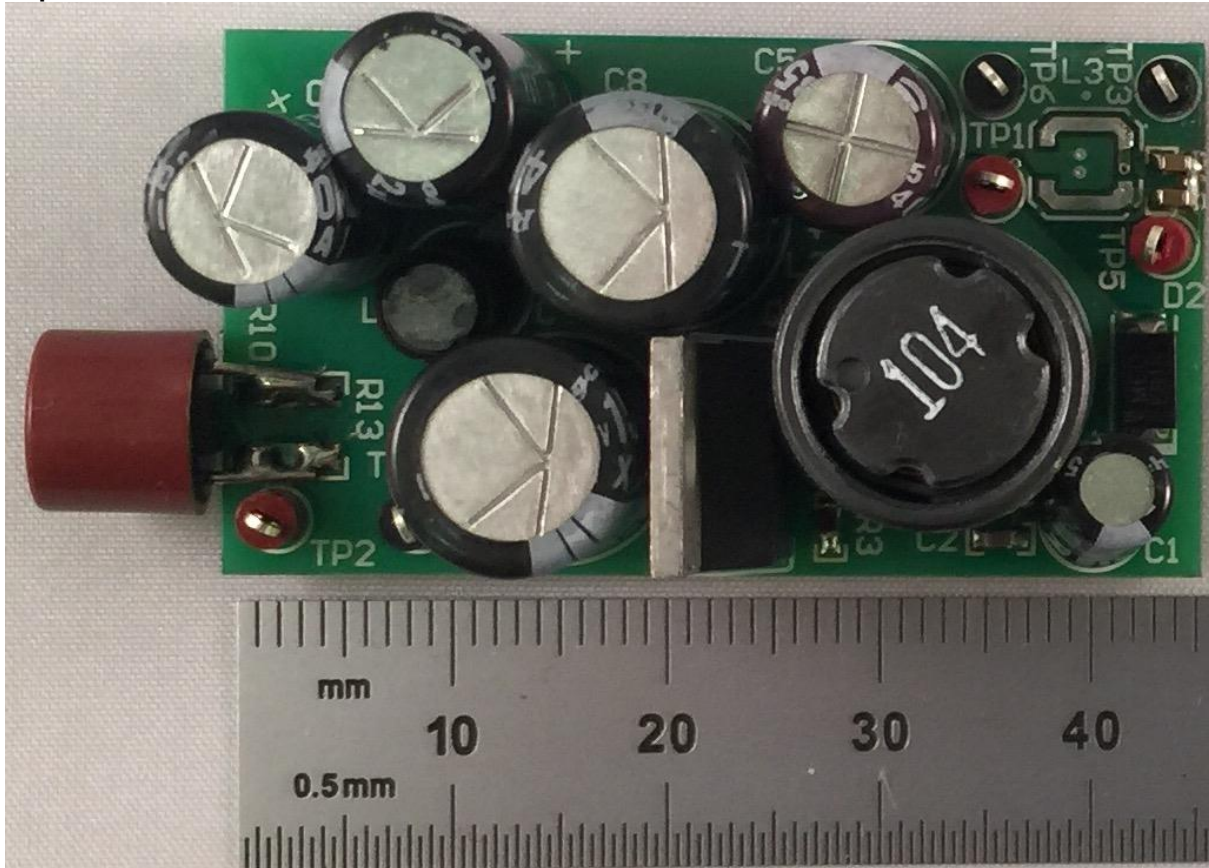


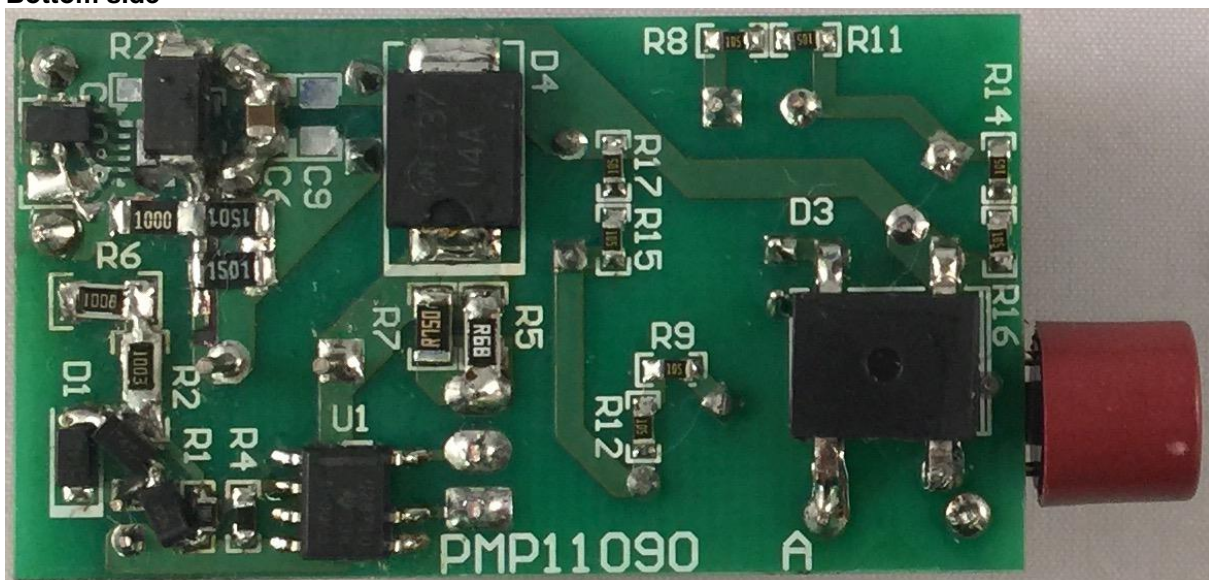
## 1 Photo

The photographs below show the PMP11090 Rev A assembly. This circuit was built on a PMP11090 Rev A PCB.

**Top side**

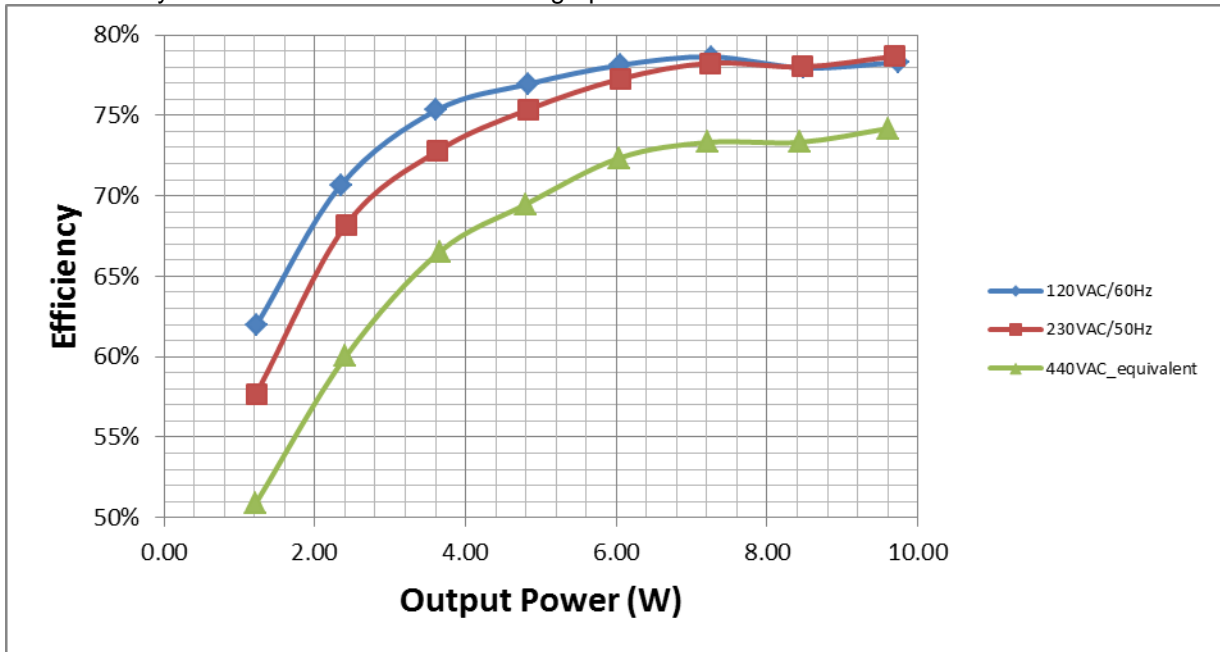


**Bottom side**



## 2 Converter Efficiency

The efficiency data is shown in the tables and graph below.



### V<sub>in</sub>=120V<sub>AC</sub>/50Hz

V <sub>in</sub> (V)	I <sub>in</sub> (mA)	P <sub>in</sub> (W)	V <sub>o1</sub> (V)	I <sub>o1</sub> (A)	V <sub>o2</sub> (V)	I <sub>o2</sub> (A)	P <sub>out</sub> (W)	Losses(W)	Efficiency (%)
120.02	181.32	12.44	23.97	0.402	4.99	0.0201	9.74	2.70	78.30%
120.05	162.14	10.89	23.93	0.351	4.99	0.0201	8.49	2.40	77.96%
120.07	141.16	9.23	23.91	0.300	5.00	0.0151	7.26	1.97	78.65%
120.09	122.54	7.75	23.90	0.250	5.00	0.0151	6.06	1.70	78.13%
120.12	103.46	6.29	23.91	0.200	5.03	0.0101	4.84	1.45	76.97%
120.16	83.54	4.79	23.90	0.149	5.00	0.0100	3.61	1.18	75.32%
120.20	62.37	3.32	23.90	0.097	5.01	0.0050	2.34	0.97	70.67%
120.21	40.22	1.97	23.93	0.050	5.02	0.0050	1.22	0.75	61.96%
120.24	11.62	0.49	23.87	0.000	5.03	0.0000	0.00	0.49	0.00%

**Vin=230V<sub>AC</sub>/50Hz**

Vin(V)	Iin(mA)	Pin(W)	Vo1(V)	Io1(A)	Vo2(V)	Io2(A)	Pout(W)	Losses(W)	Efficiency (%)
230.10	116.63	12.31	23.96	0.400	5.03	0.0206	9.69	2.63	78.68%
230.10	105.87	10.86	23.91	0.350	4.99	0.0204	8.47	2.39	78.02%
230.10	93.51	9.26	23.89	0.300	5.01	0.0151	7.24	2.01	78.26%
230.20	82.04	7.83	23.89	0.250	5.00	0.0150	6.05	1.78	77.27%
230.20	69.76	6.41	23.89	0.200	5.00	0.0101	4.83	1.58	75.37%
230.20	56.53	4.99	23.87	0.150	5.00	0.0101	3.63	1.36	72.80%
230.20	42.05	3.54	23.86	0.100	5.01	0.0050	2.41	1.12	68.19%
230.20	26.54	2.11	23.89	0.050	5.01	0.0051	1.22	0.89	57.70%
230.20	8.15	0.59	23.83	0.000	5.03	0.0000	0.00	0.59	0.00%

**Vin=440V<sub>AC</sub> equivalent (This voltage is achieved by an 220V<sub>AC</sub>/50Hz input with a voltage doubler circuit)**

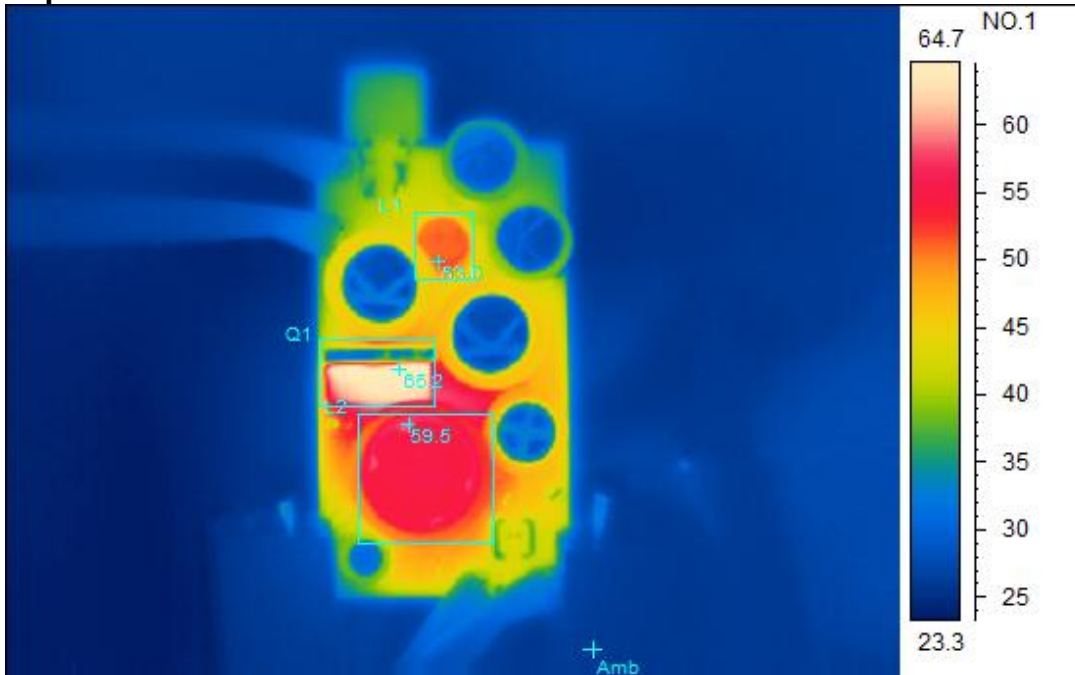
VDC(V)	Vin(V)	Iin(mA)	Pin(W)	Vo1(V)	Io1(A)	Vo2(V)	Io2(A)	Pout(W)	Losses(W)	Efficiency (%)
620	221.10	141.00	12.95	23.71	0.401	4.99	0.0200	9.61	3.34	74.19%
620.4	221.10	127.08	11.51	23.89	0.349	4.99	0.0200	8.44	3.07	73.34%
620.8	221.20	110.65	9.84	23.87	0.299	5.00	0.0150	7.21	2.62	73.32%
620.3	220.90	95.80	8.35	23.86	0.250	5.00	0.0150	6.04	2.31	72.36%
620.9	220.90	81.10	6.91	23.86	0.199	5.00	0.0100	4.80	2.11	69.48%
620.1	220.50	66.22	5.49	23.85	0.151	5.00	0.0100	3.65	1.84	66.51%
620.7	220.50	50.12	4.01	23.84	0.100	5.01	0.0050	2.41	1.60	60.02%
621.5	220.50	31.71	2.38	23.74	0.050	5.01	0.0050	1.21	1.17	50.87%
621.1	220.00	11.64	0.79	23.81	0.000	5.03	0.0000	0.00	0.79	0.00%

### 3 Thermal Images

The thermal images below show a top view and bottom view of the board under 120V<sub>AC</sub>/60Hz, 230V<sub>AC</sub>/50Hz , and 440V<sub>AC</sub>\_equivalent input conditions. The ambient temperature was 20°C with no forced air flow. The output was at 24V/0.4A and 5V/20mA.

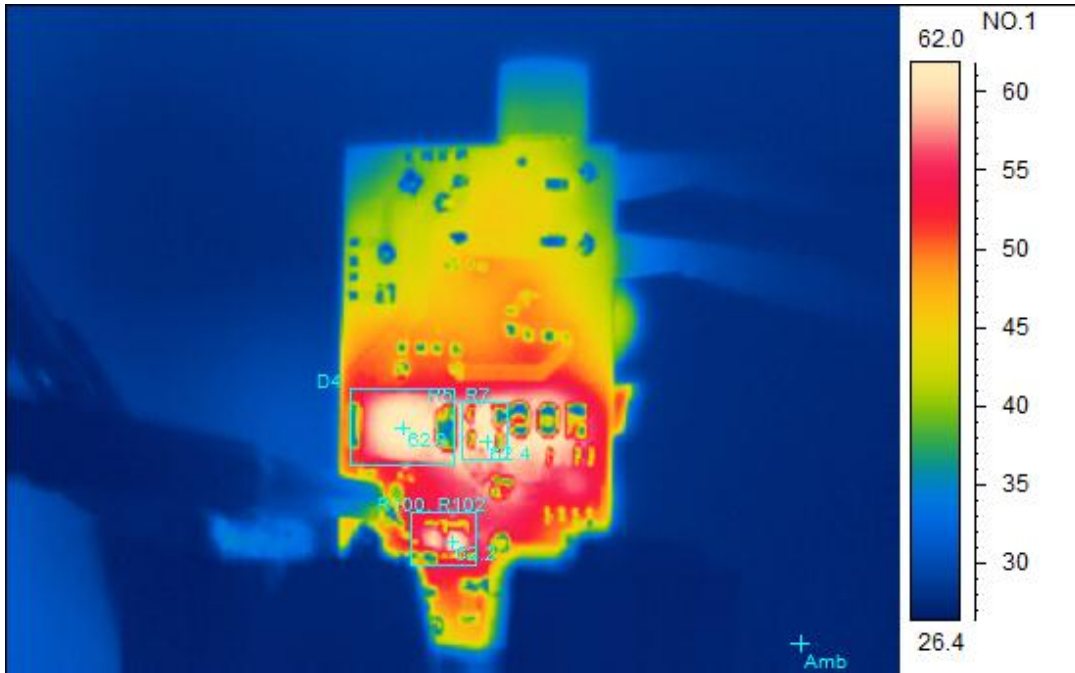
**V<sub>in</sub>=120V<sub>AC</sub>/60Hz**

**Top side**



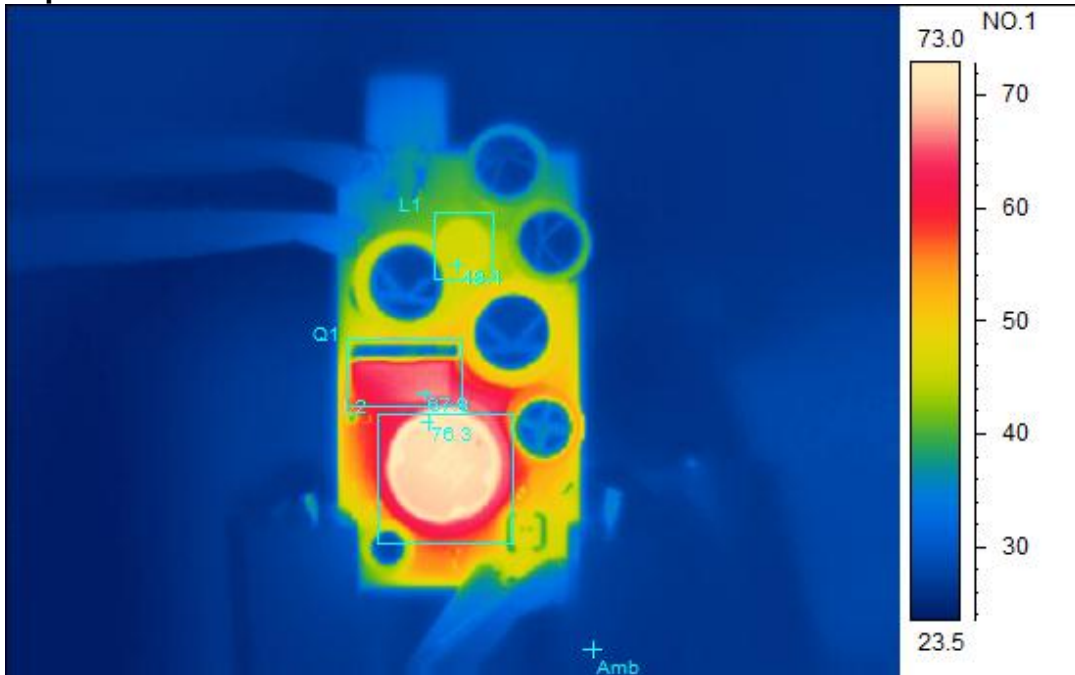
Spot analysis	Value
Amb Temperature	26.4°C
Area analysis	Value
Q1Max	65.2°C
L2Max	59.5°C
L1Max	53.0°C

**V<sub>in</sub>=120V<sub>AC</sub>/60Hz**  
**Bottom side**



Spot analysis	Value
Amb Temperature	27.2°C
Area analysis	Value
D4Max	62.8°C
R5, R7Max	62.4°C
R100, R102Max	62.2°C

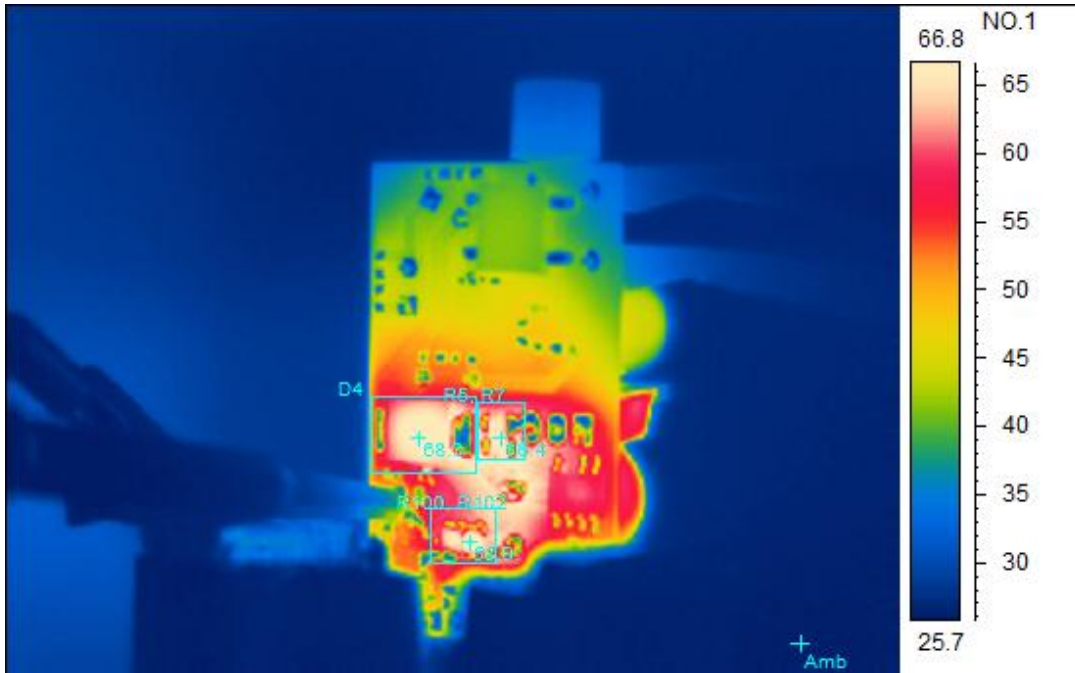
**V<sub>in</sub>=230V<sub>AC</sub>/50Hz**  
**Top side**



Spot analysis	Value
Amb Temperature	26.8°C
Area analysis	Value
Q1Max	67.9°C
L2Max	76.3°C
L1Max	49.4°C

**$V_{in}=230V_{AC}/50Hz$**

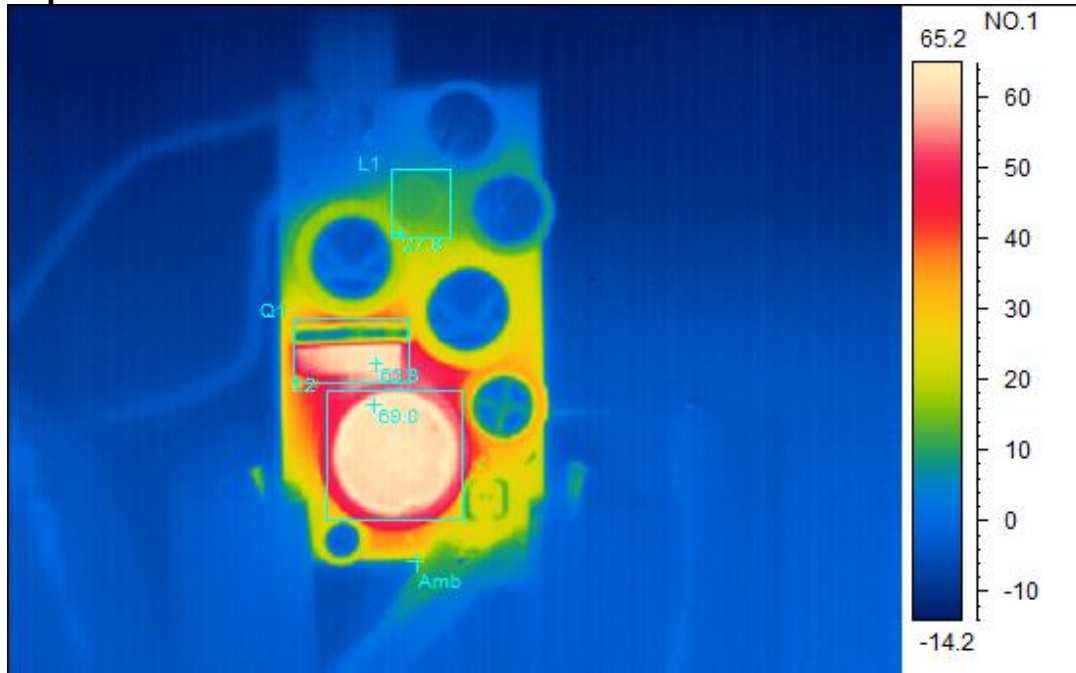
**Bottom side**



Spot analysis	Value
Amb Temperature	26.3°C
Area analysis	Value
D4Max	68.3°C
R5, R7Max	66.4°C
R100, R102Max	68.9°C

$V_{in}=440V_{AC\_equivalent}$  (This voltage is achieved by an  $220V_{AC}/50Hz$  input with a voltage doubler circuit)

Top side

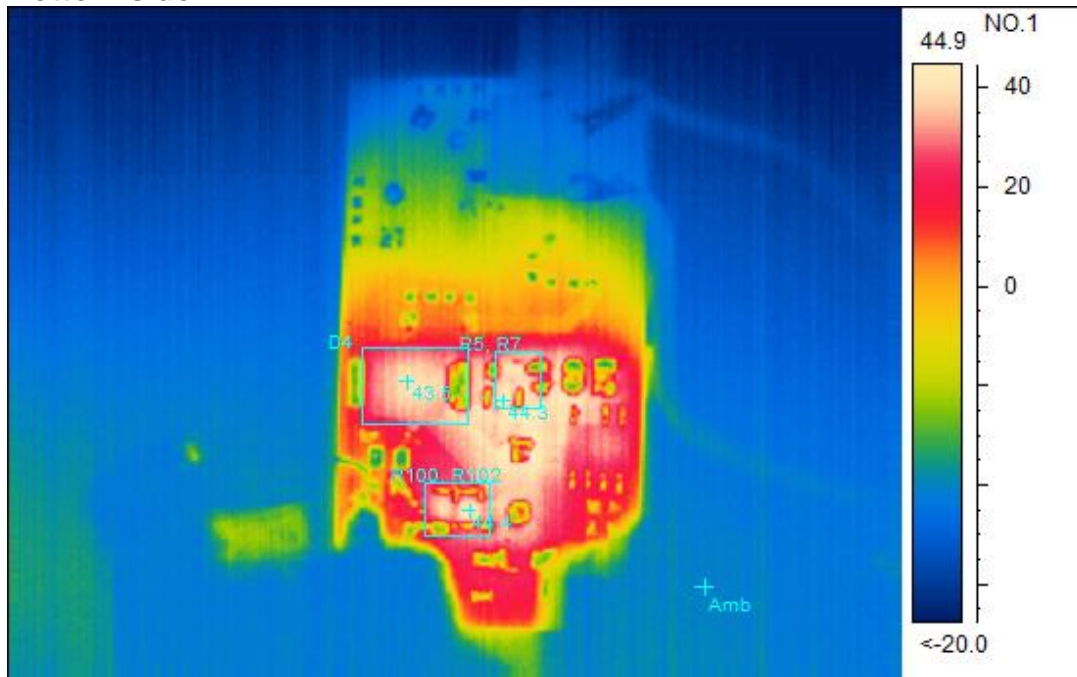


Spot analysis	Value
Amb Temperature	19.0°C
Area analysis	Value
Q1Max	63.8°C
L2Max	69.0°C
L1Max	27.8°C



**$V_{in}=440V_{AC\_equivalent}$  (This voltage is achieved by an  $220V_{AC}/50Hz$  input with a voltage doubler circuit)**

**Bottom side**

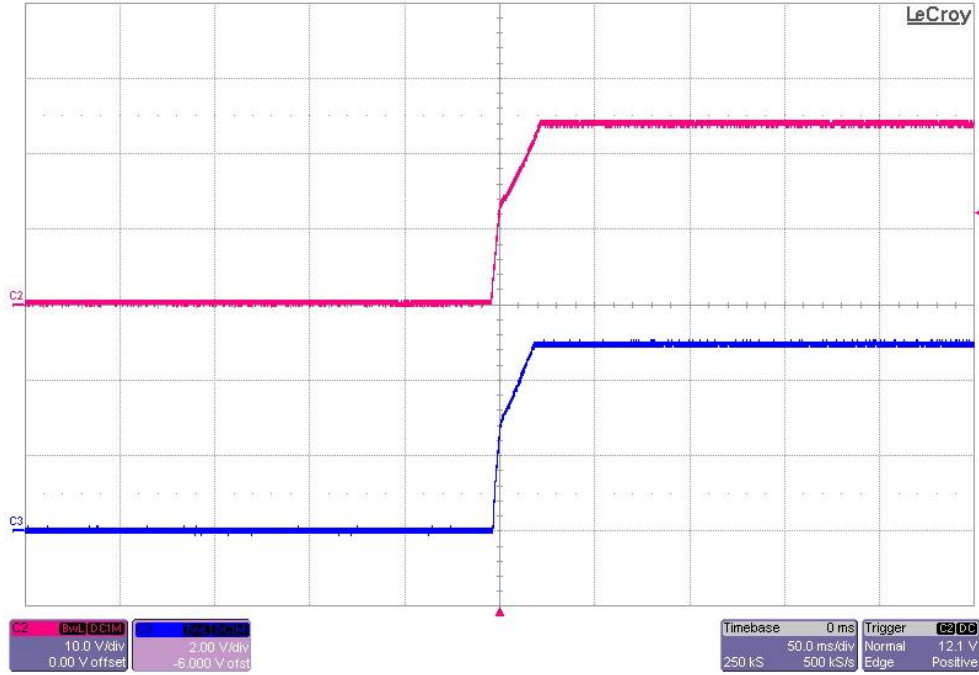


Spot analysis	Value
Amb Temperature	$\le -20.0^{\circ}C$
Area analysis	Value
D4Max	$43.5^{\circ}C$
R5, R7Max	$44.3^{\circ}C$
R100, R102Max	$44.4^{\circ}C$

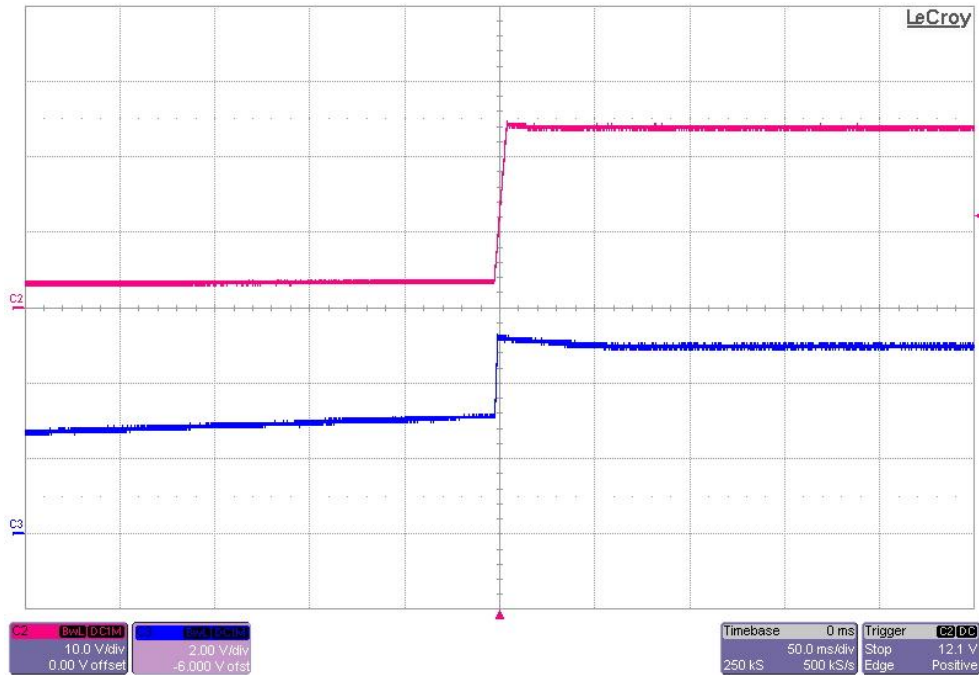
## 4 Startup Waveforms

The output voltages at startup are shown in the images below.

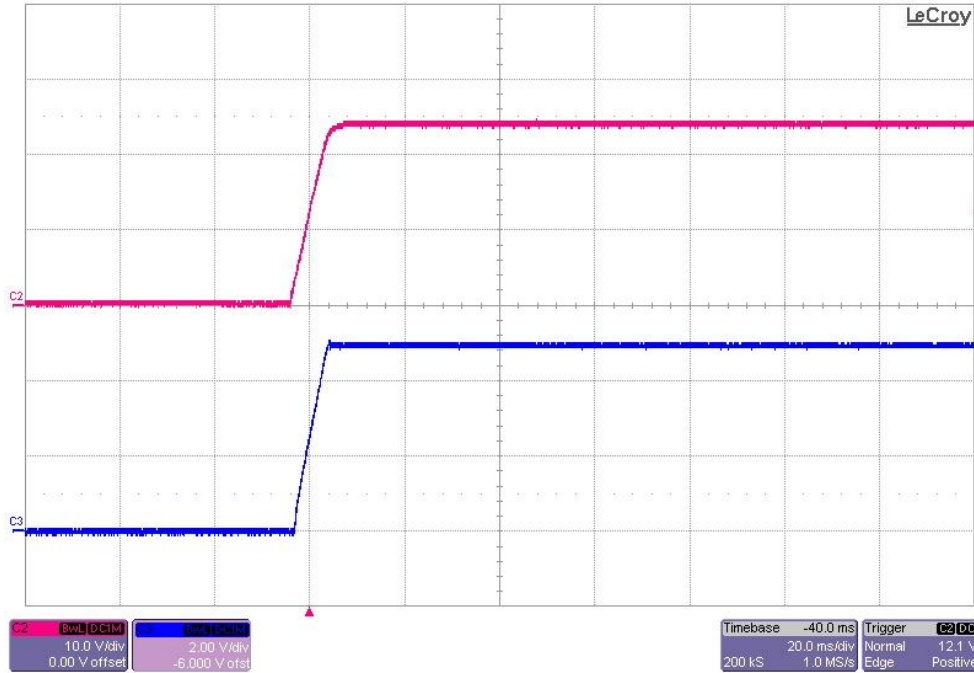
### 4.1 Start Up @ 120V<sub>AC</sub>: 24V/0.4A, 5V/20mA.



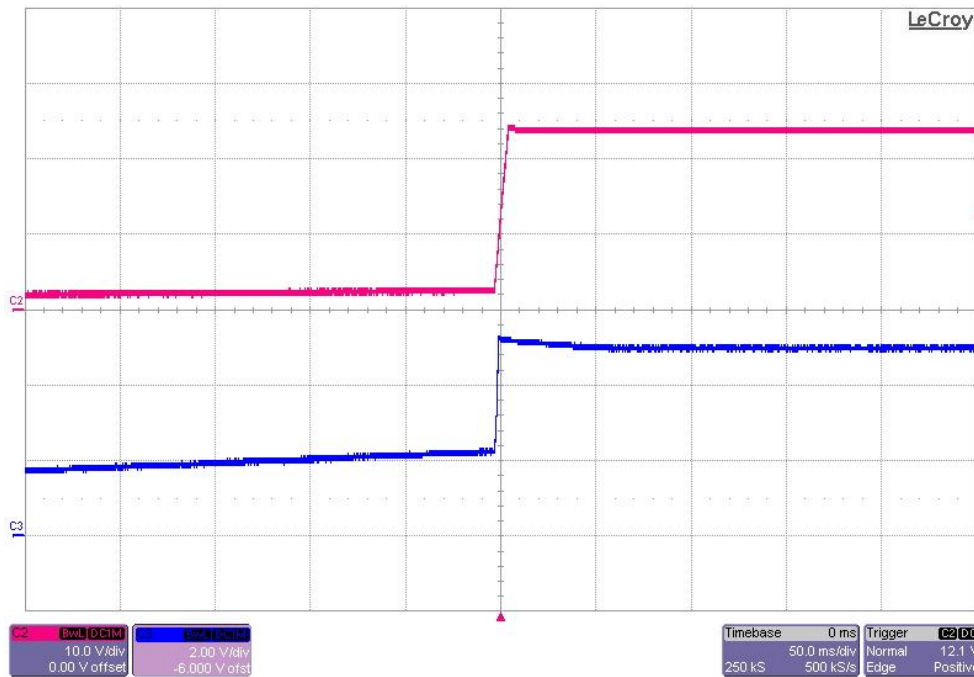
### 4.2 Start Up @ 120V<sub>AC</sub>: no load.



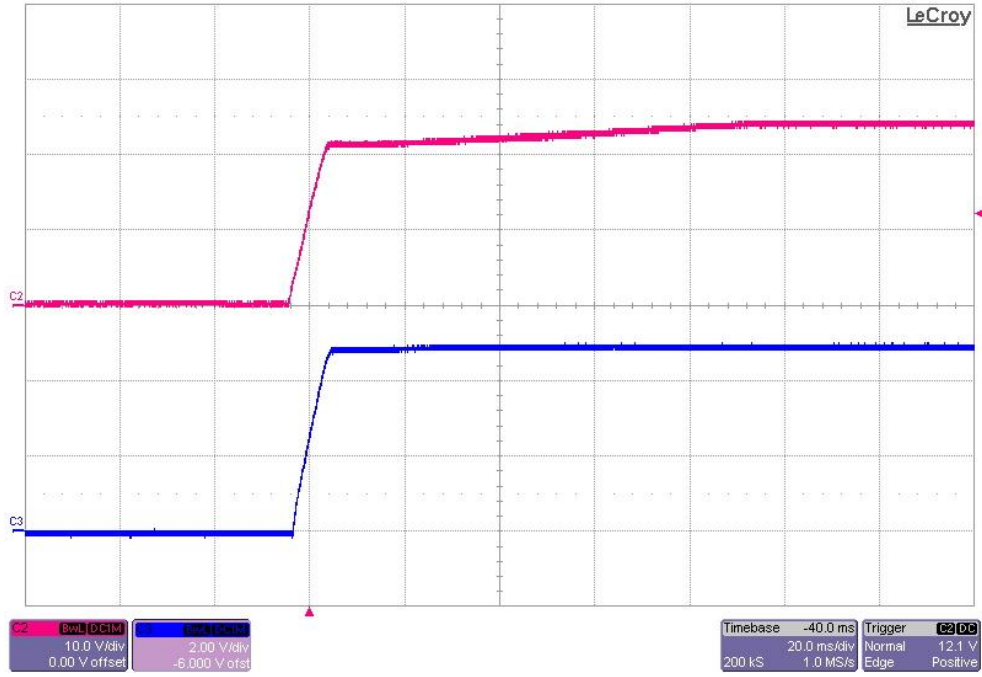
### 4.3 Start Up @ 230V<sub>AC</sub>: 24V/0.4A, 5V/20mA.



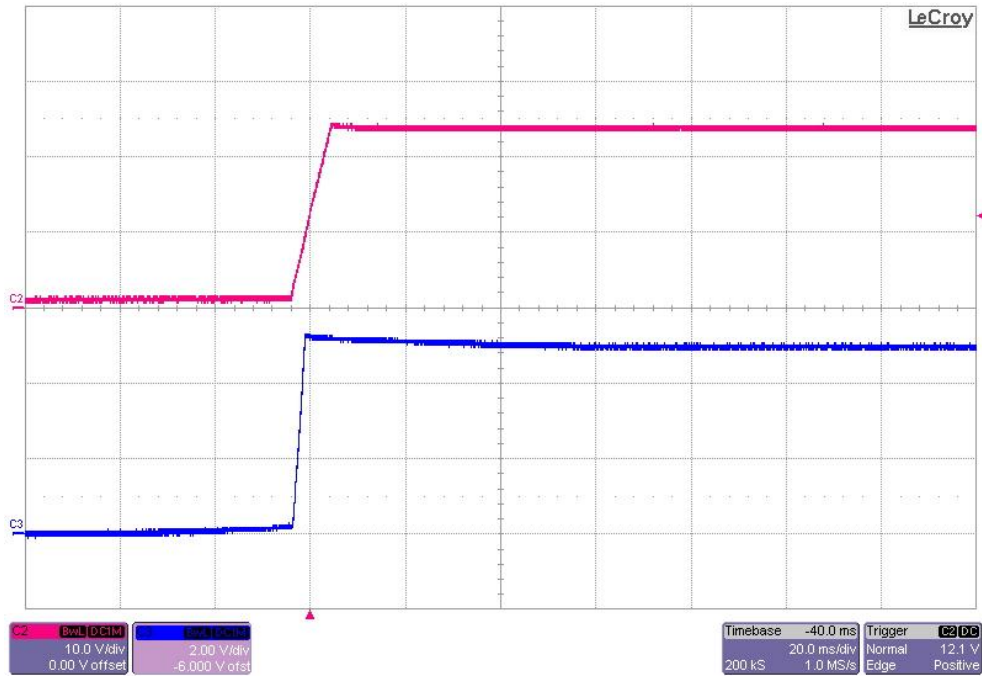
### 4.4 Start Up @ 230V<sub>AC</sub>: no load.



### 4.5 Start Up @ 440V<sub>AC</sub>: 24V/0.4A, 5V/20mA.



### 4.6 Start Up @ 440V<sub>AC</sub>: no load.

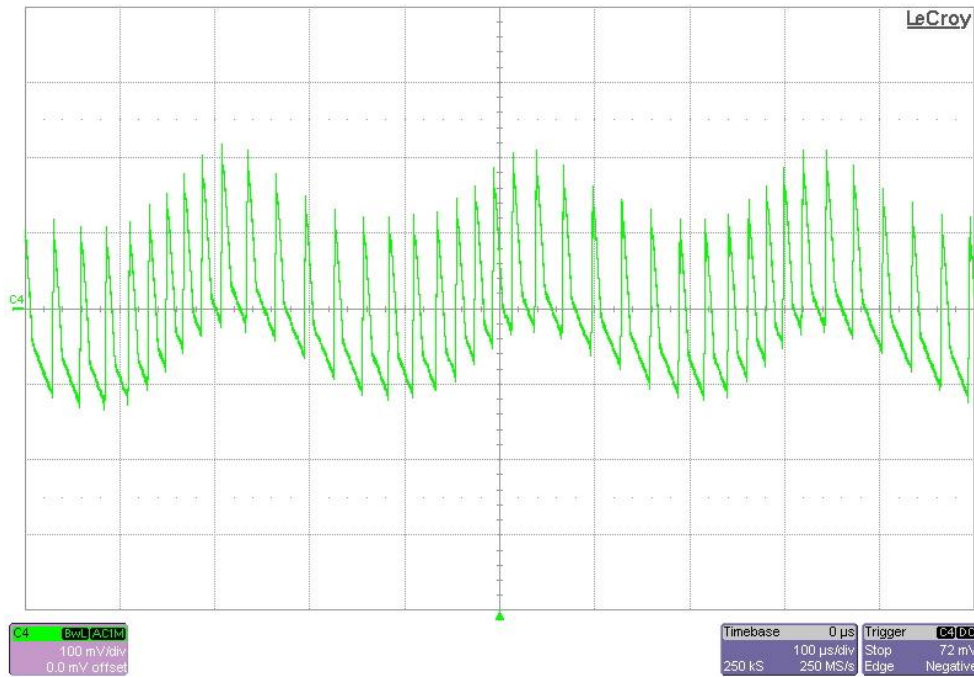


## 5 Output Ripple Voltages

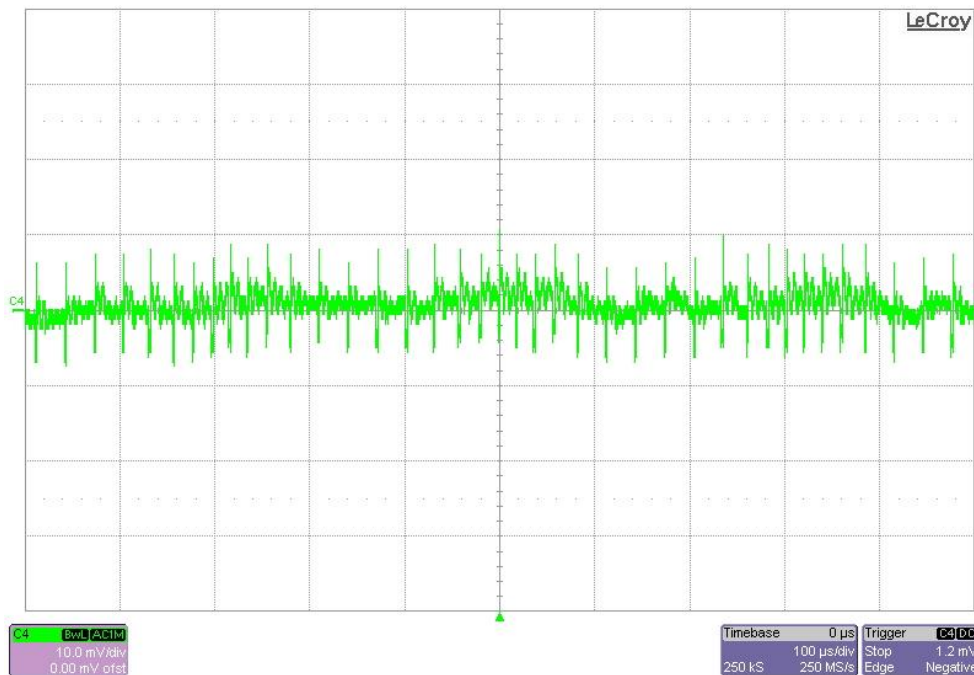
The output ripple voltages are shown in the plots below:

### 5.1 120V<sub>AC</sub>/60Hz

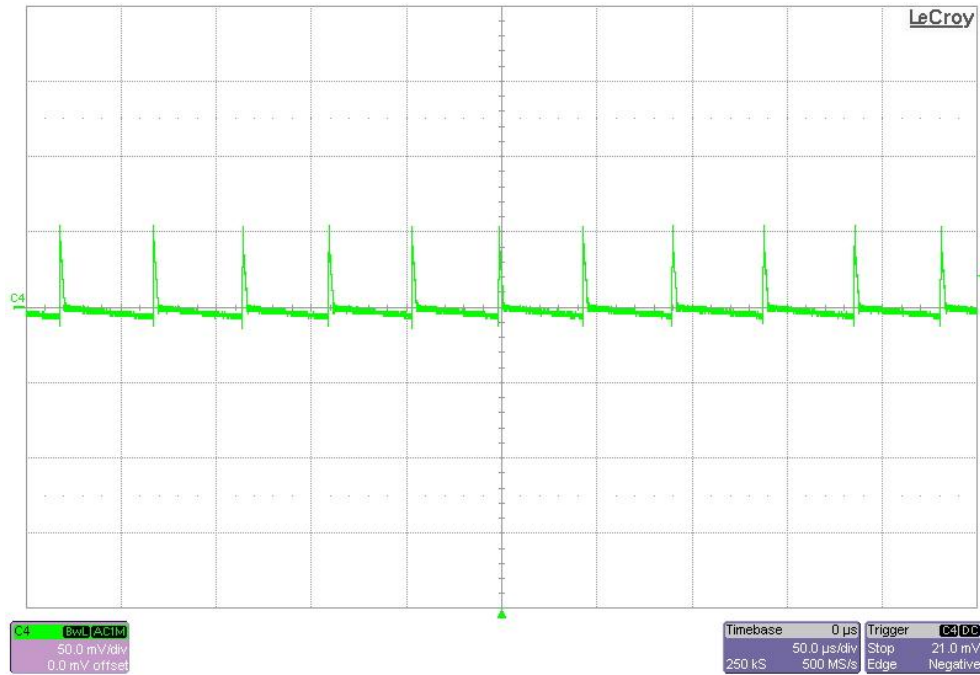
#### 5.1.1 24V@ 24V/0.4A, 5V/20mA



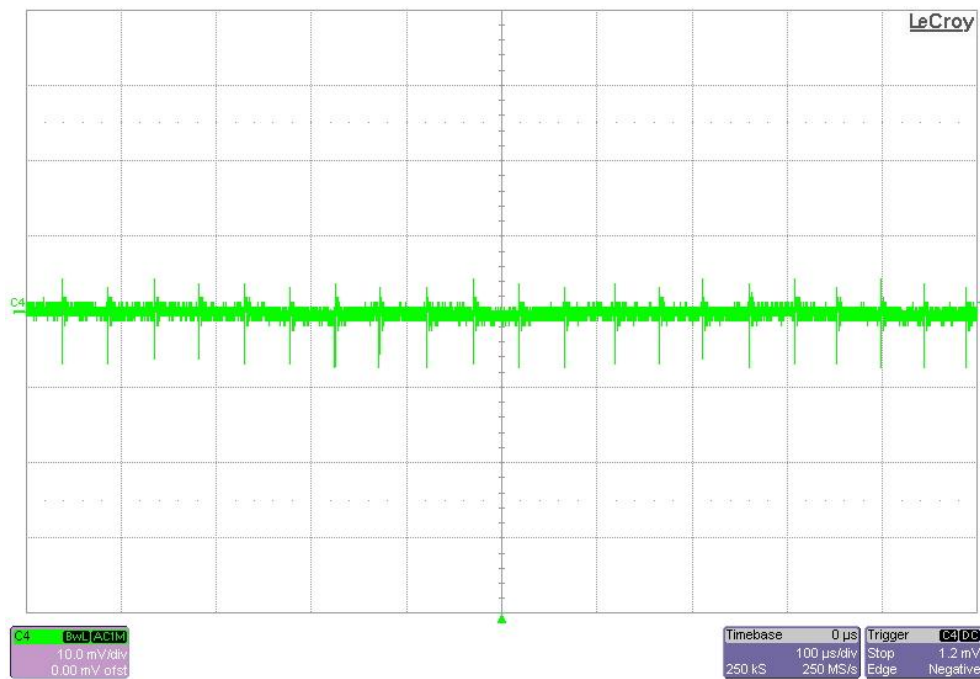
#### 5.1.2 5V@ 24V/0.4A, 5V/20mA



## 5.1.3 24V@ No load

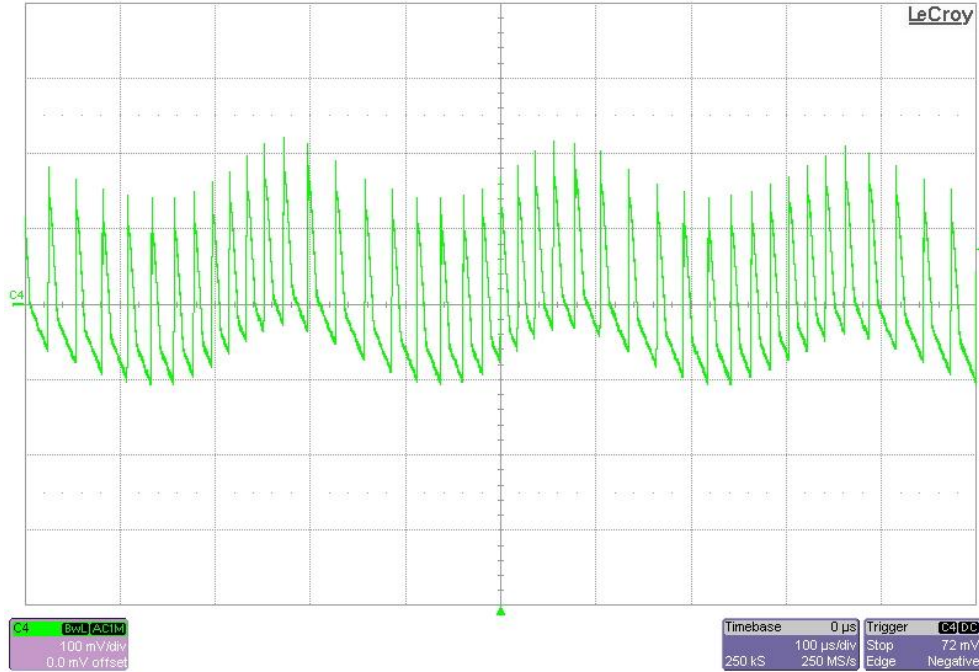


## 5.1.4 5V@ No load

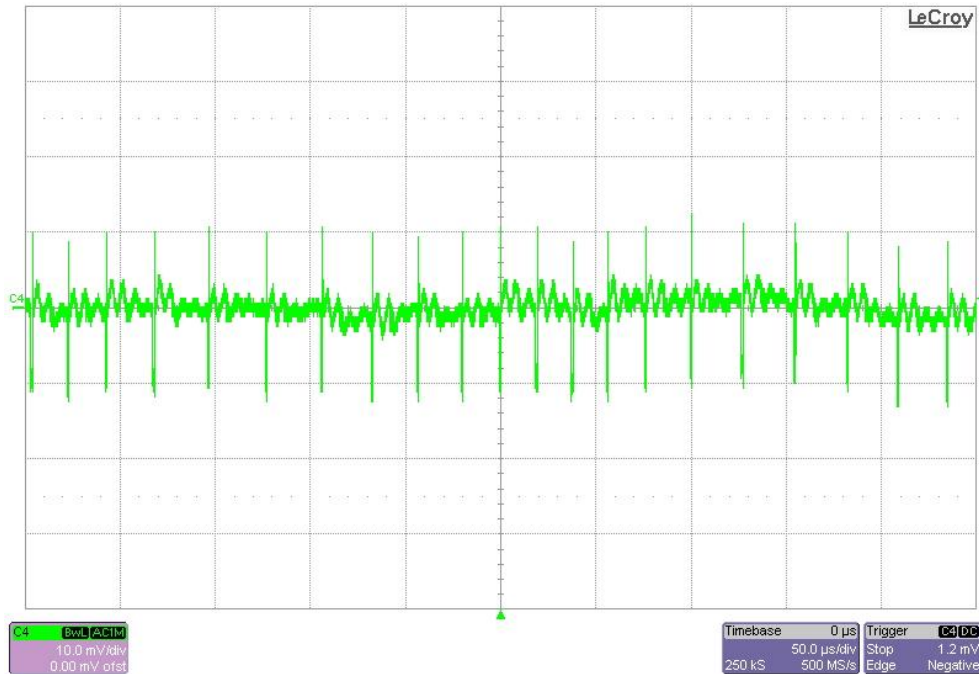


## 5.2 230V<sub>AC</sub>/50Hz

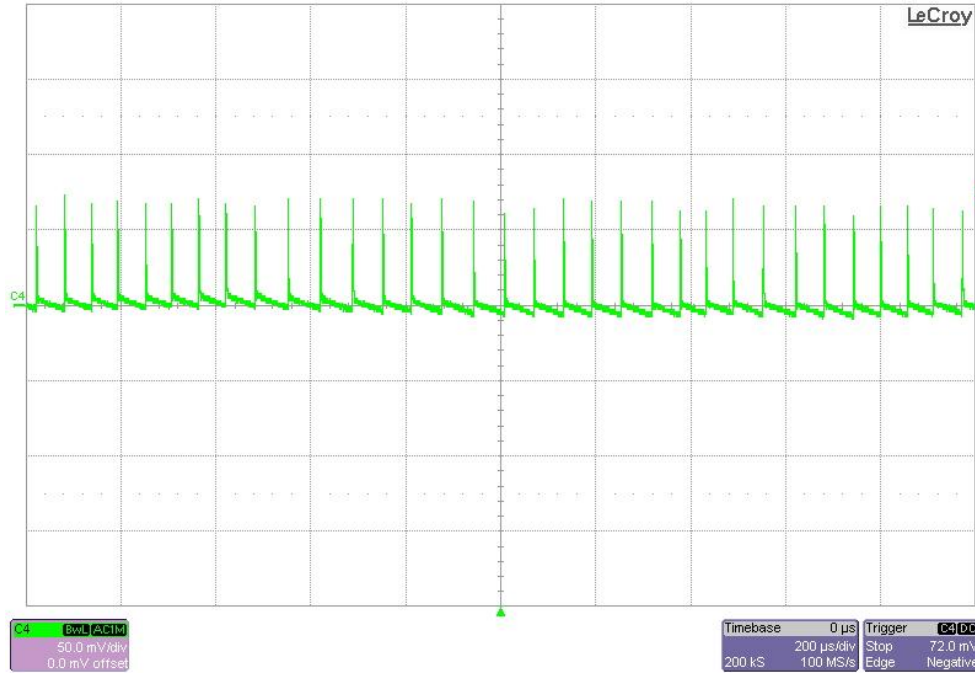
### 5.2.1 24V/0.4A, 5V/20mA



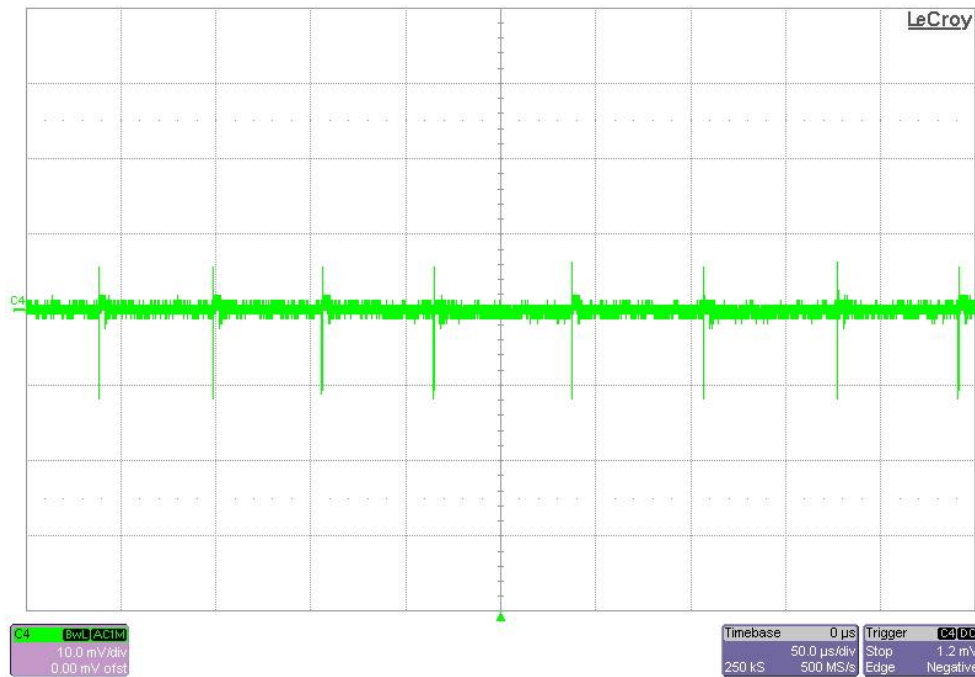
### 5.2.2 5V@ 24V/0.4A, 5V/20mA



## 5.2.3 24V@ No load



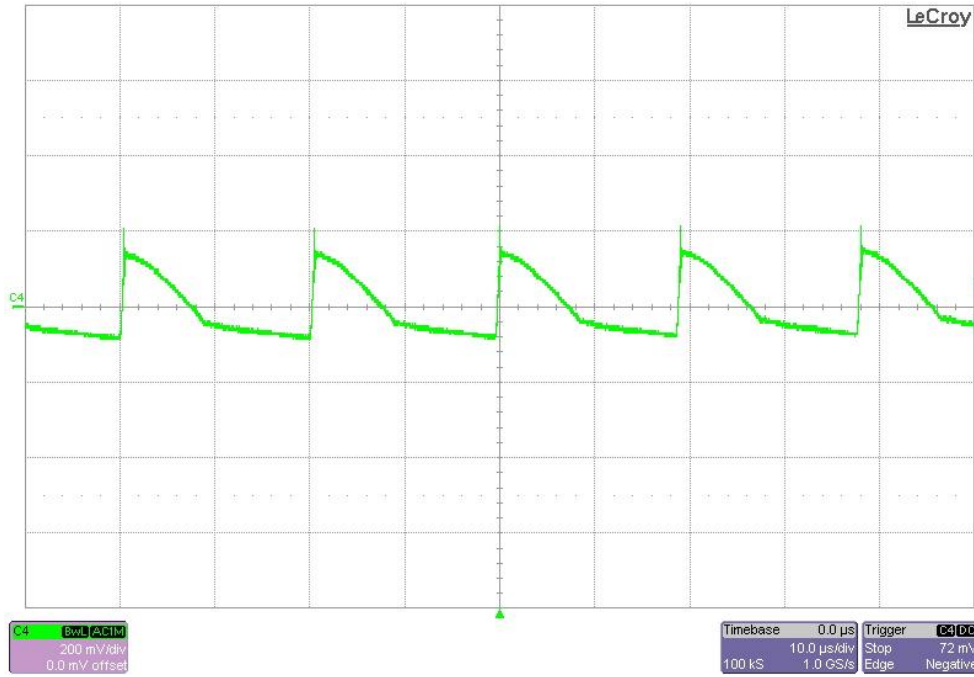
## 5.2.4 5V@ No load



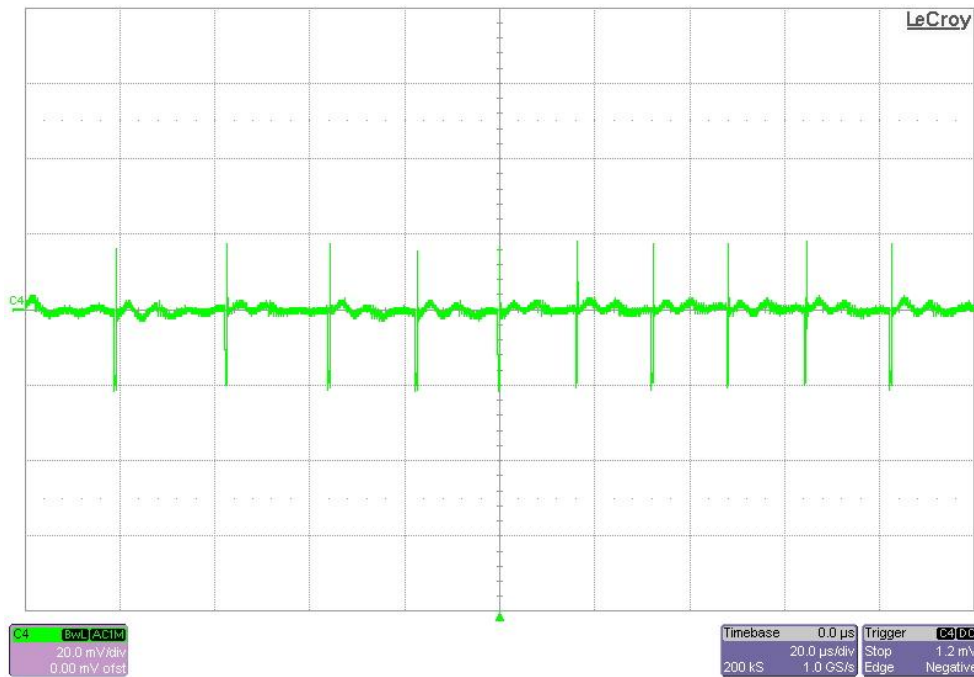


### 5.3 $V_{in}=440V_{AC\_equivalent}$ (This voltage is achieved by an $220V_{AC}/50Hz$ input with a voltage doubler circuit)

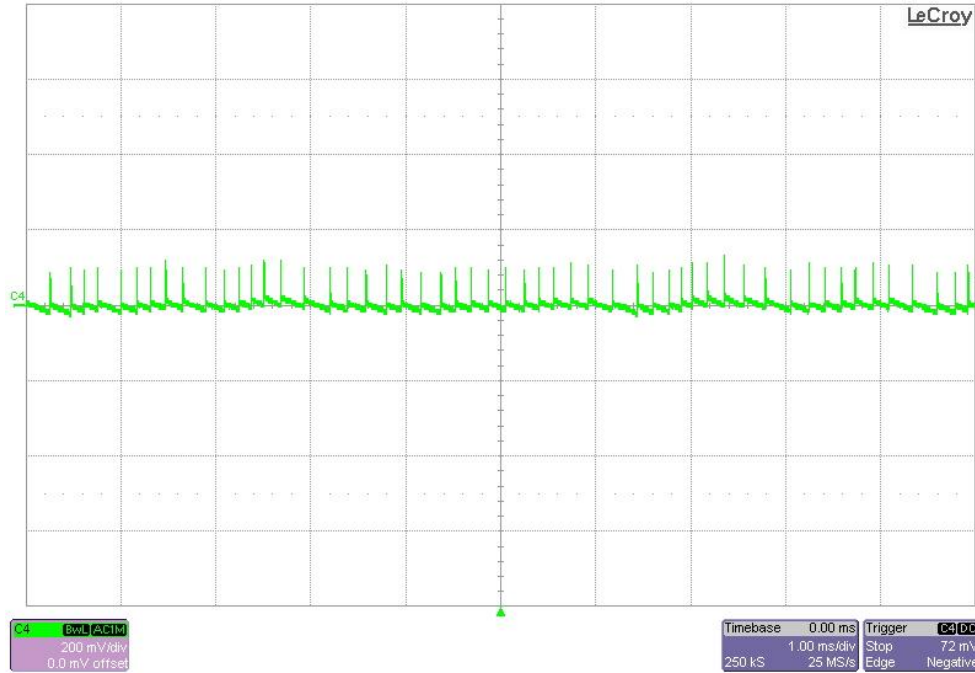
#### 5.3.1 24V@ 24V/0.4A, 5V/20mA



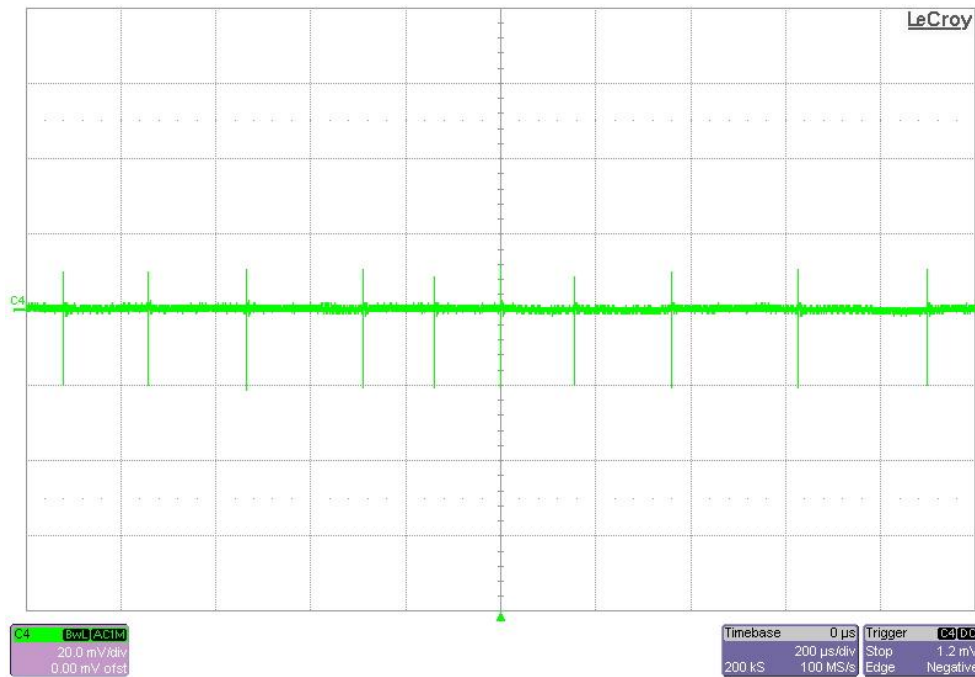
#### 5.3.2 5V@ 24V/0.4A, 5V/20mA



### 5.3.3 24V@ No load



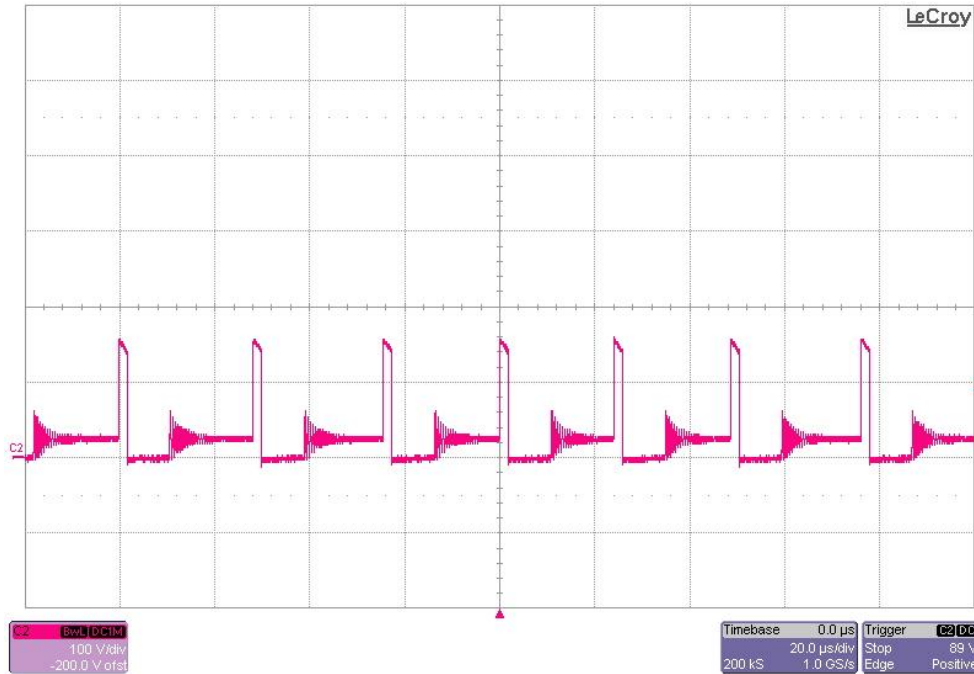
### 5.3.4 5V@ No load



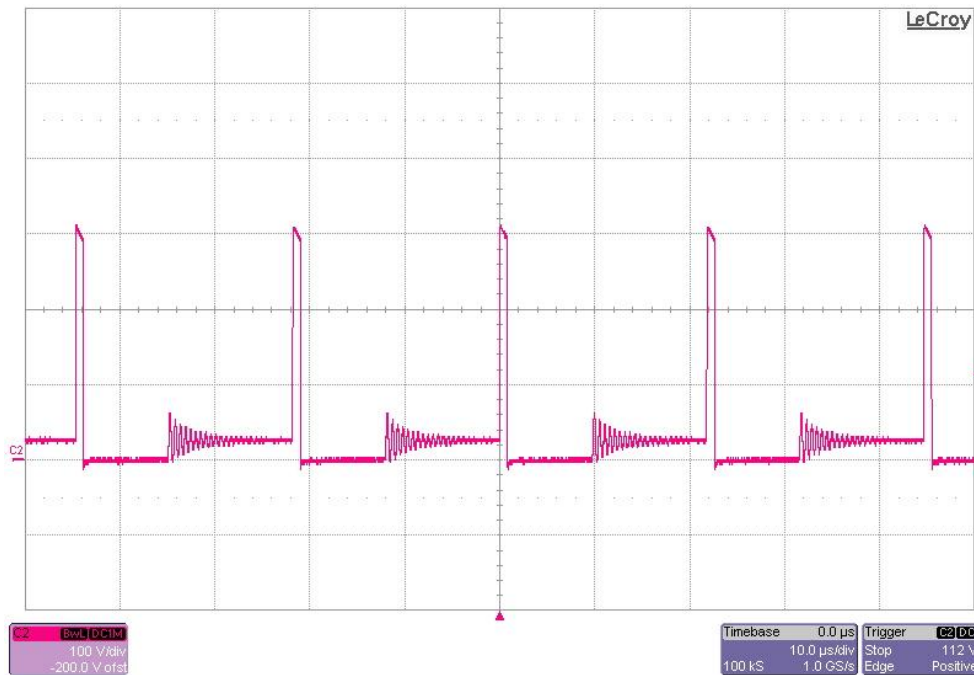
## 6 Switching Waveforms

The images below show key switching waveforms of PMP11090RevA. The waveforms are measured with 24V/0.4A and 5V/20mA load current.

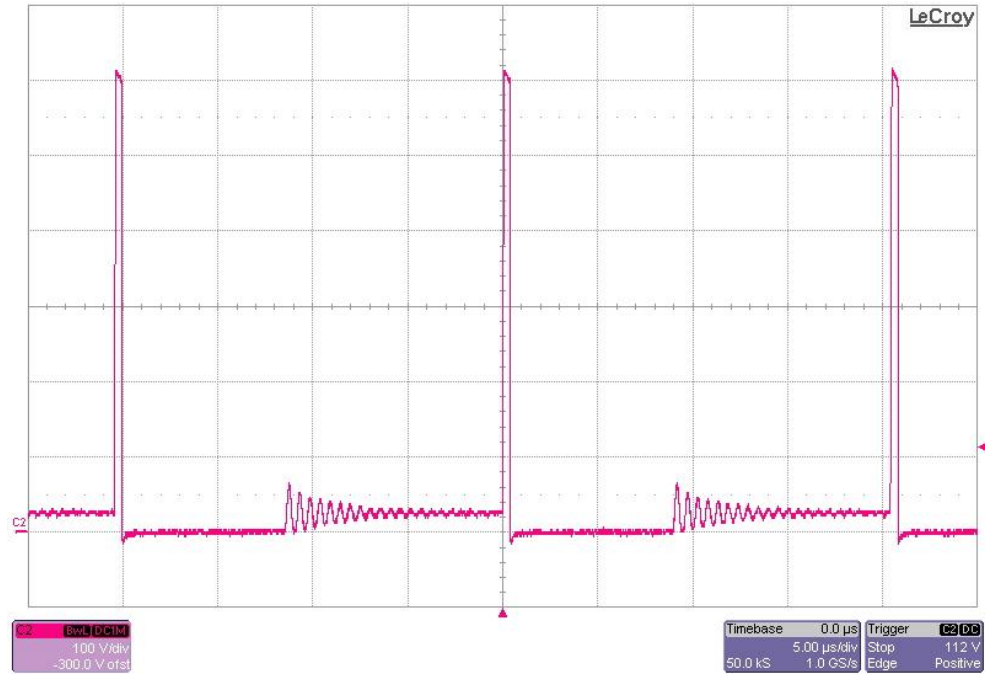
### 6.1 Diode D4 @ 120V<sub>AC</sub>/60Hz



### 6.2 Diode D4 @ 230V<sub>AC</sub>/50Hz



### 6.3 Diode D4 @ 440V<sub>AC</sub> equivalent (This voltage is achieved by an 220V<sub>AC</sub>/50Hz input with a voltage doubler circuit)



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