

Low Standby Power Wide Input Voltage UCC28750 Reference Design



Description

This reference design is designed for low standby power and low cost. This design showcases the UCC28750 isolated flyback controller and operates over an ultra-wide input voltage range of 85V_{AC} to 400V_{AC} to deliver an isolated 12V at 1.25A output.

Resources

[PMP31422](#)

Design Folder

[TLV431A](#)

Product Folder

Features

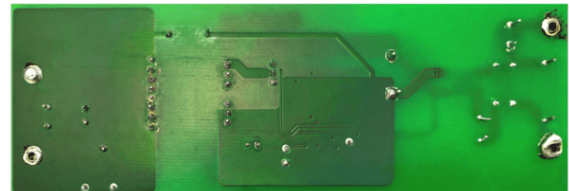
- Cycle-by-cycle overcurrent protection
- Discontinuous conduction mode (DCM) and continuous conduction mode (CCM) operation
- Low standby power
- Ultra-wide input range

Applications

- [Refrigerator and freezer](#)
- [Washer and dryer](#)
- [Electricity meter](#)



Top View



Bottom View



Angled View 1

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

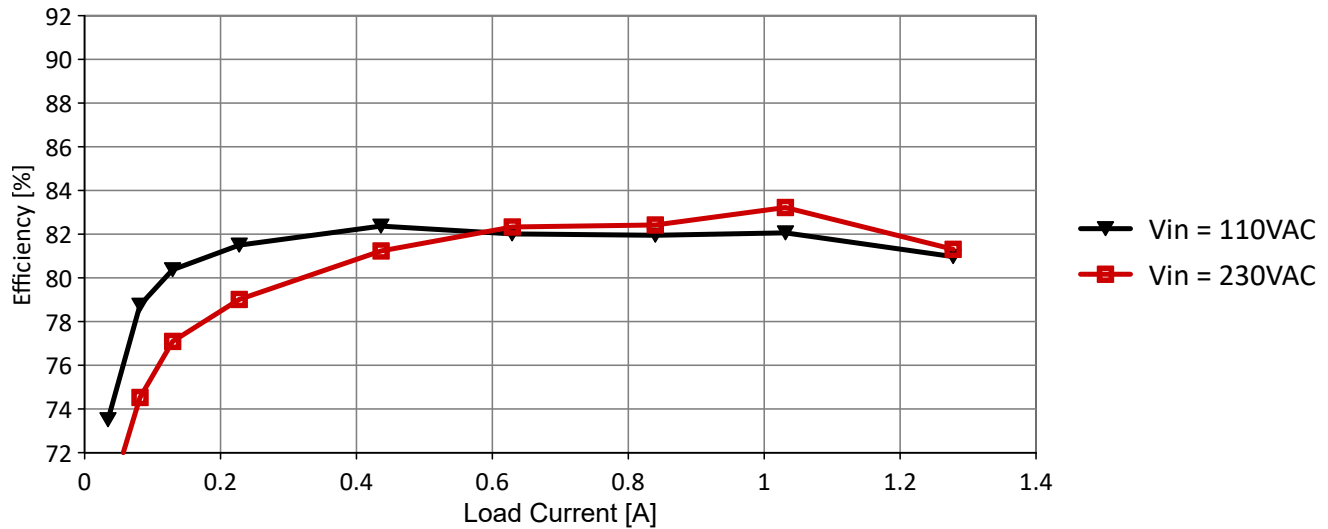
Parameter	Specifications
Input Voltage Range	85V _{AC} to 400V _{AC}
Output Voltage	12V
Maximum Output Current	1.25A
Topology	Isolated flyback

1.2 Dimensions

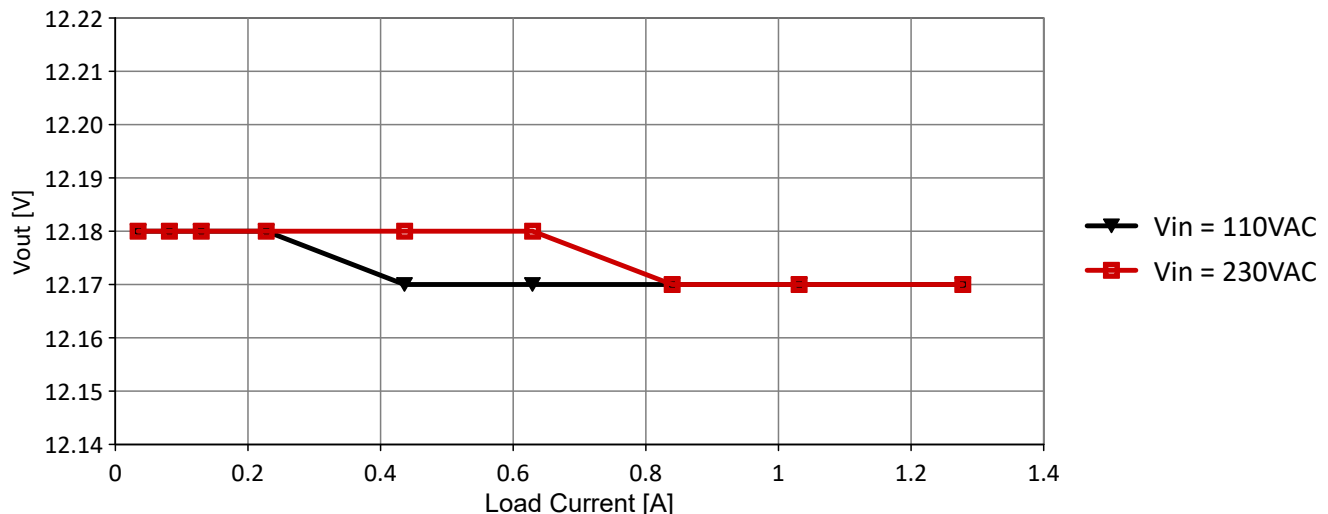
The outline of the PMP31422_RevA board is 149mm × 50mm with two copper layers. The copper thickness is 35μm on each layer.

2 Testing and Results

2.1 Efficiency Graphs


Figure 2-1. Efficiency versus Output Current

2.2 Load Regulation


Figure 2-2. Output Voltage versus Output Current

2.3 Standby Power

Standby power with different input voltages and no load.

Table 2-1. Standby Power

Input [V _{AC}]	Standby Power [mW]
85	24
110	25
150	26
200	28
230	30
273	34

2.4 Overcurrent Protection

Table 2-2. Overcurrent Protection

Input [V _{AC}]	Overcurrent protection [A]
110	1.40
230	1.55
273	1.62

2.5 Thermal Images

The thermal images in [Figure 2-3](#) and [Figure 2-4](#) were captured after 10 minutes with 1.25A output current.

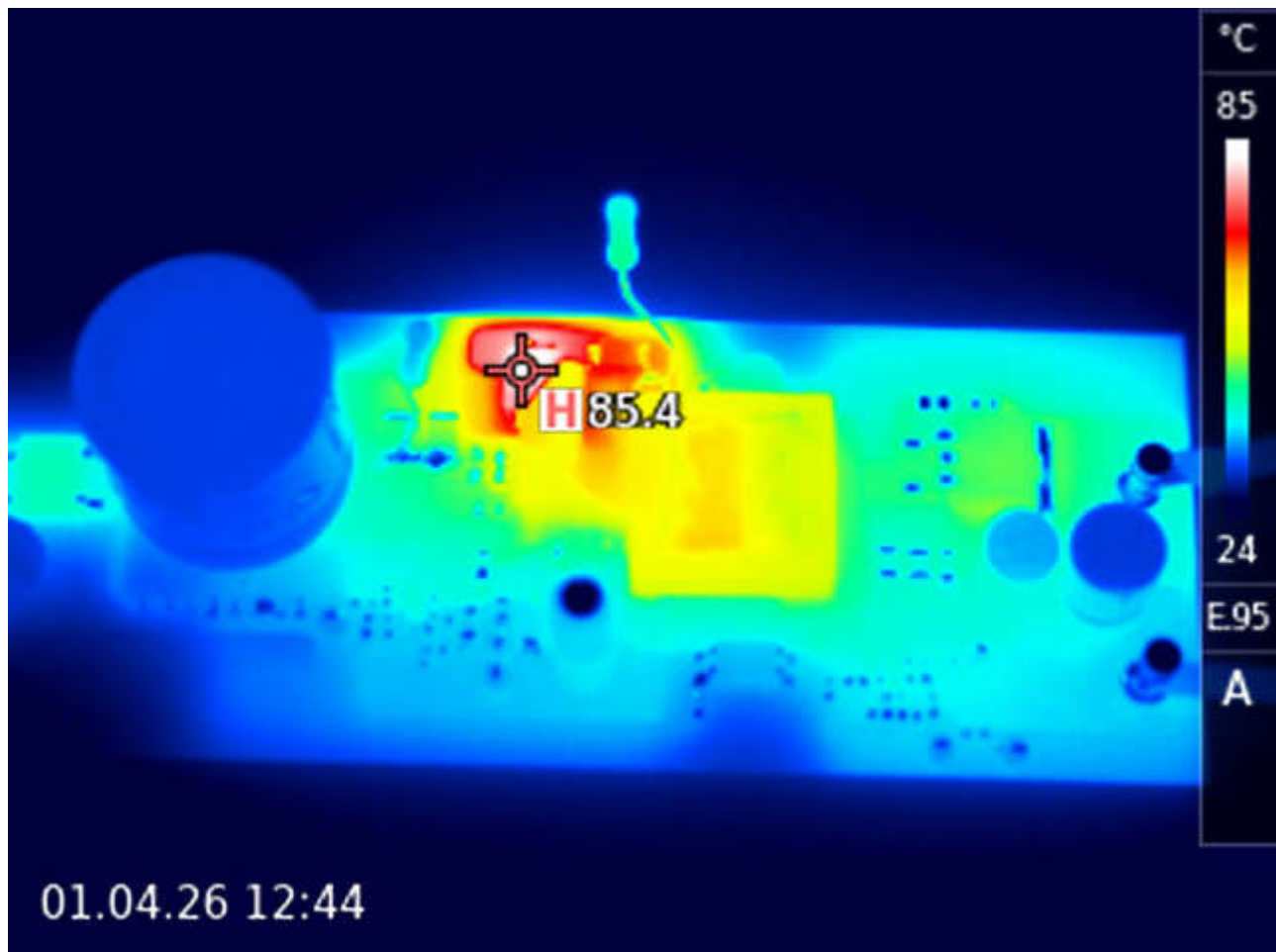


Figure 2-3. Thermal Image @ 110V_{AC_IN} and 1.25A_{OUT}

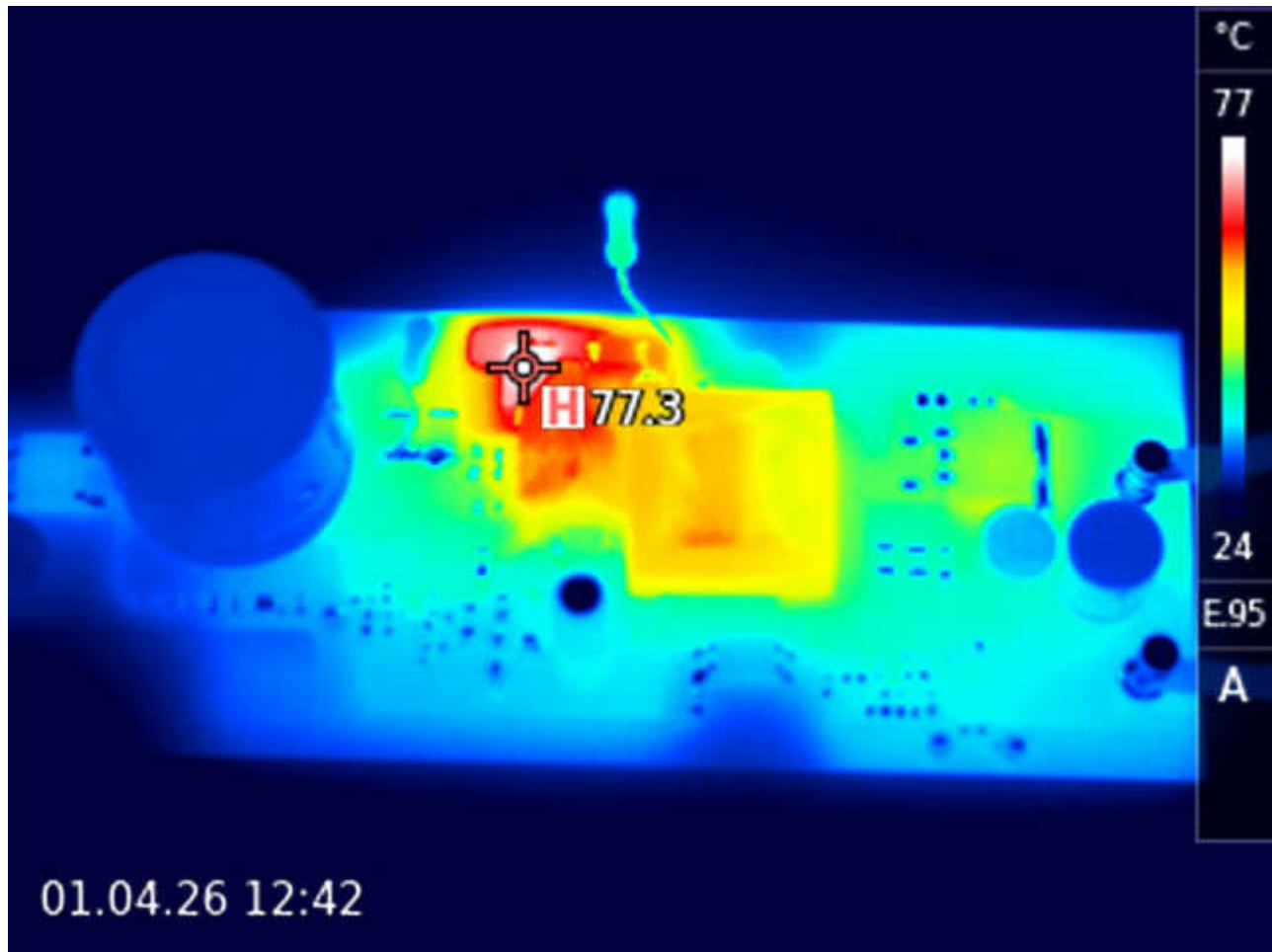


Figure 2-4. Thermal Image @ 230V_{AC_IN} and 1.25A_{OUT}

2.6 Bode Plots

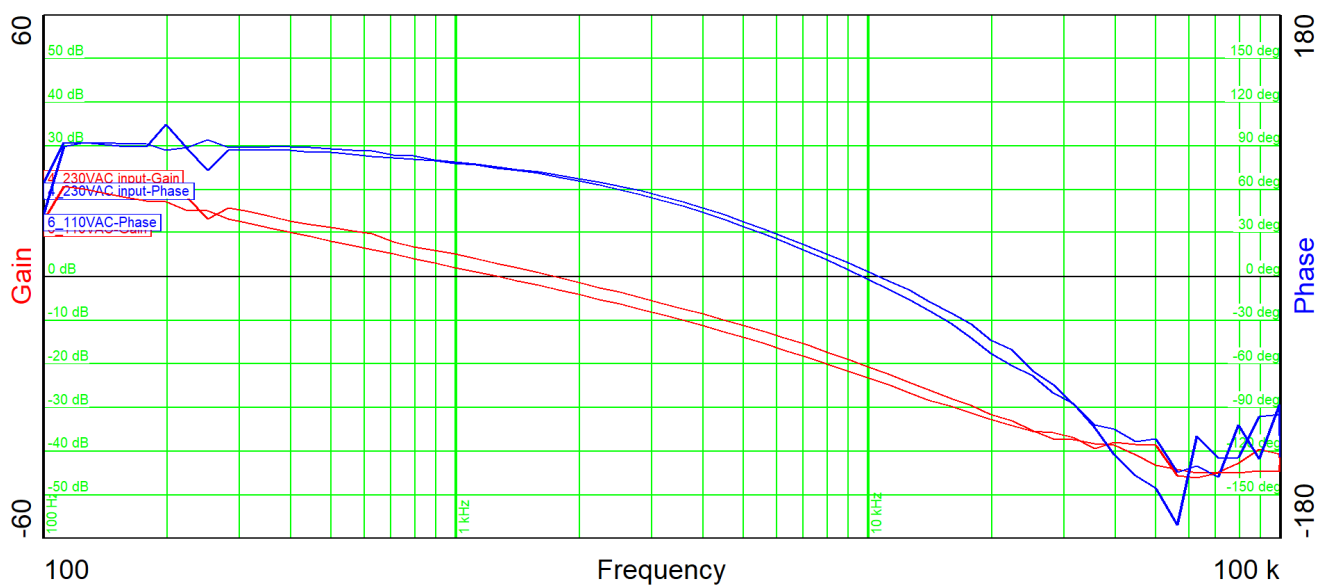


Figure 2-5. Bode Plot with 1.25A Load Current

	110V _{AC_IN}	230V _{AC_IN}
Bandwidth (kHz)	1.3	1.7
Phasemargin	75°	70°
slope (20dB/decade)	-1.01	-1.12
gain margin (dB)	-23	-21

2.7 EMI

2.7.1 Conducted Emissions 110V_{AC} Input

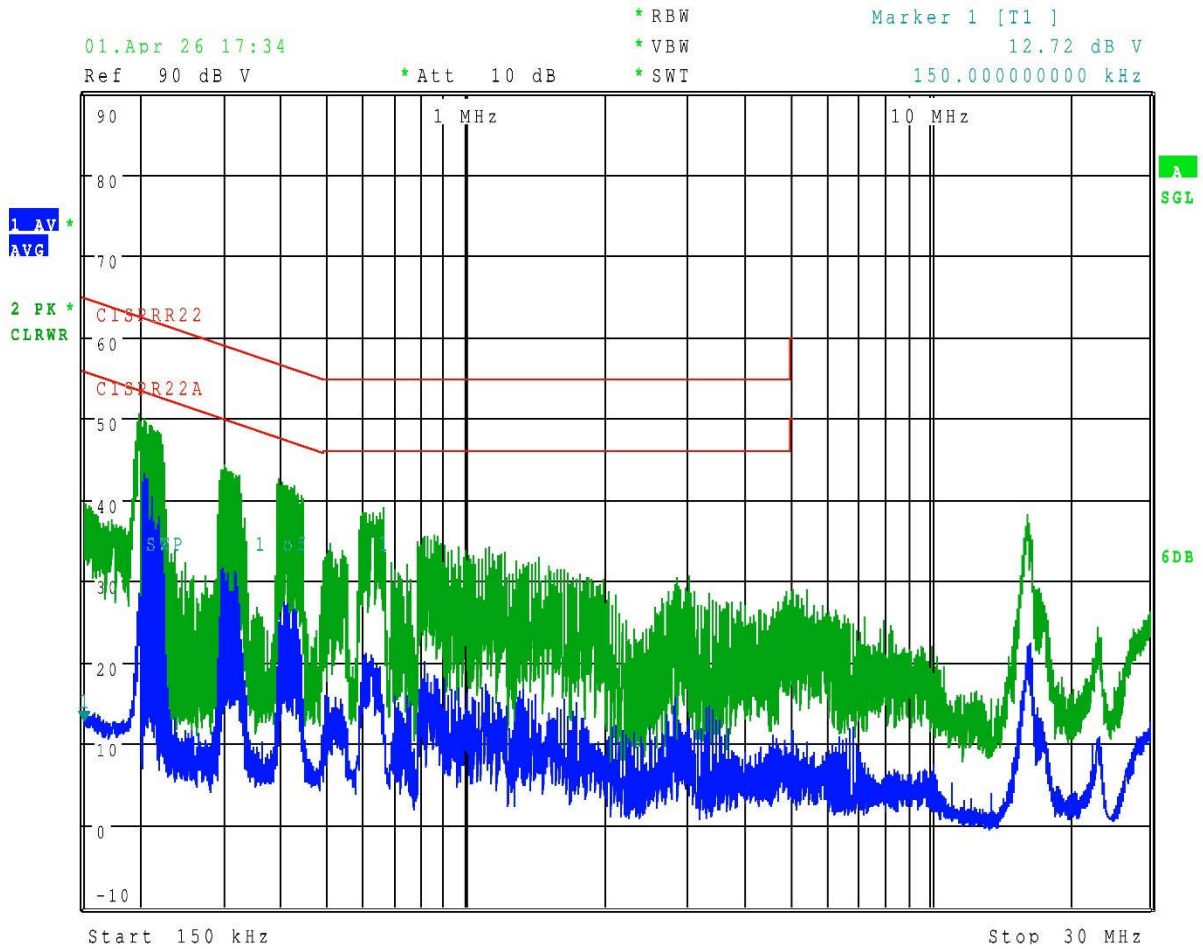


Figure 2-6. 110V_{AC} Input and 1.25A Output Current and Secondary Ground Connected to Earth

2.7.2 Conducted Emissions 230V_{AC} Input

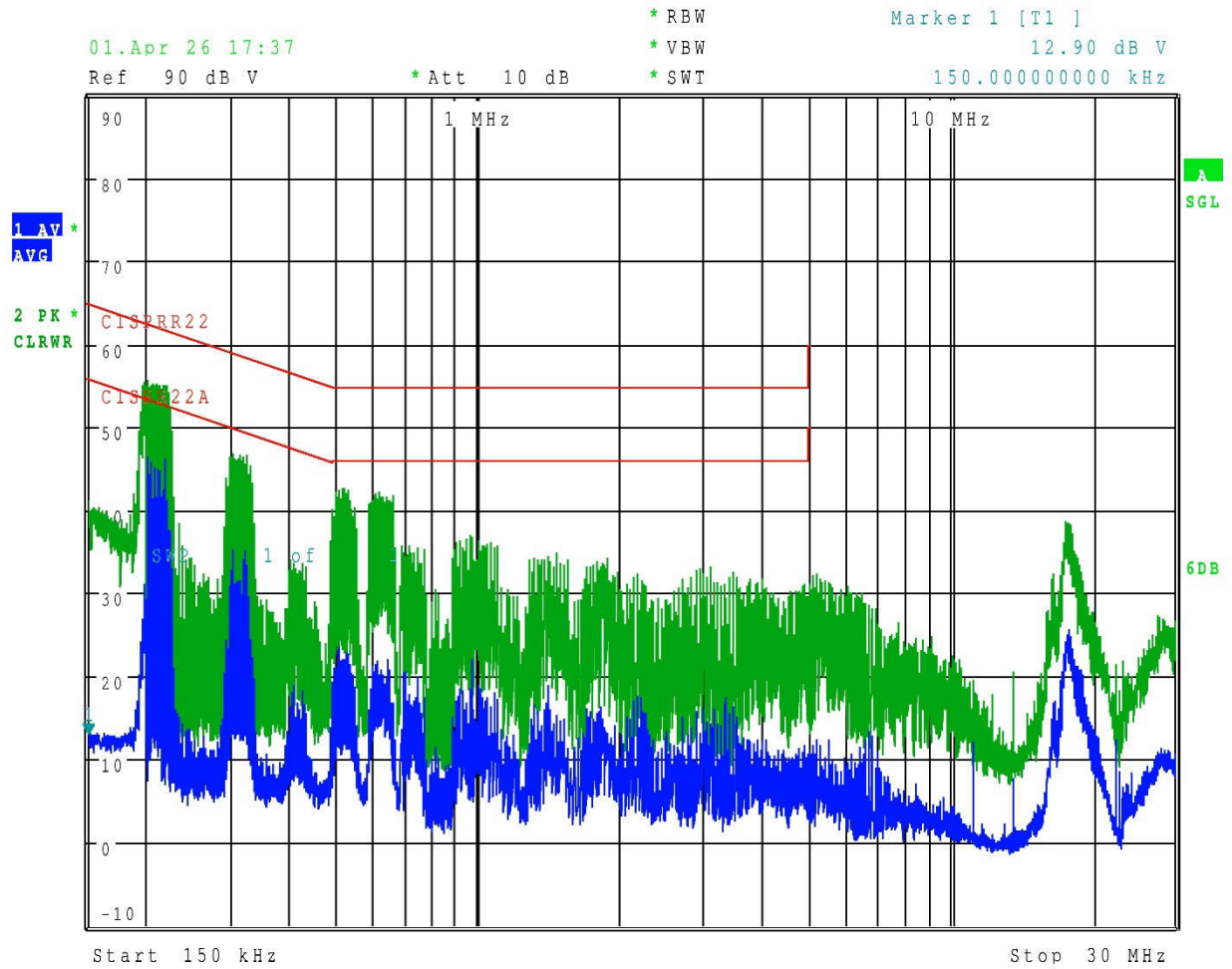


Figure 2-7. 230V_{AC} Input and 1.25A Output Current and Secondary Ground connected to Earth

3 Waveforms

3.1 Switching with 230V_{AC} Input Voltage

3.1.1 No Load

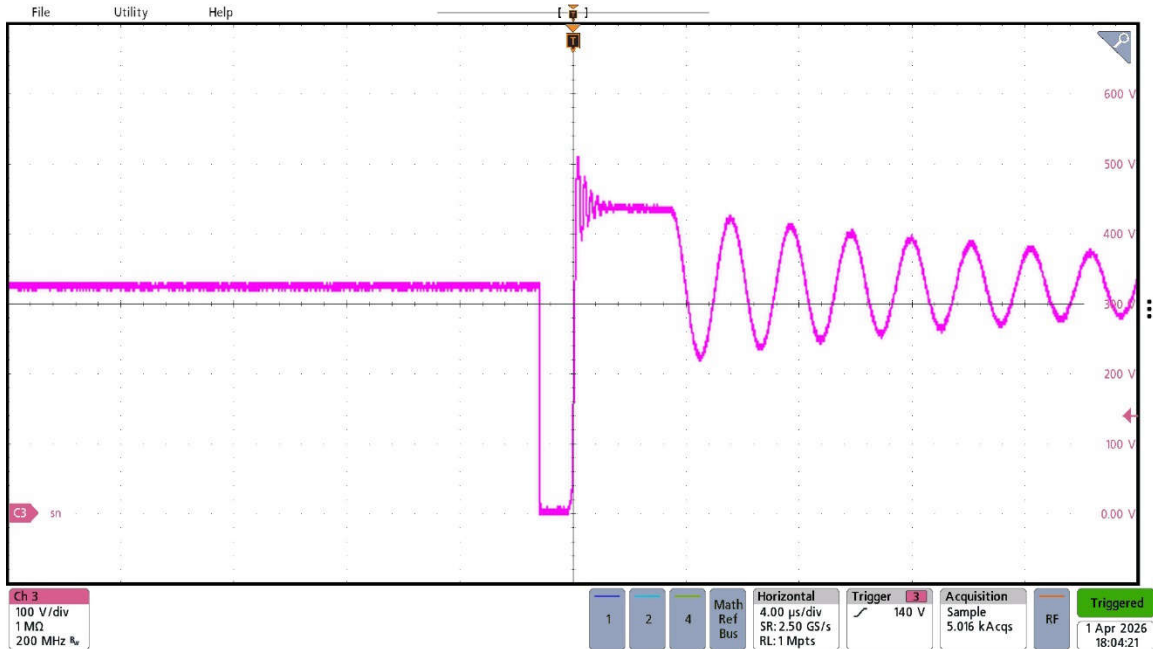


Figure 3-1. Switching with No Load (4µs/div)

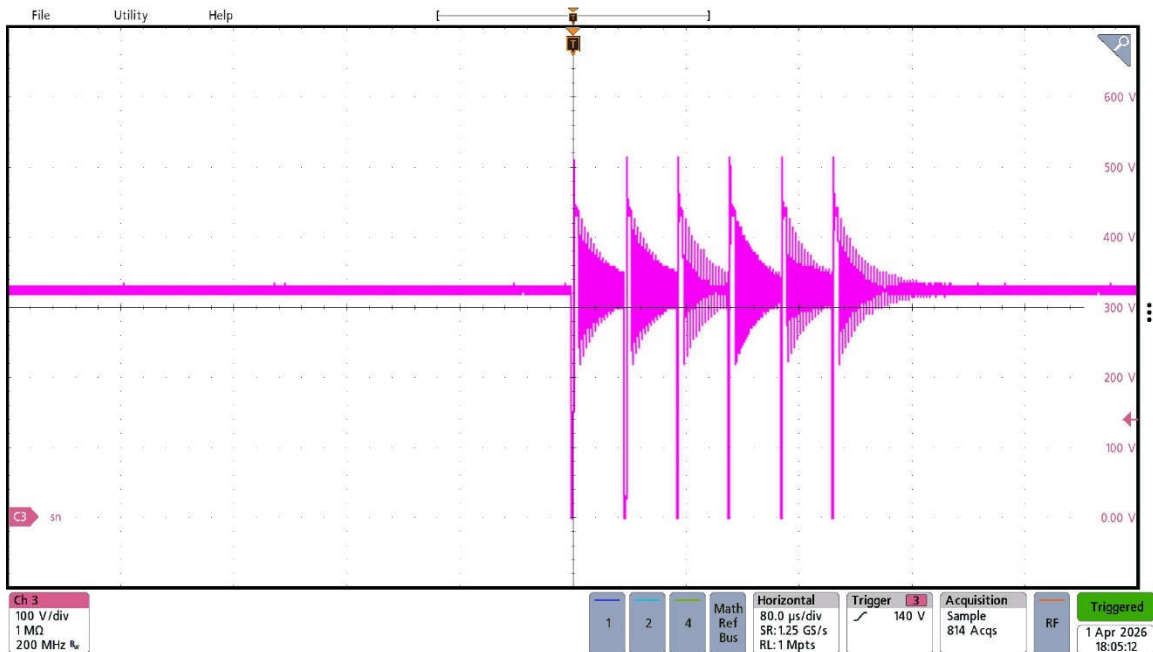


Figure 3-2. Switching with No Load (80µs/div)

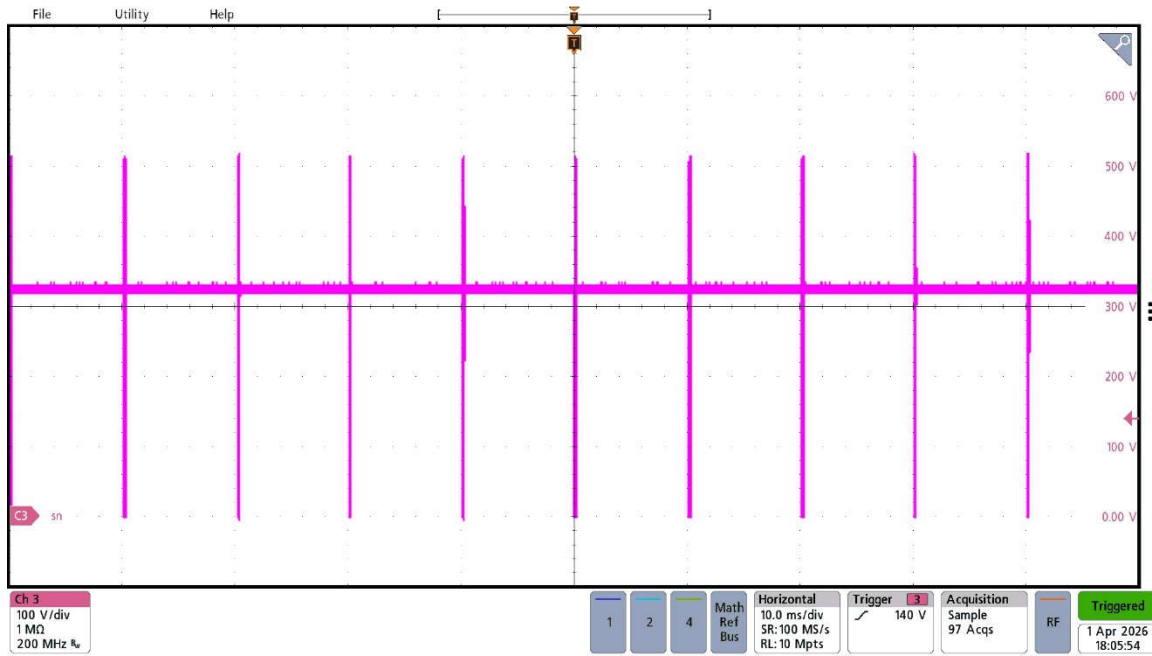


Figure 3-3. Switching with No Load (10ms/div)

3.1.2 40mA Load Current

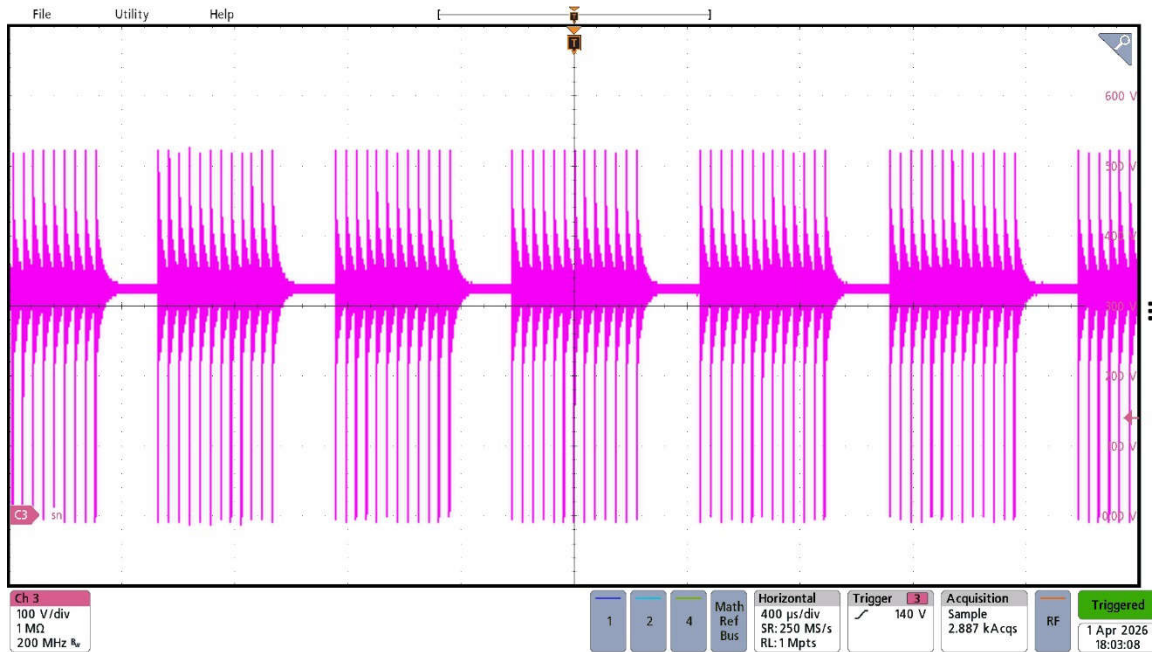


Figure 3-4. Switching with 40mA Load (400µs/div)

3.1.3 100mA Load Current

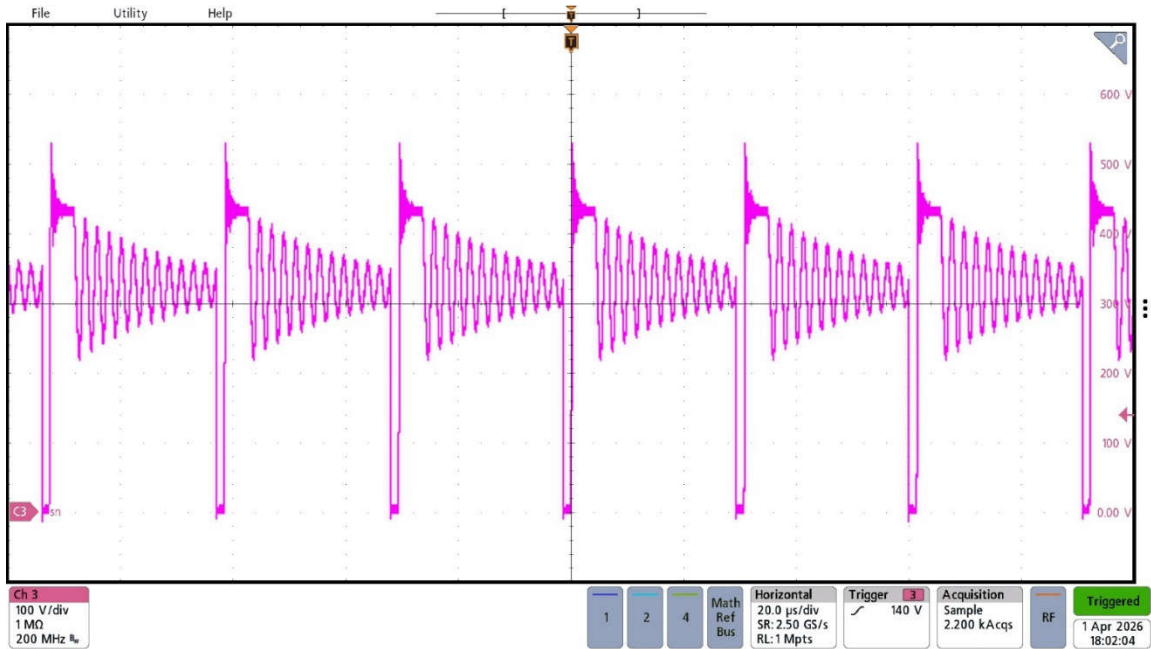


Figure 3-5. Switching with 100mA Load (20 μ s/div)

3.1.4 500mA Load Current

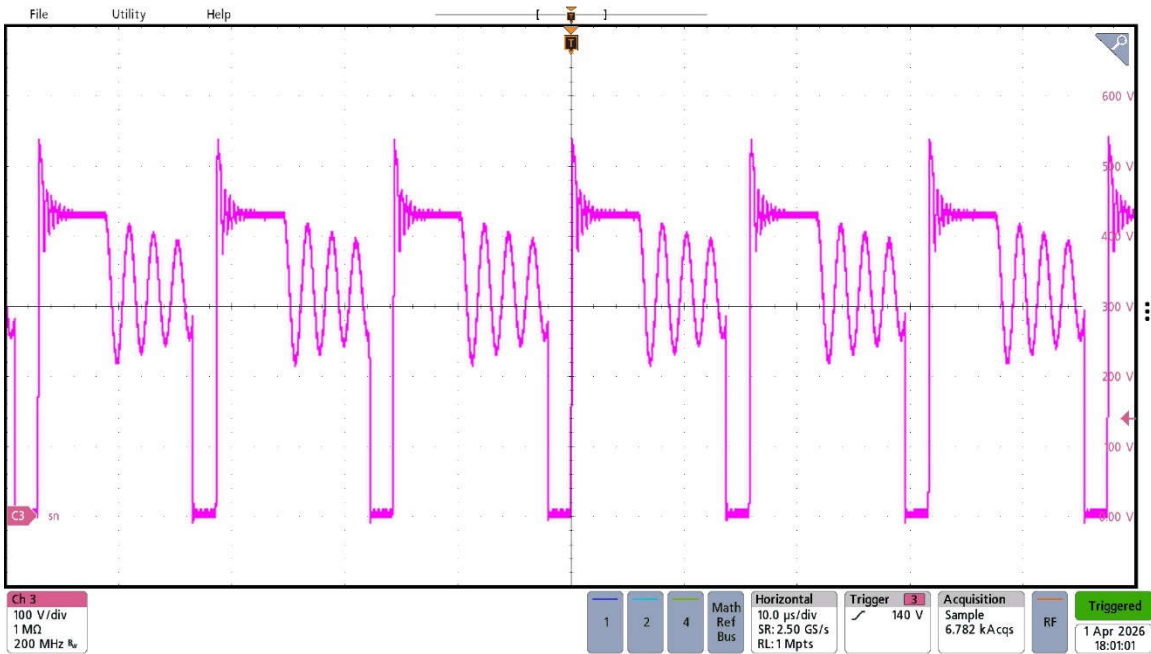


Figure 3-6. Switching with 500mA Load (10 μ s/div)

3.1.5 1.25A Load Current

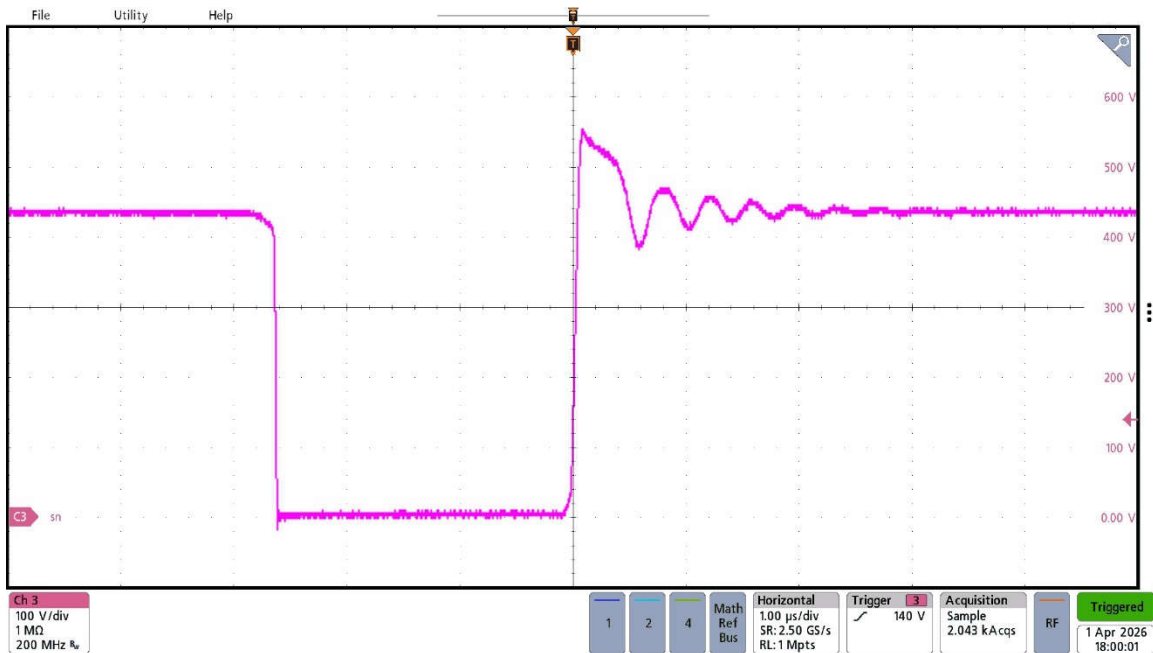


Figure 3-7. Switching with 1.25A Load (1µs/div)

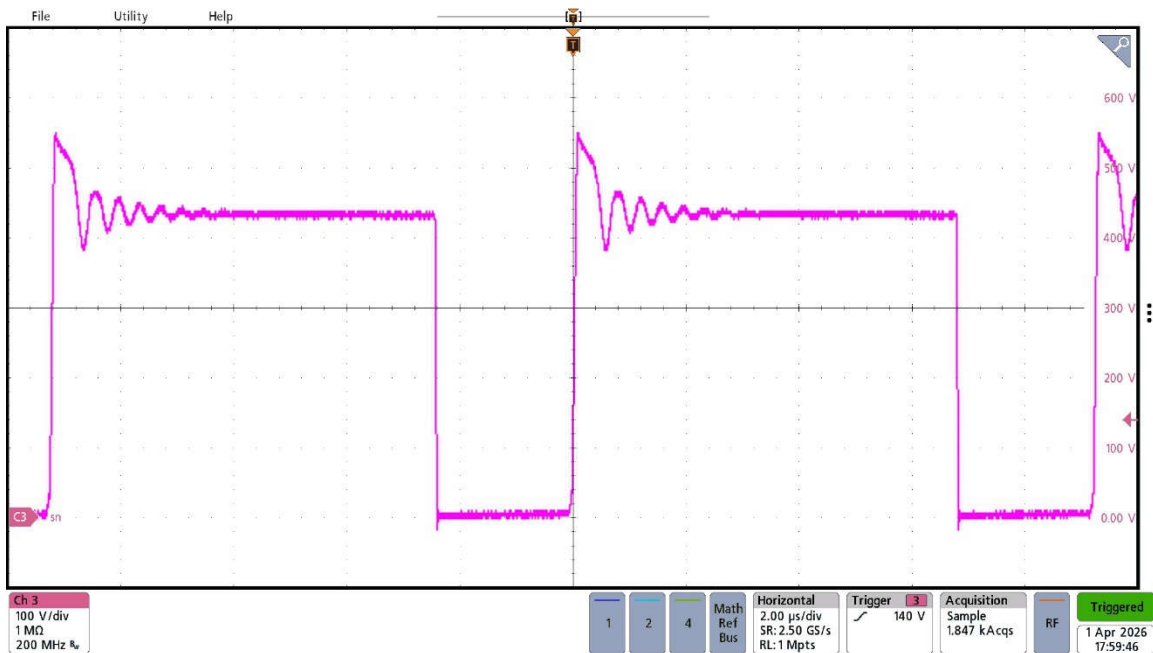


Figure 3-8. Switching with 1.25A Load (2µs/div)

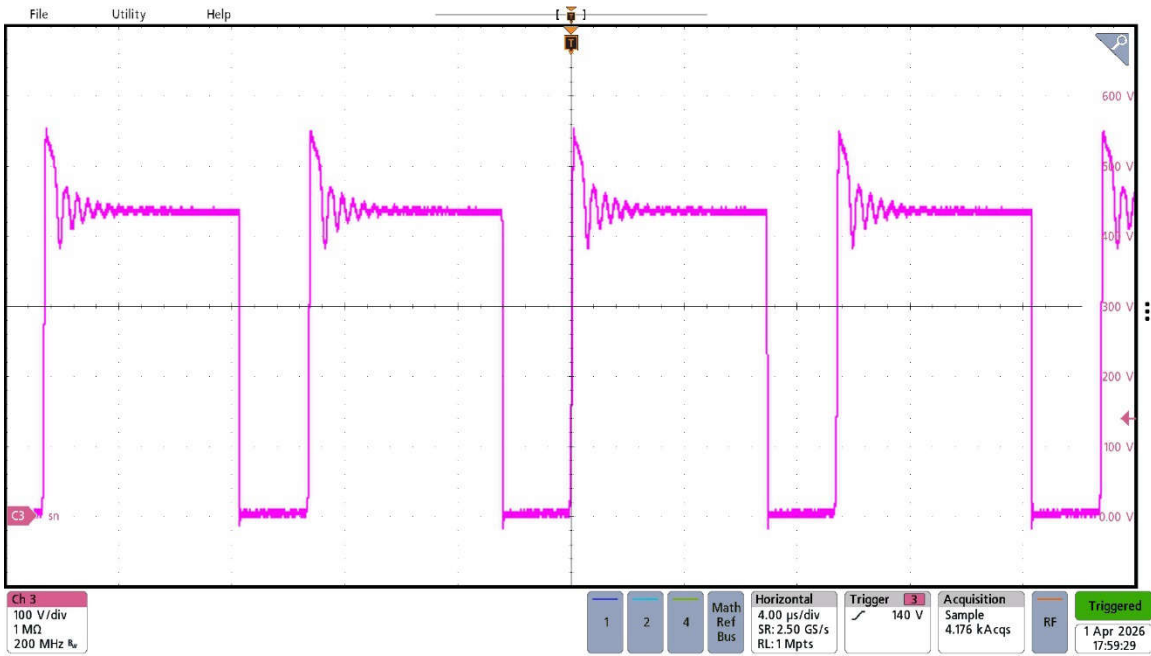


Figure 3-9. Switching with 1.25A Load (4 μ s/div)

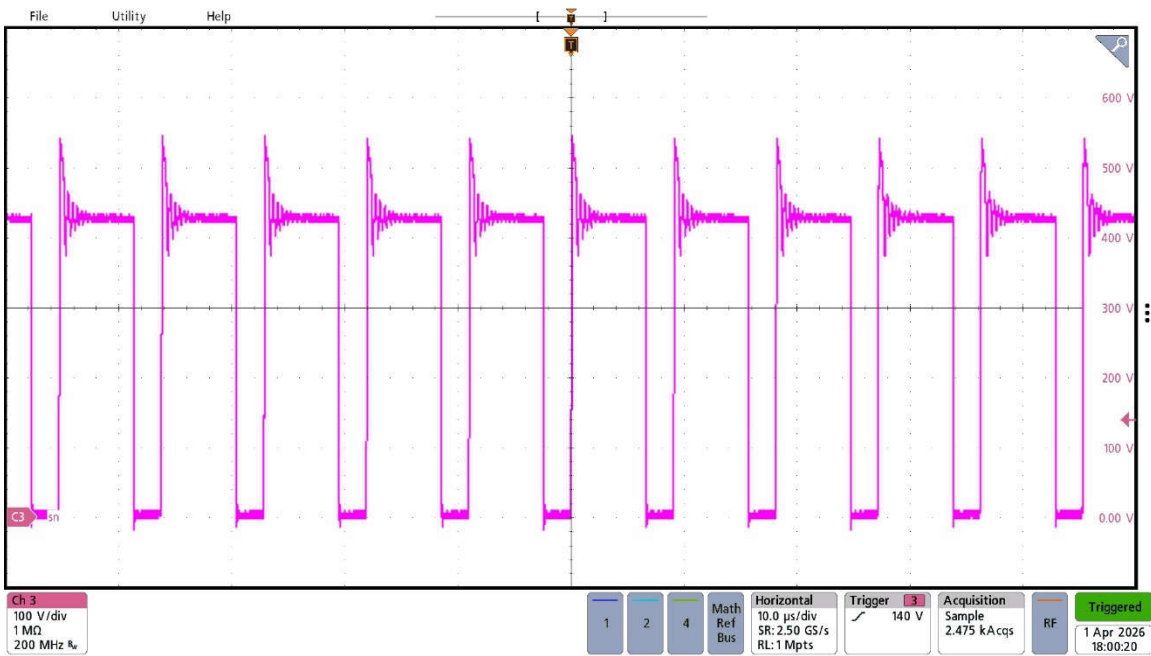


Figure 3-10. Switching with 1.25A Load (10 μ s/div)

3.2 Switching with 565V_{DC} Input Voltage

3.2.1 No Load

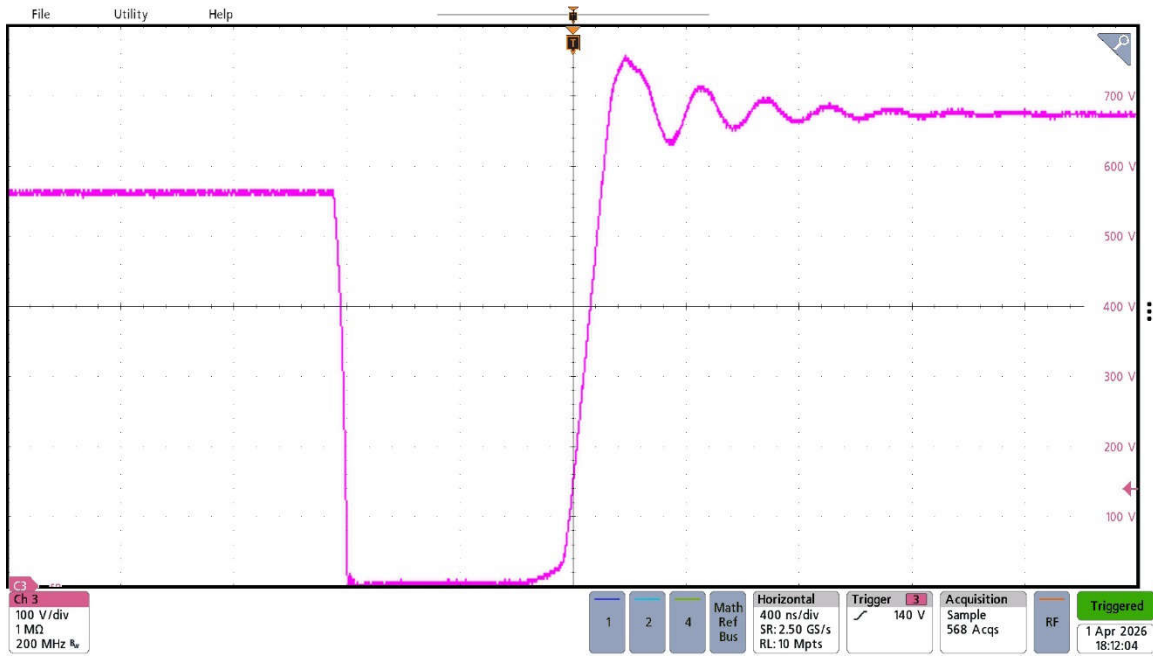


Figure 3-11. Switching with No Load (0.4 μ s/div)

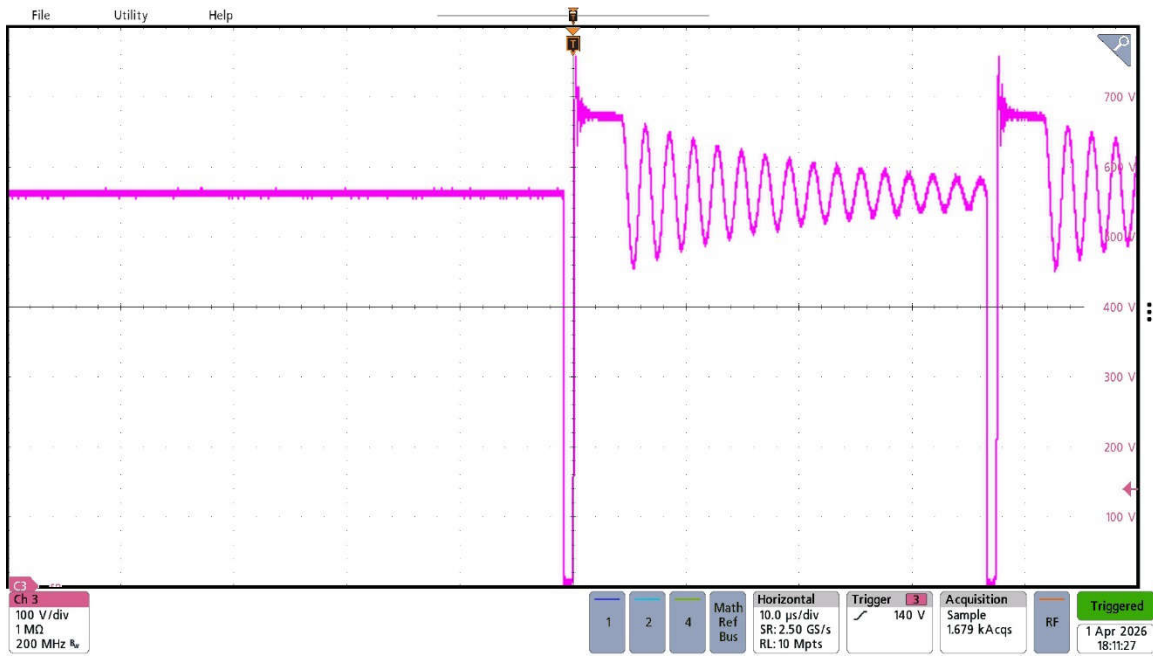


Figure 3-12. Switching with No Load (10 μ s/div)

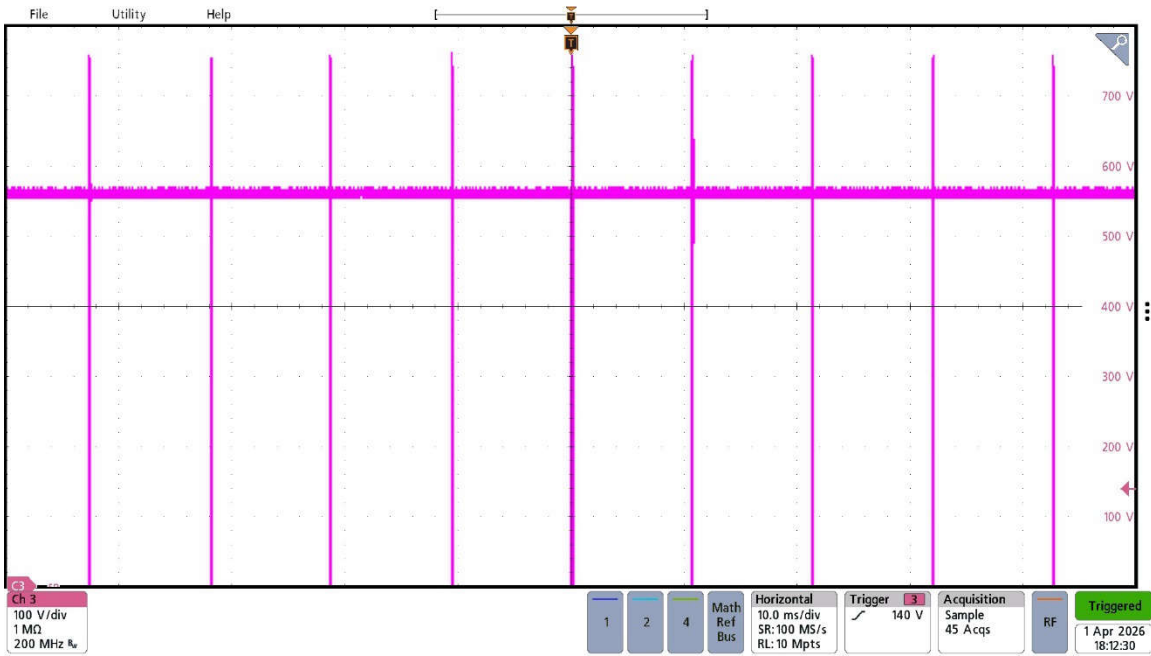


Figure 3-13. Switching with No Load (10ms/div)

3.2.2 1.25A Load Current

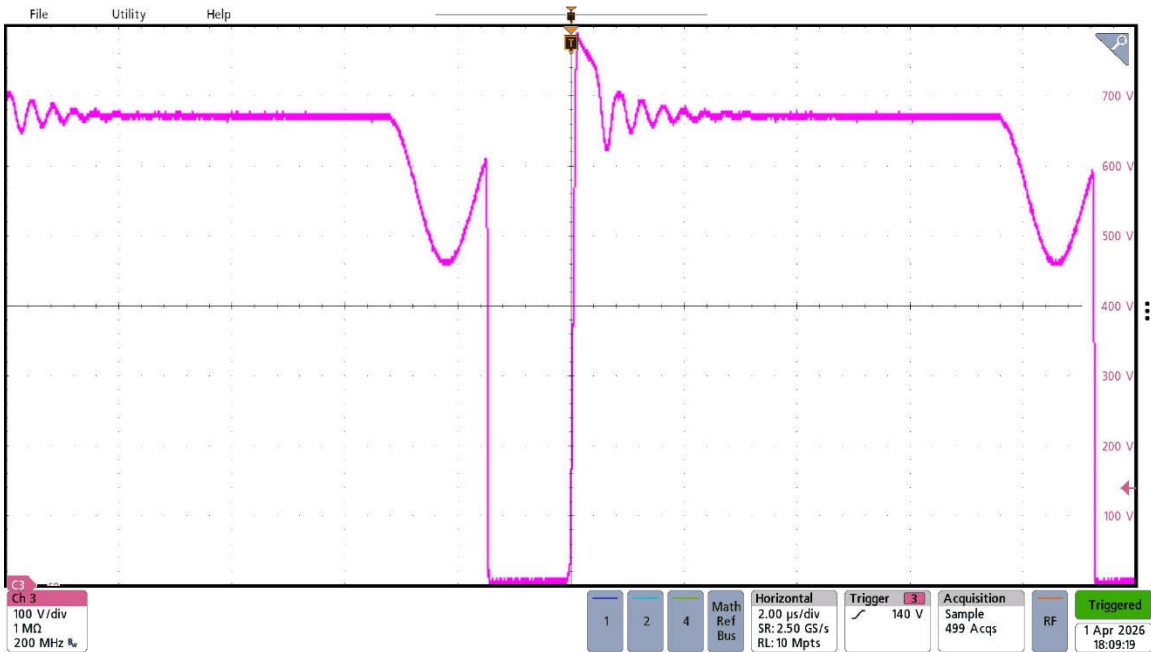


Figure 3-14. Switching 1.25A Load (2μs/div)

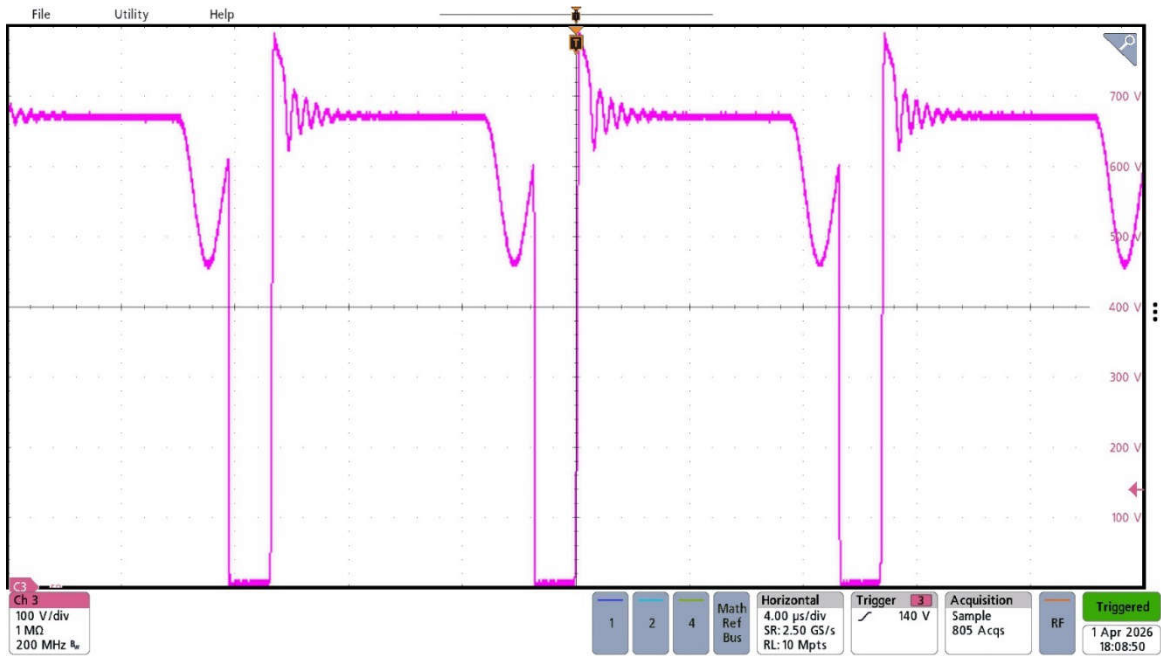


Figure 3-15. Switching 1.25A Load (4 μ s/div)

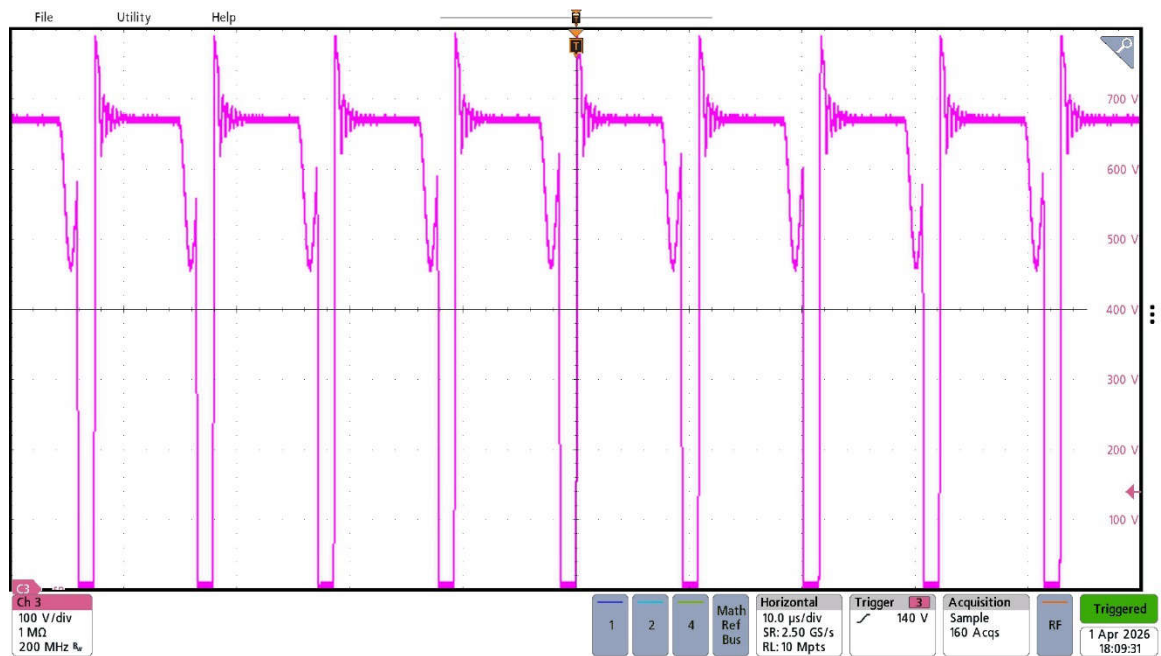


Figure 3-16. Switching 1.25A Load (10 μ s/div)

3.3 Output Voltage Ripple

3.3.1 110V_{AC} Input 1.25A Load

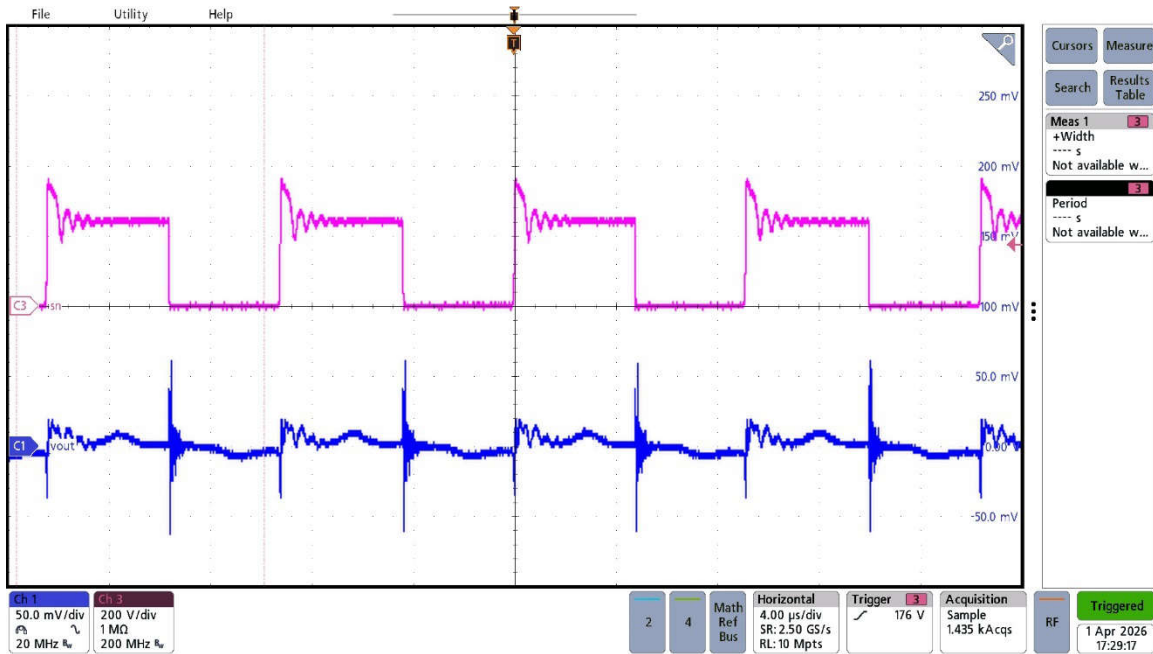


Figure 3-17. Output Voltage Ripple with 1.25A Output Current (4μs/div; 20MHz Bandwidth)

3.3.2 230V_{AC} Input 1.25A Load

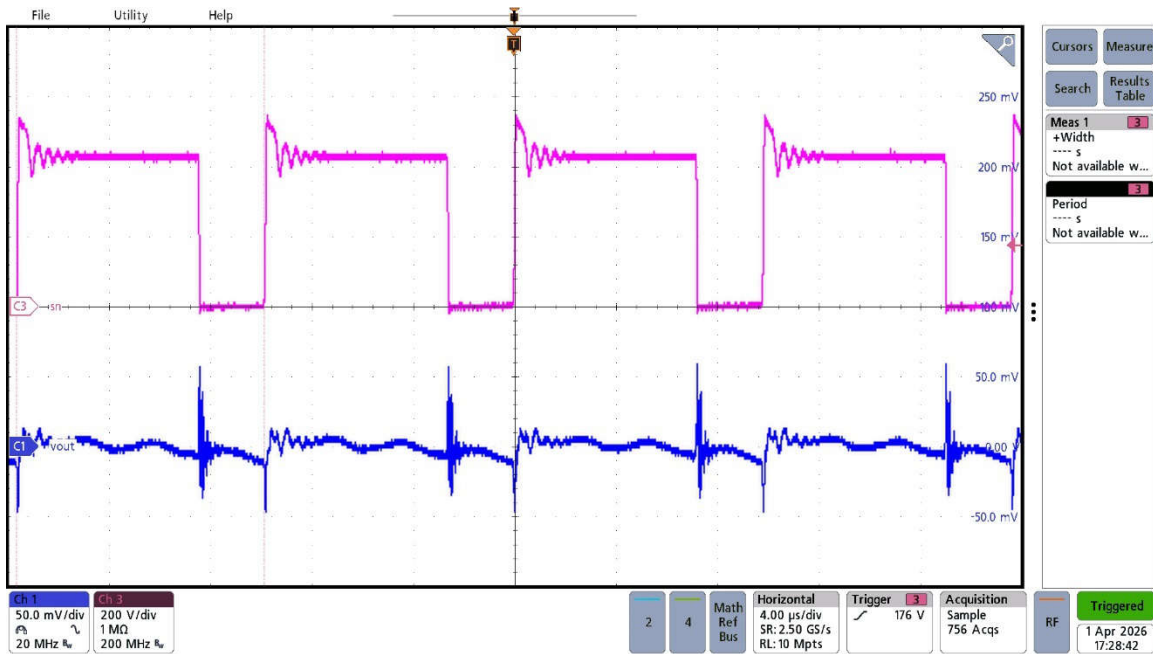


Figure 3-18. Output Voltage Ripple with 1.25A Output Current (4μs/div; 20MHz Bandwidth)

3.4 Input Ripple with 85V_{AC} / 60Hz input

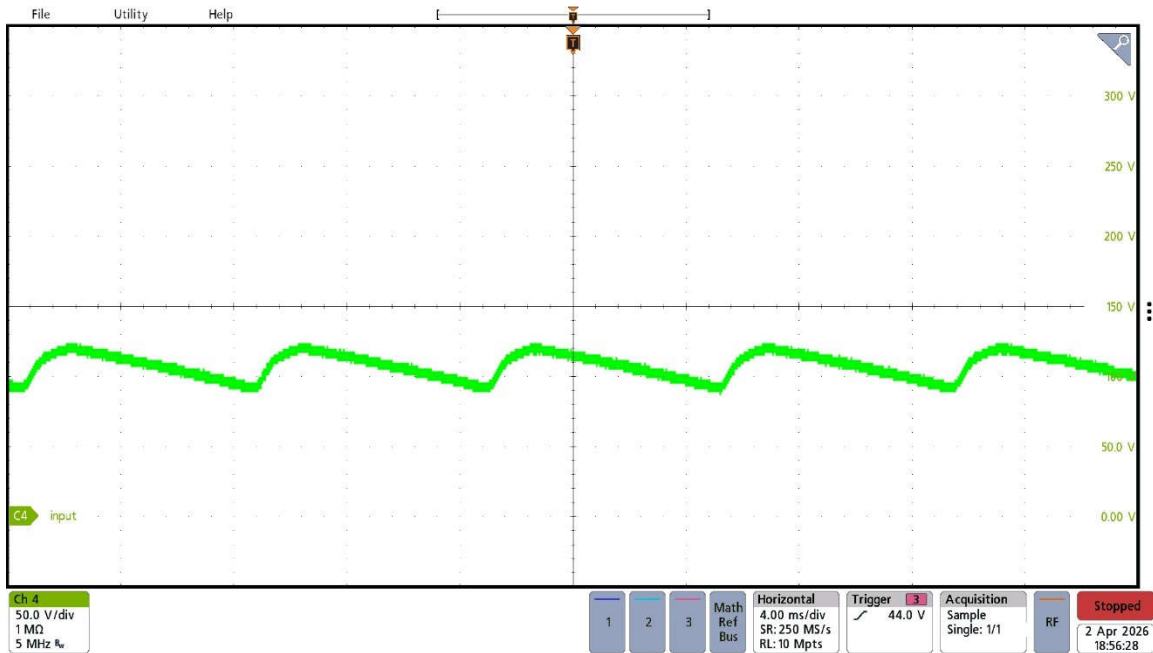


Figure 3-19. Input Voltage Ripple with 1.25A Output Current (4ms/div; 20MHz Bandwidth)

3.5 Load Transients

Load transient: 0 to 1.25A loadstep

3.5.1 85V_{AC} Input

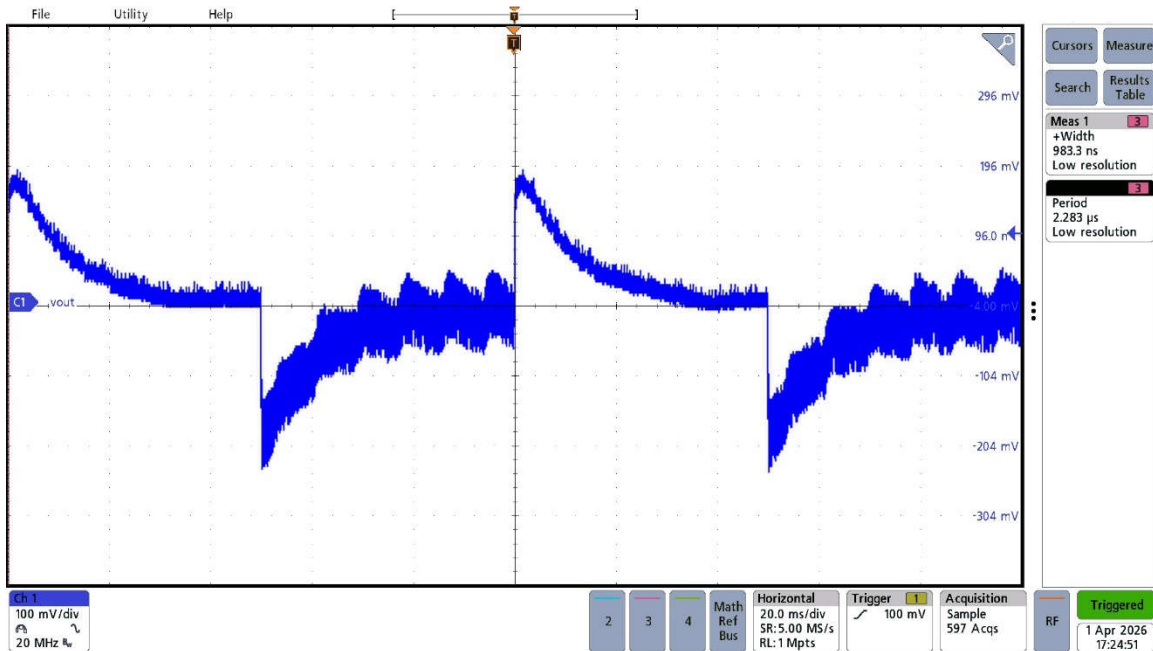


Figure 3-20. Load Transient 0A to 1.25A (100mV/div and 20ms/div)

3.5.2 273V_{AC} input

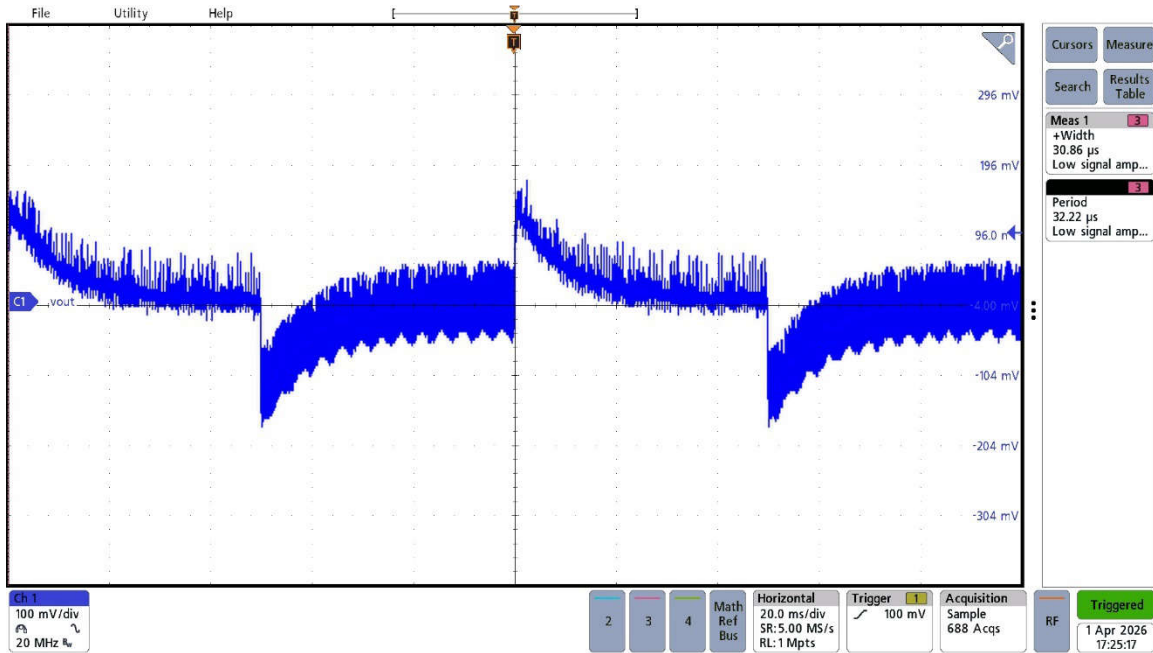


Figure 3-21. Load Transient 0A to 1.25A (100mV/div and 20ms/div)

3.6 Start-up Sequence

3.6.1 Input voltage 85V_{AC}

3.6.1.1 1.25 Load Current

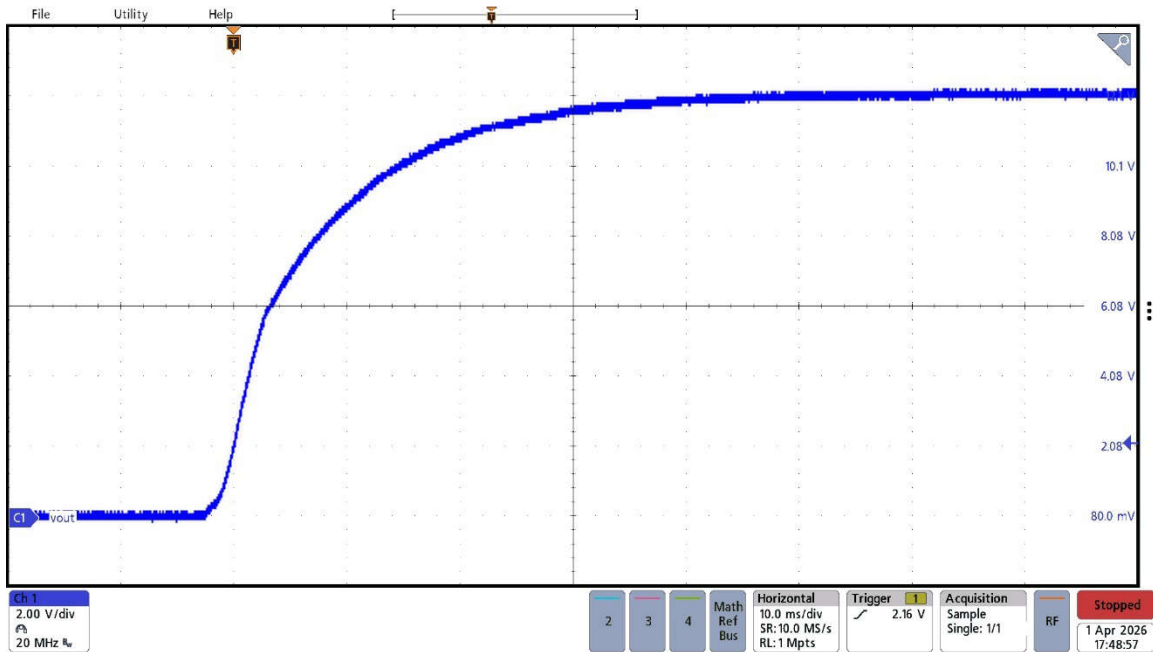


Figure 3-22. 85V_{AC} Start-up into 1.25A Output Current

3.6.1.2 No load

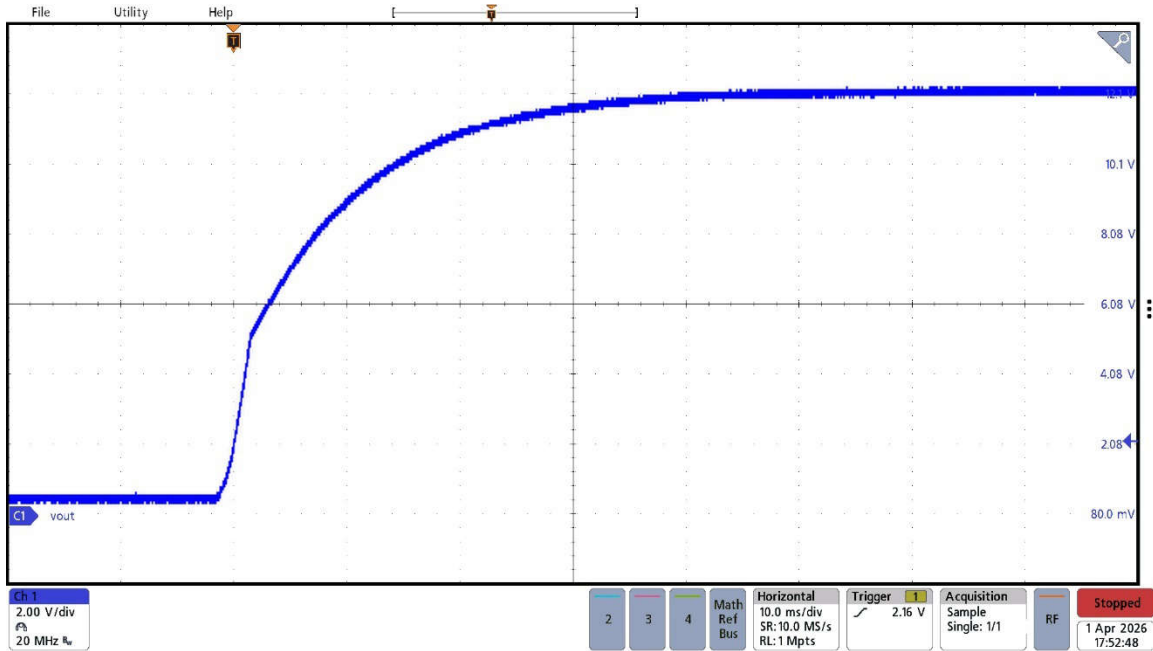


Figure 3-23. 85V_{AC} Start-up without Load

3.6.2 Input voltage 272V_{AC}

3.6.2.1 1.25A Load Current

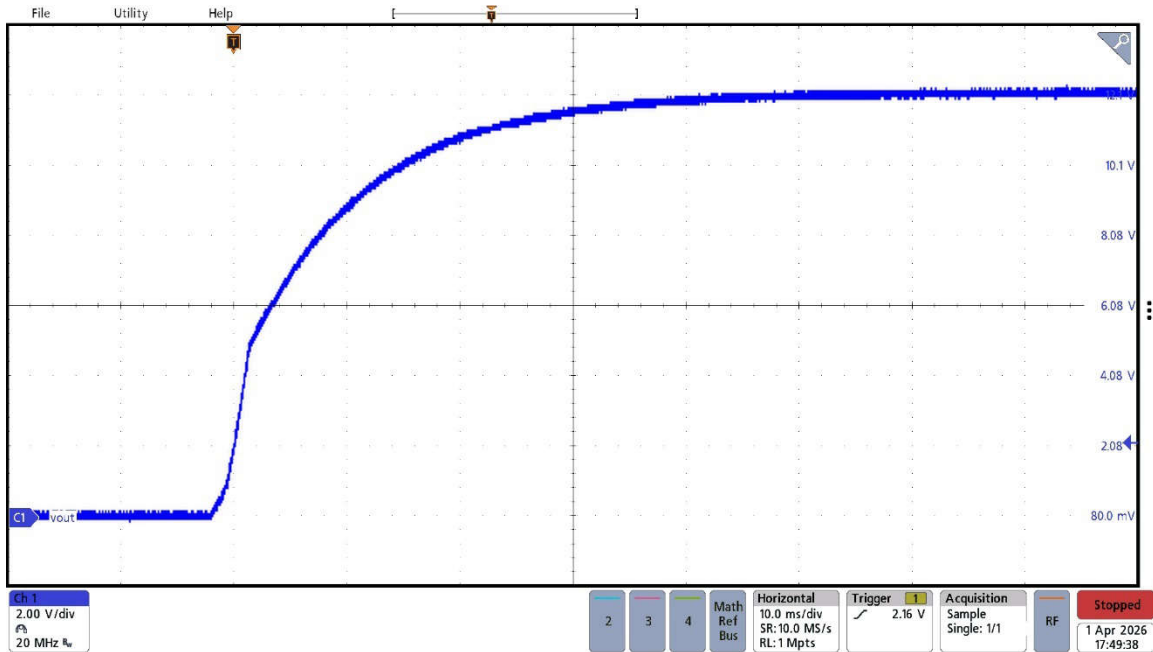


Figure 3-24. 272V_{AC} Start-up into 1.25A Output Current

3.6.2.2 No Load

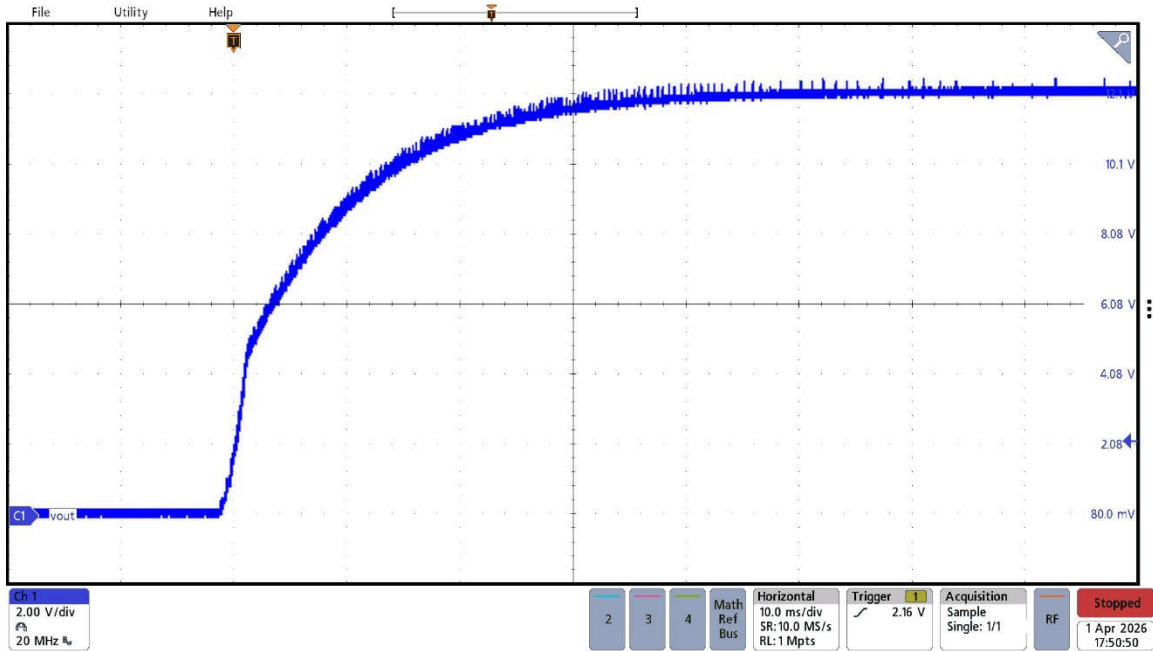


Figure 3-25. 272V_{AC} Start-up without Load

3.7 Shutdown Sequence

3.7.1 Input Voltage 230V_{AC}

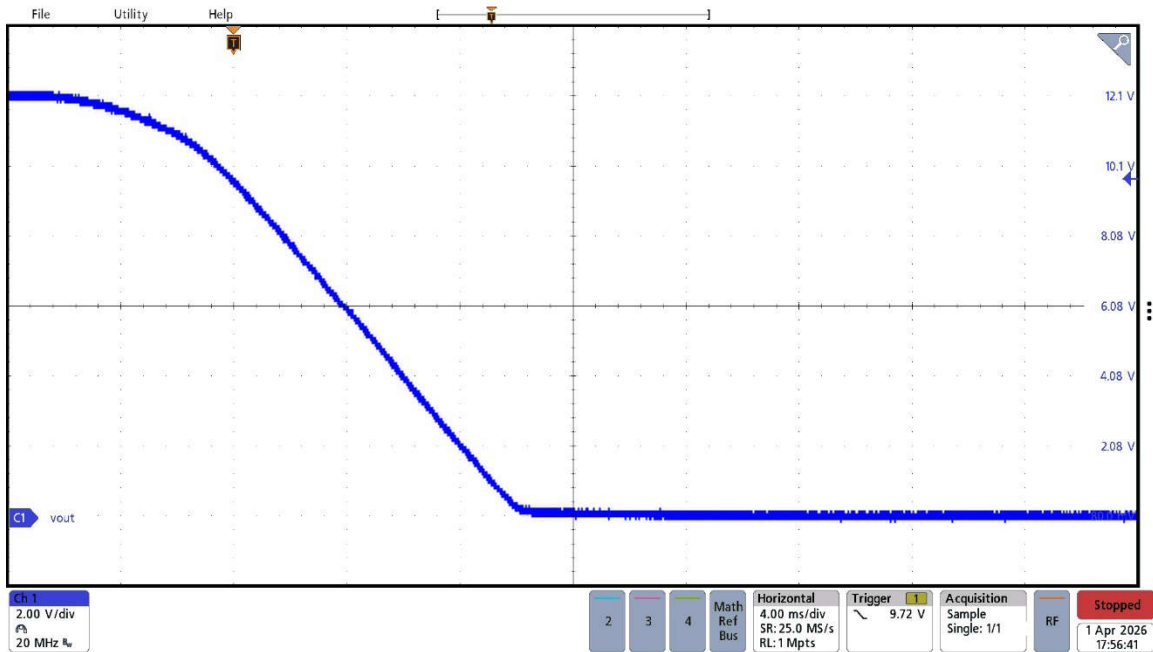


Figure 3-26. Shutdown from 1.25A Output Current

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Last updated 10/2025