Test Report: PMP21103
Class 5 PoE PD (12 V/2.5 A) supply reference design with smooth transition to auxiliary

Description

This design implements an IEEE802.3bt compliant Class 5 Power over Ethernet (PoE) Powered Device (PD) with smooth transition between the PoE input and an auxiliary supply connected to the output. The design consists of a 12V/2.5A active clamp forward converter and allows one PoE Power Source Equipment (PSE) supply and one ac/dc wall adapter auxiliary supply to be used in order to decrease the probability of power and data loss in your system. An IEEE802.3bt compliant TPS2373-4 PD controller is utilized for high power PoE control. In addition, a TPS3803 supervisor and additional circuitry enable the PD to achieve a smooth transition from PoE to auxiliary input and back to PoE without an interruption in output voltage or disconnecting from the PSE.

Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
PoE Input Voltage	42.5-57V (48V nominal)
Adapter (AUX) Input Voltage	12V+/-10%
Vout	12V
Iout	2.5A
Nominal Switching Frequency	250kHz

1.2 Required Equipment

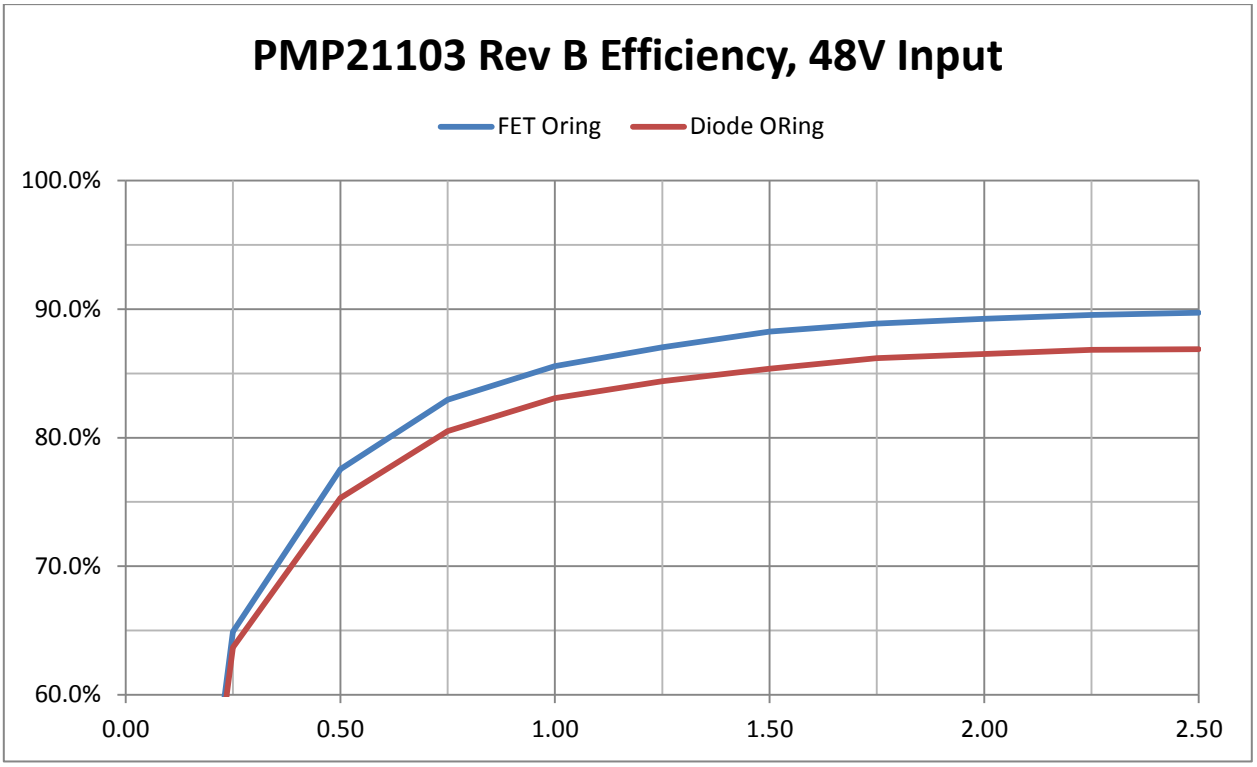
- IEEE802.3.bt Type 3 PSE
- AC/DC isolated wall adapter, 12V +/-10%, 2.5A minimum
- CAT5e ethernet cables (<100m)
- 12V/2.5A electronic load

1.3 Considerations

All testing performed with a 48V input and 2.5A load unless otherwise noted.

2 Testing and Results

2.1 Efficiency Graph

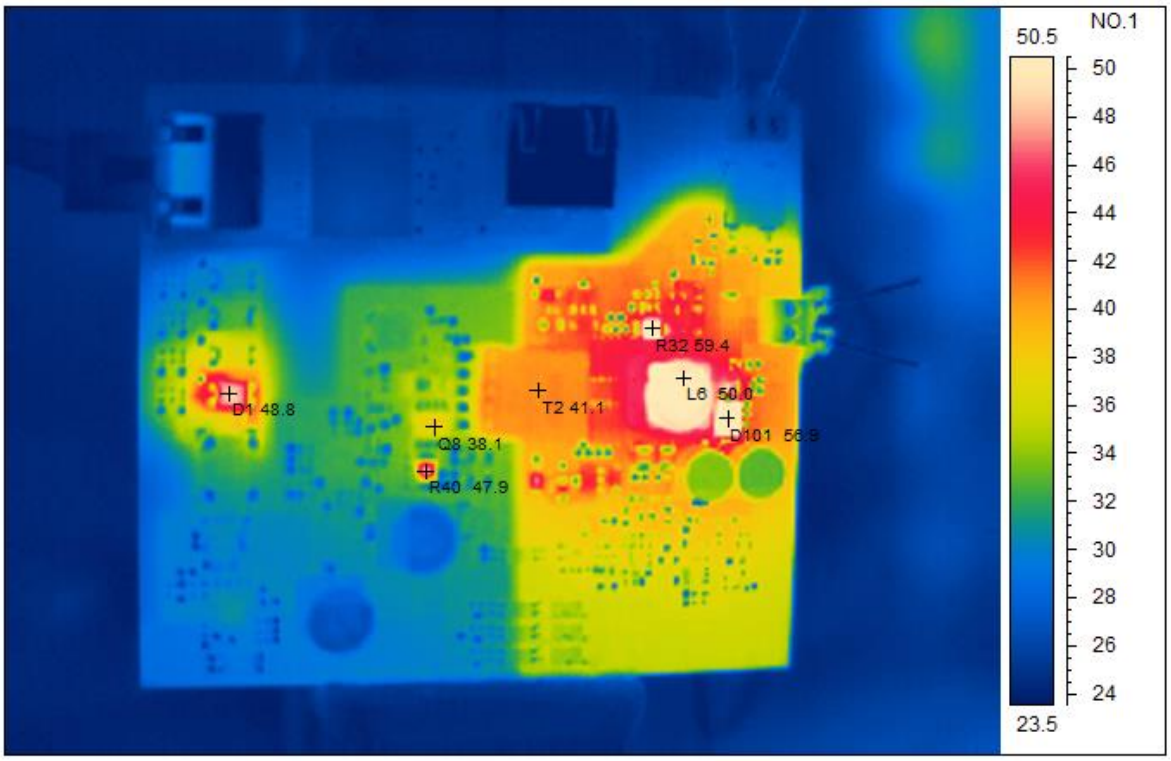


2.2 Efficiency Data

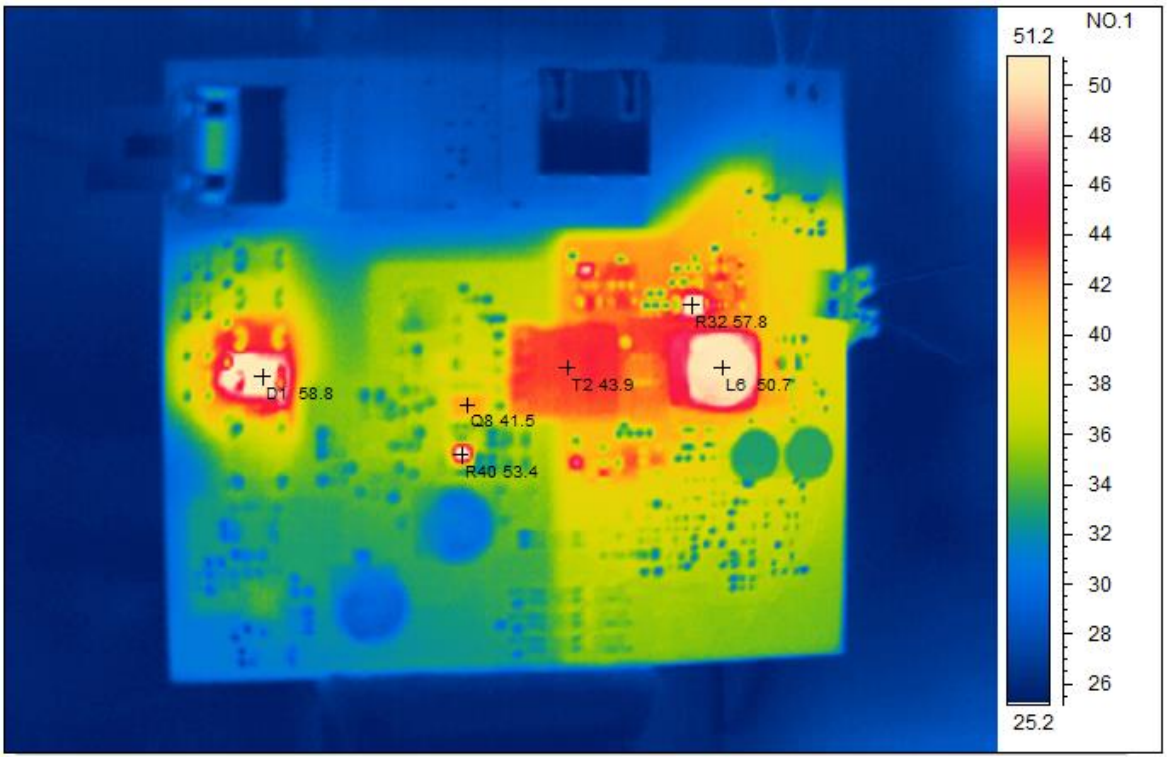
	FET Oring				Diode Oring			
J7	J7	J1	J1	J1	J7	J1	J1	J1
Iout	Vout	Iin	Vin	Eff	Vout	Iin	Vin	Eff
0.00	12.22	0.034	48.00	0.0%	10.29	0.034	48.00	0.0%
0.25	12.21	0.098	48.00	64.9%	10.15	0.083	48.00	63.7%
0.50	12.21	0.164	48.00	77.6%	10.12	0.140	48.00	75.3%
0.75	12.21	0.230	48.00	82.9%	10.10	0.196	48.00	80.5%
1.00	12.20	0.297	48.00	85.6%	10.09	0.253	48.00	83.1%
1.25	12.20	0.365	48.00	87.0%	10.08	0.311	48.00	84.4%
1.50	12.20	0.432	48.00	88.3%	10.08	0.369	48.00	85.4%
1.75	12.19	0.500	48.00	88.9%	10.07	0.426	48.00	86.2%
2.00	12.19	0.569	48.00	89.3%	10.07	0.485	48.00	86.5%
2.25	12.19	0.638	48.00	89.6%	10.06	0.543	48.00	86.8%
2.50	12.18	0.707	48.00	89.7%	10.06	0.603	48.00	86.9%

2.3 Thermal Images

Diode OR-ing:

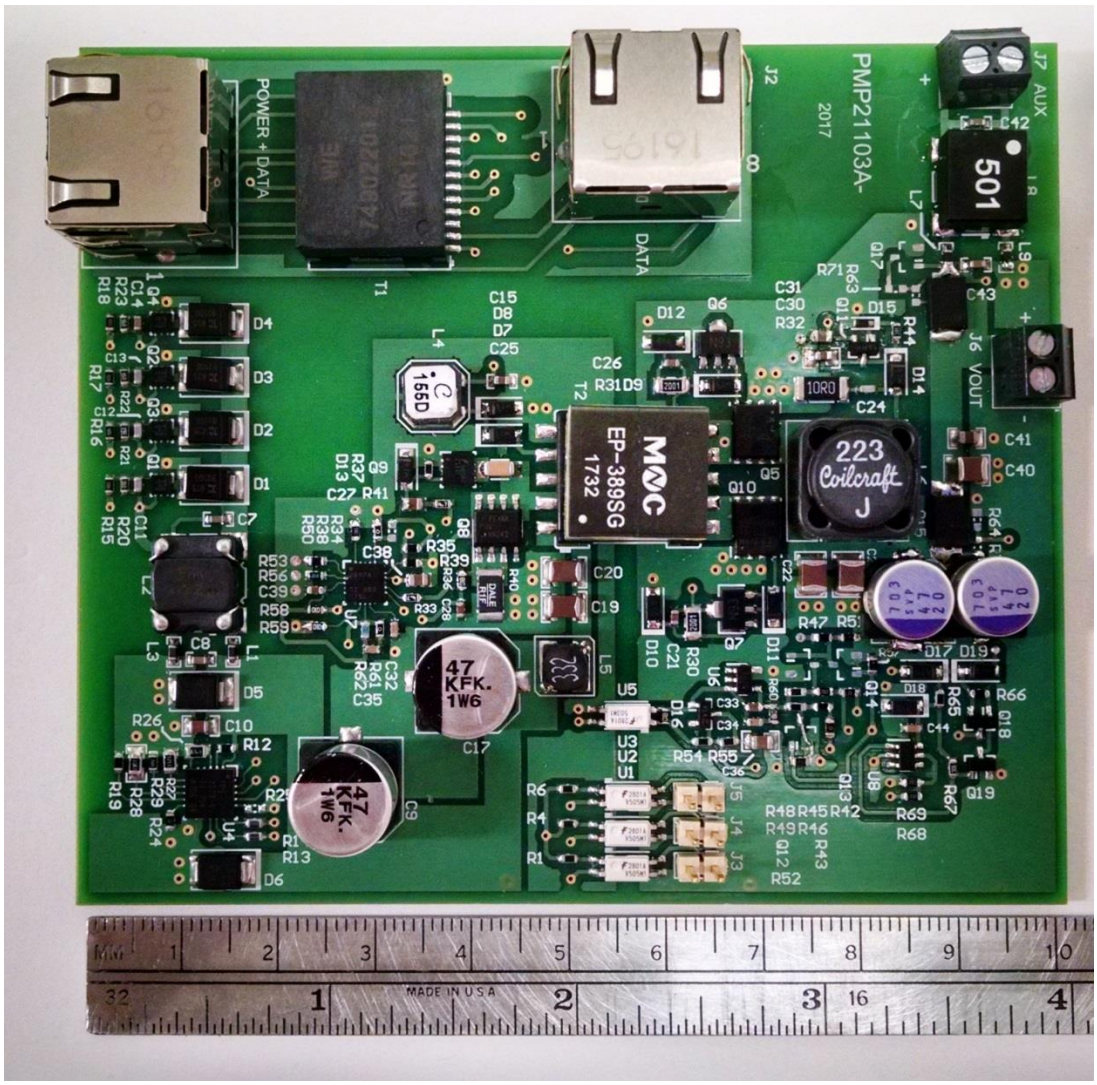


FET OR-ing:



2.4 Photo

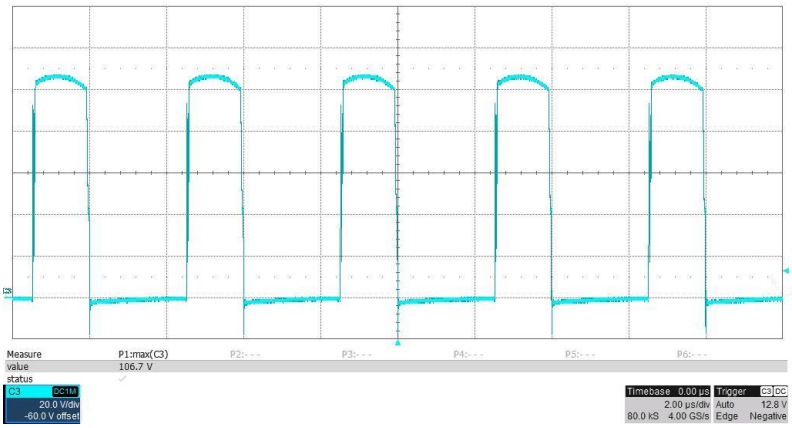
The board measures 89mm x 102mm. Shown with diode OR-ing.



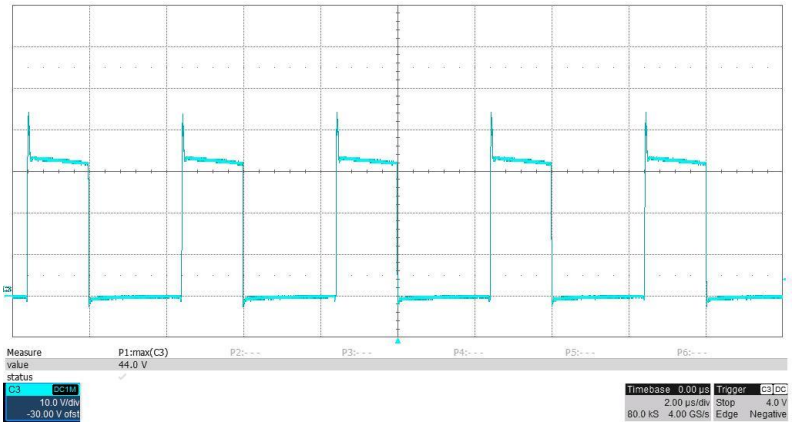
3 Waveforms

3.1 Switching

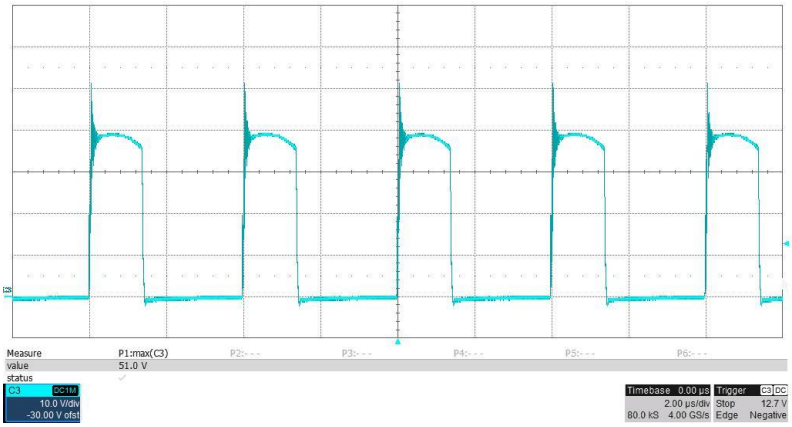
VDS, Q8, 37V input, 2.5A load, 20V/div, 2usec/div, Measured 106.7Vpeak:



VDS, Q5, 57V input, 2.5A load, 10V/div, 2usec/div, Measured 44Vpeak:



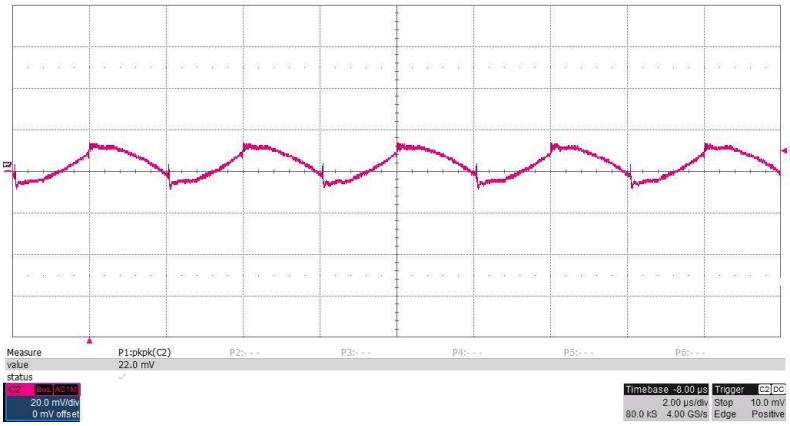
VDS, Q10, 37V input, 2.5A load, 10V/div, 2usec/div, Measured 51Vpeak:



3.2 Voltage Ripple

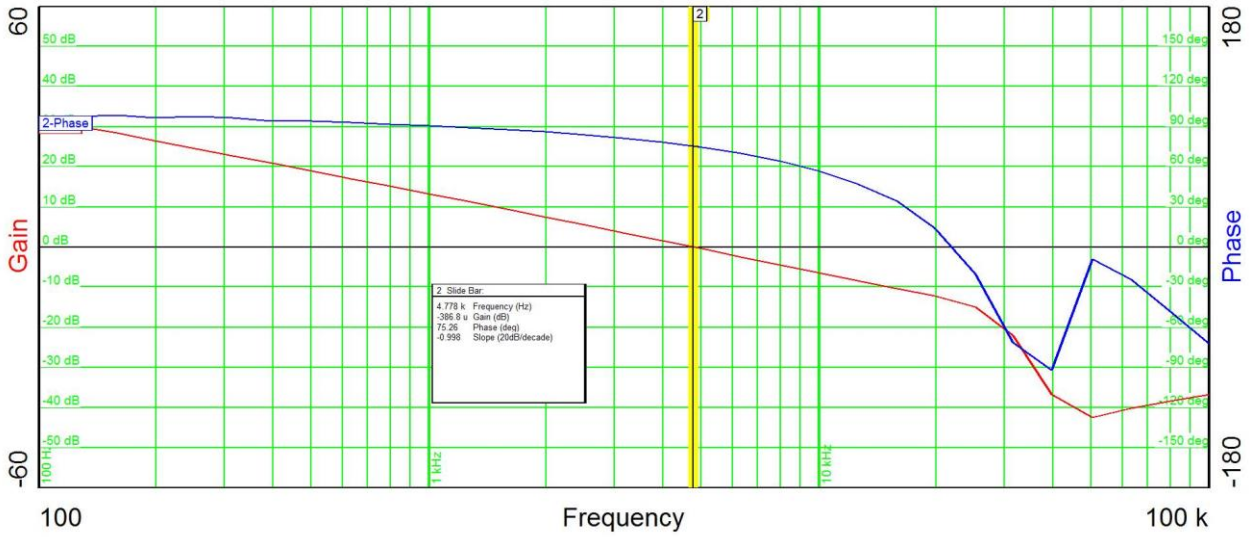
Input ripple (C8), 20mV/div, 2usec/div, measured 39.3mVpp:

Output ripple (C41), 20mV/div, 2usec/div, measured 22mVpp:



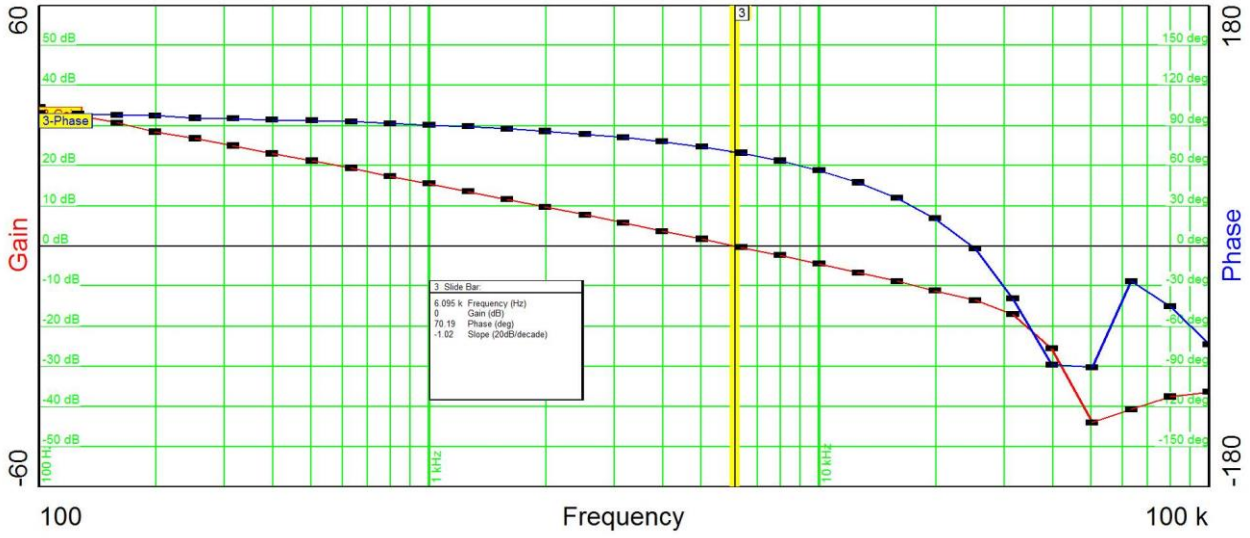
3.3 Bode Plot

No adapter, 2.5A load:



Bandwidth= 4.7 kHz Phase Margin=75 degrees Gain Margin=13dB

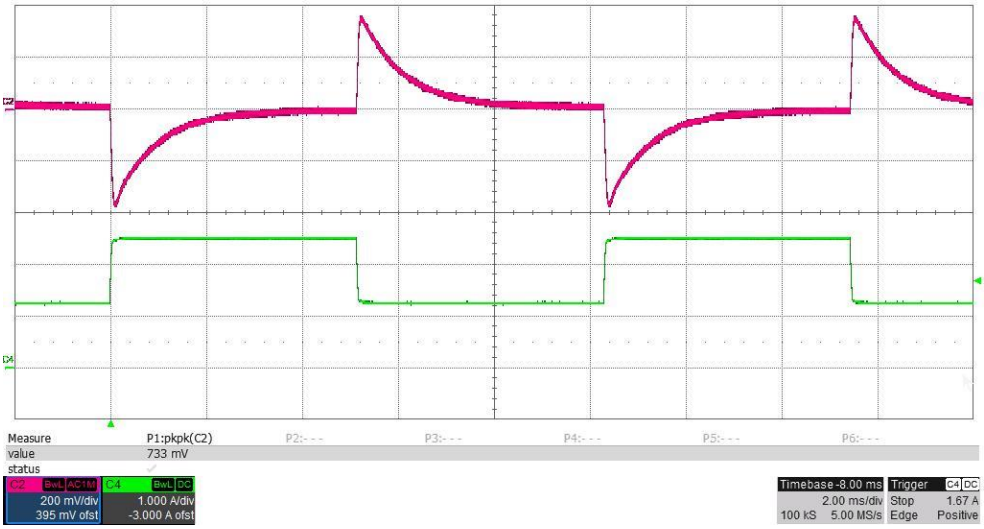
Adapter, 0A load:



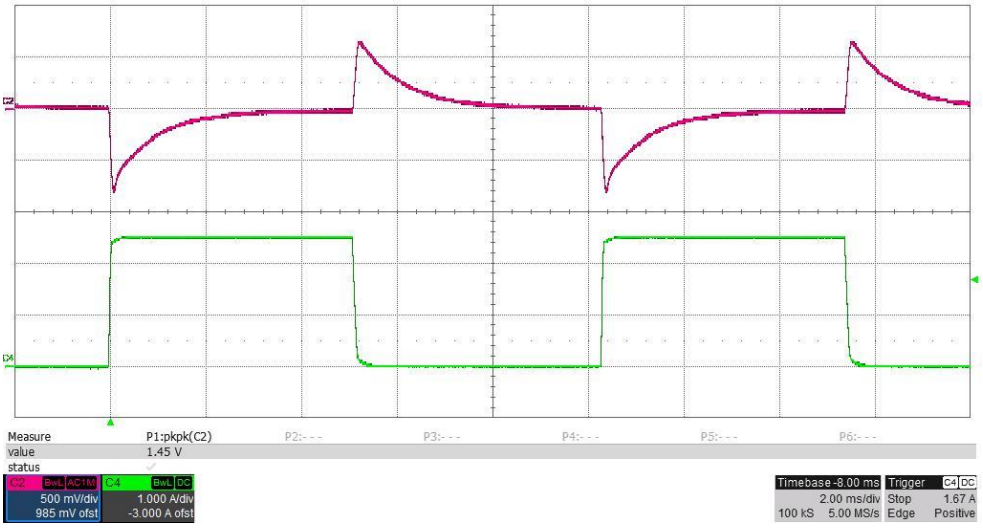
Bandwidth= 6.1 kHz Phase Margin=70 degrees Gain Margin=13dB

3.4 Load Transients

Output load step response, 1.25A to 2.50A load step
200mV/div, 1A/div, 2msec/div, slew rate = 250mA/usec
Measured 733mVpp:

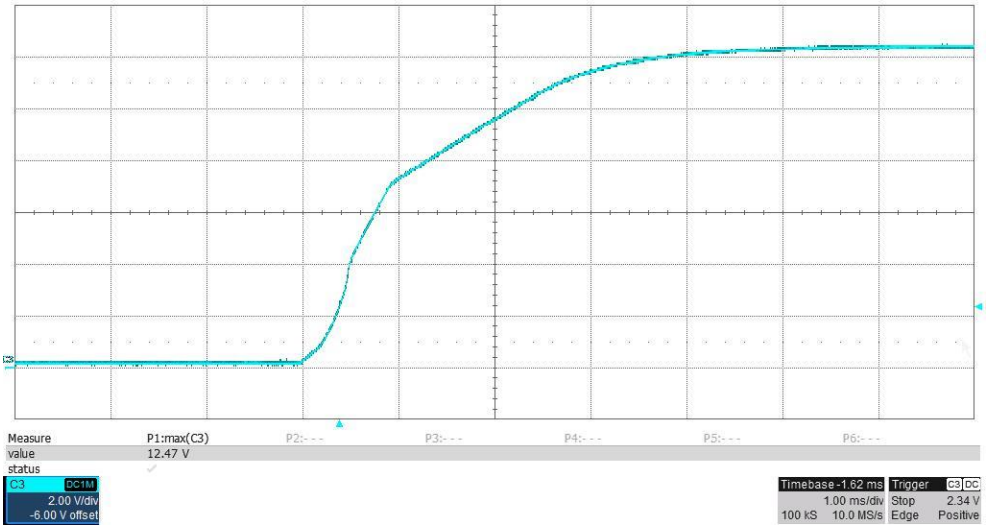


Output load step response, 0A to 2.50A load step
500mV/div, 1A/div, 2msec/div, slew rate = 250mA/usec
Measured 1.45Vpp:

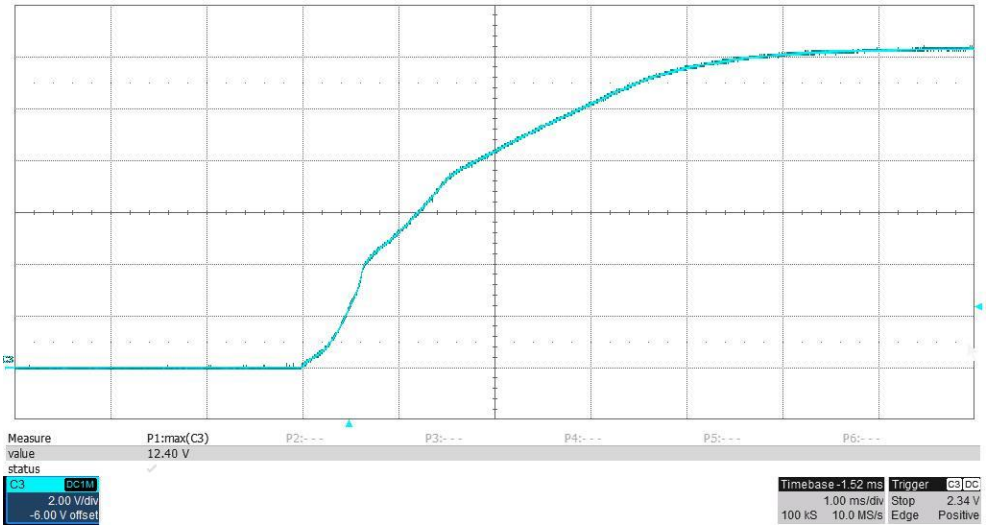


3.5 Start-up Sequence

0A load, 1msec/div, 2V/div:



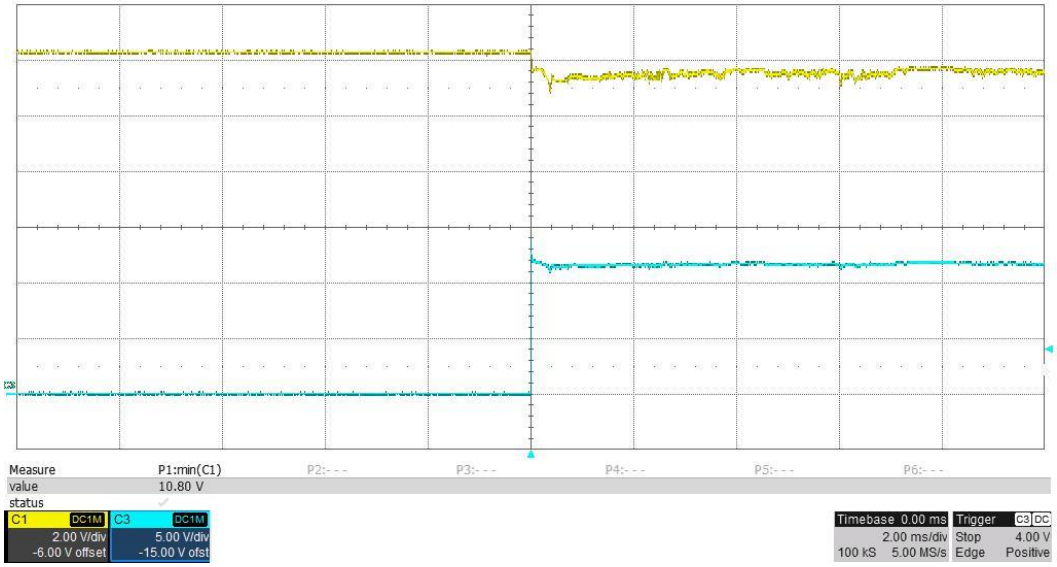
2.5A load, 1msec/div, 2V/div:



4 Smooth Transition

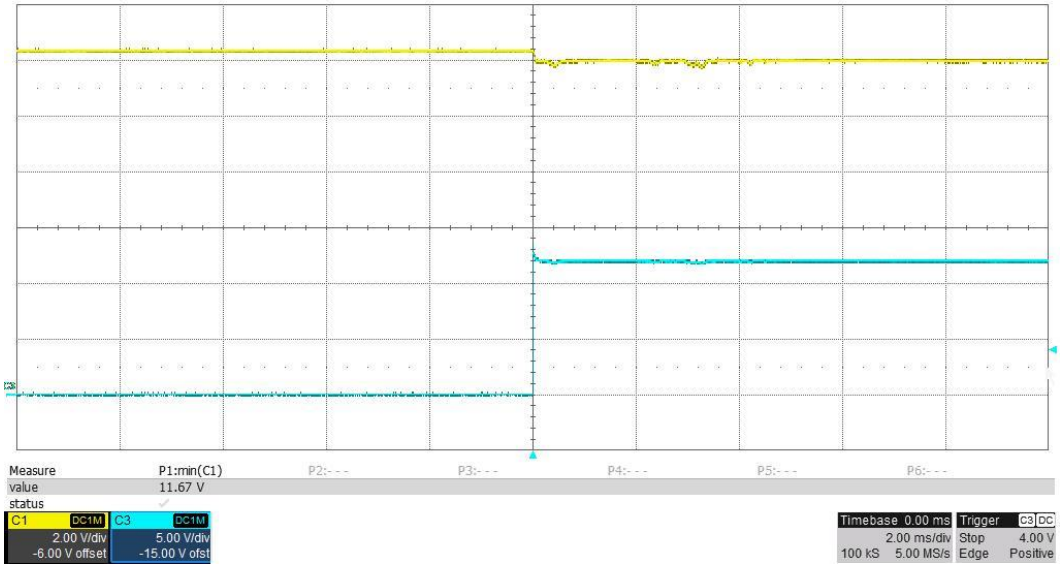
4.1 FET OR-ing

4.1.1 PoE powering system with 2.5A load then connect adapter



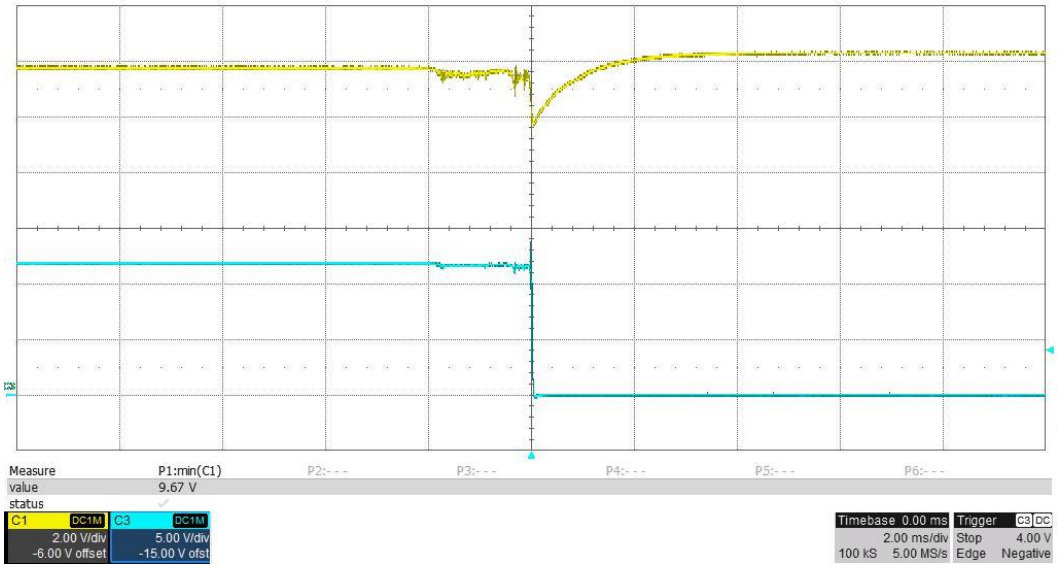
CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 2msec/div

4.1.2 PoE powering system with 0A load then connect adapter



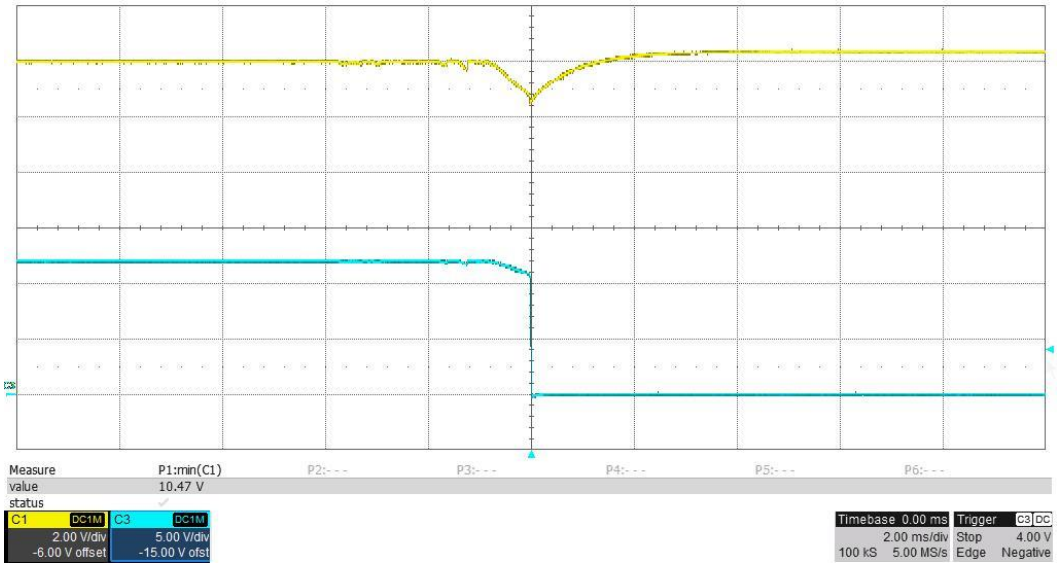
CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 2msec/div

4.1.3 Adapter powering system with 2.5A load then disconnect adapter



CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 2msec/div

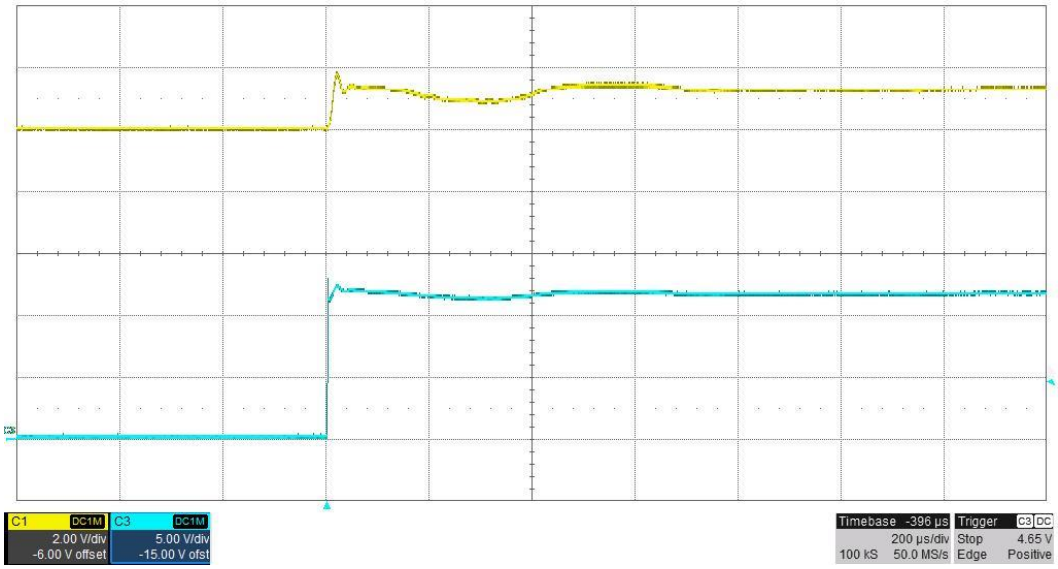
4.1.4 Adapter powering system with 0A load then disconnect adapter



CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 2msec/div

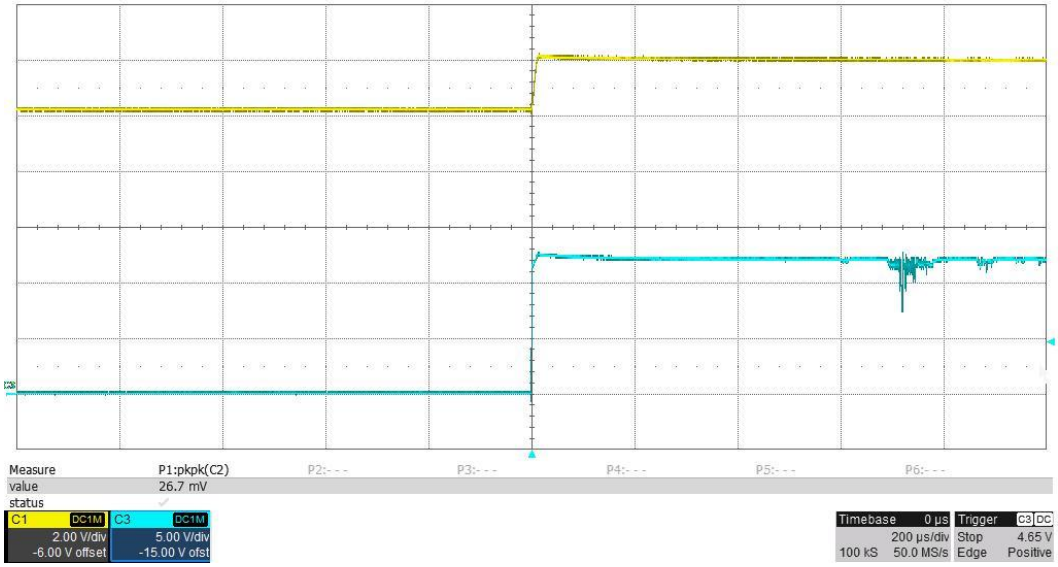
4.2 Diode OR-ing

4.2.1 PoE powering system with 2.5A load then connect adapter



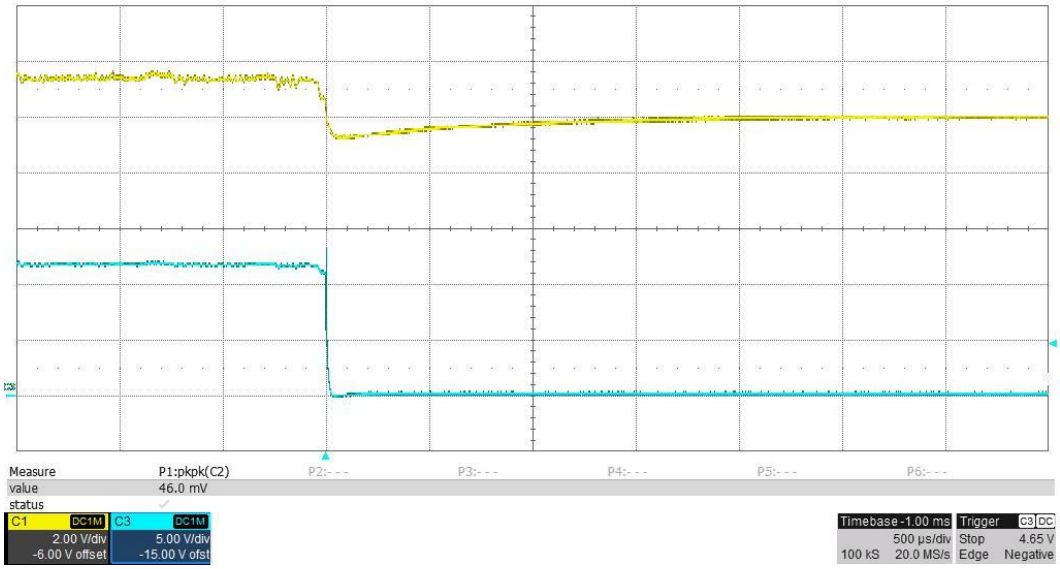
CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 200usec/div

4.2.2 PoE powering system with 0A load then connect adapter



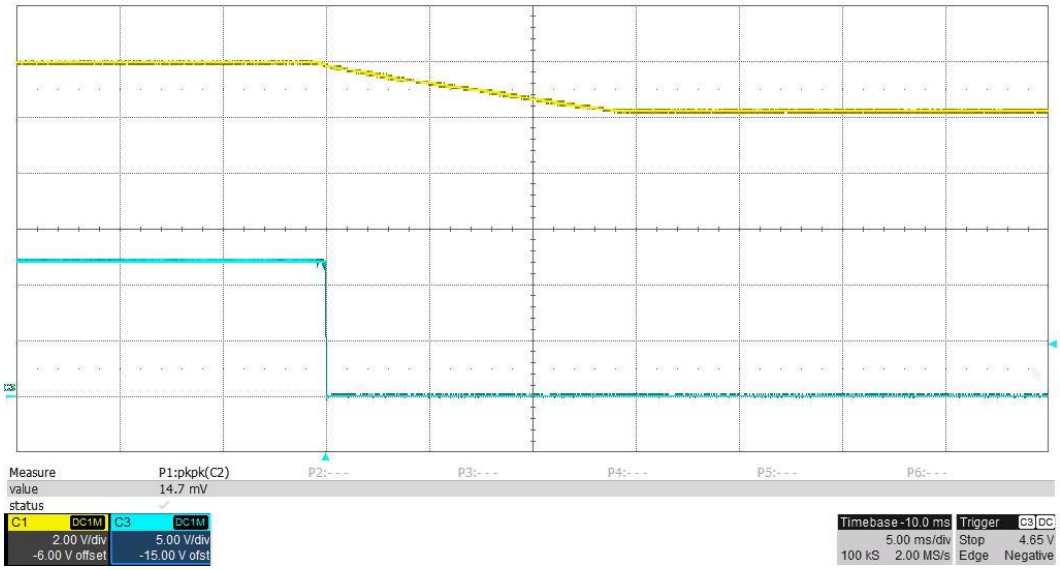
CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 200usec/div

4.2.3 Adapter powering system with 2.5A load then disconnect adapter



CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 500usec/div

4.2.4 Adapter powering system with 0A load then disconnect adapter



CH1: Vout, 2V/div CH3: Adapter Input, 5V/div 5msec/div

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 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