

LED driver with TPS40210 and INA193

- 5.5 ... 18.0V input voltage
- constant output current regulation (1.0A, depending on shunt R1)
- overvoltage protection on the output at no load
- external enable/disable
- dimming capability (100 Hz)

1 Startup

The startup waveform is shown in Figure 1. The input voltage is set at 12.0V with a 1.0A load at 12.0V on the output.

To measure both voltages simultaneous they are referenced to ground. The LED voltage is referenced to the input voltage!

Channel C1: **input voltage**
5V/div, 50ms/div

Channel C2: **output voltage**
5V/div, 50ms/div

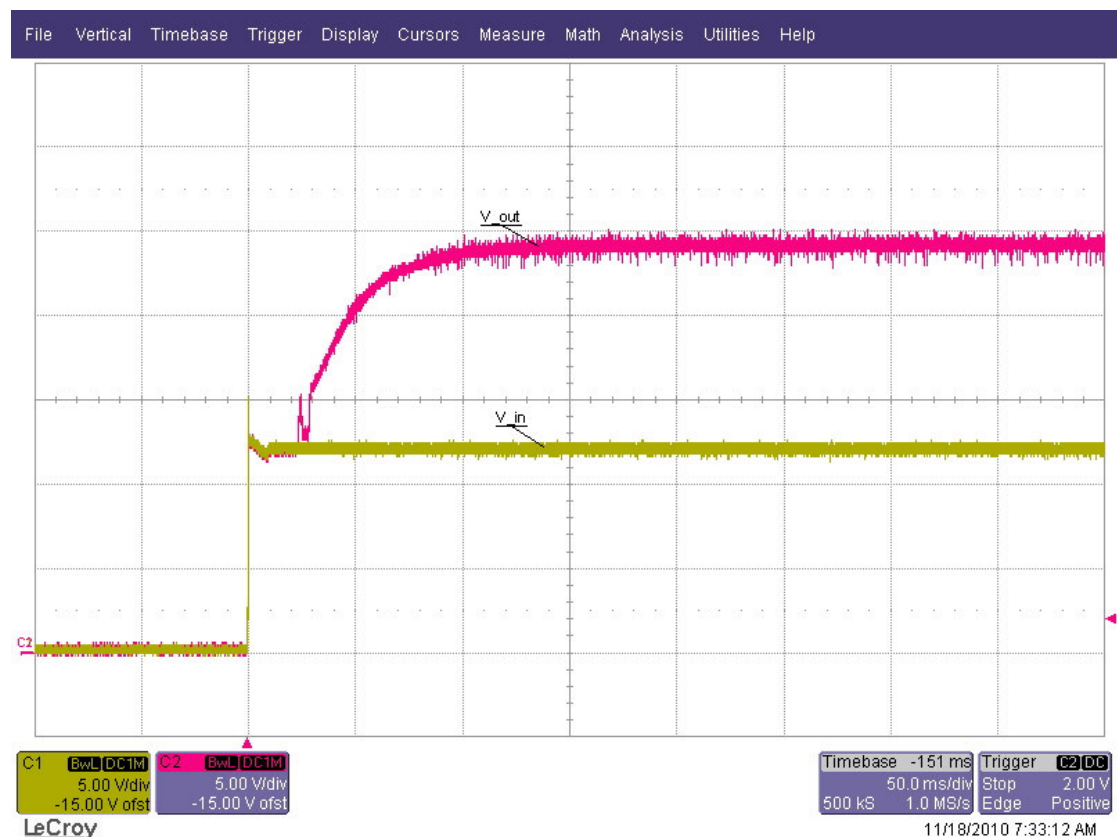


Figure 1

2 Shutdown

The shutdown waveform is shown in Figure 2. The input voltage is set at 12.0V with a 1.0A load at 12.0V on the output.

To measure both voltages simultaneous they are referenced to ground. The LED voltage is referenced to the input voltage!

Channel C1: **input voltage**
5V/div, 50us/div

Channel C2: **output voltage**
5V/div, 50us/div

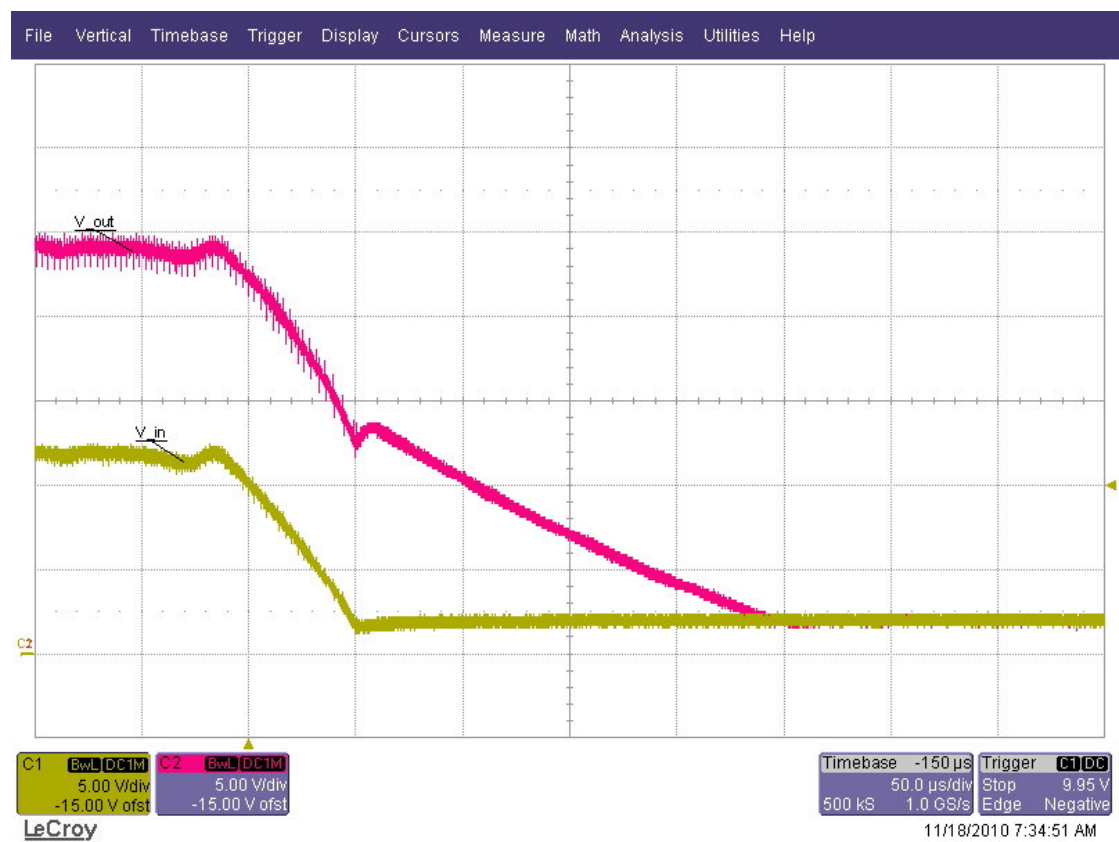


Figure 2

3 Efficiency

The efficiency of the converter is shown in Figure 3.

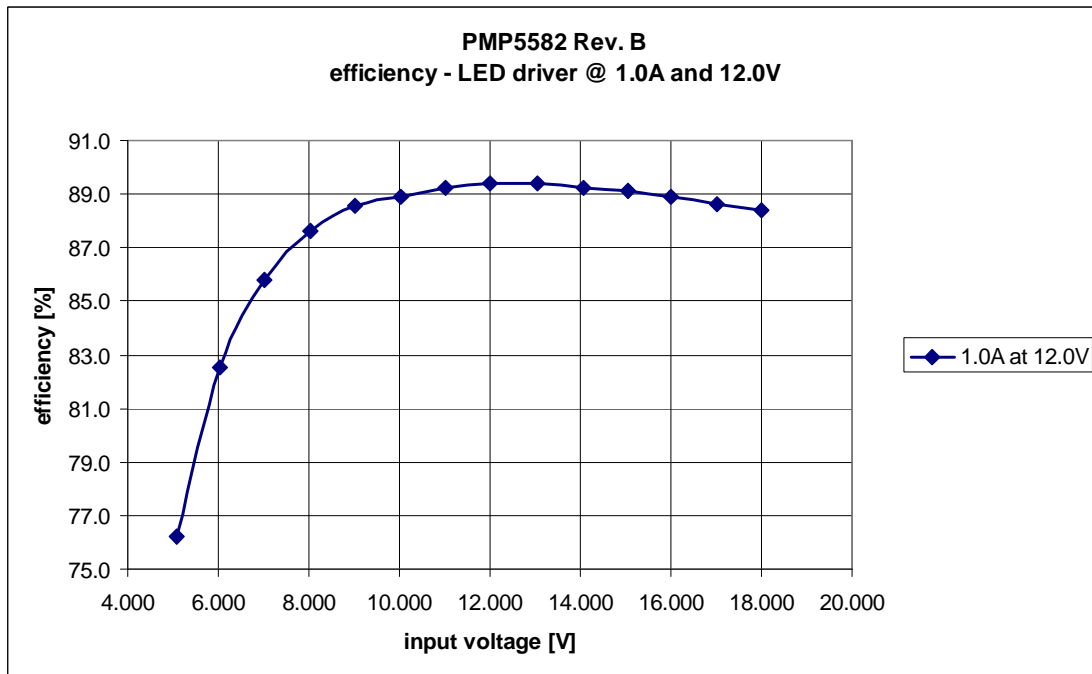


Figure 3

4 Load regulation

The load regulation is shown in Figure 4.

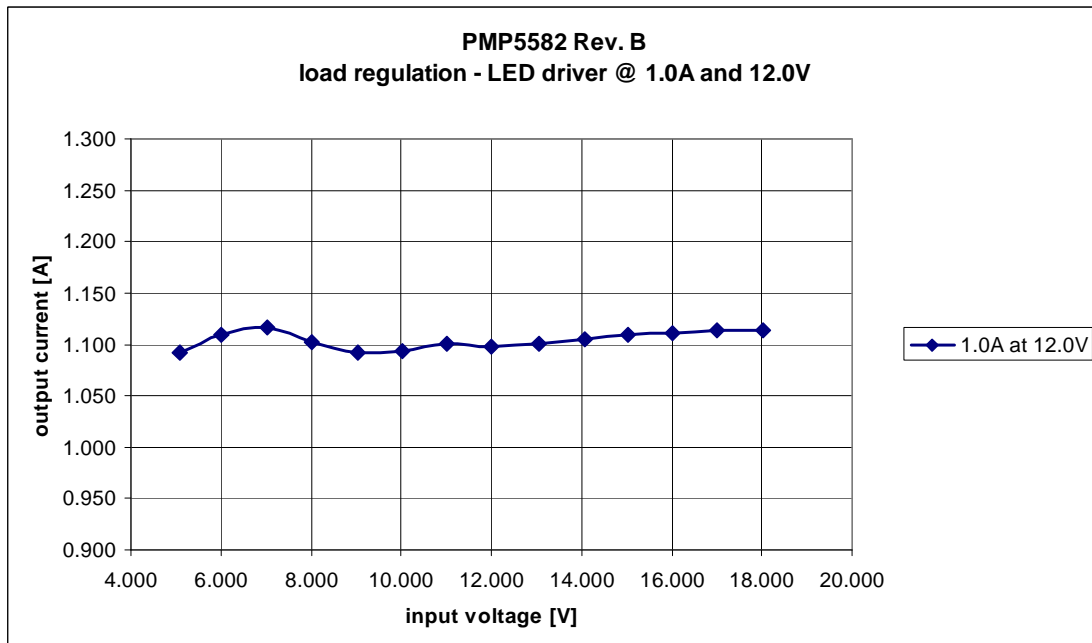


Figure 4

5 Output ripple voltage

The output ripple voltage at 1.0A load (12.0V output voltage) at 5.5, 12.0 and 18.0V input voltage is shown in Figure 5.

- 218mV peak-peak at 5.5V input voltage
- 182mV peak-peak at 12.0V input voltage
- 157mV peak-peak at 18.0V input voltage

Channel C1: **output ripple voltage**
100mV/div, 5us/div, AC coupled

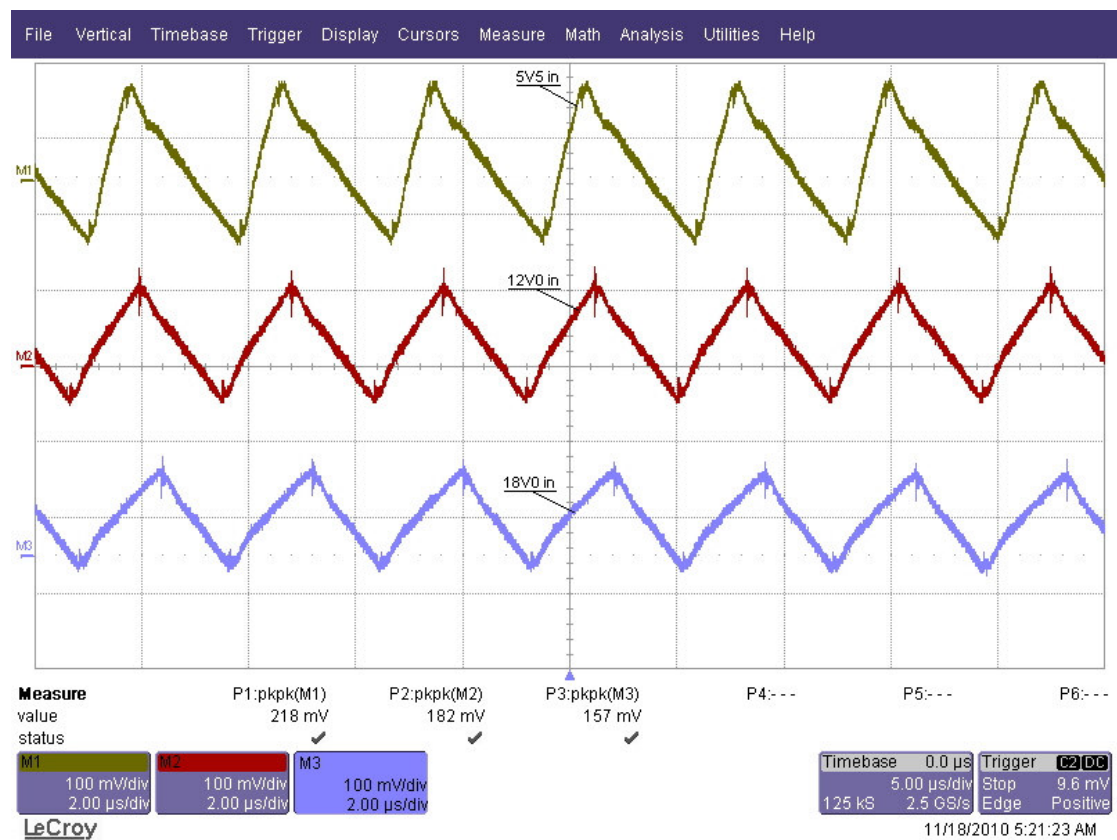


Figure 5

6 Output overvoltage protection

Due to the current regulation behavior the output voltage has to be limited when no load is connected.

Figure 6 shows that the output voltage is limited to max. 20.8V (12.0V input voltage).

Channel C1: **output voltage**
5V/div, 50ms/div

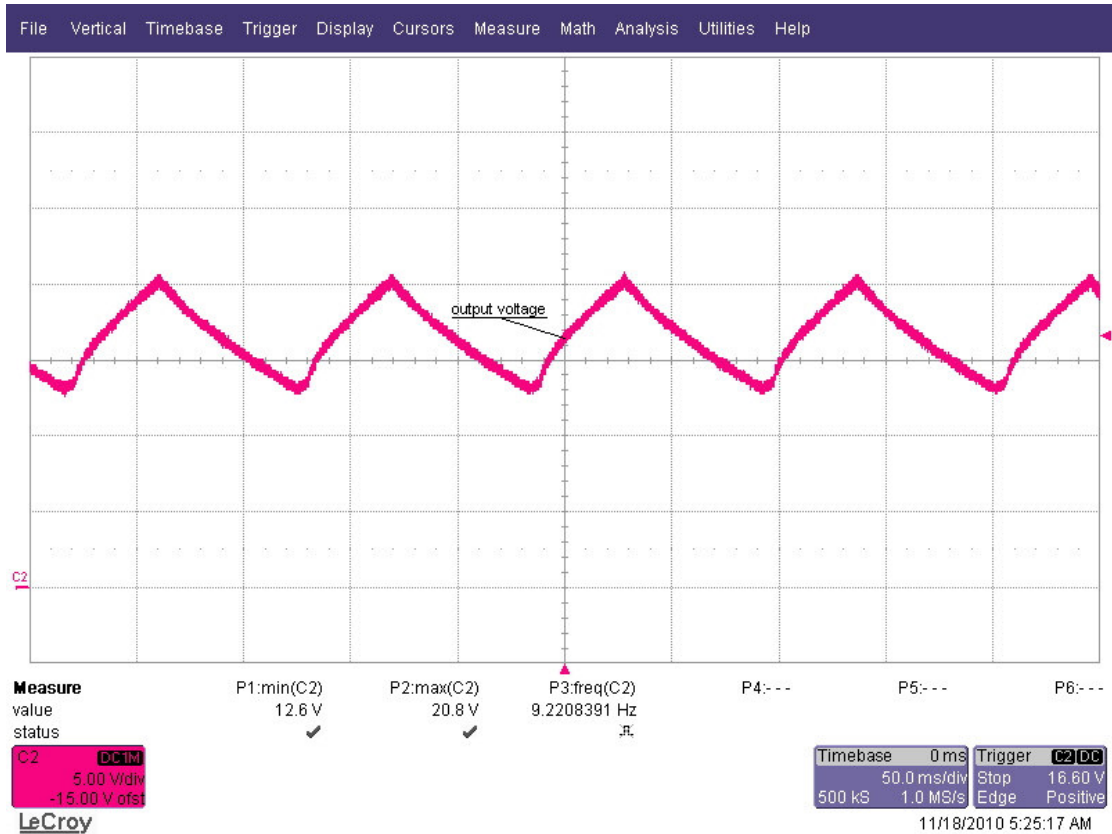


Figure 6

7 Frequency response

Figure 7 shows the loop response at 5.5, 12.0 and 18.0V input and a 1.0A load (12.0V output voltage).

- 89.7 deg phase margin @ crossover frequency 2.7 Hz
- 88.1 deg phase margin @ crossover frequency 4.2 Hz
- 89.3 deg phase margin @ crossover frequency 3.6 Hz

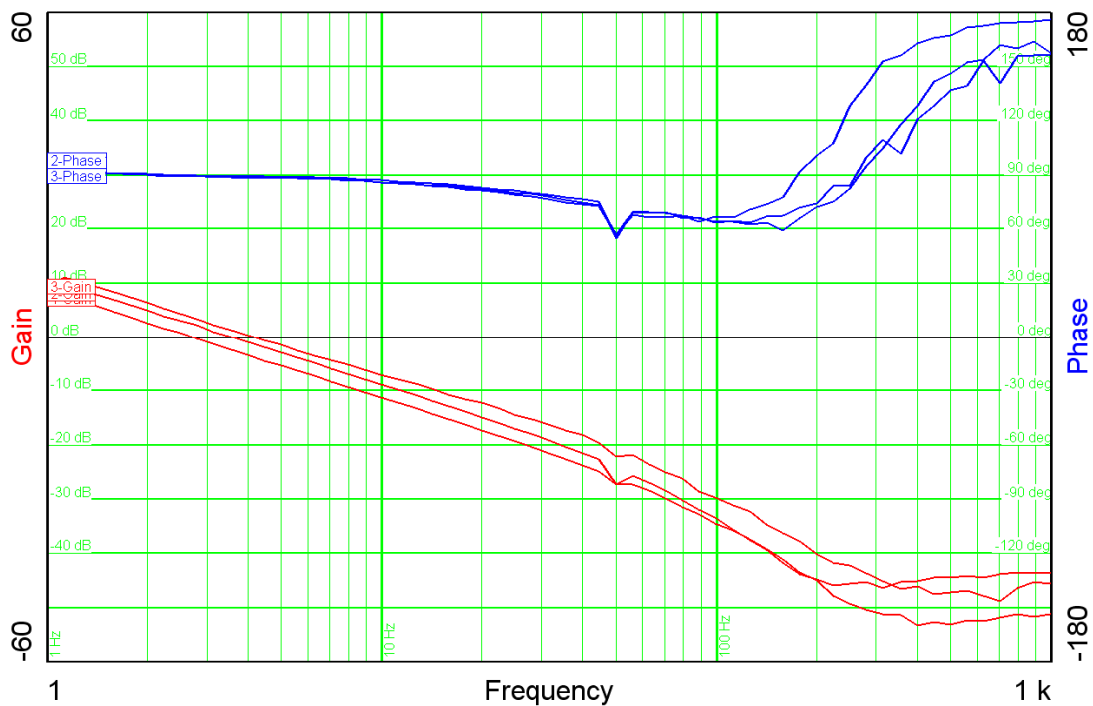


Figure 7

8 Miscellaneous waveforms

The voltage on the switching node is shown in Figure 8. The image was captured with a 18.0V input and a 1.0A load (12.0V output voltage).

Channel C2: **switching node voltage**, -2.0V minimum voltage, 37.7V maximum voltage
10V/div, 2us/div

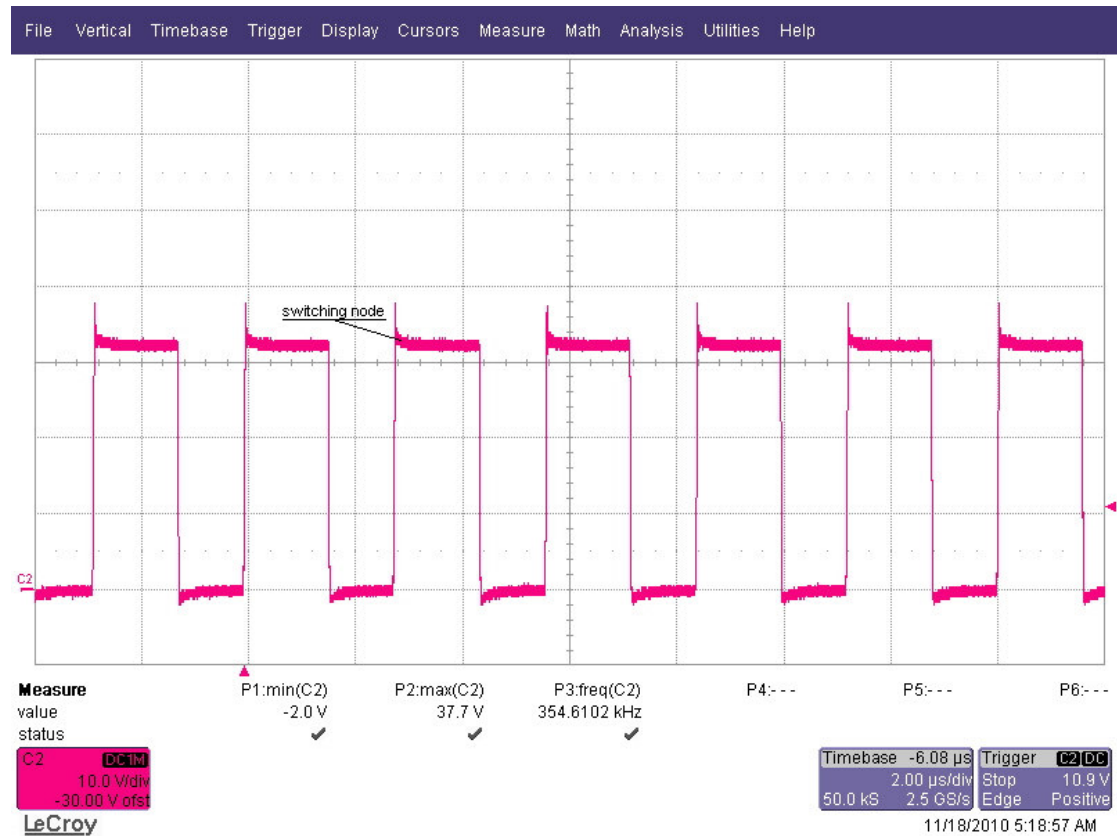


Figure 8

9 Dimming

The output current with dimming is shown in Figure 9.
 Dimming frequency is 240 Hz and the duty cycle is 50%.

- Channel C1: **output current**
200mA/div, 2ms/div
- Channel C2: **dimming signal**
5V/div, 2ms/div

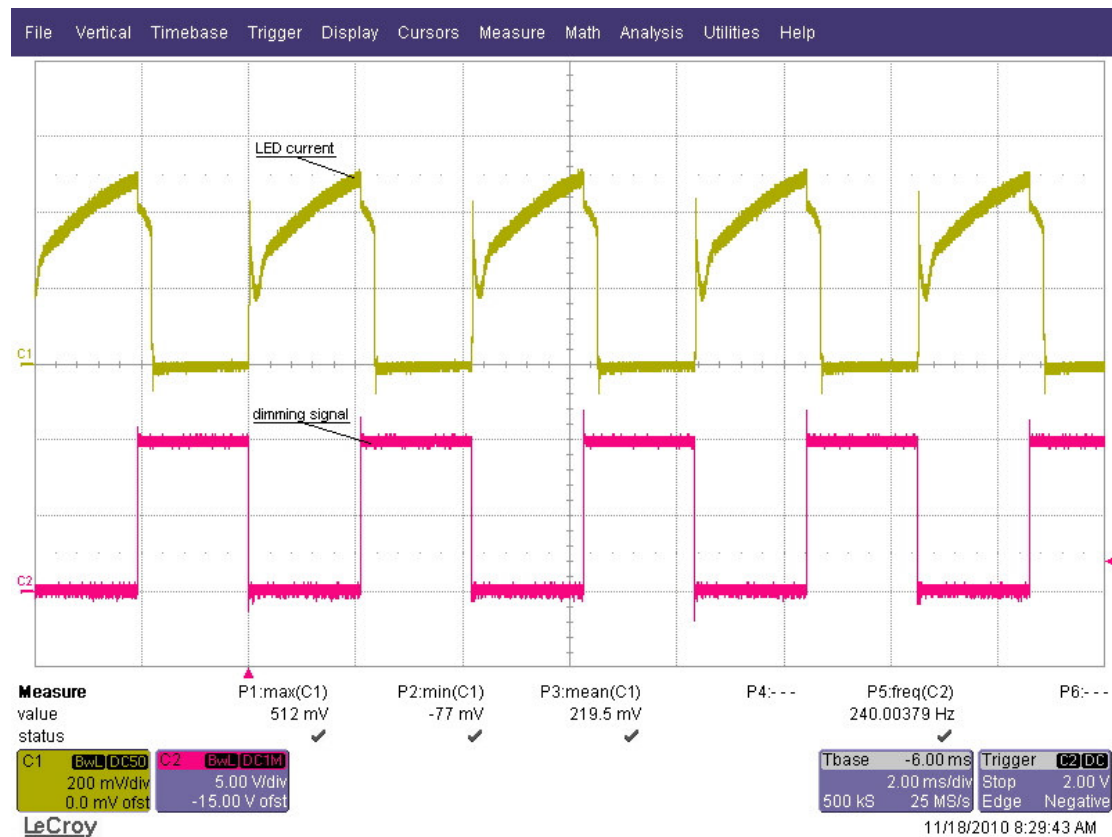


Figure 9

10 Thermal measurement

The thermal image (Figure 10) shows the circuit at an ambient temperature of 21 °C with an input voltage of 12.0V and a load of 1.0A (12.0V output voltage).

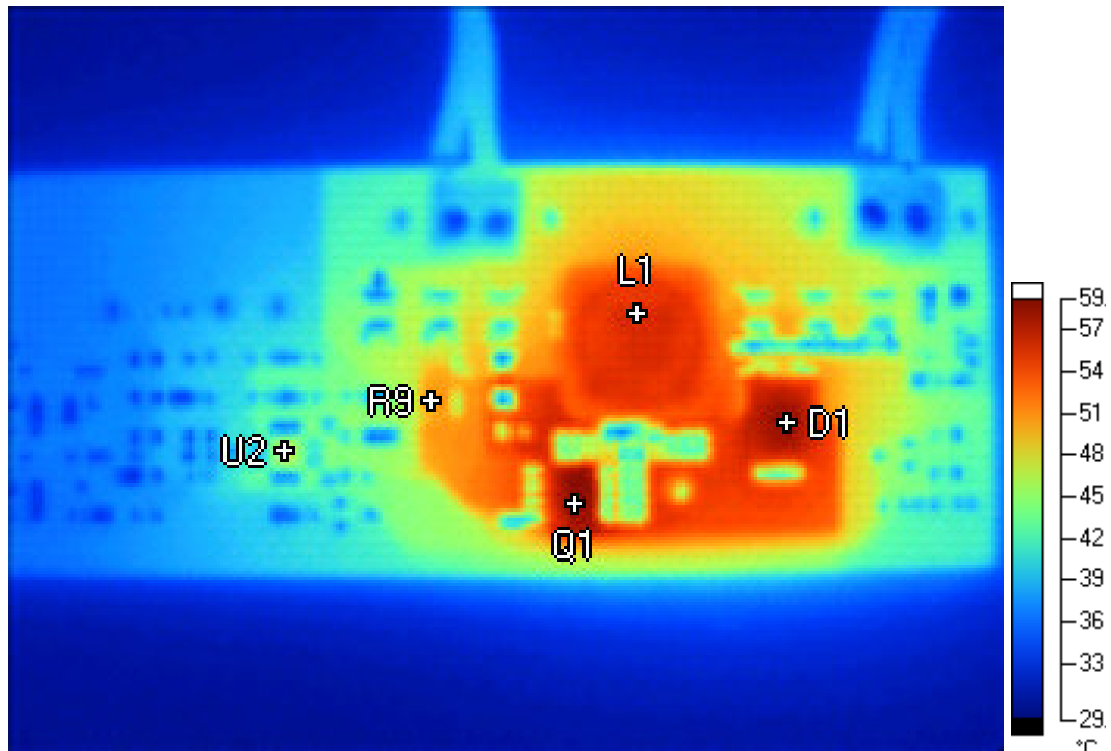


Figure 10

Markers

Label	Temperature	Emissivity	Background
D1	58.7 °C	0.95	21.0 °C
L1	56.1 °C	0.95	21.0 °C
Q1	58.9 °C	0.95	21.0 °C
R9	50.6 °C	0.95	21.0 °C
U2	46.1 °C	0.95	21.0 °C

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