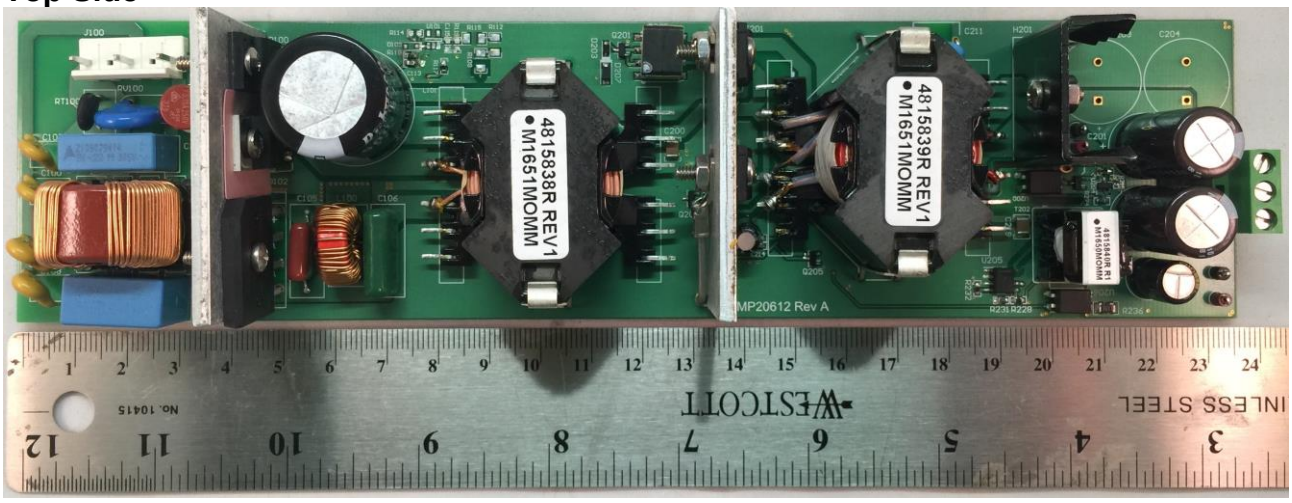
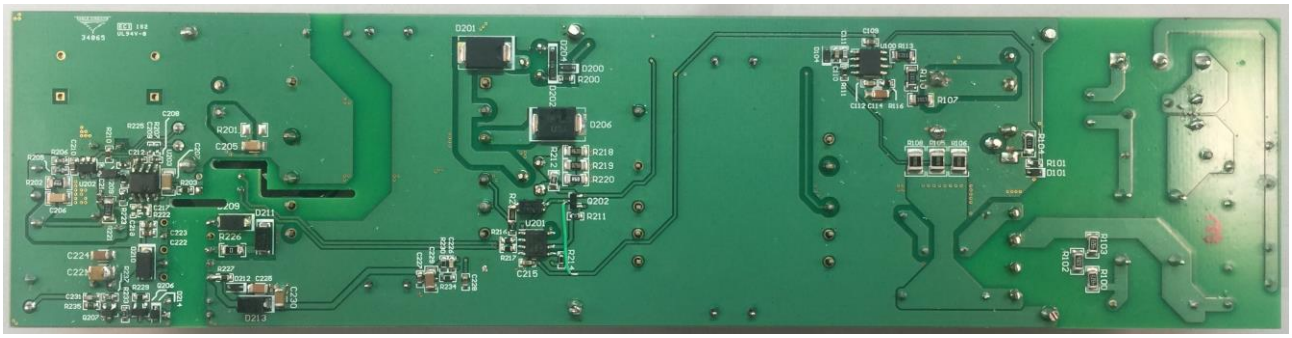
1 Photo

The photographs below show the top and bottom view of the PMP20612Rev A board.

Top Side



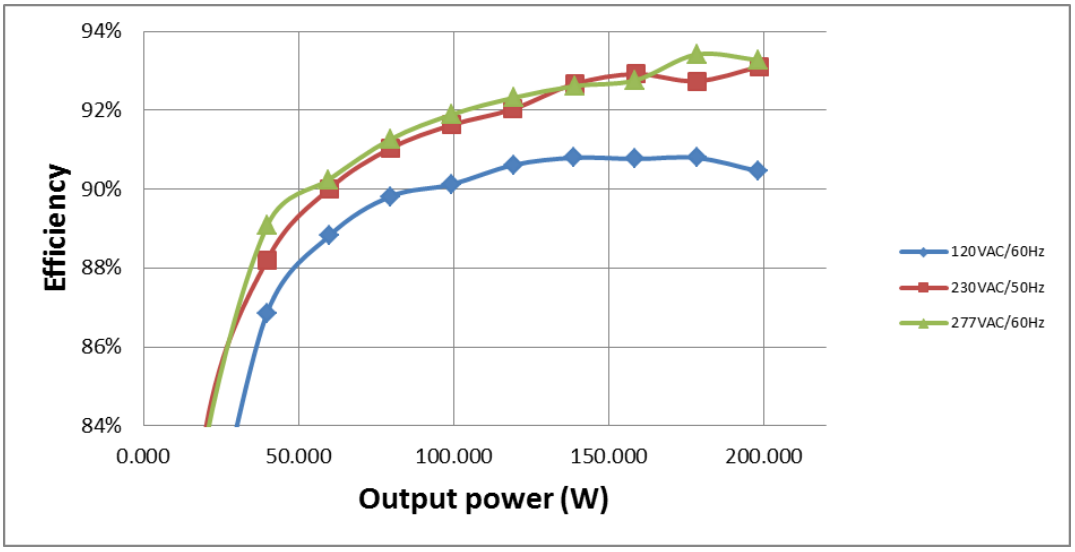
Bottom Side



2 Efficiency, Power Factor and Harmonics

The efficiency curves of total supply are shown in the tables and graph below. The efficiencies are tested with PSON signal set to high. Notice that RT100 (NTC) is shorted during efficiency test. Notice that PFC output voltage at C104 is 434V.

2.1 Total efficiency



120V_{AC}/60Hz

Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
120	1.829	219.00	0.998	4.25%	198.1	1.000	198.100	20.9000	90.46%
120.01	1.642	196.59	0.998	3.48%	198.1	0.901	178.488	18.1019	90.79%
120.01	1.458	174.60	0.998	2.79%	198.1	0.800	158.480	16.1200	90.77%
120.01	1.277	152.88	0.998	2.42%	198.3	0.700	138.810	14.0700	90.80%
120	1.100	131.59	0.997	2.37%	198.4	0.601	119.238	12.3516	90.61%
120	0.922	110.13	0.996	2.67%	198.5	0.500	99.250	10.8800	90.12%
120.08	0.741	88.45	0.994	3.22%	198.6	0.400	79.440	9.0100	89.81%
120.04	0.566	67.34	0.991	4.82%	198.7	0.301	59.809	7.5313	88.82%
120.05	0.389	45.80	0.982	6.86%	198.9	0.200	39.780	6.0200	86.86%
120.28	0.217	24.73	0.946	10.75%	199	0.100	19.900	4.8300	80.47%
120.09	0.123	12.78	0.864	3.77%	199.1	0.050	9.955	2.8210	77.92%

230V_{AC}/50Hz

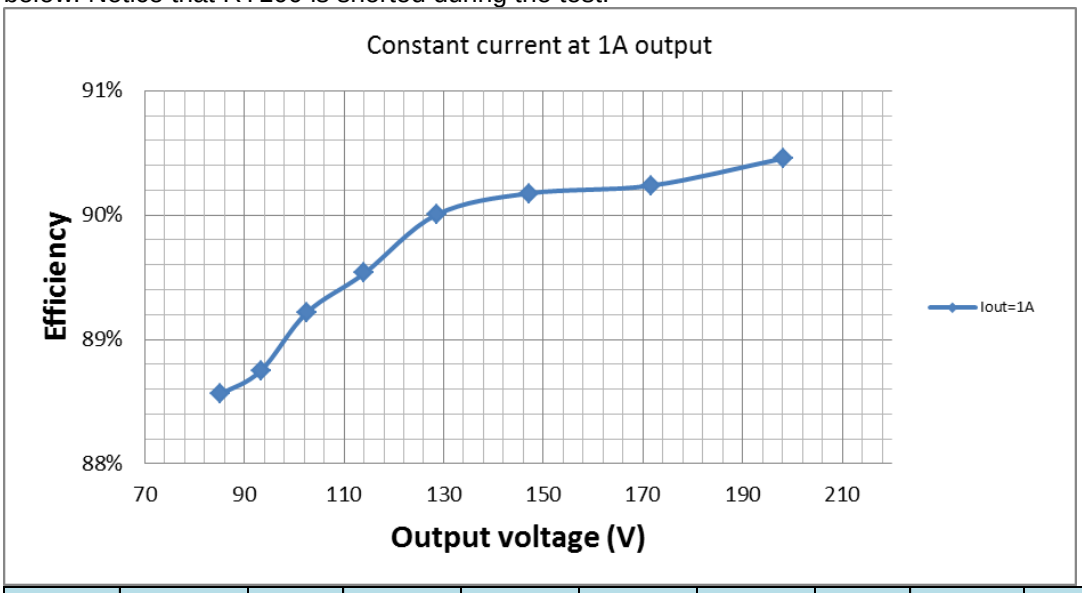
Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
230	0.937	213.20	0.990	3.93%	198.1	1.002	198.496	14.7038	93.10%
230	0.846	192.25	0.988	3.82%	198.1	0.900	178.290	13.9600	92.74%
229.9	0.753	170.77	0.986	3.44%	198.1	0.801	158.678	12.0919	92.92%
230	0.663	149.93	0.984	3.23%	198.2	0.701	138.938	10.9918	92.67%
229.9	0.574	129.35	0.980	3.07%	198.4	0.600	119.040	10.3100	92.03%
230	0.484	108.32	0.973	3.07%	198.5	0.500	99.250	9.0700	91.63%
230	0.395	87.48	0.962	3.41%	198.6	0.401	79.639	7.8414	91.04%
230	0.307	66.45	0.940	3.94%	198.7	0.301	59.809	6.6413	90.01%
230.1	0.220	45.10	0.891	5.55%	198.9	0.200	39.780	5.3200	88.20%
230	0.137	23.94	0.758	19.67%	199	0.101	20.099	3.8410	83.96%
229.9	0.098	13.23	0.586	21.15%	199.1	0.050	9.955	3.2760	75.24%

277V_{AC}/60Hz

Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
277	0.786	212.60	0.977	3.43%	198.1	1.001	198.298	14.3019	93.27%
277	0.708	190.86	0.973	3.05%	198.1	0.900	178.290	12.5700	93.41%
277	0.637	170.85	0.968	2.91%	198.1	0.800	158.480	12.3700	92.76%
277	0.564	150.02	0.961	2.80%	198.2	0.701	138.938	11.0818	92.61%
277	0.491	129.16	0.950	2.79%	198.4	0.601	119.238	9.9216	92.32%
277	0.419	108.22	0.933	2.84%	198.5	0.501	99.449	8.7715	91.89%
277	0.347	87.05	0.905	3.72%	198.6	0.400	79.440	7.6100	91.26%
277	0.277	66.06	0.862	6.49%	198.7	0.300	59.610	6.4500	90.24%
277	0.208	44.87	0.778	15.51%	198.9	0.201	39.979	4.8911	89.10%
277	0.153	24.03	0.568	20.32%	199	0.101	20.099	3.9310	83.64%
277	0.114	12.93	0.408	27.83%	199.2	0.050	9.960	2.9720	77.02%

2.2 Efficiency across different output voltages

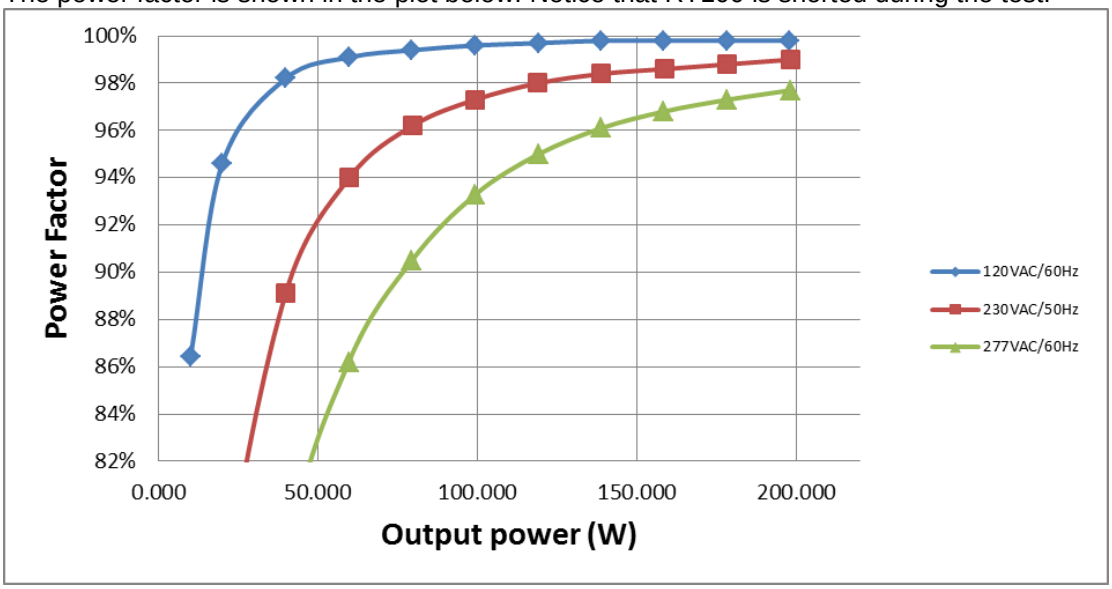
Converter efficiency across different output voltages with 1A regulation at 120VAC/60Hz is shown in the plot below. Notice that RT100 is shorted during the test.



Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
120	1.829	219.00	0.998	4.25%	198.1	1.000	198.100	20.9000	90.46%
119.96	1.631	195.22	0.998	3.42%	171.7	1.026	176.164	19.0558	90.24%
119.97	1.395	166.99	0.998	2.64%	147.2	1.023	150.586	16.4044	90.18%
120	1.214	145.31	0.997	2.29%	128.6	1.017	130.786	14.5238	90.00%
120.03	1.081	129.35	0.997	2.34%	114.1	1.015	115.812	13.5385	89.53%
120.01	0.973	116.27	0.996	2.63%	102.5	1.012	103.730	12.5400	89.21%
120.03	0.889	106.18	0.996	2.79%	93.3	1.010	94.233	11.9470	88.75%
119.94	0.812	96.88	0.995	2.96%	85.2	1.007	85.796	11.0836	88.56%

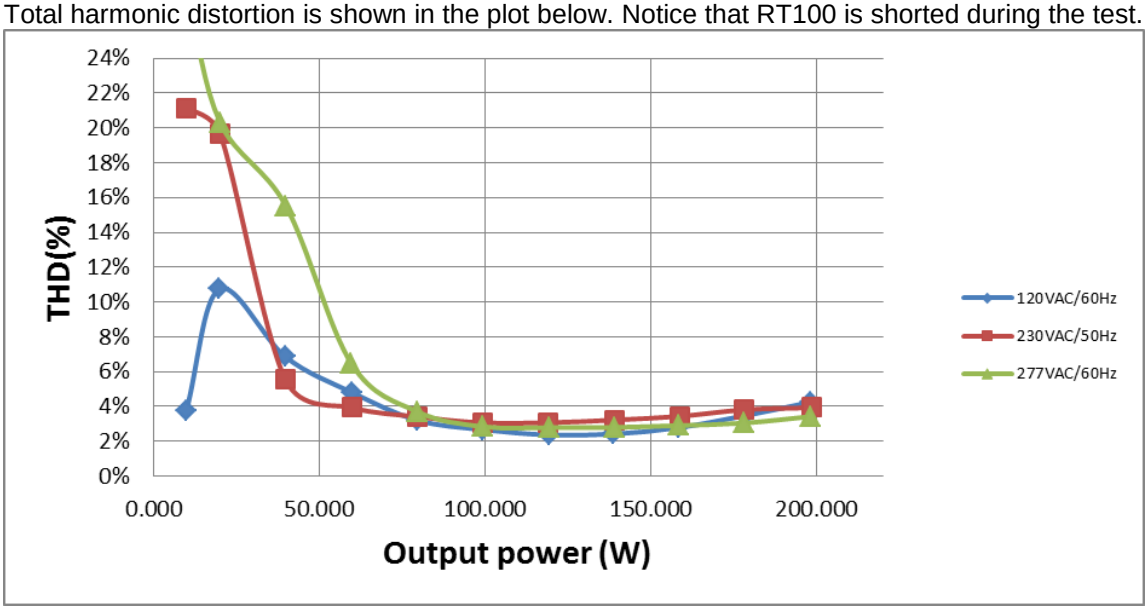
2.3 Power Factor

The power factor is shown in the plot below. Notice that RT100 is shorted during the test.



3 Total Harmonic Distortion

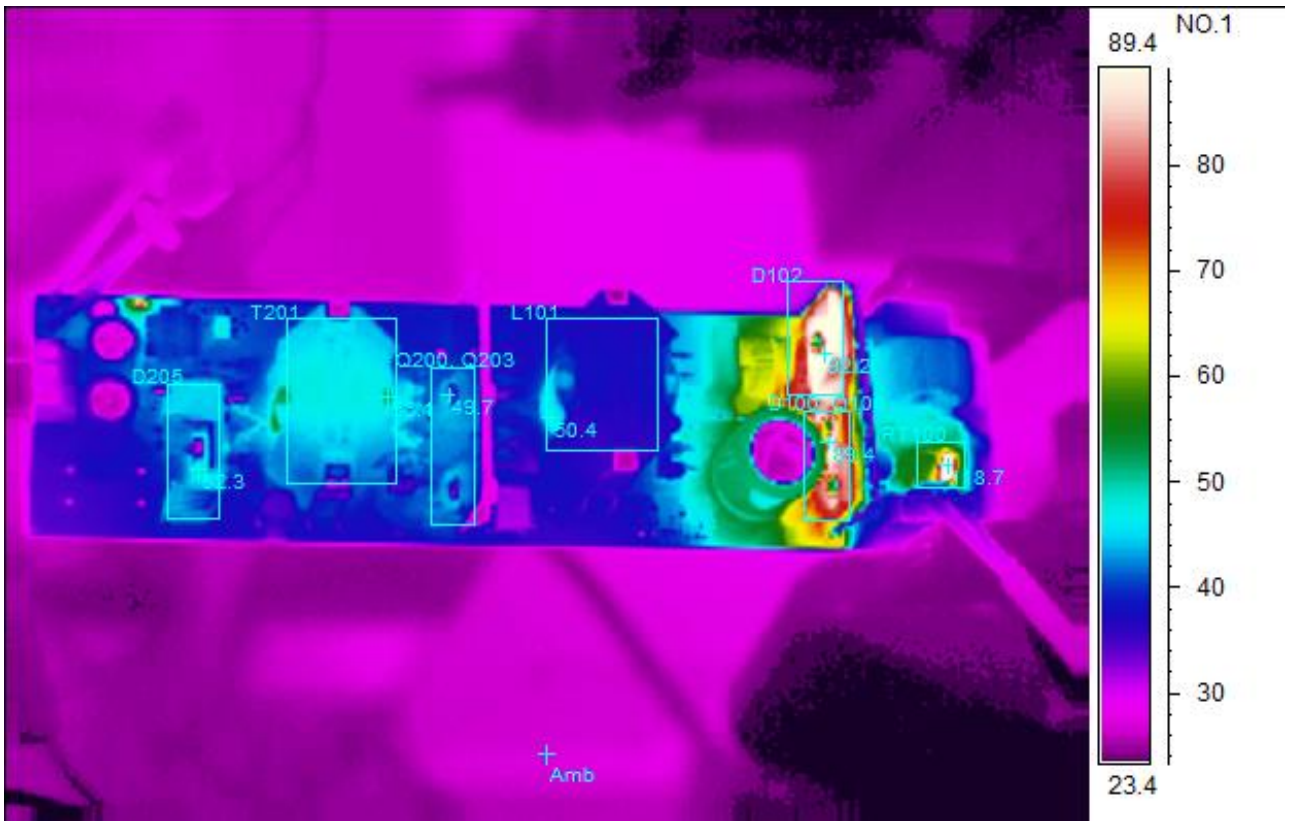
Total harmonic distortion is shown in the plot below. Notice that RT100 is shorted during the test.



4 Thermal Images

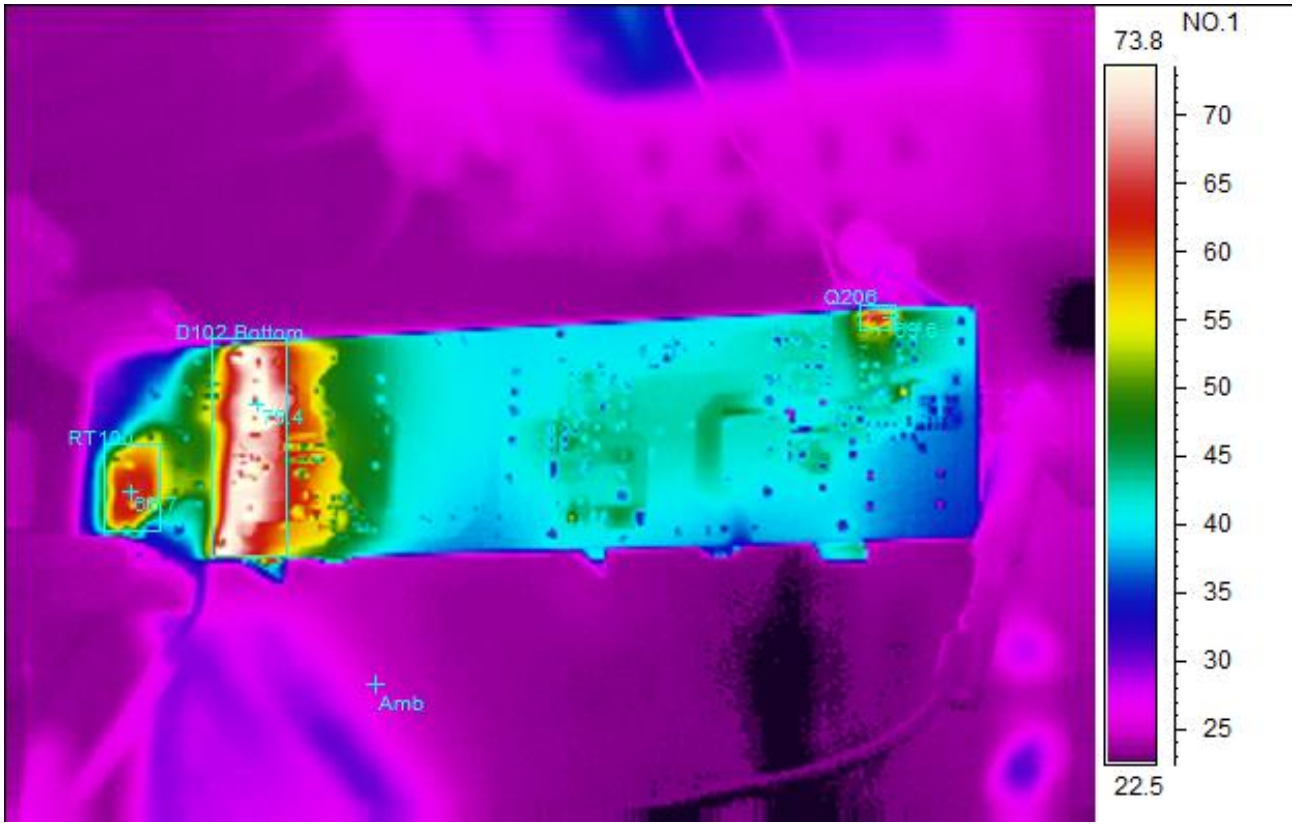
The thermal images below show a top view and bottom view of the board. The board is placed vertically during the test. The ambient temperature was 25ºC with no air flow. The output was loaded with 200V/1A.

4.1 120V/60Hz, Top Side



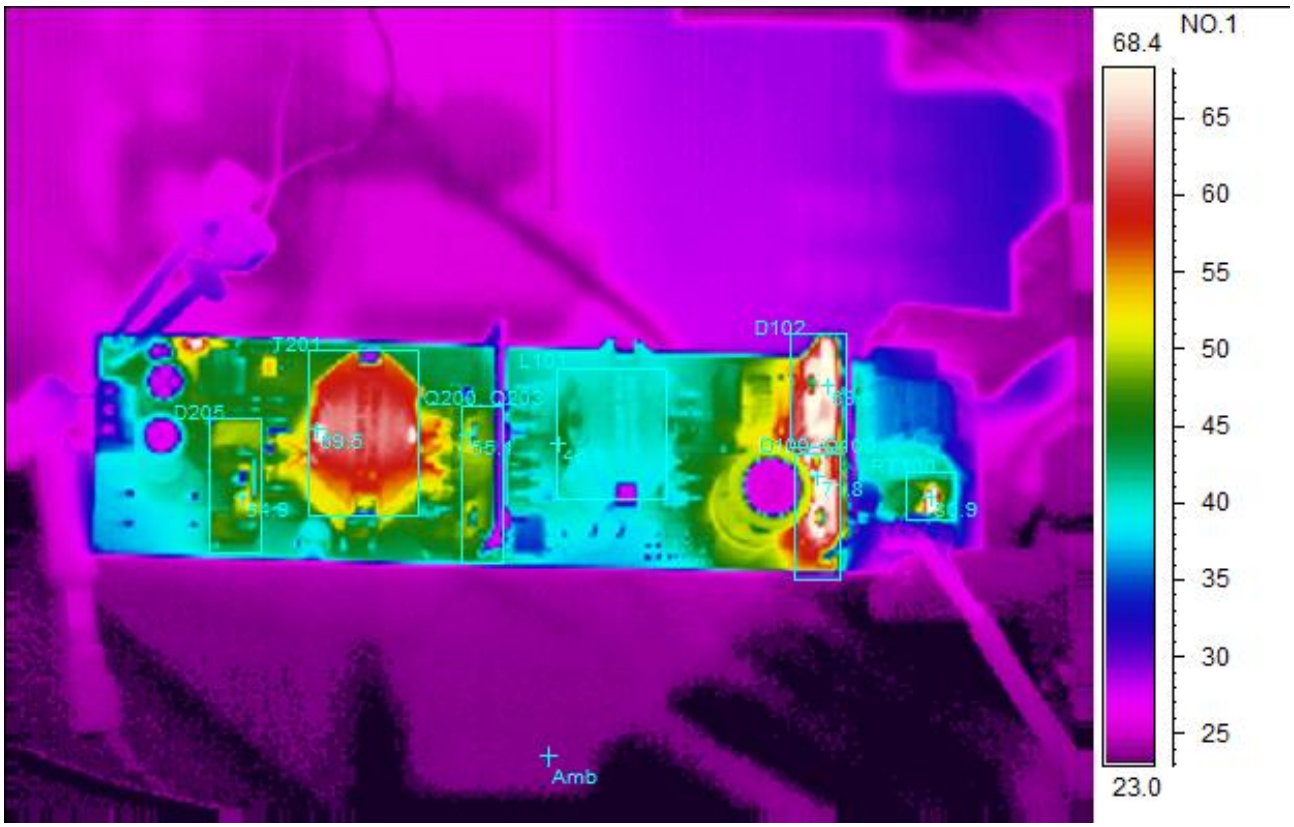
Spot analysis	Value
Amb Temperature	27.8°C
Area analysis	**Value**
RT100Max	118.7°C
D102 Max	92.2°C
D100, Q100Max	89.4°C
L101Max	50.4°C
Q200, Q203Max	49.7°C
T201Max	56.1°C
D205Max	52.3°C

4.2 120V/60Hz, Bottom Side



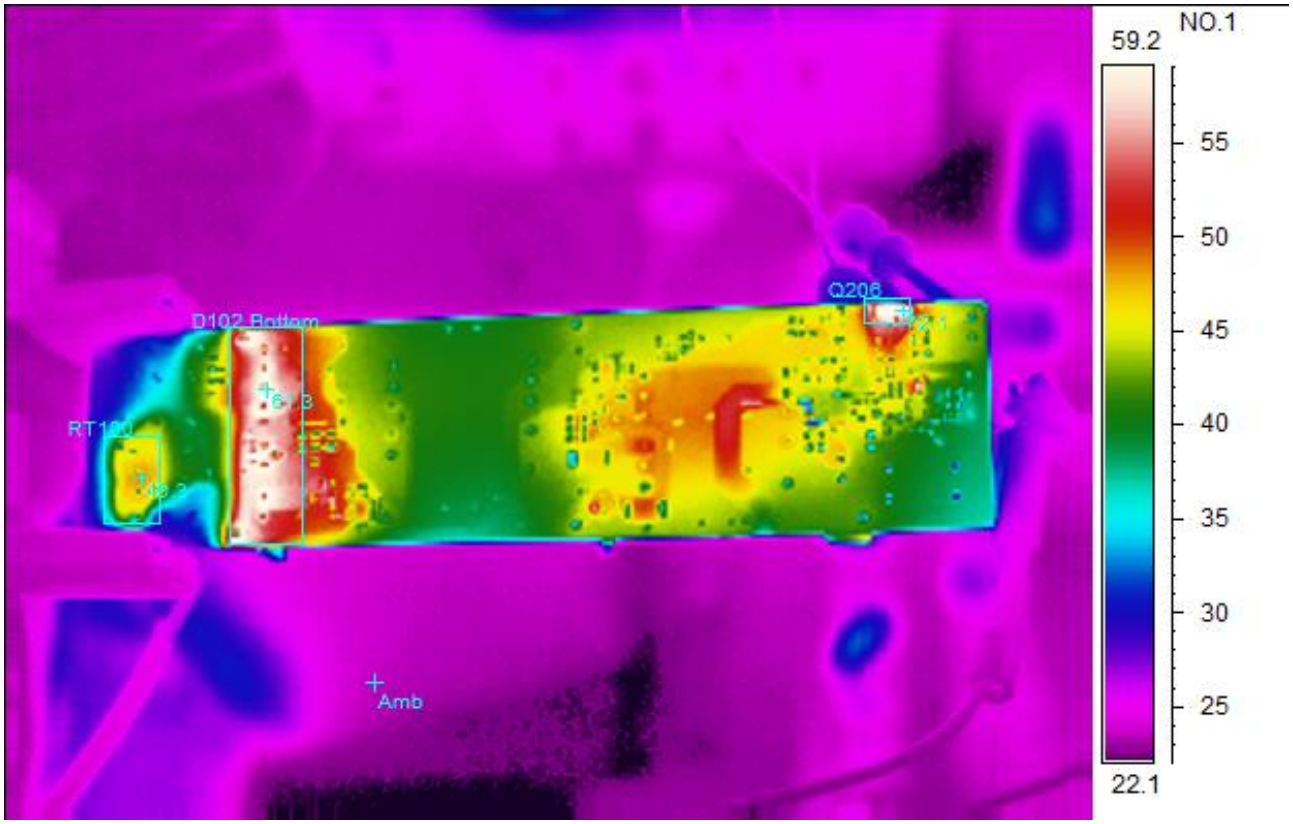
Spot analysis	Value
Amb Temperature	25.5°C
Area analysis	**Value**
RT100Max	66.7°C
D102 BottomMax	79.4°C
Q206Max	69.6°C

4.3 230V/50Hz, Top Side



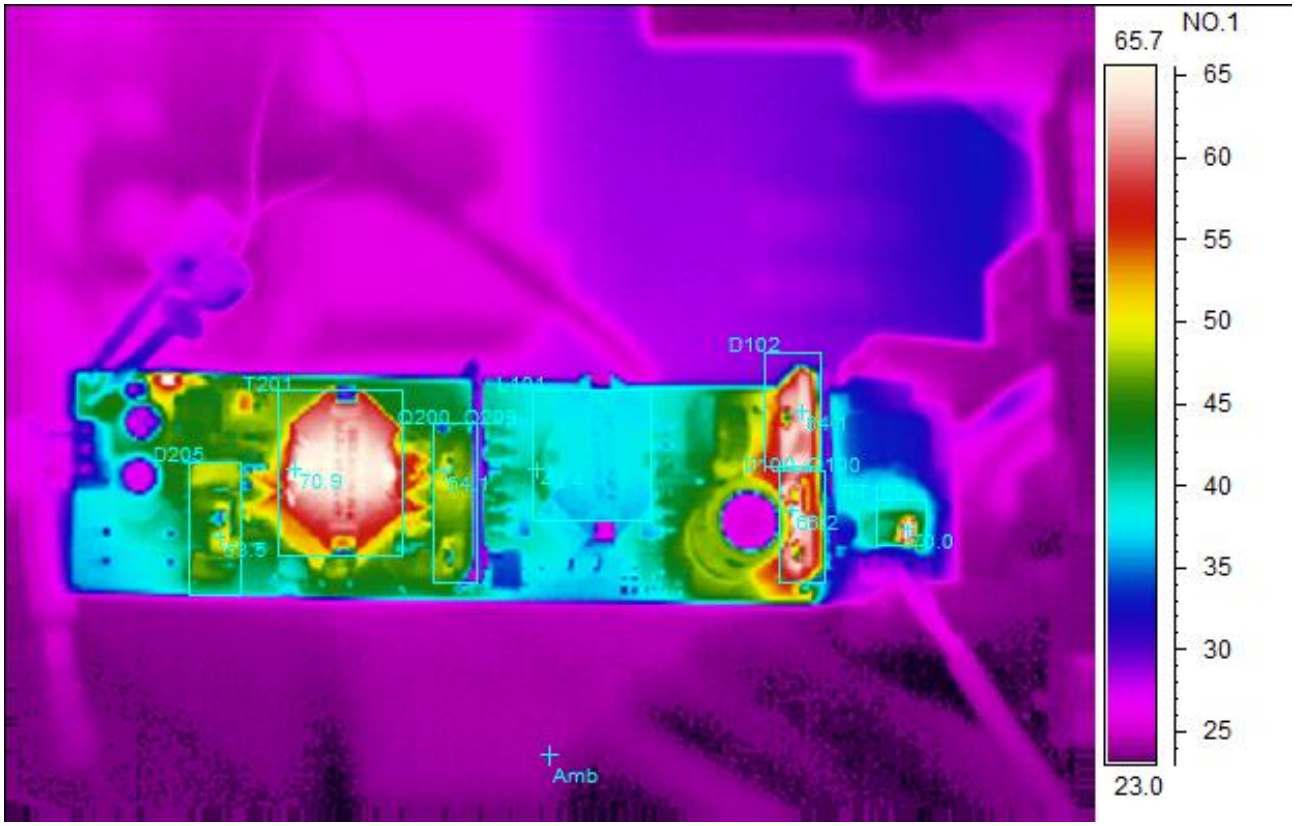
Spot analysis	Value
Amb Temperature	23.7°C
Area analysis	**Value**
RT100Max	80.9°C
D102 Max	69.6°C
D100, Q100Max	71.8°C
L101Max	46.9°C
Q200, Q203Max	55.1°C
T201Max	69.5°C
D205Max	54.9°C

4.4 230V/50Hz, Bottom Side



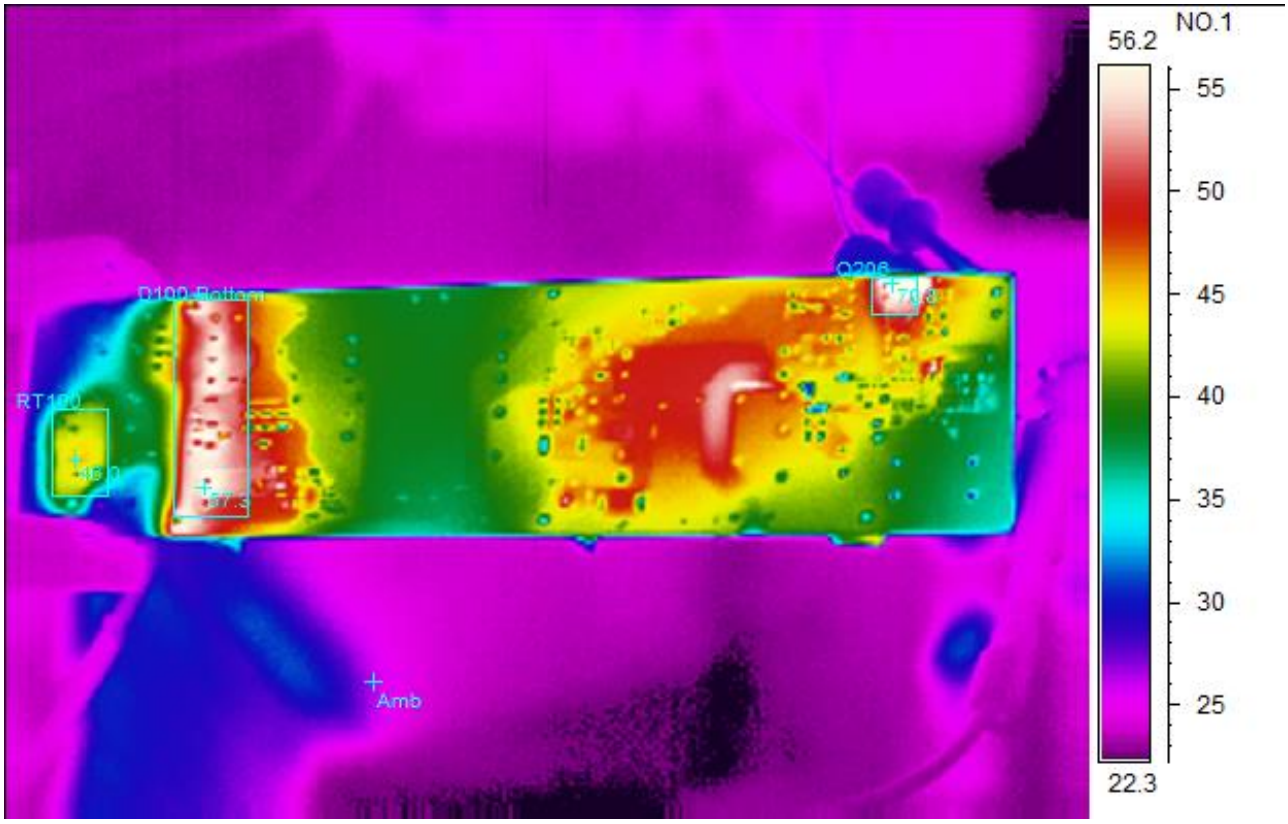
Spot analysis	Value
Amb Temperature	23.8°C
Area analysis	**Value**
RT100Max	49.3°C
D102 BottomMax	61.3°C
Q206Max	72.1°C

4.5 277V/60Hz, Top Side



Spot analysis	Value
Amb Temperature	24.2°C
Area analysis	**Value**
RT100Max	70.0°C
D102 Max	64.1°C
D100, Q100Max	66.2°C
L101Max	43.4°C
Q200, Q203Max	54.1°C
T201Max	70.9°C
D205Max	53.5°C

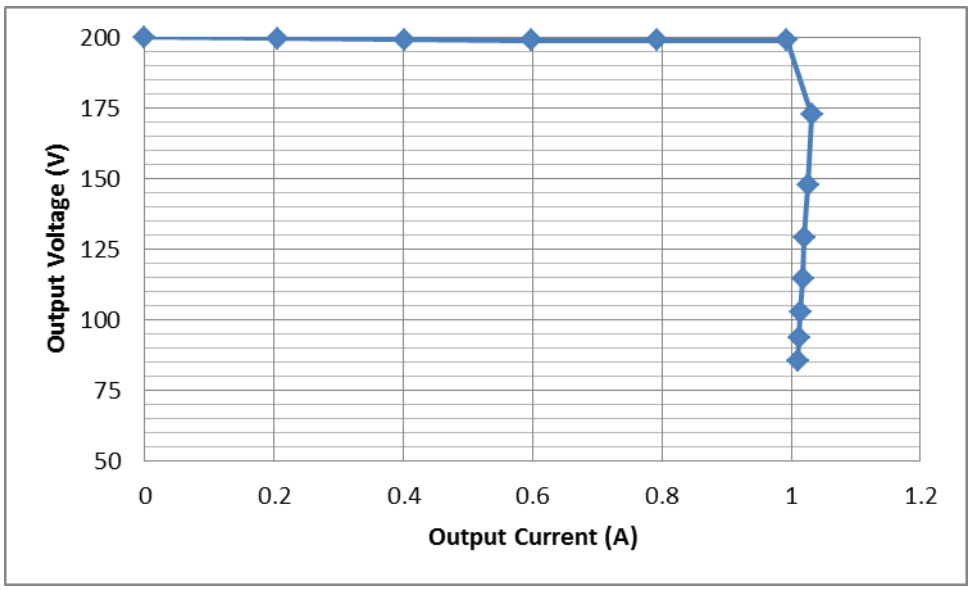
4.6 277V/60Hz, Bottom Side



Spot analysis	Value
Amb Temperature	26.3°C
Area analysis	**Value**
RT100Max	46.0°C
D100 Bottom Max	57.3°C
Q206Max	70.8°C

5 Constant Current/Constant Voltage Regulation

During this test, resistive load is applied to the output. Input condition is 120VAC/60Hz

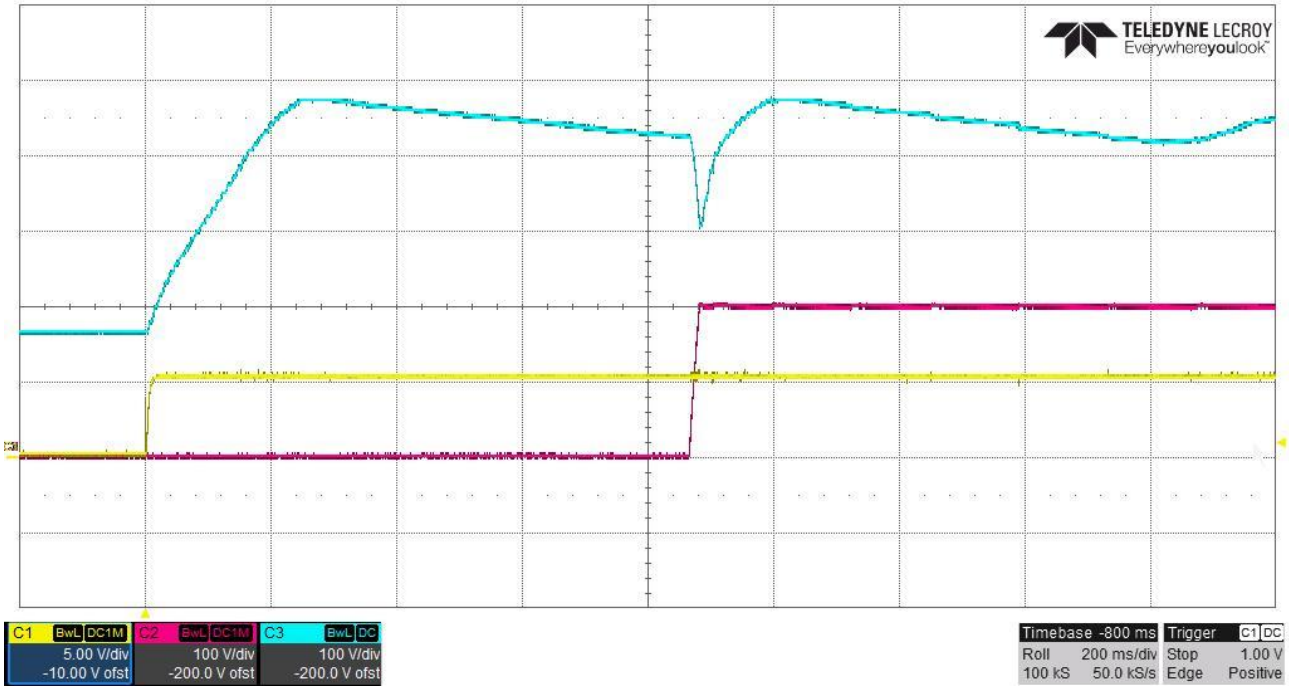


Iout(A)	0	0.205	0.403	0.599	0.793	0.993	1.032	1.026	1.02	1.018	1.014	1.012	1.01
Vout(V)	200	199.4	199.1	198.9	198.8	198.7	172.5	147.6	129	114.4	102.7	93.5	85.4
Rout(ohm)	∞	972.6829	494.0447	332.0534	250.6936	200.1007	167.1512	143.8596	126.4706	112.3772	101.2821	92.3913	84.55446

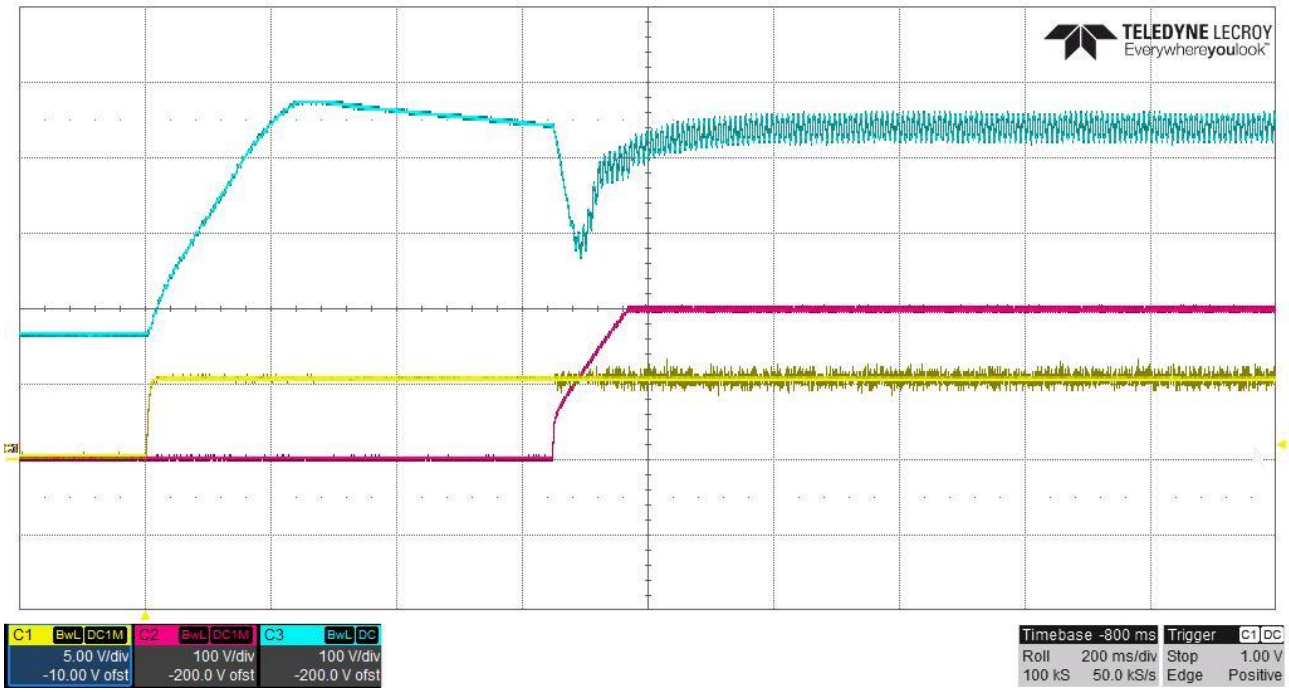
6 Startup

The voltages at startup are shown in the images below, where CH1 is the output voltage across J200, CH2 is the PSON signal on C231, and CH4 is bulk capacitor voltage across C104.

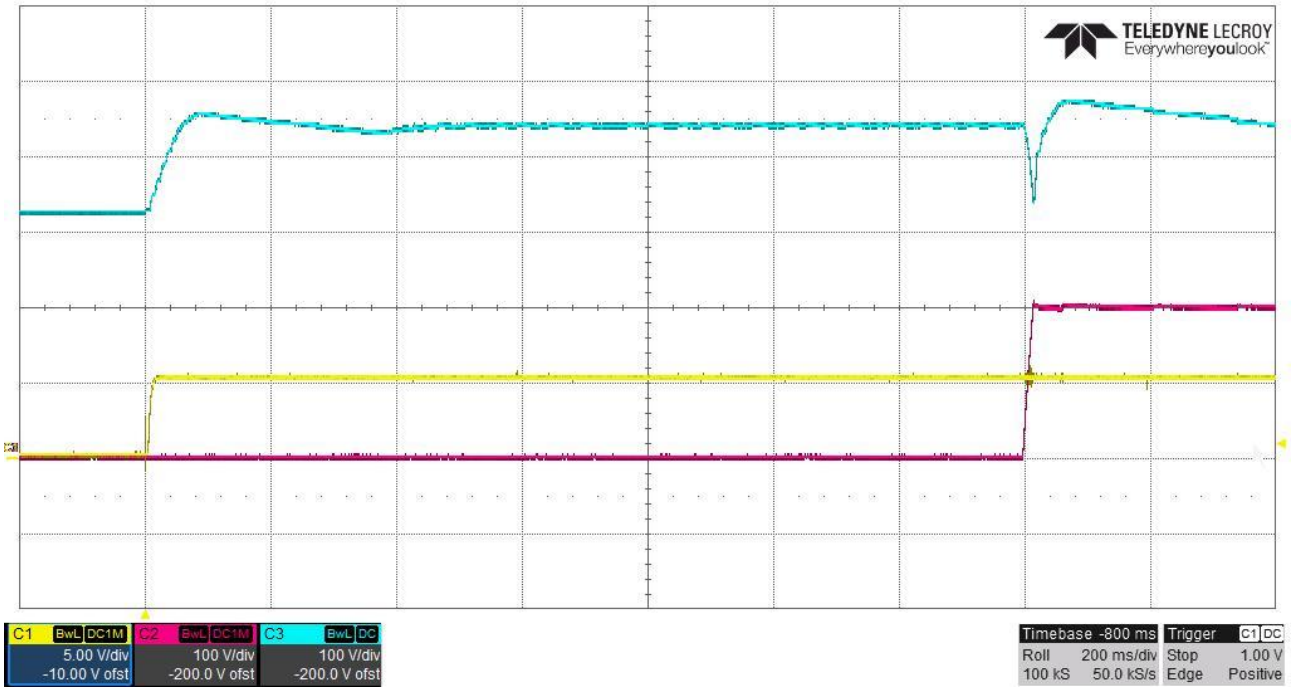
6.1 $120V_{AC}$/60Hz – No Load



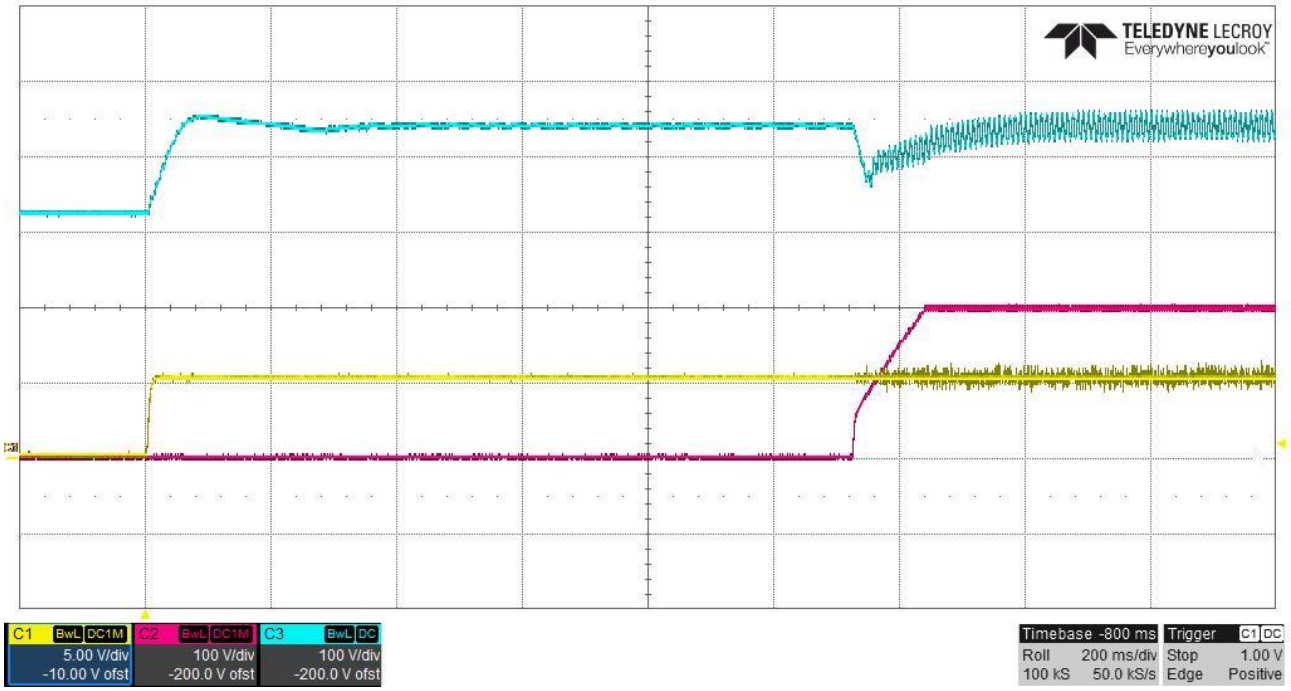
6.2 $120V_{AC}$/60Hz –200V/1A



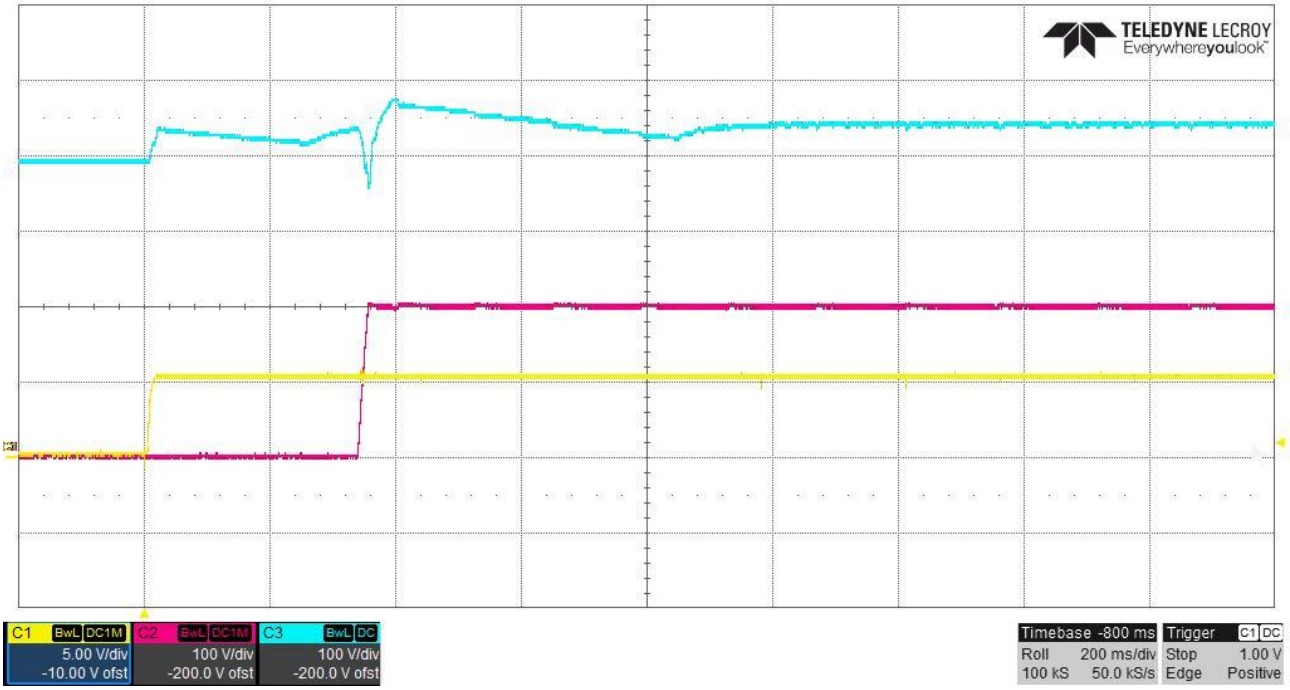
6.3 $230V_{AC}$/50Hz – No Load



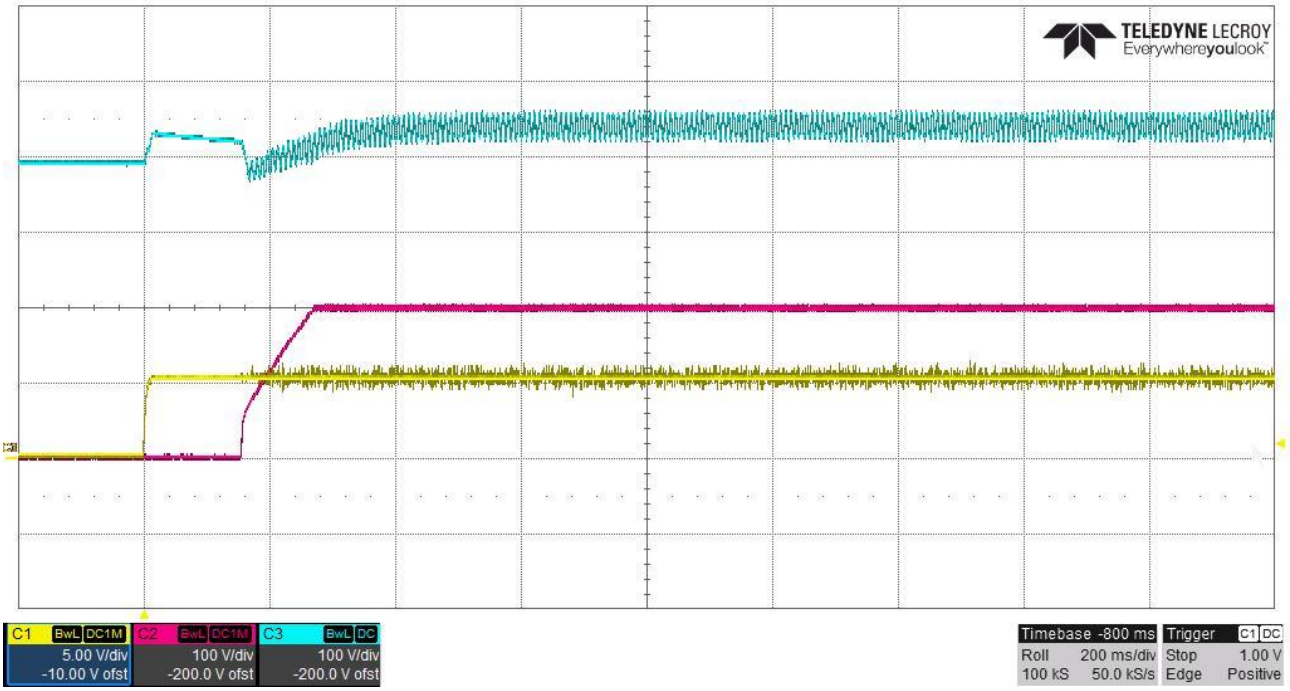
6.4 $230V_{AC}$/50Hz – 200V/1A



6.5 277V_{AC}/60Hz – No Load



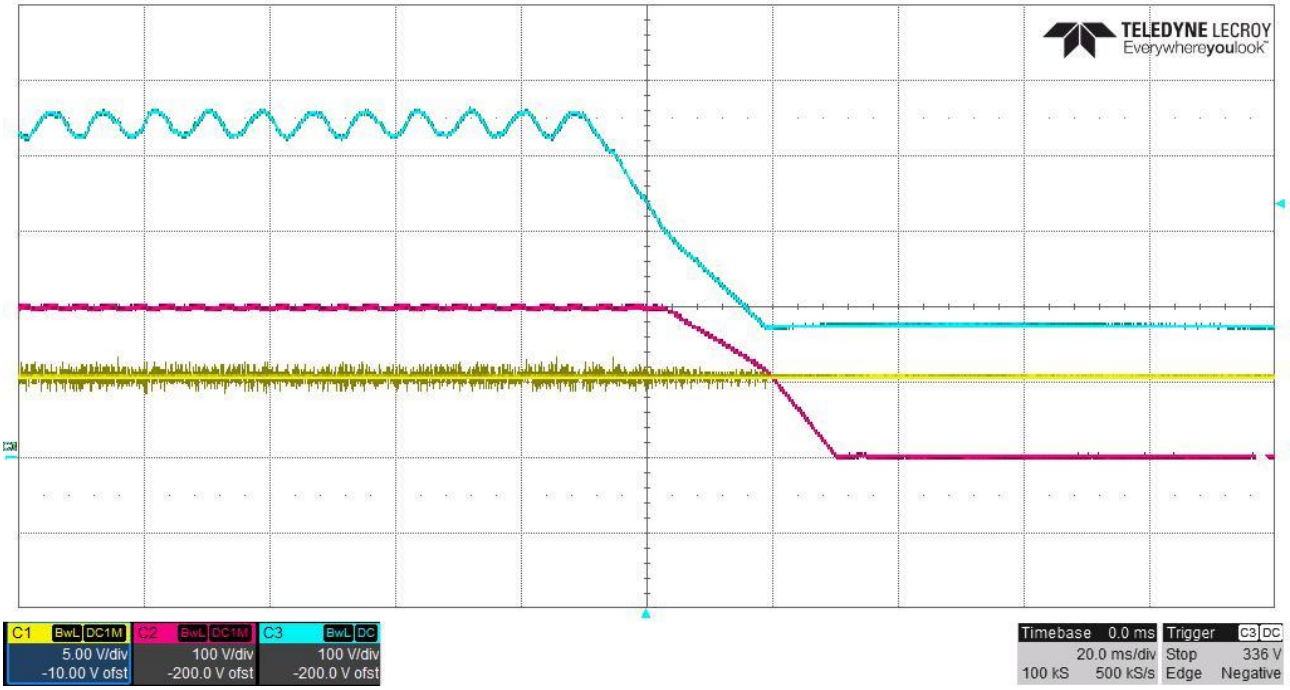
6.6 277V_{AC}/60Hz – 200V/1A



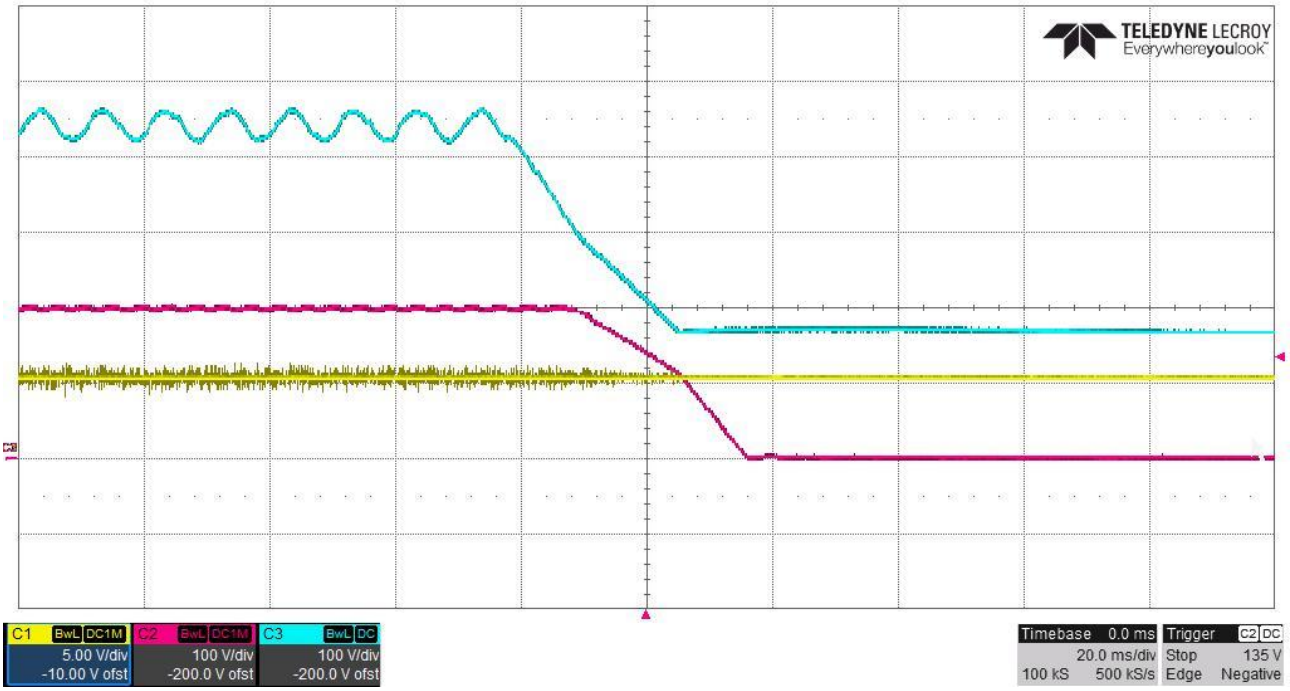
7 Turn-off

The voltages at turn-off are shown in the images below, where CH1 is the output voltage across J200, CH2 is the PSON signal on C231, and CH4 is bulk capacitor voltage across C104.

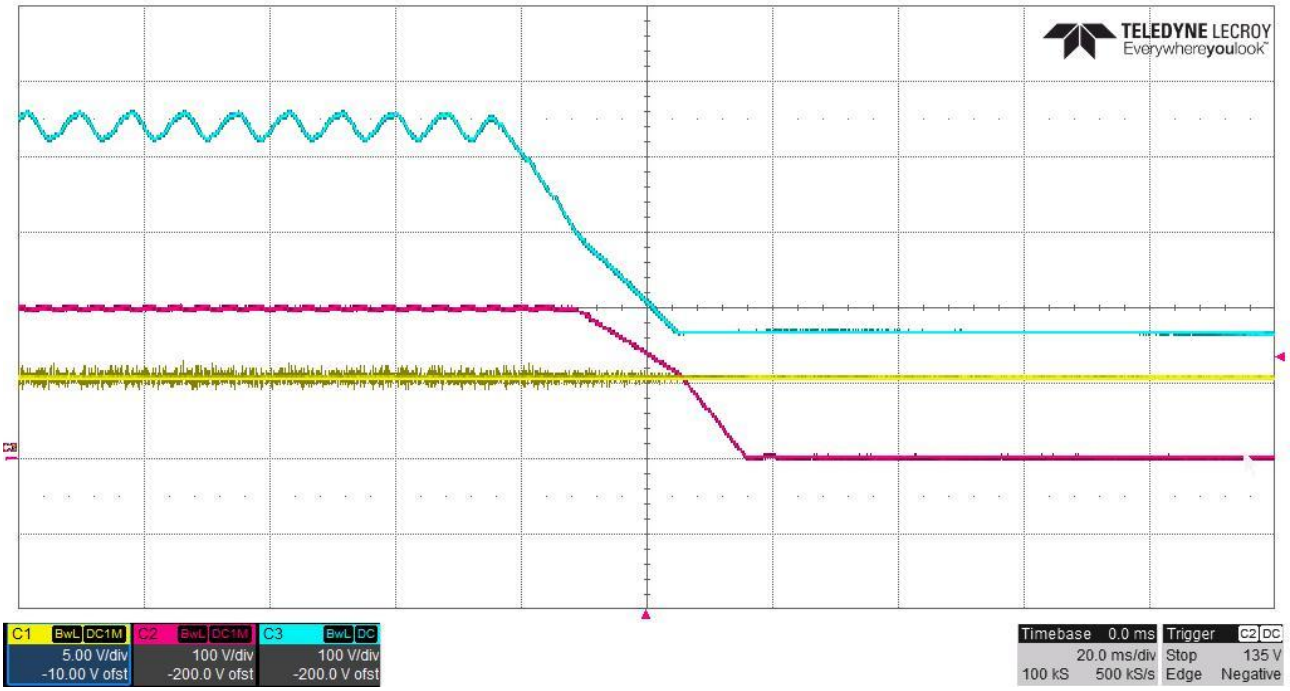
7.1 $120V_{AC}$/60Hz – 200V/1A



7.2 $230V_{AC}$/50Hz – 200V/1A

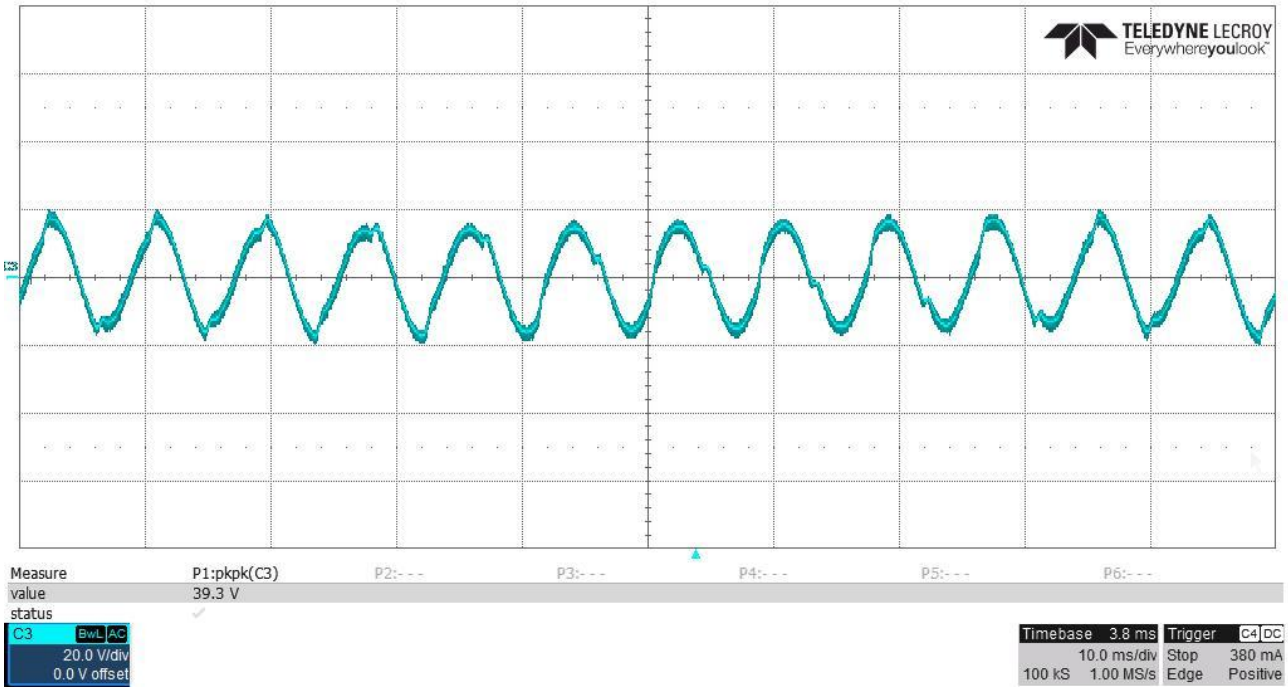


7.3 277V_{AC}/60Hz – 200V/1A

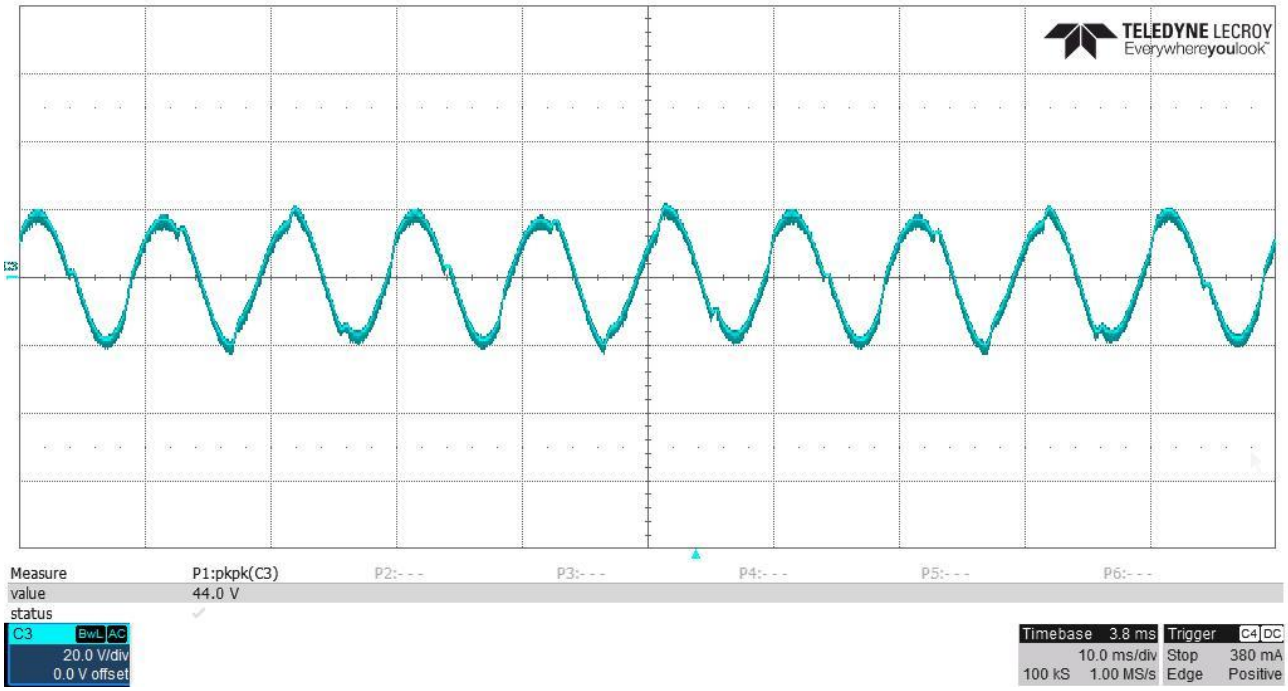


8 Ripple Voltage

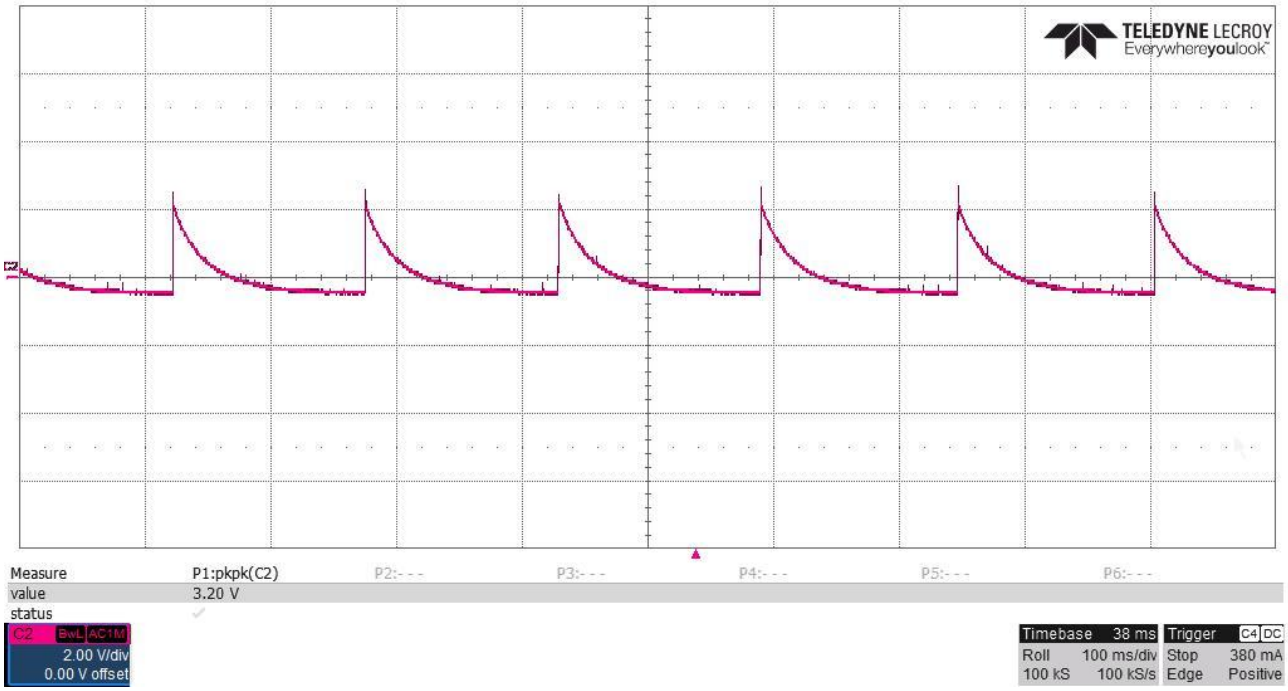
8.1 PFC output ripple (C104) at 120V_{AC}/60Hz, 200V/1A output



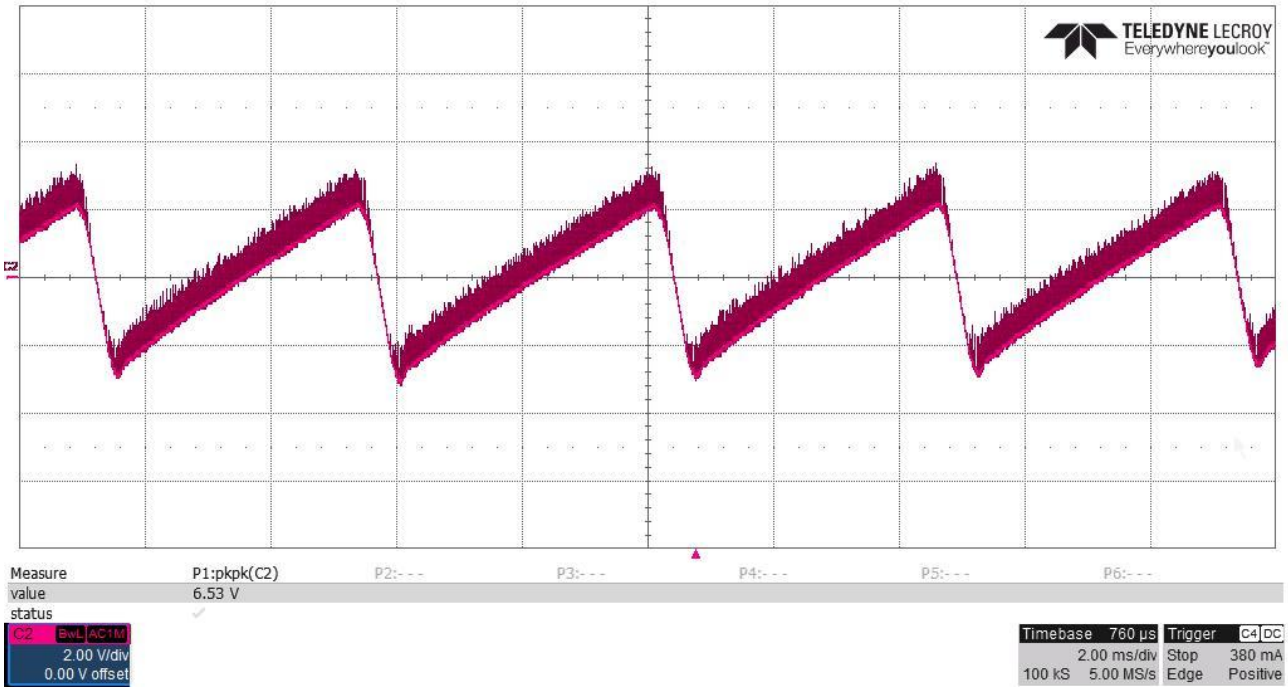
8.2 PFC output ripple (C104) at 230V_{AC}/50Hz, 200V/1A output



8.3 200V output ripple at no load



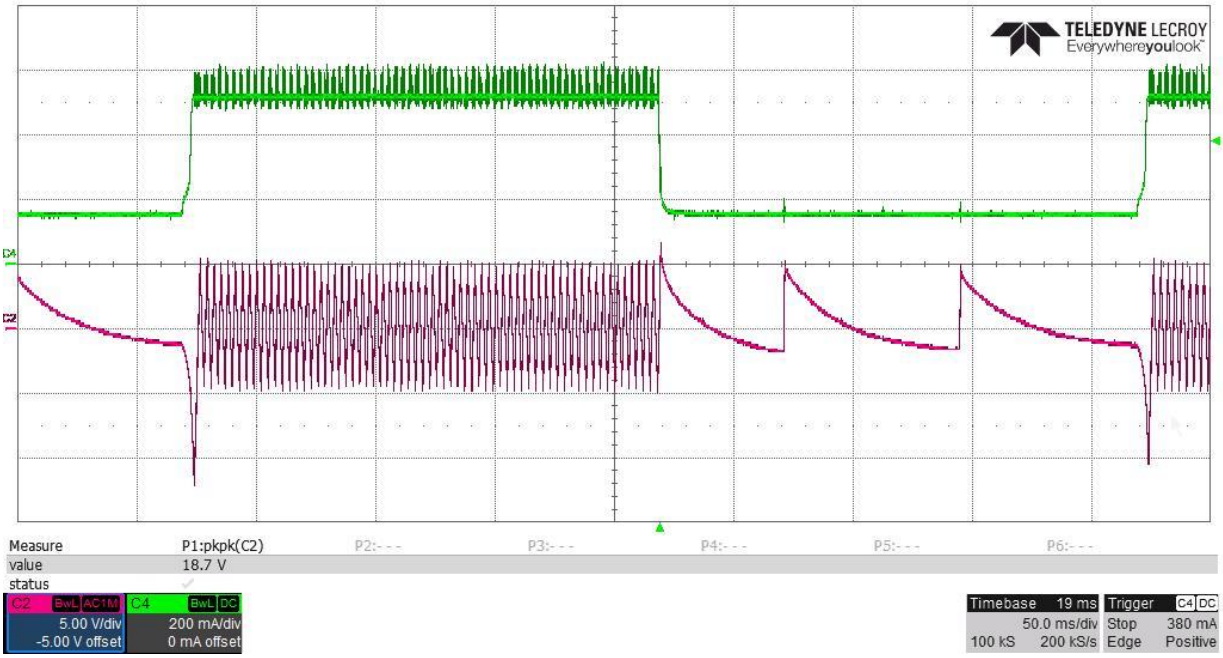
8.4 200V output ripple at 1A load



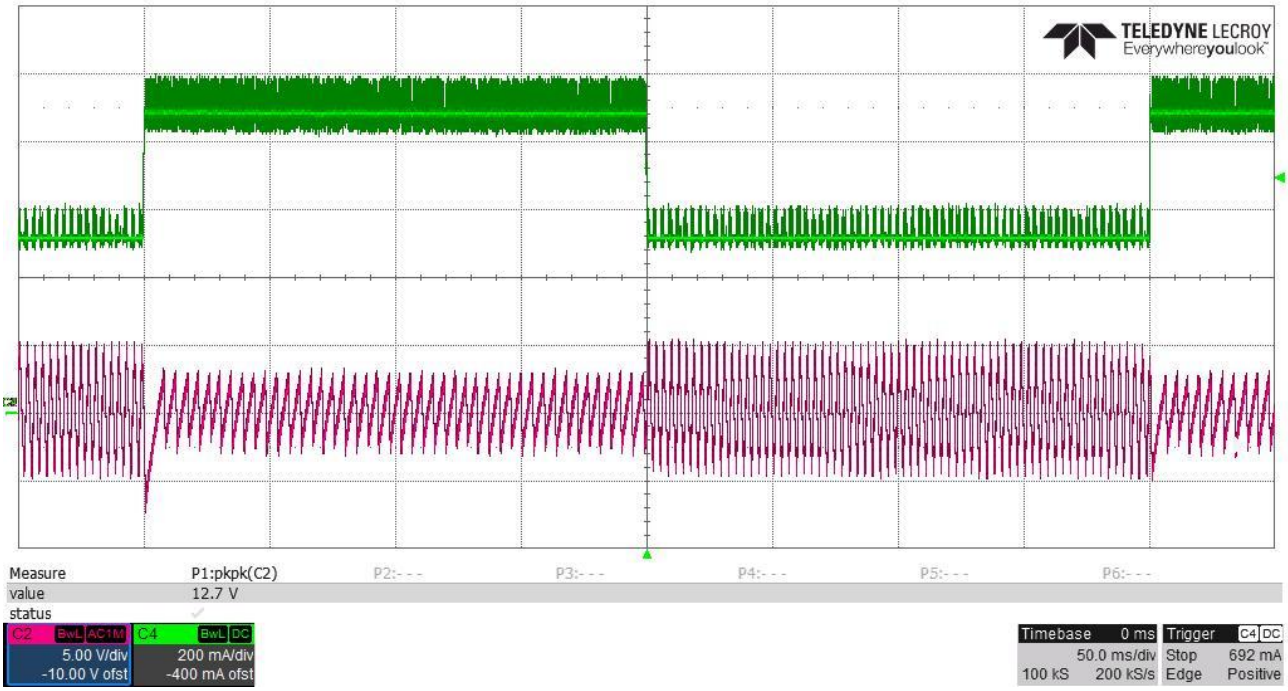
9 Load Response

Load response is tested at 230V_{AC}/50Hz input.

9.1 Load step from 0.15A to 0.5A:

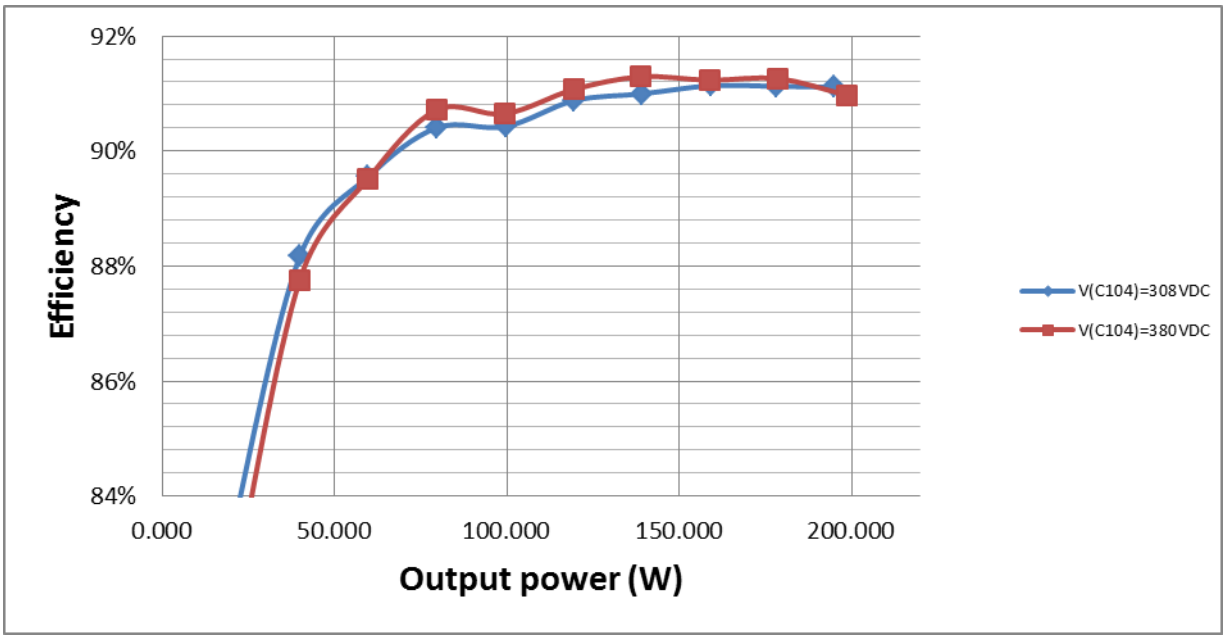


9.2 Load step from 0.5A to 1A:



10 Additional tests

10.1 Efficiencies with different PFC output voltages @ 120V_{AC}/60Hz Input



- **308VDC at C104**

Following component changes have to be made to perform this test:

- R204 => 78.7kohm
- R216 => 20.5kohm
- R118 => 16.5kohm
- Add additional 47uF/400V capacitor in parallel with C104.

Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
120.01	1.785	213.80	0.998	3.52%	194.6	1.001	194.795	19.0054	91.11%
120.05	1.631	195.45	0.998	2.77%	197.9	0.900	178.110	17.3400	91.13%
120.07	1.457	174.55	0.998	2.58%	198.6	0.801	159.079	15.4714	91.14%
120.08	1.278	153.08	0.998	2.13%	199	0.700	139.300	13.7800	91.00%
120	1.099	131.45	0.997	2.04%	199.1	0.600	119.460	11.9900	90.88%
120.03	0.921	110.09	0.996	2.23%	199.1	0.500	99.550	10.5400	90.43%
120.02	0.734	88.09	0.995	2.44%	199.1	0.400	79.640	8.4500	90.41%
120.07	0.561	66.73	0.991	3.48%	199.2	0.300	59.760	6.9700	89.55%
120.04	0.383	45.21	0.983	4.96%	199.3	0.200	39.860	5.3500	88.17%
119.89	0.213	24.18	0.948	8.10%	199.4	0.101	20.139	4.0406	83.29%
120.02	0.121	12.73	0.875	7.19%	199.4	0.051	10.169	2.5636	79.87%

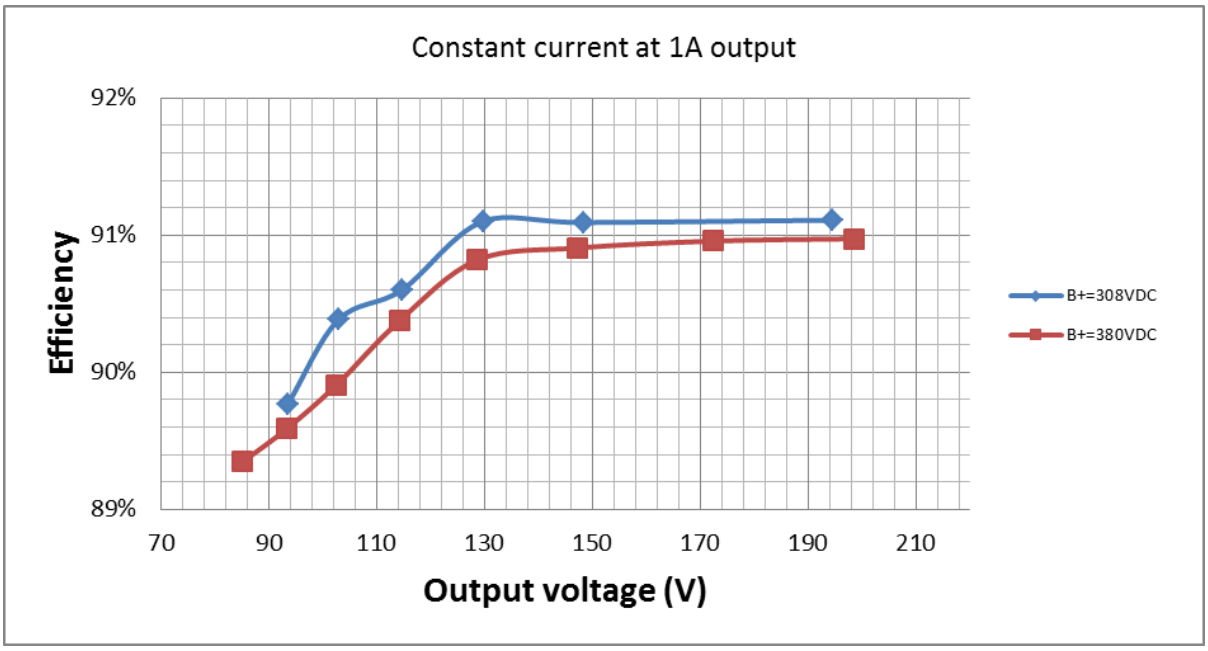
- **380VDC at C104**

Following component changes have to be made to perform this test:

- R204 => 100kohm
- R216 => 27.4kohm
- R118 => 13.3kohm
- Add additional 47uF/400V capacitor in parallel with C104.

Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
120.04	1.822	218.30	0.998	3.84%	198.4	1.001	198.598	19.7016	90.97%
119.96	1.634	195.66	0.998	2.92%	198.4	0.900	178.560	17.1000	91.26%
119.99	1.452	173.97	0.998	2.33%	198.4	0.800	158.720	15.2500	91.23%
119.99	1.276	152.20	0.998	1.90%	198.5	0.700	138.950	13.2500	91.29%
120.01	1.095	131.06	0.997	1.87%	198.6	0.601	119.359	11.7014	91.07%
120.07	0.916	109.60	0.996	2.26%	198.7	0.500	99.350	10.2500	90.65%
120.12	0.734	87.66	0.995	2.80%	198.8	0.400	79.520	8.1400	90.71%
119.98	0.561	66.69	0.991	4.24%	199	0.300	59.700	6.9900	89.52%
120.02	0.385	45.38	0.982	6.09%	199.1	0.200	39.820	5.5600	87.75%
120.07	0.213	24.27	0.947	9.66%	199.2	0.100	19.920	4.3500	82.08%
120.02	0.119	12.47	0.872	6.94%	199.3	0.049	9.766	2.7053	78.31%

10.2 Efficiencies across different output voltages with different PFC output voltage



- **308VDC at C104**

Following component changes have to be made to perform this test:

- R204 => 78.7kohm
- R216 => 20.5kohm
- R118 => 16.5kohm
- Add additional 47uF/400V capacitor in parallel with C104.

Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
120.01	1.785	213.80	0.998	3.52%	194.6	1.001	194.795	19.0054	91.11%
120.09	1.402	167.96	0.998	2.42%	148.4	1.031	153.000	14.9596	91.09%
119.99	1.220	146.07	0.997	2.05%	129.7	1.026	133.072	12.9978	91.10%
120.02	1.079	129.13	0.997	2.00%	114.7	1.020	116.994	12.1360	90.60%
120.04	0.967	115.67	0.996	2.15%	102.9	1.016	104.546	11.1236	90.38%
120.01	0.882	105.41	0.996	2.25%	93.5	1.012	94.622	10.7880	89.77%

- **380VDC at C104**

Following component changes have to be made to perform this test:

- R204 => 100kohm
- R216 => 27.4kohm
- R118 => 13.3kohm
- Add additional 47uF/400V capacitor in parallel with C104.

Vin,rms(V)	Iin,rms(A)	Pin(W)	P.F.	THD	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
120.04	1.822	218.30	0.998	3.84%	198.4	1.001	198.598	19.7016	90.97%
120.03	1.630	195.30	0.998	2.98%	172.3	1.031	177.641	17.6587	90.96%
120.06	1.385	165.92	0.998	2.19%	147.3	1.024	150.835	15.0848	90.91%
120	1.206	144.40	0.998	1.78%	128.7	1.019	131.145	13.2547	90.82%
120.05	1.073	128.51	0.997	1.93%	114.2	1.017	116.141	12.3686	90.38%
120.04	0.965	115.49	0.997	2.14%	102.5	1.013	103.833	11.6575	89.91%
120.03	0.881	105.29	0.996	2.36%	93.3	1.011	94.326	10.9637	89.59%
120.11	0.804	96.12	0.995	2.52%	85.2	1.008	85.882	10.2384	89.35%

10.3 2-SW Flyback standby power

The test was performed with B+=460VDC. I.e. R118=11kohm. Other than R118 value, following modifications have to be made to perform this test:

- Disable Bias Flyback by cutting the trace from B+ to T202.
- Remove R229, R100, R107, R109.
- R201=2.2Mohm.
- R204=39.2kohm.
- R216=10.2kohm.

Vin(Vrms)	Iin(mArms)	Fin(Hz)	Pin(mW)	Vout(V)	Iout(mA)	Pout(W)
230.3	49.6	50	250.3	198.2	0	0
240	51.58	50	254.1	198.2	0	0
265	56.49	50	270.8	198.2	0	0
277	70.89	60	282.6	198.2	0	0
230.1	50.35	50	487.3	198.2	1.09	0.216038
240	52.25	50	489.2	198.2	1.09	0.216038
265	56.99	50	496.9	198.2	1.09	0.216038
277	71.19	60	497.6	198.2	1.04	0.206128
230	50.03	50	414.9	198.2	0.757	0.150037
240	52.01	50	418.4	198.2	0.757	0.150037
265	56.78	50	421	198.2	0.757	0.150037
277	71.08	60	440.4	198.2	0.757	0.150037

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