

## Test Report: PMP22210

# High-Efficiency Neutral-Less Upside-Down Buck With 12-V/30-mA Output Reference Design



### Description

This reference design uses the UCC28910 in an upside-down buck topology to make a 12-V output capable of 30-mA loading from a 120-Vac input. The design can achieve over 70% efficiency at full loading. All components are placed on one side of the board to reduce assembly complexity and cost. The overall dimensions are 1.35" x 1.35" for the board with a max height of 0.3" (excluding test points). Across loading conditions the floating output stays within 1% regulation.

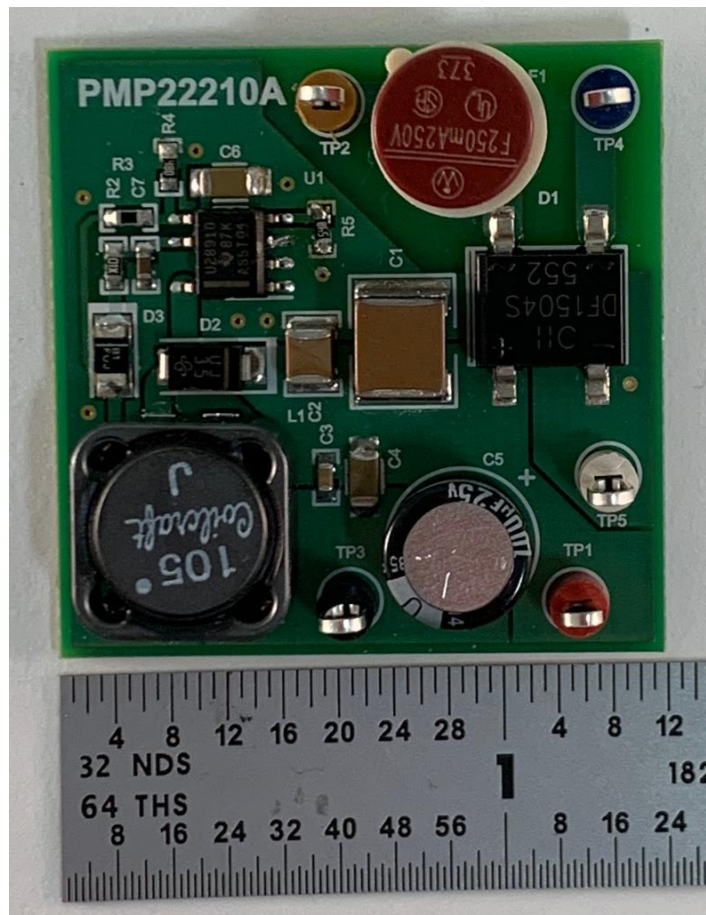


Figure 1. Board Top



An IMPORTANT NOTICE at the end of this TI reference design addresses authorized use, intellectual property matters and other important disclaimers and information.



**Figure 2.** Board Bottom

## 1 Test Prerequisites

### 1.1 Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input Voltage Range	120 Vac +/- 10%
Output Voltage	12 V +/- 1%
Output Current	30 mA
Switching Frequency	36 kHz

### 1.2 Considerations

Except for load transient measurements, resistive load was used. Unless otherwise indicated the input voltage was set to 120 Vac.

## 2 Testing and Results

### 2.1 Efficiency Graphs

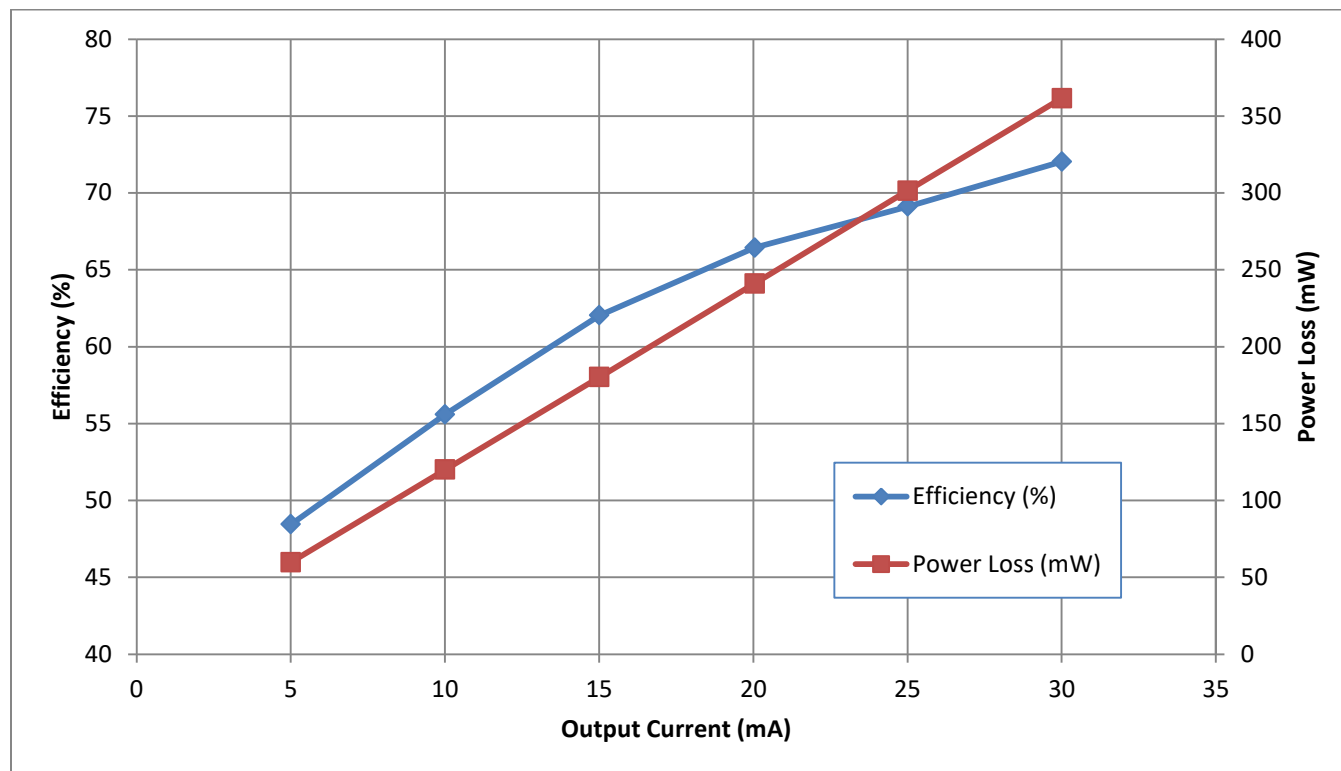


Figure 3. Efficiency with 12 Vdc Input

### 2.2 Load Regulation

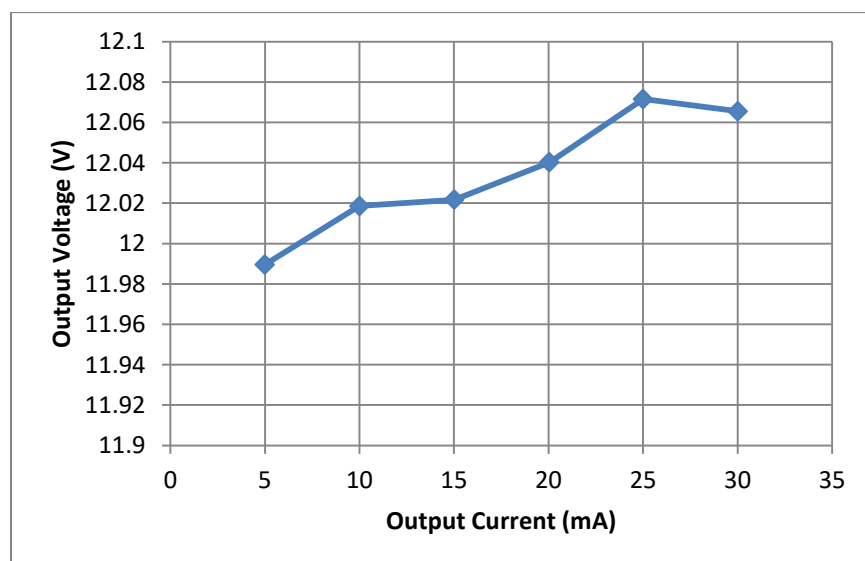


Figure 4. Efficiency with 9 Vdc Input

## 2.3 Efficiency Data

Power Factor	Input Power (mW)	Input Voltage (Vrms)	Input Current (mArms)	Output Voltage (Vdc)	Output Current (mA)	Output Power (mW)	Total Efficiency (%)	Power Loss (mW)
0.324	123.8	120.19	3.183	11.9896	5.0009	59.959	48.44	63.841
0.370	216.3	120.19	4.864	12.0186	10.006	120.257	55.597	96.043
0.400	290.9	120.19	6.057	12.0217	15.010	180.446	62.030	110.454
0.419	363.3	120.19	7.208	12.0402	20.048	241.382	66.441	121.918
0.437	436.8	120.18	8.317	12.0715	25.008	301.884	69.113	134.916
0.449	502.7	120.19	9.323	12.0655	30.011	362.098	72.031	140.602

Figure 5. Efficiency data

## 2.4 Thermal Images

Thermal image was taken after a 30 minute soak with the 12 V output at 30 mA loading and no airflow.

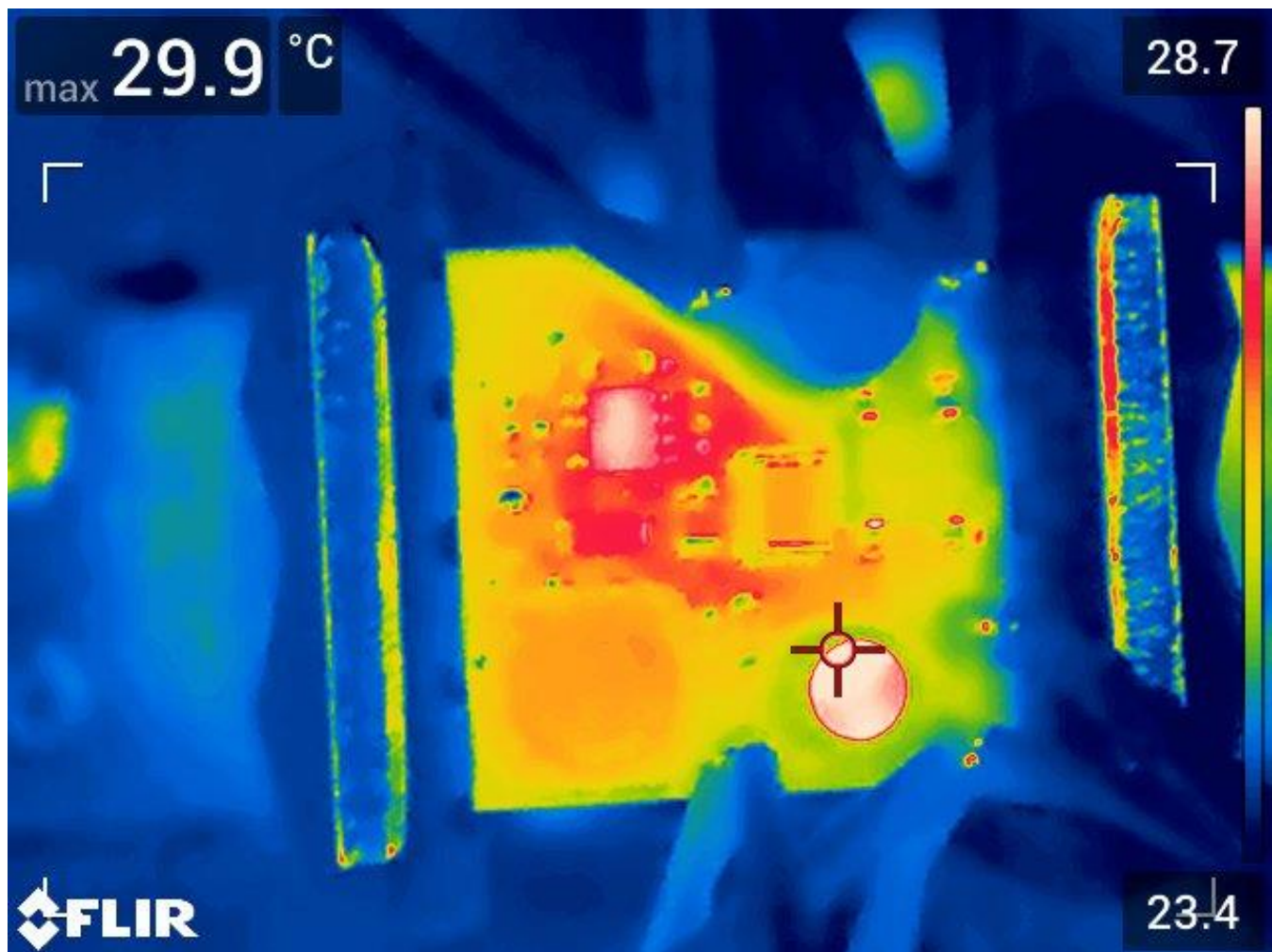
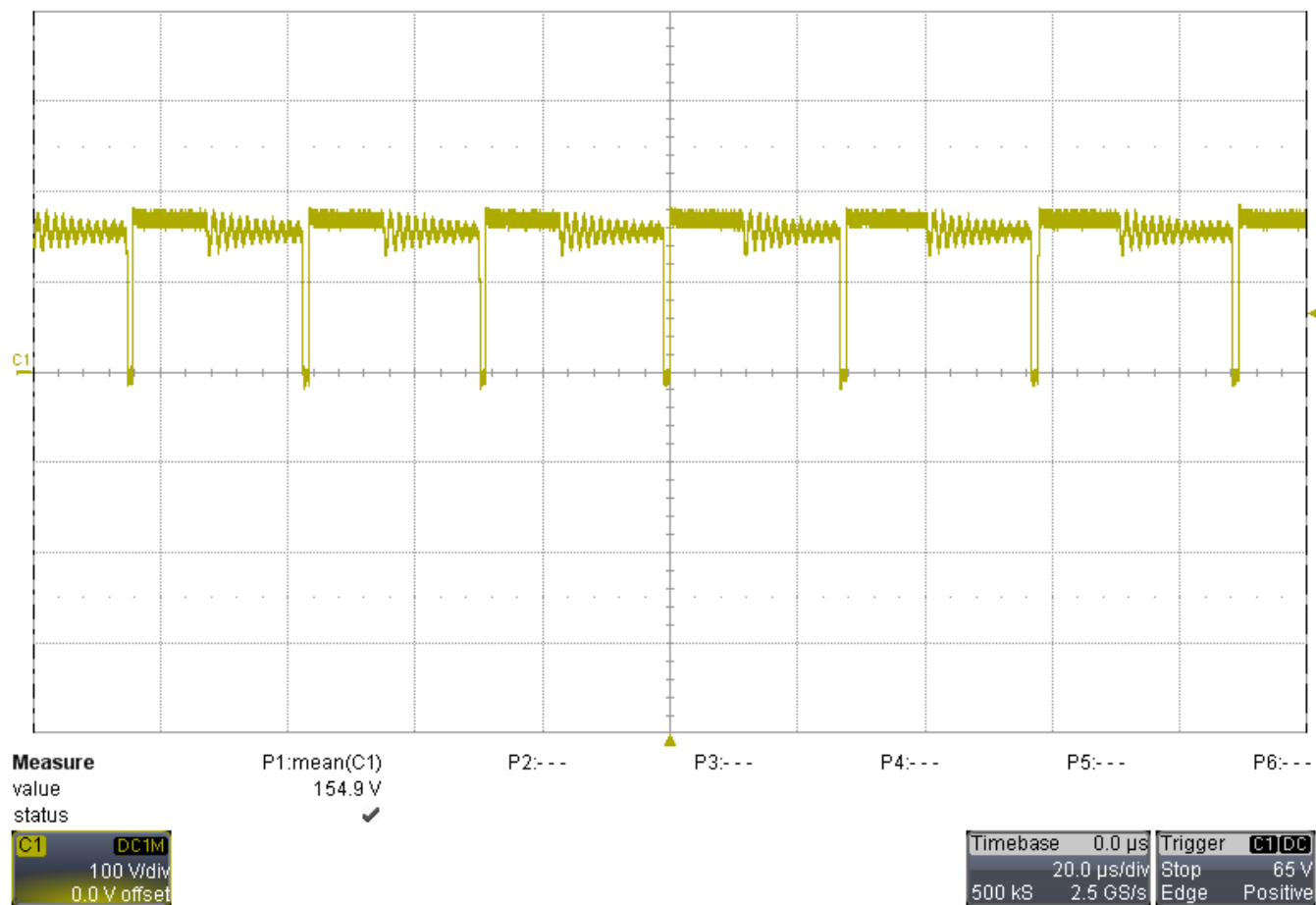


Figure 6. Board Top

## 3 Waveforms

### 3.1 Switching



**Figure 7.** Switching node with 30 mA load on the output

### 3.2 Output Voltage Ripple

Measurements were taken using the tip and barrel method across the output cap with the output at full load and a 12 Vdc input.

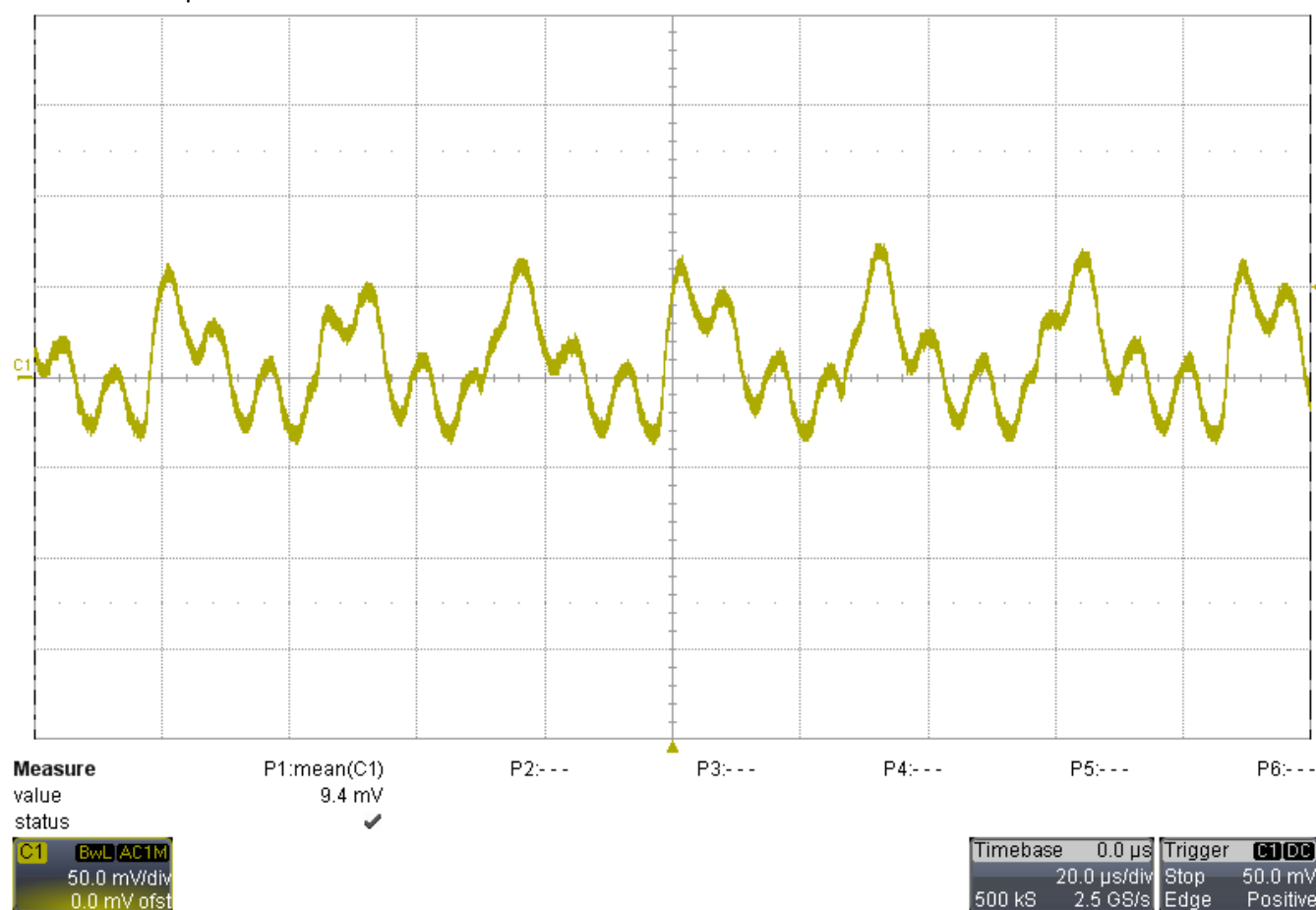


Figure 8.

### 3.3 Load Transients

For this measurement the output current was stepped between 5 mA and 25 mA at the 12 Vdc output

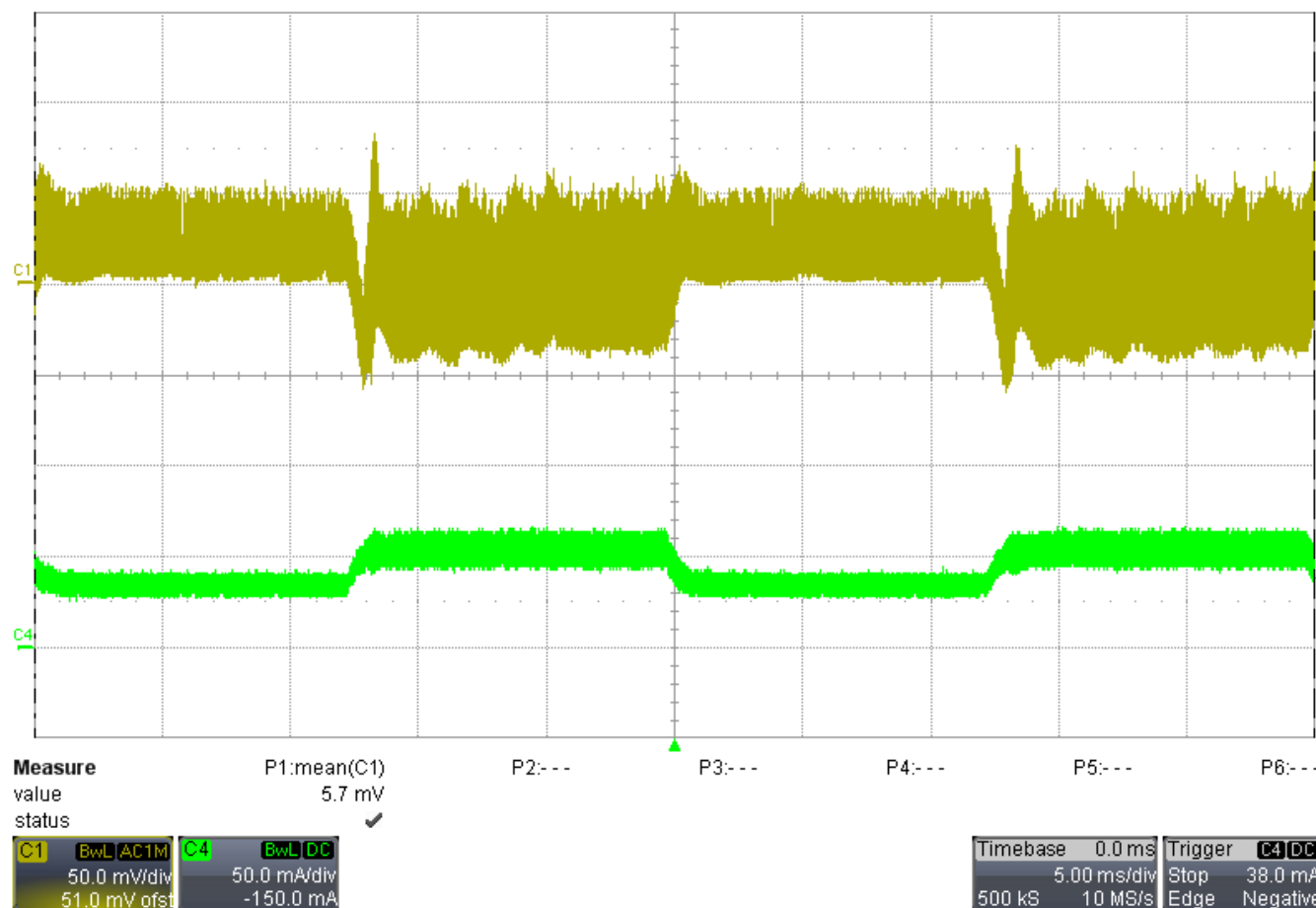


Figure 9.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (<https://www.ti.com/legal/termsofsale.html>) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2021, Texas Instruments Incorporated