



DEMO BOARD TEST REPORT

400W, Two-Phase Interleaved High Performance PFC Pre-Regulator with KP2822

FEATURES

- Stable 180° Phase Shift Control in all Conditions
- High System Frequency and Power Density with Quasi-Resonant Control
- Accurate Valley Turn-on
- High Average Efficiency, High PF & Low THD
- Standby Power Consumption <710mW with Relay Turn-on
- >6DB Margin for CE Test
- Stable Operation without Audio Noise
- Integrated Protection Features

APPLICATIONS

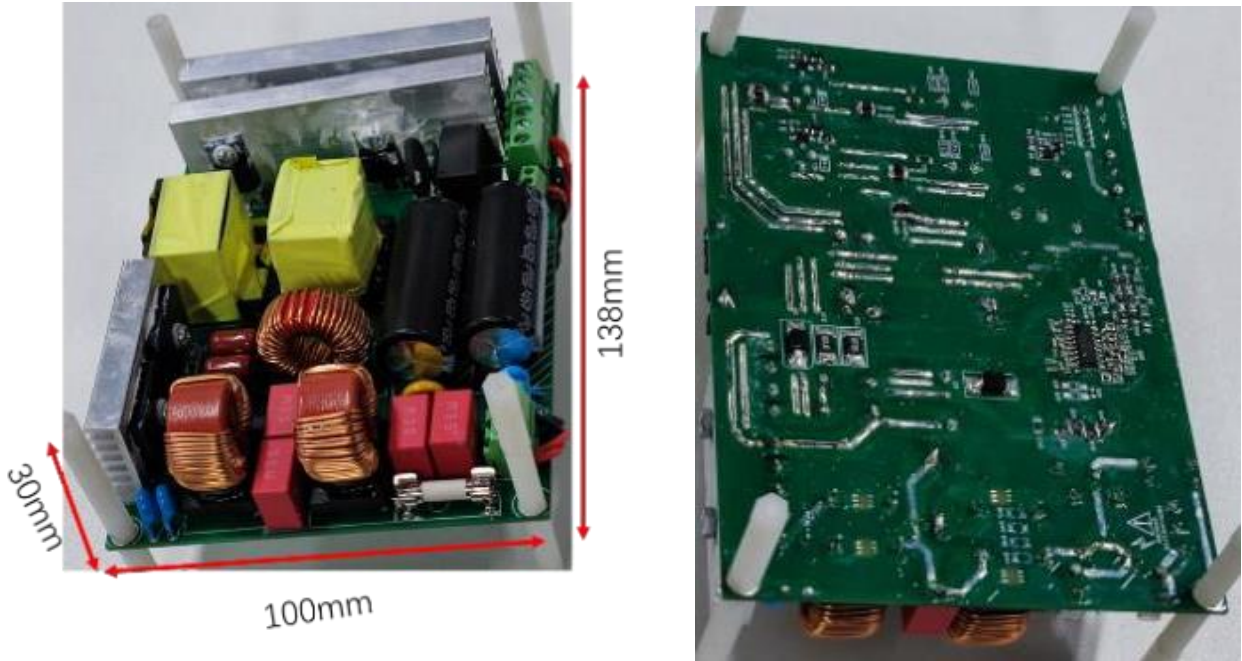
- Adapter Power Supply
- TV LCD Power Supply

DEMO BOARD SEPCIFICATION

Description	Symbol	Min	Type	Max	Unit	Note
Input Voltage	Vin	90		265	Vrms	50/60Hz
Output	Vout	388V				
Rate Output Power	Pout		400		W	
Power Factor @ Full Load		0.966				
Current THD @ Full Load			7.16		%	@230Vrms/50Hz
Ripple & Noise	Vripple			13.52	Vp-p	
Maximum Full Load Efficiency	η	>94.28			%	Board end @90Vrms/60Hz
Standby Power Consumption	Ptotal			706.57	mW	@265Vrms/50Hz
Startup Time	Tst			306.4	ms	Tested at 90Vrms/60Hz Full Load
Conducted EMI Margin	CE	6			dB	EN55022 class B
Operating Ambient	Ta	0		40	°C	
Operating Humidity		5		95	%R.H.	

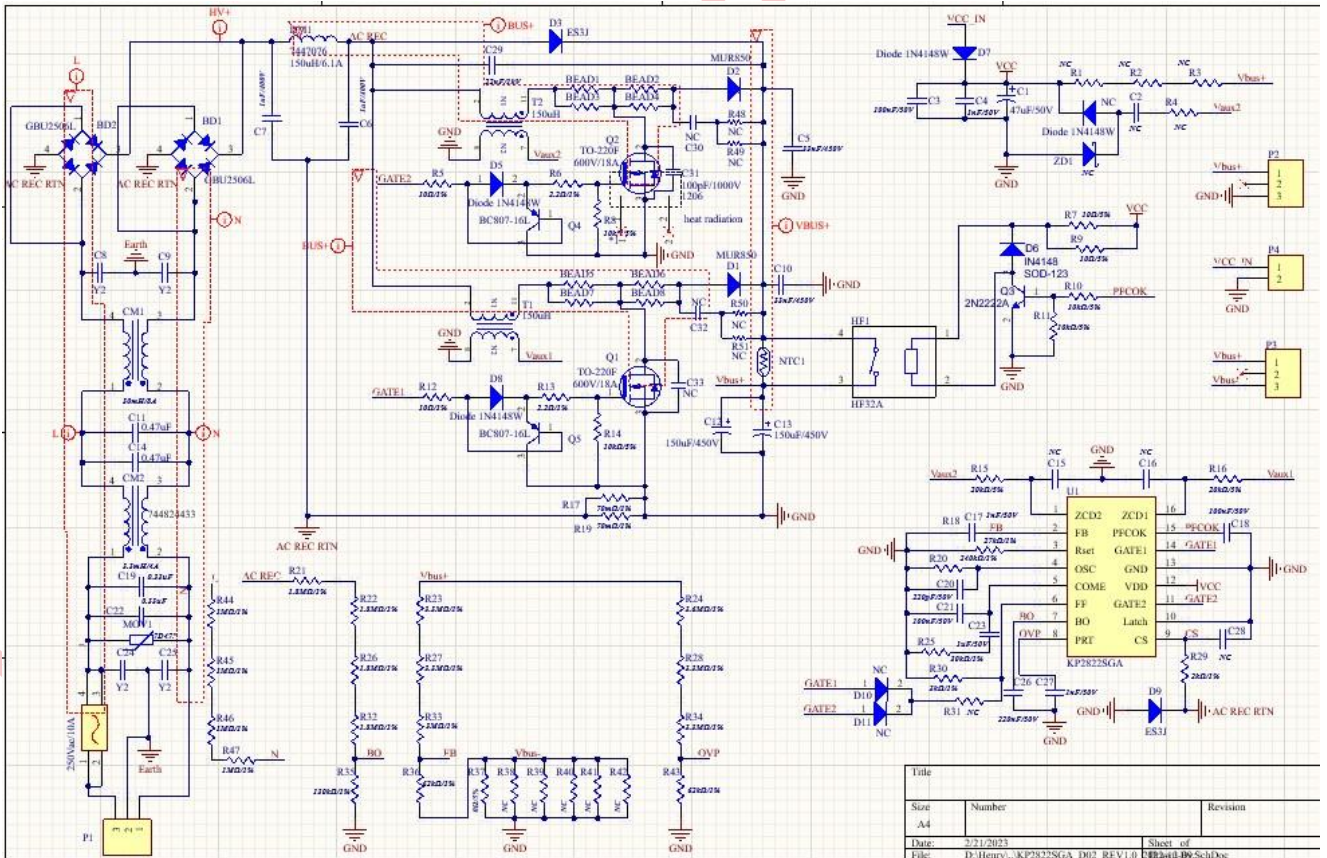
The table above shows the minimum acceptable performance of the design. Actual performance is listed in the results section.

Demo Board of KP2822-D02-REV1.1



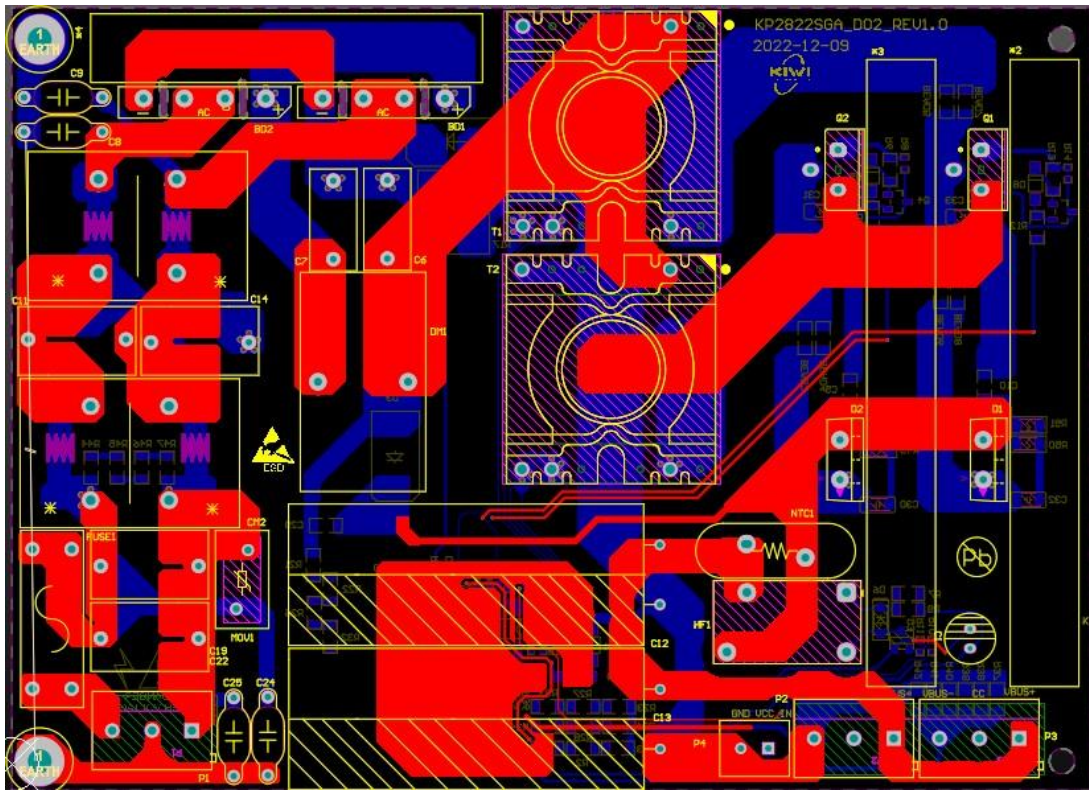
Board Size (mm): L x W x H = 138 x 100 x 30

Schematic

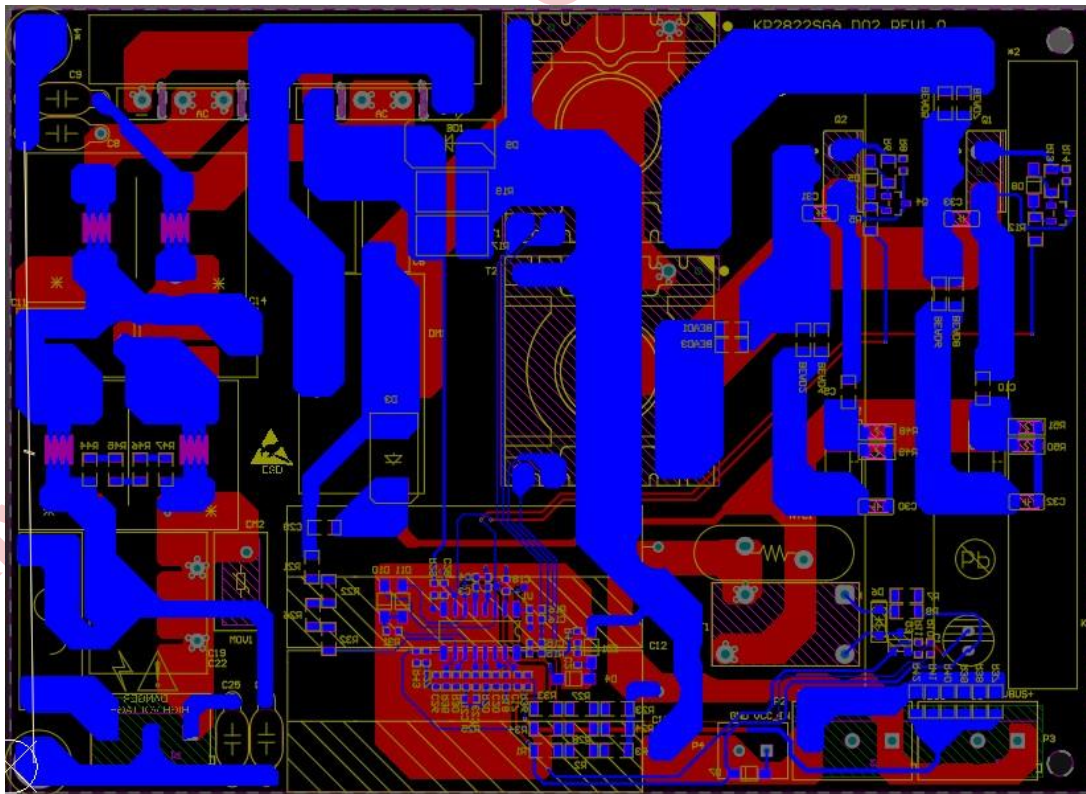


Printed Circuit Board Layout

Top Layer



Bottom Layer



Bill of Material

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	HS1		heart sink, 50mm*8mm*28mm	TH		
2	HS2, HS3		heart sink, 80mm*8mm*28mm	TH		
3	BD1, BD2	600V/25A	25A 600V BRIDGE RECTIFIER (VF=0.95V@IF=12.5A)	GBU	World	GBU2506L
4	BEAD1, BEAD2, BEAD3, BEAD4, BEAD5, BEAD6, BEAD7, BEAD8	120Ω/5A	Bead Core 120Ω ± 25% 100MHz 5A	1206	TAI-TECH	HCB3216KF -121T50
5	C1	47μF/50V	Electrolytic Cap 50V 6.3*11 P2.5	TH	AISHI	ERS1HM470 E11OT
6	C3, C18,C21	100nF/50V	Ceramic Cap 50V ±10% X7R	0603	WE	8850122060 95
7	C4, C17, C27	1nF/50V	Ceramic Cap 50V ±5% NPO	0603	WE	8850120060 63
8	C5 , C10	33nF/450V	CBB 450Vdc 12*9*5 P10	TH	STE	B22S333JN 1A21200900 50EOZ
9	C6 , C7	1μF/400V	CBB 400Vdc 17*12.5*7.5 P10	TH	STE	B22G105JQ 1B01701250 75EOJ
10	C8, C9, C24, C25	2200pF/500 VAC	Y1 Y5U 500Vac ±20% T4 P10	TH	TRX	Q09F1D222 MNOB0S0N0
11	C19, C22	330nF/275V AC	X2 Capacitor 275Vac 15*8.5*14 P12.5	TH	WE	8903240240 03CS
12	C11, C14	470nF/275V AC	X2 Capacitor 275Vac 15*10*16 P12.5	TH	WE	8903240240 05CS
13	C12, C13	150μF/450V	Electrolytic Cap 450V 18*40 P7.5	TH	AISHI	EW2WM15 1M45OT
14	C20	220pF/50V	Ceramic Cap 50V ±5% NPO	0603	WE	8850120060 59
15	C26	220nF/50V	Ceramic Cap 50V ±5% X7R	0603	WE	8850122061 25
16	C23	1μF/50V	Ceramic Cap 50V ±10% X7R	0603	WE	8850122061 26
17	C29	10nF/1kV	Ceramic Cap 1000V ±10% X7R	1206	WE	8853422080 21
18	CM1	30mH/10A	COMMON Mode INDUCTOR Isat 10A Rdc 38mΩ 25*15*10	TH	SANCI	744824433
19	CM2	3.3mH/4A	COMMON Mode INDUCTOR Isat 4A Rdc 35mΩ 27.5*18.5*33	TH	WE	744824433
20	D3, D9	600V/3A	3.0 AMP Surface Mount Super Fast Recovery Rectifiers, TRR=35ns (VF=1.7V @IF=3A)	SMC	Yangjie	ES3J
21	D5, D8, D7	100V/0.15A	DIO FRD 0.15A 100V 8nS 1.25V	SOD-123	MDD	1N4148W
22	D1, D2	600V/8A	Ultrafast Recovery Diode 600V/8A VF=1.45V @8A	TO-220AC	YANGJIE	MUR860
23	D6	1N4001	50V 1Amp General Purpose Rectifier VF=1.1V @1A	SOD123- FL	YONGYUTAI	1N4001
24	DM1	150μH/6.1A	150uH, 6.1A	TH	WE	7447076
25	FUSE1	250Vac/10A	Spring Brass, Tin-plated, Ear for 5*20mm Fuses & 250Vac 10A Time- Lag Fuse	TH	Littlefuse	01110501Z
26	FUSE1	250V/10A	5*20mm Time-Lag surge withstand ceramic body cartridge fuse	TH	Littlefuse	0215010.MX P

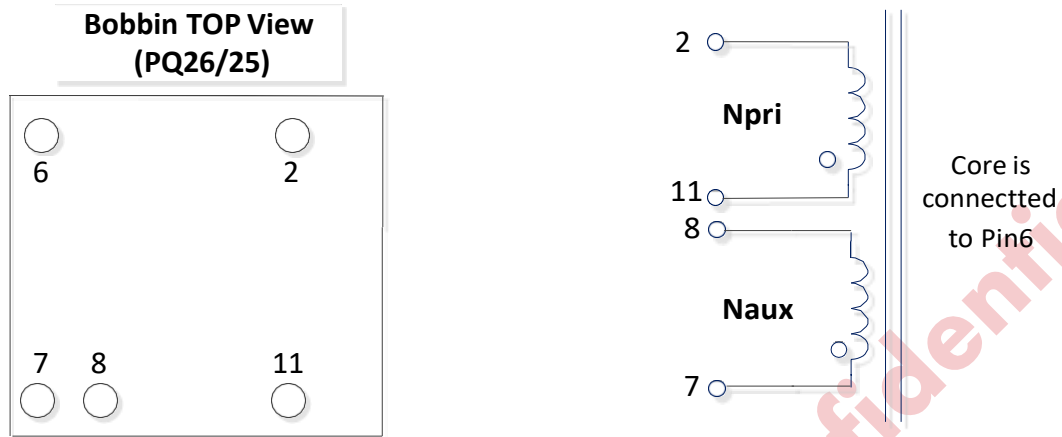


Demo Board Test Report
400W Two-Phase Interleaved High Performance
PFC Pre-Regulator with KP2822

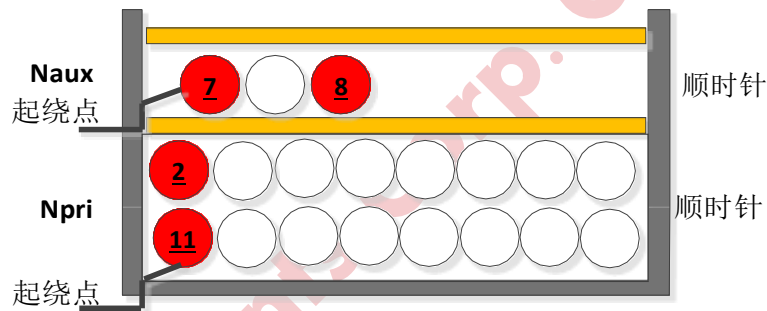
27	HF1	250V/5A	250VAC 12VDC 5A @250VAC SPST-normally open	TH	HF	HF32F/012-HS3
28	MOV1	10D471	VARISTOR 300VAC 70J 2500A	TH	WE	820513011
29	NTC1	5Ω	NTC5D-15, D=17.5mm T=6mm	TH	RUILON	NTC5D-15
30	P1, P2,		Header, 3-Pin 5.08mm 300V 20A Green	TH	KEFA	DG500-5.08-03P-14-00A(H)
31	P4		Header, 2-Pin 3.5mm 300V 10A Green	TH	KEFA	KF350-3.5-2P
32	Q1, Q2	18A/600V	MOSFET 600V 18A 190mohm@10V	TO-220F	ST	STF24N60M2
33	Q4, Q5	45V/0.5A	BJT PNP 45V 500mA 300mW	SOT-23	ONSEMI	BC807-16LT3G
34	Q3	40V/0.6A	BJT NPN 40V 600mA 350mW	SOT23	ONSEMI	MMBT222A
35	R37	0Ω/1%	Chip Resistor ±1% 1/4W	1206	FH	RS-06000FT
36	R5, R12	10Ω/5%	Chip Resistor ±1% 1/4W	1206	FH	RS-06K10R0FT
37	R6, R13	2.2Ω/1%	Chip Resistor ±1% 1/4W	1206	VO	SCR1206J2R2
38	R7, R9	10Ω/5%	Chip Resistor ±1% 1/4W	1206	FH	RS-06K10R0FT
39	R8, R14, R10, R11,	10kΩ/5%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K1002FT
40	R15, R16	20kΩ/5%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K2002FT
41	R17, R19	70mΩ/1%	Alloy Resistor ±1% 3W	2512	Milliohm	HoLR2512-70mR-1%
42	R18	27kΩ/1%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K2702FT
43	R20	240kΩ/1%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K2403FT
44	R21, R22, R26, R32	1800kΩ/1%	Chip Resistor ±1% 1/4W	1206	Tyohm	RMC12061.8M1%N
45	R23, R27, R28, R34	3300kΩ/1%	Chip Resistor ±1% 1/4W	1206	YAGEO	RV1206FR-073M3L
46	R24	3600kΩ/1%	Chip Resistor ±1% 1/4W	1206	LIZ	CR1206F43604G
47	R25	30kΩ/1%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K3002FT
48	R29	2kΩ/1%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K2001FT
49	R30	3kΩ/1%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K3001FT
50	R33	3000kΩ/1%	Chip Resistor ±1% 1/4W	1206	UNI-ROYAL	1206W4J0305T5E
51	R35	130kΩ/1%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K1303FT
52	R36, R43	62kΩ/1%	Chip Resistor ±1% 1/10W	0603	FH	RS-03K6202FT
53	T1, T2	150μH	PFC Chokes, PQ2625, Pri:Aux = 38:4, Pri:0.1mm*80 Wire Sec:0.2mm	TH		150μH
54	U1	KP2822SG	2-Phase Interleaved, CRM Boost Power Factor Controller, 16-SOIC	SOIC-16	KIWI	KP2822SG

Transformer Manufacture Guide

1 Electrical Diagram



2 Winding Diagram



3 Winding Order

Number	Winding	Layer	Start	End	Wire Size (mm)	Turns	Note
1	Npri	Primary	Pin11	Pin2	0.1*60P	38Ts	Dense
2	Naux	Auxiliary	Pin7	Pin8	0.2	4Ts	Dense

4 Electrical Specification

Items	Test Pin	Specification	Test Condition
Primary Inductance	Pin 11 - 2; other windings open	150 μ H (\pm 10%)	Ta=25 $^{\circ}$ C 100kHz/100mV
Turn Ratio	Npri (11-2): Naux (7-8)	38Ts:4Ts	
DC Resistance	Pin 11 - 2	0.12R Max	

5 BOM

Number	Materials	Specifications
1	Core	PQ2625, TPG33, AE=118
2	Bobbin	PQ2625, 6+6 Pin, Vertical
3	Wire	Φ 0.1mm*60, 2UEW, Litz
4	Wire	Φ 0.2mm, QA-1/155
7	Duct tape	W=13mm, T=0.1mm

Test Result

1 Input Characteristics

1.1 Maximum Rated Input AC Current

Standard: 10A max. @ 90Vrms/60Hz input & full load.

Result: Pass

Vin	lin_rms (A)	lin_max limit (A)	Result
90Vrms/60Hz	4.74	10	PASS

1.2 Inrush Current (Cold Start)

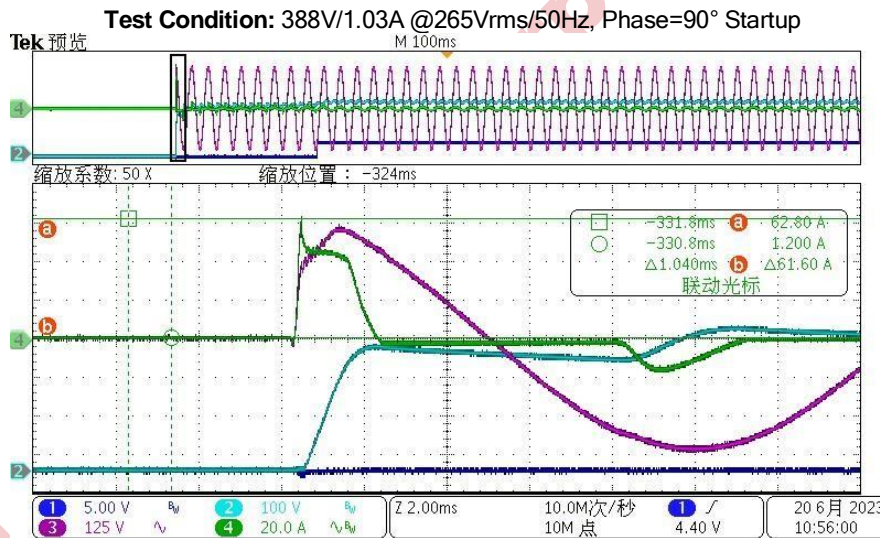
Standard:

Result:

Note: Tested @ 388V/1.03A.

Vin	Inrush (A)	lin_max limit (A)	Result
265Vrms/50Hz	62.80		

Waveforms:



(CH1-Vpfcok, CH2-Vout, CH3-Vinac, CH4-linac)

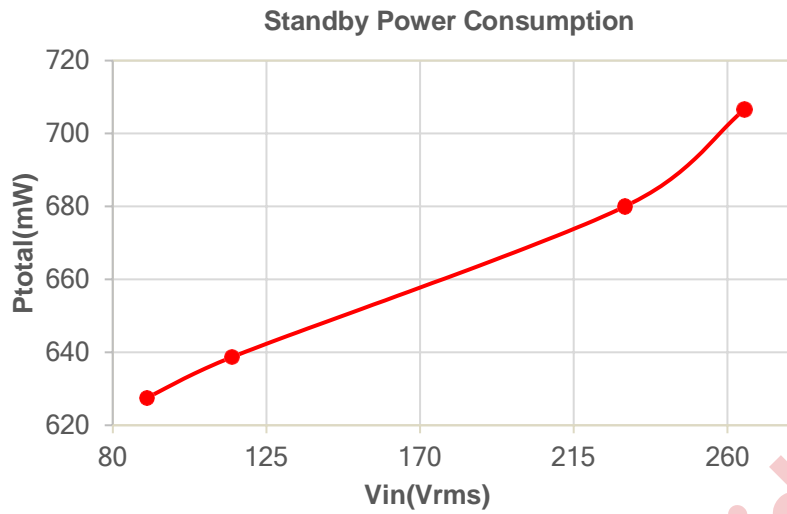
Comments: Startup Normally

1.3 No Load Input Power Dissipation

Standard: While input 90~265Vrms and the output is no load, the input power loss must be less than 1W.

Result: Pass

Vin	90Vrms/60Hz	115Vrms/60Hz	230Vrms/50Hz	265Vrms/50Hz	Result
Pin (mW)	43.11	49.68	91.54	123.52	PASS
PVDD (mW) (VDD=15V)	584.4	589.05	588.45	583.05	PASS
Ptotal (mW)	627.51	638.73	679.99	706.57	PASS



1.4 Efficiency

Standard: The average efficiency tested at the board end should larger than 92%.

Result: Pass

Test Data:

Output	Average Eff (%)				Result
	90Vrms/60Hz	115Vrms/60Hz	230Vrms/50Hz	265Vrms/50Hz	
388V	94.72	95.68	97.35	97.69	PASS

Efficiency (388V/1.03A):

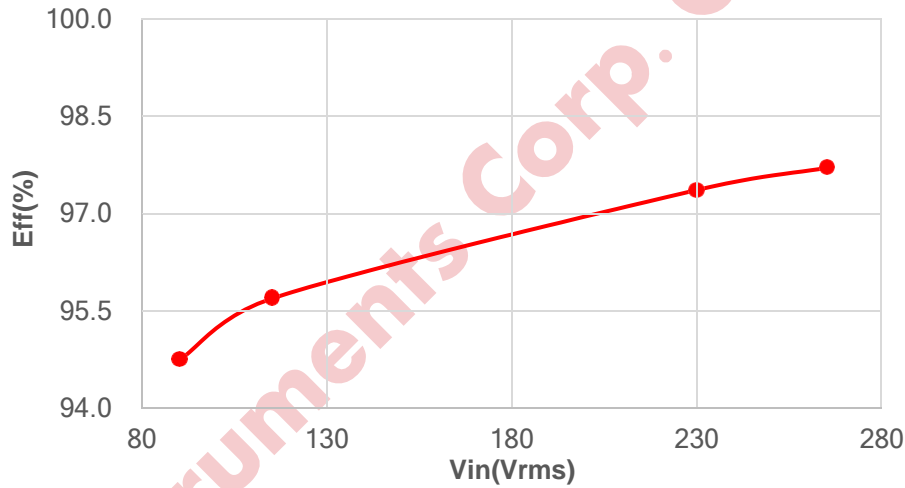
Vin (Vrms)	Fline (Hz)	Pin (W)	Vout (V)	Iout (A)	Pout (W)	Eff (%)	Eff_AVG (%)
90	60	423.43	387.600	1.030	399.228	94.28	94.72
		315.45	387.700	0.773	299.498	94.94	
		210.12	387.800	0.515	199.717	95.05	
		105.39	387.900	0.258	99.884	94.78	
		42.26	388.000	0.103	39.964	94.57	
115		416.41	387.500	1.030	399.125	95.85	95.68
		312.05	387.600	0.773	299.421	95.95	
		207.77	387.700	0.515	199.666	96.10	
		104.68	387.800	0.258	99.859	95.39	
		42.01	387.900	0.103	39.954	95.11	



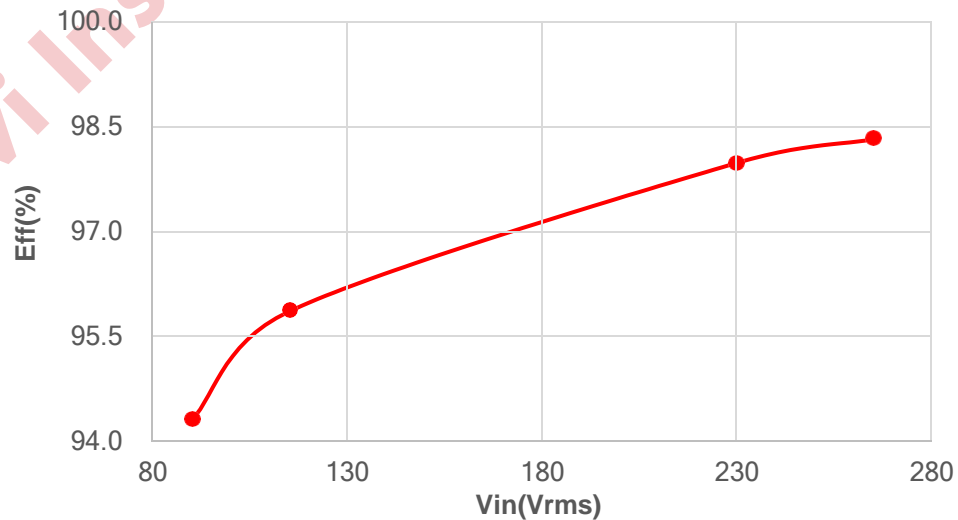
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400W Two-Phase Interleaved High Performance
PFC Pre-Regulator with KP2822

230	50	407.38	387.500	1.030	399.125	97.97	97.35
		306.09	387.600	0.773	299.421	97.82	
		204.35	387.700	0.515	199.666	97.71	
		103.10	387.800	0.258	99.859	96.86	
		41.45	388.000	0.103	39.964	96.41	
265		405.98	387.500	1.030	399.125	98.31	97.69
		305.09	387.600	0.773	299.421	98.14	
		203.94	387.800	0.515	199.717	97.93	
		102.87	387.900	0.258	99.884	97.10	
		41.21	388.030	0.103	39.967	96.99	

Average Efficiency



Full Load Efficiency



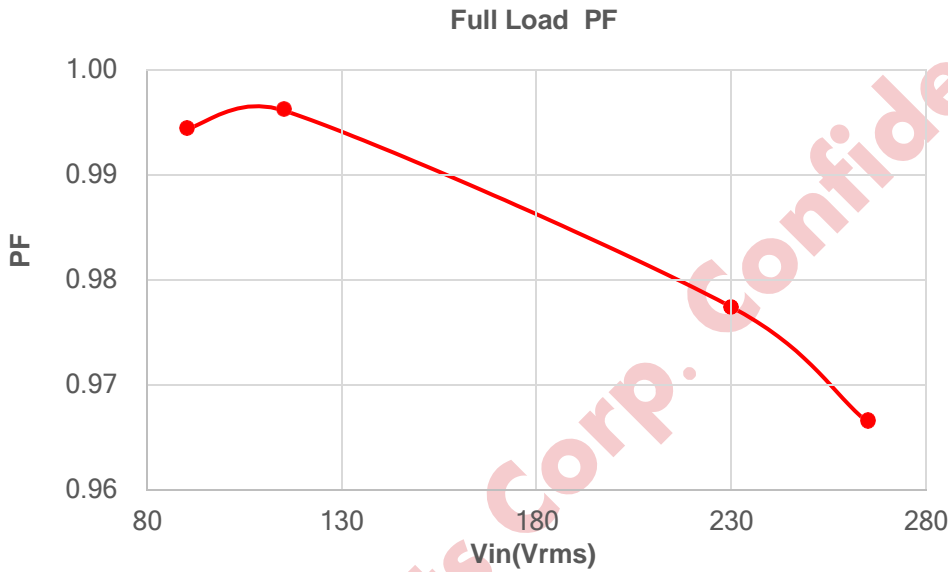
1.5 PF

Standard: The Full Load PF should be larger than 0.92.

Result: Pass

Test Data:

Output	Full Load PF				Result
	90Vrms/60Hz	115Vrms/60Hz	230Vrms/50Hz	265Vrms/50Hz	
388V	0.994	0.996	0.977	0.966	PASS



1.6 THD

Standard: The Full Load THD should be smaller than 10% @ 115Vrms/60Hz & 230Vrms/50Hz.

Result: Pass

Test Data:

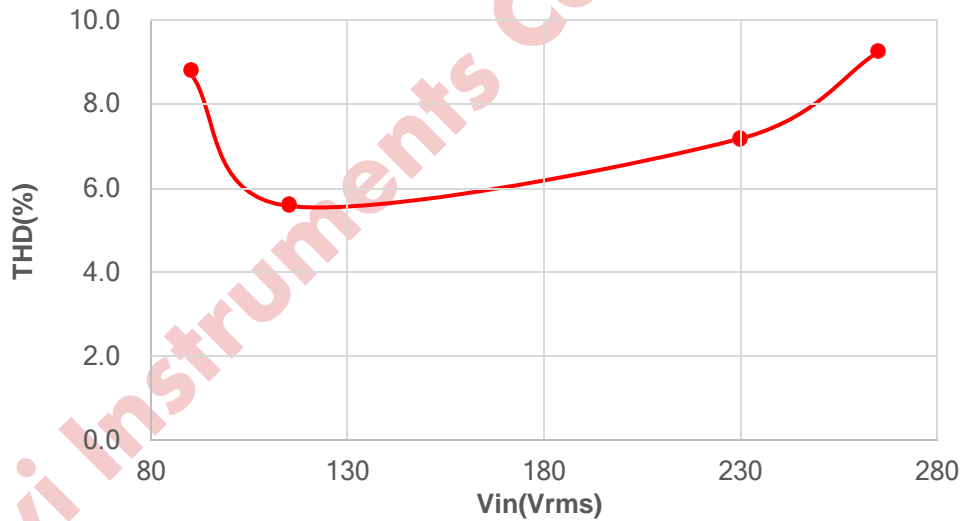
Output	Full Load THD				Result
	90Vrms/60Hz	115Vrms/60Hz	230Vrms/50Hz	265Vrms/50Hz	
388V	8.760	5.560	7.160	9.210	PASS

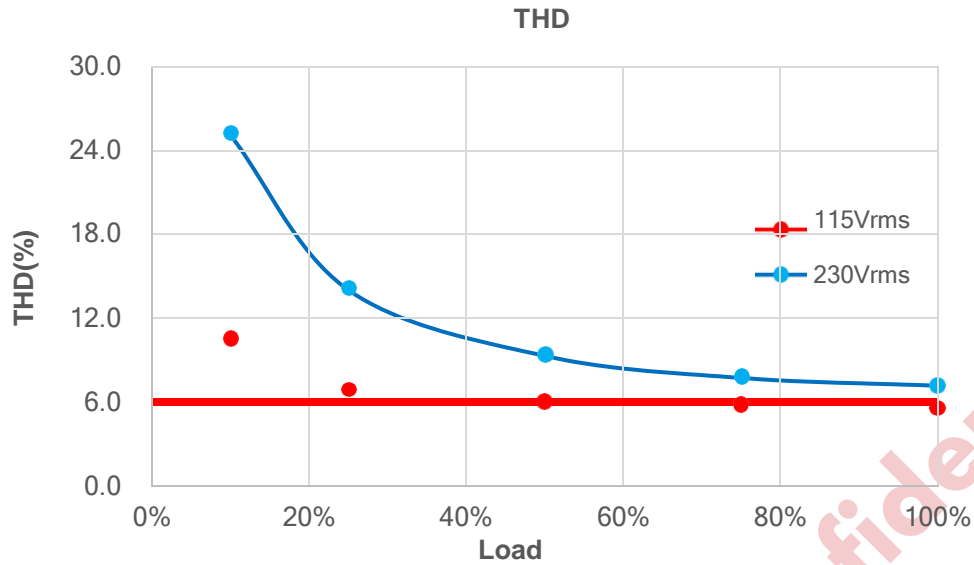
THD (388V/1.03A):

Vin (Vrms)	Fline (Hz)	Vout (V)	Iout (A)	Pout (W)	THD
90	60	387.600	1.030	399.228	8.760
		387.700	0.773	299.498	9.500
		387.800	0.515	199.717	8.400
		387.900	0.258	99.884	7.950
		388.000	0.103	39.964	8.010

115		387.500	1.030	399.125	5.560
		387.600	0.773	299.421	5.850
		387.700	0.515	199.666	6.020
		387.800	0.258	99.859	6.750
		387.900	0.103	39.954	10.430
230	50	387.500	1.030	399.125	7.160
		387.600	0.773	299.421	7.720
		387.700	0.515	199.666	9.300
		387.800	0.258	99.859	14.020
		388.000	0.103	39.964	25.120
265		387.500	1.030	399.125	9.210
		387.600	0.773	299.421	10.400
		387.800	0.515	199.717	13.750
		387.900	0.258	99.884	20.240
		388.030	0.103	39.967	31.380

Full Load THD





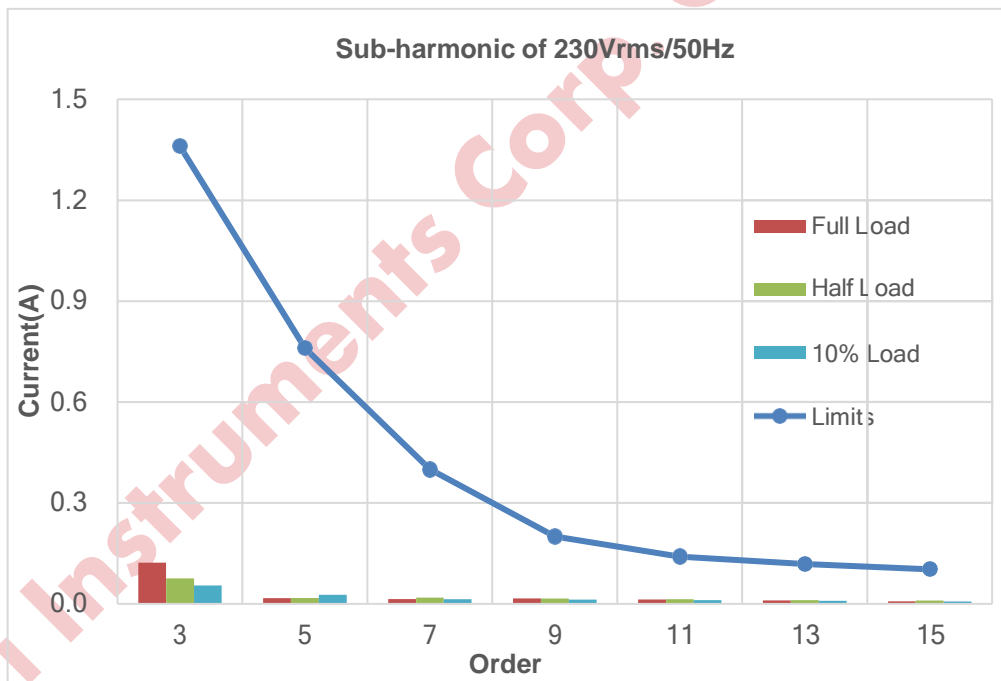
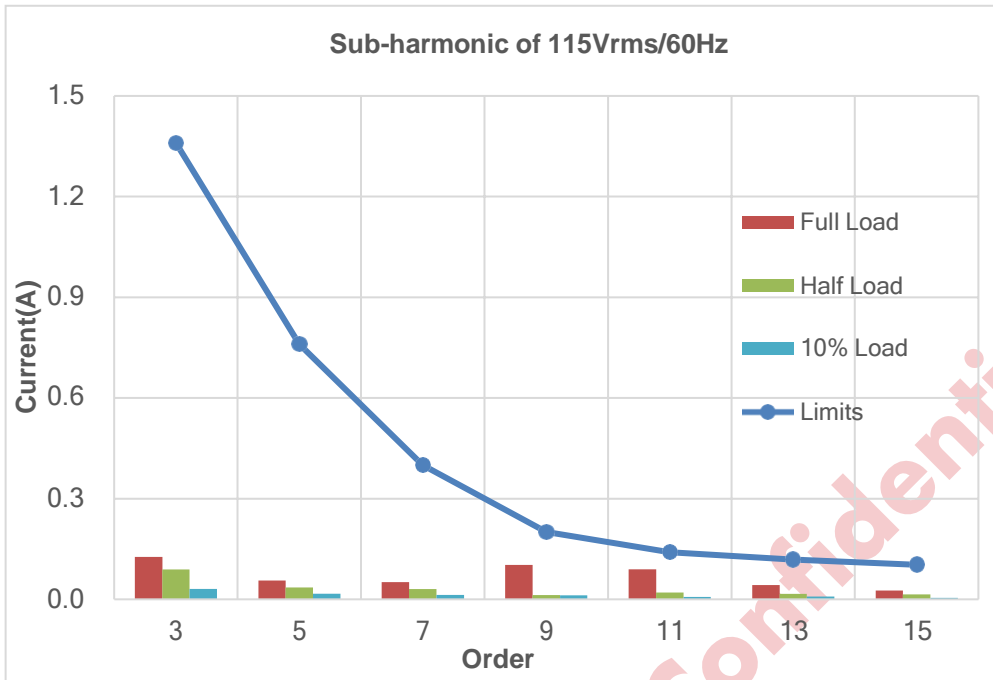
1.7 Sub-Harmonic

Standard: The Sub-Harmonic should be satisfied within the Limits for Class D equipment from IEC 61000-3-2.

Result: Pass

Test Data:

Current (A)	Order	3	5	7	9	11	13	15
Limits for Class D equipment from IEC 61000-3-2 under 400W		1.36A	0.76A	0.4A	0.2A	0.14A	0.12A	0.10A
Vin= 115Vrms/60Hz Vout=388V	1.03A (Full Load)	0.126	0.055	0.051	0.102	0.089	0.042	0.026
	0.515A (Half Load)	0.089	0.035	0.031	0.012	0.020	0.016	0.014
	0.103A (10% Load)	0.031	0.016	0.012	0.012	0.007	0.008	0.004
Vin= 230Vrms/50Hz Vout=388V	1.03A (Full Load)	0.122	0.016	0.014	0.016	0.013	0.010	0.007
	0.515A (Half Load)	0.076	0.017	0.018	0.016	0.014	0.011	0.010
	0.103A (10% Load)	0.055	0.027	0.014	0.013	0.011	0.009	0.007



2 Output Characteristics

2.1 Output Line Regulation and Load Regulation

Standard: Under the input voltage 90~265Vrms, line regulation <6%, load regulation <6%. The output voltage is tested at the output cap end.

Result: Pass

Input Voltage	For Vout=388V / Output Voltage (V)					Load Regulation
	10% Load	25% Load	50% Load	75% Load	Full Load	
90Vrms/60Hz	388.000	387.900	387.800	387.700	387.600	0.10%
115Vrms/60Hz	387.900	387.800	387.700	387.600	387.500	0.10%
230Vrms/50Hz	388.000	387.800	387.700	387.600	387.500	0.13%
265Vrms/50Hz	388.030	387.900	387.800	387.600	387.500	0.14%
Line Regulation	0.03%	0.03%	0.03%	0.03%	0.03%	

2.2 Ripple & Noise

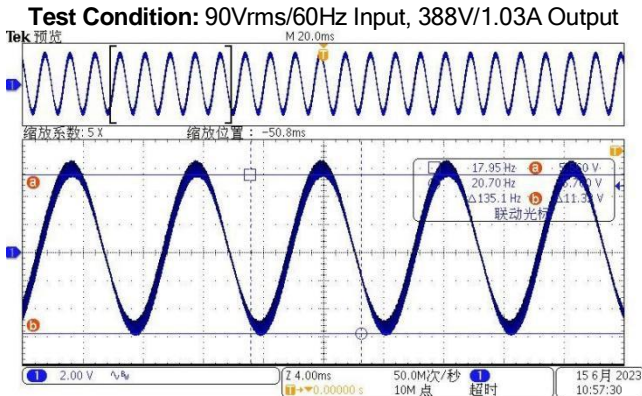
Standard: Under the input voltage 90~265Vrms, Vripple_max<30V.

Result: Pass

Note: Ripple & noise are measured with minimum measurement loop. Bandwidth is limited to 20MHz.

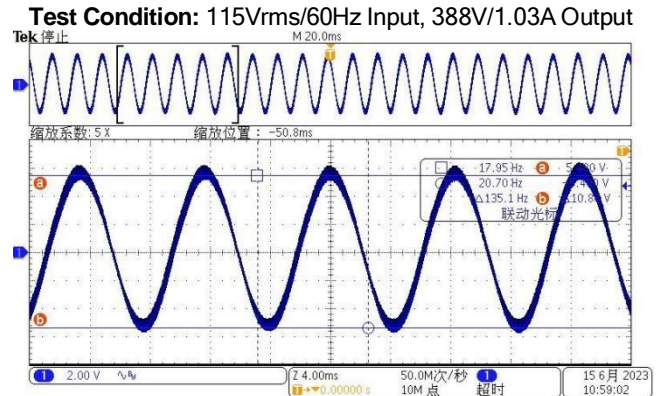
Input Voltage	10% Load Ripple (V)	Full Load Ripple (V)
	388V/0.103A	388V/1.03A
90Vrms/60Hz	1.112	11.32
115Vrms/60Hz	1.103	10.88
230Vrms/50Hz	1.252	13.16
265Vrms/50Hz	1.332	13.52

Waveforms:



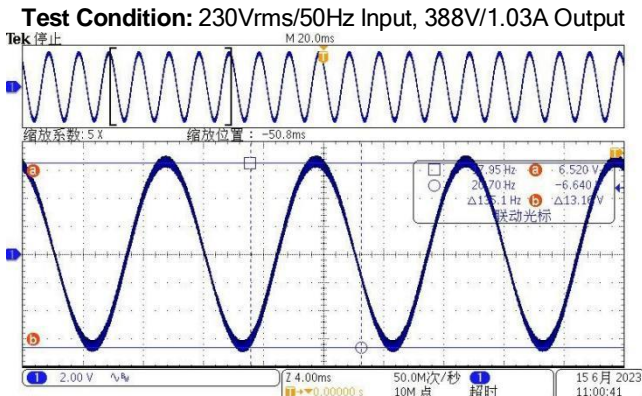
(CH1- Vripple)

Comments: Vripple=11.32V



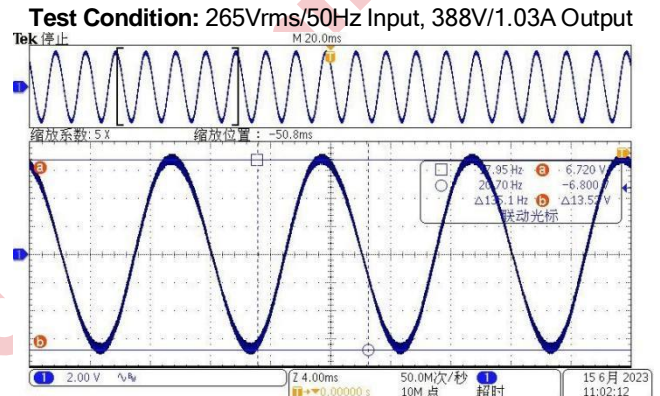
(CH1- Vripple)

Comments: Vripple=10.88V



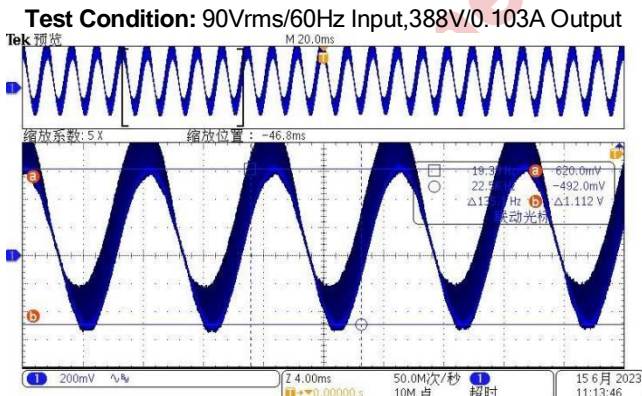
(CH1- Vripple)

Comments: Vripple=13.16V



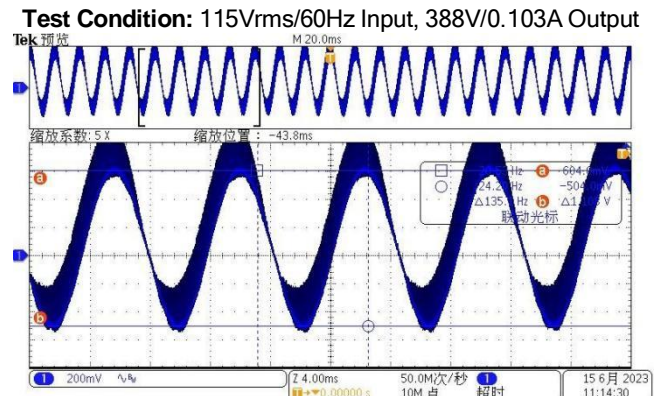
(CH1- Vripple)

Comments: Vripple=13.52V



(CH1- Vripple)

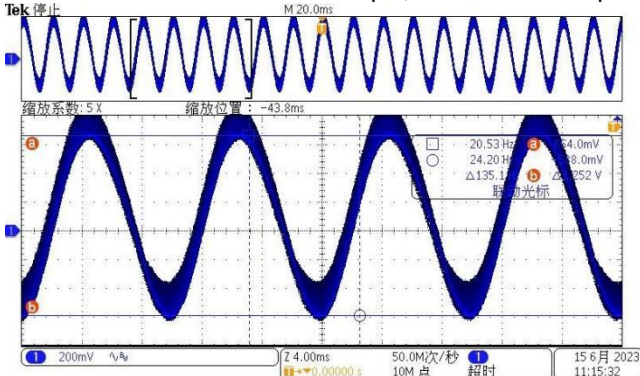
Comments: Vripple=1.112V



(CH1- Vripple)

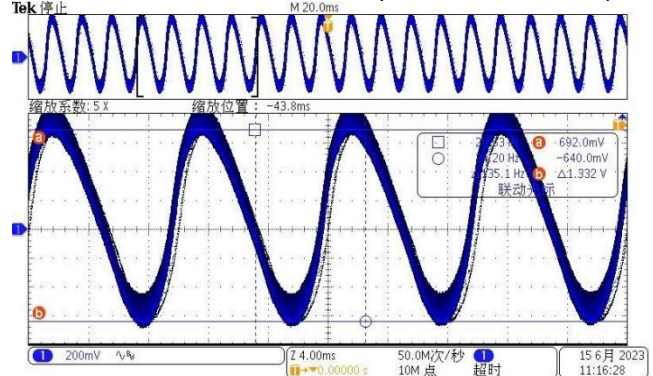
Comments: Vripple=1.103V

Test Condition: 230Vrms/50Hz Input, 388V/0.103A Output



(CH1- Vripple)
Comments: Vripple=1.252V

Test Condition: 265Vrms/50Hz Input, 388V/0.103A Output



(CH1- Vripple)
Comments: Vripple=1.332V

2.3 Load Transient Test

Standard: Under the input voltage 90~265Vrms, the output voltage transient response should be within $\pm 10\%$ normal voltage.

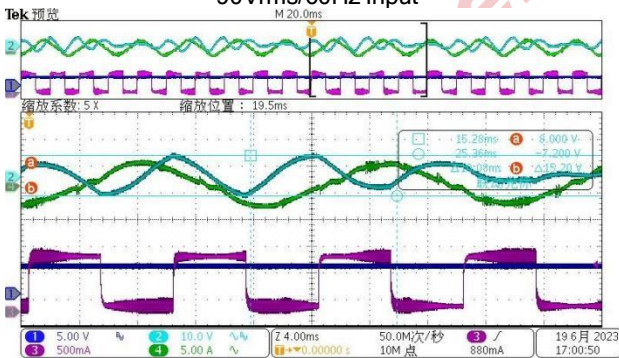
Result: Pass

Note: 10% load shift to 100% load with 0.2A/ μ s changing ramp and 100Hz changing frequency.

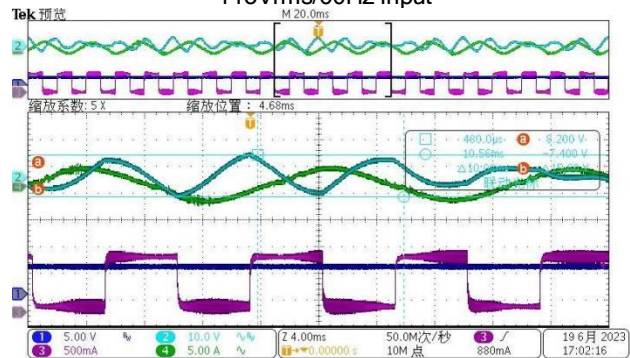
Input Voltage	90Vrms/60Hz	115Vrms/60Hz	230Vrms/50Hz	265Vrms/50Hz
Δ Vout (V)	15.2	15.6	6.5	9.4

Waveforms:

Test Condition: Load 388V/(0.103-1.03)A, frequency 100Hz, duty Cycle=50%, slew rate=0.2A/ μ s

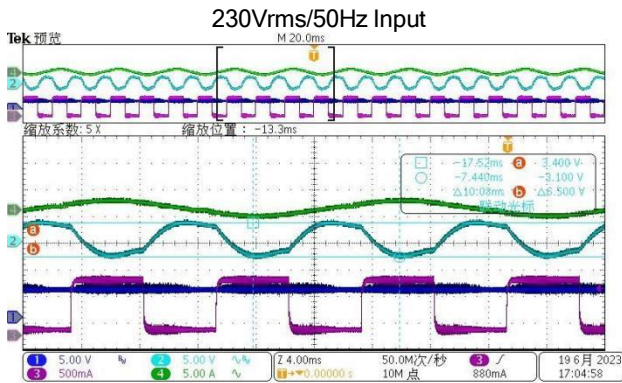


(CH1-Vpfcok, CH2-Vout(ac), CH3-Iout, CH4-Iac)
Comments: Δ Vout = 15.2V

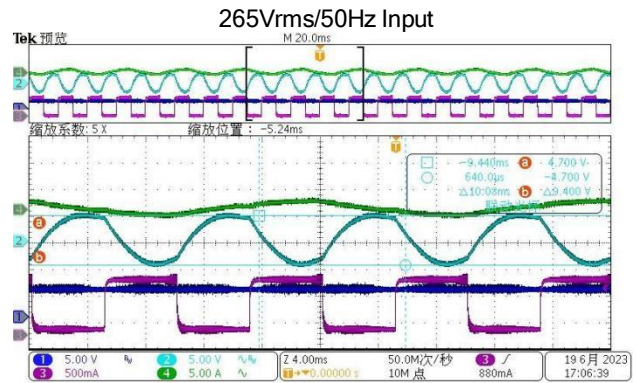


(CH1-Vpfcok, CH2-Vout(ac), CH3-Iout, CH4-Iac)
Comments: Δ Vout = 15.6V

Test Condition: Load 388V/(0.103-1.03)A, frequency 100Hz, duty Cycle=50%, slew rate=0.20A/μs



(CH1-Vpfcok, CH2-Vout(ac), CH3-Iout, CH4-Iac)
Comments: ΔVout =6.5V



(CH1-Vpfcok, CH2-Vout(ac), CH3-Iout, CH4-Iac)
Comments: ΔVout =9.4V

2.4 Startup Time and Raise Time

Standard: The startup time should be less than 3s @90Vrms/60Hz.

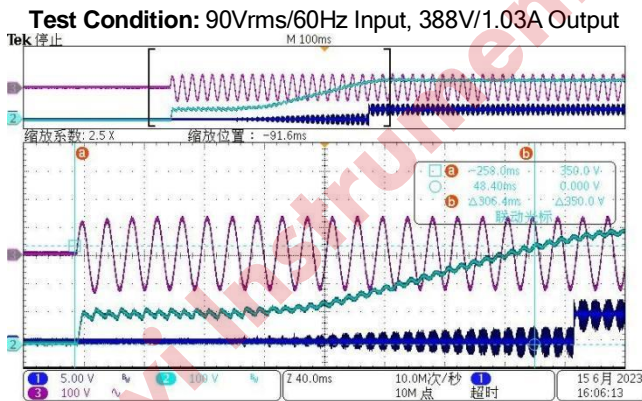
Result: Pass

Note: The output voltage is tested at the output cap end.

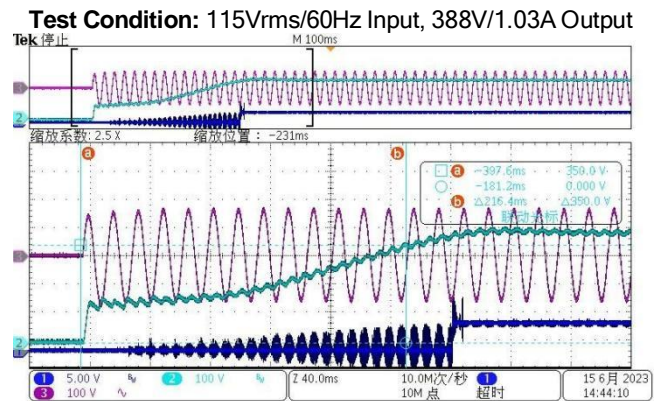
Test Data:

Input Voltage	90Vrms/60Hz	115Vrms/60Hz	230Vrms/50Hz	265Vrms/50Hz
Startup Time (ms)	306.4	216.4	197.2	50.2

Waveforms:

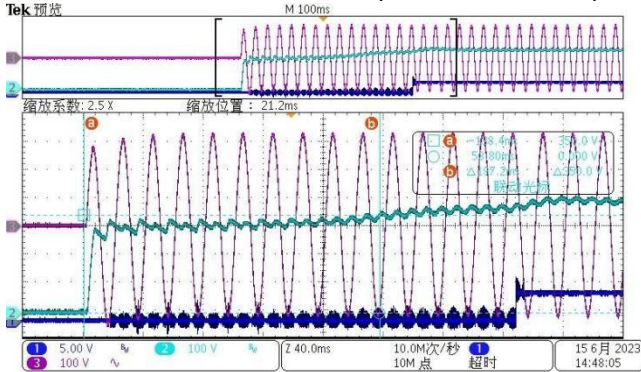


(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Startup time=306.4ms



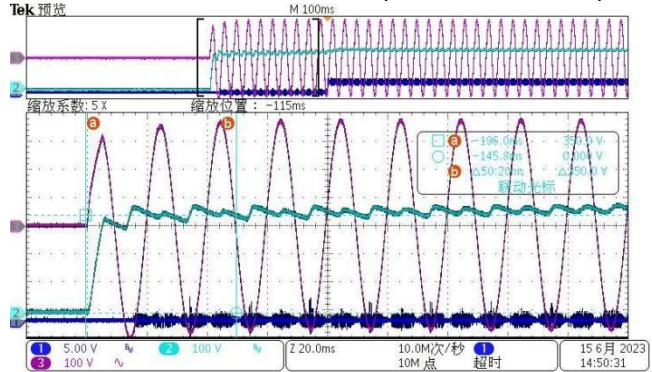
(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Startup time=216.4ms

Test Condition: 230Vrms/50Hz Input, 388V/1.03A Output



(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Startup time=197.2ms

Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output



(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Startup time=50.2ms

2.5 Holdup Time and Fall Time

Standard: The holdup time should be larger than 5ms@90~230Vrms.

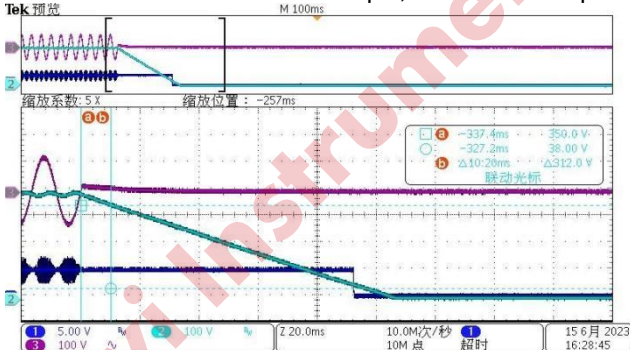
Result: Pass

Note: The output voltage is tested at the output cap end.

Input Voltage	90Vrms/60Hz	115Vrms/60Hz	230Vrms/50Hz	265Vrms/50Hz
Hold-up Time (ms)	10.2	9.4	9.8	9.8
Fall Time (ms)	86.8	86.4	85.8	86

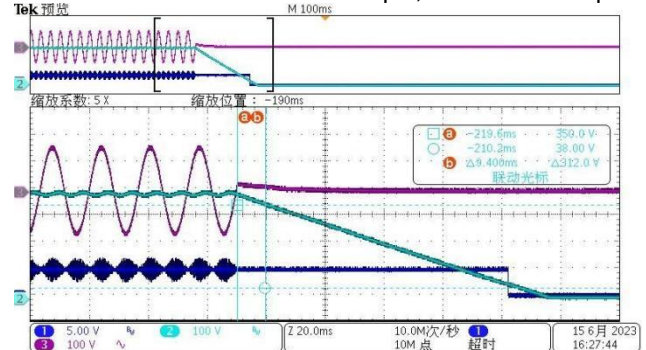
Waveforms:

Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output



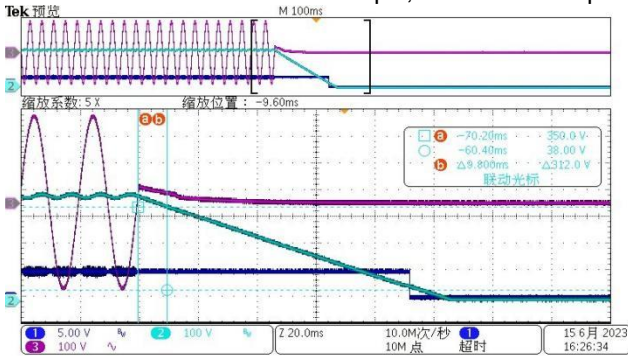
(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Holdup time=10.2ms

Test Condition: 115Vrms/60Hz Input, 388V/1.03A Output



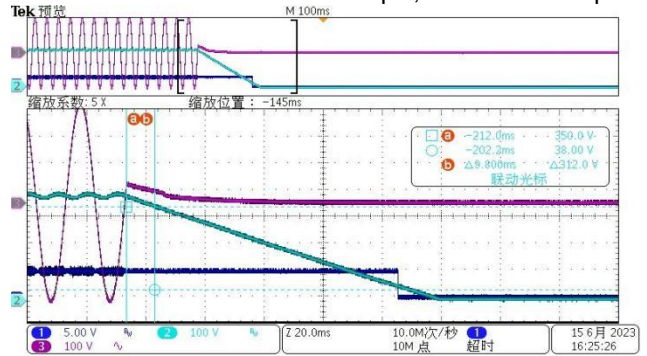
(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Holdup time=9.4ms

Test Condition: 230Vrms/50Hz Input, 388V/1.03A Output



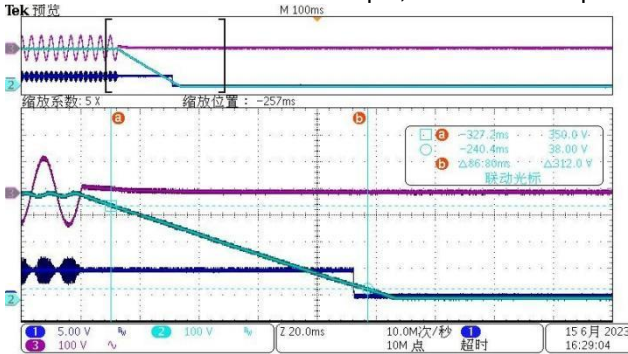
(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Holdup time=9.8ms

Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output



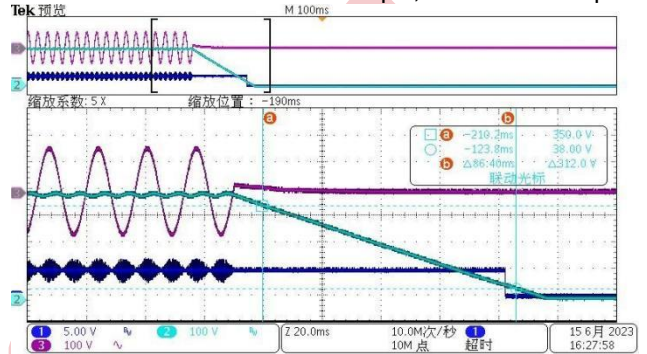
(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Holdup time=9.8ms

Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output



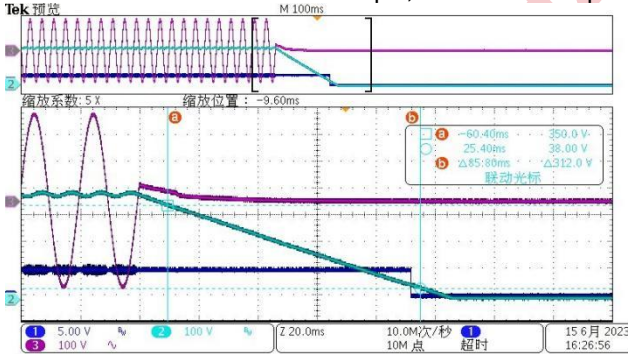
(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Fall time=86.8ms

Test Condition: 115Vrms/60Hz Input, 388V/1.03A Output



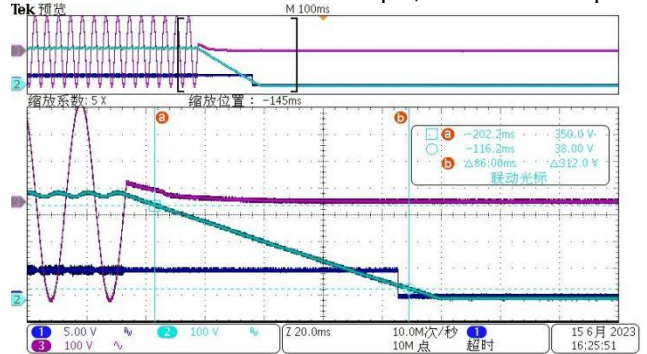
(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Fall time=86.4ms

Test Condition: 230Vrms/50Hz Input, 388V/1.03A Output



(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Fall time=85.8ms

Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output



(CH1-Vpfcok, CH2-Vout, CH3-Vinac)
Comments: Fall time=86ms

2.6 Output Overshoot Test

Standard: $V_{out-peak} < \text{Rated output voltage} * 110\%$.

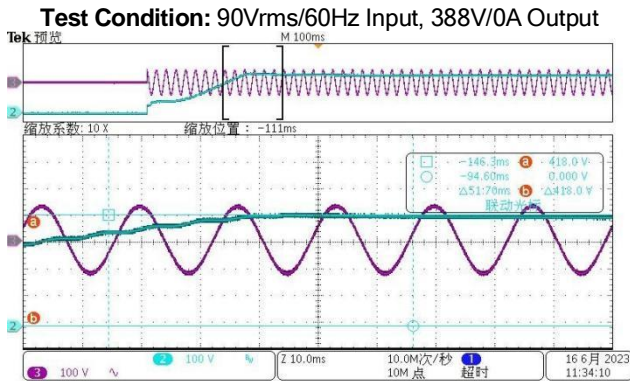
Result: Pass

Note: The output voltage is tested at the output cap end.

Test Data:

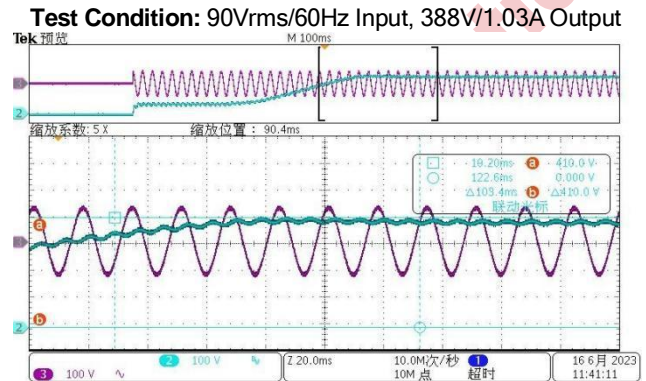
	90Vrms/60Hz		265Vrms/50Hz	
	0A	1.03A	0A	1.03A
Vout-peak (V)	418	410	398	406
Limit (V)	426.8			

Waveforms:



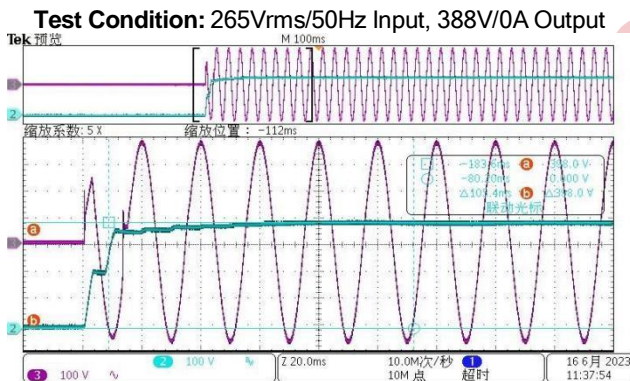
(CH2-Vout, CH3-Vinac)

Comments: Vout-peak=418V



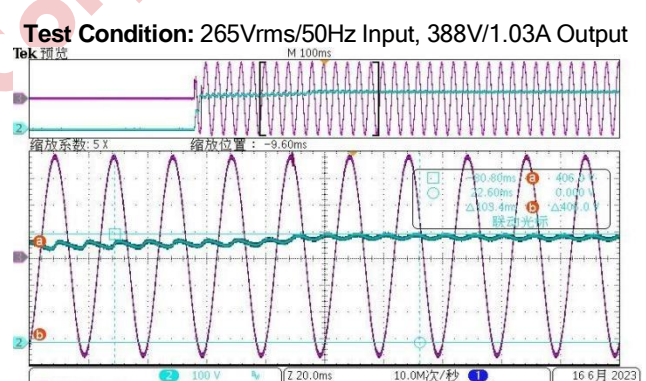
(CH2-Vout, CH3-Vinac)

Comments: Vout-peak=410V



(CH2-Vout, CH3-Vinac)

Comments: Vout-peak=398V



(CH2-Vout, CH3-Vinac)

Comments: Vout-peak=406V

3 Protection Test

3.1 Over Load Curve

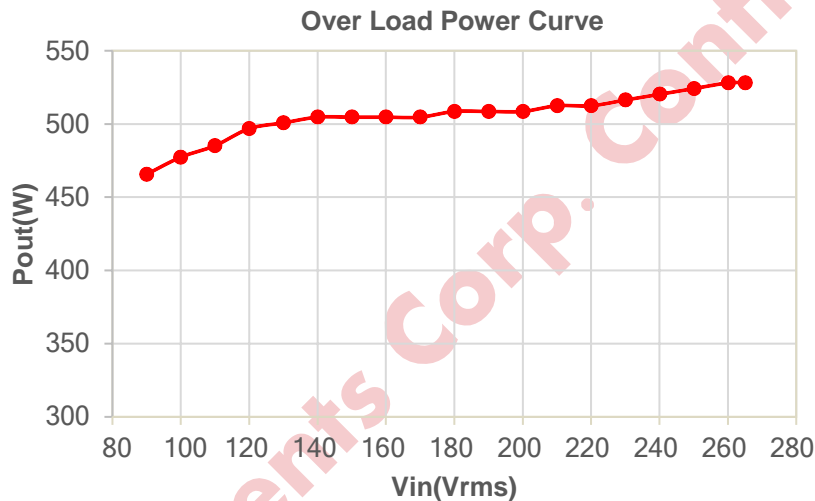
Standard: The overload current should not differ too much between low line and high line of AC input voltage.

Result: Pass

Note: Tested at the output cap end.

Test Data:

Input Voltage	90Vrms /60Hz	110Vrms /60Hz	130Vrms /60Hz	150Vrms /60Hz	170Vrms /60Hz	180Vrms /60Hz
OLP (A)	1.2	1.25	1.29	1.30	1.30	1.31
Input Voltage	190Vrms /50Hz	210Vrms /50Hz	230Vrms /50Hz	250Vrms /50Hz	260Vrms /50Hz	265Vrms /50Hz
OLP (A)	1.31	1.32	1.33	1.35	1.36	1.36



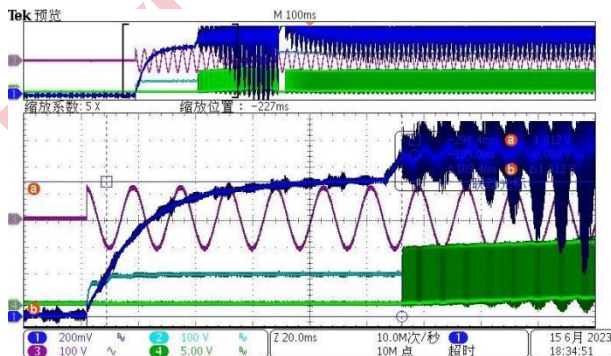
3.2 Input Brown-out Protection

Standard: The power supply should shut down when the input voltage is lower than the Brown-out protection value and return to normal operating condition when the input in the range of normal operating voltage.

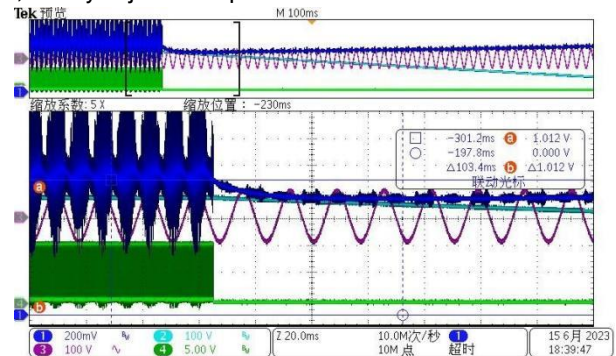
Result: Pass

Waveforms:

Test Condition: 0.1A Output, Slowly adjust the input



(CH1-Vbop, CH2-Vout, CH3-Vinac, CH4-Vgate1)
Comments: 82Vrms Protection recovery



(CH1-Vbop, CH2-Vout, CH3-Vinac, CH4-Vgate1)
Comments: 68Vrms Protection enter

4 Reliability Requirements

4.1 Device Maximum Rating Test

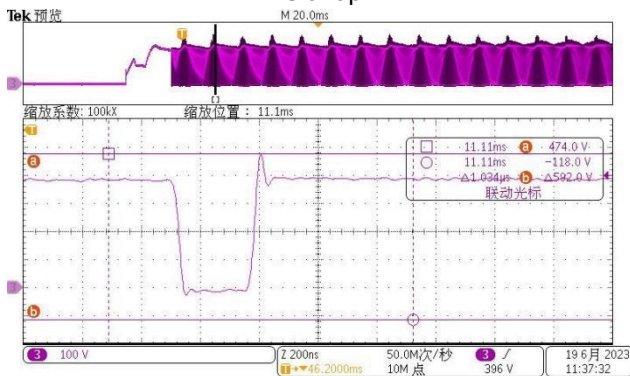
Standard: MOSFET and Diode<95% Rating

Result: Pass

Component	Rating	90Vrms/60Hz 388V/1.03A		265Vrms/50Hz 388/1.03A		Result
		Startup	Steady	Startup	Steady	
MOSFET1	650V	564V	534V	474V	458V	PASS
MOSFET2	650V	558V	532V	502V	456V	PASS
DIODE1	650V	450V	418V	424V	418V	PASS
DIODE2	650V	450V	418V	382V	398V	PASS

Waveforms:

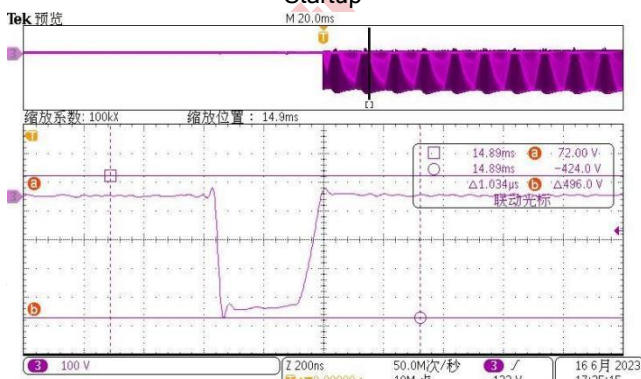
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Startup



(CH1-VDrain1)

Comments: VDrain_peak=474V

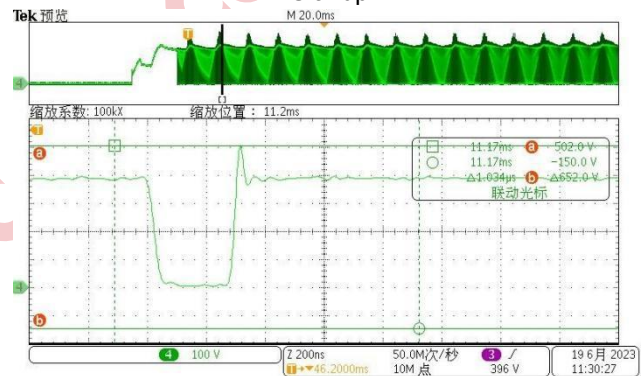
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Startup



(CH3-VDiode1)

Comments: VDiode_peak=424V

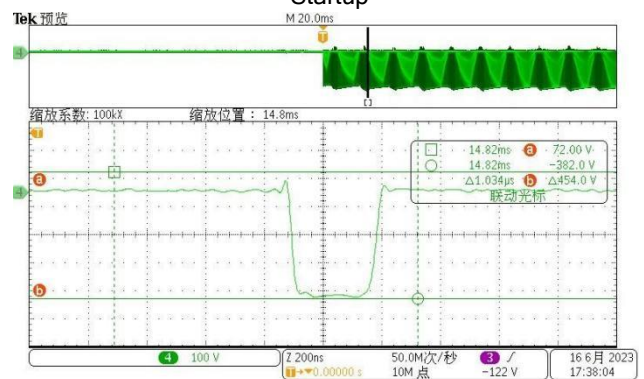
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Startup



(CH4-VDrain2)

Comments: VDrain_peak=502V

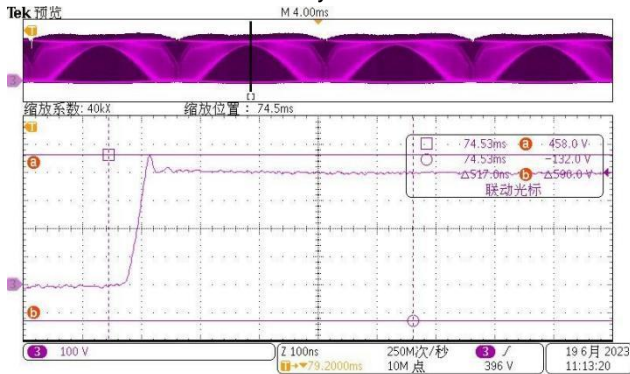
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Startup



(CH4-VDiode2)

Comments: VDiode_peak=382V

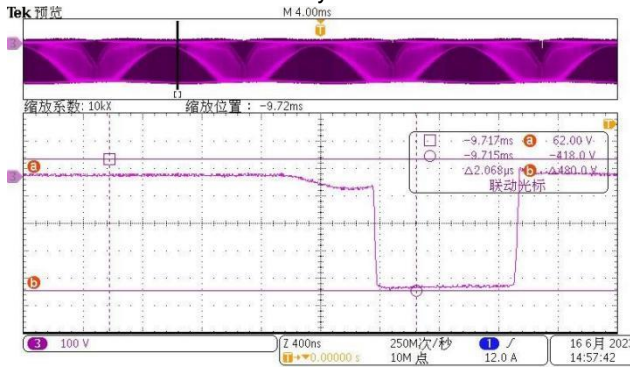
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Steady State



(CH3-VDrain1)

Comments: VDrain_peak=458V

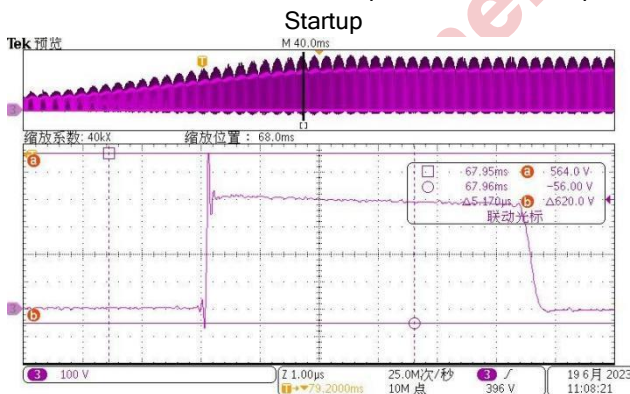
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Steady State



(CH3-VDiode1)

Comments: VDiode_peak=418V

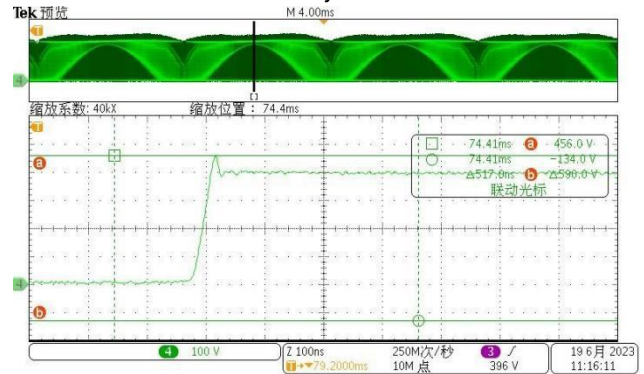
Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output, Startup



(CH1-VDrain1)

Comments: VDrain_peak=564V

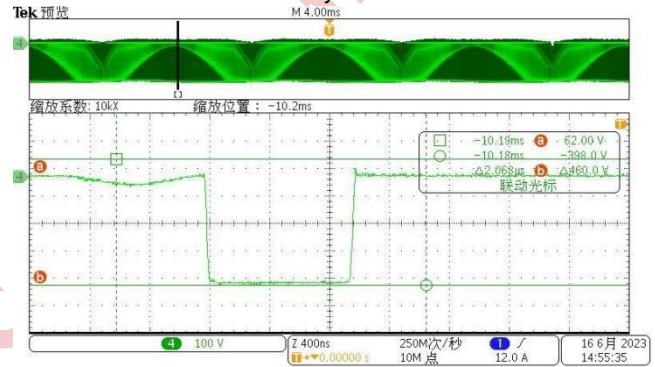
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Steady State



(CH4-VDrain2)

Comments: VDrain_peak=456V

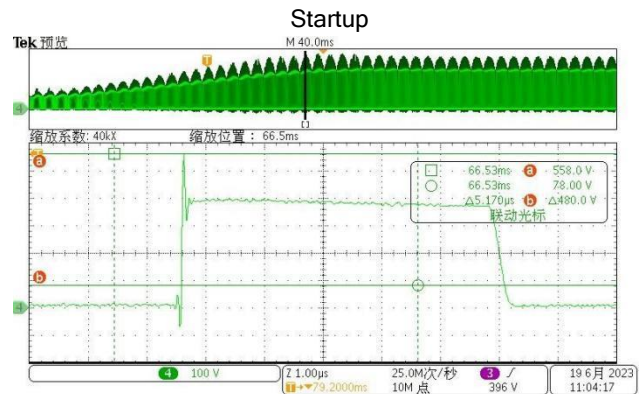
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output, Steady State



(CH4-VDiode2)

Comments: VDiode_peak=398V

Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output, Startup

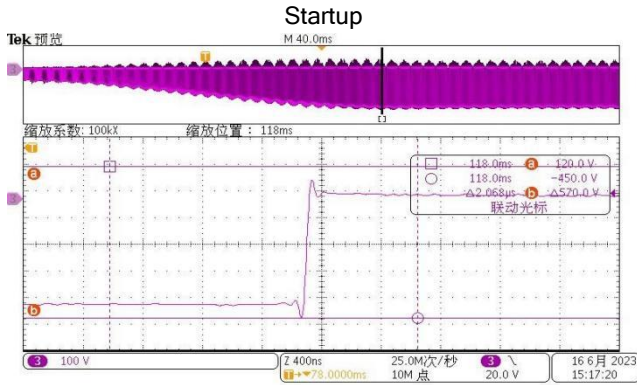


(CH4-VDrain2)

Comments: VDrain_peak=558V

Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,

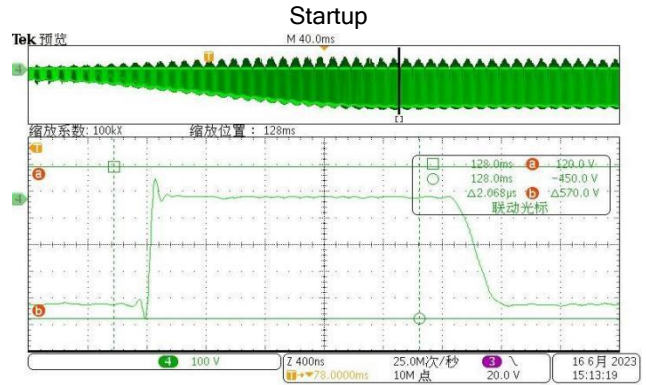
Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output,



(CH3-VDiode1)

Comments: VDiode_peak=450V

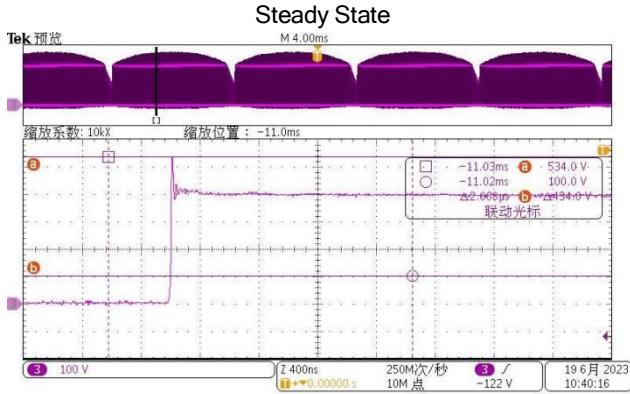
Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH4-VDiode2)

Comments: VDiode_peak=450V

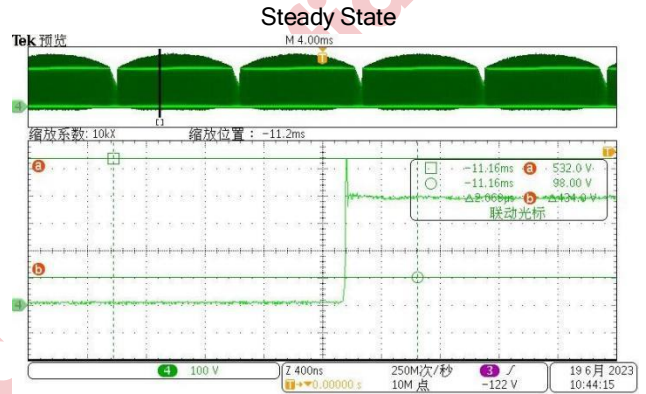
Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH3-VDrain1)

Comments: VDrain_peak=534V

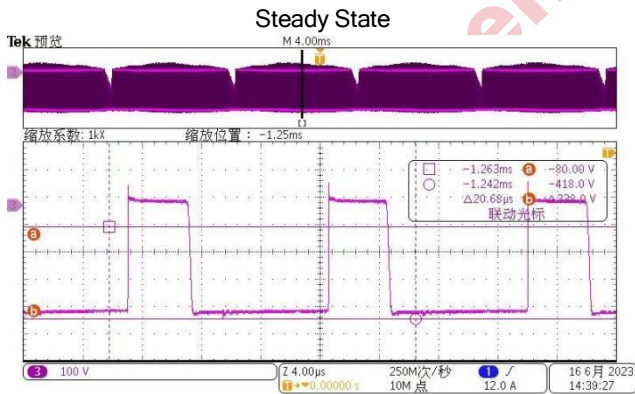
Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH4-VDrain2)

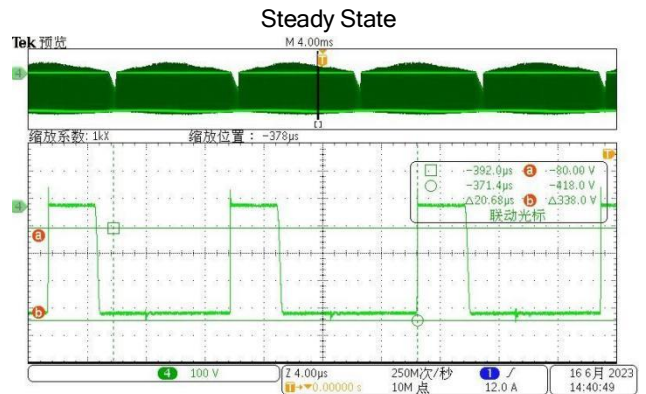
Comments: VDrain_peak=532V

Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH3-VDiode1)

Comments: VDiode_peak=418V



(CH4-VDiode2)

Comments: VDiode_peak=418V

4.2 Bmax Test

Standard: Steady-state rated load: $B_{max} \leq 0.32T$;

Transient and its peak load: $B_{max} \leq 0.38T$.

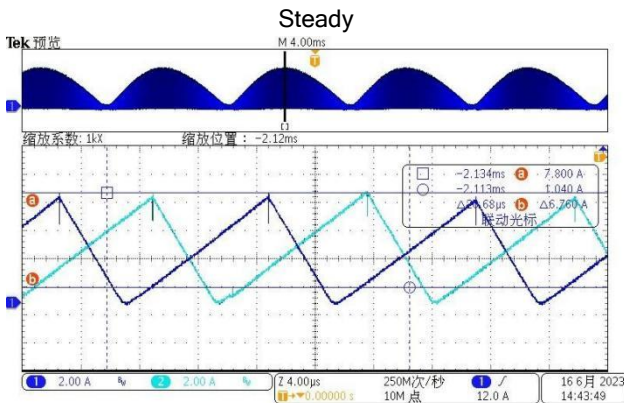
Result: Pass

Note: The turn numbers of the transform is 38, and the sectional area is 118mm², Lp is 150μH, Rcs=0.035R.

Bmax (T)	90Vrms/60Hz		265Vrms/50Hz		Bmax_Limit (T)	Result
	LM1	LM2	LM1	LM2		
Steady	0.261	0.248	0.095	0.098	0.32	PASS
Start-up	0.318	0.317	0.167	0.171	0.38	PASS

Waveforms:

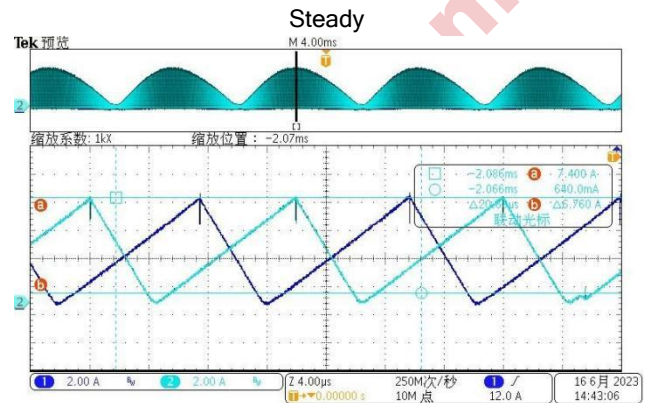
Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH1-IL1)

Comments: IL1=7.8A

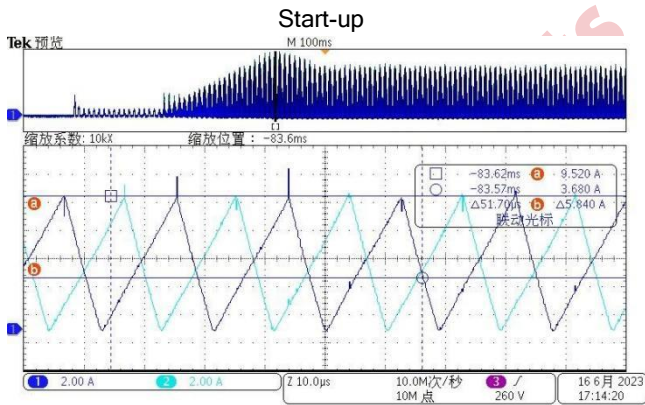
Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH2-IL2)

Comments: IL2=7.4A

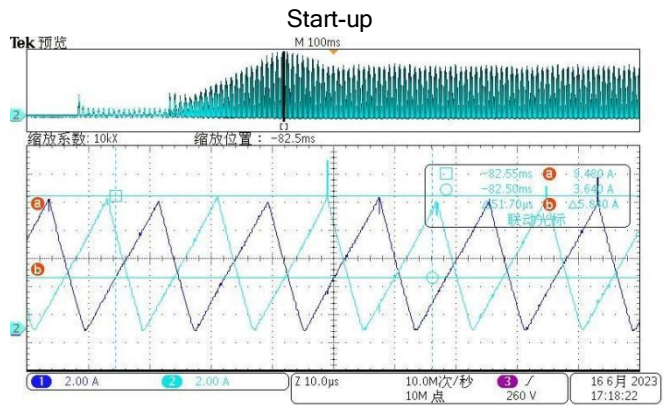
Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH1-IL1)

Comments: IL1=9.52A

Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output,



(CH2-IL2)

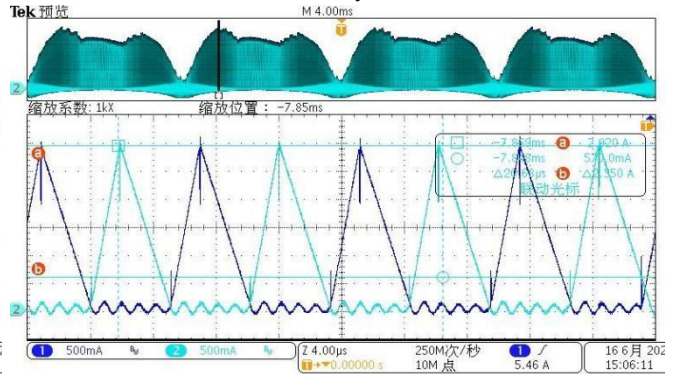
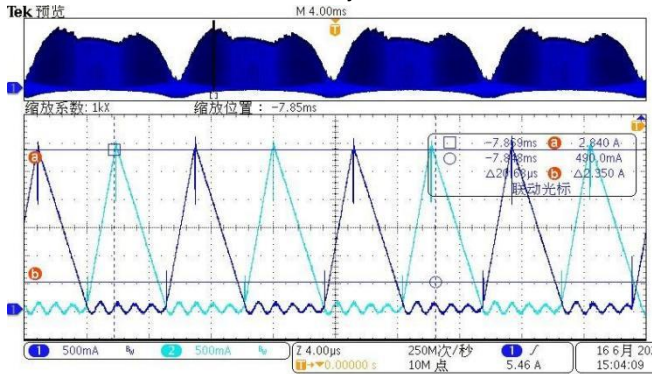
Comments: IL2=9.48A

Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output,

Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output,

Steady

Steady



(CH1-IL1)

(CH2-IL2)

Comments: IL1=2.84A

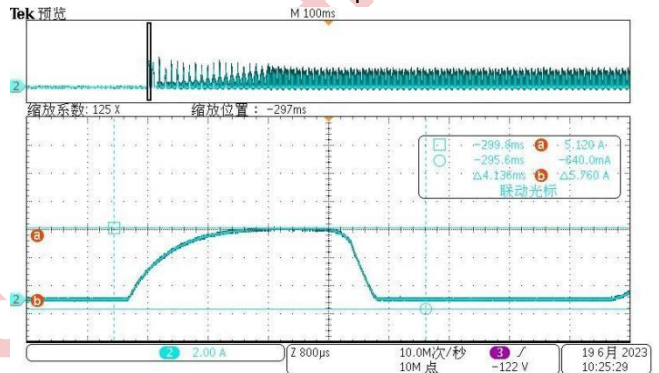
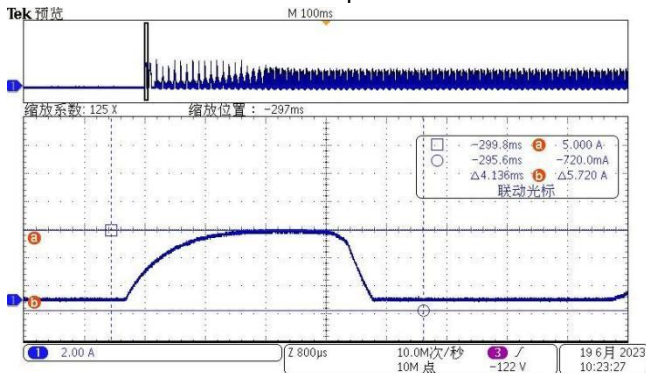
Comments: IL2=2.92A

Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output,

Test Condition: 265Vrms/50Hz Input, 388V/1.03A Output,

Startup

Startup



(CH1-IL1)

(CH2-IL2)

Comments: IL1=5.00A

Comments: IL2=5.12A

4.3 Thermal Test

Test Condition: 90Vrms/60Hz input; 388V/1.03A output; Burn-in 2Hour @ Open Air with no airflow, Ta is the ambient temperature.

Standard: MOS, IC and Diode: Ta=32°C, Trise<90°C. Transformer, Inductor: Ta=32°C, Trise<85°C.

Result: Pass

Trise (°C)	388V/1.03A	
	Ta: 32°C	
Location	90V/60Hz	
	T (°C)	Trise (°C)
KP2822	66.2	34.2
MOSFET1	115.4	83.4
MOSFET2	108.5	76.5
DIODE1	99.1	67.1
DIODE2	94.3	62.3
Rectifier	112.5	80.5
Shunt	96	64
DM Inductor	77.6	45.6
CM1 Inductor	78.9	46.9
CM2 Inductor	70.4	38.4

Test Condition: 90Vrms/60Hz Input, 388V/1.03A Output



Comments: Tmax=115.4°C

5 EMC/EMS Test Result

5.1 Conducted and Radiation Emissions

Standard:

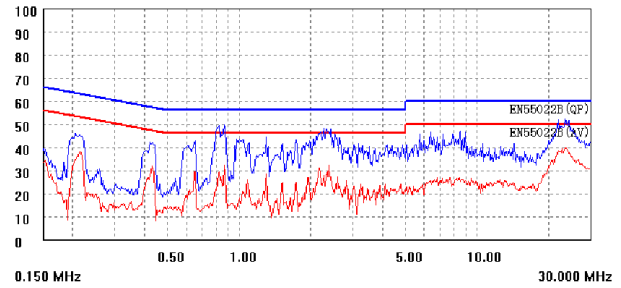
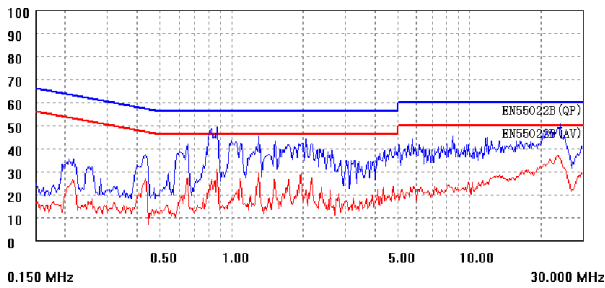
standard	EN55022B
content	CE
requirement	6dB margin

Result: Pass

Note: The resistor load is connected at the 1m Line end.

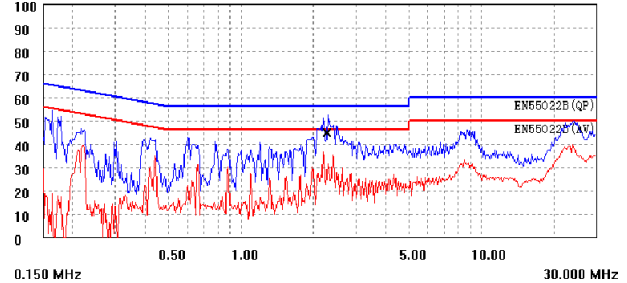
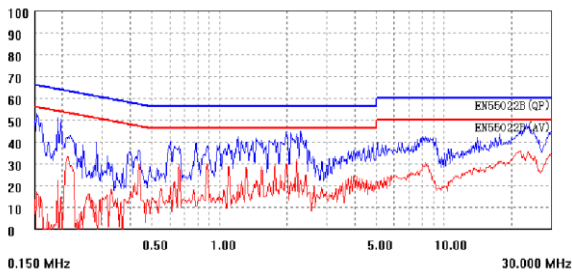
Test Condition: 220Vrms/50Hz-L Input, 388V/1.03A Output

Test Condition: 220Vrms/50Hz-N Input, 388V/1.03A Output



Test Condition: 110Vrms/50Hz-L Input, 388V/1.03A Output

Test Condition: 110Vrms/50Hz-N Input, 388V/1.03A Output





Revision History

DATE	REV	DESCRIPTION
2023/02/21	1.0	First Release
2023/06/26	1.01	Test results are based on the new version (D) of KP2822

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