

**Test Report
For PMP11478
11/09/2015**



Table of Contents

1. Design Specifications	3
2. Circuit Description and PCB details.....	3
3. PMP11478 Board Photos	4
4. Thermal Data.....	5
5. Efficiency	7
5.1 Efficiency Chart	7
5.2 Efficiency Data.....	7
6 Waveforms.....	10
6.1 Load Transient Response	10
6.2 Startup from Vin.....	11
6.3 Switch Node Voltage	13
6.4 Output Ripple.....	19
6.5 Frequency Analysis.....	20

1. Design Specifications

Vin Minimum	24VDC
Vin Maximum	36VDC
Vout	12VDC
Iout	2.5A continuous
Approximate Switching Frequency	~200KHz

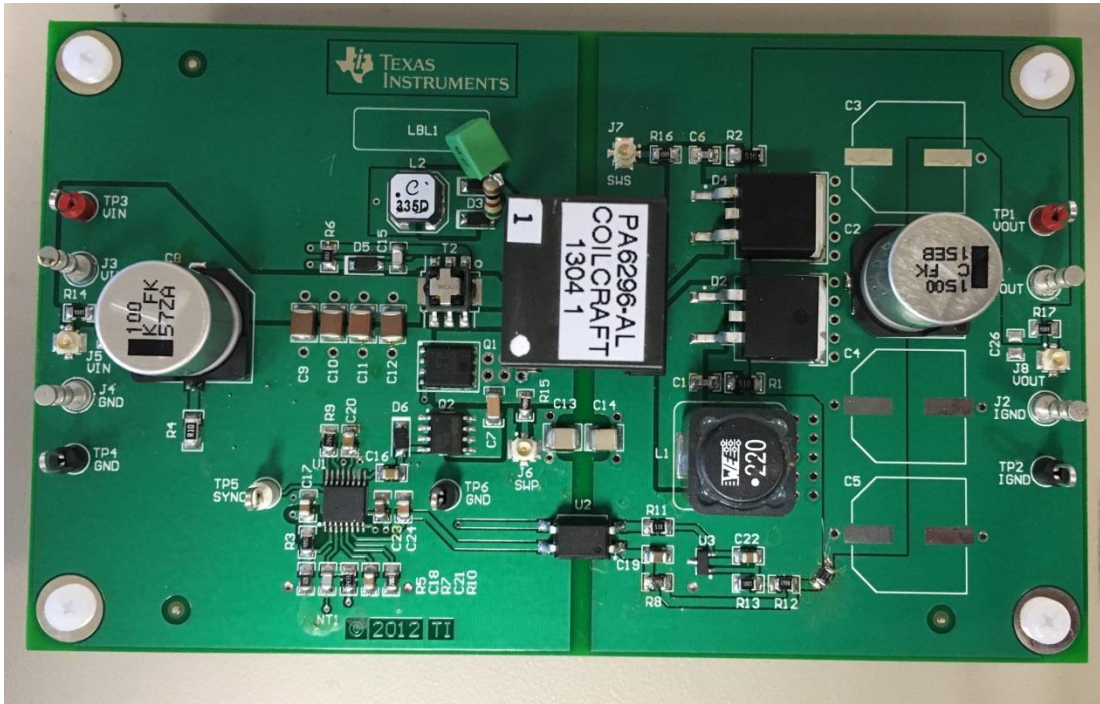
2. Circuit Description and PCB details

PMP11478 is an isolated active clamp forward converter capable of 30W output power. This design uses the LM5026 active clamp current-mode controller. Output voltage regulation is maintained using an LMV431 shunt regulator and opto-coupler feedback. Schottky rectifiers allow for holdup of 2.5ms using the stored charge of the output capacitors. The isolation voltage is 2250 VDC meeting basic insulation requirements.

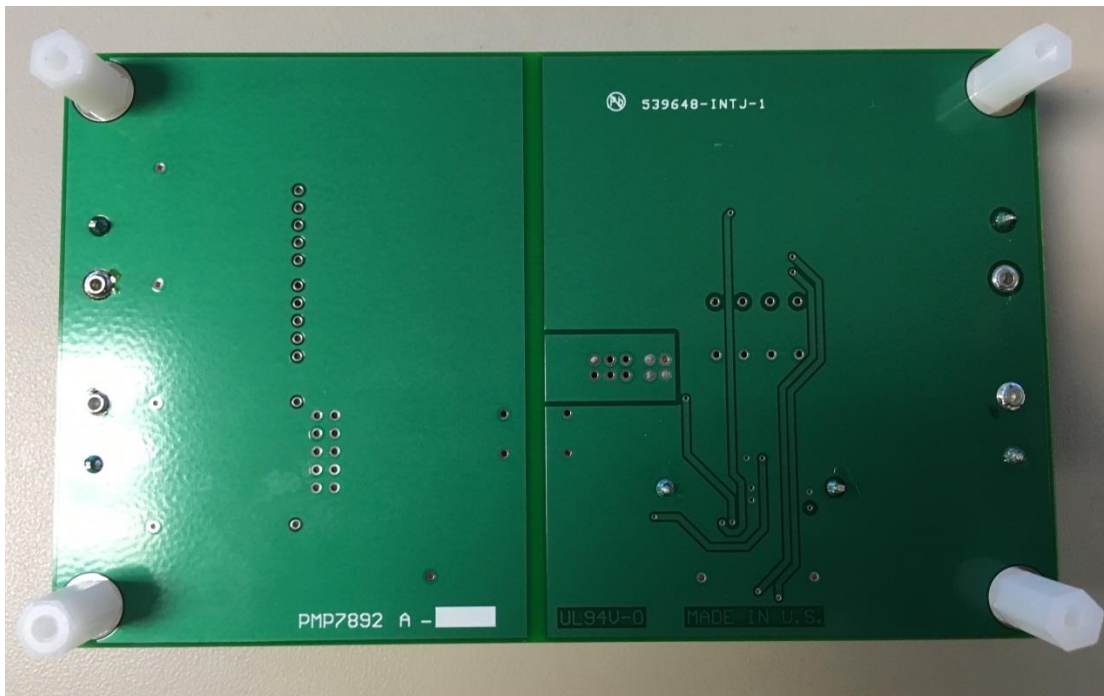
The circuit was built on PMP7892 Rev A printed circuit board. This is a four layer board with one ounce copper on all layers. The overall dimensions are 3" x 5". All components are mounted on the top side of the board.

3. PMP11478 Board Photos

Board Dimensions: 3" x 5"

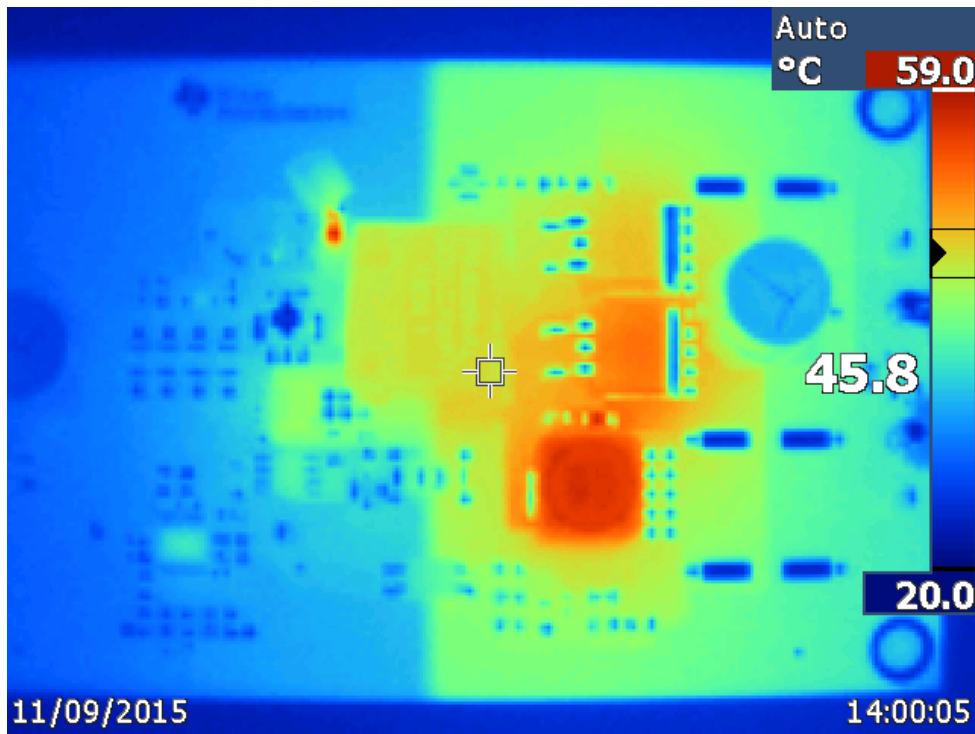


Board Photo (Top)

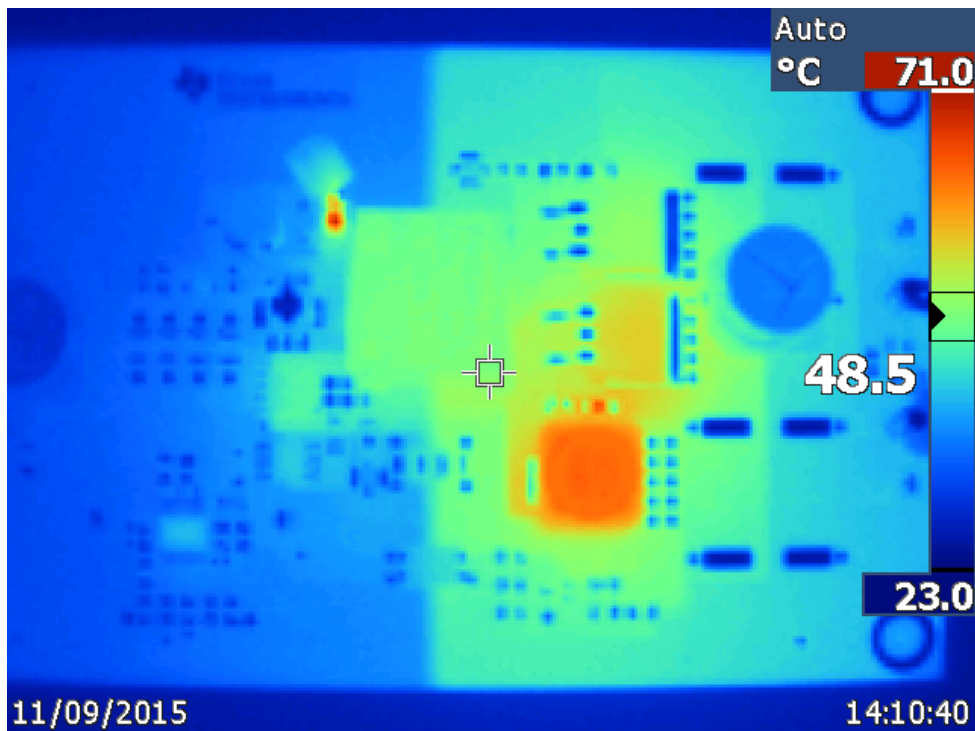


Board Photo (Bottom)

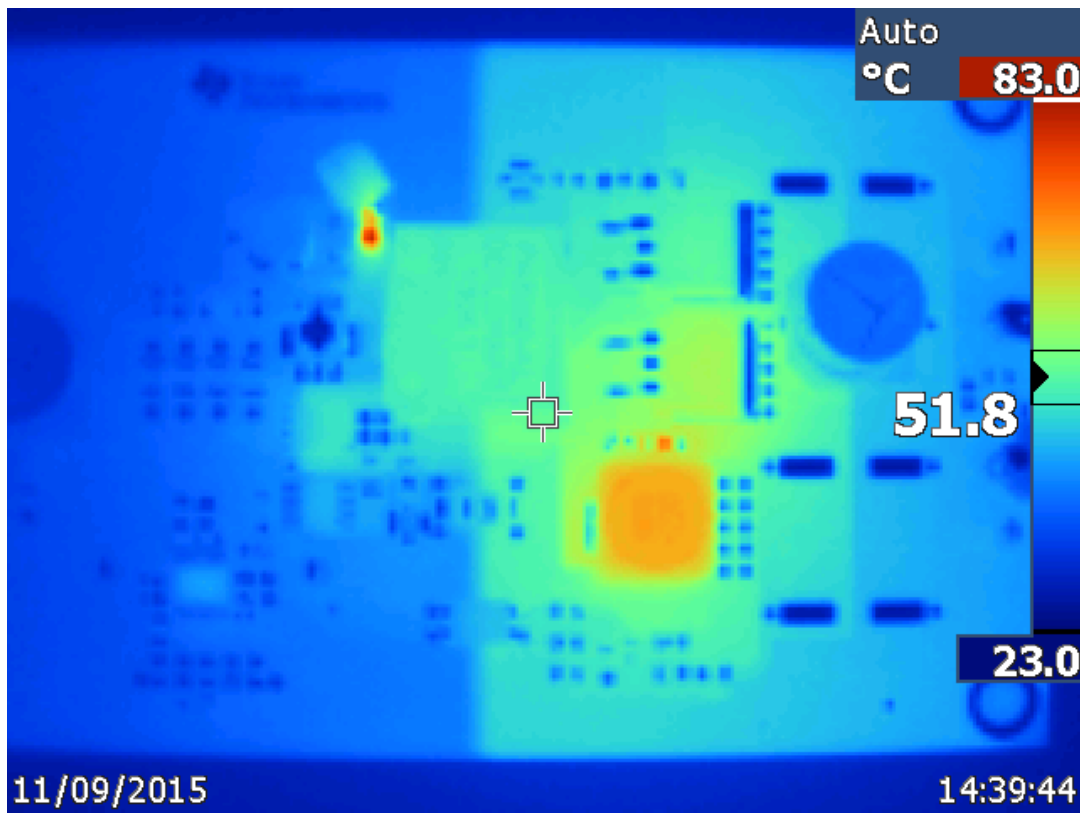
4. Thermal Data



IR thermal image taken at steady state with 24Vin and 2.5A load top (no airflow)



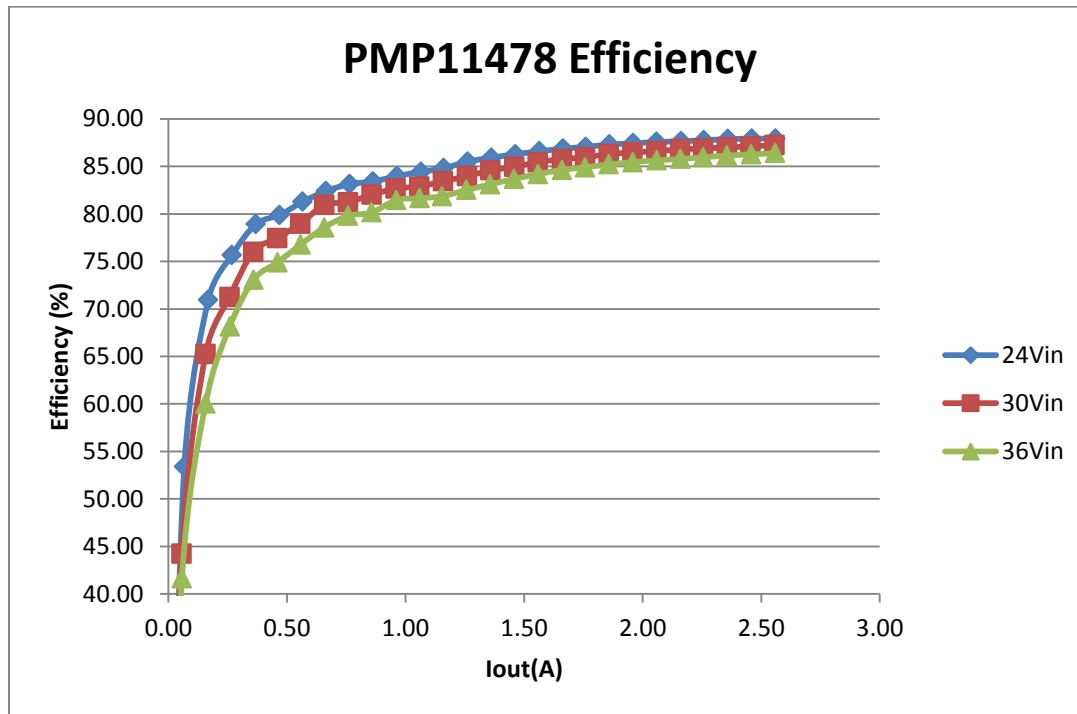
IR thermal image taken at steady state with 30Vin and 2.5A load bottom (no airflow)



IR thermal image taken at steady state with 36Vin and 2.5A load top (no airflow)

5. Efficiency

5.1 Efficiency Chart



5.2 Efficiency Data

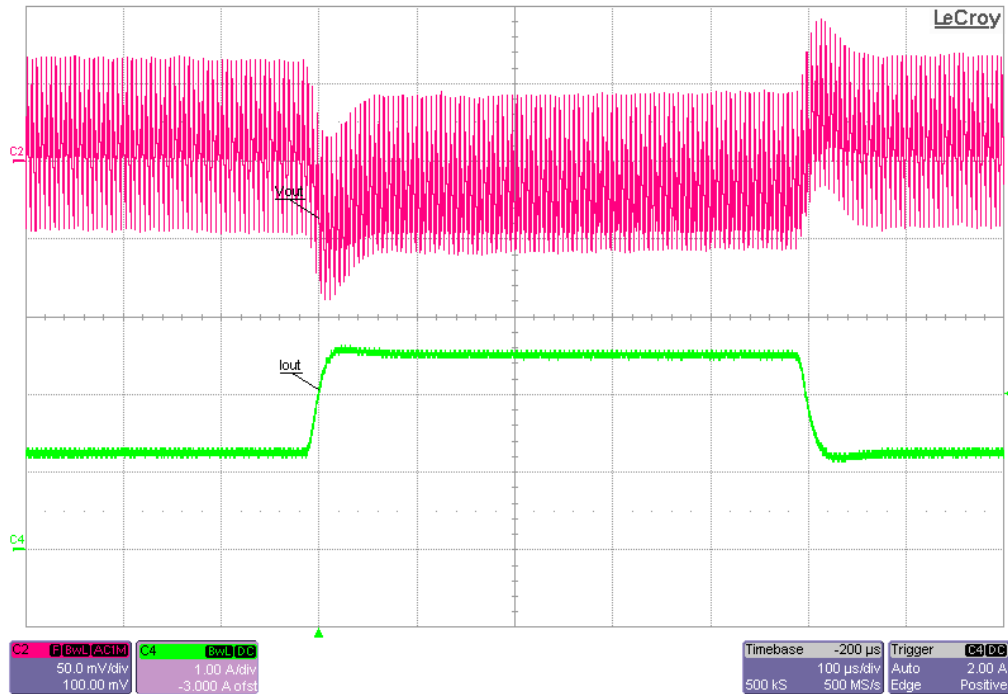
Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency(%)
24.01	0.01	0.26	11.86	0.00	0.00	0.26	0.00
24.01	0.06	1.49	11.86	0.07	0.79	0.69	53.38
24.01	0.12	2.81	11.86	0.17	1.99	0.82	70.93
24.01	0.18	4.20	11.86	0.27	3.18	1.02	75.65
24.01	0.23	5.55	11.86	0.37	4.38	1.17	78.91
24.01	0.29	6.96	11.86	0.47	5.56	1.40	79.88
24.01	0.34	8.26	11.86	0.57	6.71	1.55	81.27
24.01	0.40	9.56	11.86	0.66	7.88	1.68	82.41
24.01	0.45	10.90	11.86	0.76	9.06	1.84	83.12
24.01	0.51	12.27	11.86	0.86	10.24	2.03	83.42
24.01	0.57	13.62	11.86	0.96	11.43	2.18	83.97
24.01	0.62	14.96	11.86	1.07	12.63	2.33	84.43
24.01	0.68	16.23	11.86	1.16	13.77	2.46	84.83
24.01	0.73	17.50	11.86	1.26	14.97	2.54	85.50
24.01	0.78	18.80	11.86	1.36	16.15	2.65	85.91
24.01	0.84	20.12	11.86	1.46	17.36	2.76	86.28
24.01	0.89	21.42	11.86	1.56	18.55	2.87	86.59

24.01	0.95	22.72	11.86	1.66	19.73	2.98	86.87
24.01	1.00	23.99	11.86	1.76	20.88	3.11	87.05
24.01	1.05	25.26	11.86	1.86	22.05	3.21	87.31
24.01	1.11	26.58	11.86	1.96	23.24	3.34	87.43
24.01	1.16	27.88	11.86	2.06	24.41	3.47	87.57
24.01	1.22	29.25	11.86	2.16	25.63	3.61	87.64
24.01	1.27	30.52	11.86	2.26	26.78	3.74	87.75
24.01	1.33	31.84	11.86	2.36	27.98	3.86	87.87
24.01	1.38	33.18	11.85	2.46	29.17	4.01	87.91
24.01	1.44	34.53	11.85	2.56	30.36	4.17	87.92
24.01	1.49	35.85	11.85	2.66	31.55	4.30	88.02
30.02	0.01	0.30	11.85	0.00	0.00	0.30	0.00
30.02	0.05	1.50	11.85	0.06	0.66	0.84	44.22
30.02	0.10	2.85	11.85	0.16	1.86	0.99	65.26
30.02	0.14	4.29	11.85	0.26	3.06	1.23	71.24
30.02	0.19	5.58	11.85	0.36	4.24	1.34	76.00
30.02	0.23	7.02	11.85	0.46	5.44	1.58	77.45
30.02	0.28	8.34	11.85	0.56	6.59	1.76	78.97
30.02	0.32	9.63	11.85	0.66	7.80	1.84	80.94
30.02	0.37	11.05	11.85	0.76	8.97	2.07	81.22
30.02	0.41	12.40	11.85	0.86	10.17	2.23	82.03
30.02	0.46	13.75	11.85	0.96	11.37	2.38	82.67
30.02	0.50	15.13	11.85	1.06	12.54	2.59	82.88
30.01	0.55	16.45	11.85	1.16	13.72	2.73	83.43
30.01	0.59	17.77	11.85	1.26	14.92	2.85	83.97
30.01	0.63	19.03	11.85	1.36	16.09	2.94	84.57
30.01	0.68	20.35	11.85	1.46	17.29	3.06	84.96
30.01	0.72	21.61	11.85	1.56	18.46	3.15	85.43
30.01	0.76	22.93	11.85	1.66	19.67	3.26	85.78
30.01	0.81	24.22	11.85	1.76	20.82	3.40	85.95
30.01	0.85	25.51	11.85	1.86	22.02	3.50	86.30
30.01	0.89	26.83	11.85	1.96	23.20	3.63	86.46
30.01	0.94	28.15	11.85	2.06	24.38	3.77	86.61
30.01	0.98	29.47	11.85	2.16	25.58	3.89	86.79
30.01	1.03	30.76	11.85	2.26	26.73	4.03	86.89
30.01	1.07	32.08	11.85	2.36	27.91	4.17	87.00
30.01	1.11	33.40	11.85	2.46	29.10	4.31	87.10
30.01	1.16	34.73	11.85	2.56	30.29	4.43	87.24
30.01	1.20	36.11	11.85	2.66	31.50	4.61	87.24

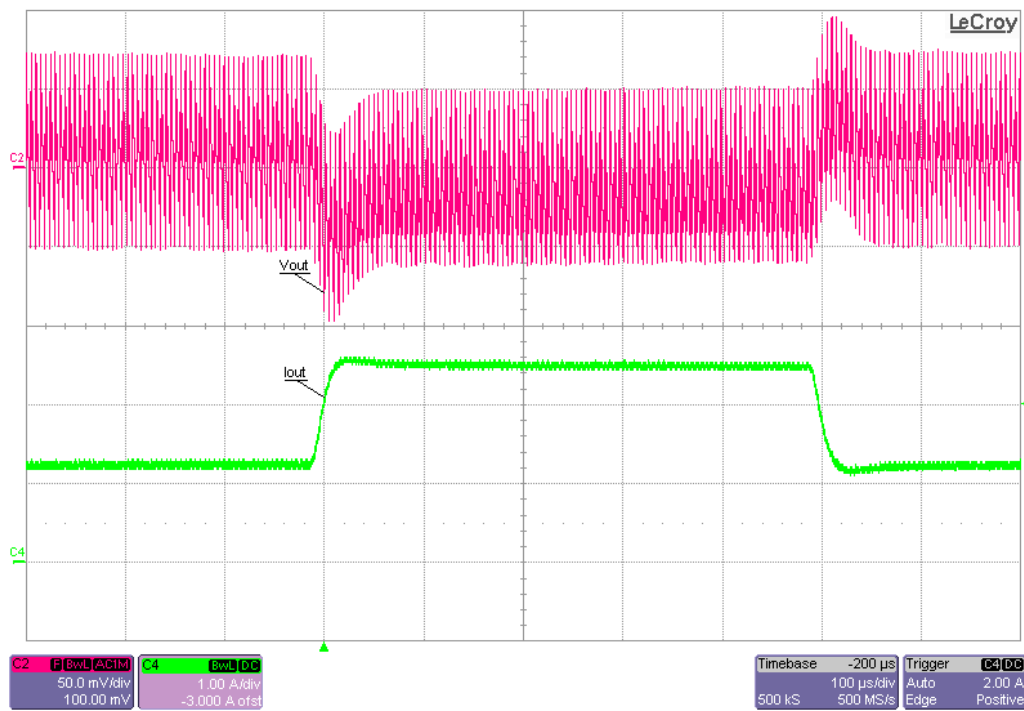
36.02	0.01	0.36	11.85	0.00	0.00	0.36	0.00
36.02	0.05	1.62	11.85	0.06	0.68	0.95	41.66
36.02	0.09	3.10	11.85	0.16	1.86	1.24	60.04
36.02	0.13	4.50	11.85	0.26	3.07	1.43	68.15
36.02	0.16	5.83	11.85	0.36	4.26	1.57	73.08
36.02	0.20	7.28	11.85	0.46	5.45	1.83	74.89
36.02	0.24	8.61	11.85	0.56	6.61	2.00	76.78
36.02	0.28	9.90	11.85	0.66	7.78	2.12	78.57
36.02	0.31	11.24	11.85	0.76	8.97	2.27	79.79
36.02	0.35	12.68	11.85	0.86	10.16	2.52	80.16
36.02	0.39	13.97	11.85	0.96	11.38	2.59	81.45
36.02	0.43	15.38	11.85	1.06	12.56	2.82	81.64
36.02	0.46	16.71	11.85	1.16	13.68	3.03	81.86
36.02	0.50	18.04	11.85	1.26	14.89	3.16	82.51
36.02	0.54	19.34	11.85	1.36	16.07	3.27	83.11
36.02	0.57	20.64	11.85	1.46	17.27	3.37	83.68
36.02	0.61	21.93	11.85	1.56	18.47	3.47	84.19
36.02	0.65	23.23	11.84	1.66	19.66	3.57	84.63
36.02	0.68	24.53	11.84	1.76	20.82	3.71	84.89
36.02	0.72	25.82	11.84	1.86	22.01	3.82	85.22
36.02	0.75	27.16	11.84	1.96	23.20	3.95	85.44
36.02	0.79	28.49	11.84	2.06	24.40	4.09	85.64
36.02	0.83	29.82	11.84	2.16	25.58	4.24	85.78
36.02	0.86	31.08	11.84	2.26	26.72	4.36	85.96
36.02	0.90	32.38	11.84	2.36	27.89	4.49	86.14
36.02	0.94	33.75	11.84	2.46	29.11	4.64	86.26
36.02	0.97	35.08	11.84	2.56	30.30	4.77	86.39
36.02	1.01	36.41	11.84	2.66	31.48	4.94	86.45

6 Waveforms

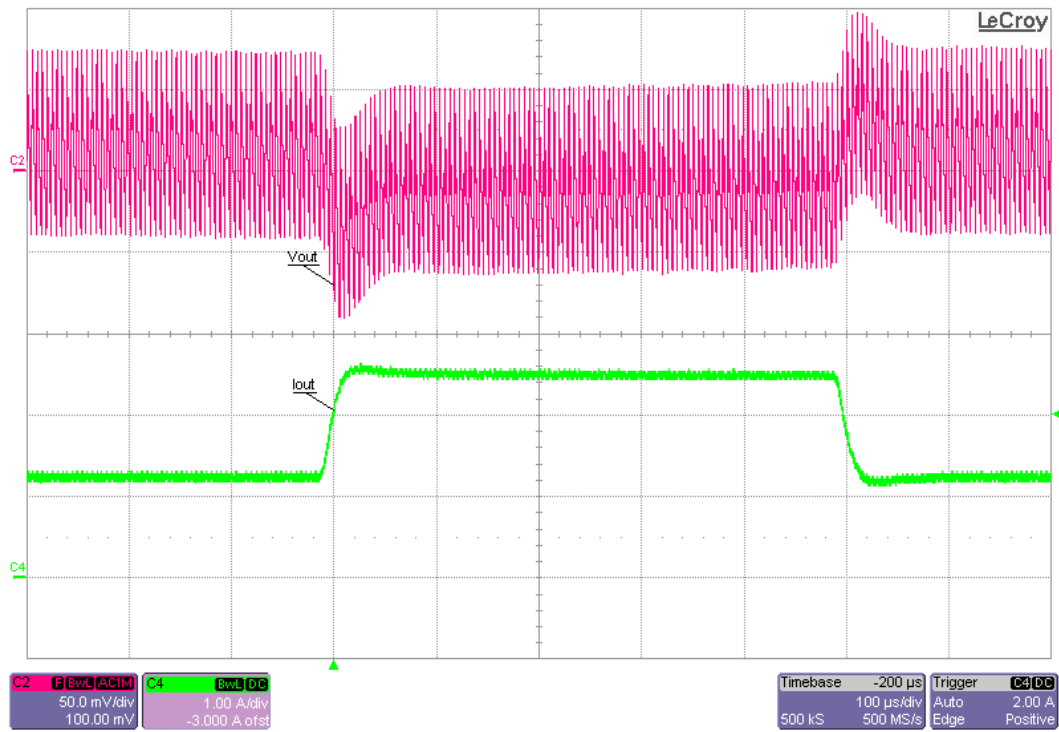
6.1 Load Transient Response



Load Transient Response at 24V_{in} and 1.25A-to-2.5A Load Step, Ch2 – V_{out} (AC coupled), Ch4- I_{out}.

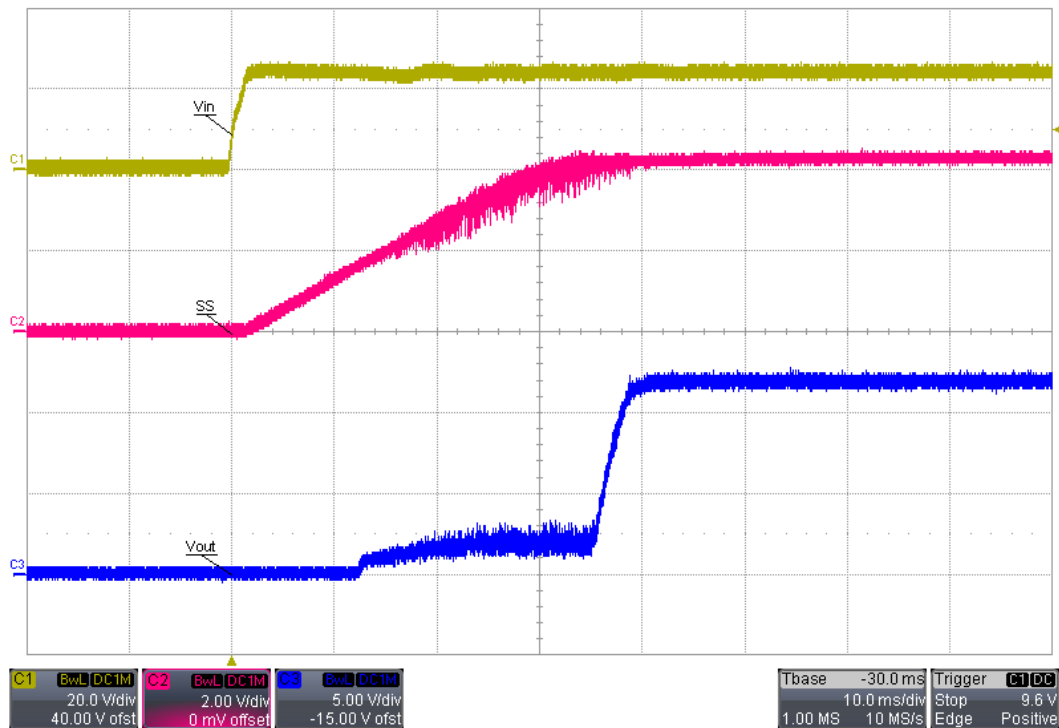


Load Transient Response at 30V_{in} and 1.25A-to-2.5A Load Step, Ch2 – V_{out} (AC coupled), Ch4- I_{out}.

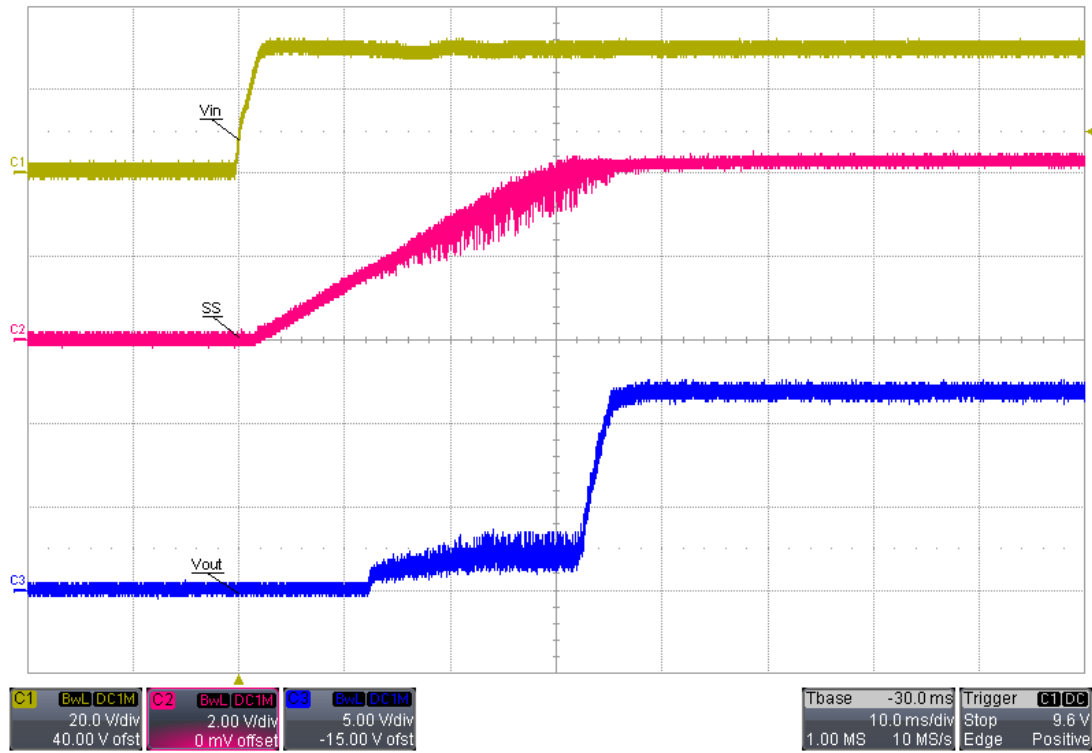


Load Transient Response at 36Vin and 1.25A-to-2.5A Load Step, Ch2 – Vout (AC coupled), Ch4- Iout.

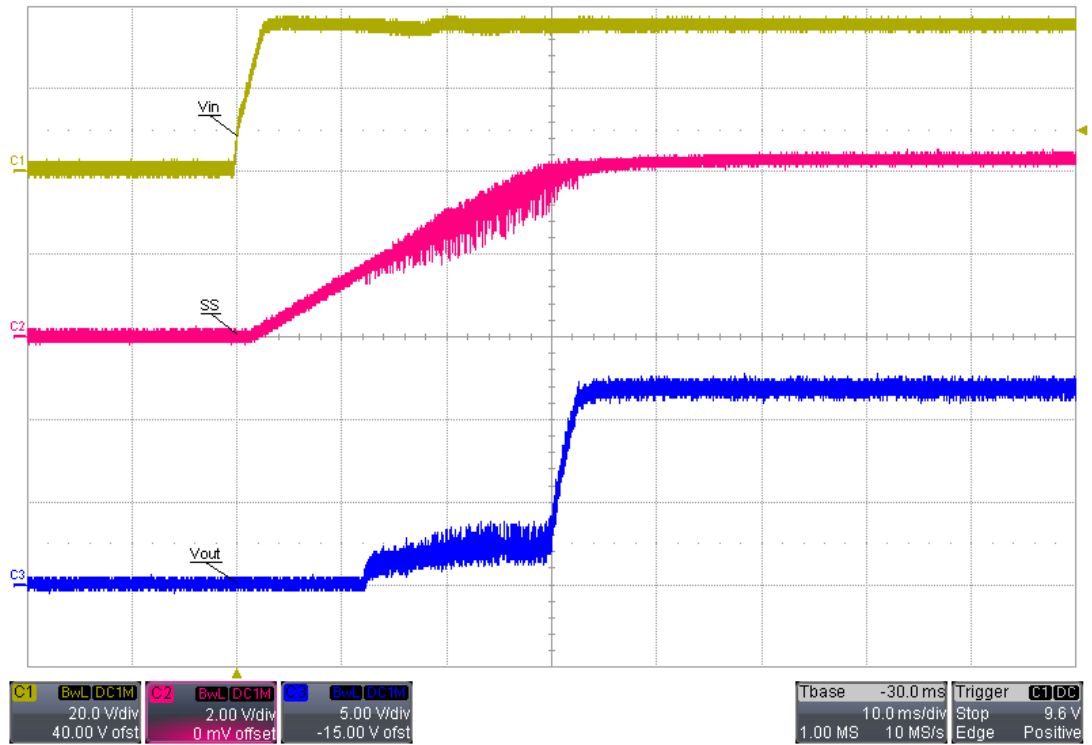
6.2 Startup from Vin



Startup into Full Load at 24Vin, Ch1-Vin, Ch2-SS, Ch3-Vout.

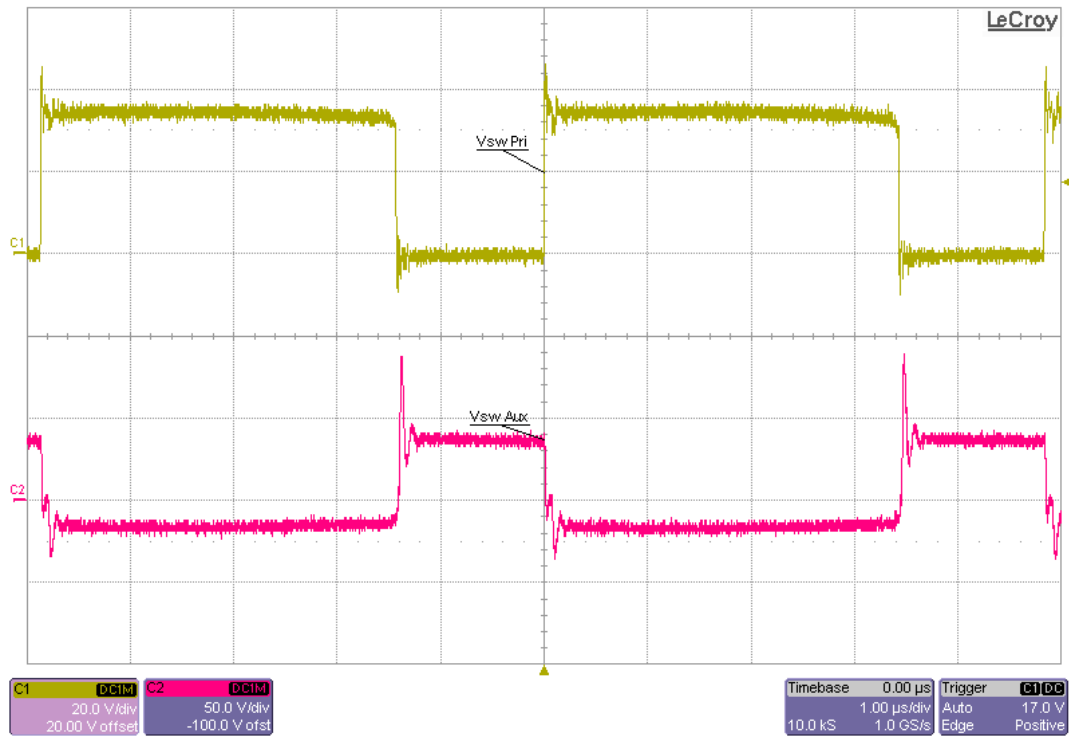


Startup into Full Load at 30Vin, Ch1-Vin, Ch2-SS, Ch3-Vout.

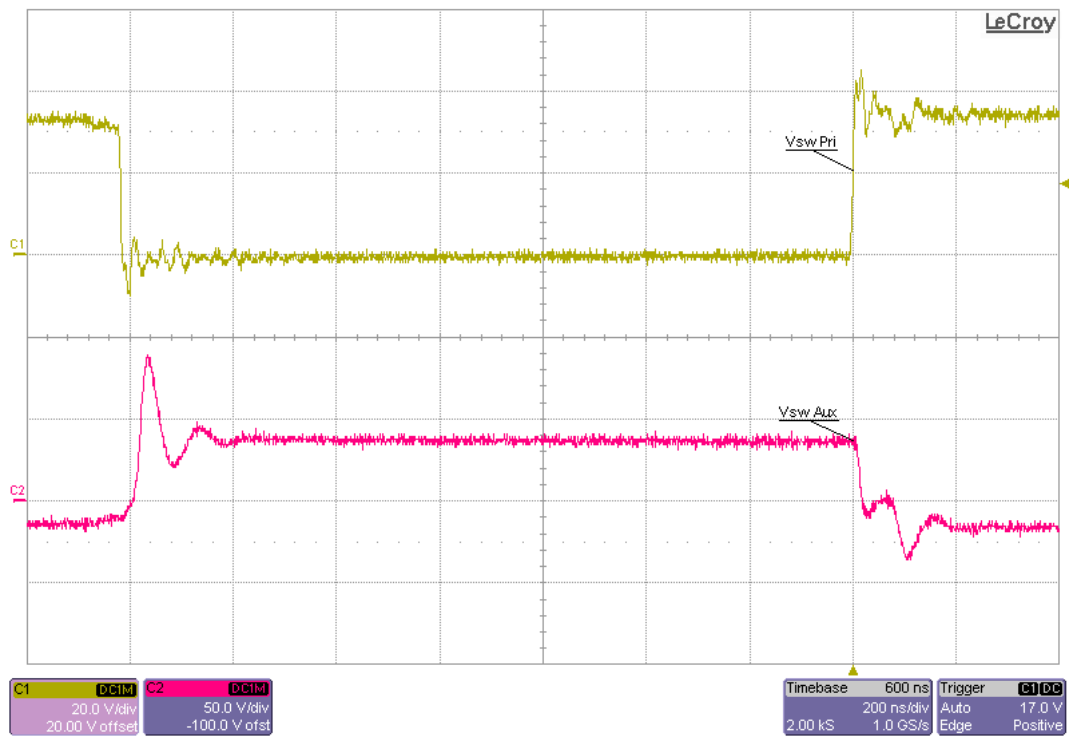


Startup into Full Load at 36Vin, Ch1-Vin, Ch2-SS, Ch3-Vout.

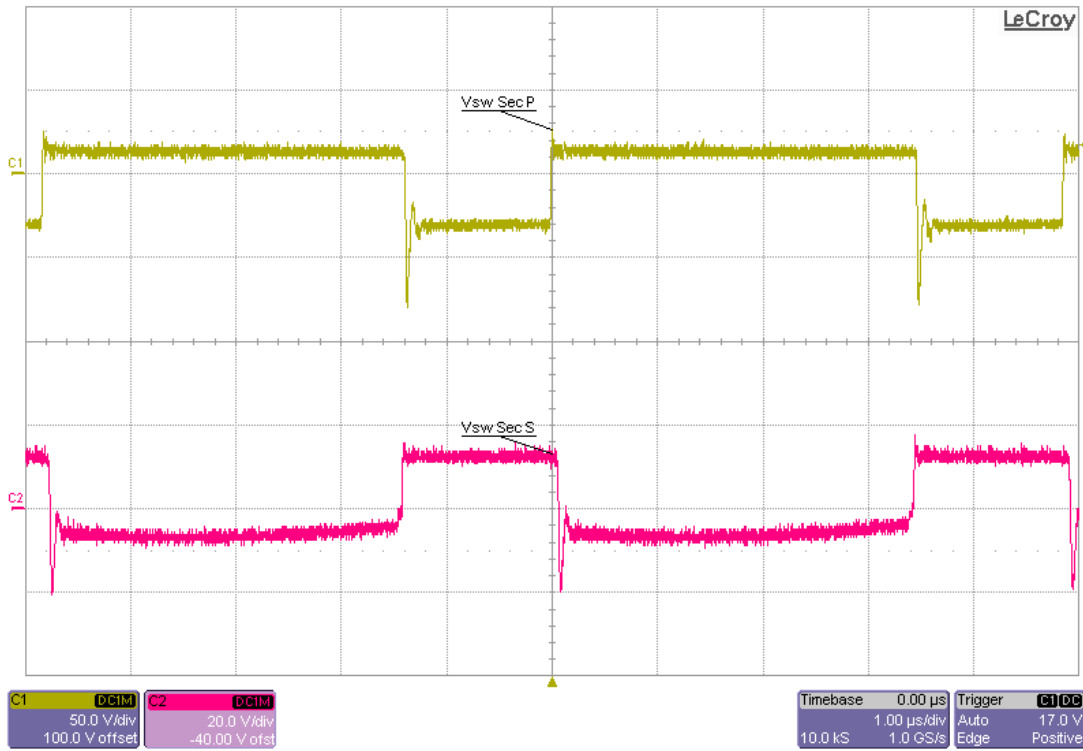
6.3 Switch Node Voltage



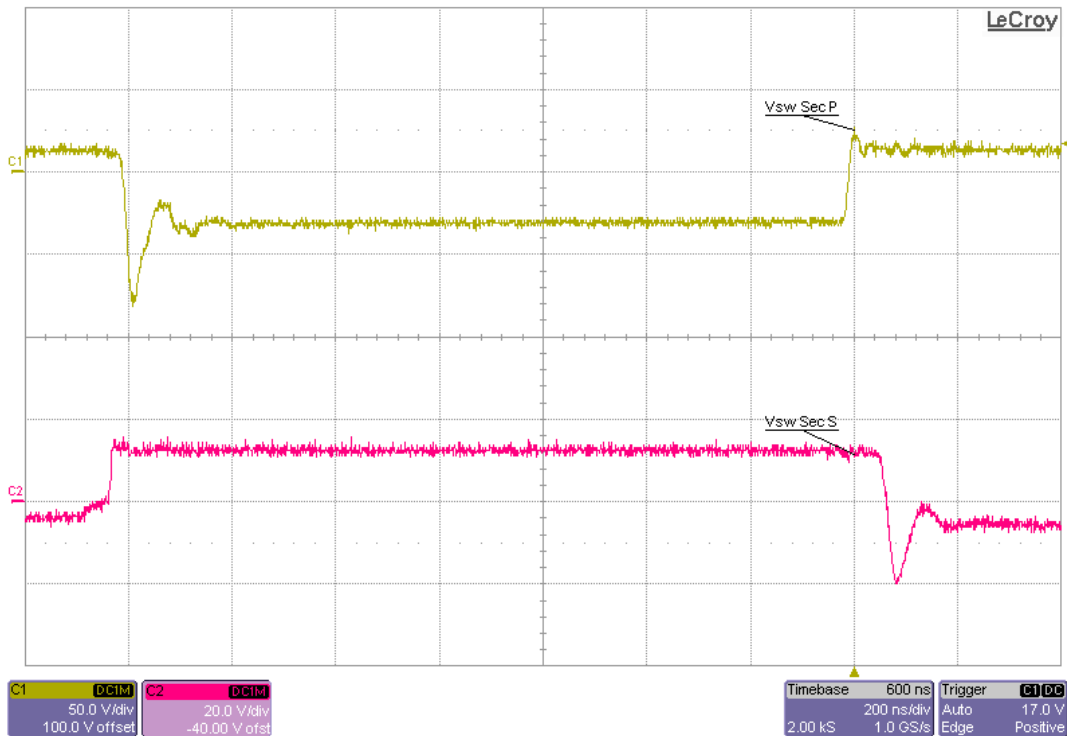
Switch Node Voltage of 24Vin and Full Load. Ch1-Pri-SW, Ch2- Aux-SW.



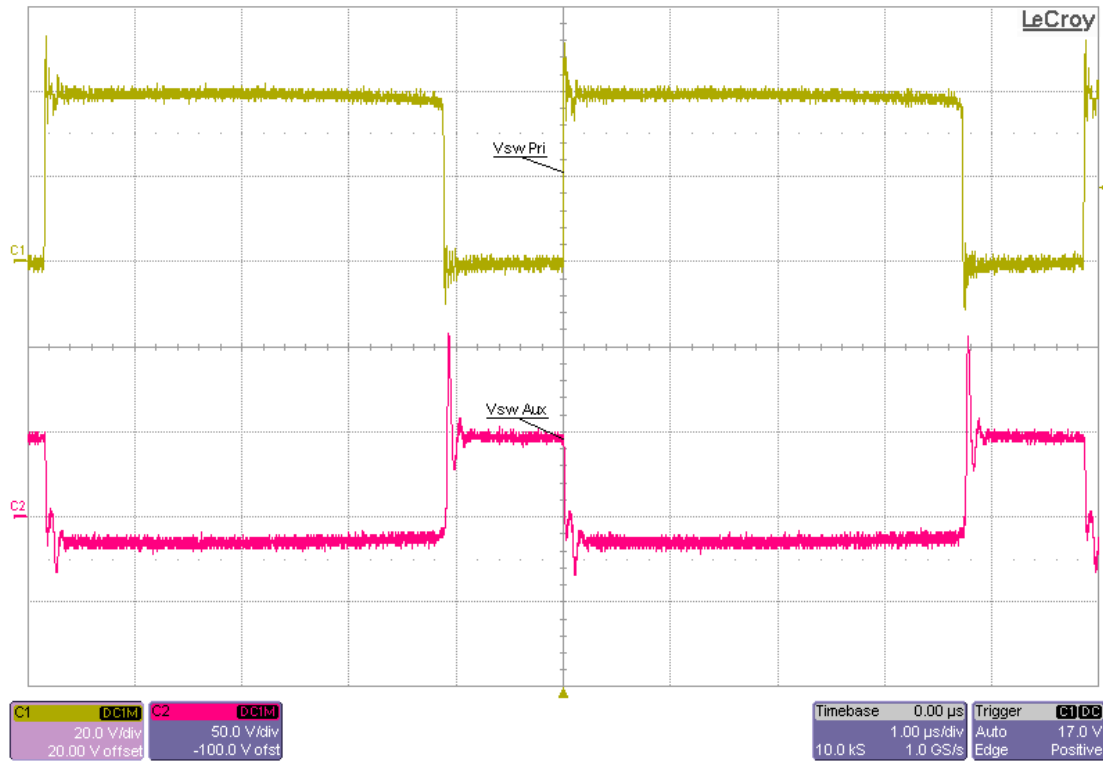
Zoomed Switch Node Voltage of 24Vin and Full Load. Ch1-Pri-SW, Ch2- Aux-SW.



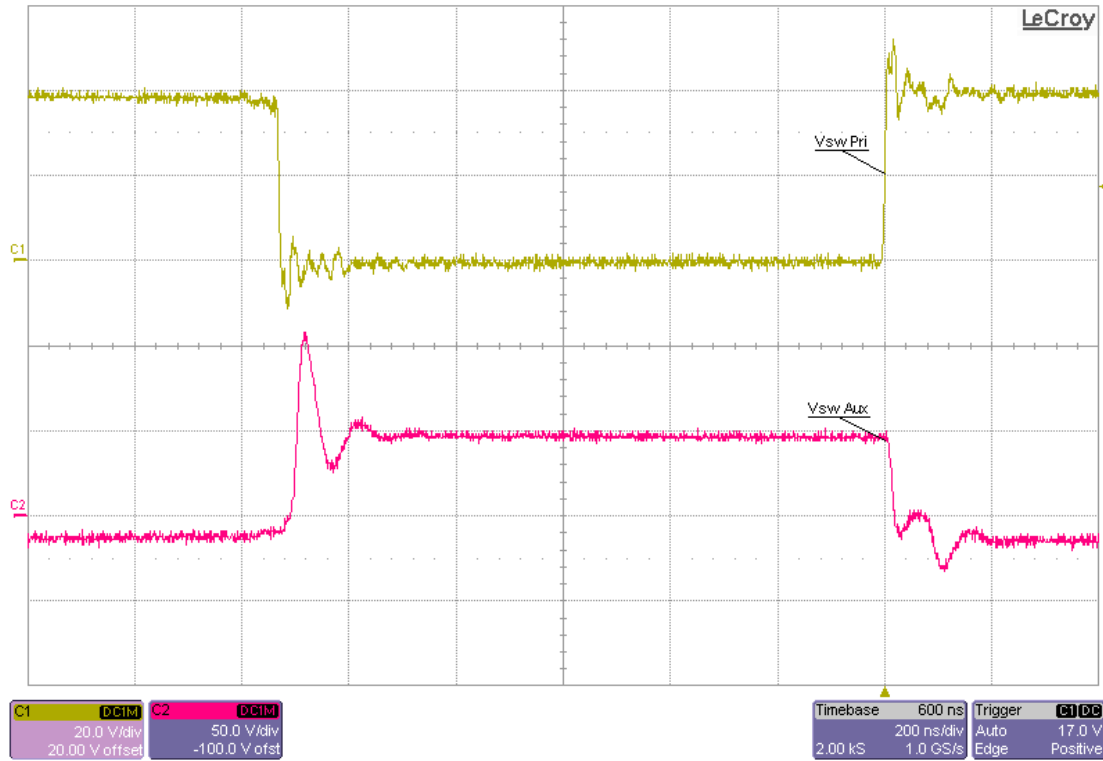
Switch Node Voltage of 24Vin and Full Load. Ch1-Sec-SW-P, Ch2- Sec-SW-N.



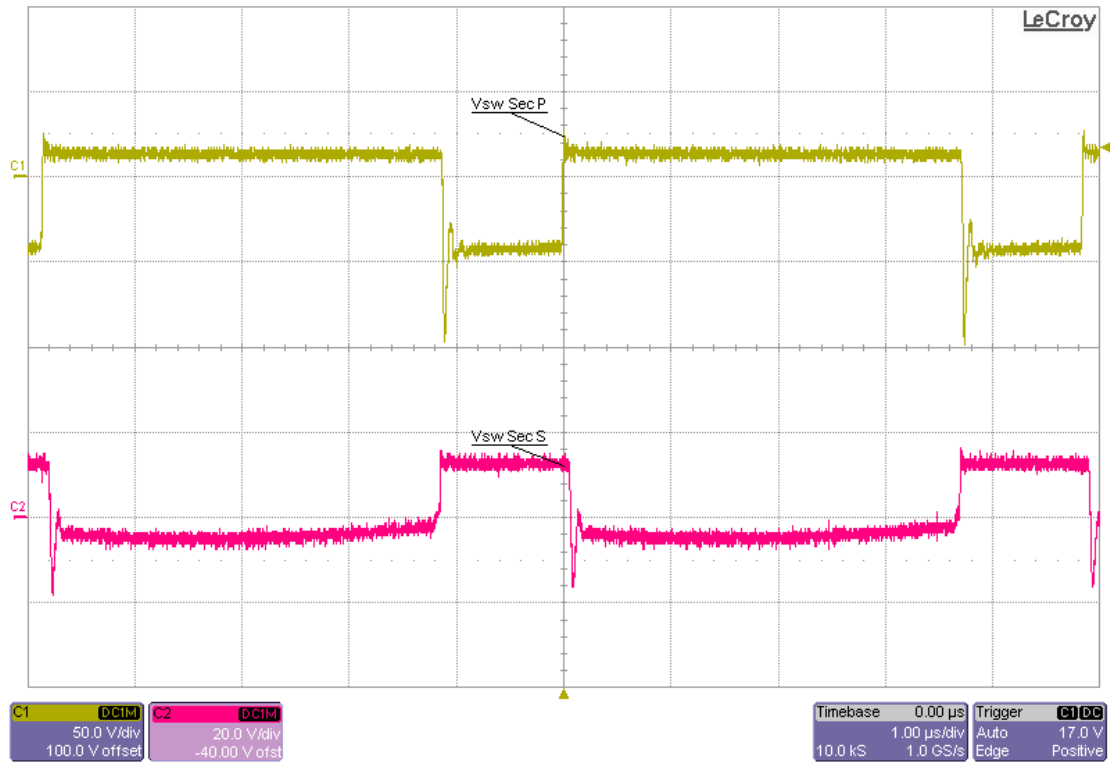
Zoomed Switch Node Voltage of 24Vin and Full Load. Ch1-Sec-SW-P, Ch2- Sec-SW-N.



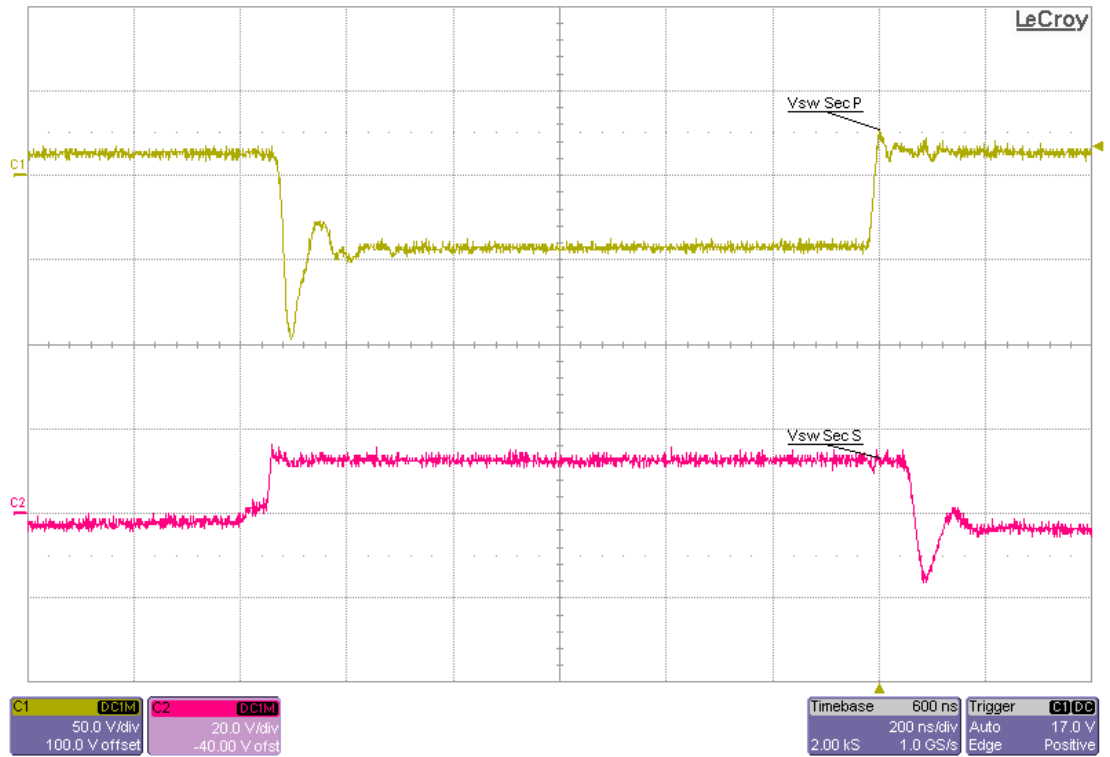
Switch Node Voltage of 30Vin and Full Load. Ch1-Pri-SW, Ch2- Aux-SW.



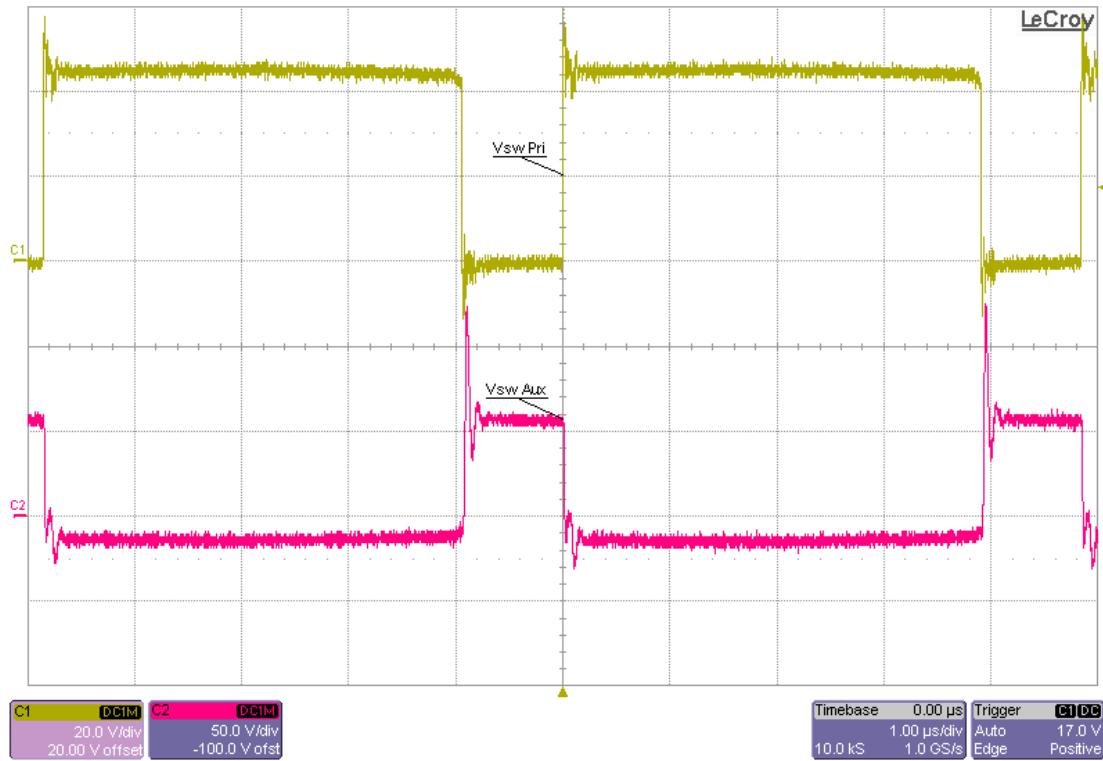
Zoomed Switch Node Voltage of 30Vin and Full Load. Ch1-Pri-SW, Ch2- Aux-SW.



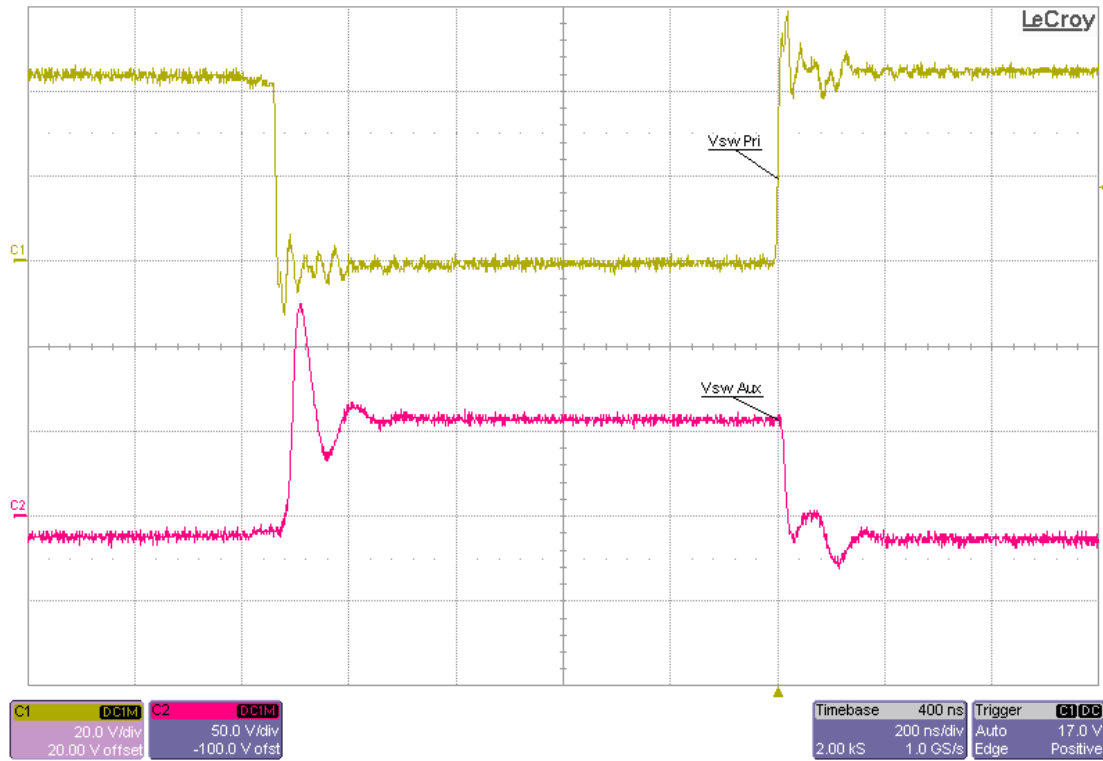
Switch Node Voltage of 30Vin and Full Load. Ch1-Sec-SW-P, Ch2- Sec-SW-N.



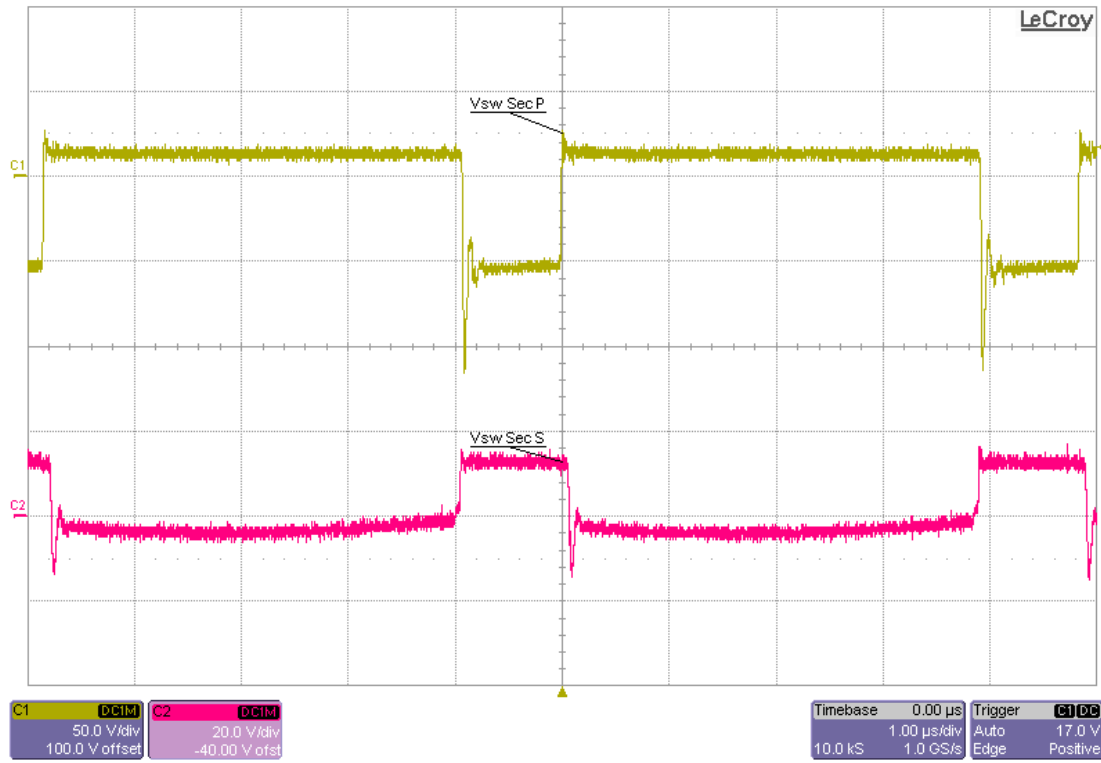
Zoomed Switch Node Voltage of 30Vin and Full Load. Ch1-Sec-SW-P, Ch2- Sec-SW-N.



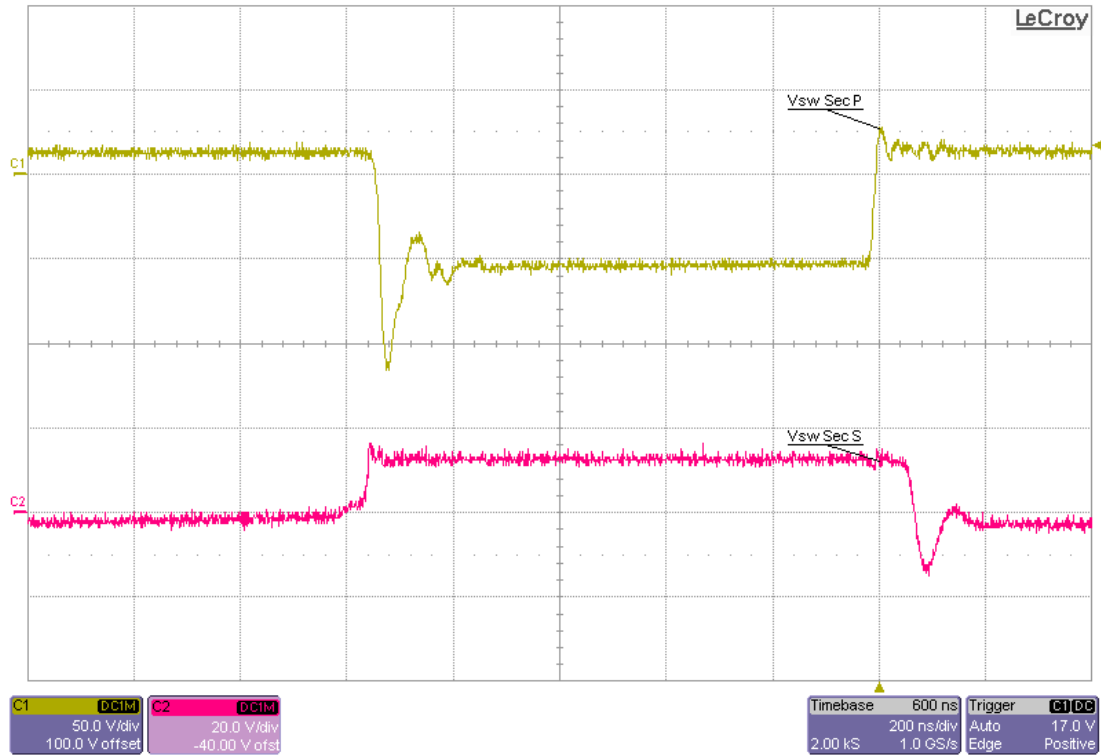
Switch Node Voltage of 36Vin and Full Load. Ch1-Pri-SW, Ch2- Aux-SW.



Zoomed Switch Node Voltage of 36Vin and Full Load. Ch1-Pri-SW, Ch2- Aux-SW.

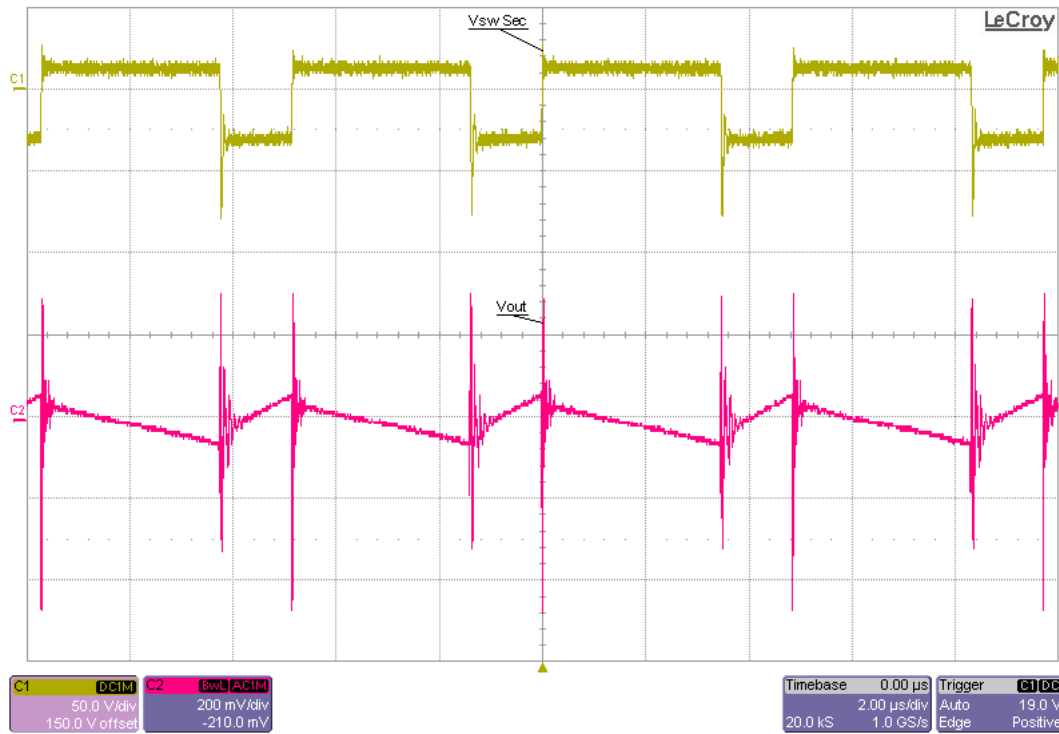


Switch Node Voltage of 36Vin and Full Load. Ch1-Sec-SW-P, Ch2- Sec-SW-N.

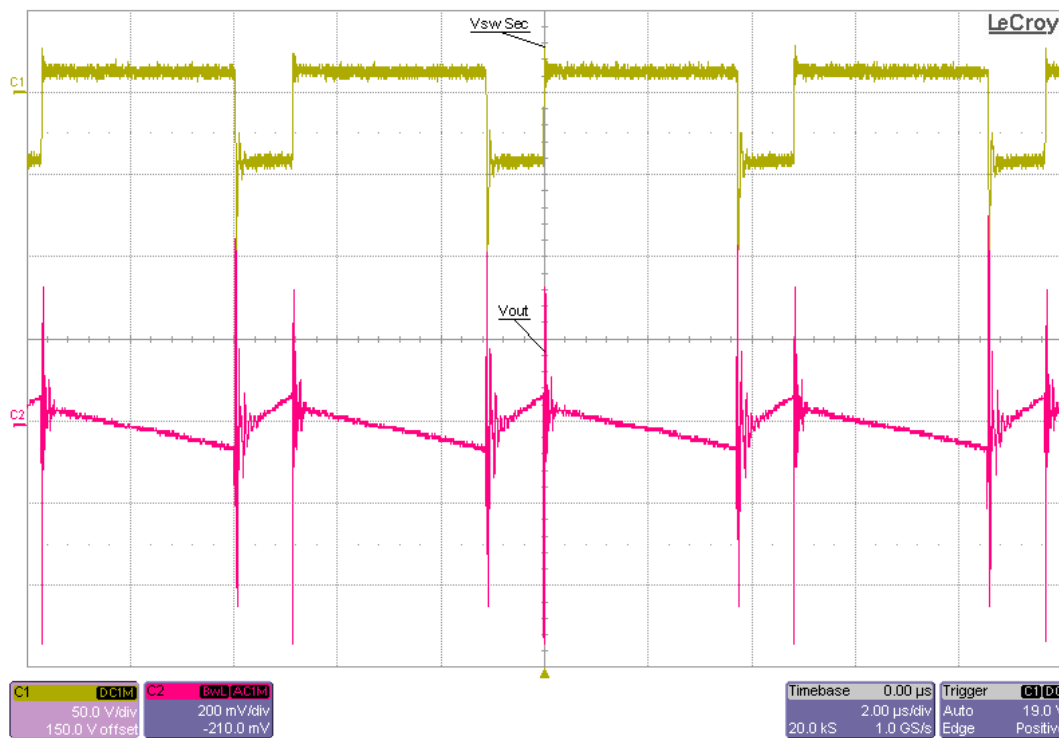


Zoomed Switch Node Voltage of 36Vin and Full Load. Ch1-Sec-SW-P, Ch2- Sec-SW-N.

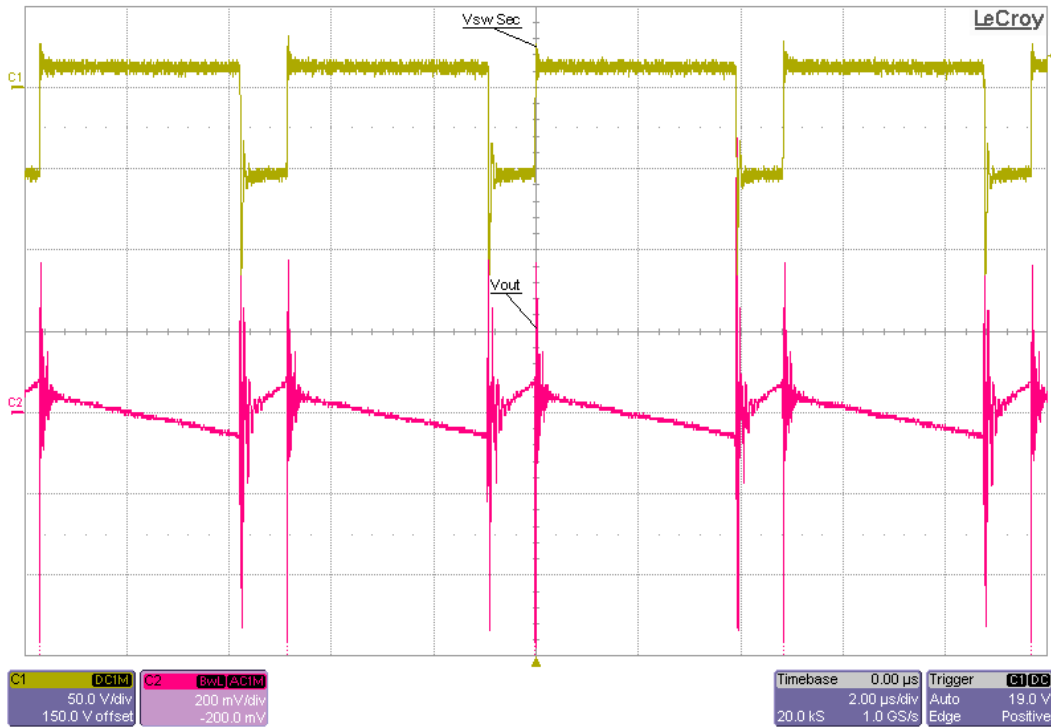
6.4 Output Ripple



Output Ripple at 24V_{in} and Full Load. Ch1-Sec-SW-P, Ch2- Vout (AC Coupled).

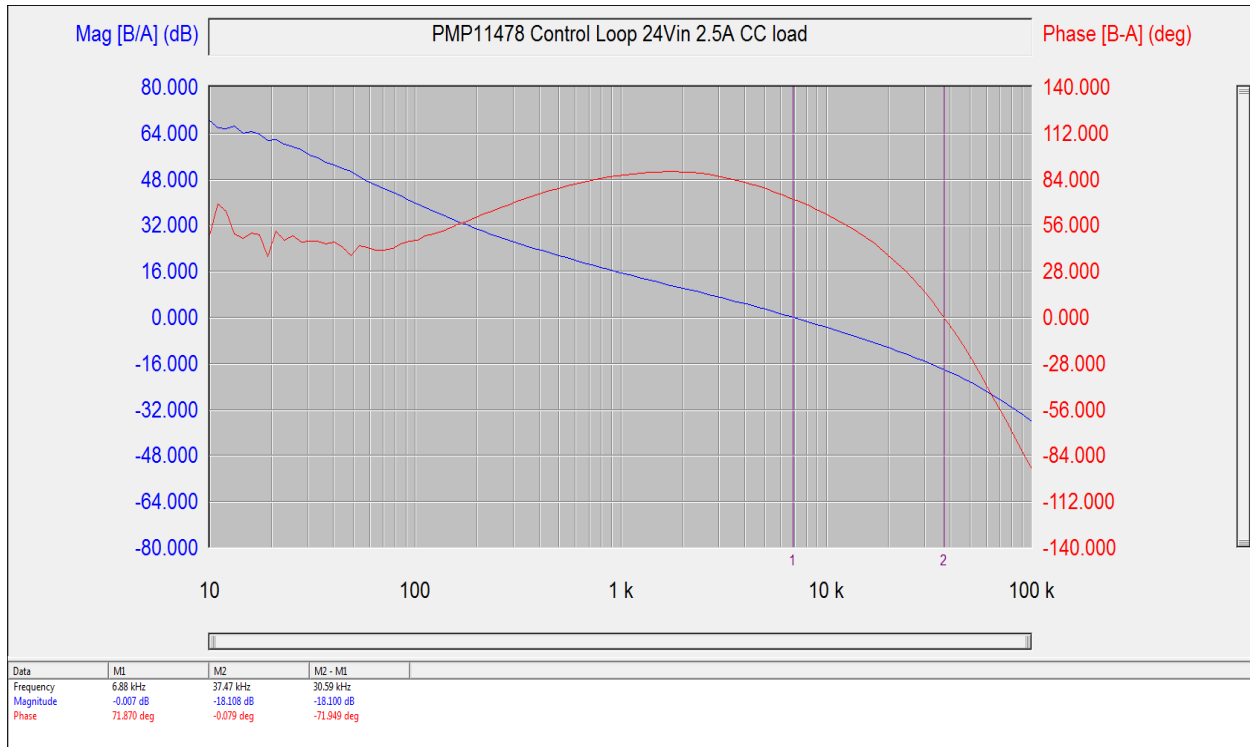


Output Ripple at 30V_{in} and Full Load. Ch1-Sec-SW-P, Ch2- Vout (AC Coupled).

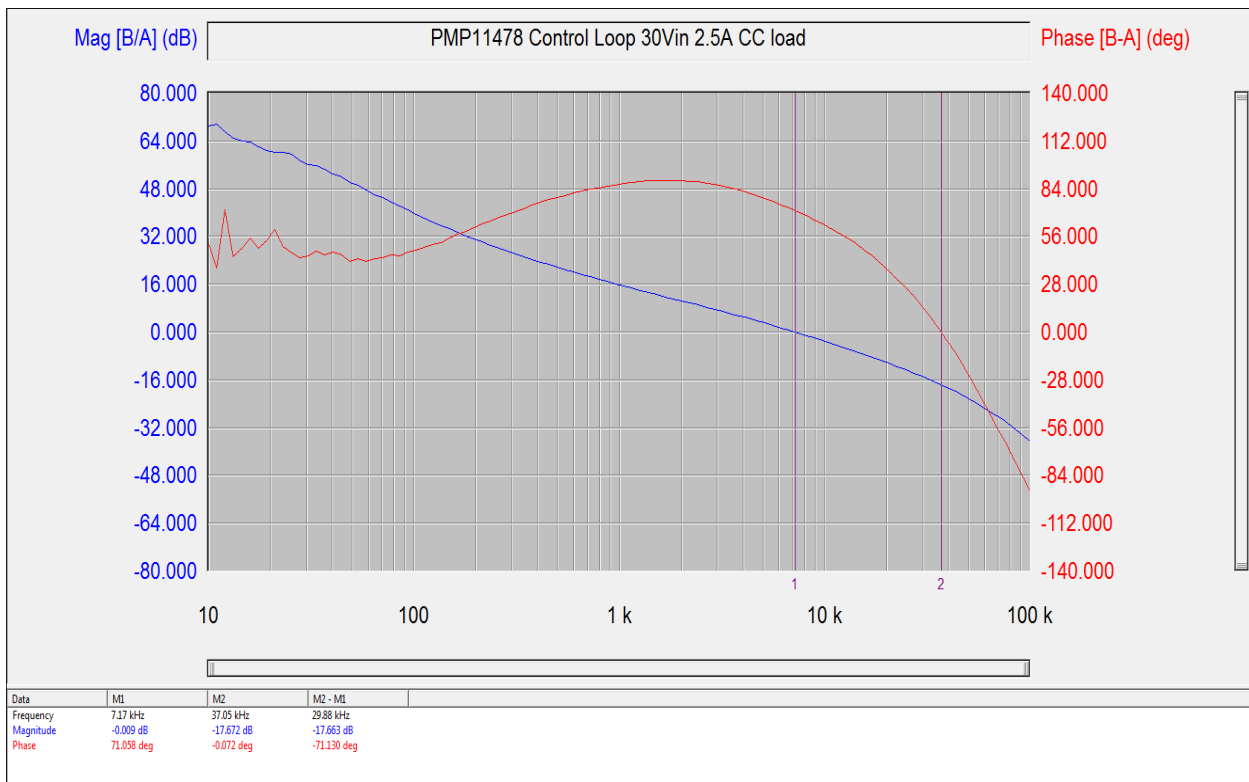


Output Ripple at 36Vin and Full Load. Ch1-Sec-SW-P, Ch2- Vout (AC Coupled).

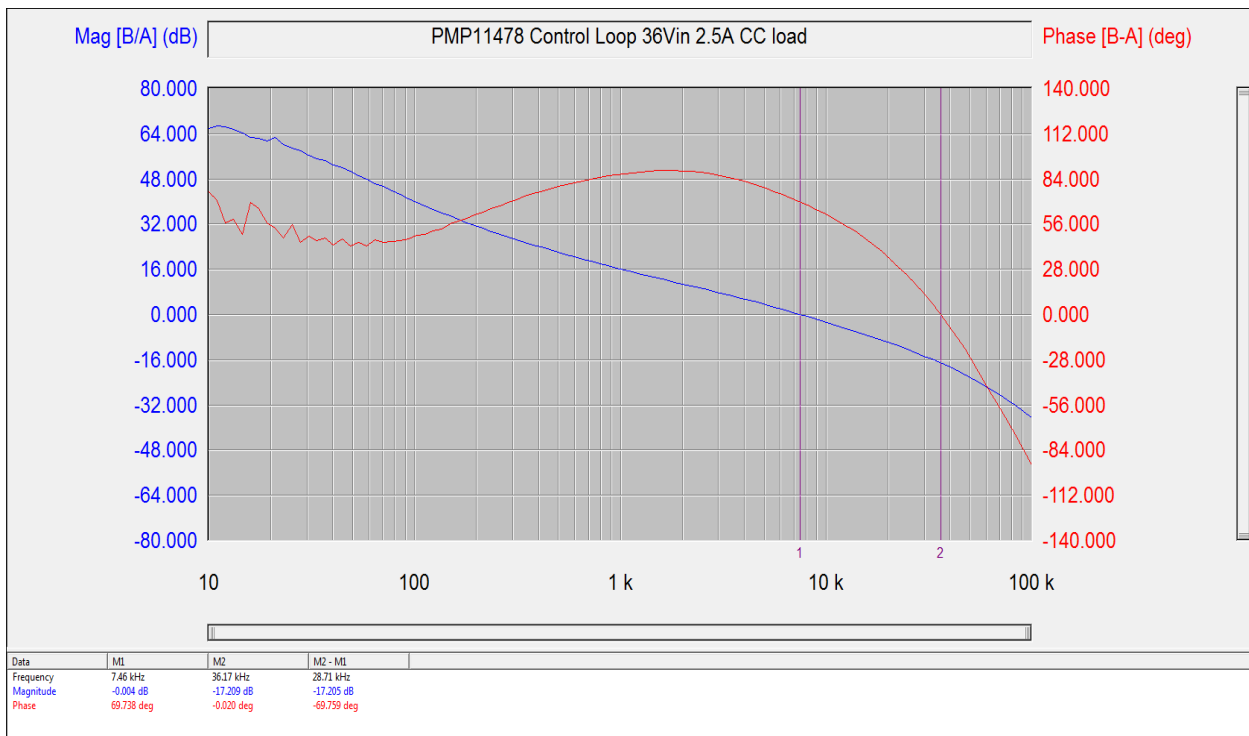
6.5 Frequency Analysis



Control Loop Analysis at 24Vin 2.5A Full Load, Phase Margin of 71.9 deg, Gain Margin of 18dB.



Control Loop Analysis at 30Vin 2.5A Full Load, Phase Margin of 71 deg, Gain Margin of 17.67dB.



Control Loop Analysis at 36Vin 2.5A Full Load, Phase Margin of 70 deg, Gain Margin of 17.2dB.

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