Test Report: PMP20634

12-V, 12-W Primary-Side Regulated (PSR) Flyback Reference Design

Description

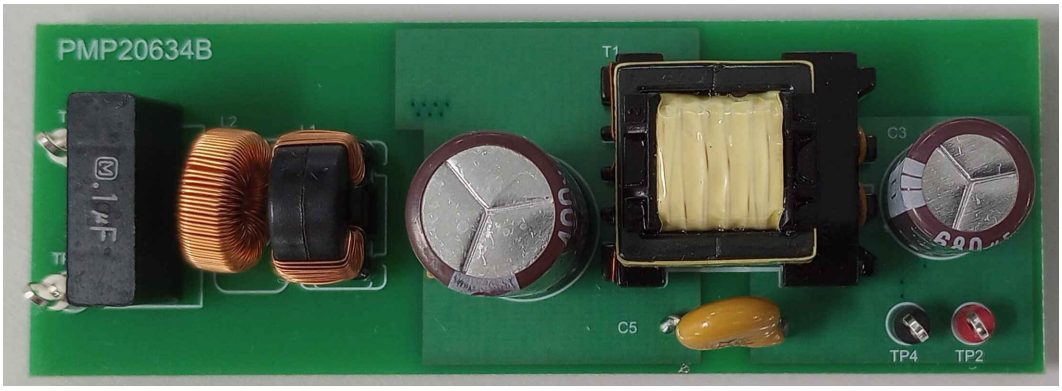
This reference design is an isolated DCM flyback design that takes a universal line input 85-VAC to 265-VAC, and produces a 12-V output capable of 12-W loading. The design uses the UCC28730 controller that achieves ultra-low standby power at no load and achieves 82% efficiency at high and low line, and measures 1 in × 3 in on a 2-layer board.

Features

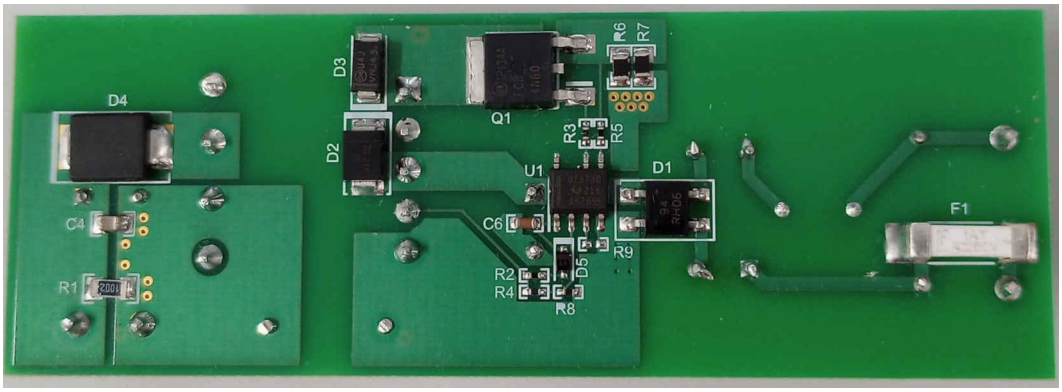
- Universal input, 85 VAC to 265 VAC
- Achieves over 82% efficiency at the low and high line
- Optional, isolated-disable circuit available
- Primary side regulation allows for simple design
- 2-layer board, 1-oz copper measuring 1 in × 3 in

Applications

- Power supply module
- Wireless control



Top of Board



Bottom of Board

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input Voltage Range	85-VAC to 265-VAC
Output Voltage	12-VDC
Output Current	1 A

2 Testing and Results

2.1 Efficiency Graphs

The efficiency and power loss graph is shown in the following image.

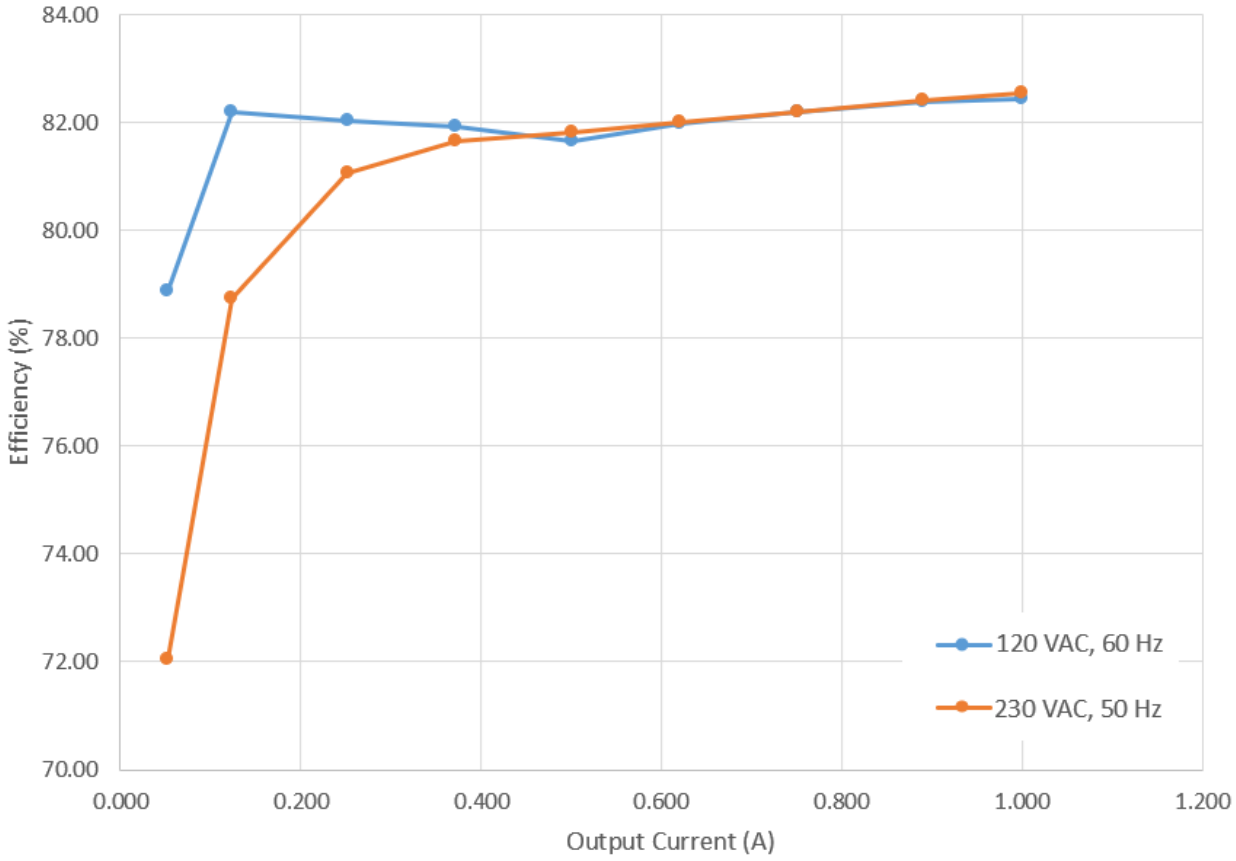


Figure 2-1. Efficiency and Power Loss Across Load

2.2 Efficiency Data

Efficiency data is shown in the following tables.

Table 2-1. Sweep Load on 12 V, 120-VAC, 60-Hz

I_{OUT} (V)	V_{OUT} (V)	V_{IN} (V)	I_{IN} (A)	P_{IN} (W)	PF	P_{OUT} (W)	Losses (W)	Efficiency (%)
0.000		120.0		0.03		0	0.03	0
0.053	12.65	120.0	0.049	0.85	0.145	0.67	0.18	78.88
0.123	12.63	120.0	0.061	1.89	0.258	1.55	0.34	82.20
0.252	12.60	120.0	0.091	3.87	0.354	3.18	0.69	82.05
0.372	12.60	120.0	0.123	5.72	0.387	4.69	1.03	81.94
0.501	12.60	120.0	0.151	7.73	0.424	6.31	1.42	81.66
0.621	12.61	120.0	0.176	9.55	0.451	7.83	1.72	82.00
0.751	12.62	120.0	0.203	11.53	0.473	9.48	2.05	82.20
0.891	12.63	120.0	0.231	13.66	0.491	11.25	2.41	82.38
1.000	12.63	120.0	0.254	15.32	0.503	12.63	2.69	82.44

Table 2-2. Sweep Load on 12 V, 230-VAC, 50-Hz

I_{OUT} (V)	V_{OUT} (V)	V_{IN} (V)	I_{IN} (A)	P_{IN} (W)	PF	P_{OUT} (W)	Losses (W)	Efficiency (%)
0		230.2		0.06		0	0.06	0
0.053	12.64	230.2	0.040	0.93	0.100	0.67	0.26	72.03
0.123	12.61	230.2	0.046	1.97	0.184	1.55	0.42	78.73
0.252	12.58	230.2	0.063	3.91	0.270	3.17	0.74	81.08
0.372	12.58	230.2	0.081	5.73	0.309	4.68	1.05	81.67
0.501	12.59	230.2	0.101	7.71	0.333	6.31	1.40	81.81
0.621	12.60	230.2	0.122	9.54	0.341	7.82	1.72	82.02
0.751	12.61	230.2	0.141	11.52	0.354	9.47	2.05	82.21
0.890	12.62	230.2	0.160	13.63	0.370	11.23	2.40	82.40
1.000	12.63	230.2	0.174	15.30	0.382	12.63	2.67	82.55

2.3 Thermal Images

Thermal images are shown in the following figures.

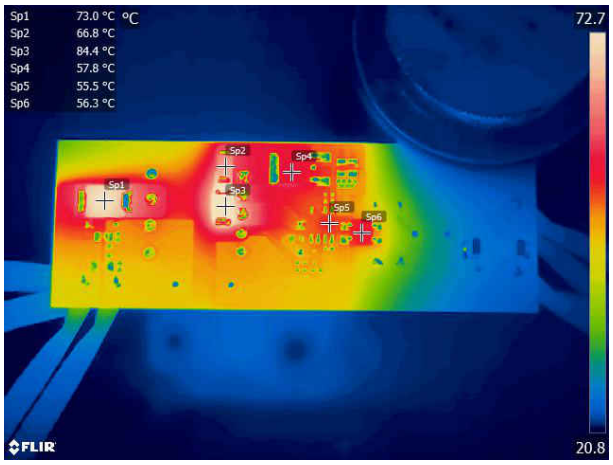


Figure 2-2. Thermal Image, 120-VAC, 60-Hz Bottom

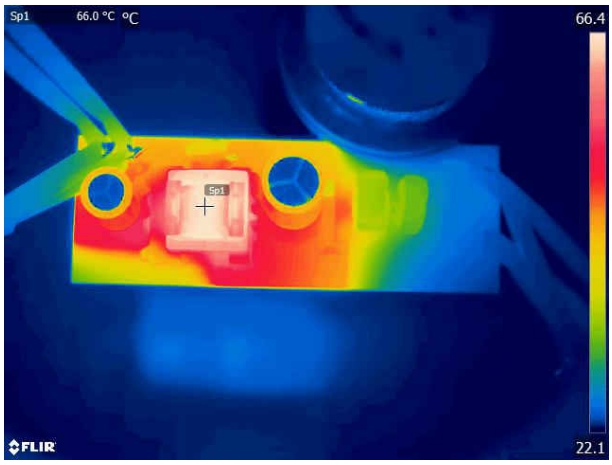


Figure 2-3. Thermal Image, 120-VAC, 60-Hz Top

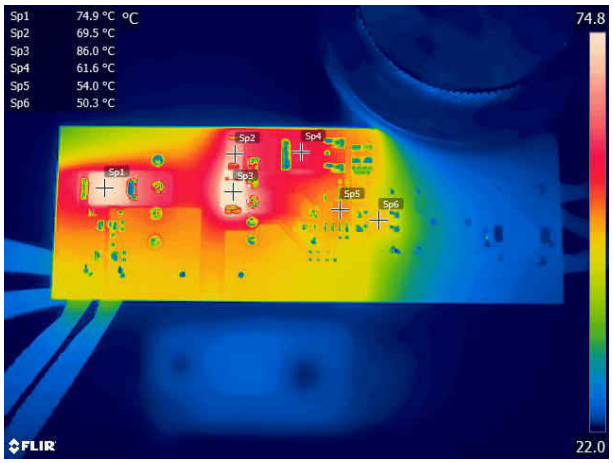


Figure 2-4. Thermal Image, 230-VAC, 50-Hz Bottom

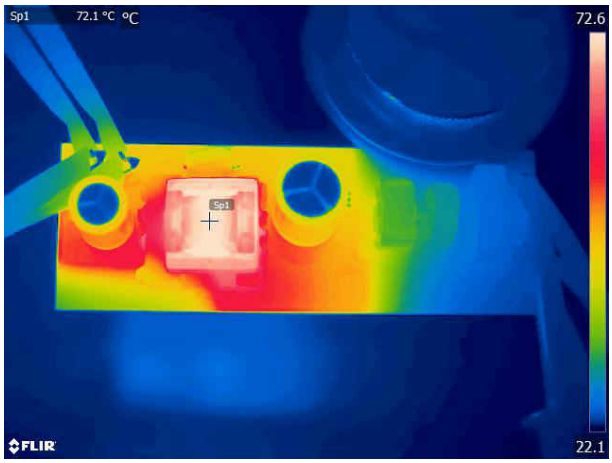


Figure 2-5. Thermal Image, 230-VAC, 50-Hz Top

3 Waveforms

3.1 Start-Up Sequence

The following waveform was taken with no load on the 12-V output.

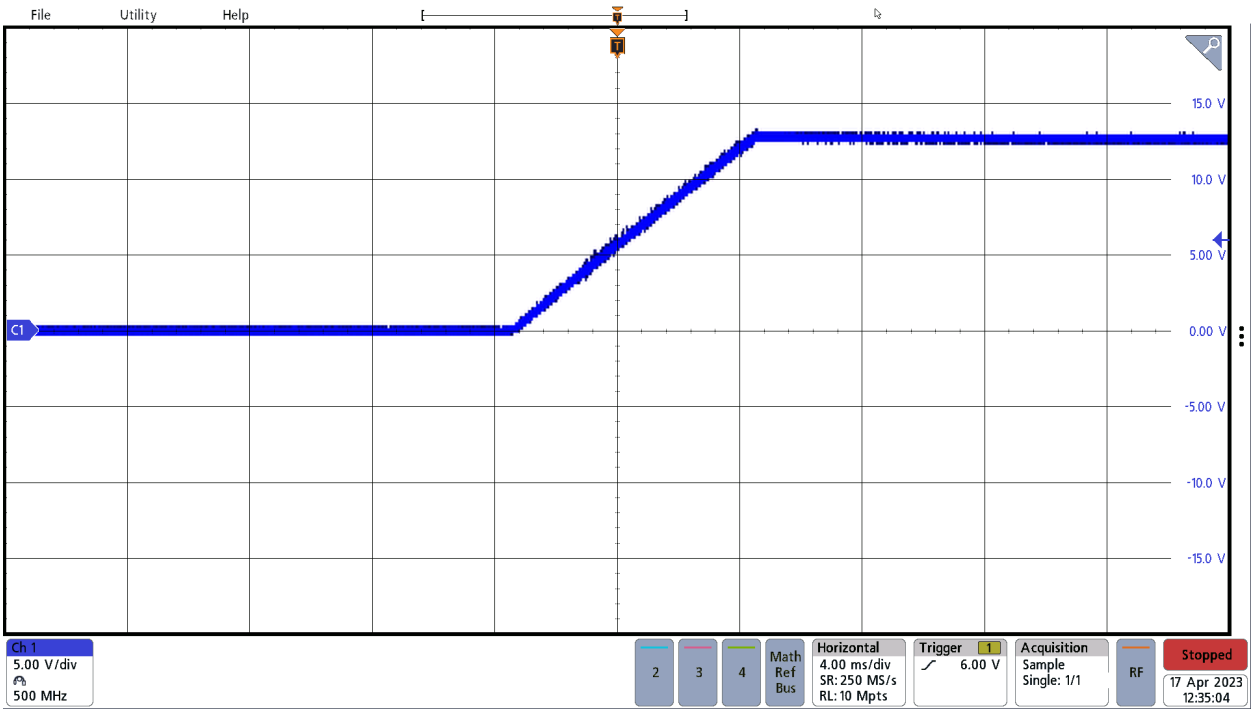


Figure 3-1. PMP20634C Output Voltage Start-Up

3.2 Output Voltage Ripple

Output voltage ripple is shown in the following figure.

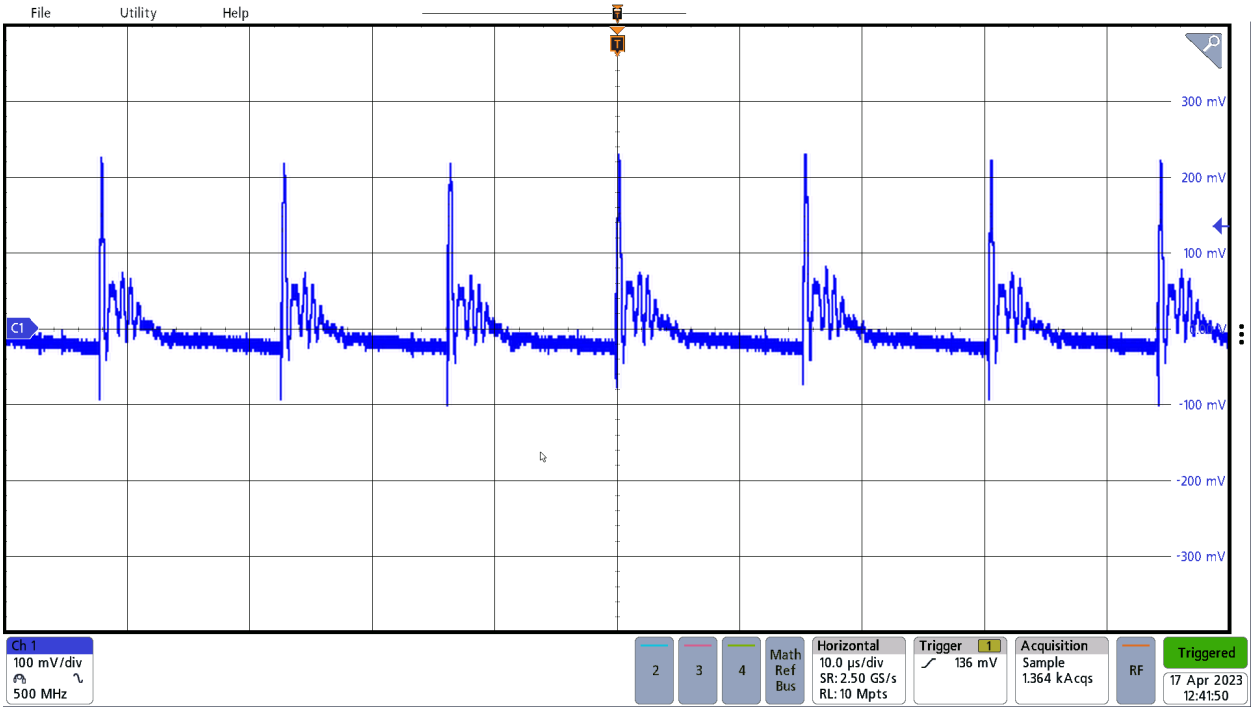


Figure 3-2. Output Voltage Ripple 12-V, 1-A

3.3 Load Transients

Load transient response waveforms are shown in the following figures.

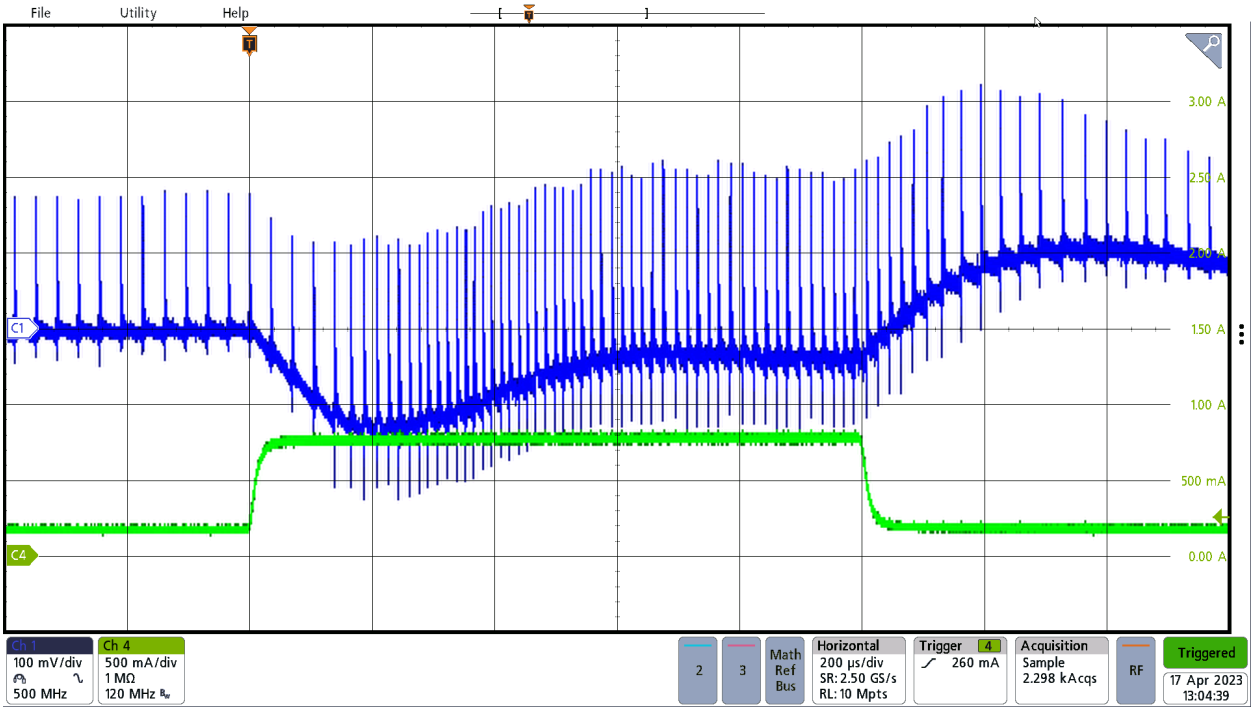


Figure 3-3. Transient Response to a 20% – 80% Load Step

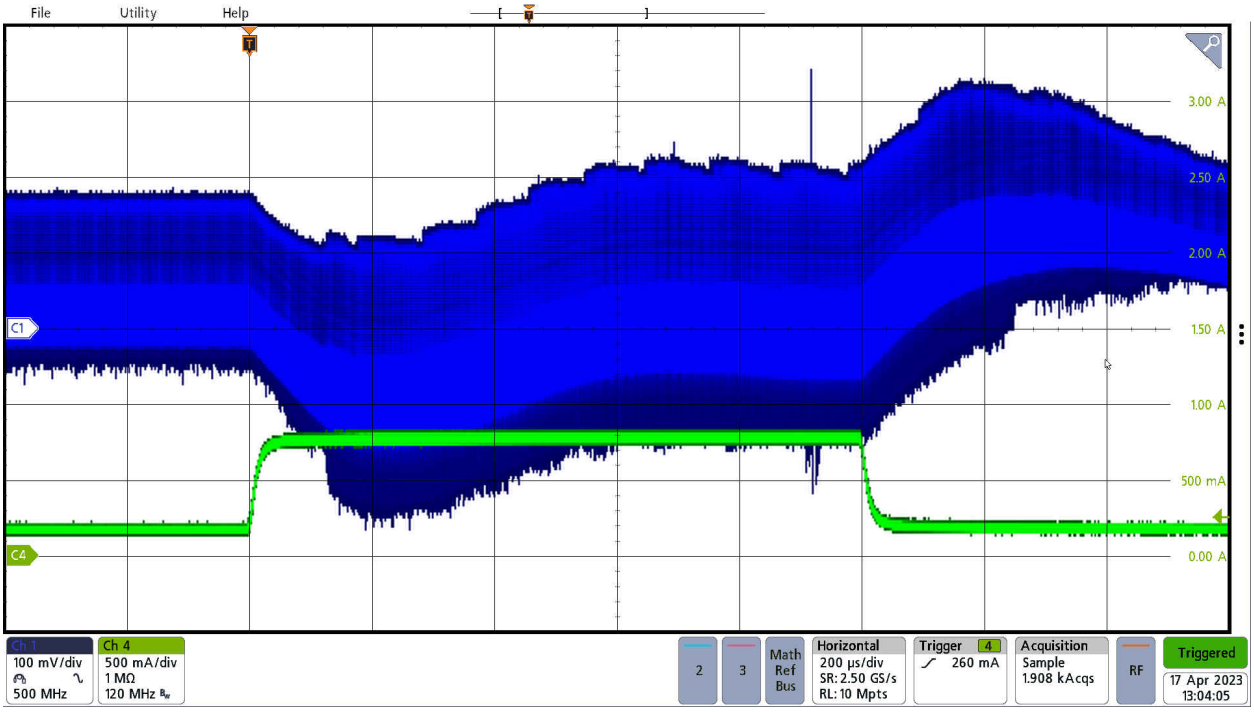


Figure 3-4. Transient Response to a 20% – 80% Load Step With Analog Persist

3.4 Switching

Switching behavior is shown in the following figures.

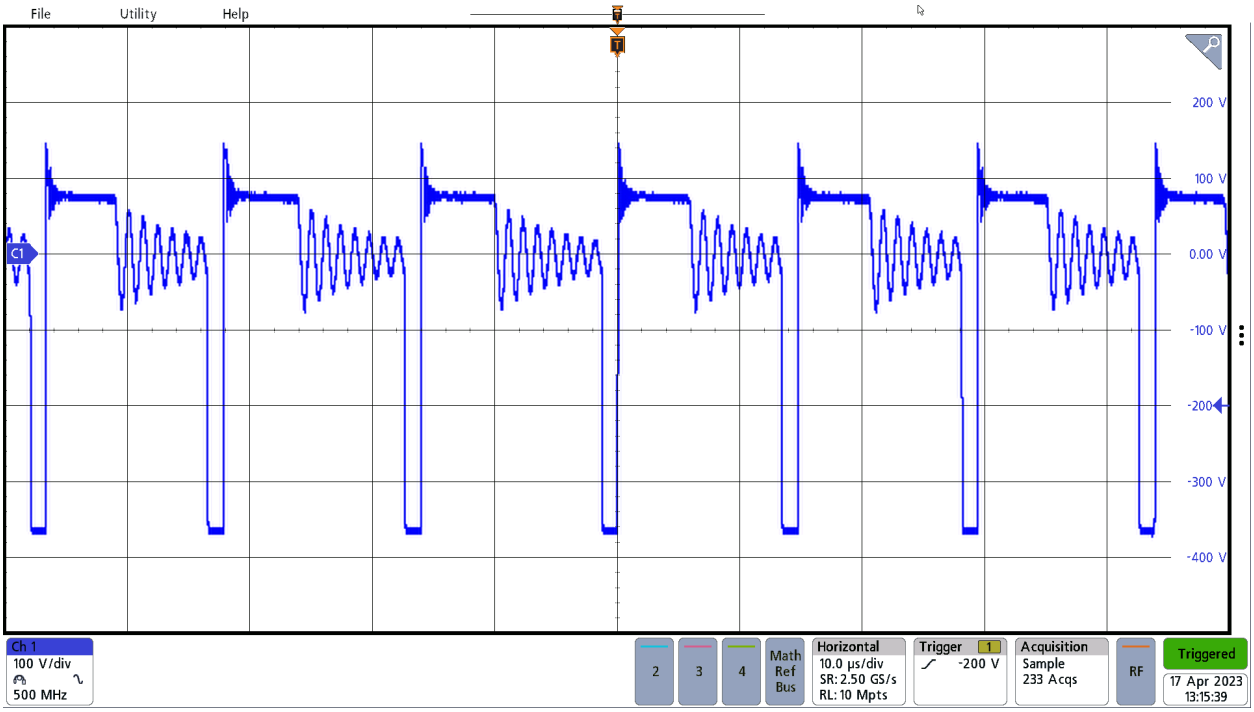


Figure 3-5. Drain of Primary FET Q1 – 265-VAC, 50-Hz Input, 12-V, 1-A Output

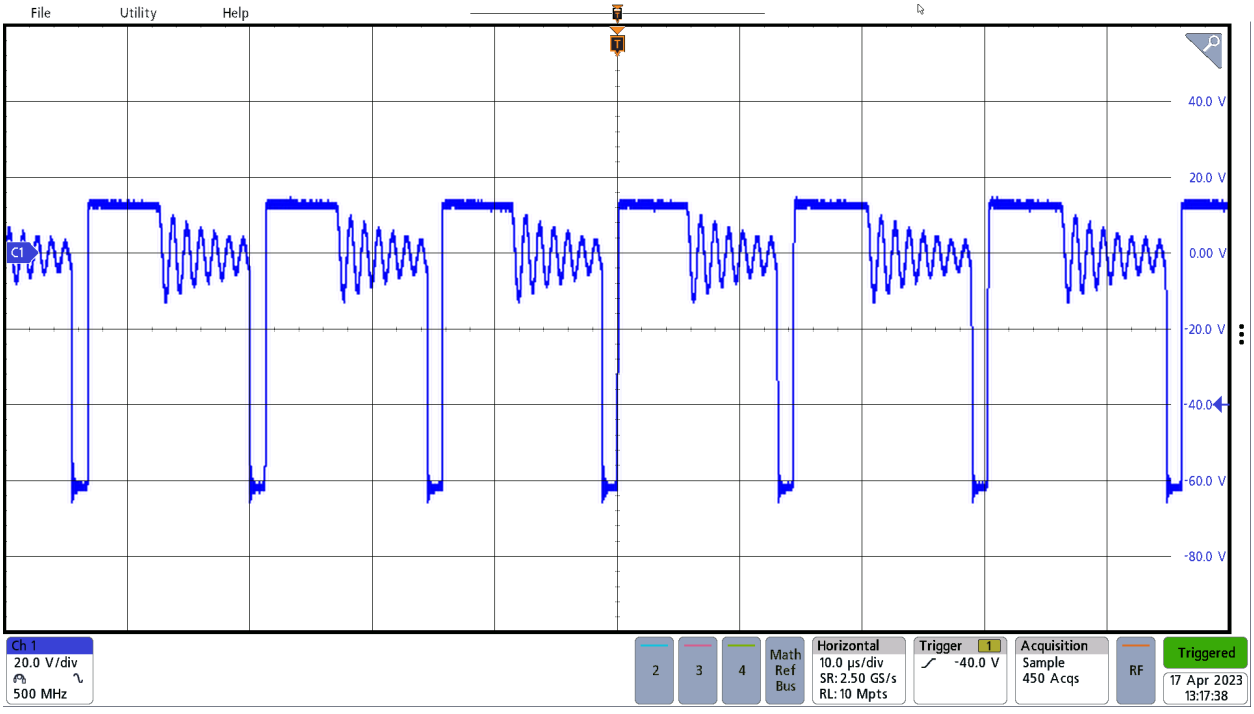


Figure 3-6. Anode of Rectifier D4 – 265-VAC, 50-Hz Input, 12-V, 1-A Output

3.5 Conducted EMI

The following conducted emissions measurements were taken using both quasi-peak detector and average peak detector methods (yellow and green traces, respectively). The measurements are compared to the CISPR-32 Class B regulations for quasi-peak and average tests. For these tests the 12-V output was loaded to 1-A with a resistive load. EMI tests were conducted with the secondary-side ground shorted to earth ground.

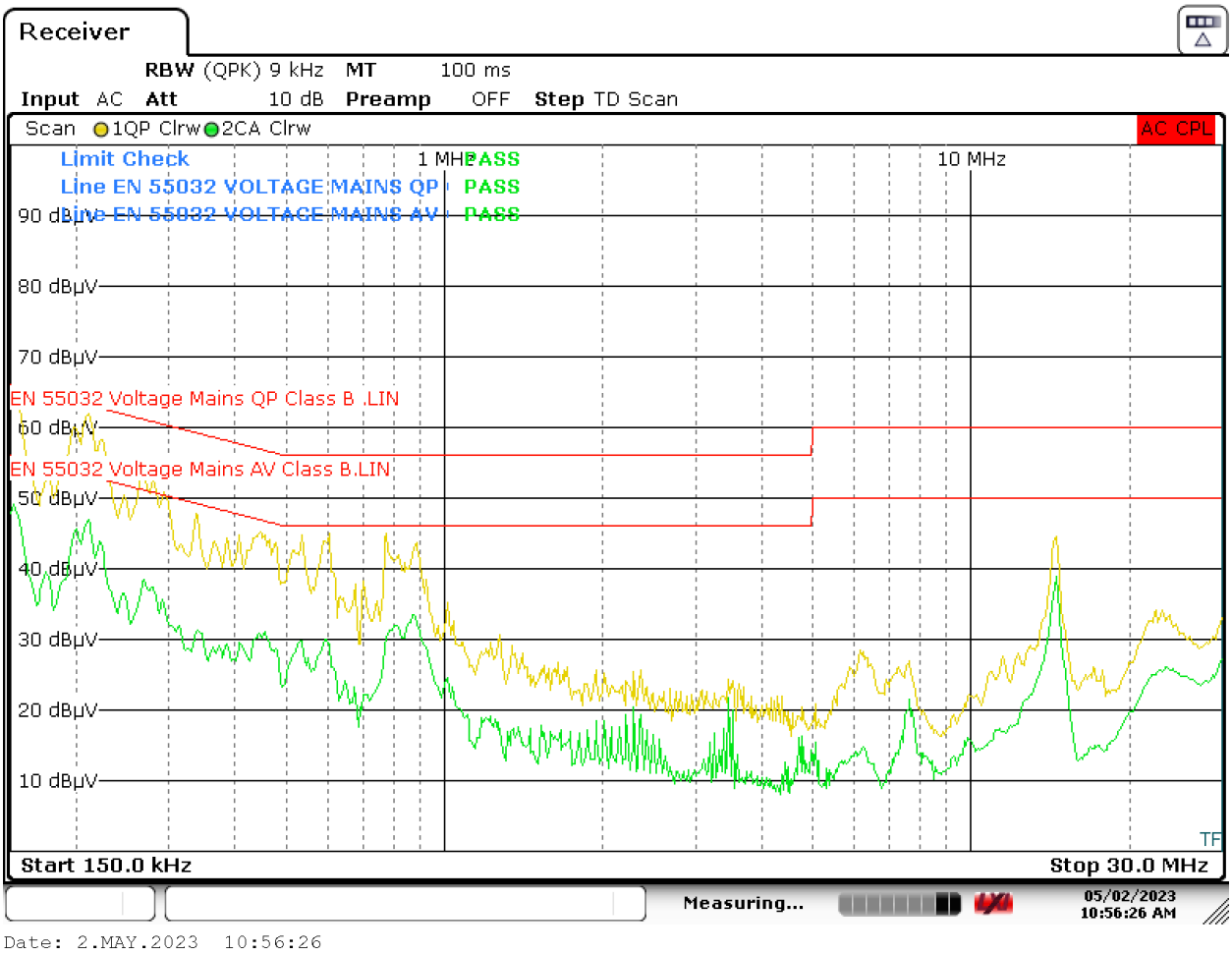


Figure 3-7. Measurement With 120-VAC, 60-Hz Input

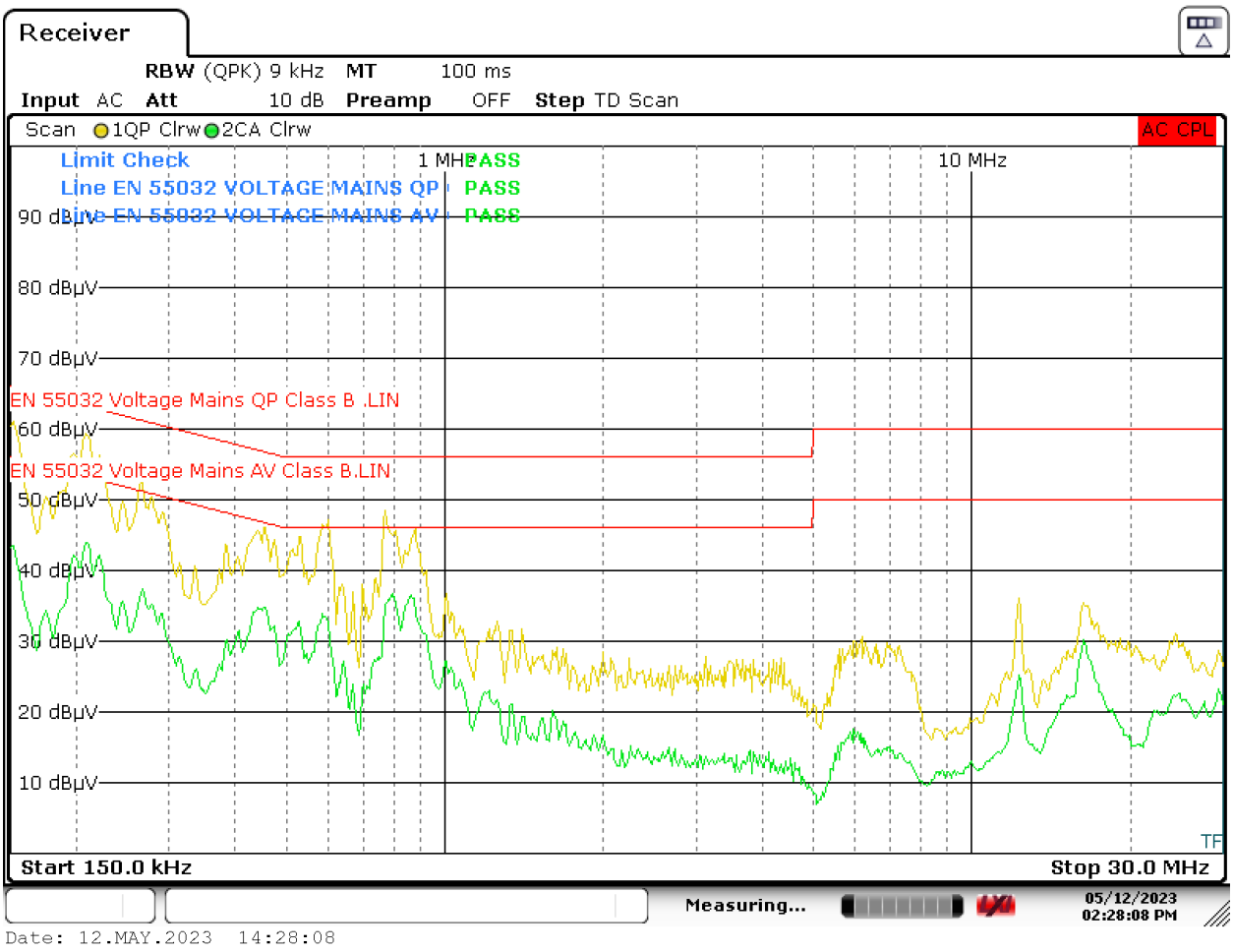


Figure 3-8. Measurement With 120-VAC, 60-Hz Input, Line Neutral Flipped

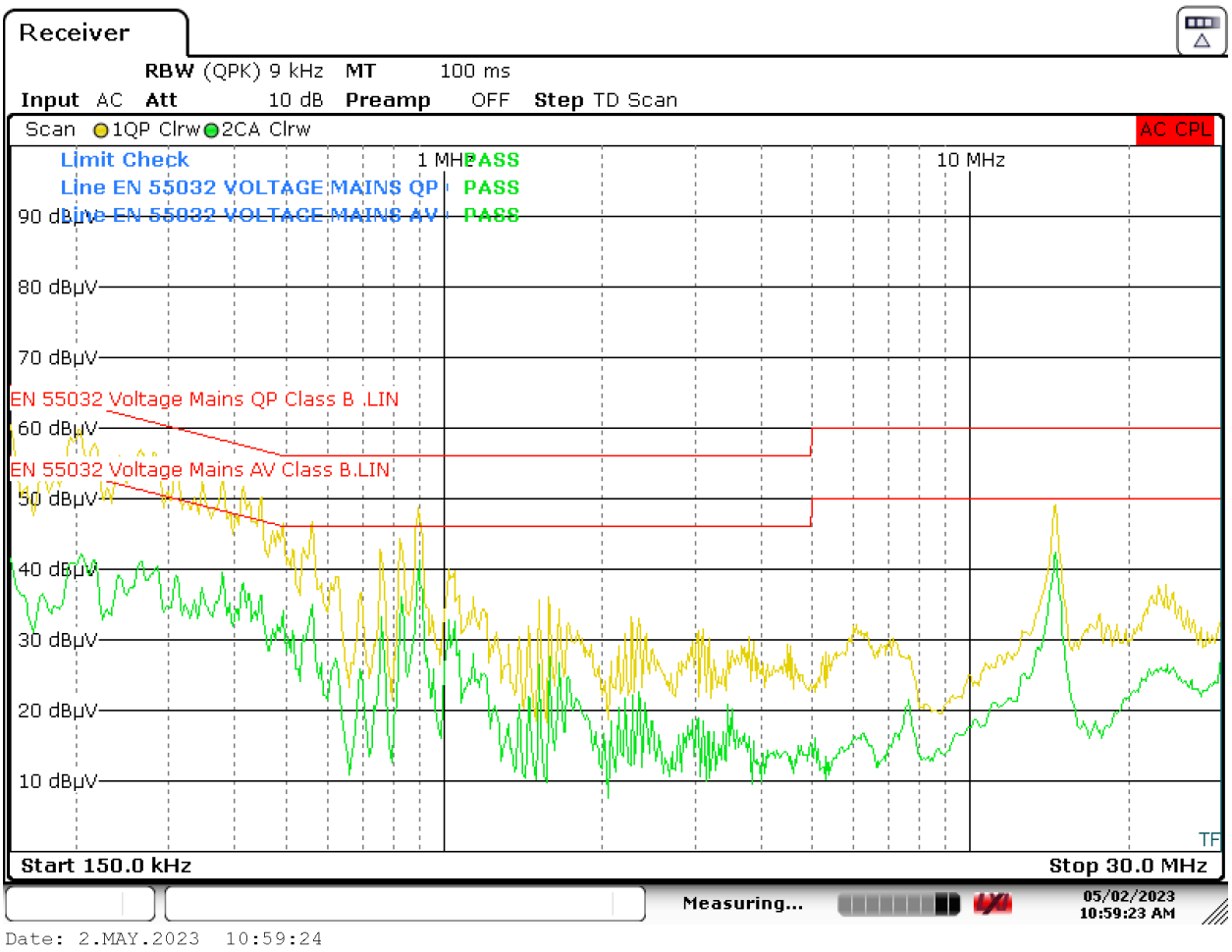


Figure 3-9. Measurement With 230-VAC, 50-Hz Input

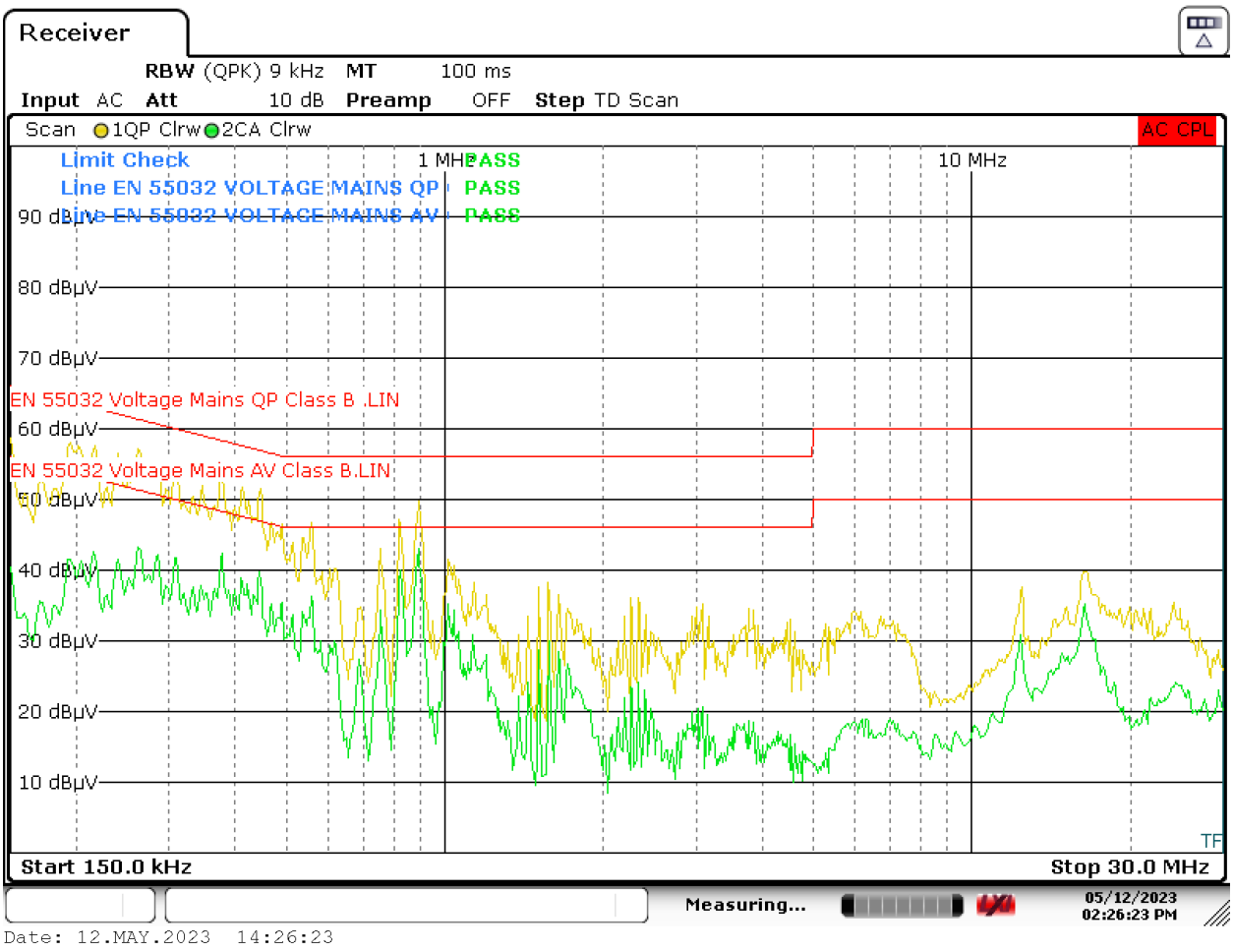


Figure 3-10. Measurement With 230-VAC, 50-Hz Input, Line Neutral Flipped

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