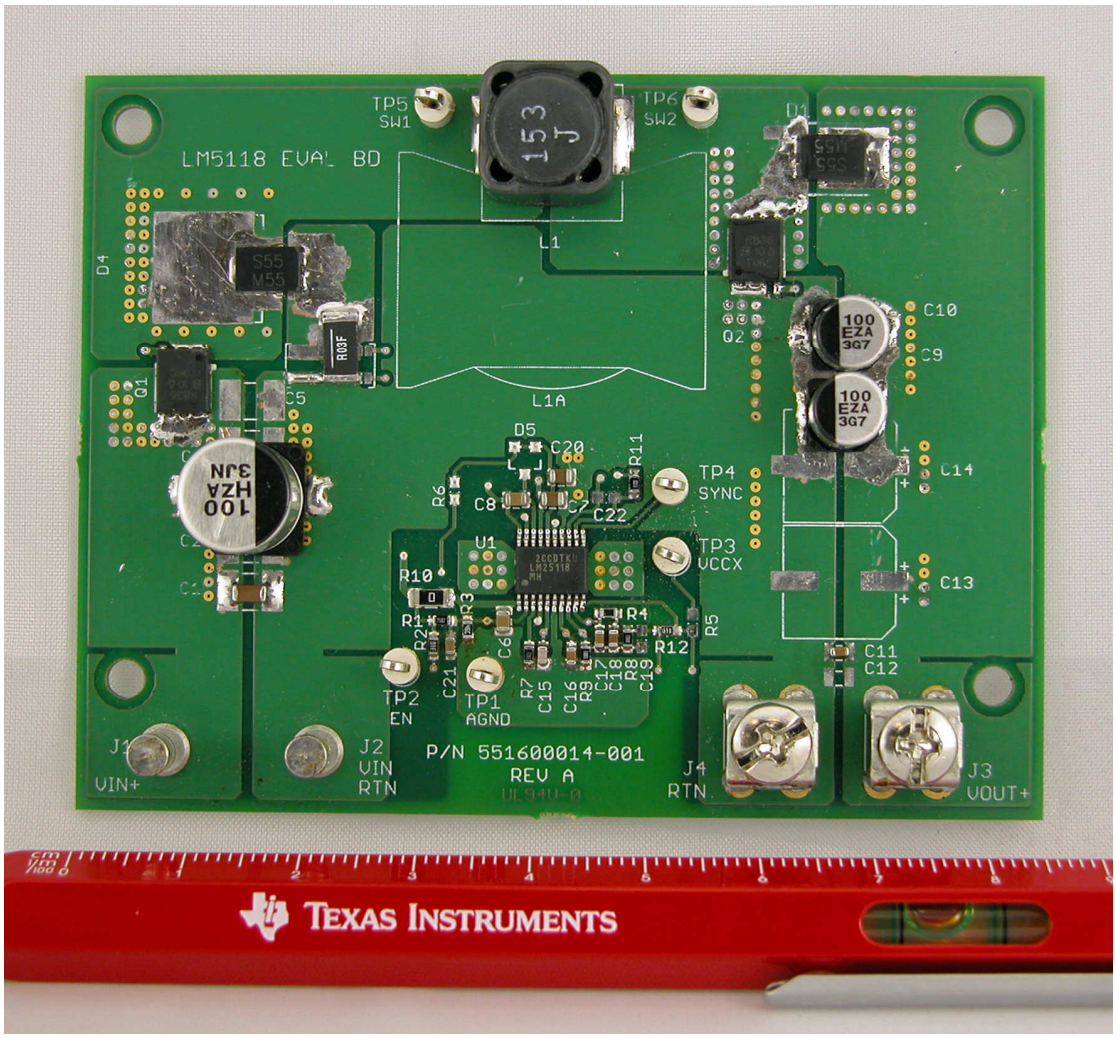
Automotive Buck-Boost - 11.5V @ 1.0A

- Input 4.5..28V DC
- Output 11.5V @ 1.0A
- Controller LM25118-Q1
- Free-Running switching frequency of 300 kHz
- Built on AN-1819 LM5118 Evaluation Board



1 Startup

The startup waveform is shown in Figure 1. The input voltage is set at 12.0V, with no load on the 11.5V output.

Channel C1: **12.0V Input voltage**
2V/div, 50ms/div

Channel C2: **11.5V Output voltage**
2V/div, 50ms/div

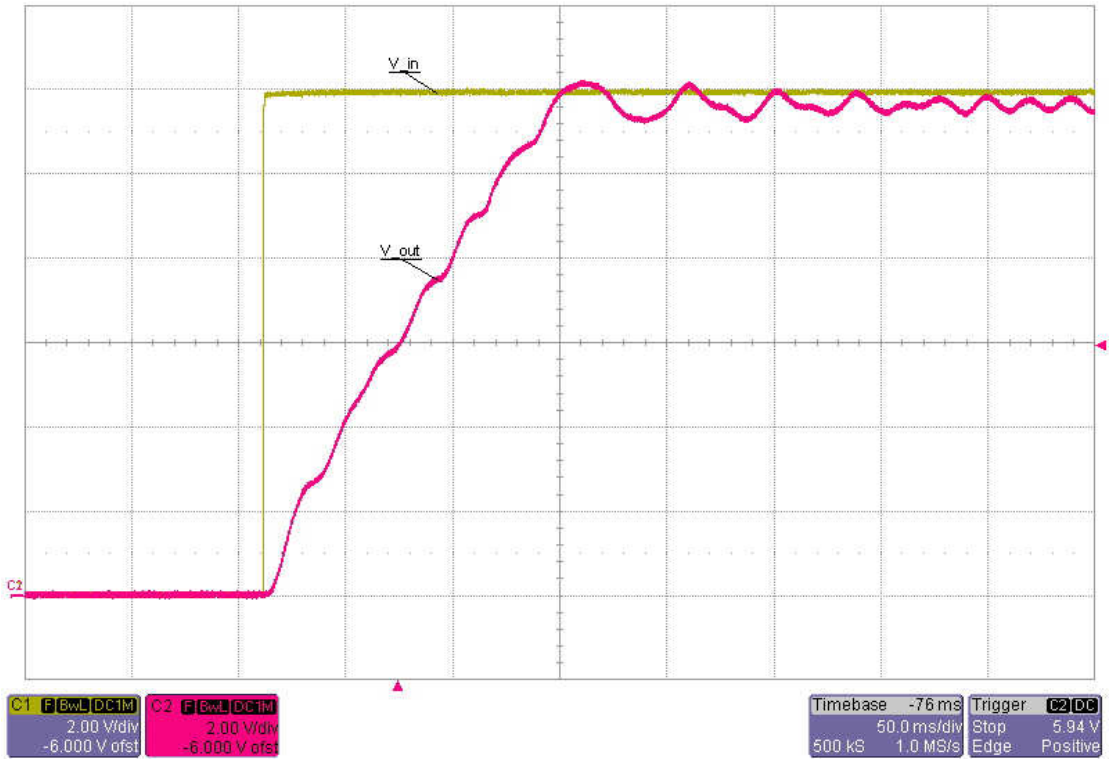


Figure 1

2 Shutdown

The shutdown waveform is shown in Figure 2. The input voltage is set at 12.0V with a 1.0A load on the 11.5V output.

Channel C1: **12.0V Input voltage**
2V/div, 1ms/div

Channel C2: **11.5V Output voltage**
2V/div, 1ms/div

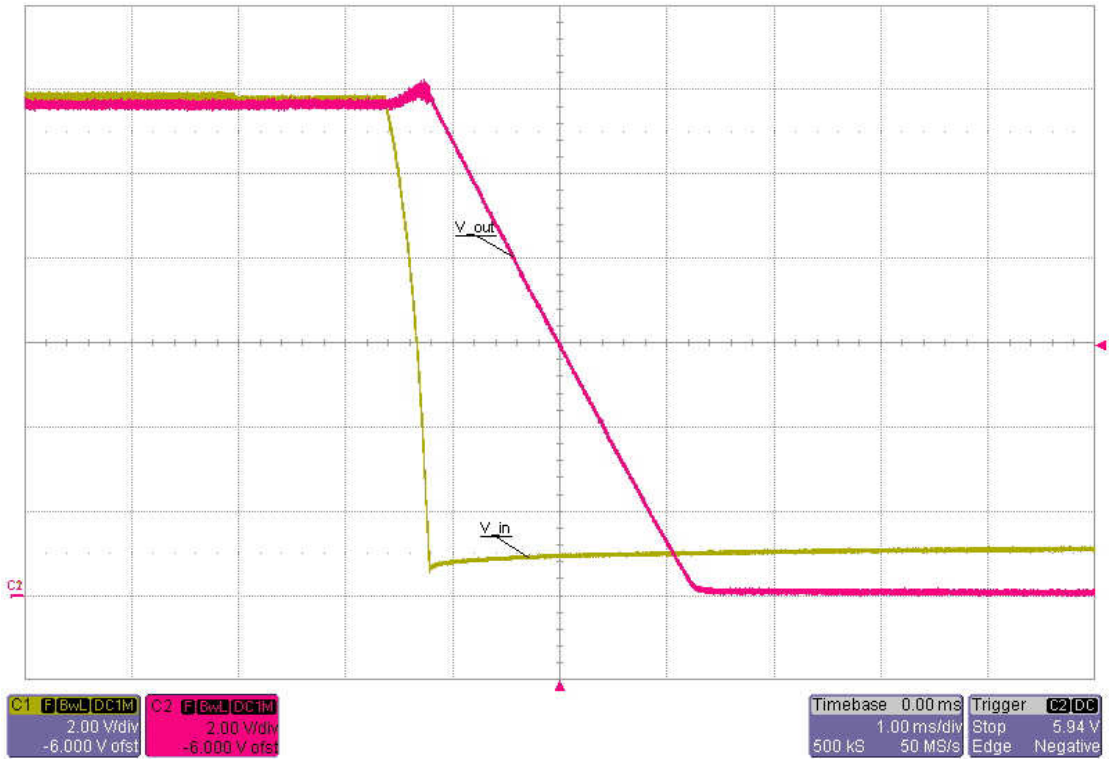


Figure 2

3 Efficiency

The efficiency and load regulation are shown in Figure 3 and Figure 4.

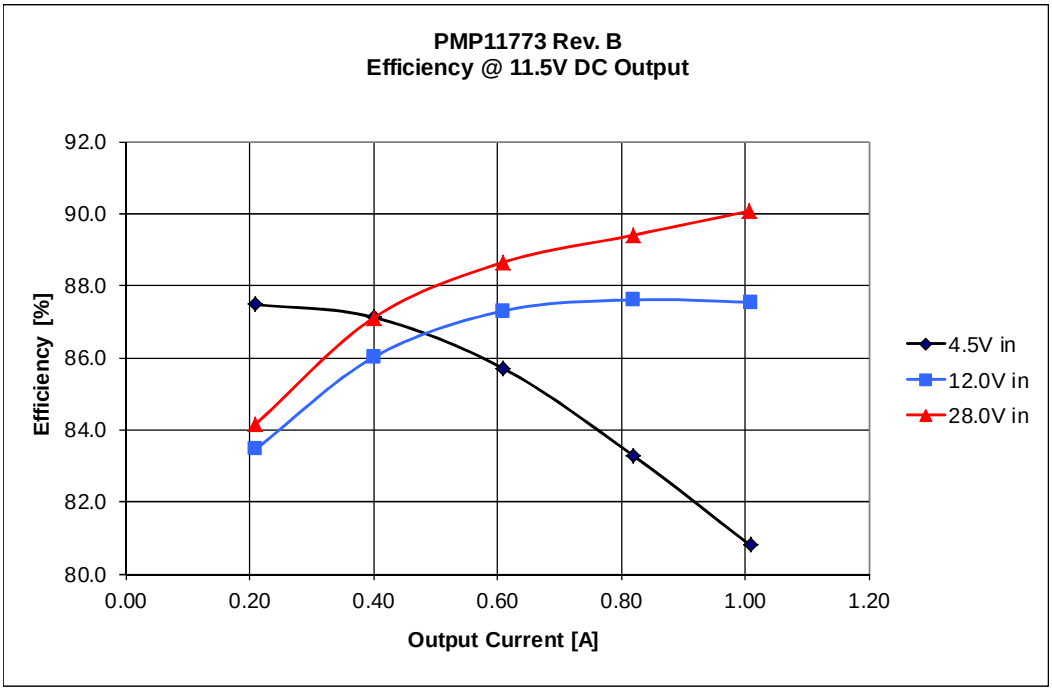


Figure 3

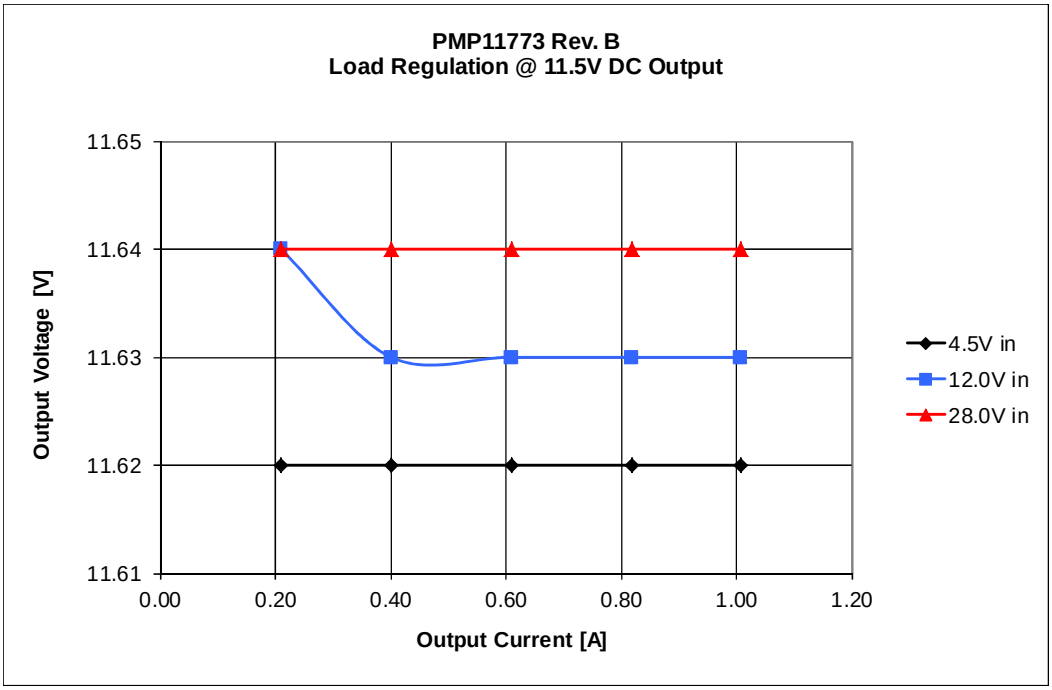


Figure 4

4 Transient Response

The response to a load step and a load dump for the 11.5V output at an input voltage of 12.0V is shown in Figure 5.

Channel C2: **Output voltage**, -309mV undershoot (2.7%), 349mV overshoot (3.0%)
200mV/div, 1ms/div, AC coupled

Channel C1: **Load current**, load step 0.5A to 1.0A and vice versa
500mA/div, 1ms/div

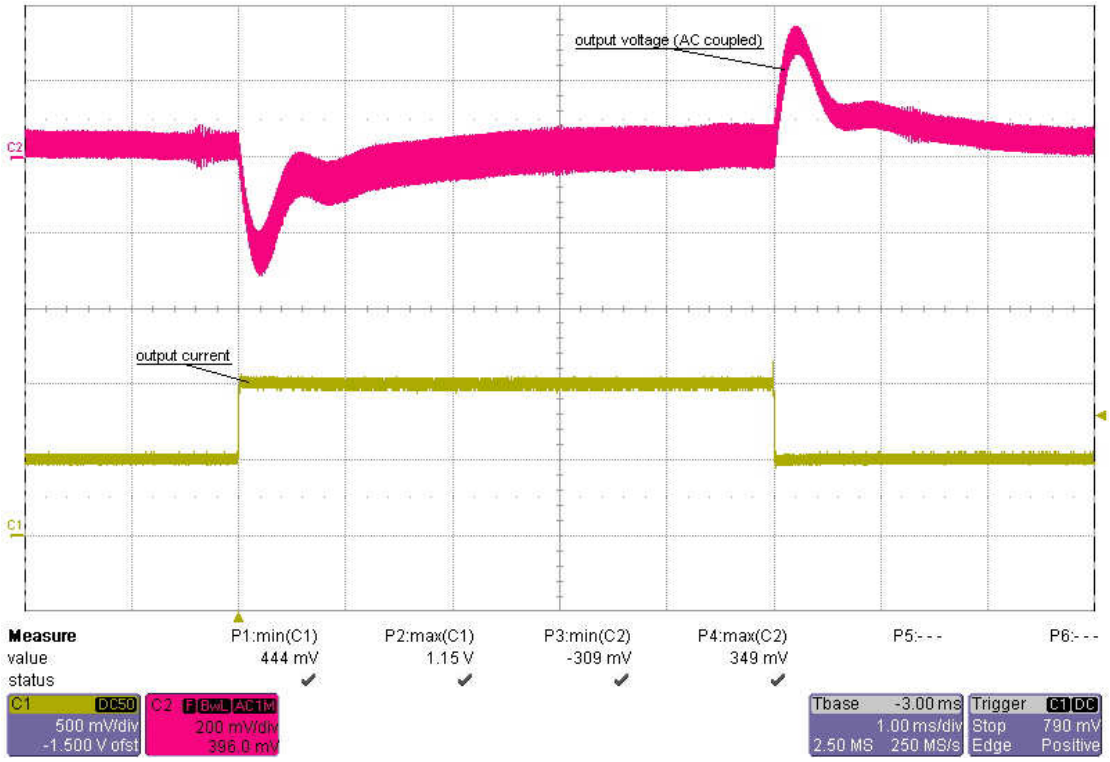


Figure 5

5 Frequency Response

Figure 6 shows the loop response at 4.5V, 12.0V and 28.0V input voltage and 1.0A load.

4.5V input

- 1.0A load 61 deg phase margin, 308 Hz bandwidth, -21 dB gain margin

12.0V input

- 1.0A load 93 deg phase margin, 153 Hz bandwidth, -38 dB gain margin

28.0V input

- 1.0A load 95 deg phase margin, 128 Hz bandwidth, -43 dB gain margin

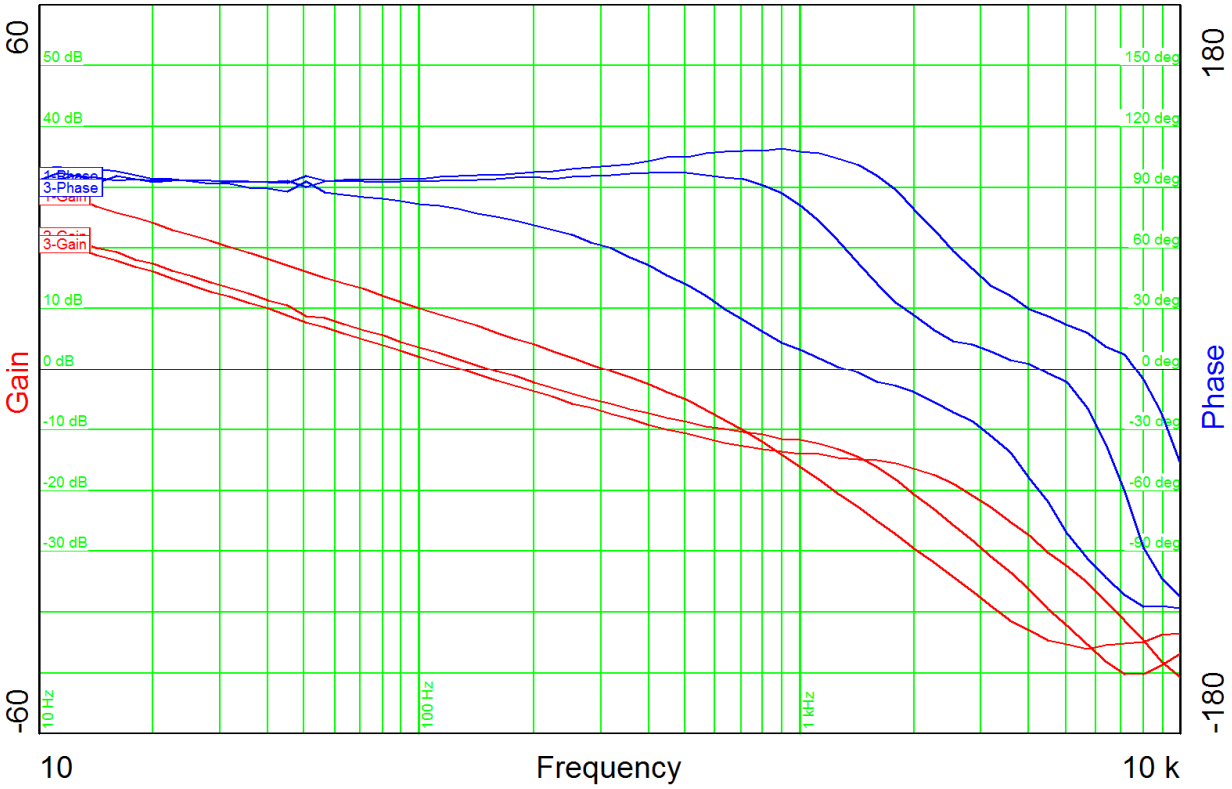


Figure 6

6 Inductor Current Stress

The maximum inductor current stress is shown in Figure 7. The image was captured with 4.5V input and 1.0A load.

Channel C1: **Inductor current**, 4.0A minimum, 4.8A maximum, 4.4A rms
1A/div, 2us/div

Channel C2: **Switching node 2**
5V/div, 2us/div, AC coupled

Channel C3: **Switching node 1**
10V/div, 2us/div

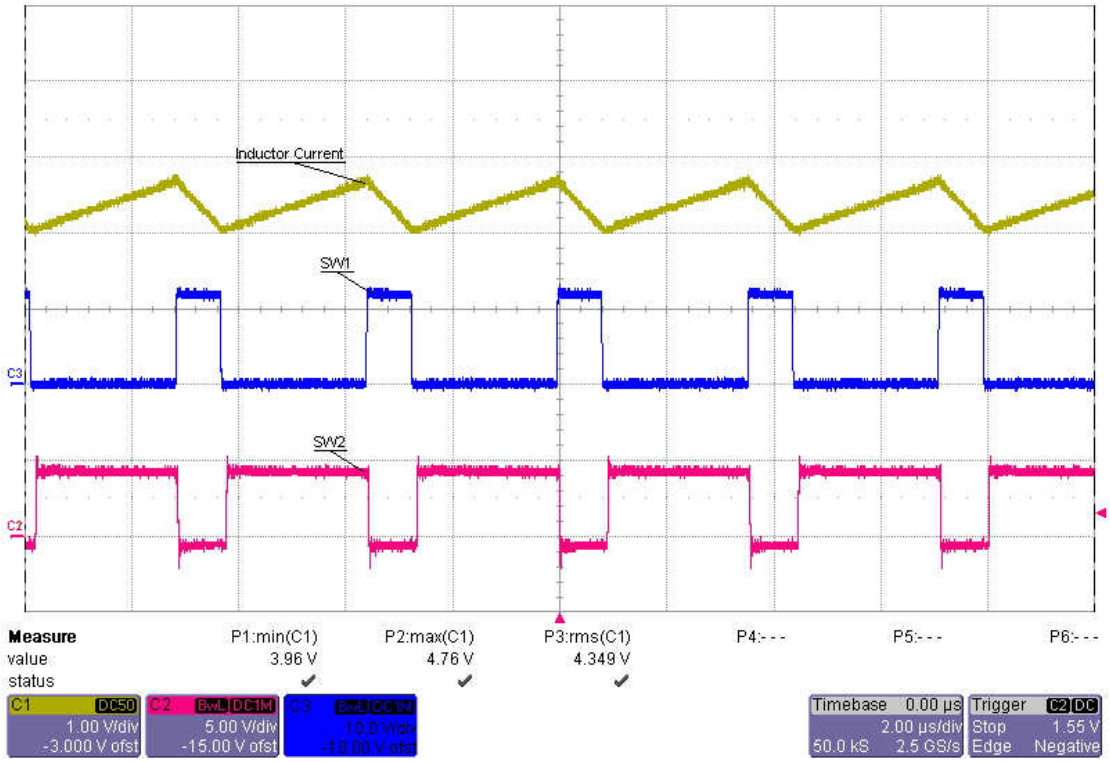


Figure 7

7 Output Ripple Voltage

The output ripple voltage at 1.0A load and 4.5V, 12.0V and 28.0V input voltage is shown in Figure 8.

Channel M1: **Output voltage @ 4.5V input**, 576mV peak-peak
200mV/div, 2us/div, AC coupled

Channel M2: **Output voltage @ 12.0V input**, 406mV peak-peak
200mV/div, 2us/div, AC coupled

Channel M3: **Output voltage @ 28.0V input**, 189mV peak-peak
200mV/div, 2us/div, AC coupled

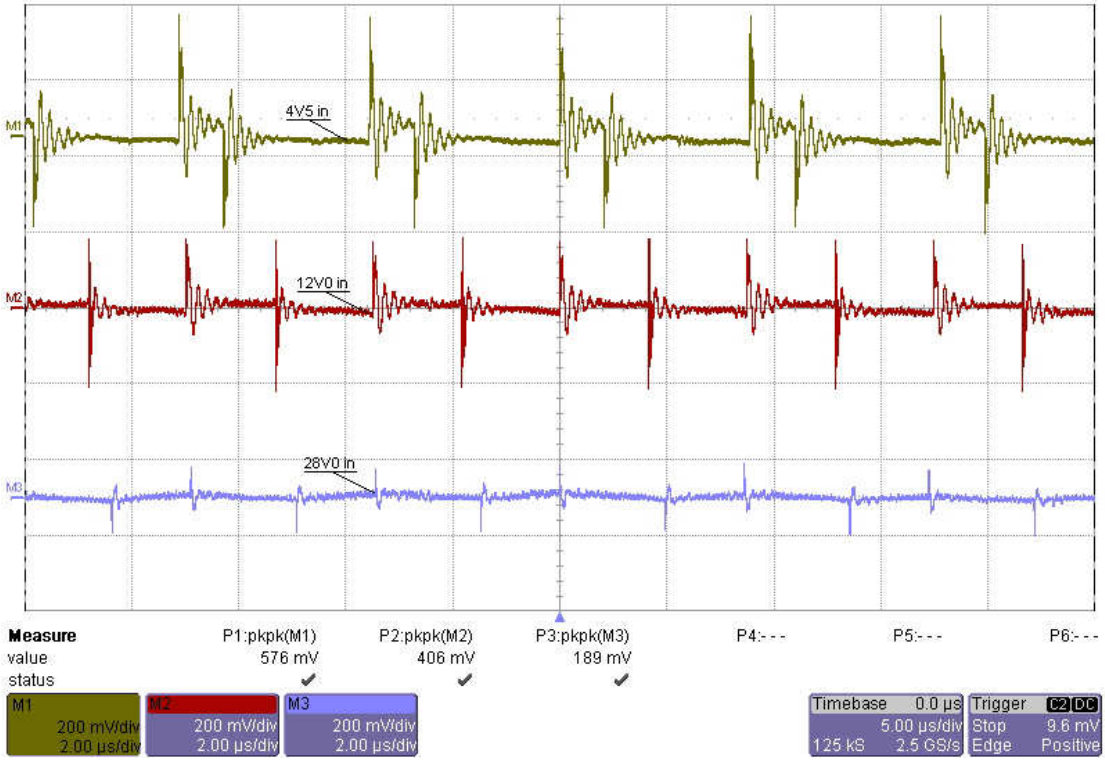


Figure 8

8 Input Ripple Voltage

The input ripple voltage at 1.0A load and 4.5V, 12.0V and 28.0V input voltage is shown in Figure 8.

Channel M1: **Input voltage @ 4.5V input**, 5066mV peak-peak
200mV/div, 2us/div, AC coupled

Channel M2: **Input voltage @ 12.0V input**, 438mV peak-peak
200mV/div, 2us/div, AC coupled

Channel M3: **Input voltage @ 28.0V input**, 557mV peak-peak
200mV/div, 2us/div, AC coupled

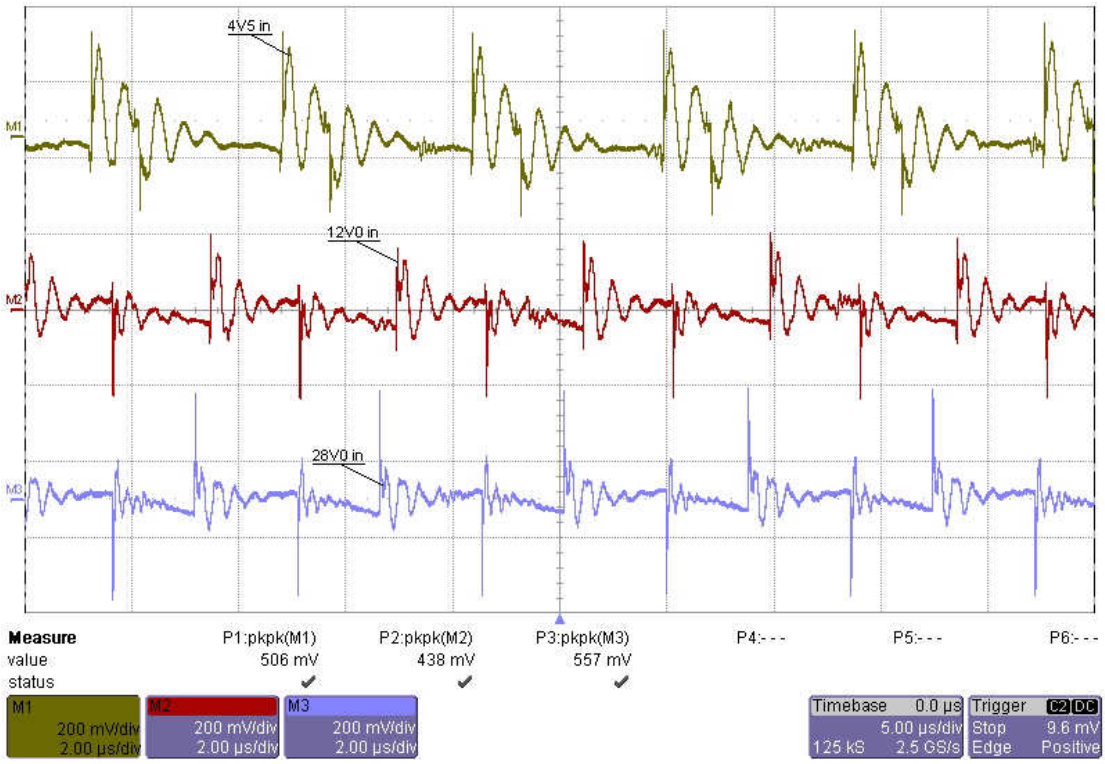


Figure 9

9 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.

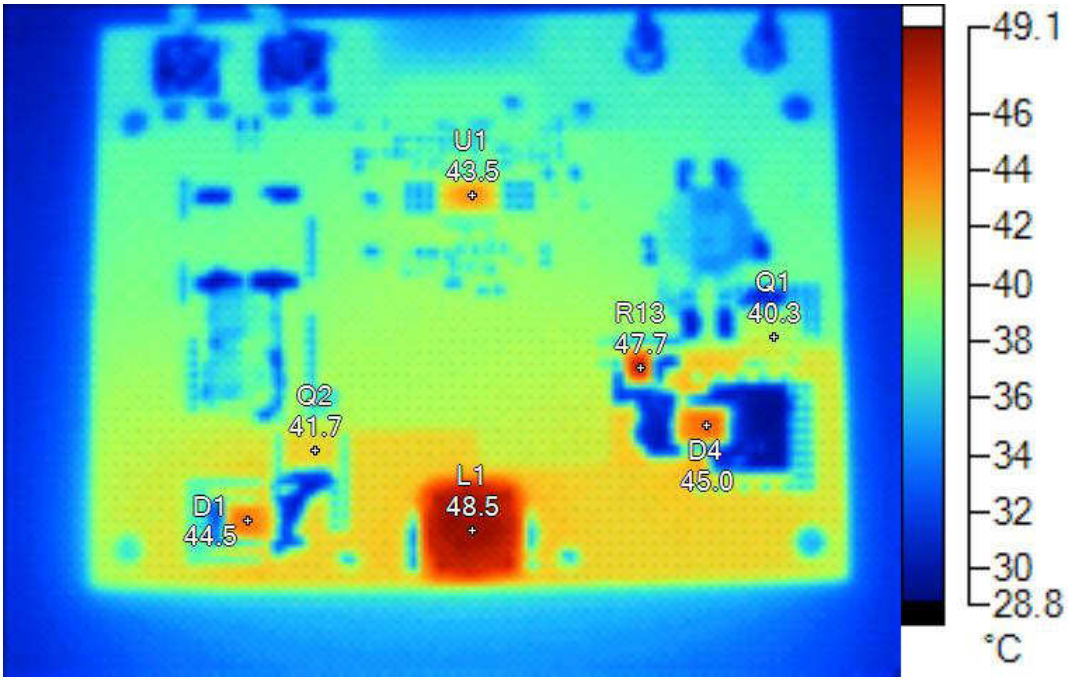


Figure 10

Markers

Label	Temperature	Emissivity	Background
L1	48.5°C	0.95	21.0°C
D1	44.5°C	0.95	21.0°C
Q2	41.7°C	0.95	21.0°C
U1	43.5°C	0.95	21.0°C
R13	47.7°C	0.95	21.0°C
D4	45.0°C	0.95	21.0°C
Q1	40.3°C	0.95	21.0°C

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