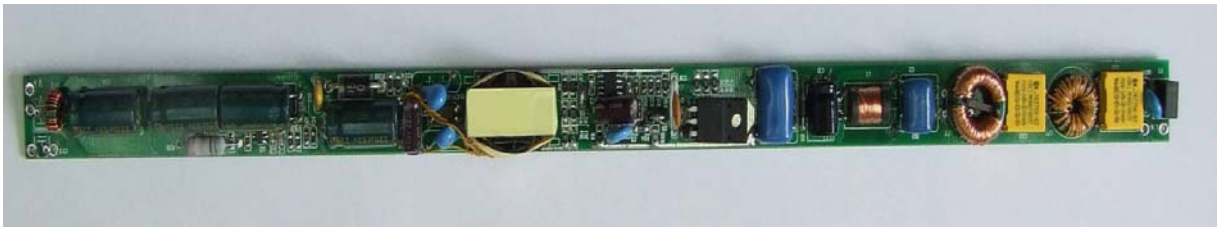
Subject

SN03A Demo Board Manual

Board Model: LED48V0.4A-SN03A.00

Doc. No.: OB_DOC_DBM_B_SN03AA1



Key features:

- Single stage critical conduction mode flyback converters for LED Driver
- Constant Voltage / Constant current operation
- Power factor >0.9
- Short circuit protection
- Audio noise free
- Meet EN55015 & Part 18 EMI

Revision History

Revise Date	Version	Reason/Issue
2010-3-23	00	First issue
2010-7-14	A0	RTP version issue
2010-7-20	A1	Modified mechanical size.

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1. Adapter Module Specification

1.1. Input Characteristics

- AC input voltage rating 100Vac ~ 240Vac
- AC input voltage range 90Vac ~ 264Vac
- AC input frequency range 47Hz ~ 63Hz

1.2. Output Characteristics

- Output Voltage(TYP) 48.0V
- load current(TYP) 0.4A

1.3. Performance Specifications

- Max. Output Power 20W
- Standby Power <1W @ no load, 25℃
- Efficiency >83%
- Line Regulation ±1% Max
- Load Regulation ±5% Max

1.4. Protection Features

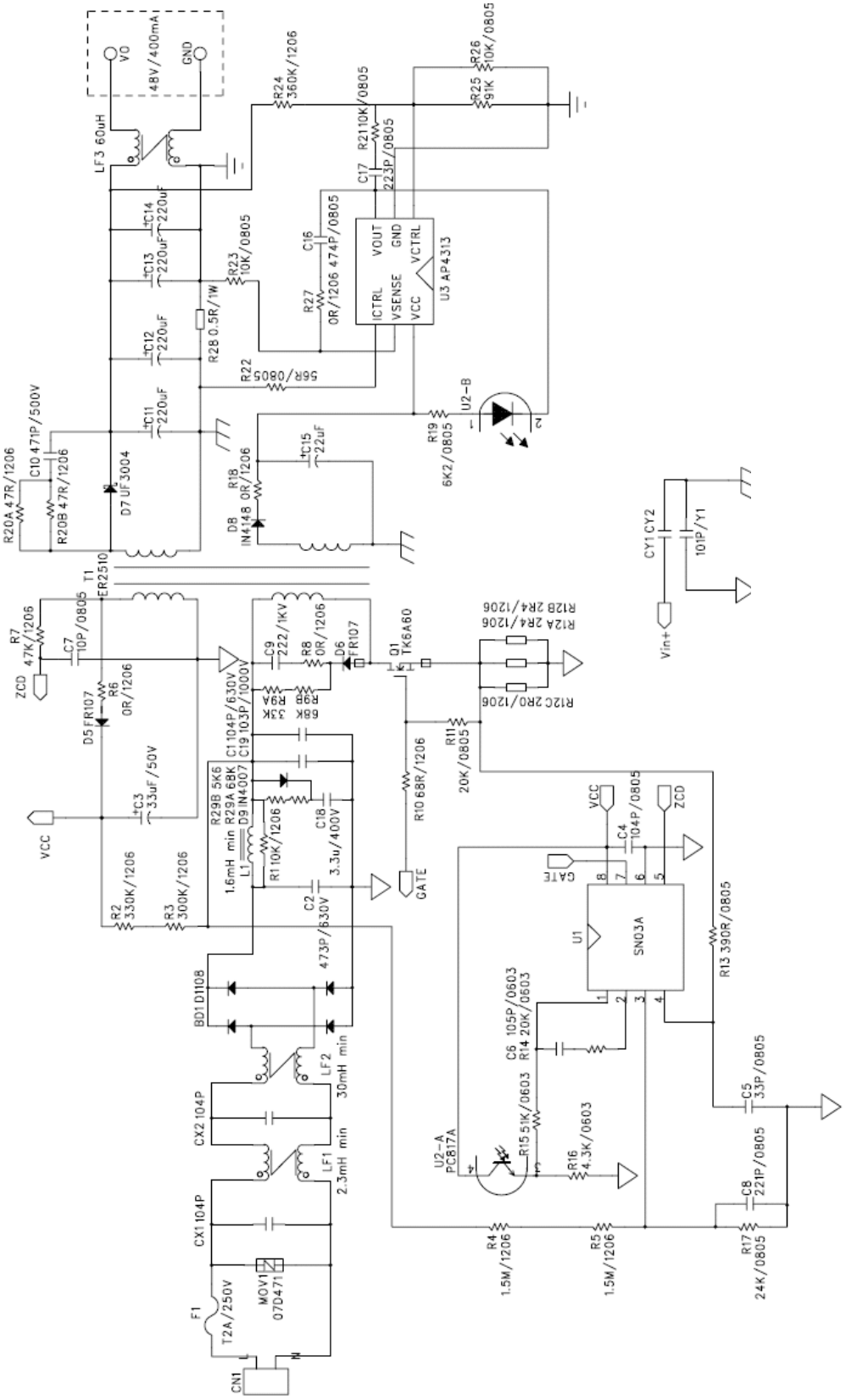
- Short circuit Protection Output shut down with automatic recovery

1.5. Environments

- Operating Temperature 0℃ to +70℃
- Operating Humidity 20% to 90% R.H.
- Storage Temperature -40℃ to +60℃
- Storage Humidity 0% to 95% R.H.

2. LED Module Information

2.1. Schematic



2.2. Bill of material

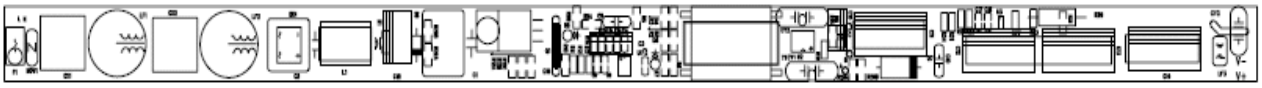
No.	Position	Description	Quantity	Remark
1	F1	FUSE, T2.0AL/250V	1	
2	MOV1	MOV, 07D471	1	
3	T1	Transformer, ER2510, 650uH	1	
4	LF1	Common Choke, Core13*7*5mm, Φ0.3*27Ts*2, 2.3mH min	1	
5	LF2	Common Choke, Core16*9*5.5mm,Φ0.25*70Ts*2,30mH min	1	
6	LF3	Common Choke, Core 8*4*3mm, Φ0.4x10Ts*2, 60uH min	1	
7	L1	Induction, DR9*12mm, Φ0.25x220Ts, 1.6mH min	1	
8	CX1,CX2	X2-CAP, 104P, +/-20%, 275Vac	2	
9	CY1,CY2	Y1-CAP, 101P, +/-20%, 250Vac	2	
10	C1	MPP, 104P/630V	1	
11	C2	MPP, 473P/630V	1	
12	C3	E.C, 33uF/50V, DIP	1	
13	C4	SMD, 104P/50V, 0805	1	
14	C5	SMD, 33P/50V, 0805	1	
15	C6	SMD, 105P/50V, 0603	1	
16	C7	SMD, 10P/50V, 0805	1	
17	C8	SMD, 221P/50V, 0805	1	
18	C9	C.C, 222P/1KV, DIP	1	
19	C10	C.C, 471P/500V, DIP	1	
20	C11-C14	E.C, 220uF/63V, Low ESR	4	
21	C15	E.C, 22uF/50V, DIP	1	
22	C16	SMD, 474P/50V, 0805	1	
23	C17	SMD, 223P/50V, 0805	1	
24	C18	E.C, 3.3uF/400V, DIP	1	
25	C19	C.C, 103P/1KV, DIP	1	
26	R1	SMD, 10K, 5%, 1206	1	
27	R2	SMD, 330K, 5%, 1206	1	
28	R3	SMD, 300K, 5%, 1206	1	
29	R4,R5	SMD, 1.5M, 5%, 1206	2	
30	R6	SMD, 0R, 5%, 1206	1	
31	R7	SMD, 47K, 5%, 1206	1	
32	R8,R27	SMD, 0R, 5%, 1206	2	
33	R9A	SMD, 33K, 5%, 1206	1	
34	R9B	SMD, 68K, 5%, 1206	1	
35	R10	SMD, 68R, 5%, 1206	1	
36	R11	SMD, 20K, 5%, 0805	1	
37	R12A,R12B	SMD, 2R4, 5%, 1206	2	
38	R12C	SMD, 2R0, 5%, 1206	1	
39	R13	SMD, 390R, 5%, 0805	1	
40	R14	SMD, 20K, 5%, 0603	1	
41	R15	SMD, 51K, 5%, 0603	1	
42	R16	SMD, 4K3, 5%, 0603	1	

43	R17	SMD, 24K, 5%, 0805	1	
44	R18	SMD, 0R, 5%, 1206	1	
45	R19	SMD, 6K2, 5%, 0805	1	
46	R20A,R20B	SMD, 47R, 5%, 1206	2	
47	R21,R23	SMD, 10K, 5%, 0805	2	
48	R22	SMD, 56R, 5%, 0805	1	
49	R24	SMD, 360K, 1%, 1206	1	
50	R25	SMD, 91K, 1%, 0805	1	
51	R26	SMD, 10K, 1%, 0805	1	
52	R28	MOR, 0R5, 1%, 1W	1	
53	R29A	SMD, 68K, 5%, 1206	1	
54	R29B	SMD, 5.6K, 5%, 1206	1	
55	BD1	D1108S, 1A , 800V	1	
56	D5,D6	Diode, FR107	2	
57	D9	Diode, IN4007	1	
58	Bead core	For D6	1	
59	D7	Diode, UF3004, 3A/400V	1	
60	D8	SMD Diode, 1N4148	1	
61	U1	PWM controller, SN03A, SOP8	1	
62	U2	Photo coupler, PC 817A	1	
63	U3	AP4313	1	
64	Q1	MOSFET, TOSHIBA TK6A60, 6A/600V	1	
65	Bead core	For Q1 S pin	1	
66	PCB	FR-4, 347mm(L)*18mm(W)	1	

2.3. PCB Gerber File

Bottom

Bottom

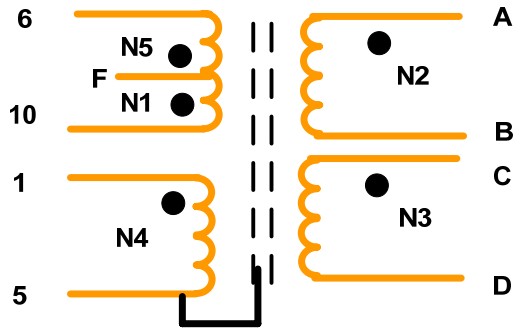


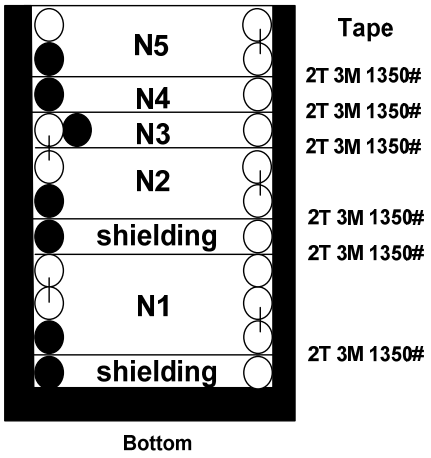
Top

Top

2.4. LED Module Snapshot

2.4.1. Transformer Specification



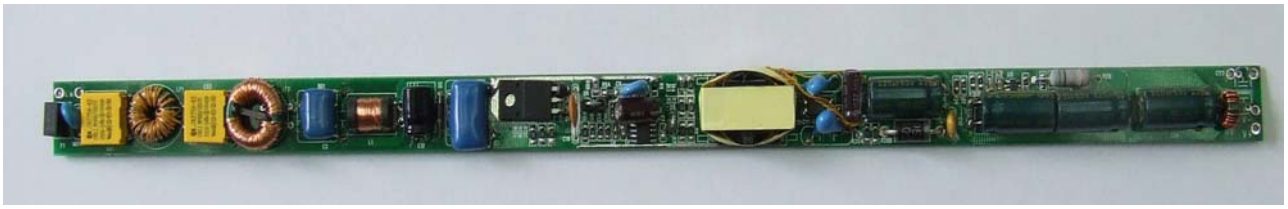


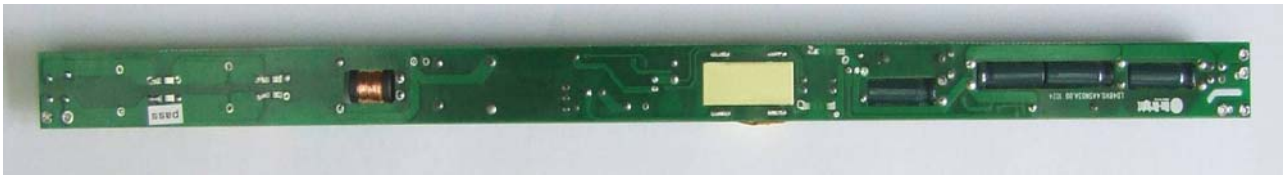
Note:
1) Bobbin: ER2510 (10Pin)
2) Core material: PC40 (TDK).or equivalent
3) L(9-10) =650uH ±5% (10KHz,1V,25℃)

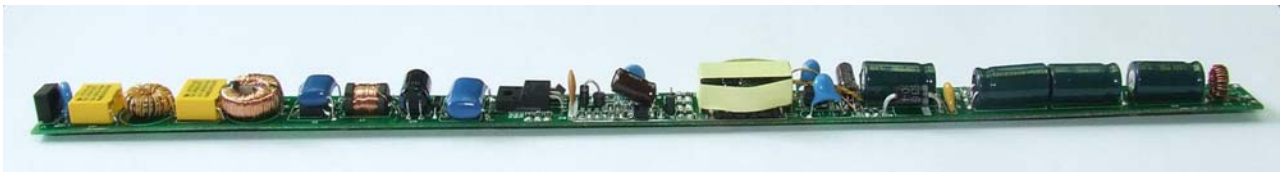
2.4.2. Transformer Winding data

Winging	Material	Start	Turns	Finish
Shielding	0.2Φ*2 2UEW	6	8	NC
TAPE	TAPE W=4mm (Y)		2	
N1	0.27Φ*1 2UEW	10	36	F
TAPE	TAPE W=4mm (Y)		2	
Shielding	0.2Φ*2 2UEW	5	8	NC
TAPE	TAPE W=4mm (Y)		2	
N2	0.3Φ*1 triple insulated wire	A	18	B
TAPE	TAPE W=4mm (Y)		1	
N3	0.3Φ*1 triple insulated wire	C	5	D
TAPE	TAPE W=4mm (Y)		2	
N4	0.2Φ*2 2UEW	1	7	5
TAPE	TAPE W=4mm (Y)		2	
N5	0.27Φ*1 2UEW	F	24	6
TAPE	TAPE W=4mm (Y)		3	
External Copper	External Copper W=2.5mm	6	1.1	

2.5. LED Module Snapshot







SIZE： 347mm（L）x18mm（W）x11mm（H）

3. Performance Evaluation

This session presents the test results of 20W LED module up to date. Results on inrush current and safety test are not included and will be added when they become available.
Overall, the module meets design specifications.
All data was measured at PCB end.

Test Equipments

Item	Vender	Module
AC Source	WEST	WEW1010
Digital Power Meter	YOKOGAWA	WT210
Electrical Load	Prodigit	3315C
Oscilloscope	LeCroy	WS424
Multimeter	VICTORY	VC9807A

3.1. Input Characteristics

3.1.1. Standby power

Table. 1 Standby power

Input voltage	Pin(W)	Vo(V)	Specification	Test result
90Vac/60Hz	0.69	49.68	<1W	Pass
115Vac/60Hz	0.33	49.68		
230Vac/50Hz	0.34	49.68		
264Vac/50Hz	0.39	49.68		

3.1.2. Efficiency

Table. 2 Efficiency

Input voltage	90Vac/60Hz	115Vac/60Hz	230Vac/50Hz	264Vac/50Hz	Spec.	Test result
Load CV 48V	85.27%	86.50%	85.31%	84.06%	>83%	Pass

3.1.3. Power Factor at Full load

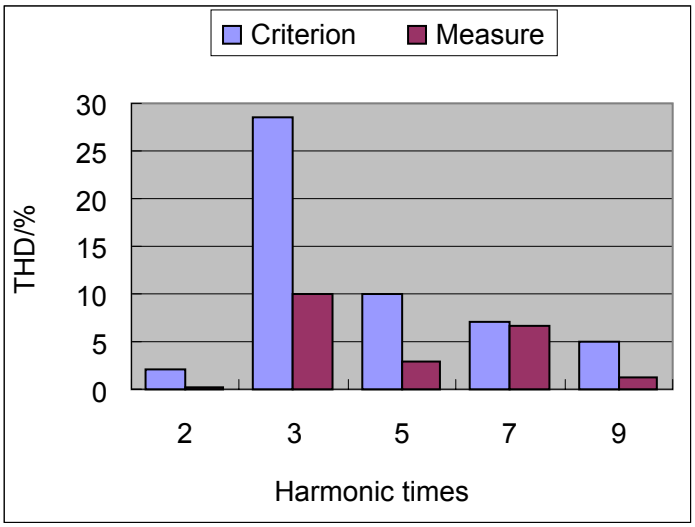
Table. 3 Power factor

Input voltage	PF	Spec.	Test result
90Vac/60HZ	0.996	>0.9	Pass
115Vac/60HZ	0.991		
230Vac/50HZ	0.949		
265Vac/50HZ	0.924		

3.1.4. THD Test at Full load

Table. 4 THD test under 230Vac input condition

Input voltage	N	THD	Spec.	Test result
230V/50Hz	2	0.2	2.0	Pass
	3	10.0	28.5	
	5	3.0	10.0	
	7	6.6	7.0	
	9	1.2	5.0	



3.2. Output Characteristics

3.2.1. Output Current Regulation

Table. 5 Line Regulation & Load Regulation

Input voltage	CV 48V	CV 40V	CV 30V	Spec.	Test result
90Vac/60Hz	402mA	401mA	401mA	Line Regulation ＜1% Load Regulation ＜5%	Pass
115Vac/60Hz	401mA	401mA	401mA		
230Vac/50Hz	401mA	401mA	401mA		
264Vac/50Hz	401mA	401mA	401mA		

3.2.2. Ripple & Noise

Table. 6 Output voltage, led current ripple & noise

Input voltage	R&N (mV)		
	Output voltage	Led current	Remark
90Vac/60Hz	1300mV	52mA	Fig. 1
115Vac/60Hz	1300mV	55mA	Fig. 2
230Vac/50Hz	1360mV	62mA	Fig. 3
264Vac/50Hz	1350mV	66mA	Fig. 4

Note: Ripple & noise were measured with 14pcs led in series for loading.

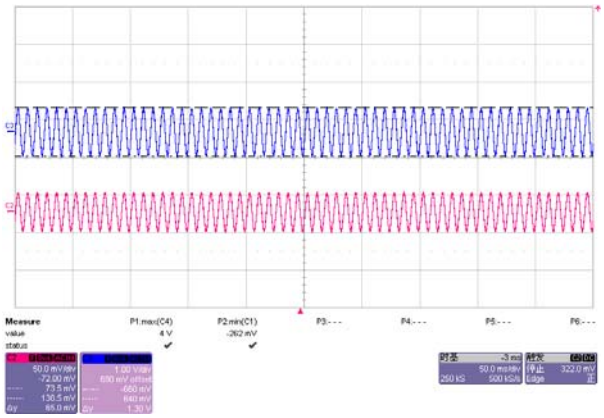


Fig. 1 Ripple & noise waveform @90Vac/60Hz

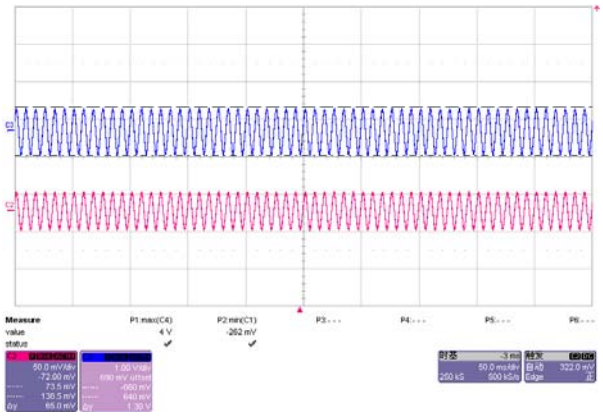


Fig. 2 Ripple & noise waveform @115Vac/60Hz

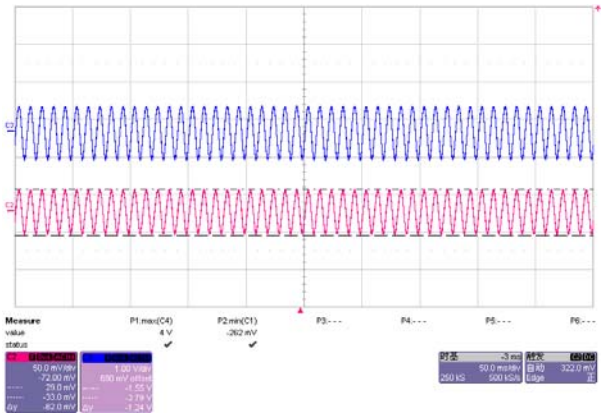


Fig. 3 Ripple & noise waveform @230Vac/50Hz

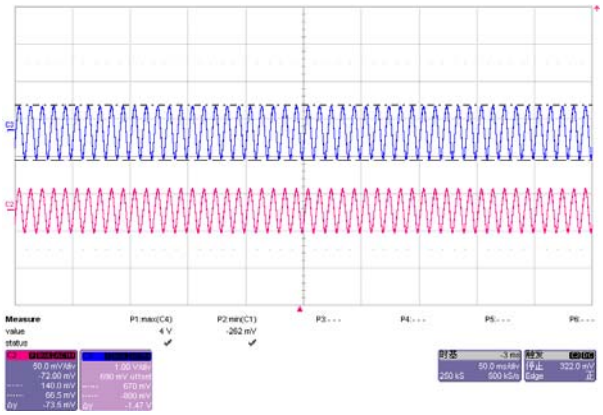


Fig. 4 Ripple & noise waveform @264Vac/50Hz

3.2.3. Output Voltage & Current Waveform

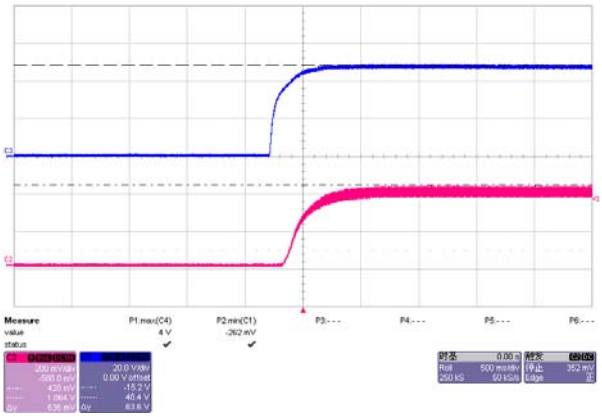


Fig. 5 Voltage & current waveform @90Vac/60Hz, output start

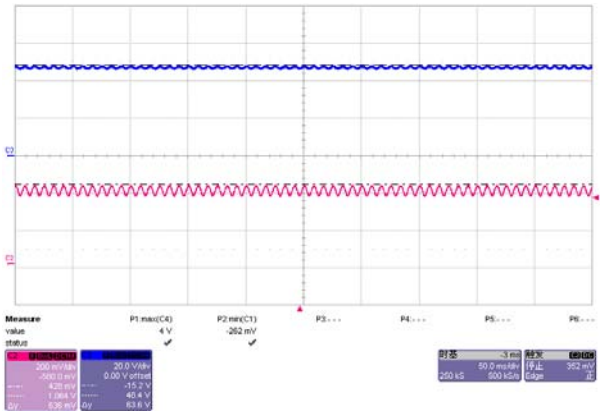


Fig. 6 Voltage & current waveform @90Vac/60Hz, normal

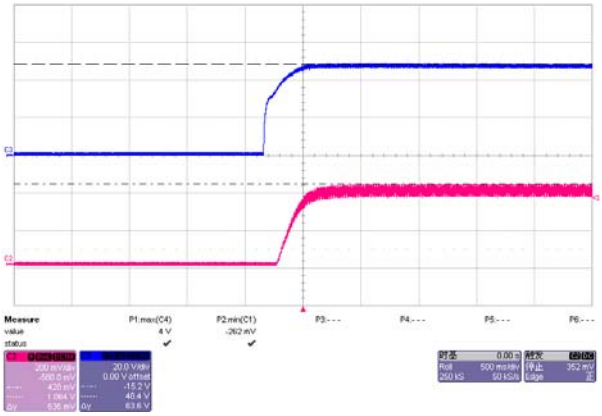


Fig. 7 Voltage & current waveform @264Vac/50Hz, output start

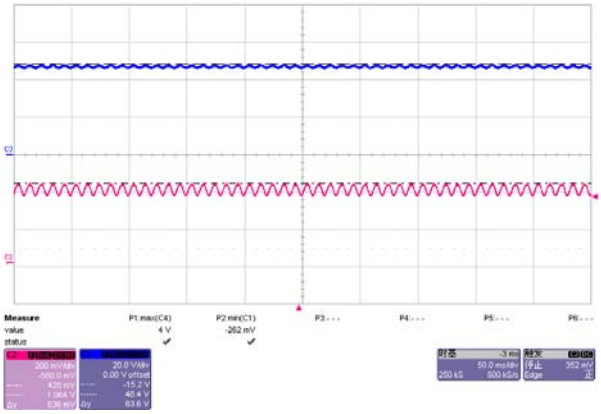


Fig. 8 Voltage & current waveform @264Vac/50Hz, normal

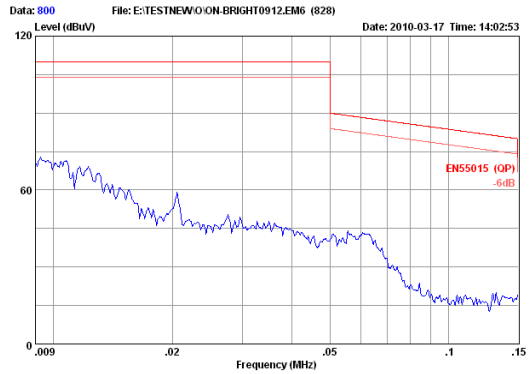
Note: The blue waveform is output voltage; the red waveform is led current, all measured with 14pcs led in series for loading.

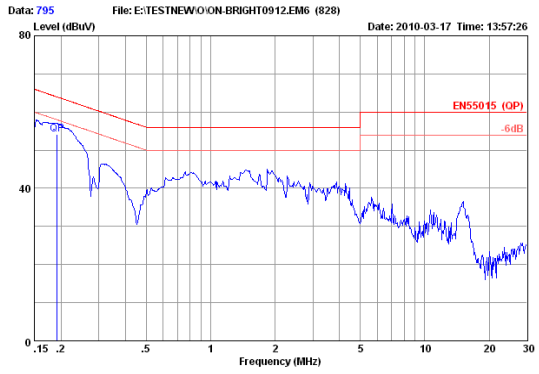
3.3. EMI Test

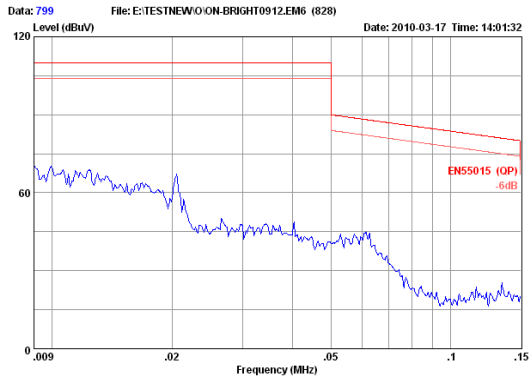
The Power supply passed EN55015 Class B & FCC PART 18 EMI requirement with more than 6dB margin

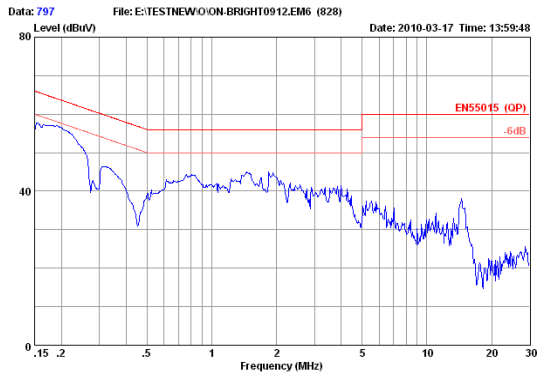
3.3.1. Conducted EMI Test

EN55015 CLASS B @ full load report

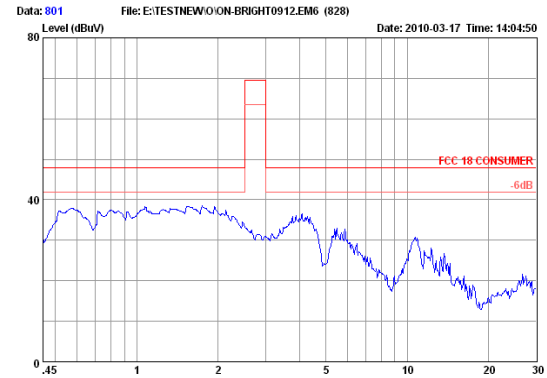


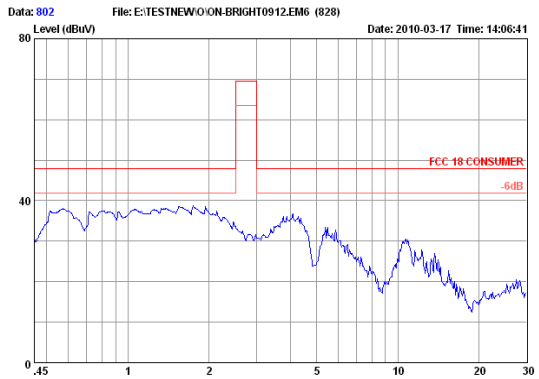






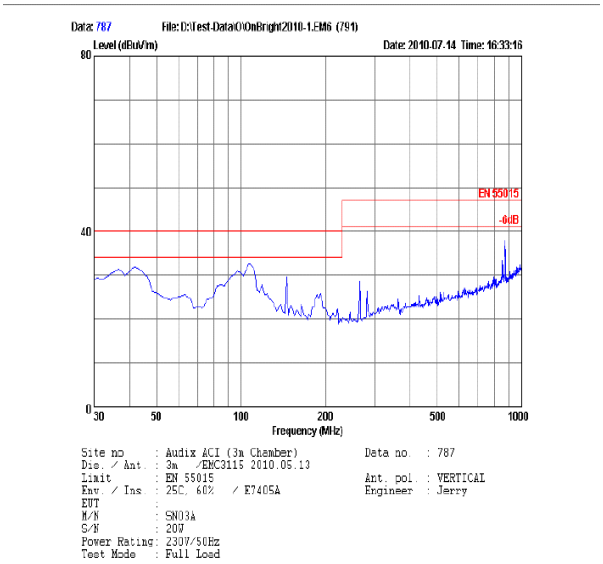
FCC PART 18 @ full load report



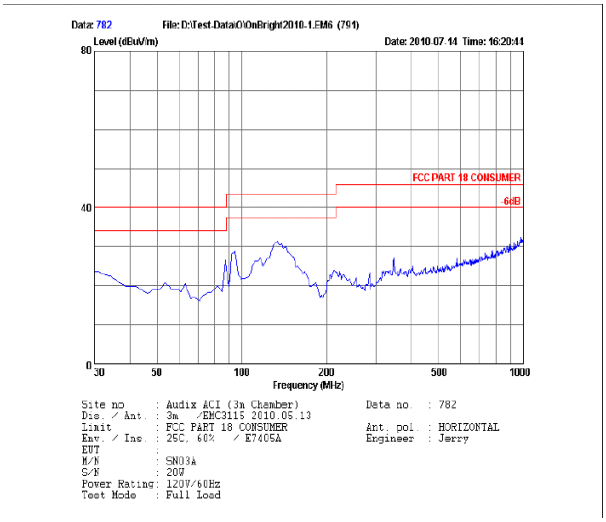


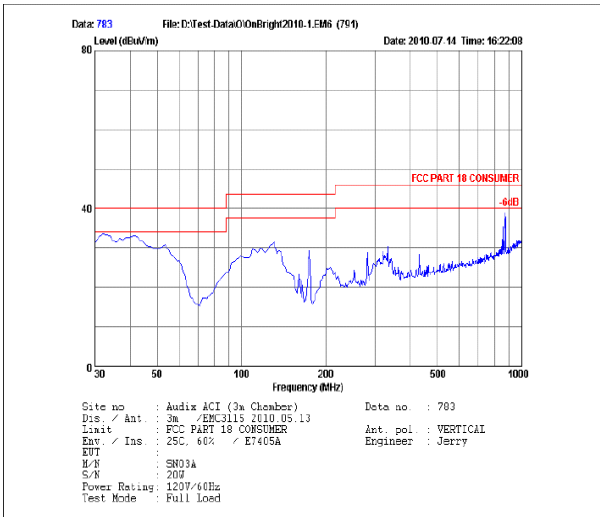
3.3.2. Radiation EMI Test

EN55015 CLASS B @ full load report



FCC PART 18 @ full load report





4. Thermal Test

The thermal test is under 40℃ ambiance after 4hour full load running with 90Vac & 264Vac input.

Table. 7 Thermal test result

Position	Description	90Vac input	264Vac Input
Q1	TK6A60	76.0℃	77.0℃
T1	T1 core	70.1℃	72.3℃
T1	T1 coil	70.6℃	71.7℃
D7	UF3004	66.0℃	72.6℃

5. Short Circuit Protection

Table. 8 Short protection & Input power

Input voltage	90Vac/60Hz	115Vac/60Hz	230Vac/50Hz	264Vac/50Hz
Short protection	Shut down	Shut down	Shut down	Shut down
Input Power (W)	0.358	0.639	1.425	1.800

6. Other Important Waveform

6.1. MOSFET Vds & Rectifier Vak @output start / normal / short

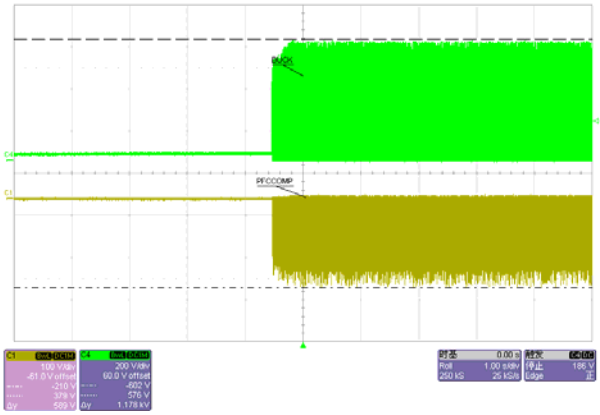


Fig. 9 Vds & Vak waveform @264 Vac/50Hz, output start

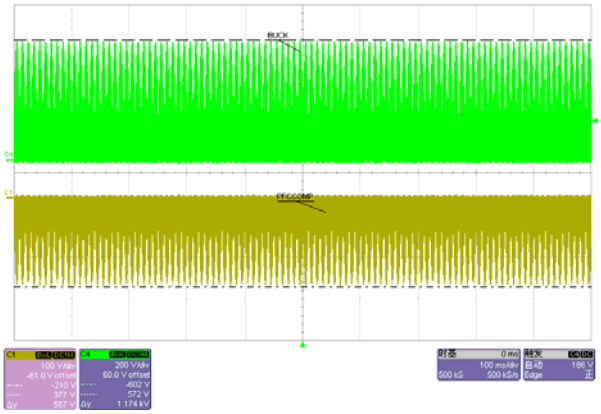


Fig. 10 Vds & Vak waveform @264 Vac/50Hz, output normal

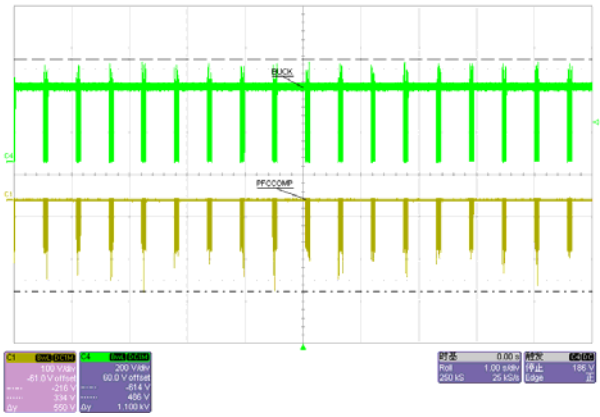


Fig. 11 Vds & Vak waveform @264 Vac/50Hz, output short

Table. 9 Vds_max, Vak_max @start/normall/output short

Input	Vds_max(V)	Vak_max(V)
264Vac/50Hz @start	576	210
264Vac/50Hz @normal	572	210
264Vac/50Hz @short	486	215

6.2. MOSFET Voltage and Current waveform

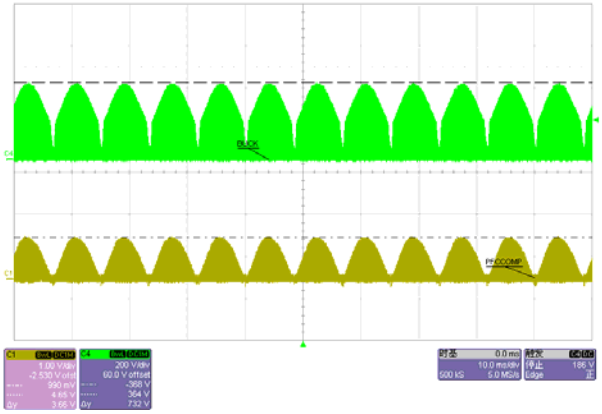


Fig. 12 Vds & Ids waveform @90Vac/60Hz, full load

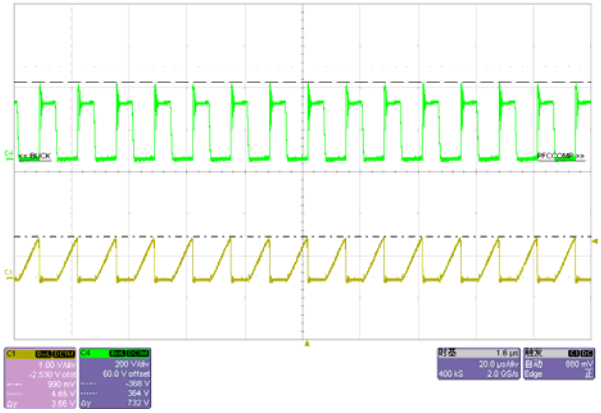


Fig. 13 Vds & Ids waveform @90Vac/60Hz, spread

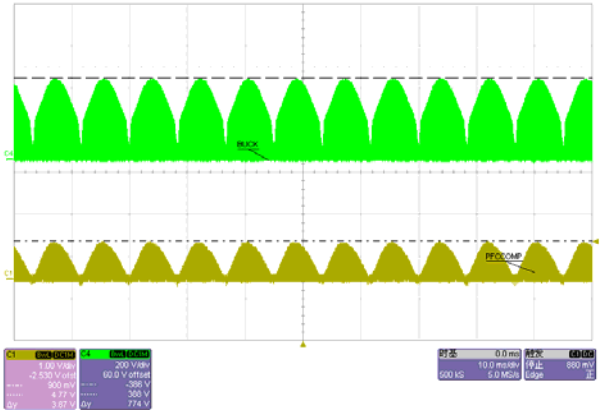


Fig. 14 Vds & Ids waveform @115Vac/60Hz, full load

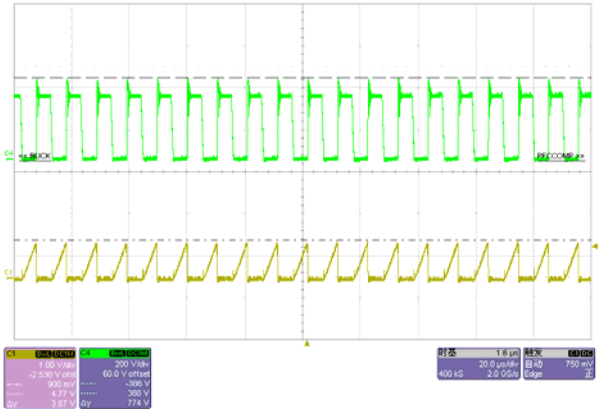


Fig. 15 Vds & Ids waveform @115Vac/60Hz, spread

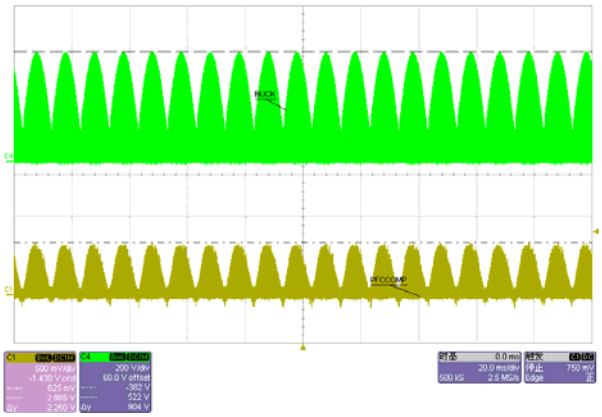


Fig. 16 Vds & Ids waveform @230Vac/50Hz, full load

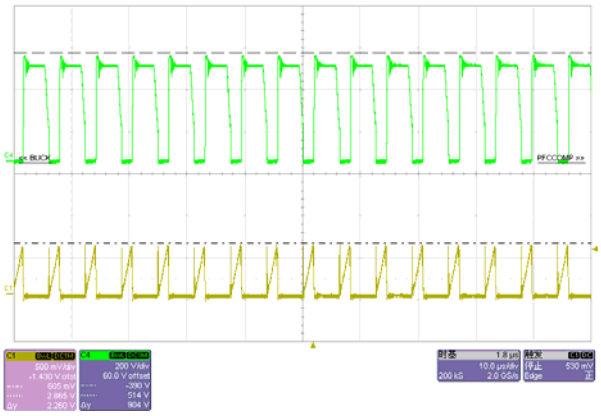


Fig. 17 Vds & Ids waveform @230Vac/50Hz, spread

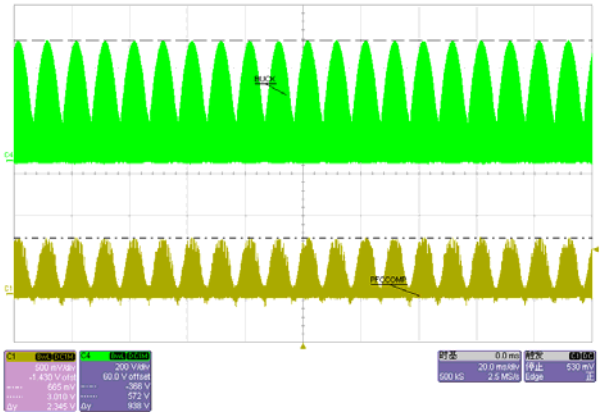


Fig. 18 Vds & Ids waveform @264Vac/50Hz, full load

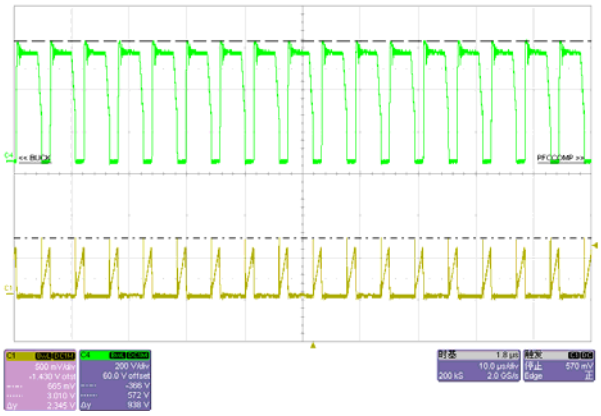


Fig. 19 Vds & Ids waveform @264Vac/50Hz, spread

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