DEMO BOARD TEST REPORT

NO Y NO CM Filter 12V1A Adapter using KP23223MSG

FEATURES

- Primary-Side–Control without Opto-Coupler or Secondary Feedback Circuit
- No Y Capacitor, No CM Filter Design
- High Precision 12V Output
- Meet DoE Level VI and CoC V5 Tier2
- Less than 75mW Standby Power
- Meet EN55022 Conducted and Radiated EMI Requirement
- Strong ESD Capability
- Single Failure Protections for power supply
- Comprehensive Protections:
  - VDD OVP& UVP & Clamp
  - On-Chip Thermal Shutdown (OTP)
  - Short Load Protection (SLP)
  - FB Over Voltage Protection (FB OVP)

INTRODUCTION

The Demo Board of KP23223MSG-D01 is typically designed for the application of 12V/1A adapter with universal input (90-265Vac,60/50Hz). The demo board adopts the design of no Y capacitor and no CM filter to save cost. Besides, the demo board passes EN55022 Class B EMI Standard and meets DoE Level VI and CoC V5 tier2 energy efficiency standard with comprehensive protections.

APPLICATIONS

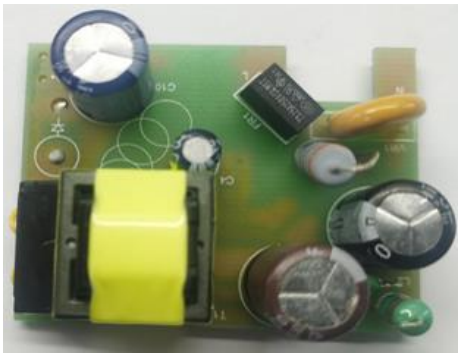
- AC/DC Power Adapter

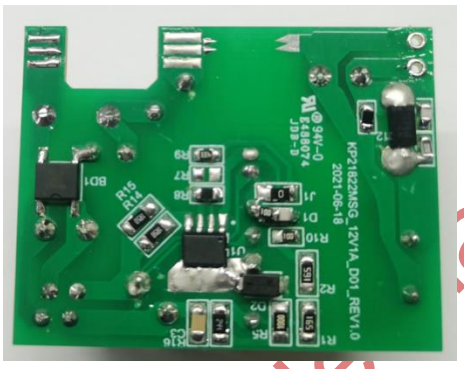
DEMO BOARD SEPCIFICATION

Description	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	V_{in}	90	-	265	V_{ac}	50/60Hz
Output Voltage	V_{out}		12	-	V_{dc}	
Output Current	I_{out}	-	1	1.429	A	
Total Output Power	P_{out}	-	12	-	W	
Ripple & Noise	V_{ripple}	-	-	110	mV_{p-p}	Line End (AWG 24#, 1.5m), 20MHz Bandwidth
System Average Efficiency	η	>83.6			%	Meets DoE Level VI and CoC V5 Tier2, Line End(24AWG)
Standby Power Consumption	P_{st}	-	-	58.73	mW	@230Vac/50Hz
Startup Time	T_{st}	-	2.676	-	s	Tested at 90Vac/60Hz
Conductive EMI Margin	-	+6	-	-	dB	EN55022 Class B
Radiant EMI Margin	-	+6	-	-	dB	EN55015
Surge Test	-	>4.5	-	-	KV	Differential Mode @ 220Vac/50Hz
	-	>4.5	-	-	kV	Common Mode @ 220Vac/50Hz
ESD (Contact/Air Discharge)	-	20/20	-		kV	On each Output Terminals +/-
Operating Ambient		0		40	℃	
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.

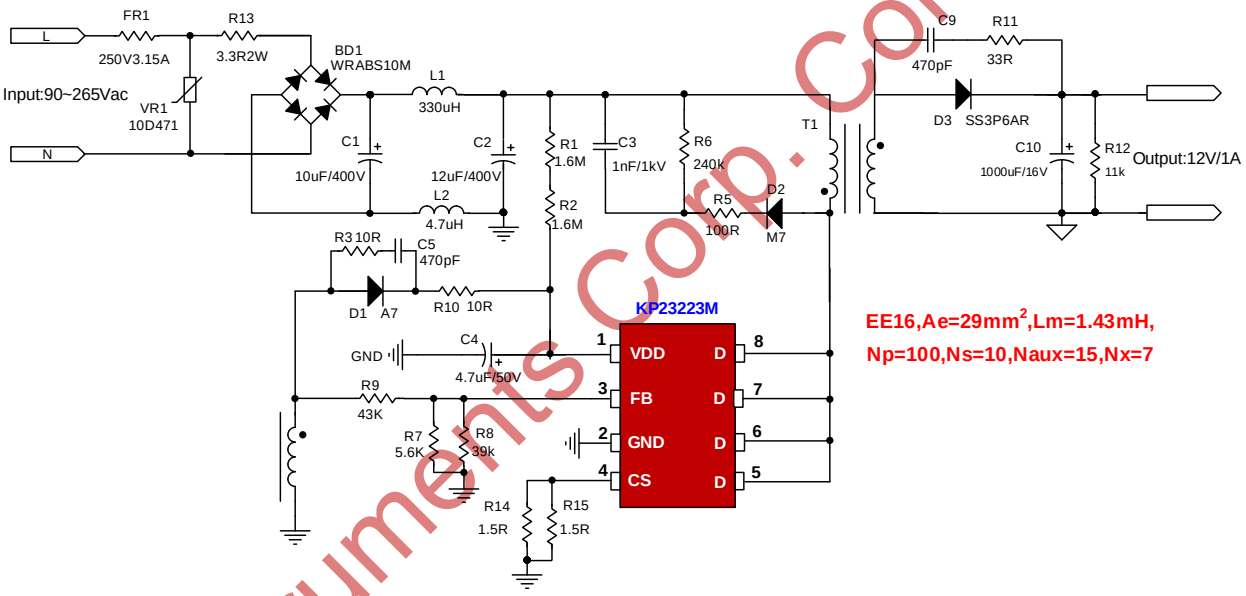
Demo Board of KP23223MSG-D01





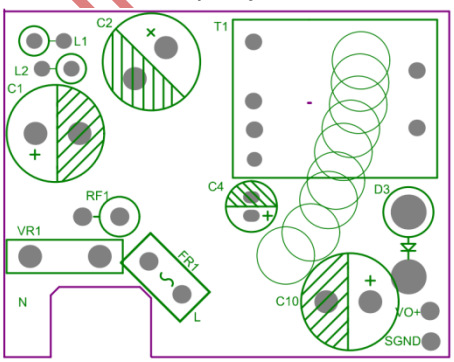
Board Size (in mm): L x W x H= 47.9mm x 37.3mm x 20.3mm

Schematic

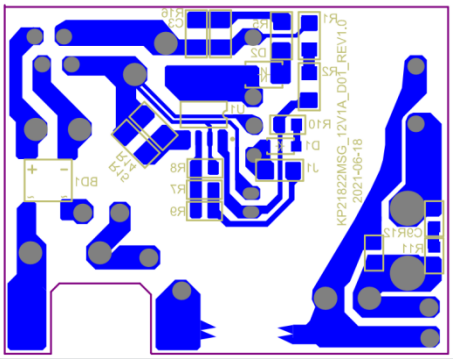


Printed Circuit Board Layout

Top Layer



Bottom Layer

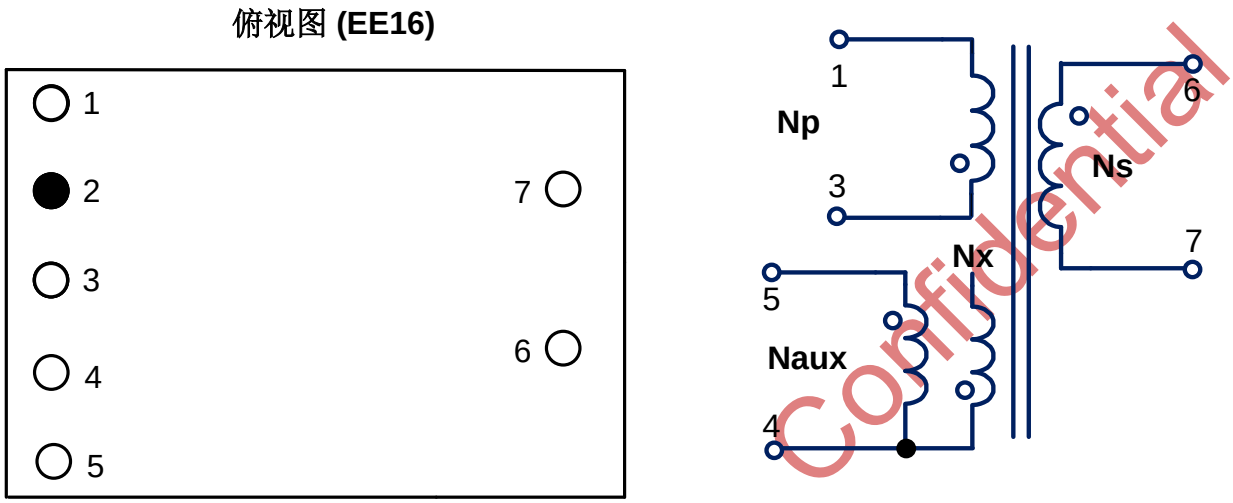


Bill of Material

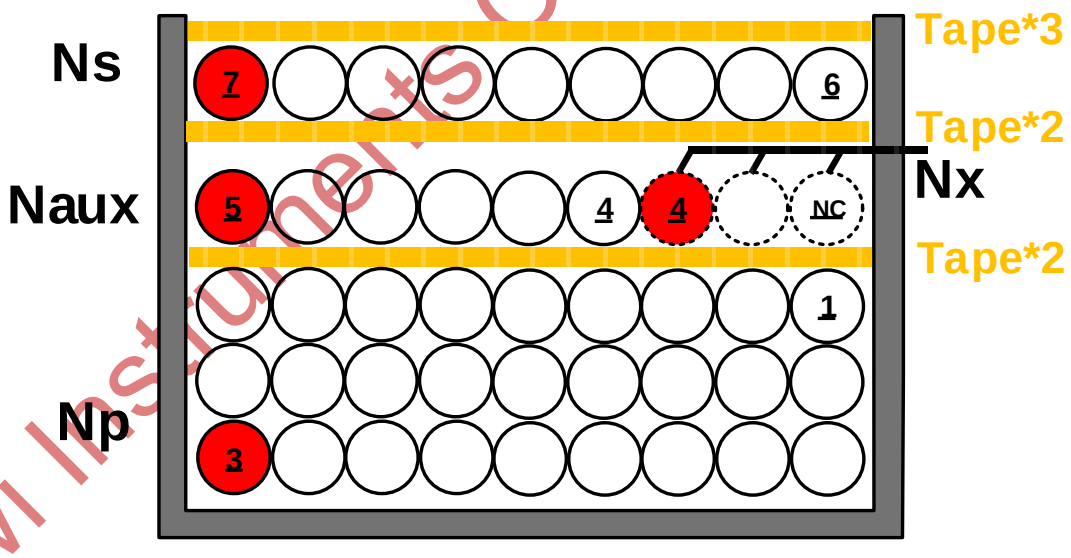
No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	BD1	WRABS 10M	Ultra-soft Recovery Bridge(VF=1V@IF=0.5A)	ABS	WORLD	Any
2	C1	10uF/400V	Electrolytic Cap, 400V,10*13	TH	AiSHi	Any
3	C2	12uF/400V	Electrolytic Cap,400V,10*17	TH	AiSHi	Any
4	C3	1nF/1000V	Ceramic Cap, 1KV X7R	1206	Murata	Any
5	C4	4.7uF/50V	Electrolytic Cap, 50V, 5*11.5	TH	jianghai	Any
6	C5,C9	470pF/50V	Ceramic Cap, 50V NPO	0805	WE	Any
7	C10	1000uF/16V	Electrolytic Cap,10*16	TH	AiSHi	Any
8	D1	1KV/1A	Fast Recovery Rectifiers, TRR=130ns(VF=1.1V@IF=1A)	SOD-123S	YEA SHIN	A7
9	D2	1KV/1A	Fast Recovery Rectifiers, TRR=150ns(VF=1.1V@IF=1A)	SMA	YEA SHIN	M7
10	D3	60V/3A	3.0AMPS Schottky Barrier Rectifiers	SMA	PINGWEI	SS3P6AR
11	FR1	3.15A/250V	4T T3.15 AL 250V	TH	Any	Any
12	R1, R2	1.6M	Film Resistor, 5%	1206	Yageo	Any
13	R5	100R	Film Resistor, 5%	1206	Yageo	Any
14	R6	240K	Film Resistor, 5%	1206	Yageo	Any
15	R7	5.6K	Film Resistor, 5%	0805	Yageo	Any
16	R8	39K	Film Resistor, 5%	0805	Yageo	Any
17	R9	43K	Film Resistor, 5%	0805	Yageo	Any
18	R3,R10	10R	Film Resistor, 1%	0805	Yageo	Any
19	R11	33R	Film Resistor, 5%	0805	Yageo	Any
20	R12	11K	Film Resistor, 5%	0805	Yageo	Any
21	R13	3.3R	Fuse Resistor,2W	TH	Any	Any
22	R14, R15	1.5R	Film Resistor, 1%	1206	Yageo	Any
23	L1	330uH	Color circle Coils	0512	Any	Any
24	L2	4.7uH	Color circle Coils	0307	Any	Any
25	VR1	10D471	Disk Varistor High-Surge WE	10D	Any	Any
26	T1	1.43mH	EE16, L=1.43mH, Np :Ns :Naux=100:10:15	EE16	Any	Any
27	U1	KP23223MSG	High Performance Primary Side Regulation CV/CC Power Switch	SOP-8	Kiwi Instruments	KP23223MSG

Transformer Manufacture Guide

1. Electrical Diagram



2. Winding Diagram



3. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	N_p	Primary	3	1	0.23d*1P	100T	Dense
2	N_{aux}	Primary	5	4	0.15d*2P	15T	Dense
3	N_x	Primary	4	NC	0.15d*2P	7T	
4	N_s	Secondary	7	6	0.6d*1P (TEX-E)	10T	Dense Reverse Wound

4. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz, 1.0 VRMS	Pins 3 - 1, all other windings open,	1.43mH± 5%
Primary Leakage Inductance	Measured at 40kHz, 1.0 VRMS	Pins3 - 1, all other windings shorted,	37uH
HI-POTHV Test	3500Vac/50Hz, One minute	Primary to Secondary	PASS
DC Resistance	-	Pins 3 - 1	1.38R

5. Transformer BOM

Items	Description
1	**Core:** EE16, PC95, AE=29mm²
2	**Bobbin:** EE16, Horizontal, 5+2 pin
3	**Wire:** 0.23ф 2UEW 130℃
4	**Wire:** 0.15ф 2UEW 130℃
5	**Triple Insulation Wire:** 0.6ф TEX-E 130℃
6	**Tape:** W=8.6mm

Test Result

1. Input Characteristics

1.1. No Load Input Power Dissipation

Standard: while input 115Vac~230Vac and the output is no load, the input power loss must be less than 75mW.

Result: PASS.

$V_{IN(AC)}$	90	115	230	265	green mode limit	**Result**
Po=0W	30.97mW	34.01mW	58.73mW	70.74mW	75mW	**PASS**

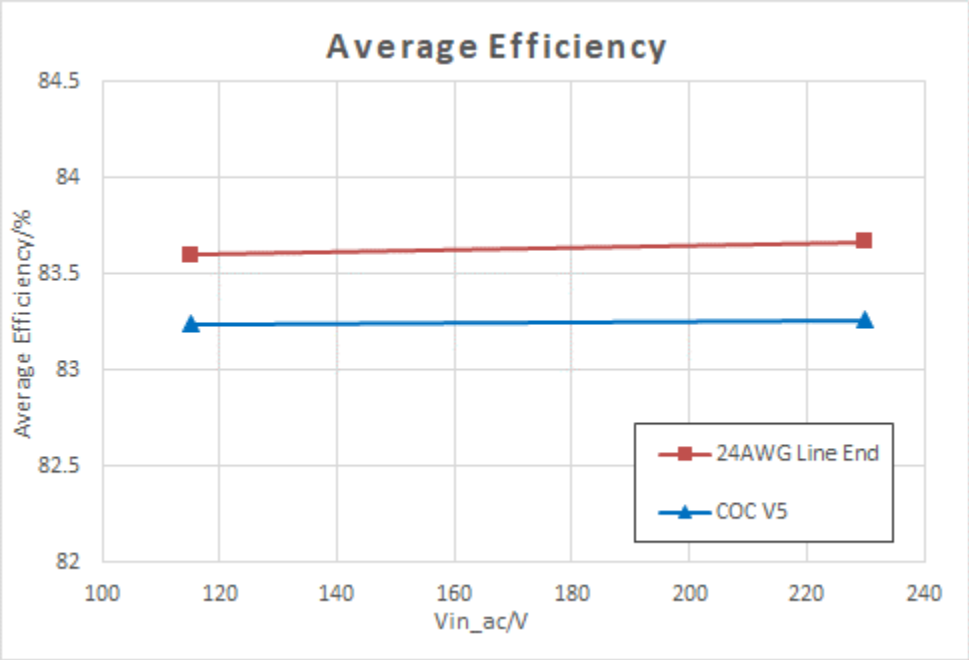
1.2. Average Efficiency

Standard: while input 115Vac and 230Vac, the average efficiency is more than 83.24%.

Test Condition:24AWG Line End

Result: PASS.

V_{in}(Vac)	F_{line}(Hz)	P_{in}(W)	V_{out}(V)	I_{out}(A)	P_{out}(W)	Eff (%)	Eff_AVG(%)	COC_V5(%)
115	**60**	14.4	11.95	1	11.95	82.99	83.60	83.24
		10.71	11.91	0.75	8.9325	83.40		
		7.0889	11.92	0.5	5.96	84.08		
		3.5555	11.94	0.25	2.985	83.95		
		1.4766	11.95	0.1	1.195	80.93	80.93	73.24
230	**50**	14.245	12	1	12	84.24	83.67	83.26
		10.642	11.95	0.75	8.9625	84.22		
		7.0999	11.93	0.5	5.965	84.02		
		3.6248	11.92	0.25	2.98	82.21		
		1.5602	11.96	0.1	1.196	76.66	76.66	73.26

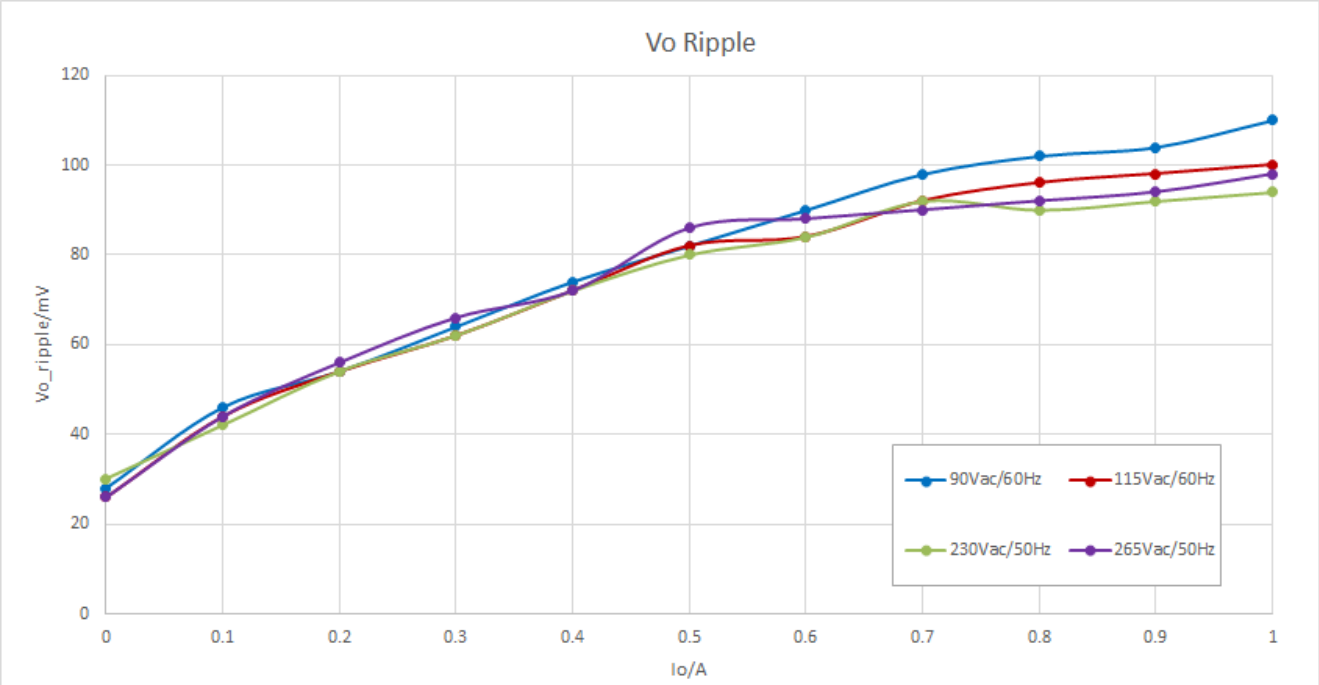


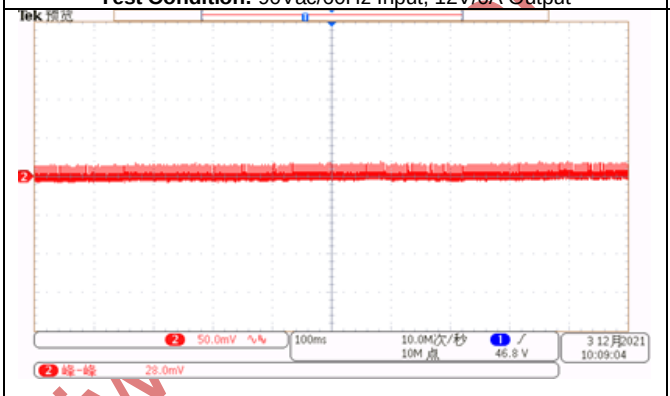
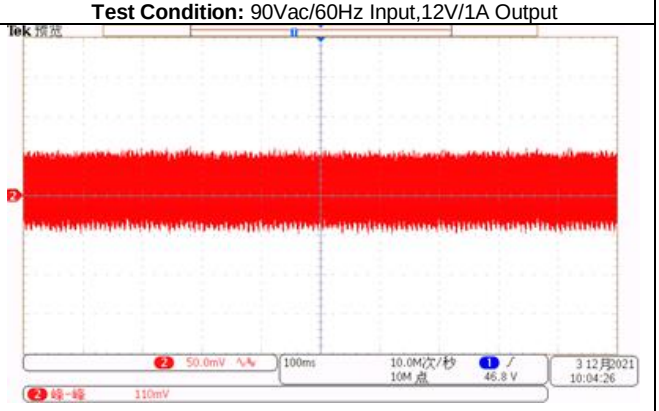
2. Output Characteristics

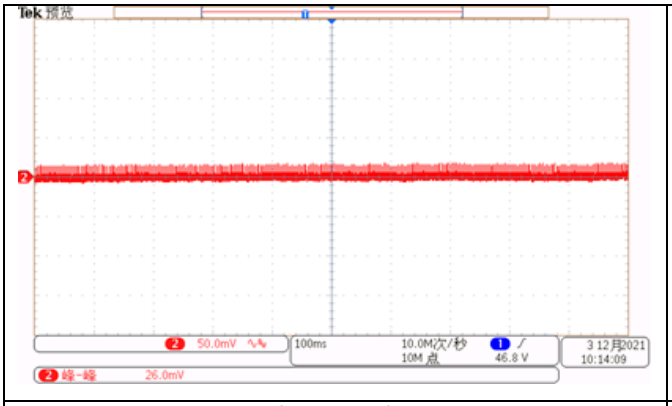
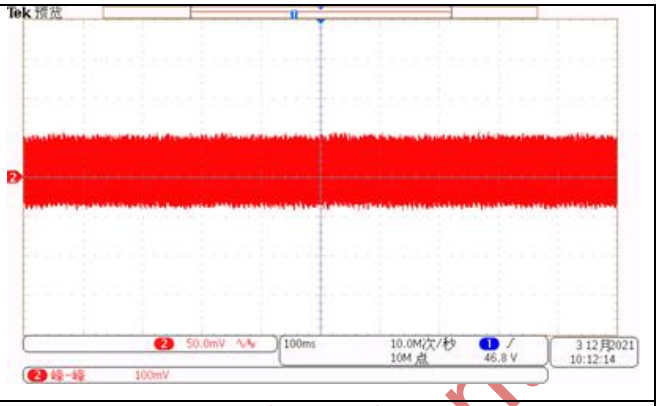
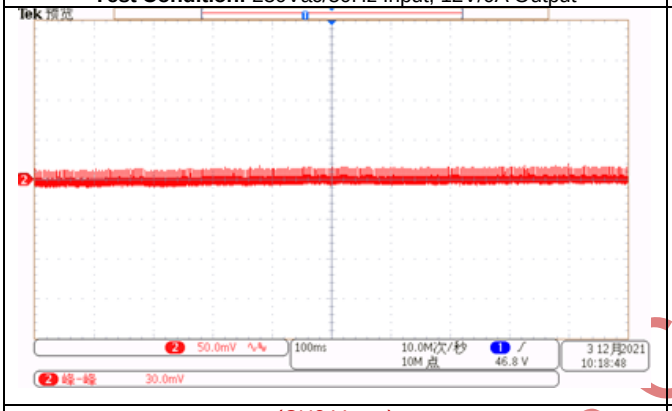
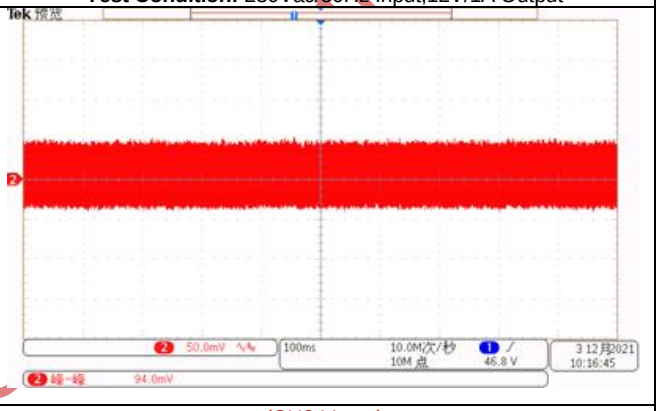
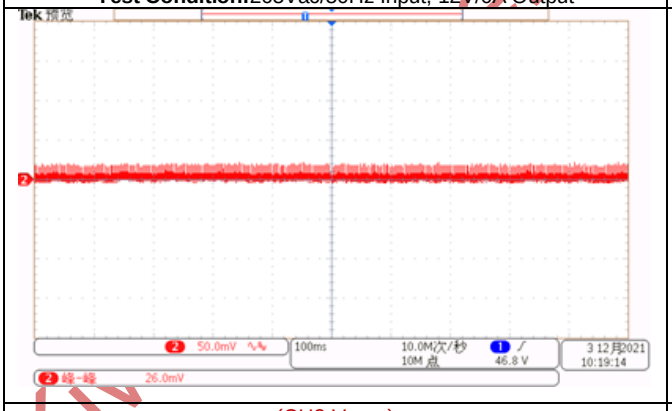
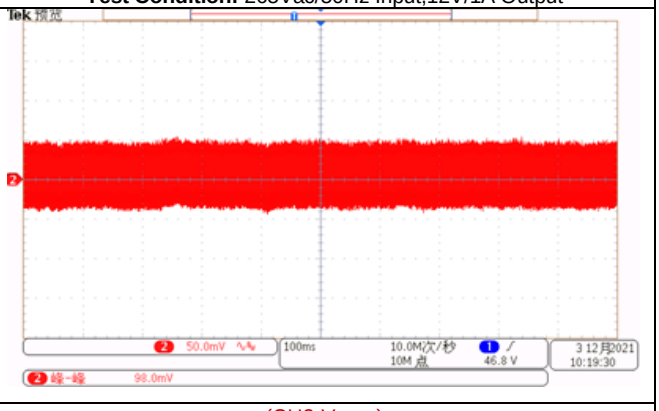
2.1. Ripple & Noise

Standard: under the input voltage 90Vac~265Vac, output with 1.5m AWG24# cable，V_{ripple} <120m$V_{p-p.}$

Result: PASS.



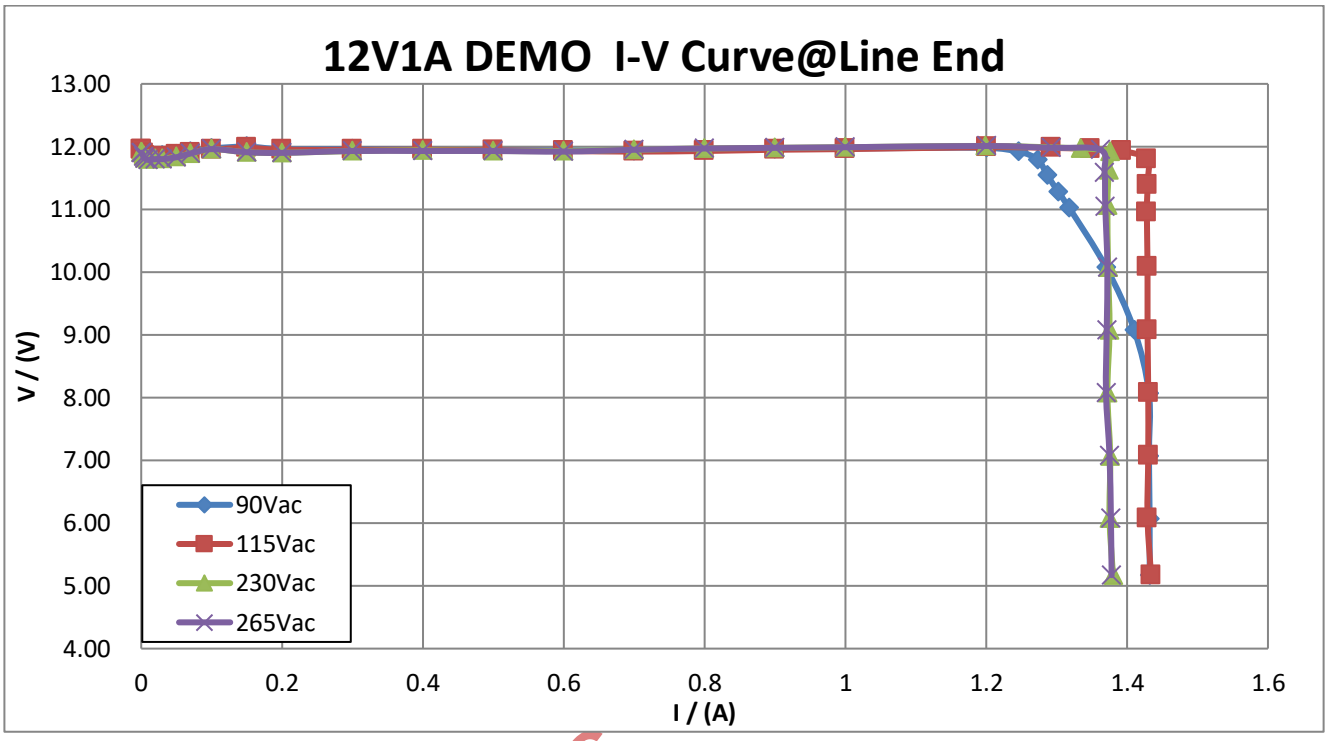
Test Condition: 90Vac/60Hz Input, 12V/0A Output	**Test Condition:** 90Vac/60Hz Input,12V/1A Output
	
(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=28mV **Comments: PASS**	(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=110mV **Comments: PASS**
Test Condition:115Vac/60Hz Input, 12V/0A Output	**Test Condition:** 115Vac/60Hz Input,12V1A Output

	
(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=26mV **Comments: PASS**	(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=100mV **Comments: PASS**
Test Condition: 230Vac/50Hz Input, 12V/0A Output	**Test Condition:** 230Vac/50Hz Input,12V/1A Output
	
(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=30mV **Comments: PASS**	(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=94mV **Comments: PASS**
Test Condition:265Vac/50Hz Input, 12V/0A Output	**Test Condition:** 265Vac/50Hz Input,12V/1A Output
	
(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=26mV **Comments: PASS**	(CH2-V_{out_ac}) $V_{out\_ripple\_pp}$=98mV **Comments: PASS**

2.2. Output Voltage / Current Characteristics

Standard: Output voltage regulation < ±3%, output current regulation < ±3%.

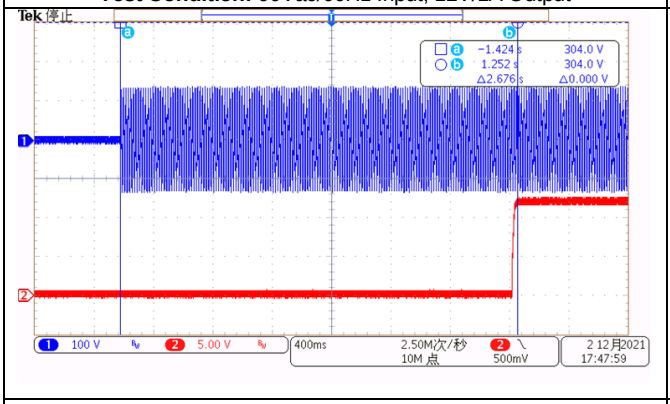
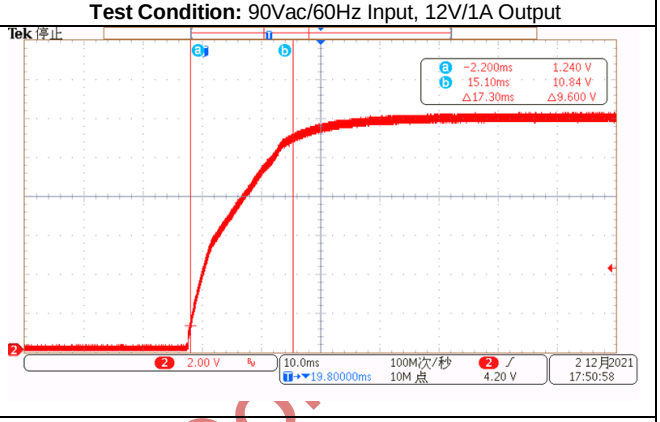
Result: PASS.



2.3. Start Time & Rise Time

Standard: Start time < 3s @ 90Vac input & full load; Rise time < 20ms @ full load.

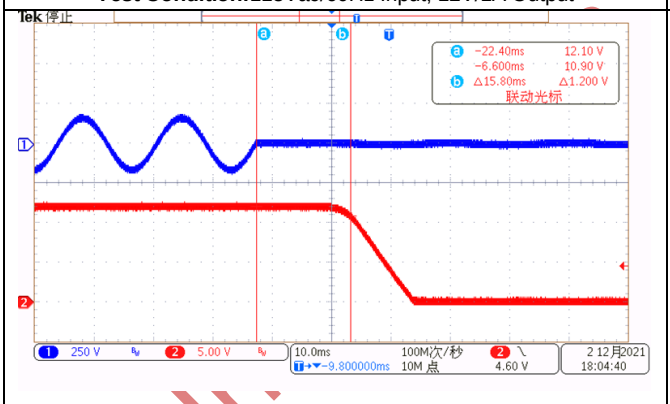
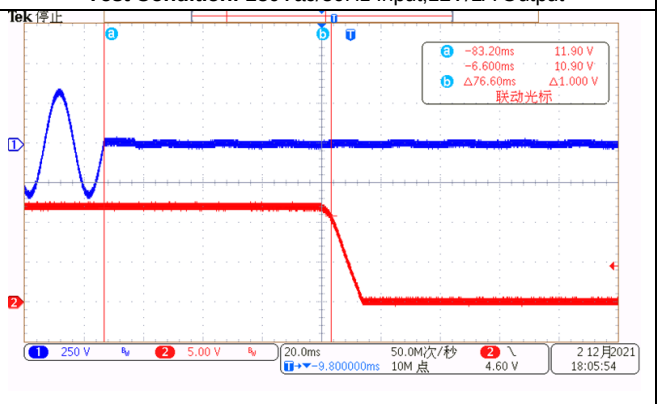
Result: PASS.

Test Condition: 90Vac/60Hz Input, 12V/1A Output	**Test Condition:** 90Vac/60Hz Input, 12V/1A Output
	
(CH1-V_{INAC}, CH2-V_{out}) $T_{startup}$=2.676s **Comments: PASS**	(CH2-V_{out}) T_{rise}=17.3ms **Comments: PASS**

2.4. Hold-up Time

Standard: 10ms min @ 115Vac/230Vac input & full load.

Result: PASS.

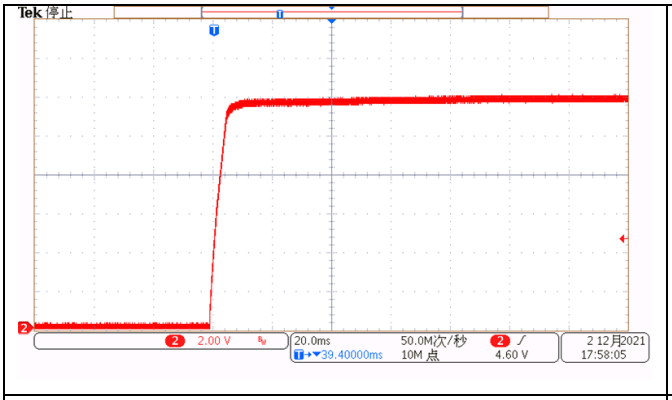
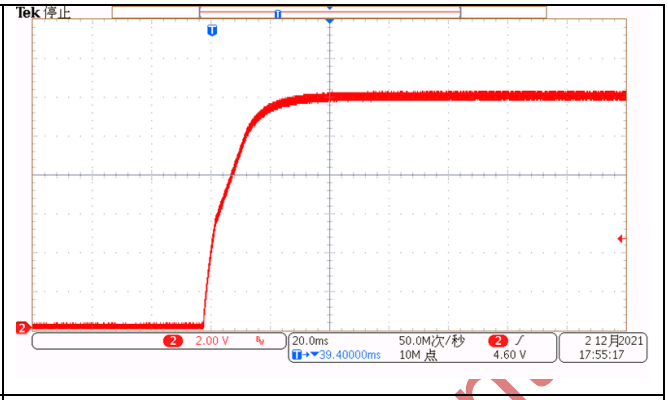
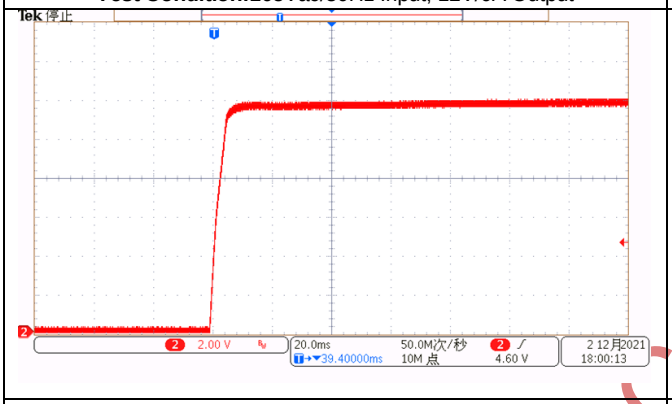
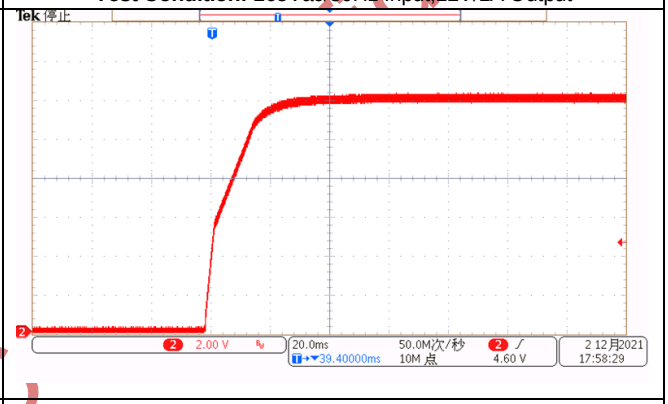
Test Condition:115Vac/60Hz Input, 12V/1A Output	**Test Condition:** 230Vac/50Hz Input,12V/1A Output
	
(CH1-V_{INac}, CH2-V_{out}) T_{holdup}=15.8ms **Comments: PASS**	(CH1-V_{INac}, CH2-V_{out}) T_{holdup}=76.6ms **Comments: PASS**

2.5. Output Overshoot

Standard: Output overshoot < 5%.

Result: PASS.

Test Condition: 90Vac/60Hz Input, 12V/0A Output	**Test Condition:** 90Vac/60Hz Input,12V/1A Output

	
(CH2-V_{out}) $V_{overshoot}$ =0mv **Comments: PASS**	(CH2-V_{out}) $V_{overshoot}$ =0mv **Comments: PASS**
Test Condition:265Vac/50Hz Input, 12V/0A Output	**Test Condition:** 265Vac/50Hz Input,12V/1A Output
	
(CH2-V_{out}) $V_{overshoot}$ =0mv **Comments: PASS**	(CH2-V_{out}) $V_{overshoot}$ =0mv **Comments: PASS**

2.6. Load Transient Test

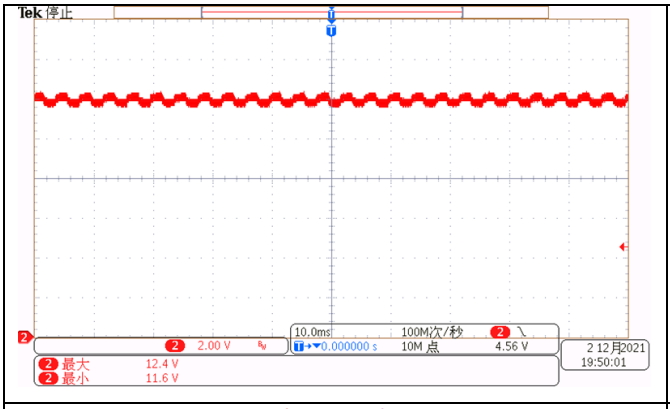
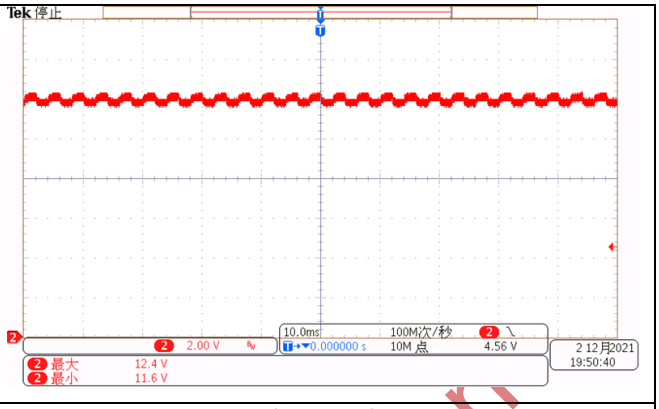
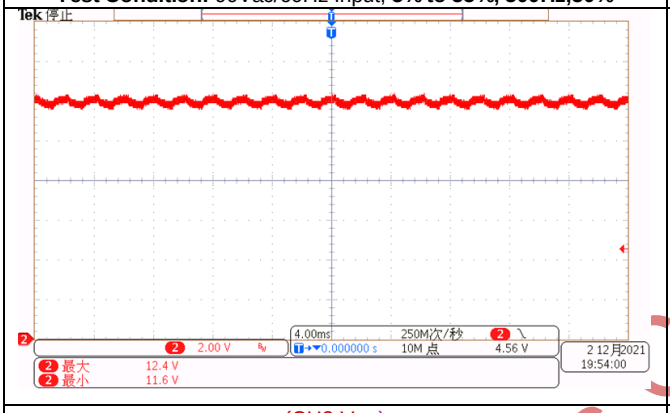
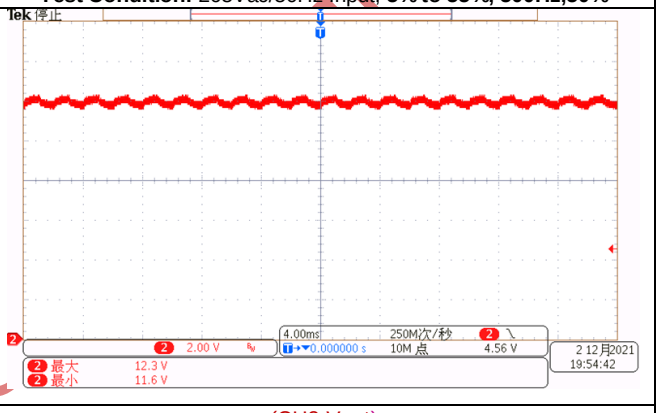
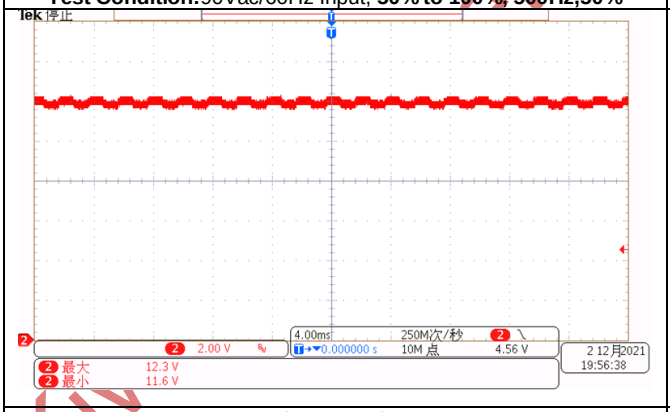
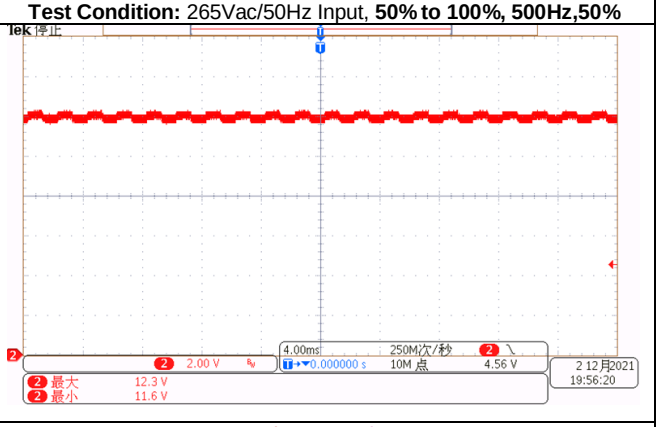
Standard:：1）RUIDIR ：Under the input voltage 90Vac~265Vac, the output Voltage transient response should be within 11.4V-12.6V (25% load shift to 75% load with 0.25A/us changing ramp and 250Hz changing frequency.).

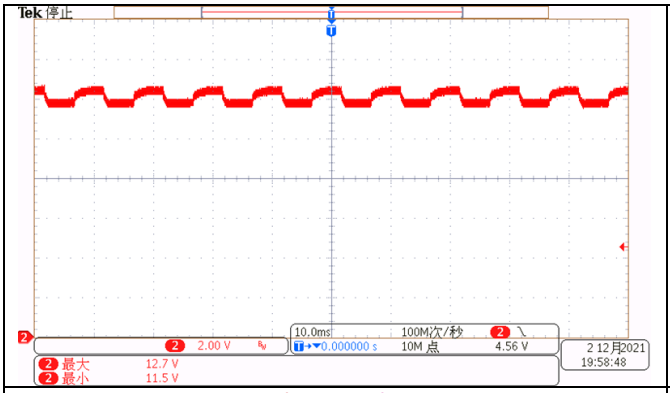
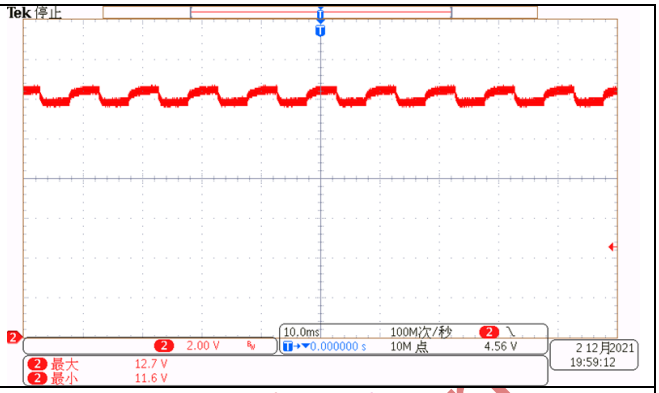
2）Europe Standard：Under the input voltage 90Vac~265Vac, the output Voltage transient response should be within 10.8V-13.2V (5% load shift to 55% load, 50% load shift to 100% load with 0.1A/us changing ramp, 500Hz-1KHz changing frequency and 10%-50% duty cycle.).

3）DIWEN Standard：Under the input voltage 90Vac~265Vac, the output Voltage transient response should be within 10.2V-13.8V (10% load shift to 90% load with 0.1A/us changing ramp and 100Hz changing frequency.).

Result：PASS.

Test Condition: 90Vac/60Hz Input, **25% to 75%, 250Hz,50%**	**Test Condition:** 265Vac/50Hz Input, **25% to 75%, 250Hz,50%**

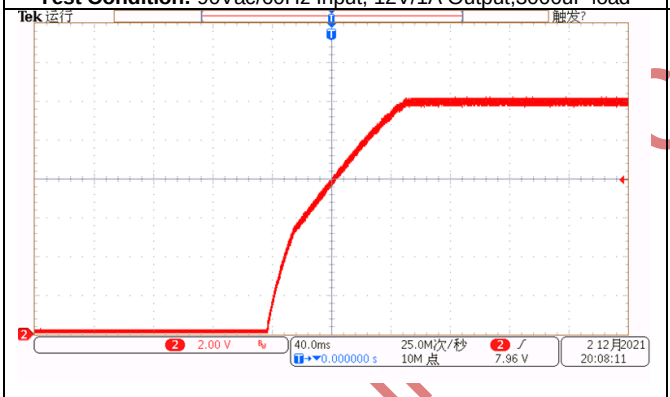
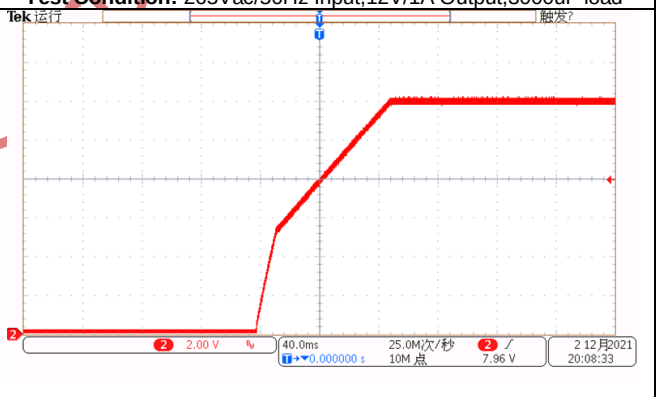
	
(CH2-Vout) VH =12.4V, VL=11.6V **Comments: PASS**	(CH2-Vout) VH =12.4V, VL=11.6V **Comments: PASS**
Test Condition: 90Vac/60Hz Input, **5% to 55%, 500Hz,50%**	**Test Condition:** 265Vac/50Hz Input, **5% to 55%, 500Hz,50%**
	
(CH2-Vou) VH =12.4V, VL=11.6V **Comments: PASS**	(CH2-Vout) VH =12.3V, VL=11.6V **Comments: PASS**
Test Condition:90Vac/60Hz Input, **50% to 100%, 500Hz,50%**	**Test Condition:** 265Vac/50Hz Input, **50% to 100%, 500Hz,50%**
	
(CH2-Vout) VH =12.3V, VL=11.6V **Comments: PASS**	(CH2-Vout) VH =12.3V, VL=11.6V **Comments: PASS**
Test Condition:90Vac/60Hz Input, **10% to 90%, 100Hz,50%**	**Test Condition:** 265Vac/50Hz Input, **10% to 90%, 100Hz,50%**

	
(CH2-Vout) VH =12.7V, VL=11.5V **Comments: PASS**	(CH2-Vout) VH =12.7V, VL=11.6V **Comments: PASS**

2.7. Capacitance Load Test

Standard:：Capacitance load: 3000uF @ 12V1A.

Result: PASS.

Test Condition: 90Vac/60Hz Input, 12V/1A Output,3000uF load	**Test Condition:** 265Vac/50Hz Input,12V/1A Output,3000uF load
	
(CH2-V_{out}) **Comments: PASS**	(CH2-V_{out}) **Comments: PASS**

3. Protection Requirements

3.1. Over Current Protection

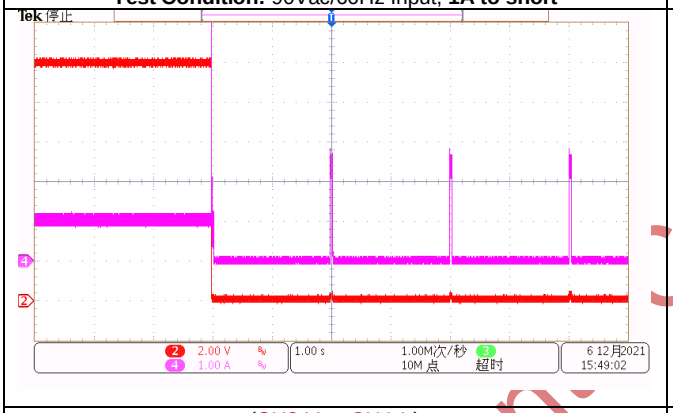
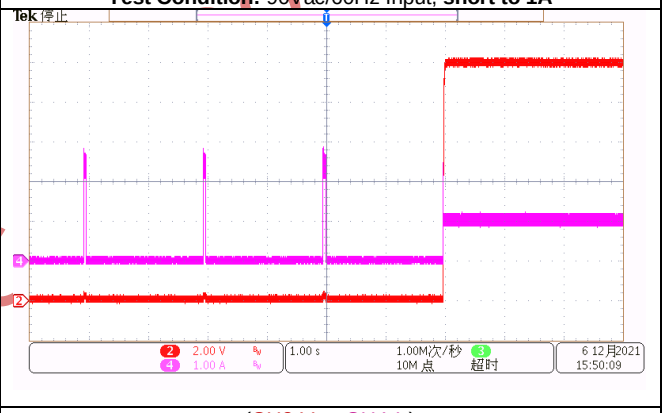
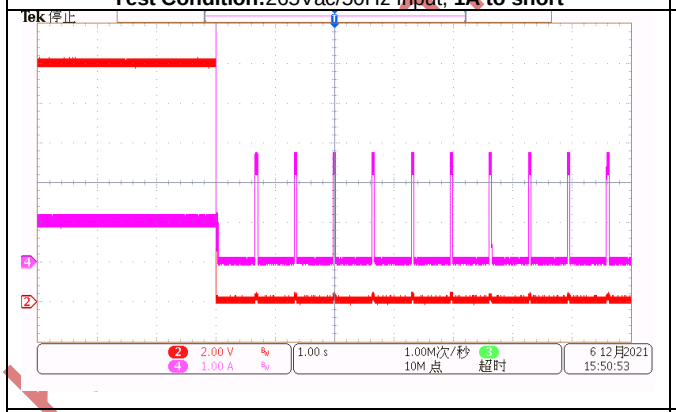
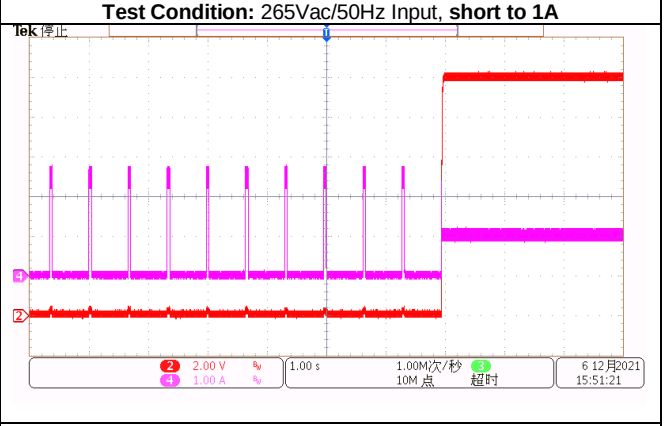
Standard: OCP point limited is between 1.2A~2A.

Result：PASS.

V_{out}	90V	115V	230V	265V	Result
11V	1.32A	1.427A	1.373A	1.368A	**PASS**
10V	1.37A	1.429A	1.376A	1.373A	**PASS**

3.2. Short Circuit Protection

Standard: Shorting of output will not cause power supply to damage or any safety hazard. The power supply shall resume normal operation after short is removed.

Test Condition: 90Vac/60Hz Input, **1A to short**	**Test Condition:** 90Vac/60Hz Input, **short to 1A**
	
(CH2-V_{out}, CH4-I_o) **Comments: PASS**	(CH2-V_{out}, CH4-I_o) **Comments: PASS**
Test Condition:265Vac/50Hz Input, **1A to short**	**Test Condition:** 265Vac/50Hz Input, **short to 1A**
	
(CH2-V_{out}, CH4-I_o) **Comments: PASS**	(CH2-V_{out}, CH4-I_o) **Comments: PASS**

3.3. Single Failure Protections

KP23223MSG integrates single failure protections which can ensure no damage to IC and no over voltage of output in the event of single point of failures.

No	Single Failure Protection	Standard	Result
1	FB pull-up resistor open protection	The power supply must shut-down in the event of single failure and automatically return to normal operating condition once the fault condition has been removed。The output voltage should be less than 18V.	PASS
2	FB pull-down resistor open protection		PASS
3	FB pull-down resistor short protection		PASS
4	Transformer windings short protection		PASS
5	Rcs open protection		PASS
6	Rectifier diode or SR short protection		PASS

4. Reliability Requirements

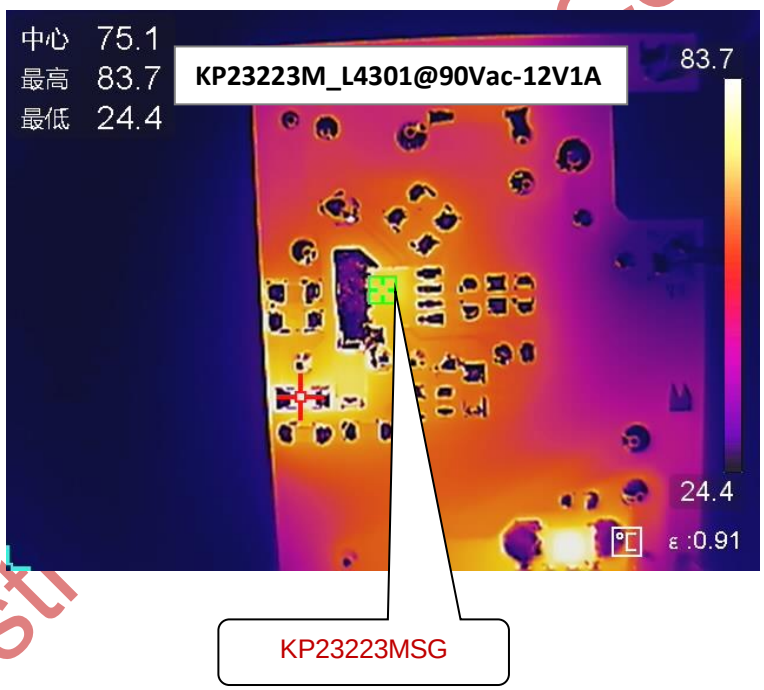
4.1. Thermal Test

Test Condition: Ambient Temperature: 25℃ and steady environment with no airflow, Ta is the temperature inside the plastic box.

Standard: IC : ΔT<75℃.

Result：PASS.

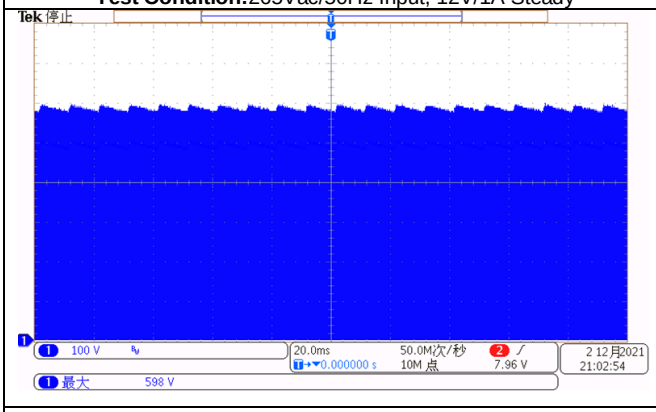
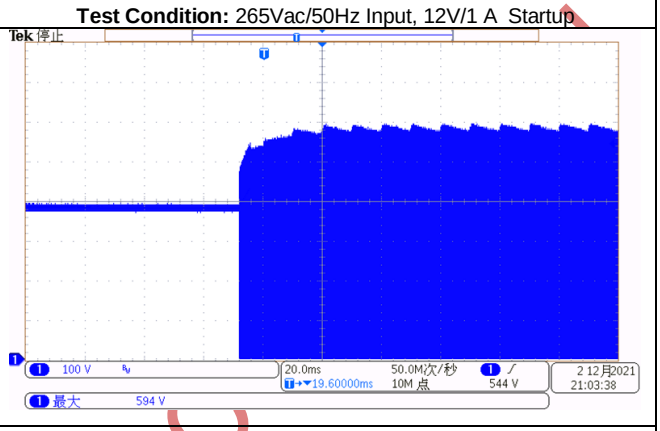
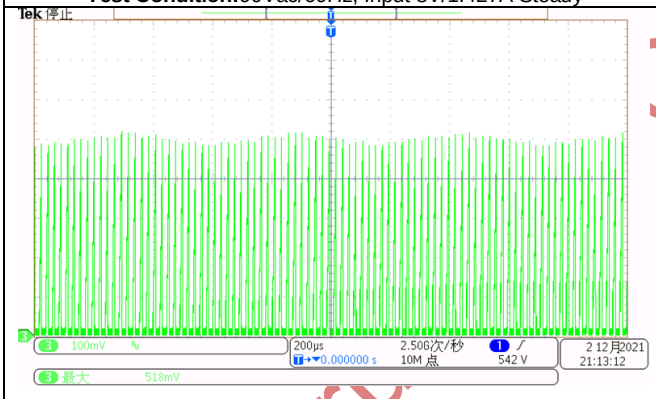
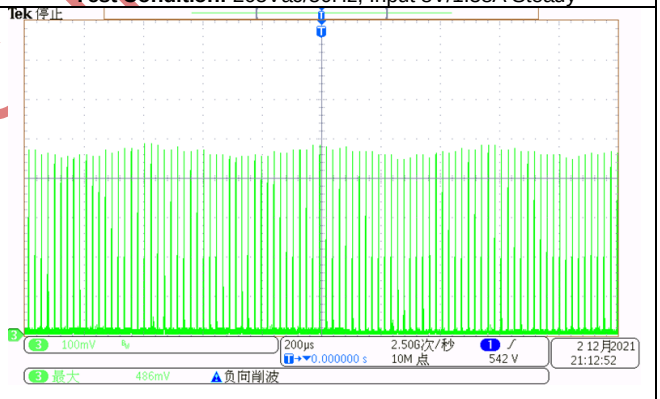
Component	90Vac		265Vac	
	T_a=23.9℃		T_a=24.2℃	
	T_c(℃)	T_{rise}(℃)	T_c(℃)	T_{rise}(℃)
KP23223MSG	75.1	51.2	72.9	48.7

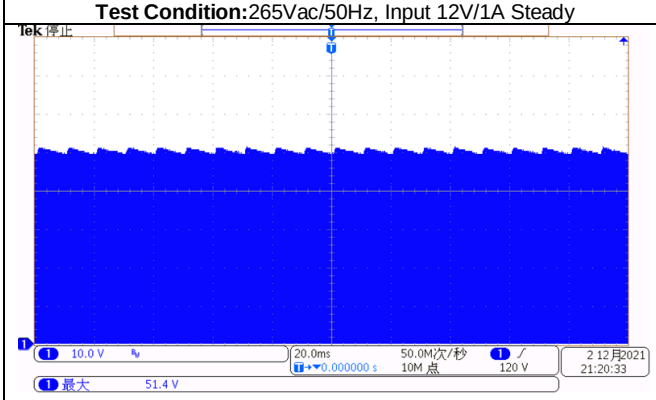
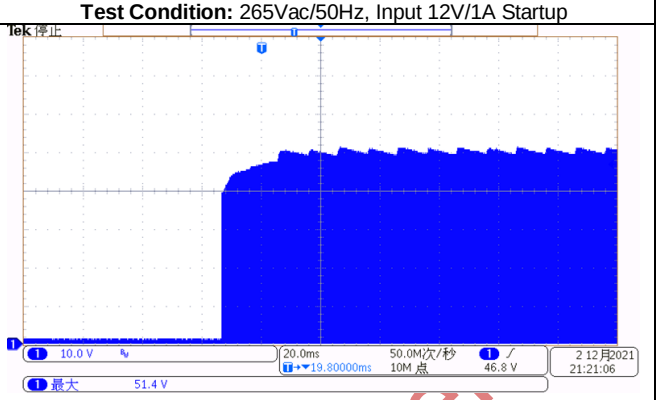


4.2. Device Maximum Rating

Standard: MOSFET, Diode and IC: <95% V_{rrm}.

Result: PASS.

Test Condition:265Vac/50Hz Input, 12V/1A Steady	**Test Condition:** 265Vac/50Hz Input, 12V/1 A Startup
	
(CH1-MOS Vds) MOS Vds=598V **Comments: PASS**	(CH1-MOS Vds) MOS Vds=594V **Comments: PASS**
Test Condition:90Vac/60Hz, Input 8V/1.427A Steady	**Test Condition:** 265Vac/50Hz, Input 8V/1.38A Steady
	
(CH3-Vcs) Vcs=518mV, Bmax=0.343T **Comments: PASS**	(CH3-Vcs) Vcs=486mV，Bmax=0.321T **Comments: PASS**

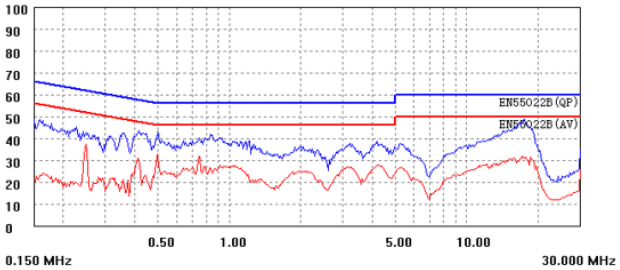
Test Condition:265Vac/50Hz, Input 12V/1A Steady	**Test Condition:** 265Vac/50Hz, Input 12V/1A Startup
	
(CH1-Vd) Vd=51.4V **Comments: PASS**	(CH1-Vd) Vd=51.4V **Comments: PASS**

5. EMI/EMS

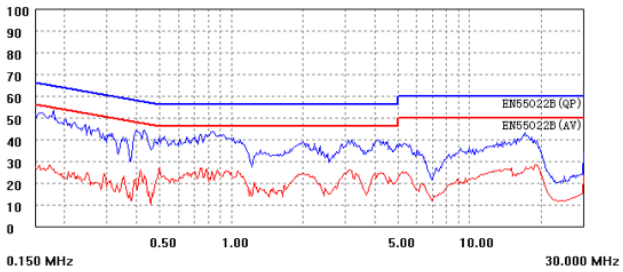
5.1. EMI Standards

standard	EN55022B/55015
content	CE & RE
requirement	6dB margin
Result	PASS

Test Condition: V_{in}=115Vac/60Hz, V_{out}=12V/1A

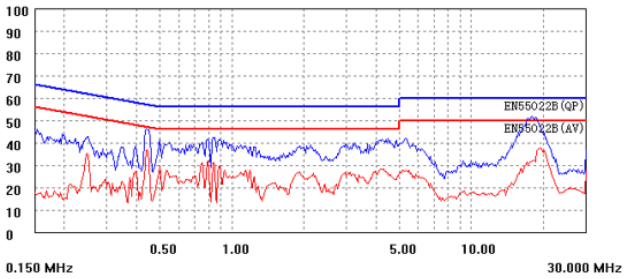


Conduction EMI---LINE

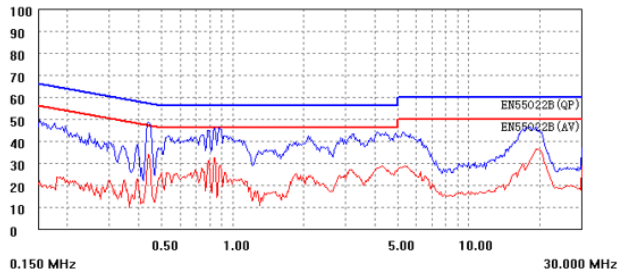


Conduction EMI---NEUTRAL

Test Condition: V_{in}=230Vac/50Hz, V_{out}=12V/1A

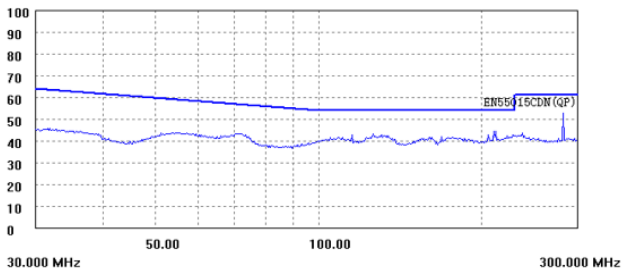


Conduction EMI---LINE



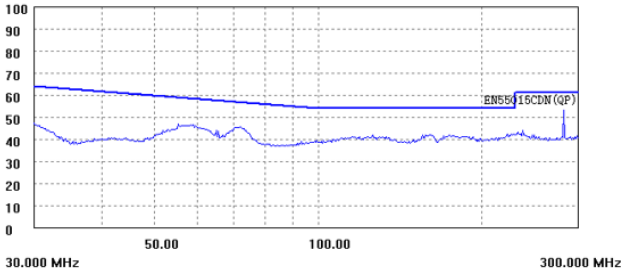
Conduction EMI---NEUTRAL

Test Condition: V_{in}=115Vac/60Hz, V_{out}=12V/1A



Radiated EMI--- CDN

Test Condition: V_{in}=230Vac/50Hz, V_{out}=12V/1A



Radiated EMI--- CDN

5.2. EMS Standards

5.2.1. IEC61000-4-2(ESD)

Test Condition: Input 220Vac/50Hz, Output 12V/1A. Discharge 10 times on each output terminals at each test voltage according to IEC61000-4-2

Standard: Air discharge 15KV, Contact discharge 8KV

Result：PASS

Air Discharge		Contact Discharge	
Test Voltage (kV)	Air Discharge	Test Voltage (kV)	Contact Discharge
13	Pass	5	Pass
-13	Pass	-5	Pass
20	Pass	20	Pass
-20	Pass	-20	Pass

5.2.2. IEC61000-4-5(surge)

Test Condition: Input 220Vac/50Hz，Output 12V/1A. 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: Common mode voltage 4KV, difference mode voltage 4KV.

Result：PASS

Test Result

Injection Location	Surge Level (V)	Injection Phase (°)	Test Result (Pass/Fail)
L to N	+4500	0	**PASS**
	+4500	90	**PASS**
	+4500	180	**PASS**
	+4500	270	**PASS**
	-4500	0	**PASS**
	-4500	90	**PASS**
	-4500	180	**PASS**
	-4500	270	**PASS**

L to PE	+4500	0	**PASS**
	+4500	90	**PASS**
	+4500	180	**PASS**
	+4500	270	**PASS**
	-4500	0	**PASS**
	-4500	90	**PASS**
	-4500	180	**PASS**
	-4500	270	**PASS**
N to PE	+4500	0	**PASS**
	+4500	90	**PASS**
	+4500	180	**PASS**
	+4500	270	**PASS**
	-4500	0	**PASS**
	-4500	90	**PASS**
	-4500	180	**PASS**
	-4500	270	**PASS**
L&N to PE	+4500	0	**PASS**
	+4500	90	**PASS**
	+4500	180	**PASS**
	+4500	270	**PASS**
	-4500	0	**PASS**
	-4500	90	**PASS**
	-4500	180	**PASS**
	-4500	270	**PASS**

6. Safety Standards

6.1. Dielectric Strength (Hi-pot)

Standard: primary to secondary: 3500Vac / 5mA /60 seconds.

V(AC)	time	I_{leak}(mA)	**Result**
3.5KV	60s	0.17	**PASS**

Revision History

DATE	REV	DESCRIPTION
2021/12/06	1.0	First Release

Disclaimer

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