Test Report: PMP23199

2-W, 120-VAC to 3.3-VDC High-Voltage Flyback Reference Design

Description

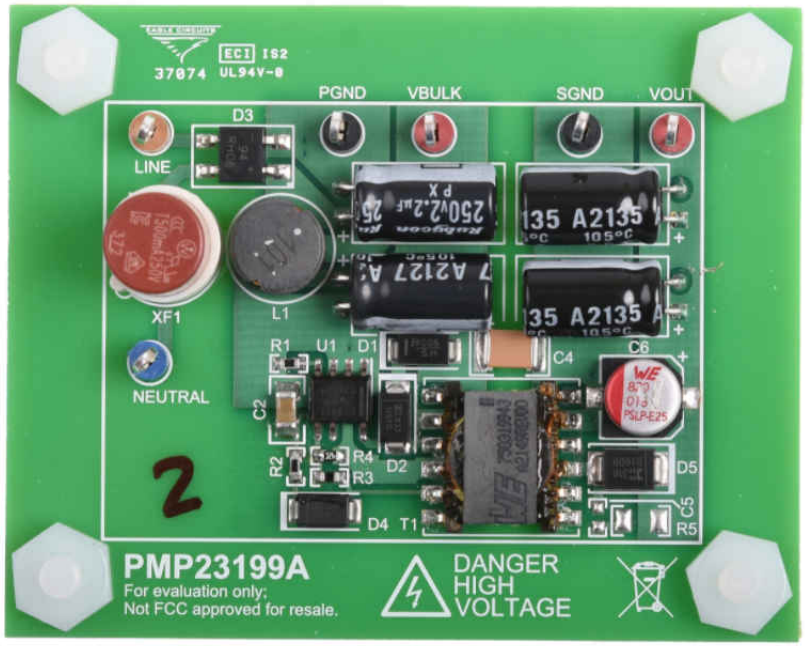
This reference design generates an isolated 2-W output (+3.3 V) from the AC line of 120 V_{AC}.
The UCC28911 device incorporates a 700-V power MOSFET and PSR controller. The design is made with the intention of achieving a low height of 0.25 in.

Features

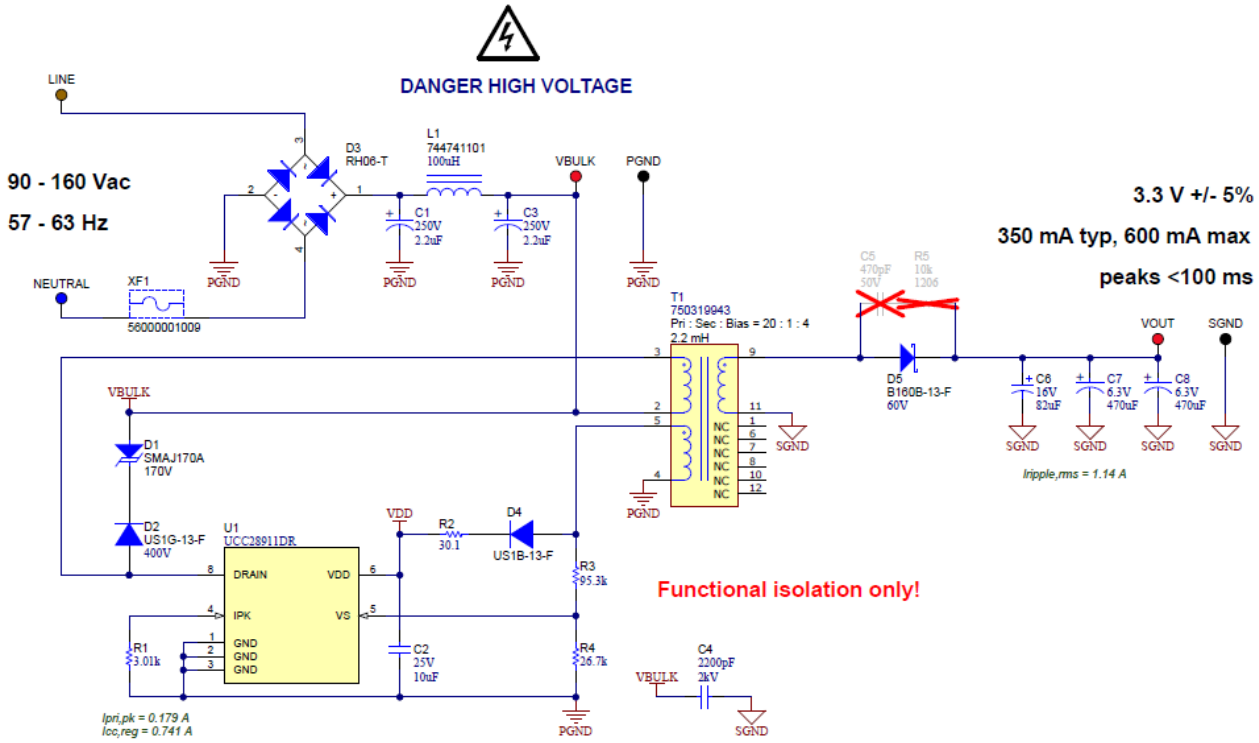
- Compact design with 1.4 in × 1.9 in and 0.25 in height
- Single-side assembly
- Small output ripple of 50 mV

Applications

- Circuit breaker (ACB, MCCB, VCB)
- Level transmitter
- Pressure transmitter
- Process analytics (pH, Gas, Concenteration, Force and Humidity)
- Flow transmitter



Board Photo



Schematic

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input Voltage Range	90 V–160 V AC
Frequency	57 Hz–63 Hz
Output Current	350 mA (nominal), 600 mA (maximum)
Output Voltage	3.3 V ±5%

1.2 Required Equipment

- AC power supply
- Electronic load
- Digital multimeters

1.3 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.

1.4 Dimensions

The PCB dimensions are 1.4 in × 1.9 in with a maximum component height of 0.25 in.

2 Testing and Results

2.1 Efficiency Graphs

Efficiency is shown in the following figure.

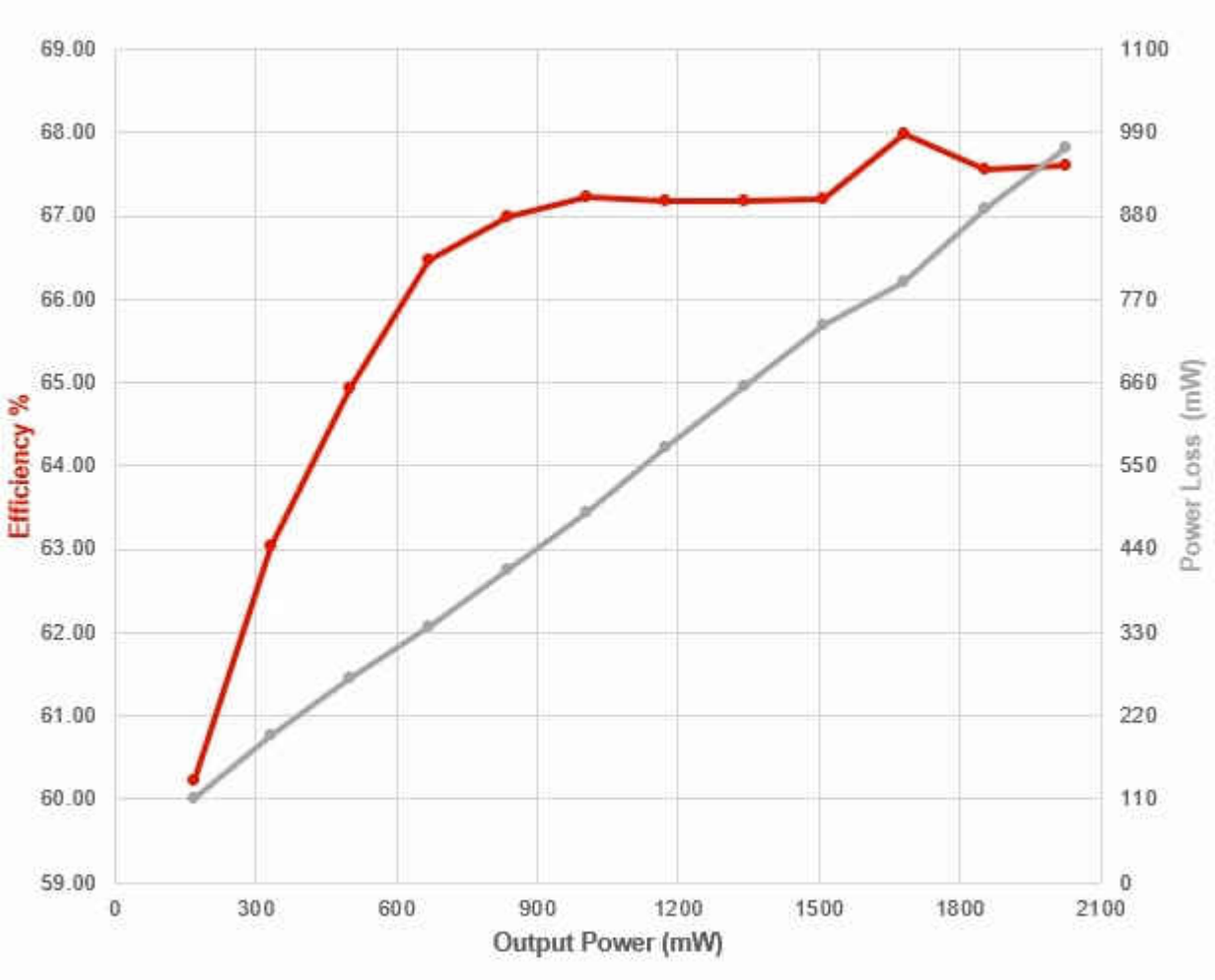


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

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

V_{OUT} (V)	I_{OUT} (mA)	P_{IN} (mW)	P_{OUT} (mW)	P_{LOSS} (mW)	Efficiency (%)
3.33	51	282	169.83	112.17	60.22
3.334	100	528.9	333.4	195.5	63.04
3.337	150	771	500.55	270.45	64.92
3.343	200	1006	668.6	337.4	66.46
3.344	250	1248	836	412	66.99
3.348	300	1494	1004.4	489.6	67.23
3.353	350	1747	1173.55	573.45	67.18
3.356	400	1998	1342.4	655.6	67.19
3.353	450	2245	1508.85	736.15	67.21
3.367	500	2476	1683.5	792.5	67.99
3.372	550	2745	1854.6	890.4	67.56
3.376	600	2996	2025.6	970.4	67.61

2.3 Thermal Images

The thermal image in Figure 2-2 was taken after 5 minutes of running with no airflow, at an ambient temperature of 25°C. Only the top view is shown in the thermal images because all components are on the top of the board.

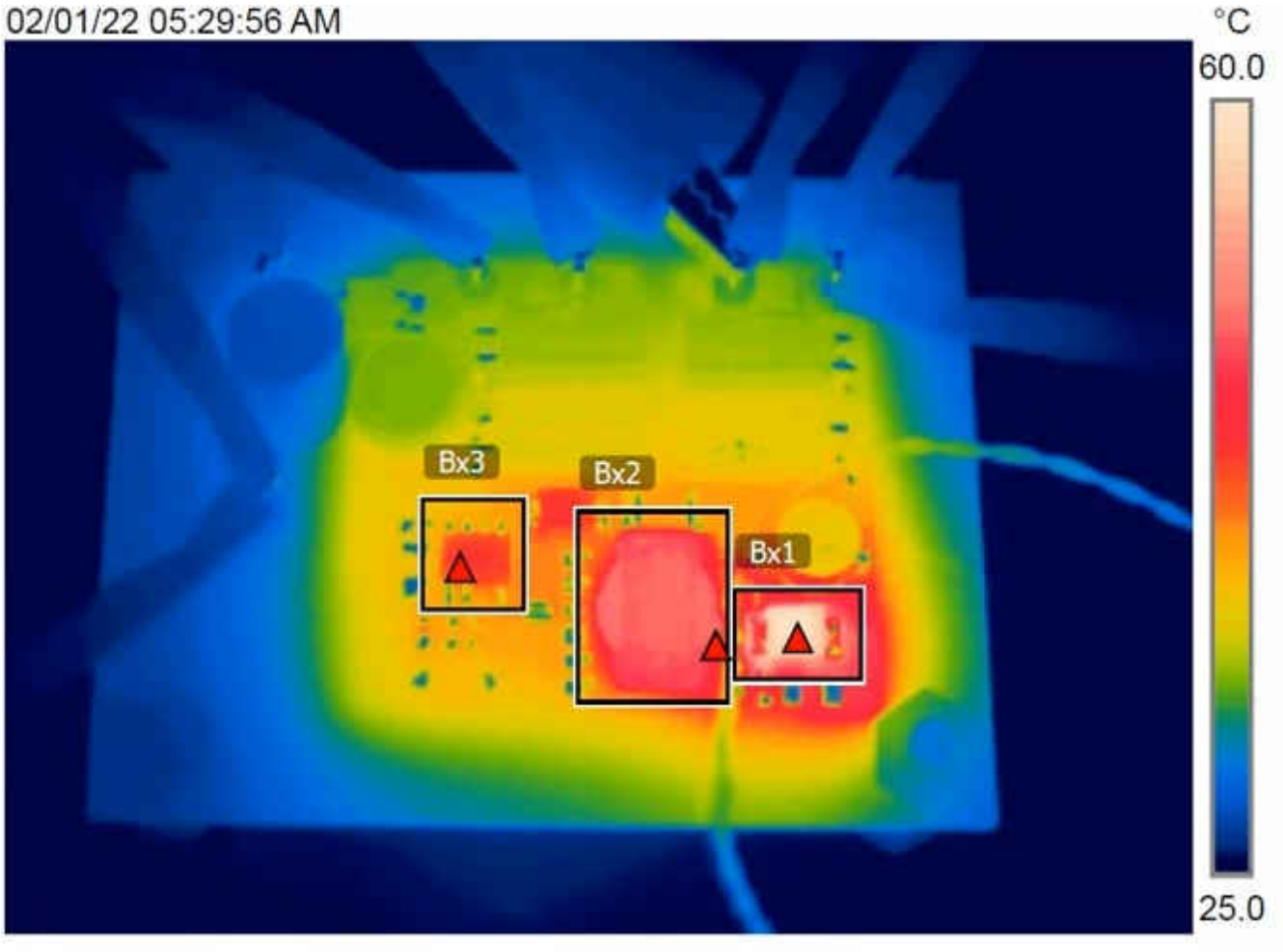


Figure 2-2. Thermal Image

2.4 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 1.98-W load to the output.

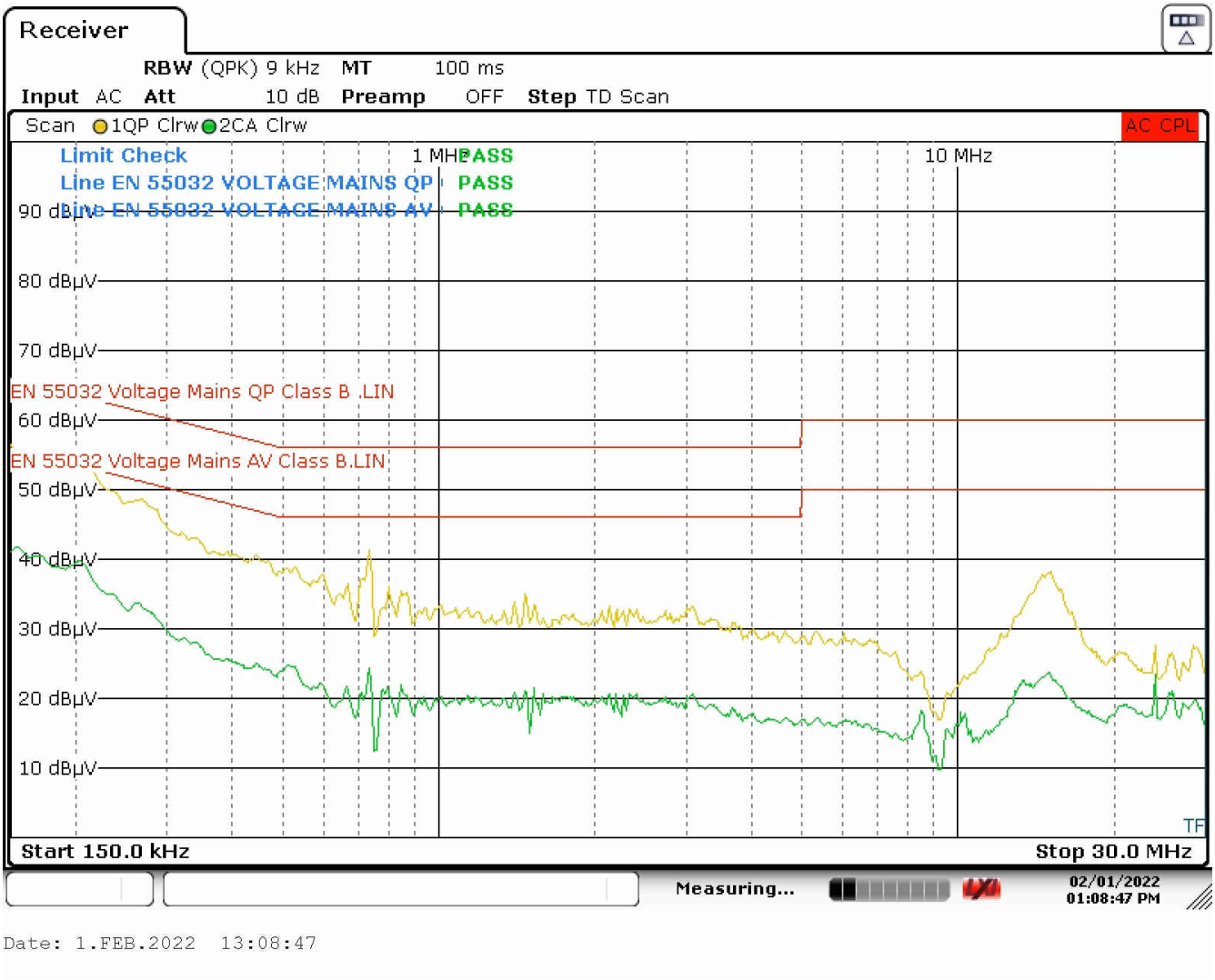


Figure 2-3. EMI

3 Waveforms

3.1 Switching

Switching behavior is shown in the following figures. The switching node in Figure 3-1 is measured across Vs to GND and the second switching node shown in Figure 3-2 is measured across D5. The maximum stress is found across the primary switching node at 395 V.

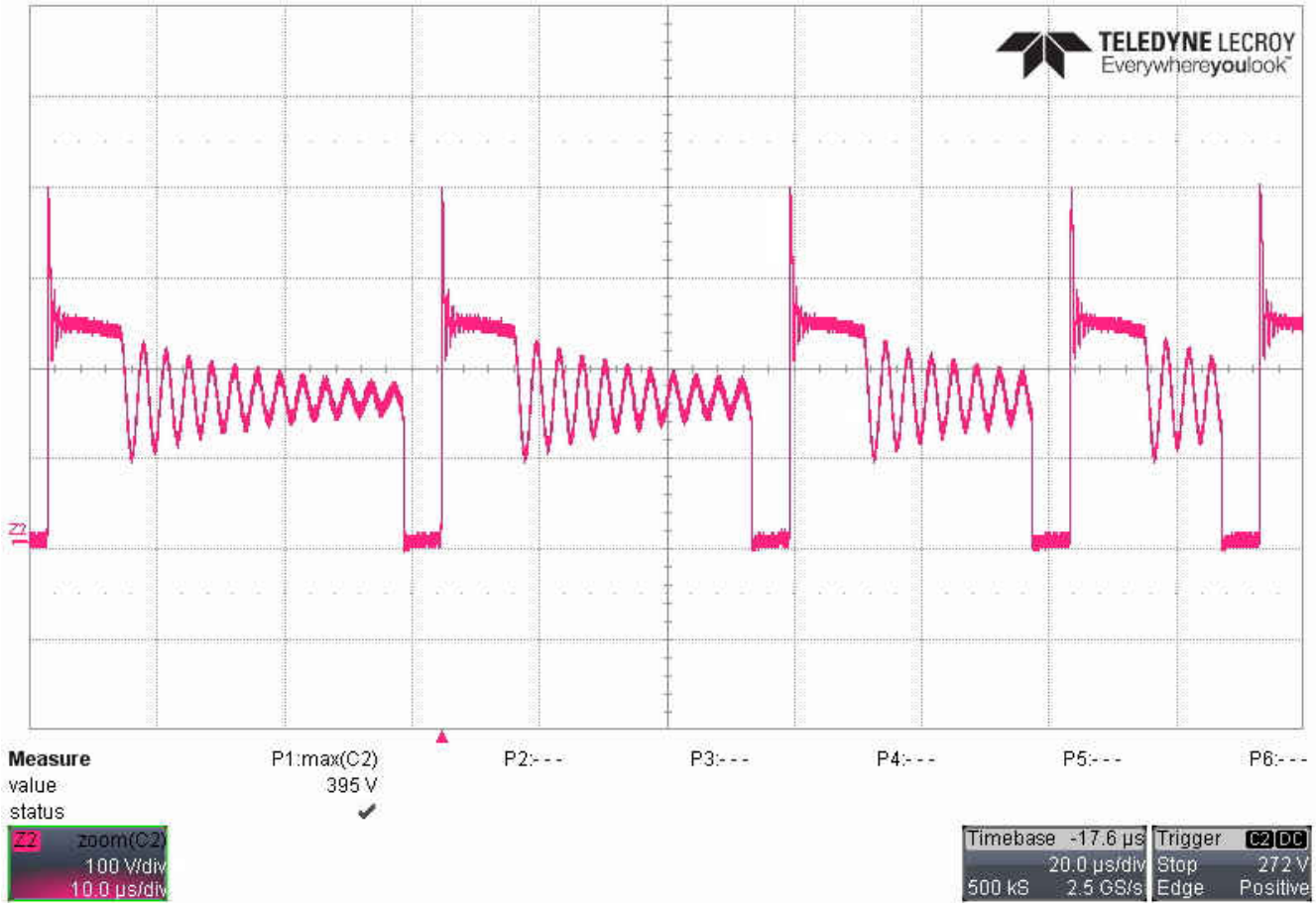


Figure 3-1. Switching 1

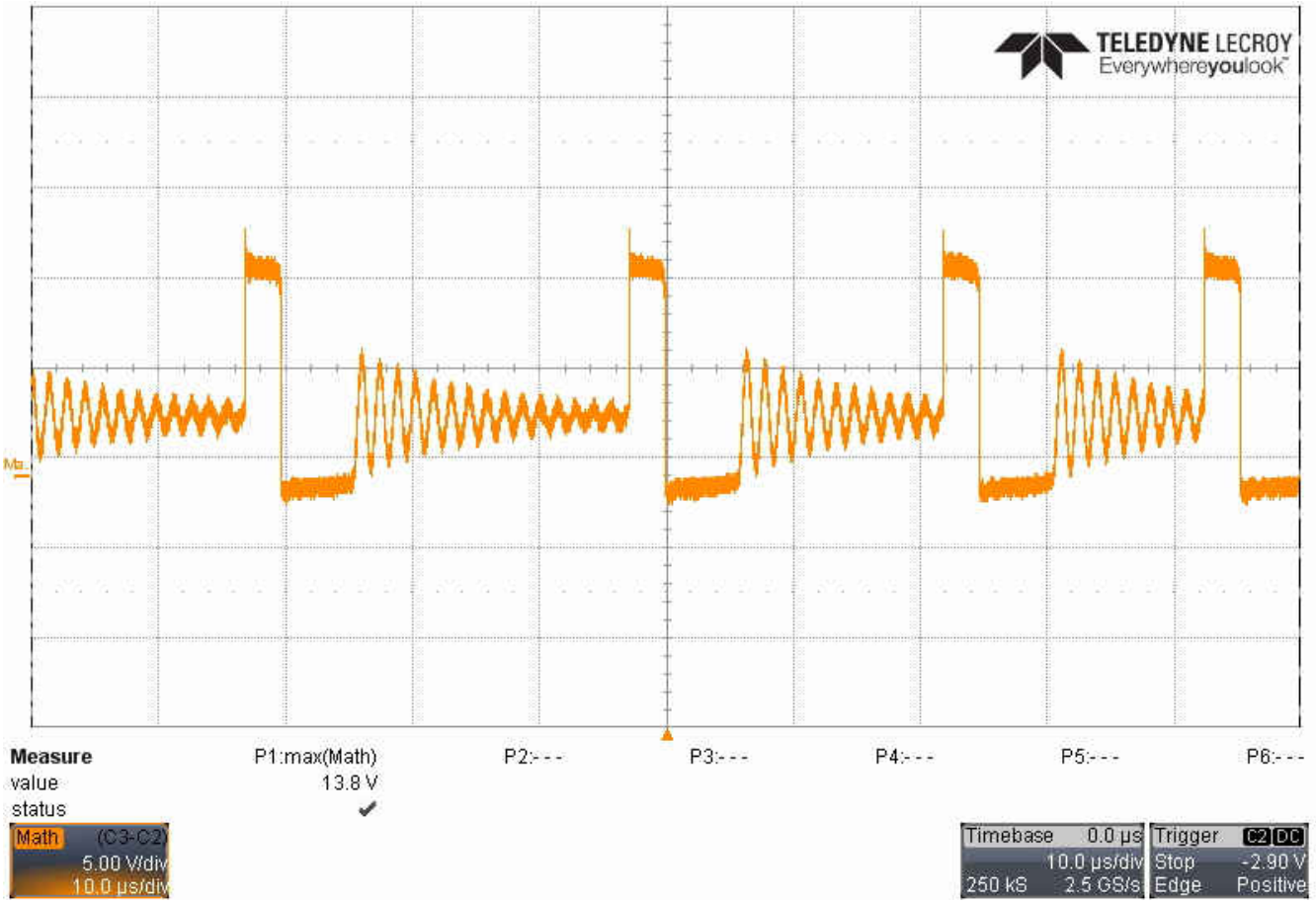


Figure 3-2. Switching 2

3.2 Output Voltage Ripple

Output voltage ripple was measured across a 0.1-µF ceramic capacitor placed across the output connector. At full load the peak-to-peak ripple is under 60 mV.

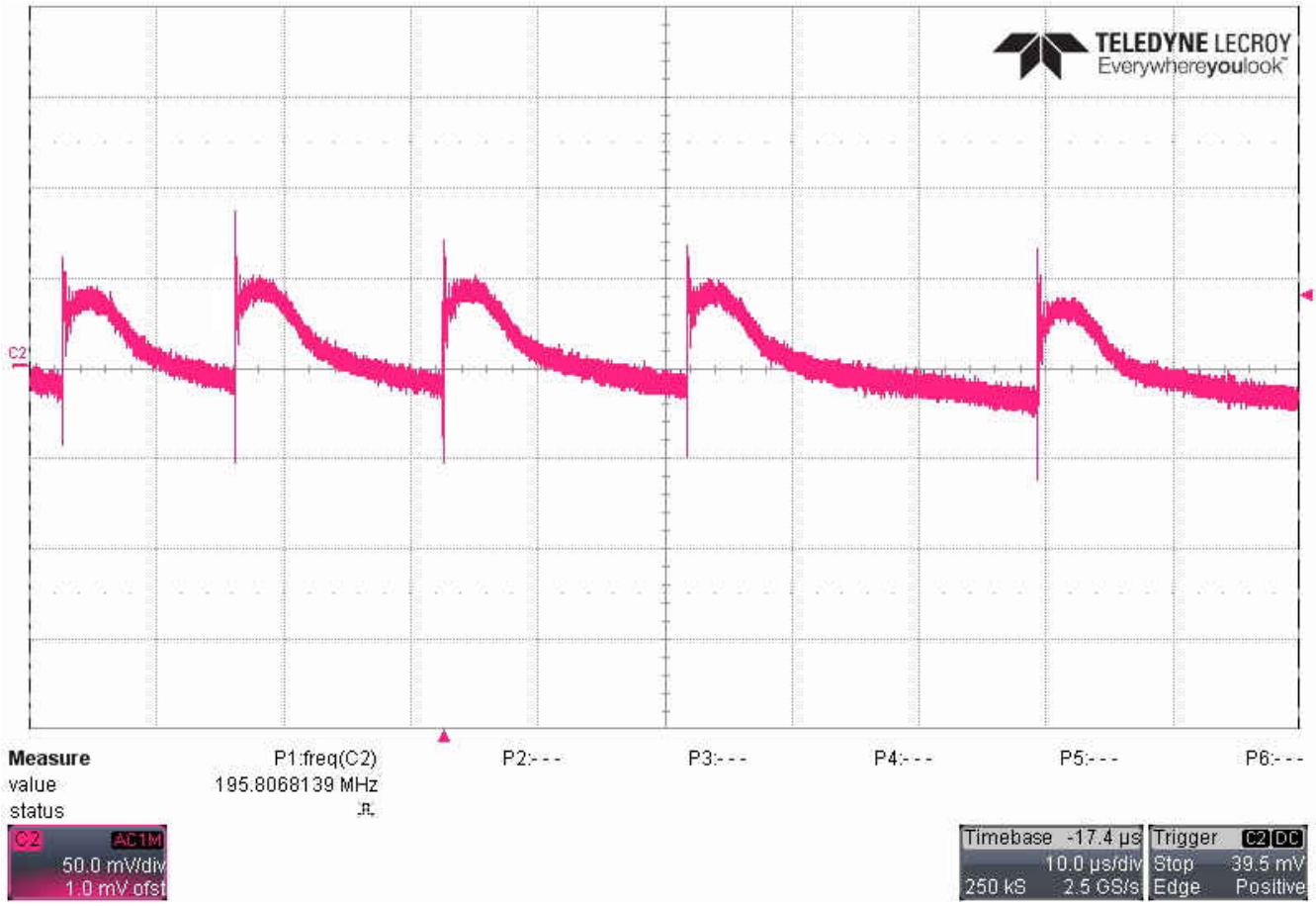


Figure 3-3. Output Voltage Ripple 1

3.3 Load Transients

Load transient response is measured while stepping between 50 mA and 300 mA. The response time is 0.25 ms with a < 50-mV deviation on the output.

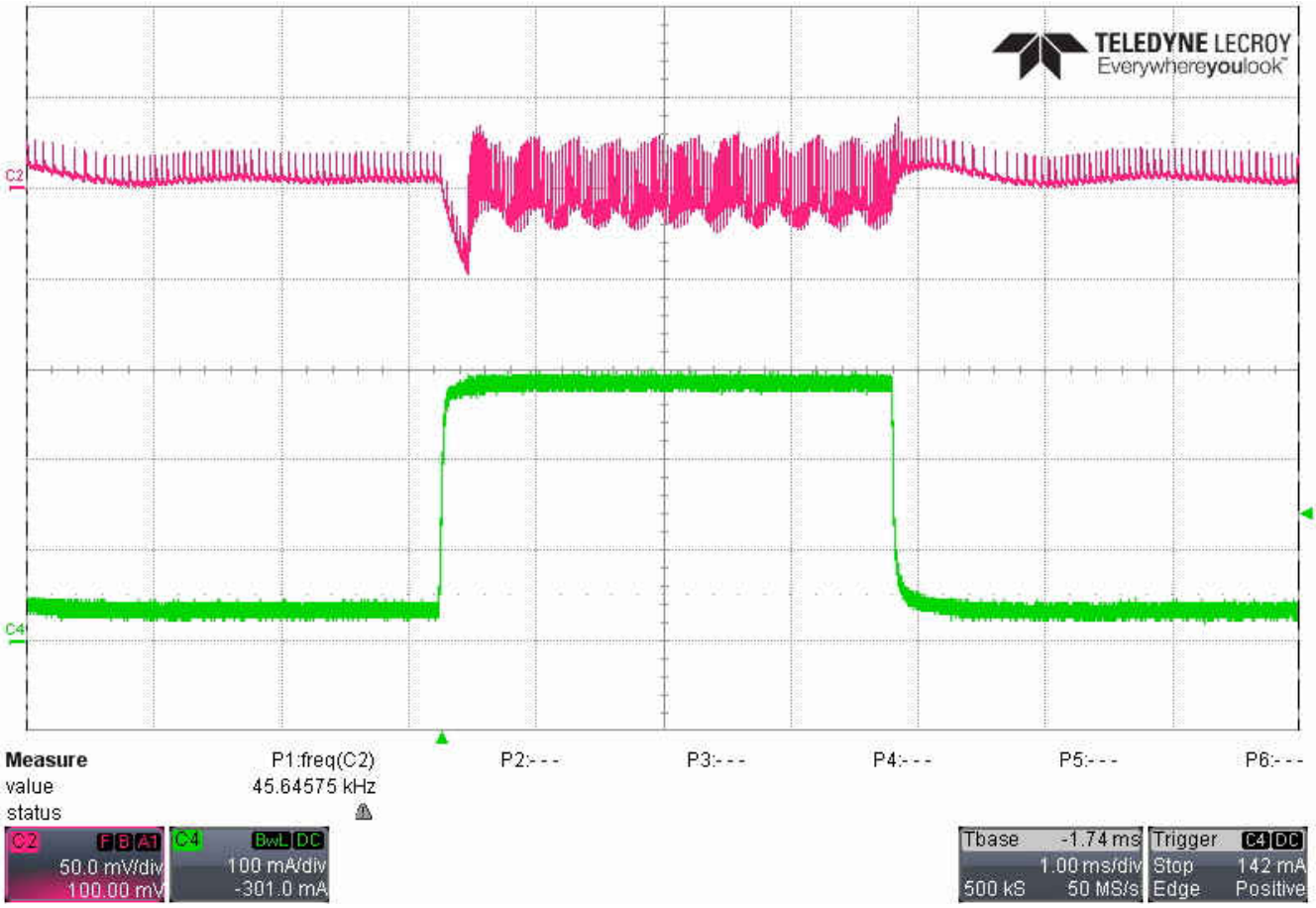


Figure 3-4. Load Transient

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