Features

- 150mA Low Dropout Regulator in 3-pin package
- Very low I<sub>Q</sub> over full load: 65µA
- Wide input voltage range: 2V to 6V
- Fixed output options: 1.0V to 3.3V
- PSRR: 65dB at 100Hz
- Fast start-up time: 80µs
- Stable with low ESR, 1µF ceramic output capacitor
- Excellent Load/Line Transient Response
- Low dropout: 150mV typical at 150mA
- Current limit protection
- Short circuit protection
- Thermal shutdown protection
- Ambient temperature range: -40°C to 85°C
- SOT23 and SOT23R: Available in “Green” Molding Compound (No Br, Sb)
- Lead Free Finish/RoHS Compliant (Note 1)

Description

The AP7313 is a 150mA, fixed output voltage, low dropout linear regulator. The device included pass element, error amplifier, band-gap, current limit and thermal shutdown circuitry.

The characteristics of low dropout voltage and low quiescent current make it suitable for low power applications, for example, battery powered devices. The typical quiescent current is approximately 65µA.

Built-in current-limit and thermal-shutdown functions prevent IC from damage in fault conditions.

The AP7313 is available in SOT23 package with different pin-outs.

Applications

- Notebook and Desktop Computers and Pheripherals
- Portable Devices
- Battery Powered Devices
- CD-ROM, DVD and LAN Cards

Typical Application Circuit
Ordering Information

AP7313 - XX XX G - 7

Output | Package | Green | Packing
--- | --- | --- | ---
10 : 1.0V | SA : SOT23 | G : Green | 7 : Tape & Reel
12 : 1.2V | SR : SOT23R
15 : 1.5V
18 : 1.8V
20 : 2.0V
25 : 2.5V
28 : 2.8V
30 : 3.0V
33 : 3.3V

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<th>Package Code</th>
<th>Packaging (Note 2)</th>
<th>7&quot; Tape and Reel</th>
<th>Quantity</th>
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<tr>
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<td>SOT23</td>
<td>3000/Tape &amp; Reel</td>
<td>-7</td>
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<td>SR</td>
<td>SOT23R</td>
<td>3000/Tape &amp; Reel</td>
<td>-7</td>
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Notes:
2. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

Pin Assignment

(1) SOT23

( Top View )

IN 1

OUT 2

GND 3

(1) SOT23R

( Top View )

GND 1

IN 3

OUT 2
Pin Descriptions

<table>
<thead>
<tr>
<th>Pin Name</th>
<th>Pin Number</th>
<th>Description</th>
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<tr>
<td>IN</td>
<td>1</td>
<td>Voltage input pin. Bypass to ground through at least 1µF capacitor</td>
</tr>
<tr>
<td>OUT</td>
<td>2</td>
<td>Voltage output pin. Bypass to ground through 1µF ceramic capacitor</td>
</tr>
<tr>
<td>GND</td>
<td>3</td>
<td>Ground</td>
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Functional Block Diagram

[Diagram of the AP7313: IN, OUT, Gate Driver, Current Limit and Thermal Shutdown, VREF, GND]
### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Ratings</th>
<th>Units</th>
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<tr>
<td>ESD HBM</td>
<td>Human Body Model ESD Protection</td>
<td>6</td>
<td>kV</td>
</tr>
<tr>
<td>ESD MM</td>
<td>Machine Model ESD Protection</td>
<td>400</td>
<td>V</td>
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<tr>
<td>VIN</td>
<td>Input Voltage</td>
<td>7</td>
<td>V</td>
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<tr>
<td></td>
<td>Continuous Load Current</td>
<td>Internal Limited</td>
<td></td>
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<tr>
<td>T_OP</td>
<td>Operating Junction Temperature Range</td>
<td>-40 ~ 125</td>
<td>°C</td>
</tr>
<tr>
<td>T_ST</td>
<td>Storage Temperature Range</td>
<td>-65 ~150</td>
<td>°C</td>
</tr>
<tr>
<td>P_D</td>
<td>Power Dissipation (Note 3)</td>
<td>SOT23</td>
<td>600 mW</td>
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<td></td>
<td></td>
<td>SOT23R</td>
<td>540 mW</td>
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<tr>
<td>T_J</td>
<td>Maximum Junction Temperature</td>
<td>150</td>
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### Recommended Operating Conditions

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<thead>
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<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
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<tbody>
<tr>
<td>VIN</td>
<td>Input voltage</td>
<td>2</td>
<td>6</td>
<td>V</td>
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<tr>
<td>I_OUT</td>
<td>Output Current (Note 4)</td>
<td>0</td>
<td>150</td>
<td>mA</td>
</tr>
<tr>
<td>T_A</td>
<td>Operating Ambient Temperature</td>
<td>-40</td>
<td>85</td>
<td>°C</td>
</tr>
</tbody>
</table>

Notes:
3. Ratings apply to ambient temperature at 25°C
4. The device maintains a stable, regulated output voltage without a load current.
### Electrical Characteristics

\( (T_A = 25\,^\circ C, \, V_{IN} = V_{OUT} + 1V, \, C_{IN} = 1\mu F, \, C_{OUT} = 1\mu F, \, \text{unless otherwise stated}) \)

<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>
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<tr>
<td>I_Q</td>
<td>Input Quiescent Current</td>
<td>I_{OUT} = 0mA</td>
<td>—</td>
<td>55</td>
<td>75</td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_{OUT} = 150mA</td>
<td>65</td>
<td>85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_{Dropout}</td>
<td>Dropout Voltage (Note 5)</td>
<td>I_{OUT} = 150mA</td>
<td>150</td>
<td>300</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>V_{OUT}</td>
<td>Output Voltage Accuracy</td>
<td>TA = -40,^\circ C to 85,^\circ C, I_{OUT} = 30mA</td>
<td>-2</td>
<td>2</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>ΔV_{OUT} / ΔV_{IN}</td>
<td>Line Regulation</td>
<td>V_{IN} = (V_{OUT} +1V) to V_{IN-Max}, I_{OUT} = 1mA</td>
<td>0.01</td>
<td>0.20</td>
<td></td>
<td>%/V</td>
</tr>
<tr>
<td>ΔV_{OUT} / V_{OUT}</td>
<td>Load Regulation</td>
<td>V_{IN} = (V_{OUT} +1V) to V_{IN-Max}, I_{OUT} from 1mA to 150mA</td>
<td>-0.6</td>
<td>0.6</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>t_{ST}</td>
<td>Start-up Time</td>
<td>V_{EN} = 0V to 2.0V, V_{OUT} = 1.8V, I_{OUT} = 150mA</td>
<td>80</td>
<td></td>
<td></td>
<td>μs</td>
</tr>
<tr>
<td>PSRR</td>
<td>PSRR</td>
<td>V_{IN} = [V_{OUT} +1V]V_{DC} + 0.5V_{ppAC}, f = 100Hz, I_{OUT} = 30mA</td>
<td>65</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>I_{SHORT}</td>
<td>Short-circuit Current</td>
<td>V_{IN} = V_{IN-Min} to V_{IN-Max}, V_{OUT} &lt; 0.2V</td>
<td>50</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>I_{LIMIT}</td>
<td>Current limit</td>
<td>V_{IN} = (V_{OUT} +1V) to V_{IN-Max}, V_{OUT}/R_{OUT} = 0.5A</td>
<td>200</td>
<td>300</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>T_{SHDN}</td>
<td>Thermal shutdown threshold</td>
<td></td>
<td>140</td>
<td></td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>T_{HYS}</td>
<td>Thermal shutdown hysteresis</td>
<td></td>
<td>15</td>
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<td>°C</td>
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<tr>
<td>θ_{JA}</td>
<td>Thermal Resistance Junction-to-Ambient</td>
<td>SOT23 (Note 6)</td>
<td>207</td>
<td></td>
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<td>°C/W</td>
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<tr>
<td></td>
<td></td>
<td>SOT23R (Note 6)</td>
<td>230</td>
<td></td>
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<td>°C/W</td>
</tr>
</tbody>
</table>

Notes:
5. Dropout voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.
6. Test conditions for SOT23 and SOT23R: Device mounted on FR-4 substrate PCB, with minimum recommended pad layout, 2oz copper, single sided.
Typical Performance Characteristics

**Quiescent Current vs Input Voltage**

- **Quiescent Current vs Input Voltage**
  - **Iload=150mA**
  - **Iload=0mA**
  - **Vout=1.8V**
  - **Vout=Vout+1V**

**Line Regulation (%/V)**

- **Output Voltage Variation (%)**
  - **Vout=1.8V**
  - **Vout=Vout+1V**

**Load Regulation (%)**

- **Output Voltage Variation (%)**
  - **Vout=1.8V**
  - **Vout=Vout+1V**

**Dropout Voltage**

- **Output Voltage Variation (mV)**
  - **Vout=2.5V**
  - **Vout=1.8V**

**Short Circuit vs Input Voltage**

- **Output Current (mA)**
  - **Vout=1.8V**

**Notes:**

- **Vout=1.8V**
- **Vin=Vout+1V**

**Temperature Conditions:**

- **-45°C**
- **25°C**
- **90°C**

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Typical Performance Characteristics (Continued)

Current Limit vs Input Voltage

PSRR

V_{out}=1.8V
V_{in}=2.8V
C_{in}=C_{out}=1\mu F
T_{a}=25^\circ C

V_{out}=2.5V
V_{in}=3.5V
C_{in}=C_{out}=1\mu F
T_{a}=25^\circ C

V_{out}=3.3V
V_{in}=4.3V
C_{in}=C_{out}=1\mu F
T_{a}=25^\circ C

V_{out}=1.8V
V_{in}=2.8V
C_{in}=C_{out}=1\mu F
T_{a}=25^\circ C
Typical Performance Characteristics (Continued)

Line Transient Response

- Vin = 4.3V to 5.3V (1V/div)
- Tr = 15us
- Vout = 3.3V (100mV/div)
- Iout = 150mA (150mA/div)

Time (50us/div)

Line Transient Response

- Vin = 5.3V to 4.3V (1V/div)
- Tf = 15us
- Vout = 3.3V (100mV/div)
- Iout = 150mA (150mA/div)

Time (50us/div)

Load Transient Response

- Tr = Tf = 15us
- Vin = 3.5V
- Vout = 2.5V (100mV/div)
- Iout = 1mA to 150mA (50mA/div)

Time (50us/div)

Load Transient Response

- Tr = Tf = 15us
- Vin = 4.3V
- Vout = 3.3V (100mV/div)
- Iout = 1mA to 150mA (50mA/div)

Time (50us/div)
Typical Performance Characteristics (Continued)

Start-Up Time (No Load)

Vin=0 to 4.3V (1V/div)
Cin =Cout=1uF
Vout=3.3V (1.5V/div)
Time (50us/div)

Start-Up Time (150mA Load)

Vin=0 to 4.3V (1V/div)
Cin =Cout=1uF
Vout=3.3V (1.5V/div)
Iout=150mA (150mA/div)
Time (50us/div)
**Input Capacitor**
A 1μF ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND. A lower ESR capacitor allows the use of less capacitance, while higher ESR type requires more capacitance.

**Output Capacitor**
The output capacitor is required to stabilize and help transient response for LDO. The AP7313 is stable with very small ceramic output capacitors. The recommended capacitance is from 1μF to 4.7μF. Equivalent Series Resistance (ESR) is from 10mΩ to 200mΩ, and temperature characteristic is X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to OUT and GND pins, and keep the leads as short as possible.

**No Load Stability**
No minimum load is required to keep the device stable. The device will remain stable and regulated in no load condition.

**Current Limit Protection**
When output current at OUT pin is higher than current limit threshold, the current limit protection will be triggered and clamp the output current to approximately 300mA to prevent over-current and to protect the regulator from damage due to overheating.

**Short Circuit Protection**
When OUT pin is short-circuit to GND or OUT pin voltage is less than 200mV, short circuit protection will be triggered and clamp the output current to approximately 50mA. This feature protects the regulator from over-current and damage due to overheating.

**Thermal Shutdown Protection**
Thermal protection disables the output when the junction temperature rises to approximately +140°C, allowing the device to cool down. When the junction temperature reduces to approximately +125°C the output circuitry is enabled again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the heat dissipation of the regulator, protecting it from damage due to overheating.

**Ultra Fast Start-up**
After turned on, the AP7313 is able to provide full power in as little as tens of microseconds, typically 80μs, without sacrificing low ground current. This feature will help load circuitry move in and out of standby mode in real time, eventually extend battery life for mobile phones and other portable devices.

**Fast Transient Response**
Fast transient response LDOs can also extend battery life. TDMA-based cell phone protocols such as Global System for Mobile Communications (GSM) have a transmit/receive duty factor of only 12.5 percent, enabling power savings by putting much of the baseband circuitry into standby mode in between transmit cycles. In baseband circuits, the load often transitions virtually instantaneously from 100μA to 100mA. To meet this load requirement, the LDO must react very quickly without a large voltage drop or overshoot — a requirement that cannot be met with conventional, general-purpose LDOs.

The AP7313’s fast transient response from 0 to 150mA provides stable voltage supply for fast DSP and GSM chipset with fast changing load.

**Small Overshoot and Undershoot**
The AP7313 has small and controlled overshoot and undershoot in load and line transitions. This feature also permits the usage of small value output decoupling capacitor with AP7313.

**Low Quiescent Current**
The AP7313, consuming only around 65μA for all input range and output loading, provides great power saving in portable and low power applications.

**Wide Output Options**
The AP7313, with multiples of fixed output voltage options, provides a versatile LDO solution for many portable applications.

---

**Marking Information**

AP7313 Rev. 2

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NOVEMBER 2009
(1) SOT23 and SOT23R

(Top View)

<table>
<thead>
<tr>
<th>XX</th>
<th>Y</th>
<th>W</th>
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</tr>
</thead>
<tbody>
<tr>
<td>3</td>
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</table>

XX : Identification code
Y : Year 0~9
W : Week : A~Z : 1~26 week; a~z : 27~52 week; z represents 52 and 53 week
X : A~Z : Green

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Package Information  (All Dimensions in mm)
(1) Package Type: SOT23 and SOT23R
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