Test Report: PMP22806

Class 4 PoE PD Isolated Flyback Converter (12 V, 2.1 A) With Primary Side Regulation Reference Design

Description

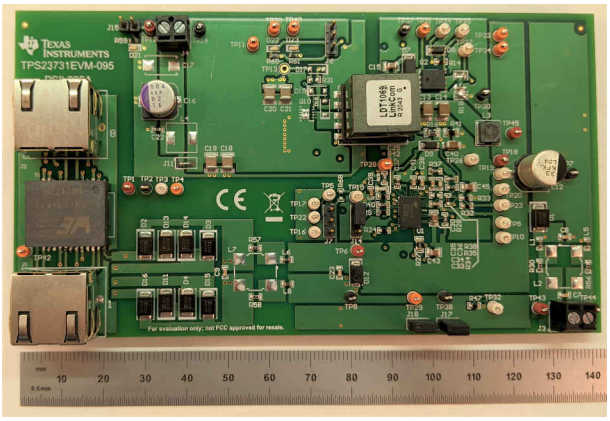
This reference design implements a Power over Ethernet (PoE) Power Device (PD) flyback converter with a 12-V, 2.1-A output. A TPS23731 PD, PWM controller provides all the necessary functions to implement the PoE PD control and the PWM control for the flyback converter. The TPS23731 device uses primary side regulation (PSR), eliminating the need for optocoupler feedback.

Features

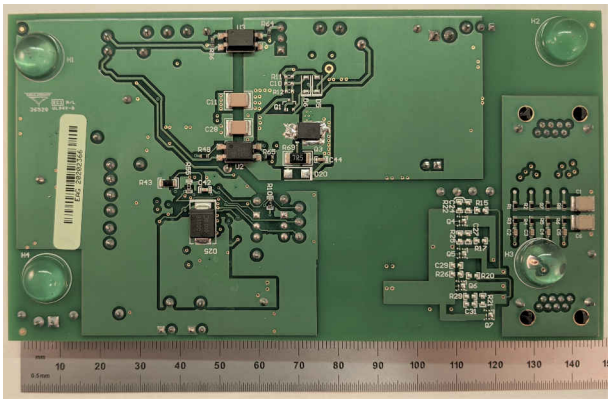
- Combined PD and PWM controller
- Primary-side regulation (no optocoupler)
- Optional 48-V adapter input
- Frequency dithering for improved EMI

Applications

- IP network camera
- WLAN, Wi-Fi® access point
- Barcode reader



Top Photo



Bottom Photo

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1-1. Voltage and Current Requirements

Parameter	Specifications
Input voltage	42.5 V–57 V
Output voltage	12 V ±3%
Output current	2.1 A
Nominal Switching Frequency	250 kHz

1.2 Required Equipment

- Type 2 PoE Power Source Equipment (PSE)
- Isolated DC power source, 0 V–57 V, 1-A minimum
- 12-V, 5-A electronic load

1.3 Considerations

- All measurements were taken at approximately 25°C ambient
- All measurements taken with 48-V input and 2.1-A load unless noted

2 Testing and Results

2.1 Efficiency Graphs

Figure 2-1 shows the PMP22806 efficiency curve.

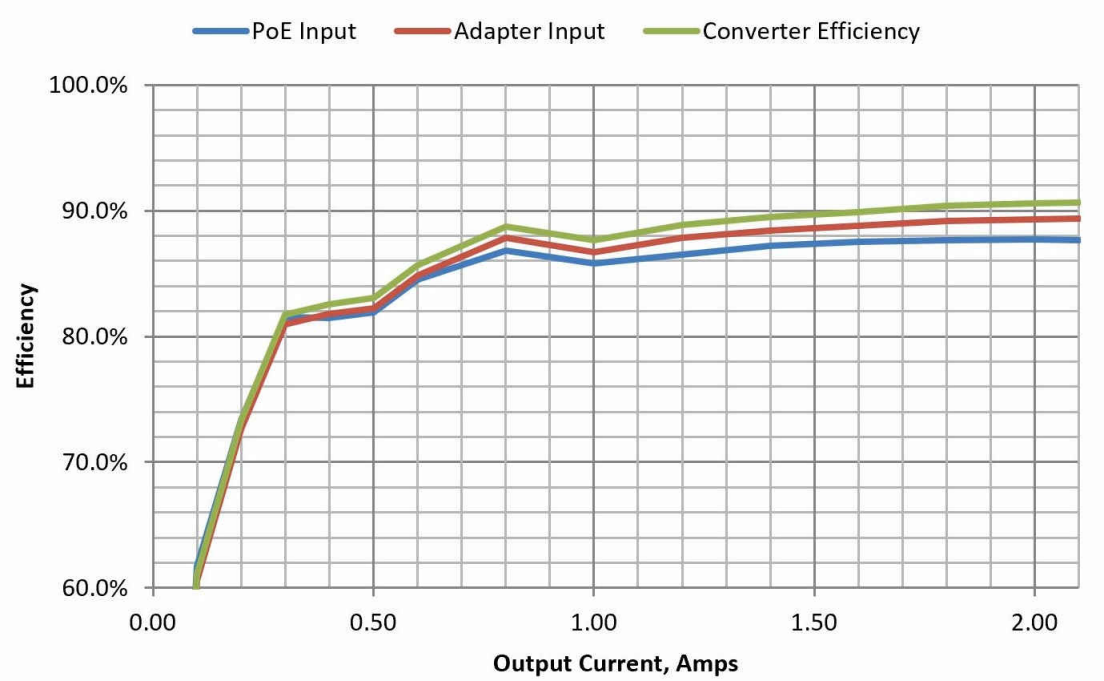


Figure 2-1. PMP22806 Rev. B Efficiency Graph, PoE Diode Bridge

2.2 Efficiency Data

Efficiency data is shown in the following tables.

I_{OUT} (J4)	V_{OUT} (J4)	I_{IN} (J1)	V_{IN} (J1)	Eff (J1)
0.00	13.594	0.013	48.03	0.0%
0.10	12.442	0.042	48.03	61.7%
0.20	12.325	0.070	48.03	73.3%
0.30	12.264	0.094	48.02	81.5%
0.40	12.225	0.125	48.02	81.5%
0.50	12.197	0.155	48.02	81.9%
0.60	12.174	0.180	48.01	84.5%
0.80	12.135	0.233	48.00	86.8%
1.00	12.108	0.294	48.00	85.8%
1.20	12.081	0.349	48.01	86.5%
1.40	12.052	0.403	48.01	87.2%
1.60	12.022	0.458	48.00	87.5%
1.80	11.992	0.513	48.01	87.6%
2.00	11.960	0.568	48.00	87.7%
2.10	11.944	0.596	48.00	87.7%

I_{OUT} (J4)	V_{OUT} (J4)	I_{IN} (J3)	V_{IN} (J3)	Eff (J3)	V_{IN} (VDD,PGND)	Eff (CONV)
0.00	13.765	0.015	48.03	0.0%	47.69	0.0%
0.10	12.509	0.043	48.03	60.6%	47.64	61.1%
0.20	12.378	0.071	48.02	72.6%	47.61	73.2%
0.30	12.311	0.095	48.01	81.0%	47.59	81.7%
0.40	12.270	0.125	48.01	81.8%	47.56	82.6%
0.50	12.239	0.155	48.00	82.3%	47.54	83.0%
0.60	12.215	0.180	48.00	84.8%	47.52	85.7%
0.80	12.179	0.231	48.03	87.8%	47.52	88.8%
1.00	12.152	0.292	48.01	86.7%	47.48	87.7%
1.20	12.126	0.345	48.01	87.9%	47.45	88.9%
1.40	12.098	0.399	48.01	88.4%	47.42	89.5%
1.60	12.069	0.453	48.02	88.8%	47.42	89.9%
1.80	12.040	0.506	48.02	89.2%	47.39	90.4%
2.00	12.009	0.560	48.01	89.3%	47.35	90.6%
2.10	11.992	0.587	48.01	89.4%	47.34	90.6%

2.3 Load Regulation

Figure 2-2 shows the PMP22806 rev B load regulation curve.

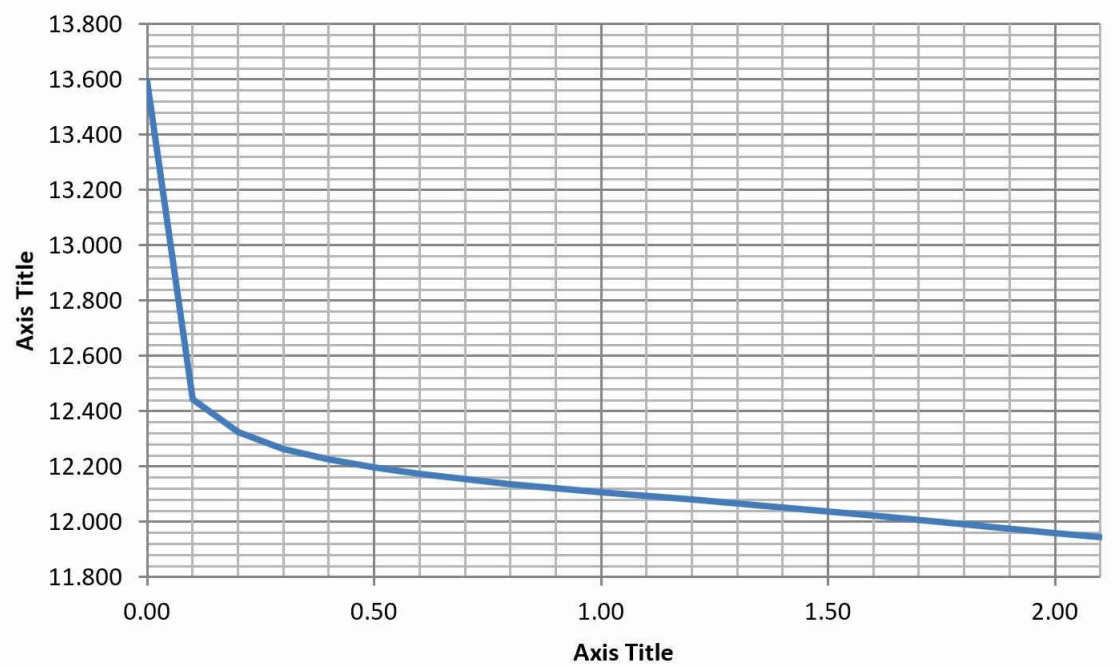


Figure 2-2. Load Regulation

2.4 Thermal Images

Figure 2-3 and Figure 2-4 show the thermal images.

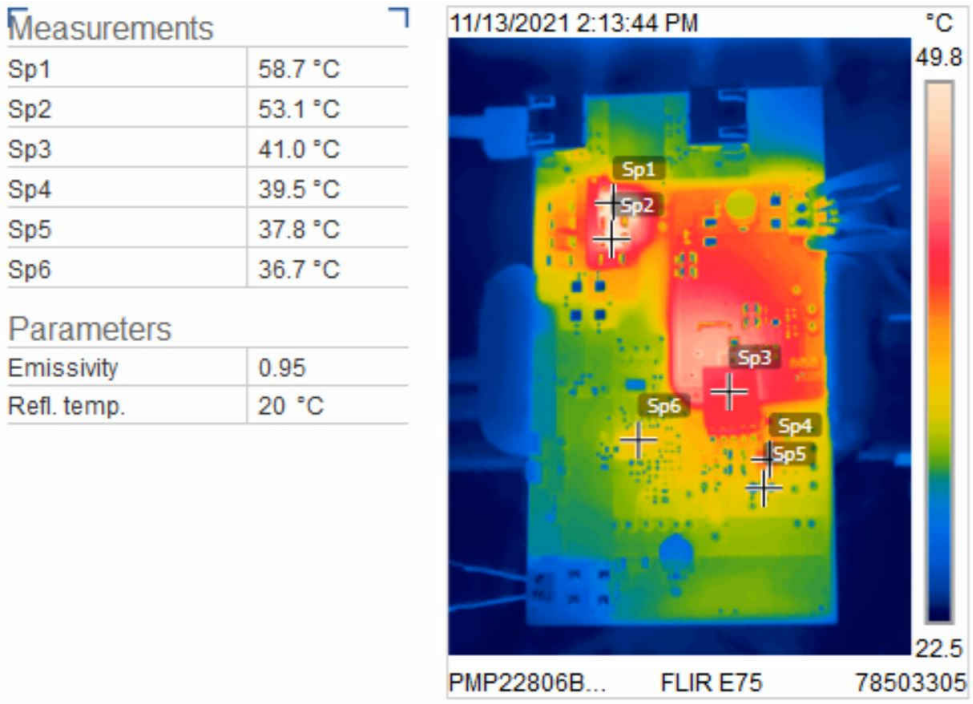


Figure 2-3. Top Thermal Image

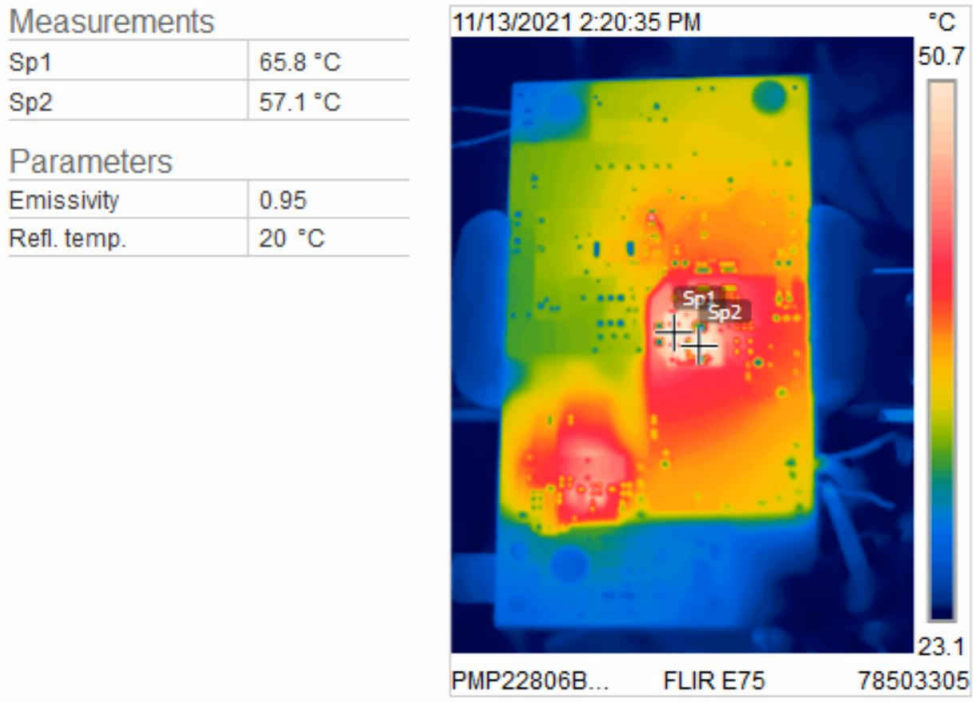


Figure 2-4. Bottom Thermal Image

2.5 Bode Plot

Figure 2-5 shows the bode plot waveform.

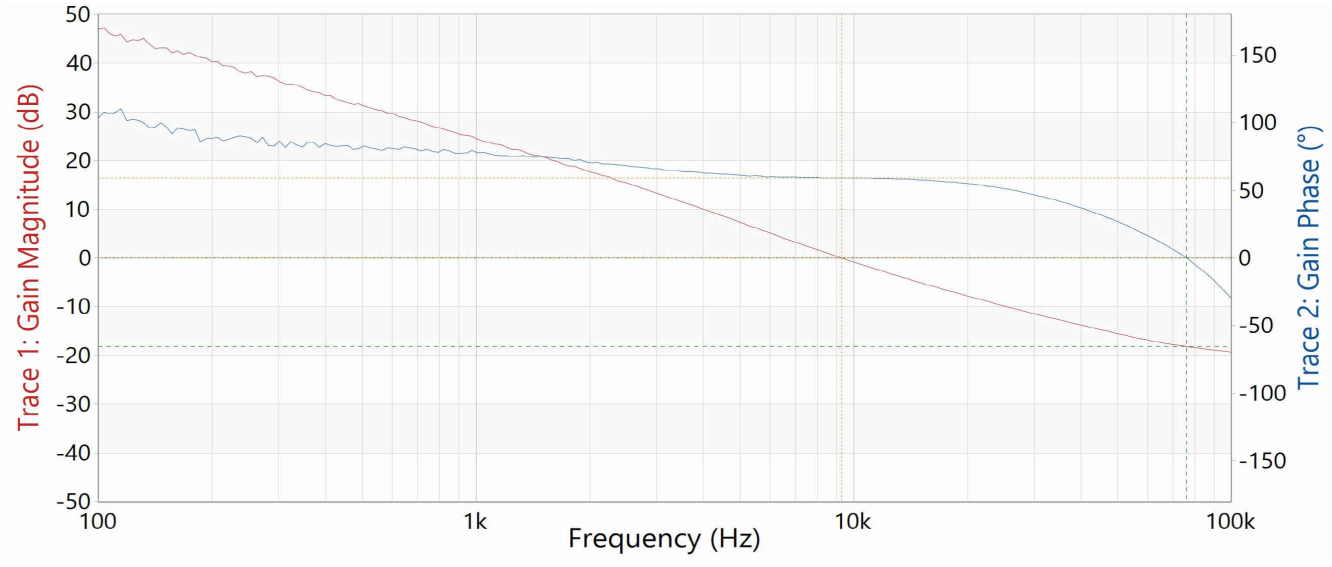


Figure 2-5. Bandwidth = 9.3 kHz, Phase Margin = 59 degrees, Gain Margin = 18.1 dB

3 Waveforms

3.1 Switching

Switching behavior is shown in the following figures.

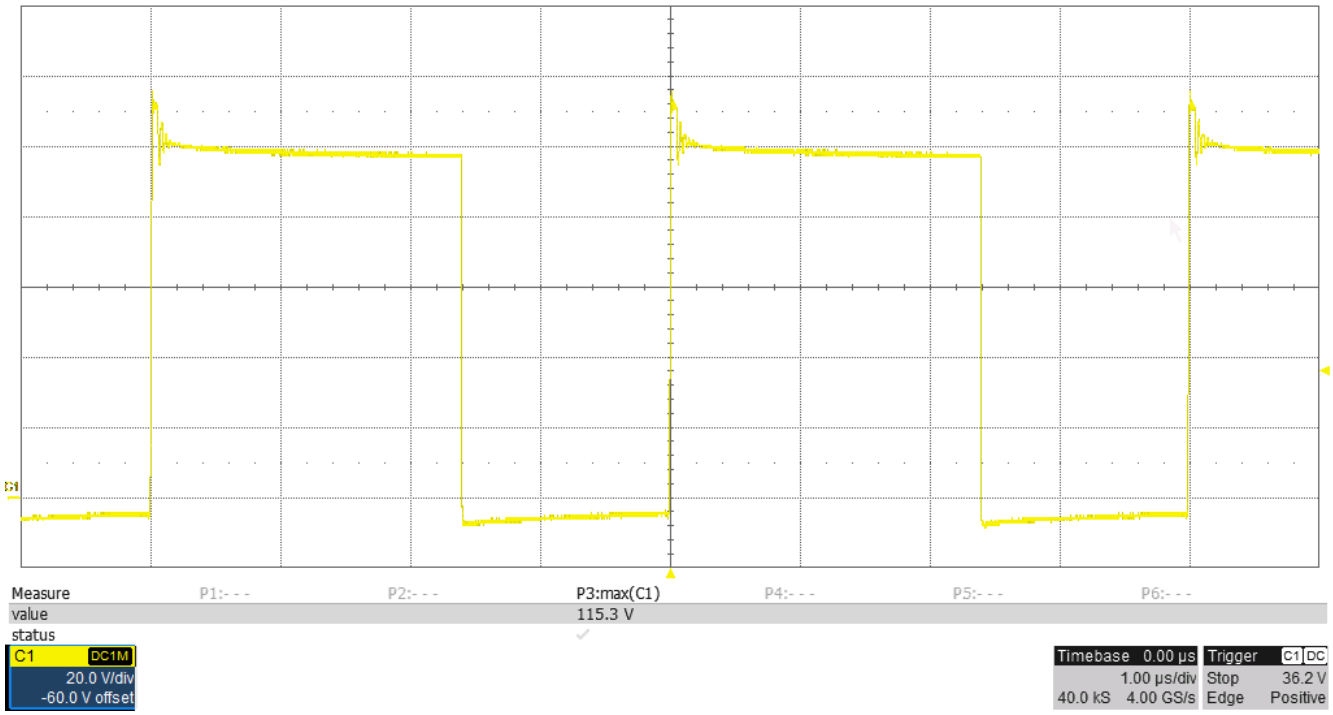


Figure 3-1. Voltage Drain to PGND, Q2, 57-V Input, 2.1-A Load, 20 V/div, 1 µs/div, Measured 115.3 Vpeak

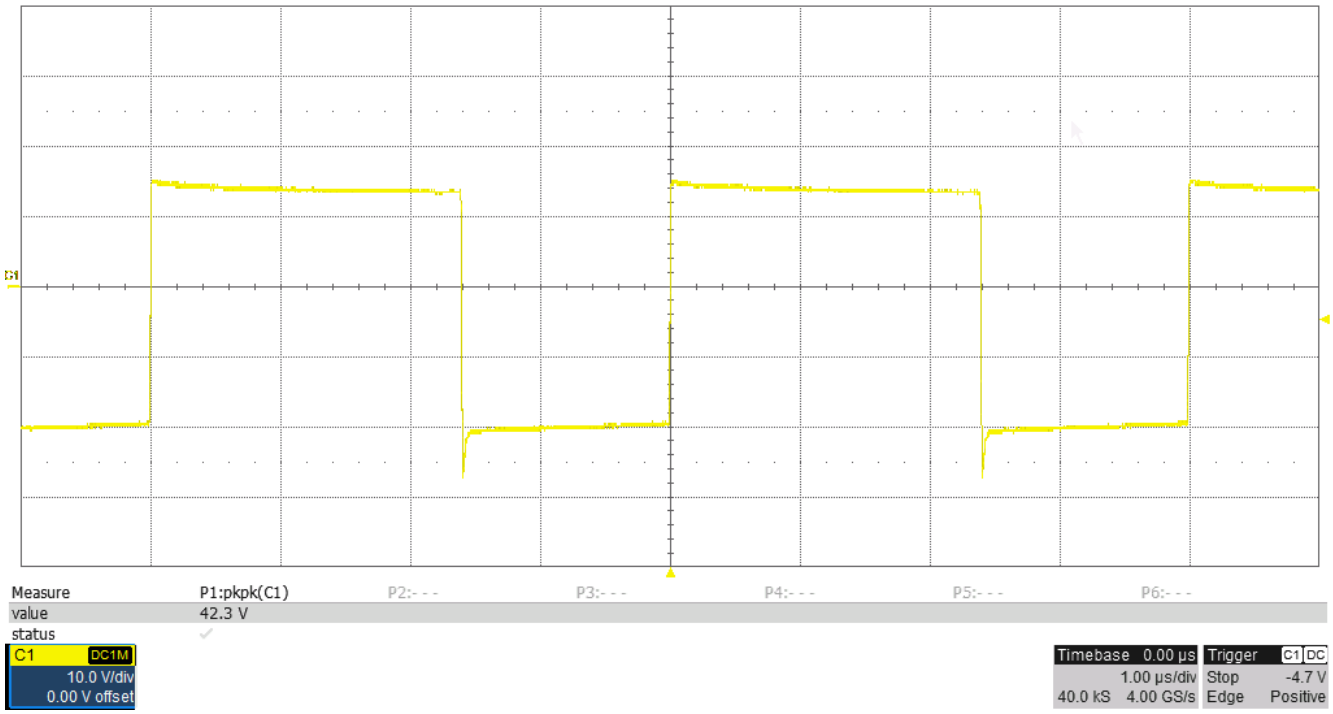


Figure 3-2. Voltage Anode to GND, D100, 57-V Input, 2.1-A Load, 10 V/div, 1 µs/div, Measured 42.3 Vpeak

3.2 Voltage Ripple

The following images show the input and output ripple waveforms.

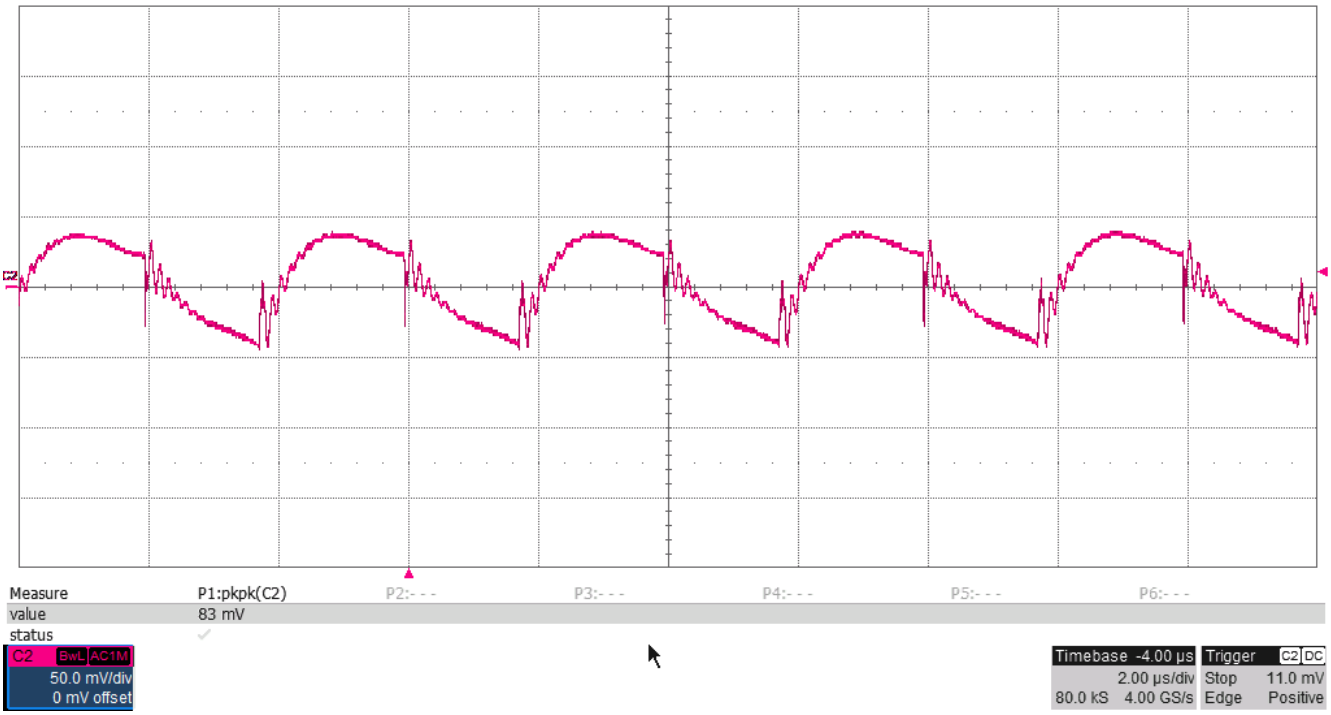


Figure 3-3. Output Ripple (J4), 50 mV/div, 2 µs/div, Measured 83.0 mVpp

Figure 3-4. Input Ripple (C43), 50 mV/div, 2 µs/div, Measured 75 mVpp

3.3 Load Transients

Load transient response is shown in the following figures.

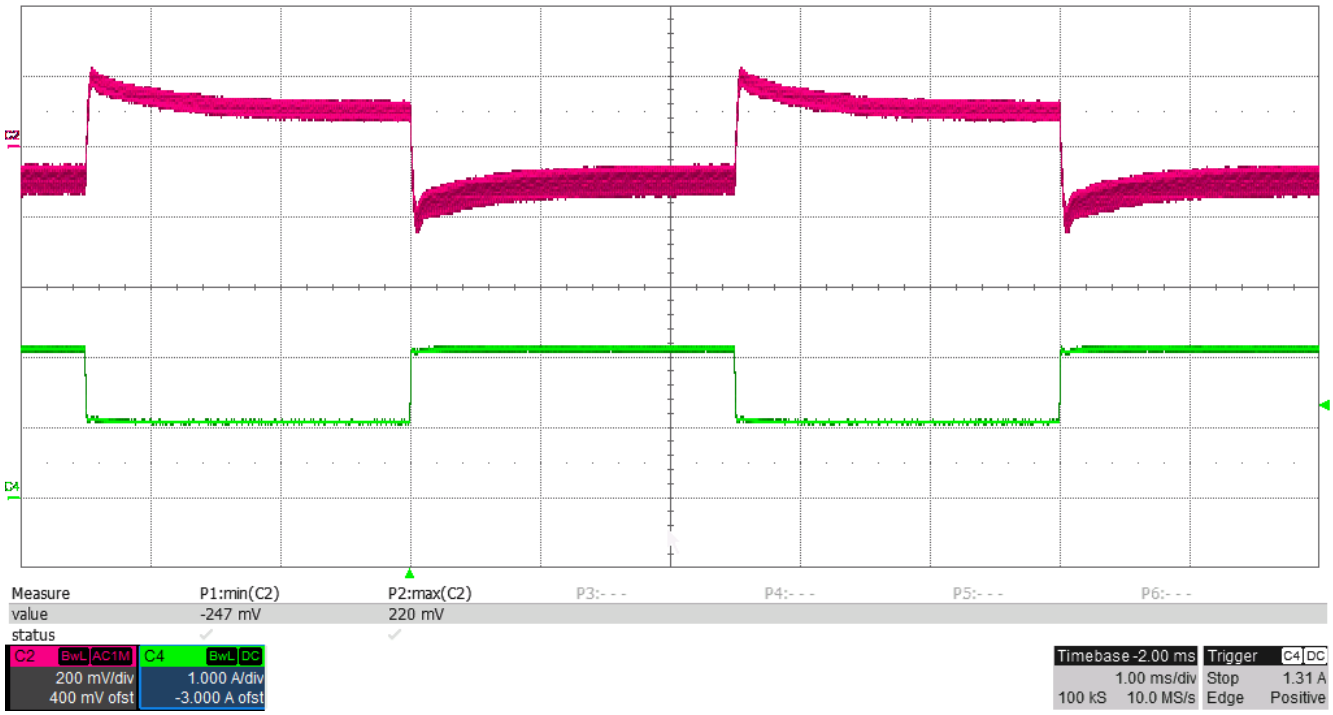


Figure 3-5. Output Load Step Response, 1.05-A to 2.10-A Load Step, 200 mV/div, 1 A/div, 1 ms/div, Slew Rate = 250 mA/µs, Measured +220 mV | –247 mV

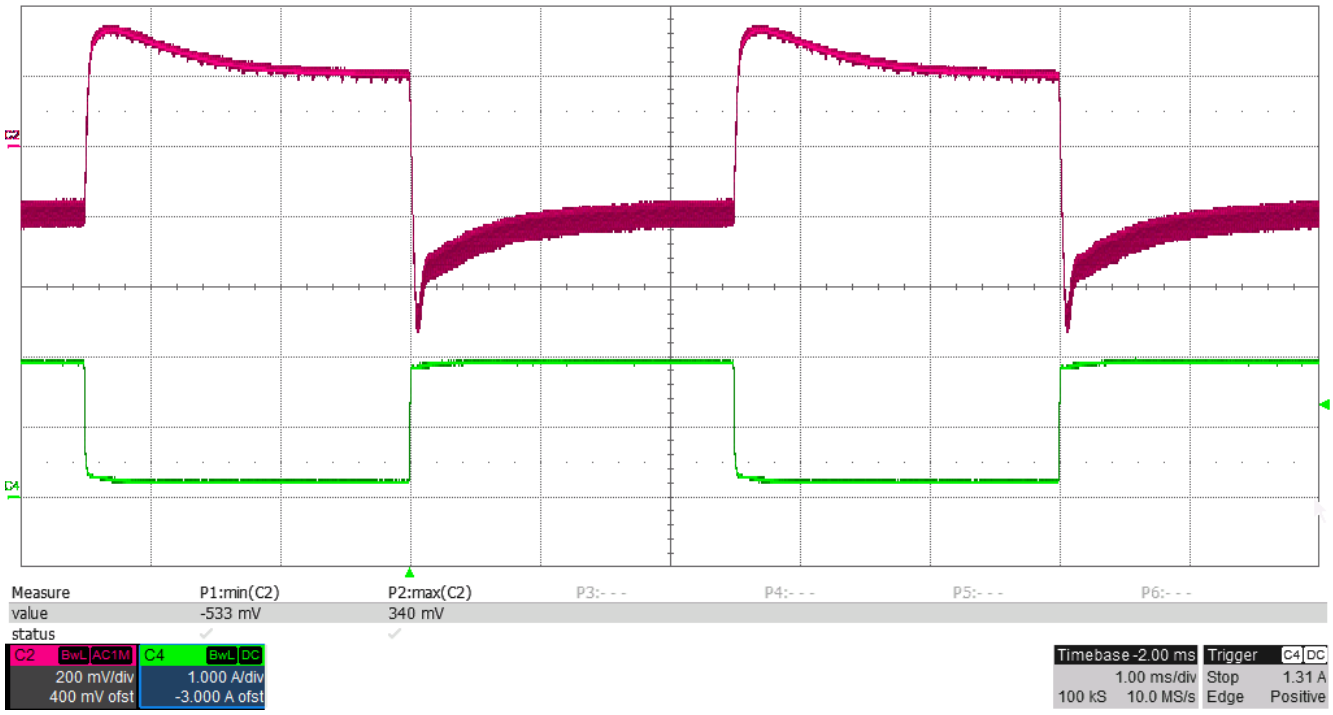


Figure 3-6. Output Load Step Response, 210-mA to 1.90-A Load Step, 200 mV/div, 1 A/div, 1 ms/div, Slew Rate = 250 mA/µs, Measured +340 mV | -533 mV

3.4 Short-Circuit Protection

Short at output connector J4. Input power during short circuit is 48.02 V, 59 mA, and 2.83 W.

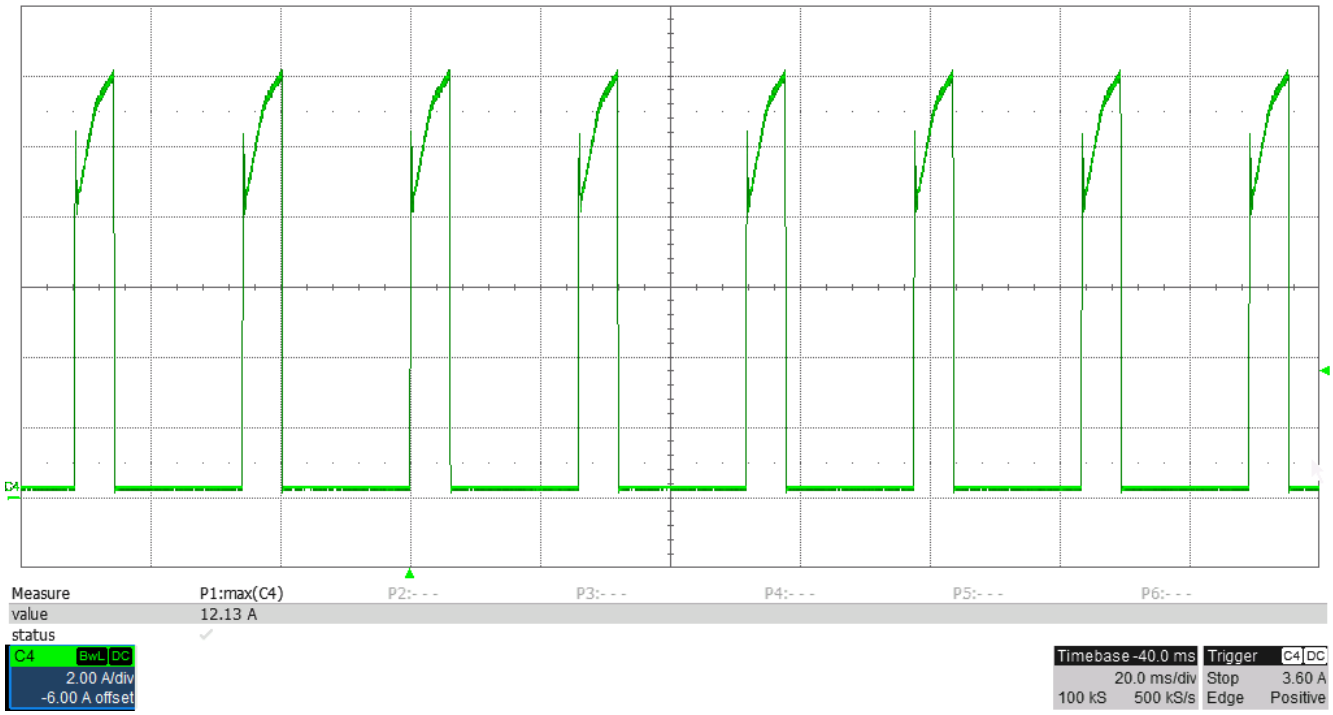


Figure 3-7. Output Current, 2 A/div, 20 ms/div, Measured 12.13 Apeak

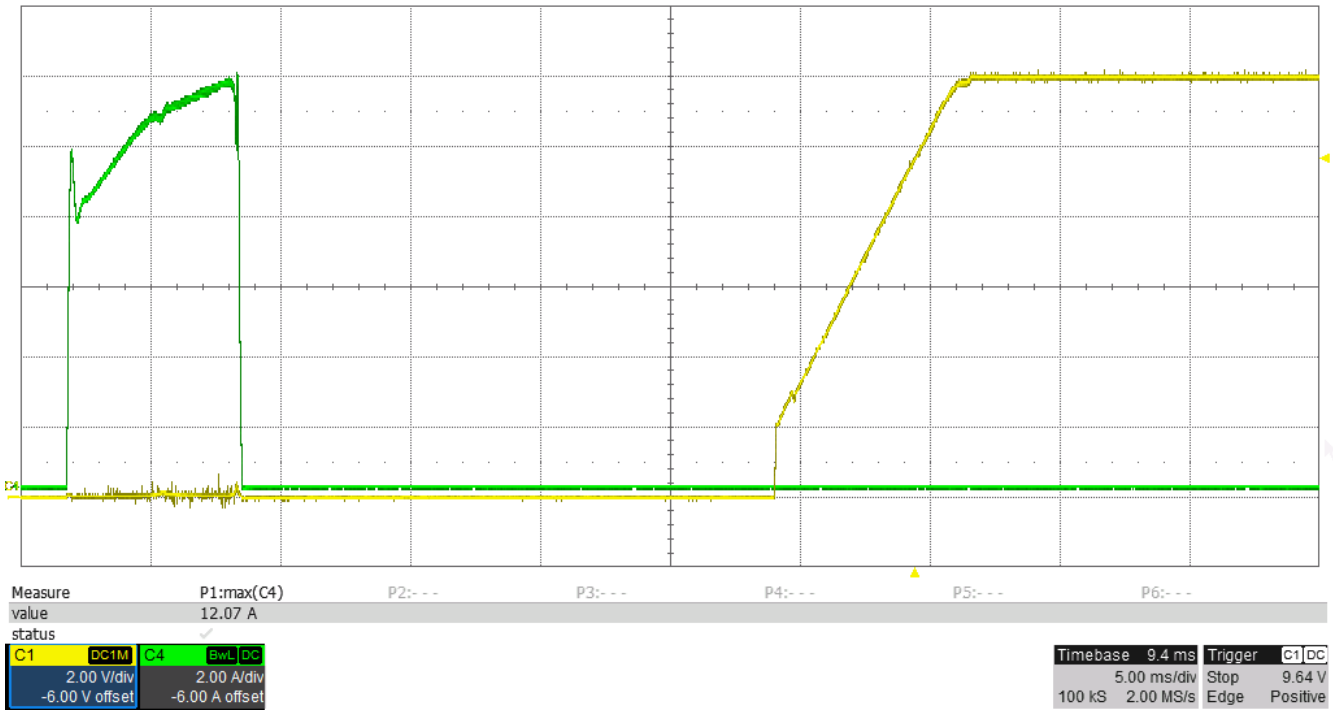


Figure 3-8. Output Voltage Recovery From Short Circuit, 2 V/div, 2 A/div, 5 ms/div

Figure 3-9 and Figure 3-10 show thermal plots during short circuit.

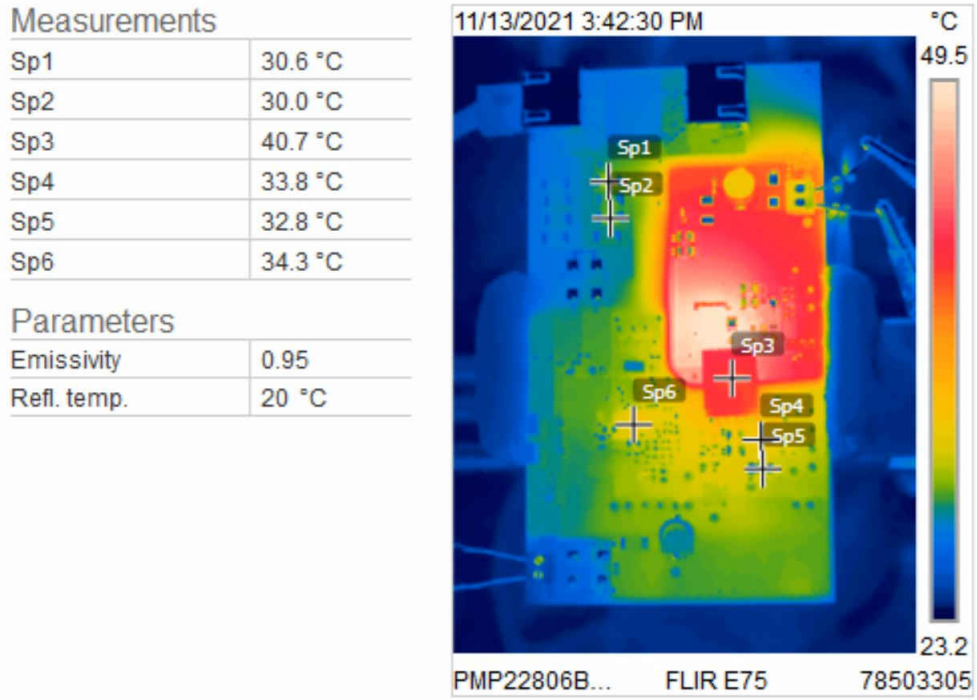


Figure 3-9. Thermal Plot During Short Circuit, Top

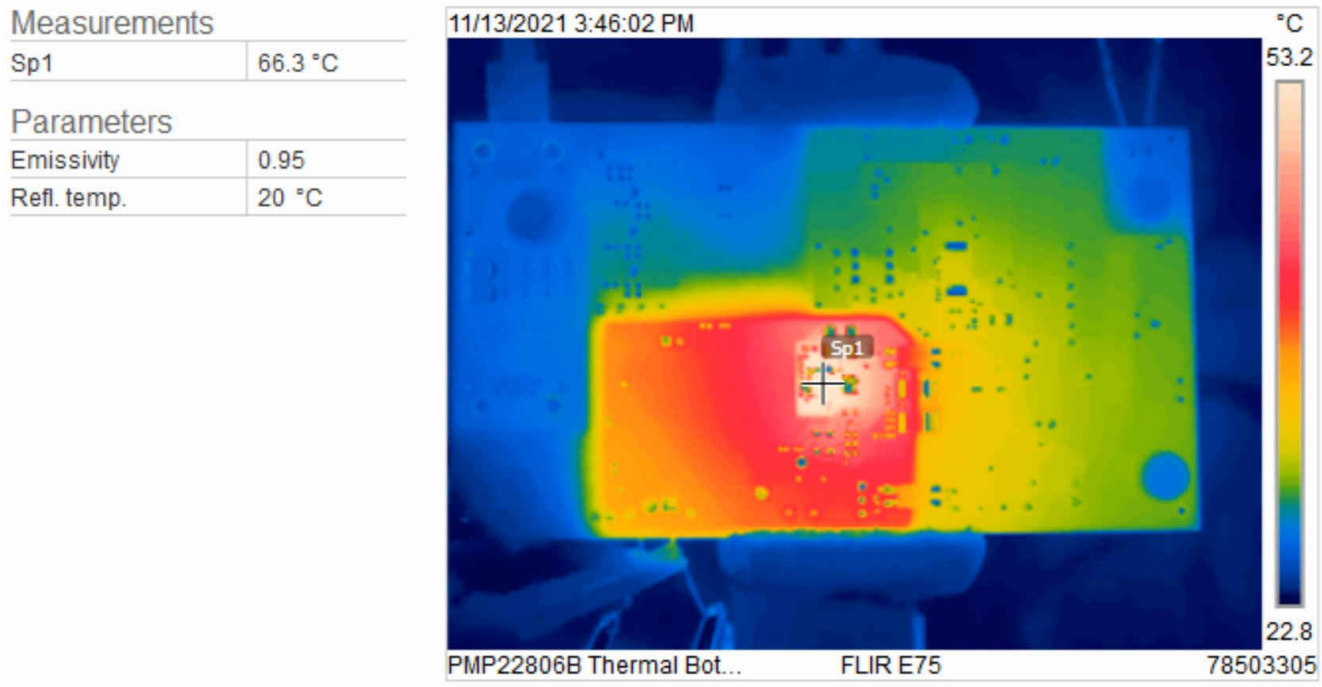


Figure 3-10. Thermal Plot During Short Circuit, Bottom (Diode D100)

3.5 Start-Up Sequence

The following images show the start-up behavior waveforms.

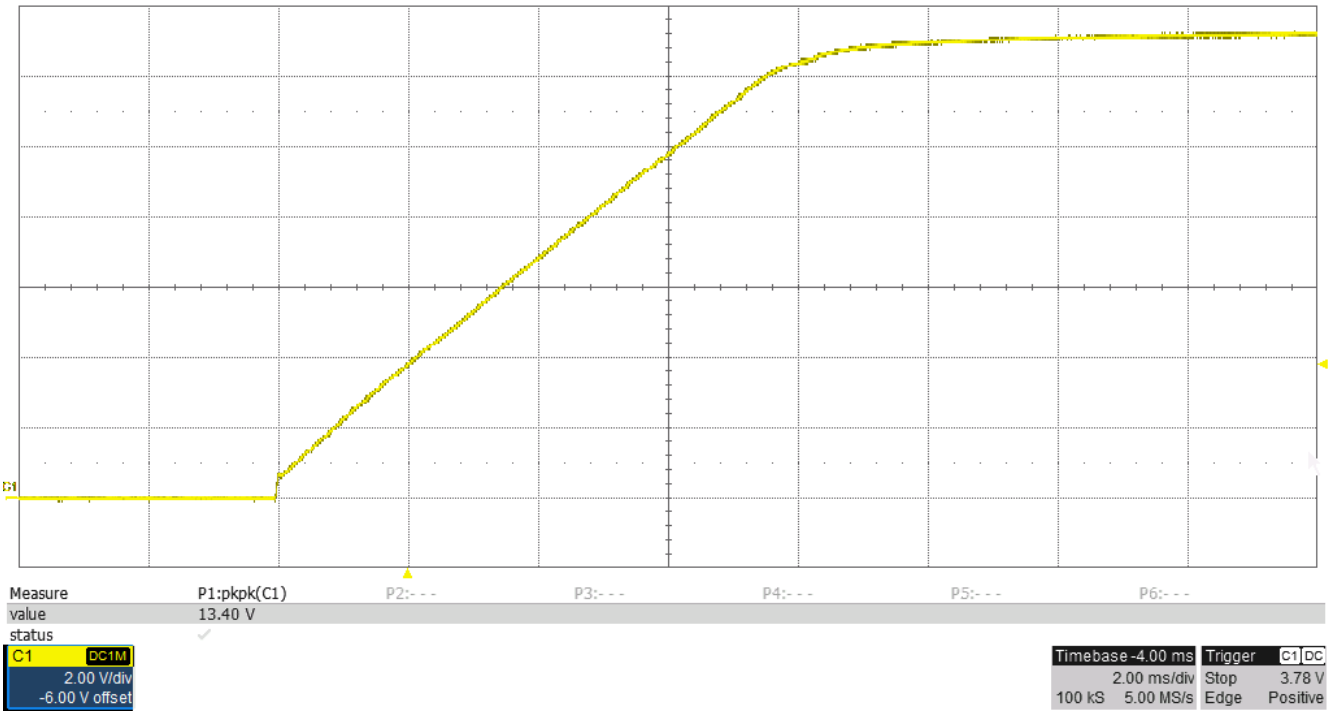


Figure 3-11. 0-A Load, 2 ms/div, 2 V/div

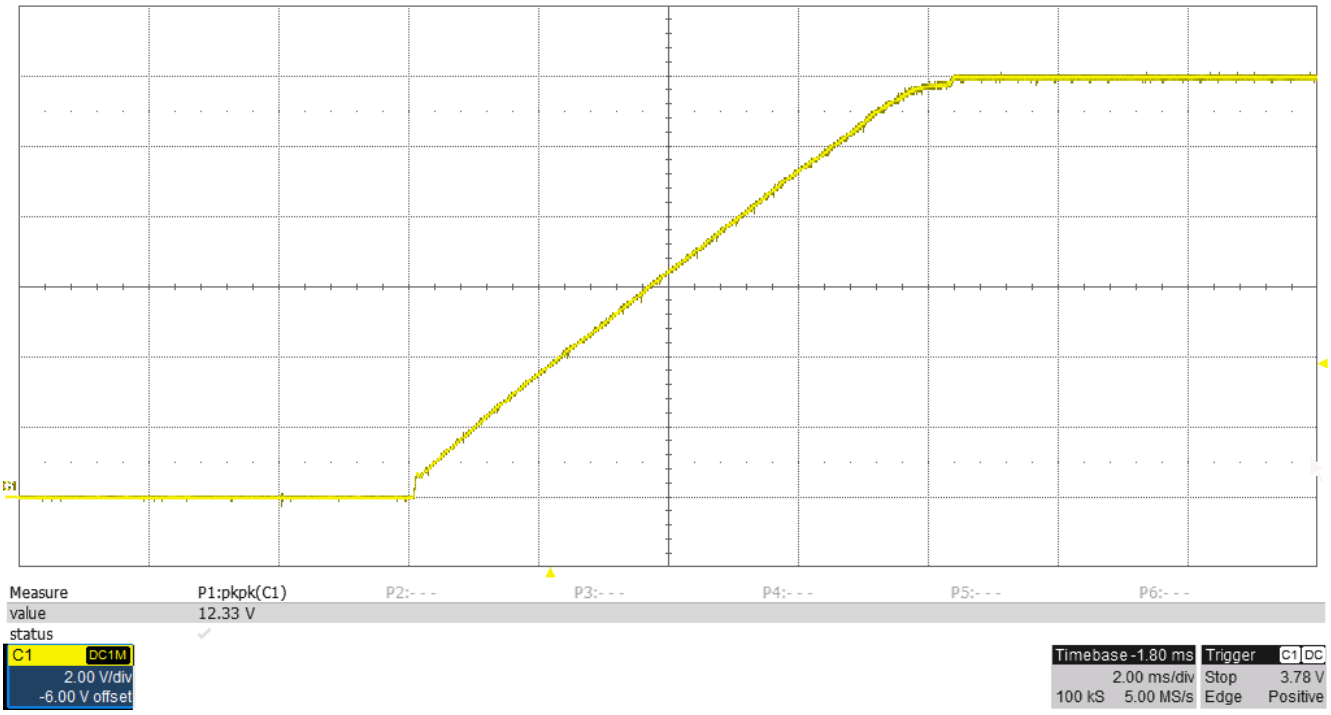


Figure 3-12. 2.1-A Load, 2 ms/div, 2 V/div

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