

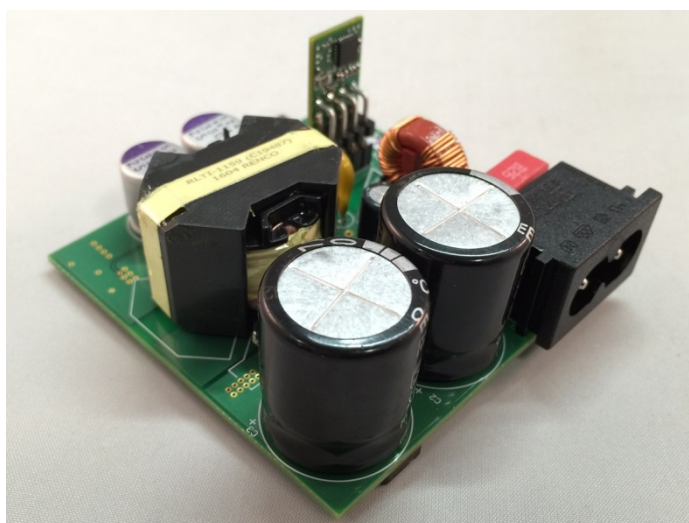
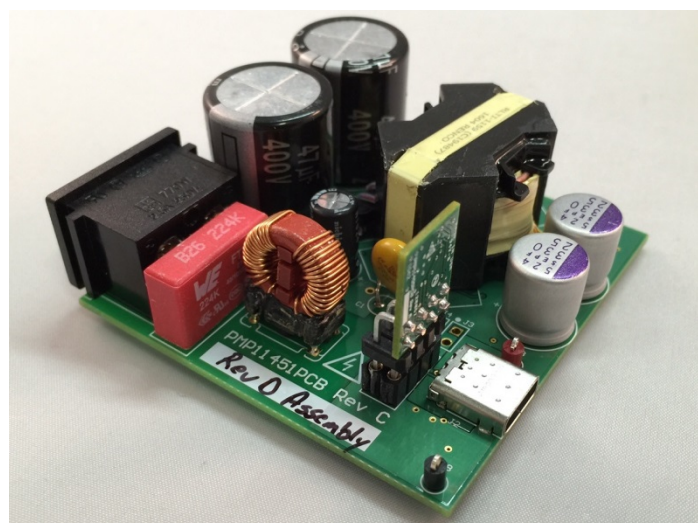
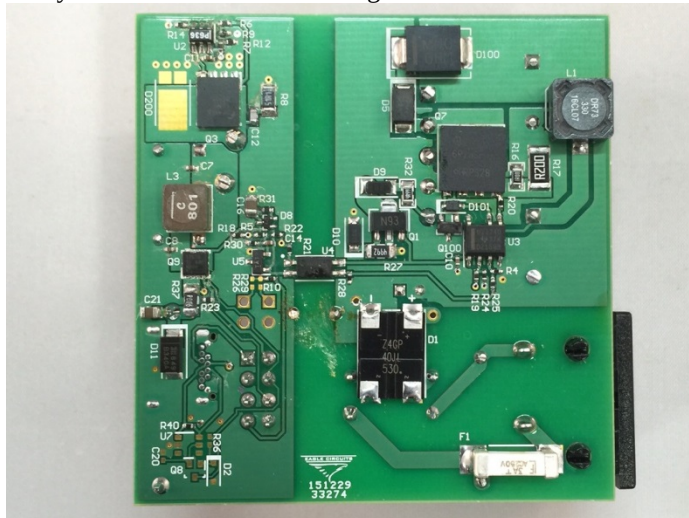
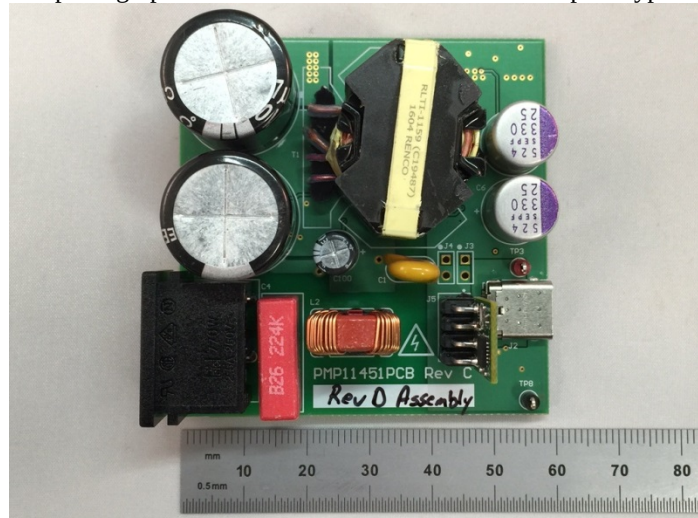
PMP11451 Rev D 60W USB Type C AC/DC Adaptor Test Results

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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

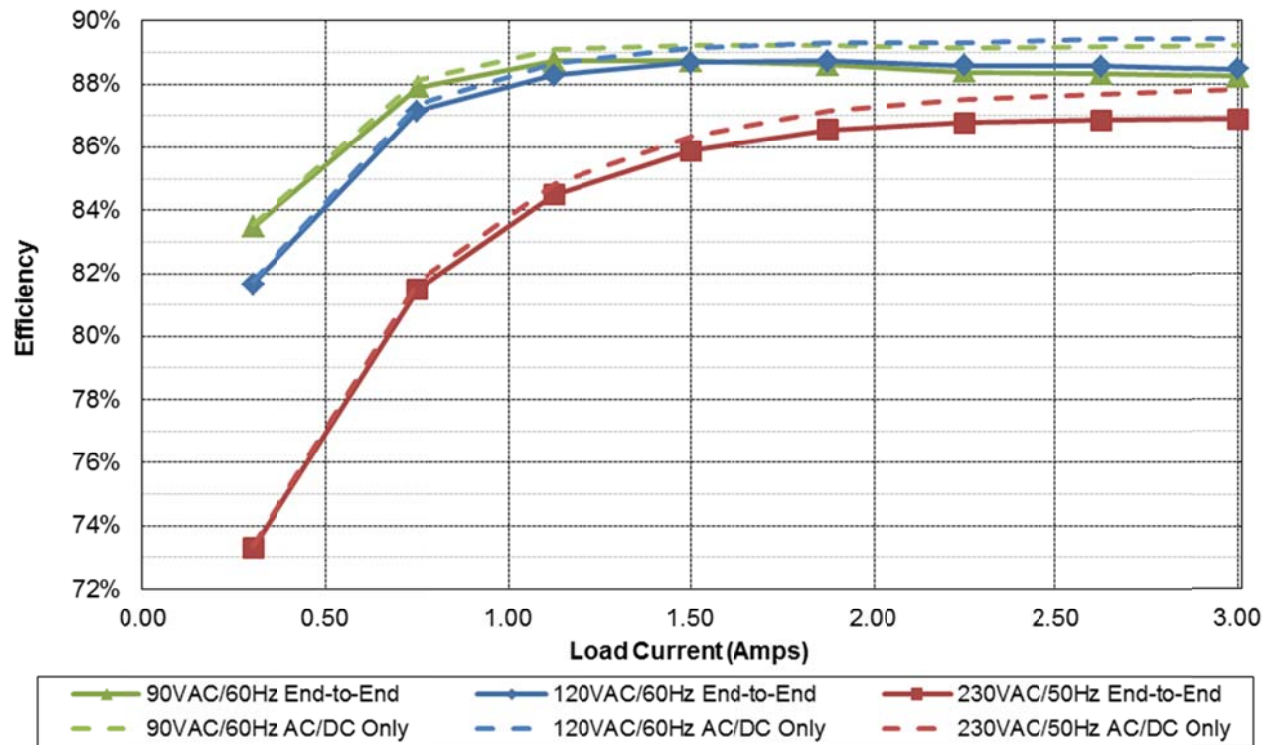
Vin	Pin	Vout	Iout	Load	Efficiency	Avg. Eff.
120VAC/60Hz	4.26	11.98	0.301	10%	84.67%	
	9.98	11.97	0.749	25%	89.88%	90.73%
	19.71	11.95	1.501	50%	91.01%	
	29.49	11.94	2.249	75%	91.06%	
	39.32	11.92	3.001	100%	90.98%	
230VAC/50Hz	4.52	11.98	0.301	10%	79.73%	
	10.22	11.97	0.751	25%	87.98%	90.10%
	19.80	11.95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

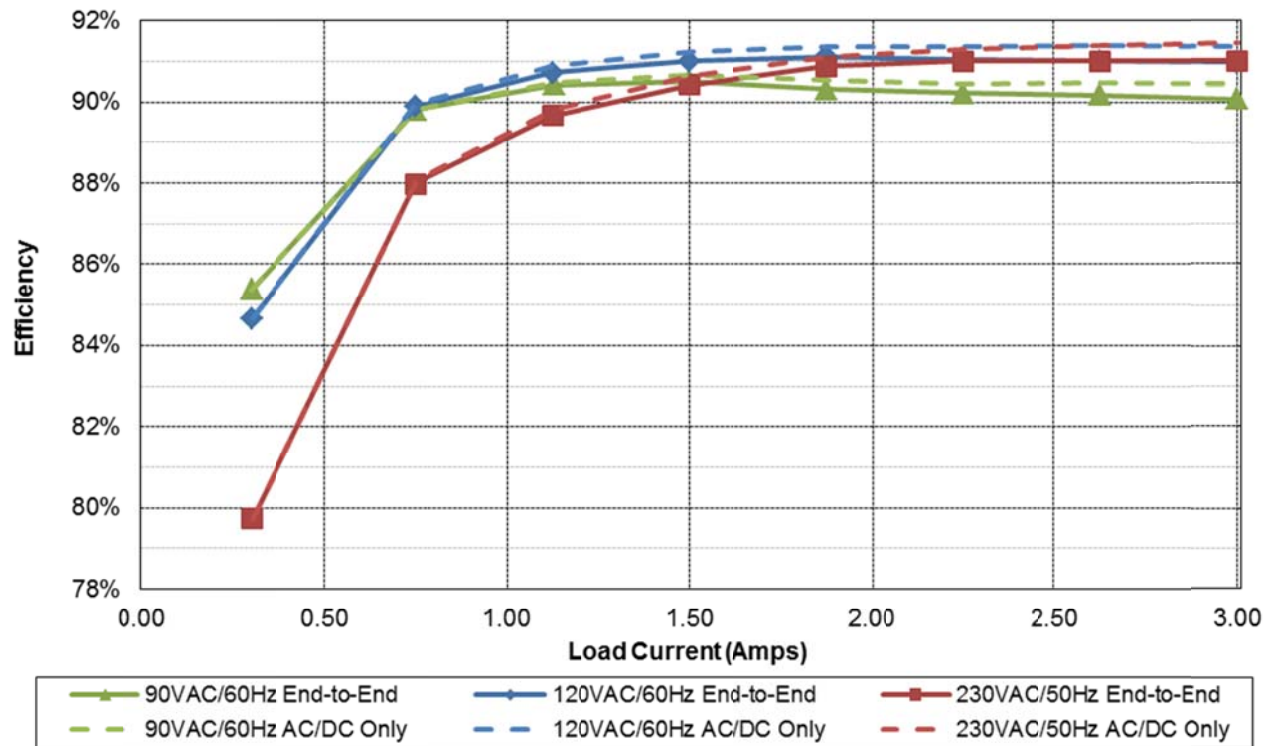
Vin	Pin	Vout	Iout	Load	Efficiency	Avg. Eff.
120VAC/60Hz	7.07	20.08	0.300	10%	85.22%	
	16.69	20.07	0.749	25%	90.07%	91.04%
	33.01	20.06	1.502	50%	91.28%	
	49.35	20.04	2.251	75%	91.41%	
	65.67	20.02	2.999	100%	91.43%	
230VAC/50Hz	7.30	20.08	0.298	10%	81.97%	
	16.85	20.07	0.750	25%	89.32%	91.02%
	32.92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

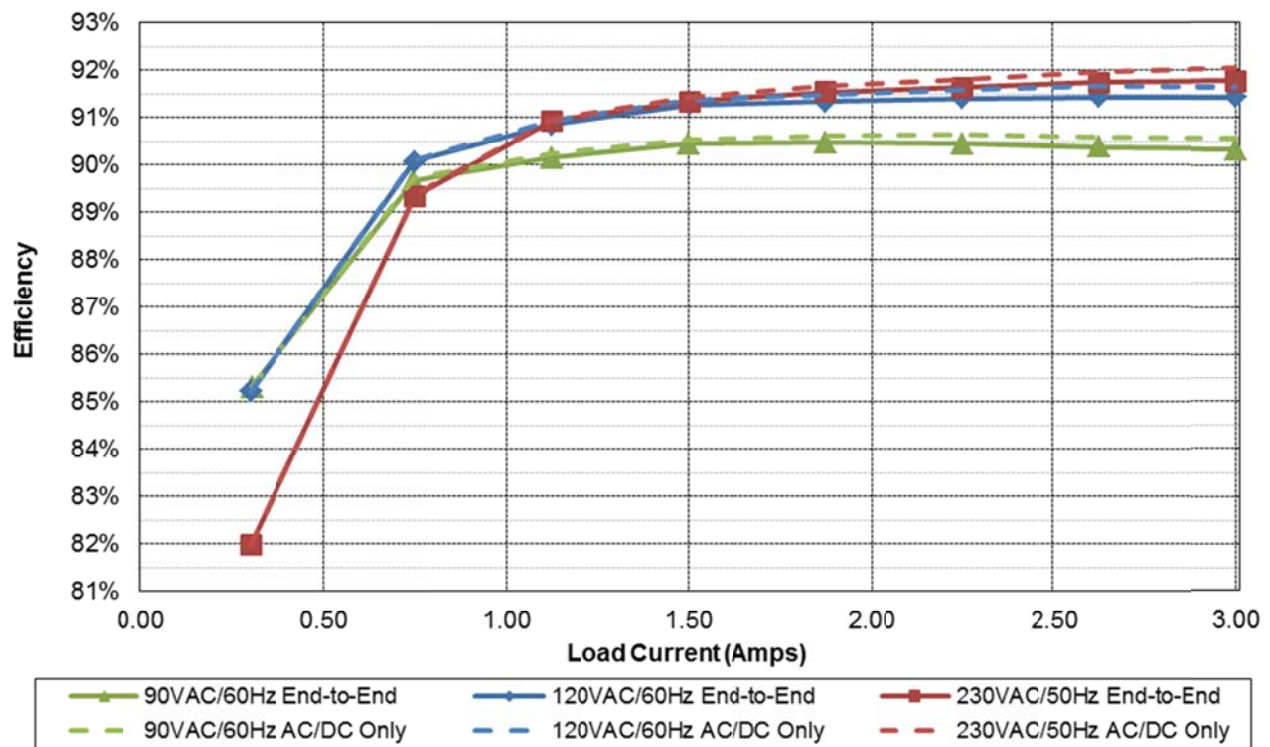
3.2.1 5V Output



3.2.2 12V Output



3.2.3 20V Output



3.3 Raw Data

3.3.1 5V Output

90VAC/60Hz											
I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	I _{in}	P _{in}	PF	P _{out} AC/DC	P _{out} 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											
I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	I _{in}	P _{in}	PF	P _{out} AC/DC	P _{out} 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											
I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	I _{in}	P _{in}	PF	P _{out} AC/DC	P _{out} 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

I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	lin	P _{in}	PF	P _{out} AC/DC	P _{out} 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

I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	lin	P _{in}	PF	P _{out} AC/DC	P _{out} 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

I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	lin	P _{in}	PF	P _{out} AC/DC	P _{out} 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%

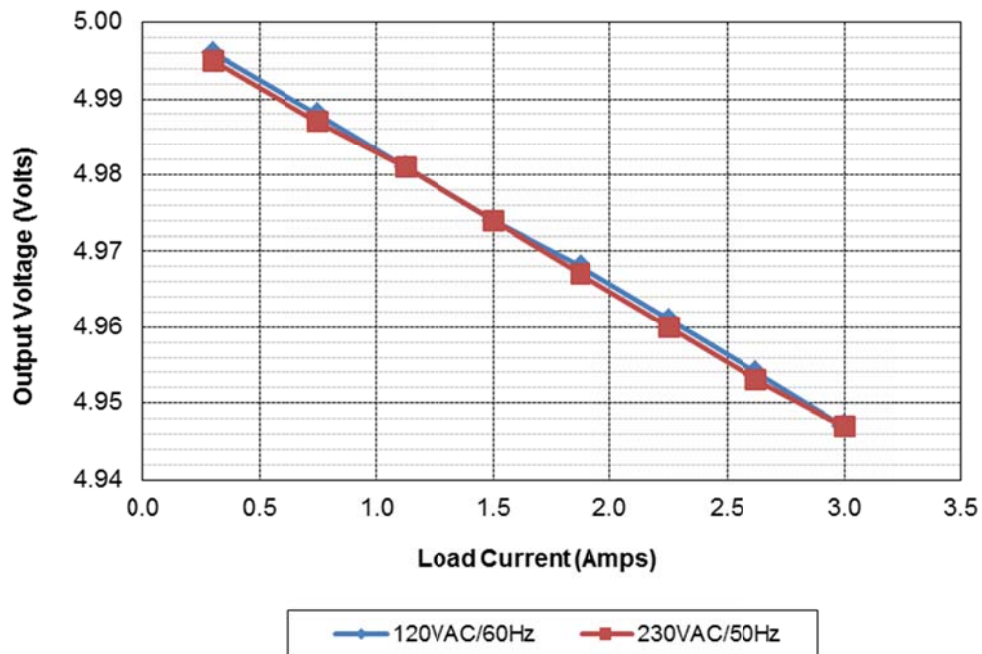
3.3.3 20V Output

90VAC/60Hz											
I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	lin	P _{in}	PF	P _{out} AC/DC	P _{out} 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											
I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	lin	P _{in}	PF	P _{out} AC/DC	P _{out} 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											
I _{out}	V _{out} AC/DC	V _{out} USB-C	V _{in}	lin	P _{in}	PF	P _{out} AC/DC	P _{out} 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%

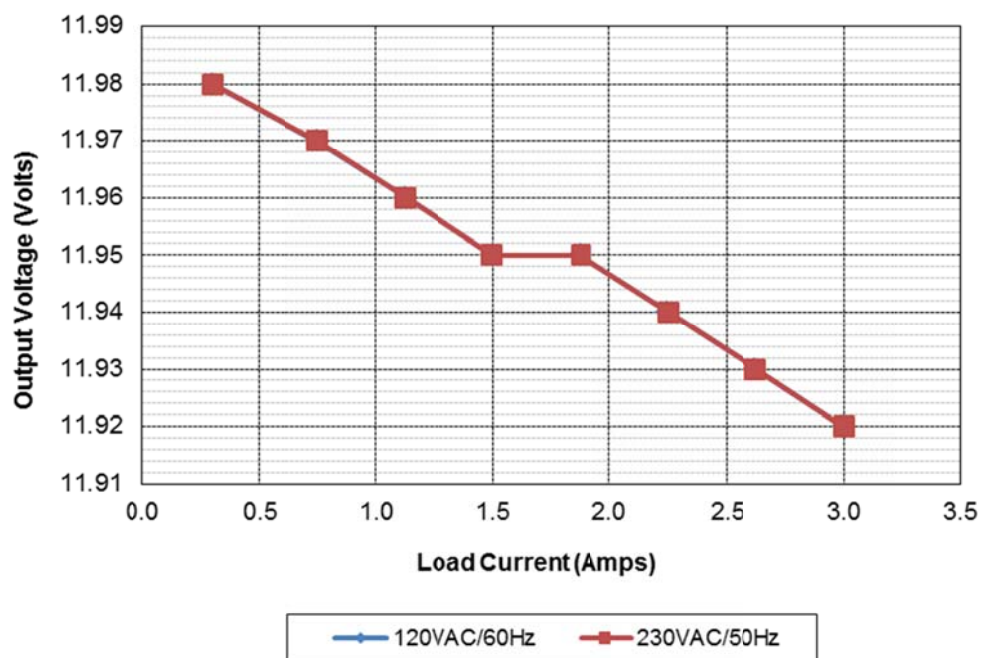
4 Regulation

Measured at TP3/TP8.

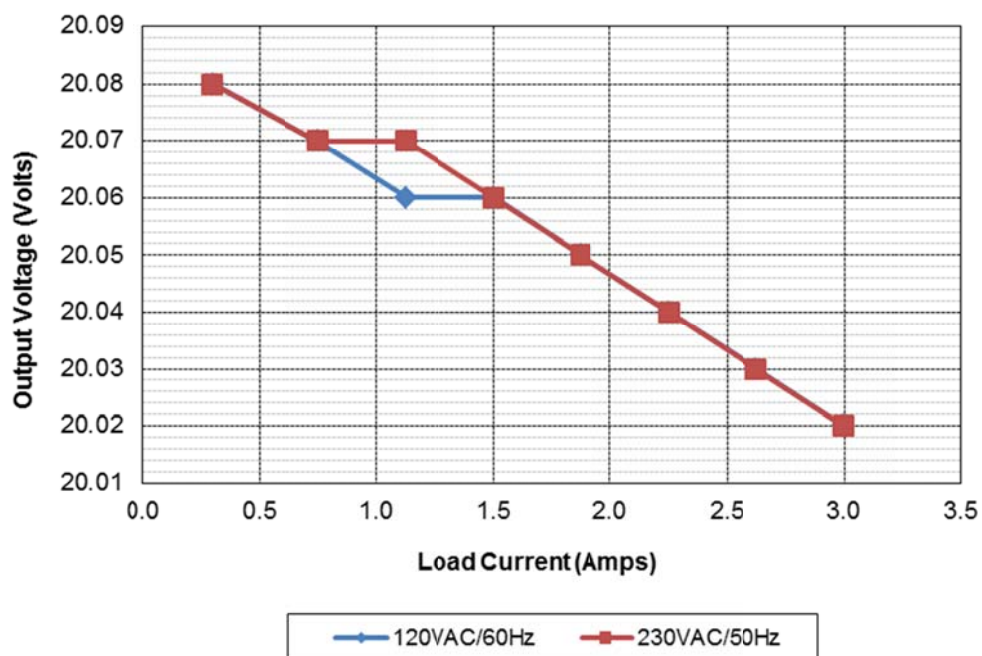
4.1 5V Output



4.2 12V Output



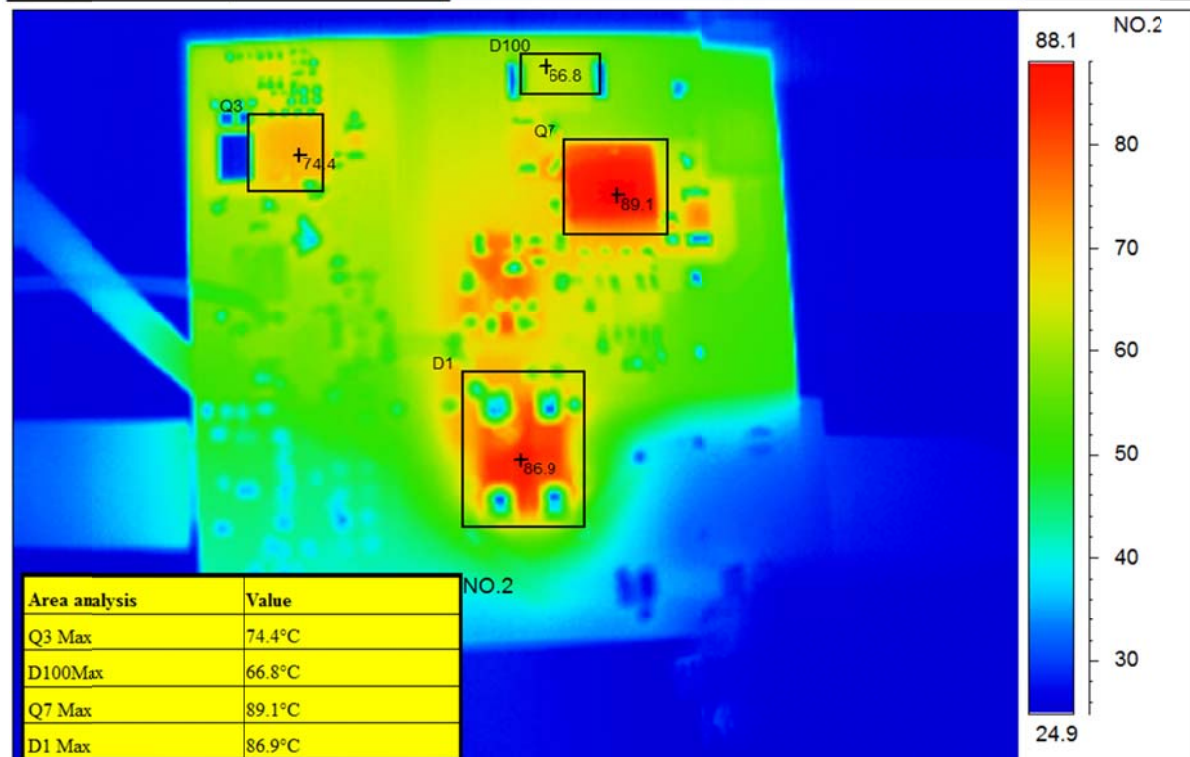
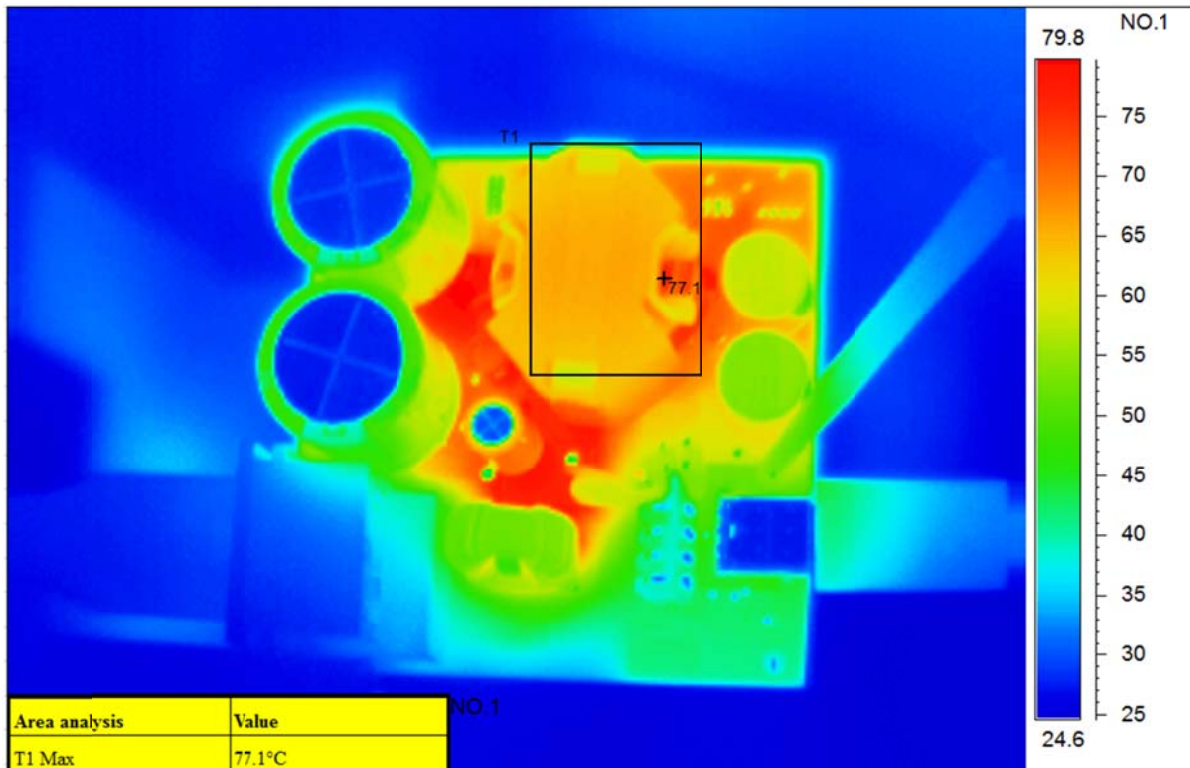
4.3 20V Output

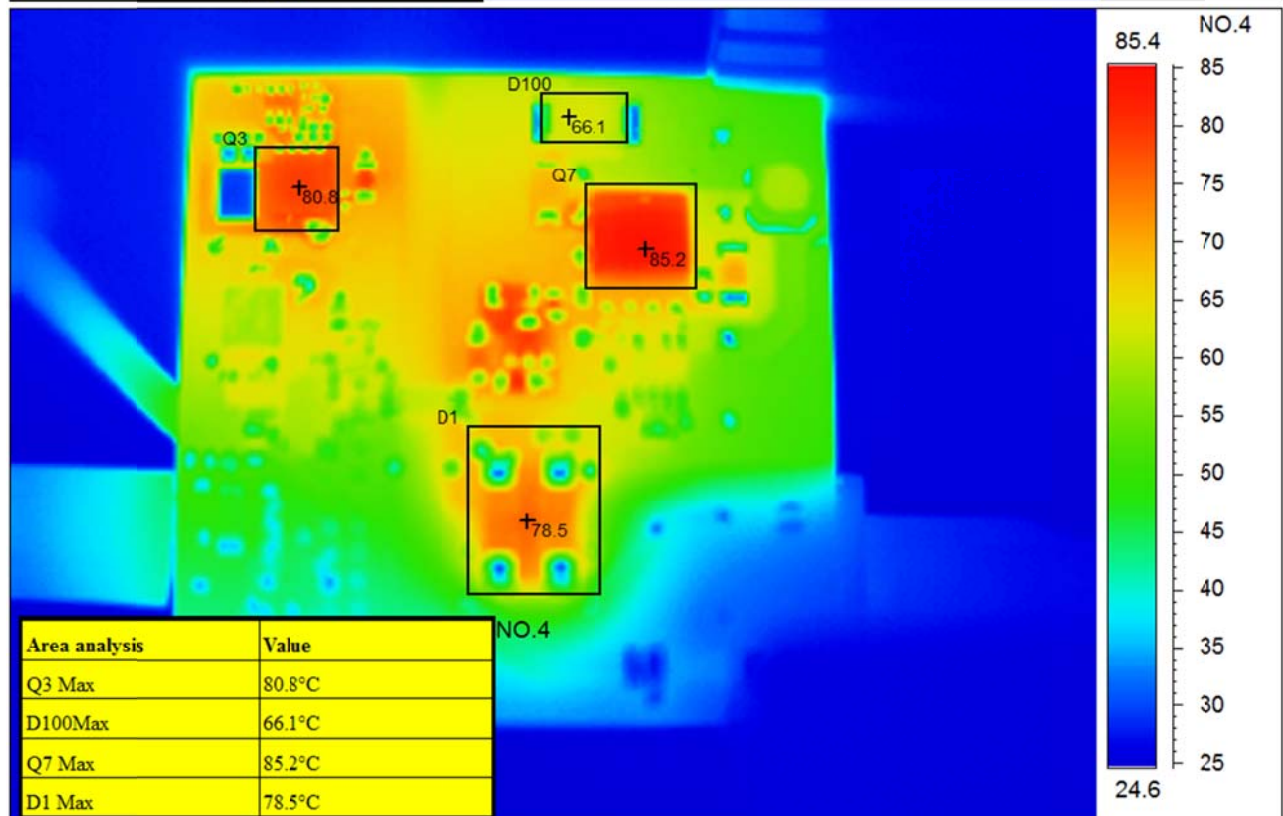
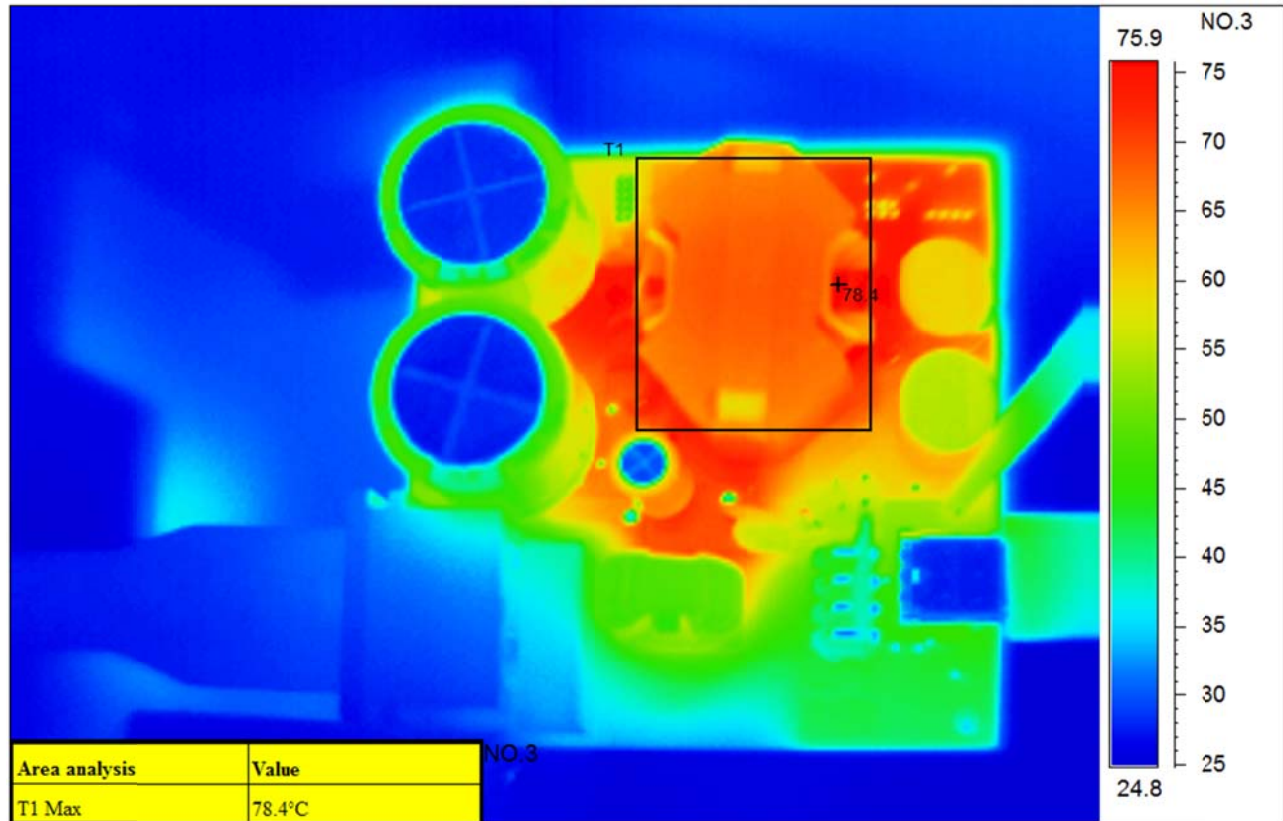


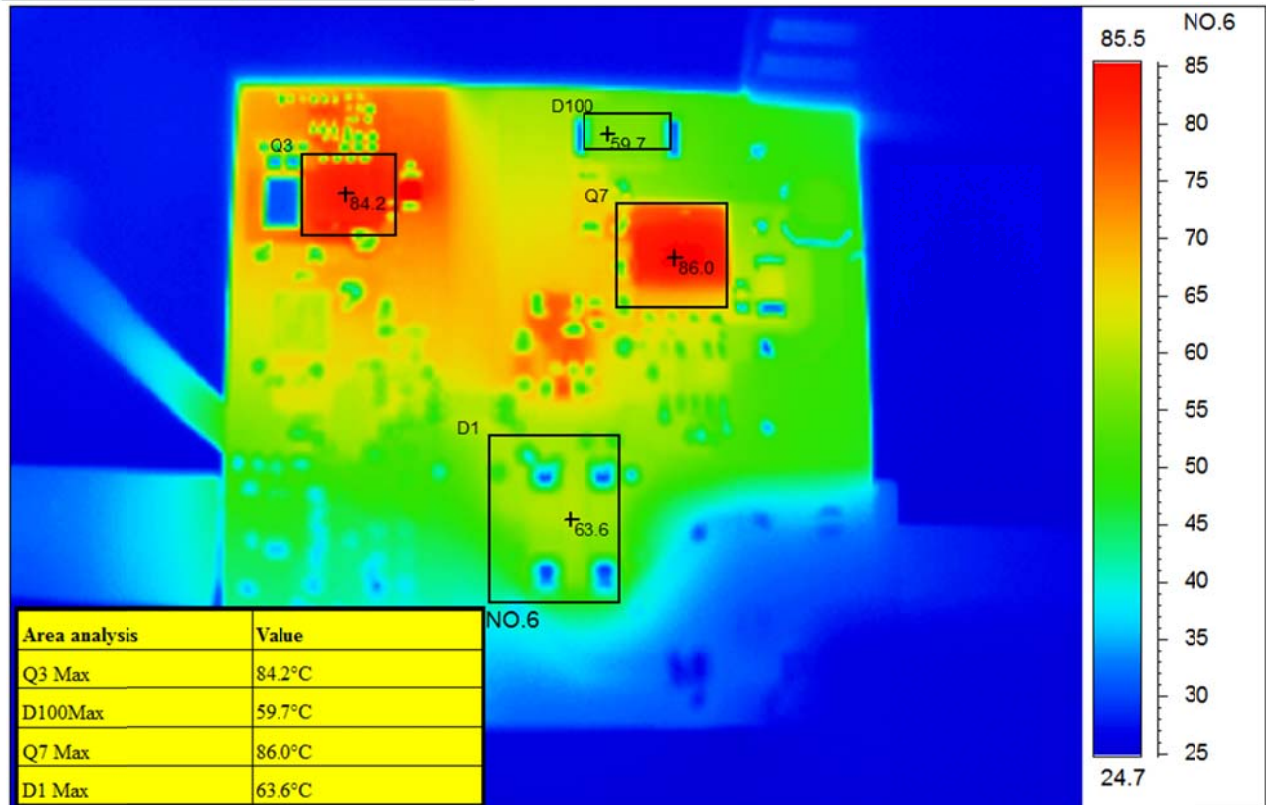
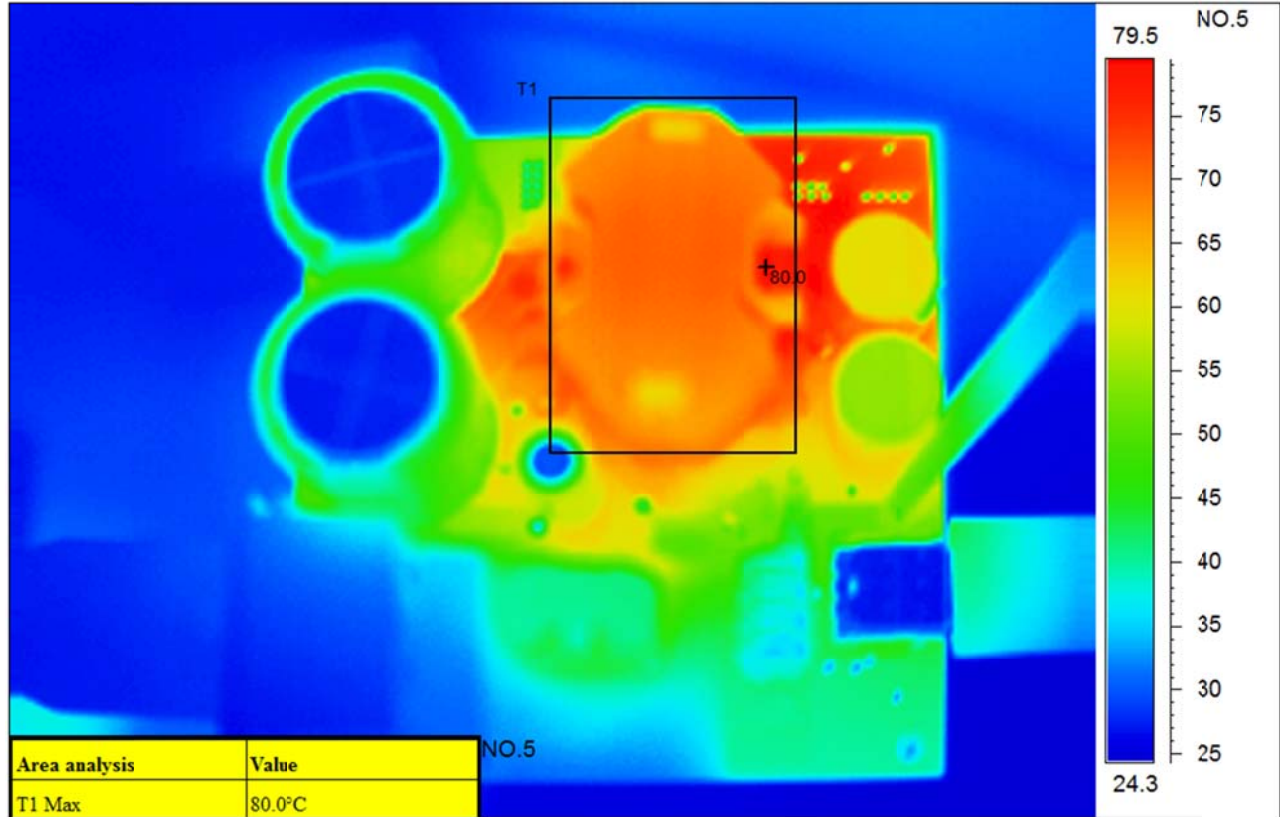
5 Thermal Images

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

5.1 90VAC/60Hz

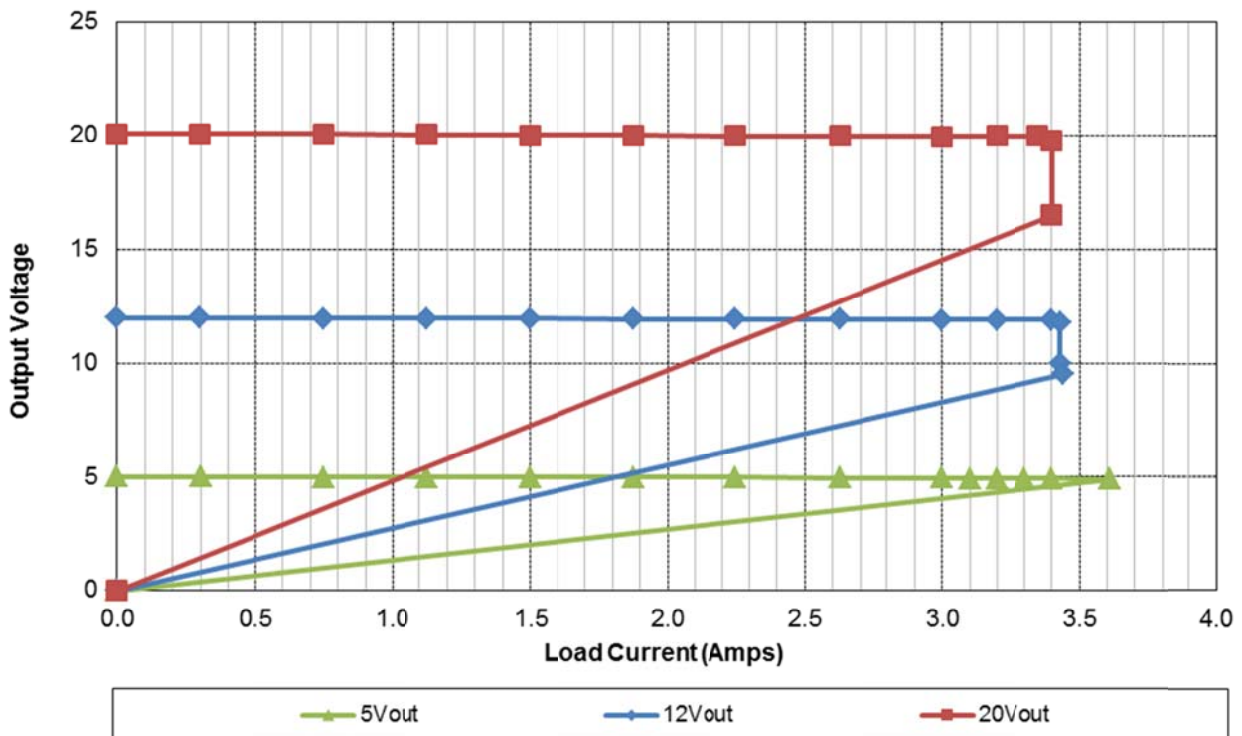


5.2 120VAC/60Hz

5.3 230VAC/50Hz

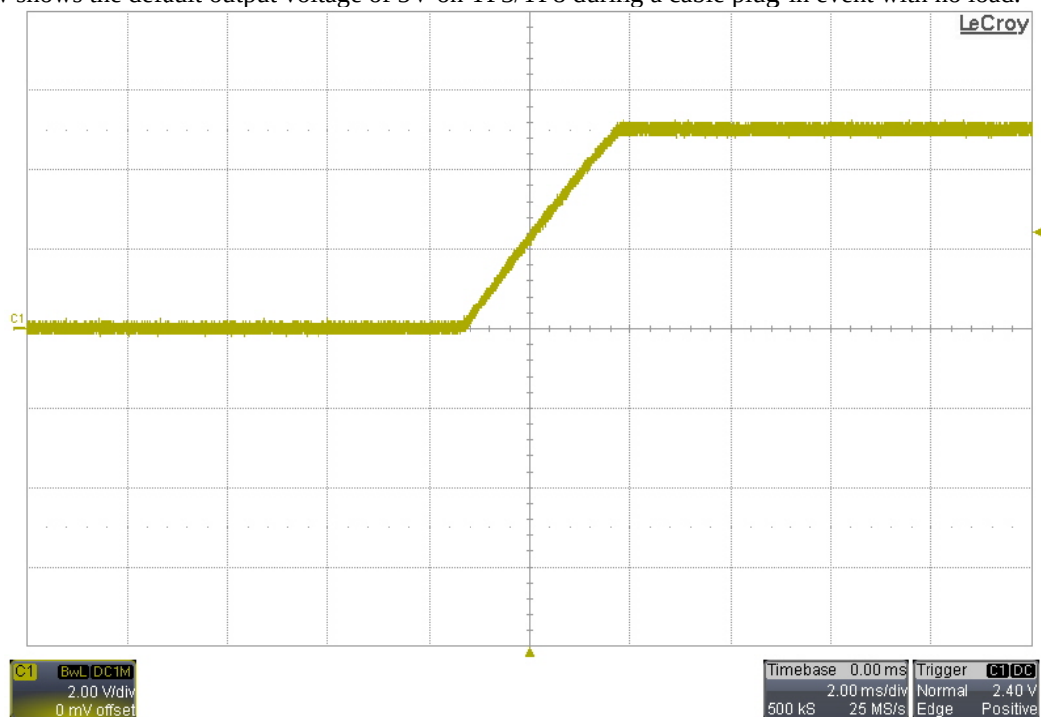
6 Current Limit

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



7 Startup

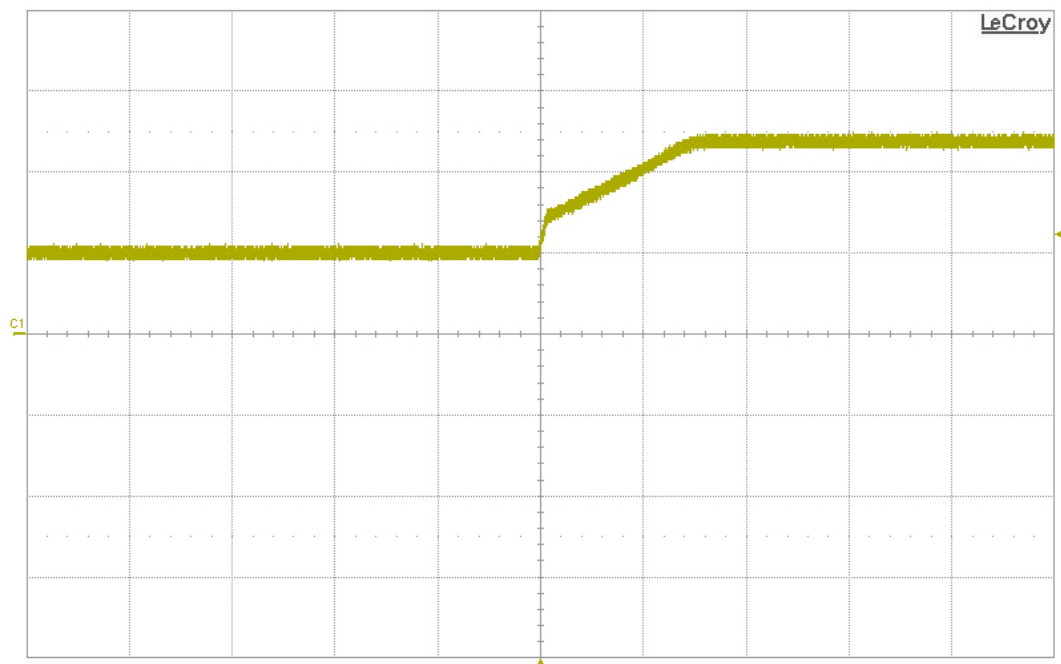
The image below shows the default output voltage of 5V on TP3/TP8 during a cable plug-in event with no load.



8 Output Voltage Transitions

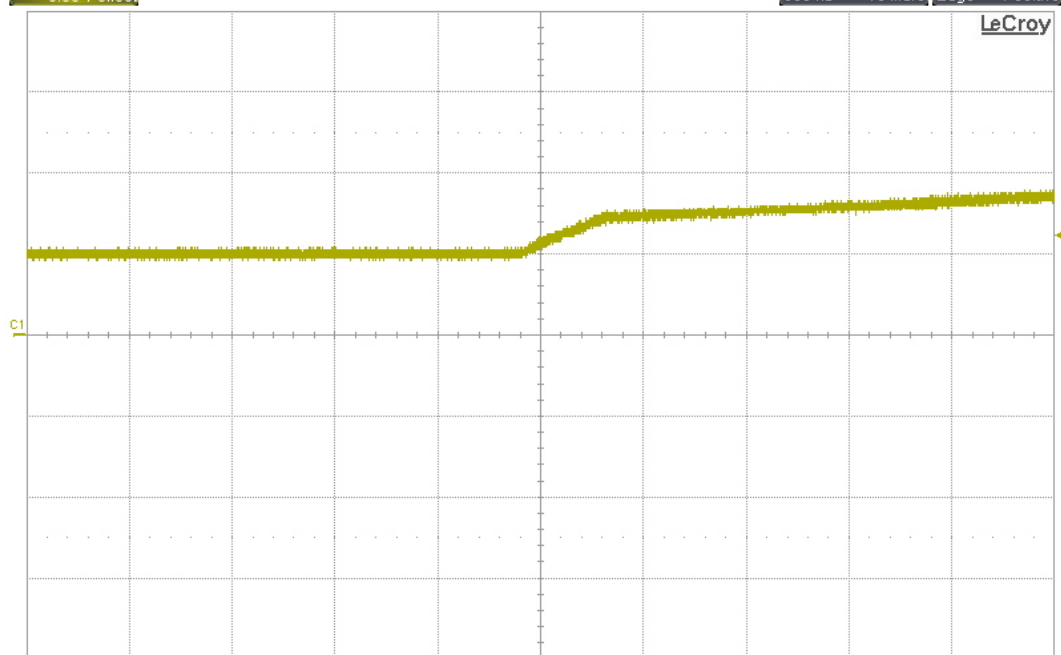
The following screenshots below demonstrate the transitions between 5V, 12V, and 20V. No load is applied.

8.1 5V to 12V



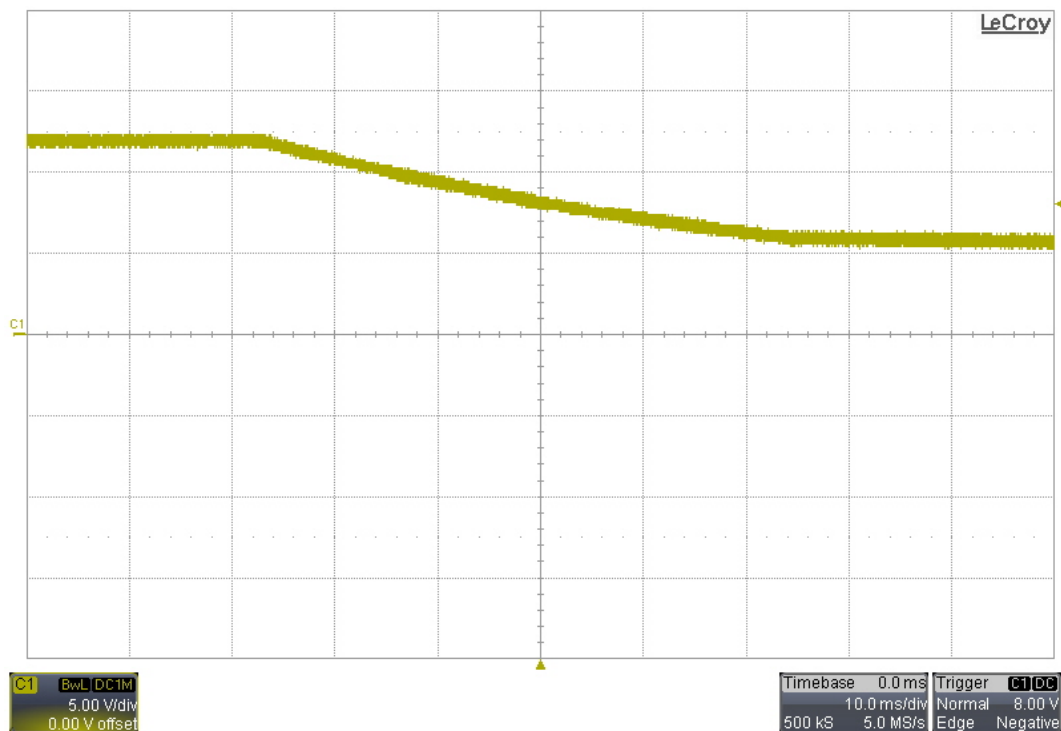
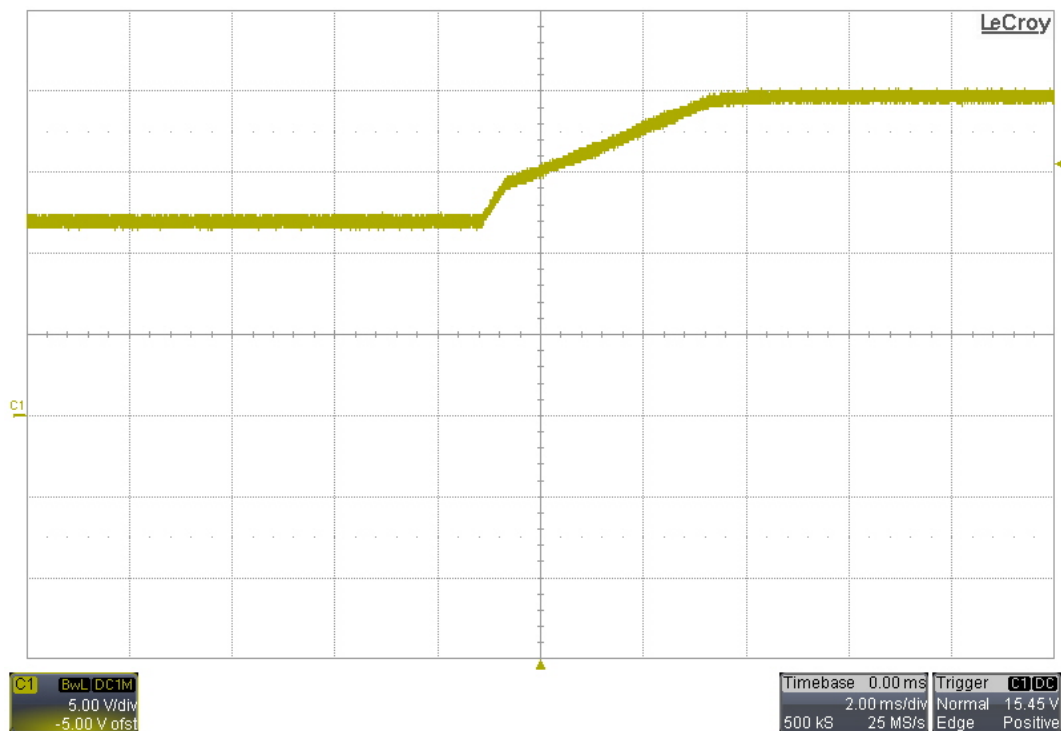
C1 BwL DC1M
5.00 V/div
0.00 V offset

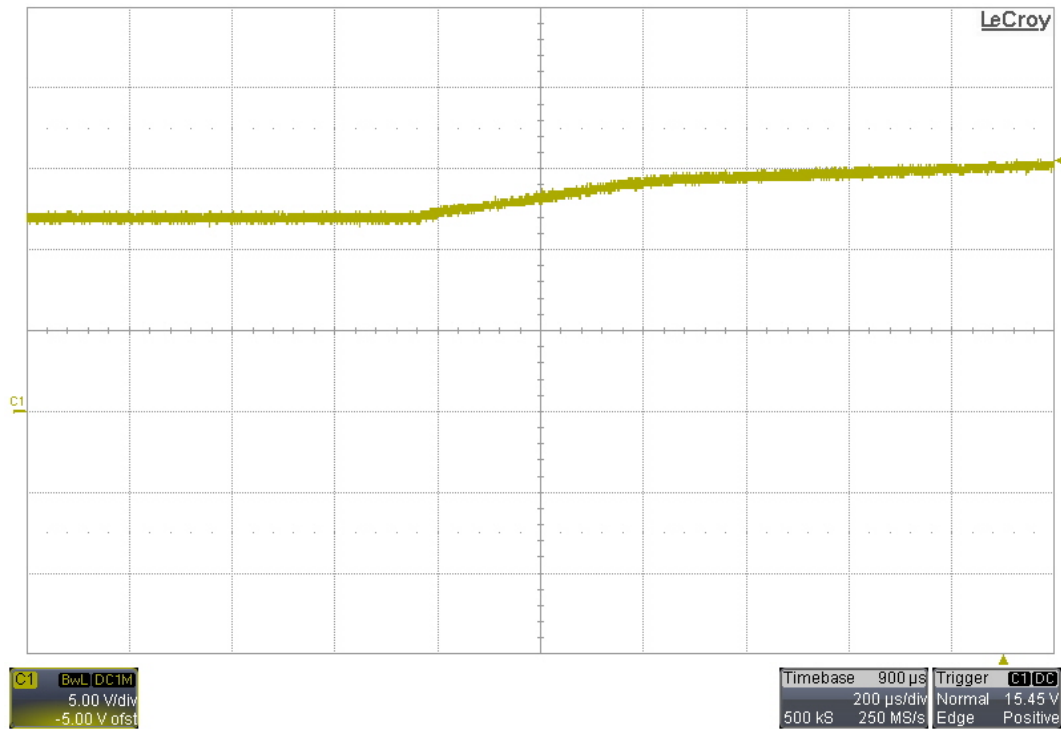
Timebase 0.0 ms Trigger C1 DC
5.00 ms/div Normal 6.15 V
500 kS 10 MS/s Edge Positive



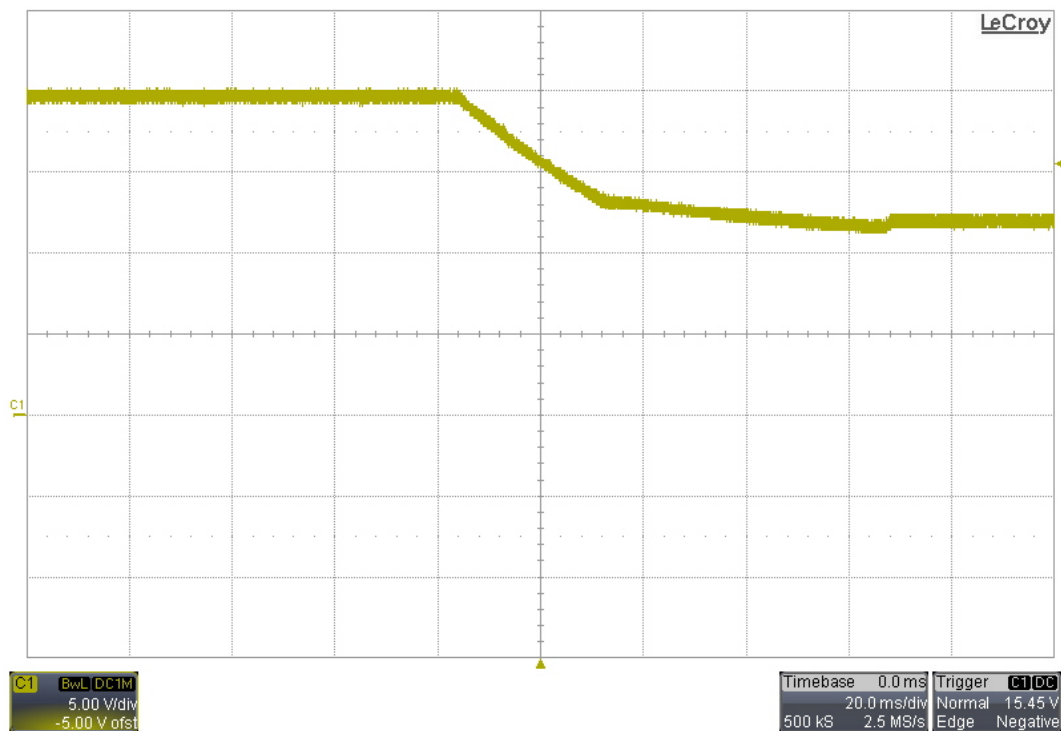
C1 BwL DC1M
5.00 V/div
0.00 V offset

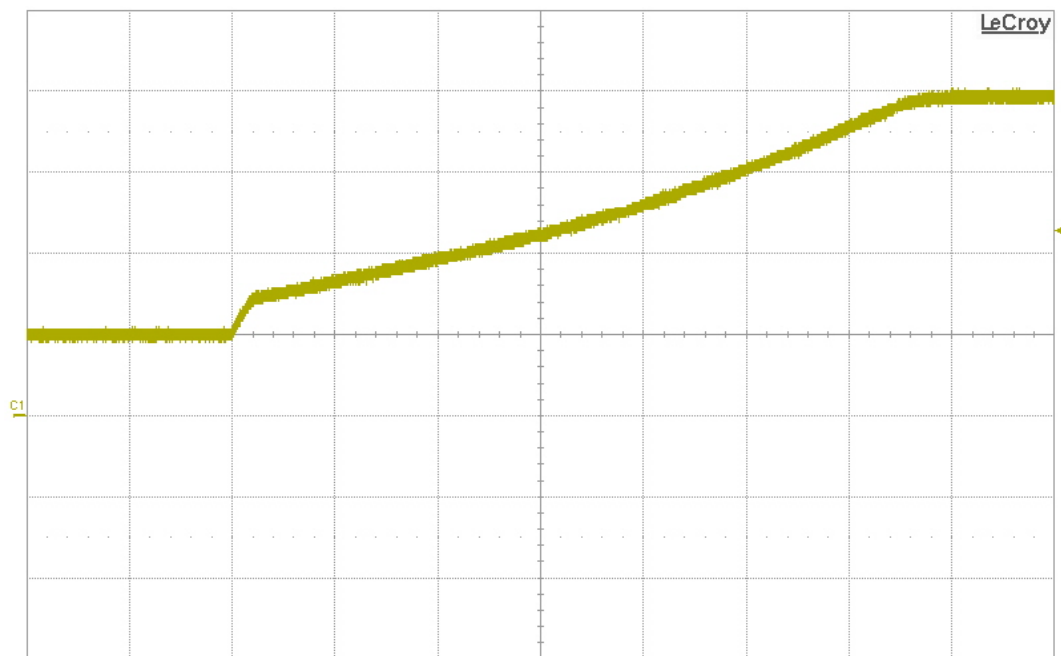
Timebase 0.00 ms Trigger C1 DC
500 µs/div Normal 6.15 V
500 kS 100 MS/s Edge Positive

8.2 12V to 5V**8.3 12V to 20V**



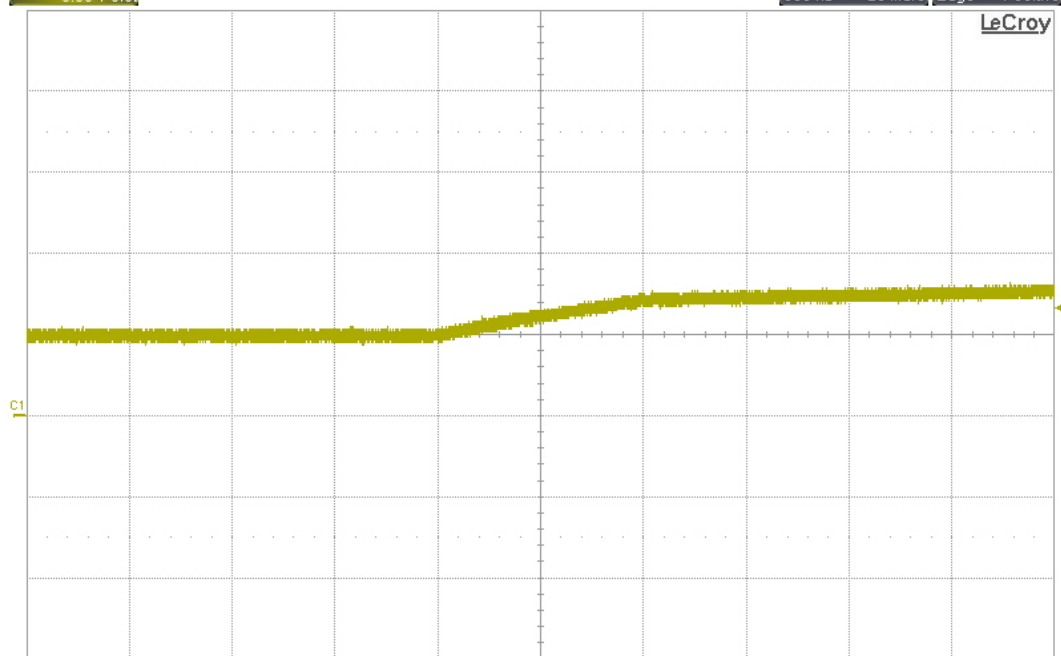
8.4 20V to 12V



8.5 5V to 20V

C1 BwL DCTM
5.00 V/div
-5.00 V ofst

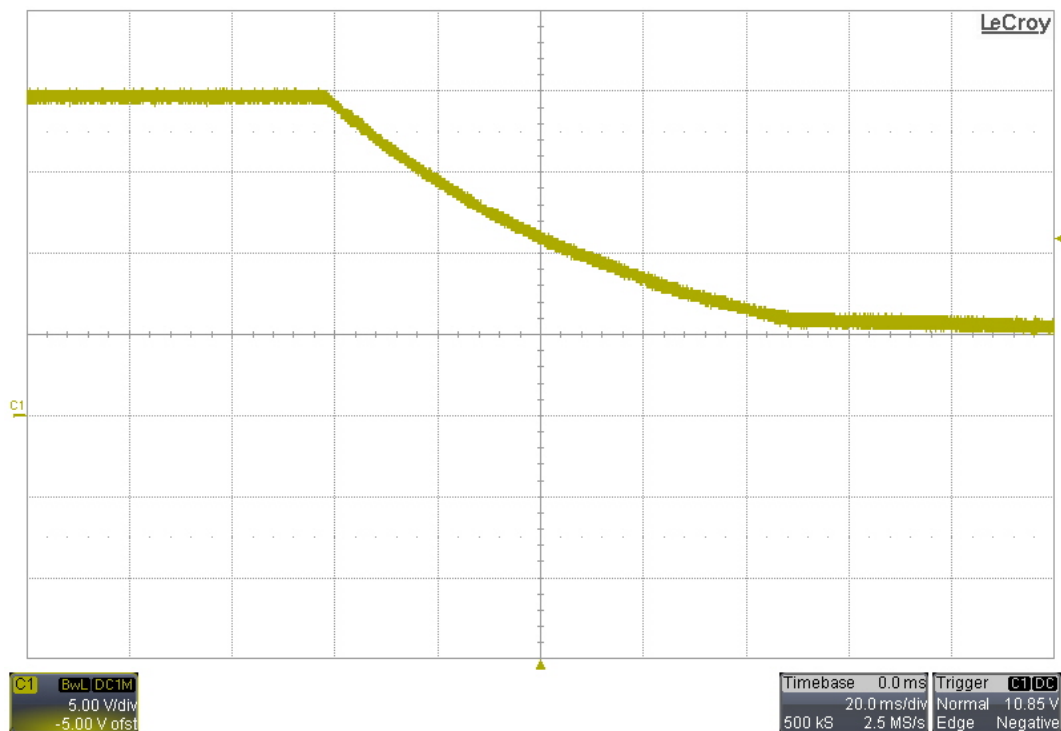
Timebase -240 μ s Trigger C1 00
2.00 ms/div Normal 11.35 V
500 kS 25 MS/s Edge Positive



C1 BwL DCTM
5.00 V/div
-5.00 V ofst

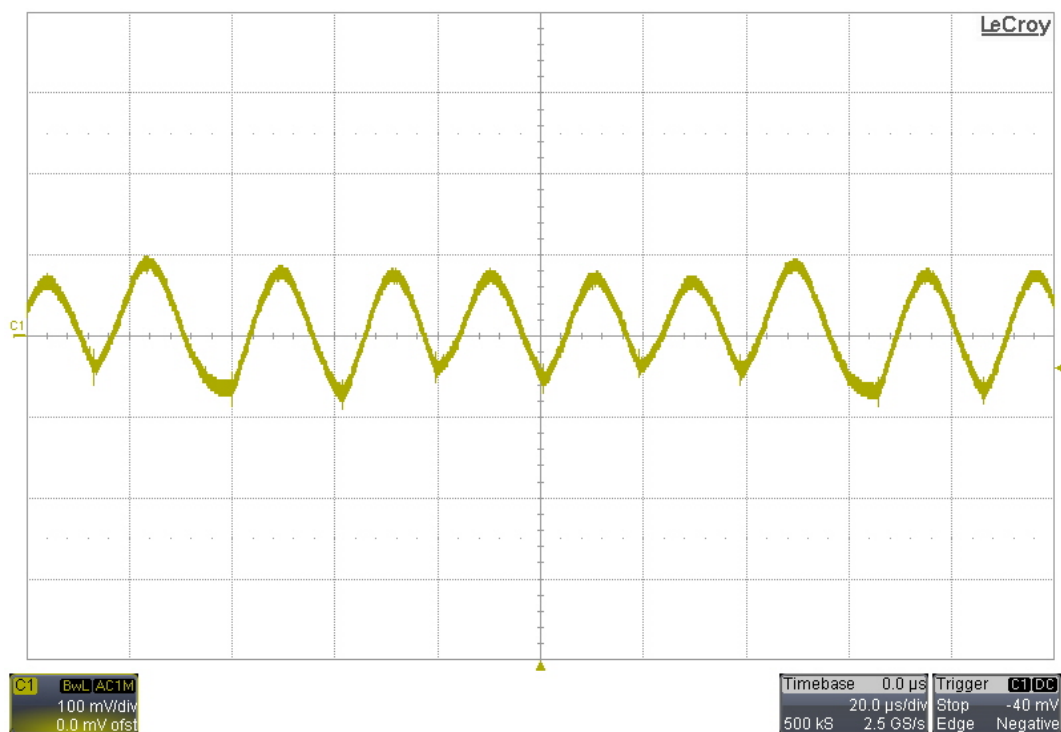
Timebase 0 μ s Trigger C1 00
200 μ s/div Normal 6.65 V
500 kS 250 MS/s Edge Positive

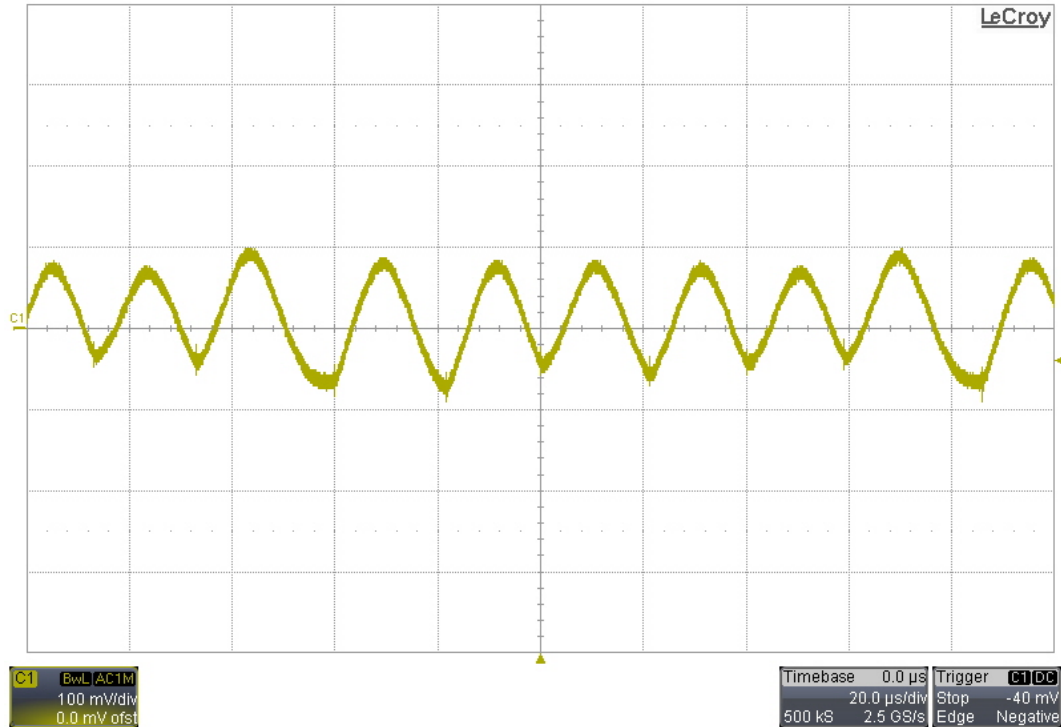
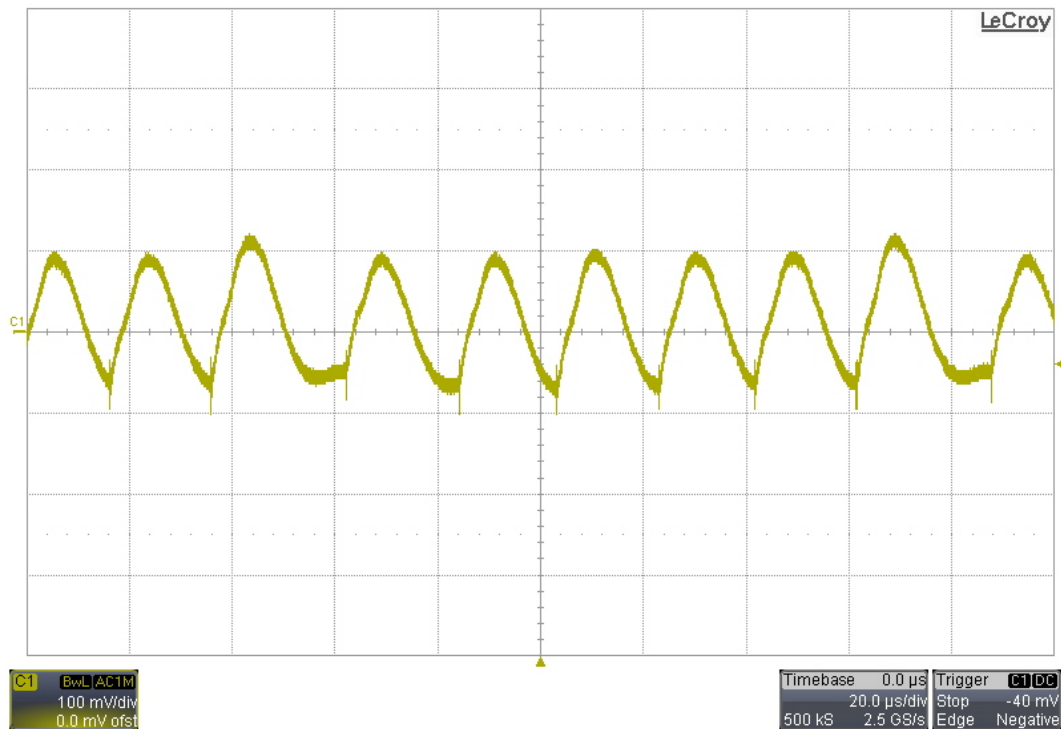
8.6 20V to 5V

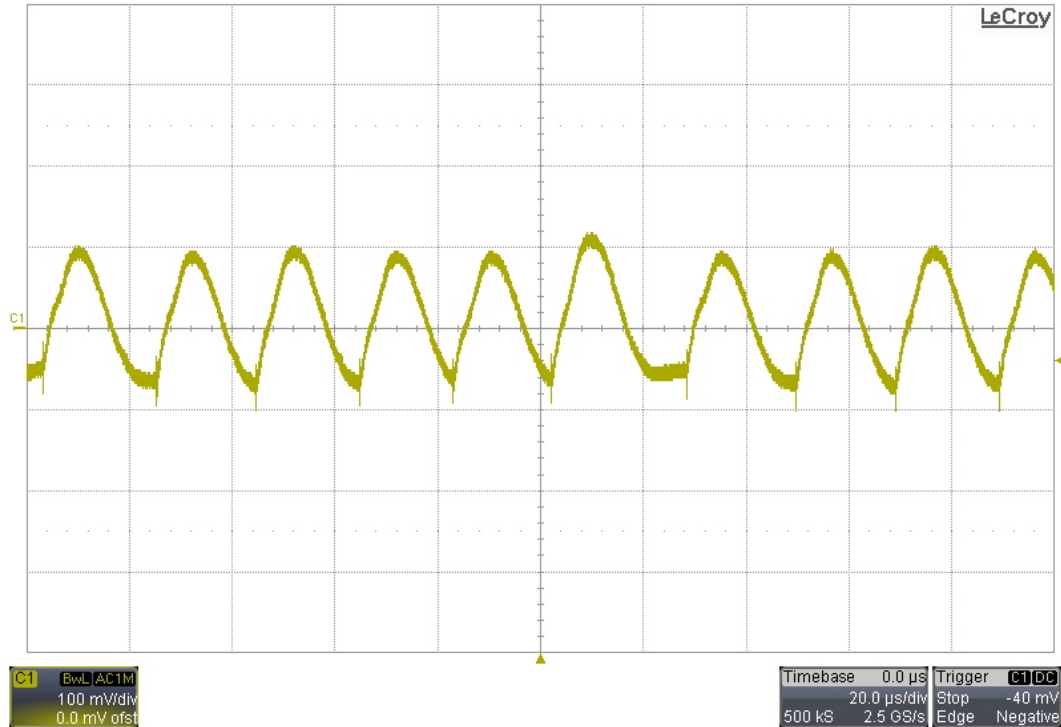
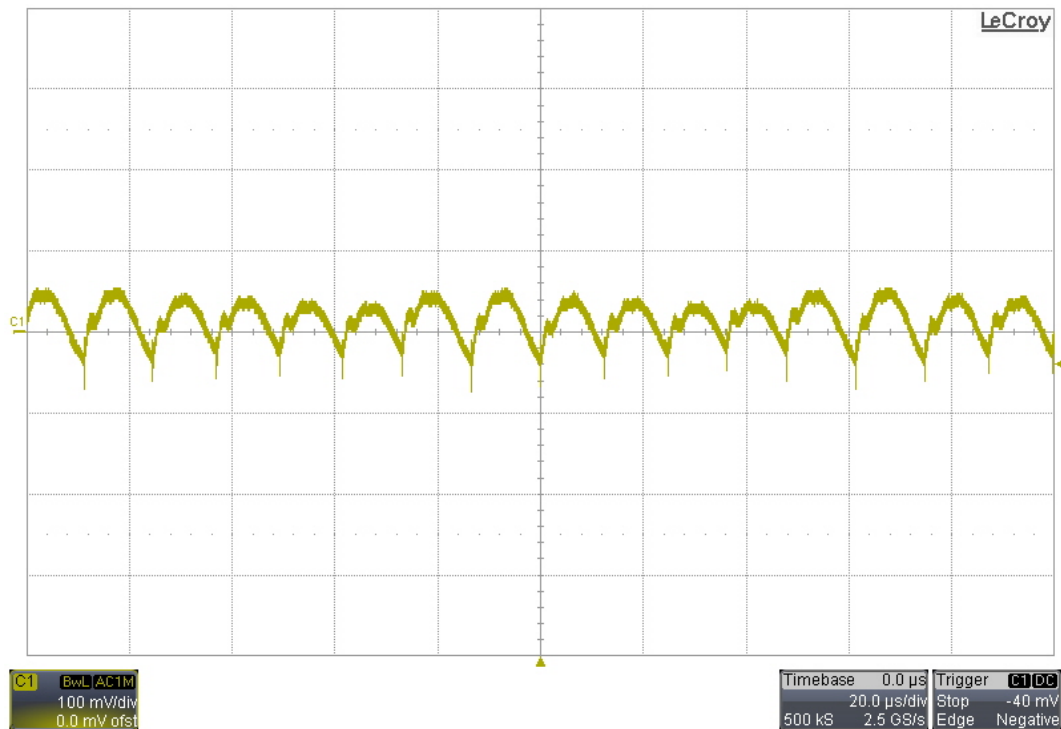


9 Output Ripple Voltage

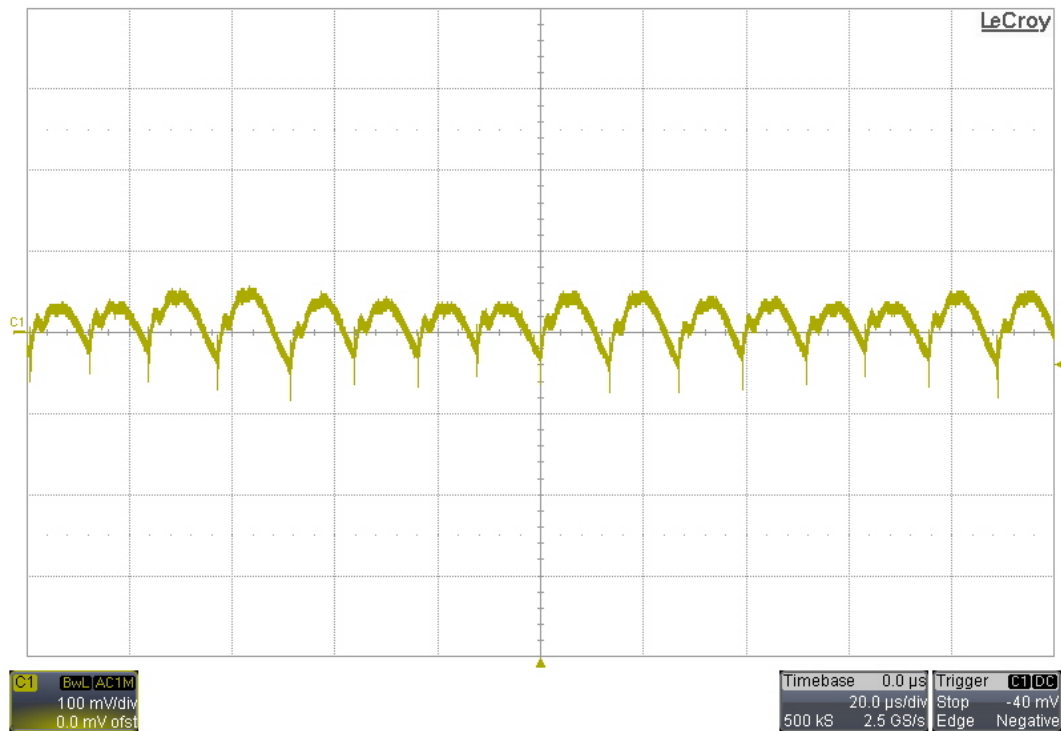
9.1 120VAC/60Hz – Measured at TP3/TP8 – 5V@3A Load



9.2 230VAC/50Hz – Measured at TP3/TP8 – 5V@3A Load**9.3 120VAC/60Hz – Measured at TP3/TP8 – 12V@3A Load**

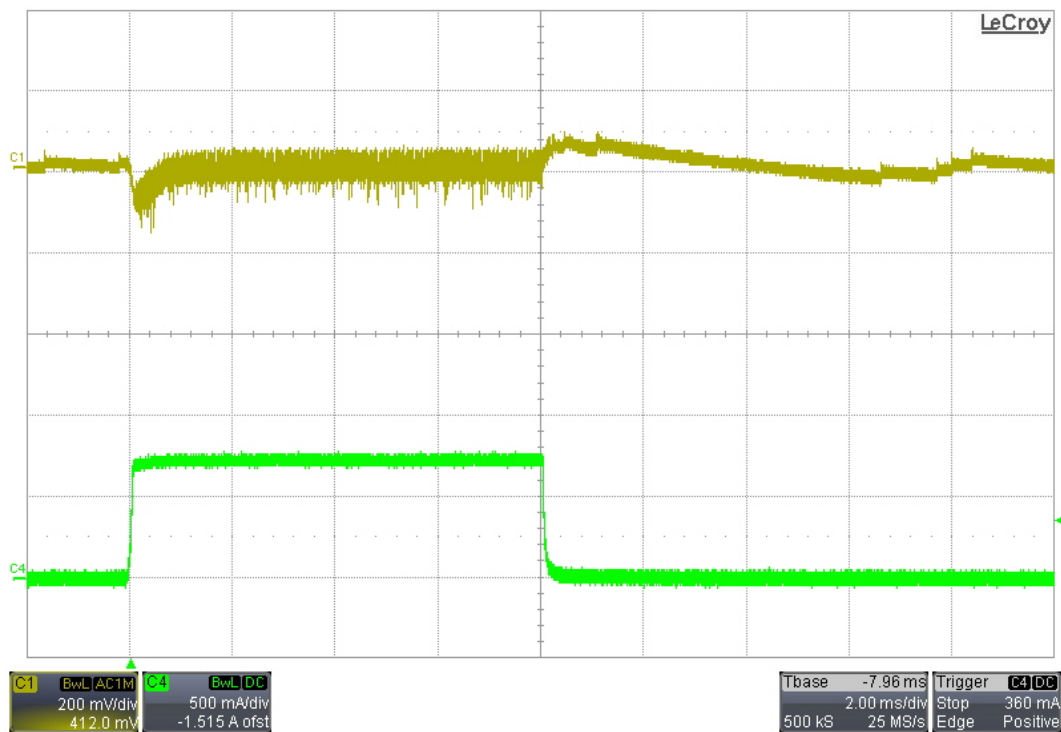
9.4 230VAC/50Hz – Measured at TP3/TP8 – 12V@3A Load**9.5 120VAC/60Hz – Measured at TP3/TP8 – 20V@3A Load**

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

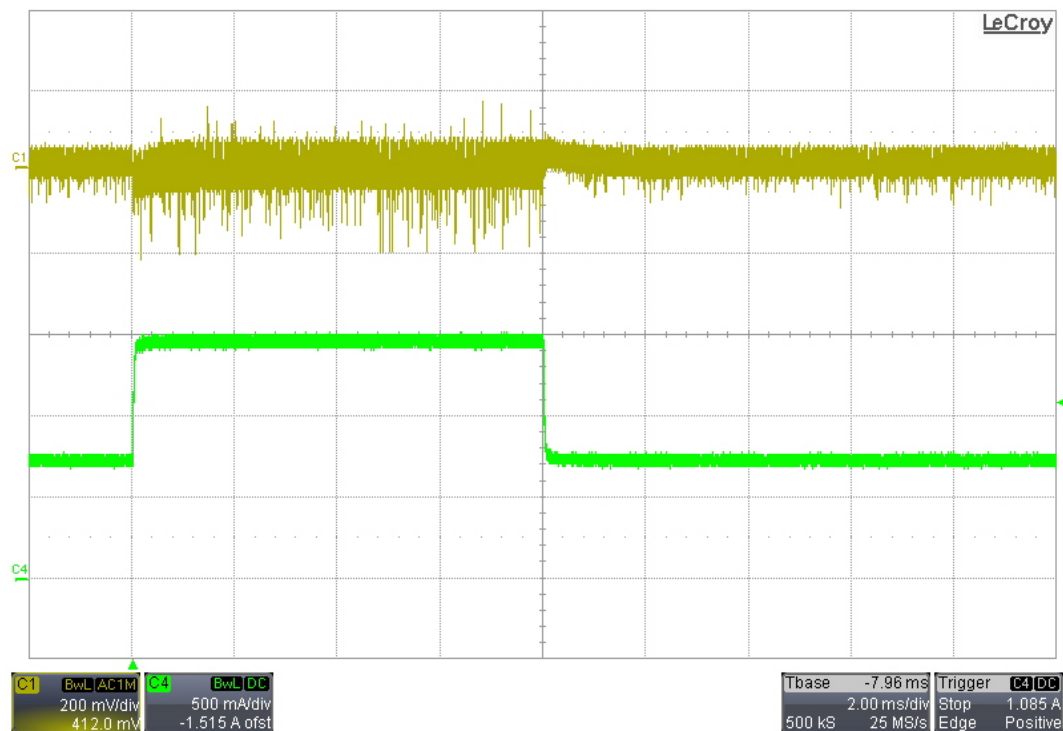


10 Load Transients

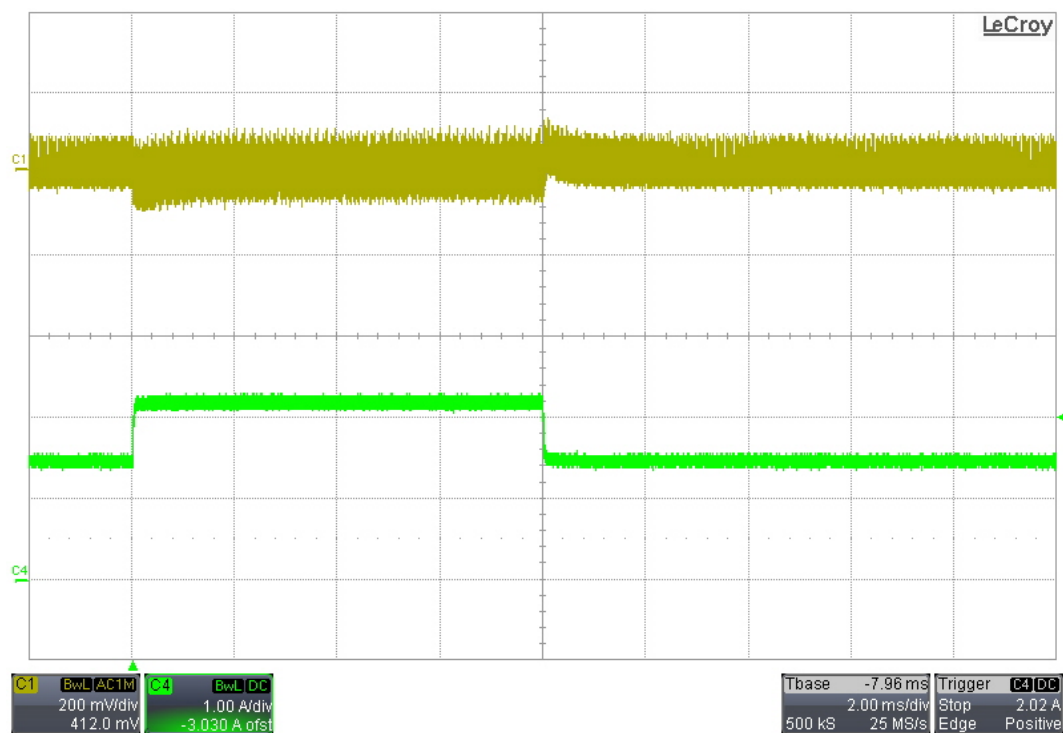
10.1 5V_{out}, 0-25% 120VAC/60Hz Input

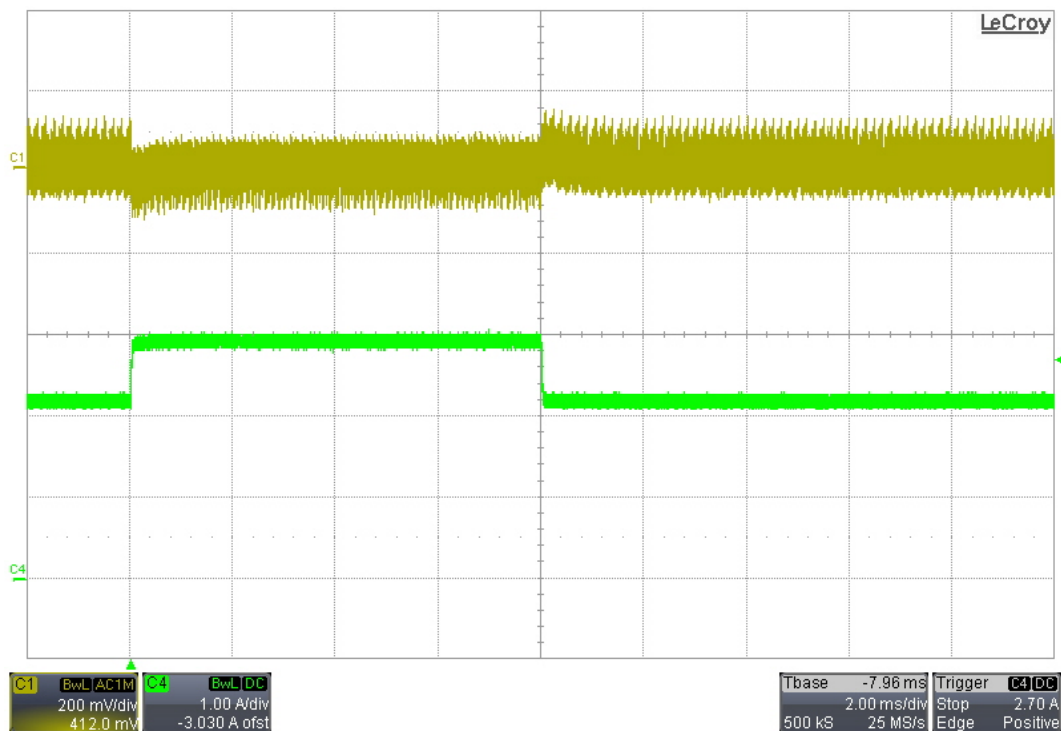
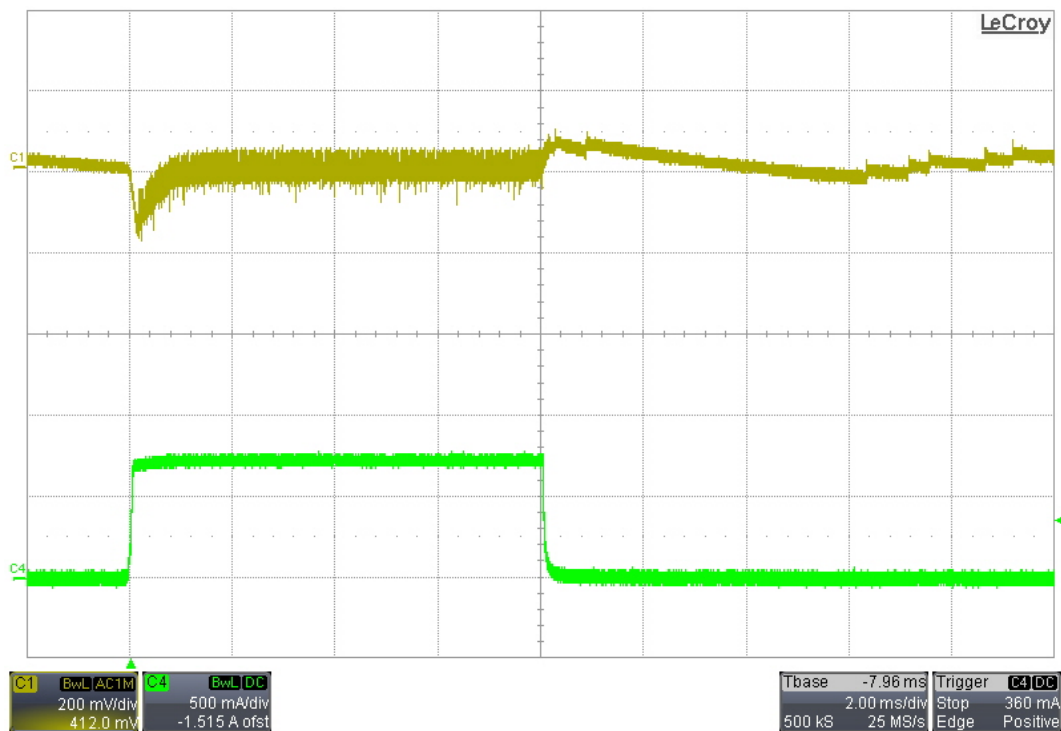


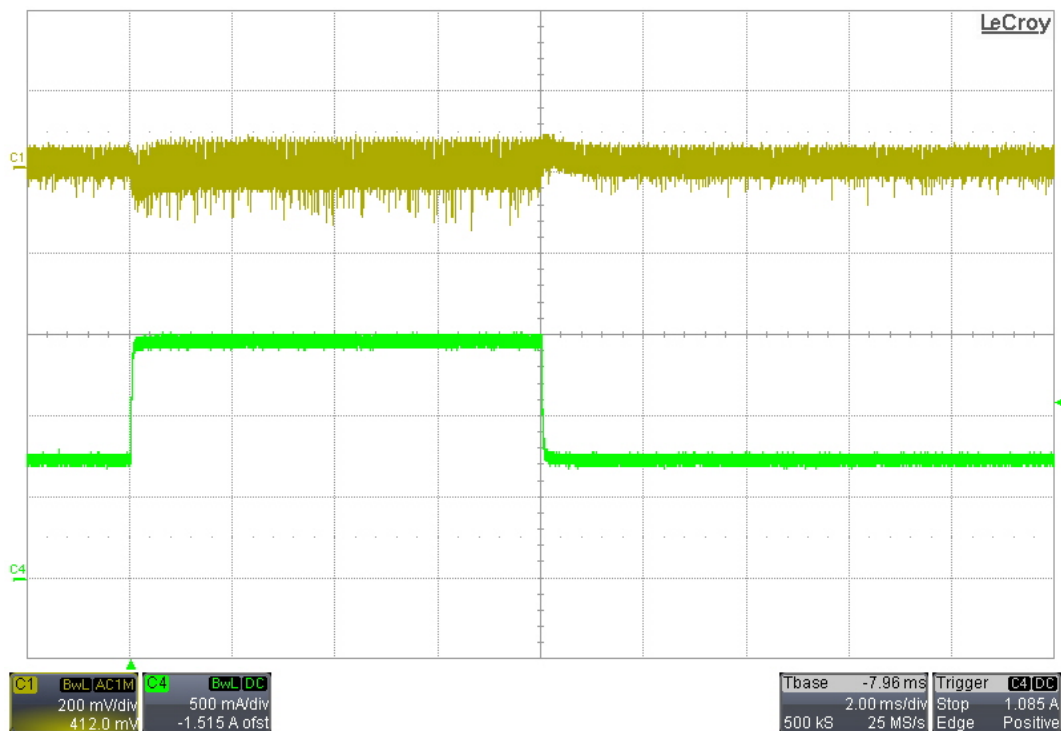
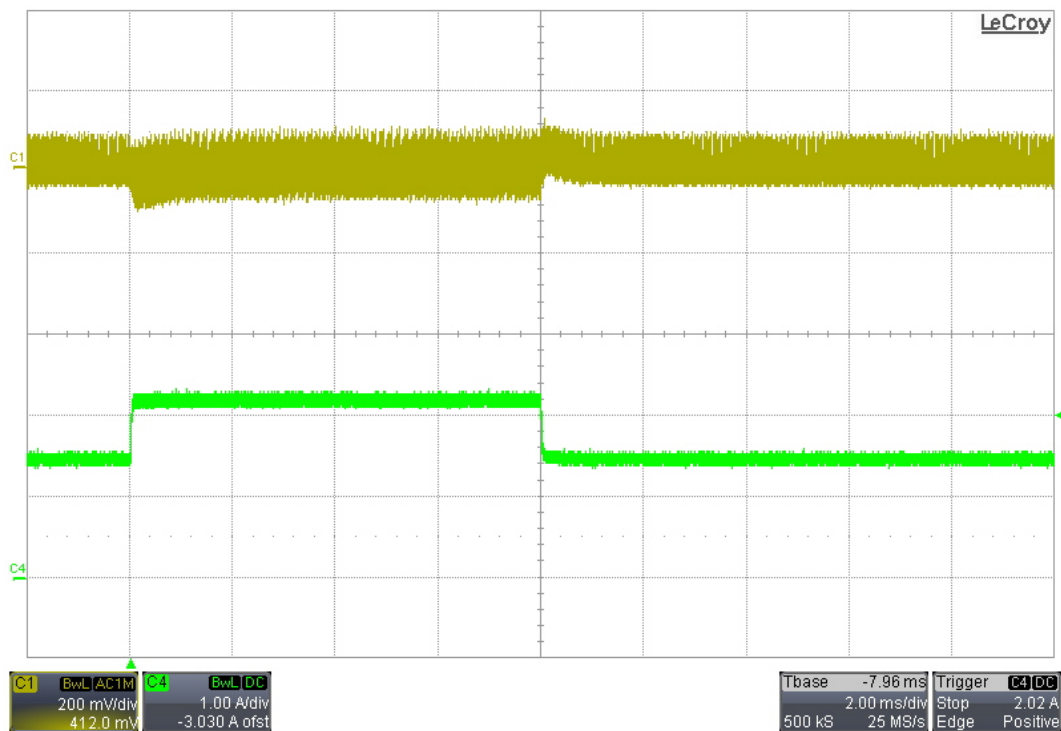
10.2 5Vout, 25-50% 120VAC/60Hz Input

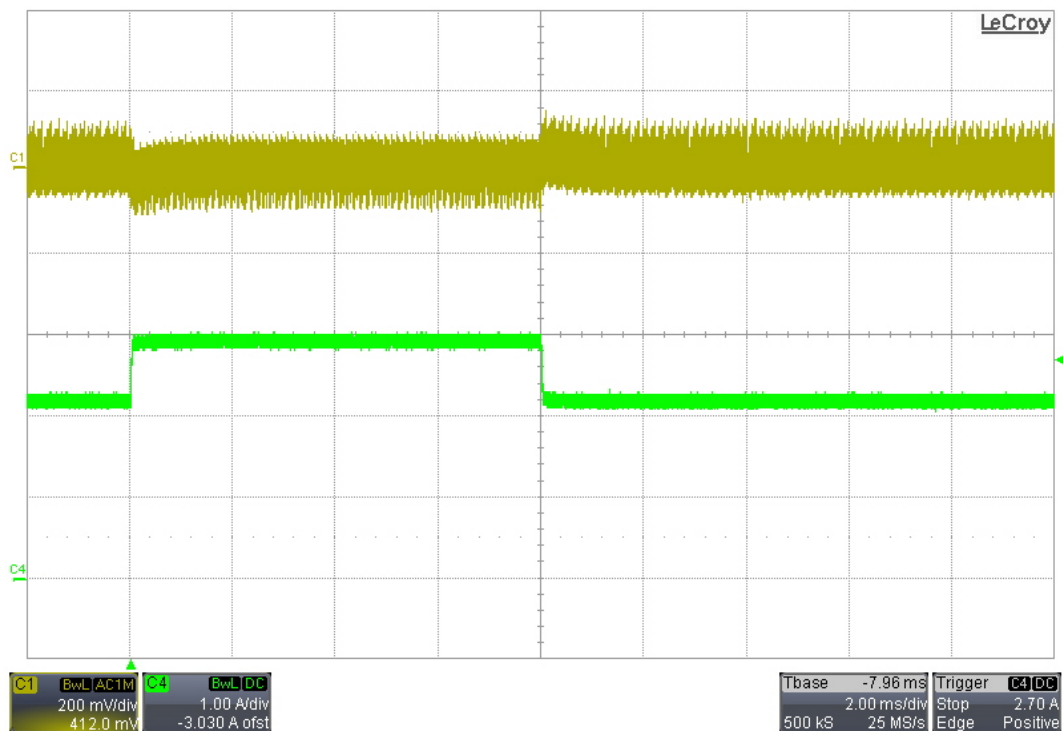
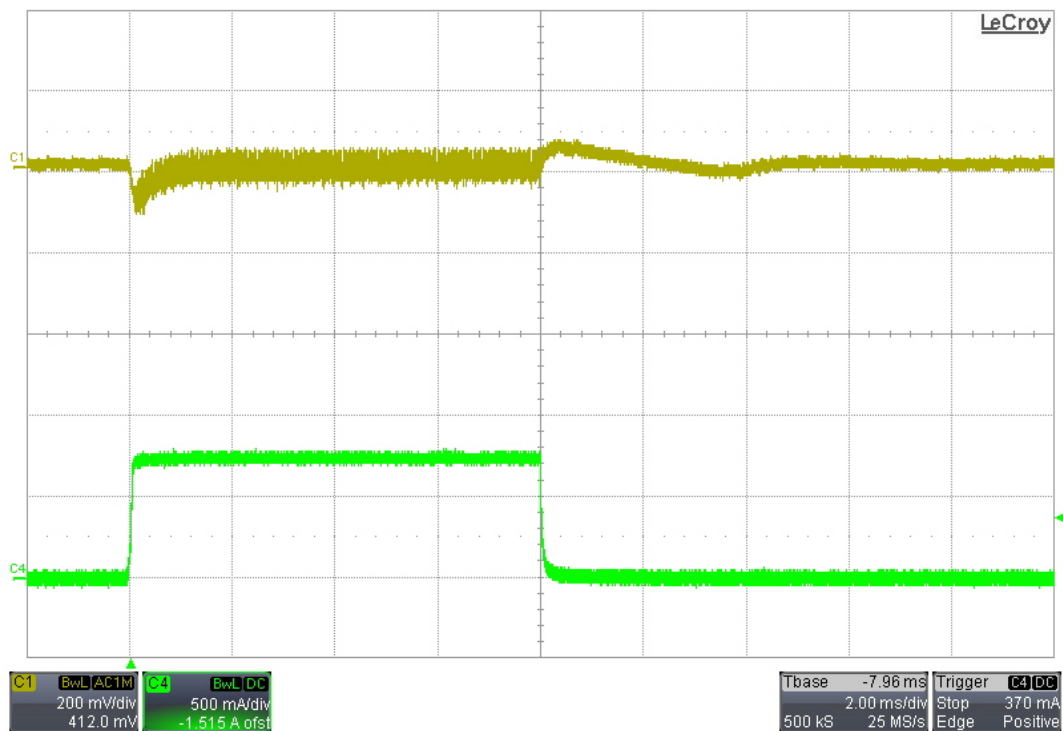


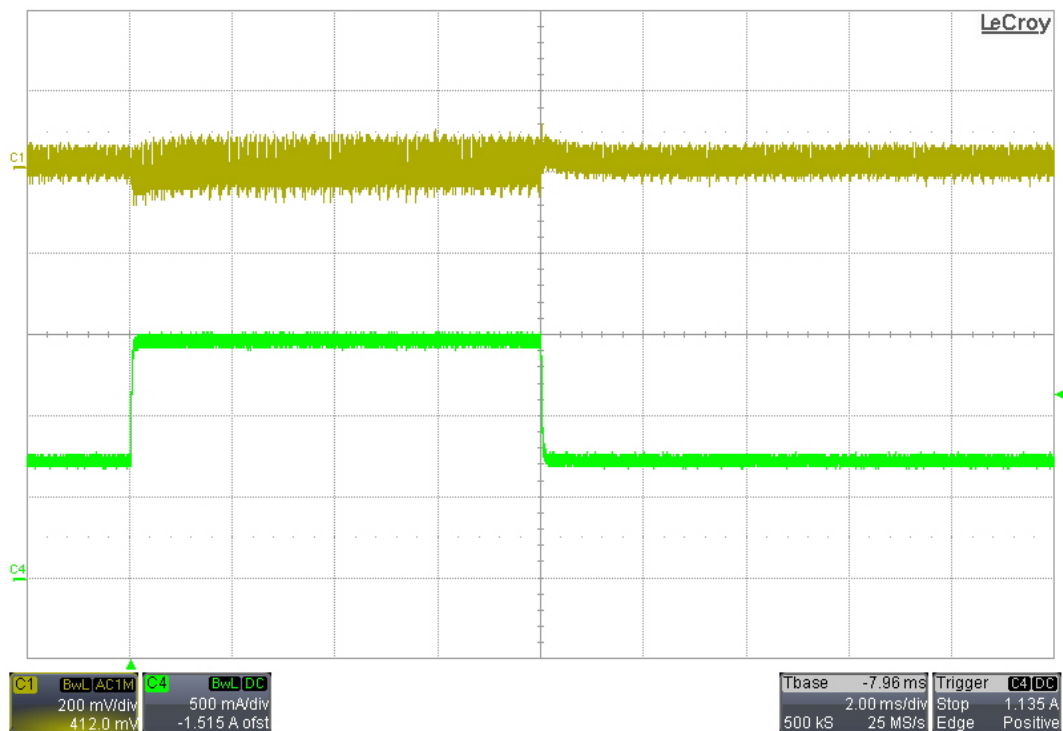
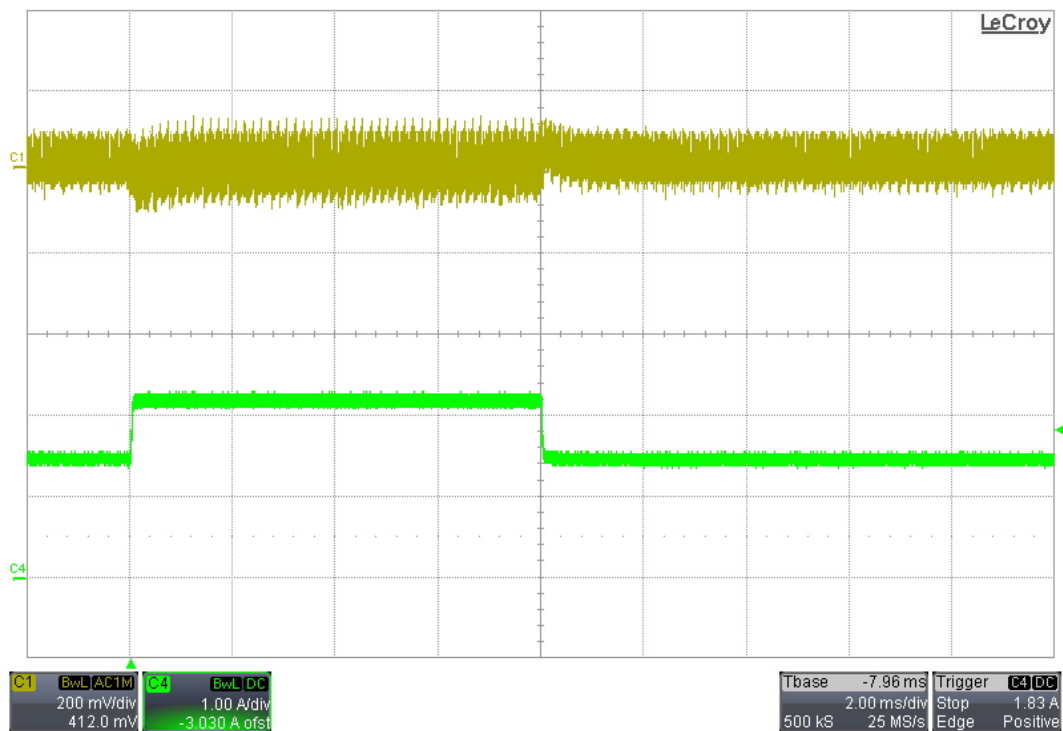
10.3 5Vout, 50-75% 120VAC/60Hz Input

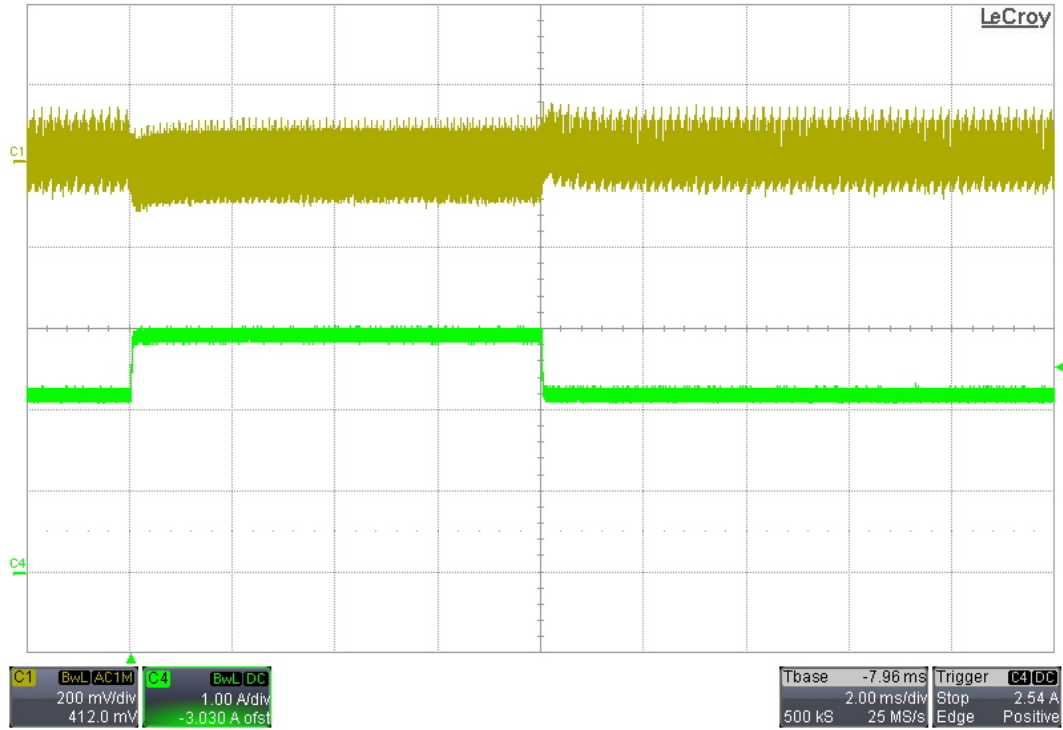
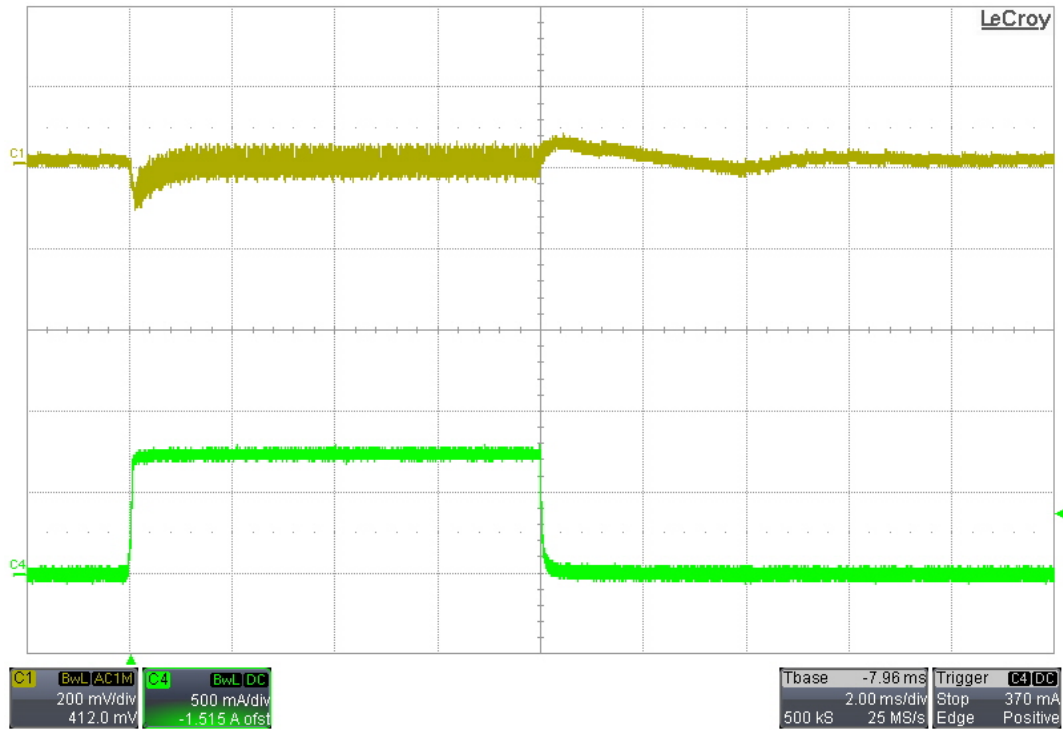


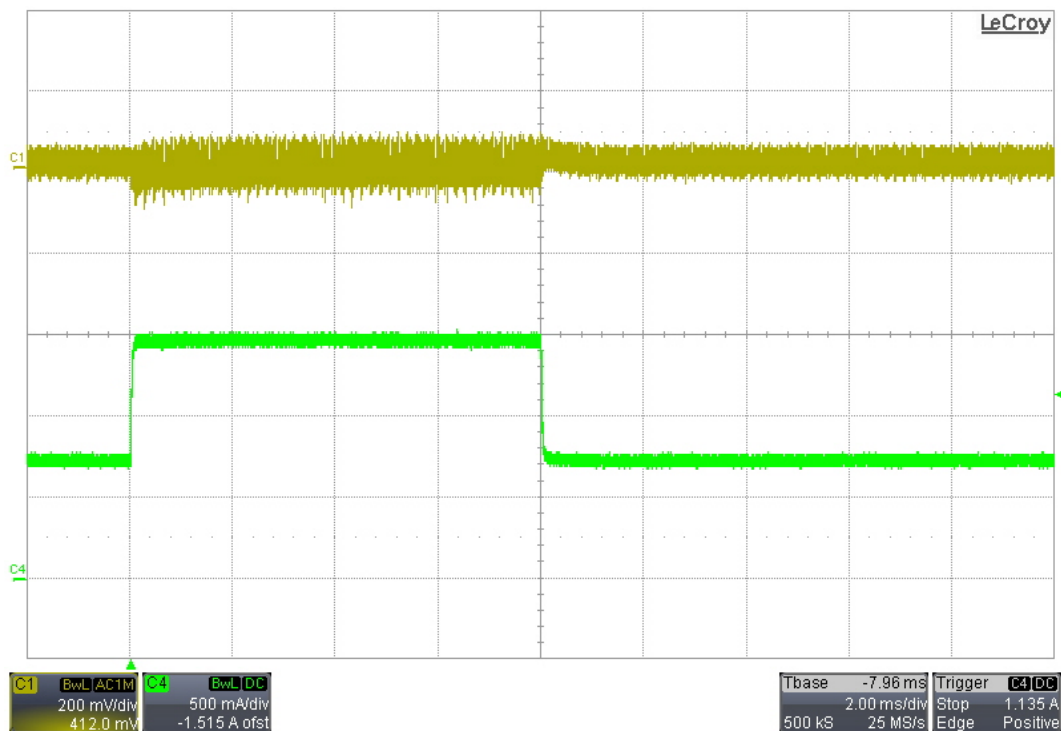
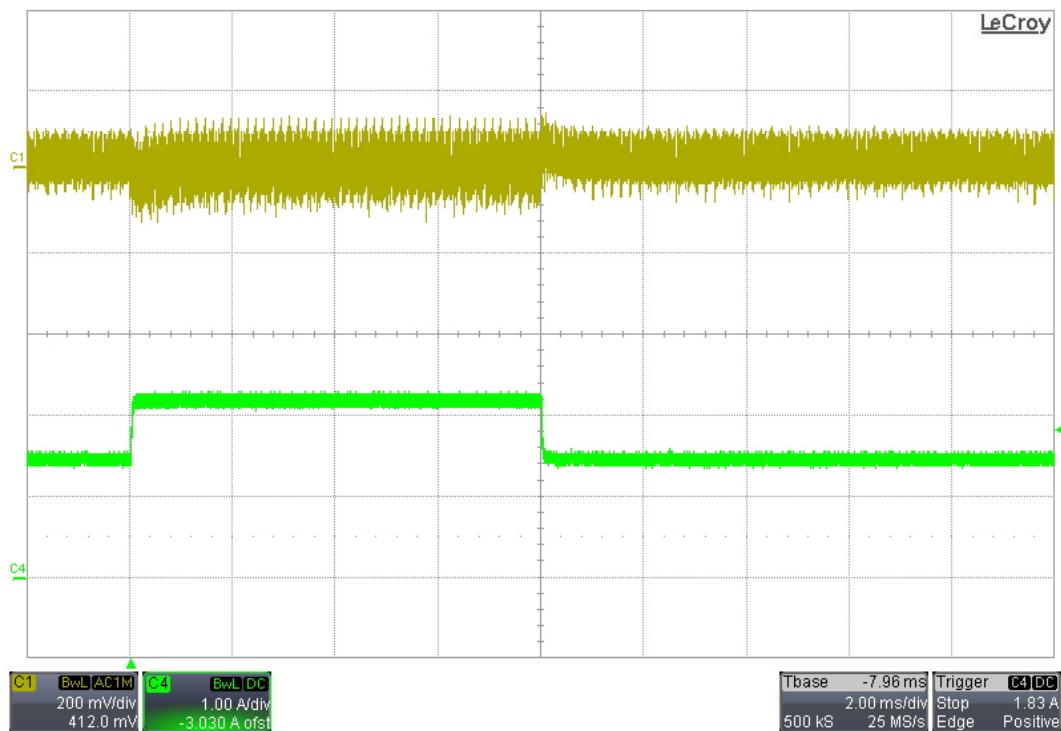
10.4 5Vout, 75-100% 120VAC/60Hz Input**10.5 5Vout, 0-25% 230VAC/50Hz Input**

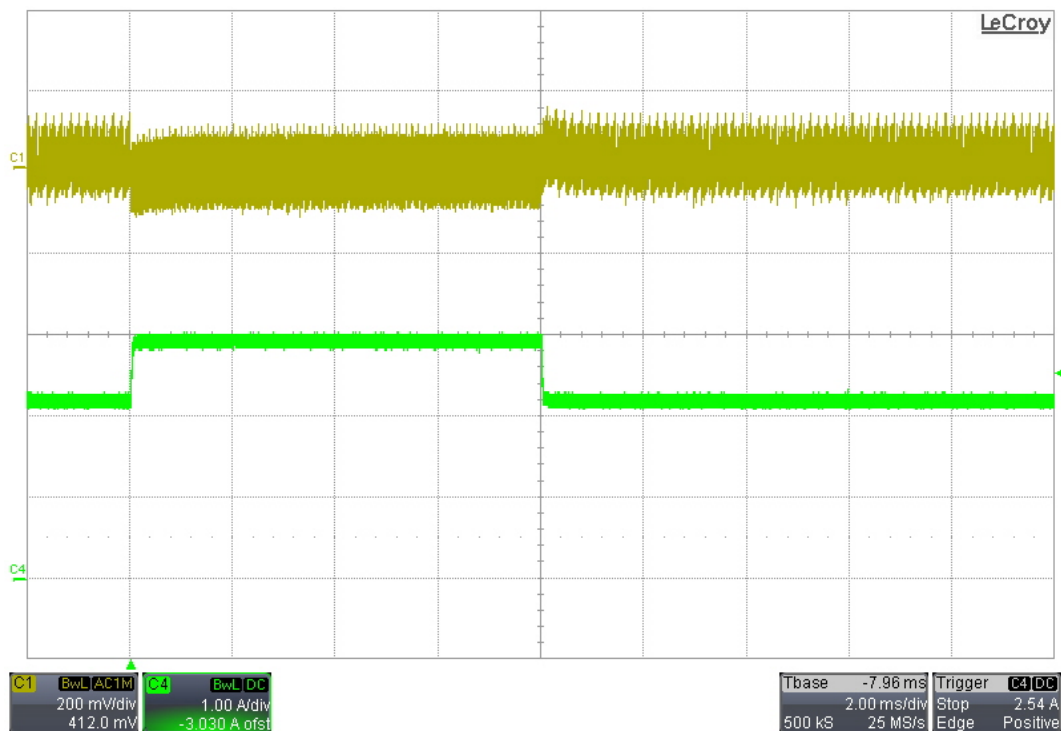
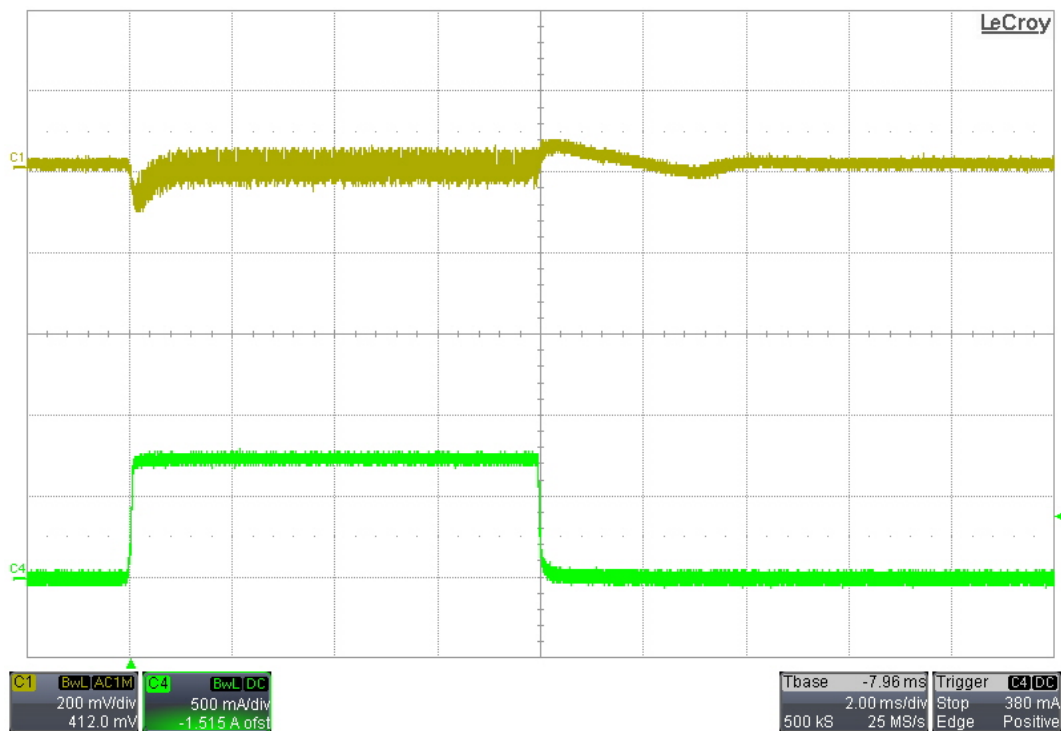
10.6 5Vout, 25-50% 230VAC/50Hz Input**10.7 5Vout, 50-75% 230VAC/50Hz Input**

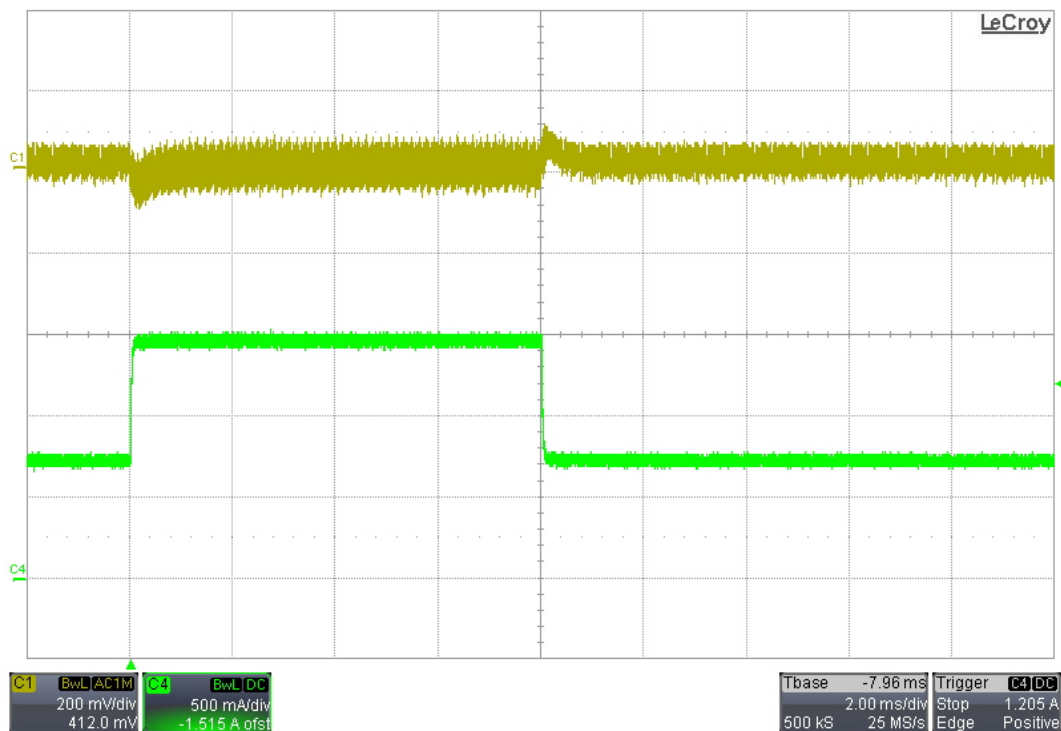
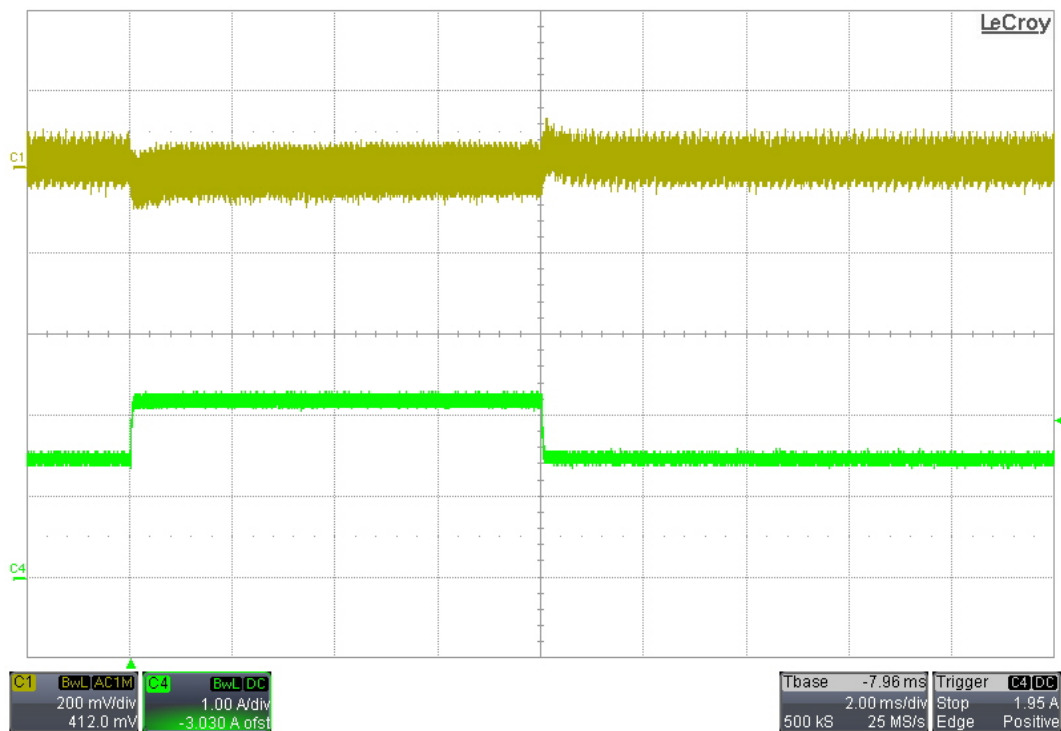
10.8 5Vout, 75-100% 230VAC/50Hz Input**10.9 12Vout, 0-25% 120VAC/60Hz Input**

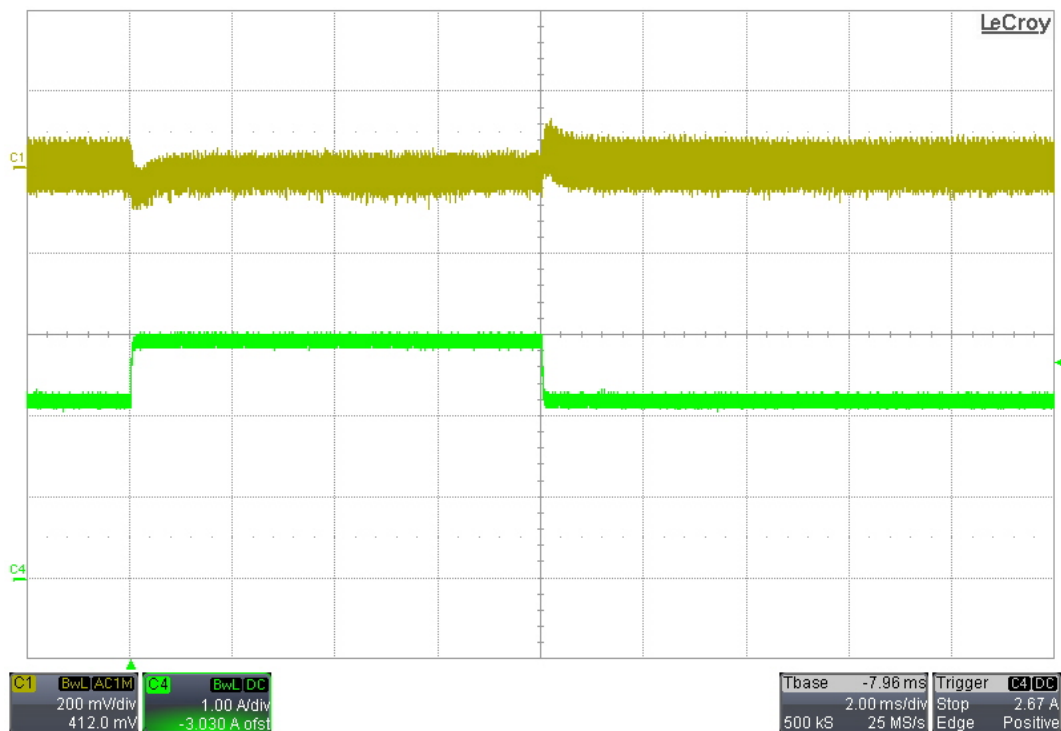
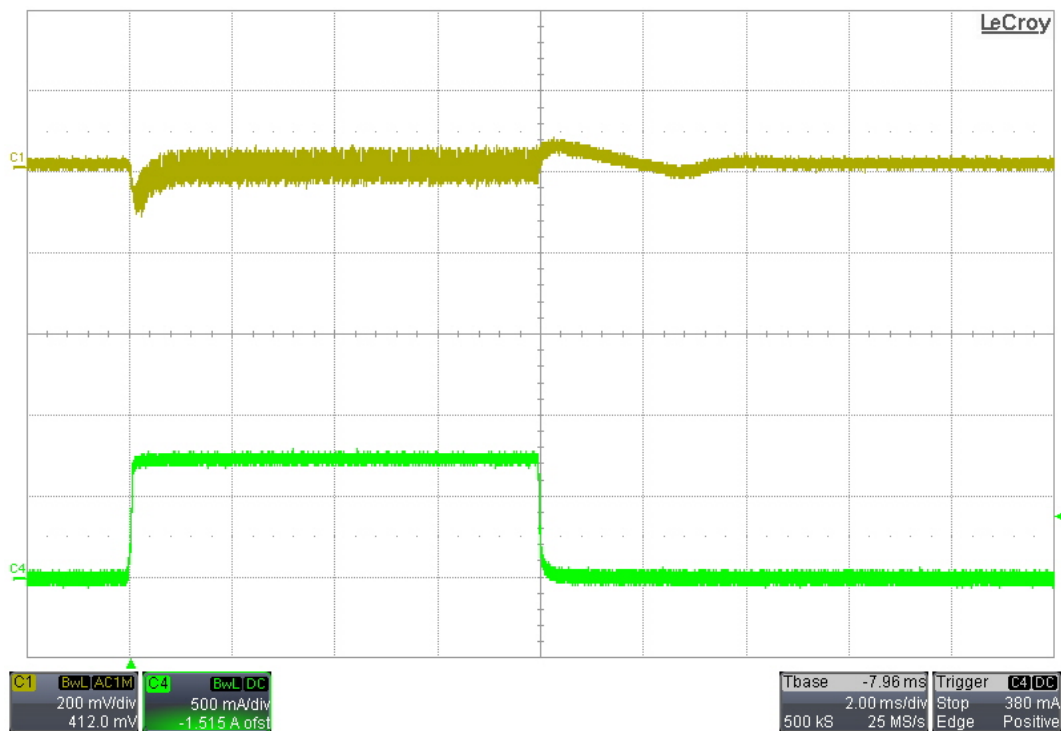
10.10 12Vout, 25-50% 120VAC/60Hz Input**10.11 12Vout, 50-75% 120VAC/60Hz Input**

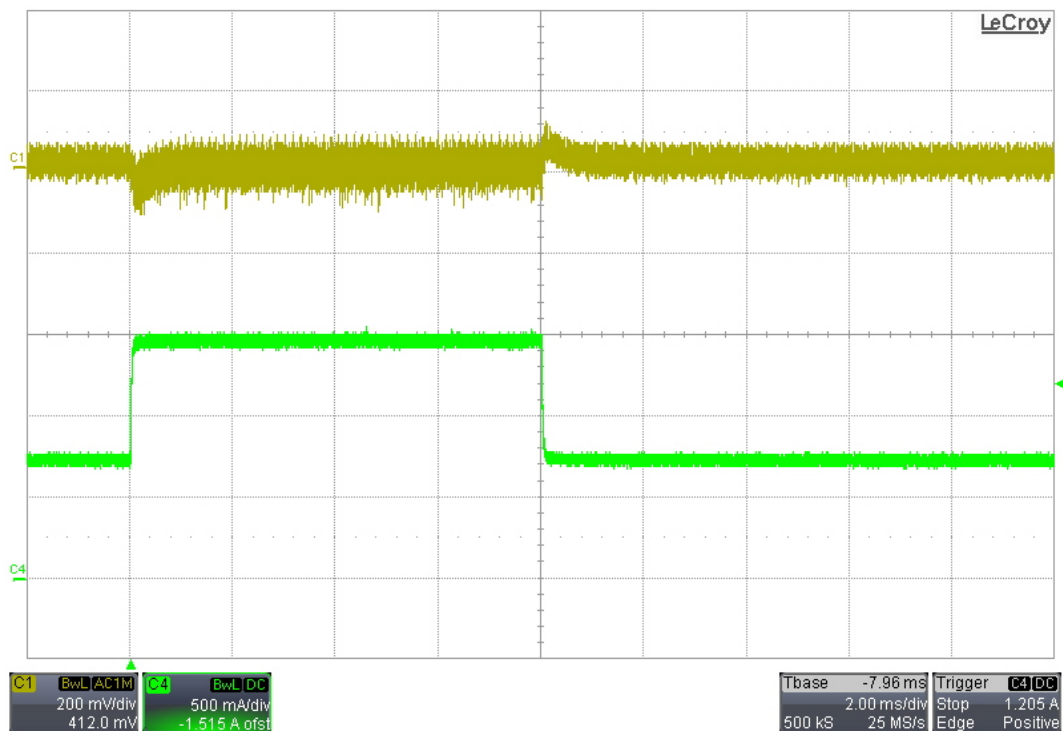
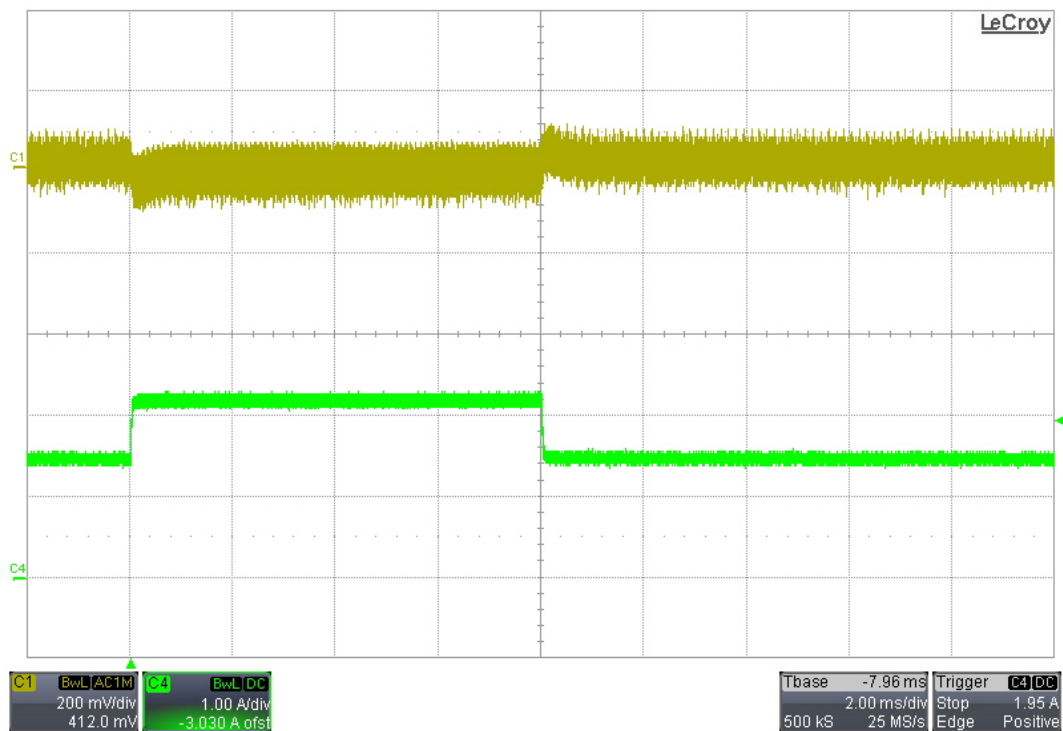
10.12 12Vout, 75-100% 120VAC/60Hz Input**10.13 12Vout, 0-25% 230VAC/50Hz Input**

10.14 12Vout, 25-50% 230VAC/50Hz Input**10.15 12Vout, 50-75% 230VAC/50Hz Input**

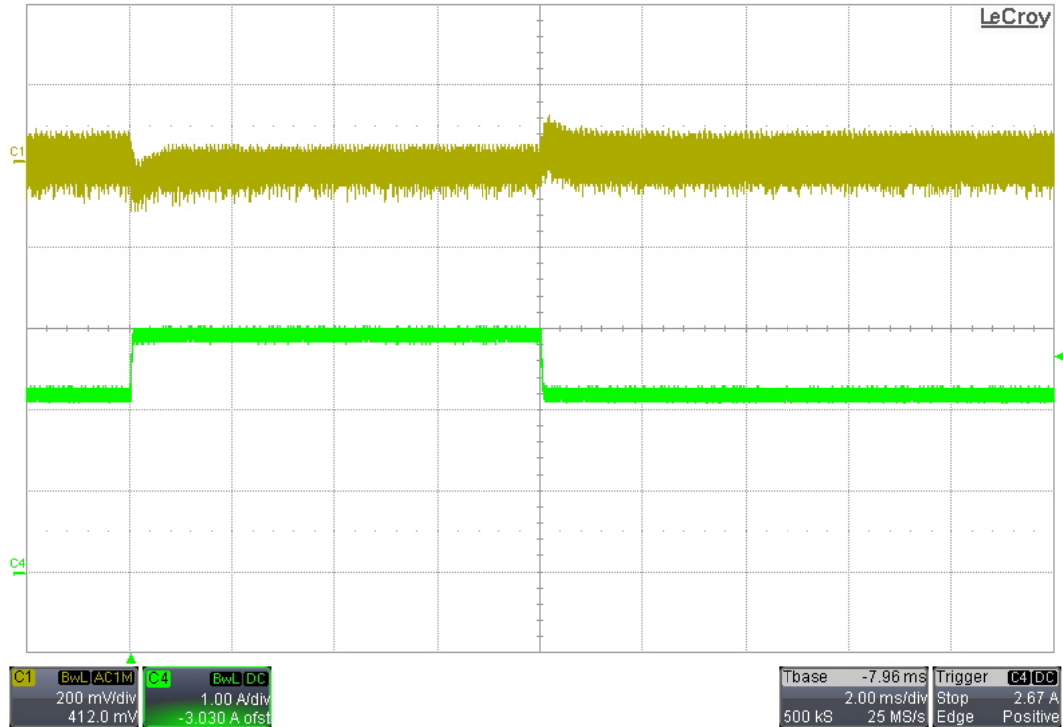
10.16 12Vout, 75-100% 230VAC/50Hz Input**10.17 20Vout, 0-25% 120VAC/60Hz Input**

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**

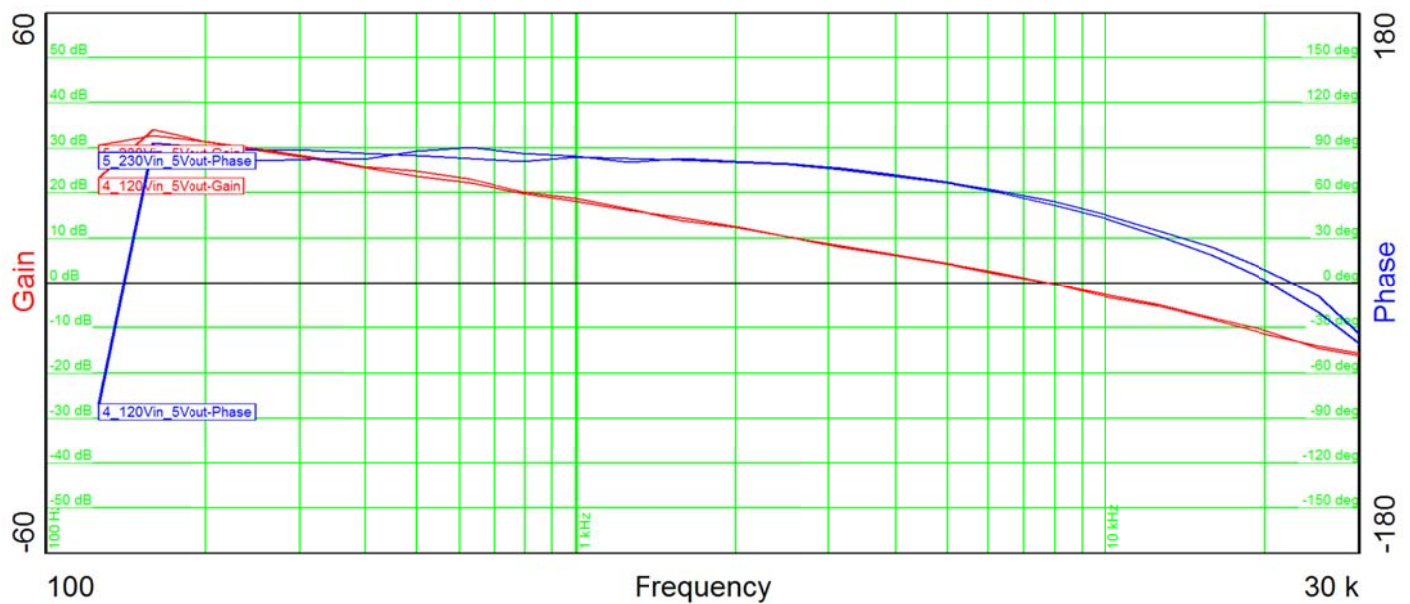
10.24 20Vout, 75-100% 230VAC/50Hz Input

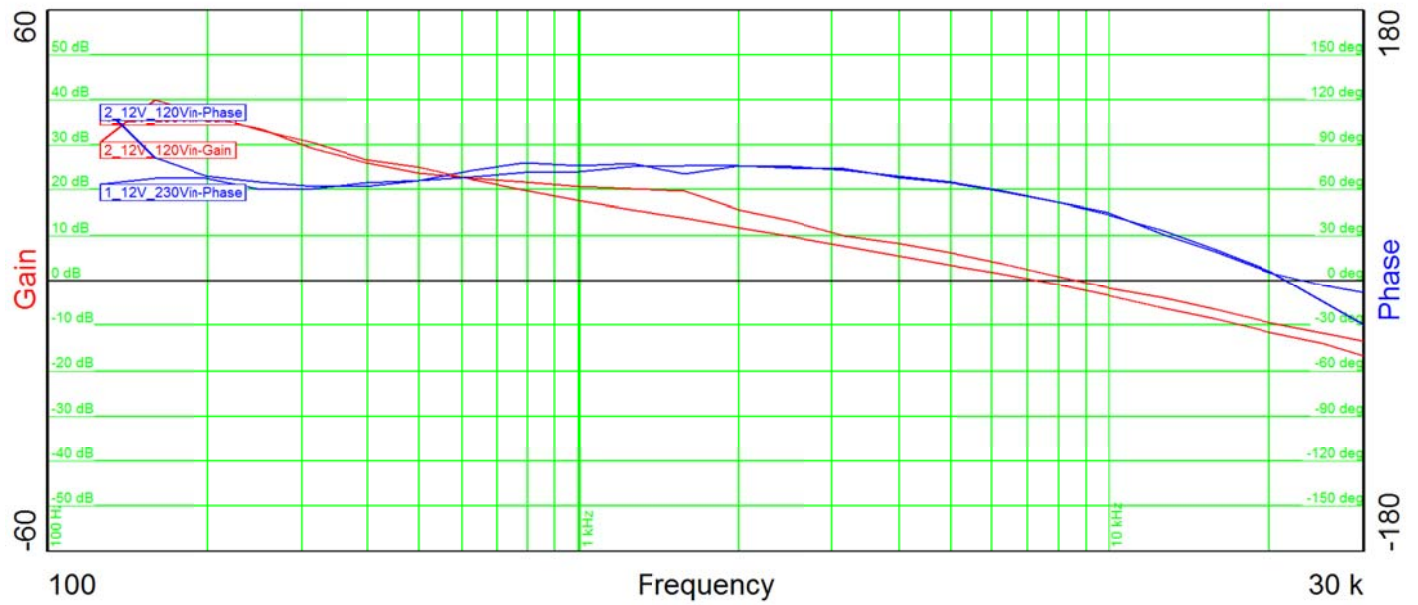
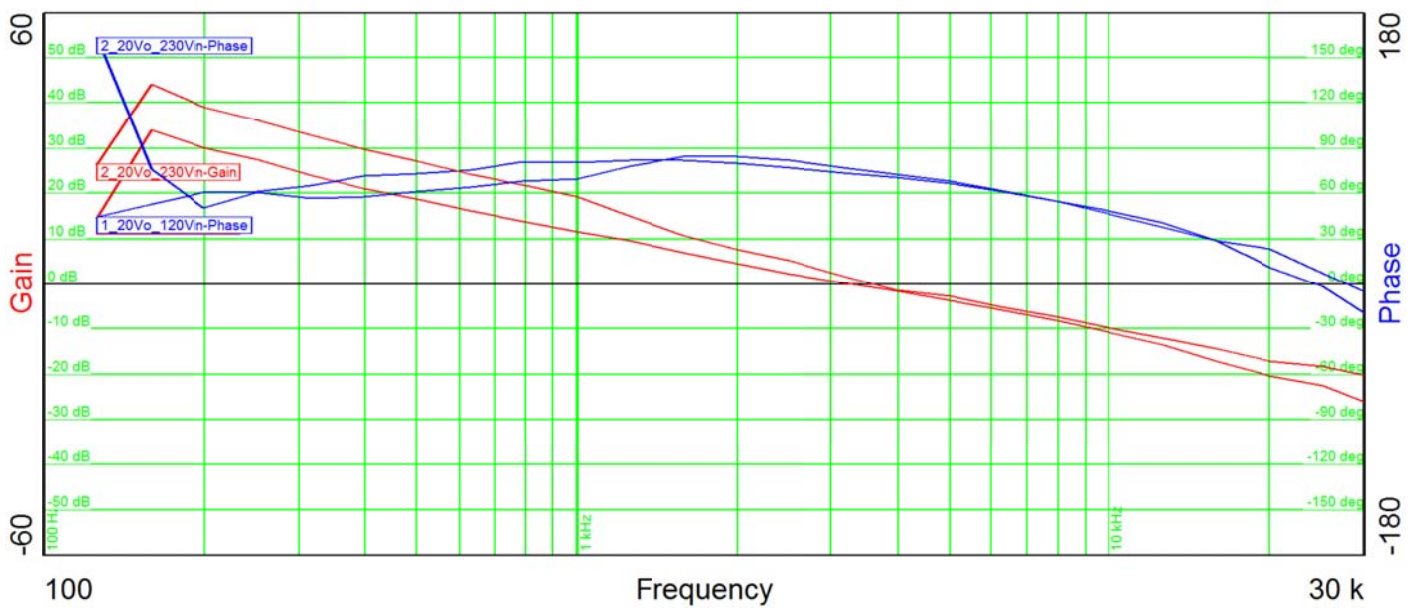


11 Loop Response

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

11.1 5Vout

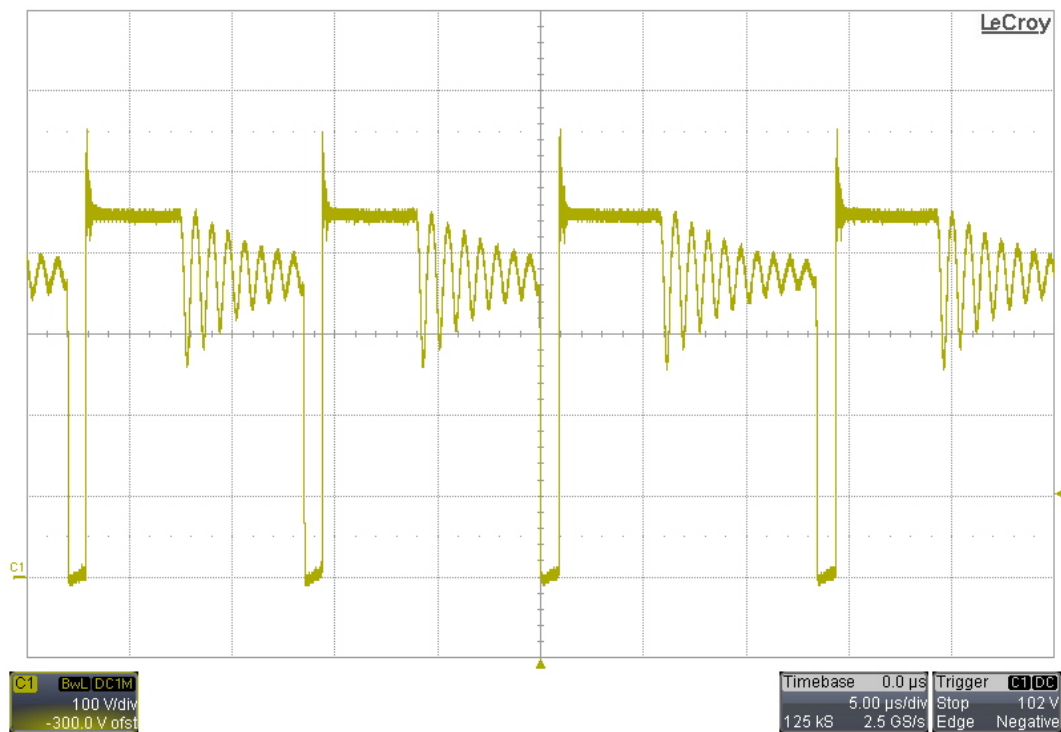


11.2 12Vout**11.3 20Vout**

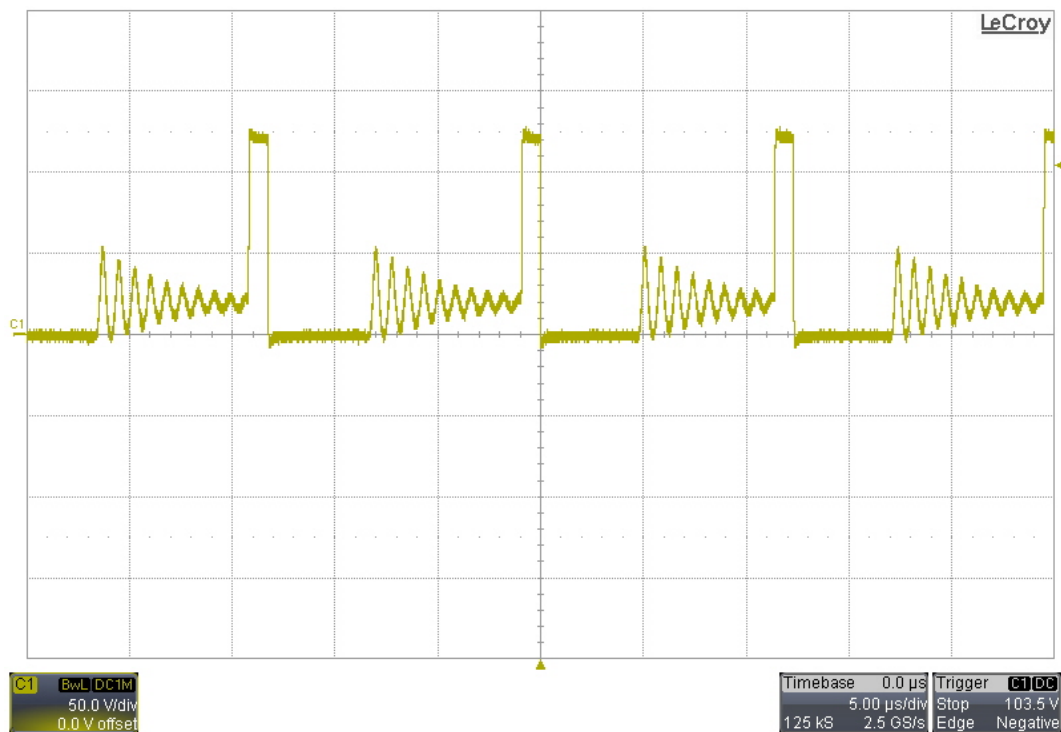
12 Switching Waveforms

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

12.1 Drain of Primary FET – Q7

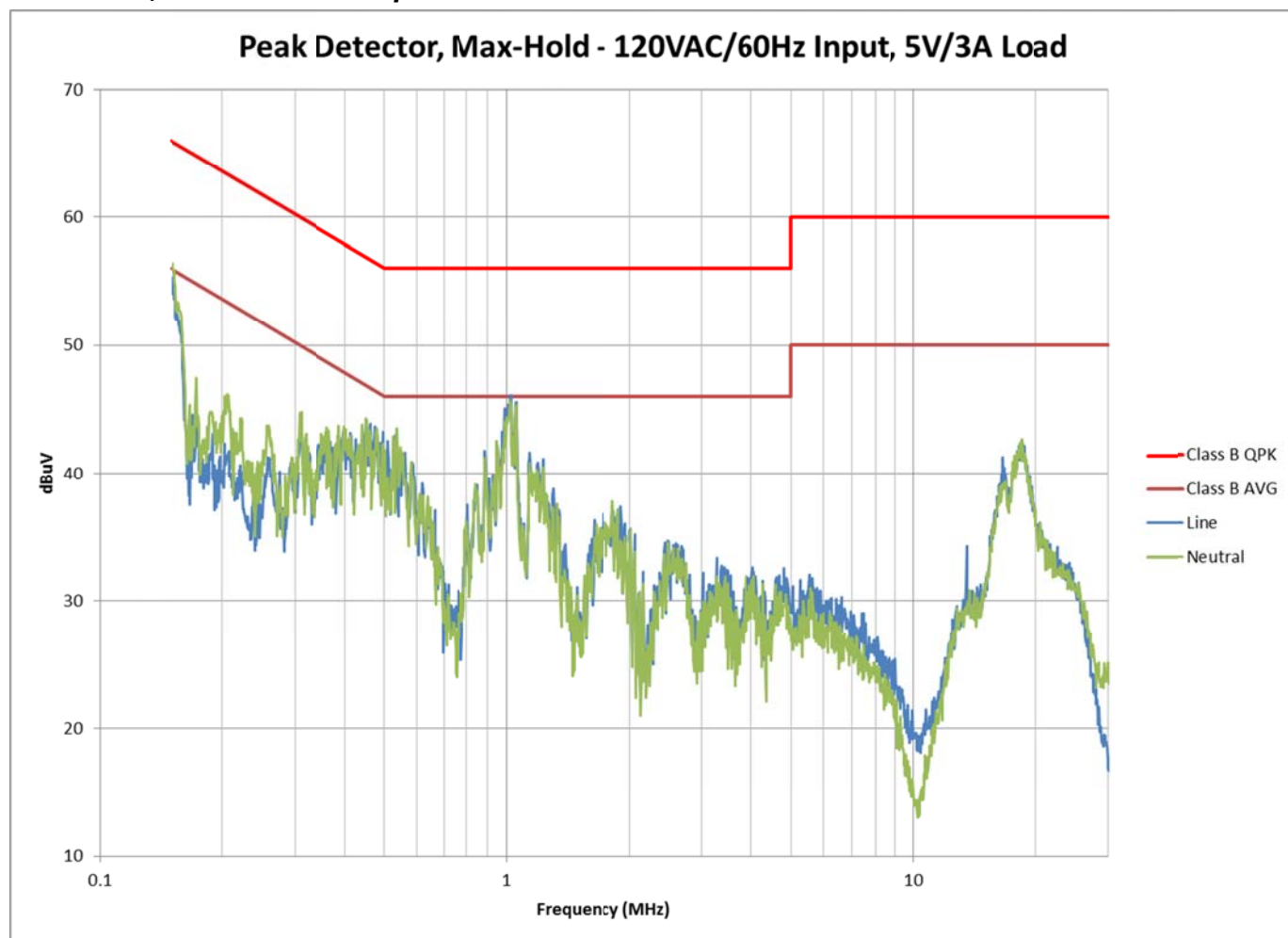


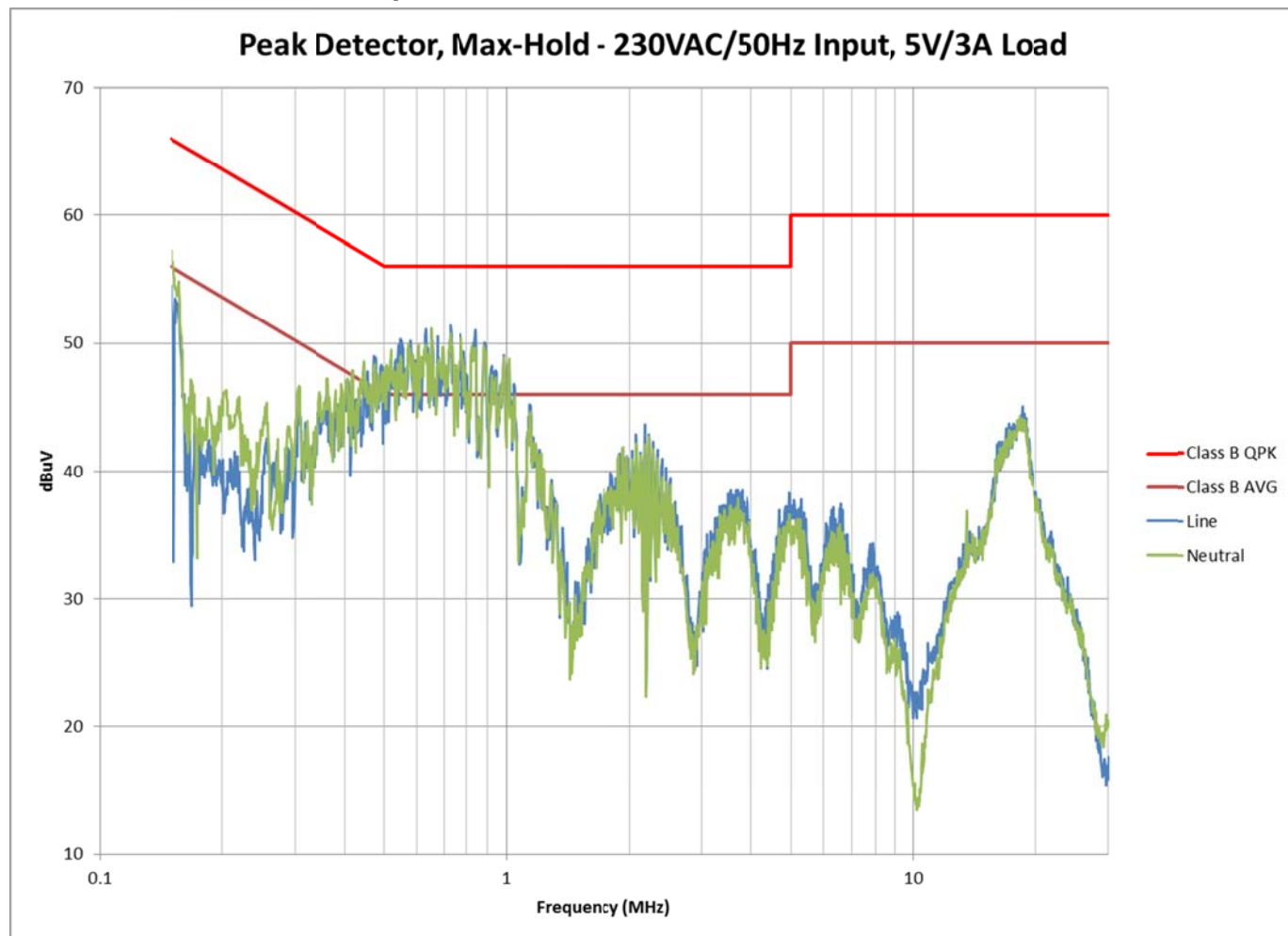
12.2 Drain of Sync FET – Q3

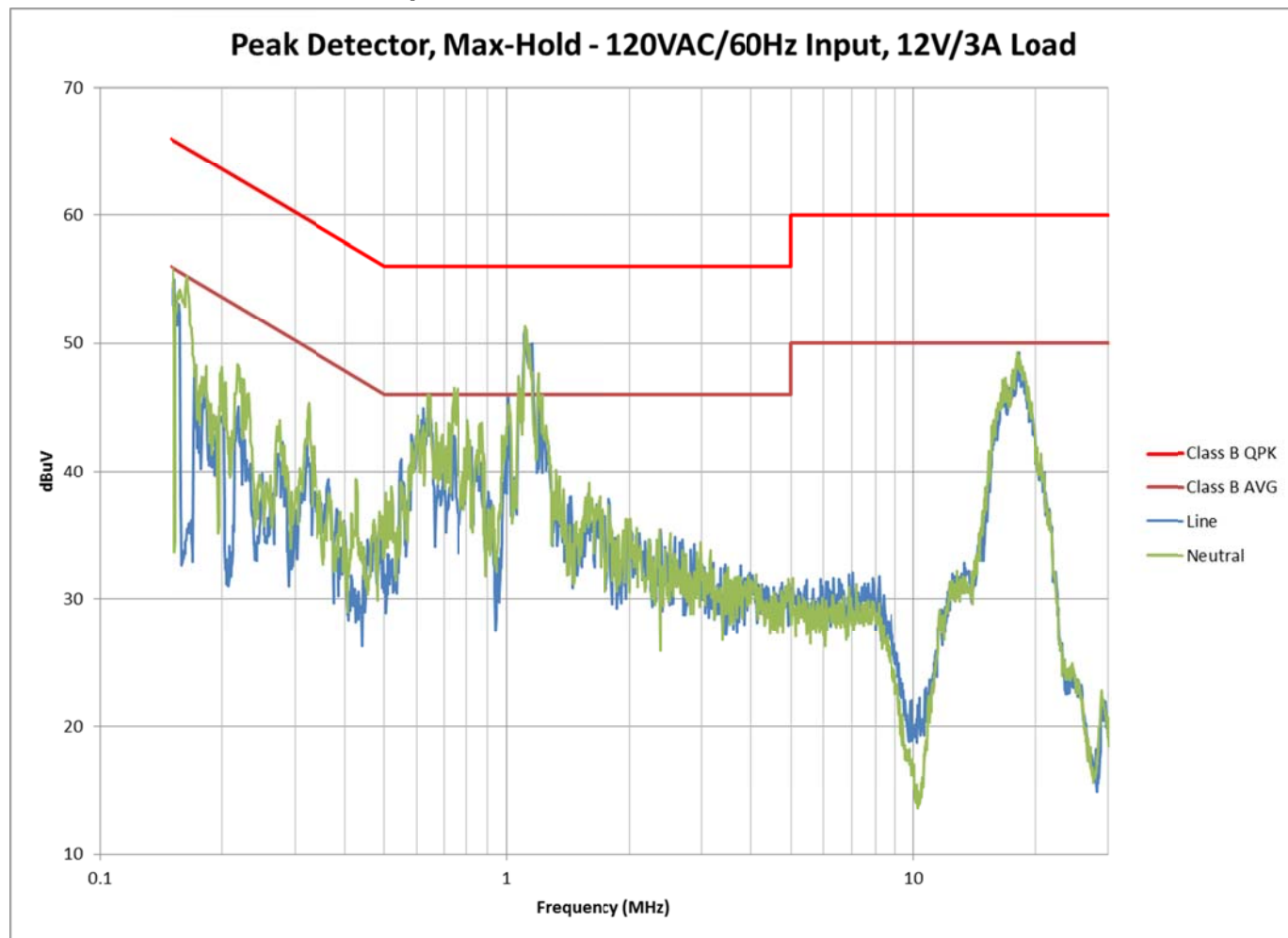


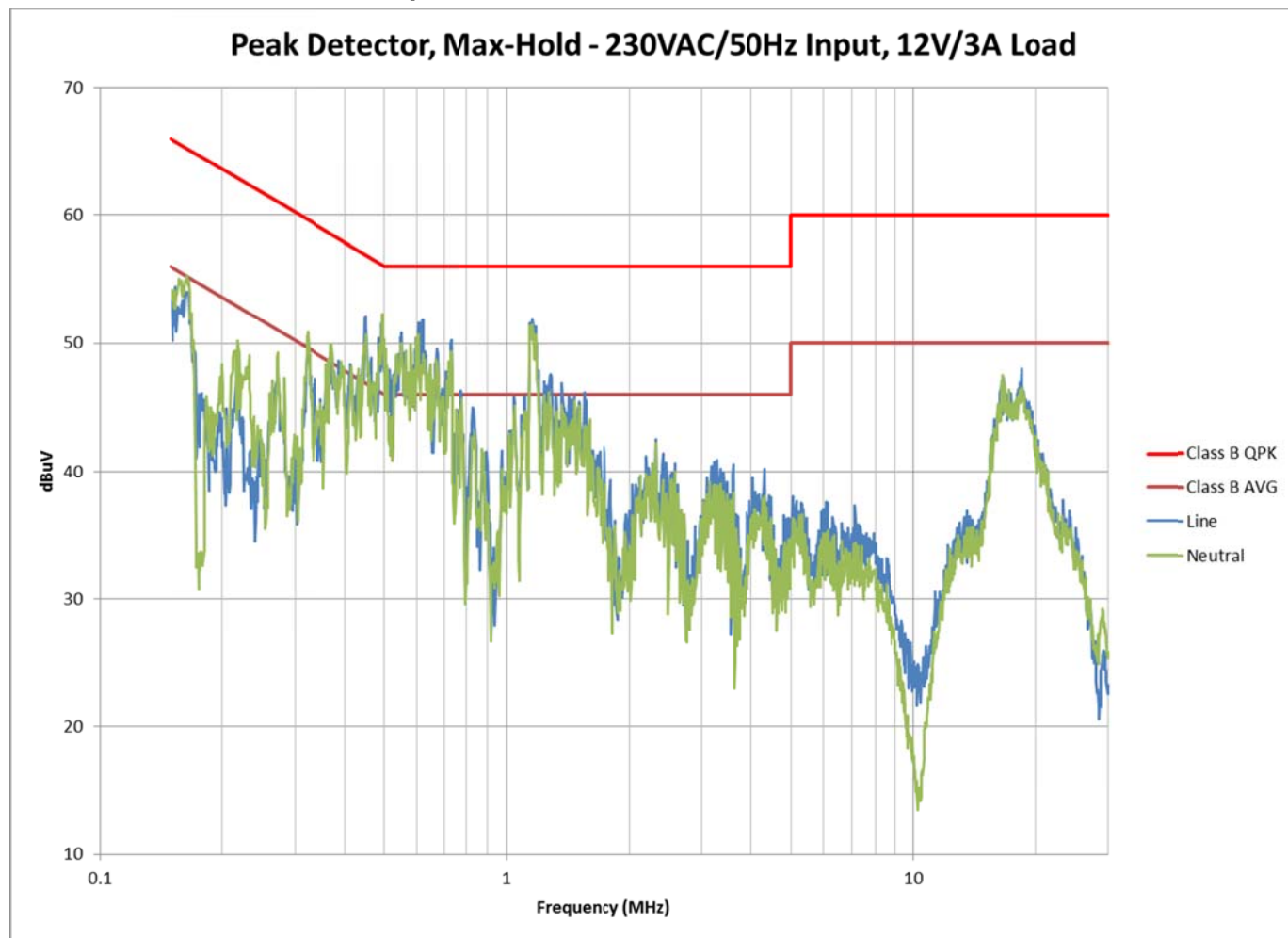
13 Conducted Emissions

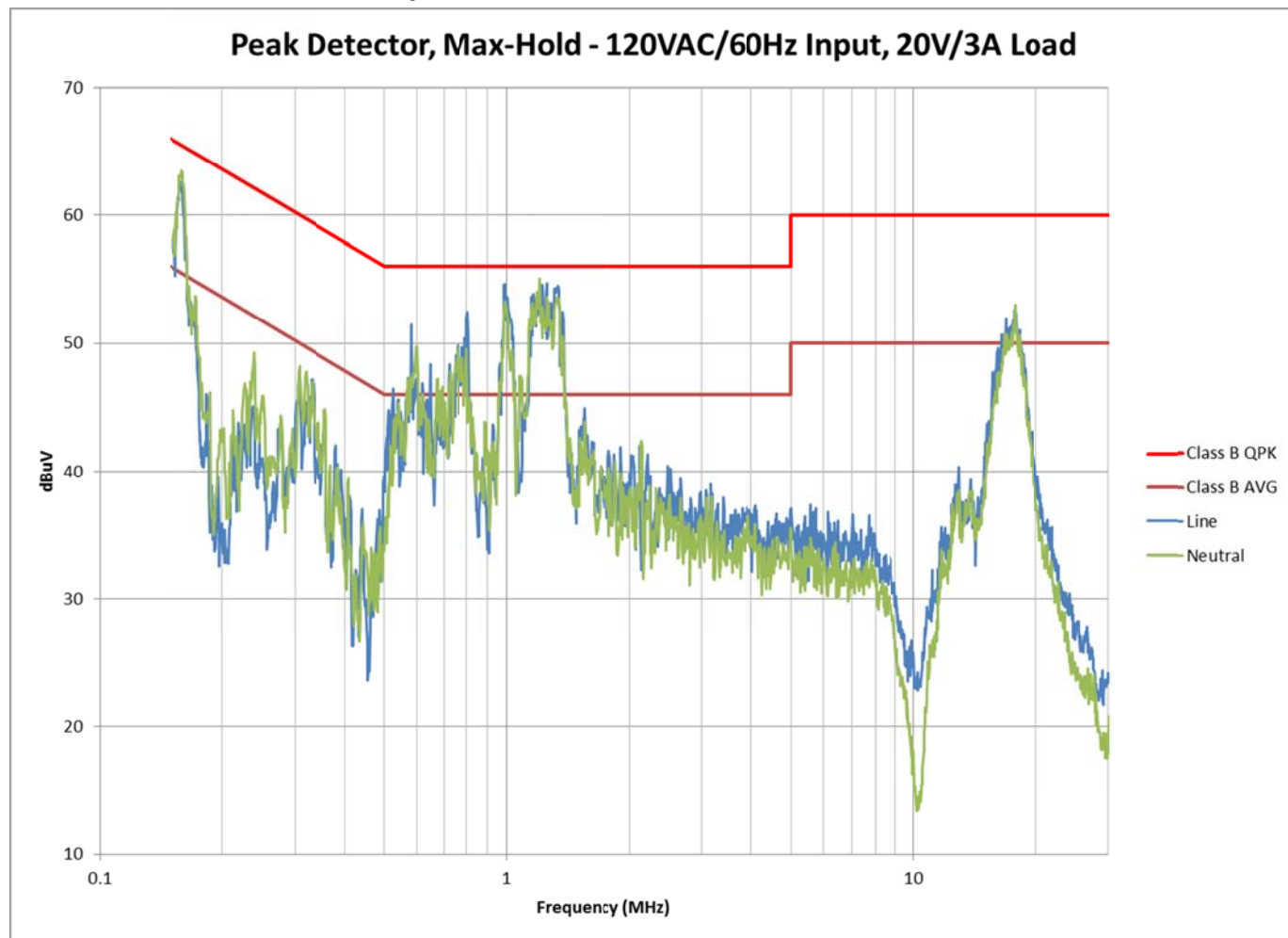
13.1 5V_{out}, 120VAC/60Hz input

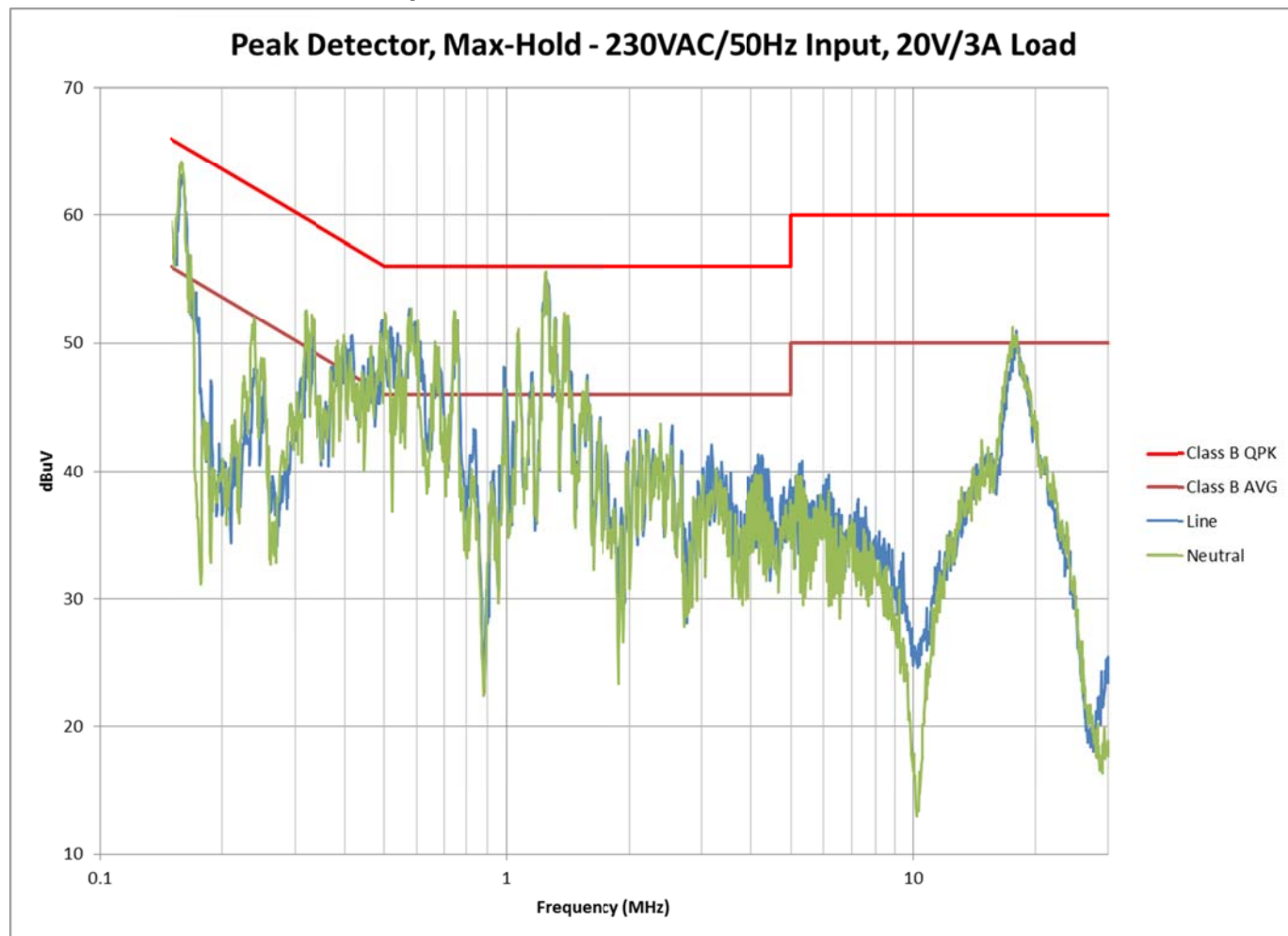


13.2 5V_{out}, 230VAC/50Hz input

13.3 12Vout, 120VAC/60Hz input

13.4 12Vout, 230VAC/50Hz input

13.5 20Vout, 120VAC/60Hz input

13.6 20V_{out}, 230VAC/50Hz input

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