DEMO BOARD TEST REPORT

High Performance 12V/4A Adapter with Current Mode PWM Controller KP201 and Synchronous rectifier KP401

FEATURES

- High Precision 12V CV Regulation with Fast Dynamic Response
- High Efficiency Meet DoE Level VI and CoC V5 Tier2
- Less than 75mW Standby Power
- Very Low Startup and Operation Current
- Multi-Mode Control with Audio Noise Free Operation
- Good EMI Performance
- Built-in Protections with Auto Recovery:
  - VDD Under Voltage Lockout (UVLO)
  - VDD Over Voltage Protection (OVP)
  - On-Chip Thermal Shutdown (OTP)
  - Cycle-by-Cycle Current Limiting
  - Over Load Protection (OLP)
  - Leading Edge Blanking (LEB)

APPLICATIONS

- **Adapter**
- **Small Home Appliance**

INTRODUCTION

KP201 is a high performance current mode PWM controller for offline flyback converter applications. The PWM switching frequency with shuffling is fixed to 65KHz and is trimmed to tight range. The IC has built-in green and burst mode control for light and zero loadings, which can achieve less than 75mw standby power for most applications.

KP401 is a secondary side synchronous rectifier controller that supports CCM, DCM and Quasi-Resonant topologies based on the proprietary of "Self-Suitable Dead Time Control" technology. An integrated Error Amplifier with 1.25V reference voltage can replace XX431 for cost saving.

The Demo Board of KP201-D01 is typically designed for the application of 12V/4A 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 EN55022 conducted and radiated EMI requirement.

DEMO BOARD SEPCIFICATION

Description	Symbol	Min	Type	Max	Unit	Note
Input Voltage	Vin	90		265	Vac	50/60Hz
Output Voltage	Vout		12		Vdc	
Output Current	Iout		4		A	
Total Output Power	Pout		48		W	
Ripple & Noise	Vripple		120		mVp-p	20MHz Bandwidth @115Vac,1.5m Cable End
System Average Efficiency	η		90.91		%	Board End @230Vac
Standby Power Consumption	Pst		69		mW	@265Vac
Startup Time	Tst		2.9		s	Tested at 90Vac/60Hz
Conducted EMI Margin		6			dB	EN55022 Class B
Radiation EMI Margin		6			dB	EN55032 Class B
Surge Test		2			kV	Differential Mode @ 230Vac/50Hz
ESD(Contact)					kV	
EFT					kV	
Safety		Designed to meet UL60950				
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.

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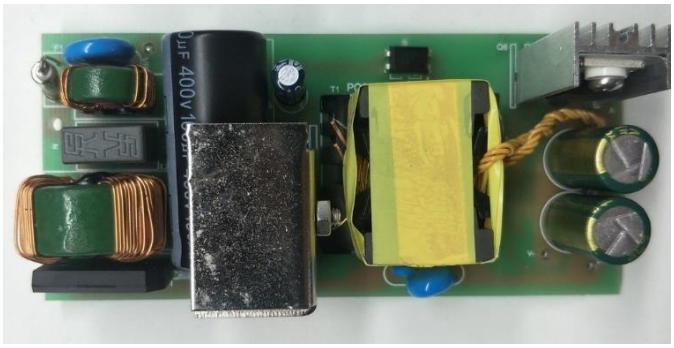
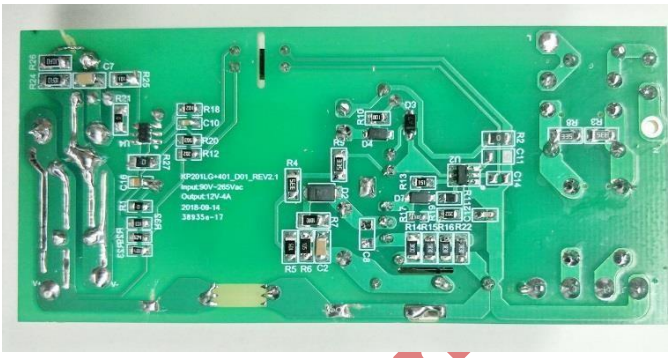
www.cokinsemi.com

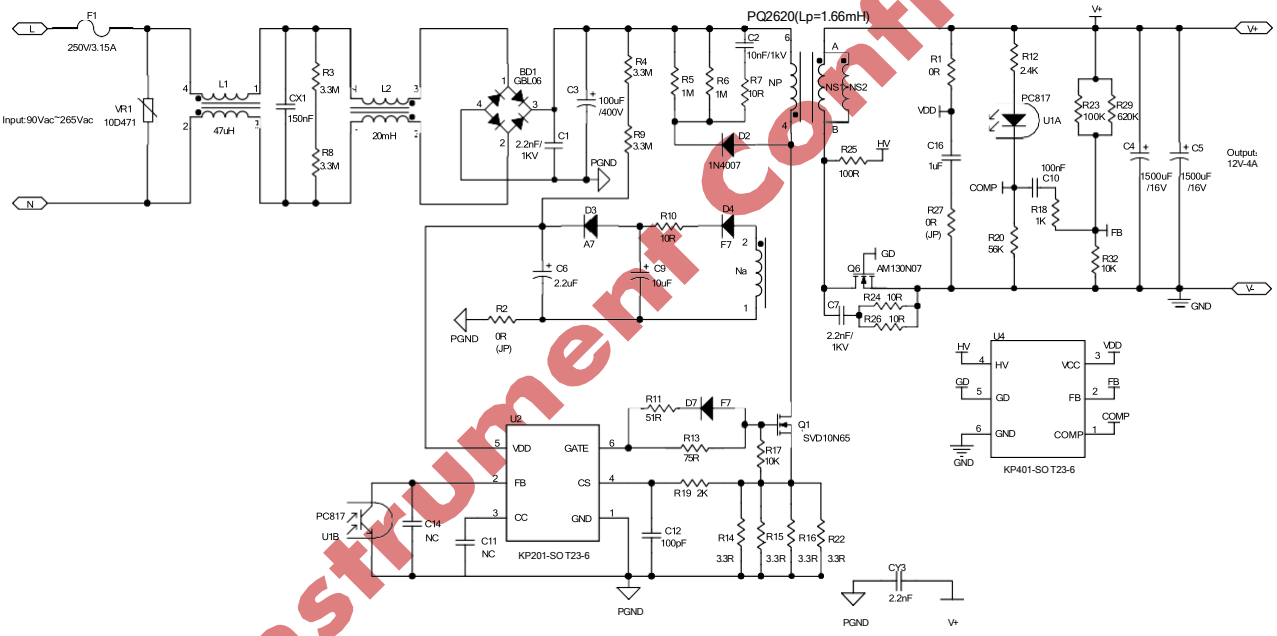
Demo Board of KP201LG+KP401LG_D01_REV2.1





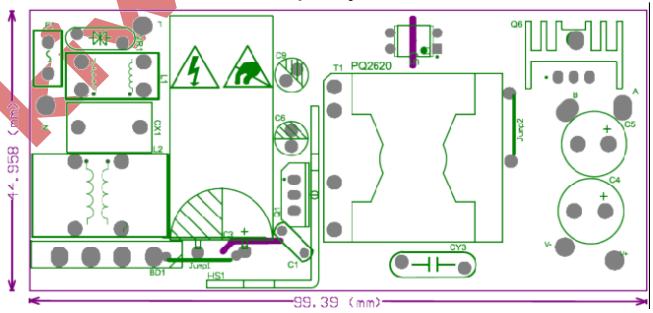
Board Size(in mm): L x W x H=99 x 45 x26

Schematic

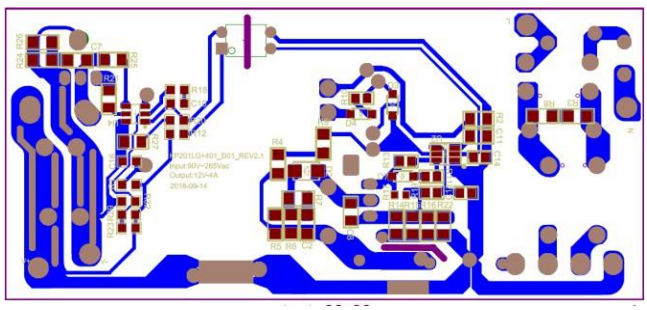


Printed Circuit Board Layout

Top Layer



Bottom Layer



Circuit Description

The Demo Board of KP201-D01 is configured in a single stage flyback topology, which combines a current mode PWM control regulator KP201LG with a synchronous rectifier KP401. KP201-D01 is typically designed for the application of 12V/4A 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. And the Primary Side CC (constant current) control is also available.

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 KP201 Operation

U2 is the current mode PWM controller KP201, 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 KP201-D01 demo board. And to make the IC work in CC/CV mode，a capacitor (typically value is 10-47nF) between SEL and GND is needed.

D4, R10, C9, D3, C6, R4 and R9 are used as VDD power supply for KP201. KP201 uses opto-coupler U1, R12, C10, R18 and inner error amplifier on KP401 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.

3. Output Voltage Regulation

U4 is the secondary side synchronous rectifier controller KP401, which supports steady CCM mode operation with KP201 and is designed with 431 internally for CV Output Control. R1, R25, C16, Q6 and U4 form the secondary side synchronous rectifier circuit, which is used to replace Schottky diodes by combined with an ultra-low on-state resistance power MOSFET for high-efficiency flyback converters. R1 and C16 are used as KP401's VDD power supply.

C4, C5 are the output capacitor used to supply output current and lower output voltage.

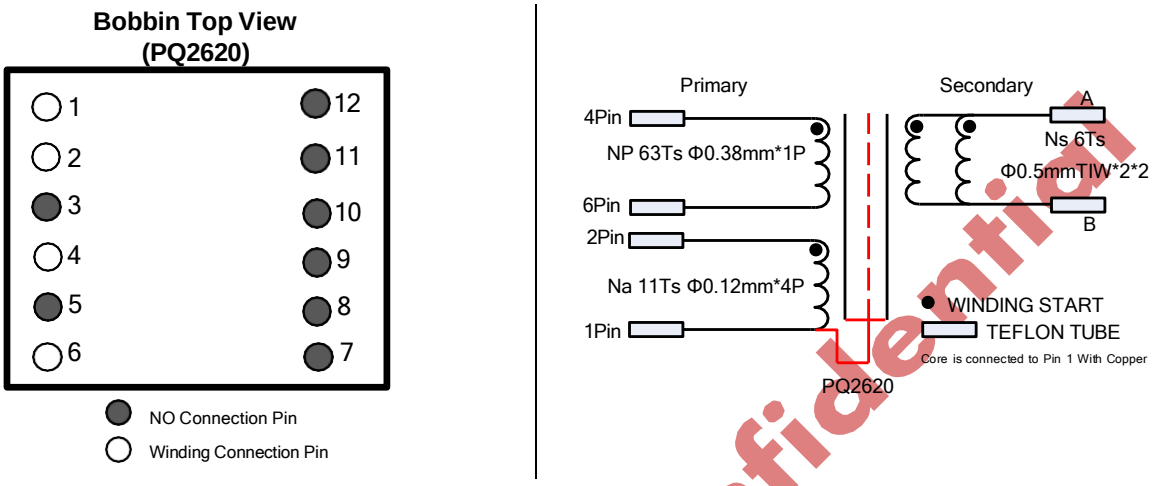
Bill of Material

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	1500uF/16V	Electrolytic Cap, 16V,10*16	TH	jianghai	
6	C5	1500uF/16V	Electrolytic Cap, 16V,10*16	TH	jianghai	
7	C6	2.2uF	Electrolytic Cap, 16V,10*16	TH	jianghai	
8	C7	2.2nF/1KV	Ceramic Cap, 1kV X7R	1206	Murata	
9	C8	NC	Ceramic Cap, 1kV X7R	1206	Murata	
10	C9	10uF	Electrolytic Cap, 16V,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	C14	NC	Ceramic Cap, 50V NPO	0805	Murata	
15	C16	1uF	Ceramic Cap, 25V X7R	0805	TDK	
16	CX1	150n	MKP62,275Vac~X2, P=10mm,T=8mm	TH	Fala	
17	CY3	2.2nF	CD/Y1 Y5U Cap,400VAC,P=10mm,T=5.0mm	TH	STE	
18	D2	M7	1.0 AMP SILICON RECTIFIERS	SMA	Any	M7
19	D3	A7	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
20	D4	F7	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
21	D7	F7	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
22	F1	250V/3.15A	Fuse 250V/3.15A	TH	Any	
23	L1	47uH	WE-744841247	XS	Wurth Elektronik	744841247
24	L2	20mH	NiZn, T20*10*10, Magnet Wire: 0.6mm	TH	Any	T20*10*10
25	Q1	SVD10N65F	N Mosfet, 650V/10A, Rdson=0.84ohm	TO-220	Silan	SVD10N65F
26	Q6	AM130N07	N Mosfet, 75V/130A, Rdson=6.3mohm	TO-220	Analog Power	AM130N07-06m3P
27	R1	0R	Film Resistor, 1%	1206	Yageo	
28	R2	0R	Film Resistor, 1%	1206	Yageo	
29	R3	3.3M	Film Resistor, 5%	1206	Yageo	
30	R4	3.3M	Film Resistor, 5%	1206	Yageo	
31	R5	1M	Film Resistor, 5%	1206	Yageo	
32	R6	1M	Film Resistor, 5%	1206	Yageo	

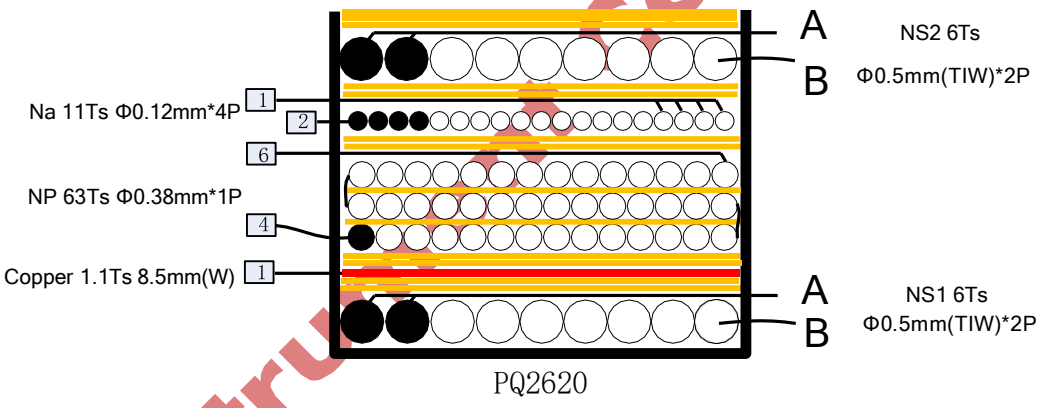
33	R7	10R	Film Resistor, 5%	1206	Yageo	
34	R8	3.3M	Film Resistor, 5%	1206	Yageo	
35	R9	3.3M	Film Resistor, 5%	1206	Yageo	
36	R10	10R	Film Resistor, 5%	0805	Yageo	
37	R11	51R	Film Resistor, 5%	0805	Yageo	
38	R12	2K	Film Resistor, 5%	0805	Yageo	
39	R13	75R	Film Resistor, 5%	0805	Yageo	
40	R14	3R3	Film Resistor, 1%	1206	Yageo	
41	R15	3R3	Film Resistor, 1%	1206	Yageo	
42	R16	3R3	Film Resistor, 1%	1206	Yageo	
43	R17	10K	Film Resistor, 5%	0805	Yageo	
44	R18	1K	Film Resistor, 5%	0805	Yageo	
45	R19	2K	Film Resistor, 5%	0805	Yageo	
46	R20	56K	Film Resistor, 5%	0805	Yageo	
47	R21	0R	Film Resistor, 5%	0805	Yageo	
48	R22	3R3	Film Resistor, 1%	1206	Yageo	
49	R23	100K	Film Resistor, 5%	0805	Yageo	
50	R24	10R	Film Resistor, 1%	1206	Yageo	
51	R25	100R	Film Resistor, 5%	0805	Yageo	
52	R26	10R	Film Resistor, 1%	1206	Yageo	
53	R27	J1(0R)	Film Resistor, 5%	0805	Yageo	
54	R29	620K	Film Resistor, 5%	0805	Yageo	
55	R32	10K	Film Resistor, 5%	0805	Yageo	
56	T1	Lm=1.66mH	Bobbin, PQ26/20, Vertical, 12 pins， Core Material PC40	PQ2620	TDG	
57	U1	None	4 Pin DIP Photo-Transistor Photocoupler	DIP4	Everlight	EL817
58	U2	KP201LG	Secondary Side Regulation CC/CV Controller	SOT-23-6	Kiwi Instruments	KP201LG
59	U4	KP401LG	Secondary Side Synchronous Rectifier(SR) Controller	SOT23-6	Kiwi Instruments	KP401LG
60	VR1	10D471	ZnO VARISTOR, P=5.0mm,T=3.5mm	10D	STE	STE10D471K
61	RH Type Bead Cores		For Drain of Q1 and Q6	RH3.5*3*1.5	Any	

Transformer Manufacture Guide

1. Electrical Diagram



2. Winding Diagram



3. Winding Order

Number	Winding	Layer	Start	End	Wire Size	Turns	Note
1	NS1	Secondary	A	B	0.5mm(TIW) *2P	6Ts	Close Wound
2	-	Shield	1		Copper 8.5(W)*0.02mm(TH)	1.1Ts	Tape on Overlap Section
3	NP	Primary	4	6	0.38*1P	63Ts	Close Wound
4	Na	Auxiliary	2	1	0.12mm*4P	11Ts	Close Wound
5	NS2	Secondary	A	B	0.5mm(TIW) *2P	6Ts	Close Wound

4. Electrical Specification

Items	Test Condition	Test Pin	Specification
Primary Inductance	Measured at 40kHz,1.0 VRMS	Pins 4 - 6; other windings open	1.66mH±5%
Leakage Inductance	Measured at 40kHz,1.0 VRMS	Pins 4 - 6; all other windings shorted	22uH
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	100MΩMin
	500Vdc	Between windings	100MΩMin
DC Resistance	-	Pins 4 – 6	2R Max

5. BOM

Items	Spec
Core	PQ2620, PC40 or equivalent
Bobbin	PQ2620, 6+6Pin
Wire	Φ0.38mm, 2UEW, Class B; Φ0.12mm, 2UEW, Class B; Φ0.5mm TIW;
Tape	9.5mm(W)×0.06mm(TH)
Copper	8.5mm(W) ×0.02mm(TH)

Test Result

1. Input characteristics

1.1 Maximum rated input AC current

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

Result: Pass

VIN(AC)	90Vac	Iin_max limit(A)	**Result**
Iout	1.17A	2A	**PASS**

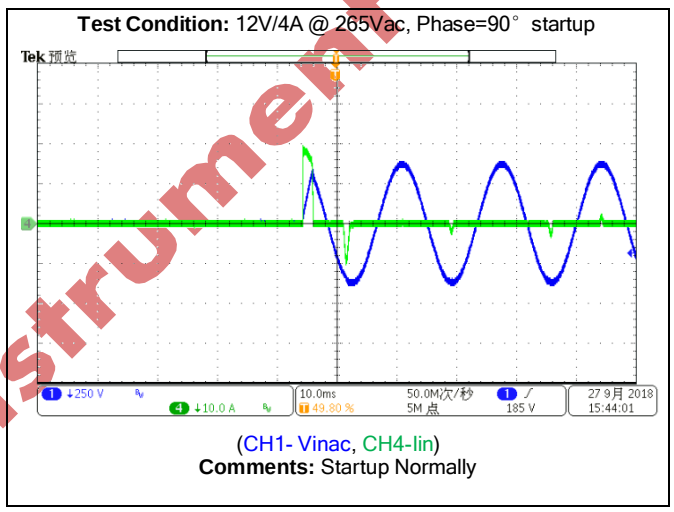
1.2 Inrush current (cold start)

Standard: 30Amax. @ 265Vac input

Result: Pass

VIN(AC)	Iinrush	Iin_max limit(A)	**Result**
265Vac	19.6A	30A	**PASS**

Waveforms:

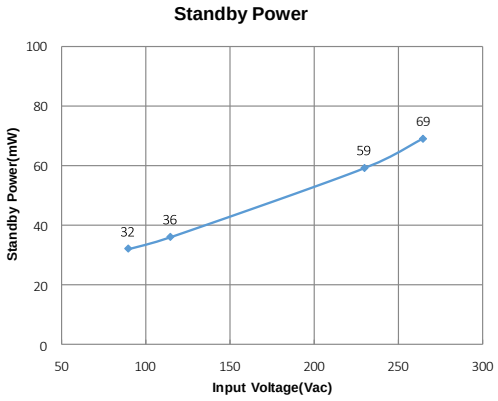


1.3 No load input power dissipation

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

Result: Pass

VIN(AC)	90	115	230	265	green mode limit(A)	**Result**
Pin	32	36	59	69	75mW	**PASS**

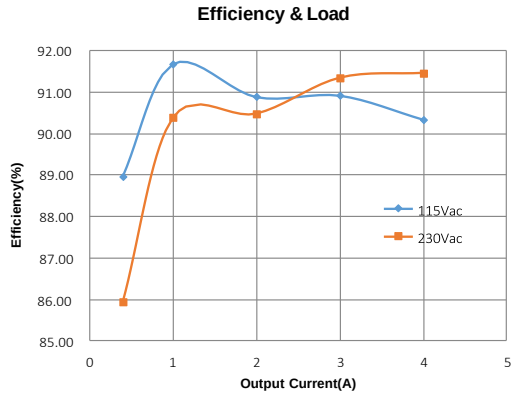


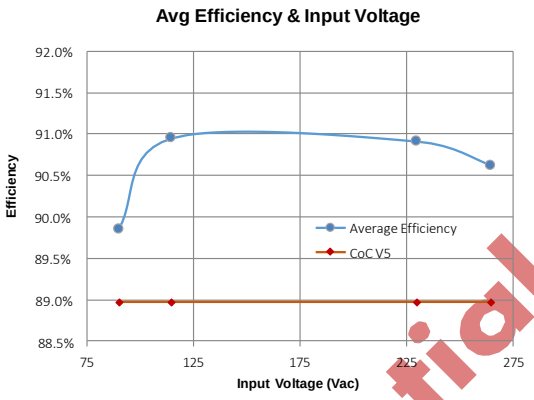
1.4 Average efficiency

Standard: The average efficiency tested on board end meets CoC V5 tier 2 with 2% margin @115Vac and 230Vac, CoC V5 tier 2 requirement for 12V/4A 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	12.01	0.4	4.804	89.13	/	78.97
		13.3	12.01	1	12.01	90.30	89.85	88.97
		26.61	12.01	2	24.02	90.27		
		40.09	12.01	3	36.03	89.87		
		54	12.01	4	48.04	88.96		
115		5.4	12.01	0.4	4.804	88.96	/	78.97
		13.1	12.01	1	12.01	91.68	90.95	88.97
		26.43	12.01	2	24.02	90.88		
		39.63	12.01	3	36.03	90.92		
		53.18	12.01	4	48.04	90.33		
230	50	5.59	12.01	0.4	4.804	85.94	/	78.97
		13.29	12.01	1	12.01	90.37	90.91	88.97
		26.55	12.01	2	24.02	90.47		
		39.48	12.02	3	36.06	91.34		
		52.53	12.01	4	48.04	91.45		
265		5.67	12.01	0.4	4.804	84.73	/	78.97
		13.54	12.01	1	12.01	88.70	90.62	88.97
		26.4	12.01	2	24.02	90.98		
		39.29	12.01	3	36.03	91.70		
		52.74	12.01	4	48.04	91.09		





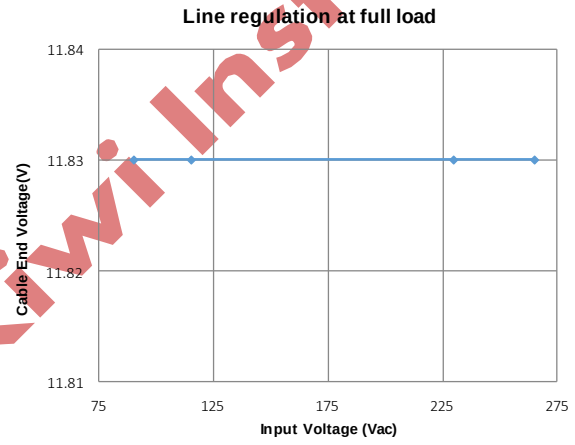
2. Output characteristics

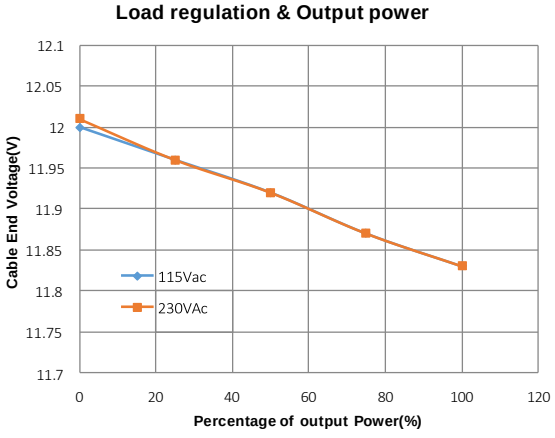
2.1 Output line regulation and load regulation

Standard: under the input voltage 90Vac~265Vac, Line regulation <6%, Load regulation <6%. The output voltage was tested at 1.5m AWG16 cable end.

Result: Pass

Input Voltage	Output Voltage(V)					Load Regulation
	0% Load	25% Load	50% Load	75% Load	Full Load	
90Vac/60Hz	12.01	11.96	11.91	11.87	11.83	1.52%
115Vac/60Hz	12	11.96	11.92	11.87	11.83	1.44%
230Vac/50Hz	12.01	11.96	11.92	11.87	11.83	1.52%
264Vac/50Hz	12.01	11.96	11.92	11.88	11.83	1.52%
Line Regulation	0.08%	0.00%	0.08%	0.08%	0.00%	





2.2 Ripple & noise

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

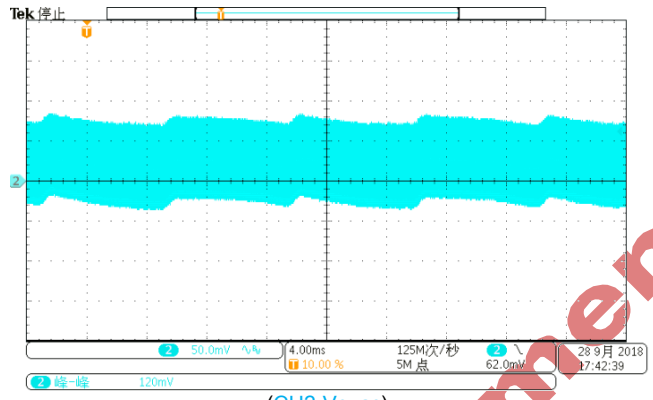
Result: Pass

Note: Ripple & noise were measured at AWG 16 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	58	138
115Vac/60Hz	58	120
230Vac/50Hz	64	122
264Vac/50Hz	50	108

Waveforms (115Vac & 230Vac):

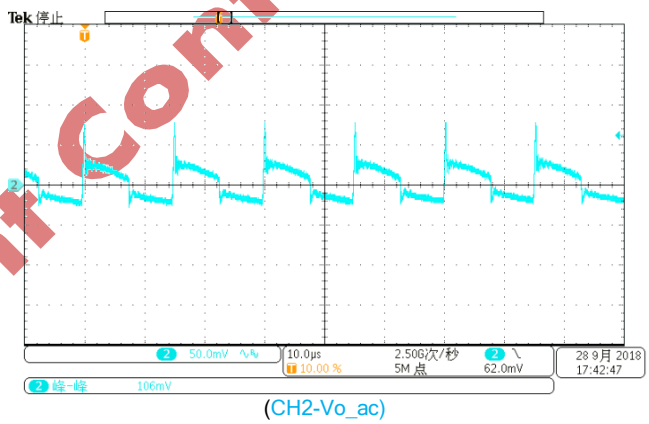
Test Condition: 115Vac/60Hz Input, 12V/4A Output



(CH2-Vo_ac)

Comments: Vo_ripple_pp=120mV

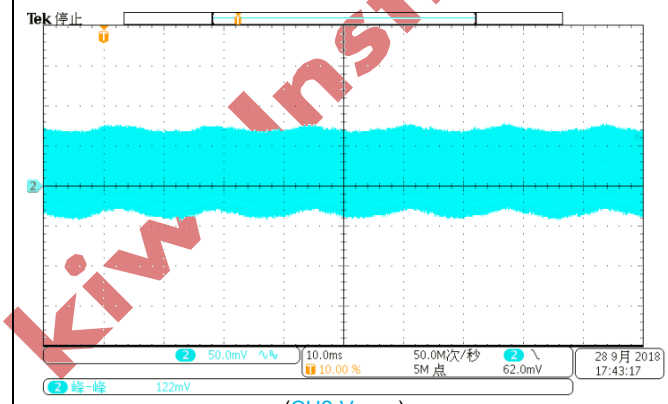
Test Condition: 115Vac/60Hz Input, 12V/4A Output



(CH2-Vo_ac)

Comments: Vo_ripple_pp=106mV

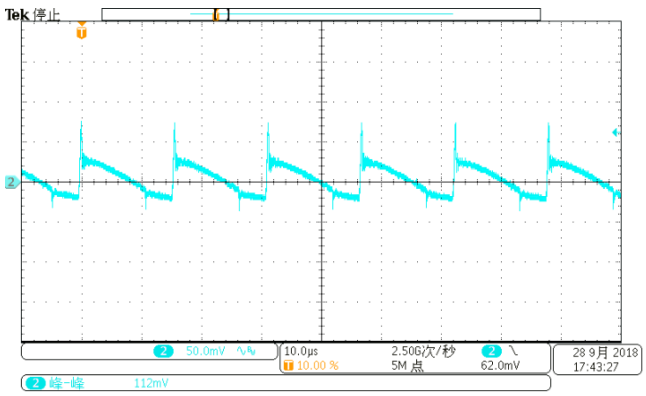
Test Condition: 230Vac/50Hz Input, 12V/4A Output



(CH2-Vo_ac)

Comments: Vo_ripple_pp=122mV

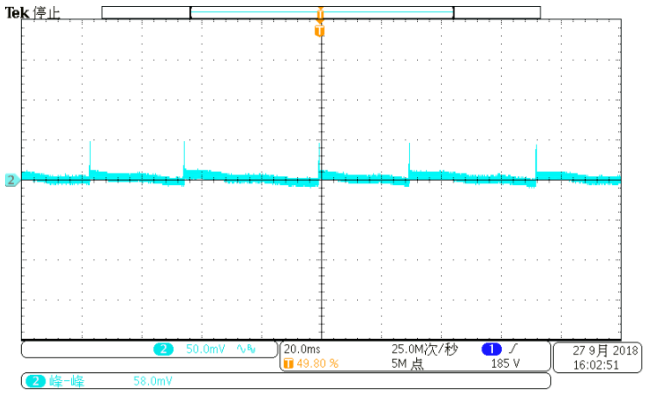
Test Condition: 230Vac/50Hz Input, 12V/4A Output



(CH2-Vo_ac)

Comments: Vo_ripple_pp=112mV

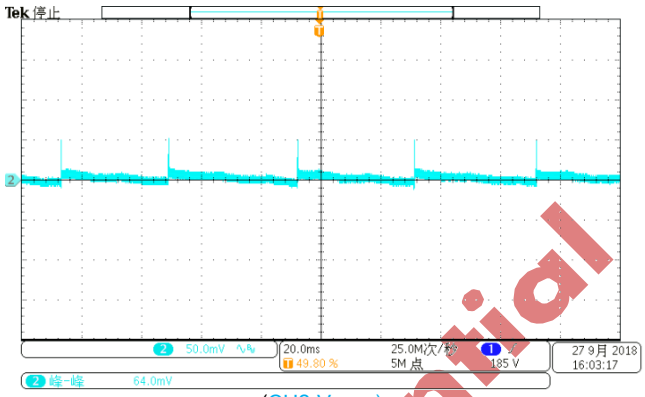
Test Condition: 115Vac/50Hz Input, 12V0A Output



(CH2-Vo_ac)

Comments: Vo_ripple_pp=58mV

Test Condition: 230Vac/50Hz Input, 12V0A Output



(CH2-Vo_ac)

Comments: Vo_ripple_pp=64mV

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

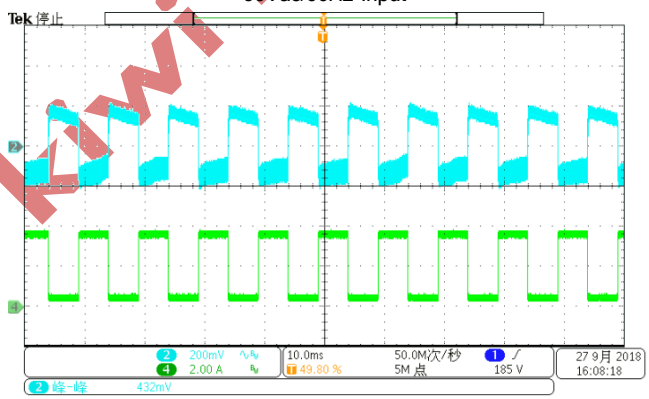
Note: 1.10% load shift to 90% load with 0.25A/us changing ramp and 100Hz changing frequency.

Input Voltage	Output Voltage(~ac)	Remark
90Vac/60Hz	432mV	Pass
115Vac/60Hz	408mV	Pass
230Vac/50Hz	384mV	Pass
264Vac/50Hz	384mV	Pass

Waveforms:

Test condition: Load 0.4-3.6A, frequency 100Hz, duty Cycle=50%, slew rate=0.25A/us

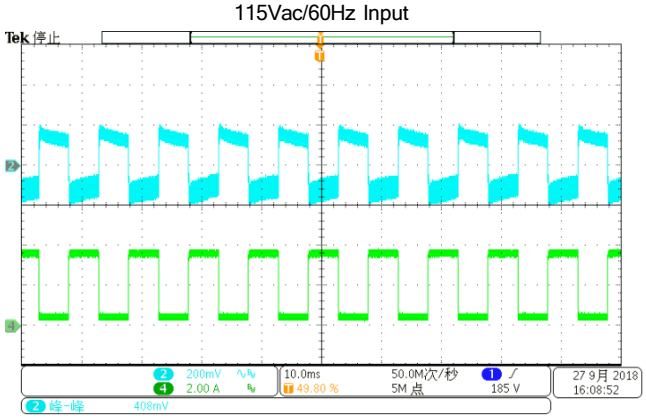
90Vac/60Hz Input



(CH2-Vo_ac, CH4-Io)

Comments: Vo_ripple_pp=432mV

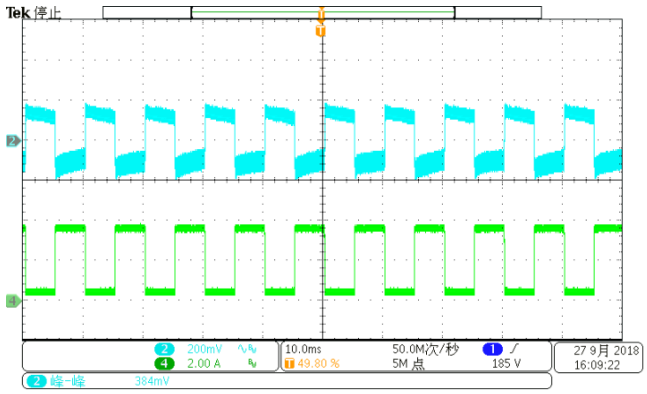
115Vac/60Hz Input



(CH2-Vo_ac, CH4-Io)

Comments: Vo_ripple_pp=408mV

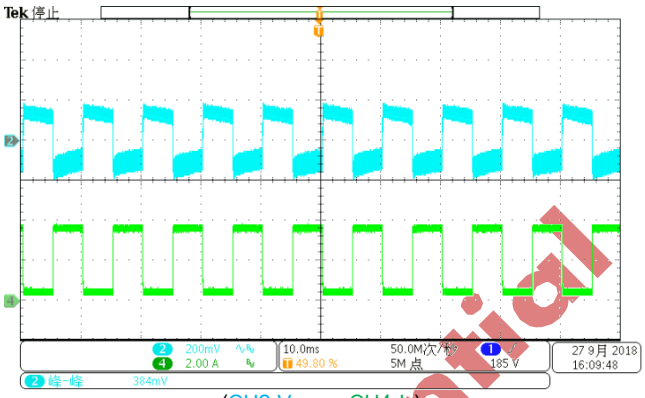
230Vac/50Hz Input



(CH2-Vo_ac, CH4-Io)

Comments: Vo_ripple_pp=384mV

265Vac/50Hz Input



(CH2-Vo_ac, CH4-Io)

Comments: Vo_ripple_pp=384mV

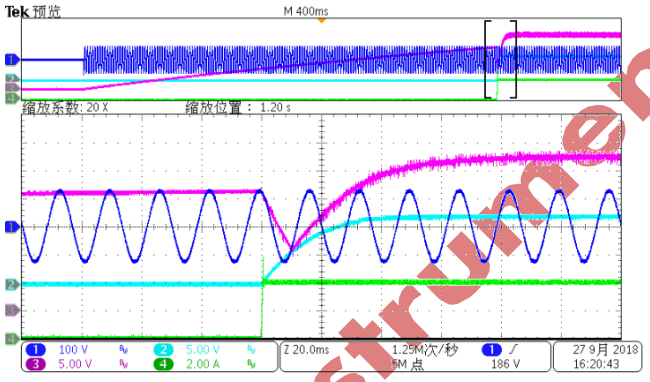
2.4 Capacitive Load Startup Test

Standard: while capacitance load is 1500uF, the power supply can turn on normally and the output is in the rated range.

Result: Pass

Waveforms:

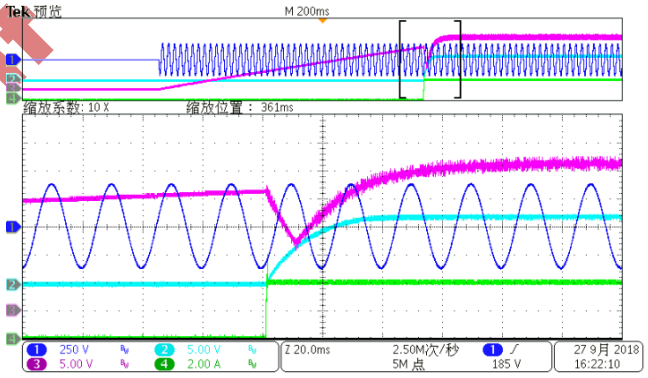
Test Condition: Load=1500uF, 12V/4A @ 90Vac



(CH1- Vinac, CH2-Vo, CH3-VDD, CH4-Io)

Comments: Startup Normally

Test Condition: Load=1500uF, 12V/4A @ 265Vac



(CH1- Vinac, CH2-Vo, CH3-VDD, CH4-Io)

Comments: Startup Normally

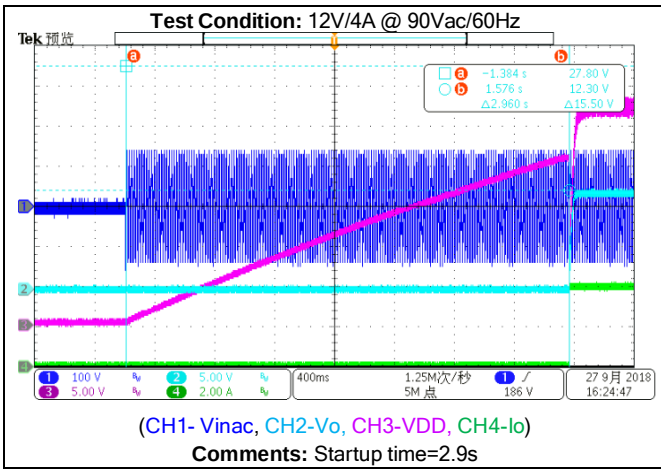
2.5 Startup Time and Holdup Time

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

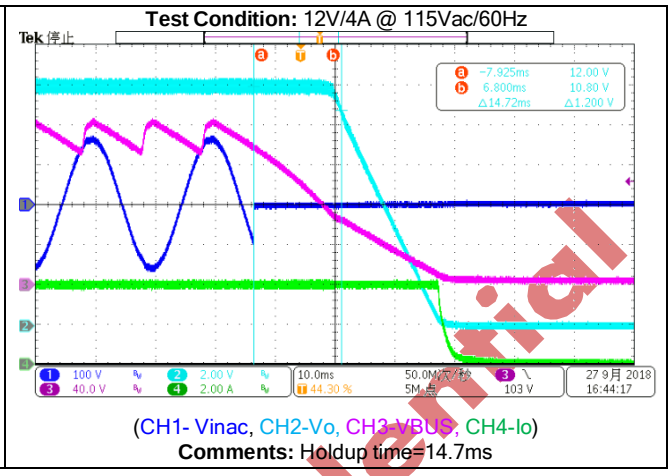
Result: Pass

Item	Input Voltage	Test Data	Remark	Note
Startup Time	90Vac	2.9s	Pass	Full Load
Holdup Time	115Vac	14.7ms	Pass	Cut off the Vac while Vbus voltage reached the lowest voltage

Waveforms:



(CH1- Vinac, CH2-Vo, CH3-VDD, CH4-Io)
Comments: Startup time=2.9s



(CH1- Vinac, CH2-Vo, CH3-VBUS, CH4-Io)
Comments: Holdup time=14.7ms

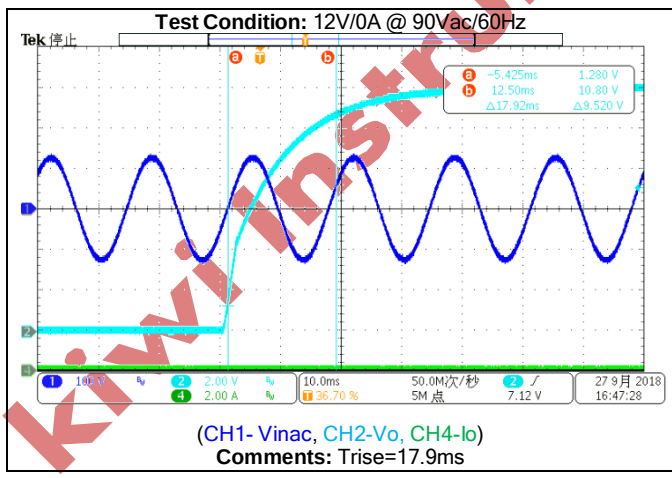
2.6 Output Voltage Rise Time and Fall Time

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

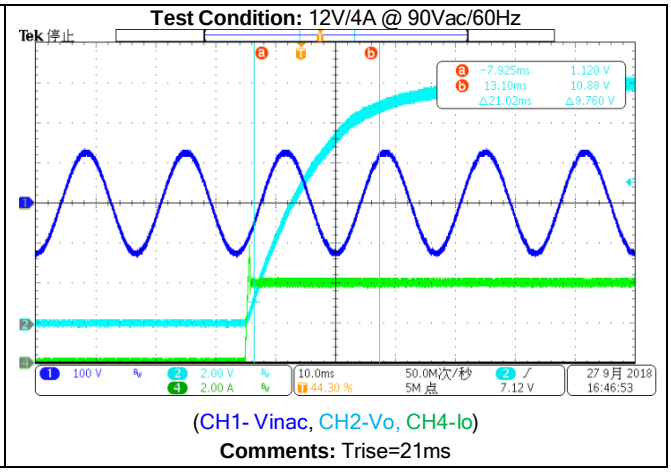
Result: Pass

Input Voltage	Load	Item	Test Result	Note
90Vac/60Hz	Full Load	Trise	21ms	No overshoot
		Tfall	17.32ms	No undershoot
	No Load	Trise	17.9ms	No overshoot
264Vac/50Hz	Full Load	Trise	19.1ms	No overshoot
		Tfall	17.8ms	No undershoot
	No Load	Trise	17.9ms	No overshoot

Waveforms:

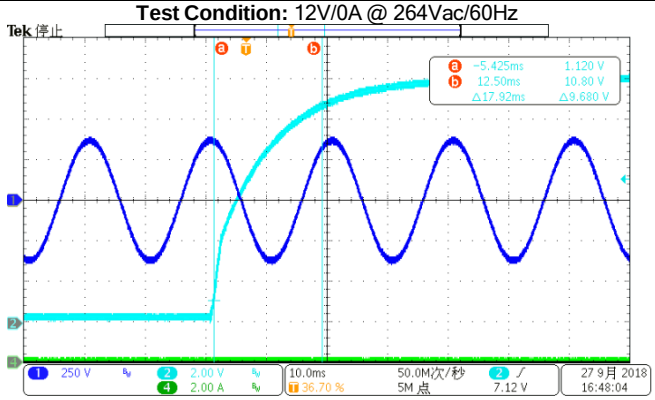


(CH1- Vinac, CH2-Vo, CH4-Io)
Comments: Trise=17.9ms



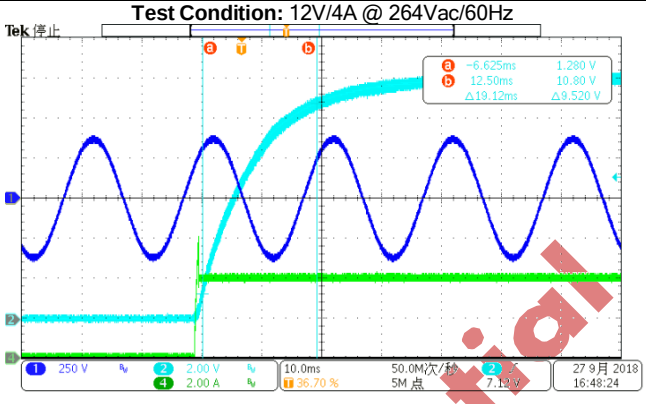
(CH1- Vinac, CH2-Vo, CH4-Io)
Comments: Trise=21ms

Test Condition: 12V/0A @ 264Vac/60Hz



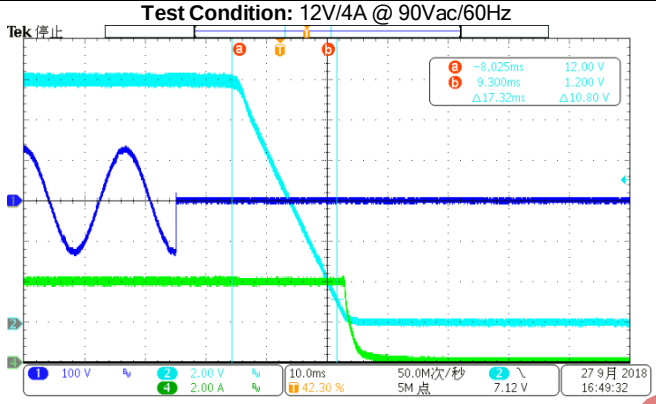
(CH1- Vinac, CH2-Vo, CH4-Io)
Comments: Trise=17.9ms

Test Condition: 12V/4A @ 264Vac/60Hz



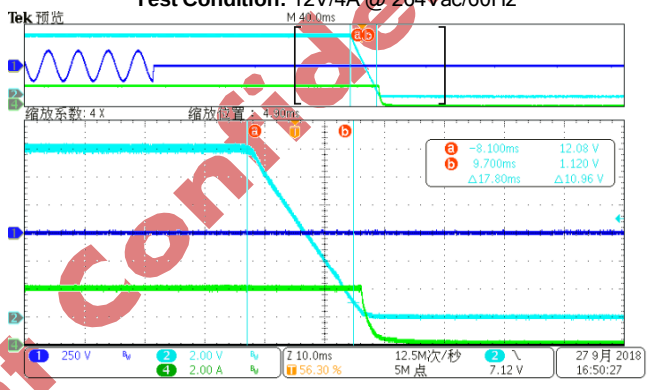
(CH1- Vinac, CH2-Vo, CH4-Io)
Comments: Trise=19.1ms

Test Condition: 12V/4A @ 90Vac/60Hz



(CH1- Vinac, CH2-Vo, CH4-Io)
Comments: Tfall=17.32ms

Test Condition: 12V/4A @ 264Vac/60Hz



(CH1- Vinac, CH2-Vo, CH4-Io)
Comments: Tfall=17.8ms

3. Protection Test

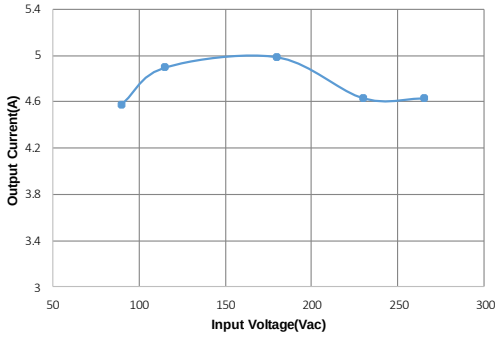
3.1 Over current protection

Standard: OCP point limited is between 110%~130% full load current.

Result: Pass

Input Voltage(Vac)	90	115	180	230	265	**Remark**
OCP Current(A)	4.58	4.9	4.99	4.63	4.63	**Pass**

Maximum Output Current & Input Voltage



3.2 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.

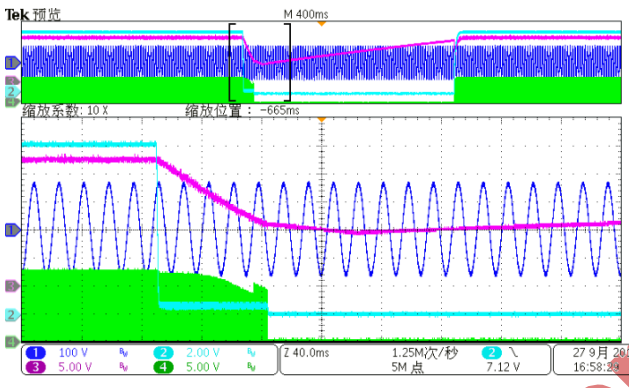
Result: Pass

Test Data:

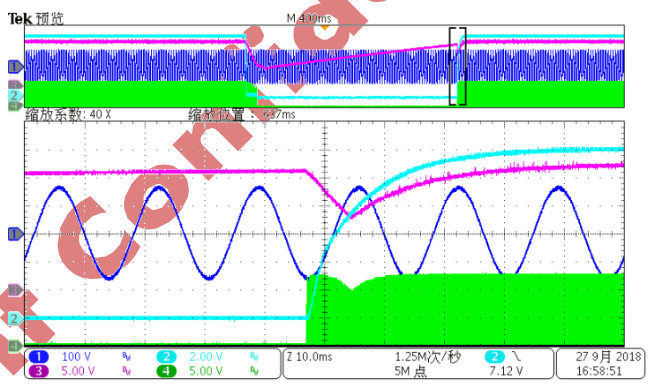
Input Voltage(Vac)	90	115	230	265	**result**
Pin(W)	0.94	1.05	2.92	4.2	**PASS**

Waveforms:

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

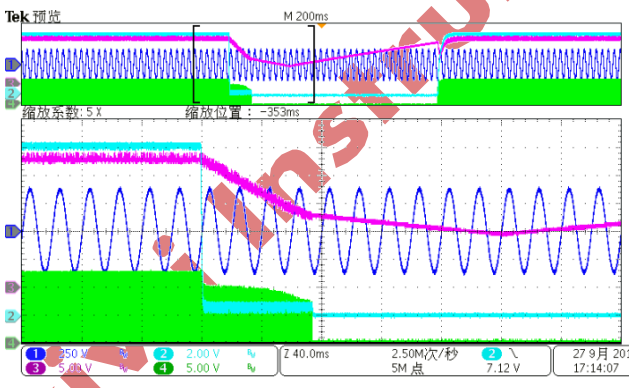


Short Load Protection Enter
(CH1-Vac, CH2-VO, CH3-VDD, CH4-Vgs)
Comments: OK

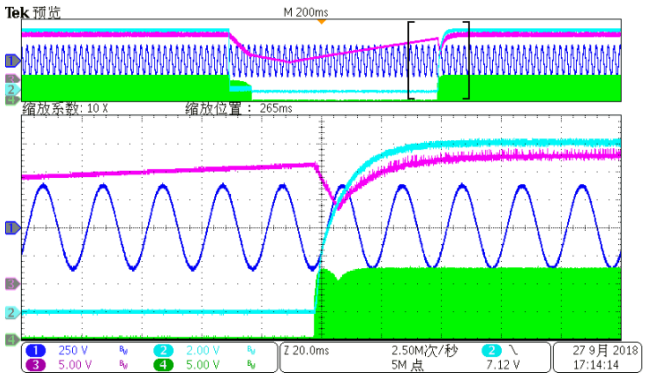


Short Load Protection Recovery
(CH1-Vac, CH2-VO, CH3-VDD, CH4-Vgs)
Comments: OK

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



Short Load Protection
(CH1-Vac, CH2-VO, CH3-VDD, CH4-Vgs)
Comments: OK



Short Load Protection Recovery
(CH1-Vac, CH2-VO, CH3-VDD, CH4-Vgs)
Comments: OK

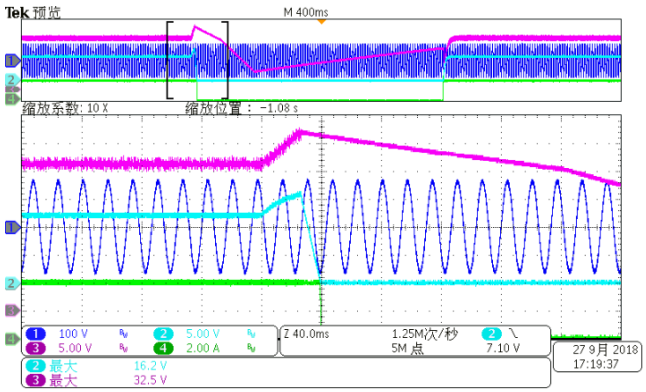
3.3 Over voltage protection

Standard: OVP point limit: <150%.

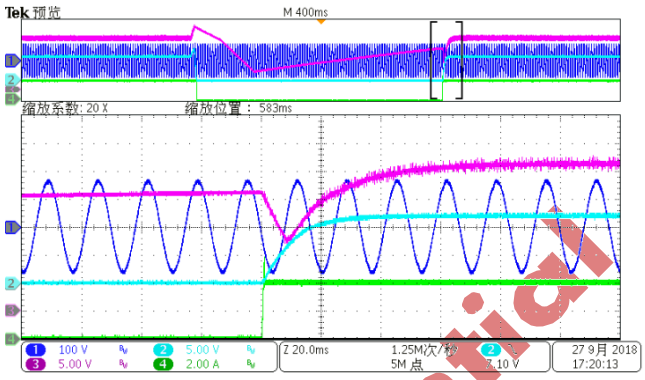
Result: Pass

Waveforms:

Test Condition: 115Vac60Hz Input, 12V4A Output

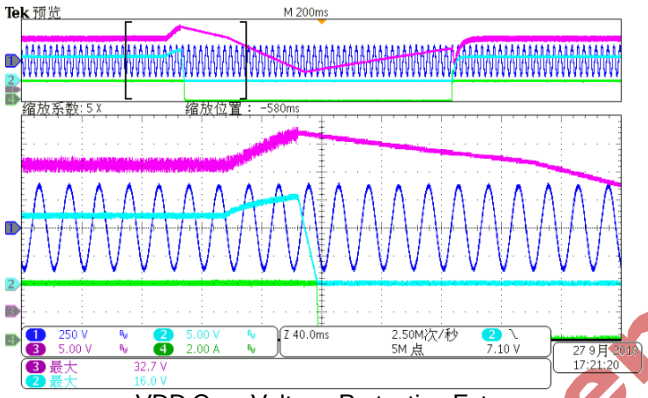


VDD Over Voltage Protection Enter
(CH1-Vac, CH2-VO, CH3-VDD, CH4-Io)
Comments: OK

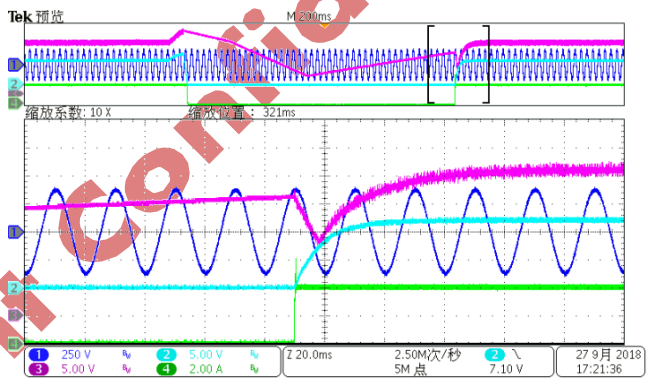


VDD Over Voltage Protection Recovery
(CH1-Vac, CH2-VO, CH3-VDD, CH4-Io)
Comments: OK

Test Condition: 230Vac/50Hz Input, 12V4A Output



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



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

4. Reliability requirements

4.1 Device Maximum Rating Test

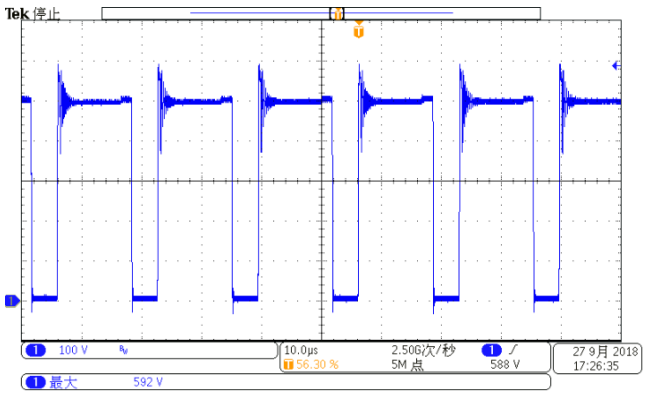
Standard: MOSFET Voltage <95% Vrrm; Bmax<0.3T.

Result: Pass

Input Voltage	Component	Test Condition	Test Result	Note
264Vac/50Hz	Q1 SVD10N65F	Startup	592V	Pass
		Steady State	592V	Pass
		Output Short	596V	Pass
	Q6 AM130N07	Startup	54.8V	Pass
		Steady State	54.8V	Pass
		Output Short	54.8V	Pass
			23.4A	Pass
	Transformer Core	Startup	0.3T	Pass
		Steady State	0.3T	Pass

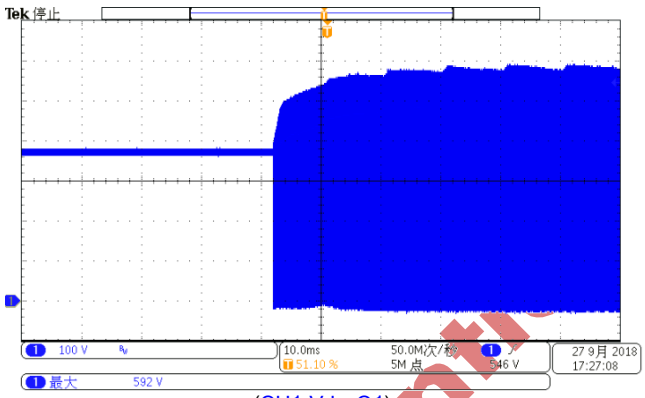
Waveforms:

Test Condition: 265Vac/50Hz Input, 12V/4A Output, Steady State and Startup



(CH1-Vds_Q1)

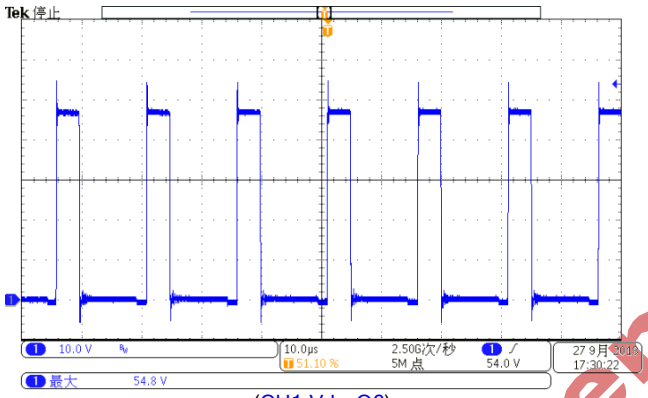
Comments: Vds_Q1=592V



(CH1-Vds_Q1)

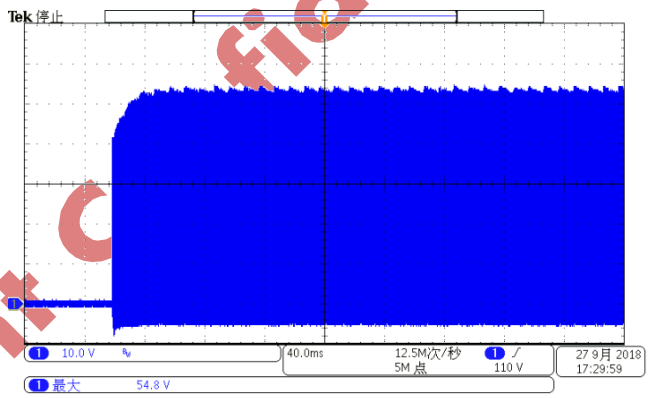
Comments: Vds_Q1=592V

Test Condition: 265Vac/50Hz Input, 12V/4A Output, Steady State and Startup



(CH1-Vds_Q6)

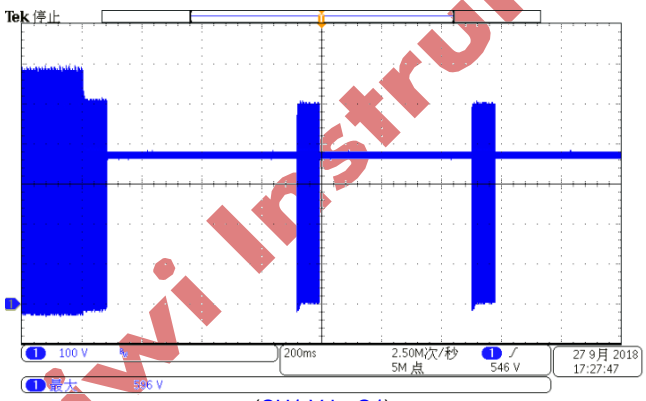
Comments: Vds_Q6=54.8V



(CH1- Vds_Q6)

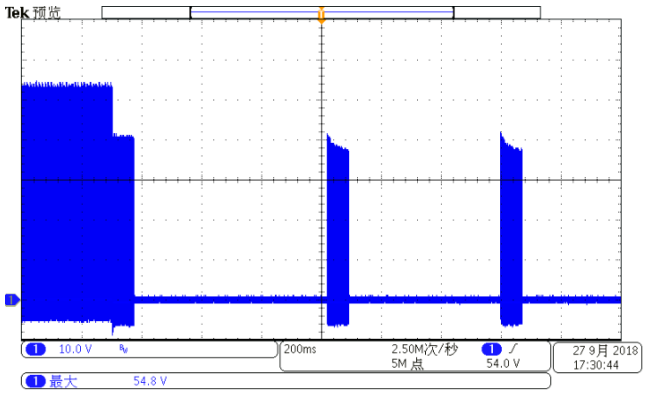
Comments: Vds_Q6=54.8V

Test Condition: 265Vac/50Hz Input, 12V/4A Output short



(CH1-Vds_Q1)

Comments: Vds_Q1=596V



(CH1-Vds_Q6)

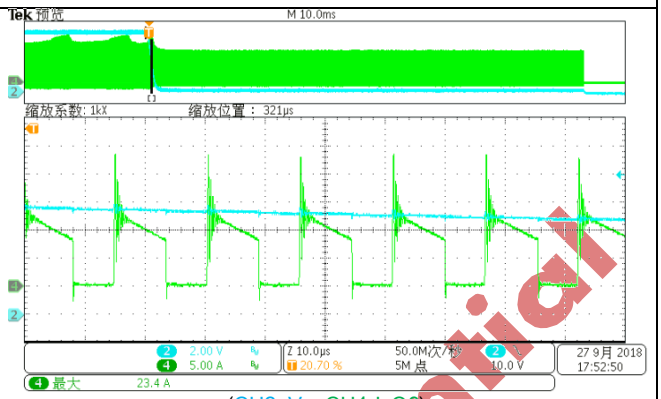
Comments: Vds_Q6=54.8V

Test Condition: 90Vac/60Hz Input, 12V/4A Startup

(CH4-I_Q6)

Comments: I_Q6_max=23A

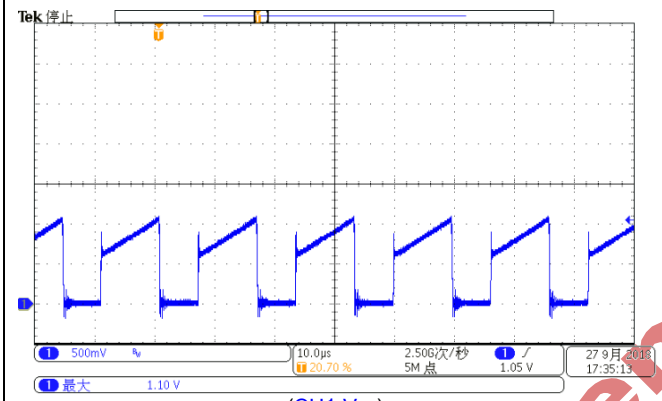
Test Condition: 90Vac/60Hz Input, 12V/4A Output Short



(CH2=Vo, CH4-I_Q6)

Comments: I_Q6_max=23.4A

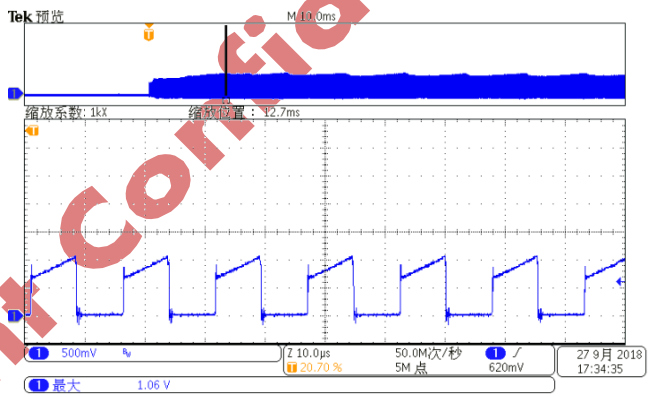
Test Condition: 90Vac/60Hz Input, 12V/4A Output Steady State



(CH1-Vcs)

Comments: ILpk=1.1V/0.825R=1.33A,Bmax=0.299T

Test Condition: 90Vac/60Hz Input, 12V/4A Output Startup



(CH1-Vcs)

Comments: ILpk=1.06V/0.825R=1.285A,Bmax=0.293T

=Kiwi Instruments Corp.
Tel: +86-18681585060 E-mail: wyq@cokinic.com
www.cokinsemi.com

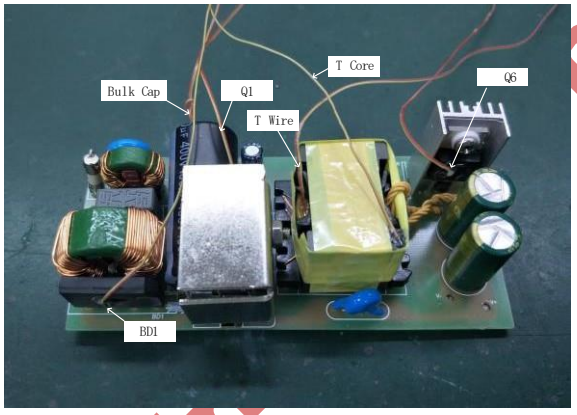
4.2 Thermal Test

Standard: MOS, IC and Diode: Ta=40℃, ΔT<75℃. Transformer: Ta=40℃, ΔT<70℃.

Result: Pass

Test Condition: 90Vac/60Hz, 265Vac/50Hz; 12V/4A output; Burn-in 1Hour @ confined container (19cm*17cm*10cm cardboard box) and steady environment with no airflow, Ta is the temperature inside the cardboard box.

Component	90Vac		265Vac	
	Ta=46℃		Ta=40.2℃	
	T(°C)	Trise(°C)	T(°C)	Trise(°C)
Q6	73.5	27.5	67.3	27.1
T1 Core	70	24	68.5	28.3
T1 Wire	78.3	32.3	75	34.8
Q1 SVD10N65F	88.6	42.6	88.5	48.3
C3 Bulk Cap	66.2	20.2	56.9	16.7
BD1 GBL06	84.3	38.3	58.6	18.4



5. EMC/EMS Test Result

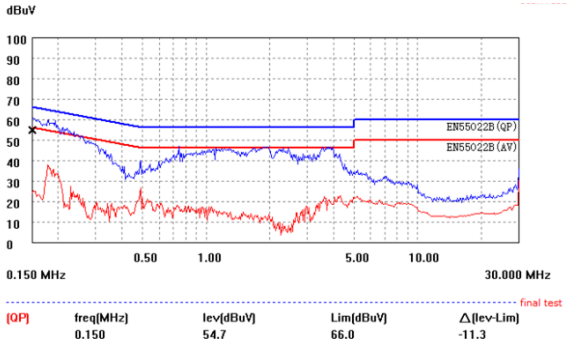
Standard：

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

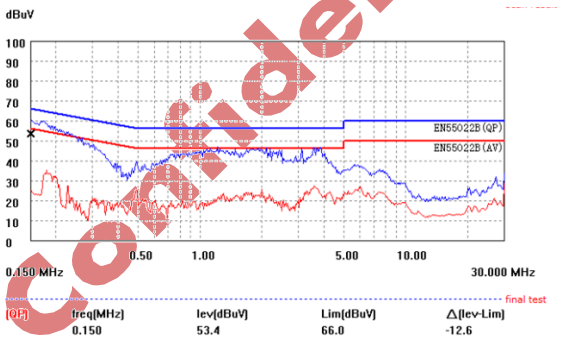
5.1 Conducted Emissions

Result：Pass

Test Condition: Vin=110VAC/60Hz, Vout=12V, Io=4A

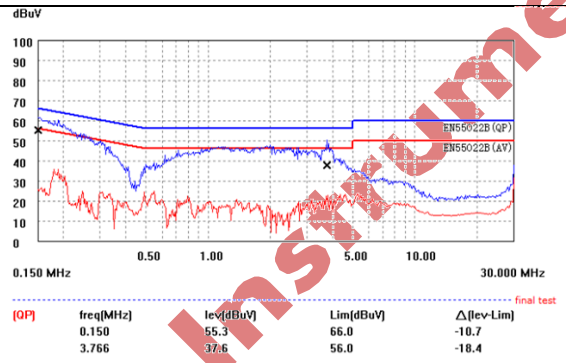


Conduction EMI---LINE

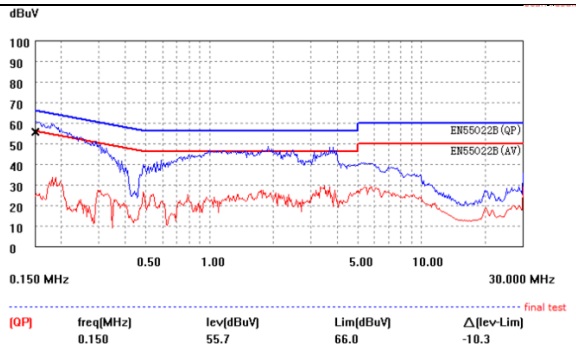


Conduction EMI---NEUTRAL

Test Condition: Vin=230VAC/50Hz, Vout=12V, Io=4A

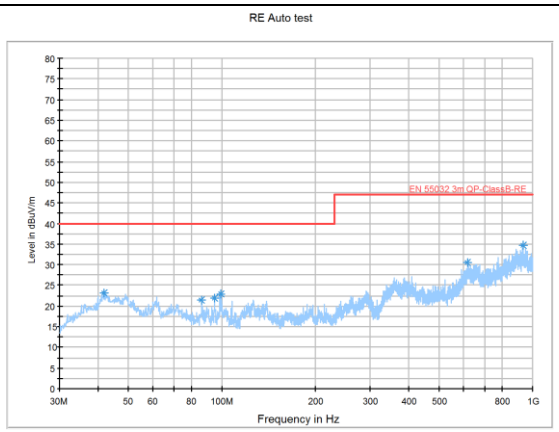
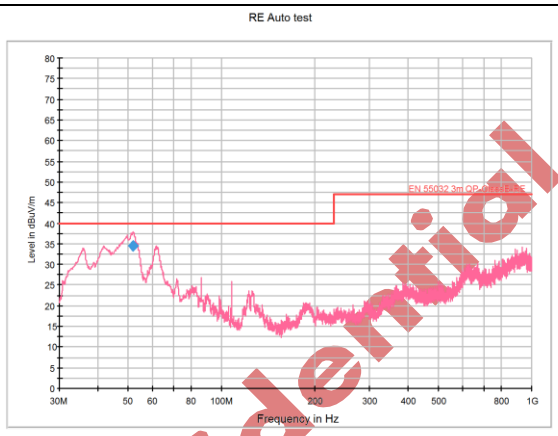
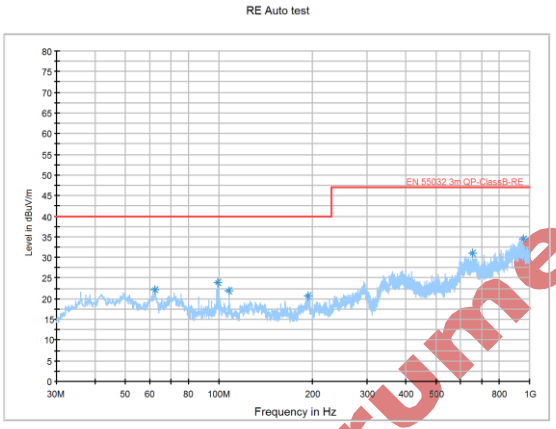
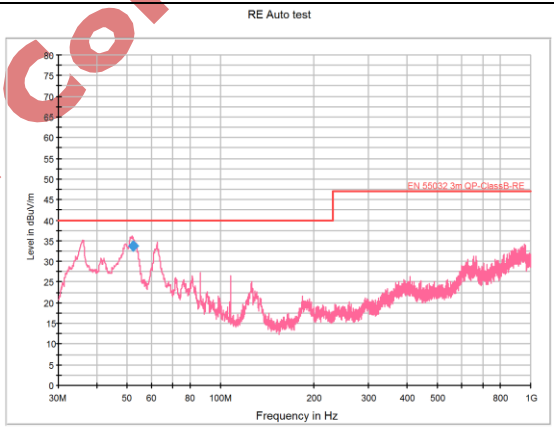


Conduction EMI---LINE



Conduction EMI---NEUTRAL

5.2 Radiated Emissions

Test Condition: Vin=110VAC/60Hz, Vout=12V, Io=4A	
	
Radiation (Horizontal)	Radiation (Vertical)
Test Condition: Vin=230VAC/50Hz, Vout=12V, Io=4A	
	
Radiation (Horizontal)	Radiation (Vertical)

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 12V-4A. 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		4	
-14		-4	
15		6	
-15		-6	
16		8	
-16		-8	

5.5 EFT Test

Input 220Vac/50Hz，Output 12V-4A. 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 12V-4A. 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
2018-09-28	2.1	First Release

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