Automotive Pre-Booster

- Input 2.7 .. 10.5V nominal, 32.0V peak
- Output 10.5V @ 3.0A
- Free-Running-Switching Frequency of 400 kHz
- Due to thermal limitations of the FET package operation at minimum input voltage is limited to a few seconds.

1. Startup

The startup waveform at 6.0V input voltage and no load on the 10.5V output is shown in Figure 1.

Channel C1 **6.0V Input Voltage**
2V/div, 1ms/div

Channel C2 **10.5V Output Voltage**
2V/div, 1ms/div

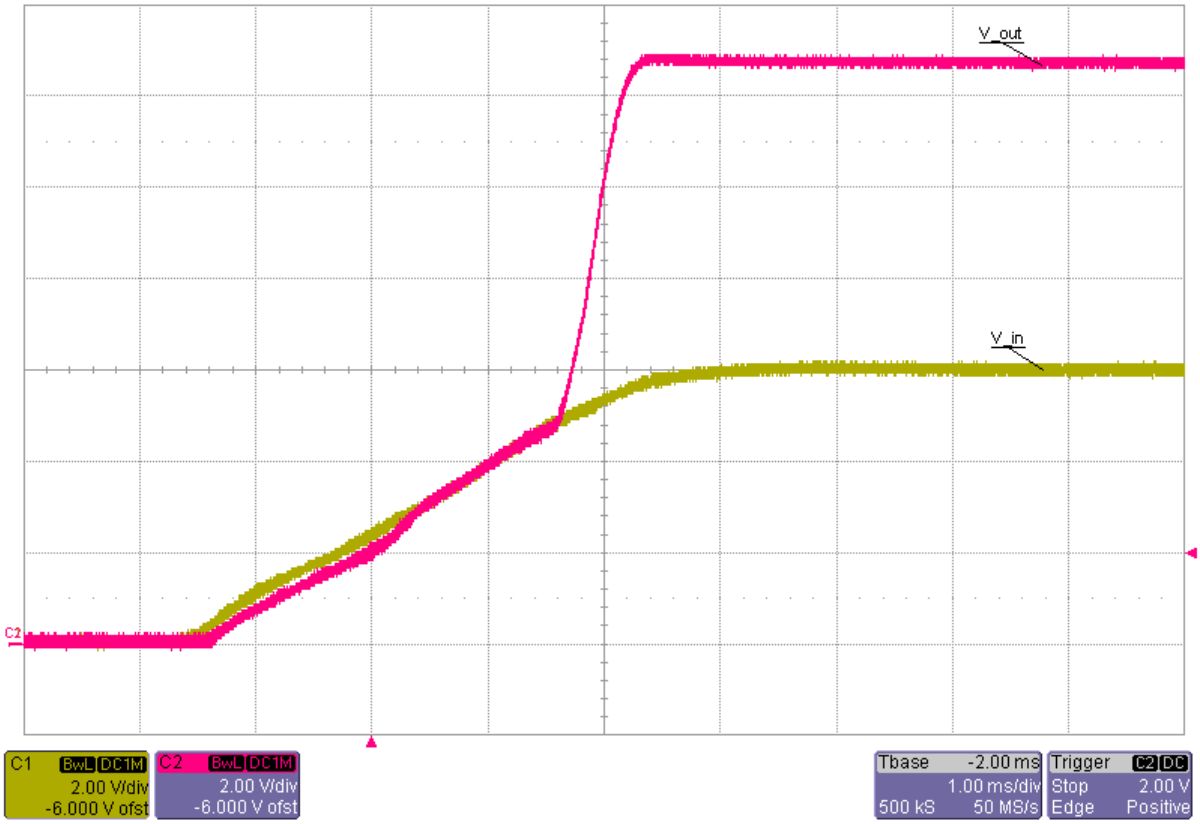

Figure 1

2. Shutdown

The shutdown waveform at 6.0V input voltage and 3.0A load at 10.5V output voltage is shown in Figure 2.

Channel C1 **6.0V Input Voltage**
2V/div, 500us/div

Channel C1 **10.5V Output Voltage**
2V/div, 500us/div

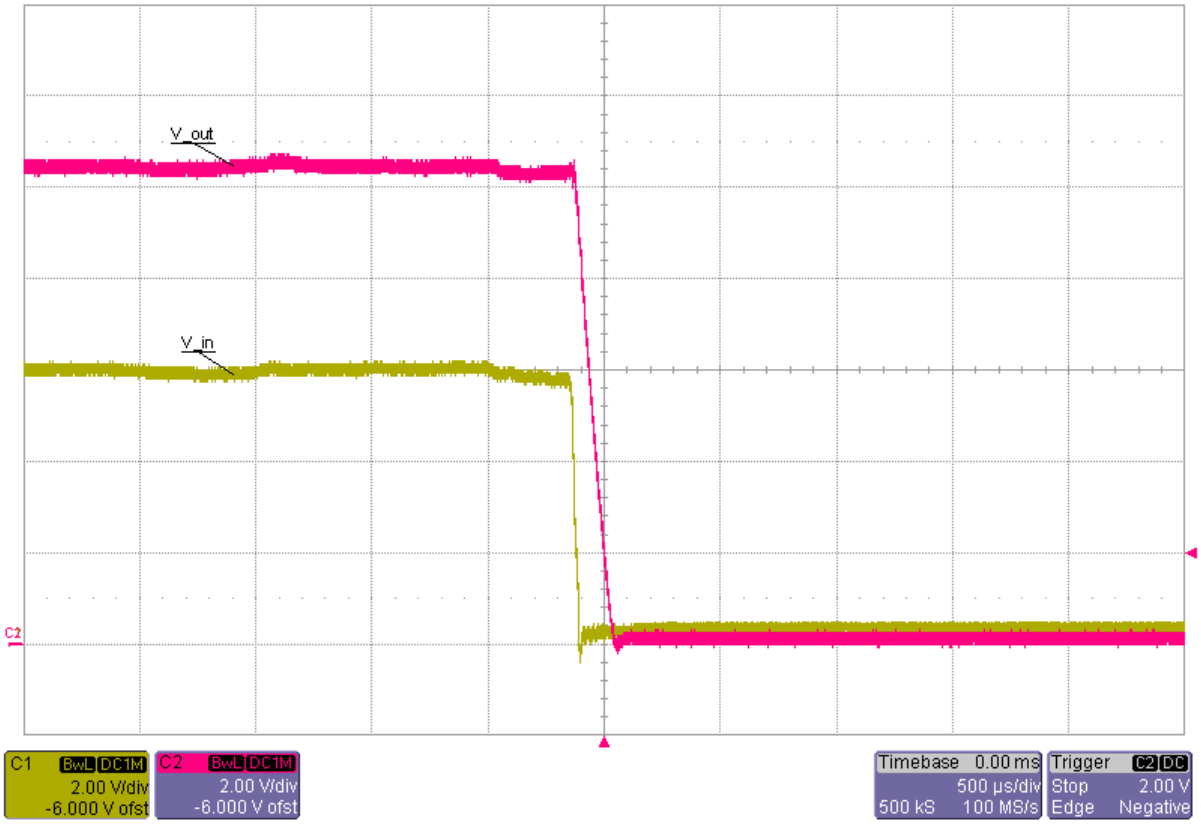

Figure 2

3. Efficiency

The efficiency and load regulation for the 3.0A load range are shown in Figure 3 and Figure 4.

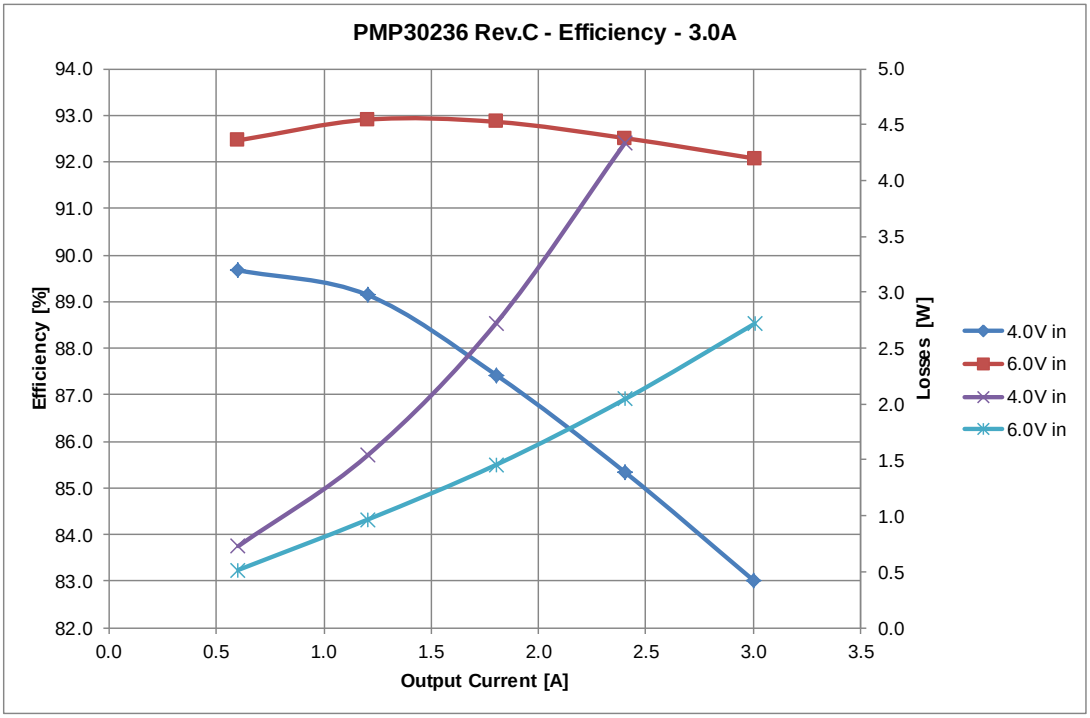

Figure 3

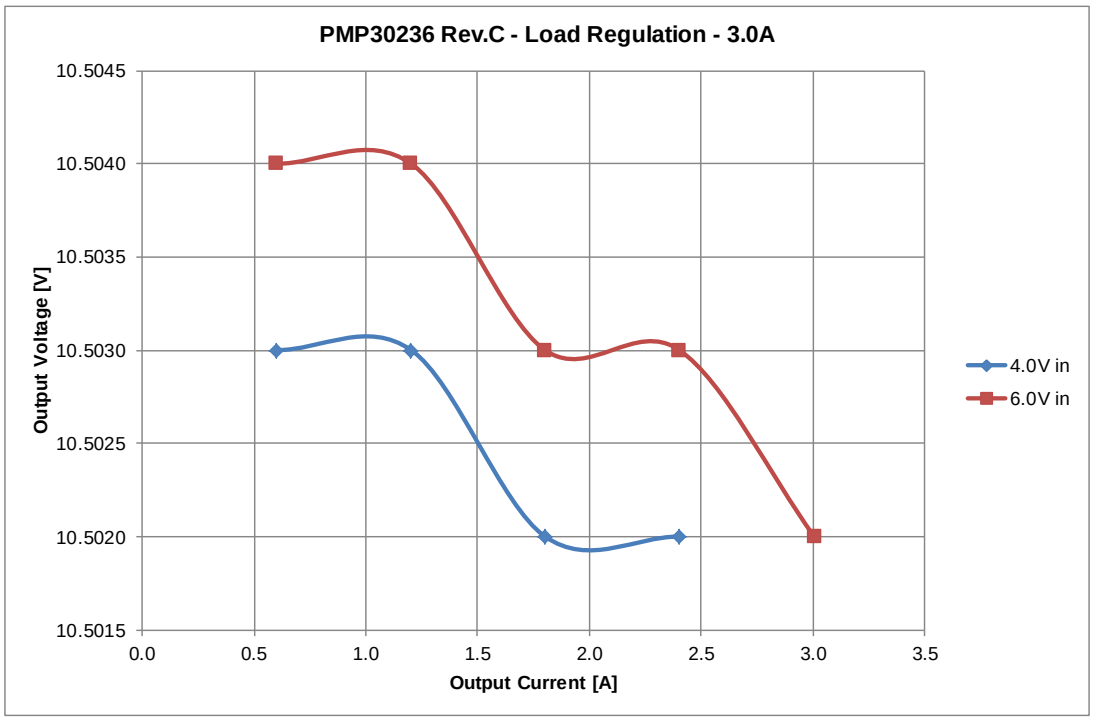

Figure 4

4. Transient Response

The response to a load step at 6.0V output voltage is shown in Figure 5.

Channel C1 **Output Current**, Load Step 1.5A to 3.0A
1A/div, 1ms/div

Channel C2 **Output Voltage**, -1.51V undershoot (14.4%), 1.91V overshoot (18.2%)
1V/div, 1ms/div, AC coupled

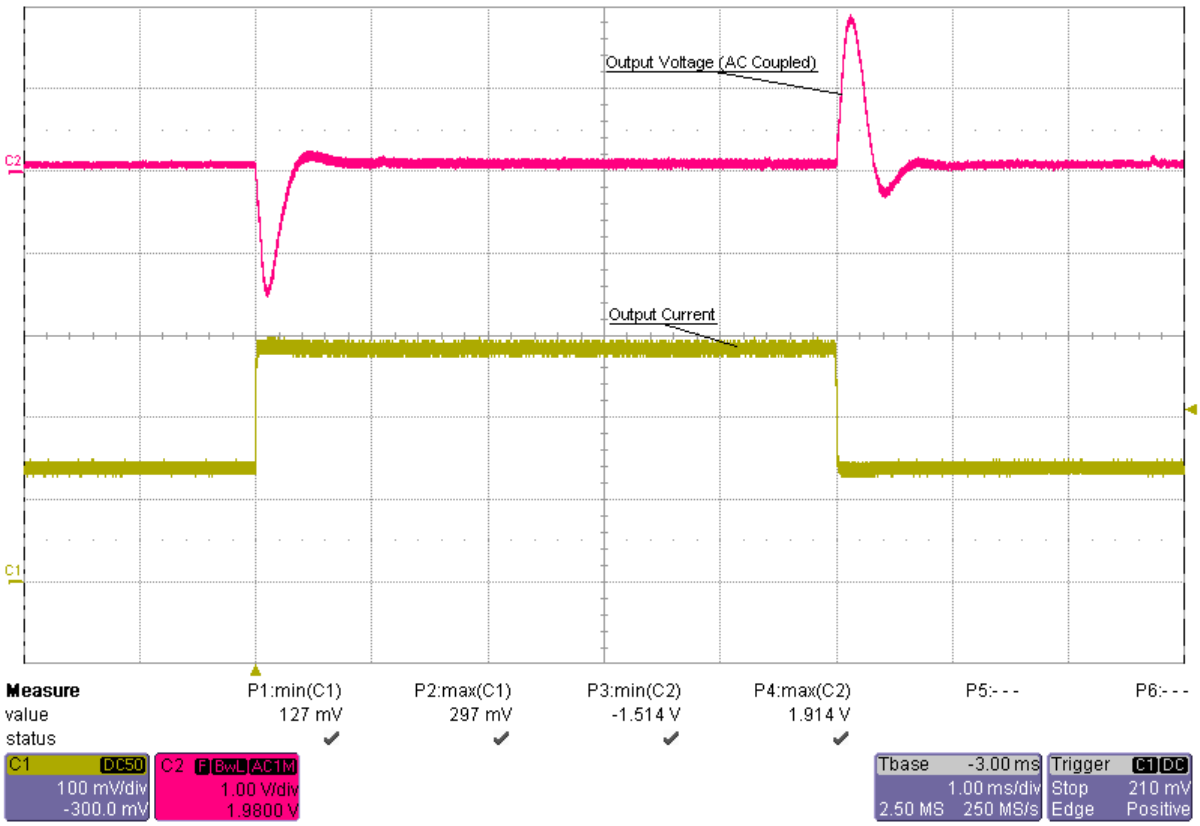

Figure 5

5. Frequency Response

The frequency response for the 2.0A load range is shown in Figure 6.

4.0V Input, 3.0A Load 0.8 kHz Bandwidth, 55 deg Phase Margin, -16 dB Gain Margin

8.0V Input, 3.0A Load 1.1 kHz Bandwidth, 79 deg Phase Margin, -25 dB Gain Margin

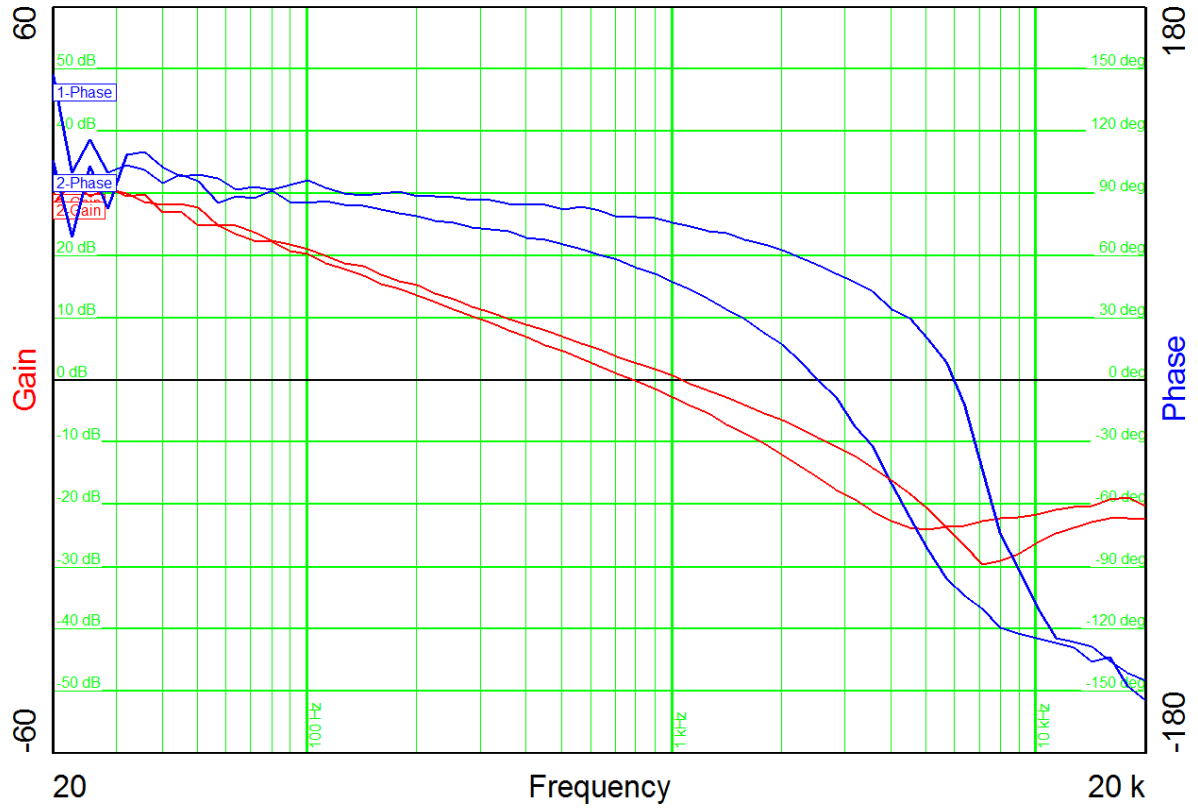

Figure 6

6. Input Ripple – After Input Filter

The input ripple on the connector (after the input filter) is shown in Figure 7.

Channel M1 **Input Voltage @ 4.0V Input / 3.0A Load**, 42mV peak-peak (1.1%)
20mV/div, 50us/div

Channel M2 **Input Voltage @ 8.0V Input / 3.0A Load**, 31mV peak-peak (0.4%)
20mV/div, 50us/div

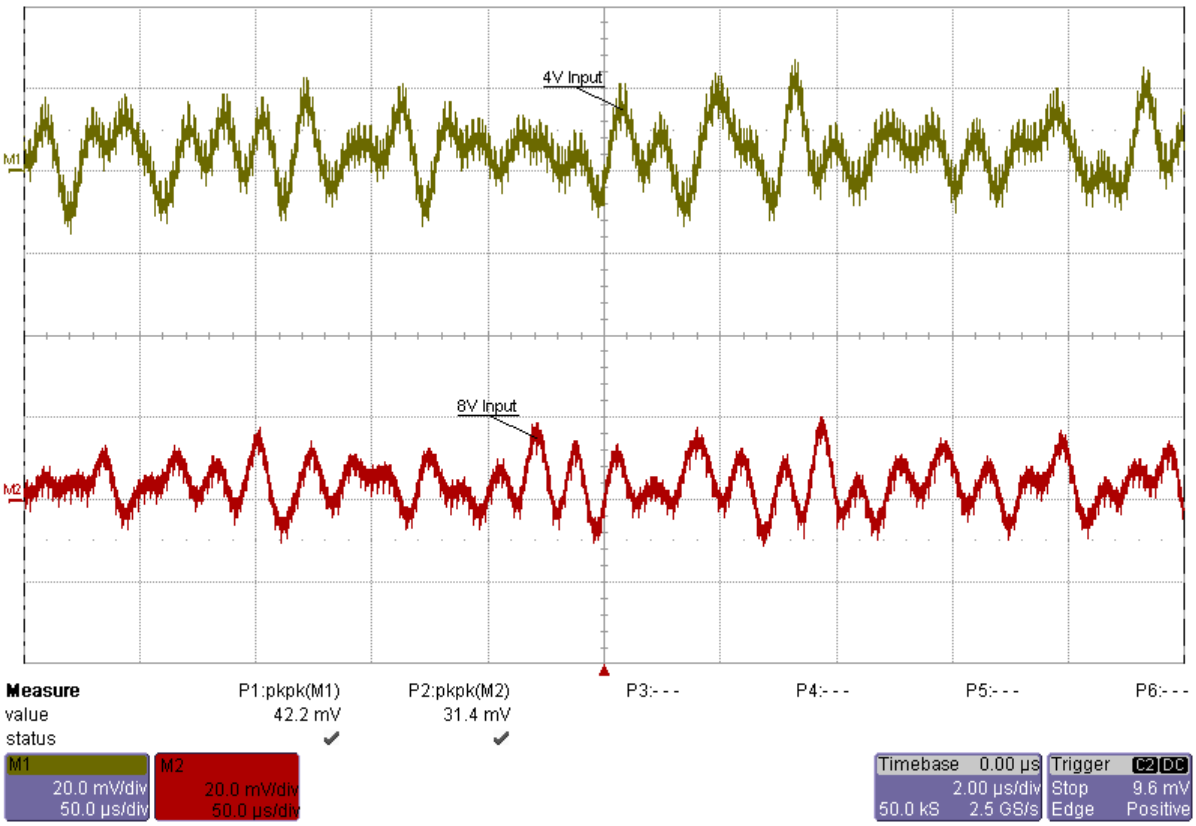

Figure 7

7. Input Ripple – Before Input Filter

The input ripple on the boost inductor (before the input filter) is shown in Figure 8.Figure 7

Channel M1 **Input Voltage @ 4.0V Input / 3.0A Load**, 126mV peak-peak (3.2%)
50mV/div, 2us/div

Channel M2 **Input Voltage @ 8.0V Input / 3.0A Load**, 110mV peak-peak (1.4%)
50mV/div, 2us/div

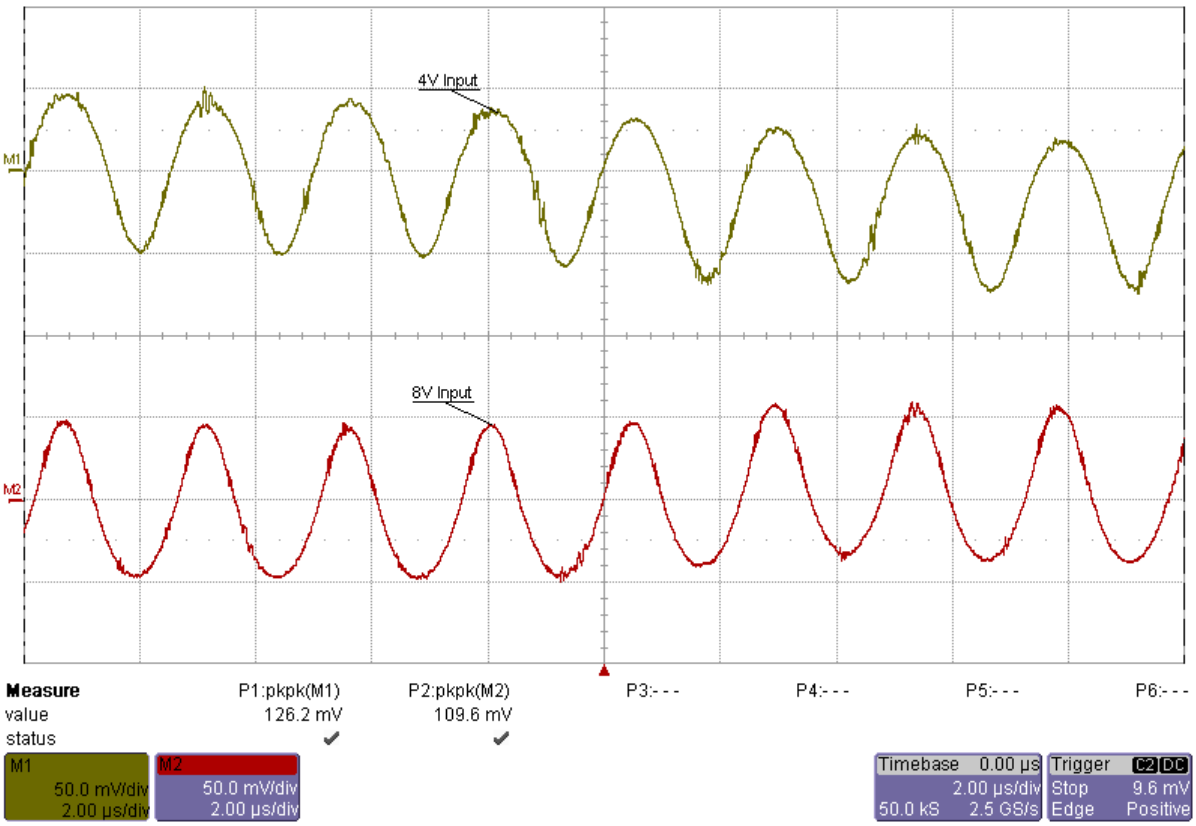

Figure 8

8. Output Ripple

The output ripple voltage is shown in Figure 9.

Channel M1 **Output Voltage @ 4.0V Input / 3.0A Load**, 172mV peak-peak (1.6%)
50mV/div, 2us/div

Channel M2 **Output Voltage @ 8.0V Input / 3.0A Load**, 80mV peak-peak (0.8%)
50mV/div, 2us/div

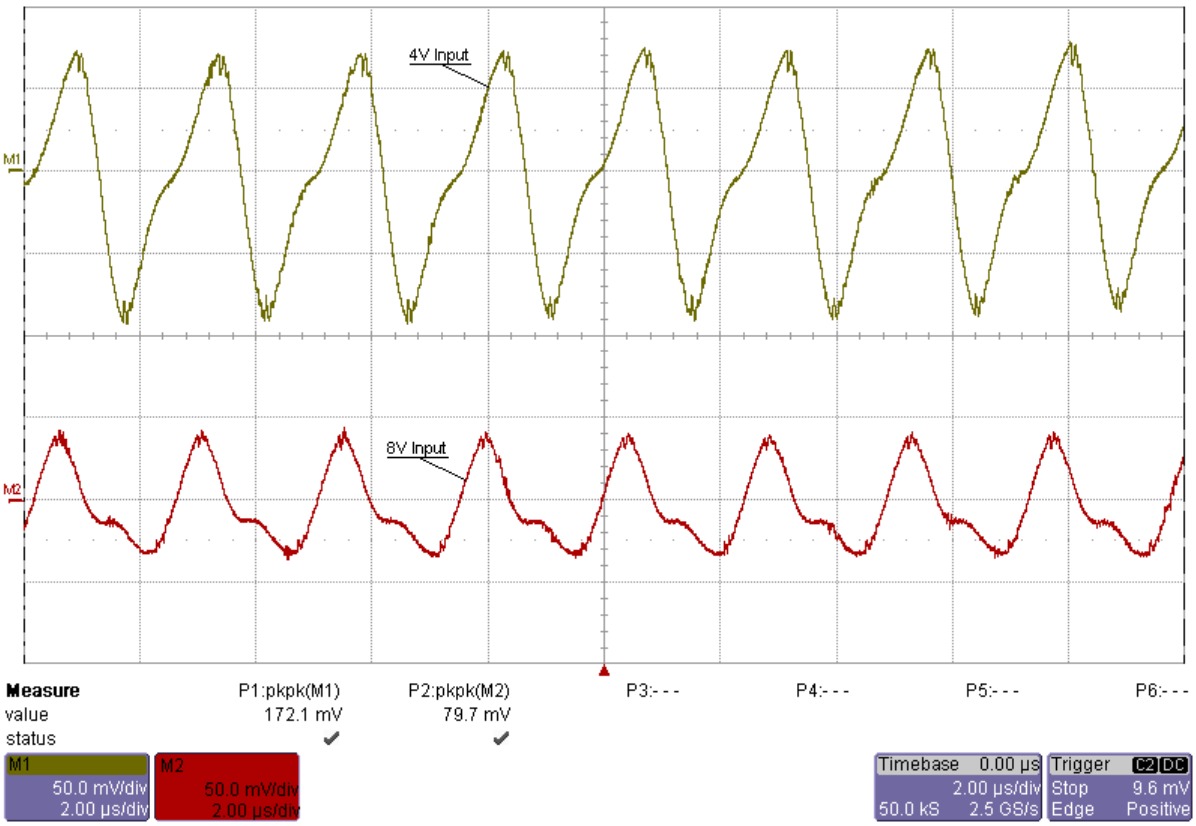

Figure 9

9. Low-Side FET (Switching Node)

The drain-source voltage of the low-side FET at 4.0V input voltage and 3.0A load on the output is shown in Figure 10.

Channel C1 **Drain-Source Voltage**, -0.4V minimum, 15.0V maximum
5V/div, 1us/div

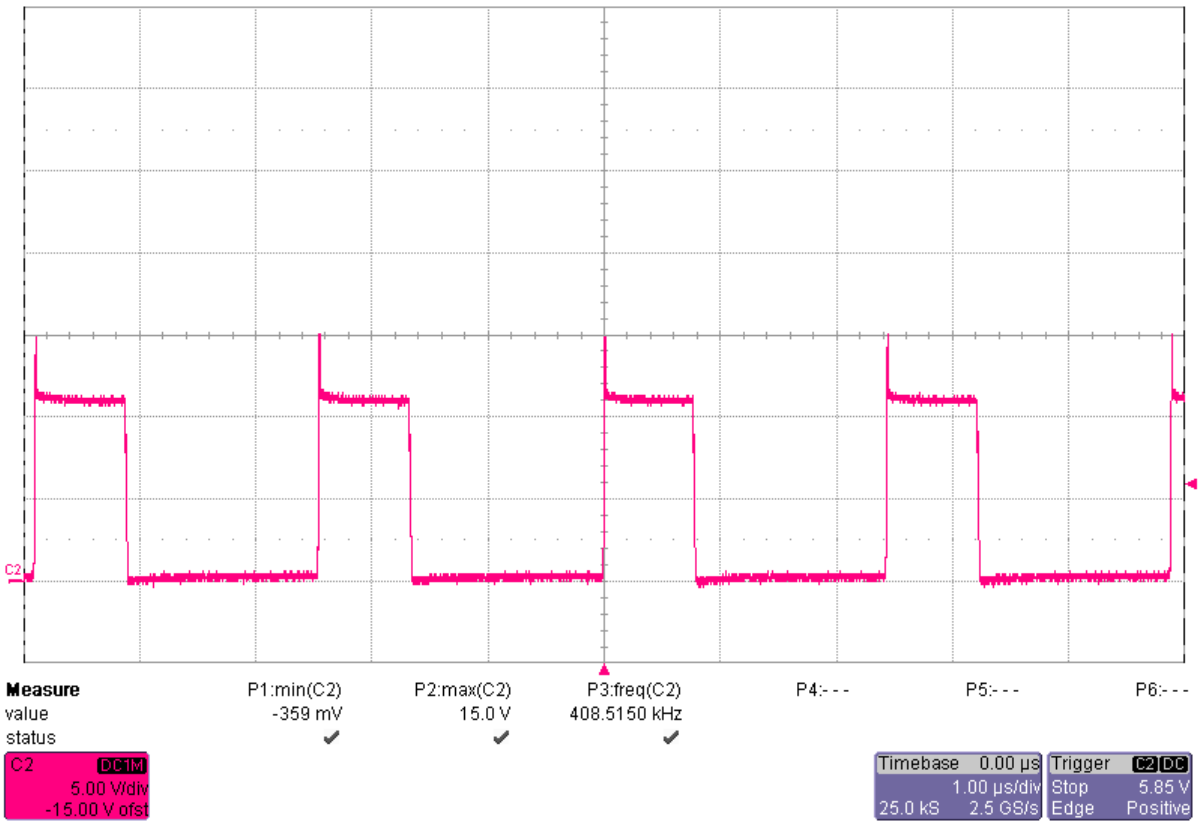

Figure 10

10.Diode

The voltage on the diode at 4.0V input voltage and 3.0A load on the output is shown in Figure 11.

Channel C1 **Anode-Cathode Voltage**, -1.4V minimum, 10.9V maximum
2V/div, 1us/div

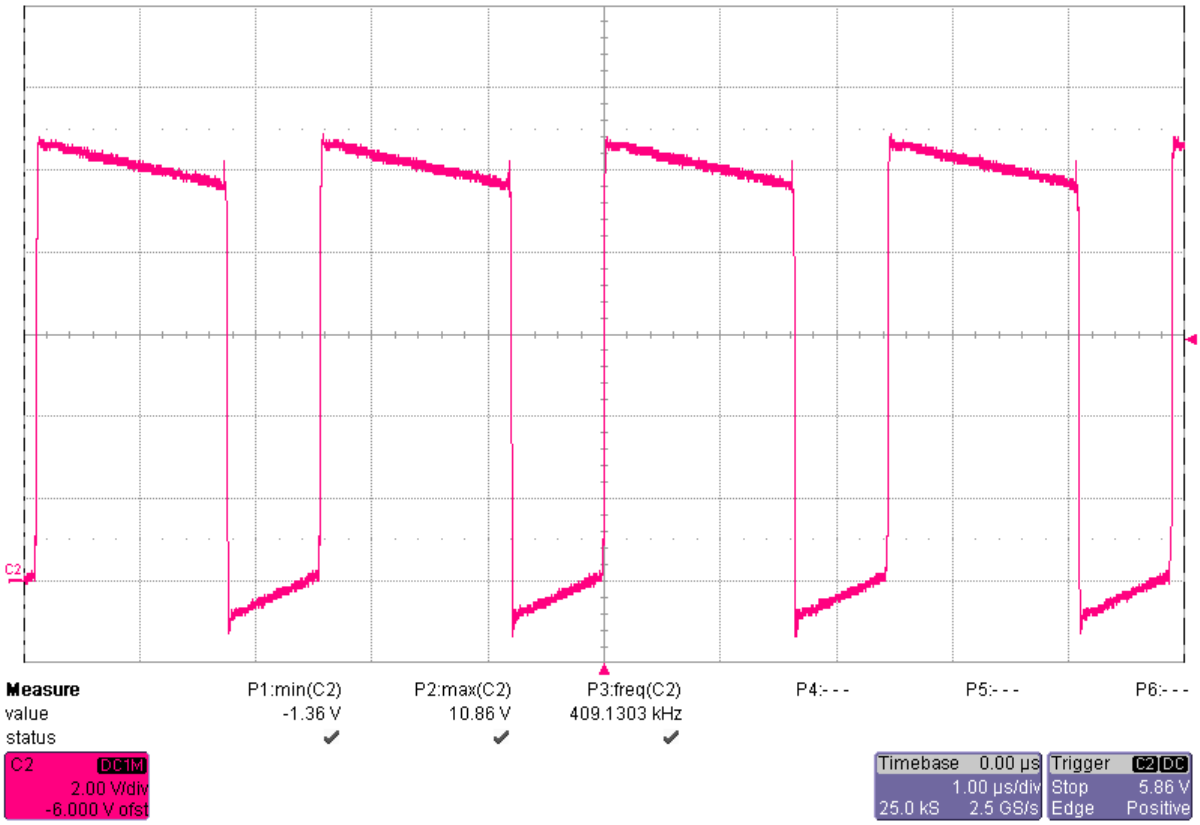

Figure 11

11.Cold Start Test Pulse “severe”

The response to the cold start test pulse “severe” at 3.0A load is shown in Figure 12.

Channel C1 **Battery Voltage**, dropping from 11.0V to 2.7V within 1ms
2V/div, 5ms/div

Channel C2 **Booster Output Voltage**
2V/div, 5ms/div

Channel C4 **Inductor Current**
5A/div, 5ms/div

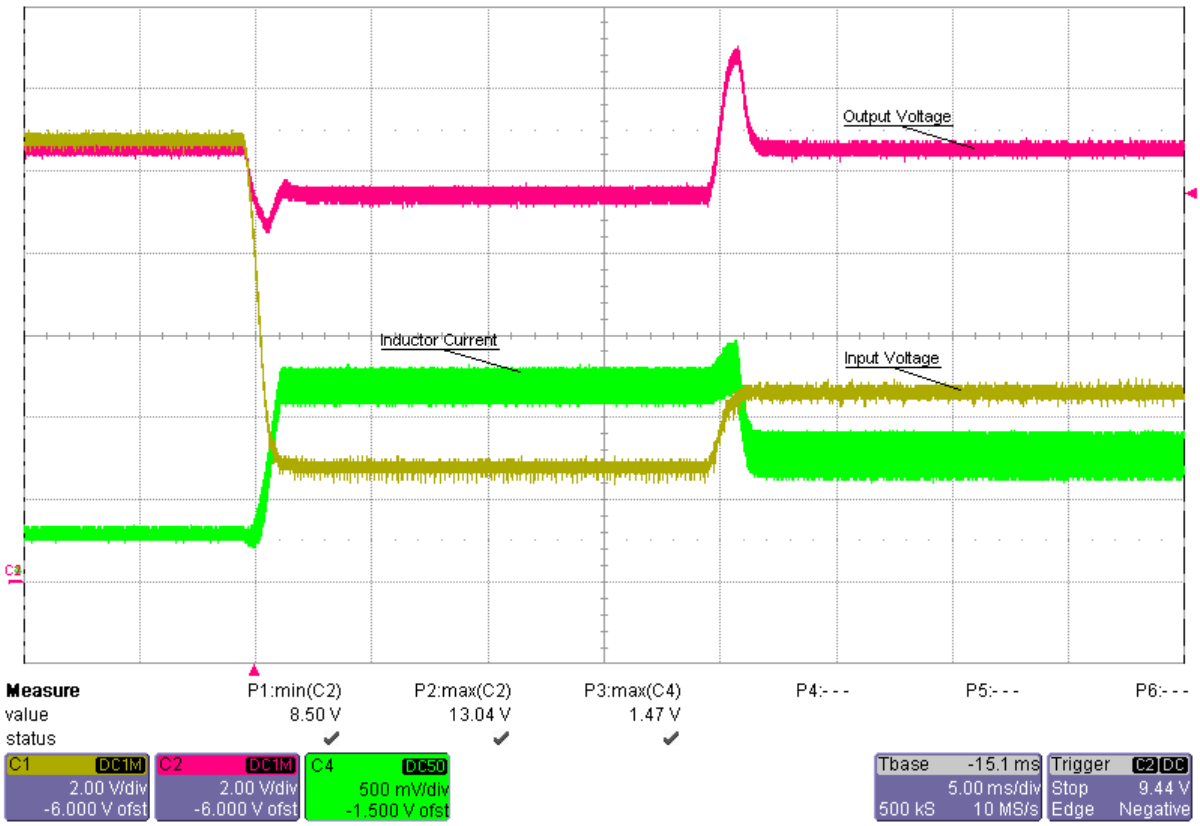

Figure 12

Channel C1 **Battery Voltage**
2V/div, 500ms/div

Channel C2 **Booster Output Voltage**
2V/div, 500ms/div

Channel C4 **Inductor Current**
5A/div, 500ms/div

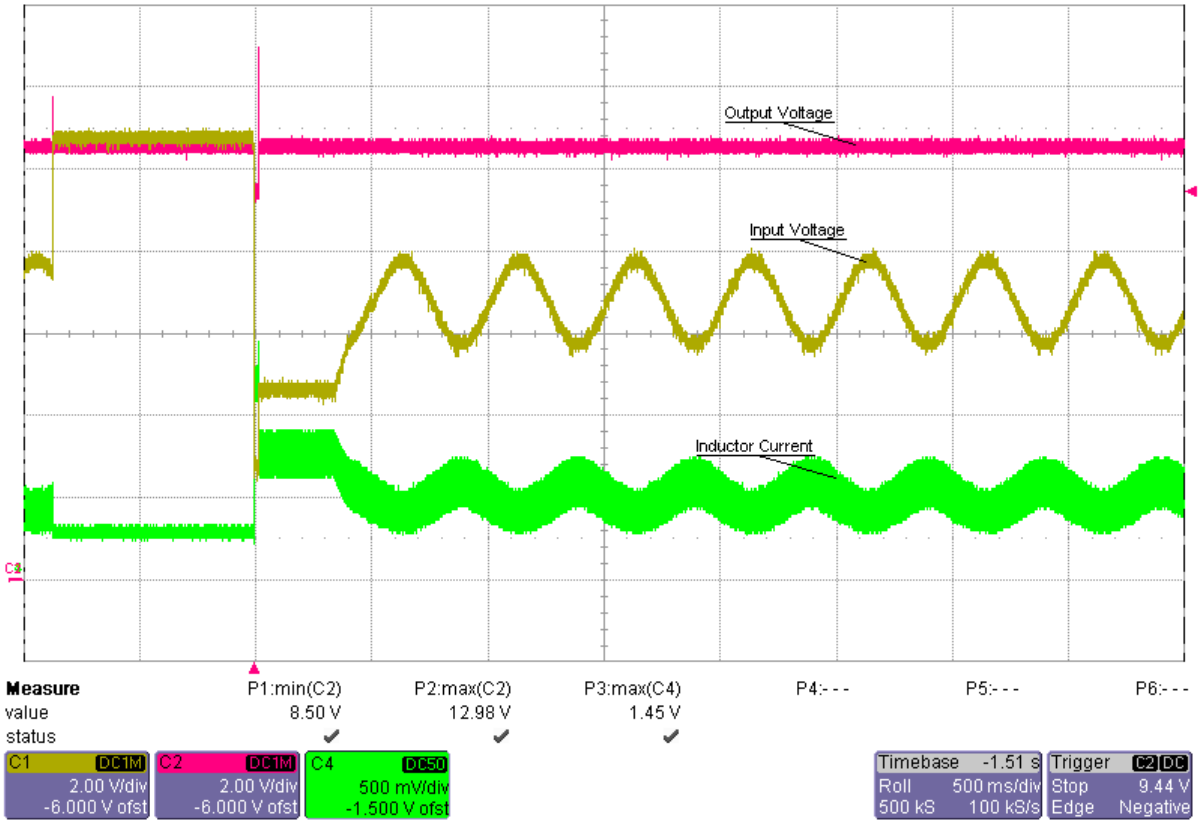

Figure 13

12.Thermal Image

The thermal image (Figure 14) shows the circuit at an ambient temperature of 20°C with an input voltage of 6.0V and 3.0A load on the output.

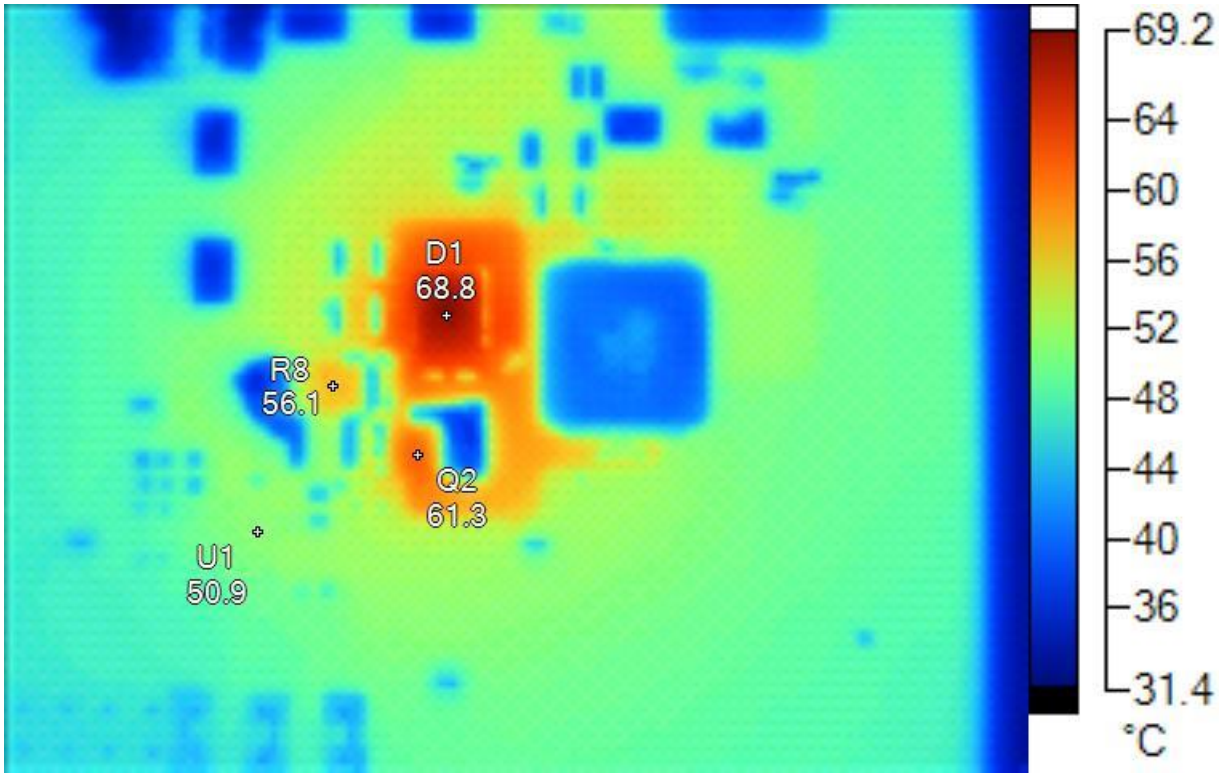

Figure 14

Name	Temperature	Emissivity	Background
Q2	61.3°C	0.95	20.0°C
D1	68.8°C	0.95	20.0°C
R8	56.1°C	0.95	20.0°C
U1	50.9°C	0.95	20.0°C

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