Test Report: PMP23445

120-Vac to 3.3-Vdc, 0.5-A Coupled-Inductor Buck Converter Reference Design

Description

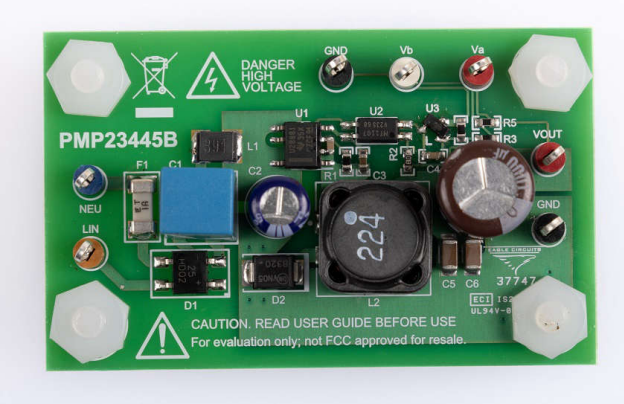
This reference design demonstrates a buck converter using the UCC28881 that converts a 120-Vac input to a 3.3-Vdc output. The use of a coupled inductor helps maintain a longer on-time while achieving an extreme conversion ratio for a non-isolated topology. Like other buck topologies this design makes a low-voltage ripple output while using minimal output capacitance.

Features

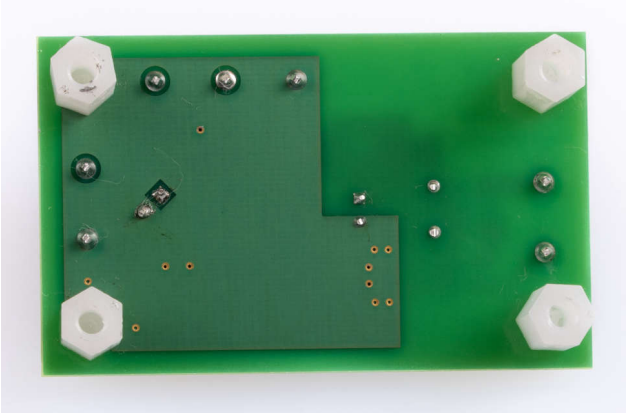
- Less than 62-mV peak-to-peak ripple on regulated 3.3-Vdc output
- Single-side assembly PCB
- Compact design can fit in a 0.75-in × 1.75-in area

Applications

- Thermal imaging camera
- Basic thermostat
- Refrigerant leak detector



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	120 Vac ±15%
Output Voltage	3.3 Vdc
Max Output Current	0.5 A

1.2 Dimensions

PMP23445B PCB measures 1.45 in × 2.35 in, maximum component height is 0.51 in.

2 Testing and Results

2.1 Efficiency Graphs

Efficiency with a 120-Vac input is shown in the following figure.

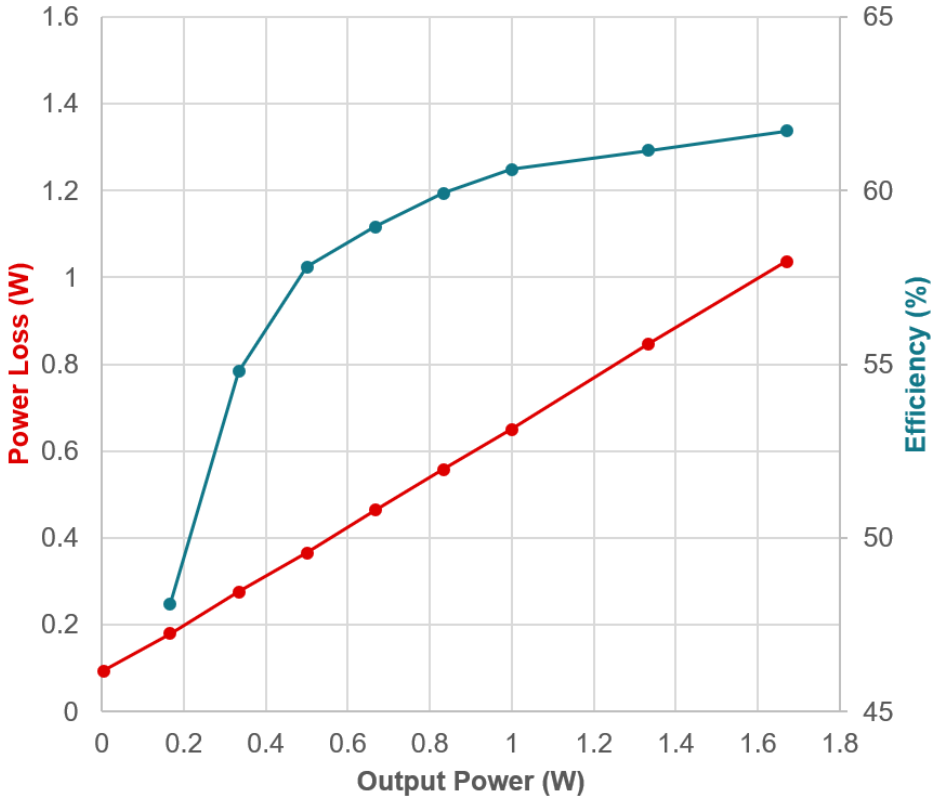


Figure 2-1. Efficiency Graph

2.2 Efficiency Data

Efficiency data is shown in the following table.

Input	Output			Total	
Power (mW)	Voltage (V)	Current (mA)	Power (mW)	Efficiency (%)	Loss (mW)
96.75	3.3351	1	3.3351	3.447	93.4149
346.7	3.335	50	166.75	48.096	179.95
608.7	3.3348	100	333.48	54.786	275.22
865.3	3.3345	150	500.175	57.804	365.125
1131.1	3.3341	200	666.82	58.953	464.28
1390.9	3.3337	250	833.425	59.920	557.475
1650	3.3333	300	999.99	60.605	650.01
2180	3.3325	400	1333	61.147	847
2706	3.3317	500	1665.85	61.561	1040.15

2.3 Thermal Image

The thermal image is shown in the following figure. Data was captured after delivering 0.5 A for 15 minutes with no airflow.

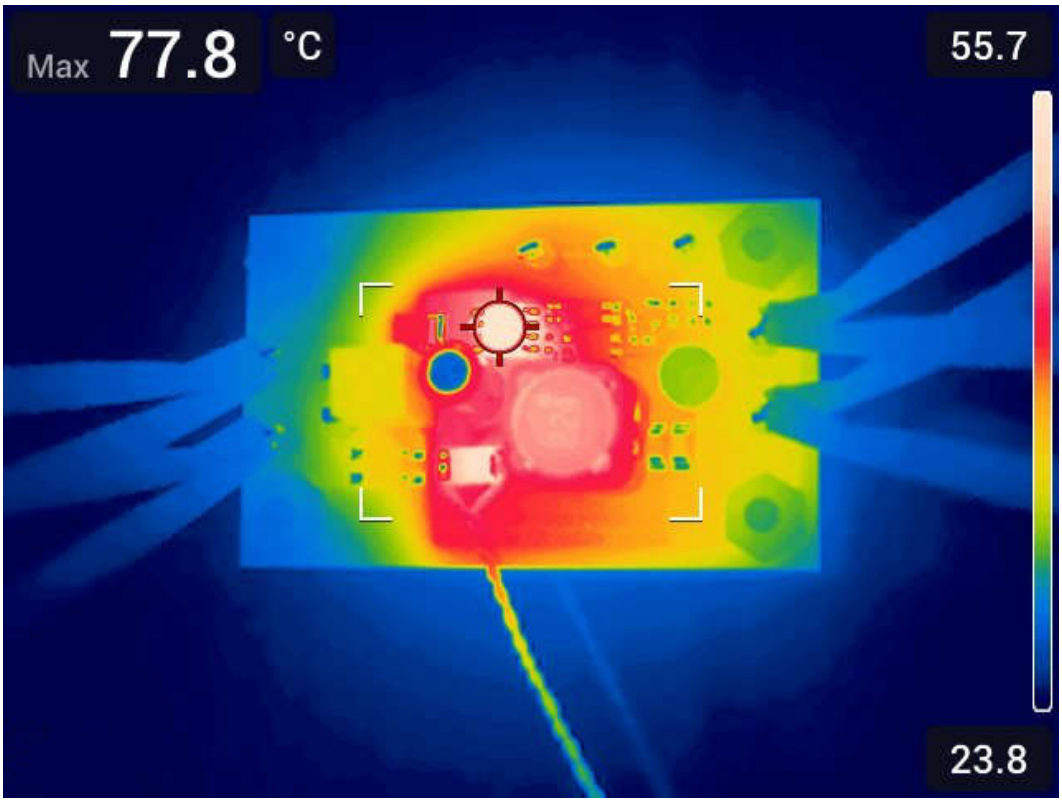


Figure 2-2. Thermal Image

2.4 EMI

EMI is shown in the following figure.

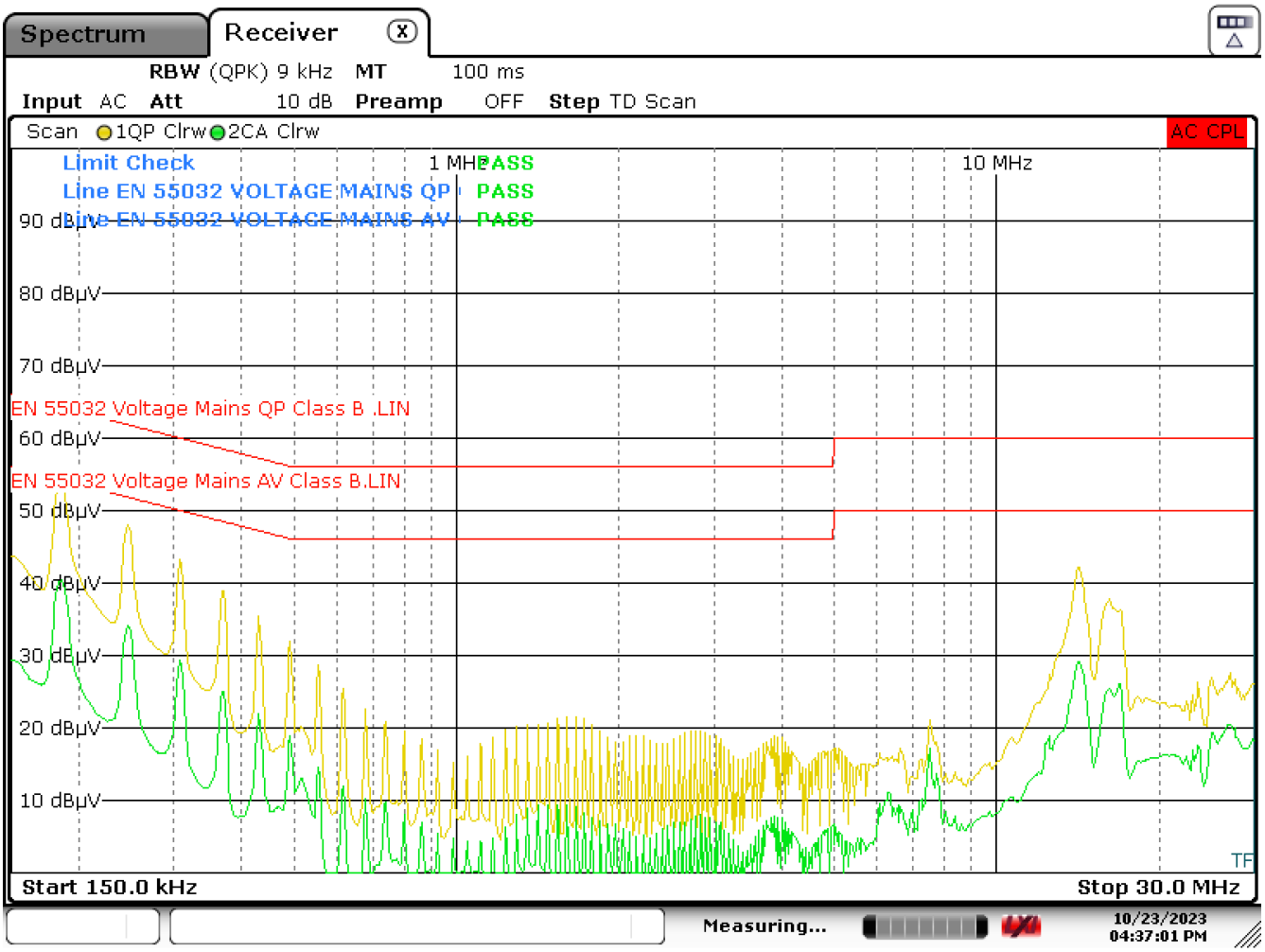


Figure 2-3. EMI

3 Waveforms

3.1 Switching Node and Output Voltage Ripple

Switching behavior and output voltage ripple is shown in the following figure.

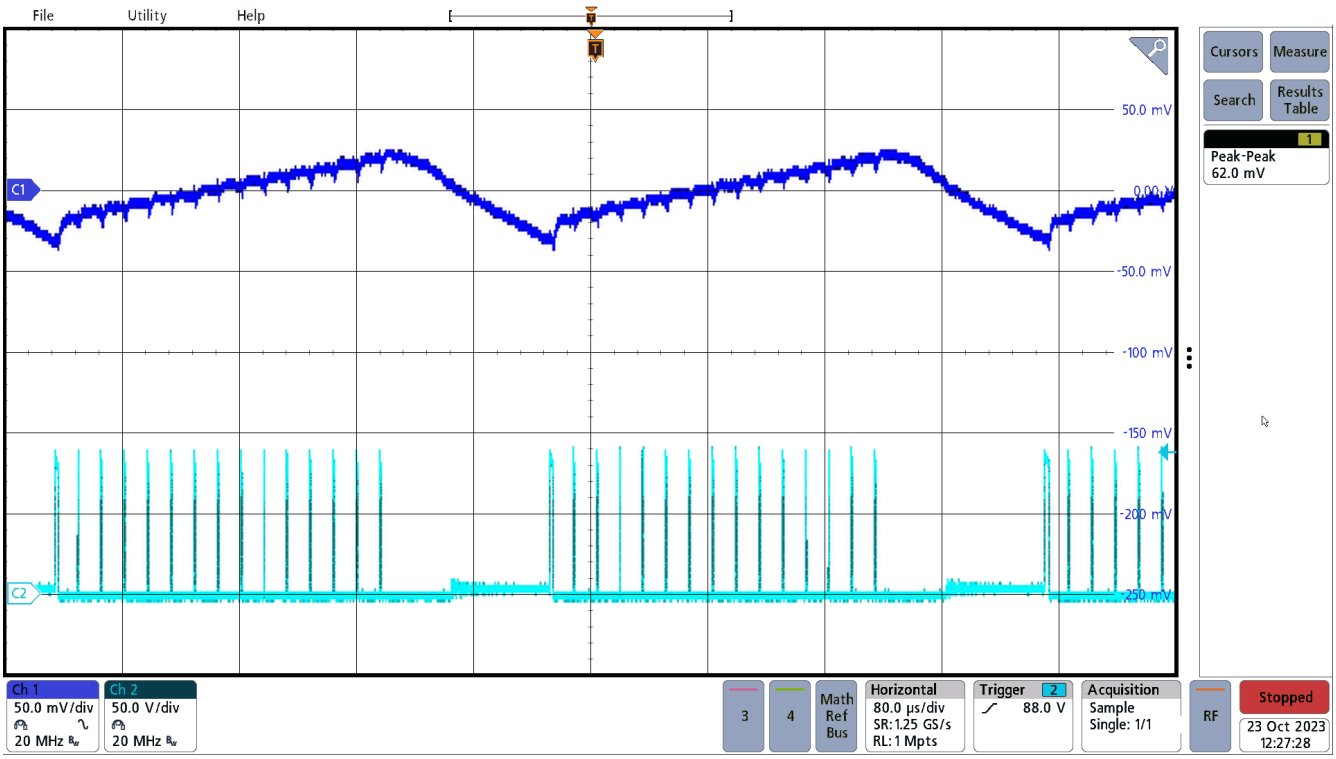


Figure 3-1. Switching Node and Output Ripple

3.2 Start-Up Sequence

Start-up behavior with a 120-Vac input is shown in the following figure.

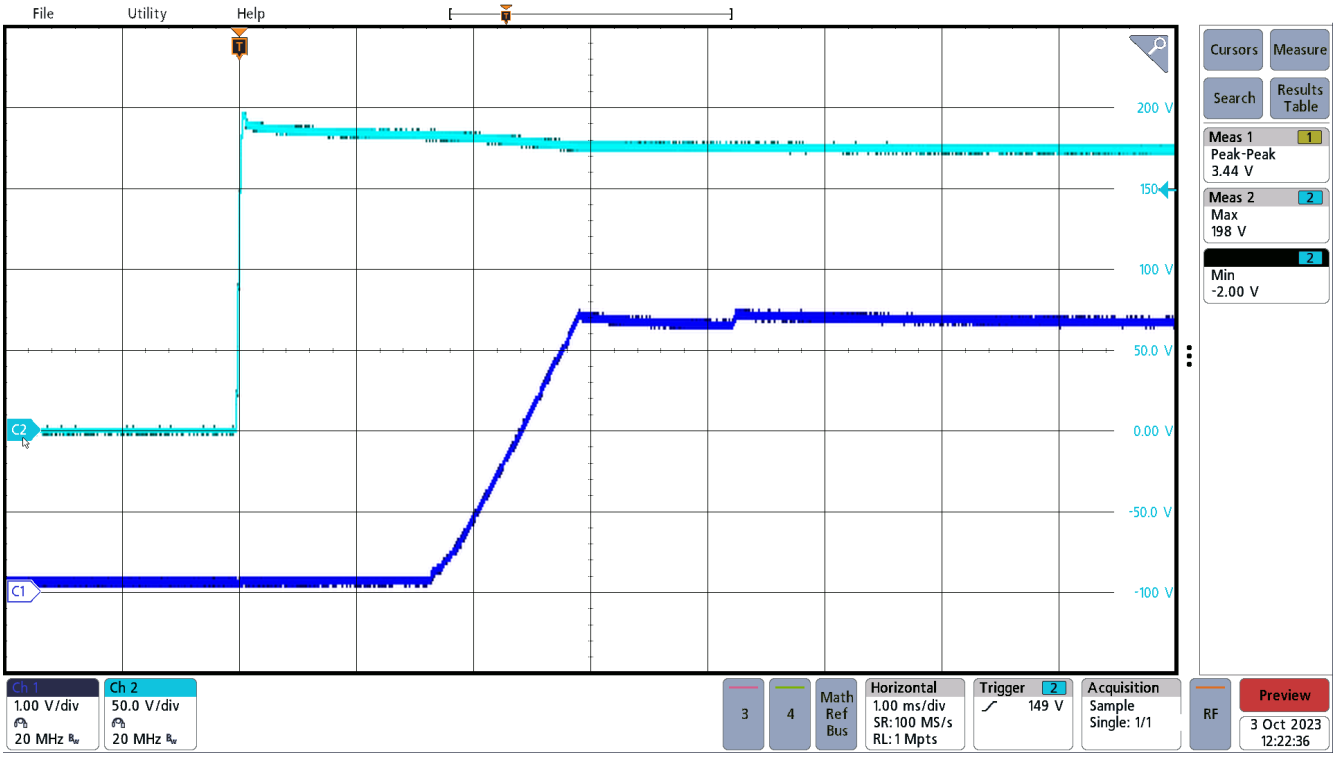


Figure 3-2. Start-Up

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