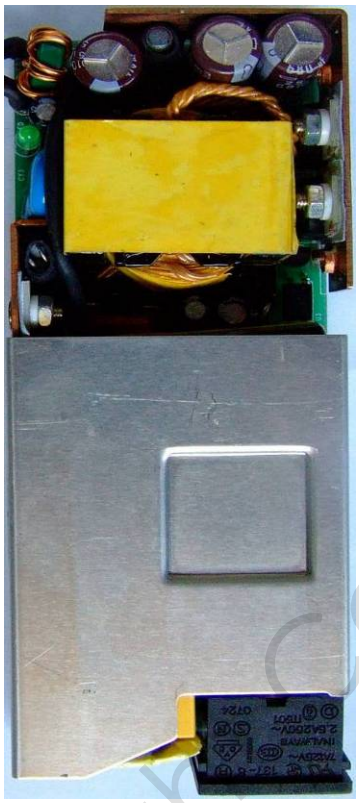
Subject

OB2203 Demo Board Manual

Board Model: AD19V4.73A2203.01
Doc. No.: OB_DOC_DBM_A_0301



Key features:

- PFC is shut down when system goes to standby
- Standby power less than 0.28W under 264VAC no load
- High efficiency more than 87.36% under normal line with full load
- OCP with line compensation
- Programmable soft start
- Precise OVP
- Meet EN55022 EMI

Revision History

Revise Date	Version	Reason/Issue
2007-10-29	00	First issue
2007-12-14	01	CY1,CY2 rejigger 2.2nF/250V/Y2

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1. Adaptor 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: 19.0V
- Output Tolerance: ±5%
- Min. load current: 0A
- Max. load current: 4.73A

1.3. Performance Specifications

- Max. Output Power: 90W
- Standby Power: <0.5W @ 240V/50Hz, no load, 25°C
- Efficiency: >85% @Ave. 25/50/75/100%Load, normal line, 25°C
- Line Regulation: ±2% Max
- Load Regulation: ±5% Max
- Ripple & Noise: 380mVpp Max
- Hold up Time: 10m Sec. Min. @100Vac with full load
- Turn on Delay Time: 2 Sec. Max. @100Vac with full load

1.4. Protection Features

- Short circuit Protection: Output shut down with automatic recovery
- Over Voltage Protection: Output shut down without automatic recovery

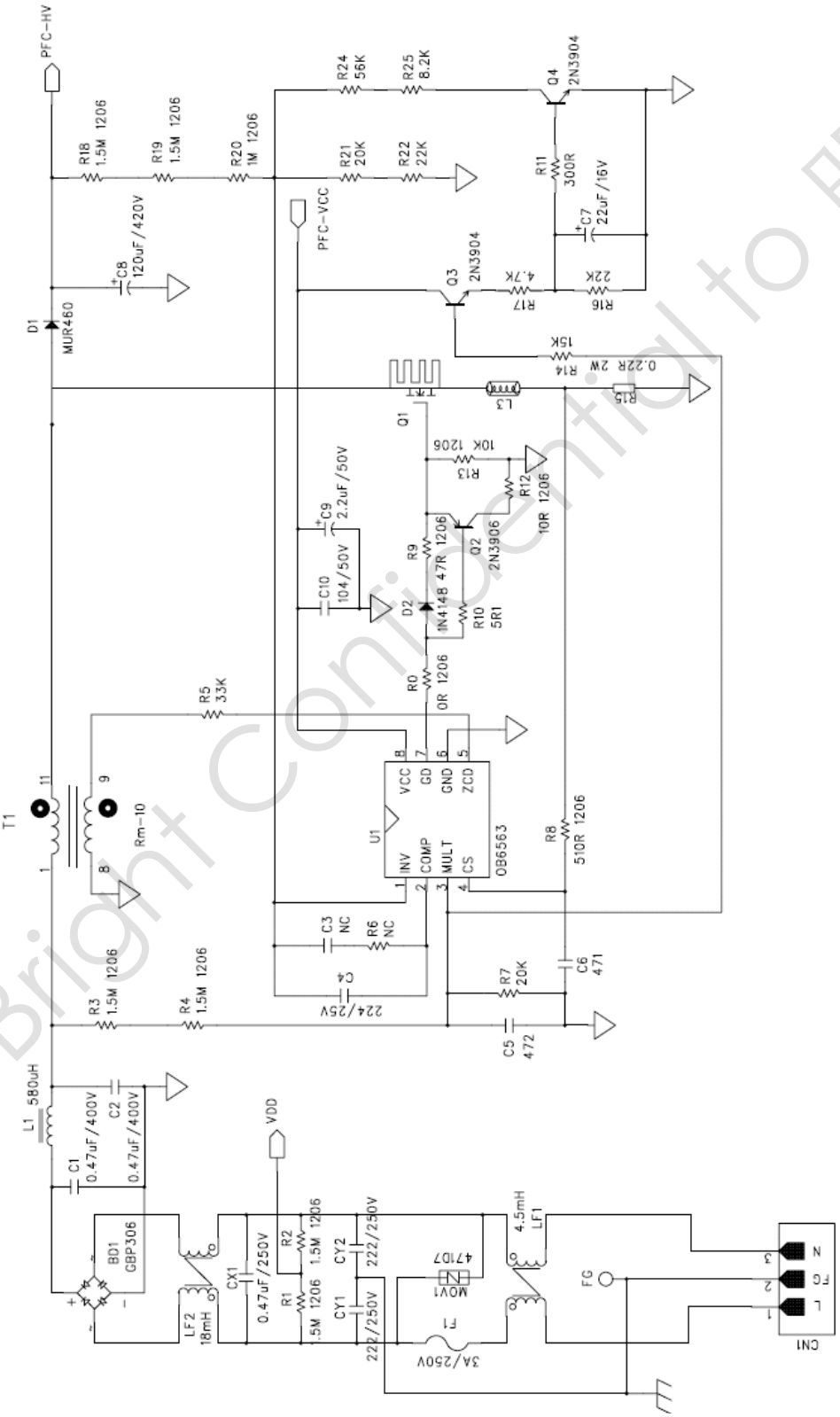
1.5. Environments

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

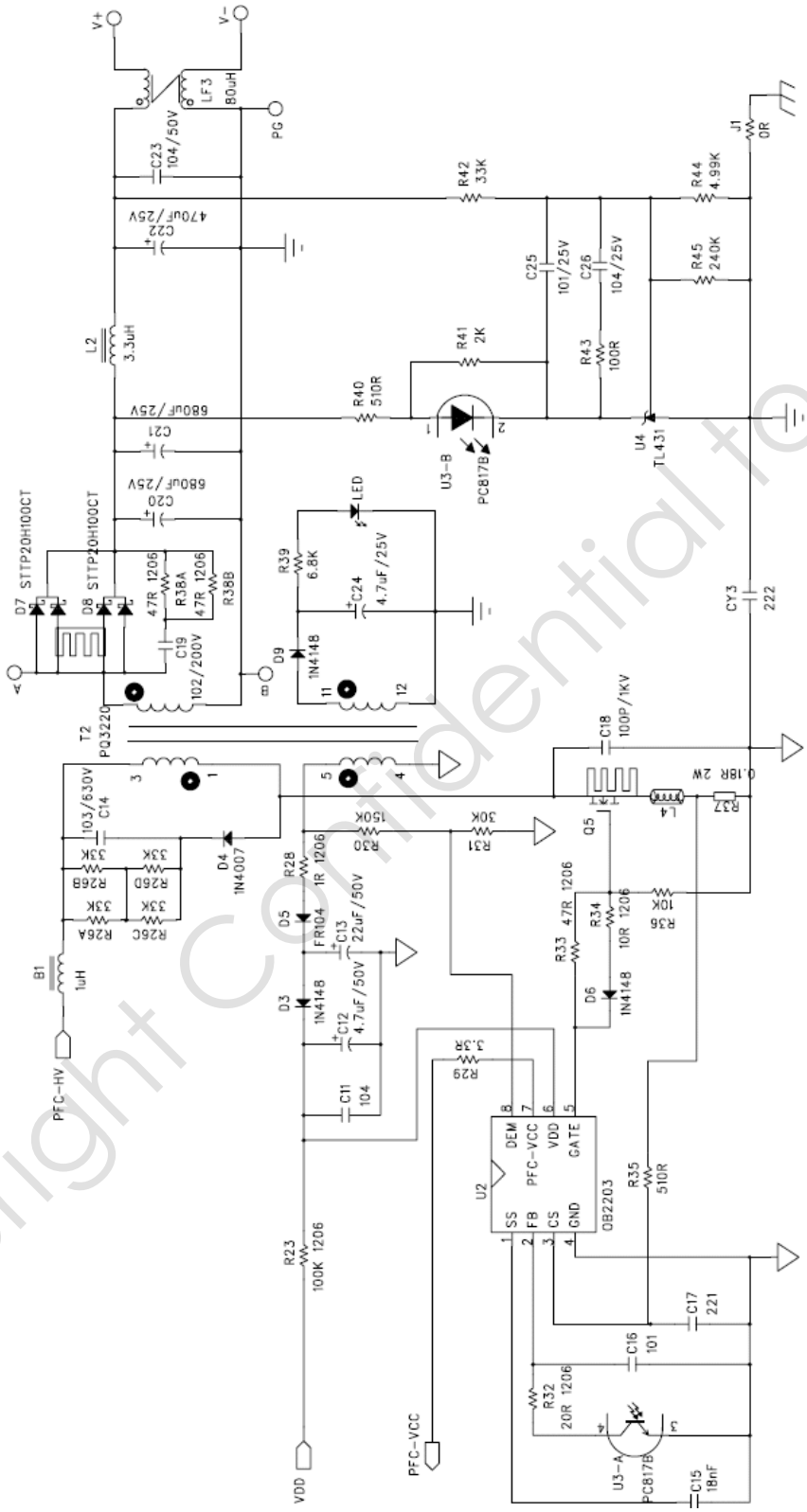
2. Adaptor Module Information

2.1. Schematic

PFC Part:



PWM Part:

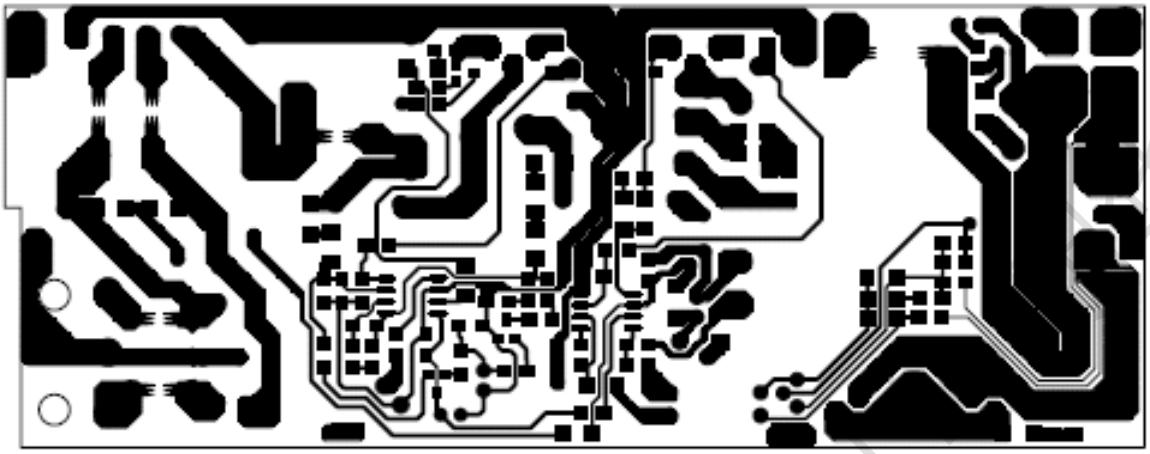


2.2. Bill of material

No	Position	Description	Quantity
1	BD1	Diode, bridge recovery, GBP306, 3A/ 600V	1
2	C1.C2	Capacitor, metal poly, 0.47U/400V, -40/105℃,±20%	2
3	C4	Capacitor, ceramic,220nF/25V, X7R, ±10%,SMD0805	1
4	C5	Capacitor, ceramic,4.7nF/25V, X7R, ±10%,SMD1206	1
5	C6	Capacitor, ceramic,470PF/25V, X7R, ±10%,SMD1206	1
6	C7.C13	Capacitor, aluminum electrolytic, 22uF/50V, -40/105℃,±20%	2
7	C8	Capacitor, aluminum electrolytic, 120uF/420V, -40/105℃,±20%,Φ18*30mm	1
8	C9.	Capacitor, aluminum electrolytic, 2.2uF/50V, -40/105℃,±20%	1
9	C10.C11.C26	Capacitor, ceramic,100nF/50V, X7R, ±10%,SMD0805	3
10	C12.C24	Capacitor, aluminum electrolytic, 4.7uF/50V, -40/105℃,±20%	2
11	C14	Capacitor, metal poly, 10nF/630V, -40/105℃,±20%	1
12	C15	Capacitor, ceramic,18nF/25V, X7R, ±10%,SMD0805	1
13	C16.C25	Capacitor, ceramic,100PF/25V, X7R, ±10%,SMD1206	2
14	C17	Capacitor, ceramic,220PF/25V, X7R, ±10%,SMD0805	1
15	C18	Capacitor, ceramic, 100P/1000V, -40/105℃,±20%	1
16	C19	Capacitor, ceramic,1nF/200V, X7R, ±10%,SMD1206	1
17	C20.C21	Capacitor, aluminum electrolytic, 680uF/25V, -40/105℃,±20%,Φ10*20mm	2
18	C22	Capacitor, aluminum electrolytic, 470uF/25V, -40/105℃,±20%,Φ10*16mm	1
19	C23	Capacitor, film,100nF/50V, -40/105℃,±10%,	1
20	CON1	Connect,AC SOCKET,2.5A/250Vac,3PIN	1
21	CX1	Capacitor,X2, 0.47uF/275VAC, -40/105℃,±20%	1
22	CY1.CY2.	Capacitor,Y2,disk,2200PF/250VAC, -40/105℃,±20%	2
23	CY3	Capacitor,Y2,disk,2200PF/250VAC, -40/105℃,±20%	1
24	D1	Diode,ultra fast recovery,MUR460, 4A/600V, DO-201	1
25	D2.D3.D6.D9	Diode ,fast recovery, 1N4148, 0.1A /100V,SMD1206H	4
26	D4	Diode ,fast recovery, 1N4007, 1A/1000V,DO-401	1
27	D5	Diode ,fast recovery, FR104, 1A/600V,DO-401	1
28	D7.D8	Diode,dual schottky, STPS20H100CT, 2*10A/100V,TO220	2
29	F1	Fuse, 3A/250V, Φ4*10mm	1
30	B1	Bead Core, 1 uH,±10%, core2.2*5.5*7.5mm,Φ0.80mm*1Ts	1
31	L1	Inductor, choke,580uH min, core15.5*11.5*6.5mm, Φ0.60mm*100Ts	1
32	L2	Inductor,power choke,3.3uH,±10%,core, Φ4*15mm, Φ0.90mm*10.5Ts	1
33	L3. L4	Bead Core,0.8uH ,0.05R,±10%,SMD1206	2
34	L5	Bead Core,for D1 cathode,3.5*9*1.3mm	1
35	L6	Bead Core,for D5 cathode,3.5*8*0.8mm	1
36	LED	LED, Φ5mm	1
37	LF1	Inductor, choke,dual winding,4.5mH min, core12.5*9 *4.5mm, Φ0.50mm*2P*24Ts	1
38	LF2	Inductor, choke,dual winding,18mH min, core18.5*9.5*7.5mm, Φ0.55mm*42Ts*2	1
39	LF3	Inductor, choke,dual winding, 80uH min, core10.5*5.5*4.5mm, Φ0.80mm*2*3Ts	1
40	MOV1	Varistor ,disk, 7D471,300Vac rms max,385Vdc rms max, 600Amax,Φ7mm	1
41	Q1	MOSFET,cool MOS power N-channel, SPP11N60C3, 11A/650V,0.38R,TO220	1

42	Q2	Transistor, PNP,2N3906,0.2A/40V,SMD,SOT23	1
43	Q3.Q4	Transistor, NPN,2N3904,0.2A/40V,SMD,SOT23	2
44	Q5	MOSFET,cool MOS power N-channel, SPP11N60C3, 11A/650V,0.38R,TO220	1
45	R0	Resistor,chip, 0R ,1/2W,±5%,SMD1206	1
46	R1~R4.R18.R19	Resistor,chip, 1.5M ,1/2W,±5%,SMD1206	6
47	R5.R26A.B.C.D	Resistor,chip, 33K ,1/2W,±5%,SMD1206	5
48	R7. R21	Resistor,chip, 20K ,1/4W, ±5%,SMD0805	2
49	R8.R35.R40	Resistor,chip, 510R ,1/4W,±5%,SMD0805	3
50	R9	Resistor,chip, 47R,1/4W,±5%,SMD0805	1
51	R10	Resistor,chip, 5R1 ,1/4W,±5%,SMD0805	1
52	R11	Resistor,chip, 300R,1/4W,±5%,SMD0805	1
53	R12.R34	Resistor,chip,10R,1/4W,±5%,SMD0805	2
54	R13.R36	Resistor,chip, 10K ,1/4W,±5%,SMD0805	2
55	R14	Resistor,chip, 15K,1/4W,±5%,SMD0805	1
56	R15	Resistor,metal film,axial,RN55,0R22, 2W, ±1%	1
57	R16.R22	Resistor,chip, 22K,1/4W,±5%,SMD0805	2
58	R17	Resistor,chip, 4.7K,1/4W,±5%,SMD0805	1
59	R20	Resistor,chip, 1M ,1/2W,±5%,SMD1206	1
60	R23	Resistor,chip, 100K ,1/2W,±5%,SMD1206	1
61	R24	Resistor,chip, 56K,1/4W,±5%,SMD0805	1
62	R25	Resistor,chip, 8.2K,1/4W,±5%,SMD0805	1
63	R28	Resistor,chip, 2R ,1/2W,±5%,SMD1206	1
64	R29	Resistor,chip, 3.3R,1/4W,±5%,SMD0805	1
65	R30	Resistor,chip, 150K,1/4W,±1%,SMD0805	1
66	R31	Resistor,chip, 30K,1/4W,±1%,SMD0805	1
67	R32	Resistor,chip, 22R,1/2W,±5%,SMD1206	1
68	R33	Resistor,chip, 100R,1/2W,±5%,SMD1206	1
69	R37	Resistor,metal film,axial,RN55,0R17, 2W, ±1%	1
70	R38A.B	Resistor,metal, 47R,1/2W,±5%,SMD1206	2
71	R39	Resistor,chip, 6.8K,1/4W,±5%,SMD0805	1
72	R41	Resistor,chip, 2K,1/4W,±5%,SMD0805	1
73	R42	Resistor,chip, 33K,1/4W,±1%,SMD0805	1
74	R43	Resistor,chip, 100R,1/4W,±5%,SMD0805	1
75	R44	Resistor,chip, 4.99K,1/4W,±1%,SMD0805	1
76	R45	Resistor,chip, 240K,1/4W,±1%,SMD0805	1
77	T1	Xfmr,boost inductor,650uH,10KHz/1V,RM10	1
78	T2	Transformer, 427uH,10KHz/1V,PQ3218	1
79	U1	IC, PFC controller,OB6563,SO-8	1
80	U2	IC,QR controller, OB2203, SO-8	1
81	U3	IC,Photocoupler ,PC817B, DIP4	1
82	U4	IC,Precision Adjustable Shunt Regulator ,TL431, TO-92	1
83	PCB	OBPD90W,49.2*125.9mm	1

2.3. PCB Gerber File



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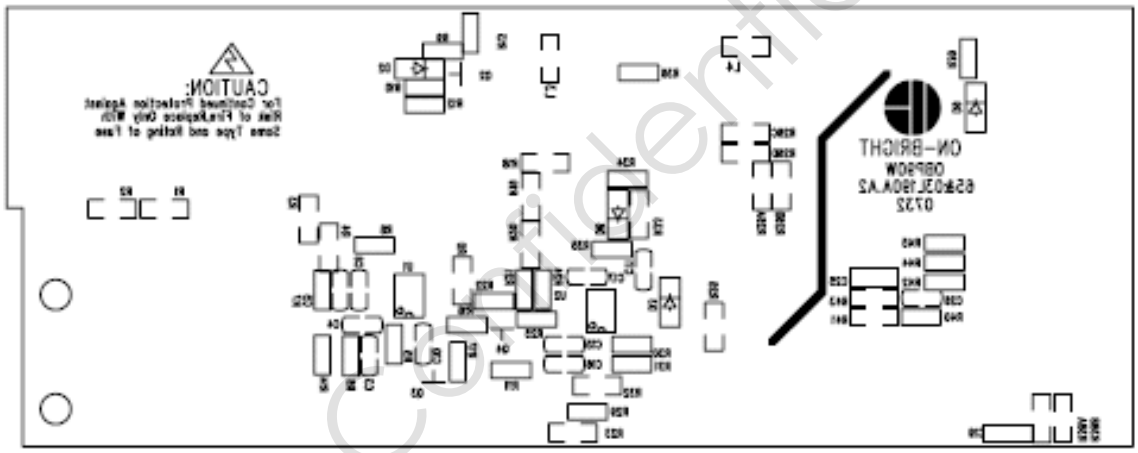

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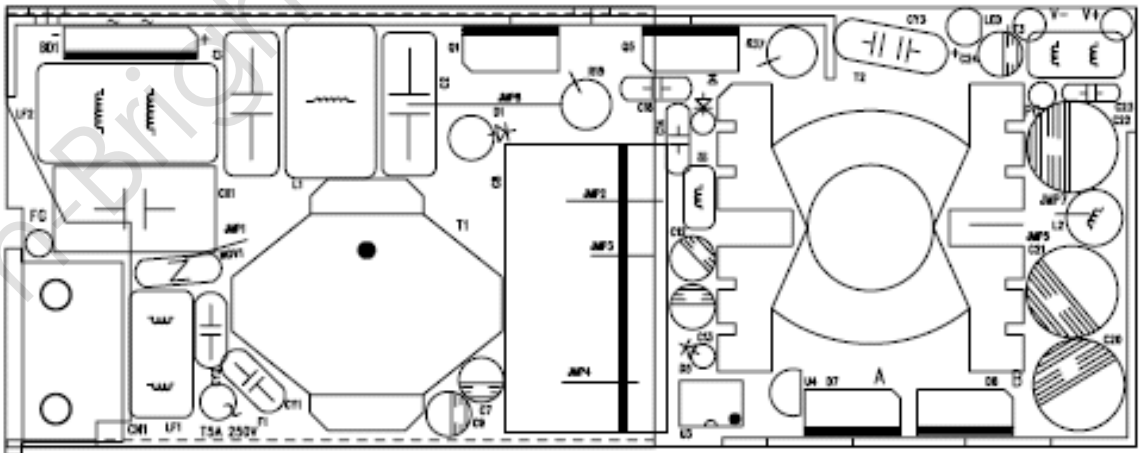

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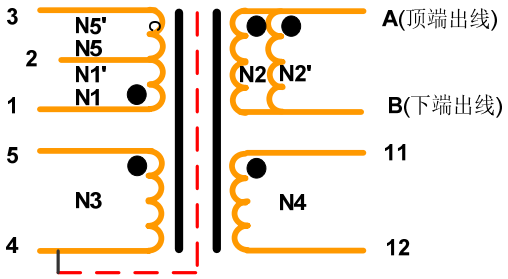
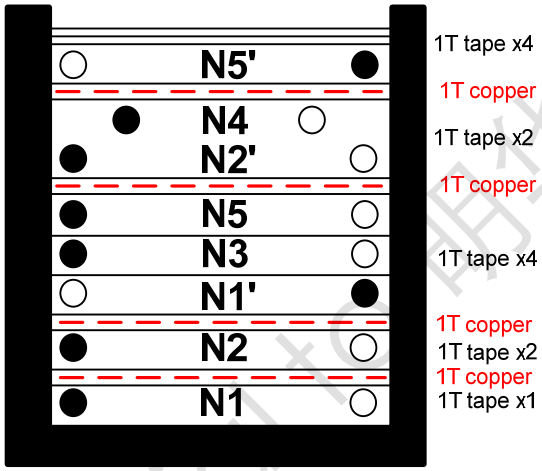
2.4. Adaptor Module Snapshot

2.4.1. Transfomer Specification





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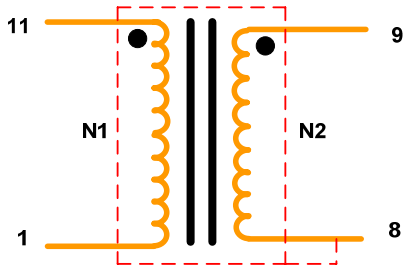
Note:

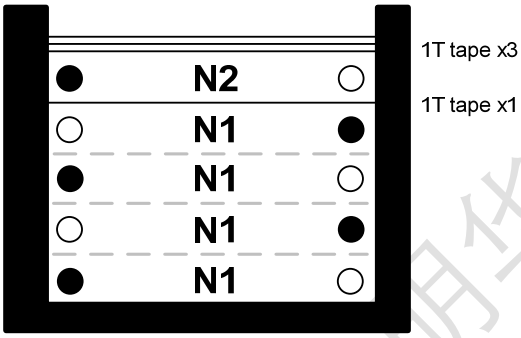
1. Bobbin: PG3218 (12 Pin) ;其中Pin6.7.9.10 cut off
2. Core 材质: TDK PC 40~44或等同.
3. L1-3=427u H +/- 5%. (at: 10 K Hz, 0.3 V)
4. HI-POT: (60 Hz/5 m A/2 SET)
   Pri to Sec 3750 Vac; Pri to core 1800Vac

2.4.2. Transformer Winding data

C	Winging	Material	Start	Turns	Finish	Remark
1	N1	Φ0.45*2 2UEW	1	**7**	→	不断线
2	TAPE	TAPE W=8.5mm (Y)		1.3		
3	Copper	Copper W=8mm P=0.02mm		1.1	4	
4	TAPE	TAPE W=8.5mm (Y)		1.3		
5	N2	Φ0.60*2 三层绝缘线	A	**5**	B	
6	TAPE	TAPE W=8.5mm (Y)		1.3		
7	Copper	Copper W=8mm P=0.02mm		1.1	4	
8	TAPE	TAPE W=8.5mm (Y)		1.3		
9	N3	Φ0.45*2 2UEW	→	**7**	2	
10	TAPE	TAPE W=8.5mm (Y)		1.3		
11	N1’	Φ0.12*3 2UEW	5	**5**	4	间绕
12	TAPE	TAPE W=8.5mm (Y)		1.3		
13	N5	Φ0.45*2 2UEW	2	**7**	→	不断线
14	TAPE	TAPE W=8.5mm (Y)		1.3		
15	Copper	Copper W=8mm P=0.02mm		1.1	4	
16	TAPE	TAPE W=8.5mm (Y)		1.3		
17	N2’	Φ0.60*2 三层绝缘线	A	**5**	B	
18	N4	Φ0.20*1 三层绝缘线	11	**2**	12	间绕到 N2
19	TAPE	TAPE W=8.5mm (Y)		1.3		
20	Copper	Copper W=8mm P=0.02mm		1.1	4	
21	TAPE	TAPE W=8.5mm (Y)		1.3		
22	N5’	Φ0.45*2 2UEW	→	**7**	3	
23	TAPE	TAPE W=8.5mm (Y)		3		

2.4.3. Boost inductor Specification





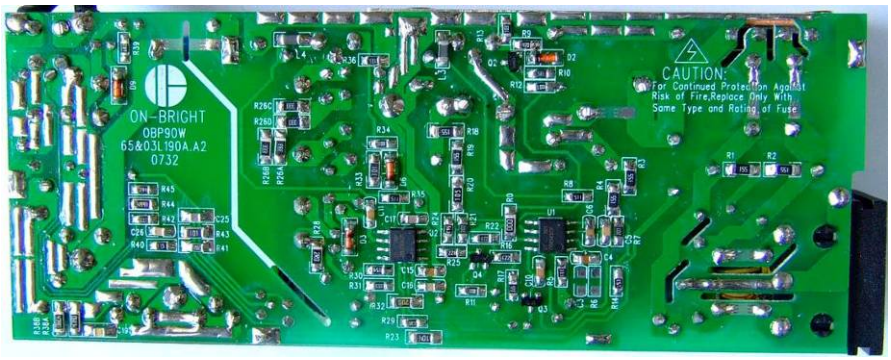
Note:

1. Bobbin: RM10 (12 Pin) ;其中Pin3,4,5,7,10,12 cut off
2. Core 材质: TDK PC40/ 44.
3. L7-11=650u H +/- 5%. (at: 10 K Hz, 0.3 V)
4. HI-POT: (60 Hz/5 m A/2 SET)
   Pri to Sec 3750 Vac; Pri to core 1500Vac

2.4.4. Boost inductor Winding data

C	Winging	Material	Start	Turns	Finish	Remark
1	N1	Φ0.20*10 利兹线	11	**67**	1	
2	TAPE	TAPE W=10mm (Y)		1.3		
3	N2	Φ0.20*2 2UEW	9	**9**	8	
4	TAPE	TAPE W=10mm (Y)		3		

2.5. Adaptor Module Snapshot



3. Performance Evaluation

This session presents the test results of OBPD90W 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.

Performance Highlights

- The standby power is about 0.28W under 264Vac/50Hz no load.
- The average efficiency more than 87.36% @25/50/75/100% load, normal line.
- EMI passed EN55022 and FCC15 Class B test with more than 6dB margin

Characterization Results Summary

Test Item	Test result
1. Input characteristics	
Input current (90V/60Hz, full load)	1.17A Max
Standby power at no load With LED (264Vac, With PFC)	0.28W
Average Efficiency (110Vac, 25%/50%/75%/100% load,)	87.36%(cable end.)
2 .Output characteristics	
Line regulation	0.1%
Load regulation	2.01%
Ripple & noise	18.1mV
Over shoot	1.3% Max
Under shoot	2.1% Max
Dynamic test	328mV
3. Time sequence (100Vac with Full load)	
Turn on delay time	1740mS
Hold up time	29.5mS
Rise time	17.9mS
Fall time	10mS

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(mW)	Vo(V)	Specification	Test result
90Vac/60Hz	129	19.10	<500mW	Pass
110Vac/60Hz	137	19.10		
132Vac/60Hz	151	19.10		
180Vac/50Hz	191	19.10		
220Vac/50Hz	229	19.10		
264Vac/50Hz	280	19.10		

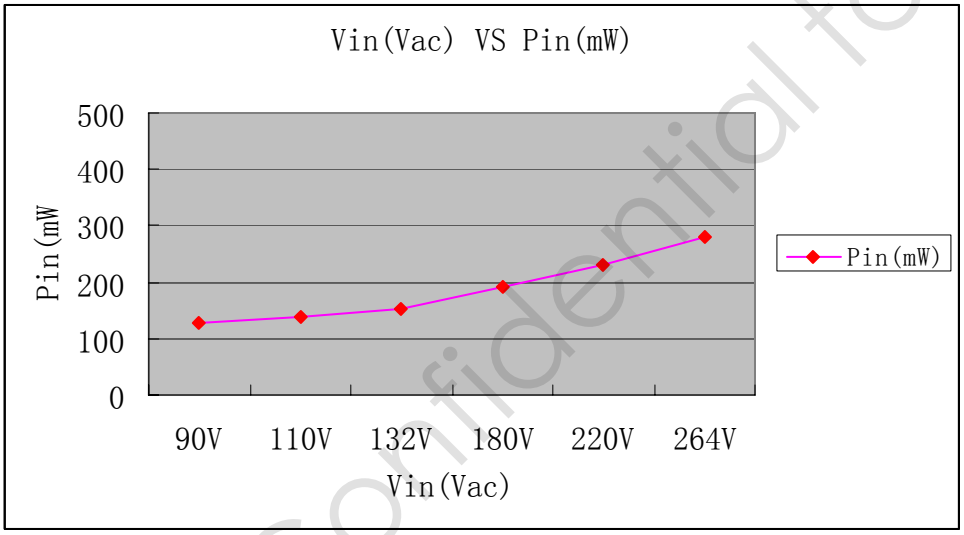


Fig. 1 No-load Input Power vs. Input Line Voltage

3.1.2. Efficiency

Table. 2 Efficiency(All data was measurement at CABLE end. CABLE=0.07ohm)

Input voltage	25%	50%	75%	100%	Aver. Eff.	Spec.
90Vac/60Hz	87.36	86.84	86.74	85.57	86.62	>85%
110Vac/60Hz	87.91	87.35	87.54	86.65	87.36	
132Vac/60Hz	87.90	87.16	87.85	87.33	87.56	
180Vac/50Hz	87.39	84.48	86.42	86.86	86.37	
220Vac/50Hz	86.57	84.52	86.64	87.19	86.23	
264Vac/50Hz	85.52	84.59	86.82	87.43	86.09	

Note: 50%~100% load data was measurement at PFC ON, 25% load data was measurement at PFC OFF

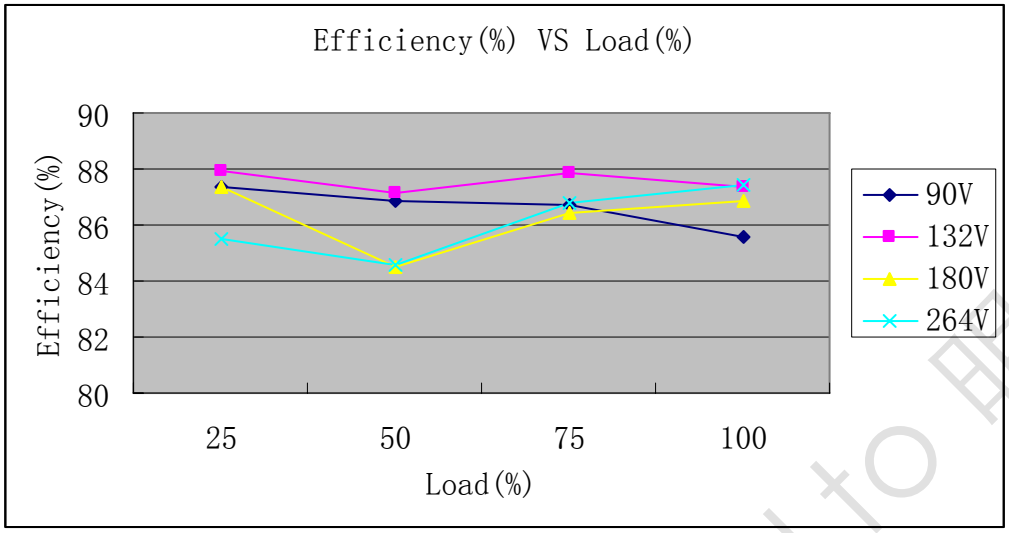


Fig. 2 Efficiency vs. Percent of Rated Output Power

3.2. Output Characteristics

3.2.1. Line Regulation & Load Regulation

Table. 3 Line Regulation & Load Regulation

Input voltage	No load	Half load	Full load	Specification	Test result
90Vac/60Hz	19.10	18.91	18.73		
132Vac/60Hz	19.10	18.91	18.73		
180Vac/50Hz	19.10	18.89	18.72		
264Vac/50Hz	19.10	18.89	18.72		
Line Regulation	0.1%			2%	**Pass**
Load Regulation	2.01%			5%	**Pass**

3.2.2. Ripple & Noise

Table. 4 Ripple & Noise

Input voltage	R&N (mV)		
	No load	Full load	Remark
90Vac/60Hz	18.8mV	16.9mV	Fig. 3,4
132Vac/60Hz	21.9mV	16.3mV	
180Vac/50Hz	21.9mV	15.0mV	
264Vac/50Hz	23.1mV	18.1mV	Fig. 5,6

Note: Ripple& noise was measured at board end without probe cap and ground clip. Measurement bandwidth was limited to 20MHz.

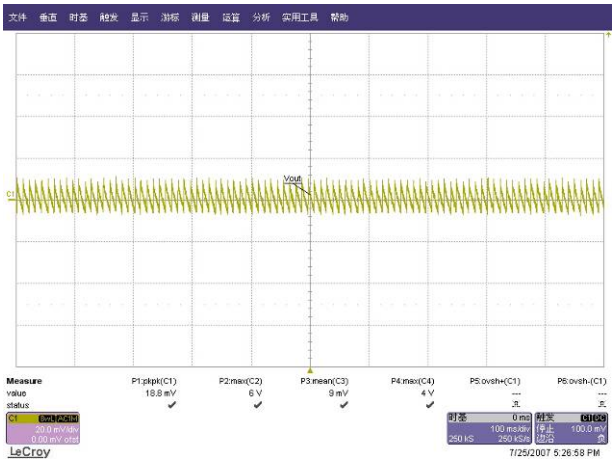


Fig. 3 Measured ripple& noise waveform@90Vac/60Hz, no load

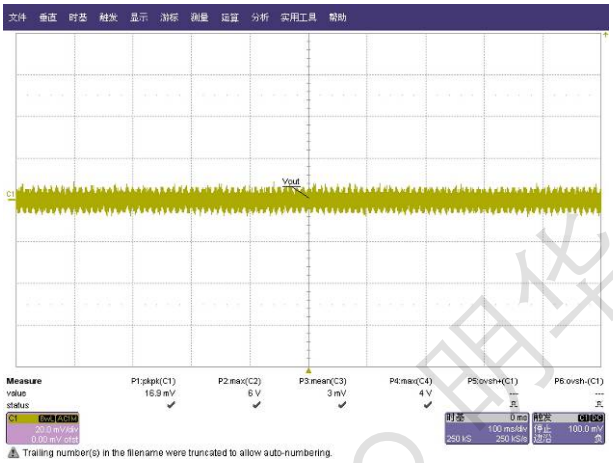


Fig. 4 Measured ripple& noise waveform@90Vac/60Hz, full load

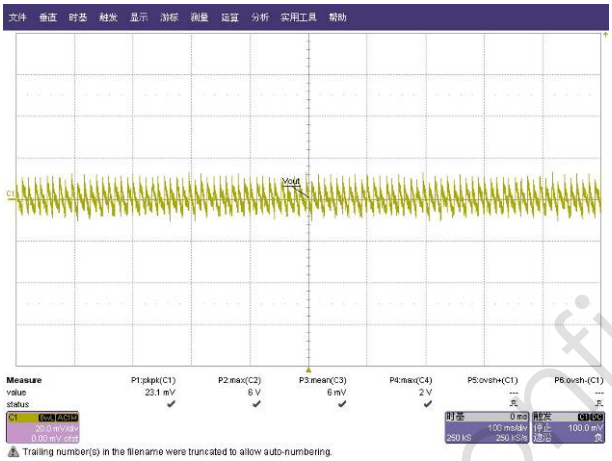


Fig. 5 Measured ripple& noise waveform@264Vac/50Hz, no load

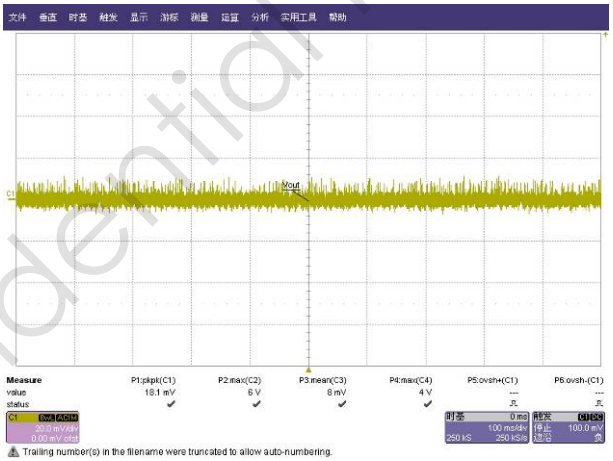


Fig. 6 Measured ripple& noise waveform@264Vac/50Hz, full load

3.2.3. Over Shoot & Under Shoot

Over shoot and under shoot were measured under below conditions.

a. AC input switch on for over shoot and off for under shoot.

b. Input voltage ranges from 90Vac/60Hz~264Vac/50Hz.

Table. 5 Over shoot & under shoot measurement results

Input	load		Remark
90V/60HZ	Full load	over shoot	Fig. 7
		under shoot	
	No load	over shoot	Fig. 8
		under shoot	
264V/50HZ	Full load	over shoot	Fig. 9
		under shoot	
	No load	over shoot	Fig. 10
		under shoot	

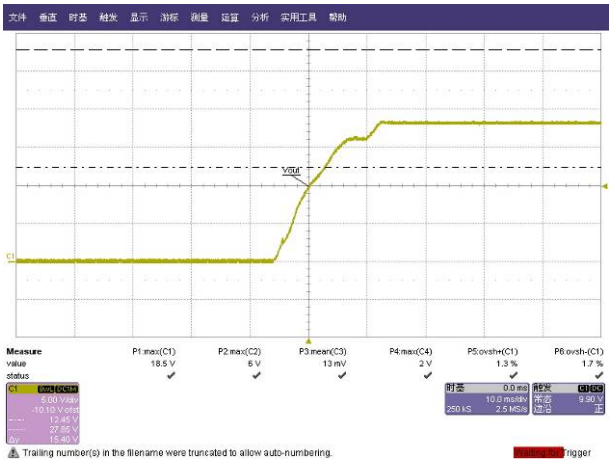


Fig. 7 Measured overshoot waveform@90Vac/60Hz, full load

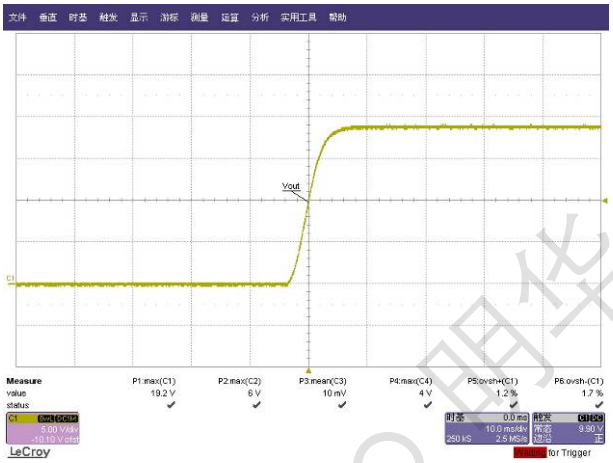


Fig. 8 Measured overshoot waveform@90Vac/60Hz, no load

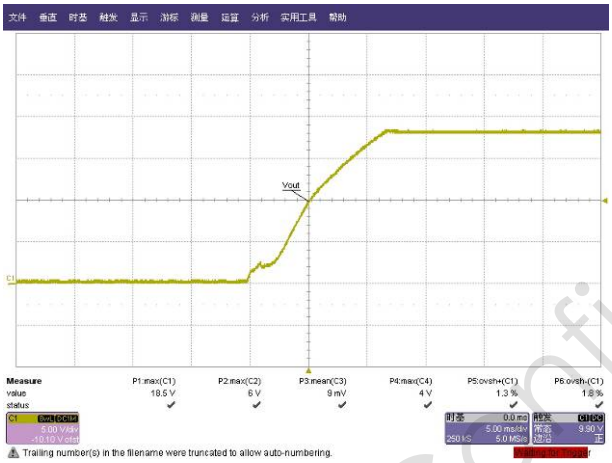


Fig. 9 Measured overshoot waveform@264Vac/50Hz, full load

Fig. 10 Measured overshoot waveform@264Vac/50Hz, no load

3.2.4. Dynamic Test

A dynamic loading with low set at 20% load lasting for 50ms and high set at 80% load lasting for 50mS is added to output. The ramp is set at 0.25A/us at transient. Measurement was taken at Board end(Same as R&N measurement)

Table. 6 Output voltage under dynamic test

Input	Output (mV)	Remark
264V/50HZ	±328mV	Fig. 11
180V/50HZ	±328mV	
115V/60HZ	±316mV	
90V/60HZ	±313mV	Fig. 12

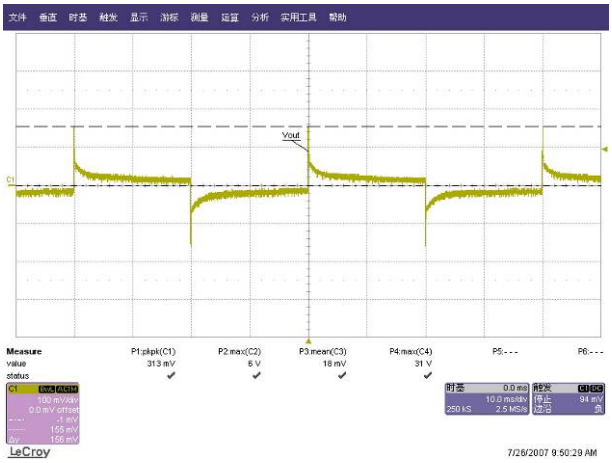


Fig. 11 Output voltage waveform under Dynamic test @264Vac/50Hz

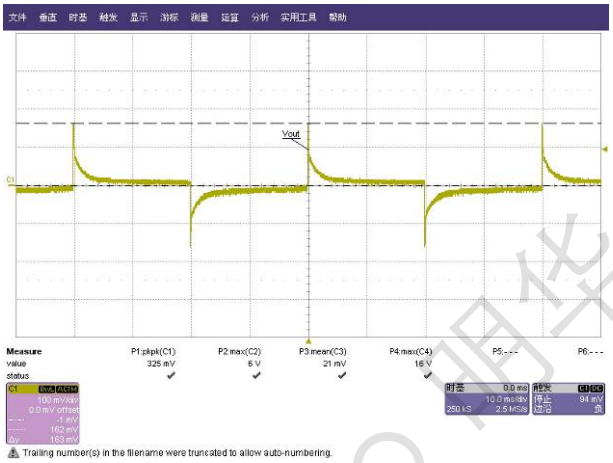


Fig. 12 Output voltage waveform under Dynamic test @90Vac/60Hz

3.2.5. Time Sequence (Full load)

Table. 7 Turn-on delay/hold-up/rise/fall time measurement results

Item	Input voltage	Meas. Data	Test spec.	Test results	Remark
Turn-on delay time	90V/60Hz	1740 mS	<2S	Pass	Fig. 13
	264V/50Hz	293 mS		Pass	Fig. 14
Hold-up time	90V/60Hz	29.5 mS	>10mS	Pass	Fig. 15
	264V/50Hz	85 mS		Pass	Fig. 16
Rise Time	90V/60Hz	17.9 mS		Pass	Fig. 17
	264V/50Hz	11.9 mS		Pass	Fig. 18
Fall Time	90V/60Hz	10 mS		Pass	Fig. 19
	264V/50Hz	9.7 mS		Pass	Fig. 20

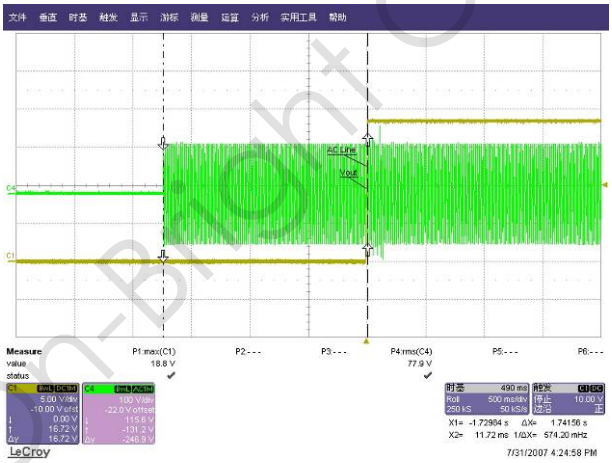


Fig. 13 Turn on delay time measured waveform @90Vac/60Hz,full load

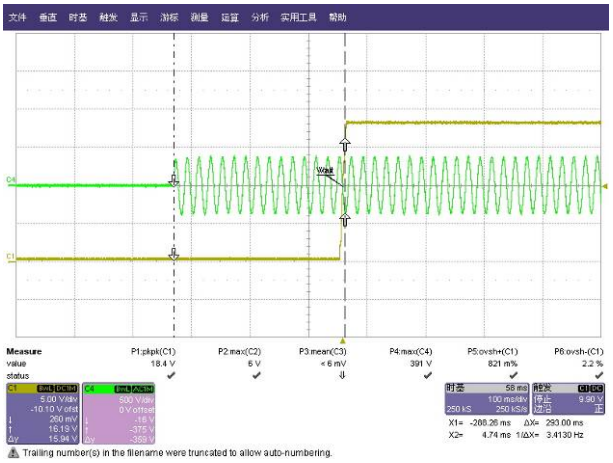


Fig. 14 Turn on delay time measured waveform @264Vac/50Hz,full load

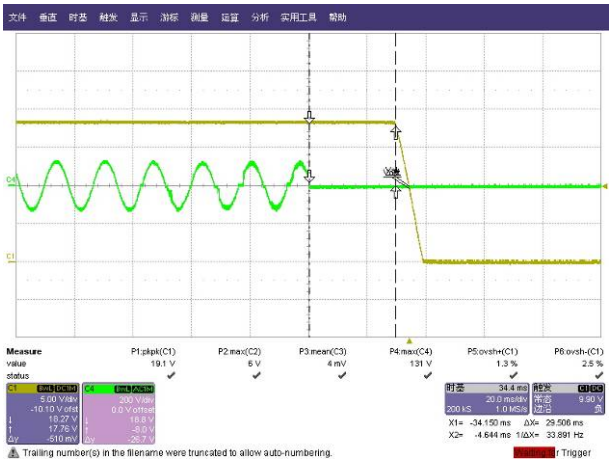


Fig. 15 Hold-up time measured waveform@90Vac/60Hz,full load

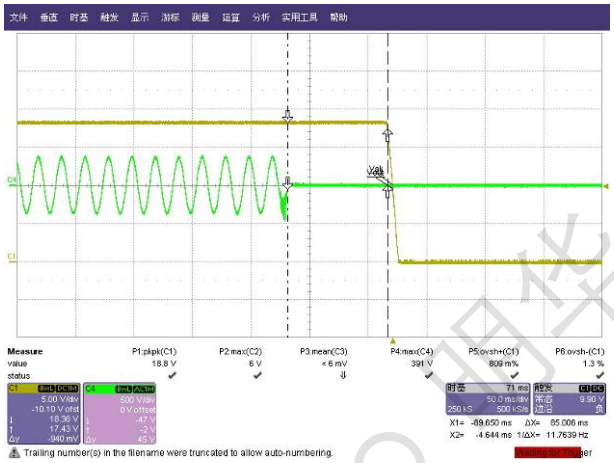


Fig. 16 Hold-up time measured waveform@264Vac/50Hz,full load

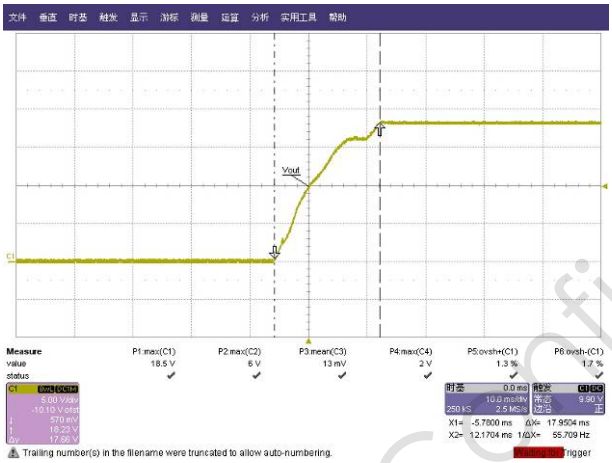


Fig. 17 Rise time measured waveform@90Vac/60Hz,full

Fig. 18 Rise time measured waveform@264Vac/50Hz,full load

Fig. 19 Fall time measured waveform@90Vac/60Hz,full load

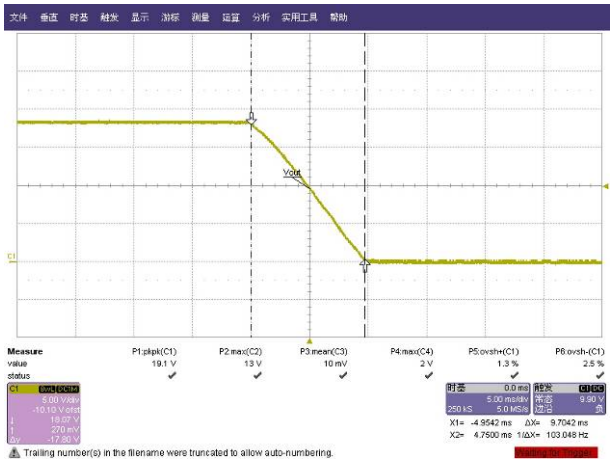


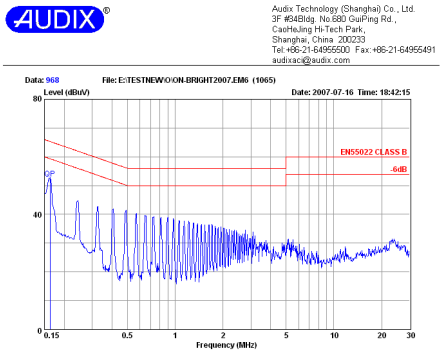
Fig. 20 Fall time measured waveform@264Vac/50Hz,full load

3.3. EMI Test

The Power supply passed EN55022 Class B EMI requirement with more than 6dB margin

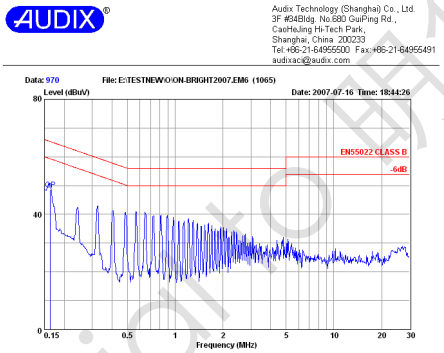
3.3.1. Conducted EMI Test

3.3.1.1. EN55022 CLASS B @ full load report



Site : Audix ACI(Conducted Emission)
Condition : EN55022 CLASS B ESH3-Z5-07.04.06 NEUTRAL
Project No. :
Applicant :
EUT : POWER SUPPLY
M/N : QR
S/N : 90W
Power Supply : 230V/50Hz
Ambient : 25℃ 55%RH
Test line : N
Test Mode : FULL LOAD
Test Engineer : Ken
Memo :
Memo :

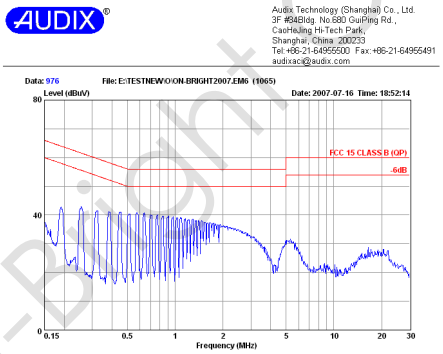
	Freq	Level	Over Limit	Limit Line	Read Level	Factor	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	dB	
1	0.16	52.37	-12.97	65.34	51.90	0.47	0.46	0.01	QP



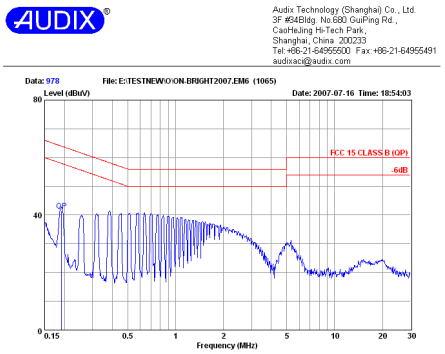
Site : Audix ACI(Conducted Emission)
Condition : EN55022 CLASS B ESH3-Z5-07.04.06 LINE
Project No. :
Applicant :
EUT : POWER SUPPLY
M/N : QR
S/N : 90W
Power Supply : 230V/50Hz
Ambient : 25℃ 55%RH
Test line : L
Test Mode : FULL LOAD
Test Engineer : Ken
Memo :
Memo :

	Freq	Level	Over Limit	Limit Line	Read Level	Factor	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	dB	
1	0.16	48.48	-16.82	65.30	47.90	0.58	0.57	0.01	QP

3.3.1.2. FCC CLASS B @ full load report



Site : Audix ACI(Conducted Emission)
Condition : FCC 15 CLASS B (QP) KNW407-4-07.04.06 VB
Project No. :
Applicant :
EUT : POWER SUPPLY
M/N : QR
S/N : 90W
Power Supply : 120V/60Hz
Ambient : 25℃ 55%RH
Test line : VB
Test Mode : FULL LOAD
Test Engineer : Ken
Memo :
Memo :

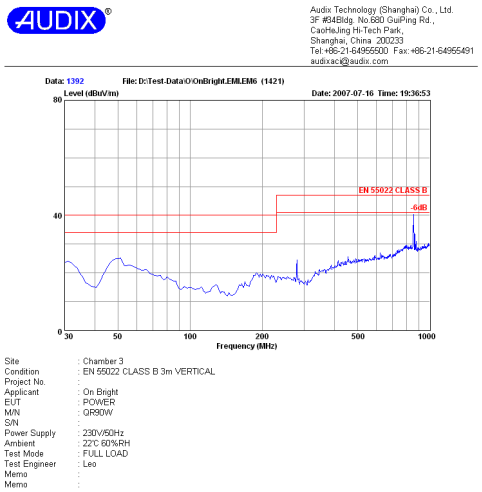


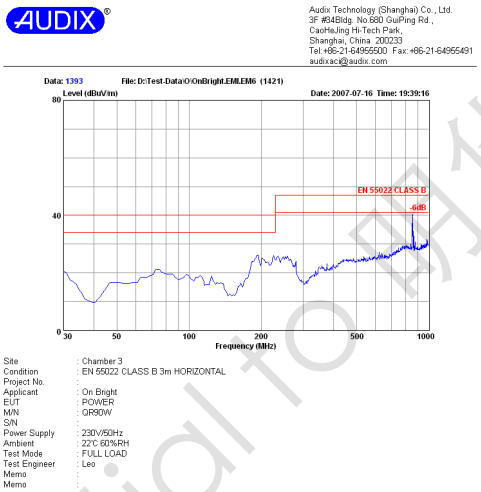
Site : Audix ACI(Conducted Emission)
Condition : FCC 15 CLASS B (QP) KNW407-4-07.04.06 VA
Project No. :
Applicant :
EUT : POWER SUPPLY
M/N : QR
S/N : 90W
Power Supply : 120V/60Hz
Ambient : 25℃ 55%RH
Test line : VA
Test Mode : FULL LOAD
Test Engineer : Ken
Memo :
Memo :

	Freq	Level	Over Limit	Limit Line	Read Level	Factor	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	dB	
1	0.19	41.51	-22.47	63.98	40.90	0.61	0.59	0.02	QP

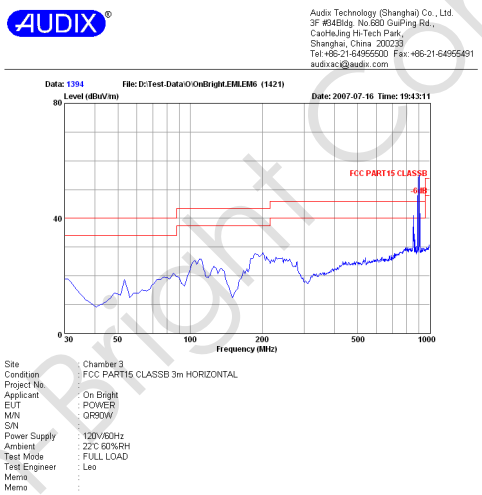
3.1.2. Radiation EMI Test

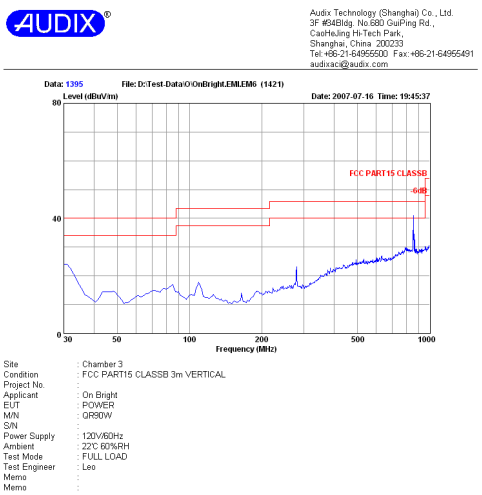
3.3.2.1. EN55022 CLASS B @ full load report





3.3.2.2. FCC CLASS B @ full load report





4. Protection

4.1. Over current protection

Table. 8 OCP @ full load

Input Voltage	OCP Trigger Current (A)
90V/60Hz	5.52
110V/60Hz	5.95
132V/60Hz	5.98
180V/50Hz	6.32
220V/50Hz	6.35
264V/50Hz	6.36

4.2. Over voltage protection

Table. 9 OVP @ no load/full load

Input Voltage	OVP Trigger Voltage (V)	
	No load	Full load
90V/60Hz	22.3	22.2
132V/60Hz	22.5	22.2
180V/50Hz	22.3	22.7
264V/50Hz	22.7	22.8

4.3. Short circuit protection

The system is protected during output short circuit condition and recovered when short circuit condition is removed.

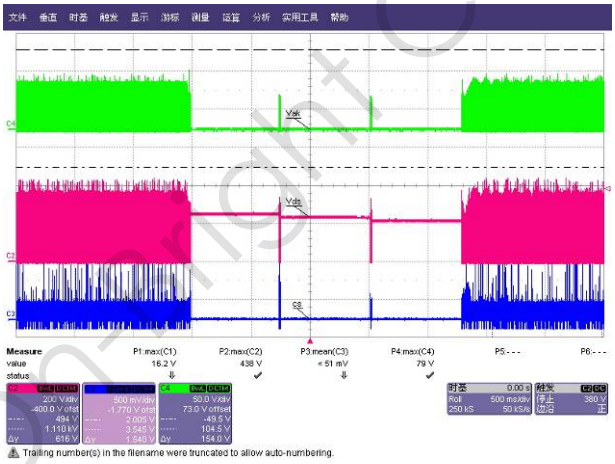


Fig. 21 Output short, Vds waveform@90 Vac/60Hz, full load

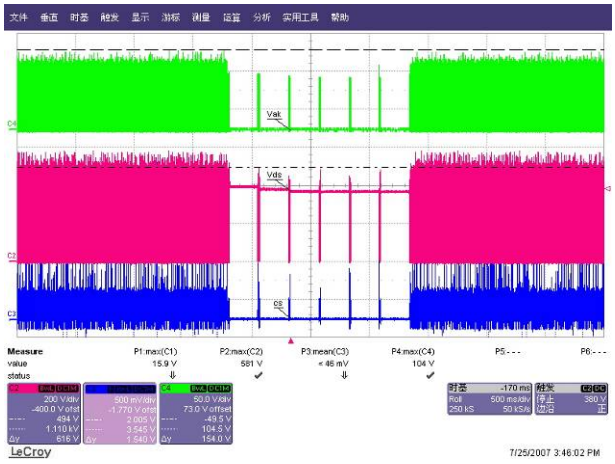


Fig. 22 Output short, Vds waveform@264 Vac/50Hz, full load

5. Other Important Waveform

5.1. Vdd, Sense& Vds waveform @ no load /full load

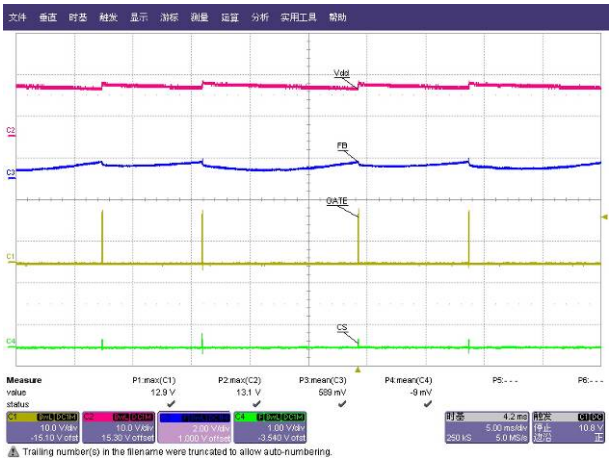


Fig. 23 Vdd, Sense&Vds waveform@90Vac/60Hz,no load

Fig. 24 Vdd, Sense & Vds waveform @90Vac/60Hz, full load

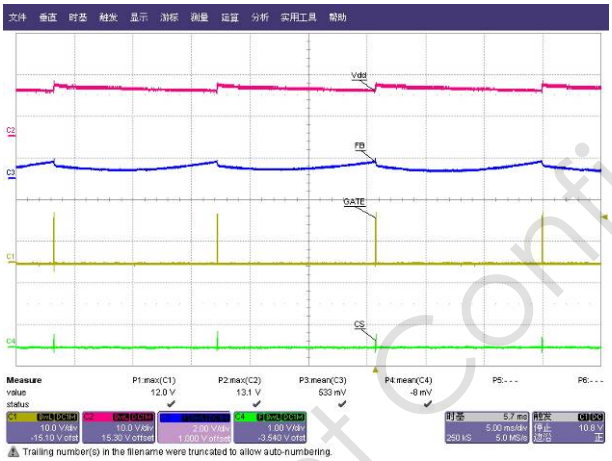


Fig. 25 Vdd, Sense & Vds waveform @264Vac/50Hz, no load

Fig. 26 Vdd, Sense & Vds waveform @264Vac/50Hz,full load

5.2. MOSFET Vds waveform @ start/normal/output short

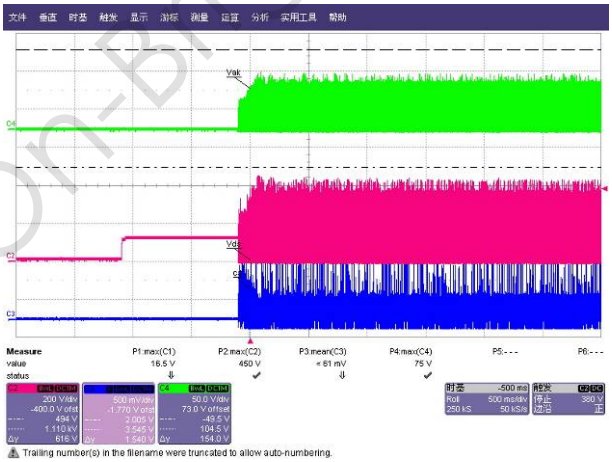


Fig. 27 Start, Vds waveform@90 Vac/60Hz, full load

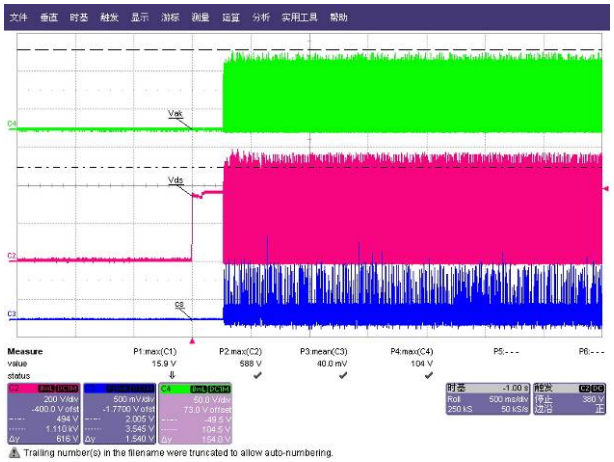


Fig. 28 Start, Vds waveform@264 Vac/50Hz, full load

Fig. 29 Normal, Vds waveform@90 Vac/60Hz, full load

Fig. 30 Normal, Vds waveform@264 Vac/50Hz, full load

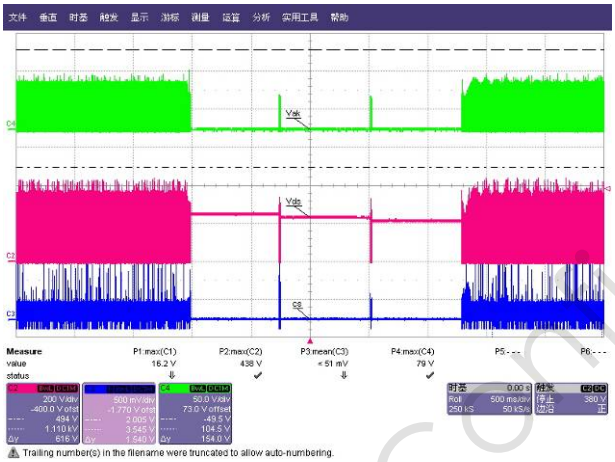


Fig. 31 Output short, Vds waveform@90 Vac/60Hz

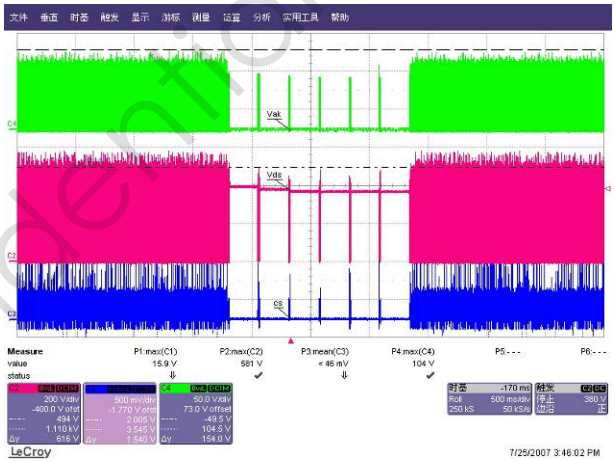


Fig. 32 Output short, Vds waveform@264 Vac/50Hz

Table. 10 Vds_max @ Start/Full load/Output short

Input	Vds_max(V)
264Vac/50Hz @Start	588
264Vac/50Hz @ Full load	569
264Vac/50Hz @ Output short	581

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