

AN-2219 Precision Current Limiting with the LMP8646 and LP38501

ABSTRACT

This application note discusses how to design the LMP8646 with the LP38501 voltage regulator and a resistive load application.

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1 Introduction

The LMP8646 is a precision current limiter used to improve the current limit accuracy of any switching or linear regulator with an available feedback node. Many regulators might have an internal current limiter, but its output accuracy is often as high as 30%. The output accuracy of the LMP8646 can be as low as 3%, making it a preferred current limiter for many regulator applications. The design procedures of the LMP8646 with the LP38501 voltage regulator and a resistive load application, as seen in [Figure 1](#), is the focus of this application note.

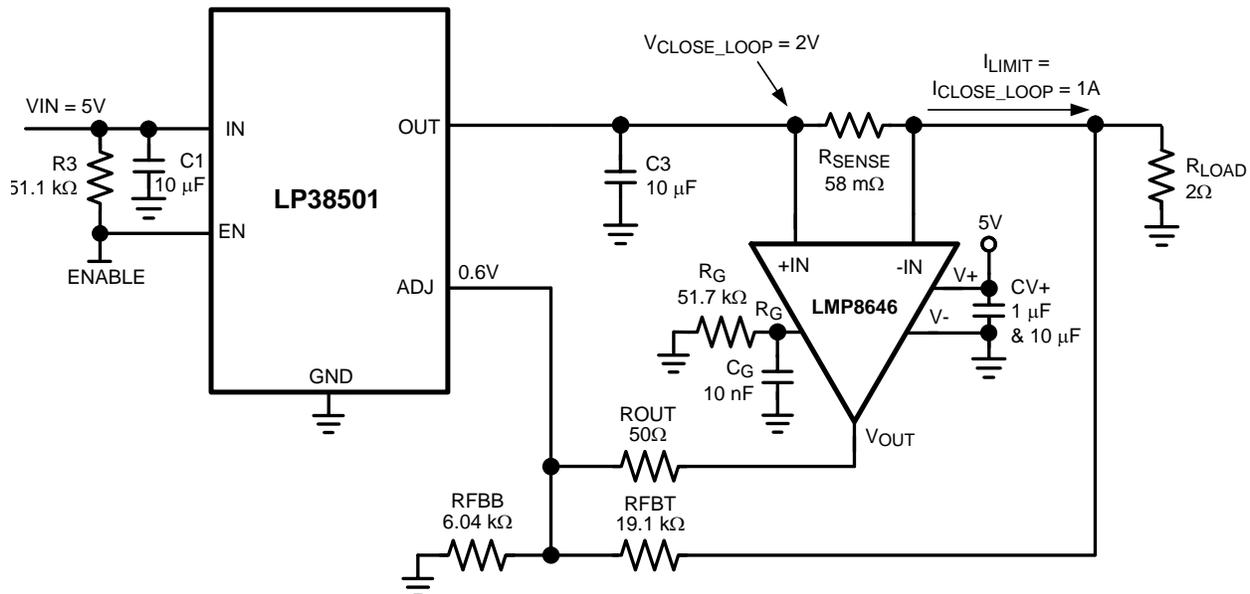


Figure 1. Resistive Load Application with LP38501 Regulator

For this example, we will let the open-loop current to be 1.25A and the close-loop current, I_{LIMIT} , to be 1A. An open-loop occurs when the LMP8646's output is not connected to the LP38501's ADJ pin; whereas, a close-loop scenario is when the LMP8646's output is connected to the LP38501's ADJ pin.

Step 1: Choose the components for the Regulator.

Refer to the LP38501 evaluation board application note (literature no: SNVA339) to select the appropriate components for the LP38501 voltage regulator. The LP38501 components chosen for this example can be seen in [Figure 1](#).

Step 2: Choose the sense resistor, R_{SENSE}

R_{SENSE} sets the voltage V_{SENSE} between +IN and -IN and has the following equation:

$$R_{SENSE} = V_{OUT} / [(I_{LIMIT}) * (R_G / 5k\Omega)] \quad (1)$$

In general, R_{SENSE} depends on the output voltage, limit current, and gain. Refer to LMP866 datasheet, section "Selection of the Sense Resistor, R_{SENSE} ", to choose the appropriate R_{SENSE} value. Typically, R_{SENSE} is a power resistor in the mOhm range. In this example, we will use 58 mOhm.

Step 3: Choose the gain resistor, R_G , for LMP8646

R_G is chosen from the limited sense current, I_{LIMIT} . As stated, $V_{OUT} = (R_{SENSE} * I_{LIMIT}) * (R_G / 5k\Omega)$. Since $V_{OUT} = V_{ADJ} = 0.6V$, $I_{LIMIT} = 1A$, and $R_{SENSE} = 58 \text{ m}\Omega$, R_G can be calculated as:

$$R_G = (V_{OUT} * 5 \text{ k}\Omega) / (R_{SENSE} * I_{LIMIT}) \quad (2)$$

$$R_G = (0.6 * 5 \text{ k}\Omega) / (58 \text{ m}\Omega * 1.0A) = 51.7 \text{ k}\Omega \quad (3)$$

Step 4: Choose the Bandwidth Capacitance, C_G .

The product of C_G and R_G determines the bandwidth for the LMP8646. Refer to the Typical Performance Characteristics plots in the LMP8646 datasheet to see the range for the LMP8646 bandwidth and gain. Since each application is very unique, the LMP8646 bandwidth capacitance, C_G , needs to be adjusted to fit the appropriate application.

Bench data has been collected for this resistive load application with the LP38501 regulator, and we found that this application works best for a bandwidth of 50 Hz to 300 Hz. Operating anything larger than this recommended bandwidth might prevent the LMP8646 from quickly limiting the current. We recommend choosing a bandwidth that is in the middle of this range and using the equation: $C_G = 1/(2*\pi*R_G*Bandwidth)$ to find C_G (this example uses a C_G value of 10 nF). After this selection, capture the plot for I_{LIMIT} and adjust C_G until a desired current plot is obtained.

Step 5: Choose the Output Resistor, R_{OUT}

R_{OUT} plays a very small role in the overall system performance for the resistive load application. R_{OUT} is used more for a supercap load because the initial current error is typically large with a capacitive load. Because current is directly proportional to voltage for a resistive load, the output current is not large at startup. The bigger the R_{OUT} , the longer it takes for the output voltage to reach its final value. We recommend that the value for R_{OUT} is at least 50 Ohm, which is the value we used for this example.

Step 6: Adjusting the Components

Capture the output current and output voltage plots and adjust the components as necessary. The most common component to adjust is C_G for the bandwidth. An example plot of the output current and voltage can be seen in [Figure 2](#).

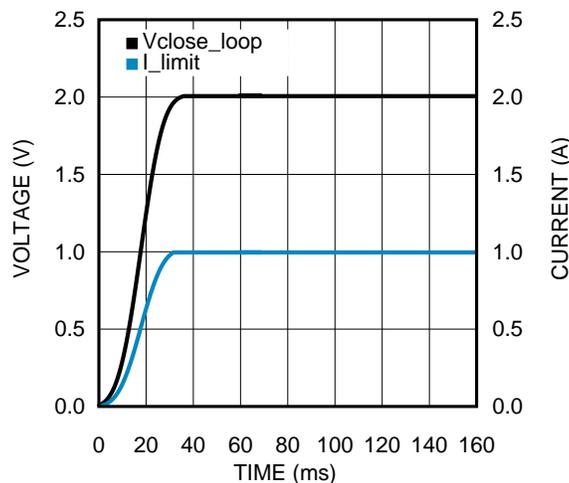


Figure 2. Plot of the Resistive Load Application with LMP8646 and LP38501

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