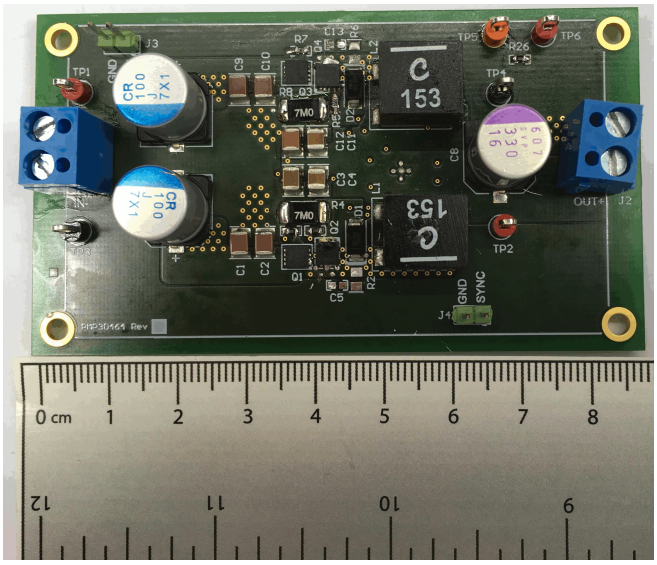
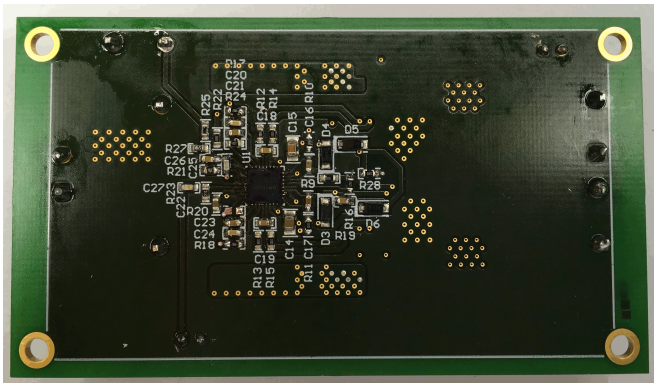
Test Report: PMP30464
96-W/180-W Peak Dual Interleaved Buck Converter Reference Design for Space Constrained Applications

Description

The PMP30464 is a dual, interleaved buck converter reference design, which covers an input voltage range of 17.0 V to 60.0 V. The output voltage is 12.0 V with a maximum load current of 15.0 A. The design has been space optimized and supports an average load current of 8.0 A.





1 Test Prerequisites

1.1 Voltage and Current Requirements

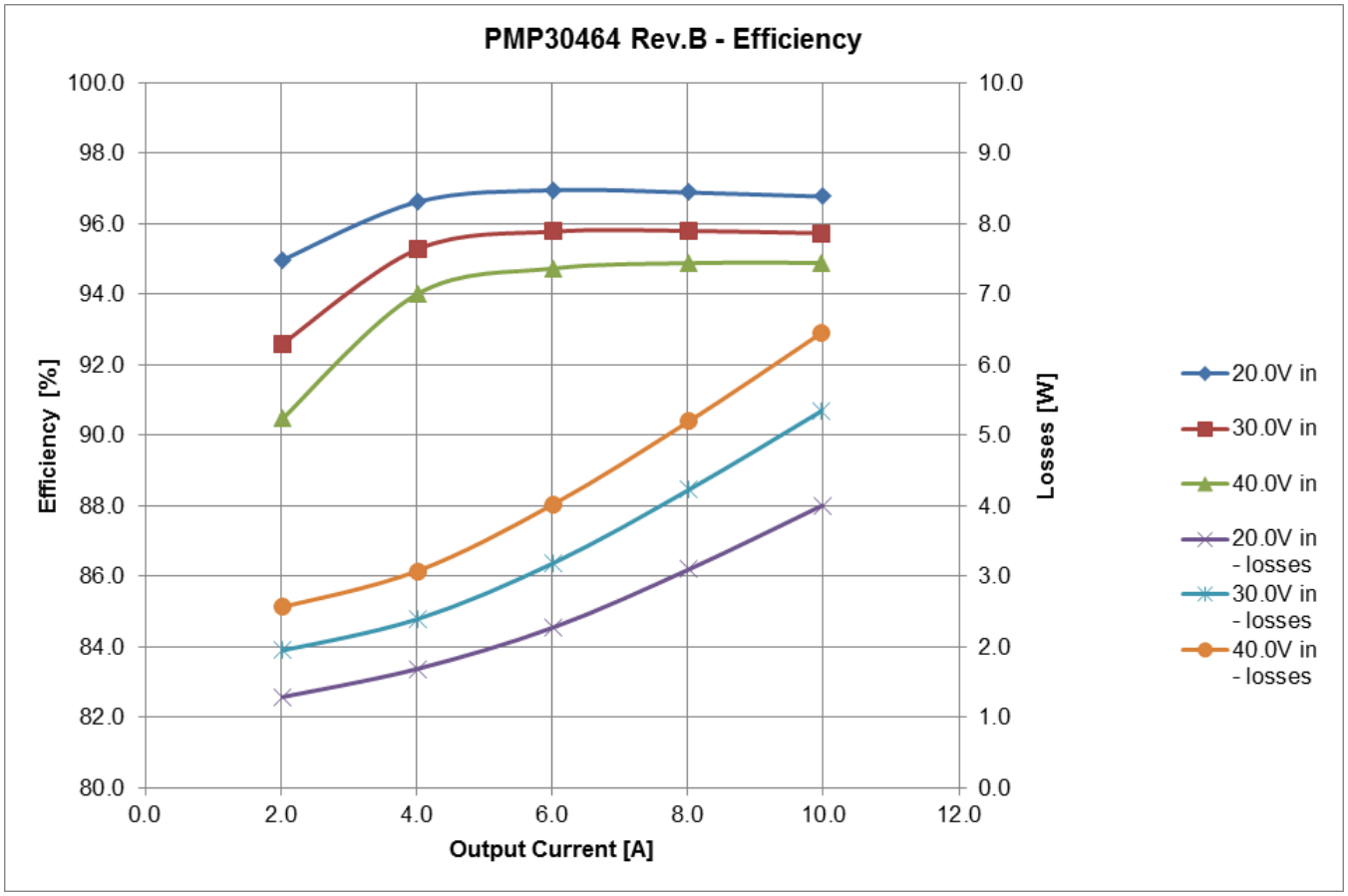
Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
V_{IN}	17V - 40V, 60V peak
V_{OUT}	12.0V
I_{OUT}	8A avg., 15A peak
Nominal switching frequency	300kHz

2 Testing and Results

2.1 Efficiency Graphs

Figure 1. Efficiency at 20.0V, 30.0V and 40.0V in



Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
19.963	6.214	124.050	12.025	9.983	120.046	4.005	96.8
20.031	4.971	99.574	12.026	8.022	96.473	3.102	96.9
20.190	3.702	74.743	12.028	6.025	72.466	2.278	97.0
20.204	2.476	50.025	12.030	4.018	48.337	1.689	96.6
20.354	1.261	25.666	12.032	2.026	24.377	1.290	95.0

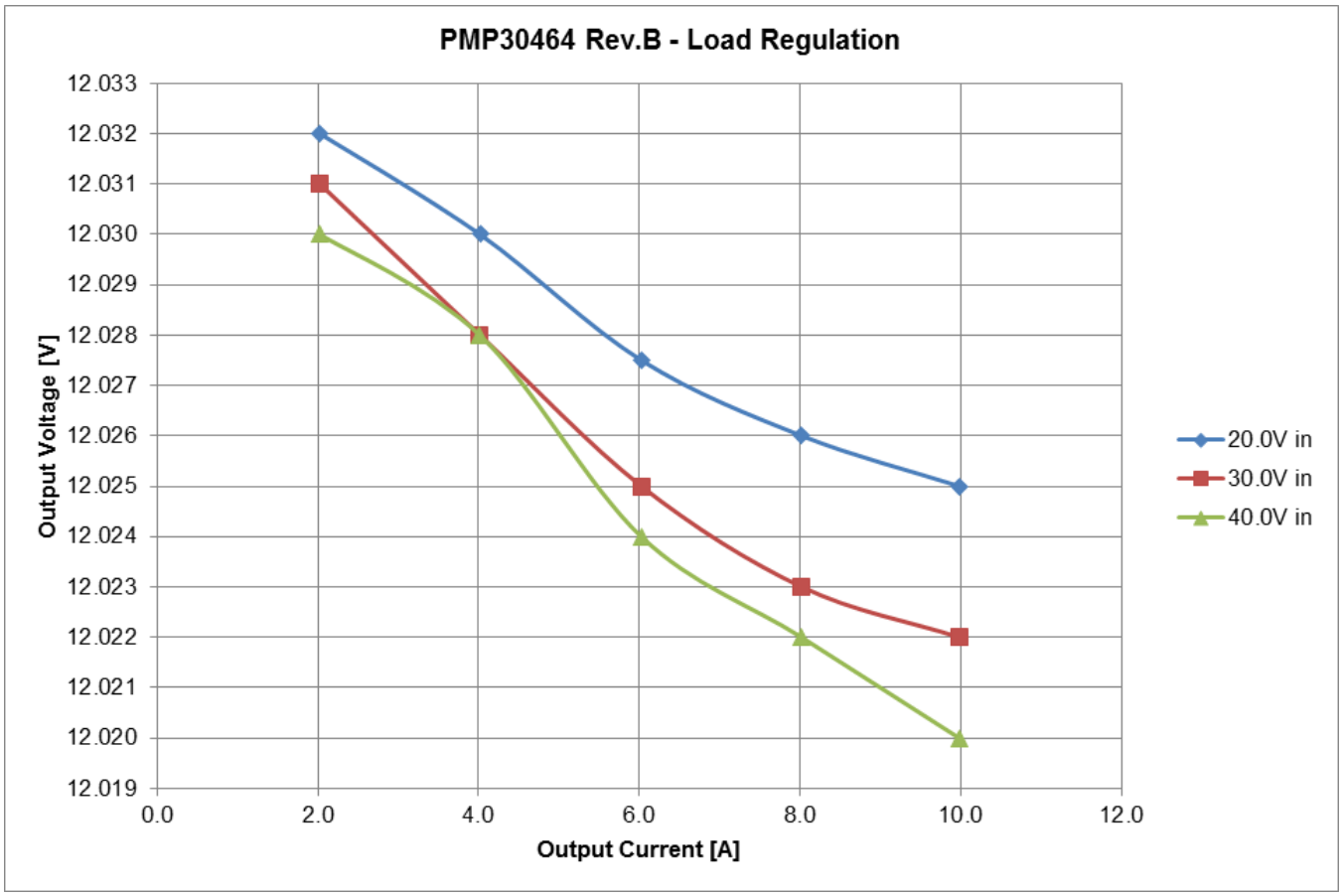
Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
30.055	4.170	125.329	12.022	9.980	119.980	5.350	95.7
30.163	3.337	100.654	12.023	8.020	96.424	4.229	95.8
30.191	2.505	75.628	12.025	6.024	72.439	3.190	95.8
30.203	1.679	50.711	12.028	4.017	48.316	2.394	95.3
30.299	0.869	26.324	12.031	2.026	24.375	1.949	92.6

Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
39.930	3.165	126.378	12.020	9.977	119.924	6.455	94.9
40.070	2.535	101.577	12.022	8.017	96.380	5.197	94.9
40.080	1.907	76.433	12.024	6.022	72.409	4.024	94.7

40.100	1.281	51.368	12.028	4.015	48.292	3.076	94.0
40.230	0.669	26.926	12.030	2.025	24.361	2.565	90.5

2.2 Load Regulation

Figure 2. Load regulation at 20.0V, 30.0V and 40.0V in



2.3 Thermal Images

Figure 3. Thermal image of the PCB's top side at 30.0V in and 8.0A load current. For a higher average load current it is recommended to use more cooling area and a copper thickness of 2oz or more.

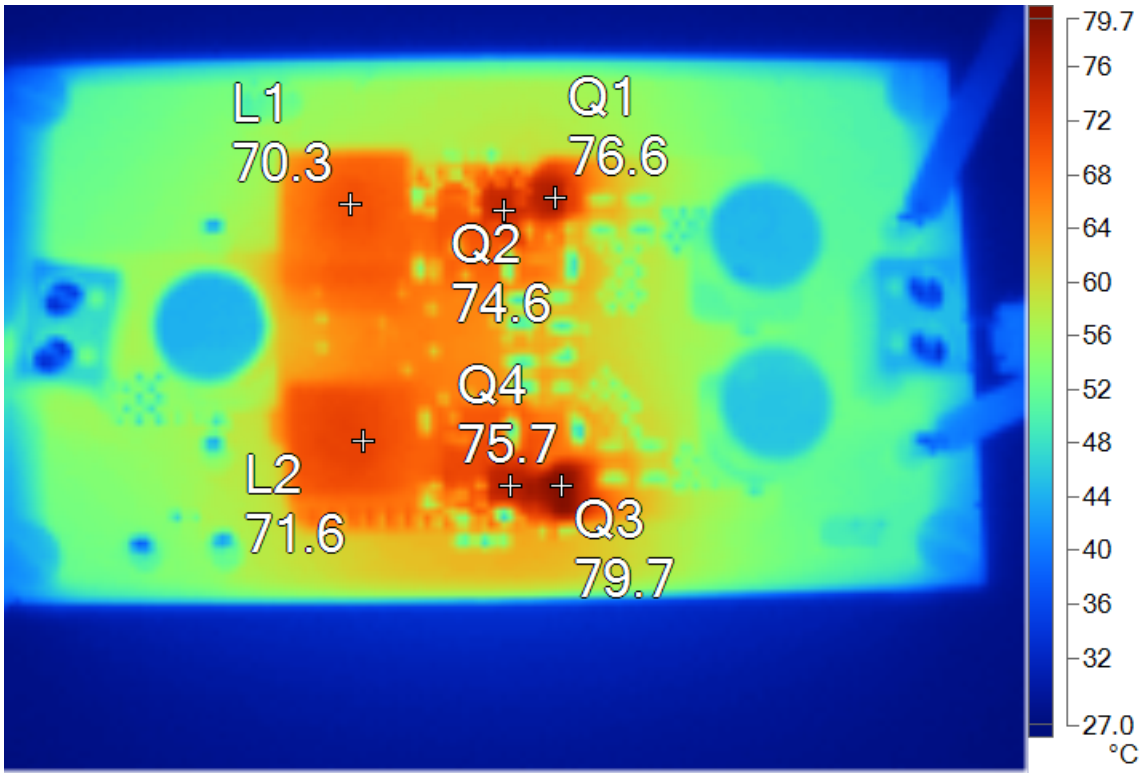
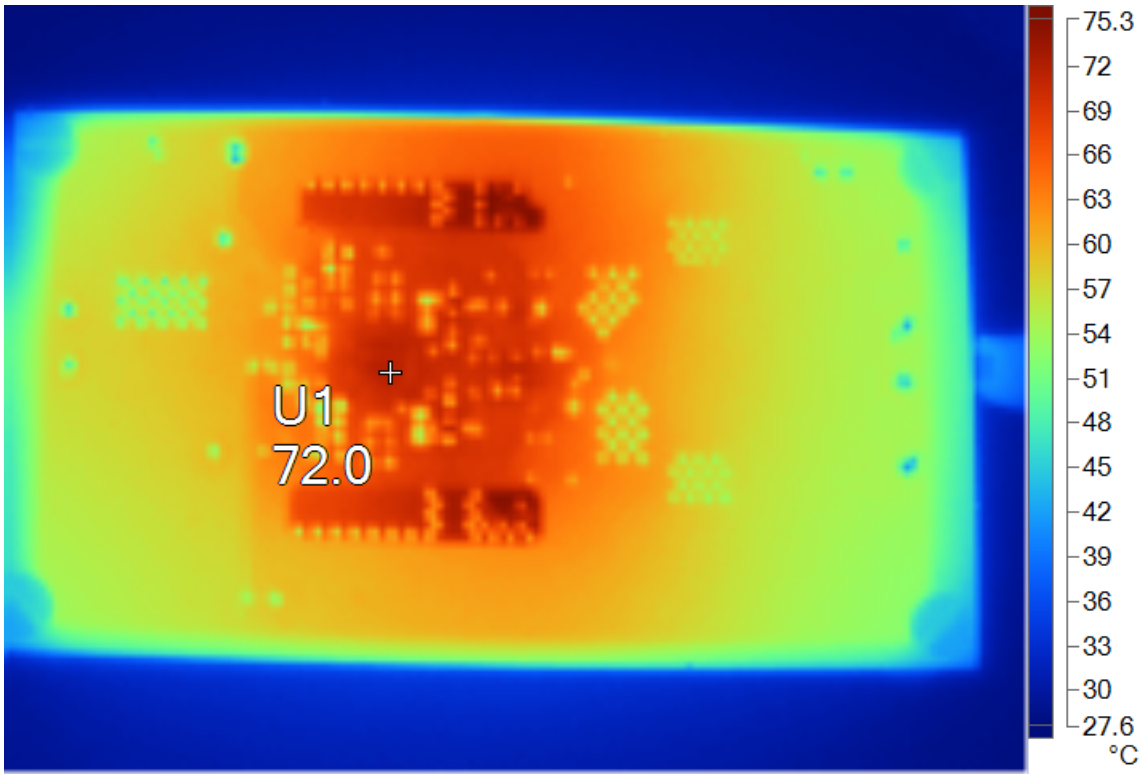


Figure 4. Thermal image of the PCB's bottom side at 30.0V in and 8.0A load current. For a higher average load current it is recommended to use more cooling area and a copper thickness of 2oz or more.



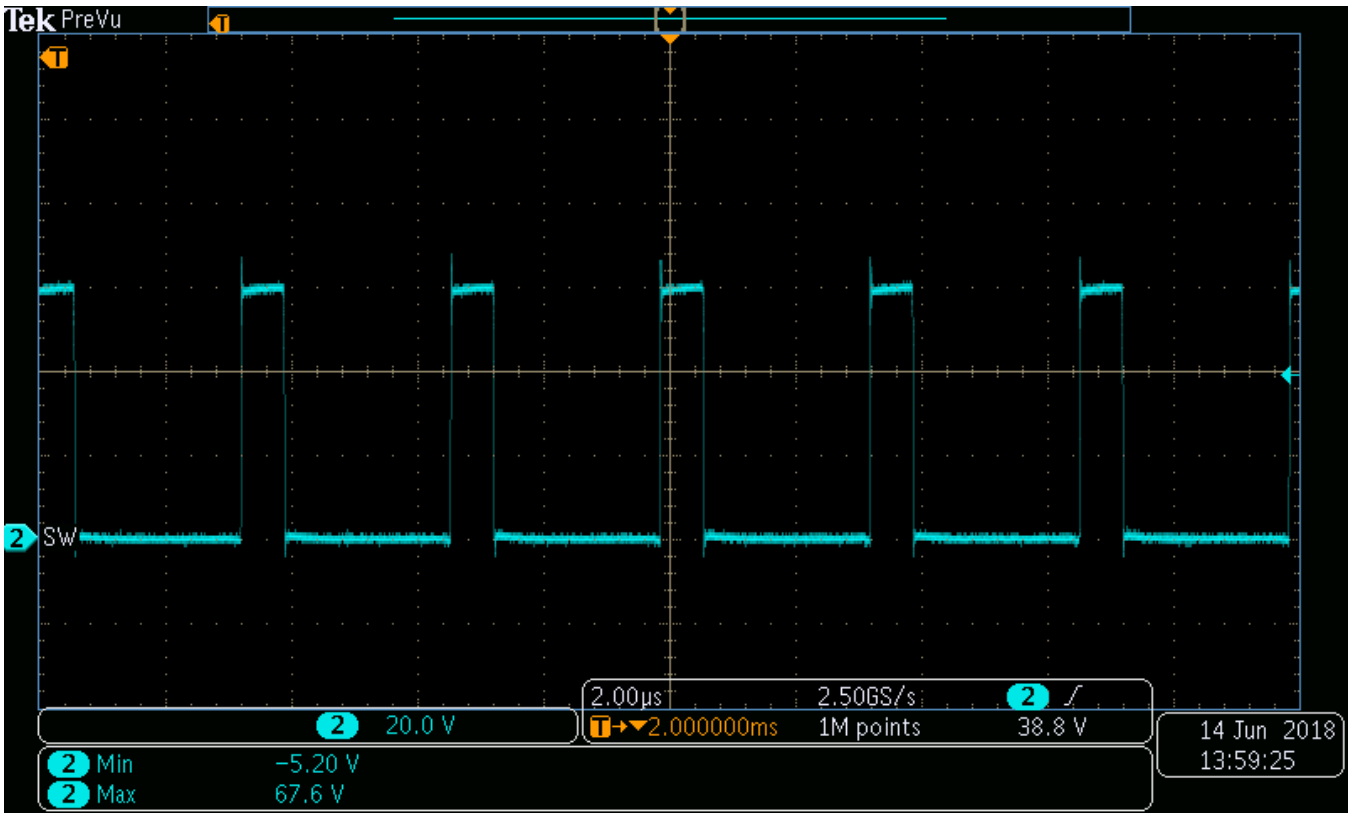
2.4 Dimensions

Total board size: 88 mm x 50 mm (components cover about 58 mm x 37.3 mm)

3 Waveforms

3.1 Switching

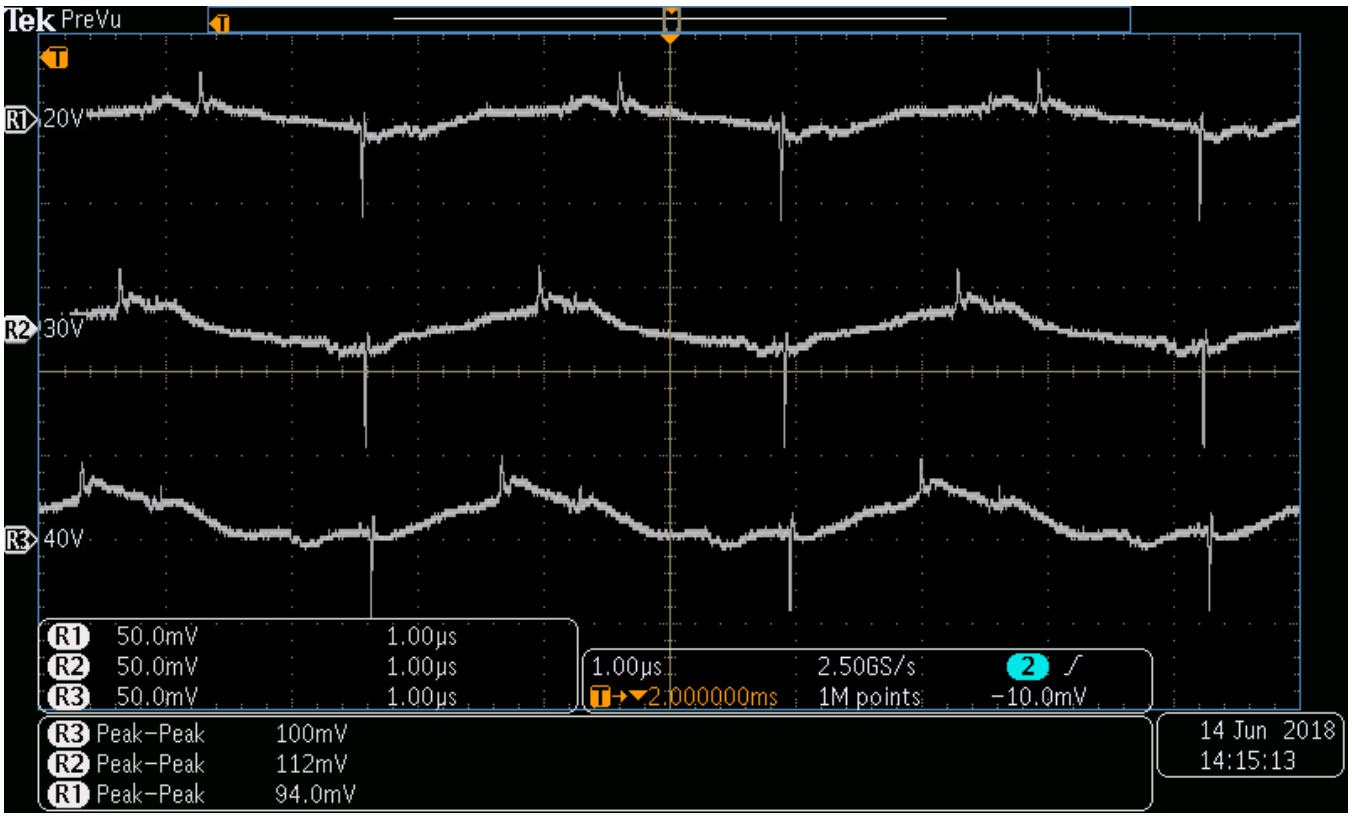
Figure 5. Switching node of Q3 and Q4 at 60.0V in and 15.0A load current.



- Ch2: Switching node of Q3 and Q4 [scale: 20.0V/div, 2.0us/div]

3.2 Output Voltage Ripple

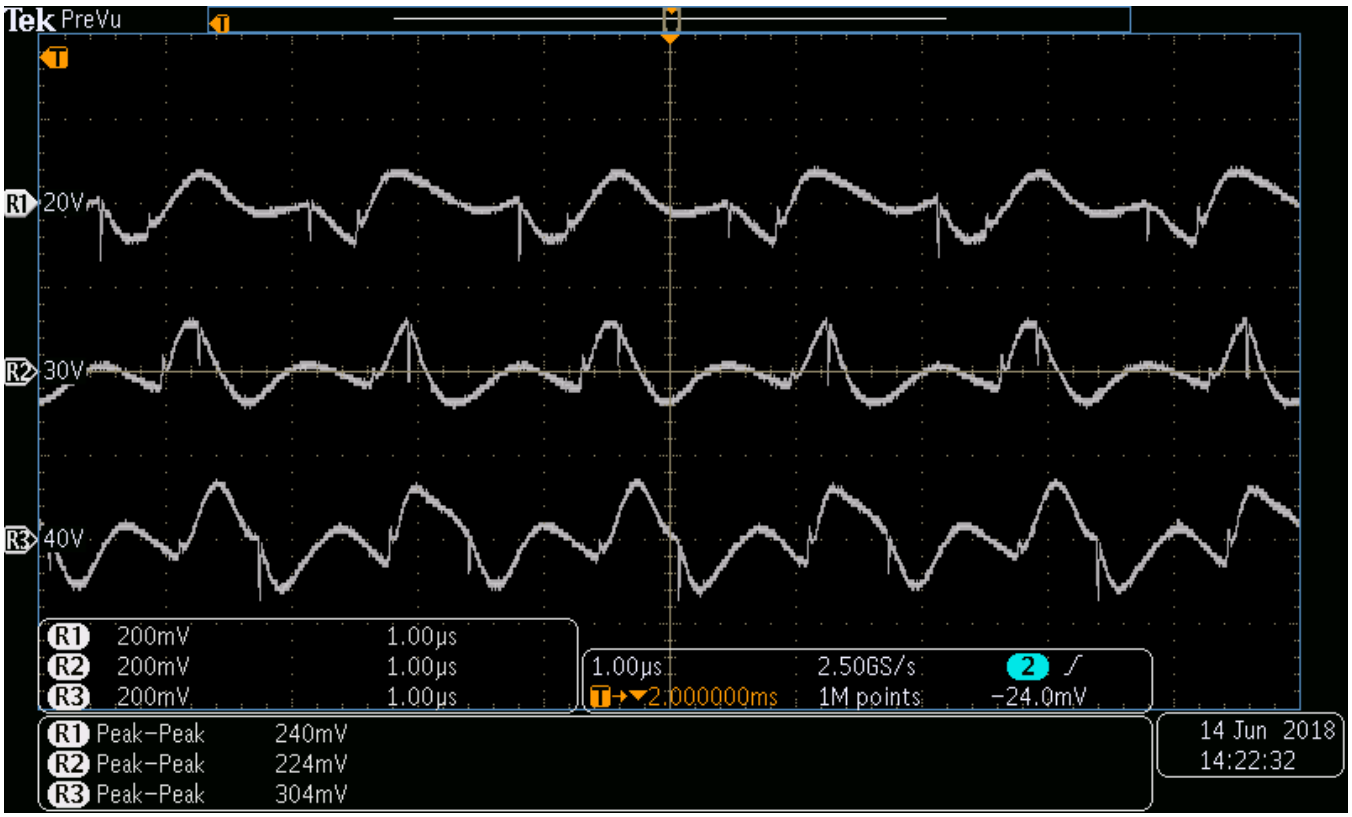
Figure 6. AC-coupled output voltage signal at 20.0V, 30.0V and 40.0V in



- R1: 20.0V in, 94.0mV peak-peak ripple (0.8%), bw limited (20MHz) [scale: 50.0mV/div, 1.0us/div]
- R2: 30.0V in, 112mV peak-peak ripple (1.1%), bw limited (20MHz) [scale: 50.0mV/div, 1.0us/div]
- R3: 40.0V in, 100mV peak-peak ripple (0.8%), bw limited (20MHz) [scale: 50.0mV/div, 1.0us/div]

3.3 Input Voltage Ripple

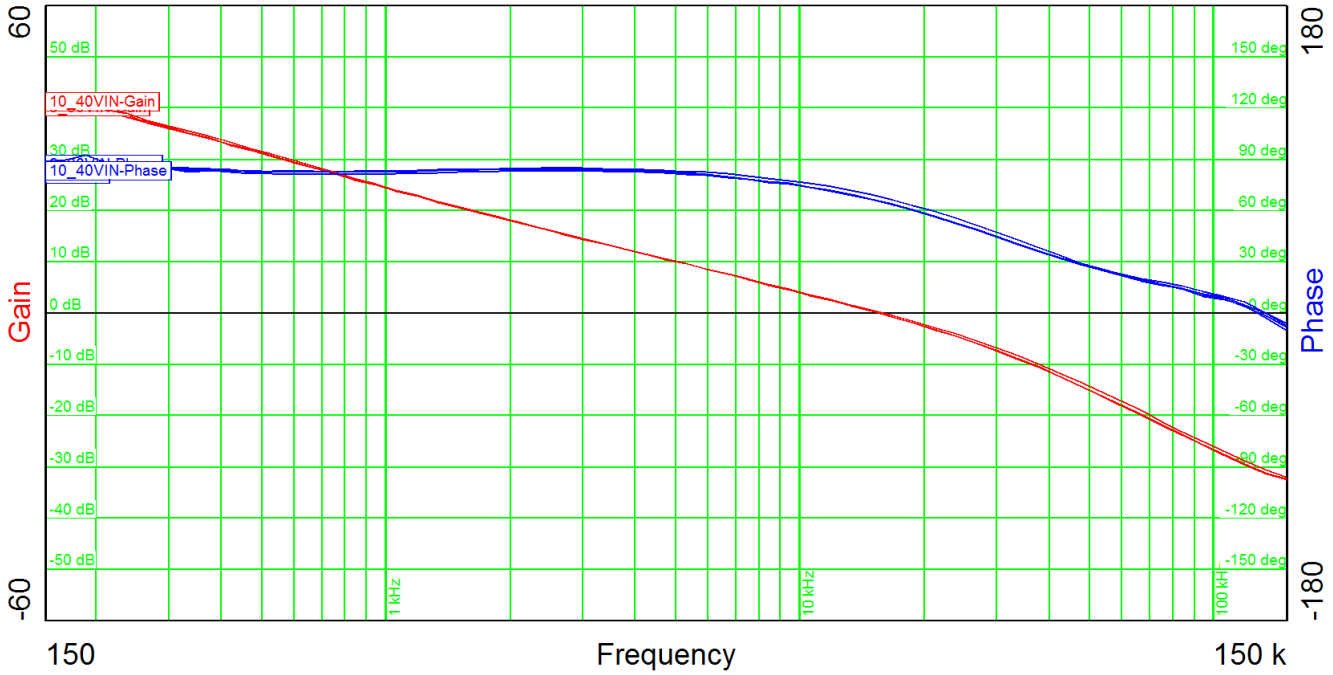
Figure 7. AC-coupled input voltage signal at 20.0V, 30.0V and 40.0V in



- R1: 20.0V in, 240mV peak-peak ripple (1.2%), bw limited (20MHz) [scale: 200.0mV/div, 1.0us/div]
- R2: 30.0V in, 224mV peak-peak ripple (0.7%), bw limited (20MHz) [scale: 200.0mV/div, 1.0us/div]
- R3: 40.0V in, 304mV peak-peak ripple (0.8%), bw limited (20MHz) [scale: 200.0mV/div, 1.0us/div]

3.4 Bode Plot

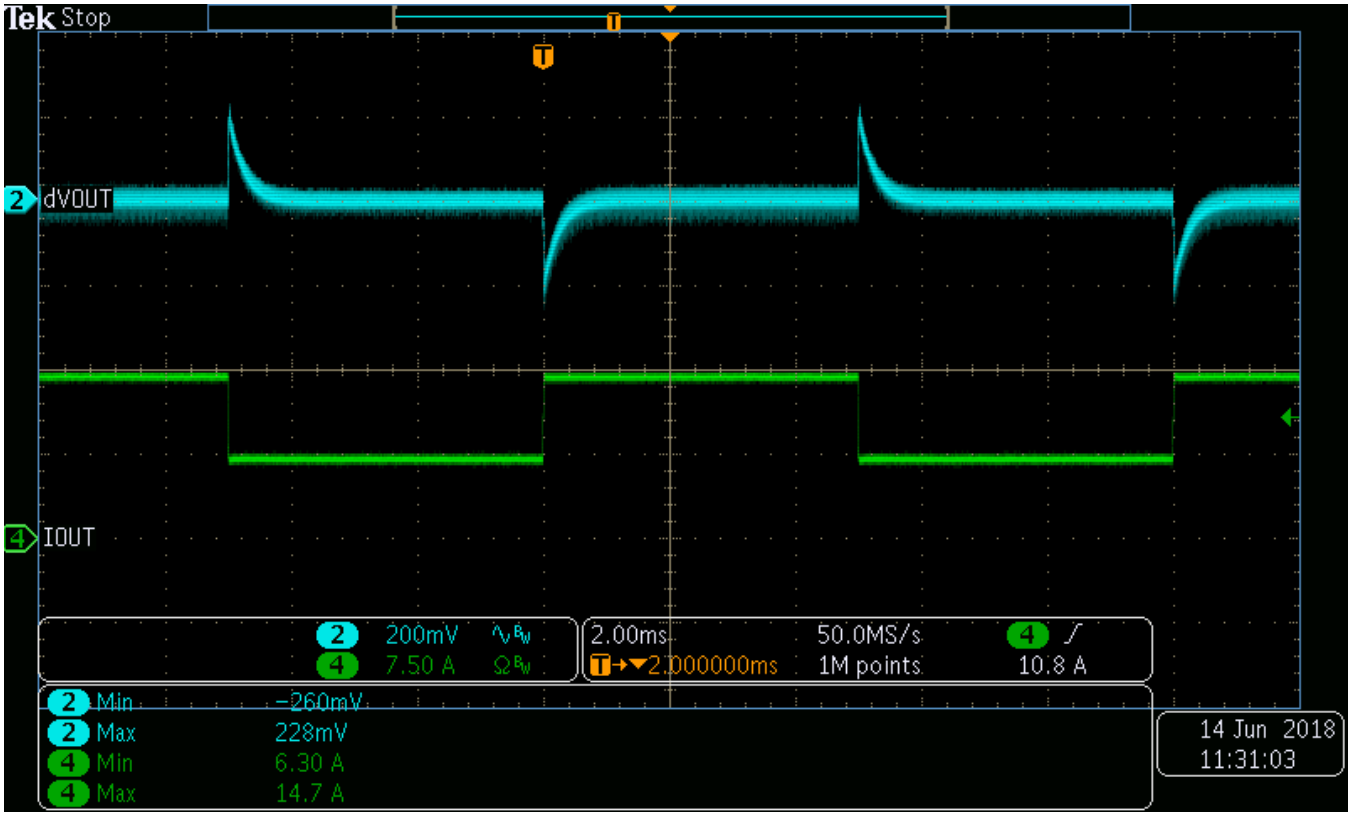
Figure 8. Bode plot at 20.0V, 30.0V and 40.0V in



- 20.0V in, 15.0A load current: fco 15.83kHz, 68deg phase margin, -30dB gain margin
- 30.0V in, 15.0A load current: fco 15.53kHz, 66deg phase margin, -31dB gain margin
- 40.0V in, 15.0A load current: fco 15.46kHz, 65deg phase margin, -31dB gain margin

3.5 Load Transients

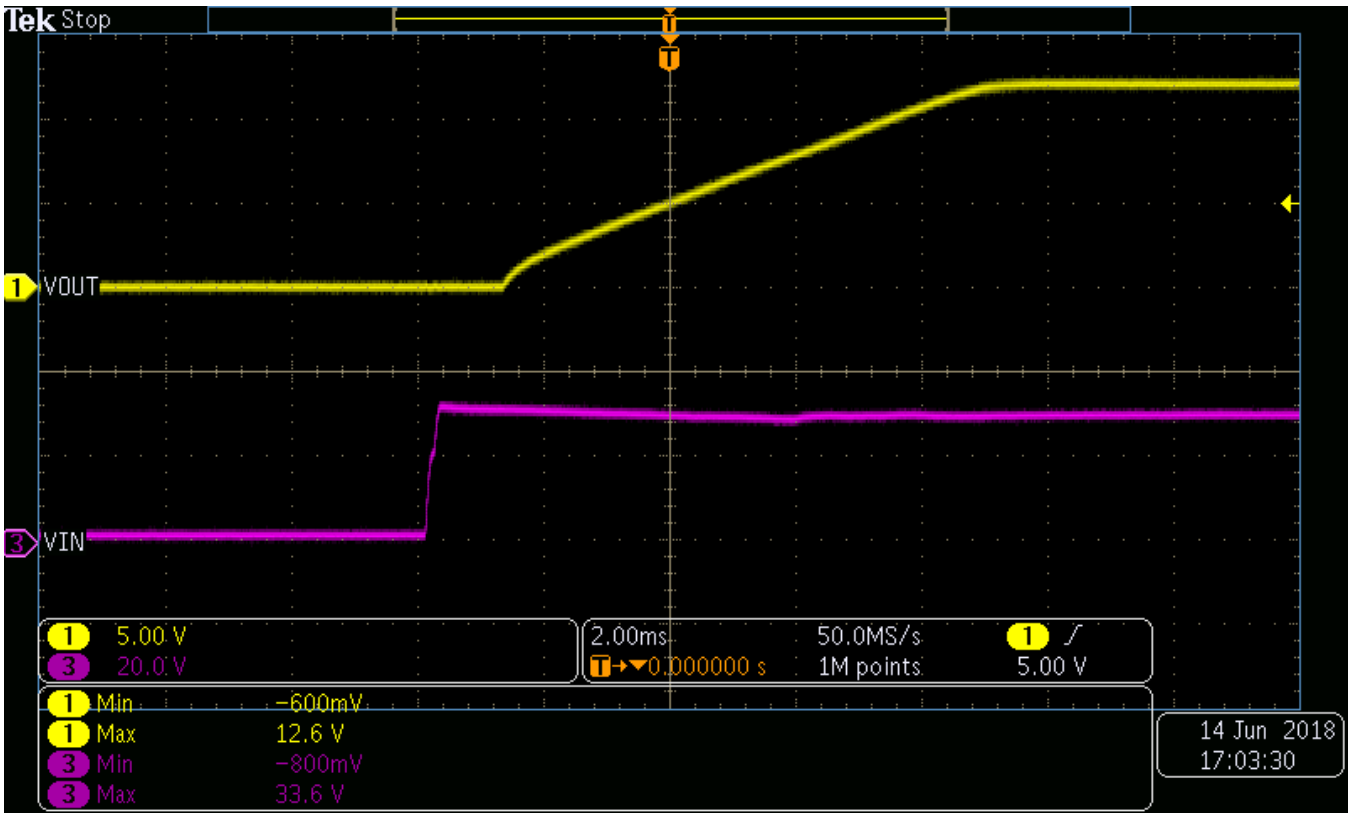
Figure 9. Load transient from 7.5A to 15.0A at 30.0V in results in 260mV undershoot (2.2%) and 228mV overshoot (1.9%).



- Ch2: AC-coupled output voltage, bw limited (20MHz) [scale: 200mV/div, 2.0ms/div]
- Ch4: output current, bw limited (20MHz) [scale: 7.5A/div, 2.0ms/div]

3.6 Start-up Sequence

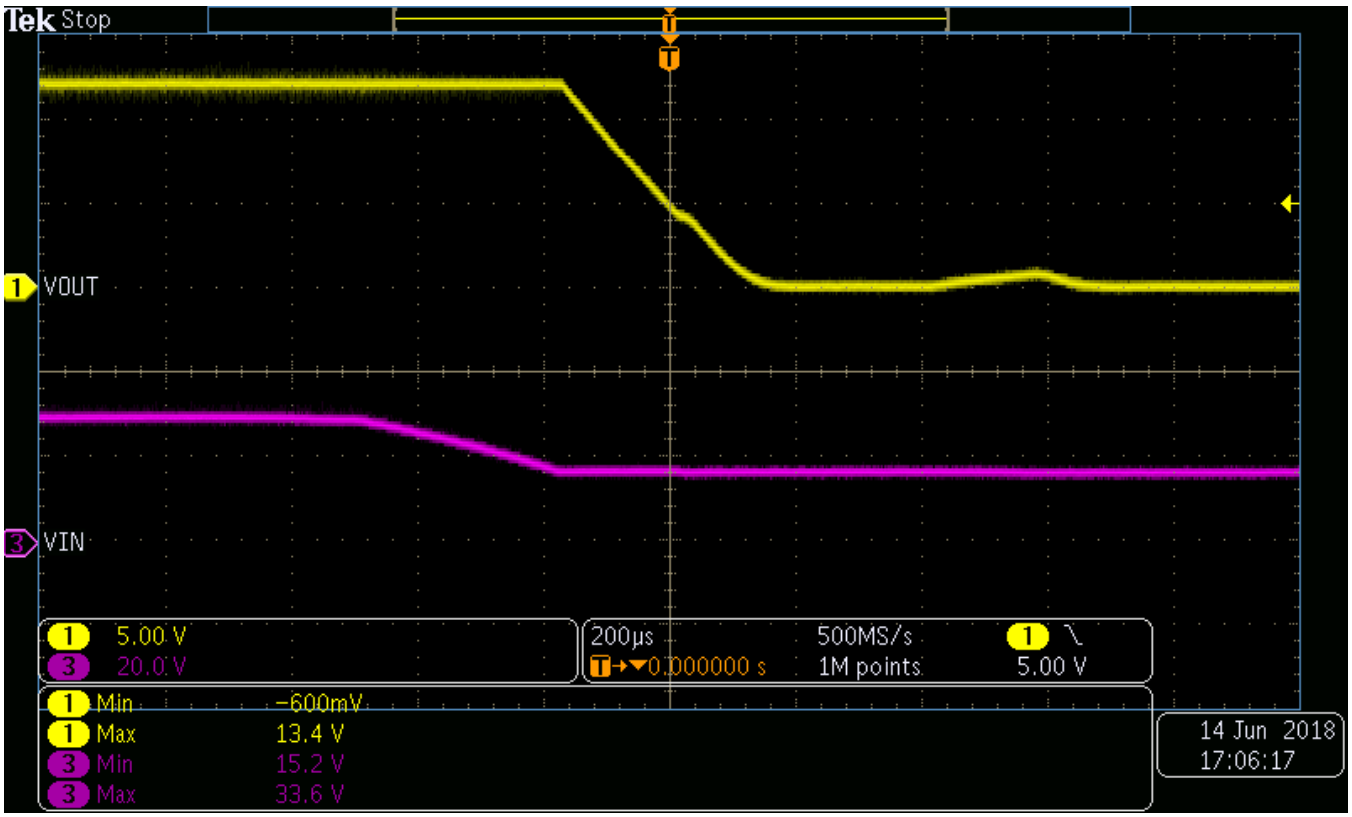
Figure 10. Start-up sequence at 30.0V in with no load attached.



- Ch1: output voltage [scale: 5.0V/div, 2.0ms/div]
- Ch3: input voltage [scale: 20.0V/div, 2.0ms/div]

3.7 Undervoltage Protection

Figure 11. Undervoltage protection with a 15.0A load attached.



- Ch1: output voltage [scale: 5.0V/div, 2.0ms/div]
- Ch3: input voltage [scale: 20.0V/div, 2.0ms/div]

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