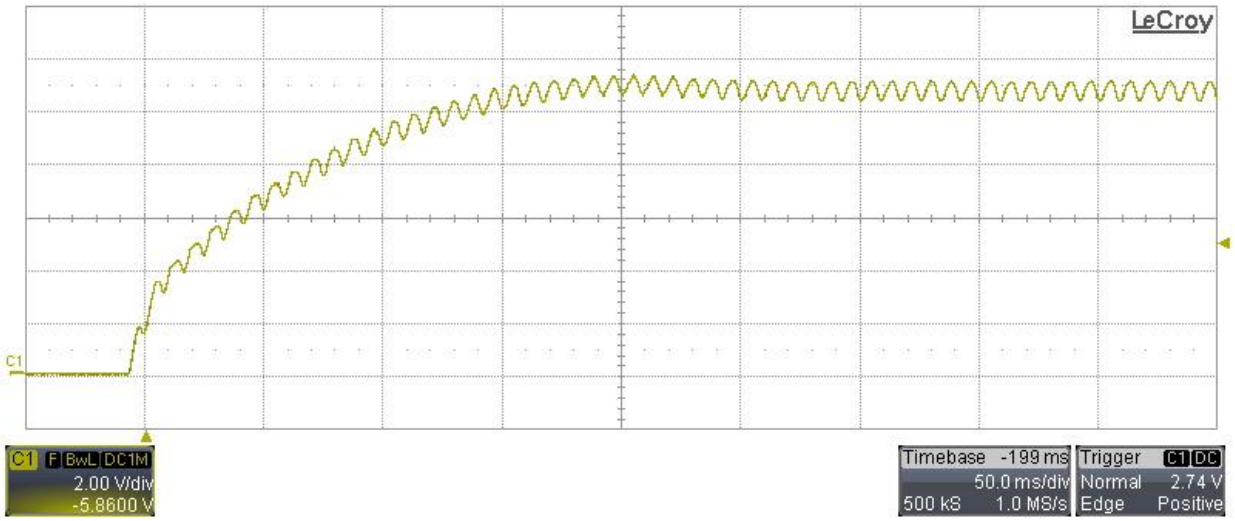
1 PHOTO OF THE PROTOTYPE

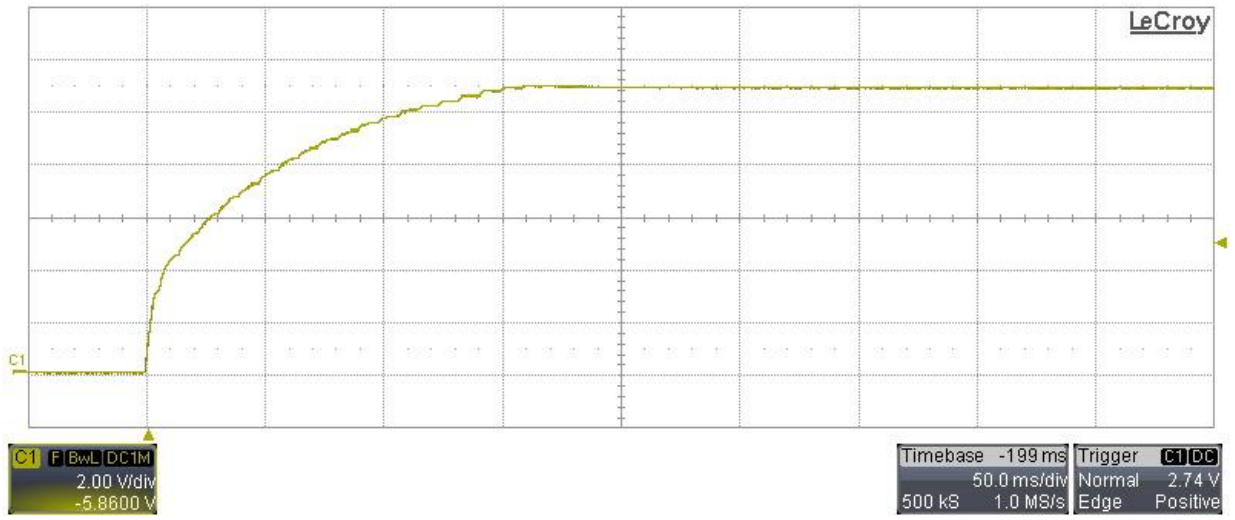
2 Startup

The output voltage behavior at startup is shown in the images below. The input voltage was set to 115Vac, 60Hz and 230Vac, 50Hz and the output loaded at 2A and 0A.

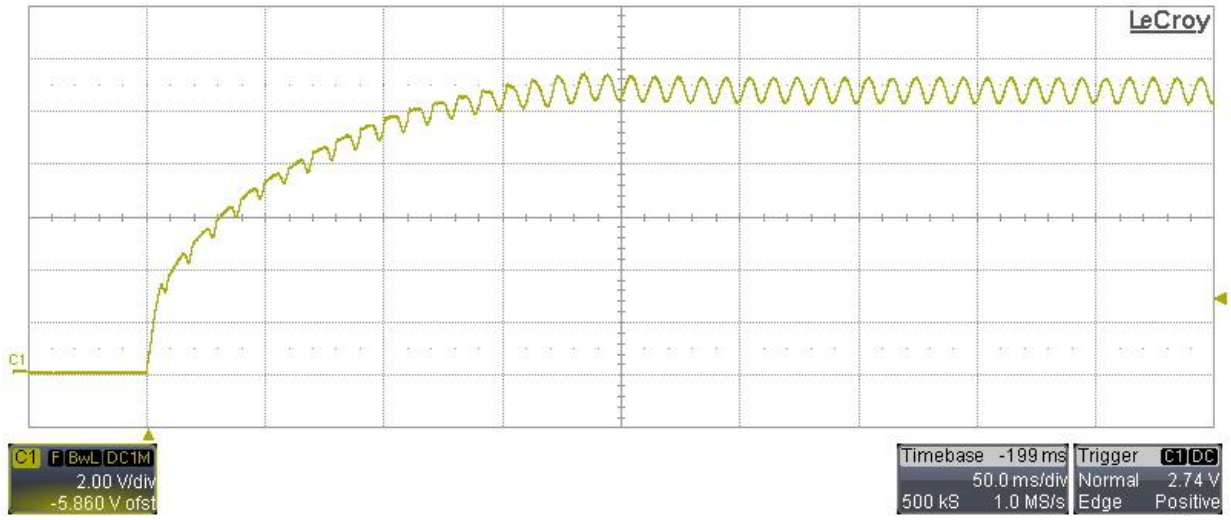
Channel 1: Output voltage (2V/div, 50ms/div, 20MHz BWL)
Vin = 115Vac, 60Hz, 2A load



Channel 1: Output voltage (2V/div, 50ms/div, 20MHz BWL)
Vin = 115Vac, 60Hz, 0A load

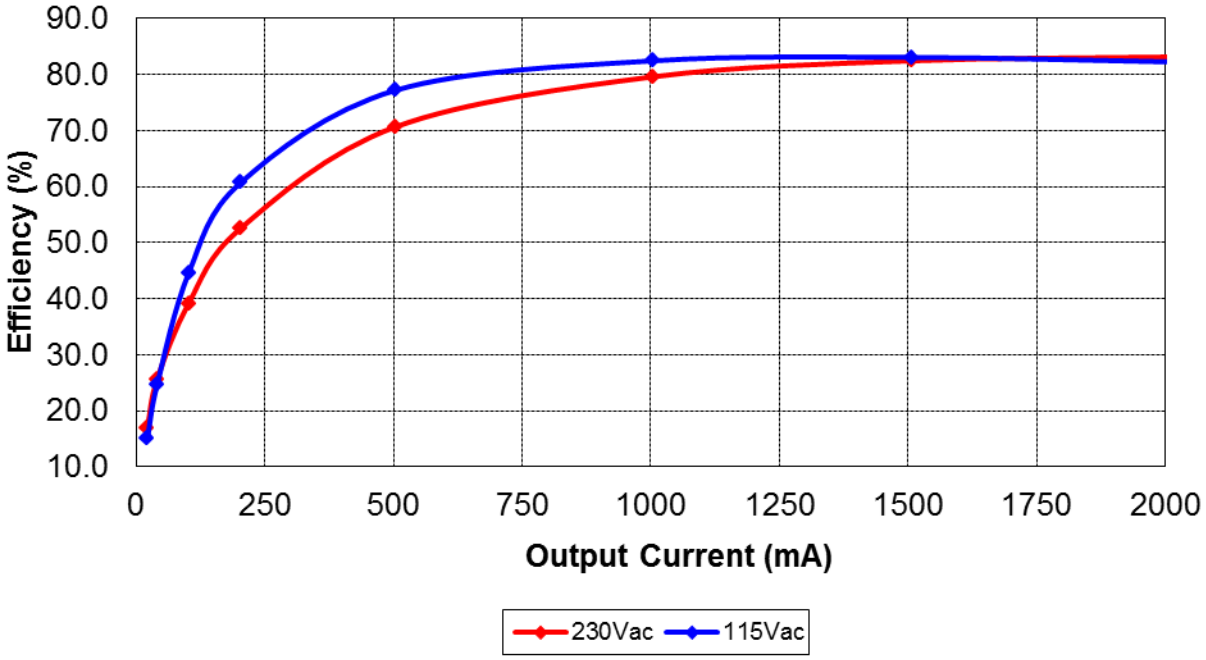


Channel 1: Output voltage (2V/div, 50ms/div, 20MHz BWL)
Vin = 230Vac, 50Hz, 2A load



3 Efficiency

The efficiency data are shown in the tables and graph below. The input and output conditions were the same as described in "startup" section.

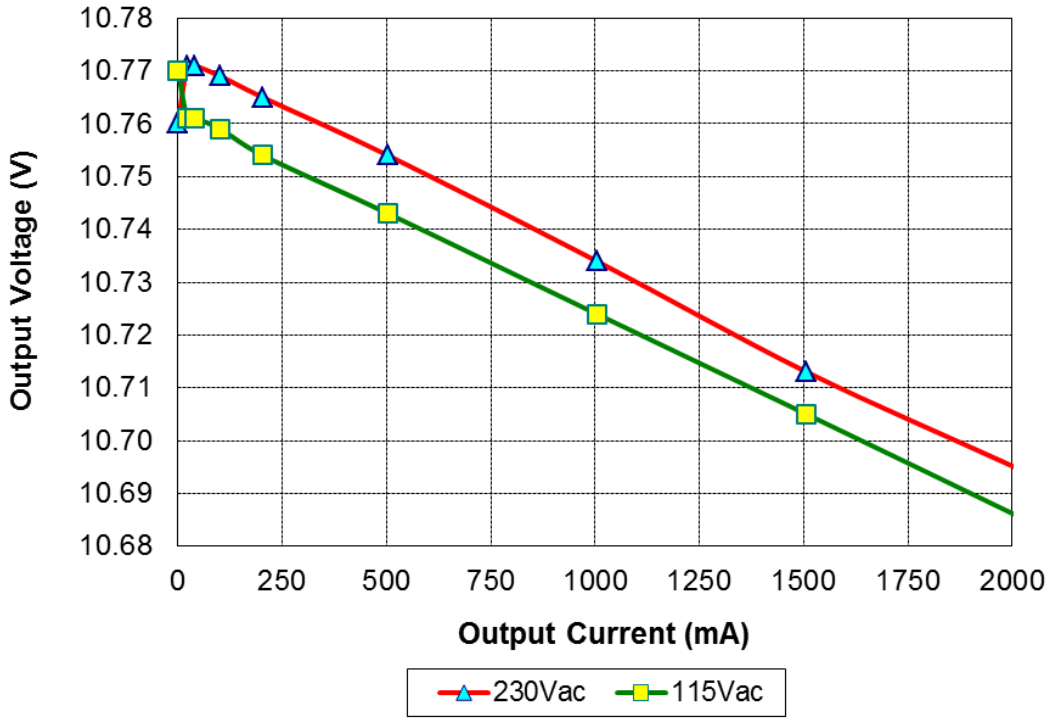


Iout (mA)	Vout (Vdc)	Pout (W)	Vin (Vac)	Pin (W)	Ploss (W)	Eff (%)	PF
0	10.770	0.00	115	0.25	0.25	0.00	0.276
21.9	10.761	0.24	115	1.56	1.33	15.08	0.753
40.6	10.761	0.44	115	1.78	1.34	24.61	0.775
102.1	10.759	1.10	115	2.47	1.37	44.56	0.841
203.5	10.754	2.19	115	3.61	1.42	60.71	0.910
503.5	10.743	5.41	115	7.01	1.60	77.14	0.972
1004	10.724	10.76	115	13.06	2.30	82.41	0.982
1507	10.705	16.13	115	19.43	3.30	83.03	0.983
2006	10.686	21.44	115	26.07	4.63	82.23	0.979

Iout (mA)	Vout (Vdc)	Pout (W)	Vin (Vac)	Pin (W)	Ploss (W)	Eff (%)	PF
0	10.760	0.00	230	0.55	0.55	0.00	0.330
21.8	10.771	0.23	230	1.39	1.15	16.94	0.419
40.6	10.771	0.44	230	1.71	1.27	25.57	0.461
102.1	10.769	1.10	230	2.81	1.71	39.17	0.607
203.5	10.765	2.19	230	4.17	1.98	52.57	0.645
503.5	10.754	5.41	230	7.67	2.25	70.61	0.775
1004	10.734	10.77	230	13.54	2.77	79.56	0.893
1507	10.713	16.14	230	19.59	3.45	82.41	0.934
2006	10.695	21.45	230	25.82	4.37	83.09	0.954

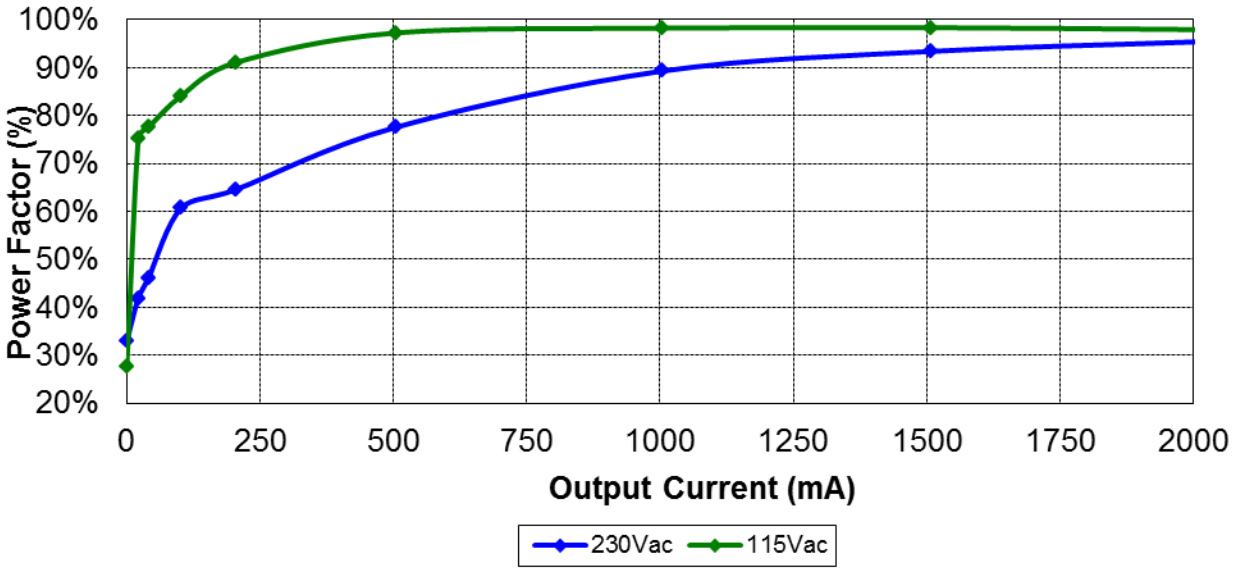
4 Output voltage regulation

The graph of the output voltage versus load current is plotted below.


10.78
10.77
10.76
10.75
10.74
10.73
10.72
10.71
10.70
10.69
10.68
Output Voltage (V)
0
250
500
750
1000
1250
1500
1750
2000
Output Current (mA)
230Vac
115Vac

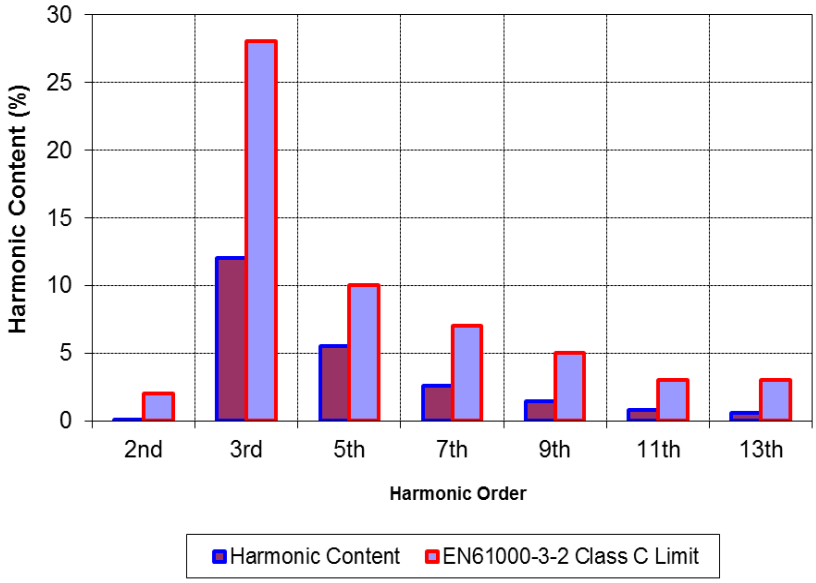
5 Power Factor

The Power Factor graph for the two input voltages 115V and 230V is shown below:



6 EN61000-3-2 Class C harmonics limits

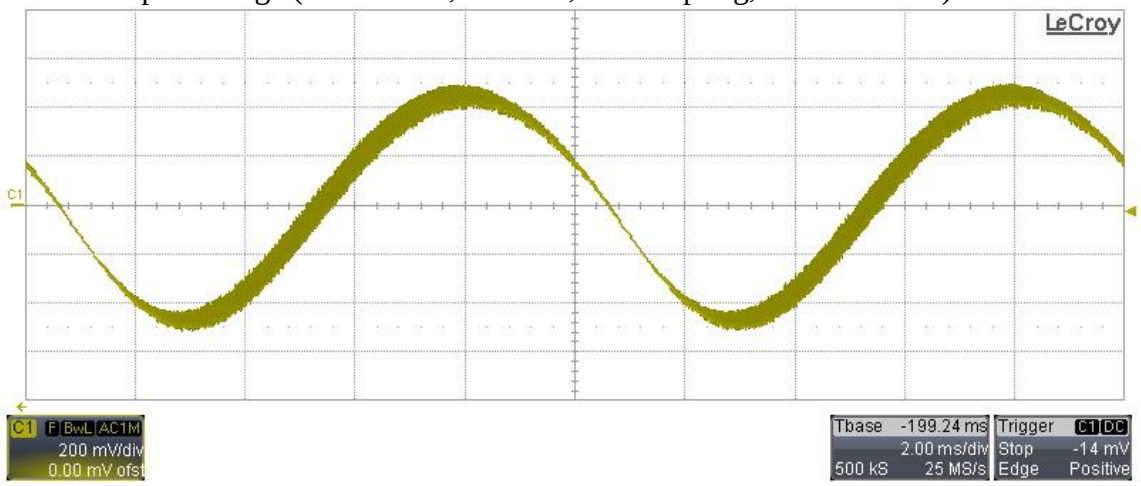
The graph below shows the limits of the harmonic content in the input current, compared to the first harmonic; the measurement shows values well below these limits. The input voltage was 230Vac, 50Hz and the output load set to 2A.



7 Output ripple voltage

The output ripple voltage is shown in the plot below. The input was set at 230Vac and the load set to 2A.

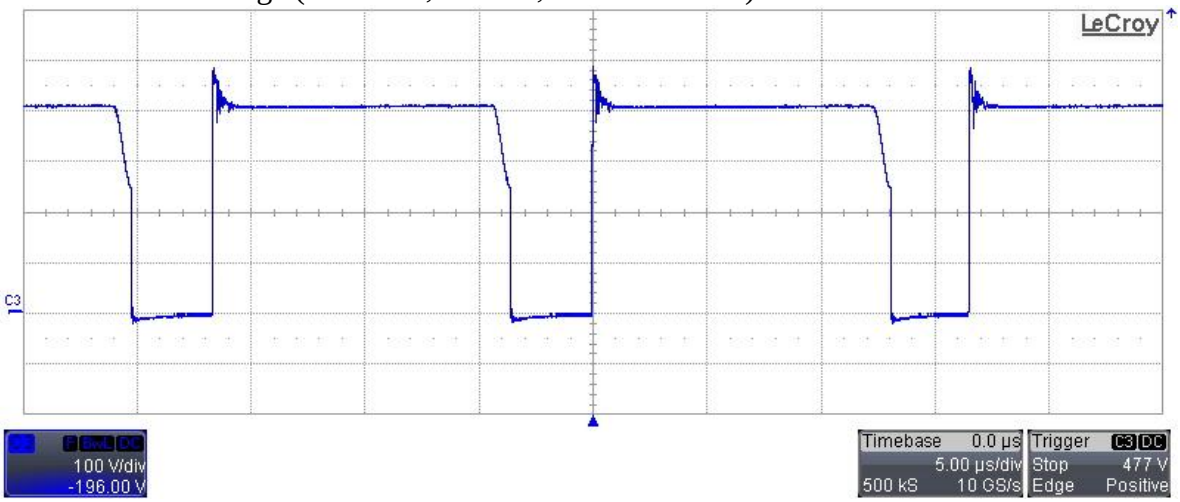
Channel 1: Output voltage (200mV/div, 2ms/div, AC coupling, 20MHz BWL).



8 Switching Node Waveform

The image below shows the voltage on the drain of the switching node (Q2) @ 230Vac input and full load.

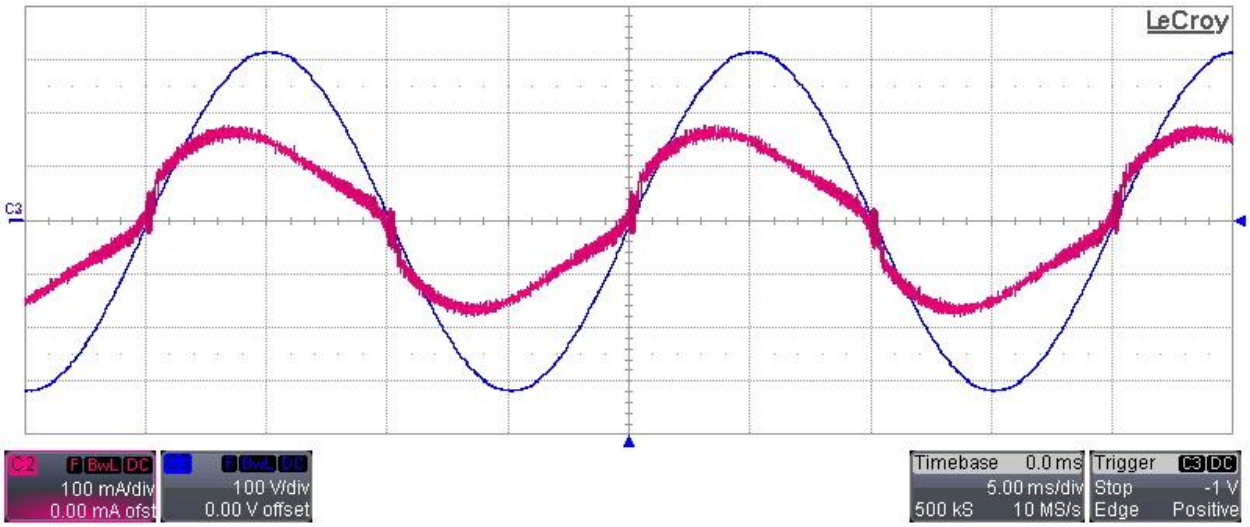
Channel 3: Drain voltage (100V/div, 5us/div, 200MHz BWL).



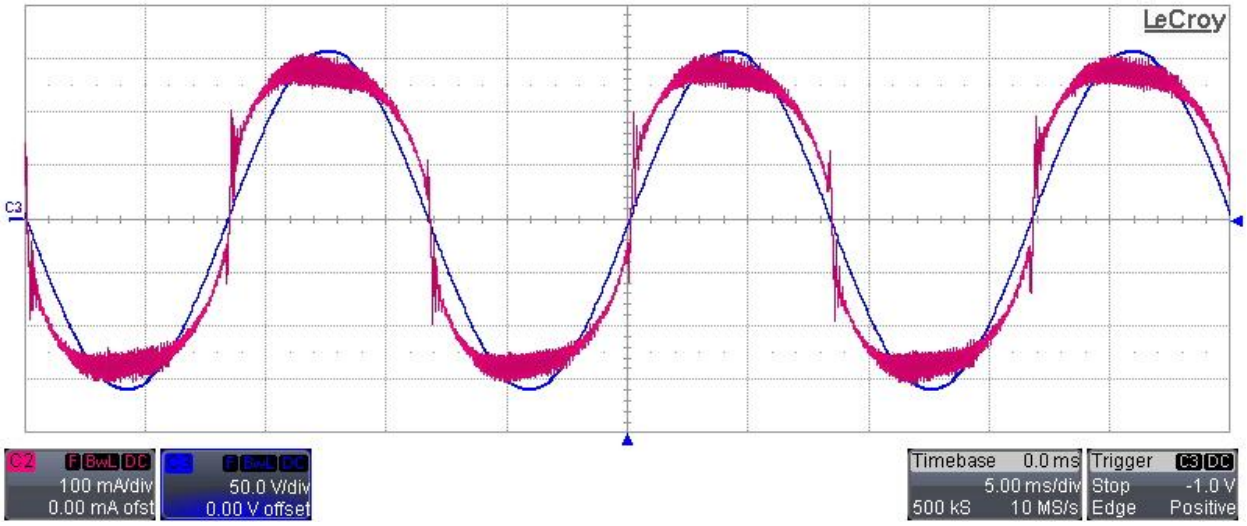
9 Input voltage and current waveforms

The images below show the input voltage and current while the source was set to the two different input voltages and the converter was fully loaded.

Channel 2: Input Current (100mA/div, 5ms/div, 20MHz BWL)
Channel 3: Input Voltage (100V/div, 20MHz BWL)
Vin = 230 Vac, 50Hz



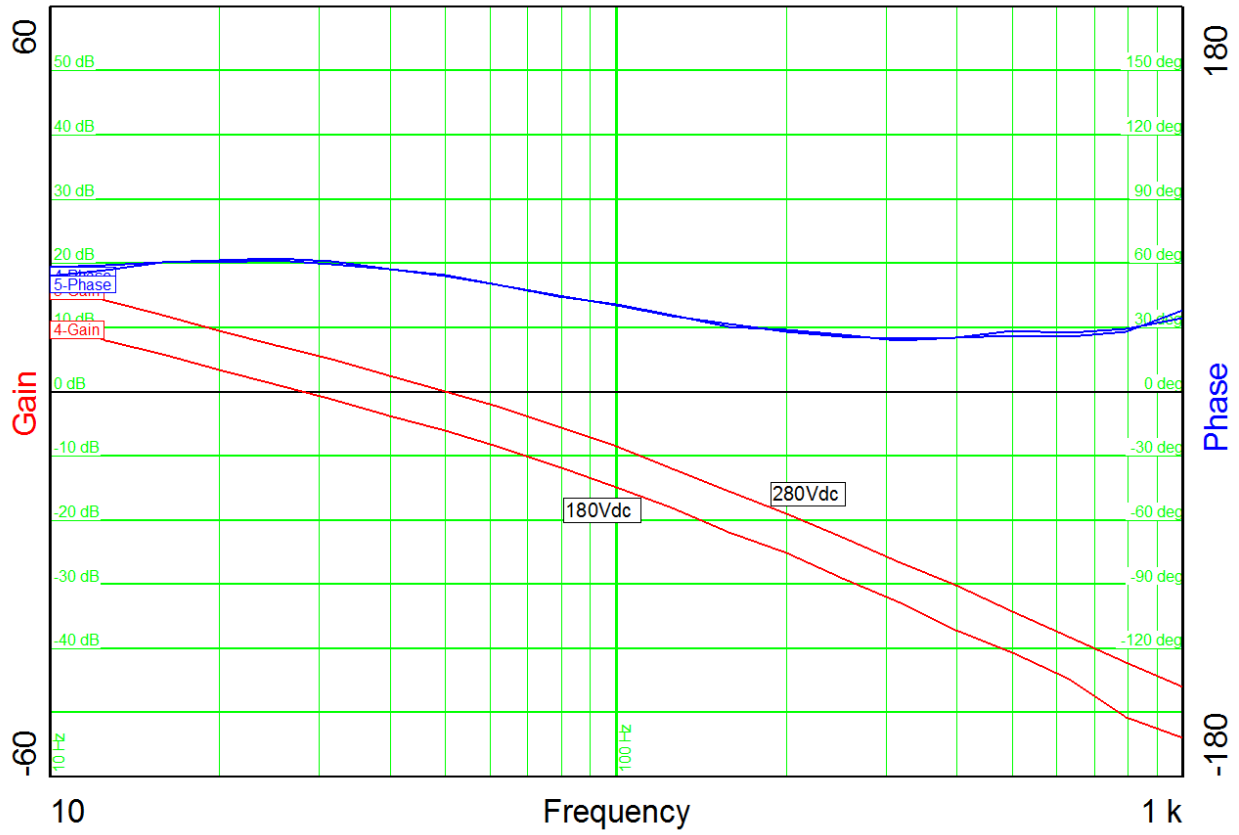
Channel 2: Input Current (100mA/div, 5ms/div, 20MHz BWL)
Channel 3: Input Voltage (50V/div, 20MHz BWL)
Vin = 115 Vac, 60Hz



10 Loop Response

The graph below shows the loop response of the converter measured at 180Vdc and 280Vdc input, while the load has been kept constant at 2A. The bandwidth (crossover frequency) and phase margin were respectively:

Vin	Crossover Frequency	Phase Margin
180Vdc	28.13Hz	61.58 deg.
280Vdc	50.24Hz	54.24 deg.



11 Thermal analysis

The thermal image has been taken in steady state condition and when the board was placed horizontally on the bench without any forced convection. The ambient temperature was 23C and the converter loaded @ 2A.

Thermal image @ 115Vac, 60Hz:

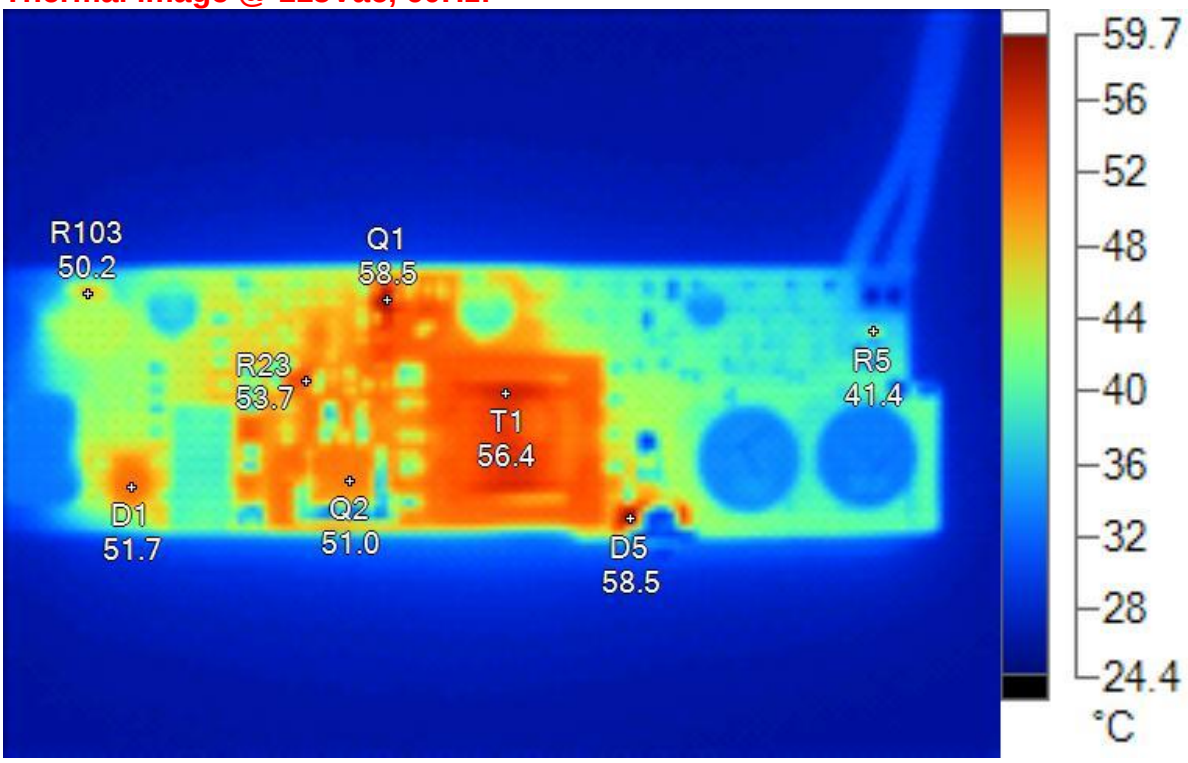


Image Info

Background temperature	20.0°C
Average Temperature	32.2°C
Image Range	25.4°C to 58.6°C
Camera Model	Ti40FT
Camera Manufacturer	Fluke
Image Time	3/3/2015 5:05:42 PM

Main Image Markers

Name	Temperature
D1	51.7°C
Q2	51.0°C
T1	56.4°C
Q1	58.5°C
D5	58.5°C
R5	41.4°C
R103	50.2°C
R23	53.7°C

Thermal image @ 230Vac, 50Hz:

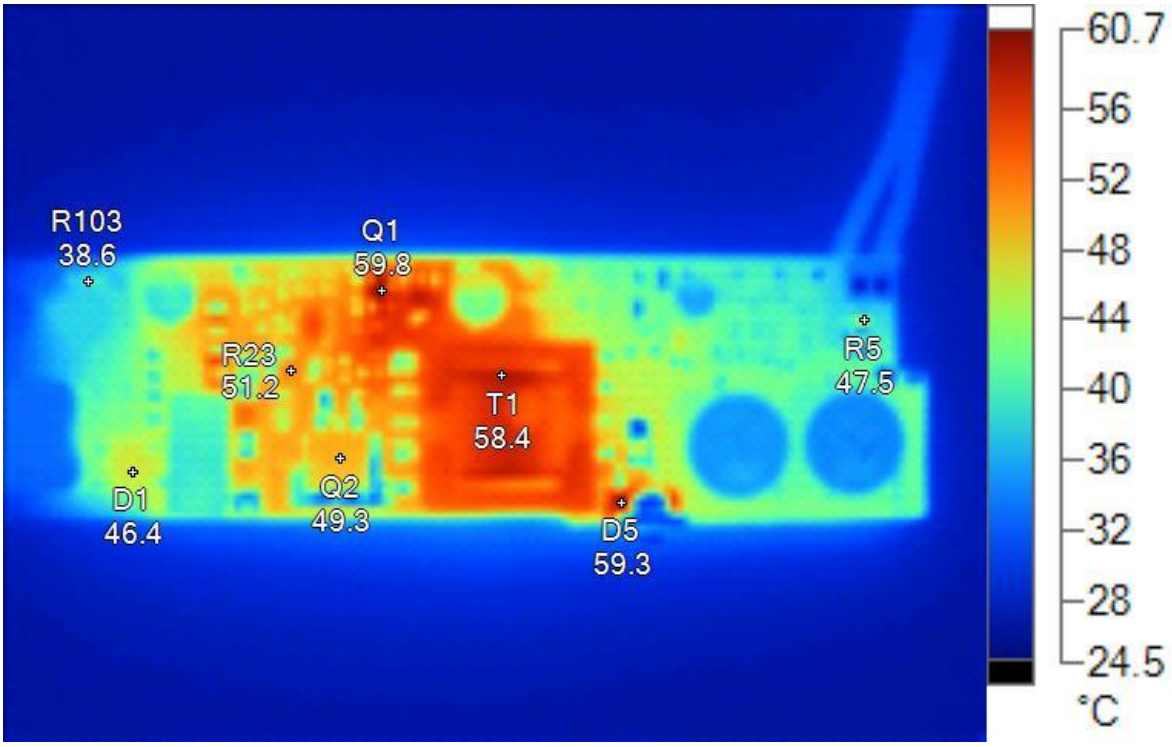


Image Info

Background temperature	20.0°C
Average Temperature	32.8°C
Image Range	25.6°C to 59.8°C
Camera Model	Ti40FT
Camera Manufacturer	Fluke
Image Time	3/3/2015 5:10:25 PM

Main Image Markers

Name	Temperature
R103	38.6°C
D1	46.4°C
Q2	49.3°C
T1	58.4°C
Q1	59.8°C
R23	51.2°C
D5	59.3°C
R5	47.5°C

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