

# Universal Input Power Factor Corrected 24W LED Driver with PWM Dimming Using KP114

#### **FEATURES**

- Low Cost PSR Buck LED Driver Solution
- Active Power Factor Correction Technique
- Universal Input Range with High PF>0.9
- Quasi-Resonant (QR) Operation Mode with Up to 91% Efficiency
- Fast Start-Up Speed <600ms
- Good Line and Load regulation <+-3%
- Flicker-Free Operation with PWM Dimmers
- Valley Switching Technique for Good EMI
- LED Short and Open Protection
- Current Sense Resistor Short and Open Protection
- Over Voltage Protection (OVP) on VDD
- Cycle-by-cycle Current Limiting
- Line Voltage Absent Protection
- Over Temperature Protection (OTP)
- Internal Soft Start

#### INTRODUCTION

KP114 is an off-line Primary Side Regulation (PSR) LED controller with PWM Dimming function, which can achieve very high Power Factor and accurate output current regulation. At the same time, the adopted QR operation Mode minimized the switching loss and lead to good EMI performance.

The Demo Board of KP114-D002 is typically designed for the application of 72V/300mA with universal input (90-265Vac, 60/50Hz). Besides the multi-protection function, this demo also has very good efficiency, current regulation, Power Factor and meet the EN55015 conducted and radiated EMI requirement.

#### **APPLICATIONS**

- Dimmable Lights
- Commercial & Residential Lighting

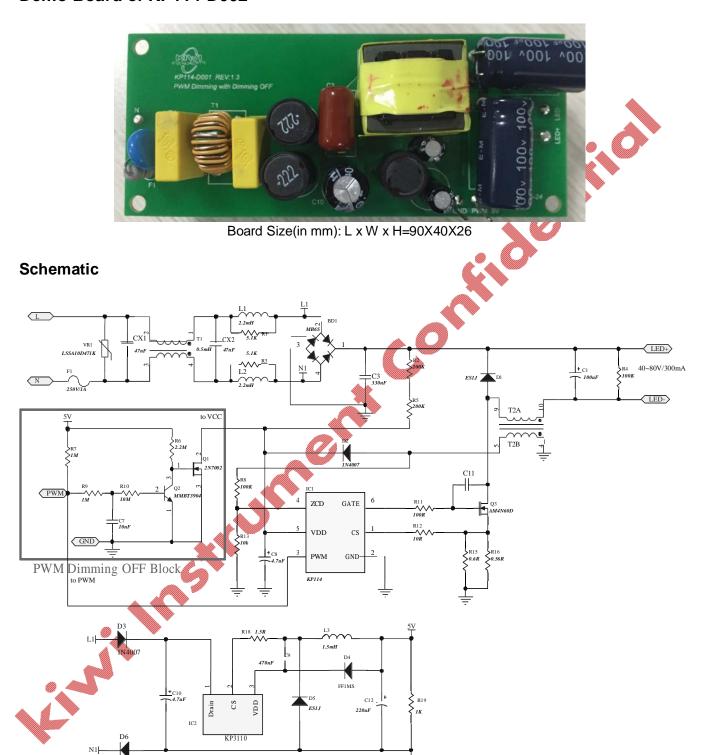
#### **DEMO BOARD SEPCIFICATION**

Description	Symbol	Min	Туре	Max	Unit	Note
Input Voltage	Vin	90		265	Vac	
Output Voltage	Vout	40		80	Vdc	
Output Current	lout		300		mA	No Dimming and PWM Dimming
Output Power	Pout			24	W	Duty Cycle>99%
Efficiency	η		90	91	%	Typical value tested at 120Vac/60Hz
Standby Power Consumption	Pst		120		mW	Typical value tested at 230Vac/50Hz
Startup Time	Tst			600	ms	Tested at 90Vac/60Hz
Power Factor	PF	0.92				
Total Harmonics Distortion	THD				%	

The table above shows the minimum acceptable performance of the design. Actual performance is listed in the results section.

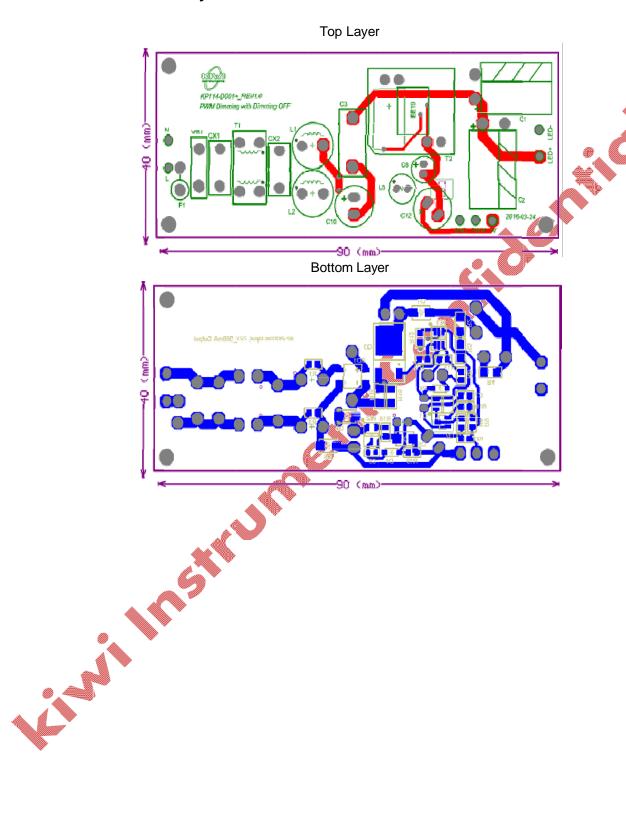


### Demo Board of KP114-D002





## **Printed Circuit Board Layout**





#### **Circuit Description**

The demo board of KP114-D002 is designed with the single stage Low Side Buck topology, which uses the primary side regulation technology to simply the circuit and save cost of BOM. With Dimming-Off Circuit added, the demo can achieve LED Current Dimming OFF when PWM Dimming duty is lower than a given value. Additionally the demo board can achieve good performance for high efficiency, high power factor and accurate output current.

#### 1. Input Rectification and EMI filtering

The circuit input stage is composed by the components of F1, CX1, CX2, T2, L1, L2, C1, R1 and R3. F1 provides the inrush current limitation in the event of component failure or a short circuit. CX1, CX2, T2, L1, L2, R1 and R3 together provide the differential and common mode EMI filtering. The bridge diode of BD1 rectifies the AC input to DC output which is followed by a high frequency noise filter capacitor C3. The value of C3 needs to be fine-tuned according to the EMI and PF requirement.

#### 2. KP114 Operation

KP114 is an off-line Primary Side Regulation (PSR) LED controller with PWM Dimming function, which operates in the QR Mode to achieve high efficiency and good EMI performance. Due to the constant on time control function, high PF result can be maintained. When PWM pulse dimming signal is applied, the output current can be automatically changed.

C8 is the DC voltage power supply for the IC, which is charged from the rectified voltage through R2 and R5 during the startup period and charged by the auxiliary winding from D2 after the output voltage is ready. When the voltage of C8 is higher than the internal OVP threshold, the IC stops switching immediately and enters quiescent operation mode.

R8 and R13 are used to detect zero current cross point for QR operation mode. When the falling edge of the ZCD Pin voltage signal is found, the GATE is turned on with some internal dely. In each switching cycle, the high voltage level of ZCD Pin is monitored and then is used to configure the OCP level on CS Pin. When LED is shorted, the output and high voltage level of ZCD Pin become nearly zero, which makes the OCP level to the minimum value.

R11 and C11 compose the GATE driver circuit which is used to slow down the MOSFET turn on and off speed for good radiated EMI performance. There's a tradeoff between the EMI margin, efficiency and LED current regulation. R15 and R16 are used as the sensing resistor. The averaged voltage on CS pin is regulated by the C which helps to achieve accurate output current.

#### 3. Output Current Regulation

T2, Q3, D1, C5 and C1 compose the typical Low Side Buck converter. R4 is the dummy resistor, and output capacitor is discharged after system is shut down.



### **Bill of Material**

Number	Designator	Value	Description Package Manufacturer		Part Number	
1	BD1	600V/0.5A	SINGLE PHASE SILICON BRIDGE,600V/0.5A	SMD	Any	MB6S
2	C1	100uF	Electrolytic Cap, 100V,12.5*20	TH	jianghai	ECR2ABK101M□□12502 0
3	C2	100uF	Electrolytic Cap, 100V,12.5*20	TH	jianghai	ECR2ABK101M□□12502 0
4	C3	330nF	C21,400Vdc,P=10mm,T=6.2mm	TH	Fala	334J 400V
5	C7	10nF	Ceramic Cap, 50V X7R	1206	Murata	GRM31CR73A103KW03
6	C8	4.7uF	Electrolytic Cap, 50V,5*11.5	TH	jianghai	ECR1HBK4R7M□□05001 1
7	C9	470nF	Ceramic Cap, 50V NPO	0603	Murata	GRM188R71H102KA01D
8	C10	4.7uF	Electrolytic Cap, 450V,10*16	TH	jianghai	ECR2WBK4R7M□□1000 16
9	C11	10pF	Ceramic Cap, 1kV X7R	1206	Murata	GRM31A5C3A100JW01 D
10	C12	220uF	Electrolytic Cap, 50V,8*11.5	TH	jianghai	ECR1HBK101M□□08001 1
11	CX1	47nF	MKP62,275Vac~X2,P=7.5mm,T=5m m	TH	Fala	C42P2473K3SC000
12	CX2	47nF	MKP62,275Vac~X2,P=7.5mm,T=5m m	TH	Fala	C42P2473K3SC000
13	D1	600V/1A	1.0 AMP Surface Mount Super Fast Recovery Rectifiers	SMA	Lision Tech	ES1J
14	D2	100V/0.3A	SILICON RECTIFIERS,100V/0.3A	SOD123	Any	1N4007
15	D3	100V/0.3A	SILICON RECTIFIERS,100V/0.3A	SOD123	Any	1N4007
16	D4	1KV/1A	Fast Recovery Rectifiers	SOD123	YEA SHIN	FF1MS
17	D5	600V/1A	1.0 AMP Surface Mount Super Fast Recovery Rectifiers	SMA	Lision Tech	ES1J
18	D6	100V/0.3A	SILICON RECTIFIERS,100V/0.3A	SOD123	Any	1N4007
19	F1	250V/1A	Fuse 250V/1A	TH	Any	
20	IC1	KP114	PWM Dimmable Primary Side Regulation PWM Controller With PFC	SOT-23-6	Kiwi Instruments	KP114
21	IC2	KP3110	High Performance Low Cost Off-line PWM Power Switch	TO-92	Kiwi Instruments	KP3110
22	L1	2.2mH	WE-TI Inductor,Isat=0.40A,Rdc=2.40Ω,9*1 3	TH	Wurth Elektronik	7447452222
23	L2	2.2mH	WE-TI Inductor,Isat=0.40A,Rdc=2.40Ω,9*1 3	TH	Wurth Elektronik	7447452222
24	L3	1.5mH	WE-TI Inductor,Isat=0.80A,Rdc=1.00Ω,10* 14	TH	Wurth Elektronik	7447480102
25	Q1	2N7002	N Mosfet, 60V/0.16A, Rdson=1.5ohm	SOT23	Any	2N7002
26	Q2	MMBT3904	SMALL SIGNAL NPN TRANSISTOR	SOT23	Any	MMBT3904
27	Q3	AM4N60D	N Mosfet, 600V/4A, Rdson=2.0ohm	TO-252	Analog Power	AM4N60D
28	R1	5.1K	Film Resistor, 5%	1206	Yageo	RC1206JR-075K1L
29	R2	240K	Film Resistor, 5%	1206	Yageo	RC1206JR-07240KL
30	R3	5.1K	Film Resistor, 5%	1206	Yageo	RC1206JR-075K1L



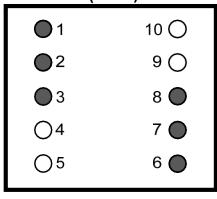
33   R6   2.2M   Film Resistor, 5%   1206   Yageo   RC1206JR-071MI     34   R7   1M   Film Resistor, 5%   1206   Yageo   RC1206JR-071MI     35   R8   82K   Film Resistor, 5%   0805   Yageo   RC0805JR-078ZK     36   R9   1M   Film Resistor, 5%   1206   Yageo   RC1206JR-071MI     37   R10   10M   Film Resistor, 5%   1206   Yageo   RC1206JR-071MI     38   R11   100R   Film Resistor, 5%   0805   Yageo   RC0806JR-0710R     39   R12   10R   Film Resistor, 5%   0805   Yageo   RC0806JR-0710R     40   R13   10k   Film Resistor, 5%   0805   Yageo   RC0806JR-0710K     41   R15   0.6R   Film Resistor, 1%   1206   Yageo   RC1206FR-07065     42   R16   0.56R   Film Resistor, 1%   1206   Yageo   RC1206FR-070R5     43   R18   1.5R   Film Resistor, 1%   1206   Yageo   RL1206FR-070R5     44   R19   1K   Film Resistor, 5%   0805   Yageo   RC0805JR-071K5     45   T1   0.5mH   WE-CMBNC Common Mode Power   Line Choke, TYPE XS   Elektronik   T448013501     47   VR1   470V@0.1m   VARISTOR, P=7.5mm, T=3.6mm   7D   Lision Tech   LSSA7D471K	Resistor	33 F 34 F 35 F 36 F 37 R 38 R 39 R 40 R 41 R 42 R 43 R 44 R 45 - 46 - 47 V	R6 2.2 R7 1M R8 82 R9 1M R10 10 R11 100 R12 10 R13 10 R15 0.6 R16 0.50 R18 1.5 R19 1H T1 0.5r T2 Lp=43 /R1 470V@	MM PK M OR OR OR OR OR FR FR FR FR FR K M M M M M M M M M M M M M M M M M M	Film Resistor, 5%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 1%  Self Widing,Np=123T,Naux=44T	1206 1206 0805 1206 0805 0805 0805 0805 1206 1206 1206 1206 1206 1207 1206 1206 1206 1206 1206 1206 1206 1206	Yageo Wurth	RC1206JR-071MI RC1206JR-071MI RC0805JR-0782K RC1206JR-071MI RC1206JR-071MI RC0805JR-07100F RC0805JR-0710R RC0805JR-0710K RC1206FR-07R60 RL1206FR-070R50 RL1206FR-070R50 RC0805JR-071K5
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37         R10         10M         Film Resistor, 5%         1206         Yageo         RC1206JR-071M           38         R11         100R         Film Resistor, 5%         0805         Yageo         RC0805JR-0710R           39         R12         10R         Film Resistor, 5%         0805         Yageo         RC0805JR-0710R           40         R13         10k         Film Resistor, 5%         0805         Yageo         RC0805JR-0710K           41         R15         0.6R         Film Resistor, 1%         1206         Yageo         RC1206FR-070R50           42         R16         0.56R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           43         R18         1.5R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing, Np=123T, Naux=44T         EE19         Lision Tech         LSSA7D471K	37         R10         10M         Film Resistor, 5%         1206         Yageo         RC1206JR-071M           38         R11         100R         Film Resistor, 5%         0805         Yageo         RC0805JR-07100F           39         R12         10R         Film Resistor, 5%         0805         Yageo         RC0805JR-0710K           40         R13         10k         Film Resistor, 5%         0805         Yageo         RC0805JR-0710K           41         R15         0.6R         Film Resistor, 1%         1206         Yageo         RC1206FR-070R50           42         R16         0.56R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           43         R18         1.5R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing,Np=123T, Naux=44T         EE19         EE19           47         VR1         470V@0.1m	37 R 38 R 39 R 40 R 41 R 42 R 43 R 44 R 45 46 47 V	R10 10 R11 100 R11 100 R12 10 R13 10 R15 0.6 R16 0.50 R18 1.5 R19 11 T1 0.5r T2 Lp=43 /R1 470V@	DR D	Film Resistor, 5%  Film Resistor, 5%  Film Resistor, 5%  Film Resistor, 5%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 5%  WE-CMBNC Common Mode Power Line Choke, TYPE XS  Self Widing, Np=123T, Naux=44T	1206 0805 0805 0805 1206 1206 1206 0805 EF XS	Yageo Yageo Yageo Yageo Yageo Yageo Yageo Yageo Wurth	RC1206JR-071MJ RC0805JR-07100F RC0805JR-0710R RC0805JR-0710K RC1206FR-07R60 RL1206FR-070R50 RL1206FR-070R50 RC0805JR-071K5
38 R11 100R Film Resistor, 5% 0805 Yageo RC0805JR-07100F 39 R12 10R Film Resistor, 5% 0805 Yageo RC0805JR-0710R 40 R13 10k Film Resistor, 5% 0805 Yageo RC0805JR-0710R 41 R15 0.6R Film Resistor, 1% 1206 Yageo RC1206FR-070R50 42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth Elektronik 7448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	38 R11 100R Film Resistor, 5% 0805 Yageo RC0805JR-07100F 39 R12 10R Film Resistor, 5% 0805 Yageo RC0805JR-0710R 40 R13 10k Film Resistor, 5% 0805 Yageo RC0805JR-0710K 41 R15 0.6R Film Resistor, 1% 1206 Yageo RC1206FR-070R50 42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth Elektronik 7448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	38 R 39 R 40 R 41 R 42 R 43 R 44 R 45 46 47 V	R11 100 R12 10 R13 10 R15 0.6 R16 0.50 R18 1.5 R19 11 T1 0.5r T2 Lp=43 /R1 470V@	OR O	Film Resistor, 5%  Film Resistor, 5%  Film Resistor, 5%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 1%  WE-CMBNC Common Mode Power Line Choke, TYPE XS  Self Widing, Np=123T, Naux=44T	0805 0805 0805 1206 1206 1206 0805 If XS	Yageo Yageo Yageo Yageo Yageo Yageo Yageo Wurth	RC0805JR-07100F RC0805JR-0710R RC0805JR-0710K RC1206FR-07R60 RL1206FR-070R56 RL1206FR-070R56
39 R12 10R Film Resistor, 5% 0805 Yageo RC0805JR-0710R 40 R13 10k Film Resistor, 5% 0805 Yageo RC0805JR-0710K 41 R15 0.6R Film Resistor, 1% 1206 Yageo RC1206FR-07R60 42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-07R60 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	39 R12 10R Film Resistor, 5% 0805 Yageo RC0805JR-0710R 40 R13 10k Film Resistor, 5% 0805 Yageo RC0805JR-0710K 41 R15 0.6R Film Resistor, 1% 1206 Yageo RC1206FR-07R60 42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-07R60 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	39 R 40 R 41 R 42 R 43 R 44 R 45 46 47 V	R12 10 R13 10 R15 0.6 R16 0.50 R18 1.5 R19 11 T1 0.5r T2 Lp=43 /R1 470V@	DR Dk Dk GR GR GR K mH 39uH	Film Resistor, 5%  Film Resistor, 5%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 5%  WE-CMBNC Common Mode Power Line Choke, TYPE XS  Self Widing, Np=123T, Naux=44T	0805 0805 1206 1206 1206 0805 Fr XS	Yageo Yageo Yageo Yageo Yageo Yageo Wurth	RC0805JR-0710R RC0805JR-0710K RC1206FR-07R60 RL1206FR-070R50 RL1206FR-070R50 RC0805JR-071K5
40 R13 10k Film Resistor, 5% 0805 Yageo RC0805JR-0710K 41 R15 0.6R Film Resistor, 1% 1206 Yageo RC1206FR-07R60 42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth Elektronik T448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	40 R13 10k Film Resistor, 5% 0805 Yageo RC0805JR-0710K 41 R15 0.6R Film Resistor, 1% 1206 Yageo RC1206FR-07R60 42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R50 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth Elektronik T448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	40 R 41 R 42 R 43 R 44 R 45 -	R13 10 R15 0.6 R16 0.56 R18 1.5 R19 11 T1 0.5r T2 Lp=43 /R1 470V@	Dk 6R 6R 6R K mH 39uH	Film Resistor, 5%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 5%  WE-CMBNC Common Mode Power Line Choke, TYPE XS  Self Widing, Np=123T, Naux=44T	0805 1206 1206 1206 0805 er XS	Yageo Yageo Yageo Yageo Yageo Wurth	RC0805JR-0710K RC1206FR-07R60 RL1206FR-070R50 RL1206FR-070R50 RC0805JR-071K5
41         R15         0.6R         Film Resistor, 1%         1206         Yageo         RC1206FR-07R60           42         R16         0.56R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           43         R18         1.5R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing,Np=123T,Naux=44T         FE19         Elettronik           47         VR1         470V@0.1m A         VARISTOR,P=7.5mm,T=3.6mm         7D         Lision Tech         LSSA7D471K	41         R15         0.6R         Film Resistor, 1%         1206         Yageo         RC1206FR-07R60           42         R16         0.56R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           43         R18         1.5R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R50           44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing,Np=123T,Naux=44T         FE19         Elettronik           47         VR1         470V@0.1m A         VARISTOR,P=7.5mm,T=3.6mm         7D         Lision Tech         LSSA7D471K	41 R 42 R 43 R 44 R 45 - 46 -	R15 0.6 R16 0.50 R18 1.5 R19 11 T1 0.5r T2 Lp=43 /R1 470V@	6R 6R 5R K mH	Film Resistor, 1% Film Resistor, 1% Film Resistor, 1% Film Resistor, 5% WE-CMBNC Common Mode Power Line Choke, TYPE XS Self Widing, Np=123T, Naux=44T	1206 1206 1206 0805 er XS	Yageo Yageo Yageo Yageo Wurth	RC1206FR-07R60 RL1206FR-070R56 RL1206FR-070R56 RC0805JR-071K5
42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-070R56 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R56 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth Elektronik T448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	42 R16 0.56R Film Resistor, 1% 1206 Yageo RL1206FR-070R56 43 R18 1.5R Film Resistor, 1% 1206 Yageo RL1206FR-070R56 44 R19 1K Film Resistor, 5% 0805 Yageo RC0805JR-071K5 45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Wurth Elektronik T448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	42 R 43 R 44 R 45 - 46 - 47 V	R16 0.50 R18 1.5 R19 1H T1 0.5r T2 Lp=43 /R1 470V@	6R 5R K mH	Film Resistor, 1%  Film Resistor, 1%  Film Resistor, 5%  WE-CMBNC Common Mode Power Line Choke, TYPE XS  Self Widing, Np=123T, Naux=44T	1206 1206 0805 er XS EE19	Yageo Yageo Yageo Wurth	RL1206FR-070R56 RL1206FR-070R56 RC0805JR-071K5
43         R18         1.5R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R56           44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing, Np=123T, Naux=44T         EE19           47         VR1         470V@0.1m A         VARISTOR, P=7.5mm, T=3.6mm         7D         Lision Tech         LSSA7D471K	43         R18         1.5R         Film Resistor, 1%         1206         Yageo         RL1206FR-070R56           44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing, Np=123T, Naux=44T         EE19           47         VR1         470V@0.1m A         VARISTOR, P=7.5mm, T=3.6mm         7D         Lision Tech         LSSA7D471K	43 R 44 R 45 - 46 - 47 V	R18 1.5 R19 1H T1 0.5r T2 Lp=43 (R1 470V@	K mH 39uH	Film Resistor, 1%  Film Resistor, 5%  WE-CMBNC Common Mode Power Line Choke, TYPE XS  Self Widing, Np=123T, Naux=44T	1206 0805 er XS EE19	Yageo Yageo Wurth	RL1206FR-070R56 RC0805JR-071K5
44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing, Np=123T, Naux=44T         EE19           47         VR1         470V@0.1m A         VARISTOR, P=7.5mm, T=3.6mm         7D         Lision Tech         LSSA7D471K	44         R19         1K         Film Resistor, 5%         0805         Yageo         RC0805JR-071K5           45         T1         0.5mH         WE-CMBNC Common Mode Power Line Choke, TYPE XS         XS         Wurth Elektronik         7448013501           46         T2         Lp=439uH         Self Widing, Np=123T, Naux=44T         EE19           47         VR1         470V@0.1m A         VARISTOR, P=7.5mm, T=3.6mm         7D         Lision Tech         LSSA7D471K	44 R 45 - 46 -	T1 0.5r  T2 Lp=43  (R1 470V@	MH 39uH	Film Resistor, 5%  WE-CMBNC Common Mode Powe Line Choke,TYPE XS  Self Widing,Np=123T,Naux=44T	0805 er XS EE19	Yageo Wurth	RC0805JR-071K5
45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Plektronik T448013501  46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19  47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	45 T1 0.5mH WE-CMBNC Common Mode Power Line Choke, TYPE XS Plektronik T448013501  46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19  47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	45 - 46 - 47 V	T1 0.5r T2 Lp=43 (R1 470V@	mH 39uH	WE-CMBNC Common Mode Powe Line Choke,TYPE XS Self Widing,Np=123T,Naux=44T	EE19	Wurth	
45 11 0.5mH Line Choke, TYPE XS Elektronik 7448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	45 11 0.5mH Line Choke, TYPE XS Elektronik 7448013501 46 T2 Lp=439uH Self Widing, Np=123T, Naux=44T EE19 47 VR1 470V@0.1m A VARISTOR, P=7.5mm, T=3.6mm 7D Lision Tech LSSA7D471K	46 - 47 V	T2 Lp=43	39uH	Line Choke,TYPE XS Self Widing,Np=123T,Naux=44T	EE19		7448013501
46 T2 Lp=439uH Self Widing,Np=123T,Naux=44T EE19 47 VR1 470V@0.1m	46 T2 Lp=439uH Self Widing,Np=123T,Naux=44T EE19 47 VR1 470V@0.1m	47 V	/R1 470V@		Self Widing,Np=123T,Naux=44T		LIORITOTIAN	
47 VRT A VARISTOR,P=7.5mm,1=3.5mm 7D Lision Tech LSSA/D4/TK	47 VRT A VARISTOR,P=7.5mm,1=3.5mm 7D Lision Tech LSSA/D4/TK		/R1	20.1m \	VARISTOR,P=7.5mm,T=3.6mm	70		
			<u> </u>	`		/U	Lision Tech	LSSA7D471K
				<b>&gt;</b>				



#### **Transformer Manufacture Guide**

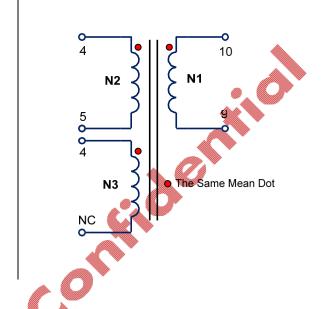
### 1. Electrical Diagram

# Bobbin Top View (EE19)

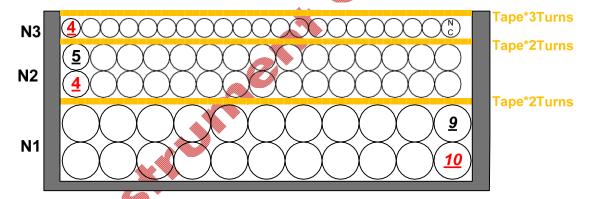


NO Connection Pin

Winding Connection Pin



## 2. Winding Diagram



## 3. Winding Order

Winding Number	Layer	Start	End	Wire Size	Turns
N1	Primary	10	9	0.3d*1P	123Ts
N2	Auxiliary	4	5	0.2d*1P	44Ts
N3	Shielding	4	NC	0.1d*1P	

### 4. Electrical Specification

		>	Value: 439uH±5%
F	Primary Inductance	>	Test condition: Pins 10 - 9,all other windings open, measured at 40kHz, 1.0
	•		VRMS



#### **Test Result**

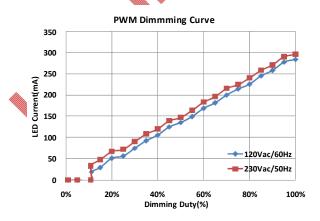
## 1. Efficiency, PF and LED Current Line Regulation

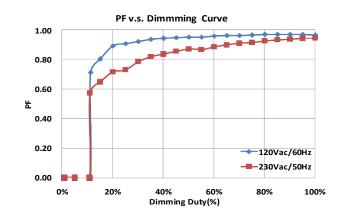
f (Hz)	Vin (VAC)	Pin (W)	Vout (V)	lout (mA)	Pout (W)	Efficiency (%)	PF
	90	22.76	71.8	285	20.46	89.91%	0.923
	100	22.40	71.8	282	20.25	90.39%	0.943
00	110	22.30	71.8	282	20.25	90.80%	0.956
60	120	22.31	71.8	282	20.25	90.76%	0.965
	130	22.37	71.8	283	20.32	90.83%	0.97
	140	22.53	71.8	284	20.39	90.51%	0.971
	190	23.35	71.8	292	20.97	89.79%	0.969
	200	23.51	71.8	293	21.04	89.48%	0.965
	210	23.64	71.8	293	21.04	88.99%	0.957
	220	23.74	71.8	293	21.04	88.62%	0.948
50	230	23.95	71.8	294	21.11	88.14%	0.947
	240	24.18	71.8	296	21.25	87.89%	0.942
	250	24.45	71.8	298	21.40	87.51%	0.936
	260	24.70	71.8	300	21.54	87.21%	0.929
	265	24.85	71.8	301	21.61	86.97%	0.924

## 2. LED Current Load Regulation

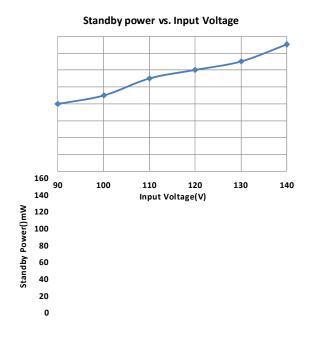
	Vout (V)	39.9	44.1	48.1	52.1	56.2	60.2	64.2	68.2	72.2	76.2	80.2
120Vac /60Hz	lout (mA)	273	275	276	276	278	279	280	281	282	283	284
230Vac /50Hz	lout (mA)	290	292	292	293	294	294	294	294	295	296	298

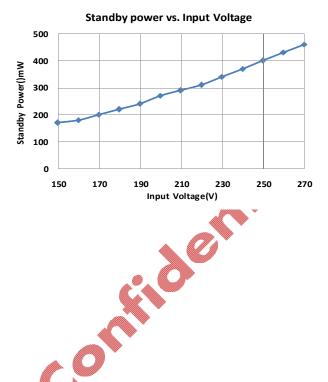
## 3. PWM Dimming Performance Test (PWM Dimming Signal: 1kHz, PWM\_H=5V, PWM\_L=0V)





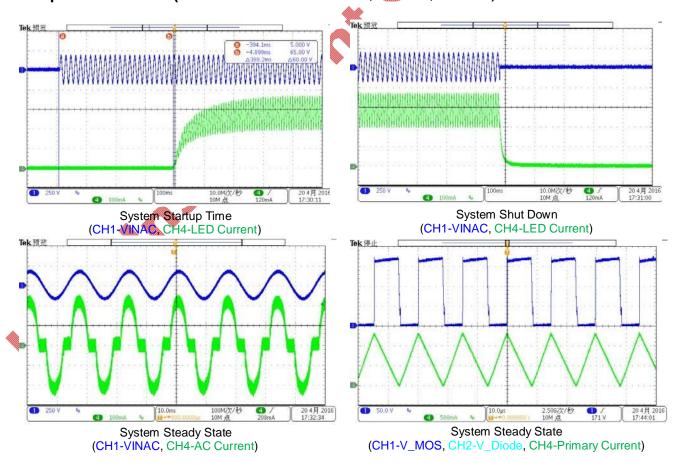




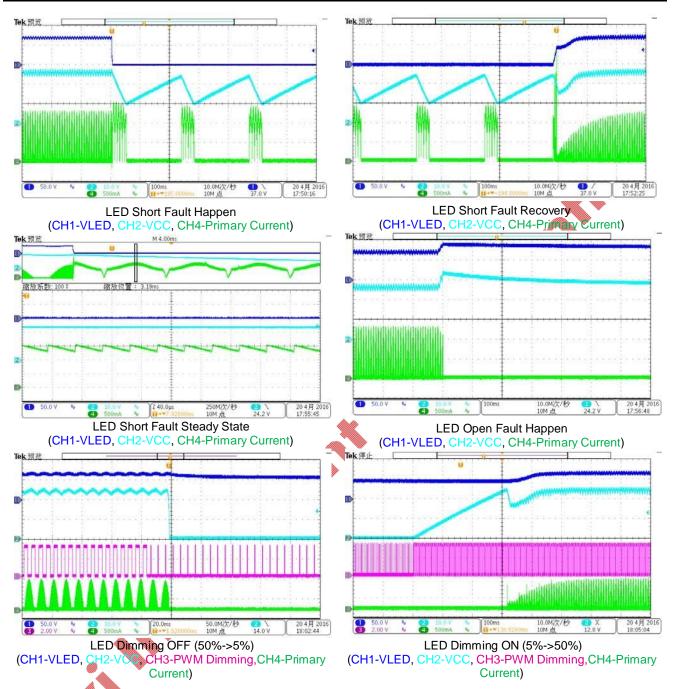


### 4. EMC Test Result (未测)

5. Operation Curves (Test Condition: Vin=120VAC/60Hz, Vout=72V, Io=300mA)

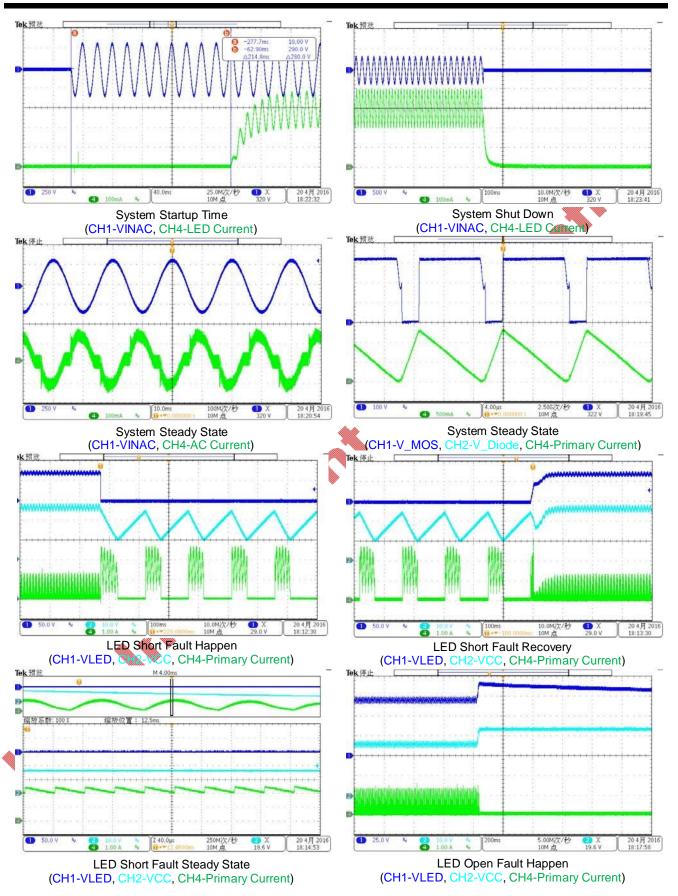




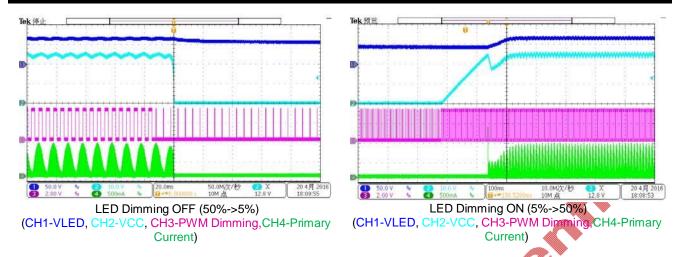


6. Operation Curves (Test Condition: Vin=230VAC/50Hz, Vout=72V, Io=300mA)



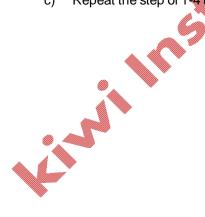






#### **Test Setup Guide**

- 1. Connect the "LED+" terminal to the anode of LED string and the "LED-" terminal to the cathode of LED string.
- 2. Set the AC Power Source to between 90VAC and 265VAC.
- 3. Connect the AC Power Source terminal to the "L" and "N" terminals on the Demo Board
- 4. Turn on the AC Power Source to make system startup; and Turn off the AC Power Source to make system shutdown.
- 5. For PWM dimming case:
  - a) Pre-define the external PWM Dimming Signal to satisfy following condition:
    - Dimming Frequency: 100Hz<PWM<20kHZ</p>
    - Dimming Voltage: 2V<PWM H<5V, PWM L<0.5V</p>
  - b) Connect the positive terminal of the PWM Dimming signal to the "PWM+" terminal on the Demo Board, and connect the GND terminal of the PWM Dimming signal to the "GND" terminal on the Demo Board.
  - c) Repeat the step of 1-4 to enable PWM dimming function.





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