Test Report
For PMP10708
07/22/2015

Table of Contents

1. Design Specifications

Vin Minimum	**3.5VDC**
Vin Maximum	**36VDC**
Vout	**6.5 VDC**
Iout	**1.2A**
Approximate Switching Frequency	**~400KHz**

2. Circuit Description and PCB details

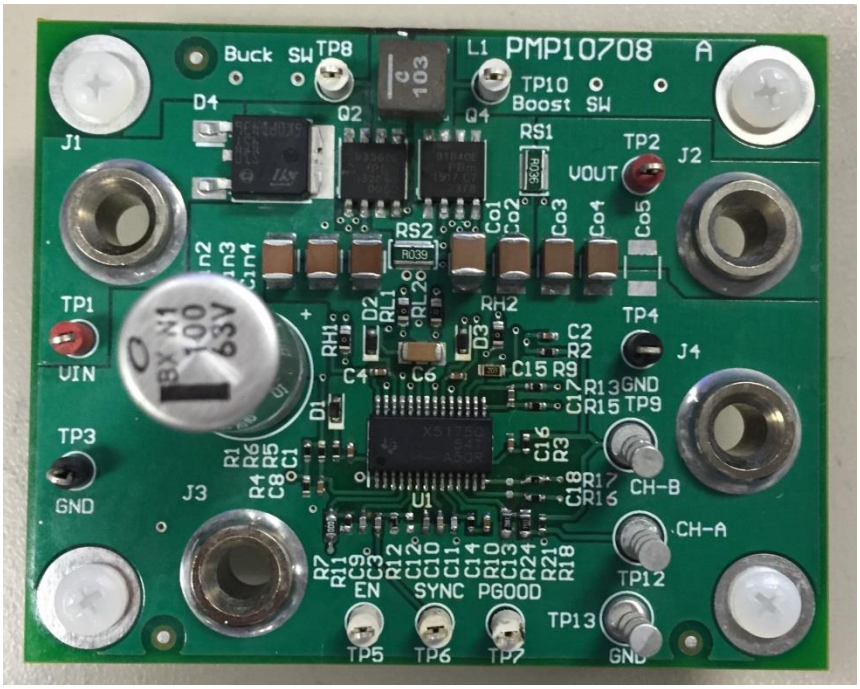
PMP10708 is a 7.8W 4-switch buck-boost converter using the LM5175 controller IC. The design accepts an input voltage of 3.5Vin to 36Vin and provides an output of 6.5Vout capable of supplying 1.2A of current to the load. The design can operate as low as 3V during start-stop or other line transient conditions.

The design implements a 41kHz frequency modulation through the DITH pin. The mode pin is configured in CCM with hiccup disabled. The bias pin of the device powers the LM5175 during low Vin operation from Vout through an internal LDO with a diode drop.

The design was built on PMP10708 with a dimension of 75mm * 40mm. Four layer PCB was used for the design, 1oz copper on top and bottom layer, 0.5oz copper on the internal layer.

3. PMP10708 Board Photos

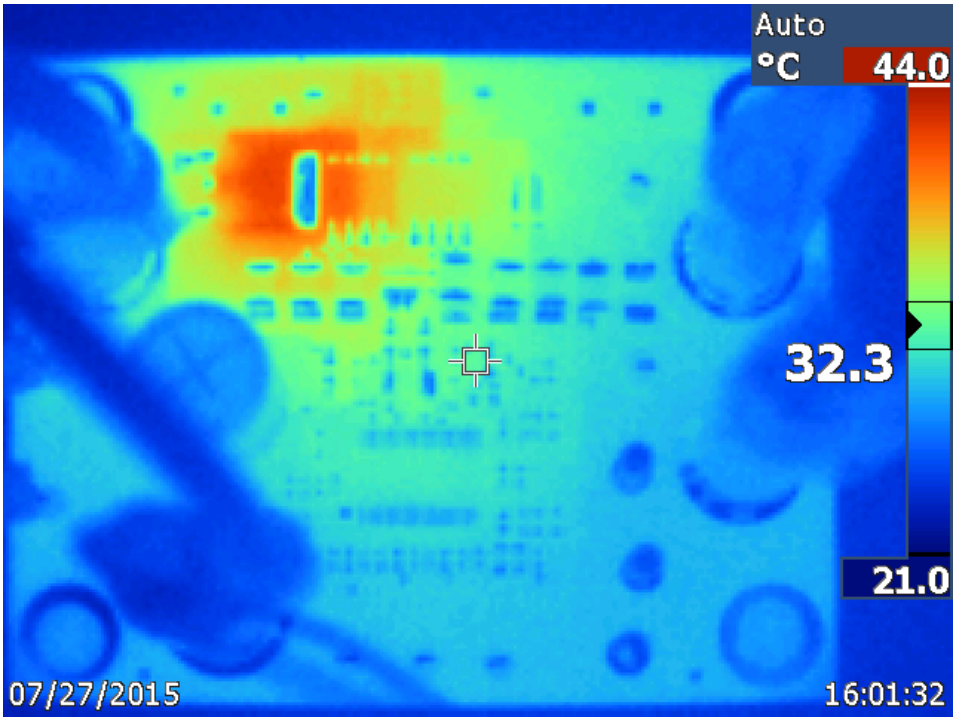
Board Dimensions: 75mm x 40mm



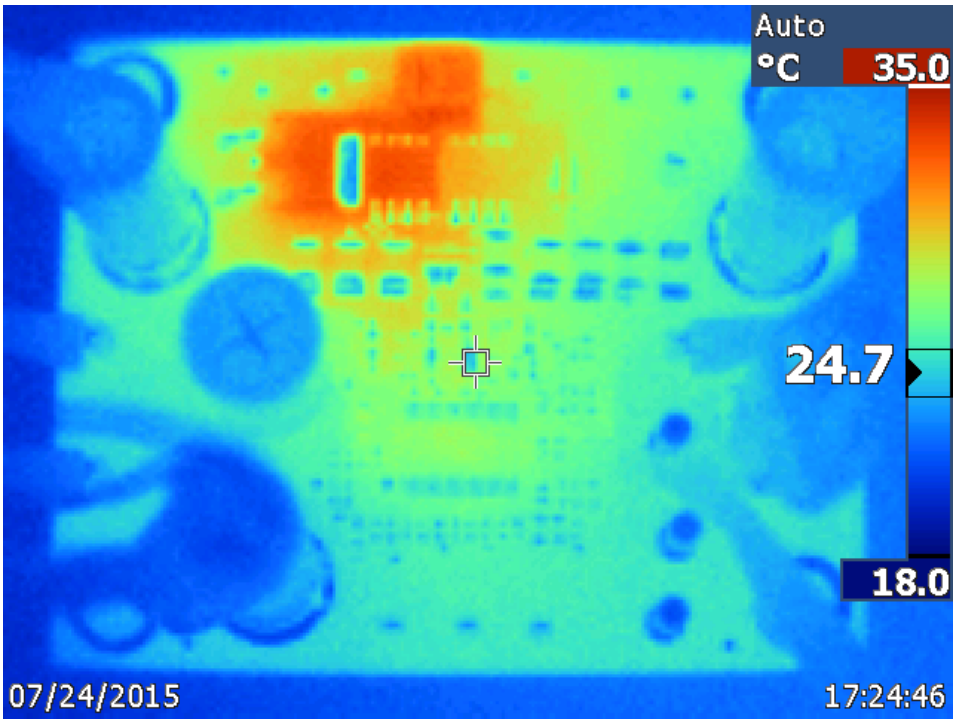
Board Photo (Top)

Board Photo (Bottom)

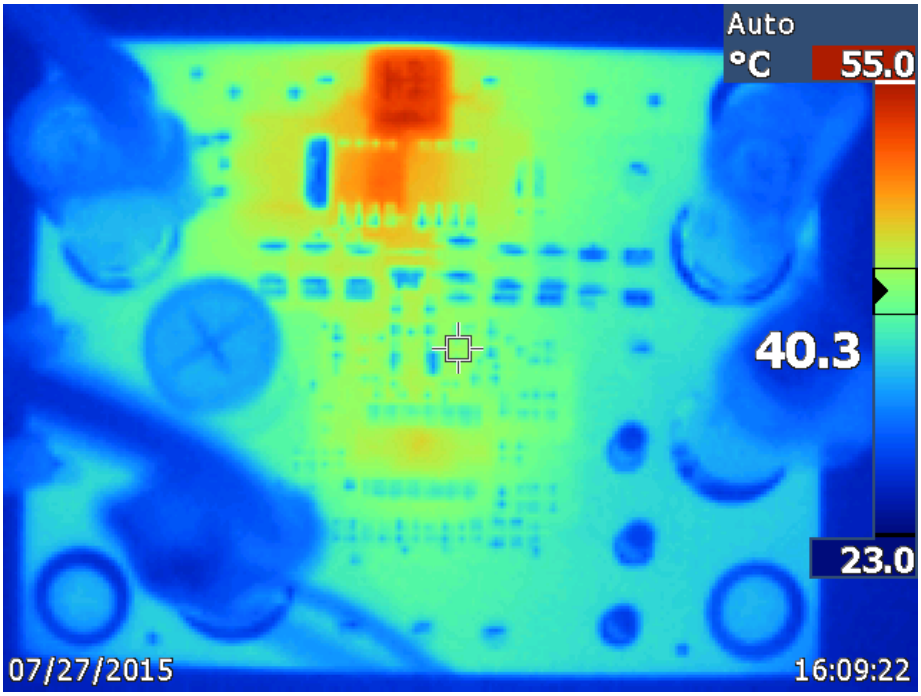
4. Thermal Data



IR thermal image taken at steady state with 6.5Vin and 1.2A load (no airflow)



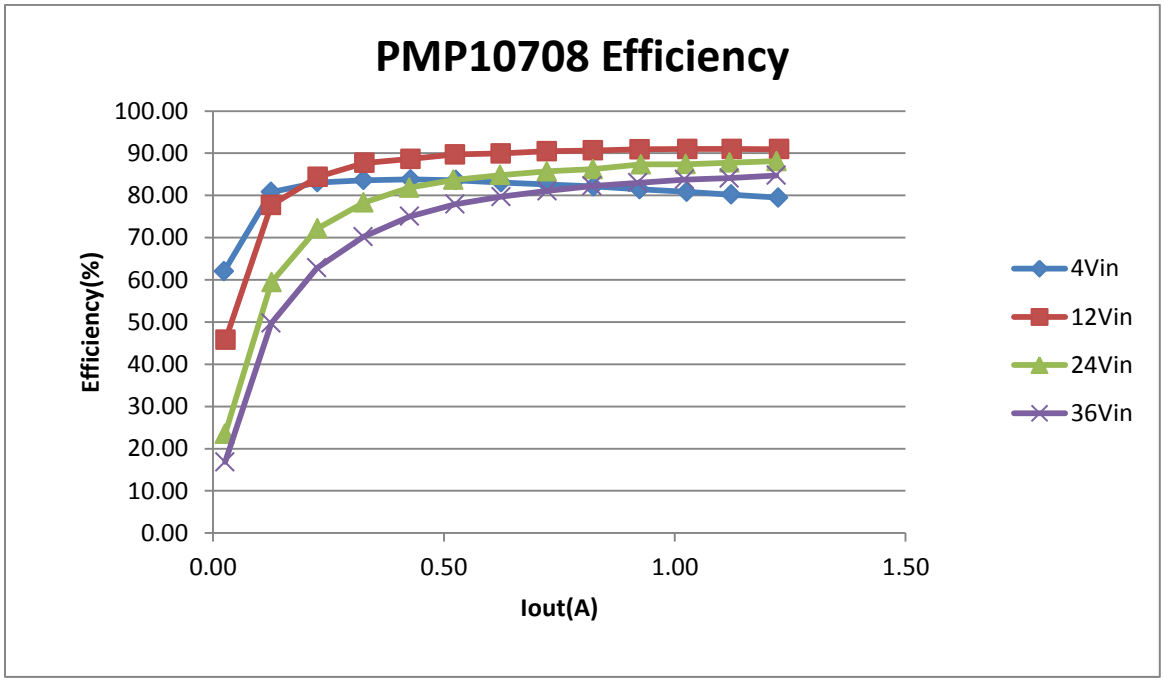
IR thermal image taken at steady state with 12Vin and 1.2A load (no airflow)



IR thermal image taken at steady state with 36Vin and 1.2A load (no airflow)

5. Efficiency

5.1 Efficiency Chart



5.2 Efficiency Data

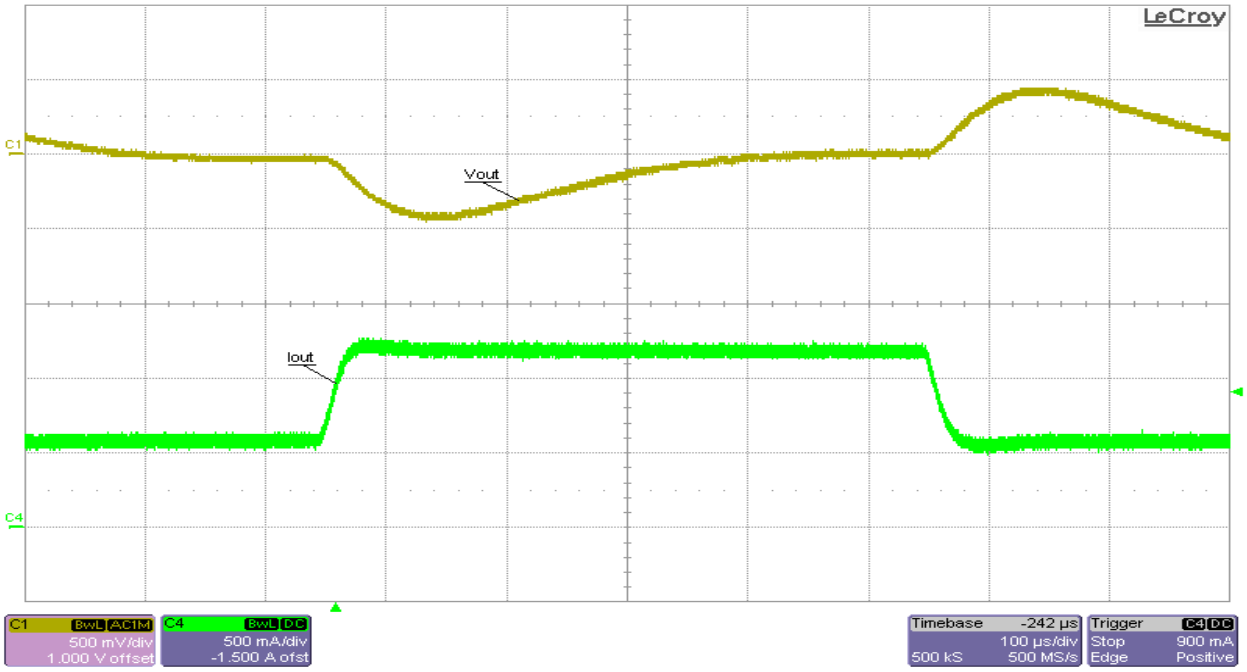
Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency(%)
4.01	0.02	0.08	6.52	0.00	0.00	0.08	0.00
4.01	0.06	0.25	6.52	0.02	0.16	0.10	62.03
4.00	0.25	1.02	6.52	0.13	0.82	0.20	80.79
4.01	0.44	1.77	6.52	0.23	1.47	0.30	83.08
4.00	0.64	2.54	6.52	0.33	2.13	0.42	83.62
4.00	0.83	3.33	6.52	0.43	2.79	0.54	83.81
4.00	1.03	4.10	6.52	0.53	3.43	0.67	83.62
4.00	1.22	4.90	6.53	0.62	4.07	0.83	83.08
4.00	1.43	5.72	6.53	0.72	4.72	0.99	82.62
4.00	1.64	6.55	6.53	0.82	5.38	1.17	82.14
4.00	1.85	7.40	6.53	0.92	6.03	1.37	81.46
4.00	2.07	8.28	6.53	1.03	6.70	1.59	80.85
4.00	2.28	9.13	6.53	1.12	7.33	1.81	80.21
4.00	2.51	10.06	6.53	1.22	7.99	2.07	79.47
4.00	2.74	10.96	6.52	1.32	8.63	2.33	78.71
4.00	1.92	7.70	4.10	1.42	5.83	1.87	75.76
4.00	2.00	8.00	3.92	1.52	5.97	2.03	74.63
12.00	0.02	0.20	6.51	0.00	0.00	0.20	0.00
12.00	0.03	0.38	6.51	0.03	0.18	0.21	45.78
12.00	0.09	1.06	6.51	0.13	0.82	0.24	77.70
12.00	0.15	1.75	6.52	0.23	1.48	0.27	84.38
12.01	0.20	2.44	6.52	0.33	2.14	0.30	87.69
12.00	0.26	3.15	6.52	0.43	2.79	0.36	88.66
12.00	0.32	3.81	6.52	0.52	3.41	0.39	89.73
12.00	0.38	4.51	6.52	0.62	4.06	0.45	89.95
12.00	0.43	5.21	6.52	0.72	4.71	0.50	90.46
12.00	0.49	5.92	6.52	0.82	5.36	0.55	90.64
12.00	0.55	6.63	6.52	0.92	6.02	0.60	90.91
12.00	0.61	7.36	6.52	1.03	6.70	0.66	90.98
12.00	0.67	8.05	6.52	1.12	7.33	0.73	90.98
12.00	0.73	8.79	6.52	1.23	7.99	0.79	90.97
12.00	0.79	9.50	6.51	1.33	8.63	0.87	90.89
12.00	0.13	1.57	0.67	1.43	0.95	0.62	60.48
12.00	0.08	0.96	0.25	1.50	0.37	0.59	38.71
24.01	0.02	0.55	6.52	0.00	0.00	0.55	0.00
24.01	0.03	0.72	6.52	0.03	0.17	0.55	23.53

24.01	0.06	1.39	6.52	0.13	0.83	0.56	59.44
24.01	0.09	2.04	6.52	0.23	1.47	0.57	72.17
24.01	0.11	2.71	6.52	0.33	2.12	0.59	78.32
24.01	0.14	3.39	6.52	0.43	2.77	0.62	81.81
24.01	0.17	4.06	6.52	0.52	3.40	0.66	83.67
24.01	0.20	4.78	6.52	0.62	4.05	0.73	84.82
24.01	0.23	5.50	6.52	0.72	4.71	0.79	85.68
24.01	0.26	6.22	6.52	0.82	5.36	0.86	86.22
24.01	0.29	6.92	6.52	0.93	6.04	0.87	87.35
24.01	0.32	7.64	6.52	1.02	6.67	0.96	87.39
24.01	0.35	8.31	6.52	1.12	7.29	1.02	87.77
24.01	0.38	9.03	6.52	1.22	7.96	1.07	88.13
24.01	0.41	9.75	6.51	1.32	8.60	1.15	88.20
24.01	0.08	1.90	0.75	1.42	1.07	0.83	56.15
24.01	0.05	1.08	0.25	1.50	0.37	0.71	34.48

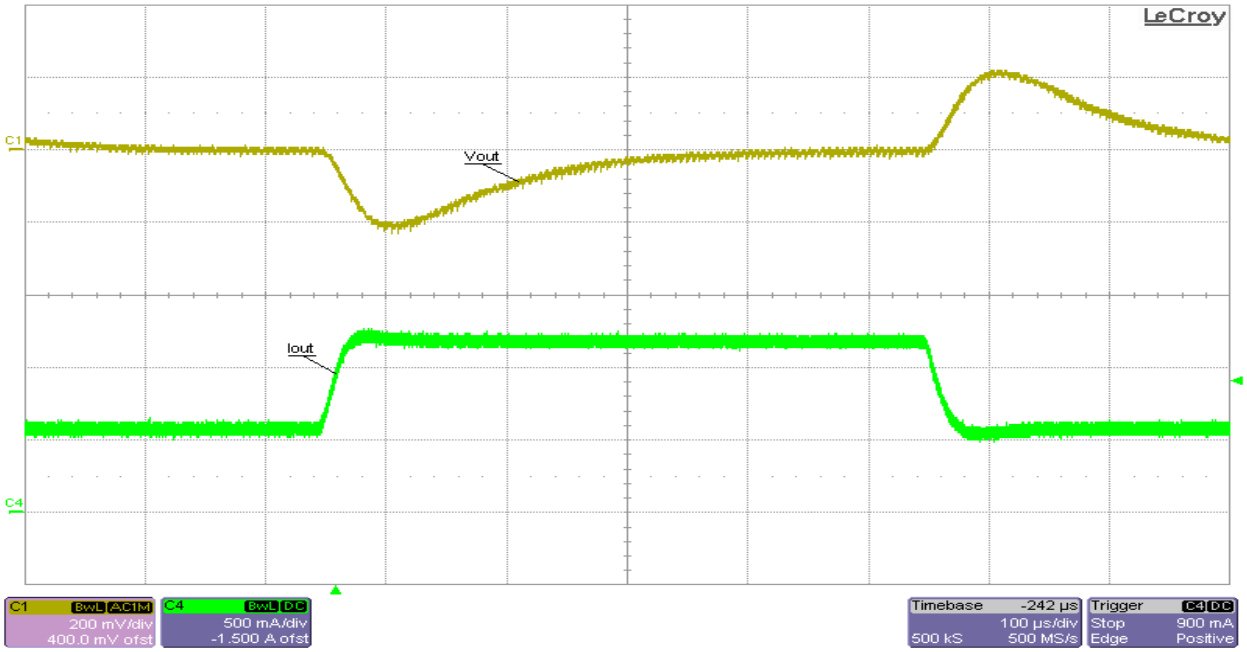
36.02	0.02	0.83	6.54	0.00	0.00	0.83	0.00
36.02	0.03	1.01	6.54	0.03	0.17	0.84	16.85
36.02	0.05	1.66	6.54	0.13	0.82	0.83	49.70
36.02	0.07	2.34	6.54	0.23	1.47	0.87	62.81
36.02	0.08	3.03	6.54	0.33	2.12	0.90	70.20
36.02	0.10	3.71	6.54	0.43	2.78	0.93	75.04
36.02	0.12	4.39	6.53	0.52	3.42	0.97	77.92
36.02	0.14	5.11	6.53	0.62	4.08	1.04	79.70
36.02	0.16	5.84	6.53	0.72	4.73	1.11	81.05
36.02	0.18	6.52	6.53	0.82	5.36	1.16	82.26
36.02	0.20	7.24	6.53	0.92	6.01	1.23	82.99
36.02	0.22	7.96	6.53	1.02	6.67	1.29	83.77
36.02	0.24	8.68	6.53	1.12	7.30	1.38	84.10
36.02	0.26	9.40	6.53	1.22	7.97	1.43	84.74
36.02	0.28	10.12	6.52	1.32	8.61	1.51	85.10
36.02	0.05	1.95	0.72	1.43	1.03	0.92	52.75
36.02	0.03	1.22	0.25	1.51	0.38	0.85	30.89

6 Waveforms

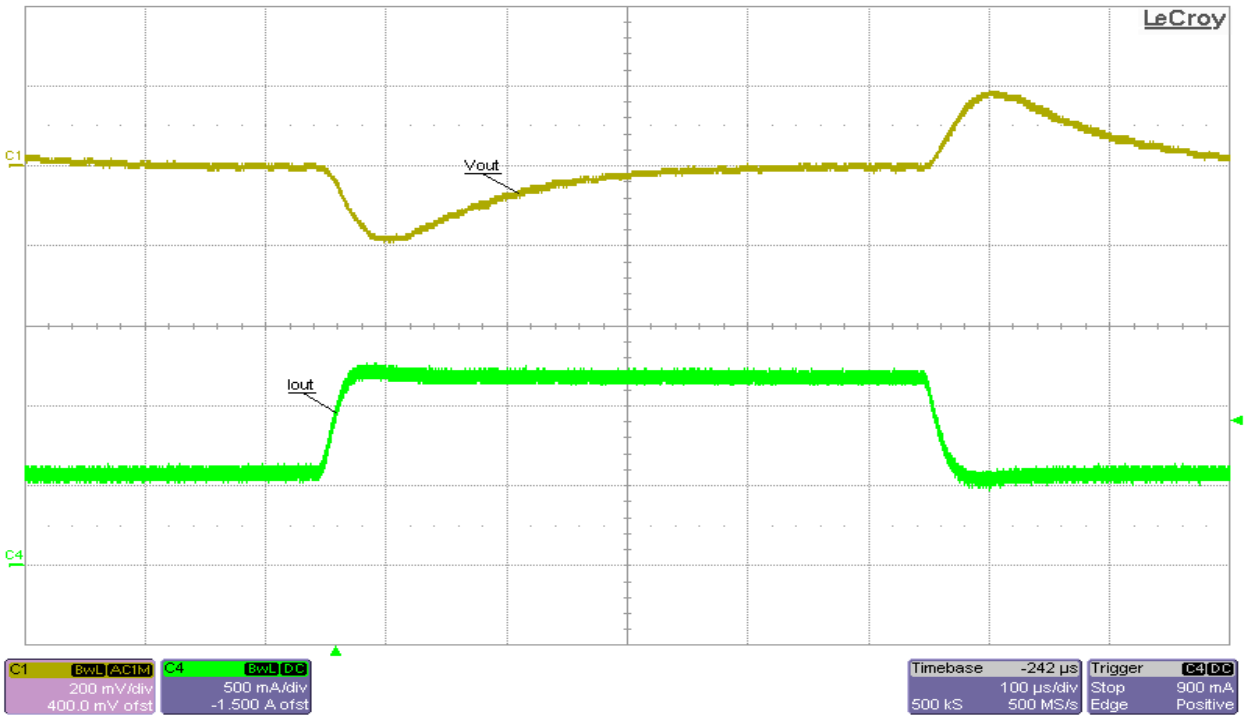
6.1 Load Transient Response



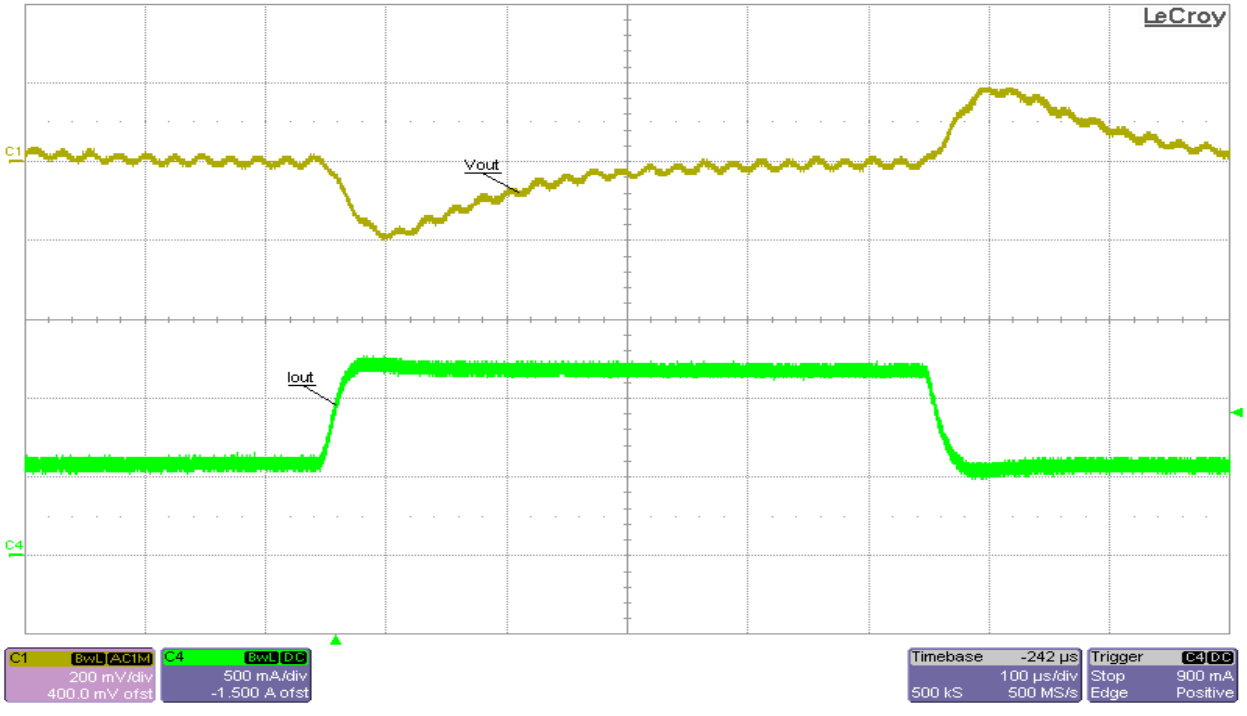
Load Transient Response at 3.5Vin and 50%-to-100% (600mA-to-1.2A) Load Step, Ch1 – Vout (AC coupled), Ch4- Iout.



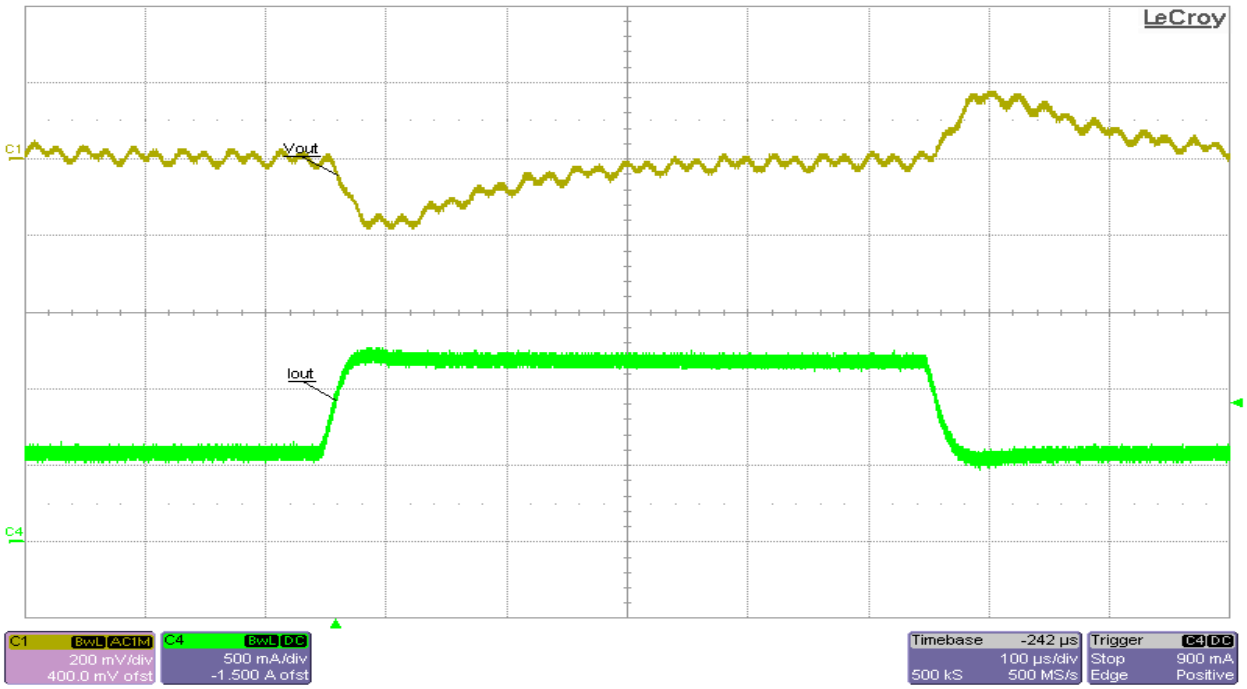
Load Transient Response at 6.5Vin and 50%-to-100% (600mA-to-1.2A) Load Step, Ch1 – Vout (AC coupled), Ch4- Iout.



Load Transient Response at 12Vin and 50%-to-100% (600mA-to-1.2A) Load Step, Ch1 – Vout (AC coupled), Ch4- Iout.

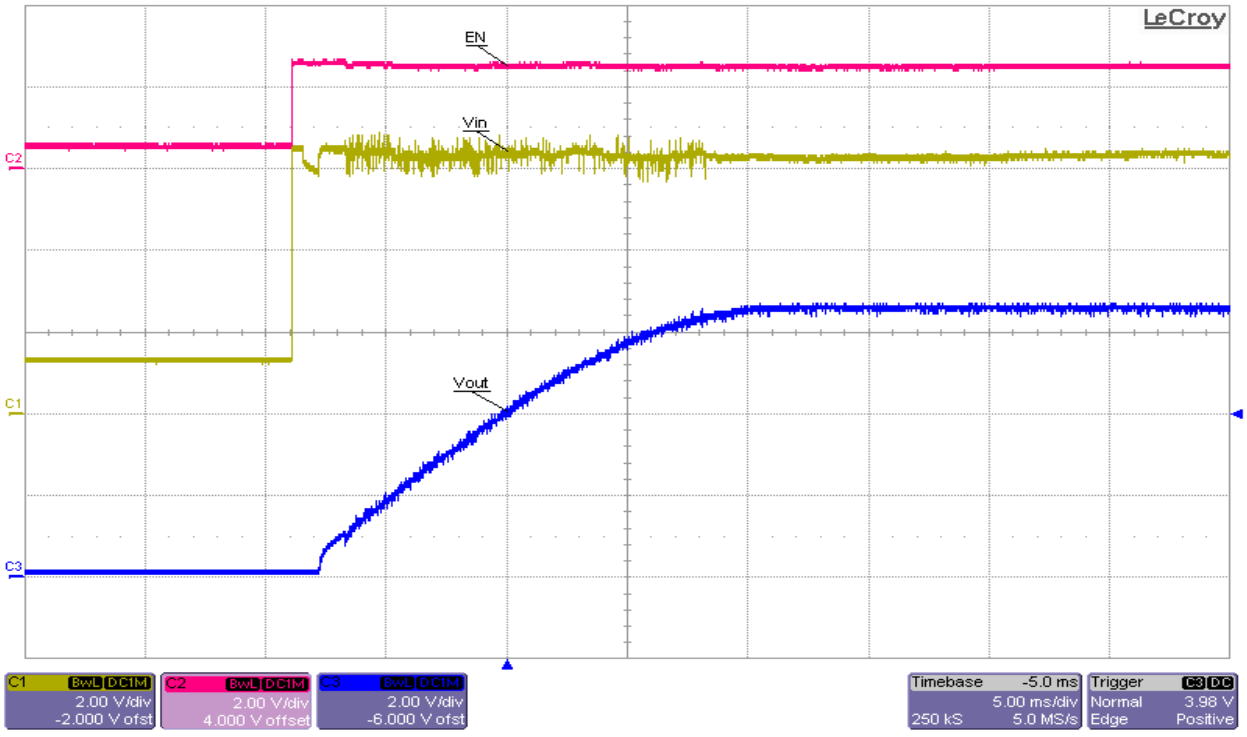


Load Transient Response at 24Vin and 50%-to-100% (600mA-to-1.2A) Load Step, Ch1 – Vout (AC coupled), Ch4- Iout.

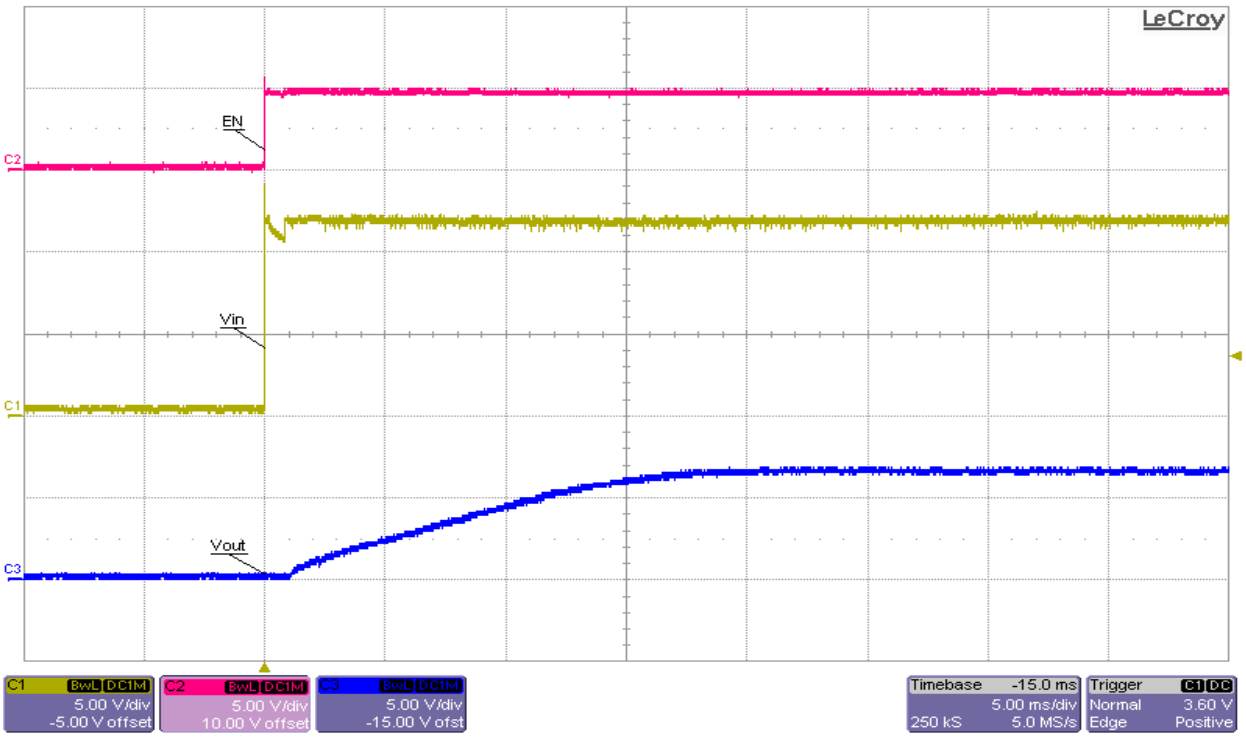


Load Transient Response at 36Vin and 50%-to-100% (600mA-to-1.2A) Load Step, Ch1 – Vout (AC coupled), Ch4- Iout.

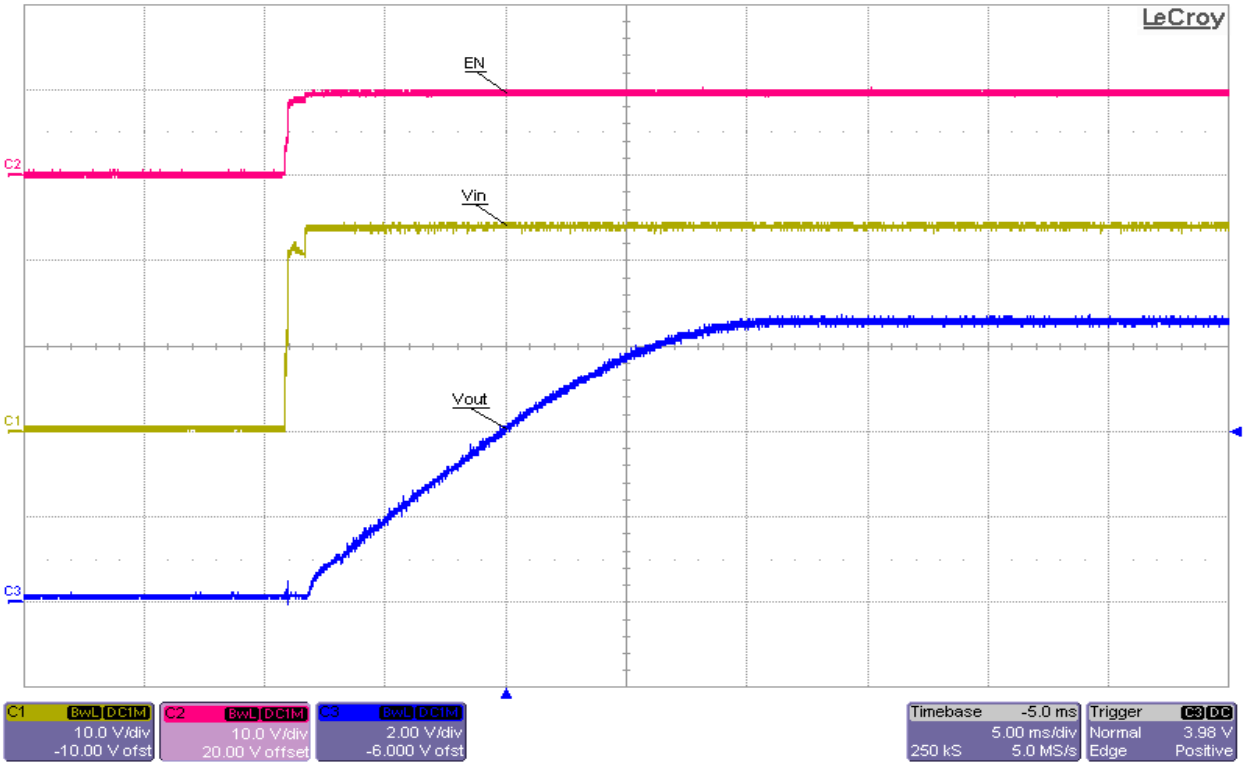
6.2 Startup



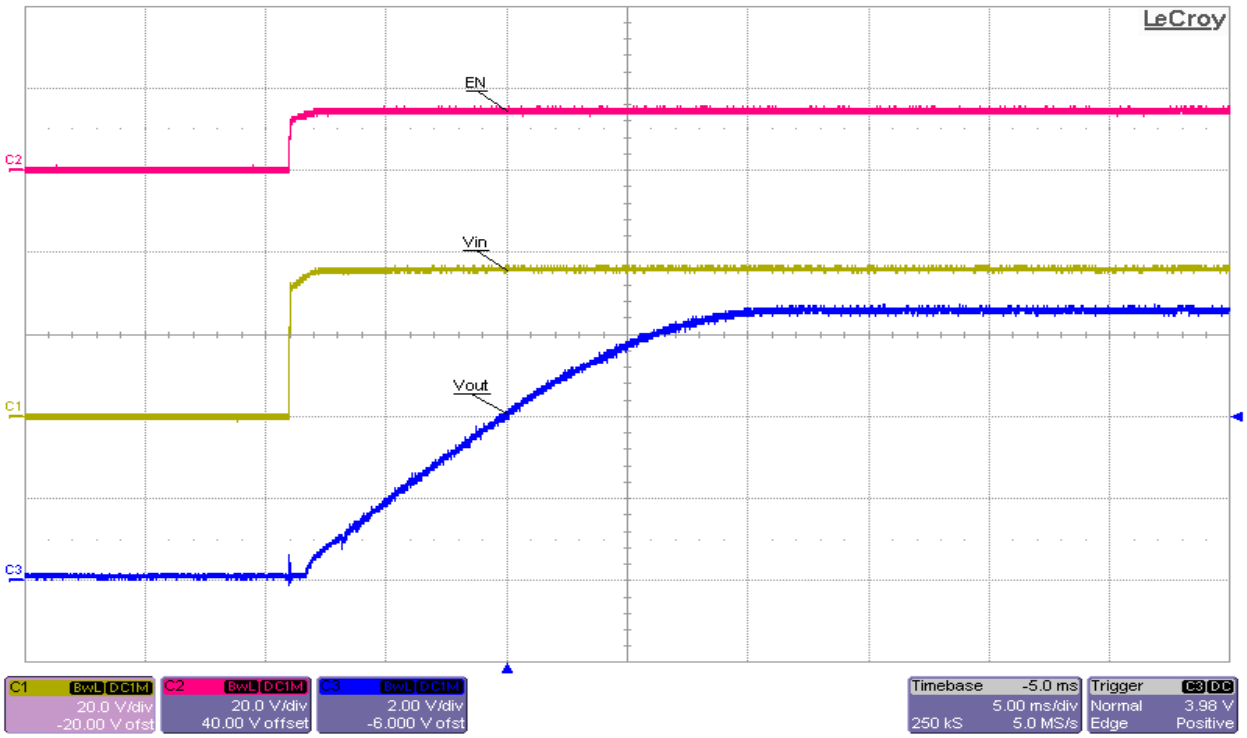
Startup into Full Load at 6.5Vin, Ch1-Vin, Ch2-EN, Ch3-Vout



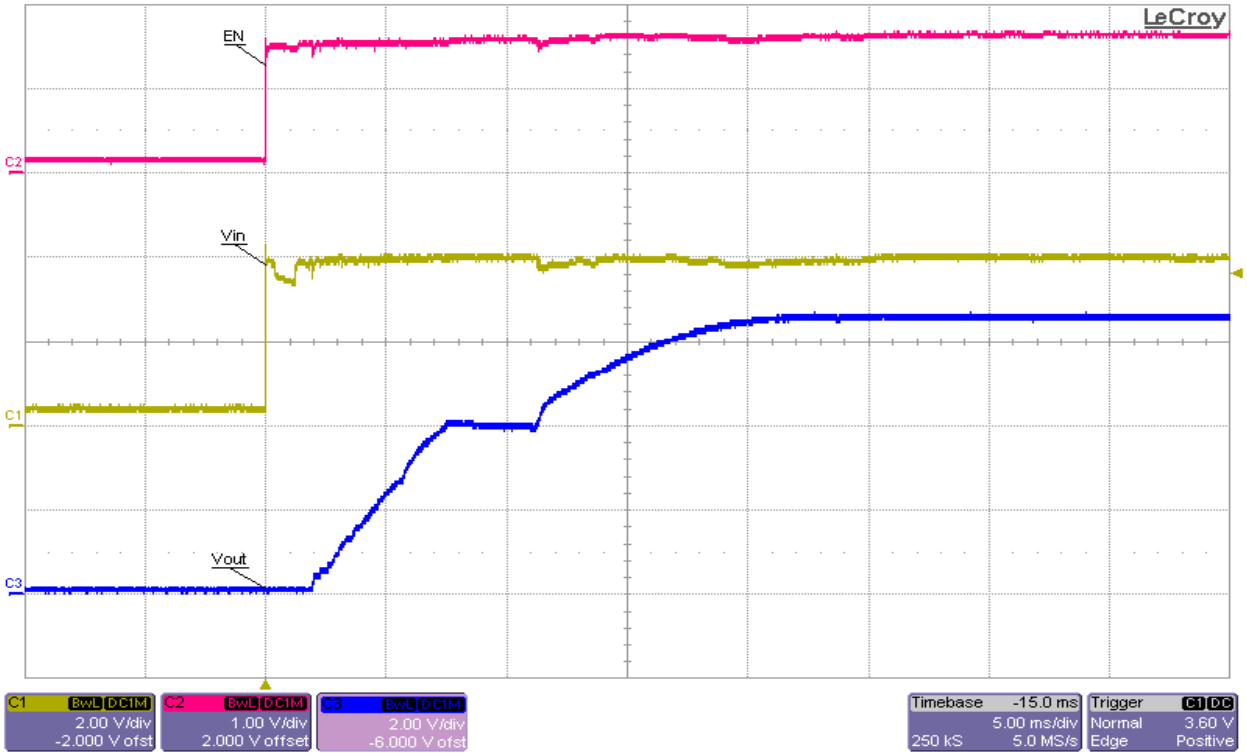
Startup into Full Load at 12Vin, Ch1-Vin, Ch2-EN, Ch3-Vout



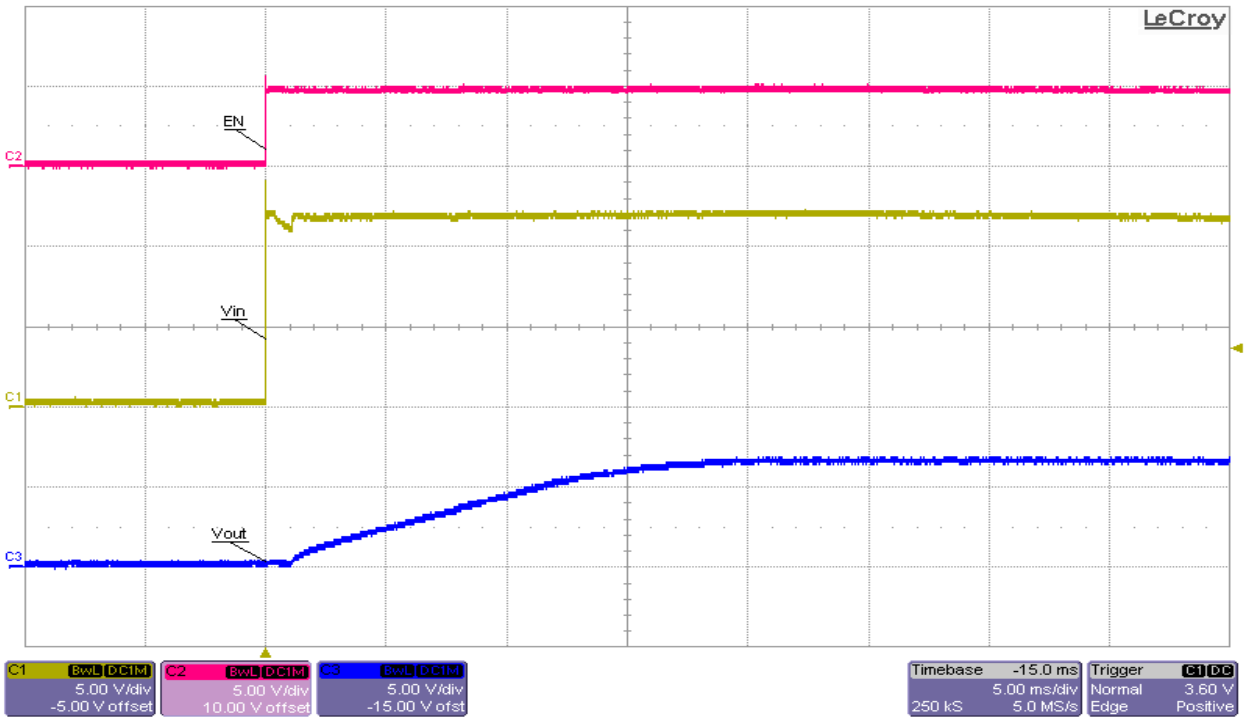
Startup into Full Load at 24Vin, Ch1-Vin, Ch2-EN, Ch3-Vout



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

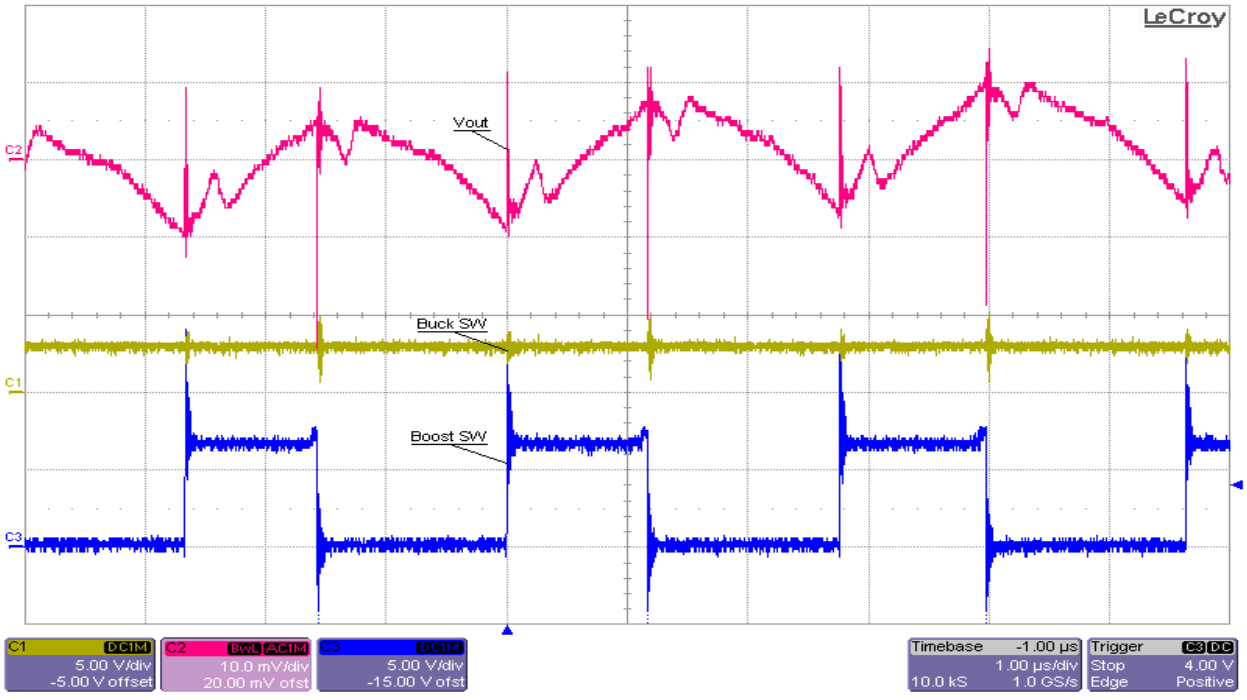


Startup into no Load at 4Vin, Ch1-Vin, Ch2-EN, Ch3-Vout

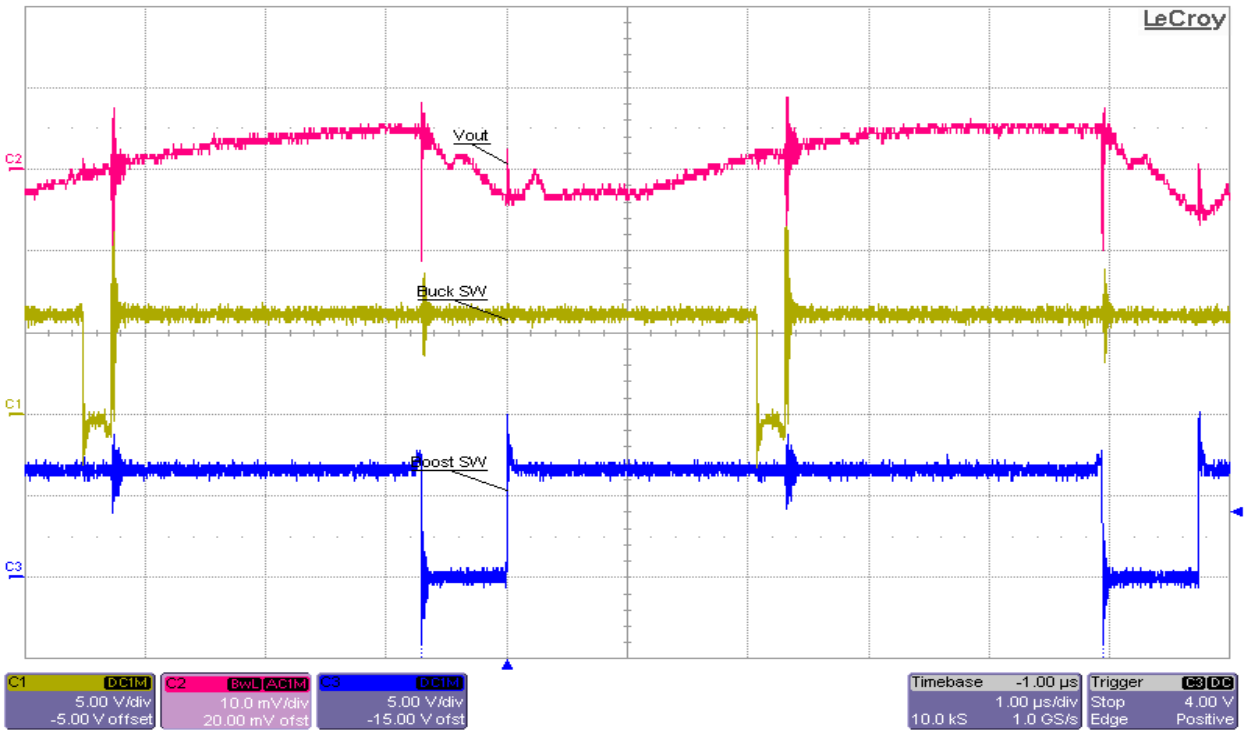


Startup into no Load at 12Vin, Ch1-Vin, Ch2-EN, Ch3-Vout

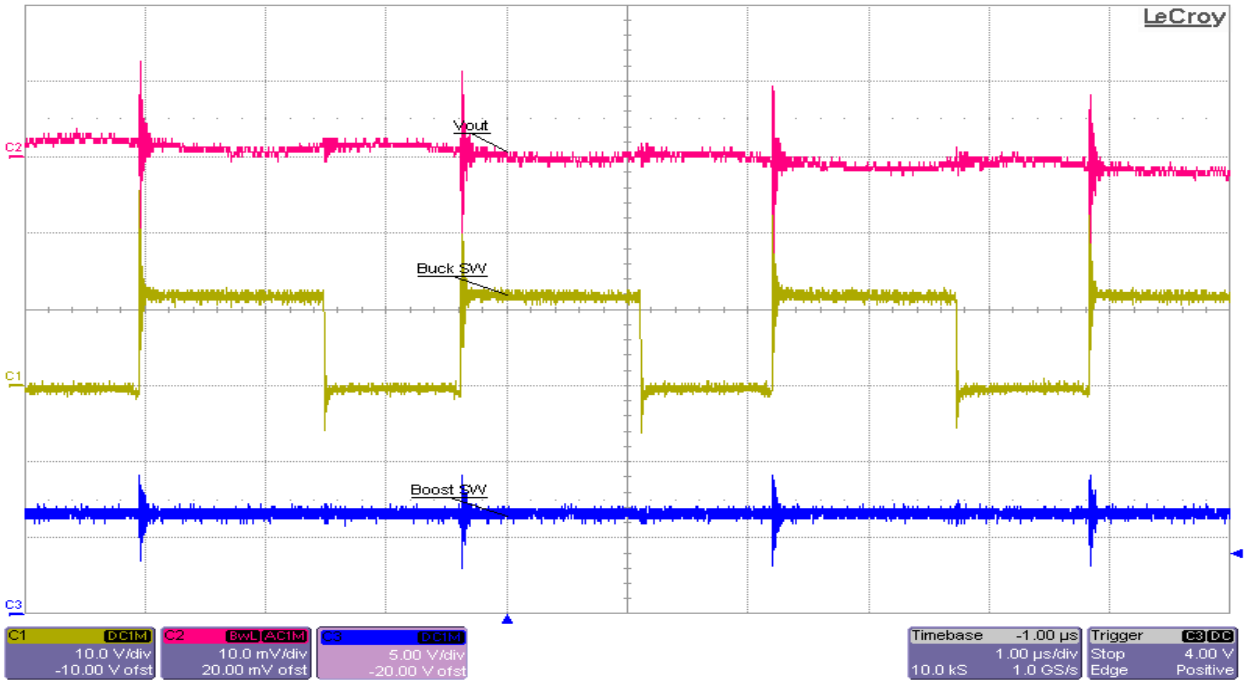
6.3 Switch Node Voltage and Output Ripple



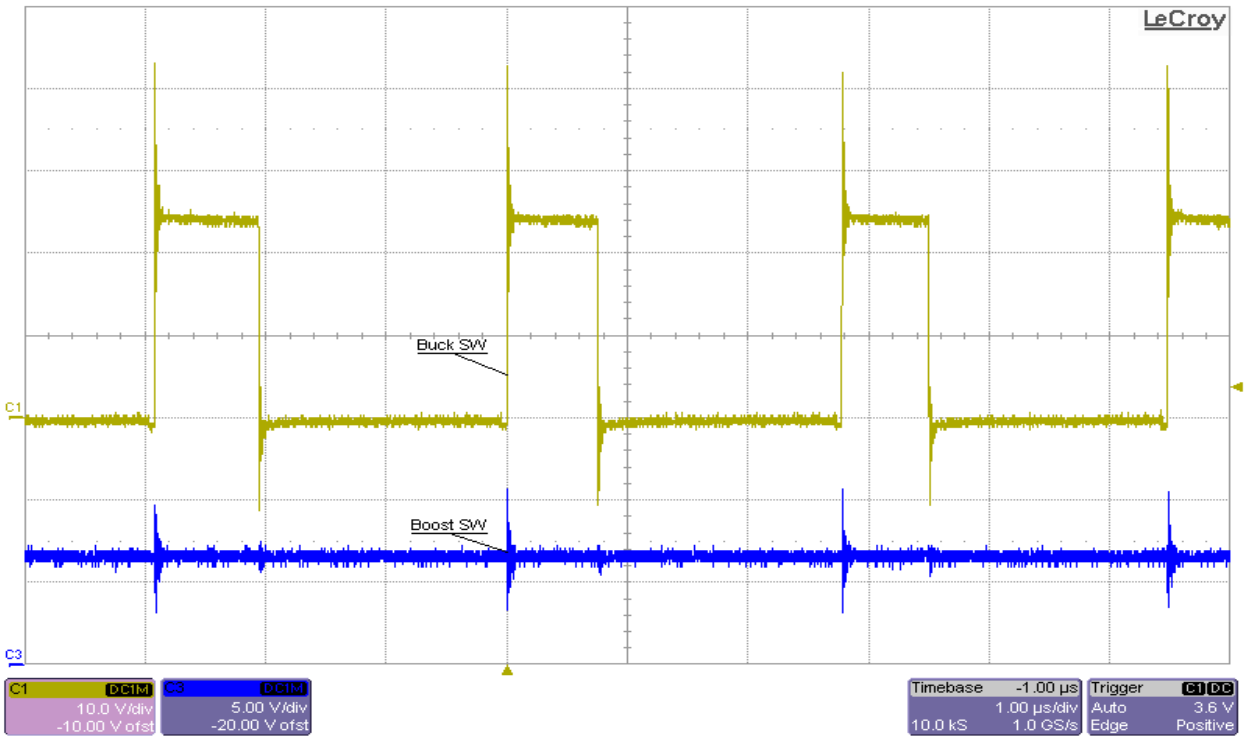
Switch Node Voltage at 3.5Vin and Full (1.2A) Load. Ch2-Vout (AC Coupled), Ch1-Buck SW, Ch3-Boost SW.



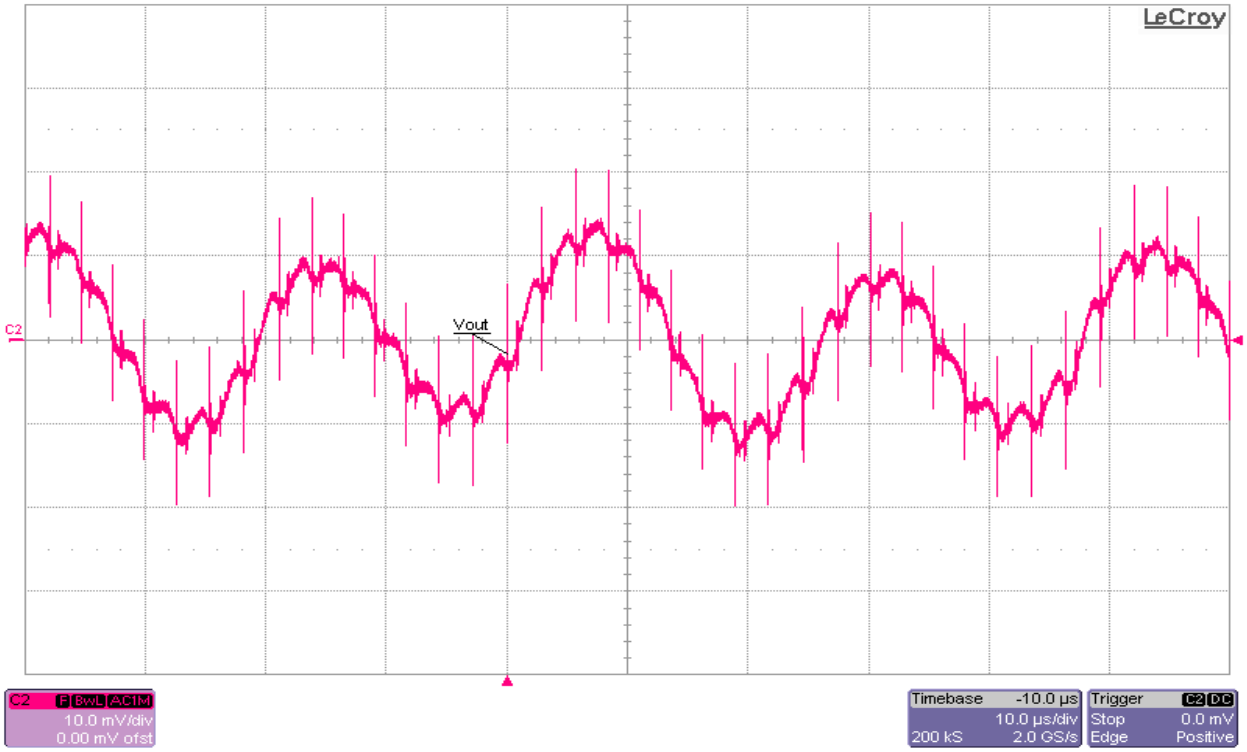
Switch Node Voltage at 6.5Vin and Full (1.2A) Load. Ch2-Vout (AC Coupled), Ch1-Buck SW, Ch3-Boost SW.



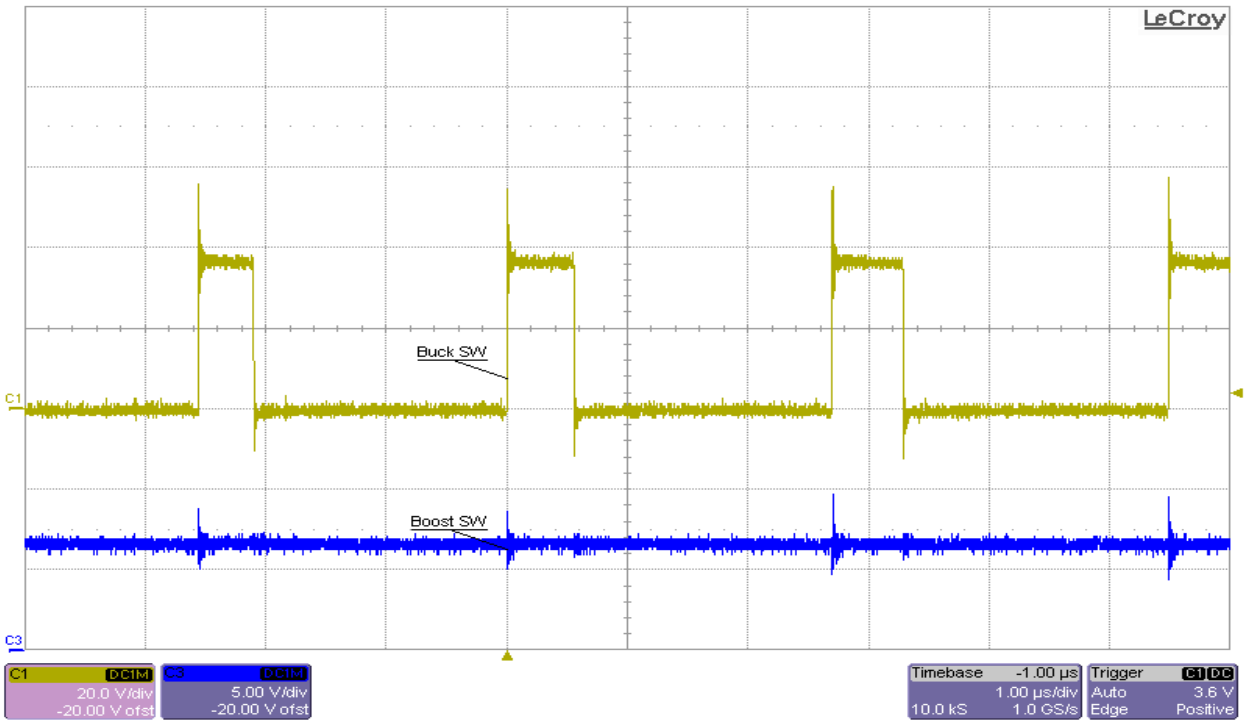
Switch Node Voltage at 12Vin and Full (1.2A) Load. Ch2-Vout (AC Coupled), Ch1-Buck SW, Ch3-Boost SW.



Switch Node Voltage at 24Vin and Full (1.2A) Load. Ch1-Buck SW, Ch3-Boost SW.

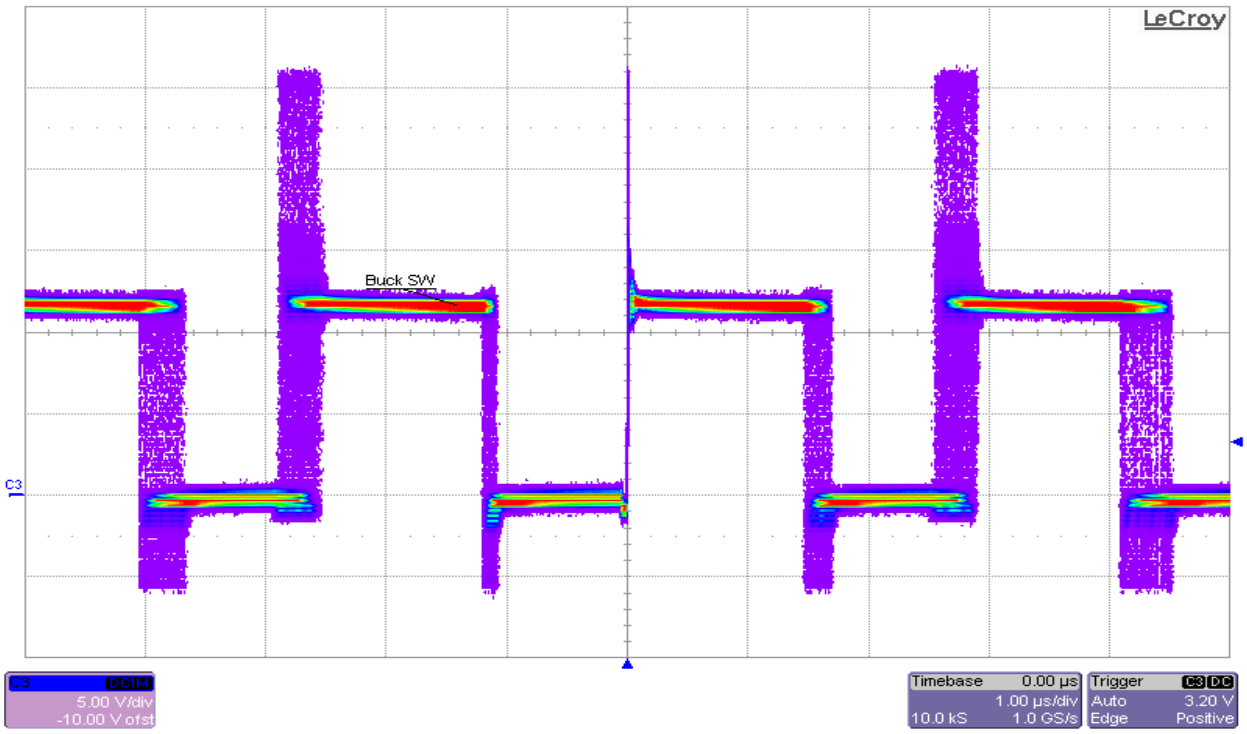


Output Ripple Voltage at 24Vin and Full Load (1.2A). Ch2-Vout (AC Coupled).

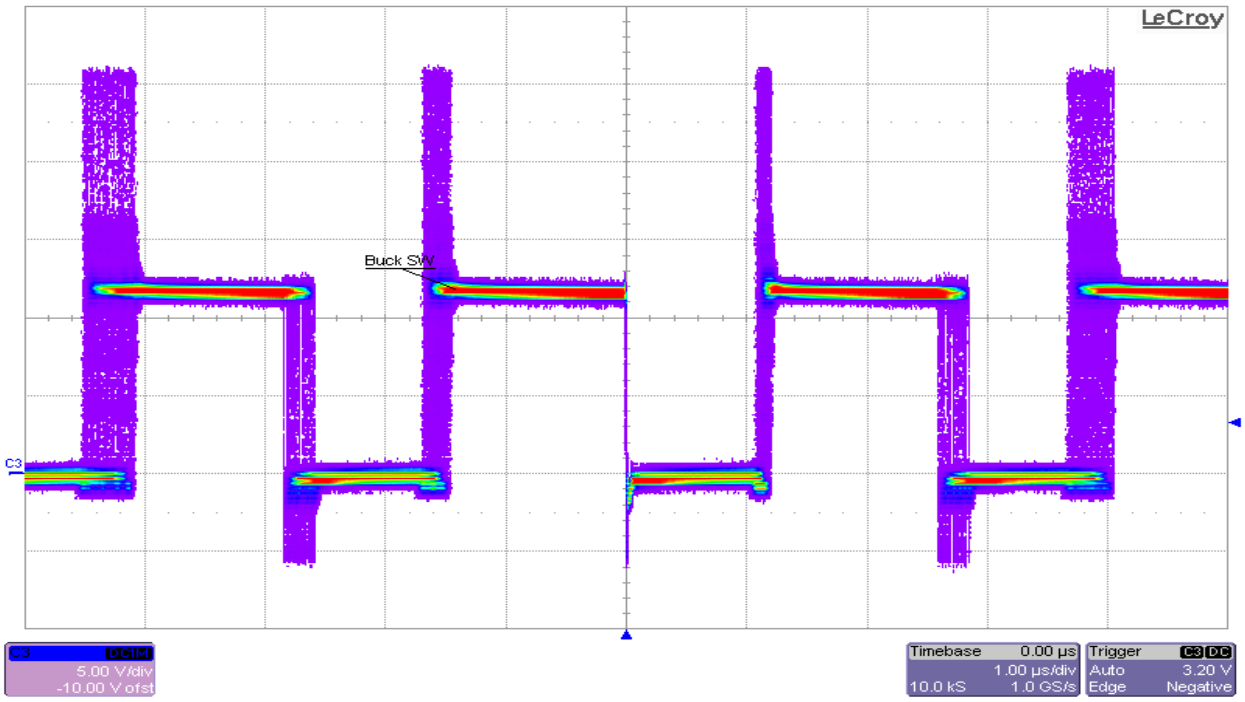


Switch Node Voltage at 36Vin and Full (1.2A) Load. Ch1-Buck SW, Ch3-Boost SW.

6.4 Frequency Dither

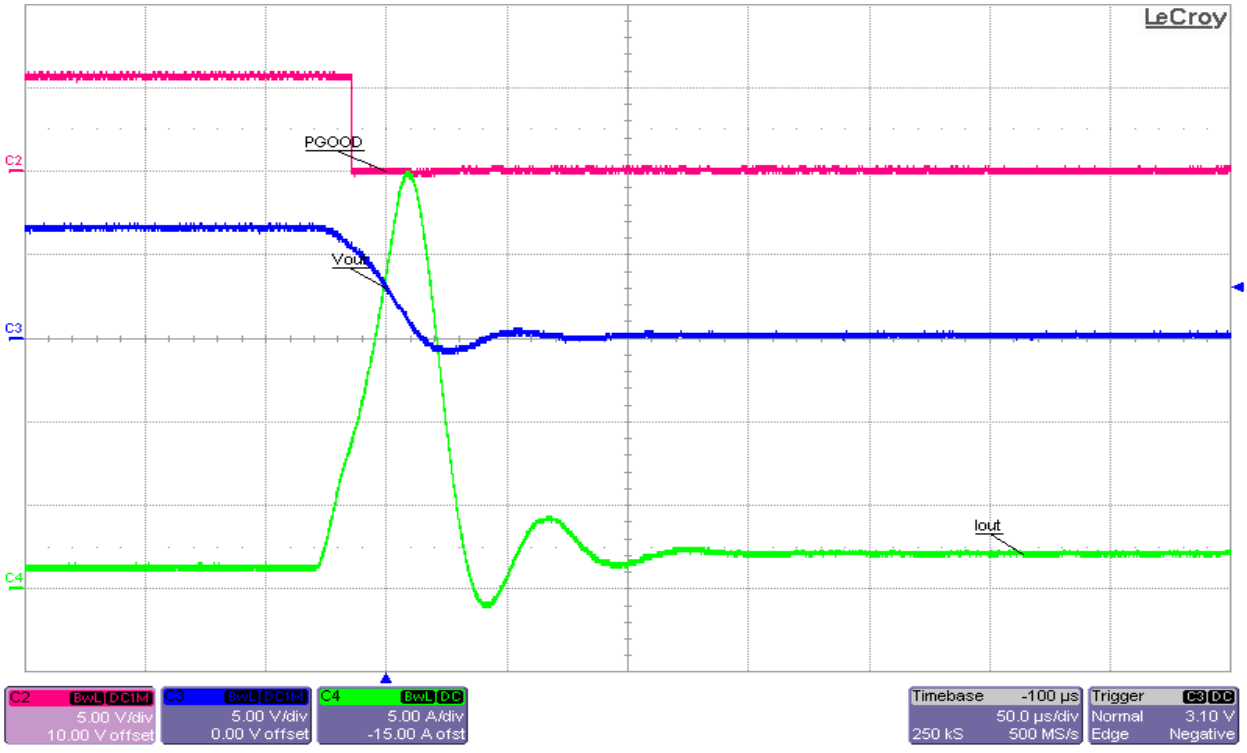


Frequency Dither at 12Vin and Full (1.2A) Load. Ch3-Buck SW (Persistent), Positive Edge Trigger.

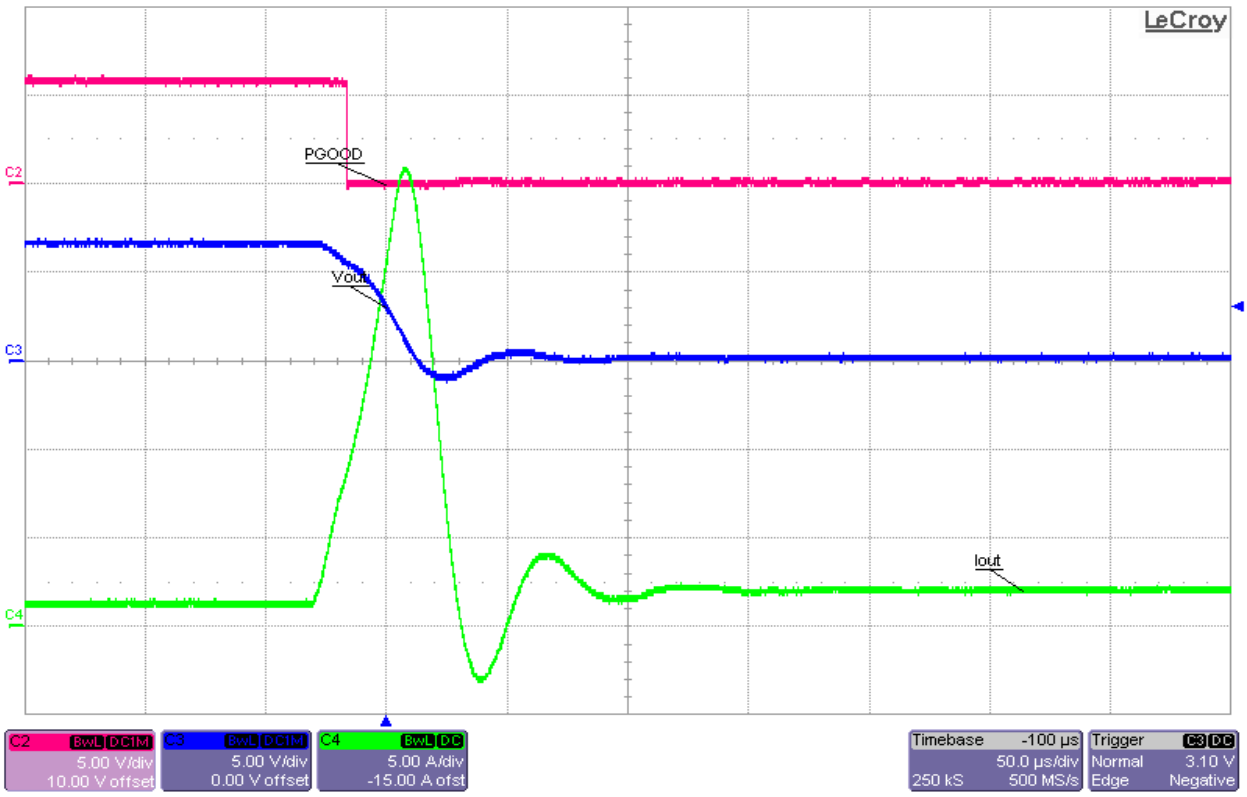


Frequency Dither at 12Vin and Full (1.2A) Load. Ch3-Buck SW (Persistent), Negative Edge Trigger.

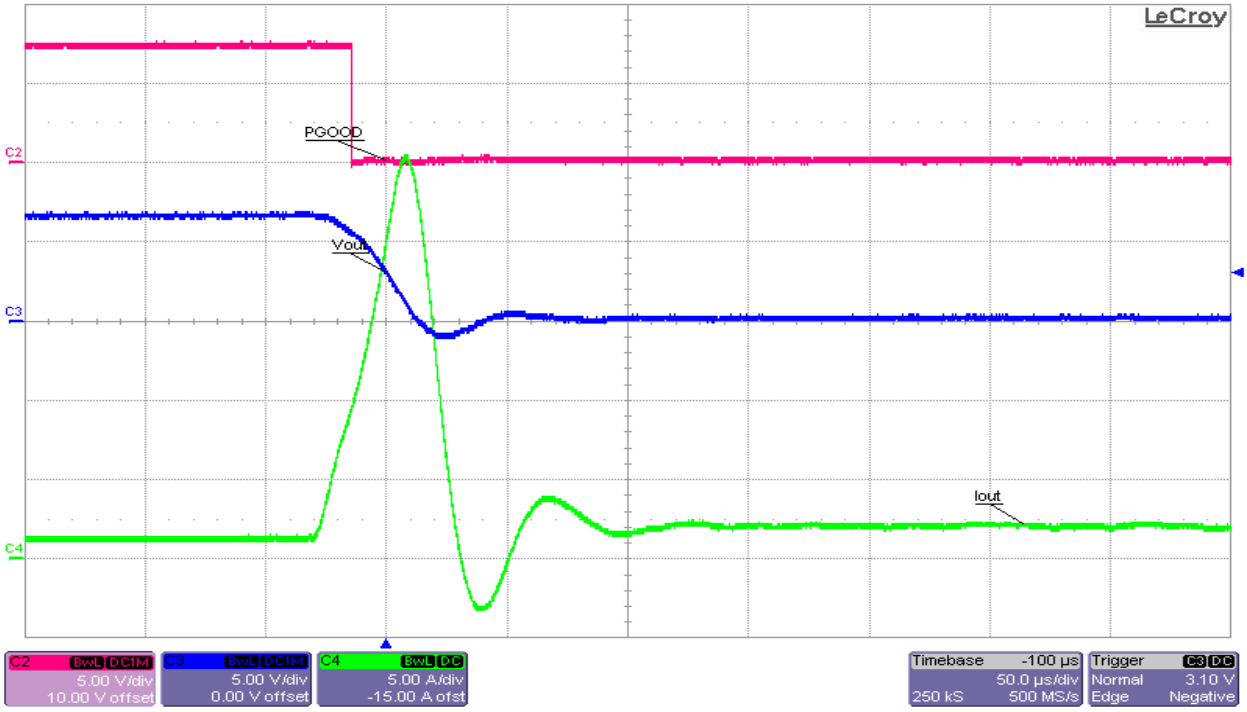
6.5 Short Circuit



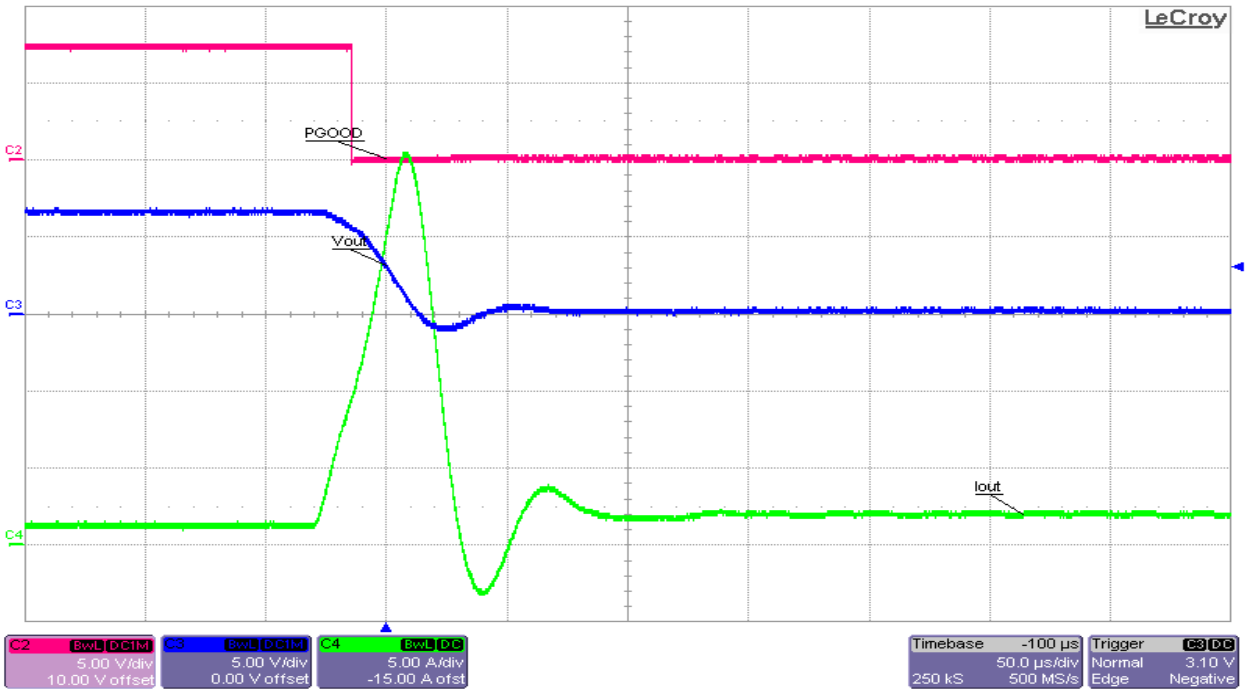
Short Circuit at 3.5Vin and Full (1.2A) Load. Ch2- PGOOD, Ch3- Vout, Ch4-Iout.



Short Circuit at 6.5Vin and Full (1.2A) Load. Ch2- PGOOD, Ch3- Vout, Ch4-Iout.

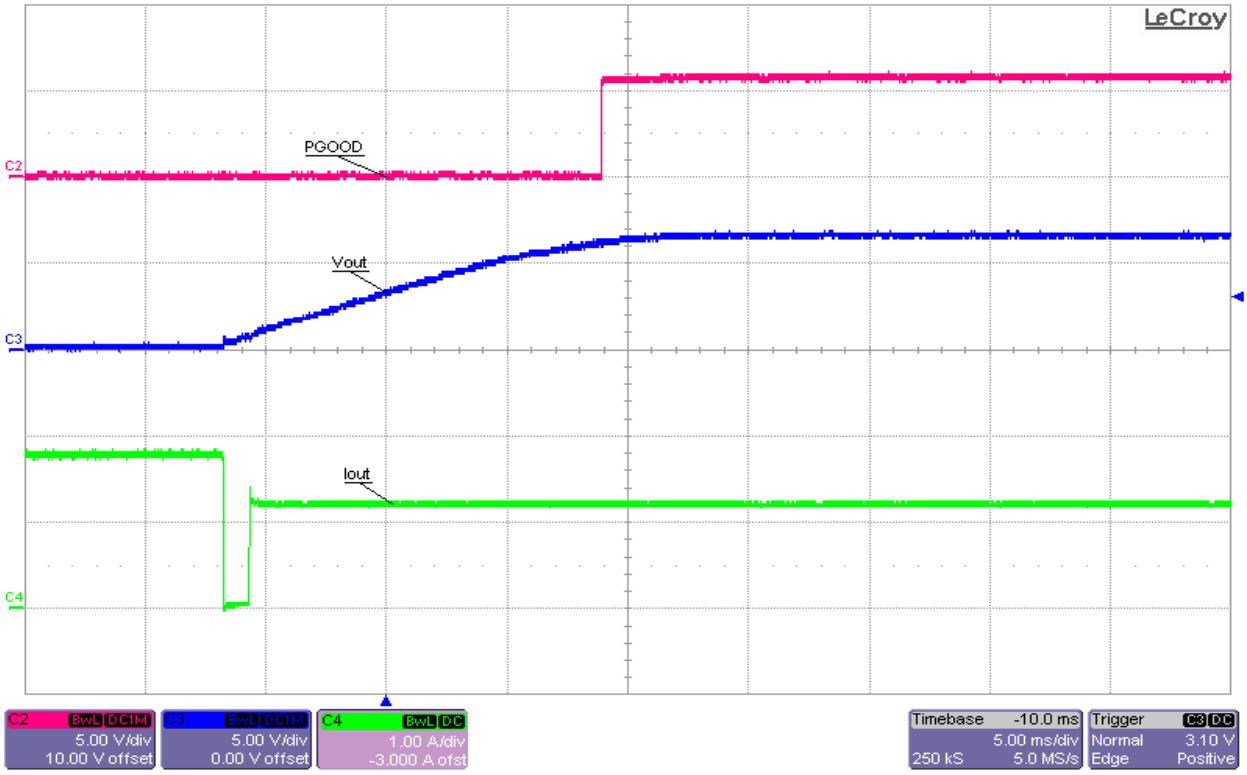


Short Circuit at 12Vin and Full (1.2A) Load. Ch2- PGOOD, Ch3- Vout, Ch4-Iout.

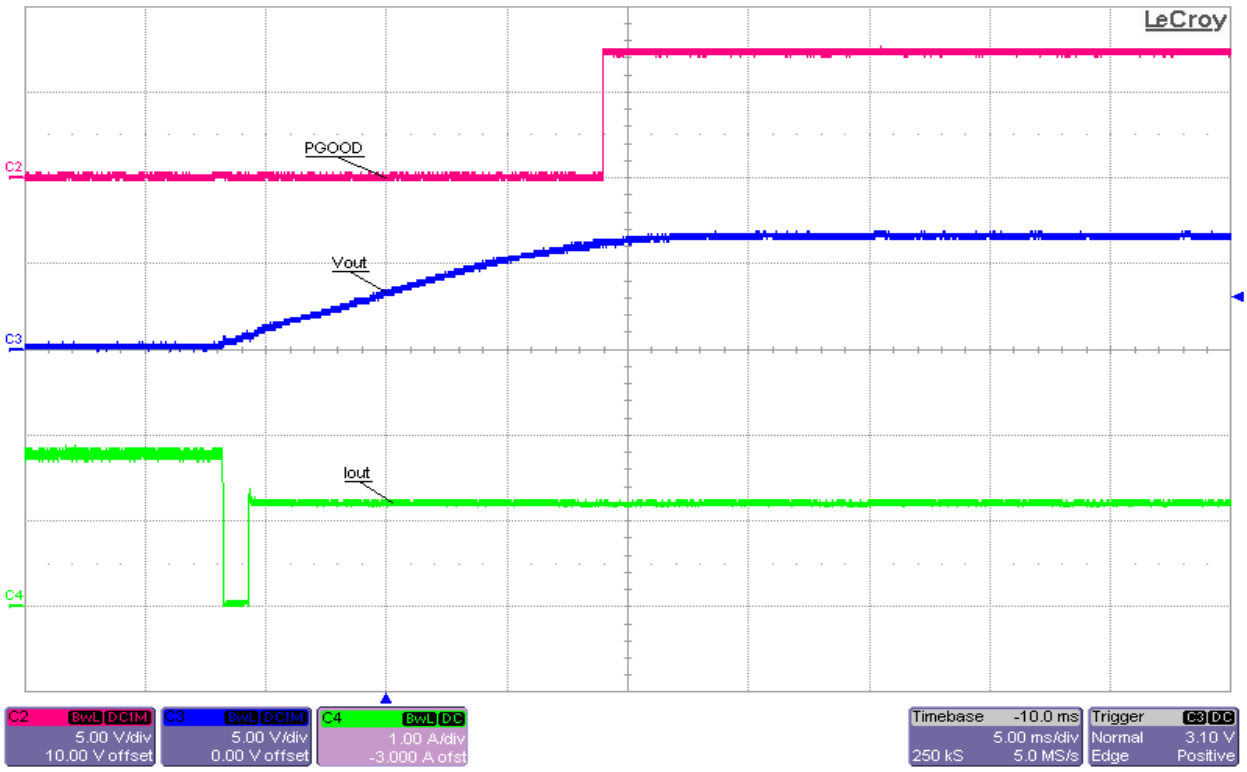


Short Circuit at 24Vin and Full (1.2A) Load. Ch2- PGOOD, Ch3- Vout, Ch4-Iout.

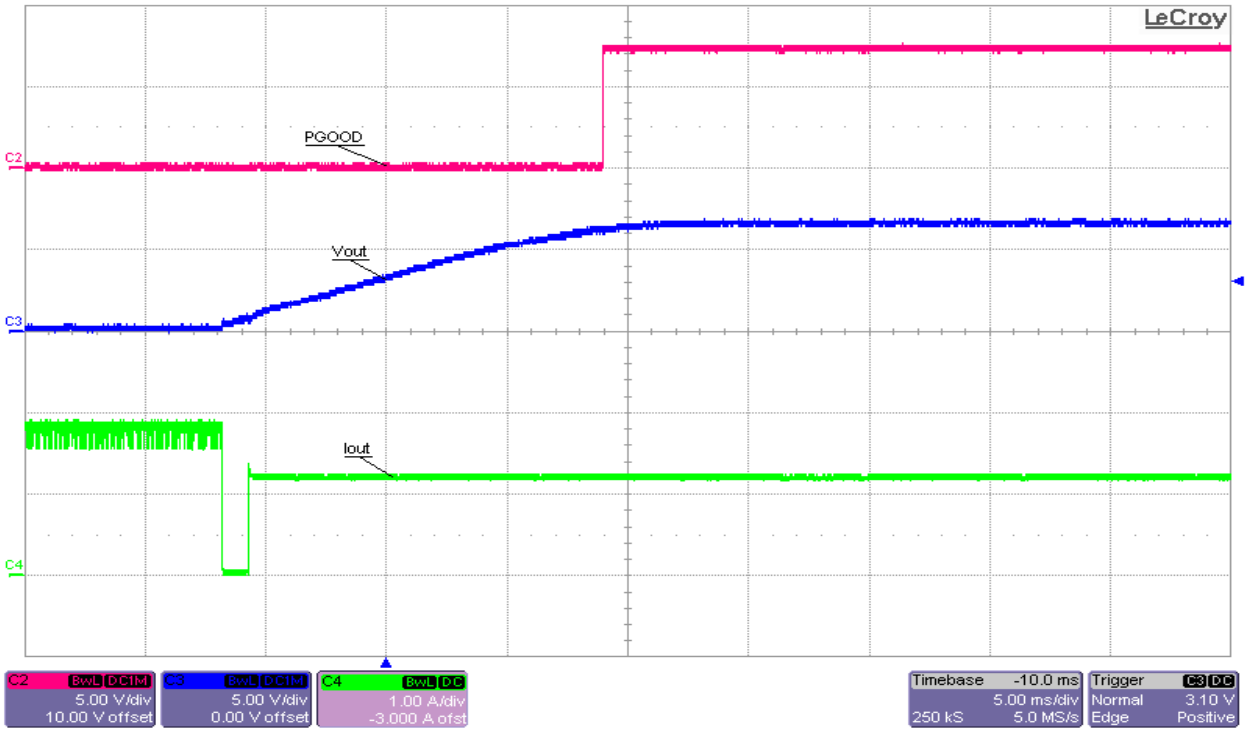
6.6 Short Circuit Recovery



Short Circuit Recovery at 6.5Vin and Full (1.2A) Load. Ch2- PGOOD, Ch3- Vout, Ch4-Iout.

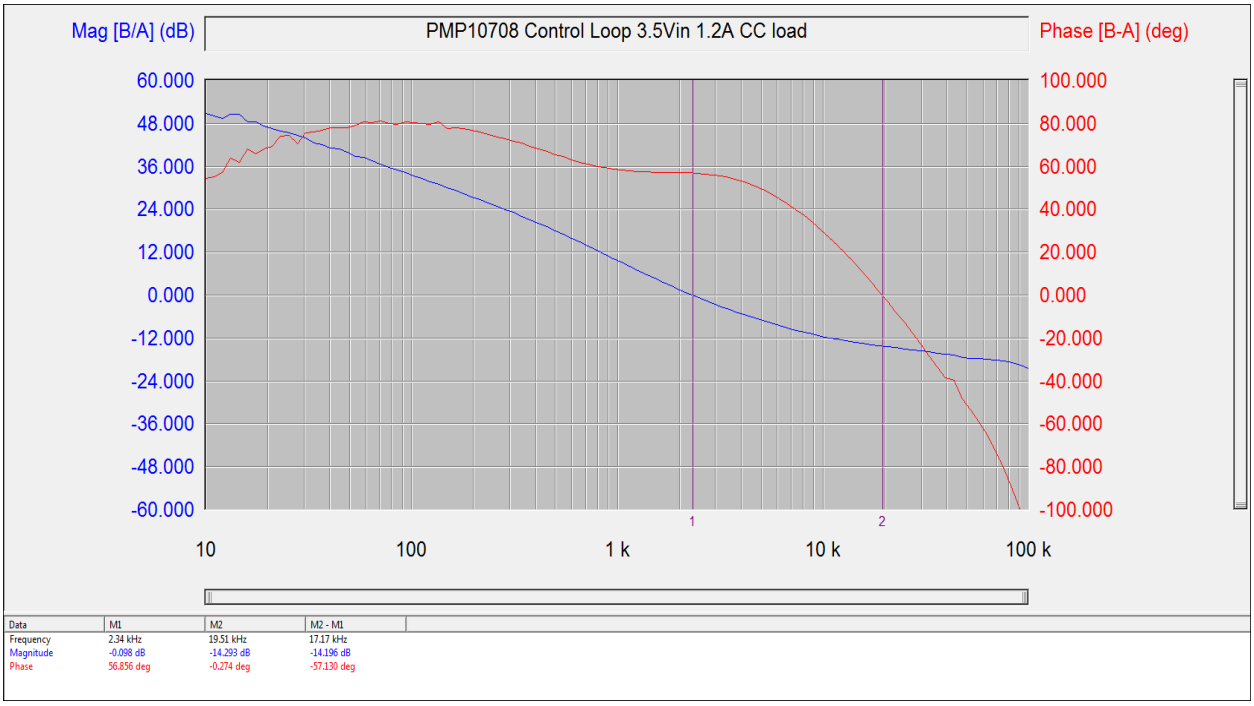


Short Circuit at 12Vin and Full (1.2A) Load. Ch2- PGOOD, Ch3- Vout, Ch4-Iout.

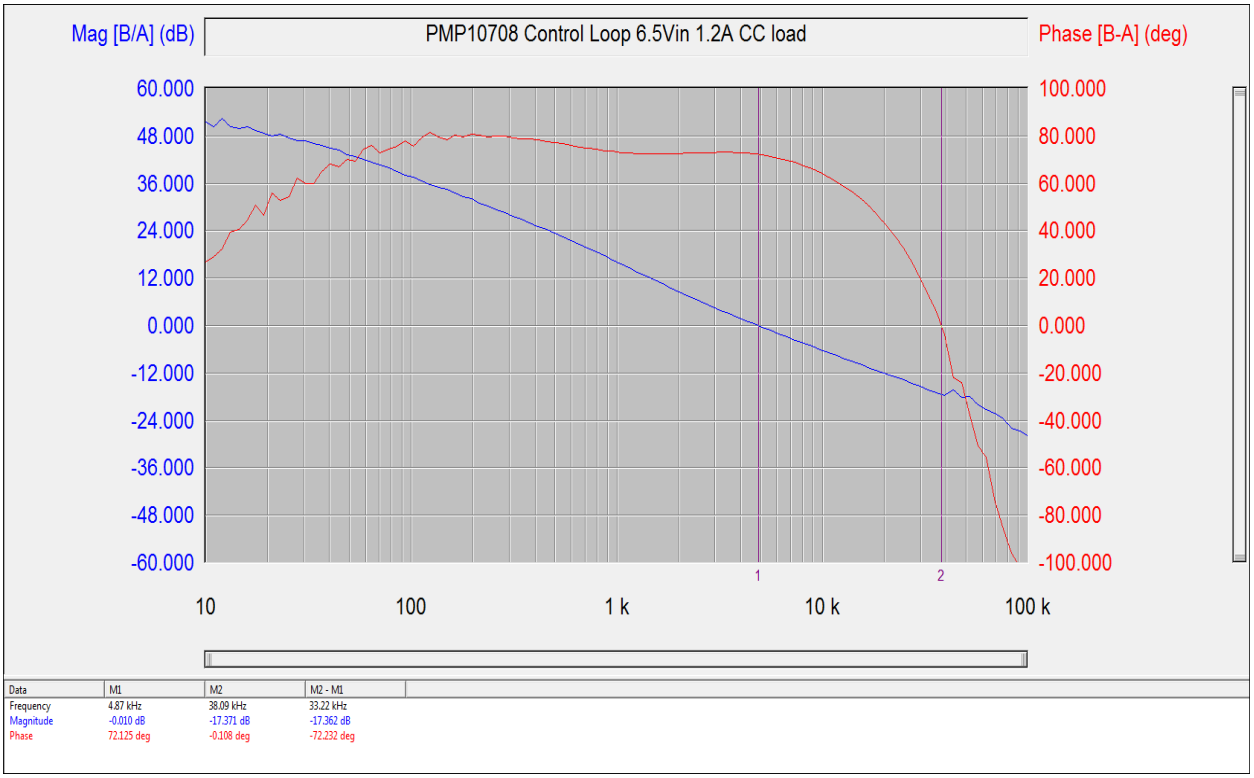


Short Circuit at 24Vin and Full (1.2A) Load. Ch2- PGOOD, Ch3- Vout, Ch4-Iout.

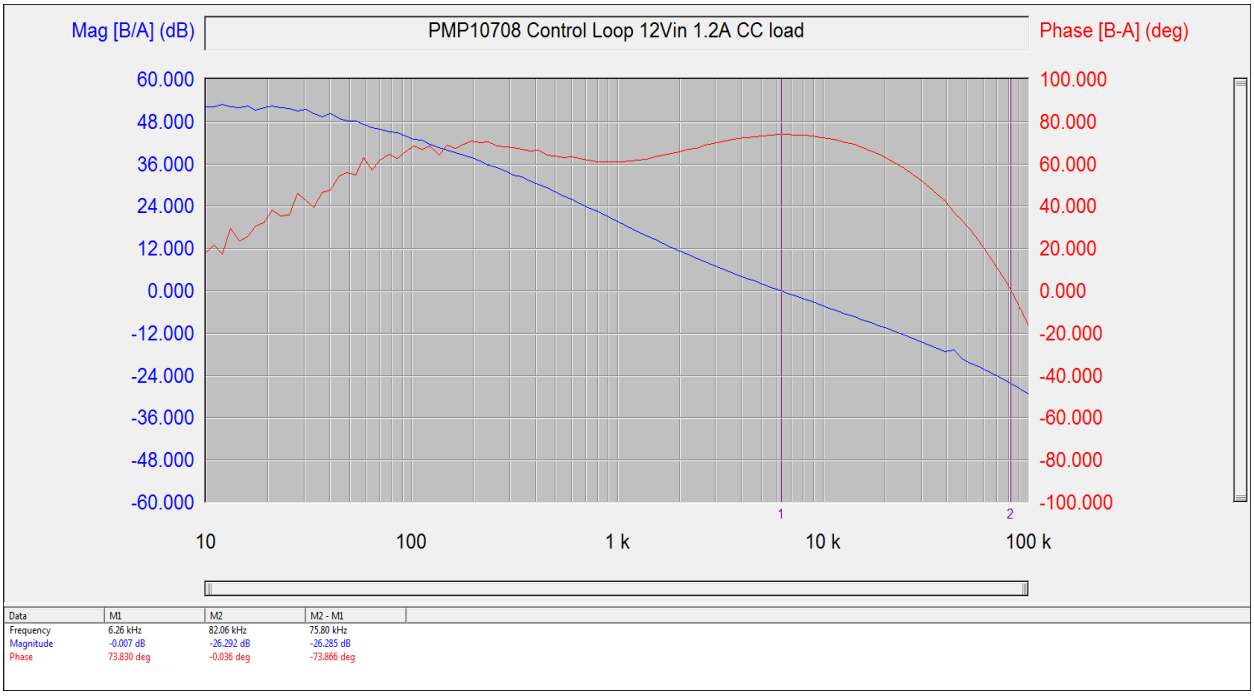
6.7 Frequency Analysis



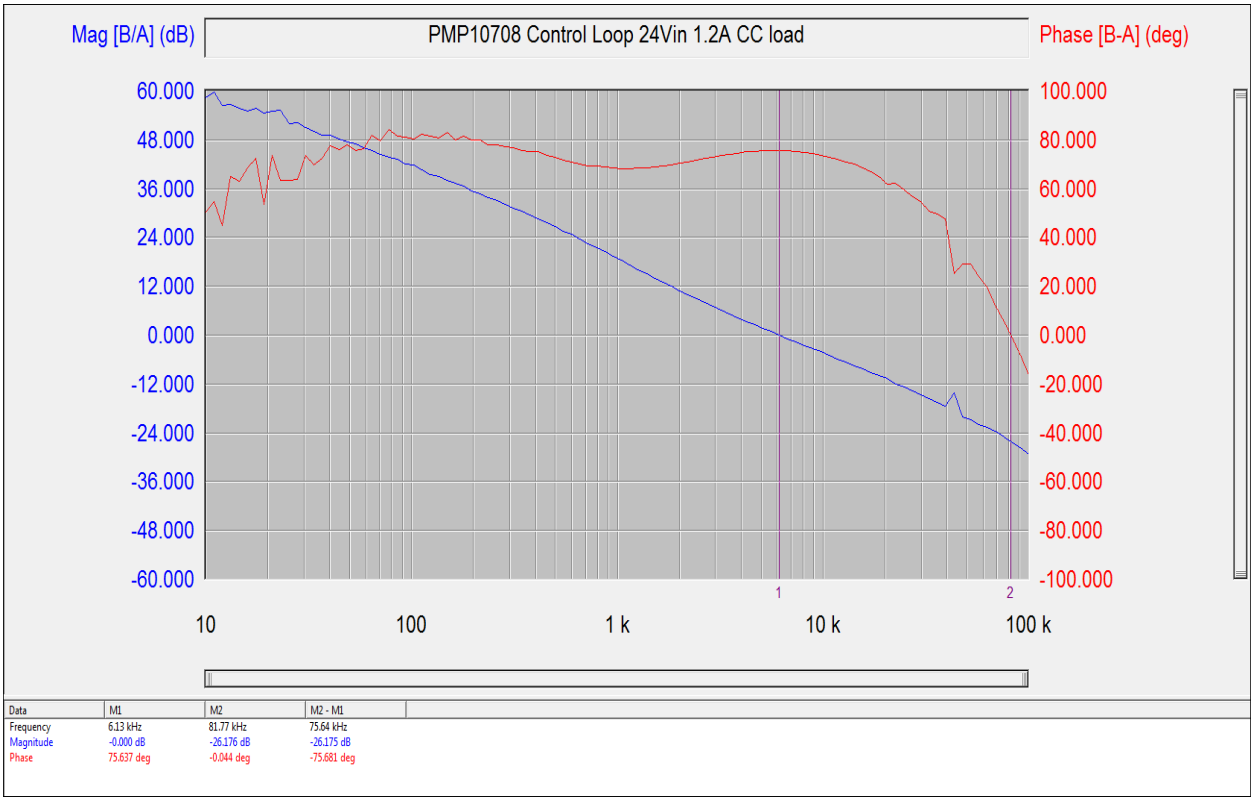
Control Loop Analysis at 3.5Vin, Phase Margin of 57 deg, Gain Margin of 14dB.



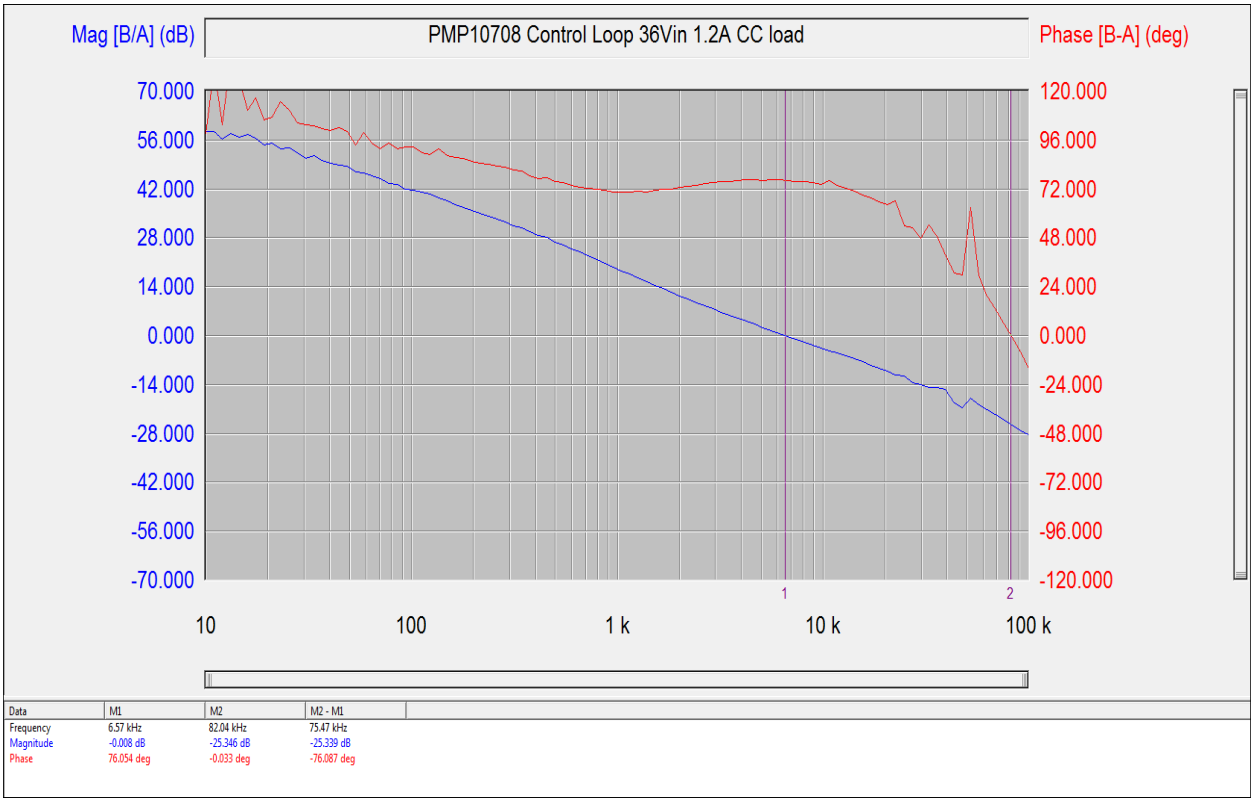
Control Loop Analysis at 6.5Vin, Phase Margin of 72 deg, Gain Margin of 17dB.



Control Loop Analysis at 12Vin, Phase Margin of 74 deg, Gain Margin of 26dB.



Control Loop Analysis at 24Vin, Phase Margin of 75 deg, Gain Margin of 26dB.



Control Loop Analysis at 36Vin, Phase Margin of 76 deg, Gain Margin of 25dB.

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