DEMO BOARD TEST REPORT

High Performance Low Cost 24V2A Adapter with Multiple Output Mode PWM Controller KP201F

FEATURES

- Primary Side Constant-Current (CC) Control for DCM and CCM Operation
- Support CC、CV、CP Application
- ±5% CC Regulation; ±1% CV Regulation
- Less than 75mW Standby Power
- Green Mode and Burst Mode Control
- Built-in Frequency Shuffling to Reduce EMI
- Built-in Current Mode Control with Internal Slope Compensation
- Built-in Line & Inductance Compensation for CC Operation
- Built-in Protections with Auto Recovery:
  - VDD Under Voltage Lockout (UVLO)
  - VDD Over Voltage Protection (OVP)
  - Output OVP Protection (CS OVP)
  - Output UVP Protection (CS UVP)
  - On-Chip Thermal Shutdown (OTP)

APPLICATIONS

- **Chargers and Adapter**
- **Motor Driver Power Supply**

INTRODUCTION

KP201F is a high performance current mode PWM controller for offline flyback converter applications. The IC has built-in General Primary Side CC control, which simplifies isolated power supply design that requires CC regulation of the output. And the IC supports constant output power mode without OLP. That makes it qualified for motor driver power supply.

In KP201F, PWM switching frequency with shuffling is fixed to 65 KHz and is trimmed to tight range. The IC has built-in green and burst mode control for light and no load condition, which can achieve less than 75mW standby power.

The Demo Board of KP201F-D04 is typically designed for the application of 24V/2A with universal input (90-265Vac, 60/50Hz). Besides the multi-protection function, this demo also has very good efficiency, line & load regulation, low standby power loss and meets the EN55022B Conduction and Radiation requirement .

DEMO BOARD SEPCIFICATION

Description	Symbol	Min	Type	Max	Unit	Note
Input Voltage	Vin	90		265	Vac	50/60Hz
Output Voltage	Vout		24		Vdc	
Output Current	Iout		2		A	
Total Output Power	Pout		48		W	
Ripple & Noise	Vripple		176		mVp-p	20MHz Bandwidth @115Vac,1.5m Cable End
System Average Efficiency	η		>90.65		%	Board End @230Vac
Standby Power Consumption	Pst		73.36		mW	@265Vac
Startup Time	Tst		2.98		s	Tested at 90Vac/60Hz
Conducted EMI Margin			6		dB	EN55022 Class B
Surge Test			2		kV	Differential Mode @ 230Vac/50Hz
ESD(Contact)			8		kV	
EFT					kV	
Safety		Designed to meet UL60950				
Operating Ambient		0		40	℃	
Operating Humidity		5		95	%R.H.	

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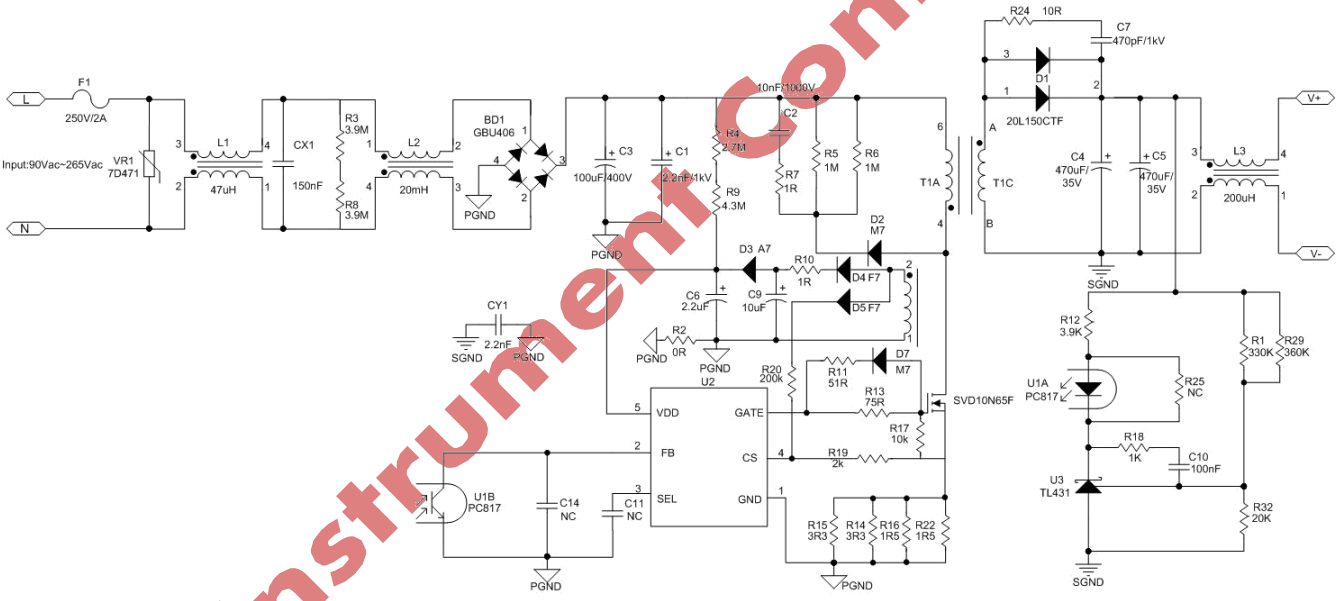
The table above shows the minimum acceptable performance of the design. Actual performance is listed in the results section.

Demo Board of KP201FLG _D01_REV1.0

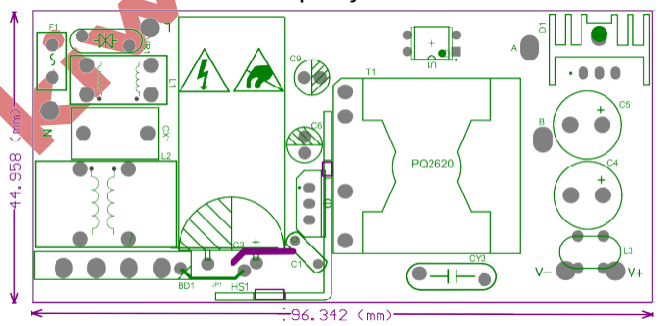
Board Size(in mm): L x W x H=96 x 45 x26

Schematic

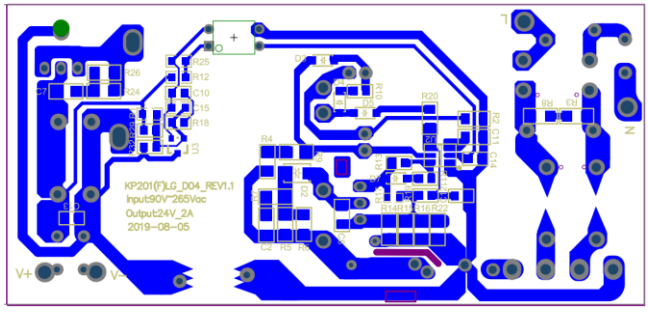


Printed Circuit Board Layout

Top Layer



Bottom Layer



Circuit Description

The Demo Board of KP201F-D01 is configured in a single stage flyback topology, which combines a multiple output mode PWM control regulator KP201FLG. KP201F-D04 is typically designed for the application of 24V/2A adapter 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 and EMI filtering

The circuit input stage is composed by the components of F1, VR1, L1, CX1, R3, R8, L2 and BD1. F1, VR1, L1 and L2 provide the inrush current limitation and Surge protection in the event of component failure, surge or short circuit event. L1, L2and CX1 are used to guarantee conducted EMI to meet EN55022B Standard. R3 and R8 are used to discharge the X-Cap CX1. The bridge diode of BD1 rectifies the AC input to DC output, which is followed by a bulk capacitor C3.

2. Current Mode PWM Controller KP201F Operation

U2 is the multiple output mode PWM controller KP201F, which is used for offline flyback converter applications. The IC has built-in General Primary Side CC control, which simplifies isolated power supply design that requires CC regulation of the output. The CC block is not used on the KP201F-D01 demo board. And to make the IC work in CV/CP mode，a capacitor (typically value is 10-47nF) between SEL and GND is removed.

D4, R10, C9, D3, C6, R4 and R9 are used as VDD power supply for KP201F. KP201F uses opto-coupler U1, R12, R25, C10, R18 and TL431 to generate FB Pin voltage on primary side to regulate the output voltage within full load range. R14, R15, R16 and R22 are sensing resistors to set maximum output power. C2, D2, R5, R6, R7 compose snubber circuit to depress the drain-source voltage spike. D5, R19 and R20 are the output voltage sensing branch.

3. Output Voltage Regulation

R18, C10, C15 and U3 TL431 compose output voltage regulation network. R1, R29 and R32 are the output voltage resistor dividers for TL431's reference compare. C4 and C5 are the output capacitors used to supply output current and lower output voltage ripple.

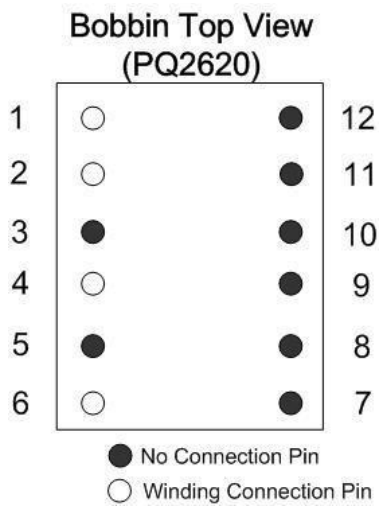
Bill of Material

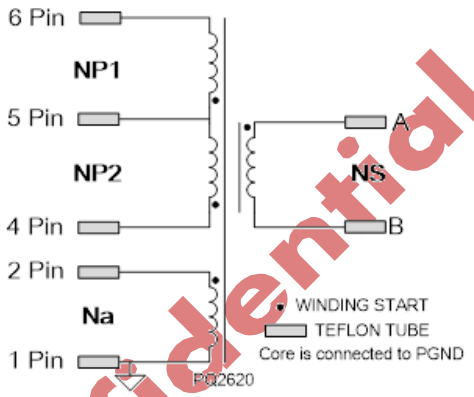
No.	Designator	Value	Description	Package	Manufacturer	Part Number
1	BD1	GBU406	4.0A GLASS PASSIVATED BRIDGE RECTIFIER	TH	DIODES	GBU406
2	C1	2.2nF/1kV	Ceramic Cap, 1kV X7R	1206	Murata	
3	C2	10nF/1kV	Ceramic Cap, 1kV X7R	1206	Murata	
4	C3	100uF/400V	Electrolytic Cap, 400V,16*35	TH	Aishi	
5	C4	470uF/35V	Electrolytic Cap, 35V,10*16	10*16	NXA	470uF/35V
6	C5	470uF/35V	Electrolytic Cap, 35V,10*16	10*16	NXA	470uF/35V
7	C6	2.2uF	Electrolytic Cap, 50V,10*16	TH	jianghai	
8	C7	470PF/1KV	Ceramic Cap, 1kV X7R	1206	Murata	
9	C8	NC	Ceramic Cap, 1kV X7R	1206	Murata	
10	C9	10uF	Electrolytic Cap, 50V,10*16	TH	jianghai	
11	C10	100n	Ceramic Cap, 25V X7R	0805	TDK	
12	C11	NC	Ceramic Cap, 50V NPO	0805	Murata	
13	C12	100pF	Ceramic Cap, 50V NPO	0805	Murata	
14	C13	NC	Ceramic Cap, 50V X7R,0805	0805	Murata	
15	C14	NC	Ceramic Cap, 50V NPO	0805	Murata	
16	C15	NC	Ceramic Cap, 25V X7R	0805	TDK	
17	CX1	150n	MKP62,275Vac~X2,P=10mm, T=8mm	TH	Fala	
18	CY3	2.2nF	Y1Cap,400VAC, P=10mm,T=5.0mm	TH	STE	
19	D1	150V/20A	Schottky Rectifier (VF=0.686V@IF=10A)	ITO-220AB	PFC Device	20L150CTF
20	D2	1KV/1A	1.0 AMP SILICON RECTIFIERS	SMA	Any	M7
21	D3	A7	Fast Recovery Rectifiers	SOD123	YEA SHIN	A7
22	D4	F7	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
23	D5	F7	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
24	D7	F7	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
25	F1	250V/2A	Fuse 250V/1A	TH	Any	
26	L1	47uH	WE-744841247	XS	Wurth Elektronik	744841247
27	L2	20mH	NiZn T16*12*8,Magnet Wire:0.5mm	TH	Any	T16*8*7
28	L3	200uH	COMMON CHOKE	TH	Any	T10*6*5
29	Q1	SVD10N65F	N Mosfet, 650V/10A, Rdson=0.84ohm	TO-220	Silan	SVD10N65F
30	R1	330K	Film Resistor, 5%	0805	Yageo	
31	R2	0R	Film Resistor, 1%	1206	Yageo	
32	R3	3.9M	Film Resistor, 5%	1206	Yageo	
33	R4	2.7M	Film Resistor, 5%	1206	Yageo	

34	R5	1M	Film Resistor, 5%	1206	Yageo	
35	R6	1M	Film Resistor, 5%	1206	Yageo	
36	R7	1R	Film Resistor, 5%	1206	Yageo	
37	R8	3.9M	Film Resistor, 5%	1206	Yageo	
38	R9	4.3M	Film Resistor, 5%	1206	Yageo	
39	R10	1R	Film Resistor, 5%	0805	Yageo	
40	R11	51R	Film Resistor, 5%	0805	Yageo	
41	R12	3.9K	Film Resistor, 5%	0805	Yageo	
42	R13	75R	Film Resistor, 5%	0805	Yageo	
43	R14	3R3	Film Resistor, 1%	1206	Yageo	
44	R15	3R3	Film Resistor, 1%	1206	Yageo	
45	R16	1R5	Film Resistor, 1%	1206	Yageo	
46	R17	10K	Film Resistor, 5%	0805	Yageo	
47	R18	1K	Film Resistor, 5%	0805	Yageo	
48	R19	2K	Film Resistor, 5%	0805	Yageo	
49	R20	200K	Film Resistor, 5%	0805	Yageo	
50	R22	1R5	Film Resistor, 1%	1206	Yageo	
51	R24	10R	Film Resistor, 1%	1206	Yageo	
52	R25	NC	Film Resistor, 5%	0805	Yageo	
53	R26	NC	Film Resistor, 1%	1206	Yageo	
54	R29	360K	Film Resistor, 5%	0805	Yageo	
55	R32	20K	Film Resistor, 5%	0805	Yageo	
56	T1	Lm=0.58mH	Bobbin, PQ26/20, Vertical, 12 pins， PC40，Transformer	PQ2620，Vertical，12 Pins	TDG	
57	U1	None	4 Pin DIP Photo-Transistor Photocoupler	DIP4	Everlight	EL817
58	U2	KP201F	Secondary Side Regulation CC/CV Controller	SOT-23-6	Kiwi Instruments	KP201F
59	U3	TL431	Plastic-Encapsulate Adjustable Reference Source	SOT-23	Hottech	TL431
60	VR1	10D471	ZnO VARISTOR, P=5.0mm,T=3.5mm	10D	STE	STE10D471K 1BN0FSB0

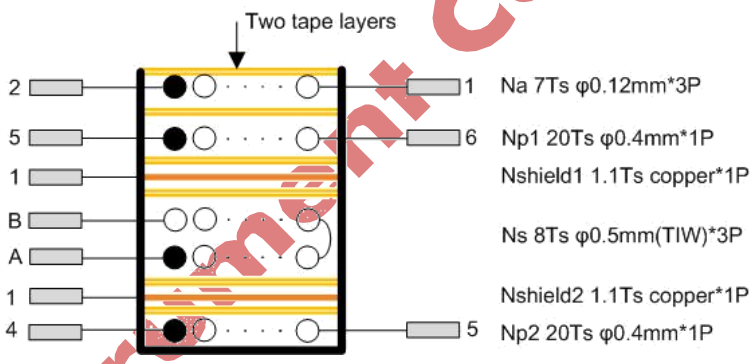
Transformer Manufacture Guide

1. Electrical Diagram





2. Winding Diagram



3. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	NP2	Primary	4	5	0.4*1P	20Ts	Close Wound
2	Nshield2	Shielding	1	NC	Copper 1oz*9mm *1P	1.1Ts	Close Wound
3	NS	Secondary	A	B	0.55TIW*3P	8Ts	Close Wound
4	Nshield1	Shielding	1	NC	Copper*1P	1.1Ts	Close Wound
5	NP1	Primary	5	6	0.4*1P	20Ts	Close Wound
6	Na	Auxiliary	2	1	0.12d*3P	7Ts	Spread Wound

4. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz,1.0 VRMS	Pins 4 – 6; other windings open	0.58mH±5%
Leakage Inductance	Measured at 40kHz,1.0 VRMS	Pins 4 – 6; all other windings shorted	6.5uH
HI-POT HV Test	3000Vac/50Hz, One minute	Primary to Secondary	3000Vac,5mA
	1500Vac/50Hz, One minute	Primary to Core	1500Vac,5mA
	1500Vac/50Hz, One minute	Secondary to Core	1500Vac,5mA
Insulation Resistance	500Vdc	All windings to core	100MΩ Min
	500Vdc	Between windings	100MΩ Min
DC Resistance	-	Pins 4 – 6	2R Max

5. BOM

Items	Spec
Core	PQ2620, PC40 or equivalent
Bobbin	PQ2620, 6+6Pin
Wire	Φ0.4mm, 2UEW, Class B; Φ0.12mm, 2UEW, Class B; Φ0.5mm TIW;
Tape	9.5mm(W)×0.06mm(TH)
copper	1oz*9mm

Test Result

1. Input characteristics

1.1 Maximum rated input AC current

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

Result: Pass

VIN(AC)	Iout	Iin_max limit(A)	**Result**
90Vac	1.005A	2A	**PASS**

1.2 Inrush current (cold start)

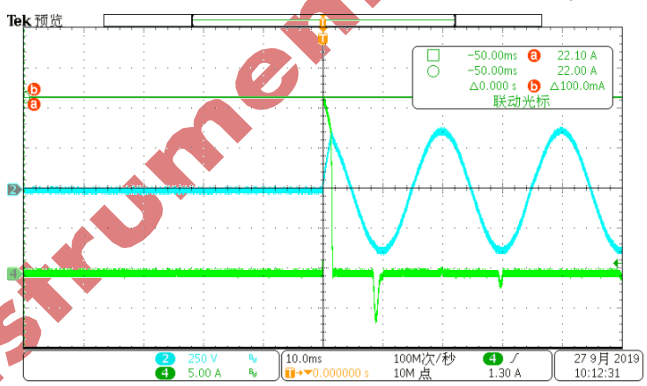
Standard: 30Amax. @ 265Vac input

Result: Pass

VIN(AC)	Iinrush	Iin_max limit(A)	**Result**
265Vac	22.1A	30A	**PASS**

Waveforms:

Test Condition: 24V/2A @ 265Vac, Phase=90° startup



(CH1- Vinac, CH4-Iin)

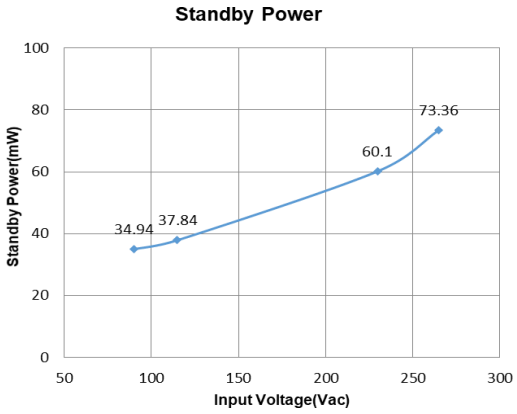
Comments: Startup Normally

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

VIN(AC)	90	115	230	265	green mode limit(A)	**Result**
Pin	34.94	37.84	60.1	73.36	75mW	**PASS**

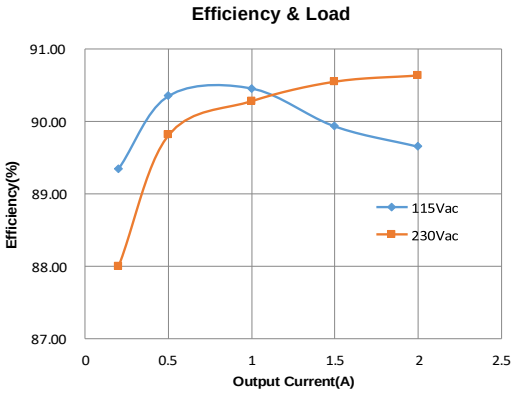


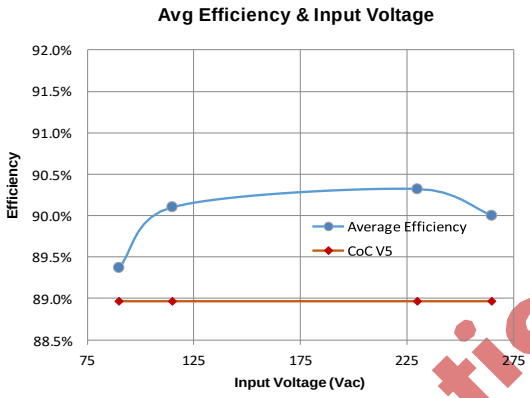
1.4 Average efficiency

Standard: The average efficiency tested on board end meets CoC V5 tier 2 with 2% margin @115Vac and 230Vac, CoC V5 requirement for 24V2A system is 88.97%.

Result: Pass

Vin(Vac)	Fline(Hz)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Eff(%)	Eff_AVG(%)	CoC V5(%)
90	60	5.39	24.08	0.2	4.816	89.35	/	78.97
		13.37	24.08	0.5	12.04	90.05	89.37	88.97
		26.89	24.07	1	24.07	89.51		
		40.51	24.06	1.5	36.09	89.09		
		54.14	24.05	2	48.1	88.84		
115		5.39	24.08	0.2	4.816	89.35	/	78.97
		13.32	24.07	0.5	12.035	90.35	90.10	88.97
		26.61	24.07	1	24.07	90.45		
		40.13	24.06	1.5	36.09	89.93		
		53.65	24.05	2	48.1	89.66		
230	50	5.47	24.07	0.2	4.814	88.01	/	78.97
		13.40	24.07	0.5	12.035	89.81	90.32	88.97
		26.65	24.06	1	24.06	90.28		
		39.84	24.05	1.5	36.075	90.55		
		53.07	24.05	2	48.1	90.64		
265		5.49	24.07	0.2	4.814	87.69	/	78.97
		13.47	24.06	0.5	12.03	89.31	90.00	88.97
		26.75	24.06	1	24.06	89.94		
		39.92	24.05	1.5	36.075	90.37		
		53.21	24.04	2	48.08	90.36		





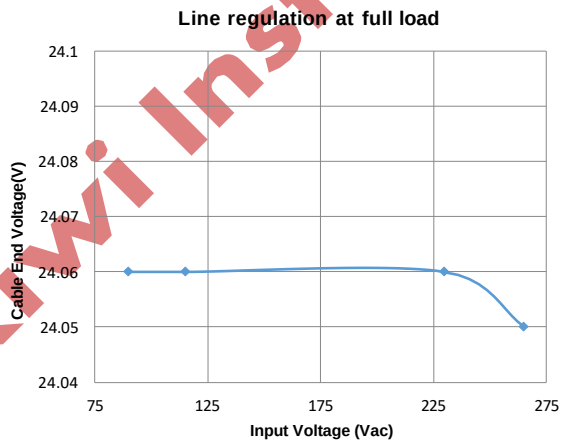
2. Output characteristics

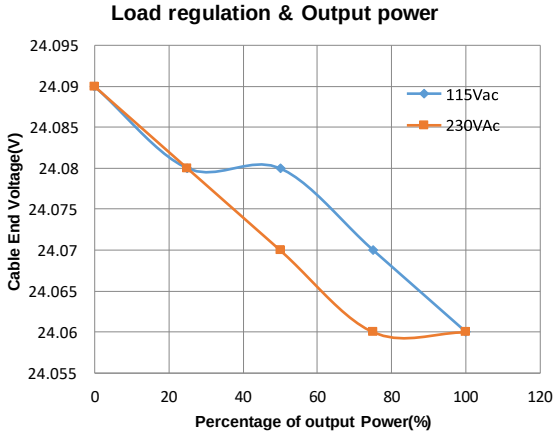
2.1 Output line regulation and load regulation

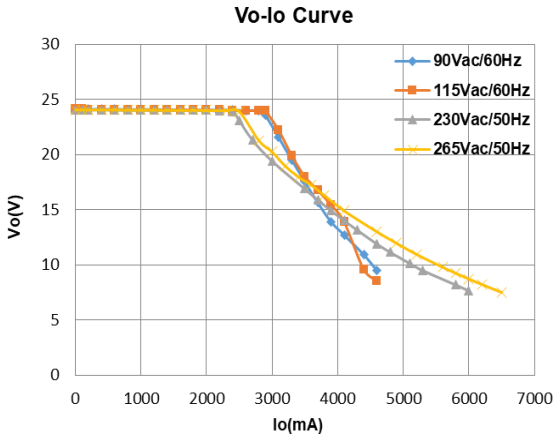
Standard: under the input voltage 90Vac~265Vac, Line regulation <6%, Load regulation <6%. The output voltage was tested at 1.5m AWG20 cable end.

Result: Pass

Input Voltage	Output Voltage					Load Regulation
	0% Load	25% Load	50% Load	75% Load	Full Load	
90Vac/60Hz	24.09	24.09	24.08	24.07	24.06	0.12%
115Vac/60Hz	24.09	24.08	24.08	24.07	24.06	0.12%
230Vac/50Hz	24.09	24.08	24.07	24.06	24.06	0.12%
264Vac/50Hz	24.08	24.07	24.07	24.06	24.05	0.12%
Line Regulation	0.04%	0.08%	0.04%	0.04%	0.04%	







2.2 Ripple & noise

Standard: under the input voltage 90Vac~265Vac, Vripple_max<150mVpp

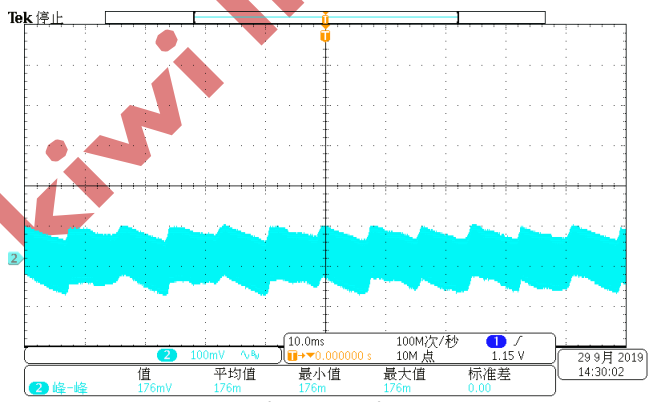
Result: Pass

Note: Ripple & noise were measured at AWG 20 cable end with a 0.1uF/50V ceramic cap connected in parallel with a 10uF/50V electrolytic cap. Bandwidh was limited to 20Mhz.

Input Voltage	Ripple & noise	
	No Load(mV)	Full Load(mV)
90Vac/60Hz	176	196
115Vac/60Hz	176	176
230Vac/50Hz	204	168
264Vac/50Hz	204	168

Waveforms (115Vac & 230Vac):

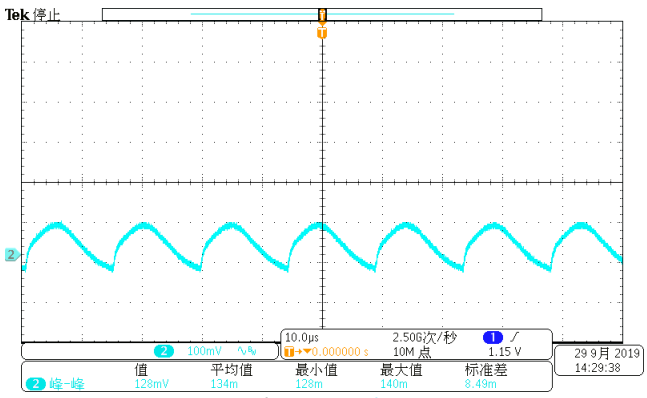
Test Condition: 115Vac/50Hz Input, 24V2A Output



(CH2-Vo_ac)

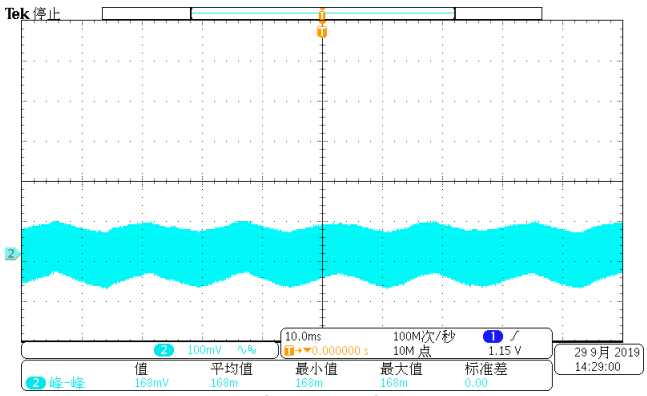
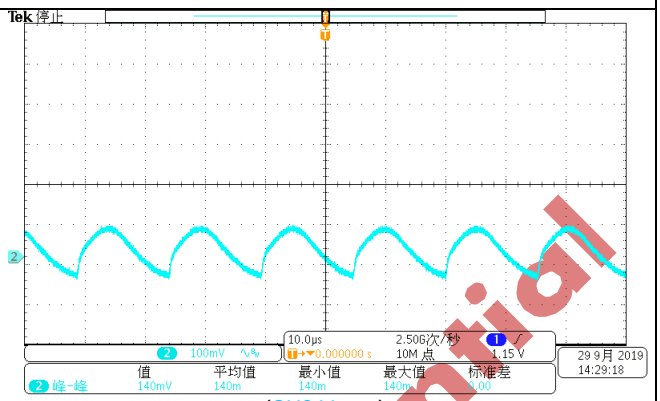
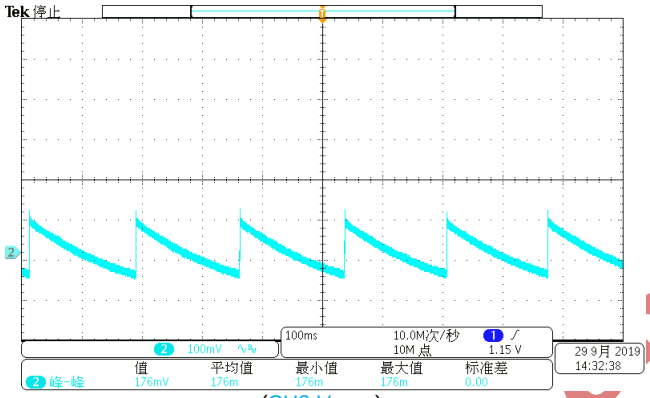
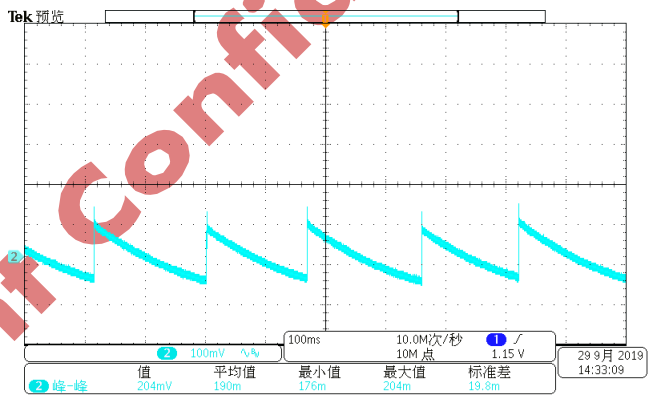
Comments: Vo_ripple_pp=176mV

Test Condition: 115Vac/50Hz Input, 24V2A Output



(CH2-Vo_ac)

Comments: Vo_ripple_pp=140mV

Test Condition: 230Vac/50Hz Input, 24V2A Output	**Test Condition:** 230Vac/50Hz Input, 24V2A Output
 (CH2-Vo_ac) **Comments:** Vo_ripple_pp=168mV	 (CH2-Vo_ac) **Comments:** Vo_ripple_pp=140mV
Test Condition: 115Vac/50Hz Input, 24V0A Output	**Test Condition:** 230Vac/50Hz Input, 24V0A Output
 (CH2-Vo_ac) **Comments:** Vo_ripple_pp=176mV	 (CH2-Vo_ac) **Comments:** Vo_ripple_pp=204mV

2.3 Load Transient Test

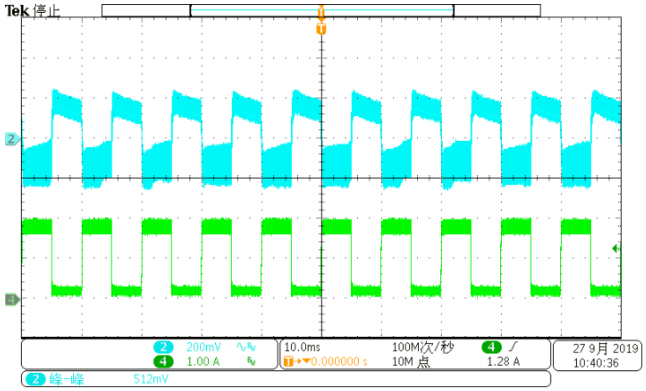
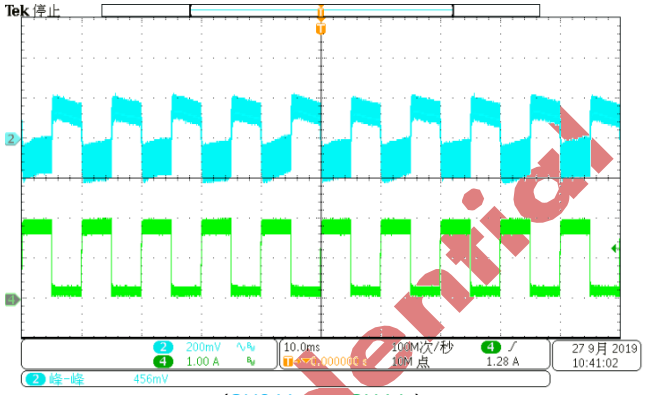
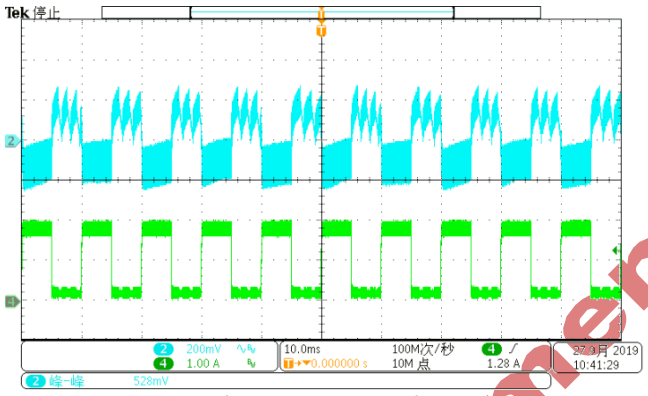
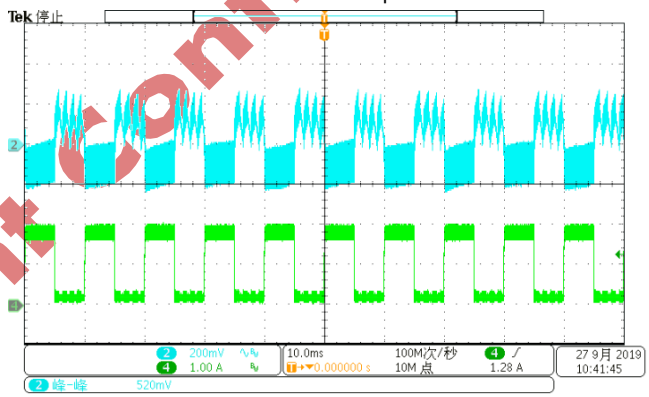
Standard: under the input voltage 90Vac~265Vac, the output Voltage transient response should be within ±10% normal voltage.

Result: Pass

Note: 1.10% load shift to 90% load with 0.25A/us changing ramp and 100Hz changing frequency.

Input Voltage	Output Voltage(~ac)	Remark
90Vac/60Hz	512mV	Pass
115Vac/60Hz	456mV	Pass
230Vac/50Hz	528mV	Pass
264Vac/50Hz	520mV	Pass

Waveforms:

Test condition: Load 0.2-1.8A, frequency 100Hz, duty Cycle=50%, slew rate=0.25A/us	
90Vac/60Hz Input  (CH2-Vo_ac, CH4-Io) **Comments:** Vo_ripple_pp=512mV	115Vac/60Hz Input  (CH2-Vo_ac, CH4-Io) **Comments:** Vo_ripple_pp=456mV
230Vac/50Hz Input  (CH2-Vo_ac, CH4-Io) **Comments:** Vo_ripple_pp=528mV	265Vac/50Hz Input  (CH2-Vo_ac, CH4-Io) **Comments:** Vo_ripple_pp=520mV

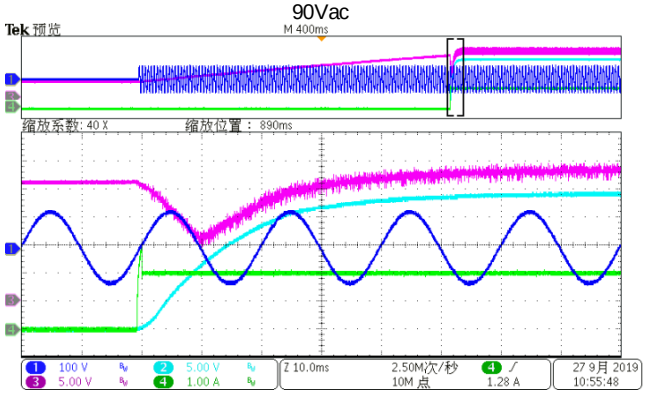
2.4 Capacitive Load Startup Test

Standard: while capacitance load is 3 times to output capacitance;, the power supply can turn on normally and the output is in the rated range.

Result: Pass

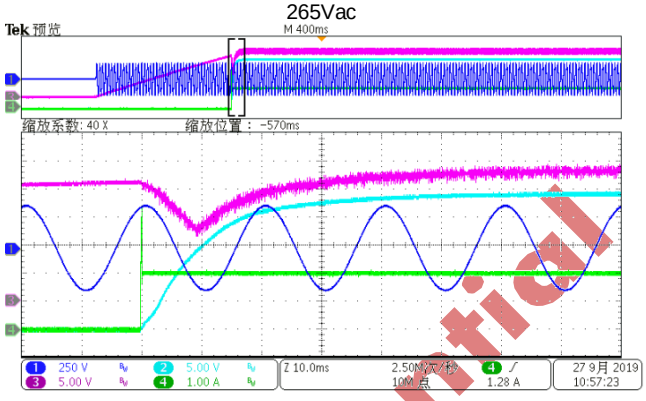
Waveforms:

Test Condition: Load=3 times to output capacitance, 24V/2A @ 90Vac



(CH1- Vinac, CH2-Vo, CH3-VDD, CH4-Io)
Comments: Startup Normally

Test Condition: Load=3 times to output capacitance, 24V/2A @ 265Vac



(CH1- Vinac, CH2-Vo, CH3-VDD, CH4-Io)
Comments: Startup Normally

2.5 Startup Time and Holdup Time

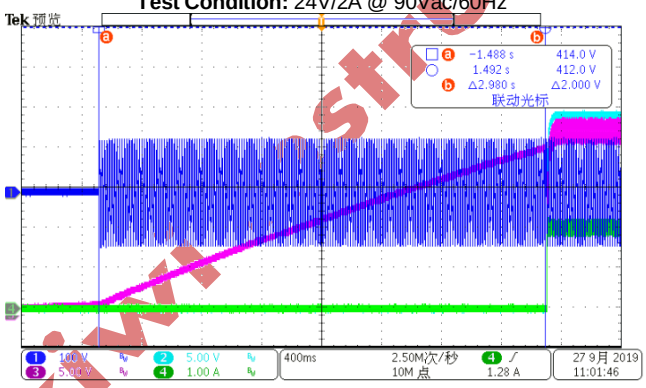
Standard: 1.the startup time should be less than 3s @90Vac. 2. The holdup time should be larger than 10ms @115Vac;

Result: Pass

Item	Input Voltage	Test Data	Remark	Note
Startup Time	90Vac	2.98s	Pass	Full Load
Holdup Time	115Vac	15.96ms	Pass	Cut off the Vac while Vbus voltage reached the lowest voltage

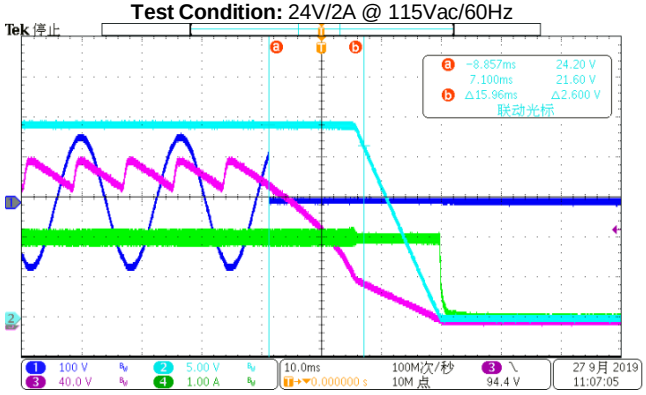
Waveforms:

Test Condition: 24V/2A @ 90Vac/60Hz



(CH1- Vinac, CH2-Vo, CH3-VDD, CH4-Io)
Comments: Startup time=2.98s

Test Condition: 24V/2A @ 115Vac/60Hz



(CH1- Vinac, CH2-Vo, CH3-VBUS, CH4-Io)
Comments: Holdup time=15.96ms

2.6 Output Voltage Rise Time and Fall Time

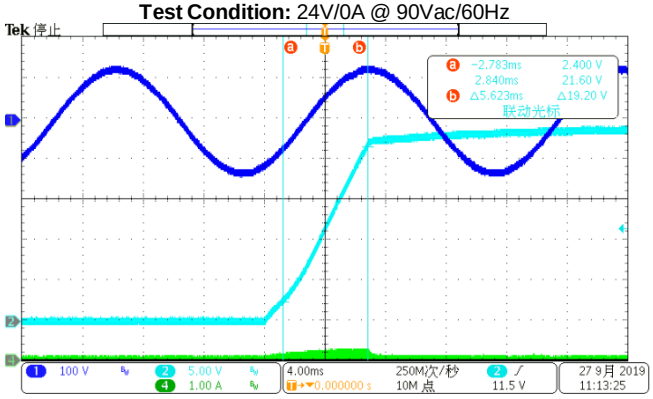
Standard: Under full load test, the output voltage rise time should be less than 50ms and the fall time should be less than 20ms.

Result: Pass

Input Voltage	Load	Item	Test Result	Note
90Vac/60Hz	Full Load	Trise	9.183ms	No overshoot
		Tfall	11.34ms	No undershoot
	No Load	Trise	5.623ms	No overshoot
264Vac/50Hz	Full Load	Trise	7.463ms	No overshoot
		Tfall	11.62ms	No undershoot
	No Load	Trise	5.583ms	No overshoot

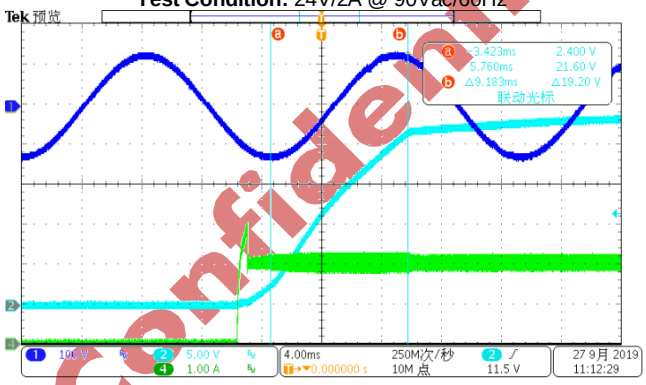
Waveforms:

Test Condition: 24V/0A @ 90Vac/60Hz



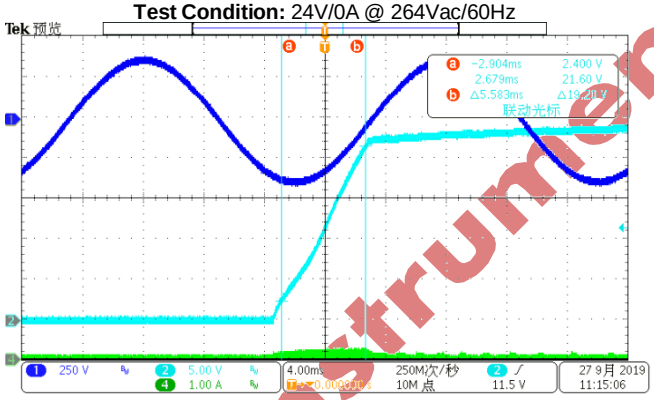
(CH1- Vinac, CH2-Vo,CH4-Io)
Comments: Trise=5.623ms

Test Condition: 24V/2A @ 90Vac/60Hz



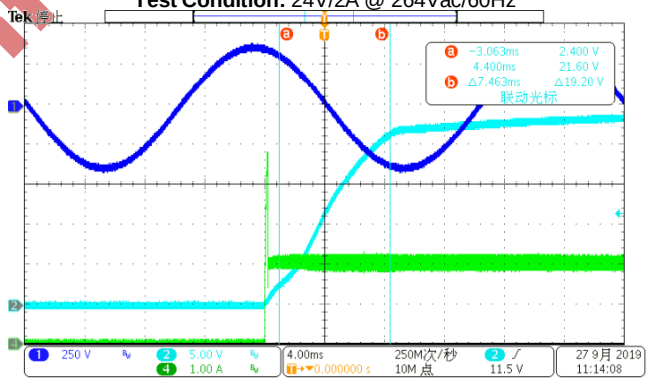
(CH1- Vinac, CH2-Vo,CH4-Io)
Comments: Trise=9.183ms

Test Condition: 24V/0A @ 264Vac/60Hz



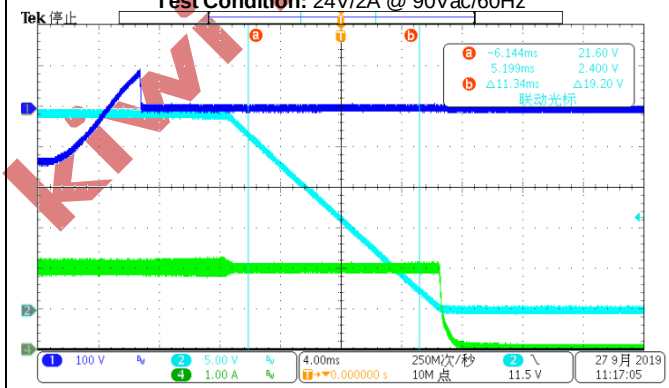
(CH1- Vinac, CH2-Vo,CH4-Io)
Comments: Trise=5.583ms

Test Condition: 24V/2A @ 264Vac/60Hz



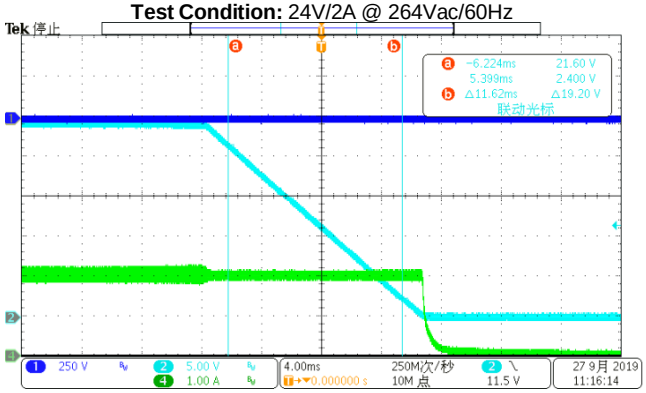
(CH1- Vinac, CH2-Vo,CH4-Io)
Comments: Trise=7.463ms

Test Condition: 24V/2A @ 90Vac/60Hz



(CH1- Vinac, CH2-Vo,CH4-Io)
Comments: Tfall=11.34ms

Test Condition: 24V/2A @ 264Vac/60Hz



(CH1- Vinac, CH2-Vo,CH4-Io)
Comments: Tfall=11.62ms

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.

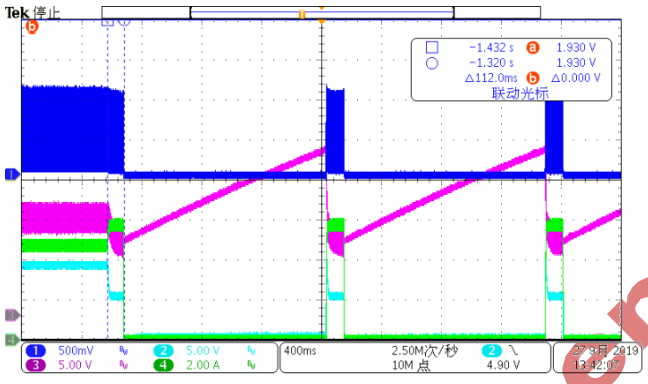
Result: Pass

Test Data:

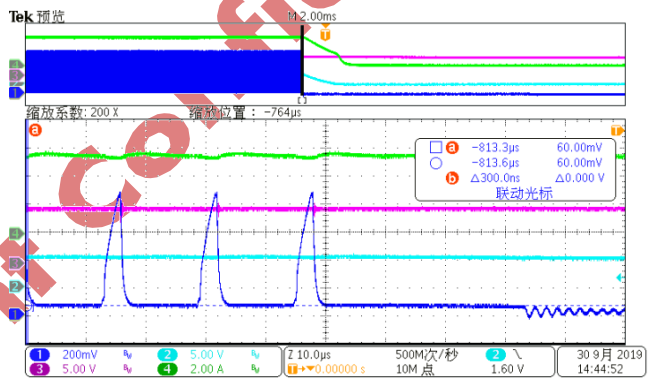
Input Voltage(Vac)	90	115	230	265	**result**
Pin(W)	2.02	5.88	13.48	15.65	**PASS**

Waveforms:

Test Condition: 115Vac/60Hz Input, Output short

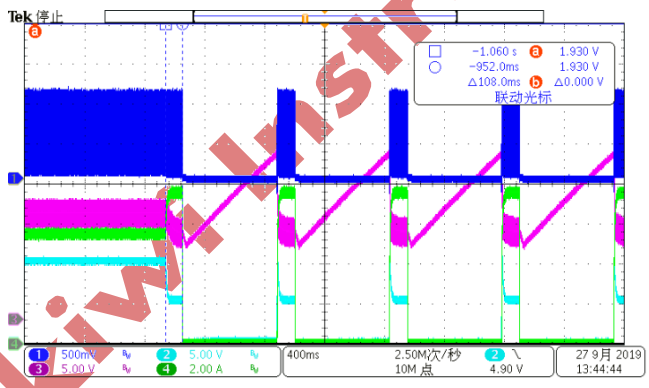


Short Load Protection Enter
(CH1-CS CH2-Vo, CH3-VDD, CH4-Io)
Comments: OK

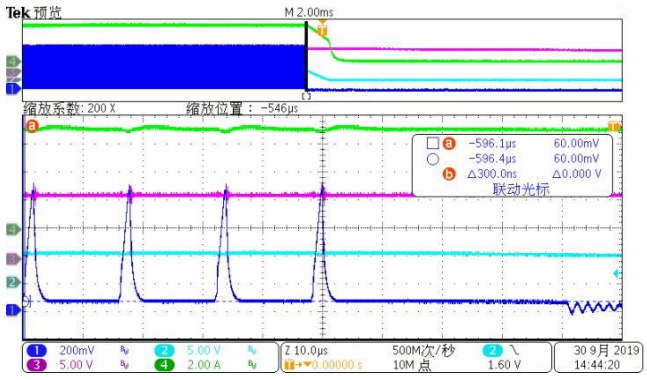


CSUVP (Short Load Protection) Enter
(CH1-CS CH2-Vo, CH3-VDD, CH4-Io)
Comments: OK

Test Condition: 230Vac/50Hz Input, Output short



Short Load Protection
(CH1-CS CH2-Vo, CH3-VDD, CH4-Io)
Comments: OK



CSUVP (Short Load Protection) Enter
(CH1-CS CH2-Vo, CH3-VDD, CH4-Io)
Comments: OK

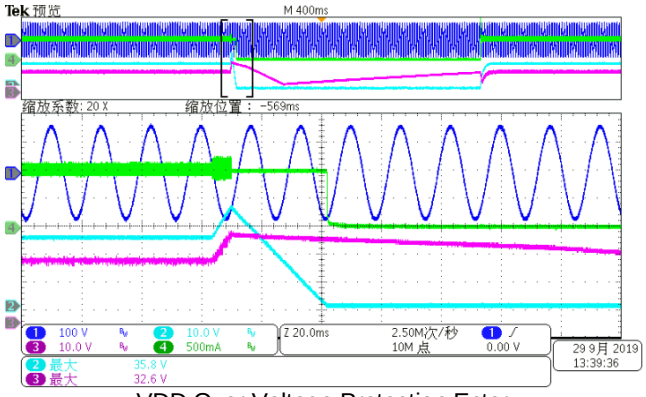
3.2 Over voltage protection

Standard: OVP point limit: <150%.

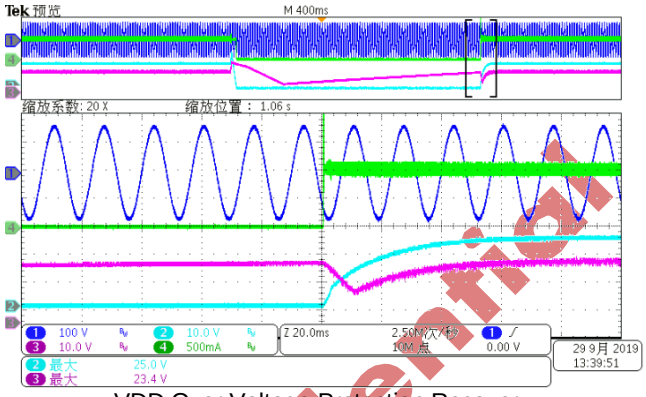
Result: Pass

Waveforms:

Test Condition: 115Vac60Hz Input, 24V1A Output

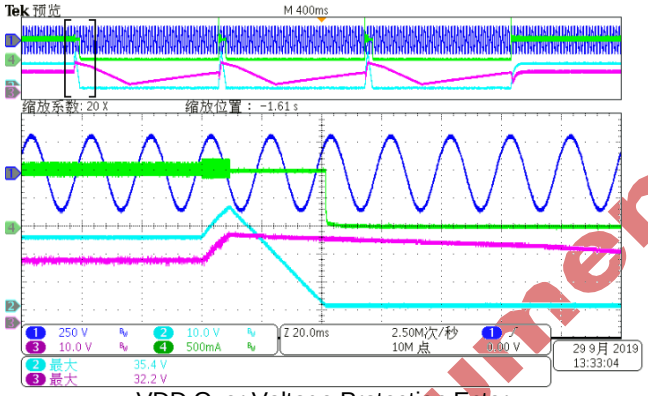


VDD Over Voltage Protection Enter
(CH1-Vinac, CH2-Vo, CH3-VDD, CH4-Io)
Comments: OK

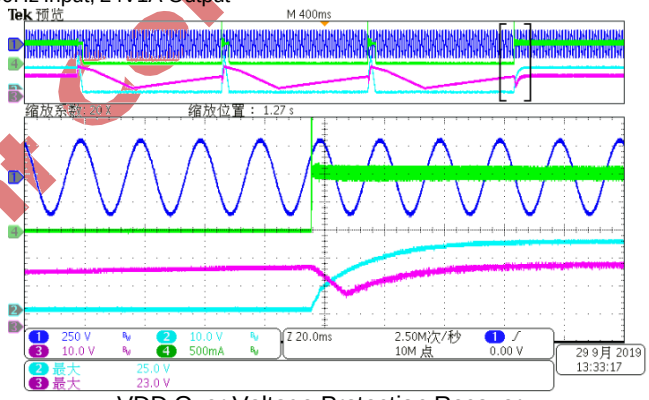


VDD Over Voltage Protection Recovery
(CH1-Vinac, CH2-Vo, CH3-VDD, CH4-Io)
Comments: OK

Test Condition: 230Vac/50Hz Input, 24V1A Output



VDD Over Voltage Protection Enter
(CH1-Vinac, CH2-Vo, CH3-VDD, CH4-Io)
Comments: OK



VDD Over Voltage Protection Recovery
(CH1-Vinac, CH2-Vo, CH3-VDD, CH4-Io
Comments: OK

4. Reliability requirements

4.1 Device Maximum Rating Test

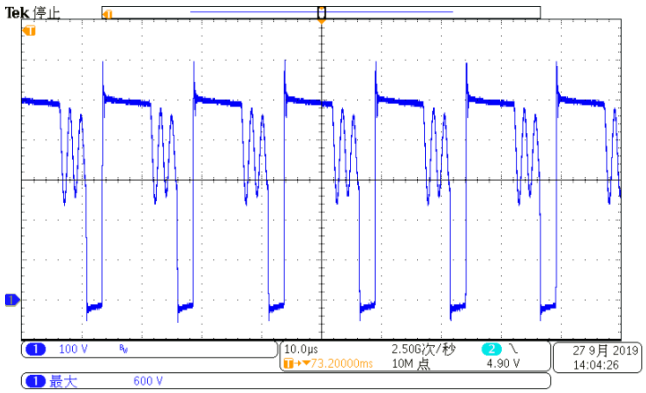
Standard: MOSFET and Diode<95% Vrrm; Bmax<0.3T.

Result: Pass

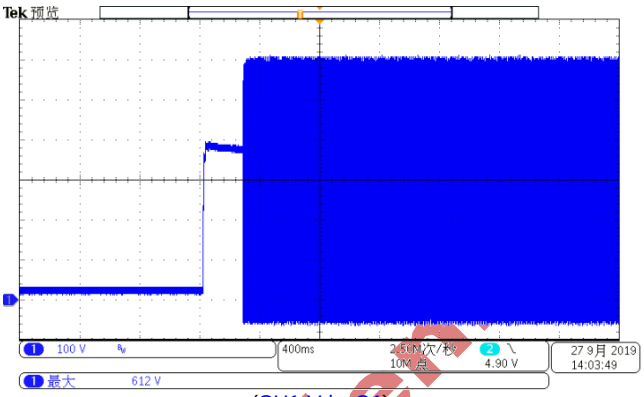
Input Voltage	Component	Test Condition	Test Result	Note
264Vac/50Hz	Q1 SVF10N65F	Startup	612V	Pass
		Steady State	600V	Pass
		Output Short	612V	Pass
	D1 20L150CTF	Startup	118V	Pass
		Steady State	115V	Pass
		Output Short	117V	Pass
			13.44A	Pass
	Transformer Core	Startup	0.259T	Pass
		Steady State	0.264T	Pass

Waveforms:

Test Condition: 265Vac/50Hz Input, 24V2A Output,

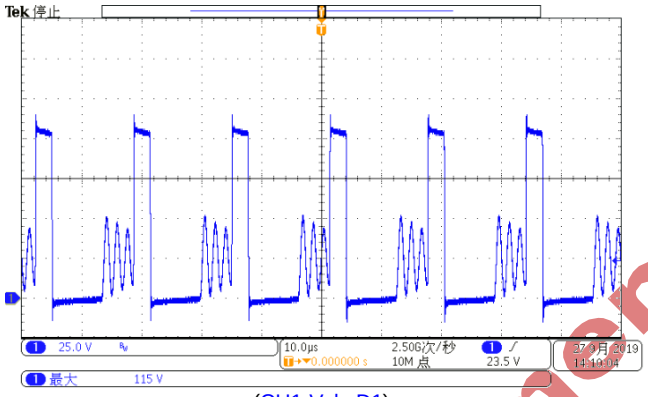


(CH1-Vds_Q1)
Comments: Vds_Q1=600V

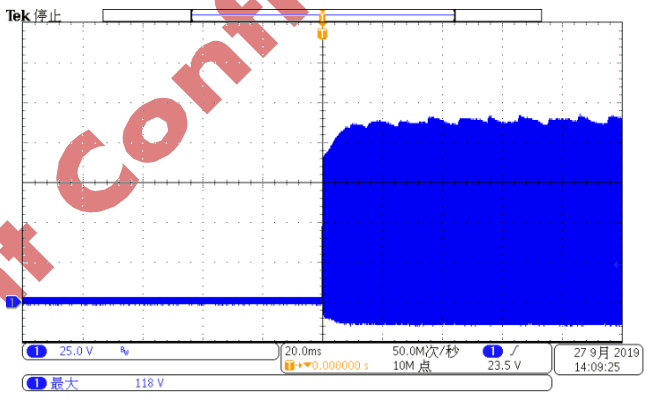


(CH1-Vds_Q1)
Comments: Vds_Q1=612V

Test Condition: 265Vac/50Hz Input, 24V2A Output

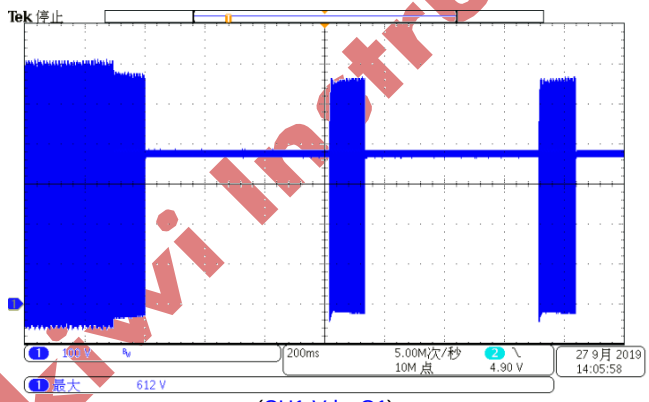


(CH1-Vak_D1)
Comments: Vak_D1=115V

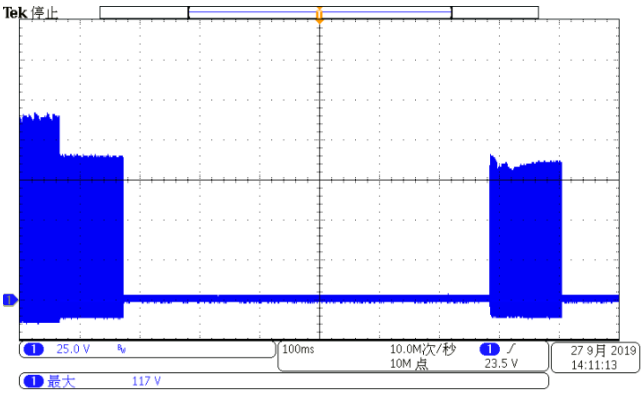


(CH1-Vak_D1)
Comments: Vak_D1=118V

Test Condition: 265Vac/50Hz Input, 24V2A Output short

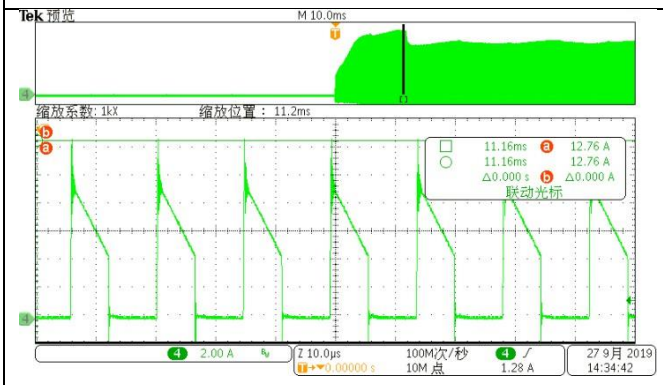


(CH1-Vds_Q1)
Comments: Vds_Q1=612V



(CH1-Vak_D1)
Comments: Vak_D1=117V

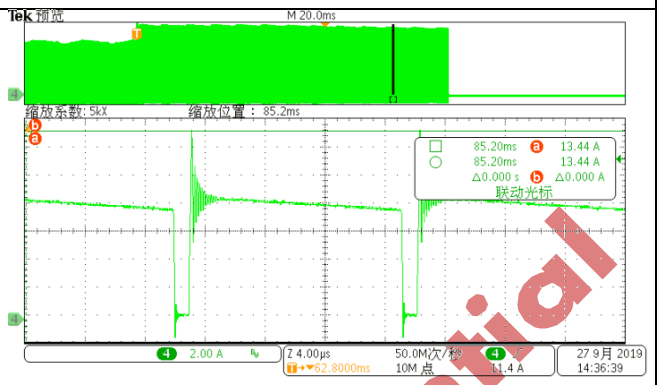
Test Condition: 90Vac/60Hz Input, 24V2A Startup



(CH4-I_D1)

Comments: I_D1_max=12.76A

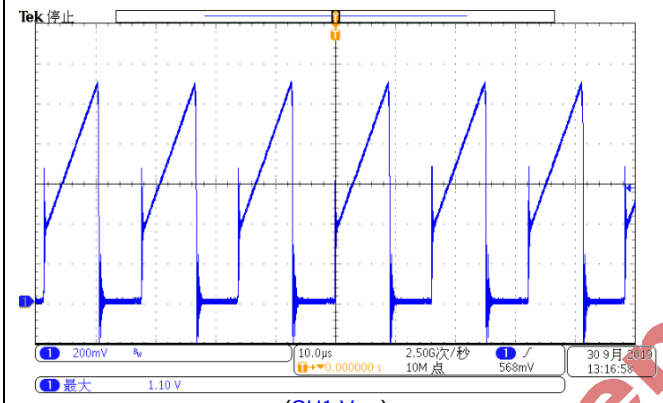
Test Condition: 90Vac/60Hz Input, 24V2A Output Short



(CH2=Vo, CH4-I_D1)

Comments: I_D1_max=13.44A

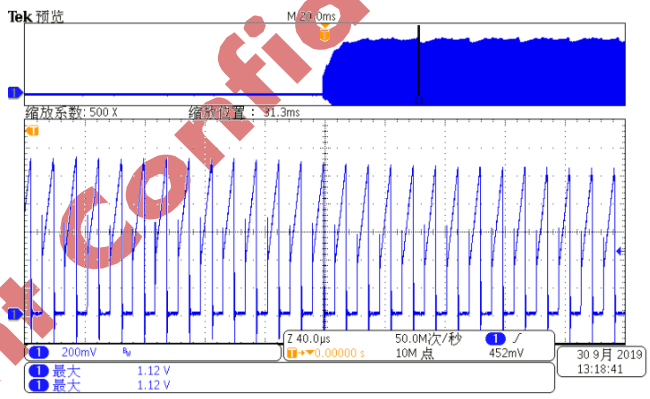
Test Condition: 90Vac/50Hz Input, 24V2.9A Output Steady State



(CH1-Vrcs)

Comments: ILpk=1.1V/0.5156R=2.133A,Bmax=0.259T

Test Condition: 90Vac/50Hz Input, 24V2.9A Output Startup



(CH1-Vrcs)

Comments: ILpk=1.12V/0.5156R =2.172A,Bmax=0.264T

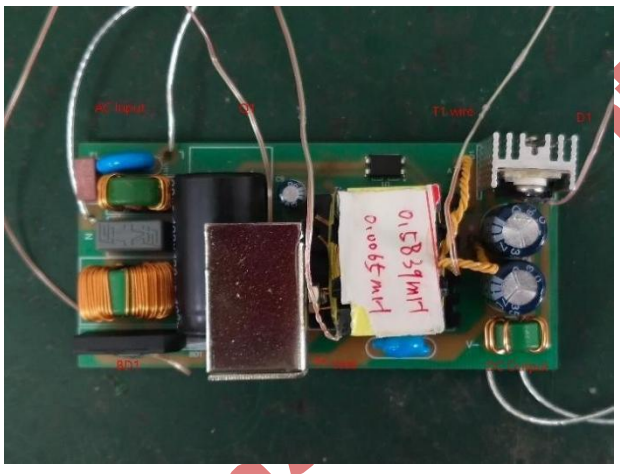
4.2 Thermal Test

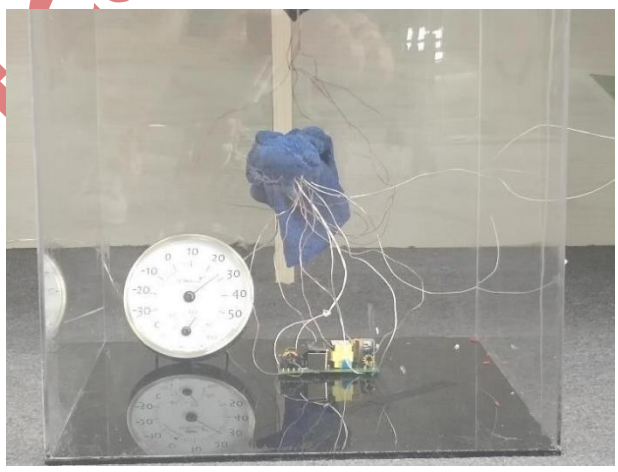
Standard: MOS, IC and Diode: Δ T<75℃. Transformer: Δ T<70℃.

Result: Pass

Test Condition: 90Vac/60Hz, 265Vac/50Hz; 24V2A output; Burn-in 1Hour @ confined container (40cm*40cm*40cm box) and steady environment with no airflow, Ta is the temperature measured by metre.

Component	90Vac		265Vac	
	Ta=28.5℃		Ta=28.5℃	
	T(°C)	Trise(°C)	T(°C)	Trise(°C)
Q1 SVD10N65F	80.1	51.6	70.3	41.8
D1 20L150CTF	72.8	44.3	73.7	45.2
T1 Core	51.8	23.3	55.3	26.8
T1 Wire	63.6	35.1	67.4	38.9
BD1 GBU406	75.4	46.9	47	18.5





5. EMC/EMS Test Result

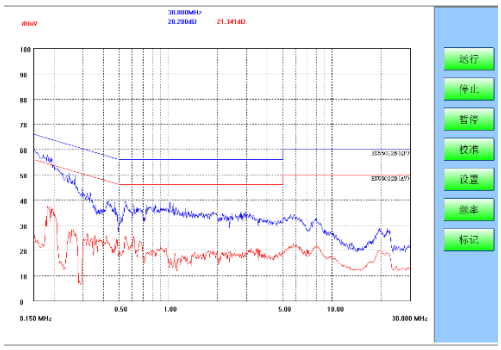
Standard：

standard	EN55022B/55032B
content	CE & RE
requirement	6dB margin

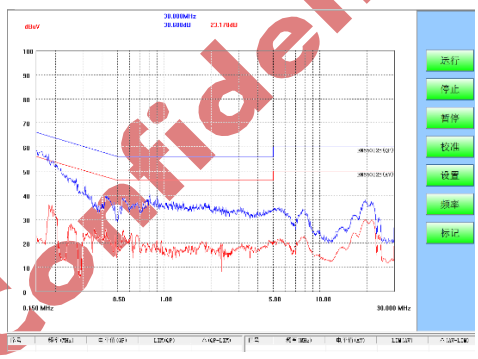
5.1 Conducted Emissions

Result：Pass

Test Condition: Vin=110VAC/50Hz, Vout=24V, Io=2A

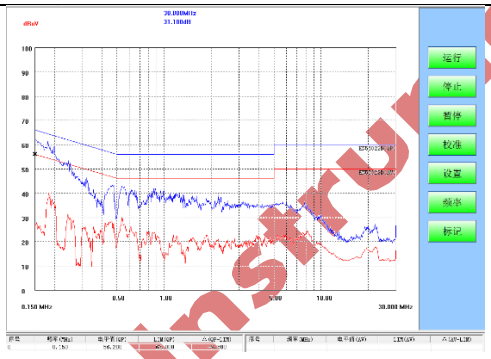


Conduction EMI---LINE

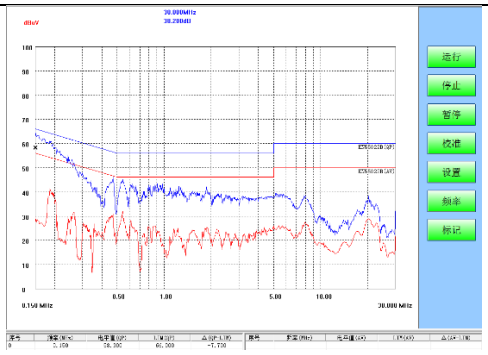


Conduction EMI---NEUTRAL

Test Condition: Vin=220VAC/50Hz, Vout=24V, Io=2A

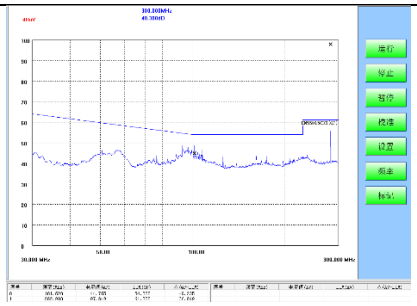
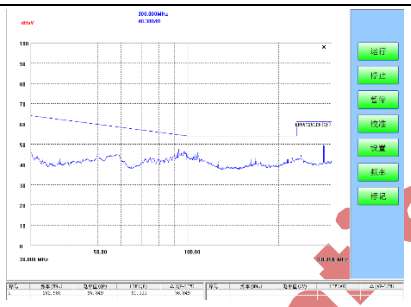


Conduction EMI---LINE



Conduction EMI---NEUTRAL

5.2 Radiated Emissions

Test Condition: Vout=24V, Io=2A	
	
CDN (Vin=110VAC/50Hz)	CDN (Vin=220VAC/50Hz)

5.3 Surge Test

Line to Line 2kV surge testing was completed according to IEC61000-4-5. Input voltage was set at 230VAC/50Hz. Output was loaded at full load and operation was verified following each surge event. Each injection phase below is tested with 5 times and hold for 60 seconds before next one.

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

5.4 ESD Test

Input 220Vac/50Hz，Output 24V-2A. Discharge 10 times on each output terminals at each test voltage according to IEC61000-4-2

Air Discharge		Contact Discharge	
Test Voltage (kV)	Air Discharge	Test Voltage (kV)	Contact Discharge
14	PASS	4	PASS
-14	PASS	-4	PASS
15	PASS	6	PASS
-15	PASS	-6	PASS
16	PASS	8	PASS
-16	PASS	-8	PASS

5.5 EFT Test

Input 220Vac/50Hz，Output 24V-2A. According to IEC61000-4-4, set EFT pulse as 15ms operation time with every 300ms cycle, Trise=50ns, Thold=50ns，Operation frequency Fsw=5kHz.

Input Voltage (VAC)	EFT Peak Voltage (V)	Injection Location	Frequency(kHz)	Test Result (Pass/Fail)
230Vac/50Hz	+1000	L to N	5	
	+1000	L to N	5	
	-1000	N to L	5	
	-1000	N to L	5	

5.6 Voltage Dip Test

Input 220Vac/50Hz，Output 24V-2A. Set voltage dips test according to IEC61000-4-11:2017 as below.

CLASS	Test Level and duration for voltage dips(50 Hz/60 Hz)				
CALSS 3	0% during 1/2 cycle	0% during 1 cycle	40% during 10/12 cycle	70% during 25/30 cycle	80% during 250/300 cycle
25/30 means 25 cycles for 50Hz Test，30 cycles for 60Hz Test.					

Test Result is classified as below:

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

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

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

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

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

Test Setup Guide

1. Connect the “V+” and “V-” terminal to the positive and negative end of the load.
2. Set the AC Power Source between 90VAC and 265VAC.
3. Connect the AC Power Source terminal to the “L” and “N” terminals on the Demo Board
4. Turn on the AC Power Source to make system startup; and Turn off the AC Power Source to make system shutdown.

Revision History

DATE	REV	DESCRIPTION
2019-09-29	1.0	First Release

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