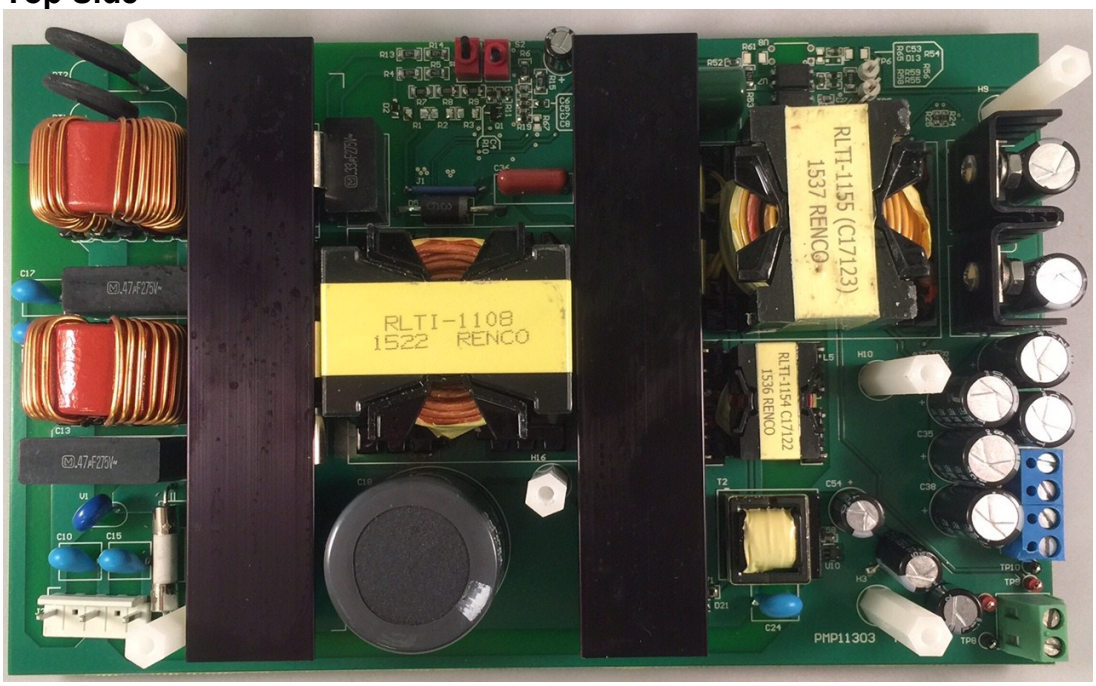
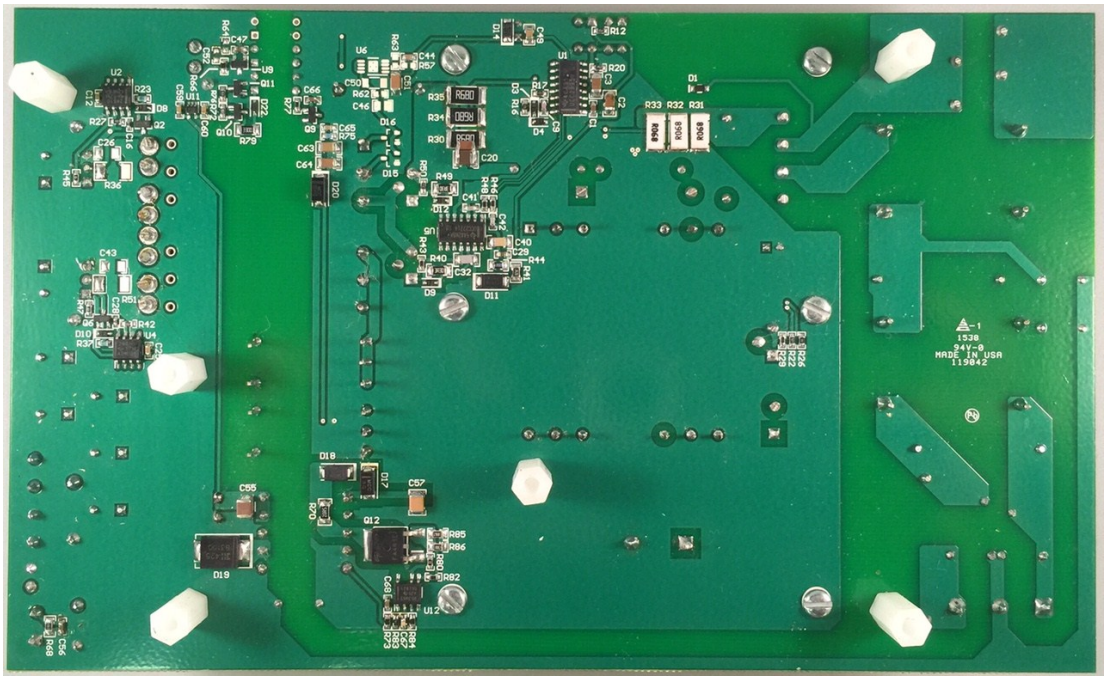
1 Photo

The photographs below show the top and bottom views of the PMP11303 Rev A board, which is built on PMP11303 Rev A PCB.

Top Side



Bottom Side

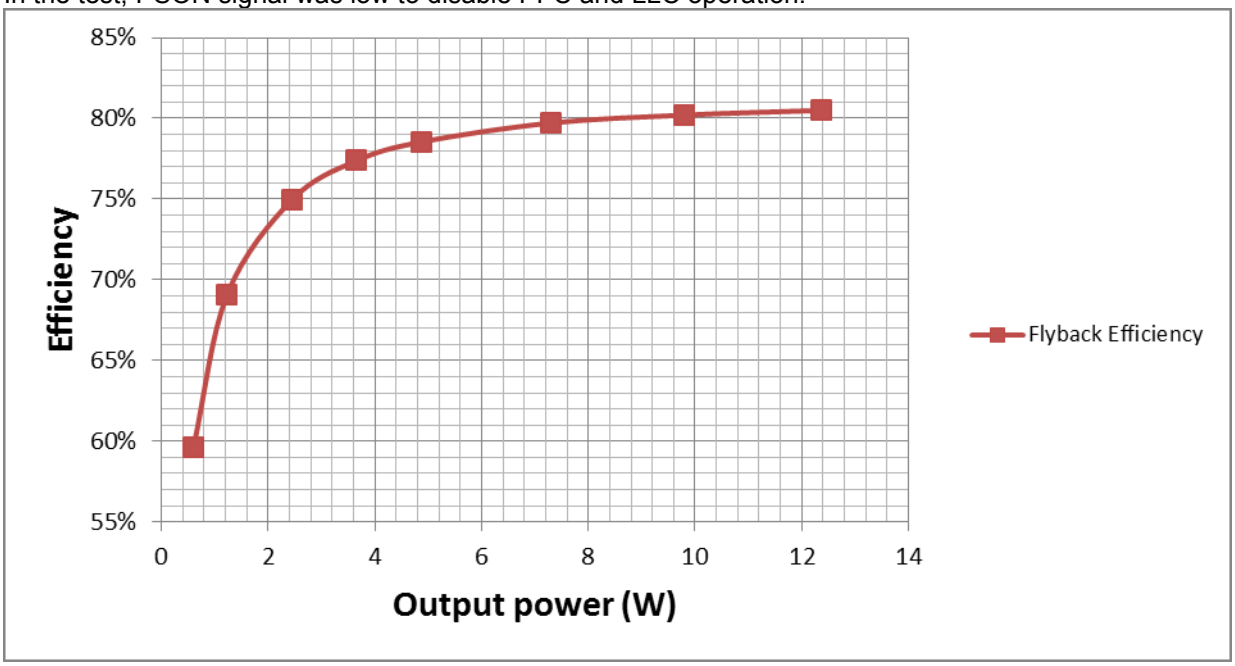


2 Efficiency and Power Factor

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

2.1 Standby mode Efficiency: Flyback Converter

In the test, PSON signal was low to disable PFC and LLC operation.



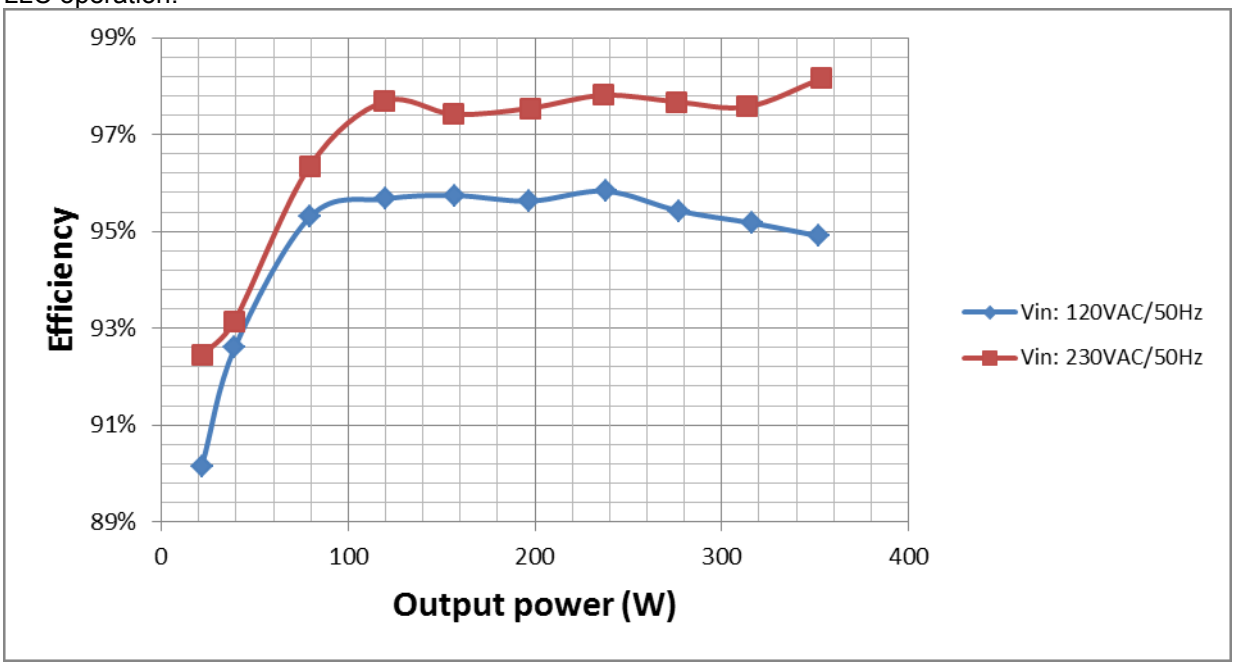
265VAC/50Hz

Vin(AC)	Iin(A)	Pin(W)	PF	12V(V)	12V(A)	Pout(W)	Losses(W)	Eff. (%)
265.0	0.148	15.35	0.392	12.244	1.009	12.359	2.994	80.50%
265.0	0.128	12.21	0.360	12.166	0.805	9.790	2.416	80.21%
265.0	0.109	9.16	0.317	12.098	0.603	7.300	1.857	79.72%
265.1	0.092	6.20	0.254	12.033	0.404	4.866	1.330	78.54%
265.1	0.084	4.72	0.211	11.994	0.305	3.655	1.068	77.38%
265.1	0.078	3.27	0.158	11.964	0.205	2.453	0.818	74.98%
265.1	0.074	1.78	0.091	11.950	0.103	1.232	0.551	69.10%
265.1	0.072	1.00	0.053	11.955	0.050	0.598	0.405	59.60%
265.1	0.071	0.18	0.000	11.991	0.000	0.000	0.180	0.00%

No load power comsumption at 230VAC/50Hz: 152mW

2.2 *Active mode Efficiency: PFC*

In the test, PSON signal was high; S1 is turned on after AC voltage applied to PMP11303 board to disable LLC operation.



120VAC/60Hz (Active mode Efficiency: PFC)

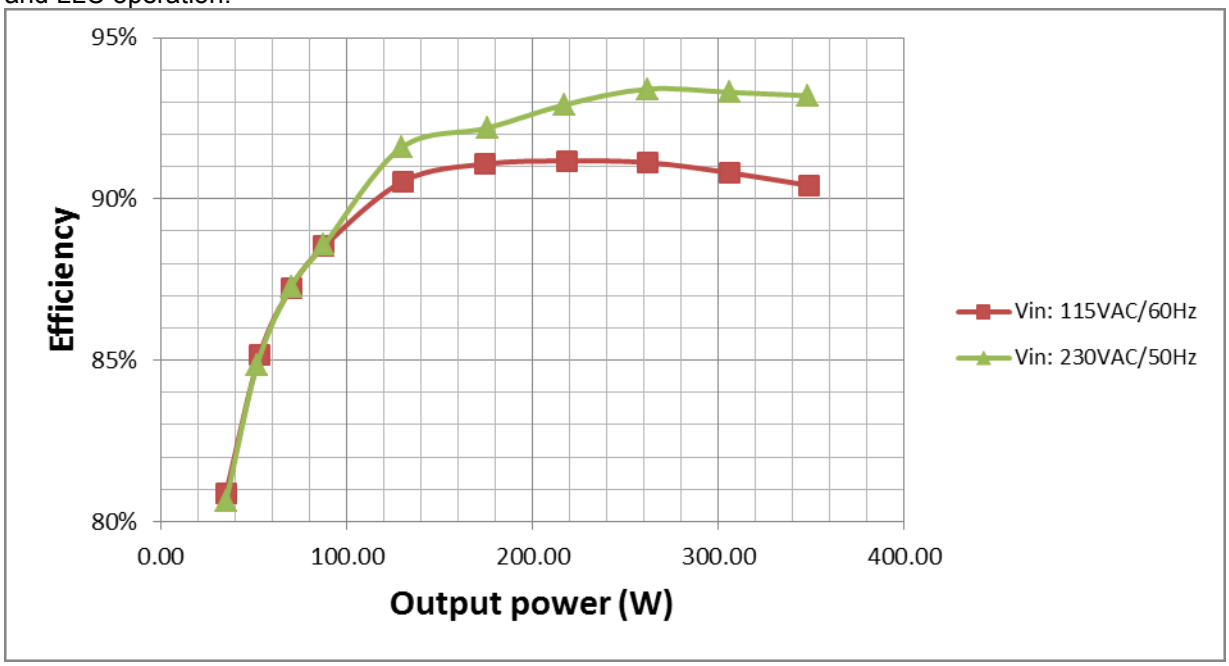
Vin(AC)	Iin(A)	Pin(W)	PF	PFC_out(V)	PFC_out(A)	Pout(W)	Losses(W)	Eff. (%)
119.9	3.096	370.80	0.999	391.71	0.898	351.912	18.888	94.91%
120.1	2.771	332.40	0.999	391.47	0.808	316.347	16.053	95.17%
120.0	2.420	290.10	0.999	391.94	0.706	276.827	13.273	95.42%
120.0	2.071	248.10	0.998	393.18	0.605	237.756	10.344	95.83%
120.0	1.722	206.20	0.998	391.70	0.503	197.182	9.018	95.63%
120.1	1.373	164.32	0.996	391.74	0.402	157.323	6.997	95.74%
120.0	1.051	125.21	0.993	392.37	0.305	119.791	5.419	95.67%
120.0	0.710	83.79	0.983	391.87	0.204	79.863	3.927	95.31%
119.8	0.367	42.35	0.964	392.15	0.100	39.215	3.135	92.60%
120.5	0.207	24.03	0.962	391.77	0.055	21.665	2.365	90.16%

230VAC/50Hz (Active mode Efficiency: PFC)

Vin(AC)	Iin(A)	Pin(W)	PF	PFC_out(V)	PFC_out(A)	Pout(W)	Losses(W)	Eff. (%)
230.1	1.579	360.00	0.991	393.32	0.898	353.359	6.641	98.16%
230.0	1.414	321.50	0.988	391.05	0.802	313.700	7.800	97.57%
230.0	1.248	282.60	0.985	391.20	0.706	276.031	6.569	97.68%
230.0	1.074	242.10	0.98	392.19	0.604	236.804	5.296	97.81%
230.0	0.903	202.20	0.974	391.80	0.503	197.232	4.968	97.54%
230.1	0.722	160.87	0.968	391.79	0.400	156.716	4.154	97.42%
229.9	0.551	122.23	0.964	393.02	0.304	119.399	2.831	97.68%
230.4	0.380	82.36	0.941	392.44	0.202	79.351	3.009	96.35%
229.9	0.201	41.73	0.903	392.20	0.099	38.867	2.863	93.14%
230.2	0.131	23.72	0.789	392.32	0.056	21.931	1.789	92.46%

2.3 Active mode Efficiency: Total (PFC+LLC+Flyback)

In the test, PSON signal was high; S2 is turned on after 12V_{OUT} raised to PMP11303 board to enable PFC and LLC operation.



115VAC/60Hz

Vin(AC)	Iin(A)	Pin(W)	PF	12V(V)	12V(A)	25V(V)	25V(A)	Pout(W)	Eff. (%)
115.11	3.351	385.70	1.000	12.19	1.003	24.930	13.499	348.75	90.42%
115.03	2.928	336.70	1.000	12.14	0.877	24.930	11.838	305.77	90.81%
115.01	2.496	287.10	1.000	12.09	0.753	24.938	10.126	261.63	91.13%
114.88	2.083	239.30	1.000	12.05	0.633	24.938	8.443	218.19	91.18%
115.10	1.664	191.43	0.999	12.00	0.503	24.938	6.750	174.36	91.08%
115.11	1.252	143.88	0.998	11.96	0.378	24.945	5.042	130.28	90.55%
115.04	0.865	99.00	0.995	11.91	0.253	24.945	3.393	87.65	88.53%
115.08	0.702	80.09	0.992	11.90	0.203	24.938	2.705	69.87	87.24%
115.02	0.547	62.05	0.986	11.88	0.153	24.961	2.044	52.84	85.16%
114.89	0.382	42.98	0.980	11.81	0.102	24.938	1.346	34.76	80.88%
115.04	0.063	4.97	0.688	12.27	0.000	24.938	0.000	0.00	0.00%

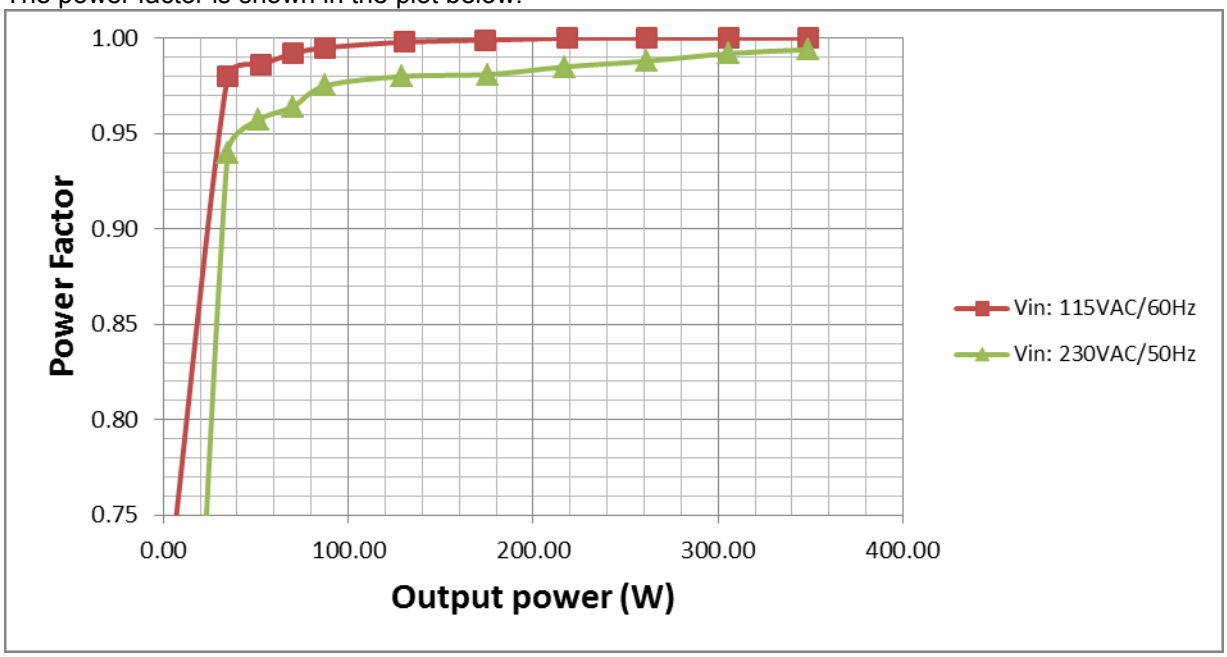
230VAC/50Hz

Vin(AC)	Iin(A)	Pin(W)	PF	12V(V)	12V(A)	25V(V)	25V(A)	Pout(W)	Eff. (%)
229.90	1.637	373.90	0.994	12.18	1.003	24.93	13.488	348.47	93.20%
229.90	1.438	327.80	0.992	12.13	0.877	24.938	11.838	305.86	93.31%
230.10	1.232	280.10	0.988	12.09	0.763	24.938	10.121	261.63	93.41%
230.00	1.030	233.40	0.985	12.05	0.633	24.938	8.390	216.86	92.91%
229.90	0.844	190.28	0.981	12.00	0.503	24.938	6.793	175.43	92.20%
229.90	0.626	141.00	0.98	11.96	0.383	24.938	4.994	129.13	91.58%
230.00	0.441	98.94	0.975	11.91	0.254	24.938	3.393	87.64	88.58%
230.00	0.361	80.06	0.964	11.90	0.203	24.945	2.704	69.88	87.28%
230.10	0.276	60.78	0.957	11.88	0.153	24.945	1.995	51.58	84.86%
229.90	0.199	43.08	0.94	11.79	0.102	24.945	1.344	34.73	80.63%
230.00	0.071	4.82	0.296	12.19	0.000	24.969	0.000	0.00	0.00%

115VAC/60Hz			230VAC/50Hz		
PF@ 25% load		0.995	PF@ 50% load		0.981
10% efficiency		80.88%	10% efficiency		80.63%
25% efficiency		**88.53%**	**25% efficiency**		**88.58%**
50% efficiency		**91.08%**	**50% efficiency**		**92.20%**
100% efficiency		**90.42%**	**100% efficiency**		**93.20%**

2.4 Power Factor

The power factor is shown in the plot below.

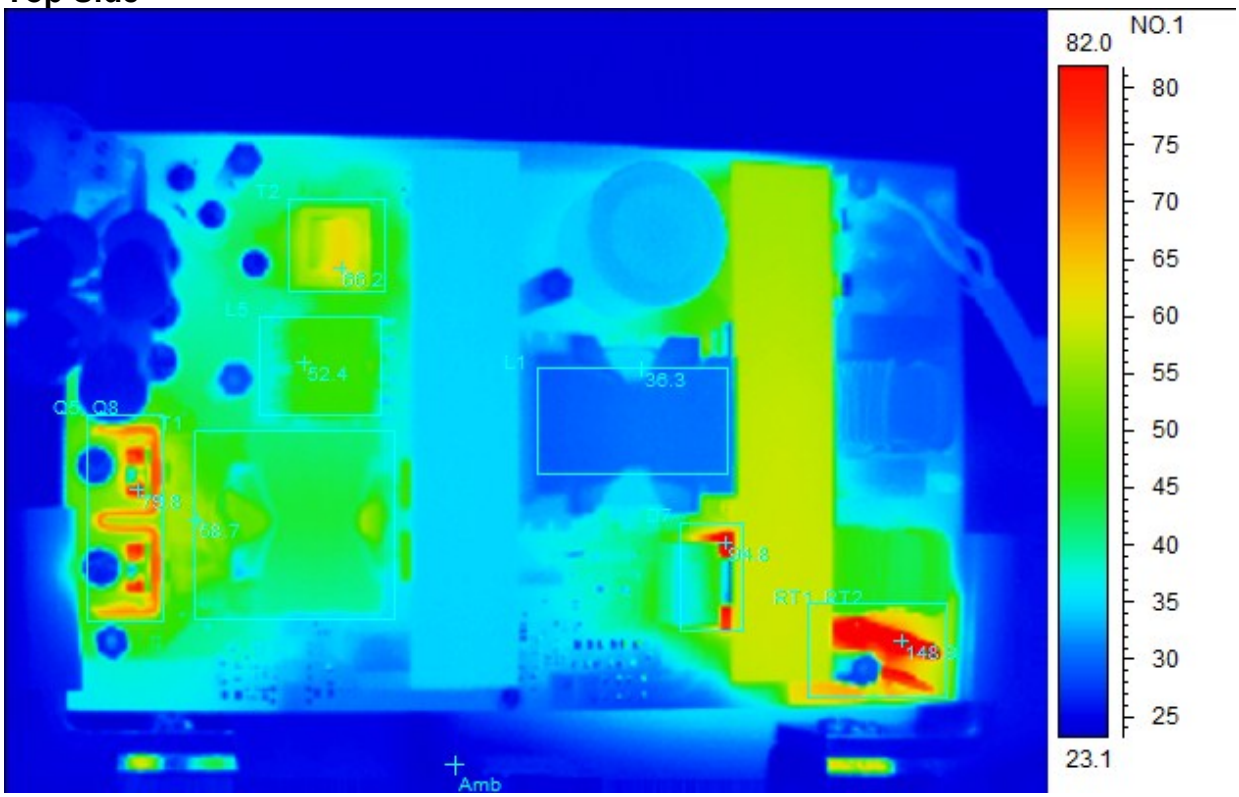


3 Thermal Images

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 25V/13.5A.

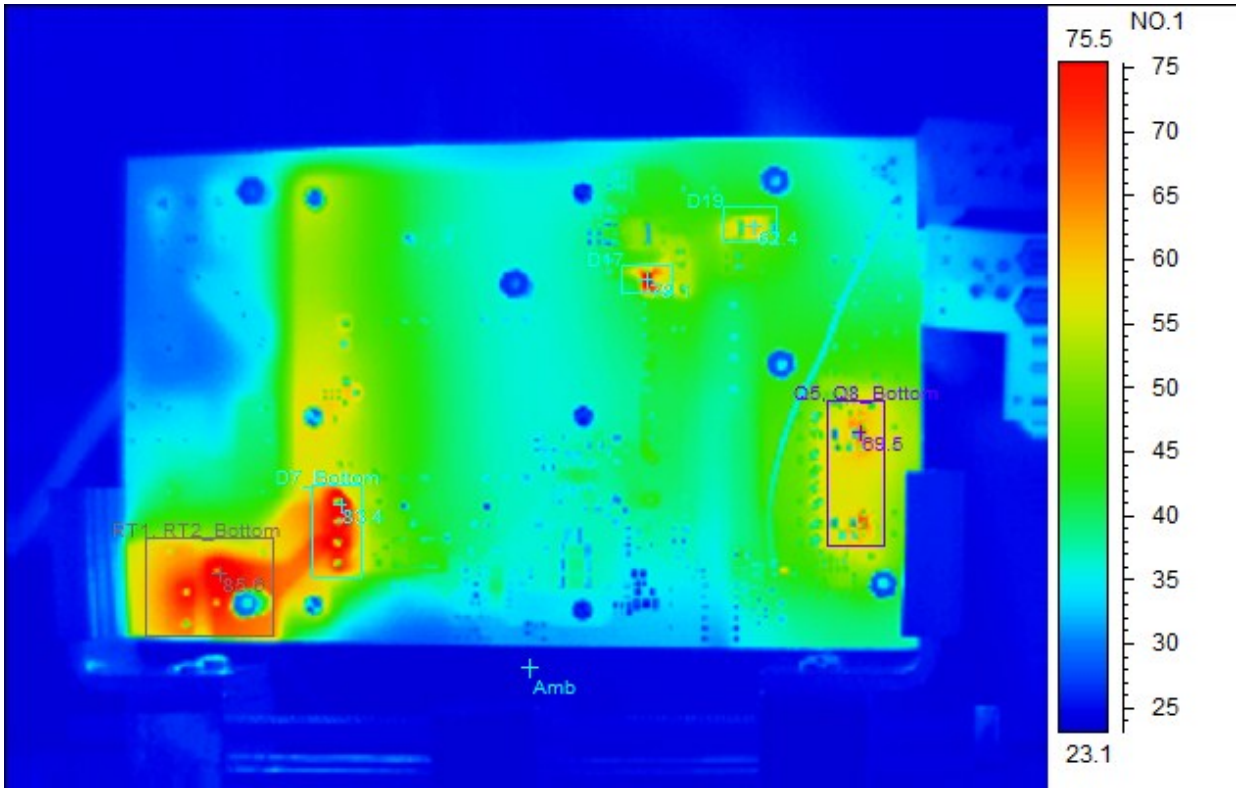
3.1 120V/60Hz

Top Side



Spot analysis	Value
AmbTemperature	23.5°C
Area analysis	**Value**
D7Max	94.8°C
RT1, RT2Max	148.9°C
Q5, Q8Max	79.8°C
T2Max	66.2°C
T1Max	58.7°C
L5Max	52.4°C
L1 Max	36.3°C

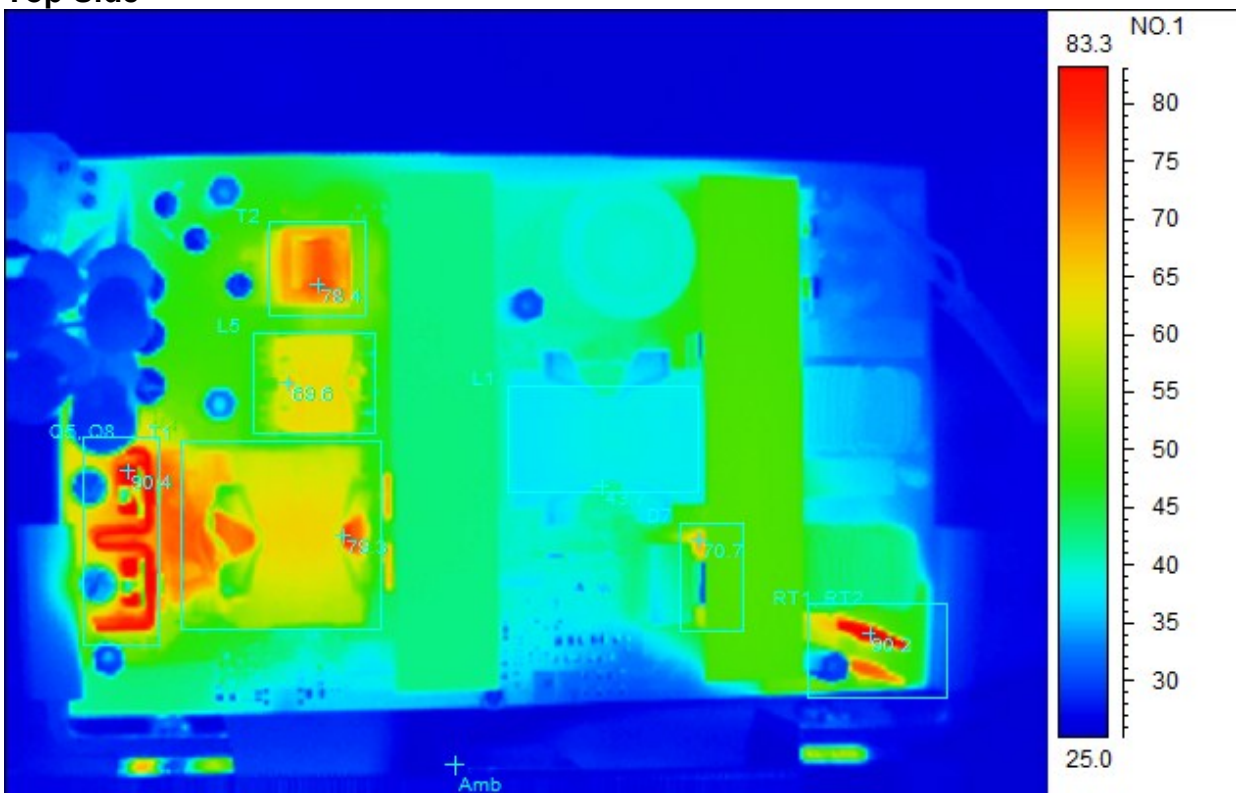
Bottom Side



Spot analysis	Value
Amb Temperature	23.6°C
Area analysis	**Value**
RT1, RT2_BottomMax	85.6°C
D7_BottomMax	83.4°C
D17Max	78.1°C
D19Max	62.4°C
Q5, Q8_BottomMax	69.5°C

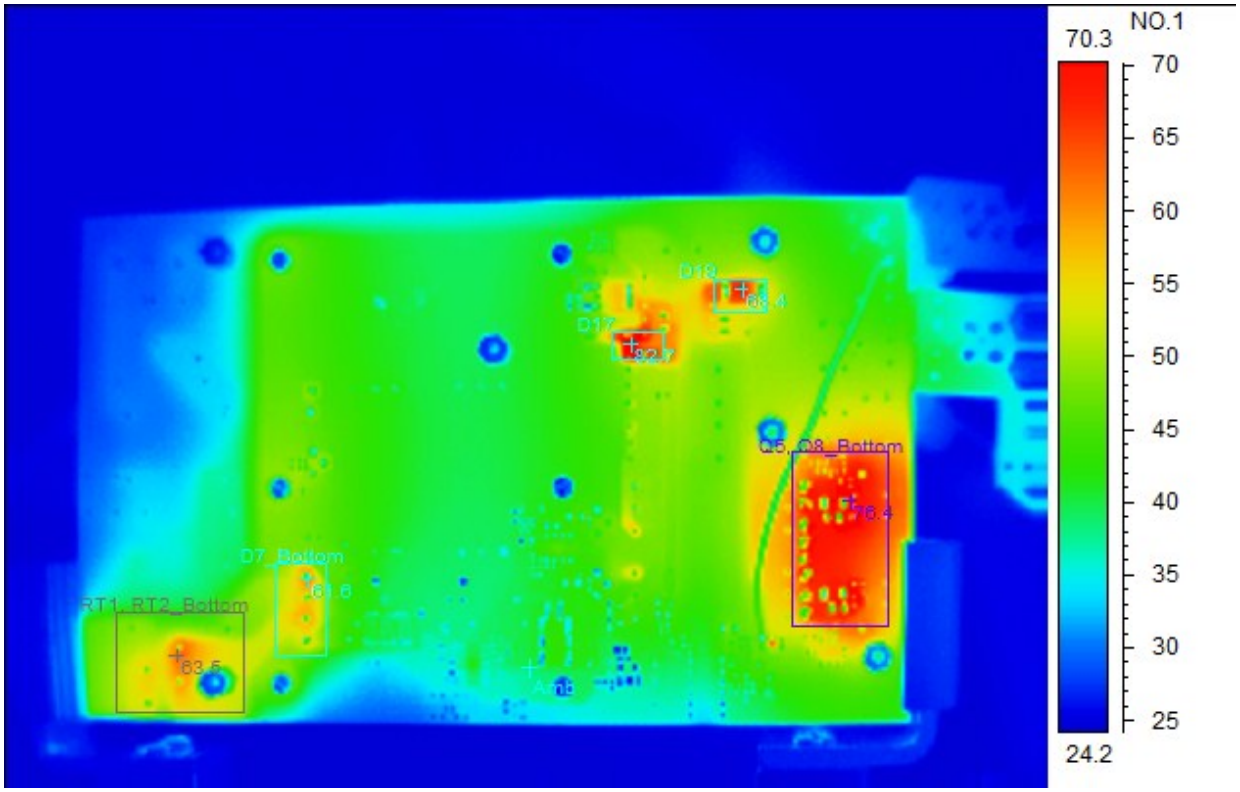
3.2 230V/50Hz

Top Side



Spot analysis	Value
AmbTemperature	25.7°C
Area analysis	**Value**
D7Max	70.7°C
RT1, RT2Max	90.2°C
Q5, Q8Max	90.4°C
T2Max	78.4°C
T1Max	79.3°C
L5Max	69.6°C
L1 Max	43.7°C

Bottom Side



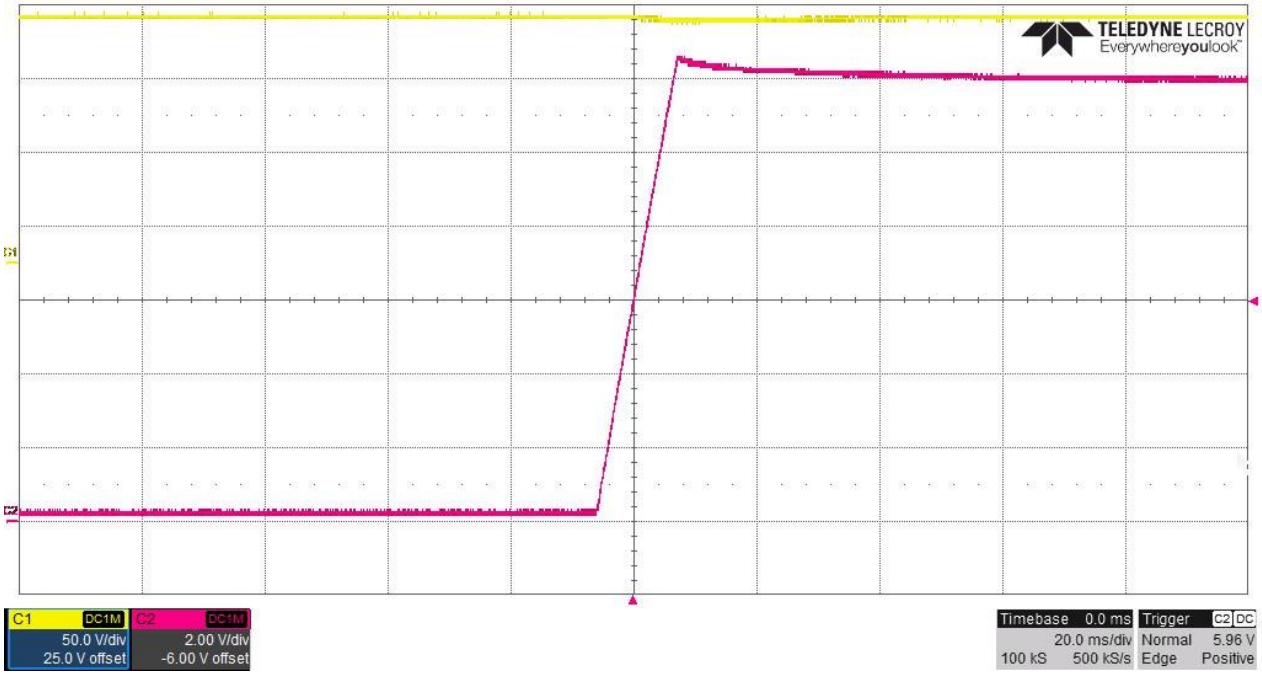
Spot analysis	Value
Amb Temperature	40.3°C
Area analysis	**Value**
RT1, RT2_BottomMax	63.5°C
D7_BottomMax	61.6°C
D17Max	82.7°C
D19Max	68.4°C
Q5, Q8_BottomMax	76.4°C

4 Startup

The voltages at startup are shown in the images below.

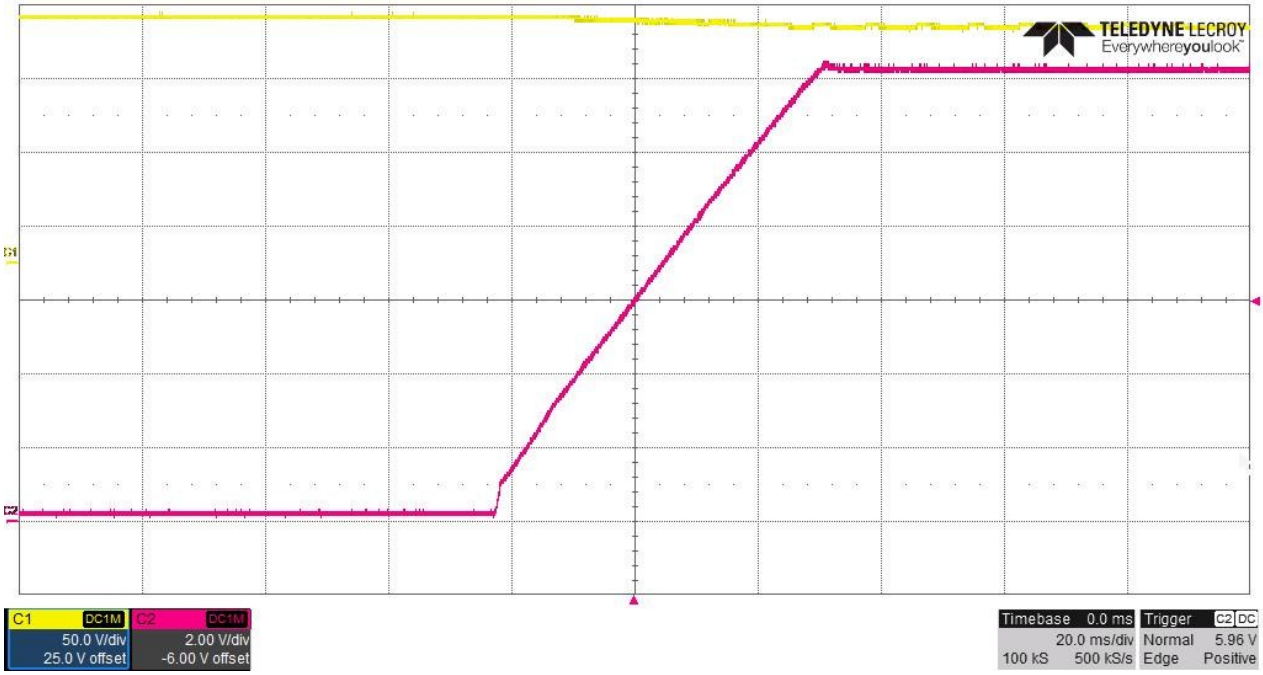
4.1 120VAC/60Hz – Standby mode (PSON low => 12V/0A)

CH1: V(C18) and CH2: $12V_{out}$.



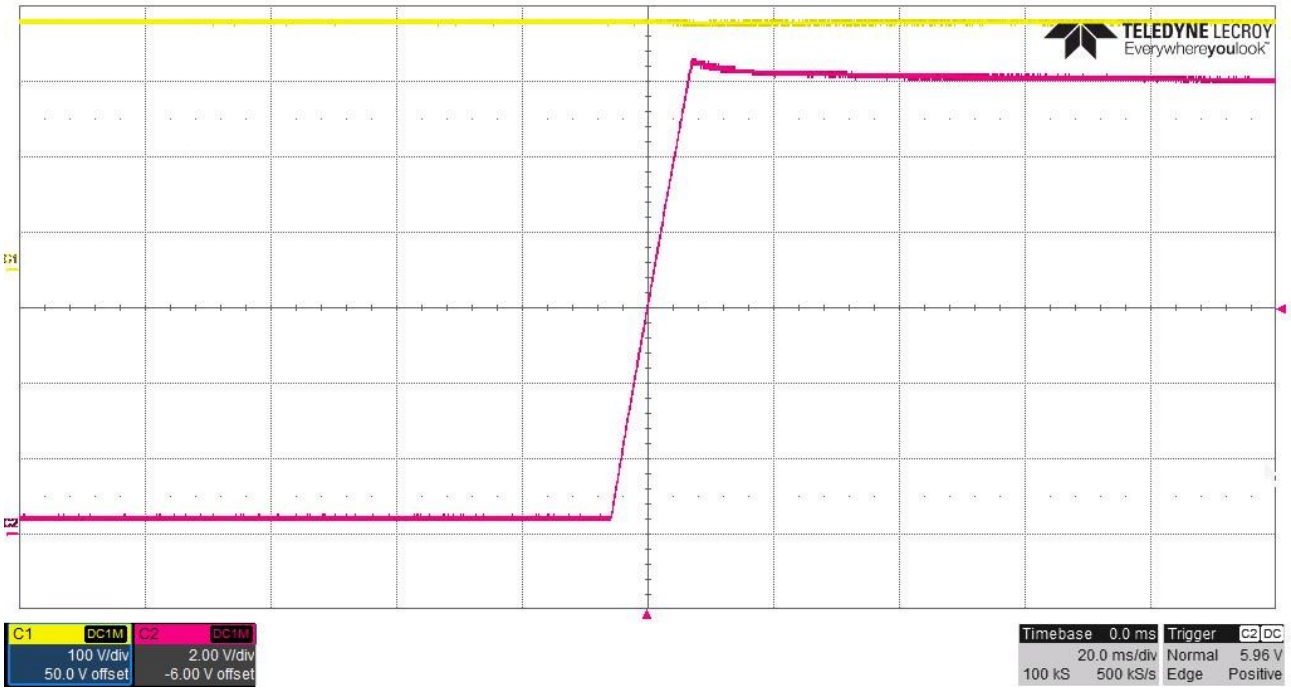
4.2 120VAC/60Hz – Standby mode (PSON low => 12V/1A)

CH1: V(C18) and CH2: $12V_{out}$.



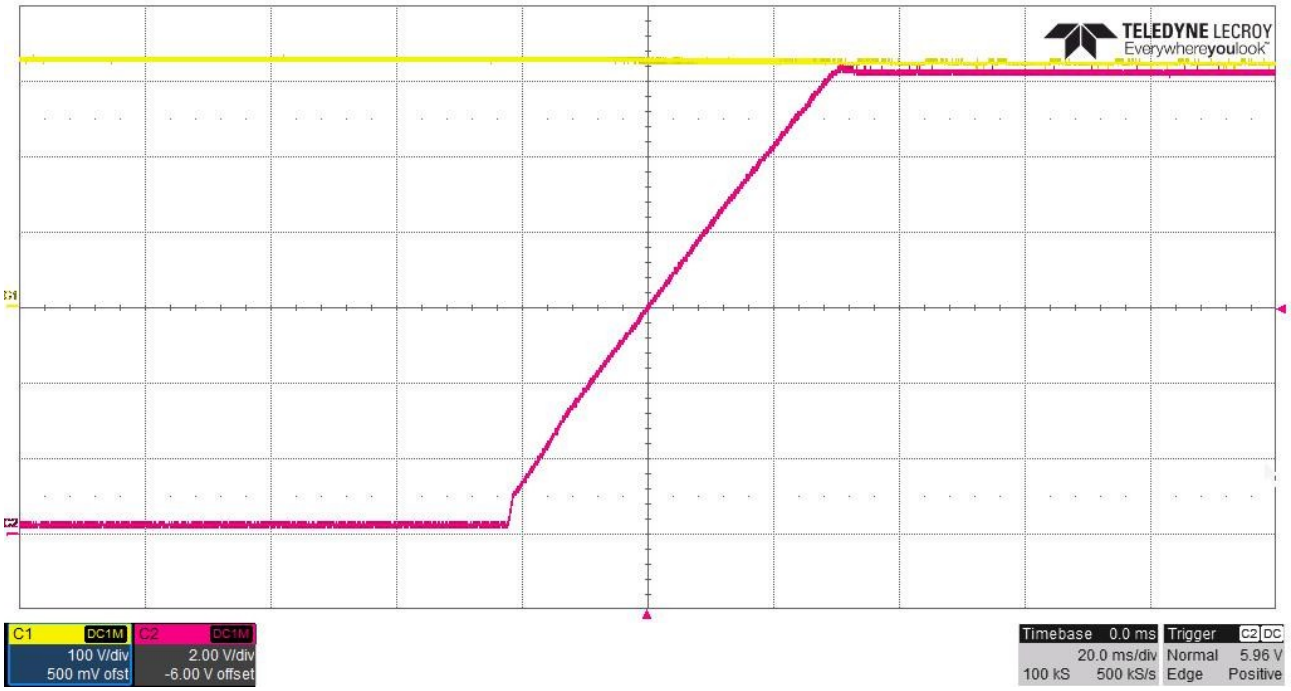
4.3 230VAC/50Hz – Standby mode (PSON low => 12V/0A)

CH1: V(C18) and CH2: $12V_{out}$.



4.4 230VAC/50Hz – Standby mode (PSON low => 12V/1A)

CH1: V(C18) and CH2: $12V_{out}$.

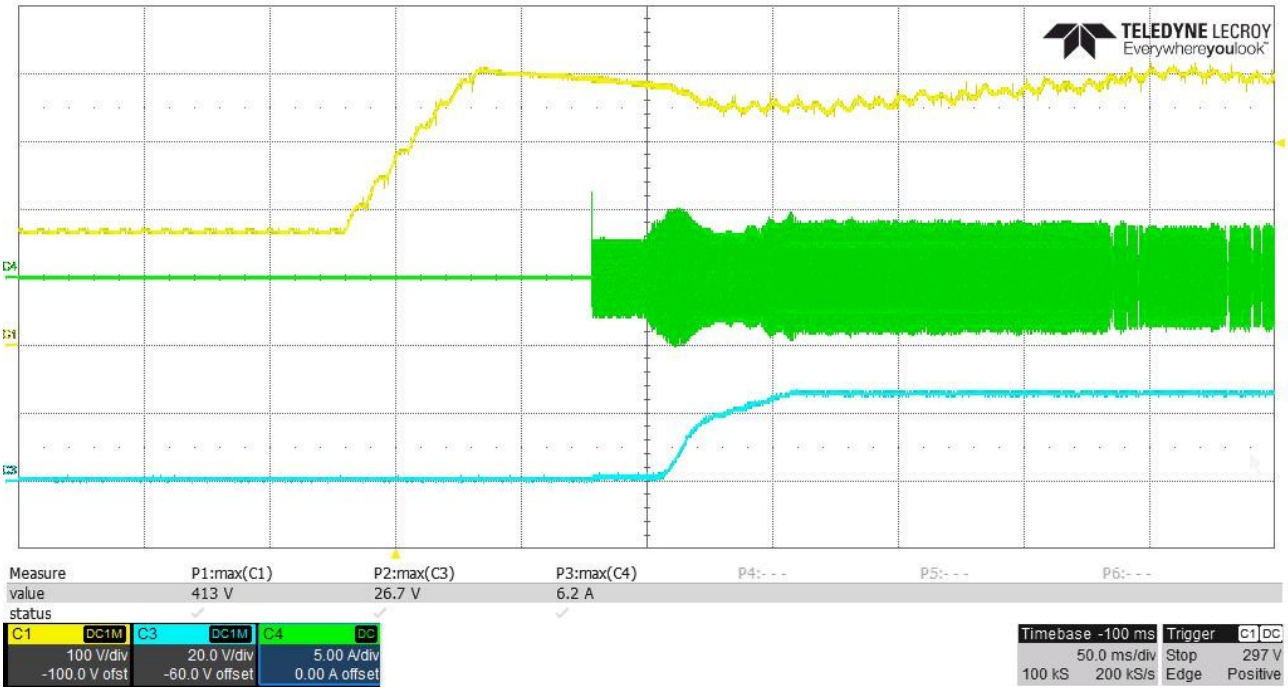


4.5 120VAC/60Hz – No Load (PSON high & S2 On=>25V/0A and 12V/0A at outputs)

CH1: V(C18), CH3: 25V_{out}, and CH4: I(C39).

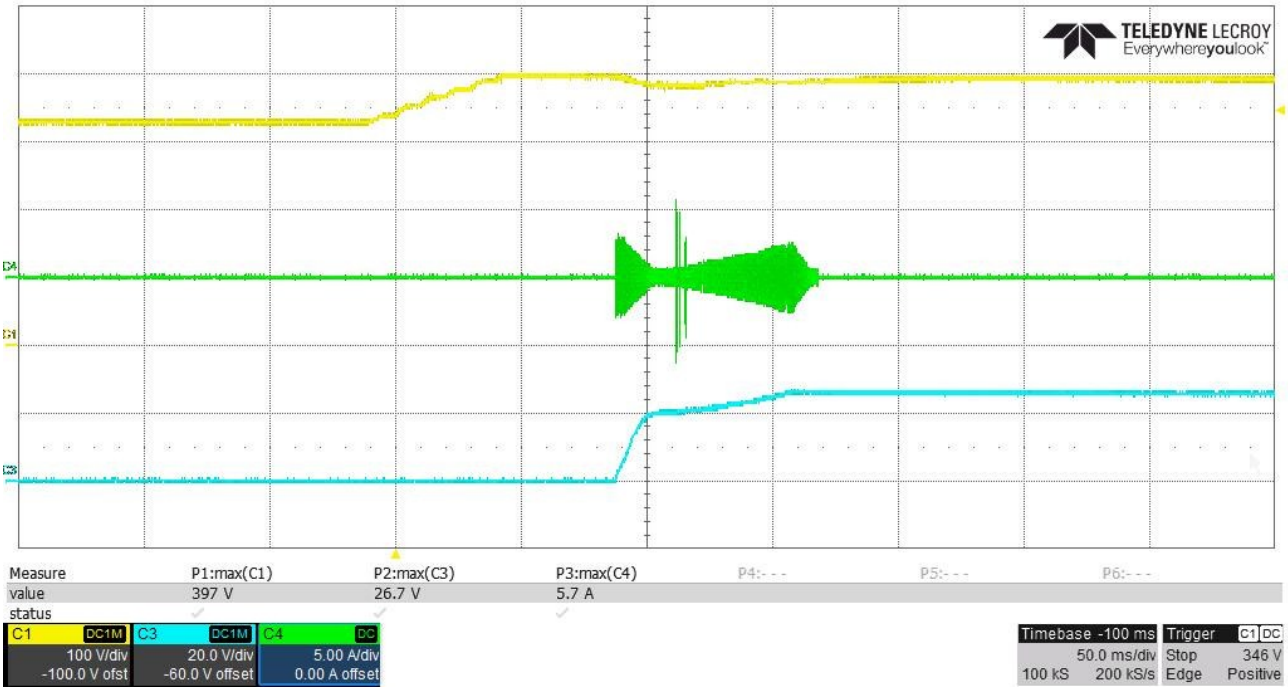
4.6 120VAC/60Hz – Full Load (PSON high & S2 On=>25V/13.5A and 12V/1A at outputs)

CH1: V(C18), CH3: 25V_{out}, and CH4: I(C39).



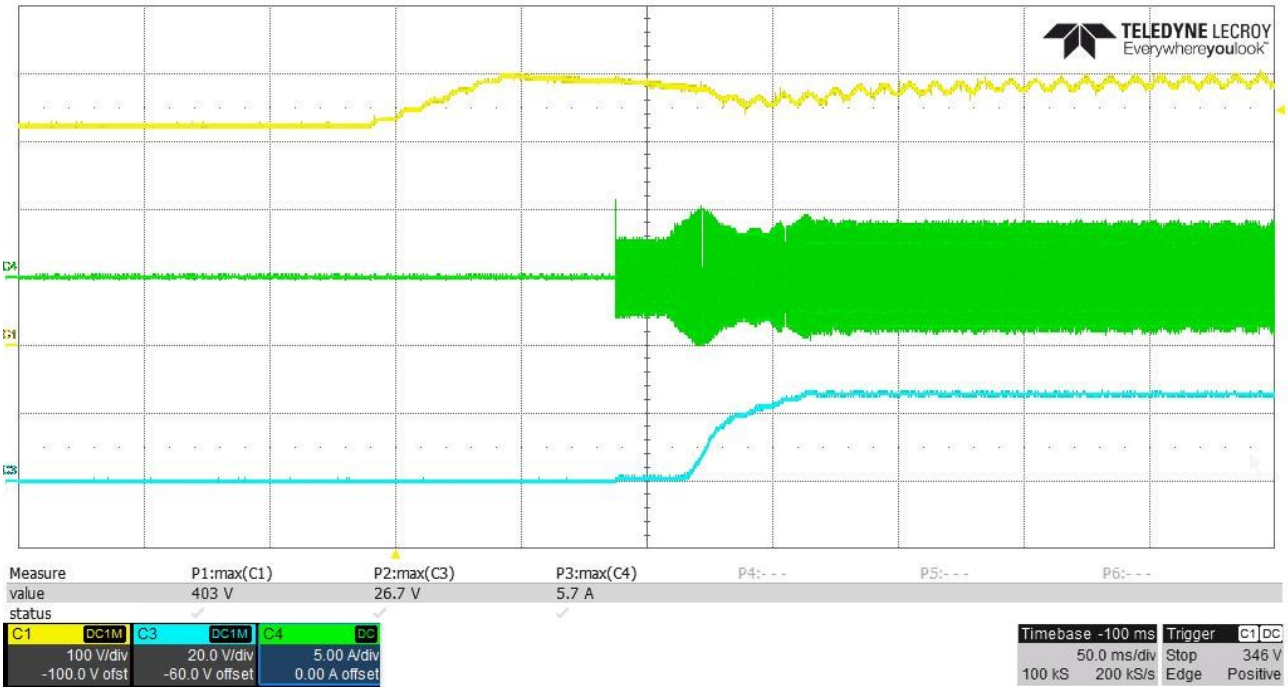
4.7 230VAC/50Hz – No Load (PSON high & S2 On=>25V/0A and 12V/0A at outputs)

CH1: V(C18), CH3: 25V_{out}, and CH4: I(C39).



4.8 230VAC/50Hz – Full Load (PSON high & S2 On=>25V/13.5A and 12V/1A at outputs)

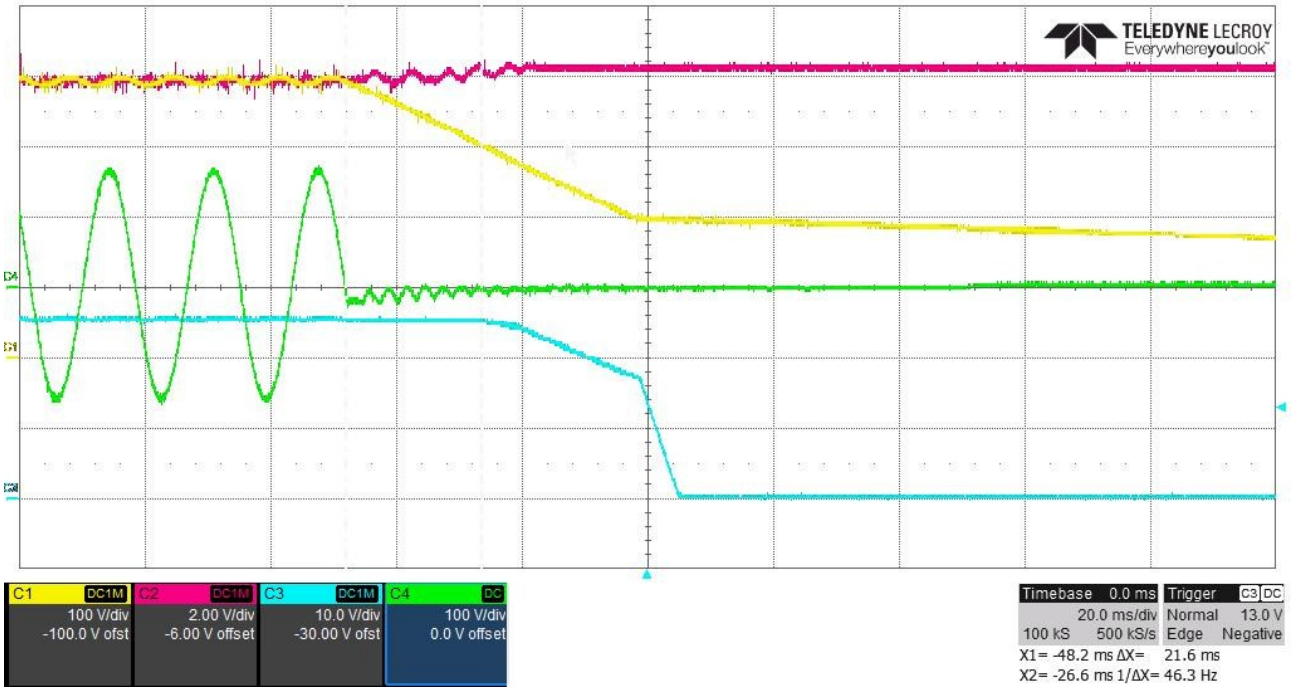
CH1: V(C18), CH3: 25V_{out}, and CH4: I(C39).



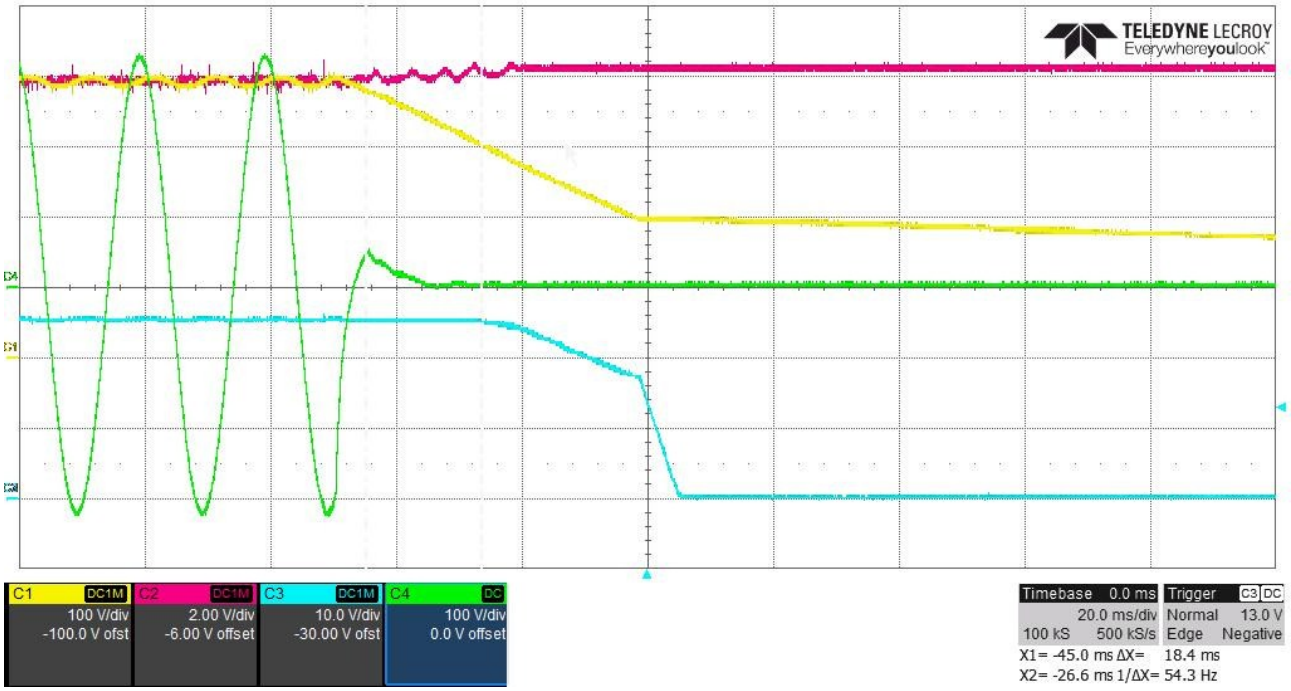
5 Turn-off

The voltages at turn-off are shown in the images below, where CH1 is the voltage across C18, CH2 is $12V_{out}$, CH3 is $25V_{out}$ and CH4 is the input voltage.

5.1 120VAC/60Hz – Full Load (25V/13.5A and 12V/1A at outputs)



5.2 230VAC/50Hz – Full Load (25V/13.5A and 12V/1A at outputs)

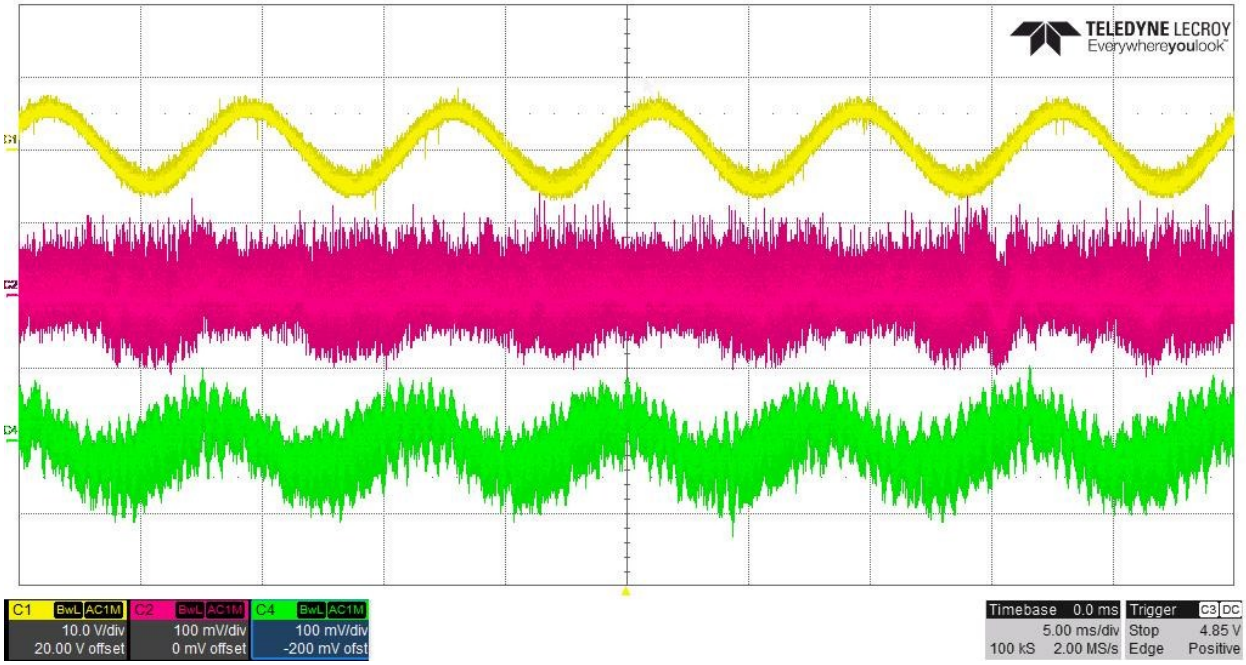


6 Output Ripple Voltage

The output ripple voltage (in AC level) during full load operation (25V/13.5A and 12V/1A at outputs) is shown in the plots below.

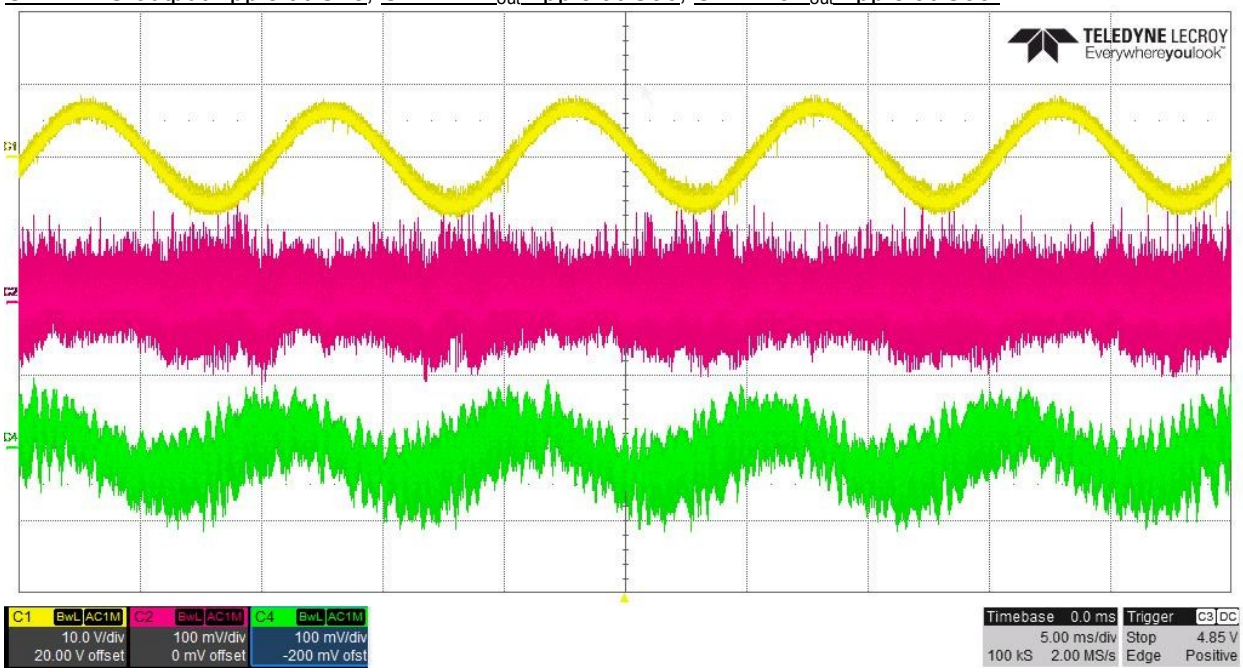
6.1 120VAC/60Hz

CH1: PFC output ripple at C18, CH2: 12V_{out} ripple at C56, CH4: 25V_{out} ripple at C35.



6.2 230VAC/50Hz

CH1: PFC output ripple at C18, CH2: 12V_{out} ripple at C56, CH4: 25V_{out} ripple at C35.

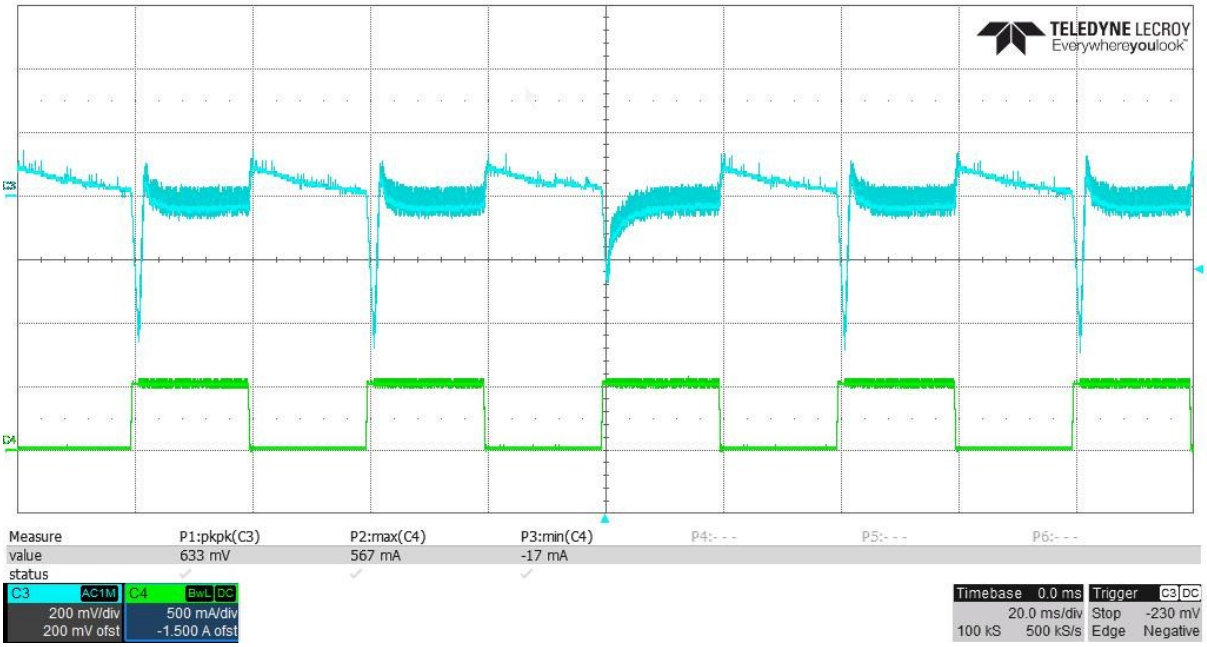


7 Transient Response

Transient responses are shown in the plots below.

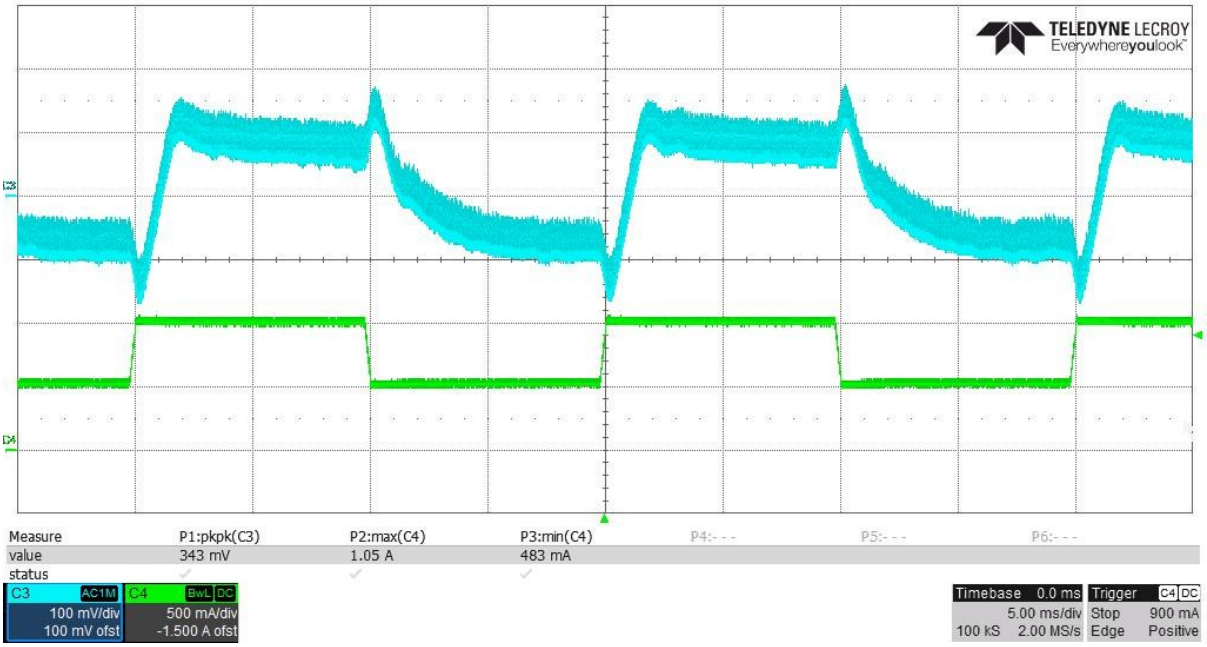
7.1 Standby mode (PSON low), 12V output current changes from 0A to 0.5A@264V_{AC}/50Hz:

CH3: 12V output current, CH4: 12V output voltage ripple

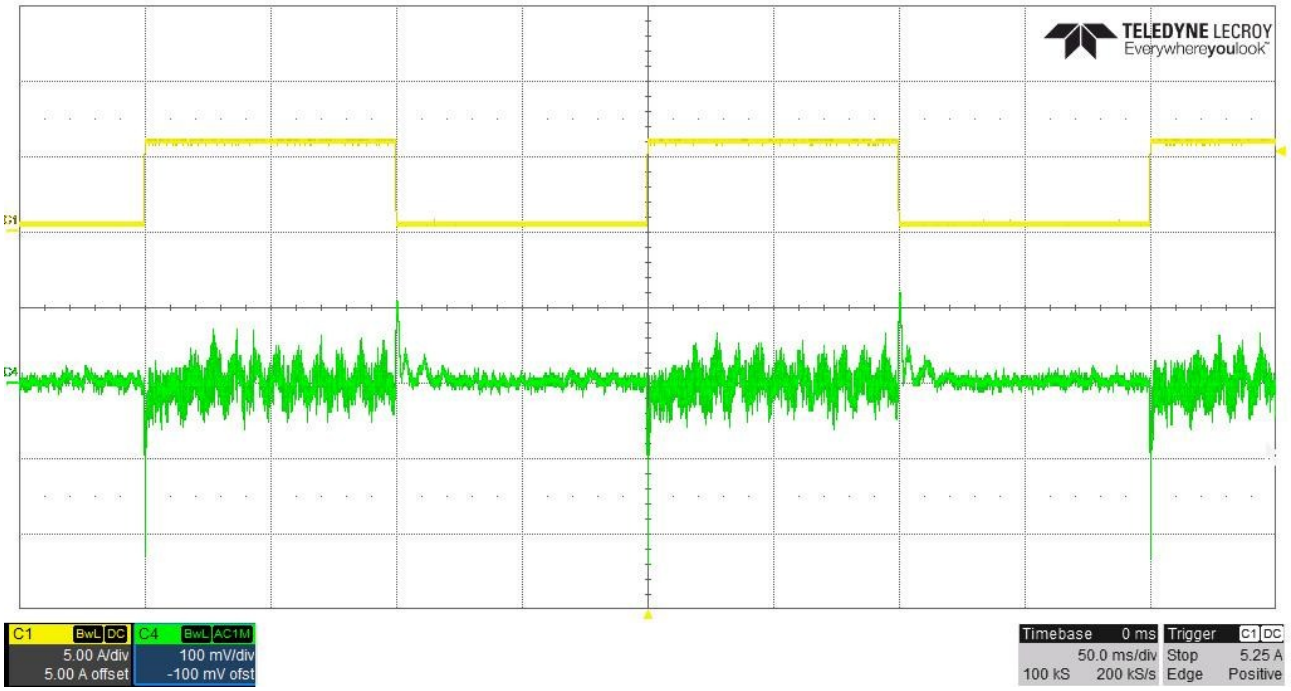


7.2 Standby mode (PSON low), 12V output current changes from 0.5A to 1A@264V_{AC}/50Hz:

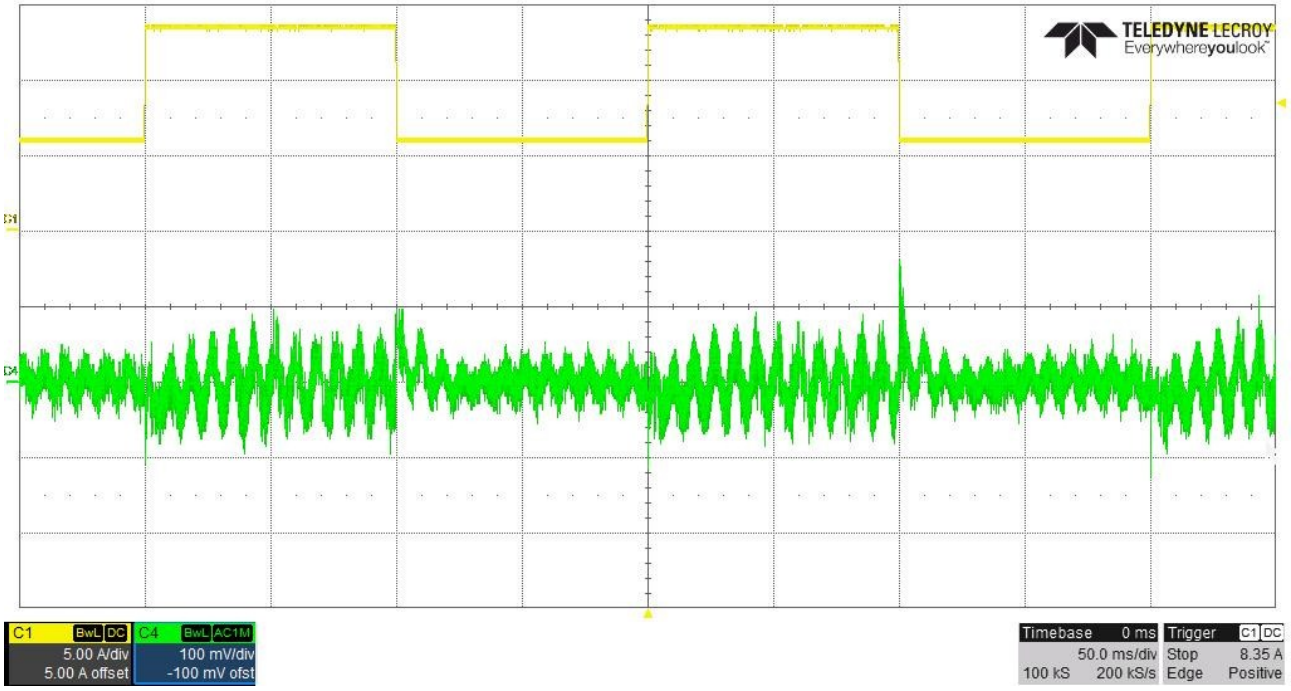
CH3: 12V output current, CH4: 12V output voltage ripple



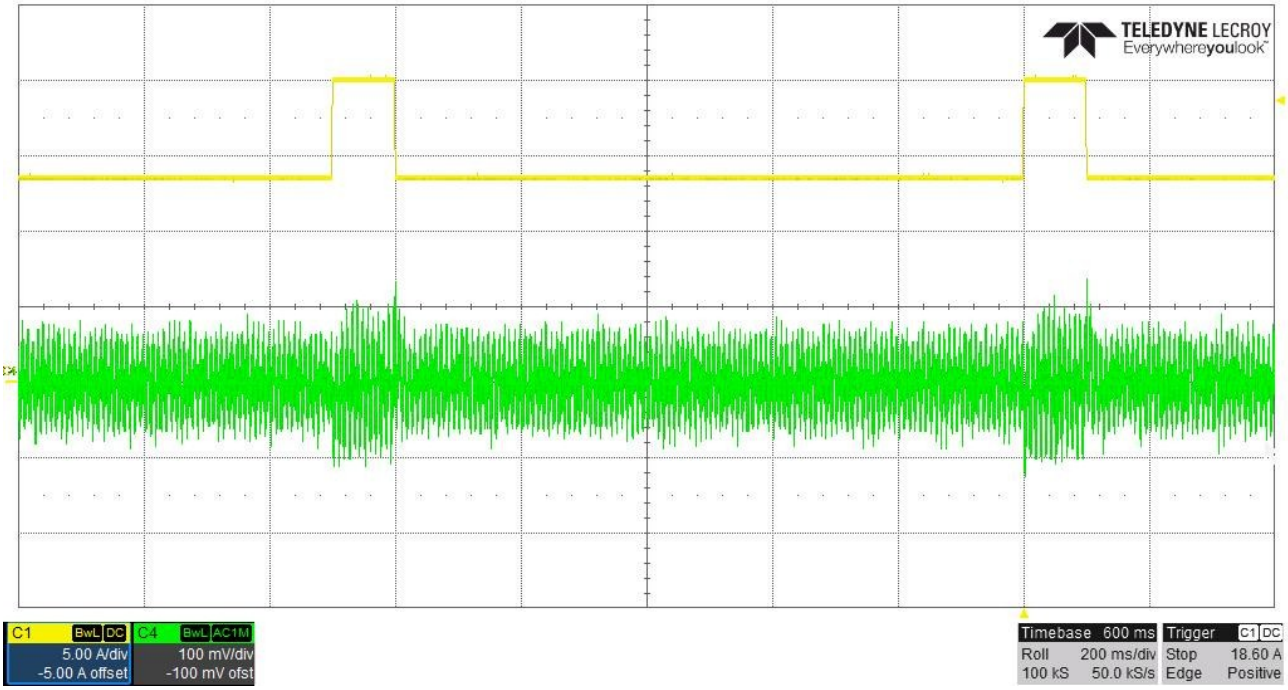
7.3 Active mode (PSON high), 25V output current changes from 0.5A to 6A:



7.4 Active mode (PSON high), 25V output current changes from 6A to 13.5A:

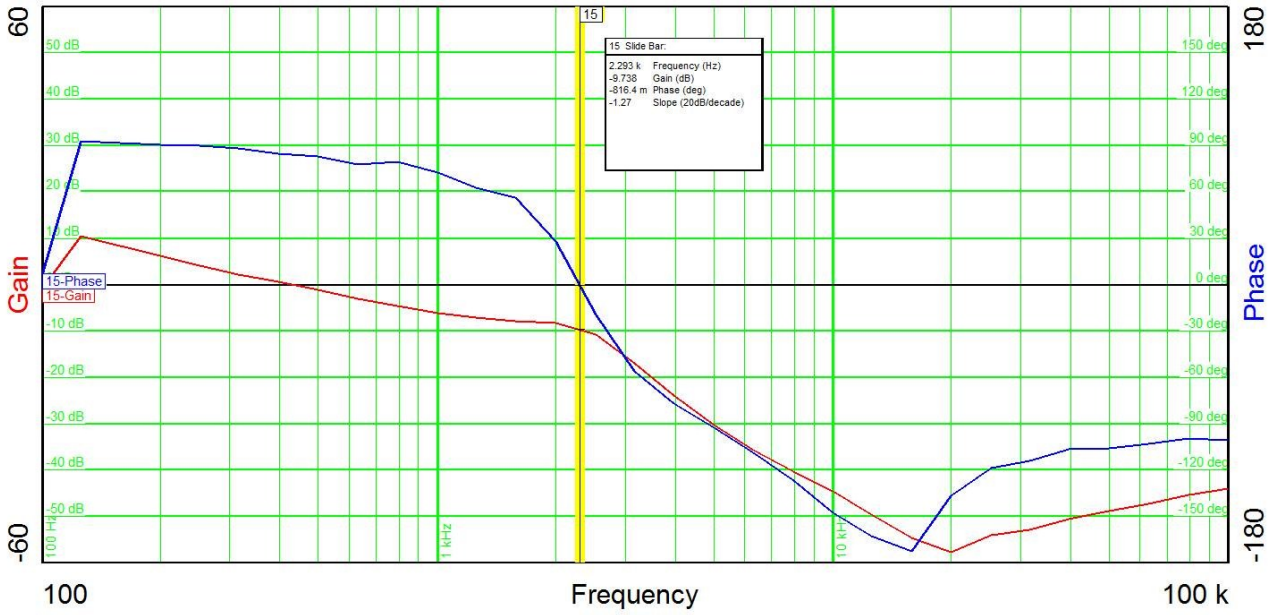


7.5 Active mode (PSON high), 25V output current changes from 13.5A to 20A:



8 LLC Resonant Converter Frequency Response

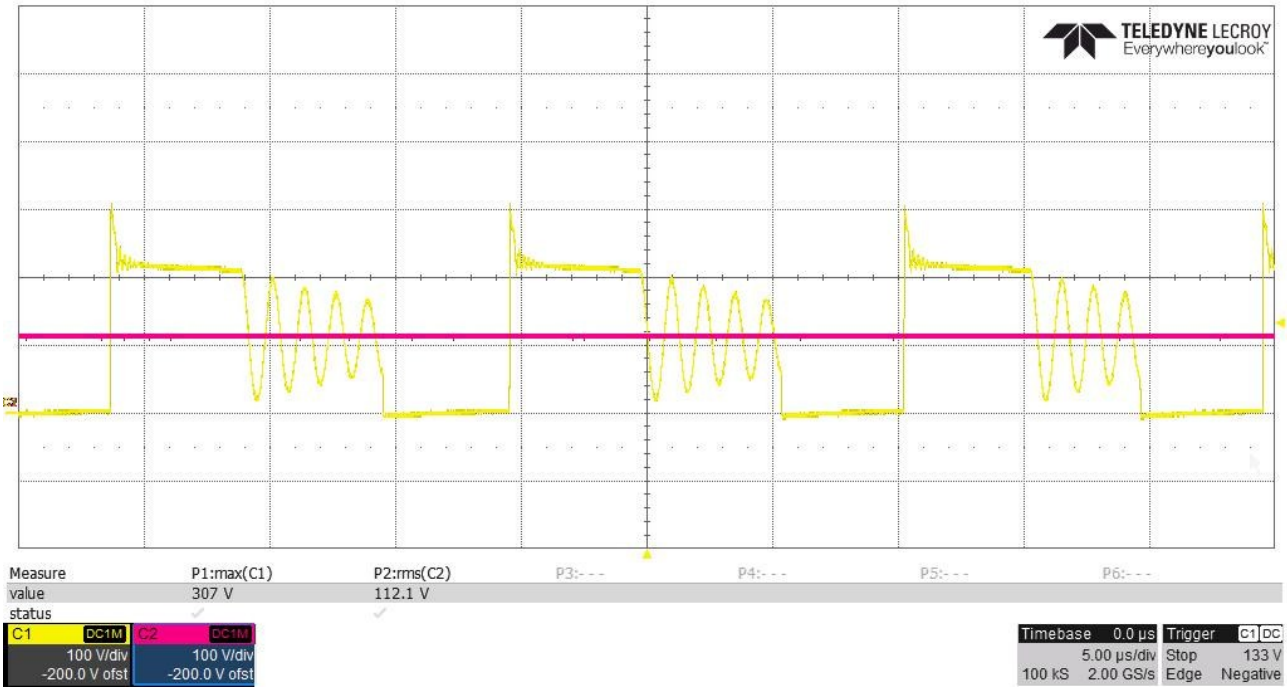
Frequency responses during full load operation (25V/13.5A and 12V/1A at outputs) are shown in the plots below.



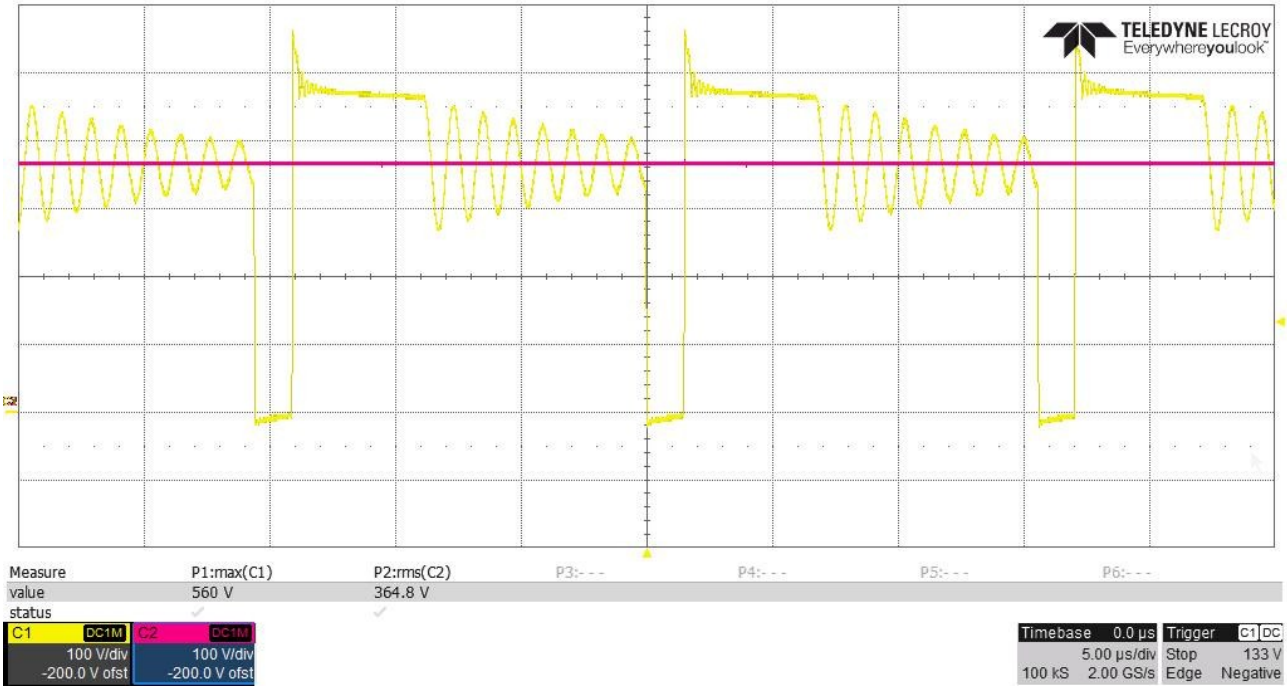
9 Key Waveforms

9.1 Q12 @ standby mode, 12V/1A

9.1.1 V_{in}=85V_{AC}/60Hz

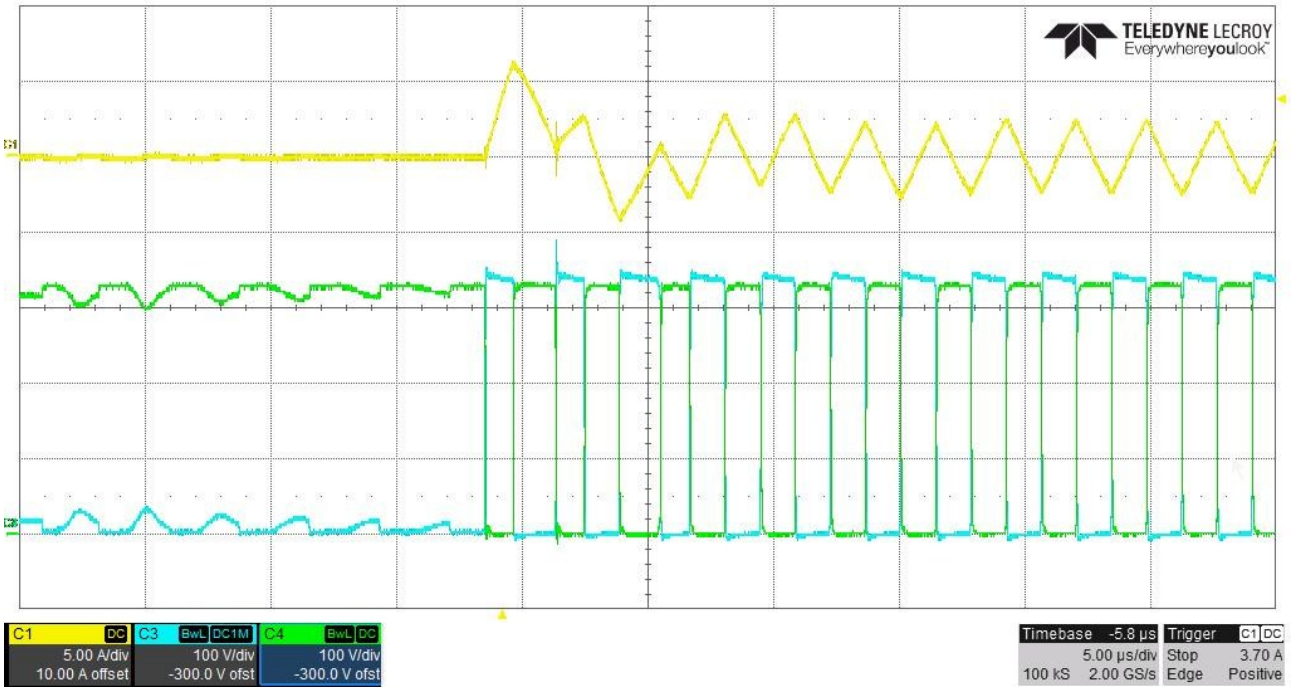


9.1.2 V_{in}=264V_{AC}/50Hz



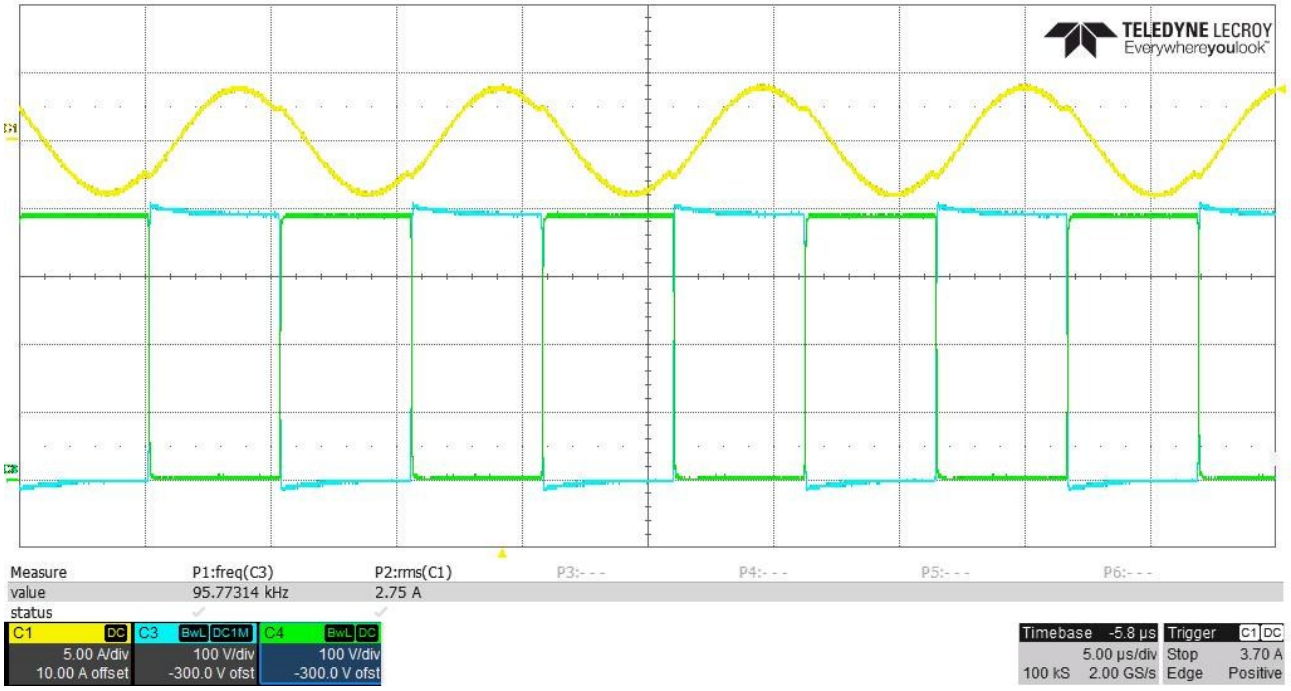
9.2 Q4, Q7, and C39 @ 25V/13.5A startup transient

CH1: I(C39), CH3: V_{DS}(Q7), and CH4: V_{DS}(Q4).



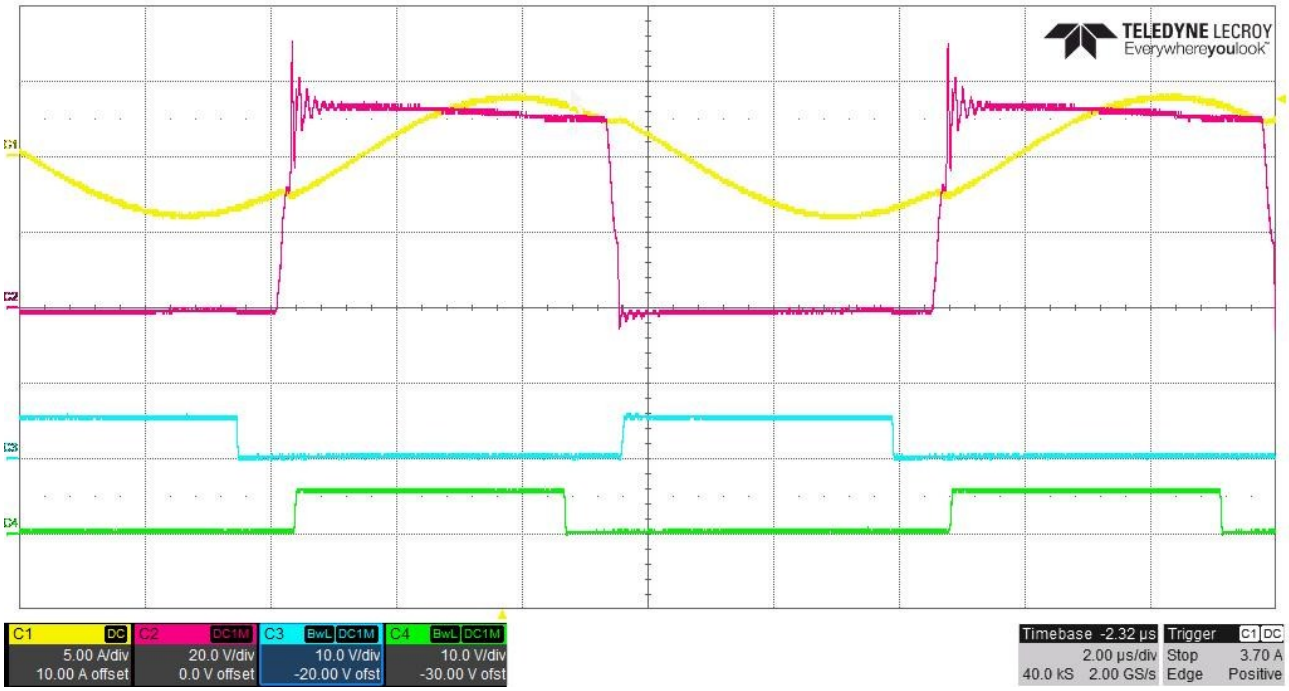
9.3 Q4, Q7, and C39 @ 25V/13.5A normal operation

CH1: I(C39), CH3: V_{DS}(Q7), and CH4:
V_{DS}(Q4).



9.4 Q5, Q8 @ 25V/13.5A normal operation

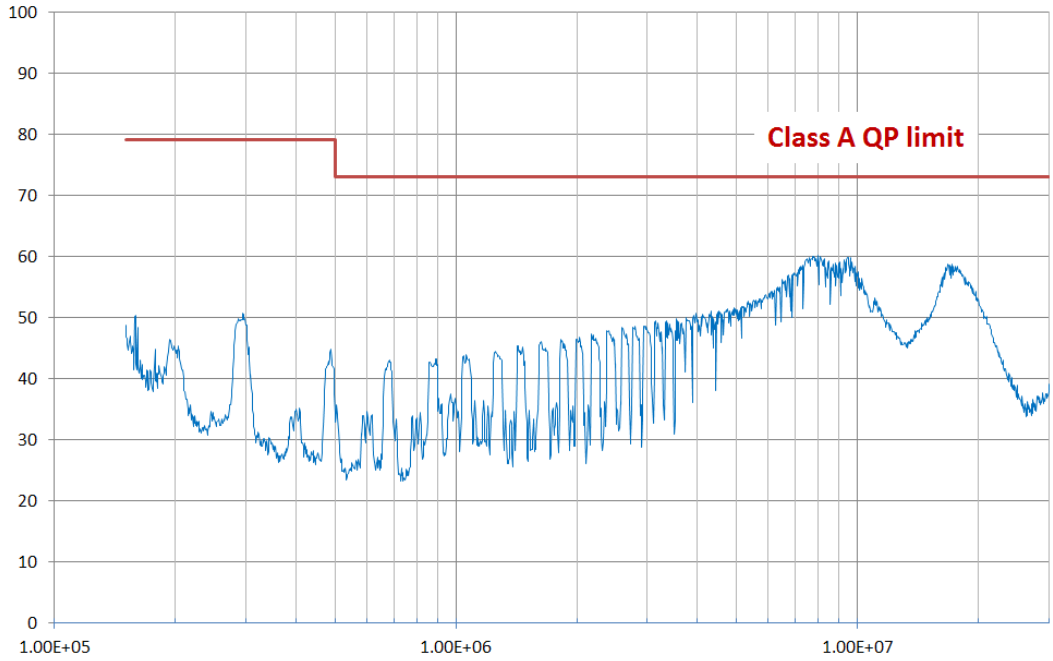
CH1:Q5_V_{DS}, CH2: Q5_V_{GS}, CH3: Q8_V_{DS}, CH4: Q8_V_{GS}



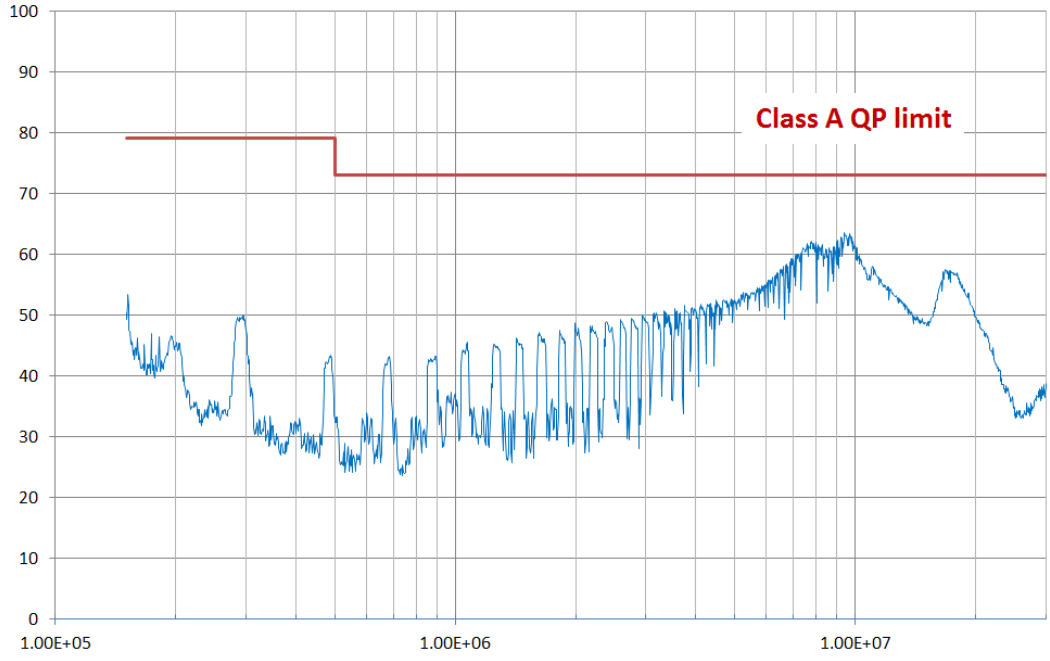
10 Conducted EMI:

The following curves show the **peak scan** results with **maximum hold**. Both 12V and 25V are enabled and loaded.

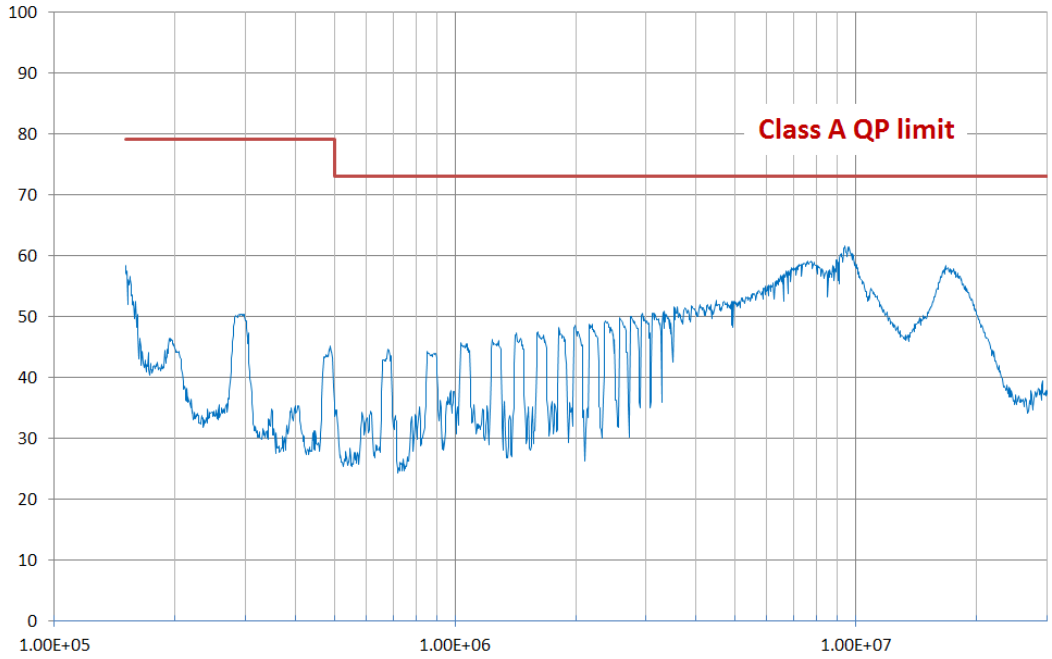
10.1 100V_{AC}/60Hz, I_{in}=3.75A: Line



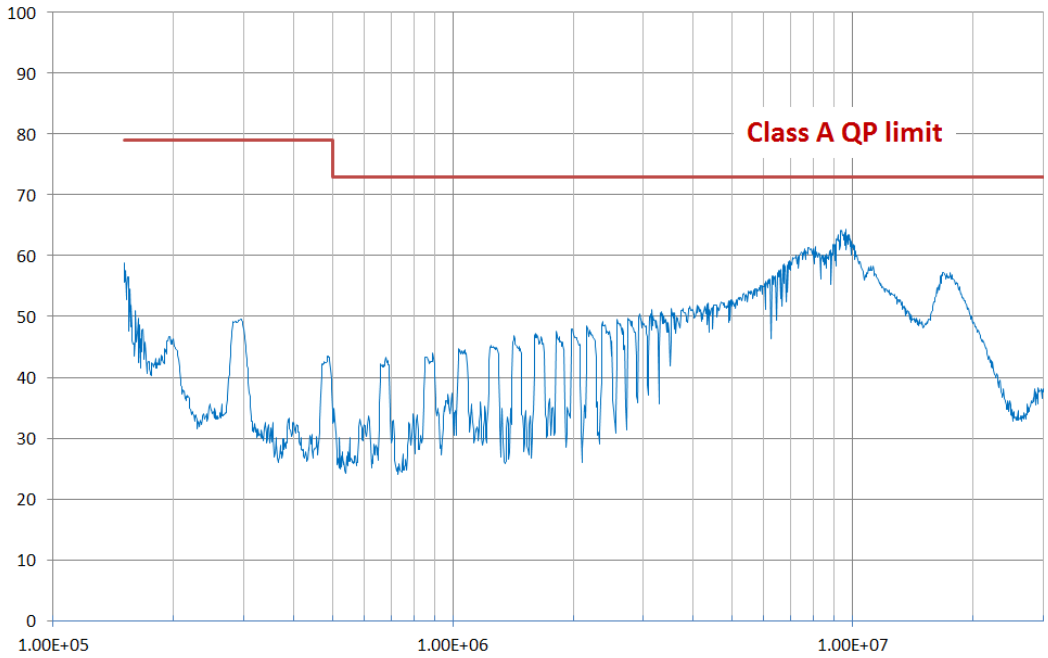
10.2 100V_{AC}/60Hz, I_{in}=3.75A: Neutral



10.3 230V_{AC}/50Hz, I_{in}=1.55A: Line



10.4 230V_{AC}/50Hz, I_{in}=1.55A: Neutral



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