LDL1117

1.2 A high PSRR low-dropout linear voltage regulator

Datasheet - production data

Features
- Input voltage from 2.5 V to 18 V
- 20 V AMR
- Available on fixed output voltages: 1.2 V (1.185 V), 1.5 V, 1.8 V, 2.5 V, 3 V, 3.3 V, 5.0 V (other options are available on request)
- Guaranteed output current 1.2 A
- Typical dropout 350 mV@1.2 A
- Internal thermal, current and power limitation
- High PSRR 87 dB @120 Hz
- Operating temperature range: -40 °C to 125 °C package SOT223

Applications
- Consumer
- Industrial
- SMPS
- Motherboard P.O.L.
- DC-DC post-regulation

Description
The LDL1117 provides 1.2 A of maximum current with an input voltage range from 2.5 V to 18 V, and a typical dropout voltage of 350 mV@1.2 A. The high power supply rejection ratio of 87 dB at 120 Hz, rolling down to more than 40 dB at 100 kHz, makes the LDL1117 suitable for direct regulations in SMPS and secondary linear regulations in DC-DC converters.
This device includes current limit, SOA and thermal protections.
## Contents

1. Block diagram ................................................................. 5
2. Pin configuration ............................................................ 6
3. Typical application .......................................................... 7
4. Maximum ratings ............................................................. 8
5. Electrical characteristics ................................................ 9
6. Application information ................................................... 10
   6.1 Thermal and short-circuit protections ............................ 10
   6.2 Input and output capacitor selection .............................. 10
7. Typical performance characteristics ................................. 11
8. Package information ....................................................... 16
   8.1 SOT223 package information ....................................... 16
9. Ordering information ...................................................... 18
10. Revision history ............................................................. 19
List of tables

Table 1: Pin description ..............................................................................................................................6
Table 2: Absolute maximum ratings ...........................................................................................................8
Table 3: Thermal data .................................................................................................................................8
Table 4: Electrical characteristics ............................................................................................................9
Table 5: SOT223 package mechanical data ............................................................................................17
Table 6: Order code ..................................................................................................................................18
Table 7: Document revision history .........................................................................................................19
List of figures

Figure 1: Block diagram .............................................................................................................................. 5
Figure 2: Pin configuration (top view) ......................................................................................................... 6
Figure 3: Typical application schematic .................................................................................................... 7
Figure 4: Output voltage vs temperature (VIN = 2.6 V, VOUT = 1.2 V, no-load) .................................... 11
Figure 5: Output voltage vs temperature (VIN = 2.6 V, VOUT = 1.2, 1200 mA) .................................... 11
Figure 6: Output voltage vs temperature (VIN = 6 V, VOUT = 5 V, no-load) .......................................... 11
Figure 7: Output voltage vs temperature (VIN = 6 V, VOUT = 5 V, 1200 mA) ........................................ 11
Figure 8: Line regulation vs temperature (VIN = 6 to 18 V, VOUT = 5 V, IOUT = 10 mA) ...................... 12
Figure 9: Line regulation vs temperature (VIN = 2.5 to 18 V, VOUT = 1.2 V, IOUT = 10 mA) ............... 12
Figure 10: Load regulation vs temperature (VIN = 6 V, VOUT = 5 V, IOUT = 10 to 1200 mA) ............ 12
Figure 11: Load regulation vs temperature (VIN = 2.6 V, VOUT = 1.2 V, IOUT = 10 to 1200 mA) ......... 12
Figure 12: Dropout voltage vs temperature .............................................................................................. 12
Figure 13: Quiescent current vs temperature (no-load) ........................................................................... 12
Figure 14: Quiescent current vs temperature (600 mA) ......................................................................... 13
Figure 15: Quiescent current vs temperature (1.2 A) ............................................................................. 13
Figure 16: Short-circuit current vs dropout voltage (VOUT = 5 V) ............................................................ 13
Figure 17: Short-circuit current vs dropout voltage (VOUT = 1.2 V) ....................................................... 13
Figure 18: SVR vs frequency .................................................................................................................... 13
Figure 19: Output noise spectral density (VO = 1.2 V) .......................................................................... 13
Figure 20: Stability plan (VOUT = 5 V) ................................................................................................. 14
Figure 21: Stability plan (VOUT = 1.2 V) ............................................................................................... 14
Figure 22: Turn-on time (VOUT = 5 V) .................................................................................................. 14
Figure 23: Turn-on time (VOUT = 1.2 V) ............................................................................................... 14
Figure 24: Line transient (VOUT = 5 V) ................................................................................................. 14
Figure 25: Line transient (VOUT = 1.2 V) ............................................................................................. 14
Figure 26: Load transient (VOUT = 1.2 V) ............................................................................................ 15
Figure 27: Load transient (VOUT = 5 V) ............................................................................................... 15
Figure 28: SOT223 package outline ......................................................................................................... 16
1 Block diagram

Figure 1: Block diagram
2 Pin configuration

Figure 2: Pin configuration (top view)

Table 1: Pin description

<table>
<thead>
<tr>
<th>Pin name</th>
<th>Pin number</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>GND</td>
<td>1</td>
<td>Ground</td>
</tr>
<tr>
<td>V_{OUT}</td>
<td>2</td>
<td>Output voltage</td>
</tr>
<tr>
<td>V_{IN}</td>
<td>3</td>
<td>Input voltage</td>
</tr>
</tbody>
</table>

The tab is connected to V_{OUT}.
3 Typical application

Figure 3: Typical application schematic
4 Maximum ratings

Table 2: Absolute maximum ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IN}$</td>
<td>Input supply voltage</td>
<td>-0.3 to 20</td>
<td>V</td>
</tr>
<tr>
<td>$V_{OUT}$</td>
<td>Output voltage</td>
<td>-0.3 to $V_{IN} + 0.3$</td>
<td>V</td>
</tr>
<tr>
<td>$I_{OUT}$</td>
<td>Output current</td>
<td>Internally limited</td>
<td>A</td>
</tr>
<tr>
<td>$P_d$</td>
<td>Power dissipation</td>
<td>Internally limited</td>
<td>W</td>
</tr>
<tr>
<td>$T_{J-OP}$</td>
<td>Operating junction temperature</td>
<td>-40 to 125</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{J-MAX}$</td>
<td>Maximum junction temperature</td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>$T_{STG}$</td>
<td>Storage temperature</td>
<td>-55 to 150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 3: Thermal data

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta_{J-C}$</td>
<td>Thermal resistance junction-to-case</td>
<td>15</td>
<td>°C/W</td>
</tr>
<tr>
<td>$\theta_{J-A}$</td>
<td>Thermal resistance junction-to-ambient</td>
<td>120</td>
<td>°C/W</td>
</tr>
</tbody>
</table>
5 Electrical characteristics

(T_\text{J} = 25 \ ^\circ \text{C}, V_\text{IN} = V_\text{OUT} + 1 \ \text{V or 2.6 V}, \text{whichever is greater}; C_\text{IN} = 1 \ \mu\text{F}; C_\text{OUT} = 4.7 \ \mu\text{F}; I_\text{OUT} = 10 \ \text{mA})

Table 4: Electrical characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_\text{IN}</td>
<td>Operating input voltage</td>
<td></td>
<td>2.6</td>
<td>18</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>V_\text{UVLO}</td>
<td>Turn-on threshold</td>
<td></td>
<td>2.3</td>
<td>2.4</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Hysteresis</td>
<td></td>
<td>200</td>
<td></td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>V_\text{OUT}</td>
<td>V_\text{OUT} accuracy</td>
<td>I_\text{OUT} = 10 \ \text{mA}, T_\text{J} = 25 \ ^\circ \text{C}</td>
<td>-2</td>
<td>+2</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_\text{OUT} = 10 \ \text{mA}, -40 \ ^\circ \text{C} &lt; T_\text{J} &lt; 125 \ ^\circ \text{C}</td>
<td>-3</td>
<td>+3</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>\Delta V_\text{OUT}</td>
<td>Line regulation</td>
<td>V_\text{OUT} + 1 \ \text{V} \leq V_\text{IN} \leq 18 \ \text{V}, I_\text{OUT} = 10 \ \text{mA}, -40 \ ^\circ \text{C} &lt; T_\text{J} &lt; 125 \ ^\circ \text{C}</td>
<td>0.002</td>
<td>0.02</td>
<td></td>
<td>%/\text{V}</td>
</tr>
<tr>
<td>\Delta V_\text{OUT}</td>
<td>Load regulation</td>
<td>I_\text{OUT} = 10 \ \text{mA} to 1.2 \ A, -40 \ ^\circ \text{C} &lt; T_\text{J} &lt; 125 \ ^\circ \text{C}</td>
<td>5</td>
<td>15</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>V_\text{DROP}</td>
<td>Dropout voltage(^{(2)})</td>
<td>I_\text{OUT} = 1.2 \ \text{A}, V_\text{OUT} &gt; 2.5 \ \text{V} - 40 \ ^\circ \text{C} &lt; T_\text{J} &lt; 125 \ ^\circ \text{C}</td>
<td>350</td>
<td>600</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>eN</td>
<td>Output noise voltage</td>
<td>10 \ \text{Hz to} 100 \ \text{kHz}, I_\text{OUT} = 100 \ \text{mA}</td>
<td>60</td>
<td></td>
<td></td>
<td>\mu\text{V RMS}/V_\text{OUT}</td>
</tr>
<tr>
<td>SVR</td>
<td>Supply voltage rejection</td>
<td>V_\text{IN} = V_\text{OUT(NOM)} + 1 \ \text{V} \pm V_\text{RIPPLE}, V_\text{RIPPLE} = 0.5 \ \text{V}, f = 120 \ \text{Hz}</td>
<td>87</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_\text{IN} = V_\text{OUT(NOM)} + 1 \ \text{V} \pm V_\text{RIPPLE}, V_\text{RIPPLE} = 0.5 \ \text{V}, f = 1 \ \text{kHz}</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_\text{IN} = V_\text{OUT(NOM)} + 1 \ \text{V} \pm V_\text{RIPPLE}, V_\text{RIPPLE} = 0.5 \ \text{V}, f = 100 \ \text{kHz}</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_\text{Q}</td>
<td>Quiescent current</td>
<td>I_\text{OUT} = 0 \ \text{mA} to 1.2 \ A, -40 \ ^\circ \text{C} &lt; T_\text{J} &lt; 125 \ ^\circ \text{C}</td>
<td>250</td>
<td>500</td>
<td></td>
<td>\mu\text{A}</td>
</tr>
<tr>
<td>I_\text{SC}</td>
<td>Output current</td>
<td></td>
<td>1.5</td>
<td>2</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>T_\text{SHDN}</td>
<td>Thermal shutdown</td>
<td></td>
<td>175</td>
<td></td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>Hysteresis</td>
<td></td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
\(^{(1)}\) V_\text{IN} = V_\text{OUT} + 1 \ \text{V or 2.6 V, whichever is greater.}
\(^{(2)}\) Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value; this specification does not apply for nominal output voltages below 2.5 V.
6 Application information

6.1 Thermal and short-circuit protections

The LDL1117 is self-protected from short-circuit conditions and overtemperature. When the output load is higher than the one supported by the device, the output current rises until the limit of typically 2 A is reached. The current limit value is dependent of the dissipated power, thanks to an additional SOA protection, so that the maximum power is limited.

The peak current available for a defined drop voltage \( V_{\text{IN}} - V_{\text{OUT}} \) is shown in Section 7: Typical performance characteristics.

The thermal protection occurs when the junction temperature reaches typically 175 °C. The IC enters the shutdown status. As soon as the junction temperature falls again below 150 °C (typ.) the device starts working again.

In order to calculate the maximum power that the device can dissipate, keeping the junction temperature below \( T_{\text{J,OP}} \), the following formula is used:

\[
P_{\text{DMAX}} = \frac{(125 - T_{\text{AMB}})}{R_{\text{THJ-A}}}
\]

\( P_{\text{DMAX}} \) should be also derated according to the maximum current allowed by the SOA protection.

6.2 Input and output capacitor selection

The LDL1117 requires external capacitors to assure the regulator control loop stability.

Any good quality ceramic capacitor can be used but, the X5R and the X7R are suggested since they guarantee a very stable combination of capacitance and ESR over the temperature range. The input/output capacitors should be placed as close as possible to the relative pins. The LDL1117 requires an input capacitor with a minimum value of 1 μF.

This capacitor must be placed as close as possible to the input pin of the device and returned to a clean analog ground. The control loop of the LDL1117 is designed to work with an output ceramic capacitor. Other type of capacitors may be used, as long as they meet the requirements of minimum capacitance and equivalent series resistance (ESR), as shown in Figure 20: "Stability plan (VOUT = 5 V)" and Figure 21: "Stability plan (VOUT = 1.2 V)."

To assure stability, the output capacitor must maintain its ESR and capacitance in the stable region, over the full operating temperature range.

The suggested combination of 1 μF input and 4.7 μF output capacitors offers a good compromise among the stability of the regulator, optimum transient response and total PCB area occupation.
7 Typical performance characteristics

(The following plots are referred to the typical application circuit and, unless otherwise noted, at $T_A = 25$ °C)

**Figure 4**: Output voltage vs temperature (VIN = 2.6 V, VOUT = 1.2 V, no-load)

**Figure 5**: Output voltage vs temperature (VIN = 2.6 V, VOUT = 1.2, 1200 mA)

**Figure 6**: Output voltage vs temperature (VIN = 6 V, VOUT = 5 V, no-load)

**Figure 7**: Output voltage vs temperature (VIN = 6 V, VOUT = 5 V, 1200 mA)
Figure 8: Line regulation vs temperature
(VIN = 6 to 18 V, VOUT = 5 V, IOUT = 10 mA)

Figure 9: Line regulation vs temperature
(VIN = 2.5 to 18 V, VOUT = 1.2 V, IOUT = 10 mA)

Figure 10: Load regulation vs temperature
(VIN = 6 V, VOUT = 5 V, IOUT = 10 to 1200 mA)

Figure 11: Load regulation vs temperature
(VIN = 2.6 V, VOUT = 1.2 V, IOUT = 10 to 1200 mA)

Figure 12: Dropout voltage vs temperature

Figure 13: Quiescent current vs temperature
(no-load)
**Typical performance characteristics**

**Figure 14**: Quiescent current vs temperature (600 mA)

**Figure 15**: Quiescent current vs temperature (1.2 A)

**Figure 16**: Short-circuit current vs dropout voltage (VOUT = 5 V)

**Figure 17**: Short-circuit current vs dropout voltage (VOUT = 1.2 V)

**Figure 18**: SVR vs frequency

**Figure 19**: Output noise spectral density (VO = 1.2 V)

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DocID030319 Rev 3 13/20
Typical performance characteristics

**Figure 20:** Stability plan (VOUT = 5 V)

**Figure 21:** Stability plan (VOUT = 1.2 V)

**Figure 22:** Turn-on time (VOUT = 5 V)

**Figure 23:** Turn-on time (VOUT = 1.2 V)

**Figure 24:** Line transient (VOUT = 5 V)

**Figure 25:** Line transient (VOUT = 1.2 V)
Typical performance characteristics

Figure 26: Load transient (VOUT = 1.2 V)

Figure 27: Load transient (VOUT = 5 V)
8 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

8.1 SOT223 package information

Figure 28: SOT223 package outline
Table 5: SOT223 package mechanical data

<table>
<thead>
<tr>
<th>Dim.</th>
<th>mm</th>
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<tbody>
<tr>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>A</td>
<td>1.8</td>
</tr>
<tr>
<td>A1</td>
<td>0.02</td>
</tr>
<tr>
<td>B</td>
<td>0.6</td>
</tr>
<tr>
<td>B1</td>
<td>2.9</td>
</tr>
<tr>
<td>c</td>
<td>0.24</td>
</tr>
<tr>
<td>D</td>
<td>6.3</td>
</tr>
<tr>
<td>e</td>
<td>2.3</td>
</tr>
<tr>
<td>e1</td>
<td>4.6</td>
</tr>
<tr>
<td>E</td>
<td>3.3</td>
</tr>
<tr>
<td>H</td>
<td>6.7</td>
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<tr>
<td>V</td>
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## 9 Ordering information

### Table 6: Order code

<table>
<thead>
<tr>
<th>Part number</th>
<th>Marking</th>
<th>Order code</th>
<th>Output voltage (V)</th>
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<tbody>
<tr>
<td>LDL1117</td>
<td>LL12</td>
<td>LDL1117S12R</td>
<td>1.185</td>
</tr>
<tr>
<td>LDL1117</td>
<td>LL15</td>
<td>LDL1117S15R</td>
<td>1.5</td>
</tr>
<tr>
<td>LDL1117</td>
<td>LL18</td>
<td>LDL1117S18R</td>
<td>1.8</td>
</tr>
<tr>
<td>LDL1117</td>
<td>LL25</td>
<td>LDL1117S25R</td>
<td>2.5</td>
</tr>
<tr>
<td>LDL1117</td>
<td>LL30</td>
<td>LDL1117S30R</td>
<td>3.0</td>
</tr>
<tr>
<td>LDL1117</td>
<td>LL33</td>
<td>LDL1117S33R</td>
<td>3.3</td>
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<tr>
<td>LDL1117</td>
<td>LL50</td>
<td>LDL1117S50R</td>
<td>5.0</td>
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</table>
10 Revision history

Table 7: Document revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
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<tbody>
<tr>
<td>27-Feb-2017</td>
<td>1</td>
<td>Initial release.</td>
</tr>
<tr>
<td>30-Mar-2017</td>
<td>2</td>
<td>Updated features in cover page and Section 9: &quot;Ordering information&quot;. Minor text changes.</td>
</tr>
<tr>
<td>04-Jul-2017</td>
<td>3</td>
<td>In Table 3: &quot;Thermal data&quot;: - thermal data values changed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minor text changes.</td>
</tr>
</tbody>
</table>
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