LM78LXX Series 3-Terminal Positive Regulators

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustment voltages and currents.

The LM78LXX is available in the metal three lead TO-39 (H), the plastic TO-92 (Z), and SO-8 plastic. With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Features

- Output voltage tolerances of ±5 % (LM78LXXAC) over the temperature range
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in plastic TO-92 and metal TO-39 and plastic SO-8 low profile packages

Voltage Range

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V</td>
<td>LM78L05</td>
</tr>
<tr>
<td>12V</td>
<td>LM78L12</td>
</tr>
<tr>
<td>15V</td>
<td>LM78L15</td>
</tr>
</tbody>
</table>

Connection Diagrams

**Metal Can Package**

- **OUTPUT**
- **GND (CASE)**

**Bottom View**

Order Number LM78L05ACH, LM78L12ACH or LM78L15ACH
See NS Package Number H03A

**SO-8 Plastic (Narrow Body)**

- **V_OUT**
- **GND**
- **NC**

**Top View**

Order Number LM78L05ACM, LM78L12ACM or LM78L15ACM
See NS Package Number M08A

**Plastic Package**

- **OUTPUT**
- **GND**
- **NC**

Order Number LM78L05ACZ, LM78L12ACZ or LM78L15ACZ
See NS Package Number 203A
### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature Range</td>
<td>0°C to 70°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>125°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>Metal Can (H Package) -65°C to +150°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Molded TO-92 (Z Package) -55°C to +150°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lead Temperature (Soldering, 10 sec.) 260°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ESD Tolerance (Note 5)</td>
<td>2000V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### LM78LXXAC Electrical Characteristics

**Note 1:** Thermal resistance of H package is typically 28°C/W, əp = 89°C/W, θja = 40°C/W, and 89°C/W θja at 40°C/W, and 89°C/W θja at 40°C/W. For the Z package, θja = 150°C/W in still air. The maximum junction temperature is not exceeded 150°C on Electrical parameters.

**Note 2:** The maximum steady state stable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of test.

**Note 3:** Recommended minimum load capacitance of 0.01 μF to limit high frequency noise bandwidth.

**Note 4:** The temperature coefficient of VOUT is typically within ±0.001°C/F.

**Note 5:** Human body model, 1.5 kΩ in series with 100 pF.

<table>
<thead>
<tr>
<th>LM78LXXAC Output Voltage</th>
<th>5V</th>
<th>12V</th>
<th>15V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage (unless otherwise noted)</td>
<td>10V</td>
<td>19V</td>
<td>23V</td>
</tr>
<tr>
<td>Symbol</td>
<td>Conditions</td>
<td>Min</td>
<td>Typ</td>
</tr>
<tr>
<td>W0</td>
<td>Output Voltage (Note 4)</td>
<td>Tj = 25°C</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>1 mA ≤ I0 ≤ 70 mA</td>
<td>1 mA ≤ I0 ≤ 40 mA and VMIN ≤ VIN ≤ VMAX</td>
<td>(7 ≤ VIN ≤ 20)</td>
</tr>
<tr>
<td>ΔV0</td>
<td>Line Regulation</td>
<td>Tj = 25°C</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>75</td>
</tr>
<tr>
<td>ΔV0</td>
<td>Load Regulation</td>
<td>Tj = 25°C, 1 mA ≤ I0 ≤ 40 mA</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tj = 25°C, 1 mA ≤ I0 ≤ 100 mA</td>
<td>20</td>
</tr>
<tr>
<td>ΔV0</td>
<td>Long Term Stability</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>I0</td>
<td>Quiescent Current</td>
<td>Tj = 25°C</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tj = 125°C</td>
<td>4.7</td>
</tr>
<tr>
<td>ΔI0</td>
<td>Quiescent Current Change</td>
<td>1 mA ≤ I0 ≤ 40 mA</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VMIN ≤ VIN ≤ VMAX</td>
<td>1.0</td>
</tr>
<tr>
<td>Vn</td>
<td>Output Noise Voltage</td>
<td>Tj = 25°C, (Note 3)</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>f = 10 Hz to 10 kHz</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>90</td>
<td>μV</td>
</tr>
<tr>
<td>ΔVIN</td>
<td>Ripple Rejection</td>
<td>f = 120 Hz</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VOUT</td>
<td>14.5</td>
</tr>
</tbody>
</table>

1-295
Typical Performance Characteristics

Maximum Average Power Dissipation (Plastic Package)

- 0.125" LEAD LENGTH FROM PCB BOARD WITH 70°C/W HEAT SINK
- 0.41" LEAD LENGTH FROM PCB BOARD WITH 30°C/W HEAT SINK
- 0.41" LEAD LENGTH FROM PCB BOARD FREE AIR

Maximum Average Power Dissipation (Metal Can Package)

- INFINITE HEAT SINK
- NO HEAT SINK WITH 30°C/W HEAT SINK

Peak Output Current

- Vout = 10V
- Iout = 40mA
- Tj = 100°C

Dropout Voltage

- Vout = 5V
- Iout = 75mA
- Iout = 18mA

Ripple Rejection

- Vrms = 10V
- Iout = 50Hz
- Tj = 25°C
- Tj = 100°C

Output Impedance

- Cload = 1uF Tantalum

Quiescent Current

- Vout = 5V
- Iout = 40mA

- Vout = 10V
- Iout = 40mA

*Required by 1st
**See Note 3 in
Equivalent Circuit

LM78LXX

Typical Applications

Fixed Output Regulator

Adjustable Output Regulator

LM78L5

V_{OUT} = 5V + \frac{(5V/R1 + I_R)R2}{8V/R1 > 3 I_R, \text{load regulation (L) = } \frac{[R1 + R2]}{R1}} [\text{of LM78L5}]

*Required if the regulator is located far from the power supply filter.
**See Note 3 in the electrical characteristics table.
Typical Applications (Continued)

Current Regulator

\[ I_{out} = \frac{(V_{in}/R_1) + I_0}{1 + \frac{R_1}{R}} \]

> \( I_0 = 1.8 \text{ mA over line and load changes} \)

5V, 500 mA Regulator with Short Circuit Protection

*Solid tantalum.

**Heat sink C2.

***Optional. Improves ripple rejection and transient response.

Load Regulation: 0.8% 0 ≤ \( I_0 \) ≤ 250 mA pulsed with \( I_{in} \) = 50 mA.

± 15V, 100 mA Dual Power Supply

*Solid tantalum.

Variable Output Regulator 0.5V-18V

\[ V_{out} = V_G + 5V, \ R_1 = (V_{in}/I_{out}) \]

\[ V_{out} \] = 5V (R2/R4) for (R2 + R3) = (R4 + R5)

A 0.5V output will correspond to (R2/R4) = 0.1 (R3/R4) = 0.8