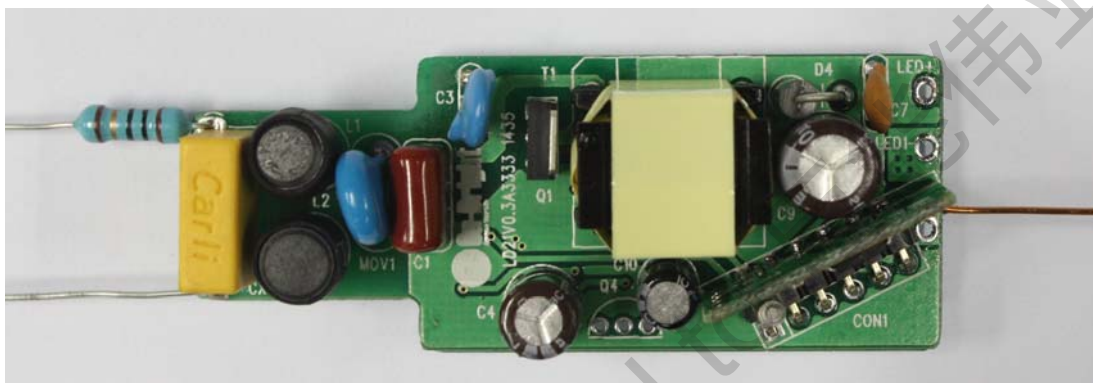


Subject

2.4G Dimmable 6W LED Lighting Demo Board Manual

Board Model: LD21V0.3A3333.00

Doc. No.: OB_DOC_DBM_A_333301



Key Features

- 2.4G color temperature and brightness adjustable for two-channel LED lighting application
- Non-isolated and primary-side constant current controller with $\pm 5\%$ current regulation
- Fast startup time 47.3mS@ 160Vac and low standby power 0.18W@ 264Vac
- Wide dimming range from 5% to 100%
- Short circuit protection and Open circuit protection
- No visible flicker and audio noise with dimming
- EMI Meet EN55015

Note: The test data in this report is by 6 Series 2 Parallel 0.5W LED array, AC voltage from 160Vac to 264Vac, 100% dimming duty if not otherwise noted.

Revision History

Revise Date	Version	Reason/Issue
2014-9-5	00	First issue
2014-10-29	01	2.4G RX Board Update

Contents Index

1	LED Lighting Specification	3
1.1	Input Characteristics	3
1.2	Output Characteristics	3
1.3	Performance Specifications	3
1.4	Protection Features	3
1.5	Environments	3
2	LED Lighting Information	4
2.1	Schematic	4
2.2	Bill of material	5
2.3	PCB Gerber File	6
2.3.1	Transformer Specification	7
2.3.2	Transformer Winding data	7
2.4	Module Snapshot	8
3	Performance Evaluation	9
3.1	Input Characteristics	10
3.1.1	Standby power	10
3.1.2	Efficiency	10
3.1.3	Power Factor	11
3.1.4	Thermal Test	11
3.2	Output Characteristics	12
3.2.1	Total LED Dimming Current	12
3.2.2	LED1 and LED2 Dimming Current	13
3.2.3	Current Ripple	13
3.2.4	Current overshoot	14
3.2.5	Time Sequence	14
3.3	EMI Test	15
3.3.1	Conduction EMI Test	15
3.3.2	Radiation EMI Test	16
4	Protection	17
4.1	Open Circuit Protection	17
4.2	Short Circuit Protection	18
4.3	Waveform at normal/ start/output open/output short	19
4.3.1	MOSFET V_{DS} and Secondary Rectifier V_{AK}	19
4.3.2	MOSFET Voltage and V_{cs} waveform with dimming	20

1 LED Lighting Specification

1.1 Input Characteristics

- AC input voltage rating 220Vac ~ 240Vac
- AC input voltage range 160Vac ~ 264Vac
- AC input frequency range 47Hz ~53Hz

1.2 Output Characteristics

- Output Current 0.3A±5%
- Output voltage 18V~21V

1.3 Performance Specifications

- Max. Output Power 6.3W
- Standby Power <300mW @ 264Vac/50Hz
- Efficiency >76%
- Turn on Delay Time 0.5Sec. Max. @ 160Vac/50Hz

1.4 Protection Features

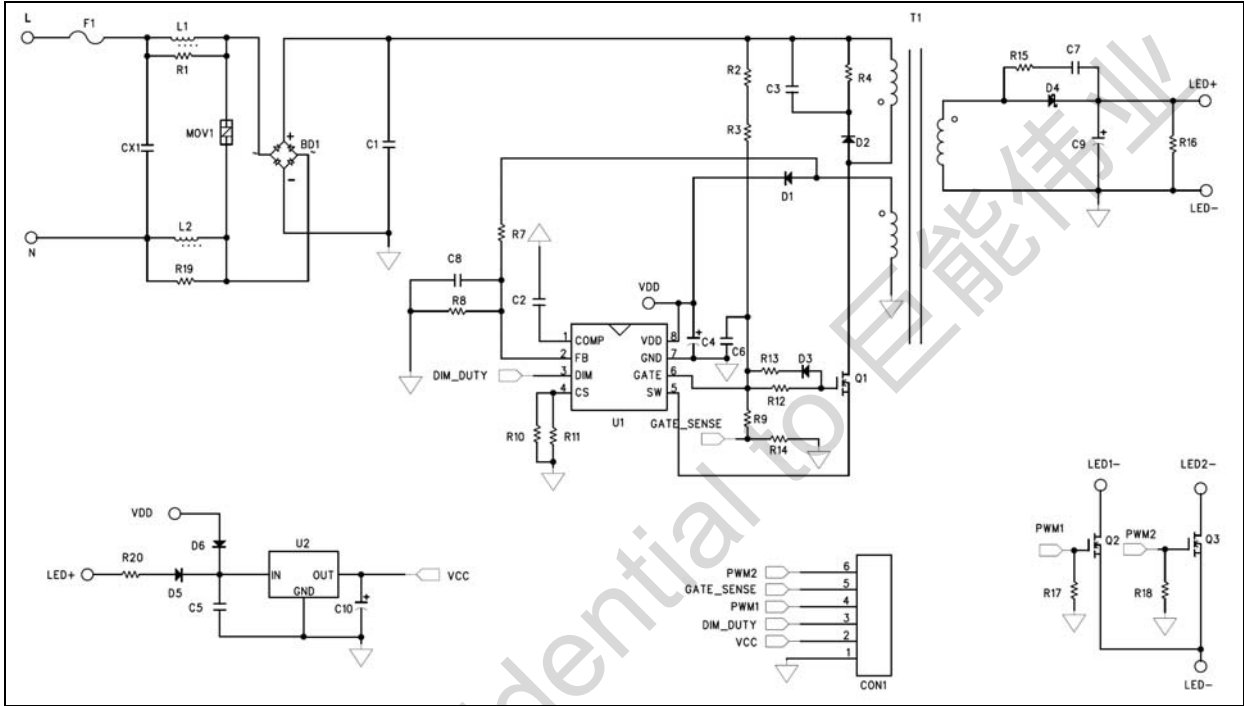
- Short Circuit Protection OK
- Open Circuit Protection OK

1.5 Environments

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

2 LED Lighting Information

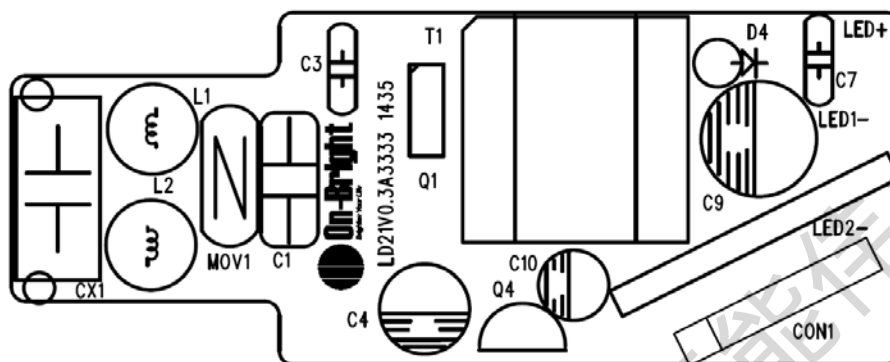
2.1 Schematic



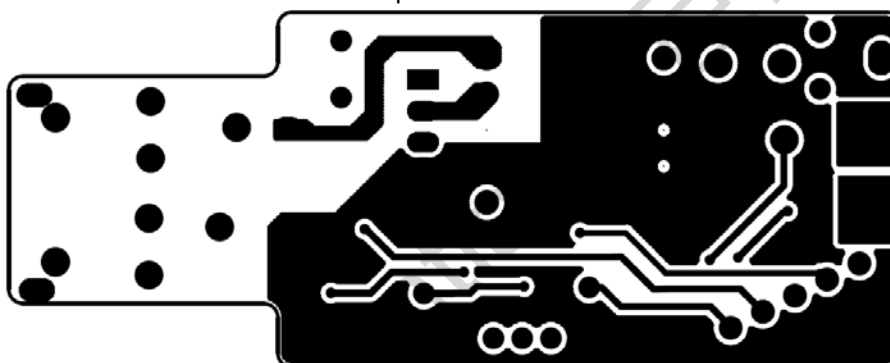
2.2 Bill of material

No.	Position	Description	Quantity	Remark
1	F1	FUSE, 10R ,1/2W	1	
2	MOV1	MOV, 7D431	1	
3	T1	Transformer, EE13,AE 32mm ²	1	
4	CX1	X2, 47nF/275V	1	
5	C1	CBB, 68nF/400V	1	
6	C2,C6	SMD, 100nF/25V, 0805	2	
7	C3	C.C, 1nF/1Kv,DIP	1	
8	C4	E.C, 47uF/25V, DIP	1	
9	C5	SMD, 1uF/35V, 0805	1	
10	C7	C.C, 470pF/1kV, DIP	1	
11	C8	SMD, 47pF/25V, 0805	1	
12	C9	E.C, 220uF/35V, Low ESR	1	
13	C10	E.C, 10uF/16V	1	
14	R1,R19	SMD, 5.6K, ±5%, 0805	2	
15	R2,R3	SMD, 1M, ±5%, 1206	2	
16	R4,R16	SMD, 100K, ±5%, 1206	2	
17	R7	SMD, 110K, ±1%, 0805	1	
18	R8	SMD, 13K, ±1%, 0805	1	
19	R9	SMD, 5.1M, ±1%, 0805	1	
20	R10	SMD, 2.2R, ±1%, 0805	1	
21	R11	SMD, 4.3R, ±1%, 0805	1	
22	R12	SMD, 200R, ±5%, 1206	1	
23	R13	SMD, 3.3R, ±5%, 1206	1	
24	R14	SMD, 1.5M, ±1%, 0805	1	
25	R15	SMD, 47R, ±5%, 1206	1	
26	R17,R18	SMD, 10K, ±5%, 0805	2	
27	R20	SMD, 0R, ±5%, 0805	1	
28	BD1	HD06, 0.8A 600V	1	
29	D1	Diode, RS1M,1A/1000V, SMD	1	
30	D2	Diode,M7,1A/1000V, SMD	1	
31	D3,D5,D6	Diode, 1N4148, SMD	3	
32	D4	Diode, HER204, 2A/300V,DO-15	1	
33	U1	OB3333, SOP8	1	
34	U2	HT7533-1,SOT-89	1	
35	Q1	MOSFET P0260AI TO-251 NIKO-SEM	1	
36	Q2,Q3	MOSFET AO3406 SOT23	2	
37	CON1	2.4G RX Board (OB6122C)	1	
38	L1,L2	DR6*8mm, 4mH, 0.12mm,390T	2	
TOTAL			47	

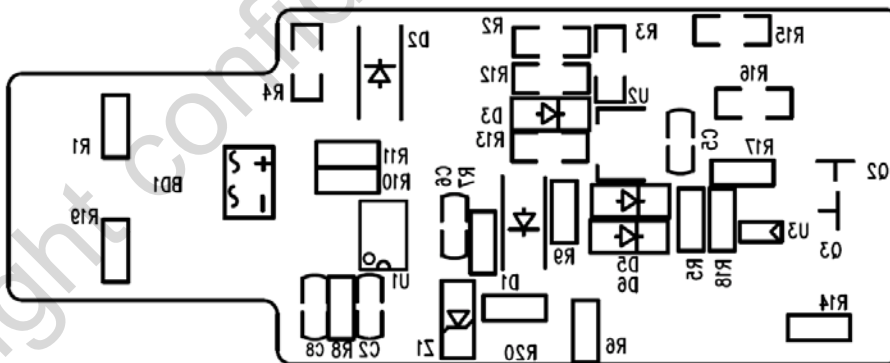
2.3 PCB Gerber File



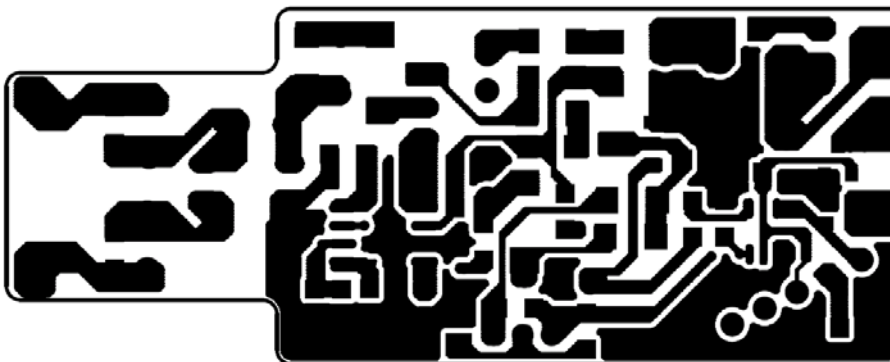
Top Silkscreen



Top

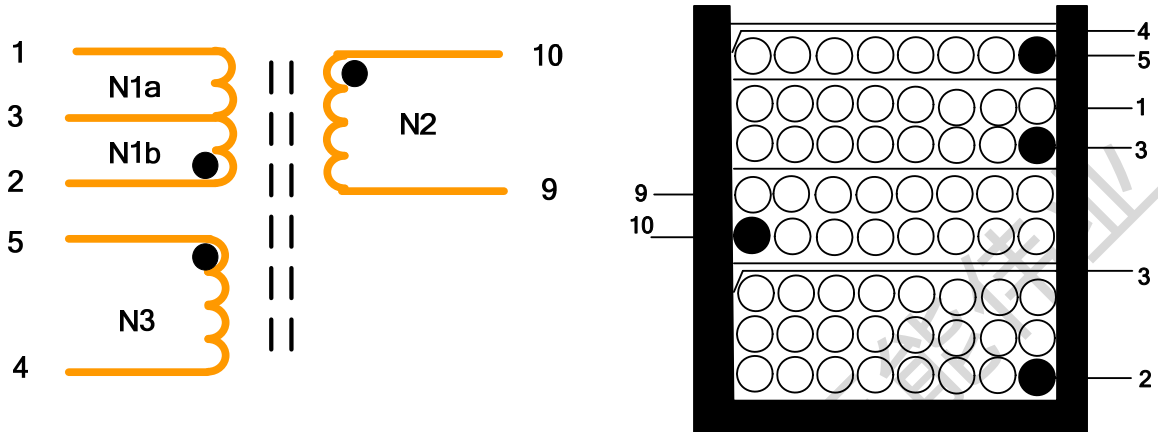


Bottom Silkscreen



Bottom

2.3.1 Transformer Specification



Note:

- 1) Bobbin: EE13 Ae=32mm² (10Pin)
- 2) Core material: PC40 (TDK).
- 3) L(1-2) = 4.15mH ± 7% (10KHz, 1V, 25°C)

2.3.2 Transformer Winding data

Step	Winding	Material	Start	Turns	Finish	Remark
1	N1b	2UEW Φ0.13×1	2	46	→	
		2UEW Φ0.13×1	→	46	→	
		2UEW Φ0.13×1	→	46	3	
2	TAPE	7.5mm		2		
3	N2	2UEW Φ0.3×1	10	22	→	
		2UEW Φ0.3×1	→	22	9	
4	TAPE	7.5mm		2		
5	N1a	2UEW Φ0.13×1	3	46	→	
		2UEW Φ0.13×1	→	46	1	
6	TAPE	7.5mm		2		
7	N3	2UEW Φ0.16×1	5	37	4	
8	TAPE	7.5mm		2		

Note: Black dot is start

3 Performance Evaluation

Performance Highlights

- Standby power under 300mW@264VAC
- Efficiency more than 76%@230VAC
- Power factor >0.7
- Startup time <0.5S
- EMI passed EN55015 test with more than 6dB margin.

Characterization Results Summary

Test Item	Test result
1. Input characteristics	
Standby power @264Vac	0.18W
Efficiency @230Vac	78.98%
2. Output characteristics	
Current overshoot	0%
3. Power factor	
Power factor @230Vac	0.828
4. Time sequence	
Turn on delay time @160Vac	47.3ms
5. Protections	
Short Circuit protection	OK
Open Circuit protection	OK

Test Equipments

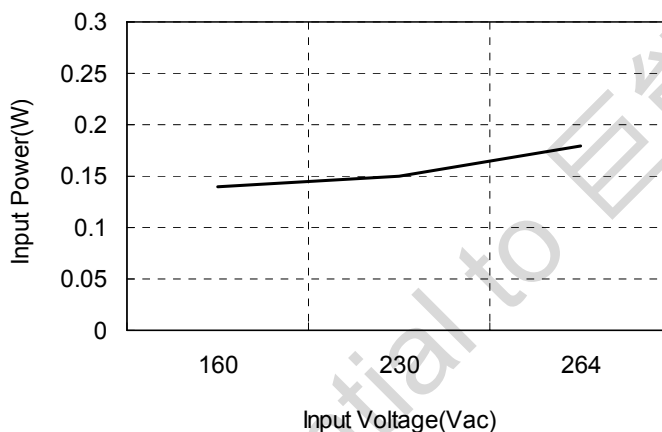
Item	Vender	Module
AC Source:	WEST	WEW1010
Digital Power Meter	YOKOGAWA	WT210
Electrical Load	Prodigit	3315C
Oscilloscope	LeCroy	WS424
Multimeter	VICTORY	VC9807A
Thermal	FLUKE	HS2

3.1 Input Characteristics

3.1.1 Standby power

Standby power

Input Voltage	160Vac/60Hz	230Vac/50Hz	264Vac/50Hz	Spec
Pin (W)	0.14	0.15	0.18	<0.3

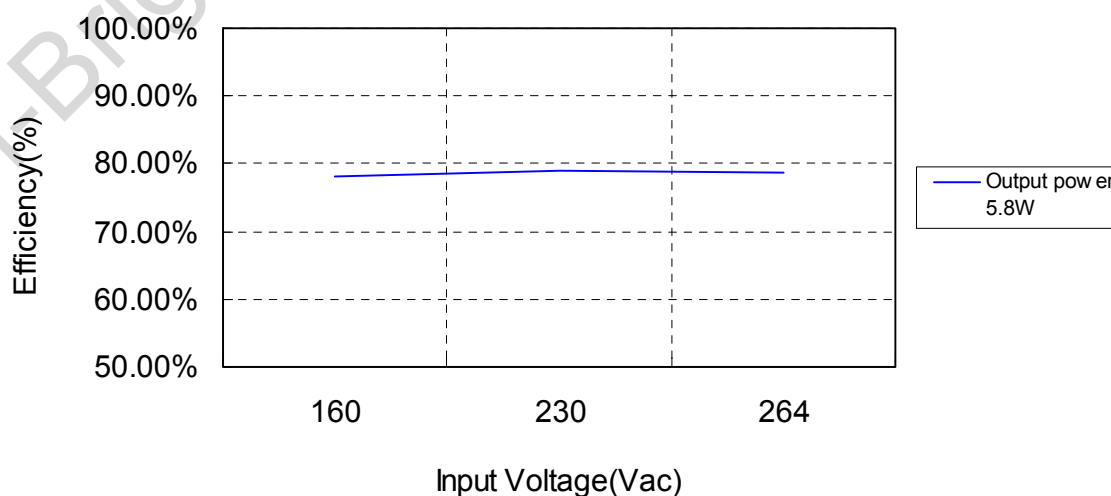


Standby Power vs. Input Line Voltage

3.1.2 Efficiency

Efficiency

	160Vac/60HZ	230Vac/50HZ	264Vac/50HZ	Spec
Output power 5.8W	78.18%	78.98%	78.77%	>76%



Efficiency vs. Input Line Voltage

3.1.3 Power Factor

Power Factor

	160Vac/60HZ	230Vac/50HZ	264Vac/50HZ	Spec
Output power 5.8W	0.874	0.828	0.798	>0.7

3.1.4 Thermal Test

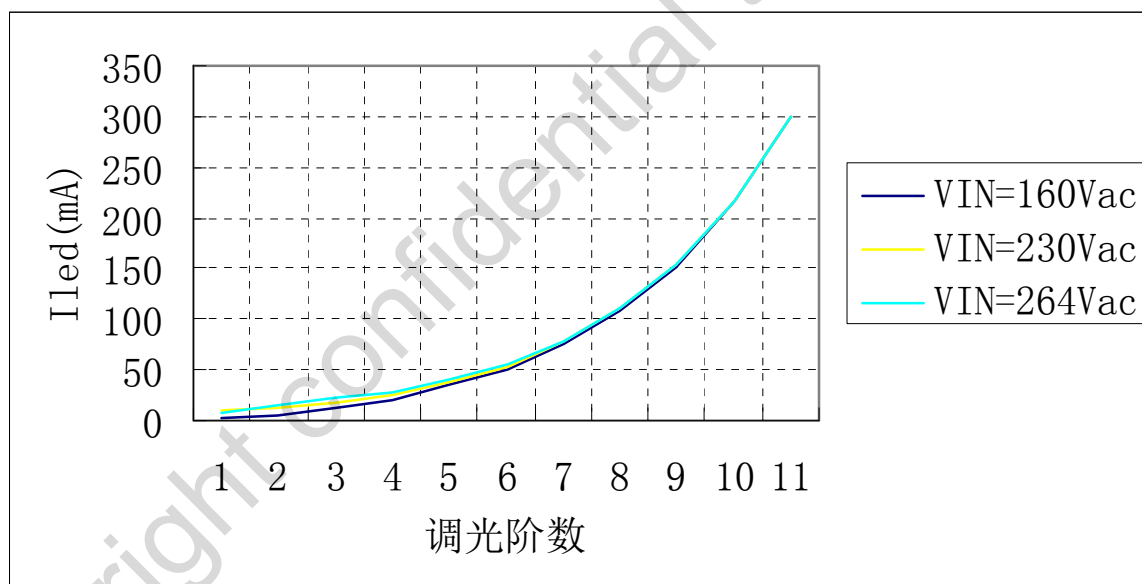
Item		VIN=160Vac	VIN=230Vac	VIN=264Vac
Transformer T1	Primary winding (°C)	65	66	66
MOSFET Q1	Package (°C)	58	58	58
DIODE D4	Package (°C)	74	75	76

Note: Thermal performance was measured by putting the power inside a box, protected from air flow. An ambient thermal probe was placed about one inch away from the power and ambient degree is 25°C Thermal test after the power had worked for an hour under output power 5.8W

3.2 Output Characteristics

3.2.1 Total LED Dimming Current

调光阶数	DIM Duty	I _{LED} (mA)		
		VIN=160Vac	VIN=230Vac	VIN=264Vac
1	4.5%	1.5	8.9	8.7
2	6.1%	5.3	12.0	15.9
3	8.4%	11.6	16.7	21.8
4	11.4%	21.0	24.8	28.1
5	15.7%	34.9	38.2	39.1
6	20.9%	51.3	53.8	56.2
7	28.5%	74.9	76.9	79.0
8	39.4%	108.7	110.1	111.1
9	53.4%	151.6	152.9	153.5
10	74.0%	216.1	216.6	217.1
11	100%	299.3	298.6	298.4



Output Current vs. Dimming step

3.2.2 LED1 and LED2 Dimming Current

LED1 PWM Duty 51%, LED2 PWM Duty 49%

调光阶数	DIM Duty	VIN=230Vac	
		I _{LED1} (mA)	I _{LED2} (mA)
1	4.5%	4.5	4.4
2	6.1%	6.1	5.8
3	8.4%	8.4	8.1
4	11.4%	12.5	12.1
5	15.7%	19.1	18.4
6	20.9%	27.0	26.0
7	28.5%	38.7	37.2
8	39.4%	55.4	53.2
9	53.4%	77.1	74.0
10	74.0%	109.4	104.9
11	100%	150.9	144.7

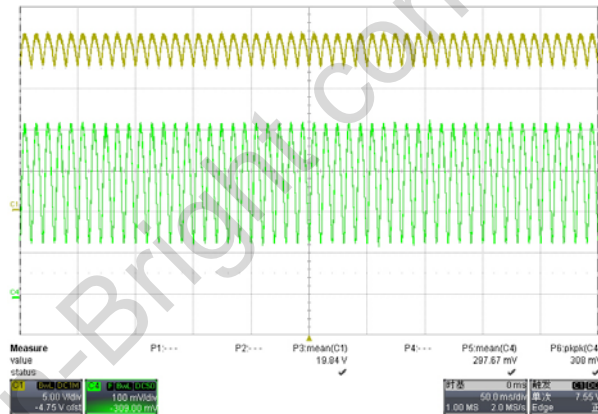
3.2.3 Current Ripple

Current Ripple measure results

Input Voltage	Current Ripple
160Vac/50HZ	308mA
264Vac/50HZ	300mA

Current ripple waveform

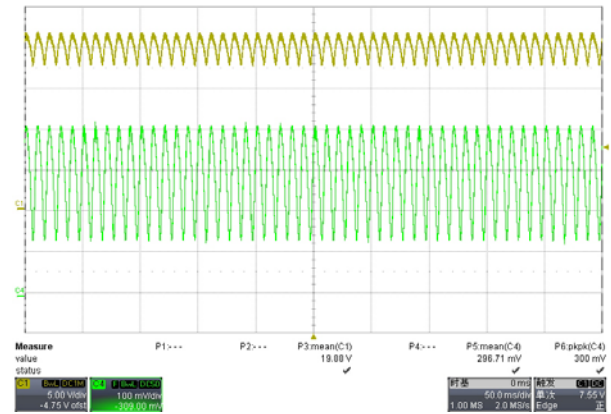
VIN=160Vac



CH1: V_{LED}
CH3:

CH2:
CH4: I_{LED}

VIN=264Vac



CH1: V_{LED}
CH3:

CH2:
CH4: I_{LED}

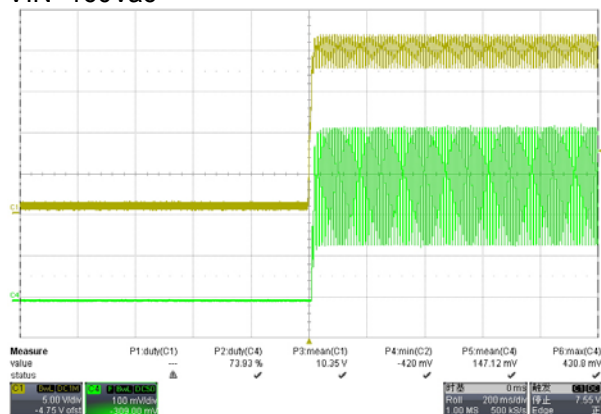
3.2.4 Current overshoot

Current overshoot measurement results

Input Voltage	Current overshoot
160V/50Hz	0%
264V/50Hz	0%

Output Voltage and Current overshoot

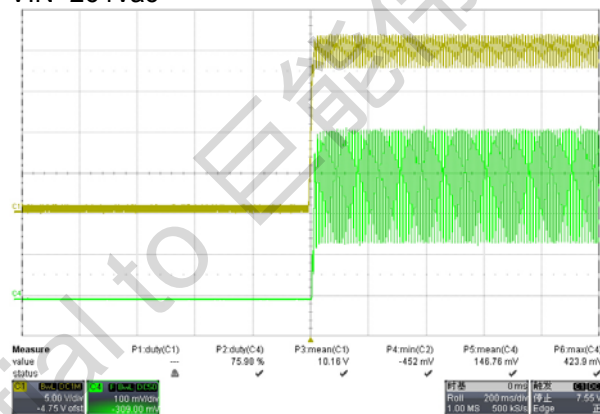
VIN=160Vac



CH1: V_{LED}
CH3:

CH2:
CH4: I_{LED}

VIN=264Vac



CH1: V_{LED}
CH3:

CH2:
CH4: I_{LED}

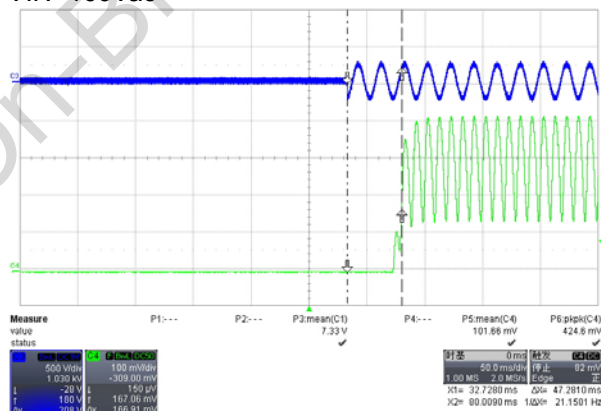
3.2.5 Time Sequence

Turn-on delay measurement results

Input voltage	Turn-on delay	Spec
160V/50Hz	47.3mS	<0.5S
264V/50Hz	29.8mS	

Turn-on delay

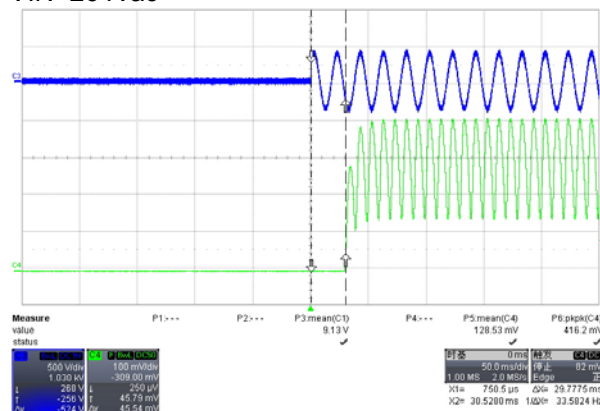
VIN=160Vac



CH1
CH3: VIN

CH2:
CH4: I_{LED}

VIN=264Vac



CH1:
CH3: VIN

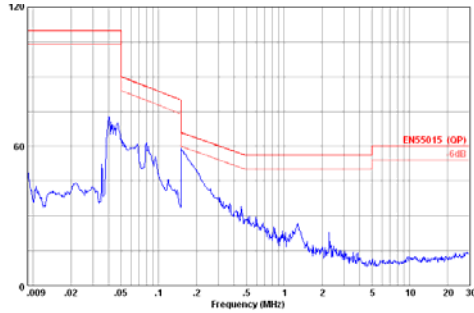
CH2:
CH4: I_{LED}

3.3 EMI Test

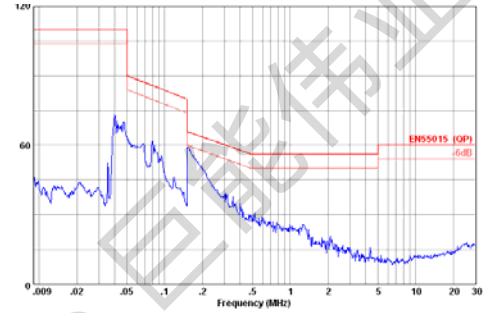
The Power supply passed EN55015 EMI requirement with more than 6dB margin

3.3.1 Conduction EMI Test

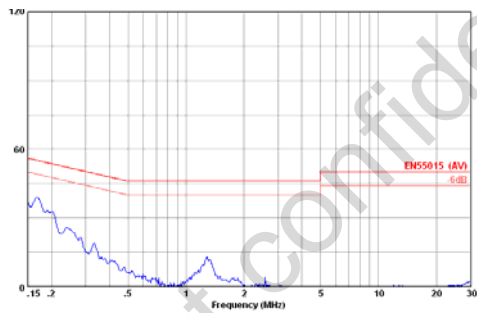
EN55015 CE



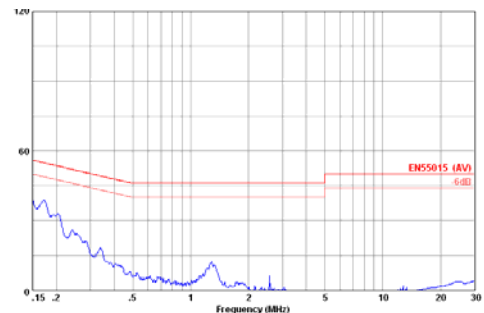
Site : Audix(Shanghai) Shielded1
 Condition : EN55015 (QP) ESH2-25-2014 LINE
 Project No. :
 Applicant :
 EUT : OB3333
 M/N :
 S/N :
 Power Supply : 230V/50Hz
 Ambient : 22°C 40%RH
 Test line : L
 Test Mode :
 Test Engineer : Jarrey
 Memo :



Site : Audix(Shanghai) Shielded1
 Condition : EN55015 (QP) ESH2-25-2014 NEUTRAL
 Project No. :
 Applicant :
 EUT : OB3333
 M/N :
 S/N :
 Power Supply : 230V/50Hz
 Ambient : 22°C 40%RH
 Test line : N
 Test Mode :
 Test Engineer : Jarrey
 Memo :



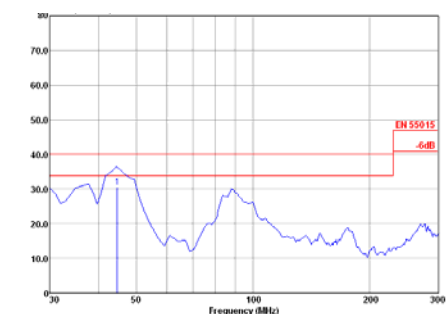
Site : Audix(Shanghai) Shielded1
 Condition : EN55015 (AV) ESH2-25-2014 LINE
 Project No. :
 Applicant :
 EUT : OB3333
 M/N :
 S/N :
 Power Supply : 230V/50Hz
 Ambient : 22°C 40%RH
 Test line : L
 Test Mode :
 Test Engineer : Jarrey
 Memo :



Site : Audix(Shanghai) Shielded1
 Condition : EN55015 (AV) ESH2-25-2014 NEUTRAL
 Project No. :
 Applicant :
 EUT : OB3333
 M/N :
 S/N :
 Power Supply : 230V/50Hz
 Ambient : 22°C 40%RH
 Test line : N
 Test Mode :
 Test Engineer : Jarrey
 Memo :

3.3.2 Radiation EMI Test

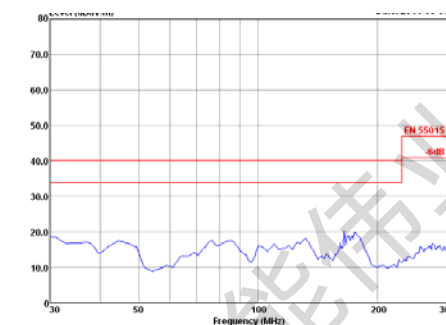
EN55015 RE



```

Site      : Audix (Shanghai) Chamber3
Condition : EN 55015 VERTICAL
Project No. :
Applicant :
EUT       :
M/N       : OB3333
S/N       :
Power Supply : 230V/50Hz
Ambient    : 22°C 60%RH
Test Mode  : Lighting
Test Engineer: Bill
Memo       :
  
```

	Read	Cable	Antenna	Level	Limit	Over	
Freq	Level	Loss	Factor	Level	Line	Limit	Remark
MHz	dBuV	dB	dS/m	dBuV/m	dBuV/m	dB	
1	44.72	19.01	0.00	10.65	30.46	40.00	-9.54 OP



```

Site      : Audix (Shanghai) Chamber3
Condition : EN 55015 HORIZONTAL
Project No. :
Applicant :
EUT       :
M/N       : OB3333
S/N       :
Power Supply : 230V/50Hz
Ambient    : 22°C 60%RH
Test Mode  : Lighting
Test Engineer: Bill
Memo       :
  
```

On-Bright confidential to 巨能伟业

4 Protection

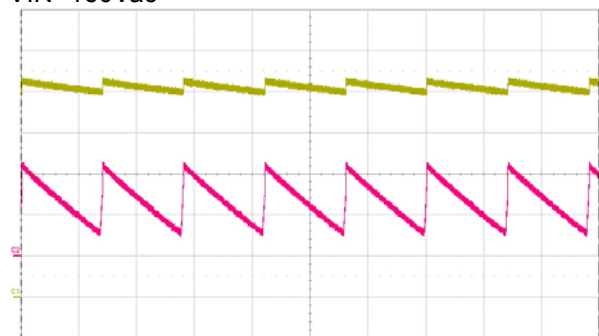
4.1 Open Circuit Protection

Output voltage under no-load condition

	160Vac/60HZ	230Vac/50HZ	264Vac/50HZ	Spec.
Output voltage	26.7V	26.7V	26.7V	<30V

Output Open

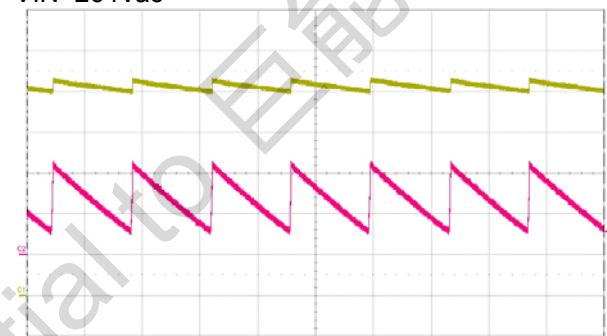
VIN=160Vac



CH1: Vout
CH3:

CH2: VDD
CH4:

VIN=264Vac



CH1: Vout
CH3:

CH2: VDD
CH4:

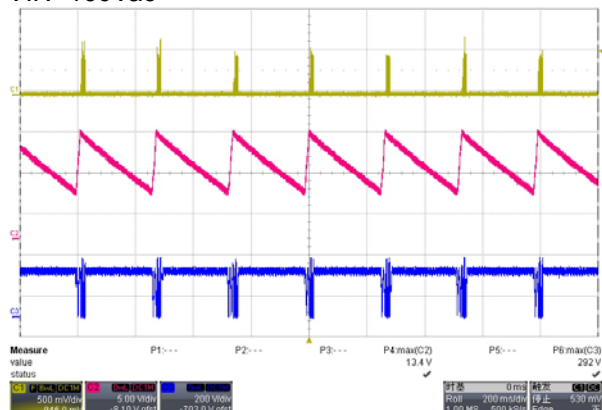
4.2 Short Circuit Protection

Output short protection & Input power

	160Vac/60HZ	230Vac/50HZ	264Vac/50HZ	Spec.
Input Power (W)	0.54	0.78	0.87	< 1W

Output Short

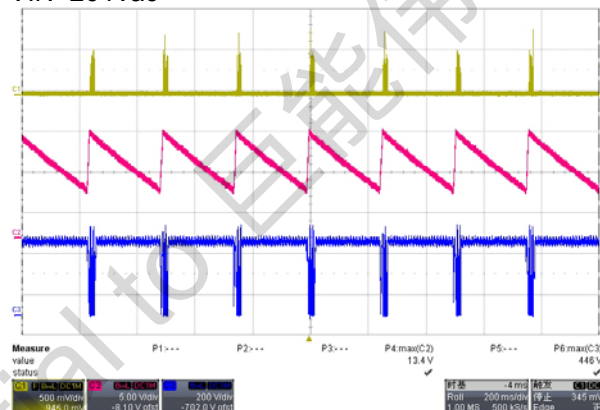
VIN=160Vac



CH1: V_{CS}
CH3: V_{DS}

CH2: V_{DD}
CH4:

VIN=264Vac

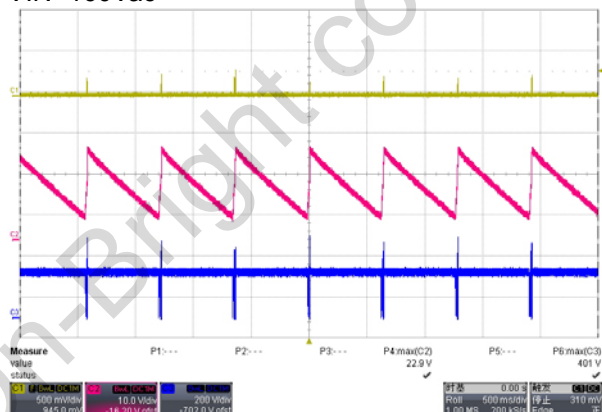


CH1: V_{CS}
CH3: V_{DS}

CH2: V_{DD}
CH4:

LED Short

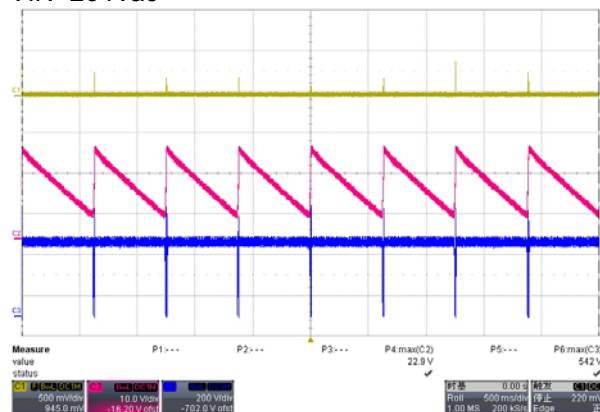
VIN=160Vac



CH1: V_{CS}
CH3: V_{DS}

CH2: V_{DD}
CH4:

VIN=264Vac



CH1: V_{CS}
CH3: V_{DS}

CH2: V_{DD}
CH4:

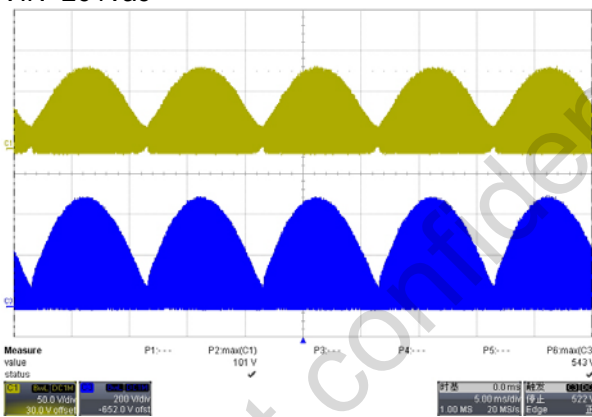
4.3 Waveform at normal/ start/output open/output short

4.3.1 MOSFET V_{DS} and Secondary Rectifier V_{AK}

Input	$V_{DS_max}(V)$	$V_{AK_max}(V)$
Normal @ 264Vac/50Hz	543	101
Start @ 264Vac/50Hz	543	101
Output open @ 264Vac/50Hz	543	96
Output short @ 264Vac/50Hz	447	108

Normal

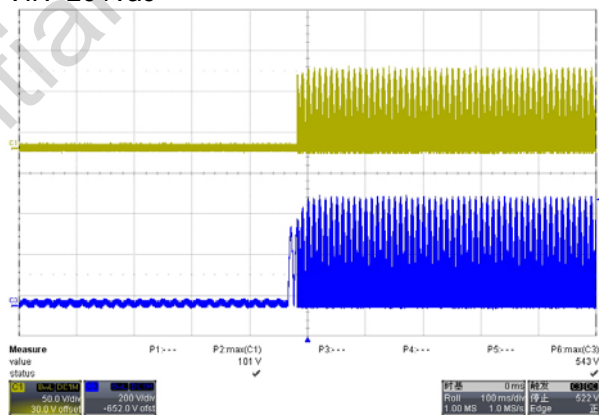
VIN=264Vac



CH1: V_{AK}
CH3: V_{DS}
CH2:
CH4:

Startup

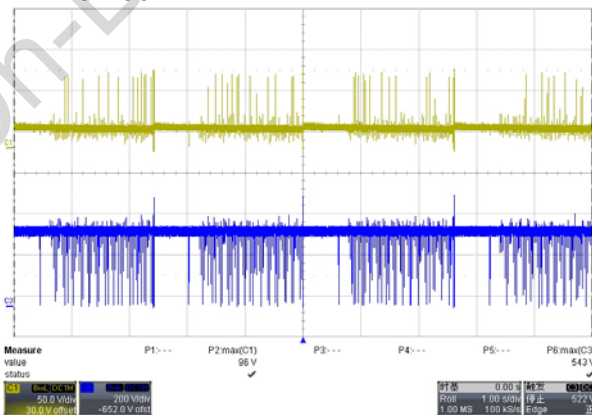
VIN=264Vac



CH1: V_{AK}
CH3: V_{DS}
CH2:
CH4:

Output open

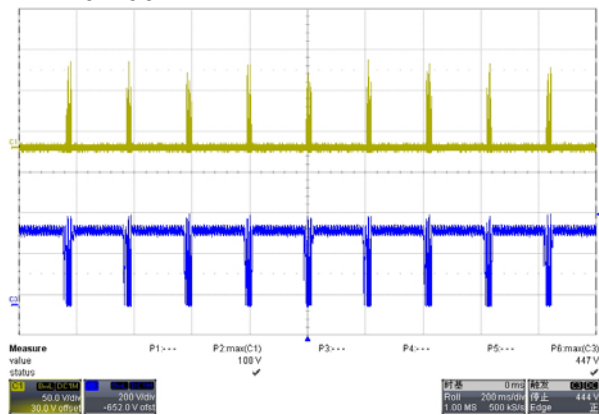
VIN=264Vac



CH1: V_{AK}
CH3: V_{DS}
CH2:
CH4:

Output short

VIN=264Vac

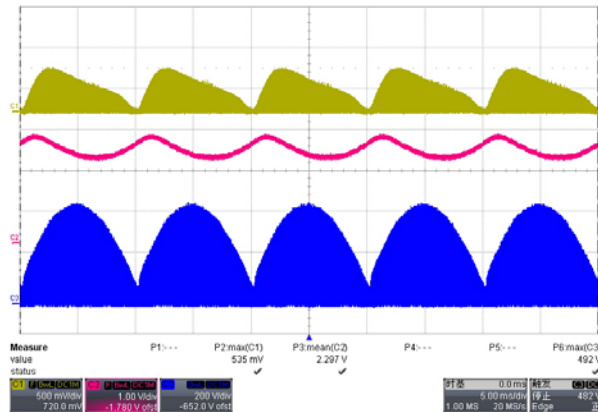


CH1: V_{AK}
CH3: V_{DS}
CH2:
CH4:

4.3.2 MOSFET Voltage and Vcs waveform with dimming

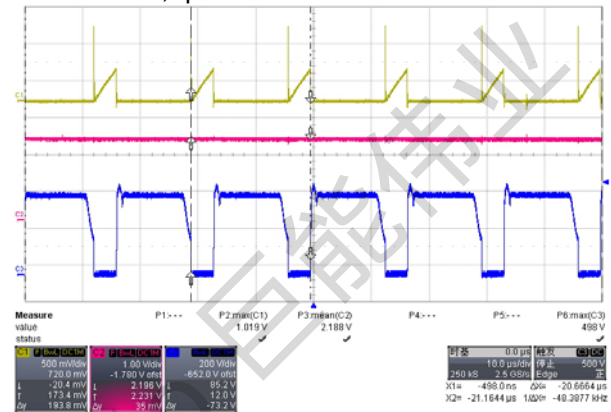
100% DIM Duty

VIN=230Vac



CH1: V_{CS} CH2: V_{COMP}
 CH3: V_{DS} CH4:

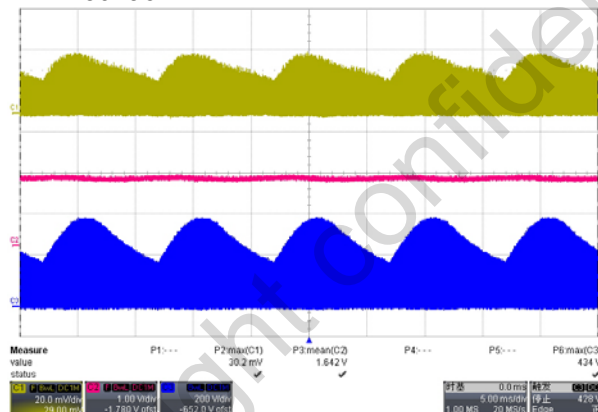
VIN=230Vac, Spread



CH1: V_{CS} CH2: V_{COMP}
 CH3: V_{DS} CH4:

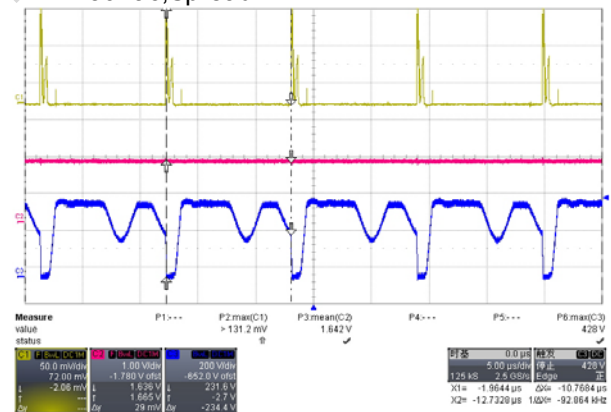
4.5% DIM Duty

VIN=230Vac



CH1: V_{CS} CH2: V_{COMP}
 CH3: V_{DS} CH4:

VIN=230Vac, Spread



CH1: V_{CS} CH2: V_{COMP}
 CH3: V_{DS} CH4:

Disclaimer

On-Bright Electronics reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its documents, products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

This document is under copy right protection. None of any part of document could be reproduced, modified without prior written approval from On-Bright Electronics.