

Subject
OB2530P Demo Board ManualBoard Model: CH12V1A2530P.00
Doc. No.: OB_DOC_DBM_2530P00**Key features:**

- Standby power less than 75mW@264Vac
- Precise CV regulation
- Primary-side sensing and regulation without TL431 and opto-coupler
- Cost effective and simplified system design
- Average efficiency meet DOE&COC
- Driver MOSFET Switch
- Audio noised free operation
- Frequency shuffling technology to improve EMI performance
- Meet EN55022&FCC part 15 EMI

Revision History

Revise Date	Version	Reason/Issue
2015-03-16	00	First issue

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1. Charger 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 12V
- Output Tolerance $\pm 5\%$
- Min. load current 0A
- Max. load current 1A

1.3. Performance Specifications

- Max. Output Power 12.0W
- Standby Power <75mW @ 230V/50Hz, no load, 25°C
- Efficiency Meet DOE & COC
- Line Regulation $\pm 2\%$ Max
- Load Regulation $\pm 5\%$
- Ripple & Noise 80 mV Max
- Turn on Delay Time 2 Sec. Max. @100Vac with full load

1.4. Protection Function

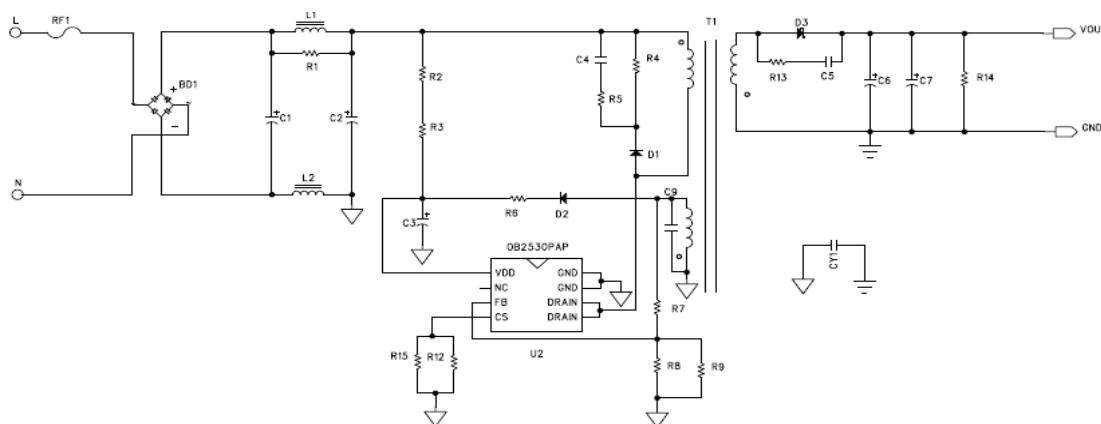
- Short Circuit Protection Output shut down with automatic recovery
- Over Voltage Protection Output shut down with automatic recovery
- Open Loop Protection Output shut down with automatic recovery

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. Charger Module Information

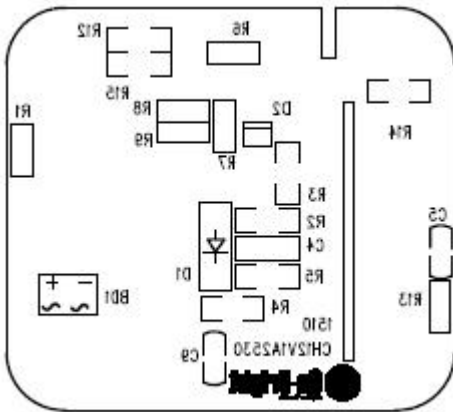
2.1. Schematic



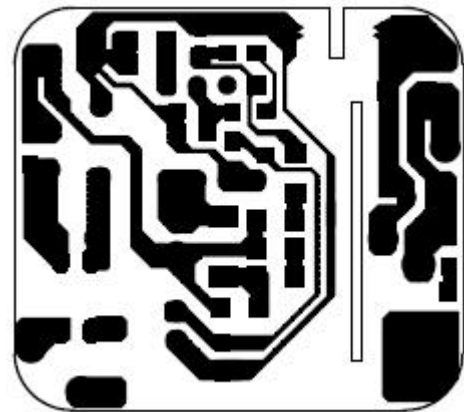
2.2. Bill of material

No.	Position	Description	Quantity	Remark
1	RF1	Fuse 1A/250V	1	
2	R1	RES SMD 0805 1KΩ 5%	1	
3	R2	RES SMD 1206 3MΩ 5%	1	
4	R3	RES SMD 1206 2MΩ 5%	1	
5	R4	RES SMD 1206 470KΩ 5%	1	
6	R5	RES SMD 1206 100Ω 5%	1	
7	R6	RES SMD 0805 7.5Ω 5%	1	
8	R7	RES SMD 0805 22kΩ 1%	1	
9	R8	RES SMD 0805 150kΩ 1%	1	
10	R9	RES SMD 0603 3.9KΩ 1%	1	
11	R12	RES SMD 1206 1Ω 1%	1	
12	R13	RES SMD 0805 33Ω 5%	1	
13	R14	RES SMD 0805 10kΩ 5%	1	
14	R15	RES SMD 1206 2.2Ω 1%	1	
15	C1,C2	EC 10μF/400V Φ8*13mm	2	
16	C3	E.C 2.2μF/50V Φ5*11mm	1	
17	C4	Cap SMD 1206 470pF/630V	1	
18	C5,	Cap SMD 0805 1000pF	1	
19	C6,C7	EC 330μF/16V Φ6.3*11mm low Esr	2	
20	CY1	Y1 220PF/250V	1	
21	BD1	Bridge Rectifier SMD HD06 600V/1A	1	
22	D1	Diode M7 1000V/1A	1	
23	D2	Diode R1G 1A1000V	1	
24	D3	Schottky Diode SB5100	1	
25	T1	EE13L Lm:850uH	1	
26	L1	Choke 330uH/1W Φ4*7mm	1	
27	L2	Choke 2.2uH/ 1W Φ4*7mm	1	
28	U1	OB2530PAP DIP8	1	

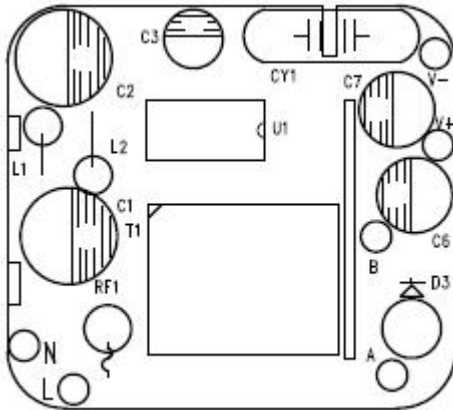
2.3 PCB Gerber File



Bottom



Bottom



Top

2.4 Charger Module Snapshot

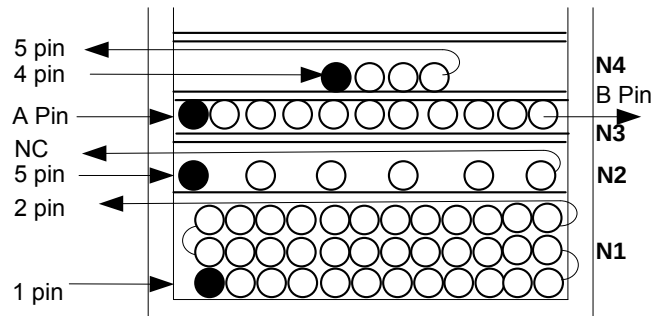
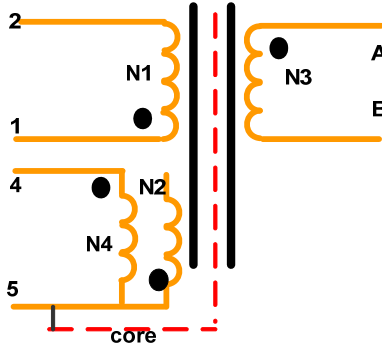


2.5 Transformer design

2.5.1 Transformer Specification

- 1) Bobbin: EE13L (10Pin) Vertical Ae=33mm²
- 2) Core material: PC40 (TDK).
- 3) L(1-2) = 850uH ±7% (10KHz, 1V, 25°C)

2.5.2 Structure/Material



Winding	Material	Start	Turns	Finish	Remark
N1	Φ0.32mm *1 2UEW	1	60	2	Close winding for 3 layers
TAPE	TAPE W=7.5mm (Y)		1		
N2	Φ0.15mm *1 2UEW	5	5	NC	Spread winding for the whole layer
TAPE	TAPE W=7.5mm (Y)		2		
N3	Φ0.55mm *1 triple insulated wire	A	9	B	
TAPE	TAPE W=7.5mm (Y)		2		
N4	Φ0.15mm *1 2UEW	4	12	5	Close winding in the middle
TAPE	TAPE W=7.5mm (Y)		2		
Note: Transformer Core connect to Pin 2.					

3. Performance Evaluation

This session presents the test results of OB2530P 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 the end of 1.8m, 22 AWG output cable.

Performance Highlights

- Standby power less than 75mW@264Vac
- Precise CV/CC regulation
- The average efficiency meet DOE&COC
- EMI passed EN55022 and FCC part 15 test with more than 6dB margin

System Electrical Specification

Description	Symbol	Min	Typ	Max	Units	Comment
Input Section						
Input Voltage	V_{IN}	90		264	V _{AC}	2 Wire
Line Frequency	f_{LINE}	47	50/60	63	Hz	
Standby Power				75	mW	230Vac
Output characteristics						
CV Section	Output Voltage	$V_{OUT CV}$	11.4	12.6	V	
	Output Current	$I_{OUT CV}$	0	1.0	A	
Ripple & Noise	V_{RIPPLE}			80	mV _{P P}	
Continuous Output Power	P_{OUT}		12W			
Over Current Protection	$I_{OUT MAX}$			1.2	A	
Active Mode Efficiency	η	83.26			%	Measured at Line End, $V_{IN}=115V_{AC}/230V_{AC}$
Time sequence						
Turn on delay time				2	S	
Environmental						
Conducted/Radiation EMI	Meets CISPR22B/EN55022B					
Safety	Meets IEC950,UL1950,Class II					
ESD		18			kV	

Test Equipments

Item	Vender	Module
AC Source	WEST	WEW1010
Digital Power Meter	YOKOGAWA	WT210
Electrical Load	Chroma	63030
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	32	12.187	<75mW	Pass
115Vac/60HZ	35	12.193		
230Vac/50HZ	55	12.184		
264Vac/50HZ	66	12.182		

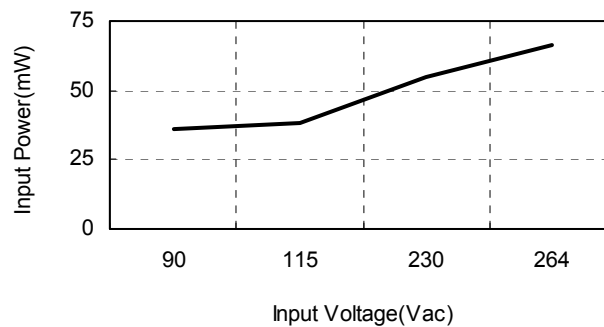


Fig. 1 No-load Input Power vs. Input Line Voltage

3.1.2. Efficiency

Table. 2 Efficiency Line end with 22AWG 1.8M(195mΩ)

Input voltage	10%	25%	50%	75%	100%	25%~100 % Load Aver. Eff.	Standards		Test Result
							DOE	COC	
115V/60Hz	84.20	85.36	84.87	84.50	84.02	84.68	82.96	73.26 (10%Load)	Pass
230V/50Hz	81.07	84.19	84.88	84.89	84.62	84.64		83.26	

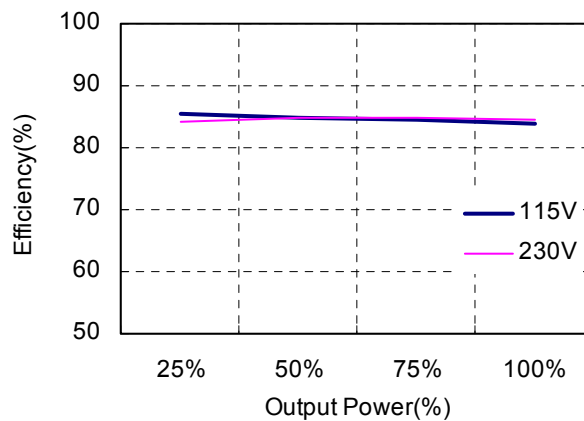


Fig. 2 Efficiency vs. Percent of Rated Output Power

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	12.193	12.179	12.171	11.4-12.6	
115Vac/60HZ	12.189	12.176	12.173	11.4-12.6	
230Vac/50HZ	12.187	12.161	12.174	11.4-12.6	
264Vac/50HZ	12.183	12.153	12.169	11.4-12.6	
Line Regulation	0.21%			<2%	Pass
Load Regulation	0.24%			<±5%	Pass

3.2.2. Ripple & Noise

Table. 4 Ripple & Noise

Input voltage	R&N (mV)		
	No load	Full load	Remark
90Vac/60HZ	27mV	70mV	Fig. 3,4
115Vac/60HZ	28mV	68mV	
230Vac/50HZ	30mV	65mV	
264Vac/50HZ	28mV	63mV	Fig.5,6

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

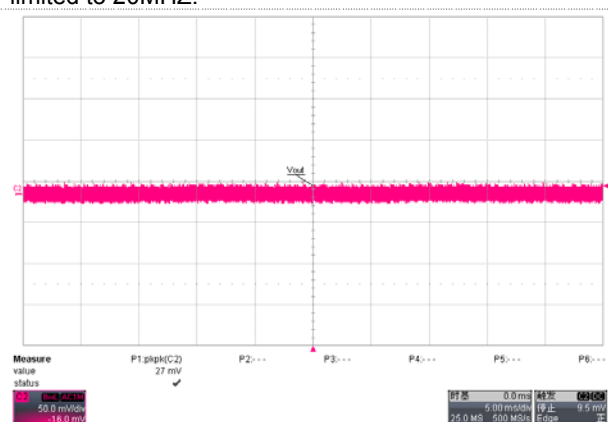


Fig. 3 Measured ripple& noise waveform@90Vac/60HZ, no load

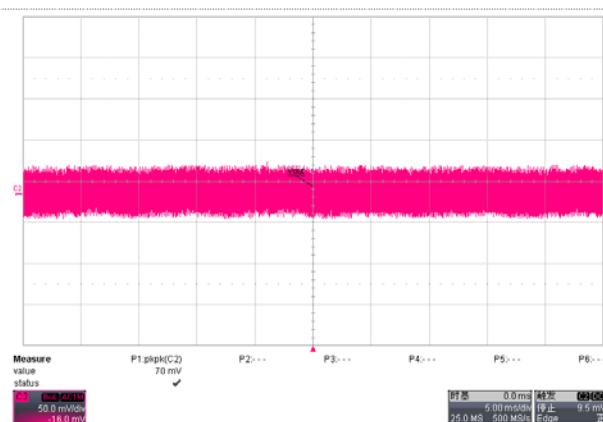


Fig. 4 Measured ripple& noise waveform@90Vac/60HZ, full load

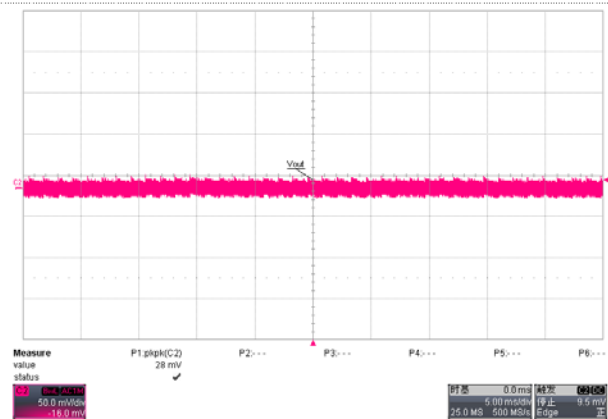


Fig. 5 Measured ripple& noise waveform@264Vac/50HZ, no load

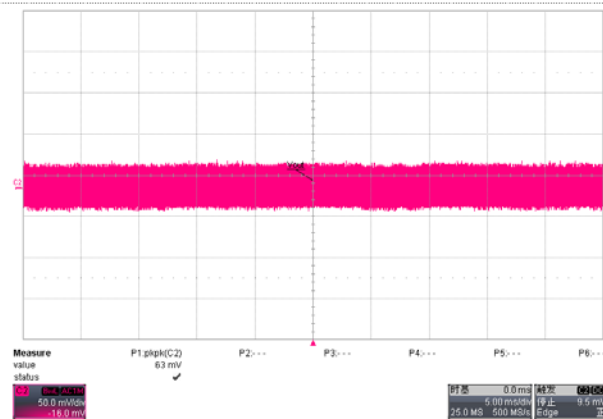


Fig. 6 Measured ripple& noise waveform@264Vac/50HZ, full load

3.2.3. Over Shoot & Under Shoot

Over shoot and under shoot were measured under below conditions.

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

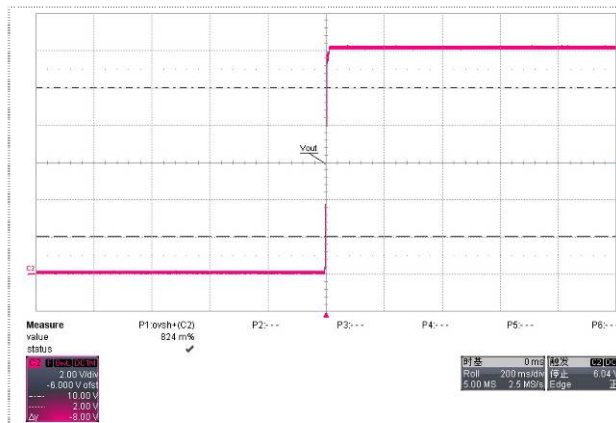


Fig. 7 Measured overshoot waveform@90Vac/60HZ, full load

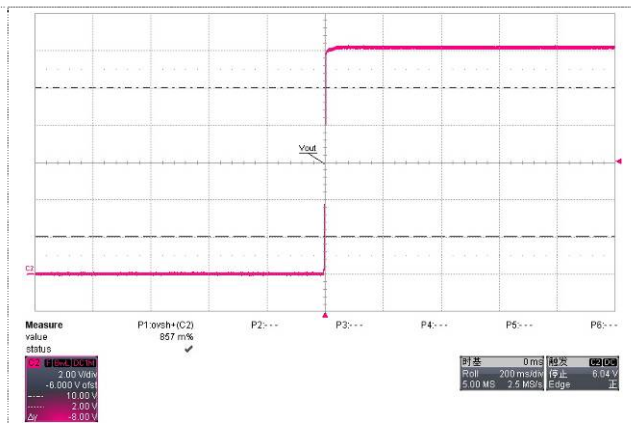


Fig. 8 Measured overshoot waveform@90Vac/60HZ, no load

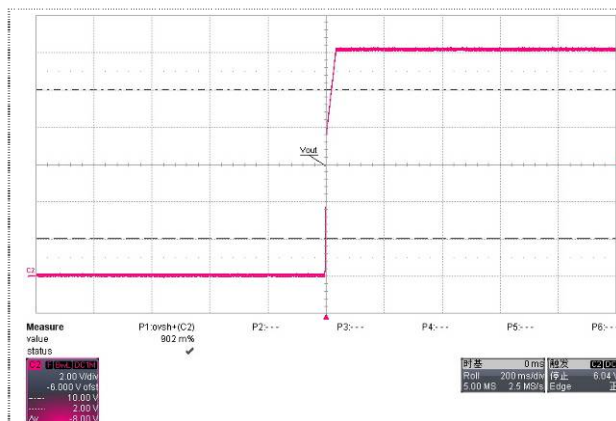


Fig. 9 Measured overshoot waveform@264Vac/50HZ, full load

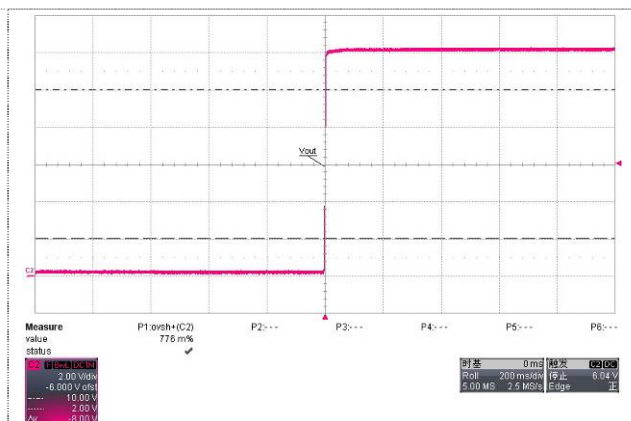


Fig. 10 Measured overshoot waveform@264Vac/50HZ, no load

3.2.4. Dynamic Test

A dynamic loading with low set at 0A lasting for 20mS&50mS and high set at 0.5A load lasting for 20mS&50mS is added to output. The ramp is set at 0.125A/us at transient. Measurement was taken at line end.

Table. 6 Output voltage under dynamic test(High load:0.5A Low load:0A) 20mS

Input	Vomin-Vomax(v)	Remark
90V/60HZ	11.590-12.770	Fig. 11
115V/50HZ	11.570-12.770	
230V/50HZ	11.640-12.800	
264V/50HZ	11.640-12.800	Fig. 12

Output voltage under dynamic test(High load:0.5A Low load:0A) 50mS

Input	Vomin-Vomax(v)	Remark
90V/60HZ	10.590-12.790	Fig. 13
115V/50HZ	10.680-12.810	
230V/50HZ	10.820-12.870	
264V/50HZ	10.940-12.870	Fig. 14

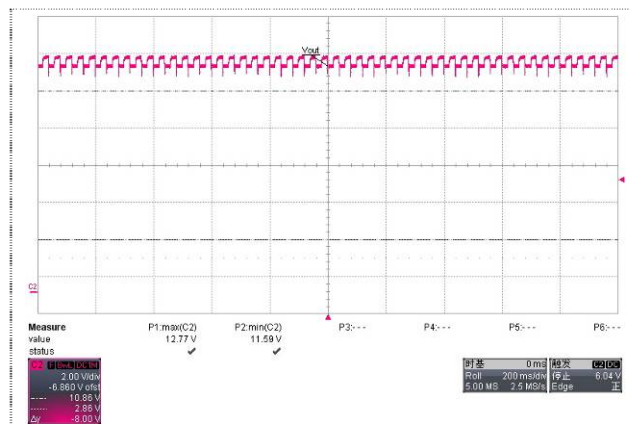


Fig. 11 Output voltage waveform under Dynamic test @90Vac/60Hz 0-0.5A 20mS

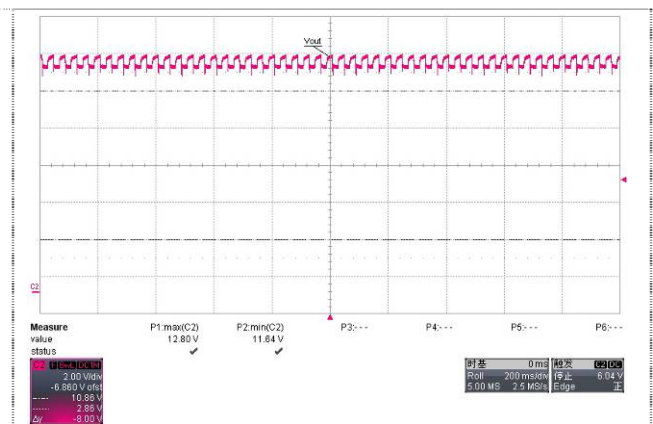


Fig. 12 Output voltage waveform under Dynamic test @264V/50Hz 0-0.5A 20mS

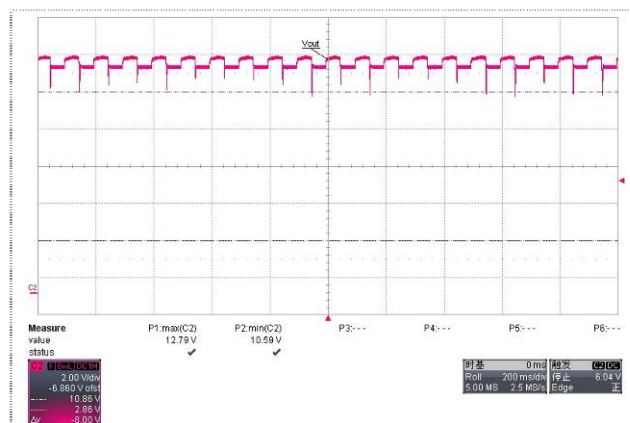


Fig. 13 Output voltage waveform under Dynamic test @90Vac/60Hz 0-0.5A 50mS

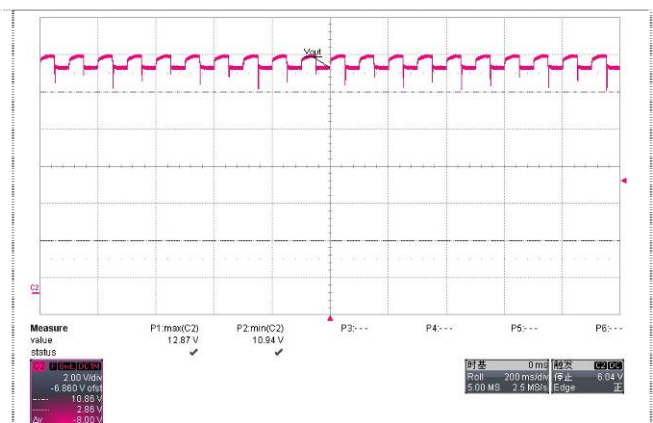


Fig. 14 Output voltage waveform under Dynamic test @264V/50Hz 0-0.5A 50mS

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	100V/60HZ	1.55S	<2S	Pass	Fig. 15
	240V/50HZ	0.6S		Pass	Fig. 16
Rise Time	100V/60HZ	23mS		Pass	Fig. 17
	240V/50HZ	25mS		Pass	Fig. 18
Fall Time	100V/60HZ	10.2mS		Pass	Fig. 19
	240V/50HZ	11.6mS		Pass	Fig. 20

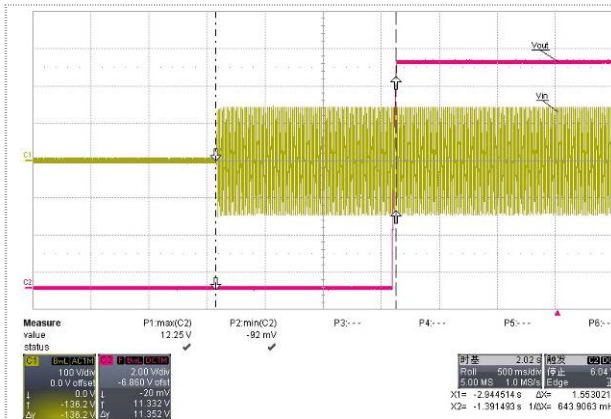


Fig. 15 Turn on delay time measured waveform@100V/60Hz no load

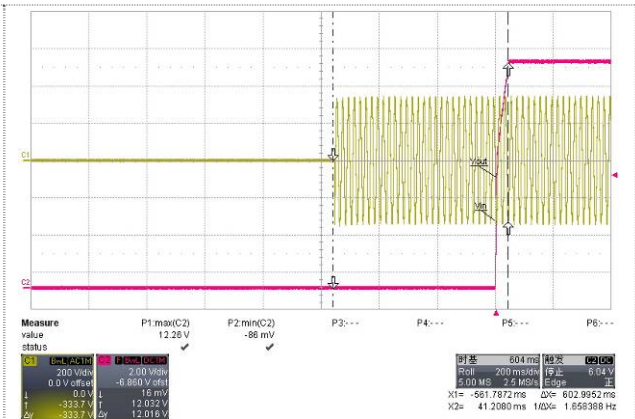


Fig. 16 Turn on delay time measured waveform@240V/50Hz full load

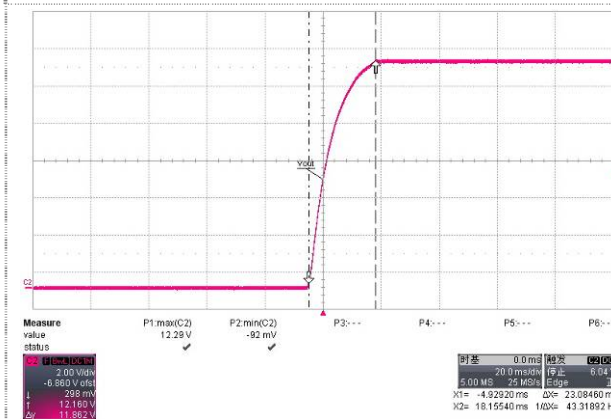


Fig. 17 Rise time measured waveform@100Vac/60Hz,full load

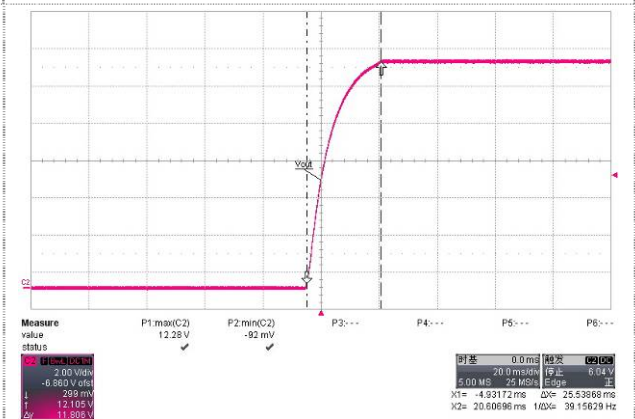


Fig. 18 Rise time measured waveform@240Vac/50Hz,full load

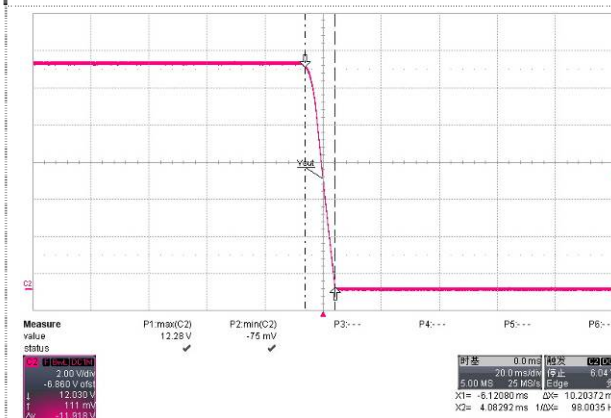


Fig. 19 Fall time measured waveform@100Vac/50Hz,full load

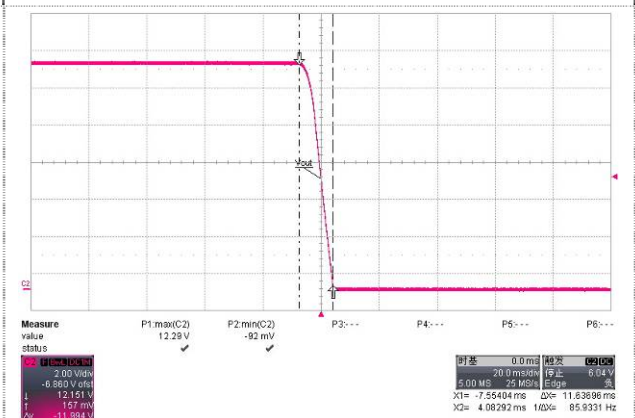


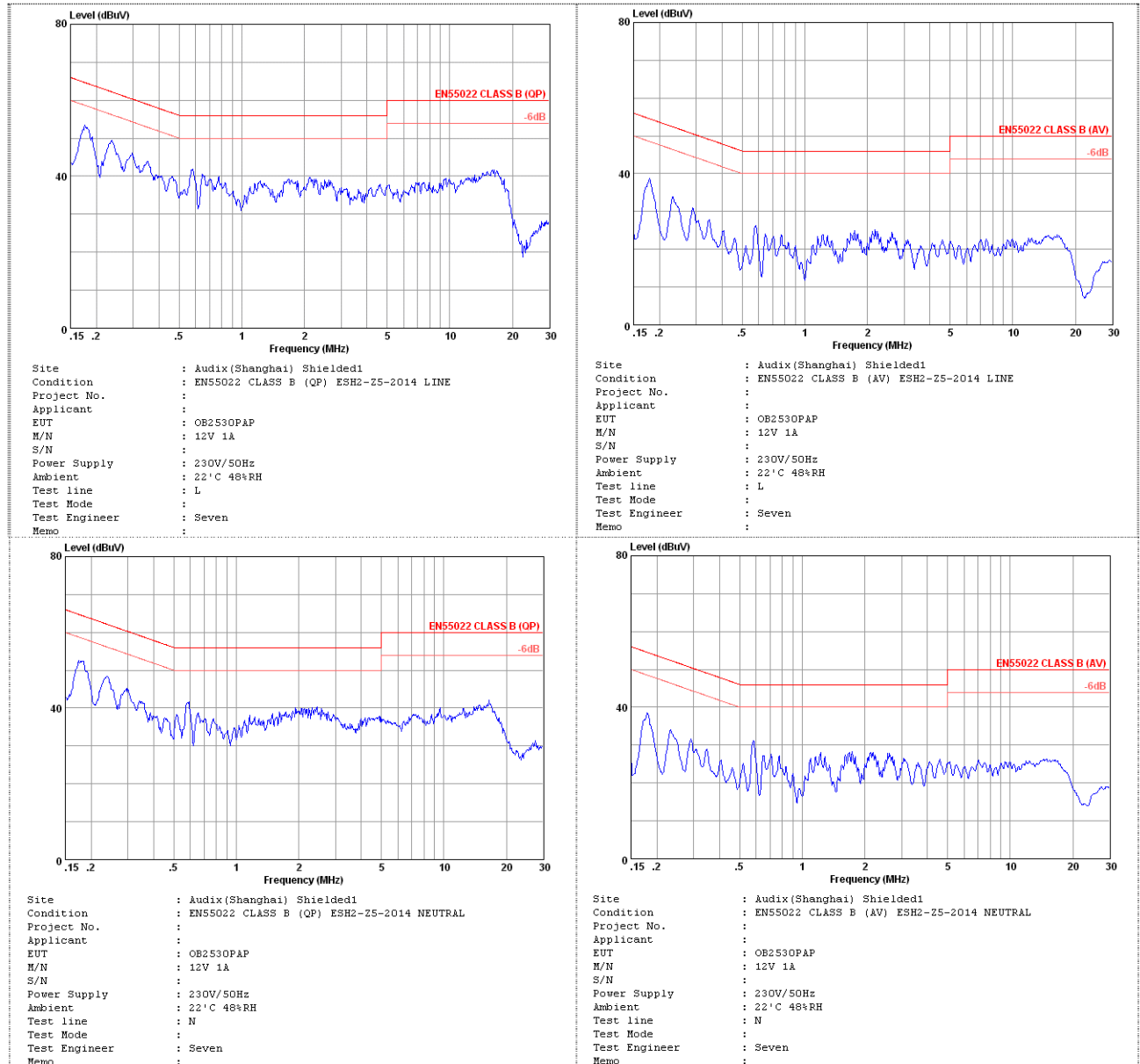
Fig. 20 Fall time measured waveform@240Vac/50Hz,full load

3.3. EMI Test

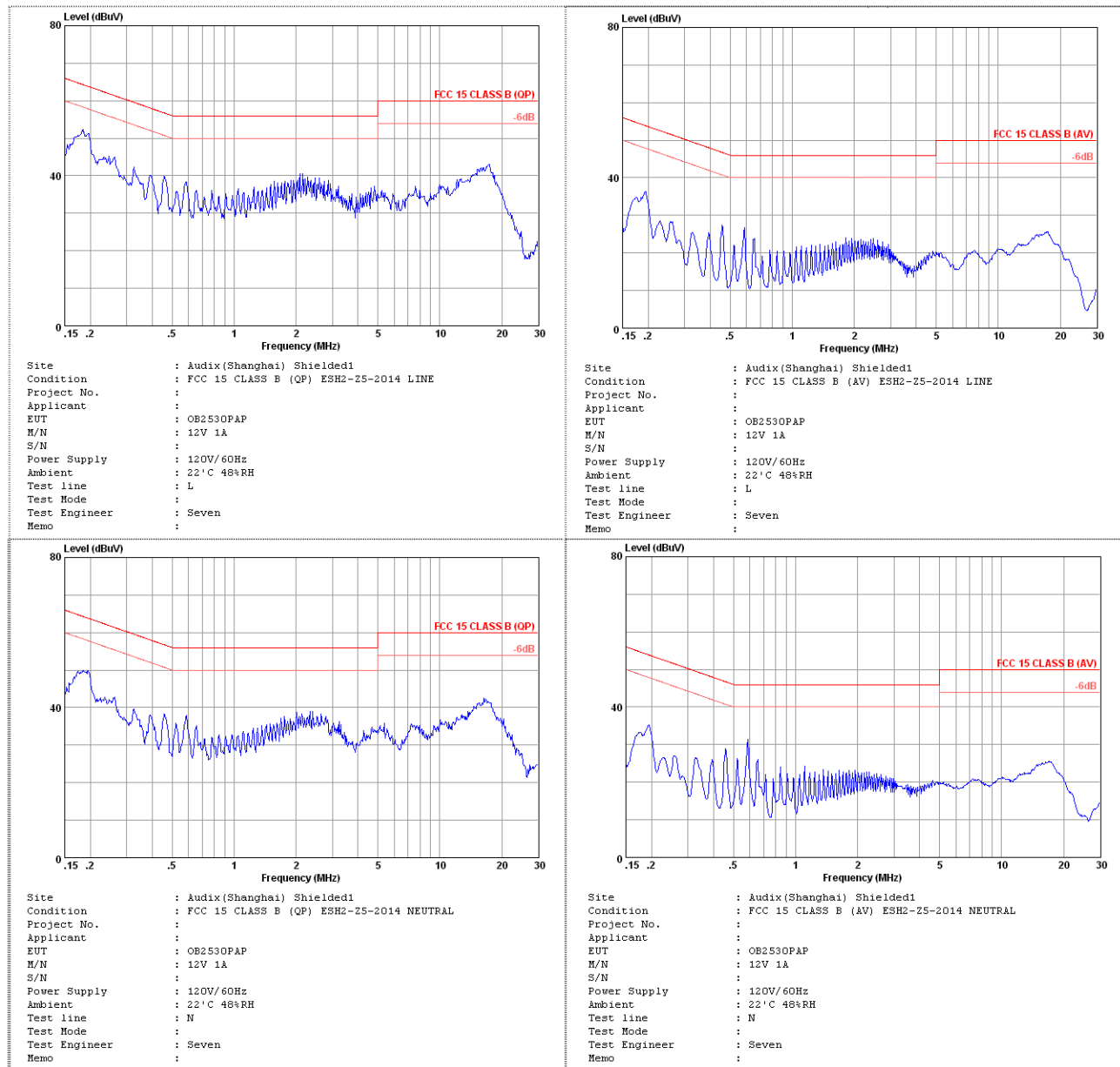
The Power supply passed EN55022 Class B EMI requirement with more than 6dB margin

3.3.1. Conducted EMI Test

3.3.1.1. EN55022 CLASS B @ full load report

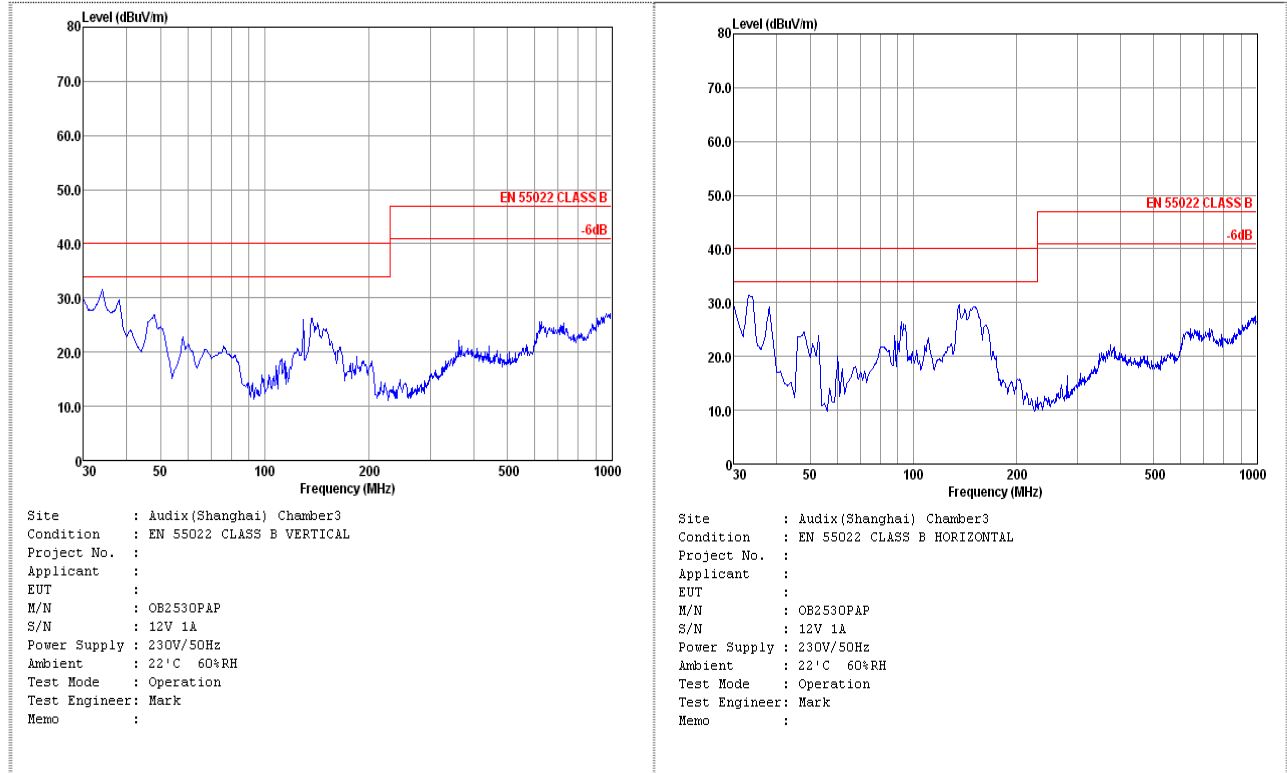


3.3.1.2. FCC PART 15 @ full load report

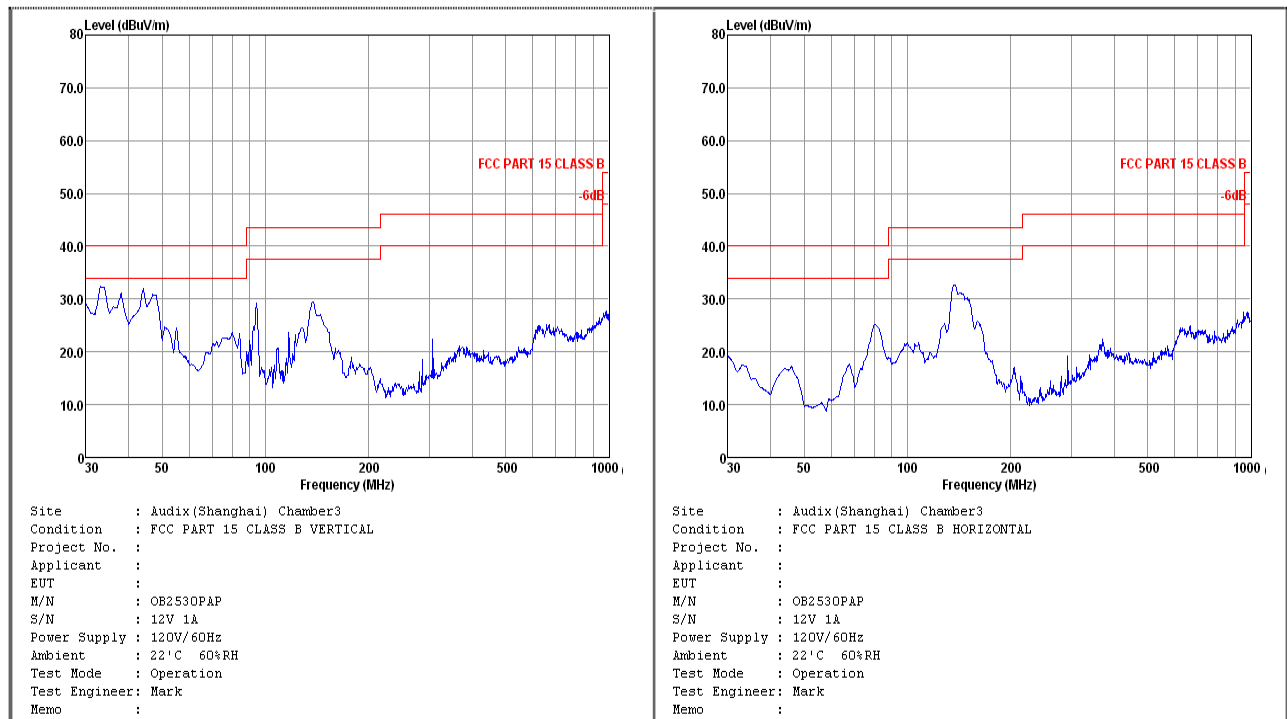


3.3.2. Radiation EMI Test

3.3.2.1. EN55022 CLASS B @ full load report



3.3.2.2. FCC PART 15 @ full load report



4. Protection Function

4.1. Over voltage protection

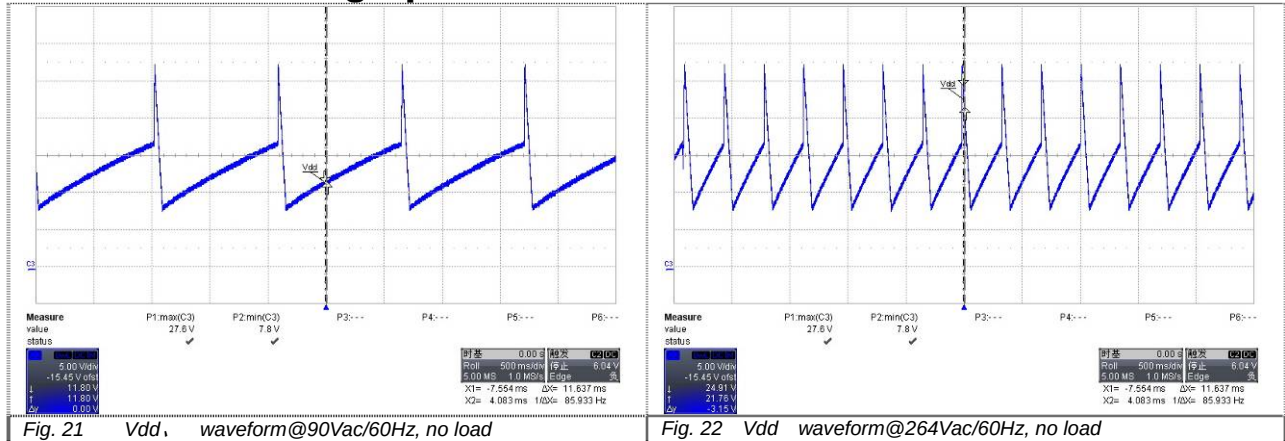
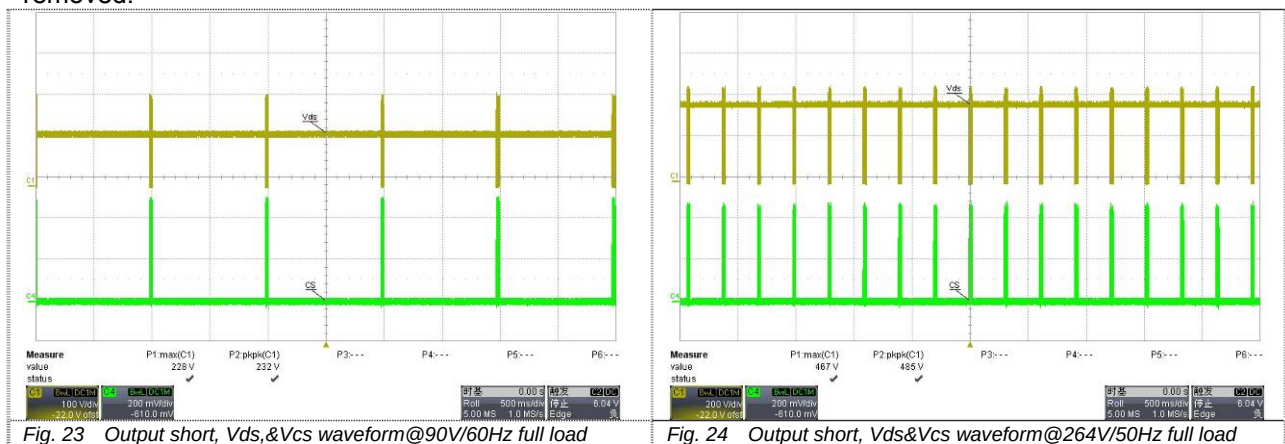


Table. 8 OVP @ no load

Input	VDD@OVP Protection
90Vac/60Hz	27.6V
264Vac/50Hz	27.6V

4.2. Short circuit protection

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



4.3. Over Current Protection

Table. 9 Over current Protection

Input	OCP Current	Max. startup current
90Vac/60Hz	1.156A	1.120A
115 Vac/60Hz	1.130A	1.115A
230Vac/50Hz	1.110A	1.100A
264Vac/50Hz	1.120A	1.110A

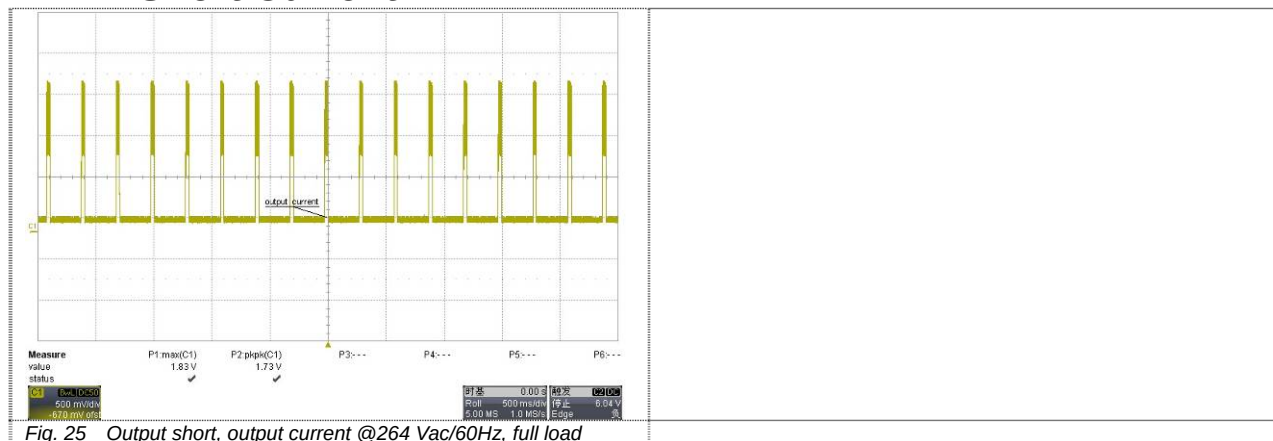


Table. 10 OLP @ Full load

Input	OLP Protection
115Vac/60Hz	OK
230Vac/50Hz	OK

5. Thermal Testing

Vin	Po	Ambient	IC	Output Diode	Tr(wire)	Tr(core)
90Vac/60Hz	12W	40℃	109.4℃	108.6℃	90.3℃	87.8℃
264Vac/50Hz	12W	40℃	99.6℃	110.6℃	84.3℃	81.2℃

Note: All data were be measured at 22AWG (1.8m) Line end

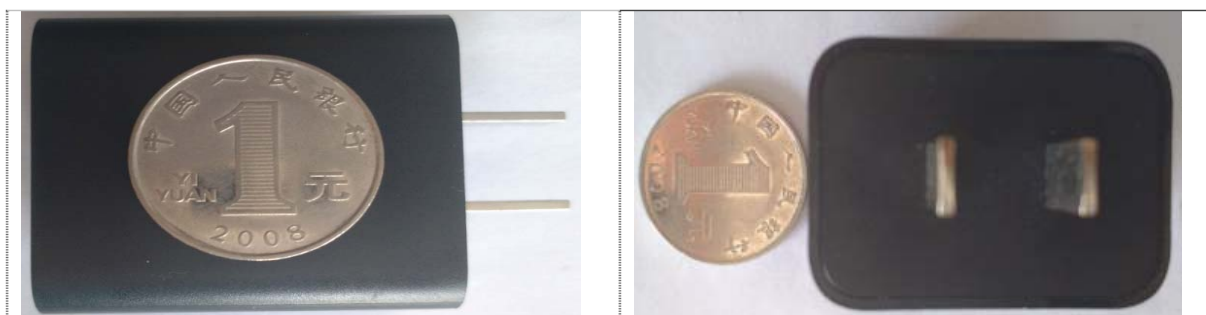


Fig. 26 Case: 44mmX39mmX27mm

6. Other Important Waveform

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

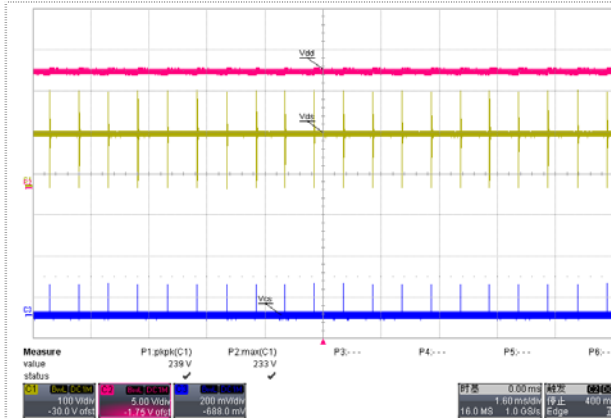


Fig. 27 Vdd, Sense & Vds waveform @90Vac/60Hz, no load

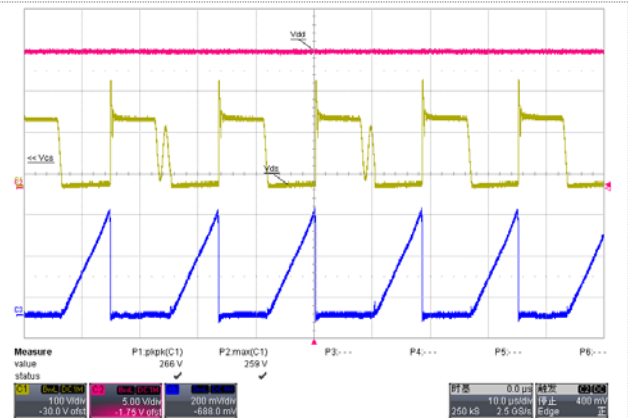


Fig. 28 Vdd, Sense & Vds waveform @90Vac/60Hz, full load

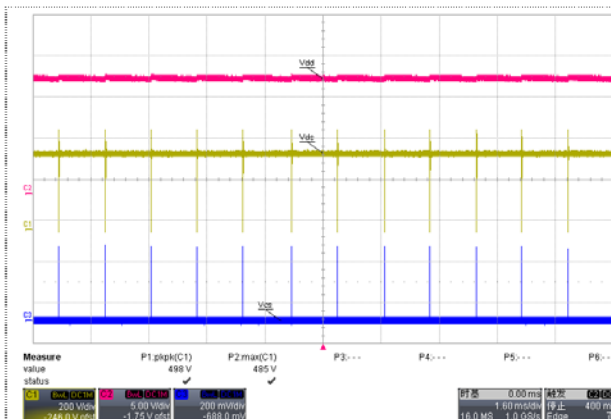


Fig. 29 Vdd, Sense & Vds waveform @264Vac/50Hz, no load

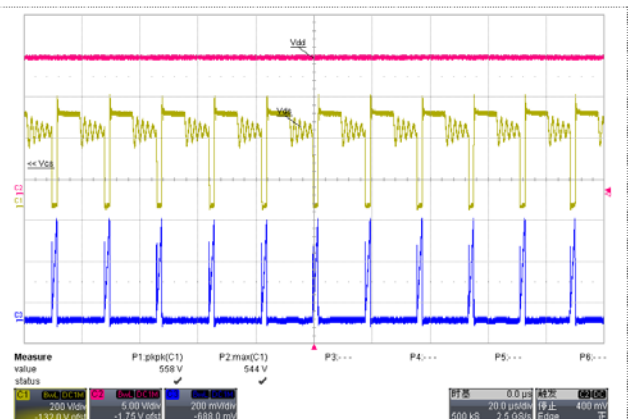


Fig. 30 Vdd, Sense & Vds waveform @264Vac/50Hz, full load

6.2. Mosfet Vds waveform @ start/normal/output short

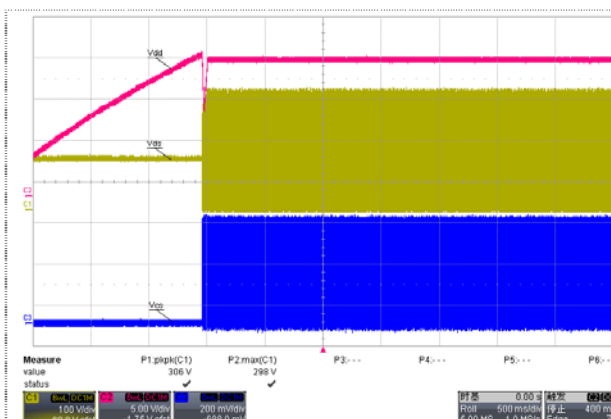


Fig. 31 Start, Vds waveform @90 Vac/60Hz, full load

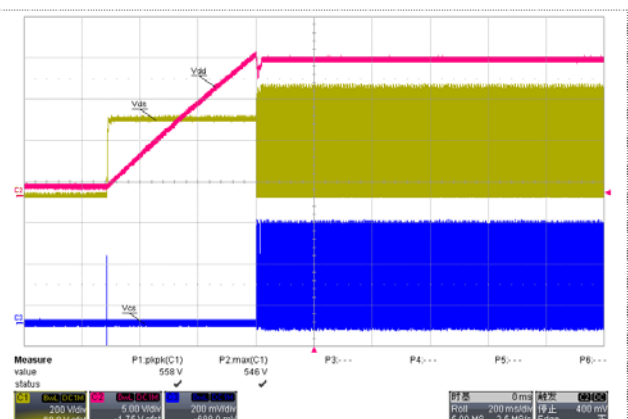


Fig. 32 Start, Vds waveform @264 Vac/50Hz, full load

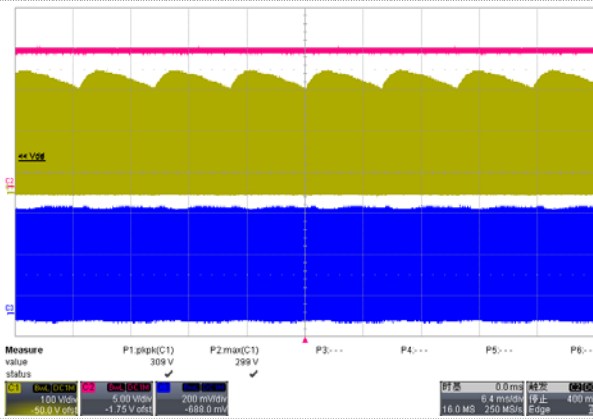


Fig. 33 Normal, Vds waveform@90 Vac/60Hz, full load

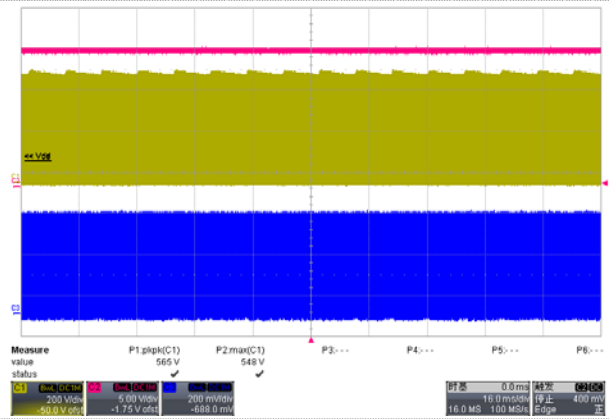


Fig. 34 Normal, Vds waveform@264 Vac/50Hz, full load

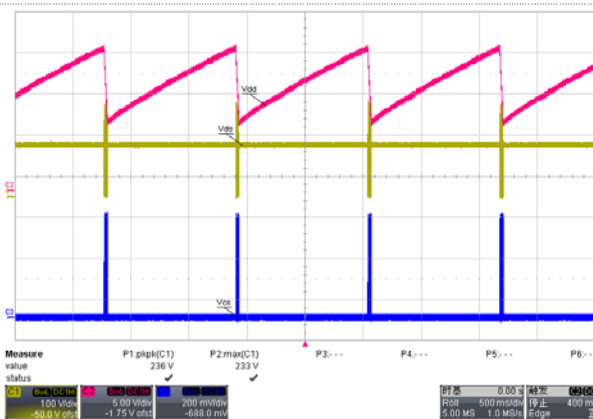


Fig. 35 Output short, Vds waveform@90 Vac/60Hz

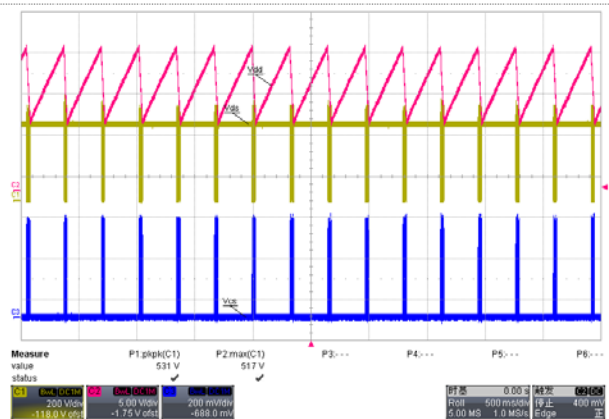


Fig. 36 Output short, Vds waveform@264 Vac/50Hz

Table. 11 Vds_max @ Full load / Output short

Input	Vds_max(V)
264Vac/50Hz @Short	531
264Vac/50Hz @ Full load	565
264Vac/50Hz @ Start	558

6.3 Output schottky Vak waveform @ start /output short/normal

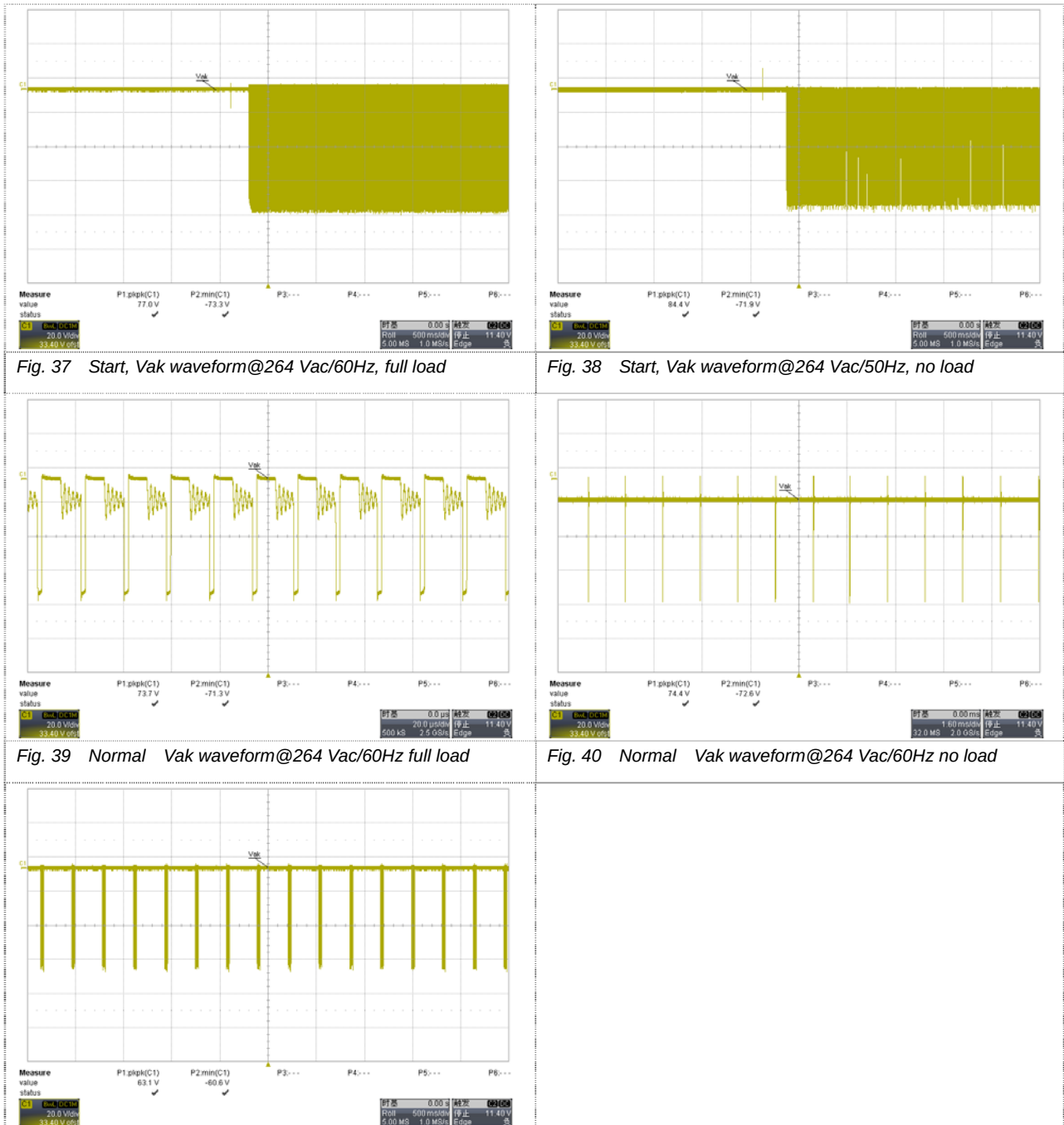


Fig. 41 Short, Vak waveform@264 Vac/60Hz, full load

Table. 12 Vak_max @ Full load / Output short/Start

Input	Vds_max(V)
264Vac/50Hz @ Start Full load	77
264Vac/50Hz @ Full load	73.7
264Vac/50Hz @ Output short	63.1

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