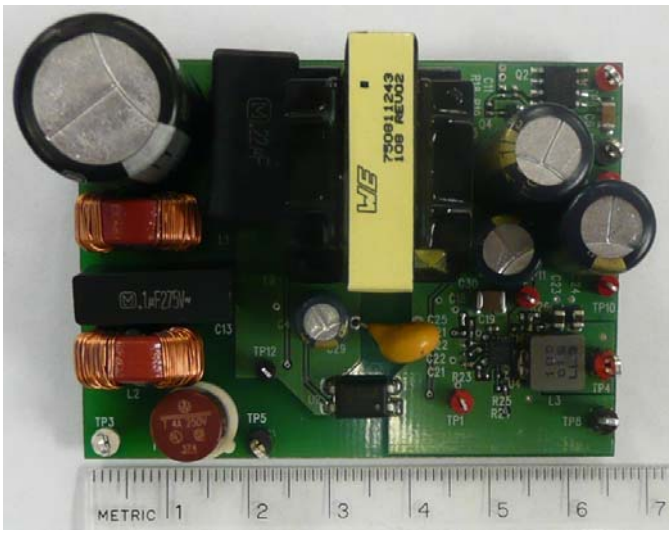
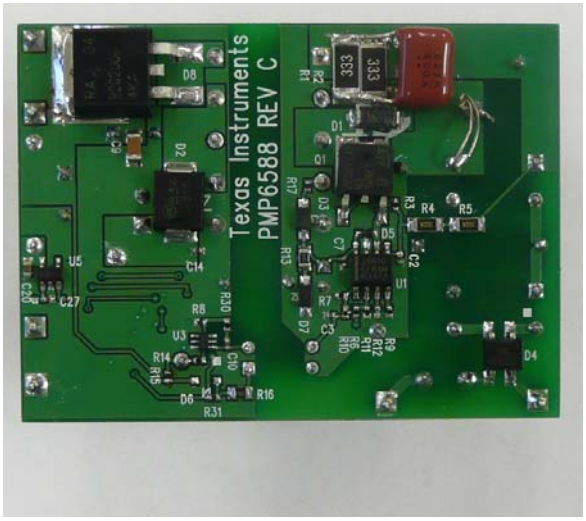
1 Photo

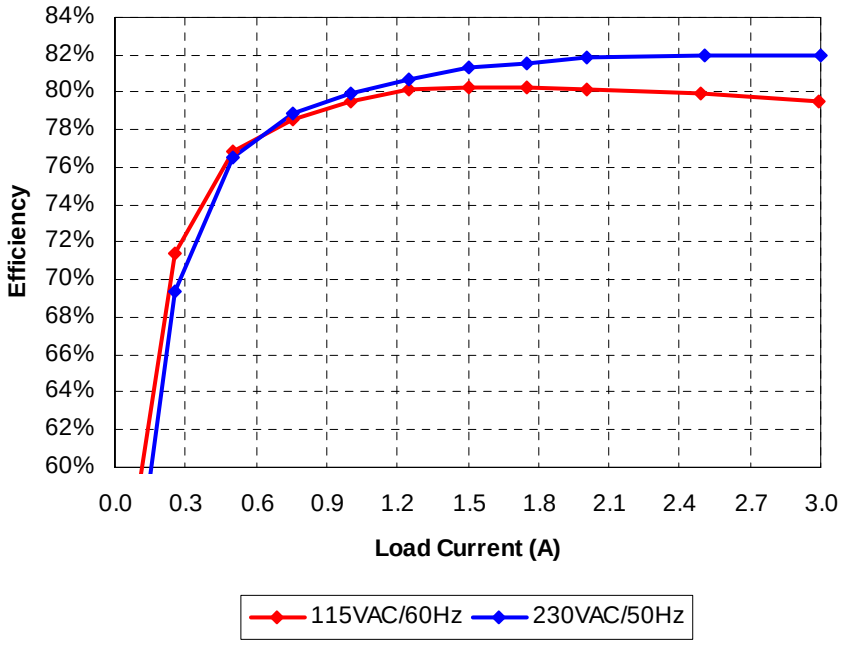
The photographs below show the top and bottom views of the PMP6588 Rev D demo board. This circuit was built on a PMP6588 Rev C PWB.





2 Flyback Efficiency (Wurth Transformer)

The flyback efficiency data using the Wurth transformer is shown in the tables and graph below. The 5V output was unloaded. (R12=28k, R8=2.74k)



115VAC/60Hz

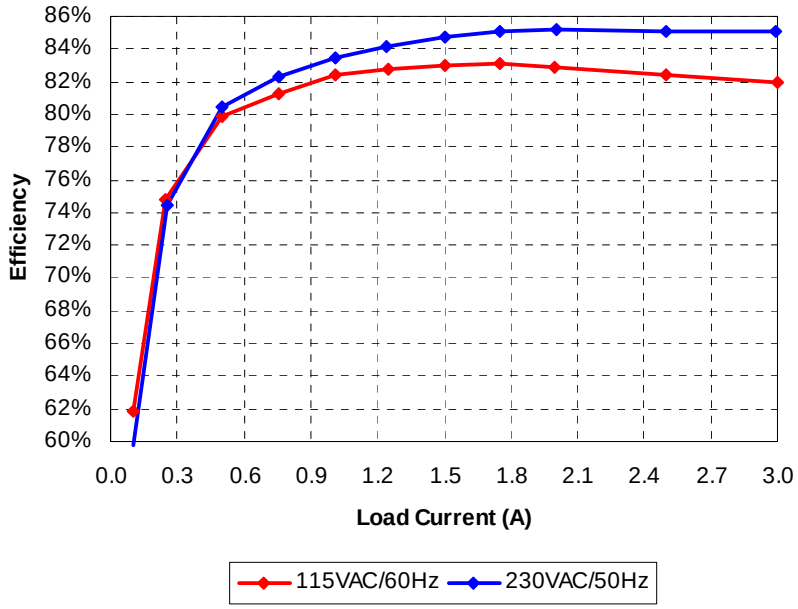
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.102	23.67	114.6	0.081	4.10	2.41	1.686	58.9%
0.253	23.65	115.7	0.151	8.38	5.98	2.397	71.4%
0.502	23.63	115.5	0.261	15.44	11.86	3.578	76.8%
0.753	23.60	115.4	0.369	22.6	17.77	4.859	78.5%
1.002	23.58	115.3	0.474	29.7	23.63	6.073	79.6%
1.253	23.55	115.2	0.577	36.8	29.51	7.292	80.2%
1.502	23.52	115.1	0.678	44.0	35.33	8.673	80.3%
1.753	23.49	114.9	0.774	51.3	41.18	10.122	80.3%
2.004	23.45	114.8	0.872	58.6	46.99	11.606	80.2%
2.494	23.38	114.5	1.064	72.9	58.31	14.590	80.0%
2.994	23.28	114.2	1.274	87.7	69.70	18.000	79.5%

230VAC/50Hz

Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.102	23.66	232.1	0.051	4.38	2.41	1.967	55.1%
0.253	23.63	232.0	0.093	8.61	5.98	2.632	69.4%
0.502	23.61	231.9	0.155	15.48	11.85	3.628	76.6%
0.753	23.58	231.8	0.217	22.5	17.76	4.744	78.9%
1.002	23.55	231.7	0.277	29.5	23.60	5.903	80.0%
1.253	23.52	231.7	0.336	36.5	29.47	7.029	80.7%
1.502	23.49	231.6	0.391	43.4	35.28	8.118	81.3%
1.753	23.45	231.5	0.446	50.4	41.11	9.292	81.6%
2.004	23.42	231.4	0.500	57.3	46.93	10.366	81.9%
2.503	23.33	231.2	0.608	71.2	58.39	12.805	82.0%
3.003	23.23	231.0	0.712	85.1	69.76	15.340	82.0%

3 Flyback Efficiency (Renco Transformer)

The flyback efficiency data using the Renco transformer is shown in the tables and graph below. The 5V output was unloaded.



115VAC/60Hz

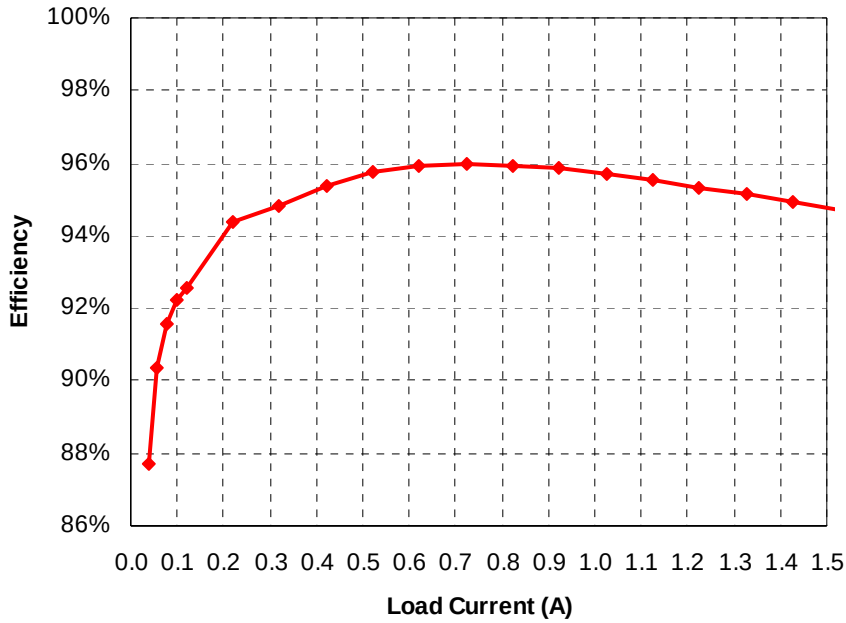
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.098	24.68	115.6	0.079	3.91	2.42	1.491	61.9%
0.245	24.66	115.5	0.150	8.08	6.04	2.038	74.8%
0.499	24.63	115.4	0.268	15.38	12.29	3.090	79.9%
0.753	24.61	115.2	0.379	22.8	18.53	4.269	81.3%
1.009	24.58	115.0	0.480	30.1	24.80	5.299	82.4%
1.247	24.55	114.9	0.572	37.0	30.61	6.356	82.8%
1.500	24.52	114.8	0.667	44.3	36.78	7.520	83.0%
1.750	24.49	114.7	0.766	51.6	42.86	8.743	83.1%
1.998	24.46	114.5	0.868	59.0	48.87	10.129	82.8%
2.499	24.39	114.2	1.088	74.0	60.95	13.049	82.4%
3.000	23.91	113.9	1.262	87.5	71.73	15.770	82.0%

230VAC/50Hz

Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.101	24.68	230.8	0.049	4.17	2.49	1.677	59.8%
0.252	24.66	230.8	0.091	8.35	6.21	2.136	74.4%
0.502	24.63	230.7	0.157	15.36	12.36	2.996	80.5%
0.753	24.60	230.6	0.220	22.5	18.52	3.976	82.3%
1.009	24.57	230.5	0.283	29.7	24.79	4.909	83.5%
1.244	24.54	230.5	0.338	36.3	30.53	5.772	84.1%
1.508	24.51	230.4	0.400	43.6	36.96	6.639	84.8%
1.751	24.48	230.3	0.454	50.4	42.86	7.536	85.0%
2.003	24.45	230.2	0.488	57.5	48.97	8.527	85.2%
2.500	24.37	230.0	0.501	71.6	60.93	10.675	85.1%
2.993	24.27	229.8	0.724	85.4	72.64	12.760	85.1%

4 Synchronous Buck Efficiency

The 5V buck efficiency data is shown in the table and graph below. This data was collected using the TPS53312 EVM.



TPS53312, 700KHz, 10uH, 2 x 22uF output caps							
Vin	Iin	Iout	Vout	Pin	Pout	Ploss	Efficiency
12.00	0.001	0.00	4.98	0.02	0.00	0.02	0.00%
12.00	0.018	0.04	4.98	0.21	0.19	0.03	87.70%
12.00	0.027	0.06	4.98	0.32	0.29	0.03	90.34%
12.00	0.035	0.08	4.97	0.43	0.39	0.04	91.58%
12.00	0.044	0.10	4.98	0.53	0.49	0.04	92.23%
12.00	0.053	0.12	4.98	0.64	0.59	0.05	92.55%
12.00	0.096	0.22	4.98	1.16	1.09	0.07	94.36%
12.00	0.140	0.32	4.97	1.68	1.59	0.09	94.82%
12.00	0.183	0.42	4.99	2.20	2.10	0.10	95.38%
12.00	0.226	0.52	4.99	2.71	2.60	0.11	95.77%
12.00	0.269	0.62	4.99	3.23	3.10	0.13	95.95%
12.00	0.313	0.72	4.99	3.75	3.60	0.15	96.00%
12.00	0.356	0.82	4.98	4.28	4.10	0.17	95.93%
12.00	0.400	0.92	4.98	4.80	4.60	0.20	95.85%
12.00	0.445	1.02	4.98	5.33	5.11	0.23	95.70%
12.00	0.489	1.13	4.98	5.87	5.61	0.26	95.56%
12.00	0.534	1.23	4.98	6.40	6.11	0.30	95.33%
12.00	0.579	1.33	4.98	6.94	6.61	0.34	95.14%
12.00	0.624	1.43	4.98	7.49	7.11	0.38	94.91%
12.00	0.669	1.53	4.98	8.03	7.61	0.43	94.68%

5 No Load Power Consumption

The table below shows the input power with no external loads connected to the power supply. An external 1000uF capacitor was connected across the 24V output.

5.1 Wurth Transformer

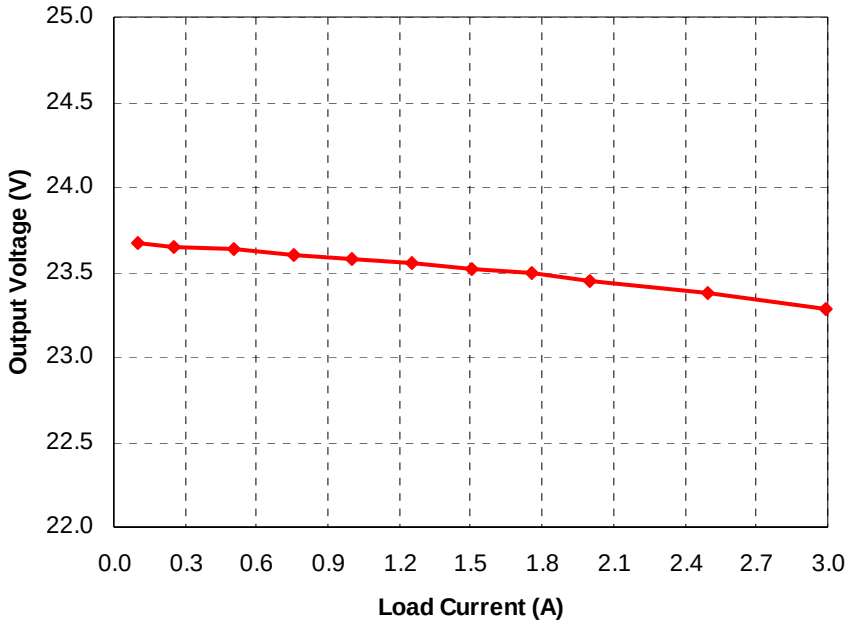
Input	Loss
115VAC/60Hz	155mW
230VAC/50Hz	380mW

5.2 Renco Transformer

Input	Loss
115VAC/60Hz	218mW
230VAC/50Hz	394mW

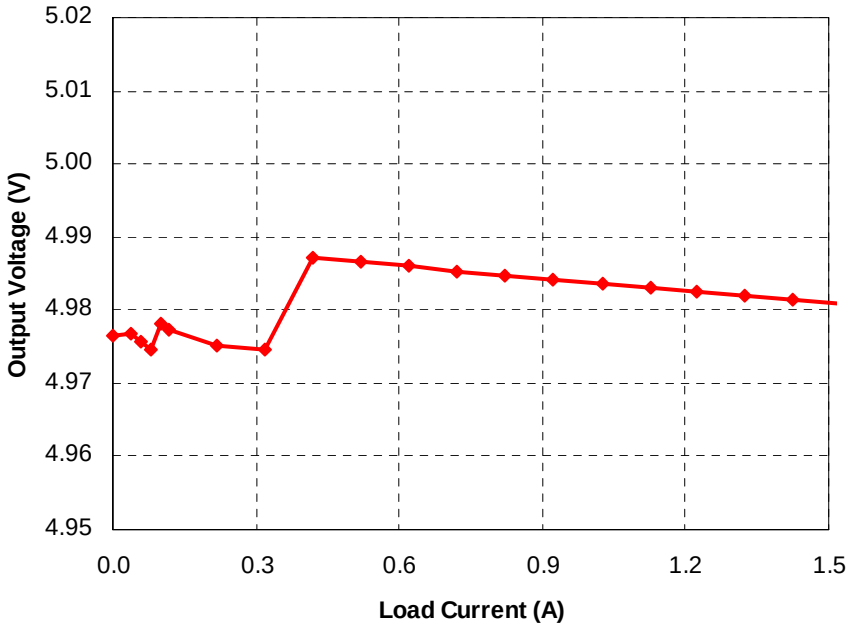
6 24V Load Regulation

The 24V output voltage versus 24Vcurrent is shown in the chart below.



7 5V Load Regulation

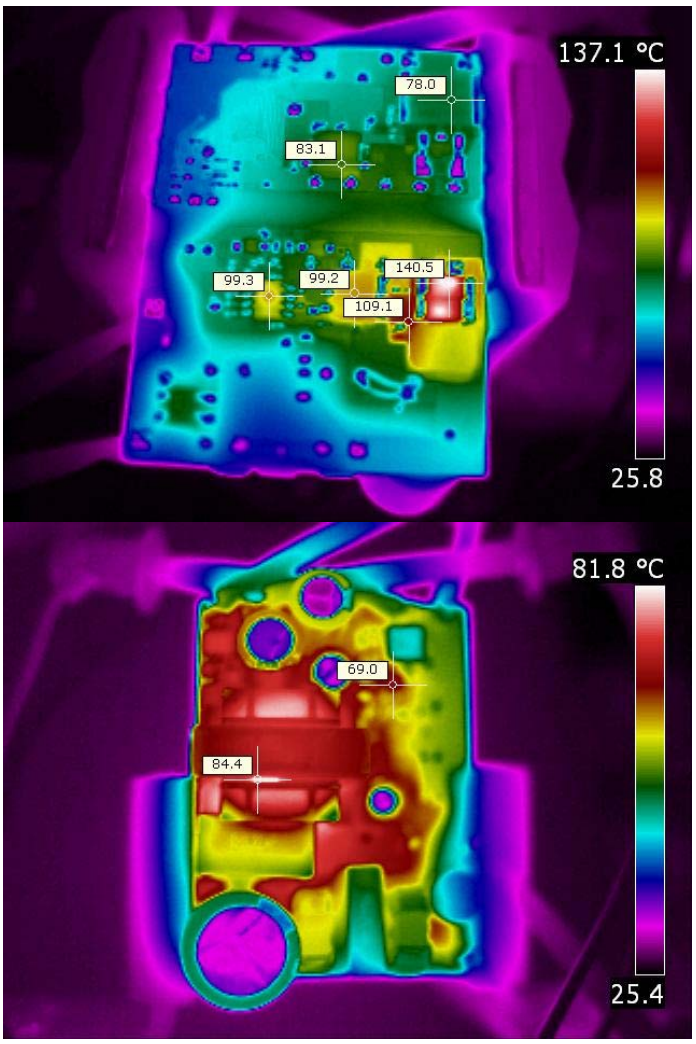
The 5V output voltage versus 5V current is shown in the chart below.

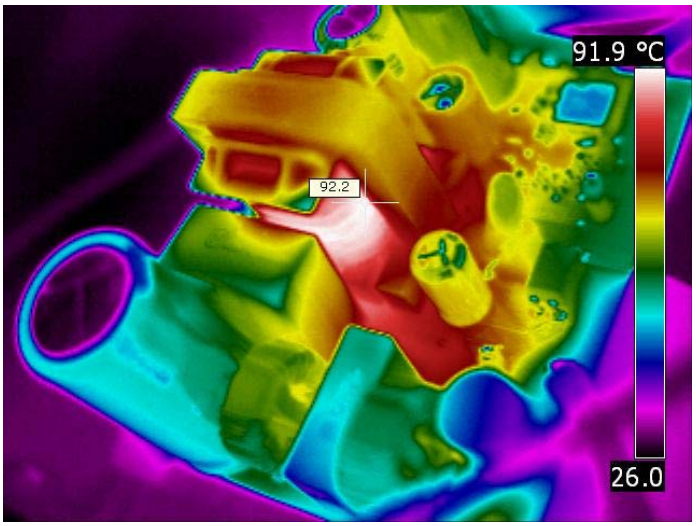


8 Thermal Images (Wurth Transformer)

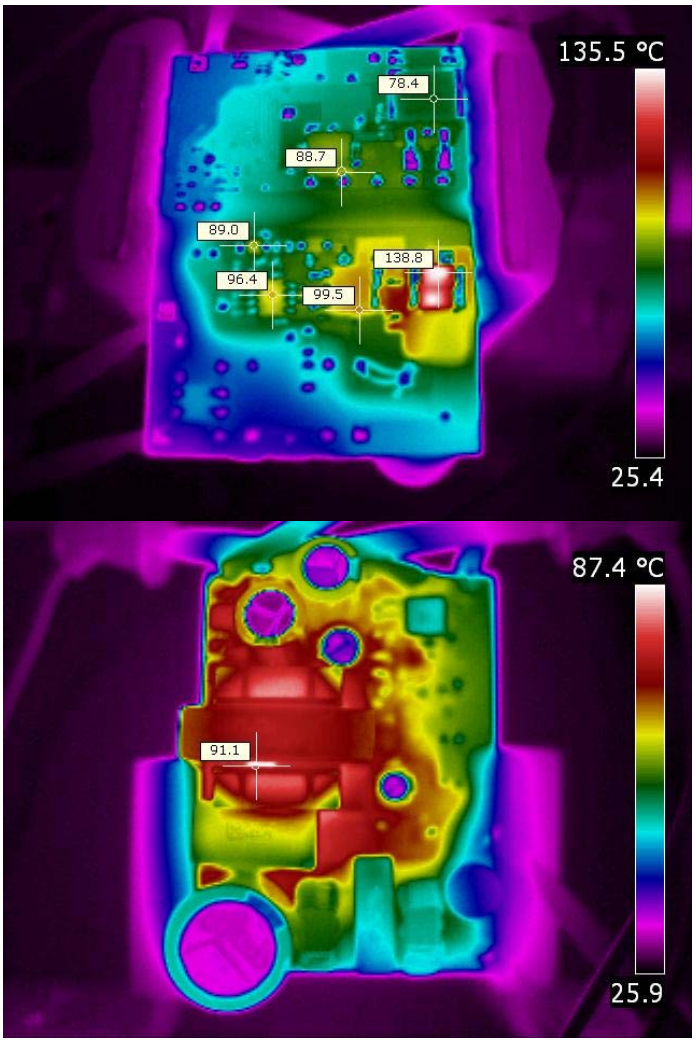
The thermal images below show a top and bottom view of the board and a close up of the transformer. The ambient temperature was 26ºC with no forced air flow. The 24V output was loaded with 1A, and the 5V output was loaded with 1A. (R12=28k, R8=2.74k, R1=R2=33k)

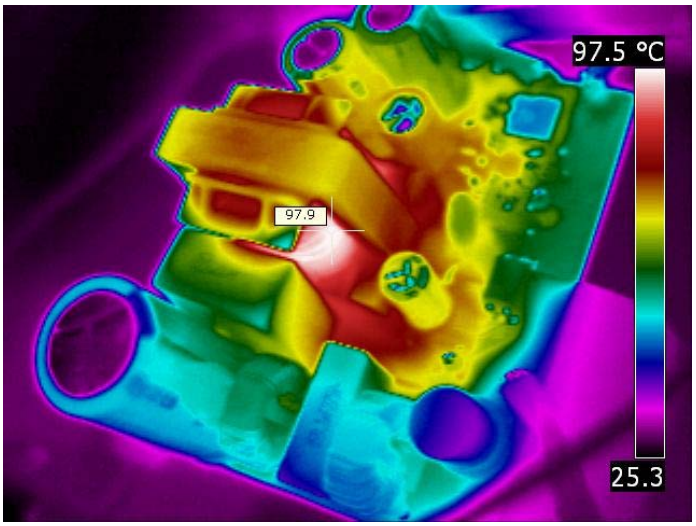
8.1 115VAC, 60Hz Input





8.2 230VAC, 50Hz Input

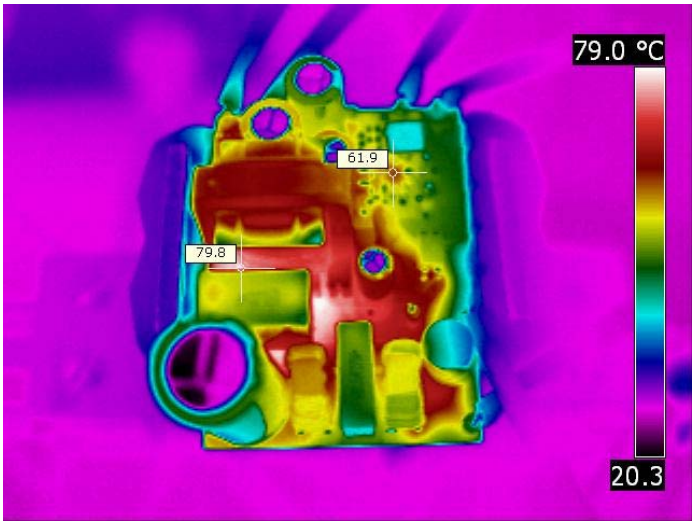


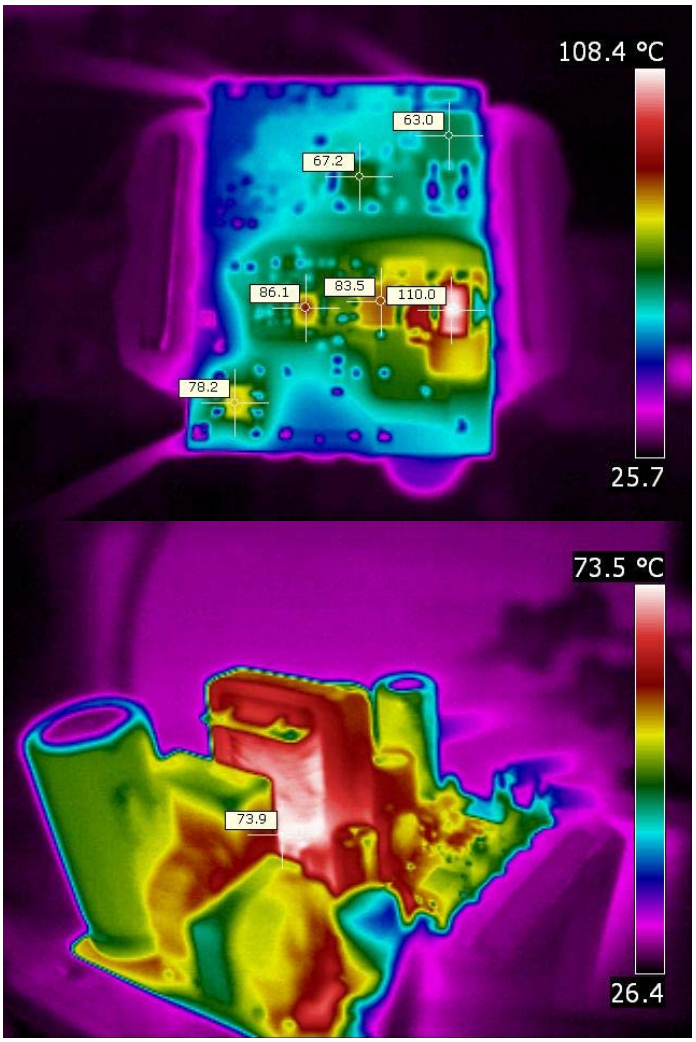


9 Thermal Images (Renco Transformer)

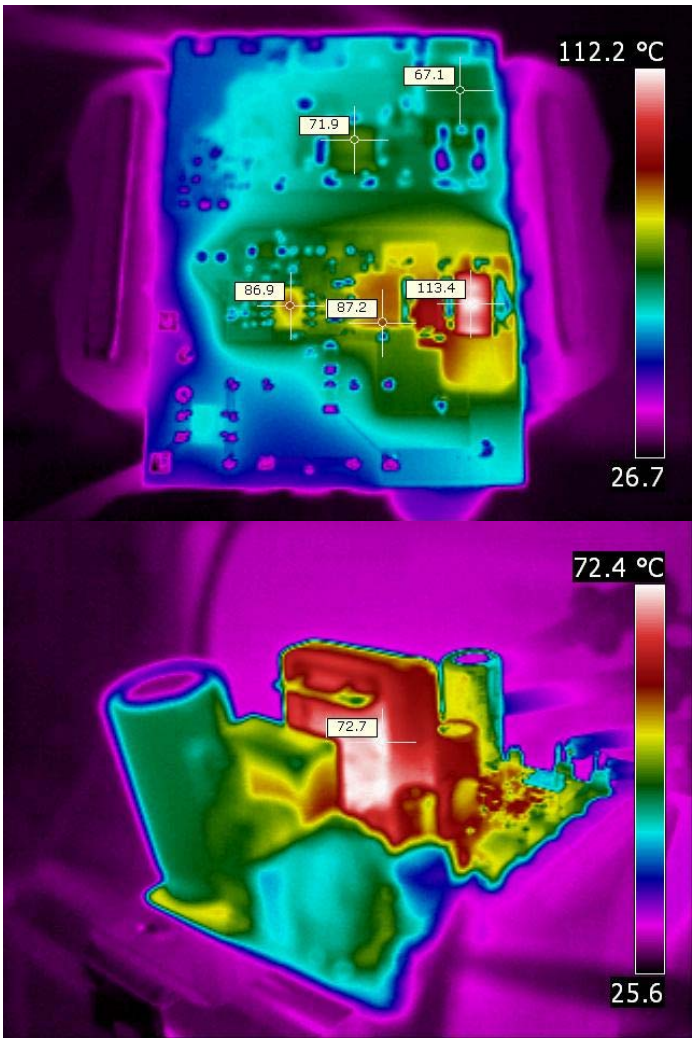
The thermal images below show a top and bottom view of the board and a close up of the transformer. The ambient temperature was 26ºC with no forced air flow. The 24V output was loaded with 1A, and the 5V output was loaded with 1A.

9.1 115VAC, 60Hz Input



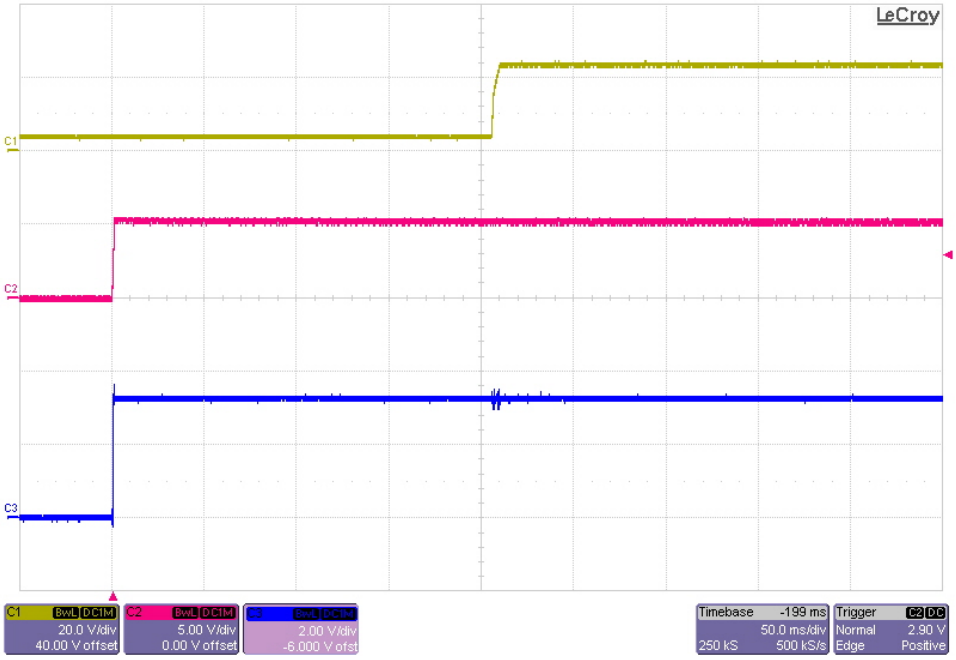


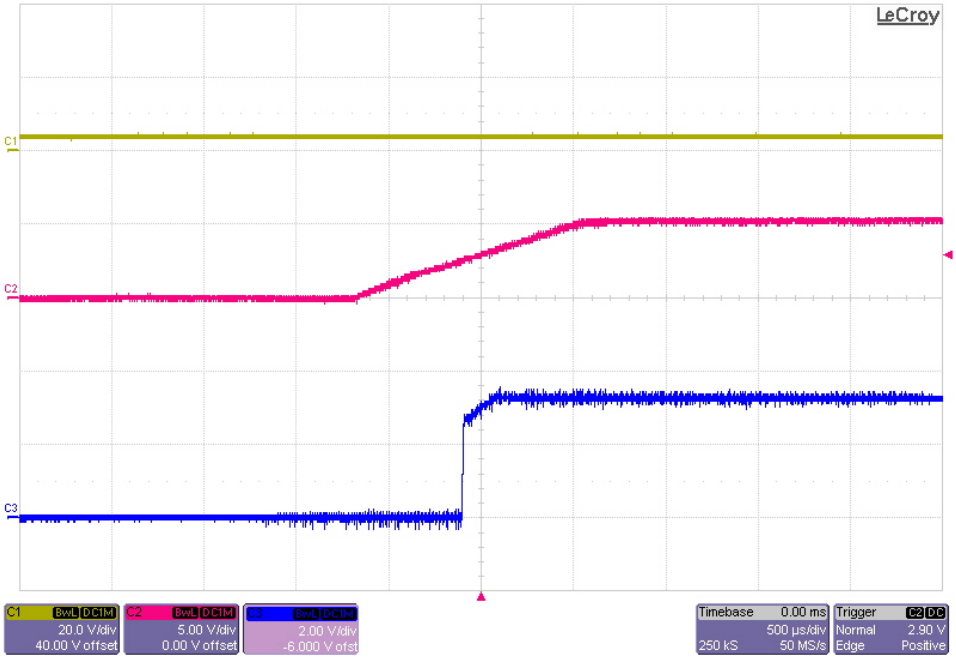
9.2 230VAC, 50Hz Input


112.2 °C
67.1
71.9
86.9
87.2
113.4
26.7
72.4 °C
72.7
25.6

10 Startup

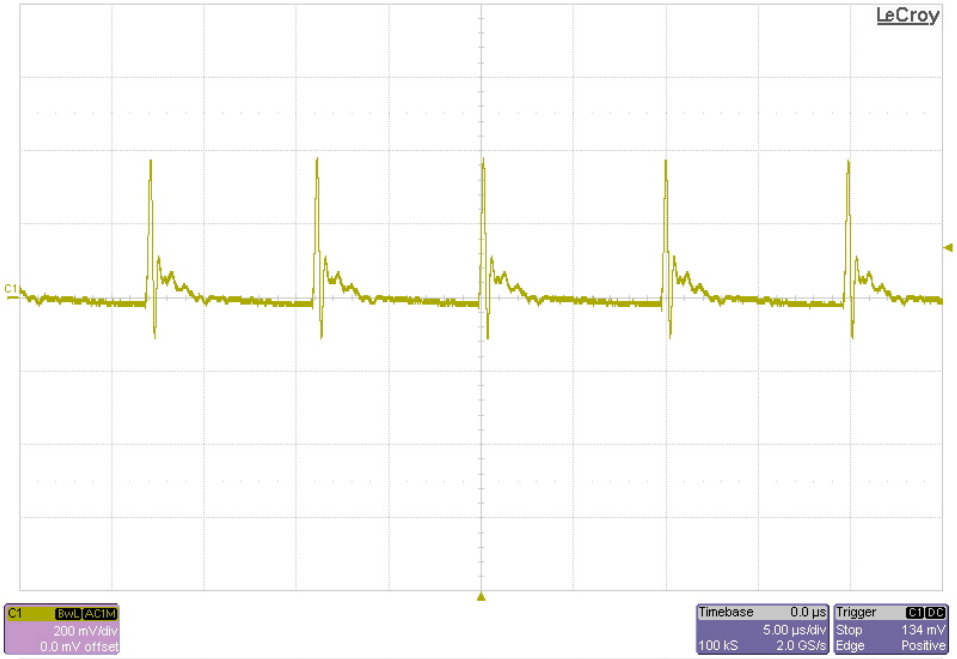
The output voltages at startup with all outputs unloaded are shown in the images below. The input was 115VAC/60Hz. The 24V output voltage is shown on Channel 1, the 5V output voltage is shown on Channel 2, and the 3.3V output voltage is shown on Channel 3.

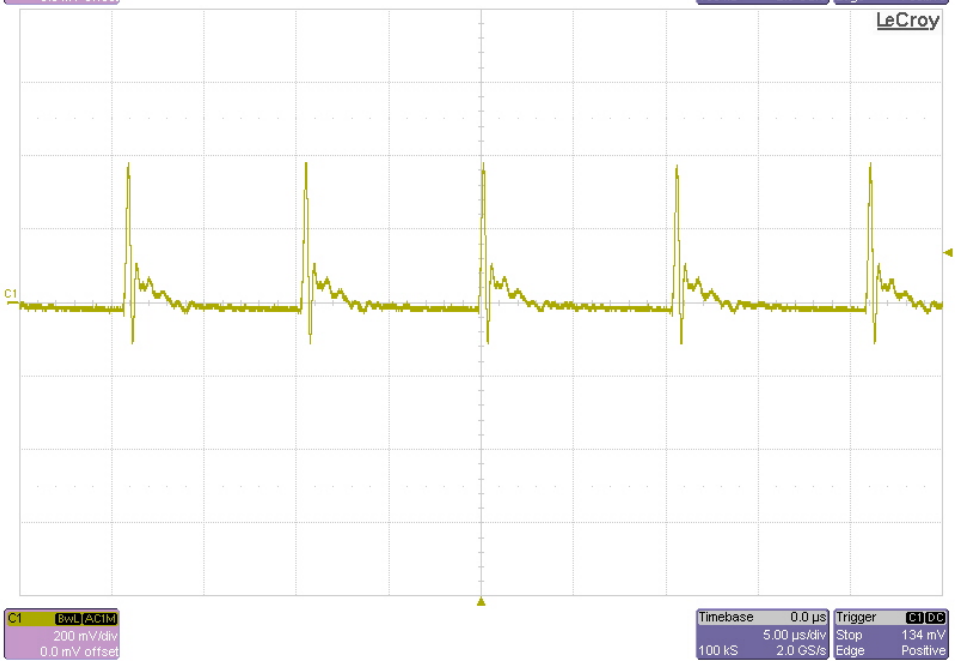




11 24V Output Ripple Voltage

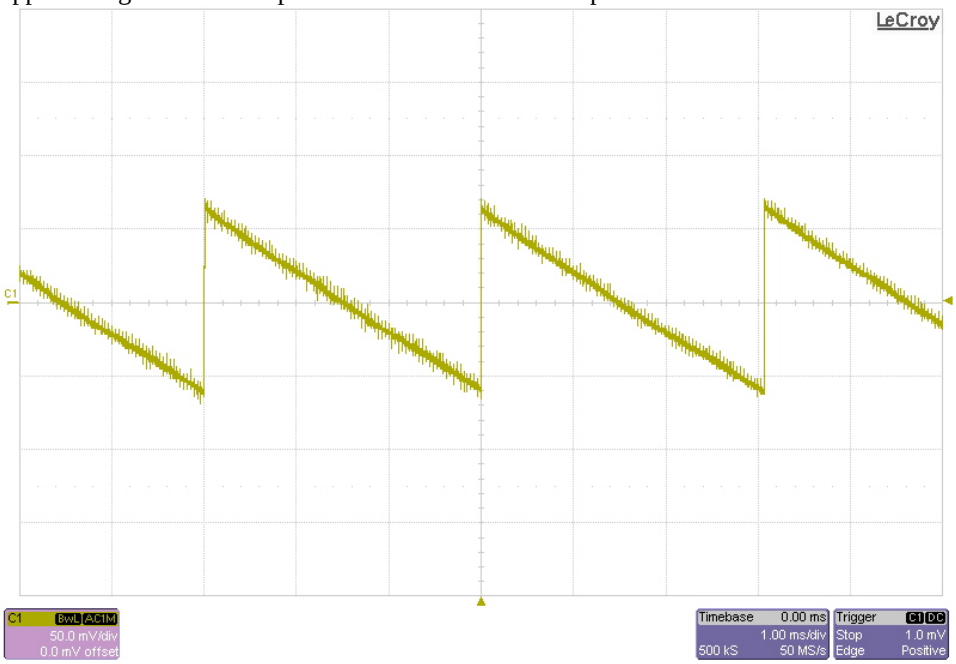
The 24Voutput ripple voltage is shown in the plots below. The 24V output was loaded with 3A, and an external 1000uF capacitor was added across the 24V output. The top image shows the ripple with an 115VAC/60Hz input. The bottom image shows the ripple with a 230VAC/50Hz.





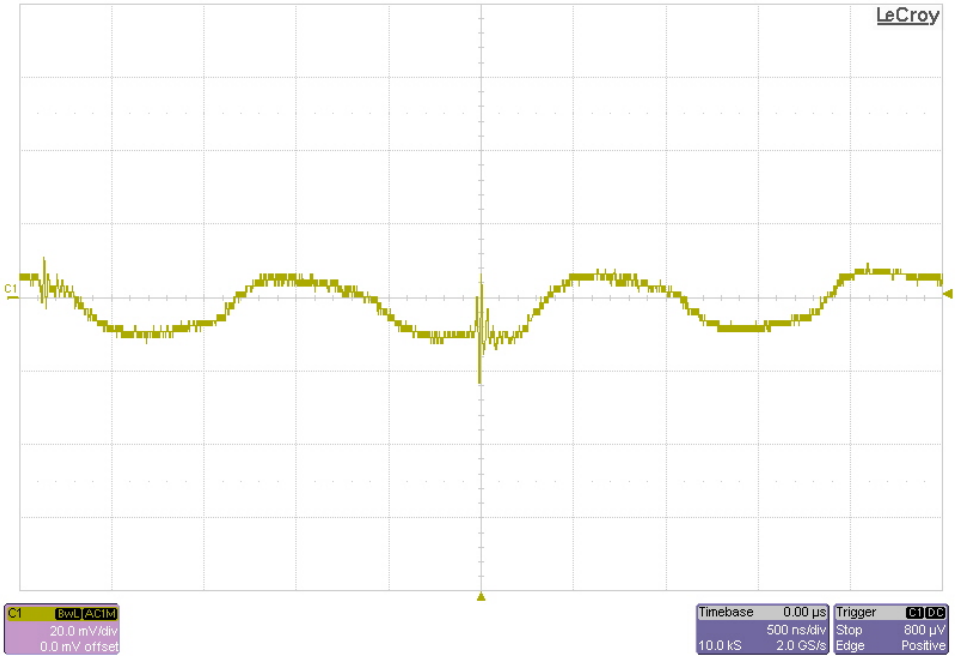
12 5V Output Ripple Voltage – No Load

The 5V output ripple voltage with the output unloaded is shown in the plot below.



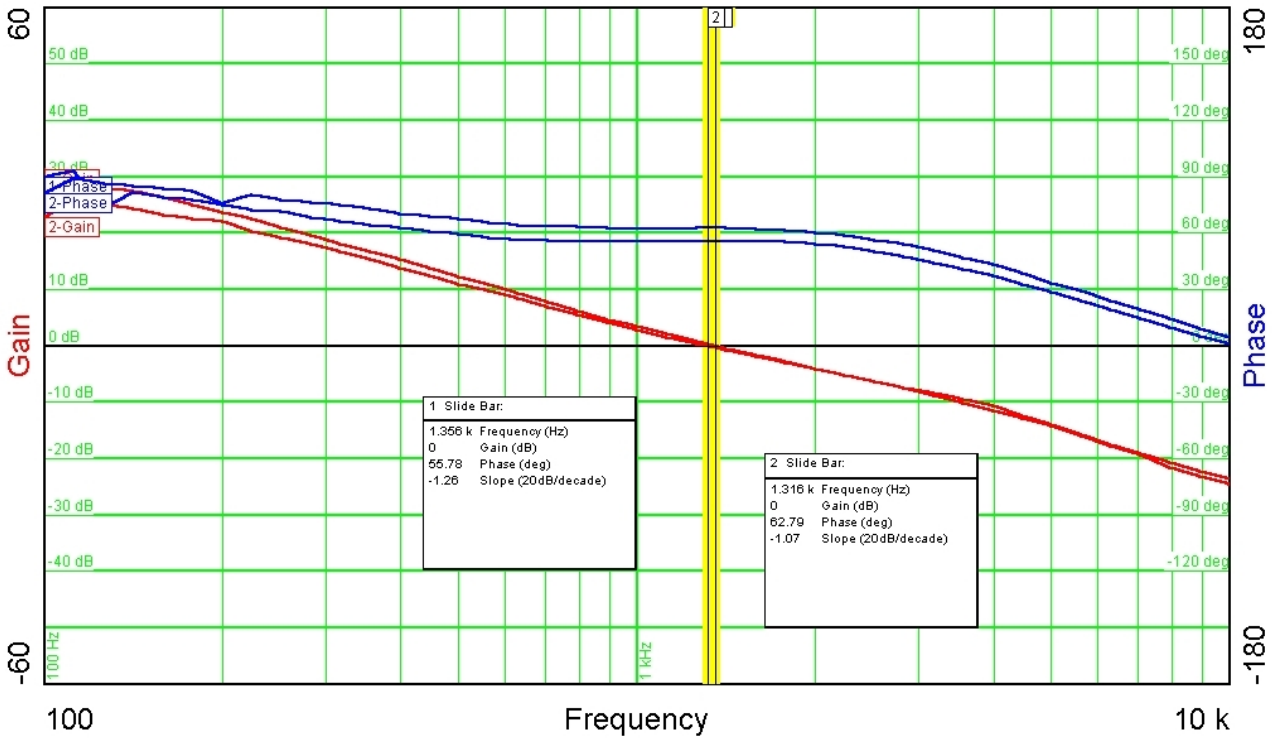
13 5V Output Ripple Voltage – Full Load

The 5Voutput ripple voltage during full load (1.5A) operation is shown in the plot below.



14 Loop Response

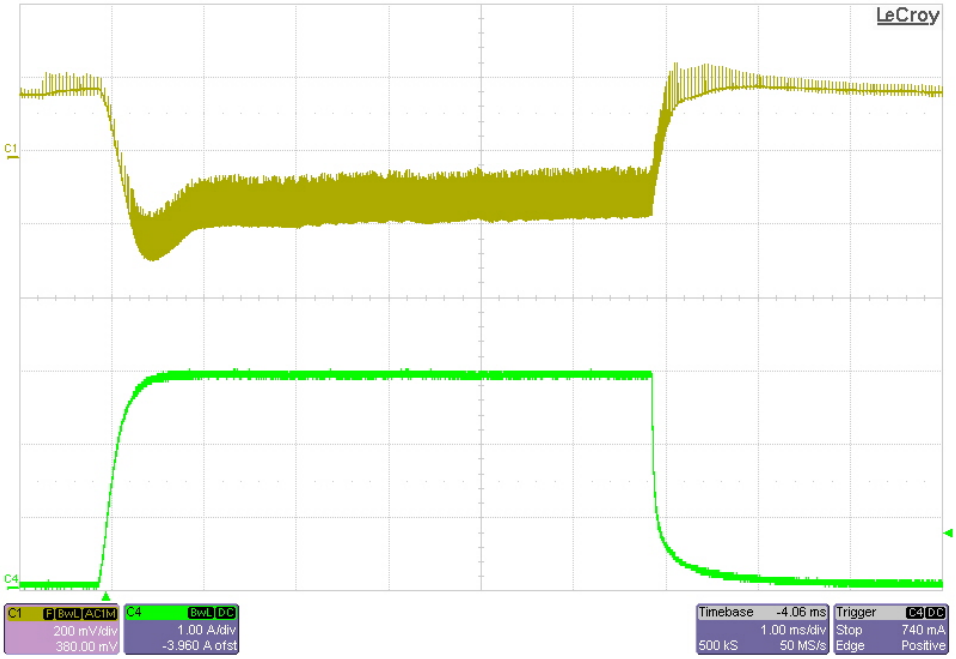
The frequency response of the 24V feedback loop is shown in the image below. The gain/phase plot #1 was measured with an 115VAC input, and the gain/phase plot #2 was measured with a 230VAC input. The outputs were loaded with 24V/1.5A and 5V/1.5A. An external 1000uF capacitor was connected across the 24V output.

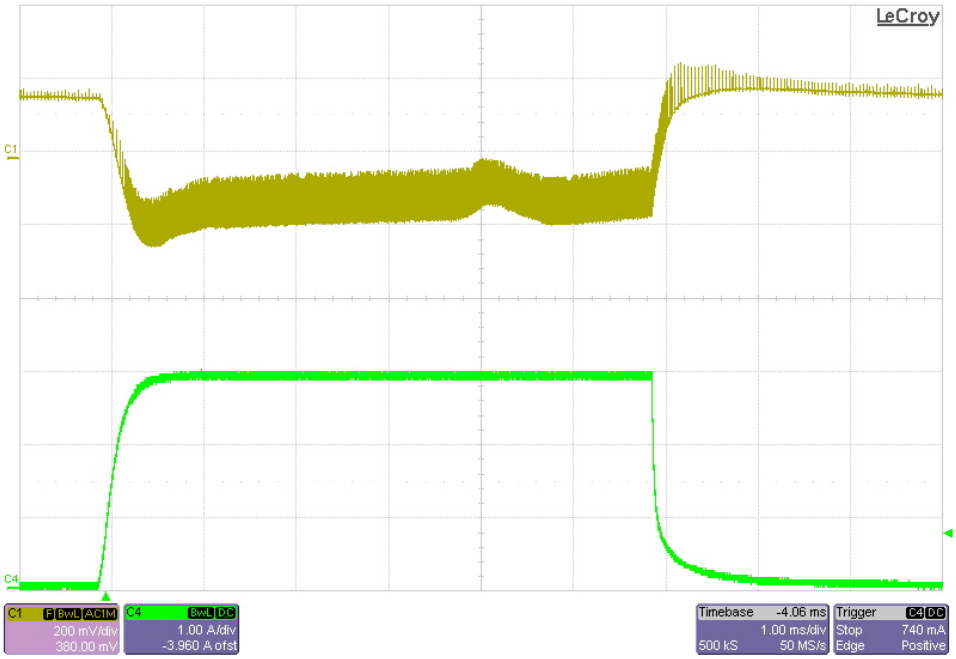


15 24V Load Transients

The images below show the response to a 0A to 3A load transient on the 24V output. For the top image, the input voltage was set to 115VAC/60Hz. For the bottom image, the input was set to 230VAC/50Hz. An external 1000uF capacitor was connected across the 24V output.

Channel 1: 24Vout (ac coupled) 200mV/div Channel 4: 24V Iout 1A/div

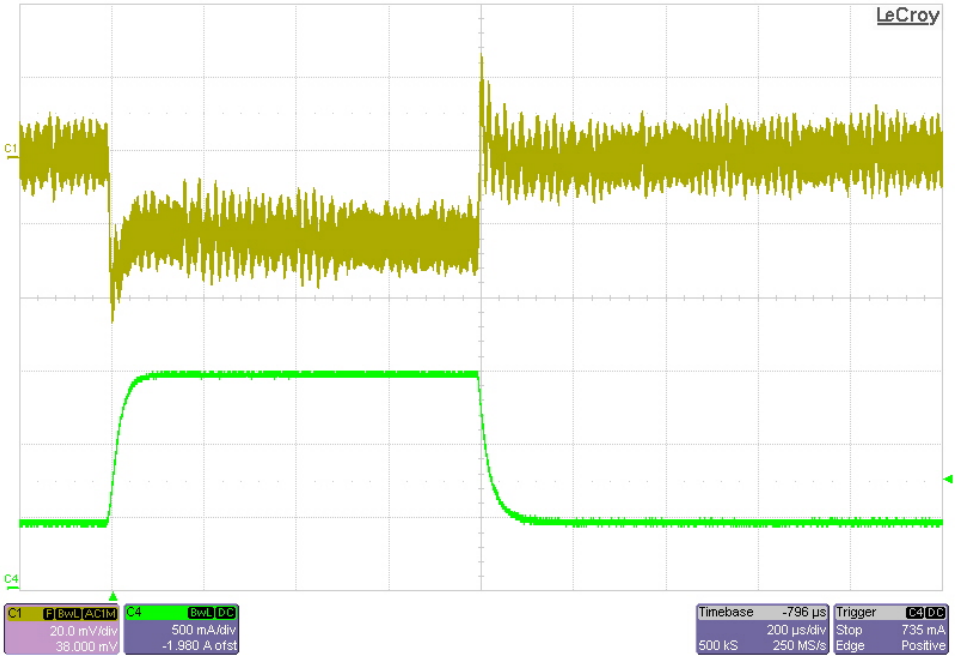




16 5V Load Transients

The image below shows the response to a 0.5A to 1.5A load transient on the 5V output.

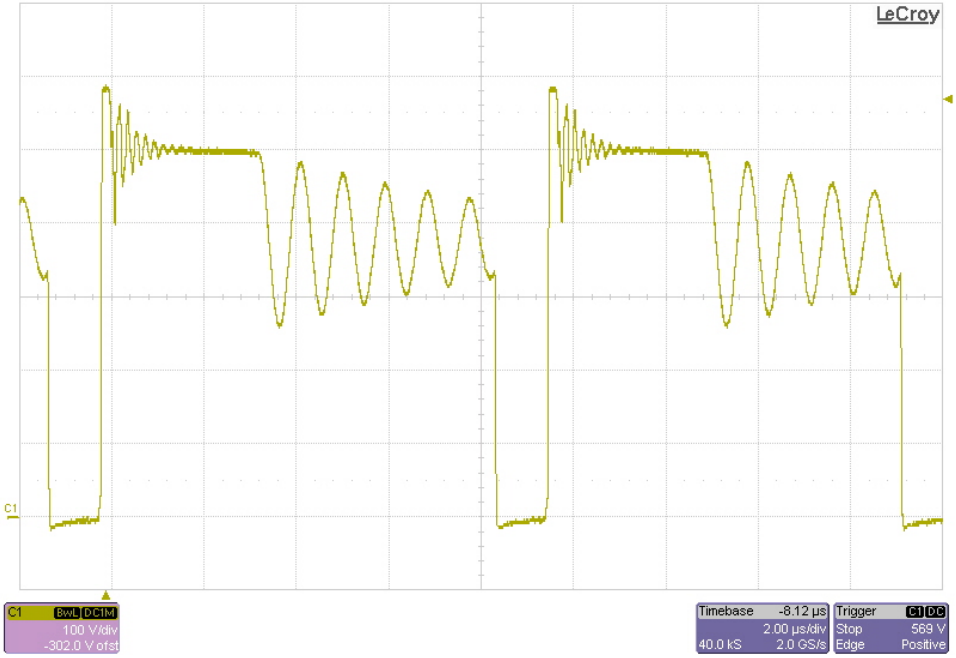
Channel 1: 5Vout (ac coupled) 20mV/div Channel 4: 5V Iout 0.5A/div



17 Switching Waveforms

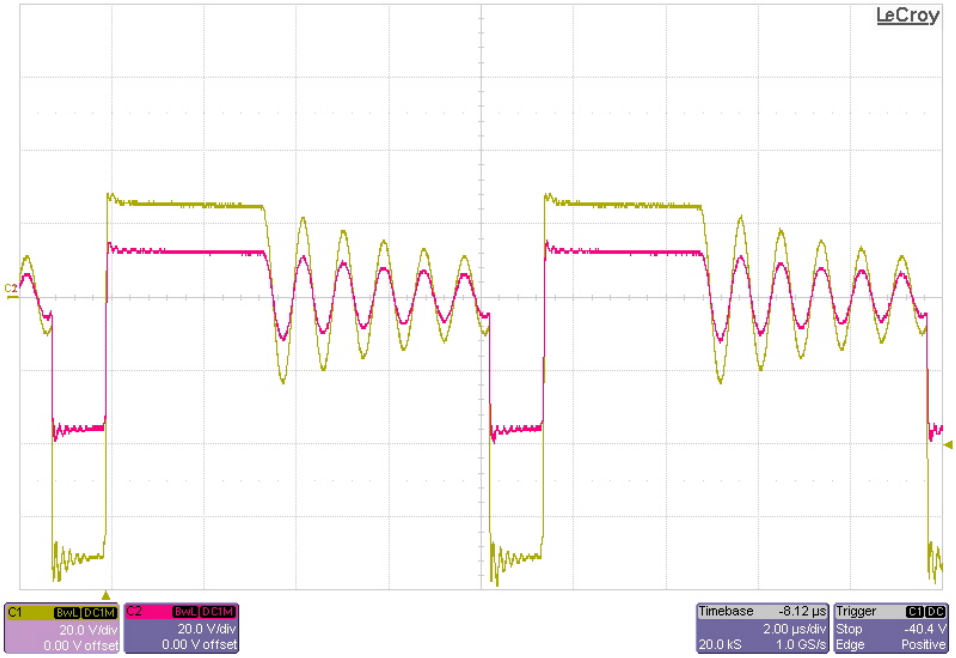
17.1 Primary MOSFET Drain

The image below shows the drain-to-source voltage waveform on the primary MOSFET (Q1). The outputs were loaded with 24V/3A and 5V/1.5A, and the input was set to 265VAC/50Hz. The image was captured near the peak of the sinewave.



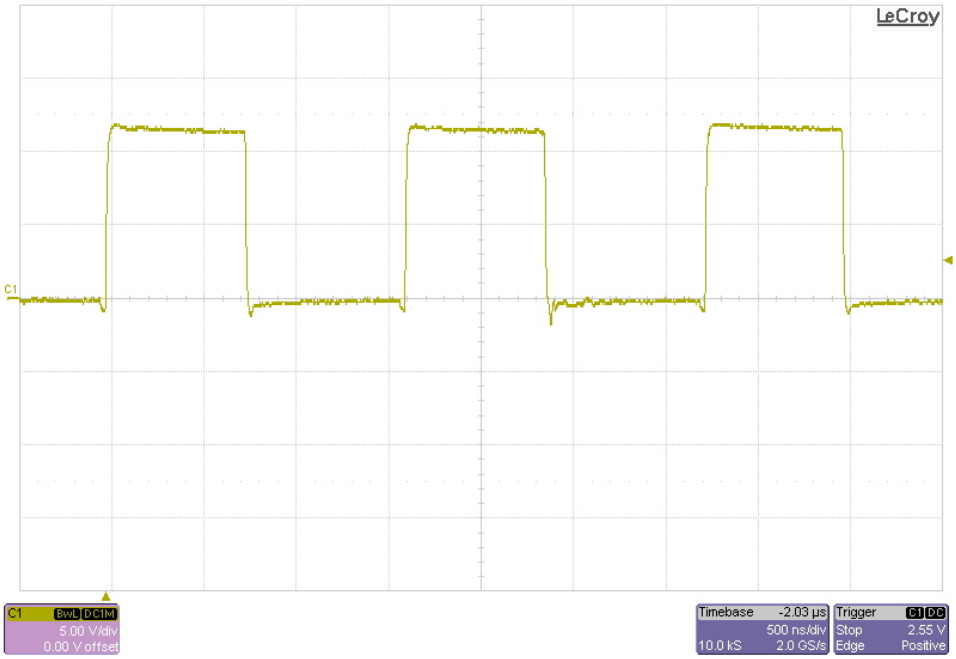
17.2 Flyback Diodes

The image below shows the voltage waveforms on the anodes of the output diodes. The outputs were loaded with 24V/3A and 5V/1.5A, and the input was set to 265VAC/50Hz. The image was captured near the peak of the sinewave. Channel 1 shows the voltage on the anode of the 24V diode (D8). Channel 2 shows the voltage on the anode of the 12V diode (D2).



17.3 Sync Buck Switch Node

The image below shows the voltage on the switch node (U4, pins 9, 10, and 11) of the 5V synchronous buck regulator. The 5V output was loaded with 1.5A.



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