

## Test Report: PMP22144

# 15-W Wide-Input Flyback Reference Design



### Description:

This reference design uses a UCC28742 flyback controller and an ATL432LI shunt reference to produce an isolated 24-V output capable of 0.625-A from an 85-V to 480-Vac input. All components are placed on one side of the board to reduce assembly complexity and cost. The design can achieve 80% efficiency across various input conditions.

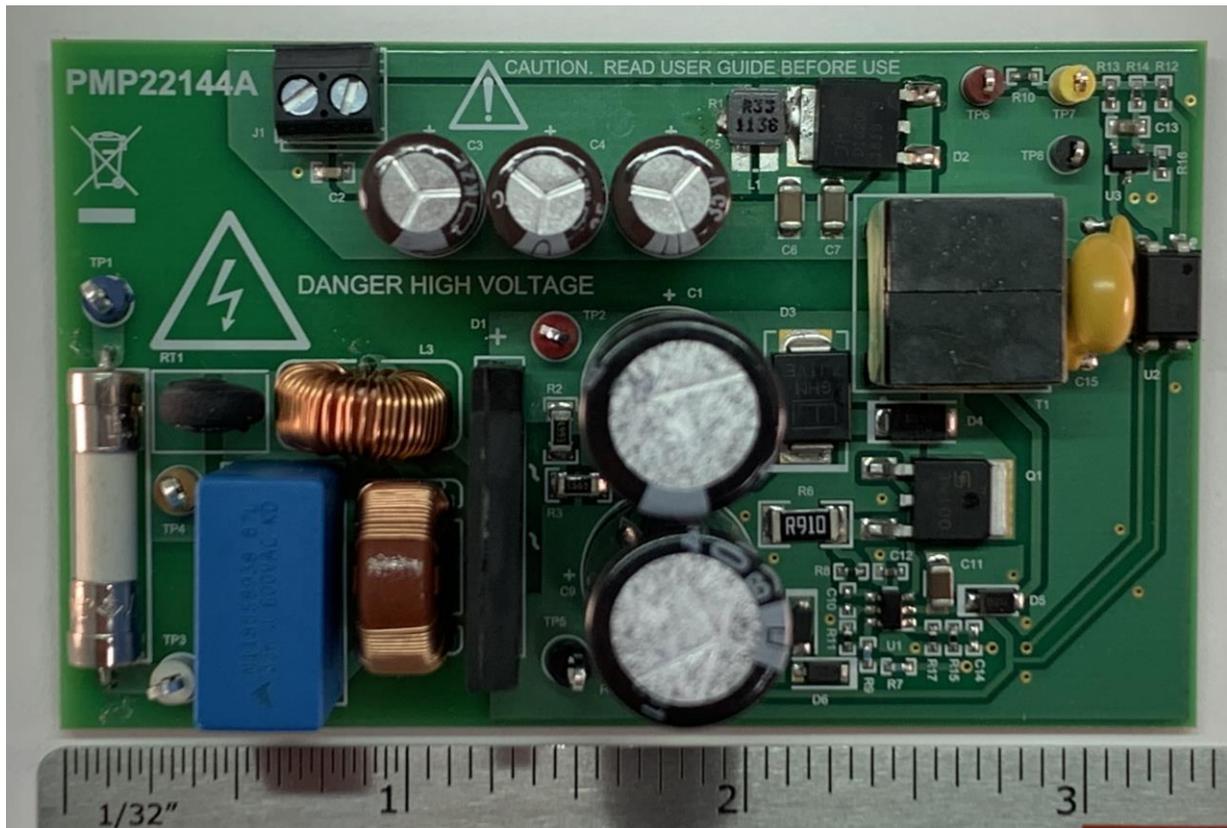


Figure 1. Board Top



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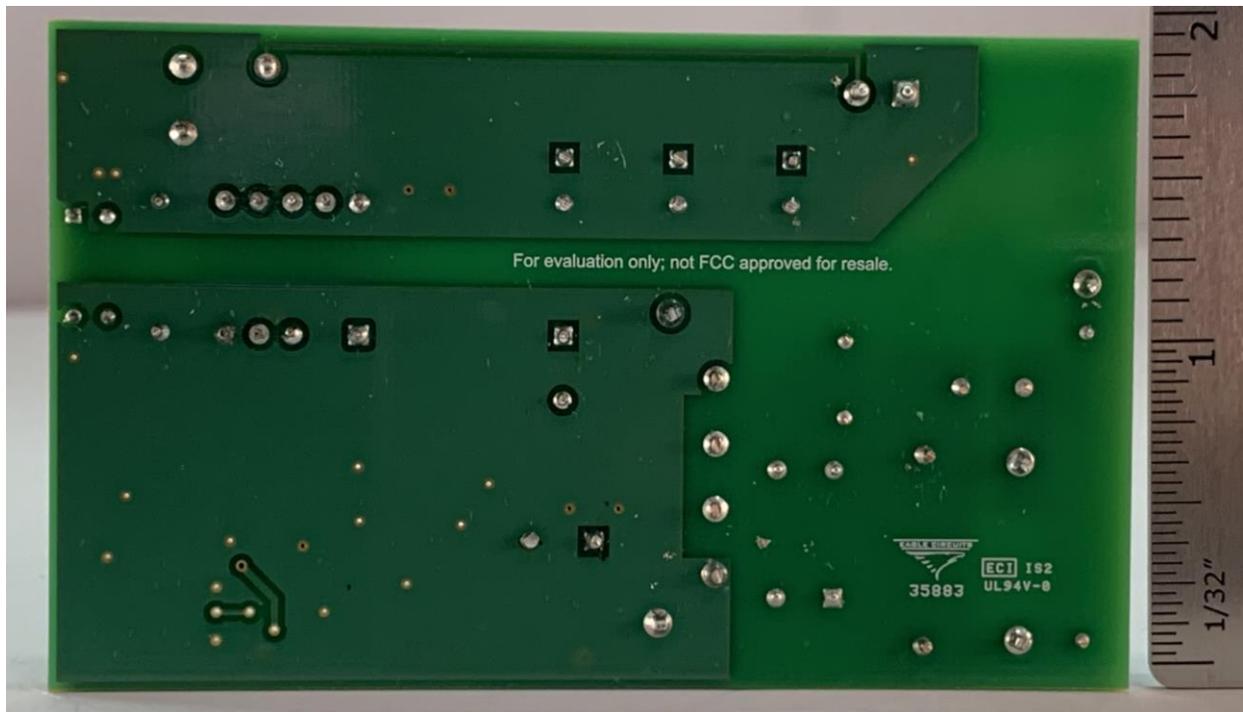


Figure 2. Board Bottom

## 1 Flyback Stage

### 1.1 Test Prerequisites

#### 1.1.1 Voltage and Current Requirements

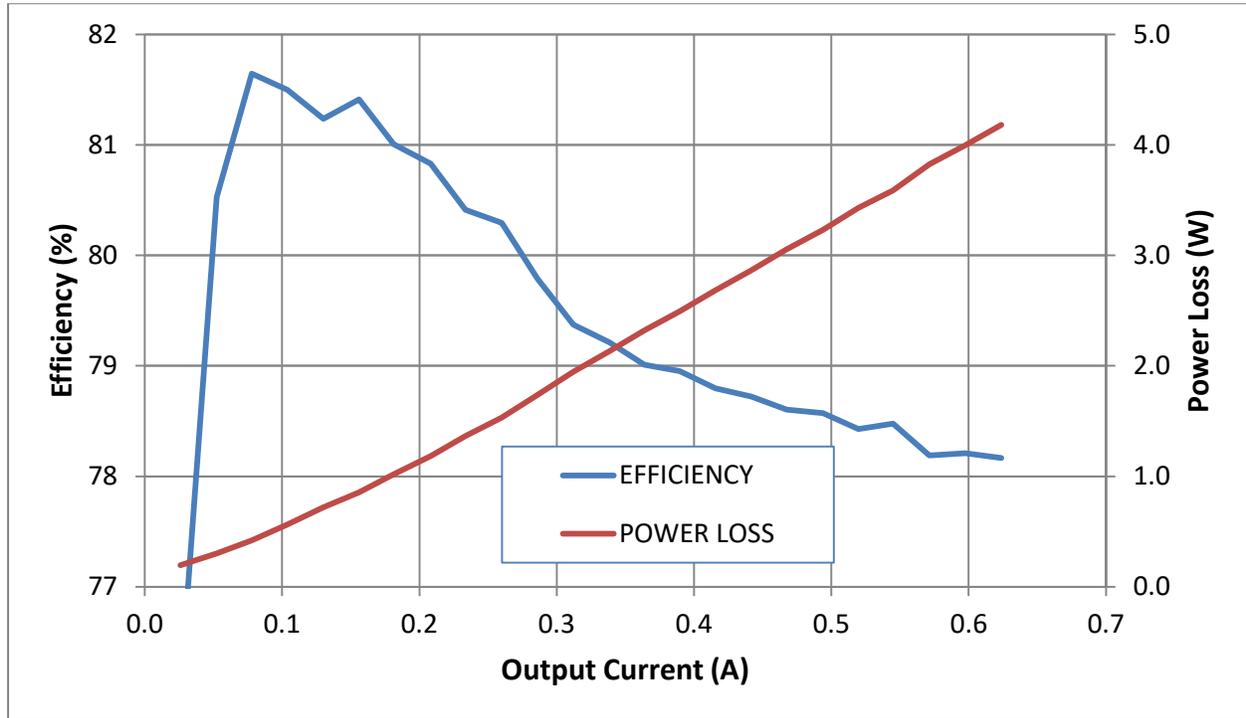
PARAMETER	SPECIFICATIONS
Input Voltage Range	85 Vac – 480 Vac
Output Voltage	24 V +/- 0.5%
Output Current	0.625 A
Switching Frequency	60 kHz

#### 1.1.2 Considerations

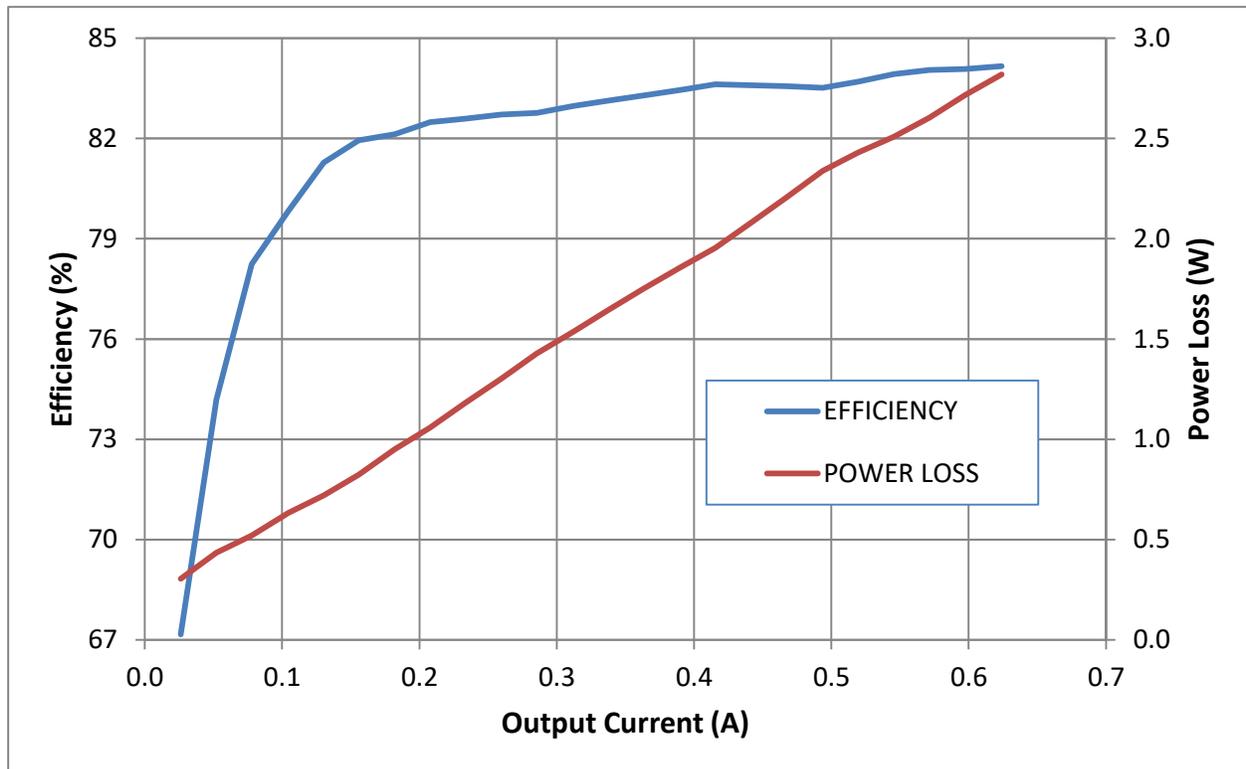
- 1) For all tests an electronic load was used.
- 2) 620 Vdc measurements were taken using TP2 and TP5 across the bulk capacitance.

## 1.2 Testing and Results

### 1.2.1 Efficiency Graphs



**Figure 3.** Efficiency and Power Loss for a 90 Vac input



**Figure 4.** Efficiency and Power Loss for a 120 Vac input

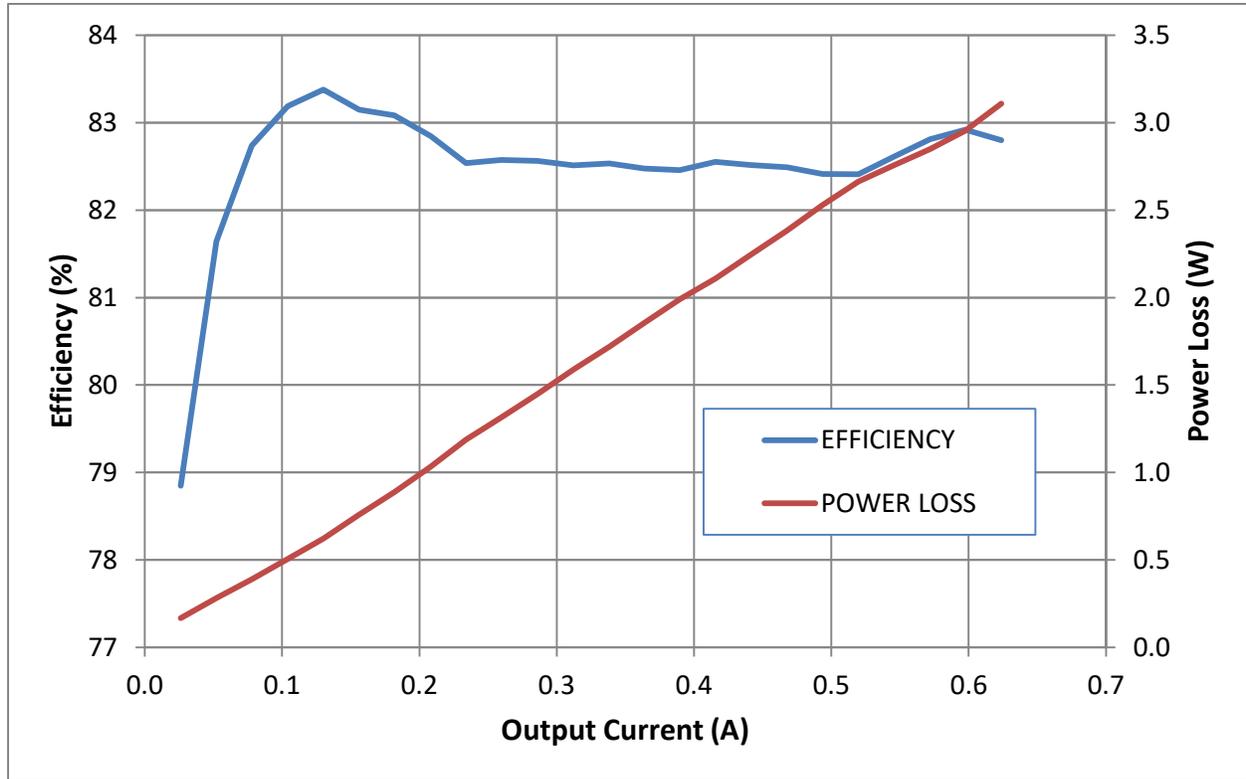


Figure 5. Efficiency and Power Loss for a 230 Vac input

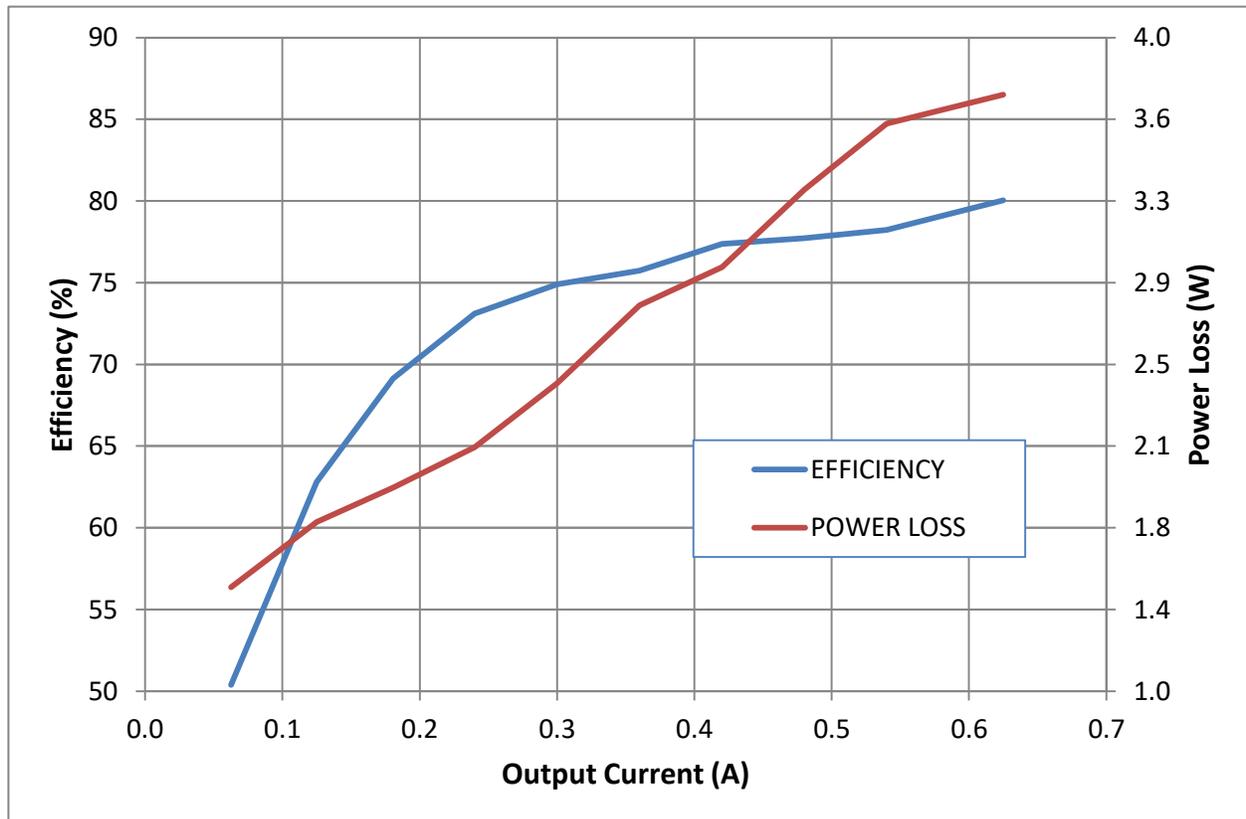


Figure 6. Efficiency and Power Loss for a 620 Vac input

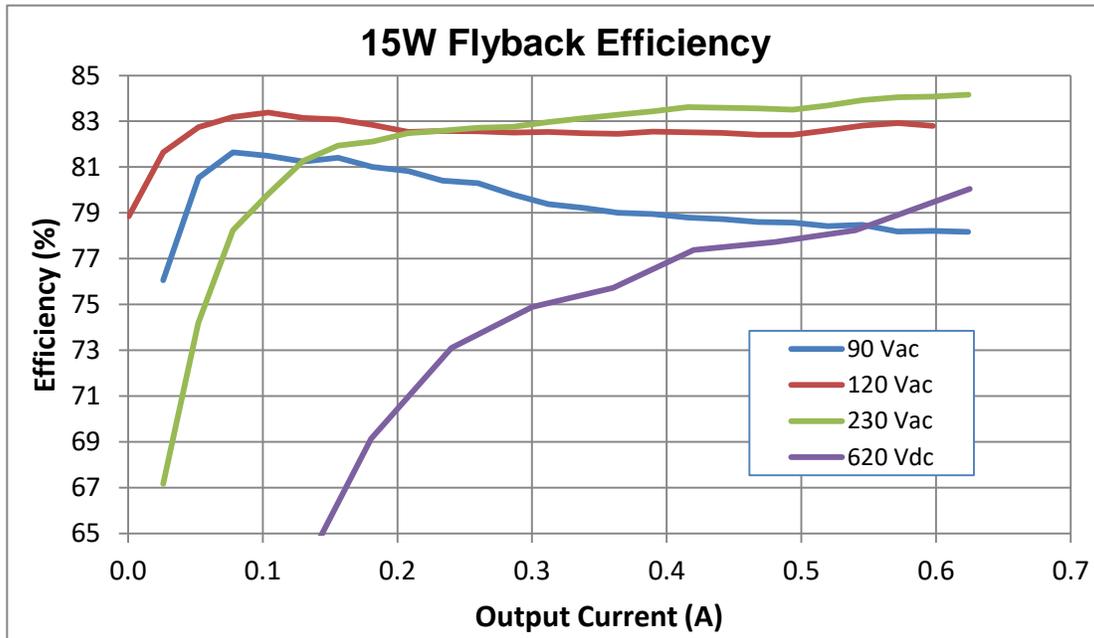


Figure 7. Comparison of efficiency curves for different input conditions

### 1.2.2 Efficiency Data

Input Voltage Source	Input Power (W)	Output Voltage (V)	Output Current (A)	Output Power (W)	Power Loss (W)	Efficiency (%)
90 Vac	3.05	23.99	0.10	2.49	0.56	81.50
	6.96	23.99	0.23	5.60	1.36	80.41
	11.05	23.99	0.36	8.73	2.32	79.01
	15.08	23.99	0.49	11.85	3.23	78.58
	19.15	23.99	0.62	14.97	4.18	78.17
120 Vac	3.01	24.00	0.10	2.50	0.51	83.19
	6.81	24.00	0.23	5.62	1.19	82.54
	10.59	24.00	0.36	8.73	1.86	82.48
	14.37	24.00	0.49	11.84	2.53	82.41
	18.08	24.00	0.62	14.97	3.11	82.80
230 Vac	3.14	24.00	0.10	2.51	0.63	79.83
	6.79	24.00	0.23	5.61	1.18	82.59
	10.47	24.00	0.36	8.72	1.75	83.28
	14.18	24.00	0.49	11.85	2.34	83.51
	17.79	24.00	0.62	14.97	2.82	84.16
620 Vdc	4.78	24.00	0.13	3.00	1.78	62.80
	7.88	24.00	0.24	5.76	2.12	73.10
	11.41	24.00	0.36	8.64	2.77	75.73
	14.83	24.00	0.48	12.96	3.30	77.72
	18.73	23.99	0.63	15.00	3.74	80.05

Figure 8. Efficiency data from light load, one quarter load, half load, third quarter load, and full load

### 1.2.3 Thermal Images

A thermal image was taken after 15 minutes of running with the output at 0.625 A (100% load), without airflow.

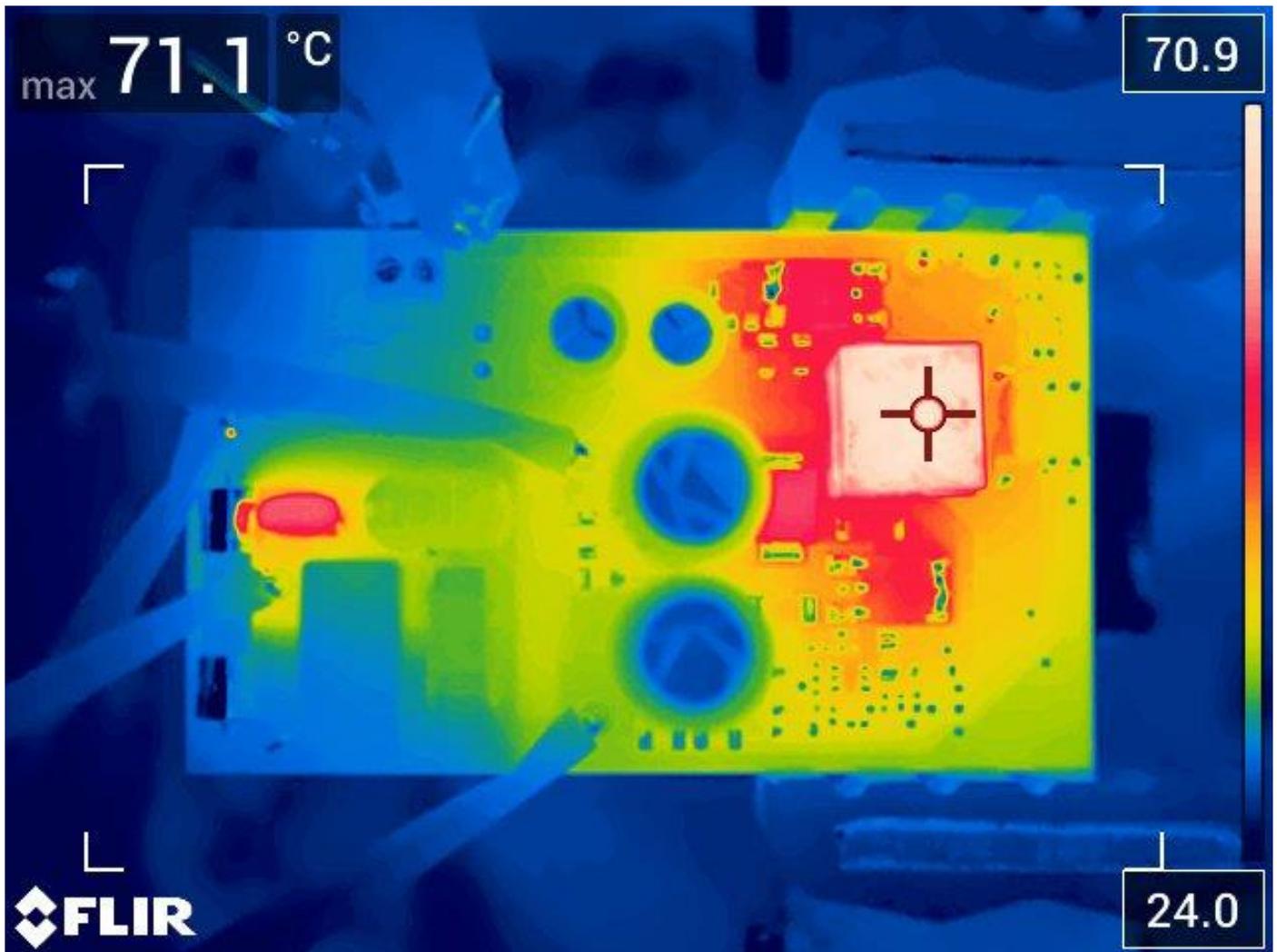
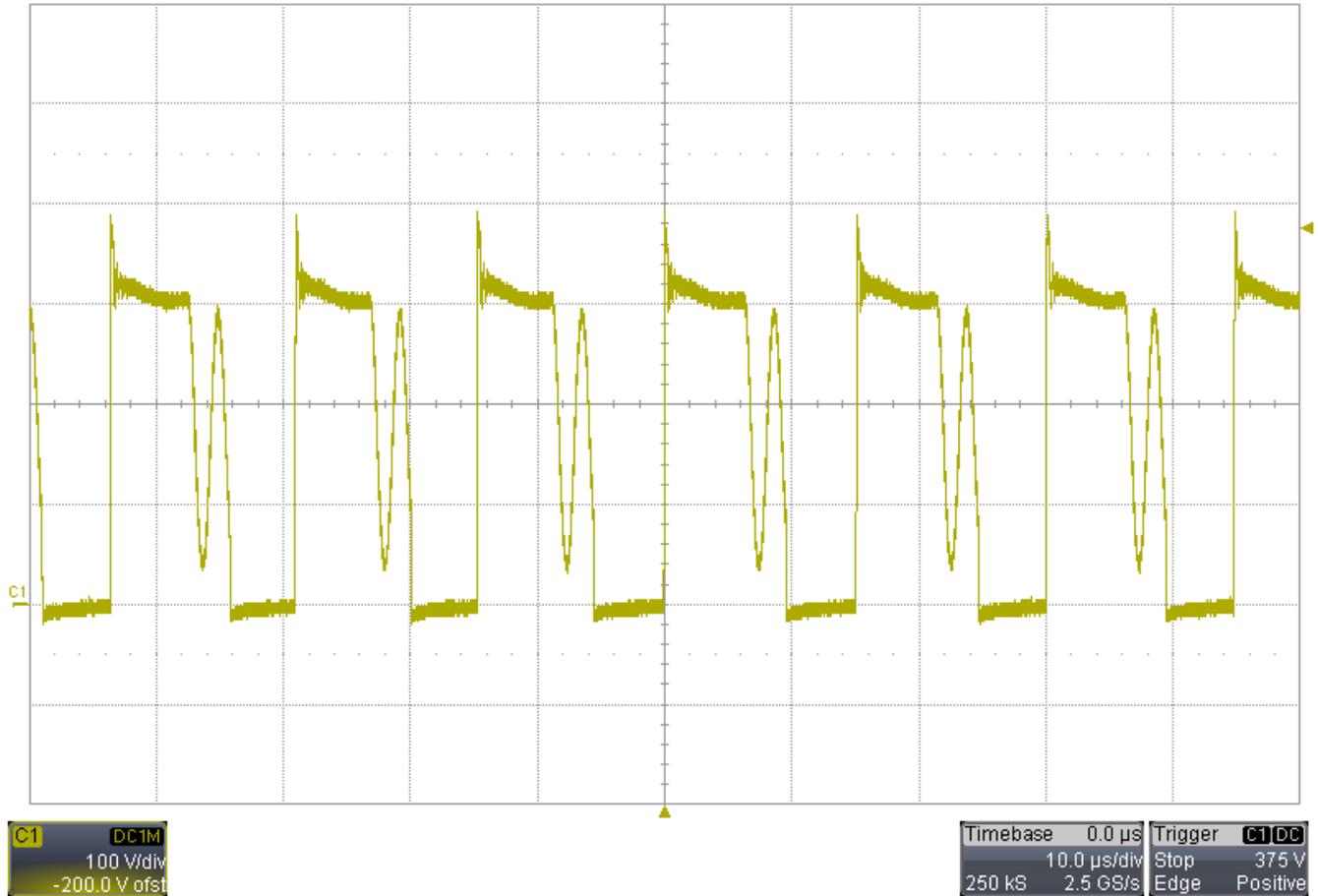


Figure 9. Board top thermal image

### 1.3 Waveforms

#### 1.3.1 Switching

The switch node was measured at both the primary and secondary side at full load. The secondary side was measured using two probes at each side of the diode (D2) and the math function.



**Figure 10.** Primary Switch Node at 120 Vac Input

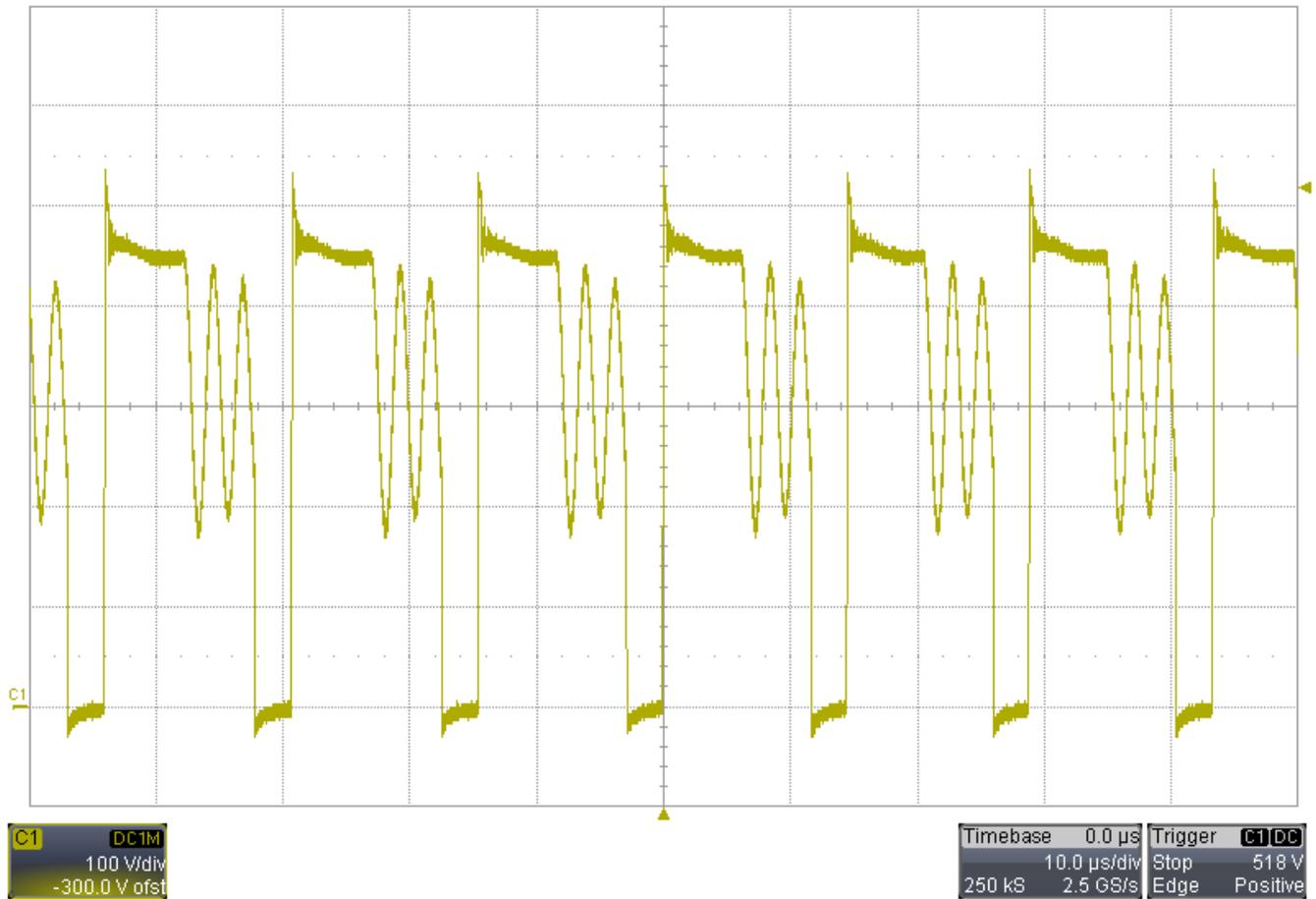


Figure 11. Primary Switch Node at 230 Vac Input

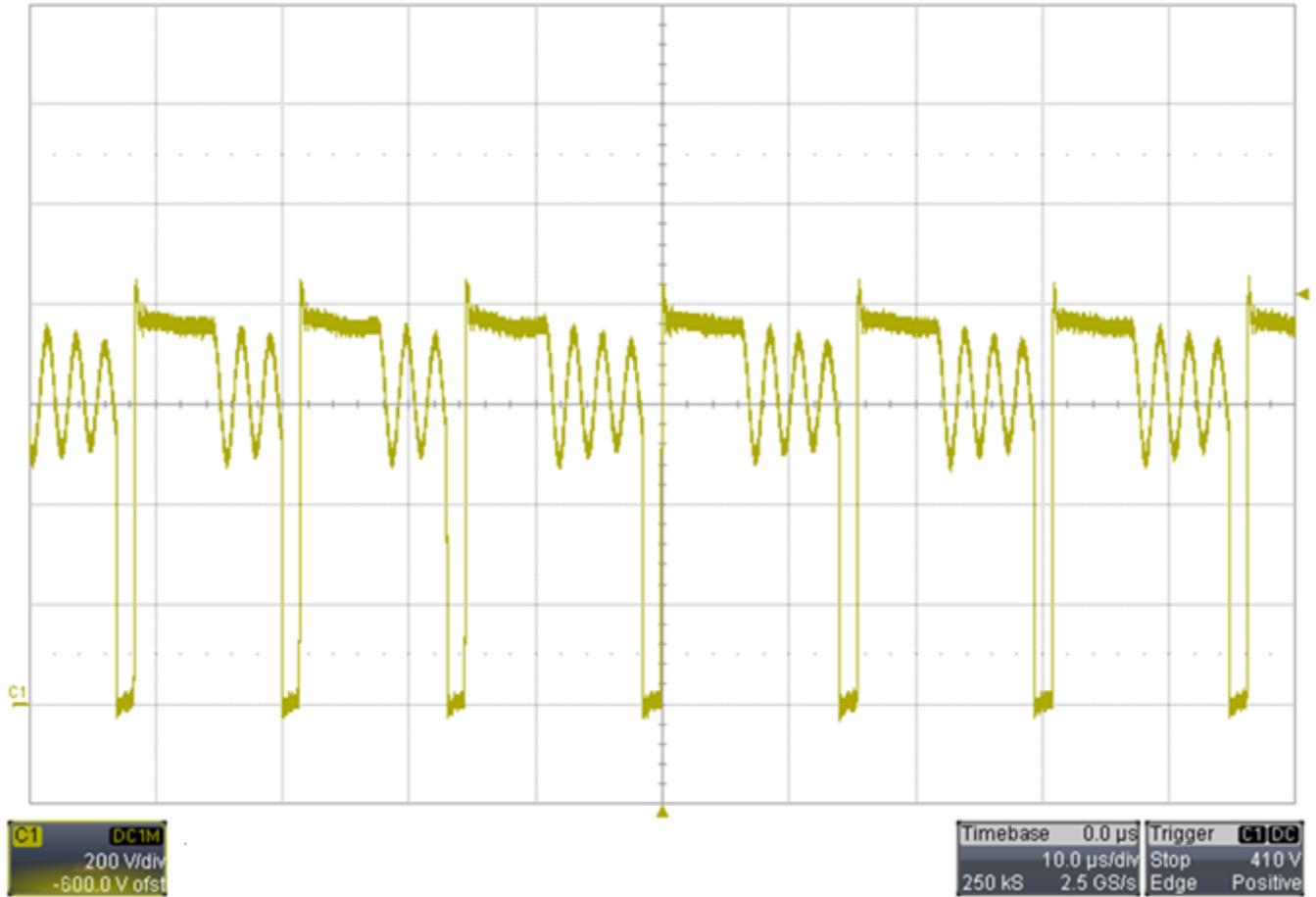


Figure 12. Primary Switch Node at 620 Vdc Input.

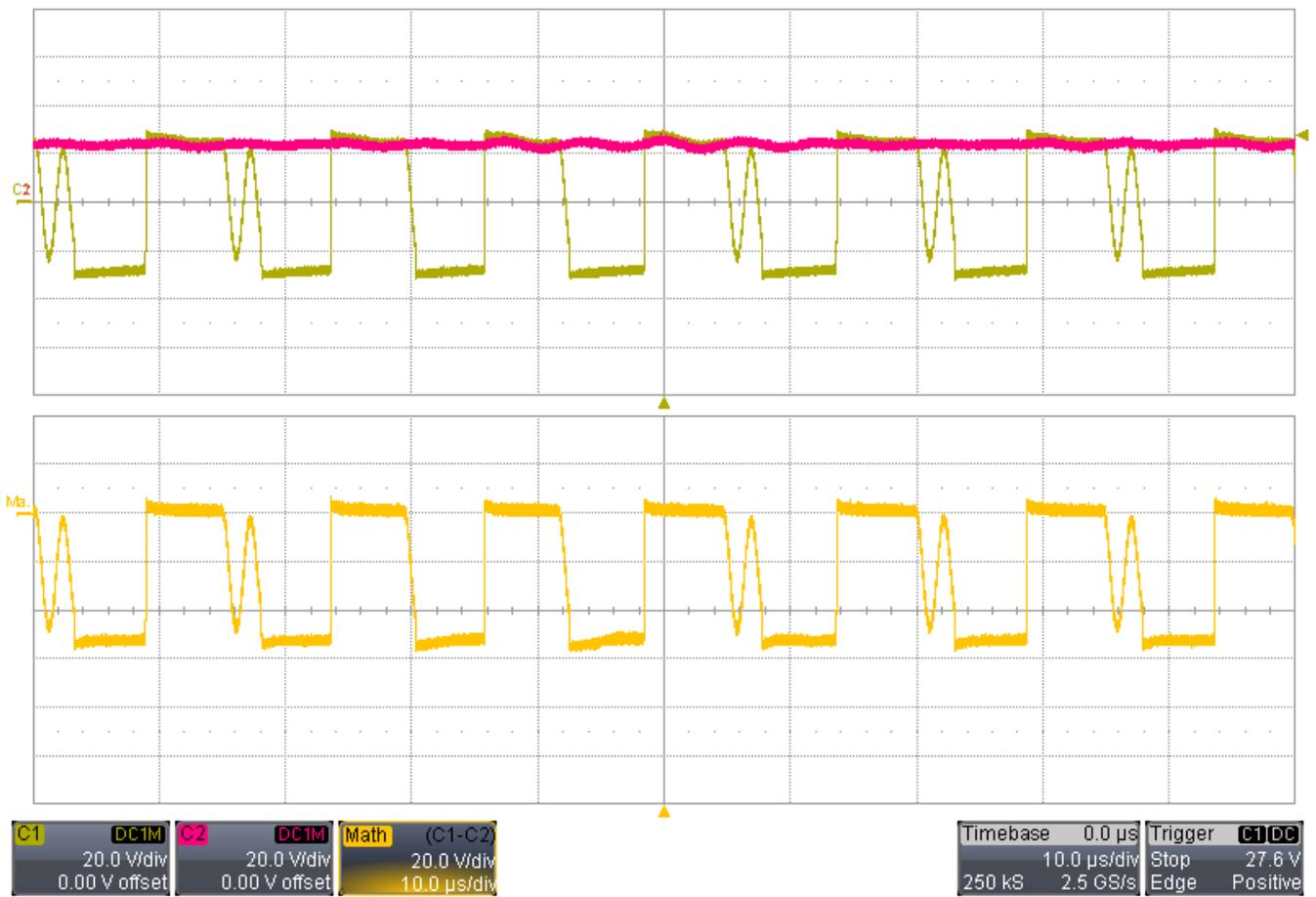


Figure 13. Secondary Switch Node at 120 Vac Input

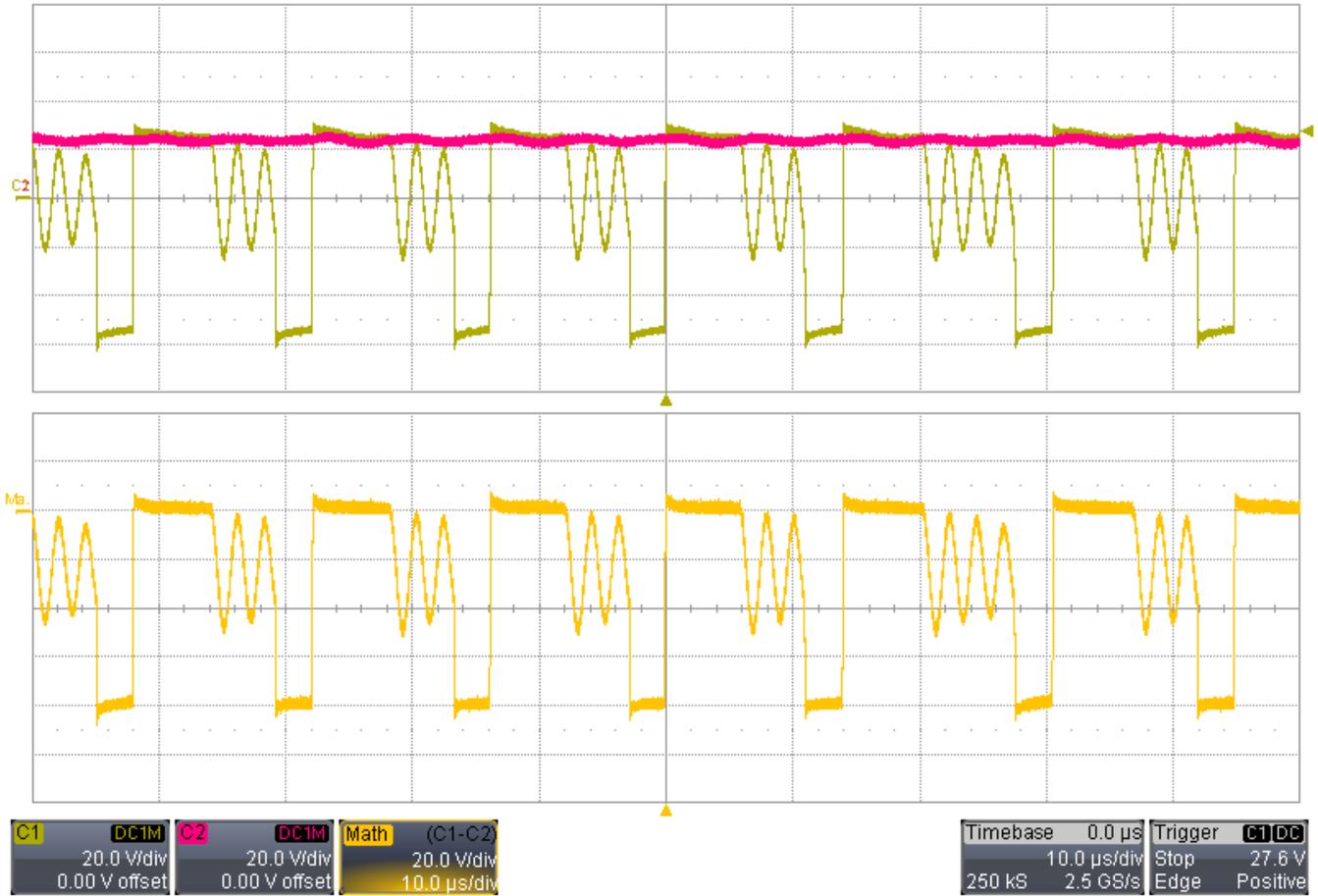


Figure 14. Secondary Switch Node at 230 Vac Input

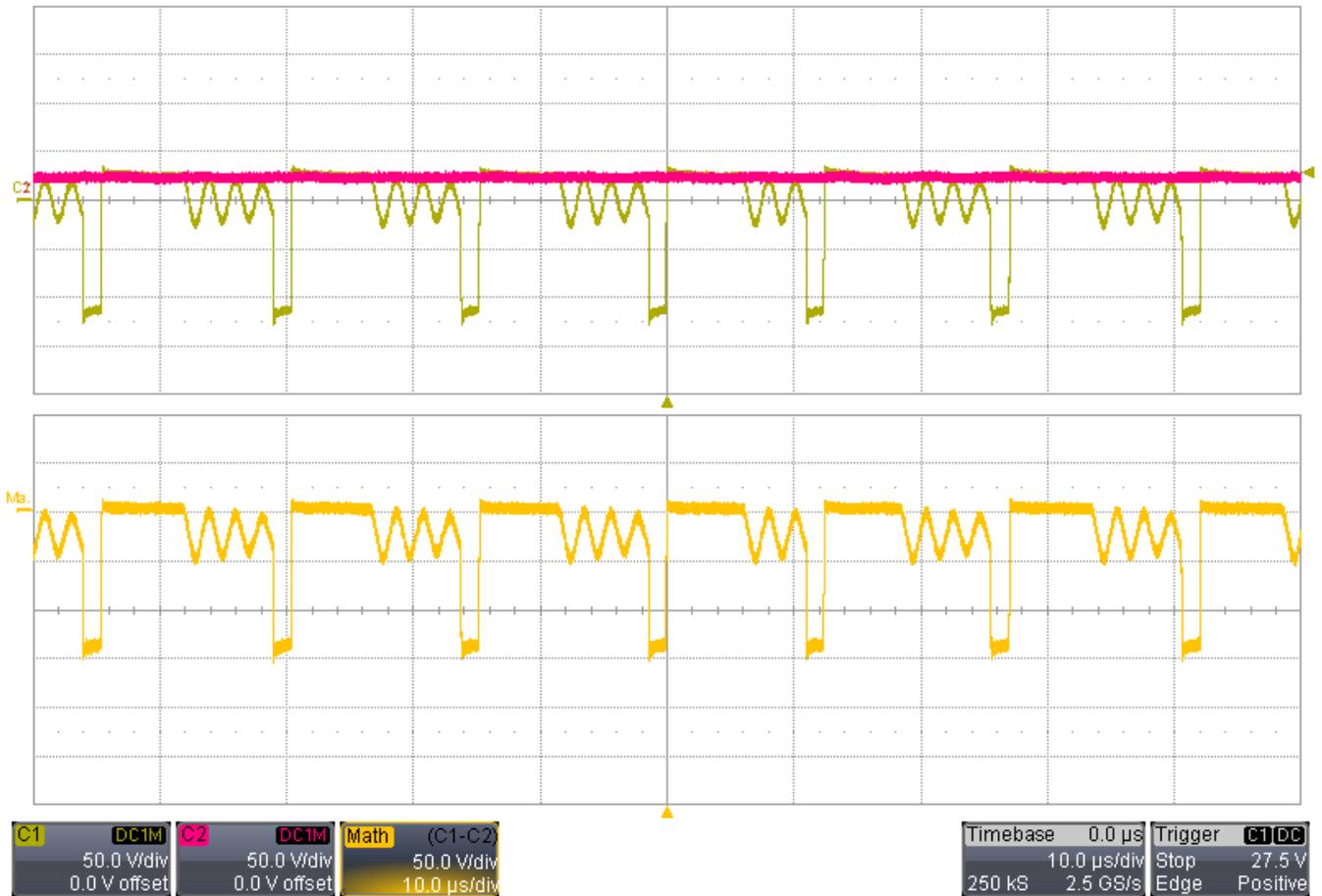
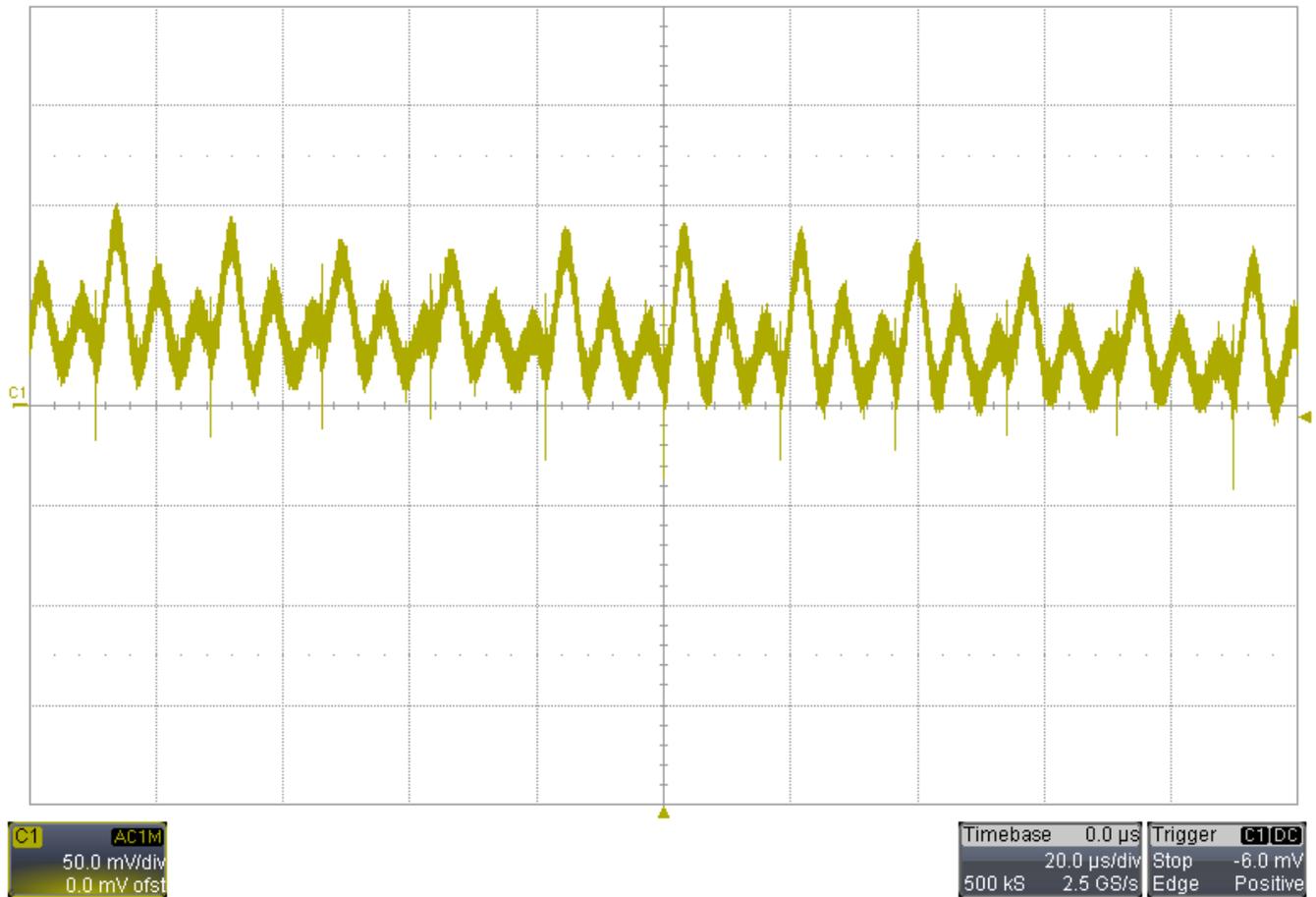


Figure 15. Secondary Switch Node at 620 Vdc Input

### 1.3.2 Output Voltage Ripple

Measurements were taken using the tip and barrel method across the output capacitor (C2) with the output at full load.



**Figure 16.** Output Ripple at 90 Vac Input

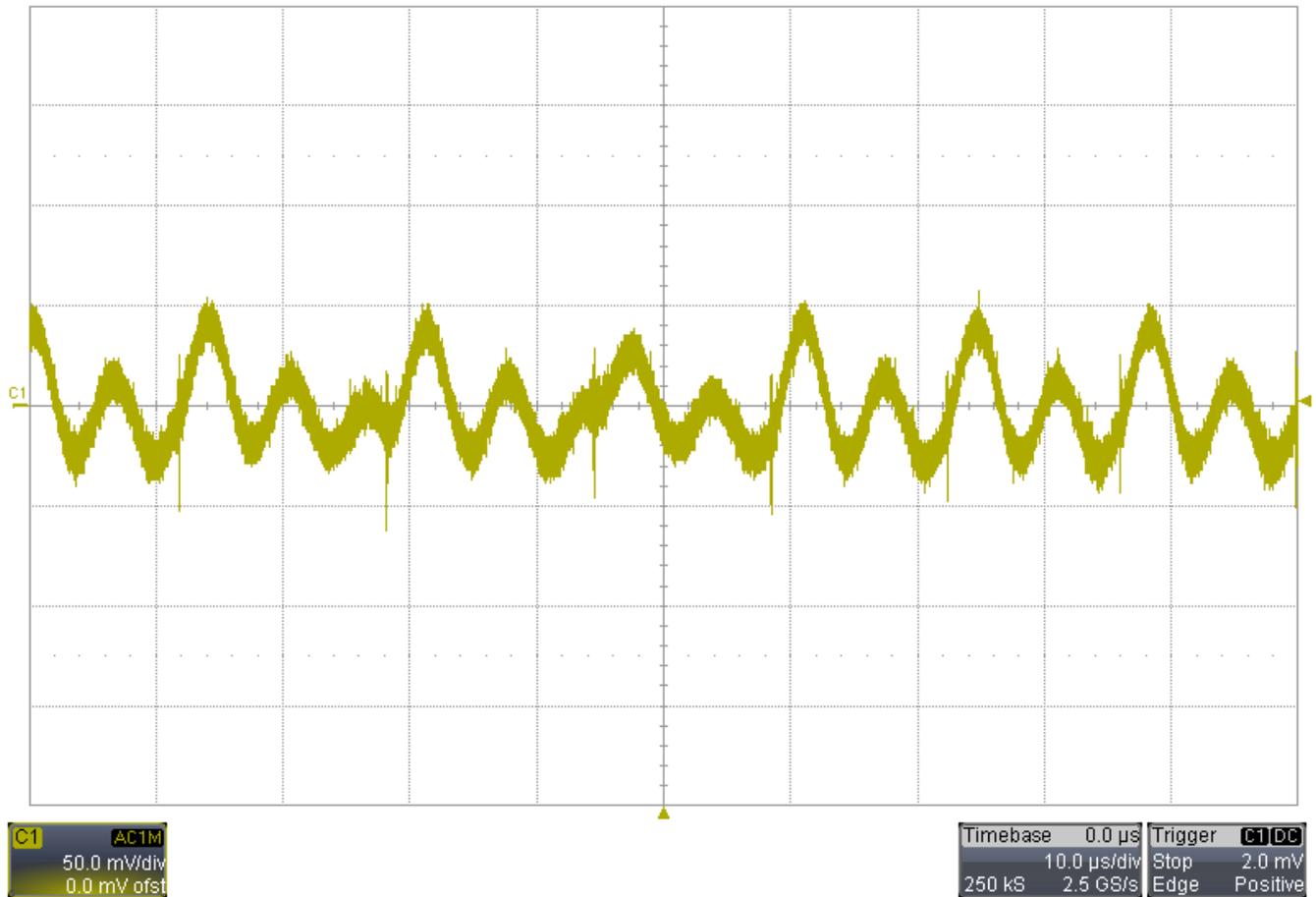


Figure 17. Output Ripple at 230 Vac Input

### 1.3.3 Load Transients

The output voltage (AC coupled) was measured across the output capacitor (C2).

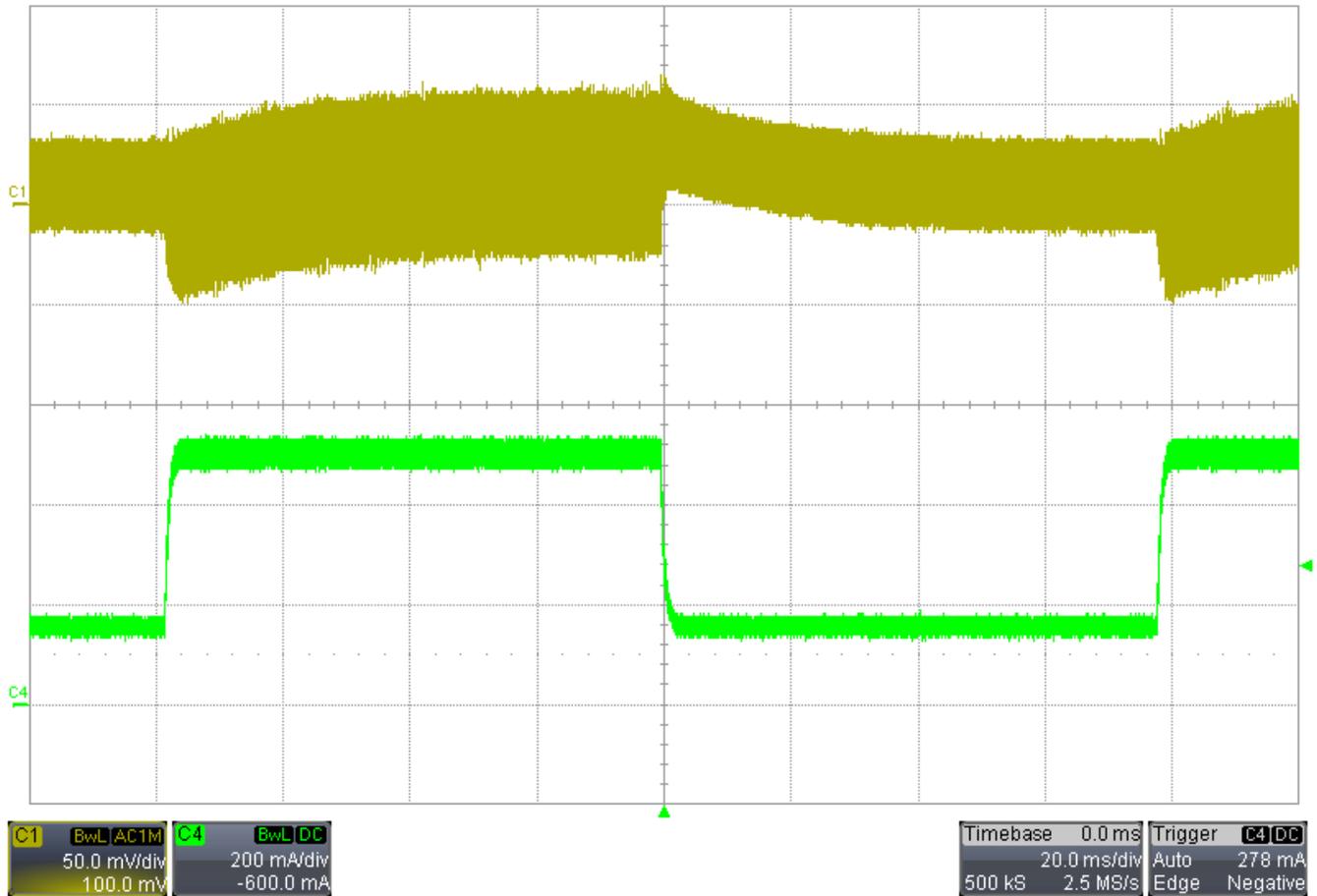


Figure 18. Load stepping between 0.125 A and 0.5 A (20% to 80% load step)

### 1.3.4 Control Loop/Stability

For this measurement the output was loaded to 0.625 A. The table below shows the bandwidth and phase margin measurements.

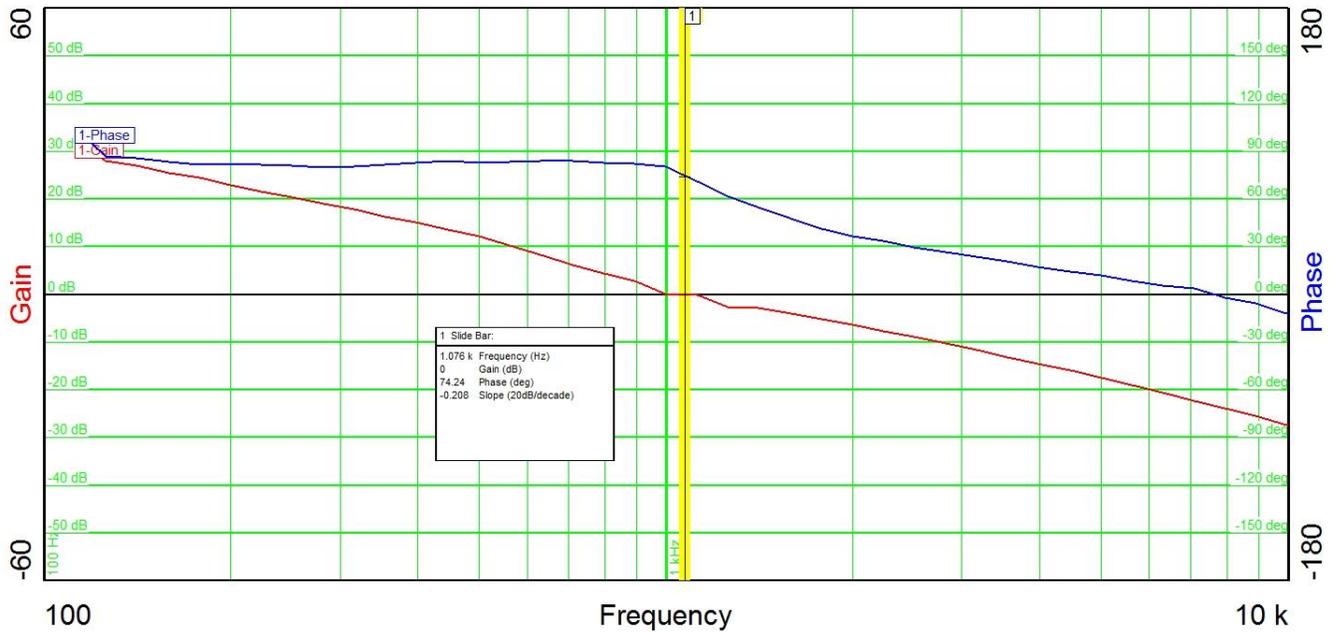


Figure 19. 120 Vac Input Bode Plot at full load

Input Voltage (V)	Bandwidth (kHz)	Phase Margin (degrees)
120 Vac	1.076kHz	74.24°

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