TI reference design number: PMP10507 Rev B

Input: 35V

Output: 17-54V @ 7A (170W Max)

DC–DC Converter Test Results

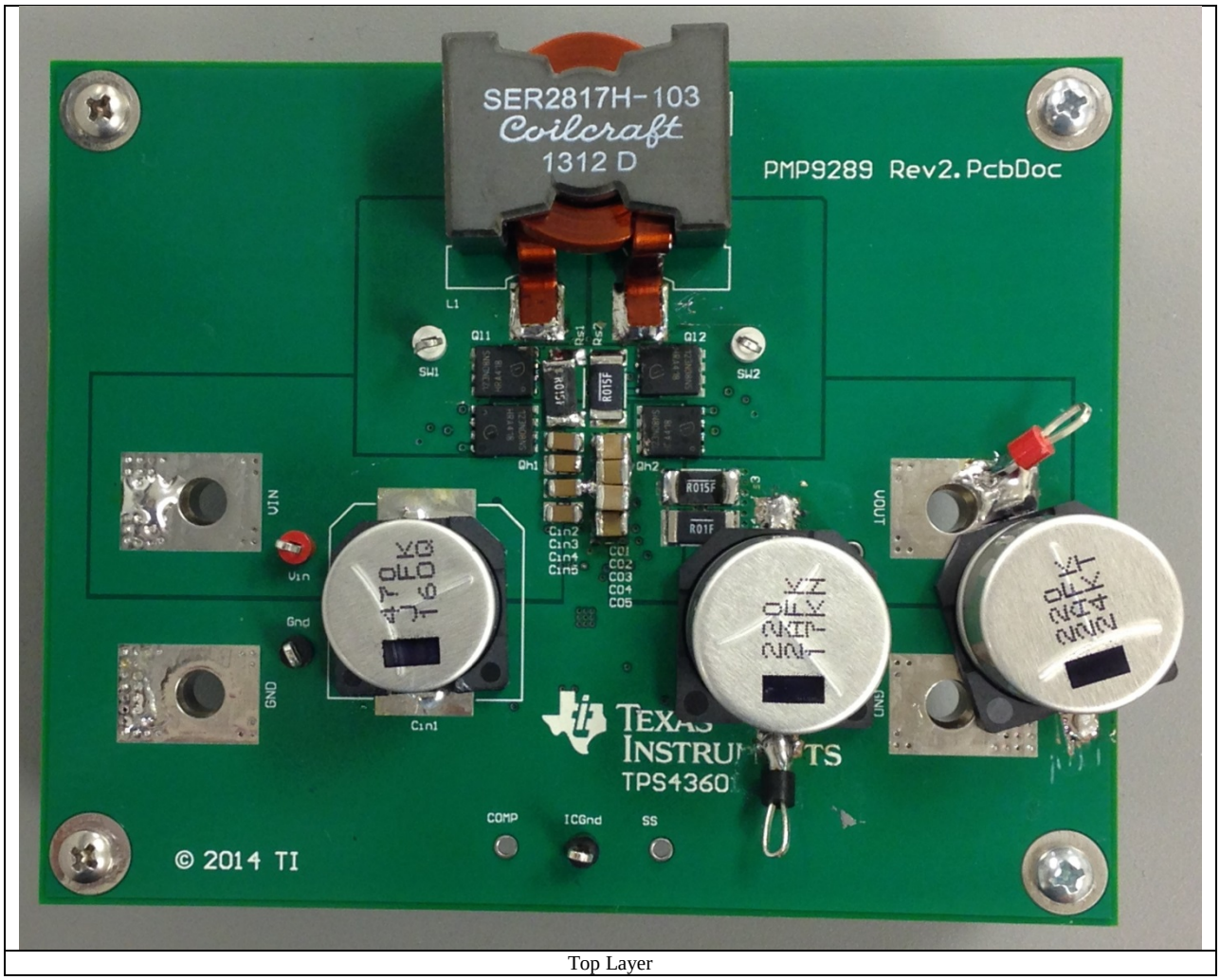
Table of Contents

1. Circuit Description

PMP10507 is configured for 35Vin and was tested at a range of 17 to 54Vout. This design utilizes the LM5175, which is a wide VIN four switch synchronous Buck-Boost controller. This design is capable of regulating the output while the input is at, above or below the output. This design is ideal for industrial and automotive applications. The switching frequency is set to 200 kHz. The output voltage was adjusted by changing the bottom feedback resistor.

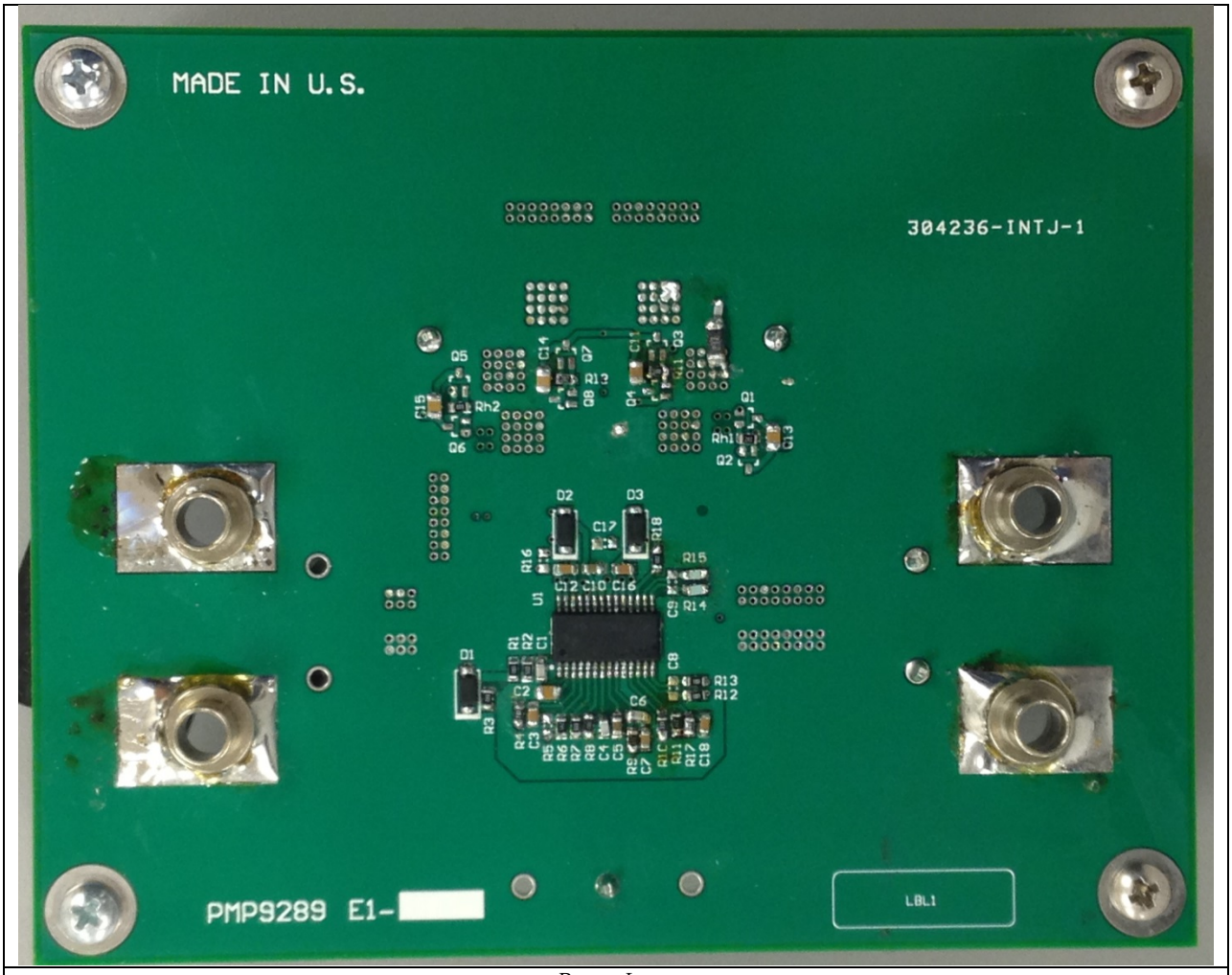
2. Fabrication

The PMP10507 is built on a PMP9289 Rev 2 PCB. This is a six layer board with overall dimensions of 4.44” (112mm) x 3.22” (82mm). The copper weight is 1oz on the outer layers and 0.5oz the inner layers.



Top Layer

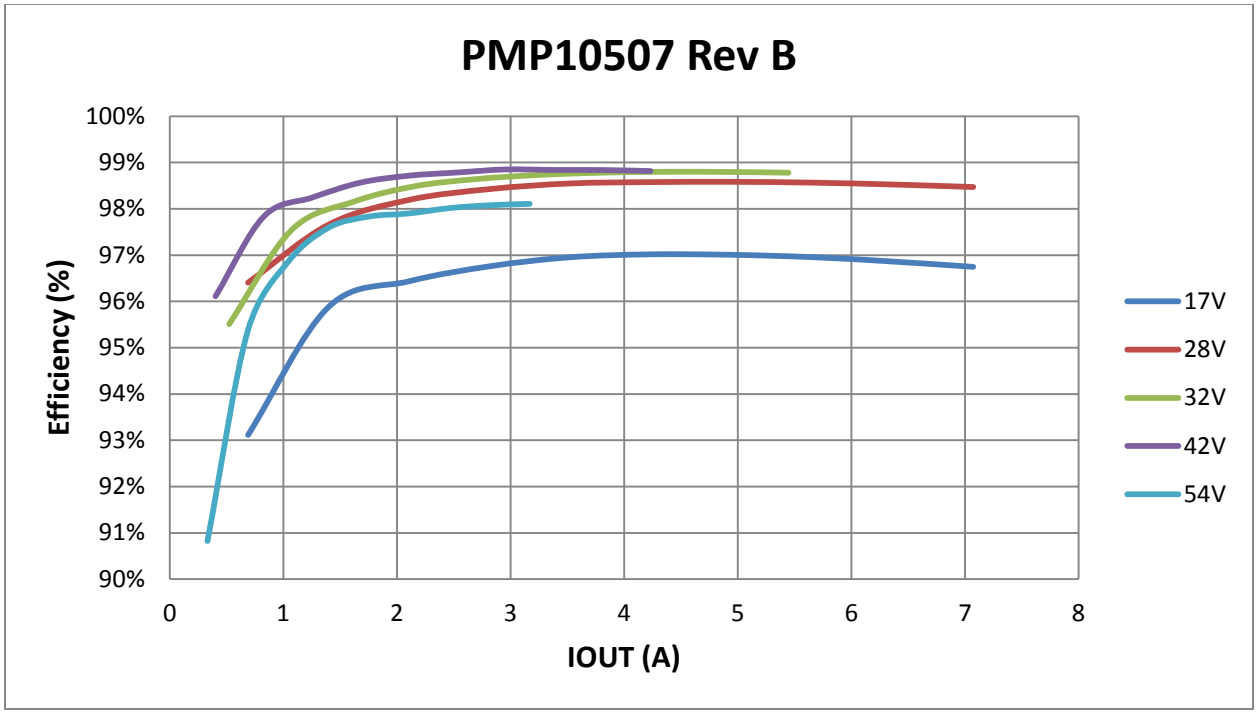
Buck-Boost Controller



Bottom Layer

Buck-Boost Controller

3. Efficiency



3.1 17VOUT

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
35.071	0.025	16.852	0.000	0.875	0.003	0.326%	0.872
35.055	0.356	16.853	0.689	12.475	11.617	93.117%	0.859
35.040	0.701	16.855	1.398	24.578	23.566	95.881%	1.012
35.023	1.052	16.857	2.108	36.852	35.538	96.436%	1.313
35.007	1.401	16.858	2.816	49.062	47.471	96.759%	1.590
34.991	1.752	16.859	3.525	61.299	59.433	96.954%	1.867
34.975	2.104	16.860	4.234	73.574	71.380	97.017%	2.195
34.959	2.457	16.862	4.941	85.892	83.322	97.007%	2.570
34.943	2.813	16.863	5.651	98.290	95.298	96.957%	2.991
34.926	3.170	16.862	6.361	110.732	107.258	96.862%	3.475
34.910	3.531	16.862	7.072	123.256	119.246	96.747%	4.010

3.2 28VOUT

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
35.070	0.019	27.999	0.000	0.667	0.007	1.051%	0.660
35.050	0.527	28.006	0.636	18.474	17.810	96.406%	0.664
35.029	1.060	28.014	1.295	37.139	36.270	97.659%	0.869
35.009	1.592	28.022	1.953	55.737	54.730	98.195%	1.006
34.988	2.124	28.023	2.611	74.325	73.155	98.427%	1.169
34.967	2.659	28.025	3.270	92.977	91.627	98.548%	1.350
34.947	3.195	28.026	3.928	111.661	110.072	98.577%	1.589
34.926	3.732	28.026	4.585	130.346	128.499	98.583%	1.847
34.906	4.271	28.024	5.243	149.077	146.939	98.566%	2.138
34.884	4.813	28.024	5.903	167.898	165.423	98.526%	2.475
34.864	5.357	28.024	6.563	186.767	183.912	98.471%	2.855

3.3 32VOUT

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
35.070	0.024	32.192	0.000	0.854	0.006	0.747%	0.848
35.051	0.504	32.200	0.524	17.652	16.860	95.511%	0.792
35.031	1.010	32.208	1.071	35.366	34.496	97.540%	0.870
35.011	1.517	32.215	1.619	53.128	52.147	98.154%	0.981
34.991	2.025	32.219	2.166	70.849	69.781	98.492%	1.068
34.971	2.533	32.223	2.712	88.588	87.389	98.646%	1.200
34.952	3.043	32.226	3.259	106.360	105.013	98.733%	1.347
34.932	3.555	32.230	3.806	124.168	122.654	98.781%	1.513
34.912	4.067	32.233	4.352	141.971	140.268	98.800%	1.704
34.892	4.581	32.234	4.899	159.835	157.912	98.797%	1.923
34.872	5.096	32.235	5.446	177.712	175.546	98.781%	2.167

3.4 42 VOUT

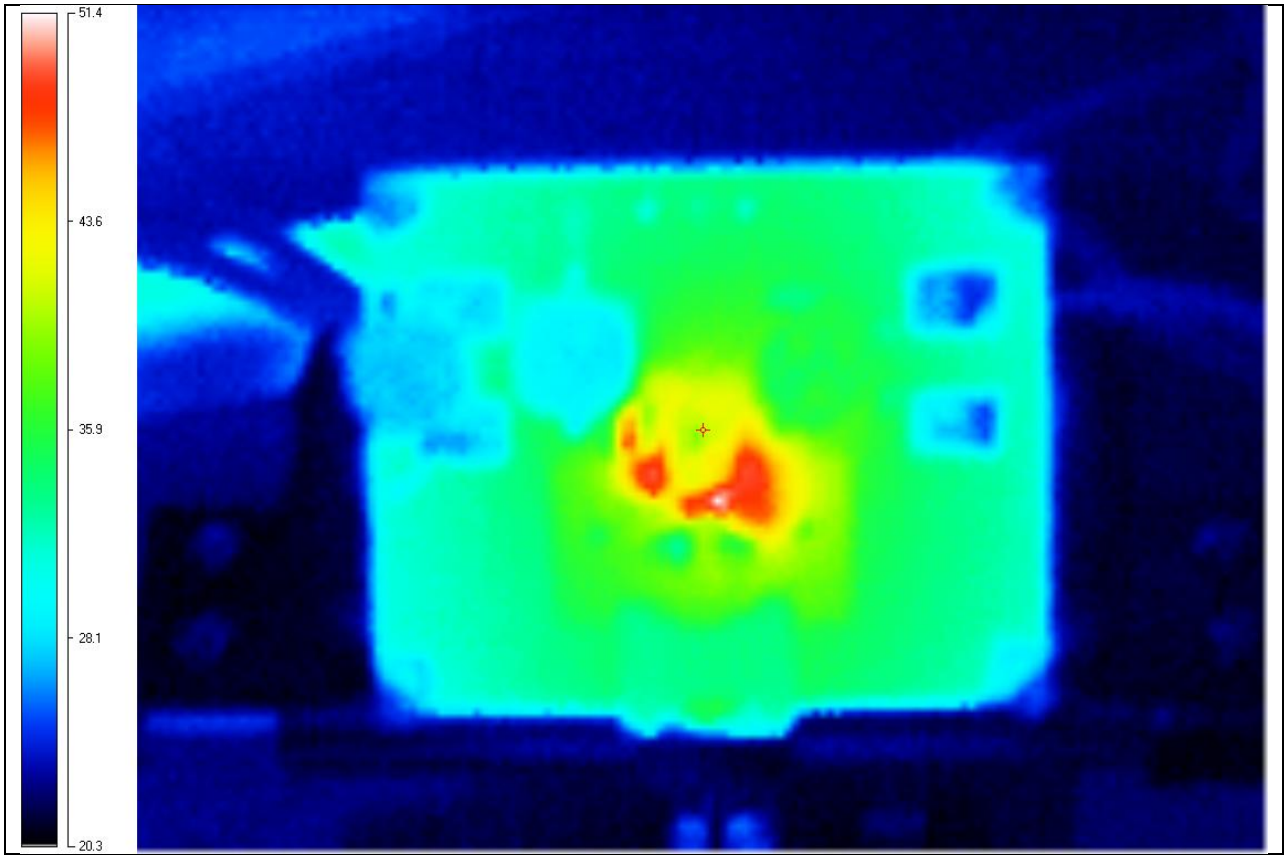
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
35.070	0.021	41.495	0.000	0.732	0.012	1.582%	0.720
35.052	0.496	41.499	0.403	17.400	16.723	96.112%	0.677
35.034	1.003	41.500	0.829	35.146	34.385	97.836%	0.761
35.015	1.513	41.505	1.254	52.981	52.051	98.244%	0.930
34.997	2.022	41.508	1.680	70.761	69.748	98.567%	1.014
34.979	2.531	41.512	2.106	88.546	87.410	98.717%	1.136
34.960	3.042	41.517	2.530	106.333	105.041	98.785%	1.292
34.942	3.553	41.520	2.956	124.145	122.719	98.851%	1.426
34.923	4.067	41.525	3.380	142.022	140.374	98.840%	1.648
34.904	4.582	41.531	3.806	159.928	158.070	98.838%	1.858
34.886	5.098	41.536	4.231	177.851	175.746	98.816%	2.105

3.5 54 VOUT

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Efficiency (%)	Losses (W)
35.069	0.055	55.111	0.000	1.934	0.009	0.472%	1.925
35.049	0.575	55.119	0.332	20.152	18.303	90.826%	1.849
35.029	1.133	55.127	0.687	39.704	37.864	95.365%	1.840
35.008	1.694	55.134	1.042	59.302	57.437	96.855%	1.865
34.987	2.255	55.139	1.396	78.884	76.984	97.592%	1.900
34.966	2.824	55.142	1.752	98.750	96.610	97.833%	2.140
34.945	3.395	55.143	2.106	118.626	116.137	97.901%	2.490
34.924	3.964	55.150	2.460	138.424	135.676	98.015%	2.748
34.904	4.533	55.154	2.814	158.225	155.183	98.077%	3.042
34.883	5.106	55.162	3.168	178.106	174.735	98.107%	3.371

4. Thermal

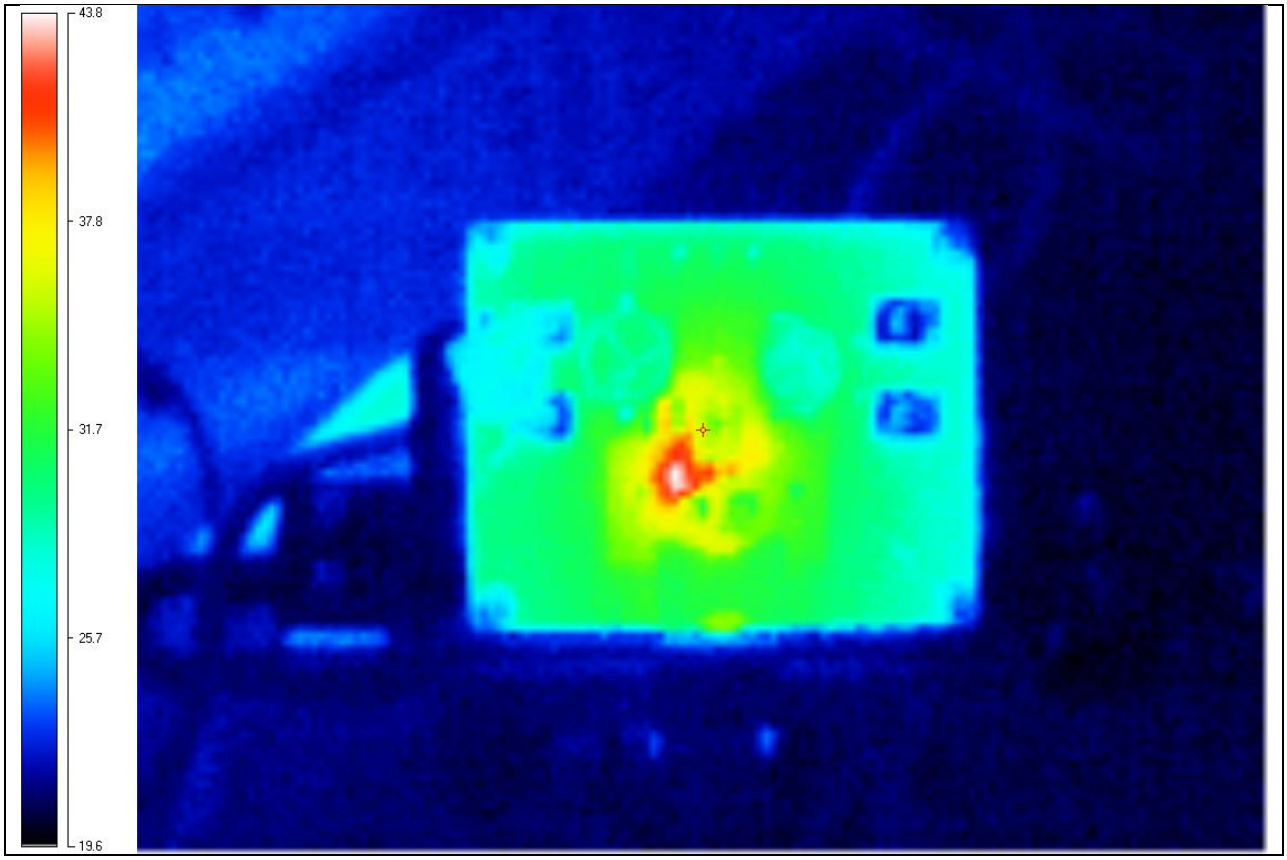
4.1 Steady State Temperature, 35VIN and 17VOUT @ 7A.



Top View

The warmest components are the MOSFETs. This image displays a 30°C temperature rise.

4.2 Steady State Temperature, 35VIN and 54VOUT @ 3.1A.

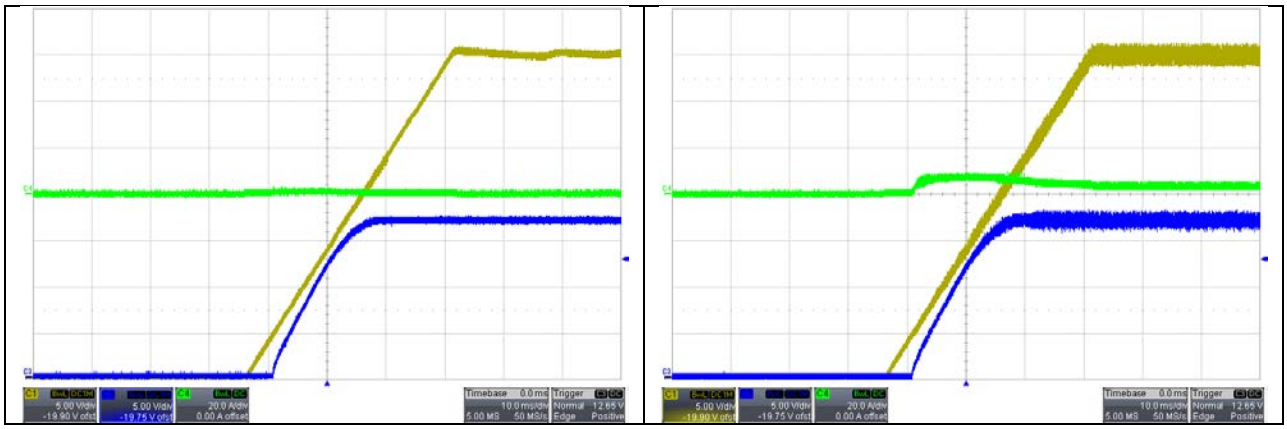


Top View

The warmest components are the MOSFETs. This image displays a 24°C temperature rise.

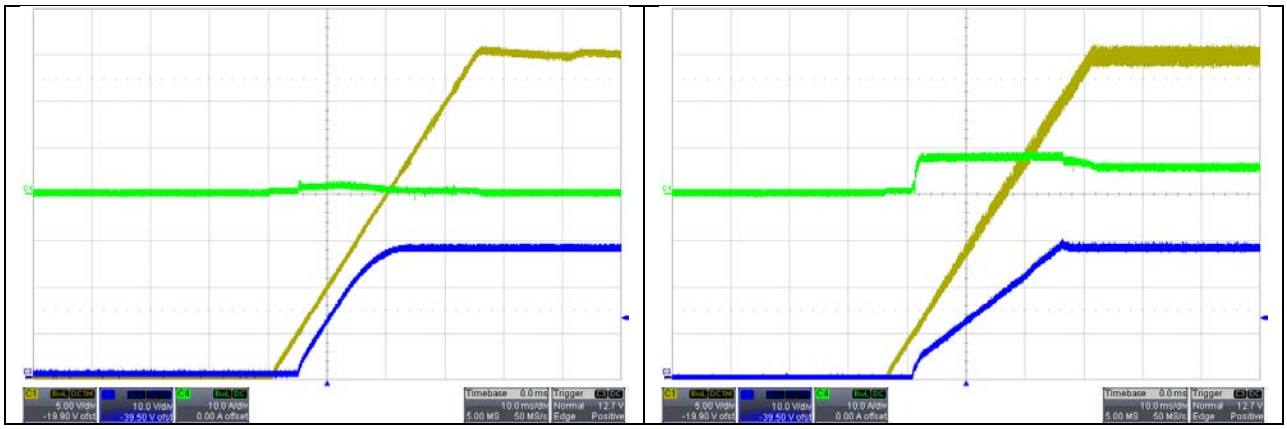
5. Power Up

5.1 Power Up at 17 VOUT – No Load *Power Up at 17 VOUT –7A*



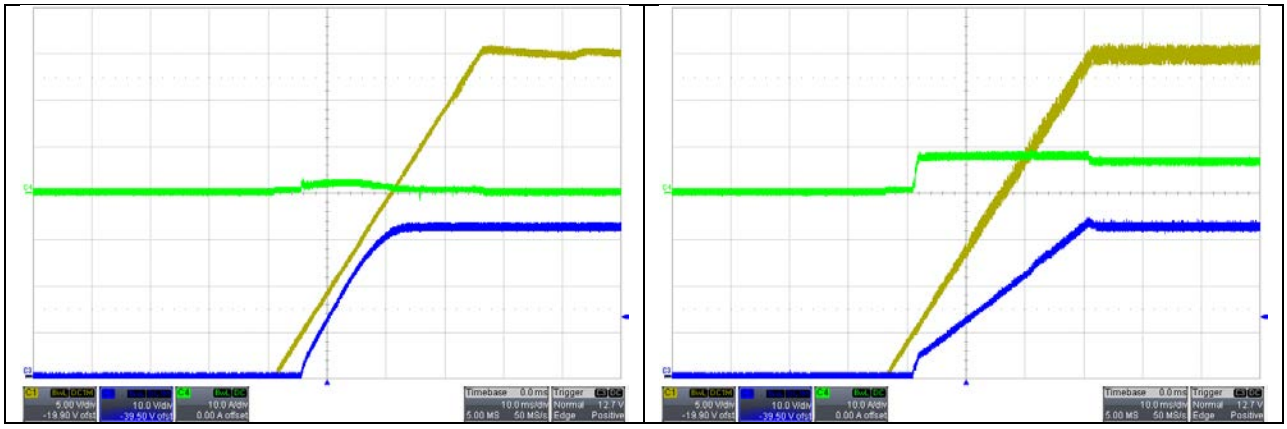
Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.2 Power Up at 28 VOUT – No Load *Power Up at 28 VOUT –7A*



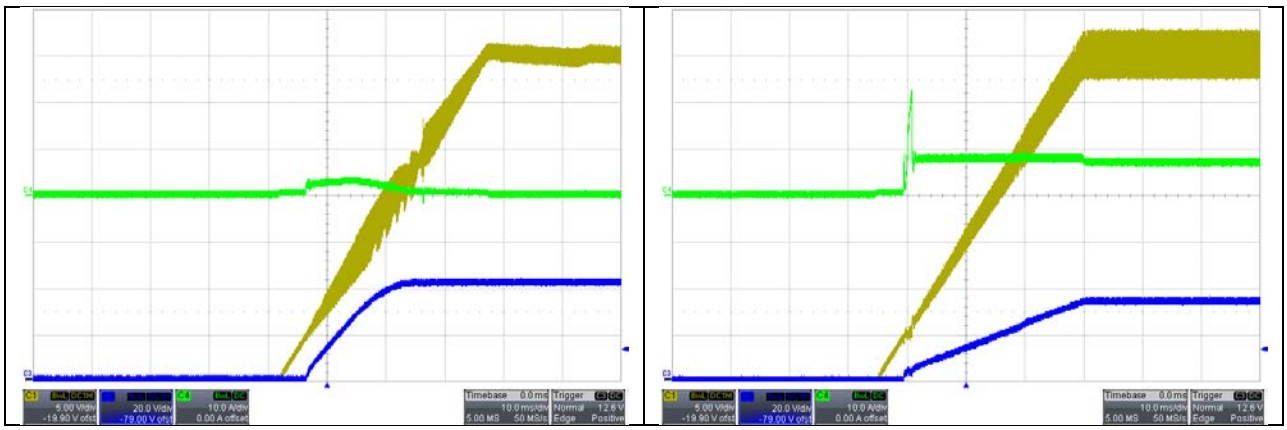
Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.3 Power Up at 32 VOUT – No Load *Power Up at 32 VOUT –5.3A*



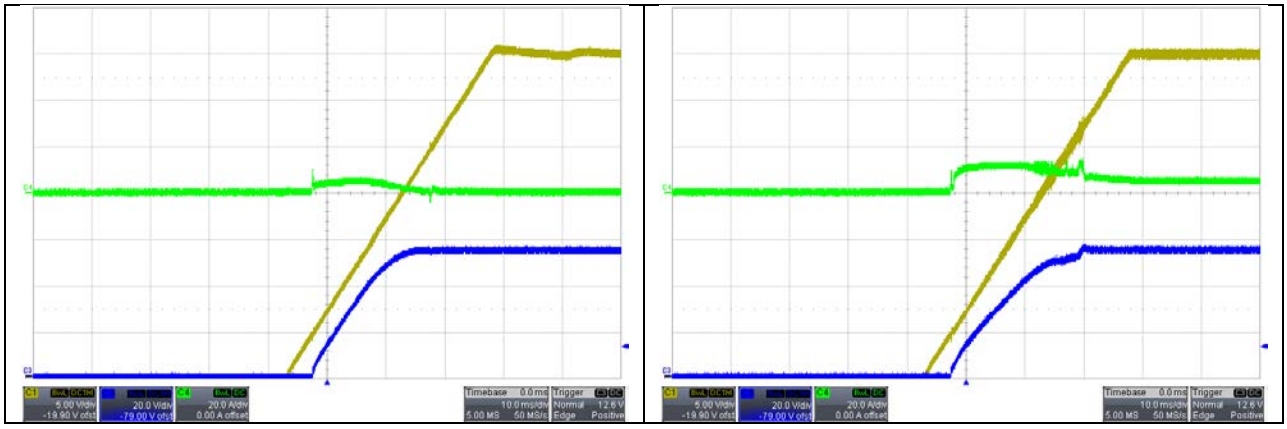
Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

5.4 Power Up at 42 VOUT – No Load *Power Up at 42 VOUT –4A*



Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

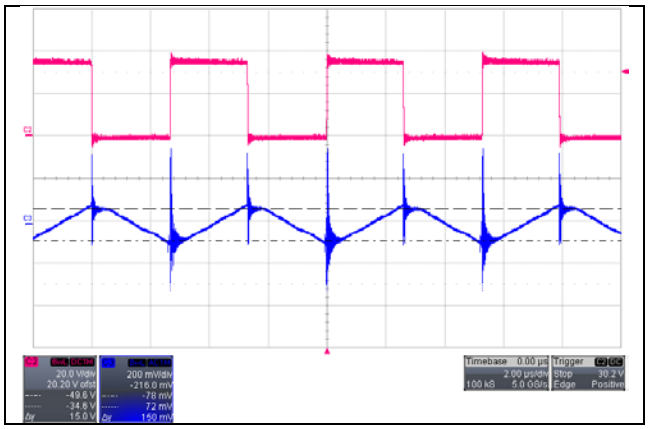
5.5 Power Up at 54 VOUT – No Load *Power Up at 54 VOUT –3.1A*



Channel 1 VIN
Channel 3 VOUT
Channel 4 IIN

6. Switching and Ripple

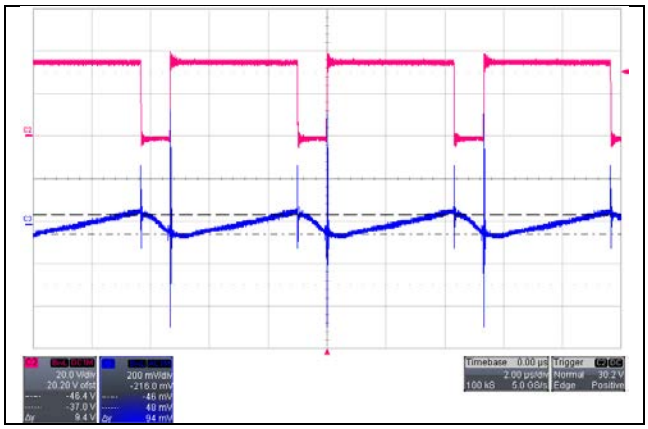
6.1 17 VOUT @ 7A



The cursors indicate 150mV ripple.

Channel 2 VSW
Channel 3 Vout

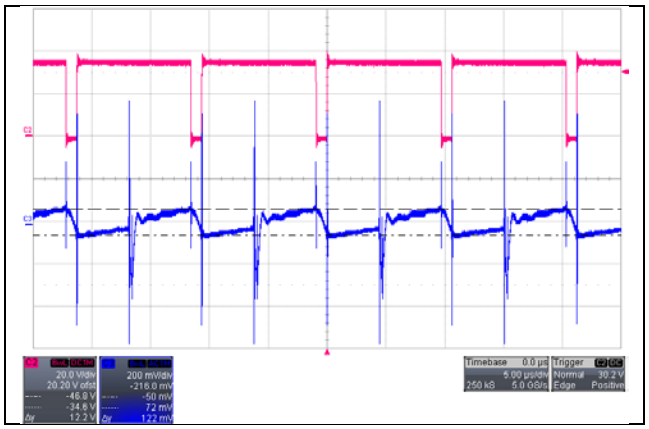
6.2 28 VOUT @ 7A



The cursors indicate 94mV ripple.

Channel 2 VSW
Channel 3 Vout

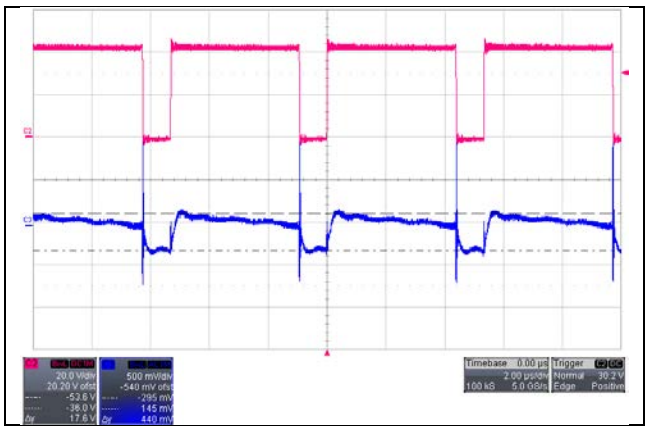
6.3 32 VOUT @ 5.3A



The cursors indicate 122mV ripple.

Channel 2 VSW
Channel 3 Vout

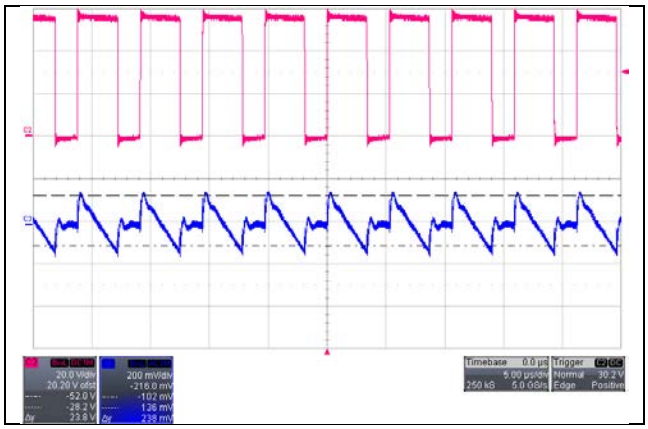
6.4 42 VOUT @ 4A



The cursors indicate 440mV ripple.

Channel 2 VSW
Channel 3 Vout

6.5 54 VOUT @ 3.1W

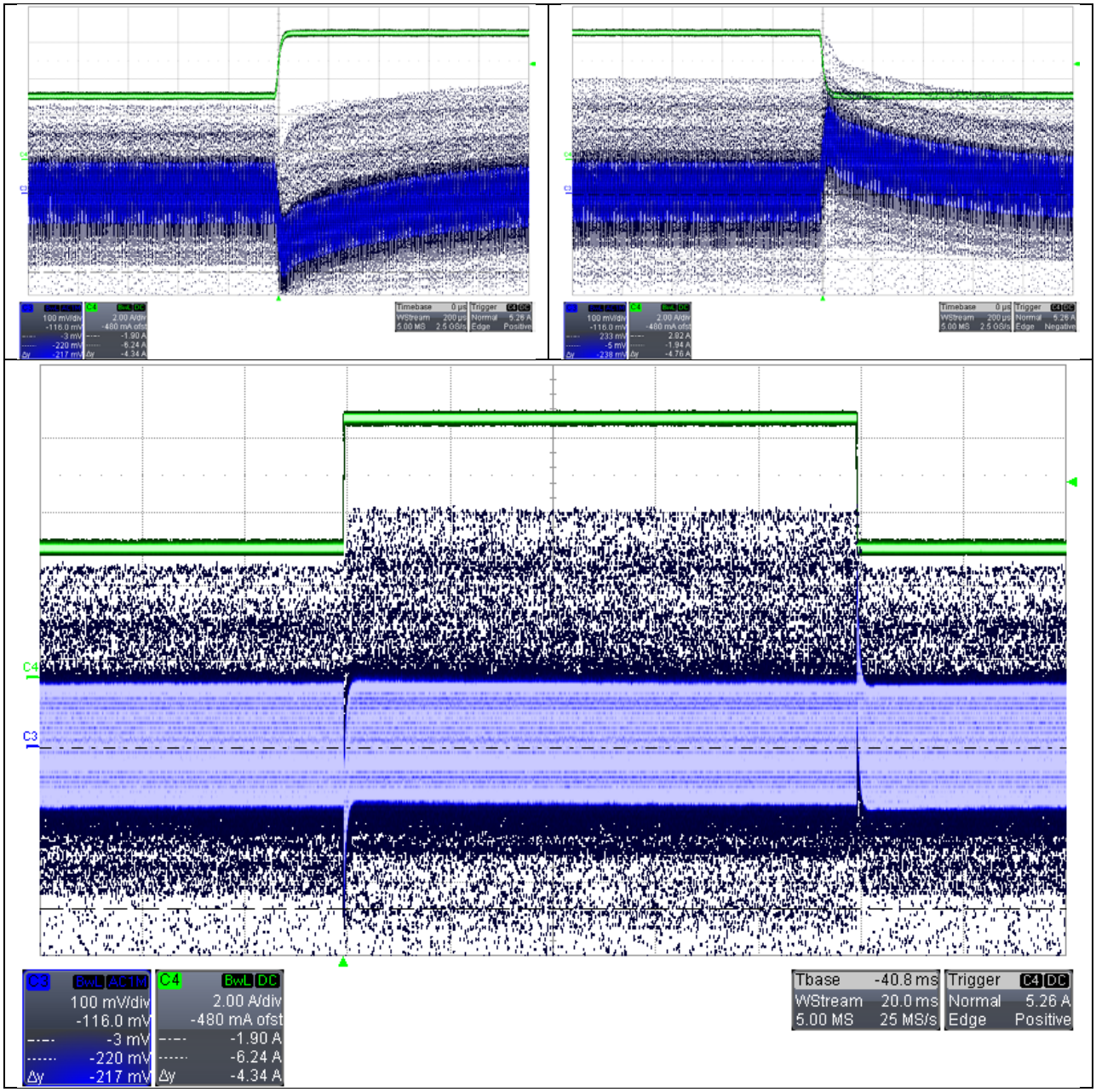


The cursors indicate 238mV ripple.

Channel 2 VSW
Channel 3 Vout

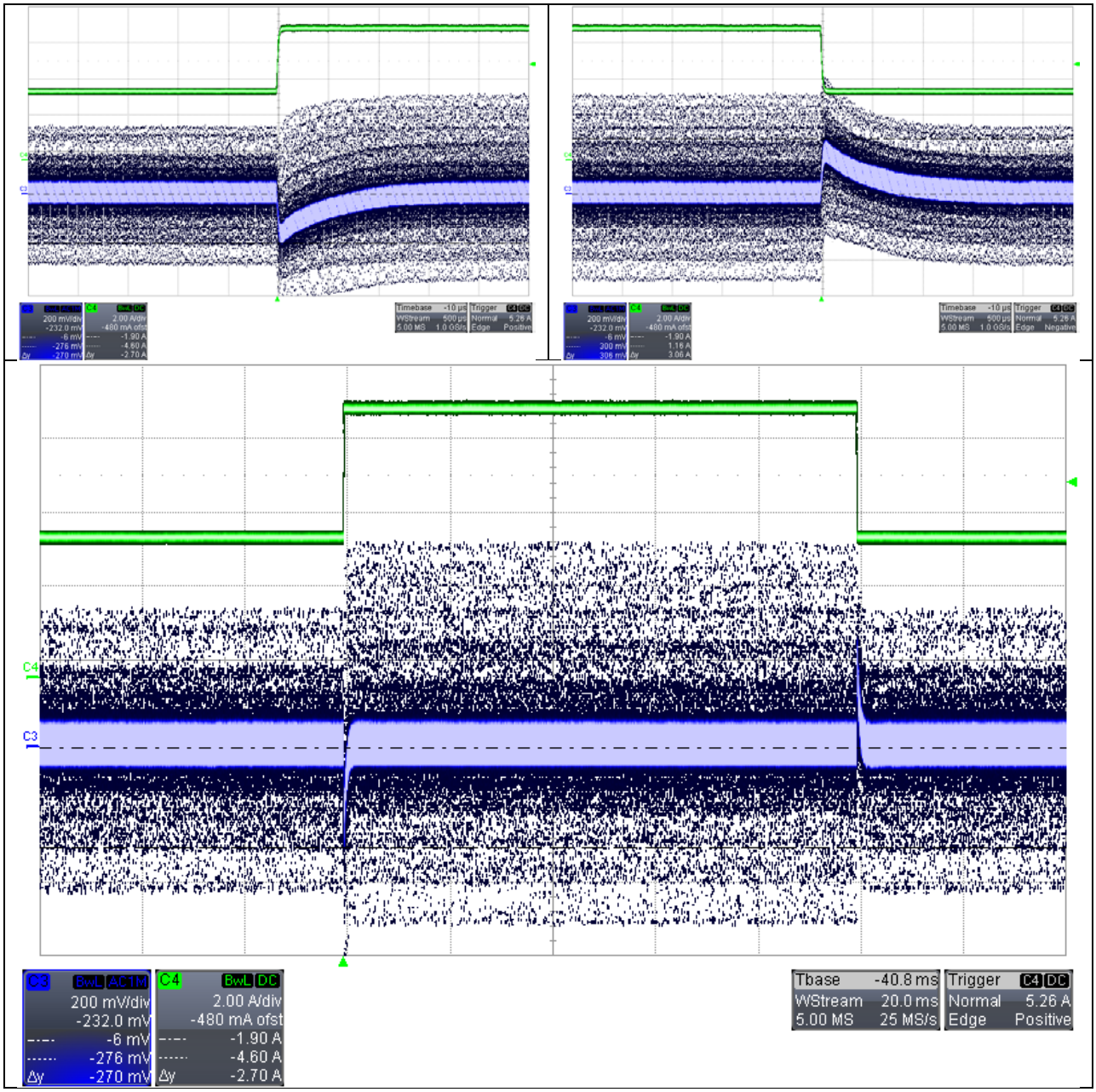
7. Transient Response

7.1 17 VOUT –3.5A -7A Step, 400mA/µs, 5 Hz



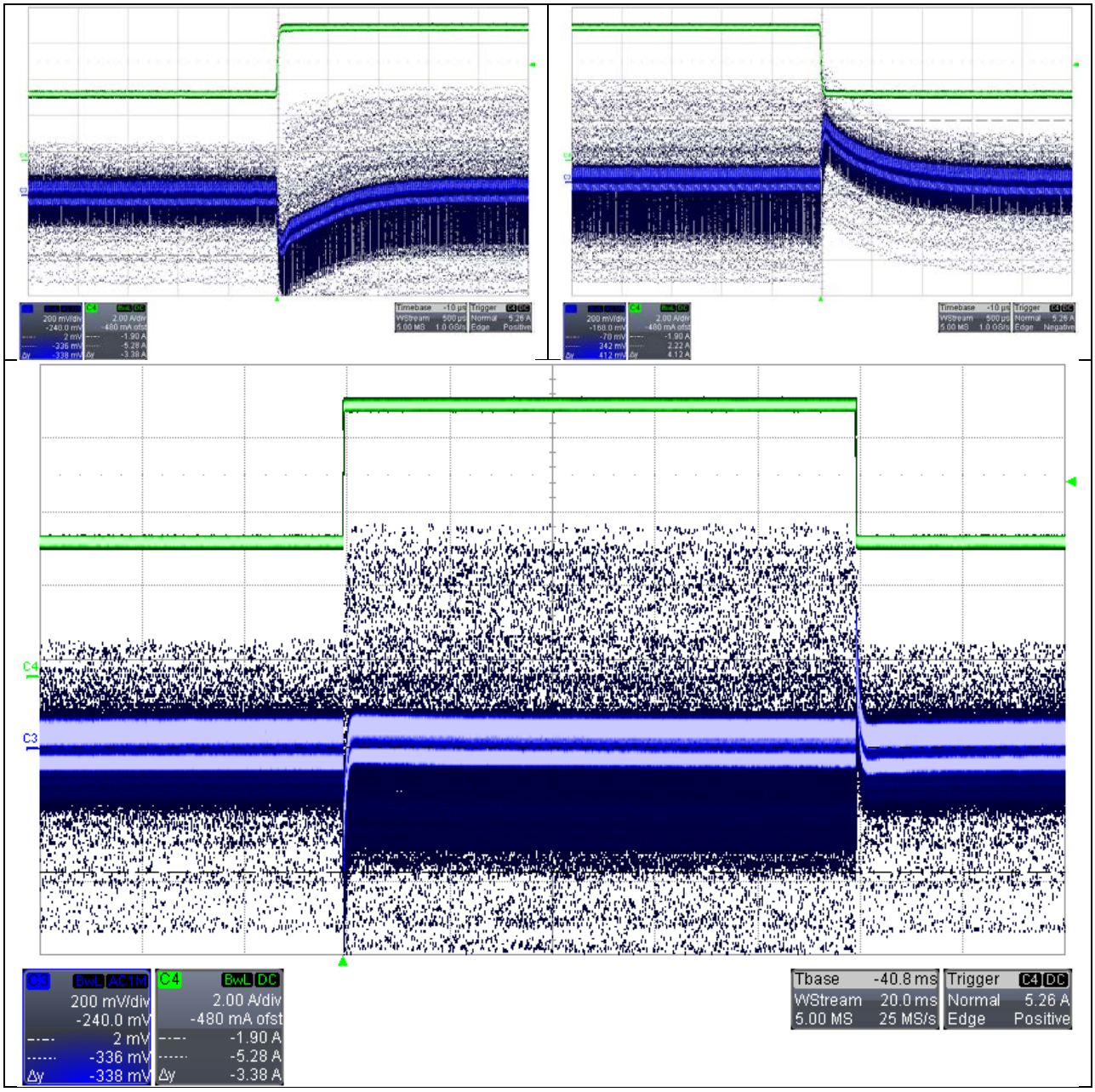
Cursors indicate ~217mV deviation across output capacitors.

7.2 28 VOUT 3.5A – 6.25A Step, 400mA/µs, 5 Hz



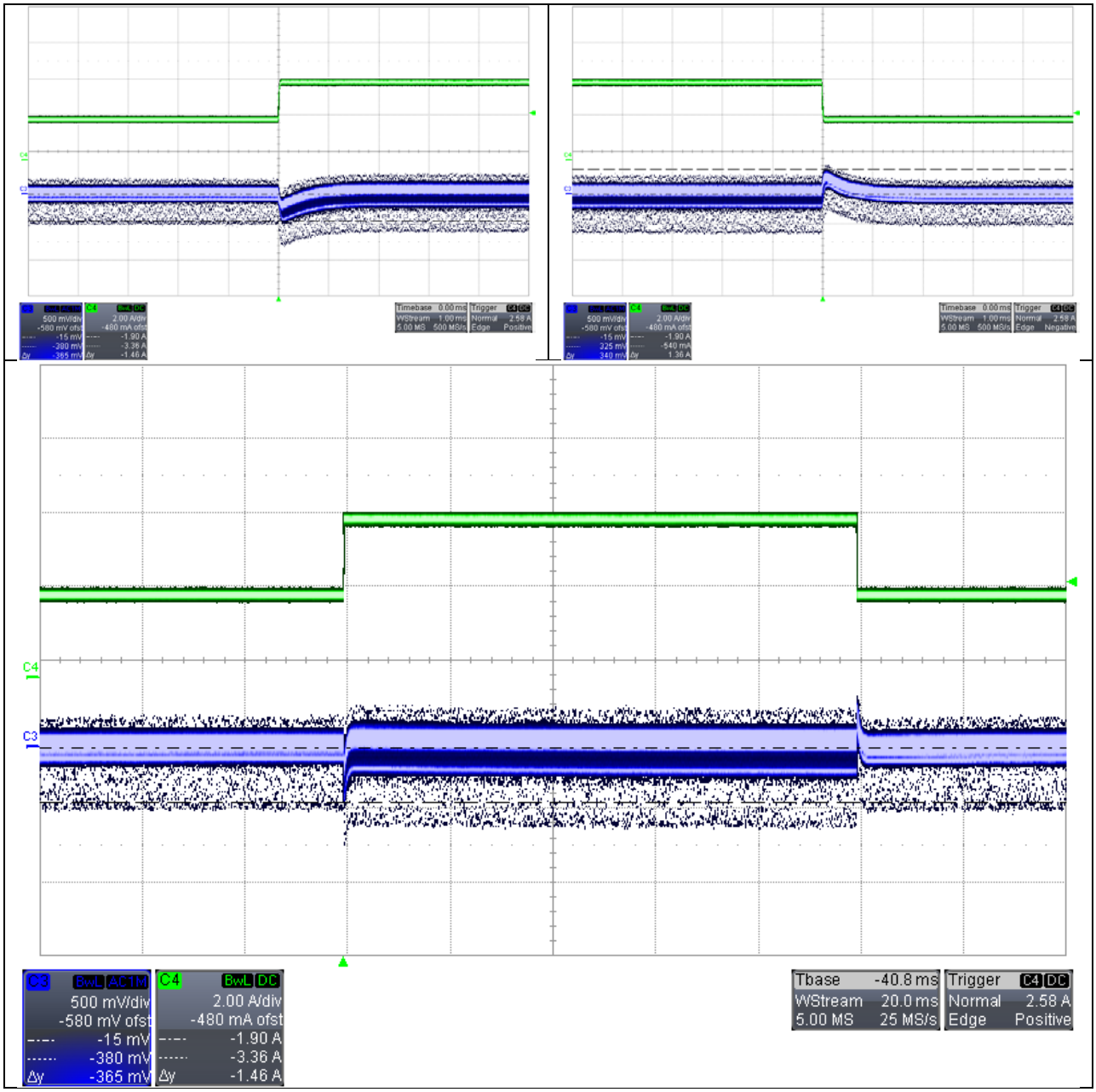
Cursors indicate ~270mV deviation across output capacitors.

7.3 32 VOUT –3.5A to 7A Step, 400mA/µs, 5 Hz



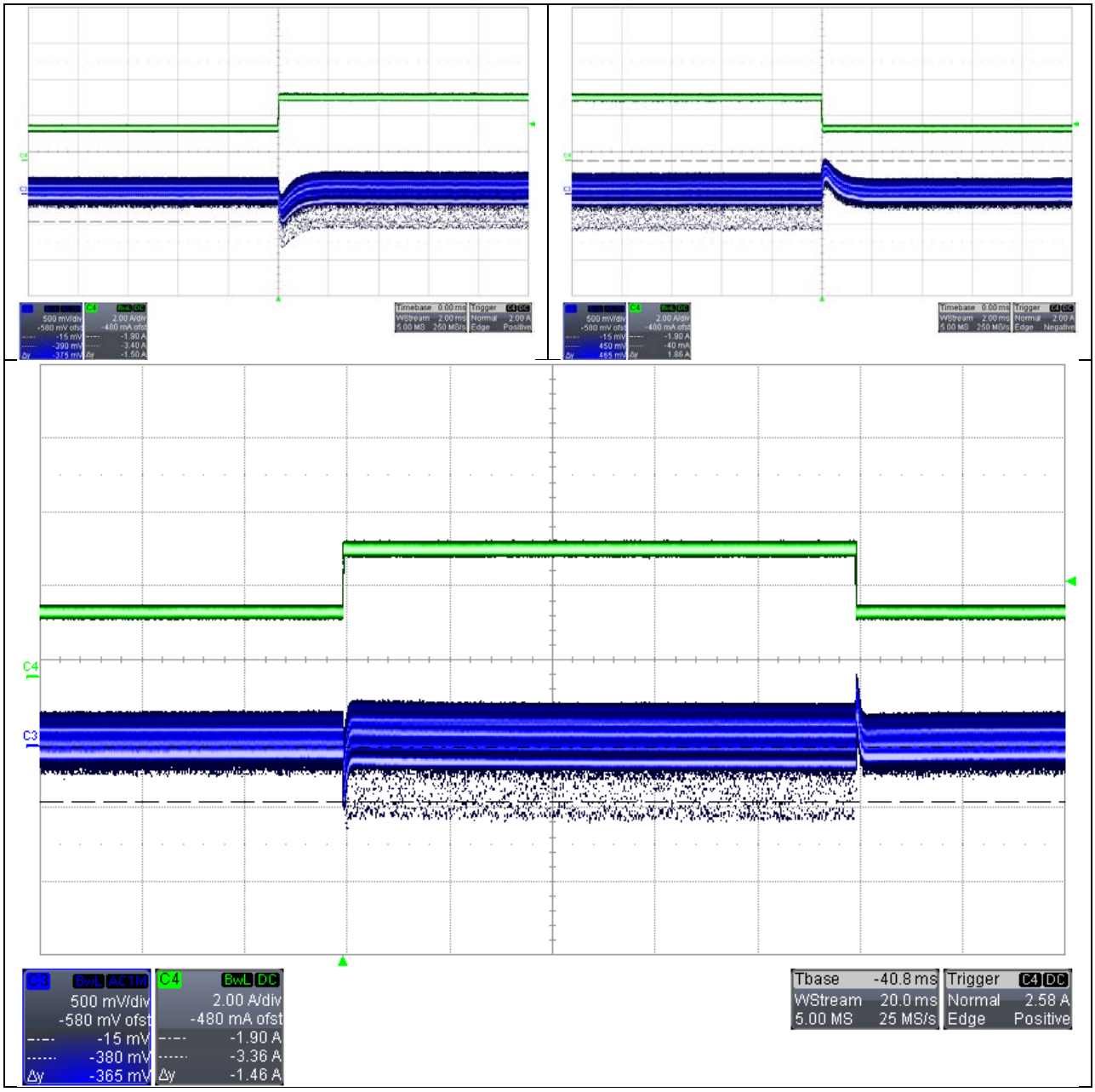
Cursors indicate ~338mV deviation across output capacitors.

7.4 42 VOUT 2A - 4A Step, 400mA/µs, 5 Hz



Cursors indicate ~365mV deviation across output capacitors.

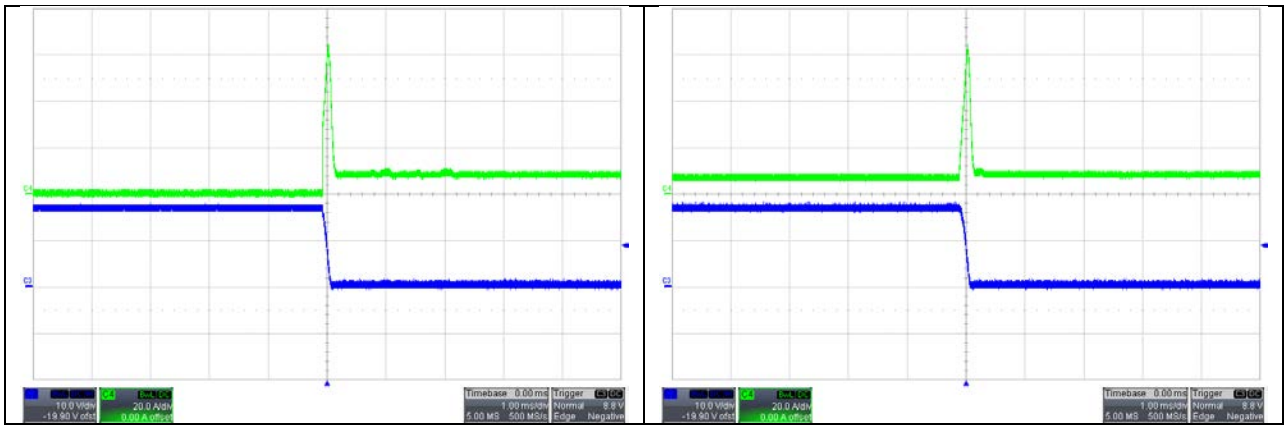
7.5 54 VOUT –1.5A -3.25A Step, 400mA/µs, 5 Hz



Cursors indicate ~365mV deviation across output capacitors.

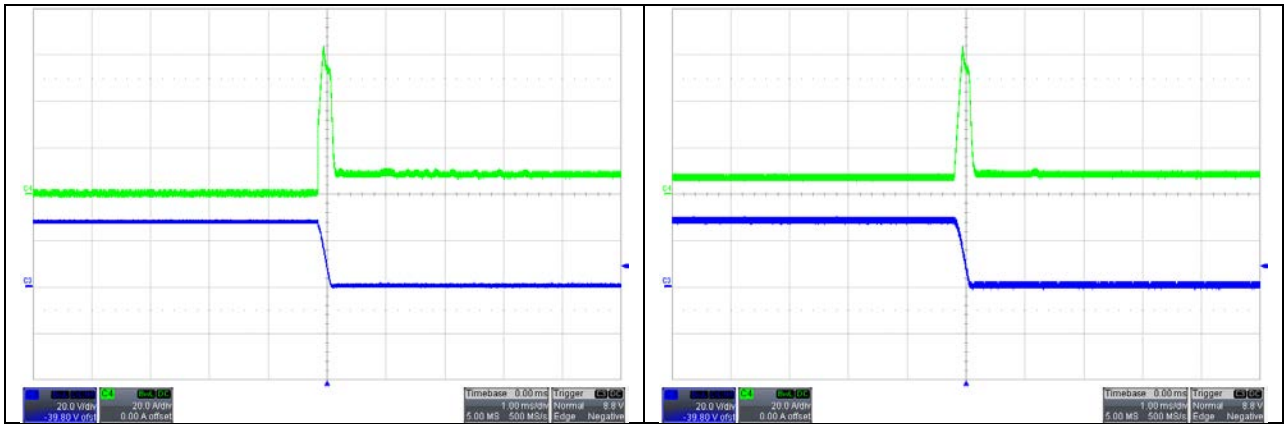
8.1 Short Circuit Tests

8.1 17 VOUT No Load 17 VOUT 7A



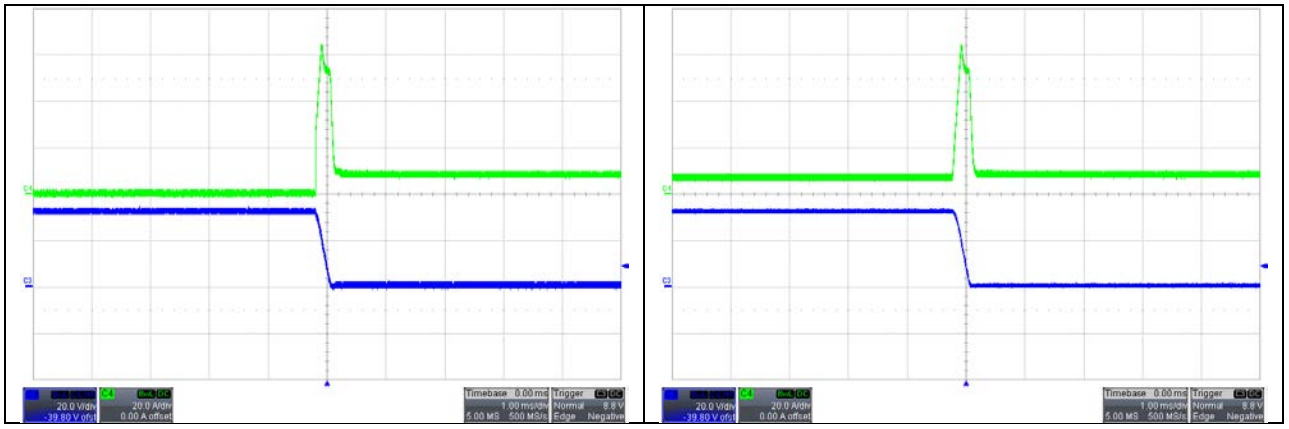
Channel 3 VOUT
Channel 4 IOUT

8.2 28 VOUT No Load 28 VOUT 7A



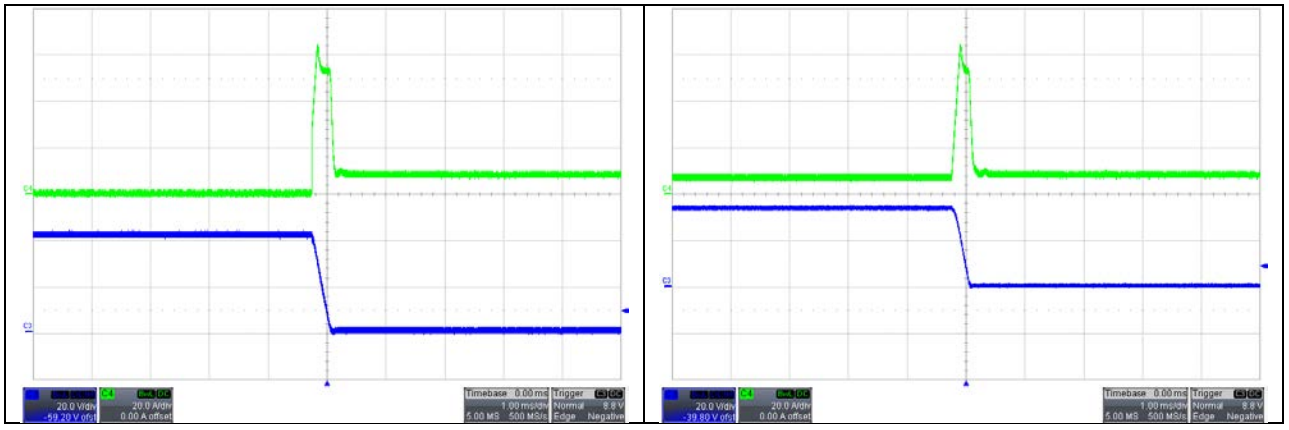
Channel 3 VOUT
Channel 4 IOUT

8.3 32 VOUT No Load 32 VOUT 5.3A



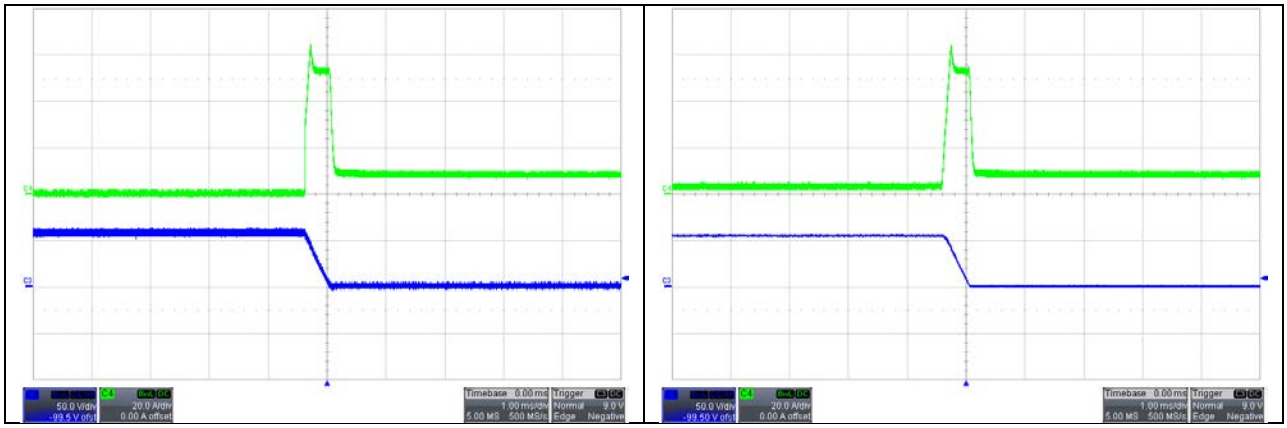
Channel 3 VOUT
Channel 4 IOUT

8.4 42 VOUT No Load 42 VOUT 4A



Channel 3 VOUT
Channel 4 IOUT

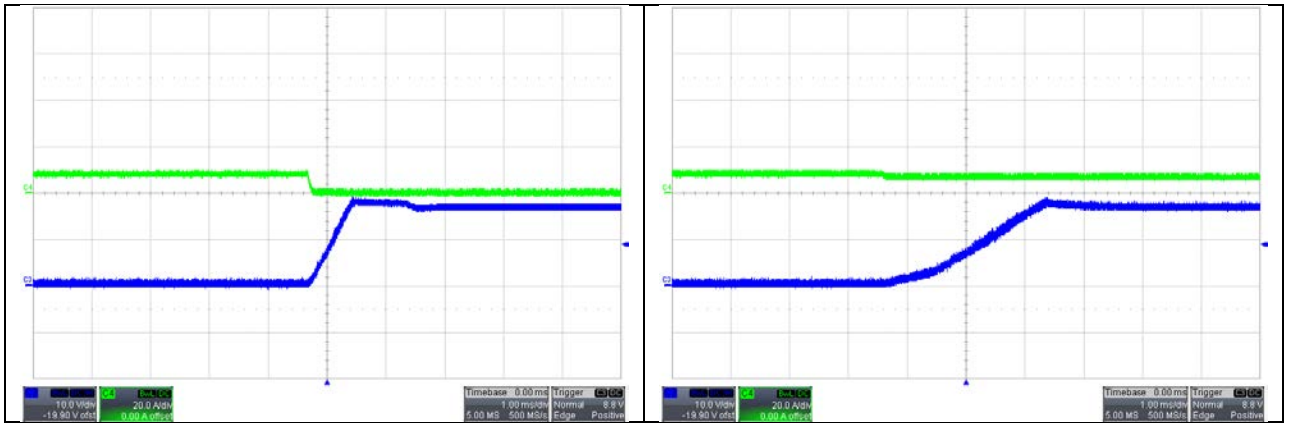
8.5 54 VOUT No Load 54 VOUT 3.1A



Channel 3 VOUT
Channel 4 IOUT

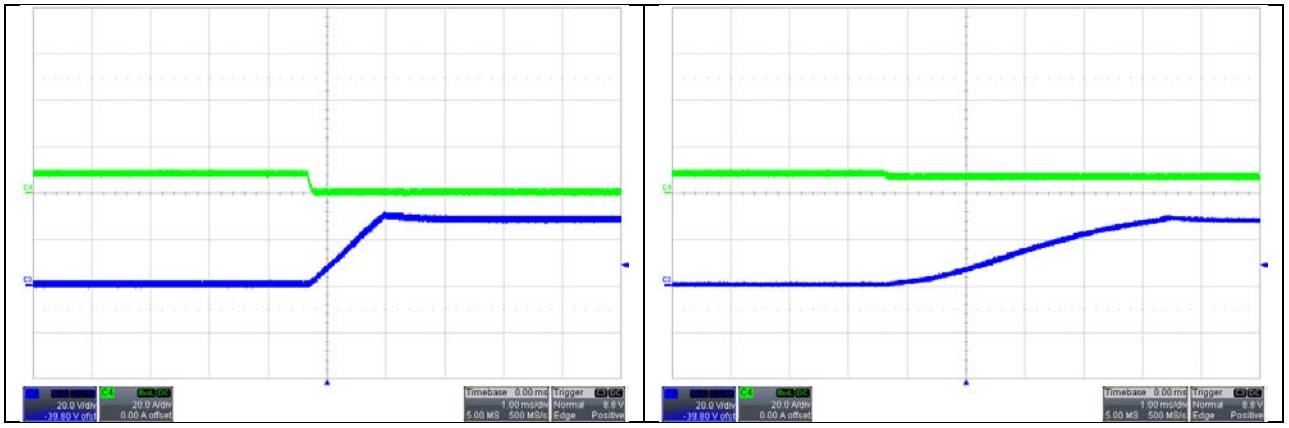
9. Short Circuit Recovery Tests

9.1 17 VOUT No Load 17 VOUT 7A



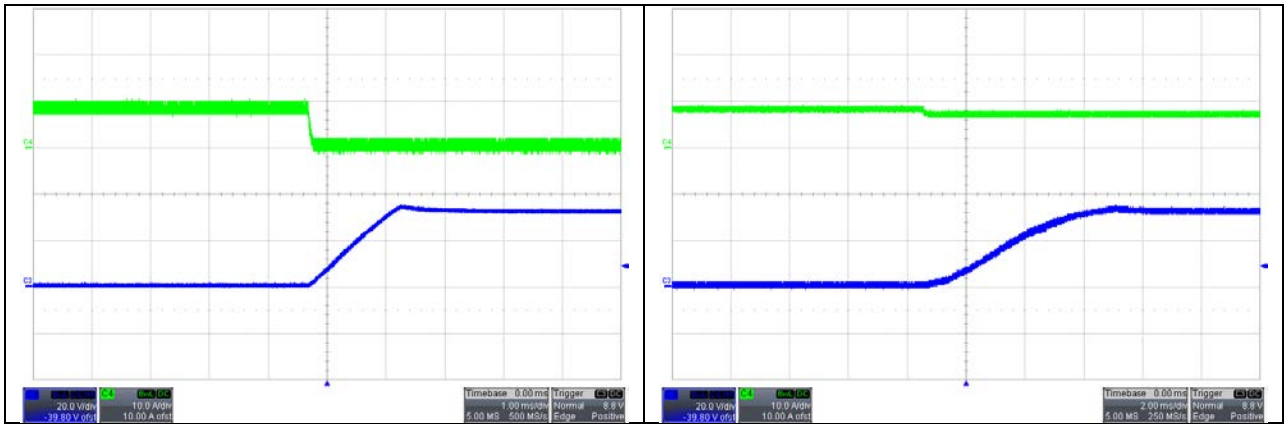
Channel 3 VOUT
Channel 4 IOUT

9.2 28 VOUT No Load 28 VOUT 7A



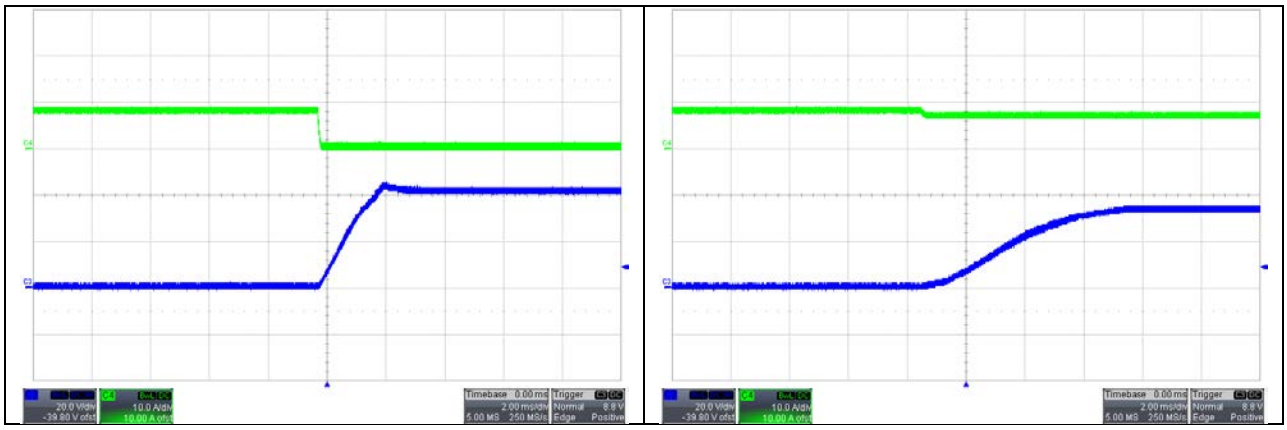
Channel 3 VOUT
Channel 4 IOUT

9.3 32VOUT No Load 32 VOUT 5.3A



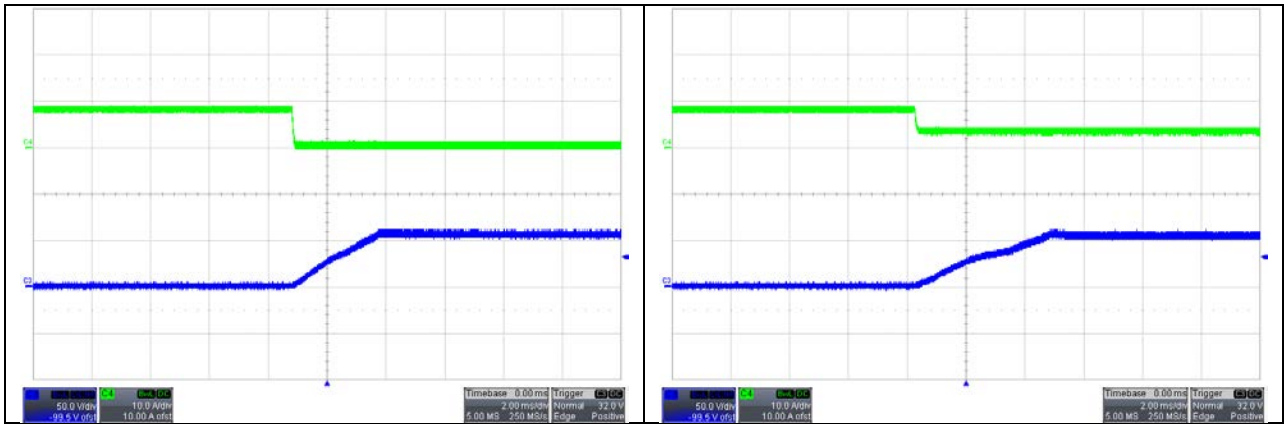
Channel 3 VOUT
Channel 4 IOUT

9.4 48 VOUT No Load 48 VOUT 4A



Channel 3 VOUT
Channel 4 IOUT

9.5 54 VOUT No Load 54 VOUT 3.1A

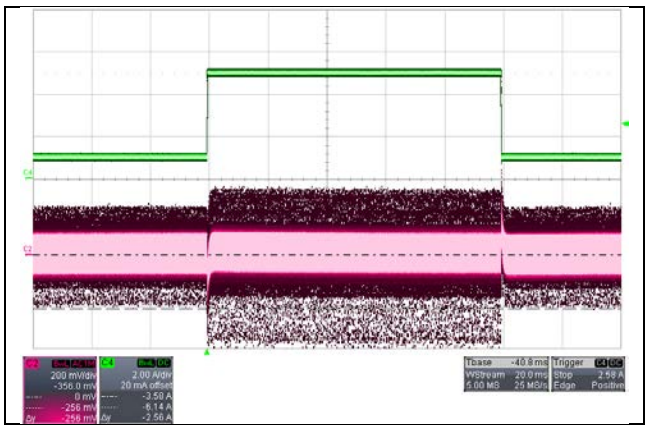


Channel 3 VOUT
Channel 4 IOUT

10. Supplemental

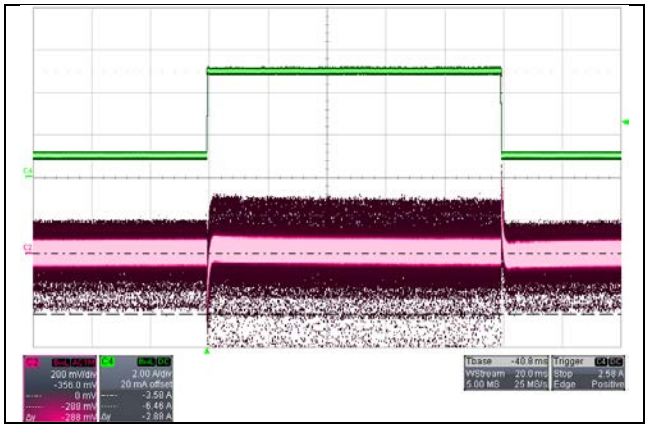
Transient Response

17 VOUT 1A to 5A Step, 400mA/µs, 5 Hz



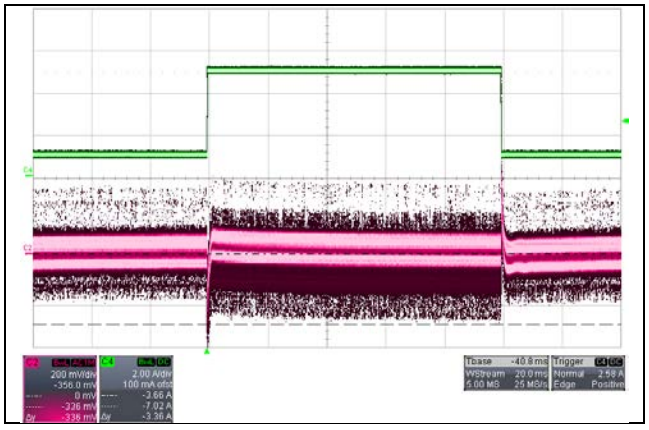
Cursors indicate ~256mV deviation across output capacitors.
Channel 2 Vout
Channel 4 Iout

28 VOUT 1A to 5A Step, 400mA/µs, 5 Hz



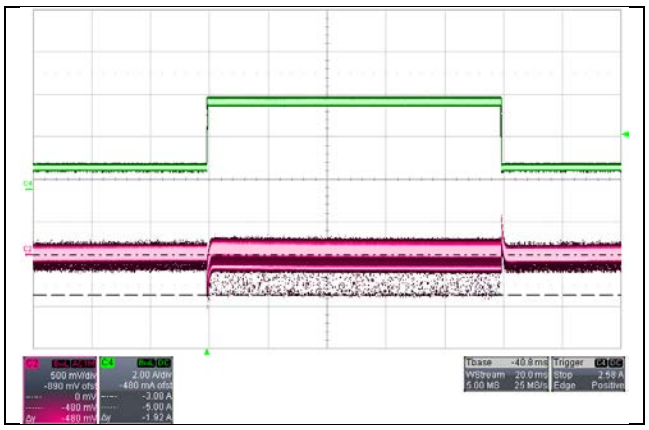
Cursors indicate ~288mV deviation across output capacitors.
Channel 2 Vout
Channel 4 Iout

36 VOUT 1A to 5A Step, 400mA/µs, 5 Hz



Cursors indicate ~336mV deviation across output capacitors.
Channel 2 Vout
Channel 4 Iout

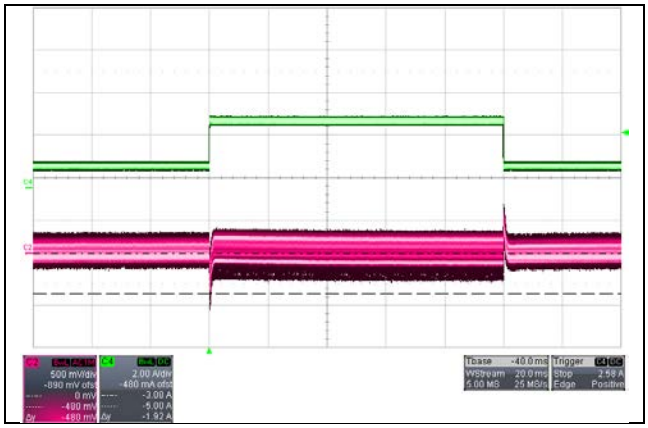
48 VOUT 1A to 4.1A Step, 400mA/µs, 5 Hz



Cursors indicate ~480mV deviation across output capacitors.

Channel 2 Vout
Channel 4 Iout

54 VOUT 1A to 3.1A Step, 400mA/µs, 5 Hz

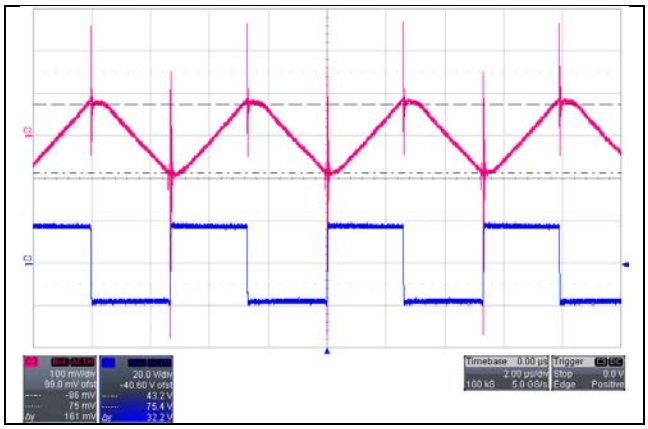


Cursors indicate ~480mV deviation across output capacitors.

Channel 2 Vout
Channel 4 Iout

Switching and Ripple

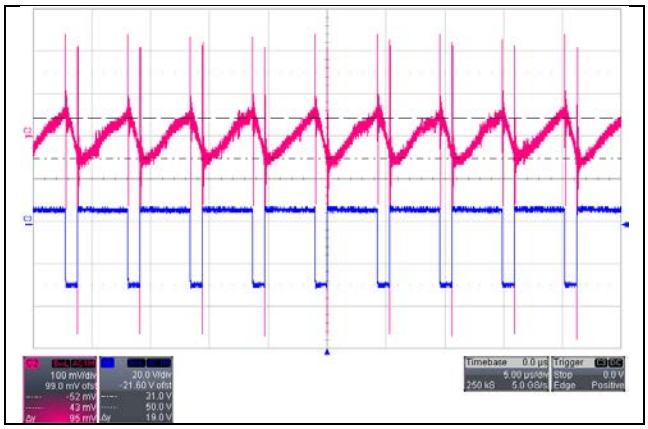
17 VOUT @ 5A



The cursors indicate 161mV ripple.

Channel 2 Vout
Channel 3 VSW

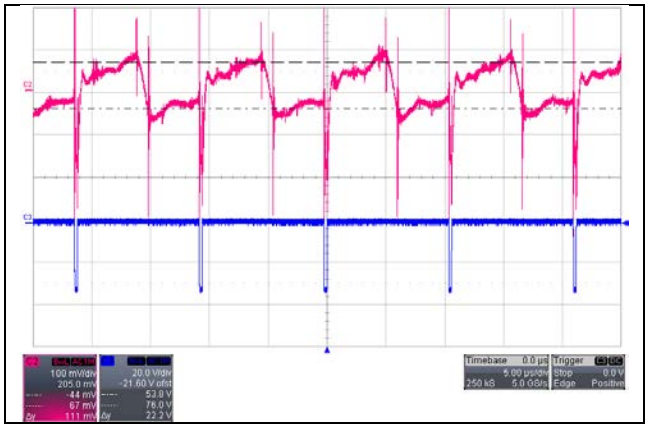
24 VOUT @ 5A



The cursors indicate 95mV ripple.

Channel 2 Vout
Channel 3 VSW

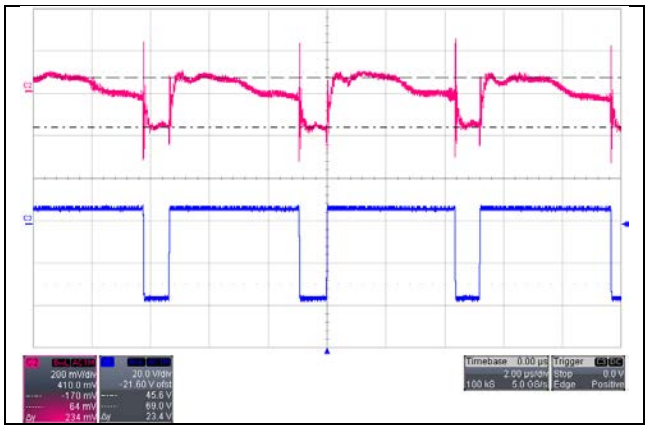
36 VOUT @ 5A



The cursors indicate 111mV ripple.

Channel 2 Vout
Channel 3 VSW

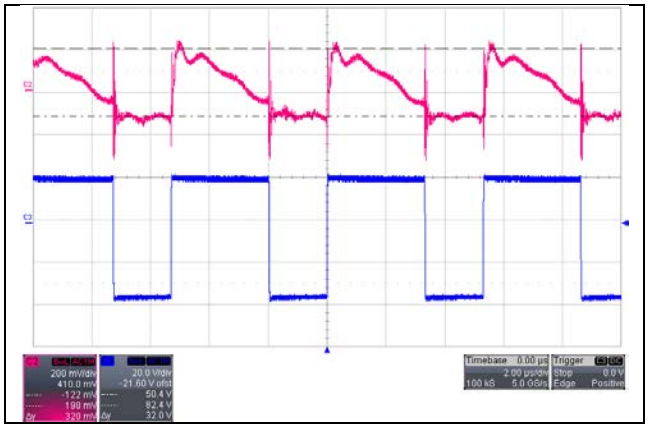
42 VOUT @ 4.1A



The cursors indicate 234mV ripple.

Channel 2 Vout
Channel 3 VSW

54 VOUT @ 3.1A



The cursors indicate 320mV ripple.

Channel 2 Vout
Channel 3 VSW

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