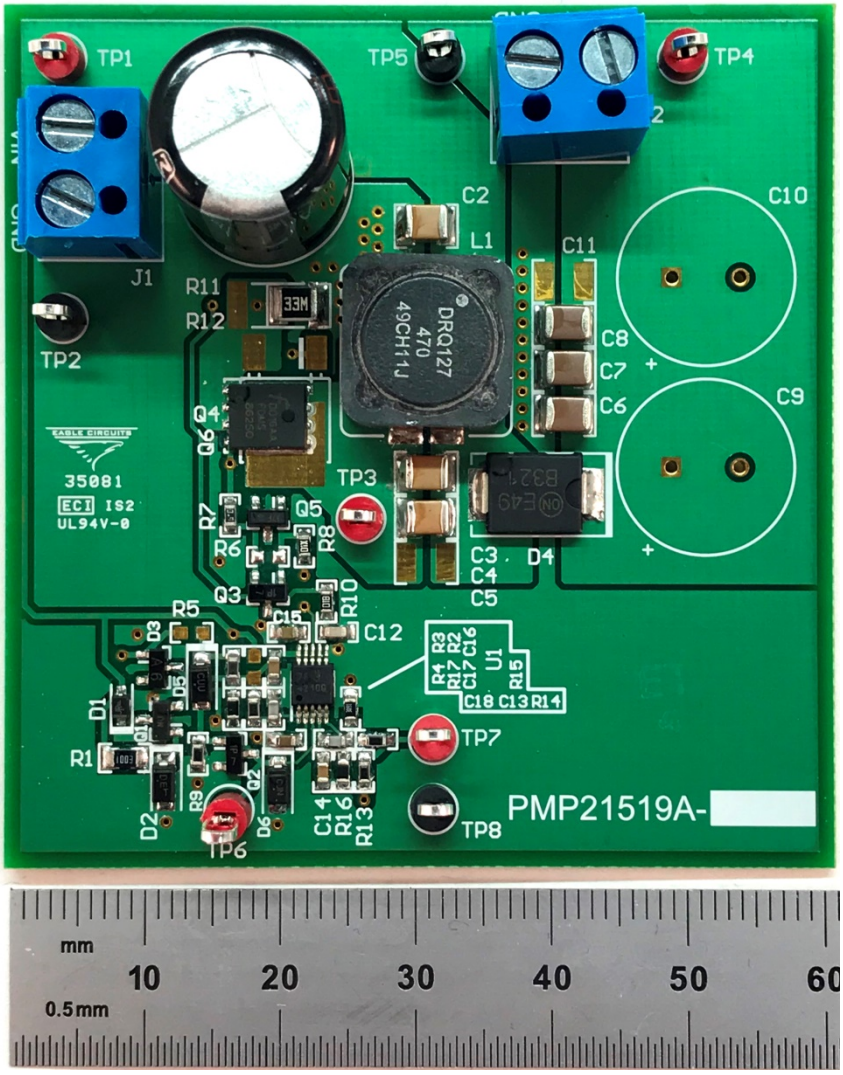
Test Report: PMP21519

Wide input voltage SEPIC converter power supply reference design for industrial applications

TEXAS INSTRUMENTS

Description

This SEPIC converter operates over an input voltage range of 10 V - 100 V and provides a non-isolated output of 12 V/1 A. Once operating, the 12-V output supplies bias power to the control circuit, allowing operation below 10 Vin. With efficiency greater than 85%, this converter can tolerate multiple input rail ranges, allowing one converter to satisfy many applications.



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1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input voltage range	10 V – 100 V
SEPIC output voltage	12 V
SEPIC output current	1 A
Switching frequency	200kHz

1.2 Required Equipment

- Power supply capable of 100 V and 3 A
- 5 A Active or resistive load
- Digital Multimeters
- 500 MHz oscilloscope and probes
- Stability measurement device (Venable)

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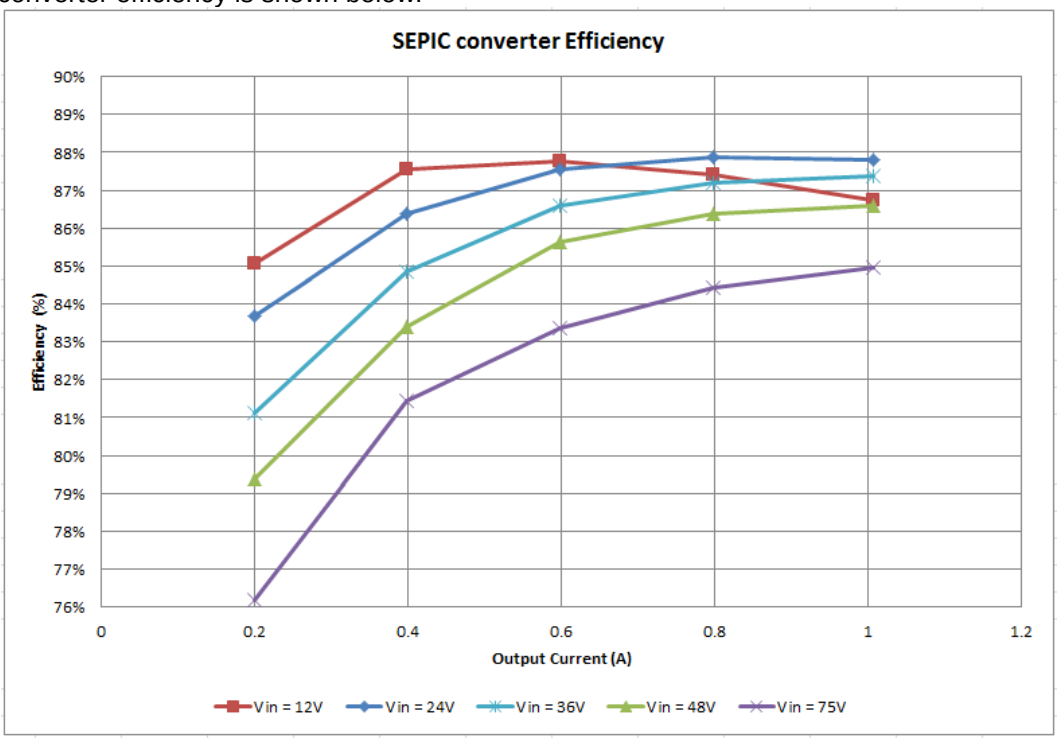
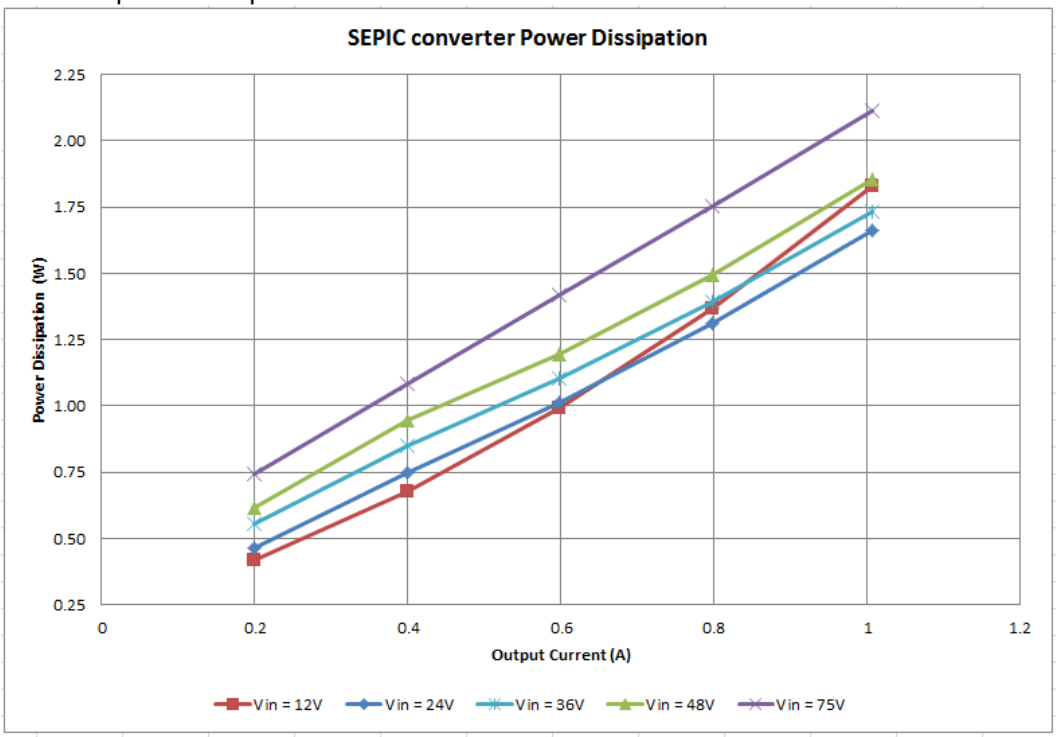
2 Testing and Results

2.1 Efficiency and Regulation Graphs

The SEPIC converter efficiency is shown below.



The SEPIC converter power dissipation is shown below.



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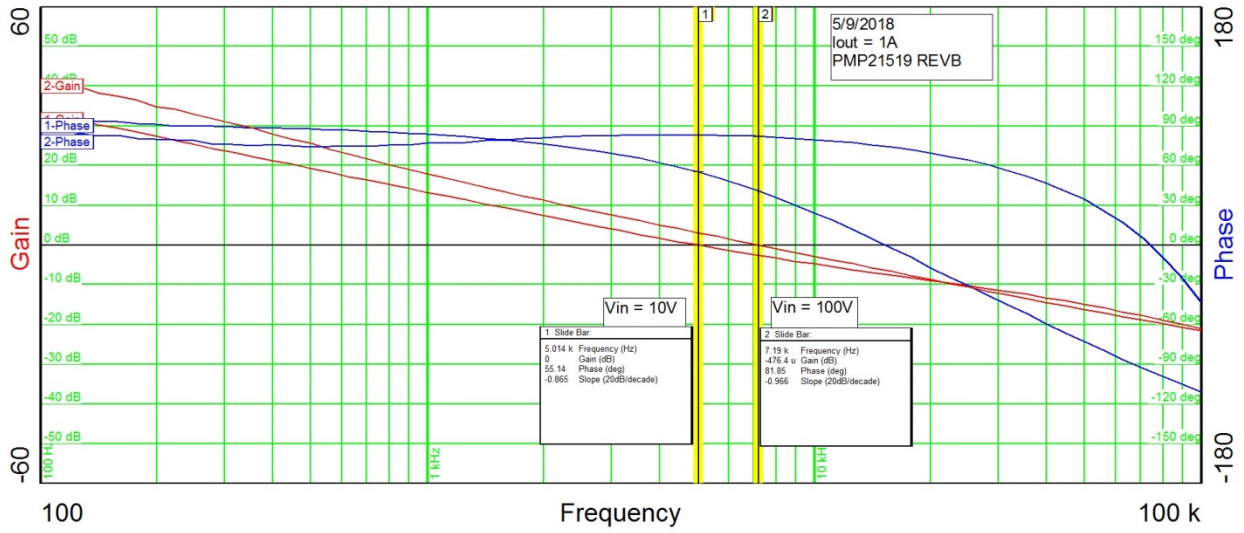
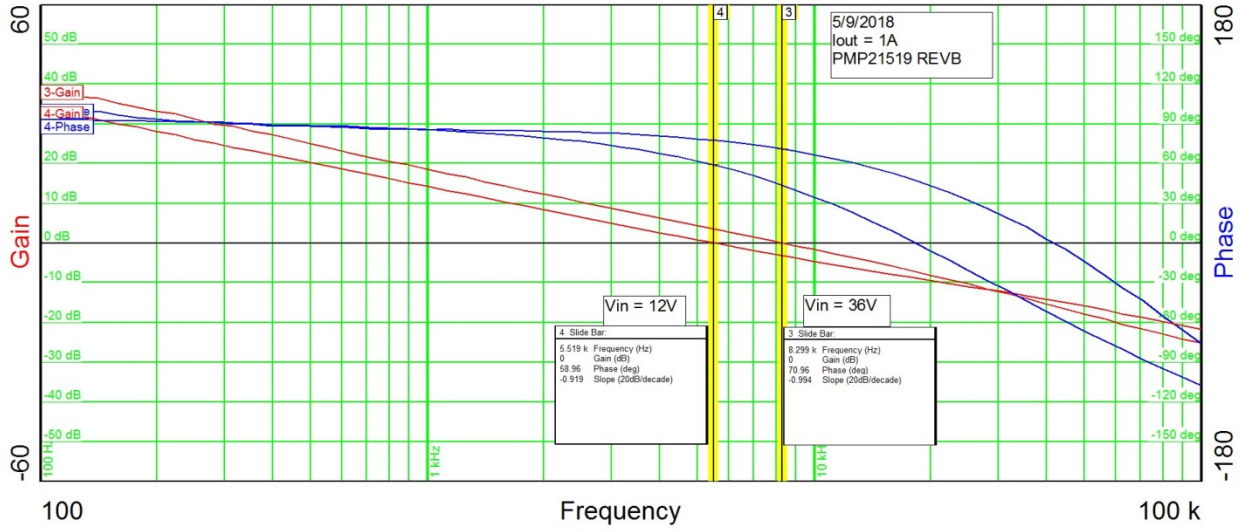
2.2 SEPIC Loop Gain

The plots below shows the loop gain with the output loaded at 1 A.

Loop Gain (Vin = 10 V)	BW: 5.01 kHz	PM: 55 degrees
Loop Gain (Vin = 100 V)	BW: 7.19 kHz	PM: 82 degrees



Loop Gain (Vin = 12 V)	BW: 5.52 kHz	PM: 59 degrees
Loop Gain (Vin = 36 V)	BW: 8.30 kHz	PM: 71 degrees



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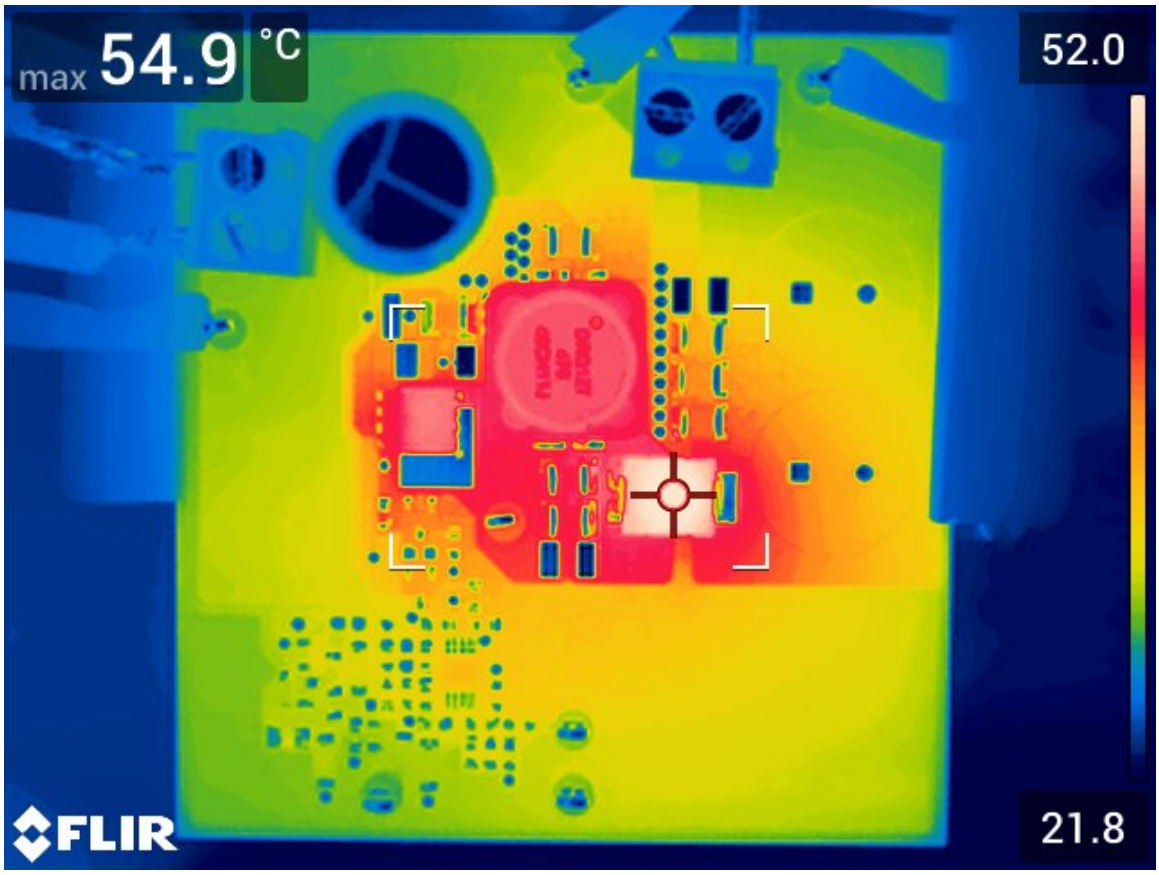
2.3 Thermal Image

A thermal image is shown below when operating at 36 V input, 12 V @ 1 A output and no air flow.



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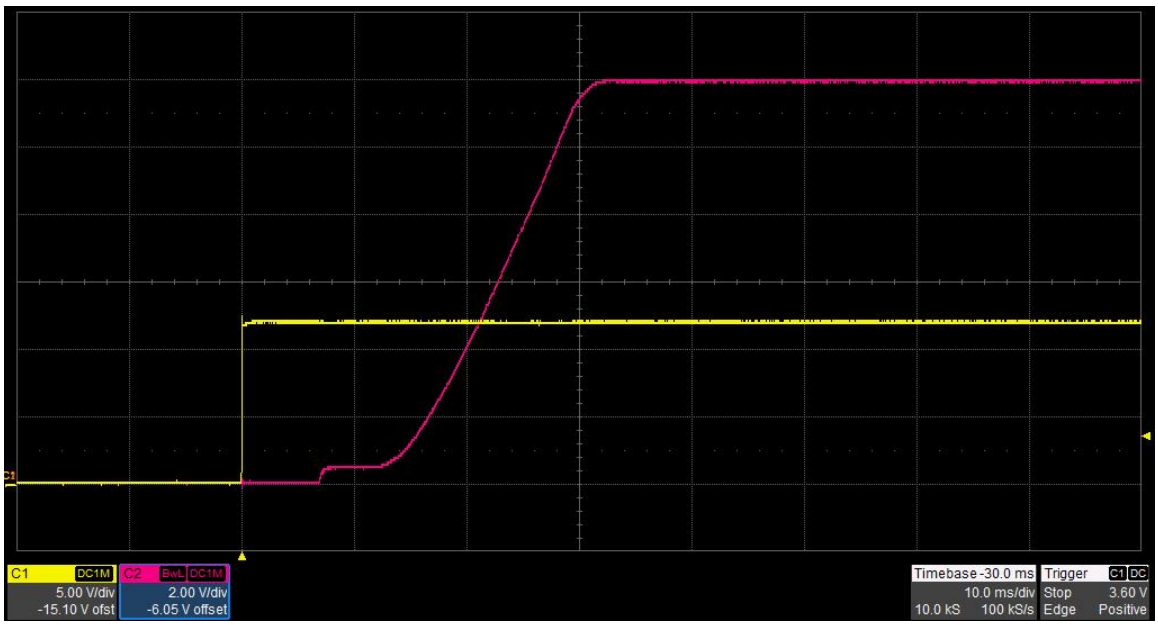
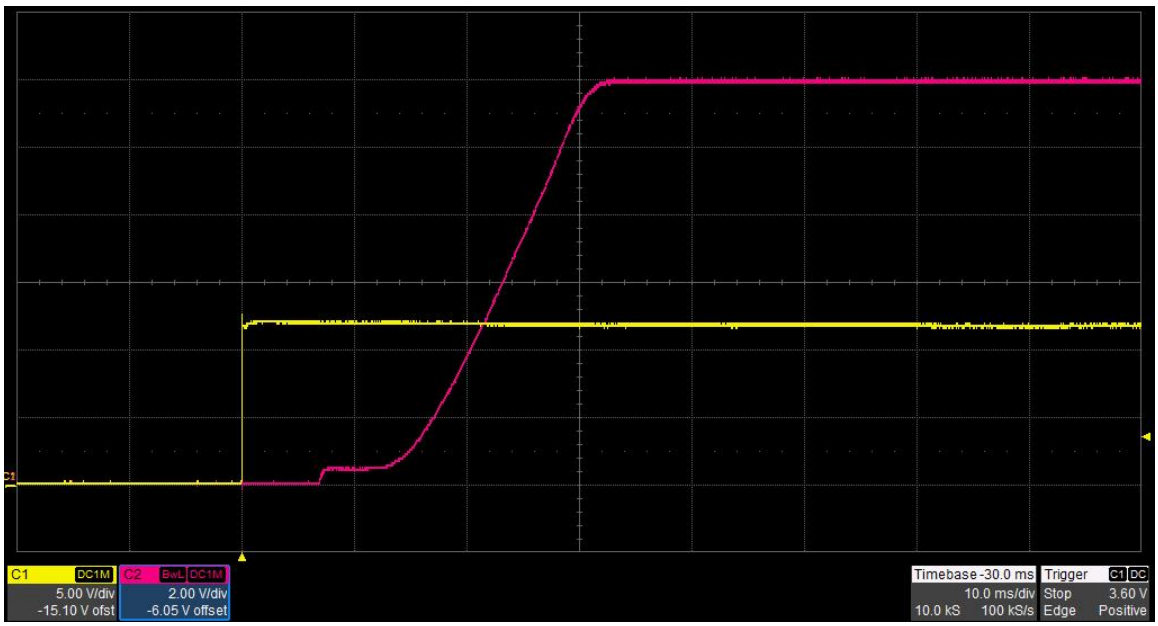
3 Waveforms

3.1 Startup

The photo below shows the 12 V output voltage startup waveforms after the application of 12 Vdc input. The output was loaded with to 0 A. (Vin is 5 V/DIV, Vout is 2 V/DIV, 10 mS/DIV)



The photo below shows the 12 V output voltage startup waveforms after the application of 12 Vdc input. The output was loaded with to 1 A. (Vin is 5 V/DIV, Vout is 2 V/DIV, 10 mS/DIV)



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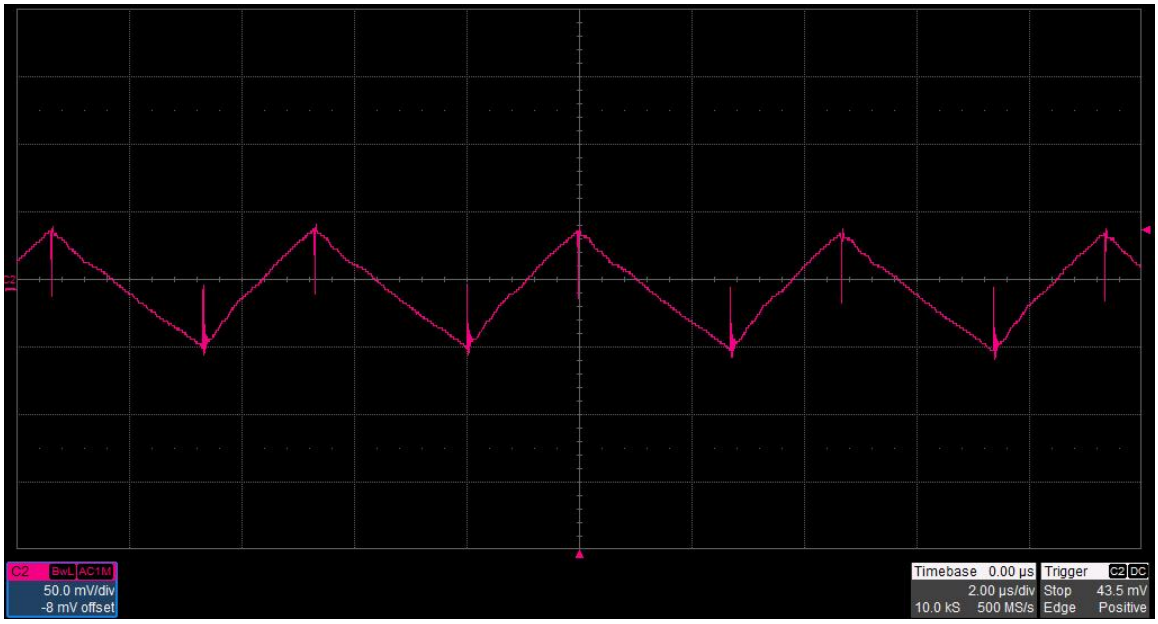
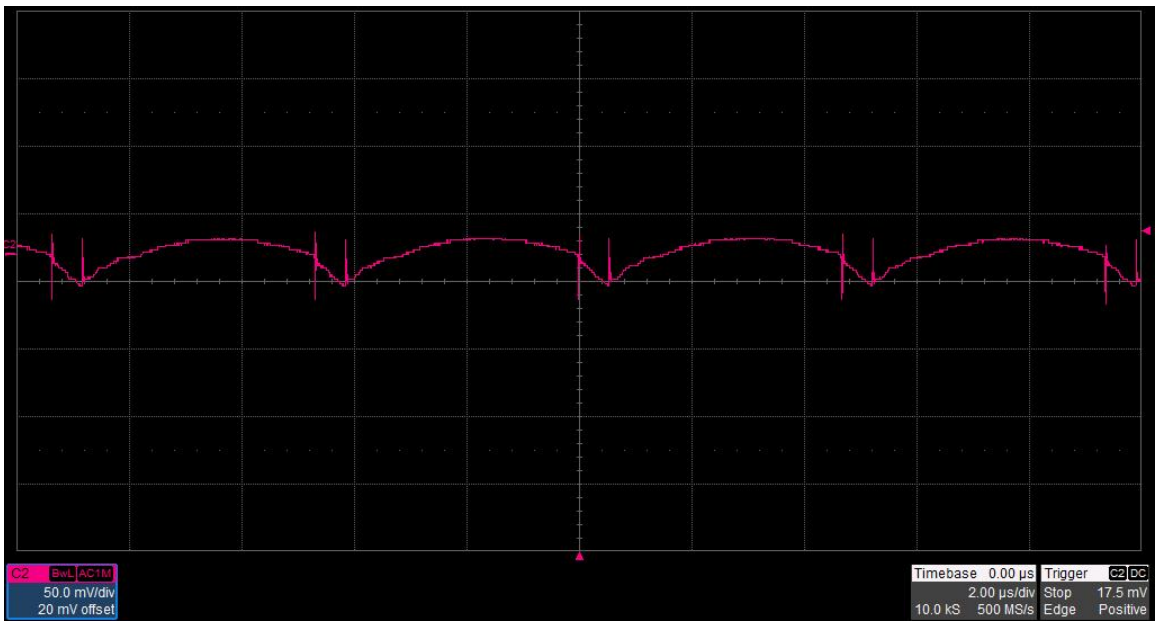
3.2 Output Ripple Voltage

The 12 V output ripple voltage is shown in the figure below. The image was taken with the output loaded to 1 A and the input voltage set to 10 Vdc. (50 mV/DIV, 2 uS/DIV)



The 12 V output ripple voltage is shown in the figure below. The image was taken with the output loaded to 1 A and the input voltage set to 100 Vdc. (50 mV/DIV, 2 uS/DIV)



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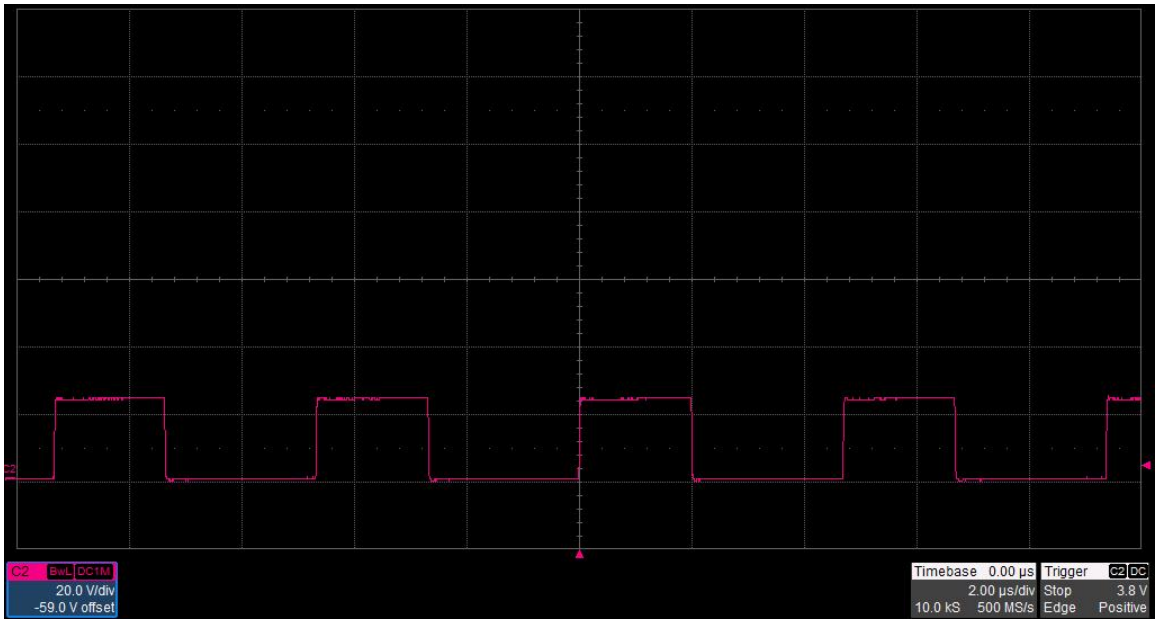
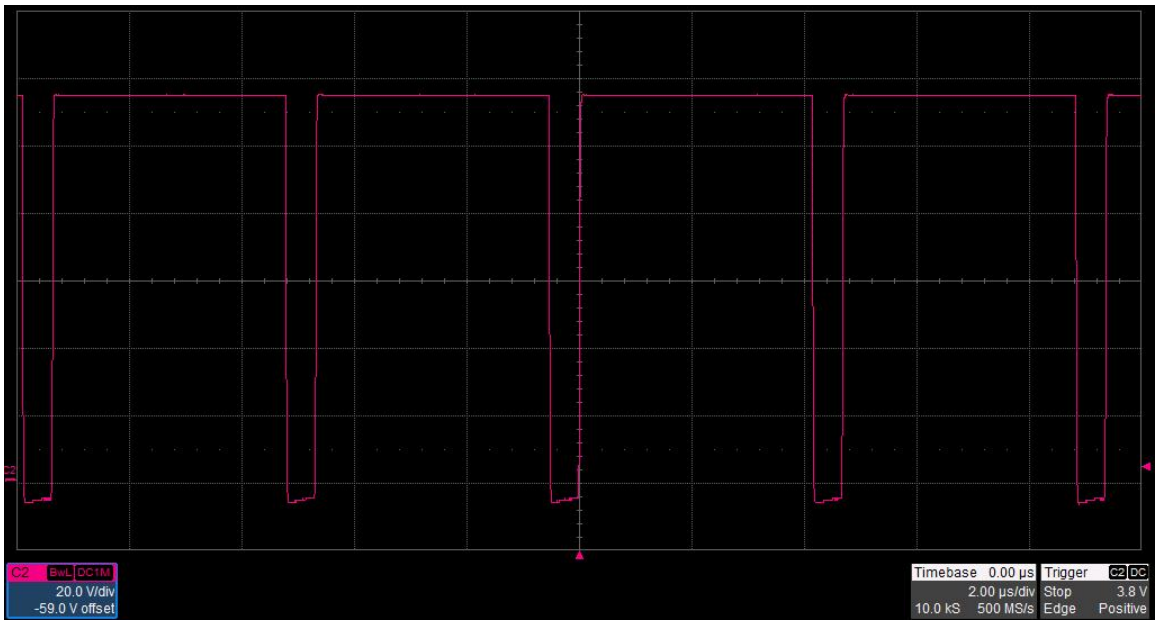
3.3 Switch Node Waveforms

The photo below is the N-ch FET drain waveform. The input voltage is 10 V and the output is loaded to 1 A. (20 V/DIV, 2 uS/DIV)



The photo below is the N-ch FET drain waveform. The input voltage is 100 V and the output is loaded to 1 A. (20 V/DIV, 2 uS/DIV)



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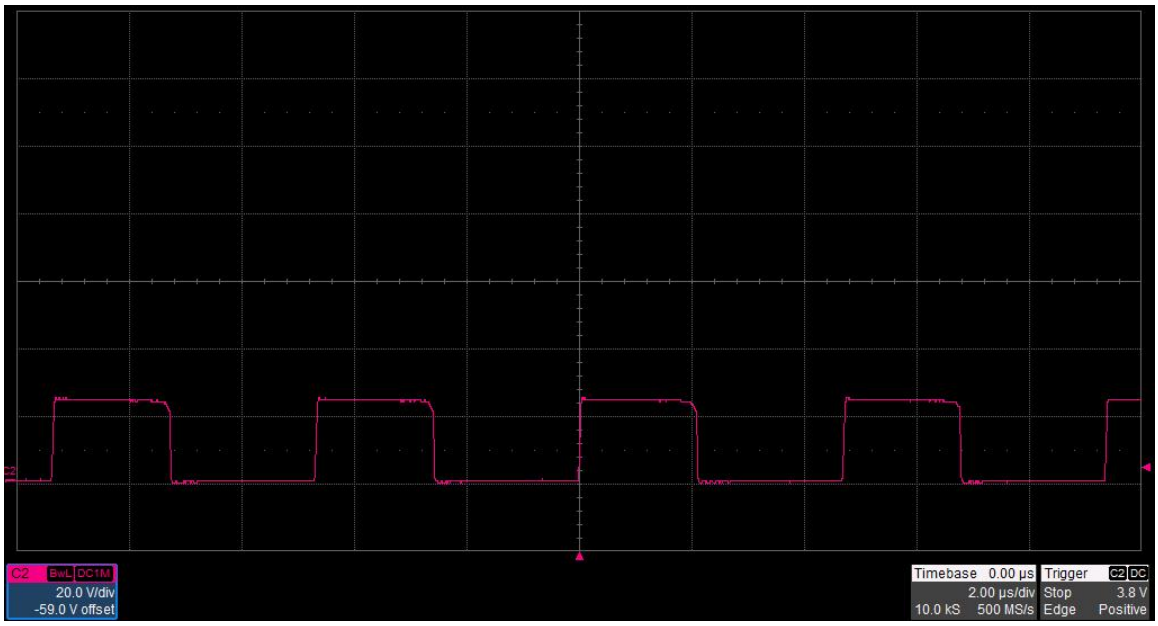
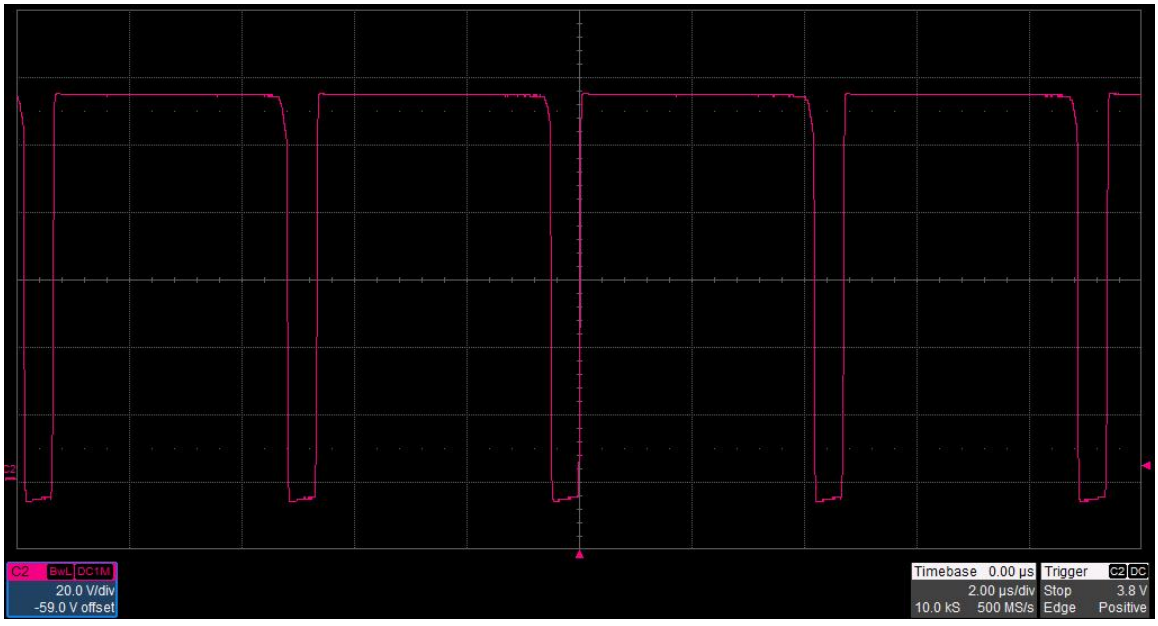
The photo below is the N-ch FET drain waveform. The input voltage is 10 V and the output is loaded to 0.1 A. The converter is operating in DCM. (20 V/DIV, 2 uS/DIV)



The photo below is the N-ch FET drain waveform. The input voltage is 100 V and the output is loaded to 0.45 A. The converter is operating in DCM. (20 V/DIV, 2 uS/DIV)



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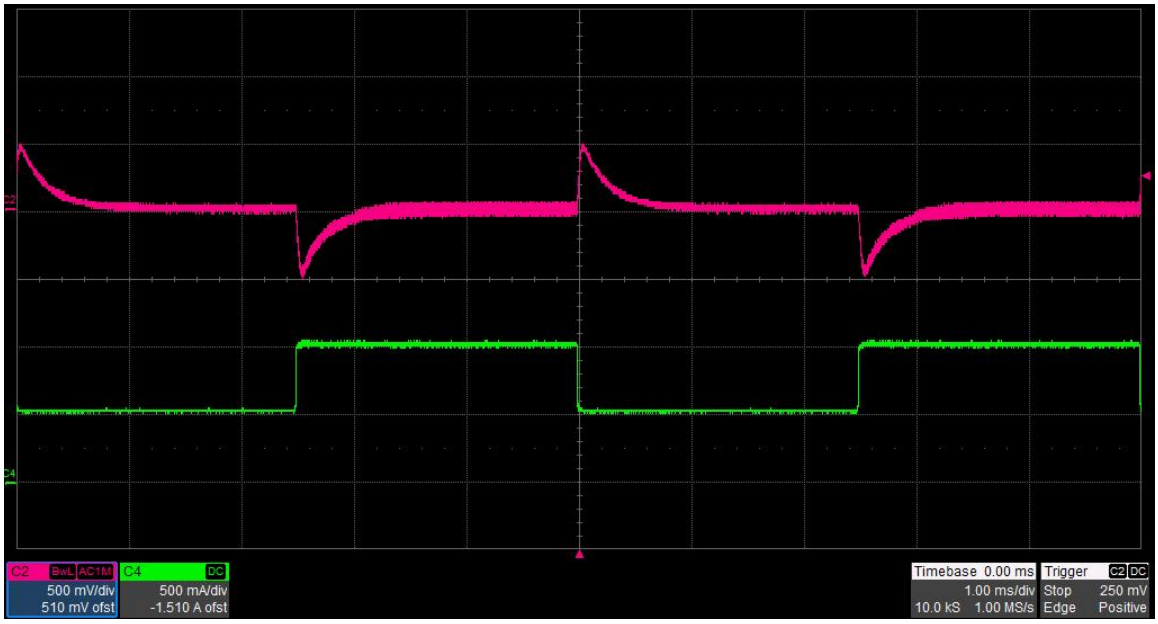
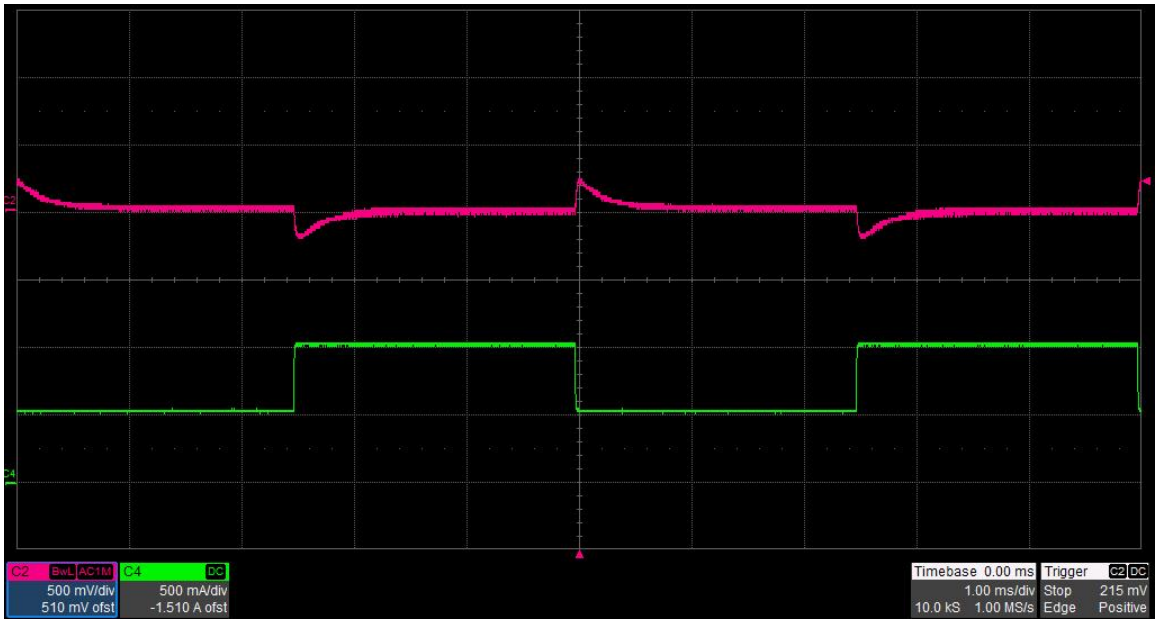
3.4 Load Transient

The photo below shows the 12 V output voltage (top, ac coupled) when the load current is stepped between 0.5 A to 1 A. Vin = 10 Vdc (500 mV/DIV, 500 mA/DIV, 1 mS/DIV)



The photo below shows the 12 V output voltage (top, ac coupled) when the load current is stepped between 0.5 A to 1 A. Vin = 100V dc (500 mV/DIV, 500 mA/DIV, 1 mS/DIV)



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