DEMO BOARD TEST REPORT

142W High Efficiency LCD TV Backlighting Solution with KP2806+KP2591+KP1601

FEATURES

- Universal Input Voltage Range from 90~265Vac
- High PF >0.96 & Low THD <15%
- Harmonics Meets IEC61000-3-2 Class C
- Wide Dimming Range 1%-100%
- No flicker with Low Output Ripple
- High Efficiency >88%
- Less than 300mW Standby Power
- Excellent Line Regulation and Load Regulation

APPLICATIONS

- TV Backlighting

INTRODUCTION

The demo board is a high performance three stage isolated dimmable LED driver. The 1st stage is a high performance, quasi resonant (QR) mode power factor correction (PFC) controller KP2806LGA; the 2nd stage is a high performance, switching power supply controller for LLC resonant converter KP2591SGA; the 3rd stage is a high-precision dimmable controller KP1601SGA.

This demo board is designed with excellent dimming linearity and 1% minimum dimming brightness, which supports dimming off mode and consumes very low standby power.

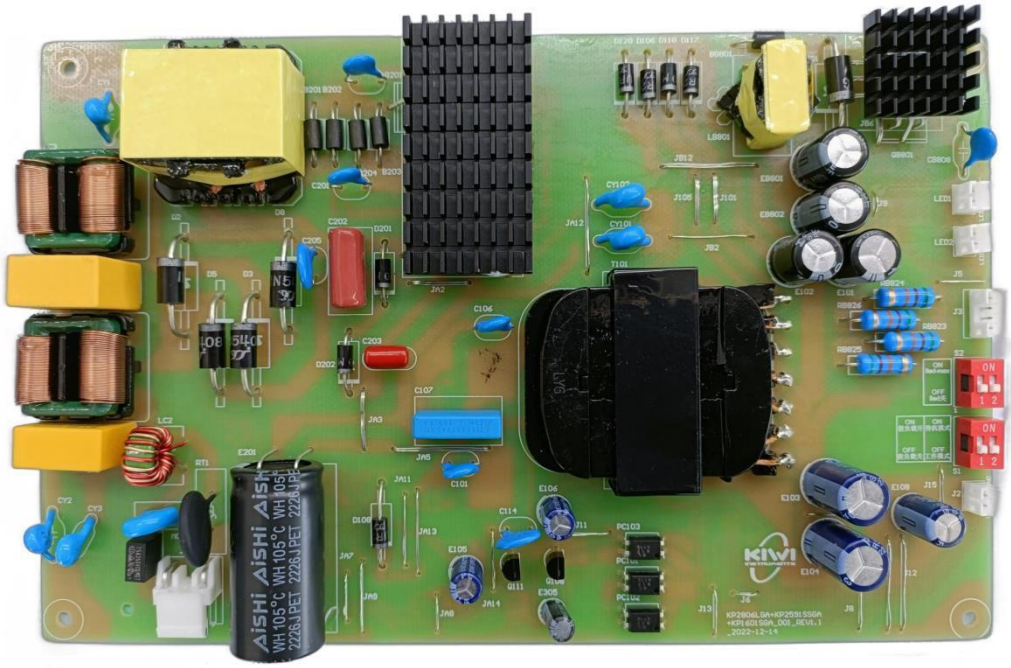
The demo board is typically designed for 142W output and universal input from 90Vac to 265 Vac.

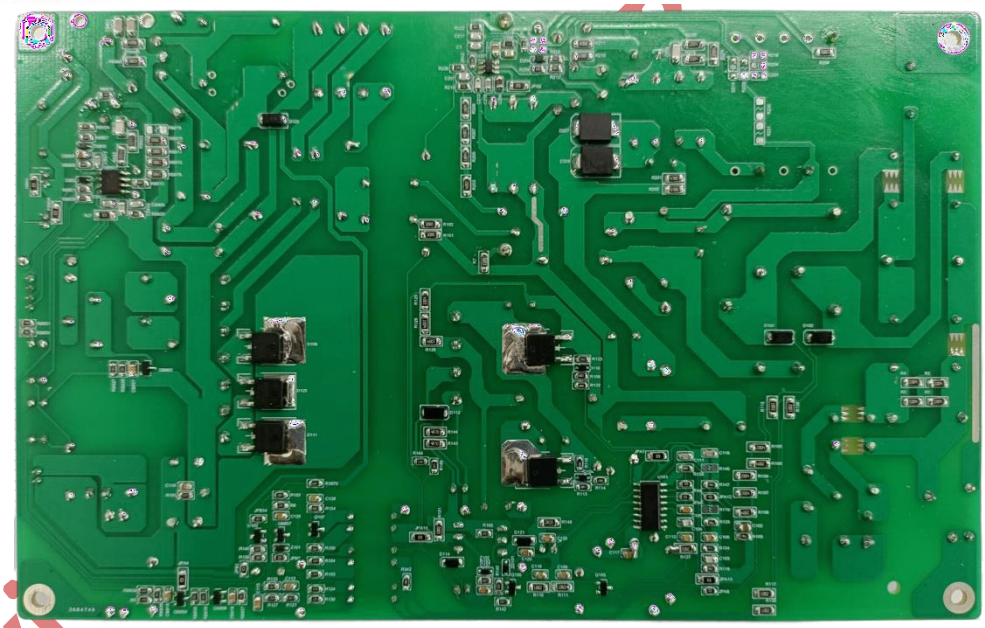
DEMO BOARD SEPCIFICATION

Description	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	Vin	90		265	Vac	50/60Hz
Output1	Vout/Iout	12V/3.5A				
Output2	Vout/Iout	150-200V/0.5A				
Total Output Power	Pout		142		W	
Dimming Range	Dim	1		100	%	
System Power Factor	PF	>0.96			%	90Vac-265Vac Vo1:12V/3.5A; Vo2=200V/0.5A
System Harmonic	THD	<15%			%	90Vac-265Vac Vo1:12V/3.5A; Vo2=200V/0.5A
System Average Efficiency	η	>88			%	90Vac-265Vac Vo1:12V/3.5A; Vo2=200V/0.5A
Standby Power	Ploss			214	mW	90Vac-265Vac
Startup Time	Tst			0.426	s	Tested at 90Vac/60Hz
Conducted EMI Margin	CE	4			dB	EN55015
Surge Test		2			kV	Differential Mode @ 230Vac/50Hz

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

Demo Board

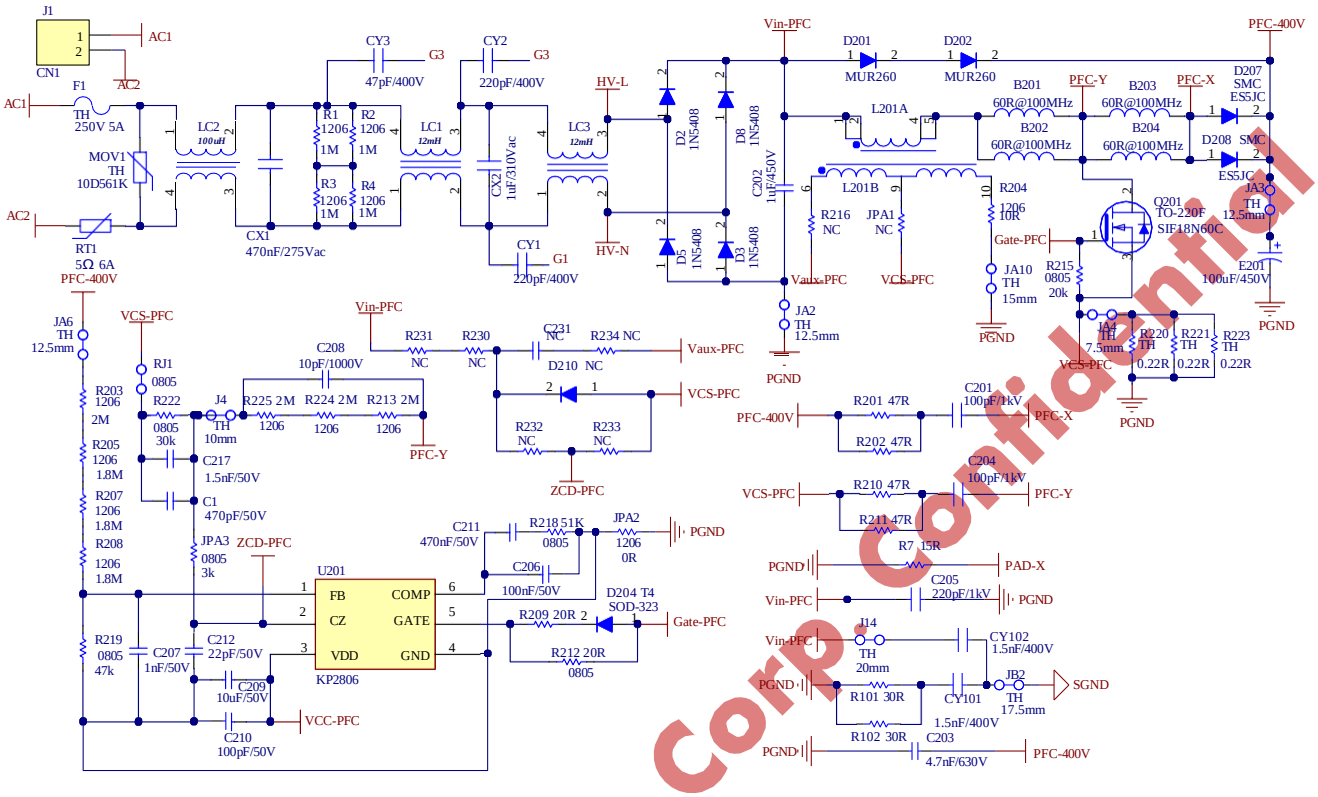




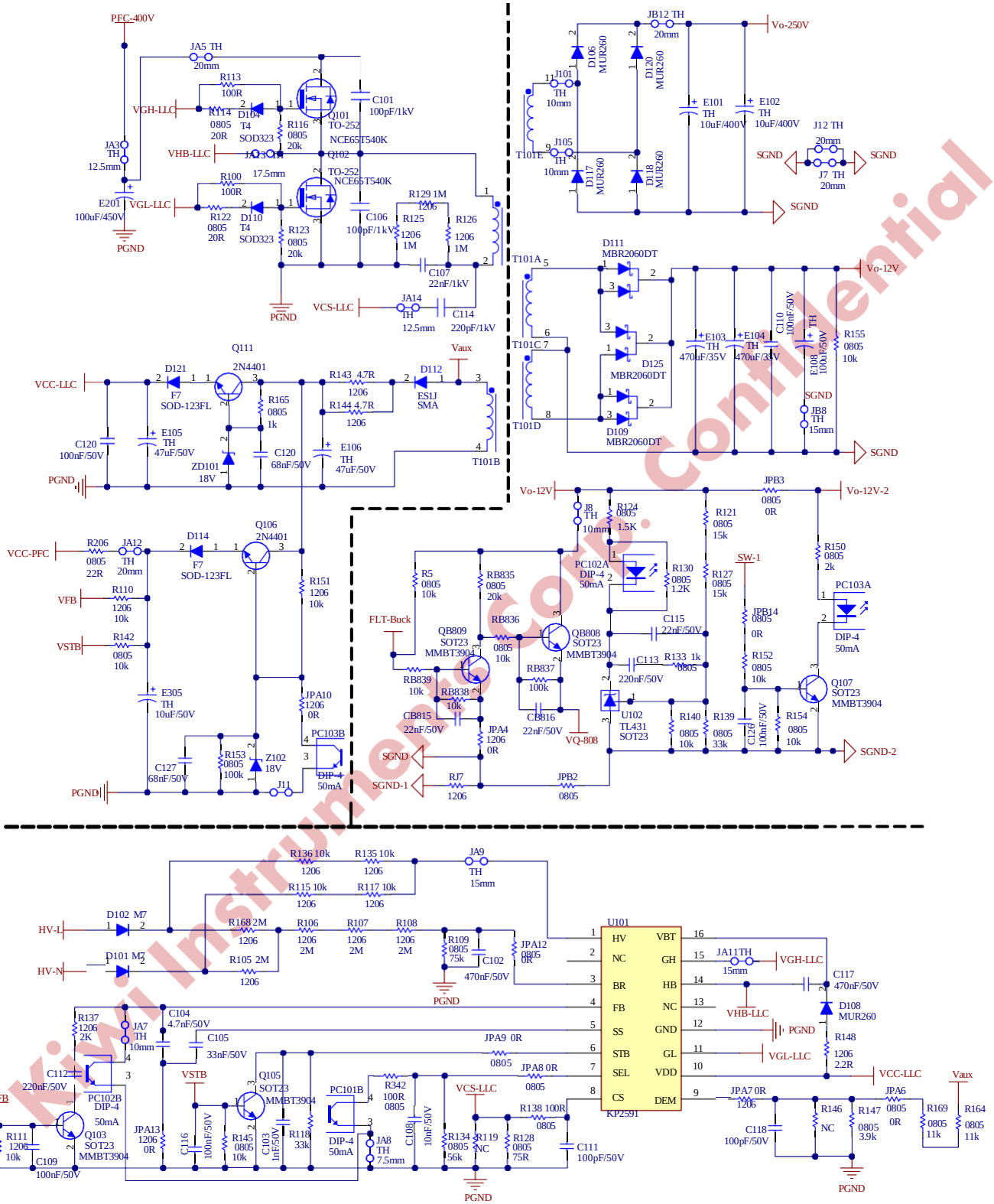
Board Size (mm): L x W=200 x 127

Schematic

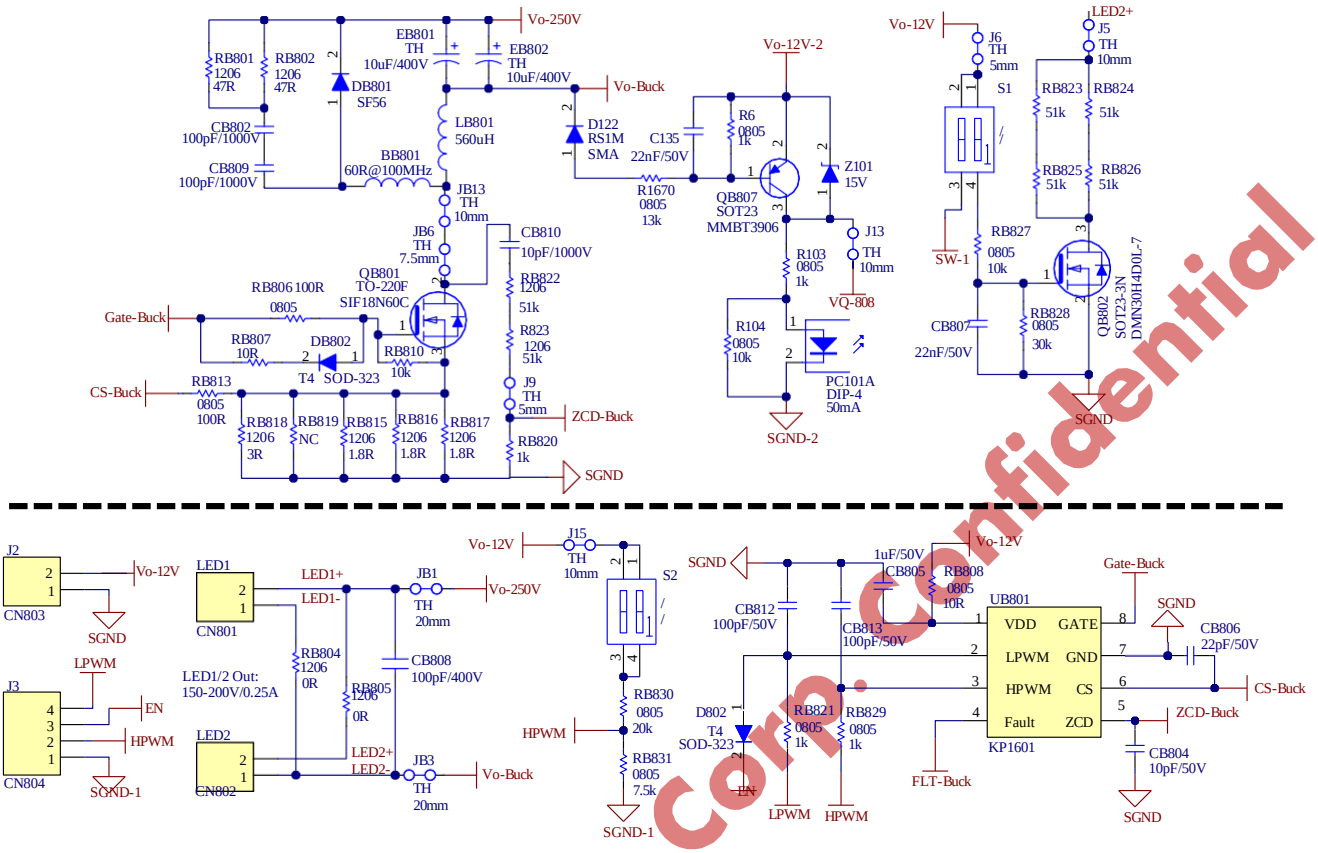
1. Input and PFC Circuit Section:



2. LLC Circuit Section:

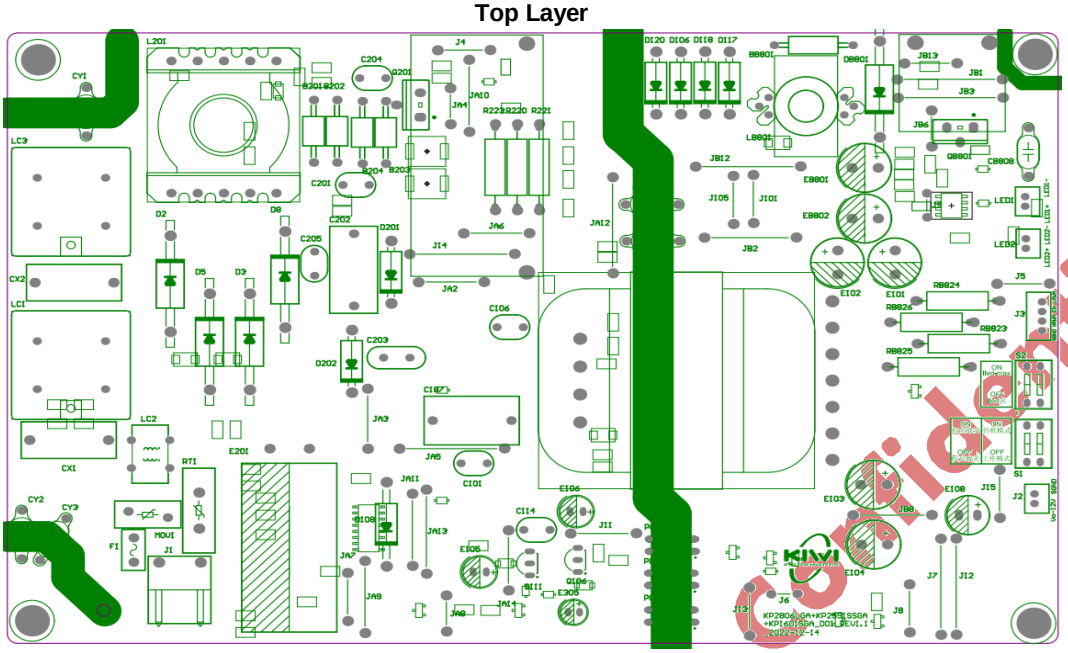


3. Buck and Control Circuit Section:

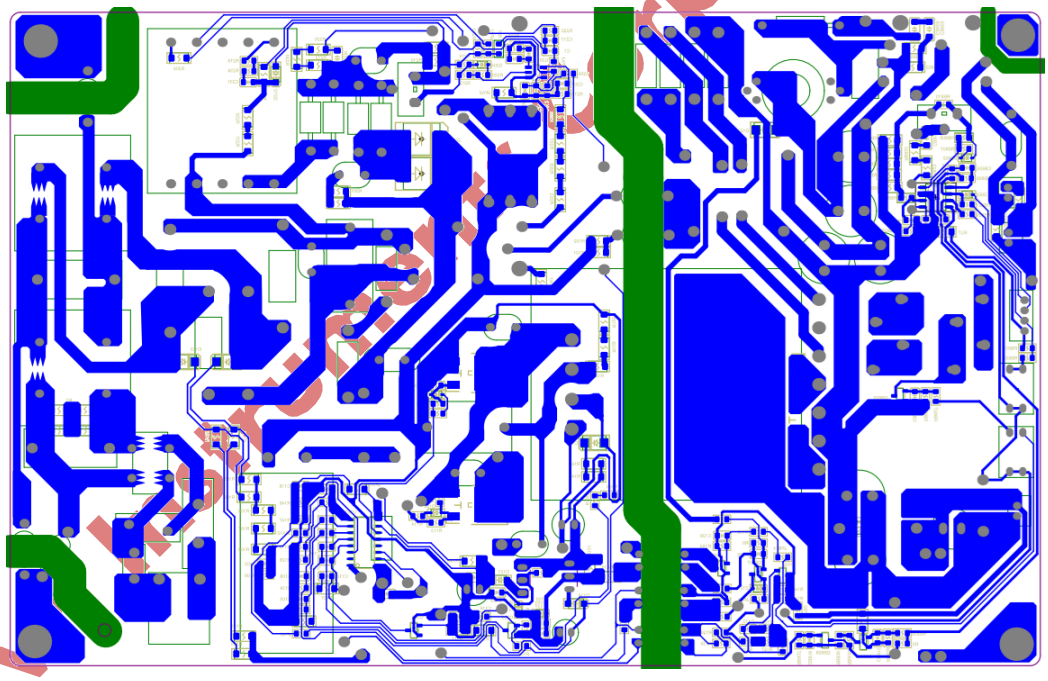


Printed Circuit Board Layout

Top Layer



Bottom Layer



Bill of Material

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	F1	250V 5A	Fuse 250V 5A	TH	CONQUER	MST 5A 250V
2	MOV1	10D561K	VARISTOR 350VAC 70J 1250A	TH	STE	STE10D561K1E Q0FST0R0
3	RT1	1Ω	RES NTC 1Ω 9A	TH	TDK	B57237S0109M 000
4	LC1, LC3	12mH	Common Mode Inductor 22.5*22.5*14 P10	TH	Guangsheng	
5	LC2	100μH	Common Mode Inductor 10*6*5	TH	Rongyao	
6	CX1	470nF	X2 Capacitor 310Vac 17.5*8.5*14.5 P15	TH	KYET	PX474K2C1513
7	CX2	1μF	X2 Capacitor 310Vac 18*10*18 P15	TH	KNSCHA	MPX105K31D5 KN15800
8	CY1, CY2	220pF	Y1 Capacitor 400Vac ±10% T5 P10	TH	STE	Q07B1D221KN0 B0S0N0
9	CY3	47pF	Y1 Capacitor 400Vac ±10% T4 P10	TH	STE	Q08S1D470KN0 B0S0N0
10	CY101, CY102	1.5nF	Y1 Capacitor 400Vac ±10% T5 P10	TH	STE	Q08F1D152MN 0B0S0N0
11	PC101, PC102, PC103	EL817	PHOTO TR 50mA 200%-400%	TH	EVERLIGHT	EL817(A)-F
12	Q101, Q102	650V/8A	MOSFET 650V 8A 540mΩ	TO-252	NCE	NCE65T540K
13	Q201, QB801	600V/18A	MOSFET 650V 18A 330mΩ	TO-220	SI	SIF18N60C
14	QB802	300V/0.25A	MOSFET 300V 0.25A 4Ω	SOT23	DIODES	DMN30H4D0L-7
15	QB807	MMBT3906	T Ransistor -40V -0.1A PNP	SOT23	LGE	MMBT3906LT1
16	Q103, Q105, Q107,QB808, QB809	MMBT3904	T Ransistor 40V 0.1A NPN	SOT23	LGE	MMBT3904 1AM
17	Q106, Q111	2N4401	T Ransistor 25V 1.5A NPN	TO-92	CJ	2N4401
18	Z101	15V	Diode Zener 15V 2% 200mW	SOD323	PANJIT	BZT52-B15S
19	Z102, ZD101	18V	Diode Zener 18V 2% 200mW	SOD323	PANJIT	BZT52-B18S
20	U101	KP2591SGA	High performance, switching power supply controller for LLC current resonant converter	SOP-16	Kiwi instruments	KP2591SGA
21	U201	KP2806LGA	High performance, quasi resonant (QR) boost mode power factor correction (PFC) controller	SOT23-6	Kiwi instruments	KP2806LGA
22	UB801	KP1601SGA	High precision, deep dimming QR buck LED driver	SOP8	Kiwi instruments	KP1601SGA
23	U102	TL431	IC VOL REF 2.5V 100mA 1% 36V	SOT23-3N	MDD	TL431
24	T101	560μH	EE4314, Vertical 4+7pins, Core Material PC44	EE4314	Guangsheng	EE4314
25	L201	180μH	EQ3016, Vertical 5+5pins, Core Material PC44	EQ3016		
26	LB801	560μH	RM6, Vertical 3+3pins, Core Material PC44	RM6		
27	B201, B202, B203, B204, BB801	60R@100MHz	Lead bead	TH	Meled	ML3.5*6*0.8

28	D2, D3, D5, D8	1000V/3A	DIO FRD 3A 1000V 1.1V	DO-201AD	YANGJIE	1N5408
29	D101, D102	1000V/1A	DIO FRD 1A 1000V 1.1V	SMA	MDD	M7
30	D104, D110, D204, D802, DB802	1000V/0.15A	DIO FRD 0.15A 100V 4nS 1.25V	SOD323	CJ	1N4148WS-G
31	D106, D117, D118, D120, D201,D202,D108	600V/2A	DIO FRD 2A 600V 1.25V	DO-15	YANGJIE	MUR260
32	D109, D111, D125	60V/20A	DIO SBD 20A 60V 0.66V	TO-252	PINGWEI	MBR2060GCT
33	D112	600V/1A	DIO FRD 1A 600V 1.1V	SMA	MDD	ES1J
34	D114, D121	1000V/1A	DIO FRD 1A 1000V 500nS 1.3V	SOD123	DIYI	F7
35	D122	1000V/1A	DIO FRD 1A 1000V 500nS 1.3V	SMA	CJ	RS1M
36	D207, D208	ES5JC	DIO FRD 5A 600V 35nS 1.68V	SMC	MDD	ES5JC
37	D210	NC				
38	DB801	400V/5A	DIO SBD 5A 400V 1.25V	DO-27	MDD	SF56
39	E101, E102, EB801, EB802	10μF	Electrolytic Cap 400V 10*12 P5.0	TH	AISHI	EWH2GM100G12OT
40	E103, E104	470μF	Electrolytic Cap 35V 10*16 P5.0	TH	AISHI	ERS1VM471G16OT
41	E105, E106	47μF	Electrolytic Cap 50V 6.3*11 P2.5	TH	AISHI	ERS1HM470E11OT
42	E108	100μF	Electrolytic Cap 50V 8*12 P3.5	TH	AISHI	ERS1HM101F12OT
43	E201	100μF	Electrolytic Cap 450V 18*35 P7.5	TH	AISHI	EWH2WM101M30OT
44	E305	10μF	Electrolytic Cap 50V 5*11 P2.0	TH	AISHI	EWH1HM100D11OT
45	C1	470pF	Ceramic Cap 50V ±5% NPO	0805	WE	885012007061
46	C101, C106, C201, C204, CB808	100pF	Ceramic Cap 1000V ±5% NPO	TH	TDK	CC45SL3DD101JYSNA
47	C102, C117, C211	470nF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207102
48	C103, C207	1nF	Ceramic Cap 50V ±5% NPO	0805	WE	885012007063
49	C104	4.7nF	Ceramic Cap 50V ±5% NPO	0805	WE	885012007067
50	C105	33nF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207095
51	C107	22nF	CBB Cap 1000V ±5% NPO	TH	TDK	B32652A0223J189
52	C108	10nF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207092
53	C109, C110, C116, C120, C126, C206	100nF	Ceramic Cap 50V ±10% X7R	0805	WE	85012207098
54	C111, C118, C210,CB812, CB813	100pF	Ceramic Cap 50V ±5% NPO	0805	WE	885012007057
55	C112, C113	220nF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207100
56	C114, C205	220pF	Ceramic Cap 1000V ±5% NPO	TH	TDK	CC45SL3DD221JYSNA
57	C115, C135, CB807, CB815, CB816	22nF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207094

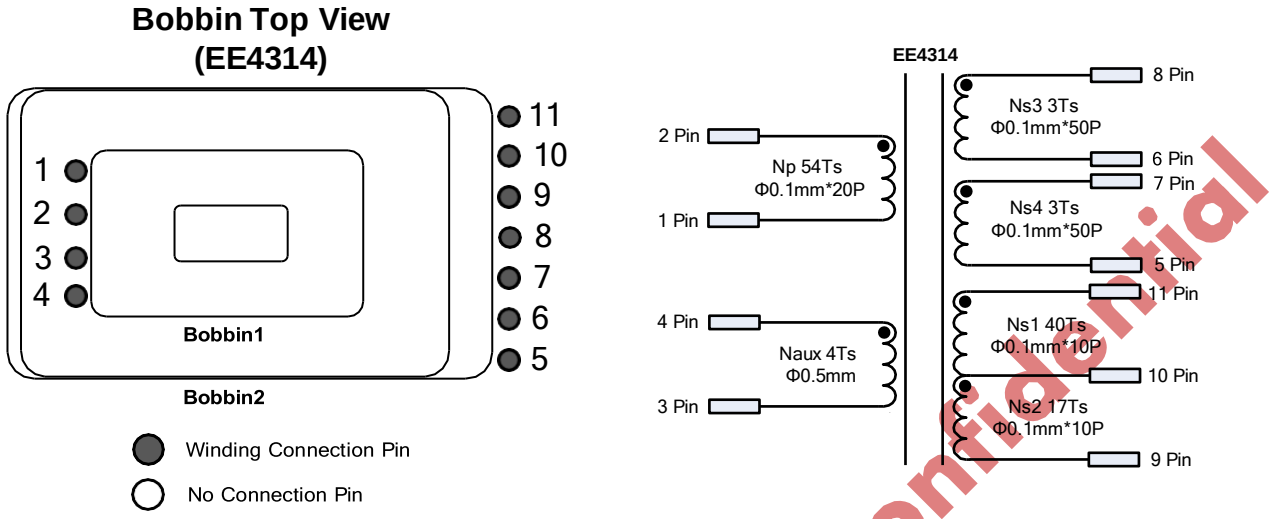
58	C120, C127	68nF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207097
59	C202	1μF	CBB Cap 450V ±10% X7R	TH	PANASONIC	ECWF2W105KA
60	C203	4.7nF	CBB Cap 630V ±5% NPO	TH	SRD	MPP472J2J1LC 4075LC
61	C208, CB810	10pF	Ceramic Cap 1000V ±5% NPO	1206	YAGEO	CC1206JKNPO CBN100
62	C209	10μF	Ceramic Cap 50V ±10% X5R	0805	Murata	GRM21BR61H1 06KE43L
63	C212, CB806	22pF	Ceramic Cap 50V ±5% NPO	0805	WE	885012007053
64	C217	1.5nF	Ceramic Cap 50V ±5% NPO	0805	WE	885012007064
65	C231	NC				
66	CB802, CB809	100pF	Ceramic Cap 1000V ±5% NPO	1206	WE	885342008009
67	CB804	10pF	Ceramic Cap 50V ±5% NPO	0805	WE	885012007051
68	CB805	1μF	Ceramic Cap 50V ±10% X7R	0805	WE	885012207103
69	R1, R2, R3, R4, R125, R126, R129	1M	Chip Resistor ±1% 1/4W	1206	FH	RS-06K1004FT
70	R5, R104, R140, R142, R145, R152, R154, R155	10k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1002FT
71	R6, R103, R133, R165, RB820,	1k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1001FT
72	RB821, RB829	1k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1001FT
73	RB810, RB827, RB836, RB838, RB839	10k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1002FT
74	R7	15R	Chip Resistor ±1% 1/4W	1206	FH	RS-06K15R0FT
75	R100, R113, R138, R342	100R	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1000FT
76	R101, R102	30R	Chip Resistor ±1% 1/4W	1206	FH	RS-06K30R0FT
77	R105, R106, R107, R108, R168, R203	2M	Chip Resistor ±1% 1/4W	1206	FH	RS-06L2004FT
78	R213, R224, R225	2M	Chip Resistor ±1% 1/4W	1206	FH	RS-06L2004FT
79	R109	75k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K7502FT
80	R110, R111, R115, R117, R135, R136, R151	10k	Chip Resistor ±1% 1/4W	1206	FH	RS-06K1002FT
81	R114, R122, R209, R212	20R	Chip Resistor ±1% 1/8W	0805	FH	RS-05K20R0FT
82	R116, R123, R215, RB830 RB835	20k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K2002FT
83	R118, R139	33k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K3302FT
84	R119, R146, R216, R230, R231, R232	NC				
85	R233, R234, JPA1, RB819	NC				

86	R121, R127	15k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1502FT
87	R124	1.5K	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1501FT
88	R128	75R	Chip Resistor ±1% 1/8W	0805	FH	RS-05K75R0FT
89	R130	1.2K	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1201FT
90	R134	56k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5602FT
91	R137	2K	Chip Resistor ±1% 1/4W	1206	FH	RS-06K2003FT
92	R143, R144	4.7R	Chip Resistor ±1% 1/4W	1206	FH	RS-06L4R70FT
93	R147	3.9k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K3901FT
94	R148	2.2R	Chip Resistor ±1% 1/4W	1206	FH	RS-06L2R20FT
95	R150	2k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K2001FT
96	R153, RB837	100k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1003FT
97	R164, R169	11k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1102FT
98	R201, R202, R210, R211, RB801, RB802	47R	Chip Resistor ±1% 1/4W	1206	FH	RS-06K47R0FT
99	R204	10R	Chip Resistor ±1% 1/4W	1206	FH	RS-06K10R0FT
100	R205, R207, R208	1.8M	Chip Resistor ±1% 1/4W	1206	FH	RS-06L1804FT
101	R206	22R	Chip Resistor ±1% 1/8W	0805	FH	RS-05K22R0FT
102	R218	51K	Chip Resistor ±1% 1/8W	0805	FH	RS-05K5102FT
103	R219	47k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K4702FT
104	R220, R221, R223	0.22R	Sampling Resistor ±5% 3W	TH		
105	R222, RB828	30k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K3002FT
106	R823, RB822	51k	Chip Resistor ±1% 1/4W	1206	FH	RS-06K5102FT
107	R1670	13k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1302FT
108	RB806, RB813	100R	Chip Resistor ±1% 1/8W	0805	FH	RS-05K1000FT
109	RB807, RB808	10R	Chip Resistor ±1% 1/8W	R0805	FH	RS-05K10R0FT
110	RB815, RB816, RB817	1.8R	Chip Resistor ±1% 1/4W	1206	FH	RS-06L1R80FT
111	RB818	3R	Chip Resistor ±1% 1/4W	1206	FH	RS-06L3R00FT
112	RB823, RB824, RB825, RB826	51k	Metal Film Resistor ±5% 2W	TH	YAGEO	MFR2WSJB-MB51K
113	RB831	7.5k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K7501FT
114	JPA6, JPA8, JPA9, JPA12, JPB2, JPB3, JPB14	0R	Chip Resistor ±1% 1/8W	0805	FH	RS-05000FT
115	JPA2, JPA4, JPA7, JPA10	0R	Chip Resistor ±1% 1/4W	1206	FH	RS-06000FT
116	JPA13,RB804, RB805, RJ7	0R	Chip Resistor ±1% 1/4W	1206	FH	RS-06000FT
117	JPA3	3k	Chip Resistor ±1% 1/8W	0805	FH	RS-05K3001FT
118	J1	/	7.92mm pitch / disconnectable crimp style connectors	TH	JST	
119	J2,LED1, LED2	/	2.0mm pitch / disconnectable crimp style connectors	TH	JST	

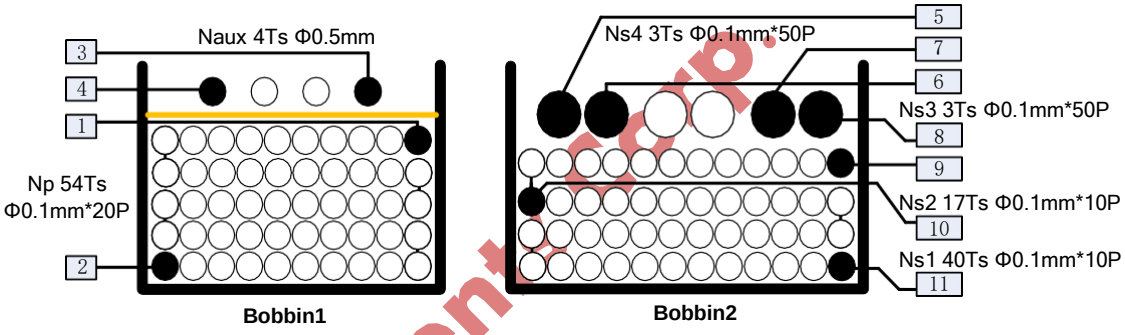
120	J3	/	2.0mm pitch / disconnectable crimp style connectors	TH	JST	
121	S1, S2	/	2.54mm 2 position DIP switches	TH	YIYUAN	YDA02HG2

Transformer Manufacture Guide---T101

1. Electrical Diagram



2. Winding Diagram



3. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	Np	Primary	2	1	0.1*10P	54T	
2	Naux	Auxiliary	4	3	0.5mm	3T	Smooth Wound
3	Ns1	Secondary1	11	10	0.1*10P	40T	
4	Ns2	Secondary1	10	9	0.1*10P	17T	
5	Ns3	Secondary2	8	6	0.1*50P	3T	Parallel Wound
6	Ns4	Secondary3	7	5	0.1*50P	3T	

4. Electrical Specification

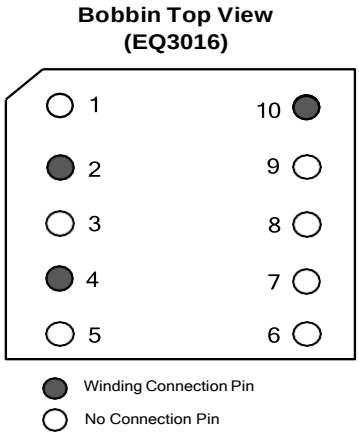
Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1 - 2, all other windings open	560H±5%
Primary Leakage Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1 - 2, all other windings shorted	79μH±5%
DC Resistance	Measured at 40kHz, 1.0 VRMS	Pins 1 - 2	0.38Ω Max

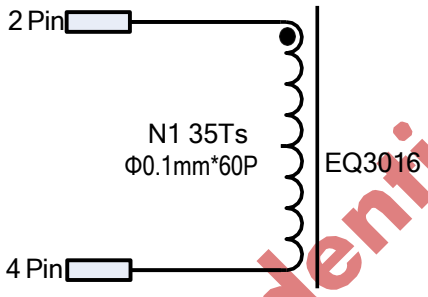
5. Transformer BOM

Items	Description
1	**Core:** EE4314, PC44 or equivalent, AE=78mm^2
2	**Bobbin:** EE4314, 4+7 Pin
3	**Wire:** Φ0.1*10mm, 2UEW, Class B
4	**Wire:** Φ0.1*20mm, 2UEW, Class B
5	**Wire:** Φ0.1*50mm, 2UEW, Class B
6	**Triple Insulation Wire:** Φ0.5mm TIW
7	**Tape:** 6mm(W)×0.06mm(TH)

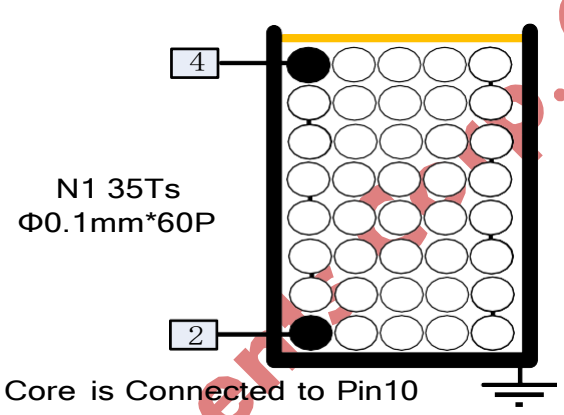
Transformer Manufacture Guide---L201

6. Electrical Diagram





7. Winding Diagram



8. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	N1	Primary	2	4	0.1*60P	35T	

9. Electrical Specification

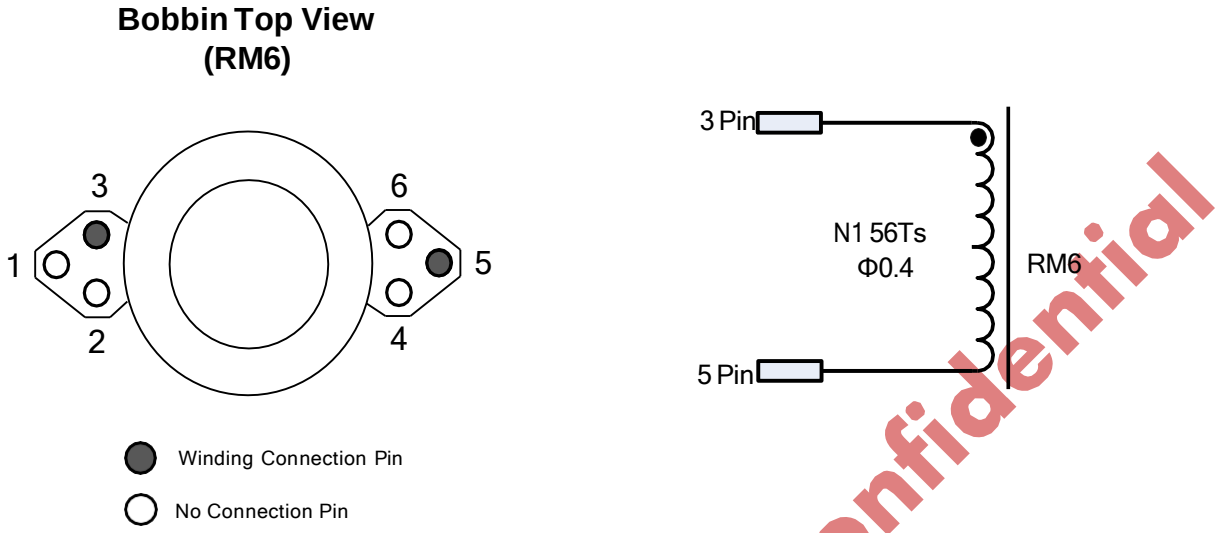
Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 2 - 4, all other windings open	180μH±5%
DC Resistance	Measured at 40kHz, 1.0 VRMS	Pins 2 - 4	0.08Ω Max

10. Transformer BOM

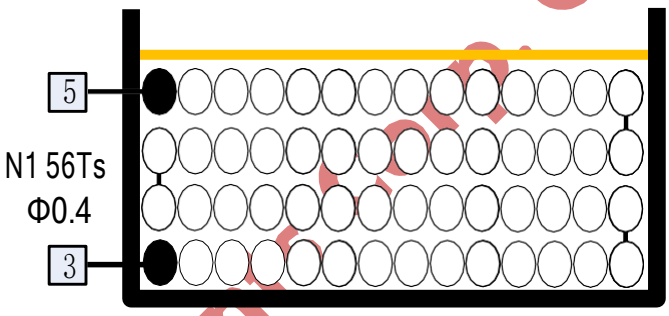
Items	Description
1	**Core:** EQ3016, PC44, AE=110mm^2
2	**Bobbin:** EQ3016, 5+5 Pin
3	**Wire:** Φ0.1mm*60P, 2UEW, Class B
4	**Tape:** 8mm(W)×0.06mm(TH)

Transformer Manufacture Guide---LB801

11. Electrical Diagram



12. Winding Diagram



13. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	N1	Primary	3	5	0.4mm	56T	

14. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 3 - 5, all other windings open	560μH±5%
DC Resistance	Measured at 40kHz, 1.0 VRMS	Pins 3 - 5	0.22Ω Max

15. Transformer BOM

Items	Description
1	**Core:** RM6, PC44, AE=37mm^2
2	**Bobbin:** RM6, 3+3 Pin
3	**Wire:** Φ0.4mm, 2UEW, Class B
4	**Tape:** 6mm(W)×0.06mm(TH)

Test Result

1. Steady State Characteristics

1.1 PF and THD

Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=150-200V/0.5A.

Standard: PF>0.95, THD<15% @90~265Vac & Full load.

Result: Pass

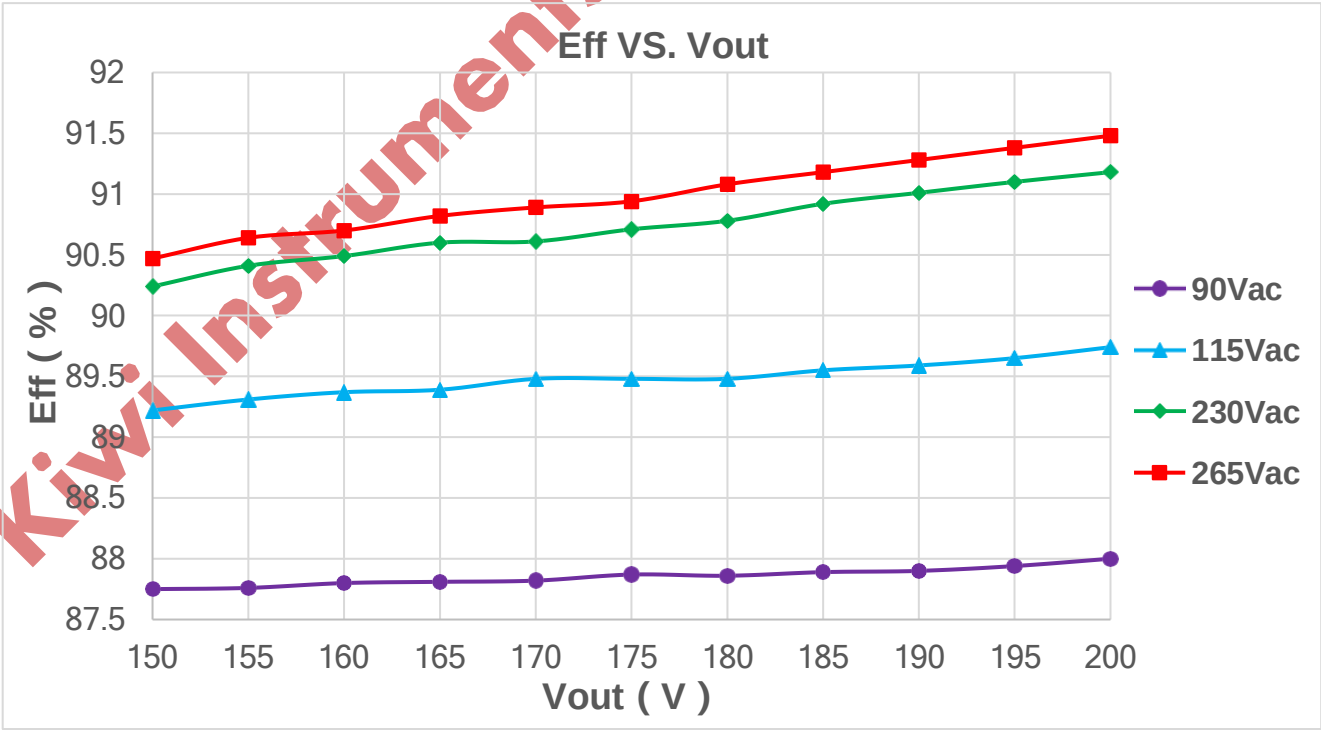
Vo2(V)	Vin(V)	F(Hz)	PF	THD
150V	90	60	0.992	12.64%
	115	60	0.986	13.45%
	230	50	0.968	12.29%
	265	50	0.952	11.93%
200V	90	60	0.994	10.2%
	115	60	0.99	10.37%
	230	50	0.973	12.51%
	265	50	0.961	12.55%

1.2 Efficiency VS. Vo Curve

Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=150-200V/0.5A.

Standard: Eff > 86%.

Result: Pass

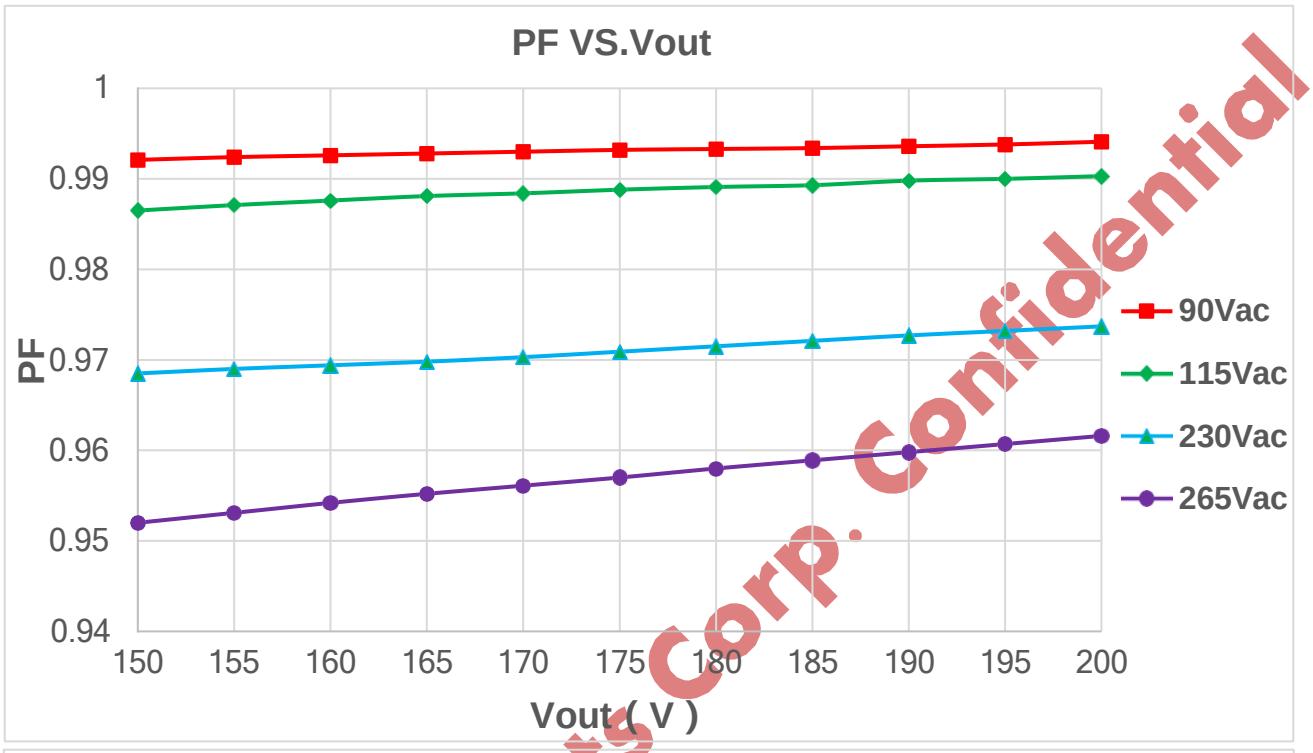


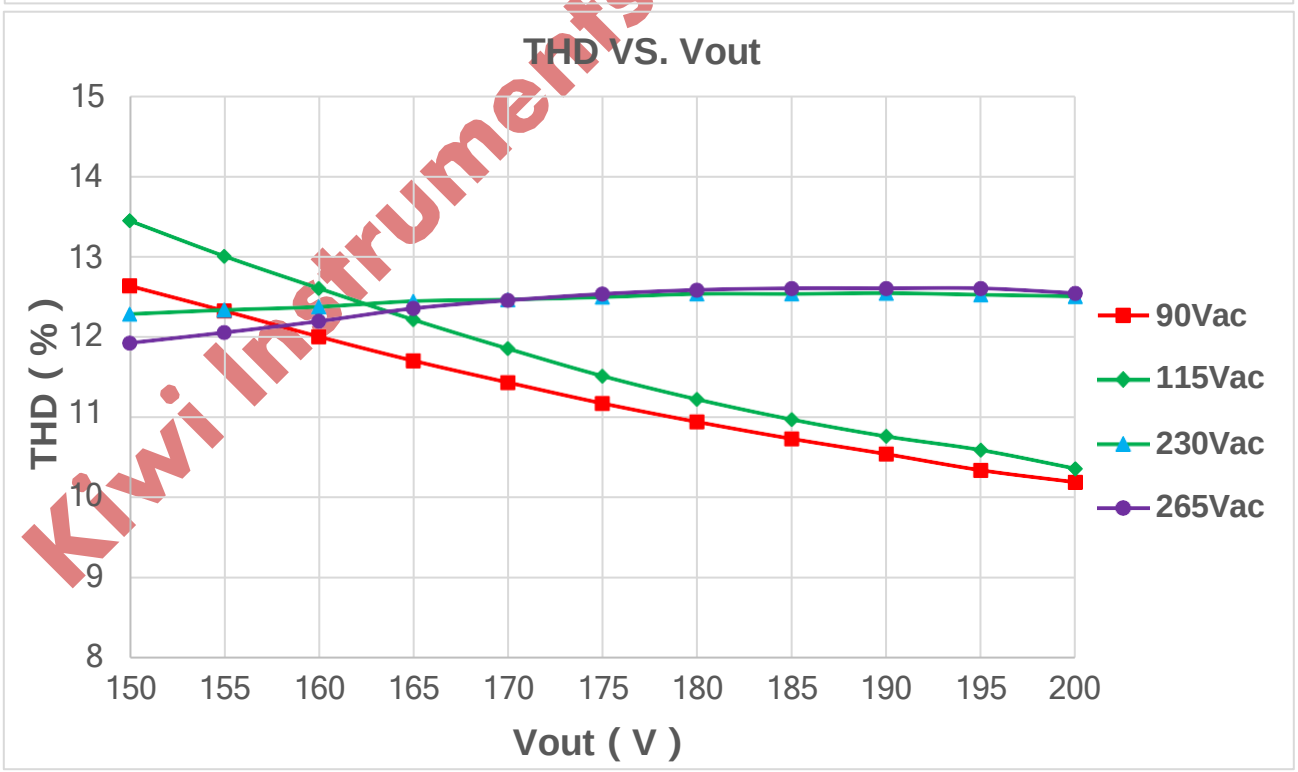
1.3 PF, THD VS. Vout

Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=150-200V/0.5A.

Standard: PF>0.95 @ Full load.

Result: Pass





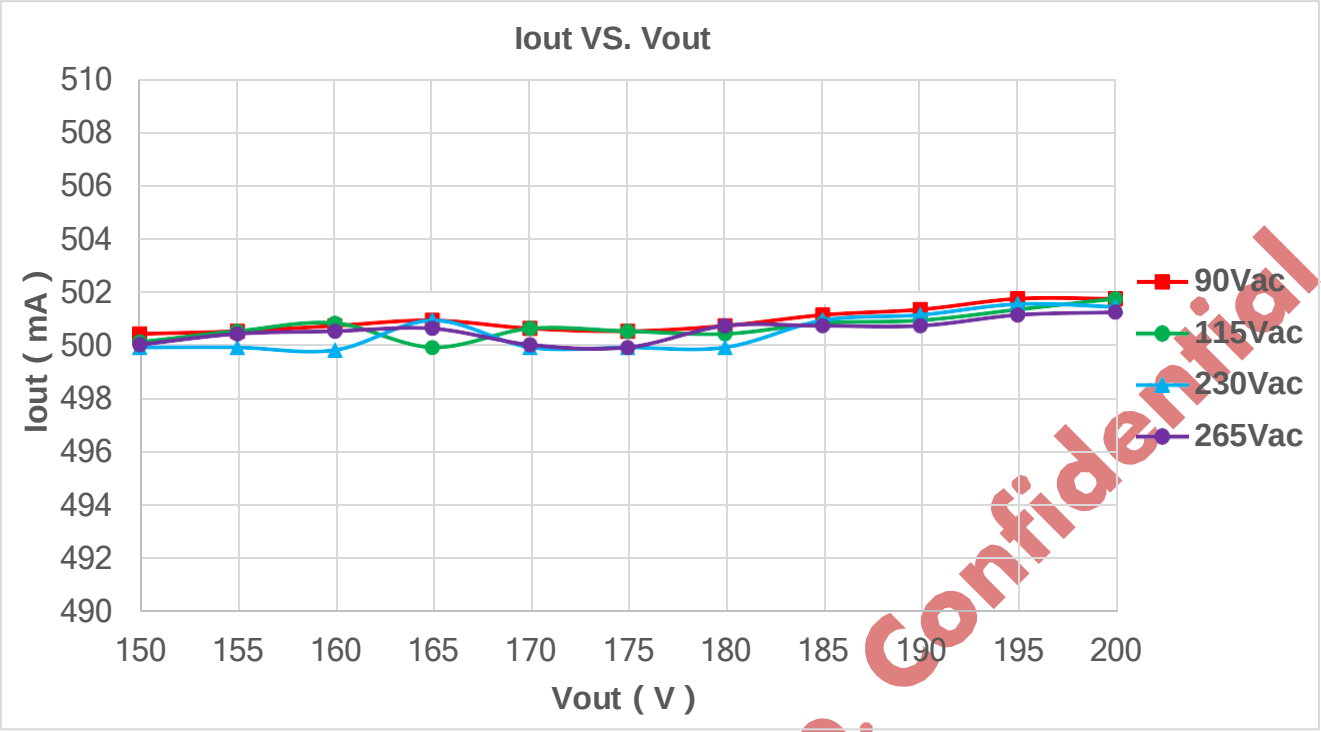
1.4 Line Regulation

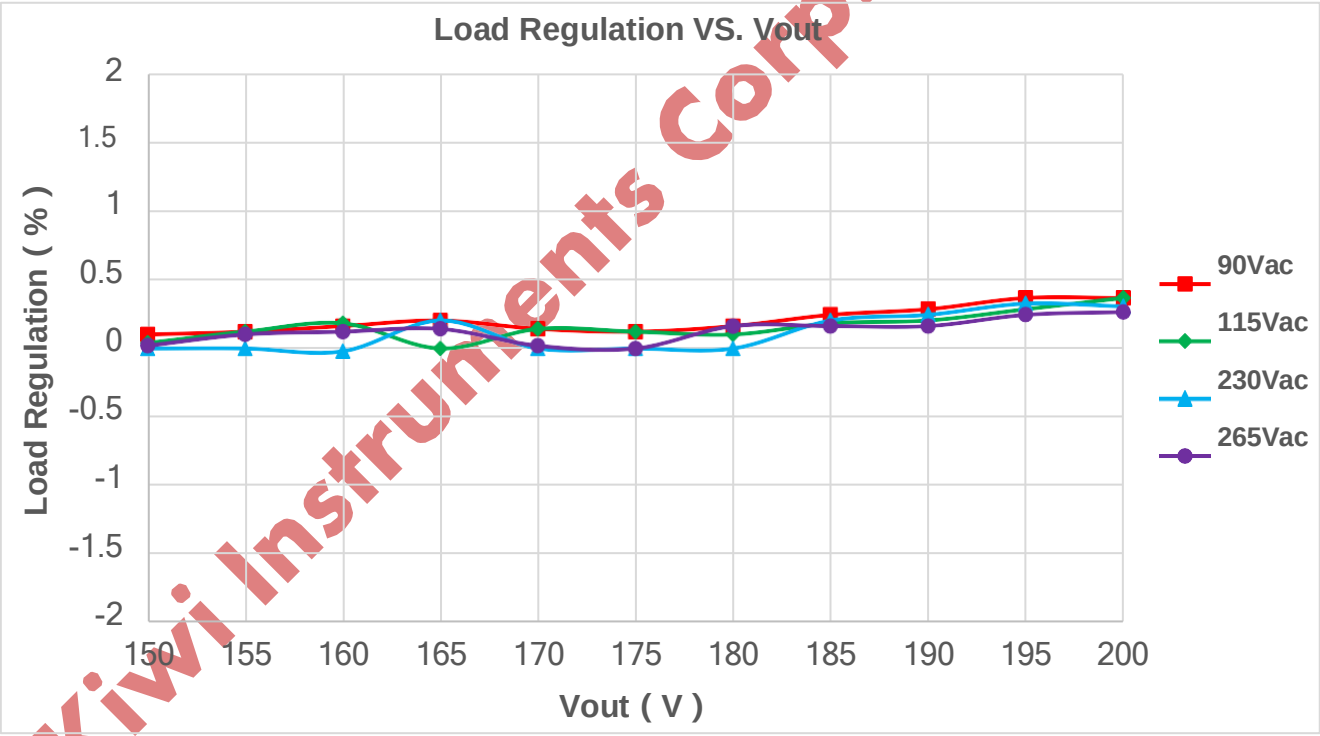
Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=150-200V/0.5A.

Standard: Line Regulation <1%.

Result: Pass

Vin(Vac)	Io(mA)										
	Vo= 150V	Vo= 155V	Vo= 160V	Vo= 165V	Vo= 170V	Vo= 175V	Vo= 180V	Vo= 185V	Vo= 190V	Vo= 195V	Vo= 200V
90	500.5	500.6	500.8	501	500.7	500.6	500.8	501.2	501.4	501.8	501.8
115	500.2	500.6	500.9	500	500.7	500.6	500.5	500.9	501	501.4	501.8
230	500	500	499.9	501	500	500	500	501	501.2	501.6	501.5
165	500.1	500.5	500.6	500.7	500.1	500	500.8	500.8	500.8	501.2	501.3
Line Reg	0.10%	0.12%	0.20%	0.20%	0.14%	0.12%	0.16%	0.08%	0.12%	0.12%	0.10%





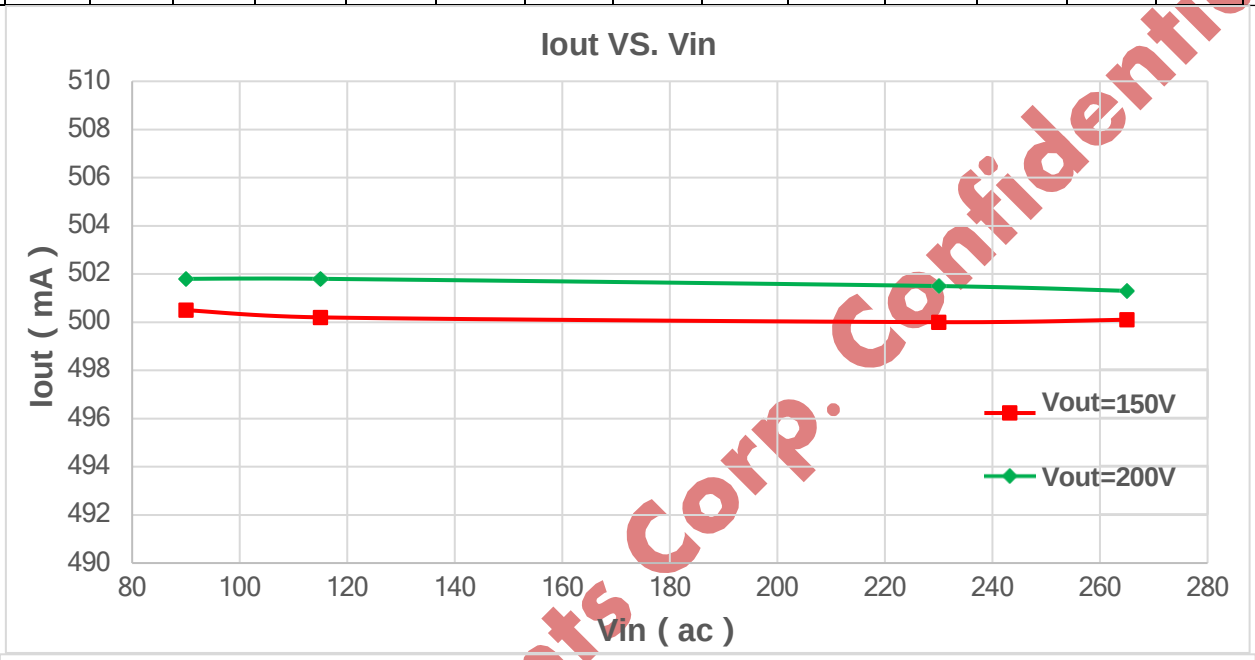
1.5 Output Current Regulation

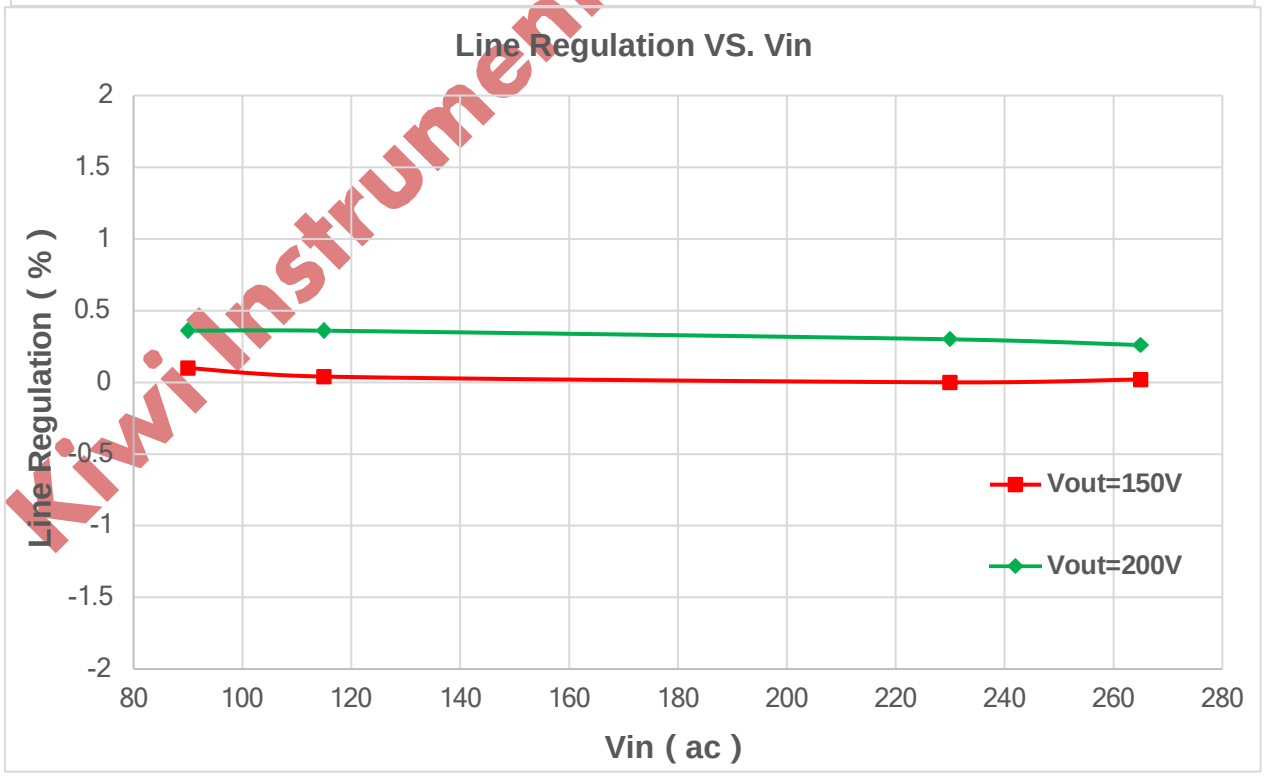
Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=150-200V/0.5A.

Standard: Load Regulation <2%.

Result: Pass

Vin	Io(mA)														Load
	Vo=150V	Vo=155V	Vo=160V	Vo=165V	Vo=170V	Vo=175V	Vo=180V	Vo=185V	Vo=190V	Vo=195V	Vo=200V	Max	Min	Avg	Reg
240	500.5	500.6	500.8	501	500.7	500.6	500.8	501.2	501.4	501.8	501.8	501.8	500.5	501	0.26%
264	500.2	500.6	500.9	500	500.7	500.6	500.5	500.9	501	501.4	501.8	501.8	500	500.7	0.36%
277	500	500	499.9	501	500	500	500	501	501.2	501.6	501.5	501.6	499.9	500.5	0.34%
300	500.1	500.5	500.6	500.7	500.1	500	500.8	500.8	500.8	501.2	501.3	501.3	500	500.6	0.26%





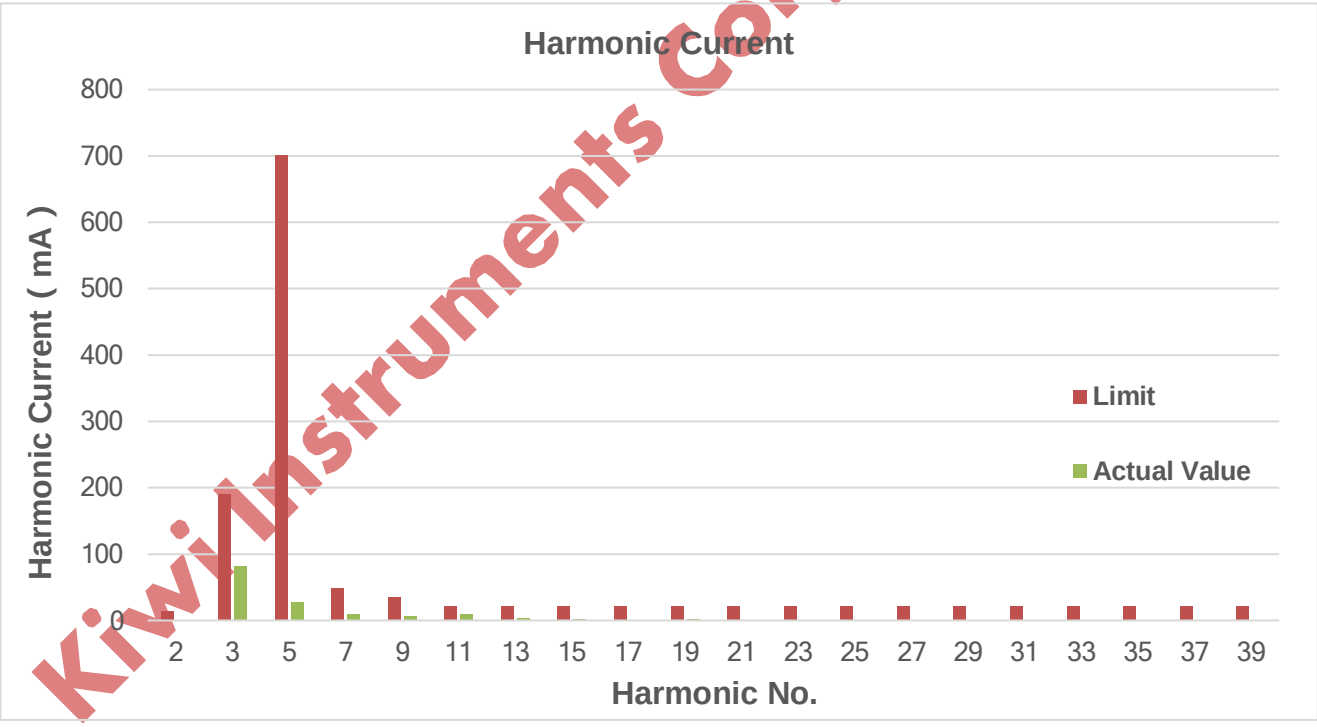
1.6 Harmonic Current

Test Conditions: Input voltage: 230Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard: IEC61000-3-2 Class C.

Result: Pass

Harmonic NO.	Limit (mA)	Actual Value(mA)	Result	Harmonic NO.	Limit (mA)	Actual Value(mA)	Result
2	14	0.4	Pass	3	190	81.5	Pass
5	702	27.5	Pass	7	49	9.86	Pass
9	35	7.23	Pass	11	21	8.9	Pass
13	21	3.45	Pass	15	21	2.5	Pass
17	21	0.87	Pass	19	21	1.85	Pass
21	21	0.76	Pass	23	21	0.9	Pass
25	21	0.25	Pass	27	21	0.83	Pass
29	21	0.38	Pass	31	21	0.44	Pass
33	21	0.1	Pass	35	21	0.36	Pass
37	21	0.1	Pass	39	21	0.32	Pass



1.7 Output Current Ripple

Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

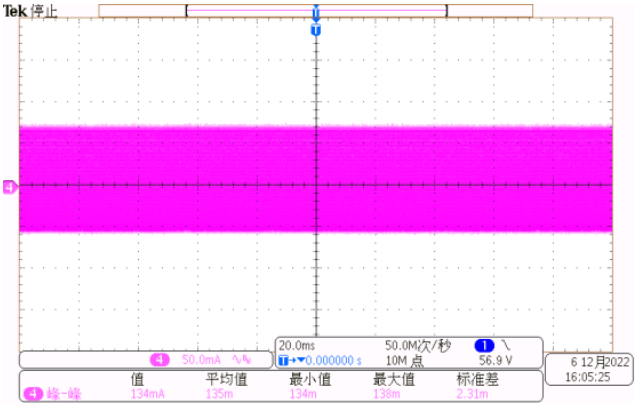
Standard: Ripple <30%.

Result: Pass

Vin(Vac)	F(Hz)	Io(mA)	Current Ripple Ipeak-peak (mA)	Ripple (%)
90	60	501.8	134	13.4
115	60	501.8	130	13
230	50	501.5	140	14
265	50	501.3	136	13.6

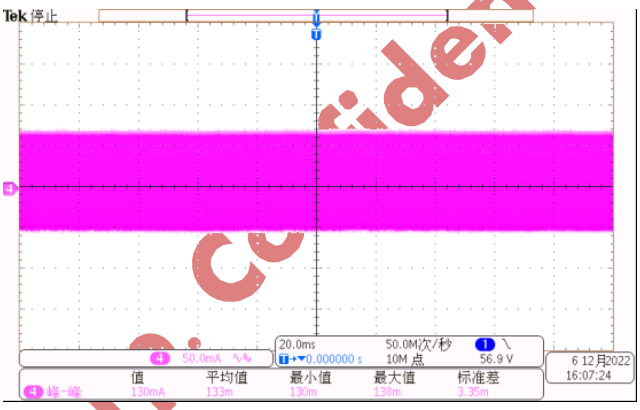
Waveforms:

Test Condition: 90Vac/60Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output



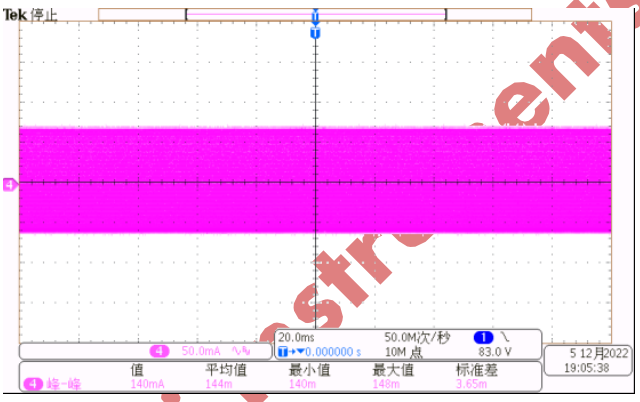
(CH4-Io)
Comments: Ipeak-peak=134mA

Test Condition: 115Vac/60Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output



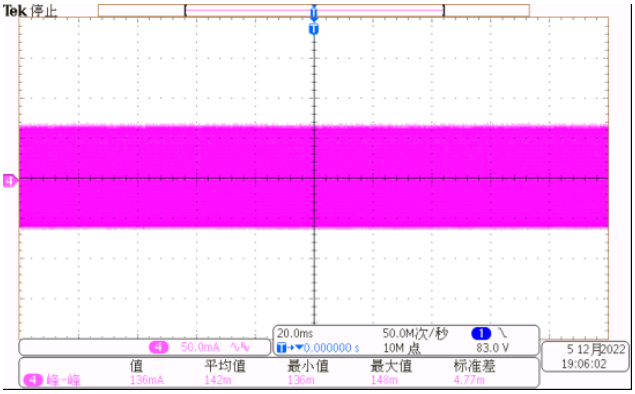
(CH4-Io)
Comments: Ipeak-peak=130mA

Test Condition: 230Vac/50Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH4-Io)
Comments: Ipeak-peak=140mA

Test Condition: 265Vac/50Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output



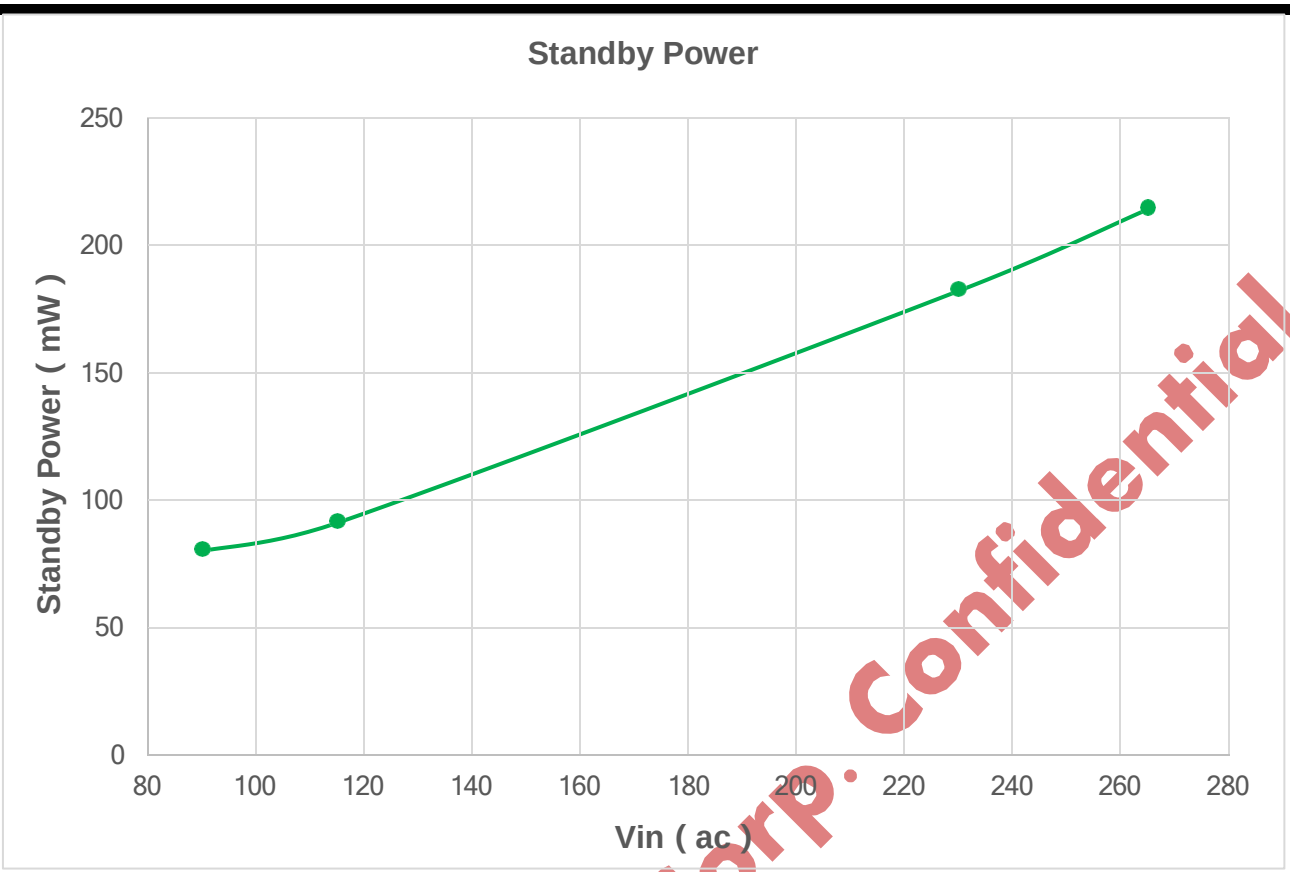
(CH4-Io)
Comments: Ipeak-peak=136mA

1.8 Standby Power

Test Conditions: Input voltage: 90-265Vac; Output: Dim OFF.

Standard: Standby power < 500mW.

Result: Pass



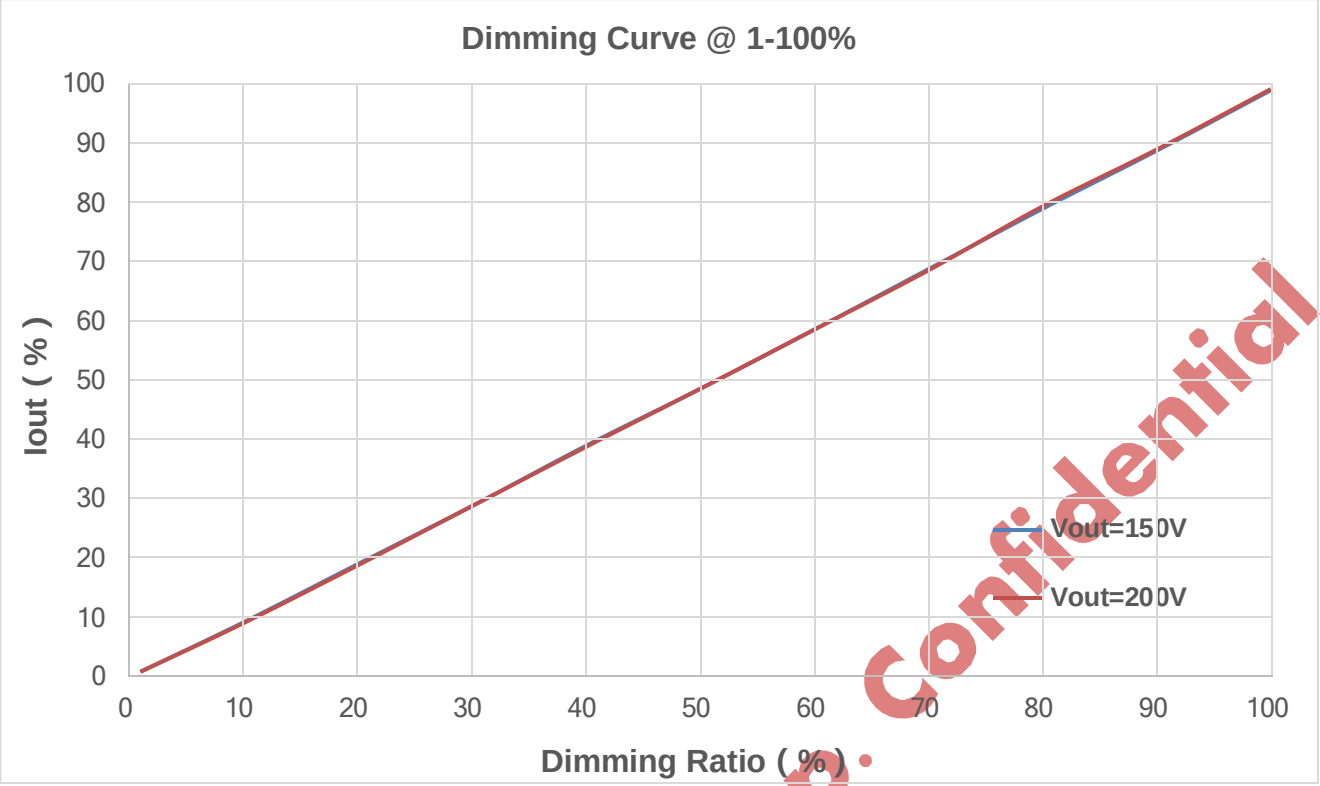
1.9 Dimming Curve

Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=150/200V;

Dimming range: 1%-100%.

Standard: High linearity of dimming curve.

Result: Pass



2 Dynamic Characteristics

2.1 Start-up Characteristics

Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

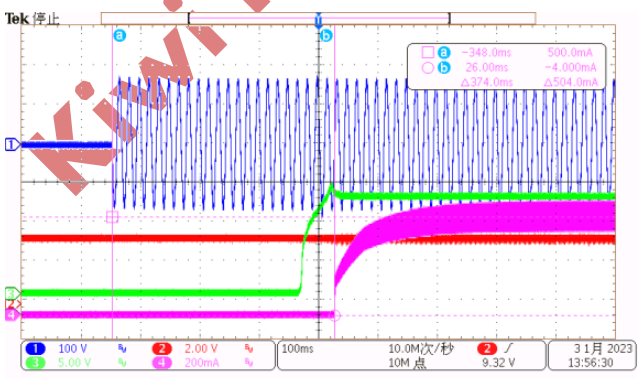
Standard: Startup time < 500ms, and no flicker and no overshoot.

Result: Pass

Input Voltage	90Vac/60Hz	115Vac/60Hz	230Vac/50Hz	265Vac/50Hz
Startup Time(mS)	484	374	341	338

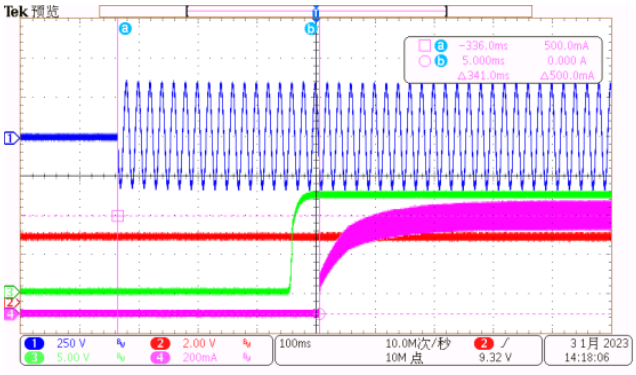
Waveforms:

Test Condition: 115Vac/60Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

Test Condition: 230Vac/50Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

2.2 Power off Characteristics

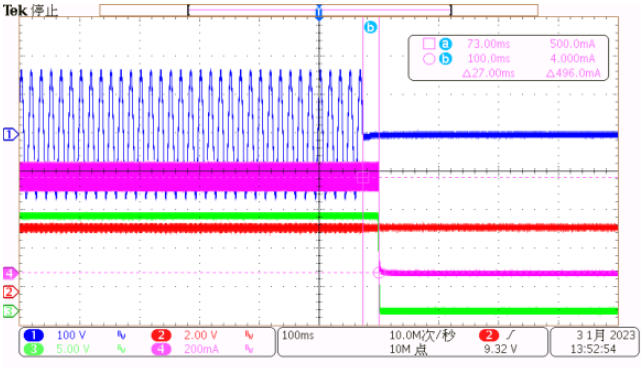
Test Conditions: Input: 115/230Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard: Holdup time ⩾ 10ms, and no flicker and no overshoot.

Result: Pass

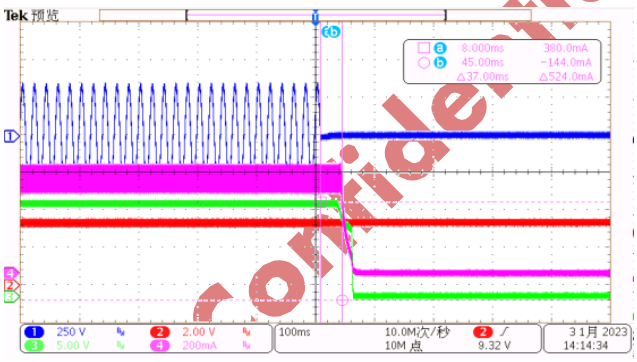
Waveforms:

Test Condition: 115Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

Test Condition: 230Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

2.3 Dim on/off Characteristics

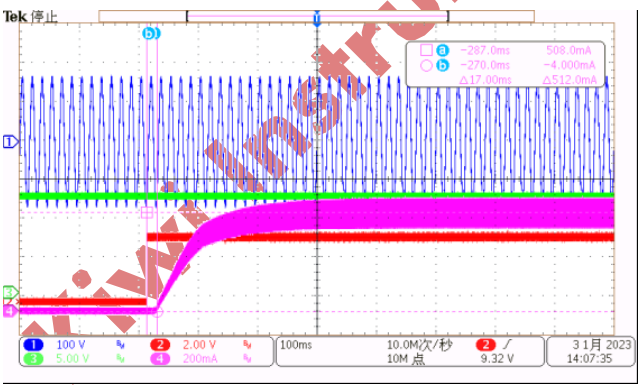
Test Conditions: Input: 115/230Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard: No flicker and no overshoot

Result: Pass

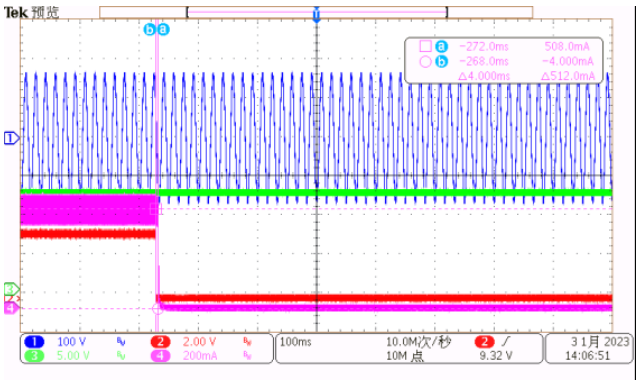
Waveforms:

Test Condition: 115Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Dim on



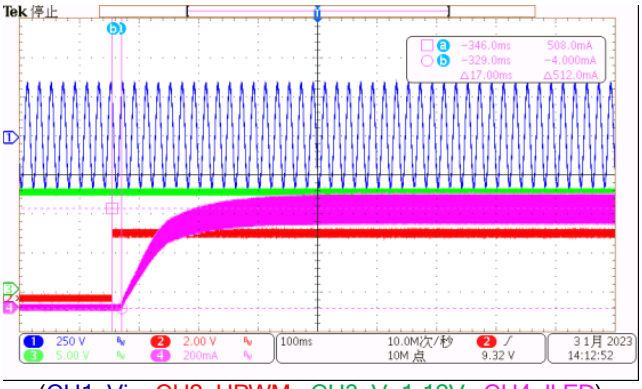
(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

Test Condition: 115Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Dim off



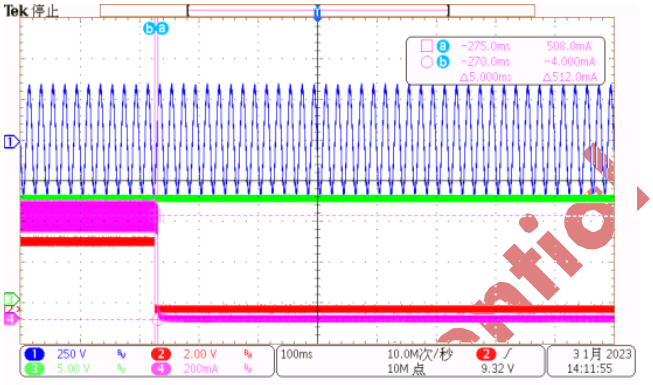
(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

Test Condition: 230Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Dim on



(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

Test Condition: 230Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Dim off



(CH1: Vin; CH2: HPWM; CH3: Vo1-12V; CH4: ILED)
Comments: OK, no flicker and no overshoot

3 Reliability Testing

3.1 Output Short Protection

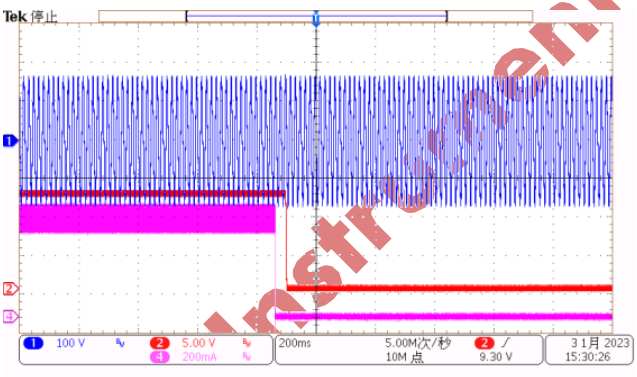
Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard: Output is latch and no component damaged.

Result: Pass

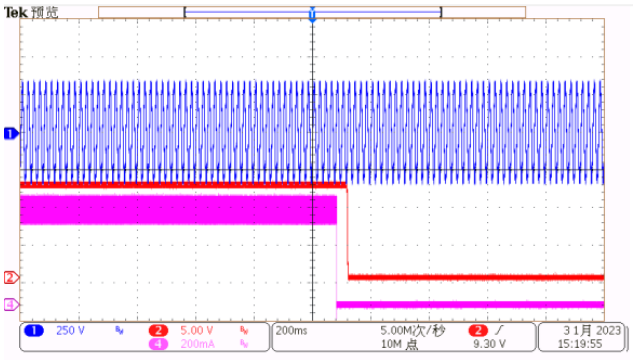
Waveforms:

Test Condition: 115Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: Vo1-12V; CH4: ILED)
Comments: OK

Test Condition: 230Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: Vo1-12V; CH4: ILED)
Comments: OK

3.2 Open Load Protection

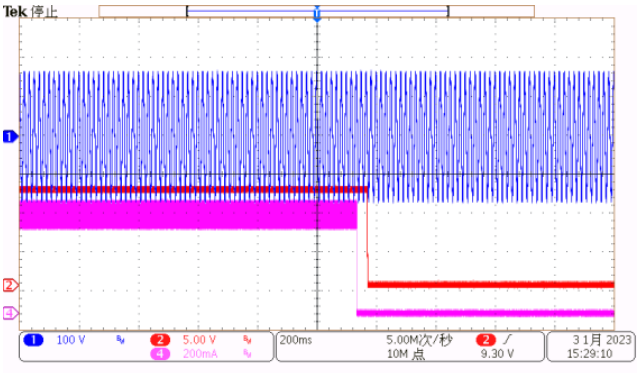
Test Conditions: Input voltage: 90-265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard: Output is latch and no component damaged.

Result: Pass

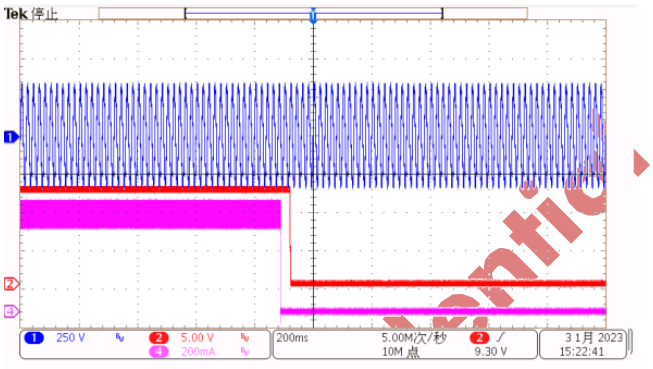
Waveforms:

Test Condition: 115Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: Vo1-12V; CH4: ILED)
Comments: OK

Test Condition: 230Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output



(CH1: Vin; CH2: Vo1-12V; CH4: ILED)
Comments: OK

3.3 Maximum Stress of PFC Circuit

Test Conditions: Input voltage: 265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

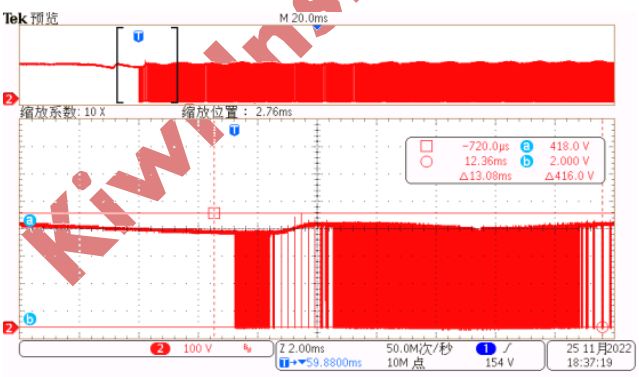
Standard: MOSFET and DIODE < 90% Rating.

Result: Pass

Component	Maximum Stress(V)			Rating	Result
	Startup	Steady	Short		
MOSFET Q201	418	410	442	600V	PASS
DIODE Q207/Q208	382	410	434	600V	PASS

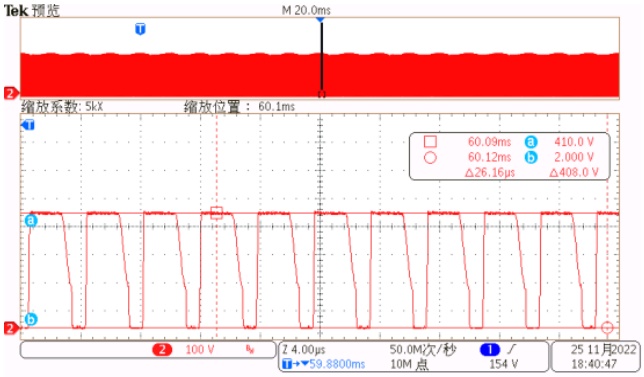
Waveforms:

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



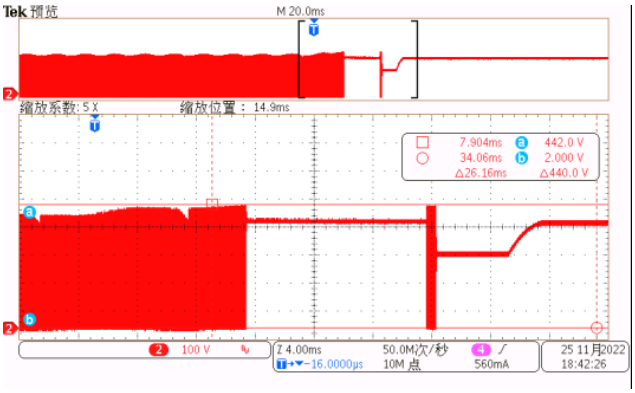
(CH2: VDS)
Comments: OK, VDS_max=418V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



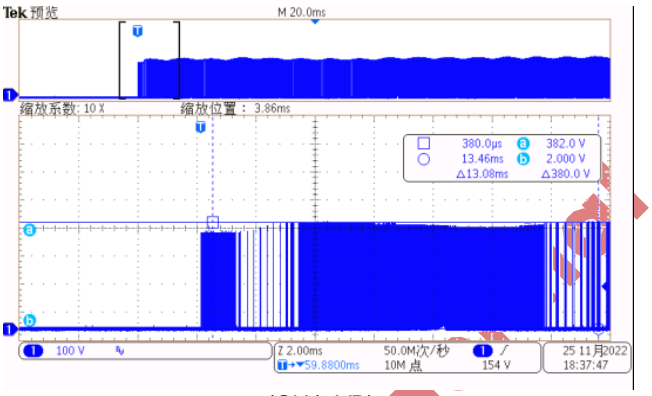
(CH2: VDS)
Comments: OK, VDS_max=410V

Test Condition: 265Vac/50Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



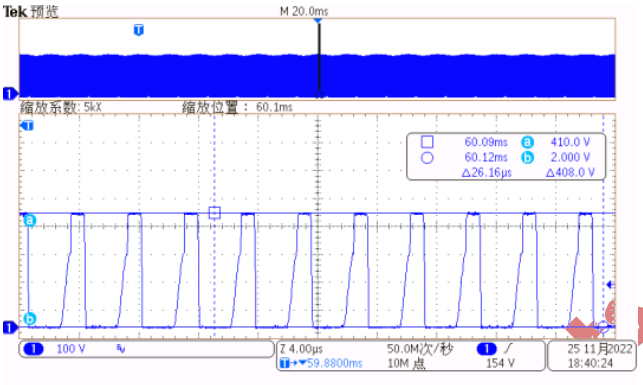
(CH2: VDS)
Comments: OK, VDS_max=442V

Test Condition: 265Vac/50Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



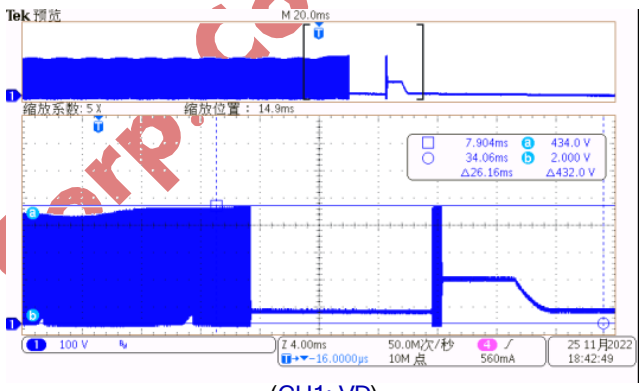
(CH1: VD)
Comments: OK, VD_max=382V

Test Condition: 265Vac/50Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



(CH1: VD)
Comments: OK, VD_max=410V

Test Condition: 265Vac/50Hz Input, Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



(CH1: VD)
Comments: OK, VD_max=434V

3.4 Maximum Stress of LLC Circuit

Test Conditions: Input voltage: 265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

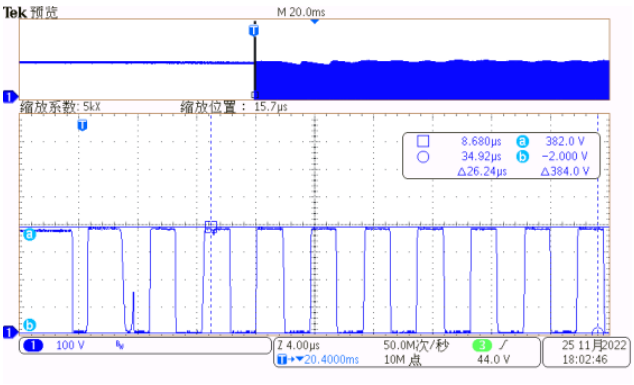
Standard: MOSFET and DIODE < 90% Rating.

Result: Pass

Component	Maximum Stress(V)			Rating	Result
	Startup	Steady	Short		
MOSFET Q101	382	414	430	650V	PASS
MOSFET Q102	382	414	430	650V	PASS
CAP C107	430	324	426	1000V	PASS
DIODE D106	265	257	257	600V	PASS
DIODE D117	265	257	257	600V	PASS

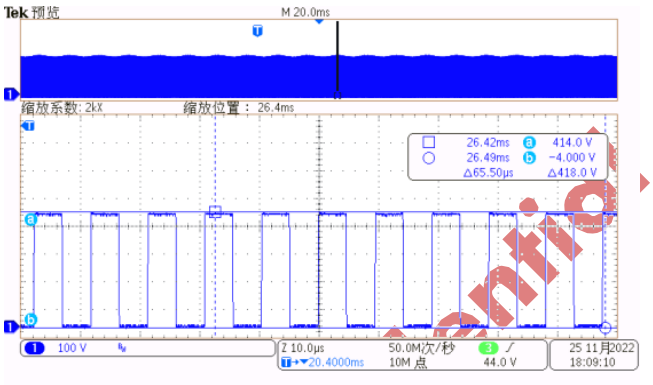
Waveforms:

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



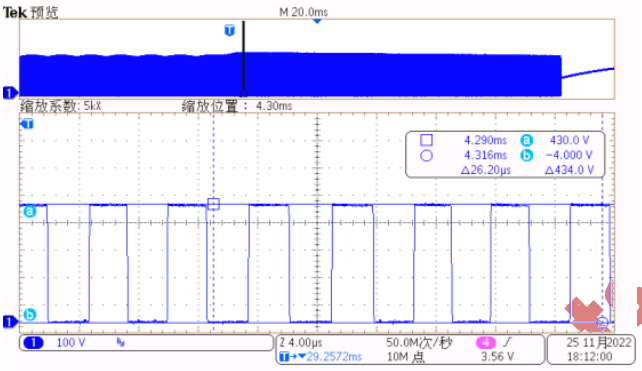
(CH1: VDS-Q101)
Comments: OK, VDS_max=382V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



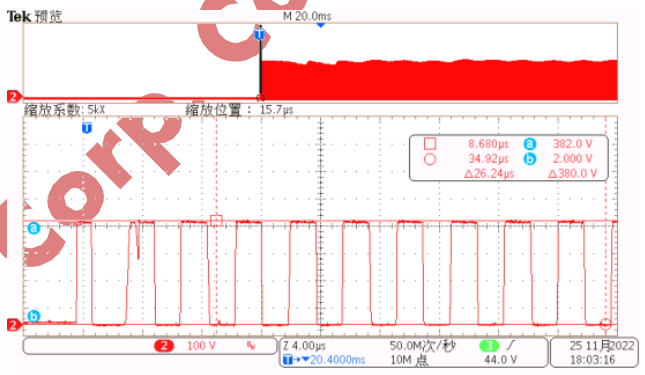
(CH1: VDS-Q101)
Comments: OK, VDS_max=414V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



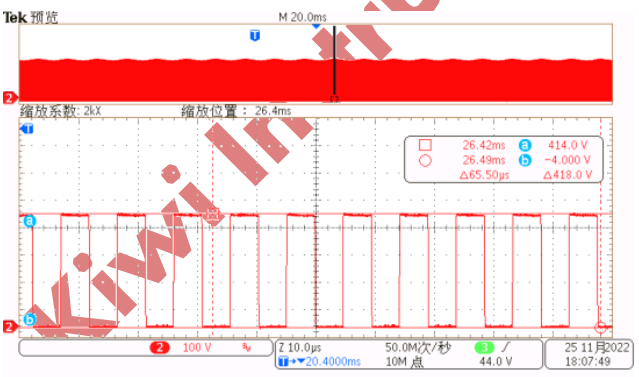
(CH1: VDS-Q101)
Comments: OK, VDS_max=430V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



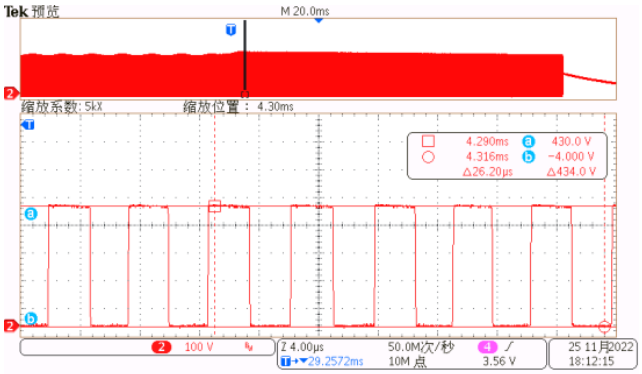
(CH2: VDS-Q102)
Comments: OK, VDS_max=382V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



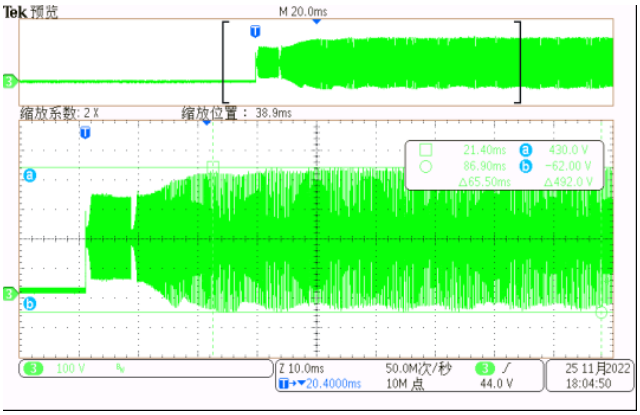
(CH2: VDS-Q102)
Comments: OK, VDS_max=414V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



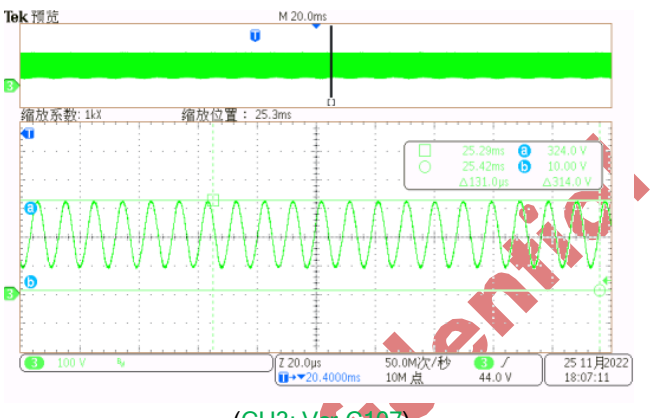
(CH2: VDS-Q102)
Comments: OK, VDS_max=430V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



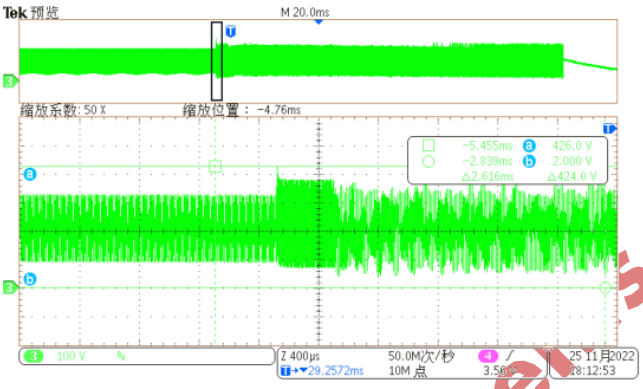
(CH3: Vcr-C107)
Comments: OK, Vcr_max=430V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



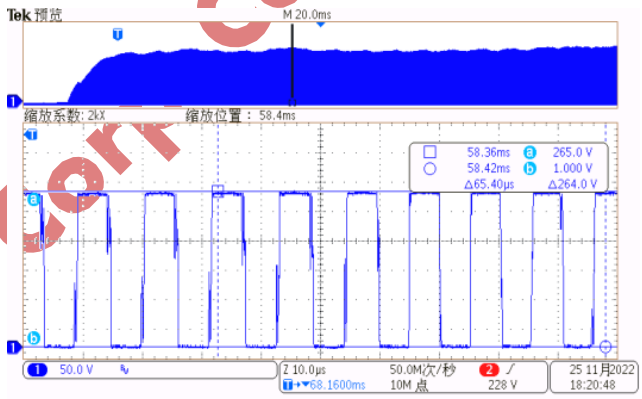
(CH3: Vcr-C107)
Comments: OK, Vcr_max=324V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



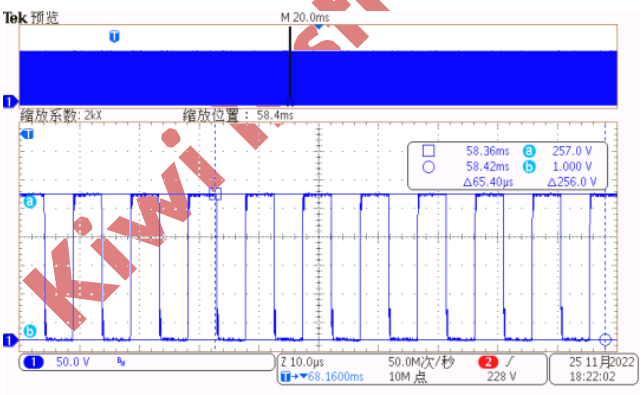
(CH3: Vcr-C107)
Comments: OK, Vcr_max=426V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



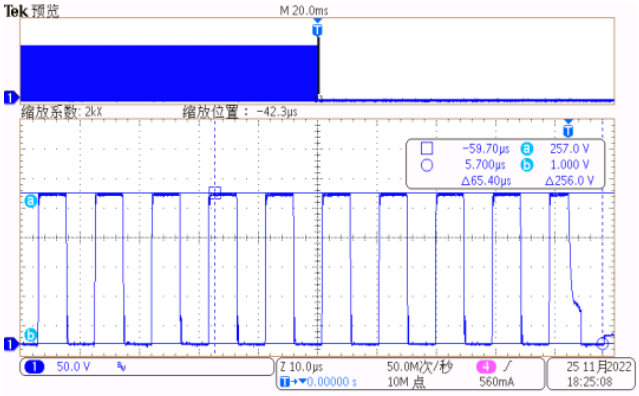
(CH1: VD-D106)
Comments: OK, VD_max=265V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



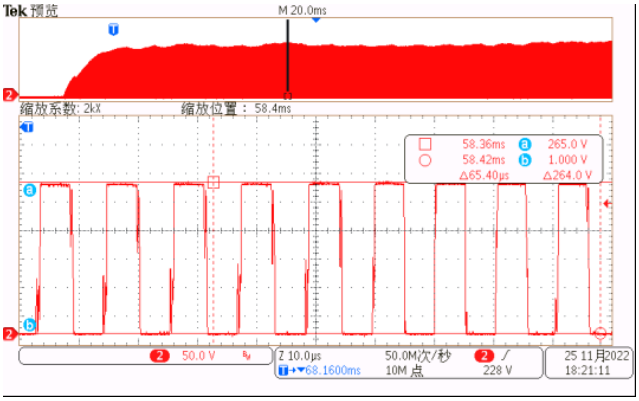
(CH1: VD-D106)
Comments: OK, VD_max=257V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



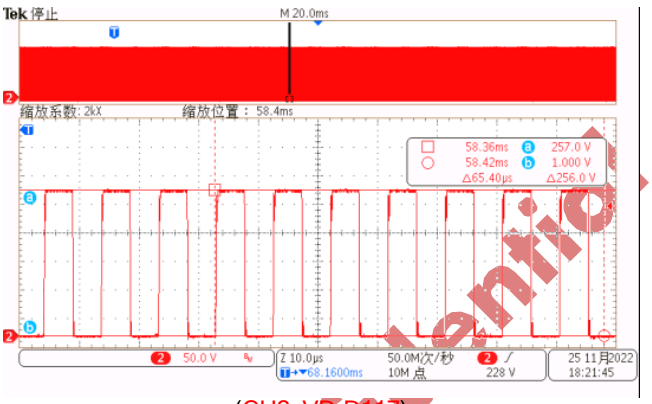
(CH1: VD-D106)
Comments: OK, VD_max=257V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



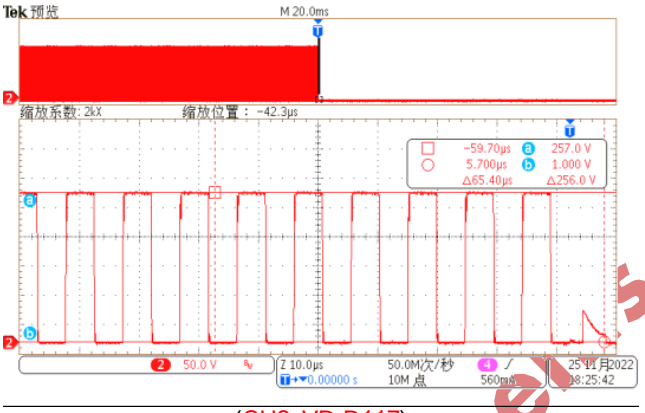
(CH2: VD-D117)
Comments: OK, VD_max=265V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



(CH2: VD-D117)
Comments: OK, VD_max=256V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



(CH2: VD-D117)
Comments: OK, VD_max=257V

3.5 Maximum Stress of Buck Circuit

Test Conditions: Input voltage: 265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

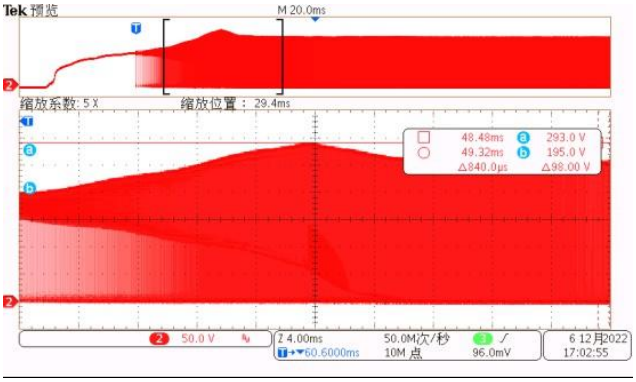
Standard: MOSFET and DIODE < 90% Rating.

Result: Pass

Component	Maximum Stress(V)			Rating	Result
	Startup	Steady	Short		
MOSFET QB801	260	261	269	600V	PASS
DIODE DB801	256	256	265	600V	PASS

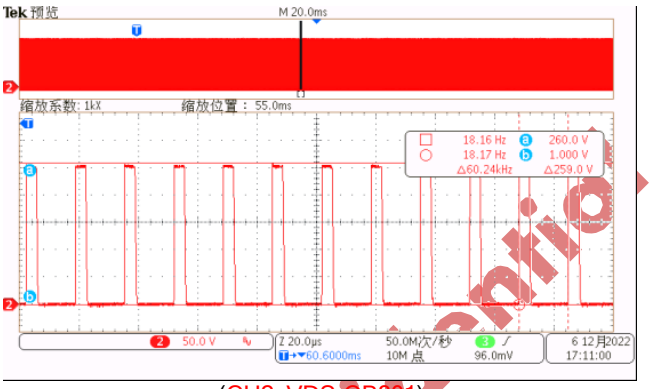
Waveforms:

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



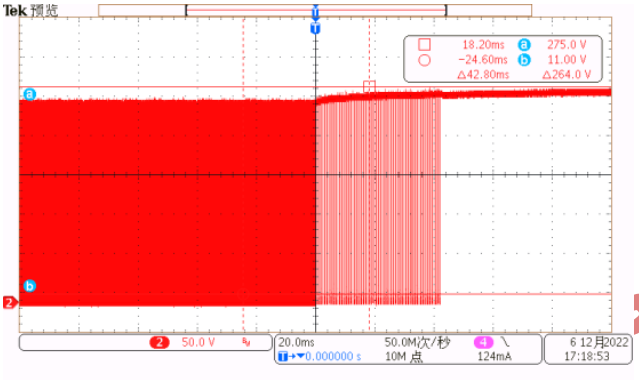
(CH2: VDS-QB801)
Comments: OK, VDS_max=293V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



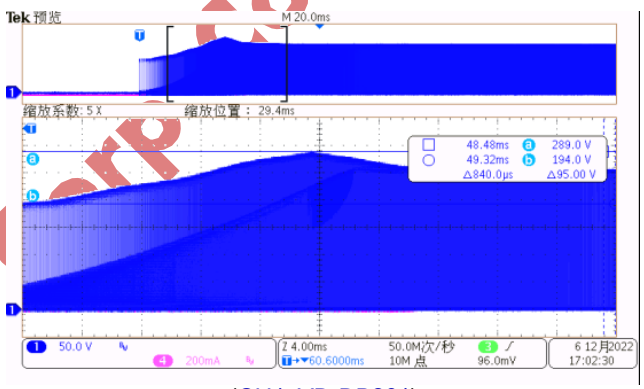
(CH2: VDS-QB801)
Comments: OK, VDS_max=260V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



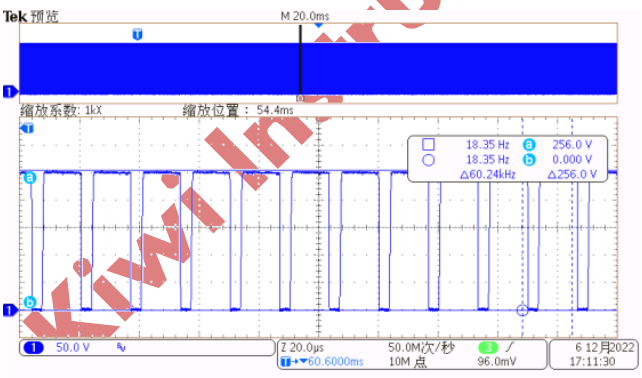
(CH2: VDS-QB801)
Comments: OK, VDS_max=275V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



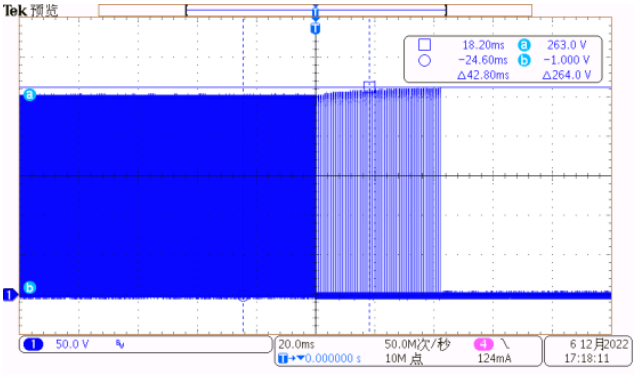
(CH1: VD-DB801)
Comments: OK, VDB_max=289V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



(CH1: VD-DB801)
Comments: OK, VD_max=256V

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



(CH1: VD-DB801)
Comments: OK, VD_max=263V

3.7 Bmax Test

Test Conditions: Input voltage: 90Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard: Steady state rated load: Bmax≤0.32T ;

Startup and short load: Bmax≤0.38T.

Note: L201: The turn Number of the inductance is 35, and the sectional area is 110mm^2;

T101: The turn Number of the transform is 54, and the sectional area is 78mm^2;

LB801: The turn Number of the transform is 56, and the sectional area is 37mm^2;

Result: Pass

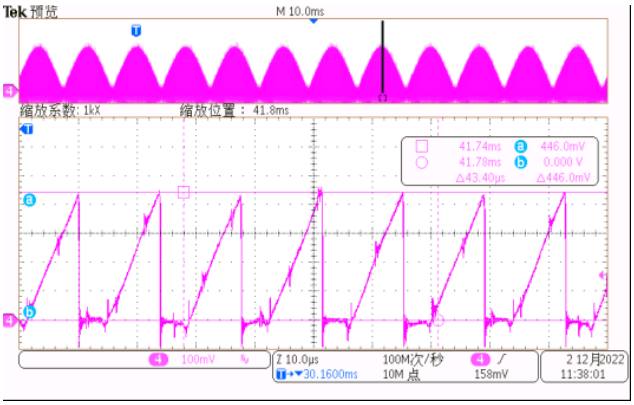
Component	State	Ipeak(A)	Bmax(T)	Rating	Result
PFC CORE L201	Startup	7.17	0.335	0.38T	PASS
	Steady	6.08	0.284	0.32T	PASS
	Short	6.33	0.296	0.38T	PASS
LLC CORE T101	Startup	2	0.266	0.38T	PASS
	Steady	1.8	0.239	0.32T	PASS
	Short	1.84	0.245	0.38T	PASS
Buck CORE LB801	Startup	0.948	0.256	0.38T	PASS
	Steady	1.116	0.3	0.32T	PASS
	Short	1.116	0.3	0.38T	PASS

Waveforms:

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup

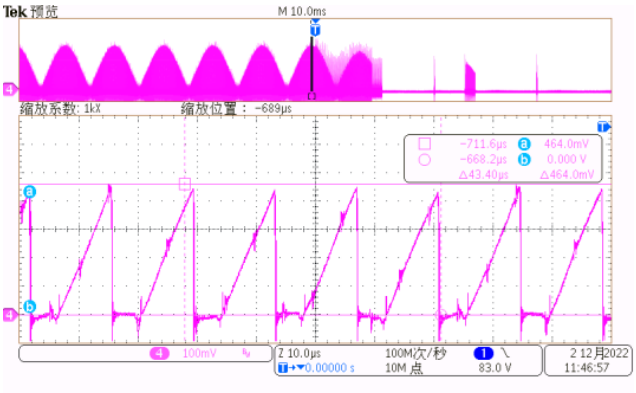
(CH4: VRcs-R220)
Comments: OK, Ipeak=7.12A, Bmax=0.335T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



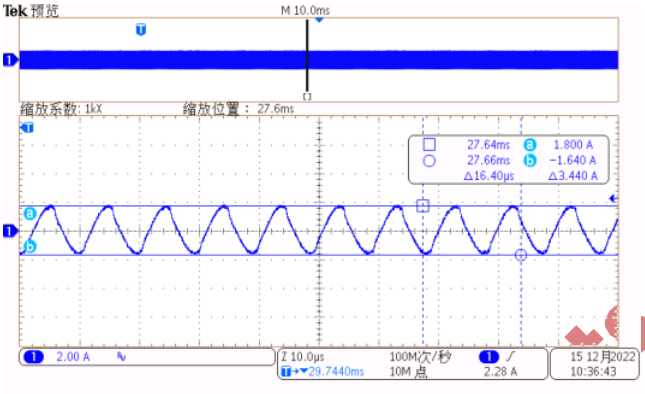
(CH4: VRcs-R220)
Comments: OK, Ipeak=6.08A, Bmax=0.284T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



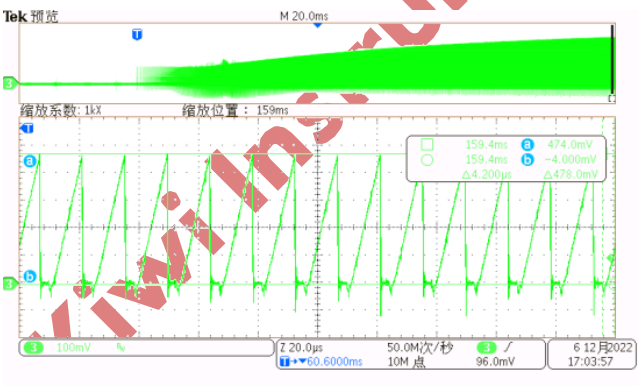
(CH4: VRcs-R220)
Comments: OK, Ipeak=6.33A, Bmax=0.294T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



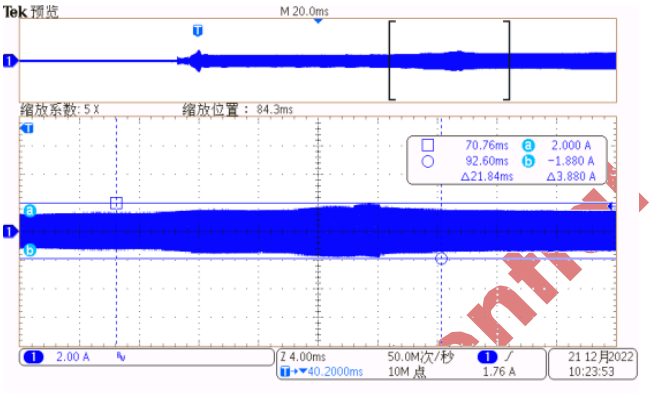
(CH1: Ilr-T101)
Comments: OK, Ipeak=1.8A, Bmax=0.239T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



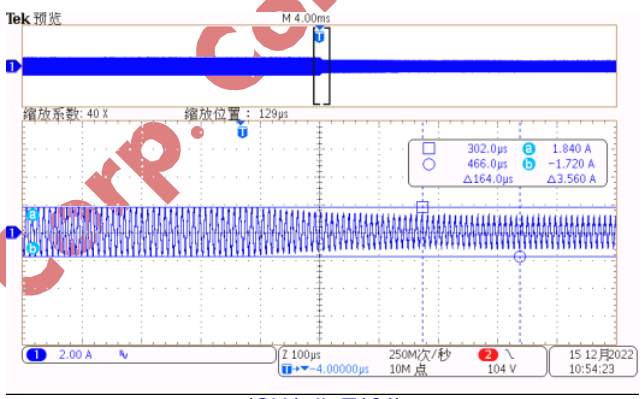
(CH3: VRcs-RB815)
Comments: OK, Ipeak=0.948A, Bmax=0.256T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Startup



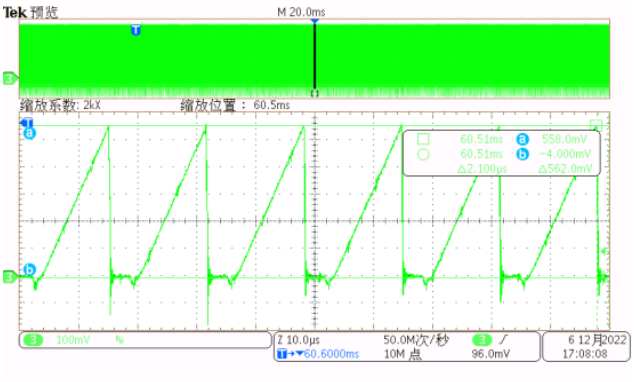
(CH1: Ilr-T101)
Comments: OK, Ipeak=2A, Bmax=0.266T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



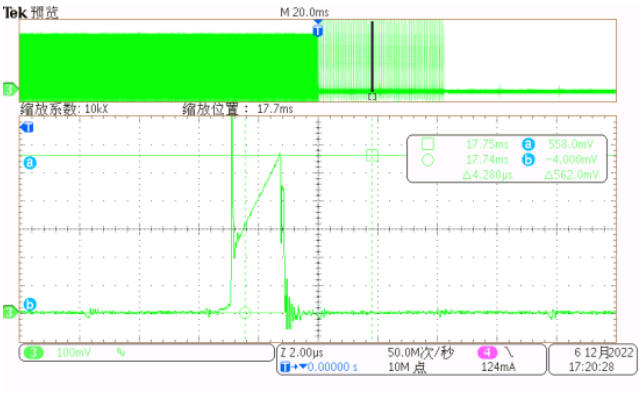
(CH1: Ilr-T101)
Comments: OK, Ipeak=1.84A, Bmax=0.245T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Steady



(CH3: VRcs-RB815)
Comments: OK, Ipeak=1.116A, Bmax=0.3T

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output, Short



(CH3: VRcs-RB815)
Comments: OK, Ipeak=1.116A, Bmax=0.3T

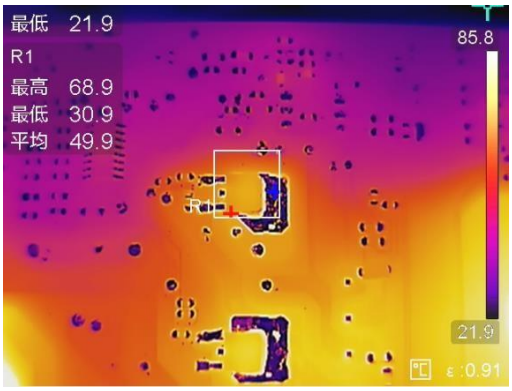
3.8 Thermal Test

Test Conditions: Input voltage: 90/265Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A. Burn-in 1hour @ confined container (30cm*30cm*30cm acrylic box) and steady environment with no airflow, Ta is the temperature inside the acrylic box.

Standard: MOS, IC and Diode: Ta=25℃, Trise<90℃. Transformer: Ta=25℃, Trise<85℃.
Result: Pass

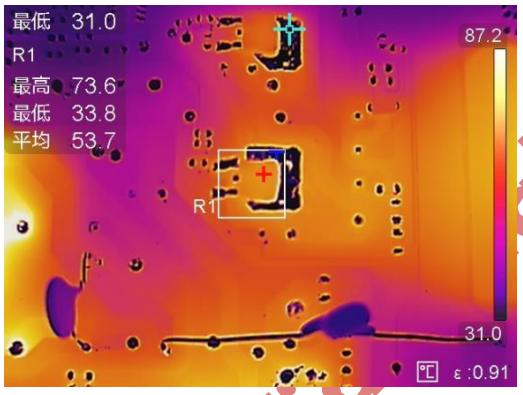
Location	Vo1=12V/3.5A & Vo2=200V/0.5A					
	90V/60Hz			265V/50Hz		
	T(℃)	Ta(℃)	Trise(℃)	T(℃)	Ta(℃)	Trise(℃)
Input Diode D2	94.7	27	67.7	53	26.5	26.5
KP2806	73.3	27	46.3	62.8	26.5	36.3
PFC Mosfet Q201	116	27	89	72.4	26.5	51.5
PFC Core	70	27	43	47.3	26.5	20.8
PFC Diode	90.2	27	63.2	60.7	26.5	34.2
KP2591	50.2	27	23.2	45.9	26.5	19.4
LLC Mosfet Q101	68.9	27	41.9	64	26.5	37.5
LLC Mosfet Q102	73.6	27	46.6	66.7	26.5	40.2
LLC Diode D125	83.9	27	56.9	84	26.5	57.5
LLC Diode D106	82.8	27	55.8	73	26.5	46.5
KP1601	45.8	27	18.8	45.9	26.5	19.4
Buck Mosfet QB801	42	27	15	40	26.5	13.5
Buck Diode DB801	48	27	21	46.5	26.5	20
Buck Core	64	27	37	61.2	26.5	34.7

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



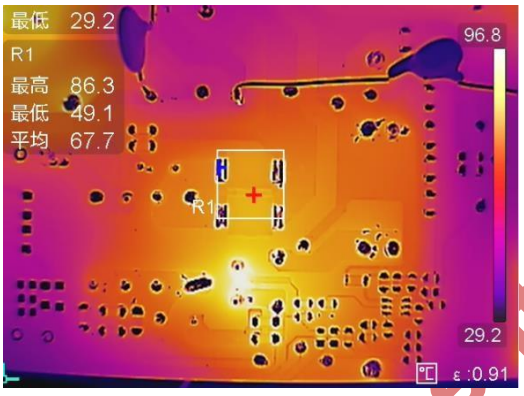
Comments: T-Q101=68.9℃

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



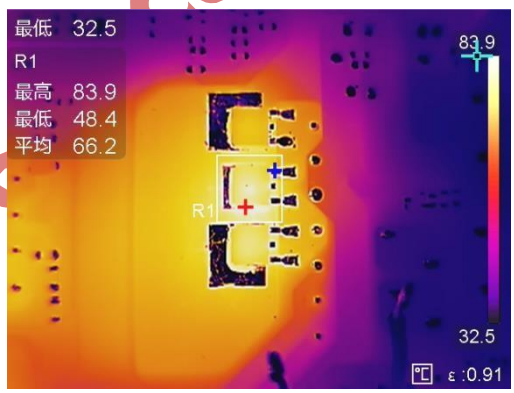
Comments: T-Q102=73.6℃

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



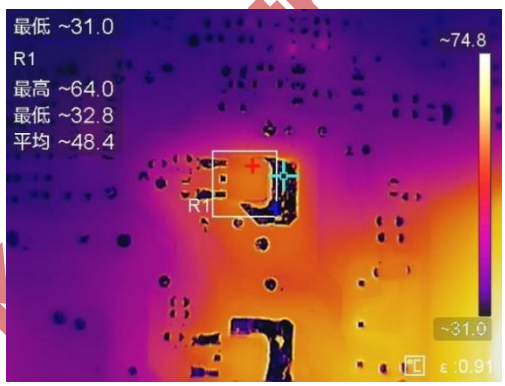
Comments: T-D207=86.3℃

Test Condition: 90Vac/60Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



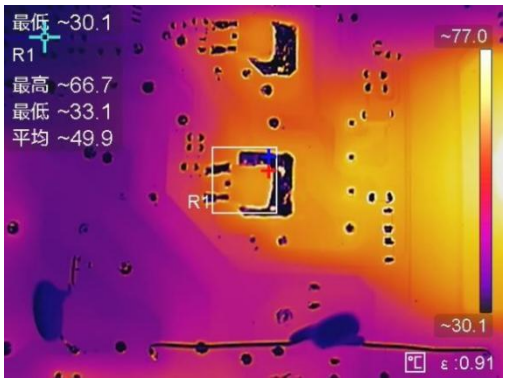
Comments: T-D125=83.9℃

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



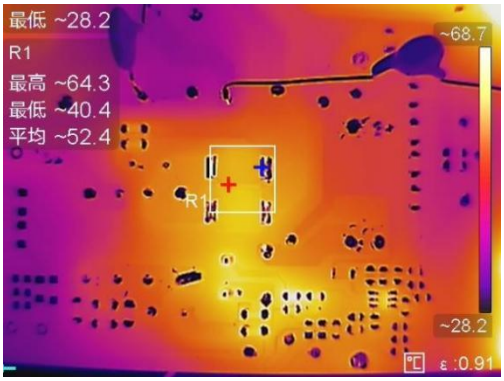
Comments: T-Q101=64℃

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



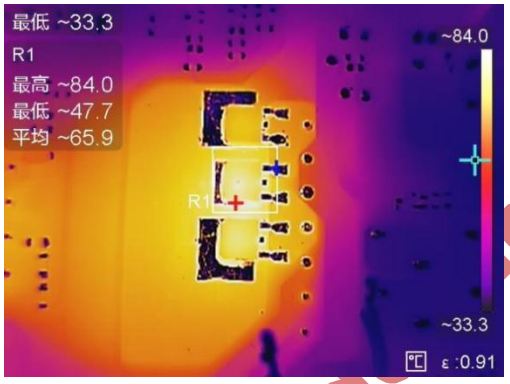
Comments: T-Q102=66.7℃

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



Comments: T-D207=64.3℃

Test Condition: 265Vac/50Hz Input,
Vo1=12V/3.5A & Vo2=200V/0.5A Output,



Comments: T-D125=84℃

3.9 EMC Test

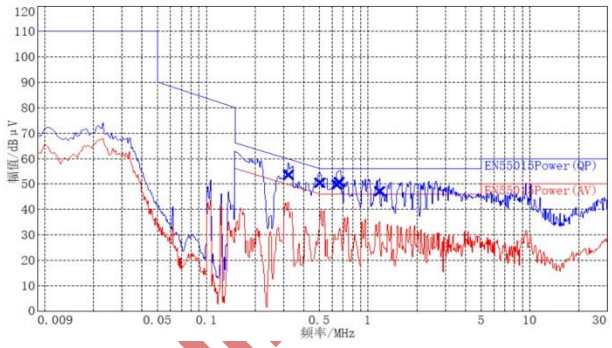
Test Conditions: Input voltage: 110/220Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard:

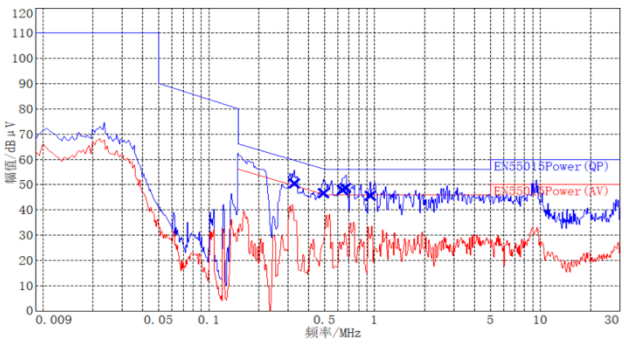
Standard	EN55015
Content	CE
Requirement	>6dB Margin

Result: Fail

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

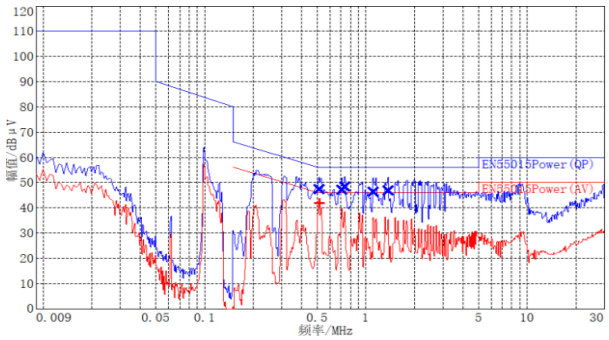


Conduction EMI---LINE

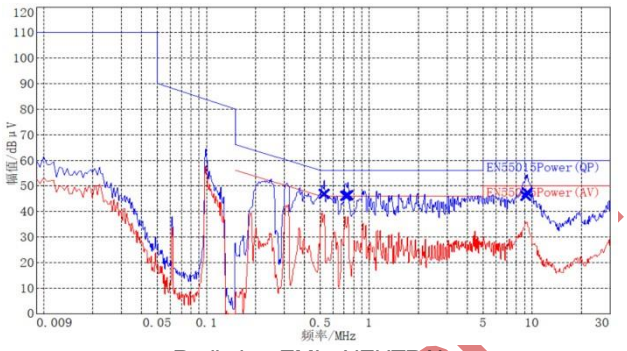


Conduction EMI---NEUTRAL

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



Radiation EMI---LINE



Radiation EMI---NEUTRAL

3.10 Surge Test

Test Conditions: Input voltage: 230Vac; Output load: Vo1=12V/3.5A & Vo2=200V/0.5A.

Standard: >1000V.

Result: Pass

Input Voltage (Vac)	Surge Level (V)	Injection Location	Injection Phase (°)	Test Result (Pass/Fail)
230Vac/50Hz	+2000	L to N	0	Pass
	+2000	L to N	90	Pass
	+2000	L to N	180	Pass
	+2000	L to N	270	Pass
	-2000	L to N	0	Pass
	-2000	L to N	90	Pass
	-2000	L to N	180	Pass
	-2000	L to N	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.

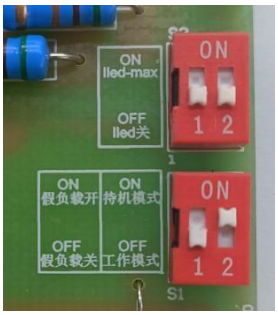
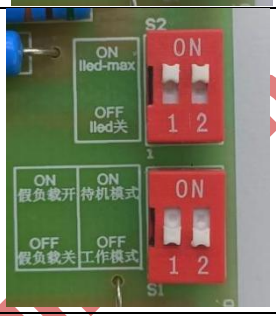
Test Result: A (A/B/C/D)

Test Setup Guide

1. Setting the AC power source between 90Vac and 265Vac.
2. Connect the “J2” terminal to the positive and negative end of the load.
3. Connect the “LED1” and “LED2” terminal to the positive and negative end of the led load.
4. Connect the “J3” terminal to PWM signal to adjust the led output current.

Turn on the AC power source to make system startup; and turn off the AC power source to make system shutdown.

There are three operating modes can be selected by setting the switch s1 and s2, as shown in the pictures below.

Mode1		Standby mode;
Mode2		Operating mode, and the LED is no output;
Mode3		Operating mode, and the LED is on maximum current output;

Revision History

DATE	REV	DESCRIPTION
2023/01/03	1.1	First Release

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