



DEMO BOARD TEST REPORT

30W High Performance PD3.0 Adapter with PWM Switch KP22035WG and Synchronous Rectifier KP40512SG

FEATURES

- Integrated with 650V Power MOS
- Ultra-Wide VDD Operation Range: 8V-70V
- Quasi-Resonant Control for Good Efficiency in Mid-Load
- Ultra-low Startup and Operating Current, Standby Power Consumption <75mW
- Maximum Frequency of 65KHz, Light Load Frequency Reduction and Burst Mode
- External Precision Output OVP/UV Protection (DEM Pin)
- Adaptive Loop Gain Control
- Integrated Protection Features of Self-Recovery Mode:
 - VDD Overvoltage Protection
 - VDD Short Protection
 - Patent Overload Protection (OLP)
 - Short Circuit Protection (SCP)
 - Leading Edge Blanking (LEB)
 - Over Temperature Protection (OTP)
- Available with ASOP-6 Package

GENERAL DESCRIPTION

KP22035WG is a high performance quasi-resonant current mode PWM switch for off-line flyback converter, with integrated green energy-saving mode, burst mode, mid-load valley bottom conduction mode to optimize system efficiency, which can easily meet DOE 6 efficiency. Moreover, the operating voltage of VDD can support 8V-70V to meet the PD power supply wide range output requirements

The KP22035WG is equipped with precision 65KHz switching frequency oscillator. with Integrated Slope Compensation, soft start, jitter technology, loop gain adjustment, which greatly improved System stability, reliability, Electromagnetic compatibility.

The KP22035WG integrates protections of Under Voltage Lockout(UVLO), VDD Over Voltage Protection (VDD OVP), Output OVP, Cycle by Cycle Current Limiting (OCP), Over Load Protection (OLP), Short Circuit Protection (SCP), On-Chip Thermal Shutdown (OTP), Soft Start, Leading Edge Blanking (LEB), etc.

APPLICATIONS

- PD Charger and Adapter
- Wide Range Output Adapter



DEMO BOARD TEST REPORT

Fast Turn-Off, High-Performance Synchronous Rectifier Switch

FEATURES

- Integrated with 100V MOSFET
- Support DCM, QR and CCM Operation
- Integrated with 180V HV Voltage Sense and VDD Supply Circuit, and aux-winding for VDD supply can be eliminated
- Integrated with Intelligent Dual LDOs for VDD Supply, SR will work even When Output Voltage Drops Down to Zero
- Support Wide Output Range, especially fit for Quick Charger Application with QC、PD Protocol
- Support High-Side and Low-Side Configuration
- <30ns Fast Turn-Off Delay
- Intelligent Turn-on Detection Function
- Intelligent ZCD Function
- Intelligent Gate Clamp before Start-up
- Available with SOP8 Package

APPLICATIONS

- USB PD Quick Chargers
- Adaptors

GENERAL DESCRIPTION

KP40512SG is a high-performance secondary side synchronous rectifier switch that replaces Schottky diodes in high-efficiency Fly-back converters.

KP40512SG supports High-Side and Low-Side configuration. It also has built-in HV supplies which can eliminate the aux-winding of VDD supply for cost saving.

KP40512SG supports DCM, QR and CCM Operations due to fast turn-off delay of SR MOSFET control.

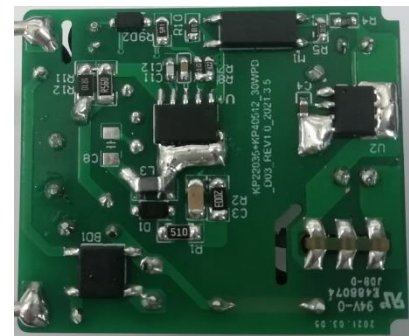
KP40512SG integrates intelligent turn-on detection function which can prevent KP40512SG from turning on falsely due to VDS oscillations at DCM operations.

DEMO BOARD SEPCIFICATION

Description	Symbol	Min	Type	Max	Unit	Note
Input Voltage	Vin	90		265	Vac	50/60Hz
Output	Vout/Iout	5V/3A; 9V/3A; 12V/2.5A;15V/2A;20V1.5A				
Rate Output Power	Pout		30		W	
Ripple & Noise	Vripple		34		mVp-p	20MHz Bandwidth @230Vac,1m Cable End
System Average Efficiency	η	>88			%	Board end @230Vac, 20V output
Standby Power Consumption	Pst		59		mW	@265Vac
Startup Time	Tst		2.812		s	Tested at 90Vac/60Hz
Conducted EMI Margin			0		dB	EN55022 Class B
Radiated EMI Margin			0		dB	EN55015 CDN
Surge Test			1.5		kV	Differential Mode @ 230Vac/50Hz
ESD(Contact Discharge)			9		kV	
ESD(Air Discharge)			16		kV	
Safety						
Operating Ambient		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.

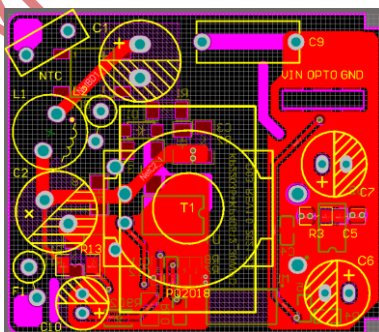
Demo Board of KP22035WG+KP40512SG_D03_REV1.0



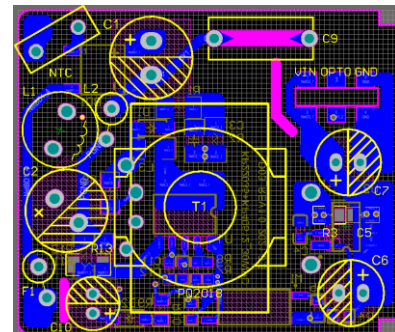
Board Size (mm): L x W x H=39.1 x 33.2 x21.9

Printed Circuit Board Layout

Top Layer

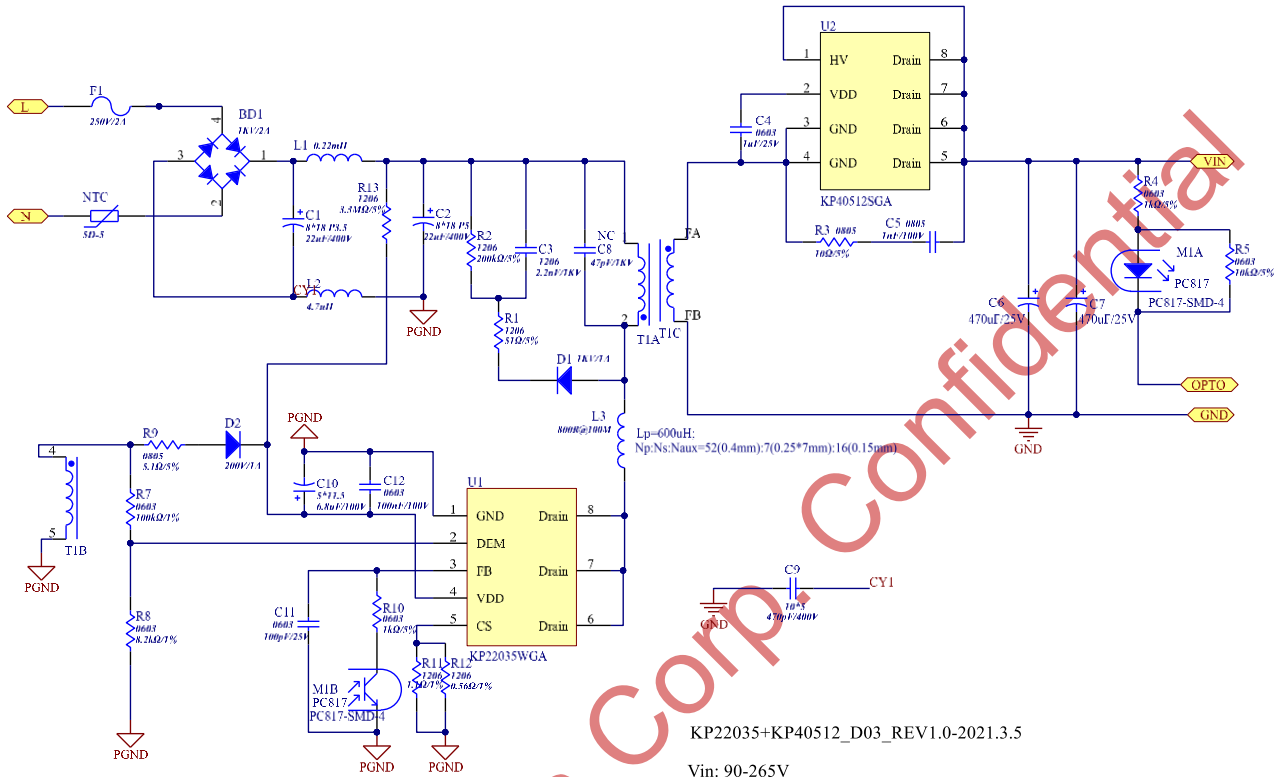


Bottom Layer



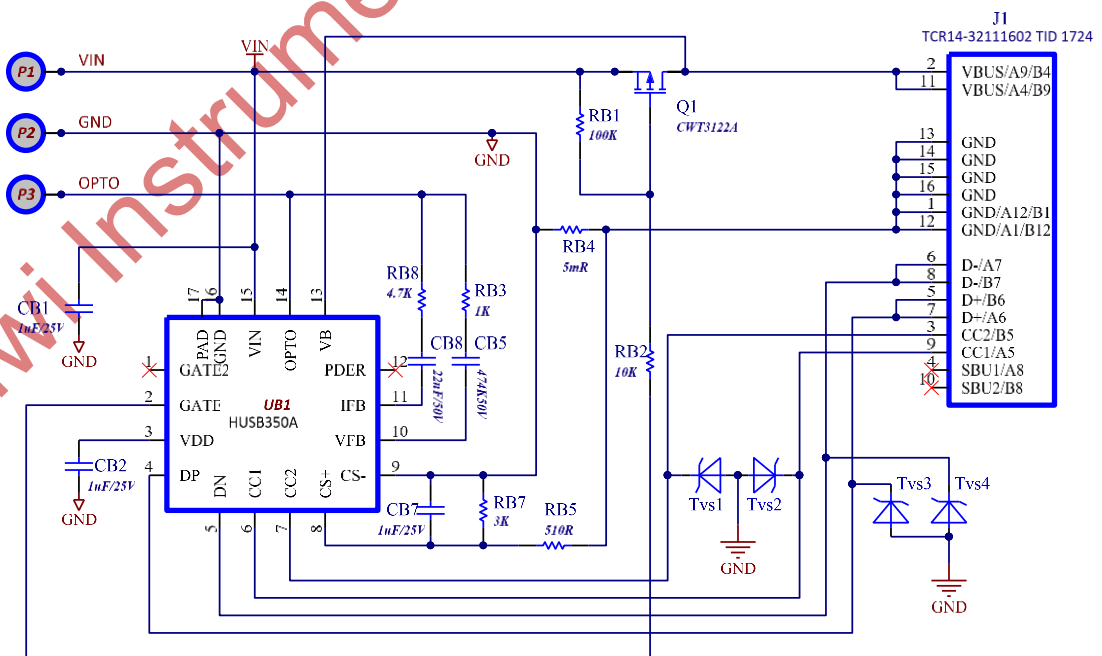
Schematic

Schematic_Part A:



KP22035+KP40512_D03_REV1.0-2021.3.5
 Vin: 90-265V
 Vout: 5V/3A, 9V/3A, 12V/2.5A, 15V/2A, 20V/1.5A

Schematic_Part B:



Circuit Description

The demo board of KP22035WG+KP40512SG is configured in a single stage flyback topology, which combines a current mode PWM switch KP22035WG with synchronous rectifier KP40512SG. The demo board is typically designed for 30W adapter together with USB PD with universal input (90-265Vac, 50/60Hz). Additionally, the demo board can achieve high efficiency, low standby power loss and precise constant voltage control.

1. Input Rectification

The circuit input stage is composed by the components of F1, NTC, and BD1. F1 and NTC provide the inrush current limitation and Surge protection in the event of component failure, surge or short circuit event. The bridge diode of BD1 rectifies the AC input to DC output.

2. Current Mode PWM Switch KP22035WG Operation

U1 is the current mode PWM switch KP22035WG, with integrated green energy-saving mode, burst mode, mid-load valley bottom conduction mode to optimize system efficiency, which can easily meet DOE 6 efficiency. Moreover, the operating voltage of VDD can support 8V-70V to meet the PD power supply wide range output requirements

3. Synchronous Rectifier KP40512SG Operation

KP40512SG is a high-performance secondary side synchronous rectifier switch that replaces Schottky diodes in high-efficiency Fly-back converters. KP40512SG supports High-Side and Low-Side configuration. It also has built-in HV supplies which can eliminate the aux-winding of VDD supply for cost saving. KP40512SG supports DCM, QR and CCM Operations due to fast turn-off delay of SR MOSFET control.

KP40512SG integrates intelligent turn-on detection function which can prevent KP40512SG from turning on falsely due to VDS oscillations at DCM operations.



Demo Board Test Report
High Performance 30W Adapter with KP22035WG and KP40512SG

Bill of Material

No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	J1	'TYPE C	TYPE C	TYPE C-2	Any	
2	F1	250V/2A	FUSE 2A 250V 3.6*10	3.6*10	HongDa	
3	NTC	SCK05052	RES NTC 5ohm 2A 2618K +/-7%	SCK05	THINKING	
4	BD1	1KV/2A	DIO BRD 2A 1KV ABS-4P SMD	ABS-4P SMD	Taiwan Semi	
5	L1	0.22mH	INDUCTOR 220uH 0.78Ω 410mA 6*8 P3.0 +/-10%	6*8 P3.0	FENGHUA	
6	L2	4.7uH	Axial fixed INDUCTOR 4.7uH 0.35 Ω 530mA 0410 +/-10%	4*10 P3	CENKER	
7	L3	800R/100MHz	Magnetic bead 800R/100MHz 250mΩ 2A 1206 +/-25%	1206	FENGHUA	
8	U1	KP22035WGA	Current Mode PWM Converter	ASOP6	Kiwi Instruments	
9	U2	KP40512SG	Secondary Side Synchronous Rectifier	SOP8	Kiwi Instruments	
10	D1	1KV/1A	DIO FRD 1A 1KV SOD-123-2P SMD	SOD123	PAN JIT	
11	D2	200V/1A	DIO FRD 1A 200V SOD-123-2P SMD	SOD123	PAN JIT	
12	R1	51Ω/5%	RES SMD 1/4W J 1206	R1206	Yageo	
13	R2	200kΩ/5%	RES SMD 1/4W J 1206	R1206	Yageo	
14	R3	10Ω/5%	RES SMD 1/8W J 0805	R0805	Yageo	
15	R4,R10,RB3	1kΩ/5%	RES SMD 1/8W J 0603	R0805	Yageo	
16	R5,RB2	10kΩ/5%	RES SMD 1/8W J 0603	R0603	Yageo	
17	R7	100kΩ/5%	RES SMD 1/8W J 0603	R0603	Yageo	
18	R8	8.2kΩ/5%	RES SMD 1/8W J 0603	R0603	Yageo	
19	R9	5.1Ω/5%	RES SMD 1/8W J 0805	R0805	Yageo	
20	R11	0.56Ω/1%	RES SMD 1/4W J 1206	R1206	Yageo	
21	R12	1.1Ω/1%	RES SMD 1/4W J 1206	R1206	Yageo	
22	R13	3.3MΩ/5%	RES SMD 1/4W J 1206	R1206	Yageo	
23	RB1	100kΩ/5%	RES SMD 1/8W J 0603	R0603	Yageo	
24	RB4	5mΩ/1%	RES SMD 1/4W J 1206	R1206	Yageo	
25	RB5	510Ω/5%	RES SMD 1/8W J 0603	R0603	Yageo	
26	RB7	3kΩ/5%	RES SMD 1/8W J 0603	R0603	Yageo	
27	RB8	4.7kΩ/5%	RES SMD 1/8W J 0603	R0603	Yageo	
28	C1,C2	22uF/400V	CAP AL LD 400V 22uF M 8*18 P3.5 105°C	8*18 P3.5	YongMing	
29	C3	2.2nF/1KV	CAP MC SMD K X7R 1206	C1206	Murata	
30	C4,CB1,CB2,CB 7	1uF/25V	CAP MC SMD K X7R 0603	C0603	Murata	
31	C5	2.2nF/50V	CAP MC SMD K X7R 0603	C0603	Murata	



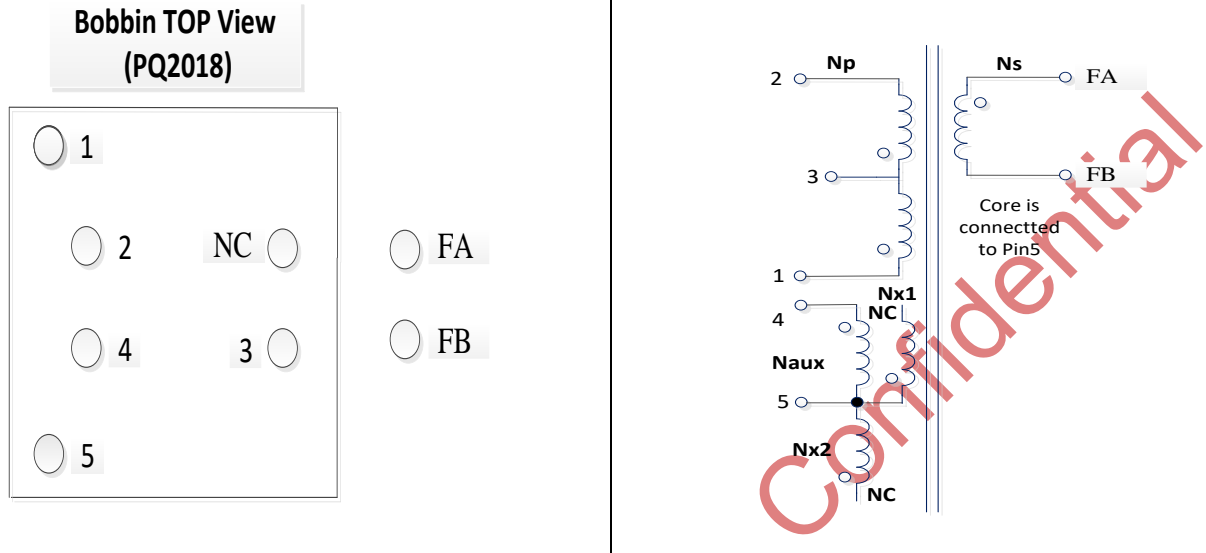
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High Performance 30W Adapter with KP22035WG and KP40512SG

32	C6,C7	470uF/25V	CAP AL LD 25V 470uF M 6.3*10 P3 105°C	6.3*10 P3	YongMing	
33	C9	470pF/400V	CAP Y1 400V 470pF M P10	P10	STE	
34	C10	6.8uF/100V	CAP AL LD 100V 6.8uF M 5*11 P2 105°C	5*11 P2	Rubycon	
35	C11	100pF/25V	CAP MC SMD K X7R 0603	C0603	Murata	
36	C12	100nF/100V	CAP MC SMD K X7R 0603	C0603	Murata	
37	CB5	470nF/50V	CAP MC SMD K X7R 0603	C0603	Murata	
38	CB8	22nF/50V	CAP MC SMD K X7R 0603	C0603	Murata	
39	Q1	CWT3122A	FET -30V -45A 11mohm PDFN3333 SMD	PDFN3333	HENA	
40	M1	EL1019	PHOTO TR 60mA 80V SOP-4L-4P 200%-400% SMD	SOP-4L-4P	EVERLIGHT	
41	UB1	HUSB350A	USB Type-C and PD Source Controller	QFN16	HyneteK	
42	T1	PQ2018	PQ2018 PC40 4+2 Horizontal	PQ2018	Any	
43	TV1,TV2,Tv3,Tv 4	ESD5Z5.0VC	DIO TVS 4A 12V SOD-523-2P SMD	SOD523	TAK VHEONG	

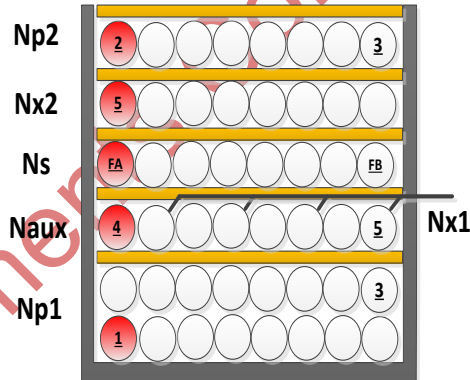
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Transformer Manufacture Guide

1. Electrical Diagram



2. Winding Diagram



3. Winding Order

Number	Winding	Property	Start	End	Wire Size(mm)	Turns	Note
1	NP1	Primary	1	3	0.4*1P	35Ts	Close Wound
2	Naux	Auxiliary	4	5	0.15*1P	16Ts	Close Wound
3	Nx1	Shielding	5	NC	0.15*1P	16Ts	Close Wound
4	Ns	Secondary	FA	FB	0.25*7P	7Ts	Close Wound
5	Nx2	Shielding	5	NC	0.2*3P	Full floor	Close Wound
6	NP2	Primary	3	2	0.4*1P	17Ts	Close Wound



4. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1 – 2; other windings open	600uH±5%
Leakage Inductance	Measured at 40kHz, 1.0 VRMS	Pins 1 – 2; all other windings shorted	14uH
HI-POT HV Test	3000Vac/50Hz, One minute	Primary to Secondary	3000Vac, 5mA
	3000Vac/50Hz, One minute	Secondary to Core	3000Vac, 5mA
Insulation Resistance	500Vdc	All windings to core	100MΩMin
	500Vdc	Between windings	100MΩMin
DC Resistance	-	Pins 1 – 2	0.65R

5. BOM

Items	Spec
Core	PQ2018, PC40
Bobbin	PQ2018, 6Pin
Wire	Φ0.4mm, 2UEW, Class B Φ0.15mm, 2UEW, Class B Φ0.2mm, 2UEW, Class B Φ0.25*7mm, 2UEW, Class B
Tape	5mm(W)×0.06mm (TH)

Test Result

1. Input characteristics

1.1 Maximum rated input AC current

Standard: 2Amax. @ 90Vac input & full load

Result: Pass

VIN (ac)	90V	115V	230V	265V	Result
lin(A)	0.602	0.485	0.252	0.2	PASS

1.2 Inrush current (cold start)

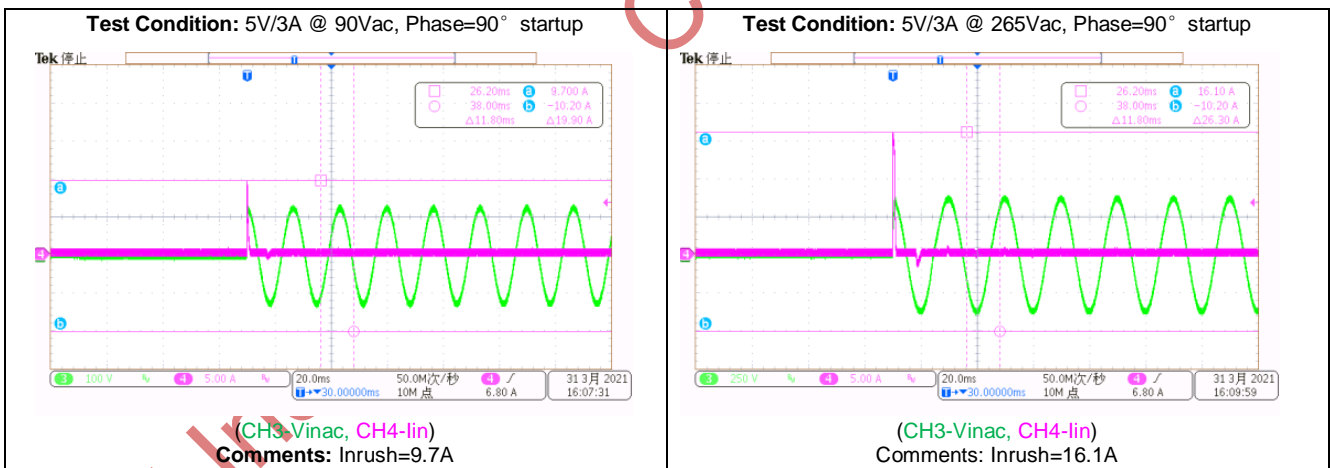
Standard: 30A max@ 265Vac input

Result: Pass

Note: Tested @ 5V/3A

VIN (ac)	90V	115V	230V	265V	Result
Inrush(A)	9.7	12.6	16	16.1	PASS

Waveforms:



1.3 No load input power dissipation

Standard: While input 90Vac~265Vac and the output is no load, the input power loss must be less than 75mW

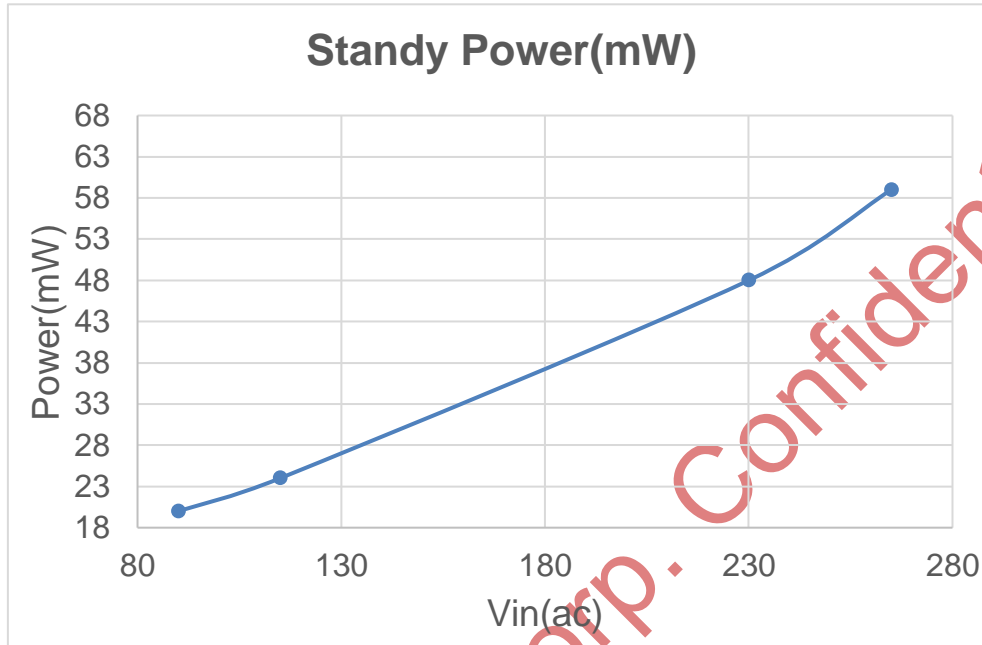
Result: Pass

Note: Tested @ 5V/no load condition, and the VDD current limiting resistor is 5.1Ω, high voltage starting resistance is 3.3MΩ



Demo Board Test Report
High Performance 30W Adapter with KP22035WG and KP40512SG

VIN (ac)	90V	115V	230V	265V	Result
Pin(mW)	20	24	48	59	PASS



1.4 Average efficiency

Standard: The average efficiency meets CoC V5 Tier 2 with 1.5% margin

Result: Pass

Note: The average efficiency tested at board ends

Efficiency Summary:

Output	Max Eff (%)					Remark
	90Vac	115Vac	230Vac	265Vac	CoC V5 Tier 2	
20V	89.43	90.19	90.87	90.6	85.45	Pass
15V	89.69	90.58	91.08	90.78	85.45	Pass
12V	89.84	90.54	90.97	90.65	85.45	Pass
9V	89.75	90.46	90.41	90.12	85.45	Pass
5V	89.01	89.44	88.78	88.24	81.84	Pass

Output	Average Eff (%)					Remark
	90Vac	115Vac	230Vac	265Vac	CoC V5 Tier 2	
20V	89.43	90.19	90.87	90.6	85.45	Pass
15V	89.69	90.58	91.08	90.78	85.45	Pass
12V	89.84	90.54	90.97	90.65	85.45	Pass
9V	89.75	90.46	90.41	90.12	85.45	Pass
5V	89.01	89.44	88.78	88.24	81.84	Pass



20V	88.53	89.2	88.98	88.48	85.45	Pass
15V	89.23	89.9	89.68	89.2	85.45	Pass
12V	89.3	90.24	89.99	89.4	85.45	Pass
9V	89.14	90	89.49	88.88	85.45	Pass
5V	88.56	88.82	88.78	88.24	81.84	Pass

Efficiency (20V/1.5A):

Vin (Vac)	Fline(Hz)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Eff (%)	Eff_AVG(%)	CoC V5(%)
90	60	8.74	20.014	0.378	7.565	86.56	88.53	85.45
		16.96	20.052	0.754	15.119	89.15		
		25.32	20.092	1.127	22.643	89.43		
		33.94	20.11	1.502	30.205	89.00		
115		8.72	20.014	0.378	7.5652	86.76	89.2	
		16.86	20.052	0.754	15.119	89.68		
		25.1	20.086	1.127	22.636	90.19		
		33.5	20.12	1.502	30.212	90.19		
230	50	8.85	20.011	0.378	7.564	85.47	88.98	
		16.94	20.045	0.754	15.113	89.22		
		25.05	20.086	1.127	22.636	90.37		
		33.24	20.11	1.502	30.205	90.87		
265		8.93	20.011	0.378	7.564	84.71	88.48	
		17.04	20.045	0.754	15.113	88.70		
		25.17	20.08	1.127	22.630	89.91		
		33.34	20.11	1.502	30.205	90.60		

Efficiency (15V/2A):

Vin (Vac)	Fline(Hz)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Eff (%)	Eff_AVG(%)	CoC V5(%)
90	60	8.51	15.018	0.502	7.539	88.59	89.23	85.45
		16.83	15.062	1.002	15.092	89.67		
		25.3	15.107	1.502	22.690	89.69		
		34.06	15.15	2	30.304	88.97		
115		8.5	15.018	0.502	7.539	88.69	89.99	
		16.71	15.062	1.002	15.092	90.32		
		25.05	15.107	1.502	22.690	90.58		
		33.55	15.15	2.001	30.319	90.37		



230	50	8.65	15.013	0.502	7.536	87.13	89.68	
		16.8	15.057	1.002	15.087	89.80		
		25.01	15.102	1.502	22.683	90.70		
		33.29	15.15	2.001	30.319	91.08		
265		8.72	15.013	0.502	7.536	86.43	89.2	
		16.9	15.06	1.002	15.09	89.29		
		25.12	15.102	1.502	22.683	90.30		
		33.39	15.15	2.001	30.311	90.78		

Efficiency (12V/2.5A):

Vin (Vac)	Fline(Hz)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Eff (%)	Eff_AVG(%)	CoC V5(%)
90	60	8.44	12.019	0.628	7.547	89.43	89.3	85.45
		16.83	12.077	1.252	15.120	89.84		
		25.42	12.135	1.876	22.765	89.56		
		34.48	12.19	2.5	30.475	88.38		
115		8.41	12.019	0.628	7.547	89.75	90.24	
		16.7	12.077	1.252	15.120	90.54		
		25.15	12.135	1.876	22.766	90.52		
		33.8	12.19	2.5	30.475	90.16		
230	50	8.56	12.019	0.628	7.547	88.18	89.99	
		16.78	12.075	1.252	15.117	90.09		
		25.09	12.132	1.876	22.753	90.71		
		33.5	12.19	2.5	30.475	90.97		
265		8.66	12.02	0.628	7.548	87.17	89.4	
		16.89	12.075	1.252	15.117	89.51		
		25.21	12.132	1.876	22.7593	90.28		
		33.62	12.19	2.5	30.475	90.65		

Efficiency (9V/3A):

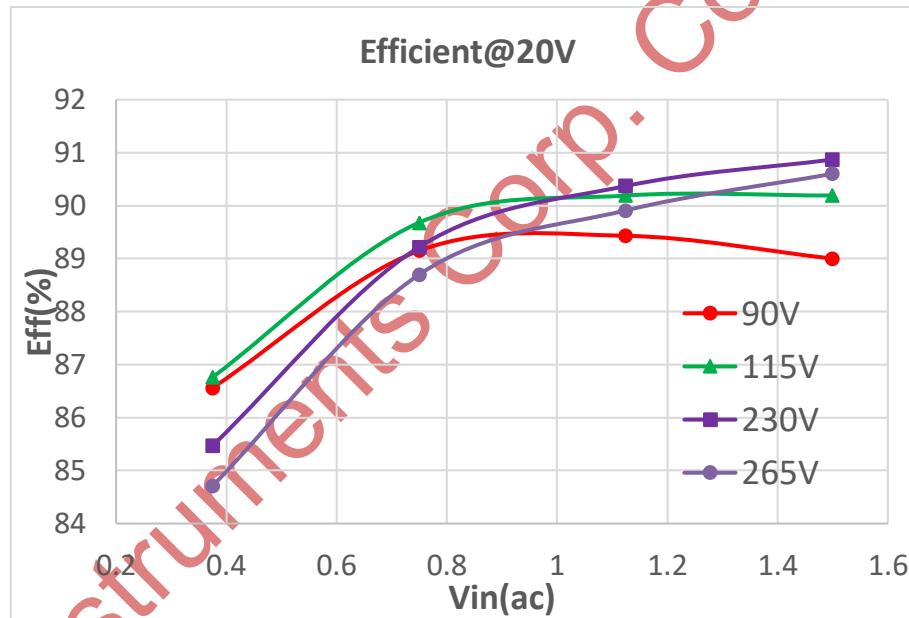
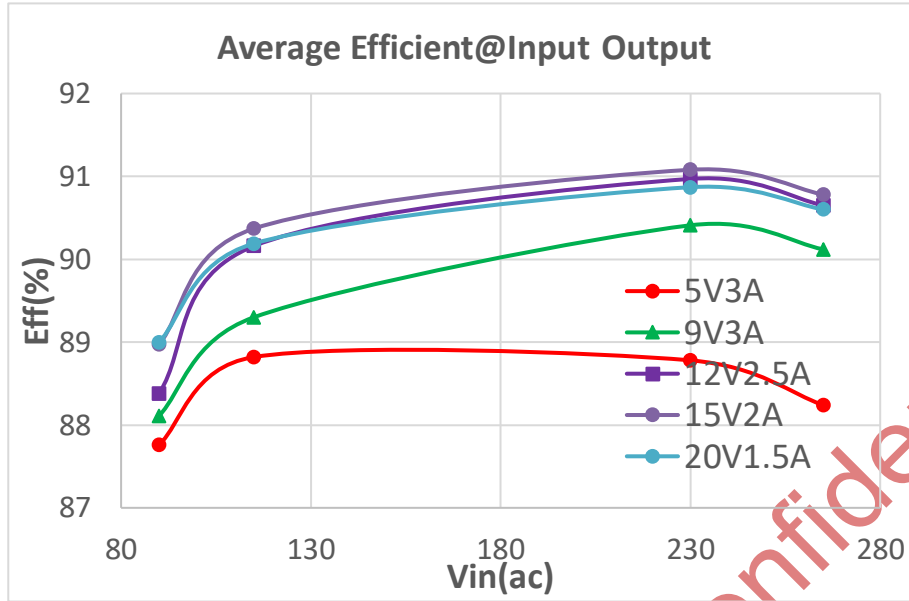
Vin (Vac)	Fline(Hz)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Eff (%)	Eff_AVG(%)	CoC V5(%)
90	60	7.60	9.035	0.754	6.812	89.64	89.14	85.45
		15.23	9.1	1.502	13.668	89.75		
		23.19	9.17	2.252	20.65	89.05		
		31.46	9.24	3	27.72	88.11		
115		7.57	9.035	0.754	6.812	89.99	90	



		15.11	9.1	1.502	13.668	90.46	
		22.88	9.17	2.252	20.65	90.26	
		31.04	9.24	3	27.72	89.30	
230	50	7.76	9.035	0.754	6.812	87.79	89.49
		15.27	9.1	1.502	13.668	89.51	
		22.88	9.17	2.252	20.650	90.26	
		30.66	9.24	3	27.72	90.41	
265	50	7.86	9.035	0.754	6.812	86.67	88.88
		15.38	9.102	1.502	13.671	88.89	
		22.99	9.17	2.252	20.65	89.83	
		30.76	9.24	3	27.72	90.12	

Efficiency (5V/3A):

Vin (Vac)	Fline(Hz)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Eff (%)	Eff_AVG(%)	CoC V5(%)
90	60	4.37	5.159	0.754	3.889	89.01	88.56	81.84
		8.83	5.226	1.502	7.849	88.90		
		13.46	5.294	2.252	11.922	88.57		
		18.34	5.365	3	16.095	87.76		
115	60	4.38	5.159	0.754	3.889	88.81	89.11	
		8.78	5.228	1.502	7.852	89.44		
		13.35	5.297	2.252	11.928	89.35		
		18.12	5.365	3	16.095	88.82		
230	50	4.58	5.159	0.754	3.889	84.93	87.45	
		8.96	5.227	1.502	7.85	87.62		
		13.48	5.295	2.252	11.924	88.46		
		18.13	5.365	3	16.095	88.78		
265	50	4.66	5.157	0.754	3.888	83.44	86.52	
		9.06	5.225	1.502	7.847	86.62		
		13.58	5.294	2.252	11.922	87.79		
		18.24	5.365	3	16.095	88.24		



2. Output characteristics

2.1 Output line regulation and load regulation

Standard: Under the input voltage 90Vac~265Vac, Line regulation <6%, Load regulation <6%.

Note: The output voltage was tested at 1 m line ends

Result: Pass

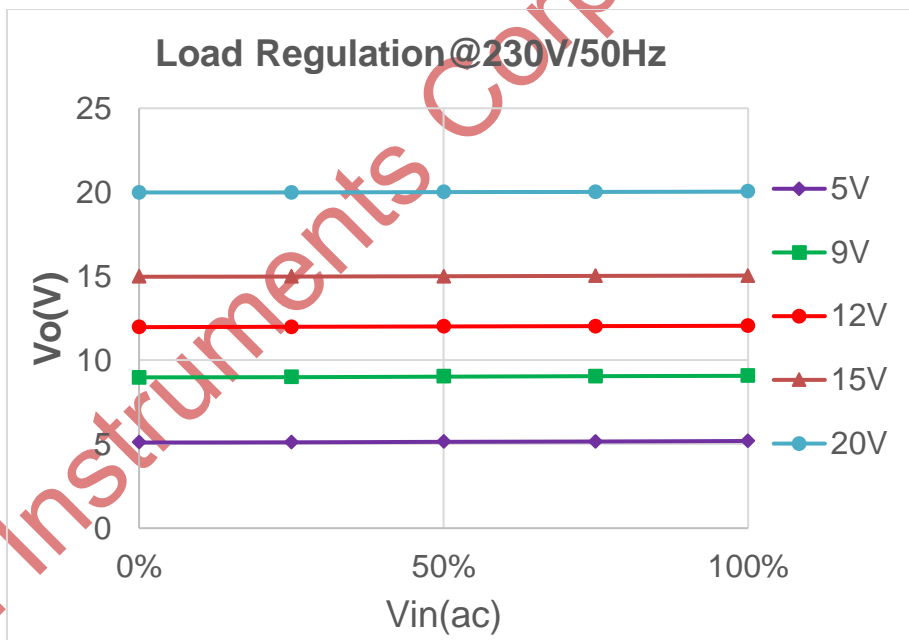
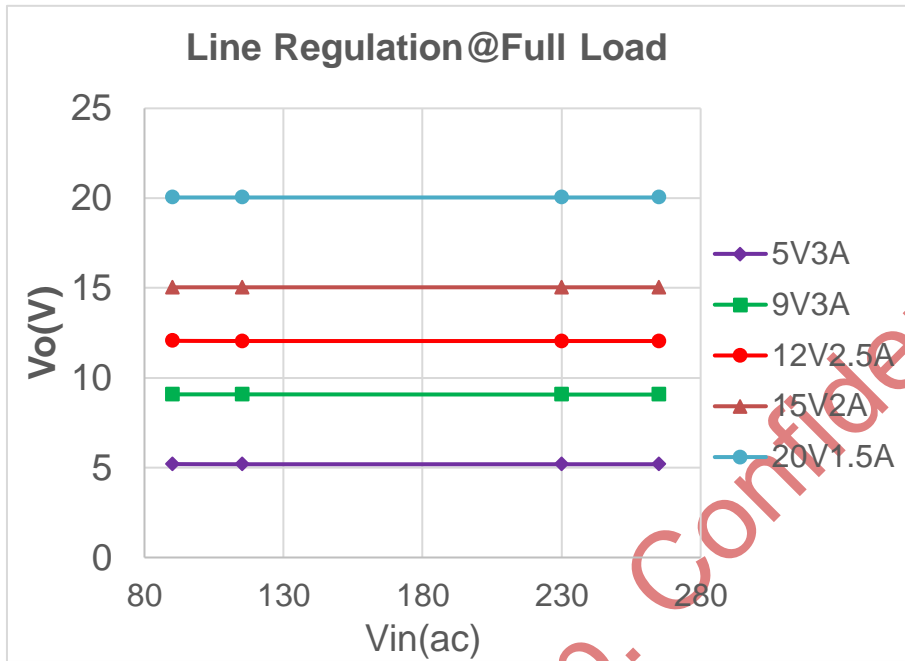
Input Voltage	For Vo=20V / Output Voltage(V)					Load Regulation
	0% Load	25% Load	50% Load	75% Load	Full Load	



Demo Board Test Report
High Performance 30W Adapter with KP22035WG and KP40512SG

90Vac/60Hz	19.99	20	20.01	20.02	20.04	0.25%
115Vac/60Hz	19.99	20	20.01	20.03	20.04	0.25%
230Vac/50Hz	19.99	19.99	20.01	20.02	20.04	0.25%
264Vac/50Hz	19.99	19.99	20.01	20.02	20.04	0.25%
Line Regulation	0.00%	0.05%	0.00%	0.05%	0.00%	
Input Voltage	For Vo=15V / Output Voltage(V)					Load Regulation
	0% Load	25% Load	50% Load	75% Load	Full Load	
90Vac/60Hz	14.98	14.99	15.01	15.02	15.04	0.26%
115Vac/60Hz	14.98	14.99	15	15.03	15.04	0.26%
230Vac/50Hz	14.97	14.98	15	15.02	15.04	0.33%
264Vac/50Hz	14.98	14.98	15	15.02	15.04	0.26%
Line Regulation	0.66%	0.66%	0.66%	0.66%	0.00%	
Input Voltage	For Vo=12V / Output Voltage(V)					Load Regulation
	0% Load	25% Load	50% Load	75% Load	Full Load	
90Vac/60Hz	11.97	11.99	12.01	12.04	12.06	0.75%
115Vac/60Hz	11.97	11.98	12.01	12.03	12.05	0.66%
230Vac/50Hz	11.97	11.99	12.01	12.03	12.05	0.66%
264Vac/50Hz	11.97	11.99	12.01	12.03	12.05	0.66%
Line Regulation	0.00%	0.08%	0.00%	0.08%	0.08%	
Input Voltage	For Vo=9V / Output Voltage(V)					Load Regulation
	0% Load	25% Load	50% Load	75% Load	Full Load	
90Vac/60Hz	8.98	9	9.02	9.05	9.08	1.11%
115Vac/60Hz	8.97	8.99	9.02	9.05	9.08	1.22%
230Vac/50Hz	8.98	8.99	9.02	9.05	9.07	1.00%
264Vac/50Hz	8.98	8.99	9.01	9.05	9.07	1.00%
Line Regulation	1.11%	0.11%	0.11%	0.00%	0.11%	
Input Voltage	For Vo=5V / Output Voltage(V)					Load Regulation
	0% Load	25% Load	50% Load	75% Load	Full Load	
90Vac/60Hz	5.1	5.12	5.14	5.17	5.2	1.96%
115Vac/60Hz	5.1	5.12	5.14	5.16	5.19	1.76%
230Vac/50Hz	5.1	5.11	5.14	5.16	5.19	1.76%
264Vac/50Hz	5.1	5.11	5.14	5.16	5.19	1.76%

Line Regulation	0.00%	0.19%	0.00%	0.19%	0.19%	
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2.2 Ripple & noise

Standard: Under the input voltage 90Vac~265Vac, Vripple_max<200mVpp

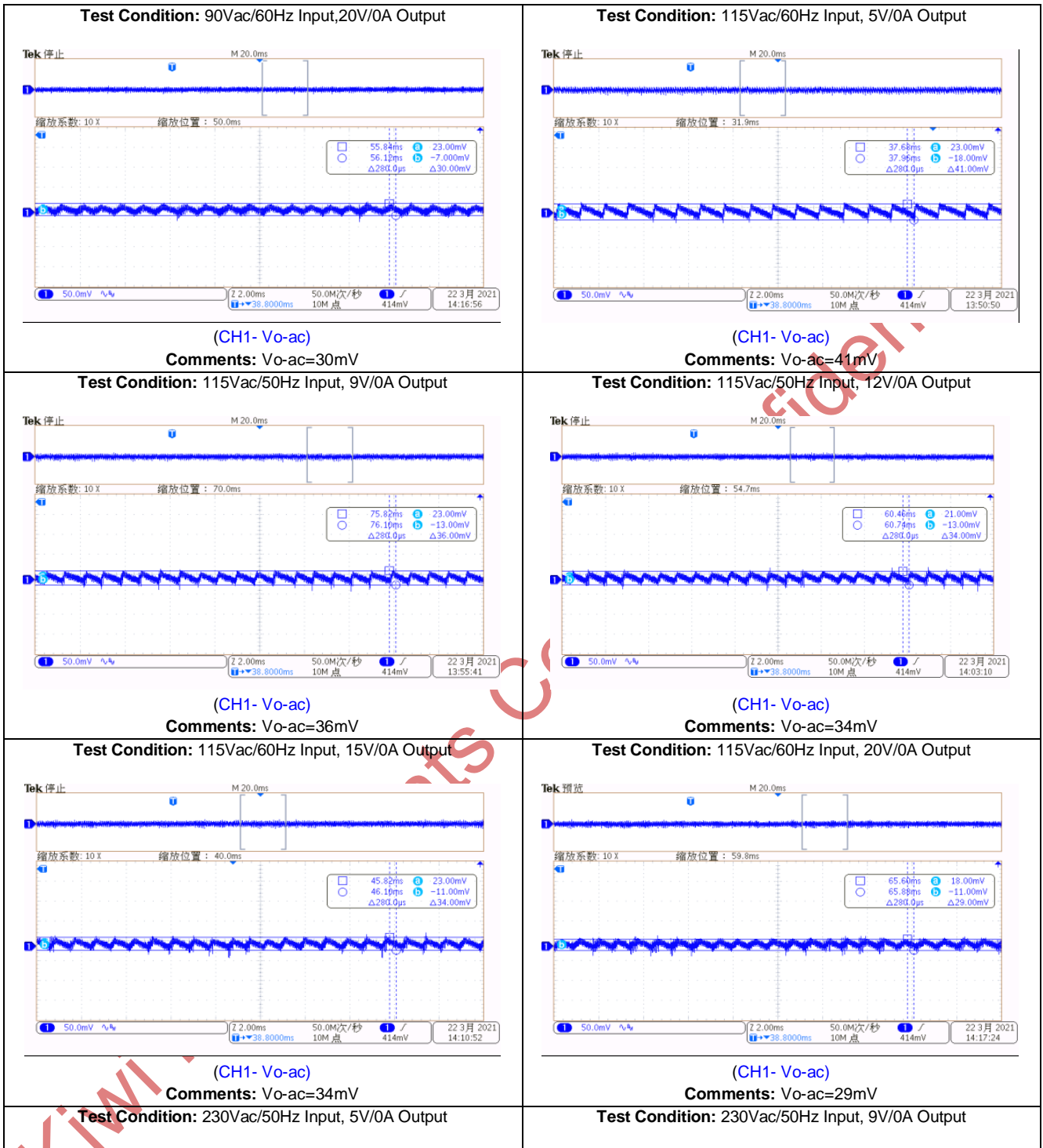
Result: Pass

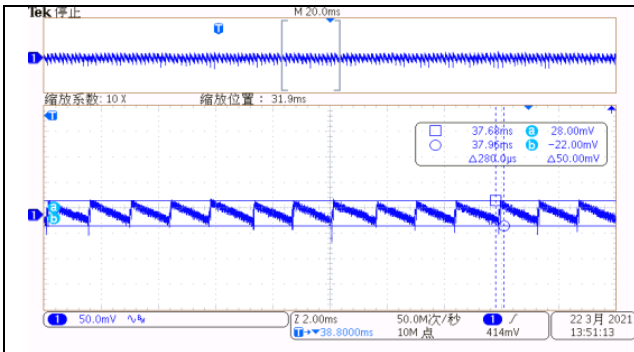
Note: Ripple & noise were measured at 1 m line ends with a 0.1uF/50V ceramic cap connected in parallel with a 10uF/50V electrolytic cap. Bandwidth was limited to 20Mhz.

Input Voltage	Ripple & noise @ no Load (mV)				
	5V/0A	9V/0A	12V/0A	15V/0A	20V/0A
90Vac/60Hz	38	36	34	35	30
115Vac/60Hz	41	36	34	34	29
230Vac/50Hz	50	45	36	33	31
264Vac/50Hz	51	39	37	34	28
Input Voltage	Ripple & noise @ Full Load (mV)				
	5V/3A	9V/3A	12V/2.5A	15V/2A	20V/1.5A
90Vac/60Hz	53	42	40	48	52
115Vac/60Hz	40	56	61	48	35
230Vac/50Hz	39	42	35	37	34
264Vac/50Hz	46	43	42	38	23

Waveforms:



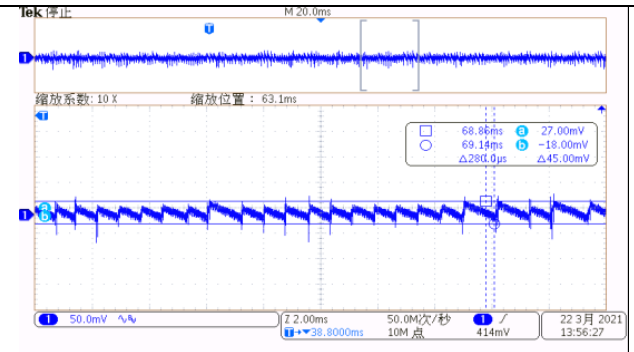




(CH1- Vo-ac)

Comments: Vo-ac=5mV

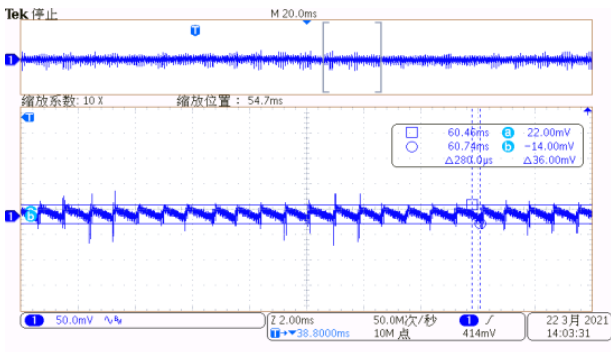
Test Condition: 230Vac/50Hz Input, 12V/0A Output



(CH1- Vo-ac)

Comments: Vo-ac=45mV

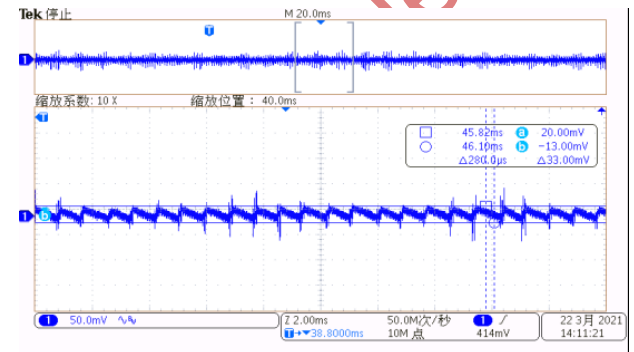
Test Condition: 230Vac/50Hz Input, 15V/0A Output



(CH1- Vo-ac)

Comments: Vo-ac=36mV

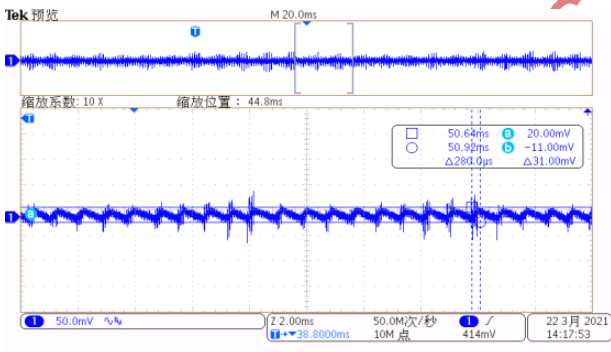
Test Condition: 230Vac/50Hz Input, 20V/0A Output



(CH1- Vo-ac)

Comments: Vo-ac=33mV

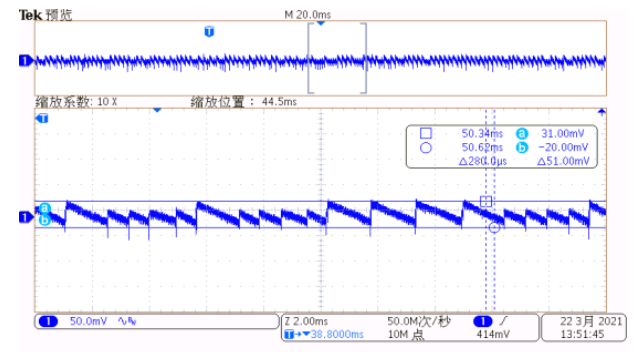
Test Condition: 265Vac/50Hz Input, 5V/0A Output



(CH1- Vo-ac)

Comments: Vo-ac=31mV

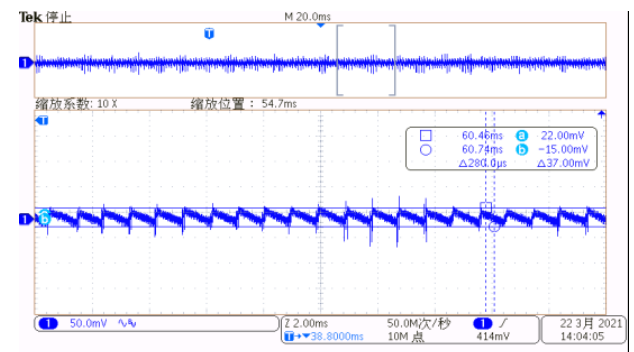
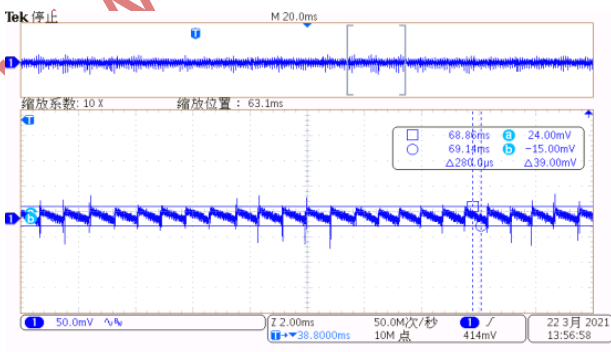
Test Condition: 265Vac/50Hz Input, 9V/0A Output

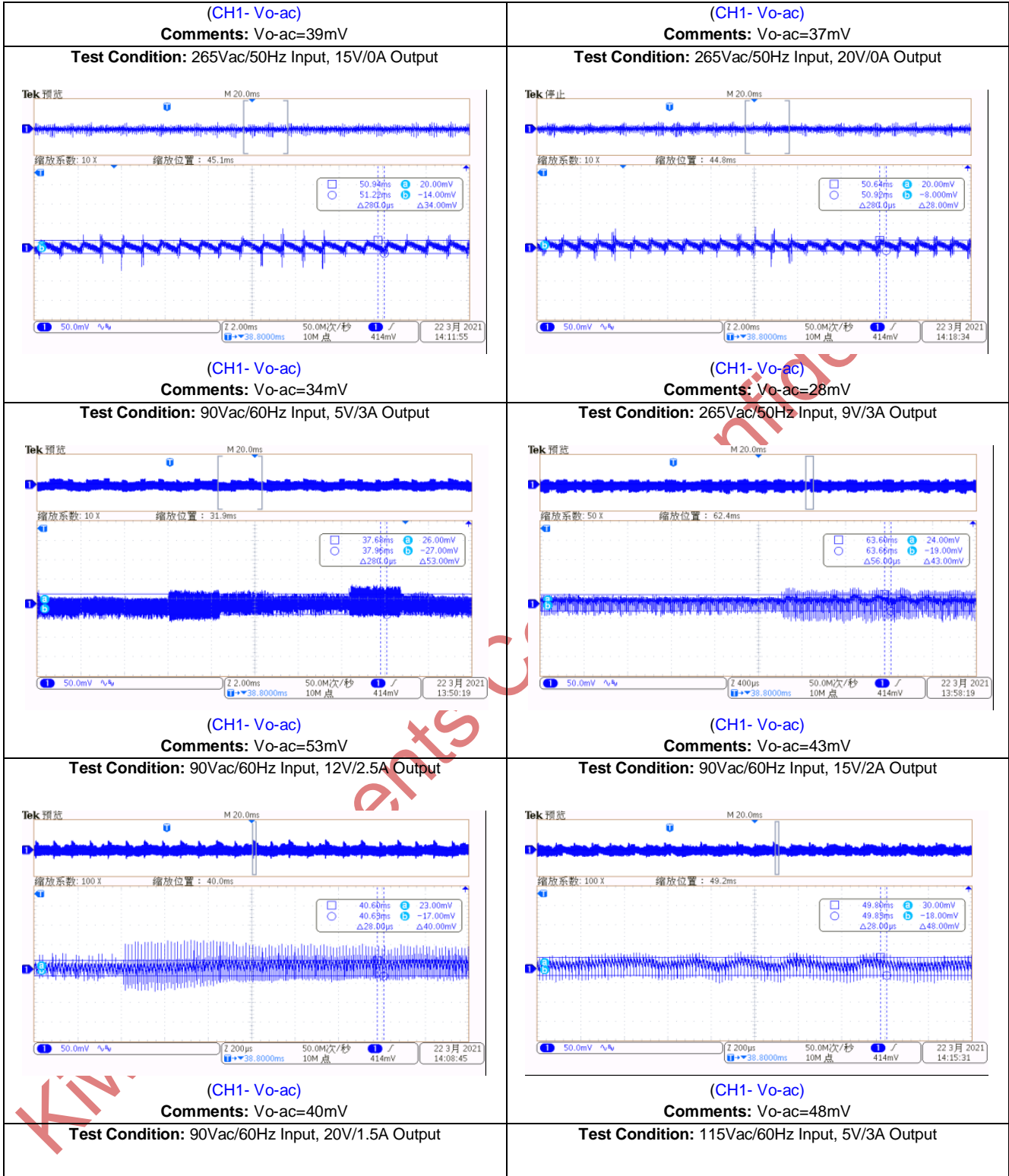


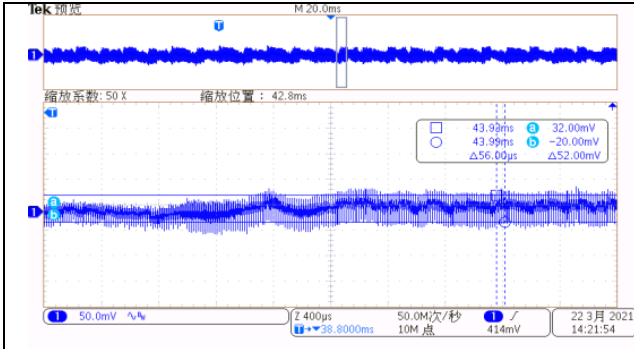
(CH1- Vo-ac)

Comments: Vo-ac=51mV

Test Condition: 265Vac/50Hz Input, 12V/0A Output



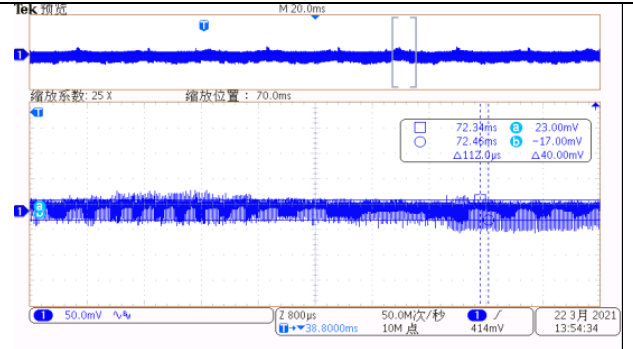




(CH1- Vo-ac)

Comments: Vo-ac=52mV

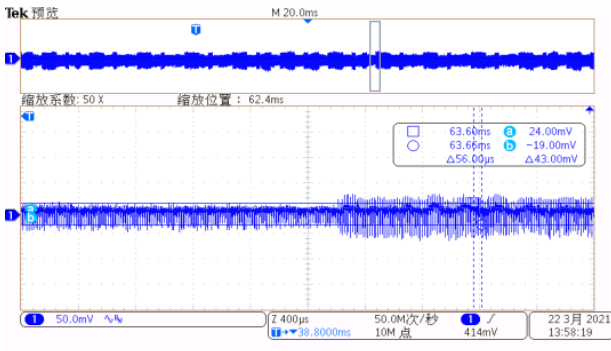
Test Condition: 115Vac/60Hz Input, 9V/3A Output



(CH1- Vo-ac)

Comments: Vo-ac=40mV

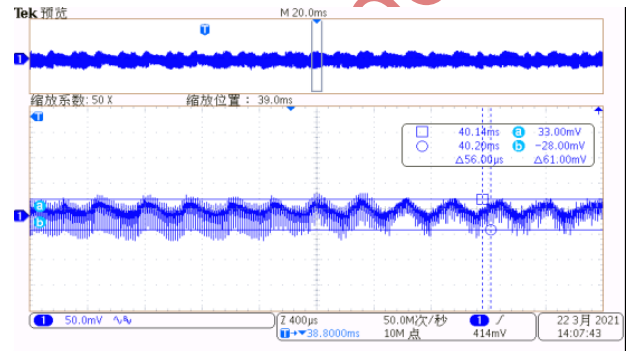
Test Condition: 115Vac/60Hz Input, 12V/2.5A Output



(CH1- Vo-ac)

Comments: Vo-ac=43mV

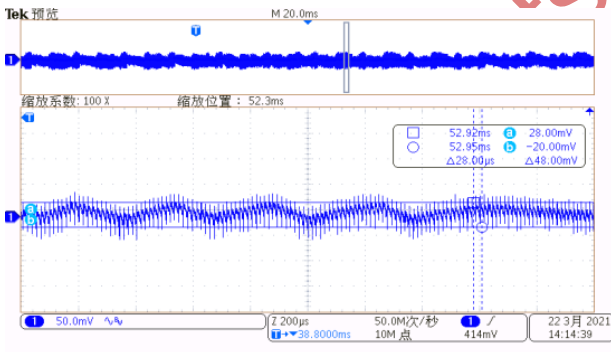
Test Condition: 115Vac/60Hz Input, 15V/2A Output



(CH1- Vo-ac)

Comments: Vo-ac=61mV

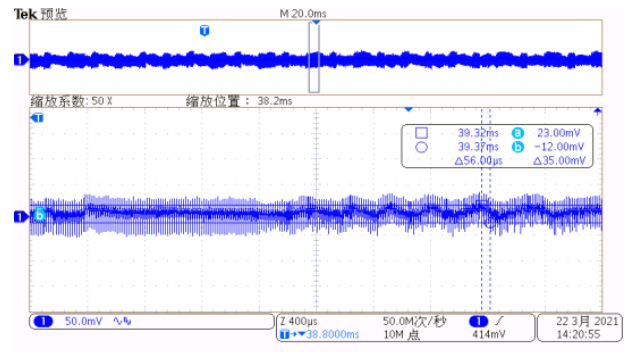
Test Condition: 115Vac/60Hz Input, 20V/1.5A Output



(CH1- Vo-ac)

Comments: Vo-ac=48mV

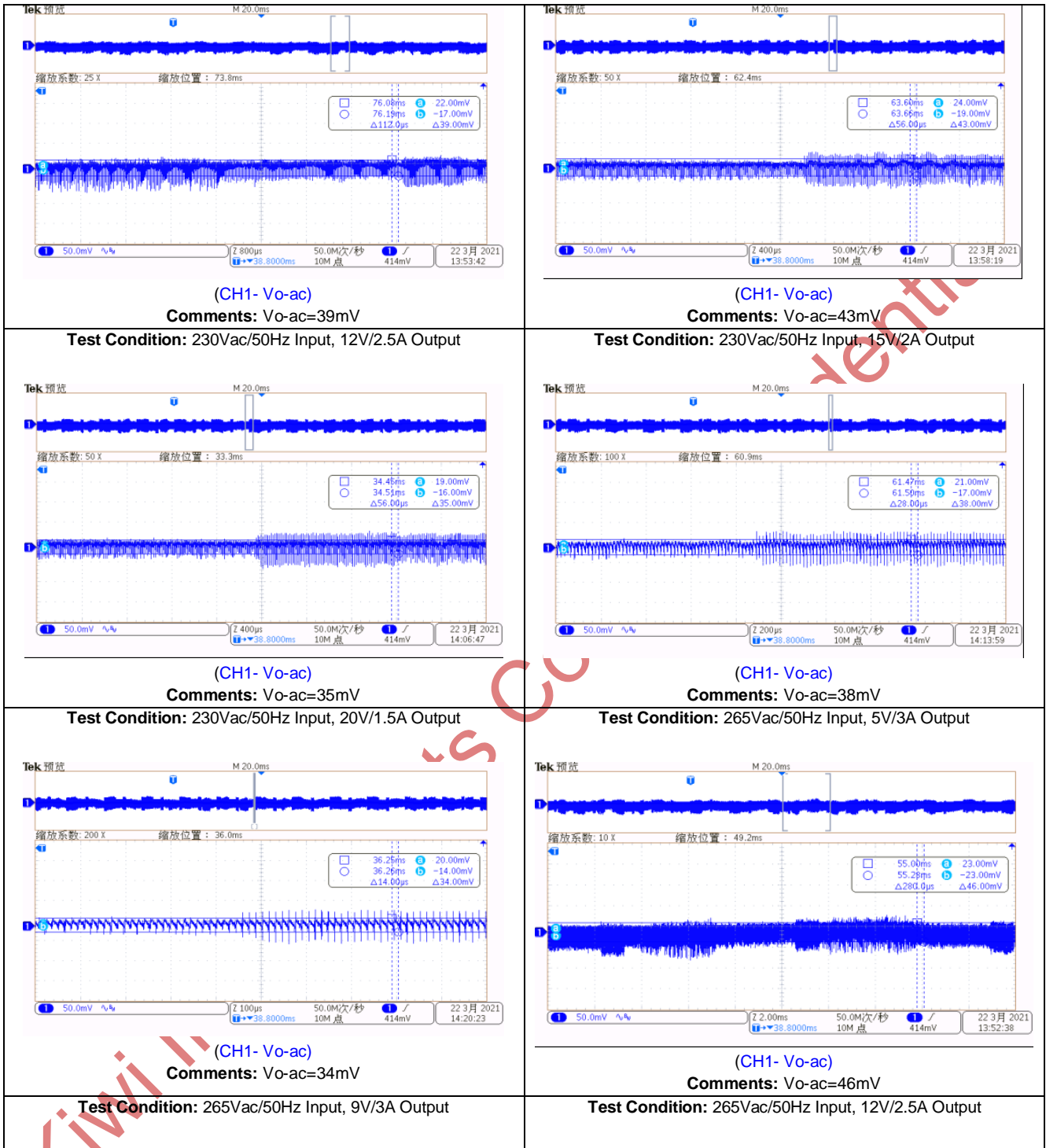
Test Condition: 230Vac/50Hz Input, 5V/3A Output

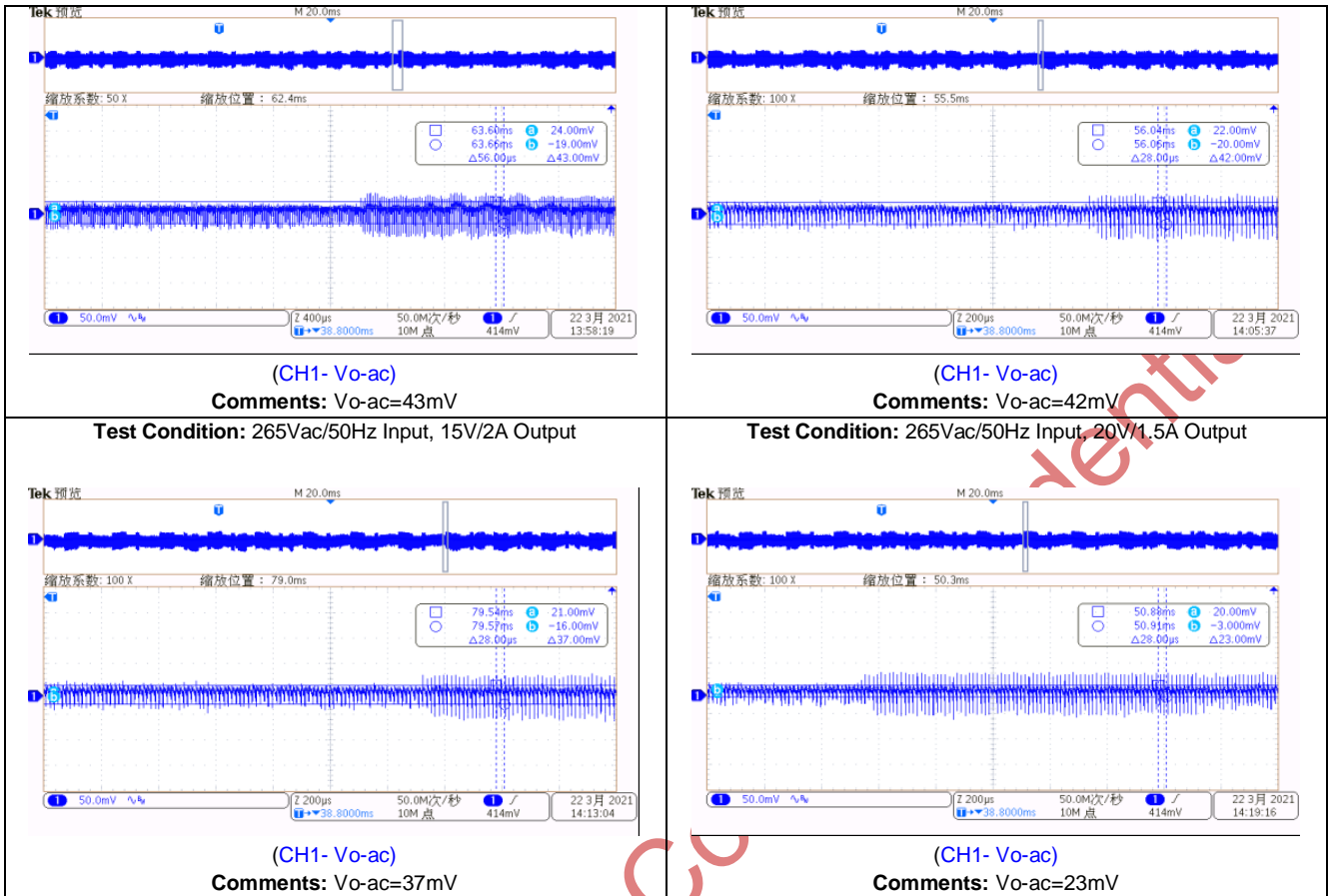


(CH1- Vo-ac)

Comments: Vo-ac=35mV

Test Condition: 230Vac/50Hz Input, 9V/3A Output





2.3 Load Transient Test

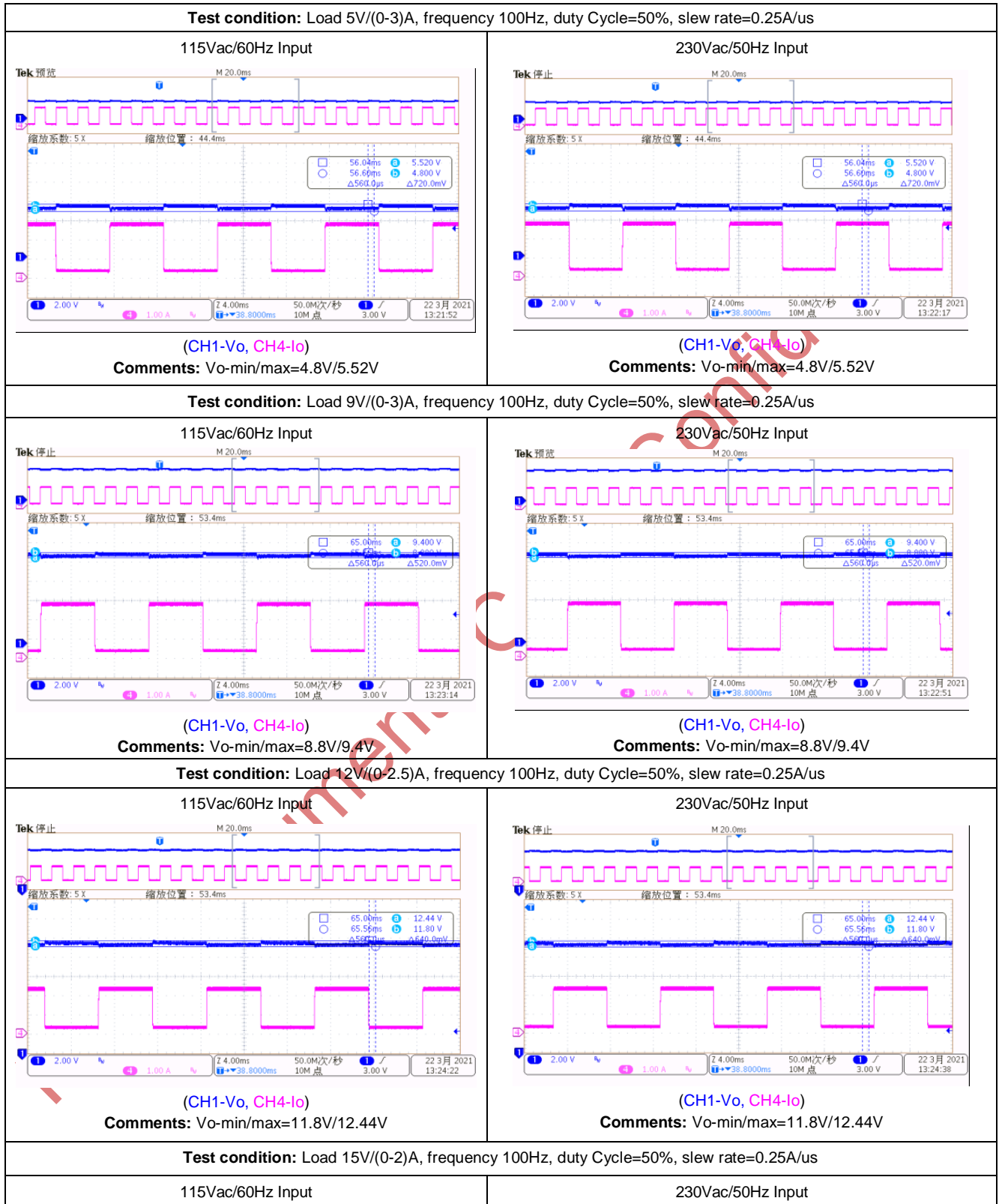
Standard: Under the input voltage 90Vac~265Vac, the output Voltage transient response should be within $\pm 10\%$ normal voltage

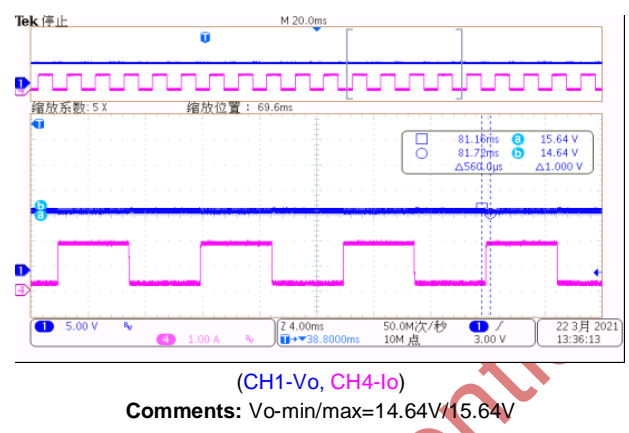
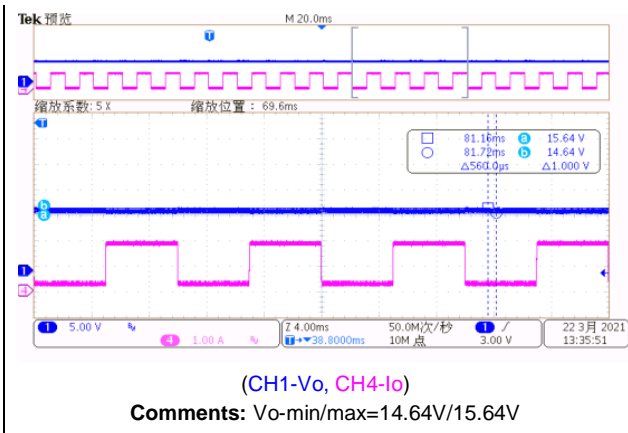
Result: Pass

Note: 0% load shift to 100% load with 0.25A/us changing ramp and 100Hz changing frequency.

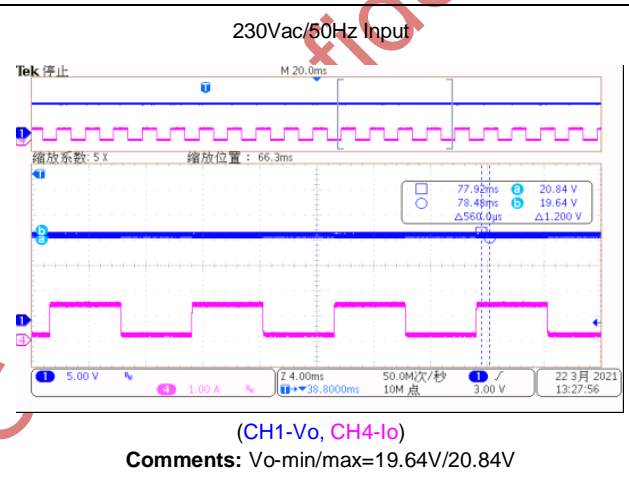
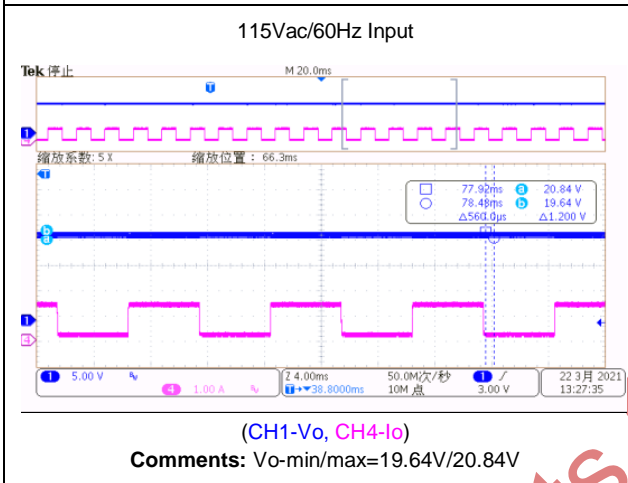
Input Voltage	Output Voltage(V)									
	5V		9V		12V		15V		20V	
	Vo-min	Vo-max	Vo-min	Vo-max	Vo-min	Vo-max	Vo-min	Vo-max	Vo-min	Vo-max
115Vac/60Hz	4.8	5.52	8.8	9.4	11.8	12.4	14.6	15.6	19.6	20.8
230Vac/50Hz	4.8	5.52	8.8	9.4	11.8	12.4	14.6	15.6	19.6	20.8

Waveforms:





Test condition: Load 20V/(0-1.5)A, frequency 100Hz, duty Cycle=50%, slew rate=0.25A/us



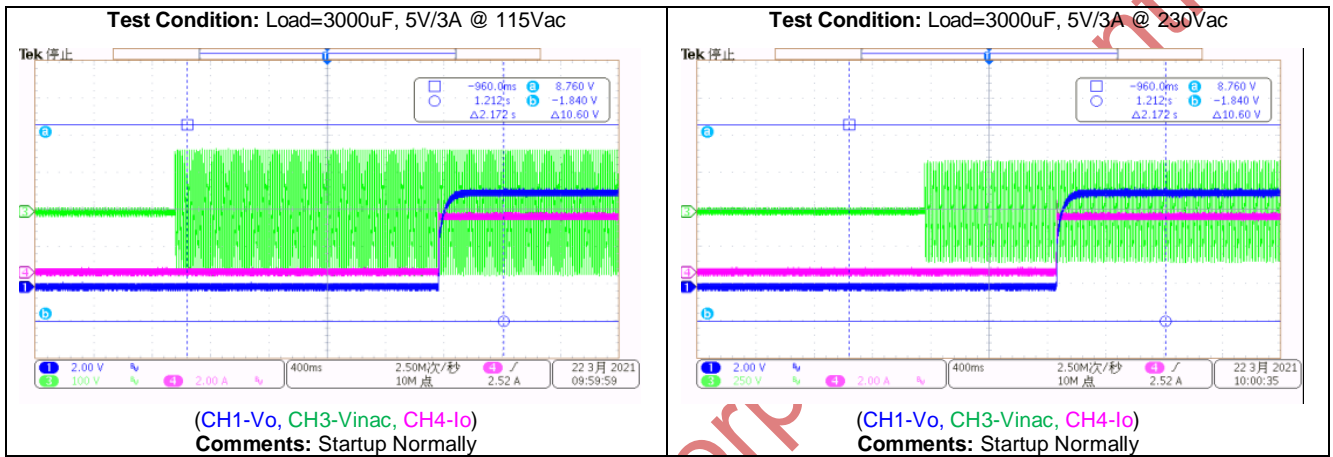
2.4 Capacitive Load Startup Test

Standard: While capacitance load is 3000uF, the power supply can turn on normally and the output is in the rated range

Result: Pass

Note: Tested at board ends @5V/3A

Waveforms:



Kiwi Instruments Corp. Trial

2.5 Turn On Delay Time and Raise Time

Standard: The Turn on delay time should be less than 3s@90Vac

Result: Pass

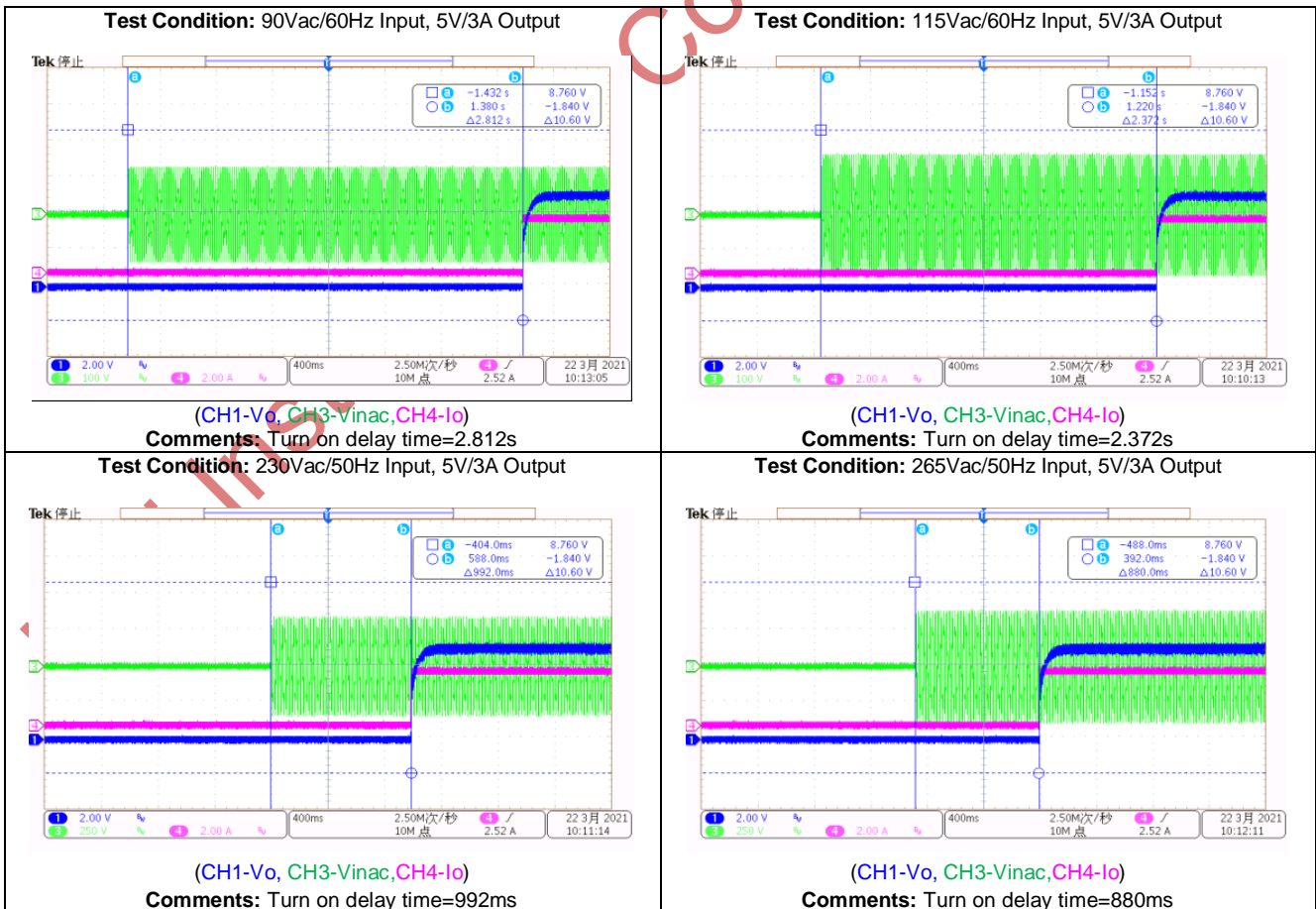
Note:The output voltage was tested at board ends

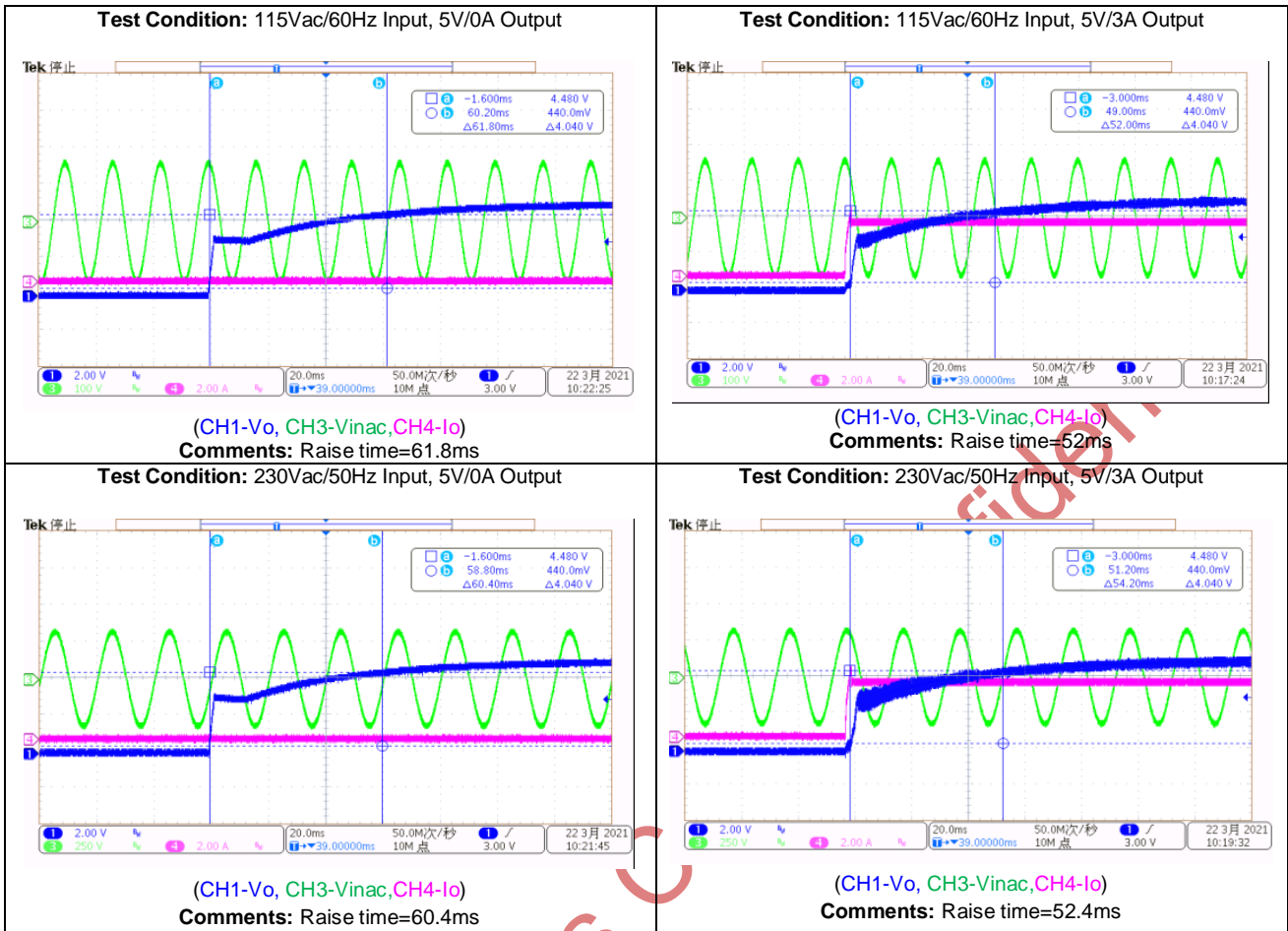
Test Data:

Input Voltage	90Vac/60Hz	115Vac/60Hz	230Vac/50Hz	265Vac/50Hz
Turn on Delay Time(S)	2.812	2.37	0.992	0.88

Input Voltage	90Vac/60Hz		115Vac/60Hz		230Vac/50Hz		265Vac/50Hz	
	5V/0A	5V/3A	5V/0A	5V/3A	5V/0A	5V/3A	5V/0A	5V/3A
Rrise Time(ms)	61.8	52	61.8	52	60.4	54.2	60.4	54.2

Waveforms:





2.6 Hold Up Time and Fall Time

Standard: The holdup time should be larger than 10ms@115/230Vac

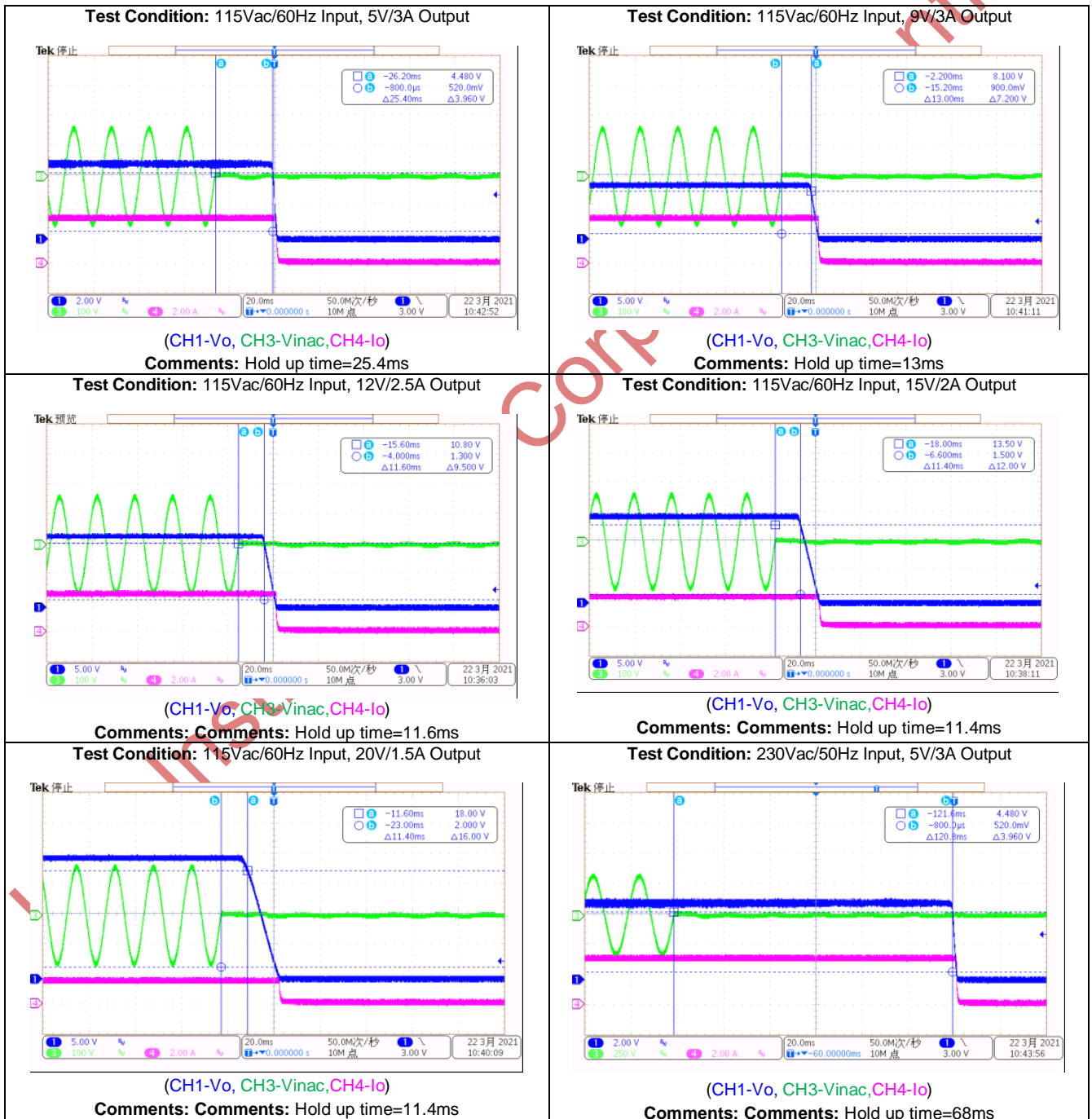
Result: Pass

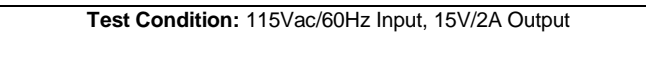
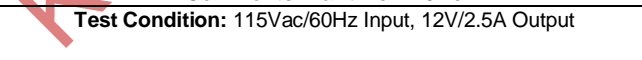
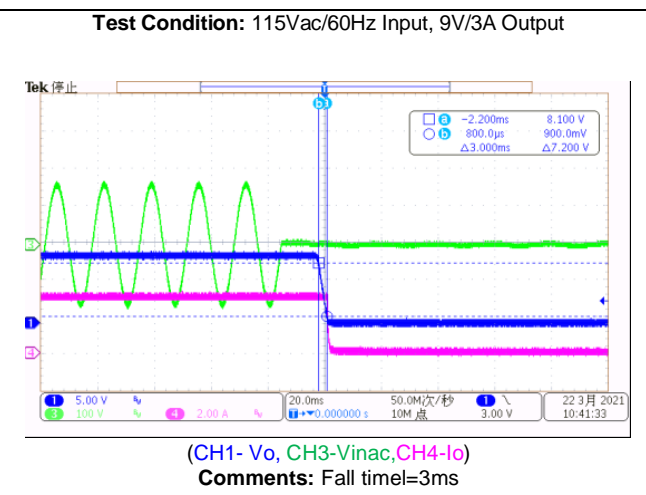
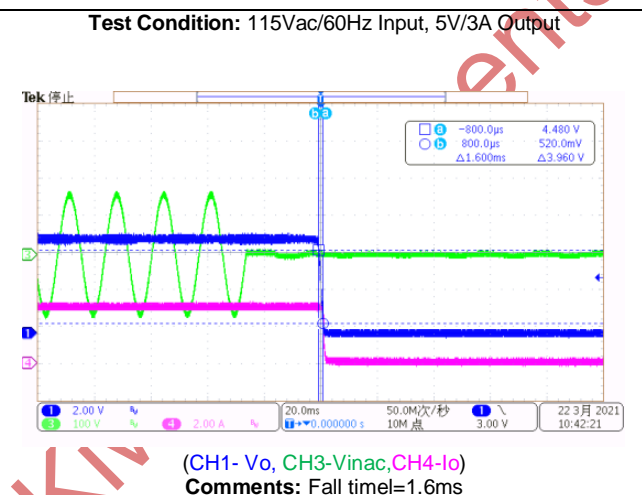
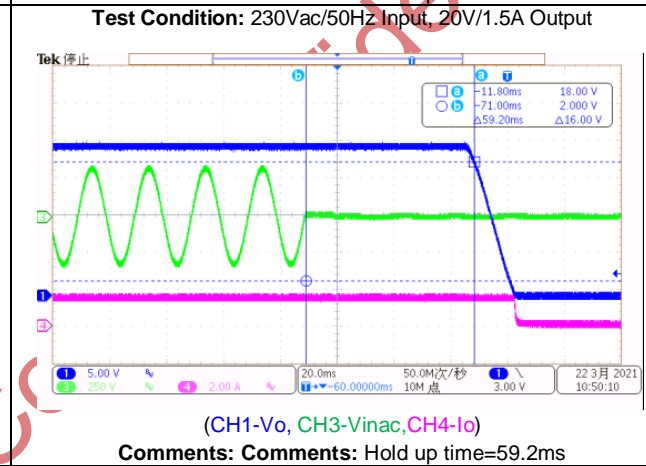
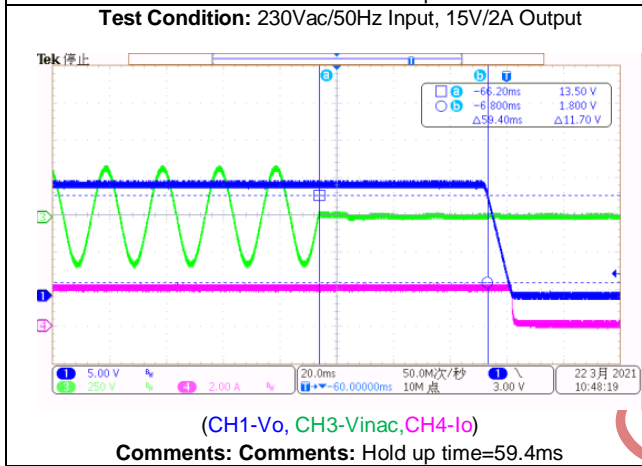
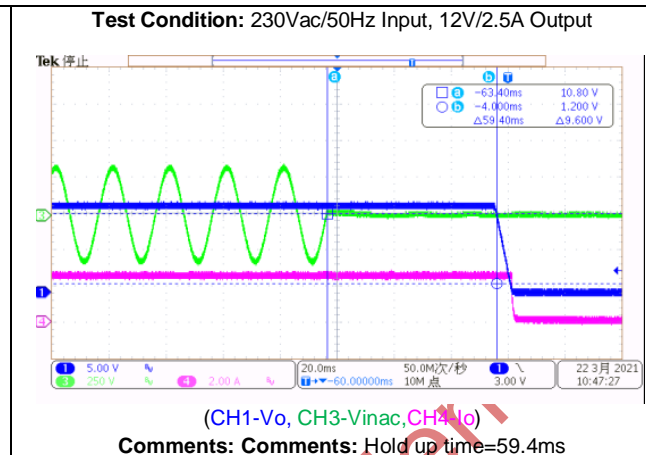
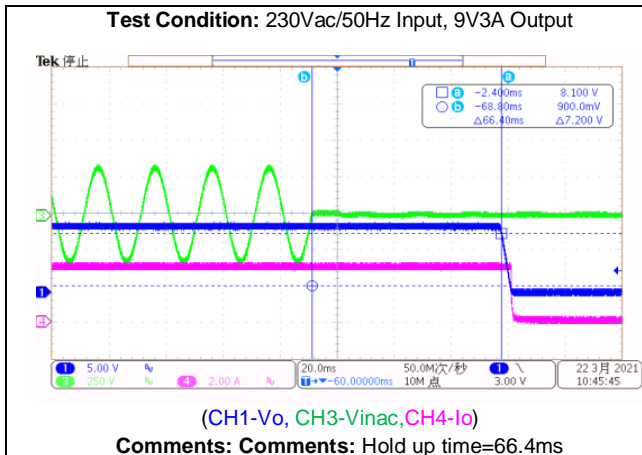
Note: The output voltage was tested at board ends

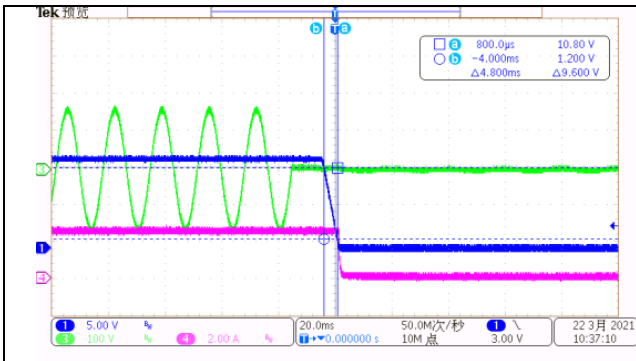
Input Voltage	Hold Up time(mS)				
	5V/3A	9V/3A	12V/2.5A	15V/2A	20V/1.5A
115Vac/60Hz	25.4	13	11.6	11.4	11.4
230Vac/50Hz	120.8	66.4	59.4	59.4	59.2
Result	Pass	Pass	Pass	Pass	Pass
Input Voltage	Fall time (mS)				

	5V/3A	9V/3A	12V/2.5A	15V/2A	20V/1.5A
115Vac/60Hz	1.6	3	4.8	7.4	12
230Vac/50Hz	1.4	3.2	4.8	7.8	12.6
Result	Pass	Pass	Pass	Pass	Pass

Waveforms:

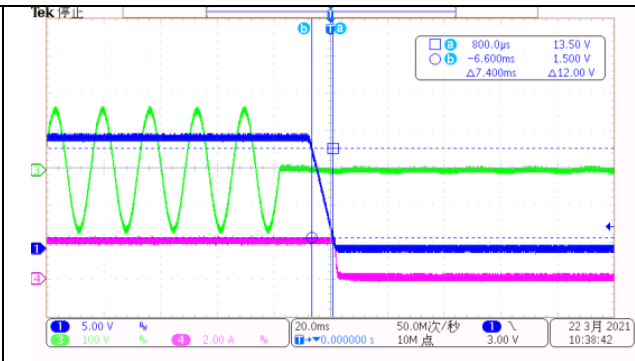






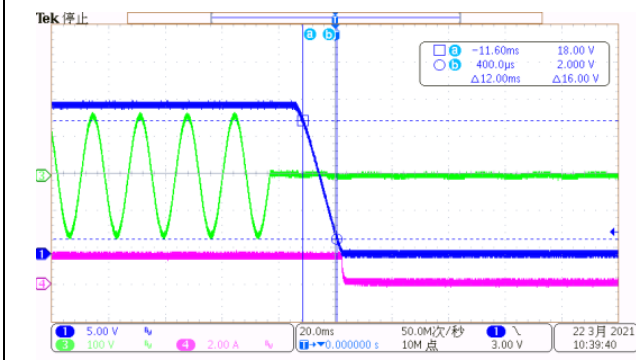
(CH1- Vo, CH3-Vinac, CH4-Io)
Comments: Fall time=4.8ms

Test Condition: 115Vac/60Hz Input, 20V/1.5A Output



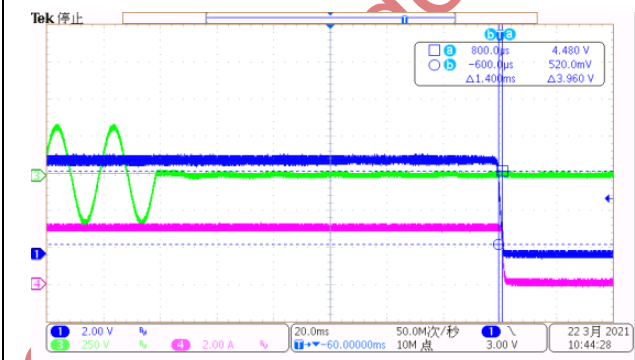
(CH1- Vo, CH3-Vinac, CH4-Io)
Comments: Fall time=7.4ms

Test Condition: 230Vac/50Hz Input, 5V/3A Output



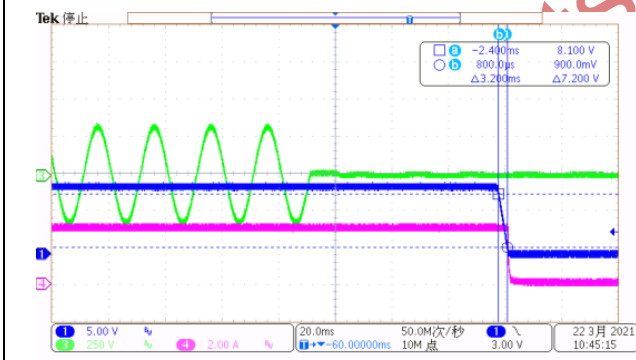
(CH1- Vo, CH3-Vinac, CH4-Io)
Comments: Fall time=12ms

Test Condition: 230Vac/50Hz Input, 9V/3A Output



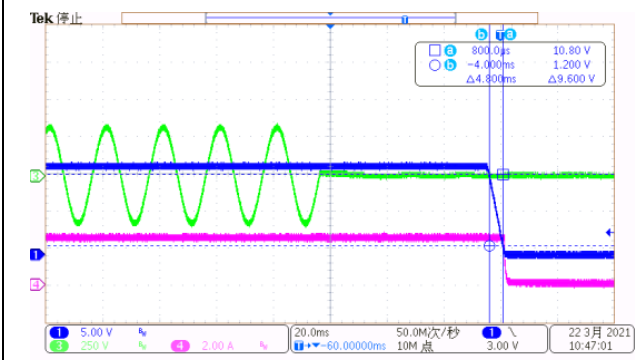
(CH1- Vo, CH3-Vinac, CH4-Io)
Comments: Fall time=1.4ms

Test Condition: 230Vac/50Hz Input, 12V/2.5A Output



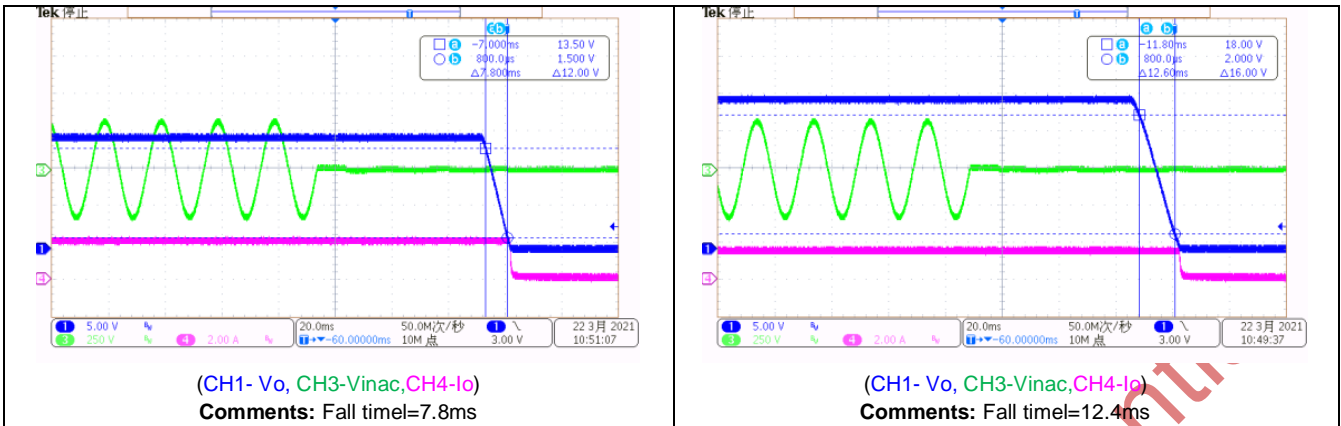
(CH1- Vo, CH3-Vinac, CH4-Io)
Comments: Fall time=3.2ms

Test Condition: 230Vac/50Hz Input, 15V/2A Output



(CH1- Vo, CH3-Vinac, CH4-Io)
Comments: Fall time=4.8ms

Test Condition: 230Vac/50Hz Input, 20V/1.5A Output



2.7 Output Overshoot Test

Standard: The range of Vo-peak is output voltage*110% max

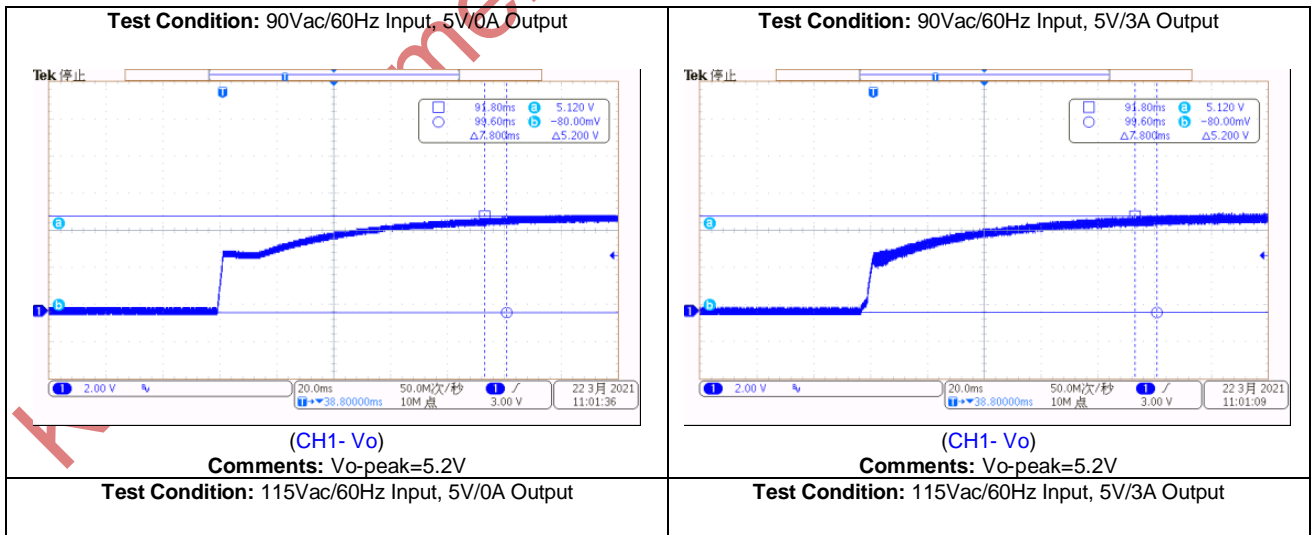
Result: Pass

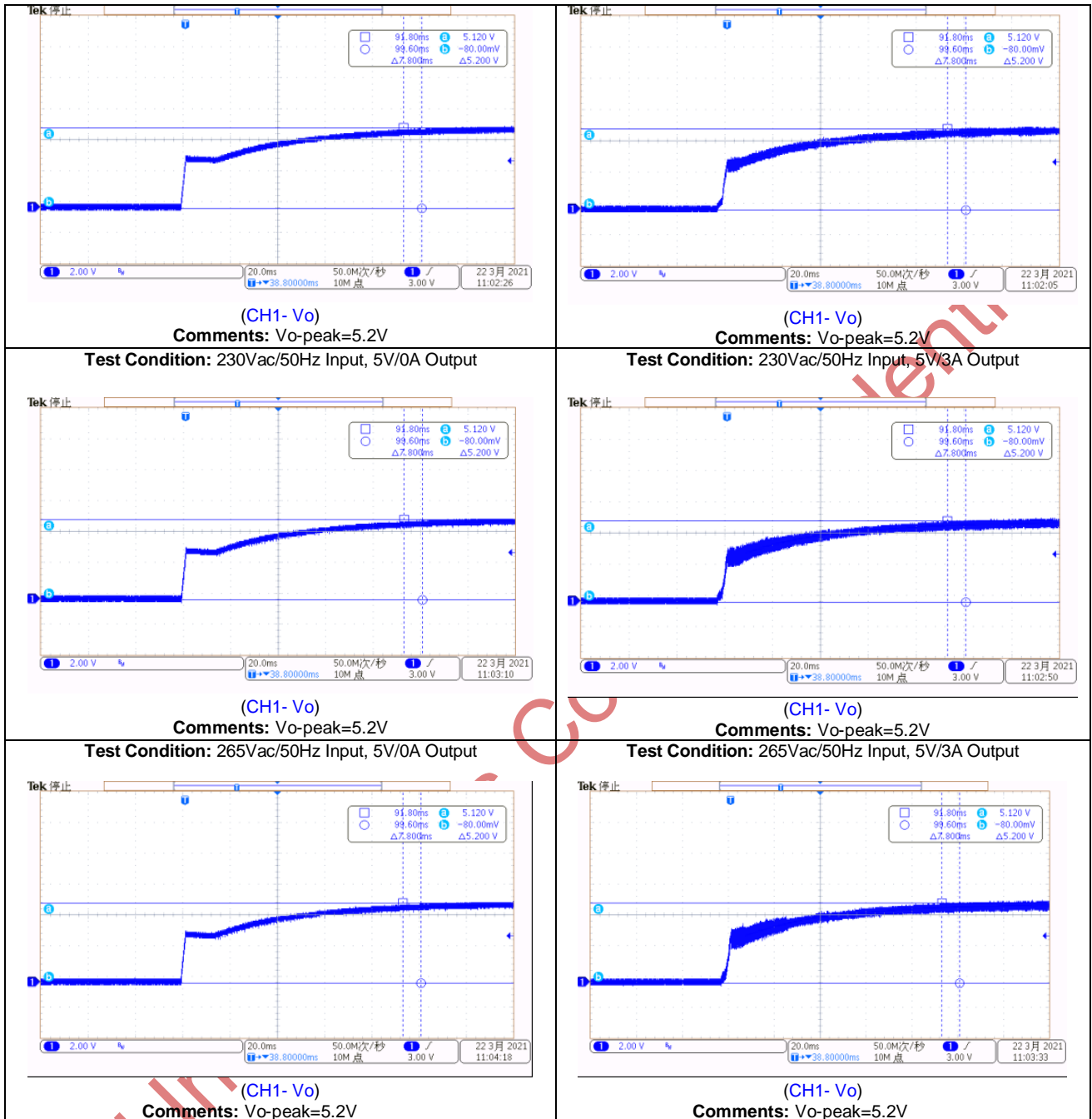
Note: The output voltage is tested at board ends

Test Data:

	90V/60Hz		115V/60Hz		230V/50Hz		265V/50Hz	
	No Load	Full Load	No Load	Full Load	No Load	Full Load	No Load	Full Load
Vo-peak(V)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2

Waveforms:





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3. Protection Test

3.1 Short circuit protection

Standard: The power supply must shut down in the event of a short circuit and automatically return to normal operating condition once the fault condition has been removed. And the peak input power should be less than 5W

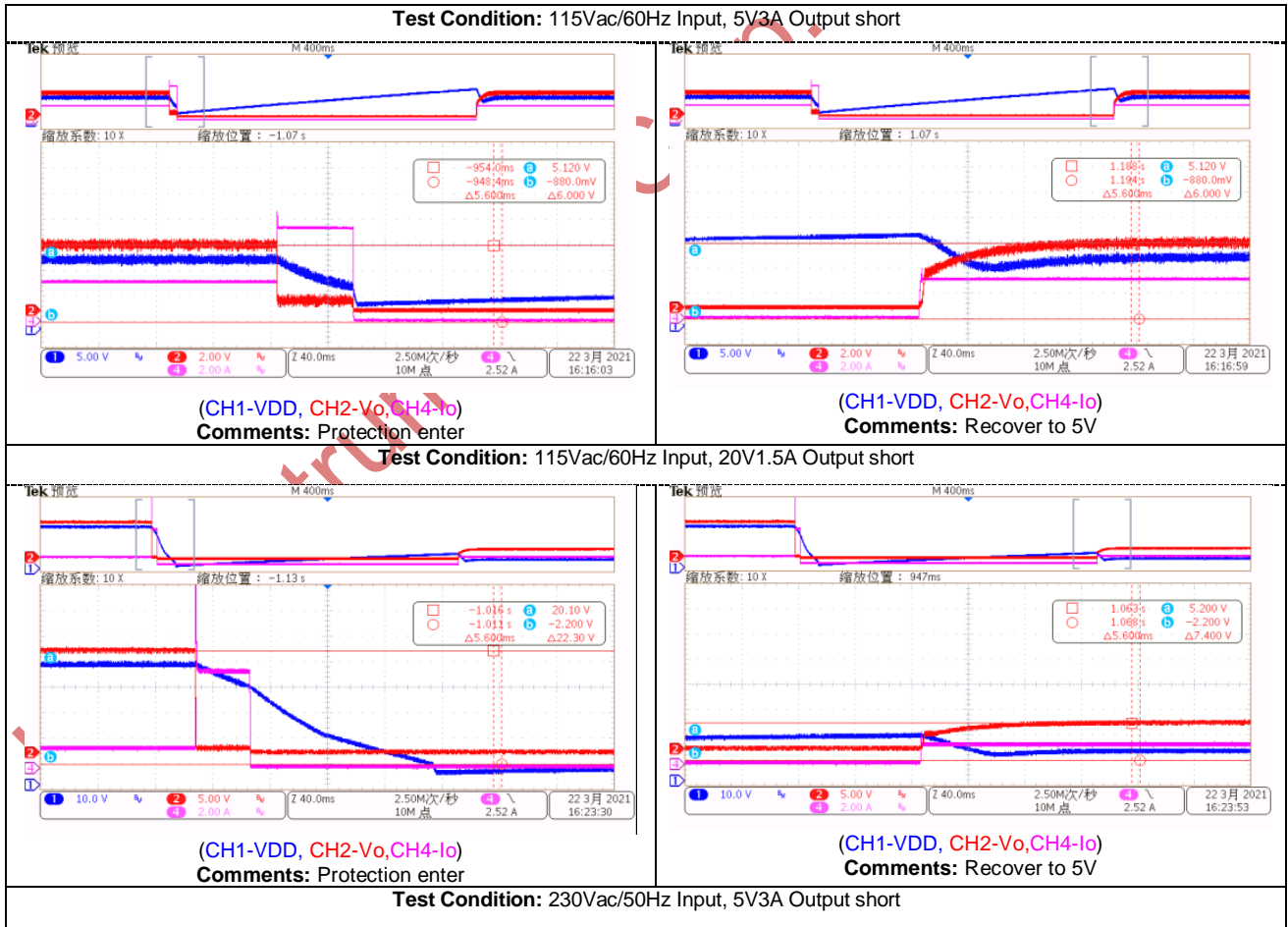
Result: Pass

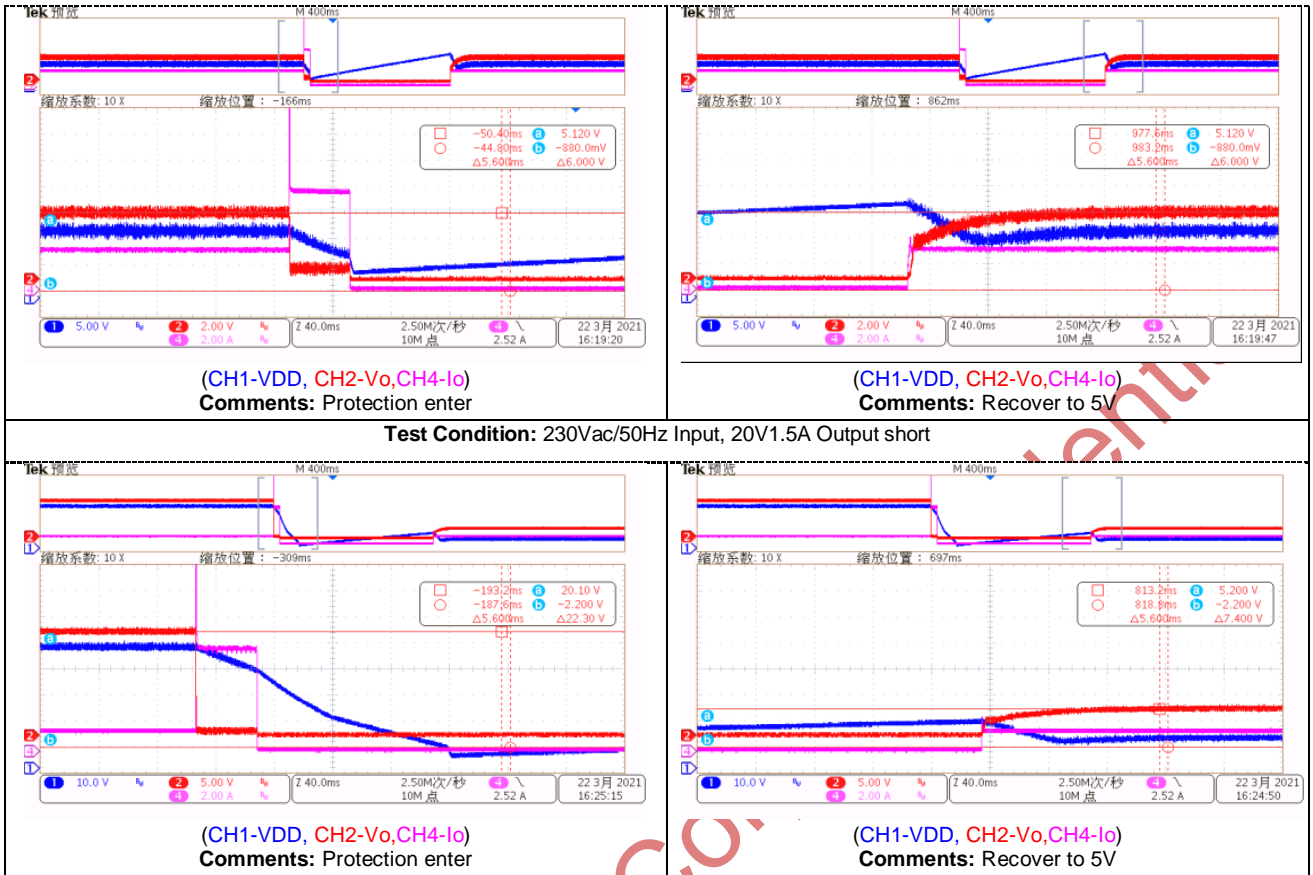
Note: The short circuit protection tested at board ends

Test Data:

Input Voltage (Vac)	90V/60Hz	115V/60Hz	230V/50Hz	265V/50Hz	Result
Pin(W)	1.76	1.81	2.05	2.24	Pass

Waveforms:





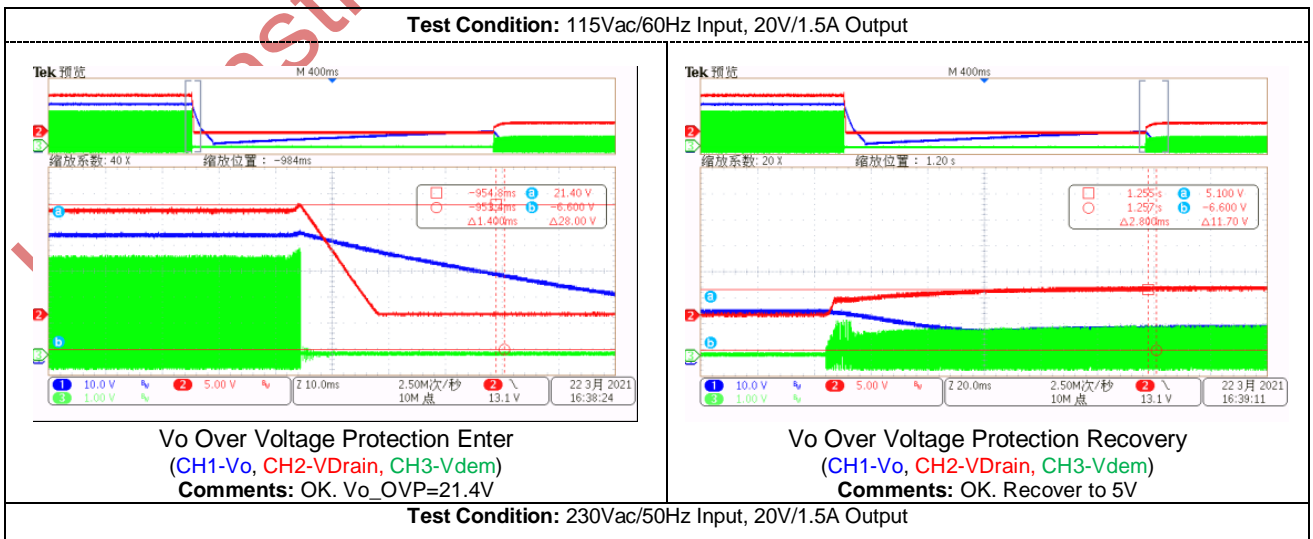
3.2 Over voltage protection

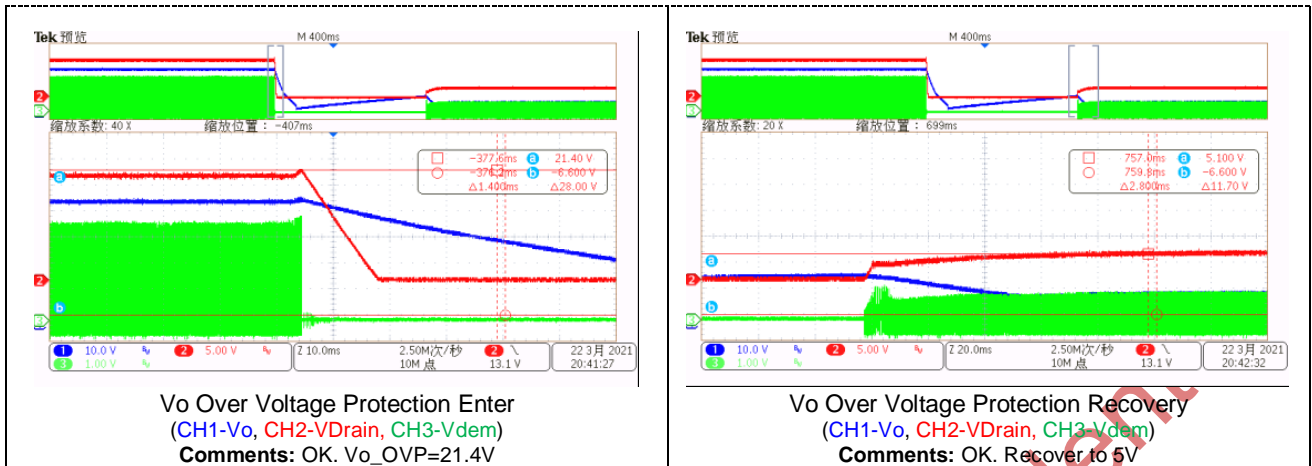
Standard: OVP point limit: <150%.

Result: Pass

Note: Make the secondary side of optocoupler short circuit to test overvoltage protection

Waveforms:





3.3 Over Load Protection

Note: Tested at board ends, Rcs=0.396R

Test Data:

Input Voltage	OLP (A)				
	5V	9V	12V	15V	20V
90Vac/60Hz	4.45	4.15	3.4	2.85	2.12
115Vac/60Hz	4.42	4.08	3.4	3	2.38
230Vac/50Hz	4.15	3.57	3.1	2.86	2.45
264Vac/50Hz	4.18	3.6	2.95	2.9	2.44

4. Reliability requirements

4.1 Device Maximum Rating Test

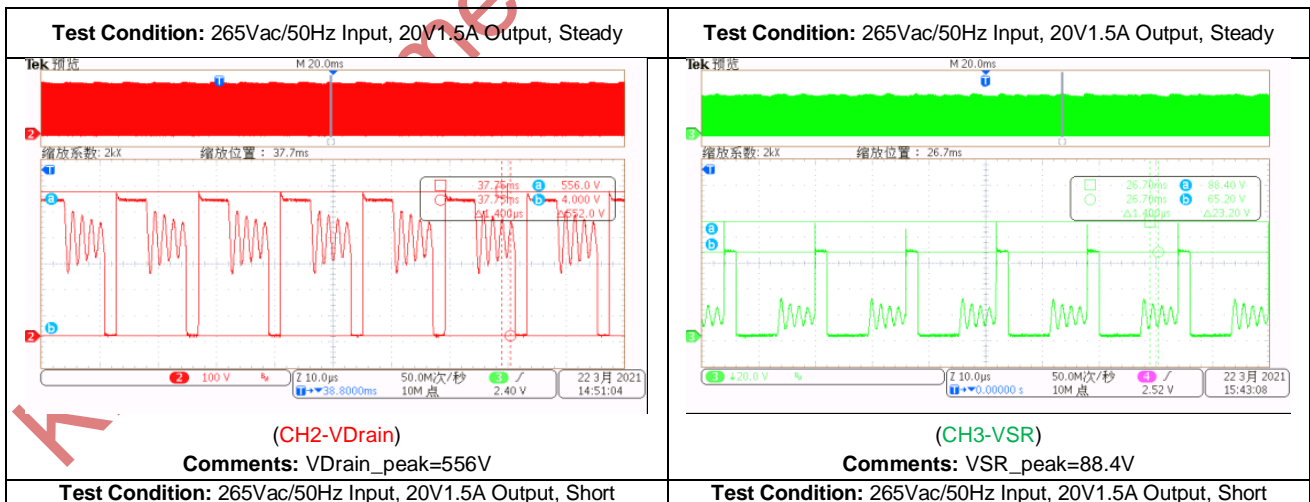
Standard: The VDrain of IC < 95% V_{rrm}

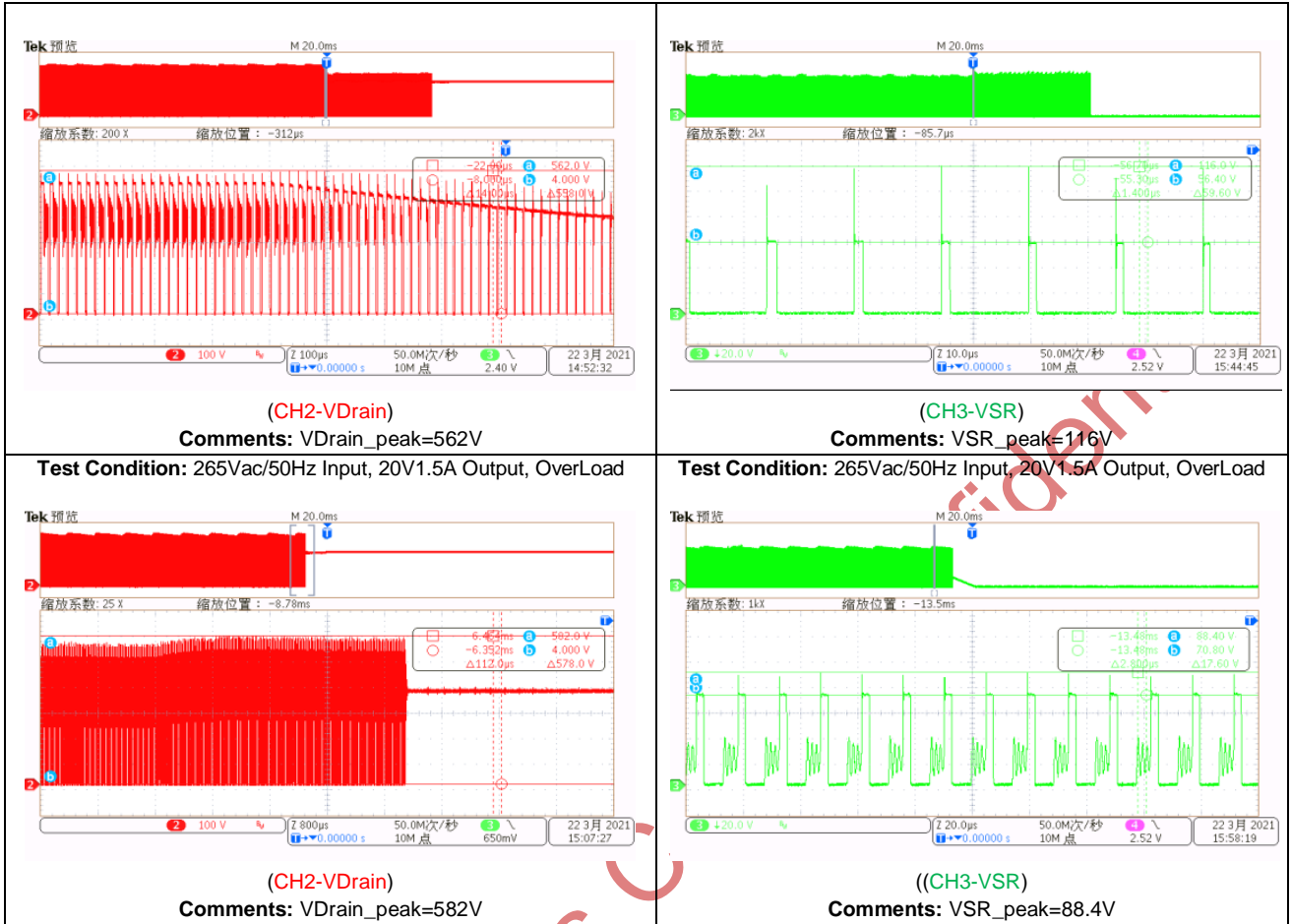
Note: Tested at board ends

Result: **Fail**

KP22035 voltage stress		VDrain-peak(V)			
		On/Off	Steady	Shoot	OverLoad
5V/3A	265V/50Hz	454	448	462	468
9V/3A	265V/50Hz		492	492	492
12V/2.5A	265V/50Hz		514	504	512
15V/2A	265V/50Hz		528	536	540
20V/1.5A	265V/50Hz		556	562	582
KP40512 voltage stress		VSR-peak(V)			
		On/Off	Steady	Shoot	OverLoad
5V/3A	265V/50Hz	112	81.2	110	109.2
9V/3A	265V/50Hz		82.8	114.8	79.2
12V/2.5A	265V/50Hz		86.8	112	86.4
15V/2A	265V/50Hz		88.4	112.4	84.8
20V/1.5A	265V/50Hz		88.4	116	88.4

Waveforms:





4.2 Bmax Test

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

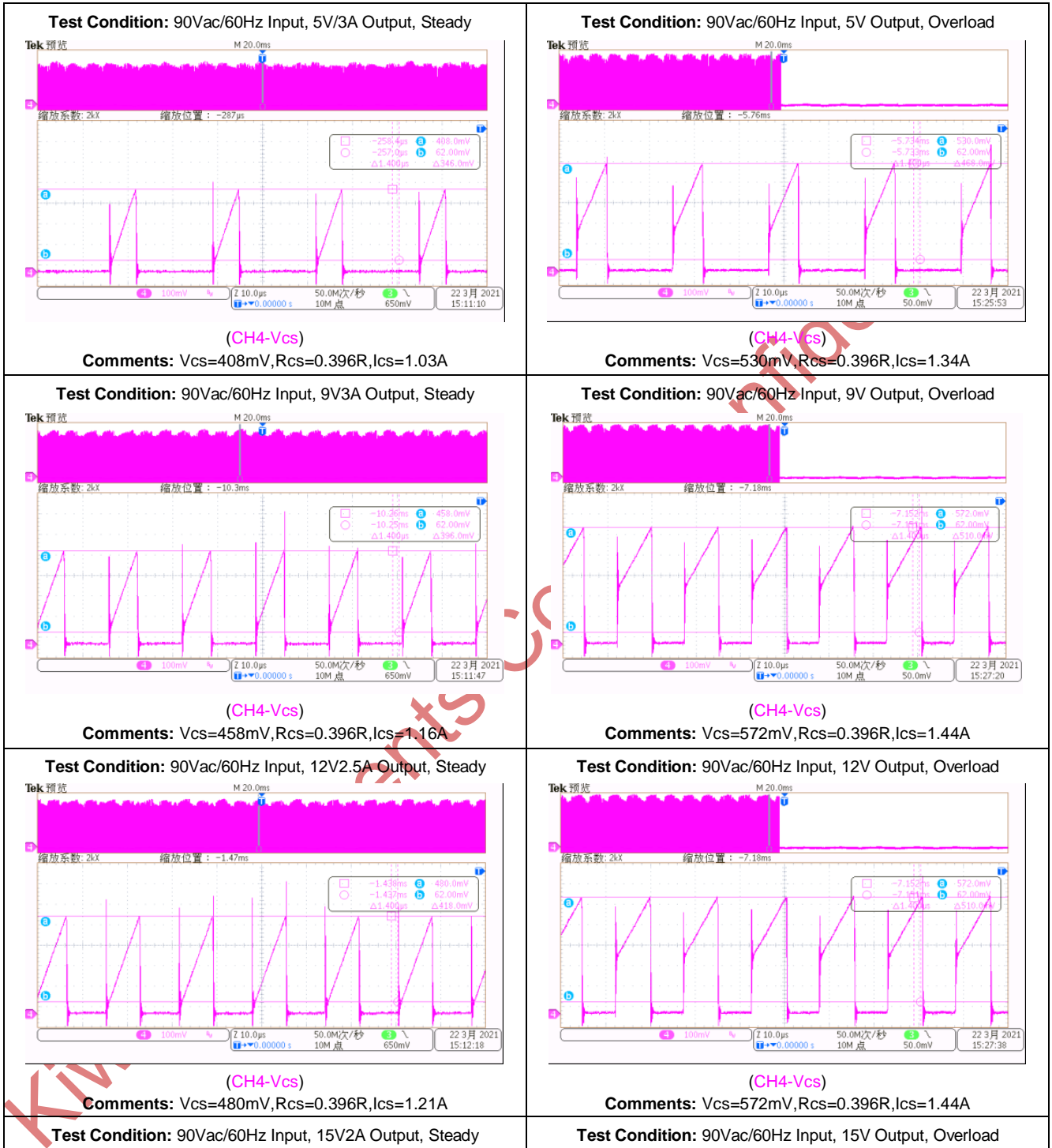
Transient and its Peak load: $B_{max} \leq 0.38T$

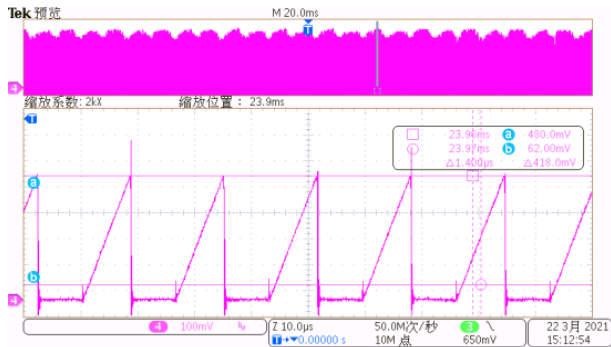
Result: Pass

Note: The turn numbers of the transform is 52, and the sectional area is 62mm^2 , L_p is $600\mu\text{H}$

Input Voltage	Bmax (T)									
	5V		9V		12V		15V		20V	
	Steady	Over Load	Steady	Over Load	Steady	Over Load	Steady	Over Load	Steady	Over Load
90V/60Hz	1.03	1.34	1.16	1.44	1.21	1.44	1.21	1.44	1.22	1.44
	0.19	0.25	0.22	0.27	0.23	0.27	0.23	0.27	0.23	0.27
265V/50Hz	1	1.2	1.04	1.14	1.14	1.21	1.18	1.27	1.17	1.47
	0.19	0.22	0.19	0.21	0.21	0.23	0.22	0.24	0.22	0.27

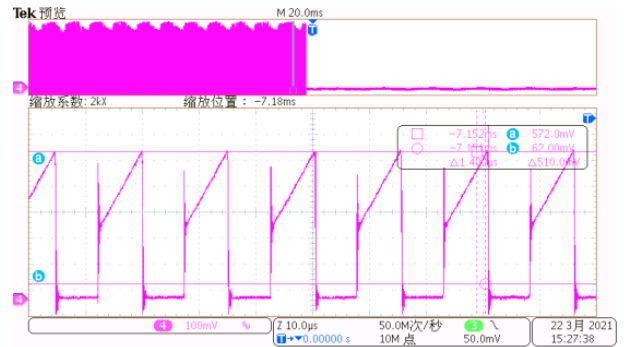
Waveforms:





(CH4-Vcs)

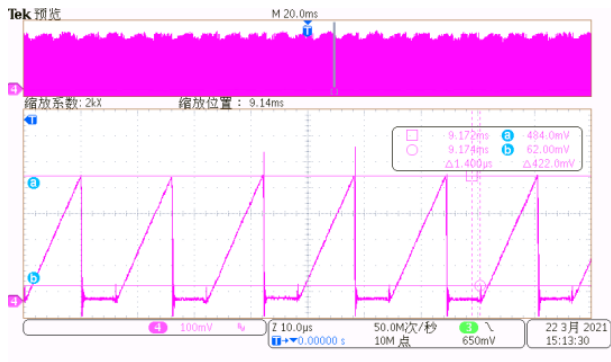
Comments: Vcs=480mV, Rcs=0.396R, Ics=1.21A



(CH4-Vcs)

Comments: Vcs=572mV, Rcs=0.396R, Ics=1.44A

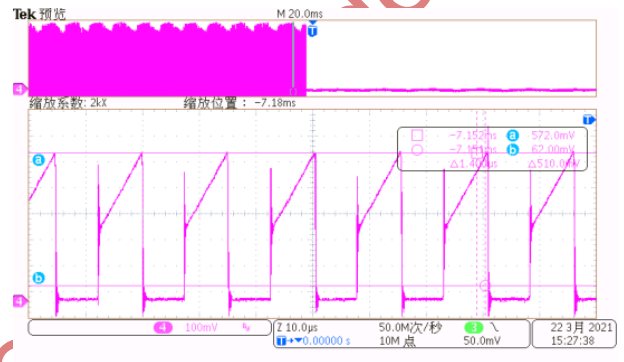
Test Condition: 90Vac/60Hz Input, 20V1.5A Output, Steady



(CH4-Vcs)

Comments: Vcs=484mV, Rcs=0.396R, Ics=1.22A

Test Condition: 90Vac/60Hz Input, 20V Output, Overload



(CH4-Vcs)

Comments: Vcs=572mV, Rcs=0.396R, Ics=1.44A

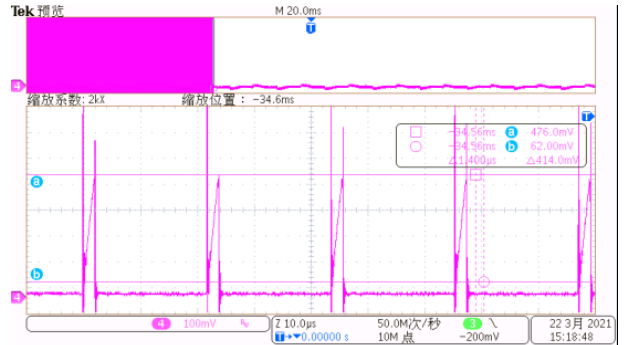
Test Condition: 265Vac/50Hz Input, 5V3A Output, Steady



(CH4-Vcs)

Comments: Vcs=398mV, Rcs=0.396R, Ics=1A

Test Condition: 265Vac/50Hz Input, 5V Output, Overload



(CH4-Vcs)

Comments: Vcs=476mV, Rcs=0.396R, Ics=1.2A

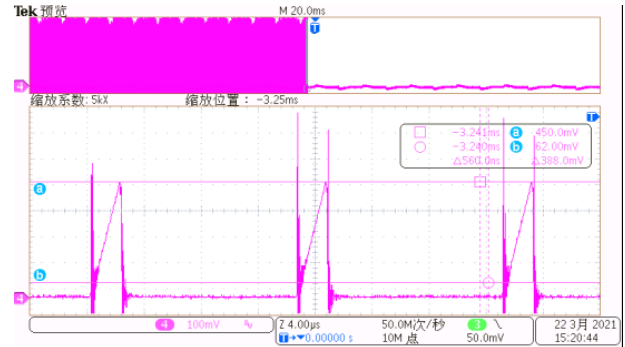
Test Condition: 265Vac/50Hz Input, 9V3A Output, Steady

Test Condition: 265Vac/50Hz Input, 9V Output, Overload



(CH4-Vcs)

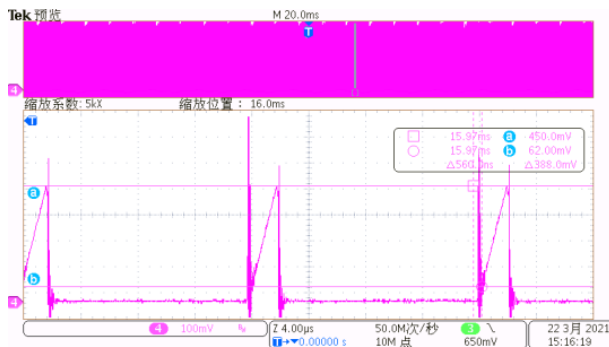
Comments: Vcs=414mV, Rcs=0.396R, lcs=1.04A



(CH4-Vcs)

Comments: Vcs=450mV, Rcs=0.396R, lcs=1.14A

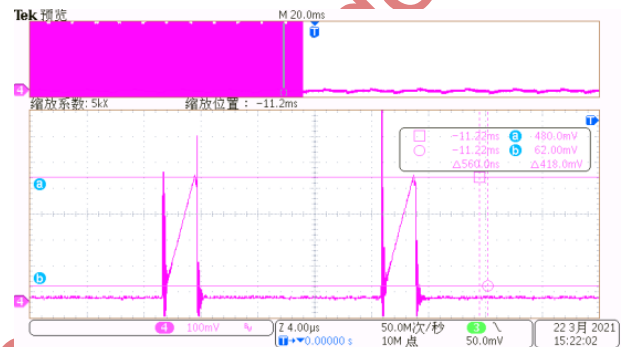
Test Condition: 265Vac/50Hz Input, 12V2.5A Output, Steady



(CH4-Vcs)

Comments: Vcs=450mV, Rcs=0.396R, lcs=1.14A

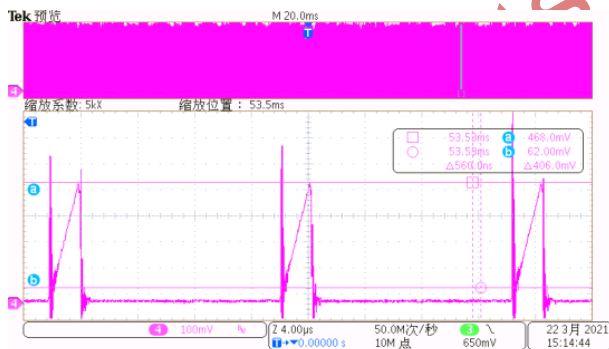
Test Condition: 265Vac/50Hz Input, 12V Output, Overload



(CH4-Vcs)

Comments: Vcs=480mV, Rcs=0.396R, lcs=1.21A

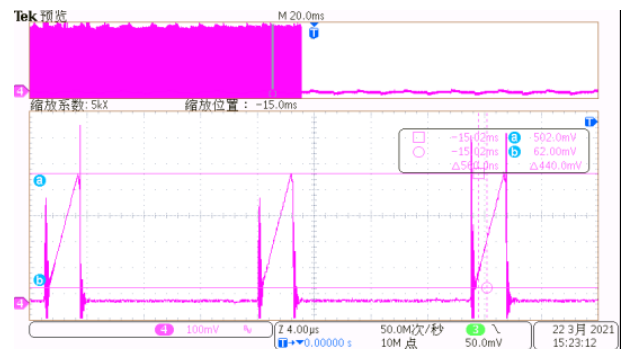
Test Condition: 265Vac/50Hz Input, 15V2A Output, Steady



(CH4-Vcs)

Comments: Vcs=468mV, Rcs=0.396R, lcs=1.18A

Test Condition: 265Vac/50Hz Input, 15V Output, Overload



(CH4-Vcs)

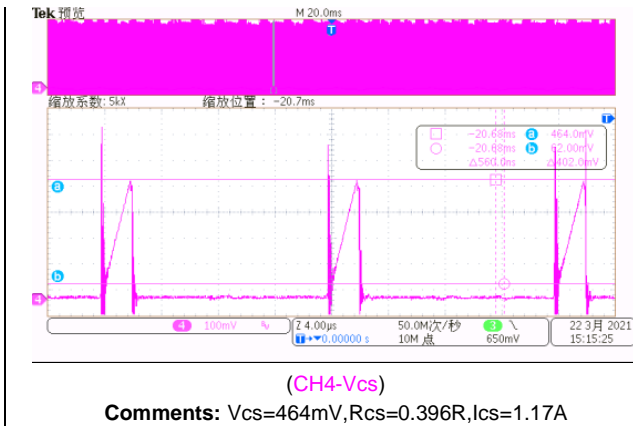
Comments: Vcs=502mV, Rcs=0.396R, lcs=1.27A

Test Condition: 265Vac/50Hz Input, 20V1.5A Output, Steady



Test Condition: 265Vac/50Hz Input, 20V Output, Overload



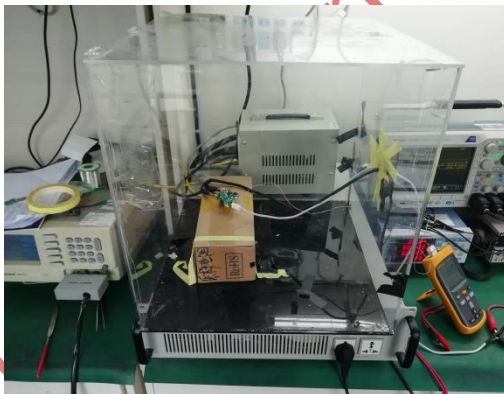


4.3 Thermal Test

Standard: IC :Ta=25°C, ΔT<75°C

Result: Pass

Trise(°C)	Ambient:25°C			
	12V/2.5A		20V/1.5A	
Location	90V/60Hz	265V/50Hz	90V/60Hz	265V/50Hz
KP22035	72.1	62.9	70.2	64.3
KP40512	57.2	54.3	45.5	48.5



5. EMC/EMS Test Result

Standard:

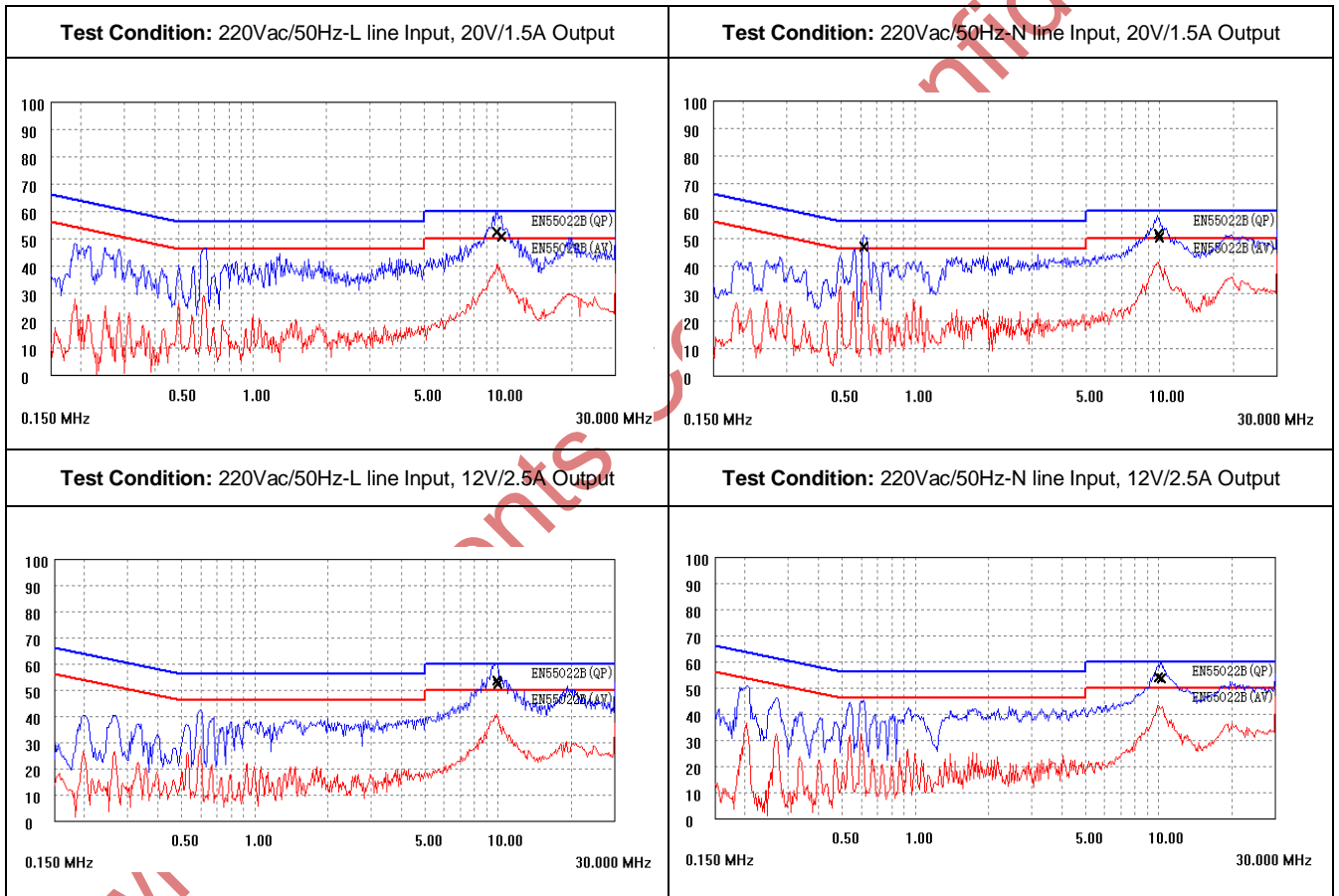
standard	EN55022B/55032B
content	CE & RE
requirement	3dB margin

5.1 Conducted Emissions

Test Condition: 220Vac/50Hz; 12V2.5A/20V1.5A output.

Result: Pass

Note: The resistor load is connected at 1m Line ends



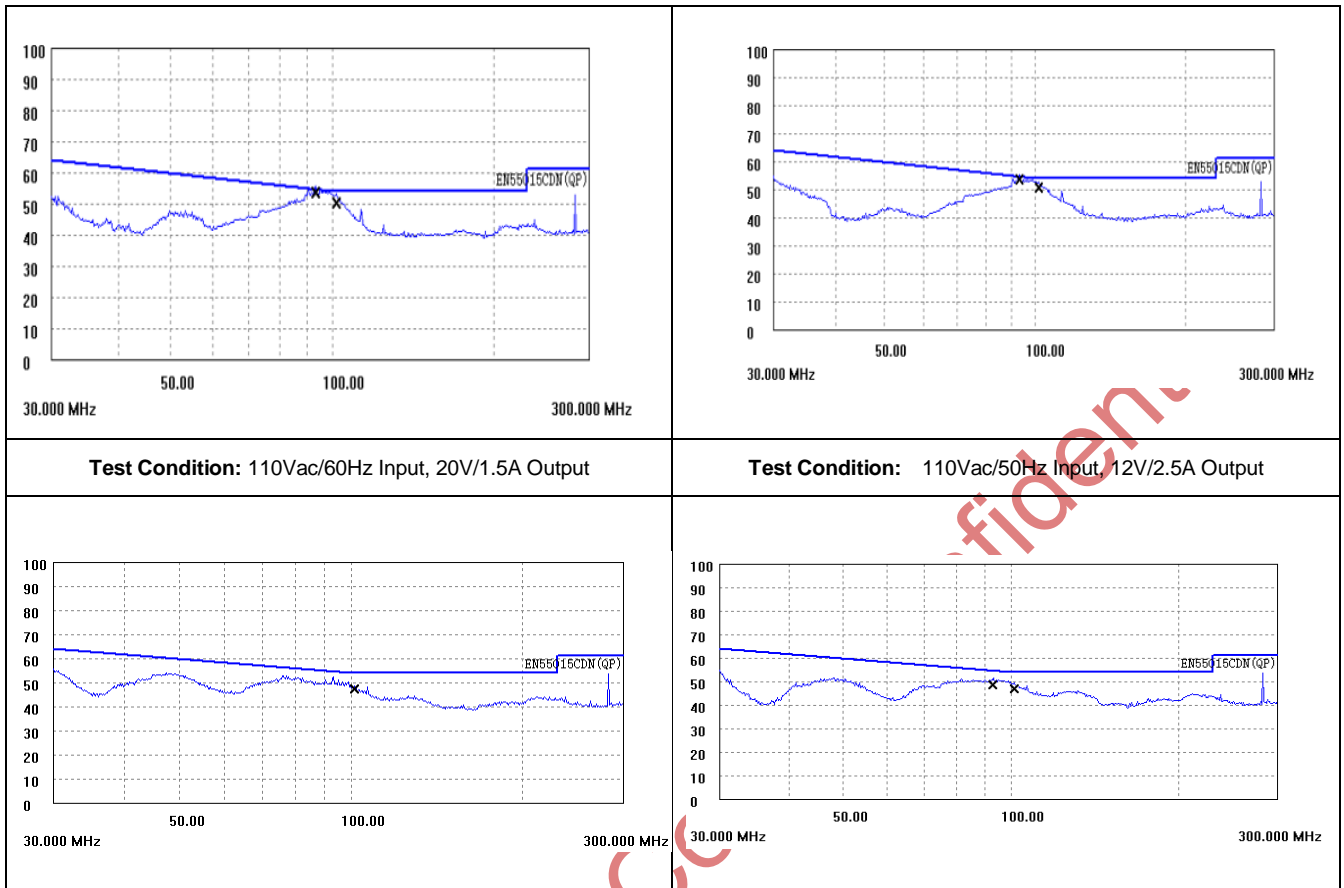
5.2 Radiated Emissions

Test Condition: 110/220Vac/50Hz; 20V1.5A/12V2.5A output.

Result: Pass

Note: The resistor load is connected at 1m Line ends

Test Condition: 220Vac/50Hz Input, 20V/1.5A Output	Test Condition: 220Vac/50Hz Input, 12V/2.5A Output
--	--



5.3 Surge Test

Test Condition: Input 220Vac/50Hz, Output 20V/1.5A. Surge testing was completed according to IEC61000-4-5 Each injection phase below is tested with 5 times and hold for 60 seconds before next one

Standard: Level3, common mode voltage 2KV, difference mode voltage 1KV

Result: Pass

Injection Location	Surge Level(V)	Injection Phase (°)	Test Result (Pass/Fail)
L to N	+1500	0	Pass
	+1500	90	Pass
	+1500	180	Pass
	+1500	270	Pass
	-1500	0	Pass



	-1500	90	Pass
	-1500	180	Pass
	-1500	270	Pass
L to PE	+2500	0	Pass
	+2500	90	Pass
	+2500	180	Pass
	+2500	270	Pass
	-2500	0	Pass
	-2500	90	Pass
	-2500	180	Pass
	-2500	270	Pass
N to PE	+2500	0	Pass
	+2500	90	Pass
	+2500	180	Pass
	+2500	270	Pass
	-2500	0	Pass
	-2500	90	Pass
	-2500	180	Pass
	-2500	270	Pass
L+N to PE	+2500	0	Pass
	+2500	90	Pass
	+2500	180	Pass
	+2500	270	Pass
	-2500	0	Pass
	-2500	90	Pass
	-2500	180	Pass
	-2500	270	Pass



5.4 ESD Test

Test Condition: Input 220Vac/50Hz, Output 20V/1.5A. Discharge 10 times on each output terminals at each test voltage according to IEC61000-4-2

Standard: Level4, air discharge 15KV, contact discharge 8KV

Result: Pass

Note: Tested at 1m line ends

Air Discharge		Contact Discharge	
Test Voltage (kV)	Result	Test Voltage (kV)	Result
16	Pass	9	Pass
-16	Pass	-9	Pass

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DATE	REV	DESCRIPTION
2021/03/26	1.0	First Release

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