

# Design Example Report

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标题	基于 PN8317 的 41W LED 应用方案 170V240mA
规格	输入电压: 180~264V 输出功率: 41W 输出电压: 170V 输出电流: 240mA $\pm$ 3%
应用范围	照明类电源产品, 吸顶灯等
文件编号	DER-8317-14-P004

## 特性概述:

双面板设计, 双面元器件, 面积: 55mm\*32mm;  
 输入电压: 180~264Vac;  
 输出功率:  $\leq$ 41W;  
 拥有 LED 灯开路、短路、过温保护、外接元器件开短路保护等功能;  
 拥有电流采样电阻短路保护;  
 41W 输出效率:  $\geq$ 88%;  
 填谷 PF 值:  $>$ 0.8(230VAC);  $>$ 0.7(176-264VAC)

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## 1. 电源介绍

该报告提供了一种基于 PN8317 170V/240mA 单路输出开关电源。系统工作在准谐振模式来实现高效率和低 EMI 的应用。芯片集成度高，BOM 器件个数少，具有 LED 灯开路、短路、过温保护等功能

该报告包含了原理图，电源输入输出规格，BOM 表，变压器参数和 PCB LAYOUT 等数据表单。

以下为该电源的实物图片：

## 2. 电源规格明细

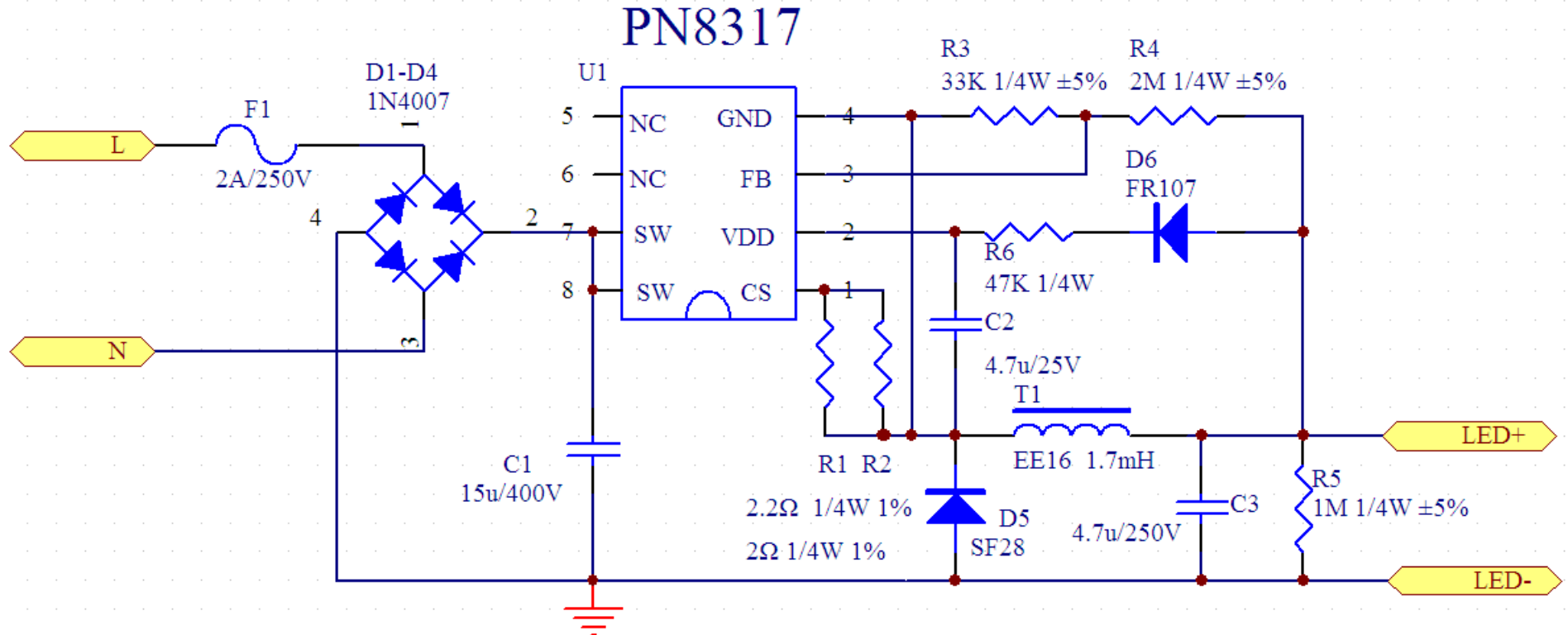
最大输入输出电气特性：

项目描述	标号	Min	Typ	Max	Unit	备注
输入电压	Vin	180	230	264	Vac	50Hz
输出电压	Vout	70		170	V	
输出电流	Iout	230	240	250	mA	
输出功率	Pout		41		W	
效率	$\eta$	88			%	CV=170V
工作环境	Tamb	0	25	85	°C	

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## 3. 电源原理图:



Note: 具体参数以 BOM 为准

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## 4. 电路描述

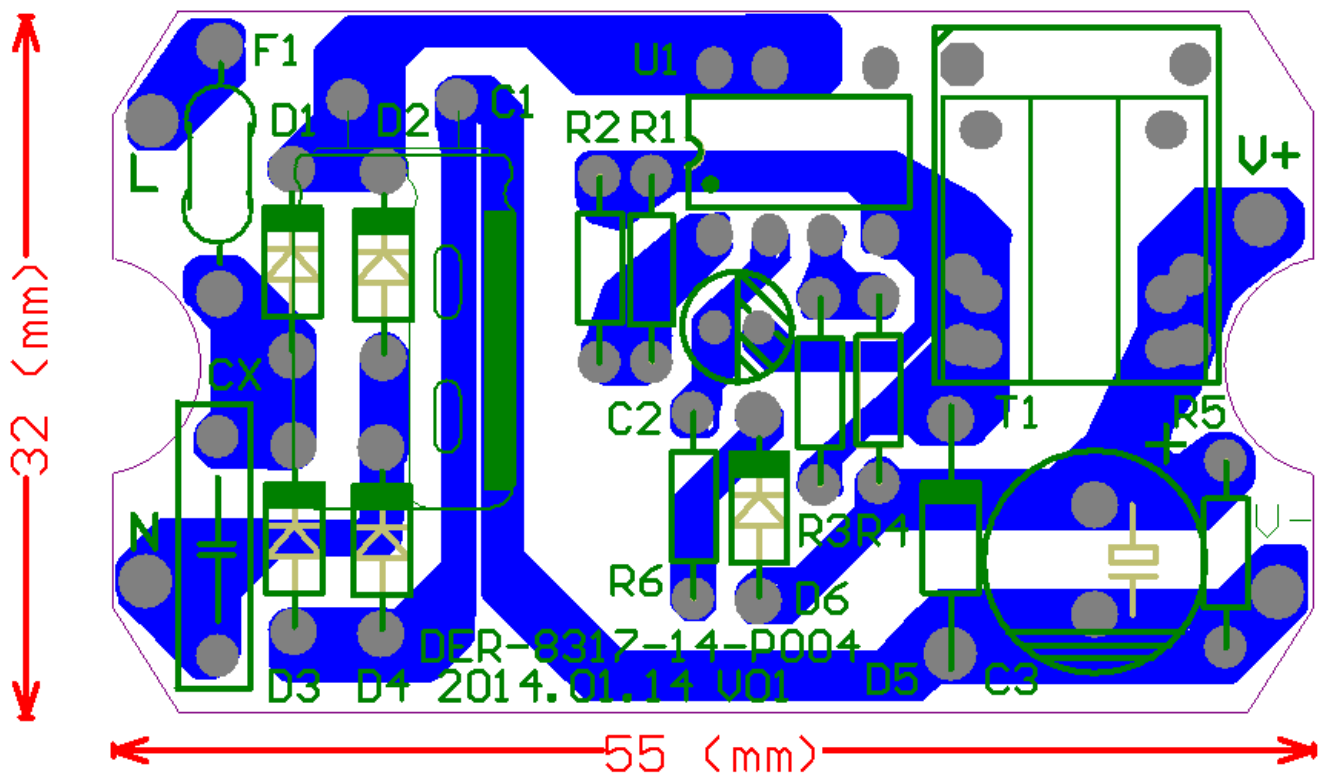
电路图中R3、R4为FB分压电阻，可通过辅助绕组采样出的电压，等比例调节R3、R4可实现LED输出开环电压值，FB过电压保护点约为3.3V。

当PN8317 本体温度太高时，其内置的 OTP 保护功能会及时启动，以保护整个系统；

该驱动具有 LED 短路、开路保护功能，当 LED 发生短路或开路时，系统将进入打嗝模式直到短路状态消除。

## 5. PCB LAYOUT

PCB 为普通单面板工艺，单面元器件，铜厚 1OZ，基材为 FR-4。PCB 长 55mm，宽 32mm，厚 1.6mm。污染等级符合 CLASS2。



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## 6. Bill of Materials

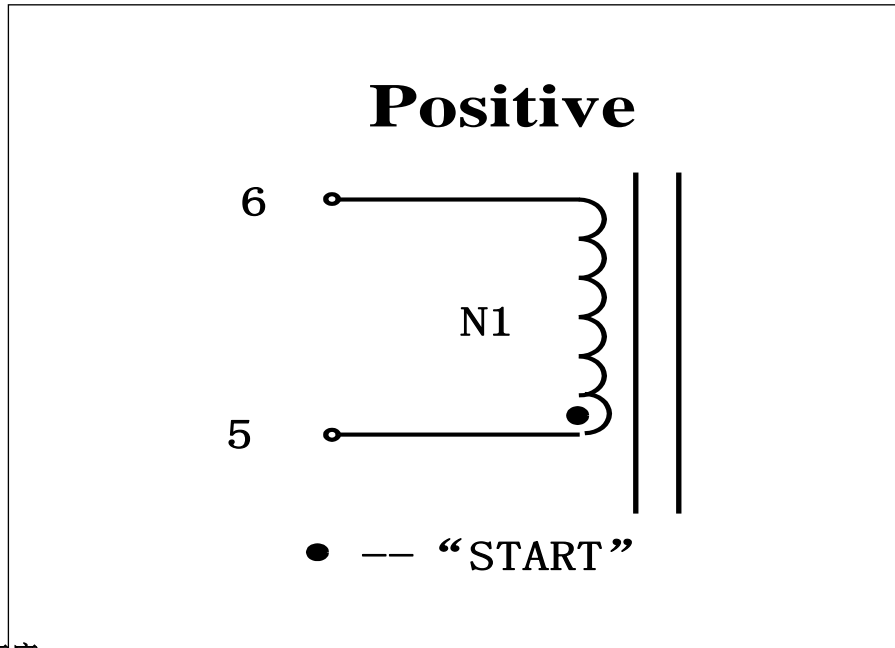
序号	元件标号	元件名称	元件型号	封装尺寸	数量	备注
1	C1	电解电容	15uF/400V	10*22mm	1	
2	C2	电解电容	4.7uF/50V	6*11mm	1	
3	C3	电解电容	4.7uF/250V	6*11mm	1	
4	D1	普通二极管	1N4007	DO-15	1	
5	D2	普通二极管	1N4007	DO-15	1	
6	D3	普通二极管	1N4007	DO-15	1	
7	D4	普通二极管	1N4007	DO-15	1	
8	D5	快速二极管	SF28	DO-15	1	
9	D6	快速二极管	FR107	DO-15	1	
10	F1	保险丝	3.15A/250V	P=10mm	1	
11	R1	插件电阻	2.2R 1%	1/4W	1	
12	R2	插件电阻	2R 1%	1/4W	1	
13	R3	插件电阻	33K	1/4W	1	
14	R4	插件电阻	2M	1/4W	1	
15	R5	插件电阻	1M	1/4W	1	
16	R6	插件电阻	47K	1/4W	1	
17	T1	变压器	EE16 式 5+5, 1.7mH	EE-13	1	
18	U1	IC	PN8317	DIP-7	1	

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## 7. 变压器规格

一, 绕线结构及视图 (磁芯: EE16; 材质: PC40) 骨架图 EE16 立式 5+5 PIN距 3.2mm 排距 10.5mm



### 二、线包制作工序

工序	漆包线规格	圈数	起点—终点	绕法	绝缘胶带
N1	$\Phi$ 0.3mm $\times$ 1P 2UEW-N	140Ts	5—6	密绕 6 层	2Ts

备注:

- 1) 浸漆。
- 2) Pin5 到 Pin6 间的感量为 1.75mH  $\pm$ 7% (1KHz, 1V);
- 3) 气隙一定要磨磁芯中柱, 不能垫气隙。

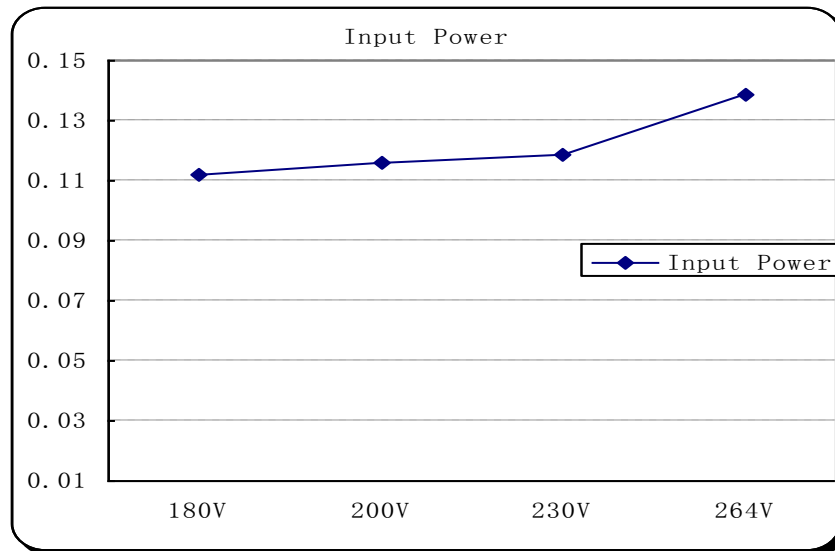
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## 8. 电源输入输出特性和工作波形

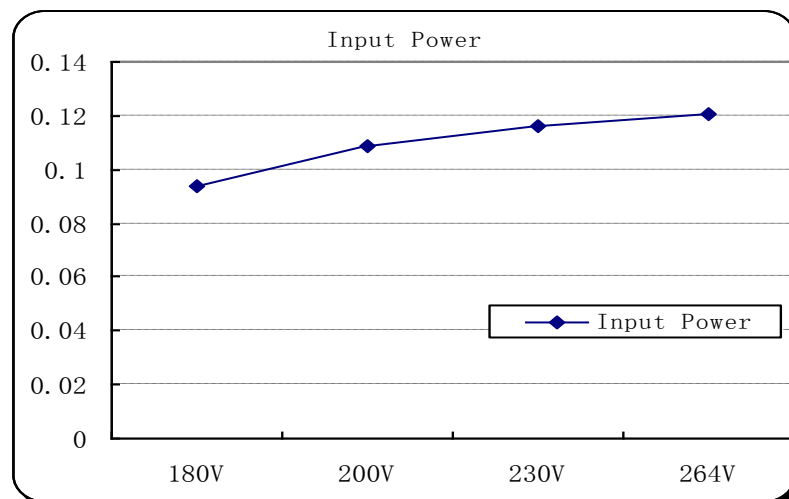
### 1) Input power when LED open

Input Power	180V	200V	230V	264V
Pin(W)	0.112	0.116	0.119	0.139



### 2) Input power when LED short

Input Power	180V	200V	230V	264V
Pin(W)	0.094	0.109	0.116	0.121



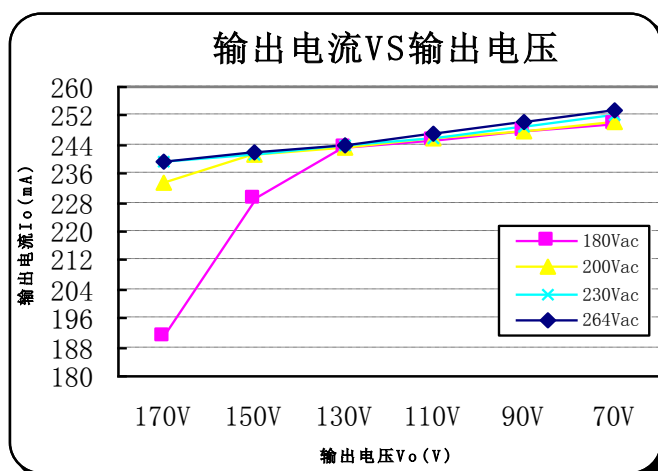
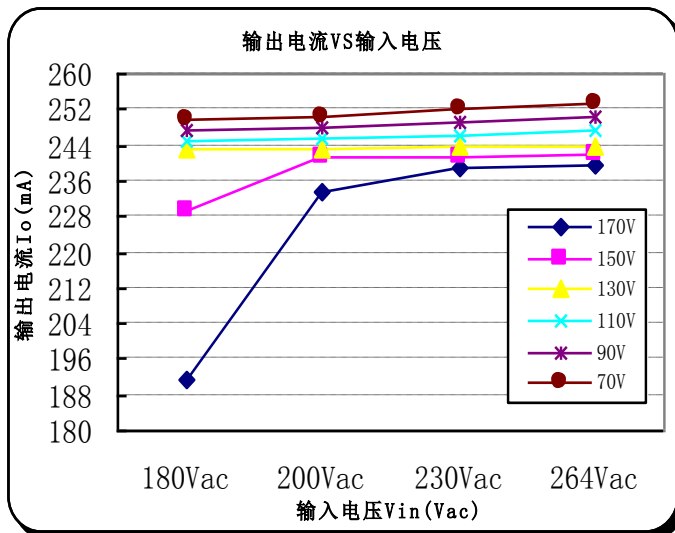
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## 3) 线性调整率&负载调整率

备注：如需满足低压180Vac 电流不下降，可适当加大输入电解电容

带载 (Vo)	输出电流 (mA)				Max.-Min.	线性调整率
	180Vac	200Vac	230Vac	264Vac		
170	191.2	233.5	239.2	239.6	48.4	±10.7%
150	229.3	241.5	241.3	242	12.7	±2.66%
130	243.3	243.3	243.6	244	0.7	±0.14%
110	245.1	245.5	246.1	247.1	2	±0.40%
90	247.5	248	248.9	250.1	2.6	±0.52%
70	250	250.6	252.1	253.3	3.3	±0.65%
Max.-Min.	58.8	17.1	12.9	13.7		
负载调整率	±12.5%	±3.50%	±2.63%	±2.78%		





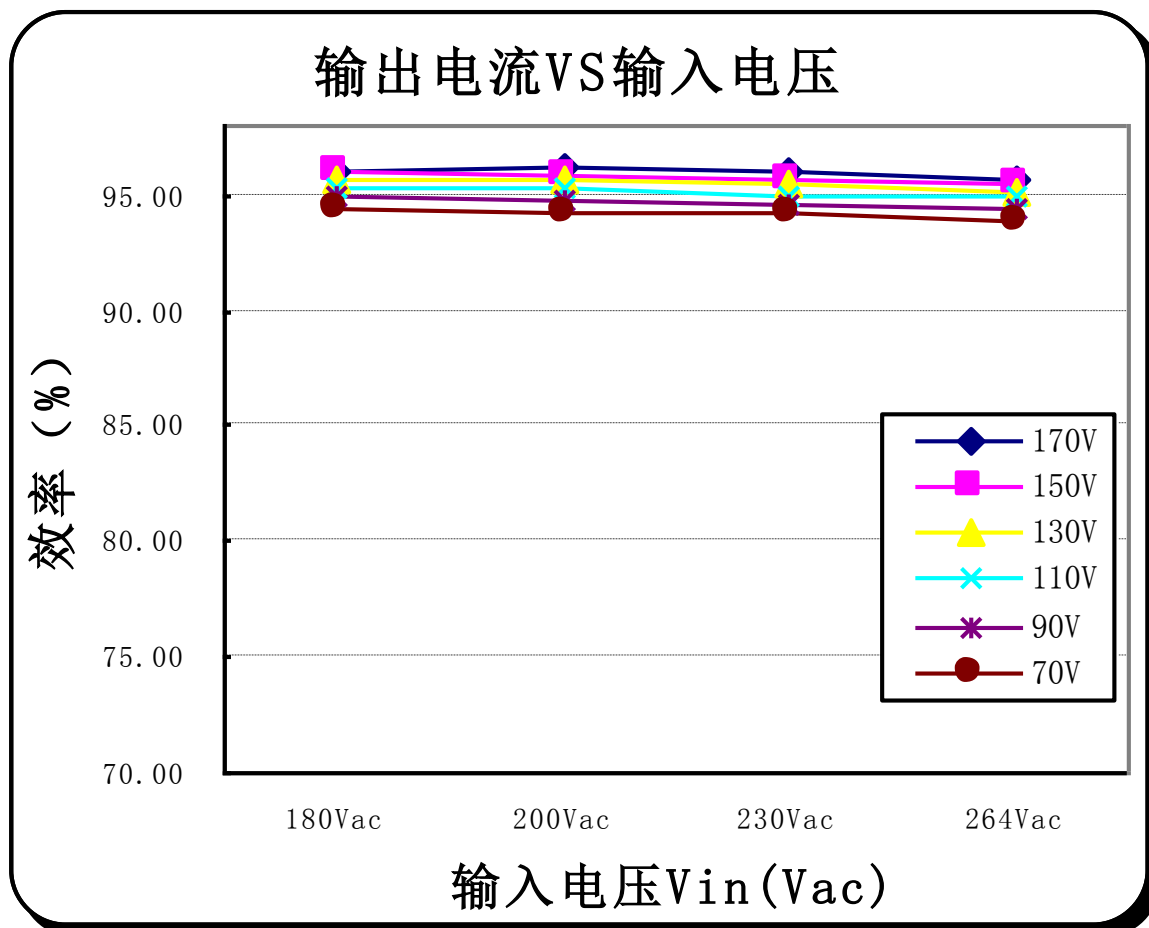
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## 4) 效率

Note: 用电子负载CV模式模拟LED负载

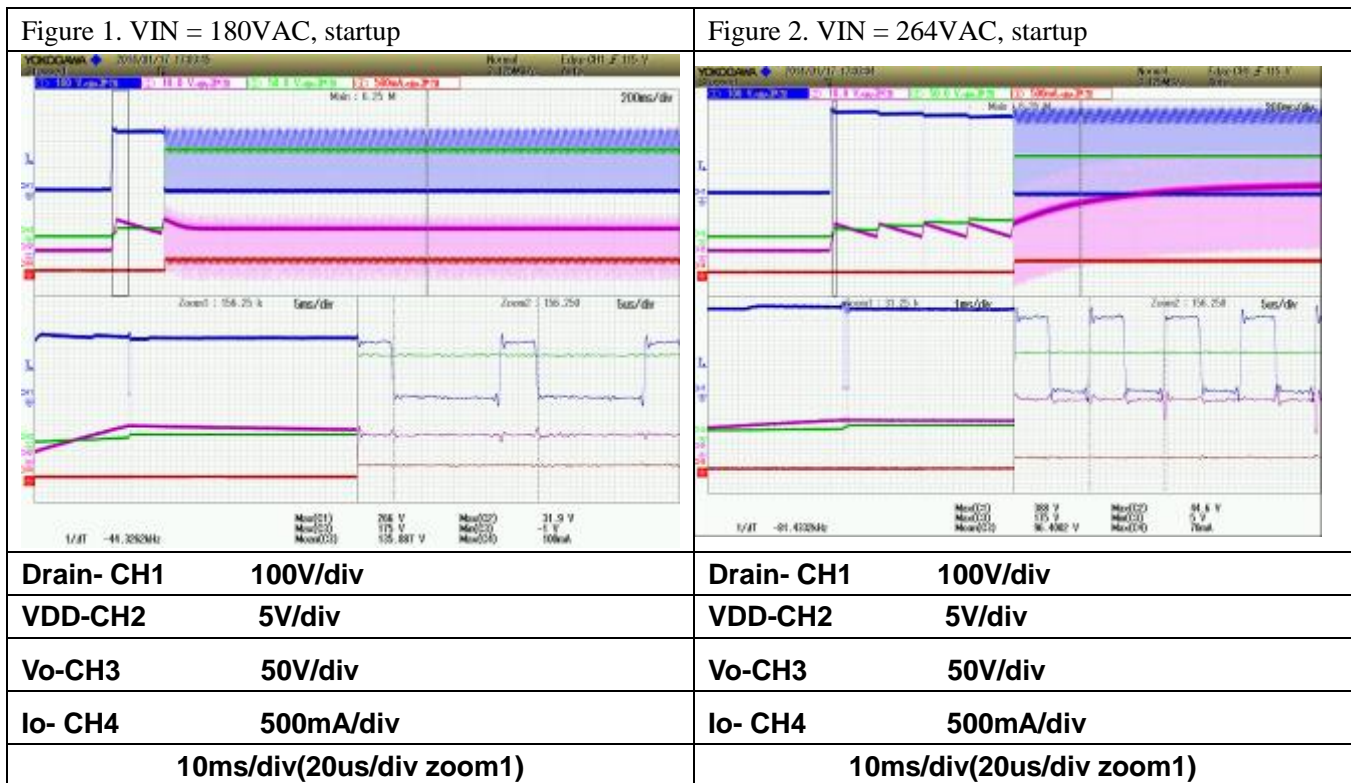
带载 (Vo)	效率 (%)			
	180Vac	200Vac	230Vac	264Vac
170V	95.97	96.23	95.97	95.64
150V	95.97	95.93	95.73	95.43
130V	95.70	95.67	95.44	95.06
110V	95.27	95.29	95.02	94.94
90V	94.99	94.82	94.64	94.42
70V	94.44	94.26	94.17	93.91



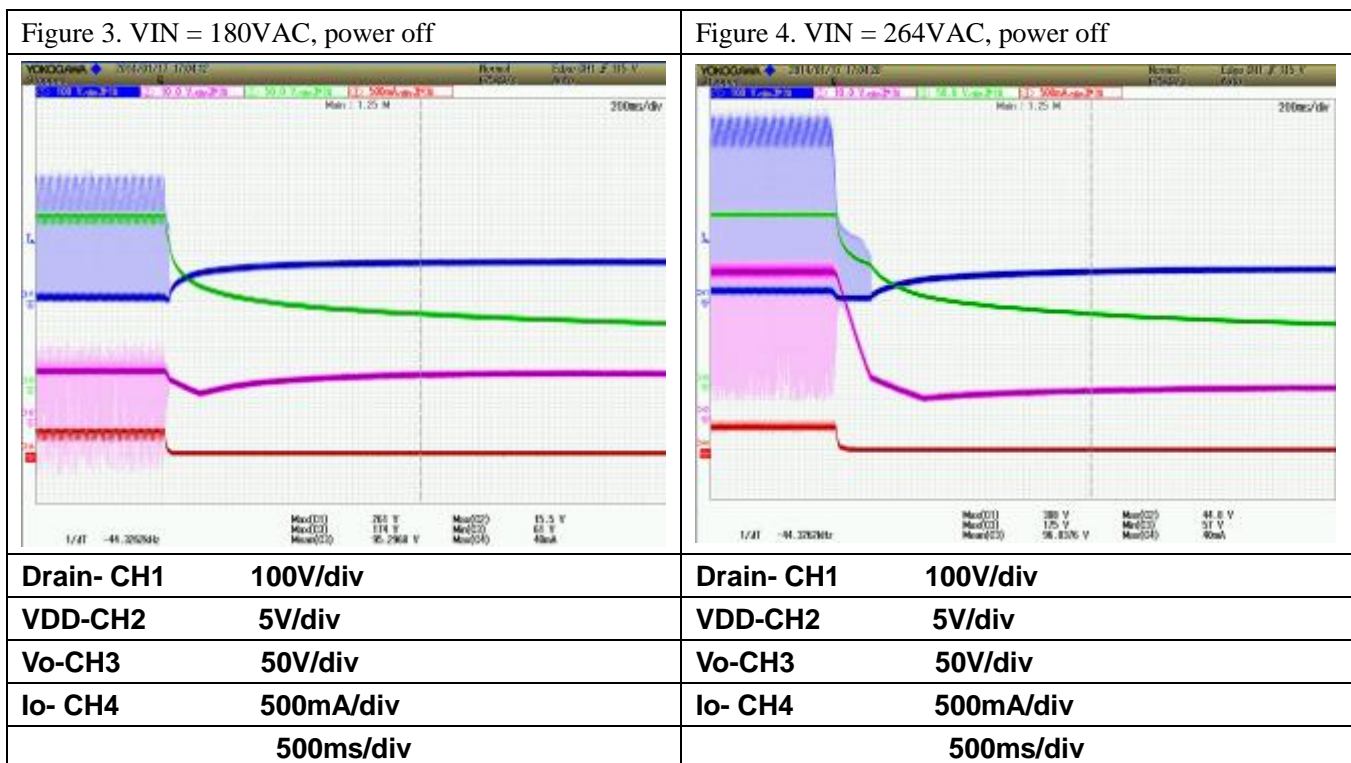
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## 7) Startup



## 8) Power off



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## 9) Operating waveforms

Figure 5. VIN = 180VAC		Figure 6. VIN = 264VAC	
Drain- CH1	100V/div	Drain- CH1	100V/div
VDD-CH2	5V/div	VDD-CH2	5V/div
Vo-CH3	50V/div	Vo-CH3	50V/div
Io- CH4	500mA/div	Io- CH4	500mA/div
10ms/div(10us/div zoom1)		10ms/div(10us/div zoom1)	

## 10 )Ripple & Noise

Figure 7. VIN = 180VAC		Figure 8. VIN = 264VAC	
Vo- CH3	2V/div	Vo- CH3	2V/div
Io- CH4	500mA/div	Io- CH4	500mA/div
5ms/div		5ms/div	









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## 11) LED Short Protection

Figure 9. VIN = 180VAC		Figure 10. VIN = 264VAC	
			
Drain- CH1	100V/div	Drain- CH1	200V/div
VDD-CH2	5V/div	VDD-CH2	5V/div
Vo-CH3	50V/div	Vo-CH3	50V/div
Io- CH4	500mA/div	Io- CH4	500mA/div
200ms/div(2ms/div zoom1)		200ms/div(1ms/div zoom1)	

## 12) LED Open Protection

Figure 11. VIN = 180VAC		Figure 12. VIN = 264VAC	
			
Drain- CH1	100V/div	Drain- CH1	100V/div
VDD-CH2	5V/div	VDD-CH2	5V/div
Vo-CH3	50V/div	Vo-CH3	50V/div
Io- CH4	500mA/div	Io- CH4	500mA/div
50ms/div(50us/div zoom1)		50ms/div(50us/div zoom1)	

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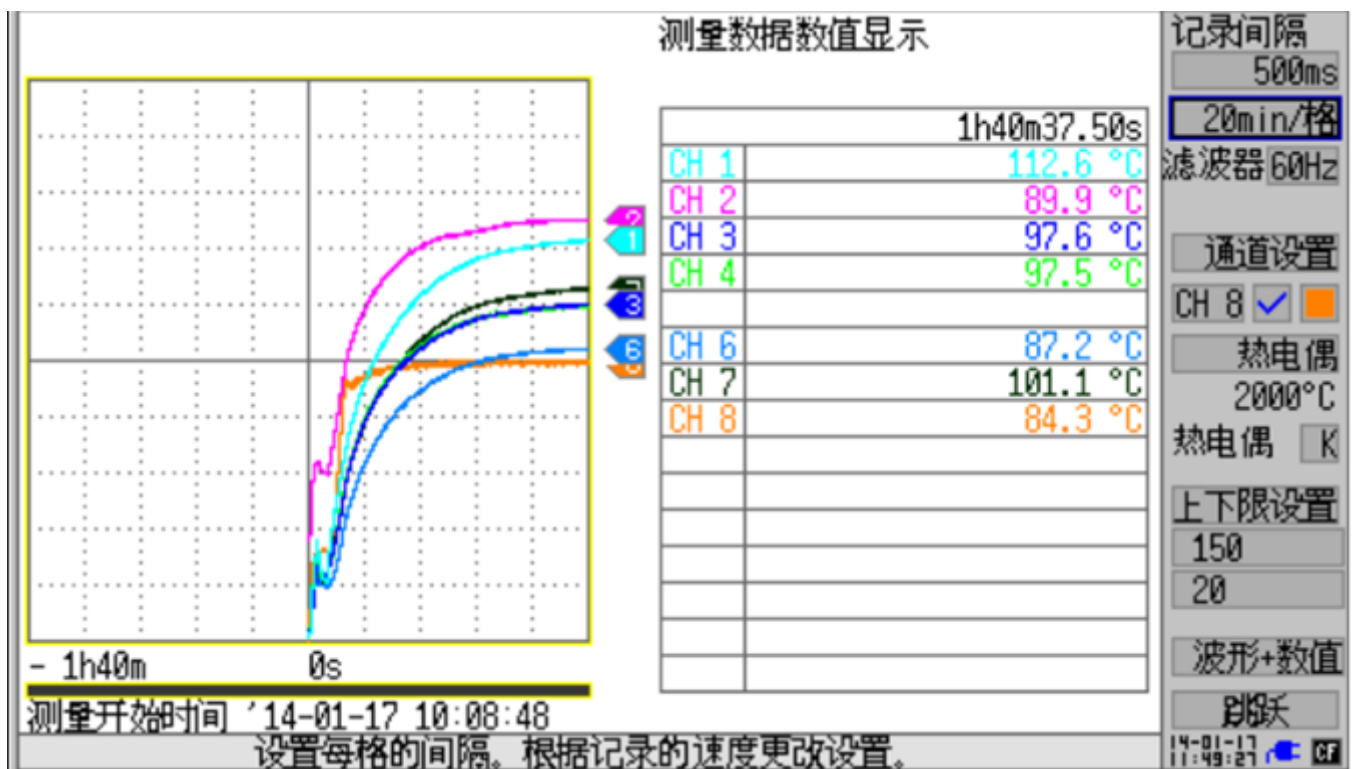
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## 8. 温度特性

测试条件：带 LED 测试 56 颗灯电压 170V 240mA 输入 41W 左右

输入电压 Vac	IC °C	输入电解电容 °C	电感磁芯 °C	电感线包 °C	输出电解电容 °C	输出二极管 °C	环境温度 °C
180	109.8	91.1	94.8	94.9	86.6	97.5	84.5
200	112.5	89.8	97.7	97.2	87.3	101.3	84
230	119.3	89.9	104.7	103.8	91.6	110.9	84.6
264	131.5	90.6	112.1	109.6	95.6	122.1	84.5

### 180VAC 温升曲线



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## 9. 电源安规测试

### 1) EFT Test

#### Electrical Fast Transient/Burst Measurement Results

Test Site	TR2		Temperature	26°C				
EUT:	170V240mA		Humidity :	48%RH				
M/N:			Barometric Pressure	101.3kPa				
S/N:			Input Voltage:	230V,50Hz				
Test Mode:	Normal operation							
Standard:	EN 55024: 1998+A1: 2001+A2: 2003, IEC 61000-4-4: 2004							
Measurement Equipment:	<input checked="" type="checkbox"/> Immunity Test System (M/N: EMCPPro) (Cali. Due Date: 2012.04.23) <input type="checkbox"/> CCL (M/N: CCL) (Cali. Due Date: 2012.04.23)							
Input a.c. power ports (Tr/Th: 5/50ns, Repetition Frequency: 5kHz)								
Inject Line	Polarity	Test Level (kV)	Test Duration (second)	Inject Method	Performance criterion	Test Result criterion	Result	Observation
L	+	1	60	Direct	B	A	Pass	Note
L	-	1	60	Direct	B	A	Pass	Note
N	+	1	60	Direct	B	A	Pass	Note
N	-	1	60	Direct	B	A	Pass	Note
L+N	+	1	60	Direct	B	A	Pass	Note
L+N	-	1	60	Direct	B	A	Pass	Note
Input a.c. power ports (Tr/Th: 5/50ns, Repetition Frequency: 100kHz)								
Inject Line	Polarity	Test Level (kV)	Test Duration (second)	Inject Method	Performance criterion	Test Result criterion	Result	Observation
L	+	1	60	Direct	B	A	Pass	Note
L	-	1	60	Direct	B	A	Pass	Note
N	+	1	60	Direct	B	A	Pass	Note
N	-	1	60	Direct	B	A	Pass	Note
L+N	+	1	60	Direct	B	A	Pass	Note
L+N	-	1	60	Direct	B	A	Pass	Note

Note: There was no change compared with initial operation during the test.

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## 2) Surge Test

### Surge Immunity Test Results

Test Site	TR1	Temperature	26°C					
EUT:	170V240mA	Humidity :	48%RH					
M/N:		Barometric Pressure	101.3kPa					
S/N:		Input Voltage:	230 V, 50 Hz					
Standard:	EN 55024:2010; IEC 61000-4-5:2005							
Measurement Equipment:	<input checked="" type="checkbox"/> Immunity Test System (M/N: EMCPro) (Cali. Due Date: 2012.04.23) <input type="checkbox"/> Coupler/Decoupler Telecom Line (M/N: CM-TELCD) (Cali. Due Date: N/A) <input type="checkbox"/> Coupler/Decoupler Signal Line (M/N: CM-I/OCD) (Cali. Due Date: N/A)							
<b>Input a.c. power ports [Tr/Th: 1.2/50us (8/20us)]</b>								
Inject Line	Polarity	Angle (degree)	Test Level (kV)	Test Interval (second)	Performance criterion	Test Result criterion	Result	Observation
L+N	+	0	0.5	60	B	A	Pass	Note1
L+N	-	0	0.5	60	B	A	Pass	Note1
L+N	+	90	0.5	60	B	A	Pass	Note1
L+N	-	90	0.5	60	B	A	Pass	Note1
L+N	+	180	0.5	60	B	A	Pass	Note1
L+N	-	180	0.5	60	B	A	Pass	Note1
L+N	+	270	0.5	60	B	A	Pass	Note1
L+N	-	270	0.5	60	B	A	Pass	Note1

Note1: There was no change operated with initial operating during the test.