APPLICATION NOTE 4501

Simple Current Limiter Is Programmable

Nov 05, 2010

Abstract: This circuit lets you program a current limit without using microcontrollers or data converters. It consists of a charge-pump voltage doubler (U1), a current-sense amplifier (U2), and two n-channel MOSFETs. The sense-resistor value determines the maximum current limit.

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Available integrated circuits can let you program a current limit, but they generally involve microcontrollers or data converters (or both). As an alternative, the Figure 1 circuit lets you program a current limit without the intervention of microcontrollers or data converters. It consists of two miniature SOT-5 devices and a few external components. The sense-resistor value determines the maximum current limit.

![Circuit Diagram](image)

Figure 1. This circuit limits the $R_{LOAD}$ current to a value determined mainly by $R1$.

The circuit consists of a charge-pump voltage doubler (U1, MAX1682), a current-sense amplifier (U2, MAX4376), and two n-channel MOSFETs. U1 doubles the supply voltage to provide gate drive for Q2, and U2 amplifies the voltage across the sense resistor ($R_{SENSE}$) with a gain of 20. This U2 output drives the Q1 gate via the R2/R3 divider, which modulates the current through R1, which in turn sets the Q1
drain voltage and Q2’s gate-drive voltage.

U2’s output voltage is 20 times the voltage between RS+ and RS-, but has a full-scale limit of 2V. **Figure 2** shows the response of this circuit when you suddenly impose a heavy (low resistance) load. It allows an initial current surge to 10A, and then (after 20μs) settles to the desired limit of 7.25A.

![Figure 2. With VSUPPLY and VIN (at U1) equal to 5V, the Figure 1 circuit limits load current to 7.25V.](image)

The maximum allowed in-rush current is set by the sense resistor. A 10mΩ value, for instance, allows a maximum in-rush current of 100mV/10mΩ = 10A. This steady-state limit is determined by the operating characteristics of Q1 and Q2, together with the values chosen for resistors R1–R3. **Figure 3** shows the ILIMIT values obtained by varying R1 alone. To set other values of ILIMIT, you can vary the ratio R2/R3 while holding the R1 value fixed.

![Figure 3. With VSUPPLY and VIN (at U1) equal to 5V, the Figure 1 circuit’s steady-state current limit varies with R1 as shown.](image)
Related Parts

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<th>Part Number</th>
<th>Description</th>
<th>Information</th>
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<tbody>
<tr>
<td>MAX1682</td>
<td>Switched-Capacitor Voltage Doublers</td>
<td>Free Samples</td>
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<tr>
<td>MAX4376</td>
<td>Single/Dual/Quad High-Side Current-Sense Amplifiers with Internal Gain</td>
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