

# ***AN-2220 Precision Current Limiting with the LMP8646 and LMZ12003***

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## **ABSTRACT**

This application report discusses how to design the Texas Instruments LMP8646 with the LMZ12003 voltage regulator and a resistive load application.

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

$R_G$  is chosen from  $I_{LIMIT}$ . As stated in Equation 1, since  $V_{OUT} = V_{FB} = 0.8V$ ,  $I_{LIMIT} = 1A$ , and  $R_{SENSE} = 50\text{ mOhm}$ ,  $R_G$  can be calculated as:

$$R_G = (V_{OUT} \times 5\text{ kOhm}) / (R_{SENSE} \times I_{LIMIT}) \tag{2}$$

$$R_G = (0.8 \times 5\text{ kOhm}) / (50\text{ mOhm} \times 1A) = 80\text{ kOhm (approximate)}$$

**Step 4: Choose the Bandwidth Capacitance,  $C_G$ .**

The product of  $C_G$  and  $R_G$  determines the bandwidth for the LMP8646. To see the range for the LMP8646 bandwidth and gain, see the Typical Performance Characteristics plots in *LMP8646 Precision Current Limiter (SNOSC63)*. 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 the supercap application with the LMZ12003 regulator; it was discovered that this application works best for a bandwidth of 2 kHz to 30 kHz. Operating anything less than this recommended bandwidth might prevent the LMP8646 from quickly limiting the current. Choosing a bandwidth that is in the middle of this range is recommended and using the equation:

$$C_G = 1 / (2 \times \pi \times R_G \times \text{Bandwidth}) \tag{3}$$

to find  $C_G$  (this example uses a  $C_G$  value of 0.1nF).

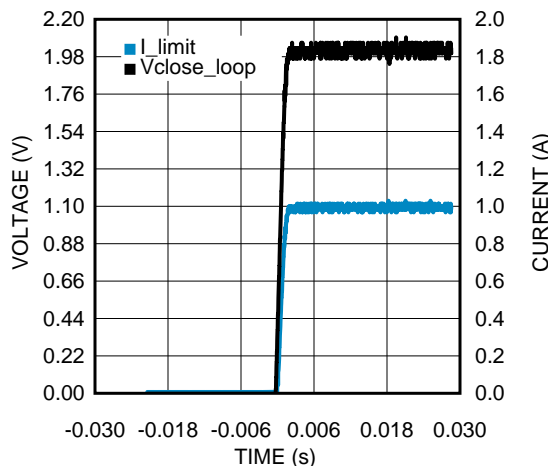
After selecting an initial  $C_G$  value, capture the plot for  $I_{LIMIT}$  and adjust  $C_G$  until a desired load current plot is obtained.

**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 more important 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. It is recommended that the value for  $R_{OUT}$  is at least 50  $\Omega$ , which is the value 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 components to adjust is  $C_G$  for the bandwidth. An example output current and voltage plot can be seen in Figure 2



**Figure 2. SuperCap Application with LMZ12003 Regulator Plot**

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