



LM25119-Q1 Dual-Phase Synchronous Buck Converter

TI reference design number: PMP20659 Rev B

Input: 4.5V to 40V

Output: 5V @ 45A

DC – DC Test Results

Table of Contents

1	Circuit Description.....	3
2	Photos	3
3	Efficiency	5
4	Output Voltage at Dropout	7
5	Thermal	8
5.1	Thermal at 22.5A load, no airflow	8
5.2	Thermal at 45A load, 700 LFM airflow	8
6	Startup	9
6.1	Startup from Vin.....	9
7	Switching and Ripple	11
7.1	Switching and Ripple	11
8	Load Transient Response.....	13
8.1	Load Transient Response.....	13
8.2	Inductor Current.....	15
9	Frequency Response.....	17
9.1	Frequency Response	17
10	Short Circuit	18
10.1	Short Circuit.....	18

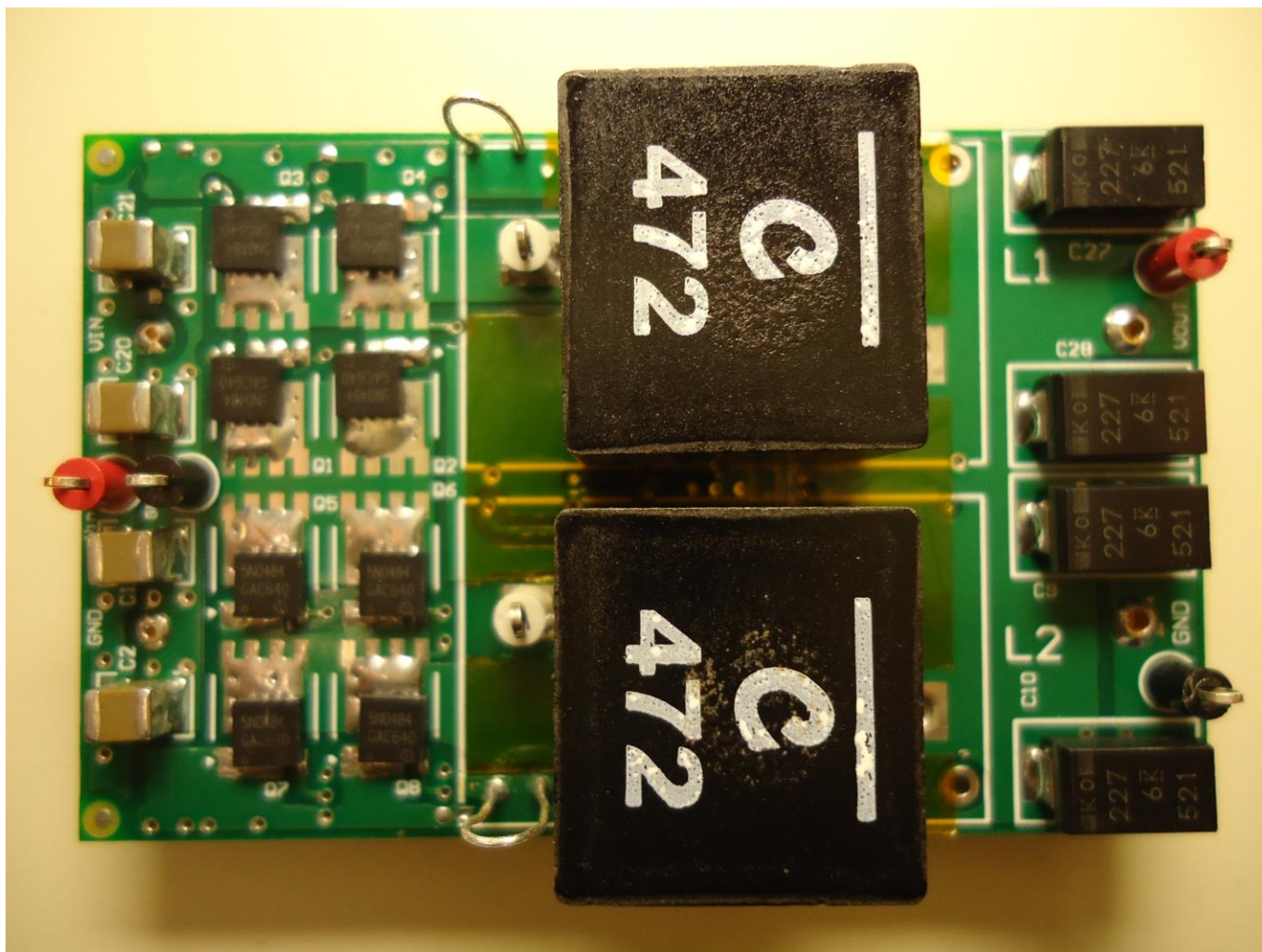
1 Circuit Description

PMP20659 is a dual-phase synchronous buck converter utilizing the LM25119-Q1 dual synchronous buck controller I.C. The design accepts an input voltage of 4.5V to 40V and provides a 5V output capable of supplying 45A of current to the load. This represents a power density design of 225W in a quarter brick footprint. The maximum component height is set by the Coilcraft XAL1510-472 inductors at 0.394 in.

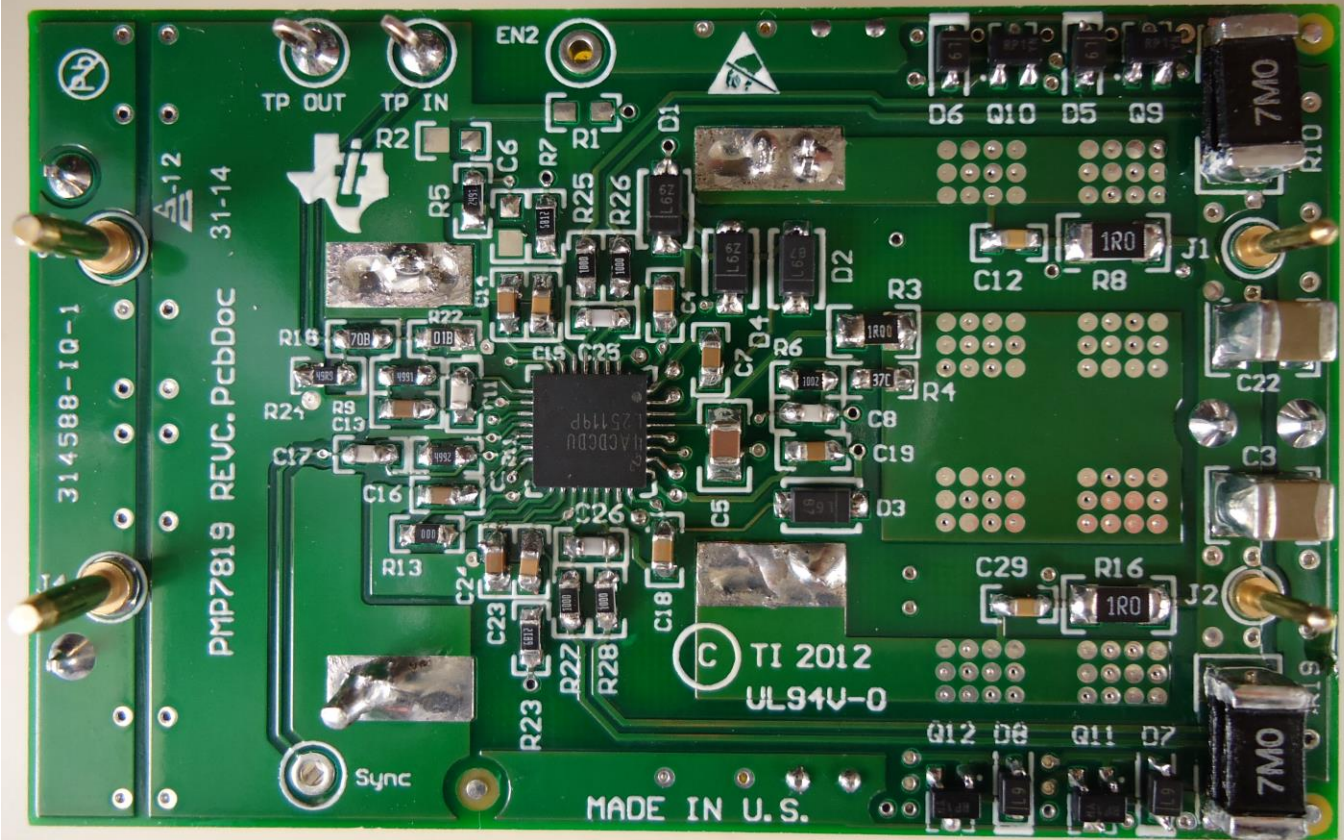
At tests were performed at room temperature on an open bench. A 100uF 100V aluminum electrolytic capacitor was used for damping at the input.

2 Photos

The photographs below show the PMP20659 Rev B 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.



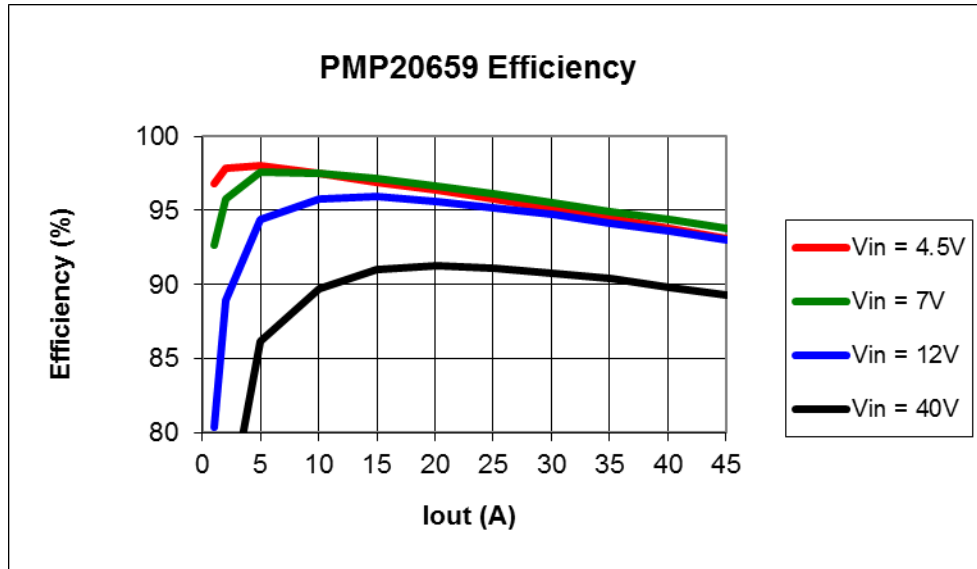
PMP20659 Rev A Test Results



PMP20659 Rev A Test Results

3 Efficiency

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



Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Losses (W)	Efficiency (%)
4.5003	0.0160	4.3891	-0.0080	0.072	-0.035	0.107	-48.76
4.5001	1.0180	4.3303	1.0240	4.581	4.434	0.147	96.79
4.5002	1.9840	4.3160	2.0240	8.928	8.736	0.193	97.84
4.4999	4.8820	4.2877	5.0220	21.968	21.533	0.435	98.02
4.4996	9.7120	4.2494	10.0240	43.700	42.596	1.104	97.47
4.4992	14.5440	4.2206	15.0220	65.436	63.401	2.035	96.89
4.4986	19.5000	4.1939	20.1500	87.722	84.507	3.214	96.34
4.4980	24.3280	4.1672	25.1440	109.428	104.779	4.649	95.75
4.4975	29.1520	4.1386	30.1340	131.111	124.711	6.400	95.12
4.4969	33.9840	4.1093	35.1380	152.824	144.392	8.432	94.48
4.4960	38.8220	4.0781	40.1420	174.545	163.702	10.843	93.79
4.4953	43.6480	4.0456	45.1400	196.209	182.619	13.590	93.07

PMP20659 Rev A Test Results

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Losses (W)	Efficiency (%)
7.0025	0.0500	5.0175	-0.0060	0.350	-0.030	0.380	-8.60
7.0025	0.7900	5.0165	1.0220	5.532	5.127	0.405	92.68
7.0025	1.5120	5.0157	2.0220	10.588	10.142	0.446	95.79
7.0020	3.6860	5.0128	5.0240	25.809	25.184	0.625	97.58
7.0016	7.3500	5.0081	10.0220	51.462	50.192	1.270	97.53
7.0015	11.0520	5.0035	15.0220	77.380	75.162	2.218	97.13
7.0006	14.8900	4.9988	20.1500	104.239	100.725	3.515	96.63
7.0002	18.6700	4.9940	25.1440	130.694	125.569	5.125	96.08
6.9996	22.4880	4.9893	30.1360	157.407	150.358	7.049	95.52
6.9988	26.3540	4.9845	35.1340	184.446	175.125	9.321	94.95
6.9979	30.2720	4.9795	40.1400	211.840	199.878	11.962	94.35
6.9971	34.2260	4.9745	45.1400	239.483	224.547	14.936	93.76

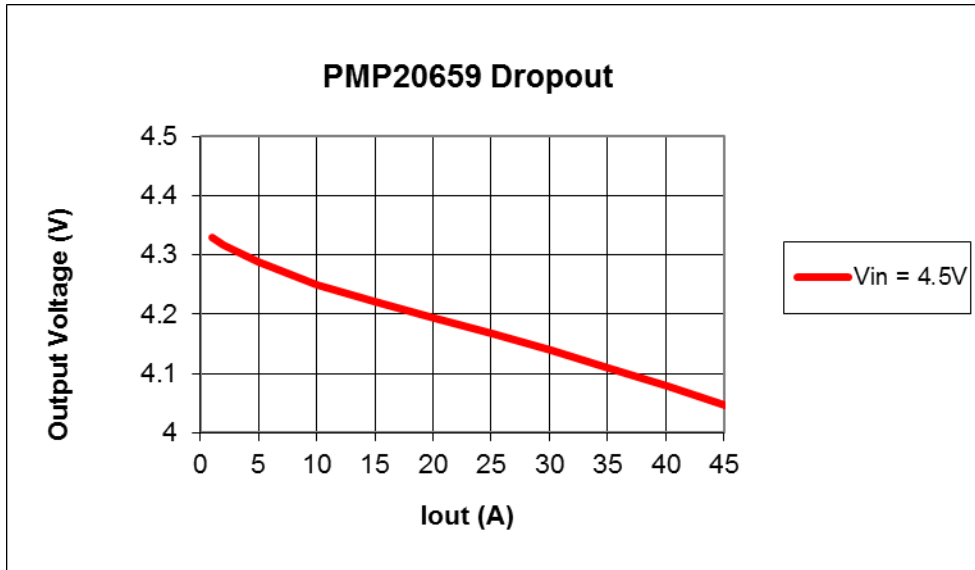
Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Losses (W)	Efficiency (%)
12.0069	0.1000	5.0179	-0.0060	1.201	-0.030	1.231	-2.51
12.0070	0.5300	5.0170	1.0200	6.364	5.117	1.246	80.41
12.0066	0.9500	5.0160	2.0220	11.406	10.142	1.264	88.92
12.0067	2.2220	5.0131	5.0220	26.679	25.176	1.503	94.37
12.0063	4.3640	5.0085	10.0200	52.396	50.185	2.211	95.78
12.0062	6.5260	5.0039	15.0220	78.353	75.169	3.184	95.94
12.0058	8.7740	4.9990	20.1480	105.339	100.720	4.619	95.62
12.0058	10.9880	4.9943	25.1440	131.920	125.577	6.343	95.19
12.0056	13.2260	4.9897	30.1340	158.786	150.359	8.427	94.69
12.0057	15.4960	4.9848	35.1360	186.040	175.146	10.894	94.14
12.0053	17.7940	4.9800	40.1420	213.622	199.908	13.715	93.58
12.0050	20.1180	4.9750	45.1400	241.517	224.573	16.945	92.98

Vin (V)	Iin (A)	Vout (V)	Iout (A)	Pin (W)	Pout (W)	Losses (W)	Efficiency (%)
40.0149	0.0880	5.0186	-0.0060	3.521	-0.030	3.551	-0.86
40.0143	0.2180	5.0176	1.0220	8.723	5.128	3.595	58.79
40.0145	0.3440	5.0167	2.0220	13.765	10.144	3.621	73.69
40.0145	0.7300	5.0139	5.0200	29.211	25.170	4.041	86.17
40.0139	1.3980	5.0093	10.0200	55.939	50.193	5.746	89.73
40.0133	2.0640	5.0046	15.0220	82.587	75.179	7.408	91.03
40.0128	2.7580	4.9999	20.1500	110.355	100.748	9.607	91.29
40.0125	3.4460	4.9951	25.1460	137.883	125.608	12.275	91.10
40.0123	4.1400	4.9904	30.1360	165.651	150.391	15.260	90.79
40.0121	4.8440	4.9857	35.1380	193.819	175.189	18.630	90.39
40.0120	5.5620	4.9810	40.1420	222.547	199.945	22.601	89.84
40.0128	6.2900	4.9761	45.1400	251.680	224.619	27.061	89.25

PMP20659 Rev A Test Results

4 Output Voltage at Dropout

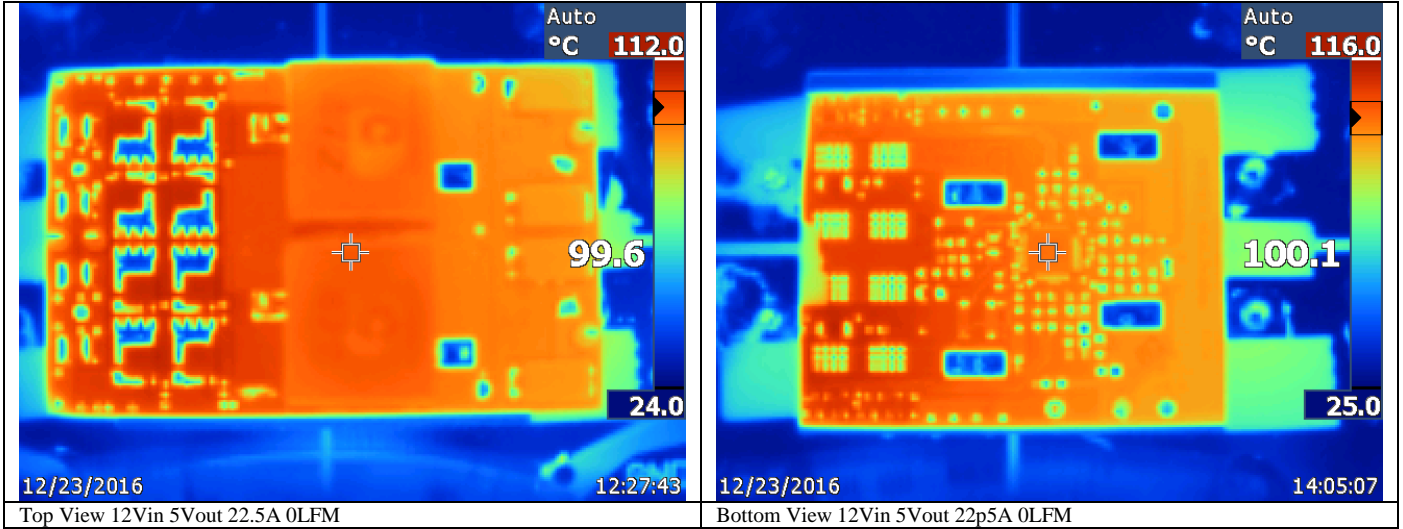
Output voltage at the minimum input of 4.5V is shown in the graph below.



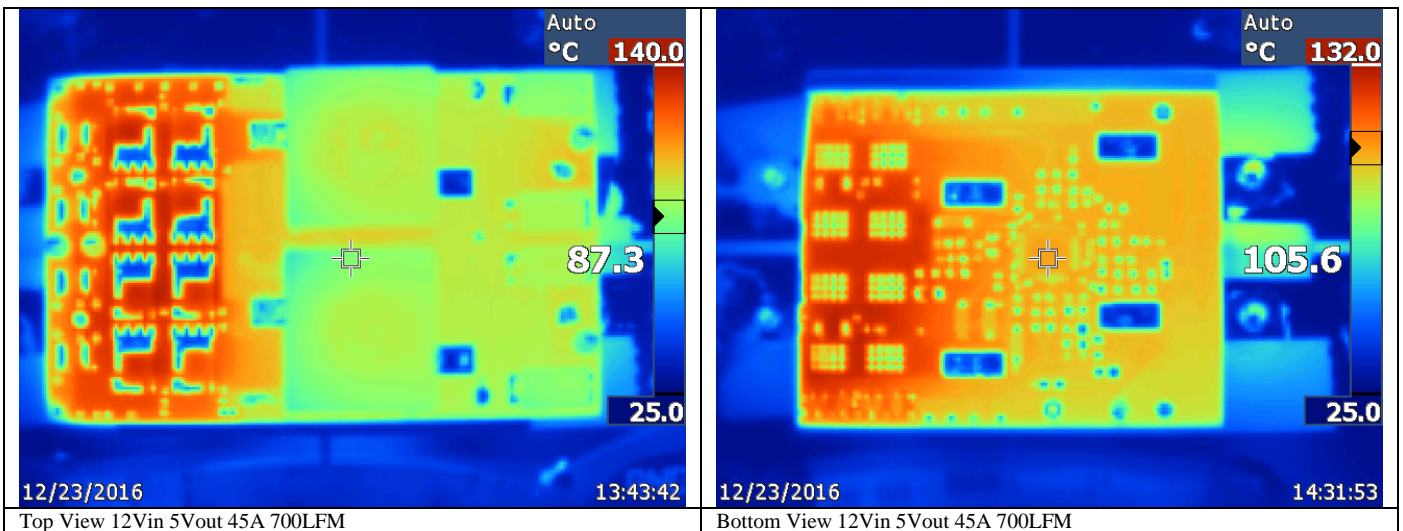
Vin (V)	Iin (A)	Vout (V)	Iout (A)
4.5003	0.0160	4.3891	-0.0080
5001	1.0180	4.3303	1.0240
4.5002	1.9840	4.3160	2.0240
4.4999	4.8820	4.2877	5.0220
4.4996	9.7120	4.2494	10.0240
4.4992	14.5440	4.2206	15.0220
4.4986	19.5000	4.1939	20.1500
4.4980	24.3280	4.1672	25.1440
4.4975	29.1520	4.1386	30.1340
4.4969	33.9840	4.1093	35.1380
4.4960	38.8220	4.0781	40.1420
4.4953	43.6480	4.0456	45.1400

5 Thermal

5.1 Thermal at 22.5A load, no airflow



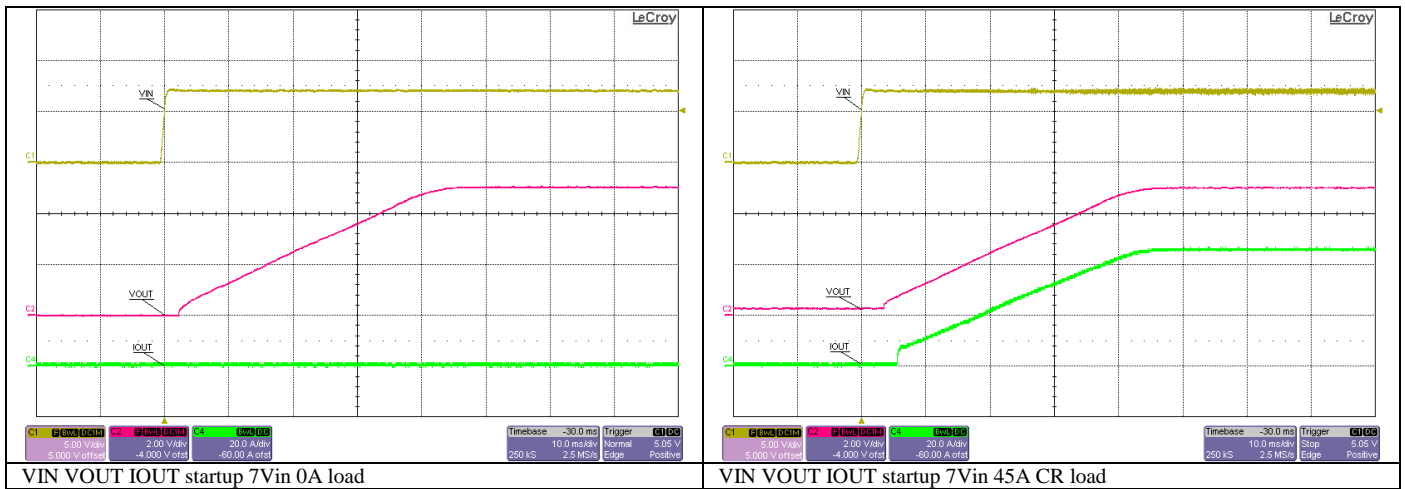
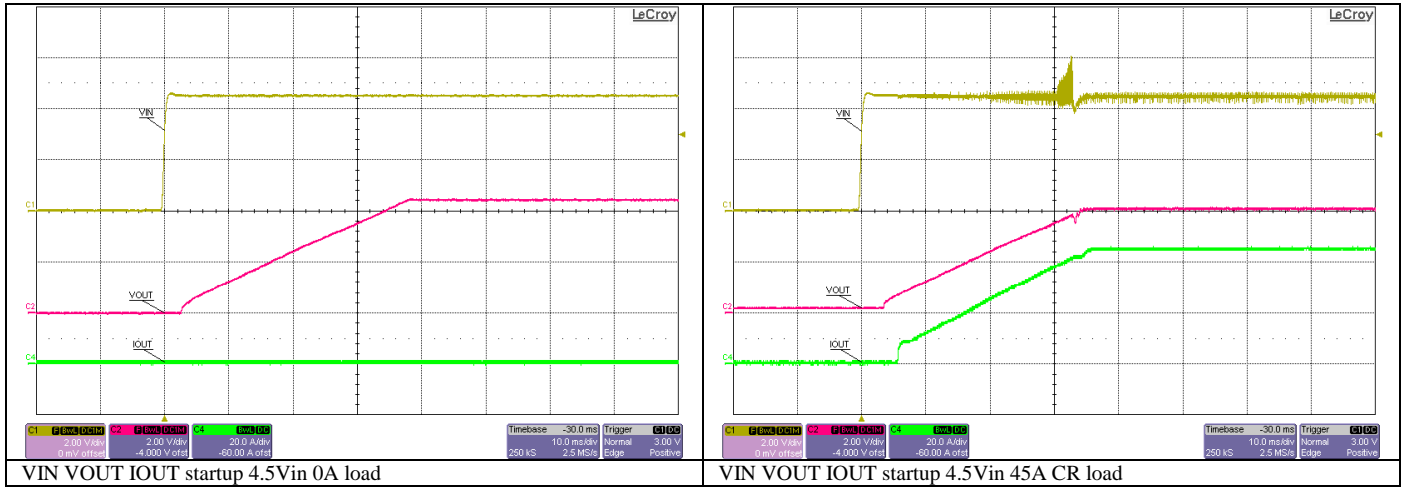
5.2 Thermal at 45A load, 700 LFM airflow



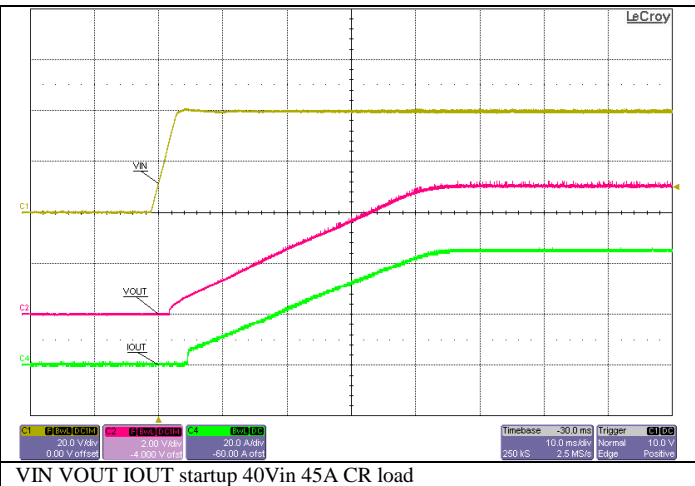
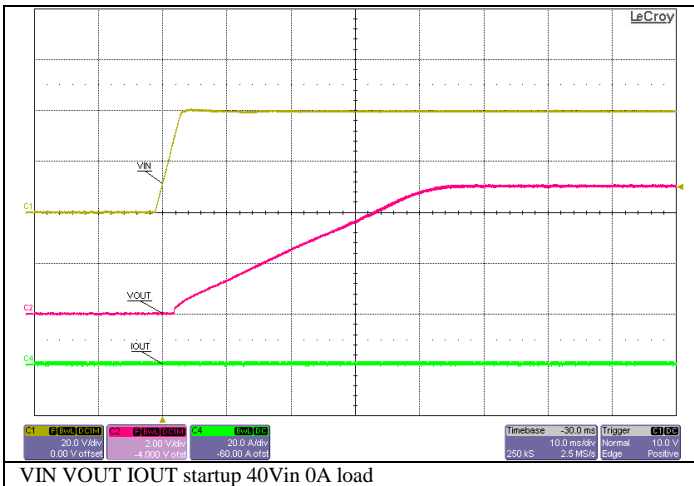
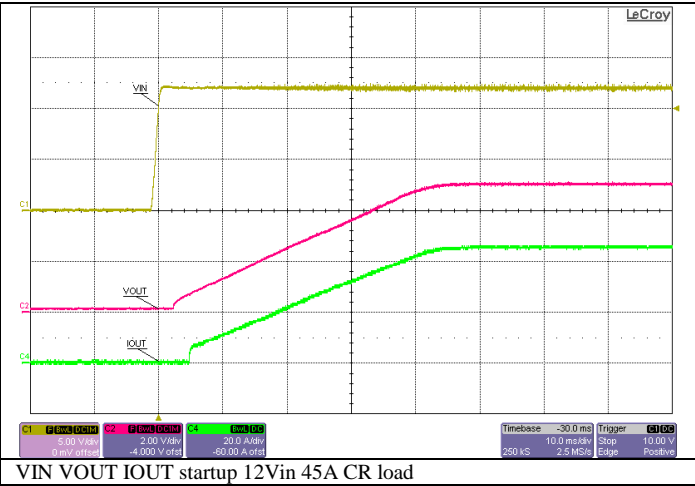
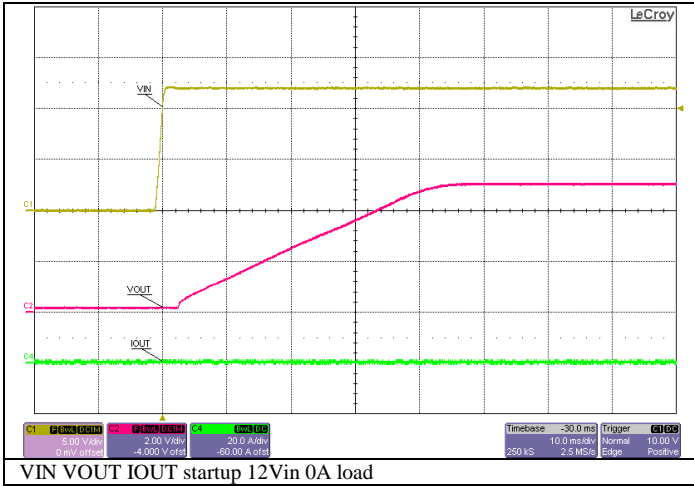
6 Startup

6.1 Startup from Vin

Startup was tested using a constant resistance electronic load.



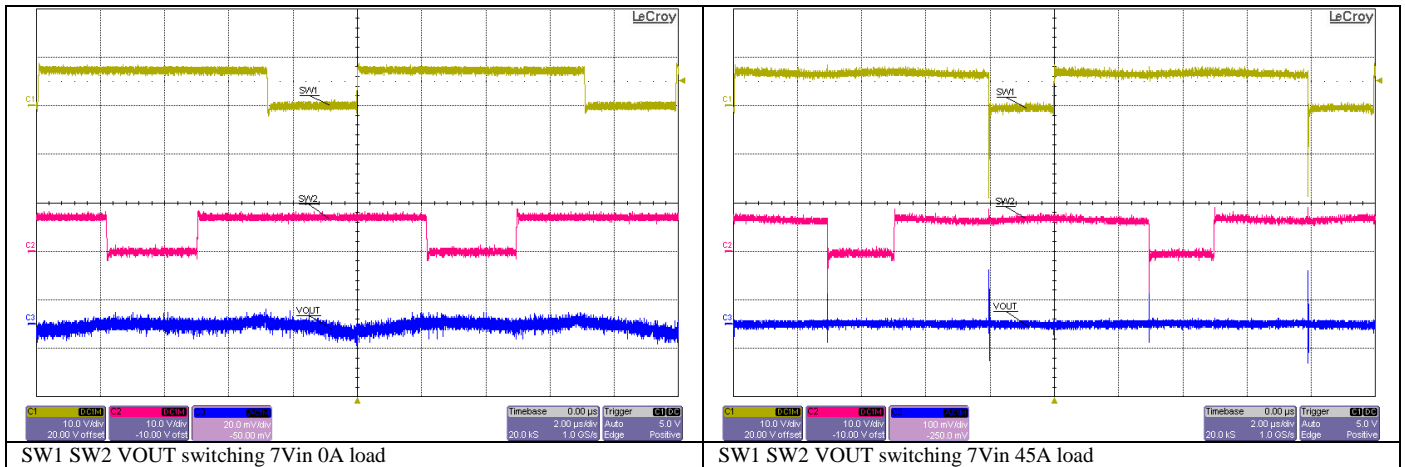
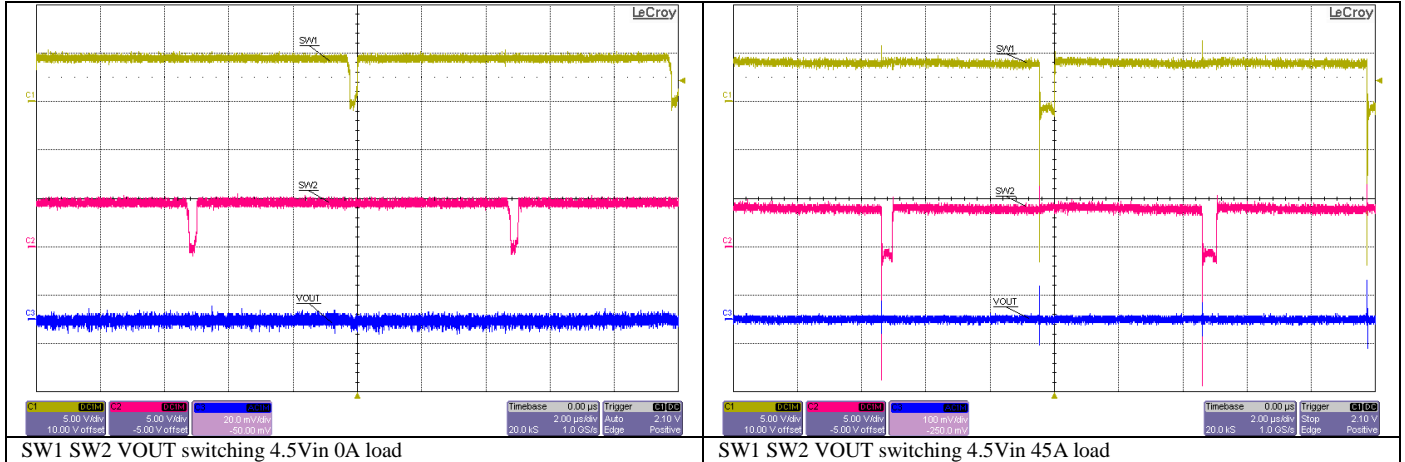
PMP20659 Rev A Test Results



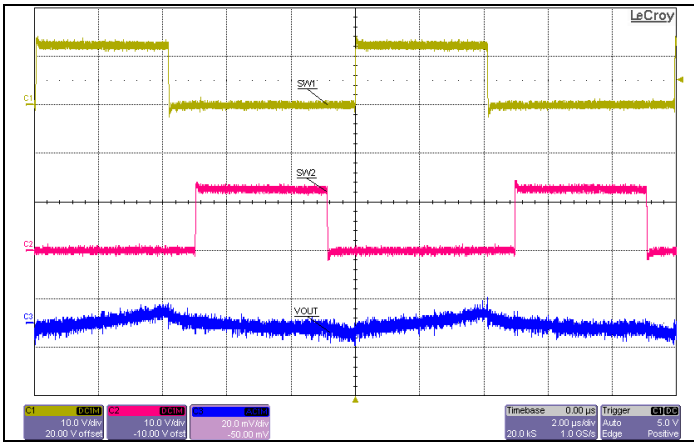
7 Switching and Ripple

7.1 Switching and Ripple

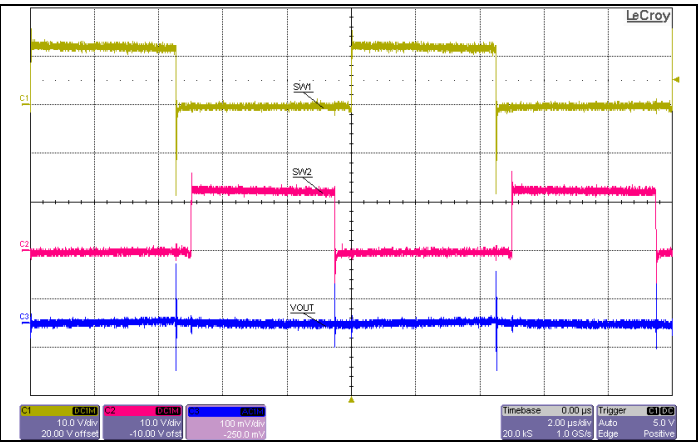
Switching and ripple were measured at full bandwidth using 500 MHz probes and 350 MHz oscilloscope.



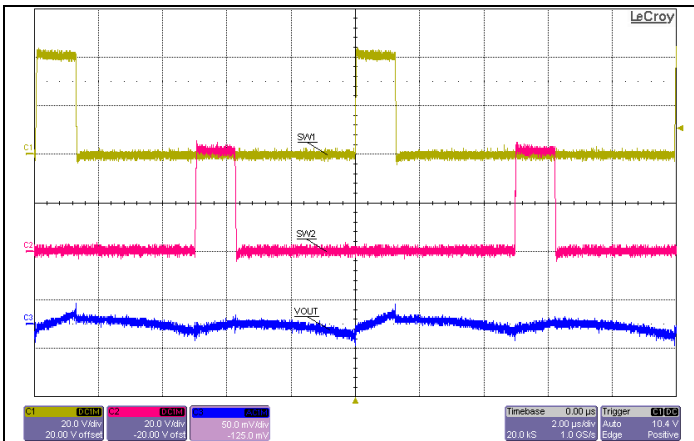
PMP20659 Rev A Test Results



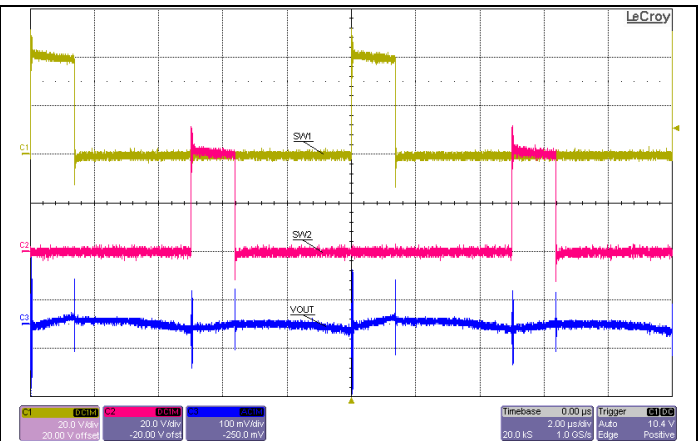
SW1 SW2 VOUT switching 12Vin 0A load



SW1 SW2 VOUT switching 12Vin 45A load



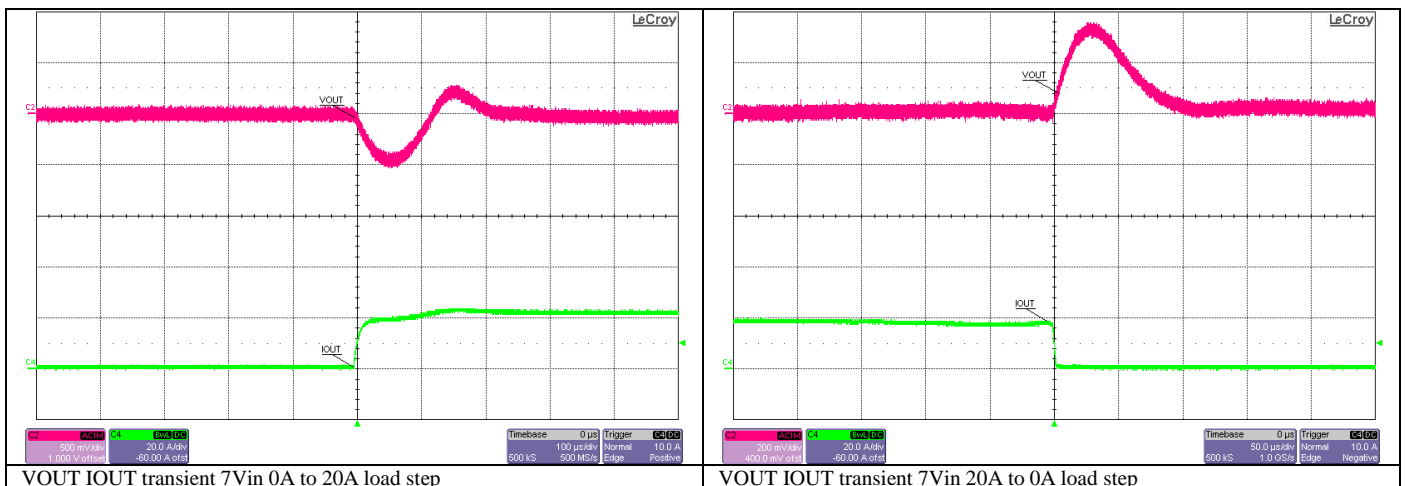
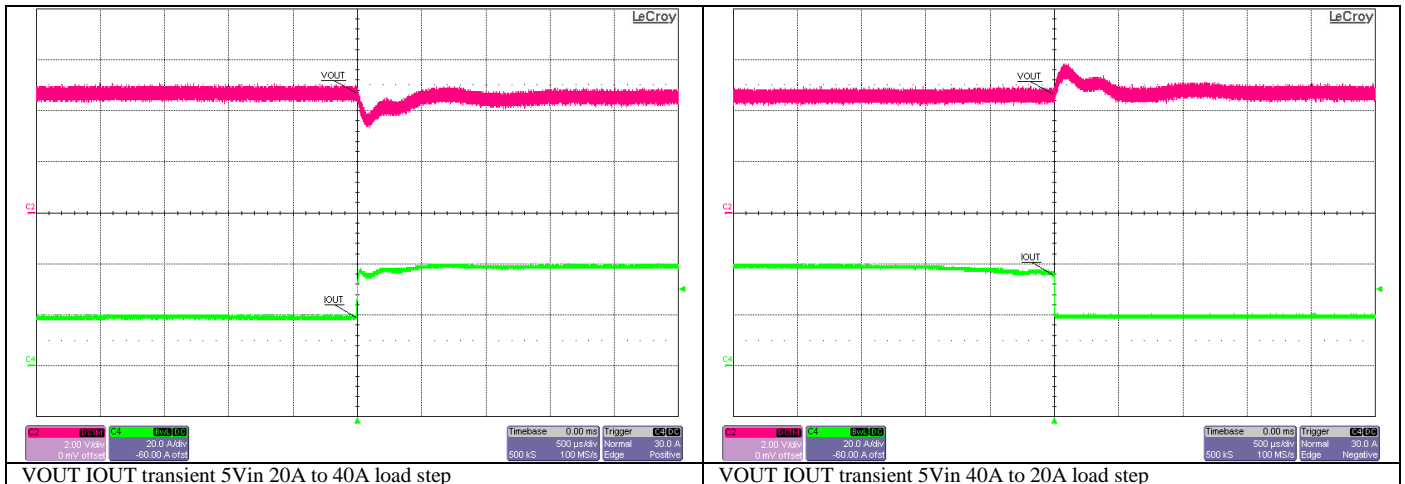
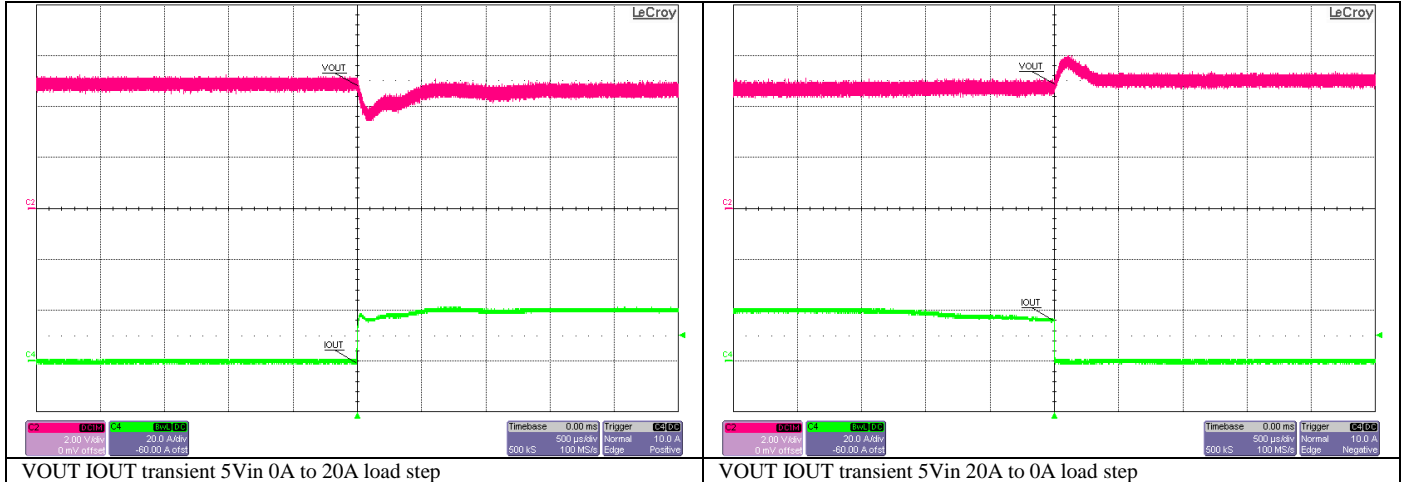
SW1 SW2 VOUT switching 40Vin 0A load



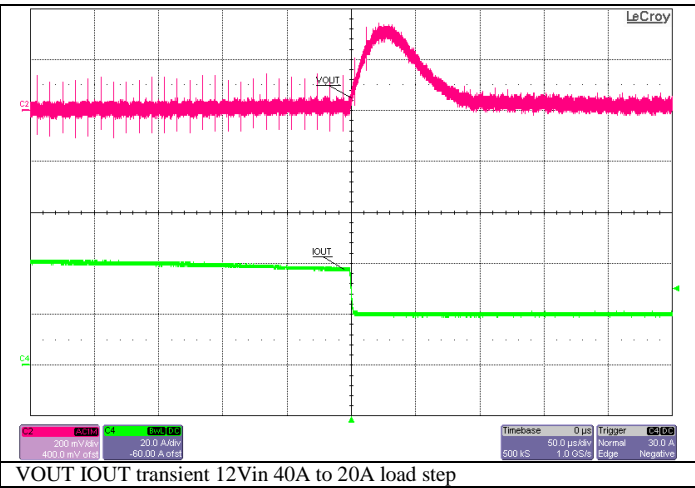
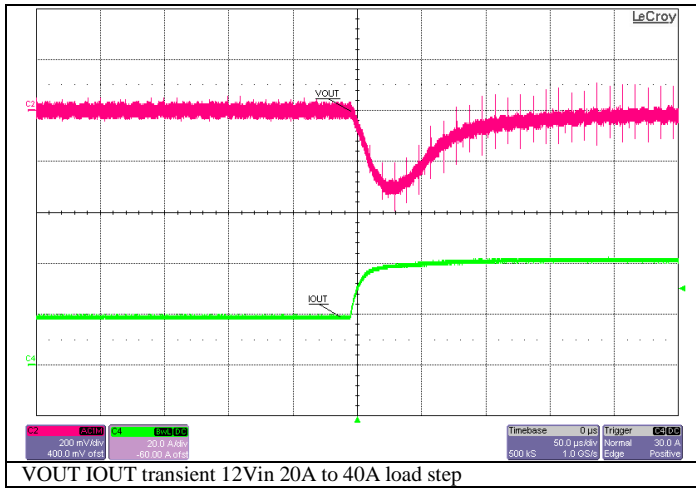
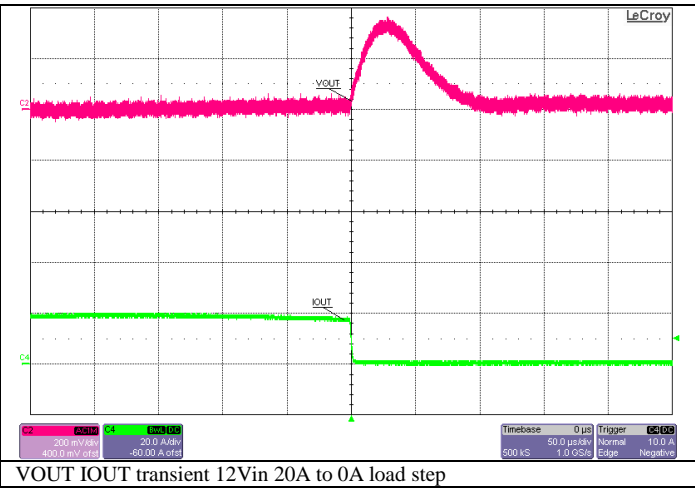
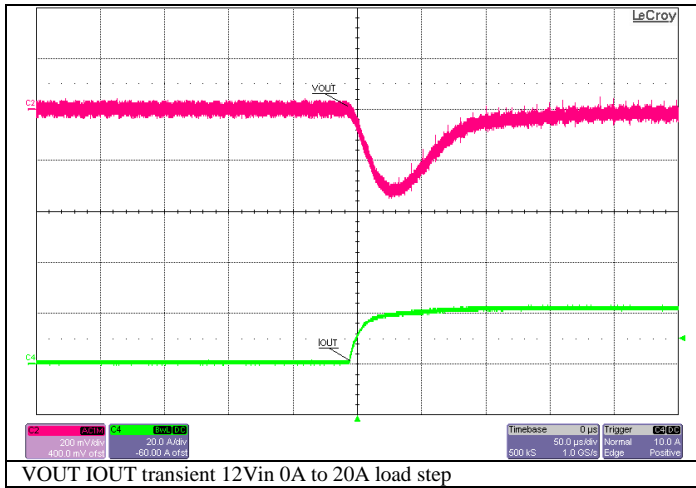
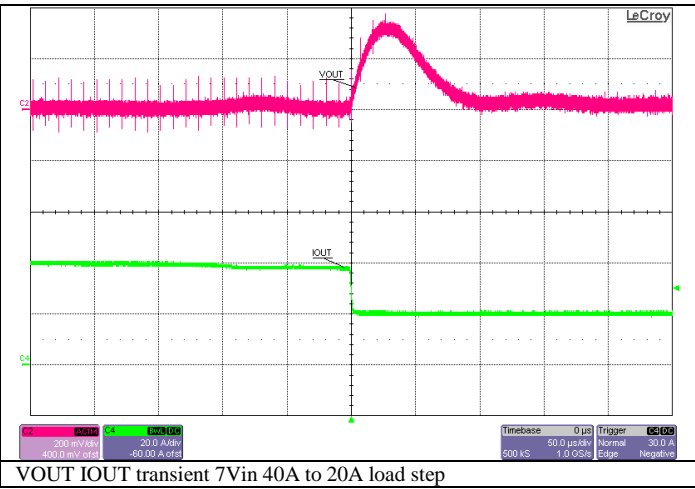
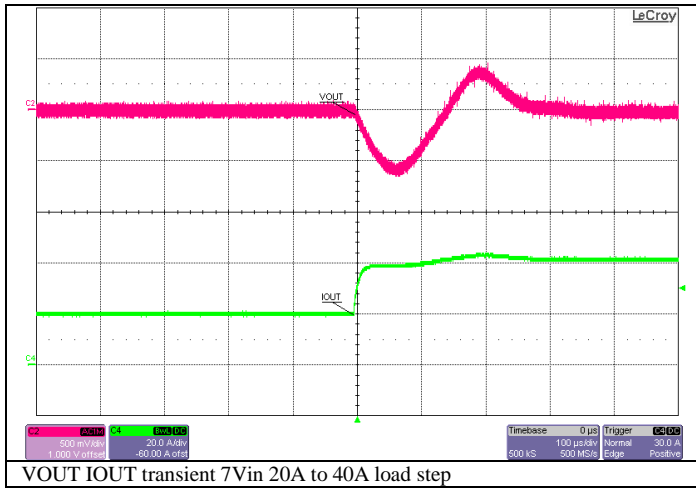
SW1 SW2 VOUT switching 40Vin 45A load

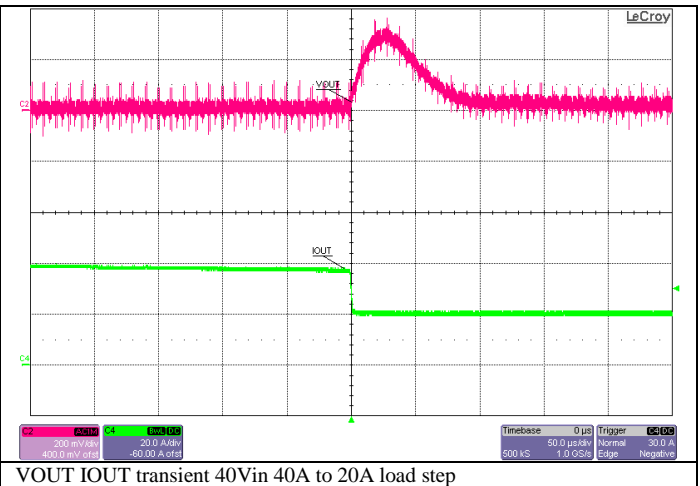
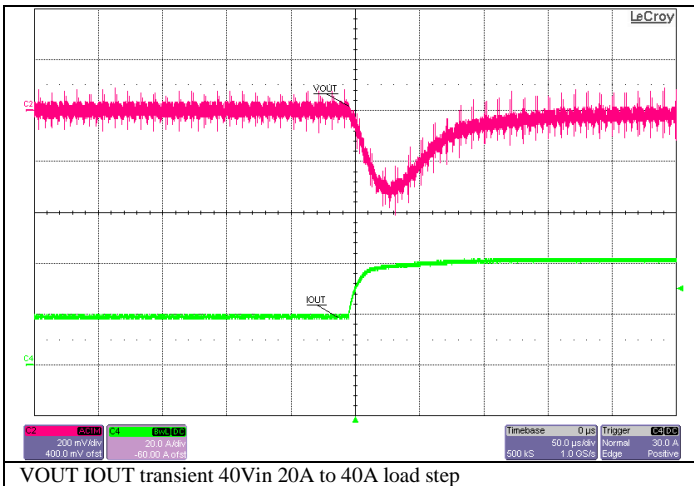
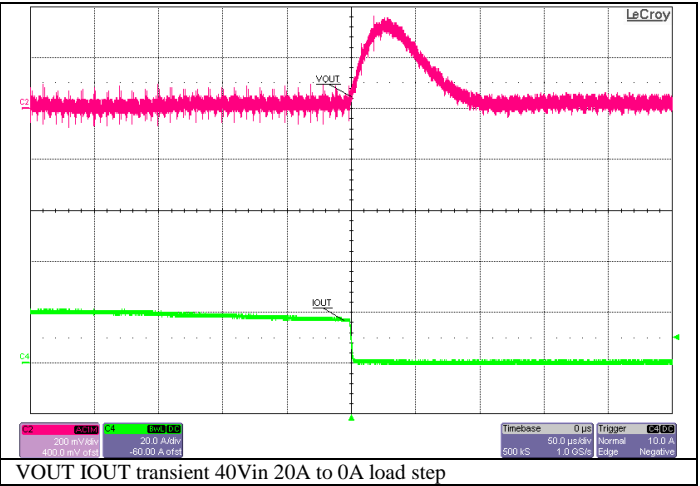
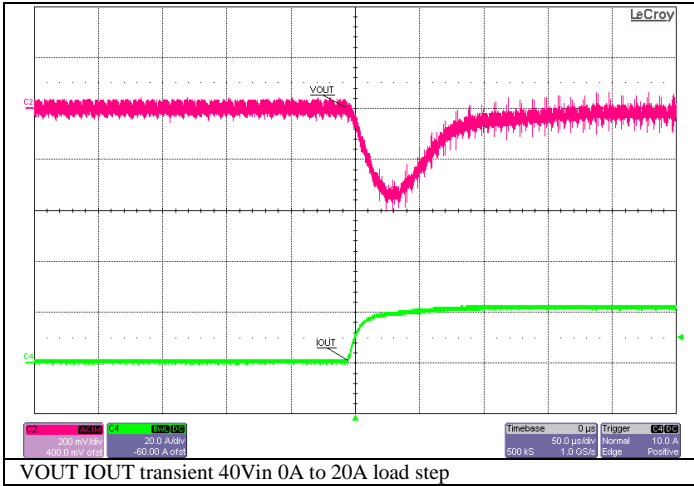
8 Load Transient Response

8.1 Load Transient Response

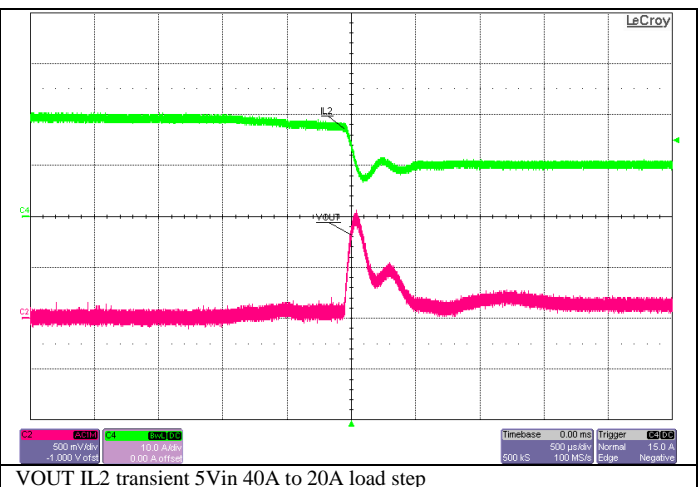
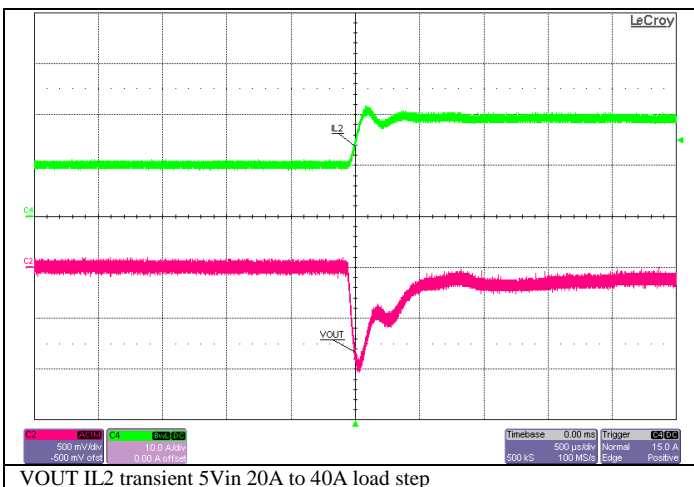


PMP20659 Rev A Test Results

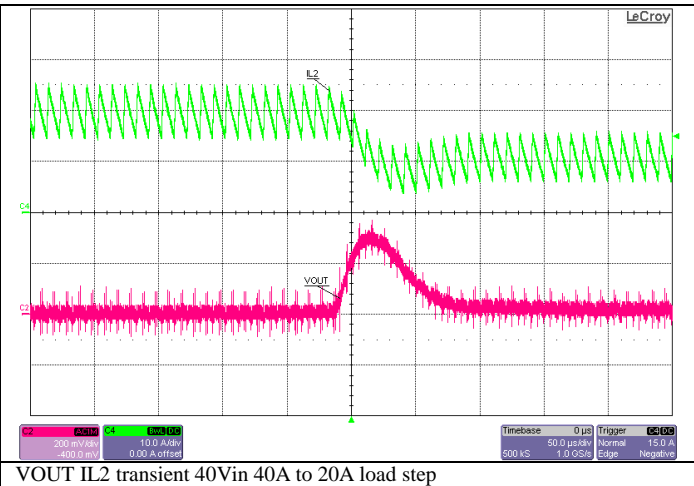
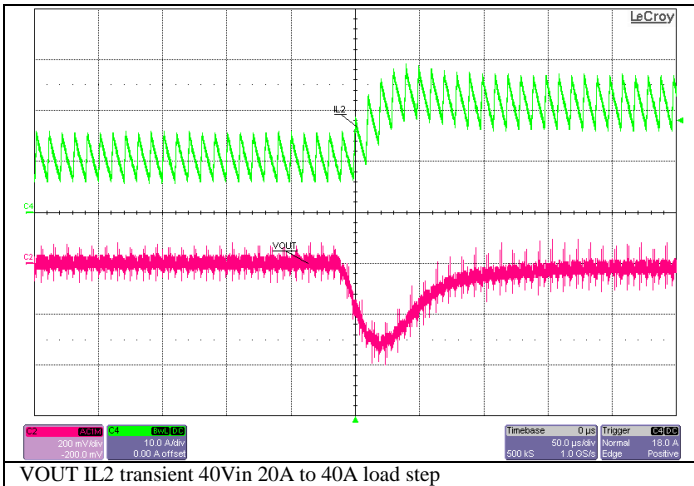
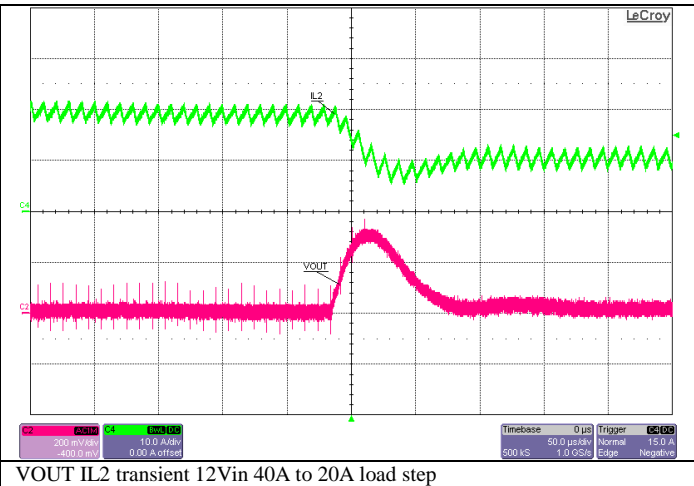
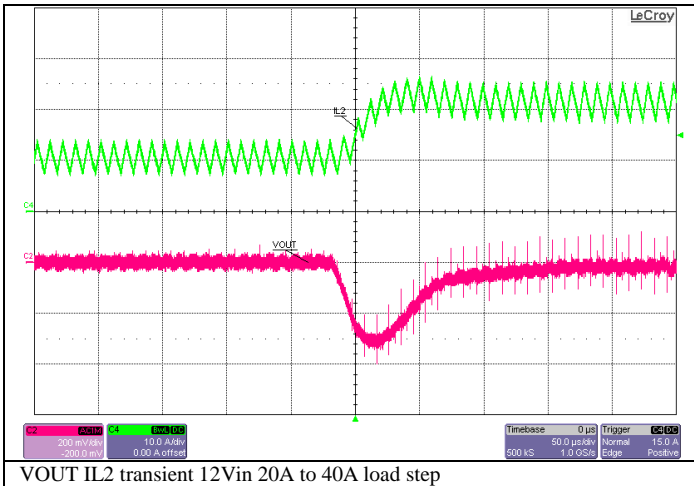
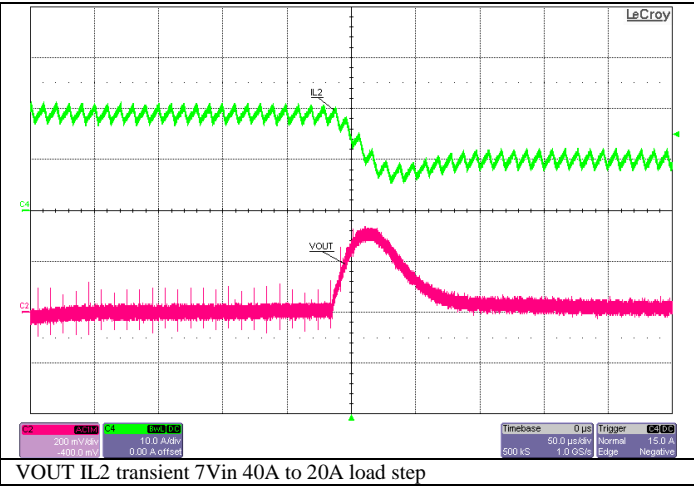
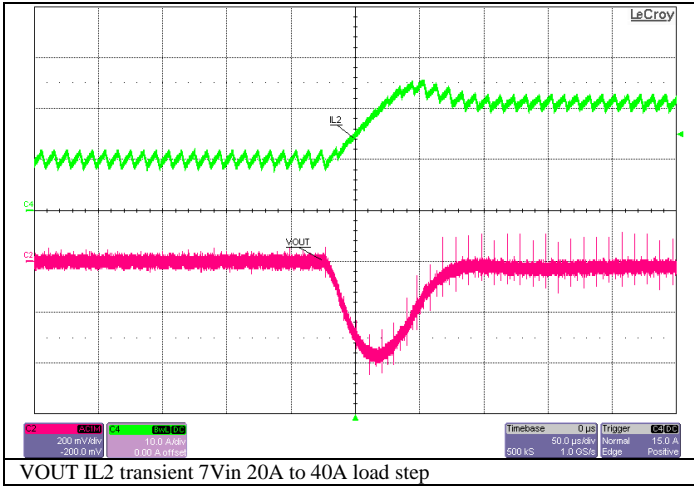




8.2 Inductor Current



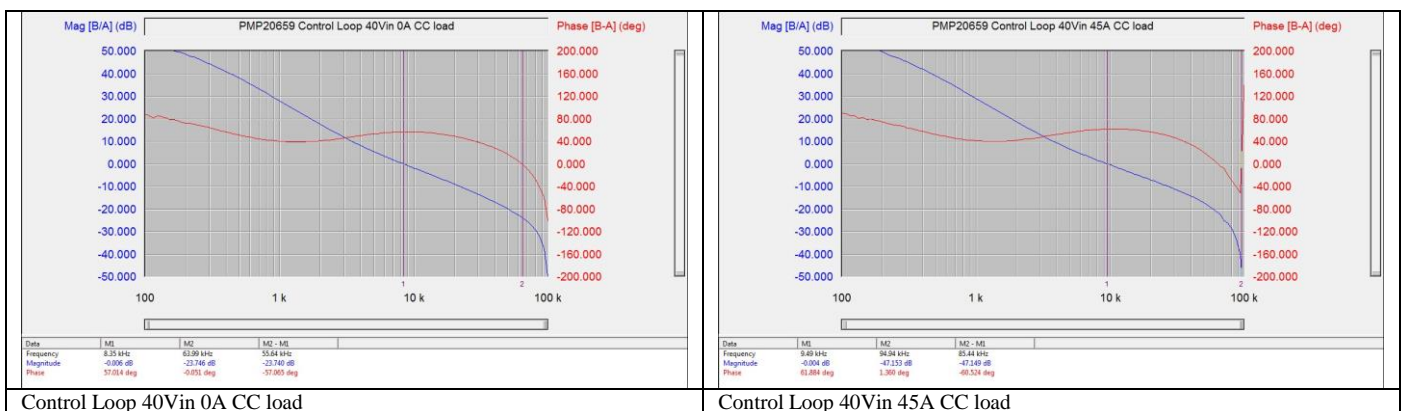
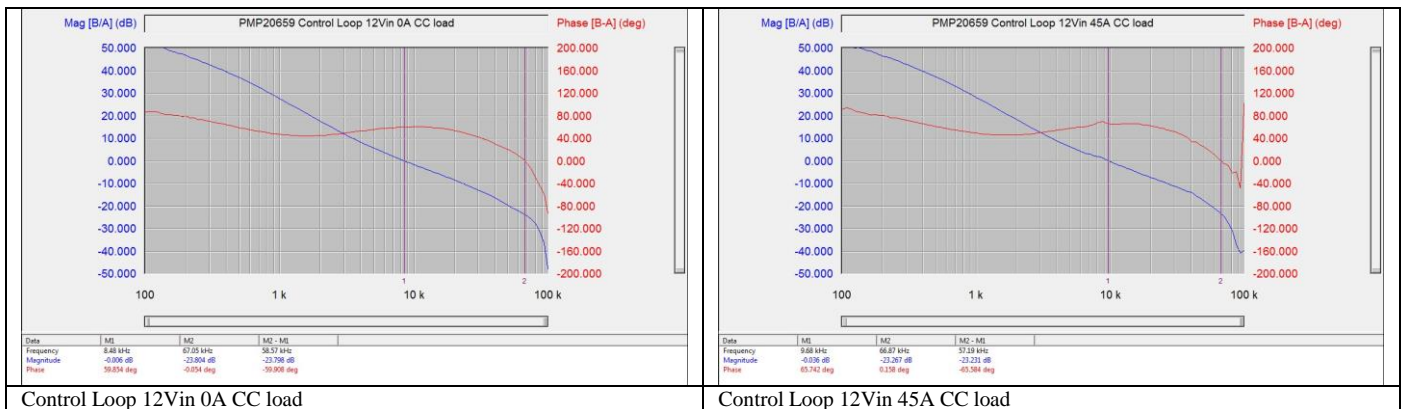
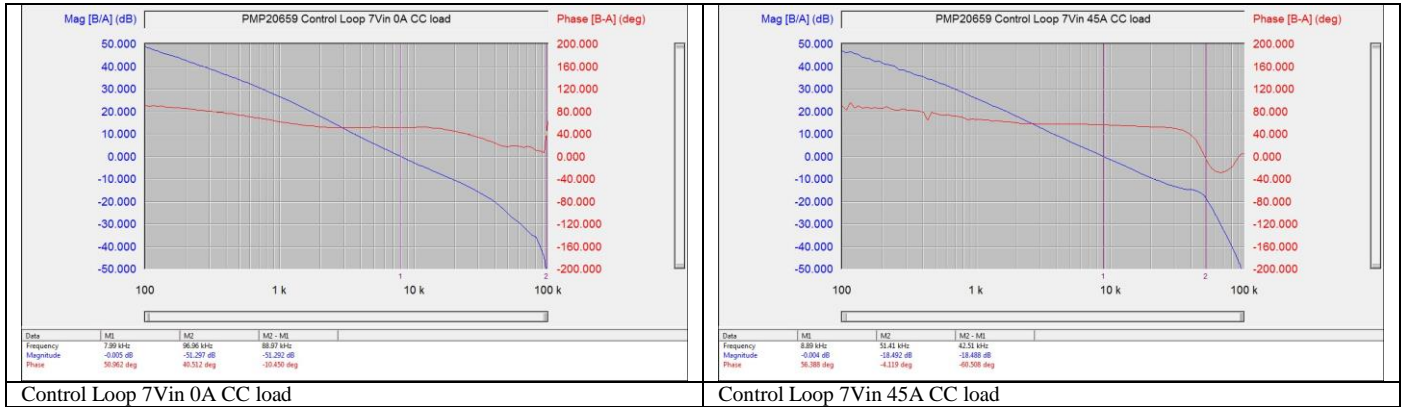
PMP20659 Rev A Test Results



9 Frequency Response

9.1 Frequency Response

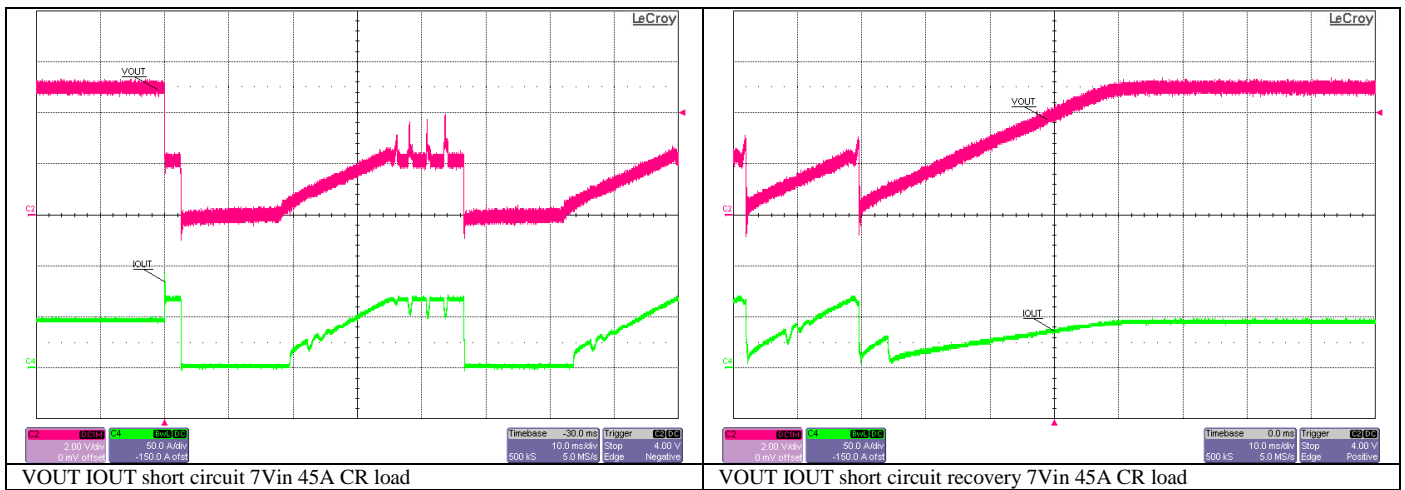
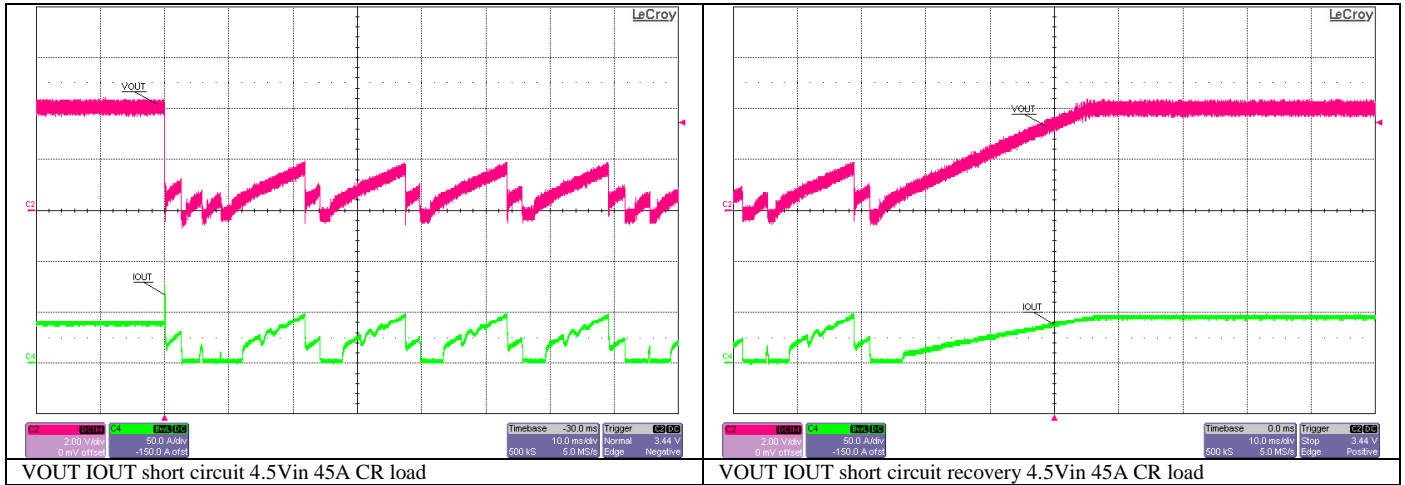
A constant current electronic load was used for frequency response tests.



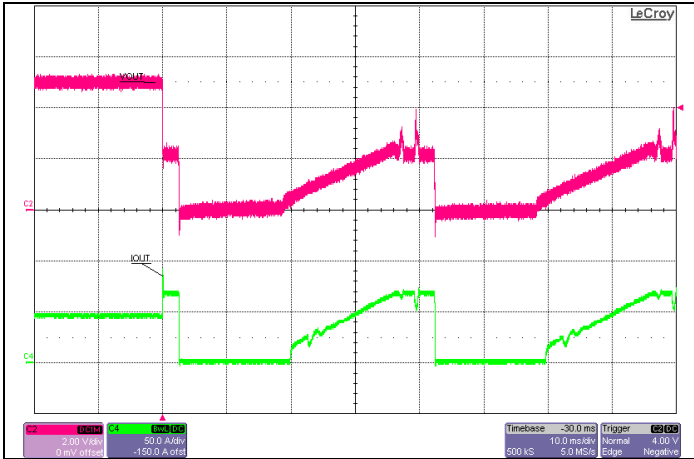
10 Short Circuit

10.1 Short Circuit

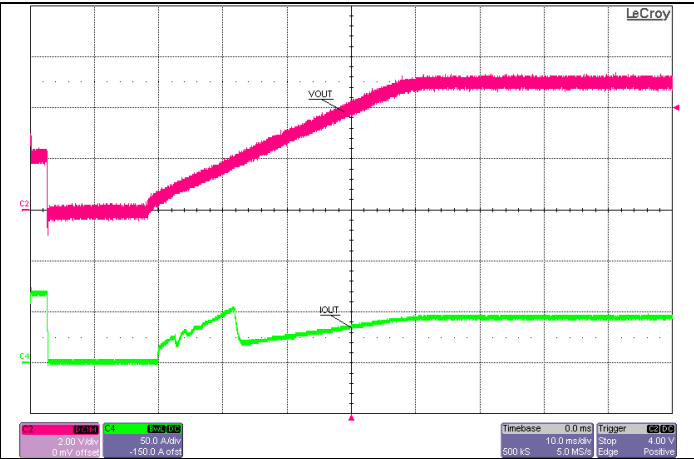
A constant resistance electronic load was used to test output short circuit protection.



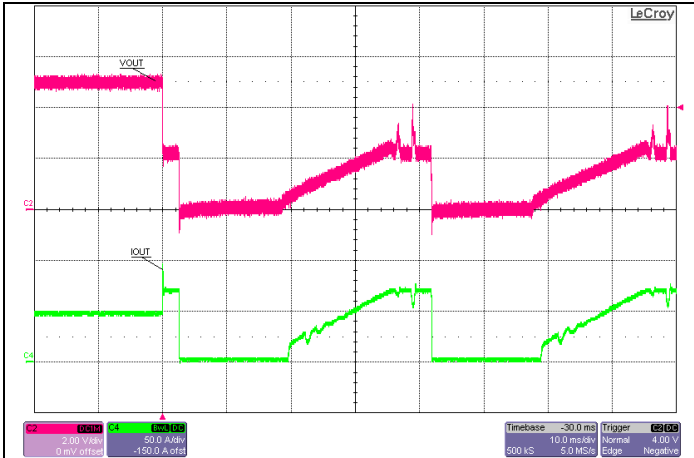
PMP20659 Rev A Test Results



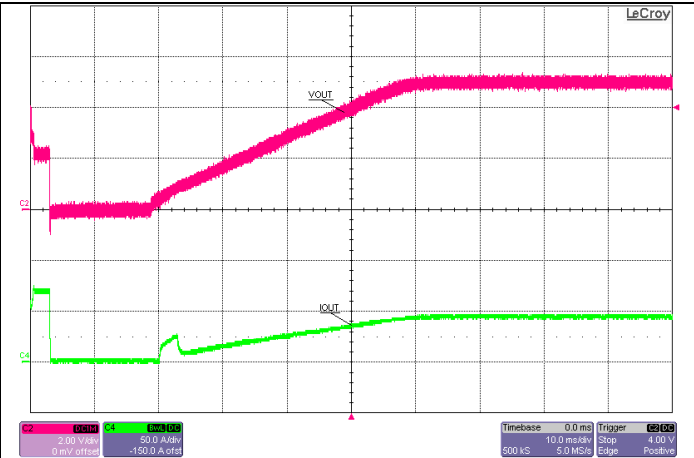
VOUT IOUT short circuit 12Vin 45A CR load



VOUT IOUT short circuit recovery 12Vin 45A CR load



VOUT IOUT short circuit 40Vin 45A CR load



VOUT IOUT short circuit recovery 40Vin 45A CR load

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