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AP3771 For 5V 2A Pad Charger Solution

General Design Specification:

Ø AC Input Range 90-264Vac

Ø DC Output 5V, 2A

Ø Meet “<30mW” No-Load standby Power Consumption Requirement

Ø Meet “6-Star” Requirement

Key Performance



Item	Spec	Test Conditions	Test Data	Result
Output Voltage	4.75~5.25V	90~264Vac @ 0~2A	4.94~5.06V	Pass
Ripple	<100mVp-p	90~264Vac @ 0~1A	85mVp-p	Pass
Standby Power	<30mW	230Vac @ 0A	23mW	Pass
Dynamic	4.5~5.5V	90~264Vac @ 0.2~1.8~0.2A 5mS 0.5A/uS	4.72~5.28V	Pass
Common Mode Noise	<2Vp-p	90~264Vac @ 0.5A 30k~500kHz	1Vp-p	Pass
EMC	EN55022B - 6dB	115Vac 230Vac@ 2A	8dB	Pass
ESD	15kV	230Vac @ 2A	18kV	Pass

Specification



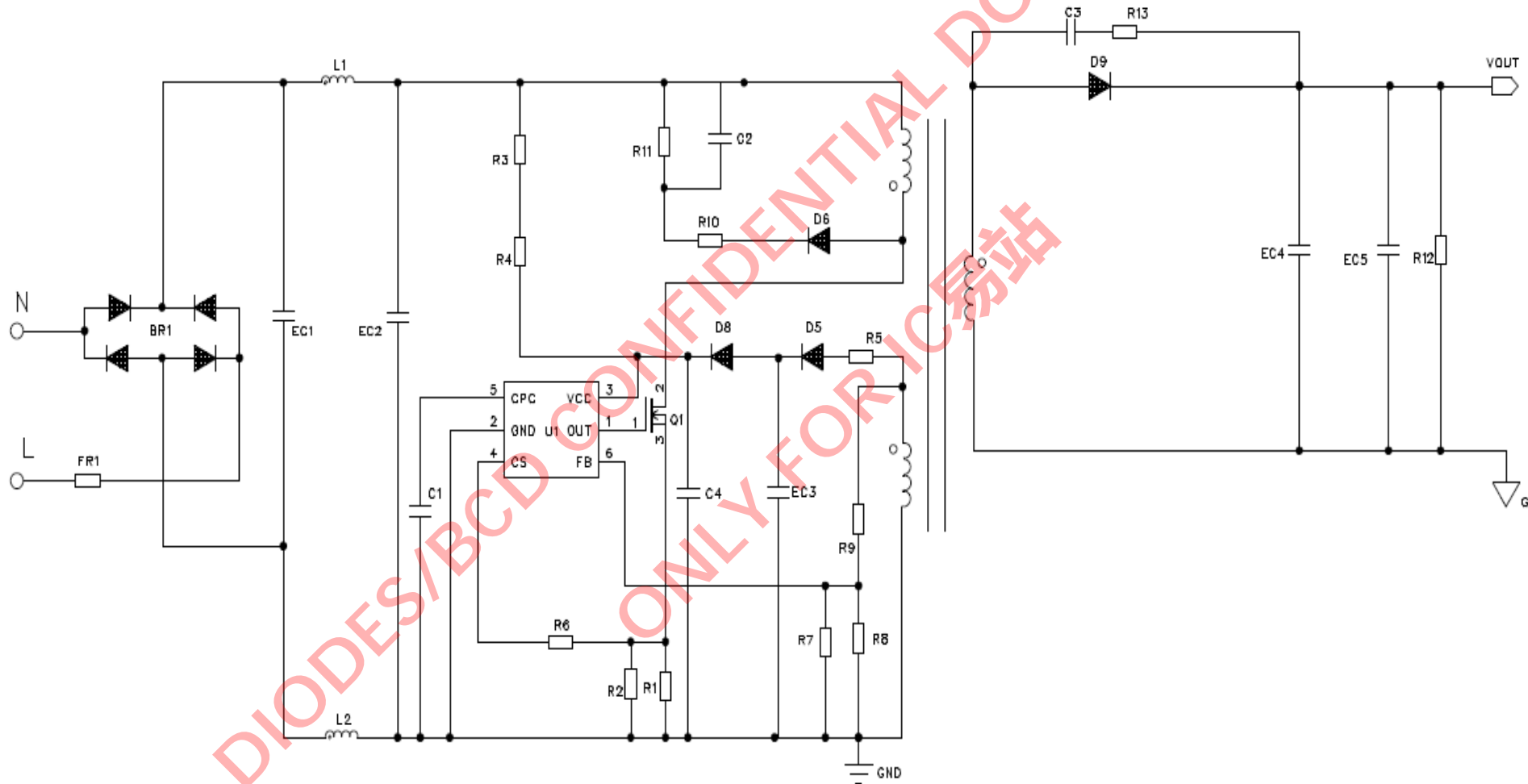
Description	Min	Type	Max	Units	Conditions
Input					
Voltage	90		264	VAC	
Frequency	47	50/60	63	Hz	
No-Load Input Power (230Vac)			30	mW	
Output					
Output Voltage	4.75	5	5.25	V	
Output Current	0		2	A	
Output Power		10		W	
Output Ripple Voltage			100	mVp-p	I _{out} = 1A @ 25°C, 20MHz bandwidth
Common Mode Noise			2	Vp-p	30k~500kHz, Load with 10ohm Resistor
Output Over Current Protection	2		2.4		Hiccup, Auto Restart
Ambient Temperature			45	°C	
Efficiency					
Average Efficiency (6-Star)	78.7			%	Measured at end of output DC-Cable, 115Vac & 230Vac @ 25°C
EMI	Pass EN55022 Class B with 6dB Margin				

Test Equipment



Item	Model
AC Source	Chroma 61602
Power Meter	YOKOGAWA WT210
Electronic Load	Chroma 63100
Oscilloscope	YOKOGAWA DLM2024 2.5GS/s 200MHz
Digit Multimeter	Agilent 34410A
Data Acquisition	Agilent 34970A

Schematic Circuit

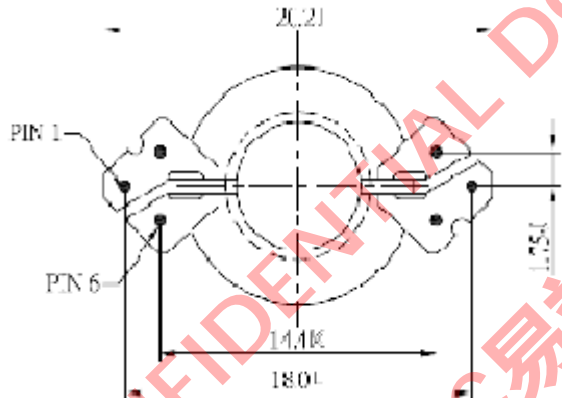
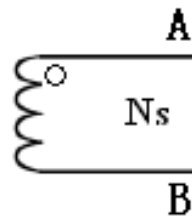
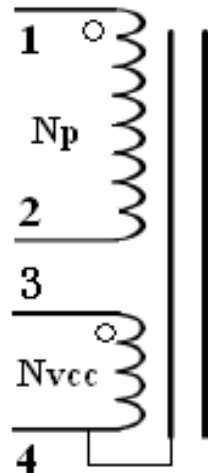


Bill Of Material



类型	规格	位号	数量
贴片器件	贴片电容0.1UF/25V ±15% 0603 X7R	C1	1
	贴片电容1000PF/250V ±15% 1206 X7R	C2	1
	贴片电容1000PF/50V ±15% 0805 X7R	C3	1
	贴片电容1uF/25V ±15% 0805 X7R	C4	1
	贴片电容4.7uF/25V ±15% 0805 X7R	C5	1
	贴片电阻 1.5Ω ±1% 0805 1/6W	R5	1
	贴片电阻 1.6Ω ±1% 1206 1/6W	R1 R2	2
	贴片电阻 6.8MΩ ±5% 1206 1/4W	R3 R4	2
	贴片电阻 3.3K ±1% 0603 1/6W	R6	1
	贴片电容 18pF/25V ±15% 0603 X7R	R7	1
	贴片电阻 16KΩ ±1% 0603 1/6W	R8	1
	贴片电阻 39KΩ ±1% 0603 1/6W	R9	1
	贴片电阻 100Ω ±5% 1206 1/4W	R10	1
	贴片电阻 100KΩ ±5% 1206 1/6W	R11	1
	贴片电阻 4.7KΩ±5% 0805 1/6W	R12	1
	贴片电阻 10Ω ±5% 0805 1/6W	R13	1
	贴片整流二极管1N4148 0.5A 70V DO-123	D8	1
	主控制芯片AP3771K6TR-G1 SOT23-6	U1	1
	OR	L2	1
	贴片整流二极管S1M 1A 1000V	D5 D6	2
贴片肖特基二极管10U45	D9	1	
贴片整流桥ABS10	BR1	1	
插件器件	N-MOSFET CS4N60 TO-126	Q1	1
	电解电容8.2uF 400V 8*14mm	EC1, EC2	2
	因态电容470uF 6.3V 6.3*11mm	EC4 EC5	2
	开关变压器 RM6	T1	1
	色环电感330uH 1W	L1	1
	Y电容 100PF/250V	L1	1
	保险丝 2A 250V	FR1	1
	USB A母4+2Pin	USB	1
PCB板 38*28 *1.6mm FR-4材质	PCB	1	

Transformer Specification



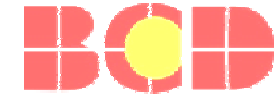
RM6 PC40

$L_p = 1\text{mH}$, $\pm 7\%$ (@ 1kHz)

$L_k < 80\text{uH}$ 40kHz

Wdg.No	Start 起线	Finish 收线	Turns 圈数	Wire Dia. 线径	Wdg Type Spread / Even	Wdg Direction 绕线方向	Turns/Layer No. Of Layers
W1	1	2	80T	$\phi 0.21\text{mm} * 1$	单线三层一次绕完	RIGHT	3 Layer
1 layers of Polyester Yellow tape, T=0.05 mm							
W2	3	4	13T	$\phi 0.21\text{mm} * 1$	单线靠原边密绕	RIGHT	1 Layers
1 layers of Polyester Yellow tape, T=0.05 mm							
W3	4	Floating	5T	$0.21\text{mm} * 1$	单线靠原边密绕	RIGHT	1 Layer
2 layers of Polyester Yellow tape, T=0.05 mm							
W4	A	B	5T	$\phi 0.4\text{mm} * 2$ 层绝缘	双线密绕	RIGHT	1 Layer
3 layer of Polyester Yellow tape, T=0.05mm							
磁芯 0.15mm 露铜线接 2 脚							
Assembling the core and curing							

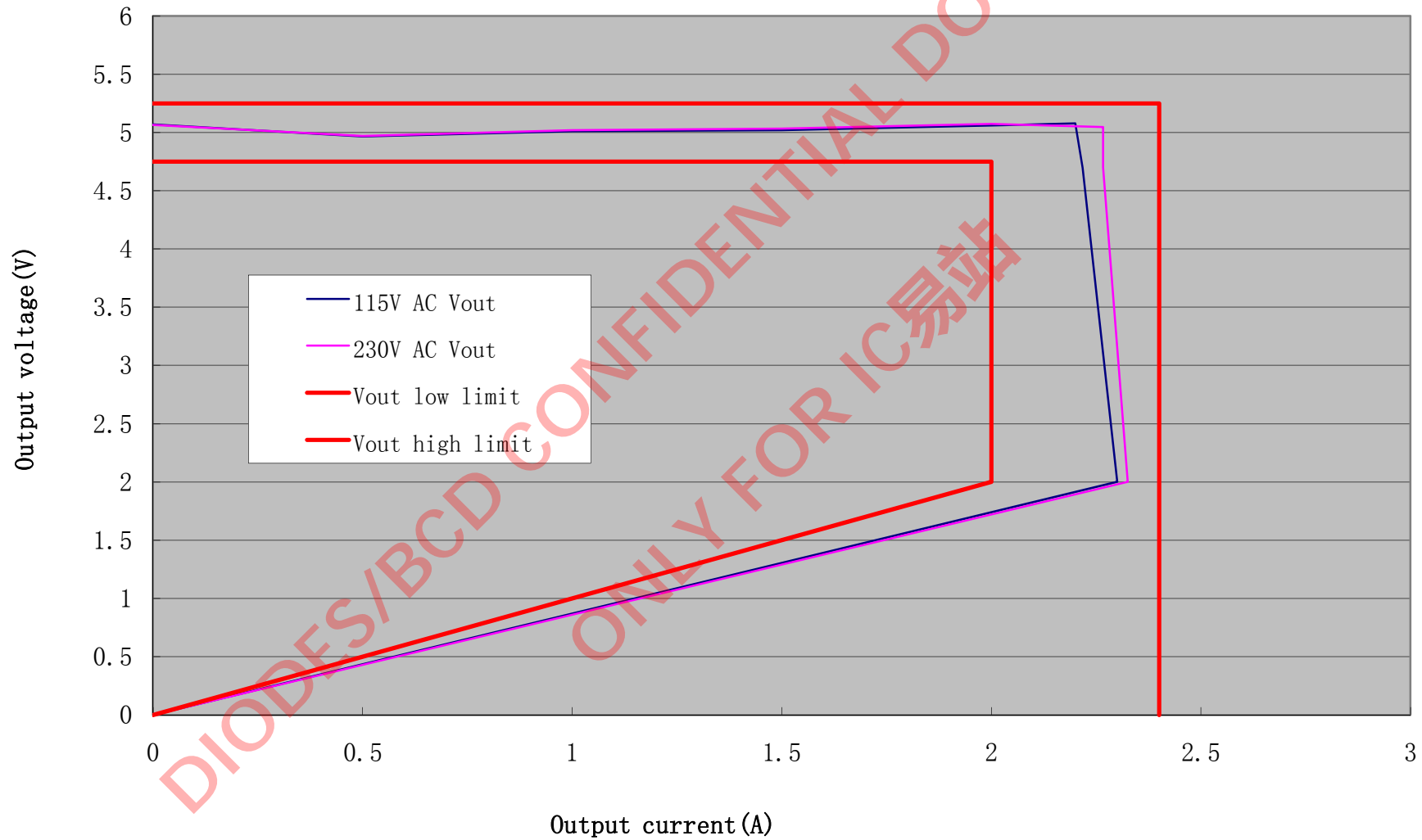
Regulation, Ripple, OCP and Efficiency



V _{IN} (V)	P _{IN} (W)	V _{OUT} (V)	I _O (A)	Ripple (mV)	P _{OUT} (W)	η	OCP	Average η	SPEC.
90V/60Hz	3.035	4.94	0.5	50	2.47	81.38%	2.18	81.4%	Level VI 78.7%
	6.11	4.976	1	75.6	4.976	81.44%			
	9.2	4.996	1.5	81.45	7.494	81.45%			
	12.41	5.047	2	85	10.094	81.35%			
115V/60Hz	3.03	4.944	0.5	48	2.472	81.58%	2.215	82%	
	6.071	4.99	1	71	4.99	82.19%			
	9.136	5.005	1.5	77.7	7.5075	82.17%			
	12.267	5.05	2	80.4	10.1	82.33%			
230V/50Hz	3.097	4.943	0.5	50.9	4.943	79.8%	2.27	81.8%	
	6.1	4.999	1	71.9	4.999	81.95%			
	9.125	5.017	1.5	72.4	7.5255	82.47%			
	12.19	5.06	2	72	10.12	83%			
264V/50Hz	3.127	4.938	0.5	50.8	2.469	78.95%	2.28	81.27%	
	6.128	5.002	1	70.1	5.002	81.62%			
	9.181	5.015	1.5	74.8	7.5225	81.93%			
	12.25	5.06	2	74.8	10.12	82.61%			

* Note: Output Voltage measured at end of PCB

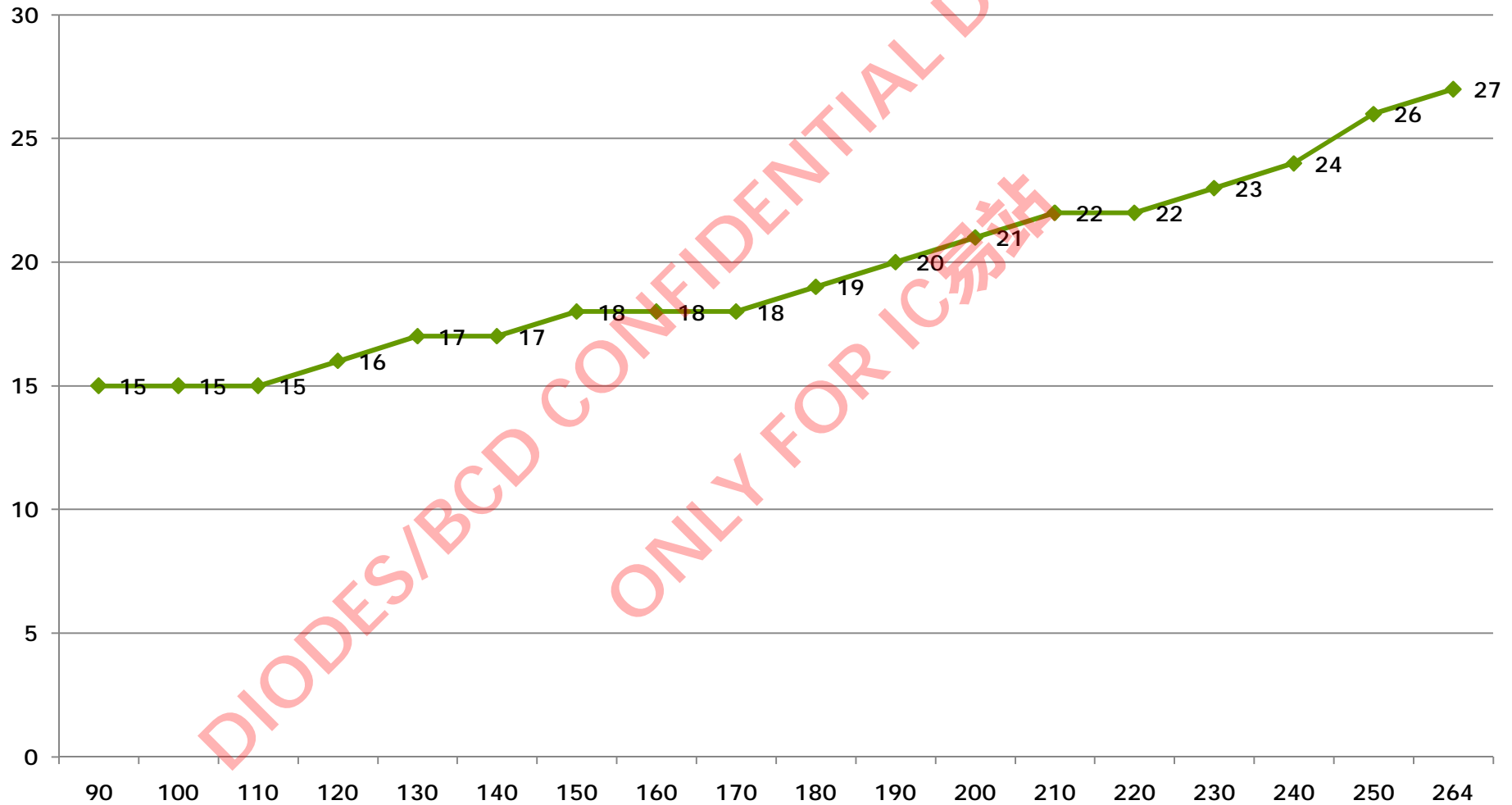
Output V-I Characteristics



Standby Power



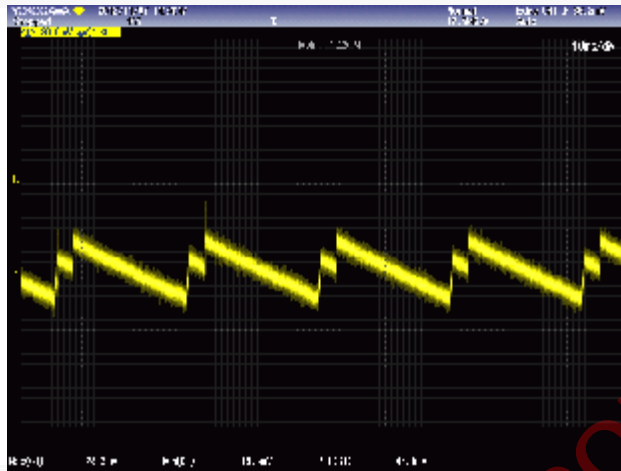
Stb Power



Output Ripple & Noise

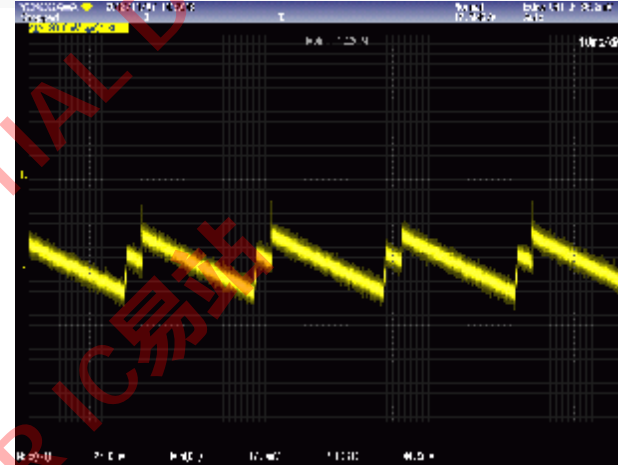


90Vac No Load



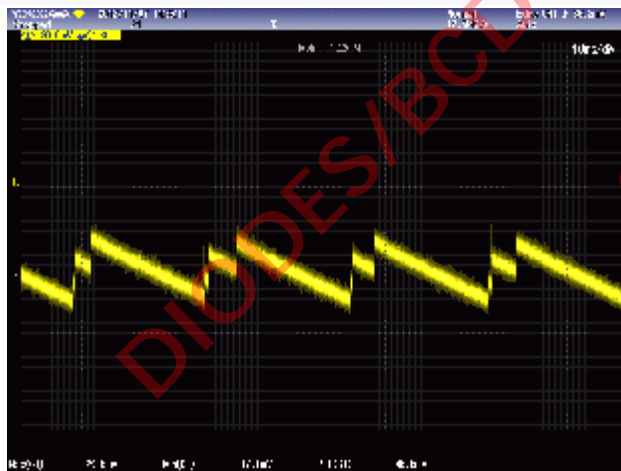
47mV

115Vac No Load



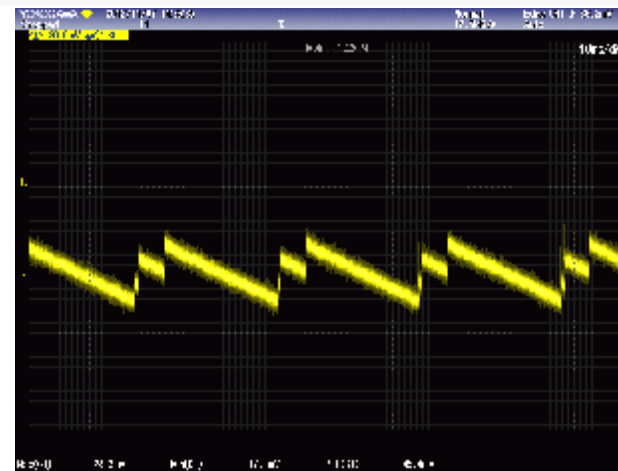
44.5mV

230Vac No Load



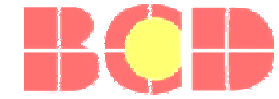
46.6mV

264Vac No Load



45.4mV

Output Ripple & Noise



90Vac Full Load



85.3mV

115Vac Full Load



80.0mV

230Vac Full Load



72.6mV

264Vac Full Load

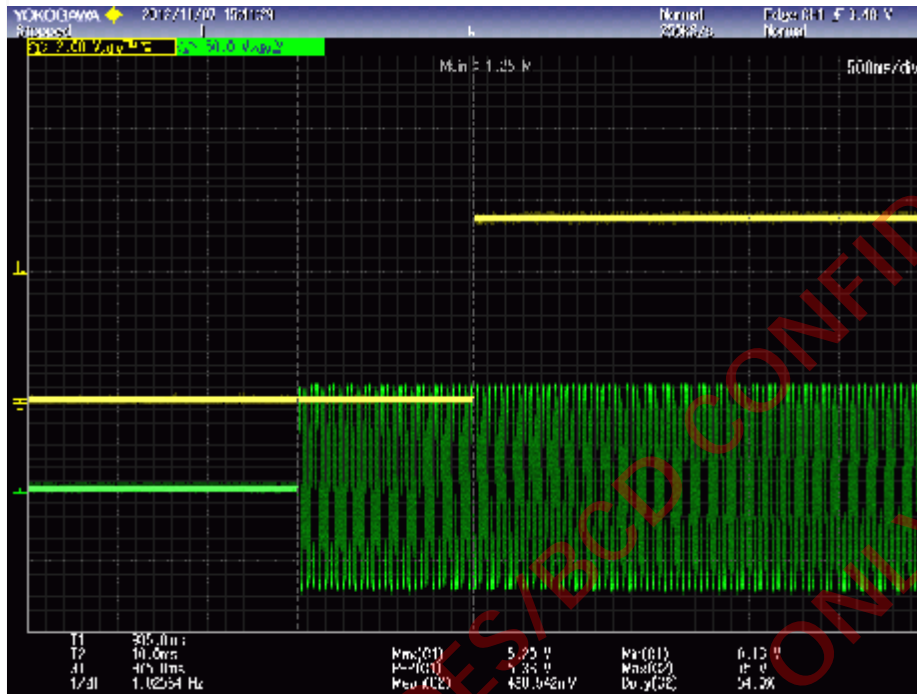


74.1mV

Turn On Delay Time

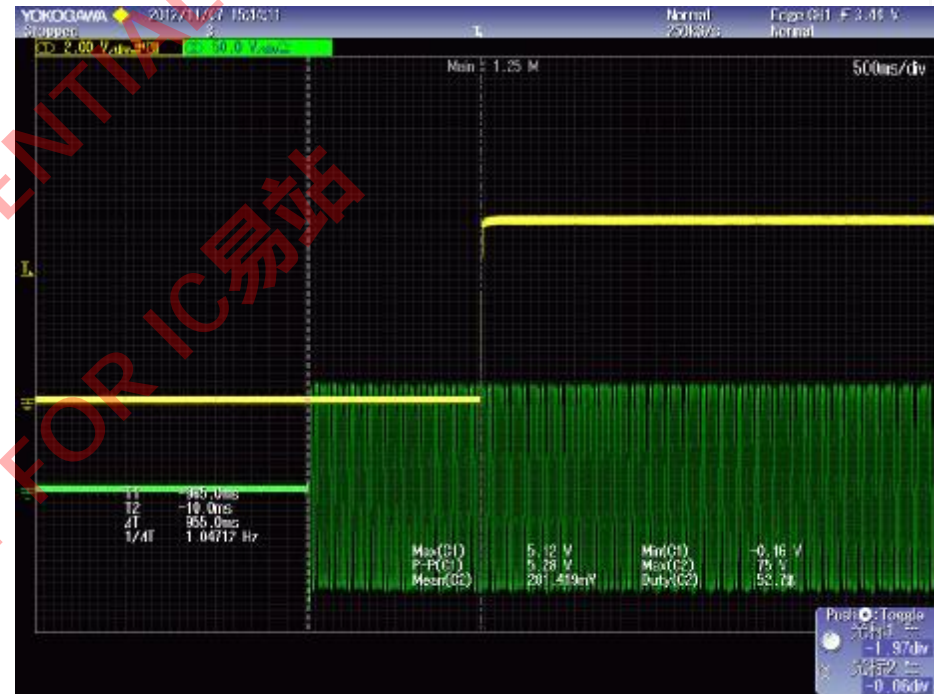


90Vac No Load



$T_{DELAY}: 0.985S$

90Vac Full Load

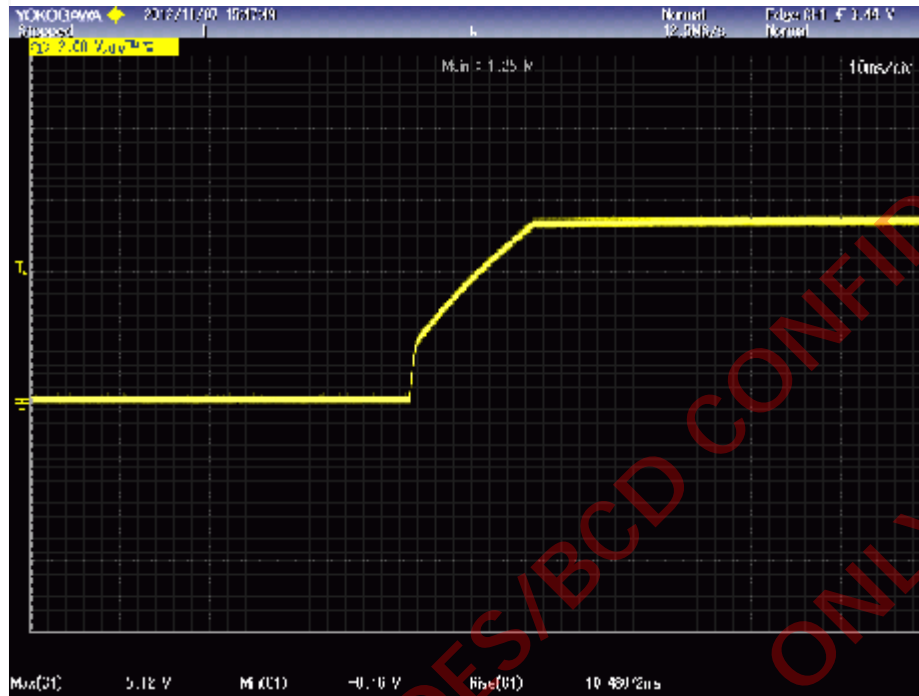


$T_{DELAY}: 0.955S$

Output Rise Time

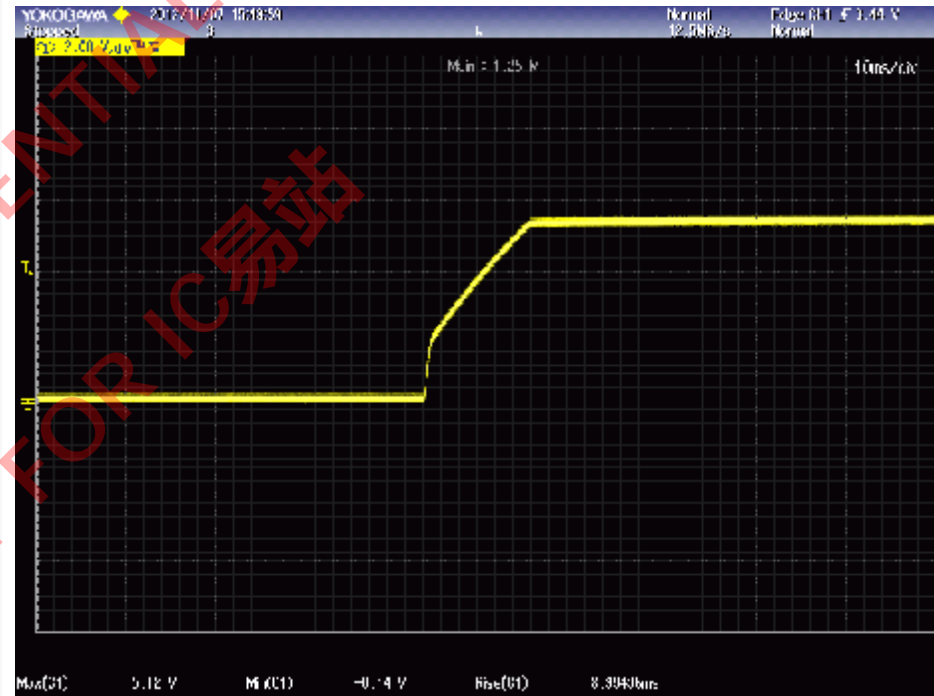


115Vac Full Load



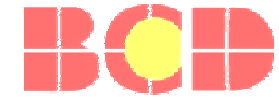
Trise: 10.48mS

230Vac Full Load

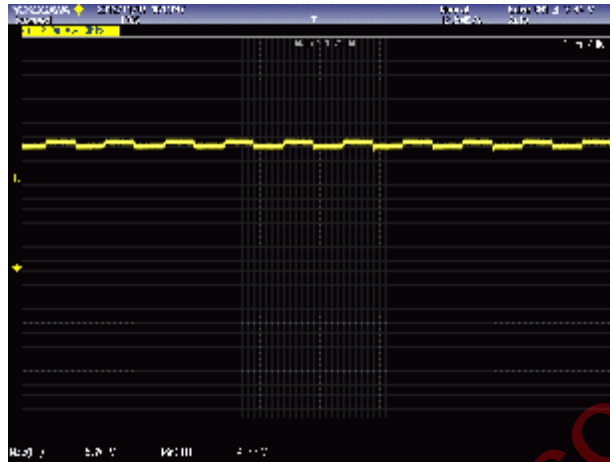


Trise: 8.995mS

Dynamic

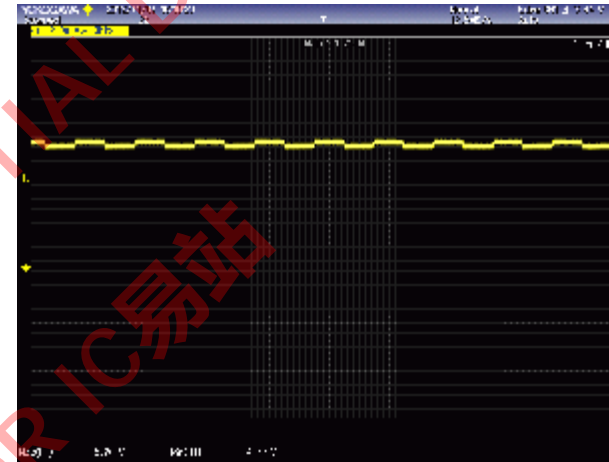


90Vac 10%~90%~10% 5mS 0.5A/uS



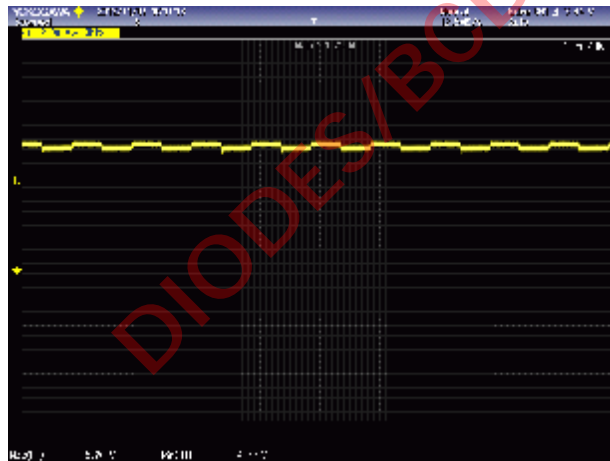
Vomin
4.72
Vomax
5.28

115Vac 10%~90%~10% 5mS 0.5A/uS



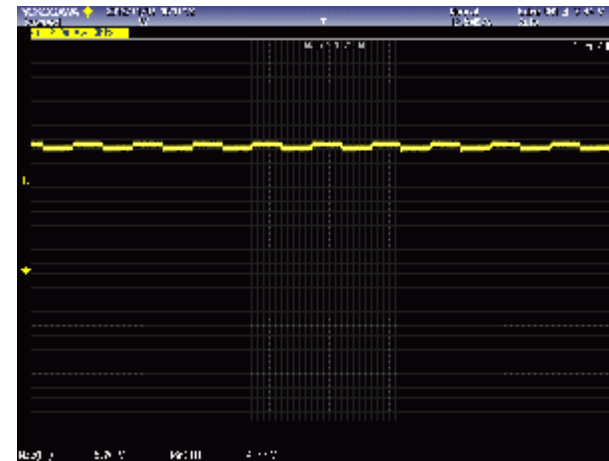
Vomin
4.72
Vomax
5.28

230Vac 10%~90%~10% 5mS 0.5A/uS



Vomin
4.72
Vomax
5.28

264Vac 10%~90%~10% 5mS 0.5A/uS



Vomin
4.72
Vomax
5.28

MOSFET Voltage Stress



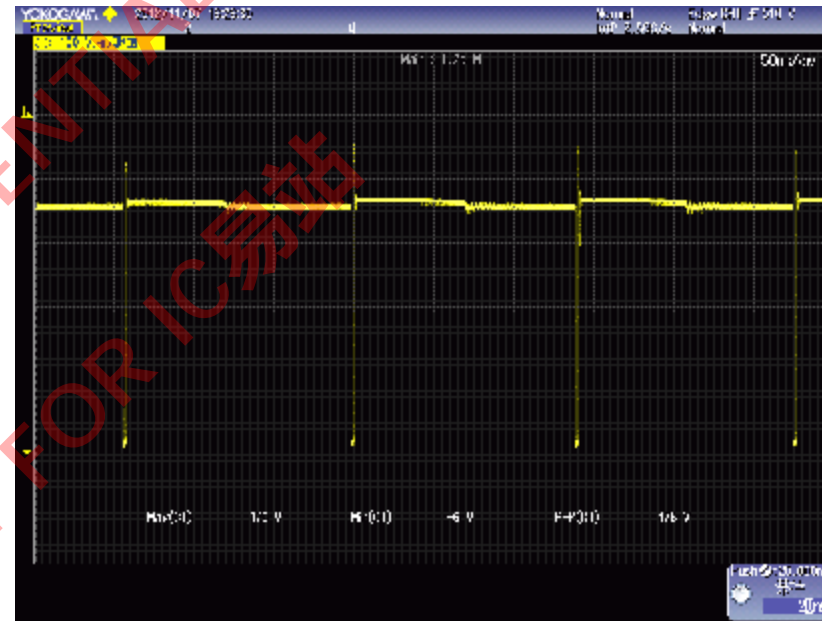
264Vac Full Load

$V_{MAX}: 538V$



264Vac Short

$V_{MAX}: 476V$



PARAMETER	SYMBOL	RATINGS	UNIT
Drain-Source Voltage	V_{DSS}	600	V
Gate-Source Voltage	V_{GSS}	± 30	V

Schottky Voltage Stress



264Vac Full Load

$V_{MAX}: 36.0V$



264Vac Short

$V_{MAX}: 30.8V$

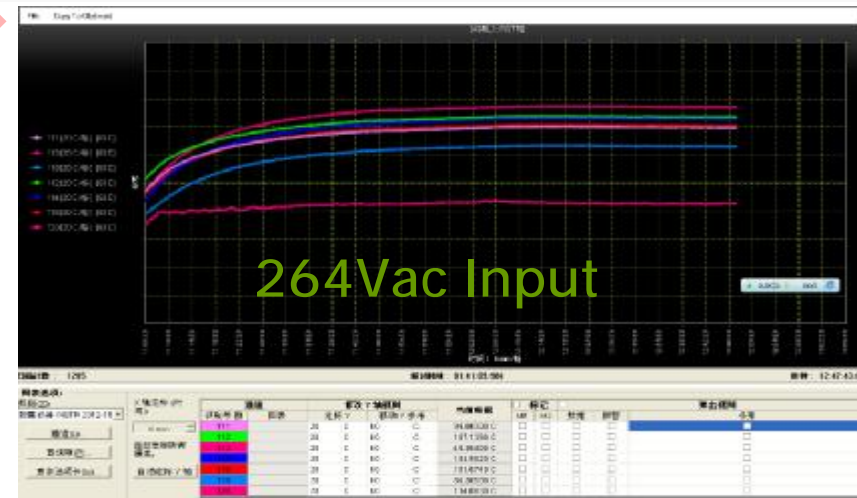


Characteristic	Symbol	Value	Unit
Peak Repetitive Reverse Voltage	V_{RRM}	45	V
Working Peak Reverse Voltage	V_{RWM}		
DC Blocking Voltage	V_{RM}		
BMS Reverse Voltage	V	21	V

Temperature Rise



Location	Rated temp (°C)	90V/AC (°C)	264V/AC (°C)	T _{MAX} (°C)	Utilization ratio
EC2(8.2uF/400V)	105	90.2	86	90.2	85.9%
EC4(6.3V/470uF)	105	98.9	99.6	88.82	94.8%
Q1(4N60)	130	100.1	101.7	101.7	78.2%
Coil	130	114.17	114	114.17	87.8%
Core	130	104.8	105	105	80.7%
Schottky (10U45)	130	106.4	107	107	82.3%
Ambient temperature		45.3	45.3	45.3	

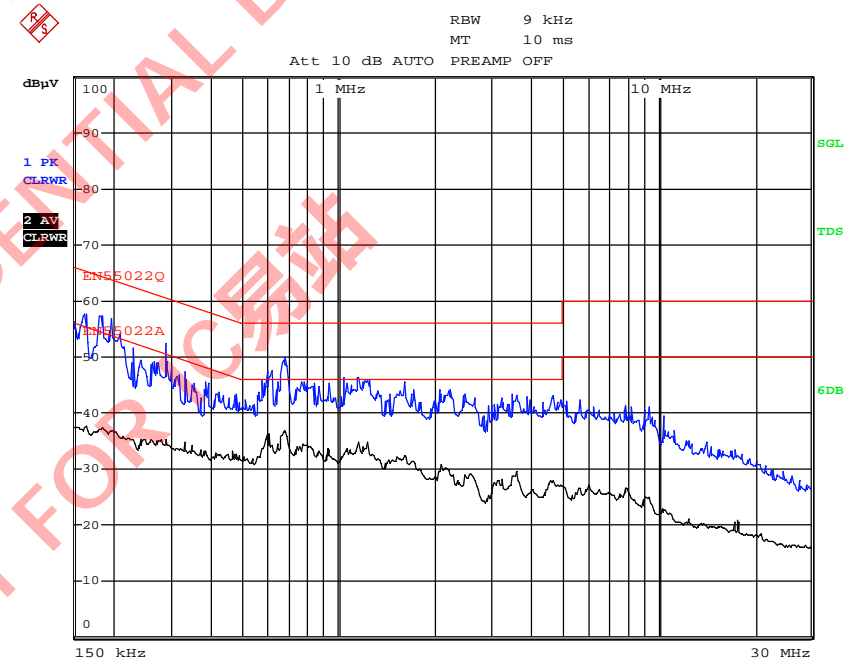
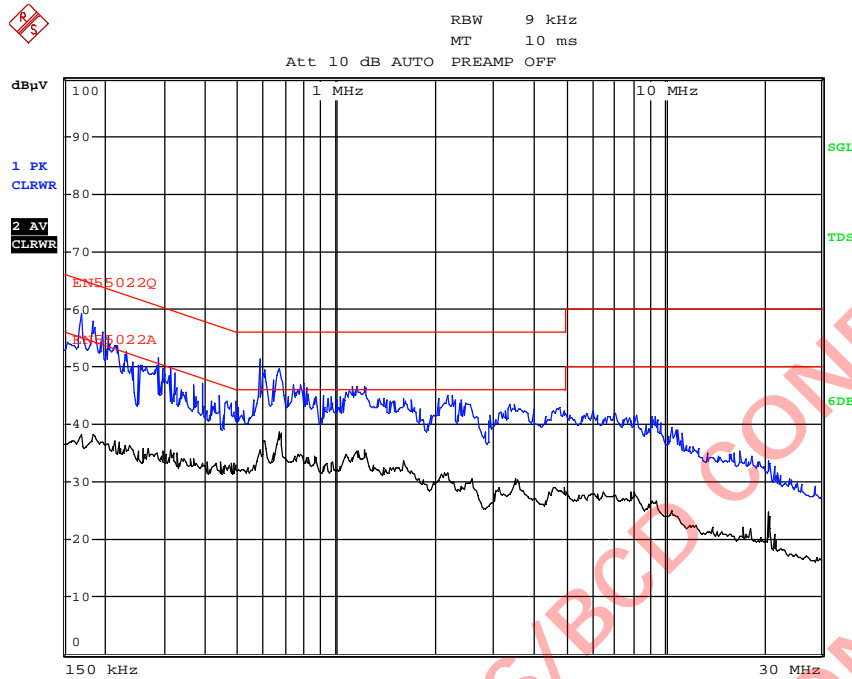


Conduction



230Vac Full Load L

230Vac Full Load N



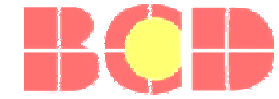
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Date: 2.NOV.2012 03:21:23

Margin: >8dB

Margin: >8dB

Radiation



230Vac Full Load H	230Vac Full Load V
Margin:	Margin:

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Common Mode Noise

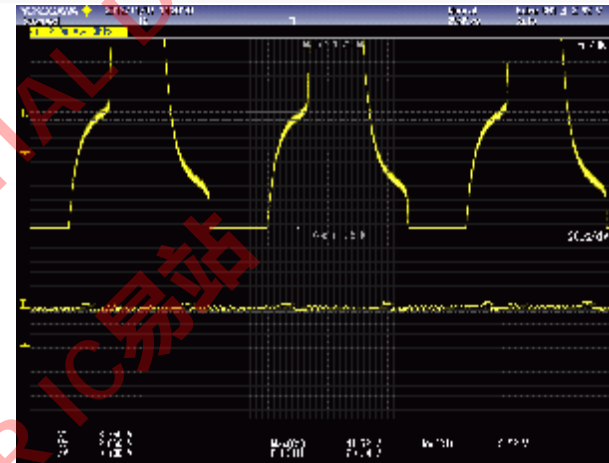


90Vac 10ohm Resistor Load



0.54V

115Vac 10ohm Resistor Load



0.7V

230Vac 10ohm Resistor Load



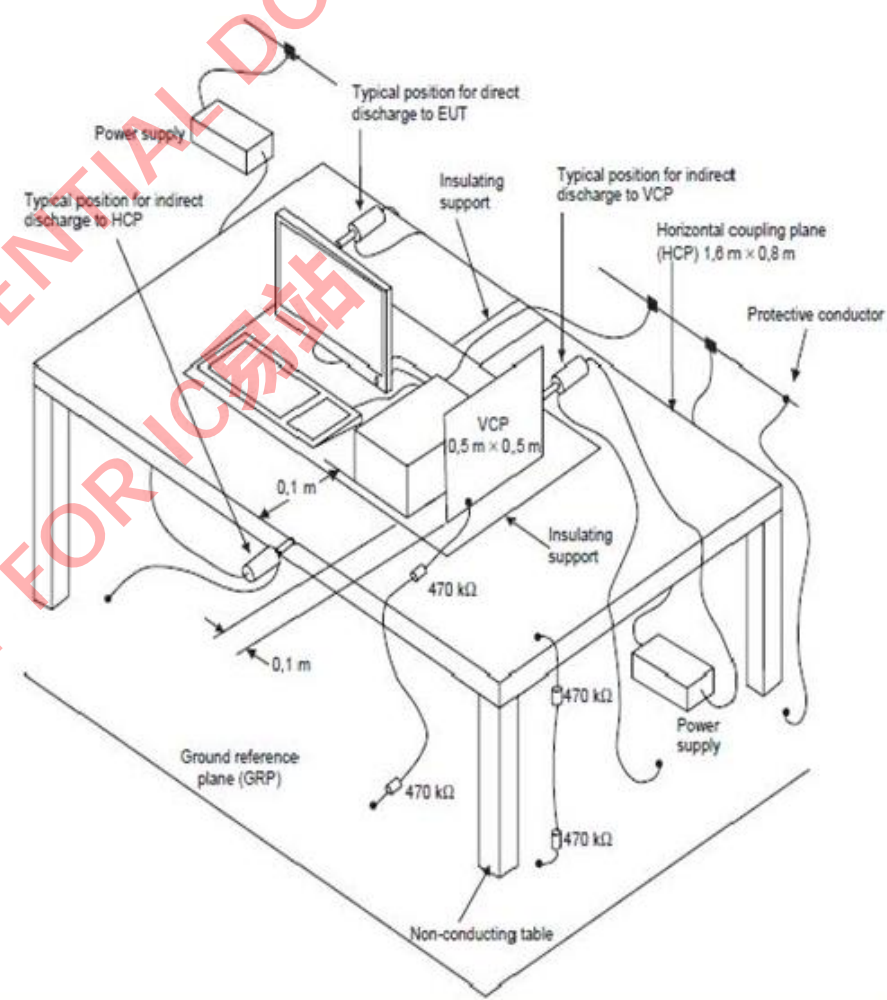
0.92V

264Vac 10ohm Resistor Load



1.08V

Air Discharged		No Load Result	Full Load Result
230Vac No Load and Full Load			
15kV	+	Pass	Pass
	-	Pass	Pass
16kV	+	Pass	Pass
	-	Pass	Pass
17kV	+	Pass	Pass
	-	Pass	Pass
18kV	+	Pass	Pass
	-	Pass	Pass
19kV	+	Pass	Pass
	-	Pass	Pass
20kV	+	Fail	Fail
	-	Fail	Fail





Thank You!!!