# Test Report
# For PMP10664
# 06/15/2015

# Table of Contents

1. Design Specifications ..... 3
2. Circuit Description and PCB details ..... 3
3. PMP10664 Board Photos ..... 4
4. Thermal Data ..... 6
5. Efficiency ..... 7
5.1 Efficiency Chart ..... 7
5.2 Efficiency Data ..... 8
6 Waveforms ..... 11
6.1 Load Transient Response ..... 11
6.2 Startup ..... 14
6.3 Output Voltage Ripple and Switch Node Voltage ..... 15
6.4 Short Circuit ..... 18
6.5 Short Circuit Recovery ..... 21
6.6 Frequency Response ..... 22

## 1. Design Specifications

| | |
|---|---|
| **Vin Minimum** | **9.8VDC** |
| **Vin Maximum** | **15.1VDC** |
| **Vout** | **3.3VDC** |
| **Iout** | **6.5A & 4A** |
| **Approximate Switching Frequency** | **~750KHz** |

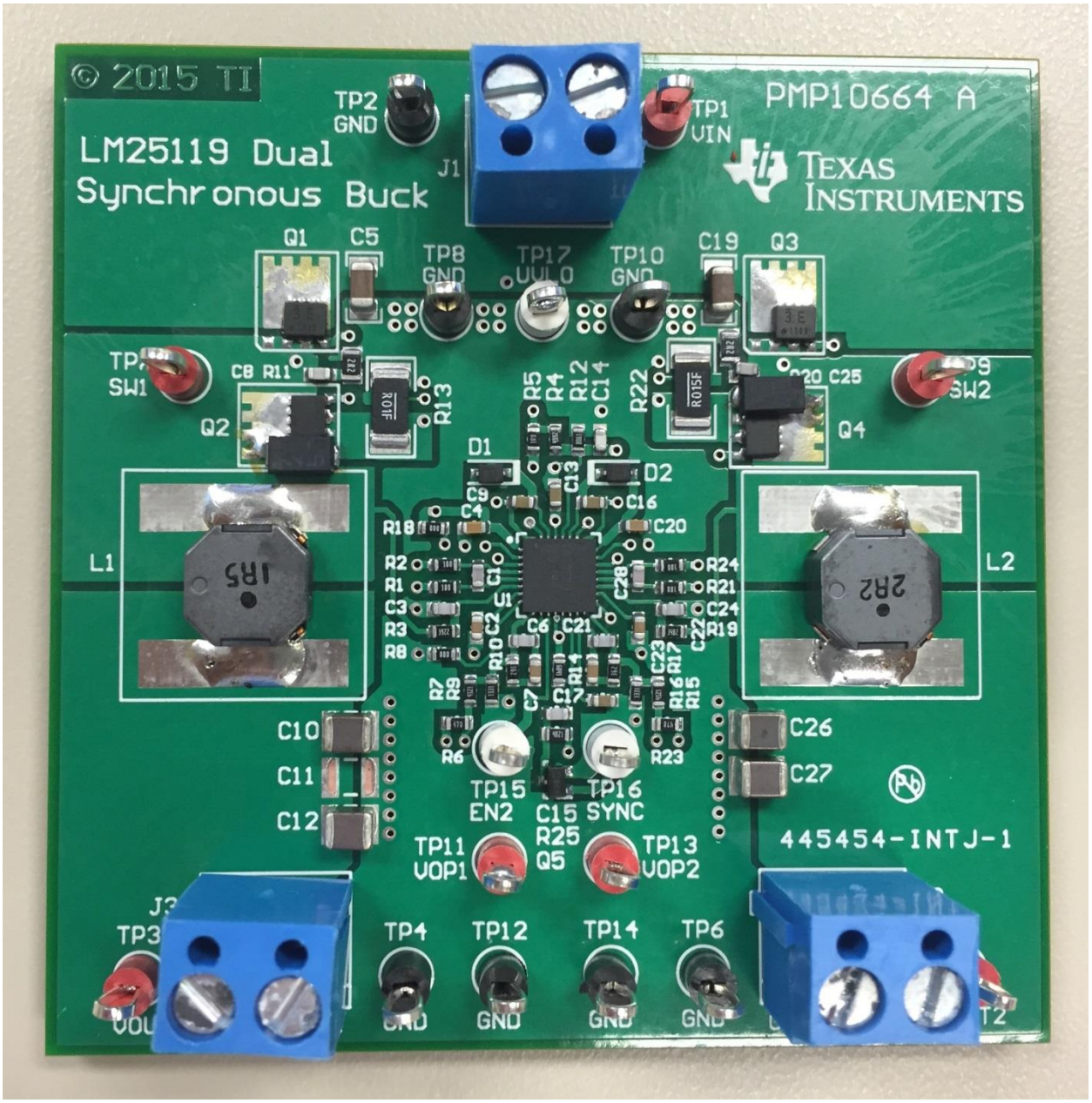
## 2. Circuit Description and PCB details

PMP10664 is a 35W dual-output synchronous buck converter using the LM25119 controller IC. The design accepts an input voltage of 9.8Vin to 15.1Vin, provides one output of 3.3V capable of supplying 6.5A of current and one output of 3.3V capable of supplying 4A of current to the load. It features a small size and is an inexpensive and more efficient solution. The design is capable of using a 3.3V, 1.5MHz external clock on the sync pin to drive the device. A Schottky diode is implemented in parallel with the low side sync FET's body diode in each channel to improve efficiency.

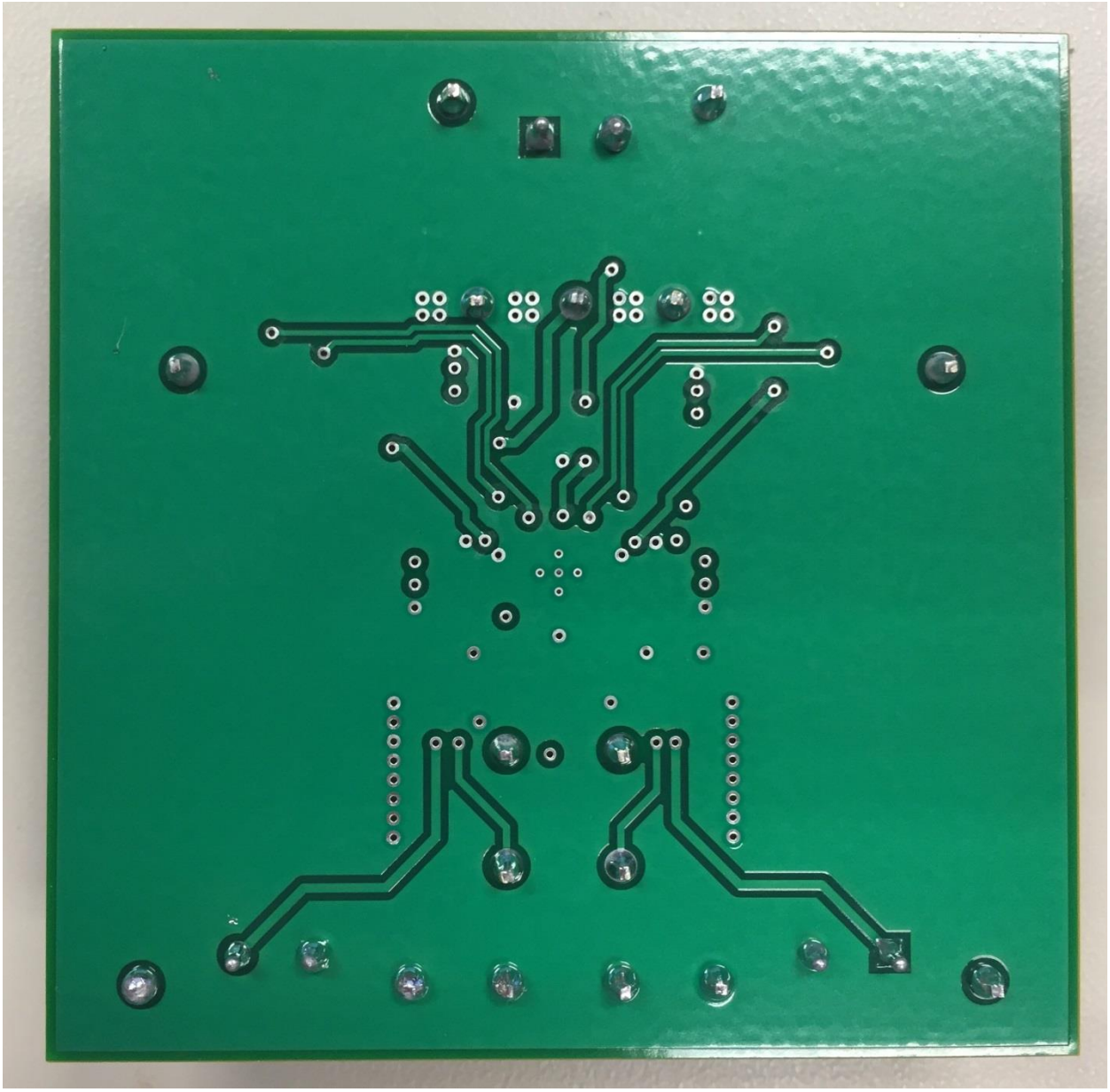
Dimension of PMP10664 PCB is 75mm * 40mm. Four layer PCB was used for the design.

## 3. PMP10664 Board Photos

**Board Dimensions: 75mm x 40mm**

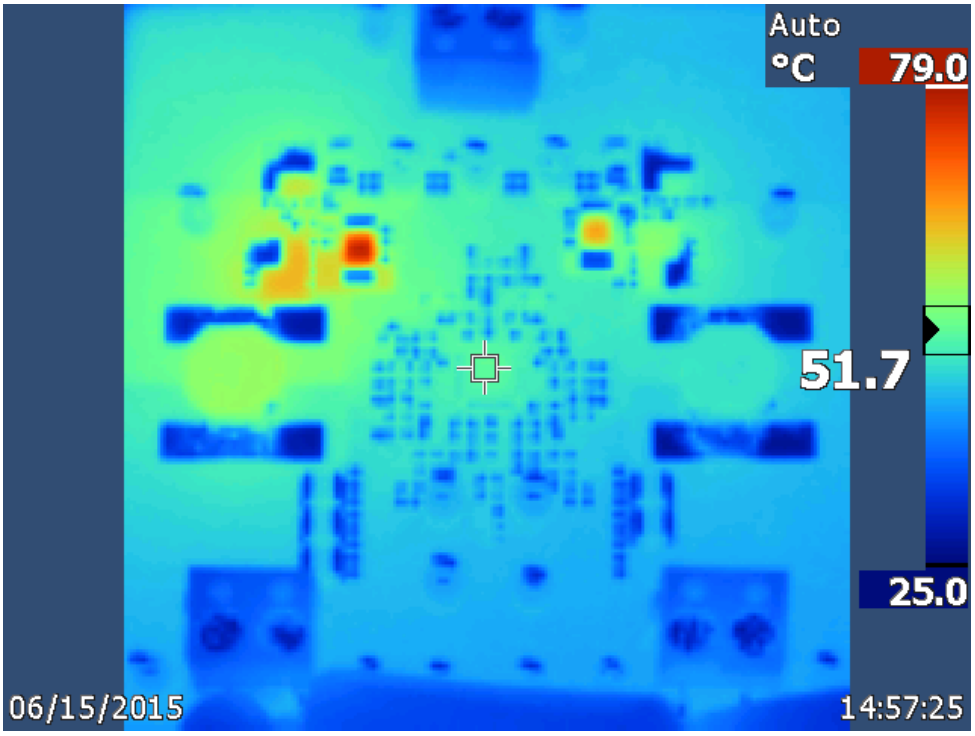



**Board Photo (Top)**

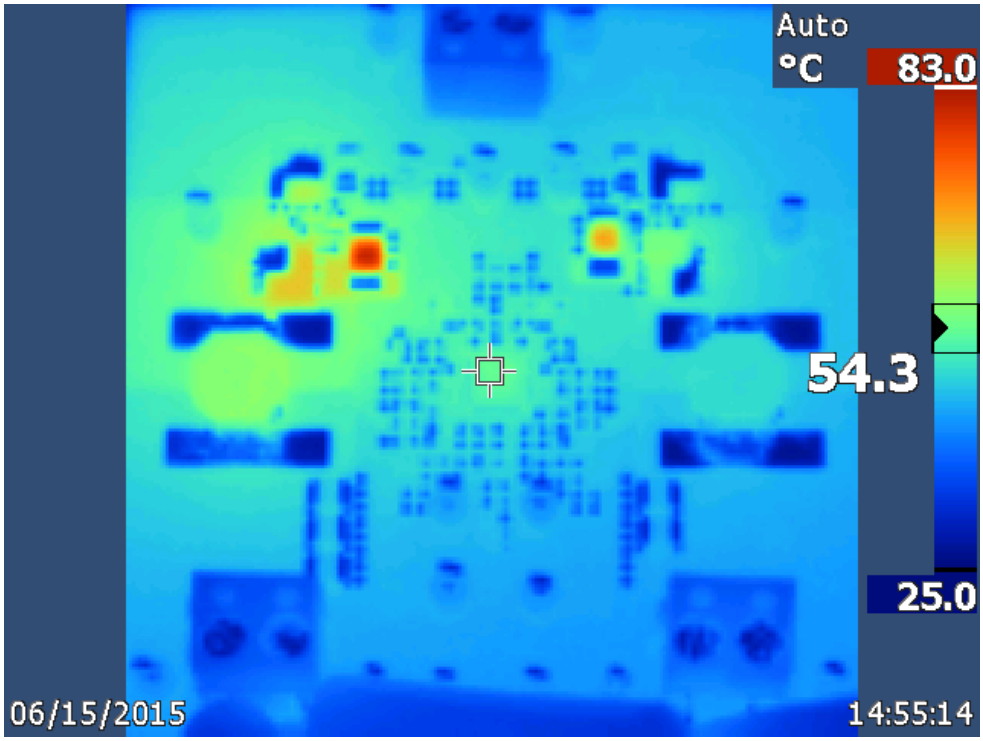


**Board Photo (Bottom)**

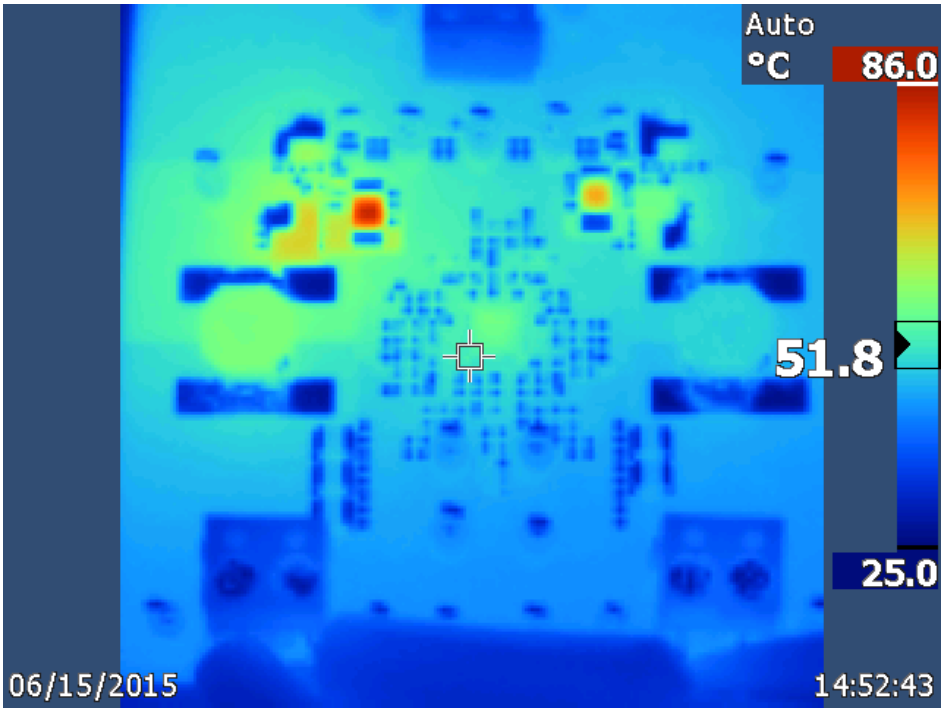
## 4. Thermal Data




**IR thermal image taken at steady state with 9.8Vin and 6.5A at Vout1, 4A at Vout2 (no airflow)**



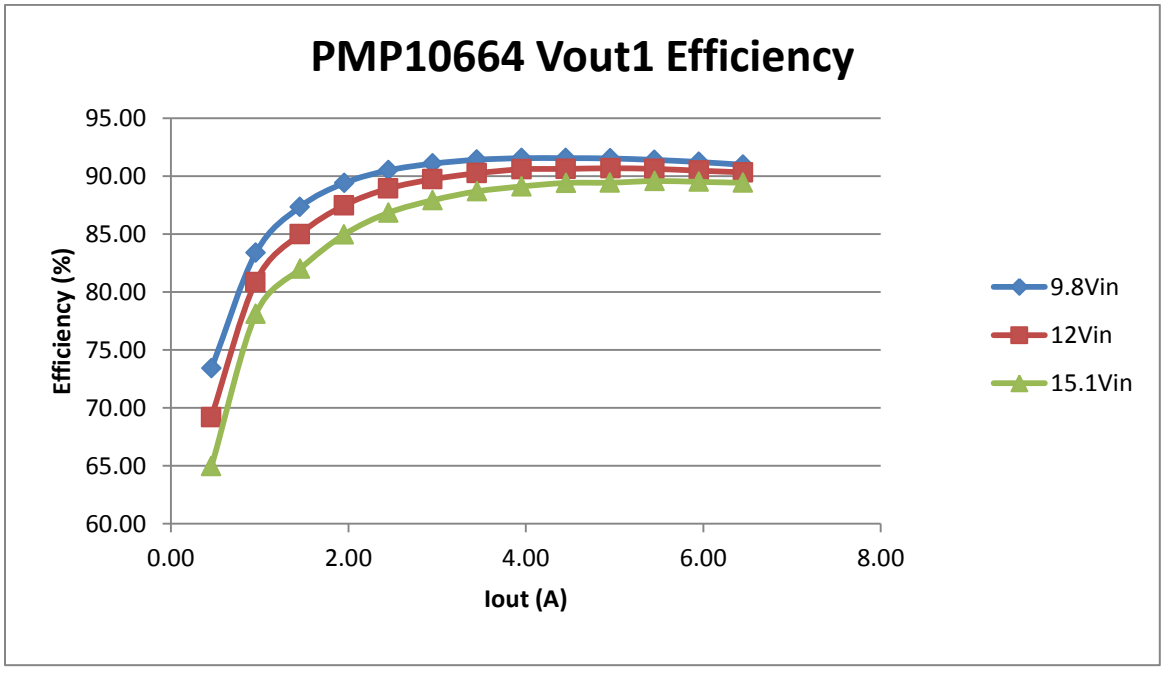

**IR thermal image taken at steady state with 12Vin and 6.5A at Vout1, 4A at Vout2 (no airflow)**

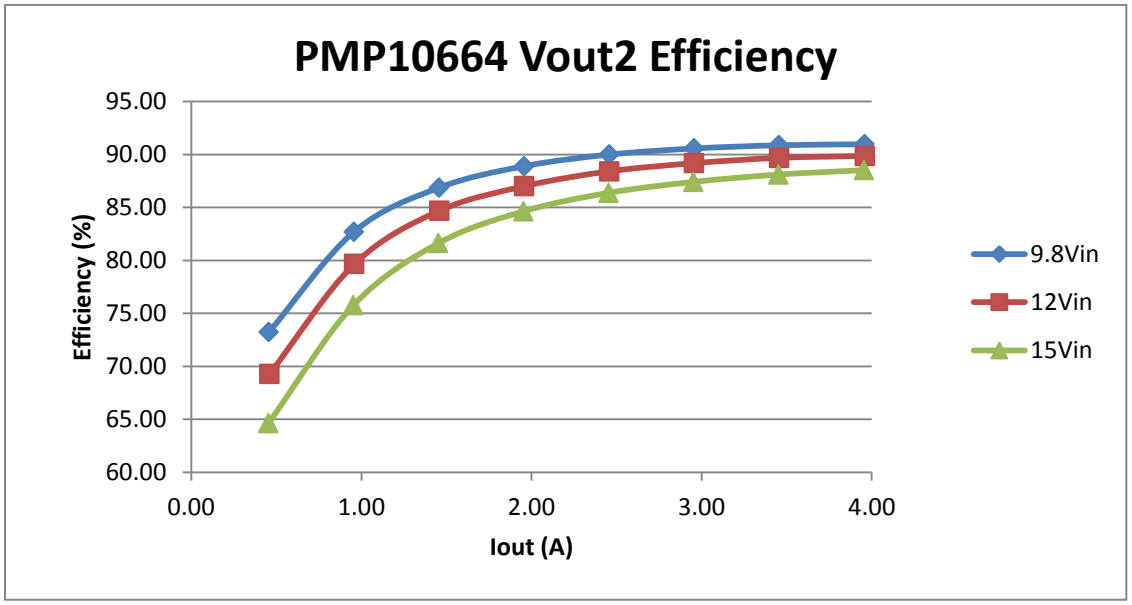



**IR thermal image taken at steady state with 15.1Vin and 6.5A at Vout1, 4A at Vout2 (no airflow)**

# 5. Efficiency

## 5.1 Efficiency Chart






## 5.2 Efficiency Data

| Vin(V) | Iin(A) | Pin(W) | Vout1(V) | Iout(A) | Pout(W) | Losses(W) | Efficiency(%) |
|---|---|---|---|---|---|---|---|
| 9.80 | 0.06 | 0.55 | 3.29 | 0.00 | 0.00 | 0.55 | 0.00 |
| 9.80 | 0.21 | 2.05 | 3.29 | 0.46 | 1.50 | 0.54 | 73.43 |
| 9.80 | 0.39 | 3.77 | 3.29 | 0.96 | 3.15 | 0.63 | 83.39 |
| 9.80 | 0.56 | 5.48 | 3.29 | 1.45 | 4.79 | 0.69 | 87.36 |
| 9.80 | 0.73 | 7.19 | 3.29 | 1.95 | 6.43 | 0.76 | 89.42 |
| 9.80 | 0.91 | 8.92 | 3.29 | 2.45 | 8.07 | 0.85 | 90.51 |
| 9.80 | 1.09 | 10.66 | 3.29 | 2.95 | 9.71 | 0.95 | 91.09 |
| 9.80 | 1.27 | 12.42 | 3.29 | 3.45 | 11.36 | 1.07 | 91.43 |
| 9.80 | 1.45 | 14.21 | 3.29 | 3.95 | 13.01 | 1.20 | 91.56 |
| 9.79 | 1.64 | 16.01 | 3.29 | 4.45 | 14.66 | 1.35 | 91.56 |
| 9.79 | 1.82 | 17.82 | 3.29 | 4.95 | 16.31 | 1.51 | 91.54 |
| 9.79 | 2.01 | 19.63 | 3.29 | 5.45 | 17.94 | 1.69 | 91.41 |
| 9.78 | 2.20 | 21.47 | 3.29 | 5.95 | 19.59 | 1.88 | 91.23 |
| 9.78 | 2.39 | 23.34 | 3.29 | 6.45 | 21.23 | 2.10 | 90.99 |
| 9.78 | 2.58 | 25.20 | 3.29 | 6.95 | 22.88 | 2.32 | 90.78 |
| 9.77 | 2.77 | 27.11 | 3.29 | 7.45 | 24.53 | 2.58 | 90.49 |

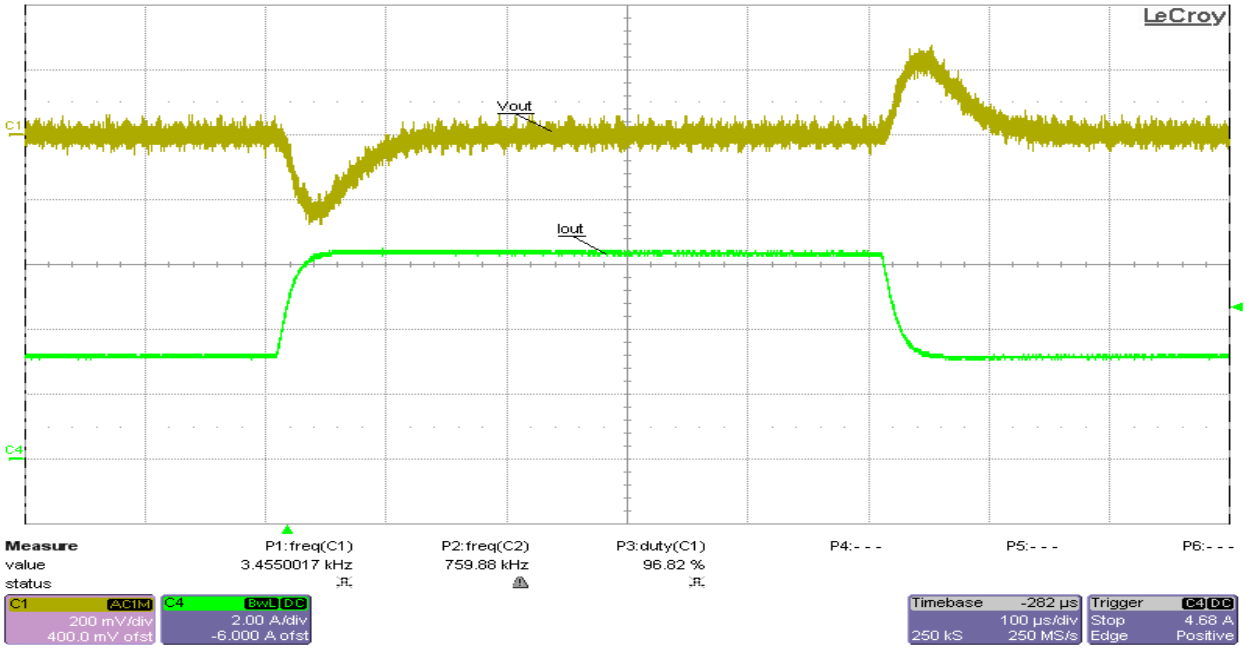
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12.00 | 0.06 | 0.66 | 3.29 | 0.00 | 0.00 | 0.66 | 0.00 |
| 12.00 | 0.18 | 2.16 | 3.29 | 0.45 | 1.50 | 0.67 | 69.20 |
| 12.00 | 0.32 | 3.88 | 3.29 | 0.95 | 3.13 | 0.74 | 80.86 |
| 12.00 | 0.47 | 5.63 | 3.29 | 1.45 | 4.78 | 0.84 | 85.00 |
| 12.00 | 0.61 | 7.34 | 3.29 | 1.95 | 6.42 | 0.92 | 87.48 |
| 12.00 | 0.76 | 9.07 | 3.29 | 2.45 | 8.07 | 1.00 | 88.94 |
| 12.00 | 0.90 | 10.82 | 3.29 | 2.95 | 9.71 | 1.11 | 89.74 |
| 12.00 | 1.05 | 12.58 | 3.29 | 3.45 | 11.36 | 1.23 | 90.26 |
| 11.99 | 1.20 | 14.37 | 3.29 | 3.95 | 13.02 | 1.35 | 90.60 |
| 11.99 | 1.35 | 16.17 | 3.29 | 4.45 | 14.66 | 1.51 | 90.64 |
| 11.99 | 1.50 | 17.99 | 3.29 | 4.96 | 16.32 | 1.67 | 90.69 |
| 11.98 | 1.65 | 19.81 | 3.29 | 5.45 | 17.95 | 1.85 | 90.64 |
| 11.98 | 1.81 | 21.66 | 3.29 | 5.95 | 19.60 | 2.06 | 90.48 |
| 11.98 | 1.96 | 23.51 | 3.29 | 6.45 | 21.24 | 2.27 | 90.34 |
| 11.97 | 2.12 | 25.39 | 3.29 | 6.95 | 22.88 | 2.51 | 90.11 |
| 11.97 | 2.28 | 27.29 | 3.29 | 7.45 | 24.53 | 2.76 | 89.88 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.11 | 0.05 | 0.82 | 3.29 | 0.00 | 0.00 | 0.82 | 0.00 |
| 15.11 | 0.15 | 2.31 | 3.29 | 0.46 | 1.50 | 0.81 | 64.96 |
| 15.11 | 0.27 | 4.03 | 3.29 | 0.96 | 3.15 | 0.88 | 78.12 |
| 15.11 | 0.39 | 5.85 | 3.29 | 1.46 | 4.79 | 1.05 | 82.01 |
| 15.11 | 0.50 | 7.57 | 3.29 | 1.95 | 6.43 | 1.14 | 84.98 |
| 15.10 | 0.62 | 9.30 | 3.29 | 2.45 | 8.08 | 1.22 | 86.86 |
| 15.10 | 0.73 | 11.05 | 3.29 | 2.95 | 9.72 | 1.33 | 87.94 |
| 15.10 | 0.85 | 12.82 | 3.29 | 3.45 | 11.37 | 1.45 | 88.70 |
| 15.10 | 0.97 | 14.61 | 3.29 | 3.96 | 13.02 | 1.59 | 89.13 |
| 15.09 | 1.09 | 16.41 | 3.29 | 4.46 | 14.67 | 1.73 | 89.43 |
| 15.09 | 1.21 | 18.23 | 3.29 | 4.95 | 16.30 | 1.92 | 89.45 |
| 15.08 | 1.33 | 20.05 | 3.29 | 5.45 | 17.96 | 2.09 | 89.59 |
| 15.08 | 1.45 | 21.89 | 3.29 | 5.95 | 19.60 | 2.29 | 89.52 |
| 15.07 | 1.58 | 23.76 | 3.29 | 6.45 | 21.25 | 2.51 | 89.43 |
| 15.07 | 1.70 | 25.65 | 3.29 | 6.95 | 22.89 | 2.75 | 89.26 |
| 15.06 | 1.83 | 27.55 | 3.29 | 7.45 | 24.54 | 3.01 | 89.06 |

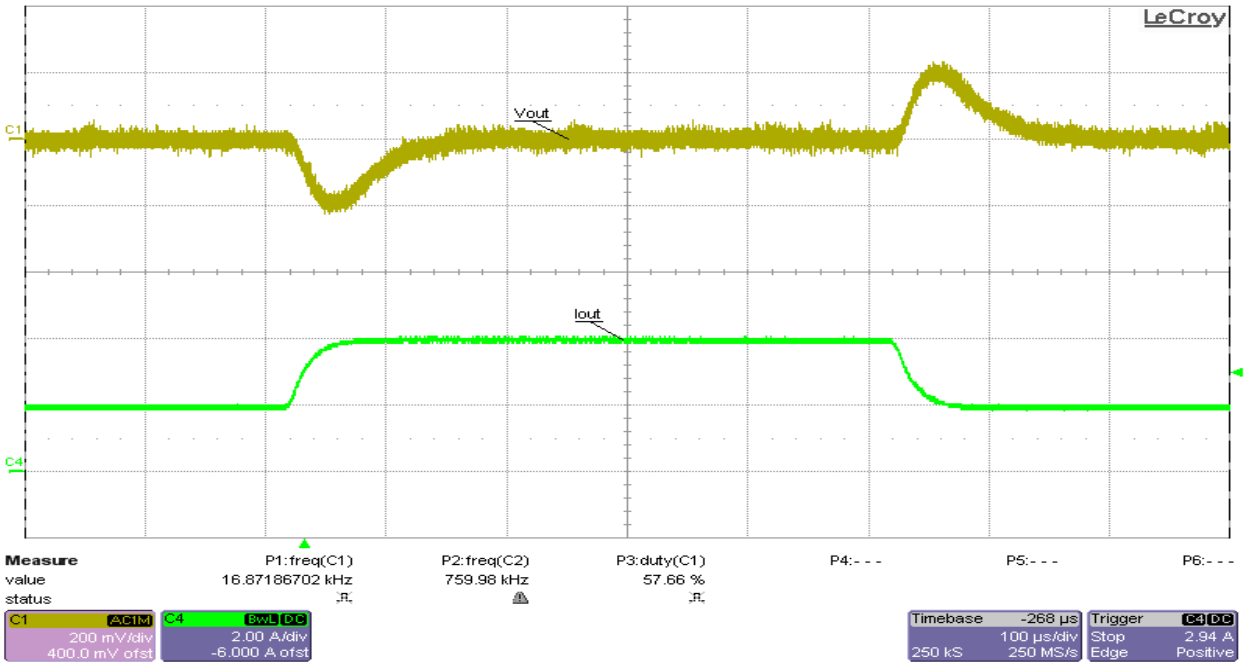
| Vin(V) | Iin(A) | Pin(W) | Vout2(V) | Iout(A) | Pout(W) | Losses(W) | Efficiency(%) |
|---|---|---|---|---|---|---|---|
| 9.80 | 0.06 | 0.55 | 3.29 | 0.00 | 0.00 | 0.55 | 0.00 |
| 9.80 | 0.21 | 2.05 | 3.29 | 0.46 | 1.50 | 0.55 | 73.22 |
| 9.80 | 0.39 | 3.80 | 3.29 | 0.96 | 3.15 | 0.66 | 82.69 |
| 9.80 | 0.56 | 5.52 | 3.29 | 1.46 | 4.79 | 0.72 | 86.86 |
| 9.80 | 0.74 | 7.24 | 3.29 | 1.96 | 6.44 | 0.80 | 88.89 |
| 9.80 | 0.92 | 8.99 | 3.29 | 2.46 | 8.09 | 0.90 | 89.99 |
| 9.80 | 1.10 | 10.74 | 3.29 | 2.96 | 9.73 | 1.01 | 90.56 |
| 9.80 | 1.28 | 12.51 | 3.29 | 3.46 | 11.37 | 1.14 | 90.87 |
| 9.79 | 1.46 | 14.32 | 3.29 | 3.96 | 13.03 | 1.29 | 90.97 |
| 9.79 | 1.65 | 16.13 | 3.29 | 4.46 | 14.67 | 1.46 | 90.95 |
| 9.79 | 1.84 | 17.96 | 3.29 | 4.96 | 16.31 | 1.65 | 90.81 |
| 12.00 | 0.06 | 0.67 | 3.29 | 0.00 | 0.00 | 0.67 | 0.00 |
| 12.00 | 0.18 | 2.18 | 3.29 | 0.46 | 1.51 | 0.67 | 69.28 |
| 12.00 | 0.33 | 3.96 | 3.29 | 0.96 | 3.16 | 0.81 | 79.66 |
| 12.00 | 0.47 | 5.66 | 3.29 | 1.46 | 4.80 | 0.87 | 84.68 |
| 12.00 | 0.62 | 7.40 | 3.29 | 1.96 | 6.44 | 0.96 | 87.01 |
| 12.00 | 0.76 | 9.14 | 3.29 | 2.46 | 8.08 | 1.06 | 88.41 |
| 12.00 | 0.91 | 10.91 | 3.29 | 2.96 | 9.73 | 1.18 | 89.18 |
| 12.00 | 1.06 | 12.68 | 3.29 | 3.46 | 11.37 | 1.31 | 89.68 |
| 11.99 | 1.21 | 14.50 | 3.29 | 3.96 | 13.03 | 1.47 | 89.86 |
| 11.99 | 1.36 | 16.31 | 3.29 | 4.46 | 14.67 | 1.63 | 89.99 |
| 11.99 | 1.51 | 18.13 | 3.29 | 4.96 | 16.31 | 1.83 | 89.93 |
| 15.11 | 0.05 | 0.82 | 3.29 | 0.00 | 0.00 | 0.82 | 0.00 |
| 15.11 | 0.15 | 2.31 | 3.29 | 0.45 | 1.49 | 0.82 | 64.64 |
| 15.11 | 0.27 | 4.14 | 3.29 | 0.95 | 3.14 | 1.00 | 75.77 |
| 15.11 | 0.39 | 5.86 | 3.29 | 1.45 | 4.79 | 1.08 | 81.64 |
| 15.11 | 0.50 | 7.60 | 3.29 | 1.95 | 6.43 | 1.17 | 84.64 |
| 15.10 | 0.62 | 9.35 | 3.29 | 2.45 | 8.08 | 1.27 | 86.38 |
| 15.10 | 0.74 | 11.11 | 3.29 | 2.95 | 9.72 | 1.40 | 87.41 |
| 15.10 | 0.85 | 12.89 | 3.29 | 3.45 | 11.36 | 1.53 | 88.10 |
| 15.10 | 0.97 | 14.70 | 3.29 | 3.96 | 13.02 | 1.69 | 88.52 |
| 15.09 | 1.10 | 16.53 | 3.29 | 4.45 | 14.66 | 1.87 | 88.70 |
| 15.09 | 1.22 | 18.36 | 3.29 | 4.95 | 16.30 | 2.06 | 88.79 |

# 6 Waveforms

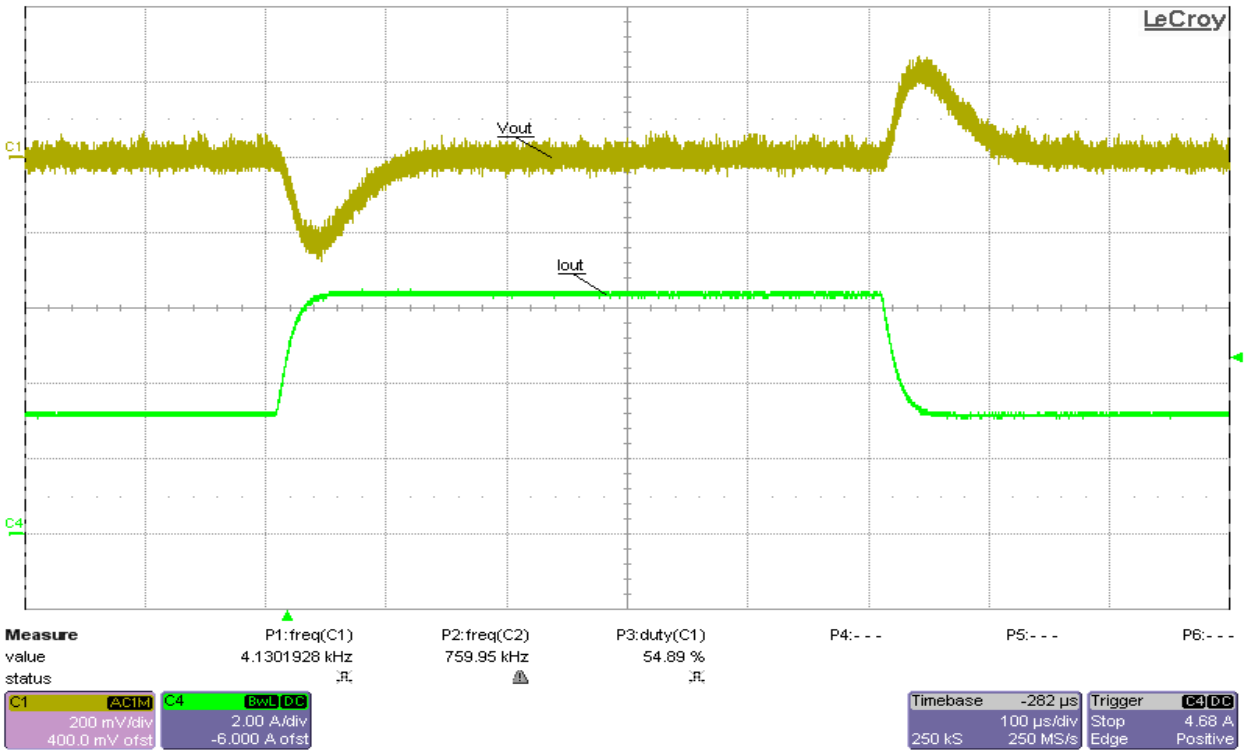
## 6.1 Load Transient Response



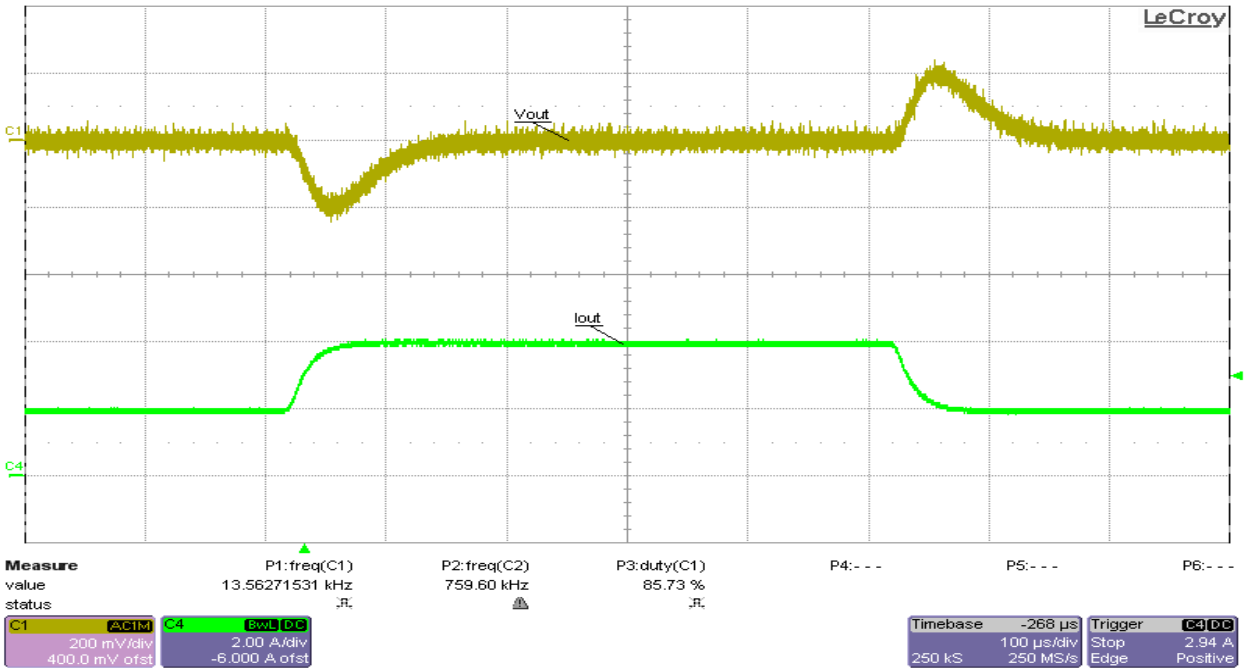

**Load Transient Response at 9.8Vin and 50%-to-100% Load Step on Vout1, Vout2 Fully Loaded at 4A, Ch1 – Vout1 (AC coupled), Ch4- Iout.**



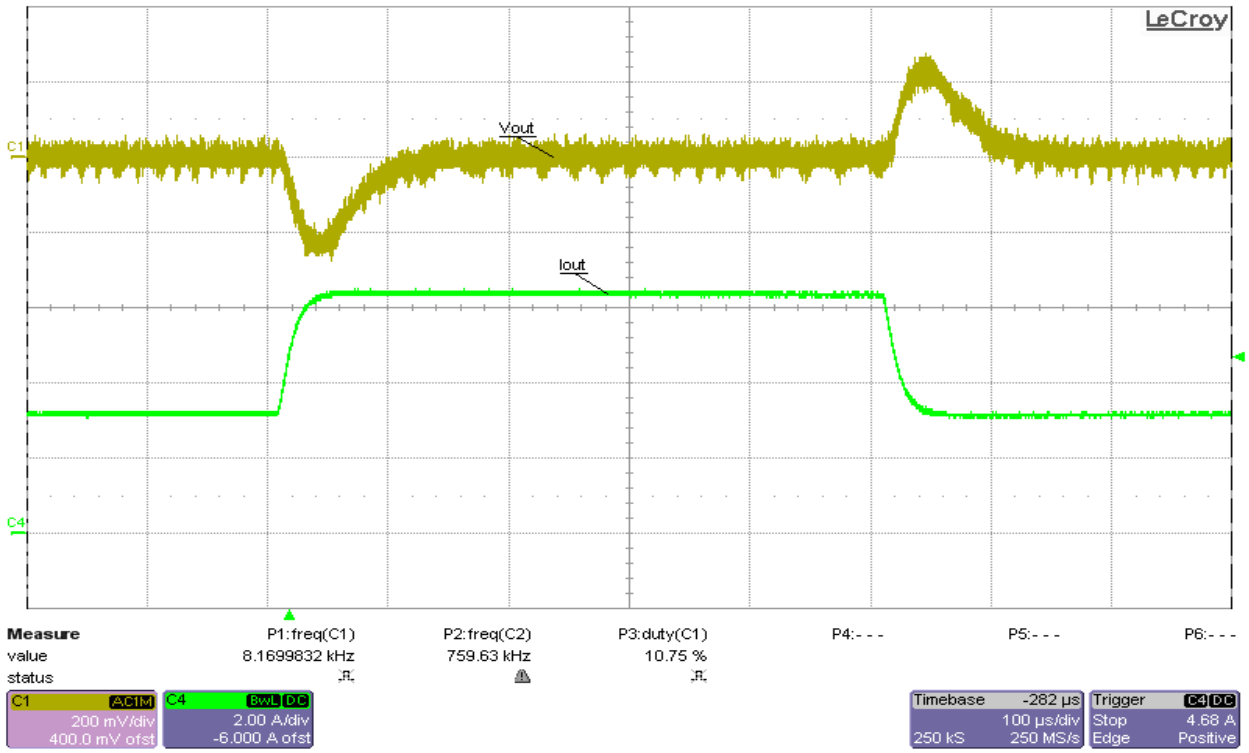

**Load Transient Response at 9.8Vin and 50%-to-100% Load Step on Vout2, Vout1 Fully Loaded at 6.5A, Ch1 – Vout1 (AC coupled), Ch4- Iout.**



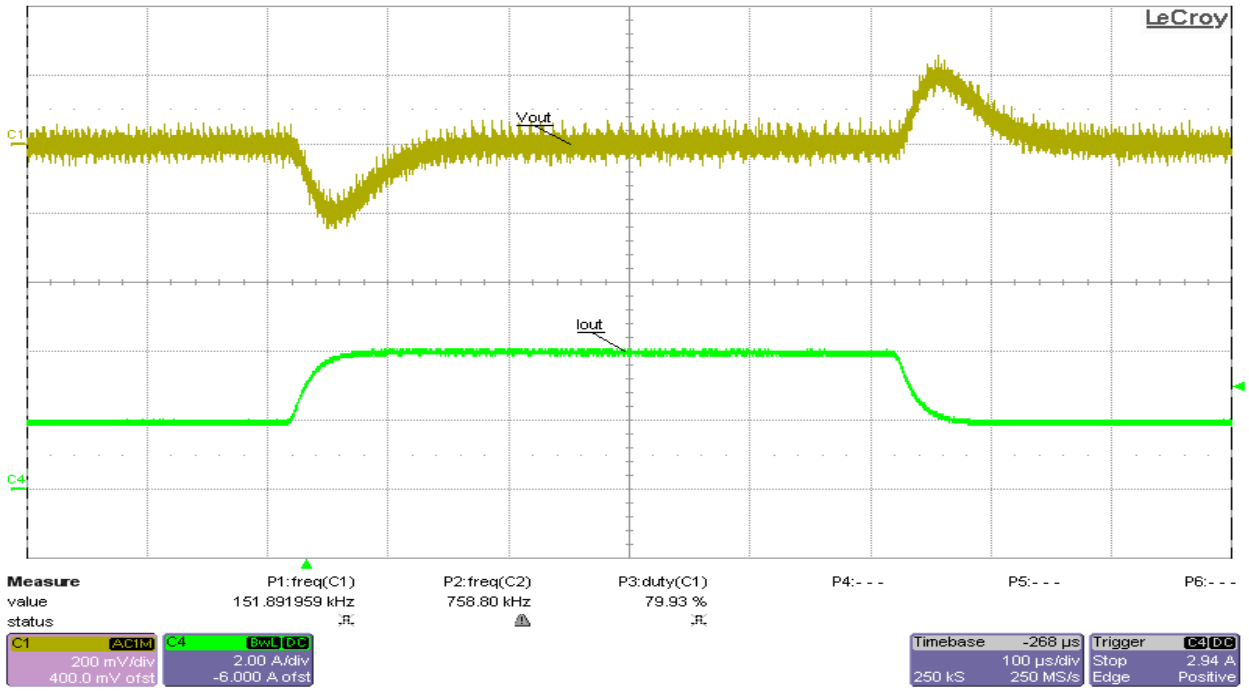

**Load Transient Response at 12Vin and 50%-to-100% Load Step on Vout1, Vout2 Fully Loaded at 4A, Ch1 – Vout1 (AC coupled), Ch4- Iout.**




**Load Transient Response at 12Vin and 50%-to-100% Load Step on Vout2, Vout1 Fully Loaded at 6.5A, Ch1 – Vout1 (AC coupled), Ch4- Iout.**

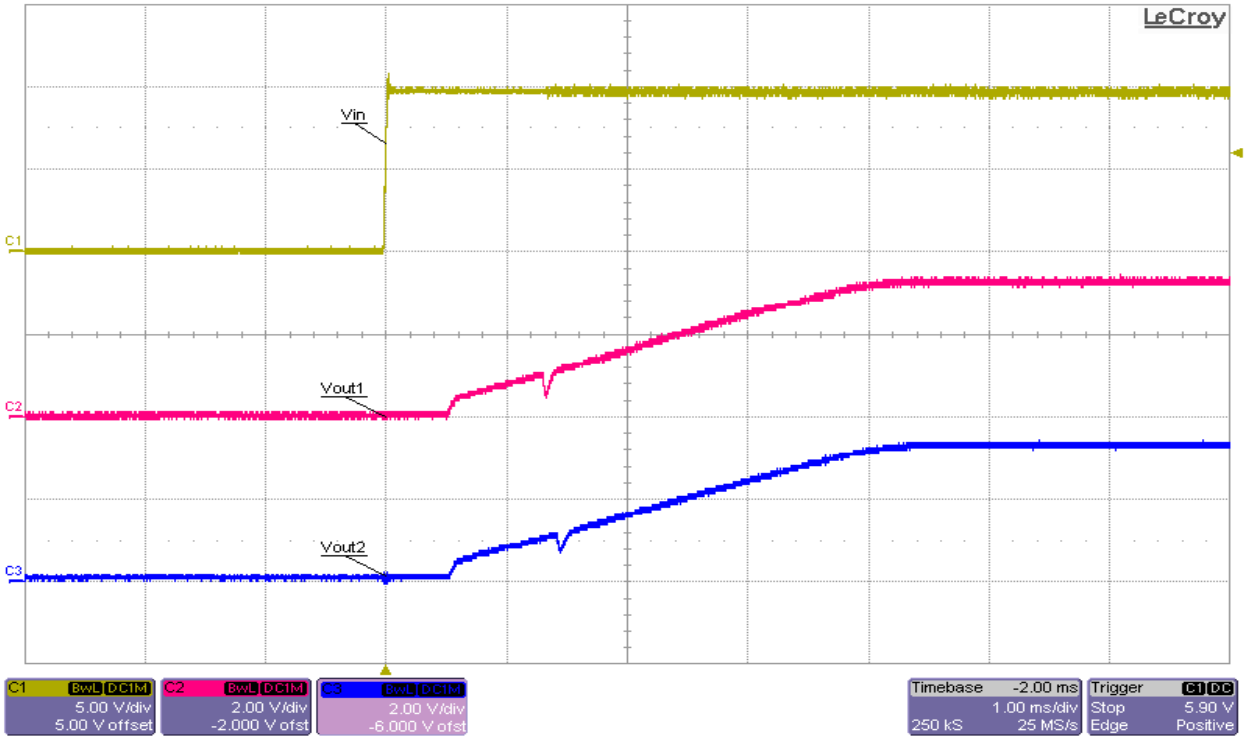



**Load Transient Response at 15.1Vin and 50%-to-100% Load Step on Vout1, Vout2 Fully Loaded at 4A, Ch1 – Vout1 (AC coupled), Ch4- Iout.**

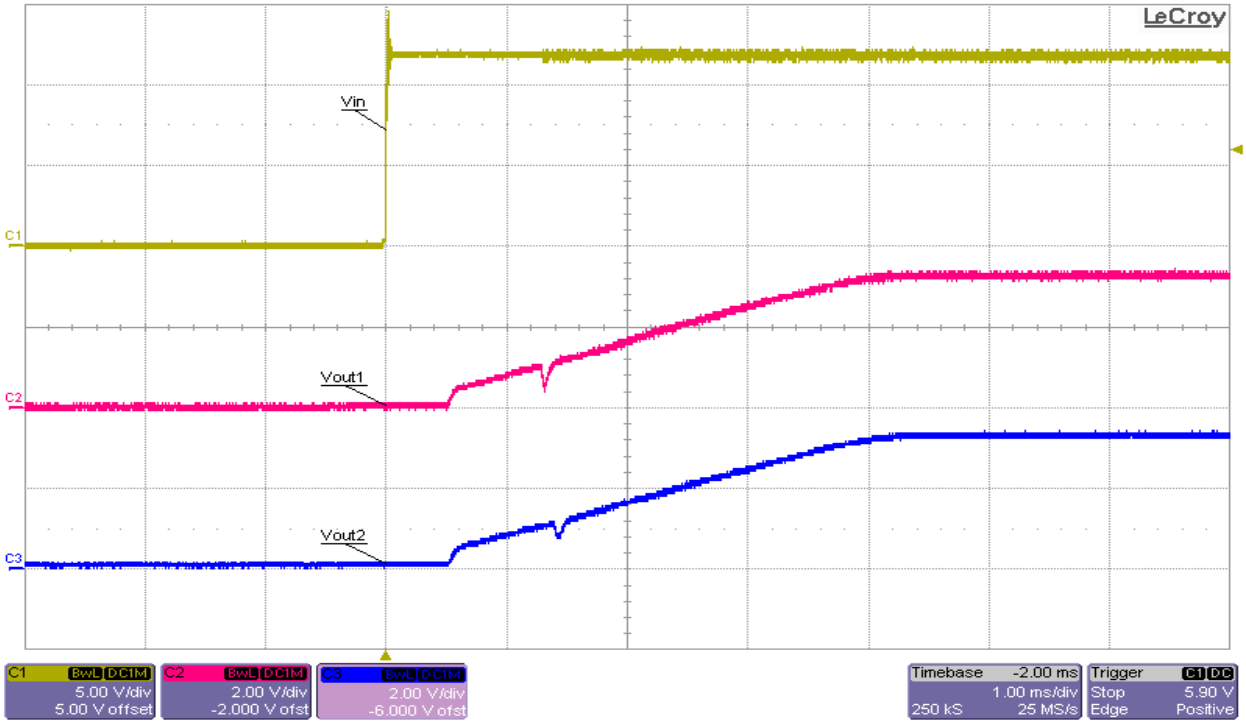



**Load Transient Response at 15.1Vin and 50%-to-100% Load Step on Vout2, Vout1 Fully Loaded at 6.5A, Ch1 – Vout1 (AC coupled), Ch4- Iout.**

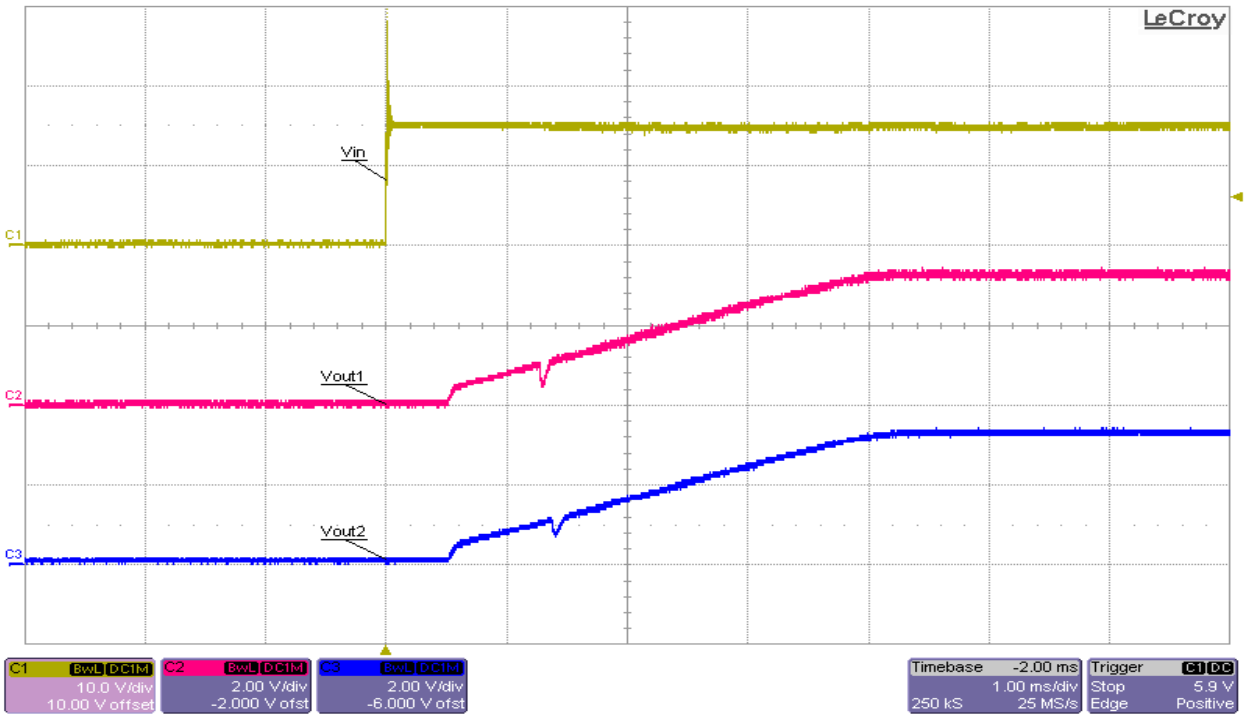
## 6.2 Startup




**Startup into Full Load at 9.8Vin, Ch1-Vin, Ch2-Vout1, Ch3-Vout2**

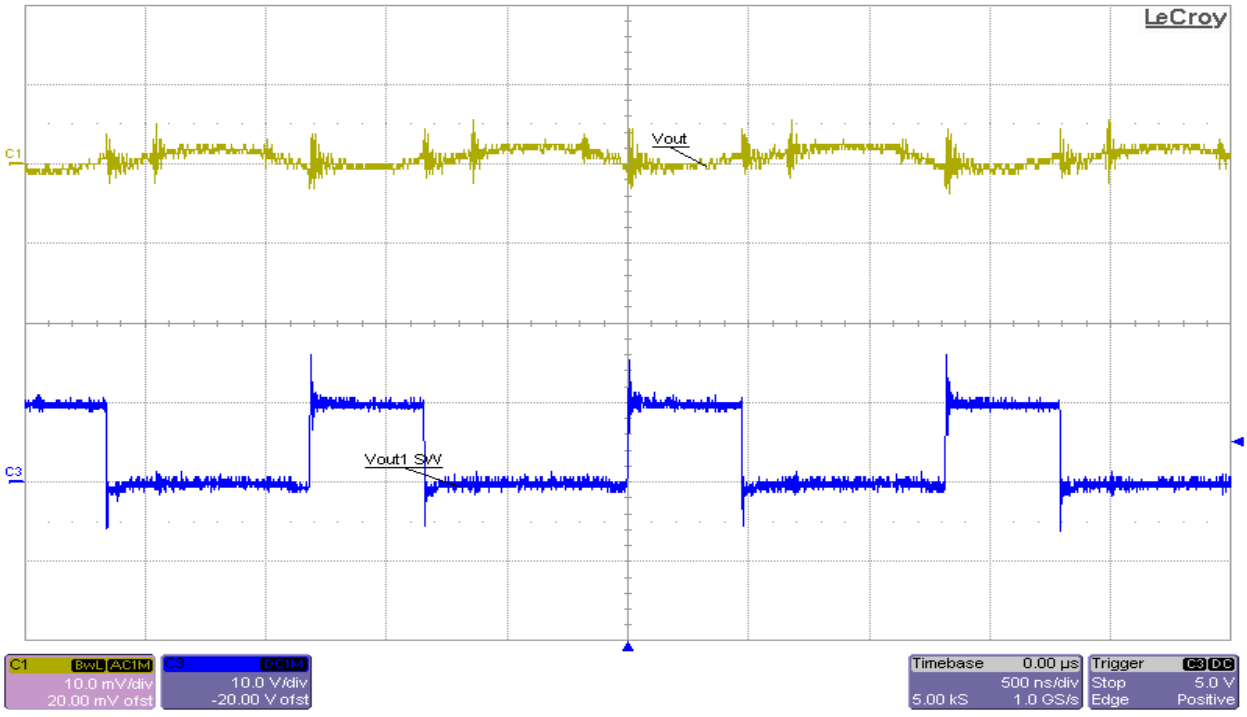



**Startup into Full Load at 12Vin, Ch1-Vin, Ch2-Vout1, Ch3-Vout2**

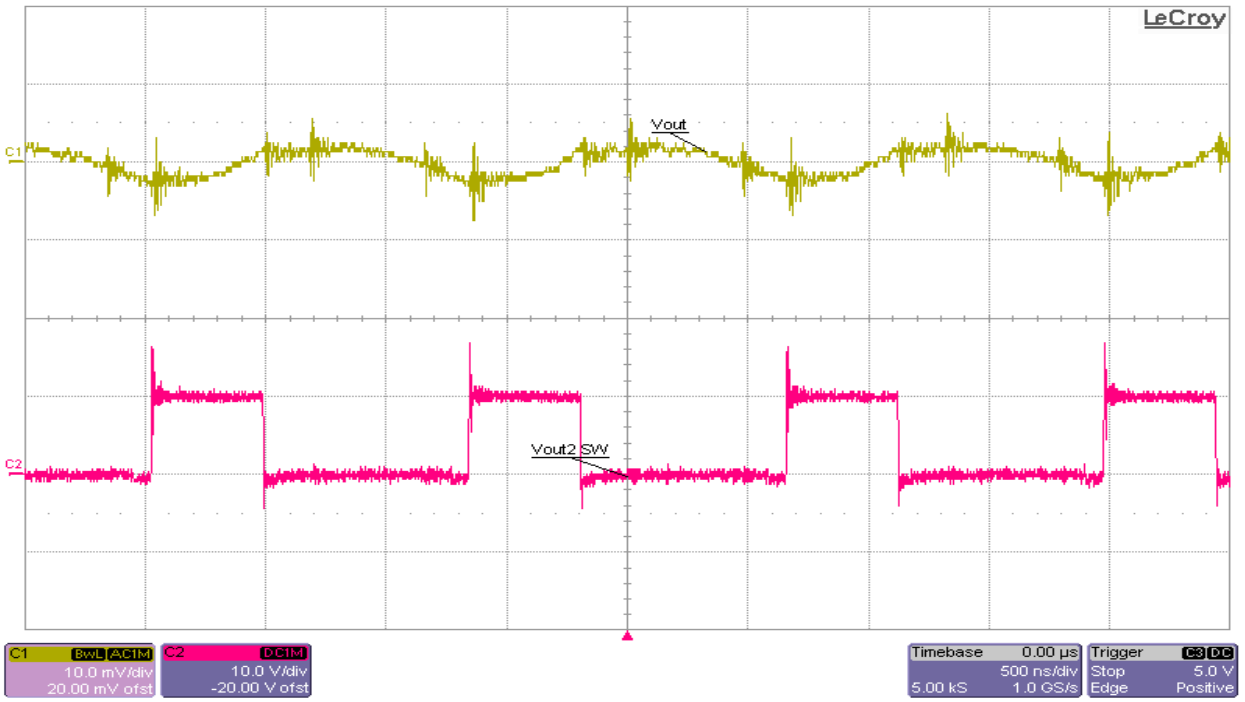



**Startup into Full Load at 15.1Vin, Ch1-Vin, Ch2-Vout1, Ch3-Vout2**

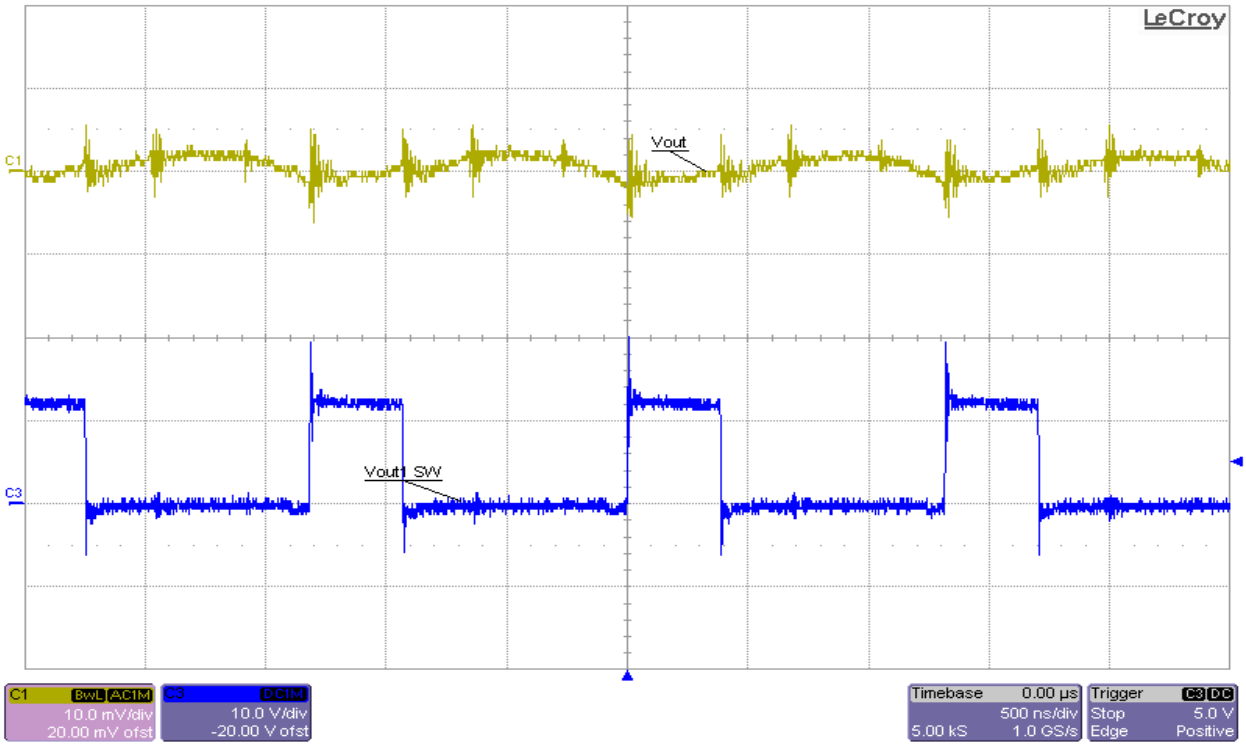
## 6.3 Output Voltage Ripple and Switch Node Voltage



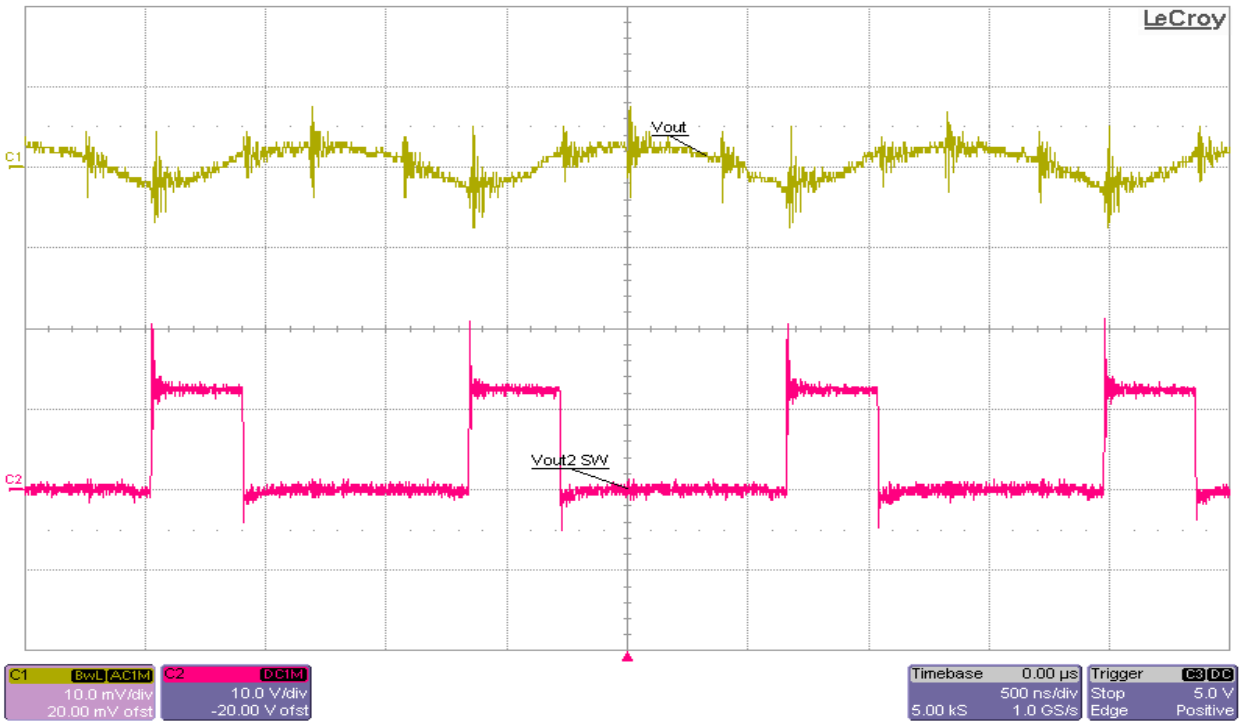

**Vout1 Switch Node Voltage and Vout1 Output Ripple at 9.8Vin and Full (6.5A) Load, Vout2 Fully Loaded at 4A. Ch1-Vout1 (AC Coupled), Ch3-Vout1 Switching Waveform.**



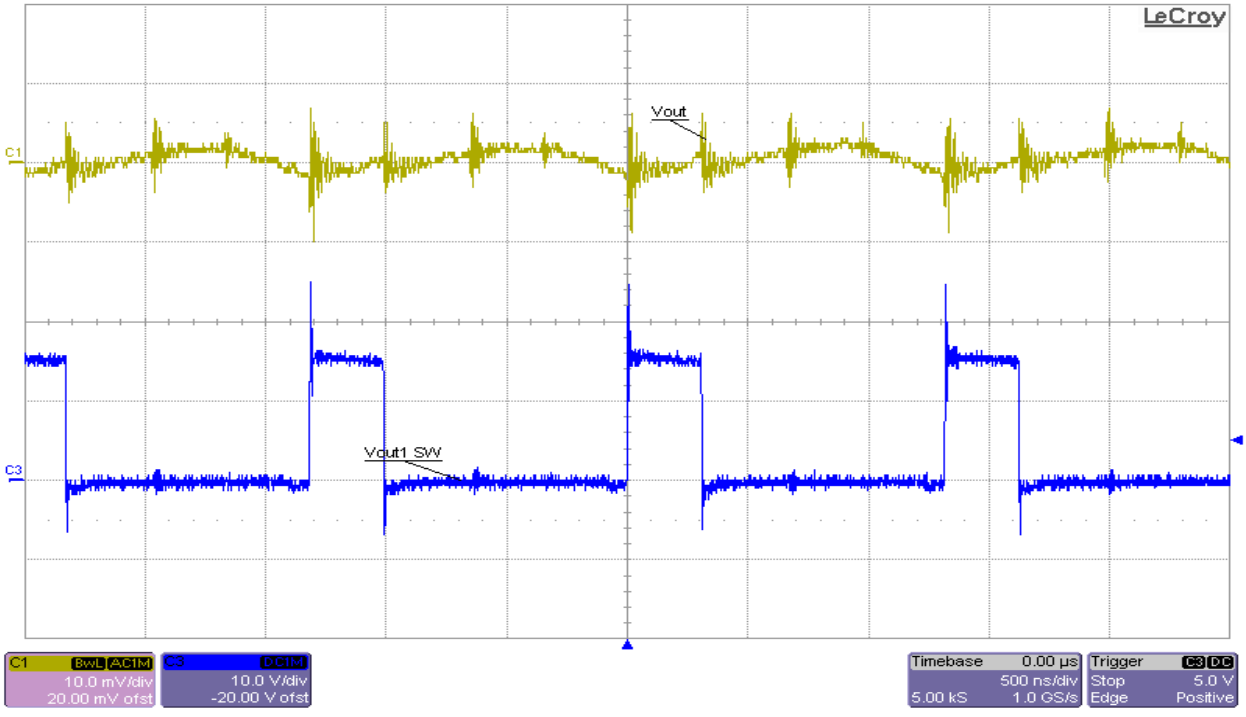

**Vout2 Switch Node Voltage and Vout2 Output Ripple at 9.8Vin and Full (4A) Load, Vout1 Fully Loaded at 6.5A. Ch1-Vout1 (AC Coupled), Ch2-Vout2 Switching Waveform.**



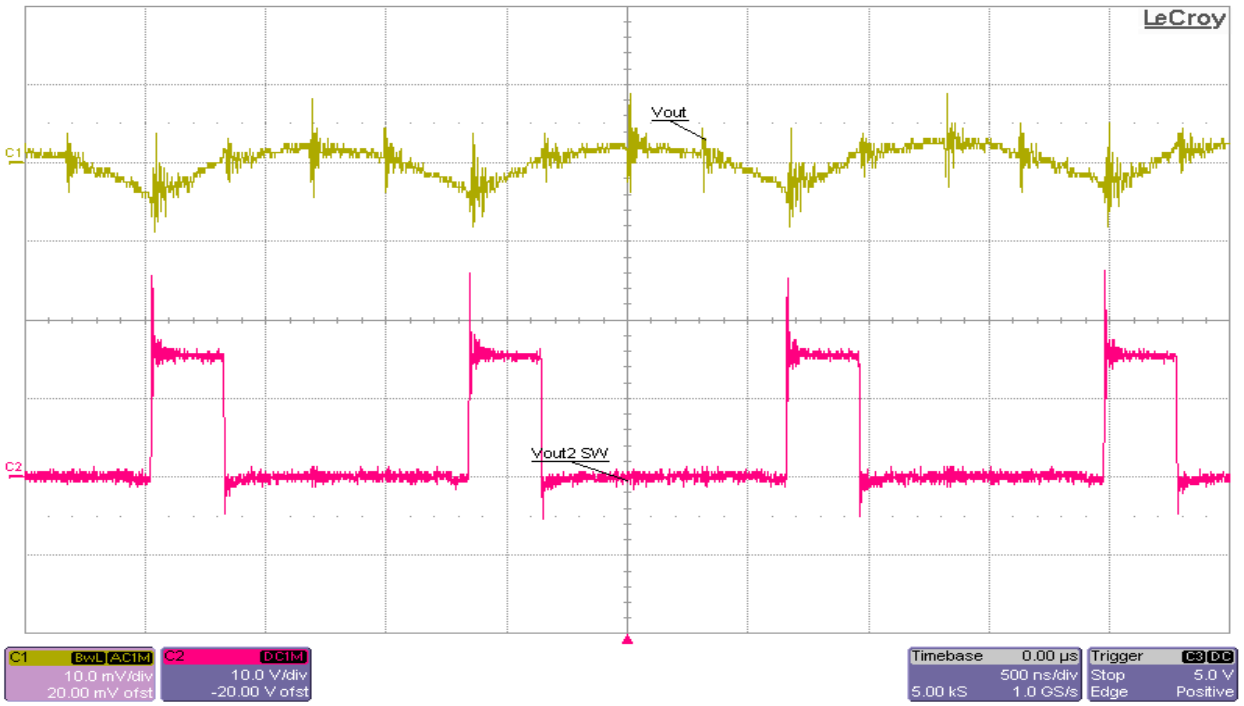

**Vout1 Switch Node Voltage and Vout1 Output Ripple at 12Vin and Full (6.5A) Load, Vout2 Fully Loaded at 4A. Ch1-Vout1 (AC Coupled), Ch3-Vout1 Switching Waveform.**




**Vout2 Switch Node Voltage and Vout2 Output Ripple at 12Vin and Full (4A) Load, Vout1 Fully Loaded at 6.5A. Ch1-Vout1 (AC Coupled), Ch2-Vout2 Switching Waveform.**

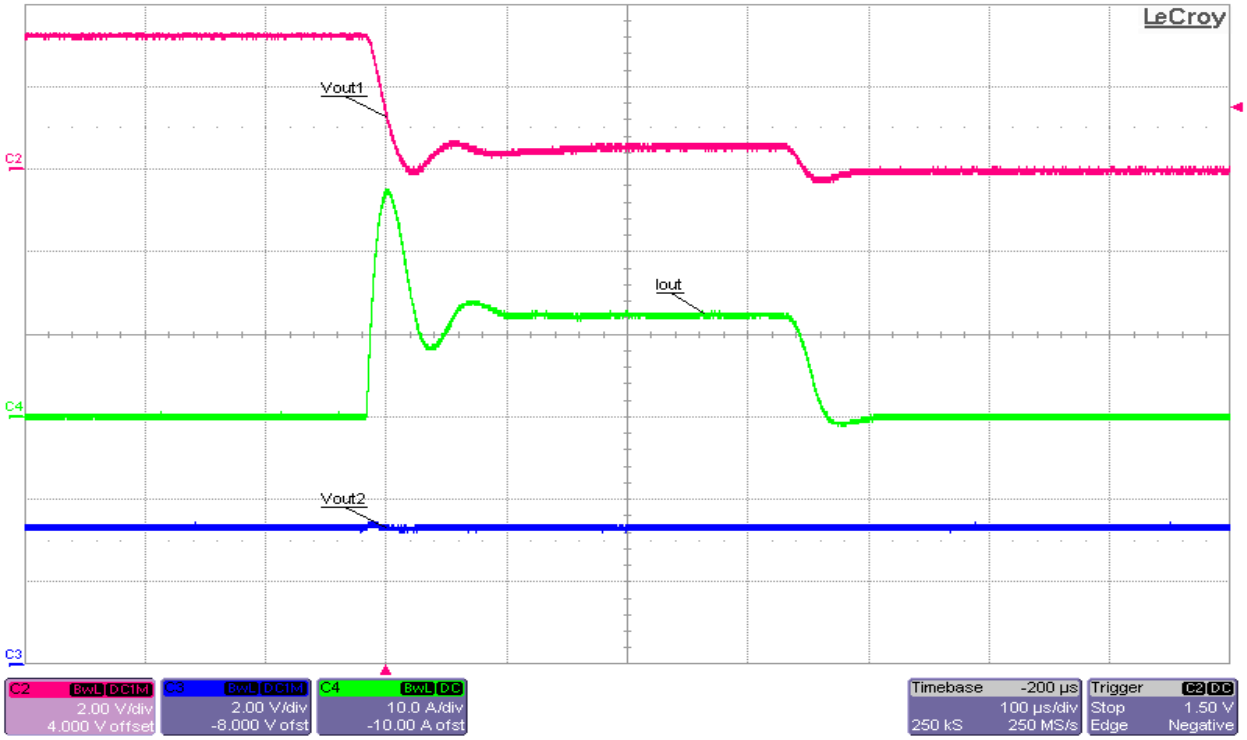



**Vout1 Switch Node Voltage and Vout1 Output Ripple at 15.1Vin and Full (6.5A) Load, Vout2 Fully Loaded at 4A. Ch1-Vout1 (AC Coupled), Ch3-Vout1 Switching Waveform.**

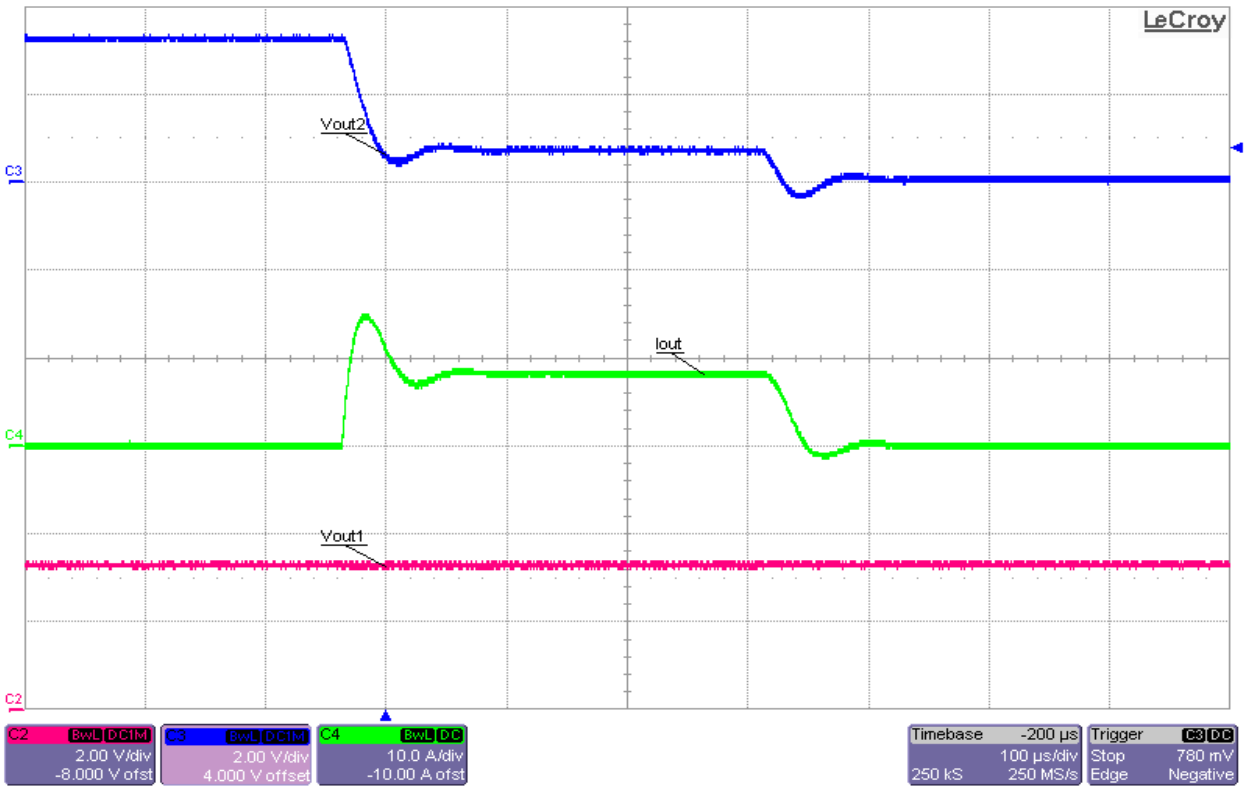



**Vout2 Switch Node Voltage and Vout2 Output Ripple at 15.1Vin and Full (4A) Load, Vout1 Fully Loaded at 6.5A. Ch1-Vout1 (AC Coupled), Ch2-Vout2 Switching Waveform.**

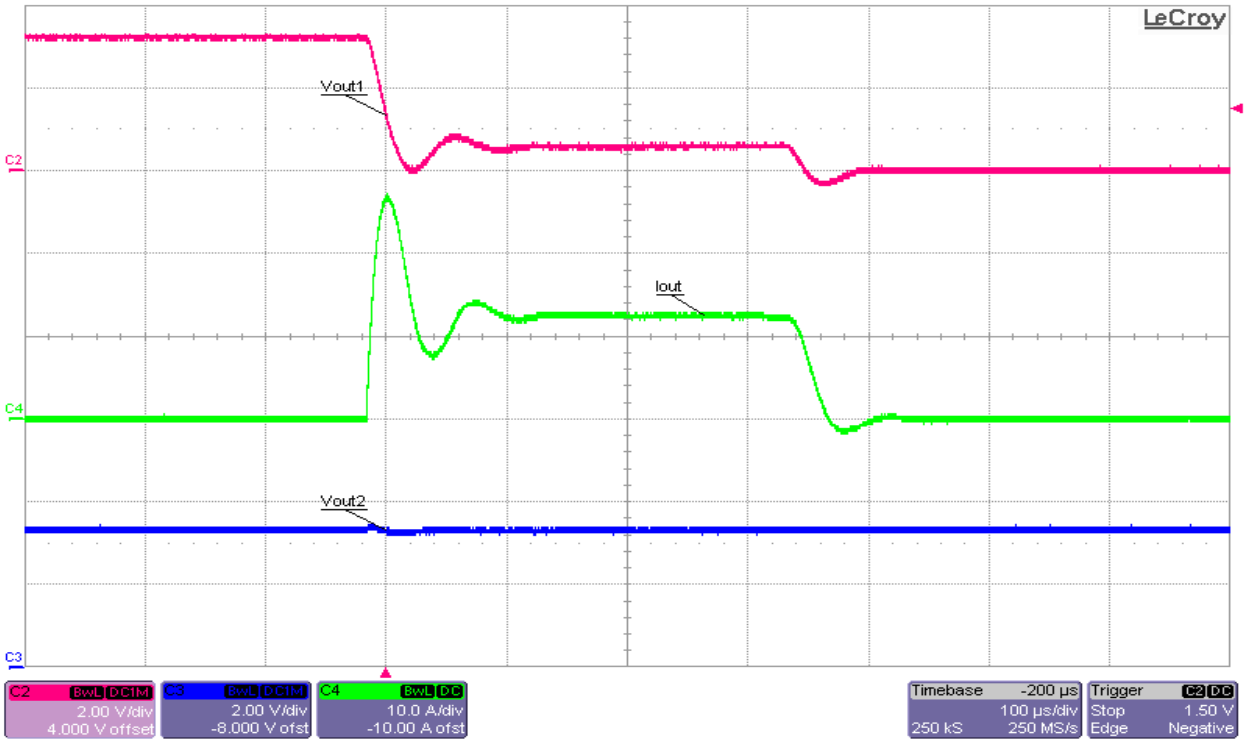
## 6.4 Short Circuit



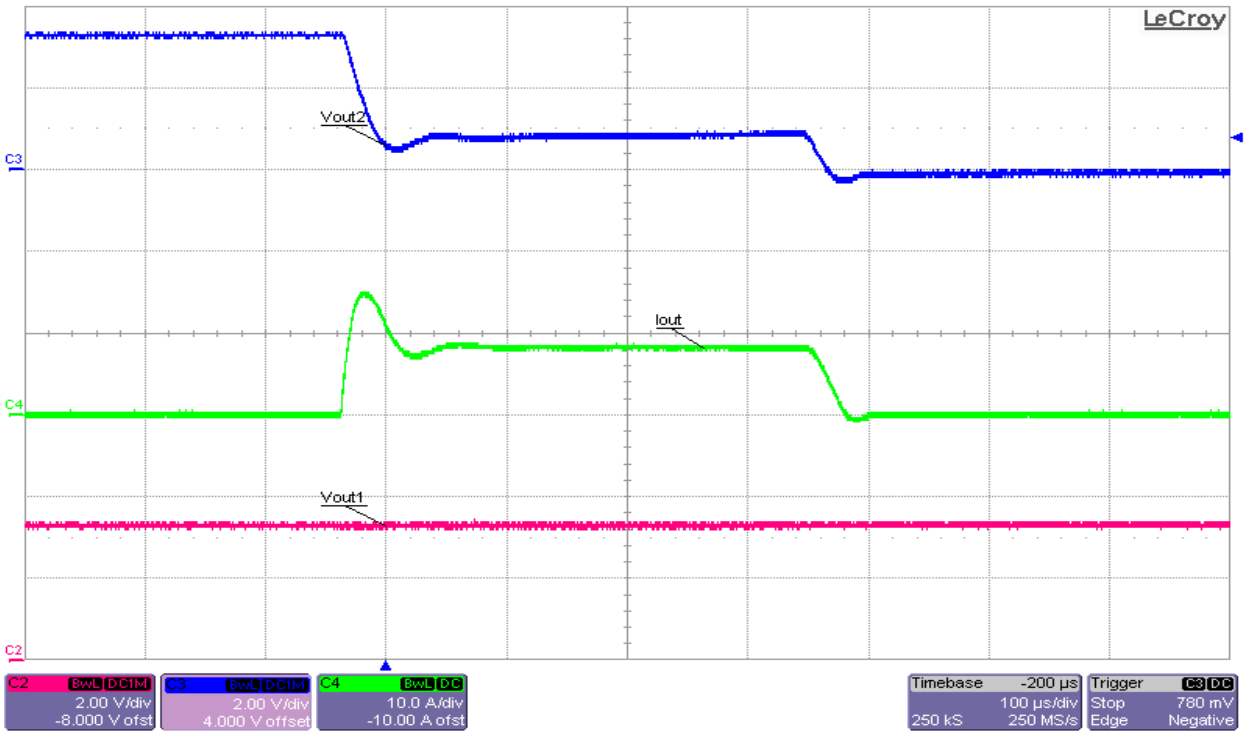

**9.8Vin, Vout1 Short Circuit at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iout.**



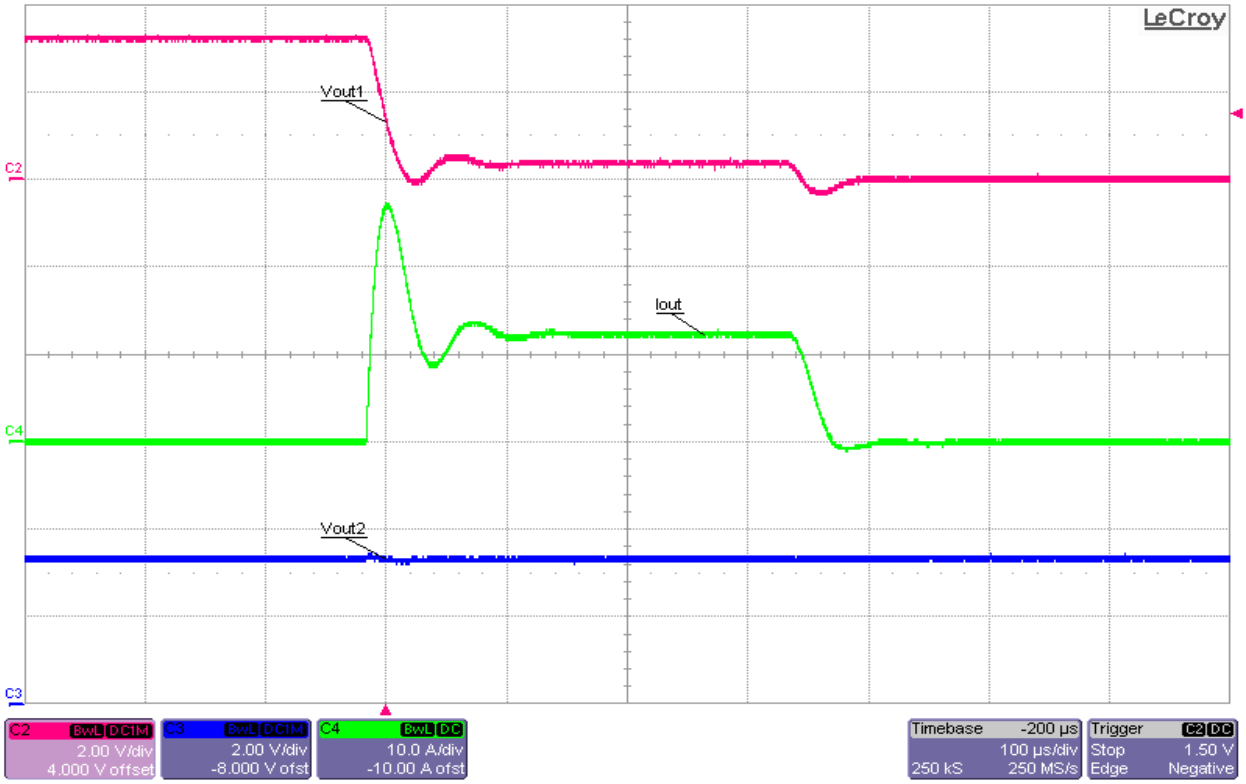

**9.8Vin, Vout2 Short Circuit at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iout.**



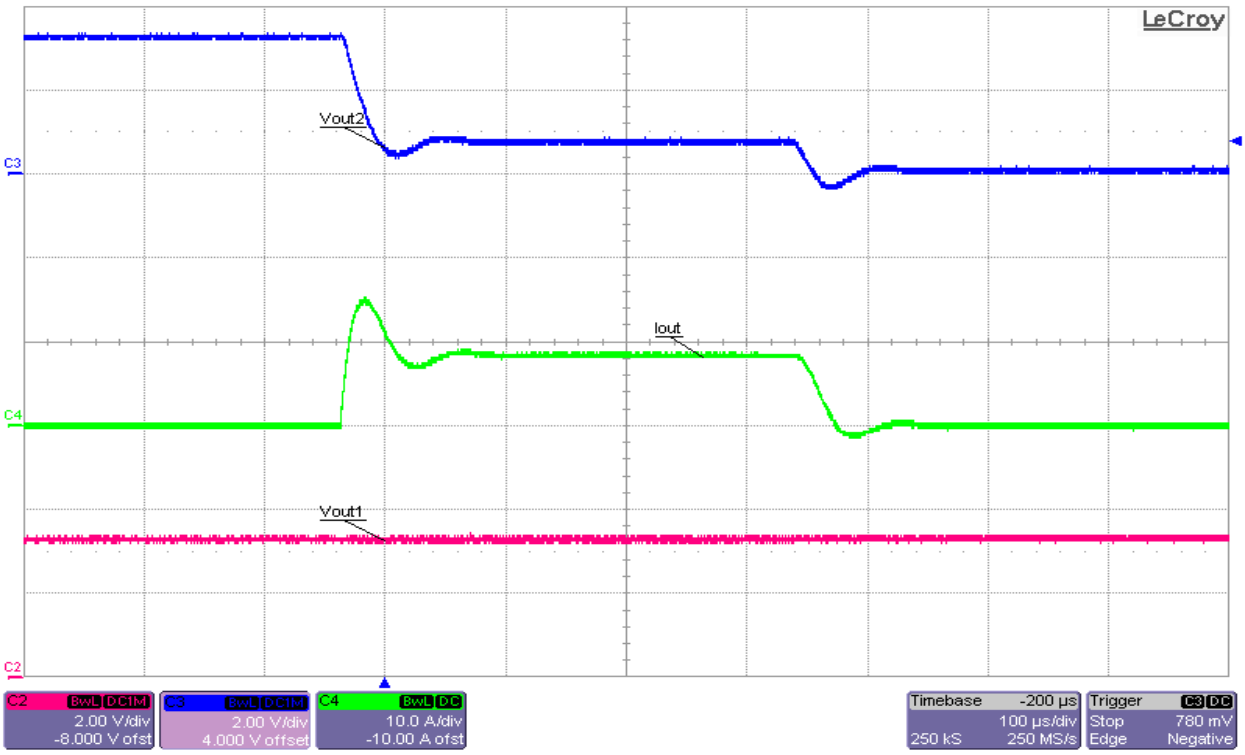

**12Vin, Vout1 Short Circuit at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iout.**




**12Vin, Vout2 Short Circuit at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iout.**

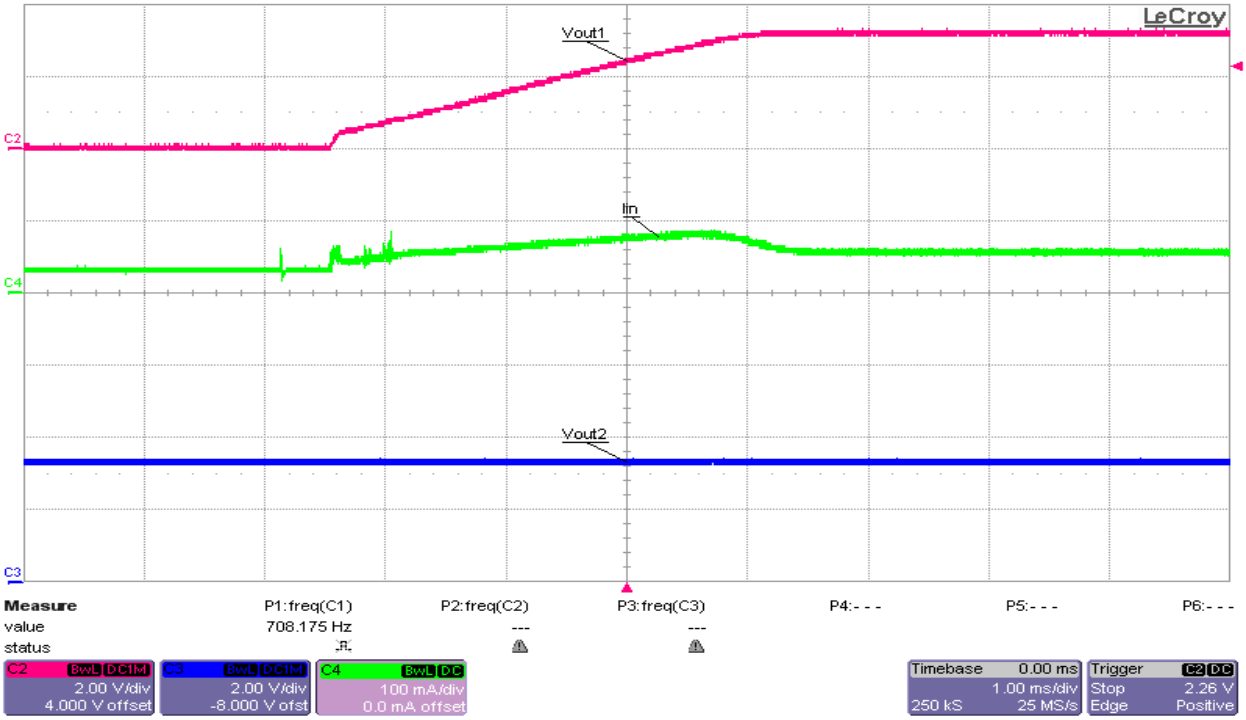



**15.1Vin, Vout1 Short Circuit at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iout.**

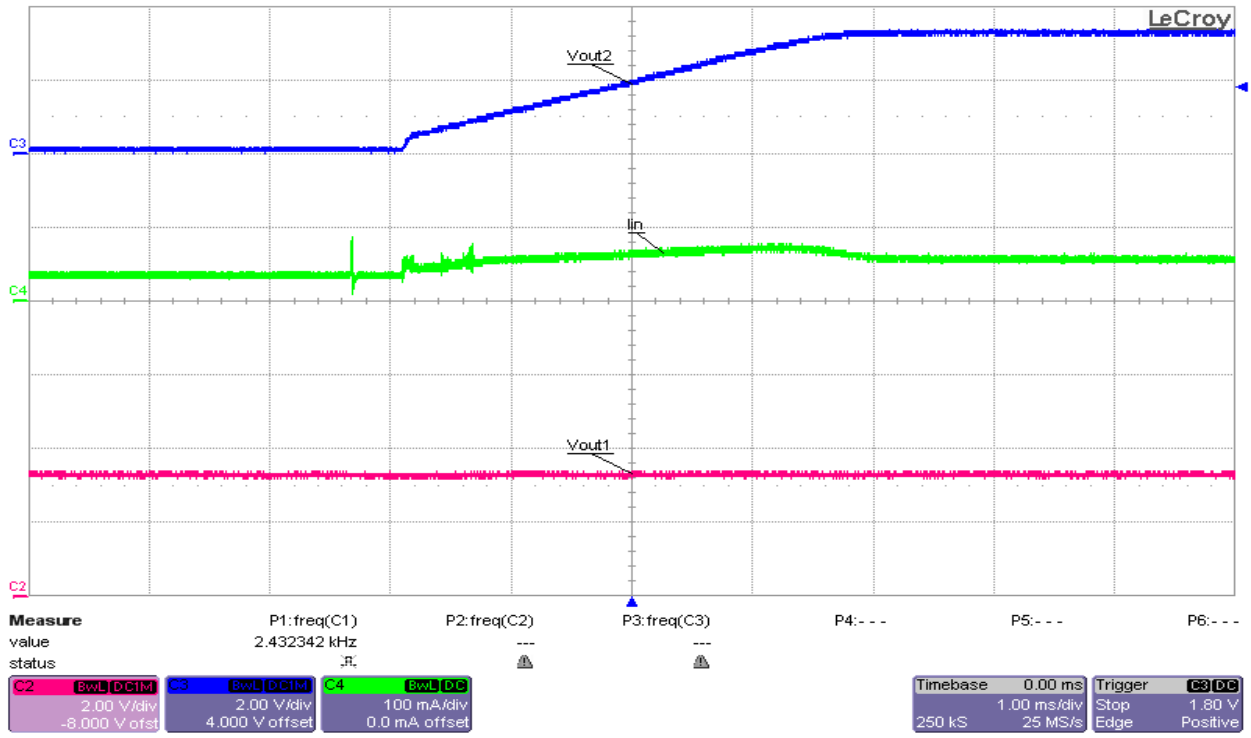



**15.1Vin, Vout2 Short Circuit at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iout.**

## 6.5 Short Circuit Recovery

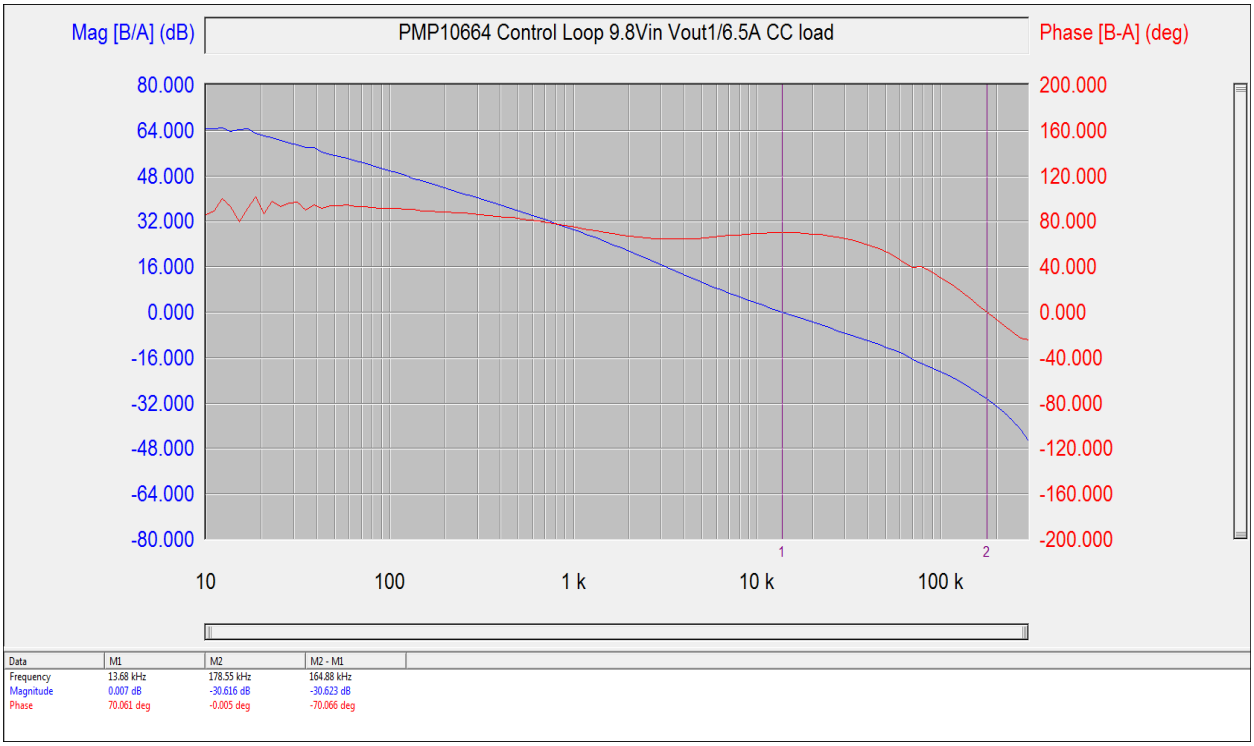



**12Vin, Vout1 Short Circuit Recovery at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iin.**

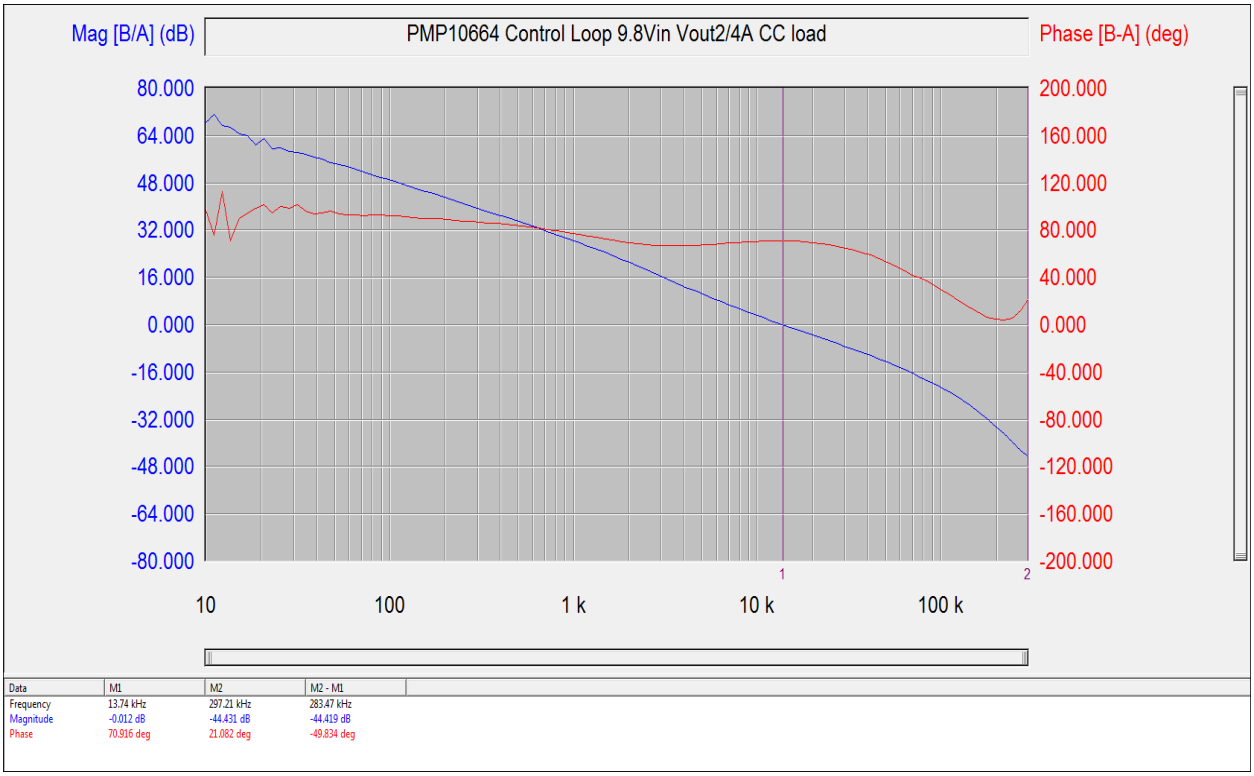



**12Vin, Vout2 Short Circuit Recovery at No Load. Ch2-Vout1, Ch3-Vout2, Ch4-Iin.**

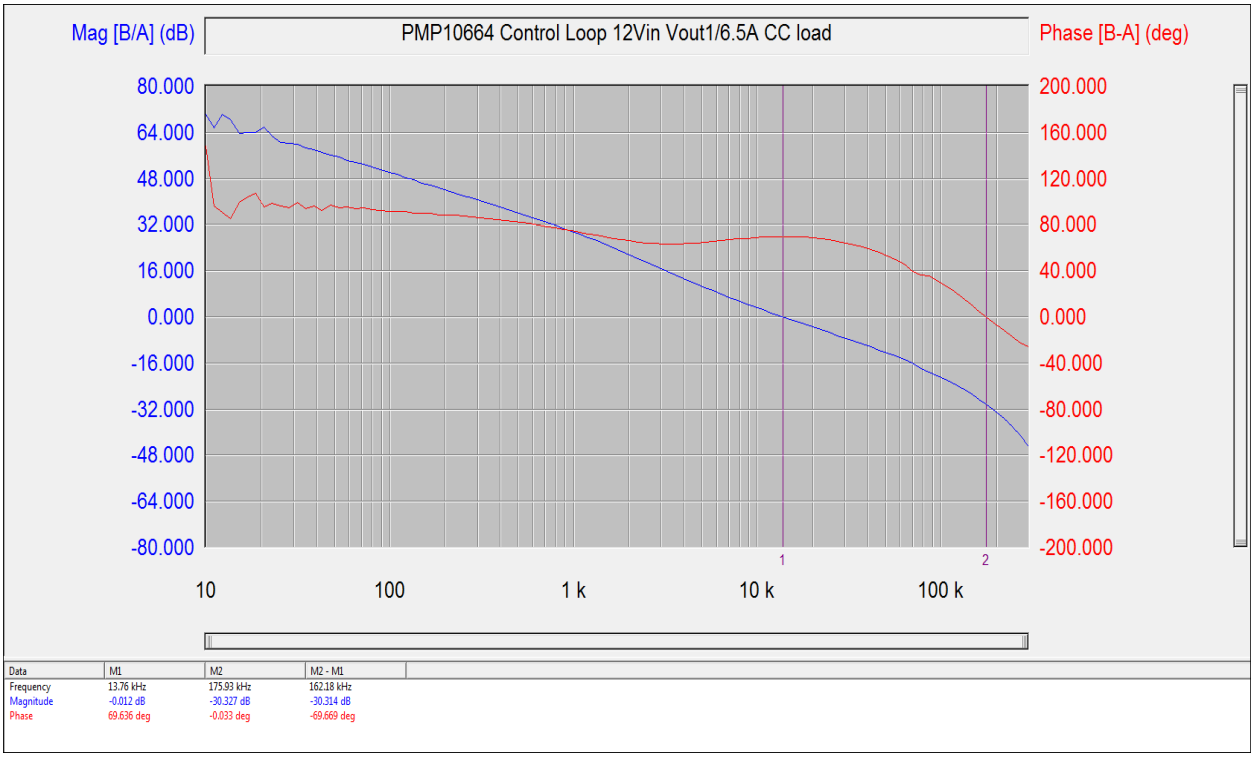
## 6.6 Frequency Response



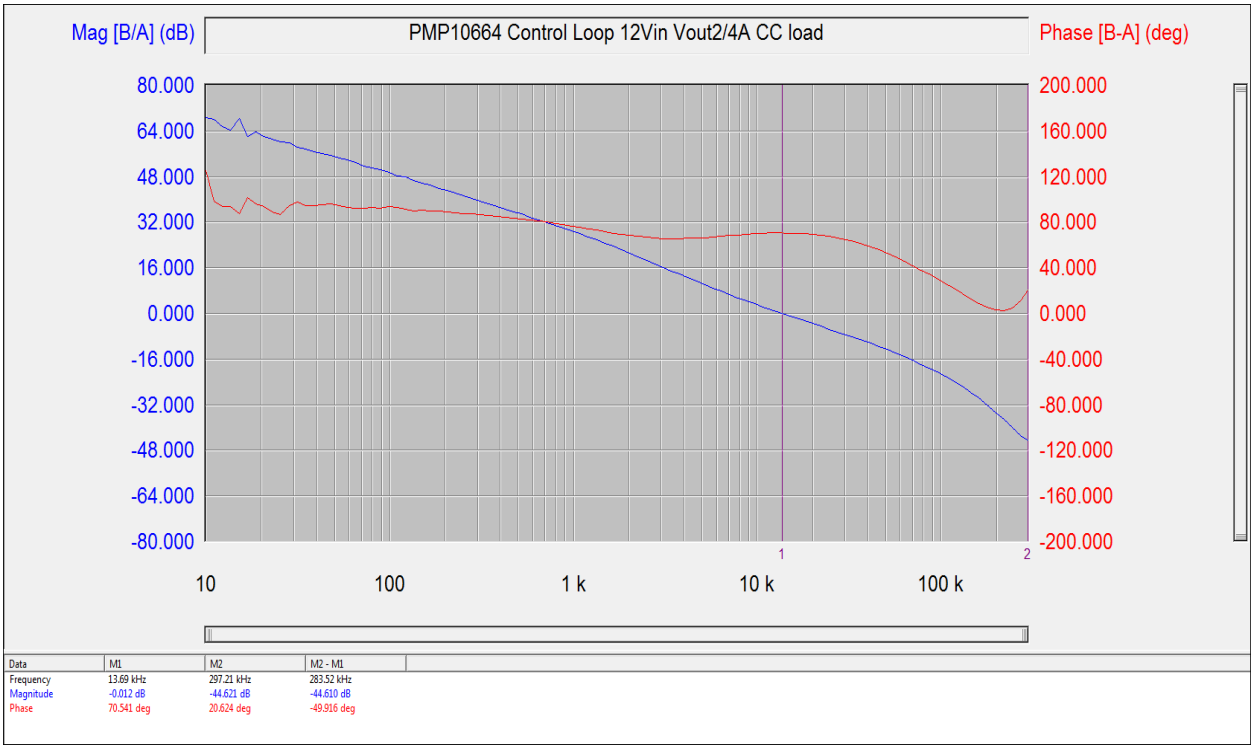

**9.8Vin, Vout1 Frequency Response at Full Load, Vout2 Full Load. 70 Degree Phase Margin.**



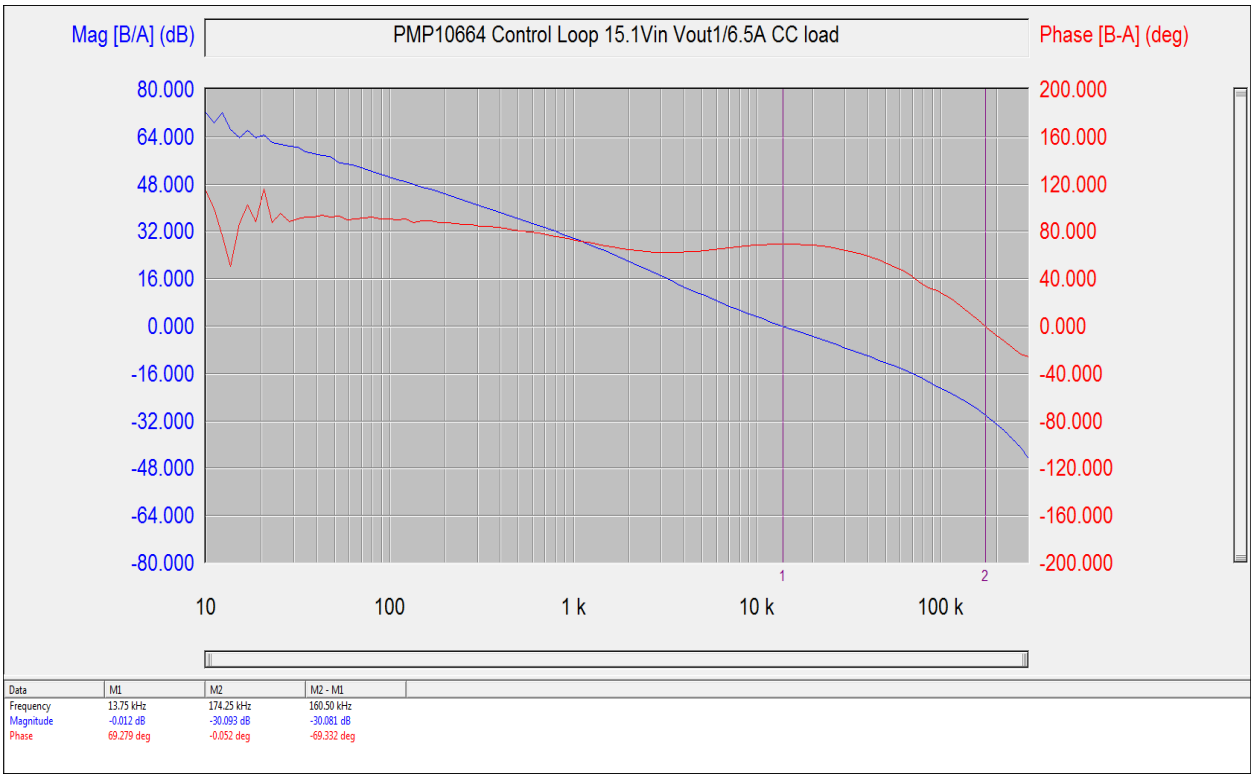

**9.8Vin, Vout2 Frequency Response at Full Load, Vout1 Full Load. 71 Degree Phase Margin.**



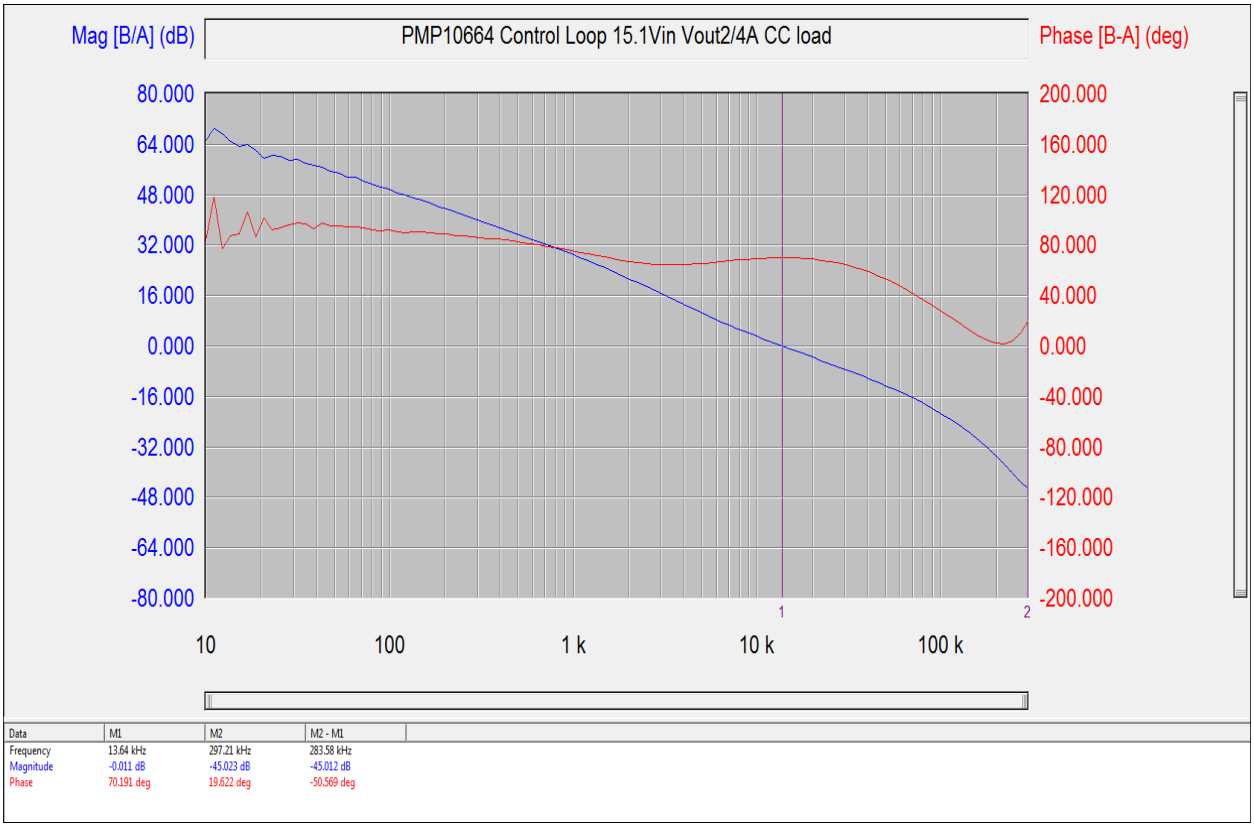

**12Vin, Vout1 Frequency Response at Full Load, Vout2 Full Load. 69 Degree Phase Margin.**




**12Vin, Vout2 Frequency Response at Full Load, Vout1 Full Load. 70.5 Degree Phase Margin.**




**15.1Vin, Vout1 Frequency Response at Full Load, Vout2 Full Load. 69 Degree Phase Margin.**




**15.1Vin, Vout2 Frequency Response at Full Load, Vout1 Full Load. 70.5 Degree Phase Margin.**

# 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