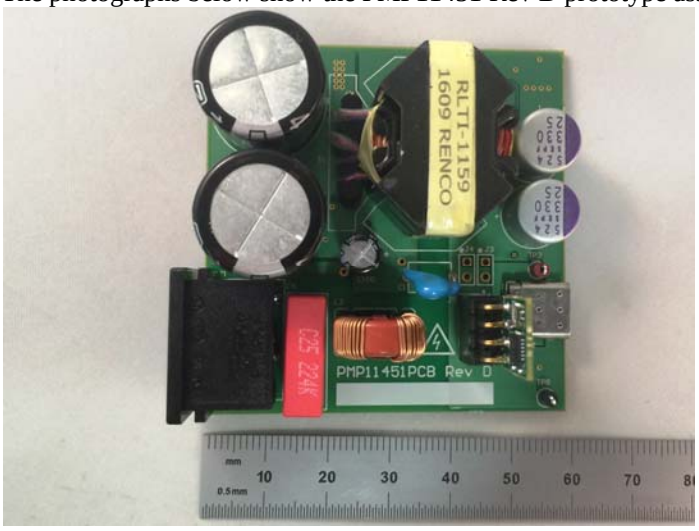
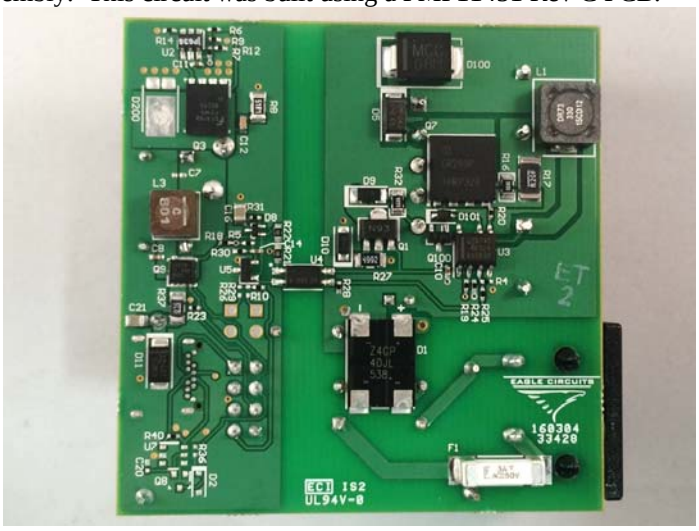
PMP11451 Rev D
60W USB Type C AC/DC Adaptor
Test Results

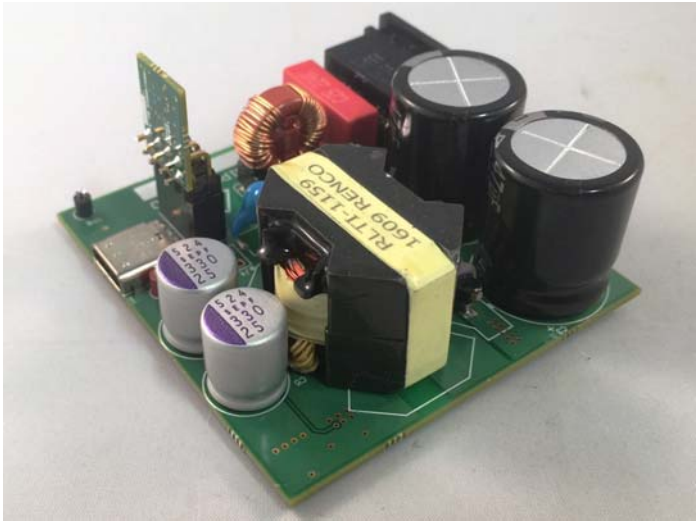
Contents

1 Photos

The photographs below show the PMP11451 Rev D prototype assembly. This circuit was built using a PMP11451 Rev C PCB.







2 Standby Power (Cable Unplugged)

Input Voltage	Input Power
120VAC/60Hz	29.7mW
230VAC/50Hz	35.2mW

3 Efficiency

"End-to-end" efficiency was measured from input connector (J1) to output connector (J5). "AC/DC only" efficiency was measured from input connector (J1) to output capacitor C8.

3.1 Average Efficiency (End-to-End)

3.1.1 5V Output

Vin	Pin	Vout	Iout	Load	Efficiency	Avg. Eff.
120VAC/60Hz	1.83	5.00	0.299	10%	81.67%	
	4.29	4.99	0.750	25%	87.14%	**88.22%**
	8.41	4.97	1.500	50%	88.67%	
	12.60	4.96	2.250	75%	88.58%	
	16.77	4.95	2.999	100%	88.47%	
230VAC/50Hz	2.04	5.00	0.299	10%	73.28%	
	4.59	4.99	0.750	25%	81.49%	**85.26%**
	8.69	4.97	1.500	50%	85.88%	
	12.86	4.96	2.250	75%	86.78%	
	17.08	4.95	3.000	100%	86.89%	

3.1.2 12V Output

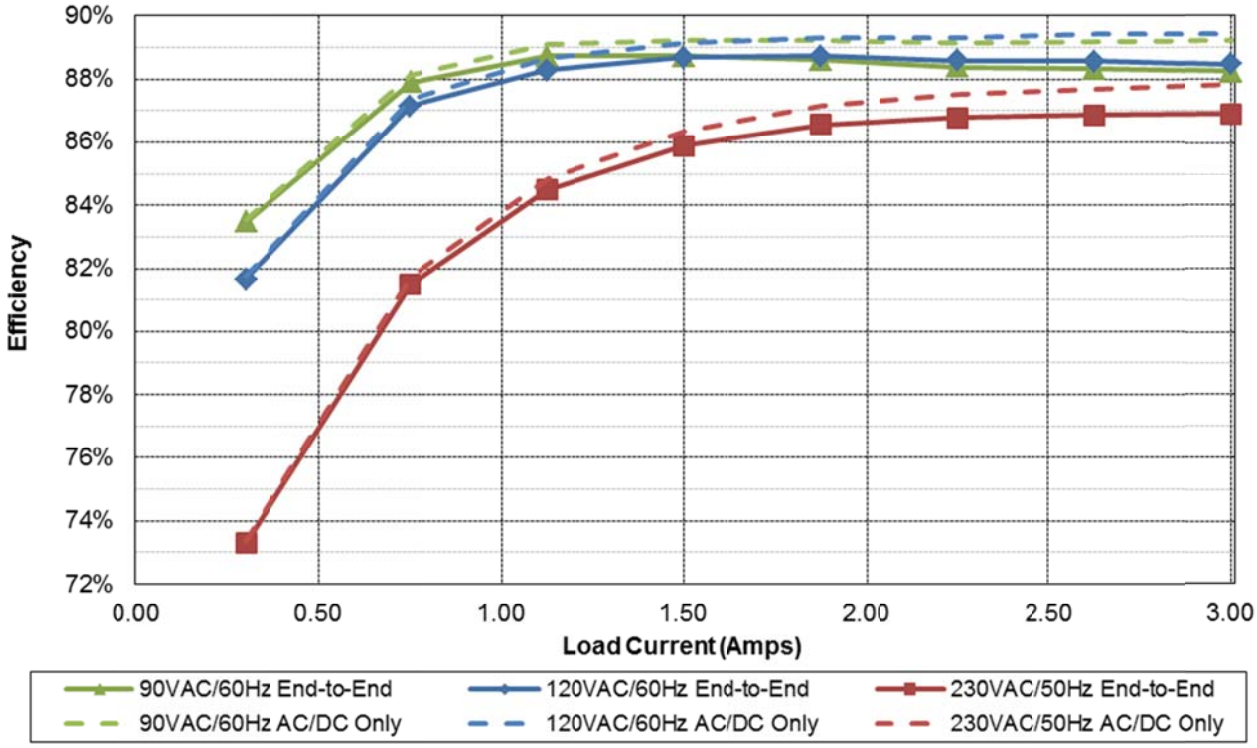
Vin	Pin	Vout	Iout	Load	Efficiency	Avg. Eff.
120VAC/60Hz	4.26	11.98	0.301	10%	84.67%	
	9.98	11.97	0.749	25%	89.88%	**90.73%**
	19.71	11.95	1.501	50%	91.01%	
	29.49	11.94	2.249	75%	91.06%	
	39.32	11.92	3.001	100%	90.98%	
230VAC/50Hz	4.52	11.98	0.301	10%	79.73%	
	10.22	11.97	0.751	25%	87.98%	**90.10%**
	19.80	11.95	1.498	50%	90.42%	
	29.52	11.94	2.250	75%	91.01%	
	39.32	11.92	3.002	100%	91.01%	

3.1.3 20V Output

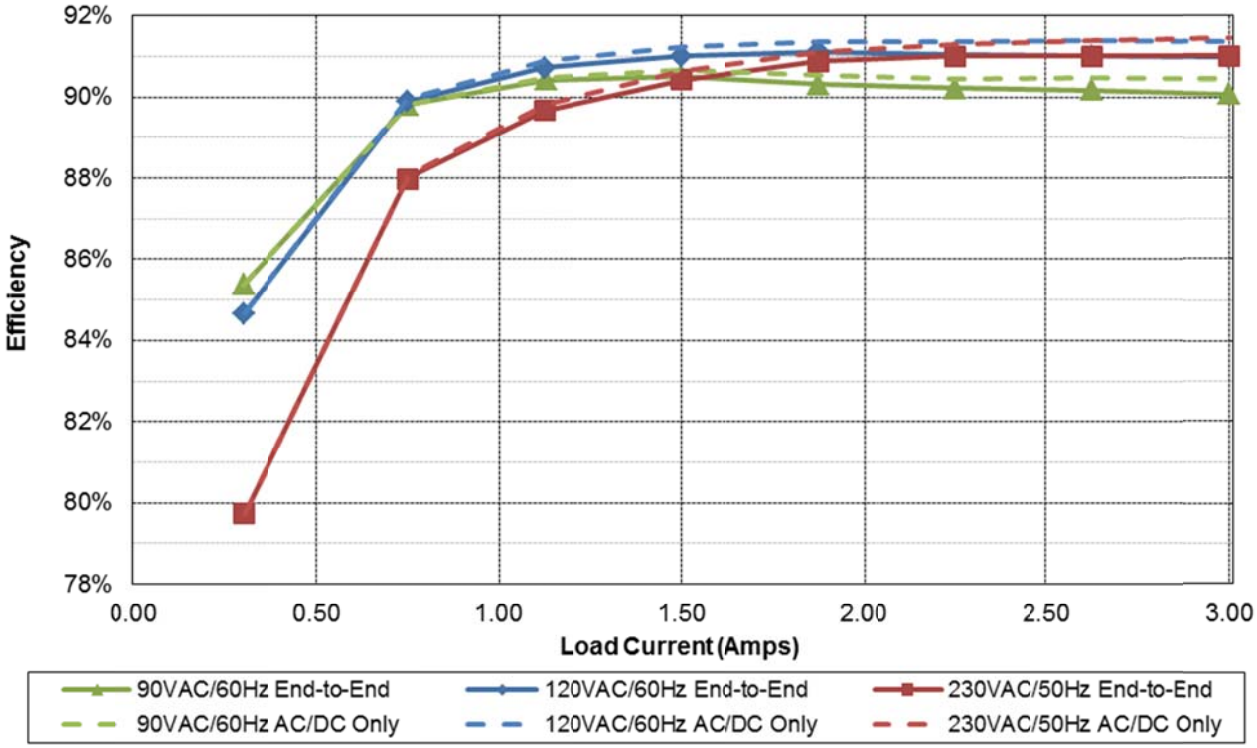
Vin	Pin	Vout	Iout	Load	Efficiency	Avg. Eff.
120VAC/60Hz	7.07	20.08	0.300	10%	85.22%	
	16.69	20.07	0.749	25%	90.07%	**91.04%**
	33.01	20.06	1.502	50%	91.28%	
	49.35	20.04	2.251	75%	91.41%	
	65.67	20.02	2.999	100%	91.43%	
230VAC/50Hz	7.30	20.08	0.298	10%	81.97%	
	16.85	20.07	0.750	25%	89.32%	**91.02%**
	32.92	20.06	1.499	50%	91.34%	
	49.23	20.04	2.251	75%	91.63%	
	65.42	20.02	2.999	100%	91.78%	

3.2 Charts

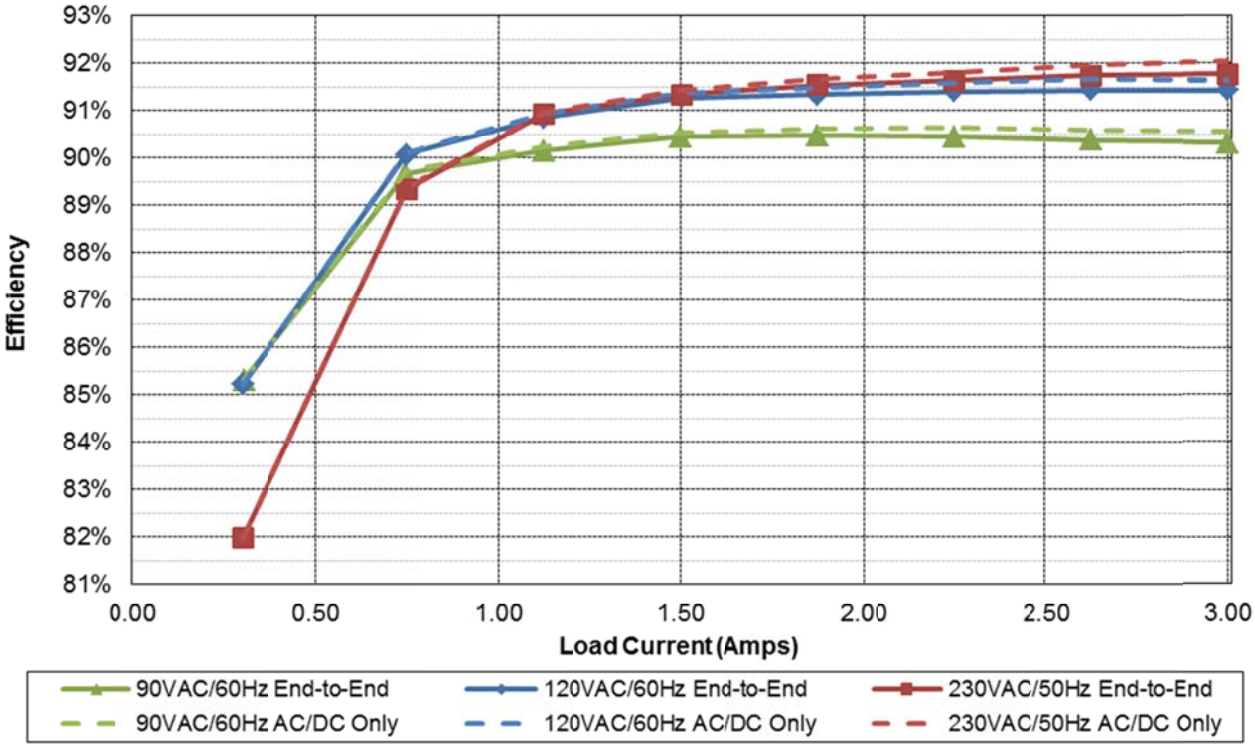
3.2.1 5V Output



3.2.2 12V Output



3.2.3 20V Output



3.3 Raw Data

3.3.1 5V Output

90VAC/60Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	5.002	5.002	90.0	0.0080	0.0529		0.00	0.00	0.05	0.0%	0.0%
0.299	5.002	4.997	90.0	0.0651	1.790	0.306	1.50	1.49	0.29	83.6%	83.5%
0.752	5.001	4.987	89.9	0.142	4.267	0.333	3.76	3.75	0.51	88.1%	87.9%
1.125	5.001	4.980	89.9	0.202	6.315	0.348	5.63	5.60	0.69	89.1%	88.7%
1.500	5.000	4.973	89.9	0.259	8.408	0.361	7.50	7.46	0.91	89.2%	88.7%
1.874	5.001	4.966	89.9	0.309	10.50	0.378	9.37	9.31	1.13	89.2%	88.6%
2.250	5.000	4.958	89.9	0.354	12.62	0.405	11.25	11.16	1.37	89.1%	88.4%
2.626	5.000	4.951	89.9	0.396	14.72	0.414	13.13	13.00	1.59	89.2%	88.3%
3.000	5.000	4.944	89.9	0.437	16.81	0.428	15.00	14.83	1.81	89.2%	88.2%

120VAC/60Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	5.003	5.003	120.1	0.0109	0.0546		0.00	0.00	0.05	0.0%	0.0%
0.299	5.002	4.996	120.1	0.0534	1.829	0.285	1.50	1.49	0.33	81.8%	81.7%
0.750	5.001	4.988	120.1	0.113	4.293	0.317	3.75	3.74	0.54	87.4%	87.1%
1.124	5.001	4.981	120.1	0.160	6.342	0.330	5.62	5.60	0.72	88.6%	88.3%
1.500	5.001	4.974	120.1	0.206	8.414	0.339	7.50	7.46	0.91	89.2%	88.7%
1.875	5.001	4.968	120.1	0.252	10.50	0.347	9.38	9.32	1.12	89.3%	88.7%
2.250	5.001	4.961	120.1	0.297	12.60	0.354	11.25	11.16	1.35	89.3%	88.6%
2.625	5.001	4.954	120.1	0.339	14.68	0.360	13.13	13.00	1.56	89.4%	88.6%
2.999	5.001	4.947	120.1	0.379	16.77	0.369	15.00	14.84	1.77	89.4%	88.5%

230VAC/50Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	5.001	5.001	230.6	0.0164	0.0639		0.00	0.00	0.06	0.0%	0.0%
0.299	5.001	4.995	230.6	0.0460	2.038	0.192	1.50	1.49	0.54	73.4%	73.3%
0.750	5.001	4.987	230.6	0.082	4.590	0.244	3.75	3.74	0.84	81.7%	81.5%
1.125	5.001	4.981	230.6	0.106	6.633	0.271	5.63	5.60	1.01	84.8%	84.5%
1.500	5.001	4.974	230.6	0.131	8.688	0.288	7.50	7.46	1.19	86.3%	85.9%
1.875	5.001	4.967	230.6	0.156	10.76	0.299	9.38	9.31	1.38	87.1%	86.5%
2.250	5.001	4.960	230.6	0.182	12.86	0.307	11.25	11.16	1.61	87.5%	86.8%
2.625	5.001	4.953	230.6	0.208	14.97	0.313	13.13	13.00	1.84	87.7%	86.9%
3.000	5.001	4.947	230.6	0.234	17.08	0.317	15.00	14.84	2.08	87.8%	86.9%

3.3.2 12V Output

90VAC/60Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	11.98	11.98	90.0	0.0109	0.182		0.00	0.00	0.18	0.0%	0.0%
0.300	11.97	11.97	89.9	0.1400	4.206	0.334	3.59	3.59	0.62	85.4%	85.4%
0.750	11.97	11.97	89.9	0.296	9.996	0.376	8.98	8.98	1.02	89.8%	89.8%
1.126	11.97	11.96	89.9	0.397	14.894	0.417	13.48	13.47	1.42	90.5%	90.4%
1.499	11.97	11.95	89.9	0.447	19.788	0.447	17.94	17.91	1.84	90.7%	90.5%
1.875	11.97	11.94	89.9	0.587	24.79	0.470	22.44	22.39	2.35	90.5%	90.3%
2.251	11.97	11.94	89.9	0.680	29.79	0.488	26.94	26.88	2.85	90.4%	90.2%
2.625	11.97	11.93	89.9	0.767	34.73	0.504	31.42	31.32	3.31	90.5%	90.2%
3.001	11.97	11.92	89.8	0.854	39.71	0.518	35.92	35.77	3.79	90.5%	90.1%

120VAC/60Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	11.98	11.98	119.9	0.0126	0.1856		0.00	0.00	0.19	0.0%	0.0%
0.301	11.98	11.98	119.9	0.1127	4.259	0.315	3.61	3.61	0.65	84.7%	84.7%
0.749	11.98	11.97	119.9	0.243	9.975	0.342	8.97	8.97	1.00	90.0%	89.9%
1.124	11.98	11.96	119.9	0.348	14.817	0.355	13.47	13.44	1.35	90.9%	90.7%
1.501	11.98	11.95	119.9	0.436	19.708	0.377	17.98	17.94	1.73	91.2%	91.0%
1.875	11.98	11.95	119.9	0.510	24.59	0.402	22.46	22.41	2.13	91.3%	91.1%
2.249	11.98	11.94	119.9	0.581	29.49	0.423	26.94	26.85	2.55	91.4%	91.1%
2.625	11.98	11.93	119.9	0.652	34.41	0.440	31.45	31.32	2.96	91.4%	91.0%
3.001	11.97	11.92	119.9	0.723	39.32	0.454	35.92	35.77	3.40	91.4%	91.0%

230VAC/50Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	11.98	11.98	229.9	0.0171	0.2097		0.00	0.00	0.21	0.0%	0.0%
0.301	11.98	11.98	229.9	0.0811	4.523	0.243	3.61	3.61	0.92	79.7%	79.7%
0.751	11.98	11.97	229.9	0.150	10.218	0.296	9.00	8.99	1.22	88.1%	88.0%
1.125	11.98	11.96	229.8	0.209	15.006	0.312	13.48	13.46	1.53	89.8%	89.7%
1.498	11.98	11.95	229.8	0.268	19.797	0.321	17.95	17.90	1.85	90.7%	90.4%
1.877	11.98	11.95	229.8	0.327	24.68	0.328	22.49	22.43	2.19	91.1%	90.9%
2.250	11.98	11.94	229.8	0.385	29.52	0.354	26.96	26.87	2.57	91.3%	91.0%
2.625	11.98	11.93	229.8	0.443	34.41	0.338	31.45	31.32	2.96	91.4%	91.0%
3.002	11.98	11.92	229.8	0.500	39.32	0.342	35.96	35.78	3.36	91.5%	91.0%

3.3.3 20V Output

90VAC/60Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	20.08	20.08	90.0	0.0170	0.388		0.00	0.00	0.39	0.0%	0.0%
0.303	20.08	20.08	89.9	0.2240	7.132	0.383	6.08	6.08	1.05	85.3%	85.3%
0.747	20.08	20.07	89.9	0.434	16.720	0.429	15.00	14.99	1.72	89.7%	89.7%
1.124	20.08	20.06	89.9	0.592	25.01	0.470	22.57	22.55	2.44	90.2%	90.2%
1.501	20.08	20.06	89.9	0.743	33.29	0.498	30.14	30.11	3.15	90.5%	90.4%
1.875	20.08	20.05	89.8	0.886	41.55	0.522	37.65	37.59	3.90	90.6%	90.5%
2.250	20.08	20.04	89.8	1.029	49.85	0.540	45.18	45.09	4.67	90.6%	90.5%
2.625	20.08	20.03	89.8	1.171	58.18	0.553	52.71	52.58	5.47	90.6%	90.4%
3.000	20.07	20.02	89.8	1.314	66.48	0.564	60.21	60.06	6.27	90.6%	90.3%

120VAC/60Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	20.08	20.08	119.9	0.0164	0.3951		0.00	0.00	0.40	0.0%	0.0%
0.300	20.08	20.08	119.9	0.1779	7.069	0.332	6.02	6.02	1.05	85.2%	85.2%
0.749	20.08	20.07	119.9	0.120	16.690	0.361	15.04	15.03	1.65	90.1%	90.1%
1.125	20.08	20.06	119.9	0.515	24.84	0.402	22.59	22.57	2.25	90.9%	90.9%
1.502	20.08	20.06	119.9	0.634	33.01	0.435	30.16	30.13	2.85	91.4%	91.3%
1.876	20.08	20.05	119.9	0.751	41.18	0.458	37.67	37.61	3.51	91.5%	91.3%
2.251	20.08	20.04	119.8	0.866	49.35	0.475	45.20	45.11	4.15	91.6%	91.4%
2.626	20.08	20.03	119.8	0.978	57.53	0.491	52.73	52.60	4.80	91.7%	91.4%
2.999	20.07	20.02	119.8	1.085	65.67	0.505	60.19	60.04	5.48	91.7%	91.4%

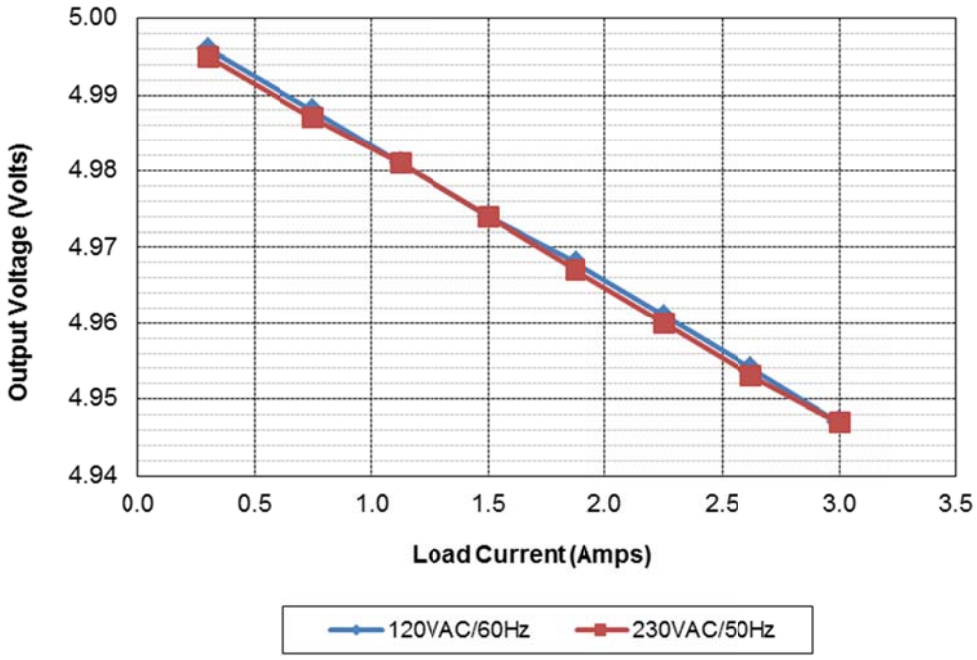
230VAC/50Hz

Iout	Vout AC/DC	Vout USB-C	Vin	Iin	Pin	PF	Pout AC/DC	Pout USB-C	Losses	Efficiency AC/DC	Efficiency USBC
0.000	20.08	20.08	229.9	0.0193	0.4308		0.00	0.00	0.43	0.0%	0.0%
0.298	20.08	20.08	229.9	0.1150	7.300	0.276	5.98	5.98	1.32	82.0%	82.0%
0.750	20.08	20.07	229.8	0.232	16.852	0.316	15.06	15.05	1.79	89.4%	89.3%
1.125	20.08	20.07	229.8	0.329	24.83	0.328	22.59	22.58	2.24	91.0%	90.9%
1.499	20.08	20.06	229.8	0.426	32.92	0.337	30.10	30.07	2.82	91.4%	91.3%
1.876	20.08	20.05	229.8	0.520	41.09	0.344	37.67	37.61	3.42	91.7%	91.5%
2.251	20.08	20.04	229.8	0.612	49.23	0.350	45.20	45.11	4.03	91.8%	91.6%
2.624	20.08	20.03	229.8	0.694	57.29	0.359	52.69	52.56	4.60	92.0%	91.7%
2.999	20.08	20.02	229.8	0.761	65.42	0.374	60.22	60.04	5.20	92.1%	91.8%

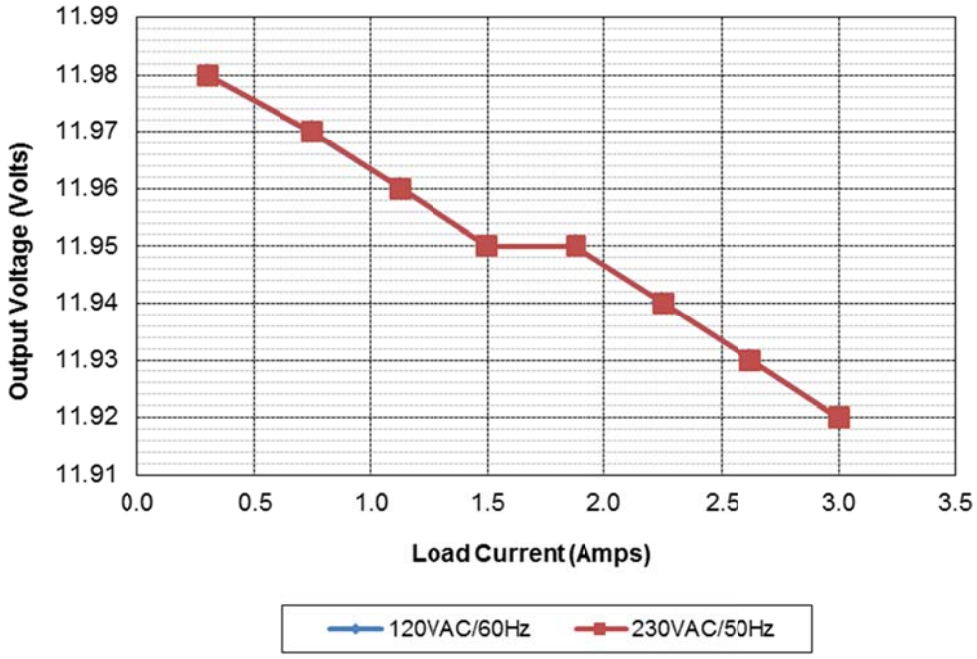
4 Regulation

Measured at TP3/TP8.

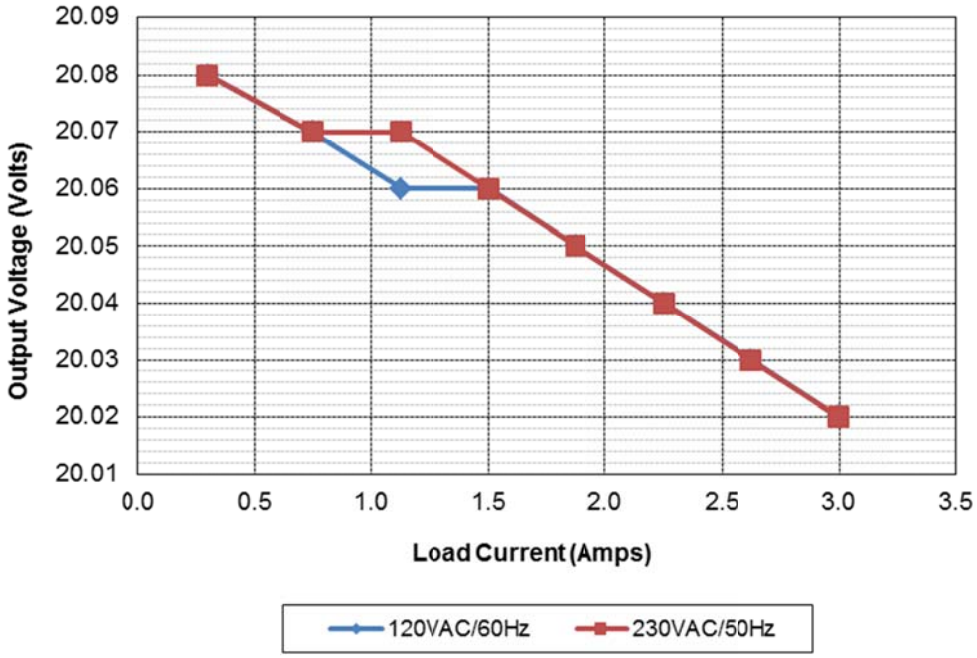
4.1 5V Output



4.2 12V Output



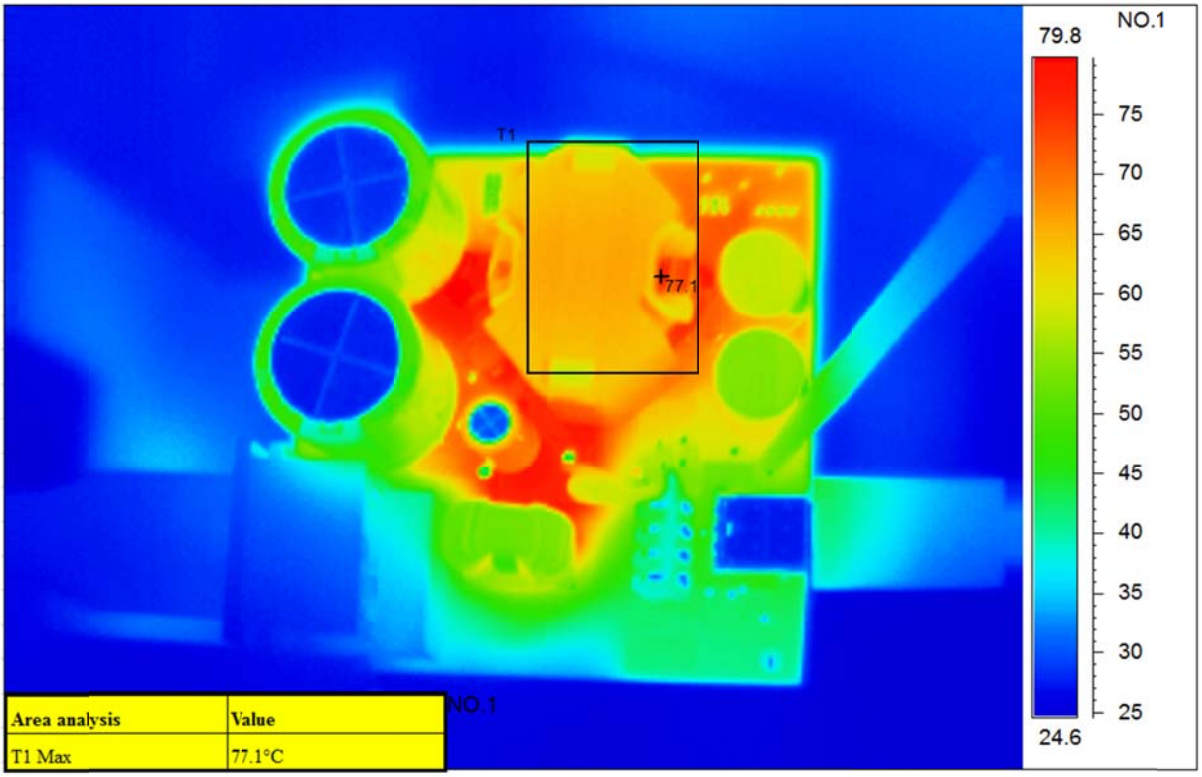
4.3 20V Output

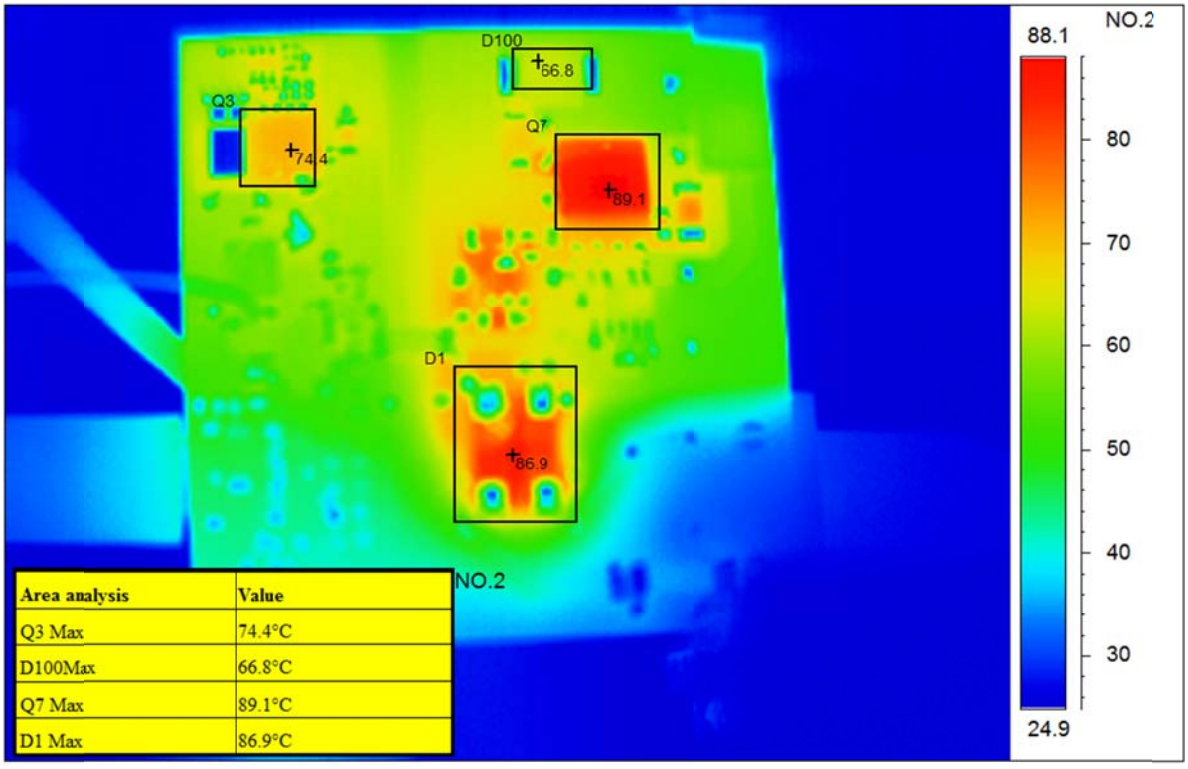


5 Thermal Images

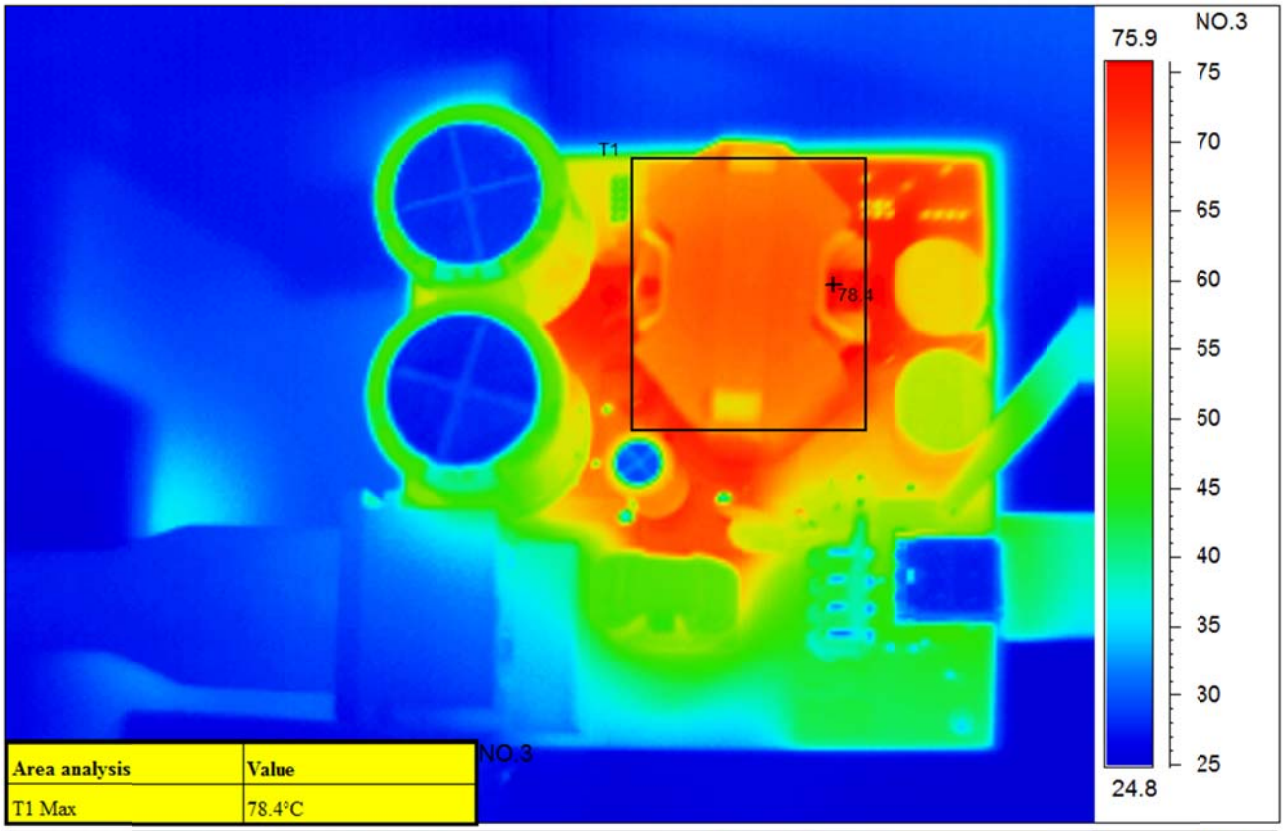
The thermal images below show the 20V output loaded with 3A. The ambient temperature was 25ºC, with no airflow.

5.1 90VAC/60Hz

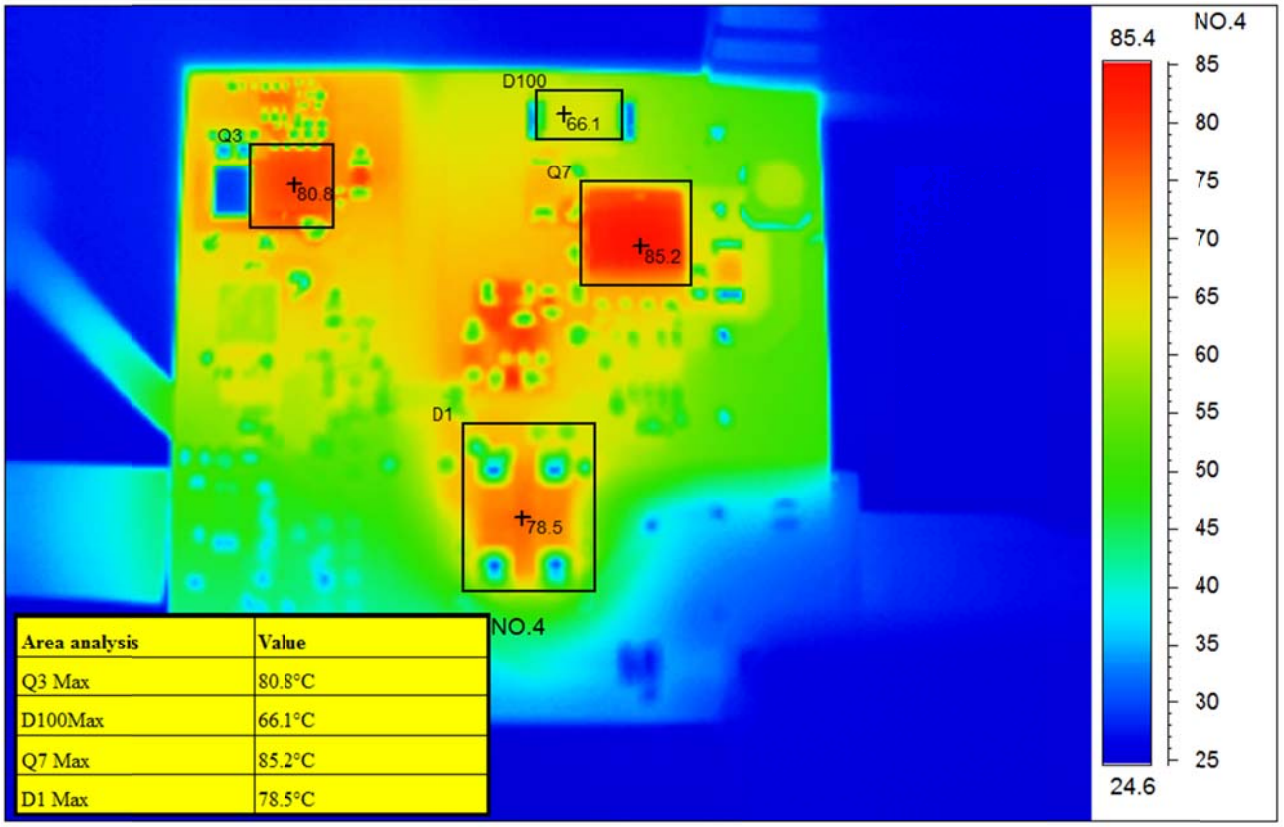




5.2 120VAC/60Hz

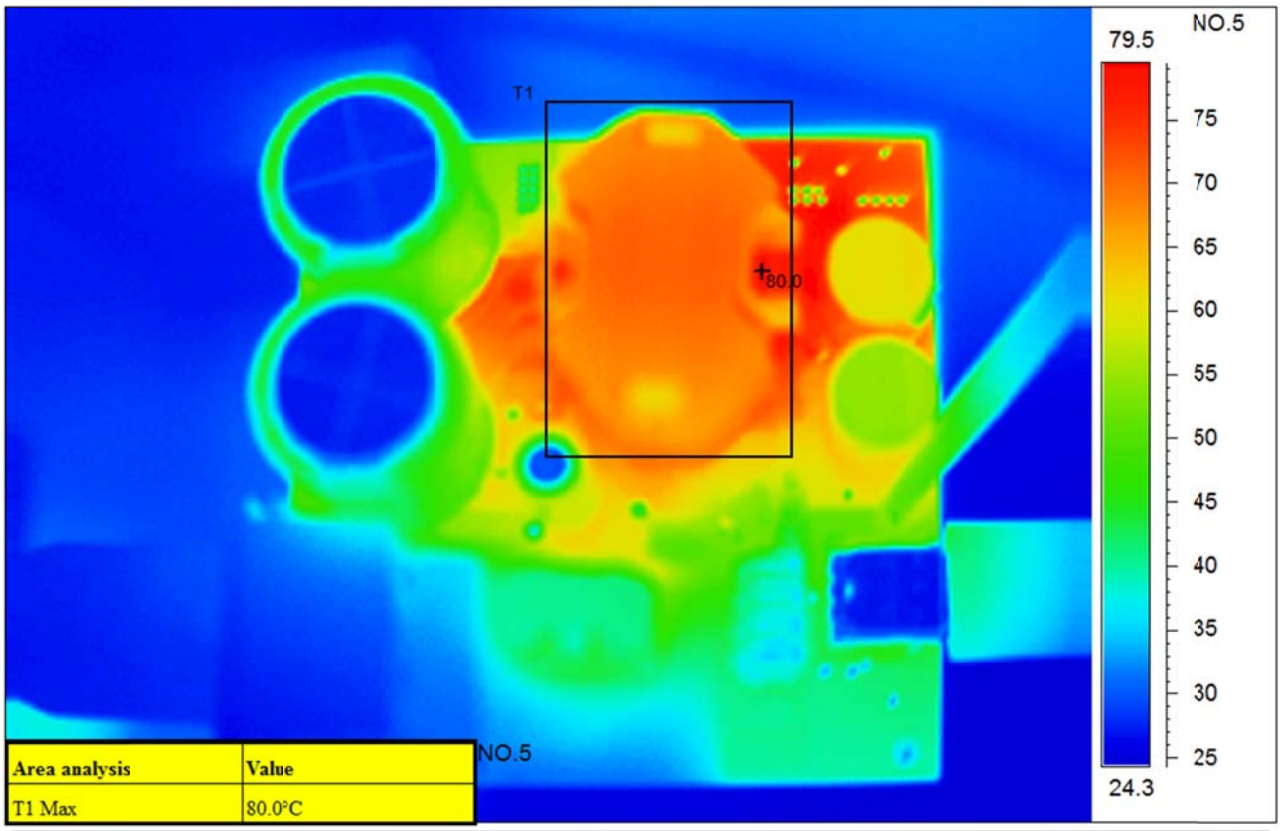


Area analysis	Value
T1 Max	78.4°C

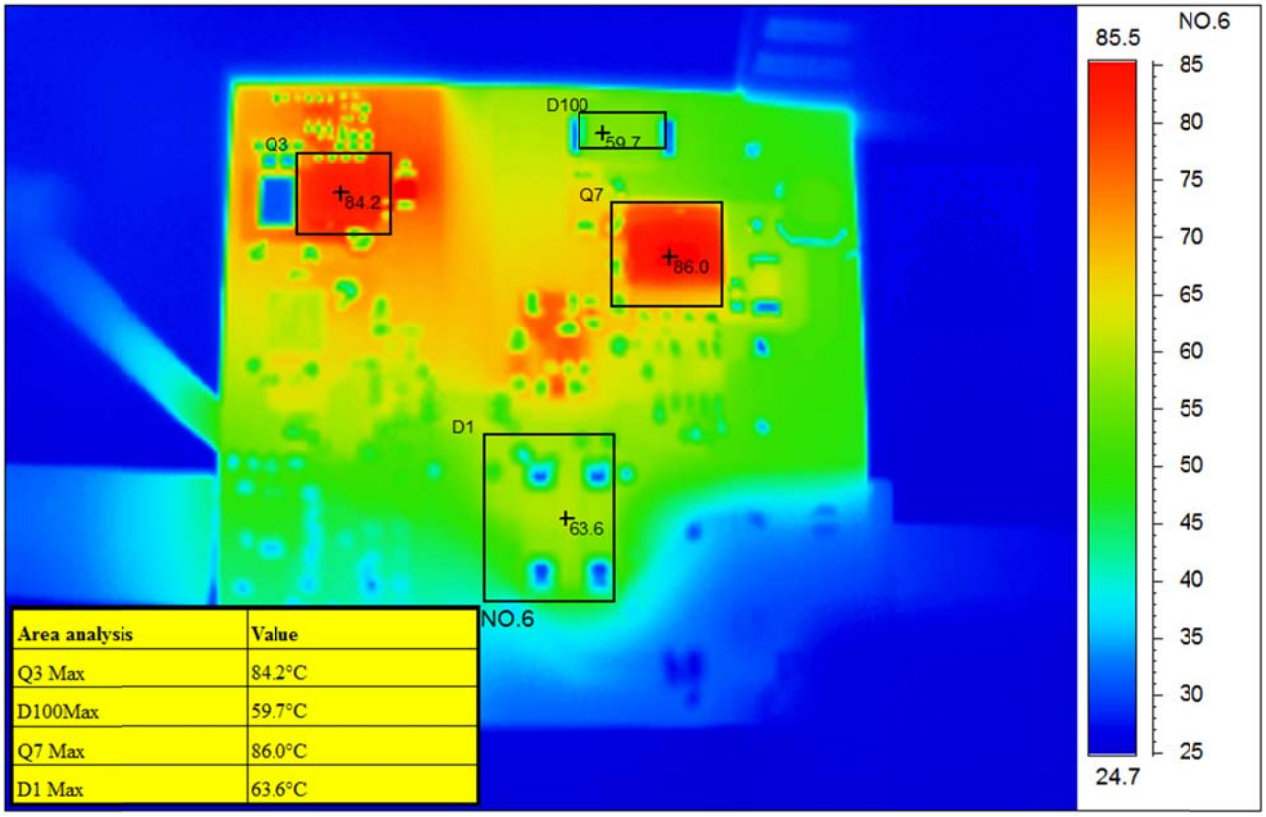


Area analysis	Value
Q3 Max	80.8°C
D100Max	66.1°C
Q7 Max	85.2°C
D1 Max	78.5°C

5.3 230VAC/50Hz



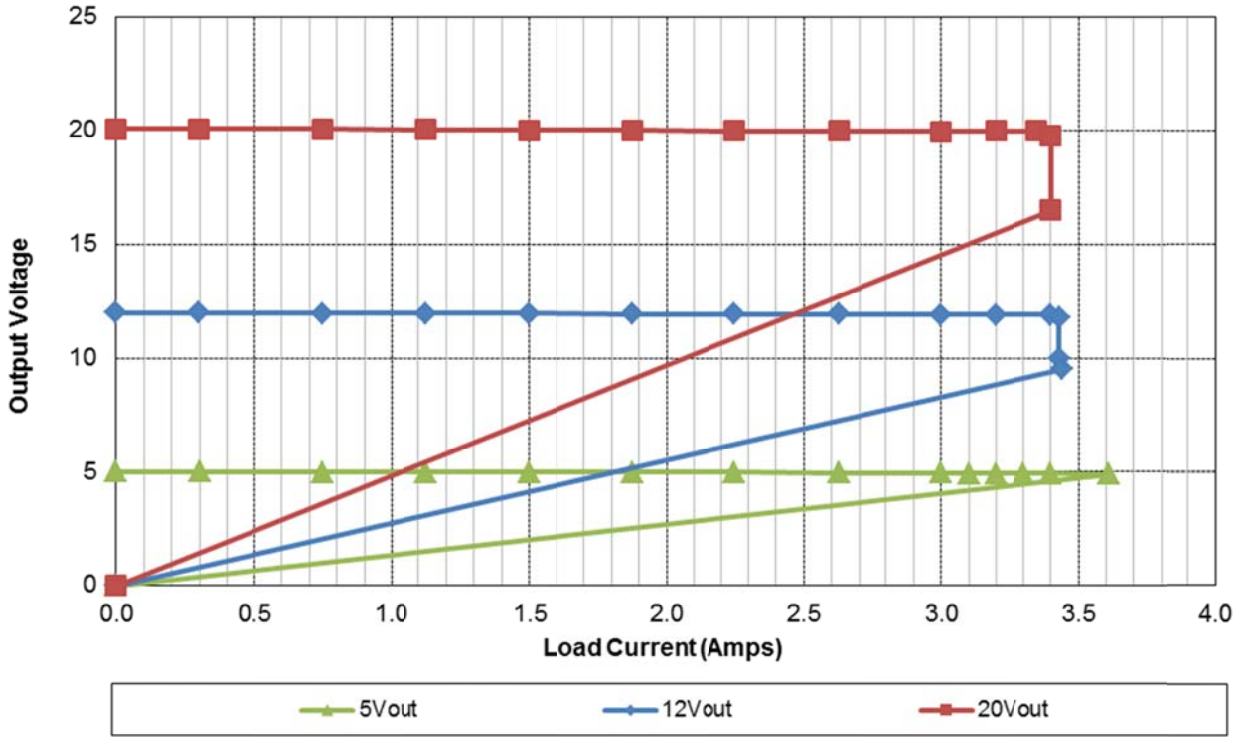
Area analysis	Value
T1 Max	80.0°C



Area analysis	Value
Q3 Max	84.2°C
D100Max	59.7°C
Q7 Max	86.0°C
D1 Max	63.6°C

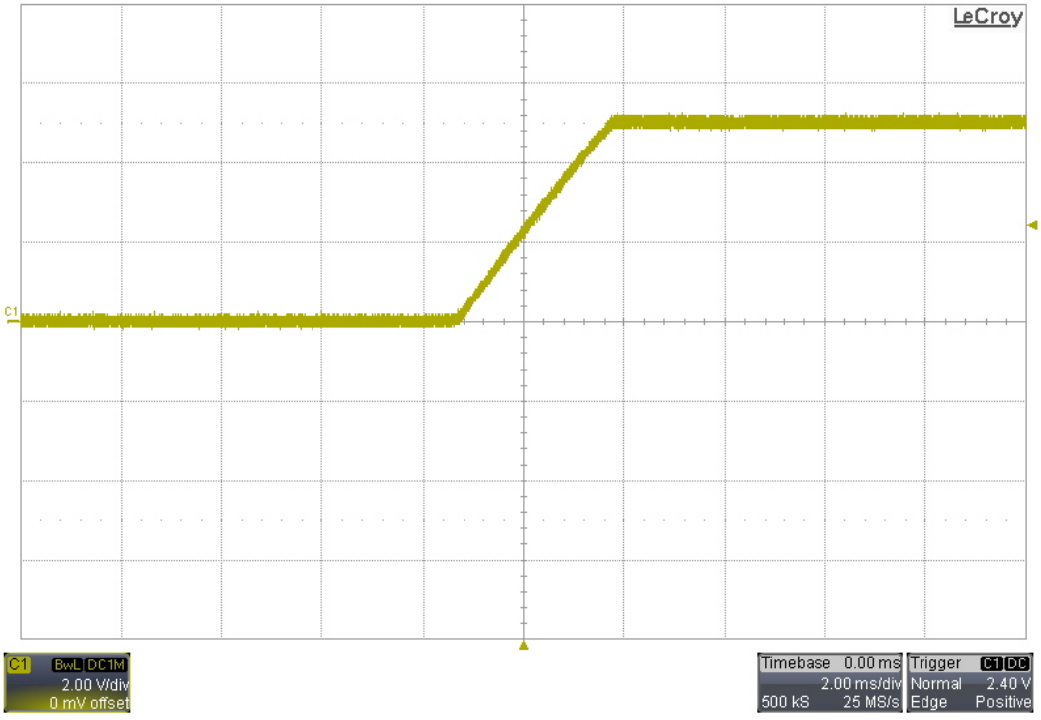
6 Current Limit

The plot below shows the output voltage on TP3/TP8 versus output current as the load is increased into current limit.



7 Startup

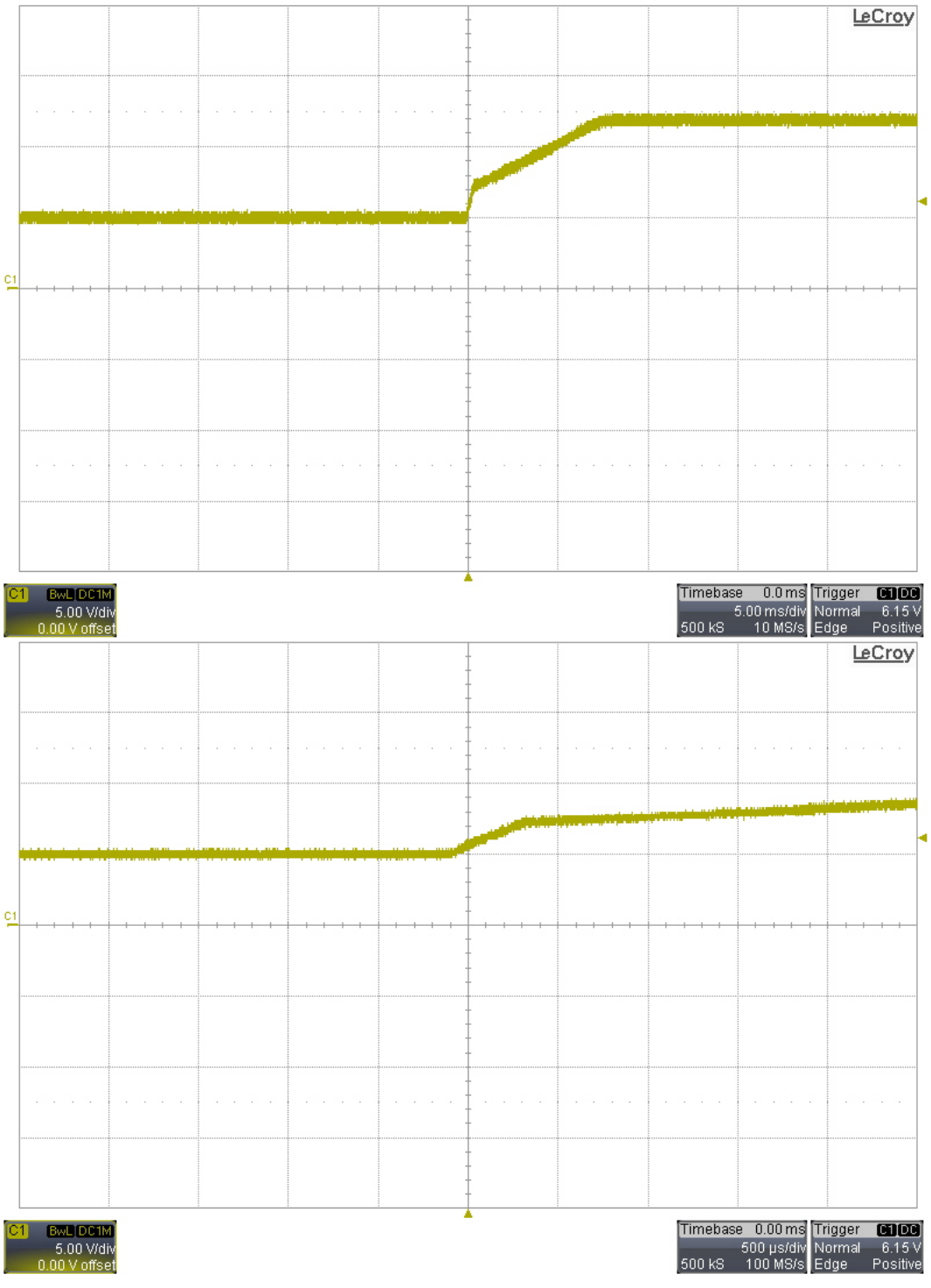
The image below shows the default output voltage of 5V on TP3/TP8 during a cable plug-in event with no load.



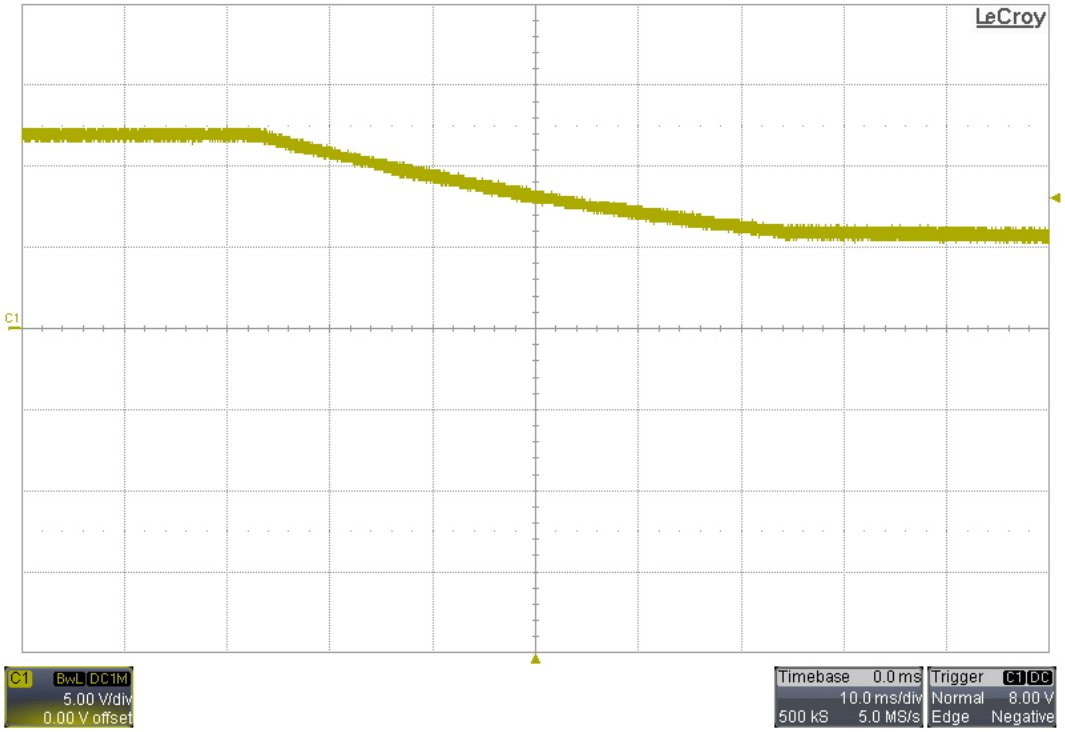
8 Output Voltage Transitions

The following screenshots below demonstrate the transitions between 5V, 12V, and 20V. No load is applied.

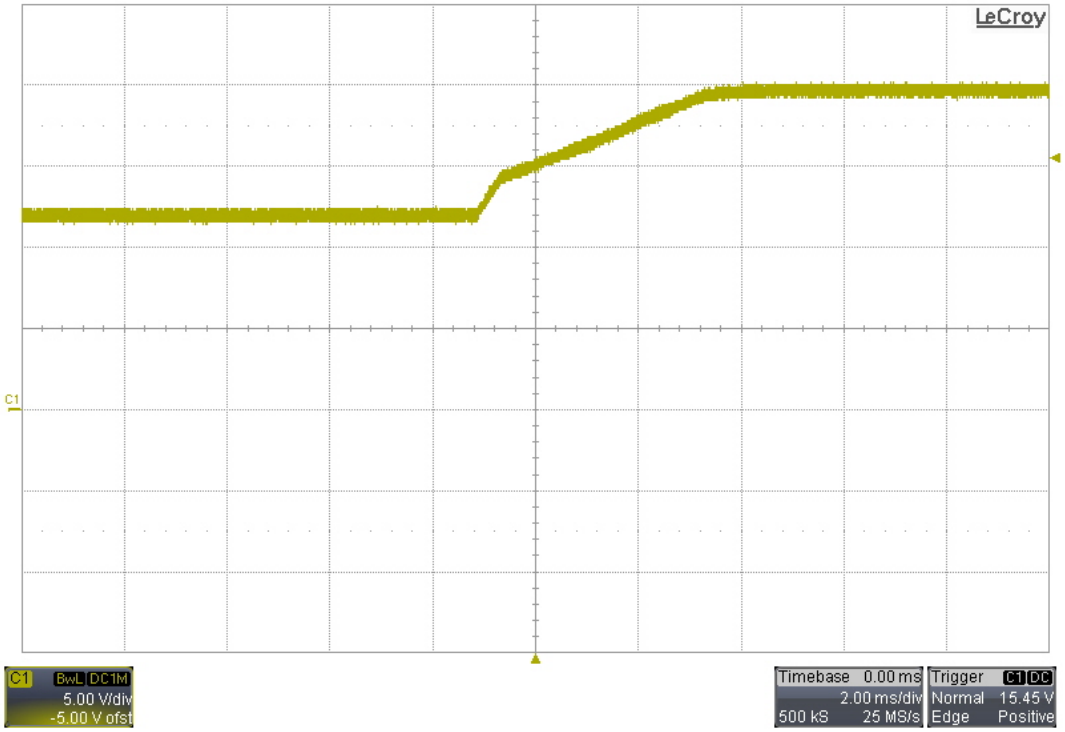
8.1 5V to 12V

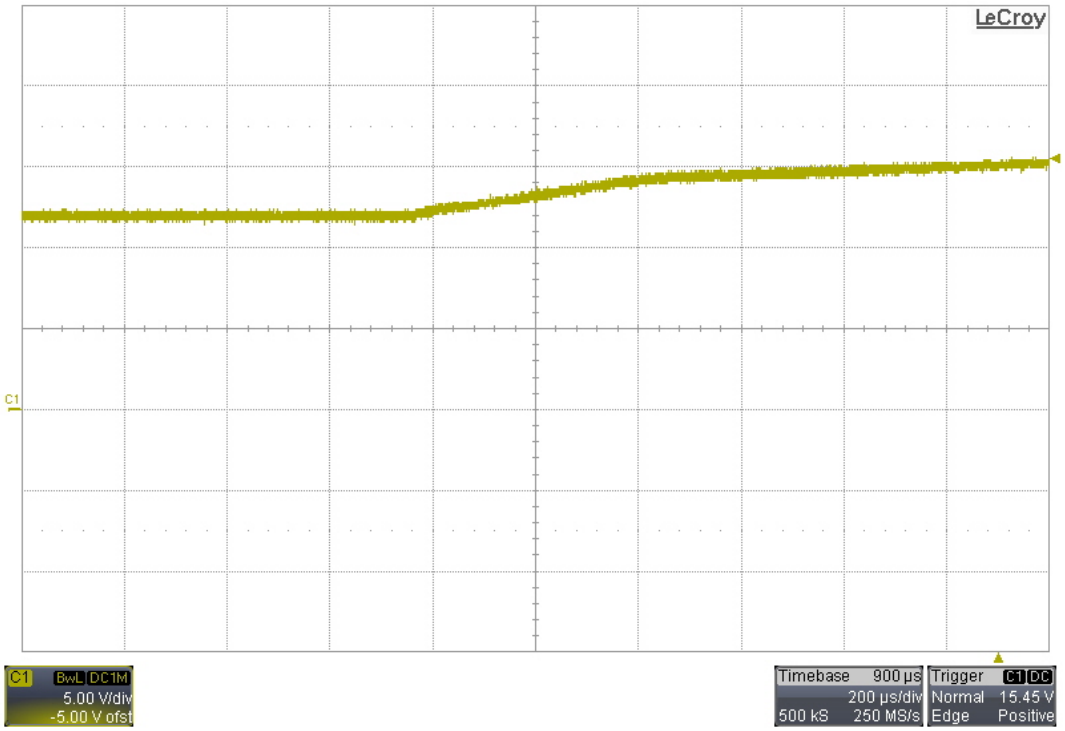


8.2 12V to 5V

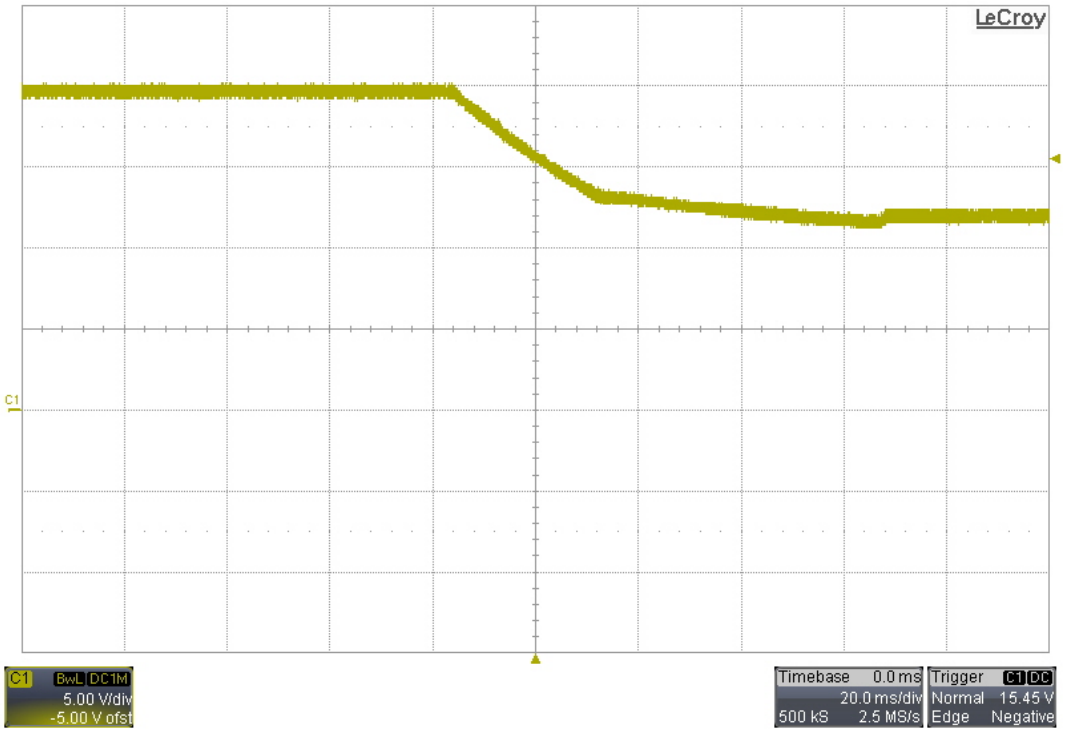


8.3 12V to 20V

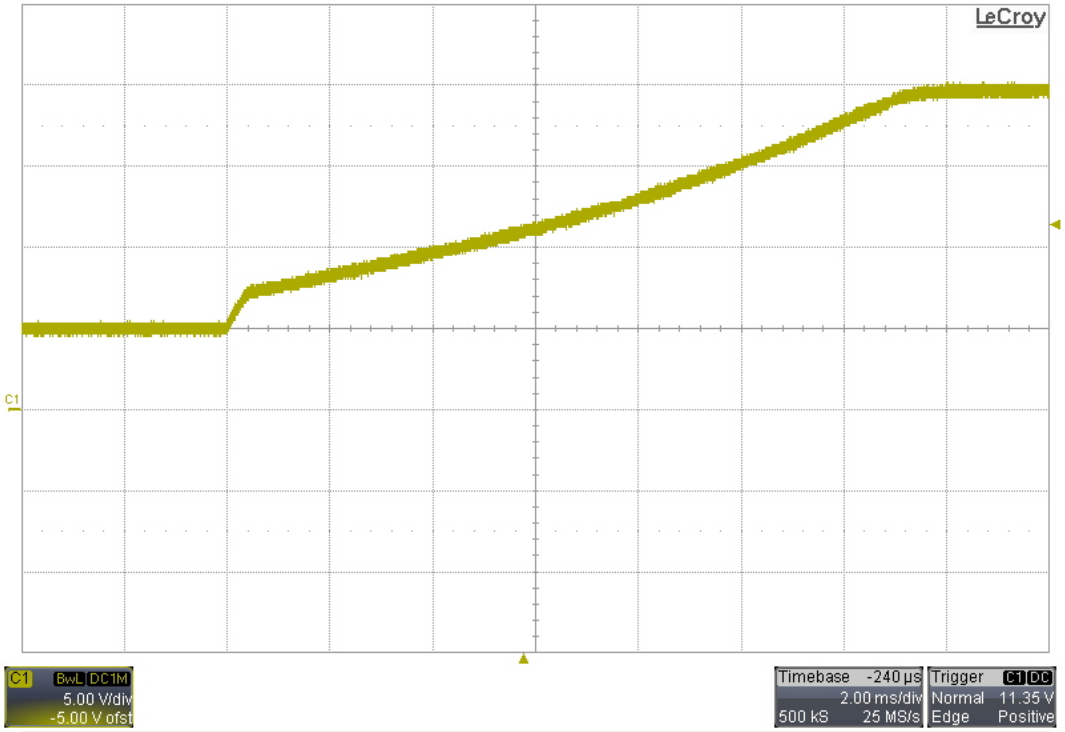


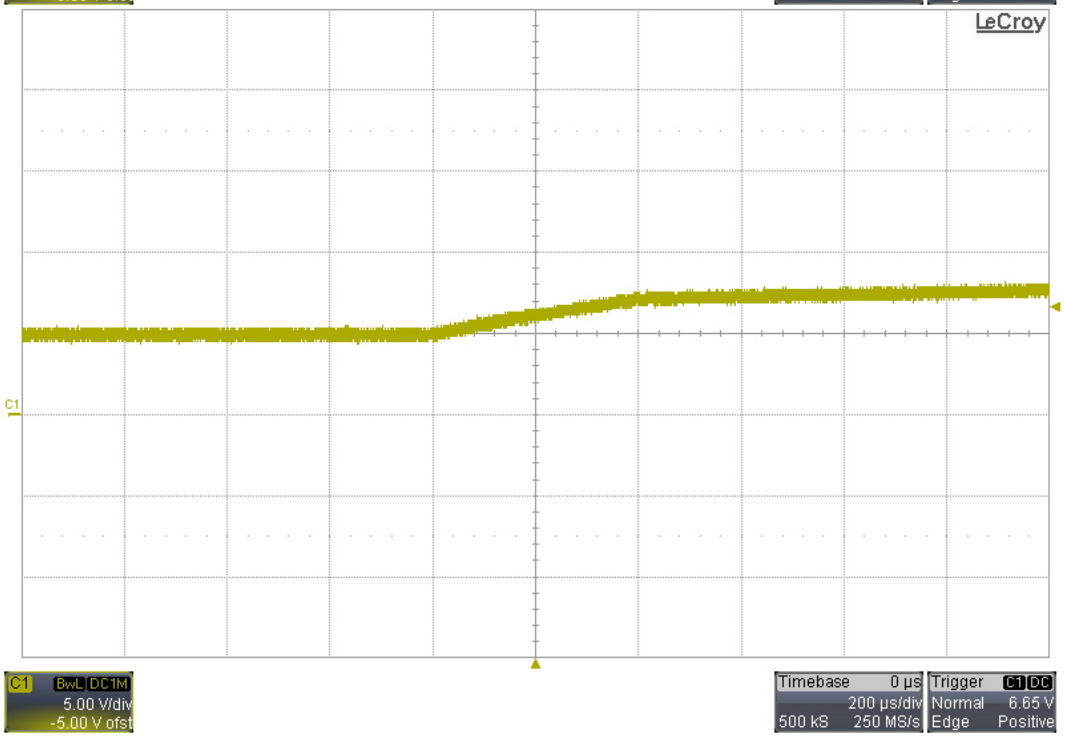

LeCroy
C1
C1 BwL DC1M
5.00 V/div
-5.00 V ofst
Timebase 900 µs
200 µs/div
500 kS 250 MS/s
Trigger C1 DC
Normal 15.45 V
Edge Positive

8.4 20V to 12V

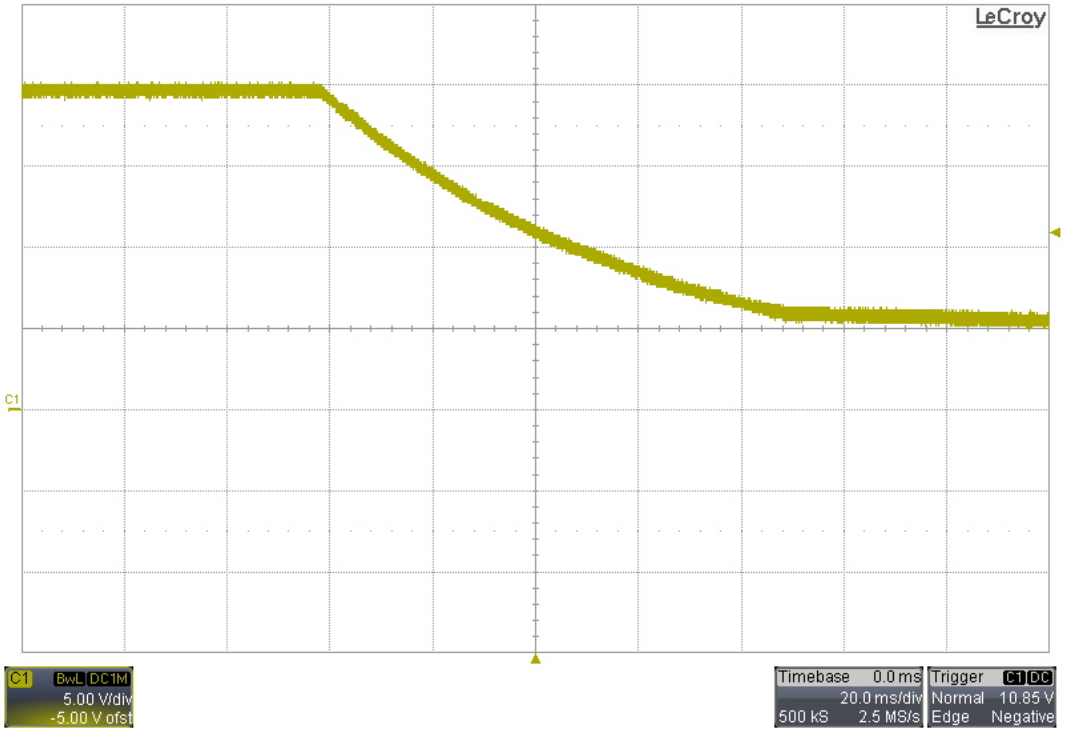

LeCroy
C1
C1 BwL DC1M
5.00 V/div
-5.00 V ofst
Timebase 0.0 ms
20.0 ms/div
500 kS 2.5 MS/s
Trigger C1 DC
Normal 15.45 V
Edge Negative

8.5 5V to 20V


LeCroy
C1
C1 BwL DC1M
5.00 V/div
-5.00 V ofst
Timebase -240 µs
2.00 ms/div
500 kS 25 MS/s
Trigger C1 DC
Normal 11.35 V
Edge Positive

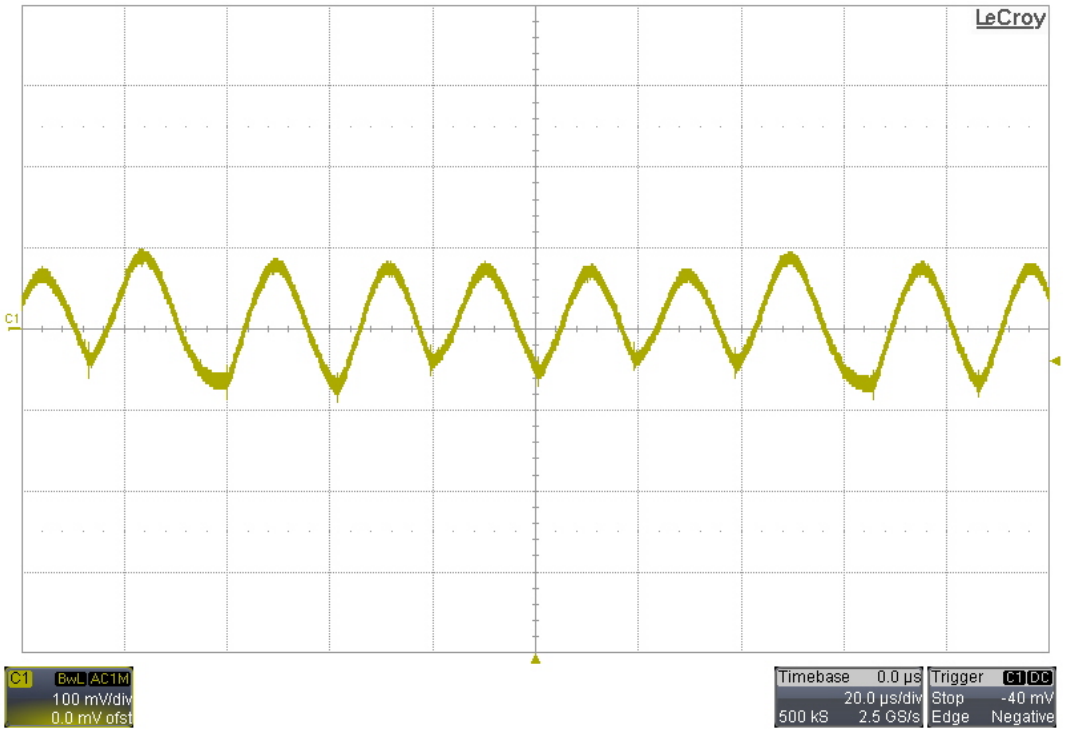

LeCroy
C1
C1 BwL DC1M
5.00 V/div
-5.00 V ofst
Timebase 0 µs
200 µs/div
500 kS 250 MS/s
Trigger C1 DC
Normal 6.65 V
Edge Positive

8.6 20V to 5V

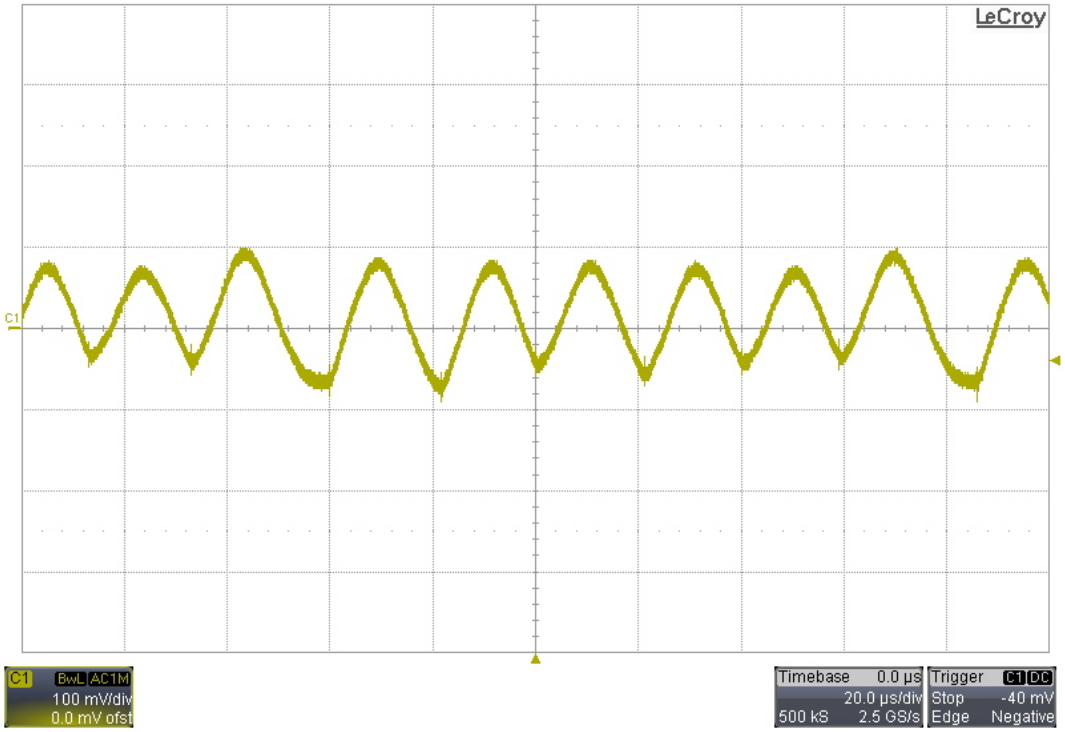


9 Output Ripple Voltage

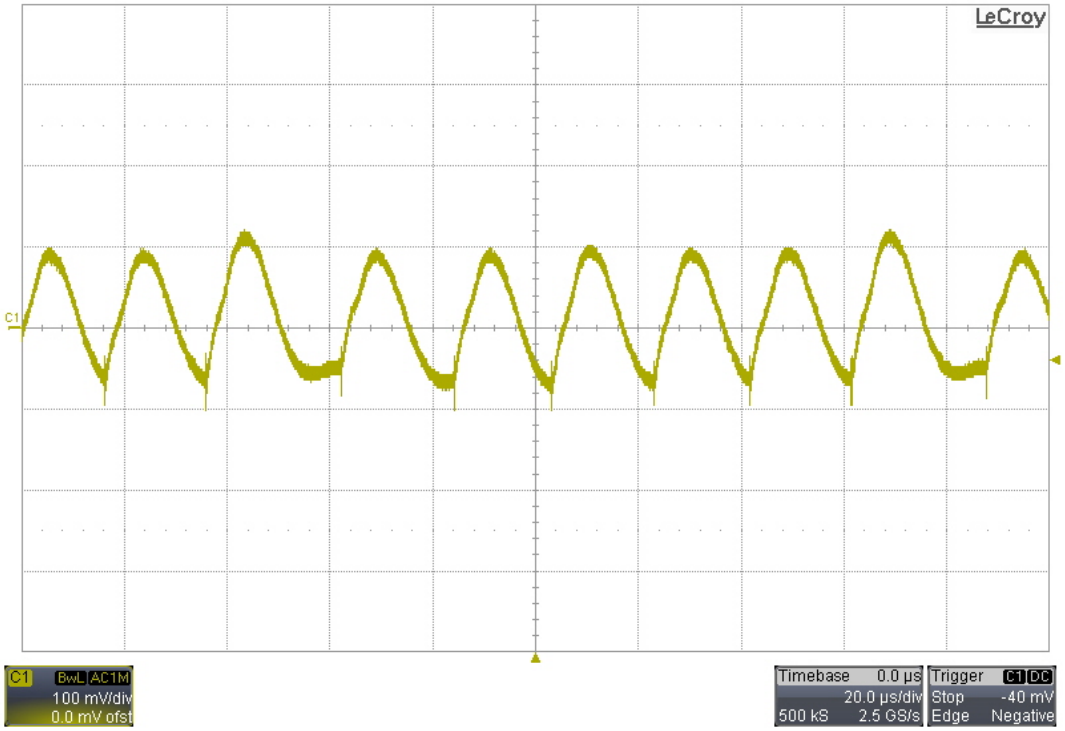
9.1 120VAC/60Hz – Measured at TP3/TP8 – 5V@3A Load



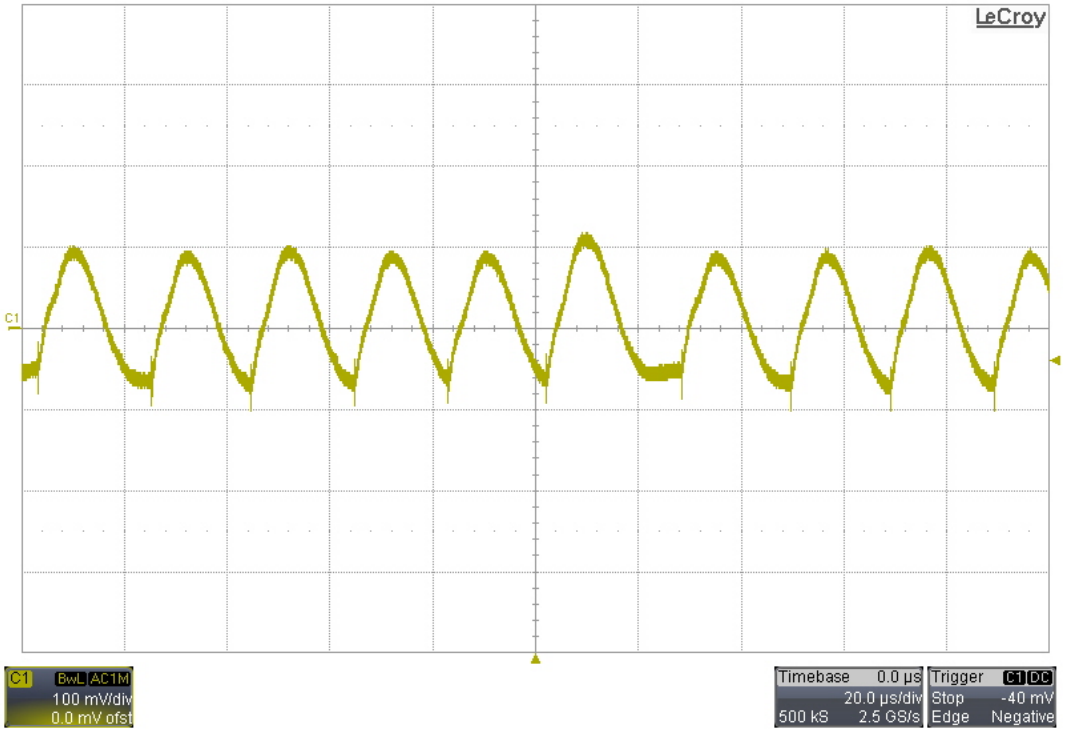
9.2 230VAC/50Hz – Measured at TP3/TP8 – 5V@3A Load



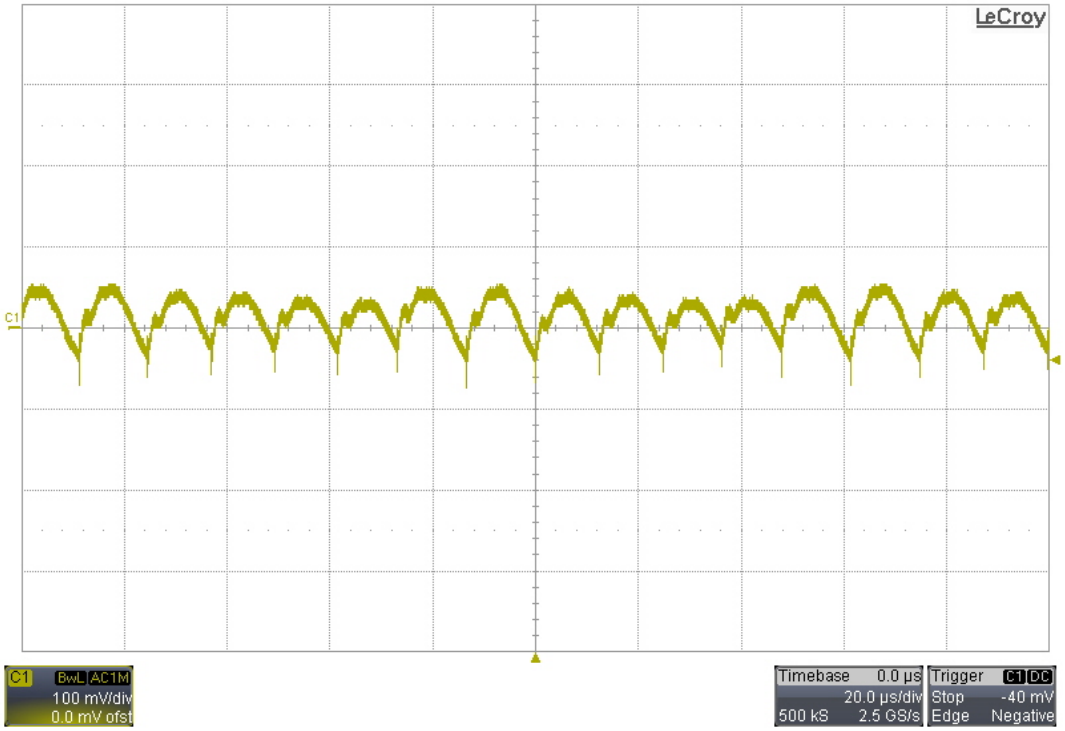
9.3 120VAC/60Hz – Measured at TP3/TP8 – 12V@3A Load



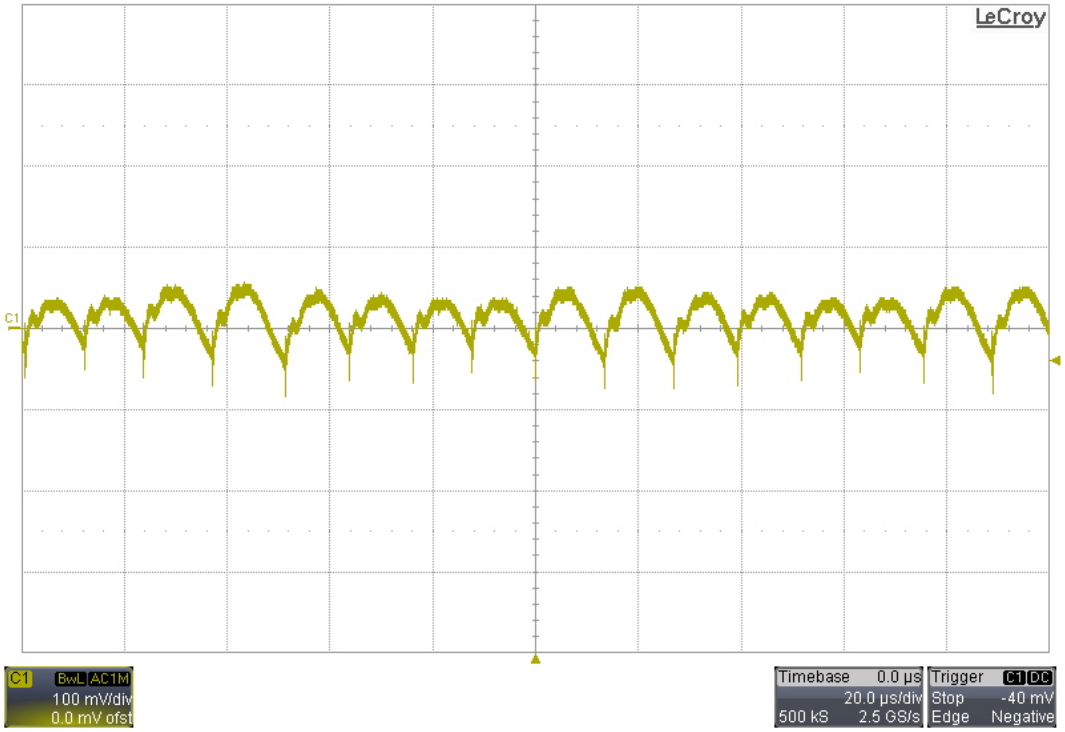
9.4 230VAC/50Hz – Measured at TP3/TP8 – 12V@3A Load



9.5 120VAC/60Hz – Measured at TP3/TP8 – 20V@3A Load

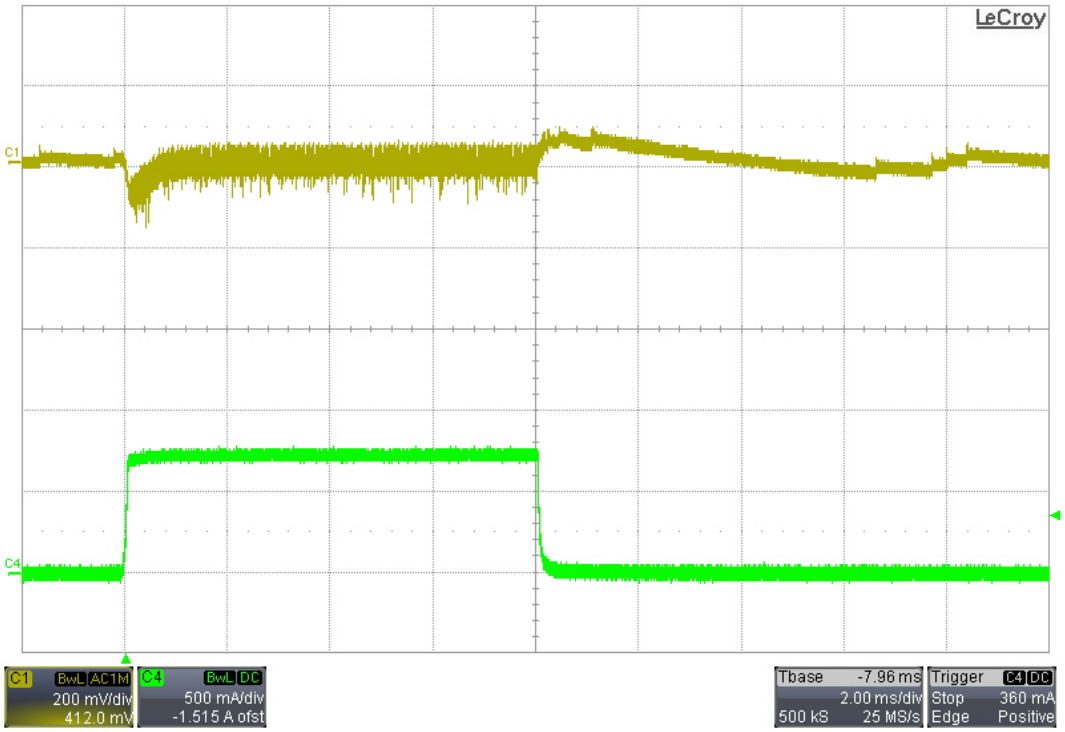


9.6 230VAC/50Hz – Measured at TP3/TP8 – 20V@A Load

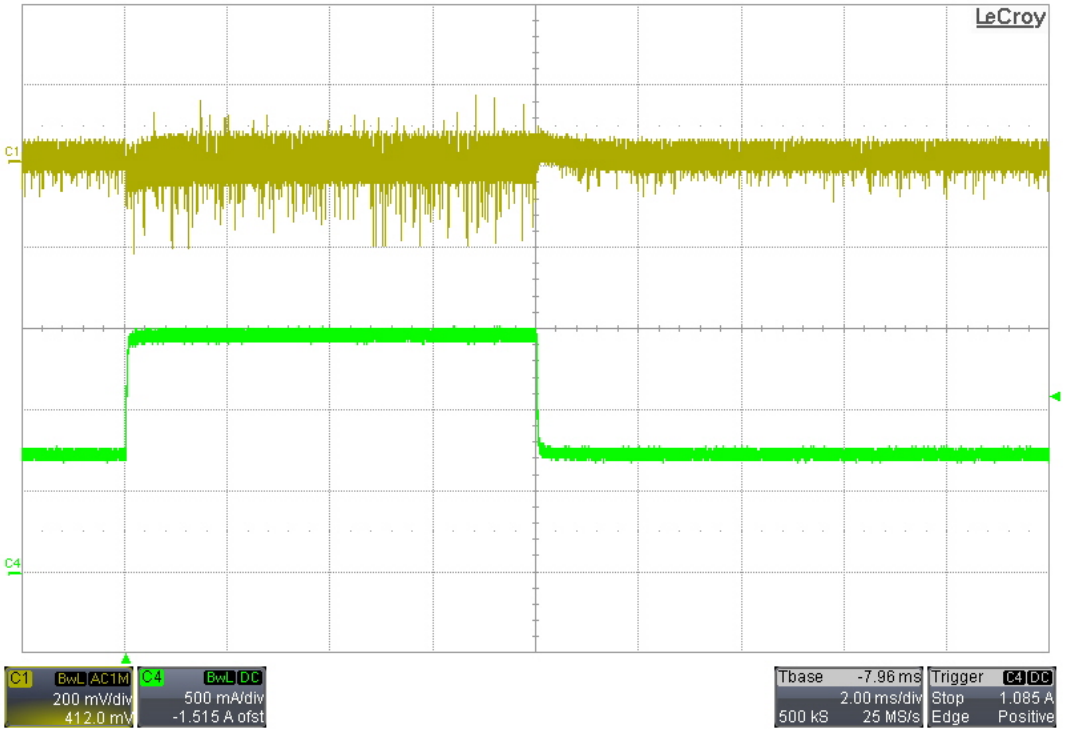


10 Load Transients

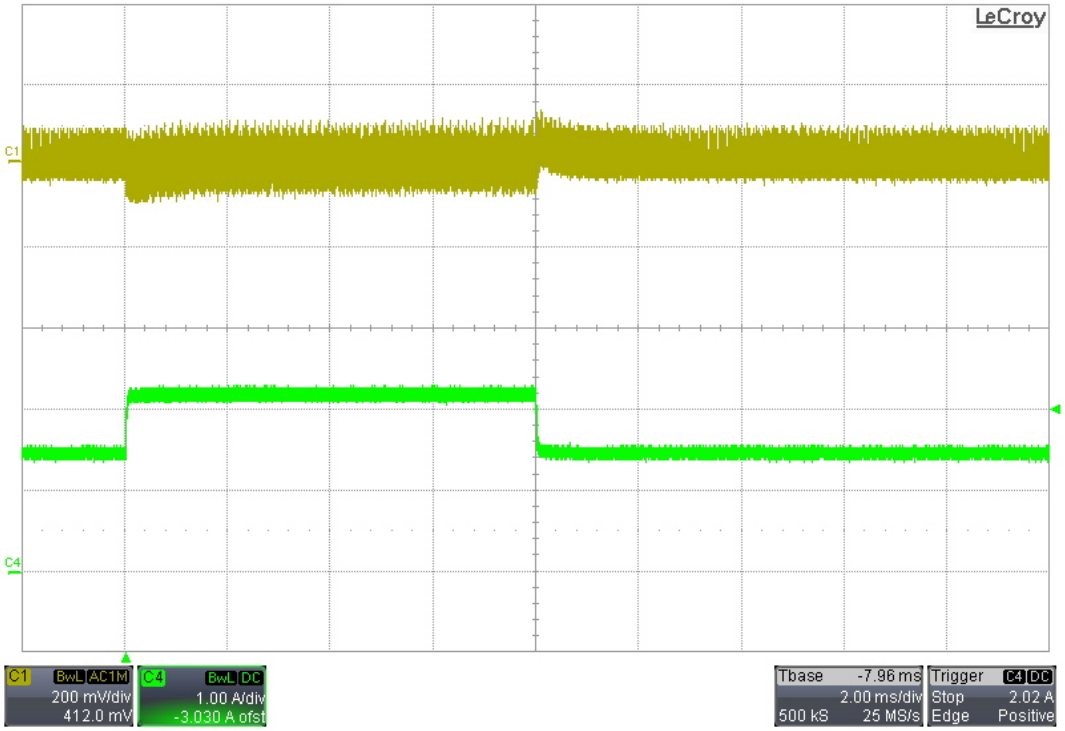
10.1 5Vout, 0-25% 120VAC/60Hz Input



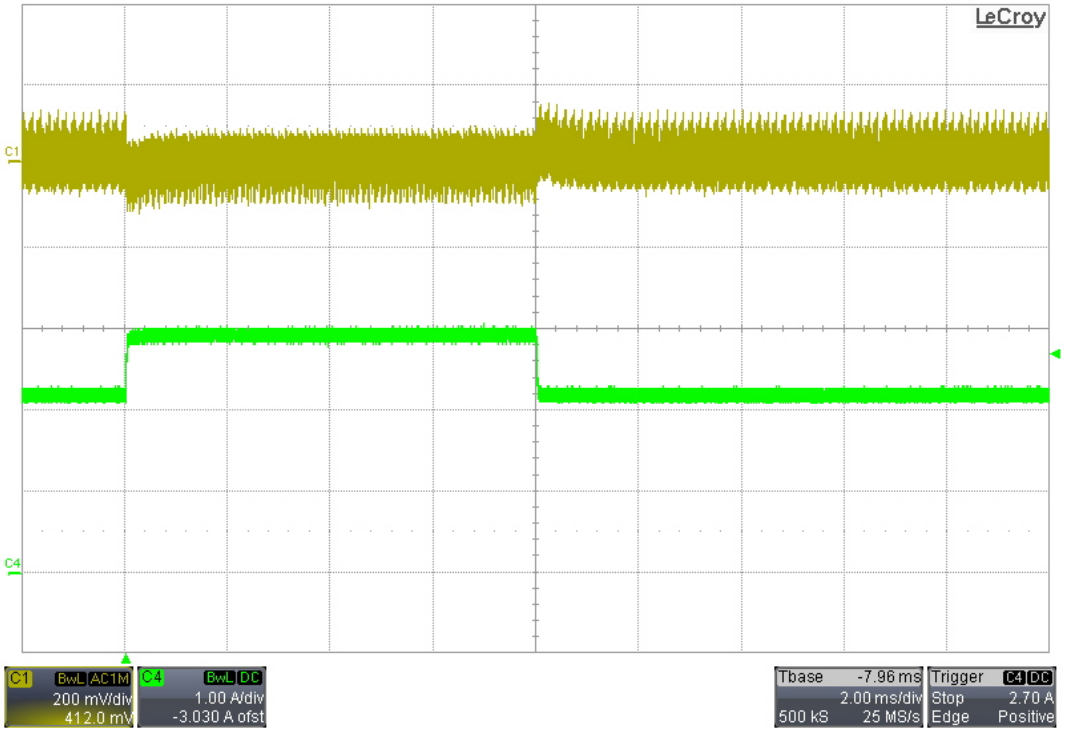
10.2 5Vout, 25-50% 120VAC/60Hz Input



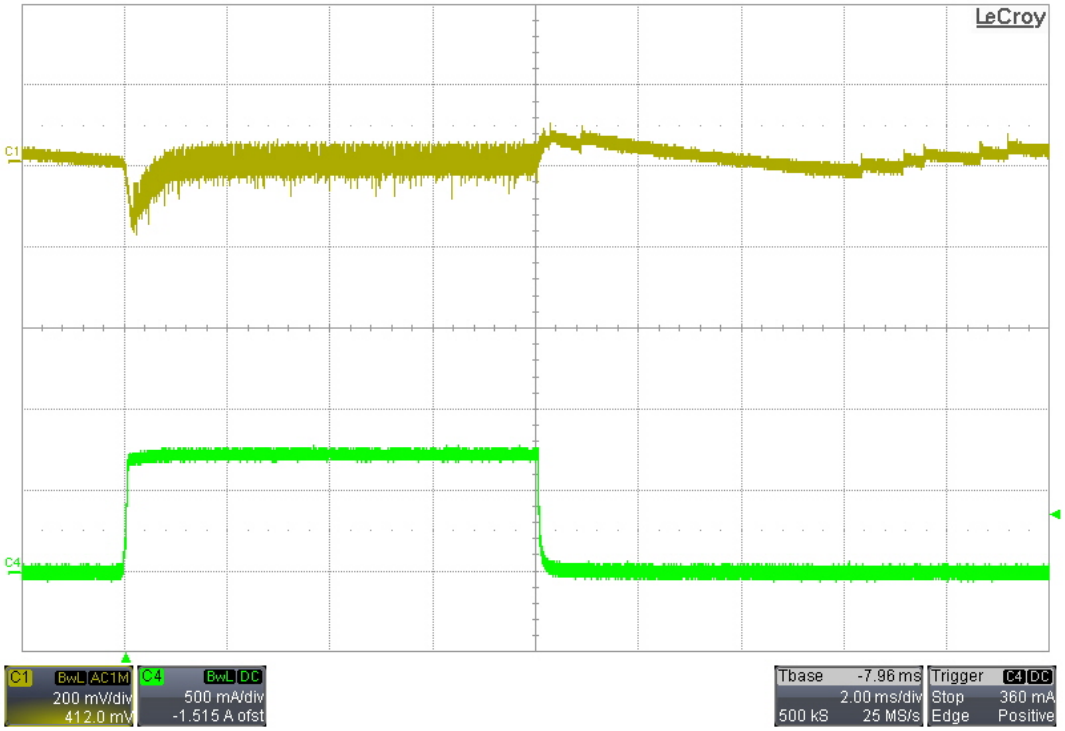
10.3 5Vout, 50-75% 120VAC/60Hz Input



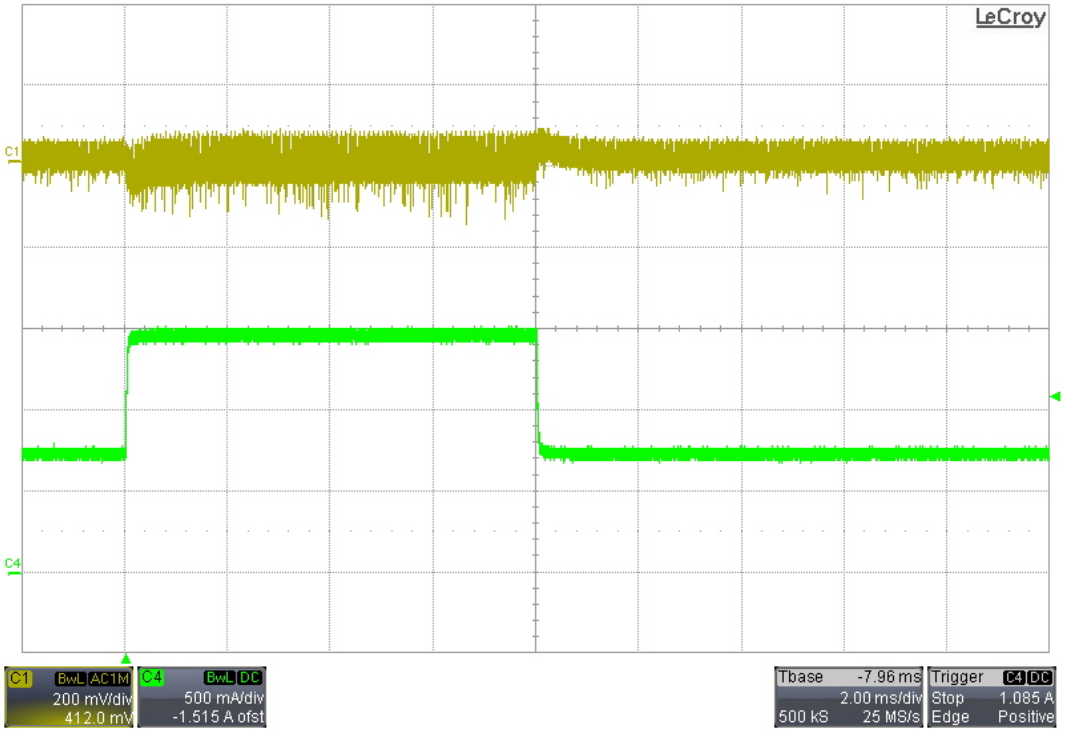
10.4 5Vout, 75-100% 120VAC/60Hz Input



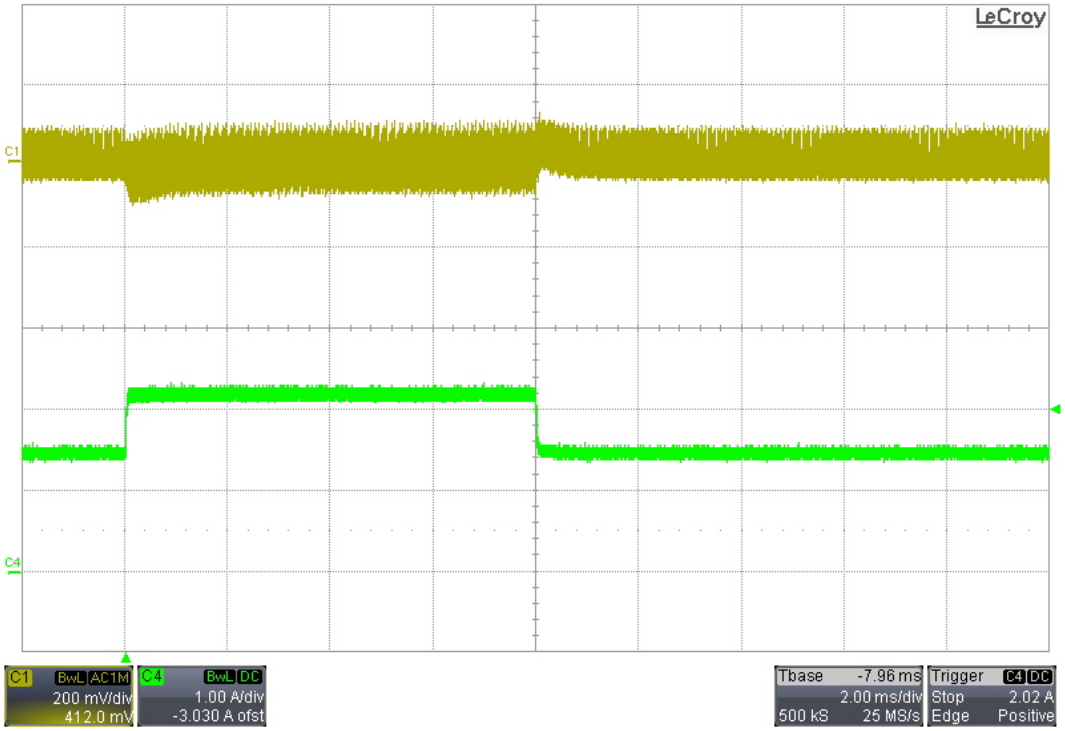
10.5 5Vout, 0-25% 230VAC/50Hz Input



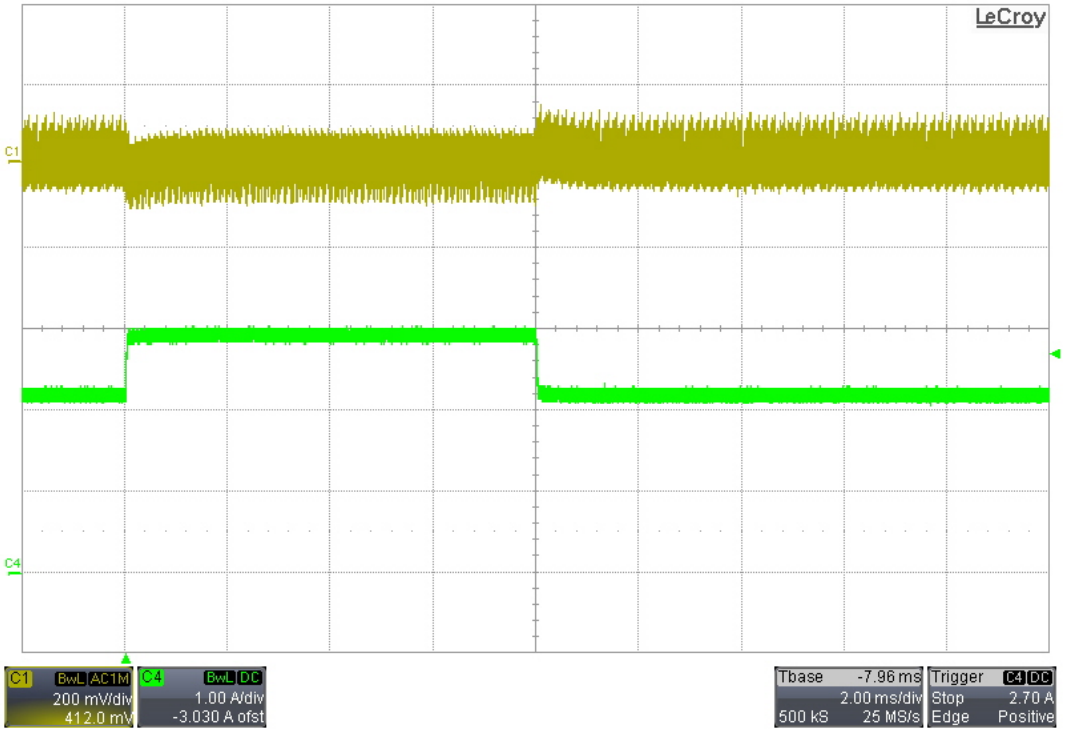
10.6 5Vout, 25-50% 230VAC/50Hz Input



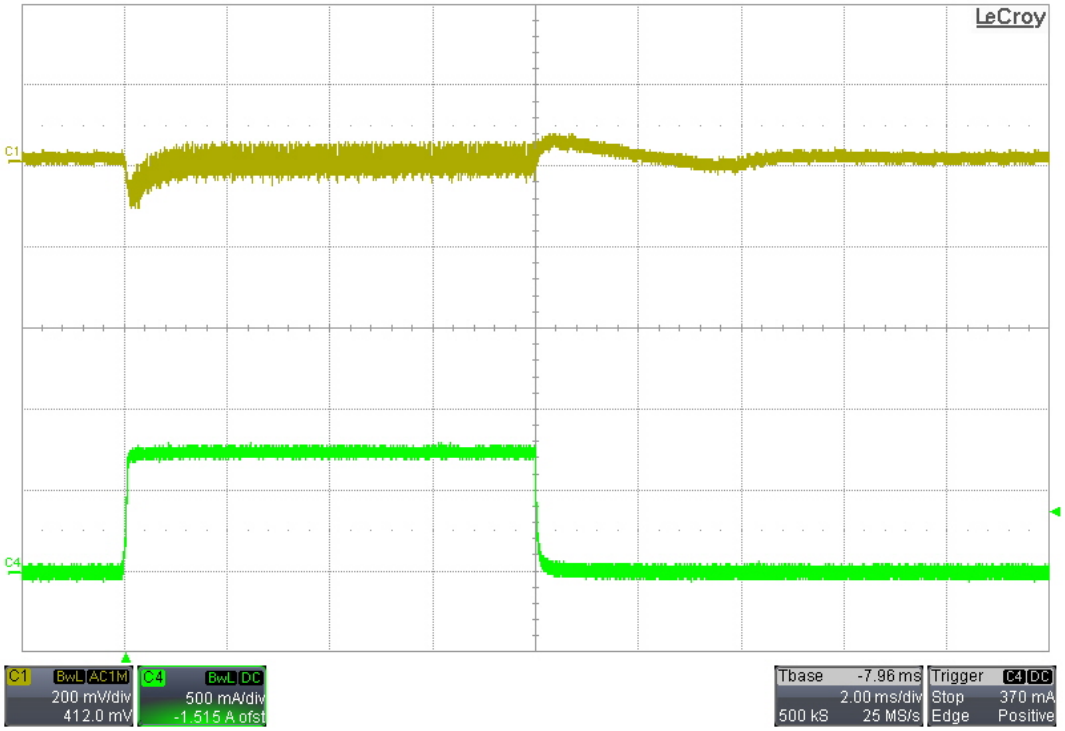
10.7 5Vout, 50-75% 230VAC/50Hz Input



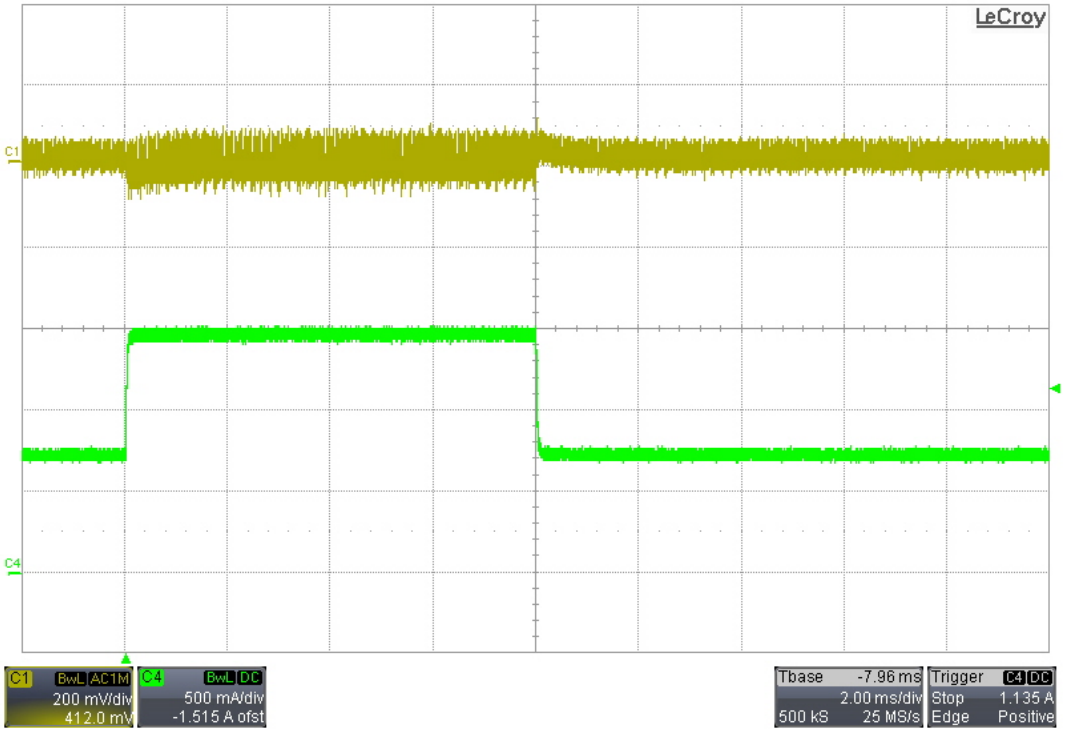
10.8 5Vout, 75-100% 230VAC/50Hz Input



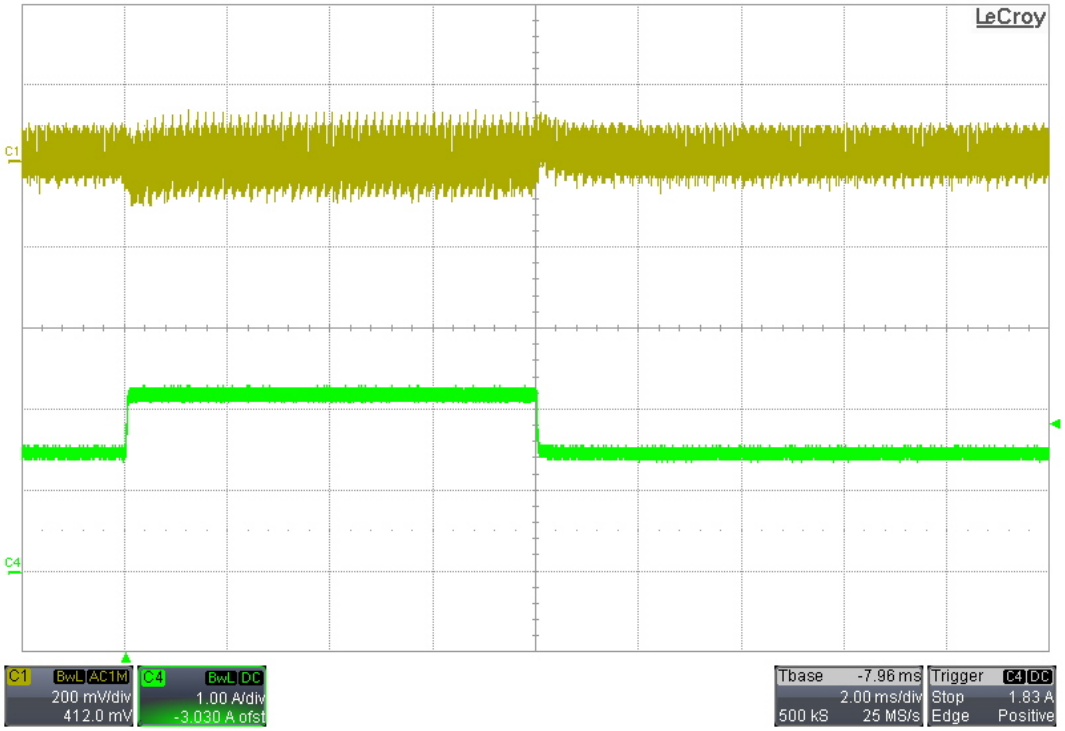
10.9 12Vout, 0-25% 120VAC/60Hz Input



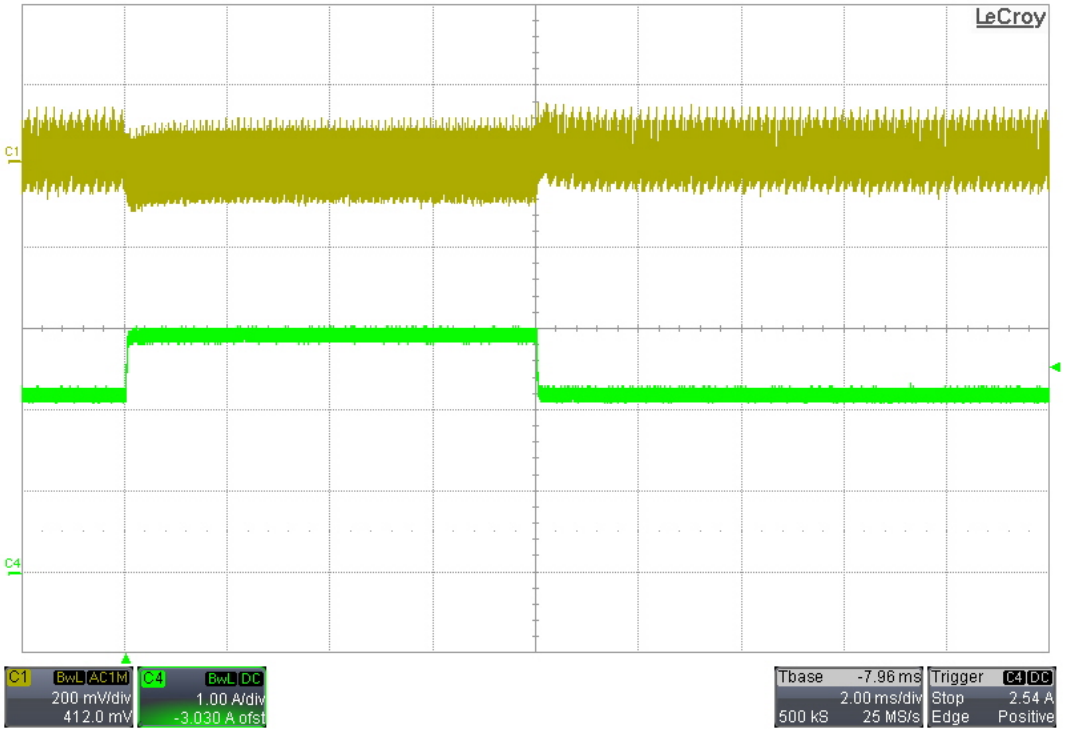
10.10 12Vout, 25-50% 120VAC/60Hz Input



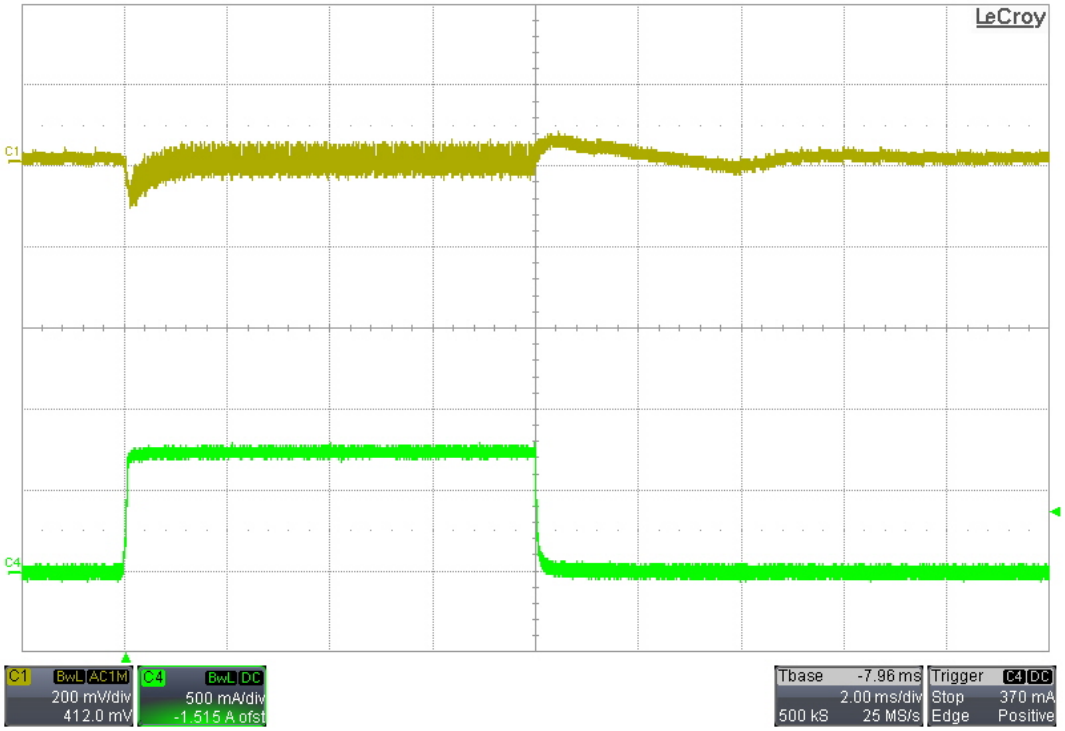
10.11 12Vout, 50-75% 120VAC/60Hz Input



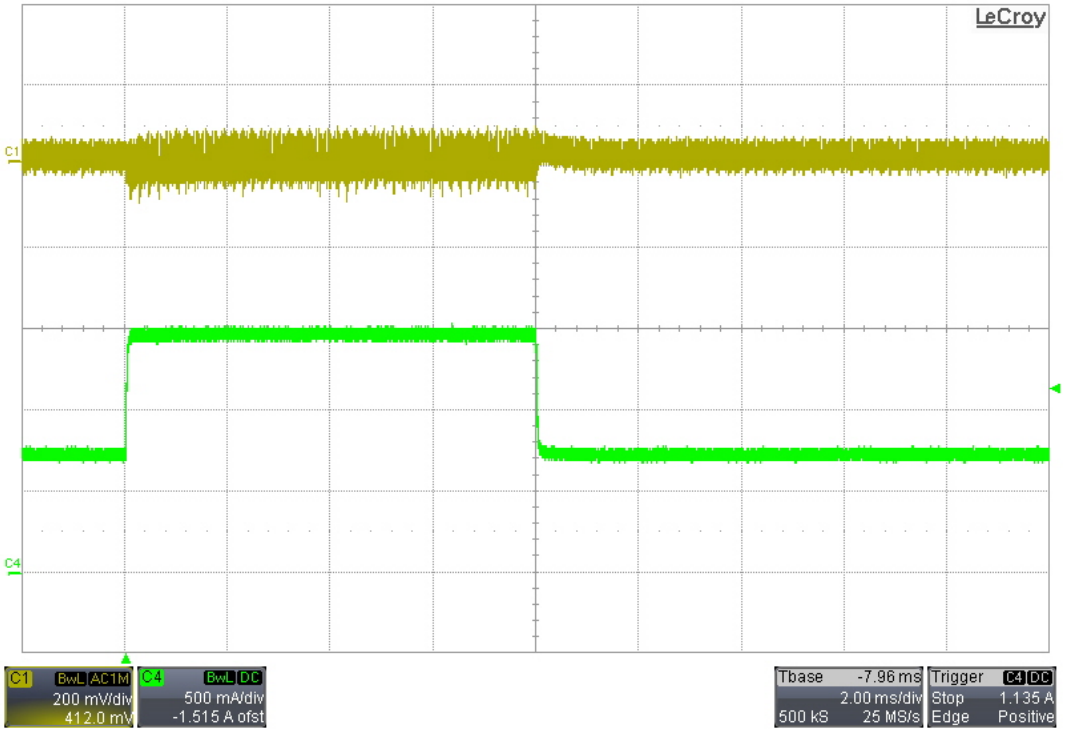
10.12 12Vout, 75-100% 120VAC/60Hz Input



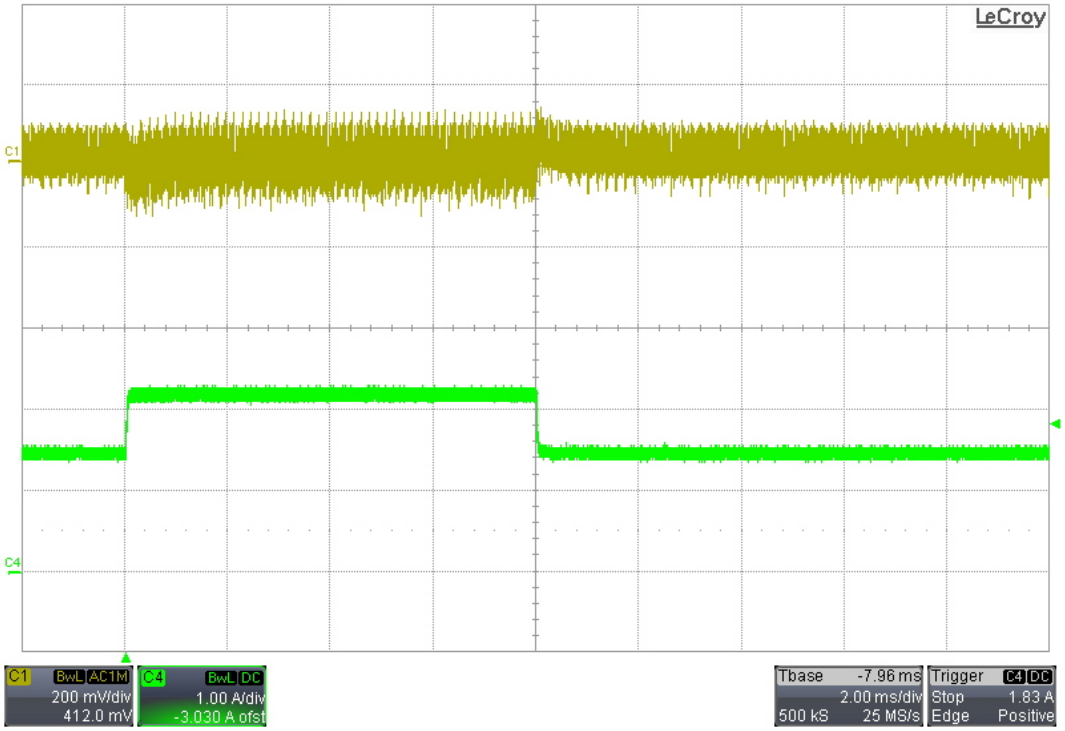
10.13 12Vout, 0-25% 230VAC/50Hz Input



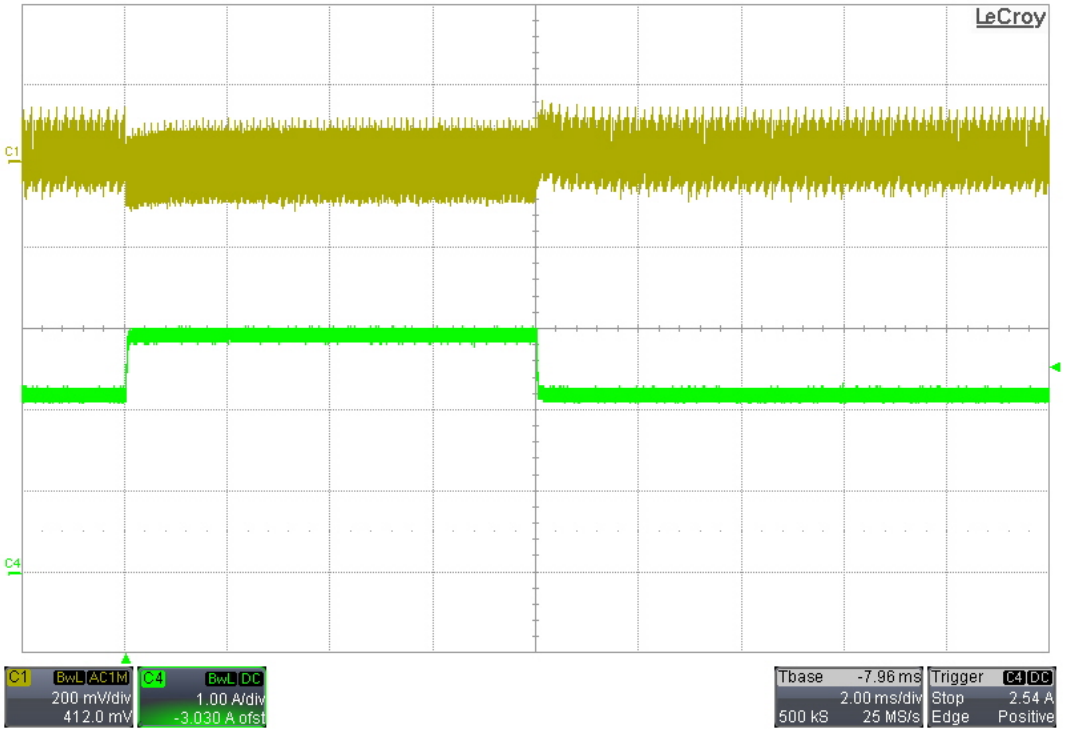
10.14 12Vout, 25-50% 230VAC/50Hz Input



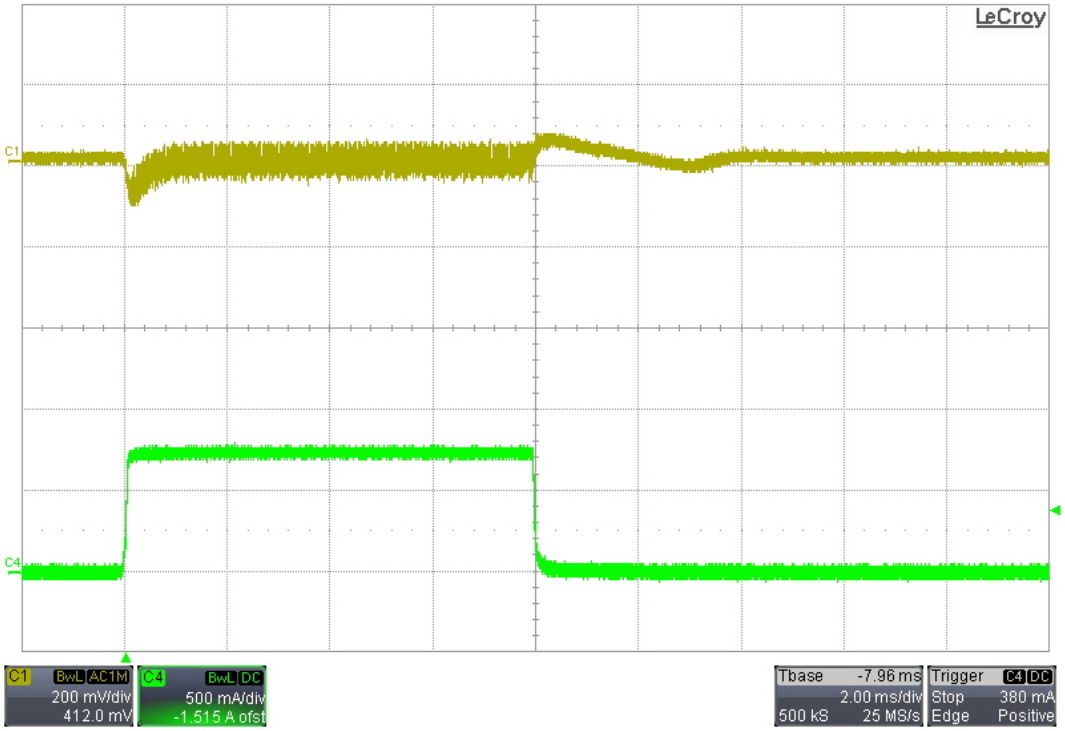
10.15 12Vout, 50-75% 230VAC/50Hz Input



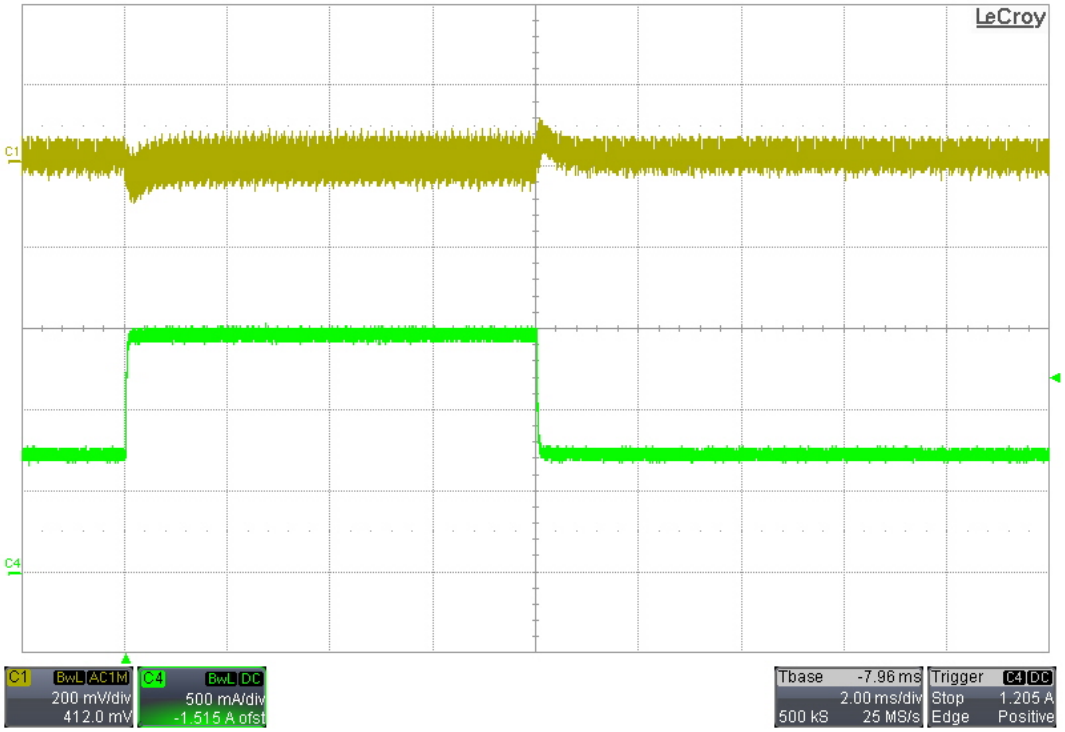
10.16 12Vout, 75-100% 230VAC/50Hz Input



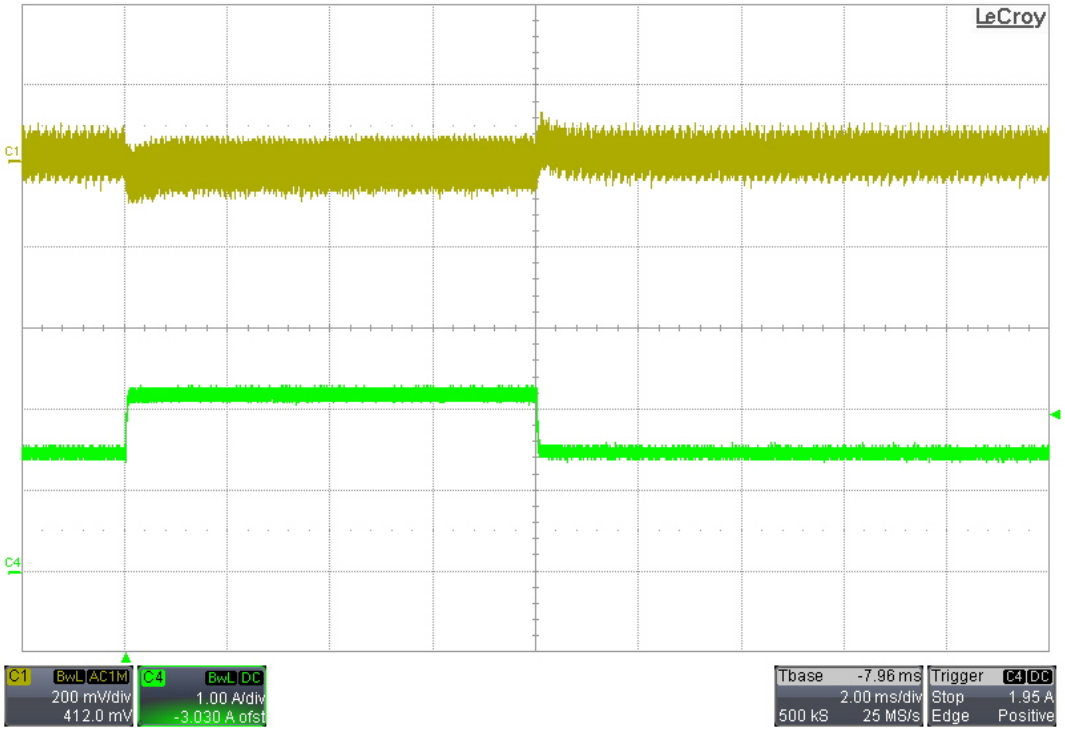
10.17 20Vout, 0-25% 120VAC/60Hz Input



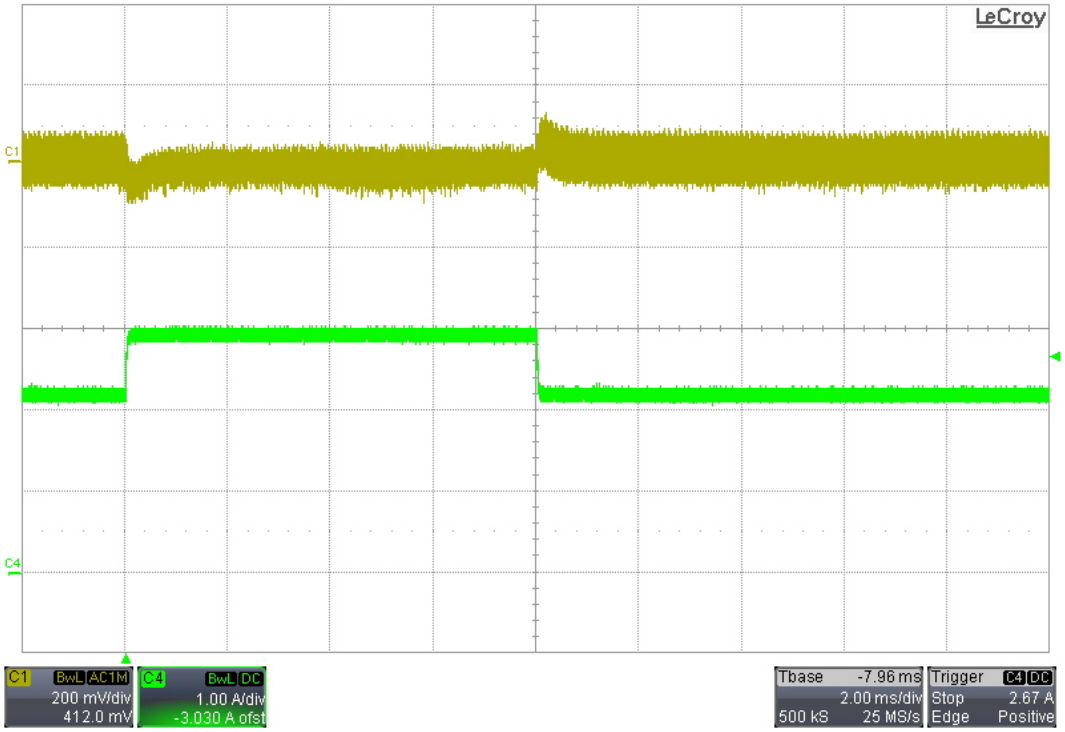
10.18 20Vout, 25-50% 120VAC/60Hz Input



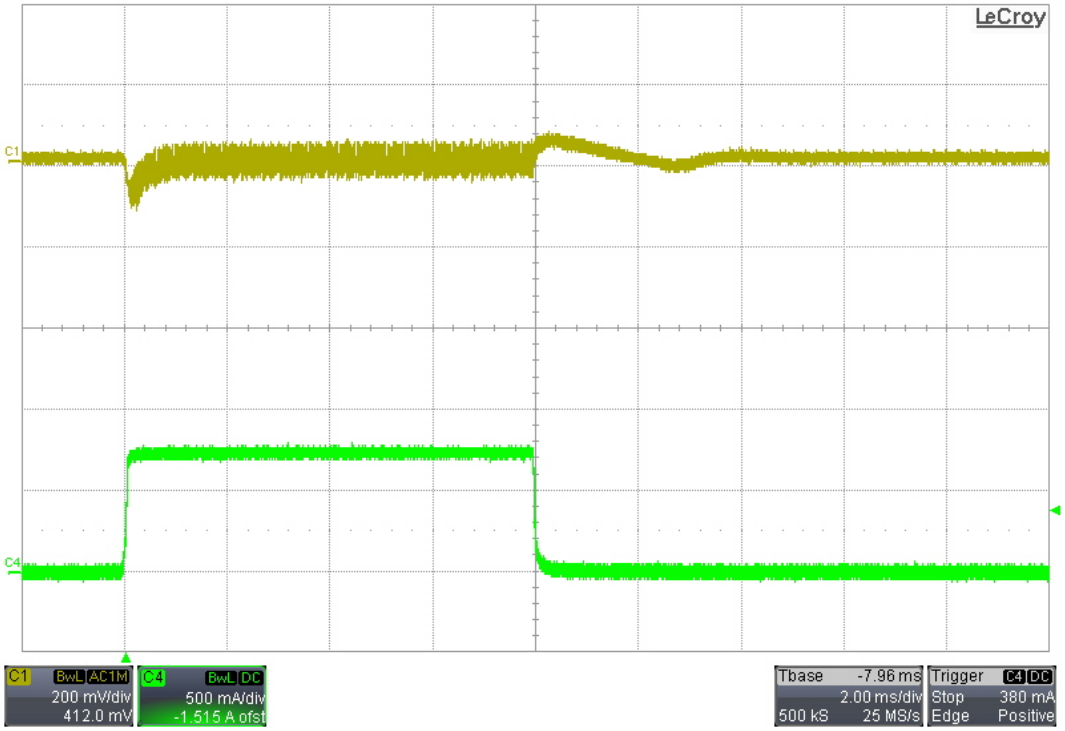
10.19 20Vout, 50-75% 120VAC/60Hz Input



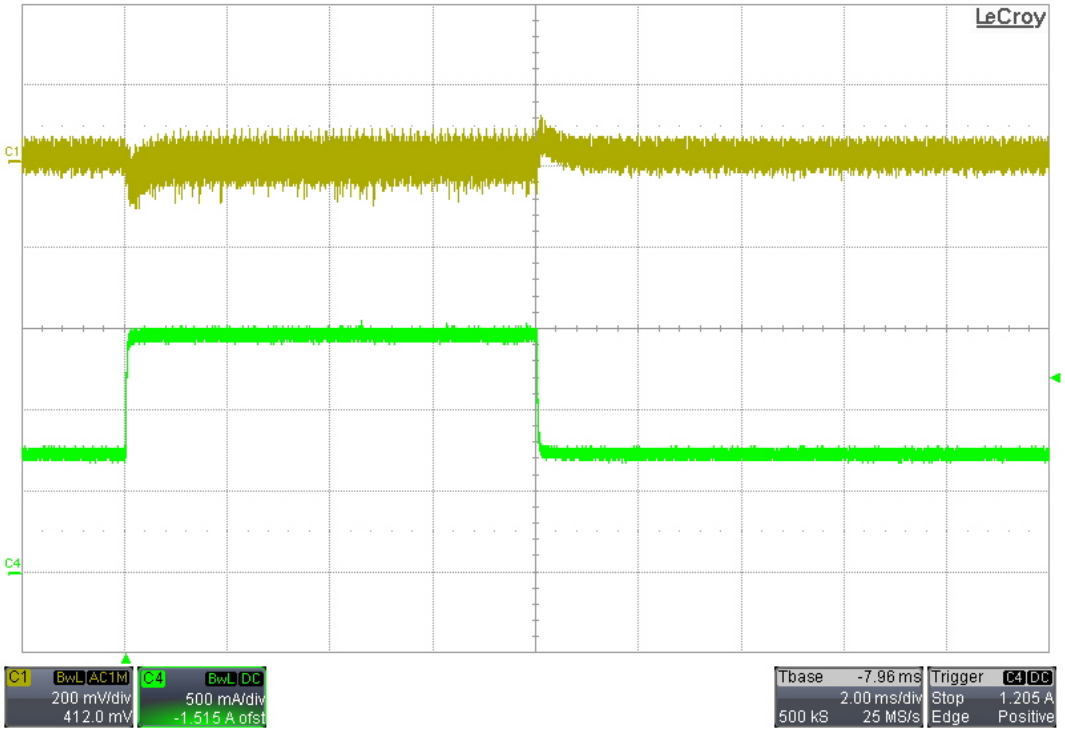
10.20 20Vout, 75-100% 120VAC/60Hz Input



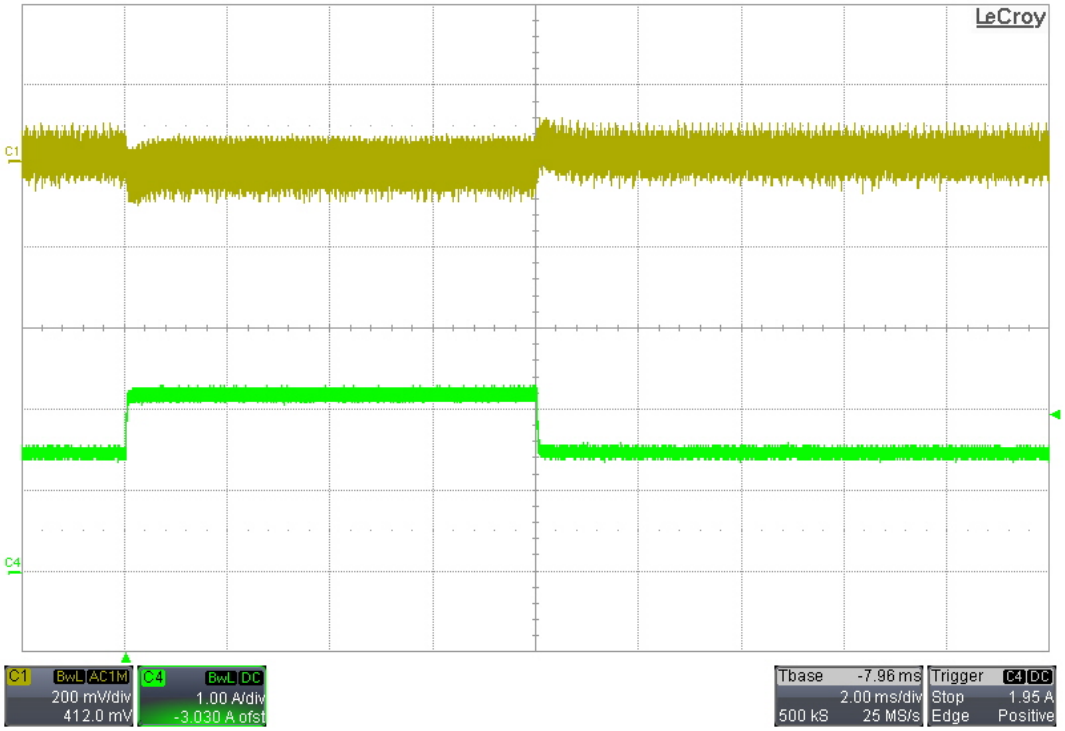
10.21 20Vout, 0-25% 230VAC/50Hz Input



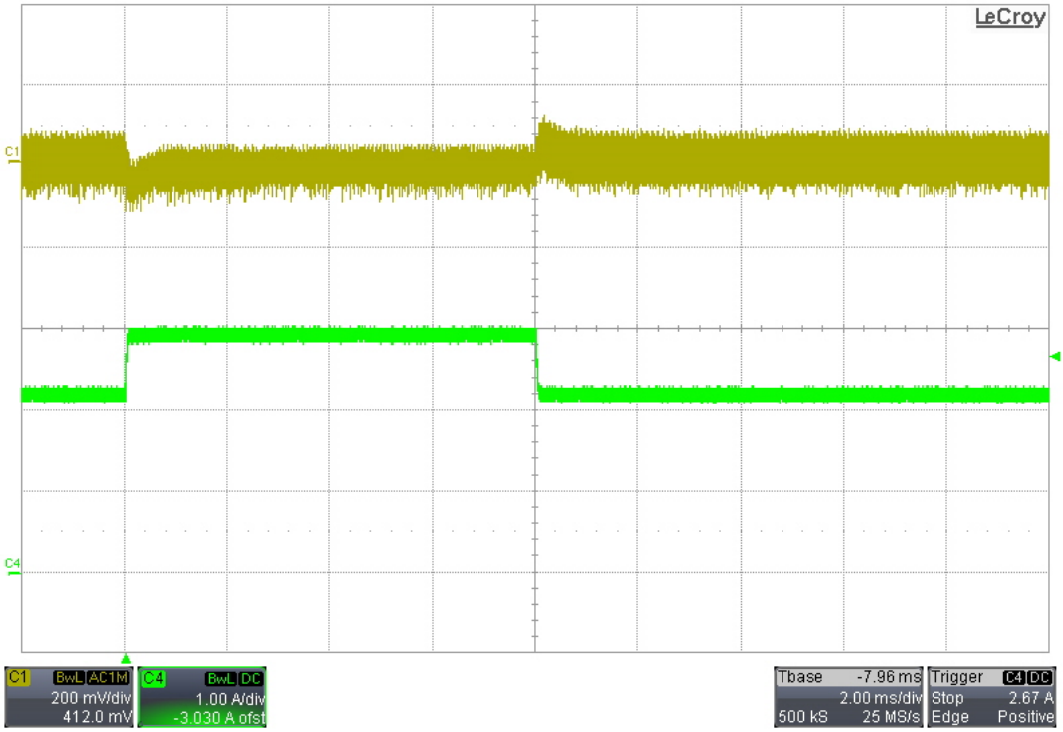
10.22 20Vout, 25-50% 230VAC/50Hz Input



10.23 20Vout, 50-75% 230VAC/50Hz Input



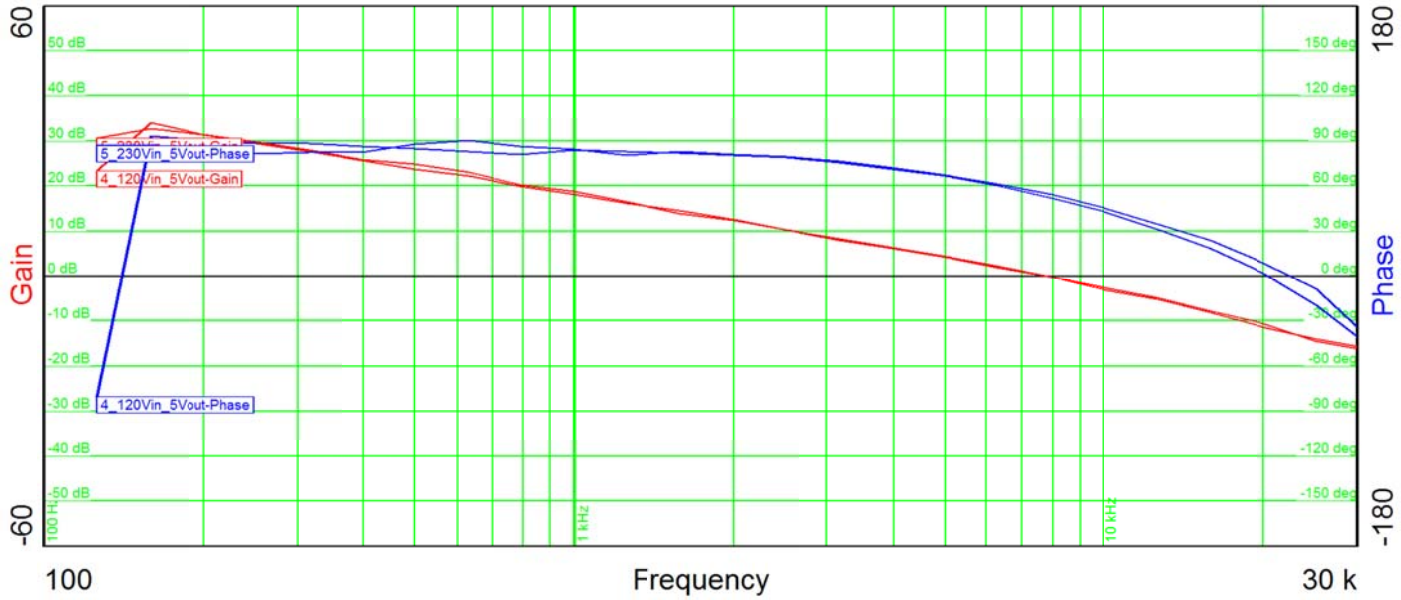
10.24 20Vout, 75-100% 230VAC/50Hz Input



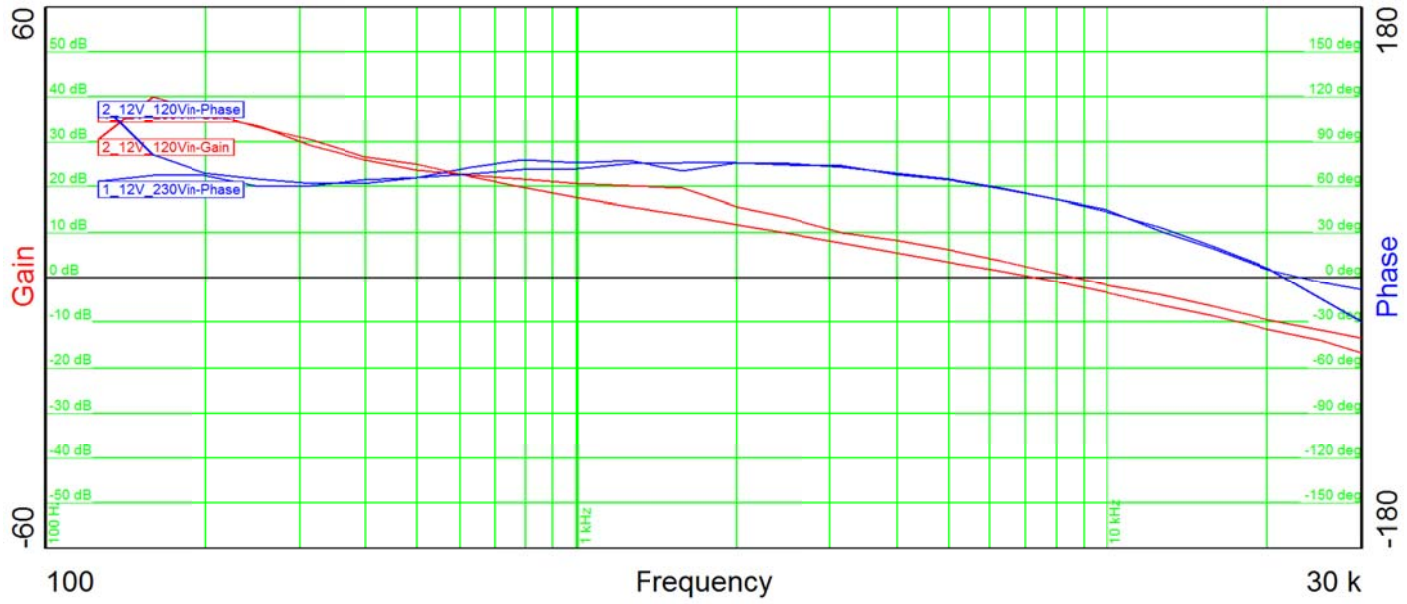
11 Loop Response

The following plots show the loop response at full load (3A) for the different outputs.

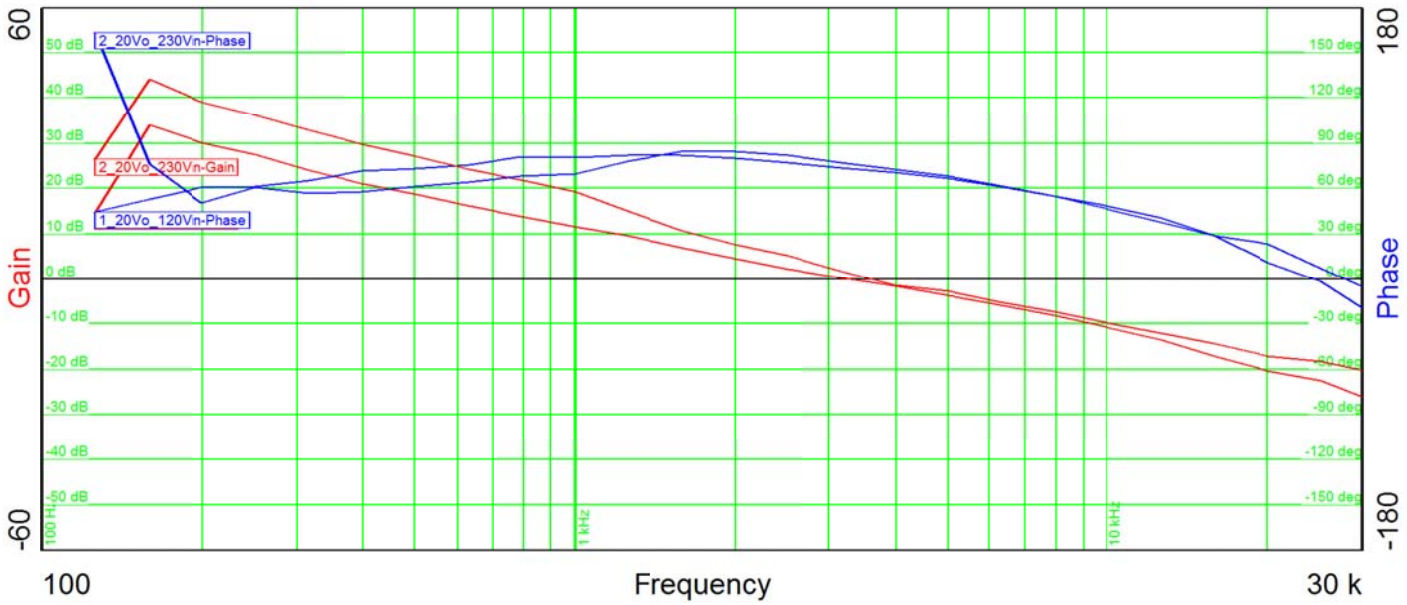
11.1 5Vout



11.2 12Vout



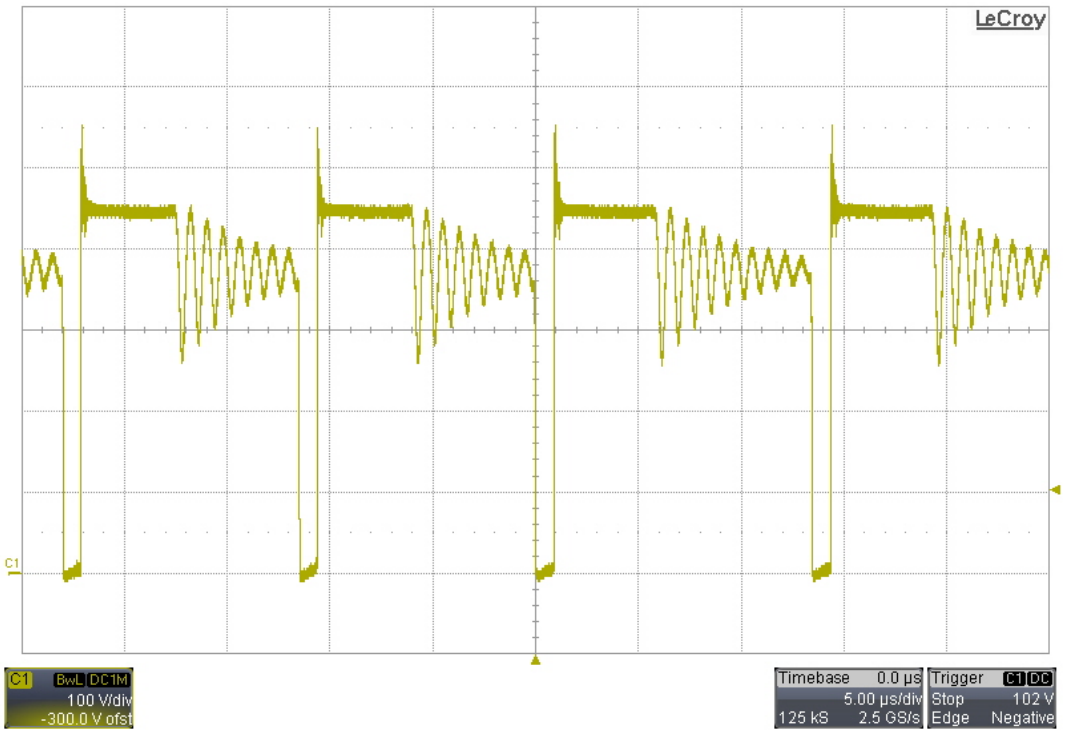
11.3 20Vout



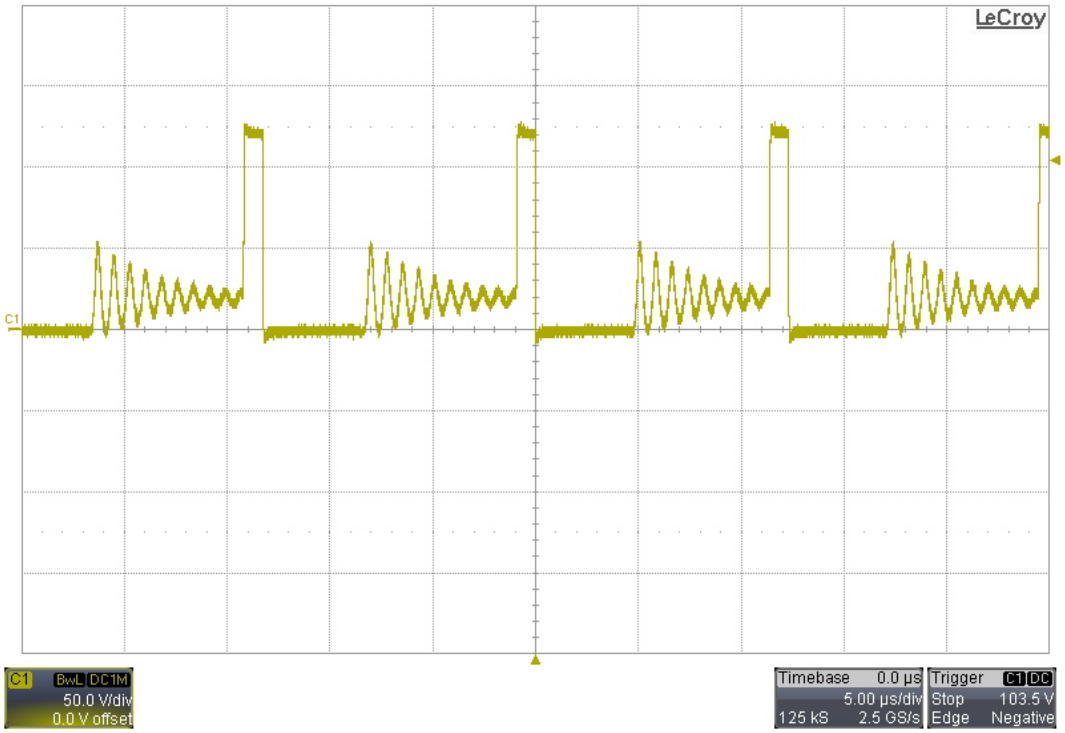
12 Switching Waveforms

The input was 265VAC/50Hz, and the output set to 20V and was loaded with 3A.

12.1 Drain of Primary FET – Q7

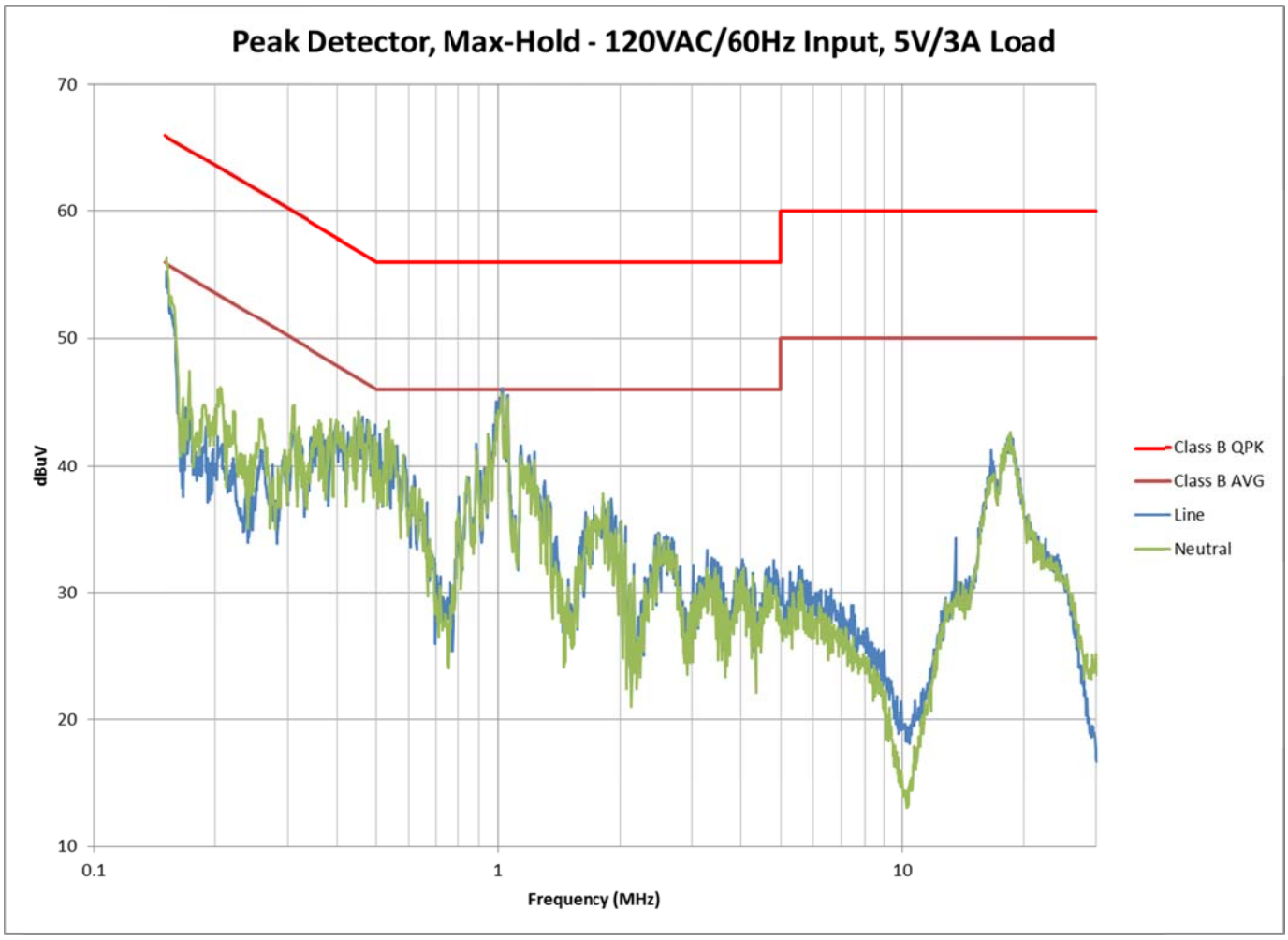


12.2 Drain of Sync FET – Q3

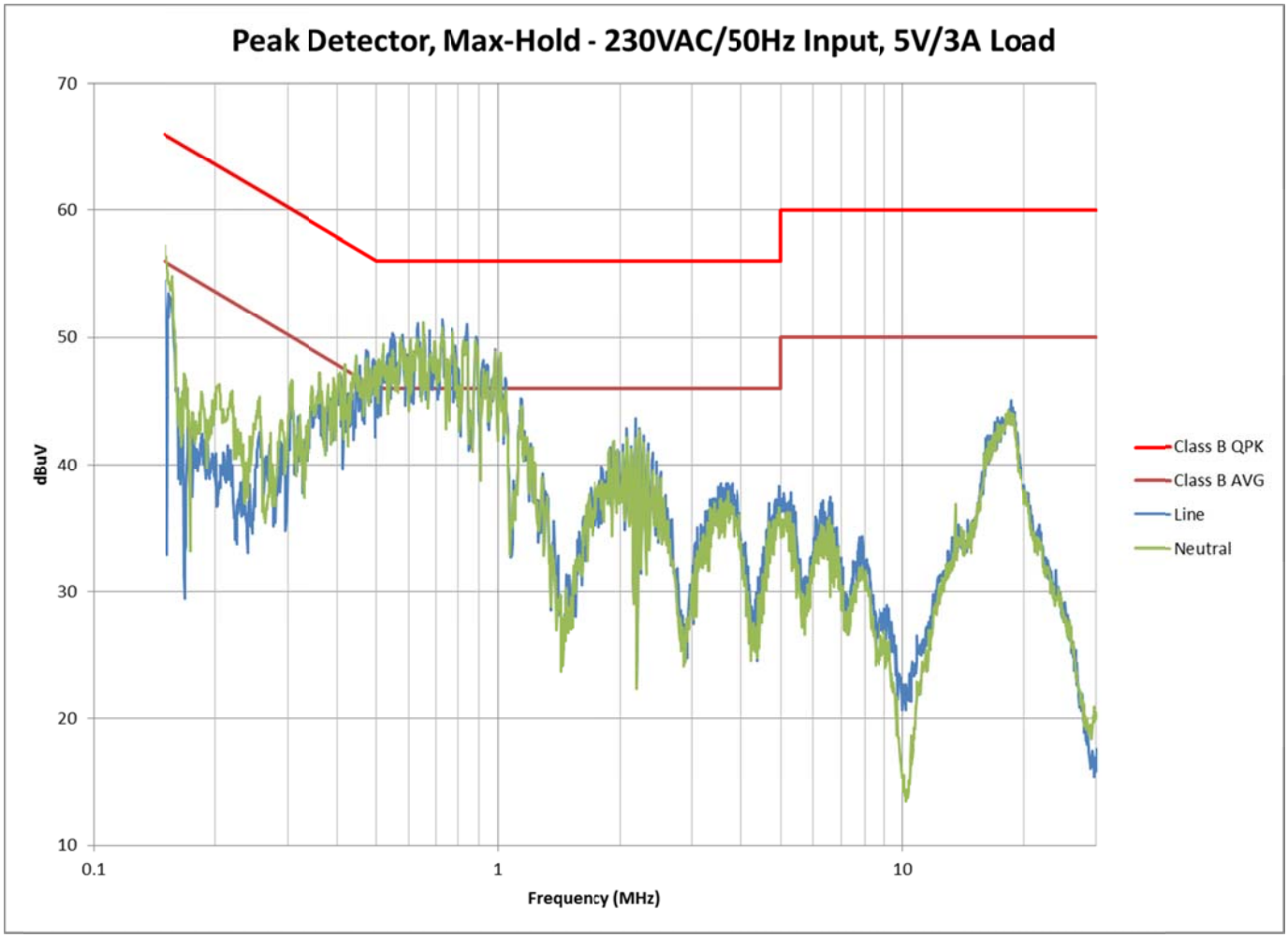


13 Conducted Emissions

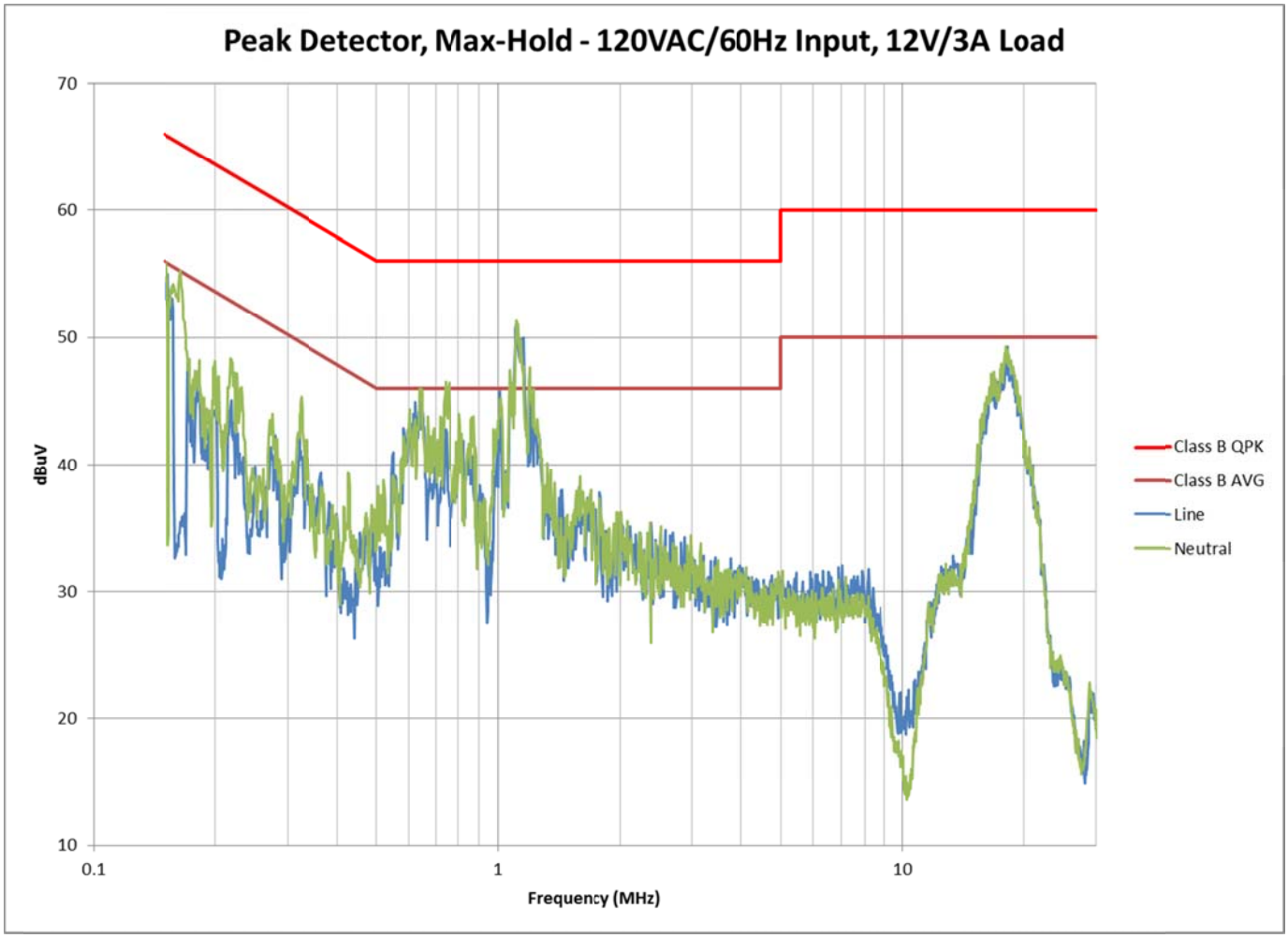
13.1 5Vout, 120VAC/60Hz input



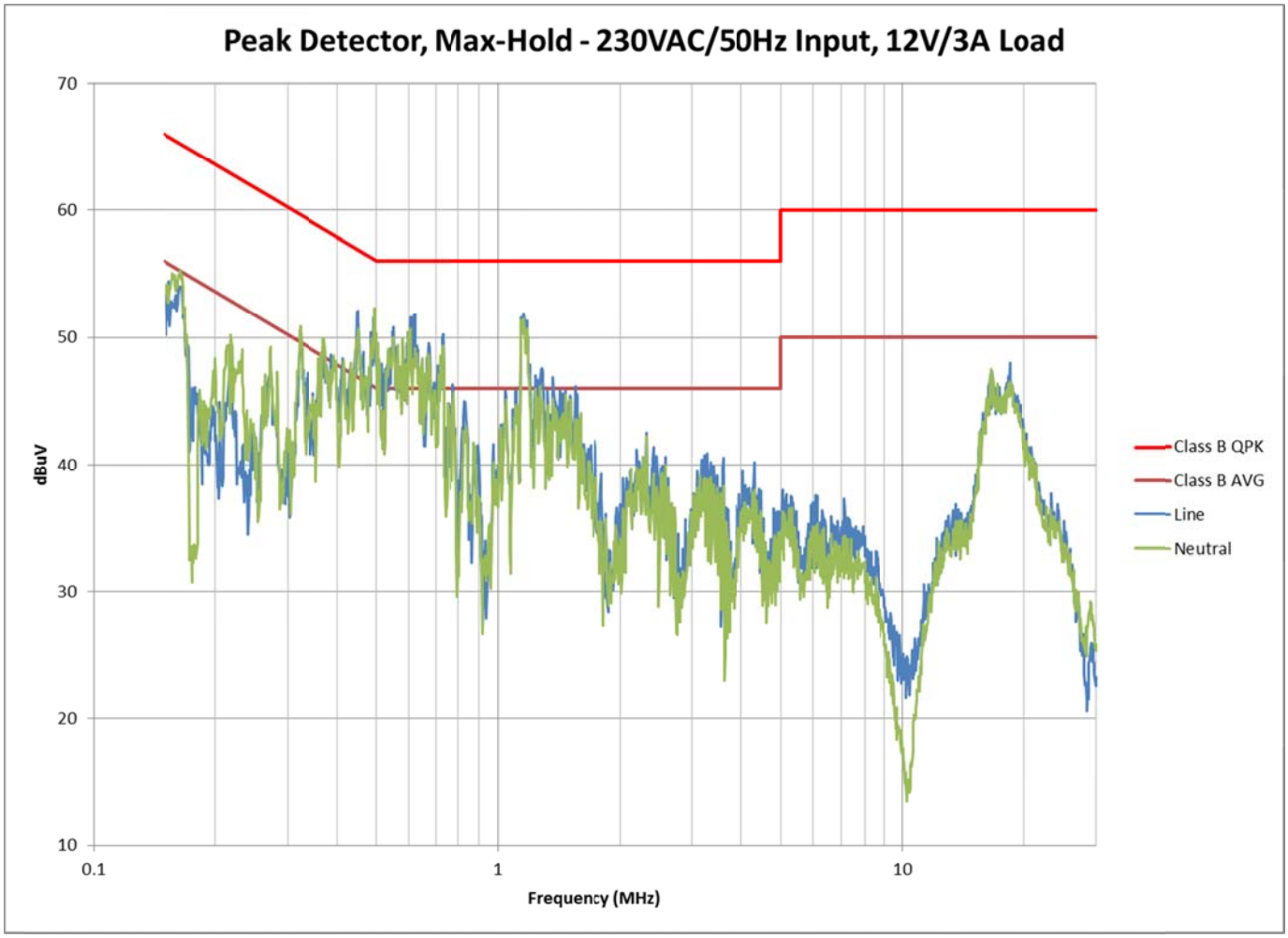
13.2 5Vout, 230VAC/50Hz input



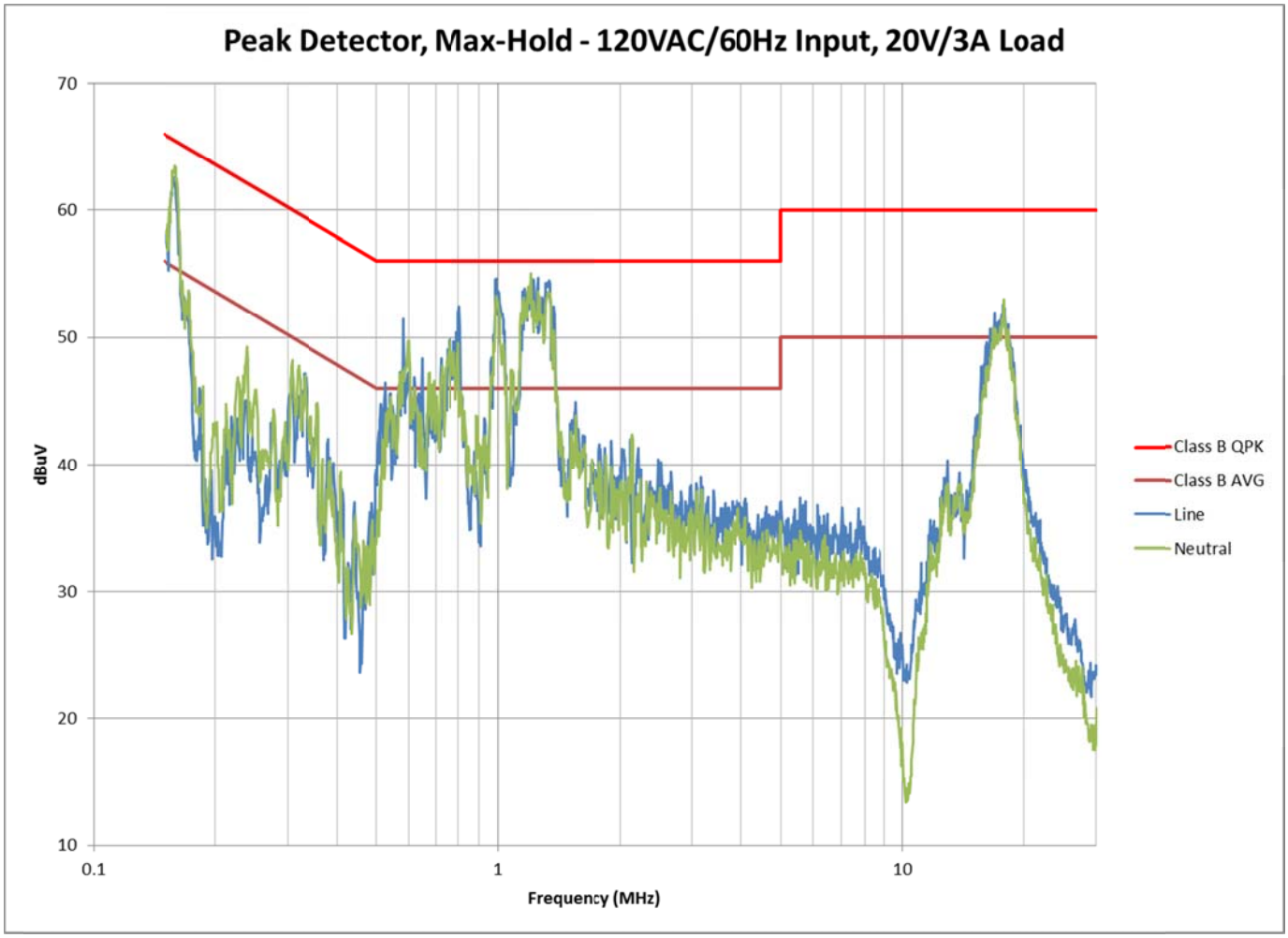
13.3 12Vout, 120VAC/60Hz input



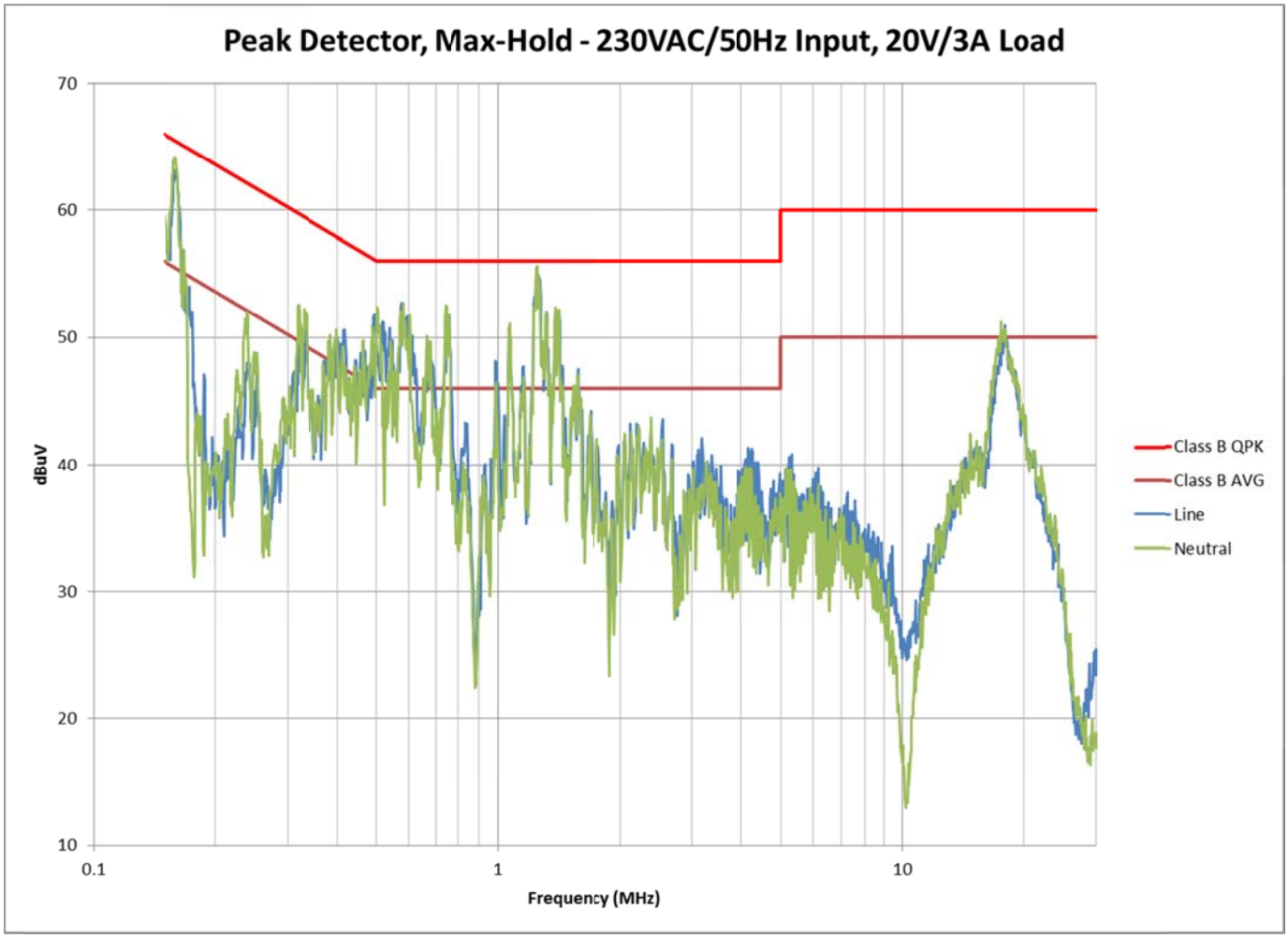
13.4 12Vout, 230VAC/50Hz input



13.5 20Vout, 120VAC/60Hz input



13.6 20Vout, 230VAC/50Hz input



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