

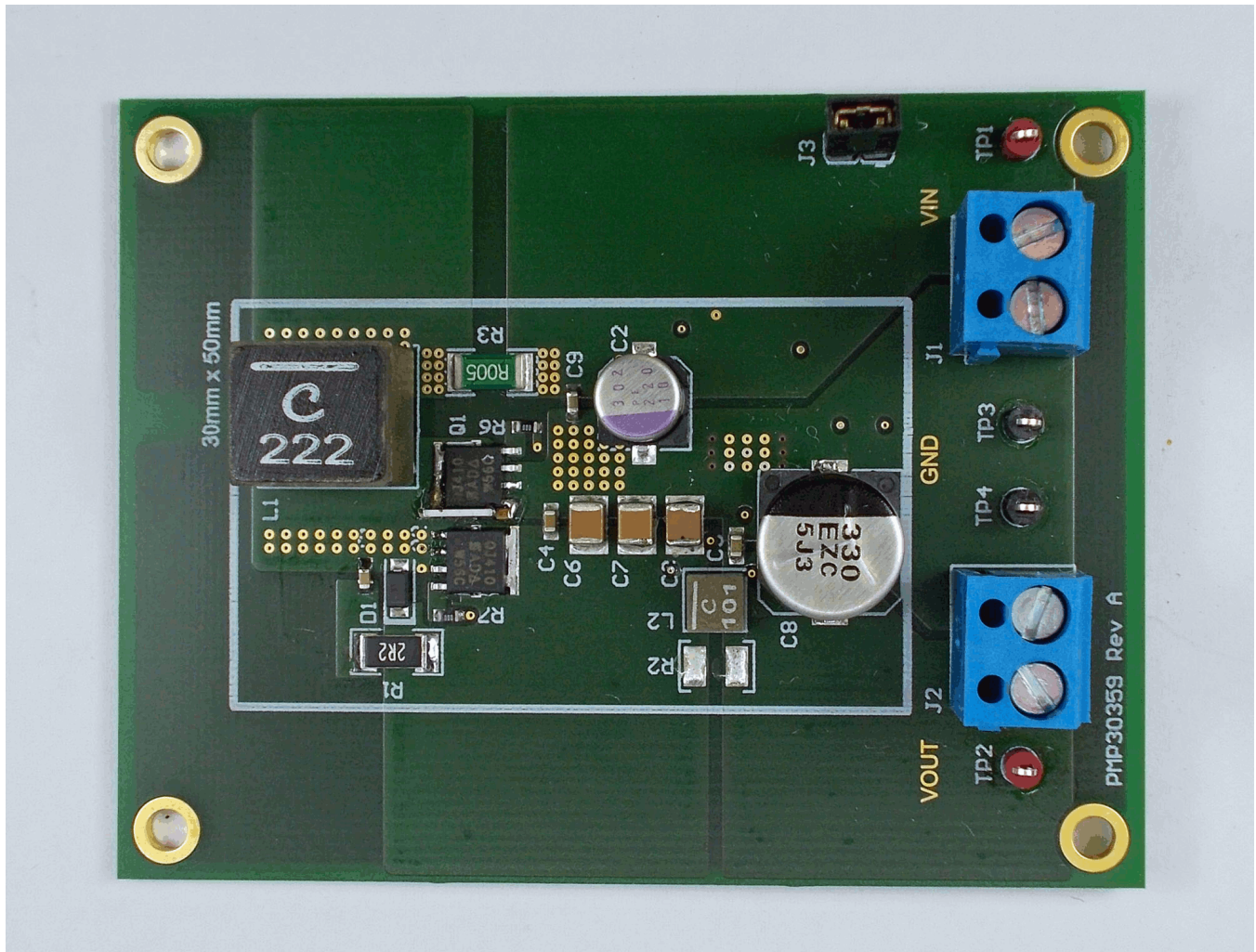
## Test Report: PMP30359

# 28-W/49-W Automotive Boost Converter Reference Design for ADAS Applications



## Description

This reference design features an automotive synchronous boost converter, which can be configured for two different output voltages. A regulated input voltage of 5.0 V is converted to either 8.0 V or 14.0 V. The maximum load current for both output voltages is 3.5 A. The design has been space optimized to fit into an area of 30 mm x 50mm in order to fit into ADAS applications.



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## 1 Test Prerequisites

### 1.1 Voltage and Current Requirements

**Table 1. Voltage and Current Requirements**

PARAMETER	SPECIFICATIONS
$V_{IN}$	5.0 V
$V_{OUT}$	8.0 V or 14.0 V @ 3.5 A
Nominal switching frequency	350 kHz

## 2 Testing and Results

### 2.1 Efficiency Graphs

Figure 1. Efficiency of the 8.0 V output at 5.0 V in

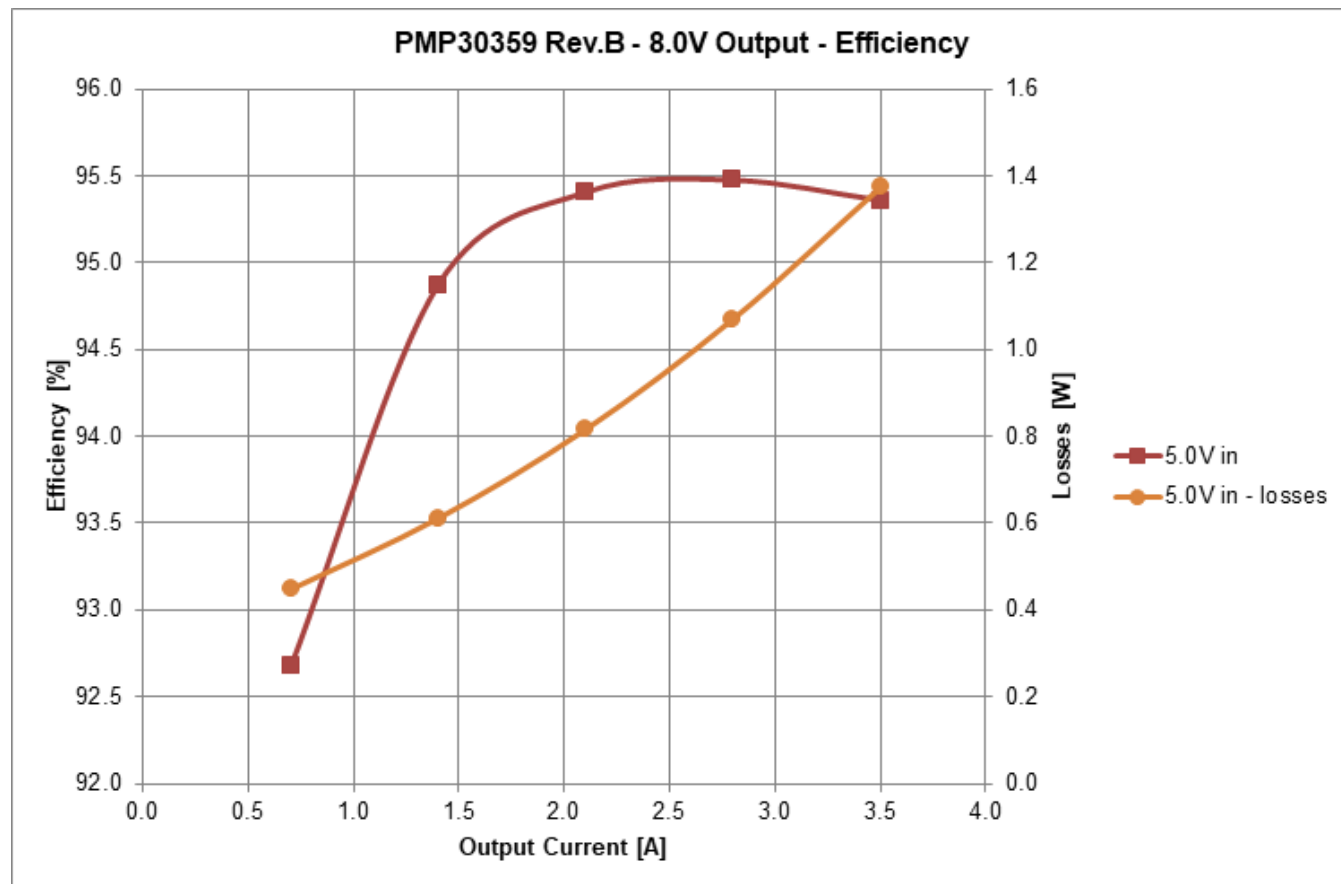
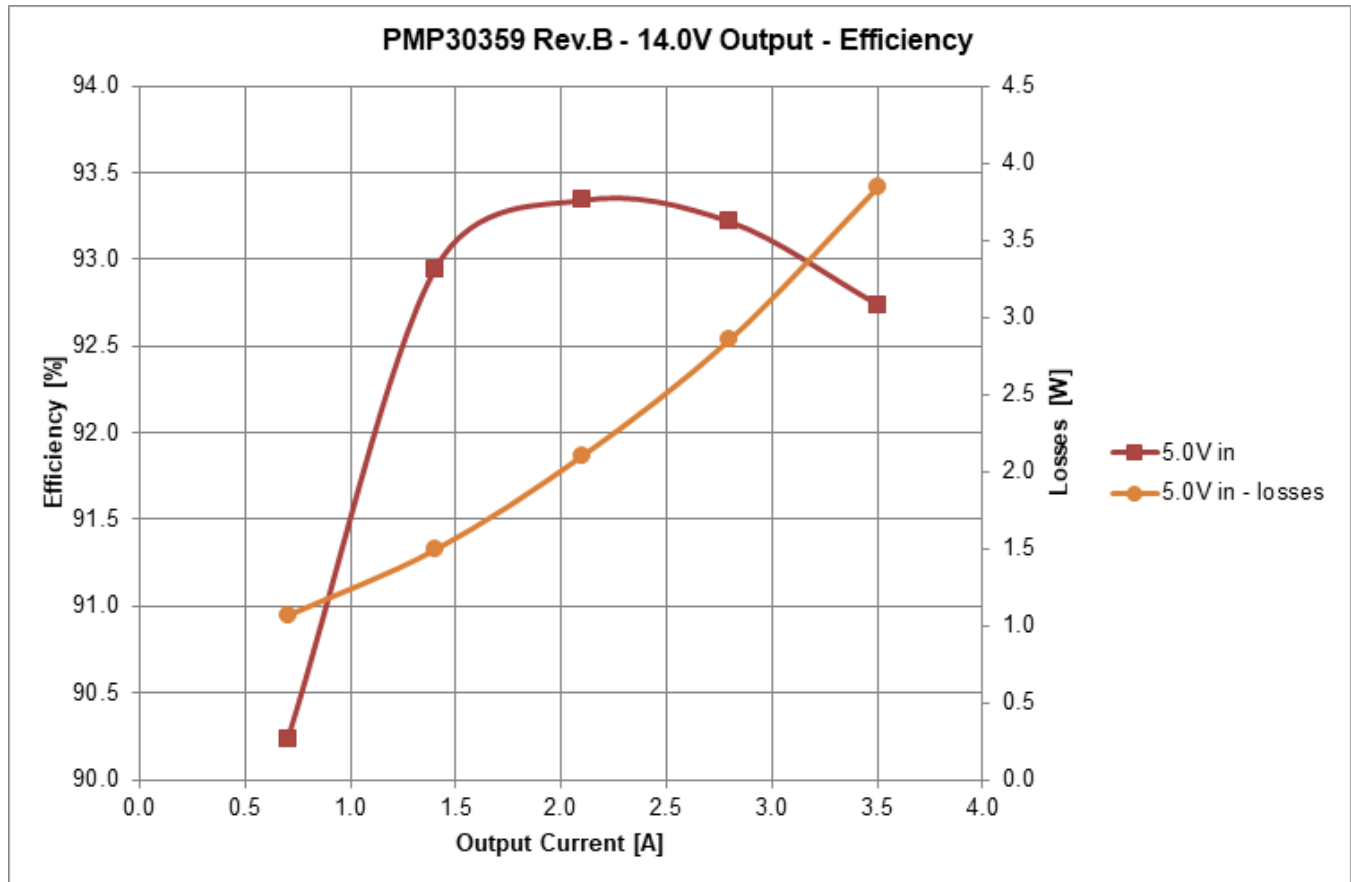


Figure 2. Efficiency of the 14.0 V output at 5.0 V in



## 2.2 Efficiency Data

Table 2. Efficiency data for the 8.0 V output

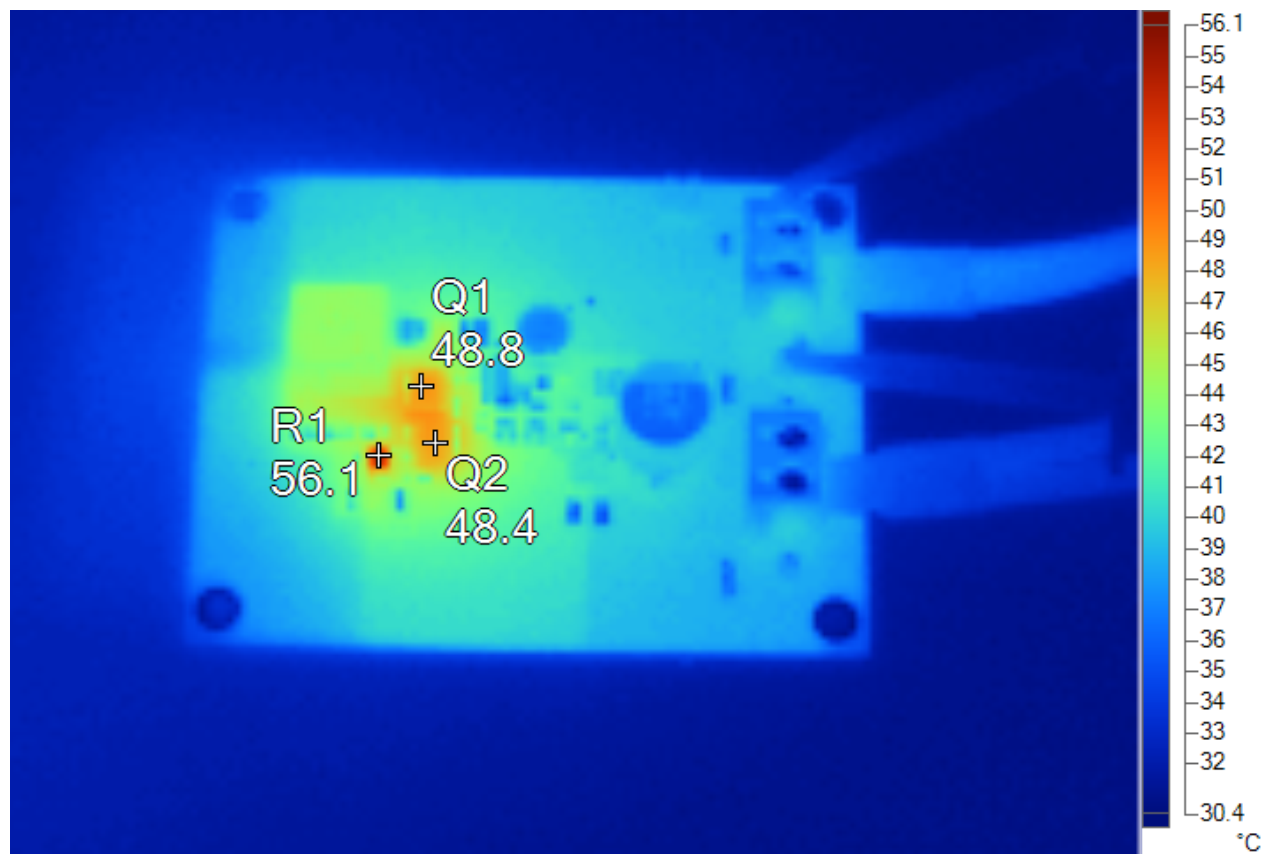
Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
4.990	1.224	6.108	8.059	0.702	5.661	0.447	92.7
4.986	2.387	11.901	8.059	1.401	11.291	0.610	94.9
4.981	3.565	17.758	8.060	2.102	16.942	0.816	95.4
4.977	4.752	23.649	8.061	2.801	22.579	1.070	95.5
4.972	5.956	29.612	8.061	3.503	28.238	1.374	95.4

Table 3. Efficiency data for the 14.0 V output

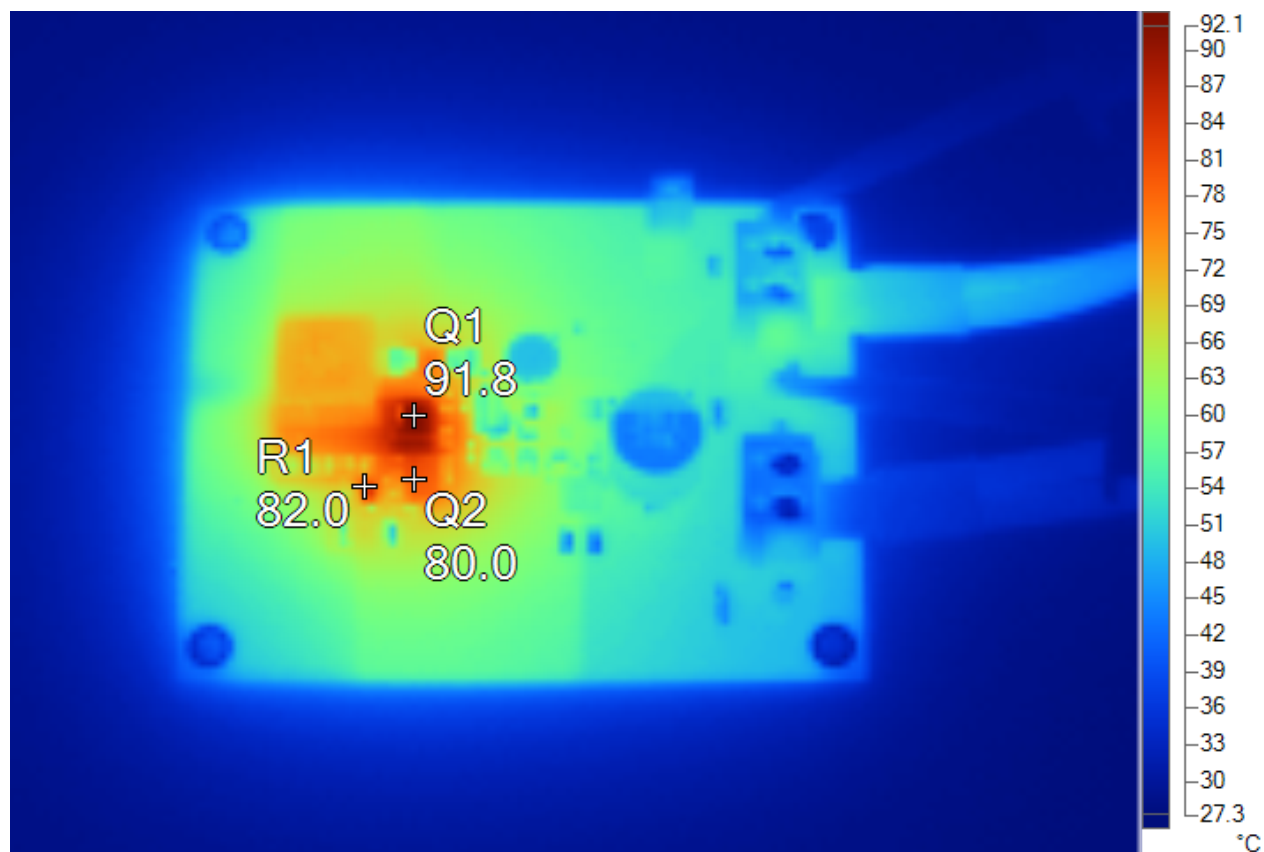
Voltage [V]	Current [A]	Power [W]	Voltage [V]	Current [A]	Power [W]	Losses [W]	Efficiency [%]
4.987	2.187	10.905	14.010	0.702	9.841	1.065	90.2
4.978	4.242	21.118	14.010	1.401	19.628	1.490	92.9
4.970	6.348	31.550	14.010	2.102	29.449	2.101	93.3
4.962	8.488	42.113	14.010	2.802	39.256	2.857	93.2
4.953	10.685	52.920	14.010	3.503	49.077	3.843	92.7

## 2.3 Thermal Images

Figure 3. Thermal image of the PCB's top side at 5.0 V in, 8.0 V out and 3.5 A load current.



**Figure 4. Thermal image of the PCB's top side at 5.0 V in, 14.0 V out and 3.5 A load current.**



## 2.4 Dimensions

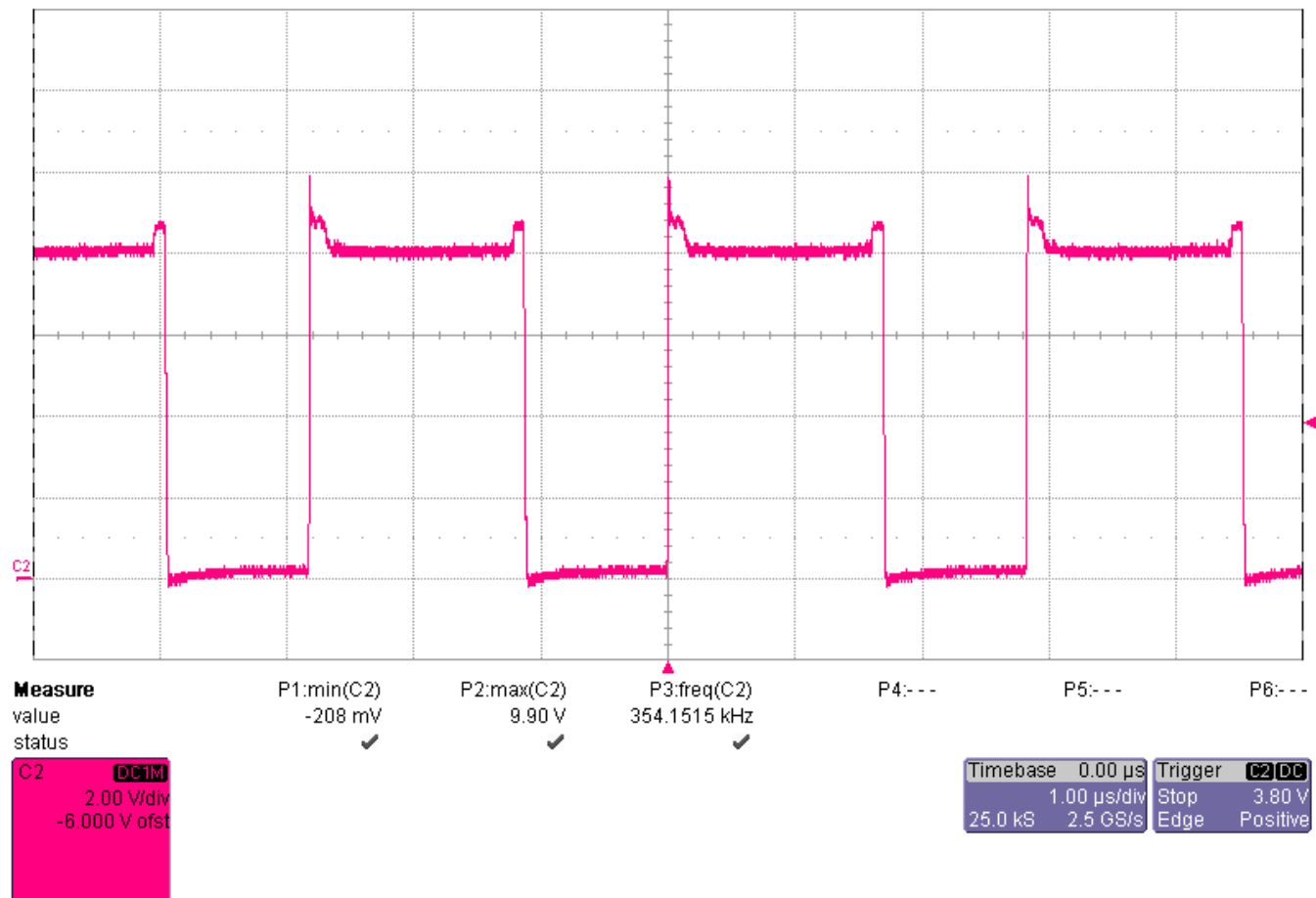
PCB: 76.2 mm x 58.4 mm

Circuit: 30 mm x 50 mm

### 3 Waveforms

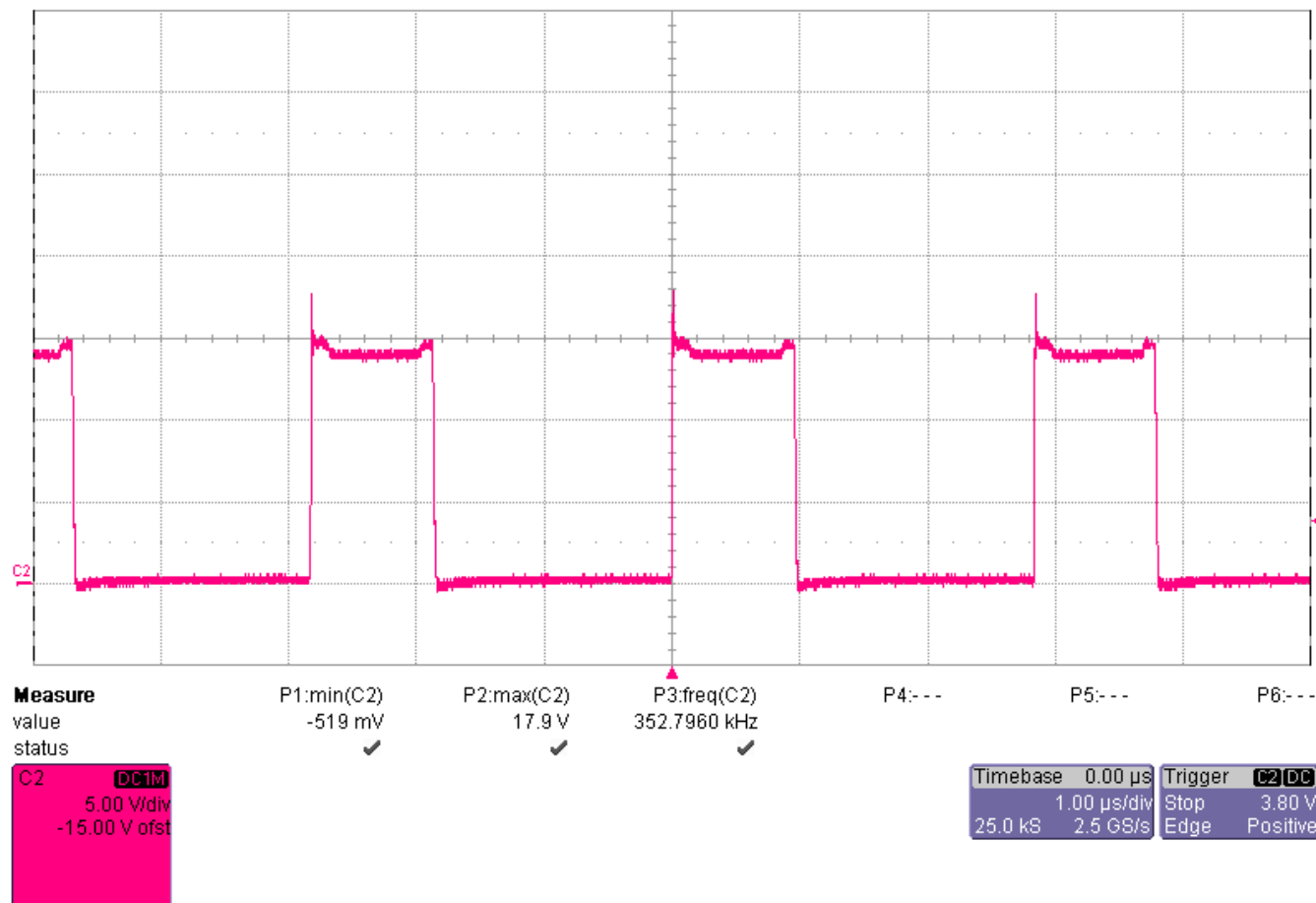
#### 3.1 Switching

Figure 5. Switching node at 5.0V in, 8.0 V out and 3.5 A load current.



- Ch2: Switching node signal [scale: 2.0V/div, 1.0us/div]

Figure 6. Switching node at 5.0V in, 14.0 V out and 3.5 A load current.

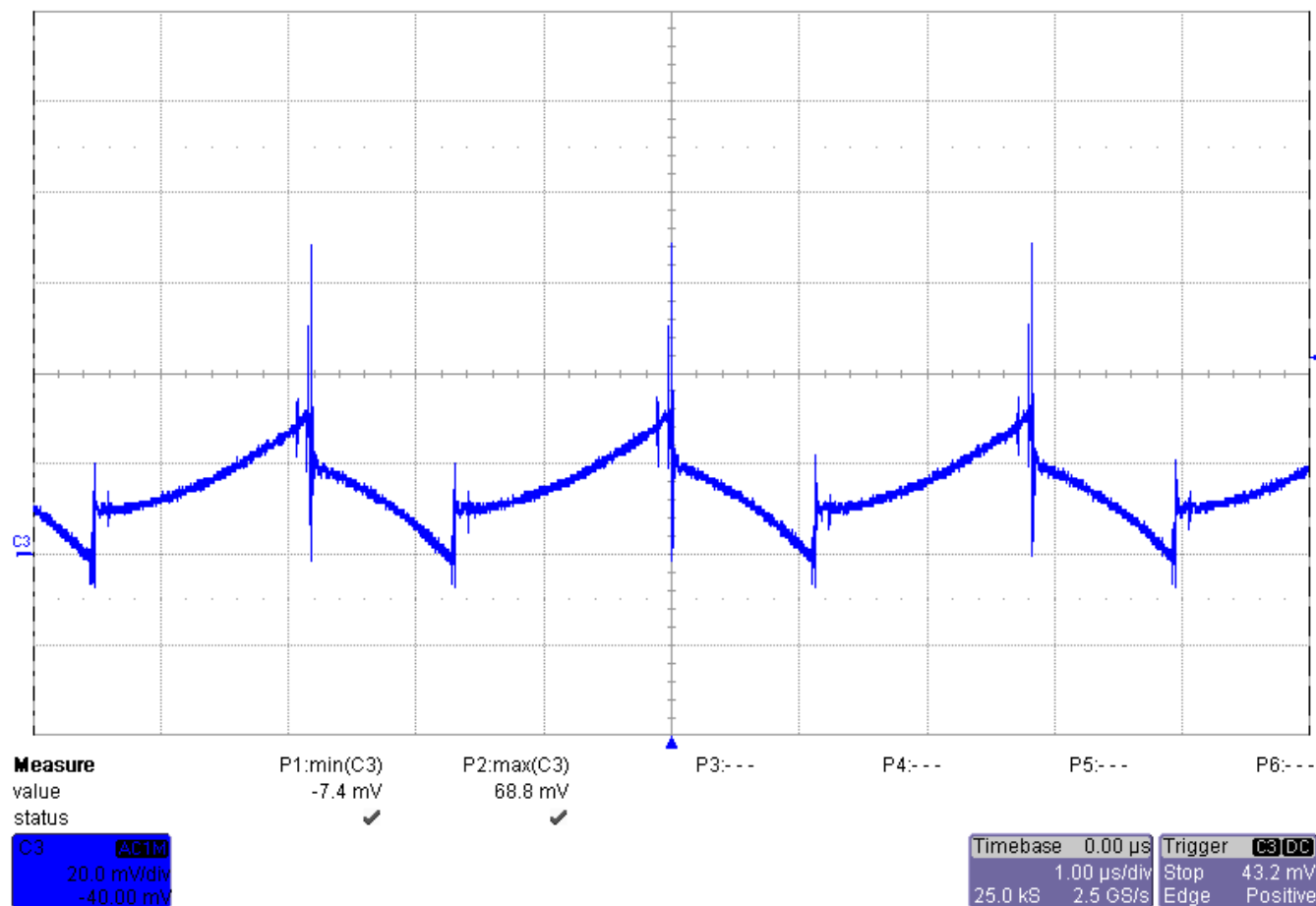


- Ch2: Switching node signal [scale: 5.0V/div, 1.0us/div]



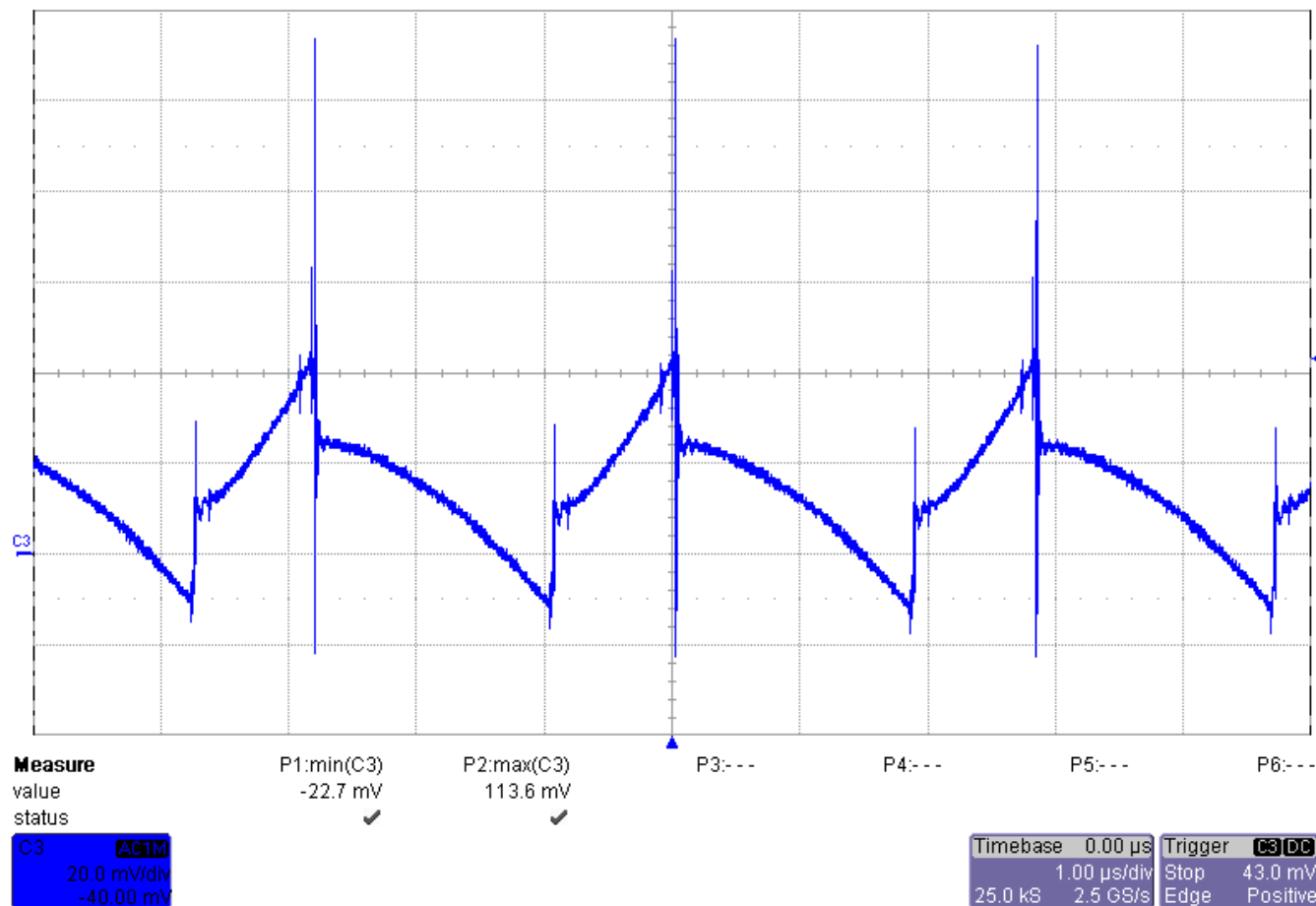
## 3.2 Input Voltage Ripple

Figure 7. AC-coupled input voltage signal at 5.0 Vin, 8.0 V out and 3.5 A load current.



- Ch3: 76.2mV peak-peak ripple [scale: 20.0mV/div, 1.0us/div]

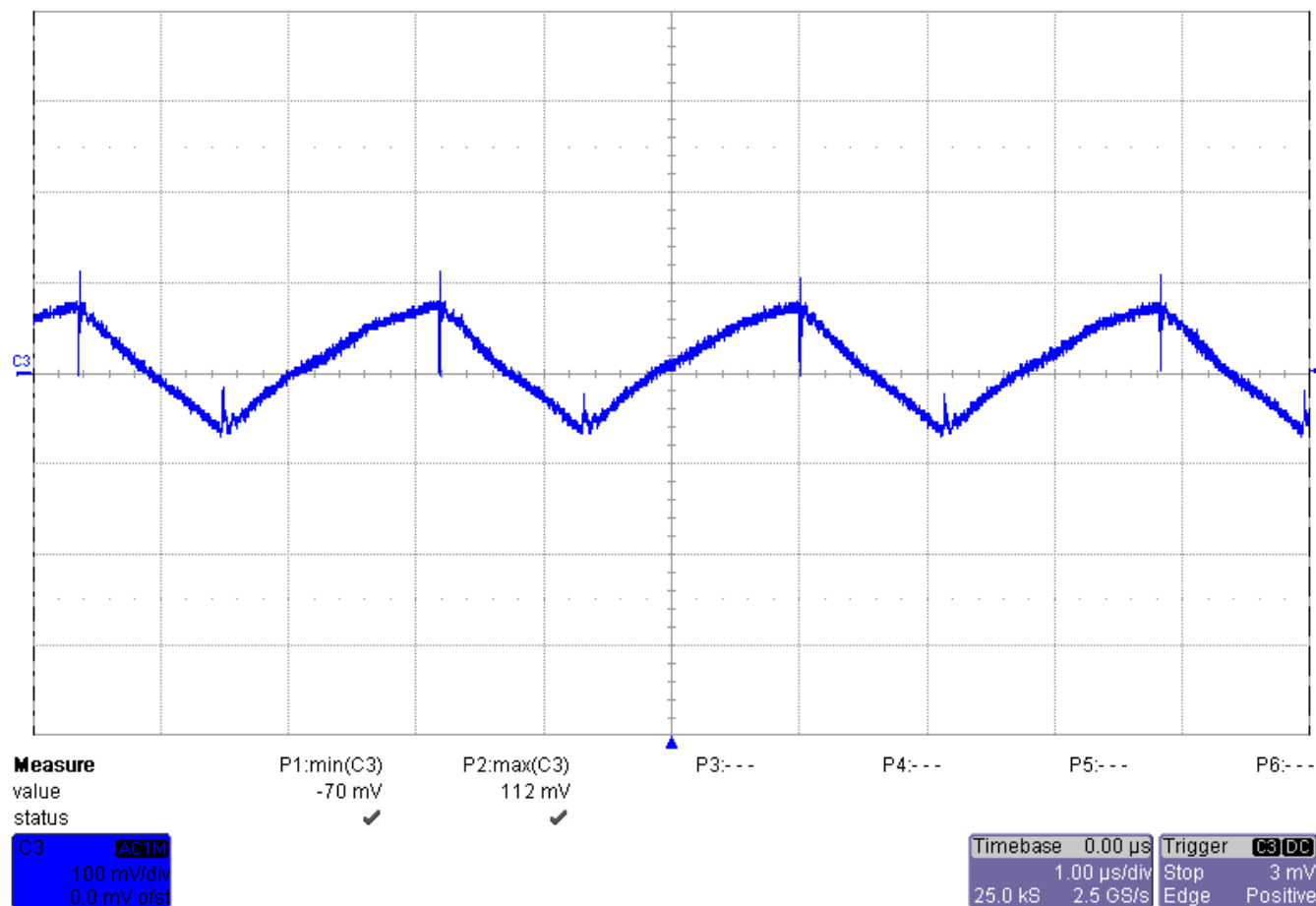
Figure 8. AC-coupled input voltage signal at 5.0 Vin, 14.0 V out and 3.5 A load current.



- Ch3: 136.3mV peak-peak ripple [scale: 20.0mV/div, 1.0us/div]

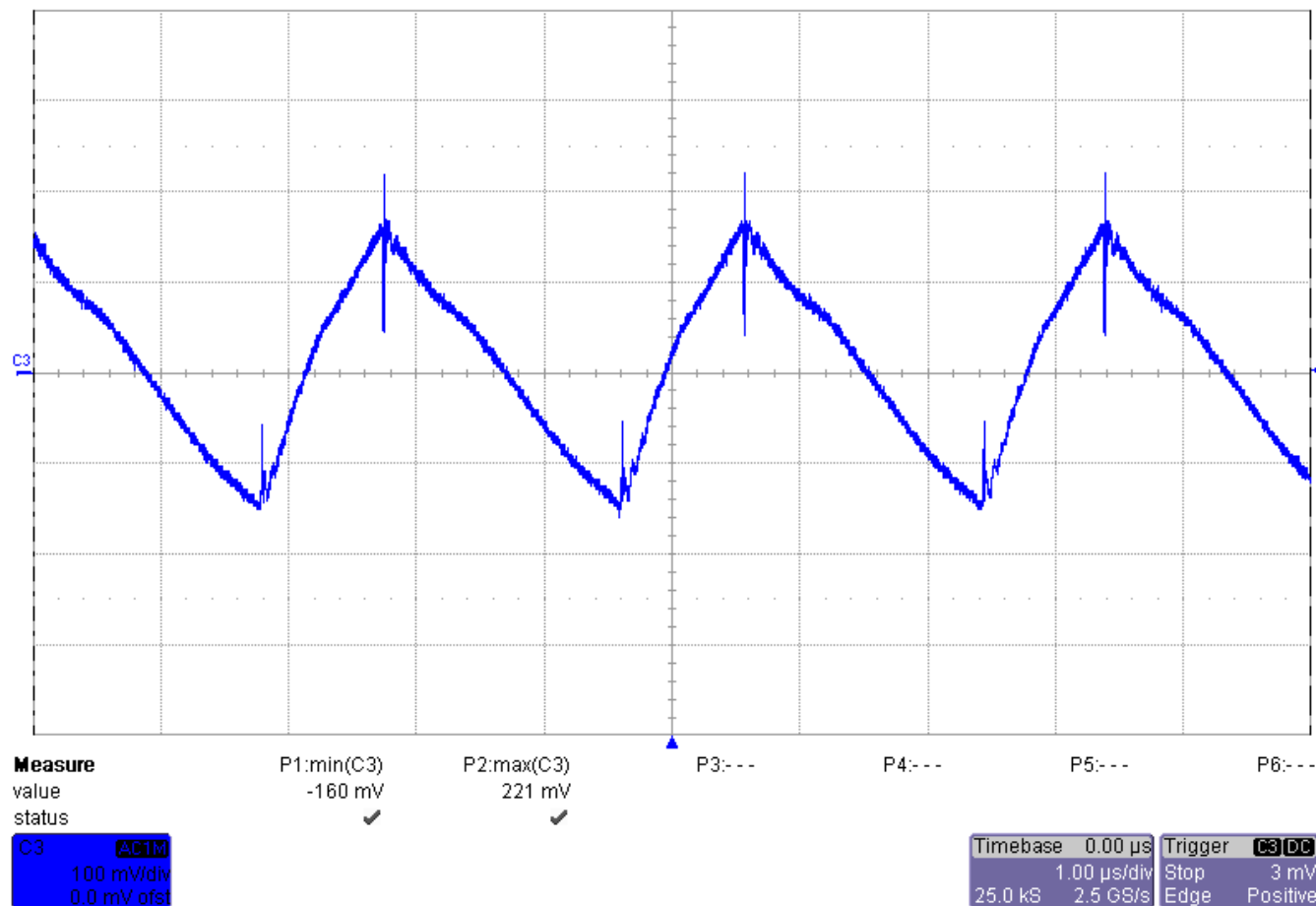
### 3.3 Output Voltage Ripple

Figure 9. AC-coupled output voltage signal at 5.0 Vin, 8.0 V out and 3.5 A load current.



- Ch3: 182mV peak-peak ripple [scale: 100.0mV/div, 1.0us/div]

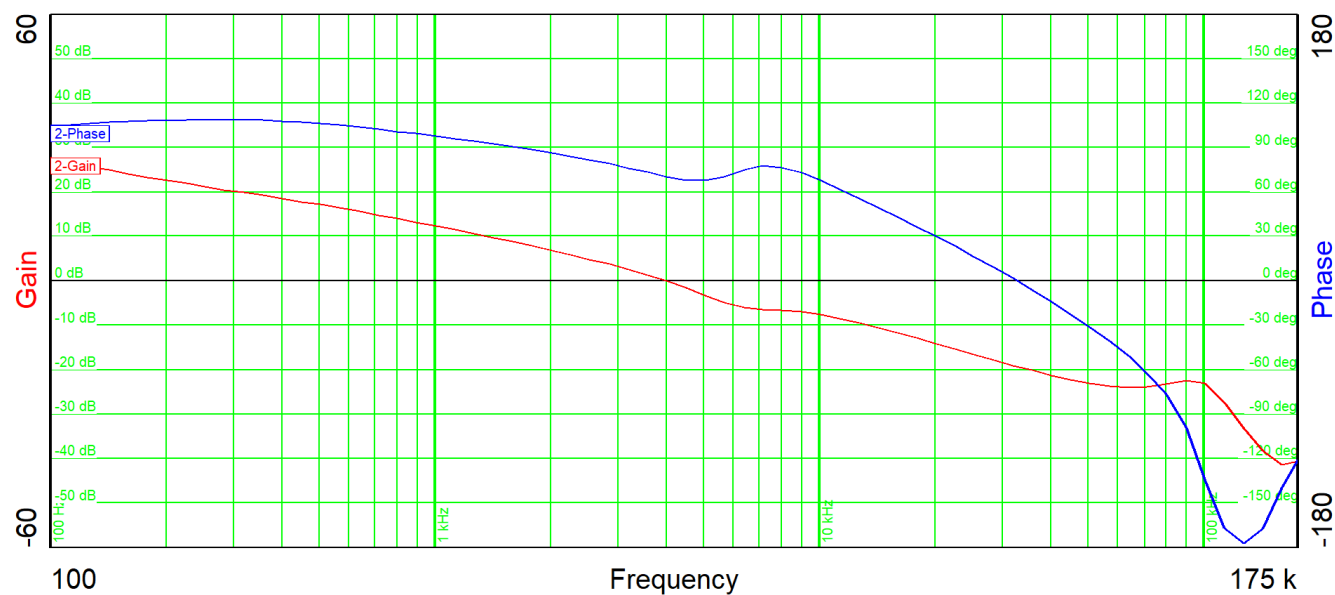
Figure 10. AC-coupled output voltage signal at 5.0 Vin, 14.0 V out and 3.5 A load current.



- Ch3: 381mV peak-peak ripple [scale: 100.0mV/div, 1.0us/div]

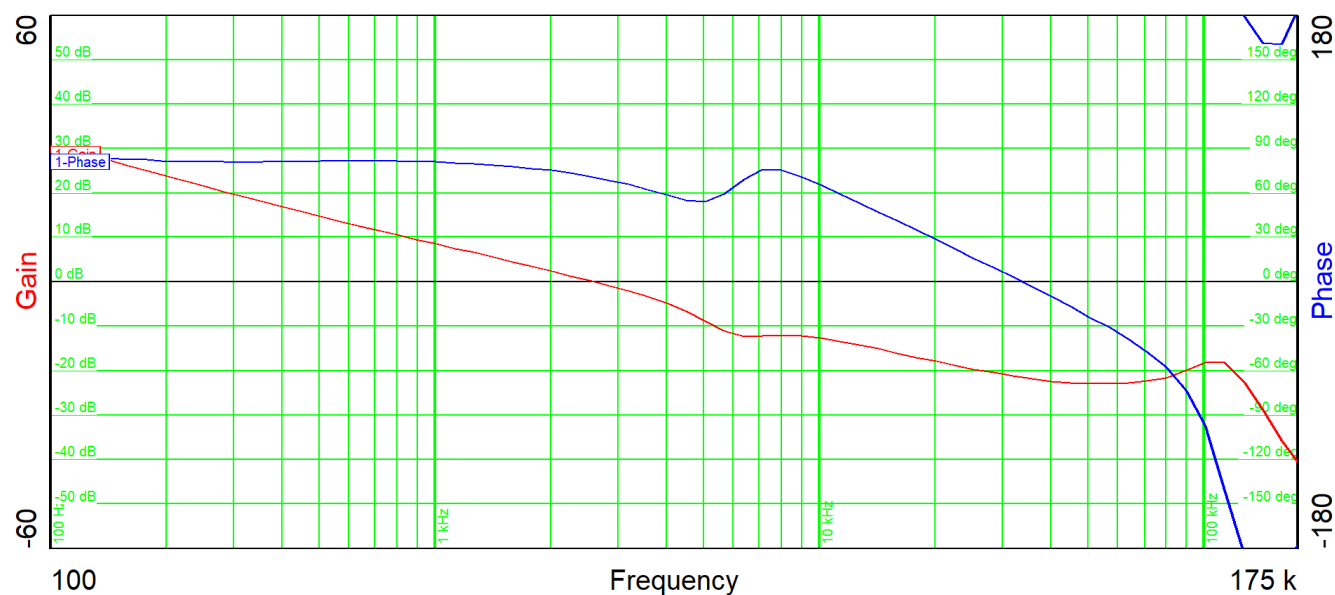
### 3.4 Bode Plot

**Figure 11. Bode plot at 5.0 V in, 8.0 V out and 3.5 A load current.**



- 5.0V in, 3.5A load current: fco 3.97kHz, 70deg phase margin, -19dB gain margin

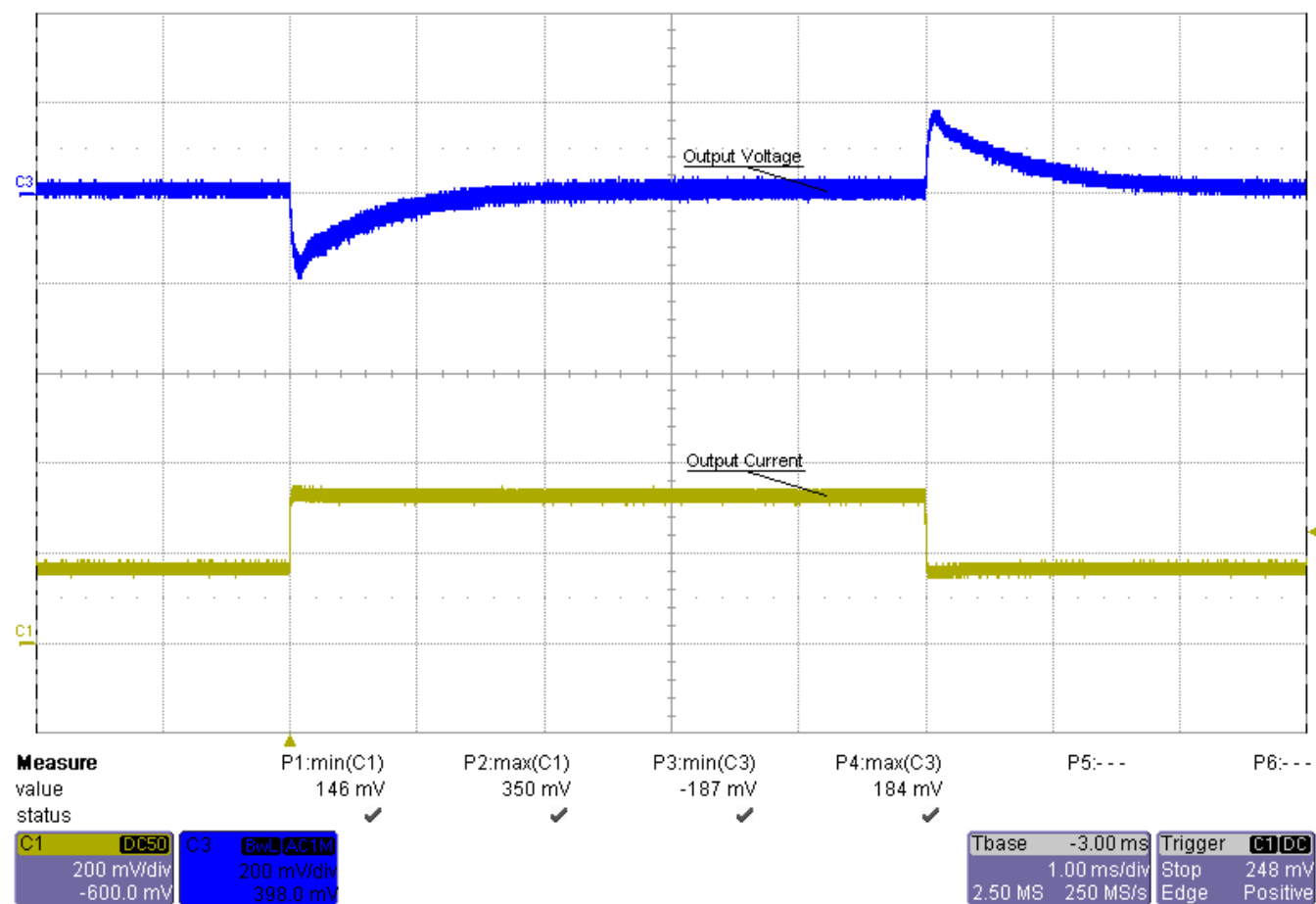
**Figure 12. Bode plot at 5.0 V in, 14.0 V out and 3.5 A load current.**



- 5.0V in, 3.5A load current: fco 2.59kHz, 70deg phase margin, -22dB gain margin

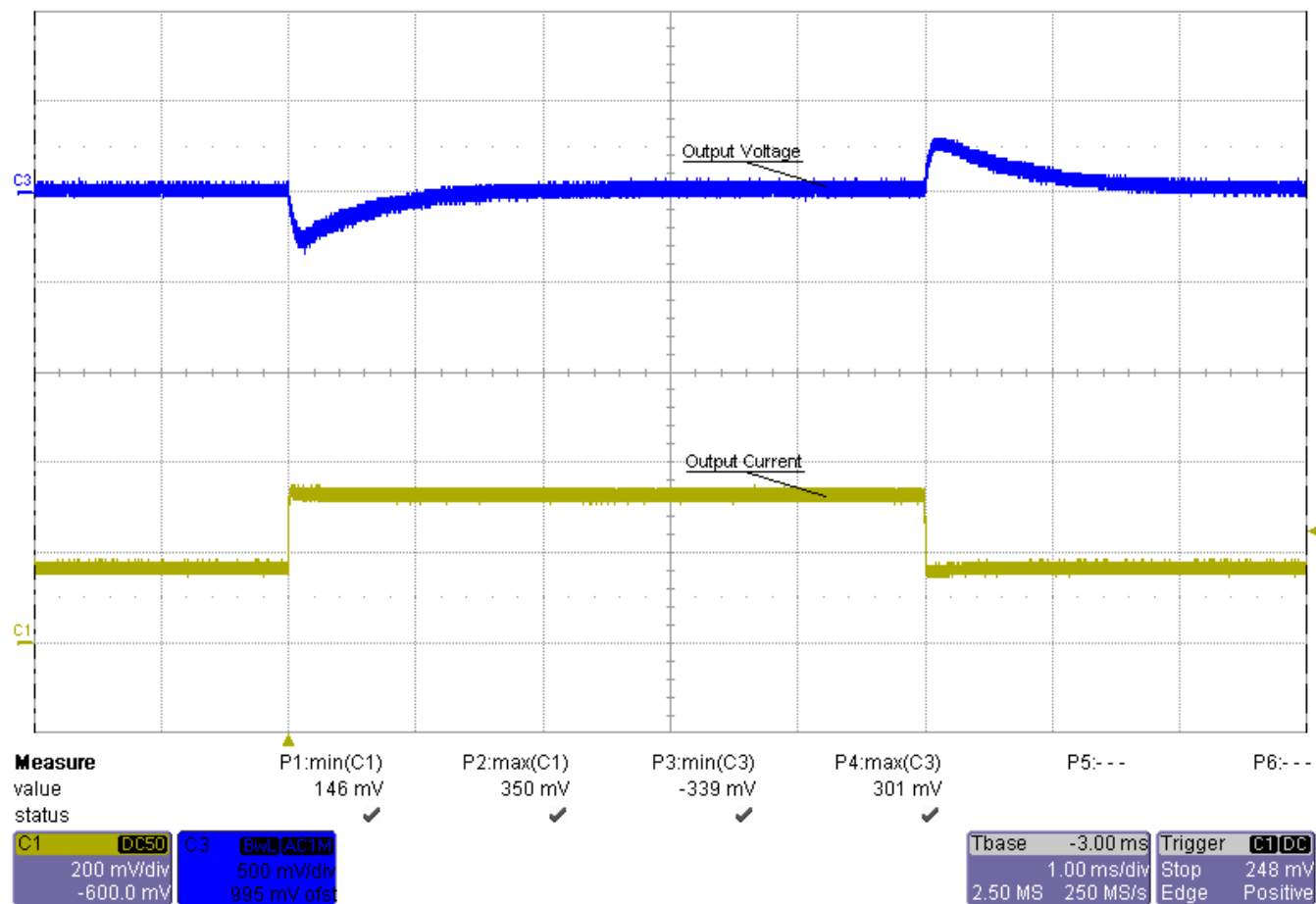
### 3.5 Load Transients

**Figure 13. Load transient from 1.75 A to 3.5 A at 5.0 V in results in 187 mV (2.3%) undershoot and 184 mV (2.3%) overshoot for the 8.0 V output.**



- Ch1: output current [scale: 2.0A/div, 1.0ms/div]
- Ch3: AC-coupled output voltage, bw limited (20MHz) [scale: 200mV/div, 1.0ms/div]

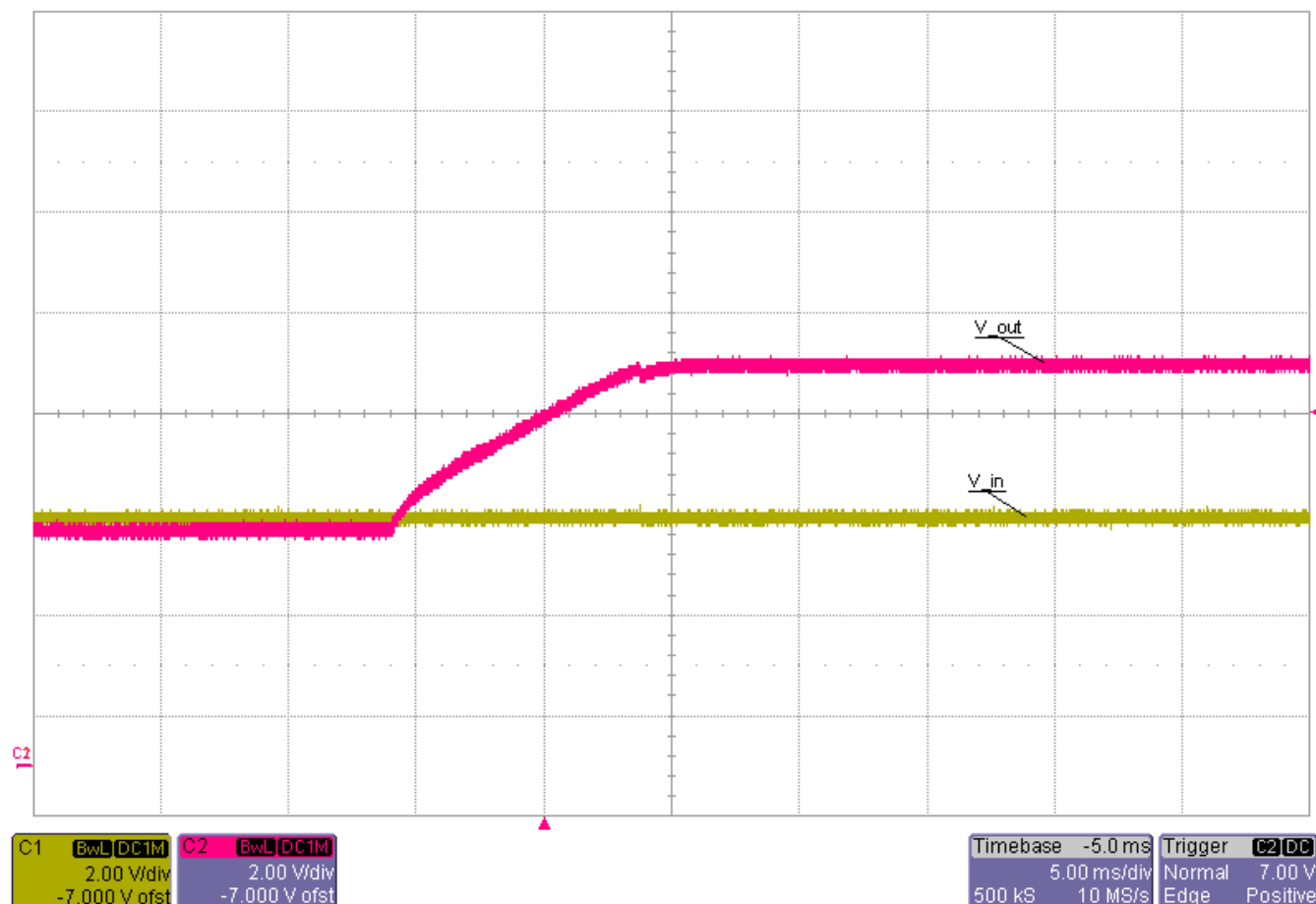
**Figure 14. Load transient from 1.75 A to 3.5 A at 5.0 V in results in 339 mV (2.4%) undershoot and 301 mV (2.2%) overshoot for the 14.0 V output.**



- Ch1: output current [scale: 2.0A/div, 1.0ms/div]
- Ch3: AC-coupled output voltage, bw limited (20MHz) [scale: 500mV/div, 1.0ms/div]

### 3.6 Start-up Sequence

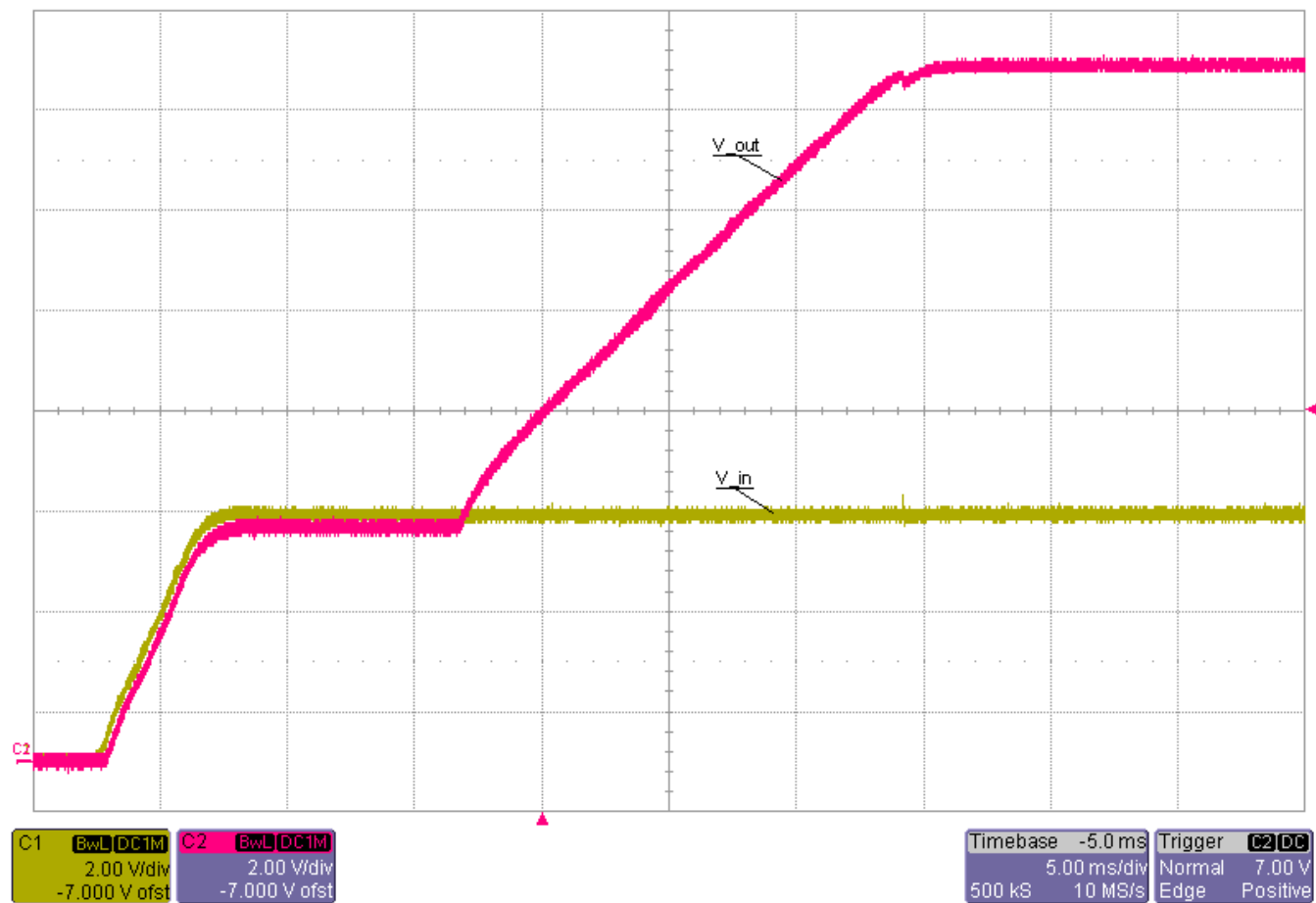
**Figure 15. Start-up sequence at 5.0 V<sub>in</sub> for the 8.0 V output with no load attached.**



- Ch1: input voltage [scale: 2.0V/div, 5.0ms/div]
- Ch2: output voltage [scale: 2.0V/div, 5.0ms/div]



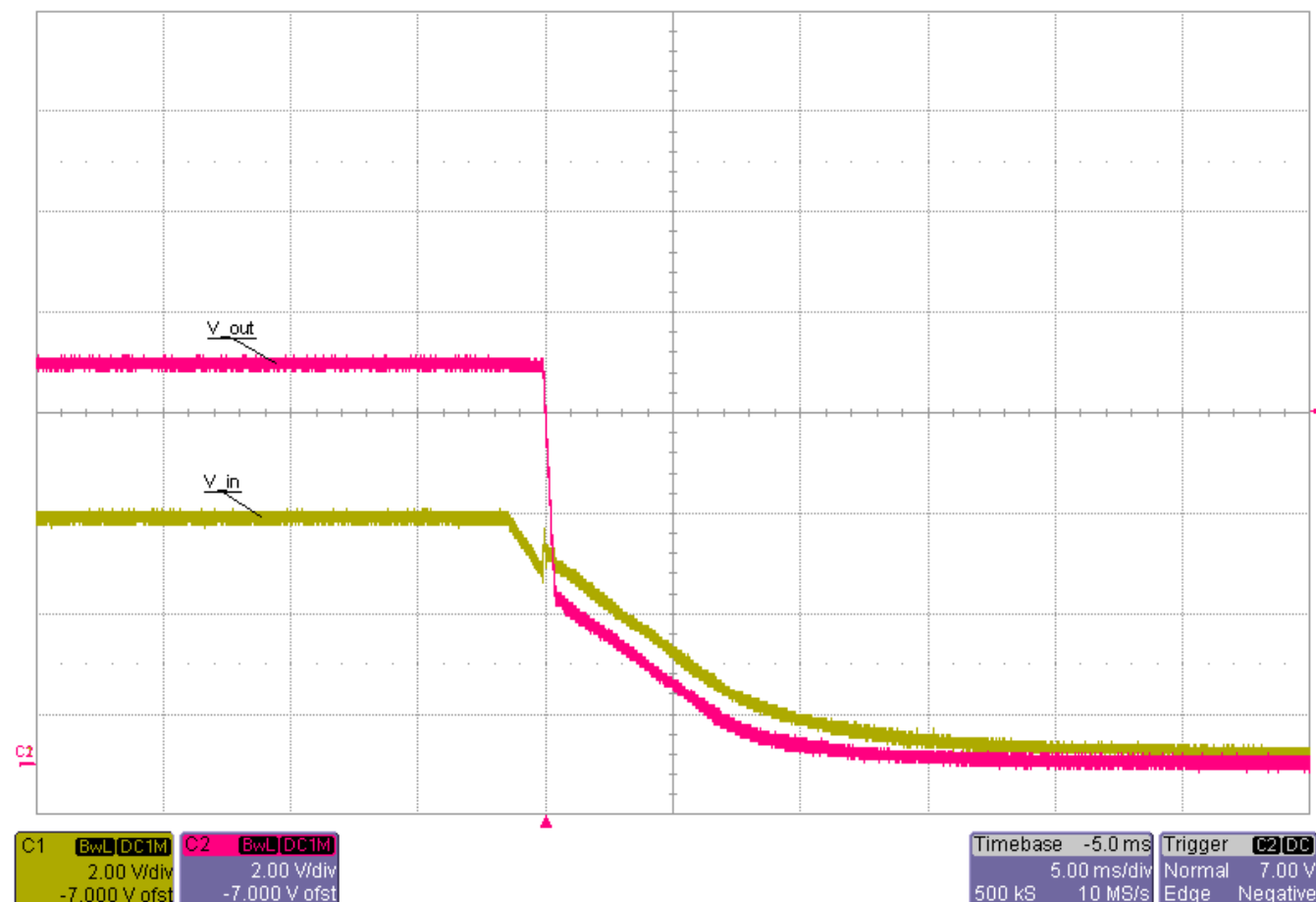
**Figure 16. Start-up sequence at 5.0 V<sub>in</sub> for the 14.0 V output with no load attached.**



- Ch1: input voltage [scale: 2.0V/div, 5.0ms/div]
- Ch2: output voltage [scale: 2.0V/div, 5.0ms/div]

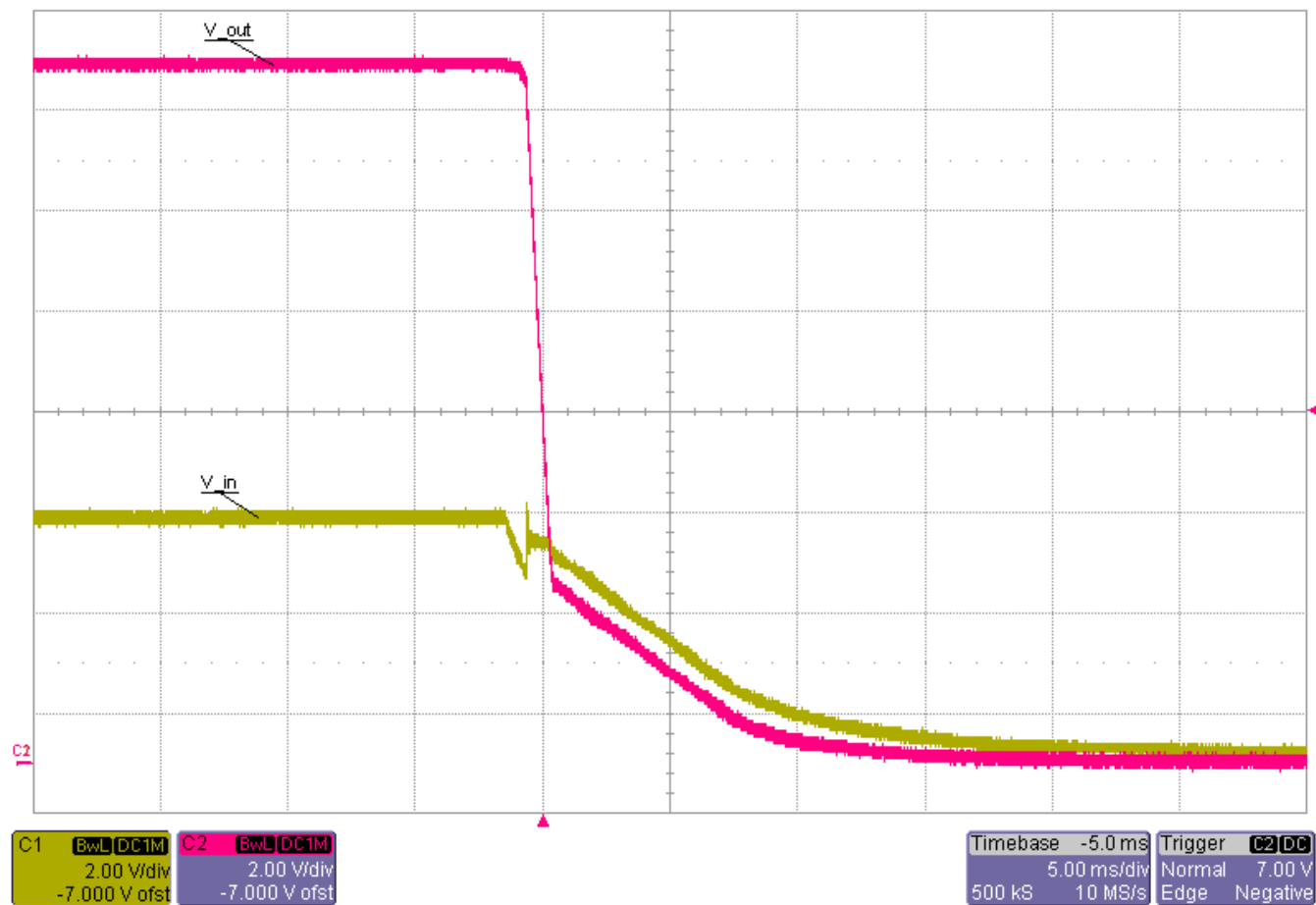
### 3.7 Undervoltage Protection

Figure 17. Undervoltage protection for the 8.0 V output with a 3.5 A load attached.



- Ch1: input voltage [scale: 2.0V/div, 5.0ms/div]
- Ch2: output voltage [scale: 2.0V/div, 5.0ms/div]

**Figure 18. Undervoltage protection for the 14.0 V output with a 3.5 A load attached.**



- Ch1: input voltage [scale: 2.0V/div, 5.0ms/div]
- Ch2: output voltage [scale: 2.0V/div, 5.0ms/div]

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