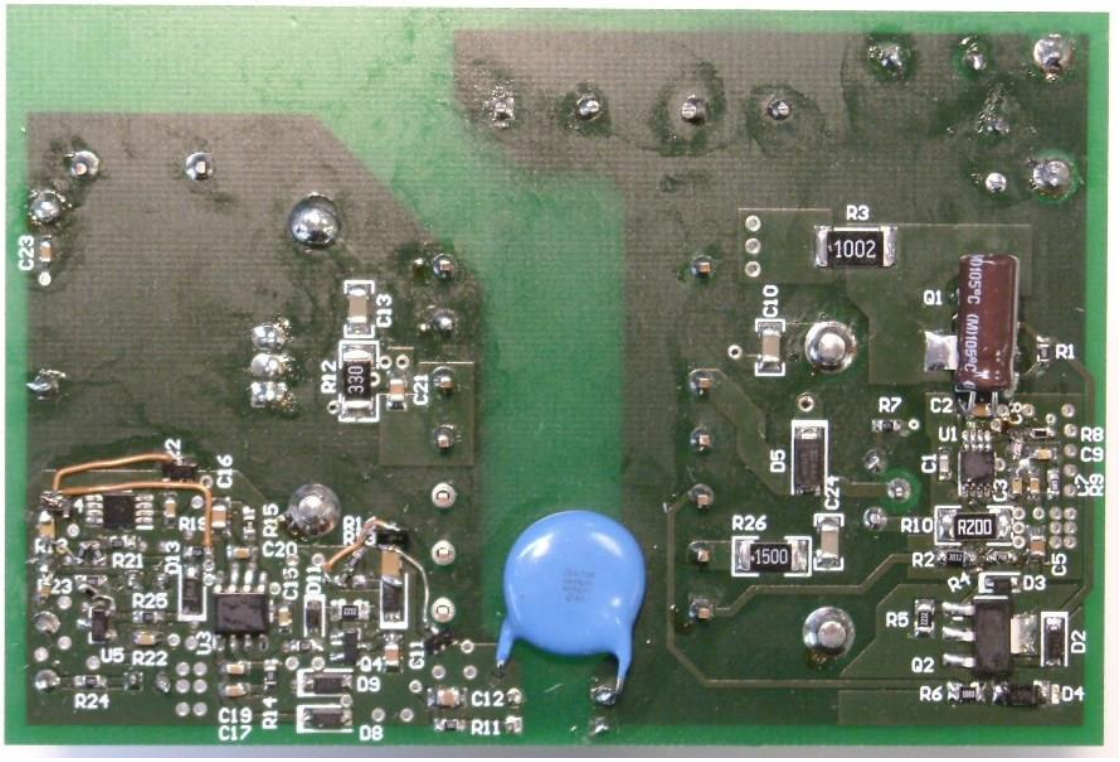
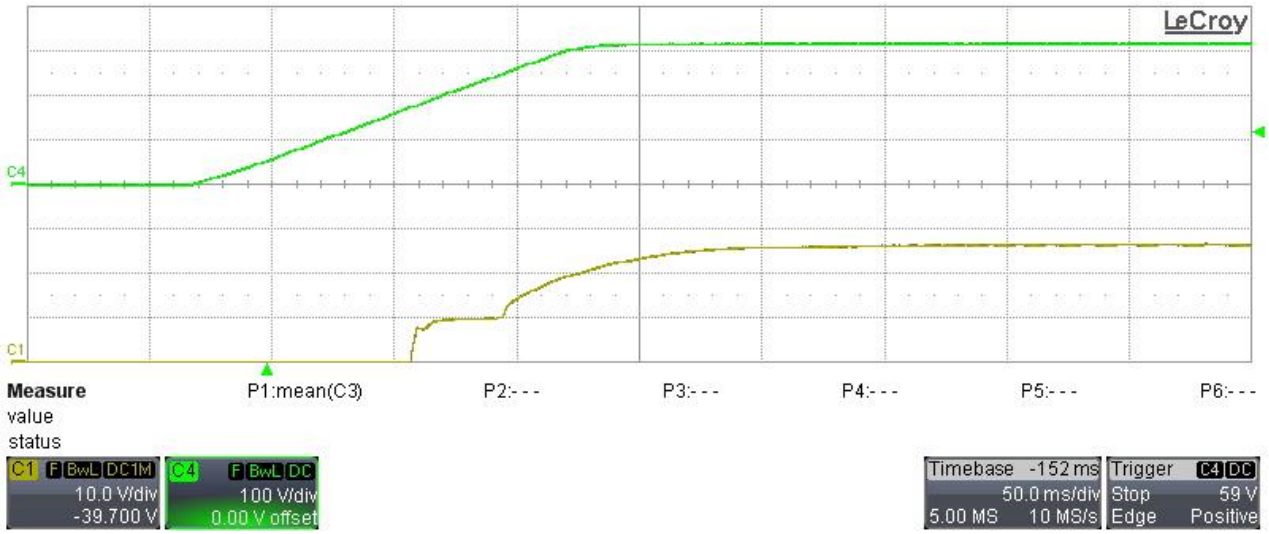
1 Photo of the prototype (60.2mm x 60.2mm).



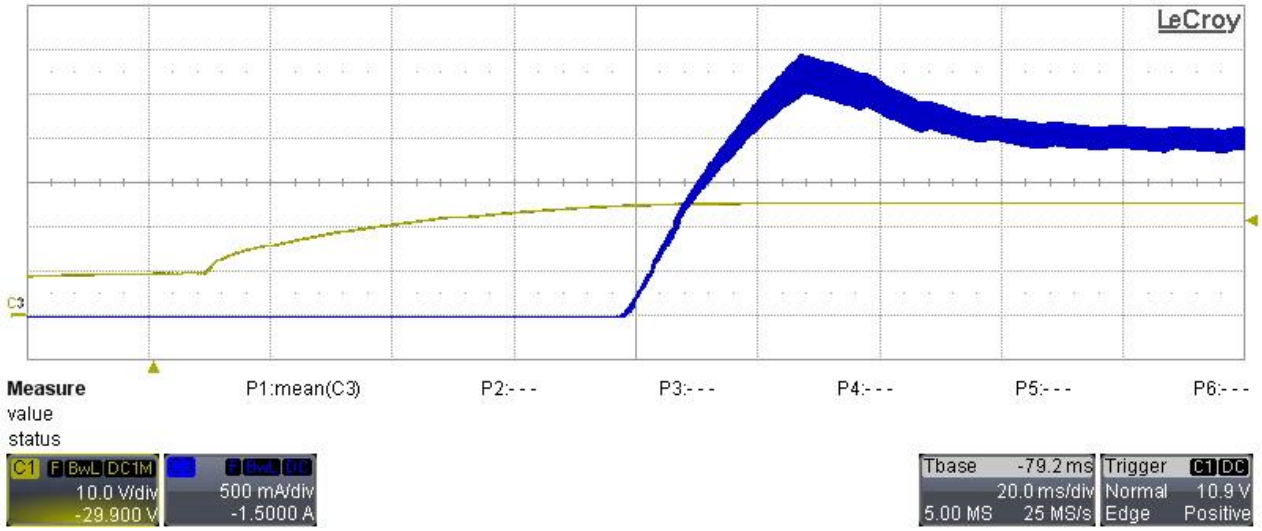
2 Startup

The output voltage and current behavior versus type of load and input voltage is shown in the images below.

Ch.1: Output voltage (10V/div, 50ms/div, 20MHz BWL)
Ch.4: Input DC voltage (100V/div, 20MHz BWL)
Battery unconnected, no load, Vin = 325Vdc.



Ch.1: Output voltage (10V/div, 20ms/div, 20MHz BWL)
Ch.3: Output current (500mA/div, 20MHz BWL)
Battery connected, charge current set to 2A, Vin = 170VAC.



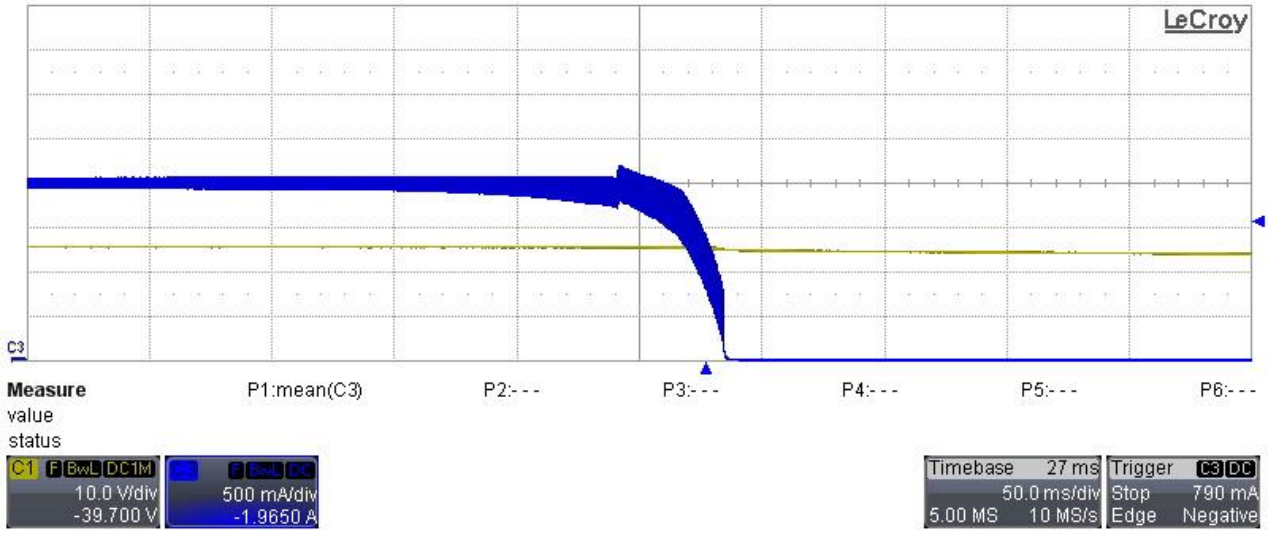
3 Shut Down

During full charge current (2A) condition, the input AC source (set to 230VAC) has been disconnected. The output voltage and current ramp down behavior is shown below.

Ch.1: Output voltage (10V/div, 50ms/div, 20MHz BWL)

Ch.3: Output current (500mA/div, 20MHz BWL)

Charge current set to 2A, Vin = 170VAC.

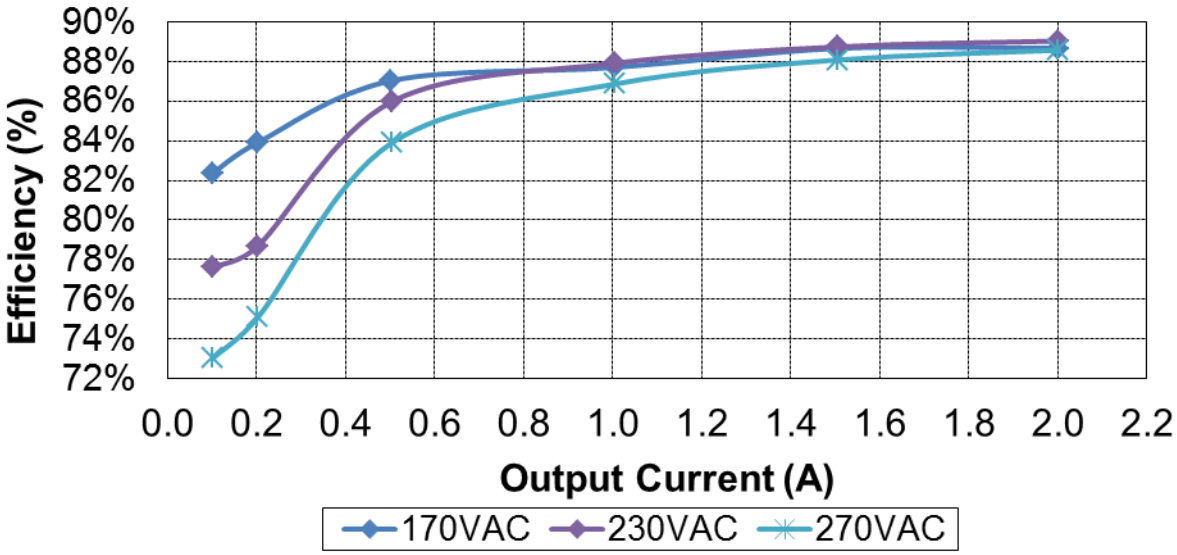


4 Efficiency

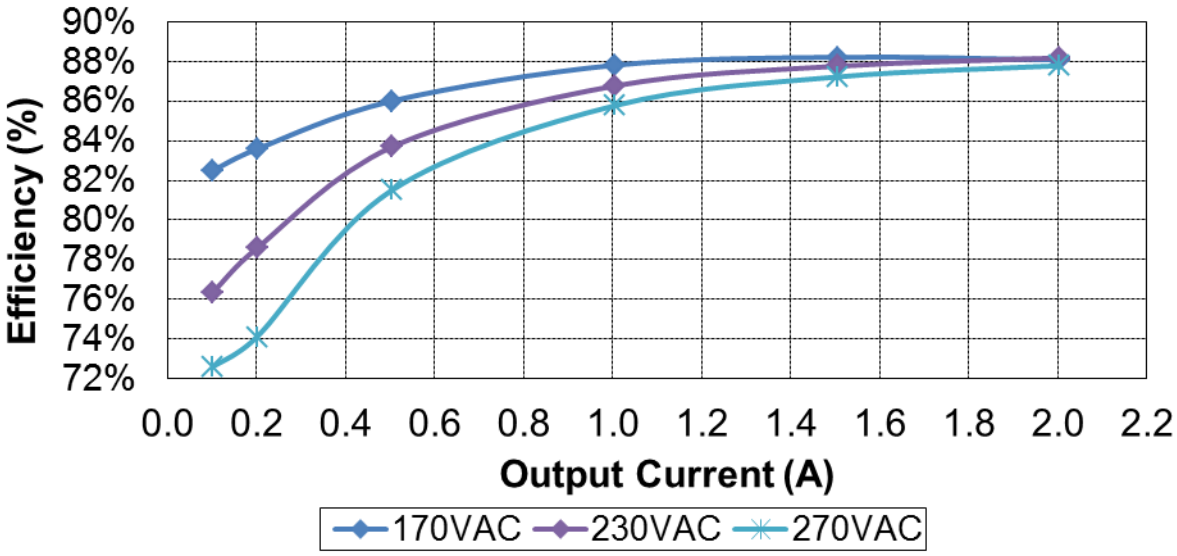
The efficiency data, versus input AC voltage and load (voltage and current), are shown in the tables and graph below.

The input voltage has been set respectively to 170VAC, 230 and 270VAC.

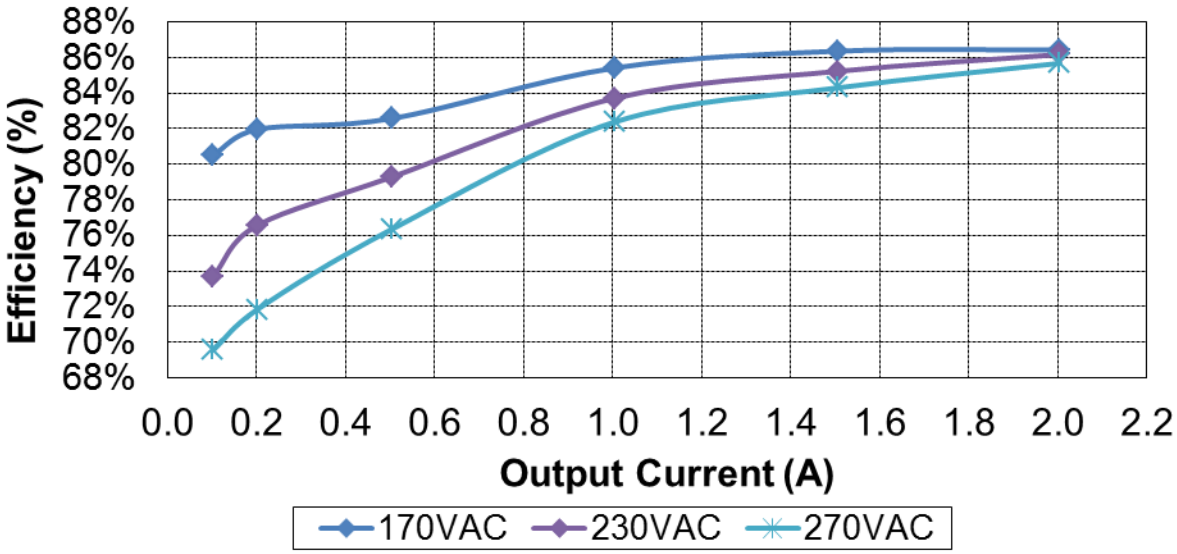
Vout = 32V



Vout = 24V



Vout = 16V



VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
170	0.1370	32.00	0	0	0.0%
170	3.98	31.99	102.5	3.279	82.4%
170	7.68	31.99	201.4	6.443	83.9%
170	18.43	31.97	501.7	16.039	87.0%
170	36.61	31.95	1005	32.11	87.7%
170	54.25	31.92	1507	48.10	88.7%
170	72.02	31.90	2002	63.86	88.7%

PMP30047 Rev_B Test Results

VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
230	0.1585	32.01	0	0	0.0%
230	4.23	32.00	102.6	3.283	77.6%
230	8.20	31.99	201.5	6.446	78.6%
230	18.76	31.97	504.4	16.126	86.0%
230	36.51	31.94	1005	32.10	87.9%
230	54.13	31.92	1505	48.04	88.7%
230	71.70	31.89	2002	63.84	89.0%

VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
270	0.1772	31.99	0	0	0.0%
270	4.48	31.98	102.3	3.272	73.0%
270	8.68	31.97	203.9	6.519	75.1%
270	19.21	31.96	504.3	16.117	83.9%
270	36.94	31.93	1005	32.09	86.9%
270	54.52	31.91	1505	48.02	88.1%
270	72.05	31.88	2002	63.82	88.6%

VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
170	0.0851	24.01	0	0	0.0%
170	2.98	24.01	102.4	2.459	82.5%
170	5.78	24.00	201.3	4.831	83.6%
170	14.06	23.98	504.3	12.093	86.0%
170	27.42	23.96	1005	24.08	87.8%
170	40.85	23.93	1506	36.04	88.2%
170	54.42	23.91	2005	47.94	88.1%

VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
230	0.1121	24.02	0	0	0.0%
230	3.22	24.01	102.4	2.459	76.4%
230	6.15	24.00	201.3	4.831	78.6%
230	14.45	23.98	504.3	12.093	83.7%
230	27.75	23.96	1005	24.08	86.8%
230	41.06	23.93	1506	36.04	87.8%
230	54.36	23.91	2005	47.94	88.2%

VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
270	0.1360	24.02	0	0	0.0%
270	3.39	24.01	102.5	2.461	72.6%
270	6.52	24.00	201.3	4.831	74.1%
270	14.84	23.98	504.4	12.096	81.5%
270	28.06	23.95	1005	24.07	85.8%
270	41.34	23.93	1507	36.06	87.2%
270	54.58	23.90	2005	47.92	87.8%

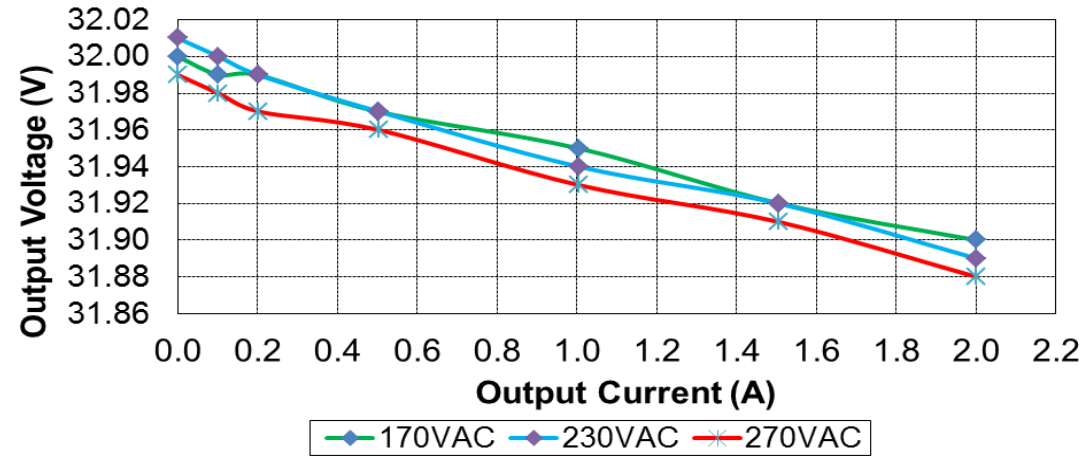
VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
170	0.0522	15.97	0	0	0.0%
170	2.03	15.96	102.4	1.634	80.5%
170	3.92	15.96	201.3	3.213	82.0%
170	9.74	15.94	504.3	8.039	82.6%
170	18.72	15.91	1005	15.99	85.4%
170	27.71	15.89	1506	23.93	86.4%
170	36.79	15.86	2005	31.80	86.4%

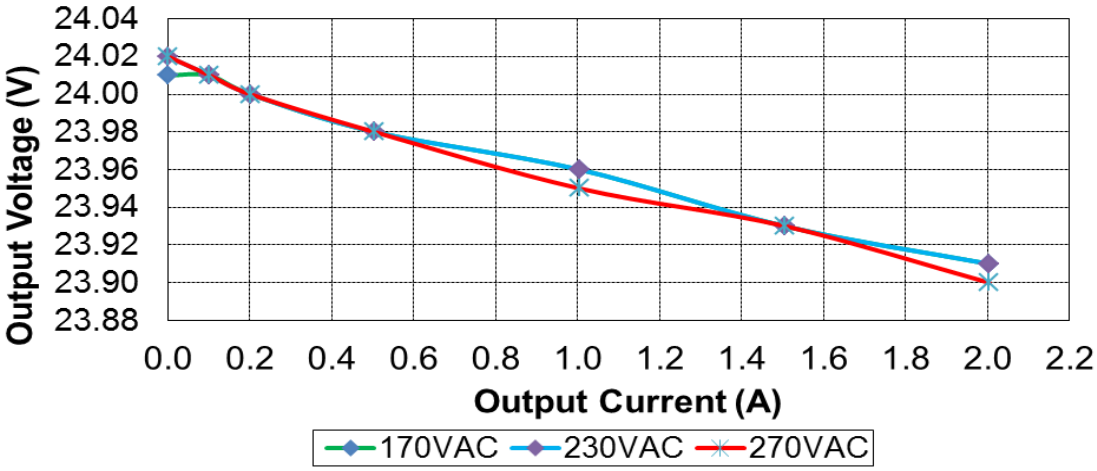
VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
230	0.0585	15.97	0	0	0.0%
230	2.21	15.95	102.1	1.628	73.7%
230	4.19	15.95	201.1	3.208	76.6%
230	10.13	15.93	504.2	8.032	79.3%
230	19.10	15.91	1005	15.99	83.7%
230	28.06	15.88	1506	23.92	85.2%
230	36.88	15.85	2005	31.78	86.2%

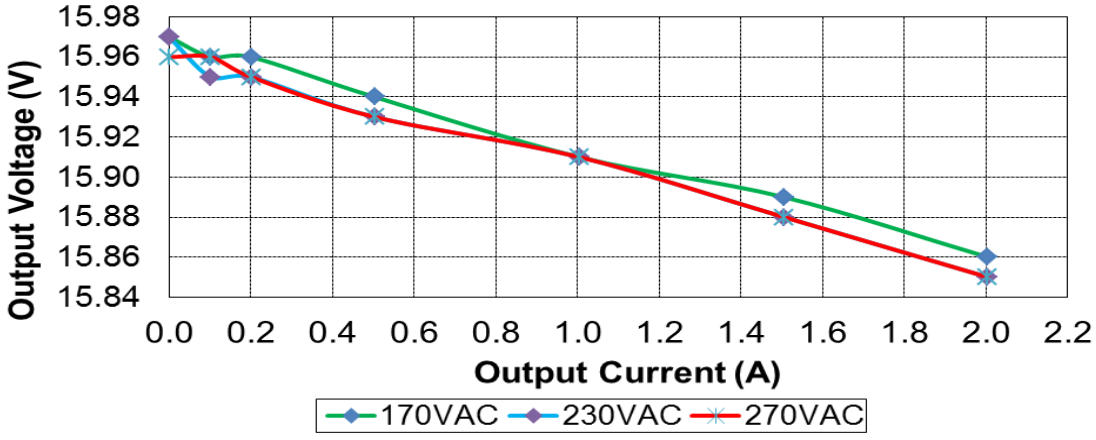
VAC (RMS)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
270	0.0919	15.96	0	0	0.0%
270	2.35	15.96	102.4	1.634	69.5%
270	4.47	15.95	201.3	3.211	71.8%
270	10.52	15.93	504.2	8.032	76.3%
270	19.41	15.91	1005	15.99	82.4%
270	28.37	15.88	1506	23.92	84.3%
270	37.09	15.85	2005	31.78	85.7%

5 Output Voltage Regulation

The output voltage variation versus load current, for different input voltages, is plotted below. In this case an electronic load, set in constant-current mode, has been employed.



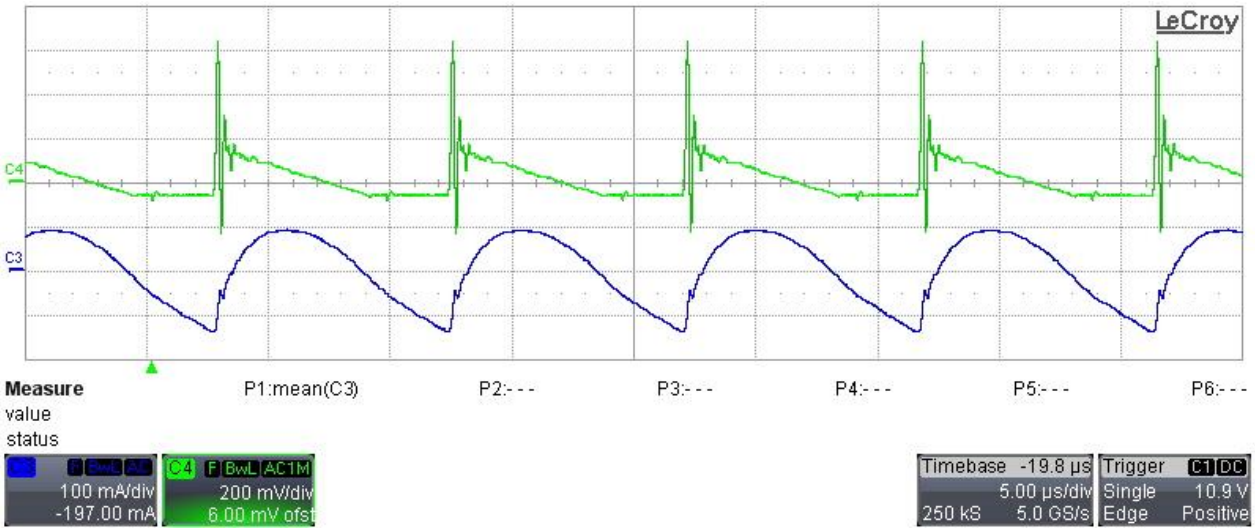




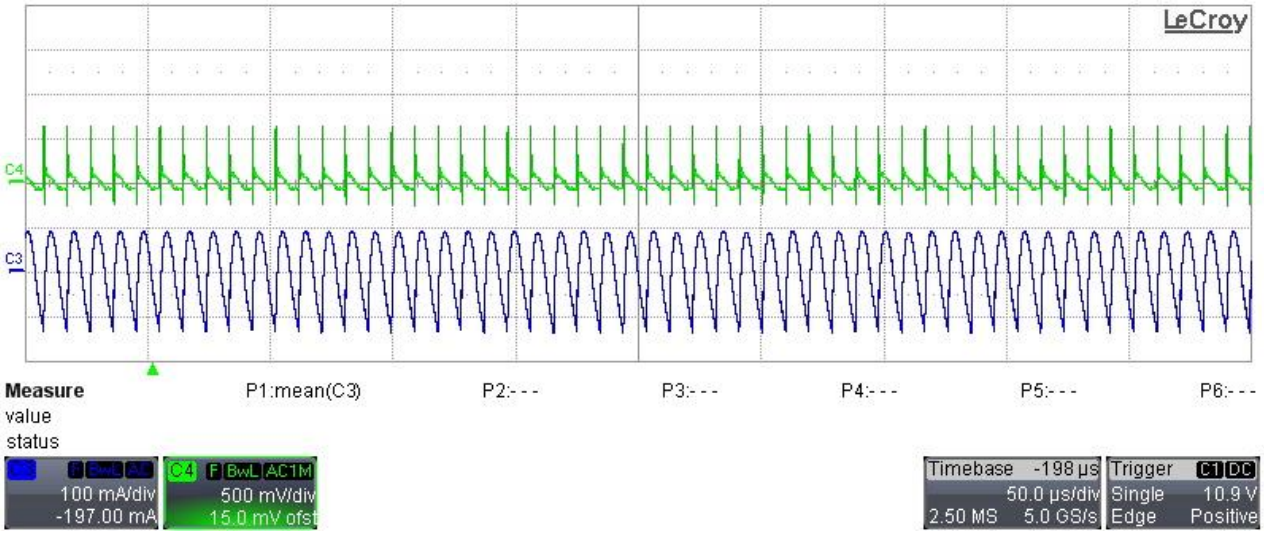
6 Output Ripple Voltage and Current

The output ripple voltage has been measured by supplying the converter at 230VAC while charging the battery at 2A; the battery voltage was 25V. (All screenshots have been taken with 20MHz bandwidth, AC coupling).

Ch.3: Output current (100mA/div, 5us/div)
Ch.4: Output voltage (200mV/div)



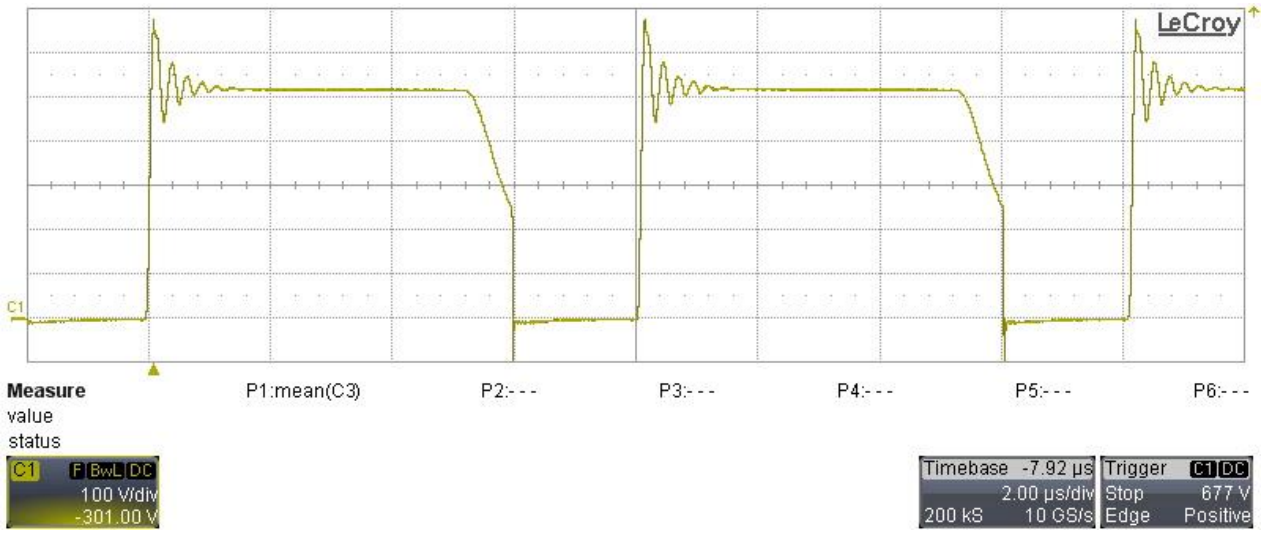
Ch.3: Output current (100mA/div, 50us/div)
Ch.4: Output voltage (500mV/div)



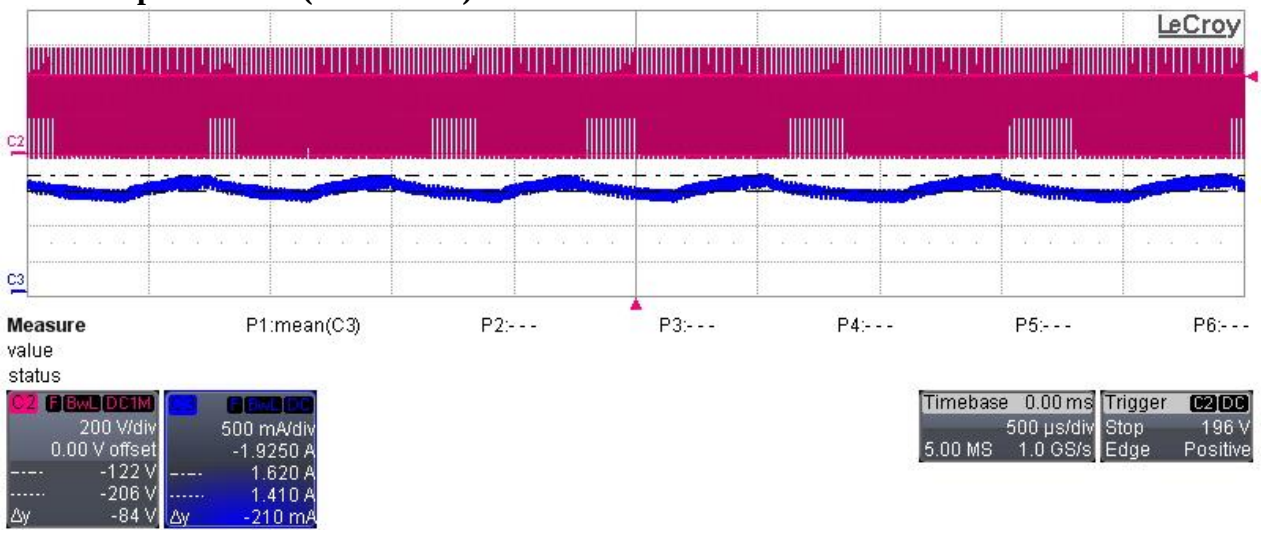
7 Switch nodes

The images below show the drain of Q3 and the output current taken in several Vin and load conditions. BWL was set to 200MHz.

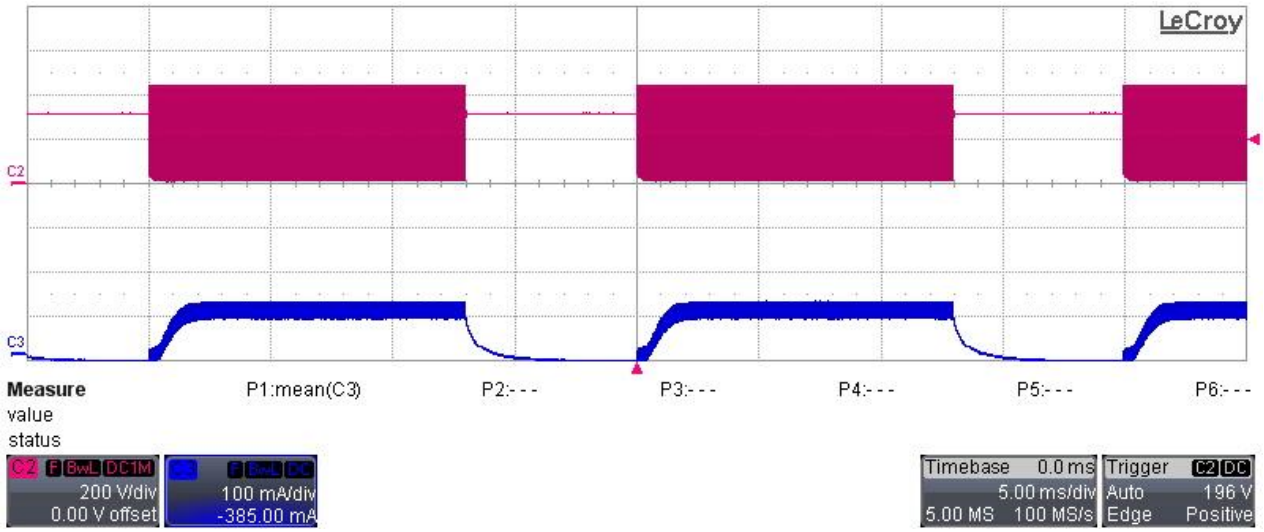
Vin = 270VAC, Vout = 32V, Iout = 2A:
Ch.1: Q3-Drain voltage (100V/div, 2us/div)



Vin = 320Vdc, Vout = 25V, Iout = 1.5A (two different valley selections):
Ch.1: Q3-Drain voltage (200V/div, 500us/div)
Ch.3: Output current (500mA/div)

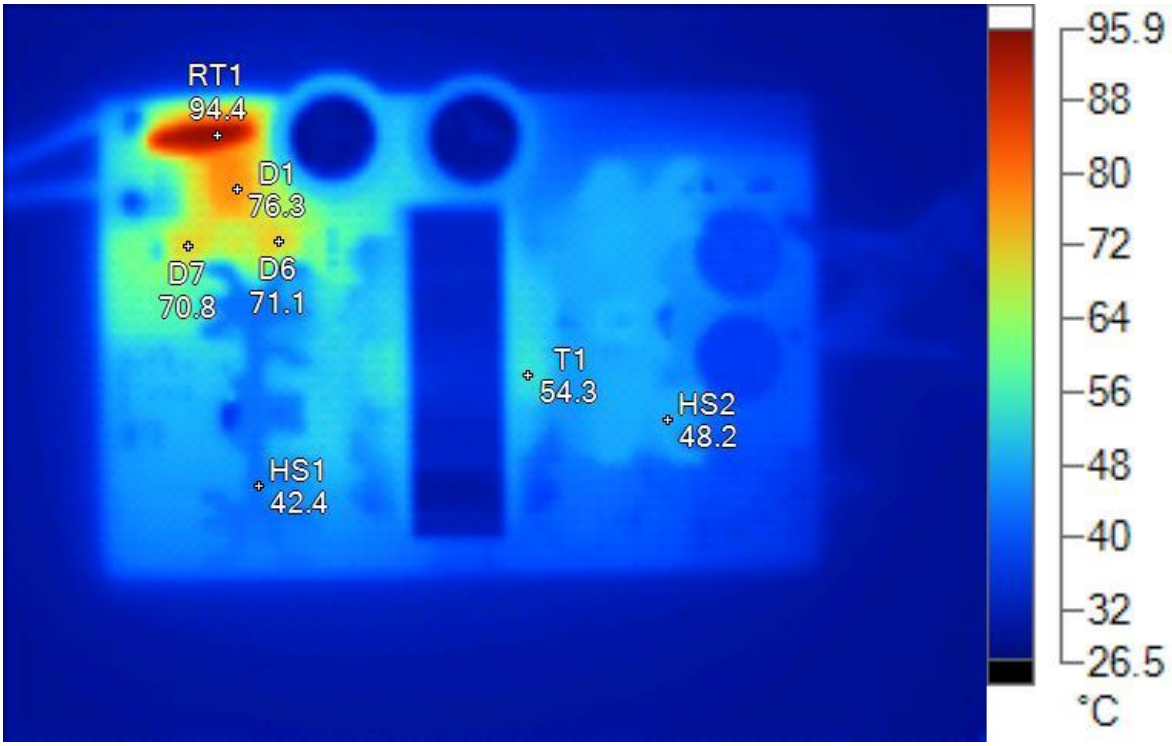


Vin = 320Vdc, Vout = 25V, Iout ~ 70mA (burst mode):
Ch.1: Q3-Drain voltage (200V/div, 5ms/div)
Ch.3: Output current (100mA/div)



8 Thermal Analysis

During the thermal analysis, the converter has been placed horizontally on the bench in still air conditions, while supplied @ 170VAC (worst case) and delivering 32V @ 2A.



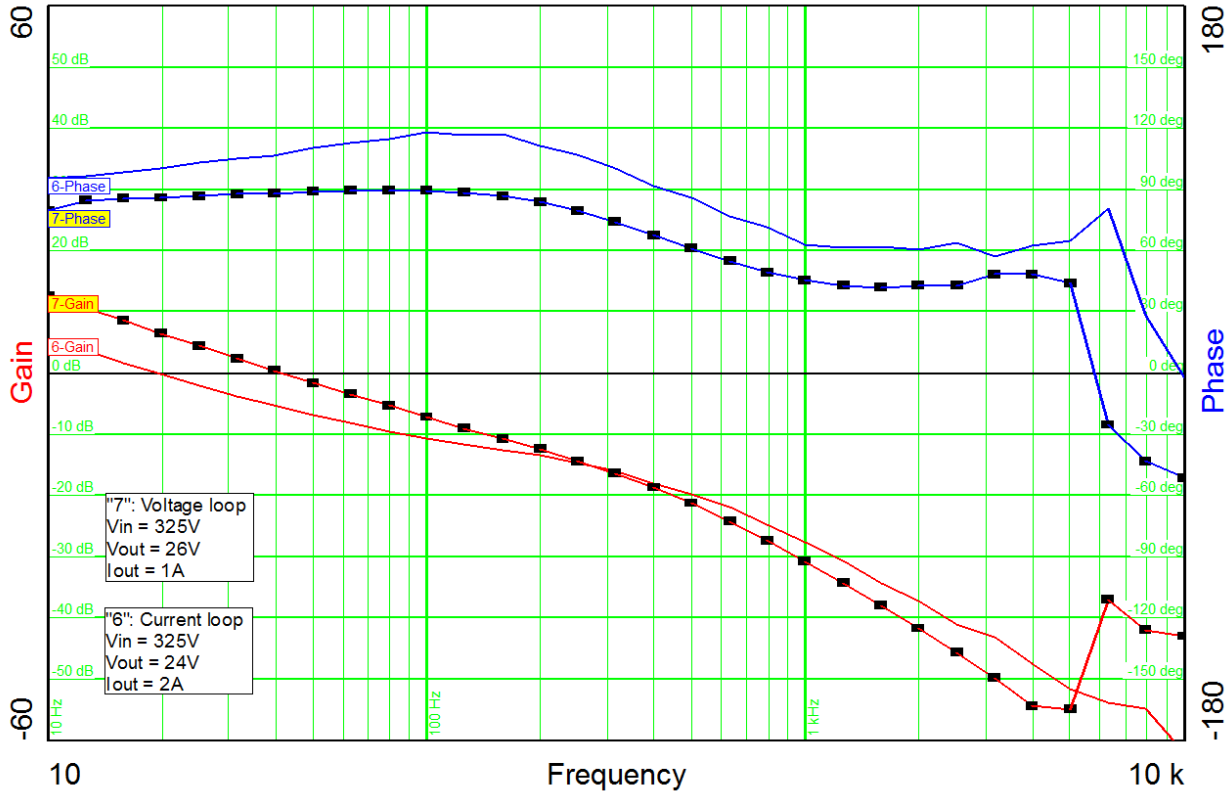
Main Image Markers

Name	Temperature	Emissivity	Background
RT1	94.4°C	0.95	24.0°C
D1	76.3°C	0.95	24.0°C
D7	70.8°C	0.95	24.0°C
D6	71.1°C	0.95	24.0°C
T1	54.3°C	0.95	24.0°C
HS1	42.4°C	0.95	24.0°C
HS2	48.2°C	0.95	24.0°C

9 Feedback Loop Analysis

The converter has been supplied with 325Vdc.
The voltage loop has been activated by watching the battery current: when its value was below the set point of the current limit, the corresponding loop has been measured.
The battery voltage has been kept in the range 24V…26V.
Voltage loop measurement conditions: Vout = 26V, Iout = 1A
Current loop measurement conditions: Vout = 24V, Iout = 2A

Type of regulation:	Crossover frequency	Phase margin	Gain margin
Voltage loop	41.74Hz	88.37 deg.	43.71 dB
Current loop	19.49Hz	100.1 deg.	61.75dB



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