Test Report: PMP22538

60-W GaN PFC Flyback Reference Design

Description

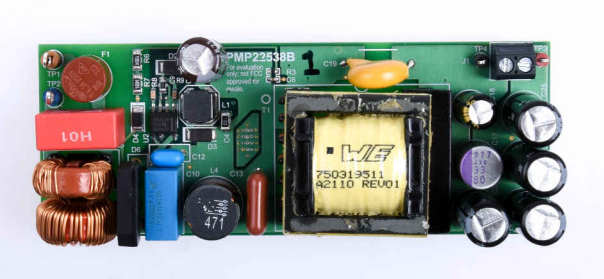
This reference design uses UCC28811 power factor correction (PFC) flyback controller to create an isolated 60-V output capable of 1-A loading while keeping input harmonic distortion low. The high efficiency of using a LMG3411R150 GaN primary switch allows for compact solution size and low temperature rise during operation.

Features

- Over 91% efficient at maximum output power
- Compact 95 mm × 36 mm PCB area and 30 mm total maximum height
- PFC control reduces peak input current

Applications

- Residential lighting



Top Photo

Bottom Photo

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input Voltage	102–265 Vac
Output Voltage	60 V, ±1%
Output Current	1 A
Nominal Switching Frequency	90 kHz

1.2 Required Equipment

- AC voltage source
- Electronic load
- Oscilloscope
- Voltmeter
- Current meter

1.3 Considerations

An electronic load was used for all tests.

Unless noted, all waveforms were captured at full load with a 1-A loading.

2 Testing and Results

2.1 Efficiency Graphs

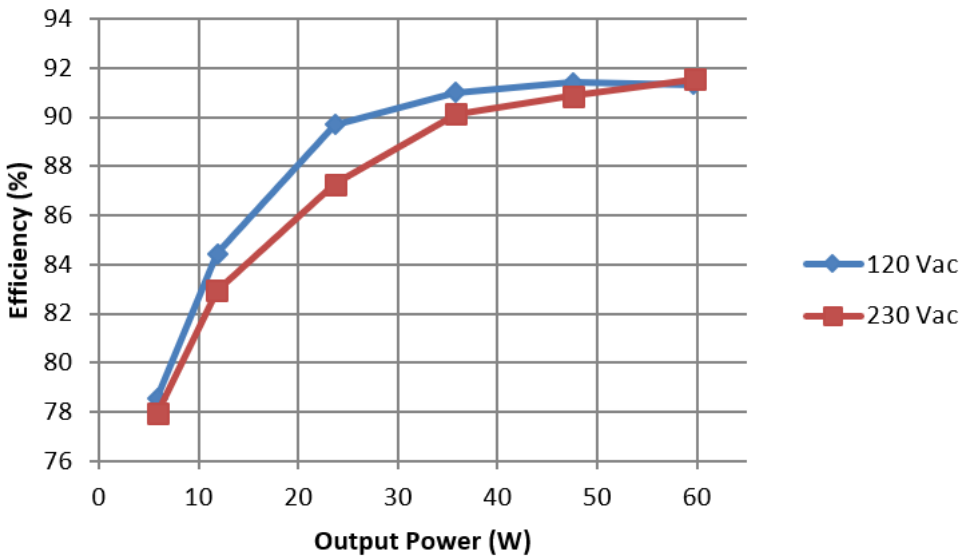


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

The following table displays the PMP22538 efficiency data.

Input	Input Current (mA_{RMS})	Apparent Power (VA)	Input Power (W)	Power Factor	Output Voltage (V)	Output Current (A)	Output Power (W)	Efficiency (%)
120 Vac, 60 Hz	91.98	11.054	7.46	0.693	59.826	0.098	5.863	78.57
120 Vac, 60 Hz	135.48	16.278	14.09	0.866	59.797	0.199	11.9	84.431
120 Vac, 60 Hz	232.4	27.92	26.41	0.946	59.754	0.396	23.686	89.687
120 Vac, 60 Hz	333.2	40.01	39.3	0.982	59.75	0.599	35.76	90.993
120 Vac, 60 Hz	439.1	52.7	52.05	0.988	59.746	0.796	47.576	91.403
120 Vac, 60 Hz	550.4	66.03	65.33	0.989	59.744	0.999	59.66	91.321
230 Vac, 50 Hz	78.62	17.45	7.52	0.431	59.806	0.098	5.861	77.938
230 Vac, 50 Hz	117.63	24.84	14.31	0.576	59.742	0.199	11.871	82.954
230 Vac, 50 Hz	171.53	39.22	27.18	0.693	59.861	0.396	23.723	87.281
230 Vac, 50 Hz	212.9	49.1	39.72	0.809	59.766	0.599	35.806	90.145
230 Vac, 50 Hz	261	60.08	52.36	0.871	59.768	0.796	47.576	90.862
230 Vac, 50 Hz	315.1	72.51	65.24	0.9	59.836	0.998	59.728	91.552

2.3 Thermal Images

Measurements		
Bx1	Max	55.1 °C
Bx2	Max	41.3 °C

Parameters	
Emissivity	0.95
Refl. temp.	20 °C

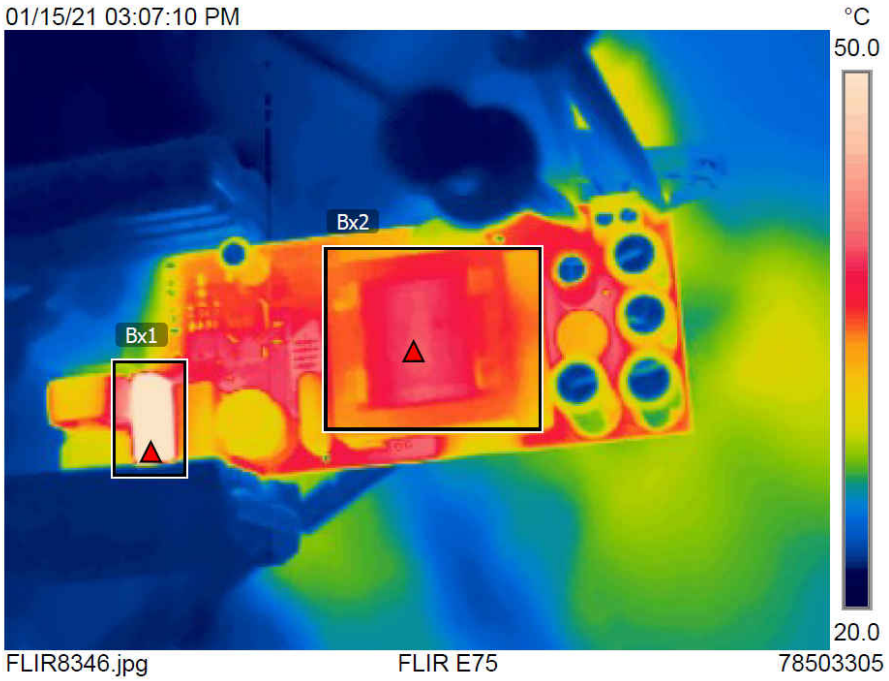


Figure 2-2. Top Thermal Image

Measurements		
Bx1	Max	54.9 °C
Bx2	Max	49.4 °C
Bx3	Max	46.4 °C

Parameters	
Emissivity	0.95
Refl. temp.	20 °C

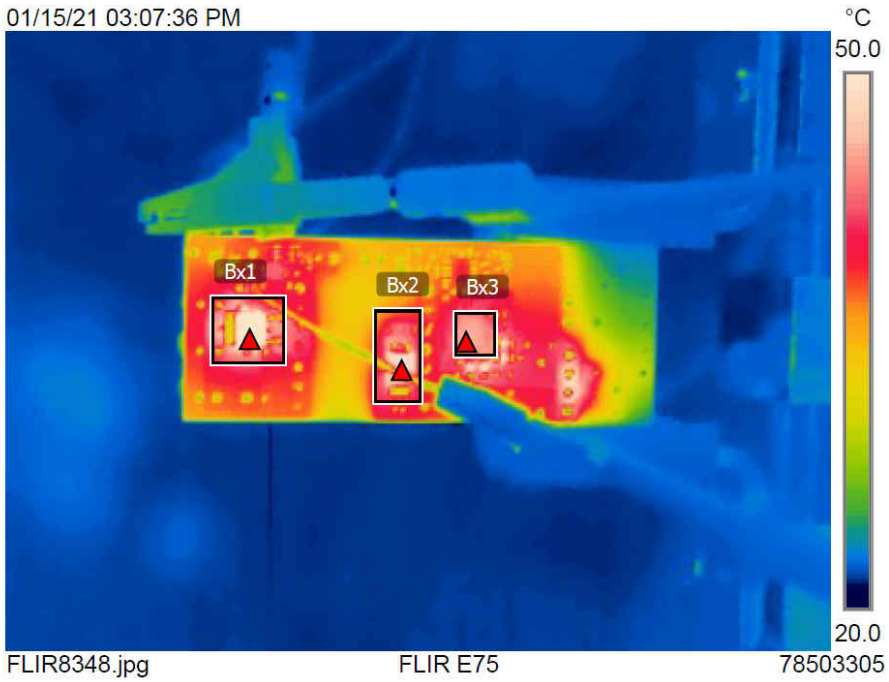


Figure 2-3. Bottom Thermal Image

2.4 EMI

Figure 2-4 and Figure 2-5 illustrate the PMP22538 EMI graphs.

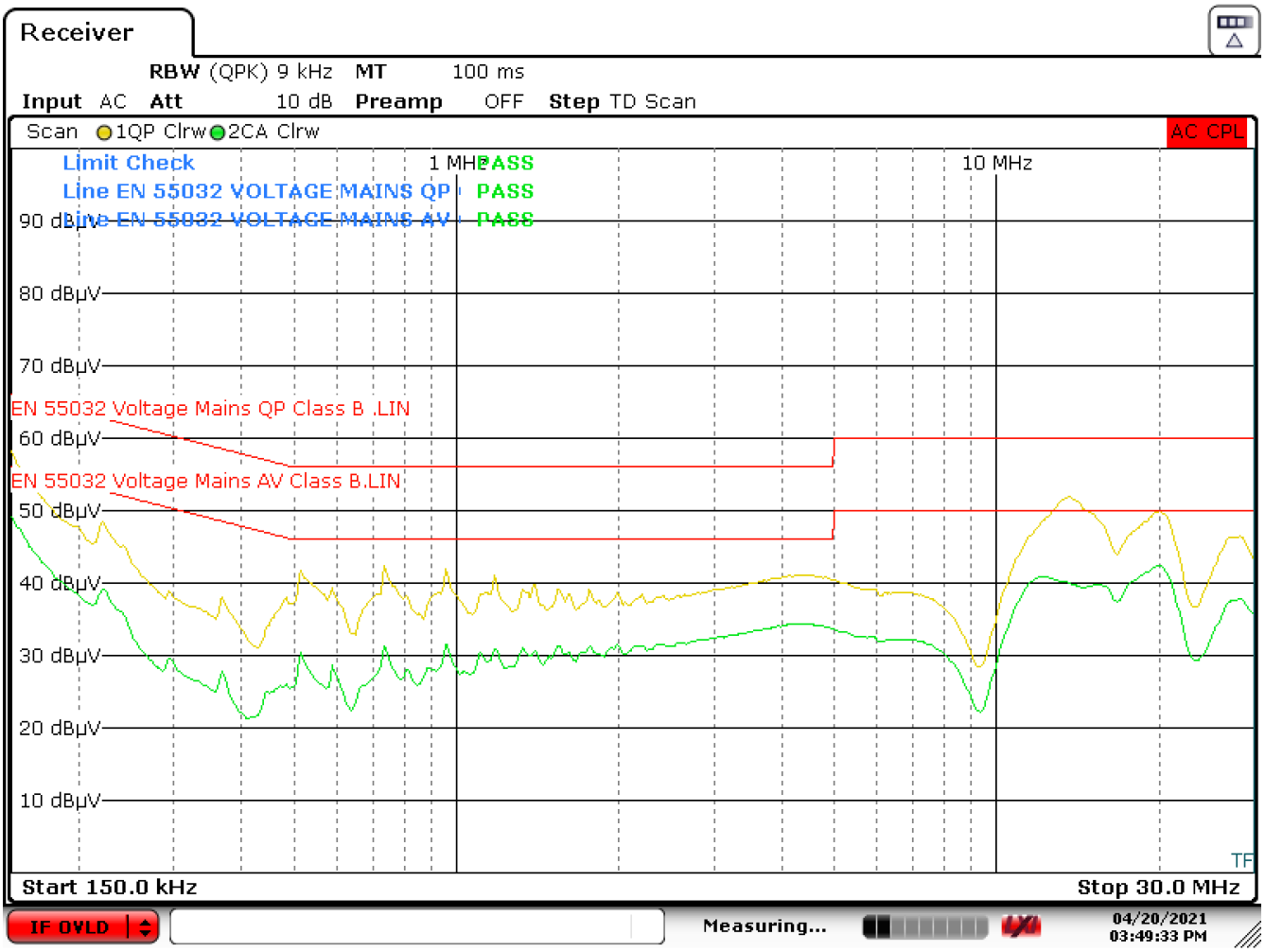


Figure 2-4. 120 Vac, 60-Hz Input

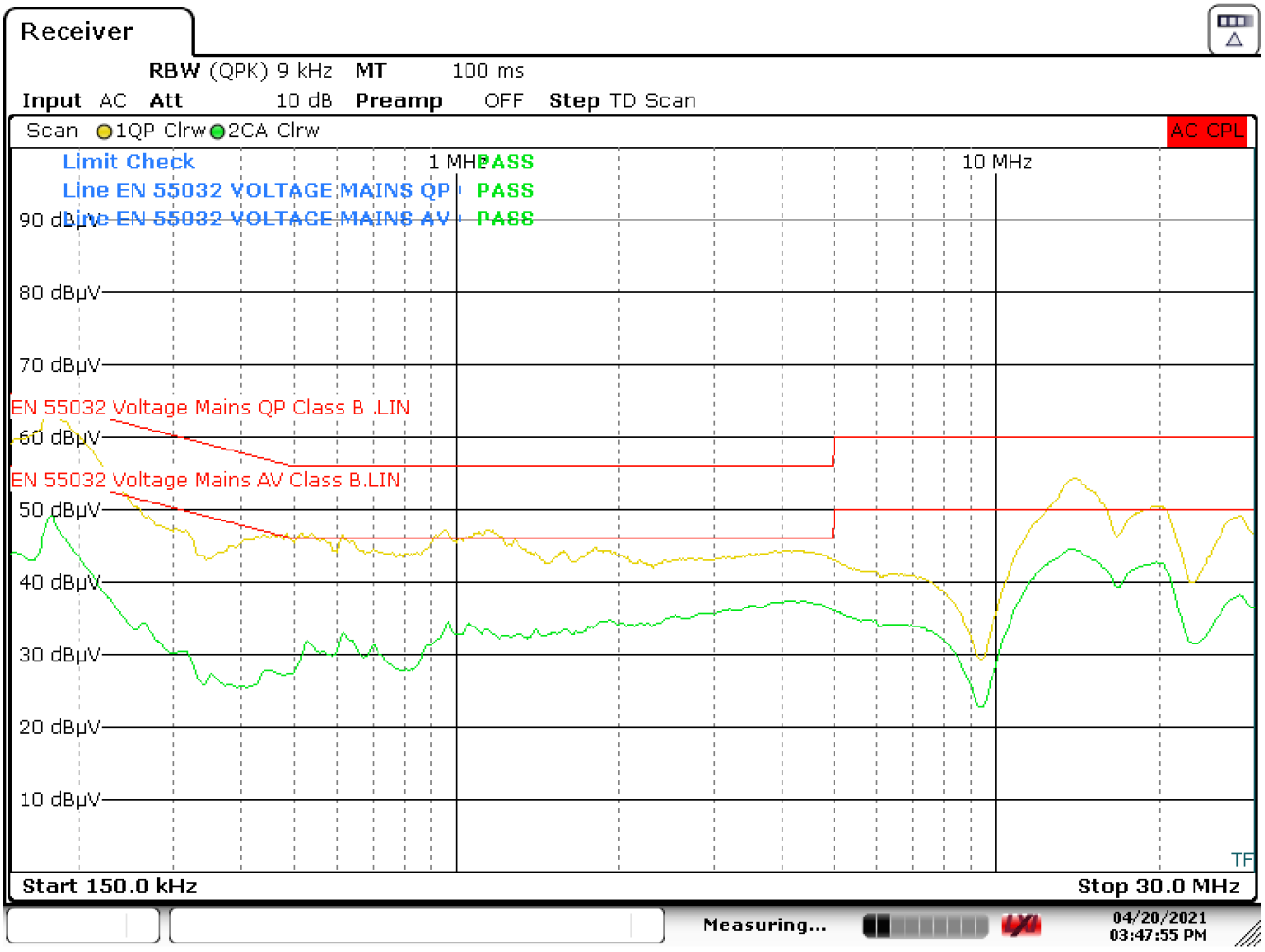


Figure 2-5. 230 Vac, 50-Hz Input

3 Waveforms

3.1 Switch Node

Figure 3-1 through Figure 3-4 show the PMP22538 switch node waveforms.

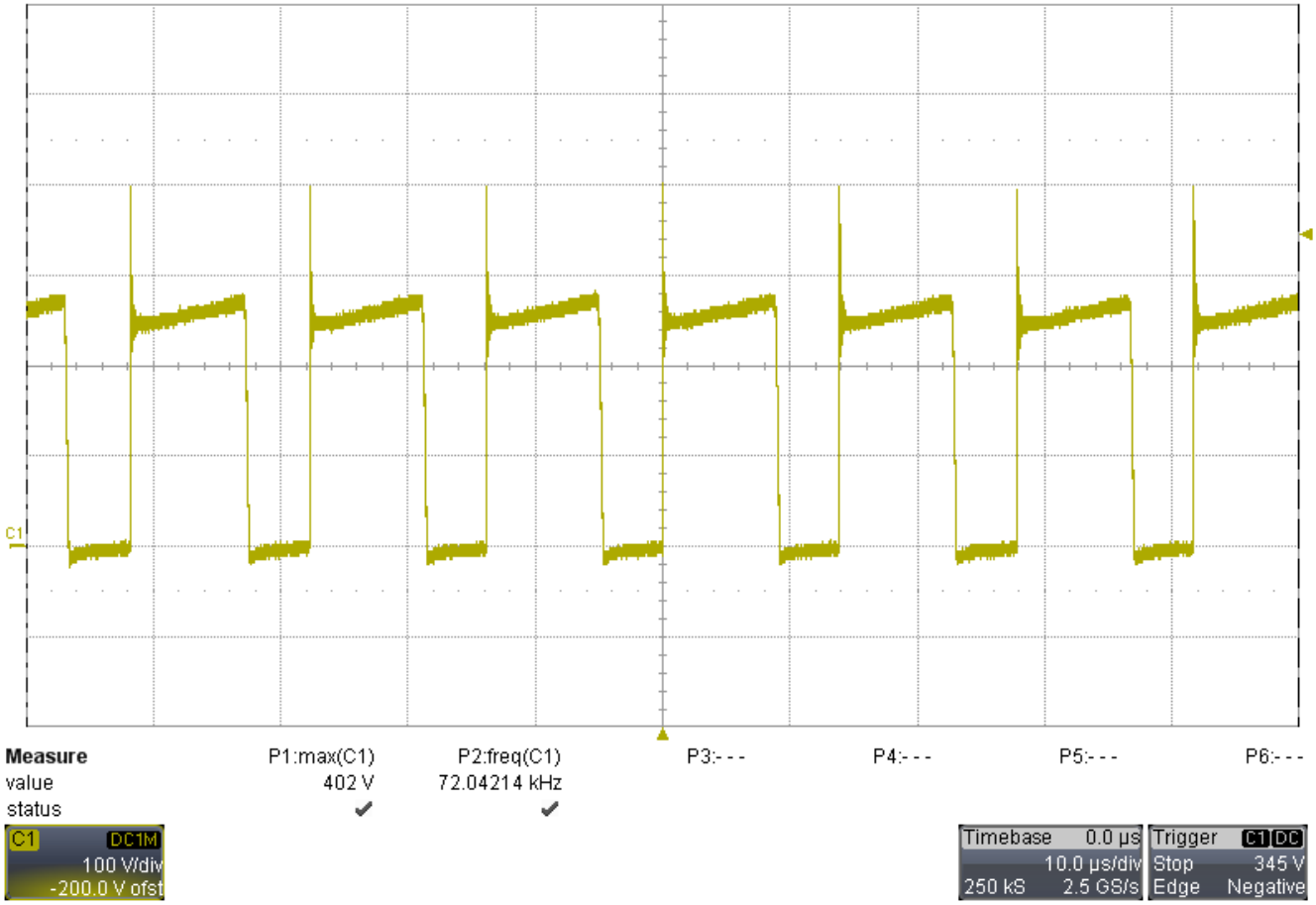


Figure 3-1. Primary Switch Node, 120 Vac, 60-Hz Input

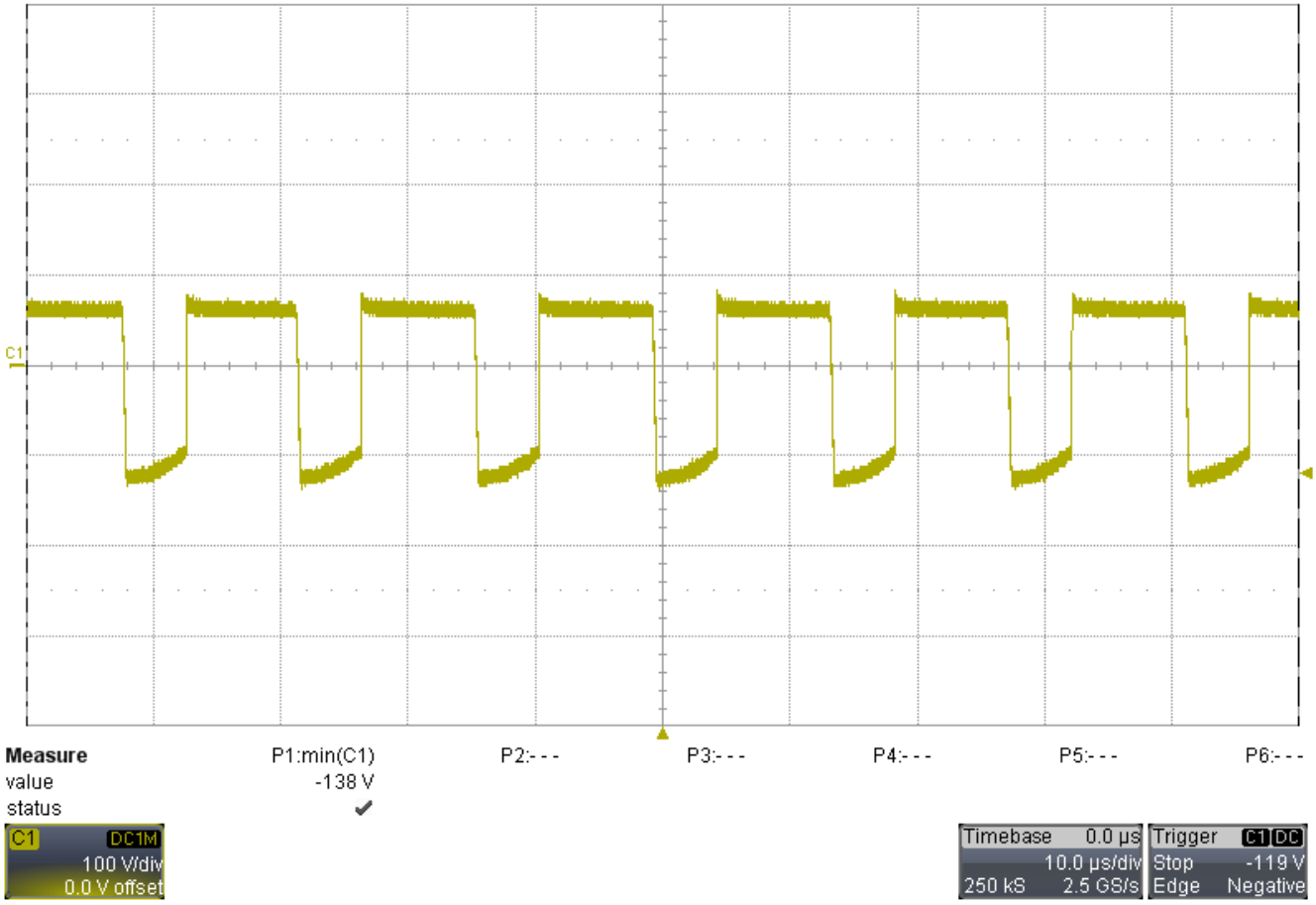


Figure 3-2. Secondary Switch Node, 120 Vac, 60-Hz Input

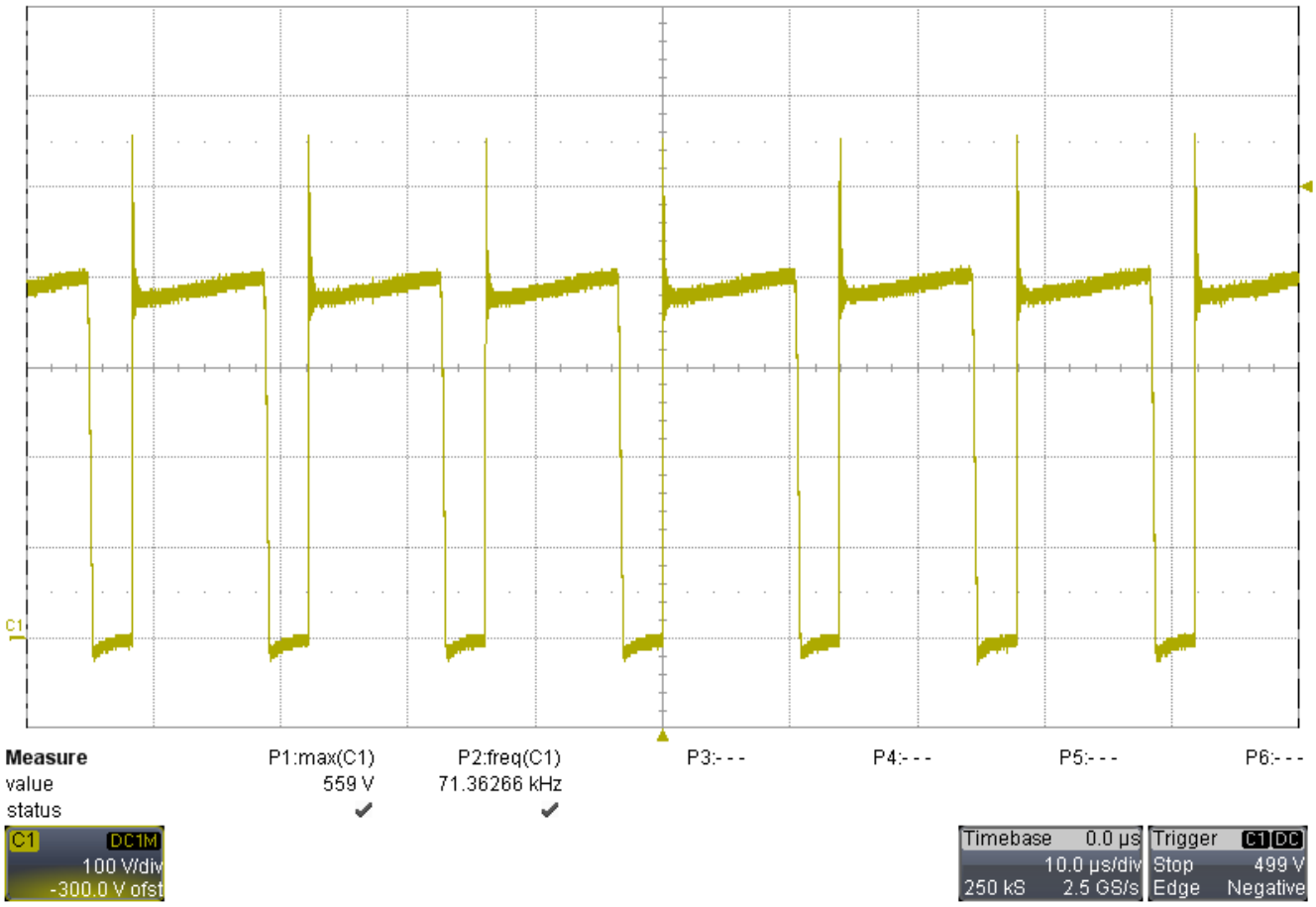


Figure 3-3. Primary Switch Node, 230 Vac, 50-Hz Input

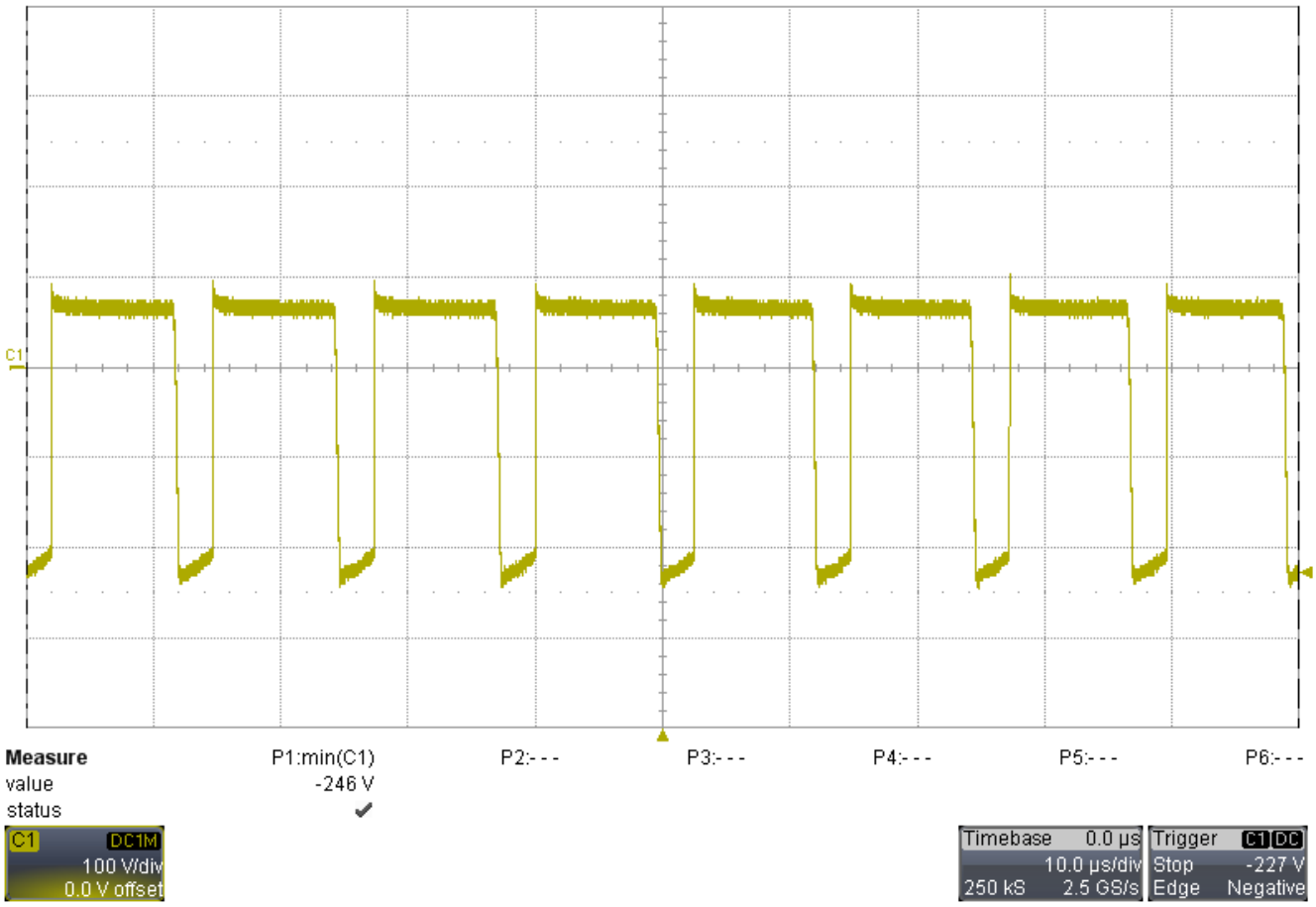


Figure 3-4. Secondary Switch Node, 230 Vac, 50-Hz Input

3.2 Output Voltage Ripple

Figure 3-5 and Figure 3-6 show the PMP22538 output voltage ripple waveforms.

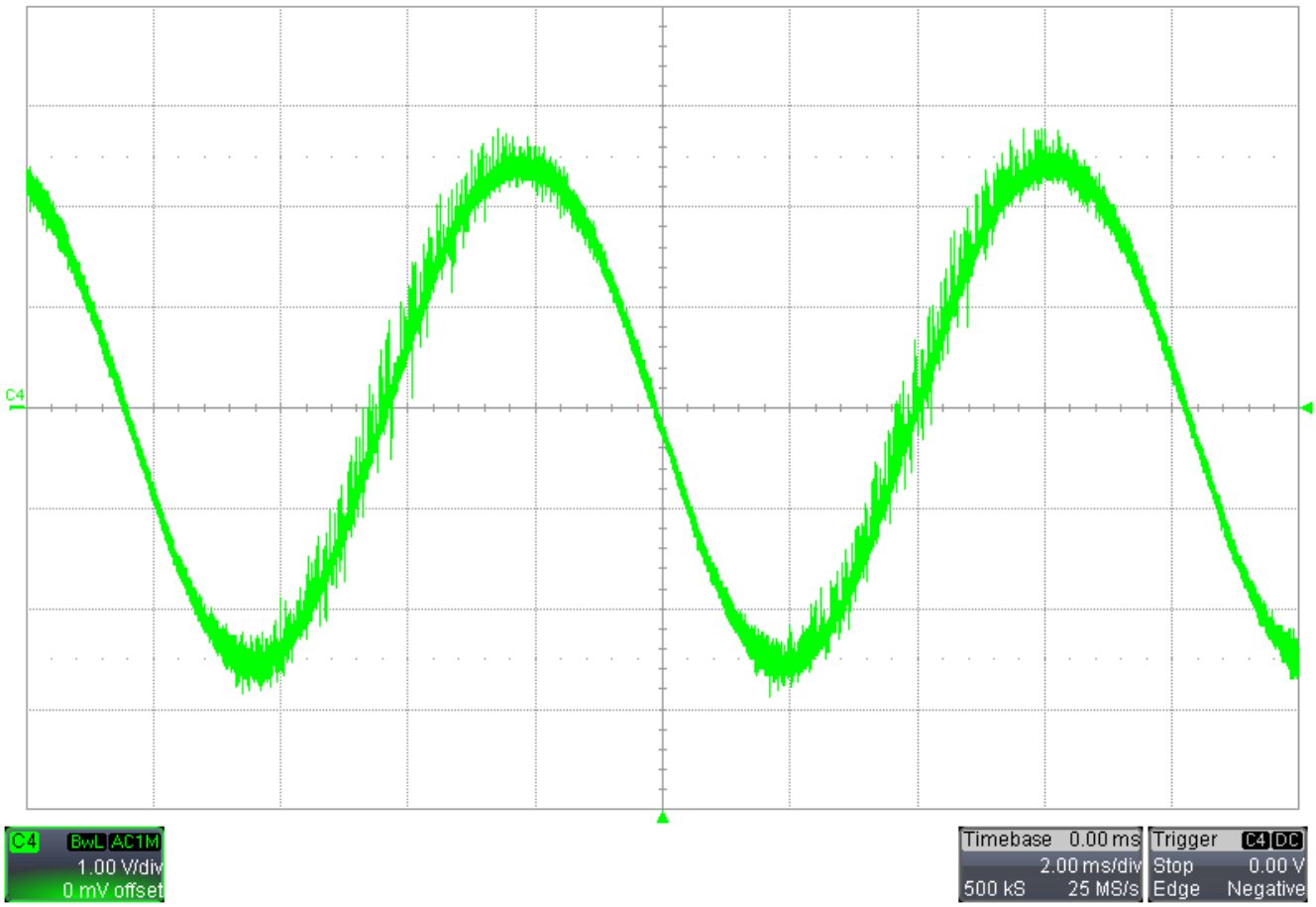


Figure 3-5. 120 Vac, 60-Hz Input, Line Frequency Ripple on Output

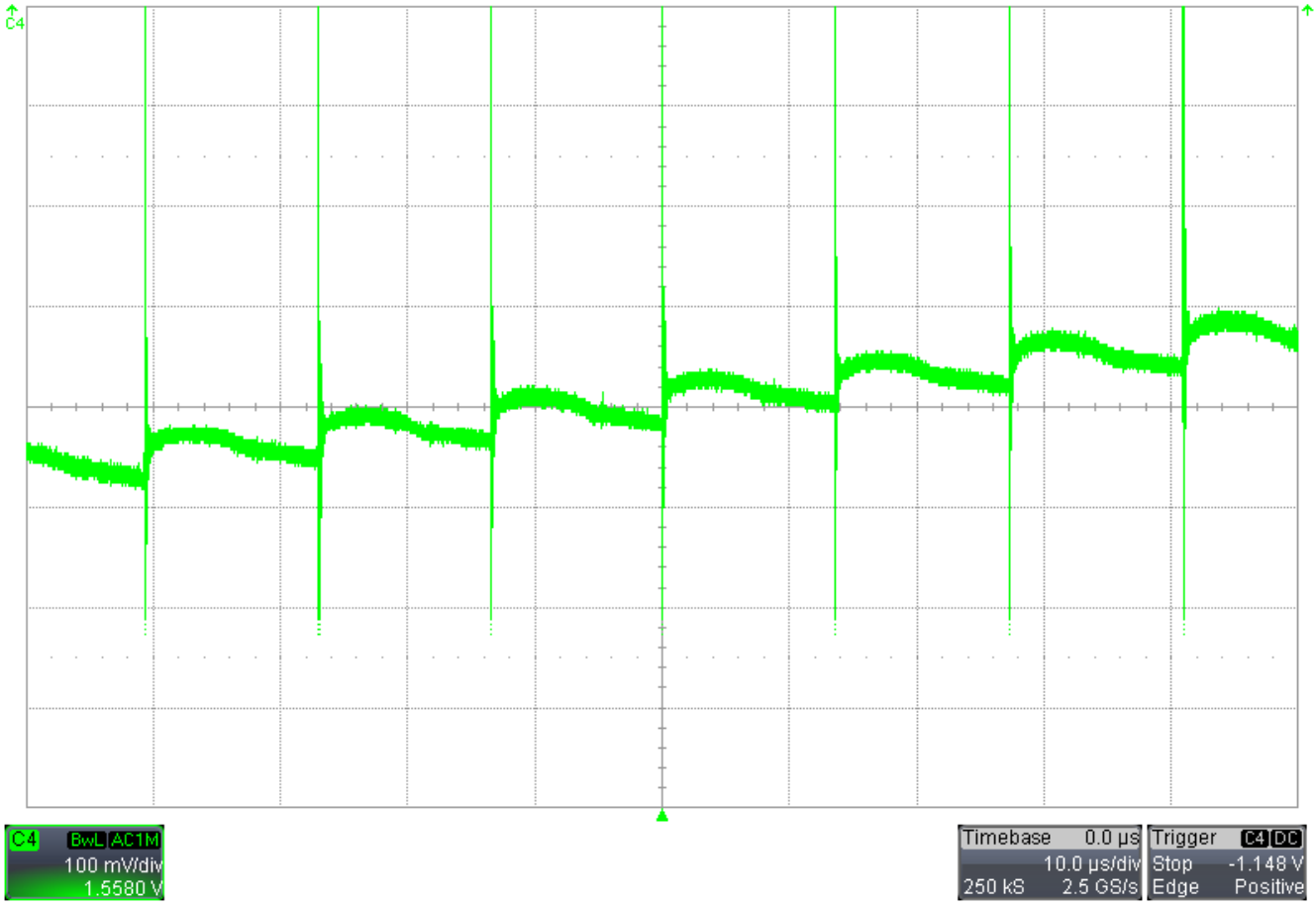


Figure 3-6. 120 Vac, 60-Hz Input, SMPS Switching Frequency on Output

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