

**Subject**  
**OB3330 Demo Board Manual**

Board Model: LED48V0.4A-OB3330.00

Doc. No.: OB\_DOC\_DBM\_A\_333000



**Key features:**

- Primary-side control with single stage PFC for LED driver
- Minimum BOM component amount
- Power factor >0.9
- THD meet IEC61000-3-2 Class C
- Short circuit protection
- Meet EN55015 & FCC Part 15 EMI

**Revision History**

Revise Date	Version	Reason/Issue
2011-12-27	00	First issue

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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                            48.0V
- Output Current                            0.4A type

### 1.3. Performance Specifications

- Output Power                            20W
- Input Current                            0.3A max
- Efficiency                                > 84%
- Line Regulation                        ±2% max
- Load Regulation                       ±5% max

### 1.4. Protection Features

- Short Circuit Protection                Output shut down with automatic recovery
- Over Voltage Protection                Output shut down with automatic recovery

### 1.5. Environments

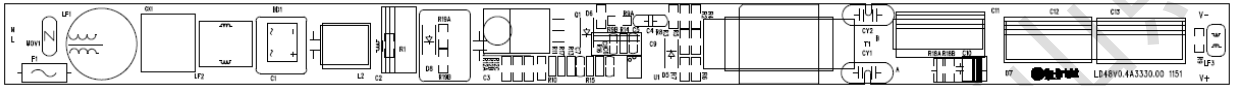
- Operating Temperature                0°C to + 70°C
- Operating Humidity                    20% to 90% R.H.
- Storage Temperature                   - 40°C to + 85°C
- Storage Humidity                       0% to 95% R.H.



## 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, ER3310, 700uH	1	
4	LF1	Common Choke, Core13*7*5mm, $\Phi$ 0.3*22Ts*2, 2mH	1	
5	LF2	Common Choke, EE12, $\Phi$ 0.21*106Ts*2, 30mH	1	
6	LF3	Common Choke, Core 8*4*3mm, $\Phi$ 0.4x10Ts*2, 60uH	1	
7	L2	Induction, DR9*12mm, $\Phi$ 0.23x230Ts, 1.8mH	1	
8	CX1	X2-CAP, 104P, +/-20%, 275Vac	1	
9	CY1,CY2	Y1-CAP, 101P, +/-20%, 250Vac	2	
10	C1	MPP, 473P/630V	1	
11	C2	E.C, 3.3uF/400V, DIP	1	
12	C3	MPP, 104P/400V	1	
13	C4	C.C, 222P/1KV, DIP	1	
14	C5	SMD, 104P/50V, 0805	1	
15	C6	SMD, 221P/50V, 0805	1	
16	C7	SMD, 474P/50V, 0805	1	
17	C9	E.C, 33uF/50V, DIP	1	
18	C10	C.C, 471P/500V, DIP	1	
19	C11-C13	E.C, 220uF/63V, Low ESR	3	
20	R1	SMD, 10K, 5%, 1206	1	
21	R2,R3	SMD, 330K, 5%, 1206	2	
22	R4,R5	SMD, 1.5M, 5%, 1206	2	
23	R6	SMD, 0R, 5%, 1206	1	
24	R7	SMD, 100K, 1%, 1206	1	
25	R8,R13	SMD, 1M, 5%, 1206	2	
26	R9	SMD, 33K, 5%, 1206	1	
27	R9A,R9B	SMD, 47K, 5%, 1206	2	
28	R10	SMD, 68R, 5%, 1206	1	
29	R11	SMD, 20K, 5%, 0805	1	
30	R12A,R12B	SMD, 3R3, 5%, 1206	2	
31	R12C	SMD, 3R9, 5%, 1206	1	
32	R14	SMD, 24K, 1%, 0805	1	
33	R15	SMD, 33K, 5%, 0805	1	
34	R16	SMD, 18K, 5%, 0805	1	
35	R17	SMD, 390R, 5%, 0805	1	
36	R18A,R18B	SMD, 47R, 5%, 1206	2	
37	R19A,R19B	SMD, 33K, 5%, 1206	2	
38	BD1	DF08S, 1A, 800V	1	
39	D5,D6	SMD Diode, RS1J	2	
40	D7	Diode, UF3004, 3A/400V	1	
41	D8	SMD Diode, M7	1	
42	U1	PFC controller, OB3330, SOP8	1	
43	Q1	MOSFET, TOSHIBA TK6A60, 6A/600V	1	
44	Bead core	For Q1 S pin	1	
45	PCB	FR-4, 277mm (L) *18mm (W) *1.0 (T)	1	

### 2.3. PCB Gerber File



Top



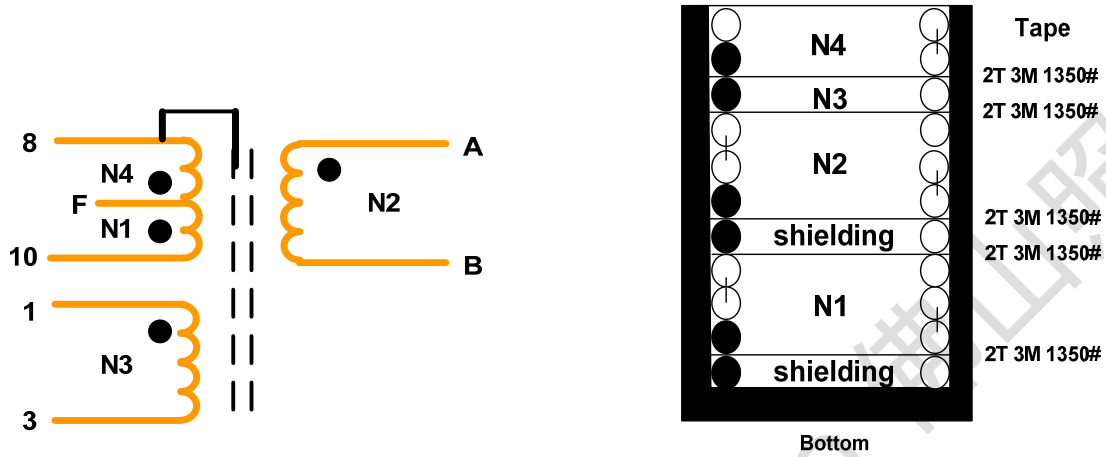
Top



Bottom

## 2.4. LED Module Snapshot

### 2.4.1. Transformer Specification



**Note:**

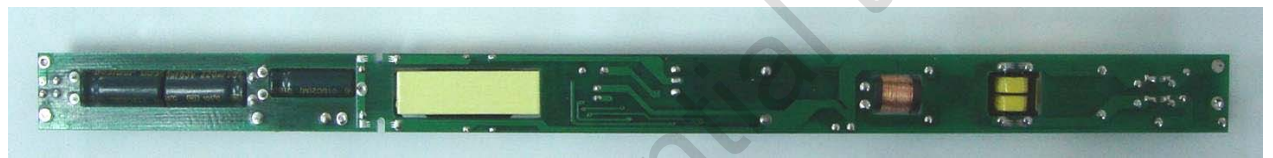
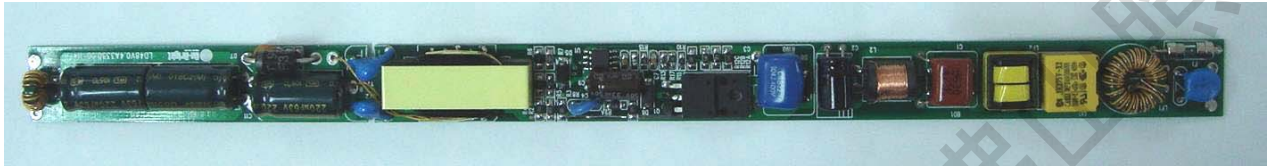
- 1) Bobbin: ER3310 (10Pin)
- 2) Core material: PC40 (TDK).or equivalent
- 3)  $L(10-8) = 700\mu\text{H} \pm 5\%$  (10KHz, 1V, 25°C)

### 2.4.2. Transformer Winding data

Winding	Material	Start	Turns	Finish
Shielding	0.18Φ*2 2UEW	8	9	NC
TAPE	TAPE W=4mm (Y)		2	
N1	0.27Φ*1 2UEW	10	35	F
TAPE	TAPE W=4mm (Y)		2	
Shielding	0.18Φ*2 2UEW	8	9	NC
TAPE	TAPE W=4mm (Y)		2	
N2	0.3Φ*1 triple insulated wire	A	22	B
TAPE	TAPE W=4mm (Y)		2	
N3	0.18Φ*2 2UEW	1	8	3
TAPE	TAPE W=4mm (Y)		2	
N4	0.27Φ*1 2UEW	F	23	8
TAPE	TAPE W=4mm (Y)		3	



## 2.5. LED Module Snapshot



**SIZE: 277mm (L) x18mm (W) x10mm (H)**

### 3. Performance Evaluation

This session presents the test results of 20W LED module up to date.  
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. Input current

Table. 1 Input current under full load

Input voltage	90V/60Hz	115V/60Hz	180V/50Hz	230V/50Hz	264V/50Hz	Spec.	Test result
Output 48V	0.25A	0.20A	0.13A	0.1A	0.09A	< 0.3A	Pass

#### 3.1.2. Efficiency

Table. 2 Efficiency under full load

Input voltage	90V/60Hz	115V/60Hz	180V/50Hz	230V/50Hz	264V/50Hz	Spec.	Test result
Output 48V	85.58%	86.90%	87.32%	86.00%	84.77%	> 84%	Pass

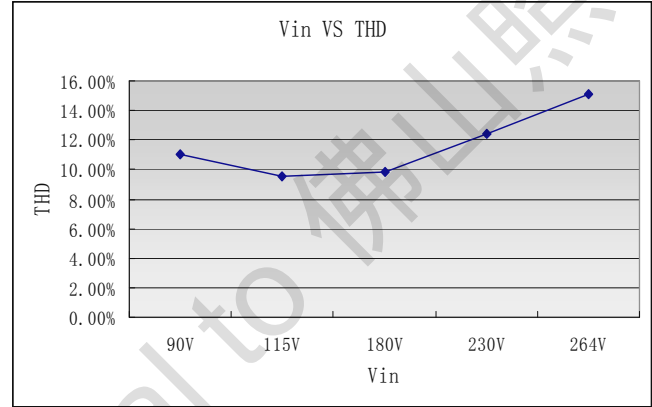
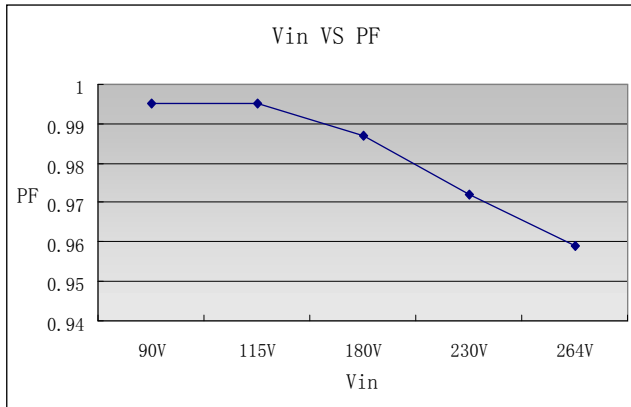
#### 3.1.3. Power Factor & THD

Table. 3 Power factor under full load

Input voltage	PF	Spec.	Test result
90V/60HZ	0.995	> 0.9	Pass
115V/60HZ	0.995		
180V/50HZ	0.987		
230V/50HZ	0.972		
264V/50HZ	0.959		

**Table. 4 THD test under full load**

Input voltage	THD	Spec.	Test result
90V/60HZ	11.0%	<b>&lt; 18%</b>	<b>Pass</b>
115V/60HZ	9.5%		
180V/50HZ	9.8%		
230V/50HZ	12.4%		
264V/50HZ	15.1%		



## 3.2. Output Characteristics

### 3.2.1. Output Current Regulation

**Table. 5 Line Regulation & Load Regulation**

Input voltage	Output 48V	Output 40V	Output 30V	Regulation	Spec.	Test result
90V/60Hz	402mA	411mA	416mA	<b>+/-1.75%</b>	<b>Load Regulation &lt; +/-5%</b>	<b>Pass</b>
115V/60Hz	405mA	414mA	416mA			
180V/50Hz	405mA	415mA	416mA			
230V/50Hz	405mA	414mA	415mA			
264V/50Hz	404mA	413mA	415mA			
<b>Regulation</b>	<b>+/-0.5 %</b>				<b>Line Regulation &lt; +/-2%</b>	

### 3.2.2. Ripple & Noise

**Table. 6 Output voltage, led current ripple & noise**

Input voltage	Current R&N (mA)	Spec.	Test result	Remark
90V/60Hz	103	<b>&lt; 120mA</b>	<b>Pass</b>	Fig. 1
115V/60Hz	102			Fig. 2
230V/50Hz	108			Fig. 3
264V/50Hz	108			Fig. 4

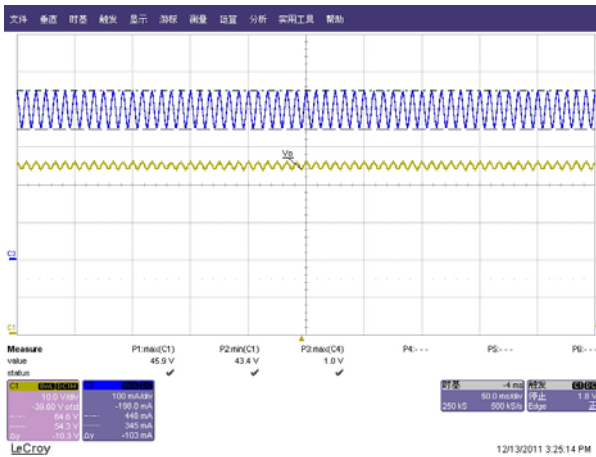


Fig. 1 Ripple & noise waveform @90Vac/60Hz

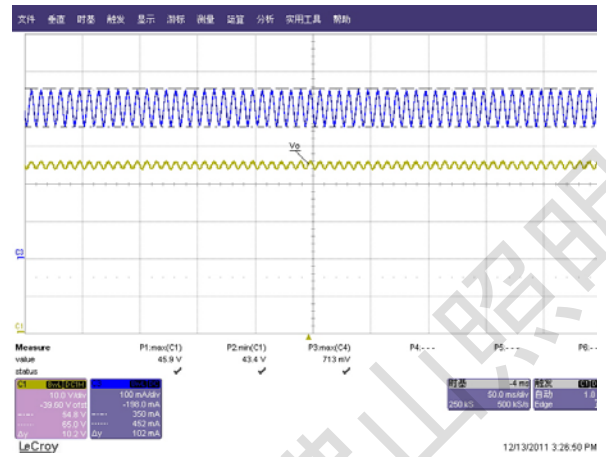


Fig. 2 Ripple & noise waveform @115Vac/60Hz

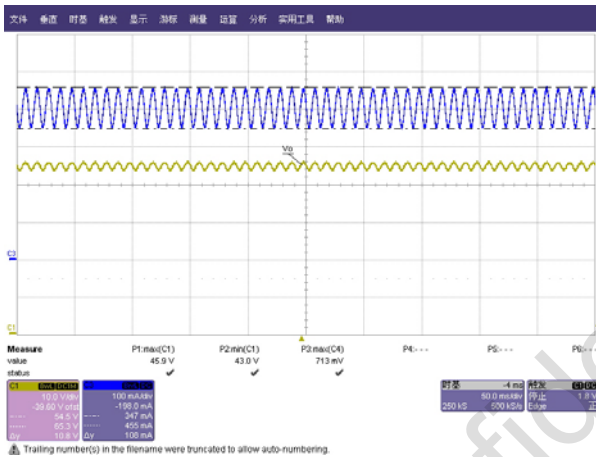


Fig. 3 Ripple & noise waveform @230Vac/50Hz

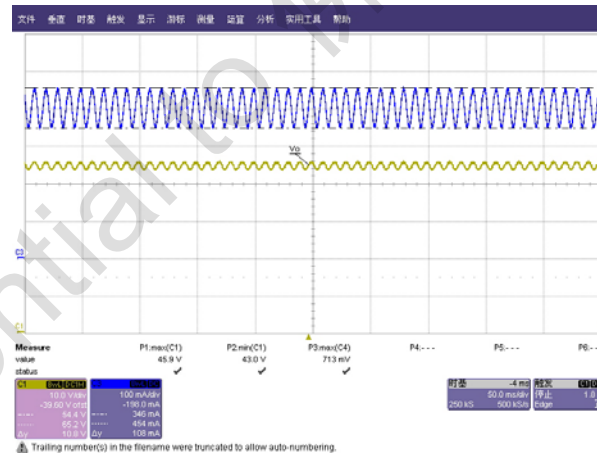


Fig. 4 Ripple & noise waveform @264Vac/50Hz

### 3.2.3. Output Voltage & Current Waveform

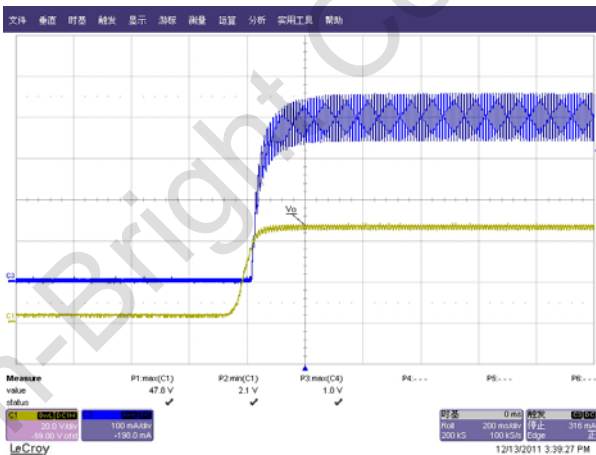


Fig. 5 Current & Voltage waveform @90Vac/60Hz, output start

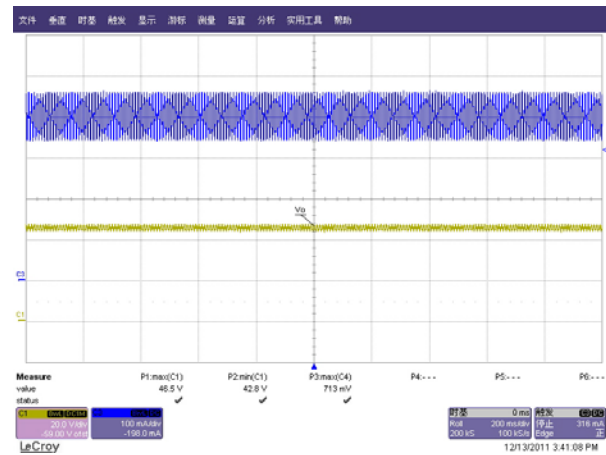


Fig. 6 Current & Voltage waveform @90Vac/60Hz, normal

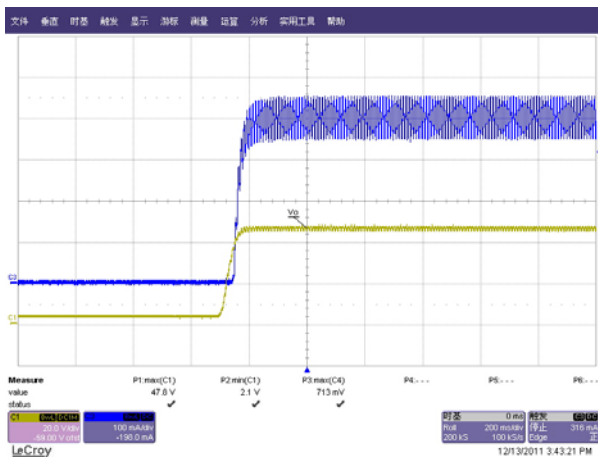


Fig. 7 Current & Voltage waveform @264Vac/50Hz, output start

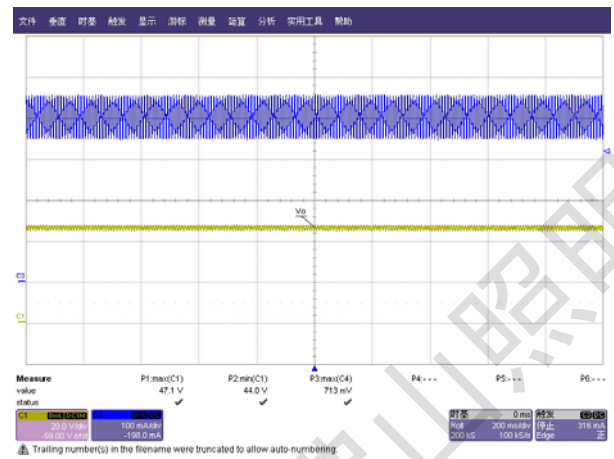


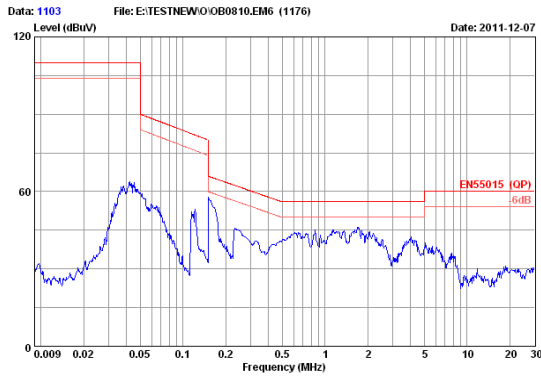
Fig. 8 Current & Voltage waveform @264Vac/50Hz, normal

### 3.3. EMI Test

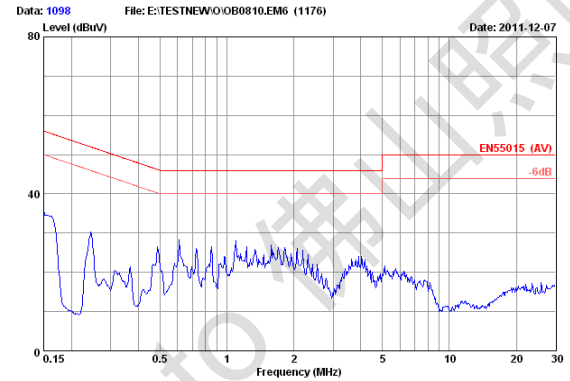
The Power supply passed EN55015 Class B & FCC Part 15 EMI requirement with more than 6dB margin

#### 3.3.1. Conducted EMI Test

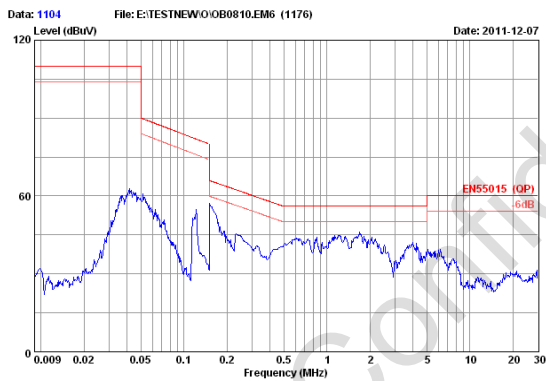
##### EN55015 CLASS B @ full load report



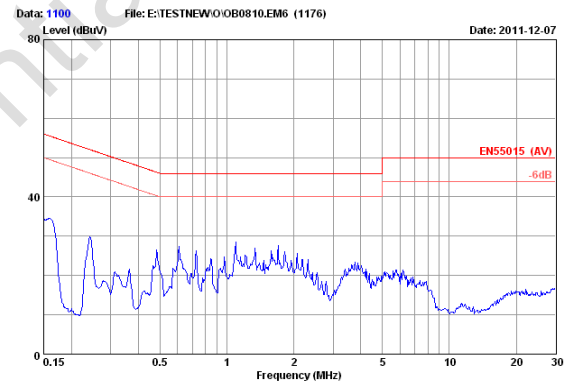
Site : Audix (Shanghai) Shielded1  
Condition : EN55015 (OP) ENV4200-11.03.22 LINE



Site : Audix (Shanghai) Shielded1  
Condition : EN55015 (AV) ENV4200-11.03.22 LINE

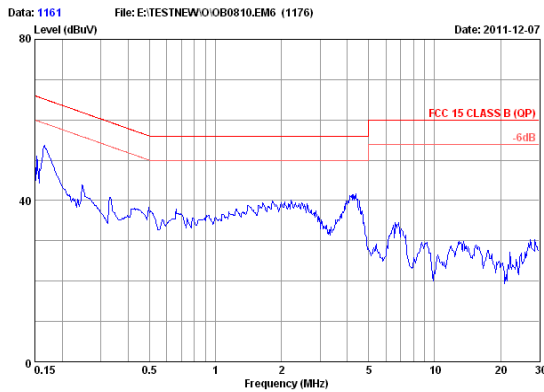


Site : Audix (Shanghai) Shielded1  
Condition : EN55015 (OP) ENV4200-11.03.22 NEUTRAL

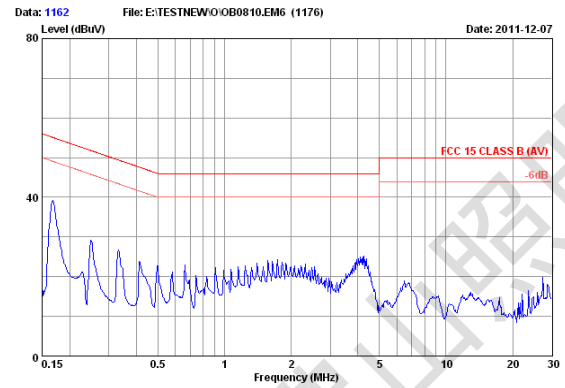


Site : Audix (Shanghai) Shielded1  
Condition : EN55015 (AV) ENV4200-11.03.22 NEUTRAL

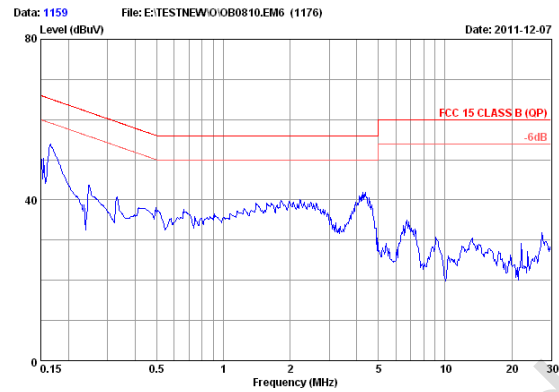
**FCC Part 15 @ full load report**



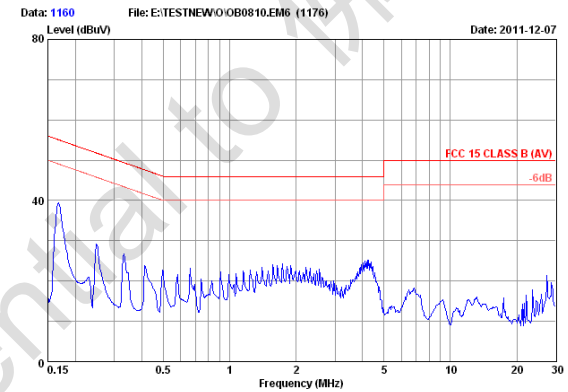
Site : Audix(Shanghai) Shielded1  
Condition : FCC 15 CLASS B (OP) ENV4200-11.03.22 LINE



Site : Audix(Shanghai) Shielded1  
Condition : FCC 15 CLASS B (AV) ENV4200-11.03.22 LINE



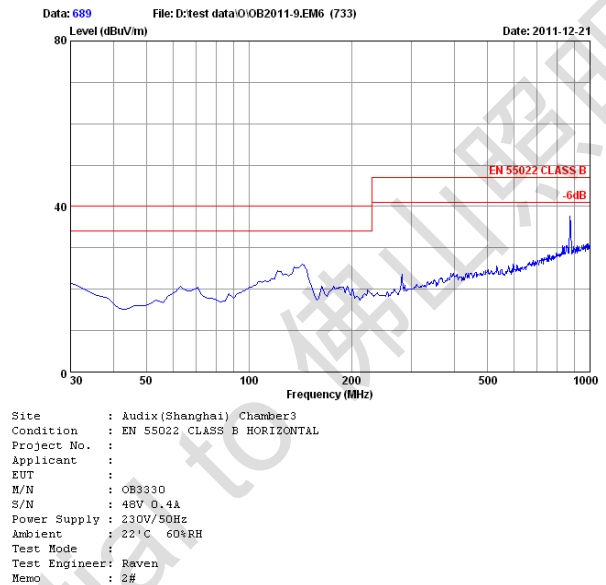
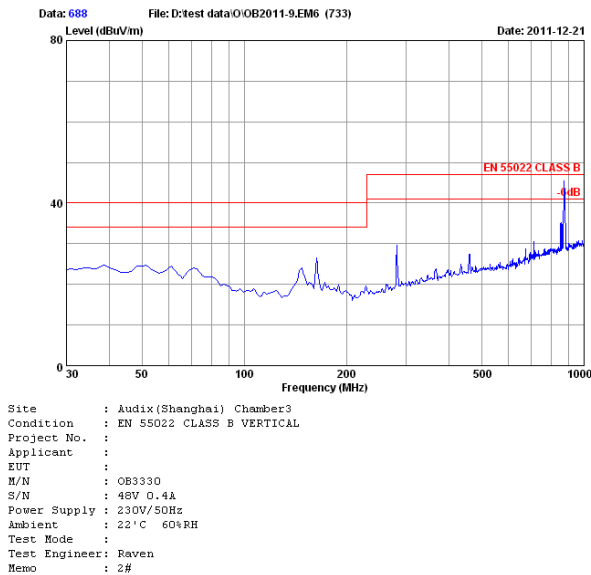
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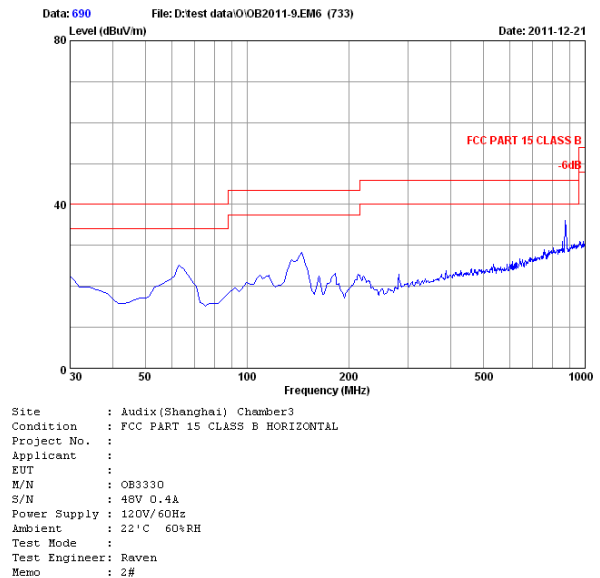
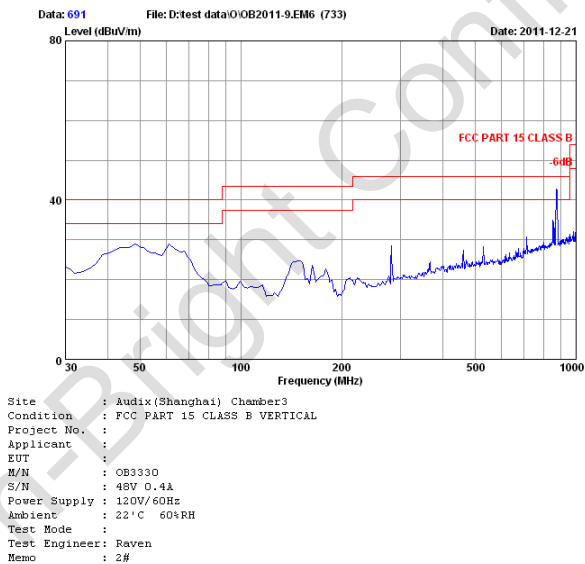
Site : Audix(Shanghai) Shielded1  
Condition : FCC 15 CLASS B (AV) ENV4200-11.03.22 LINE

### 3.3.2. Radiation EMI Test

#### EN55015 CLASS B @ full load report



#### FCC Part 15 @ full load report





### 3.4. Thermal Test

The thermal test is under 40 °C ambience after 4hour full load running with 90Vac & 264Vac input.

Table. 7 Thermal test result

Position	Description	90Vac Input	264Vac Input	Spec.	Test result
Q1	TK6A60	75.6°C	76.8°C	$\Delta T < 40^\circ\text{C}$	Pass
T1	T1 core	63.4°C	61.5°C		
T1	T1 coil	73.1°C	72.8°C		
D7	UF3004	66.2°C	74.4°C		

### 3.5. OVP

Table.8 Output voltage under no-load condition

Input voltage	90V/60Hz	115V/60Hz	230V/50Hz	264V/50Hz	Spec.	Test result
Output voltage	55.0V	55.0V	55.0V	55.0V	< 63V	Pass

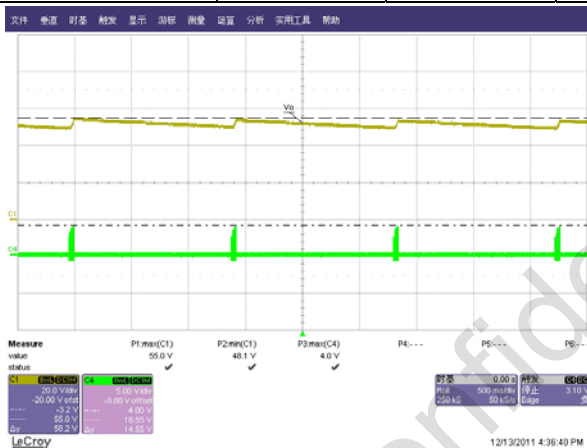


Fig. 9 Vout & Vzcd waveform @90Vac/60Hz, output no-load

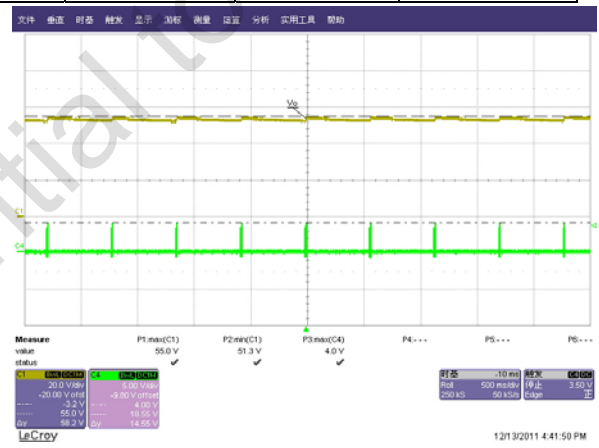


Fig. 10 Vout & Vzcd waveform @264Vac/50Hz, output no-load

### 3.6 Short Circuit Protection

Table. 9 Short protection & Input power

Input voltage	90V/60Hz	115V/60Hz	230V/50Hz	264V/50Hz	Spec.	Test result
Short protection	Shut down	Shut down	Shut down	Shut down	Shut down	Pass
Input Power (W)	0.32	0.53	1.36	1.60	< 2W	

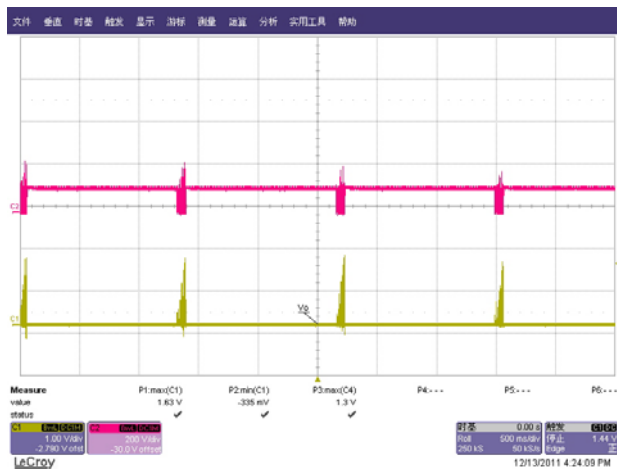


Fig. 11 Vds & Vcs waveform @90Vac/60Hz, output short

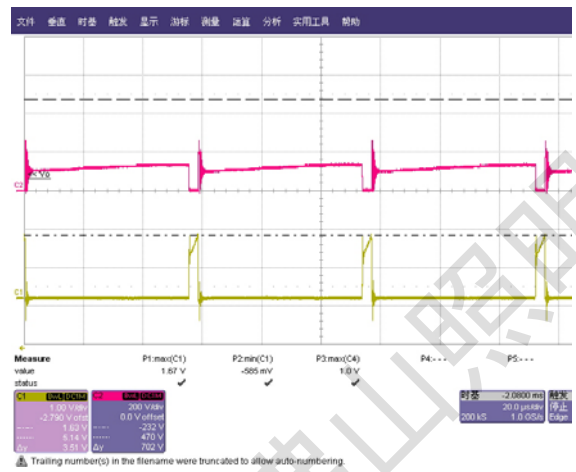


Fig. 12 Vds & Vcs waveform @90Vac/60Hz, spread

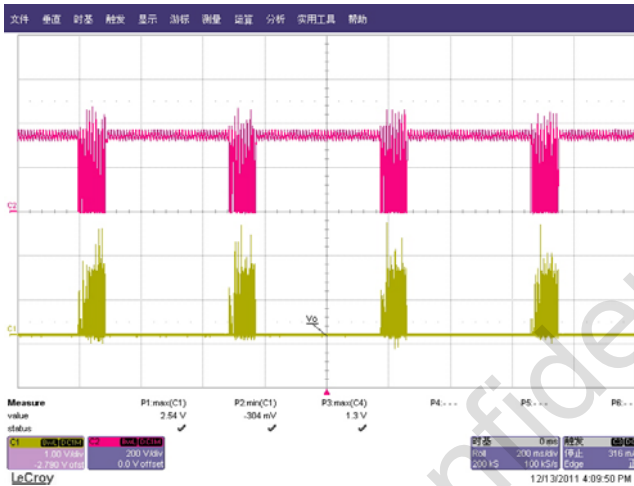


Fig. 13 Vds & Vcs waveform @264Vac/50Hz, output short

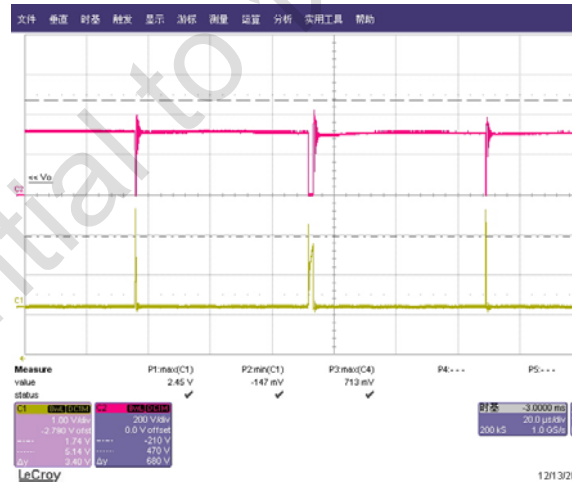


Fig. 14 Vds & Vcs waveform @264Vac/50Hz, spread

### 3.7 Other Important Waveform

#### 3.7.1 MOSFET Vds & Rectifier Vak @output start / normal / short

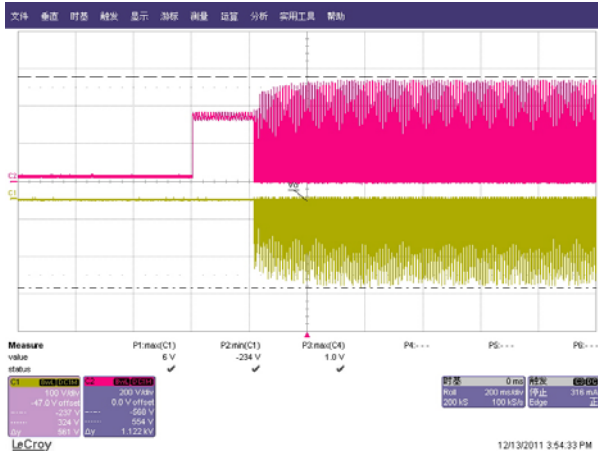


Fig. 15 Vds & Vak waveform @264 Vac/50Hz, output start

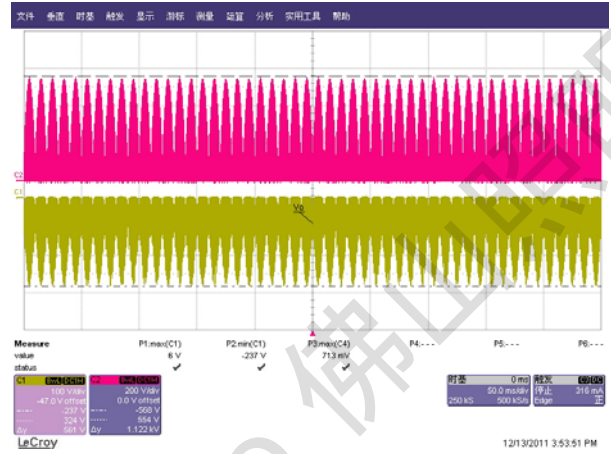


Fig. 16 Vds & Vak waveform @264 Vac/50Hz, output normal



Fig. 17 Vds & Vak waveform @264 Vac/50Hz, output short

Table.10 Vds\_max, Vak\_max @start/normal/output short

Input	Vds_max(V)	Vak_max(V)	Spec.	Test result
264V/50Hz @output start	554	237	Vds_max < 600V Vak_max < 400V	Pass
264V/50Hz @output normal	554	237		
264V/50Hz @output short	480	287		

### 3.7.2 MOSFET Voltage and Current waveform

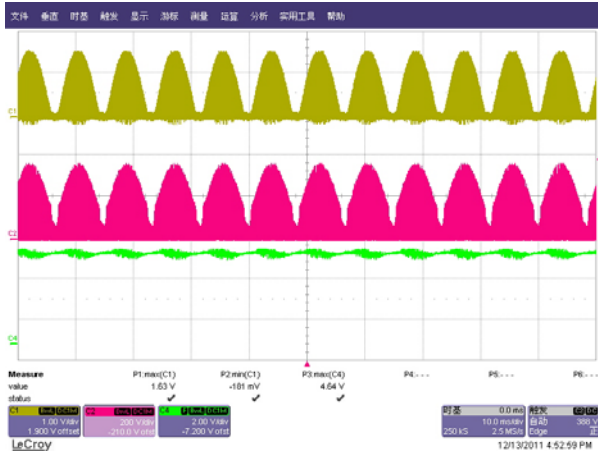


Fig. 18  $V_{cs}$ & $V_{ds}$ & $V_{comp}$  waveform @90Vac/60Hz, full load



Fig. 19  $V_{cs}$ & $V_{ds}$ & $V_{comp}$  waveform @90Vac/60Hz, spread

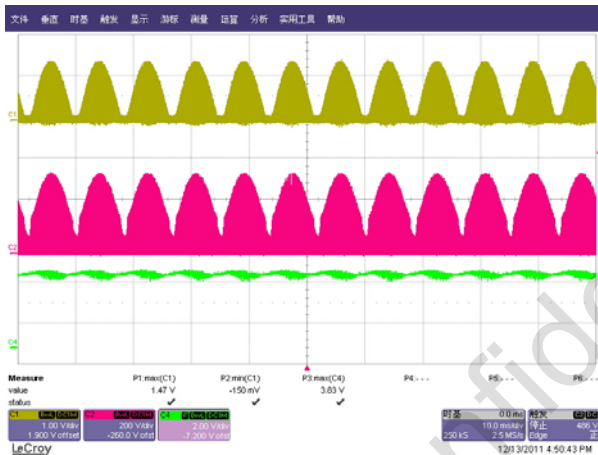


Fig. 20  $V_{cs}$ & $V_{ds}$ & $V_{comp}$  waveform @115Vac/60Hz, full load

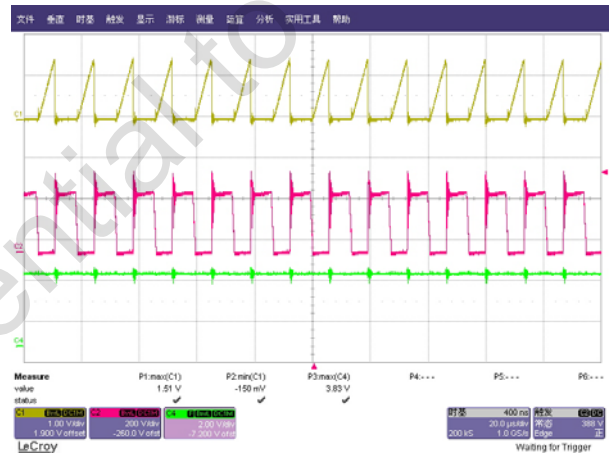


Fig. 21  $V_{cs}$ & $V_{ds}$ & $V_{comp}$  waveform @115Vac/60Hz, spread



Fig. 22  $V_{cs}$ & $V_{ds}$ & $V_{comp}$  waveform @230Vac/50Hz, full load

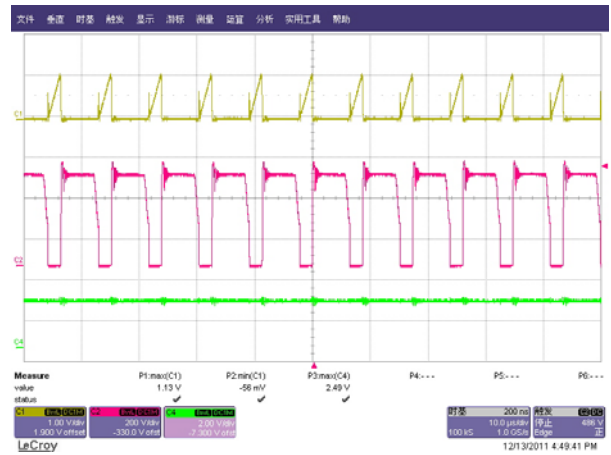


Fig. 23  $V_{cs}$ & $V_{ds}$ & $V_{comp}$  waveform @230Vac/50Hz, spread



Fig.24  $V_{cs}$  &  $V_{ds}$  &  $V_{comp}$  waveform @264Vac/50Hz, full load



Fig.25  $V_{cs}$  &  $V_{ds}$  &  $V_{comp}$  waveform @264Vac/50Hz, spread

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