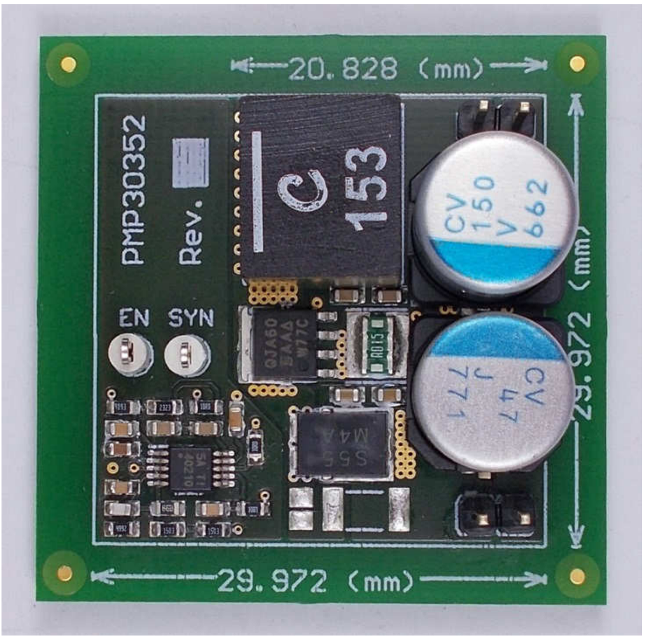
Automotive Boost

- Input 9.0 .. 16.0V (5.0 .. 24.0V operational)
- Output 45.0V @ 1.0A
- Free-Running-Switching Frequency of 350 kHz



1. Startup

The startup waveform at 12.0V input voltage and no load on the 45.0V output is shown in Figure 1.

Channel C1 **12.0V Input Voltage**
10V/div, 10ms/div

Channel C2 **45.0V Output Voltage**
10V/div, 10ms/div

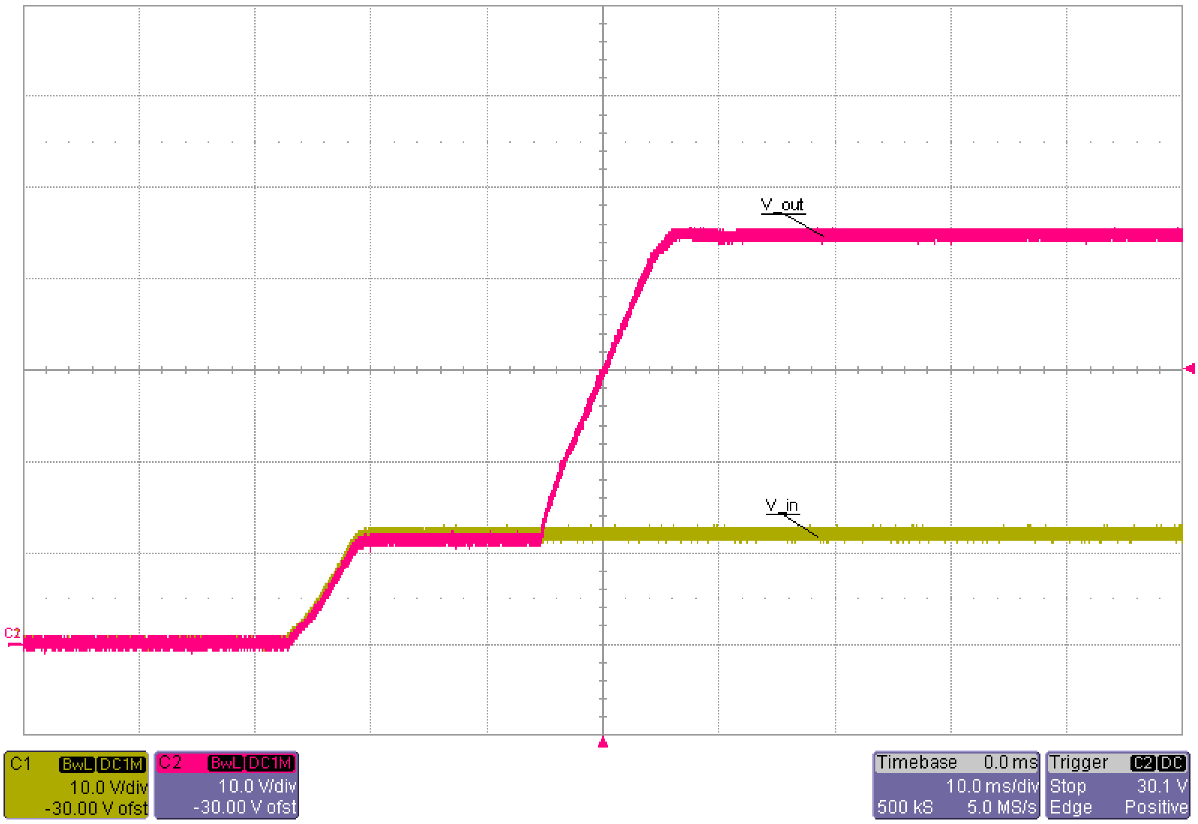


Figure 1

2. Shutdown

The shutdown waveform at 12.0V input voltage and 1.0A load at 45.0V output voltage is shown in Figure 2.

Channel C1 **12.0V Input Voltage**
10V/div, 10ms/div

Channel C1 **45.0V Output Voltage**
10V/div, 10ms/div

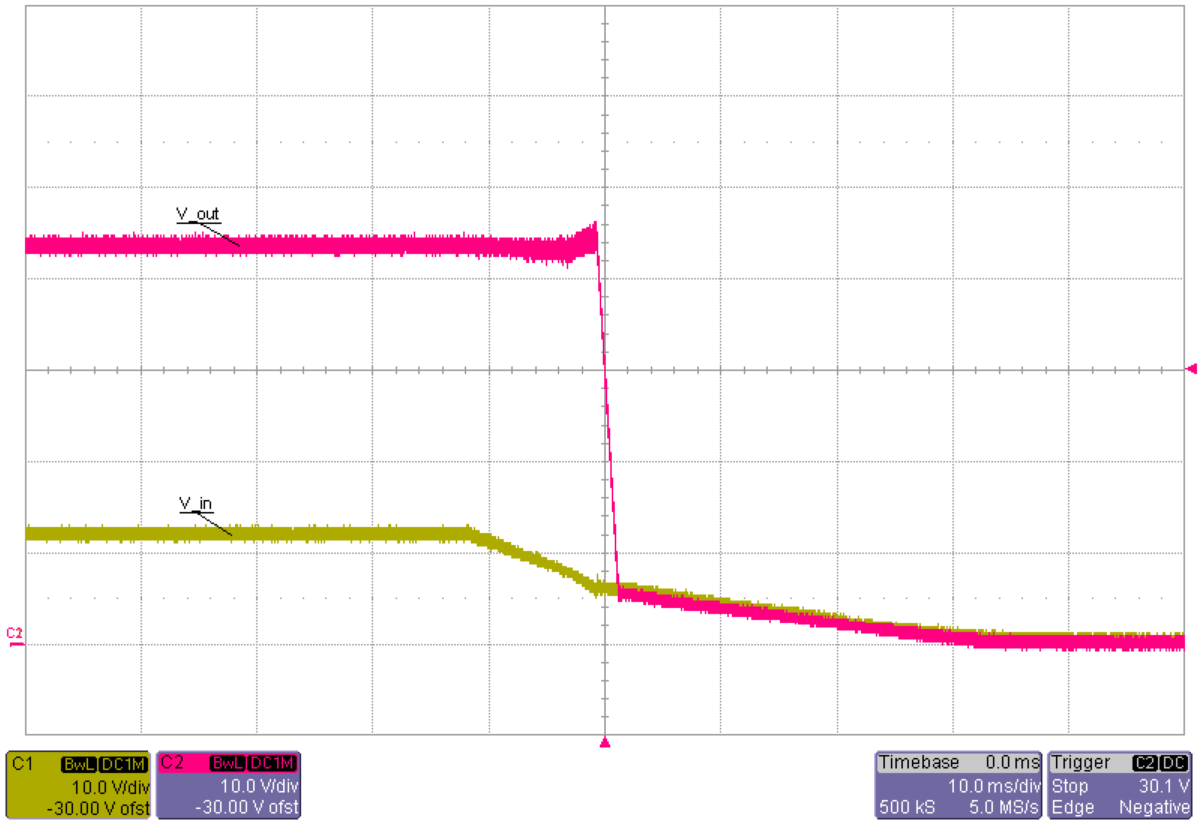


Figure 2

3. Efficiency

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

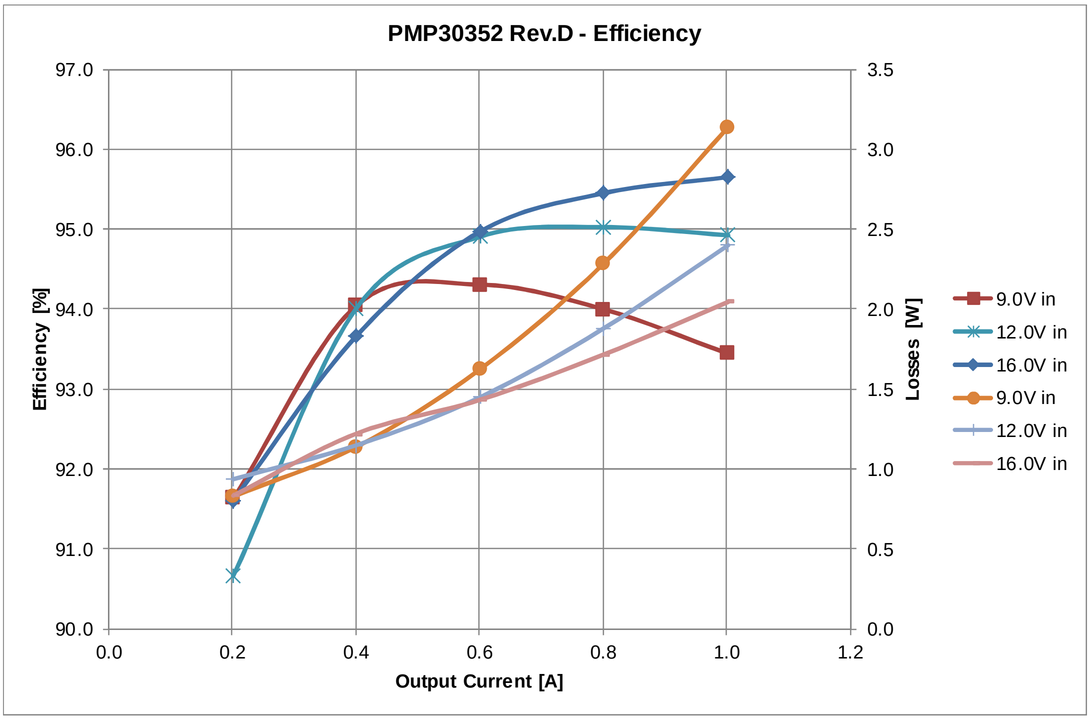


Figure 3

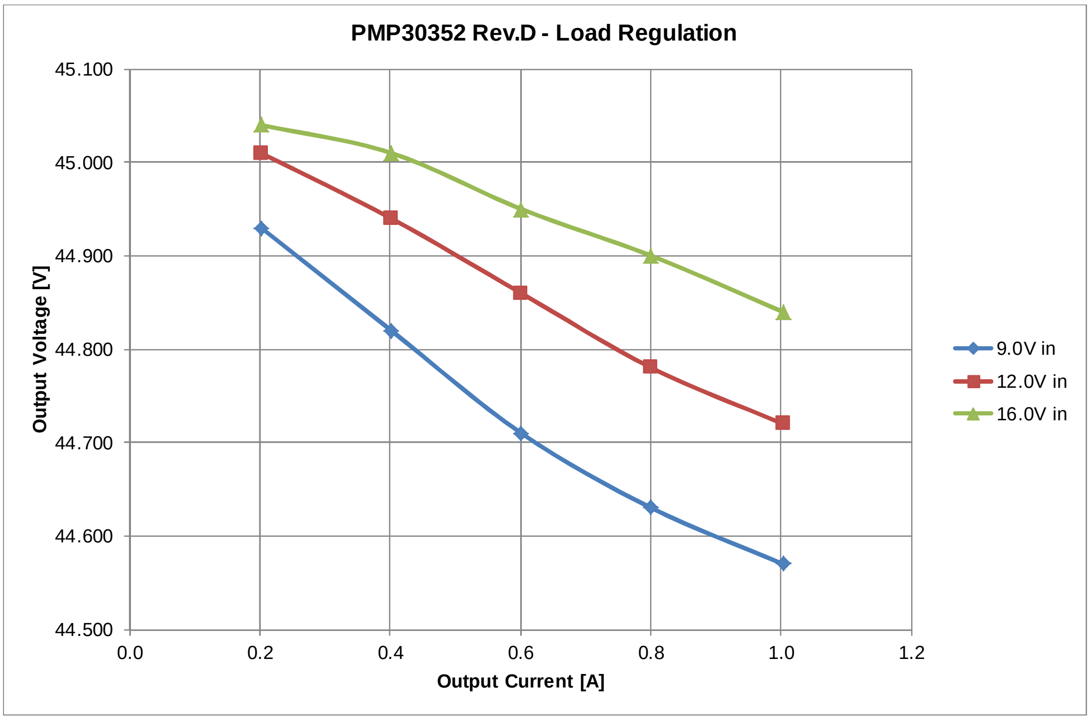


Figure 4

4. Transient Response

The response to a load step at 45.0V output voltage is shown in Figure 5.

Channel C1 **Output Current**, Load Step 0.5A to 1.0A
500mA/div, 1ms/div

Channel C2 **Output Voltage**, -1.5V undershoot (3.3%), 1.5V overshoot (3.3%)
1V/div, 1ms/div, AC coupled

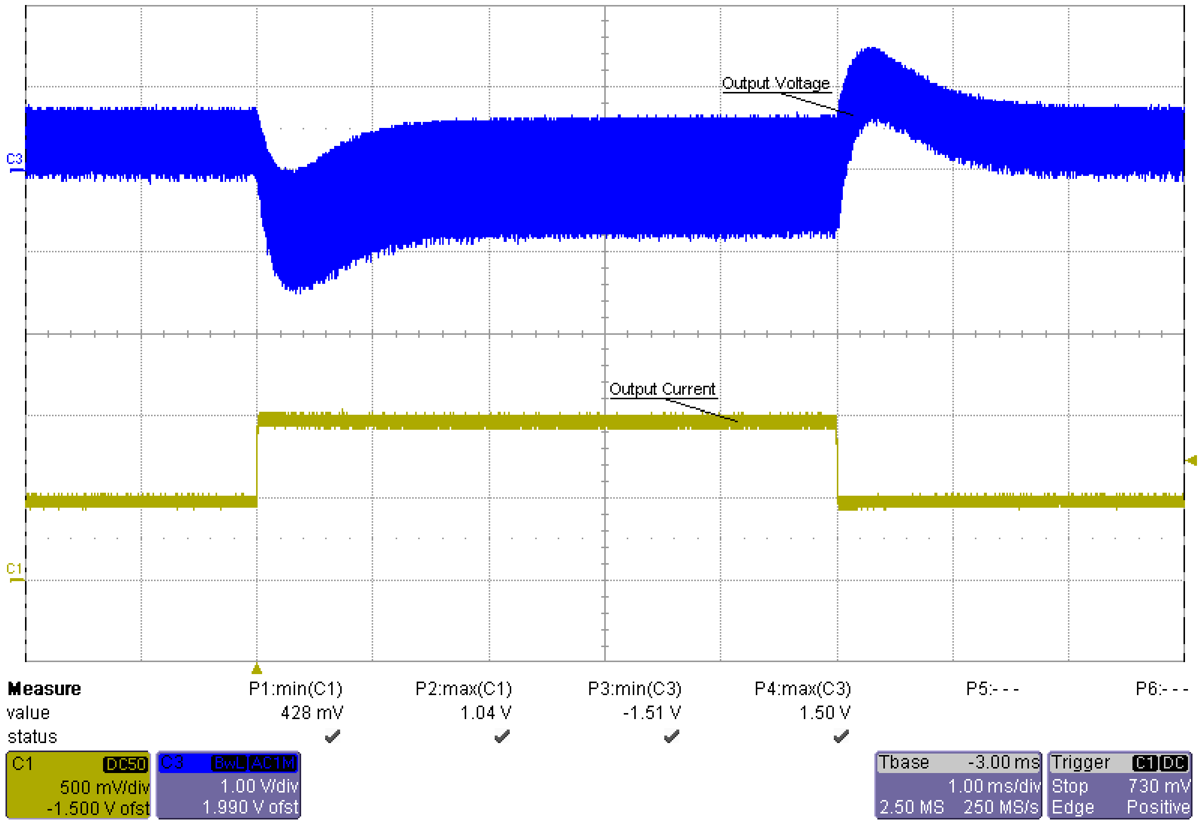


Figure 5

5. Frequency Response

The frequency response is shown in Figure 6.

9.0V Input, 1.0A Load	726 Hz Bandwidth, 82 deg Phase Margin, -29 dB Gain Margin
12.0V Input, 1.0A Load	974 Hz Bandwidth, 84 deg Phase Margin, -29 dB Gain Margin
16.0V Input, 1.0A Load	1305 Hz Bandwidth, 86 deg Phase Margin, -29 dB Gain Margin

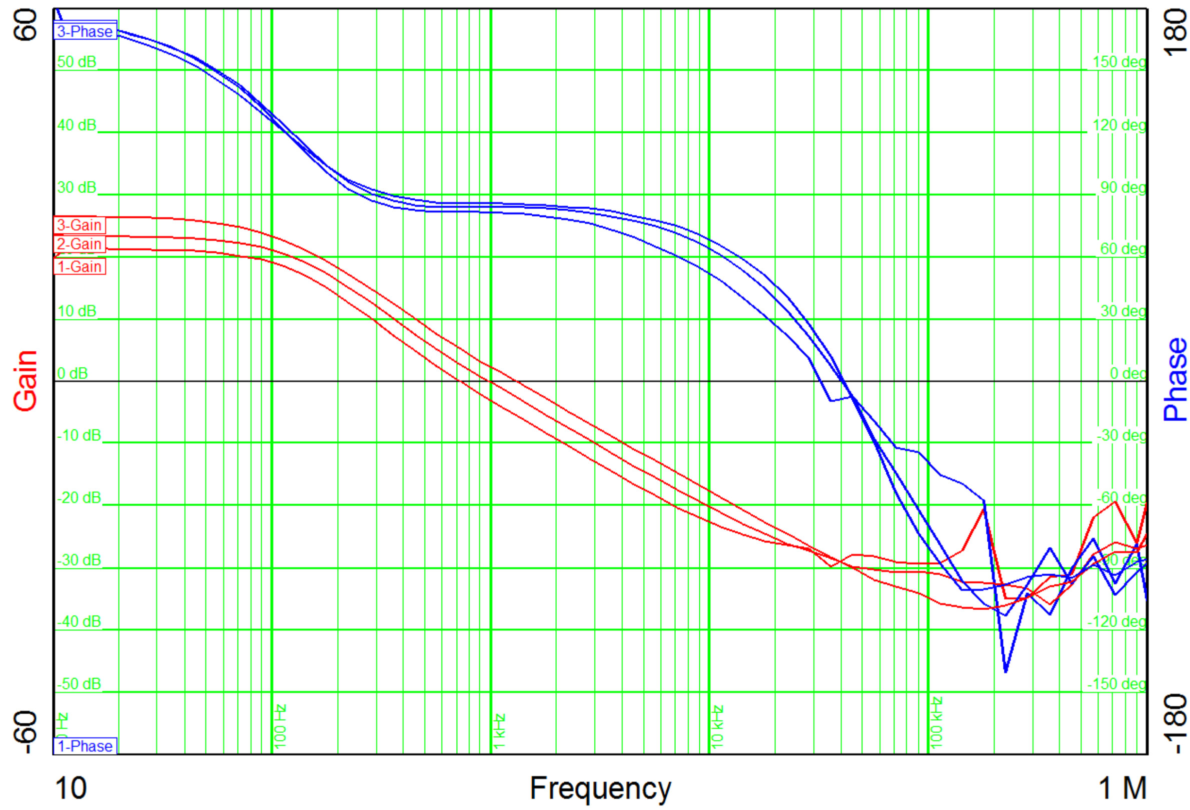


Figure 6

6. Input Ripple

The input ripple is shown in Figure 7.

Channel M1 **Input Voltage @ 9.0V Input / 1.0A Load**, 627mV peak-peak (spikes)
200mV/div, 2us/div

Channel M2 **Input Voltage @ 12.0V Input / 1.0A Load**, 483mV peak-peak (spikes)
200mV/div, 2us/div

Channel M3 **Input Voltage @ 16.0V Input / 1.0A Load**, 384mV peak-peak (spikes)
200mV/div, 2us/div

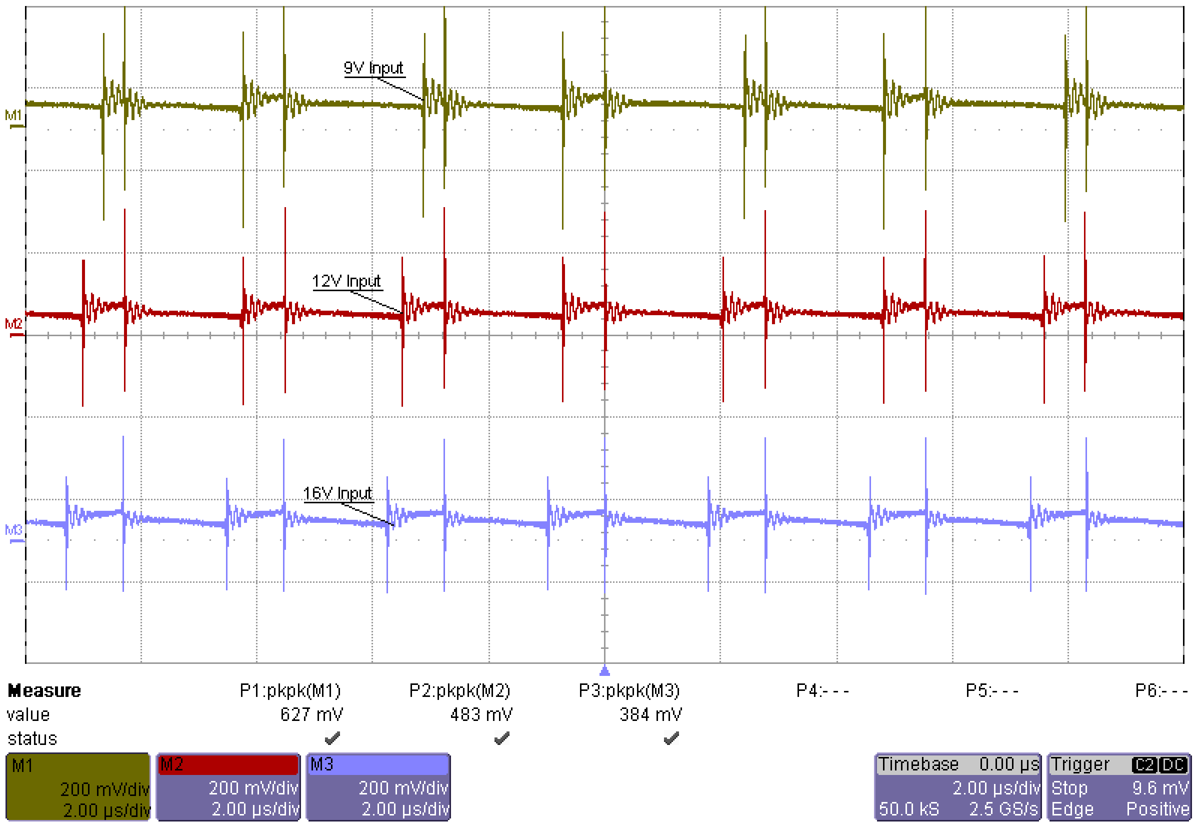


Figure 7

7. Output Ripple

The output ripple voltage is shown in Figure 8.

Channel M1 **Output Voltage @ 9.0V Input / 1.0A Load**, 5.38V peak-peak (spikes)
2V/div, 2us/div

Channel M2 **Output Voltage @ 12.0V Input / 1.0A Load**, 4.29V peak-peak (spikes)
2V/div, 2us/div

Channel M3 **Output Voltage @ 16.0V Input / 1.0A Load**, 3.74V peak-peak (spikes)
2V/div, 2us/div

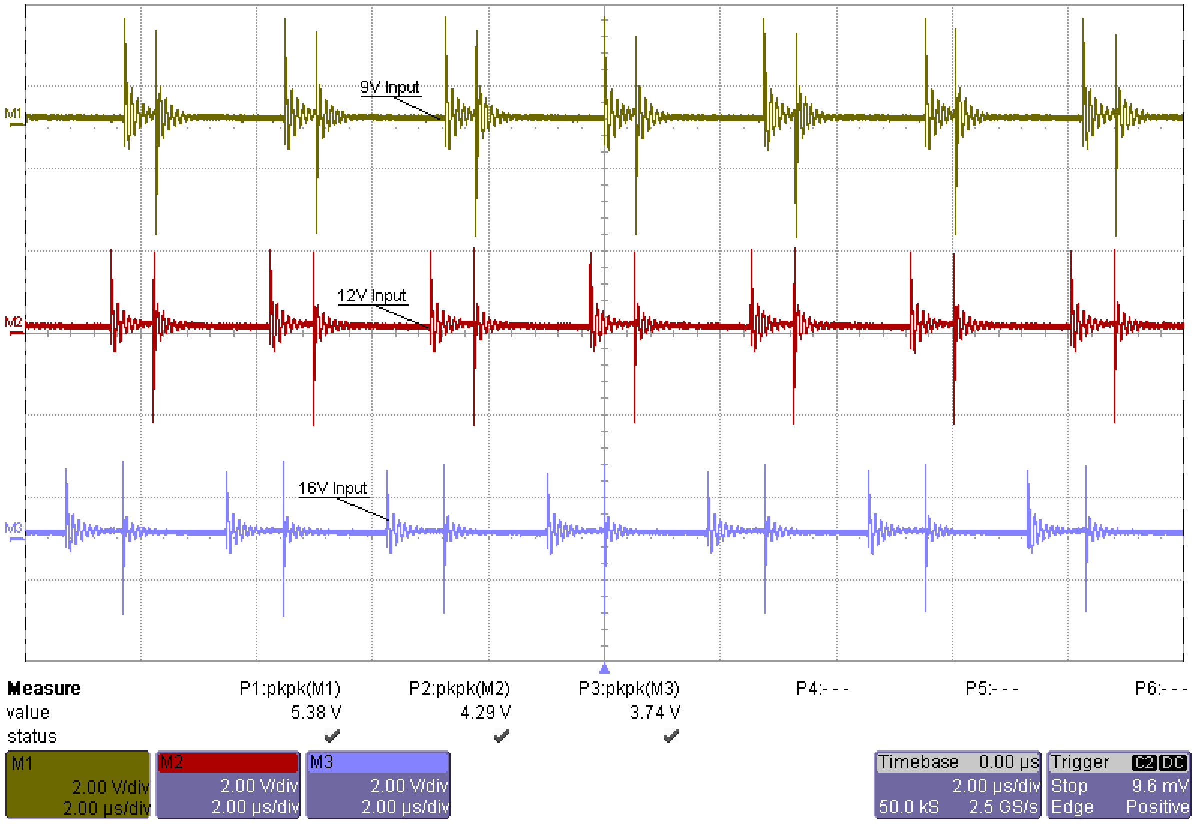


Figure 8

9. Switching Node

The drain-source voltage of the FET at 12.0V input voltage and 1.0A load on the output is shown in Figure 9.

Channel C1 **Drain-Source Voltage**, -2.6V minimum, 51.8V maximum
10V/div, 1us/div

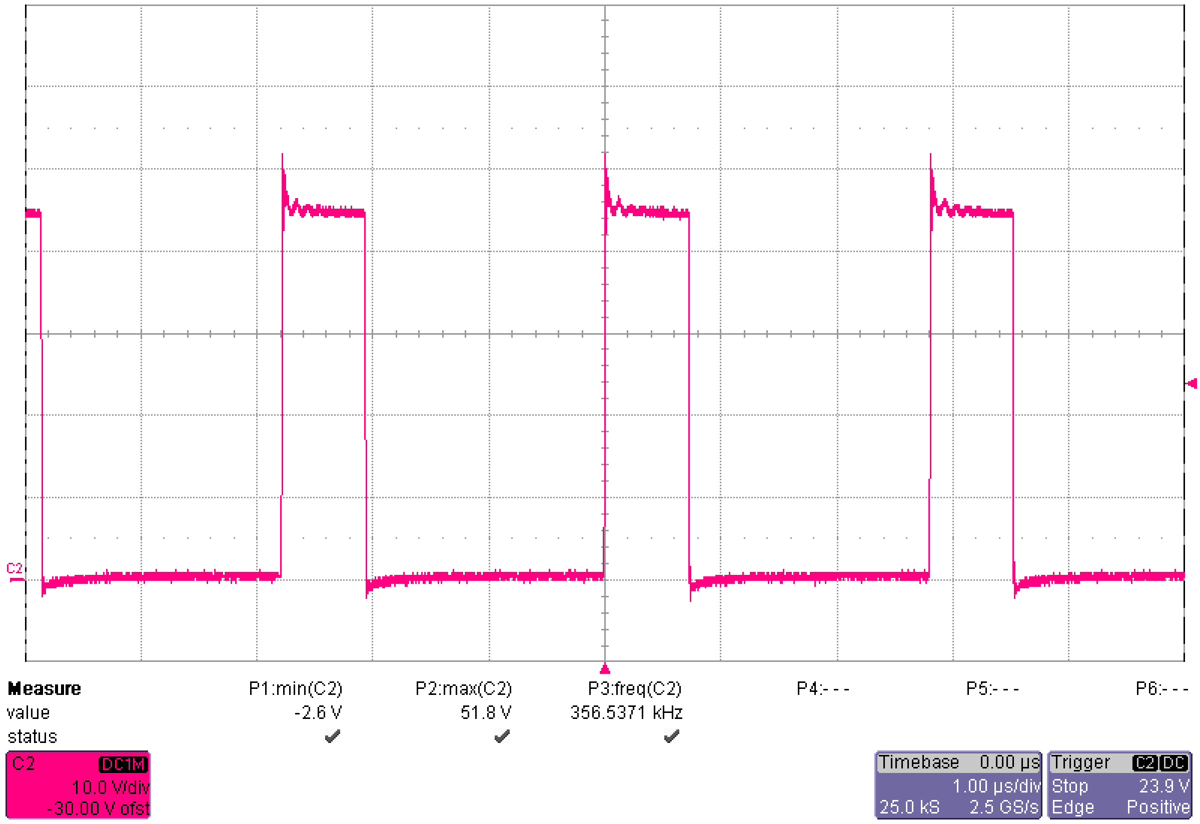


Figure 9

11.Diode Voltage

The voltage of the diode at 12.0V input voltage and 1.0A load on the output is shown in Figure 10.

Channel C1 **Anode-Cathode Voltage**, -2.0V minimum, 49.8V maximum
10V/div, 1us/div

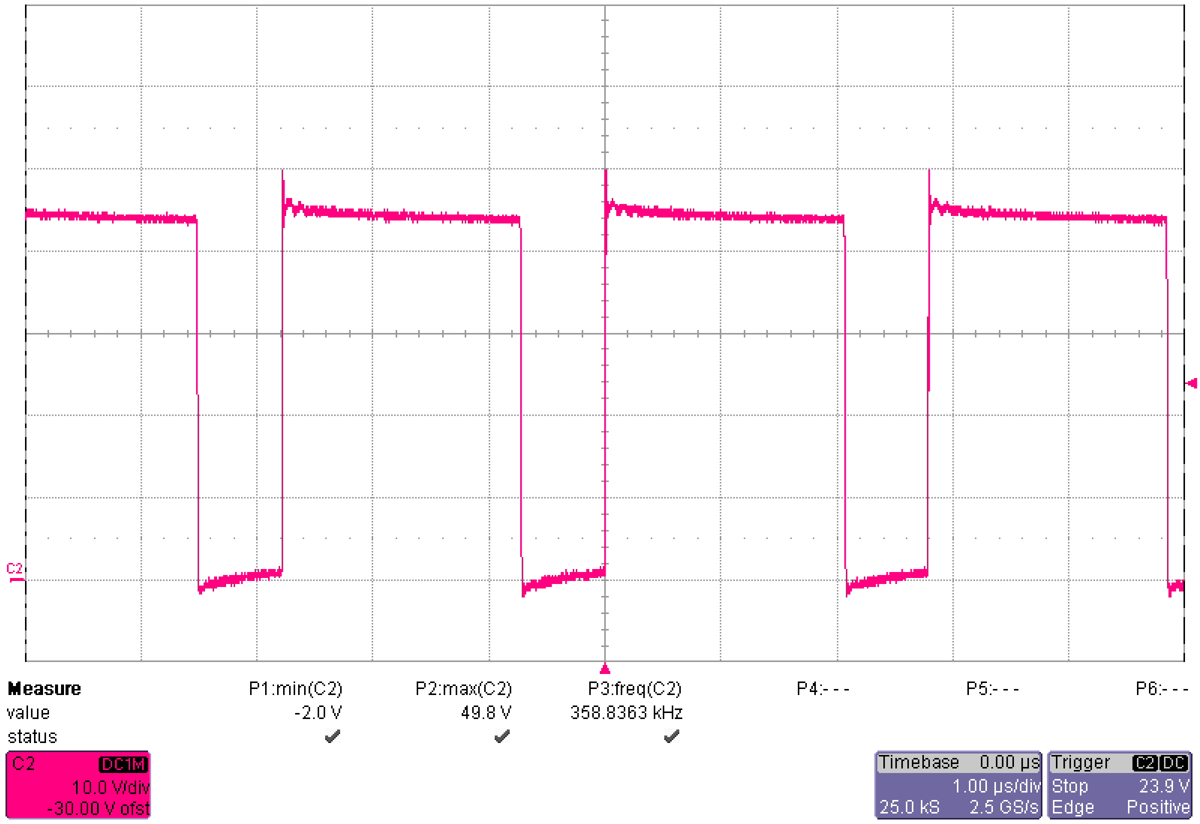


Figure 10

12.Thermal Image

The thermal image (Figure 11) shows the circuit at an ambient temperature of 20°C with an input voltage of 12.0V and 1.0A load on the output.

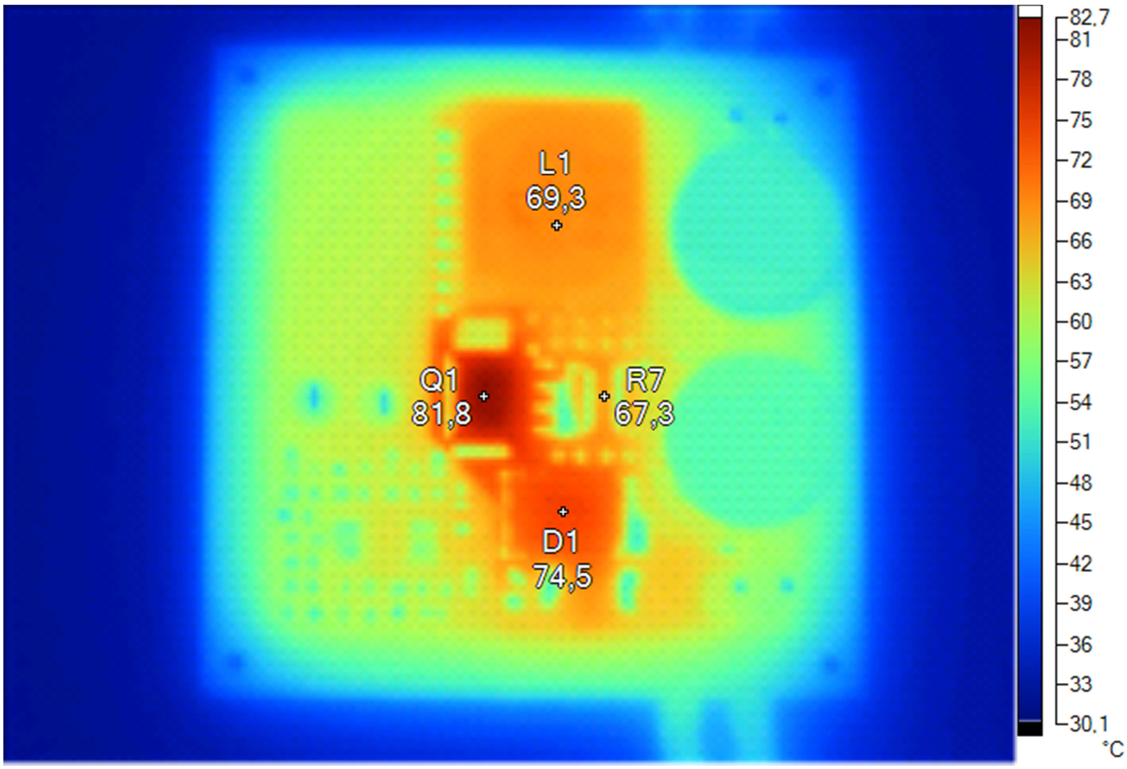


Figure 11

Name	Temperature	Emissivity	Background
D1	74.5°C	0.95	20.0°C
L1	69.3°C	0.95	20.0°C
Q1	81.8°C	0.95	20.0°C
R7	67.3°C	0.95	20.0°C

13.EMI Test

The measurement of conducted emission is shown in the following pictures.

The design was not optimized for EMI nor is the test setup conform to a standardized setup. It was only done to illustrate the effect of dithering and to compare different approaches. When comparing the results, the absolute numbers are not important, only the difference between several configurations.

For all measurements the board was supplied by 12.0V and loaded with 1.0A by an load resistor.

1. Measurement - Figure 12
   No dithering, the board is switching with a fixed switching frequency of 350 kHz.
2. Measurement - Figure 13
   A square wave (10 kHz, 50% Duty Cycle, 0/5V Level) is injected into TP2. The switching frequency changes between 350 and 390 kHz.
3. Measurement - Figure 14
   A triangular wave (10 kHz, 50% Rise/Fall Time, 0/5V Level) is injected into TP2. The switching frequency changes between 350 and 390 kHz.
4. Measurement - Figure 15
   A square wave (10 kHz, 50% Duty Cycle, 0/5V Level) is injected into TP2 by a low pass filter (1 kΩ, 10nF) to achieve a triangular-like wave form. The switching frequency changes between 350 and 390 kHz.

No dithering, the board is switching with a fixed switching frequency of 350 kHz.

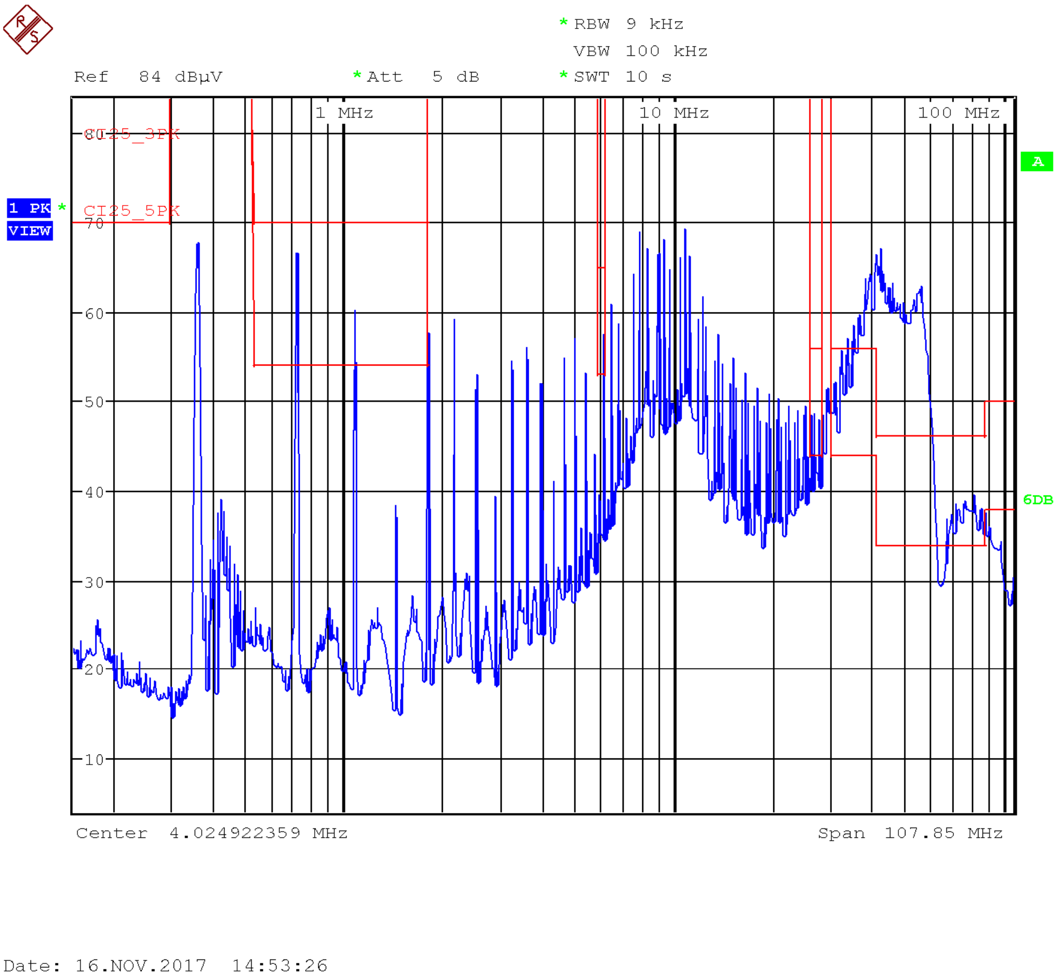


Figure 12

A square wave (10 kHz, 50% Duty Cycle, 0/5V Level) is injected into TP2.
The switching frequency changes between 350 and 390 kHz .

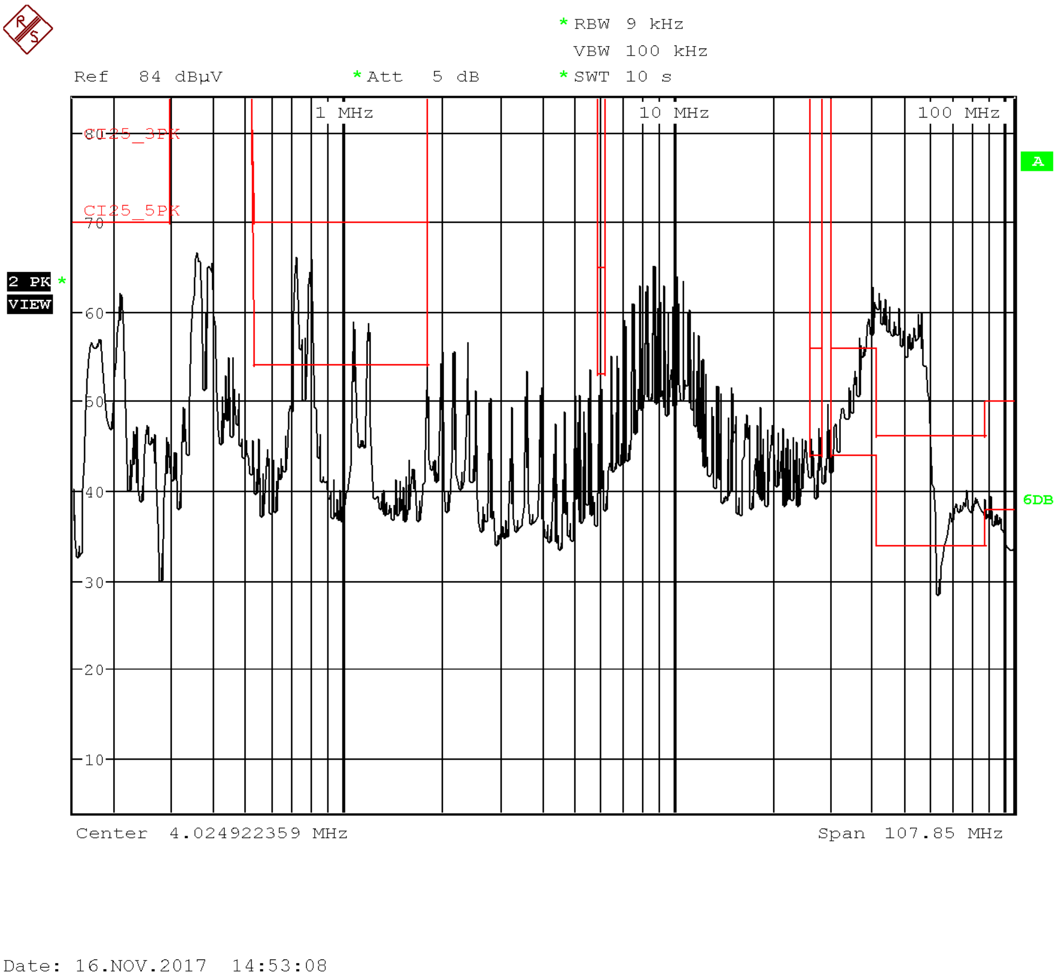


Figure 13

A triangular wave (10 kHz, 50% Rise/Fall Time, 0/5V Level) is injected into TP2. The switching frequency changes between 350 and 390 kHz.

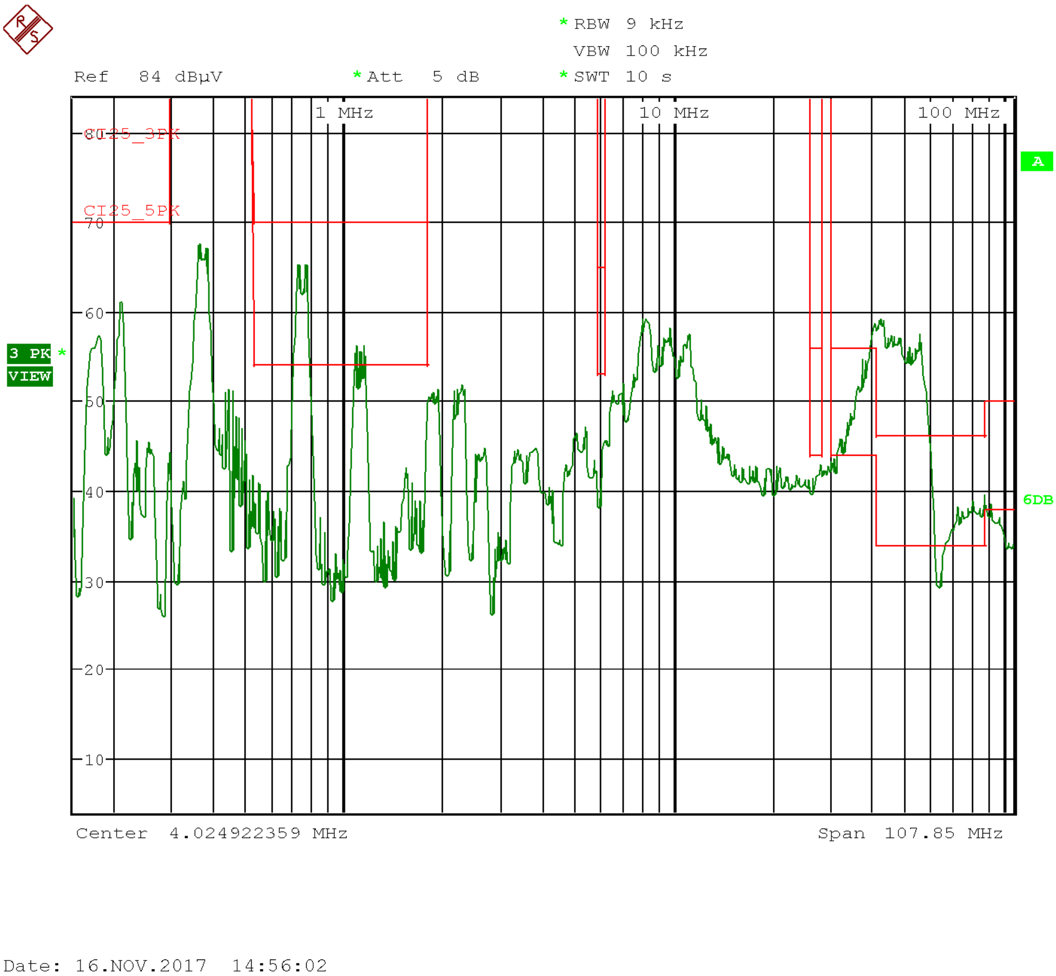


Figure 14

A square wave (10 kHz, 50% Duty Cycle, 0/5V Level) is injected into TP2 by a low pass filter (1 kΩ, 10nF) to achieve a triangular-like wave form.
The switching frequency changes between 350 and 390 kHz.

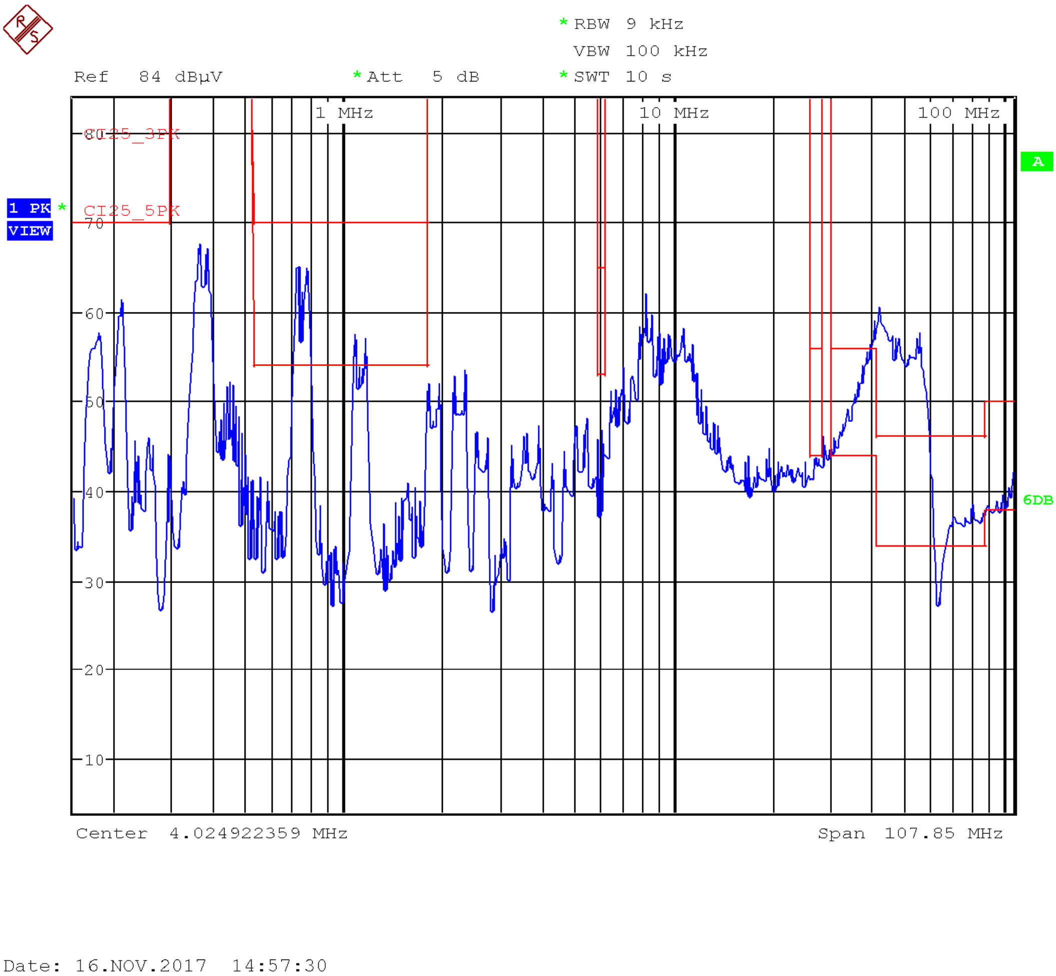


Figure 15