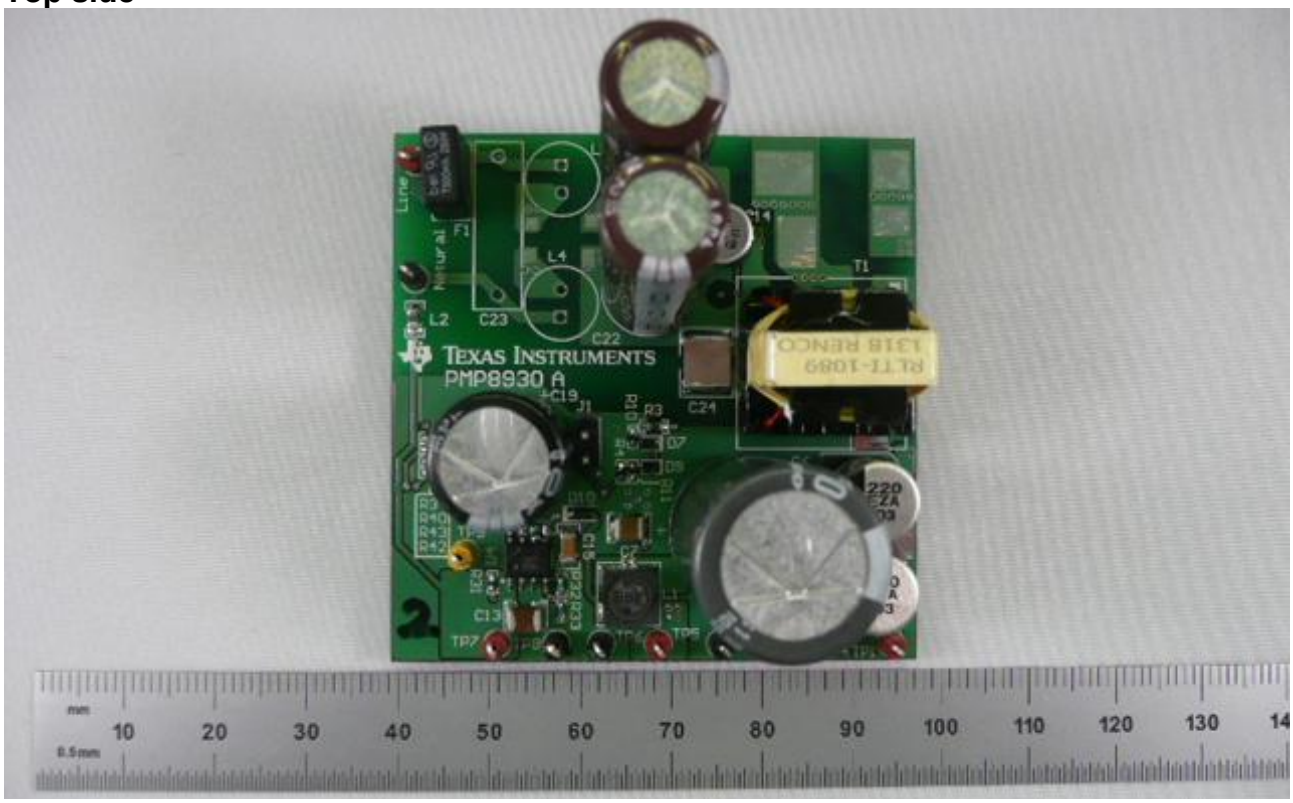
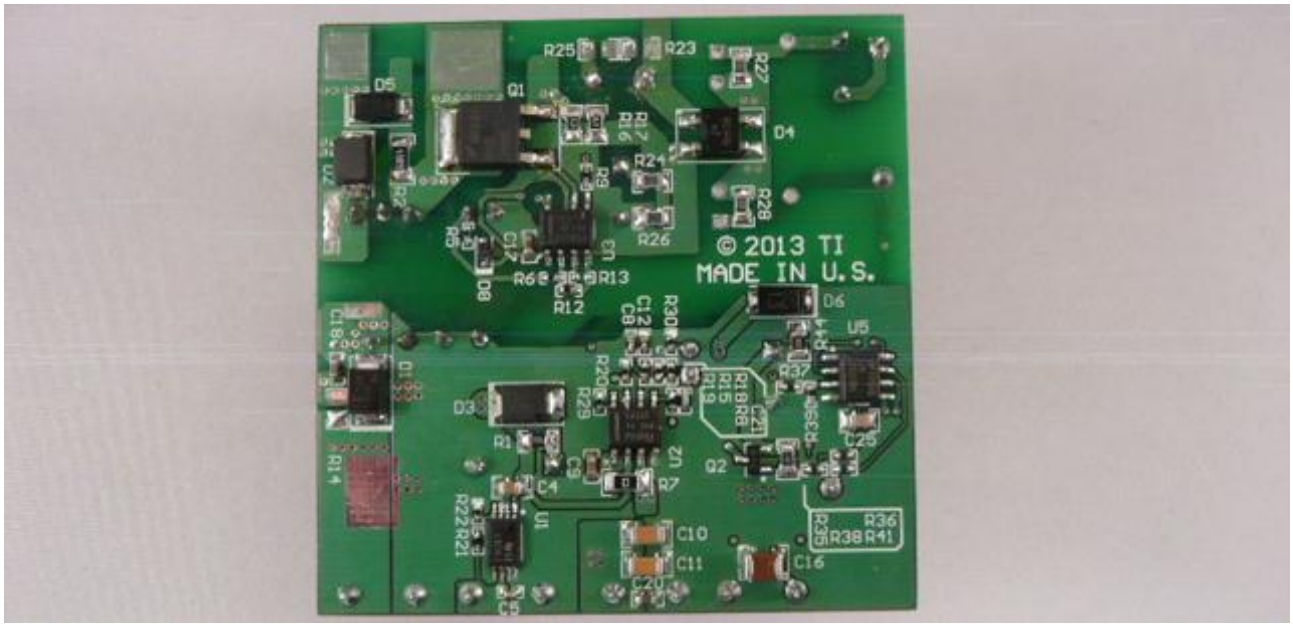
1 Photo

The photographs below show the PMP8930 Rev A assembly. This circuit was built on a PMP8930 Rev A PCB.

Top side



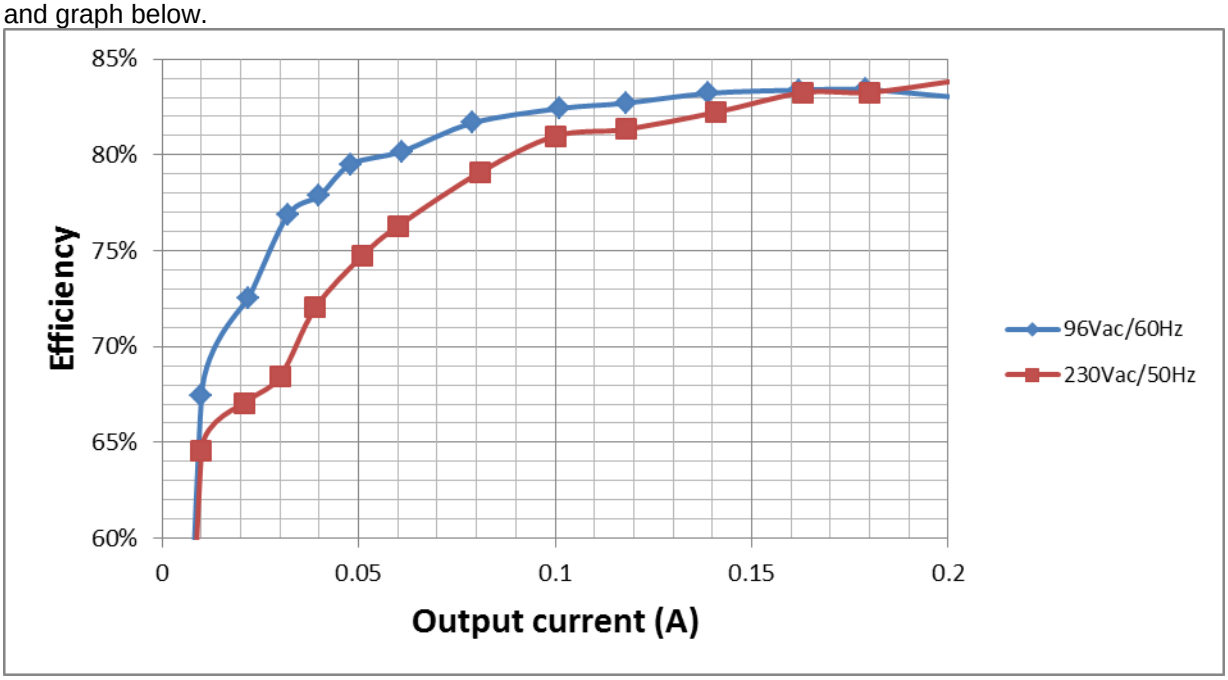
Bottom side



2 Efficiency

2.1 Flyback Converter Efficiency

Flyback converter efficiency was tested by disable U1, U2 and D6. The efficiency data is shown in the tables and graph below.



V_{in}=96V_{AC}/60Hz

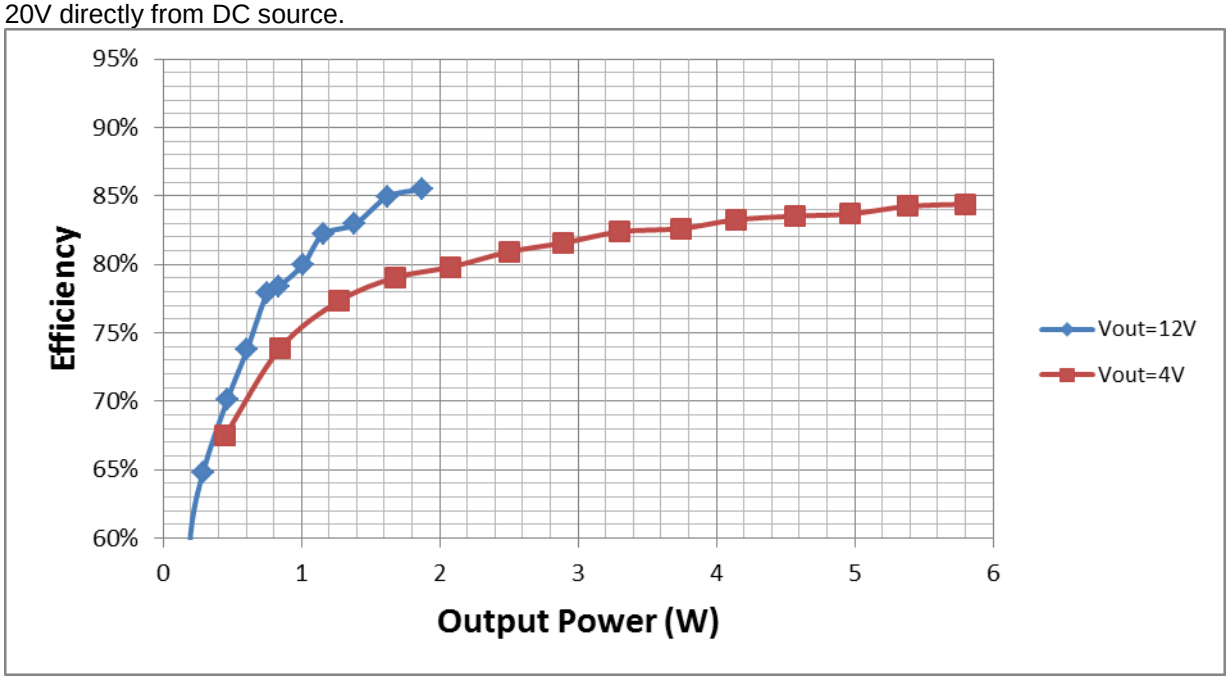
Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency (%)
96.08	0.1093	4.958	20.48	0.201	4.11648	0.84152	83.03%
96.08	0.09876	4.395	20.48	0.179	3.66592	0.72908	83.41%
96.08	0.0909	3.979	20.48	0.162	3.31776	0.66124	83.38%
96.08	0.08054	3.421	20.48	0.139	2.84672	0.57428	83.21%
96.08	0.07104	2.922	20.48	0.118	2.41664	0.50536	82.70%
96.08	0.06257	2.511	20.49	0.101	2.06949	0.44151	82.42%
96.08	0.05176	1.983	20.5	0.079	1.6195	0.3635	81.67%
96.08	0.0423	1.561	20.52	0.061	1.25172	0.30928	80.19%
96.08	0.03492	1.24	20.54	0.048	0.98592	0.25408	79.51%
96.08	0.0305	1.056	20.56	0.04	0.8224	0.2336	77.88%
96.08	0.02556	0.8571	20.59	0.032	0.65888	0.19822	76.87%
96.08	0.019525	0.626	20.64	0.022	0.45408	0.17192	72.54%
96.08	0.01044	0.306	20.64	0.01	0.2064	0.0996	67.45%
96.08	0.00245	0.06388	20.71	0	0	0.06388	0.00%

Vin=230V_{AC}/50Hz

Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency (%)
230	0.06336	4.905	20.46	0.201	4.11246	0.79254	83.84%
230	0.05824	4.423	20.46	0.18	3.6828	0.7402	83.26%
230	0.0537	4.006	20.46	0.163	3.33498	0.67102	83.25%
230	0.048	3.51	20.47	0.141	2.88627	0.62373	82.23%
230	0.04195	2.971	20.48	0.118	2.41664	0.55436	81.34%
230	0.03669	2.529	20.48	0.1	2.048	0.481	80.98%
230	0.0313	2.099	20.5	0.081	1.6605	0.4385	79.11%
230	0.02507	1.613	20.51	0.06	1.2306	0.3824	76.29%
230	0.02191	1.4	20.52	0.051	1.04652	0.35348	74.75%
230	0.018349	1.112	20.54	0.039	0.80106	0.31094	72.04%
230	0.015537	0.902	20.58	0.03	0.6174	0.2846	68.45%
230	0.011724	0.645	20.59	0.021	0.43239	0.21261	67.04%
230	0.00674	0.319	20.6	0.01	0.206	0.113	64.58%
230	0.0015	0.069	20.65	0	0	0.069	0.00%

2.2 Synchronous Buck Converter Efficiency

The efficiency of the synchronous buck converter (TPS54335 and its related circuit) was tested by applying a 20V directly from DC source.



V_{out}=4V_{DC} (J1 open)

Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency (%)
20.03	0.343	6.87029	4.13	1.404	5.79852	1.07177	84.40%
20.04	0.319	6.39276	4.13	1.304	5.38552	1.00724	84.24%
20.04	0.296	5.93184	4.13	1.202	4.96426	0.96758	83.69%
20.03	0.273	5.46819	4.13	1.106	4.56778	0.90041	83.53%
20.04	0.248	4.96992	4.13	1.002	4.13826	0.83166	83.27%
20.04	0.226	4.52904	4.13	0.906	3.74178	0.78726	82.62%
20.05	0.2	4.01	4.13	0.8	3.304	0.706	82.39%
20.05	0.177	3.54885	4.13	0.701	2.89513	0.65372	81.58%
20.05	0.154	3.0877	4.13	0.605	2.49865	0.58905	80.92%
20.06	0.13	2.6078	4.13	0.504	2.08152	0.52628	79.82%
20.06	0.106	2.12636	4.13	0.407	1.68091	0.44545	79.05%
20.06	0.082	1.64492	4.13	0.308	1.27204	0.37288	77.33%
20.06	0.057	1.14342	4.14	0.204	0.84456	0.29886	73.86%
20.07	0.033	0.66231	4.14	0.108	0.44712	0.21519	67.51%

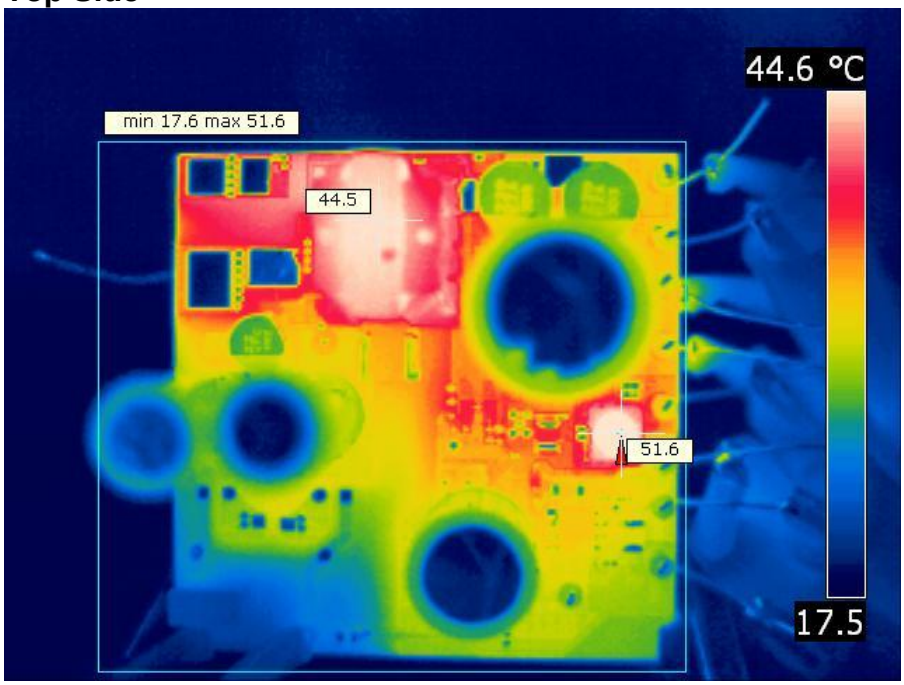
V_{out}=12V_{DC} (J1 shorted)

Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency (%)
20.08	0.109	2.18872	11.92	0.157	1.87144	0.31728	85.50%
20.09	0.095	1.90855	11.92	0.136	1.62112	0.28743	84.94%
20.09	0.083	1.66747	11.92	0.116	1.38272	0.28475	82.92%
20.09	0.07	1.4063	11.92	0.097	1.15624	0.25006	82.22%
20.1	0.063	1.2663	11.92	0.085	1.0132	0.2531	80.01%
20.1	0.053	1.0653	11.93	0.07	0.8351	0.2302	78.39%
20.1	0.048	0.9648	11.93	0.063	0.75159	0.21321	77.90%
20.1	0.041	0.8241	11.93	0.051	0.60843	0.21567	73.83%
20.1	0.033	0.6633	11.93	0.039	0.46527	0.19803	70.14%
20.1	0.022	0.4422	11.93	0.024	0.28632	0.15588	64.75%
20.11	0.016	0.32176	11.93	0.016	0.19088	0.13088	59.32%
20.11	0.004	0.08044	11.93	0	0	0.08044	0.00%

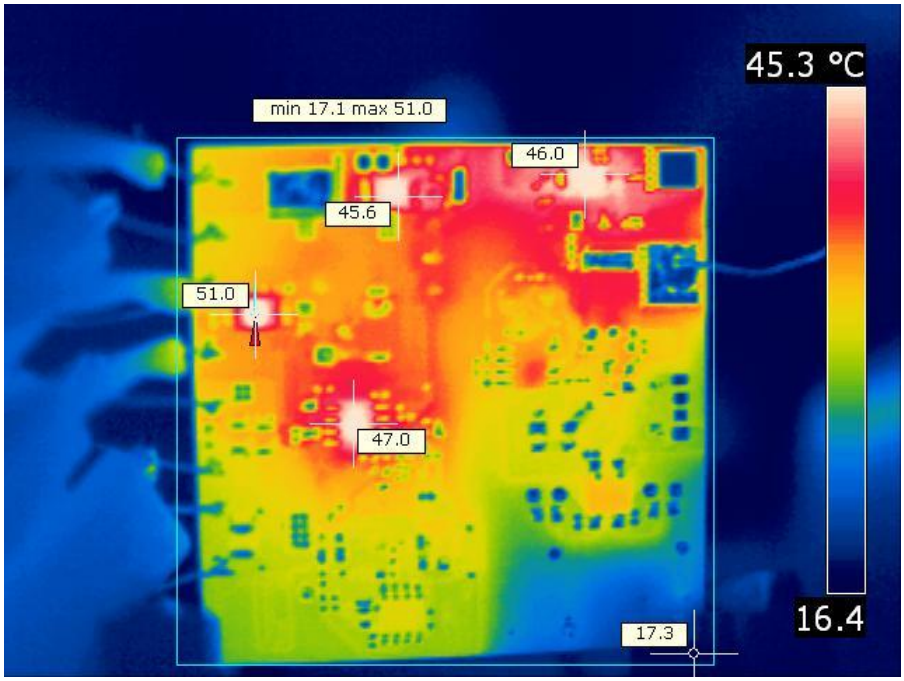
3 Thermal Images

The thermal images below show a top view and bottom view of the board with 96V_{ac}/60Hz input (P_{in}=10W). The ambient temperature was 20ºC with no forced air flow. The output was at full load: 20V/50mA, 5V/10mA, 4V/1.4A, and 3.3V/50mA.

Top Side



Bottom Side

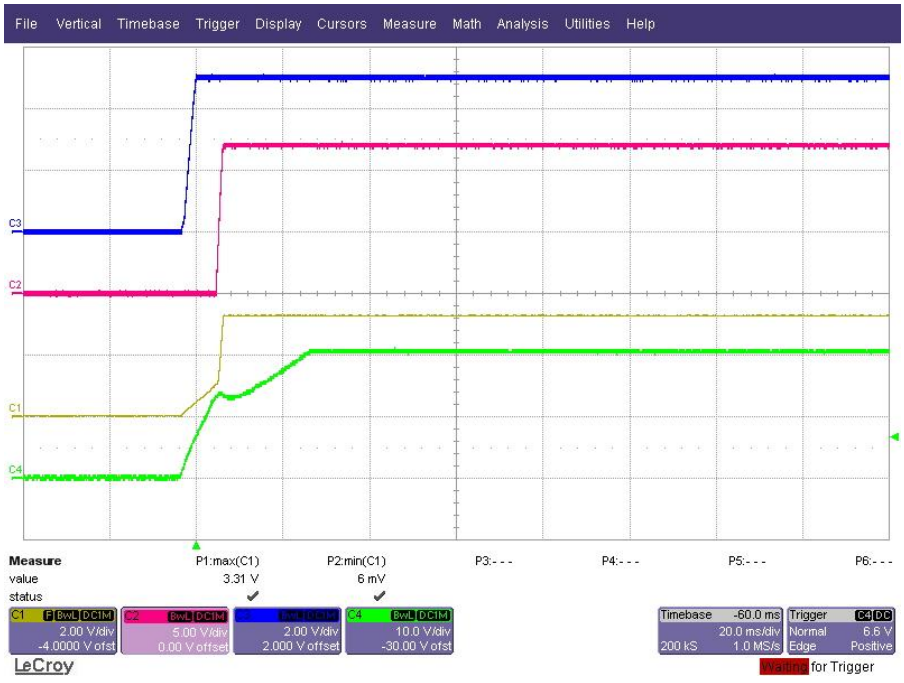


4 Startup

The output voltage at startup is shown in the images below. Channel 1: 3.3V, Channel 2: 4V or 12V, Channel 3: 5V, Channel 4: 20V.

4.1 Start Up @ 96V_{ac}: 20V/50mA, 5V/10mA, 4V/1.4A, and 3.3V/50mA.

4.2 Start Up @ 96V_{ac}: 20V/50mA, 5V/10mA, 12V/150mA, and 3.3V/50mA.



4.3 Start Up @ 275V_{ac}: 20V/50mA, 5V/10mA, 4V/1.4A, and 3.3V/50mA.

4.4 Start Up @ 275V_{ac}: 20V/50mA, 5V/10mA, 12V/150mA, and 3.3V/50mA.

5 Turn off

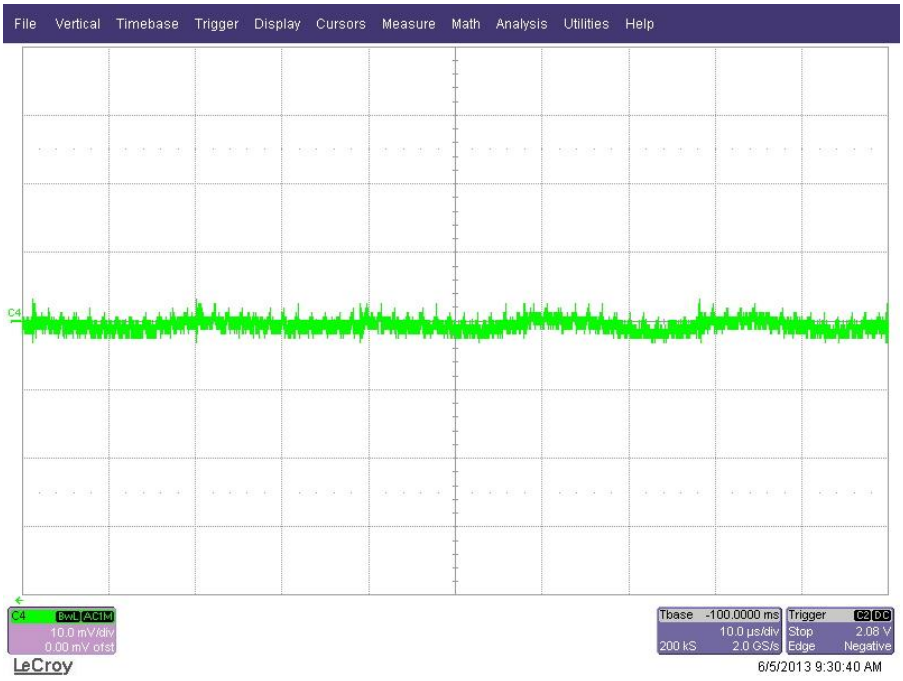
The output voltage at turn off transient is shown in the images below at full load (20V/50mA, 5V/10mA, 12V/150mA, and 3.3V/50mA) and 96V_{ac}/60Hz input. Channel 1: 3.3V, Channel 2: 4V or 12V, Channel 3: 5V, Channel 4: 20V.

6 Output Ripple Voltages - Full Load

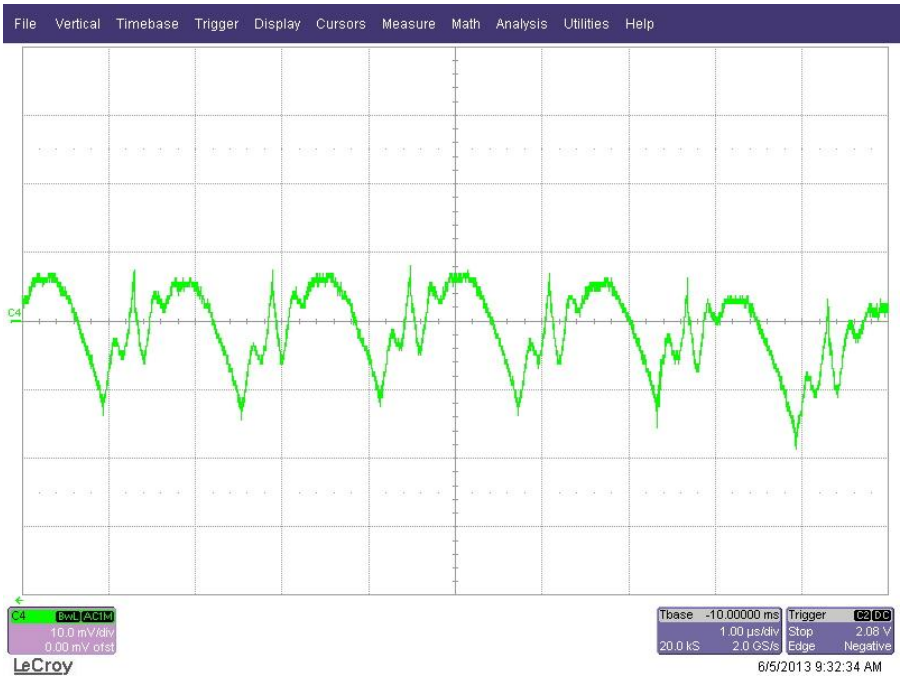
The output ripple voltages are shown in the plots below with 96V_{ac} input voltage.

6.1 20V_{ripple} with loads 20V/50mA, 5V/10mA, 4V/1.4A, and 3.3V/50mA:

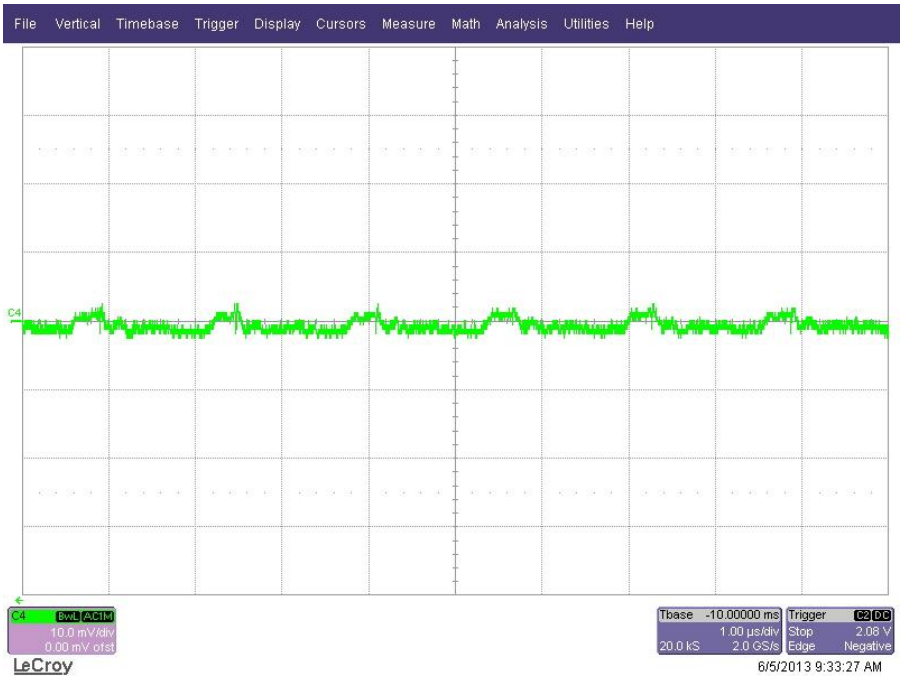
6.2 5V_{ripple} with loads 20V/50mA, 5V/10mA, 4V/1.4A, and 3.3V/50mA:



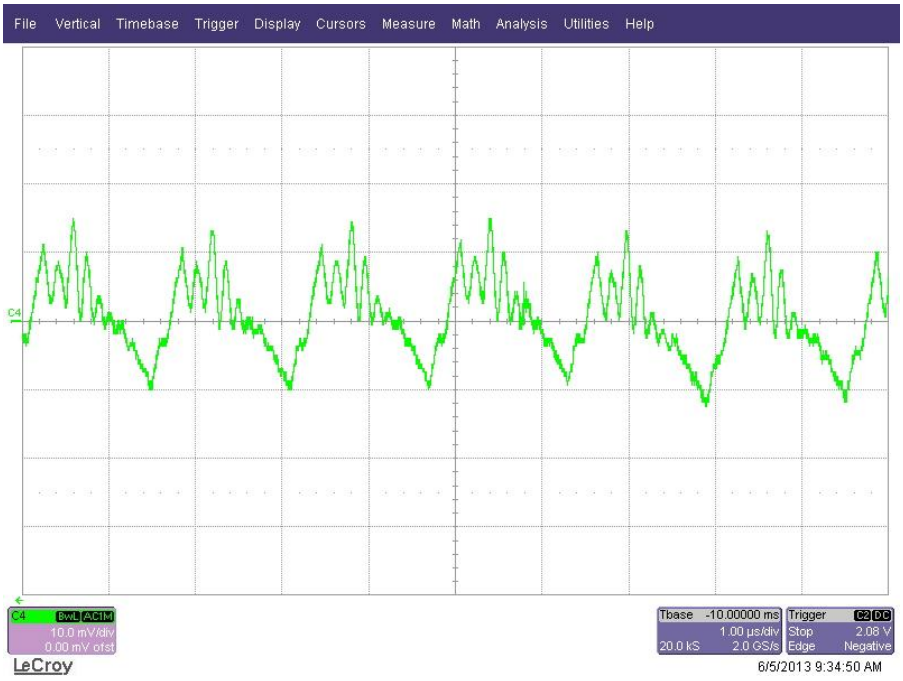
6.3 $4V_{ripple}$ with loads 20V/50mA, 5V/10mA, 4V/1.4A, and 3.3V/50mA:



6.4 $3.3V_{ripple}$ with loads 20V/50mA, 5V/10mA, 4V/1.4A, and 3.3V/50mA:

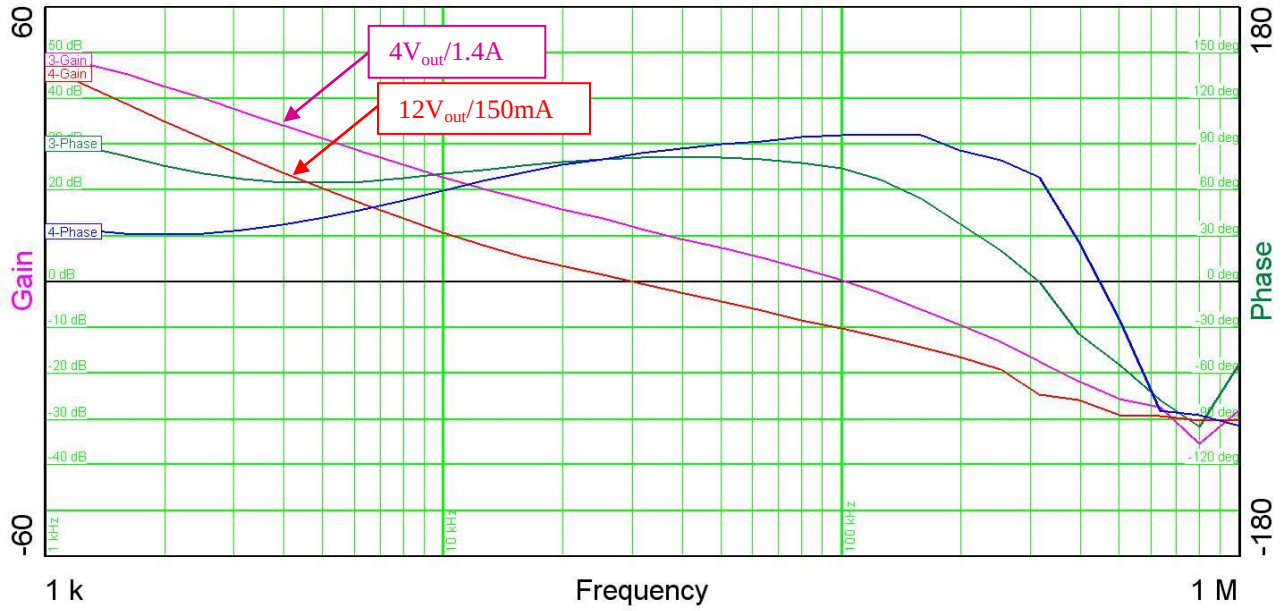


6.5 $12V_{ripple}$ with loads 20V/50mA, 5V/10mA, 12V/150mA, and 3.3V/50mA:



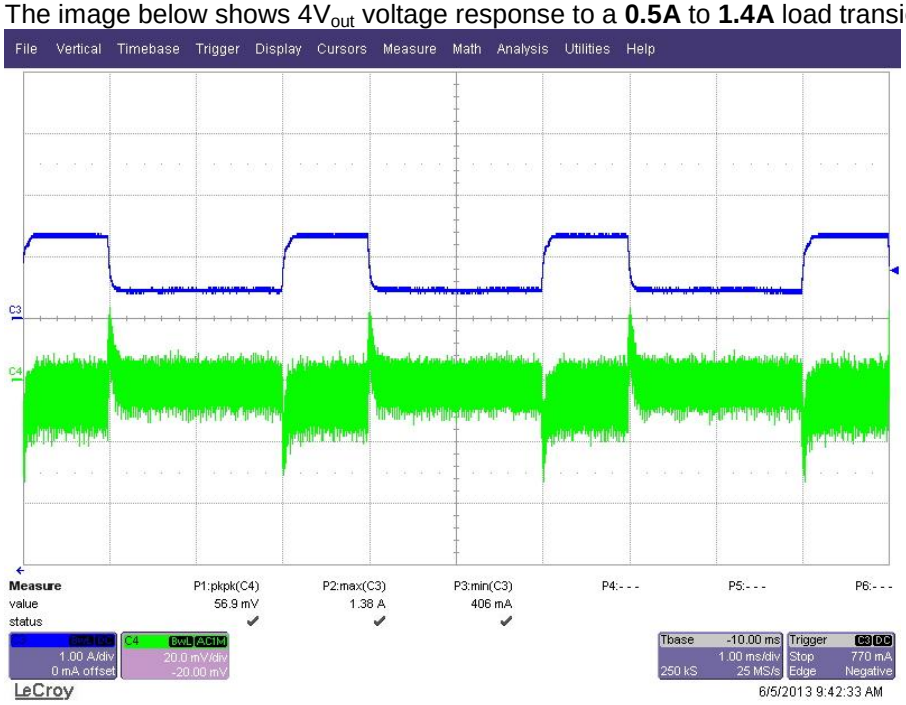
7 Synchronous Buck Converter Loop Response

The plot below shows the frequency response of the feedback loop. The input voltage was 20V.



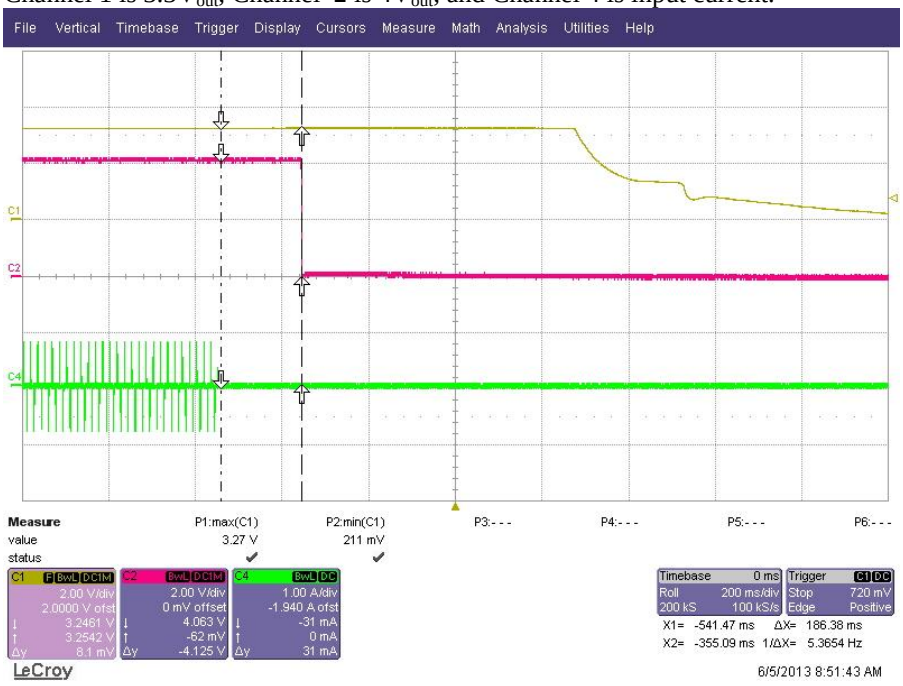
8 Load Transients

The image below shows $4V_{out}$ voltage response to a **0.5A** to **1.4A** load transient.



9 Hold-up Time

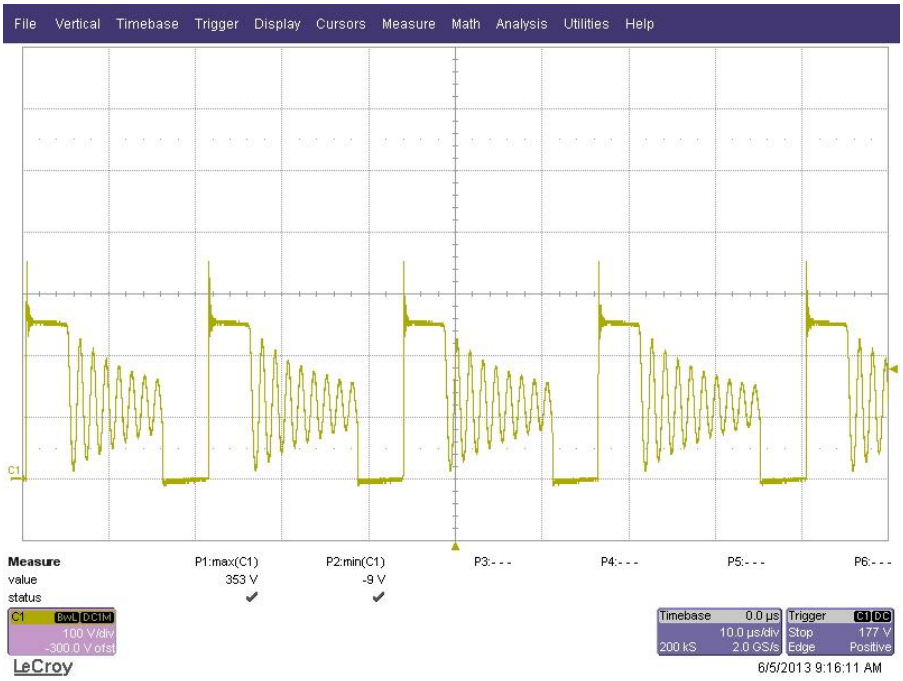
The image below shows the hold-up time with full load (20V/50mA, 5V/10mA, 12V/150mA, and 3.3V/50mA) applied. Channel 1 is $3.3V_{out}$, Channel 2 is $4V_{out}$, and Channel 4 is input current.



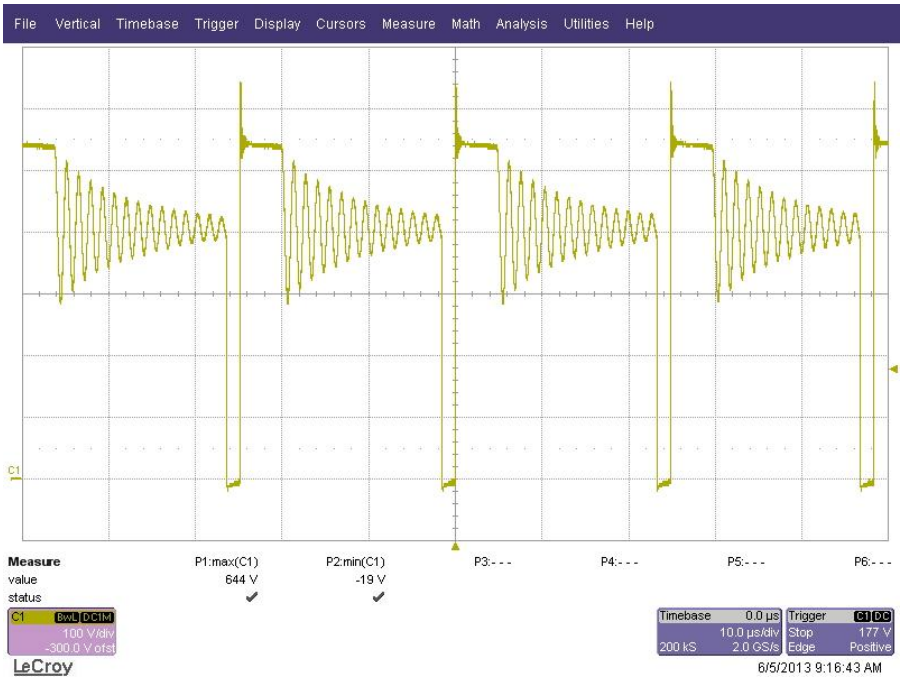
10 Switching Waveforms

The image below shows key switching waveforms of PMP8930RevA. The waveforms are measured with full load (20V/50mA, 5V/10mA, 12V/150mA, and 3.3V/50mA).

10.1 Primary MOSFET Q1 @ 96V/60Hz



10.2 Primary MOSFET Q1 @ 275V/50Hz



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