LM5121

Wide Input Synchronous Boost Controller with Disconnection Switch Control

TI reference design number: PMP9297 Rev B

Input: 34.5V - 37.5V

Output 1: 38V @ 4A
Output 2: 52V @ 3A

DC–DC Converter Test Results

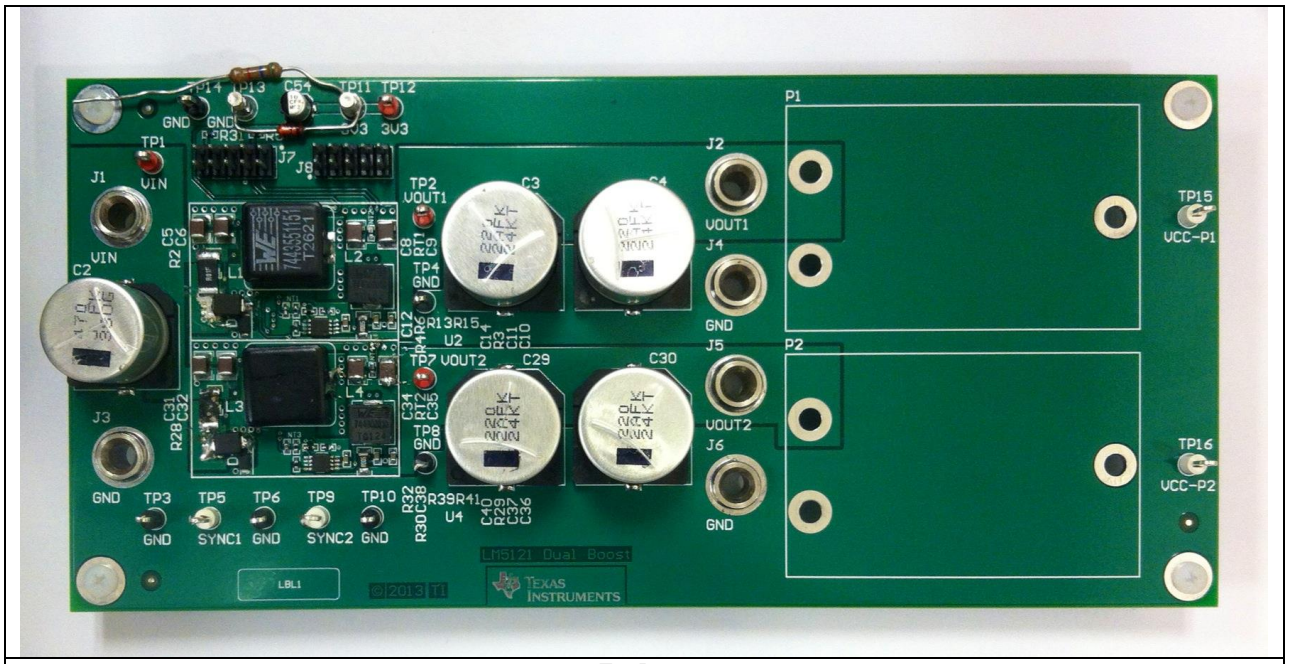
Table of Contents

1. Circuit Description

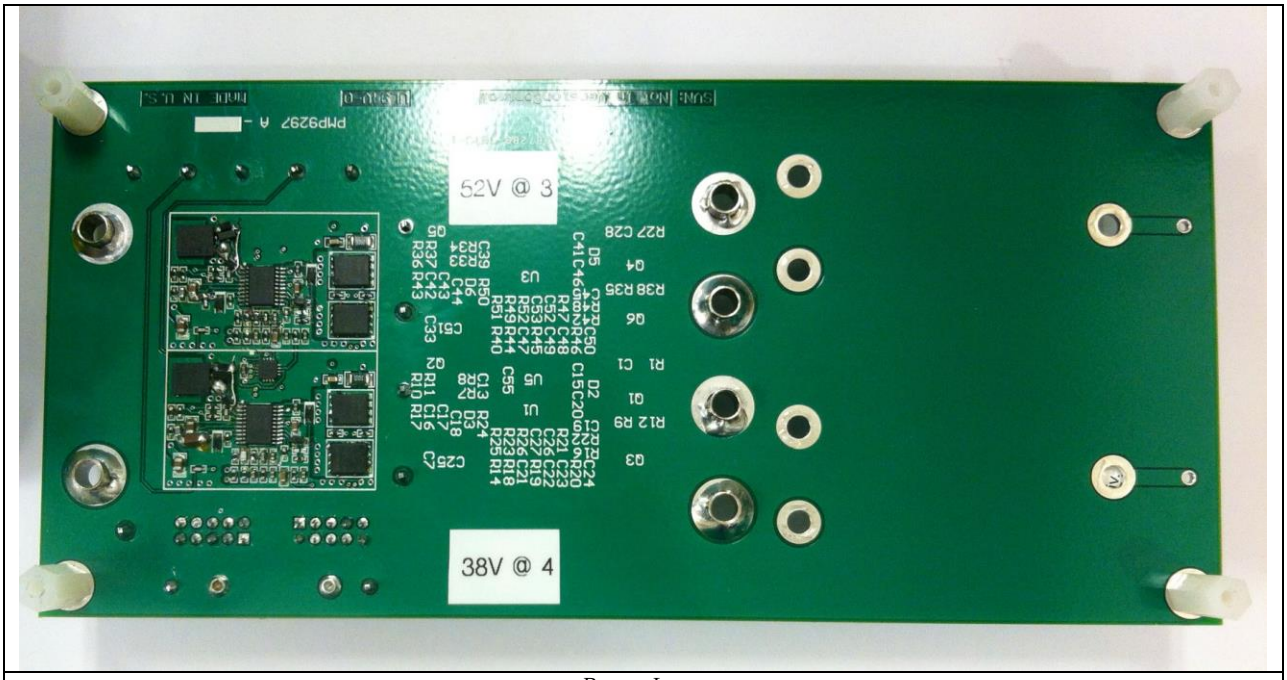
PMP9297 is a dual channel synchronous boost for GaN audio amplifier applications. It converts 35V input to an adjustable 38V to 55V output at 150W per channel. The solution size fits in a 45mm x 34 mm board area. Additional input and output bulk capacitors are included outside of the solution size area. This design uses TLP0202 dual channel digital pot to program the output voltages via SPI bus. Output current monitoring is done using LMP8481-S high-side current sense amplifiers. NTC thermistors allow temperature measurement of the High-side MOSFETs

2. Fabrication

The dual LM5121 boost circuit was built on PMP9297 Rev A printed circuit board. This is a four layer board with overall dimensions of 7.45” (189mm) x 3.45” (87mm). The copper weight is 1oz on the outer layer and 0.5oz on the inner layers. The overall solution size per channel is 1.3” (34mm) x 0.89” (22.5mm).



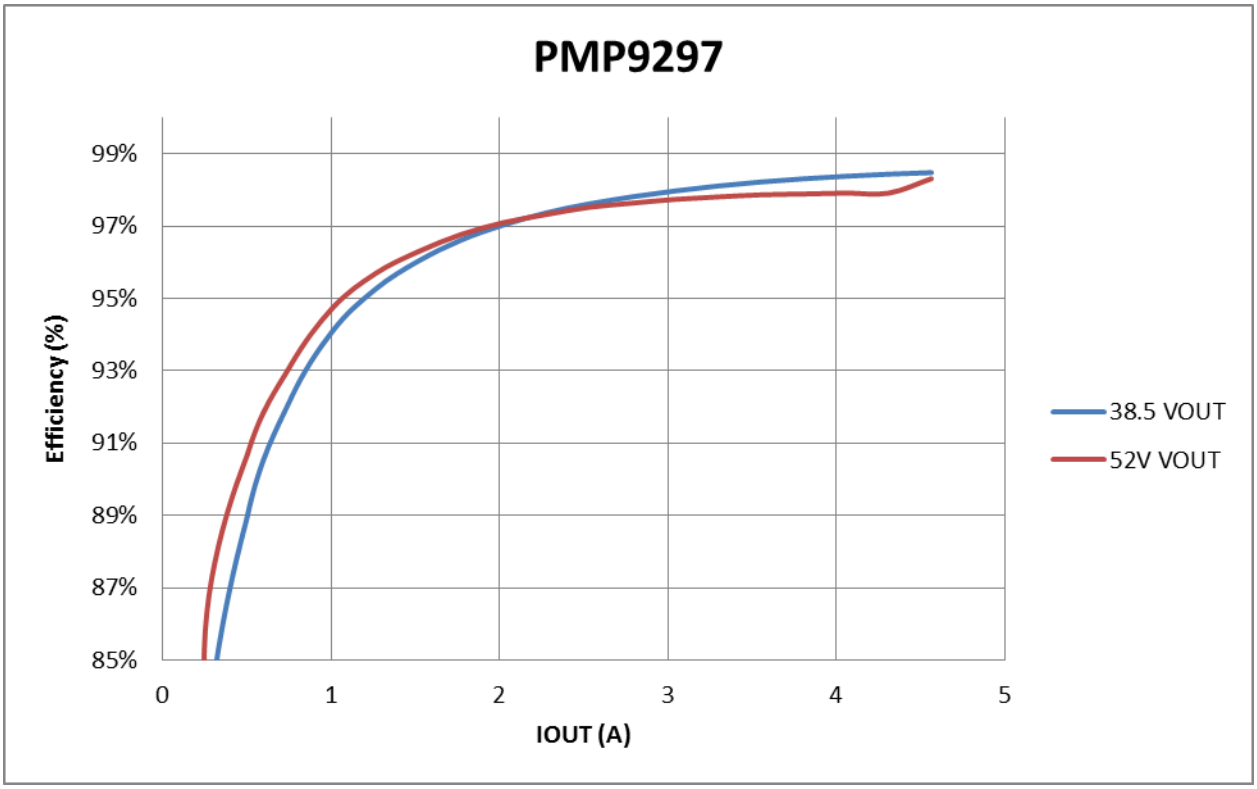
Top Layer



Bottom Layer

3. Efficiency

3.1 LM5121Boost Efficiency Data



3.2 LM5121 38V out Efficiency

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
34.999	0.066	38.404	0.000	0.18%	2.321	0.004	2.317
34.999	0.066	38.405	0.000	0.12%	2.323	0.003	2.320
34.998	0.334	38.404	0.247	81.34%	11.680	9.501	2.180
34.998	0.619	38.400	0.502	88.96%	21.655	19.264	2.391
34.998	0.900	38.398	0.756	92.18%	31.484	29.022	2.462
34.998	1.177	38.396	1.010	94.11%	41.204	38.775	2.429
34.998	1.455	38.395	1.264	95.26%	50.937	48.523	2.414
34.997	1.734	38.394	1.518	96.04%	60.682	58.278	2.404
34.997	2.012	38.392	1.772	96.62%	70.413	68.032	2.381
34.997	2.290	38.391	2.026	97.04%	80.156	77.786	2.370
34.997	2.569	38.389	2.280	97.37%	89.894	87.534	2.360
34.997	2.848	38.388	2.534	97.62%	99.658	97.286	2.372
34.997	3.126	38.387	2.788	97.82%	109.410	107.020	2.390
34.996	3.405	38.385	3.042	97.98%	119.170	116.760	2.410
34.996	3.685	38.384	3.296	98.12%	128.951	126.521	2.430
34.996	3.964	38.382	3.551	98.23%	138.742	136.280	2.461
34.996	4.244	38.381	3.805	98.31%	148.527	146.024	2.504
34.996	4.524	38.379	4.059	98.39%	158.318	155.763	2.555
34.996	4.804	38.379	4.312	98.44%	168.123	165.507	2.616
34.996	5.085	38.377	4.566	98.49%	177.941	175.247	2.694

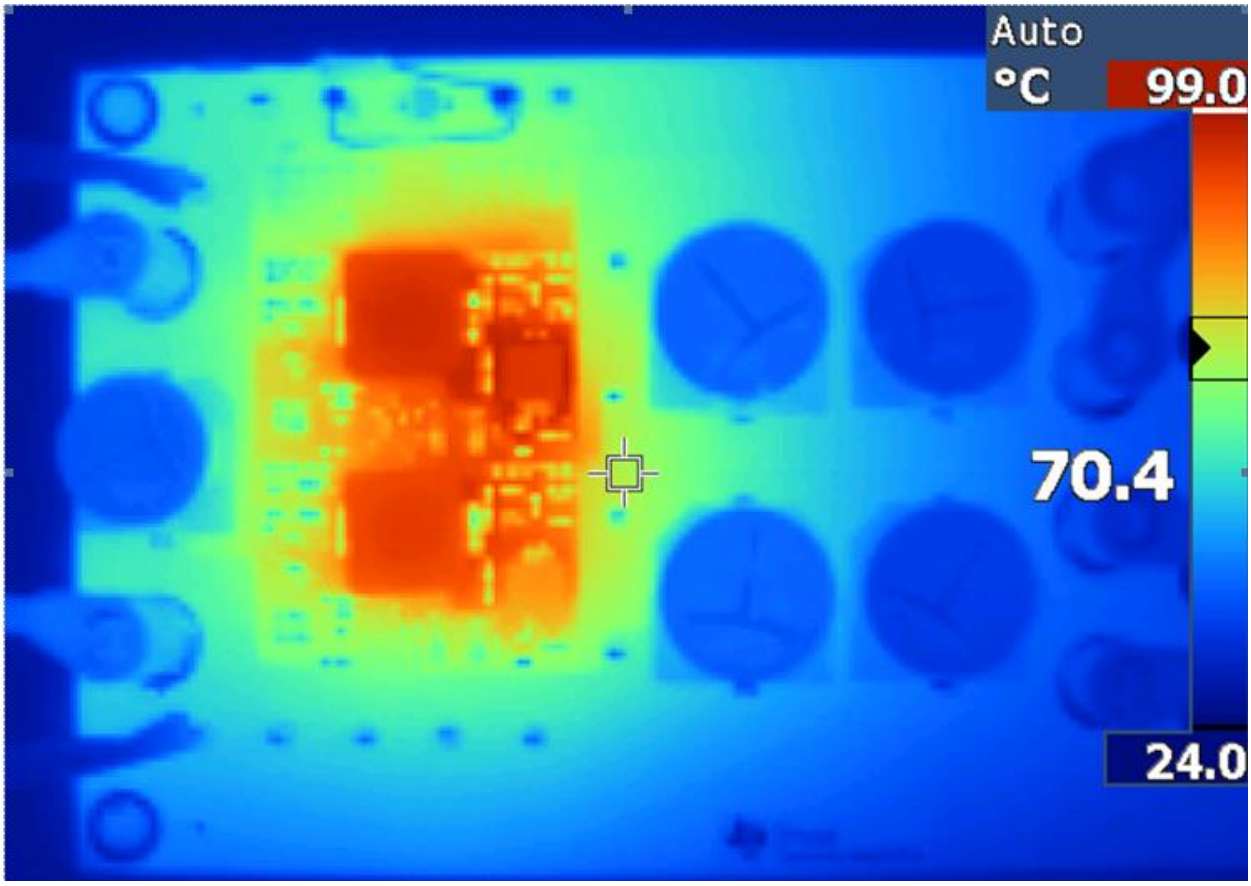
3.3 LM5121 52V out Efficiency

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Efficiency (%)	Pin (W)	Pout (W)	Losses (W)
34.999	0.066	51.419	0.000	1.04%	2.324	0.024	2.299
34.999	0.066	51.419	0.000	0.54%	2.316	0.013	2.303
34.999	0.426	51.418	0.247	85.29%	14.912	12.719	2.193
34.998	0.813	51.413	0.501	90.66%	28.437	25.781	2.656
34.998	1.192	51.410	0.756	93.12%	41.711	38.842	2.870
34.998	1.565	51.409	1.010	94.75%	54.786	51.908	2.878
34.998	1.940	51.408	1.264	95.69%	67.887	64.964	2.923
34.998	2.315	51.407	1.518	96.30%	81.012	78.013	2.999
34.998	2.689	51.406	1.772	96.77%	94.111	91.072	3.039
34.998	3.064	51.406	2.026	97.10%	107.248	104.142	3.105
34.998	3.440	51.405	2.280	97.33%	120.402	117.185	3.217
34.998	3.816	51.404	2.534	97.53%	133.567	130.265	3.302
34.998	4.193	51.403	2.788	97.64%	146.755	143.292	3.463
34.998	4.571	51.403	3.042	97.75%	159.968	156.361	3.606
34.998	4.949	51.402	3.296	97.81%	173.205	169.418	3.788
34.997	5.328	51.402	3.550	97.87%	186.451	182.480	3.971
34.997	5.707	51.401	3.804	97.89%	199.731	195.524	4.207
34.997	6.087	51.401	4.058	97.92%	213.021	208.589	4.431
34.997	6.468	51.400	4.312	97.92%	226.362	221.647	4.715

4. Thermal

4.1 Steady State Temperature - 35V in, 52V out, 3A load each channel

Top View



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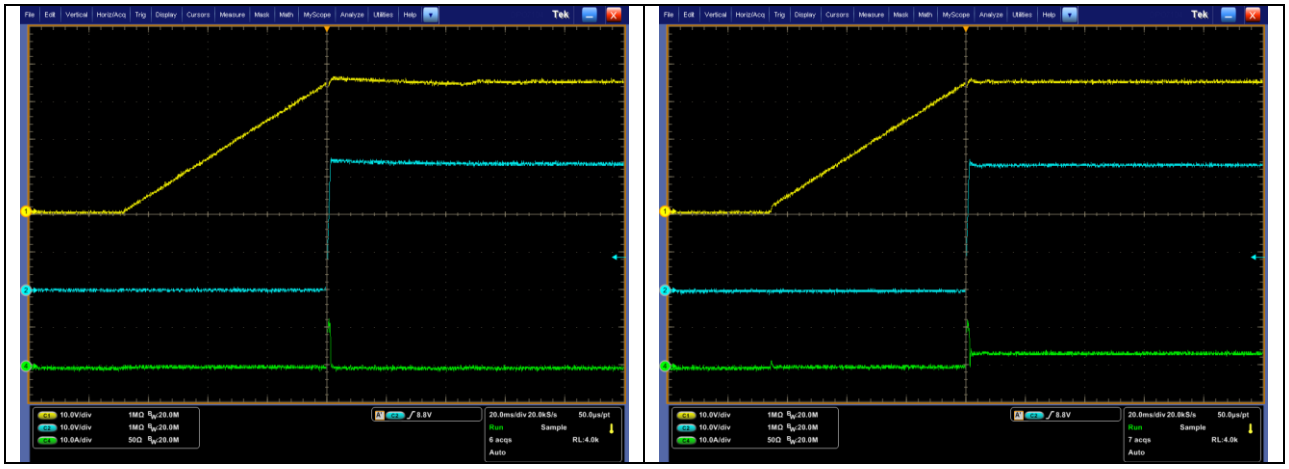
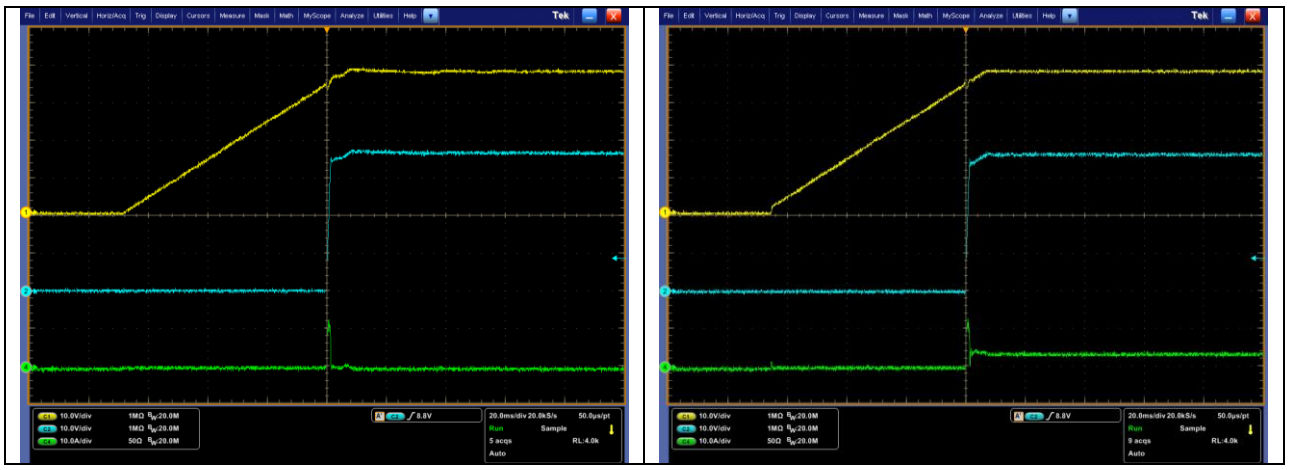
5. Power Up

5.1 Power Up at 34.5V Input – No Load *Power Up at 34.5V Input – 4A Load*



Output 1 38V
Channel 1 VIN
Channel 2 VOUT
Channel 4 IIN

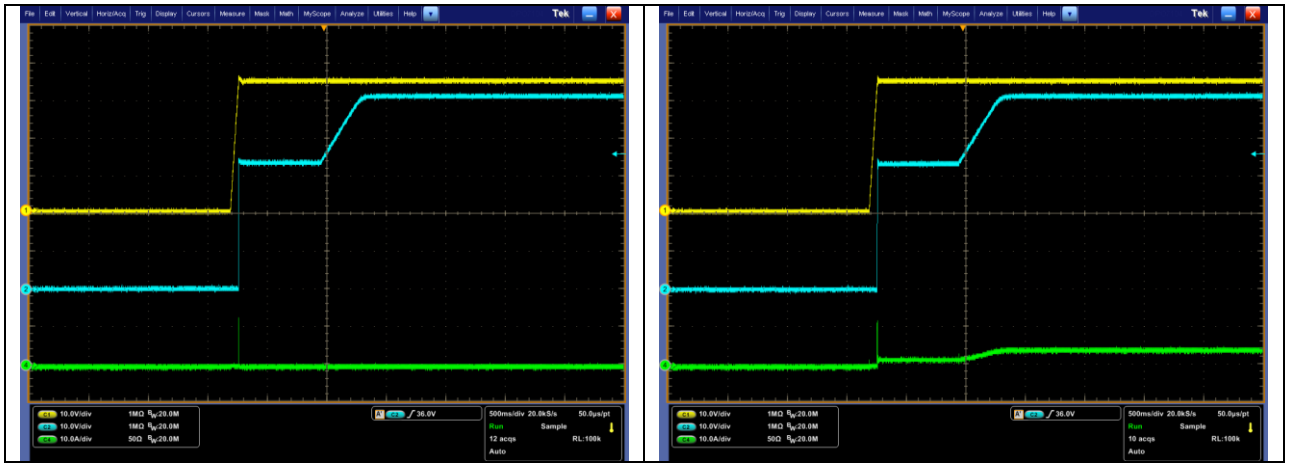
5.2 Power Up at 37.5V Input – No Load *Power Up at 37.5V Input – 4A Load*



Output 1 38V
Channel 1 VIN
Channel 2 VOUT
Channel 4 IIN

5.3 Power Up at 34.5V Input – No Load

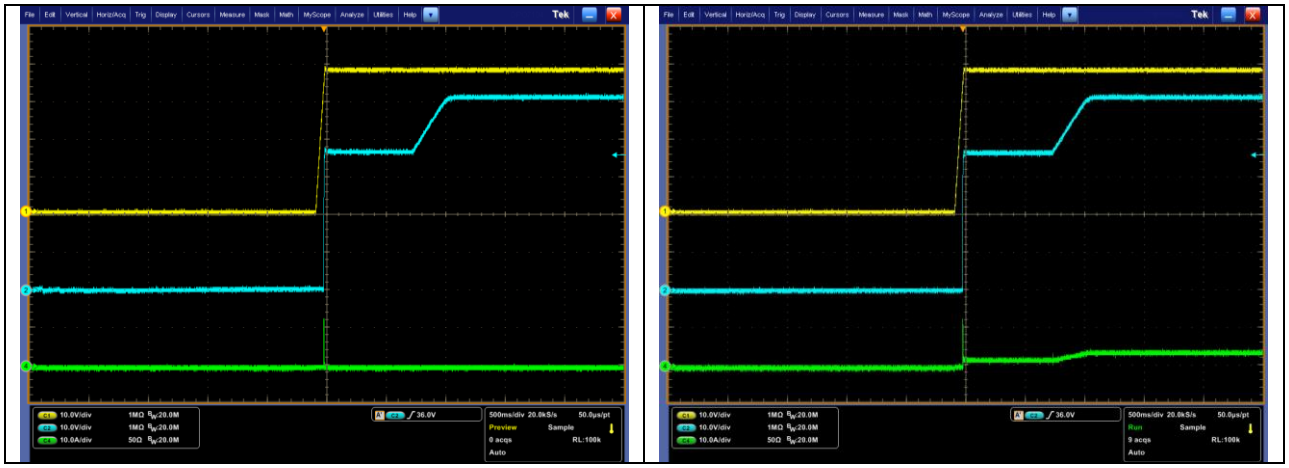
Power Up at 34.5V Input – 3A Load



Output 2 52V
Channel 1 VIN
Channel 2 VOUT
Channel 4 IIN

5.4 Power Up at 37.5V Input – No Load

Power Up at 37.5V Input – 3A Load



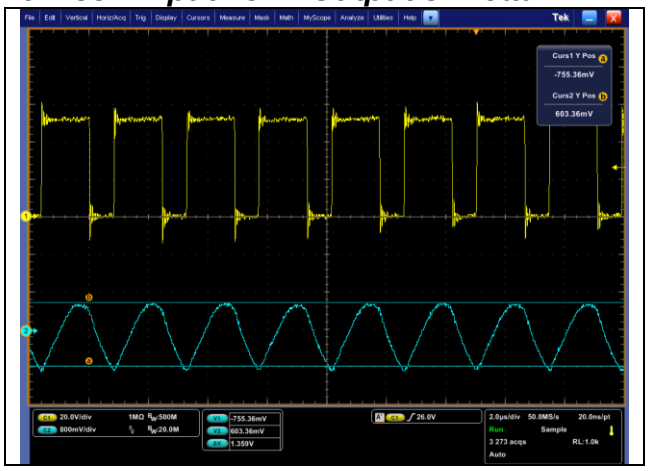
Output 2 52V
Channel 1 VIN
Channel 2 VOUT
Channel 4 IIN

6. Switch Node Voltage and Output Ripple Voltage

6.1 35V Input –38V Output 4A load

Output 1 38V
Less than 260mV p-p Ripple
Channel 1 VSW
Channel 2 VOUT

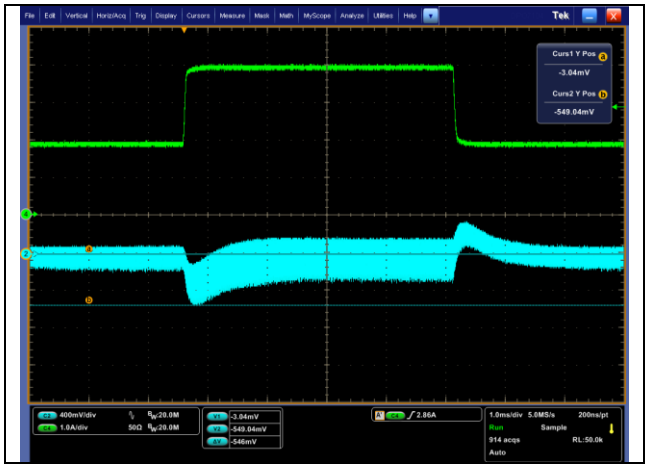
6.2 35V Input –52V Output 3A load



Output 2 52V
Less than 1.4V p-p Ripple
Channel 1 VSW
Channel 2 VOUT

7. Transient Response

7.1 34.5V Input – 2A to 4A, 100mA/µs, 100 Hz, 50% duty cycle, 38V out.

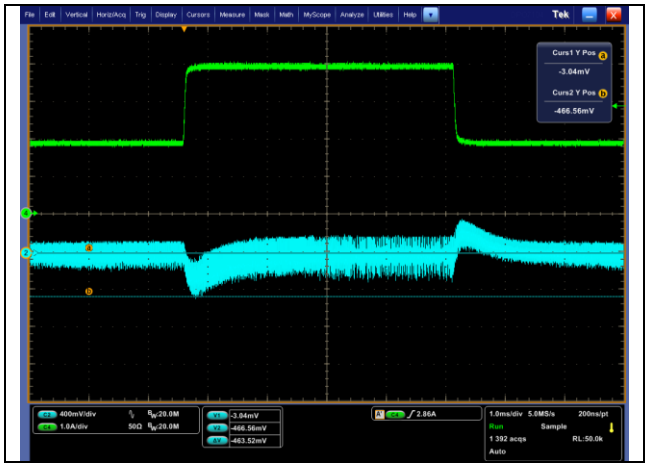


Cursors indicate ~550mV maximum deviation.

Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

7.2 37.5V Input – 2A to 4A, 100mA/µs, 100 Hz, 50% duty cycle, 38V out.

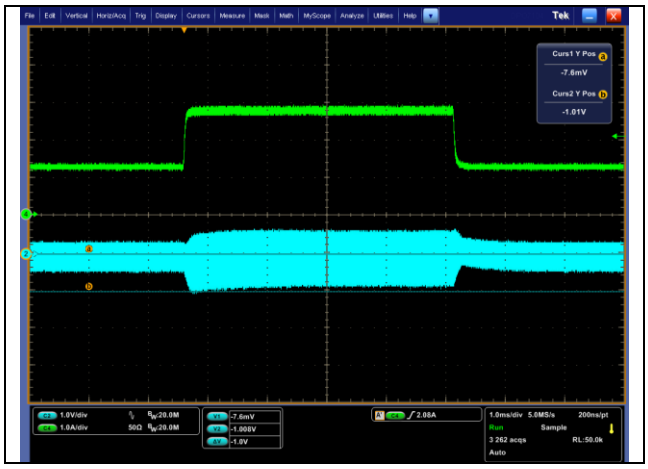


Cursors indicate ~465mV maximum deviation.

Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

7.3 34.5V Input – 1.5A to 3A, 100mA/µs, 100 Hz, 50% duty cycle, 52V out.

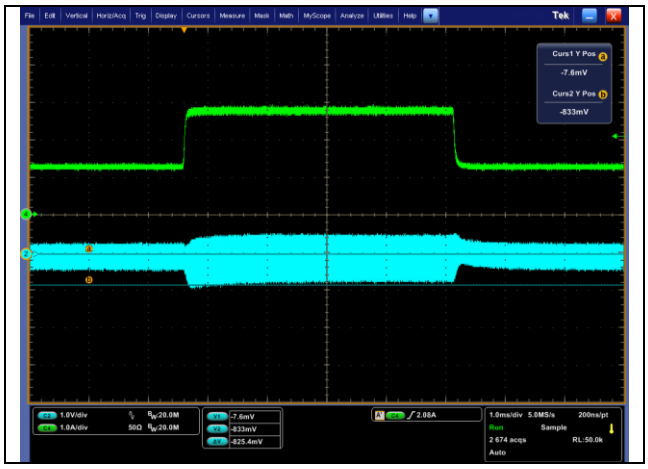


Cursors indicate ~1V maximum deviation.

Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

7.4 37.5V Input – 1.5A to 3A, 100mA/µs, 100 Hz, 50% duty cycle, 52V out.



Cursors indicate ~825mV maximum deviation.

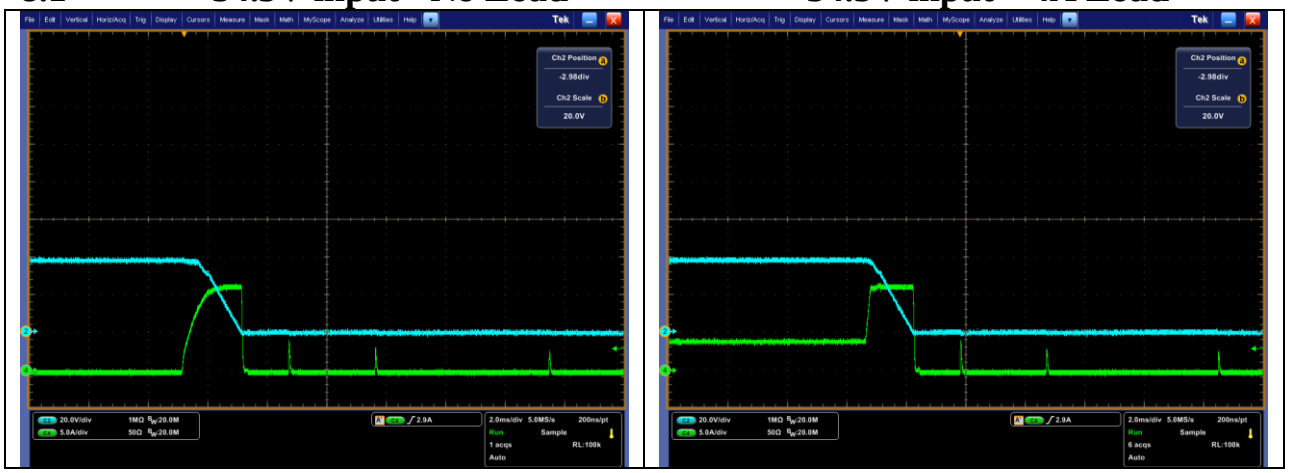
Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

8. Current Limit Tests

This test was conducted by load stepping to an over current condition.

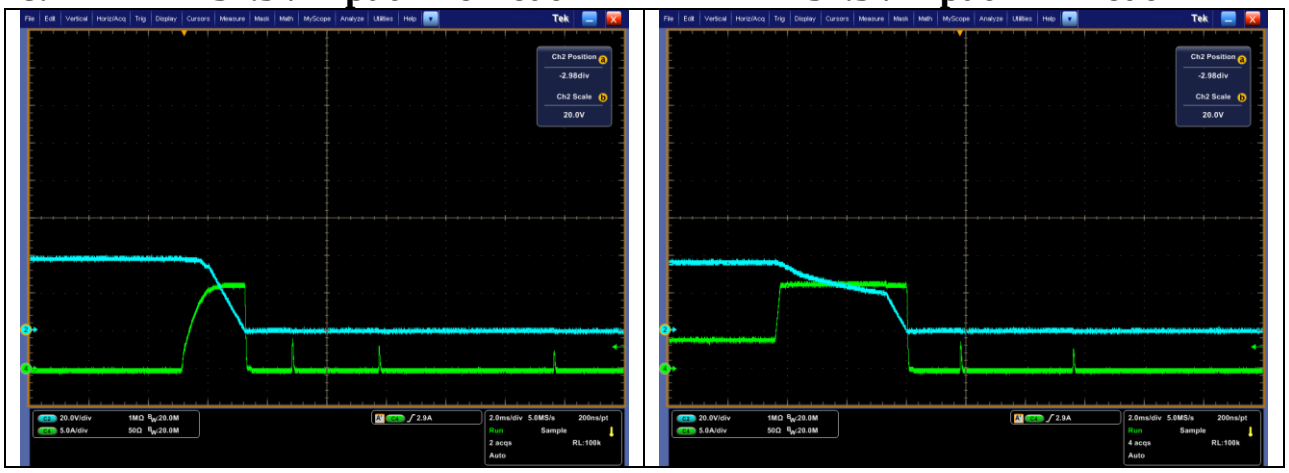
8.1 34.5V input - No Load 34.5V input – 4A Load



Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

8.2 37.5V input - No Load 37.5V input - 4A Load

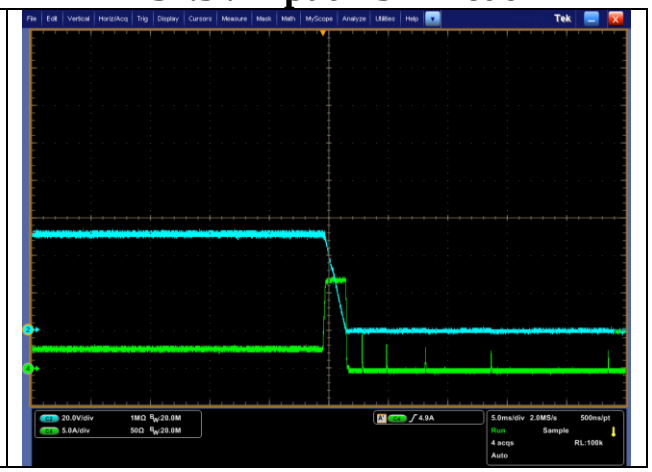


Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

8.3 34.5V input – No Load

34.5V input – 3 A Load

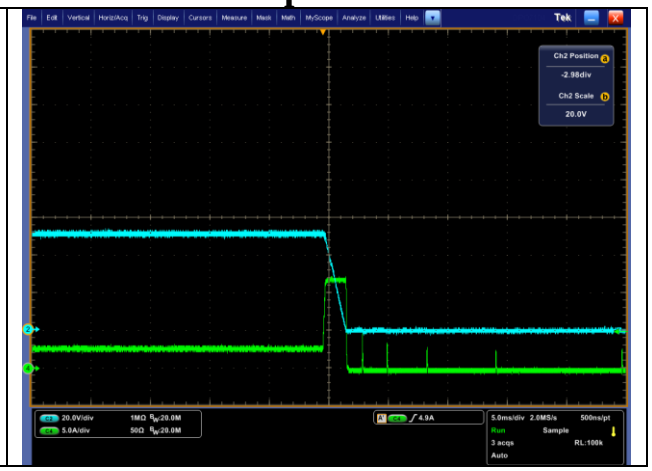


Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

8.4 37.5V input – No Load

37.5V input – 3A Load



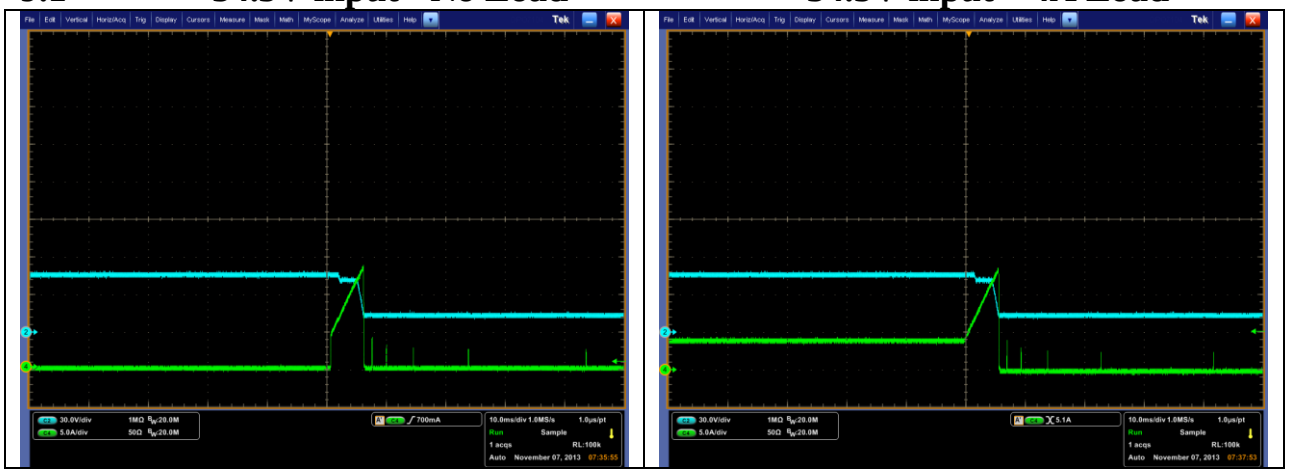
Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

9. Short Circuit Tests (I OUT Monitored)

This test was conducted by applying a short to the output.

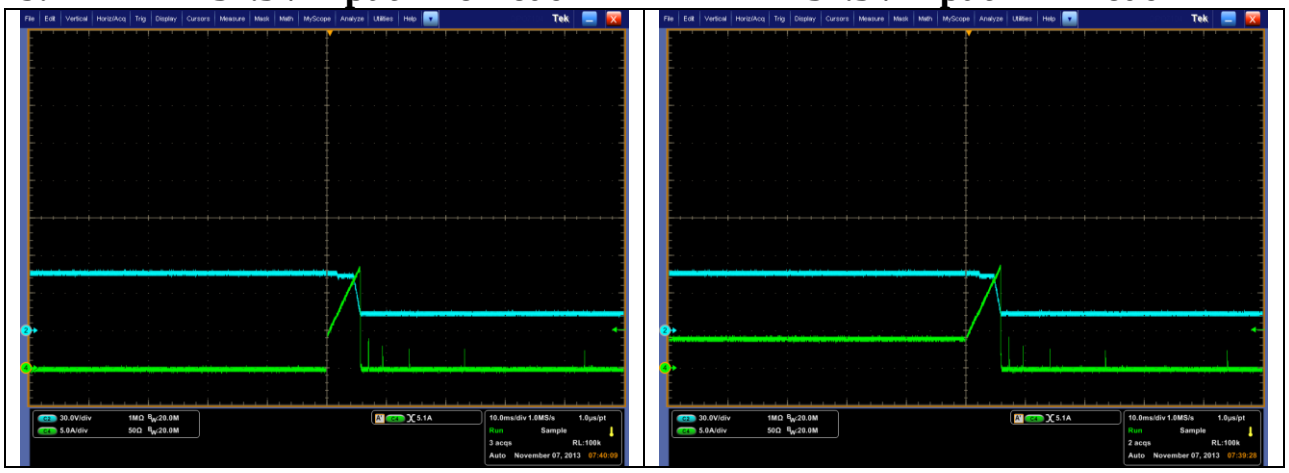
9.1 34.5V input - No Load 34.5V input – 4A Load



Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

9.2 37.5V input - No Load 37.5V input - 4A Load



Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

9.3 34.5V input – No Load

34.5V input – 3 A Load

Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

9.4 37.5V input – No Load

37.5V input – 3A Load

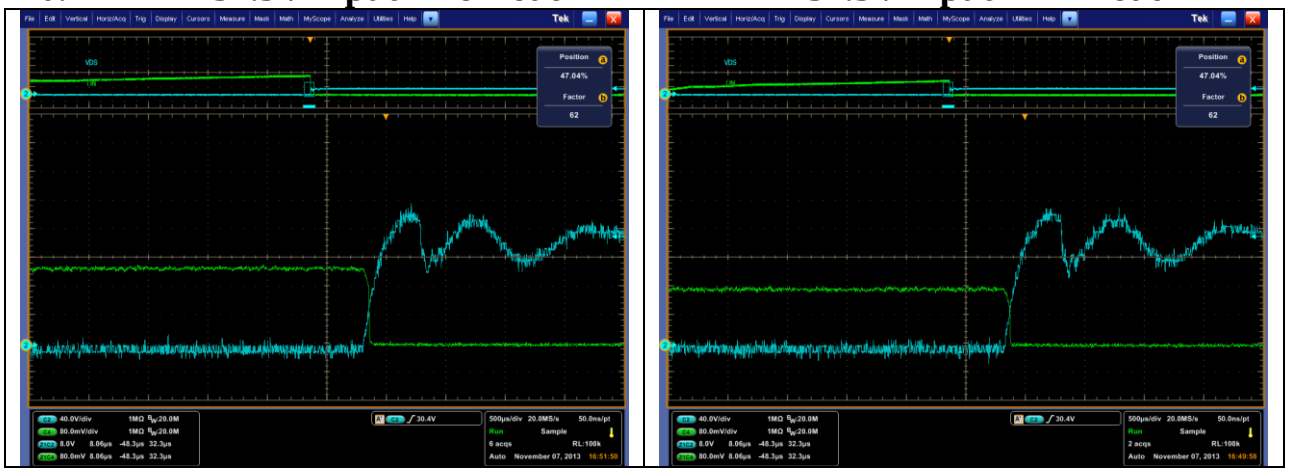
Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

10. Short Circuit Tests (I IN Monitored)

This test was conducted by applying a short to the output. A differential probe was placed across the current sense resistor and VDS was also measured.

10.1 34.5V input - No Load 34.5V input – 4A Load



Output 1 38V

Channel 2 VDS
Channel 4 IIN

10.2 37.5V input - No Load 37.5V input - 4A Load

Output 1 38V

Channel 2 VDS
Channel 4 IIN

10.3 34.5V input – No Load

34.5V input – 3 A Load

Output 2 52V

Channel 2 VDS
Channel 4 IIN

10.4 37.5V input – No Load

37.5V input – 3A Load

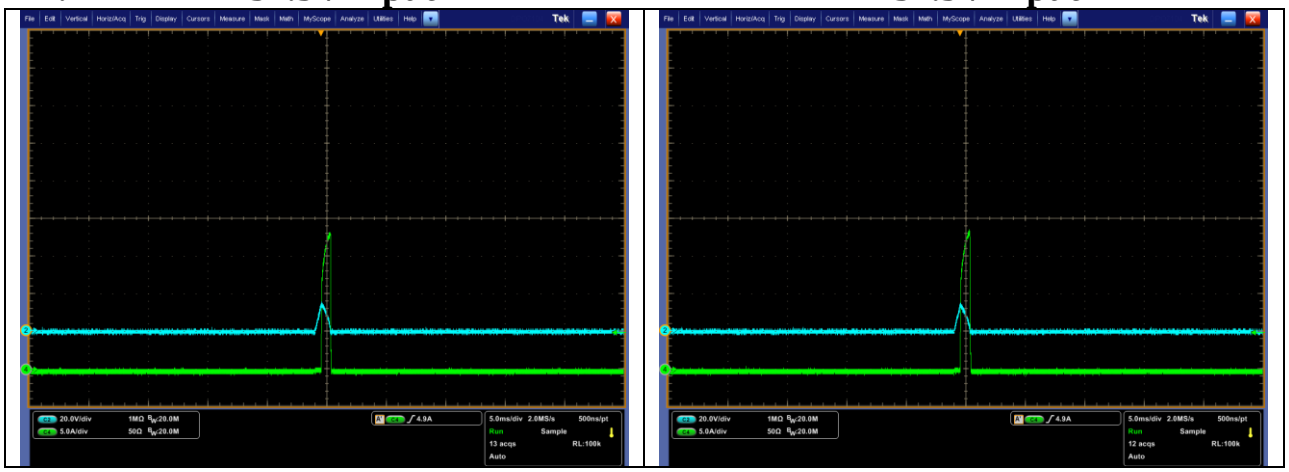
Output 2 52V

Channel 2 VDS
Channel 4 IIN

11. Power Up into a Short Circuit

This test was conducted by powering up into a short condition. Latch off.

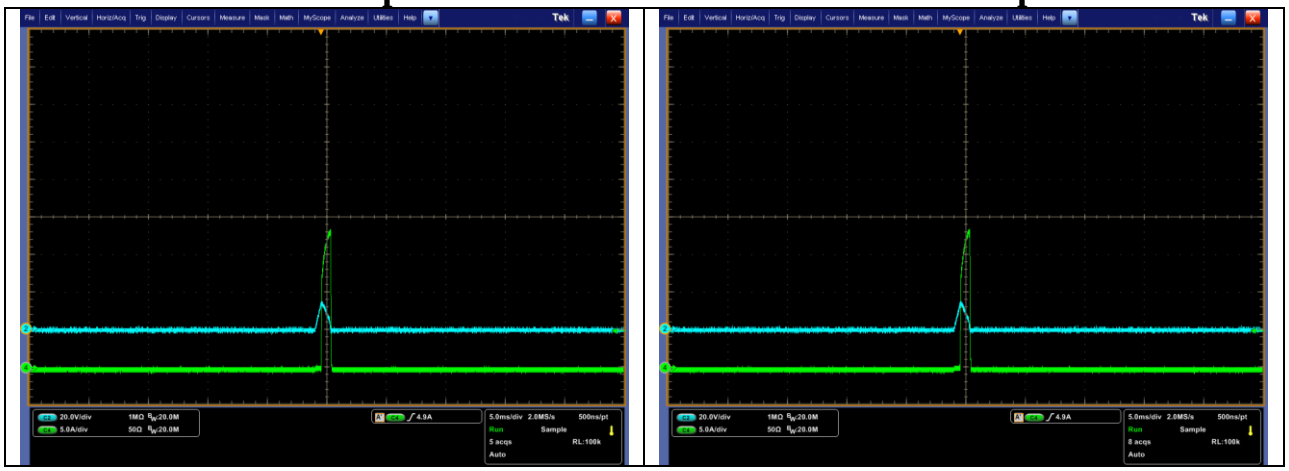
11.1 34.5V input 37.5V input



Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

11.2 34.5V input 37.5V input



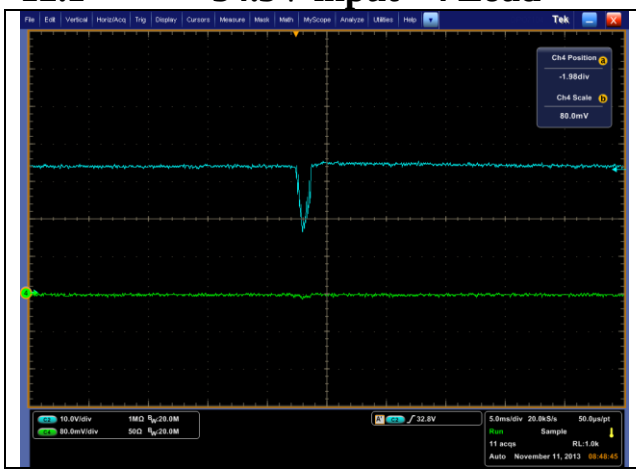
Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

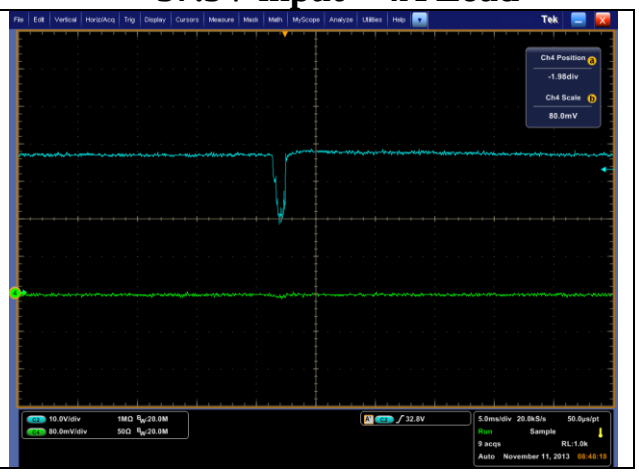
12. UVLO into a Short Circuit

Under voltage lock out was toggled to ground to restart into a short circuit. A differential probe was placed across the current sense resistor and VDS was also measured.

12.1 34.5V input - 4 Load



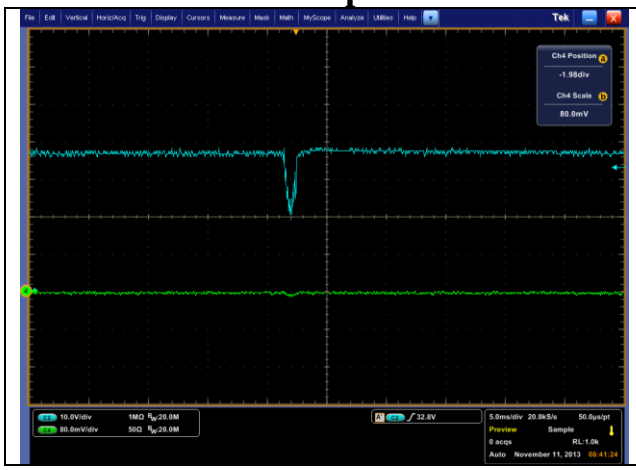
37.5V input – 4A Load



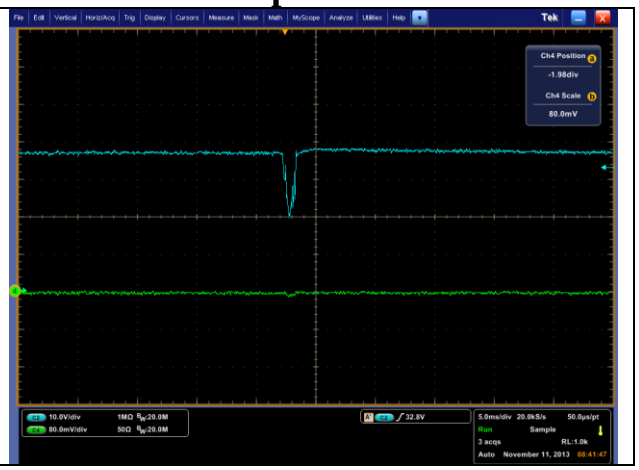
Output 1 38V

Channel 2 VDS
Channel 4 IIN

12.2 34.5V input – 3A load



37.5V input – 3 A Load



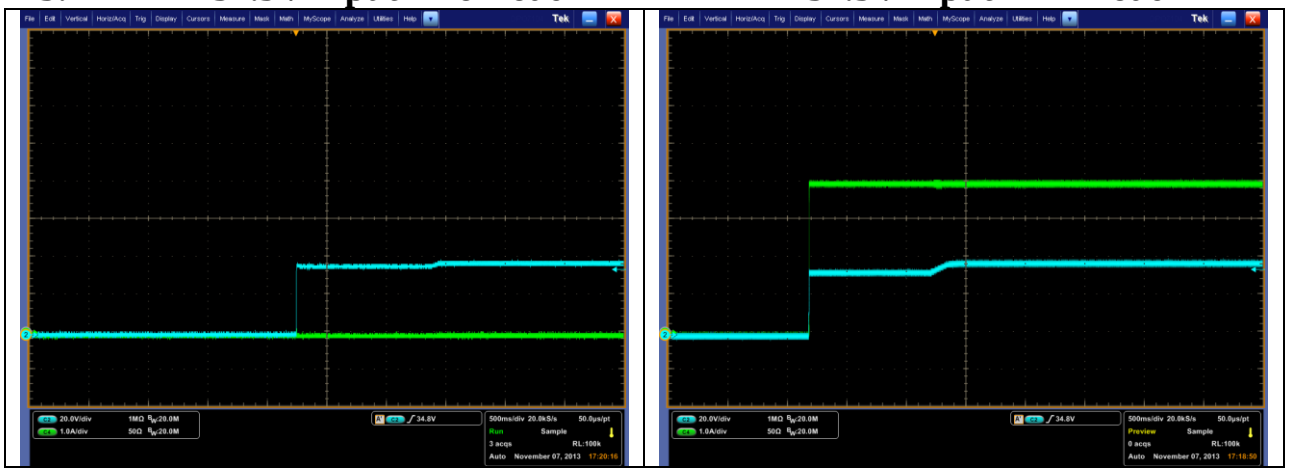
Output 2 52V

Channel 2 VDS
Channel 4 IIN

13. Short Circuit Recovery (UVLO)

Under voltage lock out was toggled to ground to restart after short circuit.

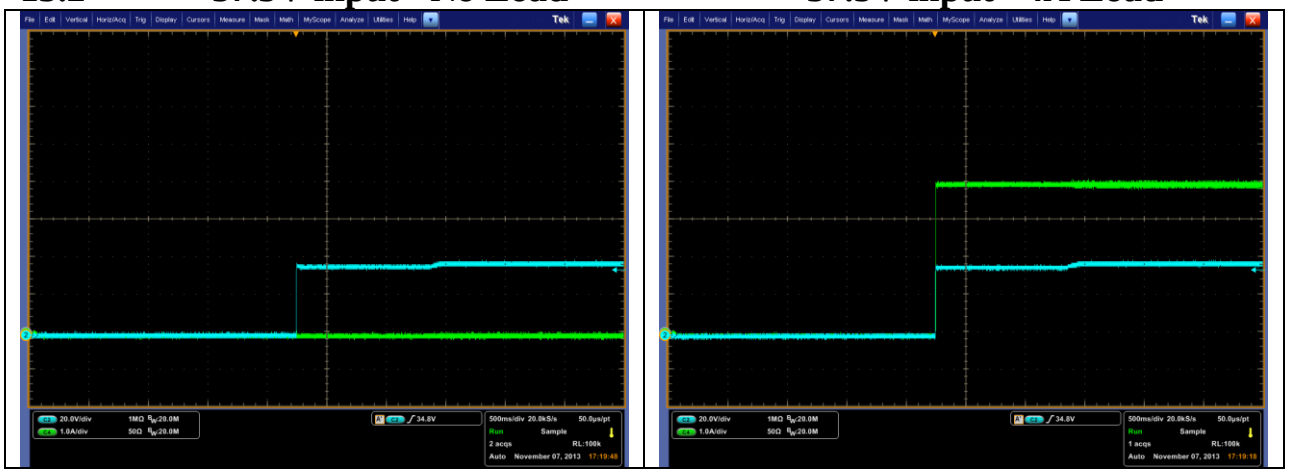
13.1 34.5V input - No Load 34.5V input – 4A Load



Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

13.2 37.5V input - No Load 37.5V input - 4A Load



Output 1 38V

Channel 2 VOUT
Channel 4 IOUT

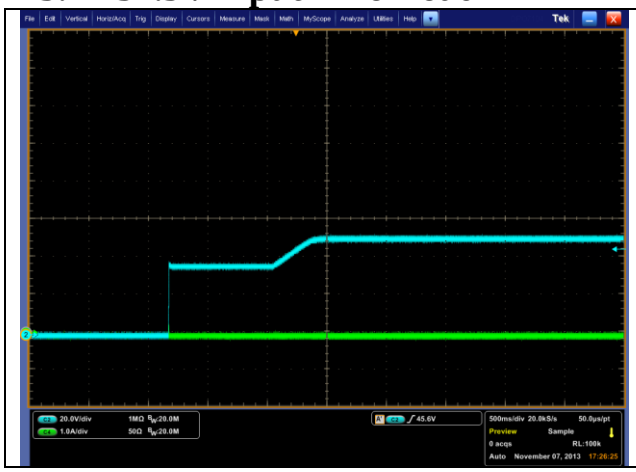
13.3 34.5V input – No Load

34.5V input – 3 A Load

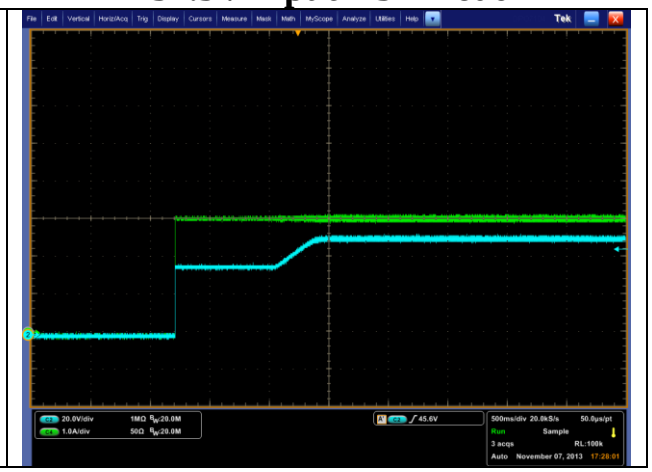
Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

13.4 37.5V input – No Load



37.5V input – 3A Load



Output 2 52V

Channel 2 VOUT
Channel 4 IOUT

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