LM5119 Wide Input Dual Synchronous Buck Controller

TI reference design number: PMP7990 Rev A

Input: 48V
Output: 12V @ 30A

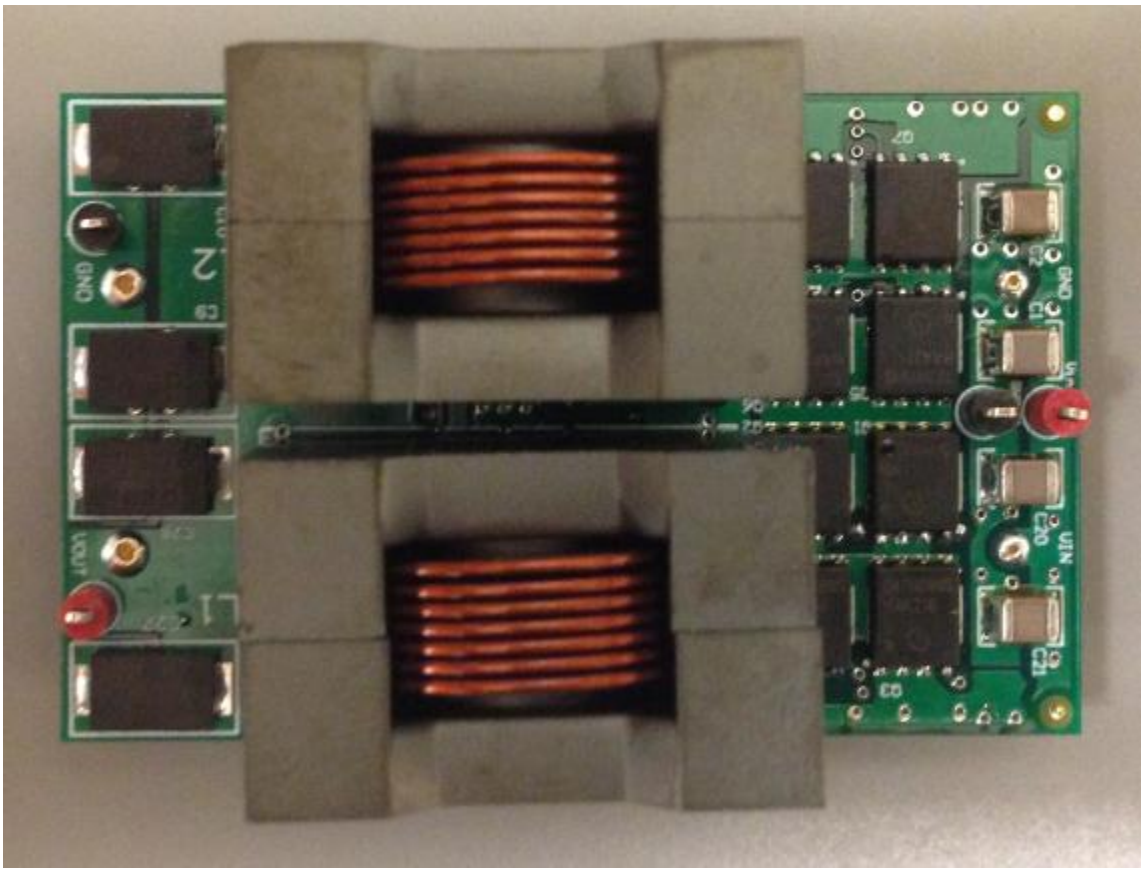
DC – DC Test Results

1 Circuit Description

The LM5119 is a dual synchronous buck controller, which is intended for step-down regulator applications from a high voltage or widely varying input supply. The application for this dual-phase synchronous buck converter is a design for 12V output at 30A, from an input voltage of 48V. The switching frequency is 100 kHz.

2 Photos

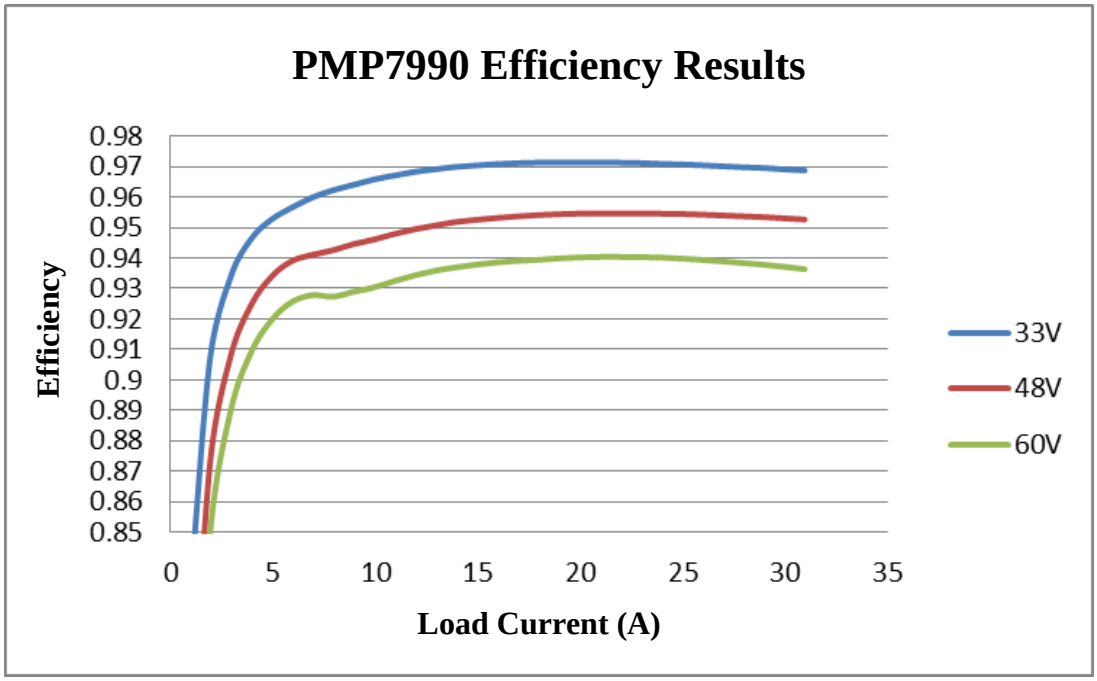
The photographs below show the PMP7819 Rev B assembly. This is a 4 layer board using 2 ounce copper on external layers and 1 ounce copper on internal layers. Power components are mounted on the top side of the board, with the control circuit on the bottom. The overall board dimensions are 2.3” x 1.45”.




TP OUT
TP IN
EN2
25-12
PMP7819 REVC.PcbDoc
239328-IRW-1
TI 2012
UL94V-0
Sync
MADE IN U.S.

3 Efficiency

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



3.1 33V 0 to 30 A

Measure	VIN (V)	IIN (A)	VOUT (V)	IOUT (A)	PIN (W)	POUT (W)	Efficiency
1	32.99778	0.070217	12.02587	-0.00023	2.316992	-0.00279	-0.0012
2	32.99784	0.067684	12.02593	-0.00123	2.233418	-0.01478	-0.00662
3	32.99765	0.398849	12.02482	0.90483	13.16107	10.88041	0.826712
4	32.99748	0.766025	12.02358	1.90561	25.27689	22.91224	0.90645
5	32.99743	1.136193	12.02199	2.911617	37.49145	35.00342	0.933637
6	32.99729	1.506142	12.02056	3.912046	49.6986	47.02498	0.946203
7	32.99701	1.877722	12.01903	4.910983	61.9592	59.02525	0.952647
8	32.99695	2.252942	12.01764	5.9174	74.34022	71.11315	0.956591
9	32.99686	2.624461	12.01601	6.918165	86.59898	83.12872	0.959927
10	32.99653	2.99686	12.01439	7.920174	98.88599	95.15605	0.96228
11	32.99651	3.369461	12.01312	8.92216	111.1804	107.183	0.964046
12	32.99647	3.739365	12.01144	9.921058	123.3858	119.1662	0.965801
13	32.99618	4.111853	12.00994	10.92535	135.6754	131.2129	0.967108
14	32.99597	4.481821	12.00863	11.92452	147.882	143.1971	0.968319
15	32.99571	4.854869	12.00712	12.93019	160.1899	155.2544	0.96919
16	32.99561	5.226157	12.00569	13.93142	172.4402	167.2564	0.969938
17	32.99548	5.59803	12.00422	14.93152	184.7097	179.2413	0.970395
18	32.99512	5.970761	12.00268	15.93525	197.006	191.2657	0.970862
19	32.99508	6.343086	12.00139	16.93601	209.2906	203.2557	0.971165
20	32.99498	6.715996	11.99977	17.93725	221.5941	215.2429	0.971338
21	32.99482	7.090209	11.99825	18.94025	233.9402	227.2498	0.971401
22	32.99459	7.463603	11.99666	19.94034	246.2585	239.2176	0.971408
23	32.99458	7.839307	11.99549	20.94524	258.6547	251.2483	0.971366
24	32.99451	8.212726	11.99398	21.94373	270.9749	263.1926	0.971281
25	32.99432	8.586761	11.99235	22.94335	283.3144	275.1447	0.971164
26	32.99432	8.964166	11.99094	23.94811	295.7666	287.1603	0.970902
27	32.9944	9.339181	11.98939	24.94862	308.1406	299.1187	0.970721
28	32.99428	9.716293	11.98797	25.95116	320.5821	311.1017	0.970427
29	32.99407	10.09276	11.98648	26.9514	333.0012	323.0524	0.970124
30	32.99424	10.46921	11.98491	27.95125	345.4236	334.9931	0.969804
31	32.99448	10.84689	11.98341	28.9559	357.8875	346.9905	0.969552
32	32.99431	11.22501	11.98192	29.95554	370.3615	358.9248	0.96912
33	32.99448	11.60299	11.9807	30.95651	382.8346	370.8806	0.968775

3.2 48V 0 to 30 A

Measure	VIN (V)	IIN (A)	VOUT (V)	IOUT (A)	PIN (W)	POUT (W)	Efficiency
1	47.99488	0.07333	12.02666	-0.00153	3.519483	-0.01835	-0.00521
2	47.99512	0.065511	12.02681	-0.00099	3.144189	-0.01187	-0.00377
3	47.9949	0.294058	12.02539	0.905373	14.11329	10.88746	0.771433
4	47.99456	0.547532	12.02394	1.905924	26.27857	22.91671	0.872069
5	47.99437	0.803382	12.02259	2.910379	38.55783	34.9903	0.907476
6	47.994	1.059792	12.02095	3.911599	50.86366	47.02114	0.924454
7	47.99342	1.317004	12.01938	4.910904	63.20753	59.02603	0.933845
8	47.9933	1.577873	12.0181	5.916928	75.72733	71.11024	0.93903
9	47.99269	1.840673	12.01668	6.918207	88.33885	83.1339	0.94108
10	47.99222	2.10395	12.01501	7.921338	100.9732	95.17499	0.942577
11	47.99142	2.364458	12.01374	8.921875	113.4737	107.1851	0.944581
12	47.99091	2.624801	12.01202	9.921289	125.9666	119.1747	0.946082
13	47.99019	2.884917	12.01071	10.92672	138.4477	131.2377	0.947922
14	47.98962	3.142806	12.00913	11.92444	150.8221	143.2021	0.949477
15	47.98857	3.40293	12.00772	12.9295	163.3018	155.2539	0.950718
16	47.98779	3.662131	12.00627	13.93258	175.7376	167.2783	0.951864
17	47.98684	3.921559	12.00467	14.93228	188.1832	179.257	0.952566
18	47.98599	4.181943	12.00325	15.93567	200.6747	191.2798	0.953184
19	47.98474	4.441848	12.00173	16.93669	213.1409	203.2696	0.953687
20	47.98387	4.701843	12.00045	17.93781	225.6126	215.2618	0.954121
21	47.98266	4.962534	11.99871	18.9402	238.1156	227.2579	0.954402
22	47.98157	5.223411	11.99724	19.94143	250.6275	239.2421	0.954572
23	47.98004	5.485383	11.9958	20.94584	263.1889	251.2622	0.954684
24	47.97844	5.746568	11.99413	21.94364	275.7114	263.1949	0.954603
25	47.97711	6.007802	11.99274	22.94318	288.237	275.1515	0.954601
26	47.97559	6.271004	11.99135	23.94951	300.8551	287.1869	0.954569
27	47.97406	6.532805	11.98982	24.94925	313.4052	299.1369	0.954474
28	47.9722	6.796283	11.98837	25.9516	326.0326	311.1173	0.954252
29	47.9704	7.059631	11.98686	26.95207	338.6533	323.0707	0.953987
30	47.96837	7.322736	11.98519	27.95084	351.2597	334.9961	0.953699
31	47.96636	7.58738	11.98391	28.95438	363.939	346.9868	0.95342
32	47.96439	7.85187	11.98205	29.95575	376.6101	358.9312	0.953058
33	47.96178	8.11683	11.98061	30.95603	389.2976	370.8722	0.95267

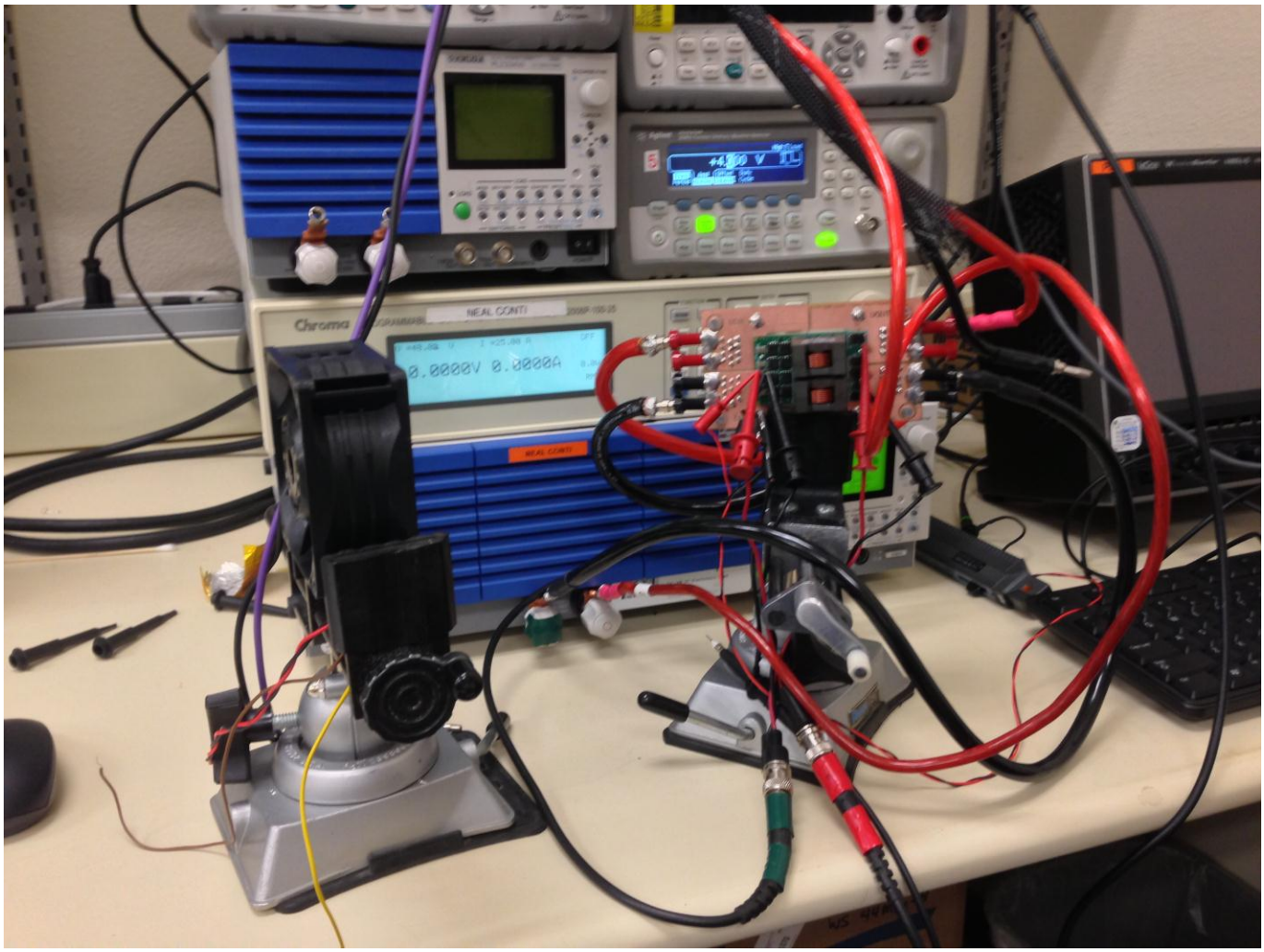
3.3 60V 0 to 30A

Measure	VIN (V)	IIN (A)	VOUT (V)	IOUT (A)	PIN (W)	POUT (W)	Efficiency
1	59.99352	0.074312	12.02728	-0.00155	4.458212	-0.01863	-0.00418
2	59.9933	0.063313	12.02722	-0.00124	3.798362	-0.01489	-0.00392
3	59.99286	0.24684	12.02607	0.905356	14.80866	10.88787	0.735237
4	59.99245	0.450234	12.0246	1.906175	27.01066	22.92099	0.848591
5	59.99208	0.655874	12.023	2.910958	39.34726	34.99845	0.889476
6	59.99156	0.862552	12.02162	3.912529	51.74586	47.03493	0.90896
7	59.99098	1.070122	12.02023	4.911339	64.19766	59.03542	0.919588
8	59.9904	1.280603	12.01858	5.916589	76.82388	71.10899	0.92561
9	59.98991	1.493687	12.01731	6.918162	89.60614	83.1377	0.927813
10	59.98918	1.710891	12.01546	7.920934	102.6349	95.17365	0.927303
11	59.98831	1.923772	12.01398	8.923231	115.4038	107.2035	0.928943
12	59.98752	2.135453	12.01256	9.921156	128.1005	119.1784	0.930351
13	59.98678	2.34629	12.01105	10.9266	140.7464	131.24	0.932458
14	59.98585	2.555149	12.00933	11.92524	153.2728	143.2141	0.934374
15	59.98449	2.765604	12.00794	12.92977	165.8934	155.2599	0.935902
16	59.98326	2.976083	12.00655	13.93102	178.5152	167.2635	0.936971
17	59.98175	3.186425	12.00507	14.93127	191.1273	179.251	0.937862
18	59.98035	3.397738	12.00365	15.93495	203.7975	191.2775	0.938566
19	59.9788	3.608663	12.00197	16.93568	216.4433	203.2614	0.939098
20	59.97661	3.820106	12.00058	17.93574	229.117	215.2393	0.93943
21	59.97492	4.03129	11.99893	18.93859	241.7763	227.2427	0.939888
22	59.97274	4.24262	11.99753	19.93988	254.4415	239.2293	0.940213
23	59.97032	4.454986	11.99601	20.94382	267.1669	251.2423	0.940394
24	59.96765	4.667045	11.99445	21.94232	279.8717	263.1862	0.940381
25	59.96494	4.879655	11.99301	22.94197	292.6082	275.1434	0.940313
26	59.96166	5.094127	11.99142	23.9486	305.4523	287.1779	0.940172
27	59.95839	5.308243	11.98996	24.9475	318.2737	299.1195	0.939819
28	59.95466	5.523704	11.9886	25.9499	331.1718	311.1029	0.9394
29	59.95078	5.739367	11.98671	26.95199	344.0795	323.0658	0.938928
30	59.94648	5.955386	11.98514	27.95089	357.0044	334.9954	0.938351
31	59.94188	6.172565	11.98375	28.95499	369.9952	346.9894	0.937821
32	59.93704	6.390164	11.98207	29.95579	383.0075	358.9324	0.937142
33	59.93138	6.60884	11.98045	30.95592	396.0769	370.8659	0.936348

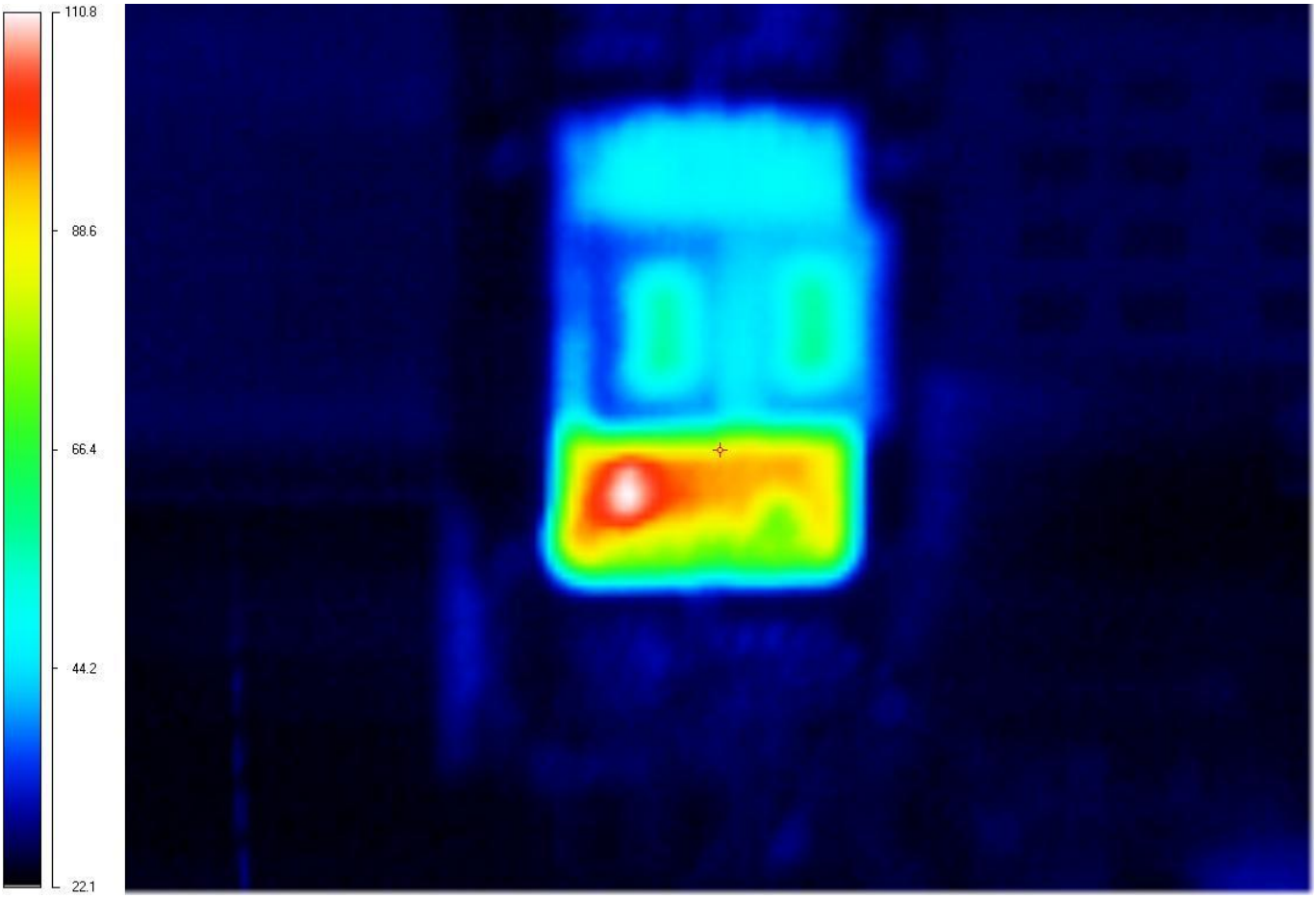
4 Thermal Tests

All tests were performed at room temperature on an open bench.

4.1 Test Setup



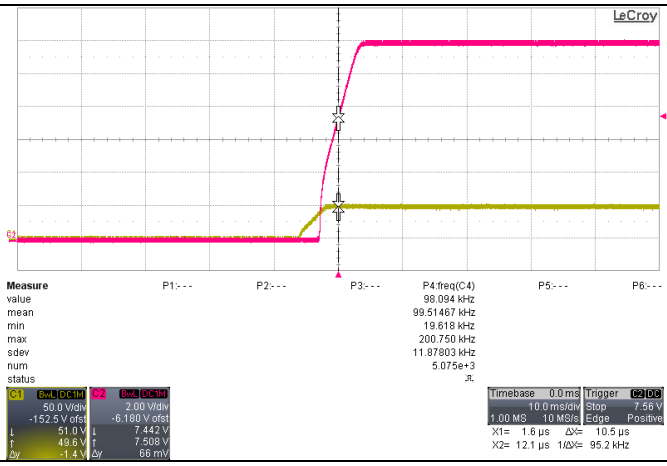
4.2 30A Load, 400 LFM Airflow



This image was taken after 20 minutes with a set airflow of 400 LFM. As one can see the highest temperature on the PCB is the MOSFETs, with a steady temperature of 110°C.

5 Start up

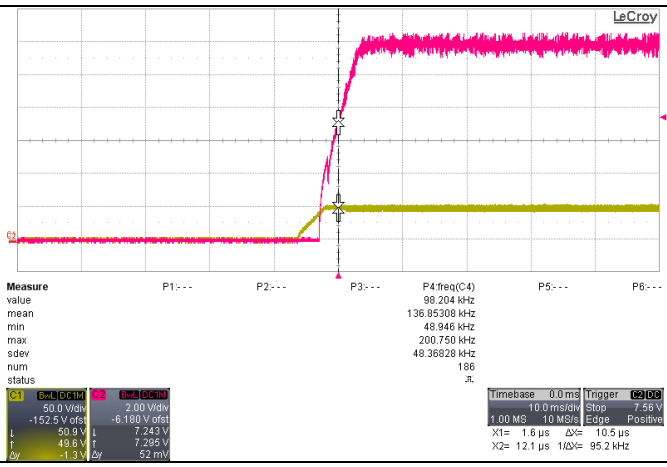
5.1 Start UP No Load



Turn-on, No Load

Red= Vout
Yellow = Vin

5.2 Startup 30A Electronic Load

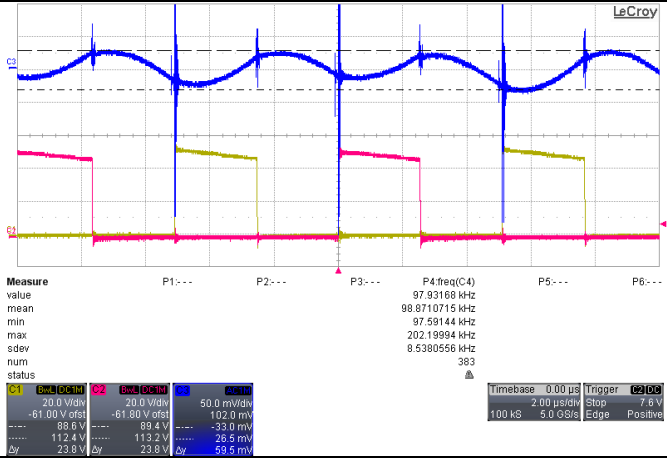


Turn-on, 30A Electronic Load

Red= Vout
Yellow = Vin

6 Switching and Ripple

6.1 Switching and Ripple

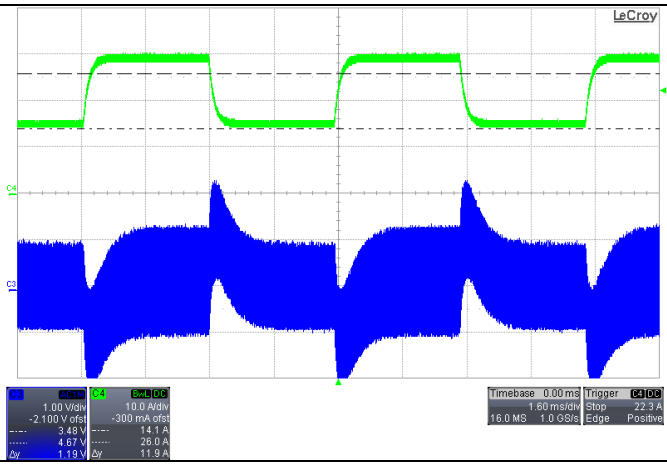


Switching and Ripple 30A Load

Yellow = VSW1
Red = VSW2
Blue = Vout ripple

7 Load Transient Response

7.1 No External Output Capacitor

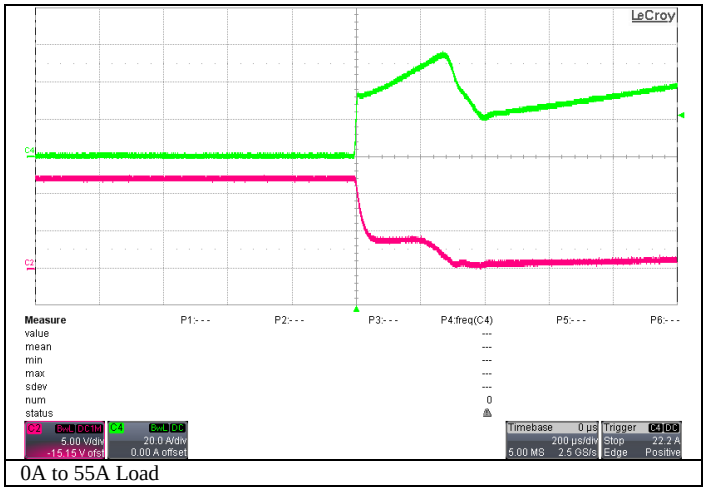


15A to 30A Load Step

Green = Load current step on and off
Blue = Vout

8 Over-Current Protection

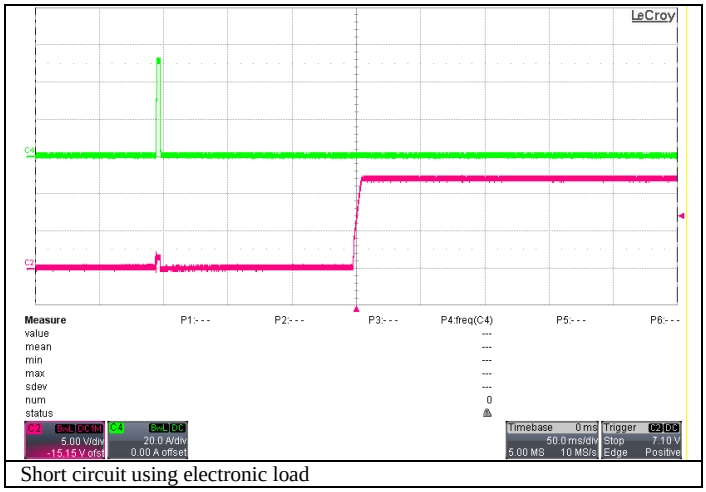
8.1 Short Circuit Protection



0A to 55A Load

Green = Iout
Red = Vout

8.2 Short Circuit Recovery

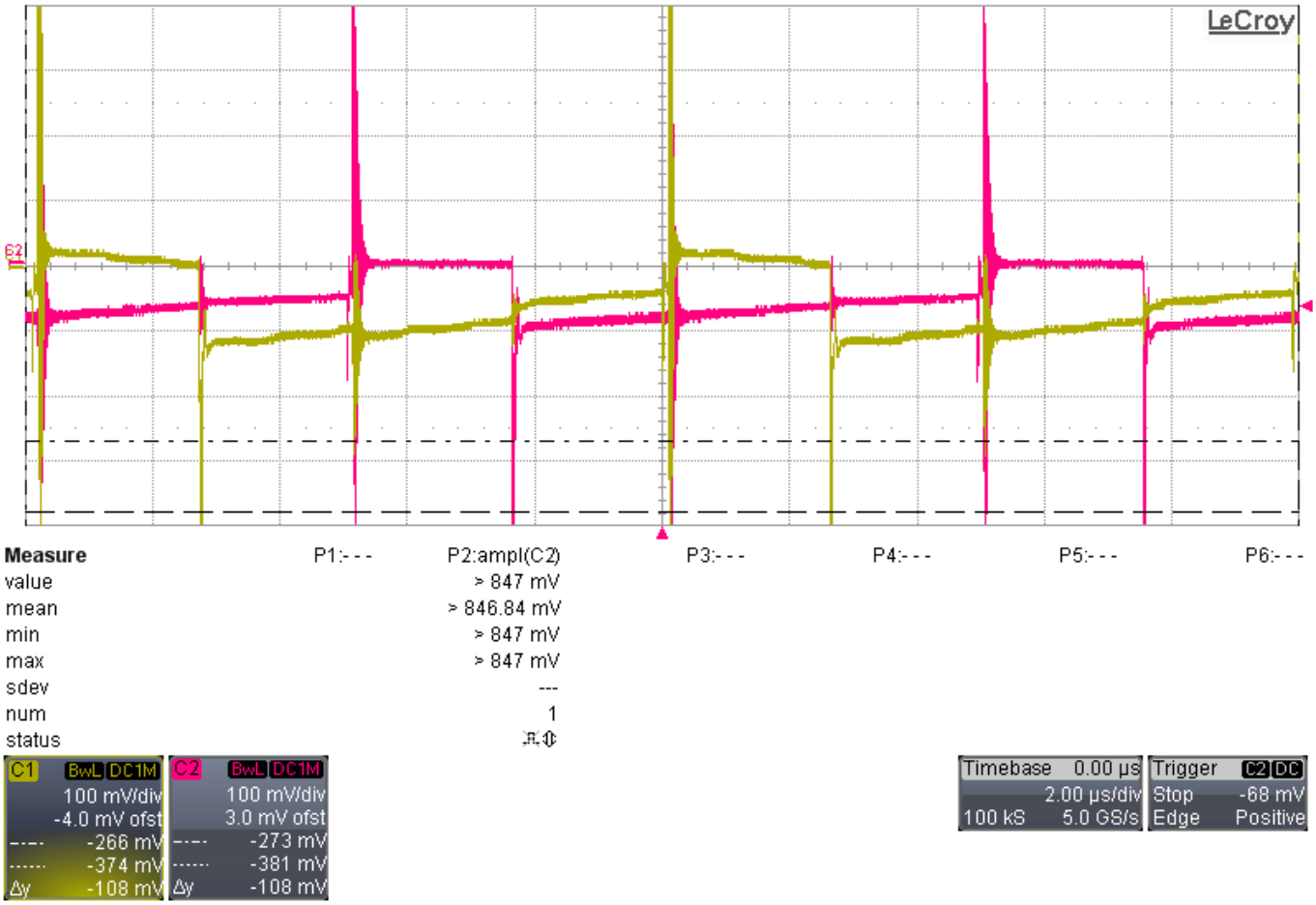


Short circuit using electronic load

Green = Iout
Red = Vout

9 Current Sharing

9.1 Differential measurement



This measurement was taken differentially across the both sense resistors (R10, R19). The electronic load was set to 30A and displays the ability to equally balance the load.

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