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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.

Ordering Information

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Marking</th>
<th>Package</th>
<th>Packing Method</th>
<th>Operating Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM350T</td>
<td>LM350</td>
<td>TO-220 3L (Single Gauge)</td>
<td>Rail</td>
<td>0 to +125°C</td>
</tr>
</tbody>
</table>
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 $T_A = 25^\circ C$ unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_I - V_O$</td>
<td>Input-Output Voltage Differential</td>
<td>35</td>
<td>V</td>
</tr>
<tr>
<td>$T_{LEAD}$</td>
<td>Lead Temperature (Soldering, 10 sec)</td>
<td>300</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{OPR}$</td>
<td>Operating Temperature Range</td>
<td>0 to +125</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>Storage Temperature Range</td>
<td>-65 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Thermal Characteristics
Values are at $T_A = 25^\circ C$ unless otherwise noted.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_D$</td>
<td>Power Dissipation</td>
<td>Internally Limited</td>
<td>W</td>
</tr>
</tbody>
</table>
Electrical Characteristics

\[ V_I - V_O = 5 \text{ V, } I_O = 1.5 \text{ A, } 0°C \leq T_J \leq +125°C, P_D \leq P_{MAX}, \] unless otherwise specified.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_{line}</td>
<td>Line Regulation (^{1} )</td>
<td>( T_A = +25°C ), ( 3 \text{ V} \leq V_I - V_O \leq 35 \text{ V} )</td>
<td>0.015</td>
<td>0.030</td>
<td>%/V</td>
<td></td>
</tr>
<tr>
<td>R_{load}</td>
<td>Load Regulation (^{1} )</td>
<td>( T_A = +25°C ), ( 3 \text{ V} \leq V_I - V_O \leq 35 \text{ V}, V_O \leq 5 \text{ V} )</td>
<td>5</td>
<td>25</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>I_{ADJ}</td>
<td>Adjustment Pin Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>ΔI_{ADJ}</td>
<td>Adjustment Pin Current Change</td>
<td>( 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_{MAX} )</td>
<td>0.2</td>
<td>5.0</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>REGT</td>
<td>Thermal Regulation</td>
<td>Pulse = 20 ms, ( T_A = +25°C )</td>
<td>0.002</td>
<td></td>
<td>%/W</td>
<td></td>
</tr>
<tr>
<td>V_{REF}</td>
<td>Reference Voltage</td>
<td>( 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} )</td>
<td>1.20</td>
<td>1.25</td>
<td>1.30</td>
<td>V</td>
</tr>
<tr>
<td>R_{line}</td>
<td>Line Regulation</td>
<td>( 3.0 \text{ V} \leq V_I - V_O \leq 35 \text{ V} )</td>
<td>0.02</td>
<td>0.07</td>
<td>%/W</td>
<td></td>
</tr>
<tr>
<td>R_{load}</td>
<td>Load Regulation</td>
<td>( 10 \text{ mA} \leq I_O \leq 3 \text{ A}, V_O \leq 5.0 \text{ V} )</td>
<td>20</td>
<td>70</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>STT</td>
<td>Temperature Stability</td>
<td>( T_J = 0°C ) to (+125°C)</td>
<td>1.0</td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>I_{O(MAX)}</td>
<td>Maximum Output Current</td>
<td>( V_I - V_O \leq 10 \text{ V}, P_D \leq P_{MAX} )</td>
<td>3.0</td>
<td>4.5</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_I - V_O = 30 \text{ V}, P_D \leq P_{MAX}, T_A = +25°C )</td>
<td>0.25</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_{L(MIN)}</td>
<td>Minimum Load Current</td>
<td>( V_I - V_O = 35 \text{ V} )</td>
<td>3.5</td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>V_{N</td>
<td>RMS Noise, % of V_OUT</td>
<td>10 \text{ Hz} \leq f \leq 10 \text{ kHz}, T_A = +25°C )</td>
<td>0.003</td>
<td></td>
<td>%/V</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>Ripple Rejection</td>
<td>( V_O = 10 \text{ V}, f = 120 \text{ Hz}, C_{ADJ} = 0 )</td>
<td>65</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_O = 10 \text{ V}, f = 120 \text{ Hz}, C_{ADJ} = 10 \mu \text{F} )</td>
<td>66</td>
<td>80</td>
<td></td>
<td></td>
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<tr>
<td>ST</td>
<td>Long-Term Stability</td>
<td>( T_J = +125°C )</td>
<td>0.3</td>
<td>1</td>
<td>%/1000HR</td>
<td></td>
</tr>
</tbody>
</table>

Note:

1. 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

Figure 14.

Note:
2. CI: CI is required if the regulator is located an appreciable distance from power supply filter.
   CO: Output capacitors in the range of 1 μF to 100 μF 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, VREF, between the output and adjustment terminal. The reference voltage is impressed across program resistor R₁ and, since the voltage is constant, a constant current I₁ then flows through the output set resistor R₂, giving an output voltage of

\[ V_O = 1.25 \times \left(1 + \frac{R_2}{R_1}\right) + I_{ADJ} \times R_2 \]

Since IADJ current (less than 100 mA) from the adjustment terminal represents an error term, the LM350 was designed to minimize IADJ 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 IADJ is controlled to less than 100 mA, the error associated with this term is negligible in most applications.
Figure 15. TO-220, MOLDED, 3LEAD, JEDEC VARIATION AB
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Definition of Terms

<table>
<thead>
<tr>
<th>Datasheet Identification</th>
<th>Product Status</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advance Information</td>
<td>Formative / In Design</td>
<td>Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.</td>
</tr>
<tr>
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<td>First Production</td>
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</table>

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