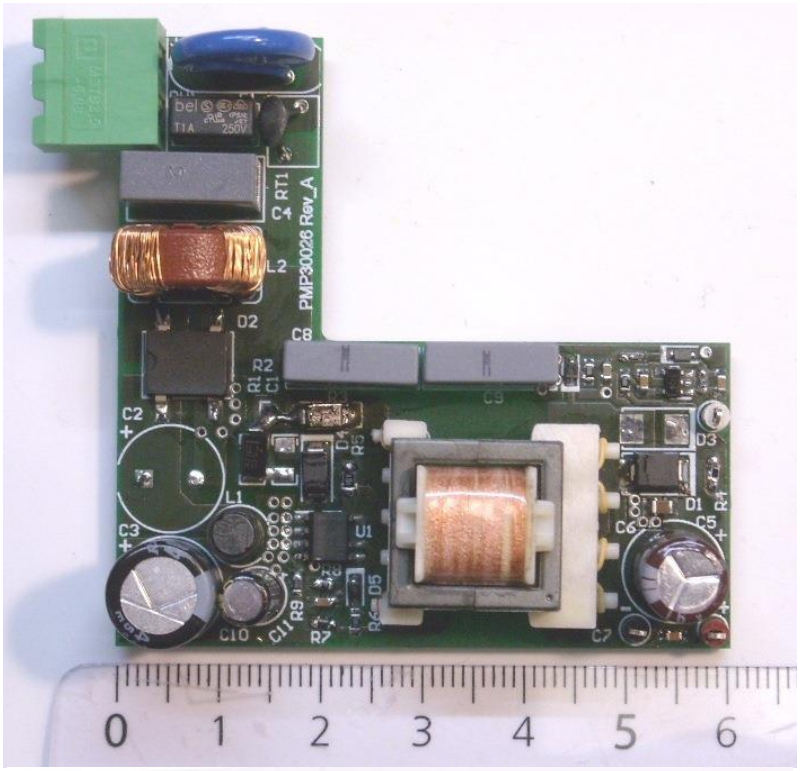
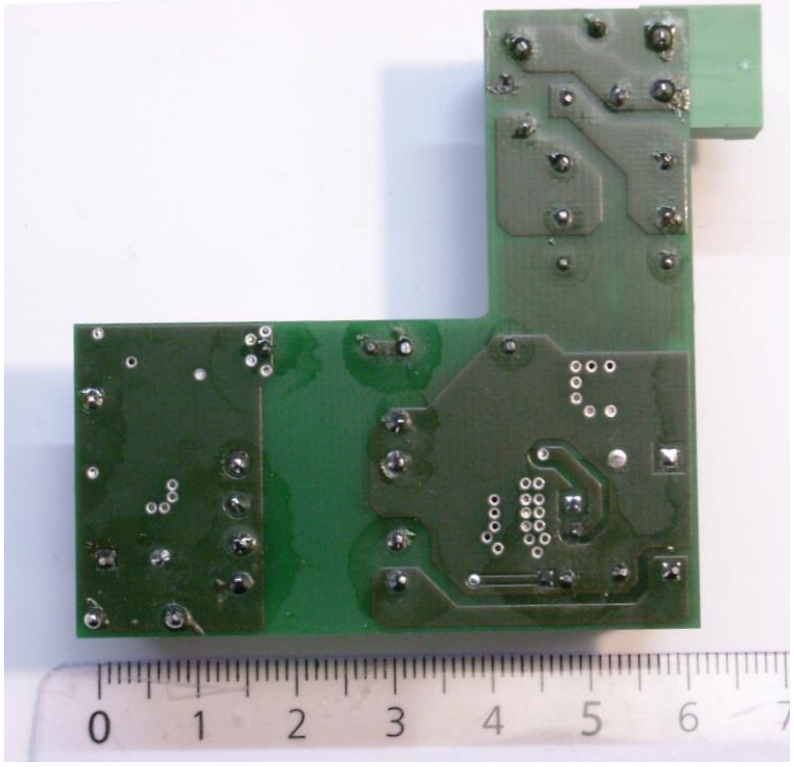
1 Photo of the prototype (60.2mm x 60.2mm).

The PMP30032 employs the same PCB of PMP30026 Rev_A.

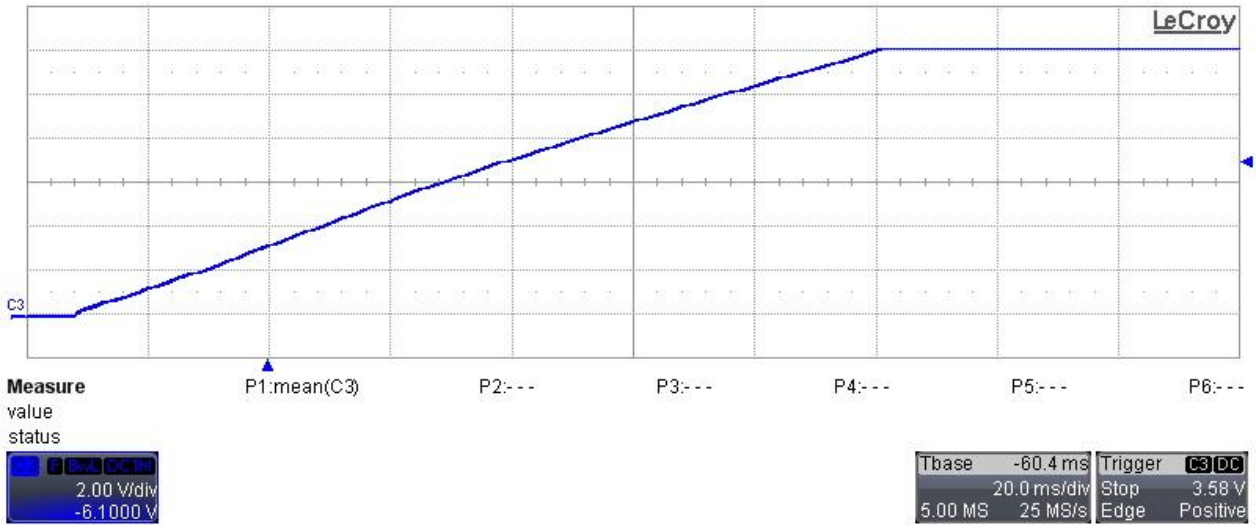




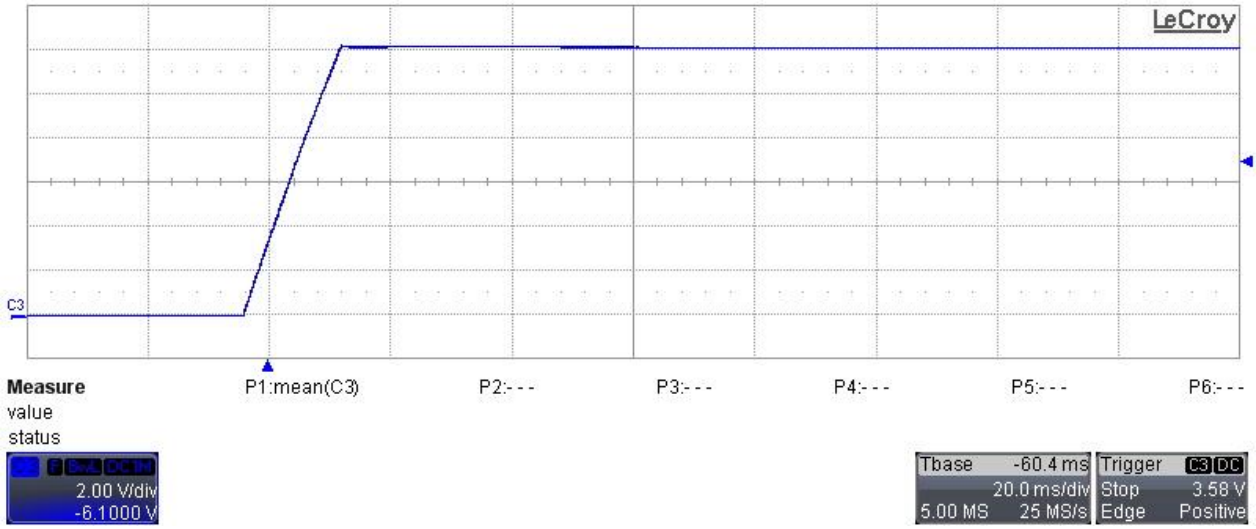
2 Startup

The output voltage behavior versus load and input AC voltage is shown in the images below. The input voltage was set to minimum and maximum value, respectively 90VAC and 265VAC.

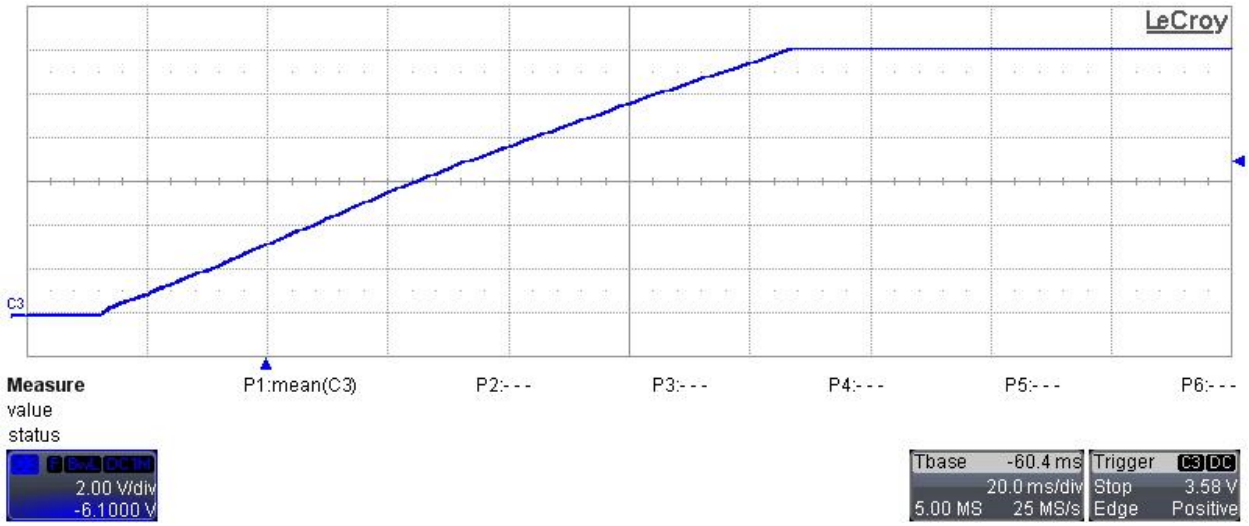
Ch.3: Output voltage (2V/div, 20ms/div, 20MHz BWL)
Full load, Vin = 90VAC, 60Hz:



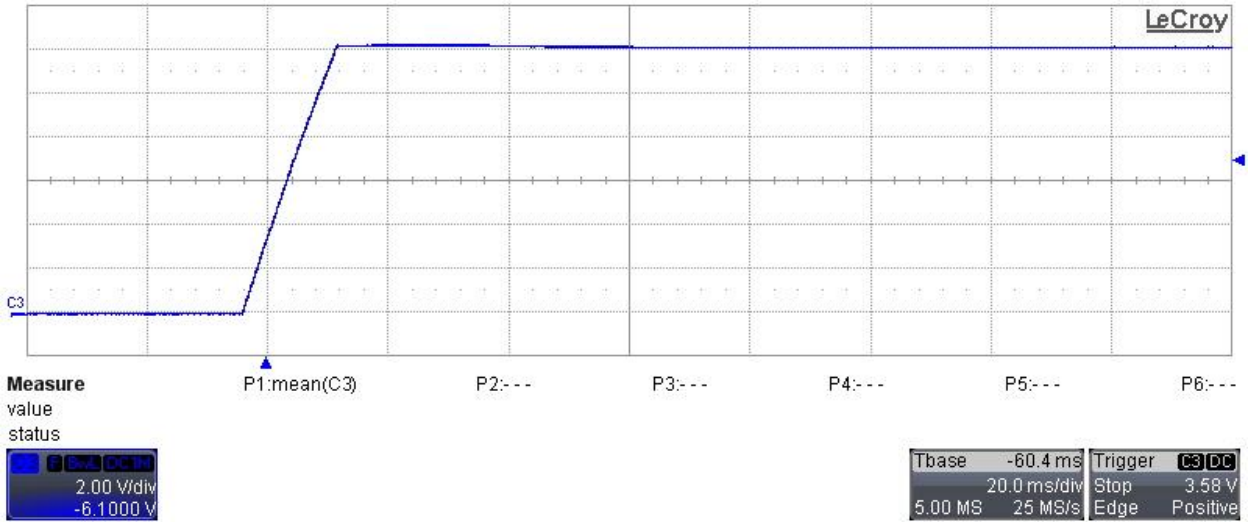
Ch.3: Output voltage (2V/div, 20ms/div, 20MHz BWL)
Zero load, Vin = 90VAC, 60Hz:



Ch.3: Output voltage (2V/div, 20ms/div, 20MHz BWL)
Full load, Vin = 265VAC, 50Hz:



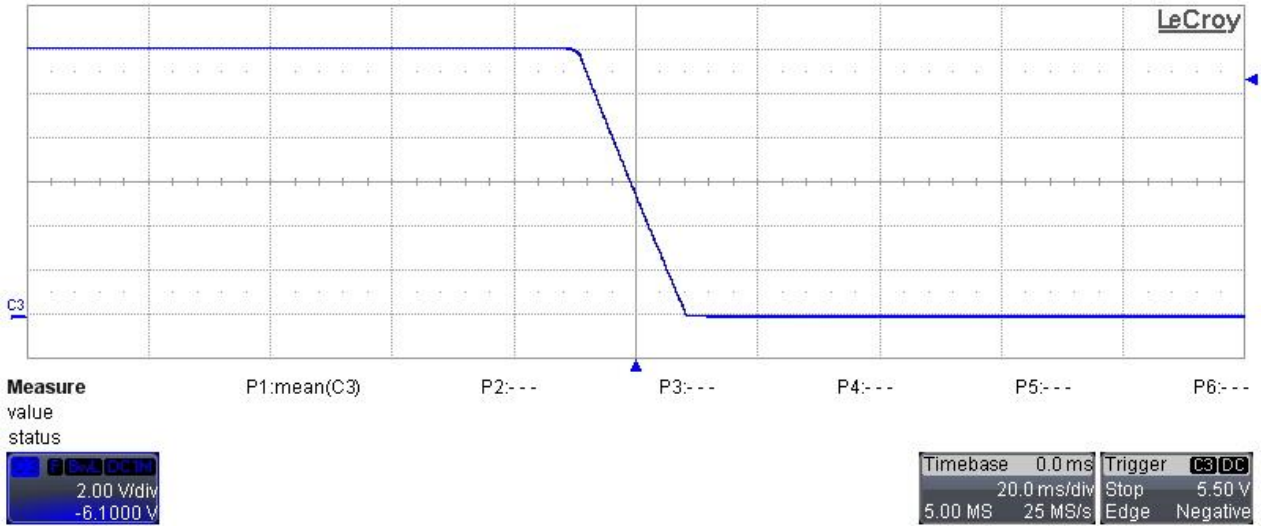
Ch.3: Output voltage (2V/div, 20ms/div, 20MHz BWL)
Zero load, Vin = 265VAC, 50Hz:



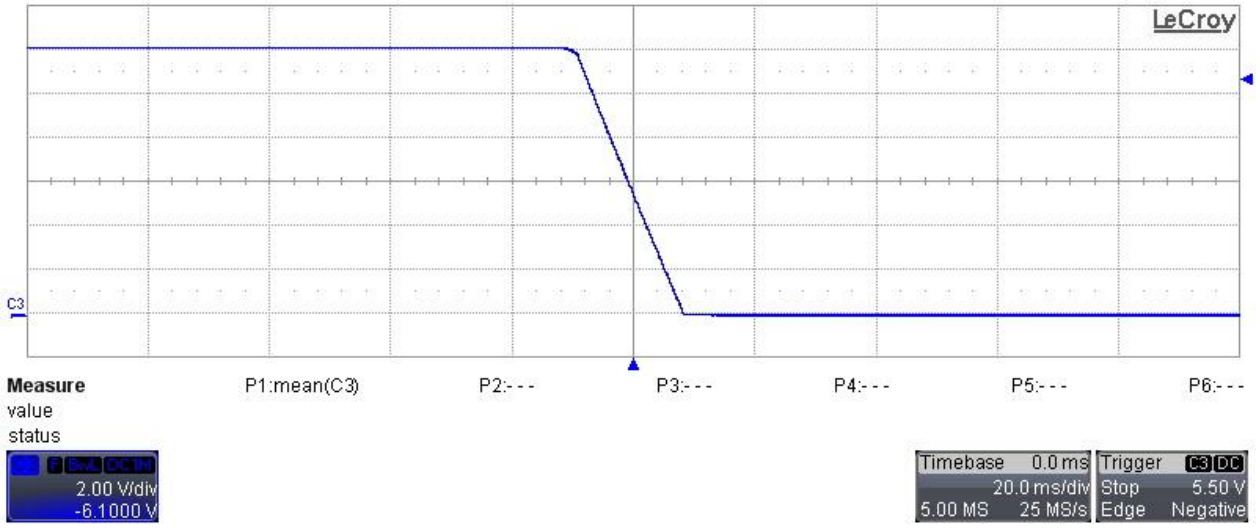
3 Shut down

During full load condition, the input AC source has been disconnected. The output voltage ramp down behavior is shown below.

Ch.3: Output voltage (2V/div, 20ms/div, 20MHz BWL)
Full load, Vin = 90VAC, 60Hz:

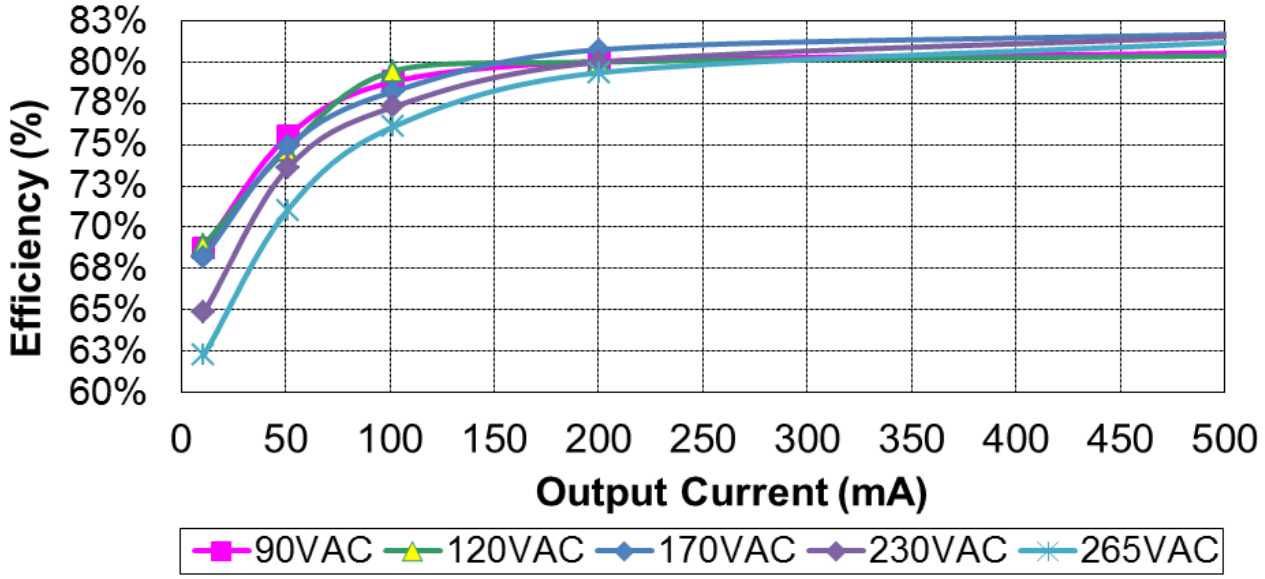


Ch.3: Output voltage (2V/div, 20ms/div, 20MHz BWL)
Full load, Vin = 265VAC, 50Hz:



4 Efficiency

The efficiency data, versus Vin and load, are shown in the tables and graph below.
The input voltage has been set respectively to 90VAC, 120VAC, 170VAC, 230VAC and 265VAC.



VAC (Vrms)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
90	0.02102	12.19	0	0	0.0%
90	0.1917	12.08	10.9	0.132	68.7%
90	0.816	12.06	51.1	0.616	75.5%
90	1.559	12.06	101.9	1.23	78.8%
90	3.025	12.07	200.6	2.42	80.0%
90	7.520	12.11	500.3	6.06	80.6%

VAC (Vrms)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
120	0.02103	12.18	0	0	0.0%
120	0.1911	12.08	10.9	0.132	68.9%
120	0.814	12.06	50.4	0.608	74.7%
120	1.545	12.06	101.8	1.23	79.5%
120	3.022	12.06	200.5	2.42	80.0%
120	7.530	12.10	500.3	6.05	80.4%

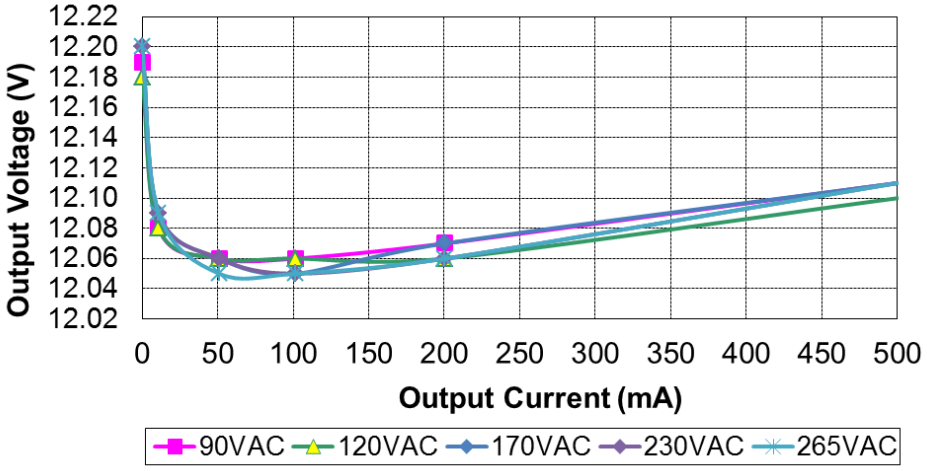
VAC (Vrms)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
170	0.02132	12.20	0	0	0.0%
170	0.1932	12.09	10.9	0.132	68.2%
170	0.823	12.06	51.1	0.616	74.9%
170	1.568	12.05	101.8	1.23	78.2%
170	3.00	12.07	200.6	2.42	80.8%
170	7.415	12.11	500.3	6.06	81.7%

VAC (Vrms)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
230	0.03080	12.20	0	0	0.0%
230	0.2033	12.09	10.9	0.132	64.8%
230	0.836	12.06	51.0	0.615	73.6%
230	1.587	12.05	101.8	1.23	77.3%
230	3.024	12.06	200.6	2.42	80.0%
230	7.428	12.11	500.3	6.06	81.6%

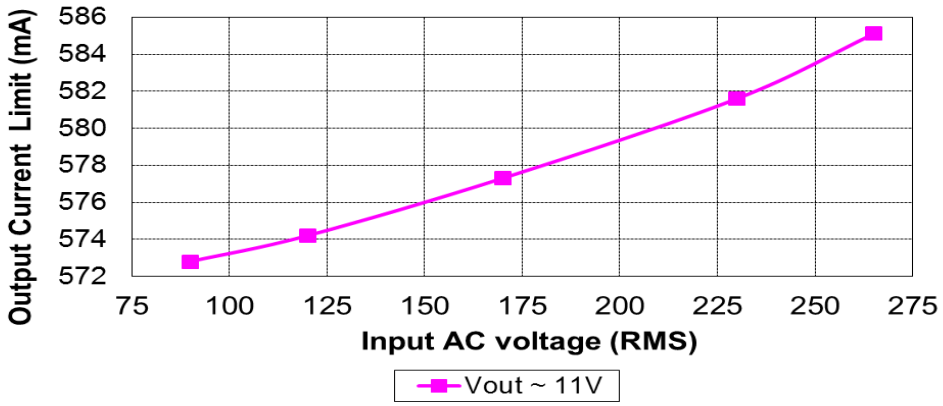
VAC (Vrms)	Pin (W)	Vout (V)	Iout(mA)	Pout (W)	Efficiency (%)
265	0.03409	12.20	0	0	0.0%
265	0.2117	12.09	10.9	0.132	62.2%
265	0.865	12.05	51.0	0.615	71.0%
265	1.612	12.05	101.8	1.23	76.1%
265	3.048	12.06	200.6	2.42	79.4%
265	7.462	12.11	500.3	6.06	81.2%

5 Output Voltage Regulation versus Load Current

The output voltage variation versus load current, for different input voltages, is plotted below.

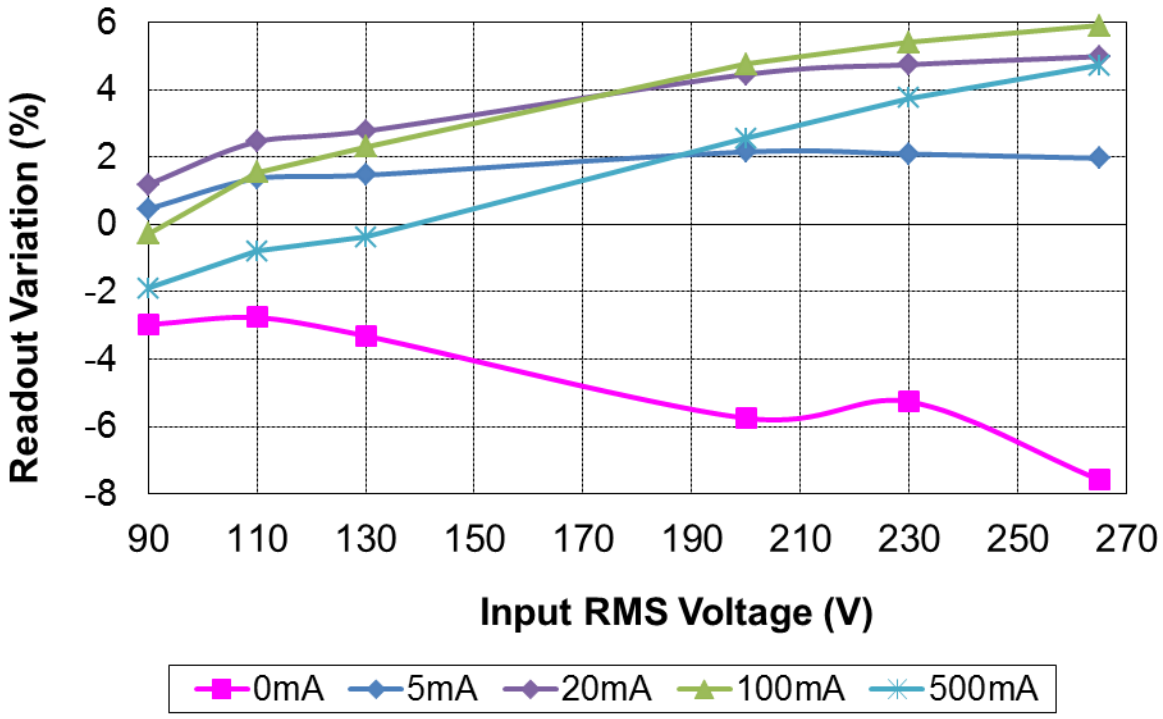


6 Output Current Limit “knee” Variation vs. Input AC Voltage



7 Input AC voltage measurement

The secondary side winding negative voltage (pin 8 & 9 of T1) is detected by D6 & C12, which is proportional by turns ratio to input peak voltage (DC) present on C3 capacitor. This information is transferred, from primary side to secondary, side during Ton. The gain on U2 is set in order to get a DC voltage on TP3 proportional to input AC voltage. With R10/R11 gain, Vtp3 = Vin(RMS)/100. In the following graph and table is shown the percentage of deviation from the exact value. It is possible to see that the readout precision is kept within -2%...+6% if a minimum load of 5mA is connected to the output of the power supply.

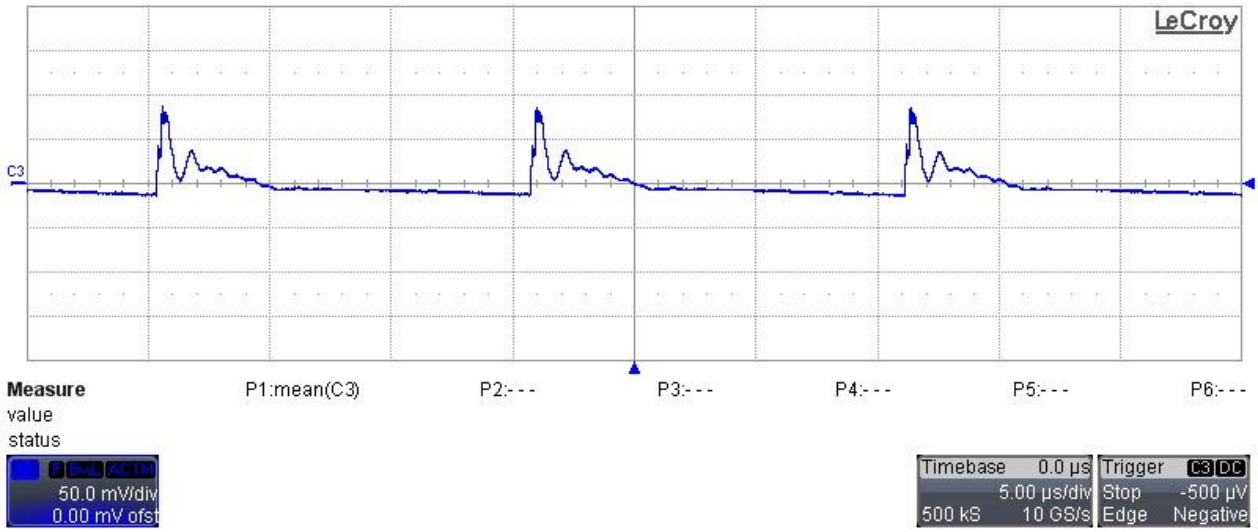


	V(TP3, Volt) vs Load current					Deviation (%)				
Vin (Vrms)	0mA	5mA	20mA	100mA	500mA	0mA	5mA	20mA	100mA	500mA
90	0.8732	0.9041	0.9107	0.8975	0.8829	-3.0	0.5	1.2	-0.3	-1.9
110	1.0696	1.1150	1.1270	1.1170	1.0913	-2.8	1.4	2.5	1.5	-0.8
130	1.257	1.319	1.336	1.330	1.295	-3.3	1.5	2.8	2.3	-0.4
200	1.885	2.043	2.089	2.095	2.051	-5.8	2.2	4.5	4.8	2.6
230	2.179	2.348	2.409	2.424	2.386	-5.3	2.1	4.7	5.4	3.7
265	2.449	2.702	2.782	2.806	2.775	-7.6	2.0	5.0	5.9	4.7

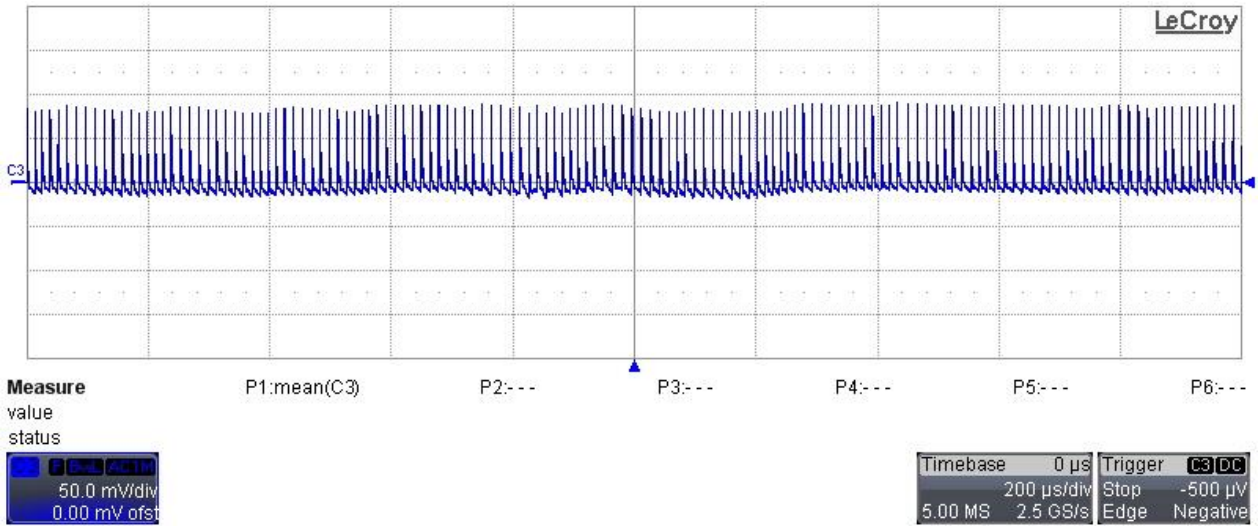
8 Output Ripple Voltage

The output ripple voltage has been measured by supplying the converter at 90VAC, 230VAC and 265VAC in full load condition and very light load as well to detect any low frequency ripple. (All screenshots have been taken with 20MHz bandwidth, AC coupling).

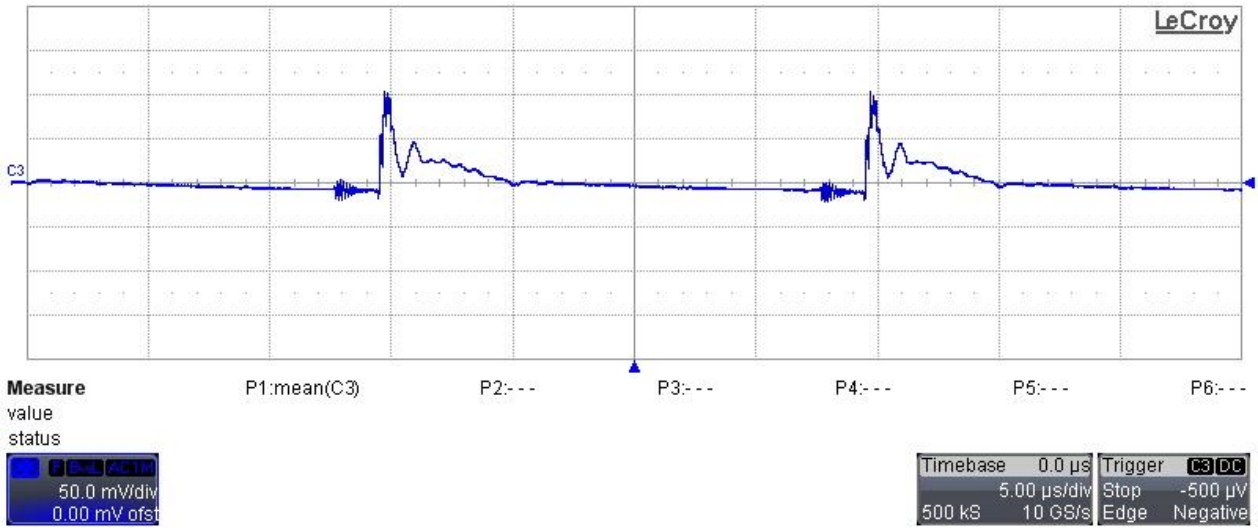
Full load, Vin = 90VAC, 60Hz:
Ch.3: Output voltage (50mV/div, 5us/div)



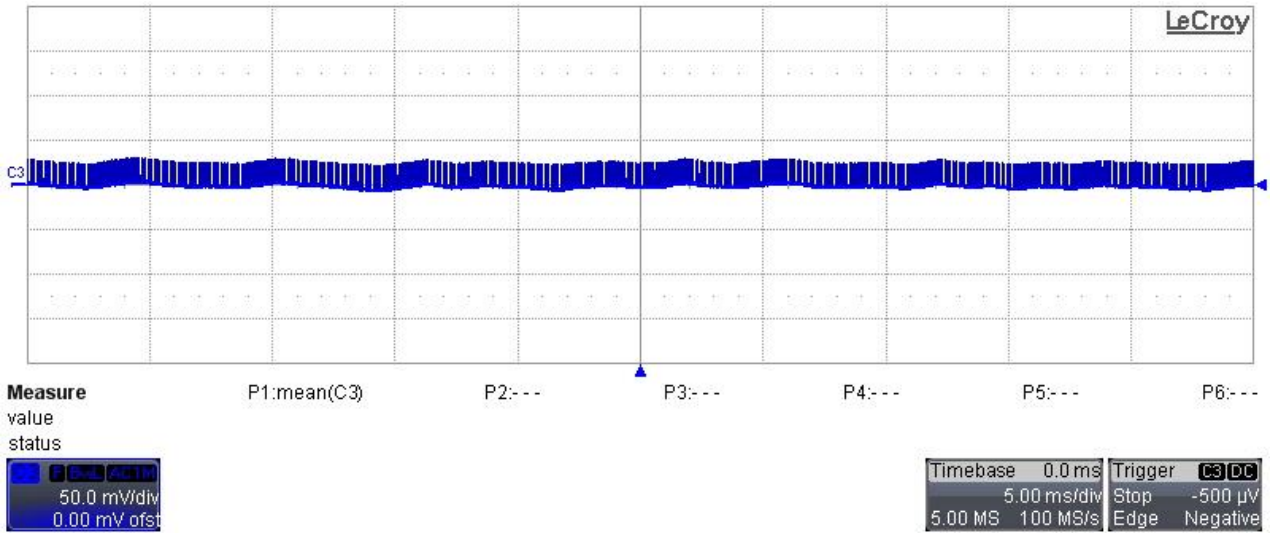
Full load, Vin = 90VAC, 60Hz:
Ch.3: Output voltage (50mV/div, 200us/div)



Full load, Vin = 265VAC, 50Hz:
Ch.3: Output voltage (50mV/div, 5us/div)



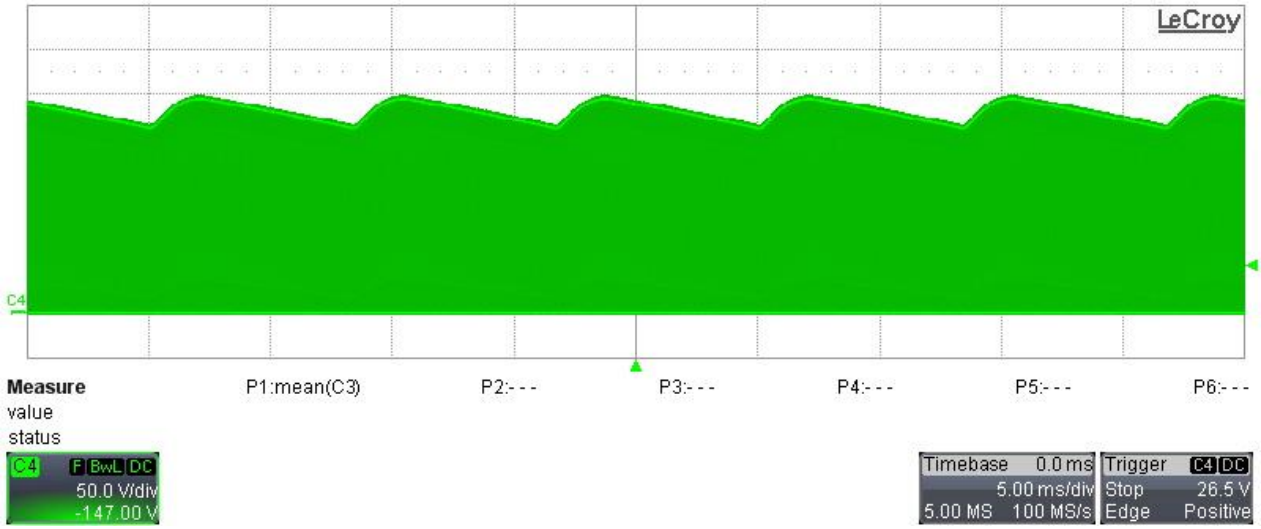
Load = 13mA, Vin = 230VAC, 50Hz:
Ch.3: Output voltage (50mV/div, 5ms/div)



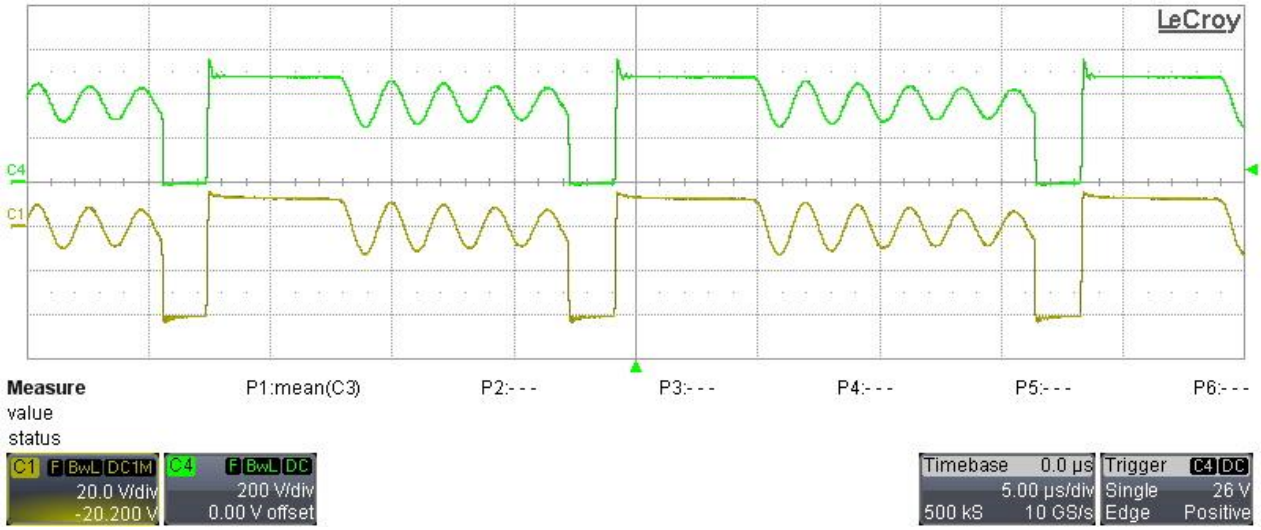
9 Switch nodes

The images below show the switch node of U1 (pin 8), taken at 90VAC (useful to show 120Hz ripple) and 265VAC input voltage while the output was fully loaded. The second screenshot shows also TP18 voltage (anode of D1, D3); for all waveforms both probes were set to DC coupling and 200MHz bandwidth limit.

Vin = 90VAC, 60Hz:
Ch.4: Pin 8, U1 (50V/div, 5ms/div)



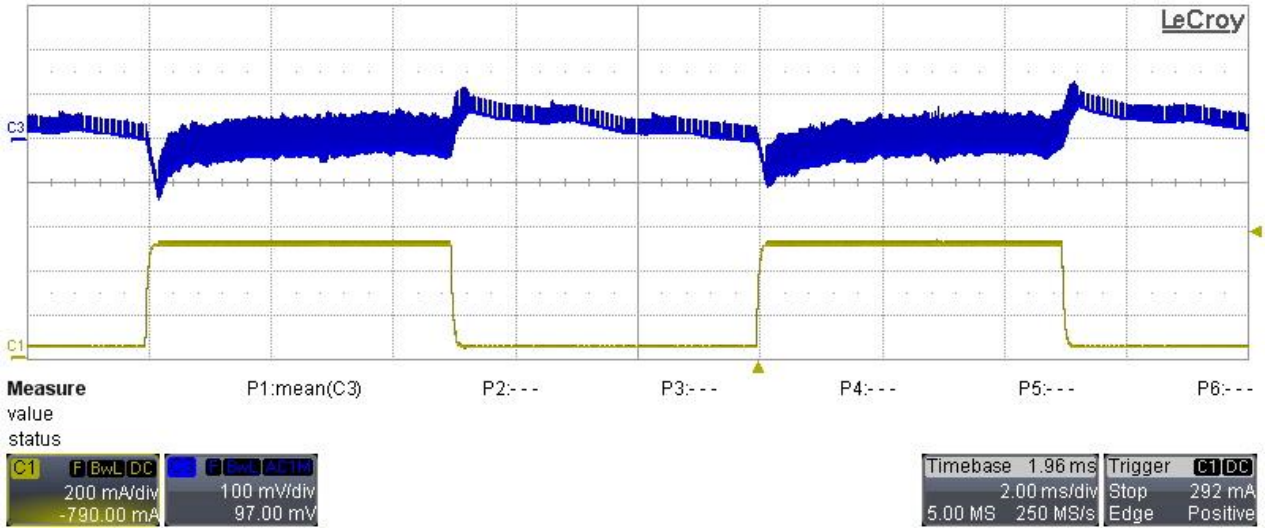
Vin = 265VAC, 50Hz:
Ch.1: TP18 Voltage (20V/div, 5us/div)
Ch.4: Pin 8, U1 (200V/div)



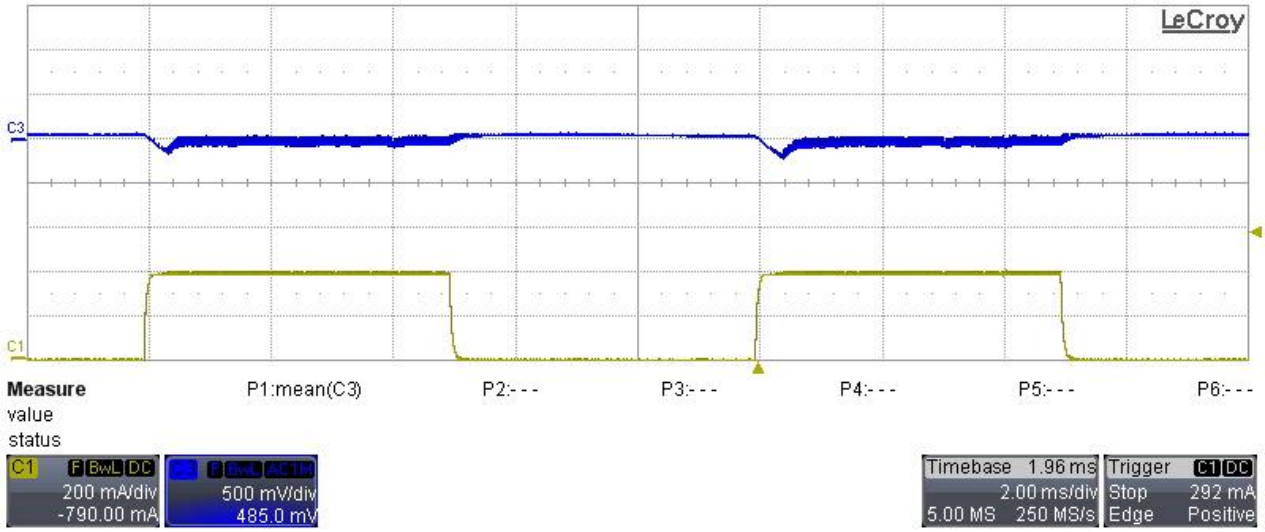
10 Transient Response

The images below show the transient response on output voltage in different load transient range and Vin conditions.

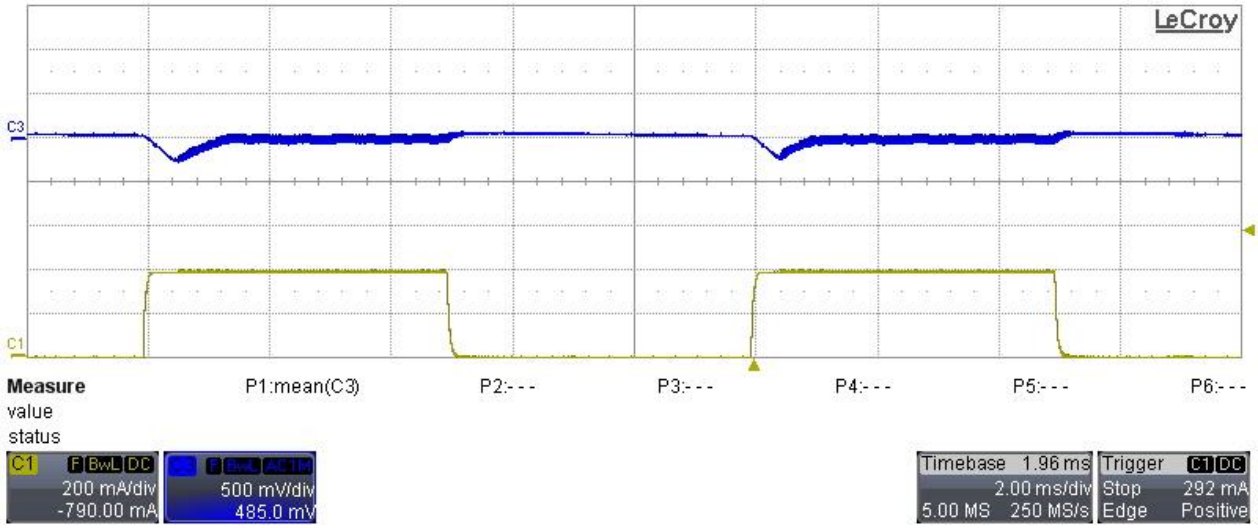
Vin = 230VAC, 50Hz; Iout = 50mA → 500mA
Ch.1: Output current (200mA/div, 2ms/div, DC coupling, 20MHz BWL)
Ch.3: Output voltage (100mV/div, DC coupling, 20MHz BWL)



Vin = 230VAC, 50Hz; Iout = 0mA → 400mA
Ch.1: Output current (200mA/div, 2ms/div, DC coupling, 20MHz BWL)
Ch.3: Output voltage (500mV/div, DC coupling, 20MHz BWL)



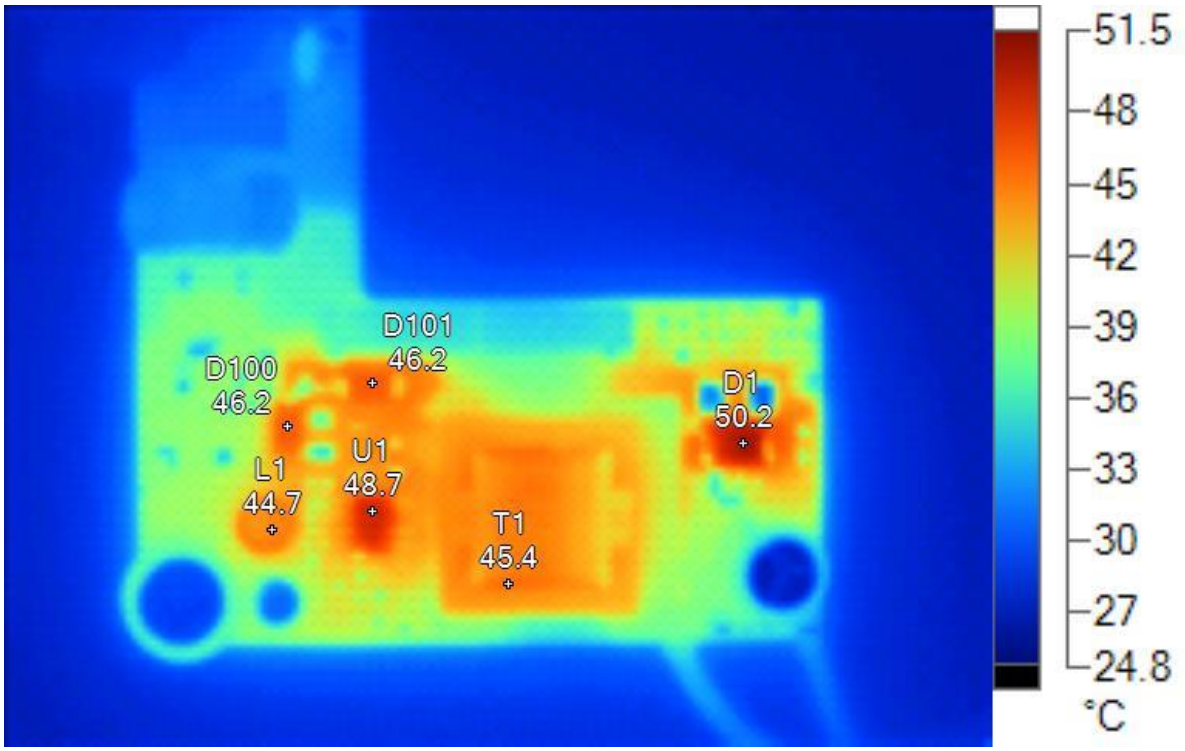
Vin = 90VAC, 60Hz; Iout = 0mA → 400mA
Ch.1: Output current (200mA/div, 2ms/div, DC coupling, 20MHz BWL)
Ch.3: Output voltage (500mV/div, DC coupling, 20MHz BWL)



11 Thermal Analysis

During the thermal analysis, the converter has been placed horizontally on the bench in still air conditions, while fully loaded and supplied @ 115Vrms.

Vin = 115VAC, Full load

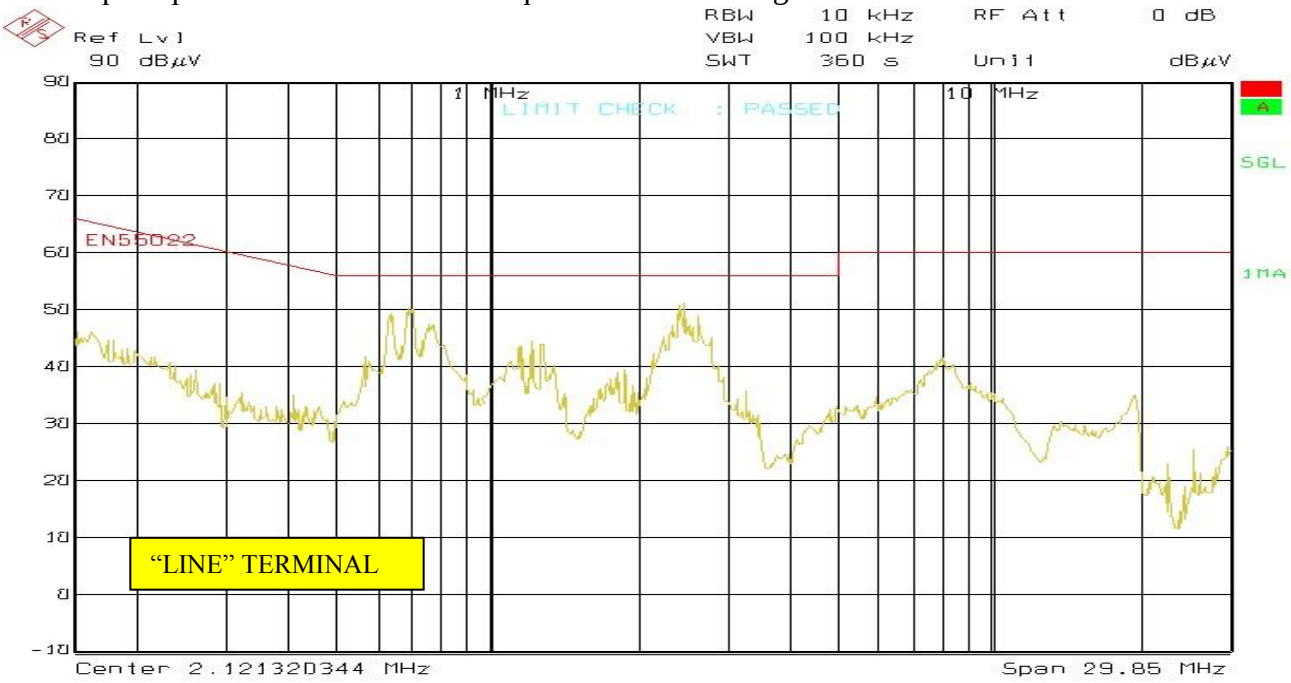


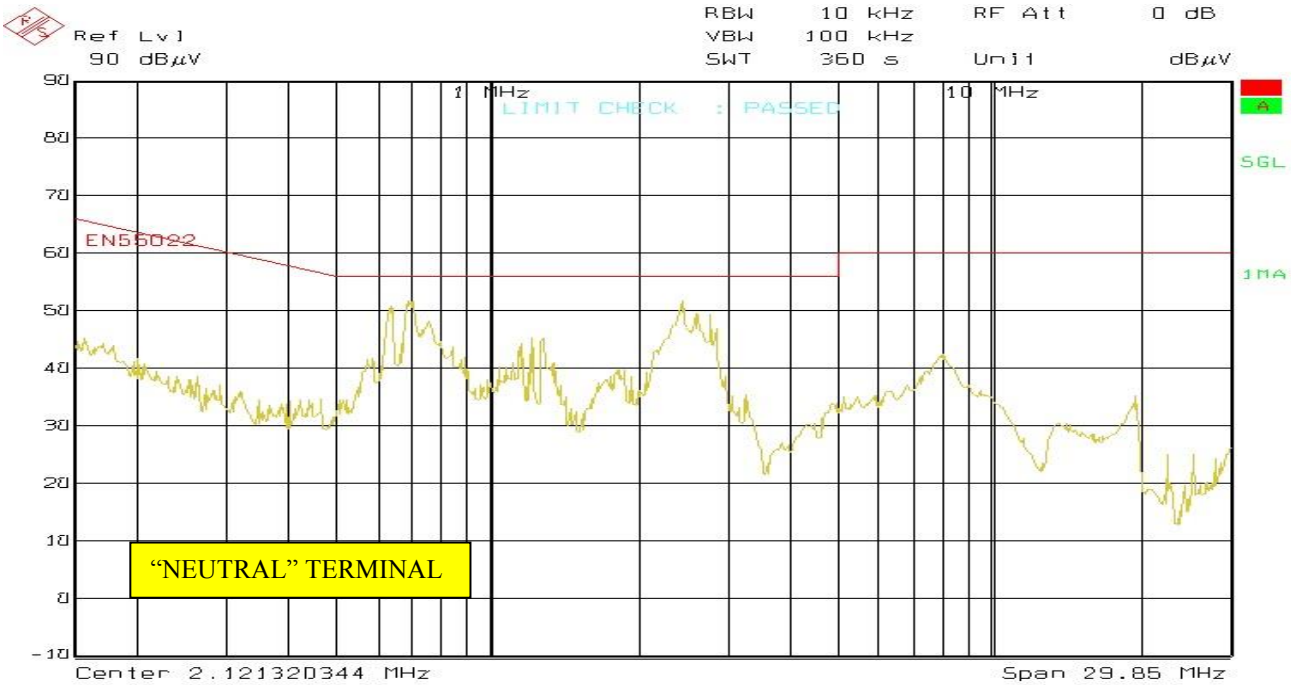
Main Image Markers

Name	Temperature	Emissivity	Background
T1	45.4°C	0.95	24.0°C
U1	48.7°C	0.95	24.0°C
D1	50.2°C	0.95	24.0°C
L1	44.7°C	0.95	24.0°C
D100	46.2°C	0.95	24.0°C
D101	46.2°C	0.95	24.0°C

12 EMI measurement

The graphs below show the EMI measurement of the converter connected to an isolation transformer through a Hameg HM6050-2 LISN. The supply voltage was 230VAC. The converter has been loaded with a power resistor adjusted to deliver full load. The output negative terminal of the converter has been connected to the ground of the LISN. The detector of the receiver was set to "quasi-peak" and the limit is the equivalent EN55022 grade B.





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