PMP15008 Test Report

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Description:

This test report demonstrates the performance of a small size, 10 A voltage regulator designed for low voltage, point-of-load applications. The dc-dc converter uses the TPS54A20 integrated circuit switching at 2 MHz per phase and is designed for 1.2 V output. The total solution footprint is 135 mm^2 and the typical height is 1.25 mm. Over 90% peak efficiency is achieved at 9 V input with an external 5 V gate drive supply. Load regulation is within ±0.1%. Output voltage deviation is within ±2% of the output voltage when 5 A load steps with 1 A/µs slew rate are applied. Bode plot measurements show a closed loop crossover frequency of 330 kHz with 50 degrees of phase margin.

1. Efficiency and Power Loss

The efficiency vs. load current for 9V, 12V and 14V input voltage is shown below. Vout=1.2V. Measurements were taken at room temperature.

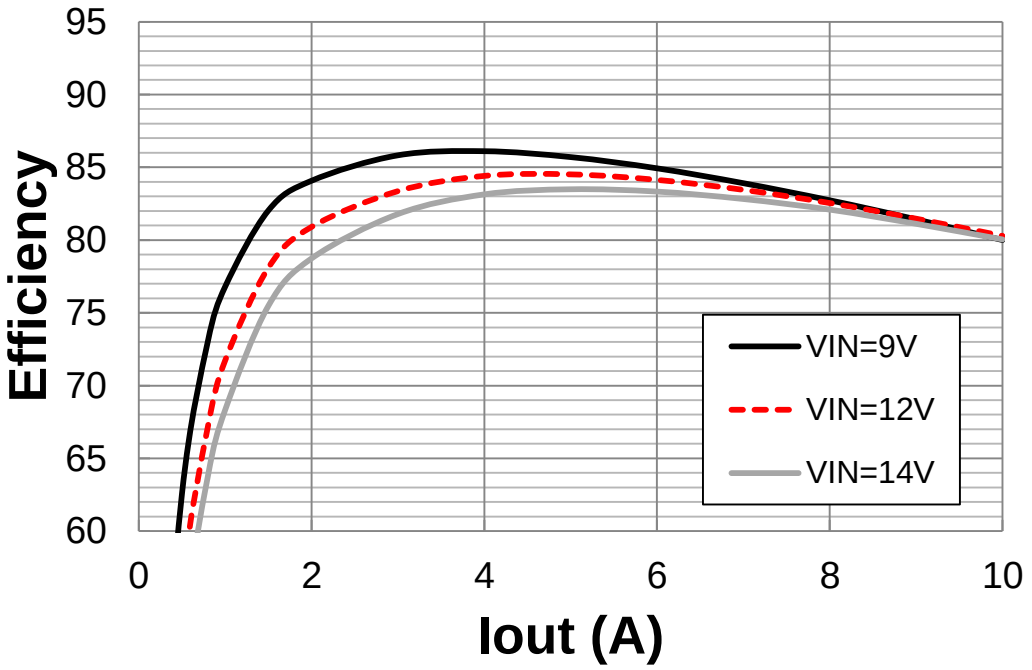

Figure 1 Efficiency with internal 5V VG+ supply

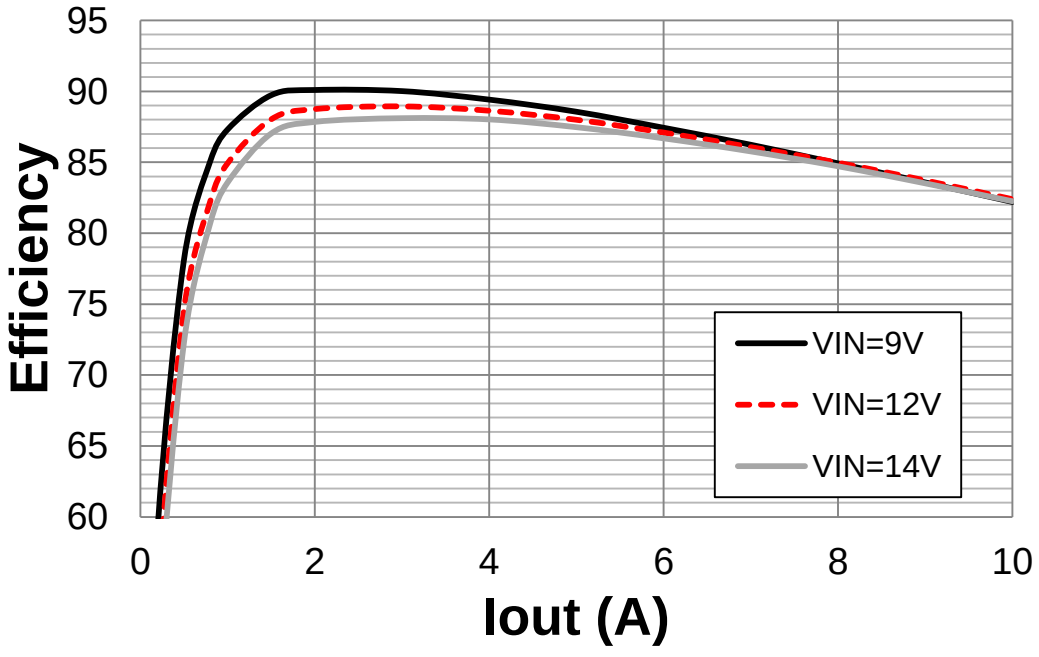

Figure 2 Efficiency with external 5V VG+ supply

Correspondingly, the power losses vs load current is shown below.

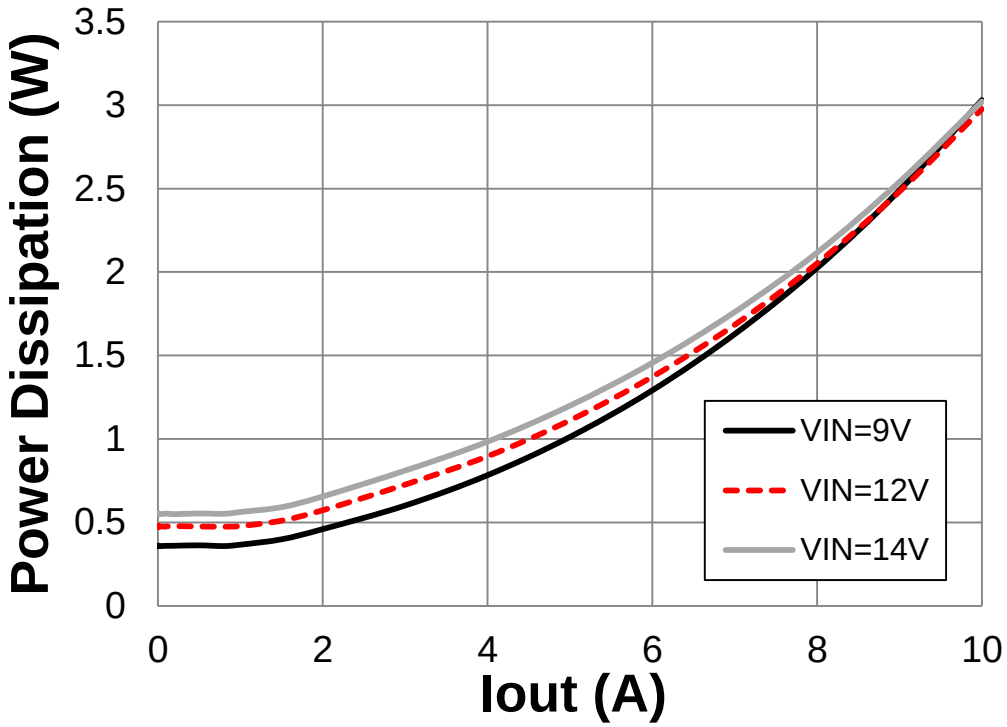

Figure 3 Power losses with internal 5V VG+ supply

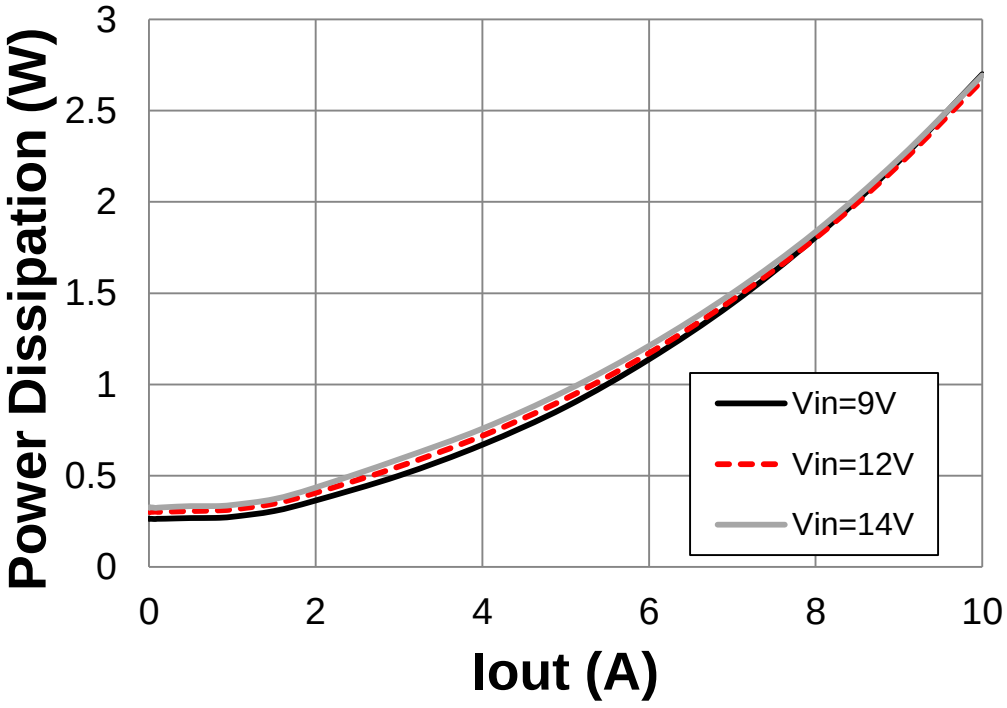

Figure 4 Power losses with external 5V VG+ supply

2. Load Regulation

The load regulation of the output is shown in Figure 5. The output voltage variation is within ±1mV. The resulting load regulation is less than ±0.1%.

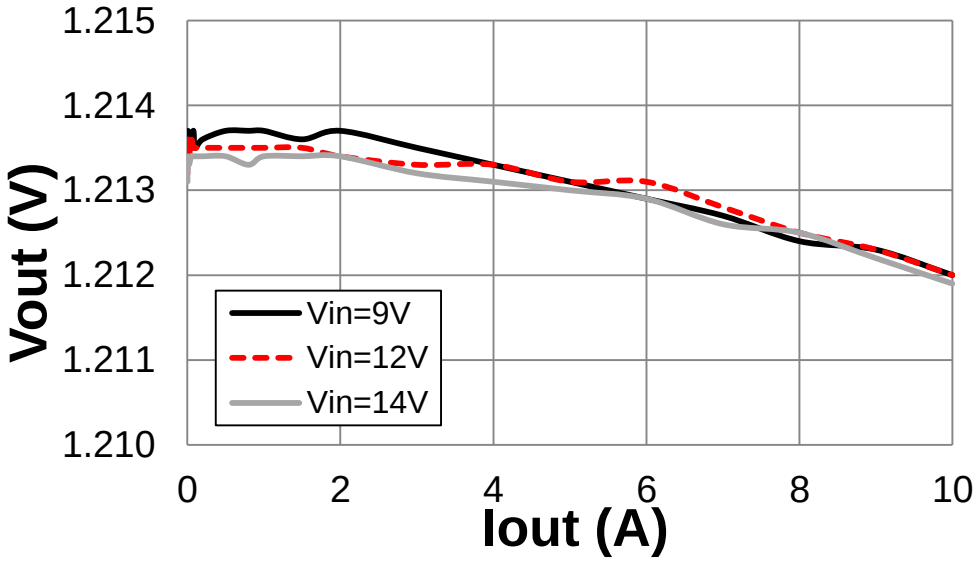

Figure 5 Load regulation

3. Line Regulation

The line regulation of the output is shown in Figure 6.

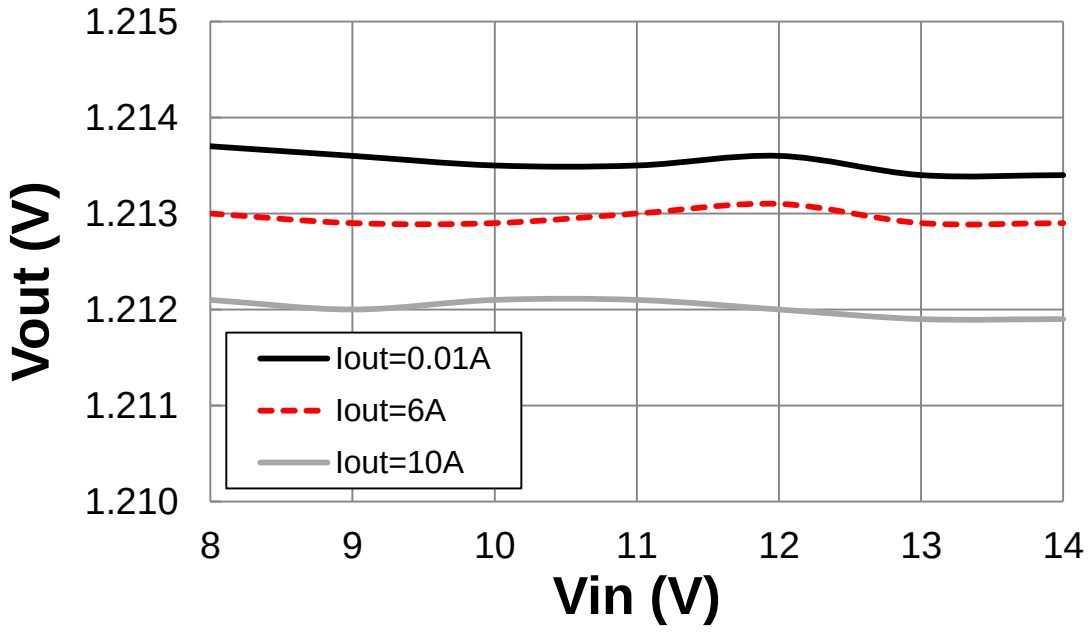

Figure 6 Line regulation

4. Load Transient

The figures below show the response to load transients. The input voltage is set to 12V. With a 1 A/µs load current slew rate and 5 A load steps, the output voltage deviation is limited to about 25 mV (2% of Vout).

Channel 2 (cyan): Vout (AC coupled), 20mV/div， Channel 3 (purple): Iout, 2A/div

Time: 10µs/div

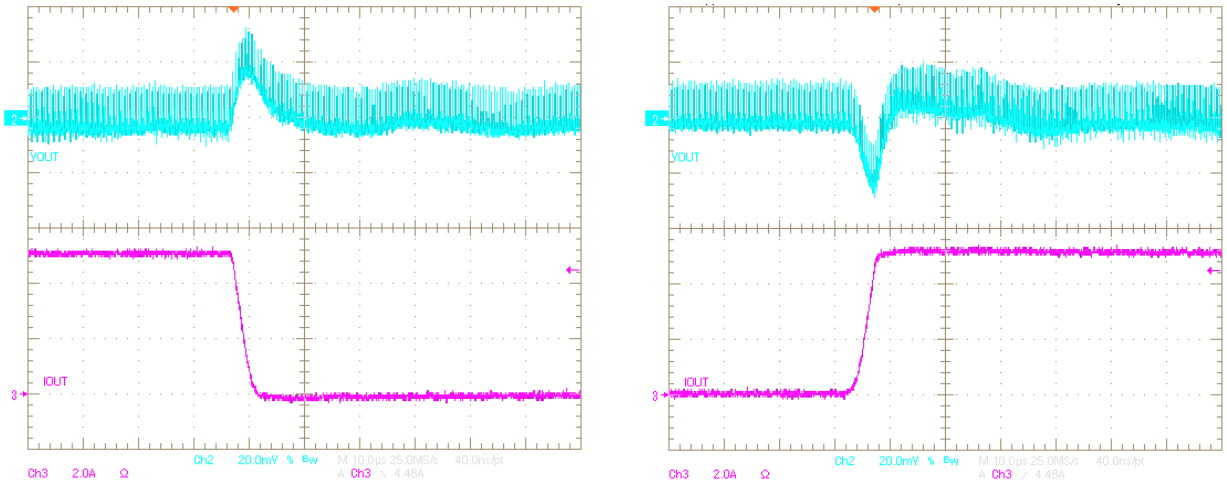

Figure 7 Output load transient (0A to 5A, 1A/µs slew rate)

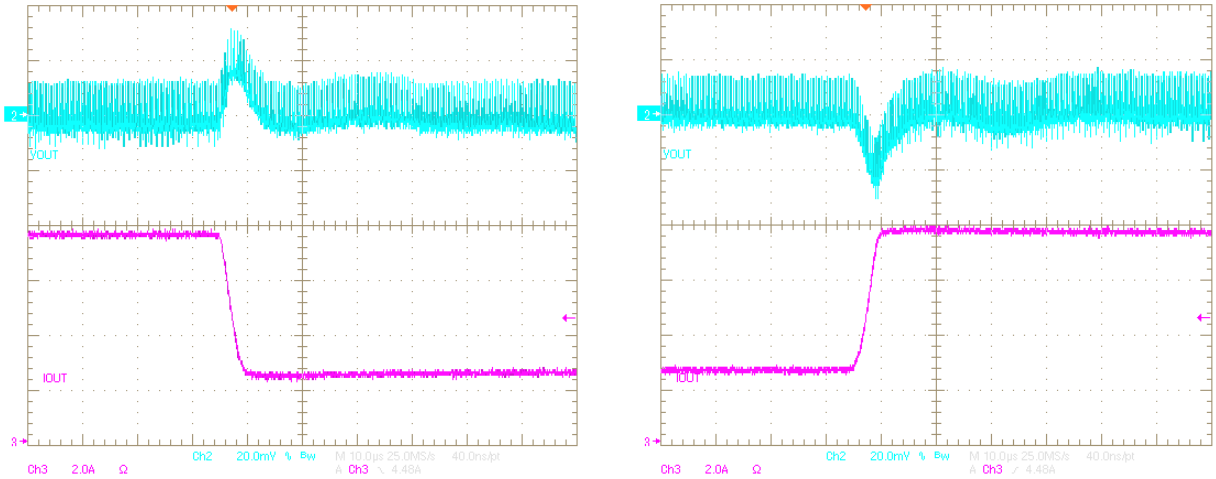

Figure 8 Output load transient (2.5A to 7.5A, 1A/µs slew rate)

5. Startup

The startup waveform is shown in the figure 9. The input voltage is ramped up and a 5A load is on the output of the converter.

Channel 1 (brown): Vout, 500mV/div, Channel 2 (blue): Vin, 5V/div

Time: (left figure) 40ms/div, (right figure) 100µs/div

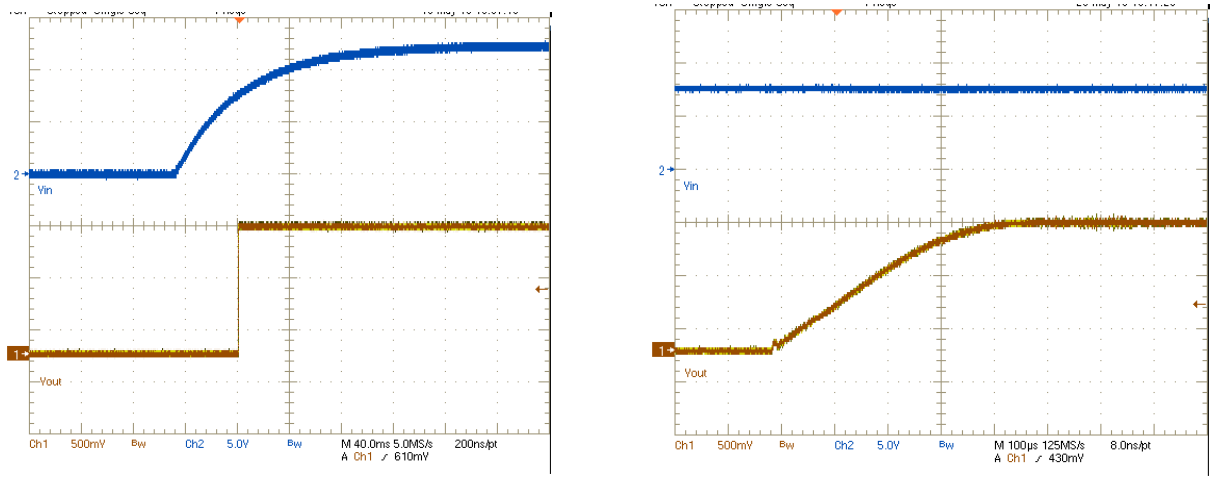

Figure 9 Startup with 5A load

6. Shutdown

The shutdown waveform is shown in the figure 8. The input voltage is ramped down and a 5A load is on the output of the converter.

Channel 1 (brown): Vout, 500mV/div, Channel 2 (blue): Vin, 5V/div

Time: (left figure) 20ms/div, (right figure) 20µs/div

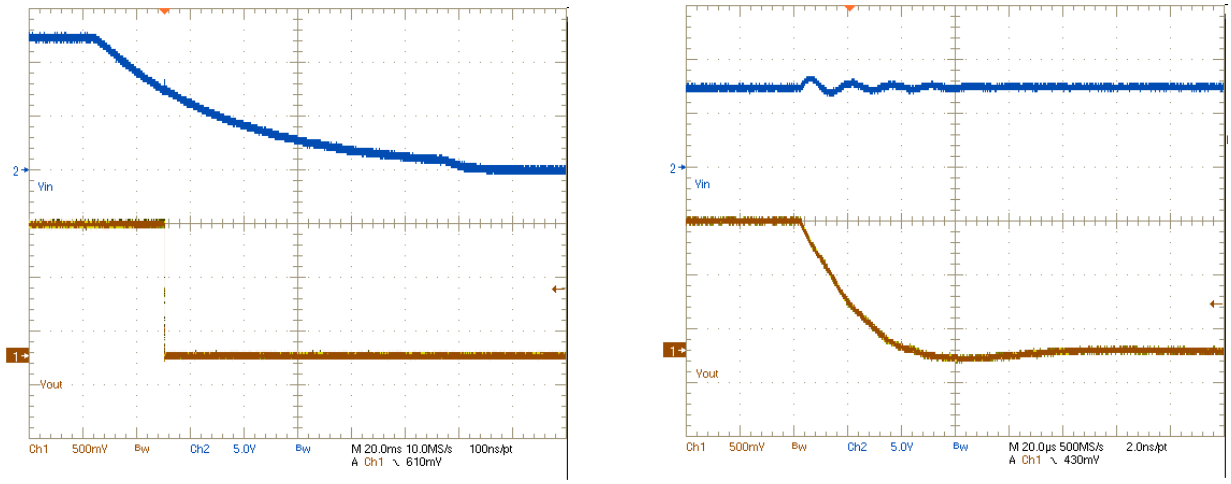

Figure 10 Shutdown with 5A load

7. Switching Waveforms

The figure 9 shows the switch node (SWA and SWB) waveforms at Vin=12V and Vout=5A.

Channel 2 (cyan): SWB (2V/div), Channel 4 (green): SWA (2V/div)

Time: 200ns/div

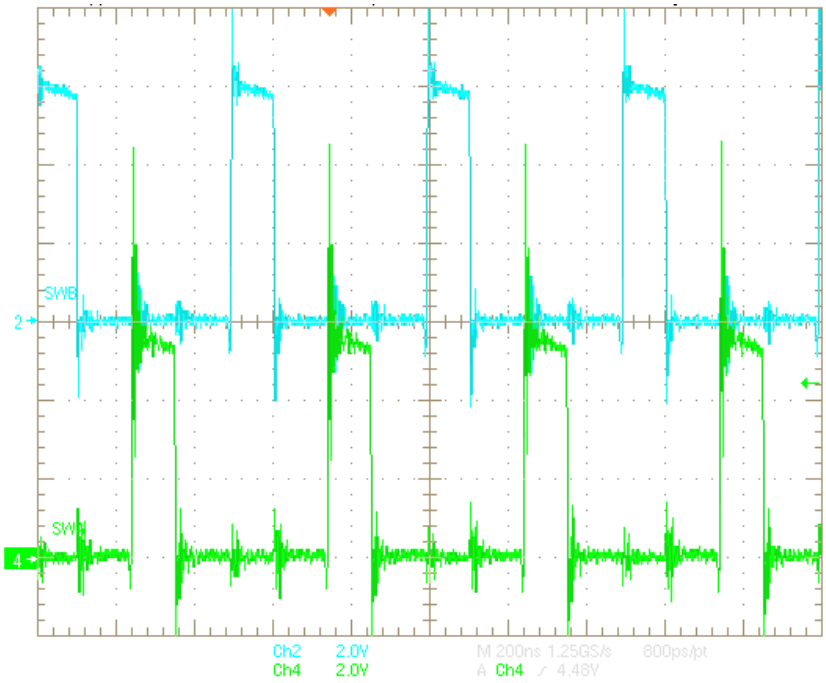

Figure 11 Switching waveforms at 12Vin, 5A load

8. Output and Input Voltage Ripple

The output ripple voltage is shown in the figure 12. The image was taken with a 5A load. There is less than 10 mV peak-to-peak ripple on Vout.

Channel 1 (brown): Vout (AC coupled), 10 mV/div

Channel 4 (green): Iout, 5A/div

Time: 200ns/div

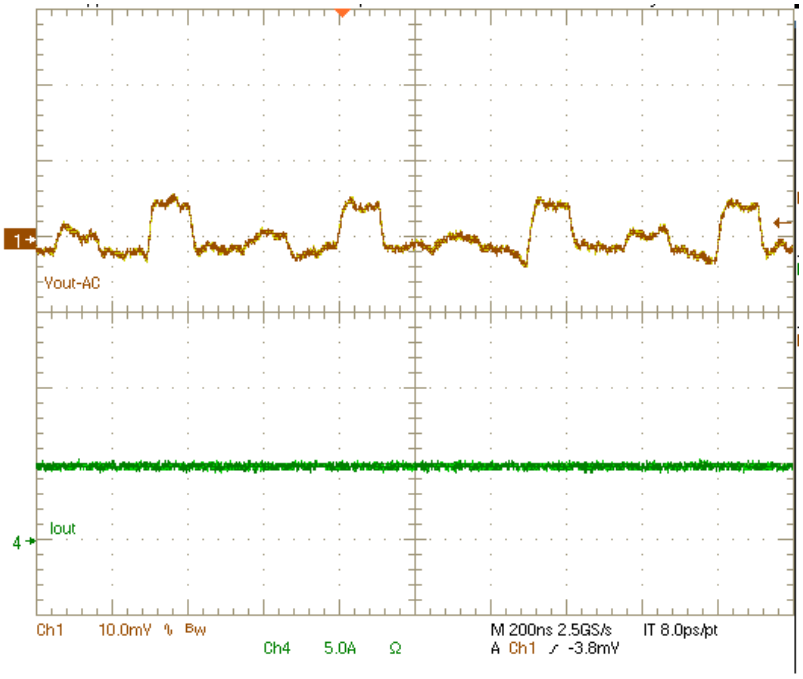

Figure 12 Output voltage ripple at 12Vin, 5A load

The input ripple voltage is shown in the figure 13. The image was taken with a 5A load. There is approximately 200mV ripple peak-to-peak.

Channel 1 (brown): Vout (AC coupled), 100 mV/div
Time: 200ns/div

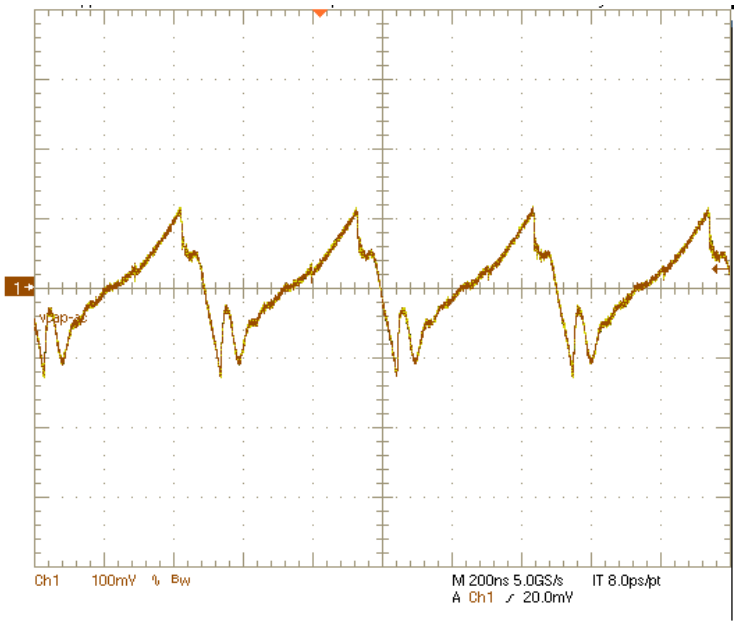

Figure 13 Input voltage ripple at 12Vin, 5A load

9. Series Capacitor Voltage (Differential)

The series capacitor voltage (differential, ac couple) is shown in figure 14. The image was taken with a 5A load. There is less than 300mV ripple peak-to-peak.

Channel 1 (brown): Vcap (AC coupled), 100 mV/div, Channel 4 (green): Iout, 5A/div
Time: 200ns/div

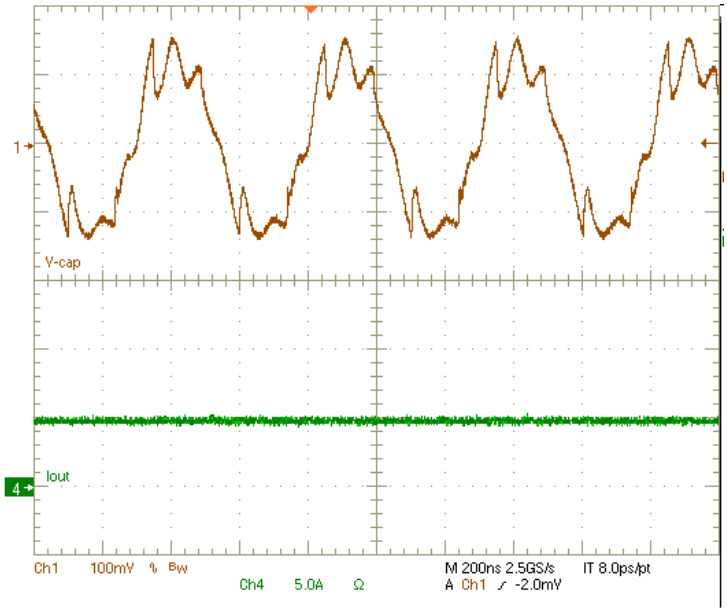

Figure 14 Series capacitor voltage ripple at 12Vin, 5A load

10. Bode Plots

The closed loop bode plot is shown in figure 15 with a 5A load and in Fig. 16 with no load (0A). The feedback trace was cut on the back side of the board and a 10 Ohm signal injection resistor was inserted in order to take the measurement. As can be seen from the results, the converter has over 300 kHz cross over frequency with over 50 degrees of phase margin in both cases.

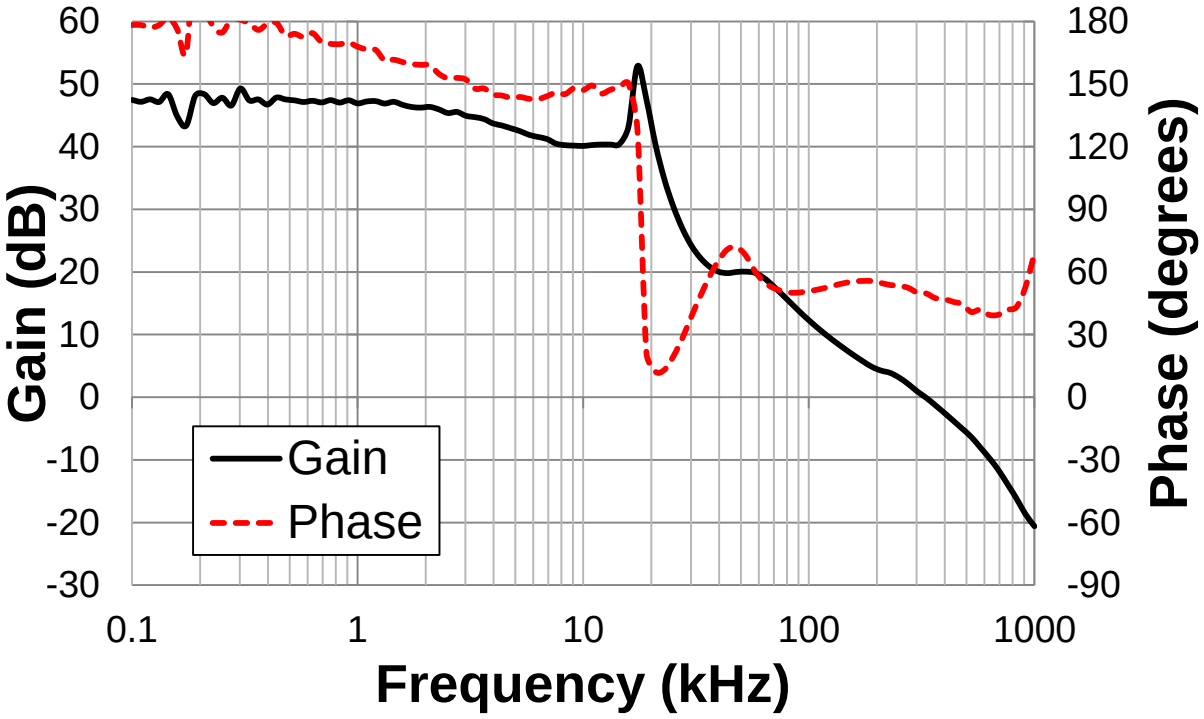

Figure 15 Bode plot measurement at 12Vin, 5A load

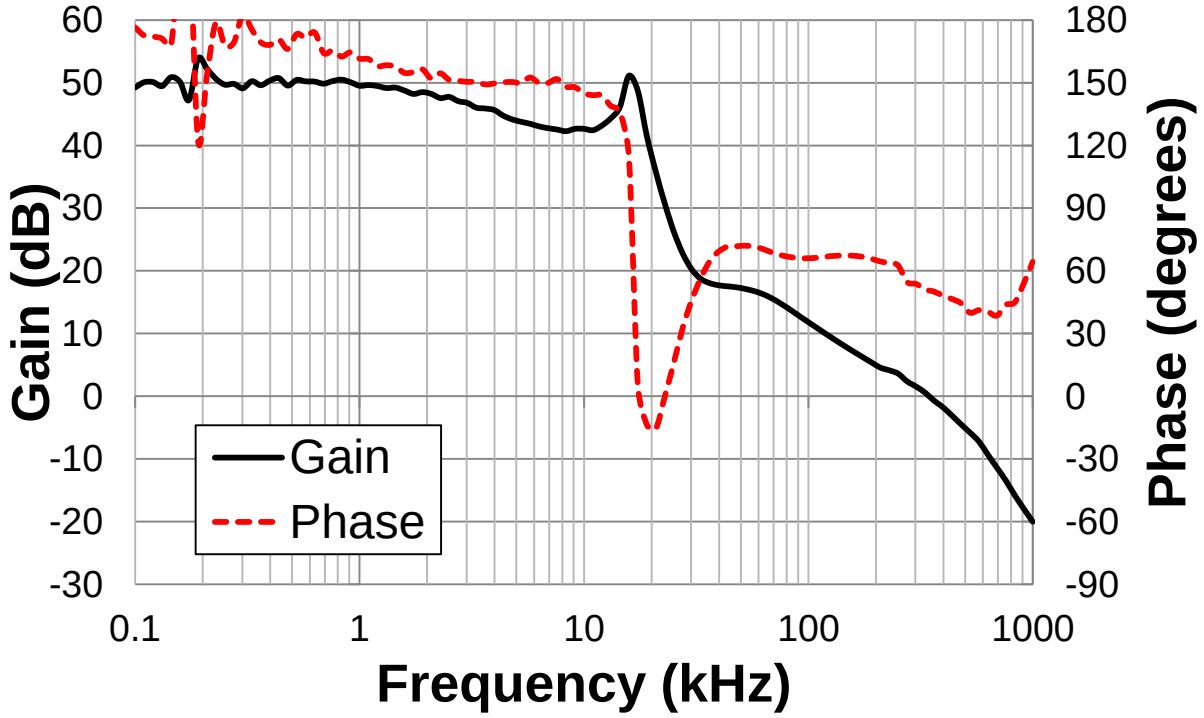

Figure 16 Bode plot measurement at 12Vin, 0A load

11. PMP15008 Board Photos

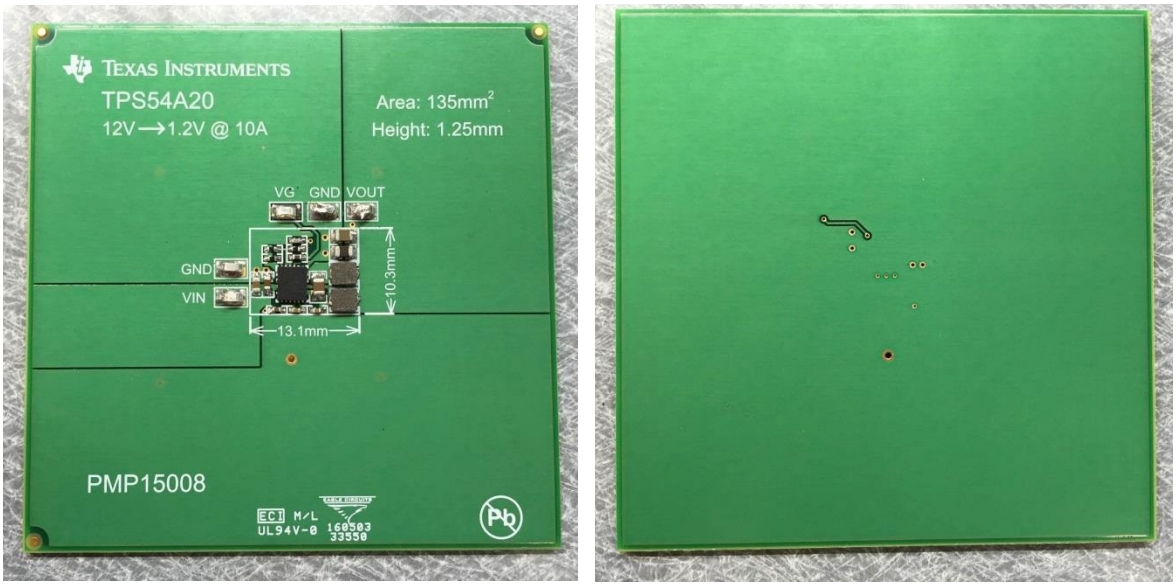

Figure 17 Top (left) and bottom (right) pictures of the board

12. Thermal Images

Thermal images are shown with 12 V input and 8A load in figure 18 and 19. The test is run at room temperature with no air flow and a 10 minute thermal soak period. The internal VG+ supply was used in Fig. 18 and an external 5V supply was used in Fig. 19. The temperature rise is less than 40 deg. C for both cases.

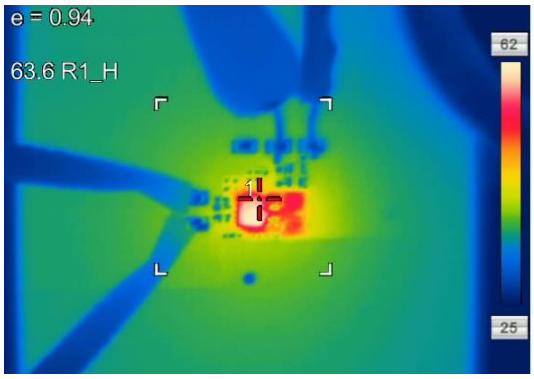

Figure 18 Thermal image with 12 V in, 8 A out with internal 5V VG+ supply

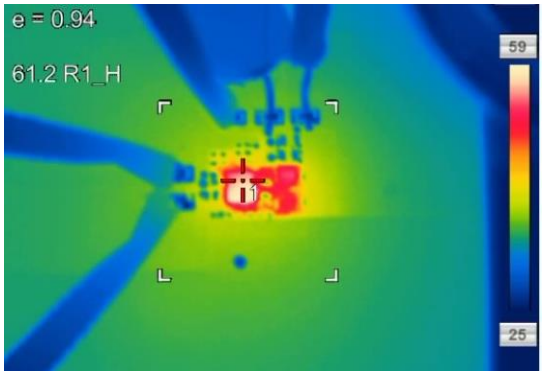

Figure 19 Thermal image with 12 V in, 8 A out with external 5V VG+ supply

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