rline	Line Regulation	$3.0\text{ V} \leq V_I - V_O \leq 35\text{ V}$		0.02	0.07	%/V
Rload	Load Regulation	$10\text{ mA} \leq I_O \leq 3.0\text{ A}$ , $V_O \leq 5.0\text{ V}$		20	70	mV
		$10\text{ mA} \leq I_O \leq 3.0\text{ A}$ , $V_O \geq 5.0\text{ V}$		0.3	1.5	%
ST <sub>T</sub>	Temperature Stability	$T_J = 0^\circ\text{C}$ to $+125^\circ\text{C}$		1.0		%
$I_{\text{O(MAX)}}$	Maximum Output Current	$V_I - V_O \leq 10\text{ V}$ , $P_D \leq P_{\text{MAX}}$	3.0	4.5		A
		$V_I - V_O = 30\text{ V}$ , $P_D \leq P_{\text{MAX}}$ , $T_A = +25^\circ\text{C}$	0.25	1.0		
$I_{\text{L(MIN)}}$	Minimum Load Current	$V_I - V_O = 35\text{ V}$		3.5	10	mA
$V_{\text{N}}$	RMS Noise, % of $V_{\text{OUT}}$	$10\text{ Hz} \leq f \leq 10\text{ kHz}$ , $T_A = +25^\circ\text{C}$		0.003		%/ $V_o$
RR	Ripple Rejection	$V_O = 10\text{ V}$ , $f = 120\text{ Hz}$ , $C_{\text{ADJ}} = 0$		65		dB
		$V_O = 10\text{ V}$ , $f = 120\text{ Hz}$ , $C_{\text{ADJ}} = 10\text{ }\mu\text{F}$	66	80		
ST	Long-Term Stability	$T_J = +125^\circ\text{C}$		0.3	1	%/ 1000HR

### Note:

- Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

## Typical Performance Characteristics

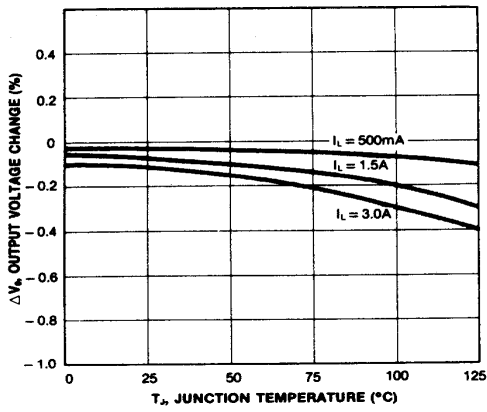


Figure 2. Load Regulation

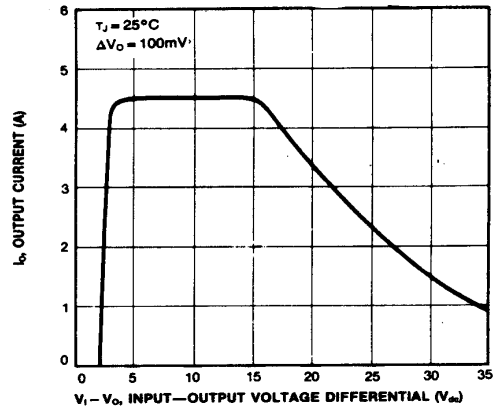


Figure 3. Current Limit

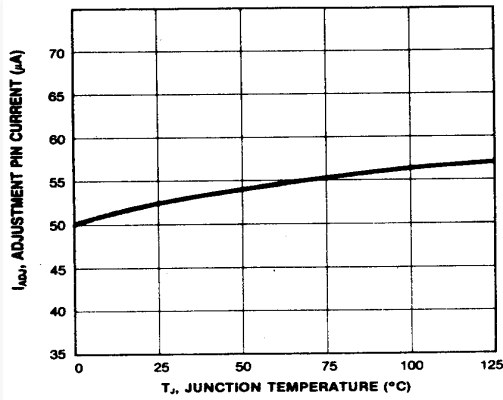


Figure 4. Adjustment Pin Current

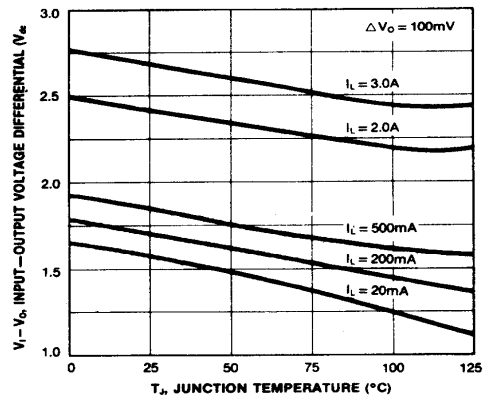


Figure 5. Dropout Voltage

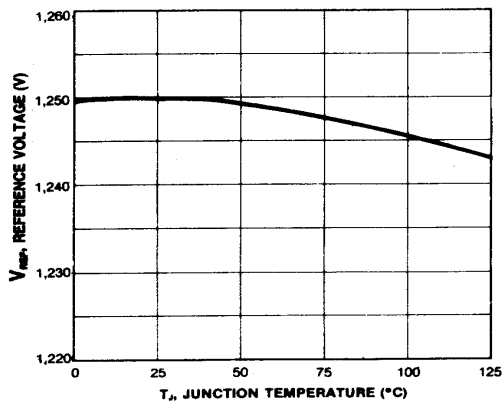


Figure 6. Temperature Stability

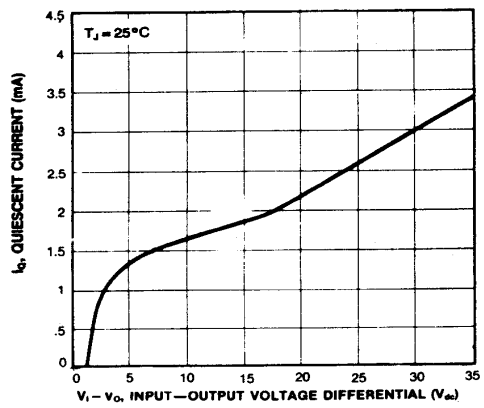


Figure 7. Minimum Load Current

Typical Performance Characteristics (Continued)

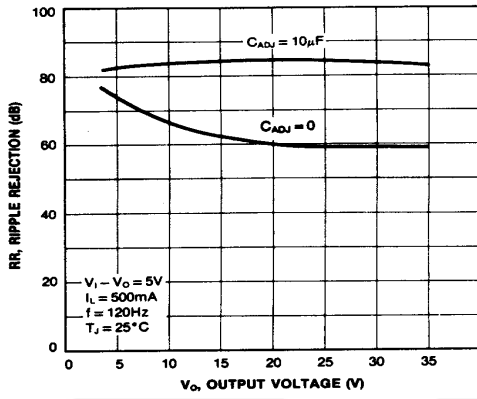


Figure 8. Ripple Rejection vs.  $V_O$

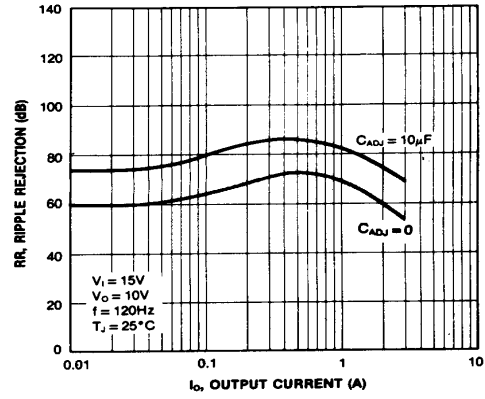


Figure 9. Ripple Rejection vs.  $I_O$

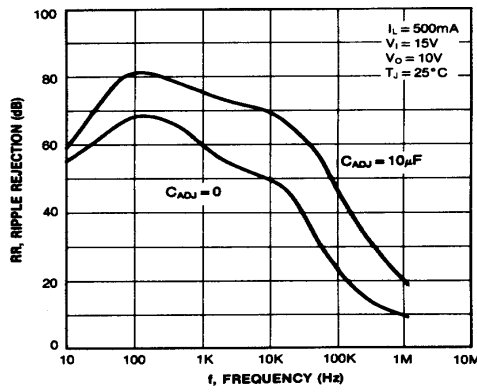


Figure 10. Ripple Rejection vs. Frequency

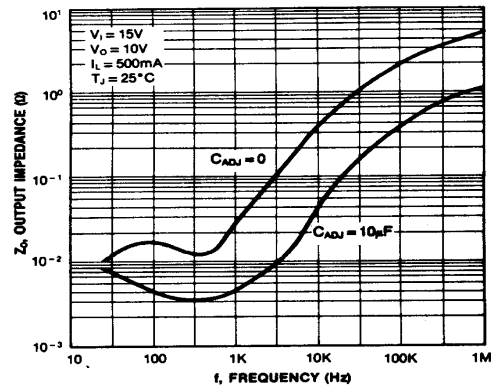


Figure 11. Output Impedance

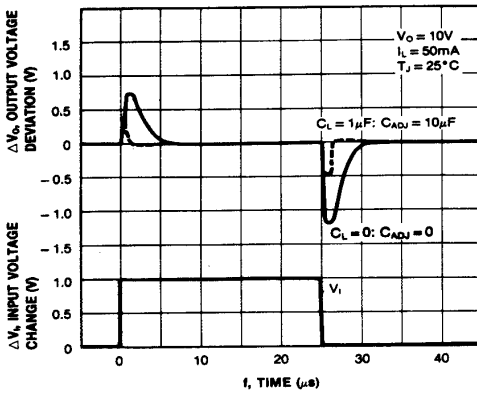


Figure 12. Line Transient Response

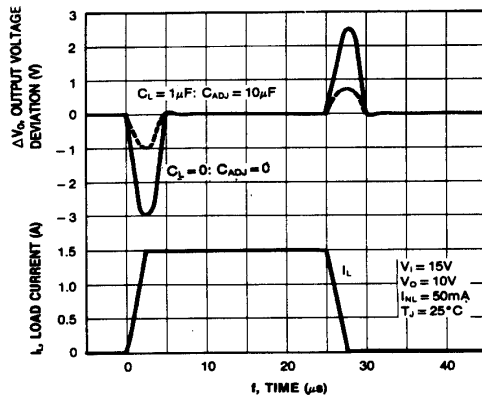


Figure 13. Load Transient Response

## Typical Application<sup>(2)</sup>

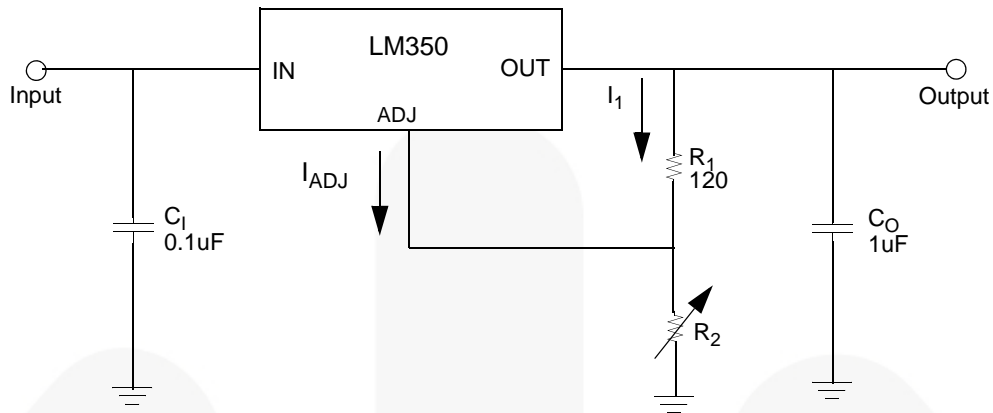


Figure 14.

**Note:**

2.  $C_1$ :  $C_1$  is required if the regulator is located an appreciable distance from power supply filter.  
 $C_0$ : Output capacitors in the range of 1  $\mu\text{F}$  to 100  $\mu\text{F}$  of aluminum or tantalum electronic are commonly used to provide improved output impedance and rejection of transients.

In operation, the LM350 develops a nominal 1.25 V reference voltage,  $V_{REF}$ , between the output and adjustment terminal. The reference voltage is impressed across program resistor  $R_1$  and, since the voltage is constant, a constant current  $I_1$  then flows through the output set resistor  $R_2$ , giving an output voltage of

$$V_O = 1.25 V(1+R_2/R_1) + I_{ADJ} R_2$$

Since  $I_{ADJ}$  current (less than 100 mA) from the adjustment terminal represents an error term, the LM350 was designed to minimize  $I_{ADJ}$  and make it very constant with line and load changes. To do this, all quiescent operating current is returned to the output establishing a minimum load current requirement. If there is insufficient load on the output, the output voltage will rise. Since the LM350 is a floating regulator, it is only the voltage differential across the circuit which is important to performance, and operation at high voltage with respect to ground is possible. Since  $I_{ADJ}$  is controlled to less than 100 mA, the error associated with this term is negligible in most applications.

## Physical Dimensions

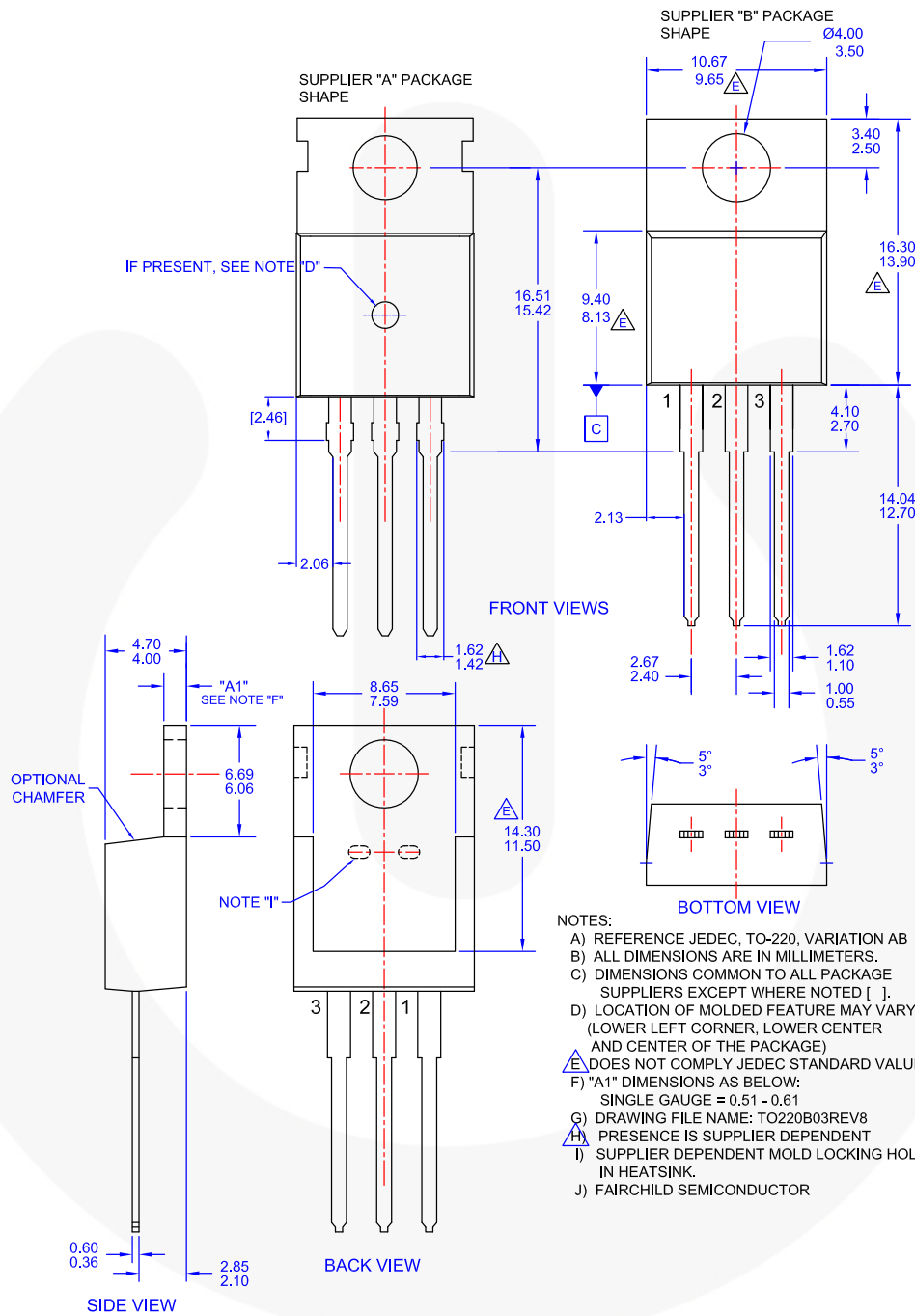


Figure 15. TO-220, MOLDED, 3LEAD, JEDEC VARIATION AB



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