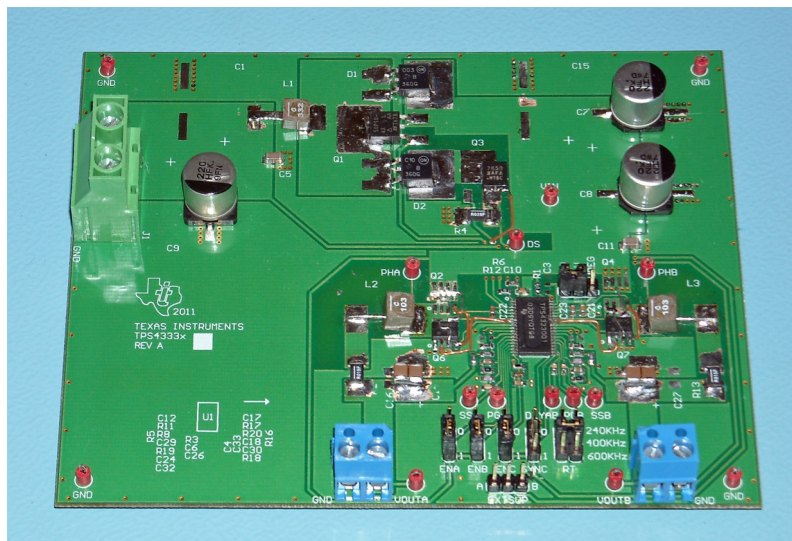


Dual Buck with Pre-Boost – TPS43330

- Input 3.5 ..35V DC
- Output 3.3V @ 2.3A, 3.3V @ 1.8A, Pre-Boost with 7.0V @ 2.1A
- Controller TPS43330-Q1
- Free-Running switching frequency of 400 kHz (Bucks) / 200 kHz (Boost)
Synchronized to 450 kHz (Bucks) / 225 kHz (Boost)
All measurements were done at 450 kHz (Bucks / 225 kHz (Boost))!
- Modified TPS43330 Evaluation Board



1 Boost – 7.0V @ 2.1A

The switching node of the Boost is shown in Figure 1.

The input voltage is set at 3.5V with 2.1A load on the 7.0V output.

Channel C2: **Switching Node**, -1.1V minimum voltage, 39.2V maximum voltage
10V/div, 2us/div

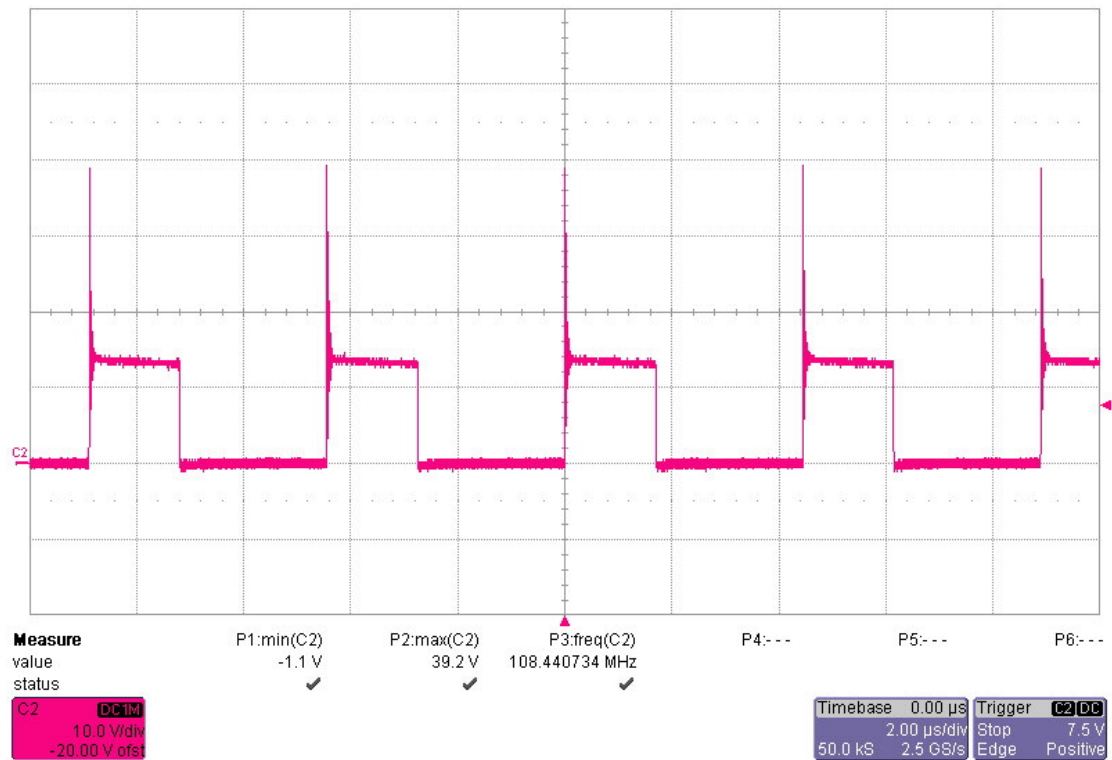


Figure 1

The output ripple voltage of the Boost at 3.5V, 4.5 and 6.0V input voltage is shown in Figure 2.

- Channel M1: **Output Ripple Voltage**, 3.5V input voltage, 318mV peak-peak (4.5%)
200mV/div, 5us/div
- Channel M2: **Output Ripple Voltage**, 4.5V input voltage, 219mV peak-peak (3.1%)
200mV/div, 5us/div
- Channel M3: **Output Ripple Voltage**, 6.0V input voltage, 138mV peak-peak (2.0%)
200mV/div, 5us/div

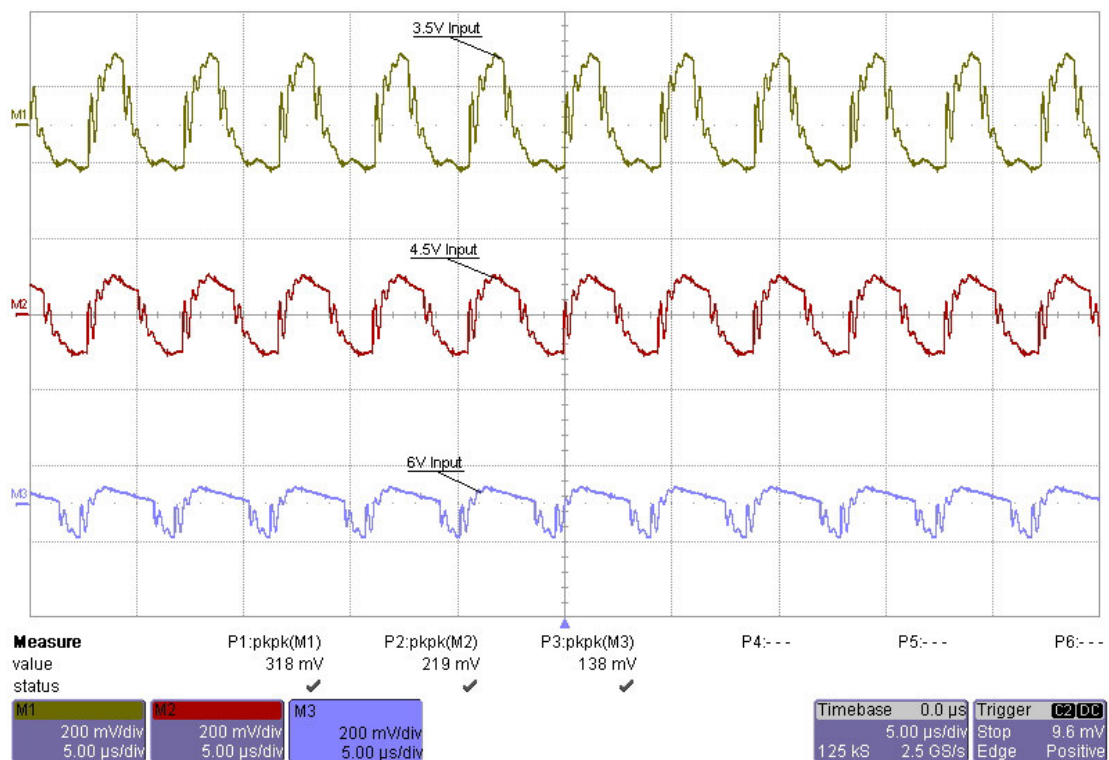


Figure 2

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

During the measurement, Buck A was enabled without load and Buck B was disabled.

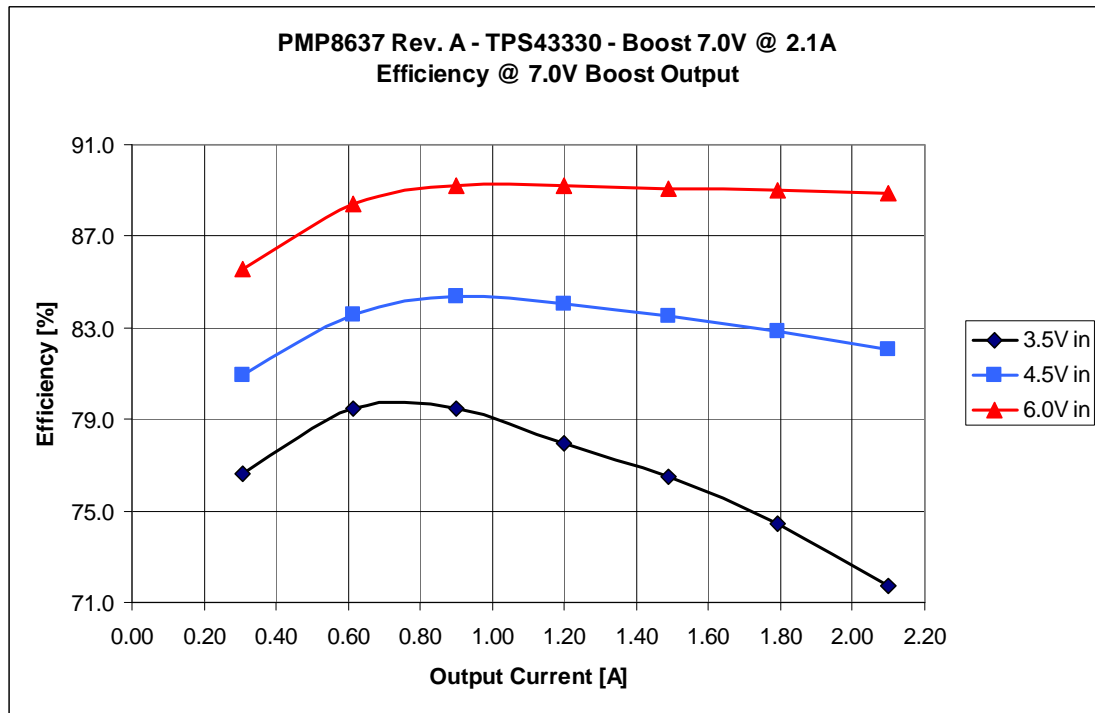


Figure 3

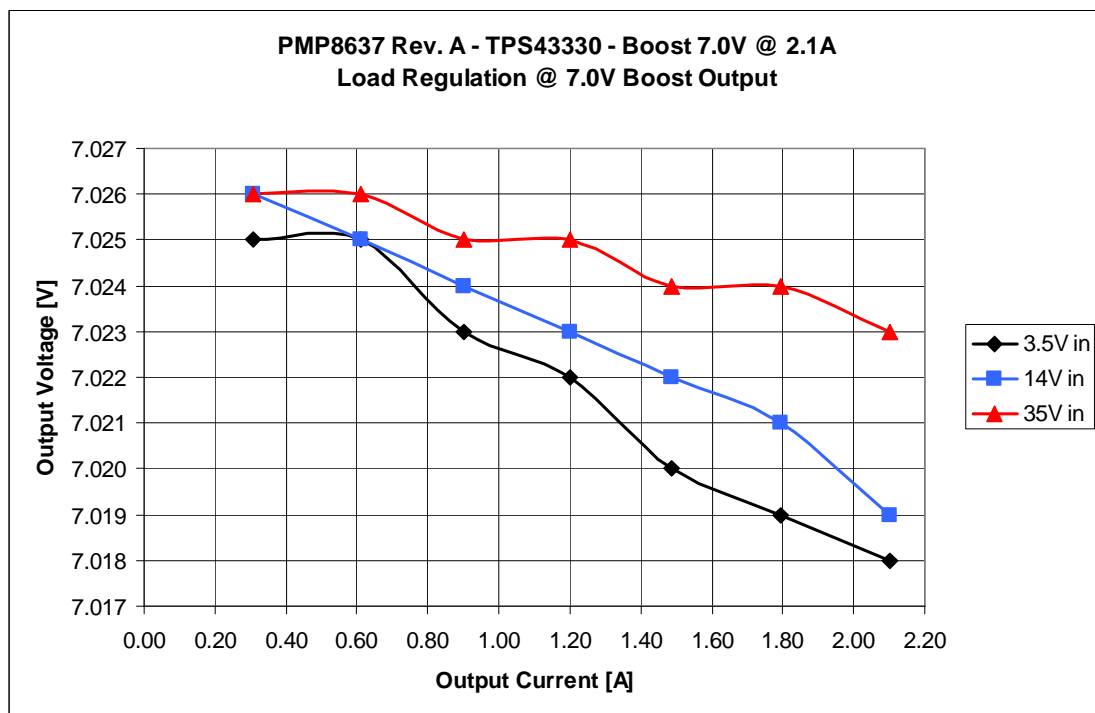


Figure 4

The response to a load step and a load dump for the Boost at 7.0V output voltage and an input voltage of 3.5V is shown in Figure 5.

Channel C2: **Output voltage**, -298mV undershoot (-4.3%), 272mV overshoot (+3.9%)
200mV/div, 1ms/div, AC coupled

Channel C1: **Load current**, load step 0.5A to 1.5A and vice versa
1A/div, 1ms/div

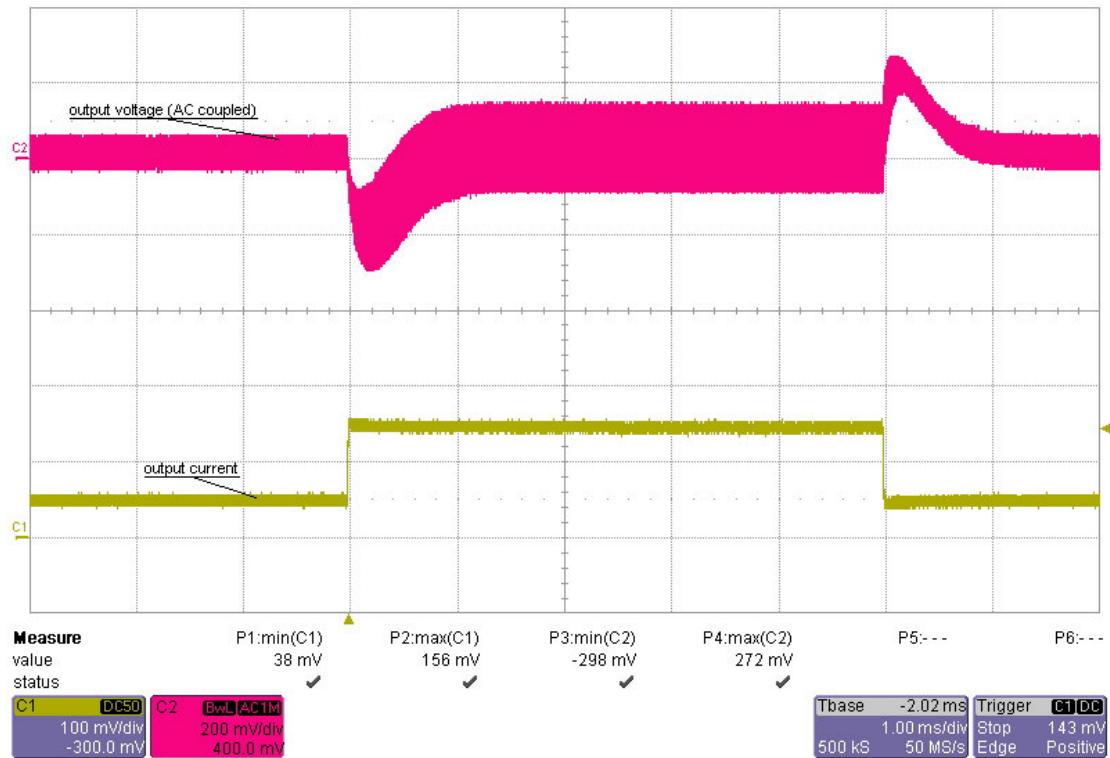


Figure 5

Figure 6 shows the loop response of the Boost at 3.5V, 4.5V and 6.0V input voltage and a load of 1.2A.

3.5V input

- 57 deg phase margin @ crossover frequency 766 Hz
- -20 db gain margin

4.5V input

- 69 deg phase margin @ crossover frequency 1.9 kHz
- -21 db gain margin

6.0V input

- 70 deg phase margin @ crossover frequency 3.8 kHz
- -20 db gain margin

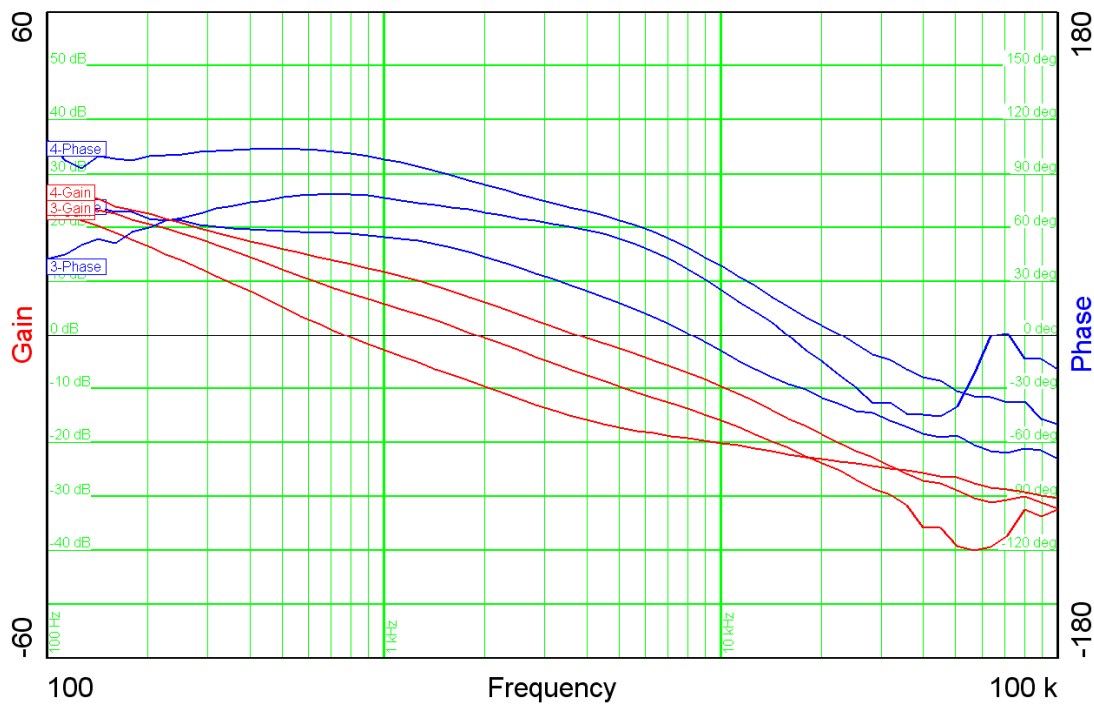


Figure 6

2 Buck A – 3.3V @ 2.3A

The switching node of Buck A is shown in Figure 7.

The input voltage is set at 35V with 2.3A load on the 3.3V output.

Channel C2: **Switching Node**, -2.6V minimum voltage, 43.8V maximum voltage
10V/div, 1us/div

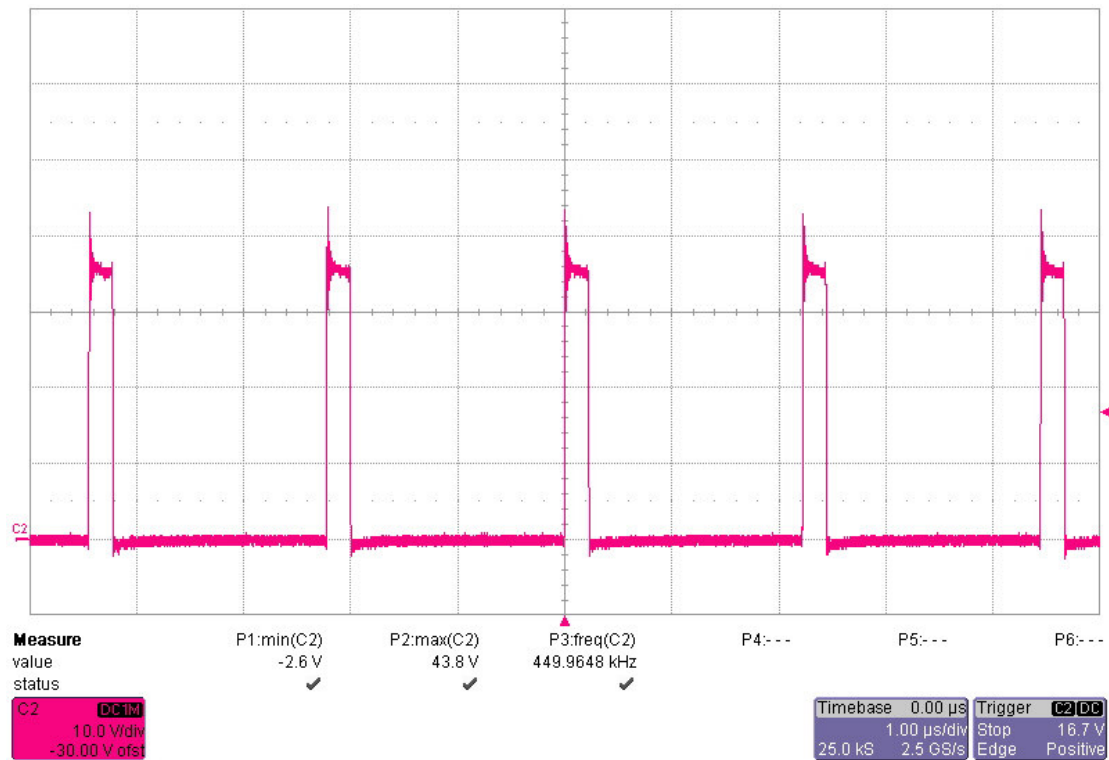


Figure 7

The output ripple voltage of Buck A at 7V, 14V and 35V input voltage is shown in Figure 8.

- Channel M1: **Output Ripple Voltage**, 7V input voltage, 10mV peak-peak (0.3%)
20mV/div, 5 μ s/div
- Channel M2: **Output Ripple Voltage**, 14V input voltage, 10mV peak-peak (0.3%)
20mV/div, 5 μ s/div
- Channel M3: **Output Ripple Voltage**, 35V input voltage, 10mV peak-peak (0.3%)
20mV/div, 5 μ s/div

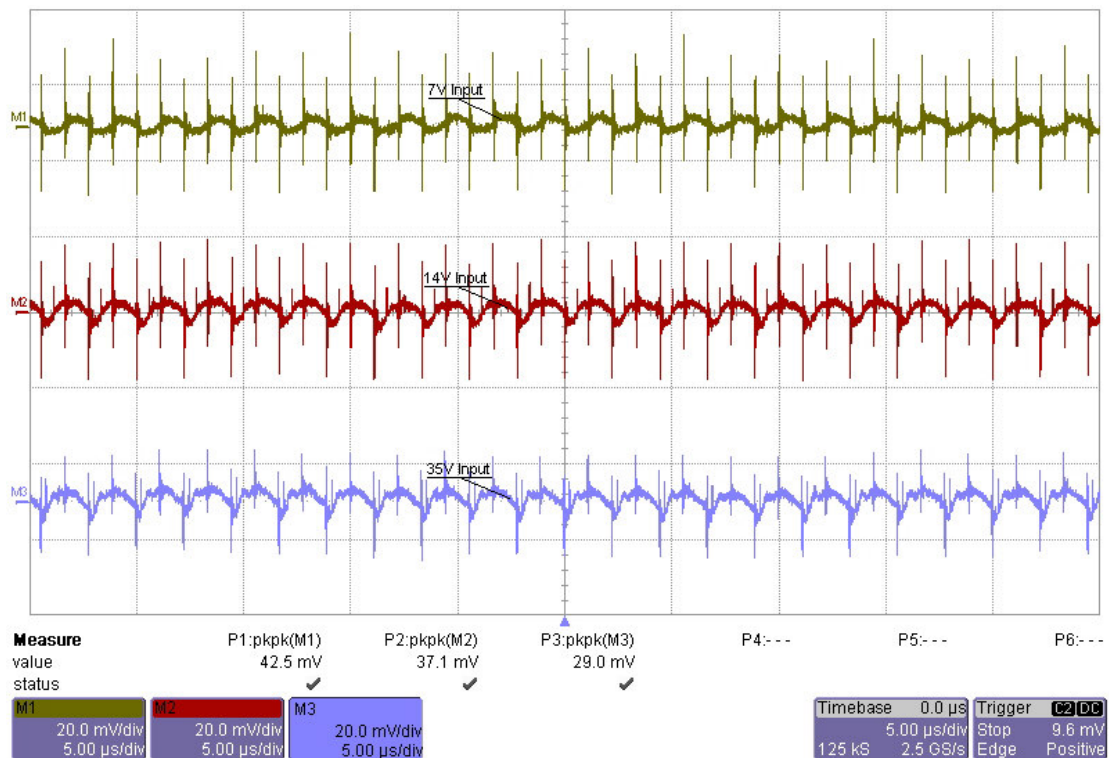


Figure 8

The efficiency and load regulation of Buck A are shown in Figure 9 and Figure 10.

During the measurement, the Boost and Buck B were disabled.

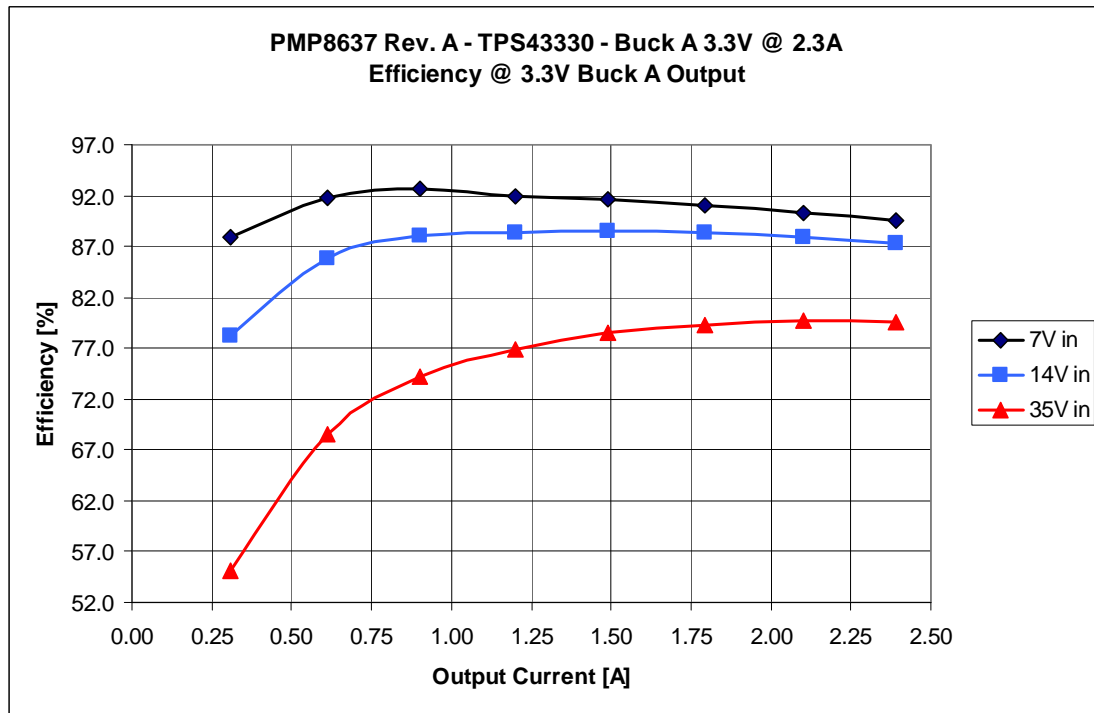


Figure 9

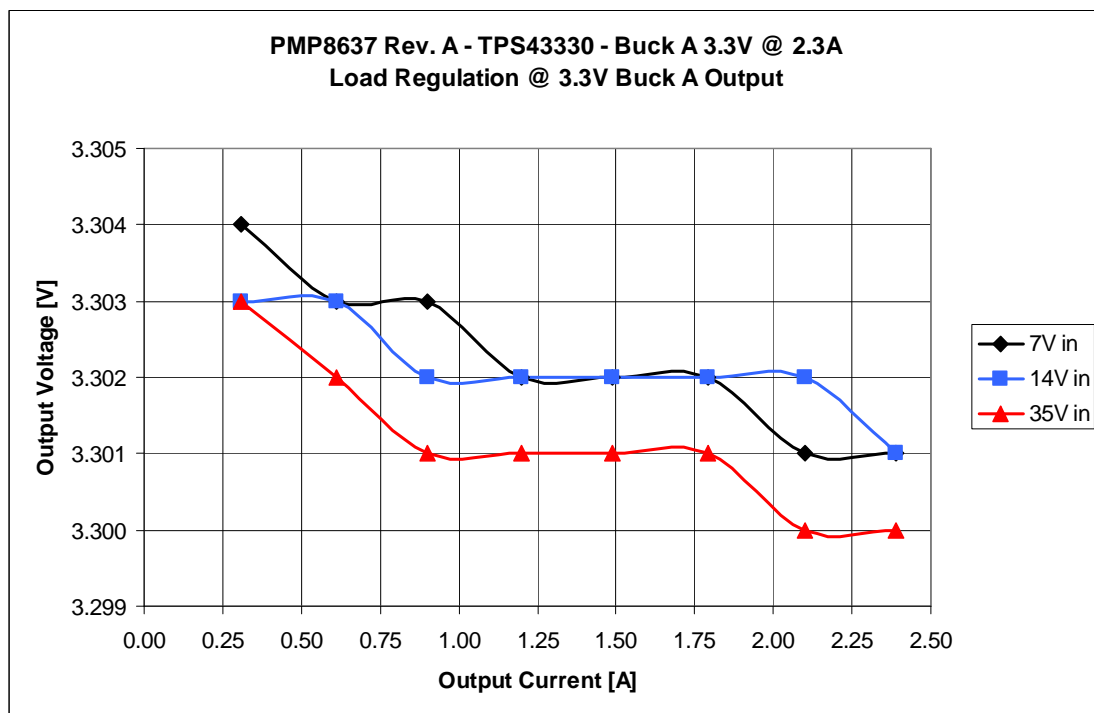


Figure 10

The response to a load step and a load dump for Buck A at 3.3V output voltage and an input voltage of 14V is shown in Figure 11.

Channel C2: **Output voltage**, -139mV undershoot (-4.2%), 133mV overshoot (+4.0%)
100mV/div, 1ms/div, AC coupled

Channel C1: **Load current**, load step 1.0A to 2.0A and vice versa
1A/div, 1ms/div

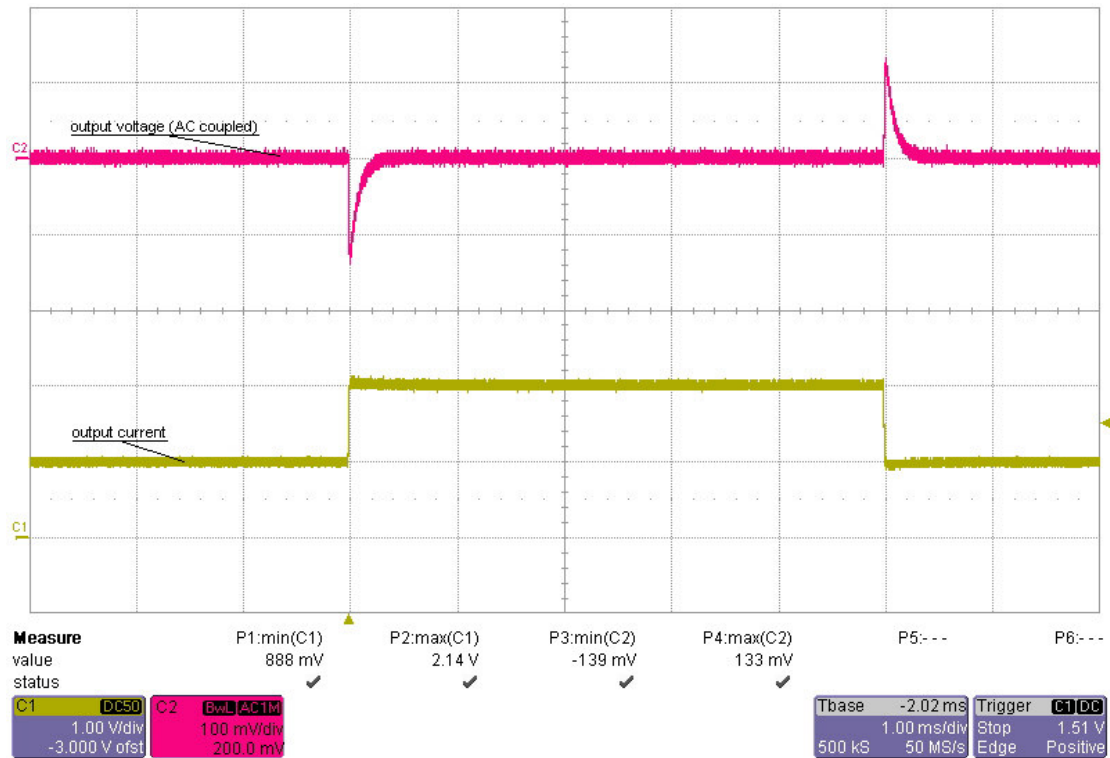


Figure 11

Figure 12 shows the loop response of Buck A at 7V, 14V and 35V input voltage and a load of 2.3A.

7V input

- 67 deg phase margin @ crossover frequency 20.9 kHz
- -15 db gain margin

14V input

- 73 deg phase margin @ crossover frequency 20.9 kHz
- -16 db gain margin

35V input

- 74 deg phase margin @ crossover frequency 19.9 kHz
- -16 db gain margin

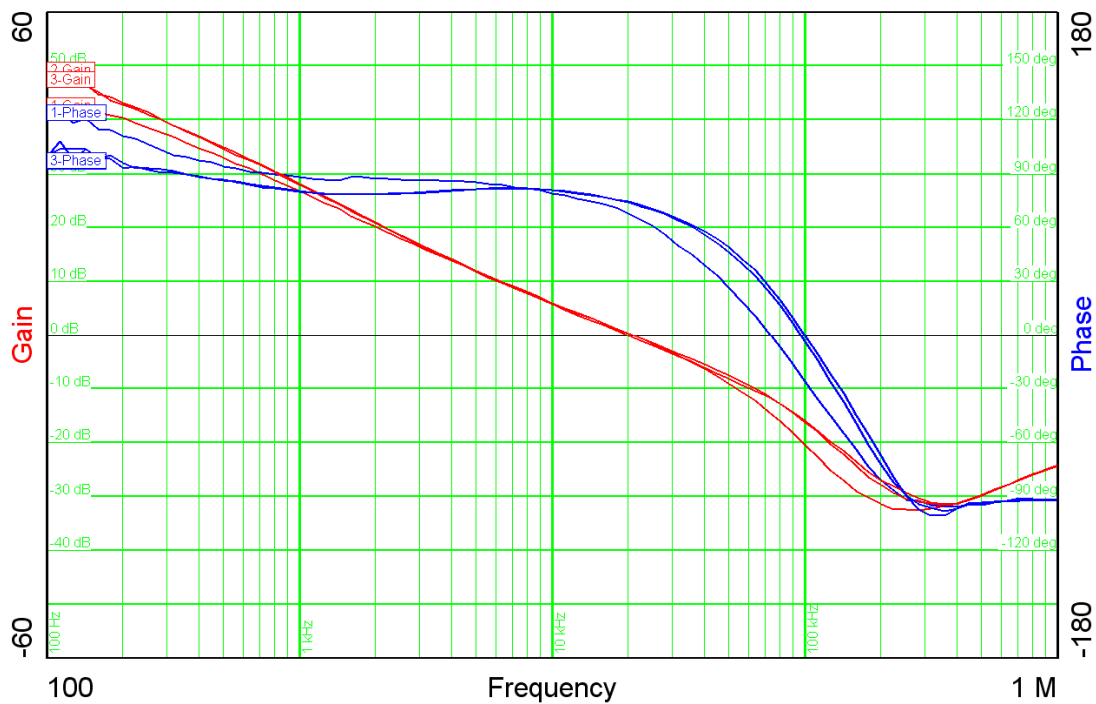


Figure 12

3 Buck B – 3.3V @ 1.8A

The switching node of Buck B is shown in Figure 13.
The input voltage is set at 35V with 1.8A load on the 3.3V output.

Channel C2: **Switching Node**, -2.3V minimum voltage, 42.8V maximum voltage
10V/div, 1us/div

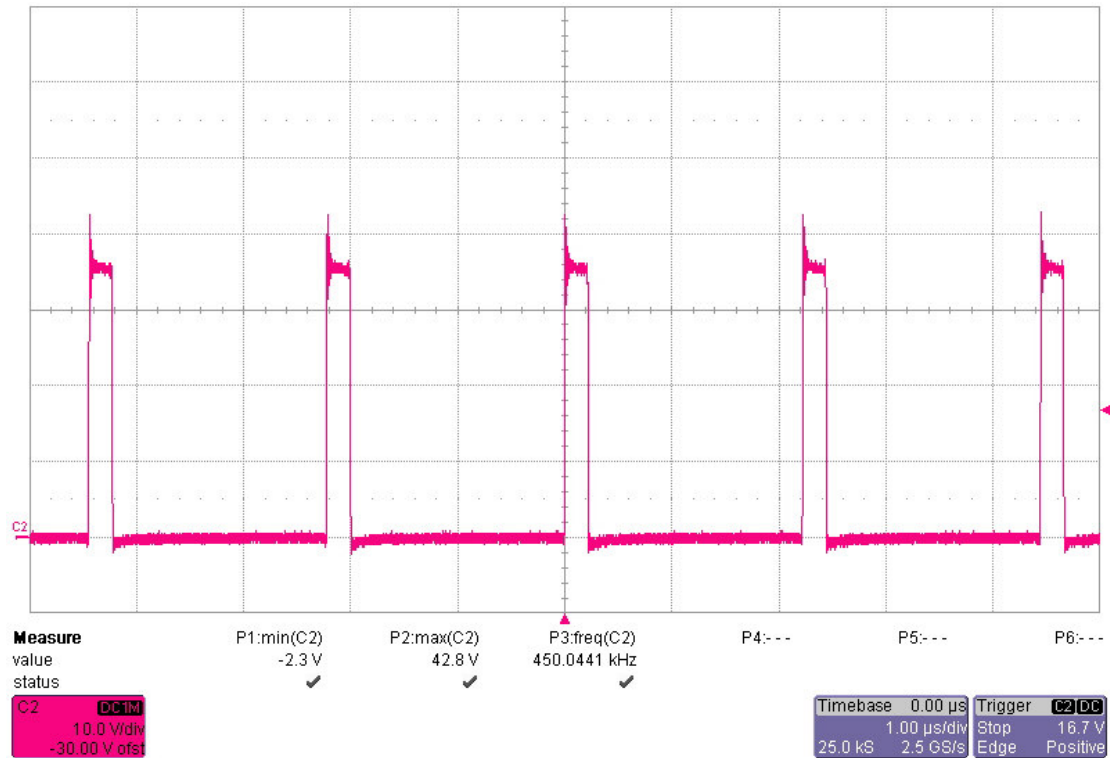


Figure 13

The output ripple voltage of Buck B at 7V, 14V and 35V input voltage is shown in Figure 14.

- Channel M1: **Output Ripple Voltage**, 7V input voltage, 10mV peak-peak (0.3%)
20mV/div, 5us/div
- Channel M2: **Output Ripple Voltage**, 14V input voltage, 10mV peak-peak (0.3%)
20mV/div, 5us/div
- Channel M3: **Output Ripple Voltage**, 35V input voltage, 10mV peak-peak (0.3%)
20mV/div, 5us/div

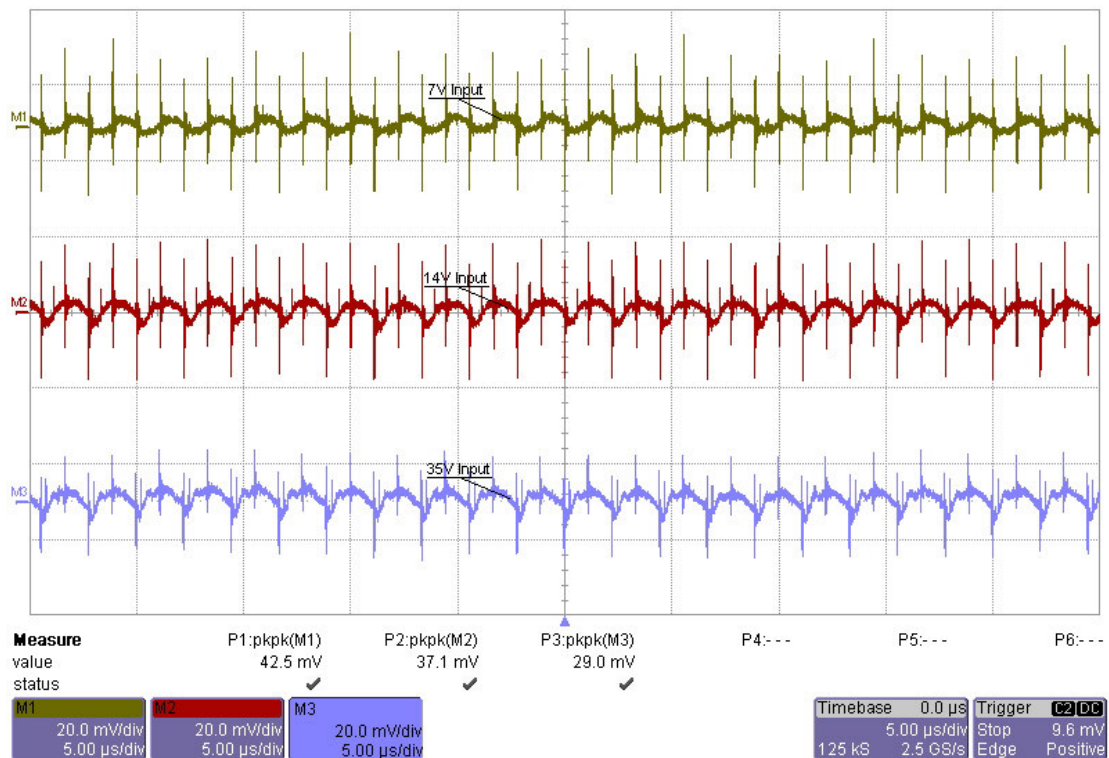


Figure 14

The efficiency and load regulation of Buck B are shown in Figure 15 and Figure 16.

During the measurement, the Boost and Buck A were disabled.

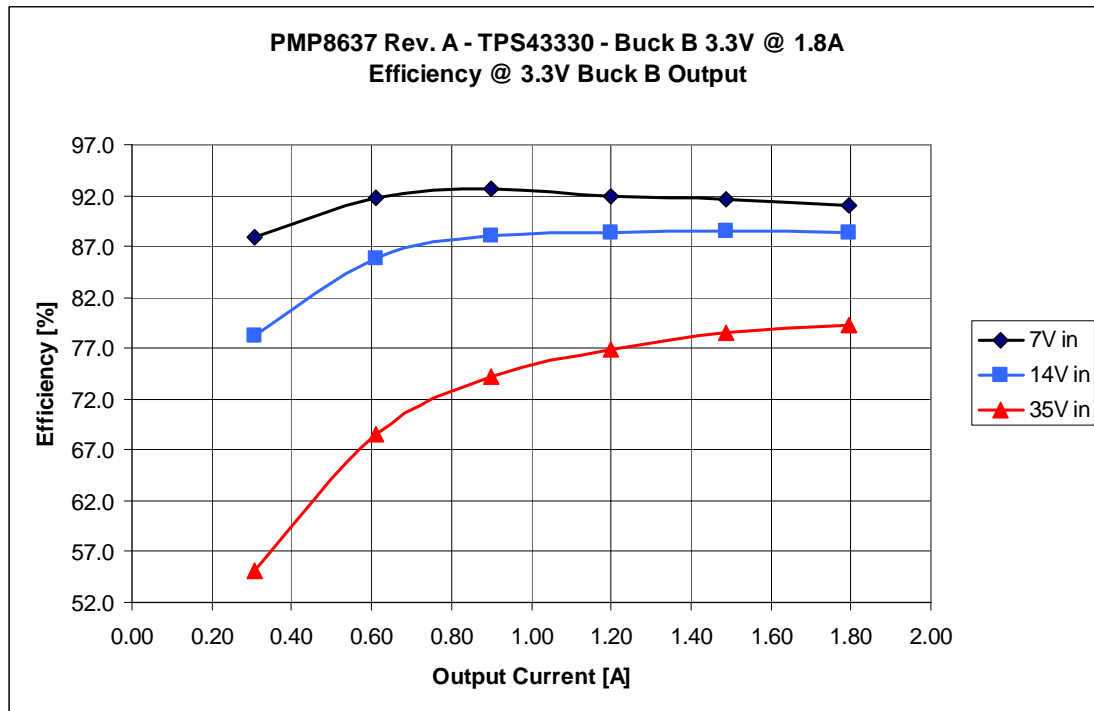


Figure 15

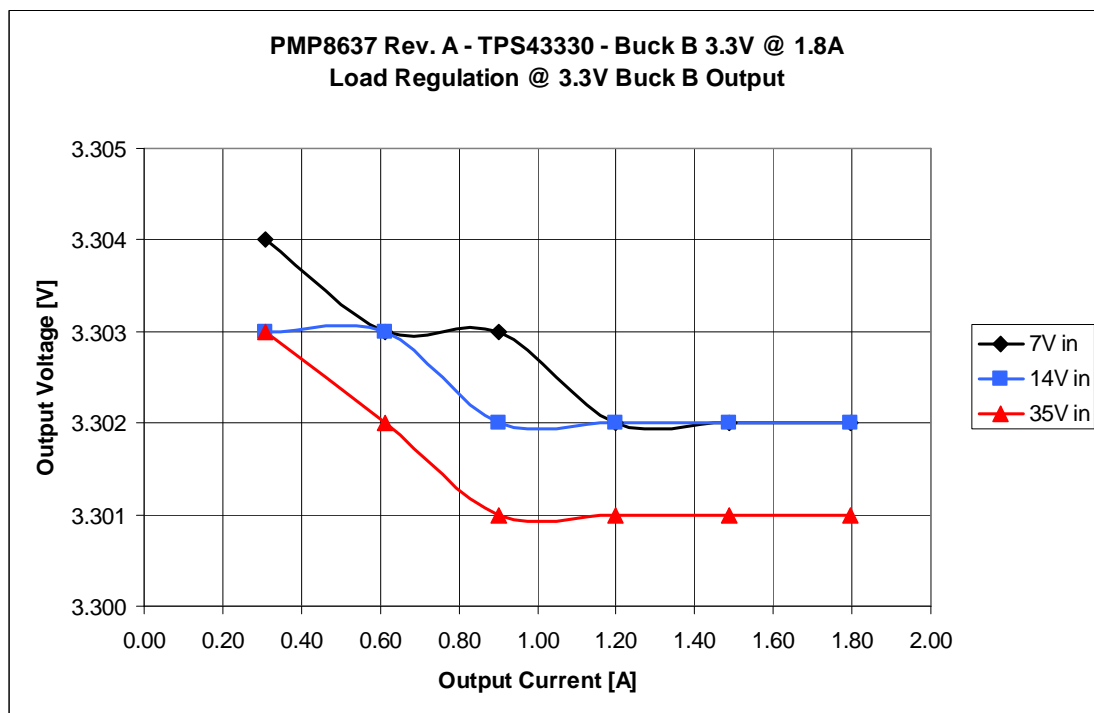


Figure 16

The response to a load step and a load dump for Buck B at 3.3V output voltage and an input voltage of 14V is shown in Figure 17.

Channel C2: **Output voltage**, -104mV undershoot (-3.2%), 98mV overshoot (+2.9%)
100mV/div, 1ms/div, AC coupled

Channel C1: **Load current**, load step 0.9A to 1.8A and vice versa
1A/div, 1ms/div

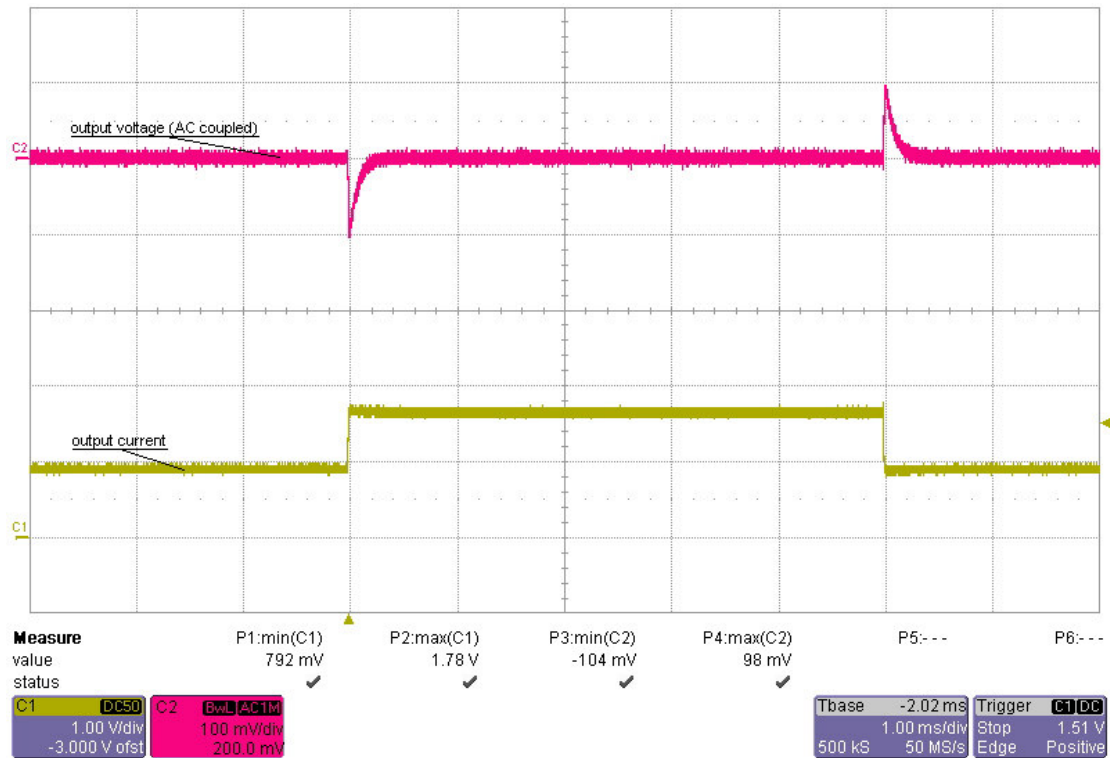


Figure 17

Figure 18 shows the loop response of Buck B at 7V, 14V and 35V input voltage and a load of 1.8A.

7V input

- 66 deg phase margin @ crossover frequency 20.7 kHz
- -15 db gain margin

14V input

- 75 deg phase margin @ crossover frequency 21.9 kHz
- -16 db gain margin

35V input

- 76 deg phase margin @ crossover frequency 22.0 kHz
- -14 db gain margin

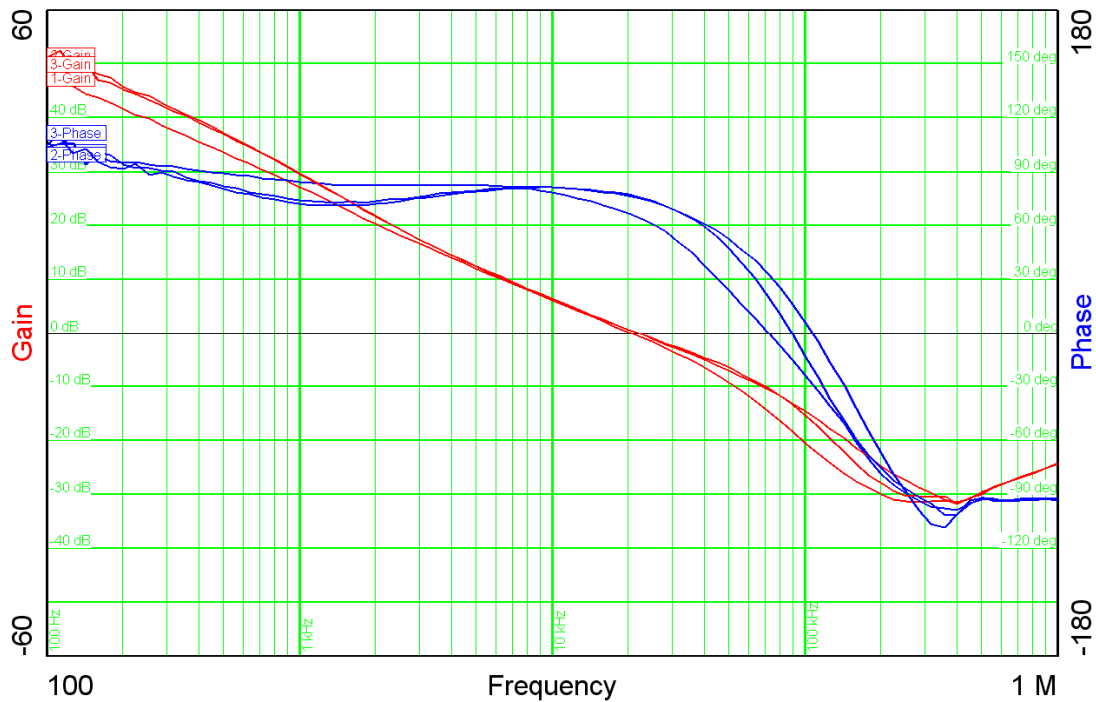


Figure 18

4 Thermal Image – Boost not working

The thermal image (Figure 19) shows the circuit at an ambient temperature of 21 °C with an input voltage of 14V and full load on the outputs.

Boost not working, Buck A with 2.3A load, Buck B with 1.8A load

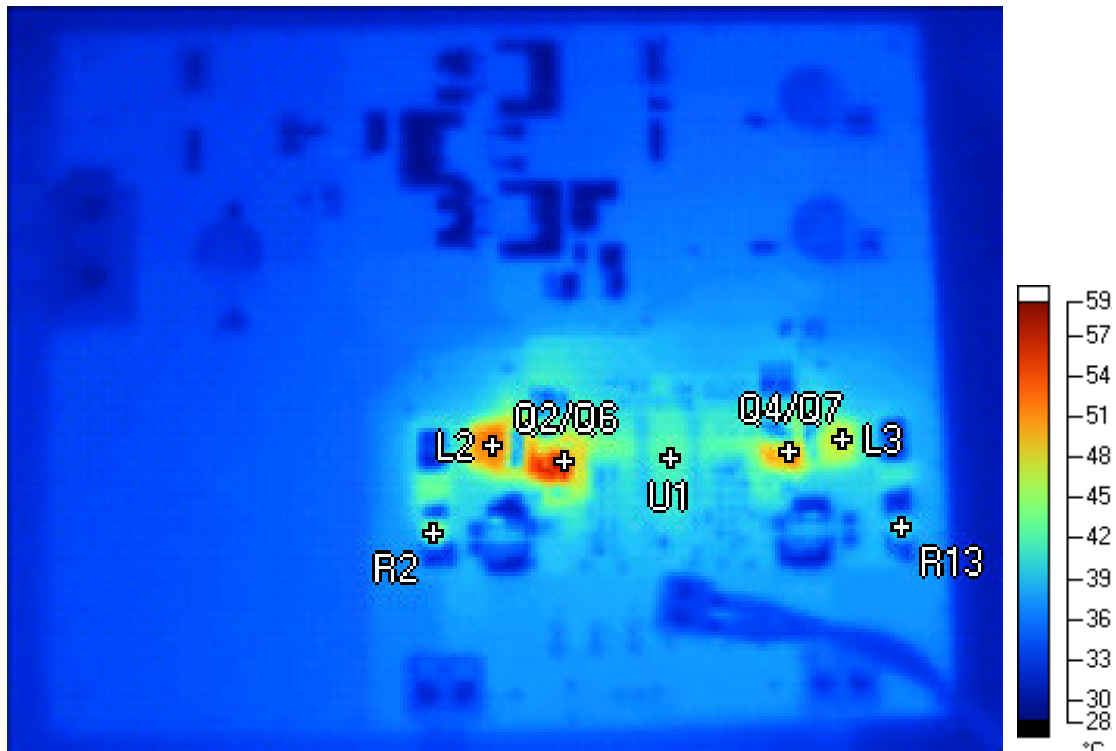


Figure 19

Markers

Label	Temperature	Emissivity	Background
Q2/Q6	58.1 °C	0.95	21.0 °C
L2	52.1 °C	0.95	21.0 °C
R2	46.4 °C	0.95	21.0 °C
U1	42.3 °C	0.95	21.0 °C
R13	42.2 °C	0.95	21.0 °C
L3	47.4 °C	0.95	21.0 °C
Q4/Q7	52.1 °C	0.95	21.0 °C

5 Thermal Image – Boost working

The thermal image (Figure 20) shows the circuit at an ambient temperature of 21 °C with an input voltage of 5V and full load on the outputs.

Boost is working and supplied Buck A and B with 7V, Buck A with 2.3A load, Buck B with 1.8A load

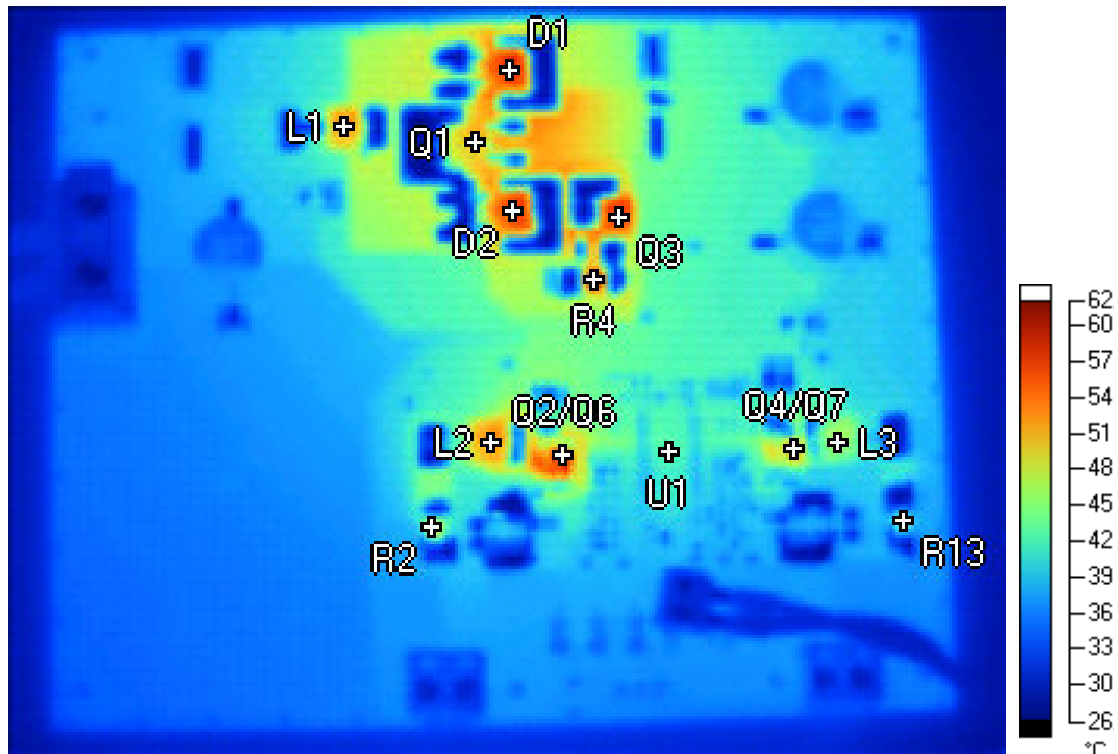


Figure 20

Markers

Label	Temperature	Emissivity	Background
R2	46.0 °C	0.95	21.0 °C
R13	42.4 °C	0.95	21.0 °C
L2	51.8 °C	0.95	21.0 °C
L3	45.5 °C	0.95	21.0 °C
Q4/Q7	51.2 °C	0.95	21.0 °C
Q2/Q6	58.0 °C	0.95	21.0 °C
U1	42.3 °C	0.95	21.0 °C
R4	60.3 °C	0.95	21.0 °C
Q3	57.0 °C	0.95	21.0 °C
D2	56.1 °C	0.95	21.0 °C
D1	57.0 °C	0.95	21.0 °C
Q1	50.1 °C	0.95	21.0 °C
L1	52.5 °C	0.95	21.0 °C

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