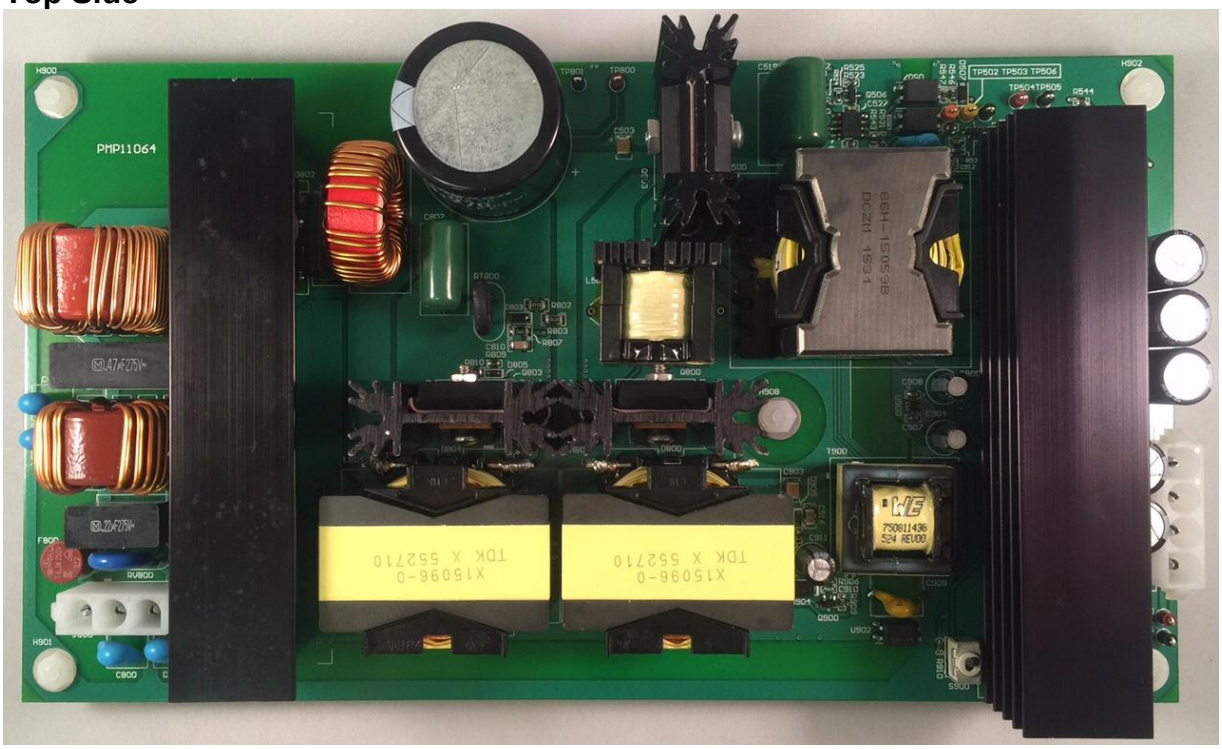
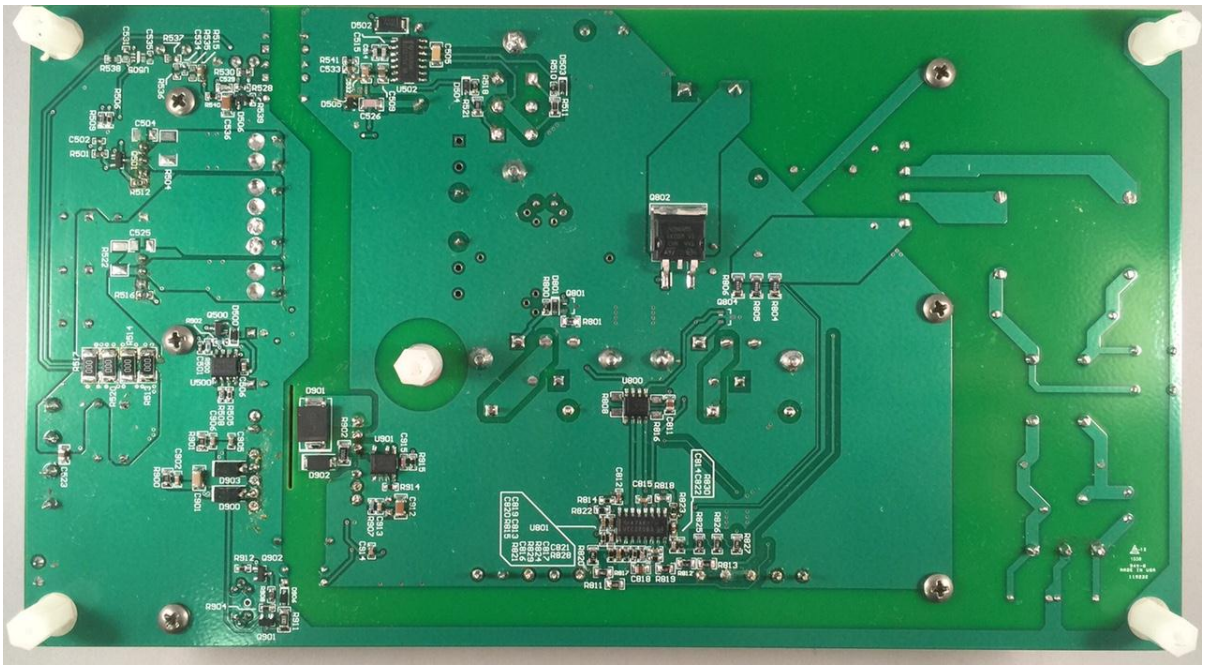
1 Photo

The photographs below show the top and bottom view of the PMP11282Rev A board, which is built on PMP11064 Rev B PCB.

Top Side



Bottom Side

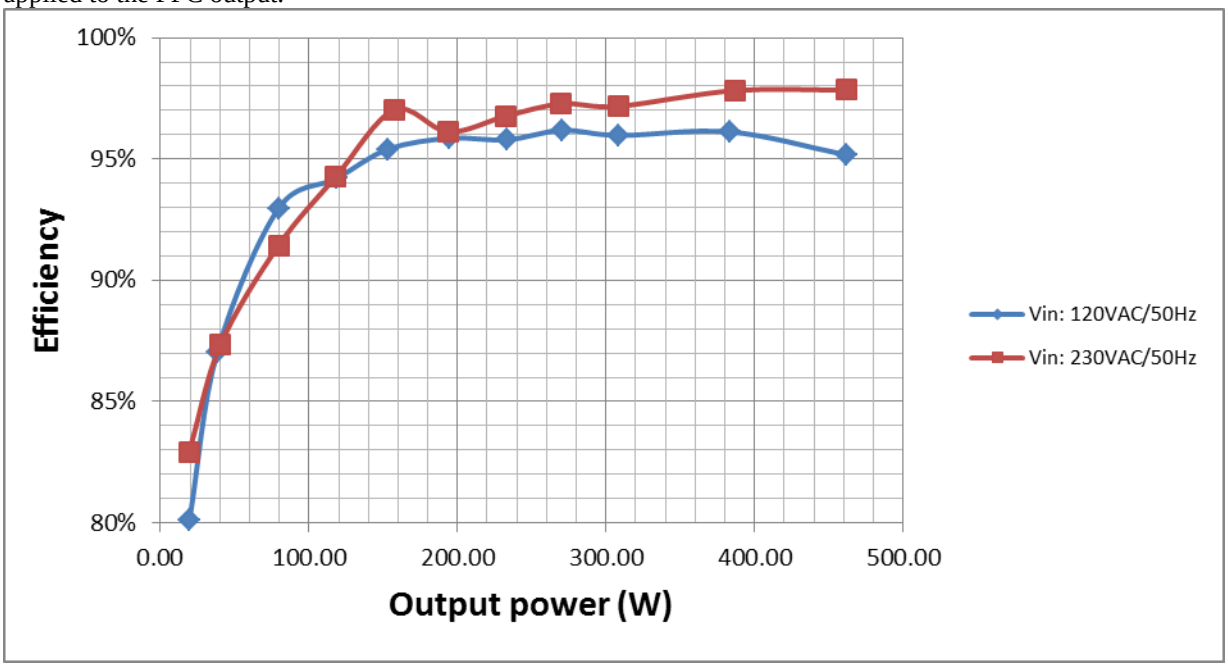


2 Efficiency

The efficiency curves of total supply are shown in the tables and graph below.

2.1 AC-DC Efficiency: PFC and Bias supply

In the test, R524 and R527 are removed to test the efficiency of PFC and Bias supply. Constant current load is directly applied to the PFC output.



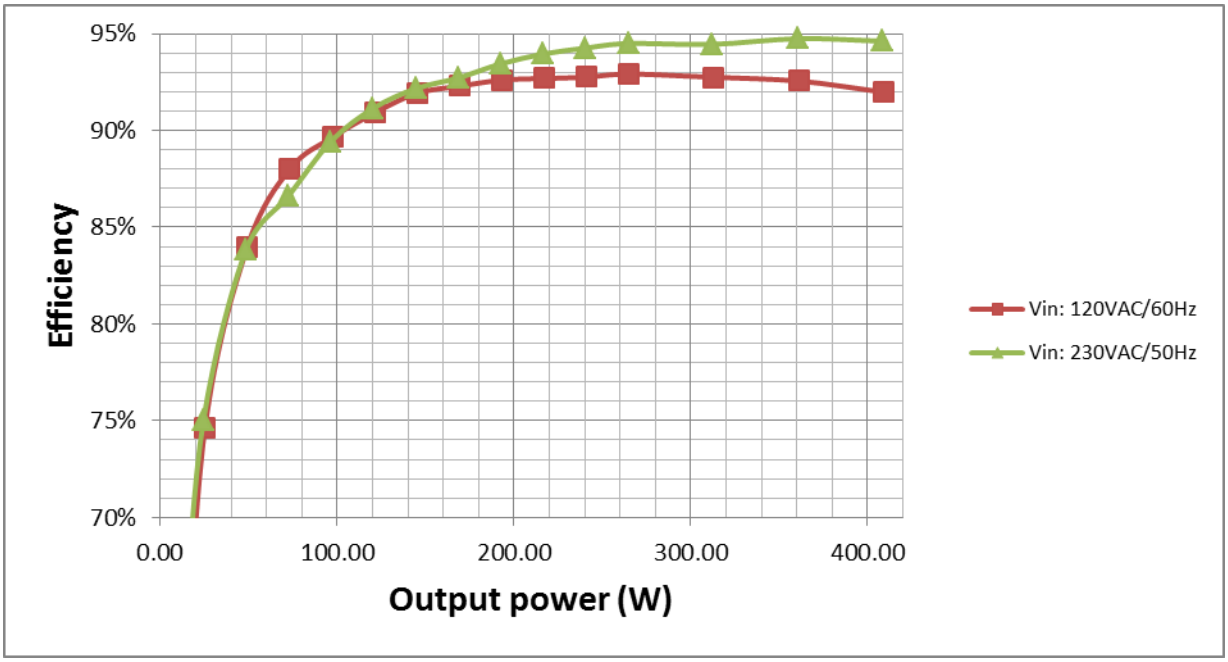
120V_{AC}/60Hz (PFC and Bias supply)

Vin(AC)	Iin(A)	Pin(W)	PF	V_B+(V)	I_B+(A)	Pout(W)	Losses(W)	Eff. (%)
120.02	4.053	485.2	0.998	383.5	1.20	461.76	23.44	95.17%
120.00	3.339	399.1	0.996	385.3	1.00	383.60	15.50	96.12%
119.94	2.700	321.8	0.994	384.1	0.80	308.85	12.95	95.97%
120.05	2.361	281.2	0.992	384.7	0.70	270.47	10.73	96.18%
119.97	2.051	243.4	0.989	384.6	0.61	233.16	10.24	95.79%
120.03	1.717	202.9	0.985	384.9	0.51	194.50	8.40	95.86%
119.86	1.373	160.6	0.976	384.8	0.40	153.19	7.38	95.41%
120.07	1.089	125.6	0.961	384.7	0.31	118.30	7.30	94.19%
119.98	0.771	85.5	0.924	384.8	0.21	79.49	6.02	92.96%
120.04	0.463	43.8	0.789	384.8	0.10	38.13	5.69	87.02%
120.01	0.336	24.4	0.606	386.7	0.05	19.56	4.86	80.12%

230V_{AC}/50Hz (PFC and Bias supply)

Vin(AC)	Iin(A)	Pin(W)	PF	V_B+(V)	I_B+(A)	Pout(W)	Losses(W)	Eff. (%)
230.00	2.091	472.6	0.982	384.02	1.20	462.40	10.20	97.84%
230.00	1.760	395.4	0.977	384.87	1.01	386.79	8.61	97.82%
230.00	1.425	317.1	0.967	383.68	0.80	308.13	8.97	97.17%
229.90	1.258	277.5	0.960	384.42	0.70	269.94	7.56	97.28%
230.00	1.100	240.4	0.950	383.95	0.61	232.64	7.76	96.77%
230.00	0.939	201.7	0.934	384.37	0.50	193.88	7.82	96.12%
230.00	0.776	162.3	0.909	384.92	0.41	157.47	4.83	97.02%
230.00	0.627	125.4	0.870	384.57	0.31	118.26	7.16	94.29%
230.10	0.472	86.9	0.800	386.59	0.21	79.48	7.45	91.43%
230.00	0.306	46.2	0.656	387.78	0.10	40.37	5.85	87.34%
230.30	0.199	23.4	0.510	387.97	0.05	19.40	3.99	82.94%

2.2 Total Efficiency



120V$_{AC}$/60Hz

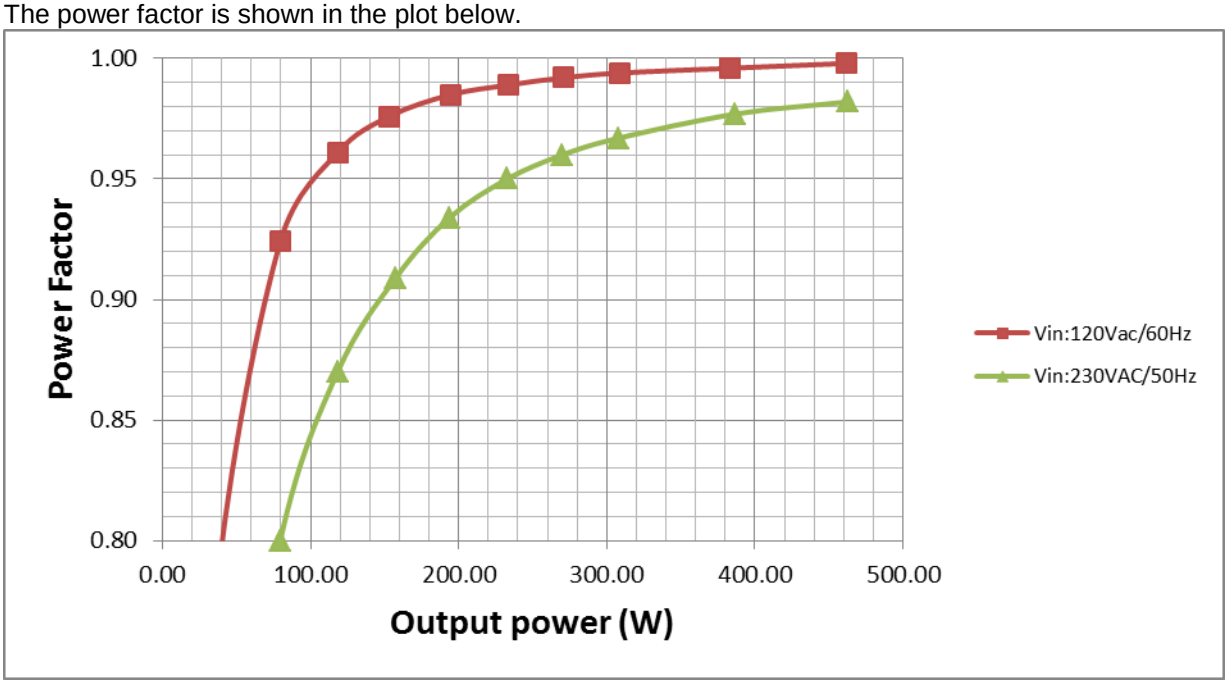
Vin(AC)	Iin(A)	Pin(W)	PF	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
120.04	3.716	444.80	0.997	24.016	17.04	409.11	35.69	91.98%
119.97	3.265	390.30	0.997	24.016	15.04	361.22	29.08	92.55%
120.08	2.824	337.50	0.995	24.008	13.04	313.02	24.48	92.75%
120.02	2.396	285.50	0.993	24.023	11.04	265.26	20.24	92.91%
120.03	2.184	260.00	0.992	24.023	10.04	241.17	18.83	92.76%
120.12	1.973	234.50	0.990	24.039	9.04	217.34	17.16	92.68%
120.05	1.762	208.70	0.987	24.031	8.04	193.27	15.43	92.61%
120.04	1.555	183.49	0.983	24.039	7.04	169.34	14.15	92.29%
120.03	1.346	157.91	0.977	24.031	6.04	145.16	12.75	91.93%
120.09	1.146	133.23	0.968	24.023	5.04	121.12	12.11	90.91%
120.09	0.948	108.41	0.953	24.031	4.04	97.18	11.23	89.64%
120.01	0.748	83.18	0.926	24.031	3.05	73.21	9.97	88.01%
120.02	0.560	58.47	0.870	24.031	2.04	49.10	9.37	83.98%
120.02	0.378	33.66	0.724	24.023	1.05	25.11	8.55	74.60%
119.98	0.309	20.61	0.557	24.055	0.50	12.07	8.54	58.54%
120.08	0.041	1.48	0.299	24.563	0.00	0.00	1.48	0.00%

230V_{AC}/50Hz

Vin(AC)	Iin(A)	Pin(W)	PF	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Eff. (%)
229.9	1.915	431.6	0.98	24.016	17.00	408.34	23.26	94.61%
230.0	1.696	380.7	0.976	24.031	15.01	360.68	20.02	94.74%
229.9	1.480	330.2	0.97	23.977	13.01	311.87	18.33	94.45%
229.9	1.267	280.1	0.962	24.039	11.01	264.67	15.43	94.49%
230.0	1.160	255.1	0.956	24.016	10.01	240.45	14.65	94.26%
229.9	1.058	230.6	0.948	24.047	9.01	216.66	13.94	93.95%
230.0	0.954	206	0.938	24.031	8.01	192.49	13.51	93.44%
230.2	0.853	181.59	0.925	24.008	7.01	168.35	13.24	92.71%
229.8	0.752	156.7	0.907	24.016	6.01	144.41	12.29	92.16%
230.2	0.650	132.03	0.882	24.016	5.01	120.33	11.70	91.14%
230.0	0.553	107.71	0.847	24.008	4.01	96.32	11.39	89.42%
230.0	0.452	83.6	0.804	24.023	3.01	72.41	11.19	86.61%
229.9	0.365	57.8	0.689	24.031	2.02	48.46	9.34	83.84%
230.3	0.223	32.45	0.632	24.031	1.01	24.35	8.10	75.05%
230.0	0.176	19.63	0.485	24.031	0.52	12.42	7.21	63.28%
229.9	49.070	1.363	0.12	24.234	0.00	0.00	1.36	0.00%

3 Power Factor

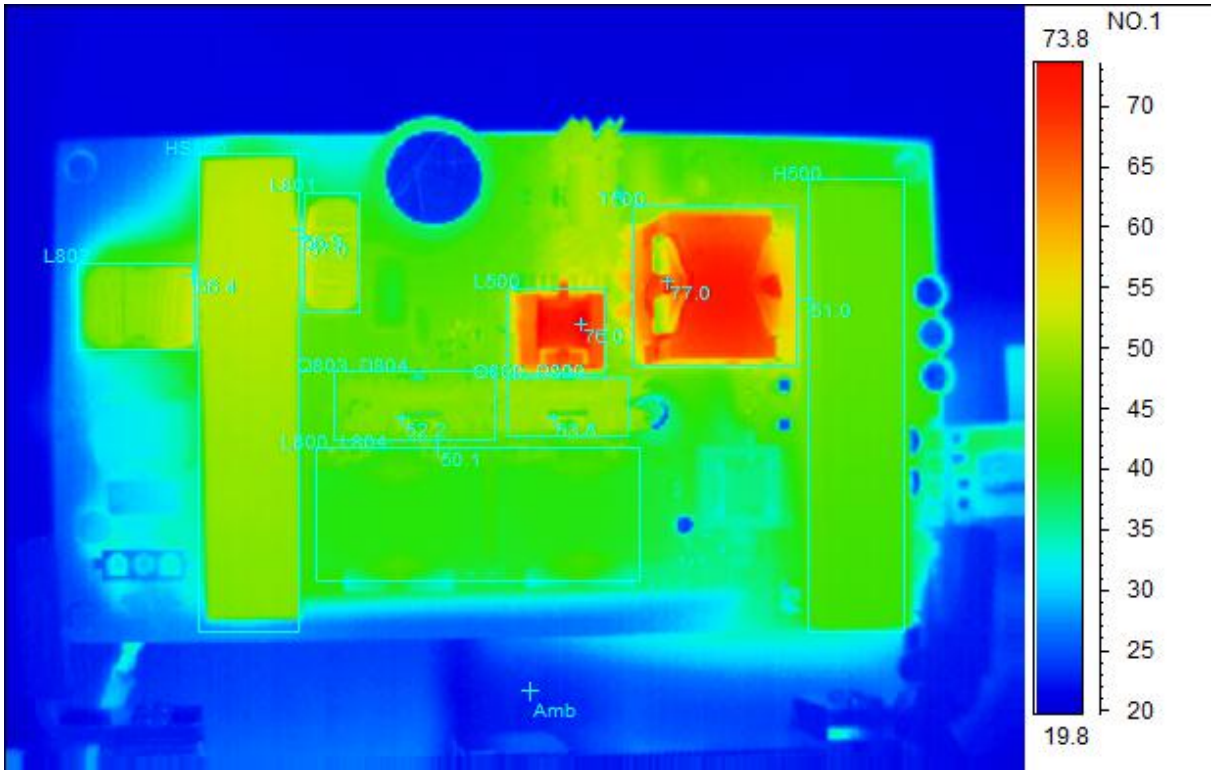
The power factor is shown in the plot below.



4 Thermal Images

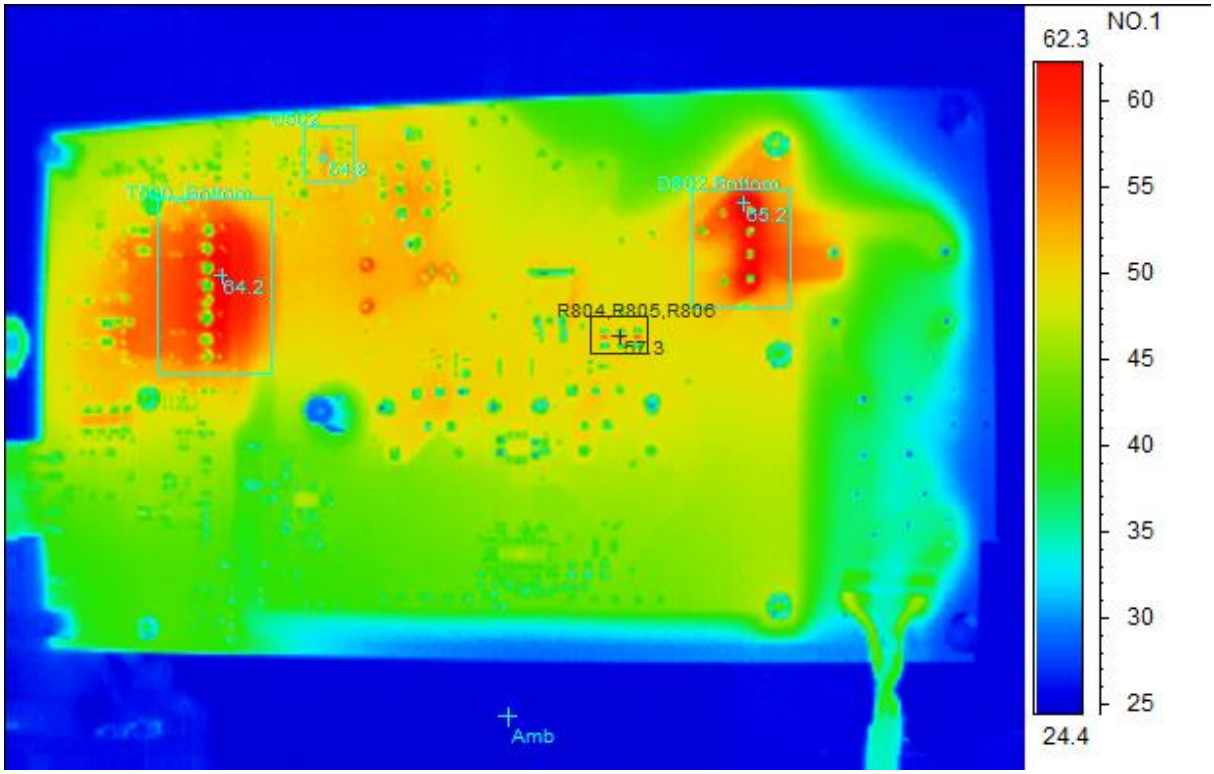
The thermal images below show a top view and bottom view of the board. The board is placed vertically during the test, where the input and output connecters are at the bottom side. The ambient temperature was 25ºC with no air flow. The output was loaded with 24V/17A.

4.1 120V/60Hz, Top Side



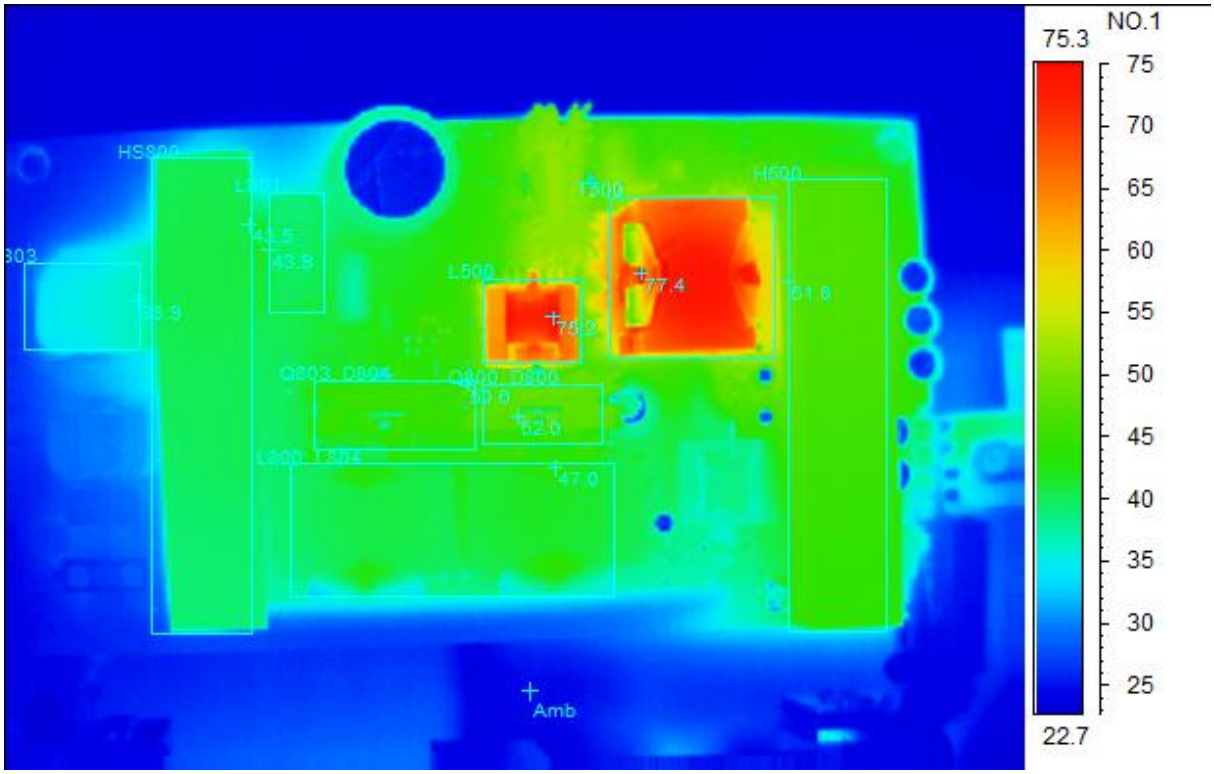
Spot analysis	Value
Amb Temperature	23.3°C
Area analysis	**Value**
L500Max	76.0°C
T500Max	77.0°C
L803Max	56.4°C
HS800Max	56.9°C
L801Max	57.0°C
Q803, D804Max	52.2°C
Q800, D800Max	53.8°C
H500Max	51.0°C
L800, L804Max	50.1°C

4.2 120V/60Hz, Bottom Side



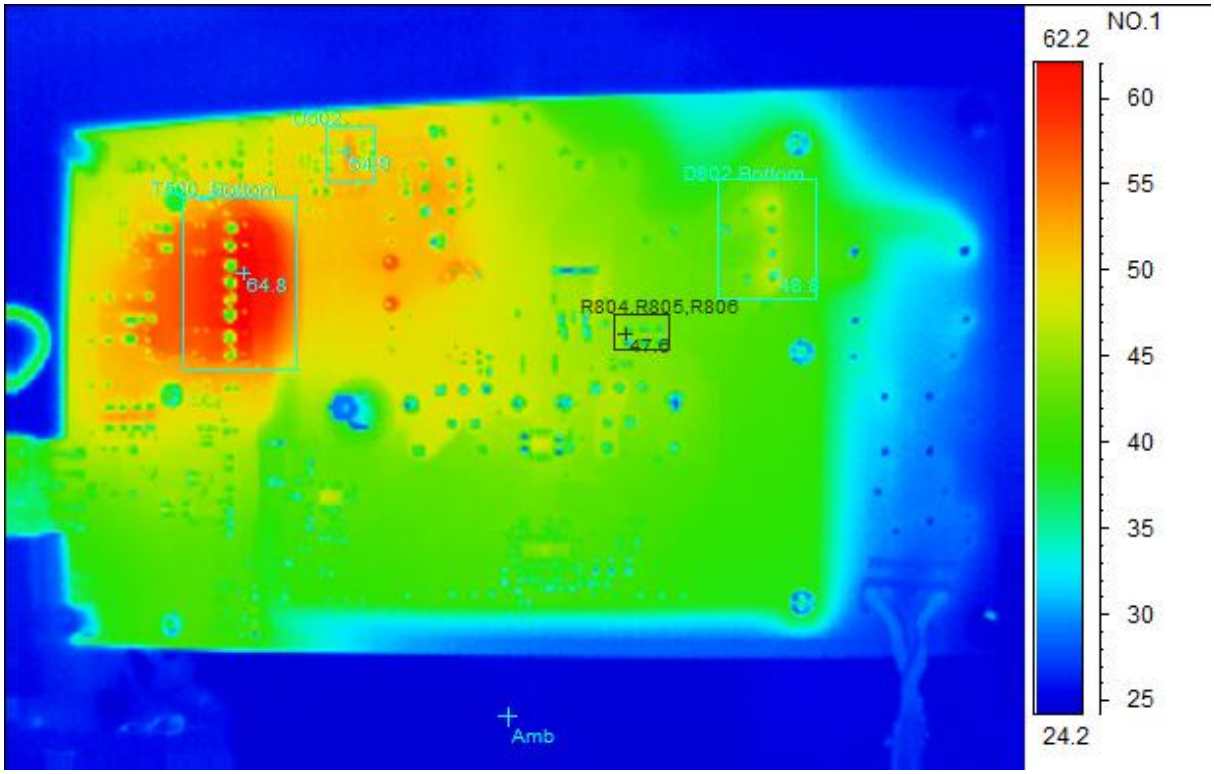
Spot analysis	Value
Amb Temperature	25.2°C
Area analysis	**Value**
D802 BottomMax	65.2°C
T500_BottomMax	64.2°C
R804,R805,R806Max	57.3°C
U502Max	54.8°C

4.3 230V/50Hz, Top Side



Spot analysis	Value
Amb Temperature	24.8°C
Area analysis	**Value**
L500Max	75.2°C
T500Max	77.4°C
L803Max	38.9°C
HS800Max	43.5°C
L801Max	43.9°C
Q803, D804Max	50.6°C
Q800, D800Max	52.0°C
H500Max	51.8°C
L800, L804Max	47.0°C

4.4 230V/50Hz, Bottom Side

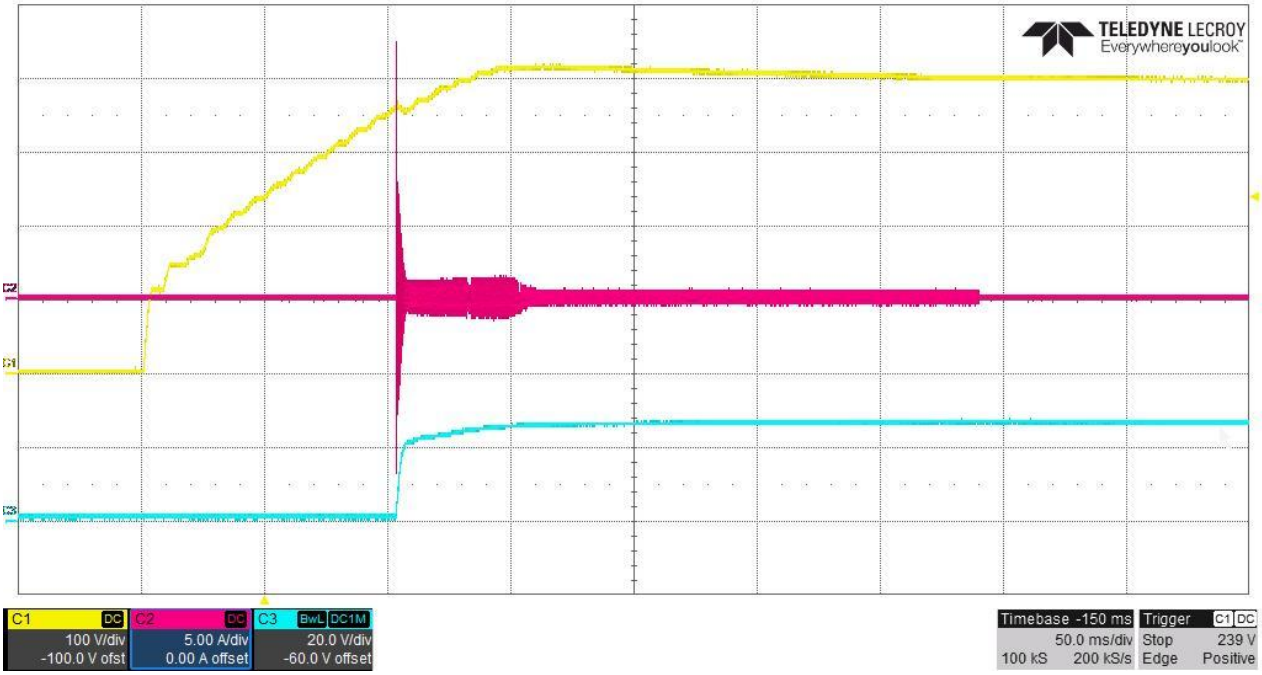


Spot analysis	Value
Amb Temperature	24.5°C
Area analysis	**Value**
D802 BottomMax	48.8°C
T500_BottomMax	64.8°C
R804,R805,R806Max	47.6°C
U502Max	54.9°C

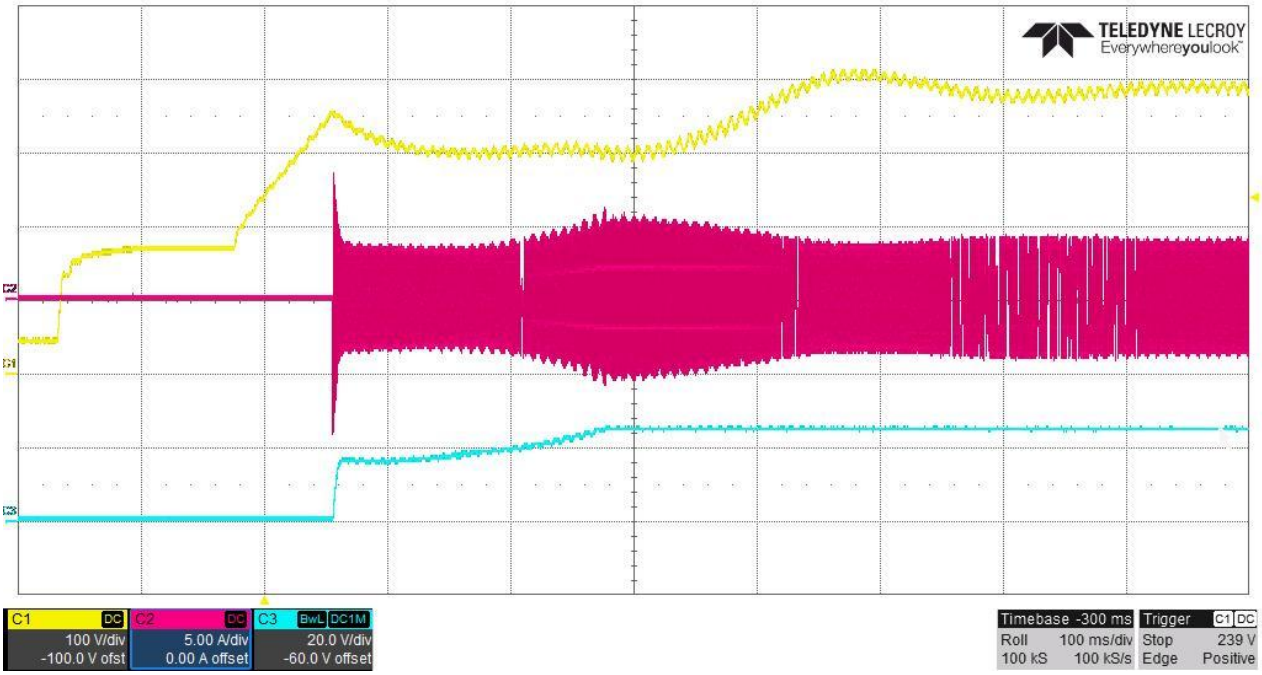
5 Startup

The voltages at startup are shown in the images below, where CH1 is the voltage across C808, CH2 is the inductor current of L500, and CH3 is the output voltage.

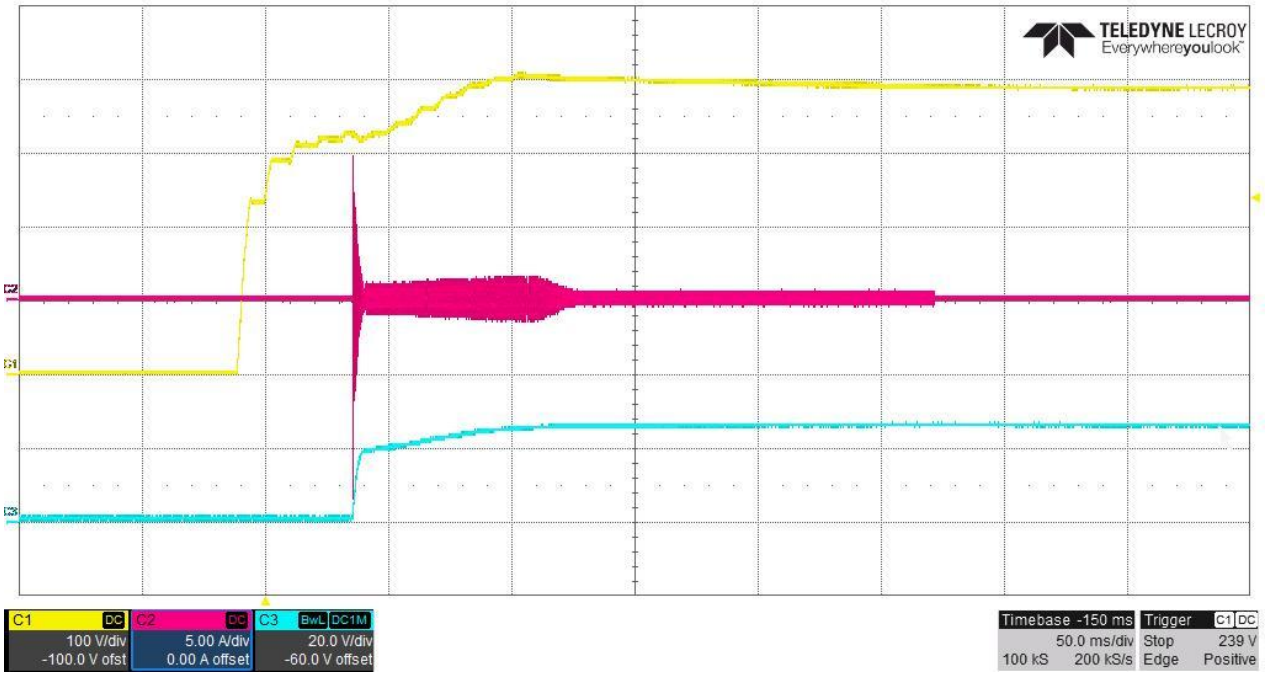
5.1 120V_{AC}/60Hz – No Load



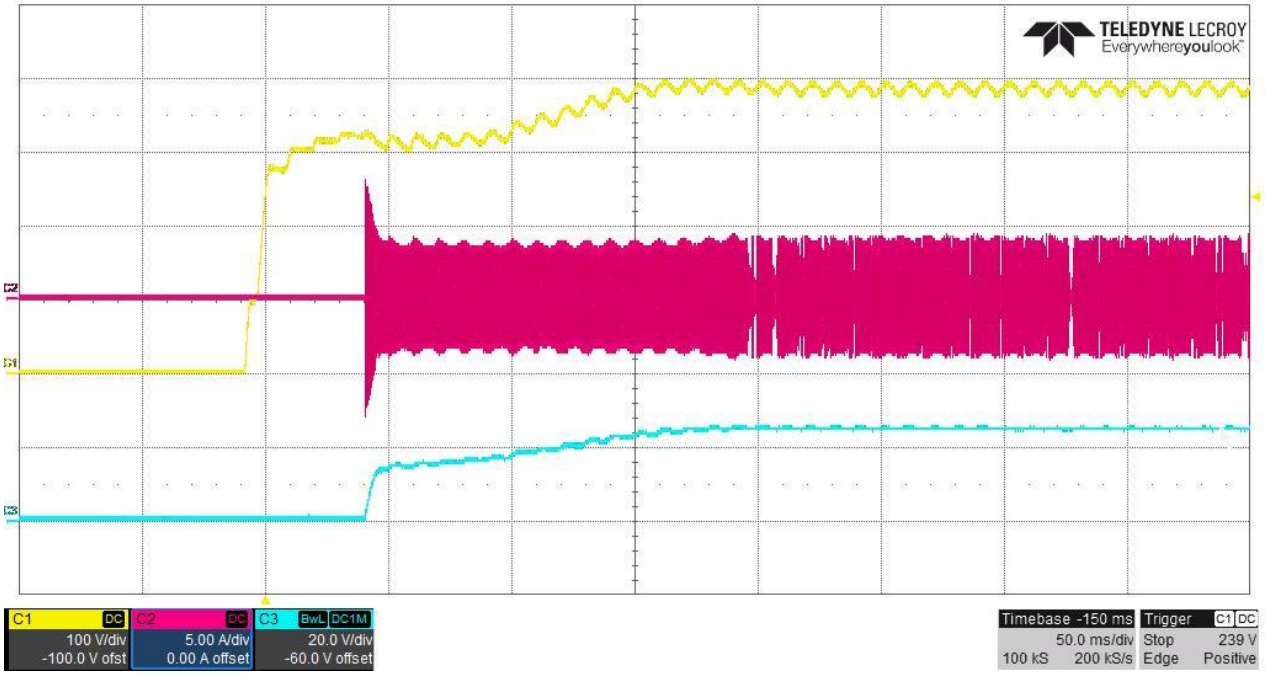
5.2 120V_{AC}/60Hz – Full Load (24V/17A at output)



5.3 230V_{AC}/50Hz – No Load



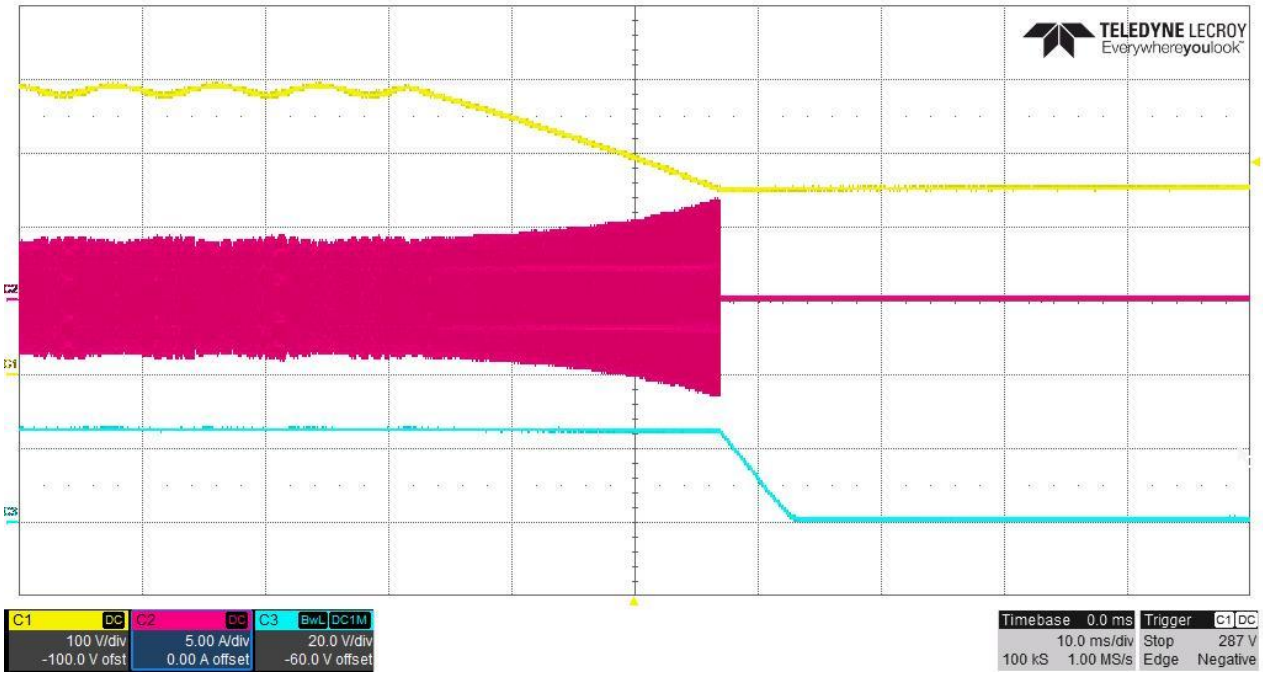
5.4 230V_{AC}/50Hz – Full Load (24V/17A at output)



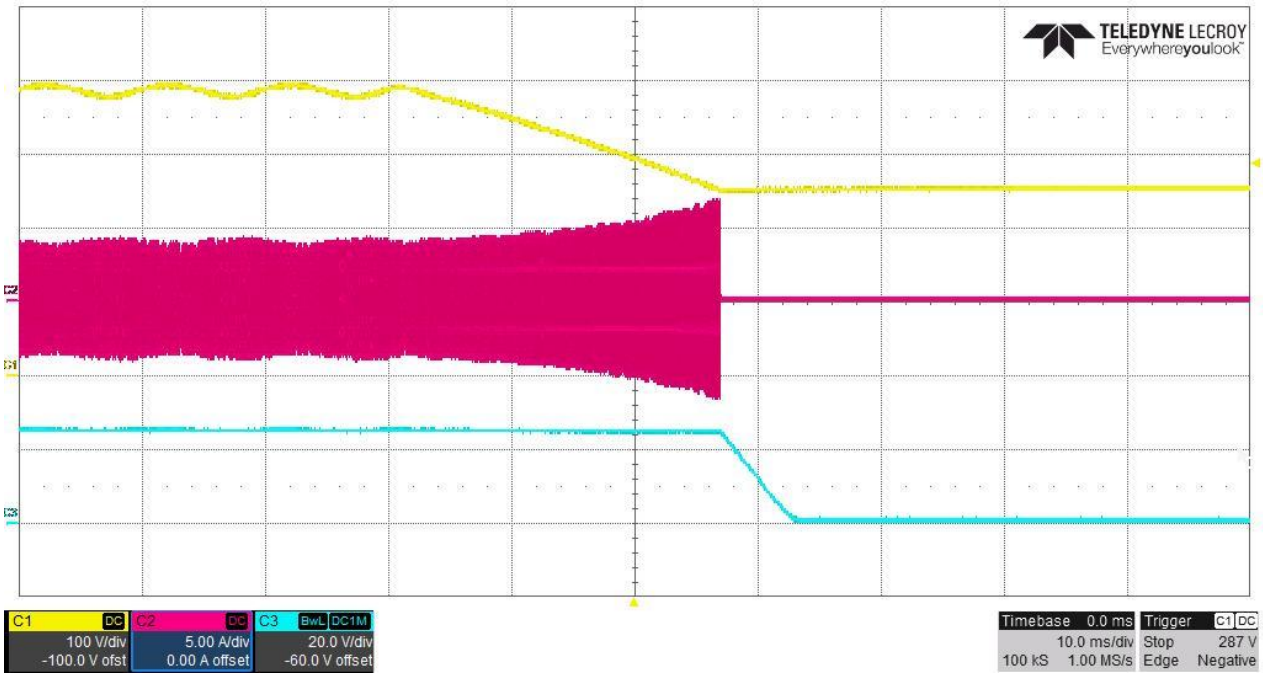
6 Turn-off

The voltages at turn-off are shown in the images below, where CH1 is C519 current, CH3 is the voltage across C808, and CH4 is the output voltage.

6.1 120VAC/60Hz – Full Load (24V/17A at output)

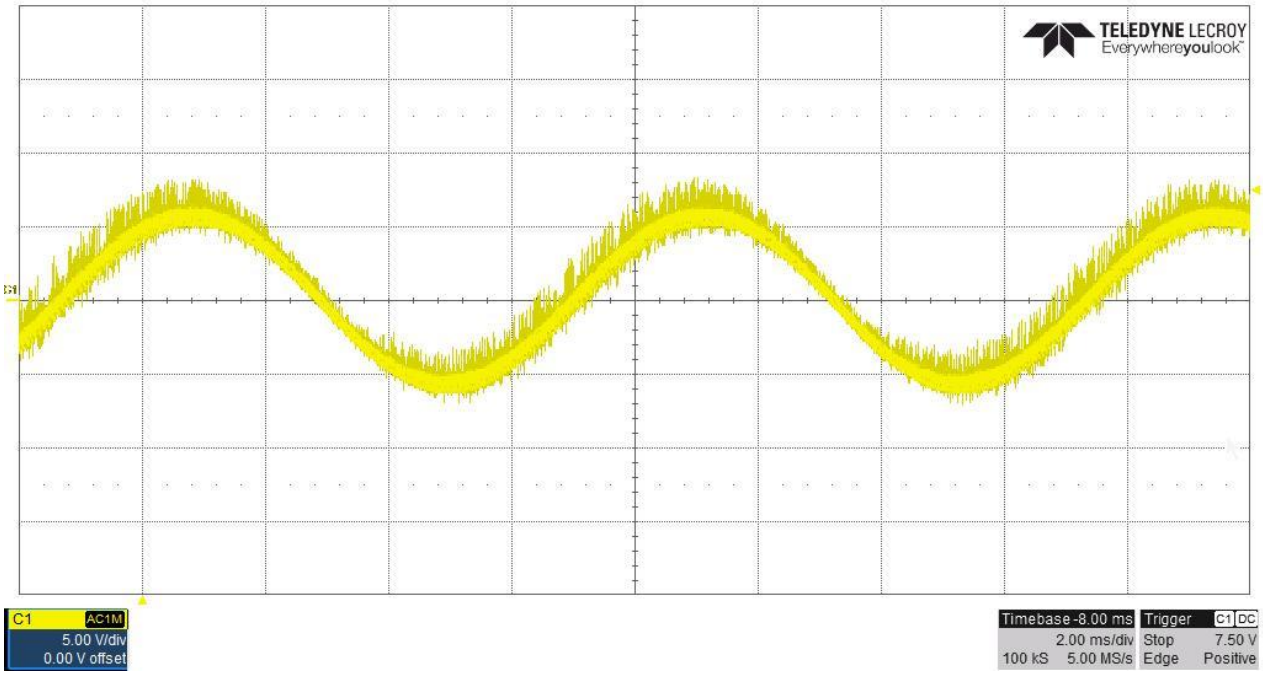


6.2 230VAC/50Hz – Full Load (24V/17A at output)

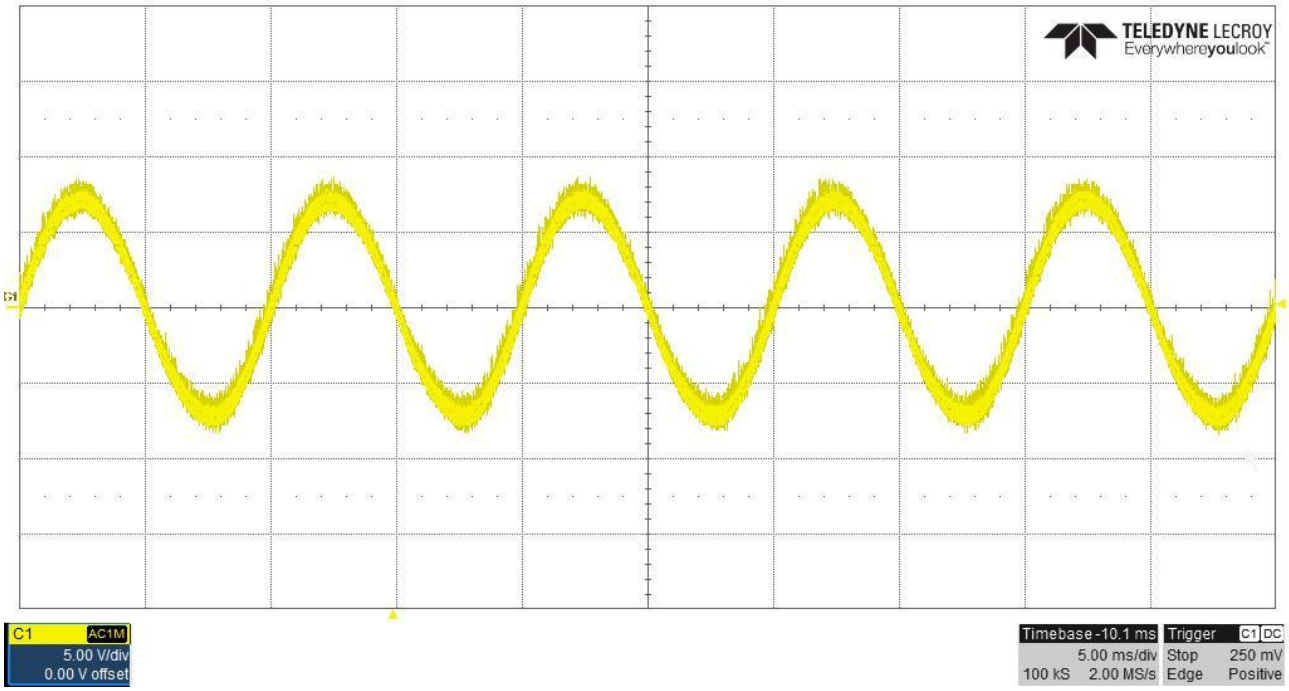


7 Ripple Voltage

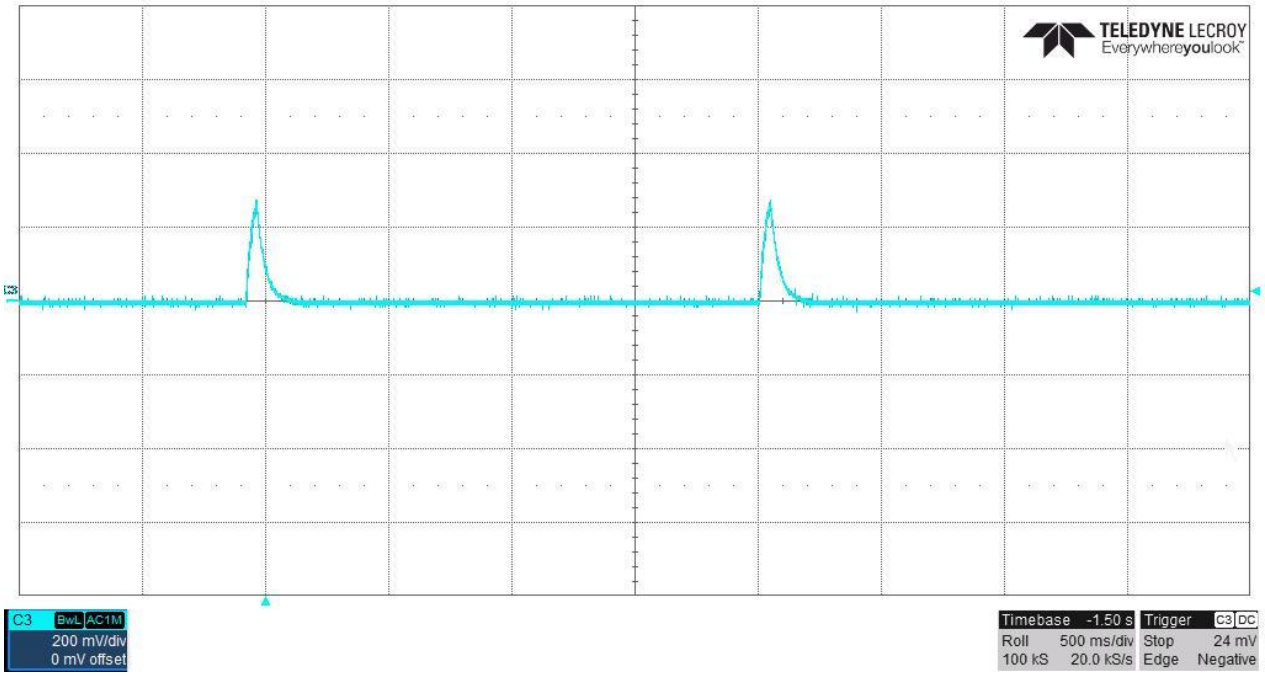
7.1 PFC output ripple (C818) at 120VAC/60Hz, 24V/17A



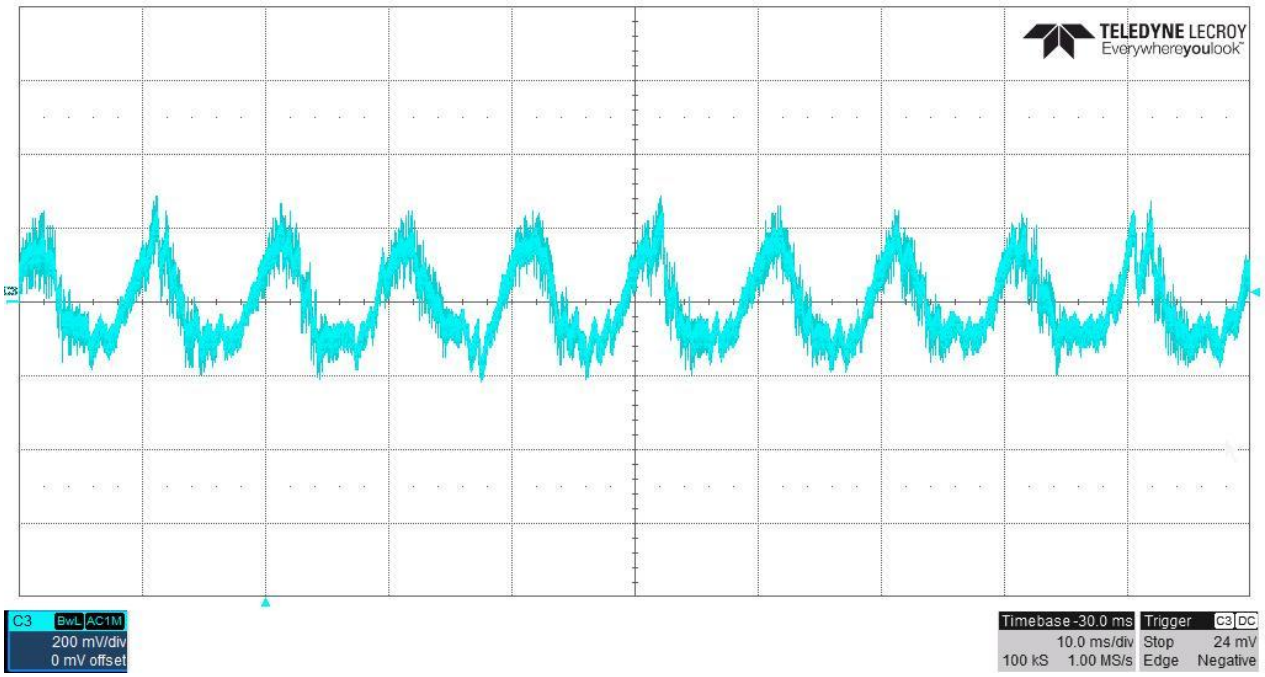
7.2 PFC output ripple (C818) at 120VAC/60Hz, 24V/17A



7.3 24V output ripple at no load

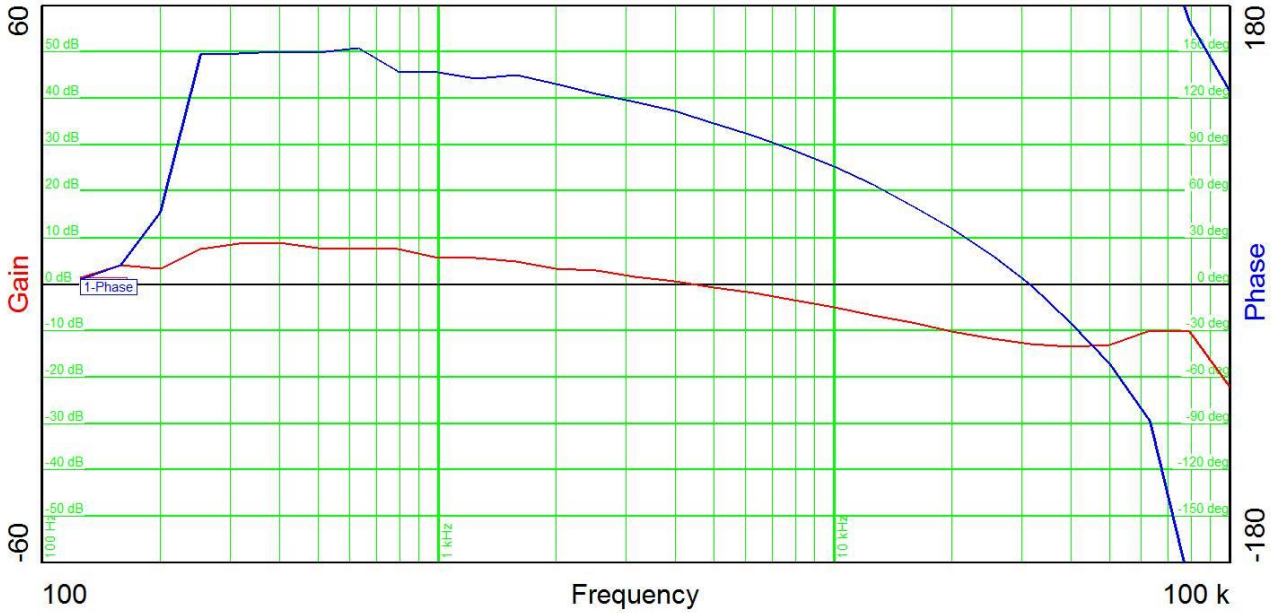


7.4 24V output ripple at full load (17A)



8 LLC Resonant Converter Frequency Response

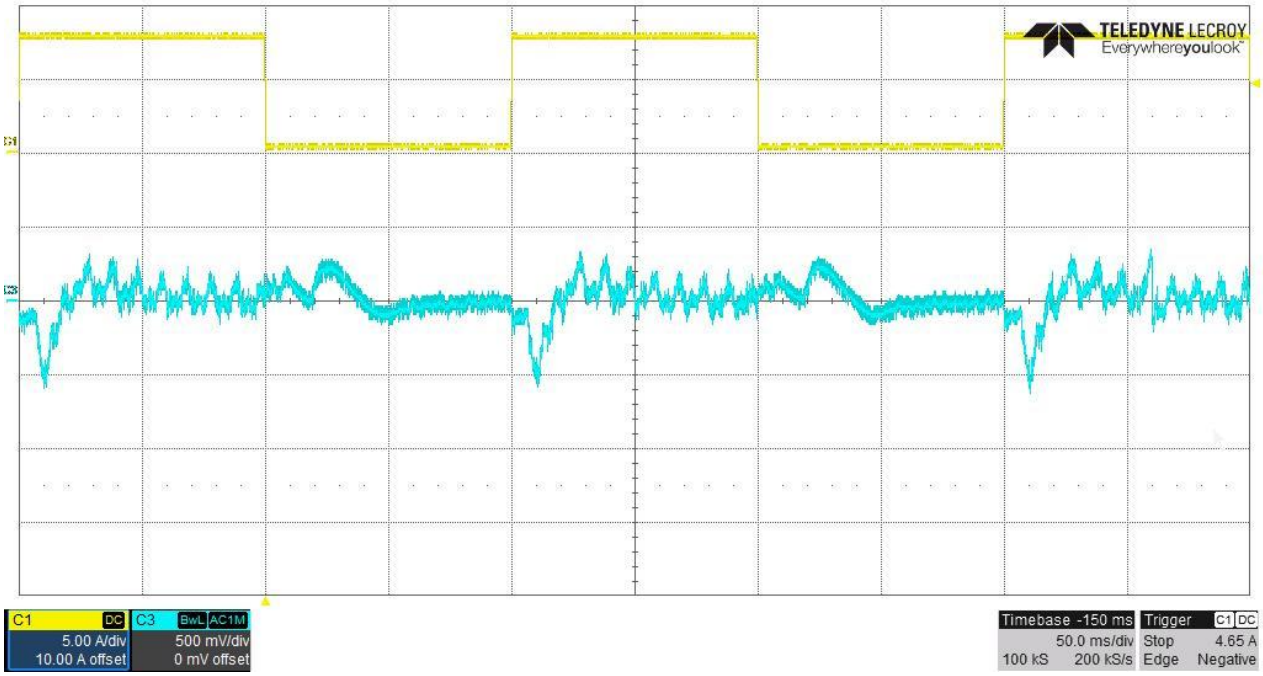
Frequency responses during full load operation (24V/17A at output) are shown in the plots below.



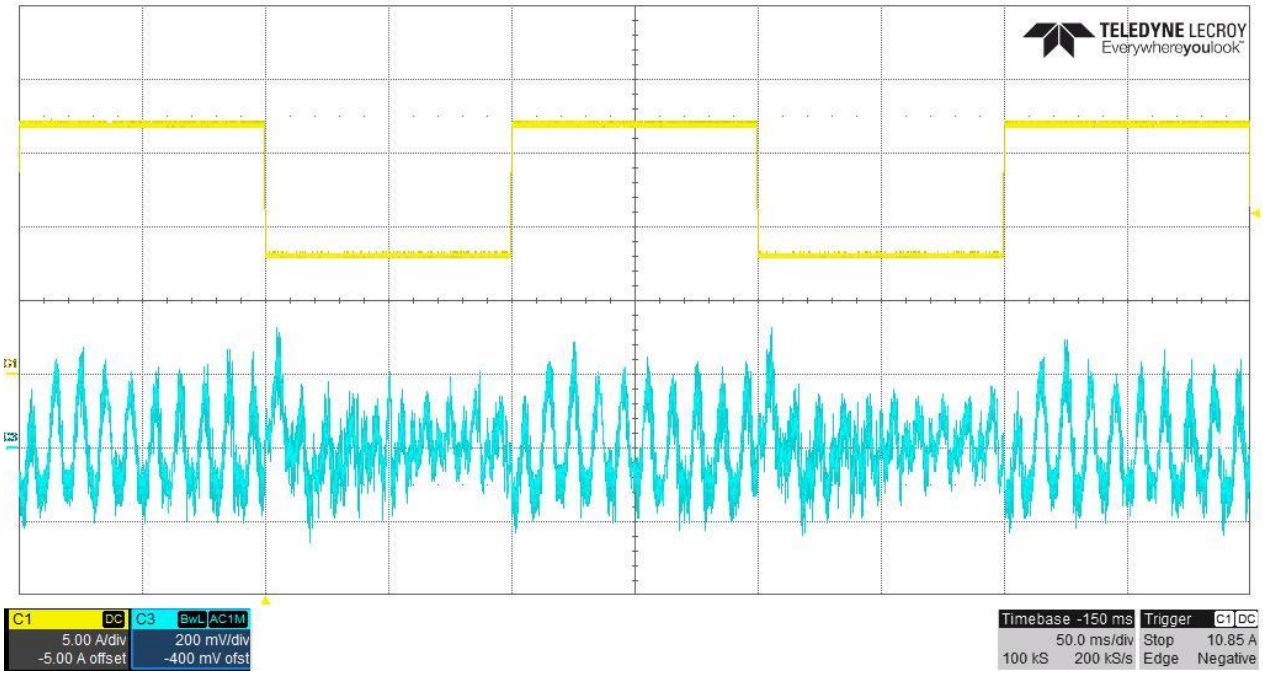
9 Load Response

Load response is tested at 230V_{AC}/50Hz input.

9.1 Load step from 0.5A to 8A:

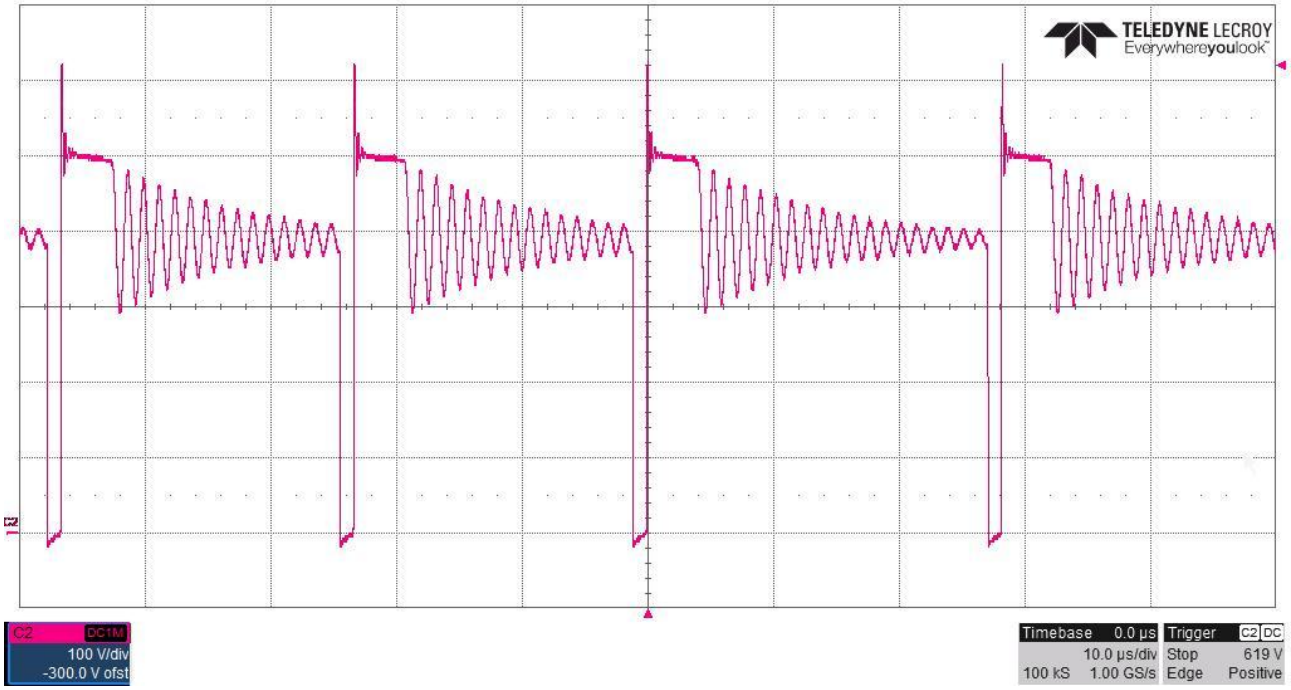


9.2 Load step from 8A to 17A:



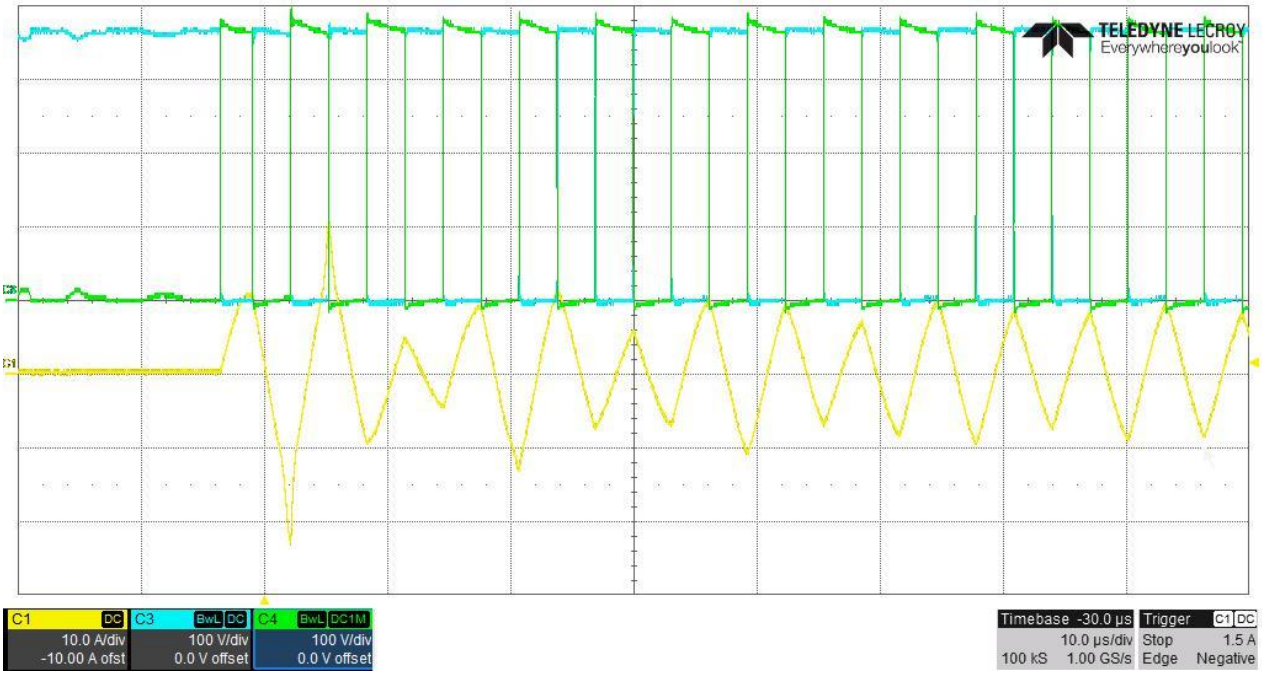
10 Key Waveforms

10.1 U901 Drain pin @ 24V/17A full load



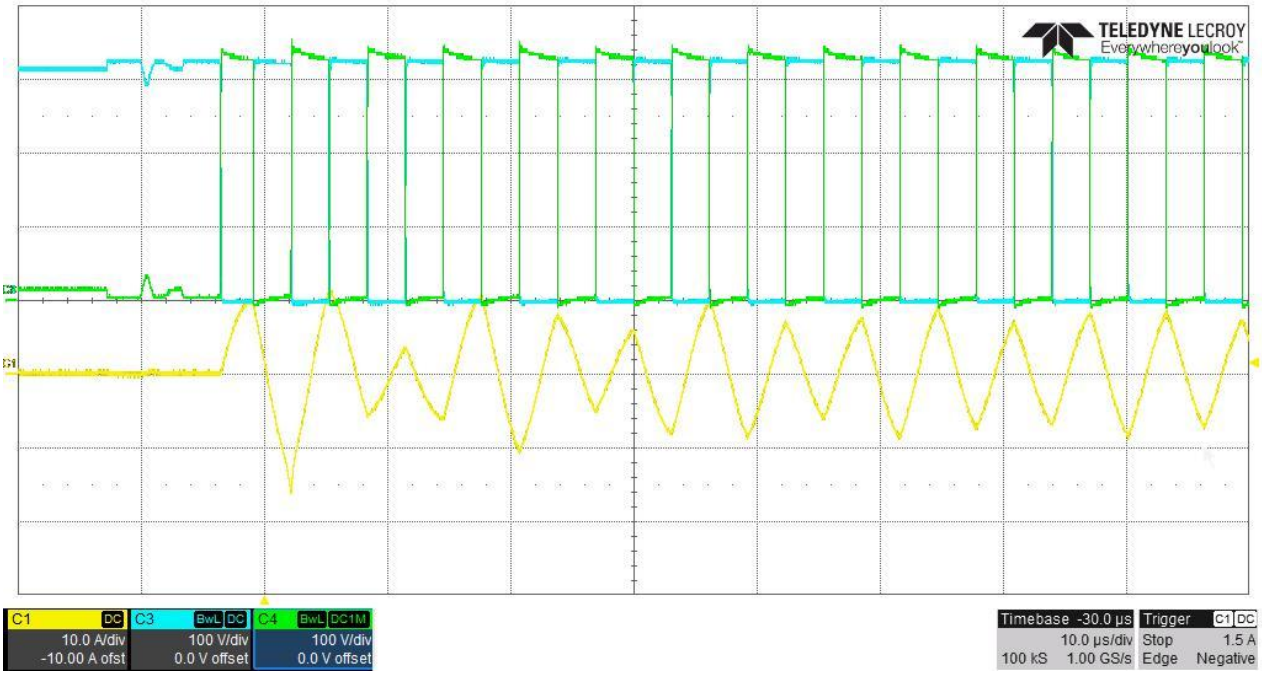
10.2 Q503, Q504, and C519 @ 24V/17A startup transient (120V_{AC}/60Hz)

CH1: I(C519), CH3: V_{DS}(Q503), and CH4: V_{DS}(Q504).



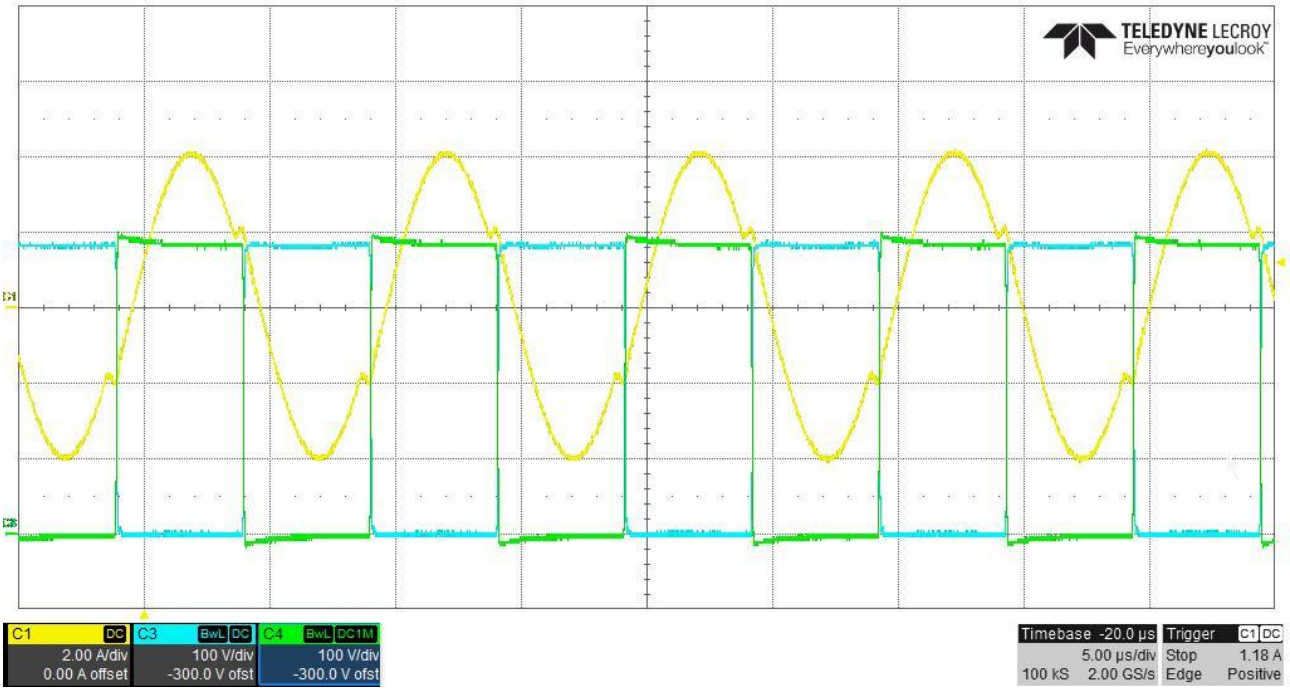
10.3 Q503, Q504, and C519 @ 24V/17A startup transient (230V_{AC}/50Hz)

CH1: I(C519), CH3: V_{DS}(Q503), and CH4: V_{DS}(Q504).



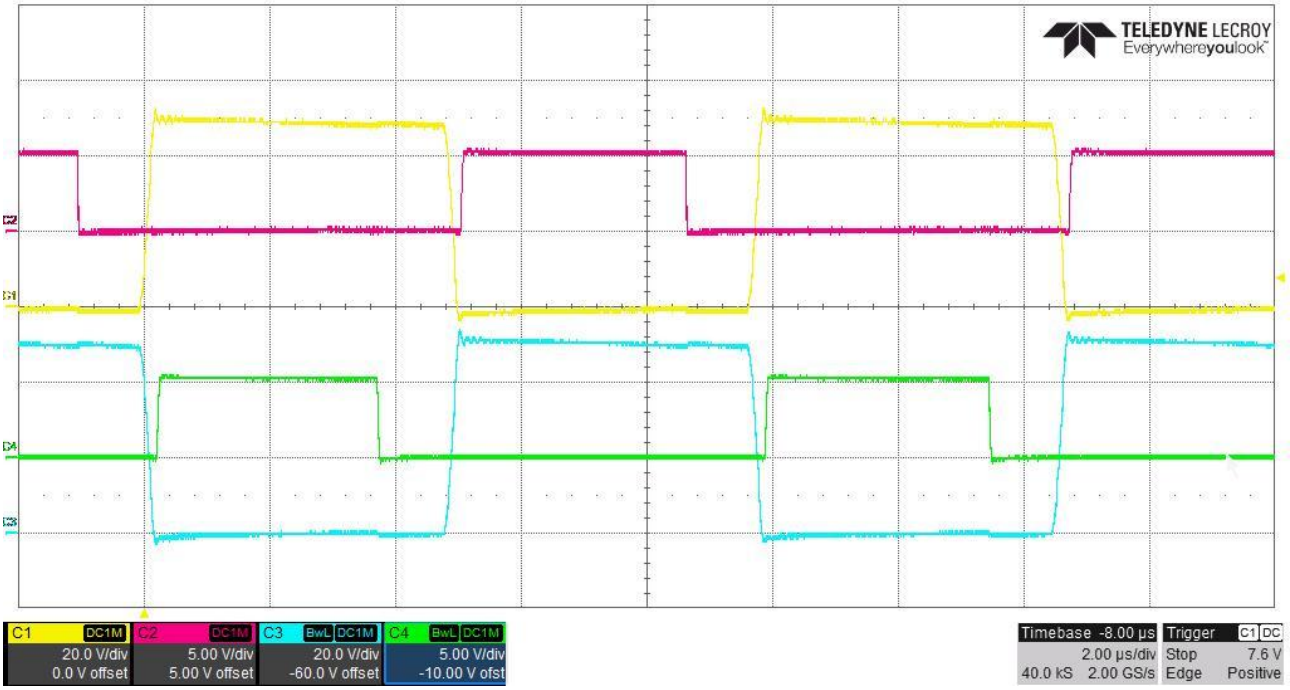
10.4 Q503, Q504, and C519 @ 24V/17A normal operation

CH1: I(C519), CH3: V_{DS}(Q503), and CH4: V_{DS}(Q504).



10.5 Q502, Q505 @ 24V/17A normal operation

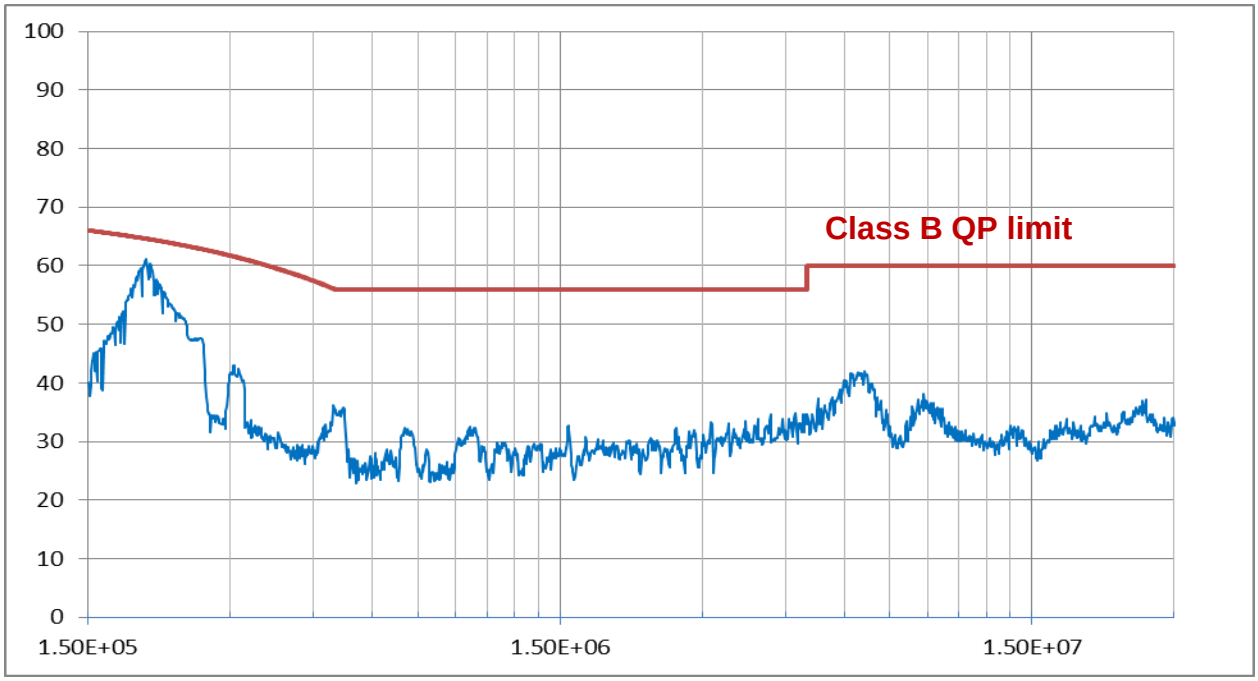
CH1: V_{DS}(Q502), CH2: V_{GS}(Q502), CH3: V_{DS}(Q505), CH4: V_{GS}(Q505)



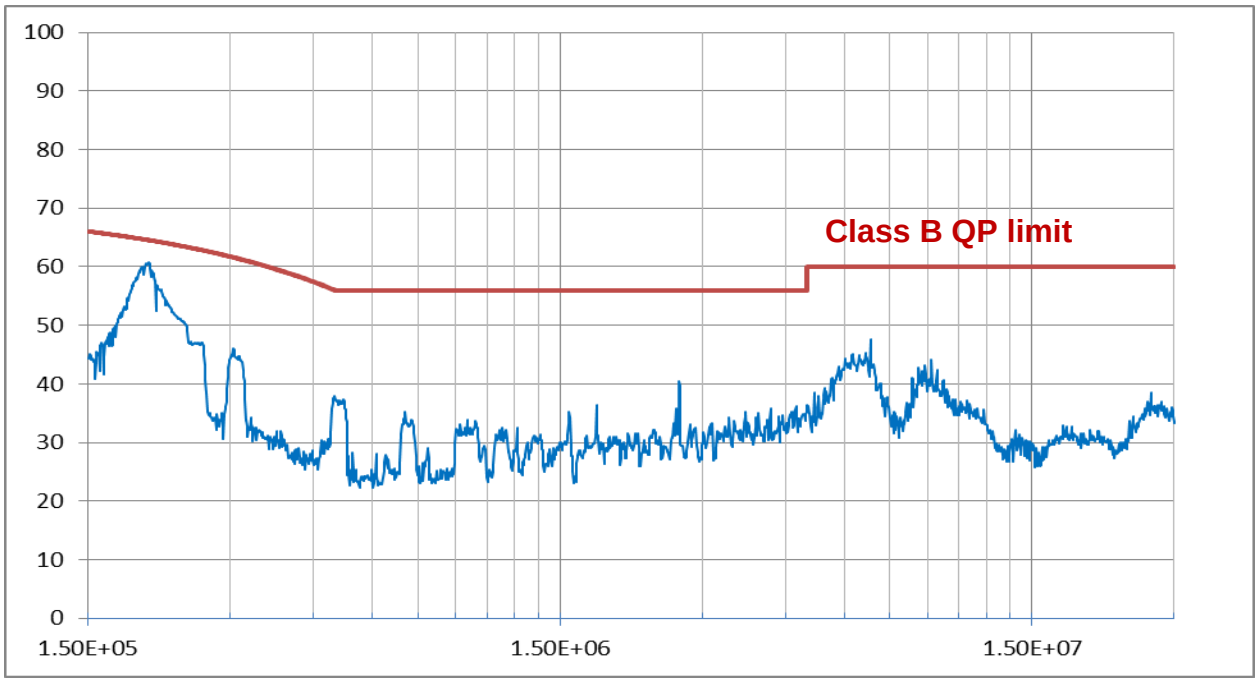
11 Conducted EMI:

The following curves show the scan results using **peak detector** with **maximum hold**. 24V Output is loaded with 15.5A.

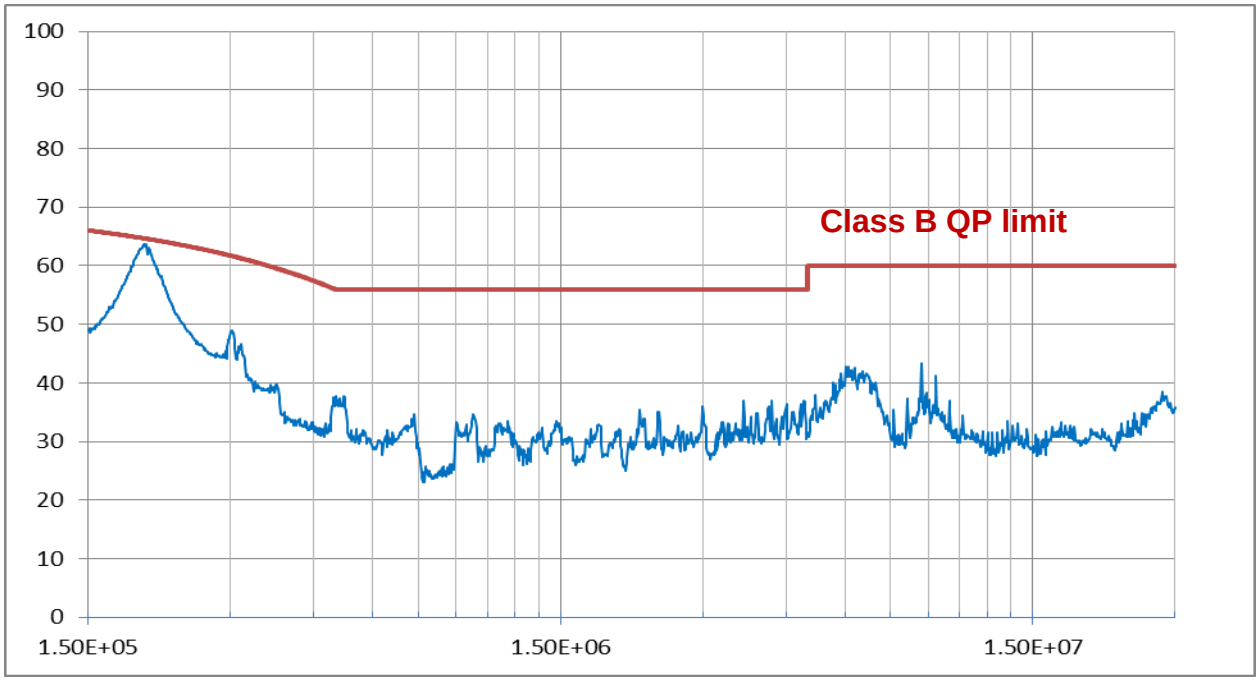
11.1 120V_{AC}/60Hz, I_{in}=3.34A: Line



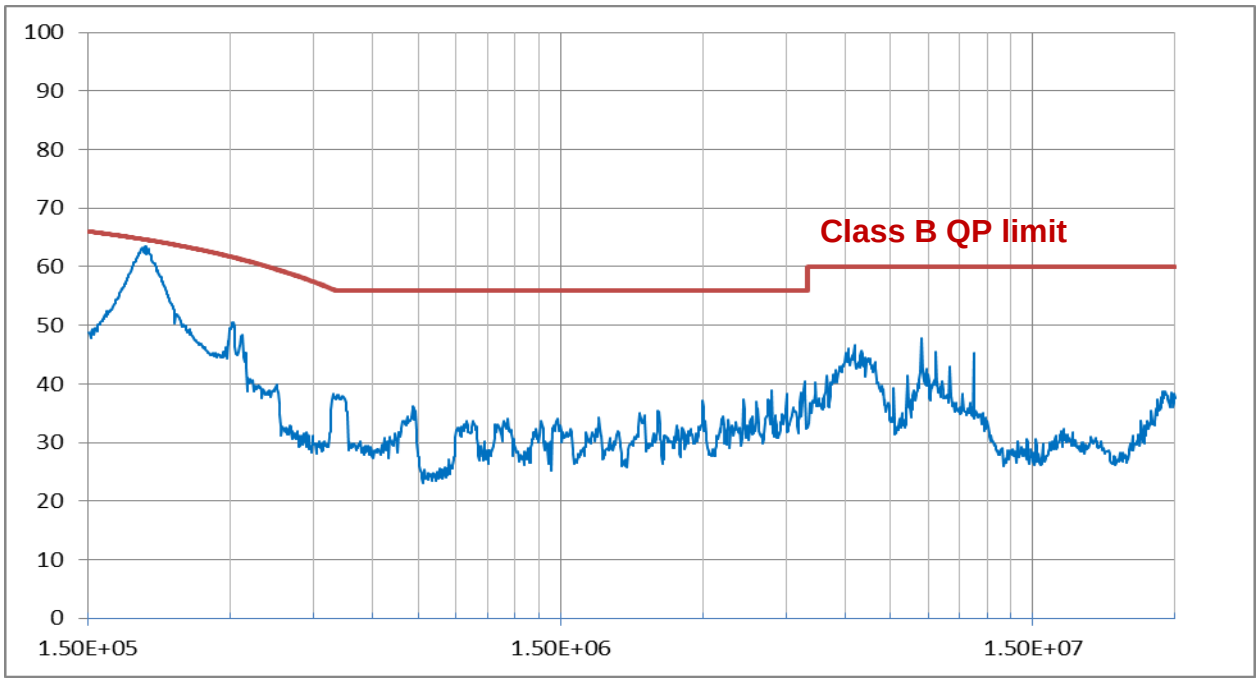
11.2 120V_{AC}/60Hz, I_{in}=3.34A: Neutral



11.3 230V_{AC}/50Hz, I_{in}=1.73A: Line



11.4 230V_{AC}/50Hz, I_{in}=1.73A: Neutral



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