Application Brief

Constant Current Operation Using the Internal Current Limiter

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This application brief describes how to drive LEDs using the LM5177 4-switch bidirectional Buck-boost controller through the internal current limiter.

Introduction

The buck-boost controller LM5177 family can be used to drive LEDs through the internal current limiter or current sense resistor efficiently and in this application brief we will also discover how can we stabilize this LED driving function through the usage of IMONOUT and COMP pins. In LM5177 controller we have two voltage current sense resistors. First one is for sensing peak current sensing R_S and is placed just before the inductor connected to pins CSA and CSB. The other is the one that we will be focusing on, it is usually placed at the output just before the LED that we need to drive, connected to ISNSN and ISNSP pins R_{CS}. We can limit and monitor the input or output current using these two sense resistors.

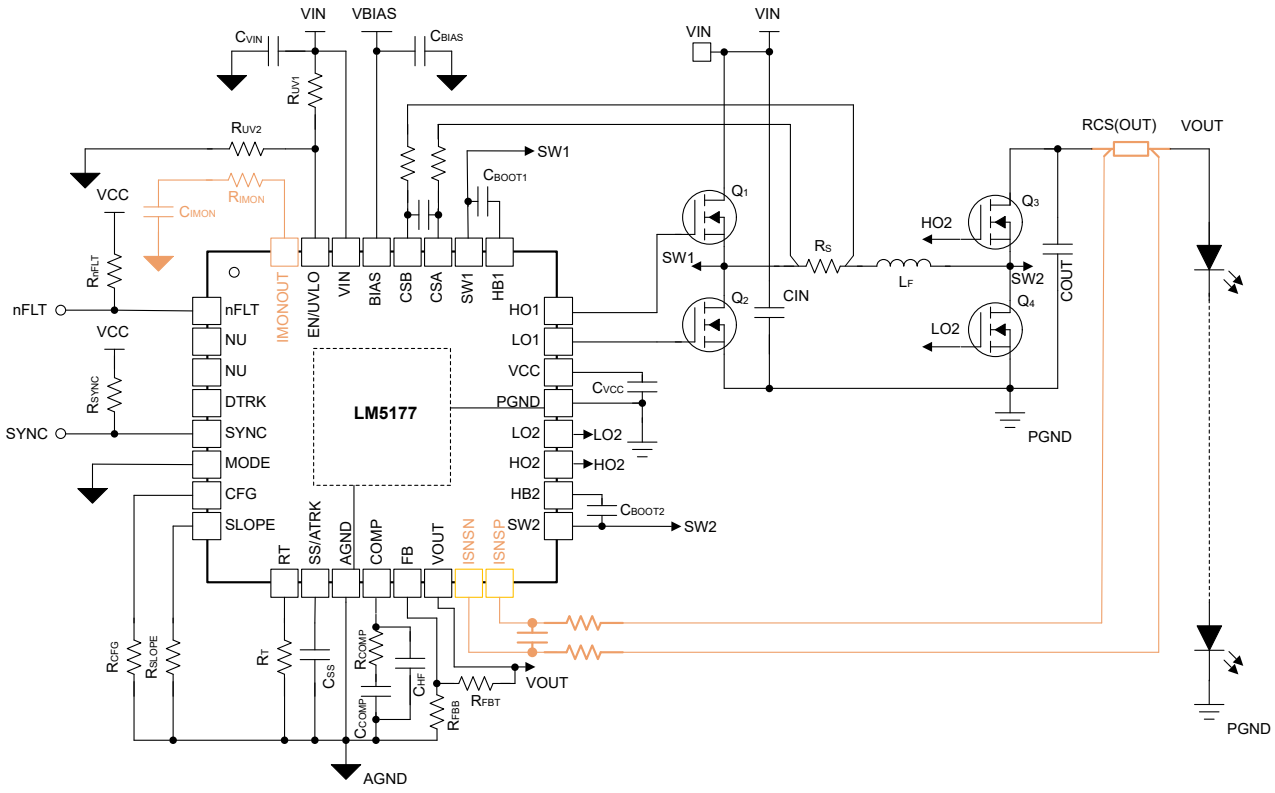

Figure 1. LM5177 4-Switch Buck-Boost Converter Schematic

For current monitoring the output voltage on the IMONOUT pin is in linear relation with the sense voltage difference across ISNSP and ISNSN pins, IMON sense amplifier transcendence and the resistor placed on the IMONOUT pin.

In current limit operation, the gm amplifier monitors the voltage across sense resistor and compares it with an internal reference, if the sense voltage is greater than the threshold the gm amplifier gradually reduces the peak current capability of the DC/DC converter until the differential voltage is equal to the reference voltage, we use this feature to regulate a constant current into the load which in our case is LEDs.

Settings

The LM5177EVM-HP is used for this application brief, as shown in Table 1, the configuration of the current limiting operation.

Table 1. Positive Current Limit Configuration Overview

LM5177 Pins	Action
Avg current limit on CFG pin	Enabled
SYNC pin	Pulled high (to VCC for example)
IMONOUT pin	Place the Compensation network

The current monitoring is enabled by default, although it can get disabled by forcing the IMONOUT pin to VCC during the device startup (pull-up IMONOUT to VCC). With the resistor connected to the CFG pin, the IMON function can be selected between monitoring and limiting function (limiting is ignored if IMONOUT is pulled to VCC). If limiting is selected, then the SYNC pin pulled to high at startup enables positive current limit.

Results

Functioning 14.2 V LED load (5 LEDs in series) with proper switching and almost no visible current ripple with 500 mA constant DC current fed to LED load through 100 m Ω for R_{CS} going into the ISNSN and ISNSP, as shown in Figure 2. As for the startup, we can see in Figure 3 the switching nodes before and after the inductor or buck and boost switch nodes alongside the Vout and Iout waveforms. We can see that the soft-start time due to the soft-start capacitor is around 8.6 ms to 9 ms.

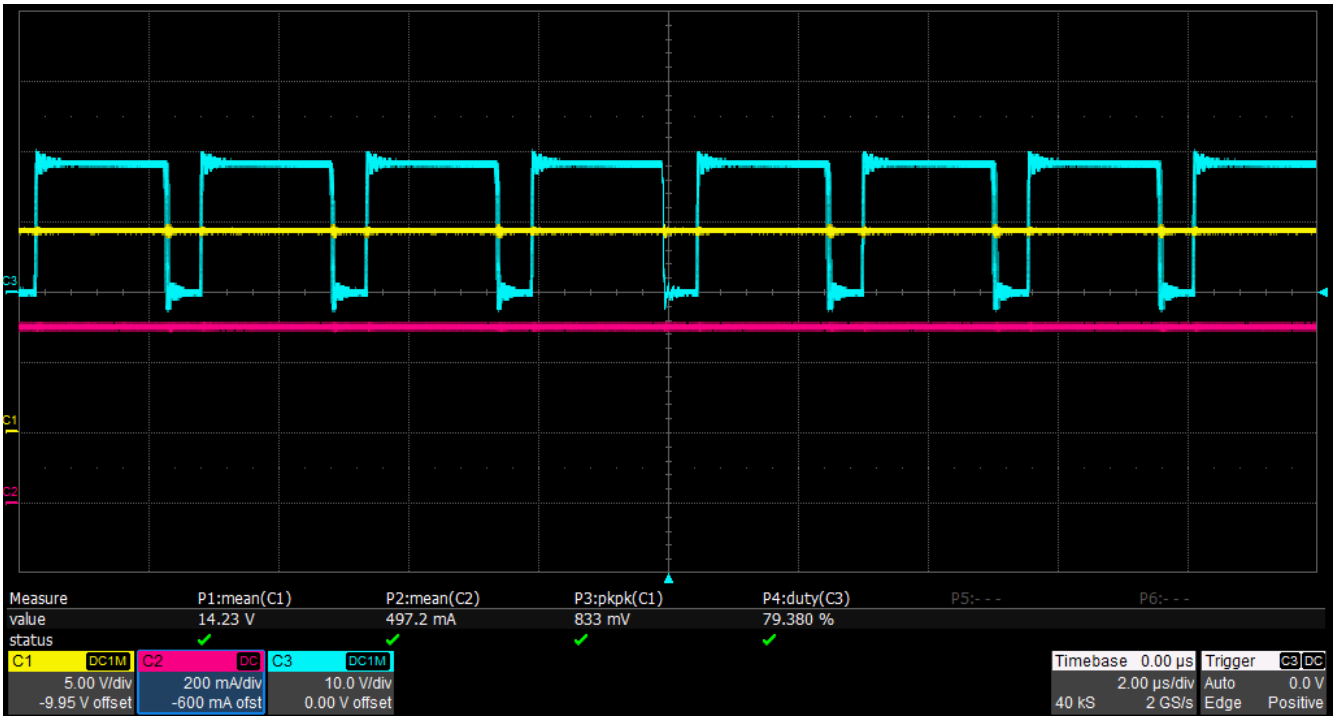

Figure 2. Steady-State Vin = 18 V, Vout =14.2 V (5 LEDs) at the Output

(Blue: Buck SW node, Yellow: Vout, Purple: Iout)

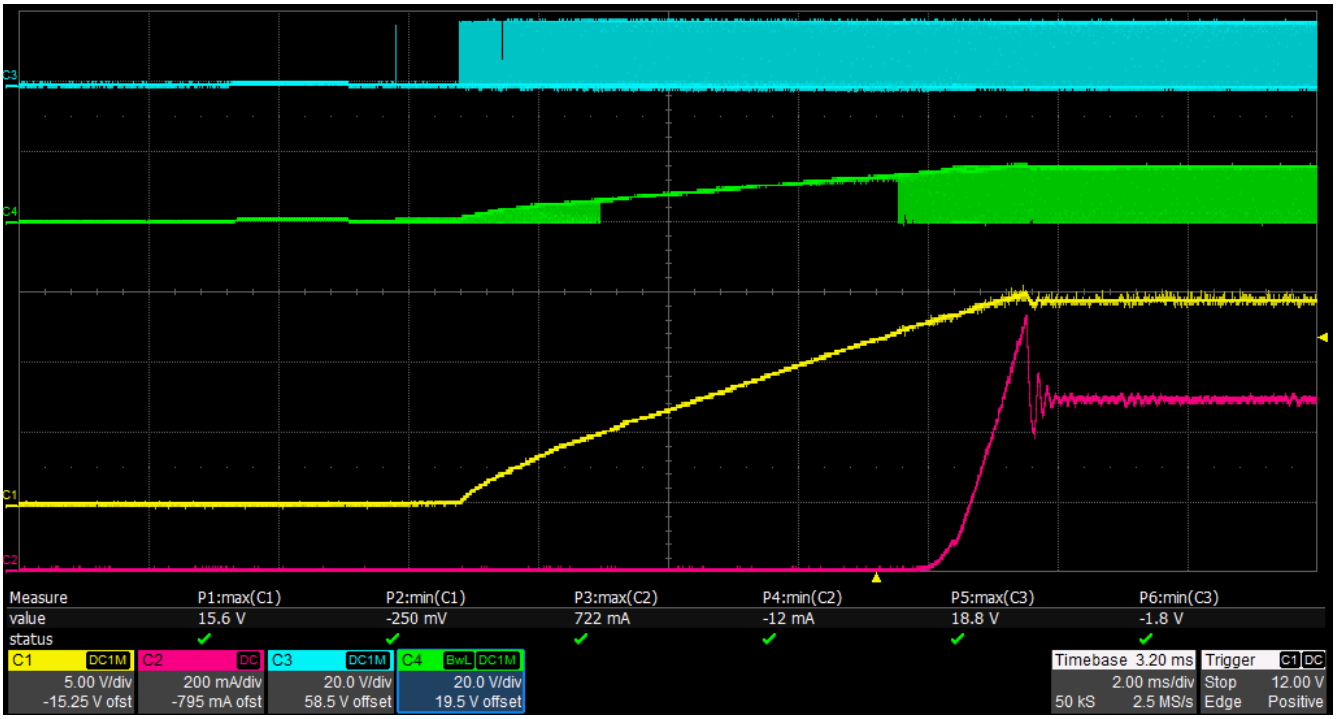

Figure 3. Startup Vin = 18 V, Vout =14.2 V (5 LEDs) at the Output

(Blue: Buck SW node, Green: Boost SW node, Yellow: Vout, Purple: Iout)

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