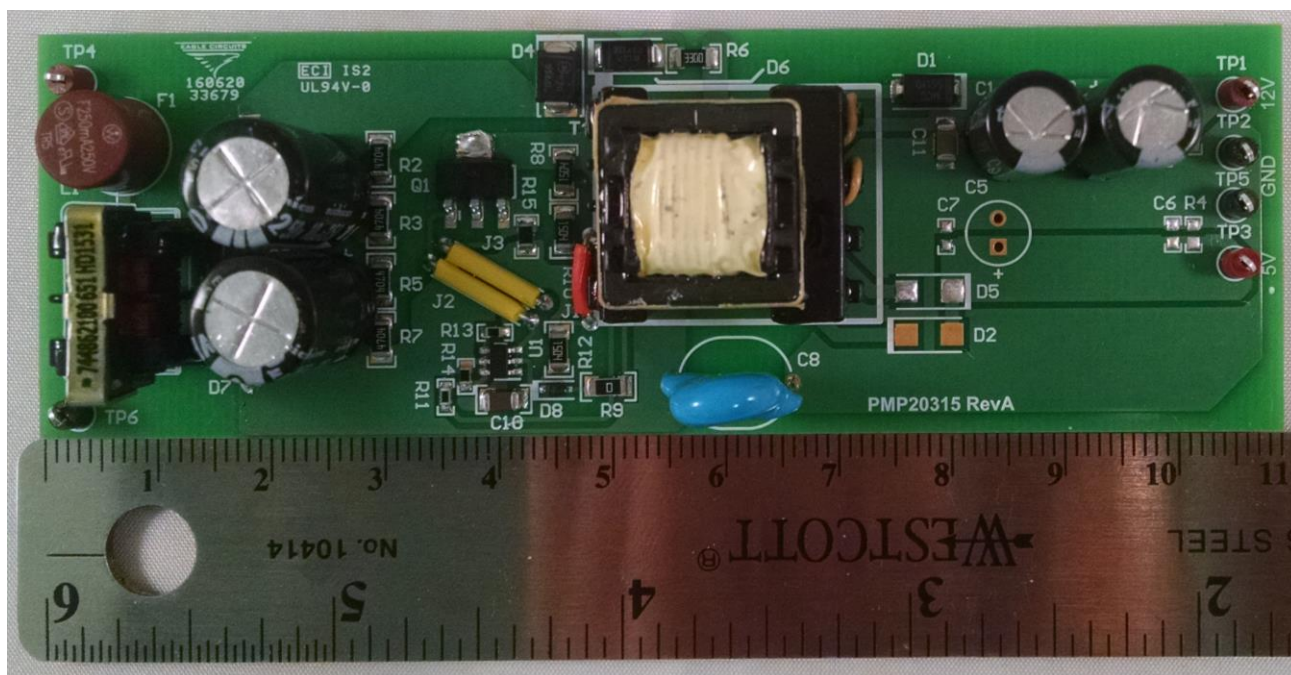


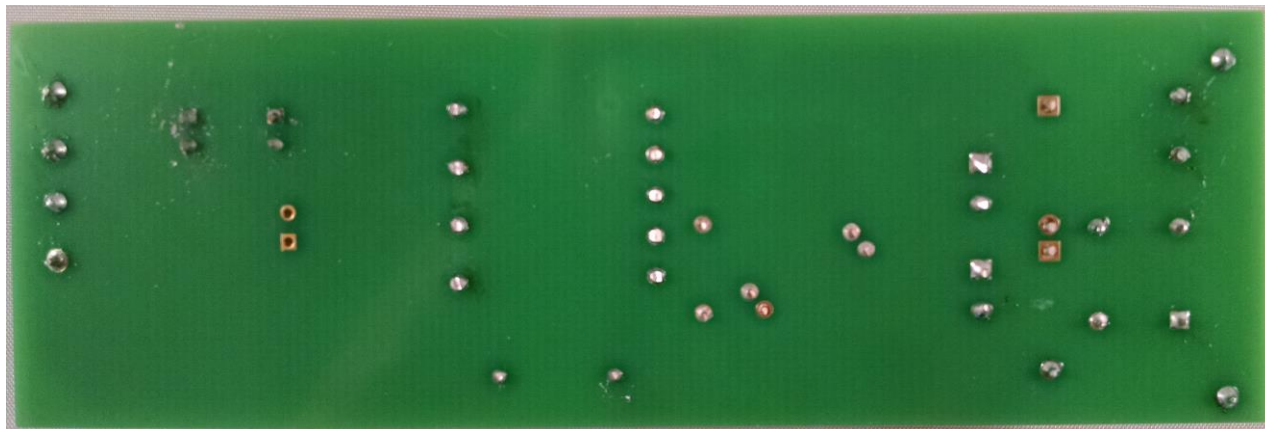
1 Photo

The photographs below show the PMP20421 Rev A assembly. This circuit was built on a PMP20315 Rev A PCB.

Top side



Bottom side



2 Converter efficiency

The efficiency data is shown in the table and graph below

102V/60Hz

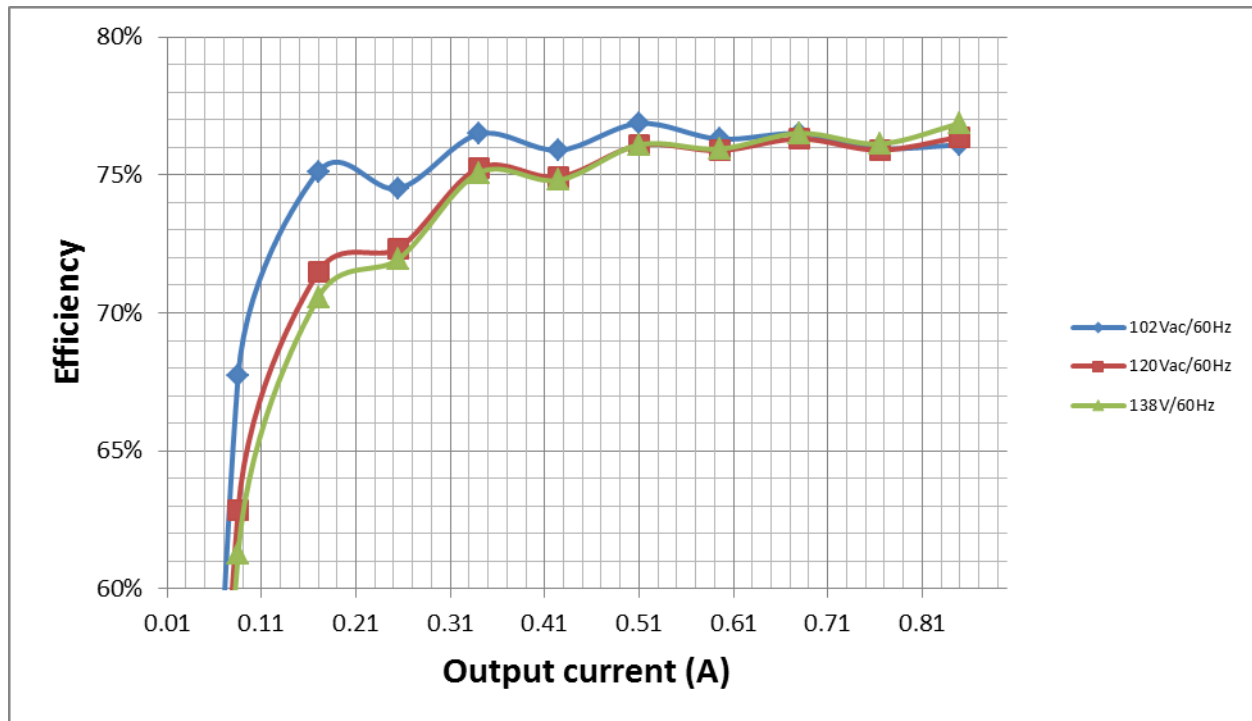
Vin(V)	Iin(mA)	P.F.	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency (%)
102.06	241.62	0.57	14.13	12.65	0.85	10.75	3.38	76.10%
102.07	215.34	0.58	12.75	12.66	0.77	9.68	3.06	75.97%
102.10	189.20	0.58	11.26	12.67	0.68	8.62	2.65	76.50%
102.12	166.81	0.58	9.88	12.67	0.60	7.54	2.34	76.30%
102.15	143.86	0.57	8.41	12.67	0.51	6.46	1.94	76.87%
102.18	123.99	0.56	7.10	12.67	0.43	5.38	1.71	75.89%
102.20	102.14	0.54	5.64	12.68	0.34	4.31	1.33	76.48%
102.23	82.36	0.52	4.34	12.67	0.26	3.23	1.11	74.51%
102.27	58.85	0.48	2.87	12.66	0.17	2.15	0.71	75.12%
102.29	36.96	0.42	1.59	12.65	0.09	1.08	0.51	67.71%
102.33	4.83	0.32	0.16	12.69	0.00	0.00	0.16	0.00%

120V/60Hz

Vin(V)	Iin(mA)	P.F.	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency (%)
120.09	200.67	0.59	14.12	12.69	0.85	10.79	3.34	76.38%
120.11	183.74	0.58	12.80	12.70	0.77	9.72	3.08	75.90%
120.13	164.28	0.57	11.31	12.69	0.68	8.63	2.68	76.31%
120.16	146.96	0.56	9.94	12.68	0.60	7.54	2.40	75.89%
120.18	128.83	0.55	8.50	12.68	0.51	6.47	2.03	76.08%
120.21	112.13	0.53	7.20	12.69	0.43	5.39	1.80	74.93%
120.23	93.25	0.51	5.73	12.68	0.34	4.31	1.42	75.25%
120.25	76.42	0.49	4.47	12.67	0.26	3.23	1.24	72.34%
120.30	55.87	0.45	3.01	12.66	0.17	2.15	0.86	71.48%
120.31	35.55	0.40	1.71	12.65	0.09	1.08	0.64	62.84%
120.33	4.68	0.31	0.17	12.68	0.00	0.00	0.17	0.00%

138V/60Hz

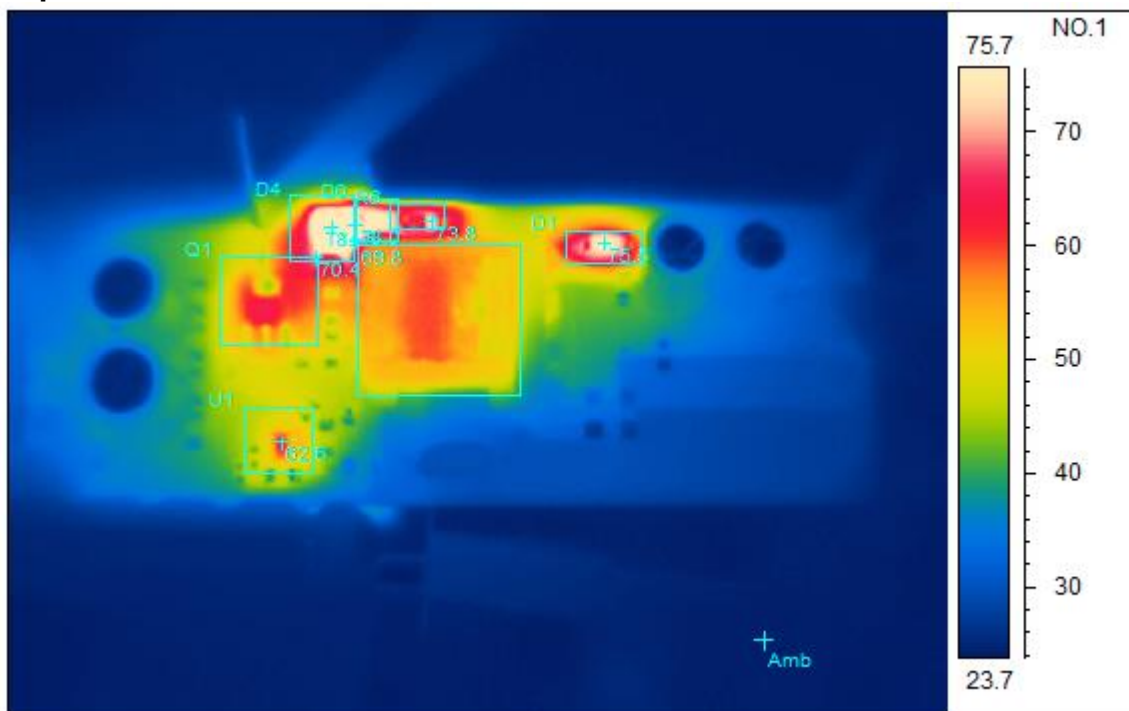
Vin(V)	Iin(mA)	P.F.	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency (%)
138.01	178.97	0.57	14.05	12.71	0.85	10.80	3.25	76.87%
138.03	164.94	0.56	12.77	12.71	0.77	9.72	3.05	76.13%
138.06	148.64	0.55	11.29	12.70	0.68	8.64	2.65	76.51%
138.08	133.83	0.54	9.94	12.69	0.60	7.55	2.39	75.95%
138.11	117.75	0.52	8.51	12.69	0.51	6.47	2.03	76.10%
138.11	103.16	0.51	7.21	12.69	0.43	5.39	1.82	74.81%
138.14	86.13	0.48	5.75	12.69	0.34	4.31	1.43	75.08%
138.16	71.02	0.46	4.49	12.68	0.26	3.23	1.26	71.95%
138.20	52.17	0.42	3.05	12.66	0.17	2.15	0.90	70.56%
138.22	33.07	0.38	1.76	12.65	0.09	1.08	0.68	61.27%
138.24	8.44	0.15	0.18	13.42	0.00	0.00	0.18	0.00%



3 Thermal Images

The thermal images below show a top view and bottom view of the board. The ambient temperature was 20°C with no forced air flow. The outputs were at 12V/0.85A loads.

- **Top side** Vin : 102Vac



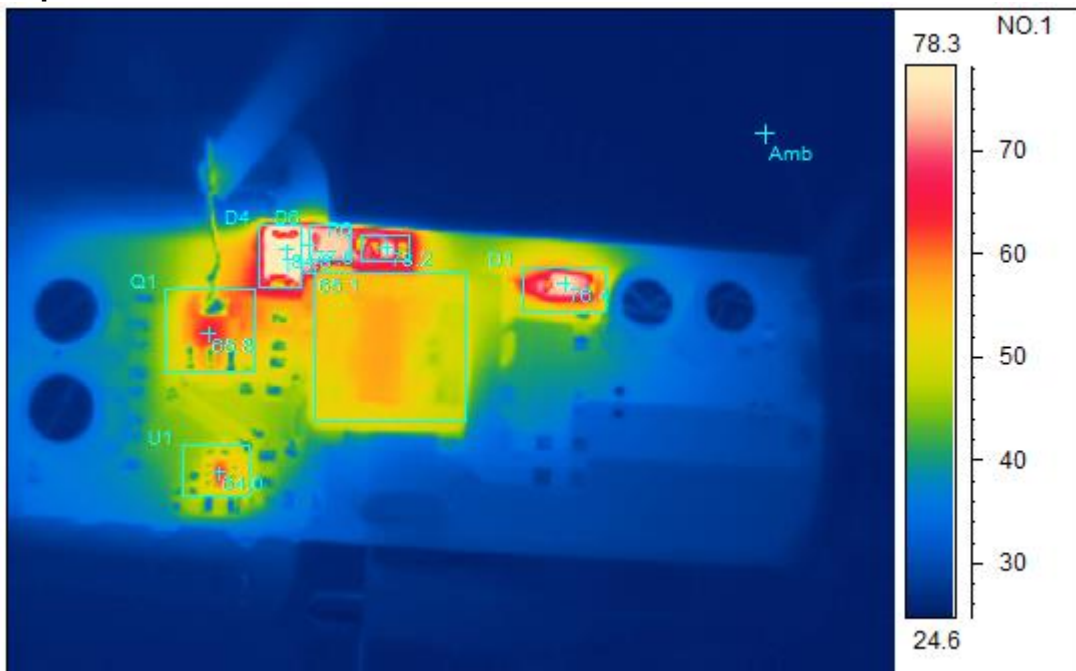
Spot analysis	Value
Amb Temperature	24.5°C
Area analysis	Value
D1Max	75.5°C
Q1Max	70.4°C
U1Max	62.6°C
T1Max	69.8°C
R6Max	73.8°C
D6Max	78.0°C
D4Max	84.5°C

- **Top side**



Spot analysis	Value
Amb Temperature	23.7°C
Area analysis	Value
D1Max	74.4°C
Q1Max	65.6°C
U1Max	65.1°C
T1Max	65.9°C
R6Max	72.8°C
D6Max	74.6°C
D4Max	81.4°C

- **Top side** Vin : 138Vac

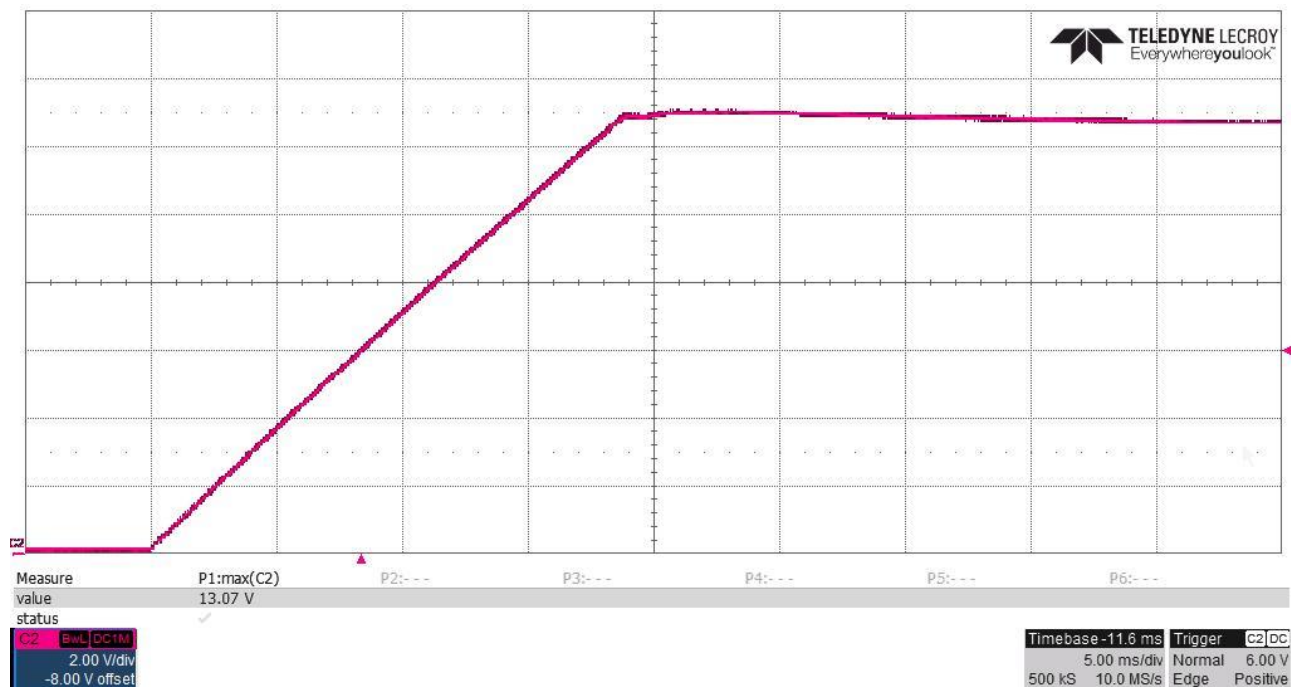


Spot analysis	Value
Amb Temperature	25.1°C
Area analysis	Value
D1Max	76.4°C
Q1Max	65.8°C
U1Max	64.0°C
T1Max	65.1°C
R6Max	78.2°C
D6Max	77.6°C
D4Max	84.8°C

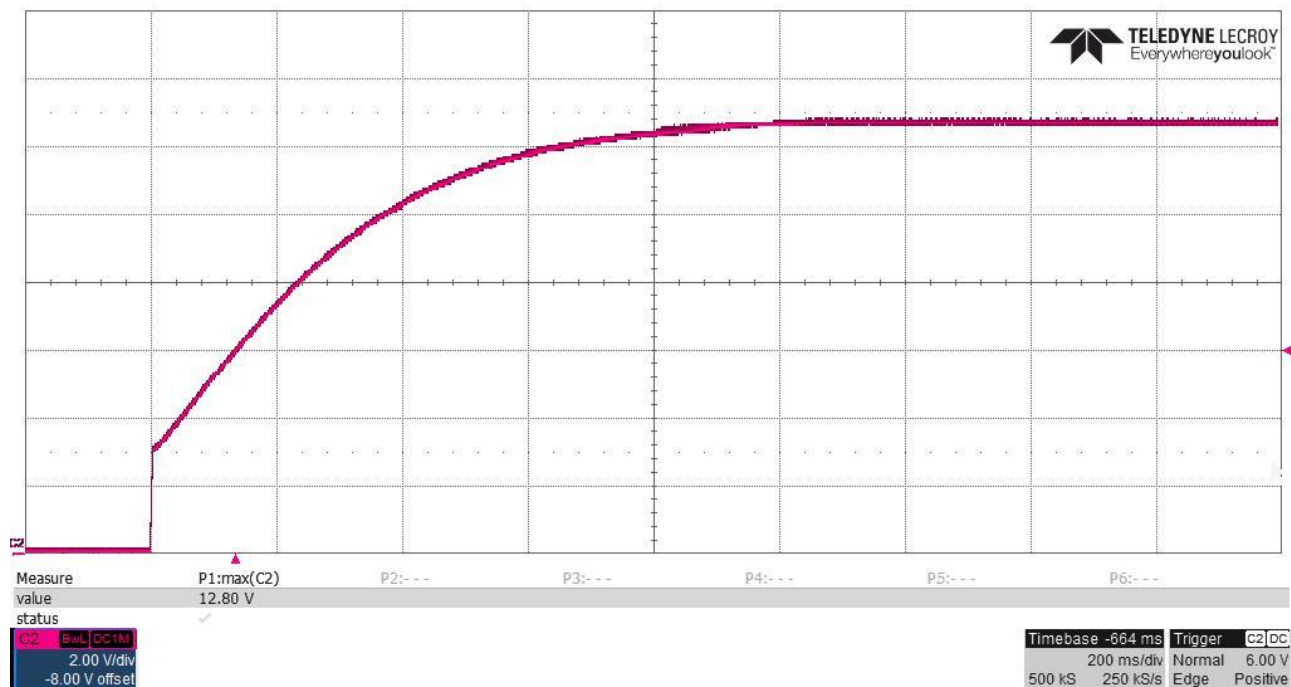
4 Startup

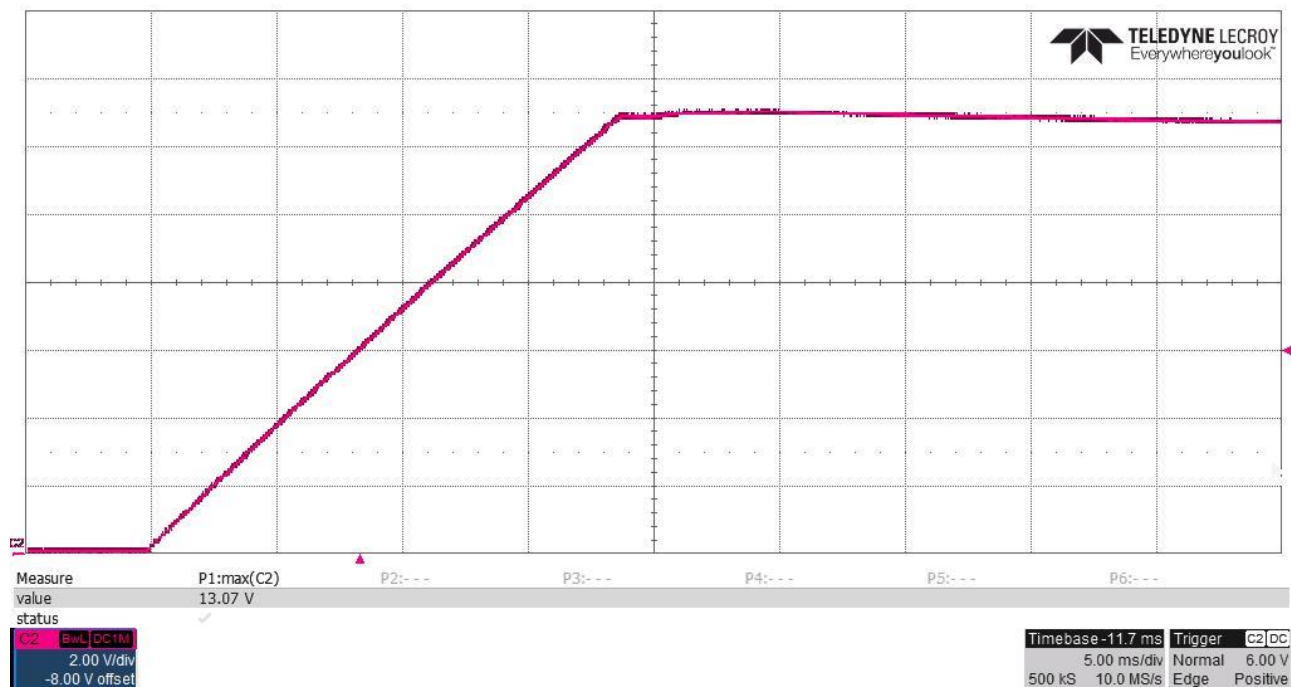
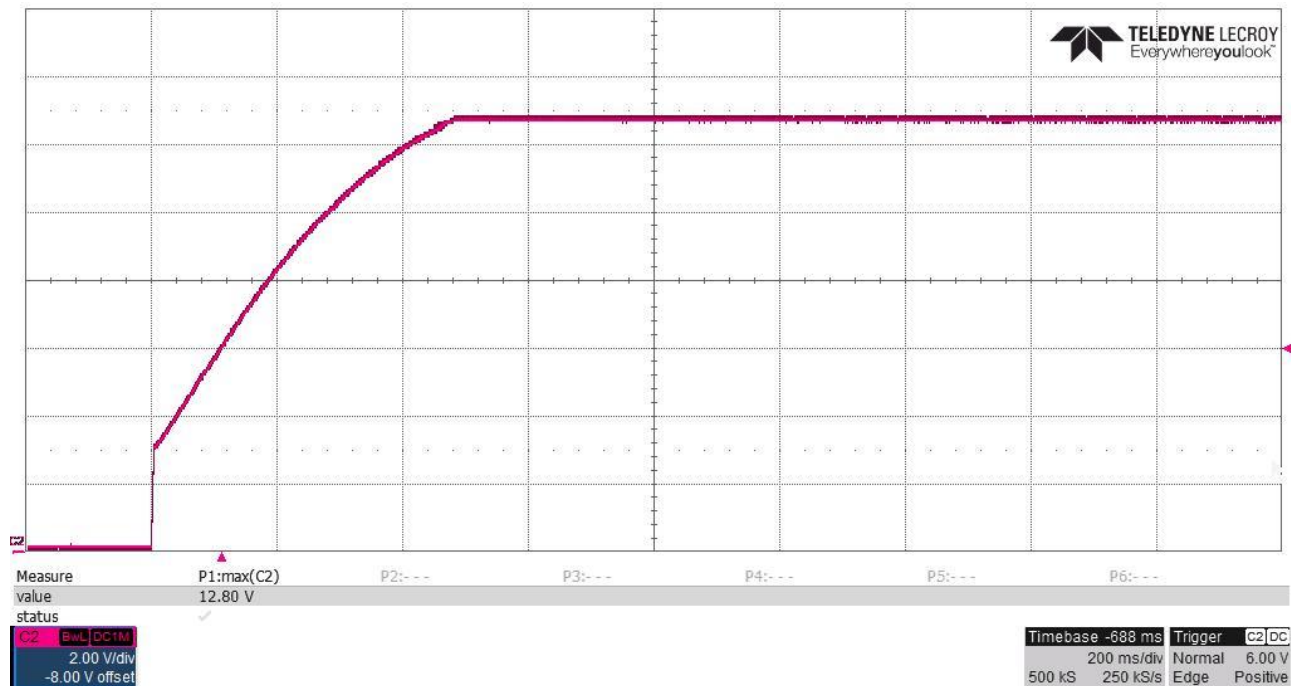
The output voltages at startup are shown in the images below.

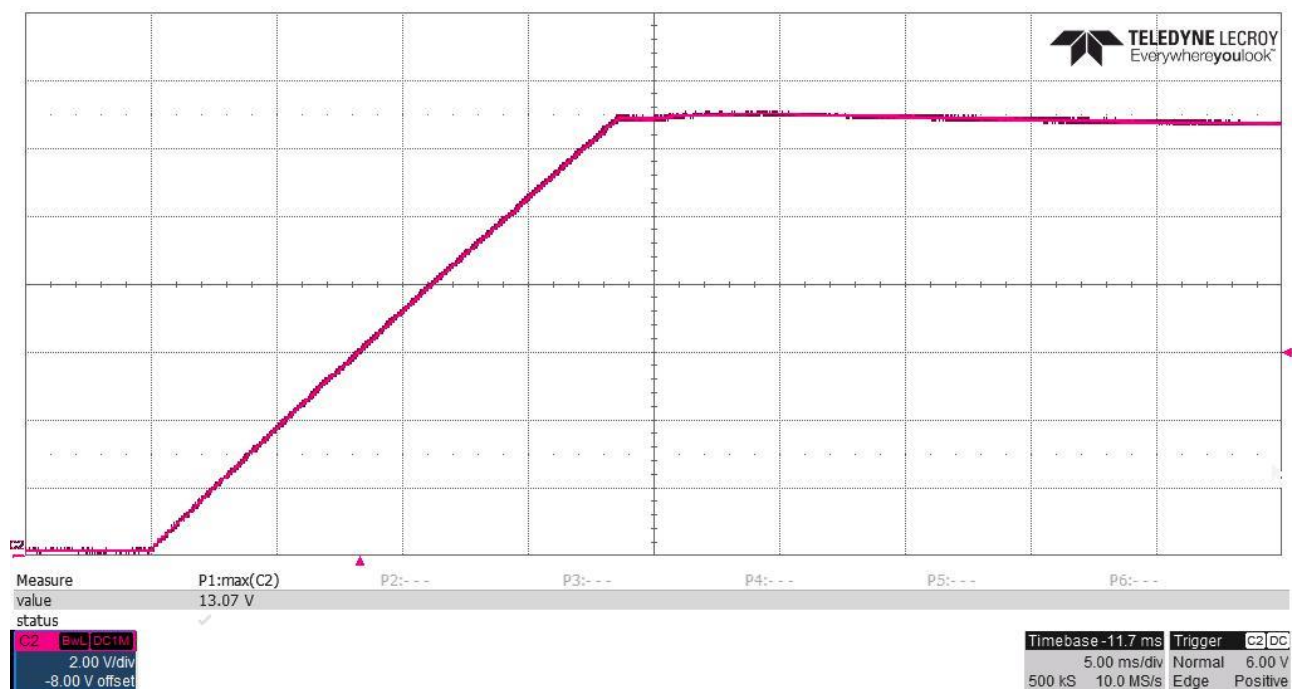
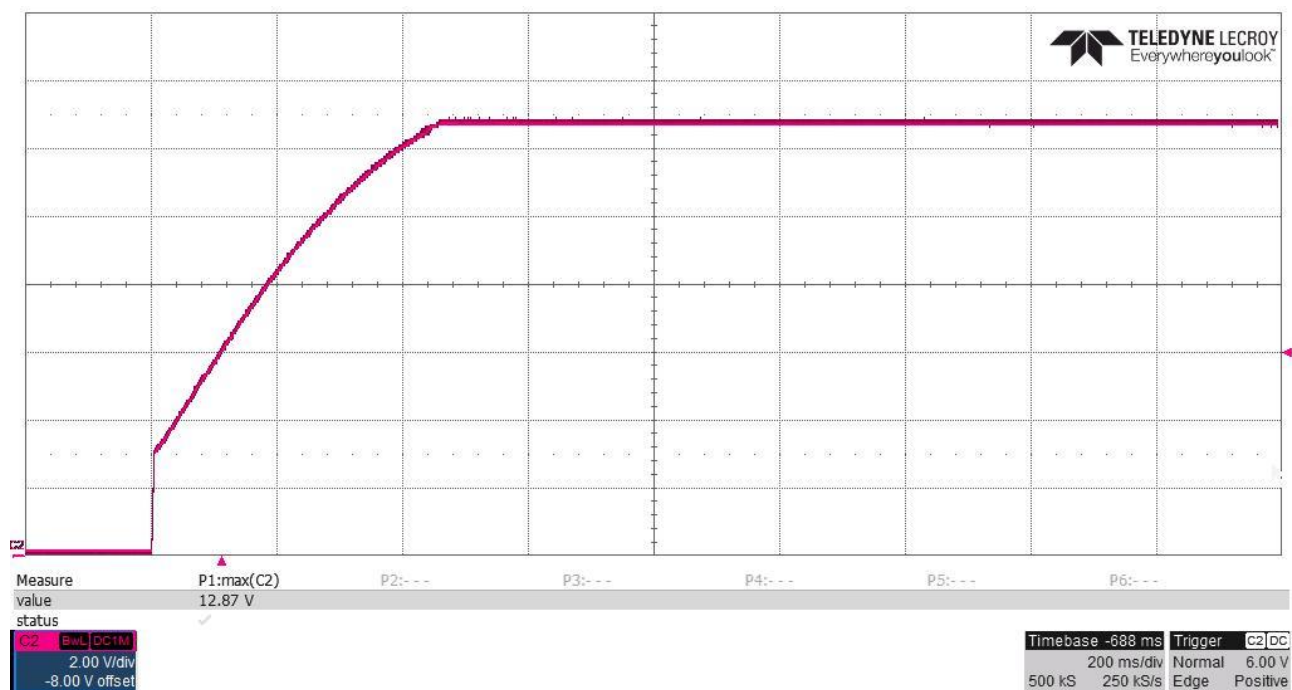
4.1.1 Start Up @ 102V_{AC}: 12V/0A



4.1.2 Start Up @ 102 V_{AC}: 12V/0.85A



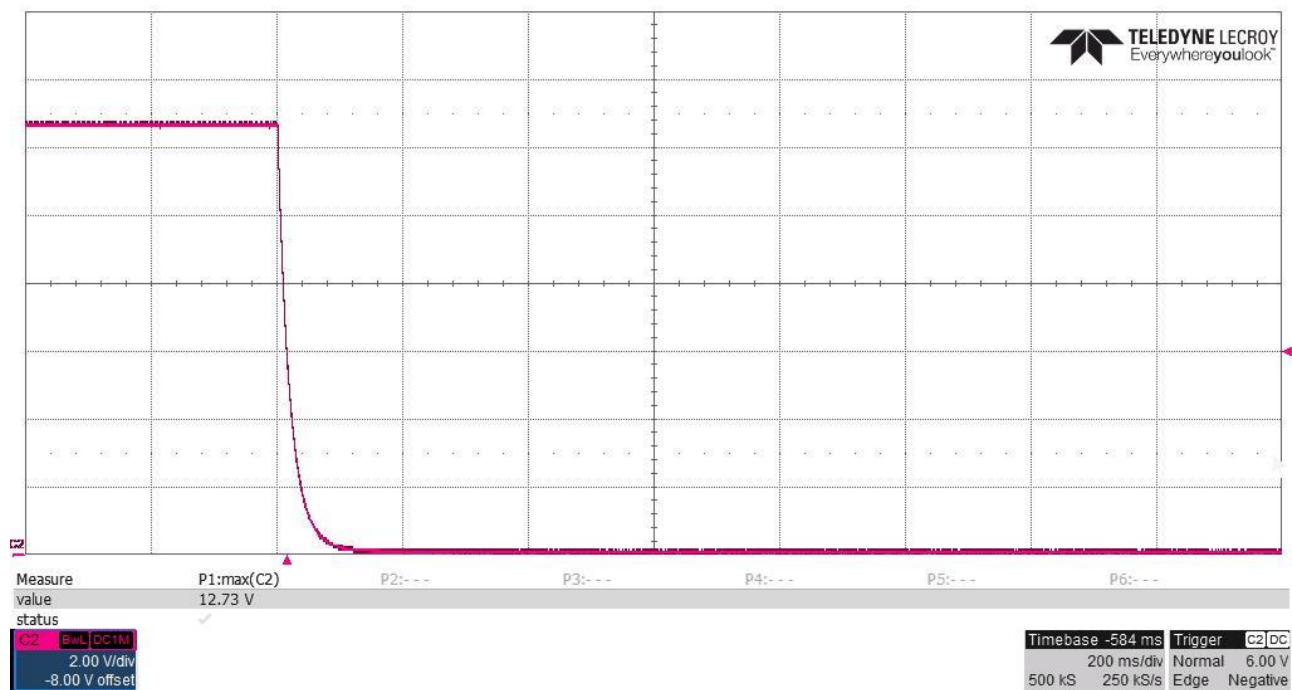
4.1.3 Start Up @ 120V_{AC}: 12V/0A**4.1.4 Start Up @ 120V_{AC}: 12V/0.85A**

4.1.5 Start Up @ 138V_{AC}: 12V/0A**4.1.6 Start Up @ 138V_{AC}: 12V/0.85A**

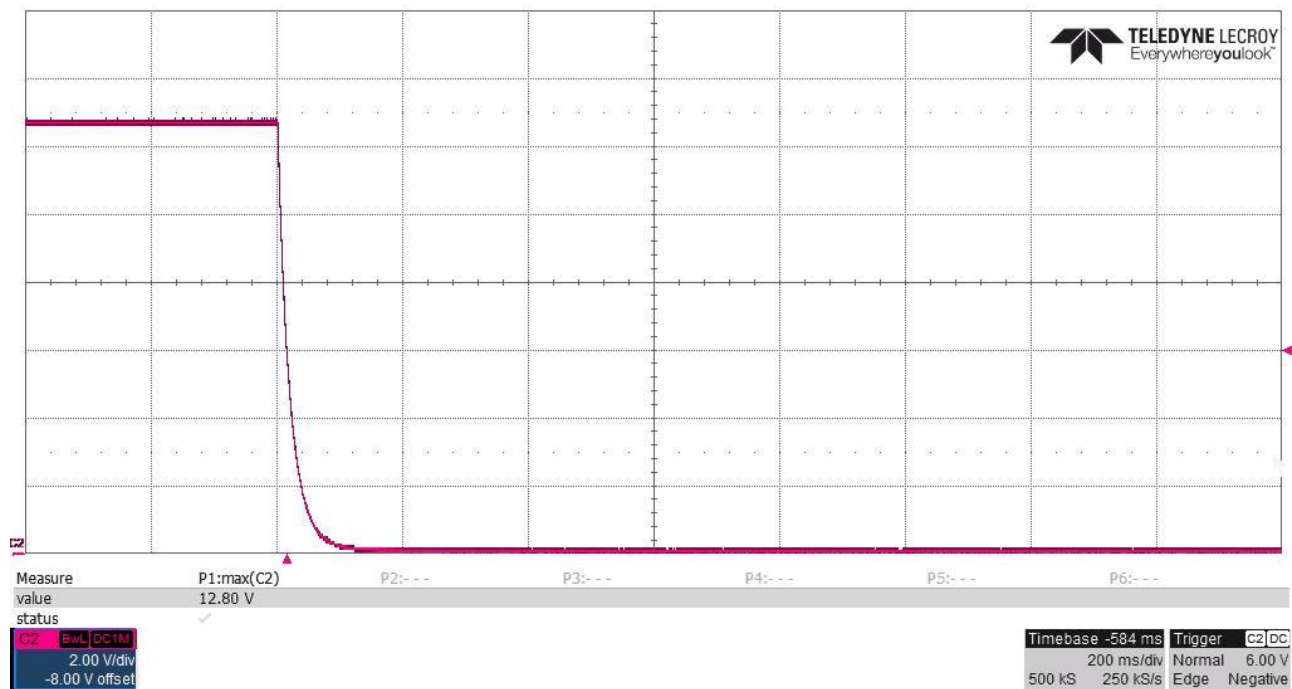
5 Turnoff

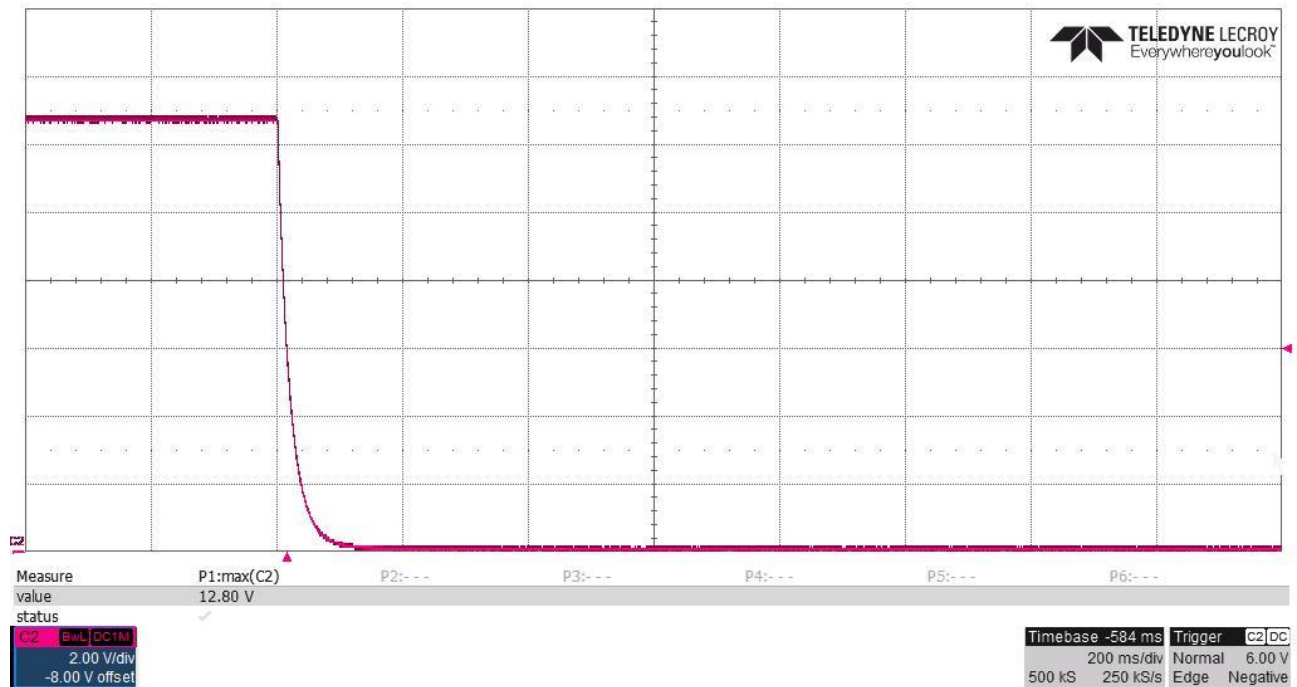
The output voltages at turnoff are shown in the images below.

5.1.1 Turnoff @ 102V_{AC}: 12V/0.85A



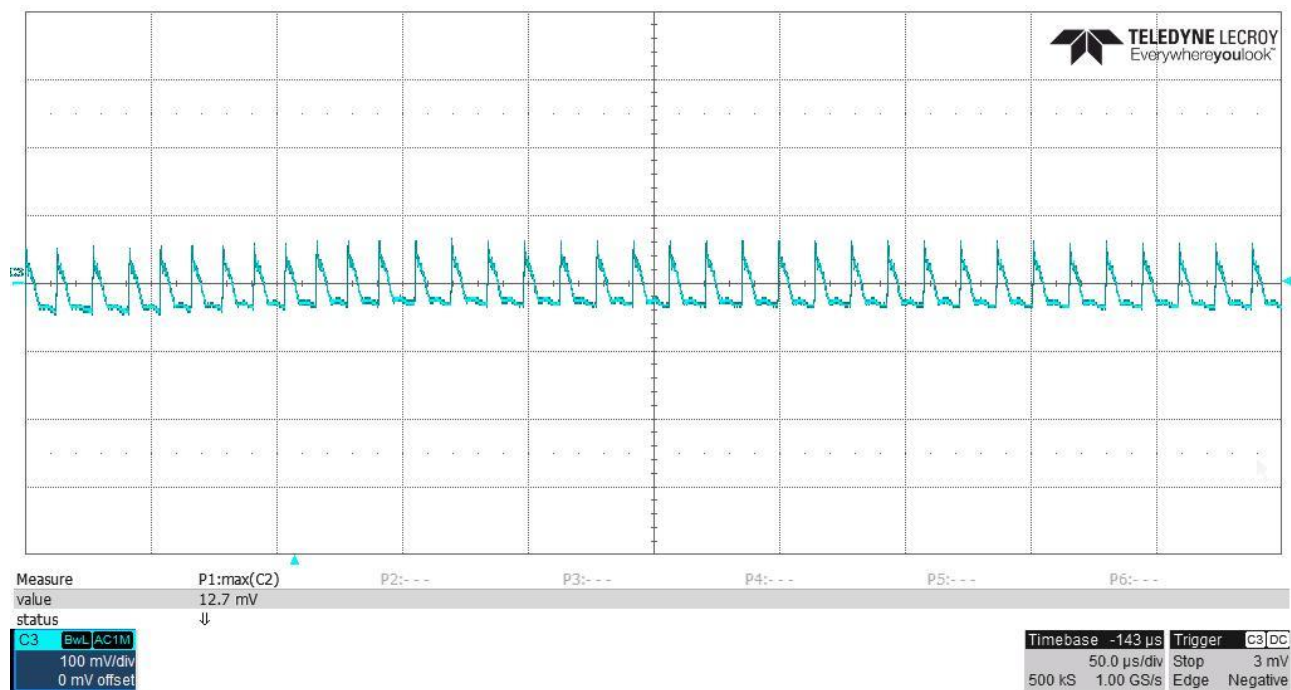
5.1.2 Turnoff @ 120V_{AC}: 12V/0.85A



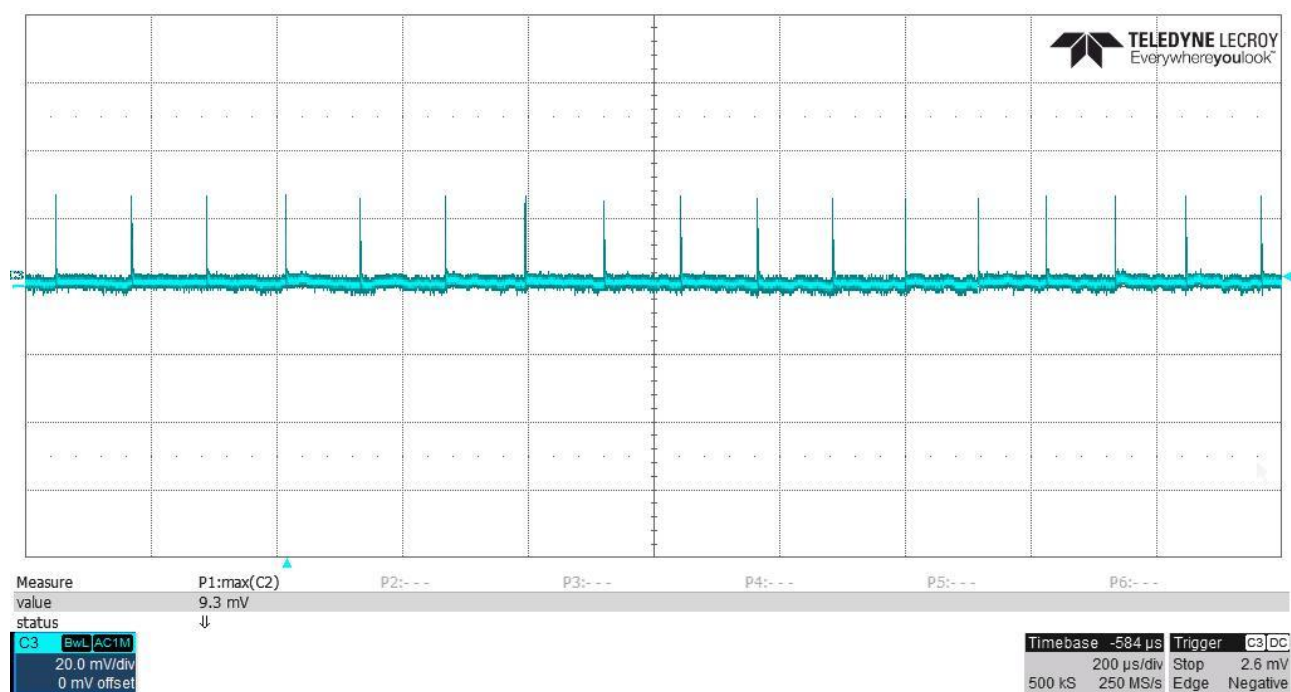
5.1.3 Turnoff @ 138V_{AC}: 12V/0.85A

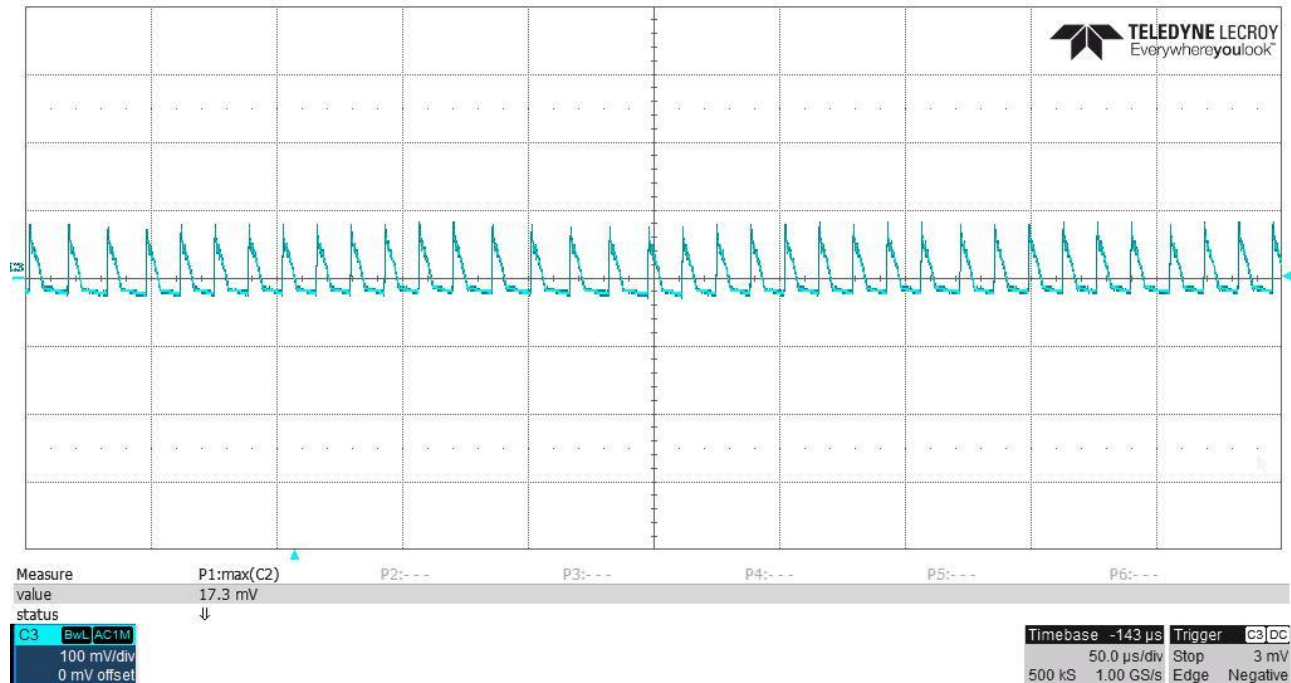
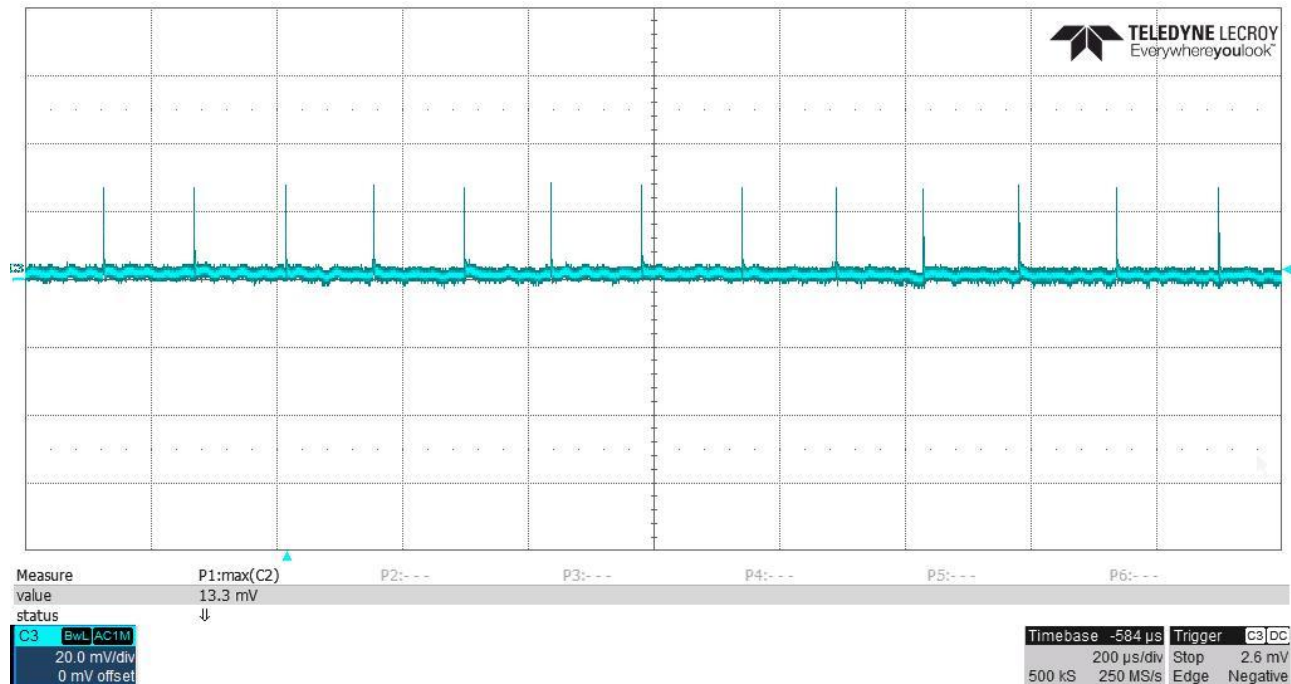
6 Output Ripple Voltage

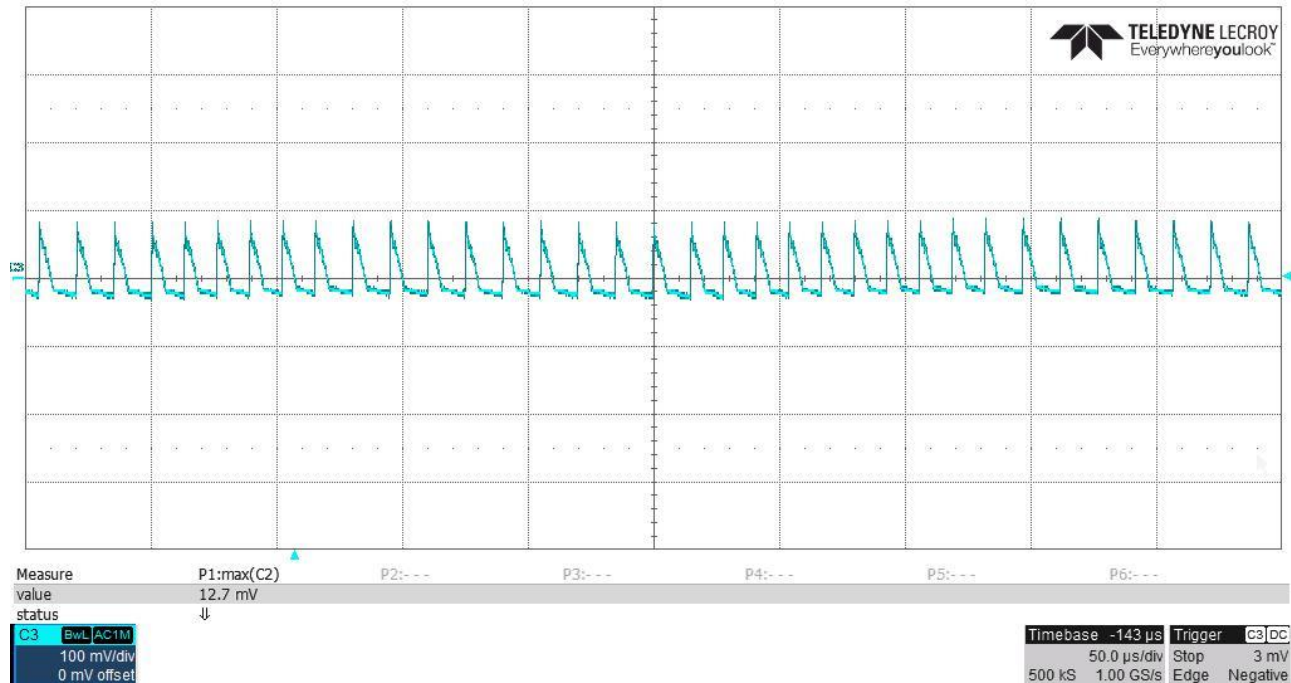
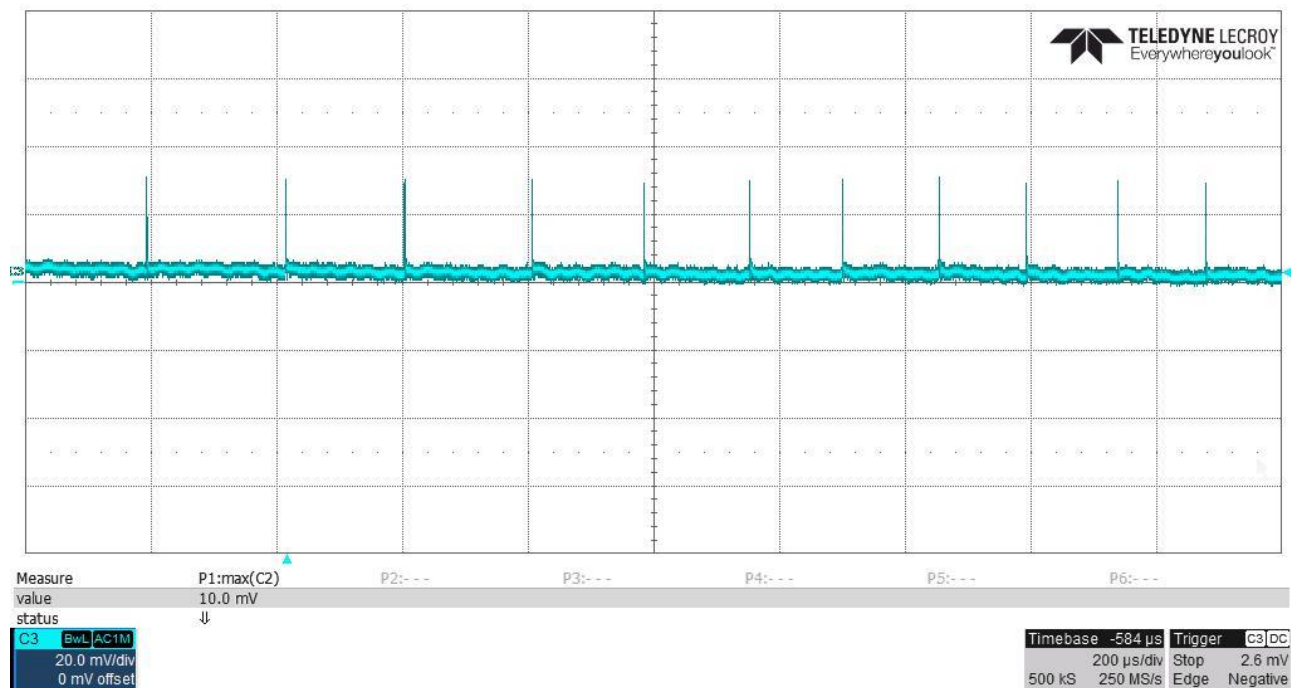
6.1.1 Output Ripple 12V @ 102V_{AC}: 12V/0.85A



6.1.2 Output Ripple 12V @ 102V_{AC}: 12V/0A

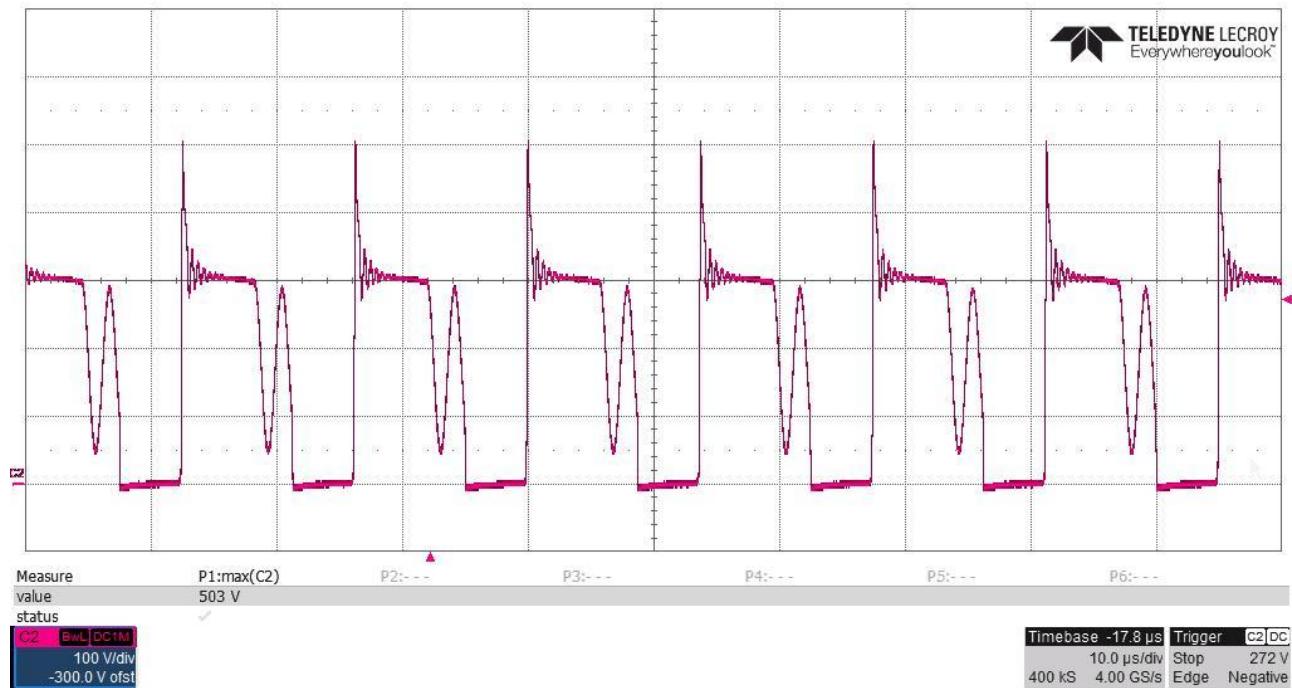


6.1.3 Output Ripple 12V @ 120V_{AC}: 12V/0.85A**6.1.4 Output Ripple 12V @ 120V_{AC}: 12V/0A**

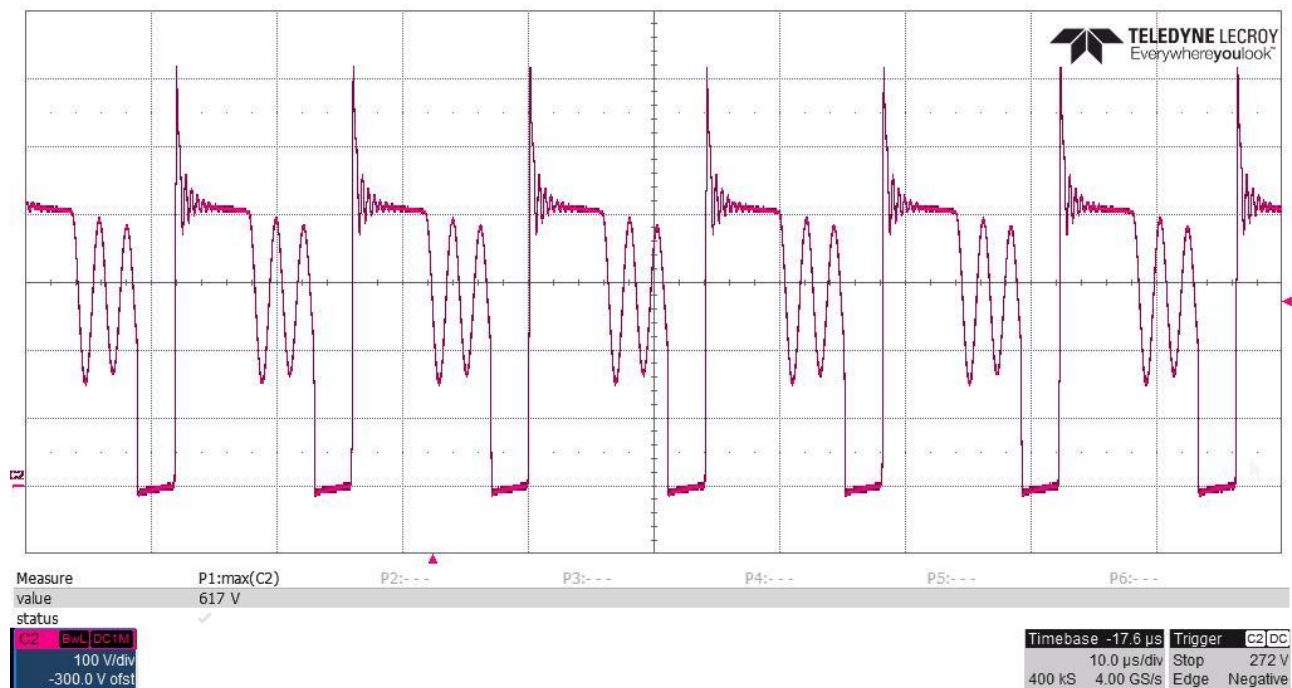
6.1.5 Output Ripple 12V@138V_{AC}: 12V/0.85A**6.1.6 Output Ripple 12V@138V_{AC}: 12V/0A**

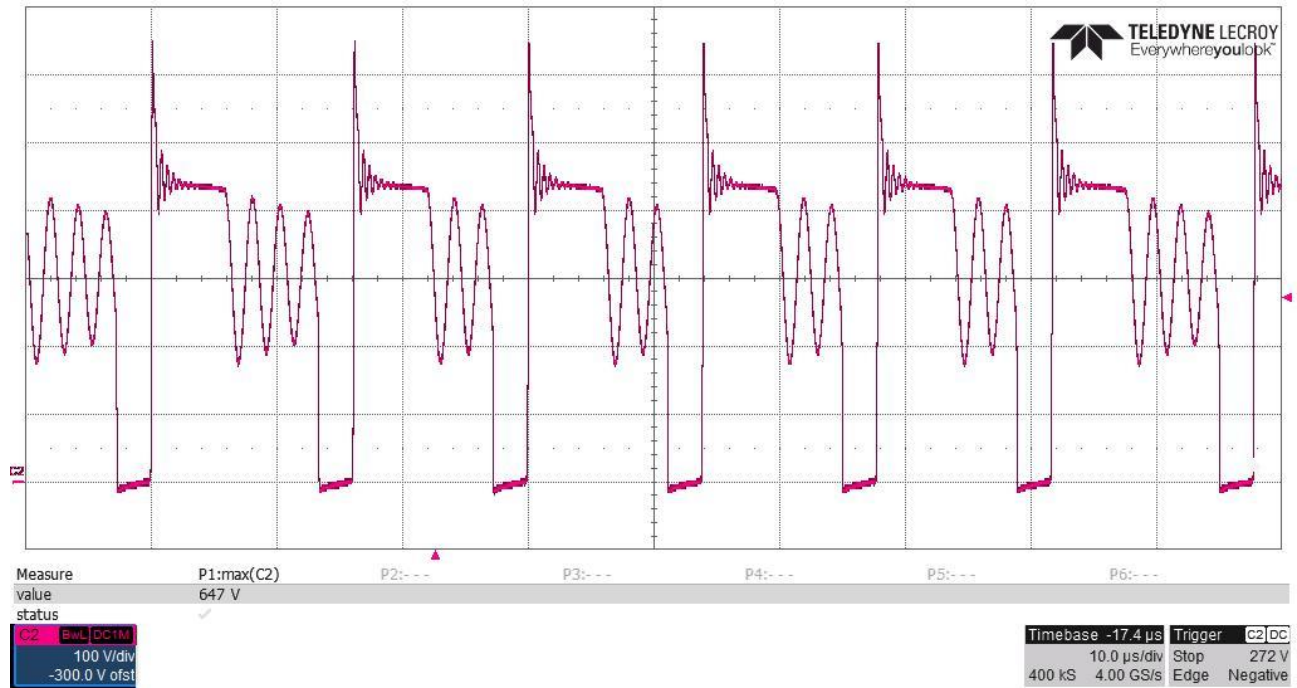
7 Switching Waveforms

7.1.1 Switching Waveform @ 102V_{AC}: 12V/0.85A



7.1.2 Switching Waveform @ 120V_{AC}: 12V/0.85A

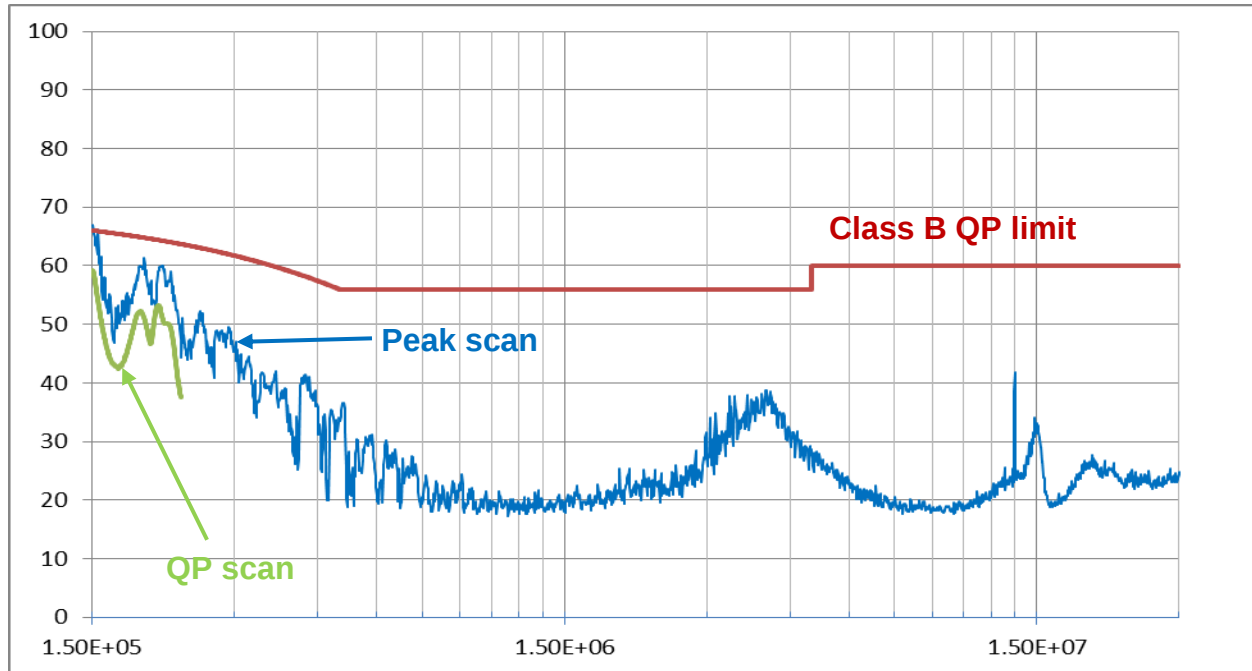


7.1.3 Switching Waveform @ 138V_{AC}: 12V/0.85A

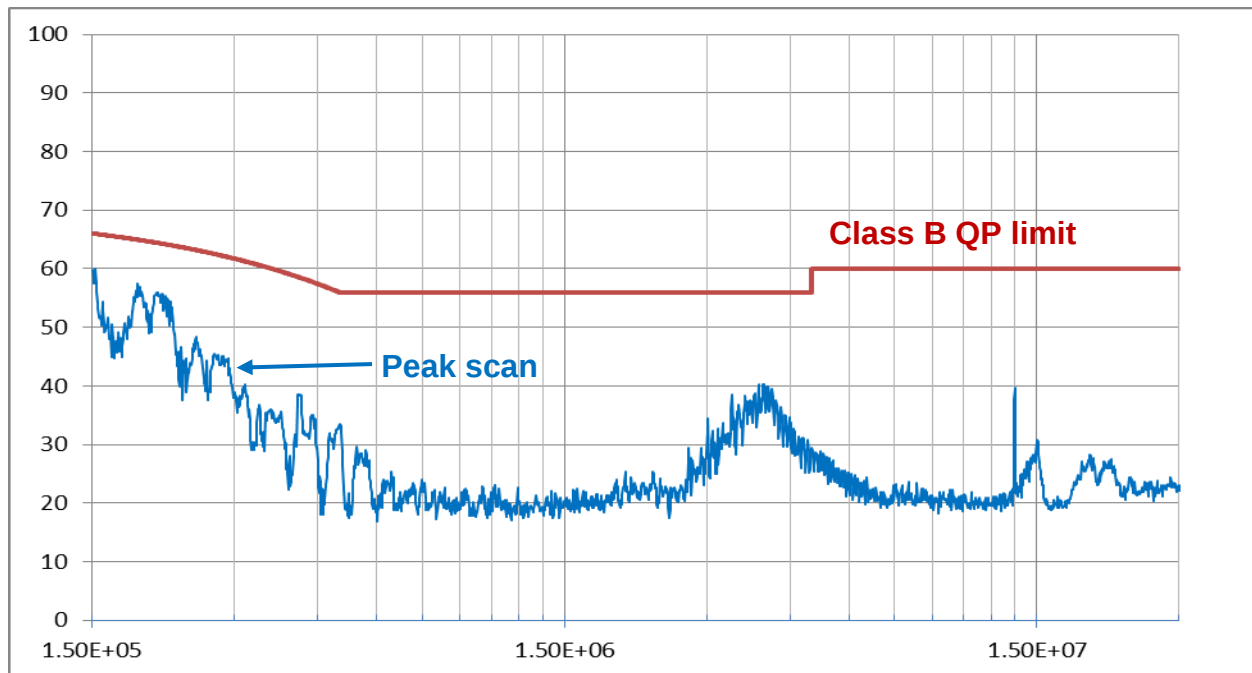
8 Conducted EMI:

The following curves show the scan results using **peak detector** with **maximum hold**. 12V Output is loaded with 0.83A. A 0.1 μ F/275V_{AC} X-cap is added across L1 pin 1 and pin 4.

8.1 120V_{AC}/60Hz: Line



8.2 120V_{AC}/60Hz: Neutral

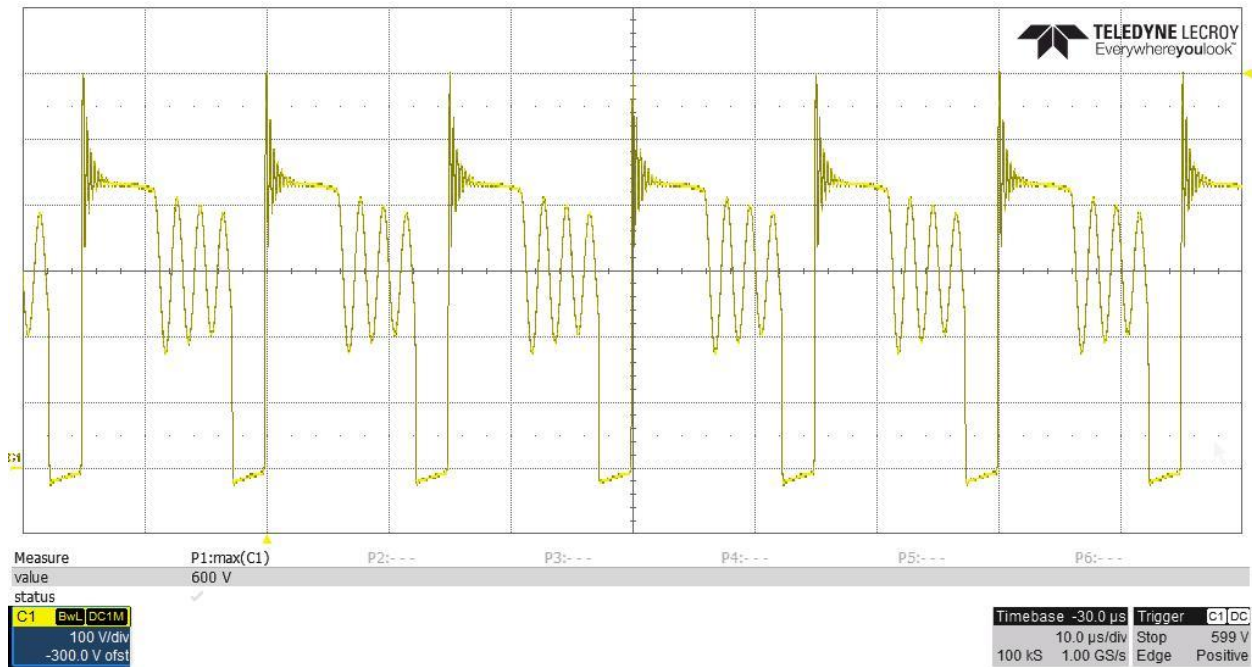


9 Additional tests

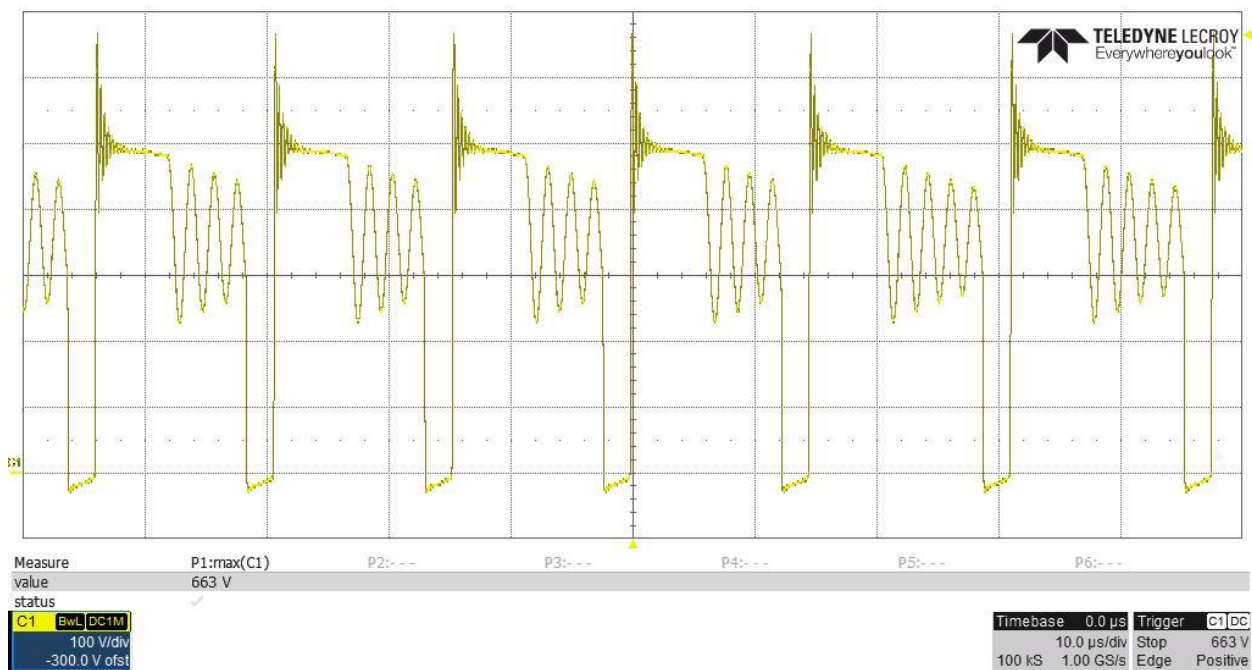
In these tests, transformers from different vendors are applied to T1.

9.1 T1 = RL-11313 (Renco)

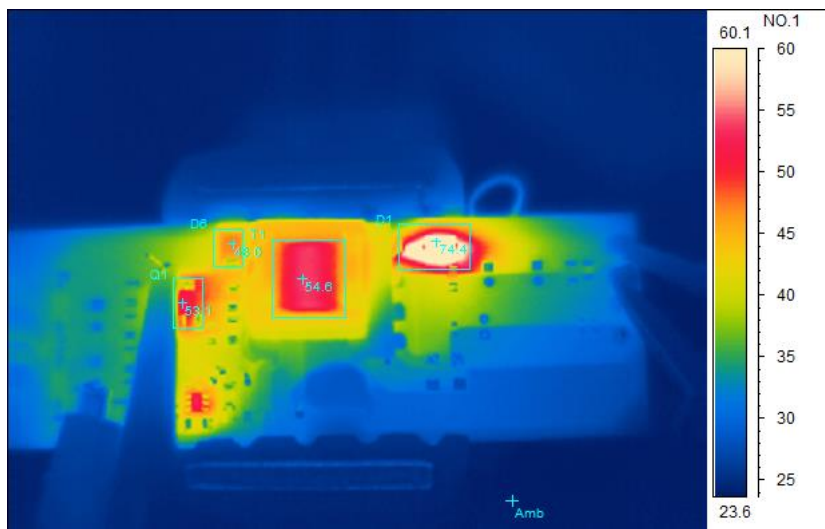
- BJT (Q1) voltage stresses at 120VAC, 12V/850mA



- BJT (Q1) voltage stresses at 138VAC, 12V/850mA



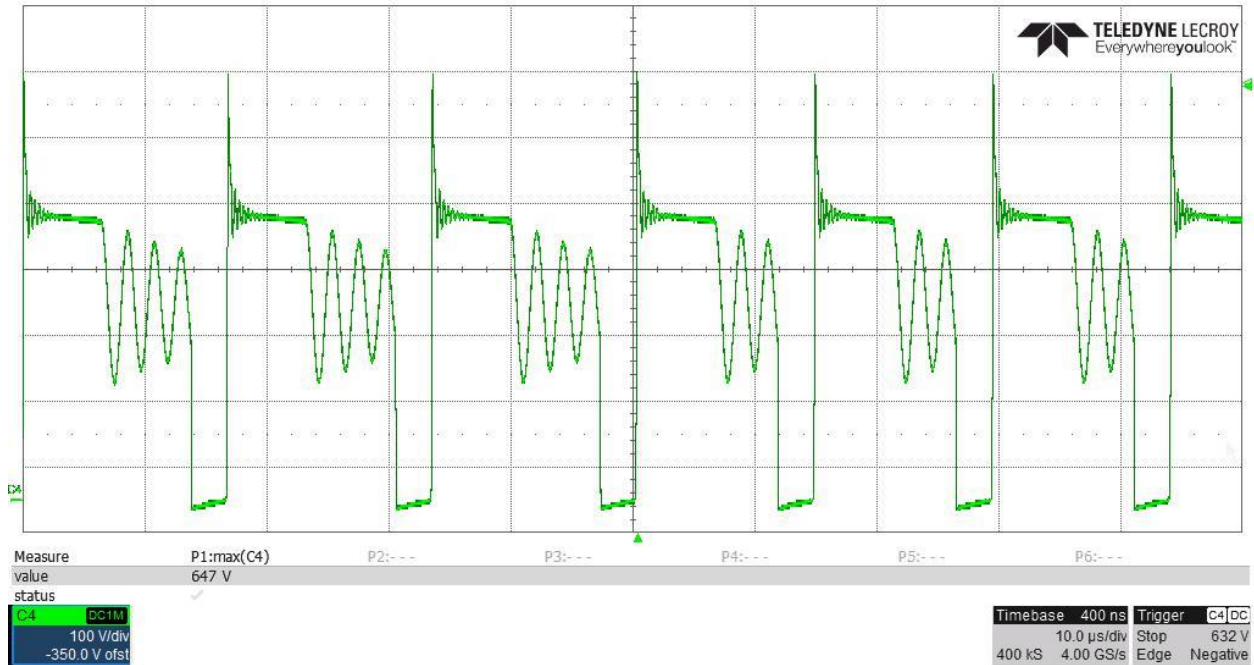
- Thermal at 120VAC, 12V/850mA



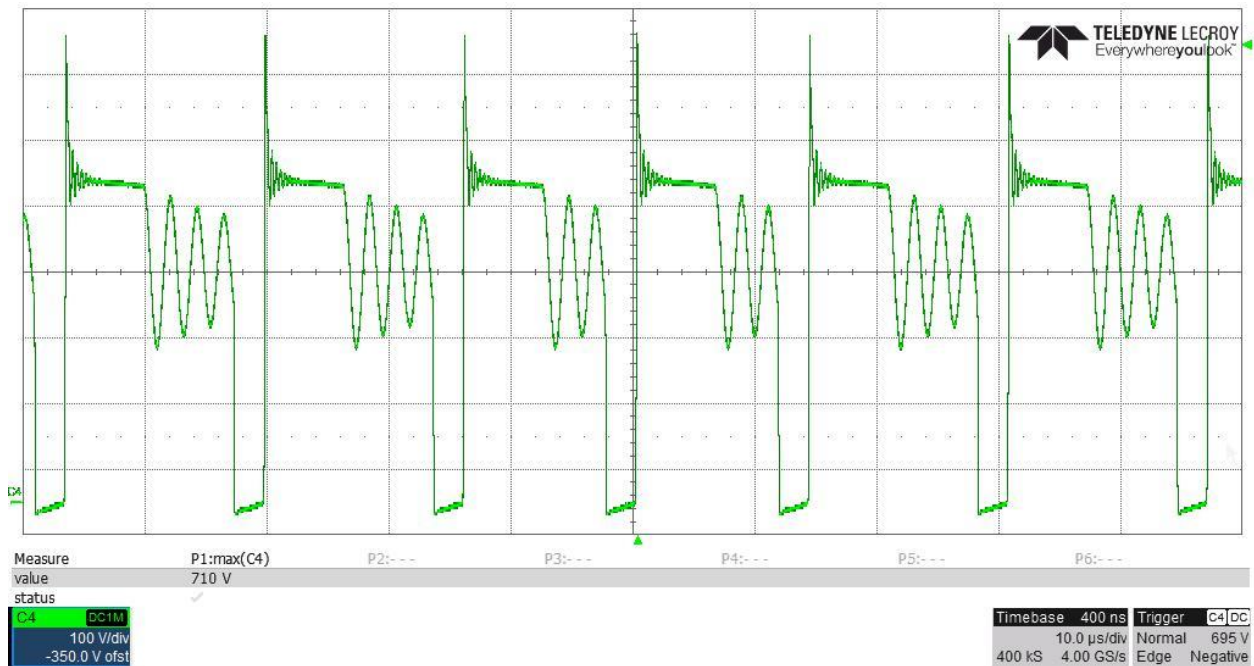
Spot analysis	Value
Amb Temperature	24.0°C
Area analysis	Value
Q1Max	53.1°C
T1Max	54.6°C
D6Max	48.0°C
D1Max	74.4°C

9.2 T1 = 750316499 Rev3 (Würth)

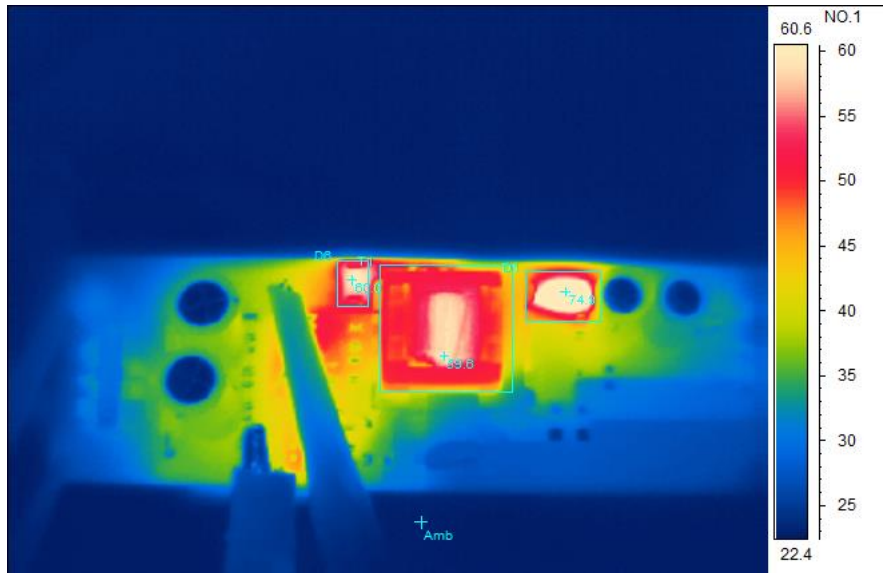
- BJT (Q1) voltage stresses at 120VAC, 12V/850mA



- BJT (Q1) voltage stresses at 138VAC, 12V/850mA



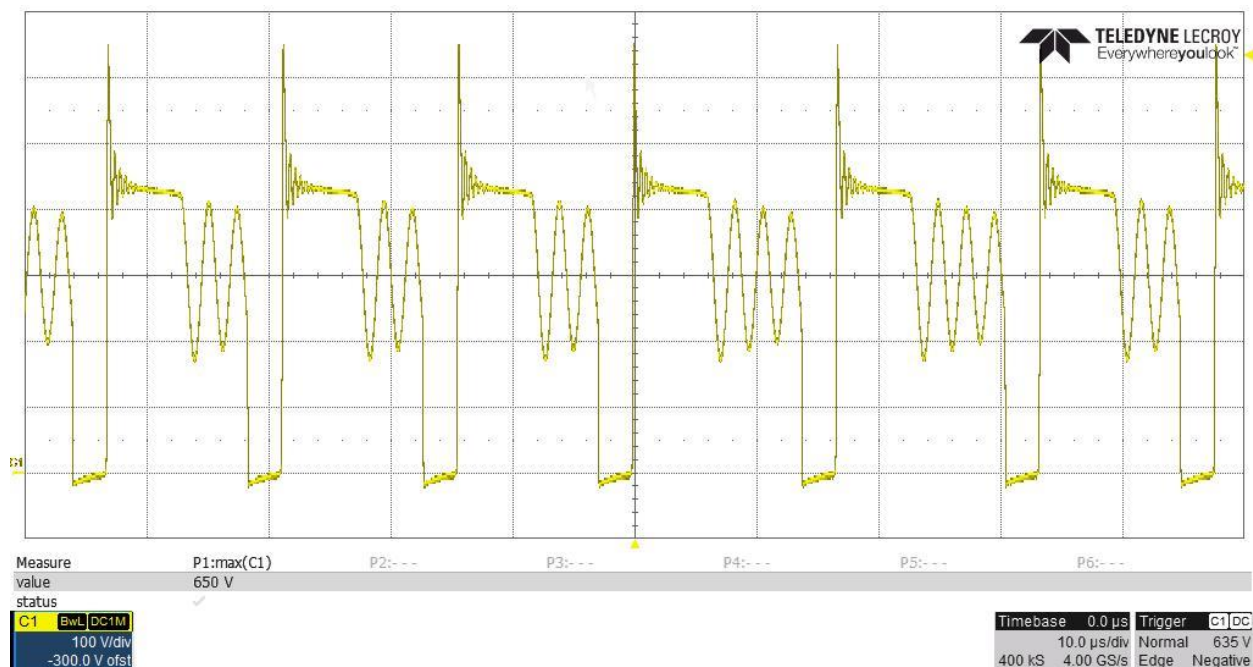
- Thermal at 120VAC, 12V/850mA



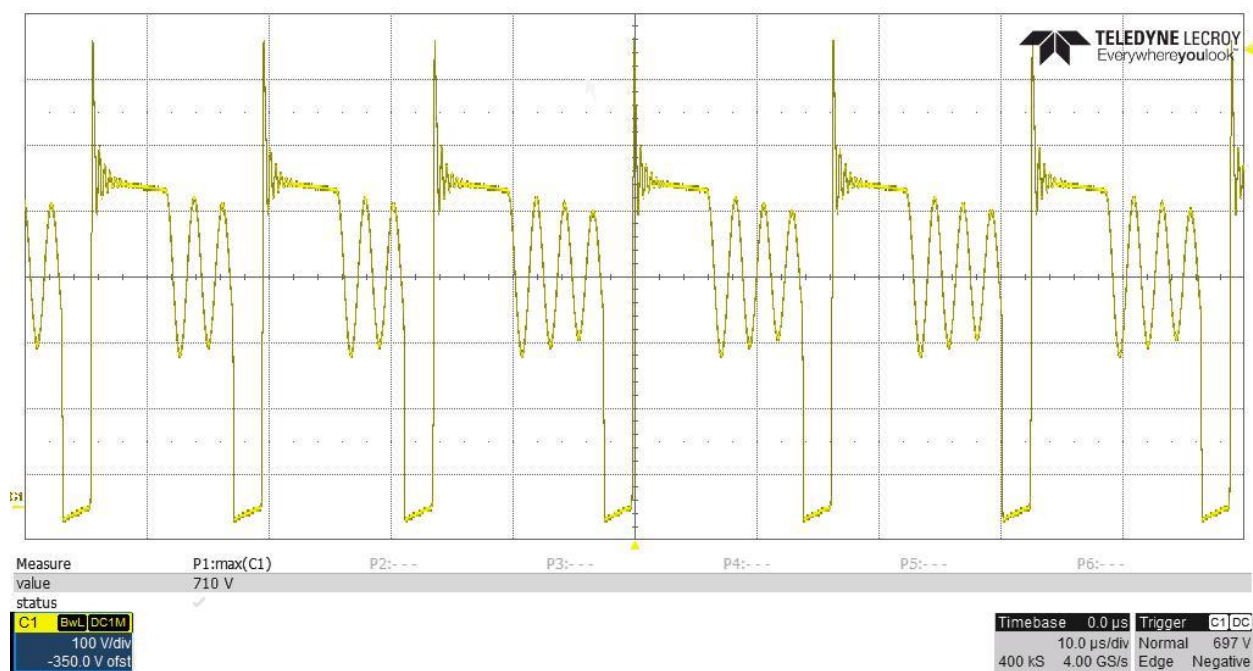
Spot analysis	Value
Amb Temperature	23.0°C
Area analysis	Value
D1Max	74.9°C
T1Max	59.6°C
D6Max	60.0°C

9.3 T1 = 73P-16002 (Kar Ming)

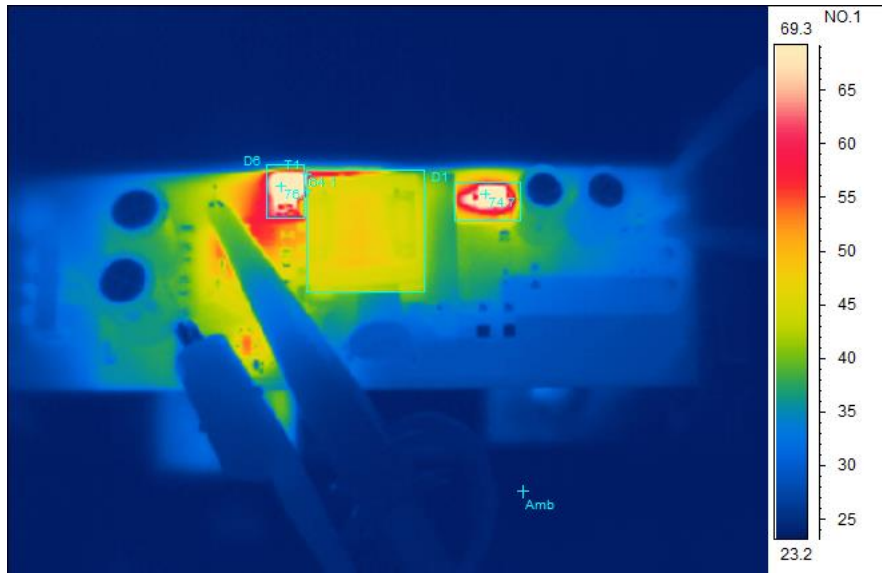
- BJT (Q1) voltage stresses at 120VAC, 12V/850mA



- BJT (Q1) voltage stresses at 138VAC, 12V/850mA



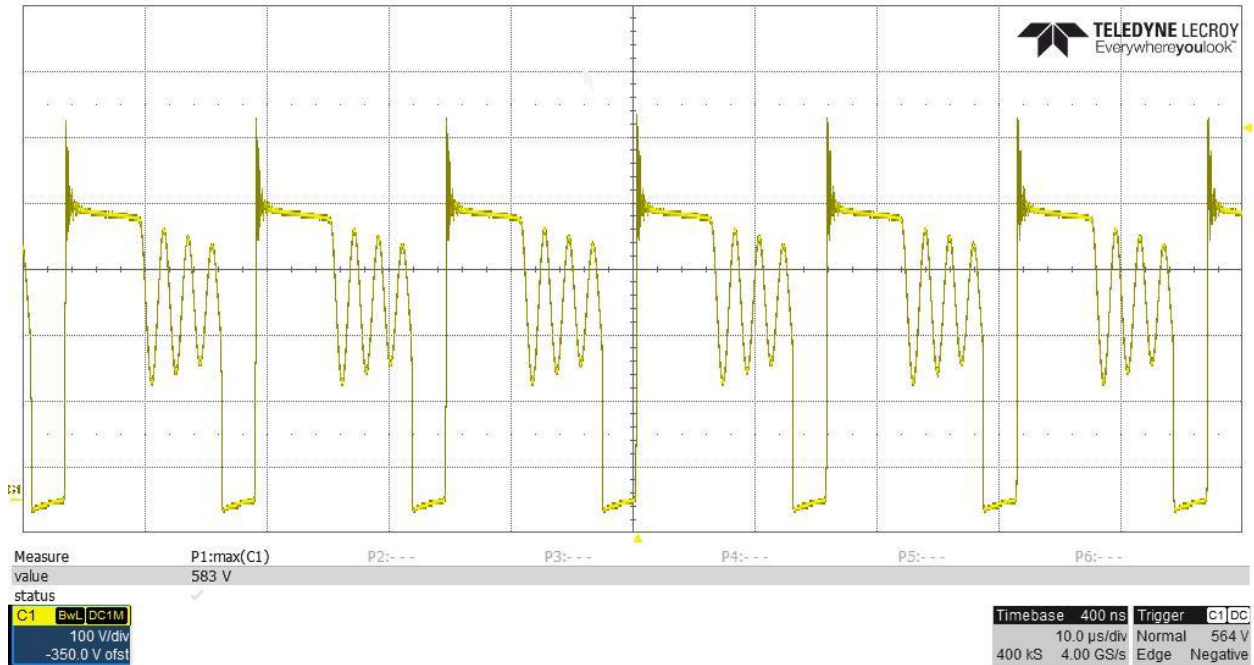
- Thermal at 120VAC, 12V/850mA



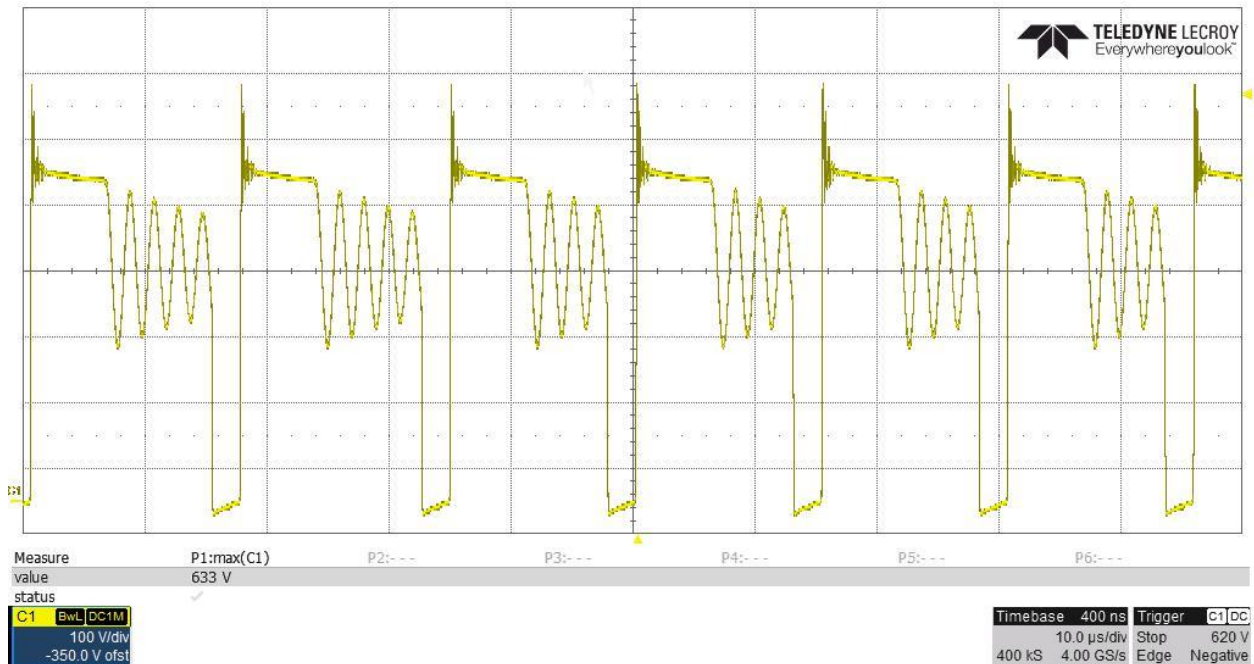
Spot analysis	Value
Amb Temperature	23.3°C
Area analysis	Value
D1Max	74.7°C
T1Max	64.1°C
D6Max	76.7°C

9.4 T1 = XF0174-EF16 (XFMRS)

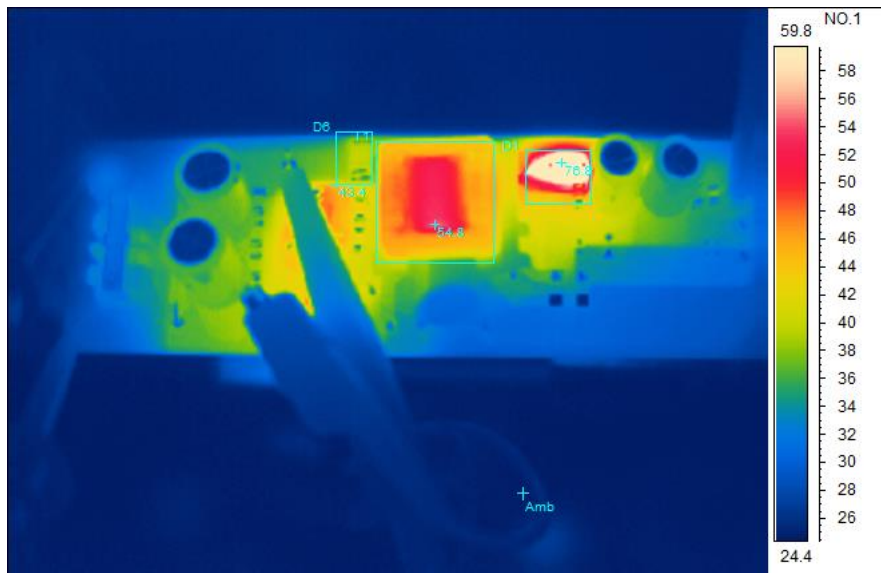
- BJT (Q1) voltage stresses at 120VAC, 12V/850mA



- BJT (Q1) voltage stresses at 138VAC, 12V/850mA



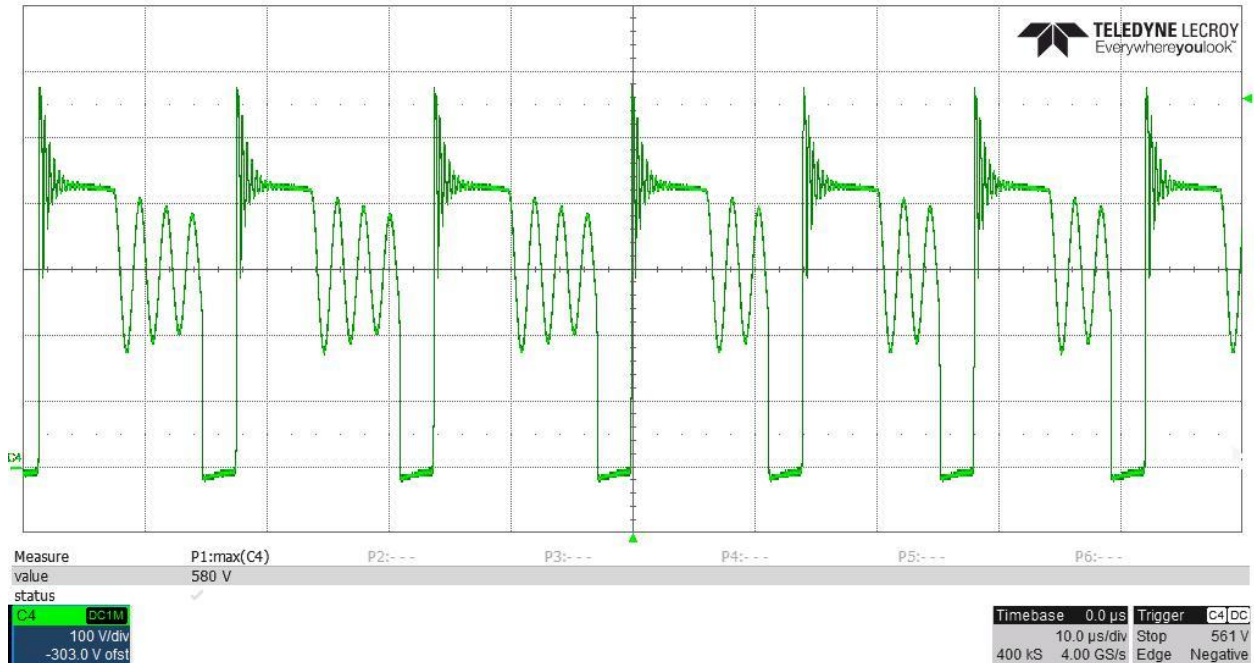
- Thermal at 120VAC, 12V/850mA



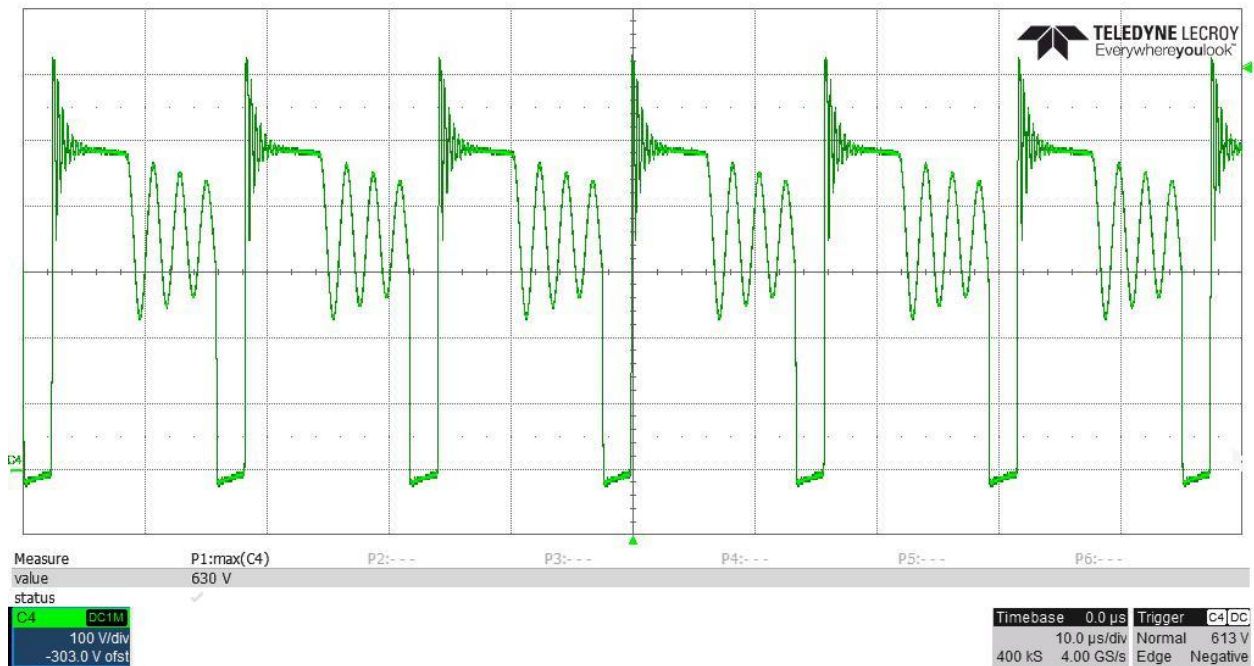
Spot analysis	Value
Amb Temperature	24.6°C
Area analysis	Value
D1Max	76.8°C
T1Max	54.8°C
D6Max	43.4°C

9.5 T1 = YA7-1473R (Alltronics)

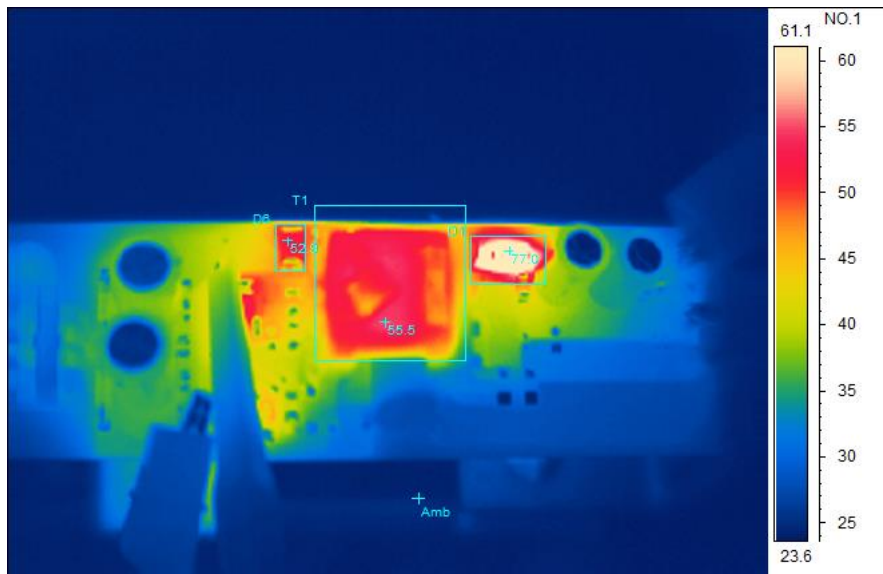
- BJT (Q1) voltage stresses at 120VAC, 12V/850mA



- BJT (Q1) voltage stresses at 138VAC, 12V/850mA



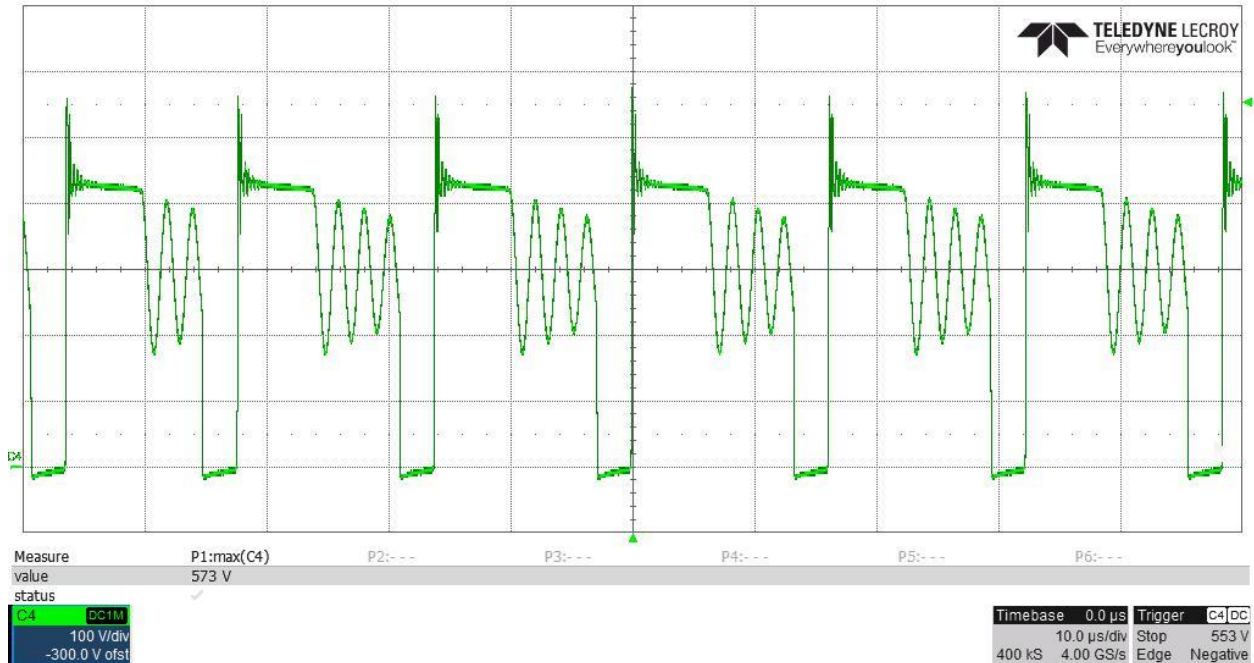
- Thermal at 120VAC, 12V/850mA



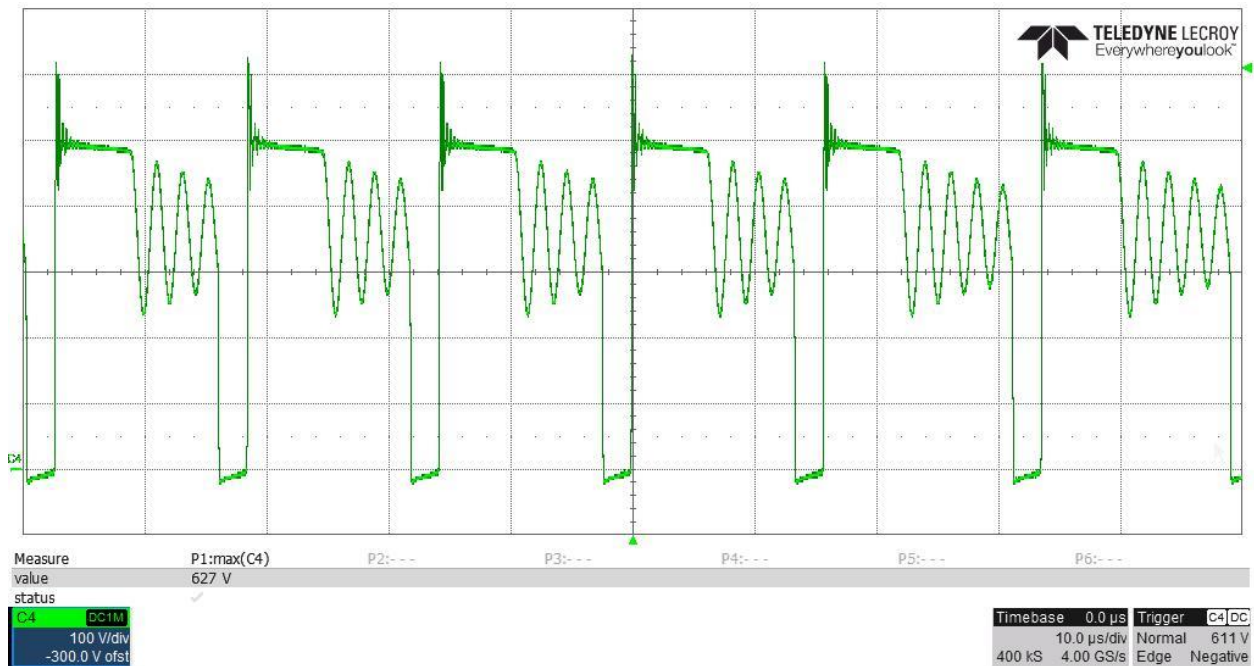
Spot analysis	Value
Amb Temperature	24.8°C
Area analysis	Value
D1Max	77.0°C
T1Max	55.5°C
D6Max	52.9°C

9.6 T1 = OWTR-A0381-1 (Ole Wolff)

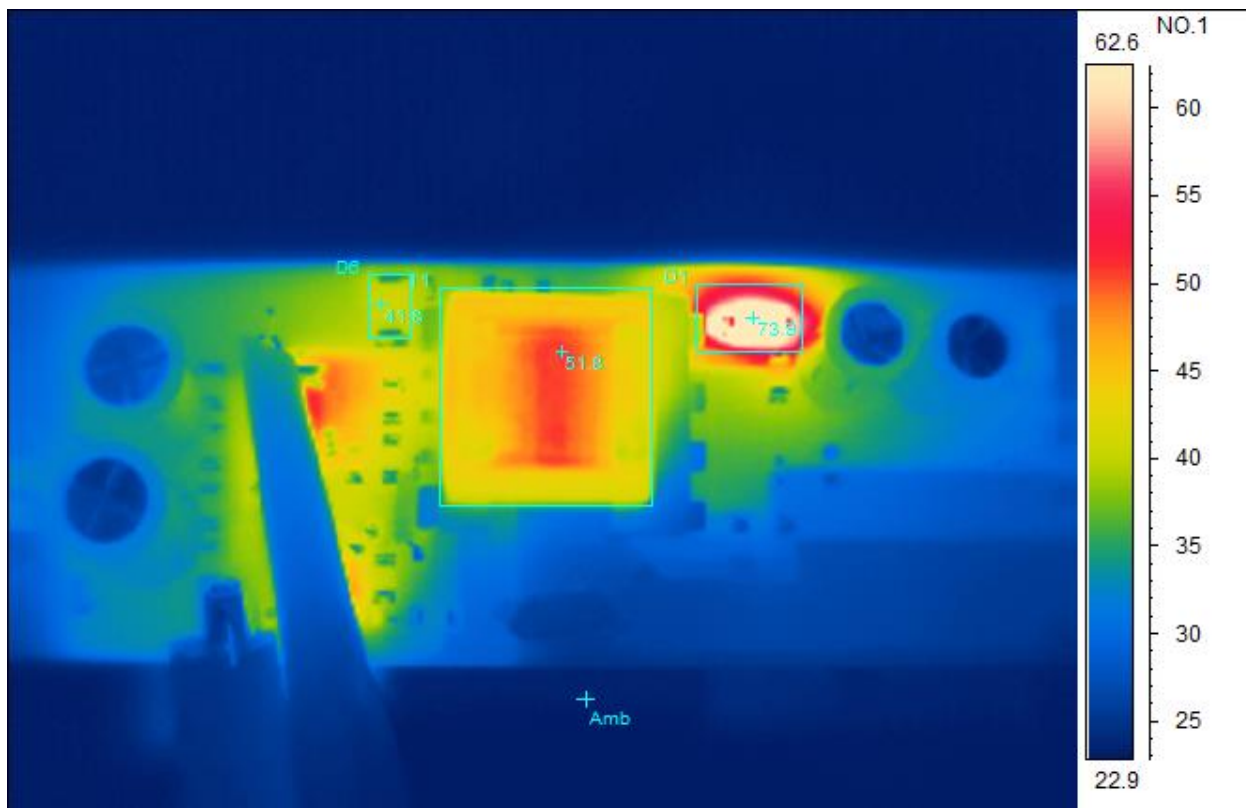
- BJT (Q1) voltage stresses at 120VAC, 12V/850mA



- BJT (Q1) voltage stresses at 138VAC, 12V/850mA



- Thermal at 120VAC, 12V/850mA



Spot analysis	Value
Amb Temperature	23.4°C
Area analysis	Value
D1Max	73.9°C
T1Max	51.8°C
D6Max	41.8°C

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