

Test Report: PMP22899

24-W, 120-V_{AC} to 24-V_{DC} High-Voltage Buck Reference Design



1 Description

This reference design uses a TL2842B as a high-side buck to convert a 120-V_{AC} input to a 24-V_{DC} output capable of 1-A loading. At full load it achieves a low peak-to-peak output ripple and over 88% efficiency at full load. This reference design was built using a 2-layer PCB and single-sided assembly.

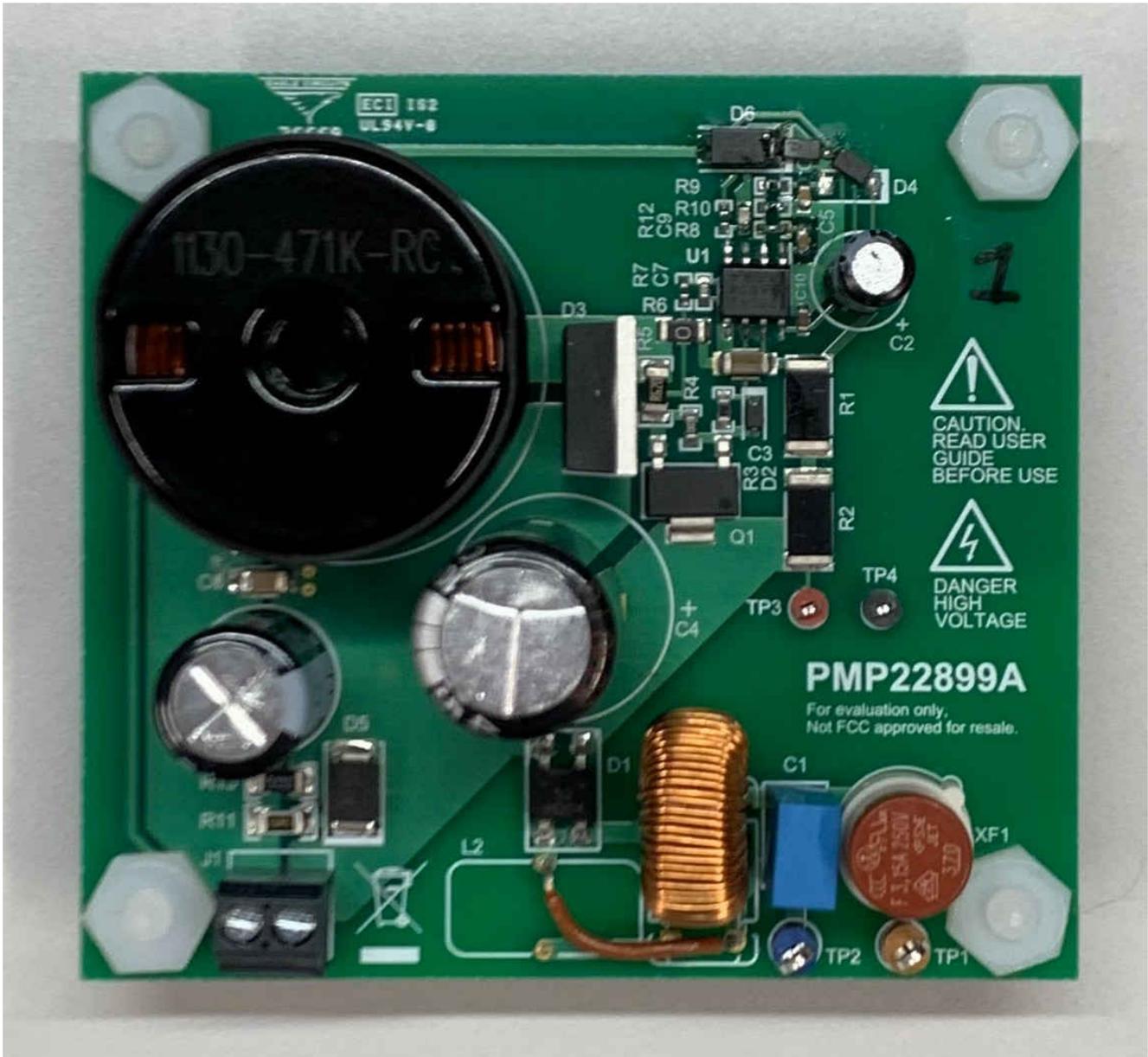


Figure 1-1. PCB Top

2 Test Prerequisites

2.1 Voltage and Current Requirements

Table 2-1. Voltage and Current Requirements

Parameter	Specifications
Input voltage range	108–132 V _{AC} , 60 Hz
Output Voltage	24 V _{DC} , ±1%
Max output current	1 A

2.2 Considerations

An electronic load was used for all tests.

Unless noted, all waveforms were captured at full load with a 120-V_{AC}, 60-Hz input.

2.3 Dimensions

The PCB is a two-layer, 1 oz per layer design. The dimensions are 2.5 in × 2.75 in with a max component height is 0.84 in.

3 Testing and Results

3.1 Efficiency Graphs

Efficiency is shown in the following figure.

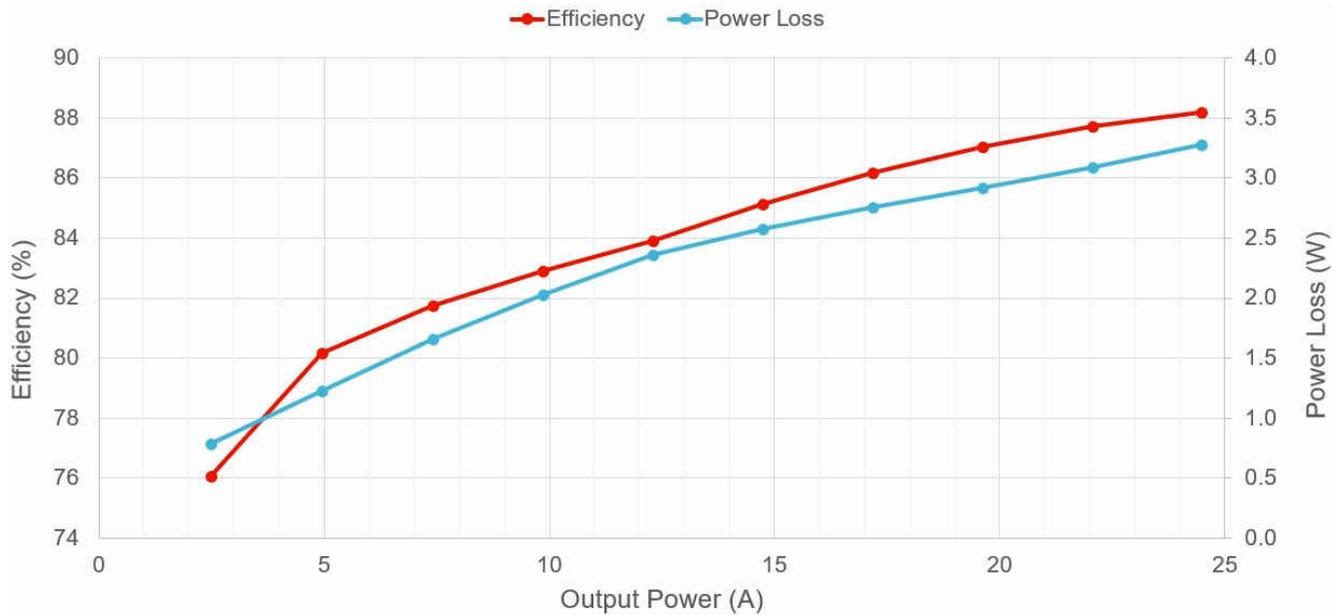


Figure 3-1. Efficiency and Power Loss With 120-V_{AC}, 60-Hz Input

3.2 Efficiency Data

Efficiency data for a 120-V_{AC}, 60-Hz input is shown in the following table.

P _{IN} (W)	V _{OUT} (V)	I _{OUT} (A)	P _{OUT} (W)	P _{Loss} (W)	Efficiency (%)
6.173	24.702	0.200	4.949	1.224	80.166
11.885	24.598	0.401	9.854	2.031	82.913
17.318	24.540	0.601	14.741	2.577	85.122
22.540	24.503	0.801	19.619	2.921	87.040
27.760	24.473	1.000	24.478	3.282	88.179

3.3 Thermal Images

Thermal images were taken after 15 minutes of running with no airflow, at an ambient temperature of 24°C.

All components are on the top of the board so it is the only view shown in the thermal images.

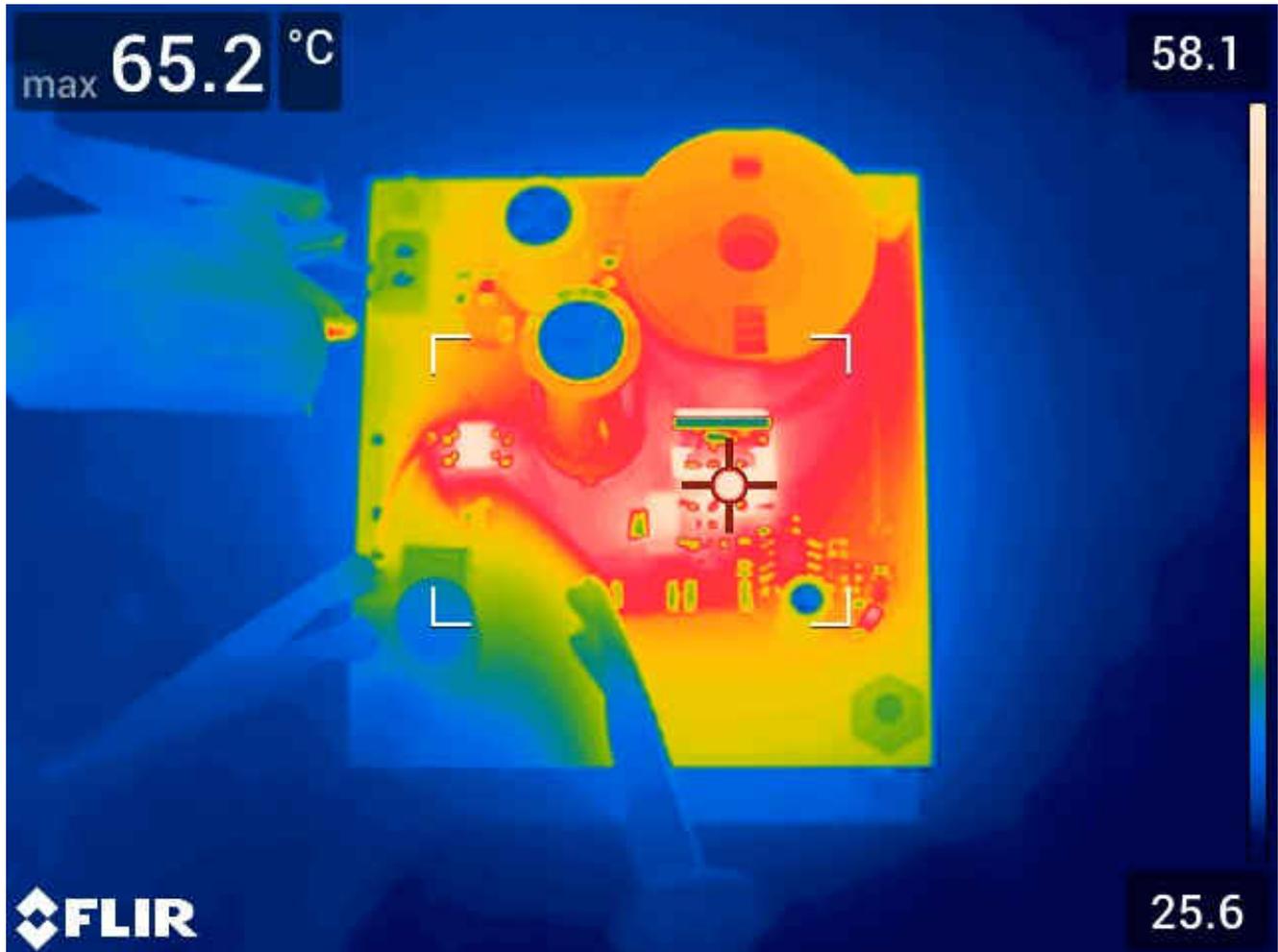
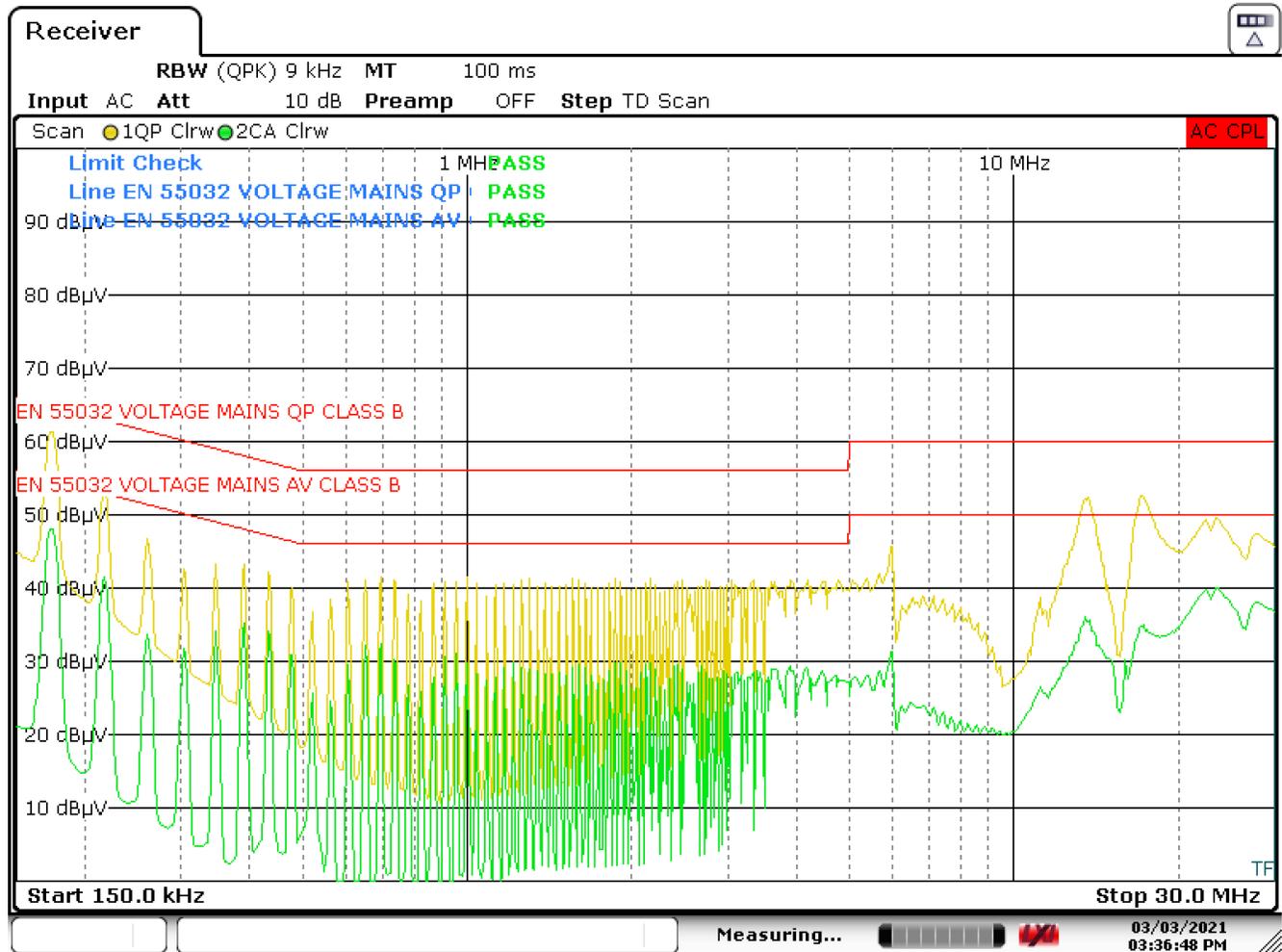


Figure 3-2. Thermal Image

3.4 EMI

Conducted emissions measurements were taken using both quasi-peak and average detector methods (yellow and green traces, respectively). The measurements are compared to the CISPR-25 Class B regulations for quasi-peak and average tests. For this test a resistive load was used to apply a 24-W load to the output.



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Figure 3-3. EMI

4 Waveforms

4.1 Switching

Switching behavior was measured across D3.

The max stress seen by the free-wheeling diode is 202-V_{DC} with a 120-V_{AC} input.

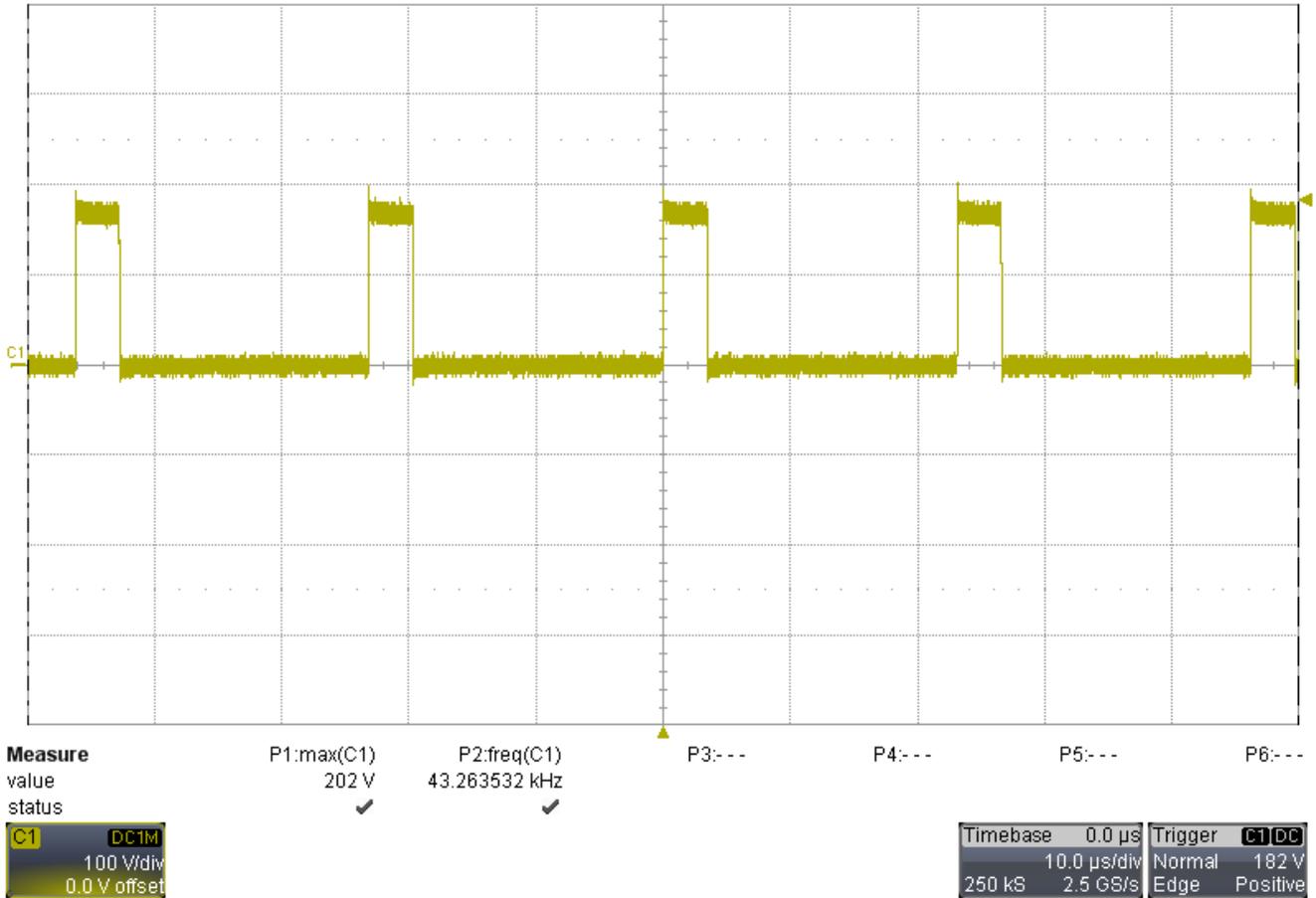


Figure 4-1. Switch Node

4.2 Output Voltage Ripple

Output voltage ripple was measured across a 0.1- μ F ceramic capacitor placed across the output connector.

At full load the peak-to-peak ripple is less than 50 mV.

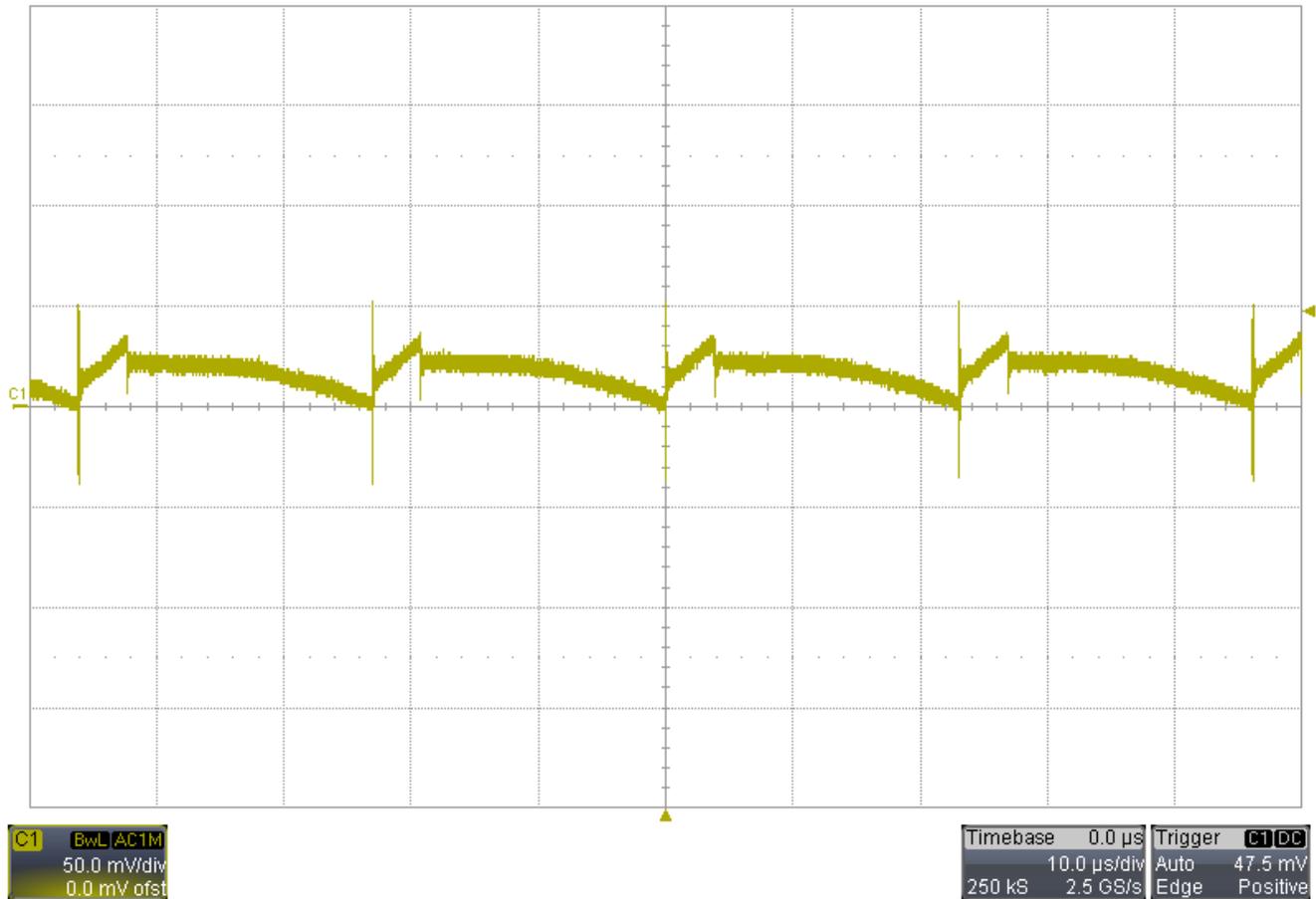


Figure 4-2. Output Voltage Ripple

4.3 Load Transients

Load transient response is measured while stepping between 0.2 and 0.8 A.

The response time is 25 ms with a <1-V deviation on the output.

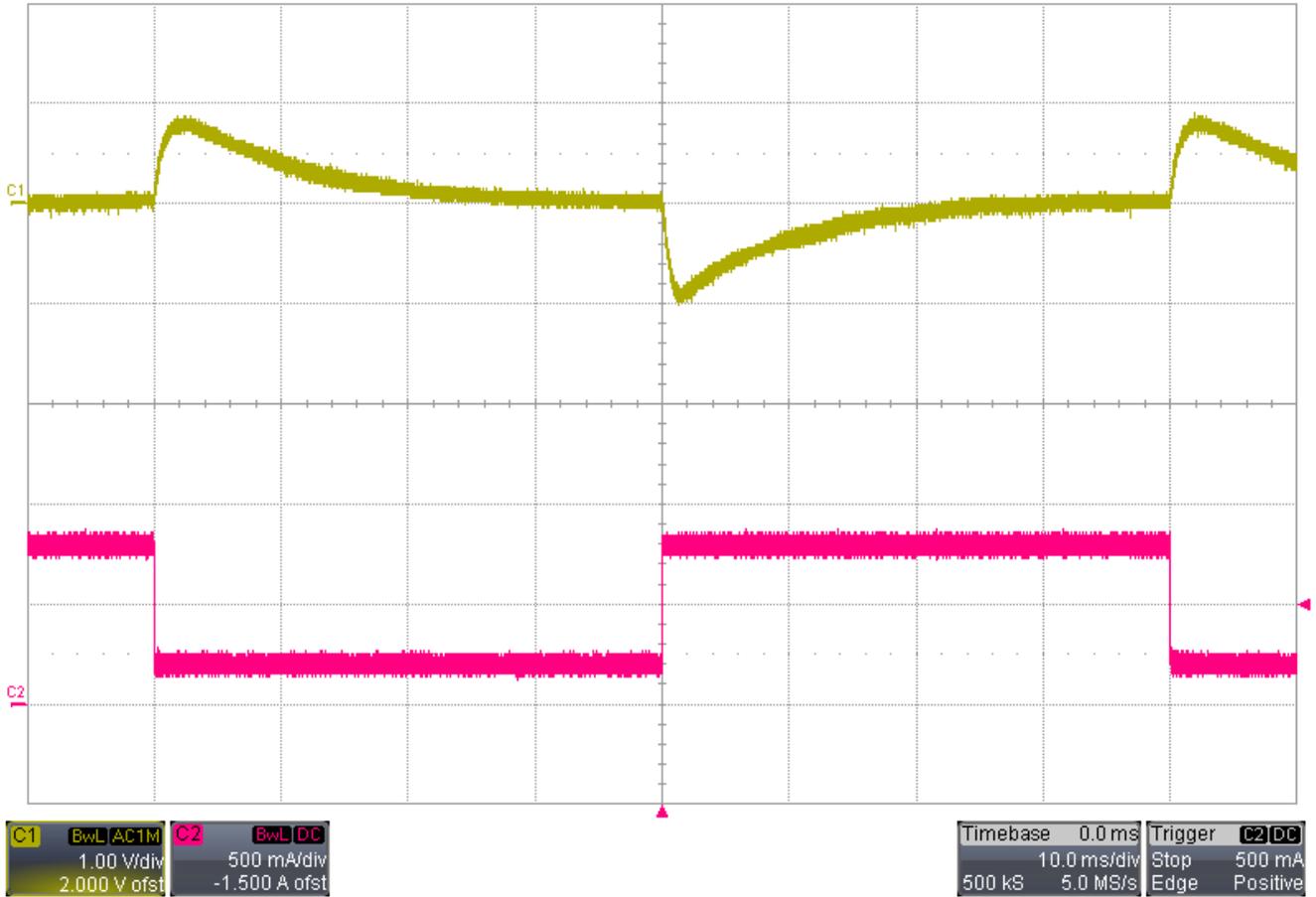


Figure 4-3. Load Transient

4.4 Start-up Sequence

Start-up behavior is determined by the start-up resistors (R1 and R2) and VCC capacitor (C2).

The output goes up after 2 seconds with 100-kΩ start-up resistors and a 22-μF capacitor.

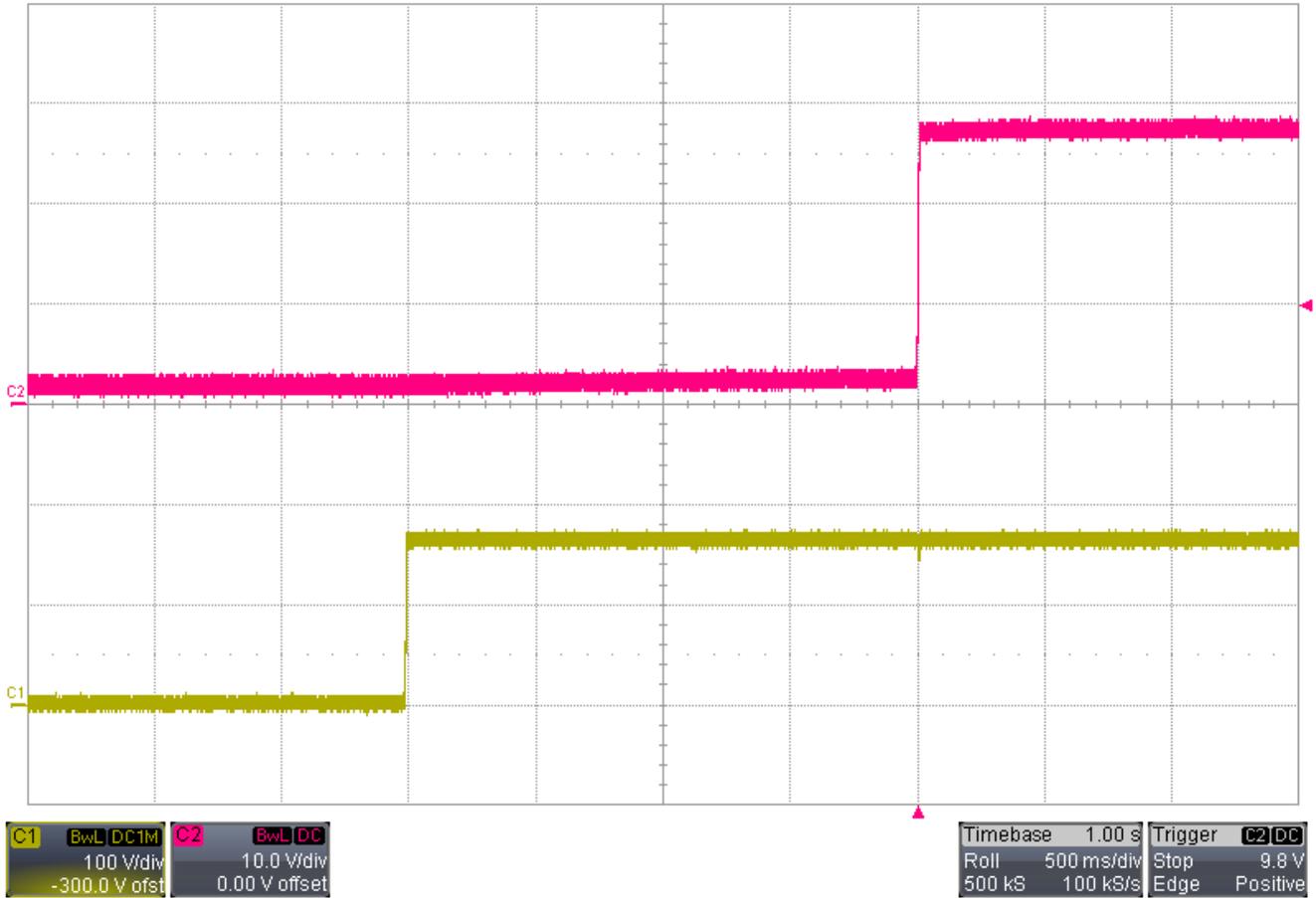


Figure 4-4. Start-up

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