



DEMO BOARD TEST REPORT

200W High Efficiency PFC Demo Board with KP2801A

FEATURES

- Universal Input Voltage Range From 90~295Vac
- High Efficiency>94.2% @110Vac full load
- High Efficiency>97.8% @277Vac full load
- High PF >0.95 & Low THD <10%@230Vac full load
- Harmonics Meets IEC61000-3-2 Class C
- Excellent Load Regulation
- Low Standby Power <0.5W

INTRODUCTION

The DEMO board is designed by a high performance CRM Boost PFC controller KP2801A. This board provides high power factor and low total harmonic distortion of input current over the extended input voltage range and very wide output load range. Performance exceeds requirements for many demanding applications including LED lighting, computing power and white goods products.

APPLICATIONS

- Boost PFC of LED Driver

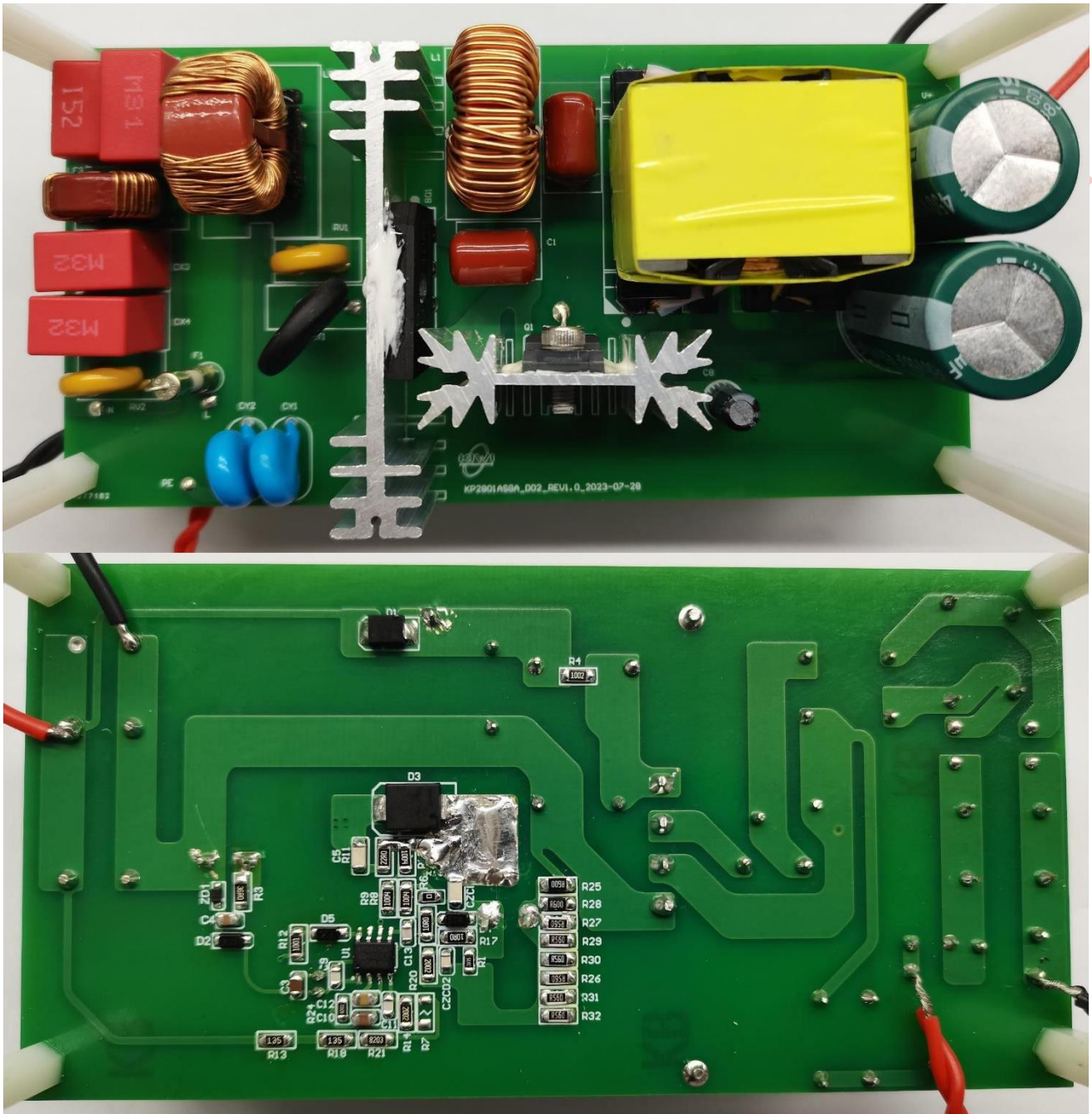
DEMO BOARD SEPCIFICATION

Description	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	Vin	90	110-277	295	Vac	50/60Hz
Output Voltage	Vout		435		Vdc	
Output Current	Iout		0.46		A	
Total Output Power	Pout		200		W	
Power Factor	PF		>0.95			230Vac@200W
Total Harmonic Distortion	THD		<10		%	230Vac@200W
System Average Efficiency	η		>90		%	110Vac@200W
Standby Power	Pstandby			0.5	W	90Vac-295Vac@No load
Startup Time	Tst			0.5	s	Tested at 110/277Vac
EMI Margin		6			dB	EN55015
Surge Test		4			kV	Differential Mode / Common Mode @ 230Vac/50Hz

Note: The table above shows the minimum acceptable performance of the design. Actual performance is listed in the results section.

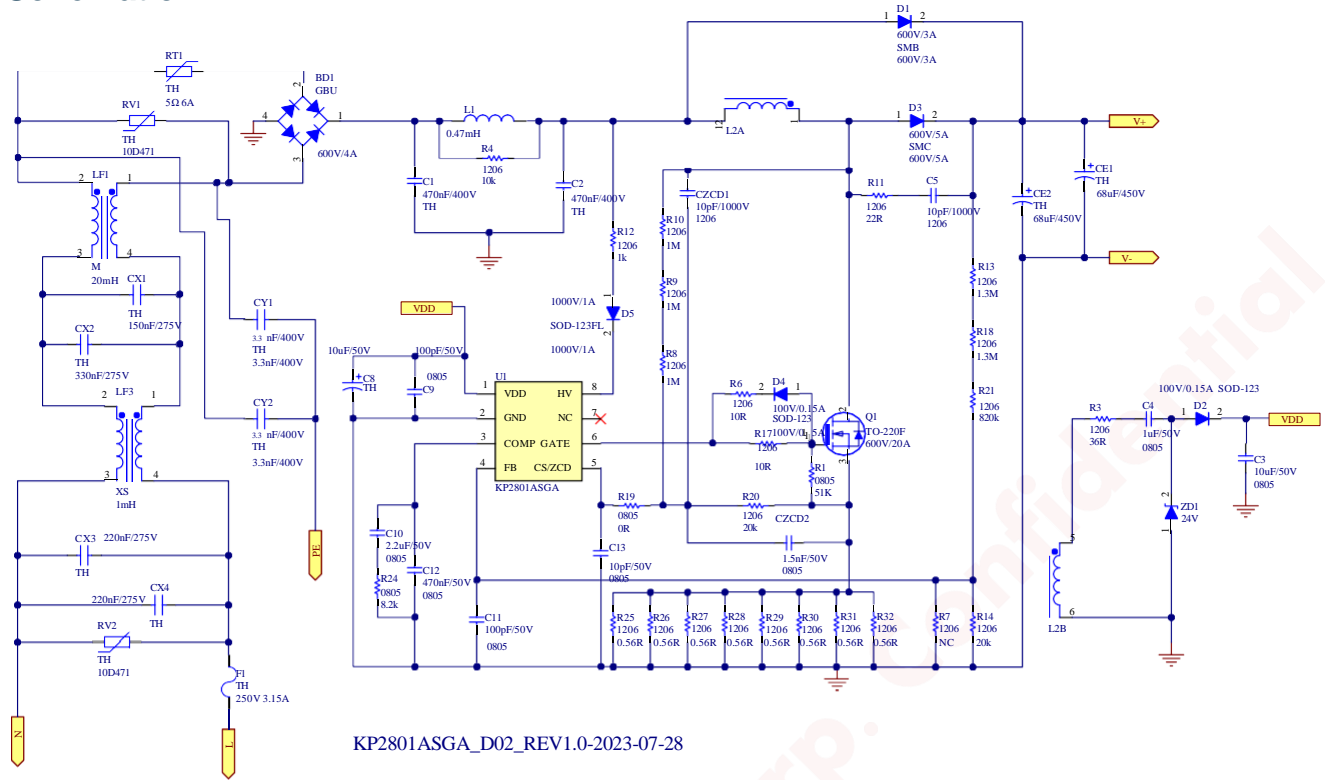
Demoboard

KP2801ASGA_D02_REV1.0_2023-07-28



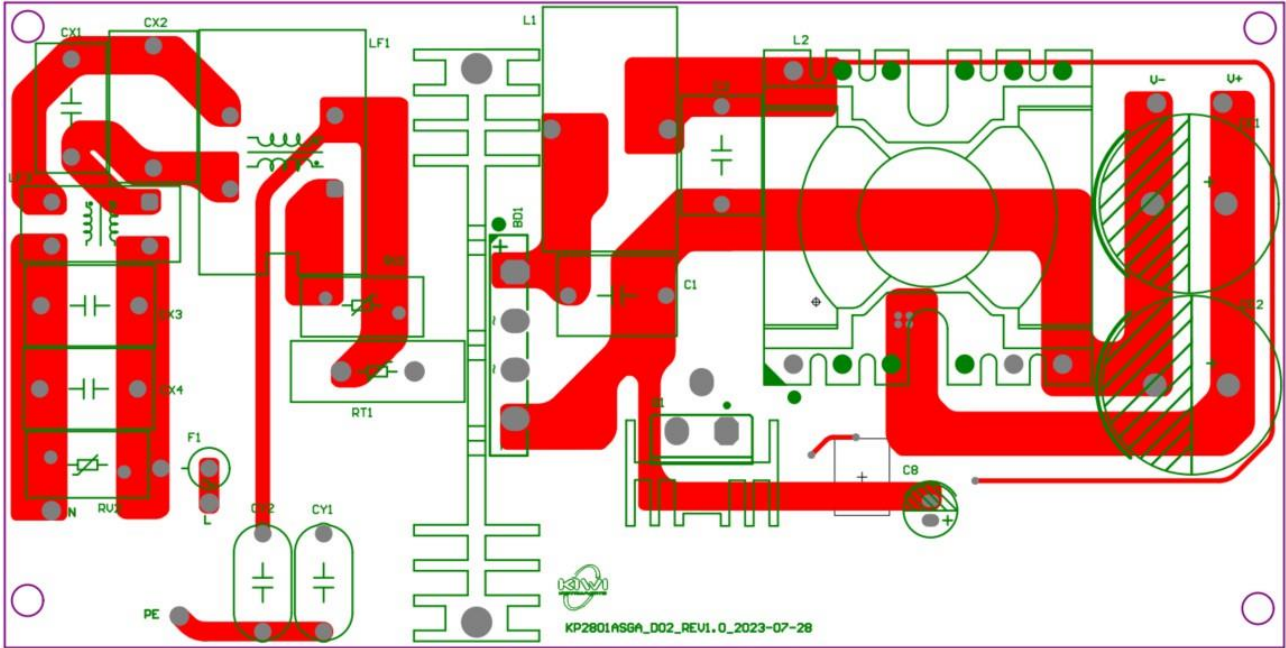
Size (mm): 130.672*65.956mm

Schematic

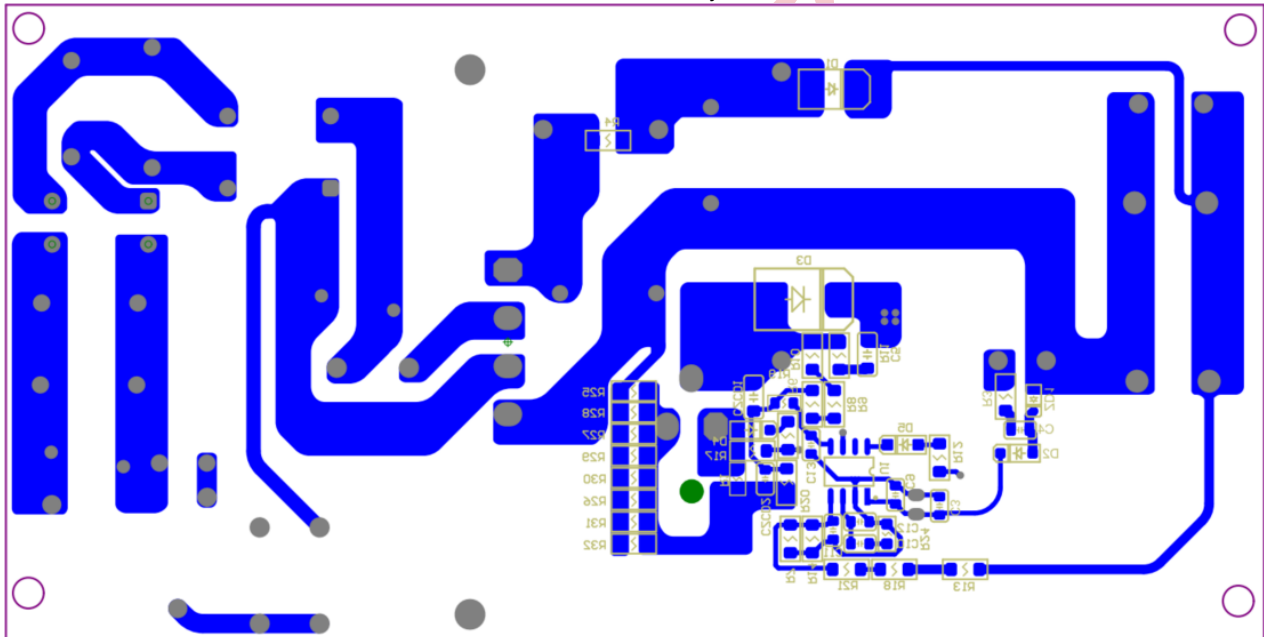


Printed Circuit Board Layout

D01-Top Layer



D01-Bottom Layer



Bill of Material

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	BD1	600V/4A	BRD 4A 600V 1V	GBU	MDD	GBU406
2	C1, C2	470nF/400V	CBB 400Vdc 12*8*15 P10	TH	STE	B22G474JN1B012 0150080EOZ
3	C3	10µF/50V	Ceramic Cap 50V ±10% X5R	0805	Murata	GRM21BR61H106 KE43L
4	C4	1µF/50V	Ceramic Cap 50V ±10% X7R	0805	WE	885012207103
5	C5, CZCD1	10pF/1000V	Ceramic Cap 1000V ±5% NPO	1206	YAGEO	CC1206JKNPOCB N100
6	C8	10uF/50V	Electrolytic Cap 50V 5*11 P2.0	TH	AISHI	EW11HM100D11 OT
7	C9, C11	100pF/50V	Ceramic Cap 50V ±5% NPO	0805	WE	885012007057
8	C10	2.2µF/50V	Ceramic Cap 50V ±10% X7R	0805	YAGEO	CC0805KXX7R9B B225
9	C12	470nF/50V	Ceramic Cap 50V ±10% X7R	0805	WE	885012207102
10	C13	10pF/50V	Ceramic Cap 50V ±5% NPO	0805	WE	885012007051
11	CE1, CE2	68uF/450V	Electrolytic Cap 450V 18*30 P7.5	TH	AISHI	EGD2WM680M30 OT
12	CX1	150nF/275V	X2 Capacitor 275Vac 13*7*12 P10	TH	WE	890324023025CS
13	CX2	330nF/275V	X2 Capacitor 275Vac 15*8.5*14 P12.5	TH	WE	890324024003CS
14	CX3, CX4	220nF/275V	X2 Capacitor 275Vac 13*8*14 P10	TH	WE	890324023028CS
15	CY1, CY2	3.3nF/400V	Y1 Capacitor 400Vac ±20% T5.5 P10	TH	STE	Q11F1D332MN0B 0SON0
16	CZCD2	1.5nF/50V	Ceramic Cap 50V ±5% NPO	0805	WE	885012007064
17	D1	600V/3A	DIO FRD 3A 600V 35nS 1.68V	SMB	MDD	ES3JB
18	D2, D4	100V/0.15A	DIO FRD 0.15A 100V 8nS 1.25V	SOD-123	MDD	1N4148W- SOD123
19	D3	600V/5A	DIO FRD 5A 600V 35nS 1.68V	SMC	MDD	ES5JC
20	D5	1000V/1A	DIO FRD 1A 1000V 1.1V	SOD-123FL	World	1N4007W(A7)
21	F1	250V 3.15A	Fuse 250V 3.15A	TH	CONQUER	PTU3.15A250V
22	L1	0.47mH	Inductor Isat 1.6A Rdc 0.11Ω 14*25	TH	WE	7447071
23	L2	280µH	PQ3225 0.1mm*80P*40Ts/0.2mm*2Ts	ANY		
24	LF1	20mH	COMMON INDUCTOR Isat 1.5A Rdc 270mΩ 25*17*26.5	M	WE	744823220
25	LF3	1mH	COMMON INDUCTOR Isat 2A Rdc 45mΩ 16*7.5*17.5	XS	WE	744821201
26	Q1	600V/20A	MOSFET 600V 20A 180mohm	TO-220F	LONTEN	LSD60R180HT
27	R1	51K	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5102FT
28	R3	36R	Chip Resistor ±1% 1/4W	1206	FH	RS-06K36R0FT
29	R4	10k	Chip Resistor ±1% 1/4W	1206	FH	RS-06K1002FT
30	R6, R17	10R	Chip Resistor ±1% 1/4W	1206	FH	RS-06K10R0FT
31	R7	NC	Chip Resistor ±1% 1/4W	1206	FH	RS-06K6202FT
32	R8, R9, R10	1M	Chip Resistor ±1% 1/4W	1206	FH	RS-06K1004FT
33	R13, R18,	1.3M	Chip Resistor ±1% 1/4W	1206	FH	RS-06K1304FT
34	R11	22R	Chip Resistor ±1% 1/4W	1206	FH	RS-06K22R0FT
35	R12	1k	Chip Resistor ±1% 1/4W	1206	FH	RS-06K1001FT

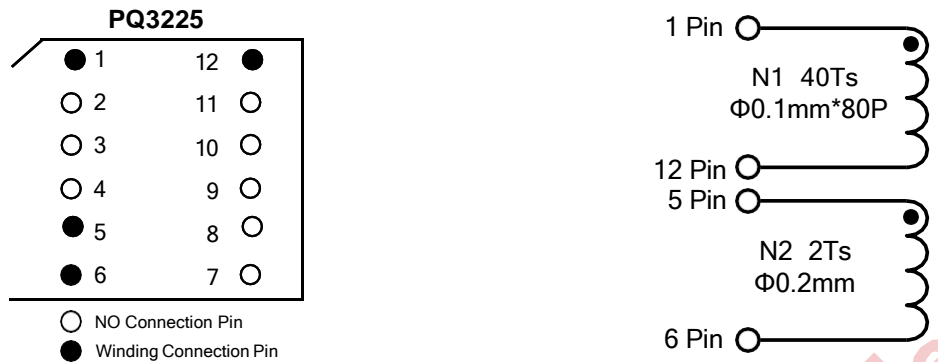


200W High Efficiency PFC Demo Board with KP2801A

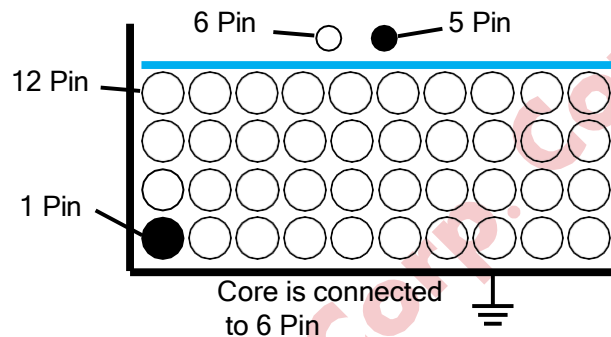
36	R14	20k	Chip Resistor $\pm 1\%$ 1/4W	1206	FH	RS-06K2002FT
37	R19	0R	Chip Resistor $\pm 1\%$ 1/8W	0805	FH	RS-05000FT
38	R20	20k	Chip Resistor $\pm 1\%$ 1/4W	1206	FH	RS-06K2002FT
39	R21	820k	Chip Resistor $\pm 1\%$ 1/4W	1206	FH	RS-06K8203FT
40	R24	8.2k	Chip Resistor $\pm 1\%$ 1/8W	0805	FH	RS-05K8201FT
41	R25, R26, R27, R28, R29, R30, R31, R32	0.56R	Chip Resistor $\pm 1\%$ 1/4W	1206	FH	RBF-06RR560FT
42	RT1	5 Ω 6A	RES NTC 5ohm 6A	TH	HEL	HEL5D-15
43	RV1, RV2	10D471	VARISTOR 300VAC 70J 2500A	TH	WE	820513011
44	U1		High Performance QR Boost PFC Constant Voltage Controller	SOP-8	KIWI	KP2801ASGA
45	ZD1	24V	Diode Zener 24V 2% 200mW	SOD-323	PANJIT	BZT52-B24S

Inductor Manufacture Guide---L2

1. Electrical Diagram



2. Winding Diagram



3. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	N1	Primary	1	12	0.1mm*80P	40Ts	
2	N2	Auxiliary	5	6	0.2mm	2Ts	

4. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1 - 12, all other windings open	0.28mH±5%
DC Resistance	Measured at 40kHz, 1.0 VRMS	Pins 1 - 12	0.1Ω Max

5. Inductor BOM

Items	Description
1	Core: PQ3225, PC44 or equivalent, AE=153mm ²
2	Bobbin: PQ3225, 6+6 Pin
3	Wire: Φ0.1mm*80P*40Ts, 2UEW, Class B
4	Tape: 16mm(W)×0.06mm (TH)

Test Result

1. Steady State Characteristics

1.1 Efficiency, PF and THD

Test Conditions: Input: 90/110/230/277/295Vac; Output: 10%-100% load.

Standard: Eff>95%, PF>0.95, THD<10% @230Vac full load.

Result: Pass

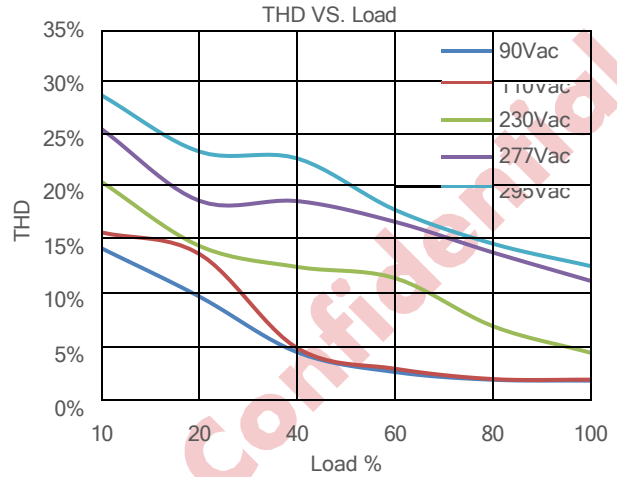
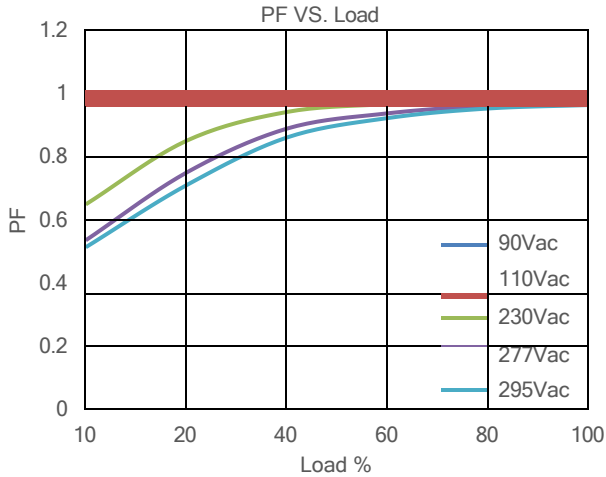
Vac	Load	F(Hz)	PF	THD	Pin(W)	Vo(V)	Io(A)	Eff
90	10%	60	0.9673	14.848%	22.655	433.19	0.05	95.61%
	20%	60	0.9891	10.384%	45.827	433.17	0.1	94.52%
	40%	60	0.997	5.239%	87.56	433.02	0.19	93.96%
	60%	60	0.9986	3.415%	129.13	432.98	0.28	93.89%
	80%	60	0.9966	2.704%	170.88	433.03	0.37	93.76%
	100%	60	0.9981	2.624%	215.86	433.02	0.46	92.28%
110	10%	60	0.9562	16.325%	22.418	433.08	0.05	96.59%
	20%	60	0.9651	14.325%	45.335	433.18	0.1	95.55%
	40%	60	0.9947	5.617%	86.59	433.22	0.19	95.06%
	60%	60	0.9976	3.721%	127.64	433.23	0.28	95.04%
	80%	60	0.9986	2.768%	169.82	433.17	0.37	94.38%
	100%	60	0.9989	2.713%	211.44	433.06	0.46	94.21%
230	10%	50	0.6484	20.987%	21.919	433.05	0.05	98.78%
	20%	50	0.8496	15.069%	44.298	433.17	0.1	97.79%
	40%	50	0.9409	13.138%	84.31	433.16	0.19	97.62%
	60%	50	0.9659	12.100%	124.22	433.11	0.28	97.63%
	80%	50	0.981	7.654%	164.27	433.07	0.37	97.54%
	100%	50	0.9873	5.199%	204.66	433.08	0.46	97.34%
277	10%	50	0.5348	25.879%	21.881	432.98	0.05	98.94%
	20%	50	0.7489	19.248%	44.055	433.06	0.1	98.30%
	40%	50	0.8882	19.234%	83.94	433.05	0.19	98.02%
	60%	50	0.9365	17.310%	123.73	433.02	0.28	97.99%
	80%	50	0.9609	14.478%	163.58	433.02	0.37	97.94%
	100%	50	0.9734	11.846%	203.64	433.04	0.46	97.82%
295	10%	50	0.5128	29.002%	21.755	432.96	0.05	99.51%
	20%	50	0.709	23.802%	43.951	433.03	0.1	98.53%
	40%	50	0.8601	23.176%	83.72	432.94	0.19	98.25%
	60%	50	0.9215	18.412%	123.54	433.06	0.28	98.15%
	80%	50	0.9519	15.289%	163.26	433.01	0.37	98.13%
	100%	50	0.9628	13.217%	203.14	433.03	0.46	98.06%

1.2 PF, THD VS. Vout

Test Conditions: Input: 90/110/230/277/295Vac; Output: 10%-100% load.

Standard: PF>0.95、THD<10% @ 230Vac full load.

Result: Pass



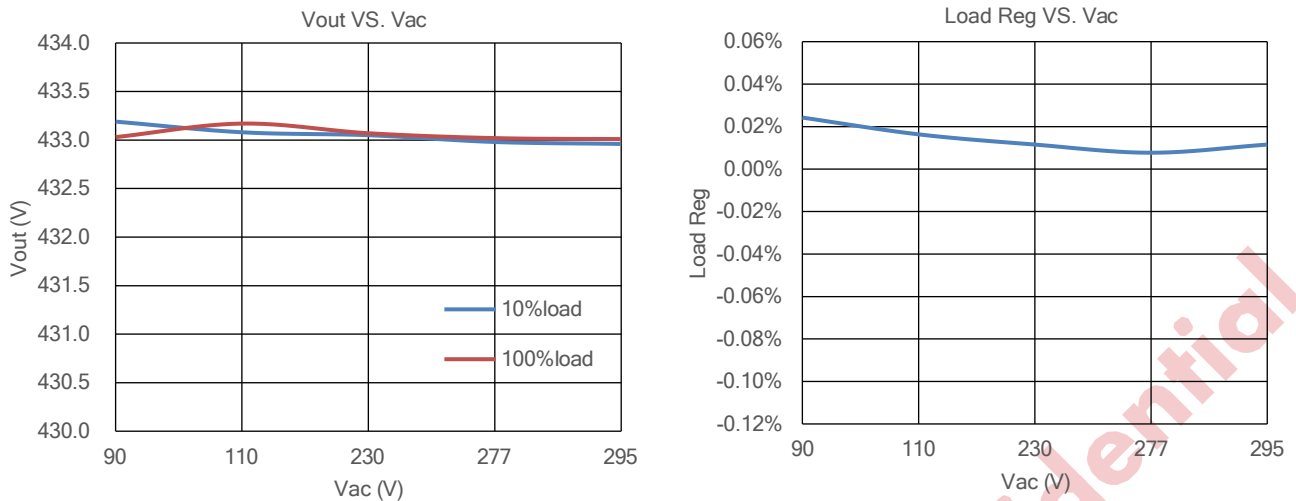
1.3 Output Load Regulation

Test Conditions: Input: 90-295Vac: Output: 10%-100% of load.

Standard: Load Regulation < 1%

Result: Pass

Vin(V)	Vo(V)									Load Reg
	Io= 0.05A	Io= 0.1A	Io= 0.19A	Io= 0.28A	Io= 0.37A	Io= 0.46A	Max	Ave	Min	
90	433.19	433.17	433.02	432.98	433.03	433.02	433.19	433.0683	432.98	0.02%
110	433.08	433.18	433.22	433.23	433.17	433.06	433.23	519.788	433.06	0.02%
230	433.05	433.17	433.16	433.11	433.07	433.08	433.17	519.728	433.05	0.01%
277	432.98	433.06	433.05	433.02	433.02	433.04	433.06	519.634	432.98	0.01%
295	432.96	433.03	432.94	433.06	433.01	433.03	433.06	519.606	432.94	0.01%



1.4 Harmonic Current

Test Conditions: Input: 230Vac; Output: 10%/100% load & 25W load.

Standard: IEC61000-3-2 Class C

Result: Pass

Harmonic Current Limit Value and Actual Value @10% load

Harmonic NO.	Limit (mA)	Actual Value(mA)	Pass Fail	Harmonic NO.	Limit (mA)	Actual Value(mA)	Pass Fail
2	18.10	0.23	Pass	3	271.53	23.67	Pass
5	90.51	14.31	Pass	7	63.36	7.18	Pass
9	45.26	5.05	Pass	11	27.15	5.93	Pass
13	27.15	3.77	Pass	15	27.15	3.31	Pass
17	27.15	3.40	Pass	19	27.15	2.77	Pass
21	27.15	2.36	Pass	23	27.15	2.35	Pass
25	27.15	2.14	Pass	27	27.15	1.86	Pass
29	27.15	1.87	Pass	31	27.15	1.77	Pass
33	27.15	1.60	Pass	35	27.15	1.48	Pass
37	27.15	1.49	Pass	39	27.15	1.38	Pass

Harmonic Current Limit Value and Actual Value @100% load

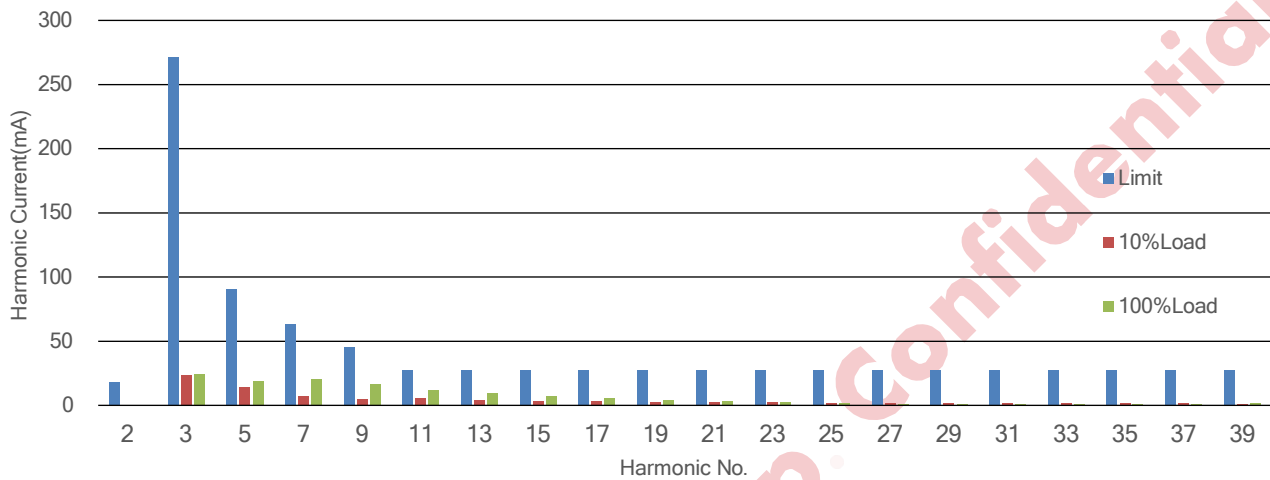
Harmonic NO.	Limit (mA)	Actual Value(mA)	Pass Fail	Harmonic NO.	Limit (mA)	Actual Value(mA)	Pass Fail
2	18.10	0.14	Pass	3	271.53	23.98	Pass
5	90.51	19.00	Pass	7	63.36	20.51	Pass
9	45.26	16.85	Pass	11	27.15	12.27	Pass
13	27.15	9.24	Pass	15	27.15	6.91	Pass
17	27.15	5.29	Pass	19	27.15	4.12	Pass
21	27.15	3.20	Pass	23	27.15	2.34	Pass



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25	27.15	1.68	Pass	27	27.15	1.08	Pass
29	27.15	0.75	Pass	31	27.15	0.73	Pass
33	27.15	0.97	Pass	35	27.15	1.23	Pass
37	27.15	1.38	Pass	39	27.15	1.64	Pass

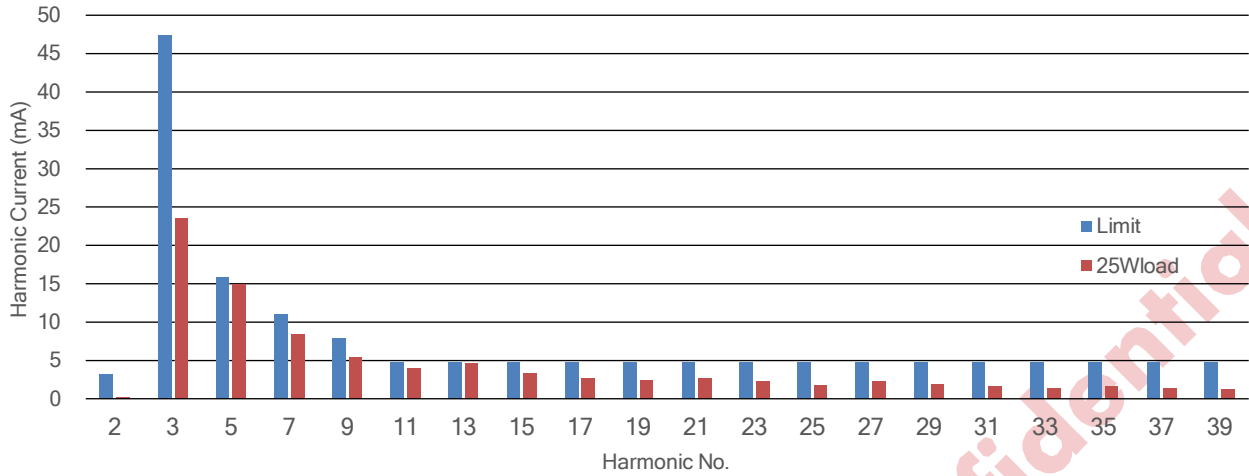
Harmonic Current VS. No. @10%/100% load



Harmonic Current Limit Value and Actual Value @25W load

Harmonic NO.	Limit (mA)	Actual Value(mA)	Pass Fail	Harmonic NO.	Limit (mA)	Actual Value(mA)	Pass Fail
2	3.16	0.21	Pass	3	47.34	23.49	Pass
5	15.78	14.94	Pass	7	11.05	8.40	Pass
9	7.89	5.37	Pass	11	4.73	3.98	Pass
13	4.73	4.61	Pass	15	4.73	3.33	Pass
17	4.73	2.70	Pass	19	4.73	2.47	Pass
21	4.73	2.72	Pass	23	4.73	2.23	Pass
25	4.73	1.72	Pass	27	4.73	2.23	Pass
29	4.73	1.92	Pass	31	4.73	1.68	Pass
33	4.73	1.36	Pass	35	4.73	1.63	Pass
37	4.73	1.32	Pass	39	4.73	1.25	Pass

Harmonic Current VS. No. @25W load

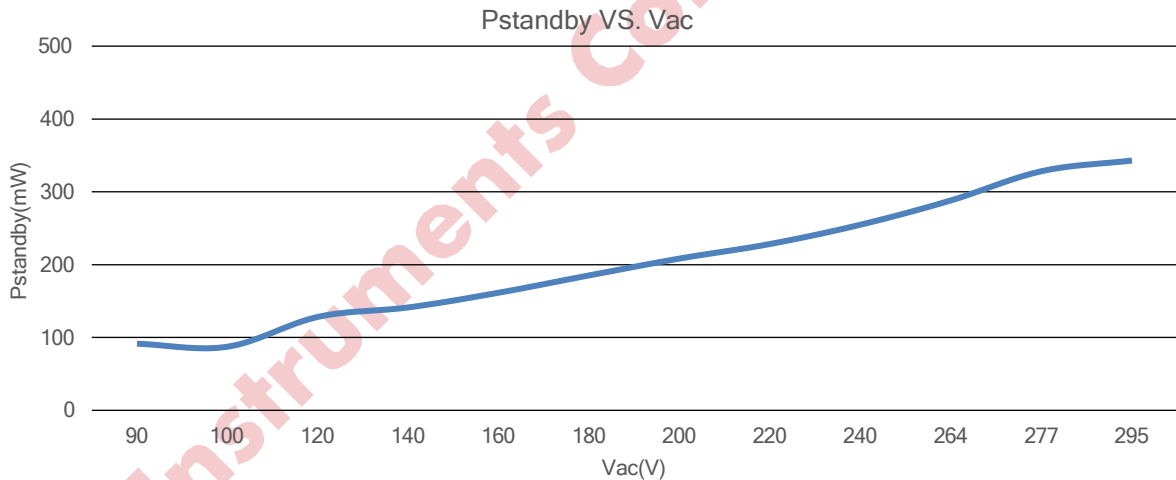


1.5 Standby Power

Test Conditions: Input: 90-295Vac; Output: No load.

Standard: $P_{Standby} < 0.5W$

Result: Pass



2 Dynamic Characteristics

2.1 Brown-Out Protection

Load	Start-up Vac	Brown-out Vac
10%	78Vac	66Vac
100%	77Vac	69Vac

2.2 Start-up Characteristics

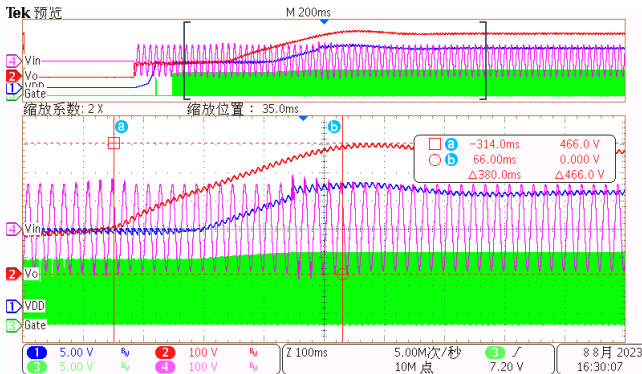
Test Conditions: Input: 110/277Vac; Output: full load.

Standard: Start up time <0.5s, and overshoot Voltage not exceed 10% of Vout typical value

Result: Pass

Waveforms:

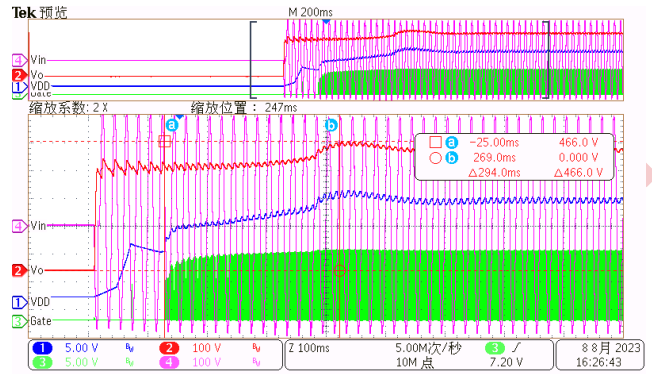
Test Condition: 110Vac/60Hz Input, 200W Output



(CH1: VDD; CH2: Vo; CH3: Gate; CH4: Vin)

Comments: Voltage rise time 380ms, overshoot voltage not exceed 10% of Vout typical value

Test Condition: 277Vac/50Hz Input, 200W Output



(CH1: VDD; CH2: Vo; CH3: Gate; CH4: Vin)

Comments: Voltage rise time 294ms, overshoot voltage not exceed 10% of Vout typical value

2.3 Power off Characteristics

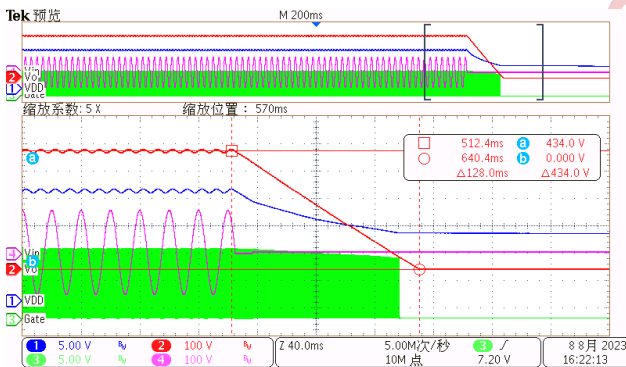
Test Conditions: Input: 110/277Vac; Output: full load.

Standard: No overshoot

Result: Pass

Waveforms:

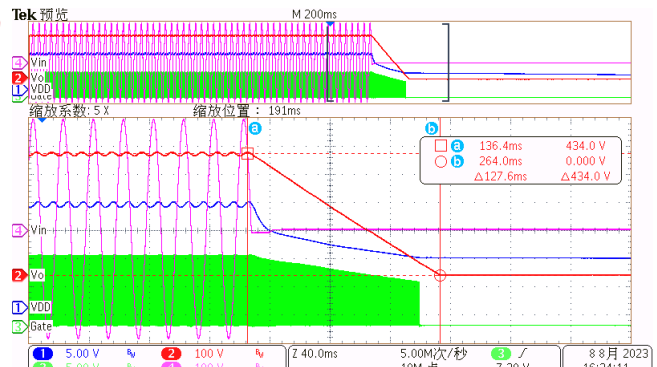
Test Condition: 110Vac/60Hz Input, 200W Output



(CH1: VDD; CH2: Vo; CH3: Gate; CH4: Vin)

Comments: OK, no overshoot

Test Condition: 277Vac/50Hz Input, 200W Output



(CH1: VDD; CH2: Vo; CH3: Gate; CH4: Vin)

Comments: OK, no overshoot

3 Reliability Testing

3.1 Maximum Stress of Boost MOSFET

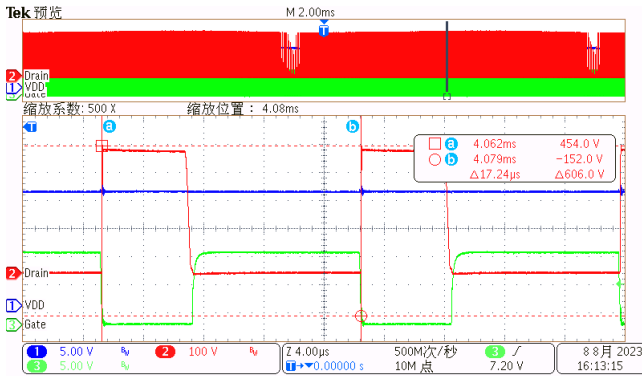
Test Conditions: Input: 110/277Vac; Output: full load.

Standard: $VDS_{peak} < 90\% * Vds_{max}$

Result: Pass

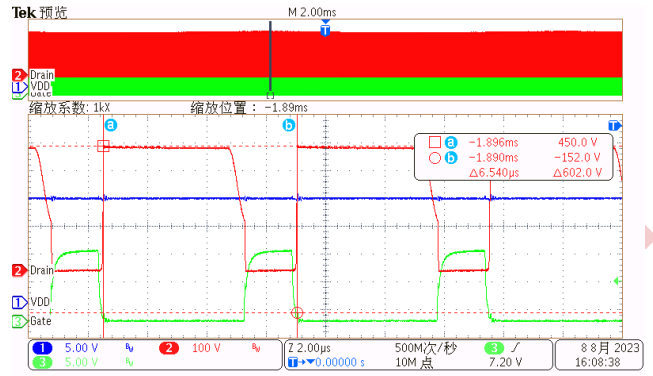
Waveforms:

Test Condition: 110Vac/60Hz Input, 200W Output



(CH1: VDD; CH2: VDS; CH3: Gate; CH4: VD)
Comments: OK, VDS_peak=454V

Test Condition: 277Vac/50Hz Input, 200W Output



(CH1: VDD; CH2: VDS; CH3: Gate; CH4: VD)
Comments: OK, VDS_peak=450V

3.2 Maximum Stress of Boost Output Diode

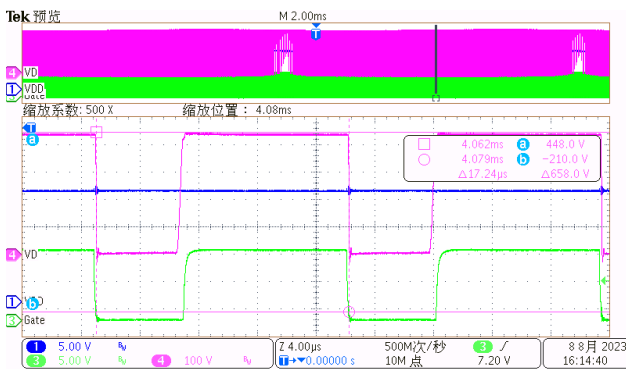
Test Conditions: Input: 110/277Vac; Output: full load.

Standard: $VD_{peak} < 90\% * VD_{max}$

Result: Pass

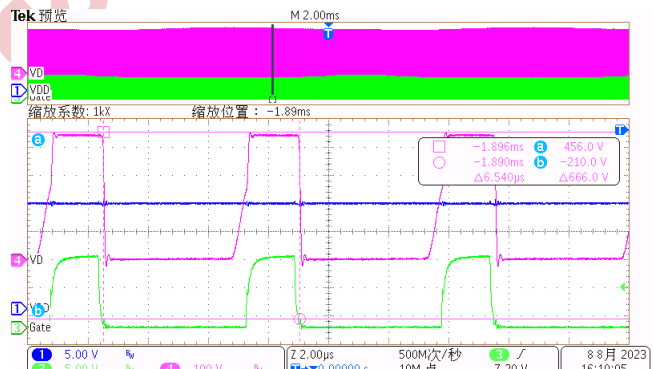
Waveforms:

Test Condition: 110Vac/60Hz Input, 200W Output



(CH1: VDD; CH2: VDS; CH3: Gate; CH4: VD)
Comments: OK, VD_peak=448V

Test Condition: 277Vac/50Hz Input, 200W Output



(CH1: VDD; CH2: VDS; CH3: Gate; CH4: VD)
Comments: OK, VD_peak=456V

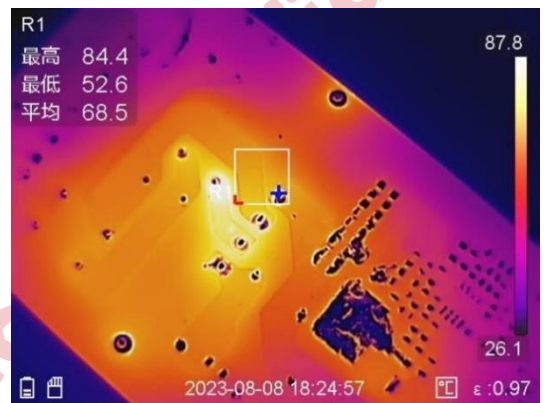
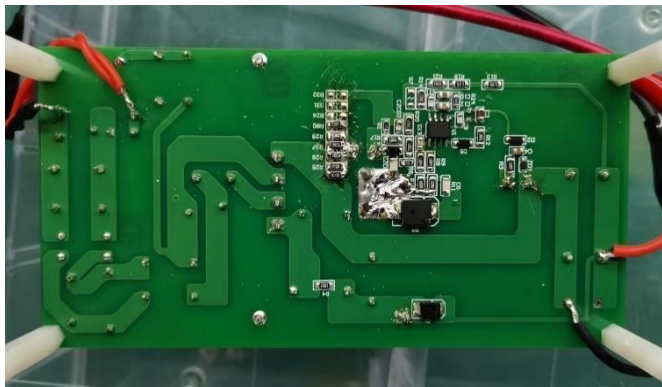
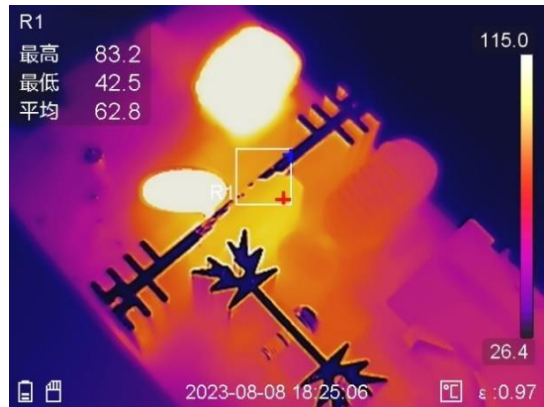
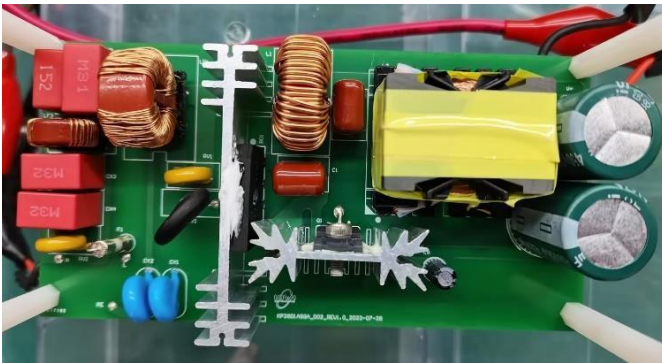
3.3 Thermal Test

Test Conditions: Input: 110/277Vac; Output: full load. Burn-in 0.5Hour @ confined container and steady environment with no airflow, Ta is the temperature inside the cardboard box.

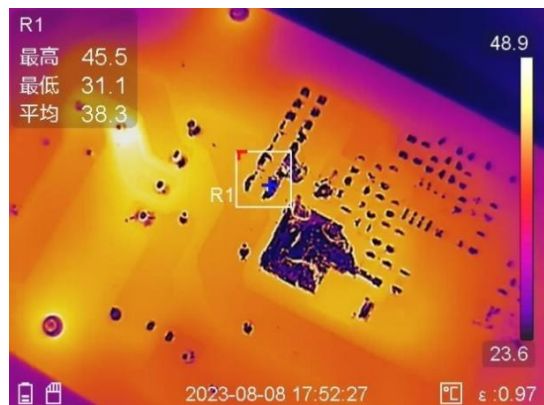
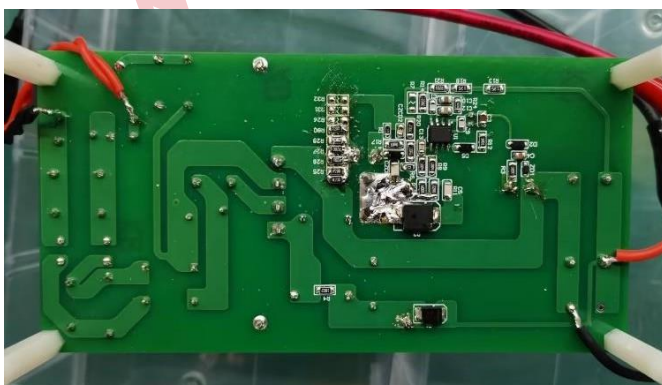
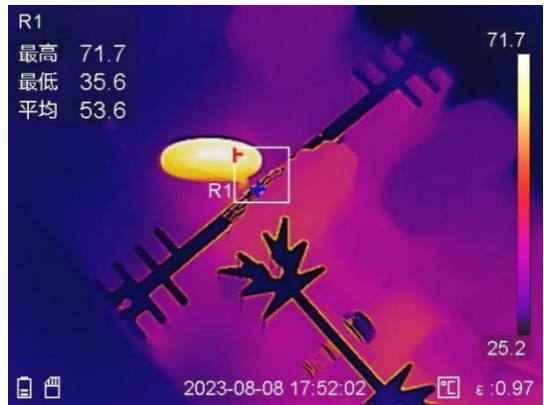
Standard: Final product will be cased and potted, the open frame thermal test data is only for reference.

Result: Pass

110Vac/50Hz, Ta=27.8°C



277Vac/50Hz, Ta=24.7°C



3.4 EMC Test

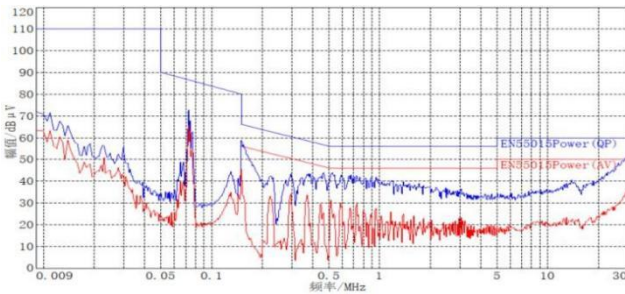
Test Conditions: Input: 110/220Vac; Output: full load.

Standard:

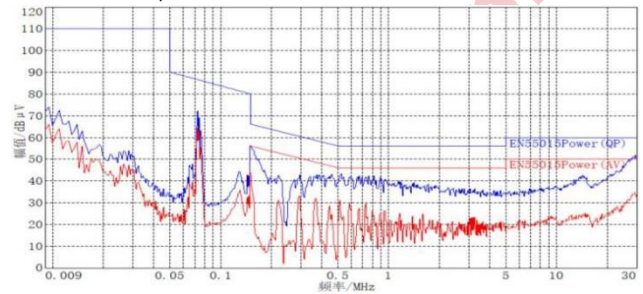
Standard	EN55015
Content	CE/CDN
Requirement	>6dB Margin

Result: CE test Pass; CDN test no Pass

Test Condition: Vin=110Vac/60Hz, CE

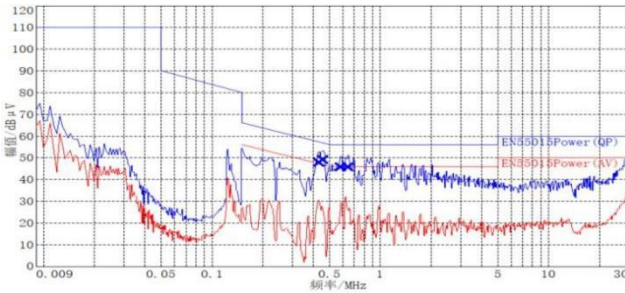


CE EMI--LINE

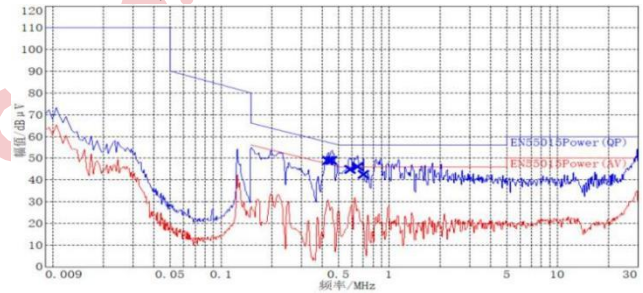


CE EMI--NEUTRAL

Test Condition: Vin=220Vac/50Hz, CE

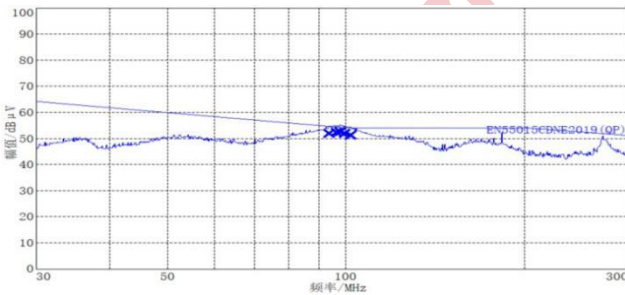


CE EMI--LINE

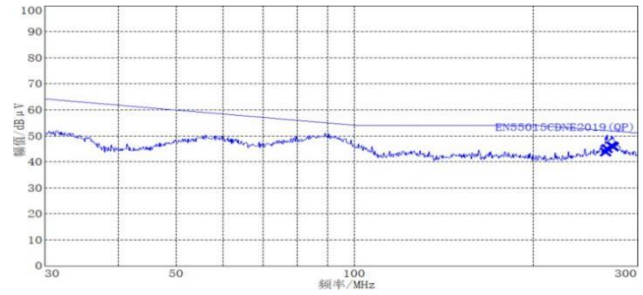


CE EMI--NEUTRAL

Test Condition: CDN



Conduction CDN--110Vac/60Hz



Conduction CDN--220Vac/50Hz

3.5 Surge Test

Test Conditions: Input: 230Vac; Output: full load.

Standard: >4000V

Result: Pass

Input Voltage (Vac)	Surge Level (V)	Injection Location	Injection Phase (°)	Test Result (Pass/Fail)
230Vac/50Hz	+4000	L to N	0	Pass
	+4000	L to N	90	Pass
	+4000	L to N	180	Pass
	+4000	L to N	270	Pass
	-4000	L to N	0	Pass
	-4000	L to N	90	Pass
	-4000	L to N	180	Pass
	-4000	L to N	270	Pass
230Vac/50Hz	+4000	L to PE	0	Pass
	+4000	L to PE	90	Pass
	+4000	L to PE	180	Pass
	+4000	L to PE	270	Pass
	+4000	N to PE	0	Pass
	+4000	N to PE	90	Pass
	+4000	N to PE	180	Pass
	+4000	N to PE	270	Pass

A: Normal performance within limits specified by the manufacturer, requestor or purchaser;

B: Temporary loss of function or degradation of performance, which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operation intervention;

C: Temporary loss of function or degradation of performance, the correction of which requires operator intervention;

D: Loss of function or degradation of performance which is not recoverable, owing to damage to hardware or software, or loss of data.

Test Result: A (A/B/C/D)

Test Setup Guide

1. Connect the “V+” and “V-” terminal to the positive and negative end of the load.
2. Set the AC Power Source between 90Vac and 295Vac.
3. Connect the AC Power Source terminal to the “L” and “N” terminals on the Demo Board.

Turn on the AC Power Source to make system startup; and Turn off the AC Power Source to make system shutdown.



Revision History

DATE	REV	DESCRIPTION
2023/08/11	1.0	First Release

Disclaimer

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