DESCRIPTION
The MP8201 is a low voltage, precision, adjustable shunt regulator. The MP8201 can operate from 1.2V to 12V where the desired value is set by external resistors. This wide dynamic range, gives the designer outstanding flexibility in the development of power supplies and instrumentation. The operating current of 60µA makes the part well suited for battery-powered portable electronic applications. The MP8201 regulates the output voltage from as low as 1.2V. The part has a sharp turn-on characteristic and a dynamic resistance of less than 1Ω.

The MP8201 is offered in 3-pin SOT23 packages.

FEATURES
- Wide Input Voltage Range: 1.2V to 12V
- Operating Current From 60µA to 20mA
- SOT-23 Package
- Initial Accuracy: ±0.5%
- 1Ω Dynamic Output Resistance of
- Stable With No External Capacitor
- Temperature Range: −40°C to +85°C

APPLICATIONS
- Instrumentation
- Linear Regulators
- Notebook Computers
- Medical Electronics
- 3V/ 5V 8-12 Bit Data Converters
- Battery-Powered Equipment

TYPICAL APPLICATION
ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Part Number*</th>
<th>Package</th>
<th>Top Marking</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP8201DT</td>
<td>SOT23-3</td>
<td>IZ6</td>
<td>–40°C to +85°C</td>
</tr>
</tbody>
</table>

* For Tape & Reel, add suffix –Z (eg. MP8201DT–Z).
For RoHS compliant packaging, add suffix –LF (eg. MP8201DT–LF–Z)

PACKAGE REFERENCE

ABSOLUTE MAXIMUM RATINGS (1)
- Reverse Current ....................................... 20mA
- Forward Current........................................ 20mA
- Continuous Power Dissipation (TA = +25°C) (2) ........................................0.52W
- Junction Temperature ....................150°C
- Lead Temperature .............................260°C
- Storage Temperature .......... −65°C to +150°C

Recommended Operating Conditions (3)
- Input Voltage.................................1.2V to 12V
- Output Voltage...............................1.2V to 10V
- Operating Temperature............ −40°C to +85°C

Thermal Resistance (4) \( \theta_JA \) \( \theta_JC \)
- SOT23-3 ........................................240 .... 110.. °C/W

Notes:
1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature \( T_J \) (MAX), the junction-to-ambient thermal resistance \( \theta_JA \), and the ambient temperature \( T_A \). The maximum allowable continuous power dissipation at any ambient temperature is calculated by \( P_D \) (MAX) = \( (T_J \) (MAX)-\( T_A \))/\( \theta_JA \). Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
3) The device is not guaranteed to function outside of its operating conditions.
4) Measured on JESD51-7, 4-layer PCB.
**ELECTRICAL CHARACTERISTICS**

*V_{out} = 1.2V, I_{IN} = 100\mu A to 10mA, T_{A} = +25^\circ C, typicals are at 25^\circ C, unless otherwise noted.*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Voltage (^{(5)})</td>
<td>V_{REF}</td>
<td></td>
<td>159.2</td>
<td>160</td>
<td>160.8</td>
<td>mV</td>
</tr>
<tr>
<td>Initial Accuracy</td>
<td>V_{OERR}</td>
<td></td>
<td>−0.8</td>
<td>+0.8</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−0.5</td>
<td>+0.5</td>
<td></td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Temperature Coefficient A Grade</td>
<td>TCV_{O}</td>
<td>0^\circ C to &lt; +70^\circ C</td>
<td>70</td>
<td></td>
<td></td>
<td>ppm/°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>−40^\circ C to +85^\circ C</td>
<td>85</td>
<td></td>
<td></td>
<td>ppm/°C</td>
</tr>
<tr>
<td>Ratio of the change in (V_{REF}) changed to (V_{OUT}) voltage change</td>
<td>ΔV_{REF}/ΔV_{OUT}</td>
<td>(I_{IN} = 0.1mA to 10mA)</td>
<td>1</td>
<td></td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Dynamic Output Impedance</td>
<td>(ΔV_{R}/ΔI_{R})</td>
<td>(I_{IN} = 1mA ± 100\mu A)</td>
<td>1</td>
<td></td>
<td></td>
<td>Ω</td>
</tr>
<tr>
<td>Minimum Operating Current</td>
<td>I_{IN}</td>
<td></td>
<td>100</td>
<td>60</td>
<td></td>
<td>µA</td>
</tr>
<tr>
<td>Voltage Noise</td>
<td></td>
<td>(f = 0.1Hz to 10Hz)</td>
<td>4</td>
<td></td>
<td></td>
<td>µV p-p</td>
</tr>
<tr>
<td>Turn-On Settling Time</td>
<td>t_{R}</td>
<td>Within 0.1% of Output</td>
<td>10</td>
<td></td>
<td></td>
<td>µs</td>
</tr>
<tr>
<td>Output Voltage Hysteresis</td>
<td></td>
<td></td>
<td>50</td>
<td></td>
<td></td>
<td>ppm</td>
</tr>
</tbody>
</table>

**Note:**

5) The forward diode voltage characteristic at −1mA is typically 0.65V.
TYPICAL PERFORMANCE CHARACTERISTICS

$I_{IN}=100\mu A$ to $10 mA$, $T_A=25^\circ C$ Unless otherwise noted.

- $V_{REF}$ vs. Temperature
  - $I_{IN}=0.1mA$, $V_{OUT}=2V$

- $V_{OUT}=1.2V$ Load Regulation
  - $V_{OUT}=1.8V$

- $V_{OUT}=2.5V$ Load Regulation
  - $V_{OUT}=3.3V$

- $V_{OUT}=1.8V$ Load Regulation

- Turn On with Load Capacitor
  - $I_{IN}=1mA$, $I_{OUT}=10mA$, $V_{OUT}=1.8V$, $C_{OUT}=4.7\mu F$

- Turn Off with Load Capacitor
  - $I_{IN}=1mA$, $I_{OUT}=10mA$, $V_{OUT}=1.8V$, $C_{OUT}=4.7\mu F$

- Line Transient
  - $V_{IN}=3V$ to $10V$, $V_{OUT}=1.8V$, $C_{OUT}=4.7\mu F$

- Load Transient
  - $V_{OUT}=1.8V$, $I_{OUT}=10mA$, $C_{OUT}=4.7\mu F$
PIN FUNCTIONS

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V+</td>
<td>Cathode</td>
</tr>
<tr>
<td>2</td>
<td>V–</td>
<td>Anode</td>
</tr>
<tr>
<td>3</td>
<td>VREF</td>
<td>Adjustable connection</td>
</tr>
</tbody>
</table>

FUNCTION BLOCK DIAGRAM

![Functional Block Diagram]

Figure 1—Functional Block Diagram
APPLICATION INFORMATION

External Bias Resistor
In the case of shunt voltage references, an external bias resistor (R_{BIAS}) is required between the supply voltage and the MP8201. R_{BIAS} sets the current that is required to pass through the load and the IC.

The load and the supply voltage can vary, so R_{BIAS} should be chosen such that it is small enough to supply the minimum current to the MP8201 when the supply voltage is at its minimum and the load current is at its maximum. In addition, R_{BIAS} needs to be large enough that the quiescent current does not exceed 10mA when the supply voltage is at its maximum and the load current is at its minimum.

Choose R_{BIAS} using the following equation:

\[
R_{BIAS} = \frac{V_{SUPPLY} - V_{OUT}}{I_L + I_Q}
\]

Adjustable Precision Voltage Source
The MP8201 can be combined with a precision op amp to produce a precise adjustable output voltage. See Figure 1.

The output of the op amp is determined by the gain of the circuit using the following equation:

\[
V_{OUT} = 1 + \frac{R_1}{R_2}
\]

An optional capacitor can be added in parallel with R2 to filter out high frequency noise.

Output Voltage Trim
Using a mechanical or digital potentiometer, the output voltage of the MP8201 can be trimmed to ±0.5%. See Figure 2. Note that trimming other resistor values may not produce an accurate output from the MP8200.

Precise Negative Voltage Reference
The MP8201 can be configured for use in applications where a precise negative voltage reference is needed.

Choose R1 such that 60µA to 20mA is provided to properly bias the MP8201, using the equation:

\[
R_1 = \frac{V_{DD}}{I}
\]
PACKAGE INFORMATION

SOT23-3

**NOTE:**

1) ALL DIMENSIONS ARE IN MILLIMETERS.
2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR.
3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.10 MILLIMETERS MAX.
5) DRAWING CONFORMS TO JEDEC TO-236, VARIATION AB.
6) DRAWING IS NOT TO SCALE.

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