

Test Report: PMP23649

40W, 48V-to-1kV Non-Isolated DCM Flyback Converter Reference Design



Description

This reference design is a high-conversion ratio flyback converter that steps up a 48V input to a regulated 960V output. The single stage design achieves less than 0.5% output ripple with minimal output capacitance used. LM5156 is used to implement the non-synchronous current-mode control design. RES60A500-Q1 scales the output voltage to a safe level for the pulse-width modulation (PWM) controller.

Resources

[PMP23649](#)

[LM5155](#), [LM51551](#), [LM5156](#)

[LM5156H](#), [LM51561](#), [LM51561H](#)

[LM5155-Q1](#), [LM51551-Q1](#), [LM5156-Q1](#)

[LM5156H-Q1](#), [LM51561-Q1](#), [LM51561H-Q1](#)

[Design Folder](#)

[Product Folder](#)

[Product Folder](#)

[Product Folder](#)

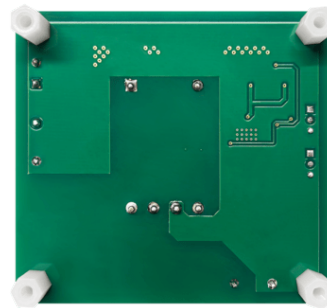
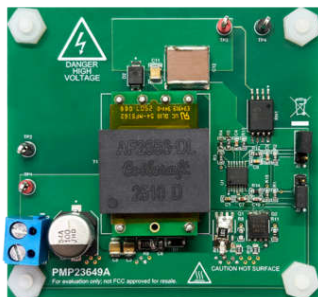
[Product Folder](#)

Features

- Low profile design, 12mm max component height
- <0.5% output ripple
- Single-side assembly with 2-layer PCB design

Applications

- [Parametric measurement unit \(PMU\)](#)



1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input voltage	48V
Output voltage	960V
Maximum output current	40mA
Switching frequency	225kHz

1.2 Required Equipment

- DC voltage supply
- DC electronic load
- Oscilloscope
- Digital multimeter
- High-voltage safety box

1.3 Considerations

- Unless noted, all tests were conducted with 40mA loading on the output
- All tests conducted in high-voltage safety box

1.4 Dimensions

PMP23649A is a two layer, 75 × 70mm PCB; max component height is 12mm.

2 Testing and Results

2.1 Efficiency Graphs

Efficiency and power loss data for a 40V input is shown in [Figure 2-1](#).

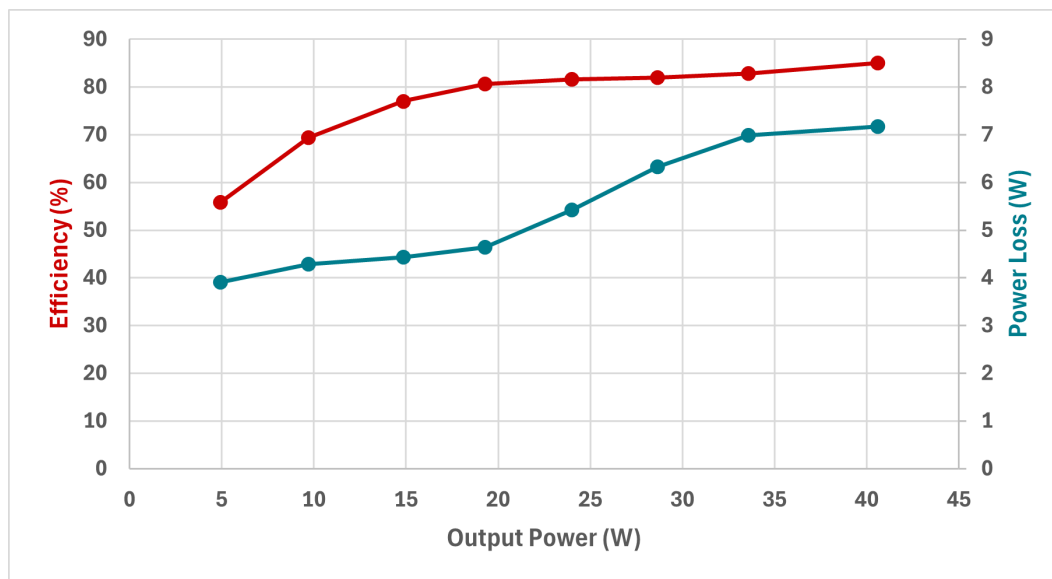


Figure 2-1. Efficiency and Power Loss Graph

2.2 Efficiency Data

Efficiency data is shown in [Table 2-1](#).

Table 2-1. Efficiency Data

Input			Output			Total	
Voltage (V)	Current (mA)	Power (W)	Voltage (V)	Current (mA)	Power (W)	Loss (W)	Efficiency (%)
47.94	184.2	8.83	954.7	5.16	4.93	3.90	55.79
47.94	292.1	14.00	954.8	10.18	9.72	4.28	69.41
47.94	402.1	19.28	954.8	15.55	14.85	4.43	77.02
47.94	499.1	23.93	954.8	20.20	19.29	4.64	80.61
47.94	613.8	29.43	954.8	25.14	24.00	5.42	81.57
47.94	729.6	34.98	954.8	30.01	28.65	6.32	81.92
47.94	846.0	40.56	954.8	35.16	33.57	6.99	82.77
47.94	996.0	47.75	954.8	42.50	40.58	7.17	84.99

2.3 Thermal Images

The thermal image is shown in [Figure 2-2](#). Image was captured after 15 minutes of full load operation with no airflow.

Measurements

Bx1	Max	96.7 °C
Bx2	Max	83.5 °C
Bx3	Max	85.1 °C
Bx4	Max	77.4 °C
Bx5	Max	71.7 °C

Parameters

Emissivity	0.96
Refl. temp.	20 °C

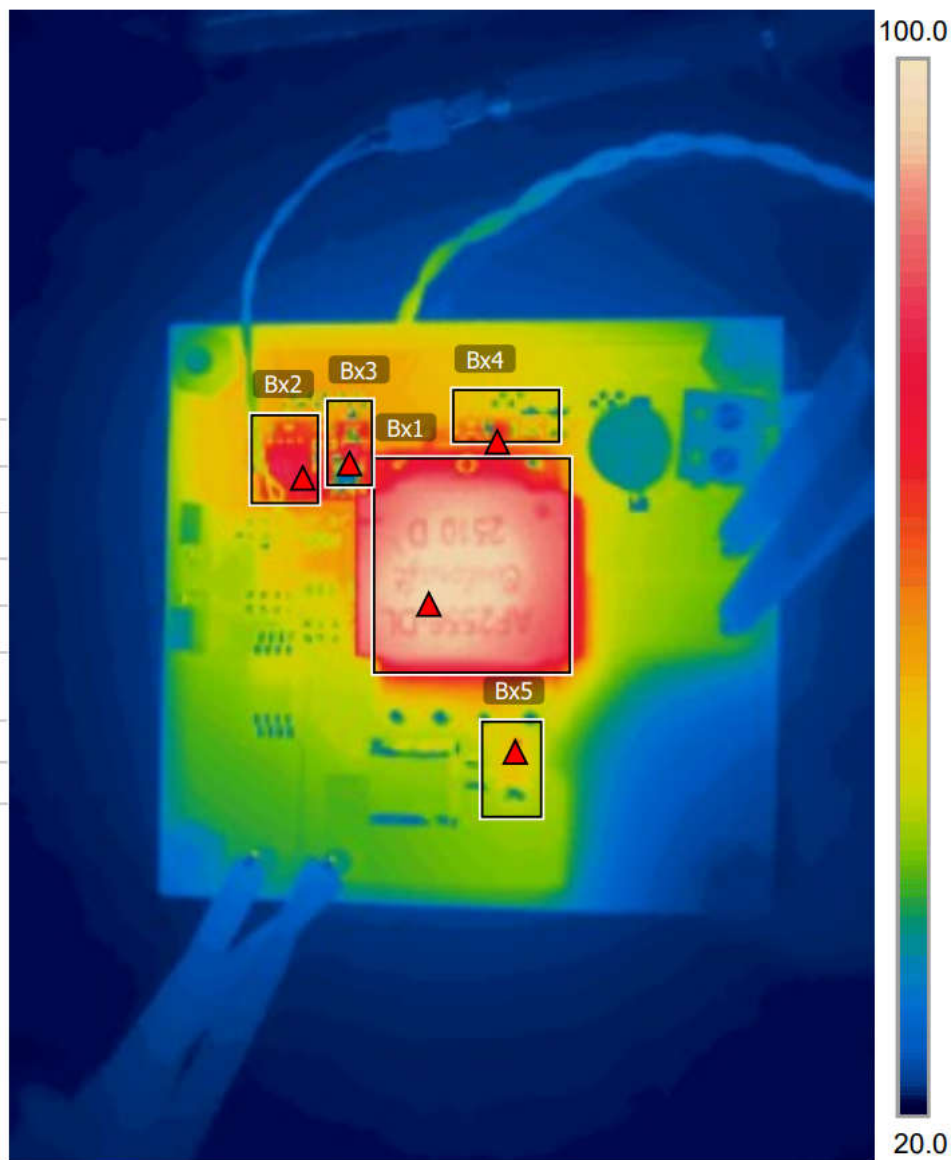


Figure 2-2. Thermal Image

3 Waveforms

3.1 Switching

Switching behavior waveforms are shown in [Figure 3-1](#) and [Figure 3-2](#).

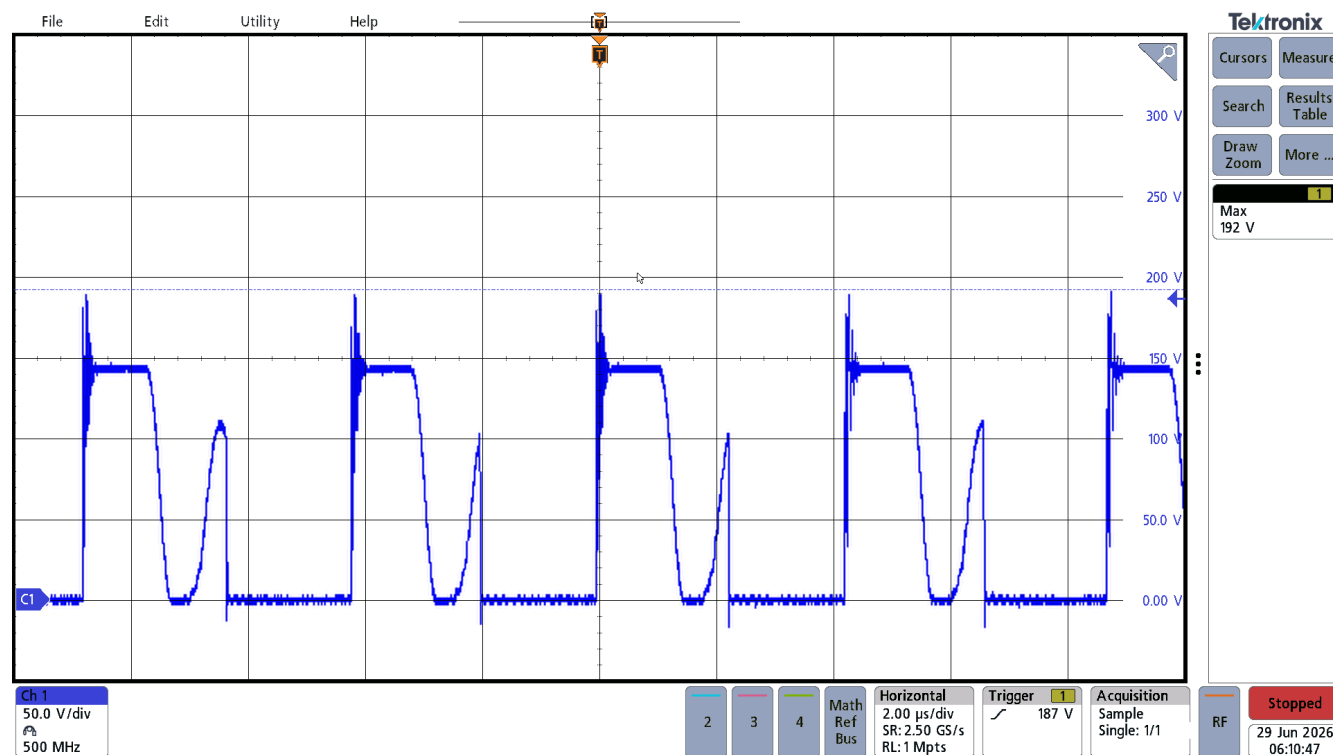


Figure 3-1. Primary Switch Node

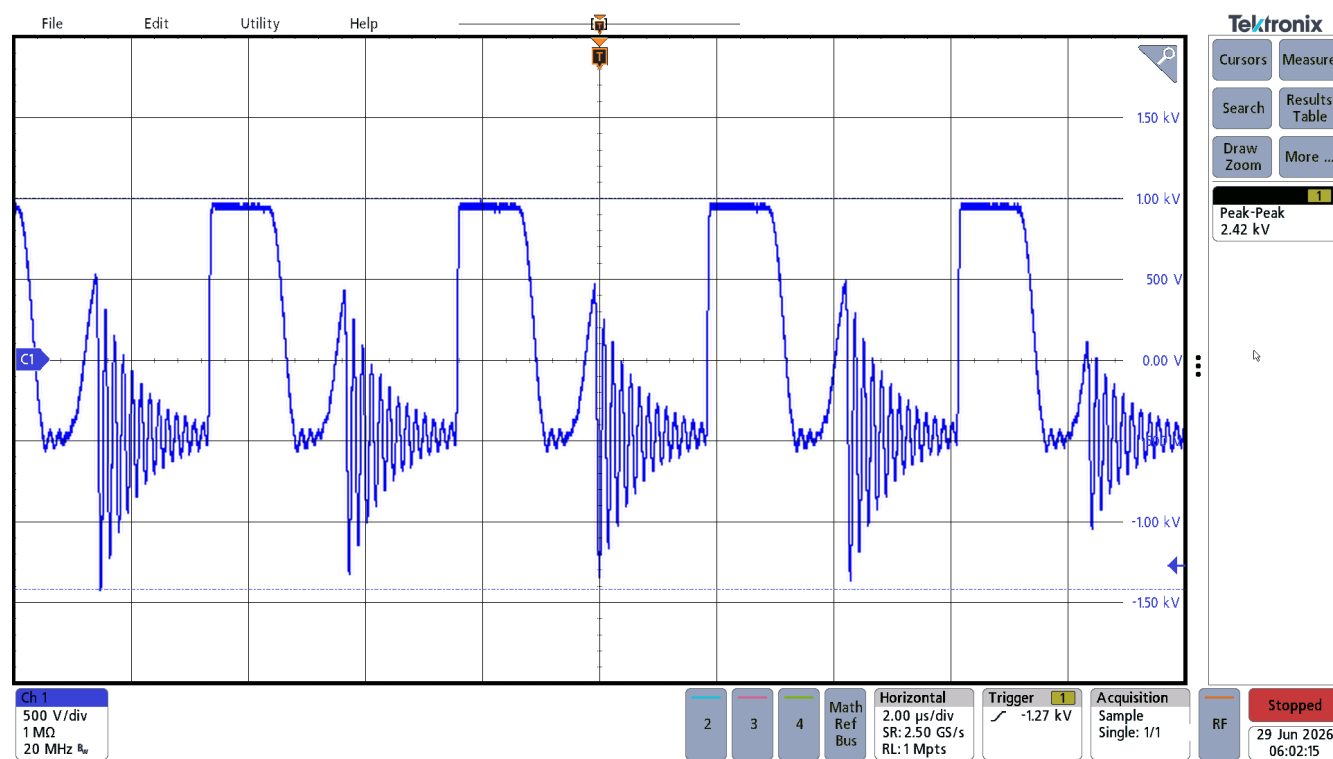


Figure 3-2. Output Rectifier Switch Node

3.2 Output Voltage Ripple

Output voltage ripple waveforms are shown in [Figure 3-3](#).

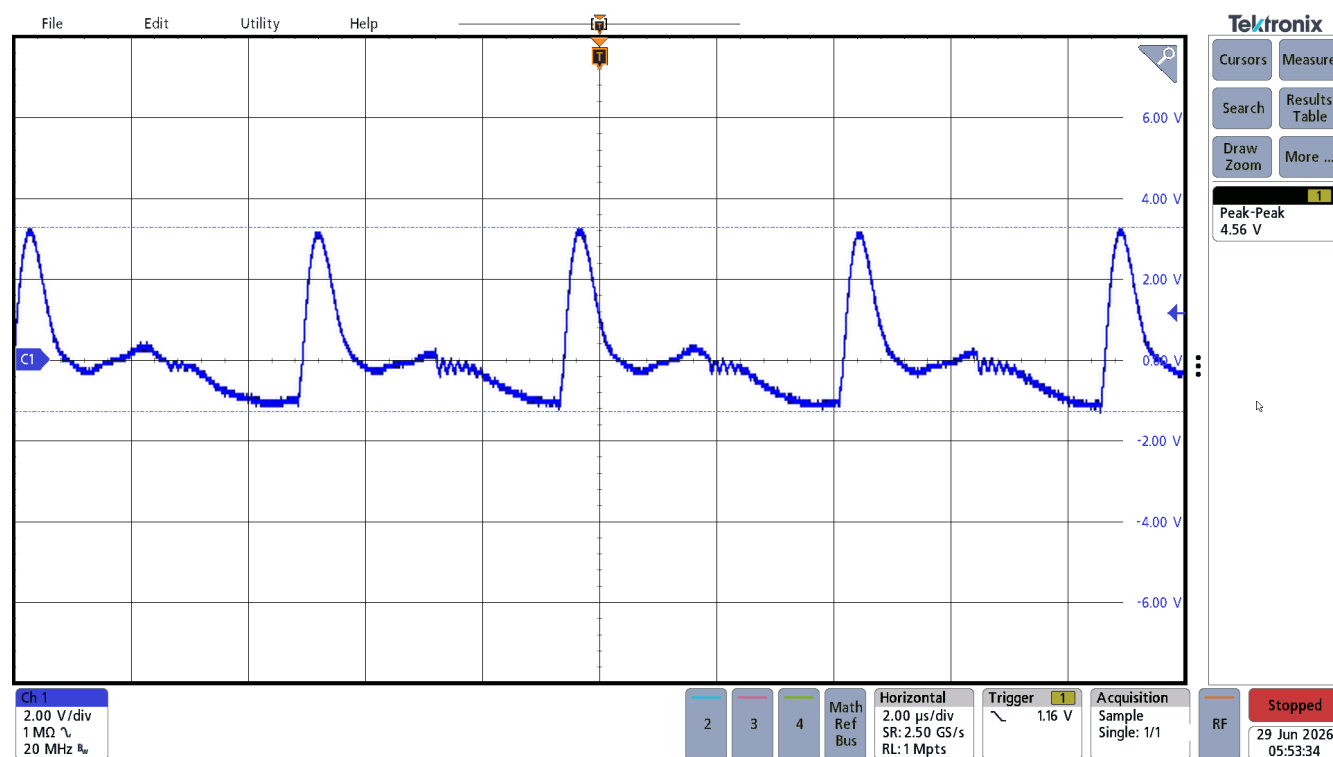


Figure 3-3. Output Voltage Ripple

3.3 Start-up Sequence

Start-up behavior waveforms are shown in [Figure 3-4](#).

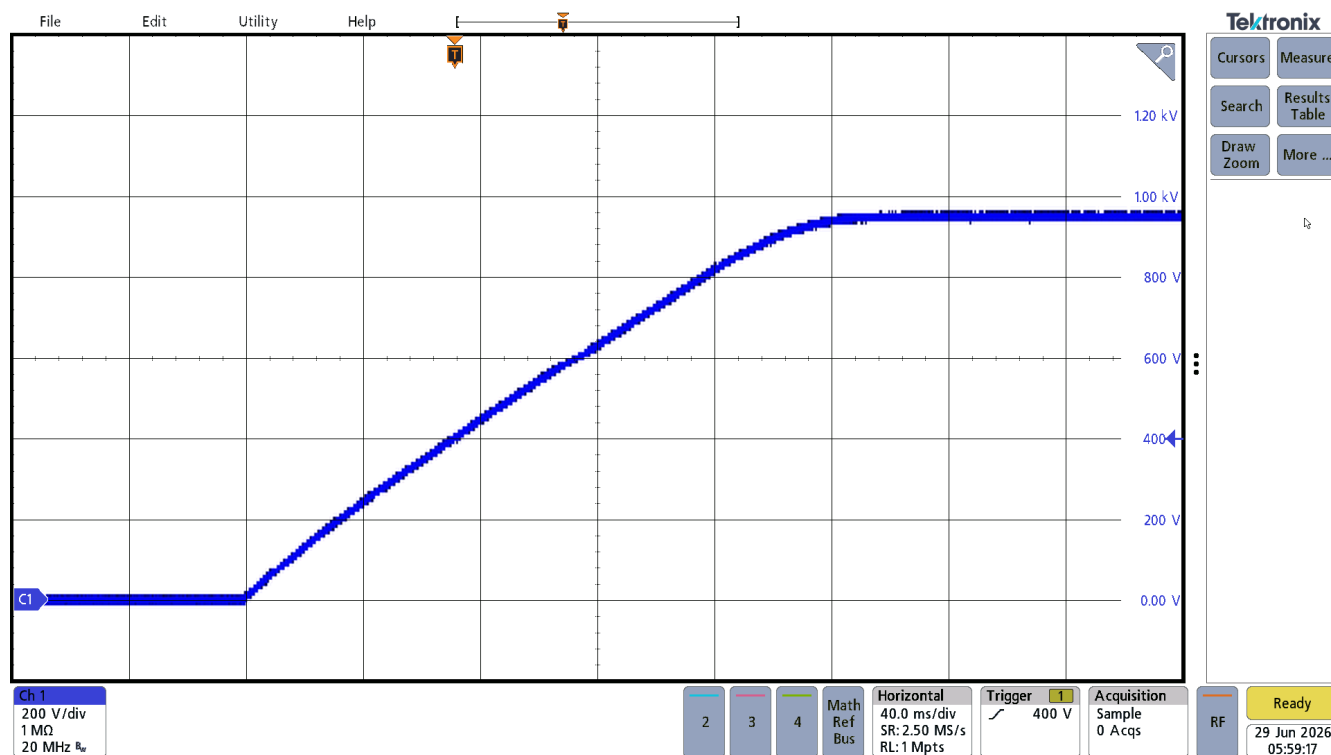


Figure 3-4. Start-up 1

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