Subject

OB2201 Demo Board Manual

Board Model: AD12V3A2201.01

Doc. No.: OB_DOC_DBM_220101

Key Features

- No load standby power under 0.135W@230VAC
- Averaged efficiency more than 87%@115VAC at AWG18 cable end
- High performance Quasi-resonant control
- Programmable OVP/OTP with latch Shutdown
- High precision OVP
- EMI passed EN55022 and FCC Part15 Class B test with more than 6dB margin
- Meet EPS2.0 level 5

Revision History

Revise Date	Version	Reason/Issue
2008-12-30	00	First issue
2008-4-14	01	Reduce PCB size; improve performance

Contents Index

Figures Index

Tables Index

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
- Input current: 1.0 Arms max.

1.2 Output Characteristics

- Output Voltage: 12.0V
- Output Tolerance: ±5%
- Min. load current: 0A
- Max. load current: 3A

1.3 Performance Specifications

- Max. Output Power: 36W
- Standby Power: <0.5W @ 230V/50Hz, no load
- Efficiency: Meet EPS2.0 level 5
>84.63% @Averaged. 25/50/75/100% Load, normal line, 25°C
- Line Regulation: ±2%
- Load Regulation: ±5%
- Ripple and Noise: <380mVpp
- Hold up Time: 8m Sec. Min. @100Vac with full load
- Turn on Delay Time: 2 Sec. Max. @100Vac with full load

1.4 Protection Features

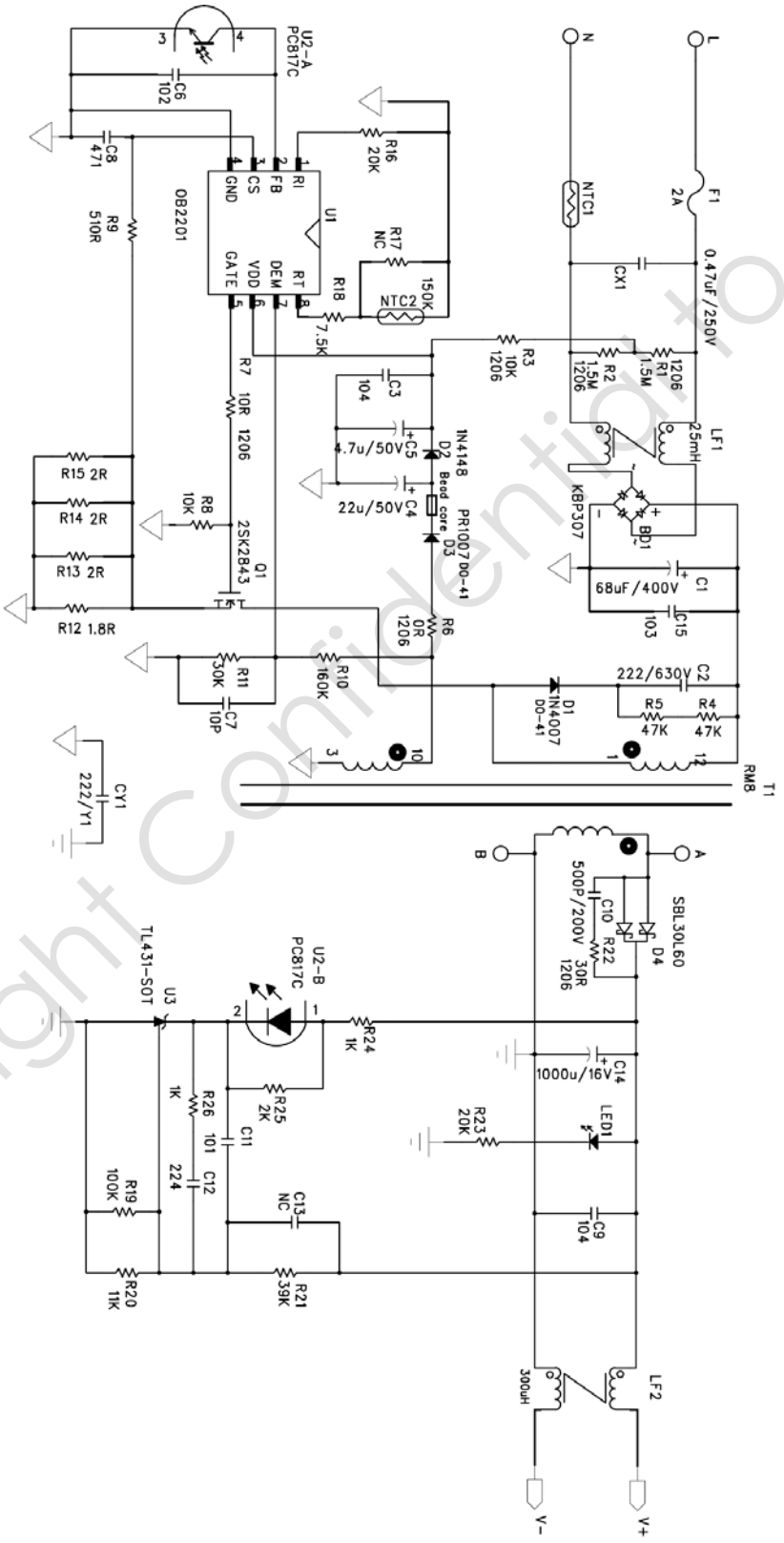
- Short Circuit Protection: Output shut down with automatic recovery
- Over Voltage Protection: Output shut down with latch
- Over Current Protection: Output shut down with automatic recovery
- Over Temperature Protection: Output shut down with latch

1.5 Environments

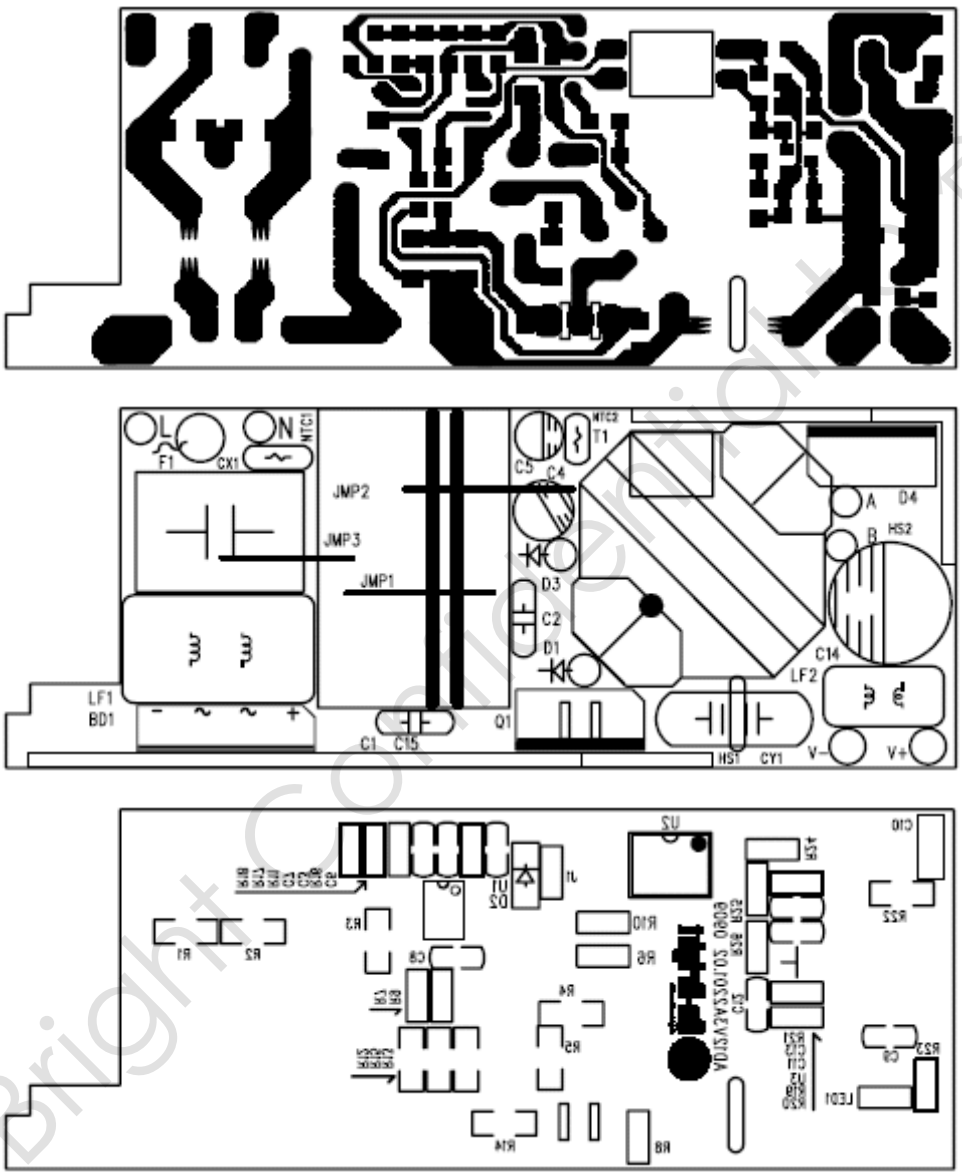
- Operating Temperature: 0℃ to +40℃
- Operating Humidity: 20% to 90% R.H.
- Storage Temperature: -40℃ to +60℃
- Storage Humidity: 0% to 95% R.H.

2 Adapter Module Information

2.1 Schematic



2.2 PCB Gerber File



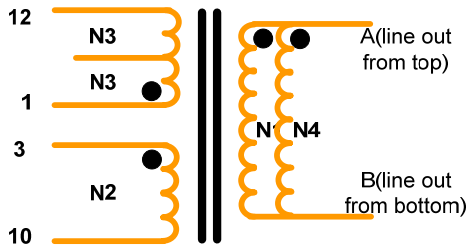
2.3 Bill of material

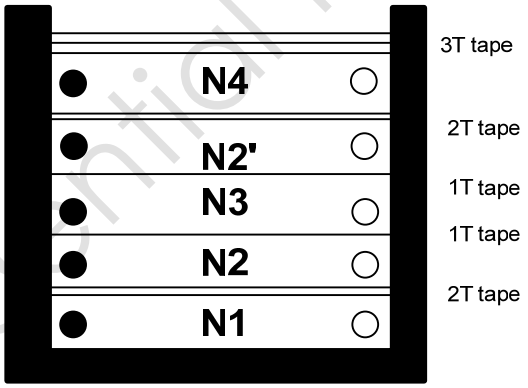
Position	Description	QTY
BD1	Diode, bridge recovery, KBP307, 3A/ 700V	1
C1	Capacitor, aluminum electrolytic, 68uF/400V, -40/105℃,±20%,Φ16*25mm	1
C2	Capacitor, metal poly, 2.2nF/630V, -40/105℃,±20%	1
C3.C9	Capacitor, ceramic,100nF/50V, X7R, ±10%,SMD0805	2
C4	Capacitor, aluminum electrolytic, 22uF/50V, -40/105℃,±20%	1
C5	Capacitor, aluminum electrolytic, 4.7uF/50V, -40/105℃,±20%	1
C6	Capacitor, ceramic,1nF/25V, X7R, ±10%,SMD0805	1
C7	Capacitor, ceramic,10PF/25V, X7R, ±10%,SMD0805	1
C8	Capacitor, ceramic,470PF/25V, X7R, ±10%,SMD0805	1
C10	Capacitor, ceramic,500PF/100V, X7R, ±10%,SMD1206	1
C11	Capacitor, ceramic,100PF/25V, X7R, ±10%,SMD0805	1
C12	Capacitor, ceramic,220nF/25V, X7R, ±10%,SMD0805	1
C14	Capacitor, aluminum electrolytic, 100uF/16V, -40/105℃,±20%,Φ10*16mm	1
C15	Capacitor, ceramic, 10nF/1000V, -40/105℃,±20%	1
CON1	Connect, AC SOCKET,2.5A/250Vac,2PIN	1
CX1	Capacitor, X2, 0.47uF/275VAC, -40/105℃,±20%	1
CY1	Capacitor,Y1,disk, 2.2nF /250VAC, -40/105℃,±20%	1
BEAD CORE	Bead Core, for D3 / Q1 /D4,3.5*8*0.8mm	3
D1	Diode ,fast recovery, 1N4007, 1A/1000V,DO-401	1
D2	Diode ,fast recovery, 1N4148, 0.1A /100V,SMD1206	1
D3	Diode ,fast recovery, PR1007, 1A/600V,DO-401	1
D4	Diode, dual Schottky, SBL30L60CT, 2*15A/60V,TO-220	1
F1	Fuse, 2A/250V, Φ4*10mm	1
LF1	Inductor, choke, dual winding,25mH min, core14 *8*7.5mm, Φ0.35mm*55Ts*2	1
LF2	Inductor, choke, dual winding,300uH , core10.5 *5.5*4.5mm, Φ0.50mm*7Ts*2	1
NTC2	NTC thermistor, 150K / 20℃, Φ3mm	1
Q1	MOSFET,MOS power N-channel, 2SK2843, 10A/600V,0.75R,TO-220NIS	1
R1.R2	Resistor, chip, 1.5M ,1/2W,±5%,SMD1206	2
R3	Resistor, chip, 10K,1/2W,±5%,SMD1206	1
R4.R5	Resistor, chip, 47K,1/2W,±5%,SMD1206	2
R6	Resistor, chip, 0R ,1/4W,±5%,SMD0805	1
R7	Resistor, chip, 10R ,1/4W,±5%,SMD0805	1
R8	Resistor, chip, 10K,1/4W,±5%,SMD0805	1
R9	Resistor, chip, 510R ,1/4W,±5%,SMD0805	1
R10	Resistor, chip, 160K,1/4W,±1%,SMD0805	1
R11	Resistor, chip, 30K,1/4W,±1%,SMD0805	1
R12.R13.R14.R15	Resistor, chip, 2R,1/2W,±5%,SMD1206	4
R16.R23	Resistor, chip, 20K ,1/4W,±5%,SMD0805	2
R18	Resistor, chip, 7.5K ,1/4W,±5%,SMD0805	1
R19	Resistor, chip, 100K ,1/4W,±5%,SMD0805	1
R20	Resistor, chip, 11K,1/4W,±1%,SMD0805	1
R21	Resistor, chip, 39K,1/4W,±1%,SMD0805	1

R22	Resistor, chip, 30R,1/2W,±5%,SMD1206	1
R24.R26	Resistor, chip, 1K,1/4W,±5%,SMD0805	2
R25	Resistor, chip, 2K,1/4W,±5%,SMD0805	1
J1	Resistor, chip, 0R,1/4W,±5%,SMD0805	1
T1	Transformer, 900uH,10KHz/0.3V,RM8	1
U1	IC,QR controller, OB2201, SO-8	1
U2	IC, photocoupler ,PC817C, DIP4	1
U3	IC, LT431, SOT-3	1
PCB	OBPD36W,30*78.7mm	1

2.4 Transformer Design

2.4.1 Transformer Specification





Bottom

Note:

1. Bobbin: RM8
2. Core material: TDK PC 47
3. L1-12=900u 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

No.	Winging	Material	Start	Turns	Finish	Remark
1	**N1**	Φ0.50*2 triple insulated wire	A	**6**	B	
2	TAPE	TAPE W=10.5mm (Y)		2		
3	**N2**	Φ0.12*4 2UEW	3	**8**	10	
4	TAPE	TAPE W=10.5mm (Y)		1		
5	**N3**	Φ0.40 2UEW	1	**60**	12	
6	TAPE	TAPE W=10.5mm (Y)		1		
7	**N2'**	Φ0.12*4 2UEW	3	**8**	10	
8	TAPE	TAPE W=10.5mm (Y)		2		
9	**N4**	Φ0.50*2 triple insulated wire	A	**6**	B	
10	TAPE	TAPE W=10.5mm (Y)		3		

2.5 Adapter Module Snapshot

3 Performance Evaluation

This session presents the test results of AD12V3A2201 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 measurement at AWG18 CABLE end.

Performance Highlights

- No load standby power under 0.135W@230VAC
- Averaged efficiency more than 87%@115VAC&230VAC
- EMI passed EN55022 and FCC Part15 Class B test with more than 6dB margin.

Characterization Results Summary

Test Item	Test result
1. Input characteristics	
Input current (90V/60Hz, full load)	0.80A Max
Standby power at no load (230Vac)	0.135W
Averaged Efficiency (115Vac, 25%~100% load for cable end)	87%
2 .Output characteristics	
Line regulation	0.26%
Load regulation	2.67%
Ripple & noise	250mV
Over shoot	2.6 % Max
Under shoot	0.82% Max
Dynamic test	685mV
3. Time sequence (90Vac, Full load)	
Turn on delay time	1330mS
Hold up time	9mS (100Vac, full)
Rise time	20mS
4. Protections	
Over voltage protection	15.9V
Over current protection (90Vac ~264Vac)	3.45A~4.08A
Short 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	HS 2

3.1 Input Characteristics

3.1. 1 Input current and Standby power

The module was tested at different input voltages (from 90Vac to 264Vac)

Table 1 Input current at full load

Input Voltage	90V/60Hz	115V/60Hz	132V/60Hz	180V/50Hz	230V/50Hz	264V/50Hz
Input Current(A)	0.77	0.65	0.60	0.49	0.41	0.38

Table 2 Standby power at no load

Input Voltage	90V/60Hz	115V/60Hz	132V/60Hz	180V/50Hz	230V/50Hz	264V/50Hz
Pin (W)	0.098	0.104	0.108	0.116	0.134	0.155

3.1. 2 Efficiency

Table 3 Efficiency

Vin	Efficiency (%)				Average Eff (%)	EPS2.0 Level 5
	25% Load	50% Load	75% Load	100% Load		
90V/60Hz	86.43	87.43	86.44	85.01	86.32	84.63%
115V/60Hz	86.67	87.81	87.57	86.51	87.14	
230V/50Hz	86.25	87.46	87.76	87.47	87.23	
264V/50Hz	85.75	86.94	87.46	87.35	86.87	

3.2 Output Characteristics

3.2.1 Line Regulation & Load Regulation

Table 4 Line Regulation & Load Regulation

Input Voltage	Output Voltage (V)			Load Regulation (%)
	No Load	Half Load	Full Load	
90V/47Hz	12.21	12.09	11.89	2.64
115V/60Hz	12.21	12.09	11.89	2.64
132V/63Hz	12.21	12.09	11.90	2.56
180V/47Hz	12.20	12.08	11.90	2.48
230V/50Hz	12.20	12.08	11.89	2.56
264V/63Hz	12.20	12.08	11.87	2.73
Line Regulation (%)	0.08	0.08	0.17	

3.2.2 Ripple & Noise

Table 5 Ripple & Noise measure results

Input Voltage	R&N (mV)		Waveform
	No Load	Full Load	
90Vac/60HZ	66mV	153mV	Fig.1
132Vac/60HZ	66mV	116mV	Fig.2
180Vac/50HZ	72mV	106mV	Fig.3
264Vac/50HZ	75mV	94mV	Fig.4

Note: Ripple & noise were measured at DC CABLE end with a 0.1uF/100V ceramic cap connected in parallel with a 10uF/50V Electrolytic cap. Bandwidth was limited to 20MHz.

R&N Waveform

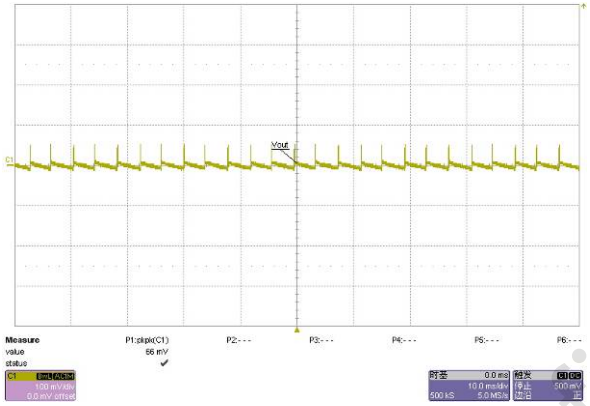


Fig. 1 R&N waveform@90Vac; no load

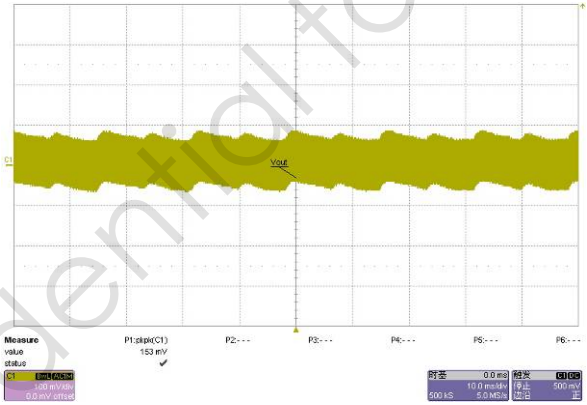


Fig. 2 R&N waveform@90Vac; full load

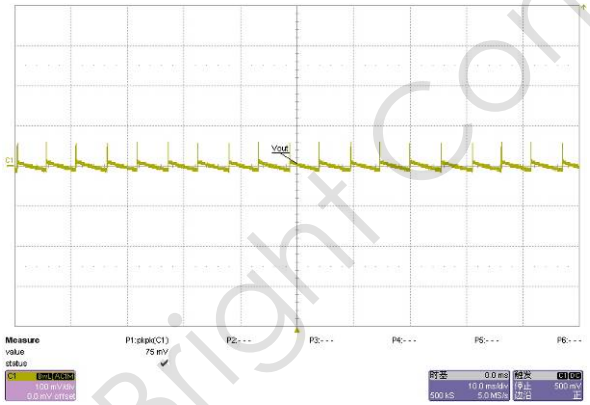


Fig. 3 R&N waveform@264Vac; no load

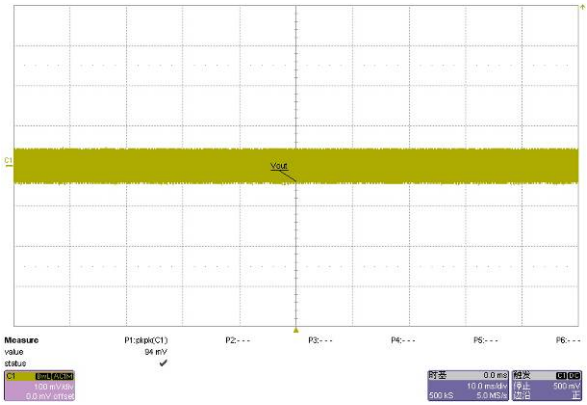


Fig. 4 R&N waveform@264Vac; full load

3.2.3 Overshoot & Undershoot

Ac input switches ON for overshoot and OFF for undershoot

Table 6 Overshoot/undershoot measurement results

Input Voltage	Load	Item	Measure Data (%)	Waveform
90V/60Hz	Full load	overshoot	2.6	Fig.5
		undershoot		
	No load	overshoot	2.5	Fig.6
		undershoot		
264V/50Hz	Full load	overshoot	1.5	Fig.7
		undershoot	0.783	Fig.9
	No load	overshoot	1.9	Fig.8
		undershoot		

Overshoot and undershoot waveform

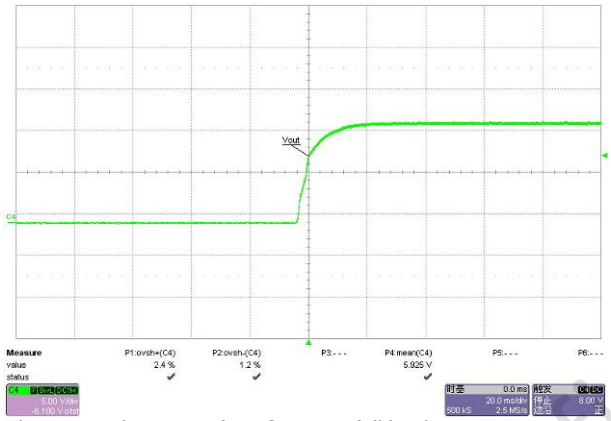


Fig. 5 Overshoot waveform@90Vac; full load

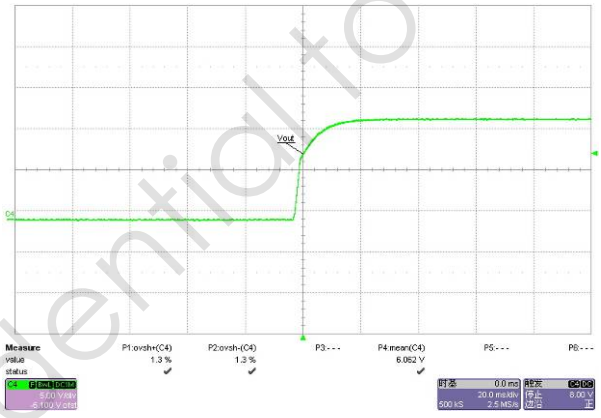


Fig. 6 Overshoot waveform @90Vac; no load

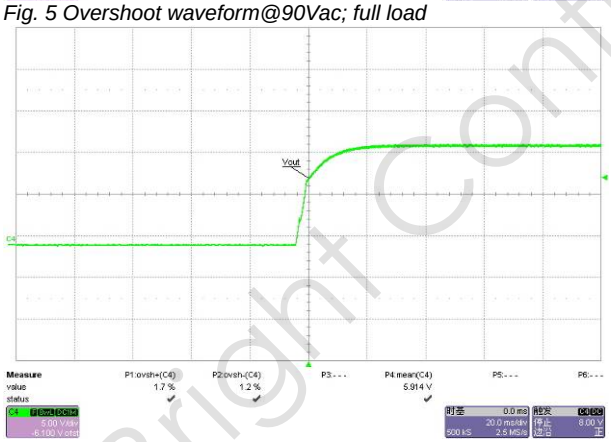


Fig. 7 Overshoot waveform @264Vac; full load

Fig. 8 Overshoot waveform @264Vac; no load

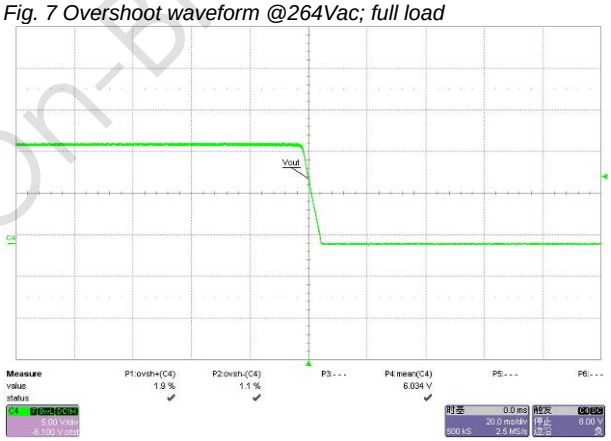


Fig. 9 Undershoot waveform @264Vac; full load

3.2.4 Dynamic Test

A dynamic loading with low set at 0.60 A lasting for 10mS and high set at 2.40A lasting for 10mS is added to output. The ramp is set at 0.25A/uS at transient.
All data was measurement at CABLE end.

Table 7 Output voltage under dynamic test

Input voltage	Output voltage (mV)	Waveform
90V/60HZ	±570	Fig.10
132V/60HZ	±465	Fig.11
180V/50HZ	±460	Fig.12
264V/50HZ	±435	Fig.13

Dynamic waveform

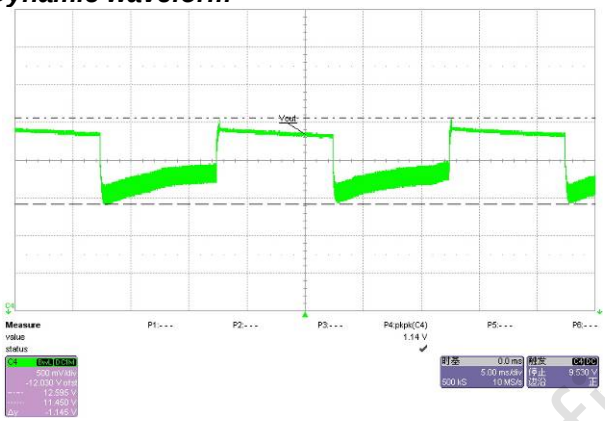


Fig. 10 Dynamic waveform@90Vac input

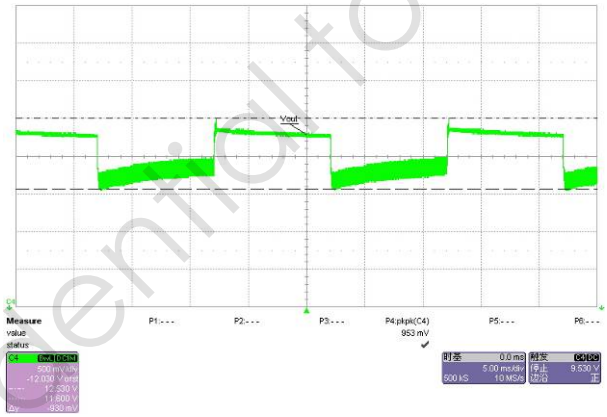


Fig. 11 Dynamic waveform@132Vac input

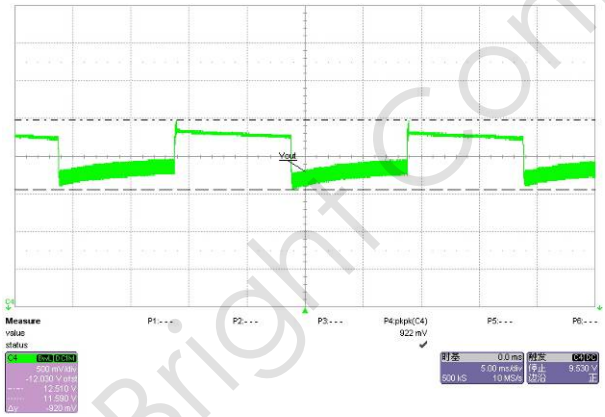


Fig. 12 Dynamic waveform @180Vac input

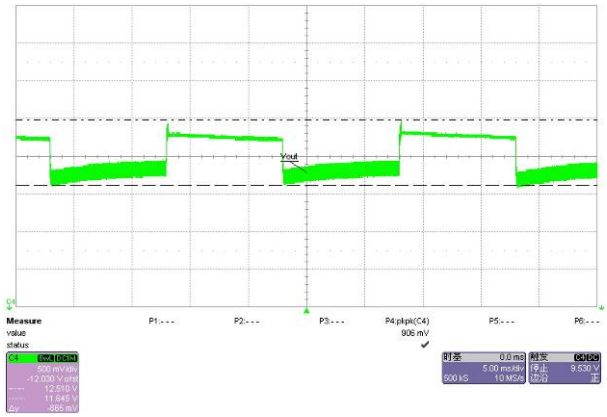


Fig. 13 Dynamic waveform @264Vac input

3.2.5 Time Sequence

Load condition: Full load

Table 8 Turn-on delay /hold-up/Rise time measurement results

Item	Input voltage	Meas. Data (mS)	Remark
Turn-on delay time	100V/60Hz	1330	Fig.14
Hold-up time	100V/60Hz	9	Fig.15
Rise Time	100V/60Hz	20	Fig.16

Time sequence waveform

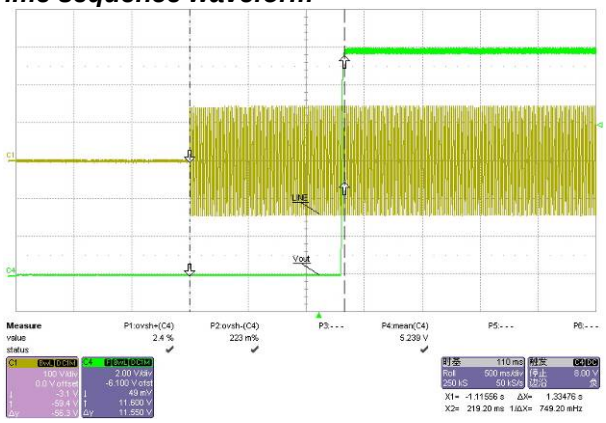


Fig. 14 Turn on waveform @100Vac; full load

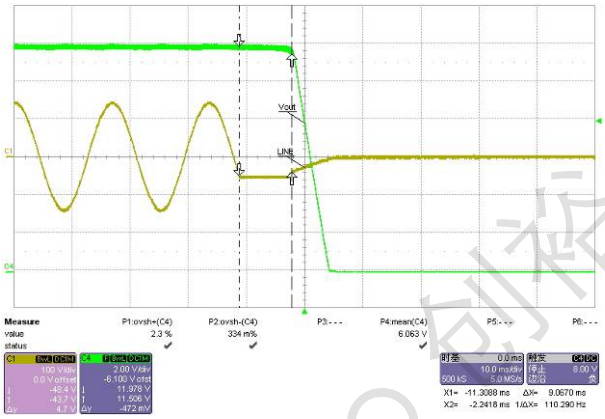


Fig. 15 Hold up waveform @100Vac; full load

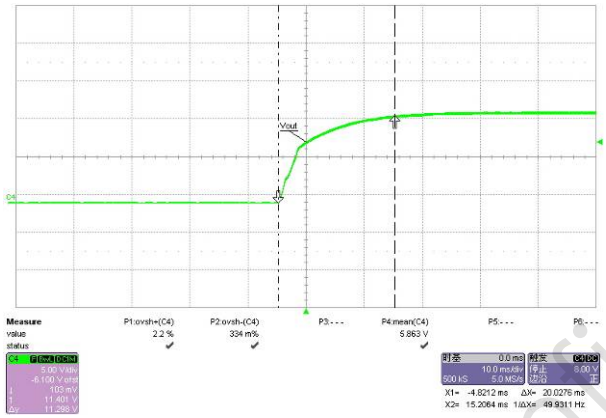


Fig. 16 Rise waveform @100Vac; full load

3.3 Protections

3.3.1 Over Current Protection (OCP)

The power supply will shut down when output current exceeds 3.3A~4.8A, and it should recover when the over current condition is removed.

Table 9 OCP value vs. input voltage

Input Voltage	90V/60Hz	115V/60Hz	132V/60Hz	180V/50Hz	230V/50Hz	264V/50Hz
OCP (A)	3.45A	3.40A	3.41A	3.67A	3.92A	4.08A

3.3.2 Over Voltage Protection (OVP)

The power supply will shut down and latch when feedback circuit is disabled, and the output voltage can not be over 19.2V. The unit should recover when the protection condition is removed and restart input.

Table 10 Load OVP test result

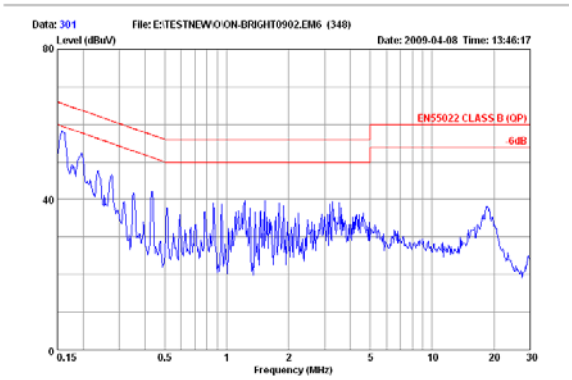
Input Voltage	OVP Trigger Voltage (V)	
	No Load	Full Load
90V/60Hz	15.9	15.3
132V/60Hz	15.8	15.3
180V/50Hz	15.8	15.4
264V/50Hz	15.9	15.6

3.4 EMI Test

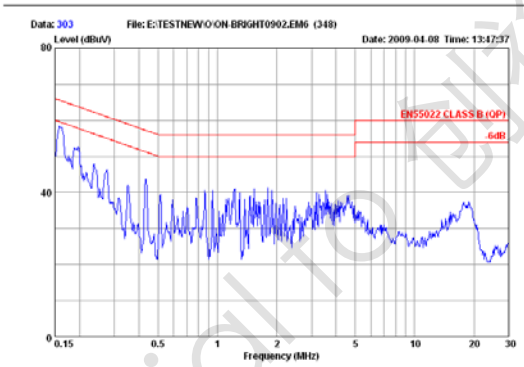
The Power supply passed EN55022 Class B & FCC class B EMI requirement with more than 6dB margin

3.4.1 Conduction EMI Test

EN55022 CLASS B @ full load report

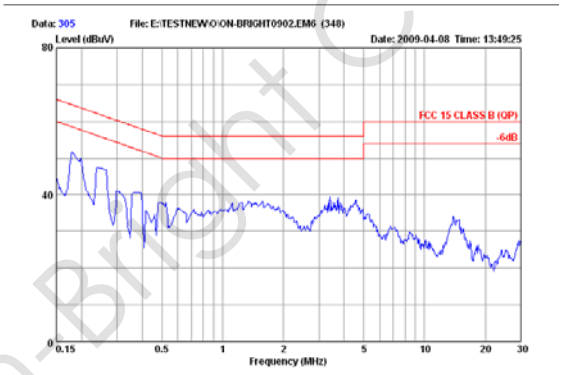


Site	: Conduction
Condition	: EN55022 CLASS B (QP) ESH2-Z5-08.04.06
Project No.	:
Applicant	:
EUT	: PC POWER
M/N	: OB2201
S/N	: 12V3A
Power Supply	: 230V/50Hz
Ambient	: 21'C 49%RH
Test line	: L
Test Mode	: Full load
Test Engineer	: Wency
Memo	: MINI 0.47u

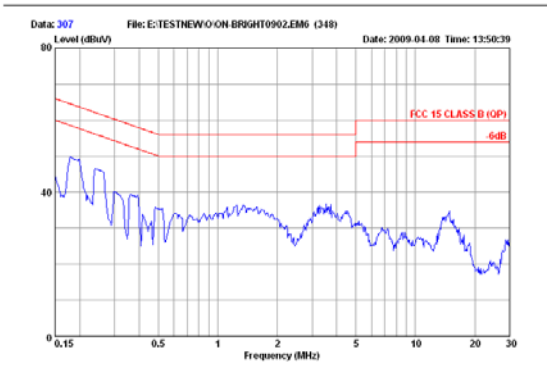


Site	: Conduction
Condition	: EN55022 CLASS B (QP) ESH2-Z5-08.04.06
Project No.	:
Applicant	:
EUT	: PC POWER
M/N	: OB2201
S/N	: 12V3A
Power Supply	: 230V/50Hz
Ambient	: 21'C 49%RH
Test line	: N
Test Mode	: Full load
Test Engineer	: Wency
Memo	: MINI 0.47u

FCC CLASS B @ full load report



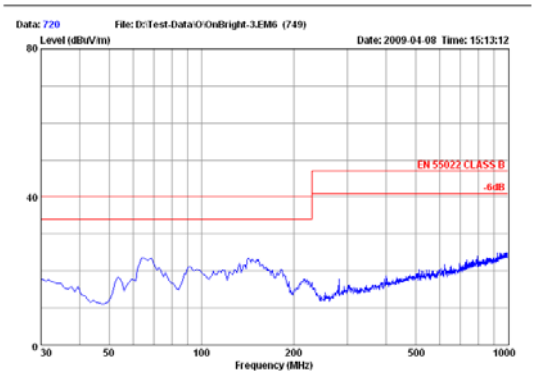
Site	: Conduction
Condition	: FCC 15 CLASS B (QP) ESH2-Z5-08.04.06
Project No.	:
Applicant	:
EUT	: PC POWER
M/N	: OB2201
S/N	: 12V3A
Power Supply	: 120V/60Hz
Ambient	: 21'C 49%RH
Test line	: N
Test Mode	: Full load
Test Engineer	: Wency
Memo	: MINI 0.47u

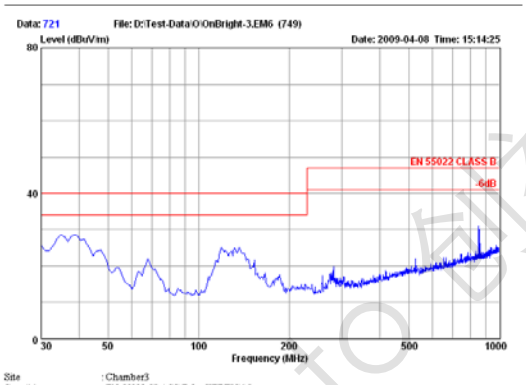


Site	: Conduction
Condition	: FCC 15 CLASS B (QP) ESH2-Z5-08.04.06
Project No.	:
Applicant	:
EUT	: PC POWER
M/N	: OB2201
S/N	: 12V3A
Power Supply	: 120V/60Hz
Ambient	: 21'C 49%RH
Test line	: L
Test Mode	: Full load
Test Engineer	: Wency
Memo	: MINI 0.47u

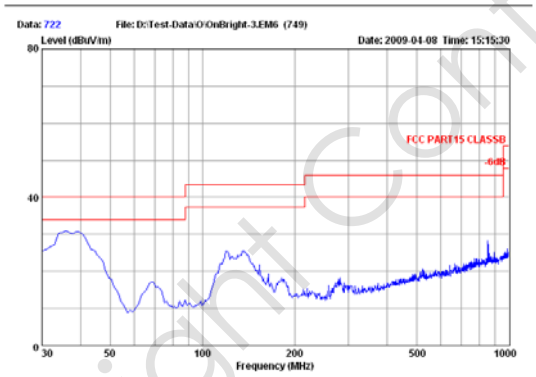
3.4.2 Radiation EMI Test

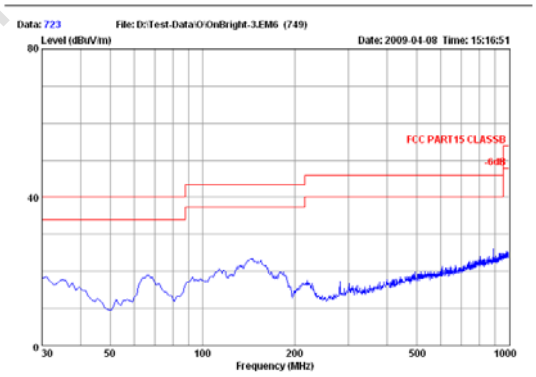
EN55022 CLASS B @ full load report





FCC CLASS B @ full load report





3.5 Thermal Test

The thermal test is under 40℃ ambiance after 4hour full load ruining with 90VAC input.
Table 11 Thermal test result

Position	Description	Value
BD1	Commute diode	94.6℃
T1	QR transformer	99.9℃
Q1	QR MOSFET	97.3℃
D5	Commute diode	101.5℃
U1	OB2201	87.8℃
C1	Bulk capacitor	90.2℃

4 Other important waveform

4.1 Vdd, FB, Sense & Gate waveform at no load/25% load/50% load/full load.

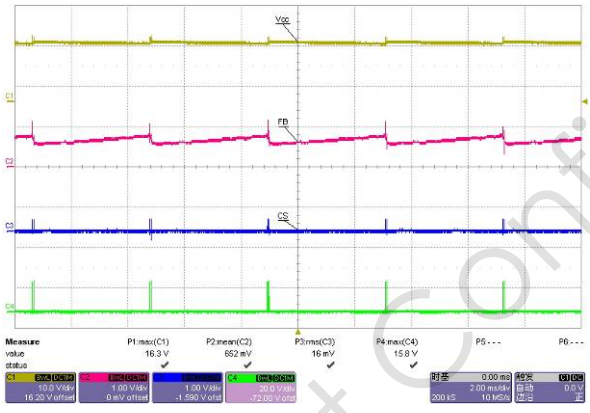


Fig. 17 Vdd,FB,Sense&Gate wave form@90Vac; no load

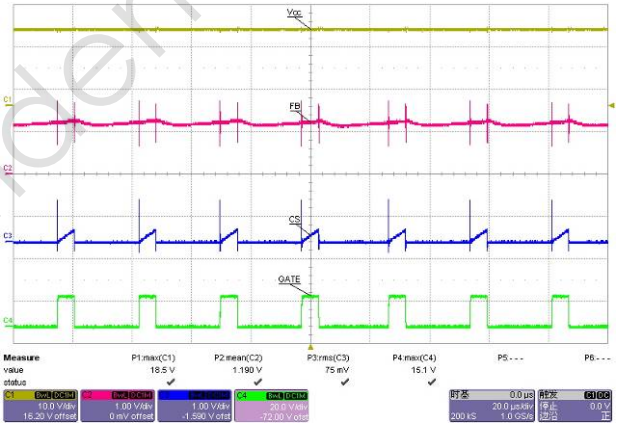


Fig. 18 Vdd,FB,Sense&Gate wave form@90Vac; 25% load

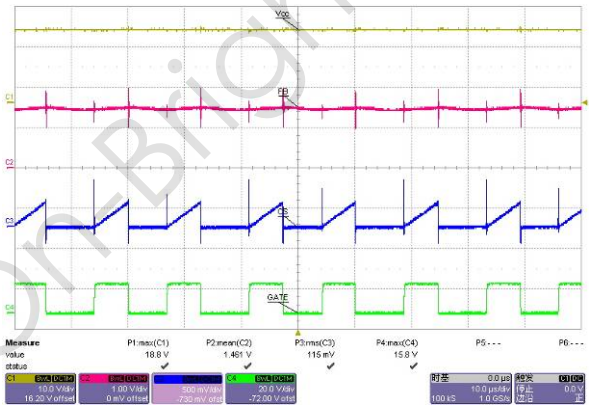


Fig. 19 Vdd,FB,Sense&Gate wave form@90Vac; 50% load

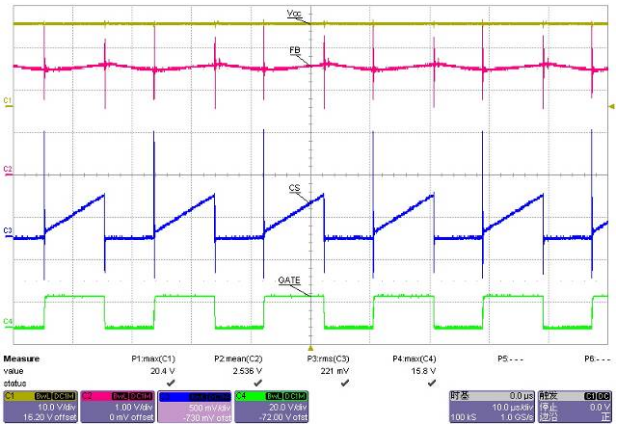


Fig. 20 Vdd,FB,Sense&Gate wave form@90Vac; full load

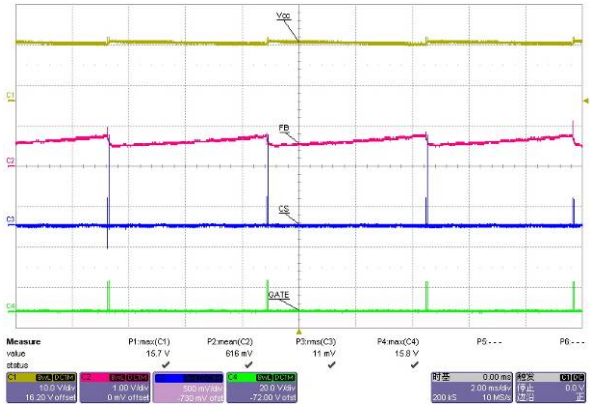


Fig. 21 Vdd,FB,Sense&Gate wave form@264Vac; no load

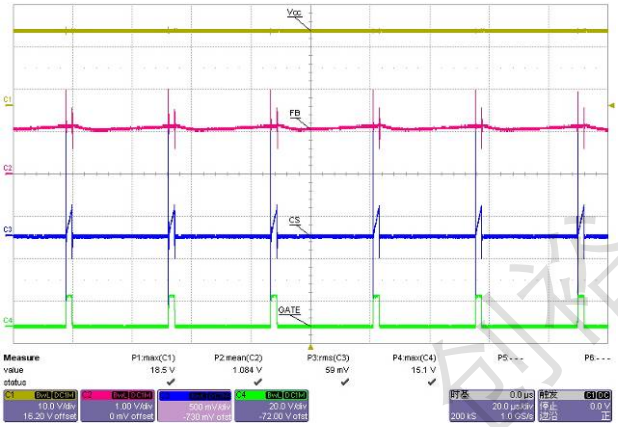


Fig. 22 Vdd,FB,Sense&Gate wave form@264Vac; 25% load

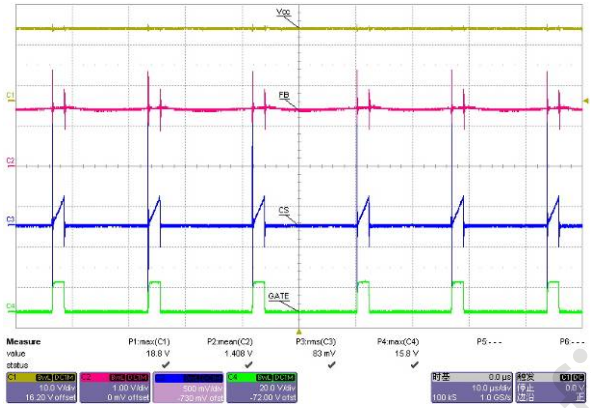


Fig. 23 Vdd,FB,Sense&Gate wave form@264Vac; 50% load

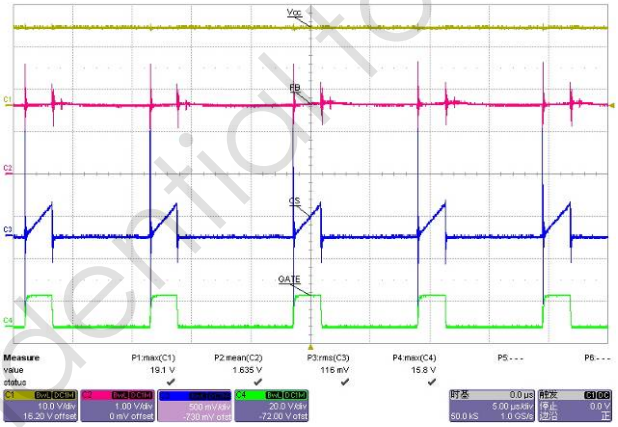


Fig. 24 Vdd,FB,Sense&Gate wave form@264Vac; full load

4.2 VDS, CS & Vout waveform at full load, start/normal/output short

4.2.1 VDS at full load, start/normal/output short

Input Voltage	start	normal	Output short
	QR-VDS	QR-VDS	QR-VDS
90V/60Hz	310V	310V	312V
264V/50Hz	544V	544V	550V

4.2.2 VDS, CS & Vout at full load, start waveform

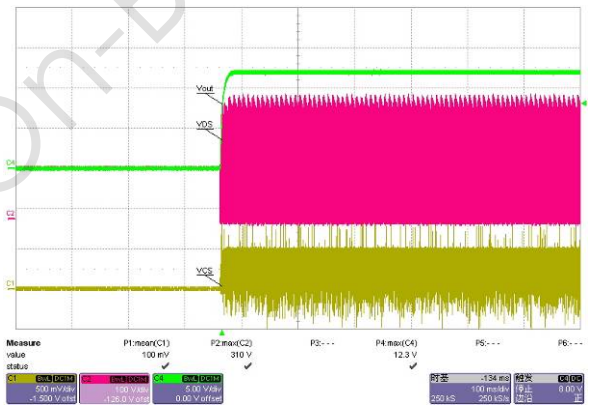


Fig. 25 VDS ,CS & Vout start waveform@90Vac; full load

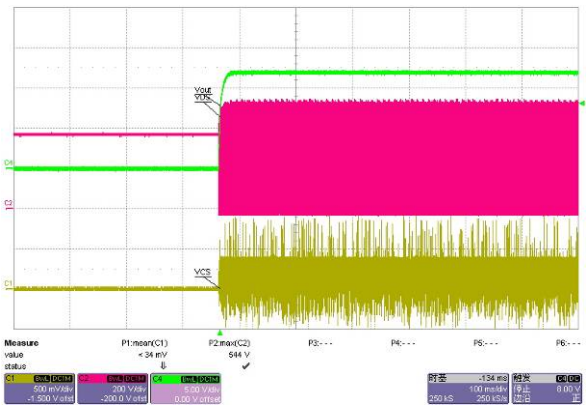


Fig. 26 VDS ,CS & Vout start waveform@264Vac; full load

4.2.3 VDS ,CS at full load, normal waveform

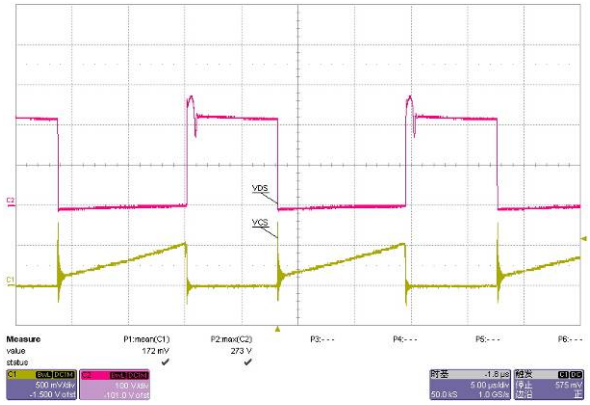


Fig. 27 VDS ,CS normal waveform@90Vac; full load

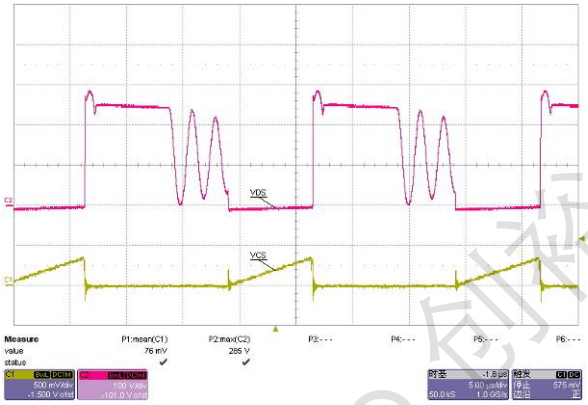


Fig. 28 VDS ,CS normal waveform@90Vac; 50% load

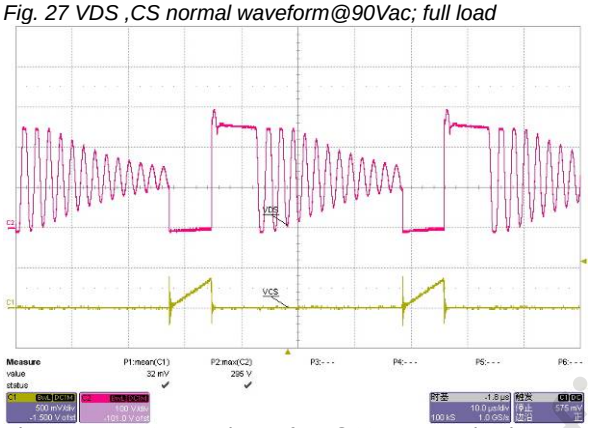


Fig. 29 VDS ,CS normal waveform@90Vac; 25% load

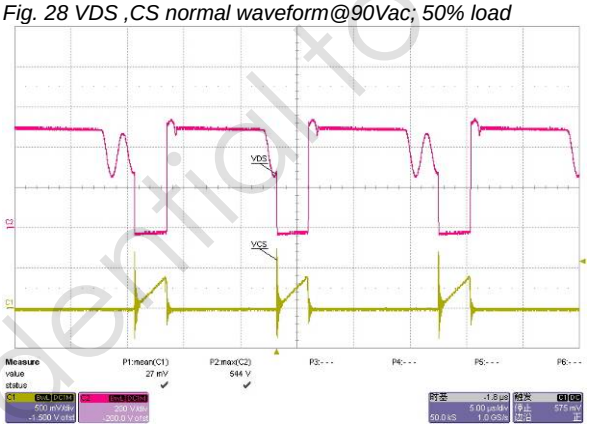


Fig. 30 VDS ,CS normal waveform@264Vac; full load

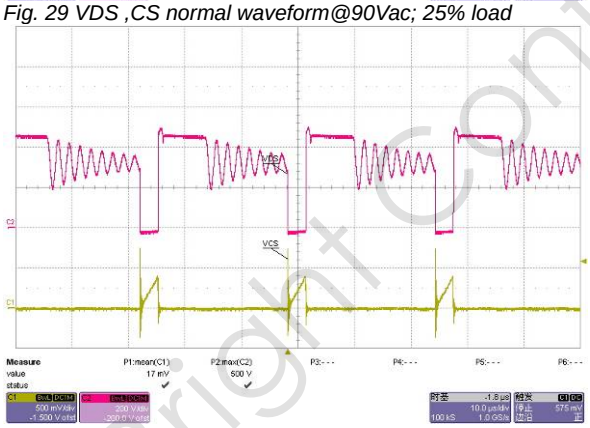


Fig. 31 VDS ,CS normal waveform@264Vac; 50% load

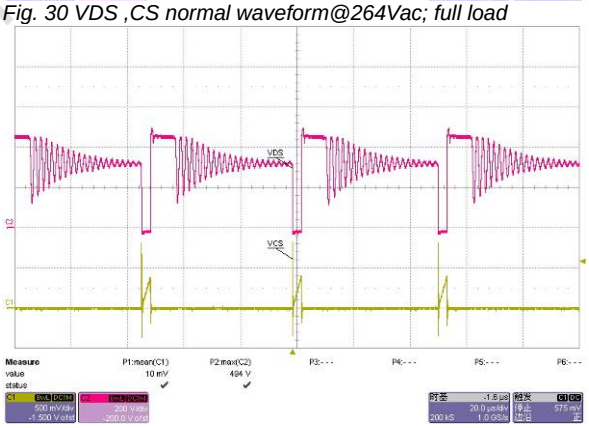


Fig. 32 VDS ,CS normal waveform@264Vac; 25% load

4.2.4 VDS ,CS at full load, output short waveform

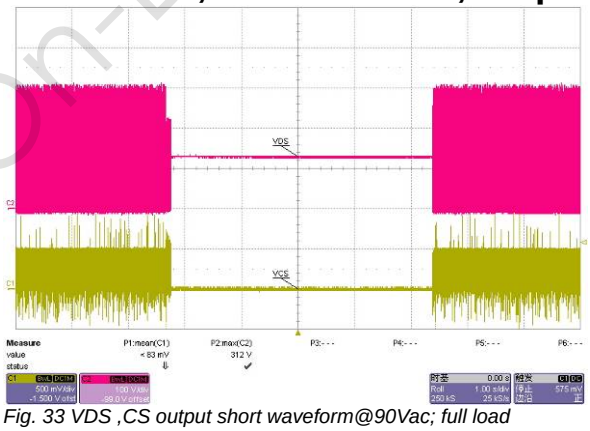


Fig. 33 VDS ,CS output short waveform@90Vac; full load

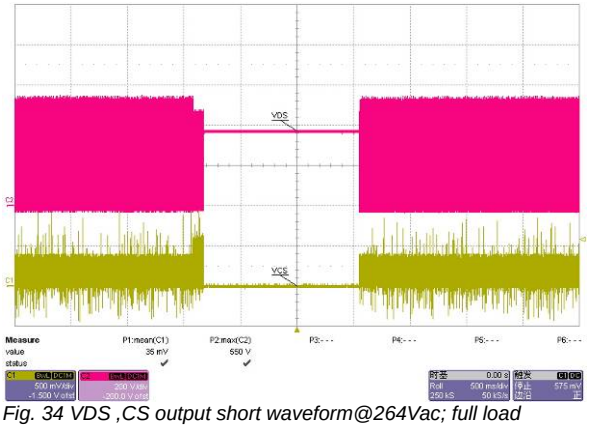


Fig. 34 VDS ,CS output short waveform@264Vac; full load

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.