LM5119 Dual Phase Synchronous Buck Converter

TI reference design number: PMP20804 Rev A

Input: 20V to 40V
Output: 12V @ 33A

DC – DC Test Results

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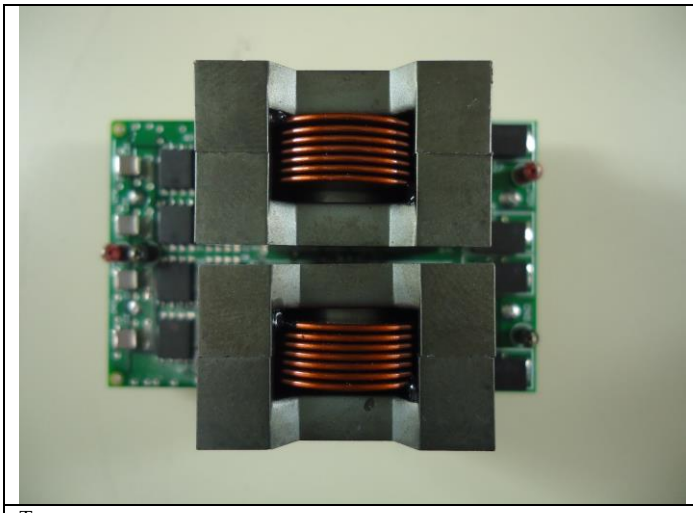
1 Circuit Description

PMP20804 is a dual-phase synchronous buck converter utilizing the LM5119 dual synchronous buck controller I.C. The design accepts an input voltage of 20V to 40V and provides a 12V output capable of supplying 33A of current to the load. This represents a power density design of 400W in a quarter brick footprint. The maximum component height is set by the Coilcraft VER2923-103 inductors at 0.875 in.

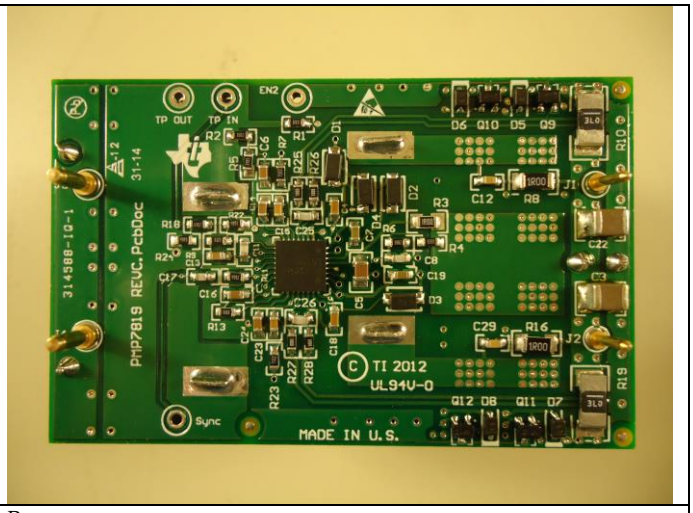
At tests were performed at room temperature on an open bench. Airflow or heat sink is required for full load operation. A 100uF 100V aluminum electrolytic capacitor was used for damping at the input.

2 Photos

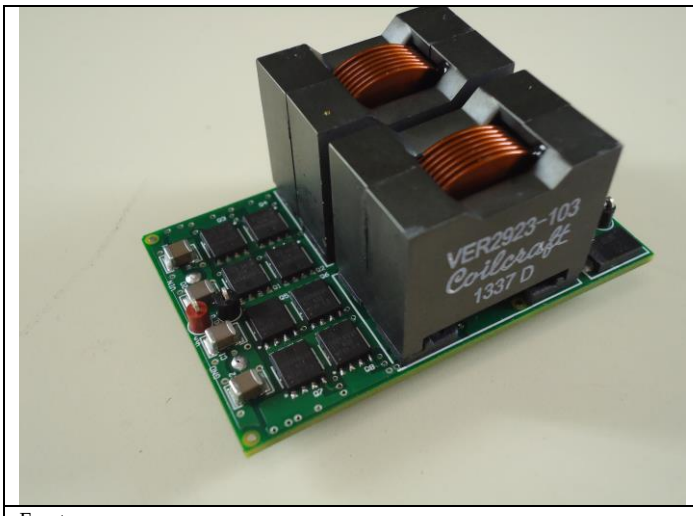
The photographs below show the PMP20804 assembly as built on the PMP7819 Rev C printed circuit board. This is a 4-layer PCB with 3 oz. copper on the external layers and 1 oz. copper on the inner layers. Board dimensions are the standard quarter brick footprint of 2.30 in. x 1.45 in.



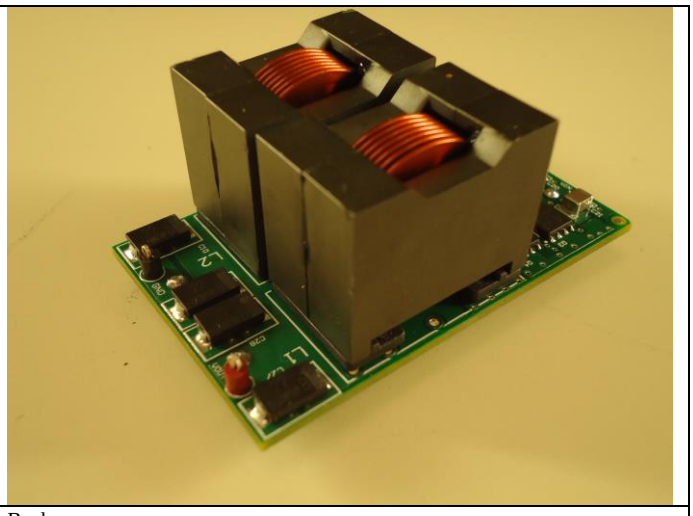
Top



Bottom



Front

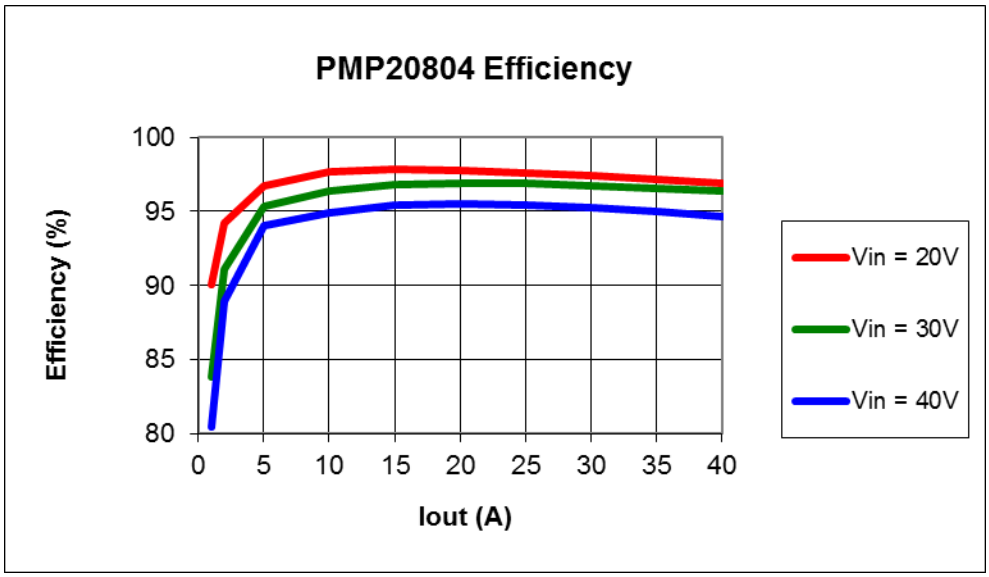


Back

3 Efficiency

3.1 Efficiency

The efficiency data is shown in the tables and graphs below.



Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Losses (W)	Efficiency (%)
20.0061	0.0560	12.0371	-0.0080	1.120	-0.096	1.217	-8.60
20.0059	0.6800	12.0352	1.0180	13.604	12.252	1.352	90.06
20.0054	1.2880	12.0342	2.0180	25.767	24.285	1.482	94.25
20.0046	3.1200	12.0298	5.0180	62.414	60.366	2.049	96.72
20.0041	6.1640	12.0225	10.0180	123.305	120.441	2.864	97.68
20.0025	9.2200	12.0156	15.0180	184.423	180.450	3.974	97.85
20.0018	12.3540	12.0080	20.1220	247.102	241.626	5.476	97.78
20.0010	15.4360	12.0009	25.1160	308.735	301.415	7.321	97.63
20.0015	18.5320	11.9935	30.1080	370.668	361.100	9.567	97.42
20.0031	21.6480	11.9859	35.1080	433.026	420.799	12.227	97.18
20.0064	24.7780	11.9782	40.1140	495.720	480.494	15.226	96.93

PMP20804 Rev A Test Results

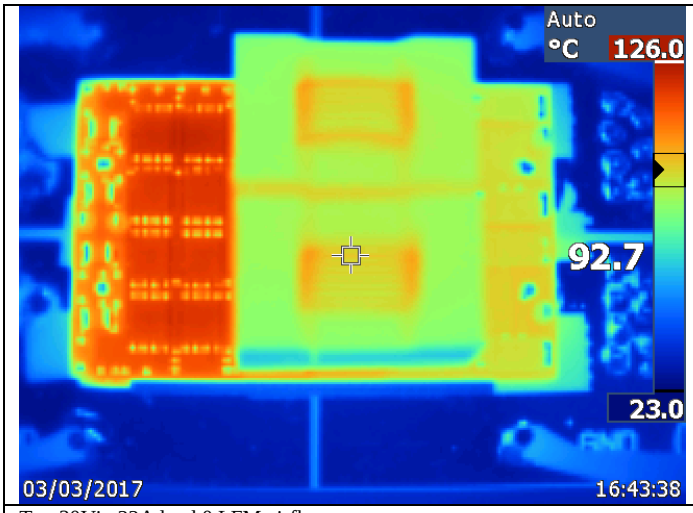
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Losses (W)	Efficiency (%)
30.0099	0.0720	12.0370	-0.0080	2.161	-0.096	2.257	-4.46
30.0099	0.4860	12.0359	1.0160	14.585	12.228	2.356	83.84
30.0097	0.8880	12.0342	2.0180	26.649	24.285	2.364	91.13
30.0093	2.1100	12.0303	5.0160	63.320	60.344	2.976	95.30
30.0073	4.1640	12.0231	10.0160	124.950	120.423	4.527	96.38
30.0039	6.2100	12.0156	15.0160	186.324	180.426	5.898	96.83
29.9985	8.3100	12.0082	20.1200	249.288	241.604	7.684	96.92
29.9919	10.3760	12.0010	25.1160	311.196	301.418	9.778	96.86
29.9832	12.4520	11.9935	30.1080	373.350	361.100	12.250	96.72
29.9726	14.5420	11.9860	35.1100	435.862	420.828	15.034	96.55
29.9605	16.6460	11.9788	40.1140	498.722	480.519	18.203	96.35

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Losses (W)	Efficiency (%)
40.0125	0.0700	12.0379	-0.0080	2.801	-0.096	2.897	-3.44
40.0126	0.3800	12.0361	1.0160	15.205	12.229	2.976	80.43
40.0126	0.6820	12.0346	2.0160	27.289	24.262	3.027	88.91
40.0112	1.6040	12.0305	5.0160	64.178	60.345	3.833	94.03
40.0065	3.1720	12.0227	10.0180	126.901	120.443	6.457	94.91
39.9974	4.7280	12.0158	15.0160	189.108	180.429	8.678	95.41
39.9838	6.3260	12.0083	20.1220	252.938	241.631	11.307	95.53
39.9659	7.9020	12.0009	25.1160	315.810	301.415	14.396	95.44
39.9431	9.4920	11.9935	30.1080	379.139	361.100	18.039	95.24
39.9157	11.1000	11.9861	35.1080	443.064	420.808	22.256	94.98
39.8831	12.7240	11.9783	40.1140	507.473	480.499	26.974	94.68

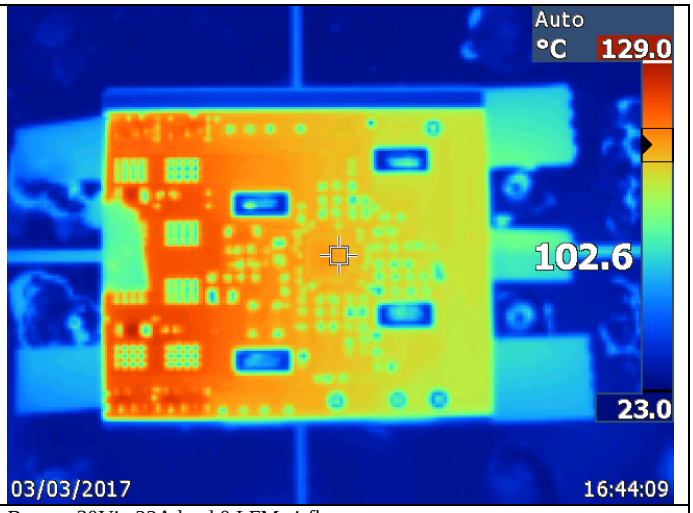
4 Thermal

4.1 Thermal Plots

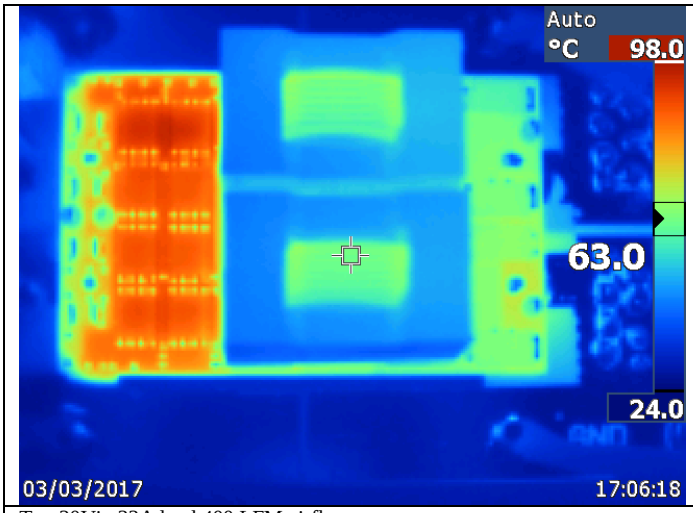
Thermal plots were taken at room temperature on an open bench. Airflow or heat sink is required for full load operation.



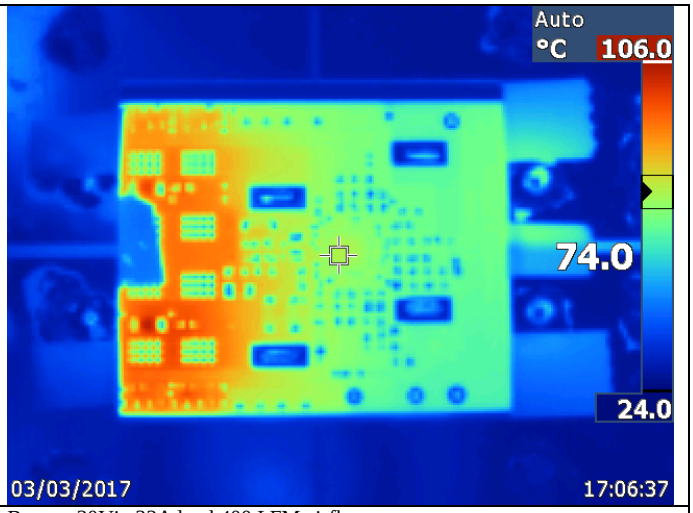
Top 30Vin 22A load 0 LFM airflow



Bottom 30Vin 22A load 0 LFM airflow



Top 30Vin 33A load 400 LFM airflow

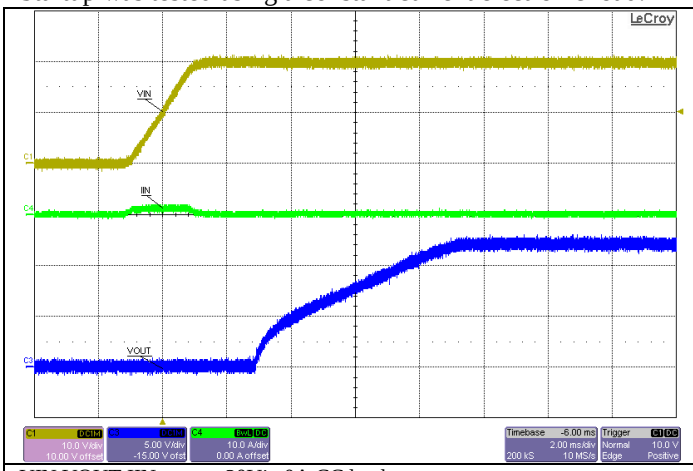


Bottom 30Vin 33A load 400 LFM airflow

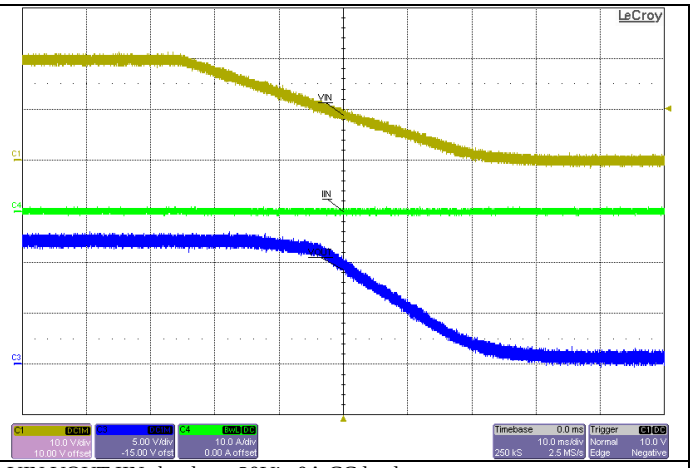
5 Startup

5.1 Startup and Shutdown from Vin

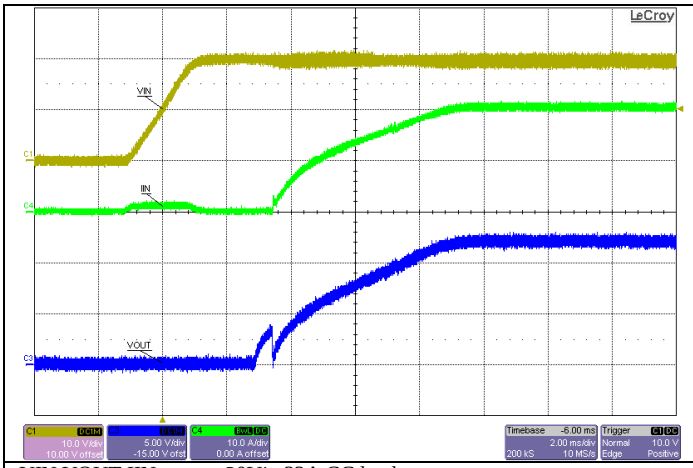
Startup was tested using a constant current electronic load.



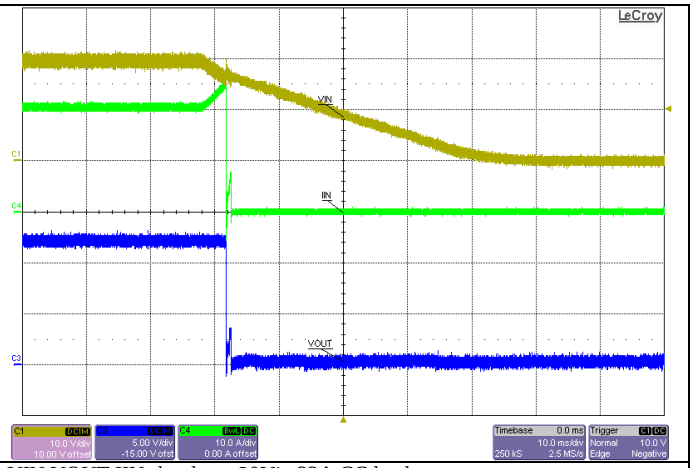
VIN VOUT IIN startup 20Vin 0A CC load



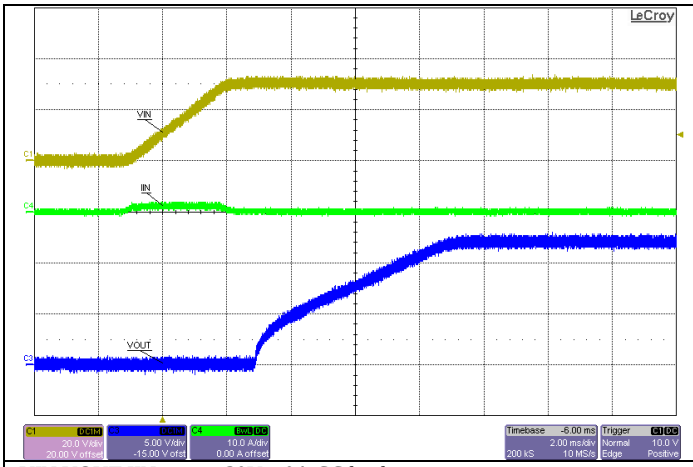
VIN VOUT IIN shutdown 20Vin 0A CC load



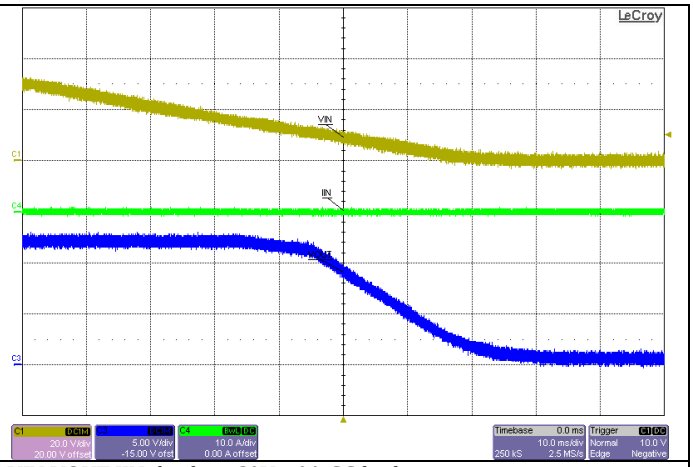
VIN VOUT IIN startup 20Vin 33A CC load



VIN VOUT IIN shutdown 20Vin 33A CC load



VIN VOUT IIN startup 30Vin 0A CC load



VIN VOUT IIN shutdown 30Vin 0A CC load

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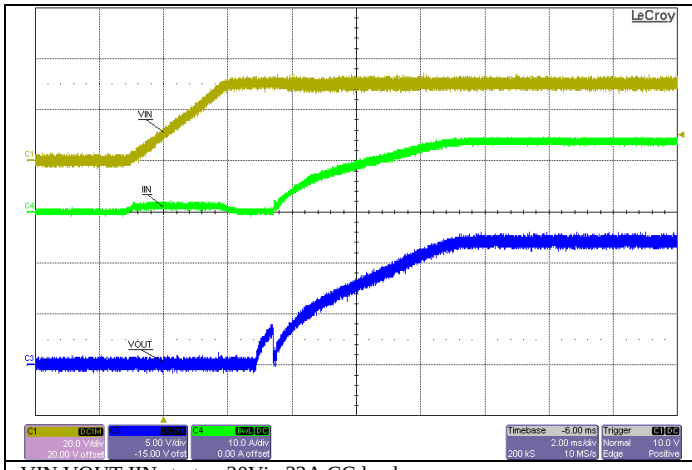
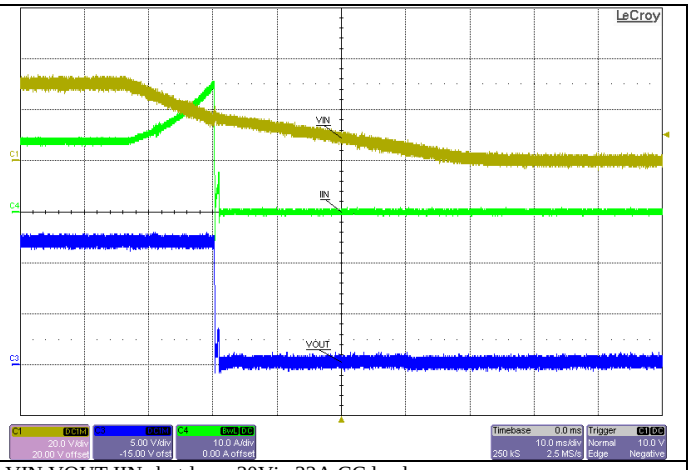
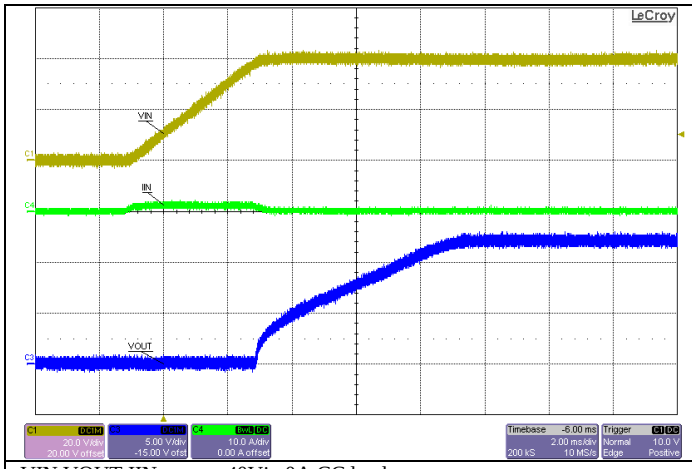


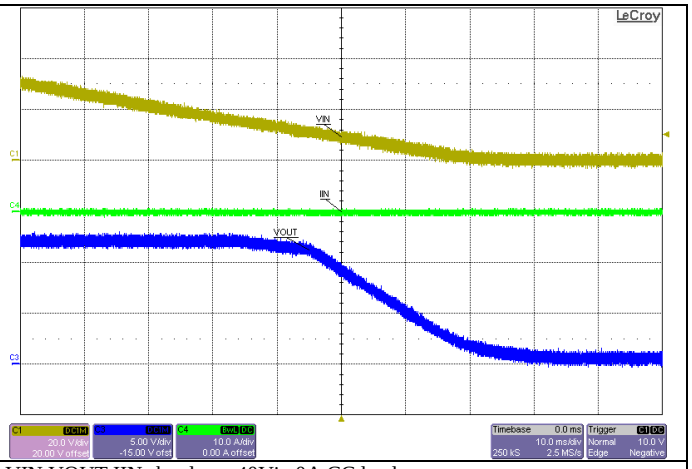
VIN VOUT IIN startup 30Vin 33A CC load



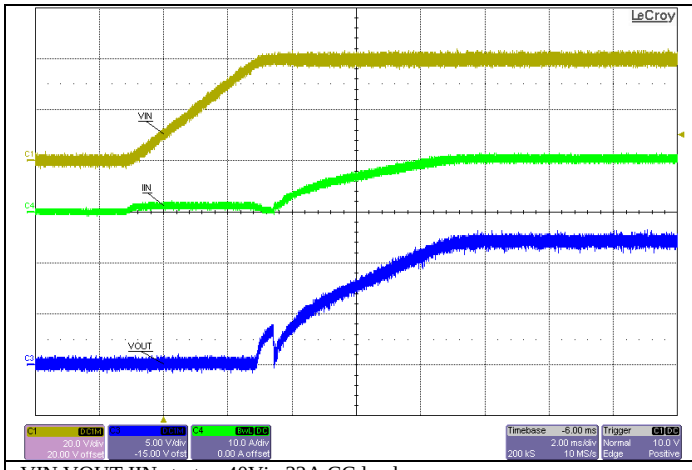
VIN VOUT IIN shutdown 30Vin 33A CC load



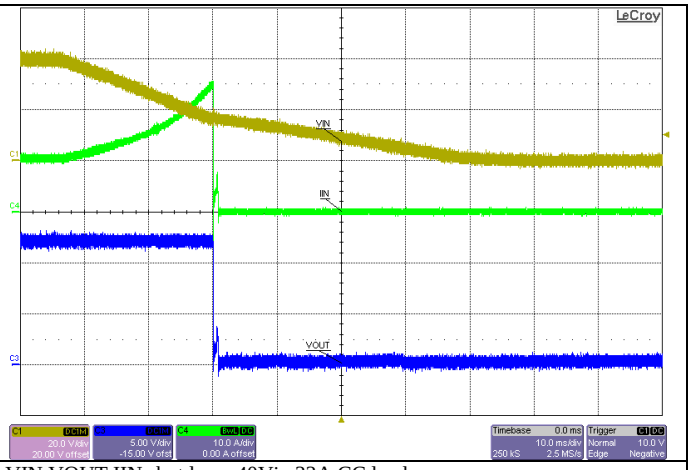
VIN VOUT IIN startup 40Vin 0A CC load



VIN VOUT IIN shutdown 40Vin 0A CC load



VIN VOUT IIN startup 40Vin 33A CC load

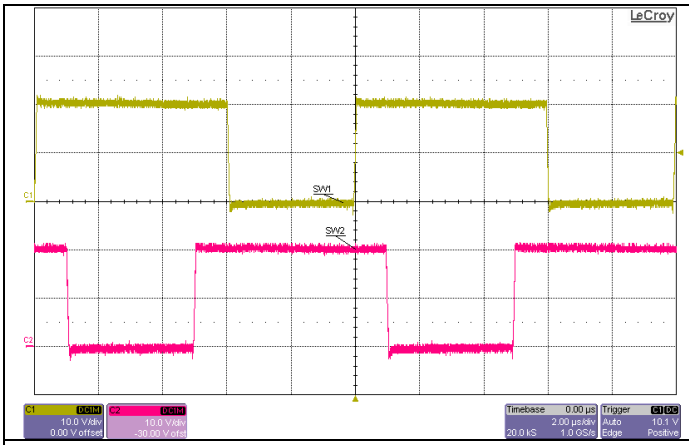


VIN VOUT IIN shutdown 40Vin 33A CC load

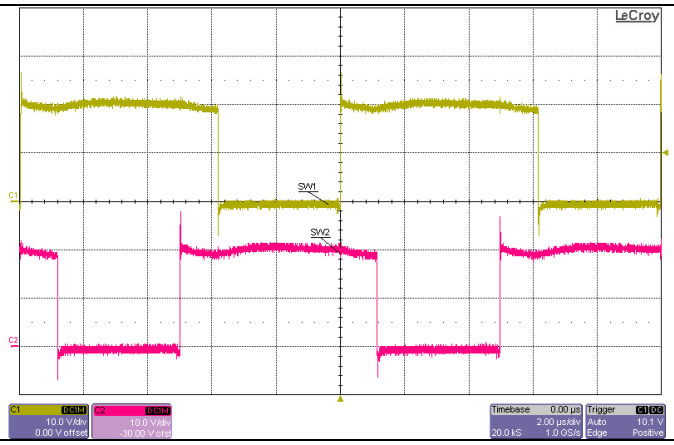
6 Switching

6.1 Switching

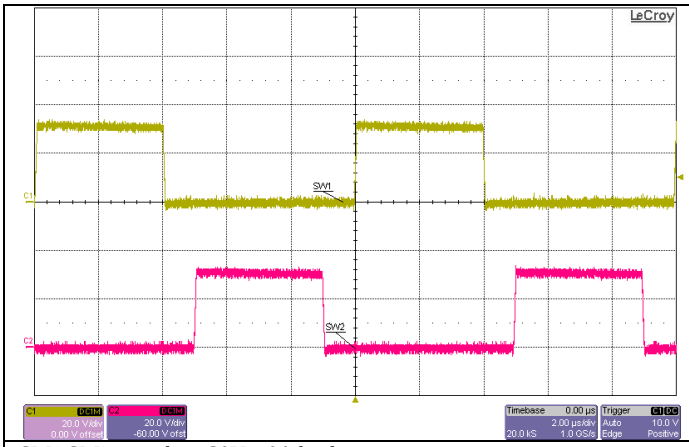
Switching was measured at full bandwidth using 500 MHz probes and 350 MHz oscilloscope.



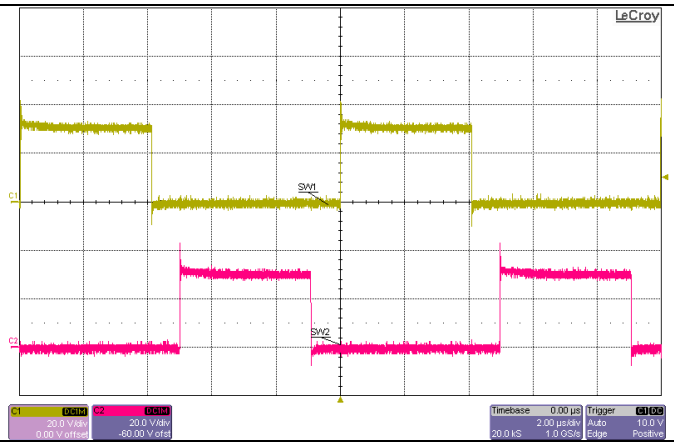
SW1 SW2 switching 20Vin 0A load



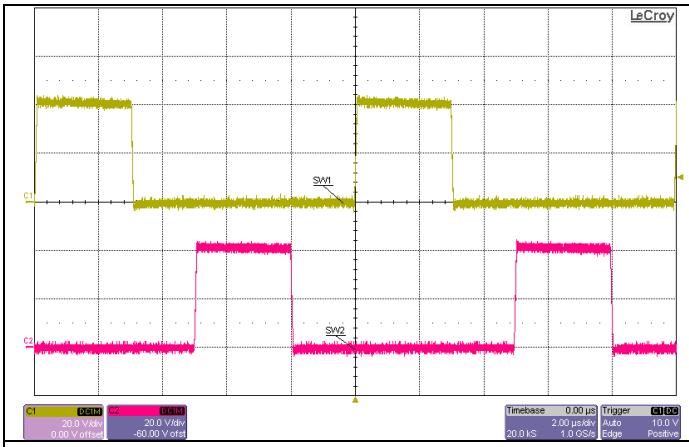
SW1 SW2 switching 20Vin 33A load



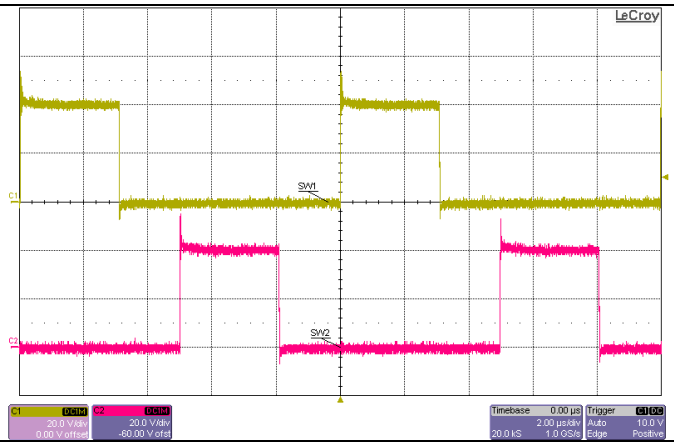
SW1 SW2 switching 30Vin 0A load



SW1 SW2 switching 30Vin 33A load



SW1 SW2 switching 40Vin 0A load

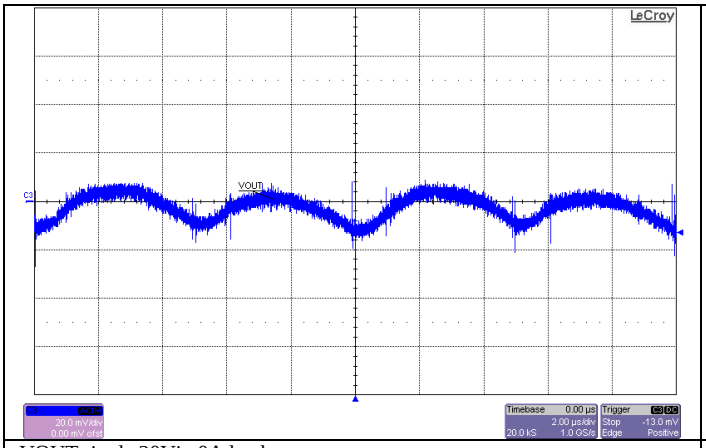


SW1 SW2 switching 40Vin 33A load

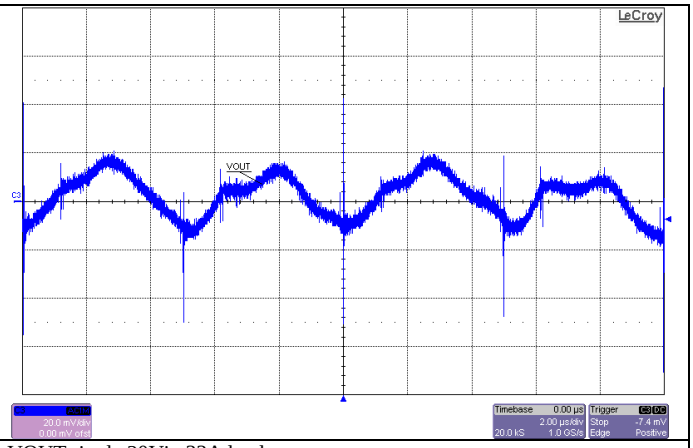
7 Ripple

7.1 Output Voltage Ripple

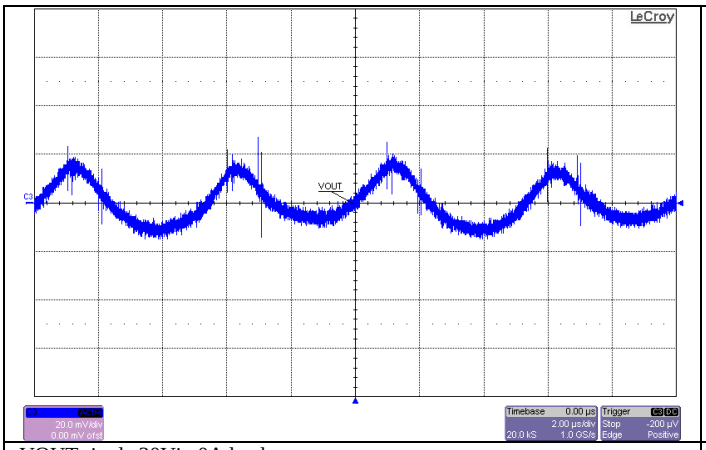
Output voltage ripple was measured at full bandwidth using 500 MHz probes and 350 MHz oscilloscope.



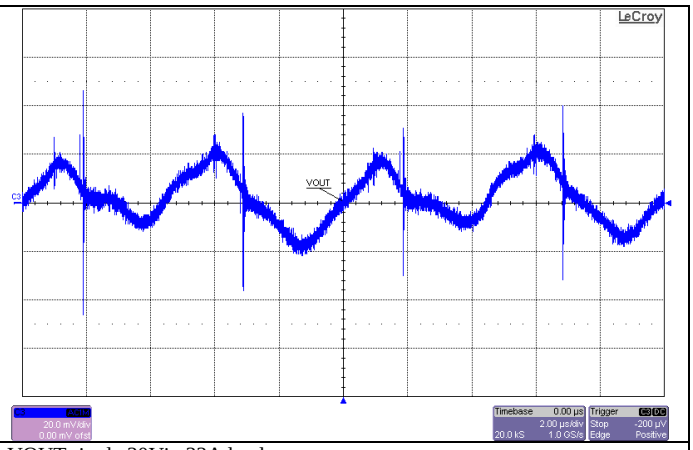
VOUT ripple 20Vin 0A load



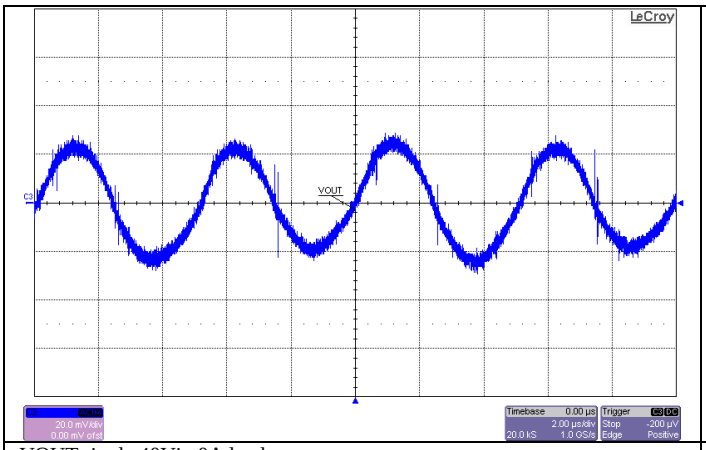
VOUT ripple 20Vin 33A load



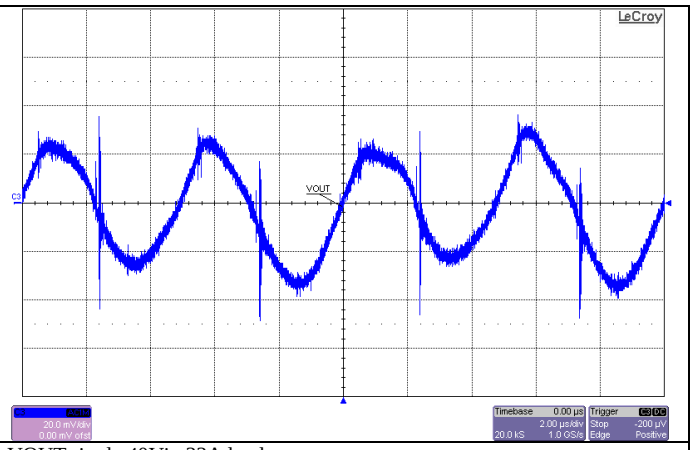
VOUT ripple 30Vin 0A load



VOUT ripple 30Vin 33A load



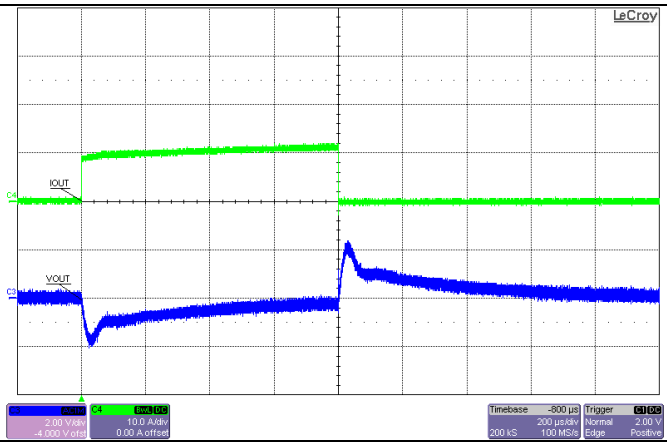
VOUT ripple 40Vin 0A load



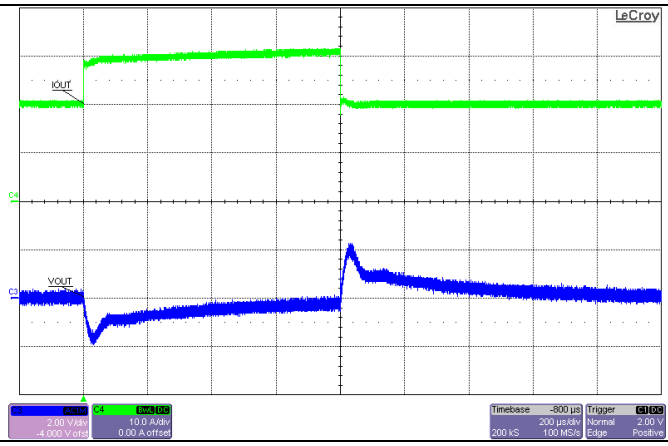
VOUT ripple 40Vin 33A load

8 Load Transient Response

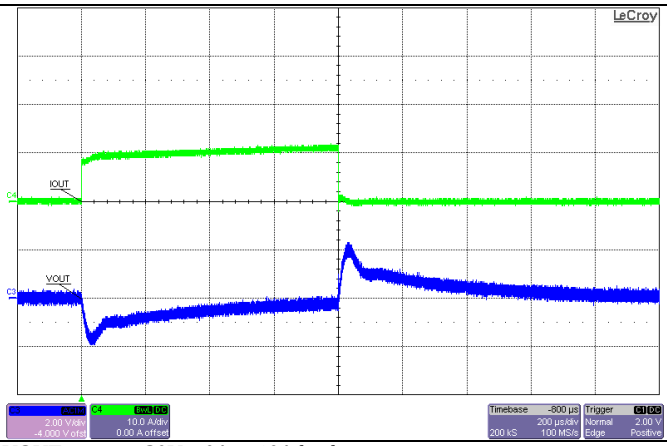
8.1 Load Transient Response



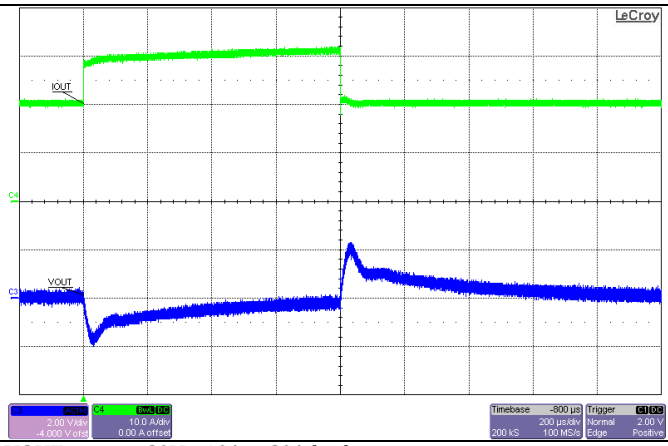
VOUT transient 20Vin 0A to 10A load step



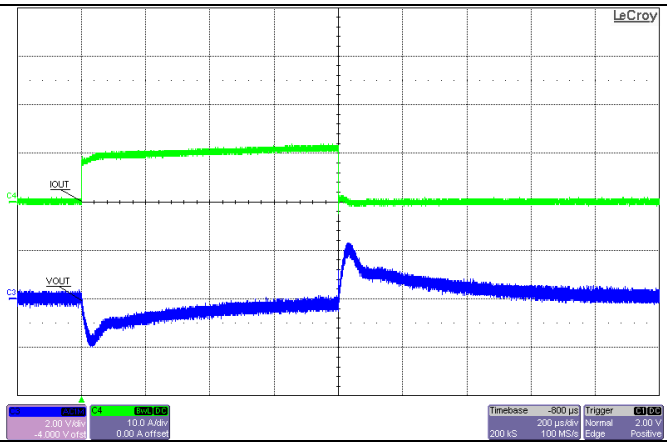
VOUT transient 20Vin 20A to 30A load step



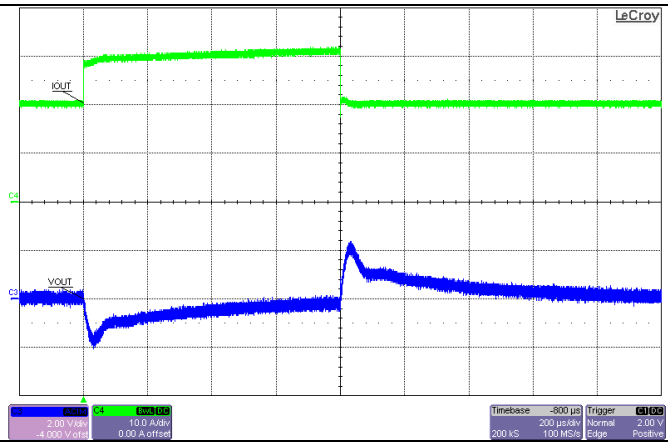
VOUT transient 30Vin 0A to 10A load step



VOUT transient 30Vin 20A to 30A load step



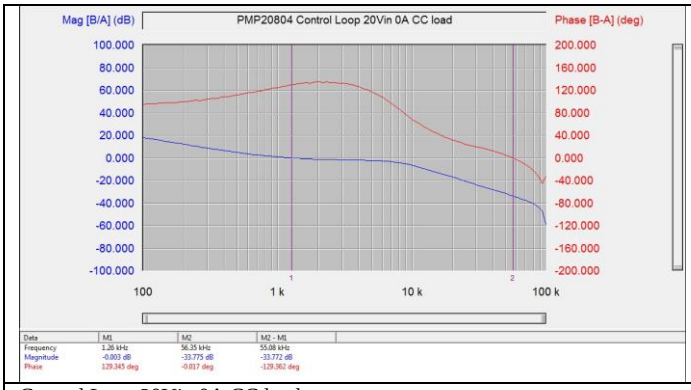
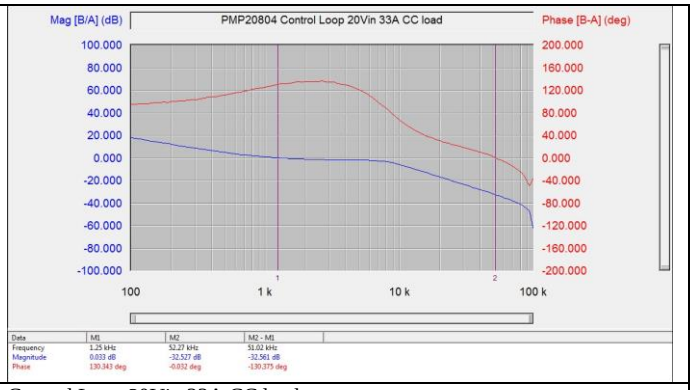
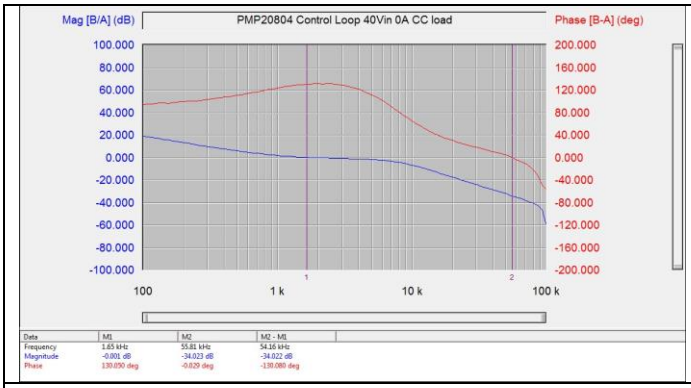
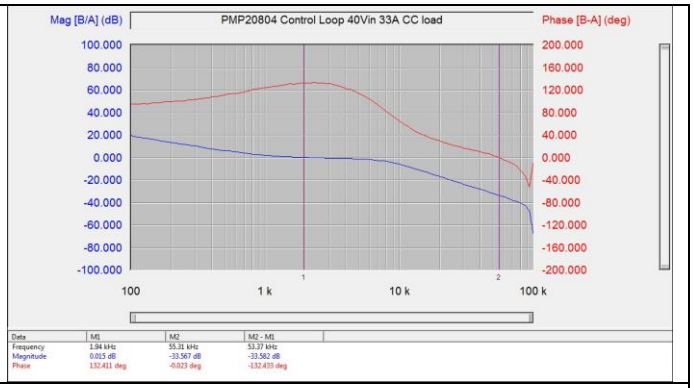
VOUT transient 40Vin 0A to 10A load step



VOUT transient 40Vin 20A to 30A load step

9 Frequency Response

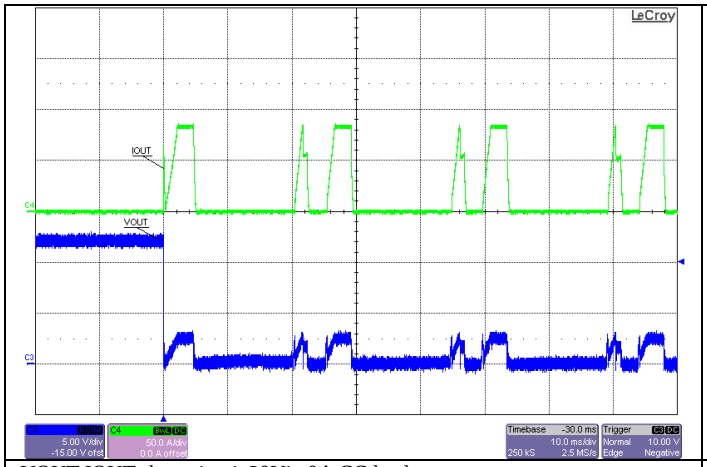
9.1 Frequency Response

	
Control Loop 20Vin 0A CC load	Control Loop 20Vin 33A CC load
	
Control Loop 40Vin 0A CC load	Control Loop 40Vin 33A CC load

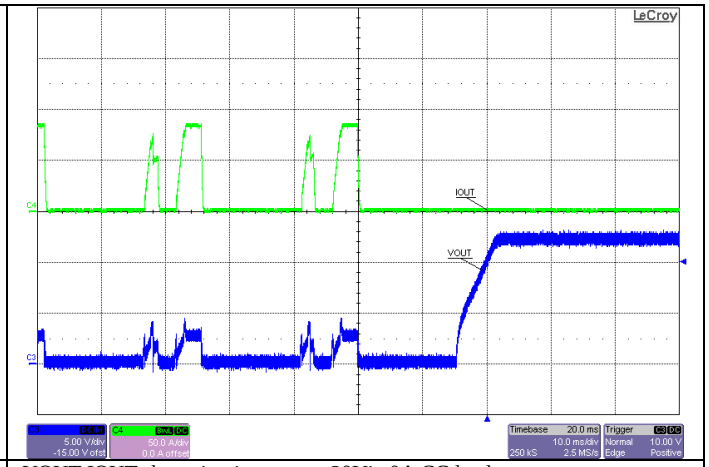
10 Short Circuit

10.1 Short Circuit

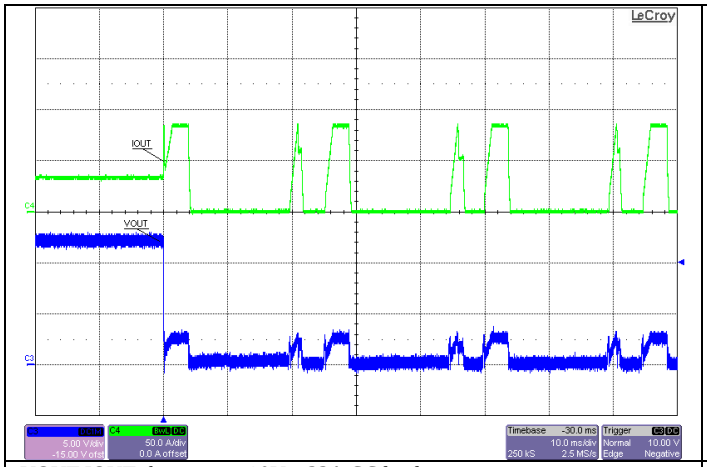
A constant-current electronic load was used to test short circuit.



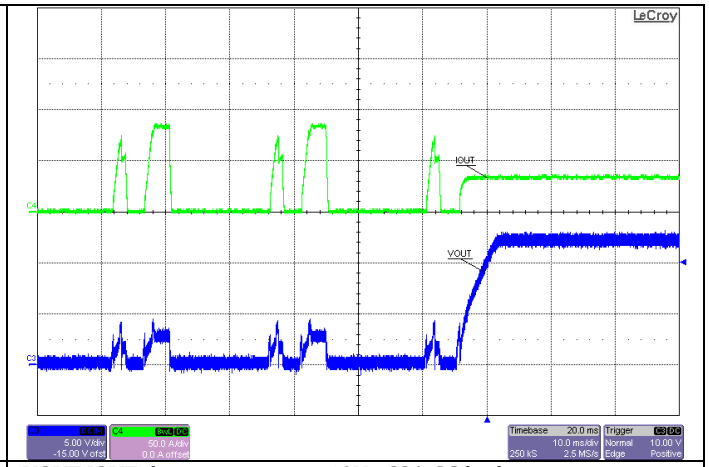
VOUT IOUT short circuit 20Vin 0A CC load



VOUT IOUT short circuit recovery 20Vin 0A CC load

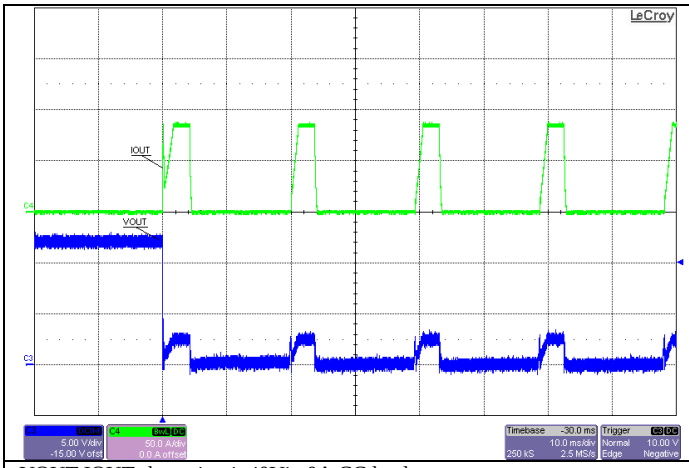


VOUT IOUT short circuit 20Vin 33A CC load

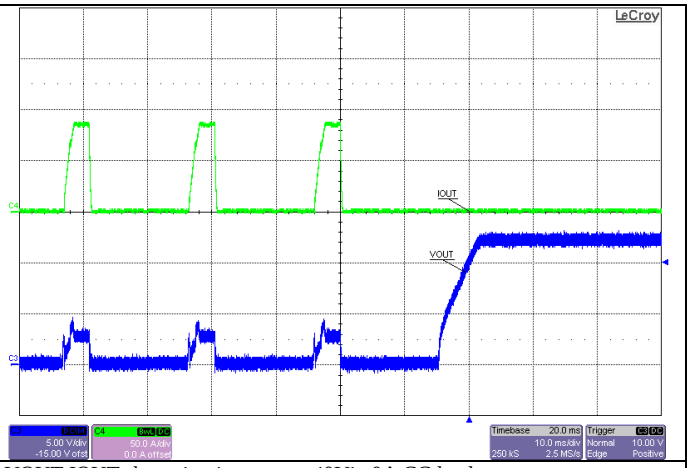


VOUT IOUT short circuit recovery 20Vin 33A CC load

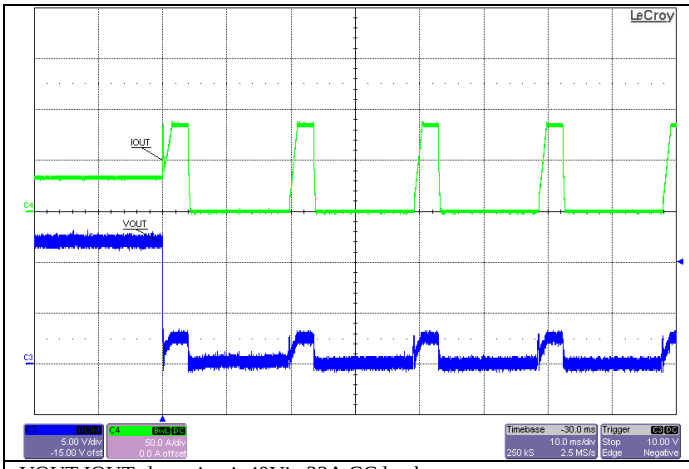
PMP20804 Rev A Test Results



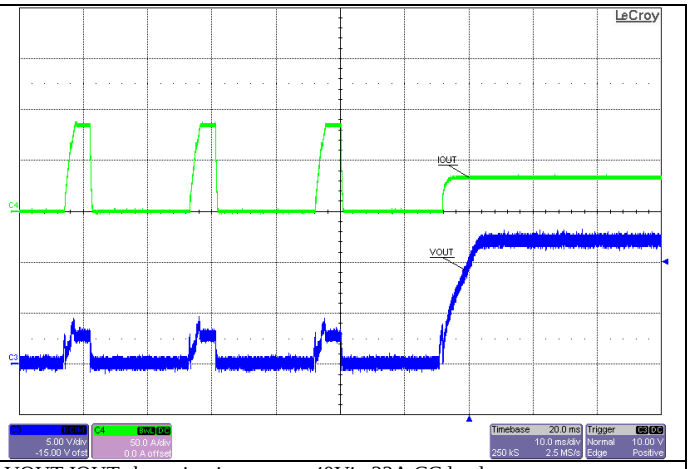
VOUT IOUT short circuit 40Vin 0A CC load



VOUT IOUT short circuit recovery 40Vin 0A CC load



VOUT IOUT short circuit 40Vin 33A CC load



VOUT IOUT short circuit recovery 40Vin 33A CC load

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