DEMO BOARD TEST REPORT

Universal Input High Power Factor 18W LED Driver Using KP101B

FEATURES

- Low Cost and High Efficiency Buck LED Driver Solution
- Lowest Cost and Size to Pass EMI
- Quasi-Resonant (QR) Operation Mode with Up to 92% Efficiency
- Universal Input Range with High PF>0.9
- Fast Start-Up Speed <600ms
- Good Line and Load regulation <+-1%
- LED Short and Open Protection
- Over Voltage Protection (OVP) on VDD
- Cycle-by-cycle Current Limiting
- Over Temperature Protection (OTP)

INTRODUCTION

KP101B is a pulse-width modulated(PWM) controller with integrated high side floating gate driver for the application of low to medium power single stage power factor corrected(PFC) LEDs. The devices operate in boundary mode and are suitable for buck topologies. Constant on-time boundary mode control scheme guarantees high power factor and low gate turn-on loss.

The Demo Board of KP101B-D007 is typically designed for the application of 72V/240mA 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

- **T8 Lights**
- **Commercial & Residential Lighting**

DEMO BOARD SEPCIFICATION

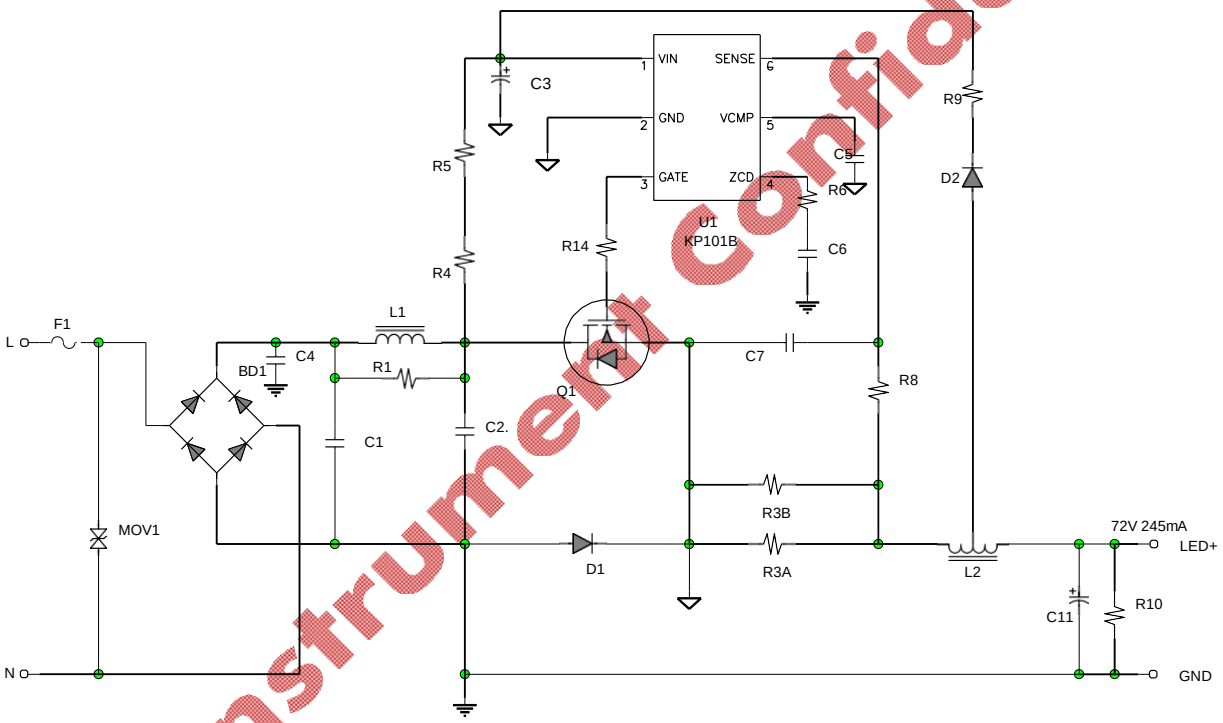
Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	Vin	90	120/230	265	Vac	50Hz/60HZ
Output Voltage	Vout	50.2	72	80	Vdc	
Output Current	Iout		240		mA	
Output Power	Pout		17.28		W	
Efficiency	ɳ	90	92		%	Typical value tested at 230Vac/50Hz,24LEDs in series
Power Factor	PF	0.9				
Startup Time	Tst			600	ms	Tested at 90Vac/60Hz
Over Voltage	Vovp		99		V	

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

Demo Board of KP101B-D007

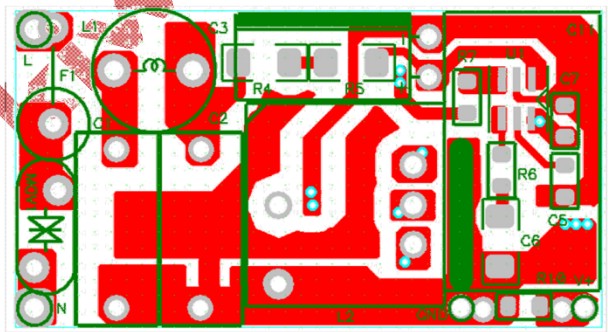
Board Size(in mm): L x W x H=38X20X17

Schematic

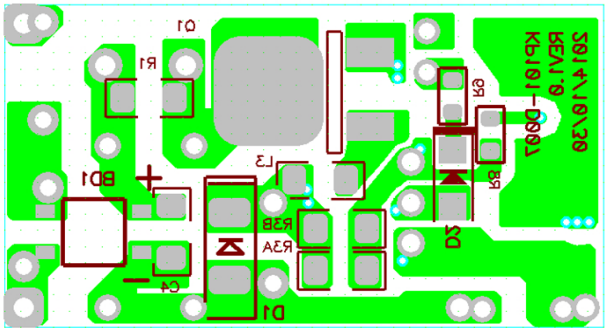


Printed Circuit Board Layout

Top Layer



Bottom Layer



Circuit Description

The demo board of KP101B-D001 is designed with the single stage High Side Buck topology, which applies constant on-time boundary mode control scheme to achieve high power factor and low gate turn-on loss. 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, MOV1, BD1,C4,C1,C2,L1,R1. F1 provides the inrush current limitation in the event of component failure or a short circuit. C4,C1,C2,L1,R1 together provide EMI filtering. The diode bridge BD1 rectifies the AC input to DC output which is followed by high frequency noise filter capacitor C4 and C1. The value of C4 and C1 need to be fine-tuned according to the EMI and PF requirement.

2. KP101B Operation

KP101B is a pulse-width modulated(PWM) controller with integrated high side floating gate driver for the application of low to medium power single stage power factor corrected(PFC) LEDs. The devices operate in boundary mode to achieve high power factor and low gate turn-on loss. Build-in gate control limits the switching frequency range from 16 kHz to 200 kHz, solving the audible noise and high switching loss issue inherited from boundary mode operation.

C3 is the DC voltage power supply for the IC, which is charged from the rectified voltage through R4 and R5 during the startup period and charged by the auxiliary winding from D2 after the output voltage is ready. When the voltage of C2 is higher than the internal OVP threshold, the IC stops switching immediately and enters quiescent operation mode.

R6 and C6 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.

R14 is the GATE resistor 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. R3A, R3B, are used as the sensing resistor. R8 and C7 are used to filter the sensing current. The averaged voltage on ISEN pin is regulated by the IC which helps to achieve accurate output current.

3. Output Current Regulation

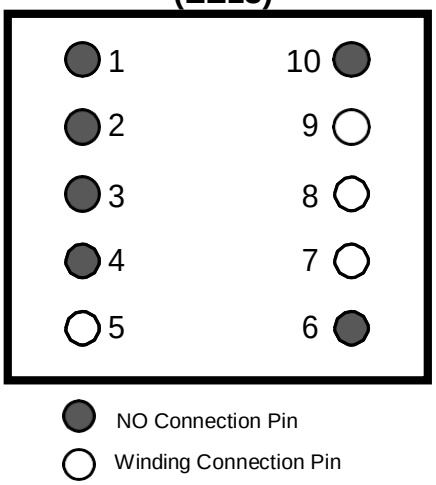
L2, Q1, D1, C11 and R10 compose the typical High Side Buck converter. R10 is the dummy resistor, and output capacitor is discharged after system is shut down.

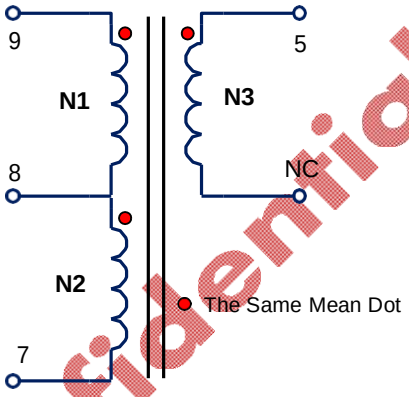
Bill of Material

Number	Designator	Value	Description	Package	Manufacturer	Part Number
1	MOV1	470V @0.1mA	ZnO VARISTOR,P=5.0mm,T=3.5mm	7D	STE	STE07D471K1BN0FSB0
2	F1	4.7R	FUSE RES 4.7R 1W	TH	Any	
3	C1	100nF	CBB21104J450V,P=10mm,T=5.0mm	TH	STE	104J450V
4	C2	220nF	CBB21 224J450V,P=10mm,T=6.5mm	TH	STE	224J450V
5	C3	10uF	Electrolytic Cap, 50V,5*11.5	TH	jianghai	ECR1HBK100M□□ 050011
6	C4	22nF	Ceramic Cap, 1kV X7R	1206	YAGEO	GRM31CR73A223KW03L
7	C5	1uF	Ceramic Cap, 25V X7R	0805	TDK	C2012X7R1E105K
8	C6	10pF	Ceramic Cap, 1kV X7R	1206	Murata	GRM31A5C3A100JW01D
9	C7	100pF	SMD C.C 100pF 50V NP0 0805	0805	YAGEO	
10	C11	100uF	C.E 100uF 100V 105C 10D*16mm P=5	TH	YM	
11	R1	4.7k	Film Resistor, 5%	0805	YAGEO	RC0805JR-074K7L
12	R3A	0.75R	Film Resistor, 1%	1206	YAGEO	RL1206FR-070R75L
13	R3B	0.75R	Film Resistor, 1%	1206	YAGEO	RL1206FR-070R75L
14	R4	240K	Film Resistor, 5%	1206	YAGEO	RC1206JR-07240KL
15	R5	240K	Film Resistor, 5%	1206	YAGEO	RC1206JR-07240KL
16	R6	470K	Film Resistor, 5%	0805	YAGEO	RC0805JR-07470KL
17	R7	100R	Film Resistor, 5%	0805	YAGEO	RC0805JR-07100RL
18	R8	100R	Film Resistor, 5%	0805	YAGEO	RC0805JR-07100RL
19	R9	10R	Film Resistor, 5%	0805	YAGEO	RC0805JR-0710RL
20	R10	100K	Film Resistor, 5%	0805	YAGEO	RC0805JR-07100KL
21	R11	150R	Film Resistor, 5%	0805	YAGEO	RC0805JR-07150RL
22	BD1	1KV/1A	SINGLE PHASE SILICON BRIDGE,1KV/1A	SMD	Yea Shin	ABS10
23	D2	1KV/1A	SMD DIODE 1A 1000V F7 SOD-123	SOD-123	Yea Shin	
24	D4	600V/2A	Super Fast Recovery Rectifier	SMA	Yea Shin	ES2J
25	Q1	600V	N Mosfet, 600V/4A, Rdson=2.5ohm	TO-252	Lision	LS4N60
26	L1	4.7mH	CHOKE DR8*10 4.7mH(0.3A) 0.14Φ	TH	Any	
27	L2	0.6mH	Inductor EE-13 0.6mH	TH	Any	Self Winding
28	IC1	KP101BLGA	Enhanced Performance Non-Isolated PFC Controller	SOT23-6	KIWI	KP101BLGA
29	PCB	20*37*1.2	PCB KP101B-D007 20*37*1.2mm	-	KB	-

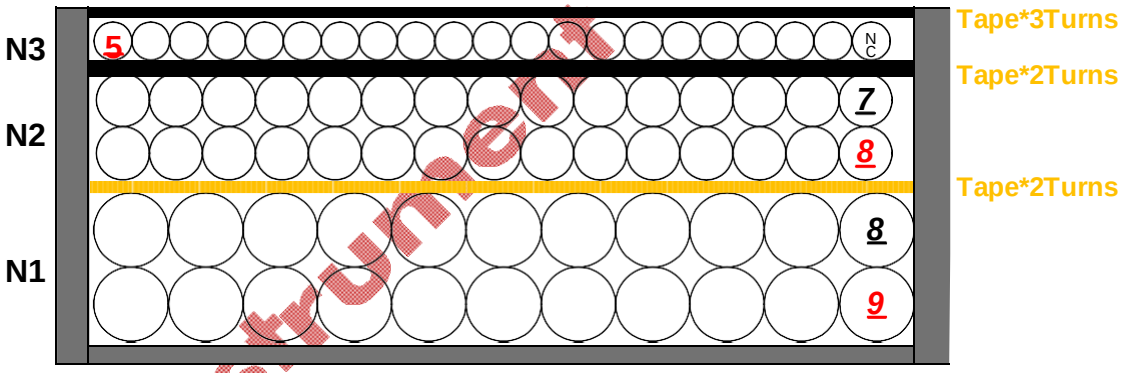
Transformer Manufacture Guide

1. Electrical Diagram





2. Winding Diagram



3. Winding Order

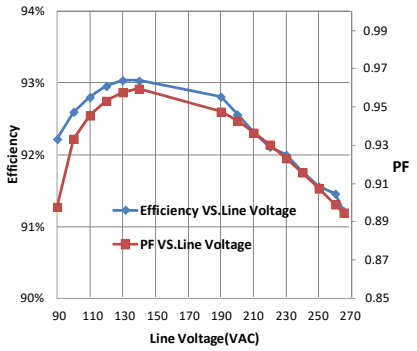
Winding Number	Layer	Start	End	Wire Size	Turns
N1	Primary	9	8	0.23d*1P	54Ts
N2	Auxiliary	8	7	0.12d * 1P	79Ts
N3	Shielding	5	NC	0.12d * 1P	-

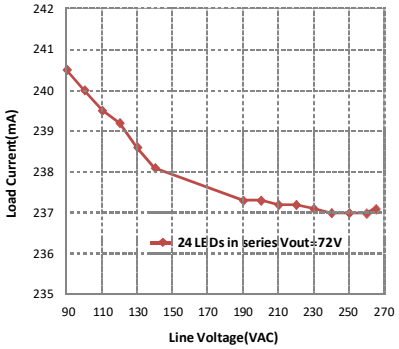
4. Electrical Specification

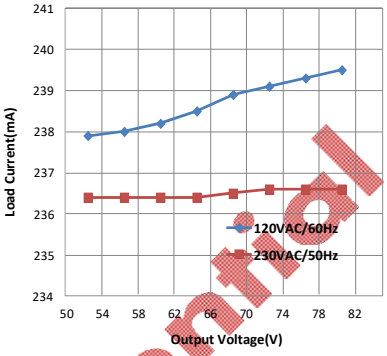
Primary Inductance	➢ **Value:** 0.6mH±8% ➢ **Test condition:** Pins 9 - 7,all other windings open, measured at 40kHz, 1.0 VRMS

Test Result

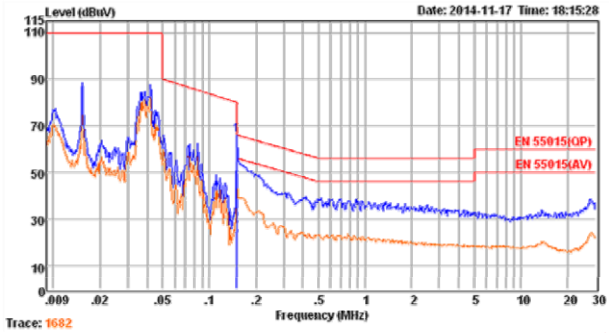
1. Efficiency, PF ,LED Current Line Regulation and Load Regulation



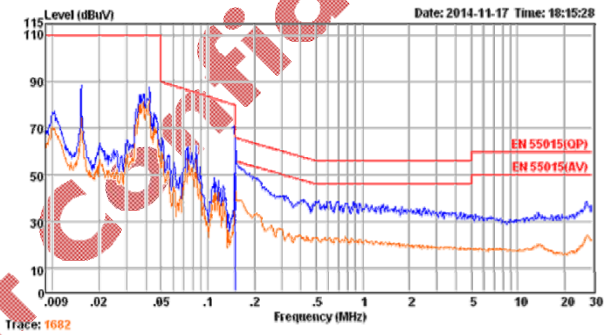




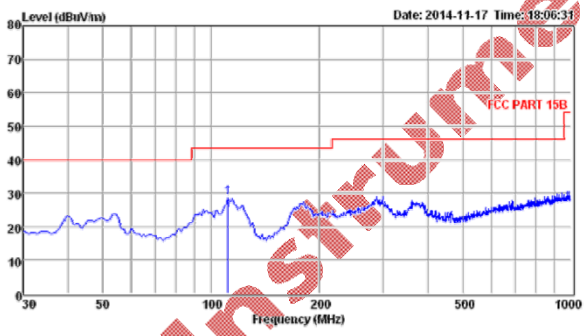
2. EMC Test Result (Test Condition: Vin=120VAC/60Hz, Vout=72V, Io=240mA)



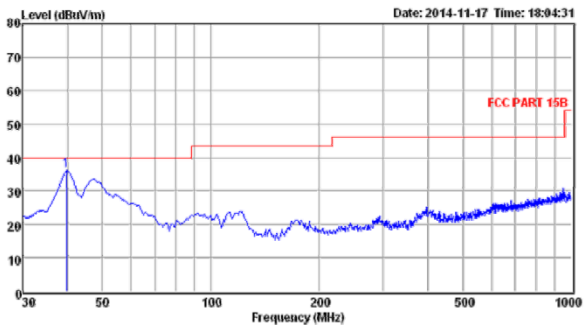
Conduction EMI---LINE



Conduction EMI---NEUTRAL

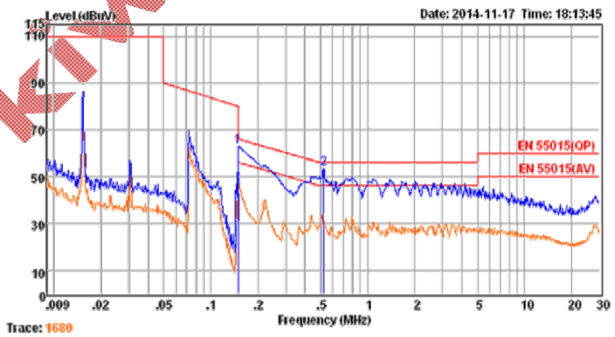


Radiation EMI---HORIZONTAL

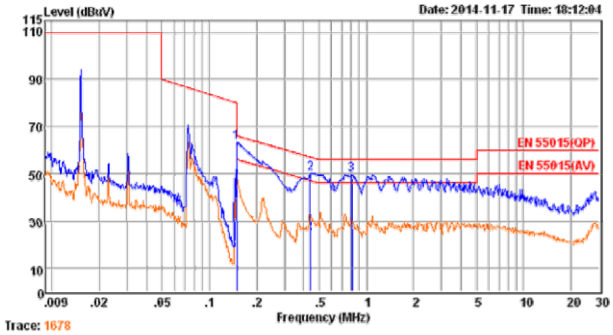


Radiation EMI---VERTICAL

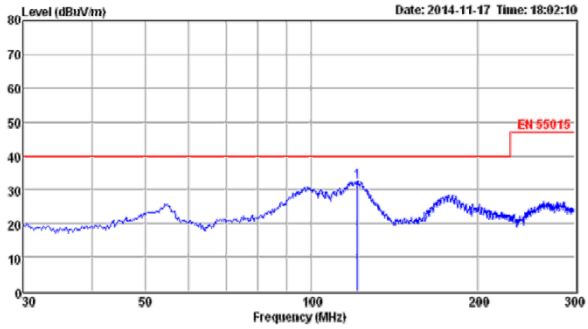
3. EMC Test Result (Test Condition: Vin=230VAC/50Hz, Vout=72V, Io=240mA)



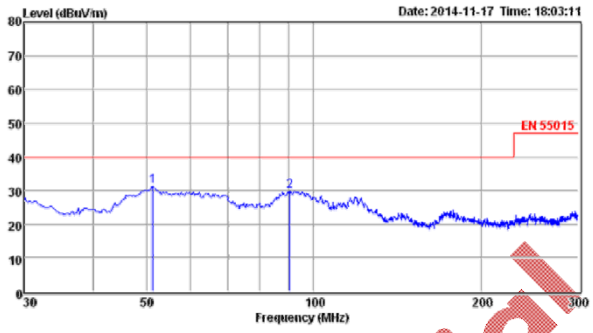
Conduction EMI---LINE



Conduction EMI---NEUTRAL

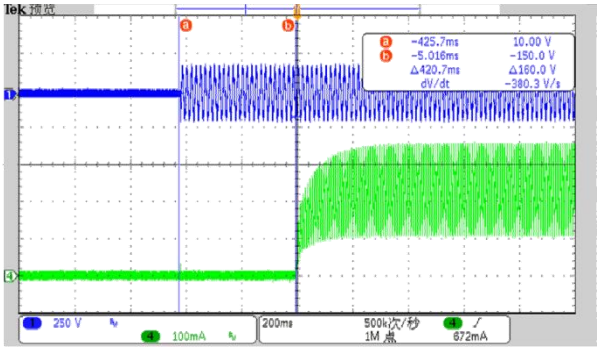


Radiation EMI---HORIZONTAL

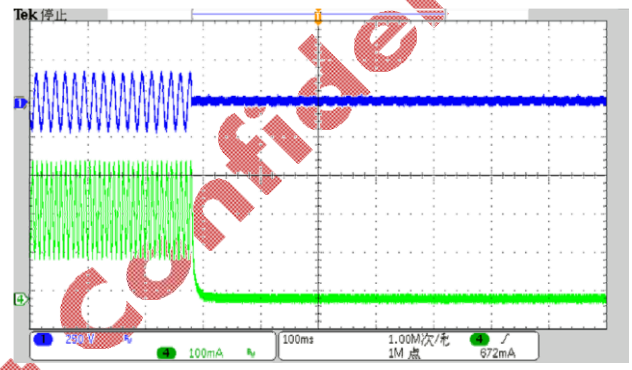


Radiation EMI---VERTICAL

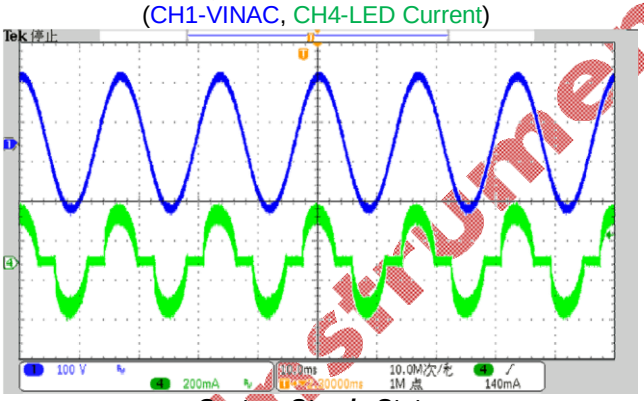
4. Operation Curves (Test Condition: Vin=120VAC/60Hz, Vout=72V, Io=240mA)



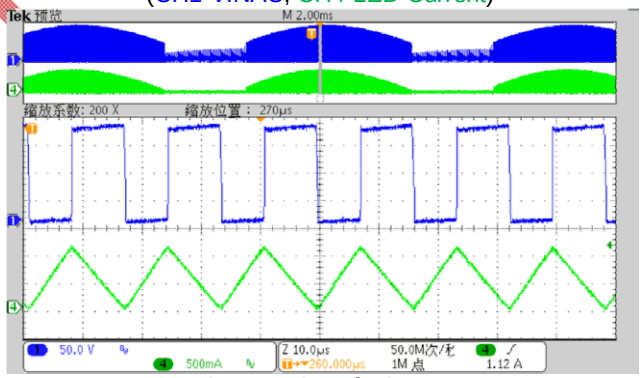
System Startup Time
(CH1-VINAC, CH4-LED Current)



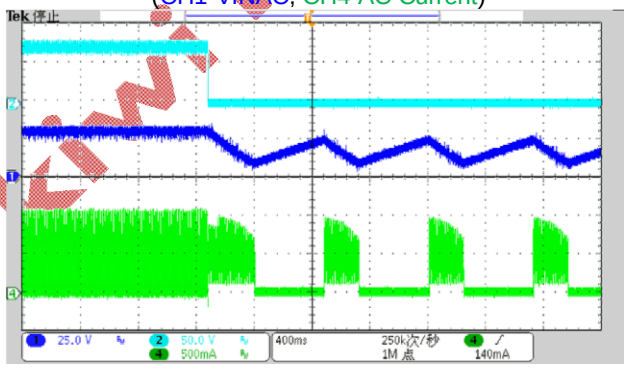
System Shut Down
(CH1-VINAC, CH4-LED Current)



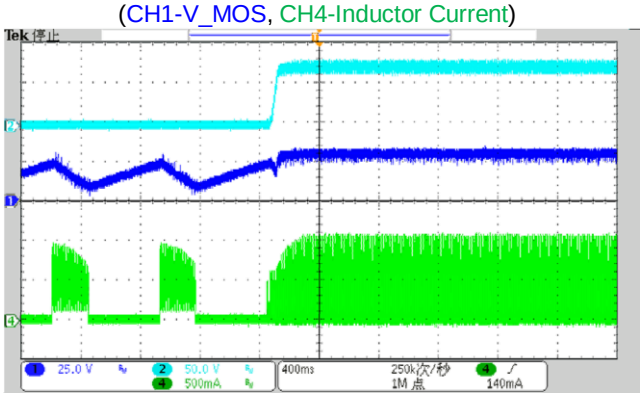
System Steady State
(CH1-VINAC, CH4-AC Current)



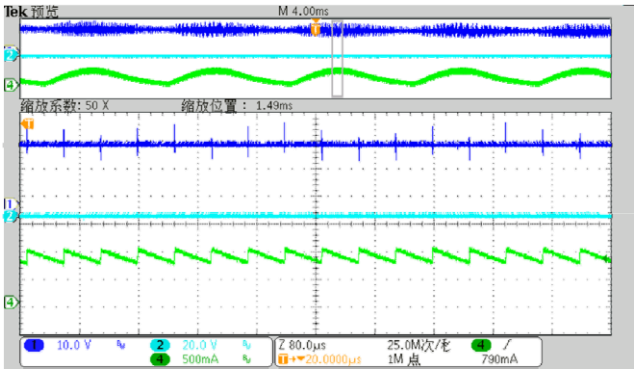
System Steady State
(CH1-V_MOS, CH4-Inductor Current)



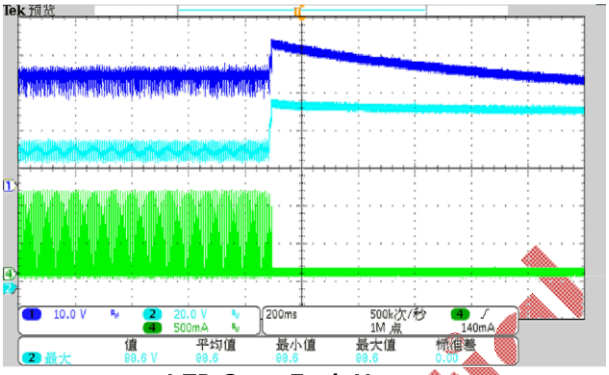
LED Short Fault Happen
(CH1-VCC, CH2-VOUT, CH4-Inductor Current))



LED Short Fault Recovery
(CH1-VCC, CH2-VOUT, CH4-Inductor Current)

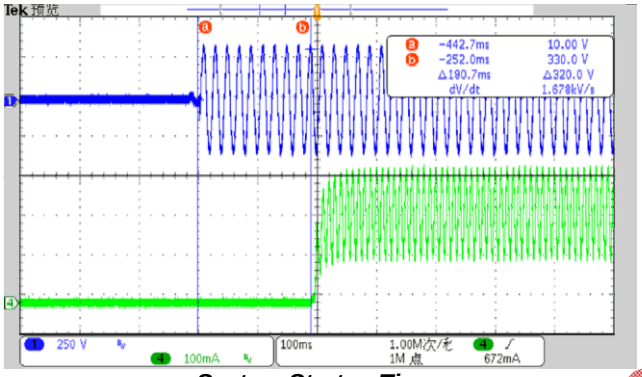


LED Short Fault Steady State
(CH1-VCC, CH2-VOUT, CH4-Inductor Current)

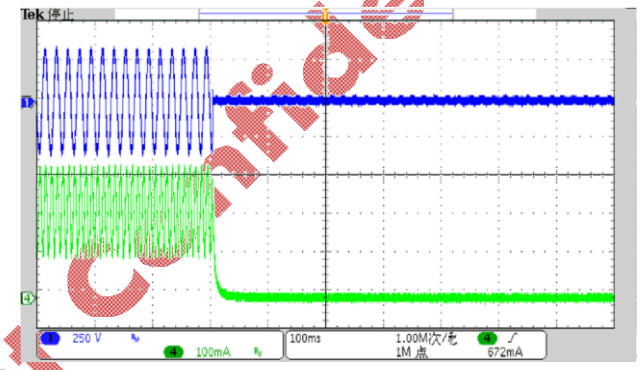


LED Open Fault Happen
(CH1-VCC, CH2-VOUT, CH4-Inductor Current)

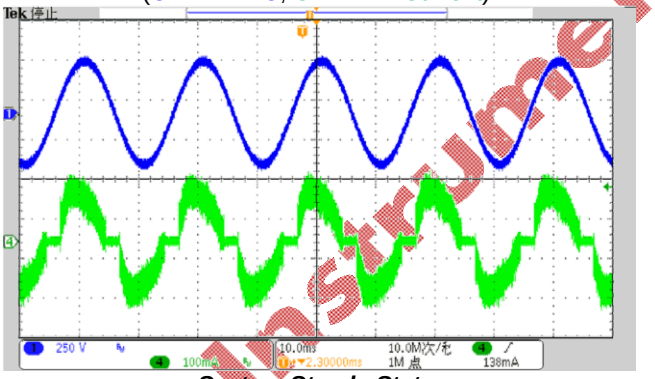
5. Operation Curves (Test Condition: Vin=230VAC/50Hz, Vout=72V, Io=240mA)



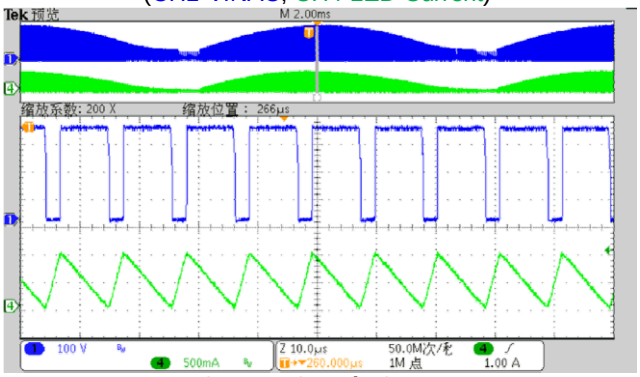
System Startup Time
(CH1-VINAC, CH4-LED Current)



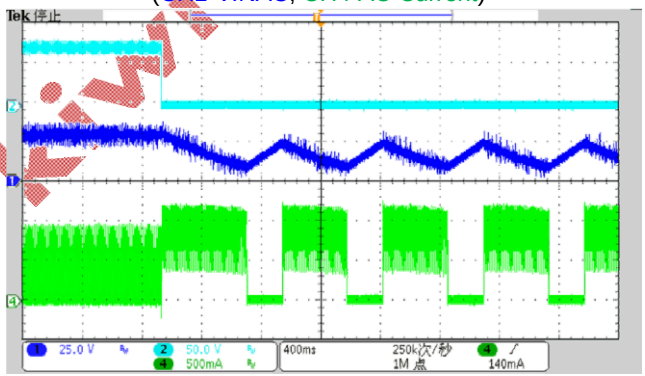
System Shut Down
(CH1-VINAC, CH4-LED Current)



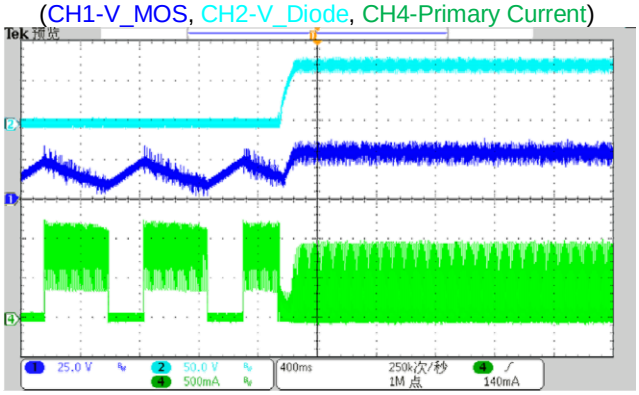
System Steady State
(CH1-VINAC, CH4-AC Current)



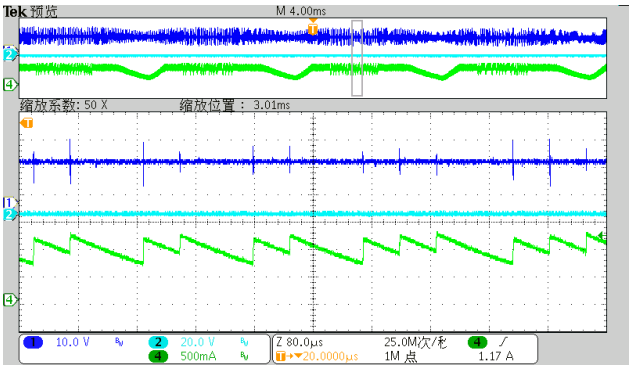
System Steady State
(CH1-V_MOS, CH2-V_Diode, CH4-Primary Current)



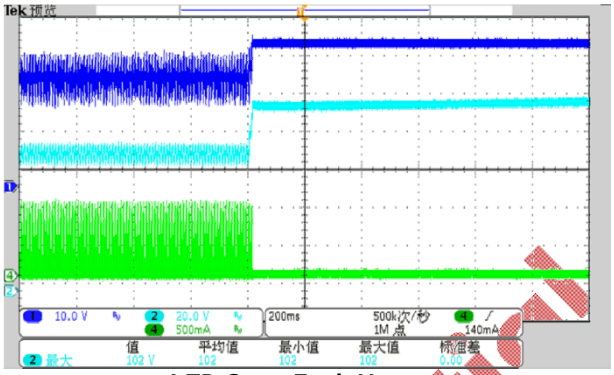
LED Short Fault Happen
(CH1-VCC, CH2-VOUT, CH4-Inductor Current)



LED Short Fault Recovery
(CH1-VCC, CH2-VOUT, CH4-Inductor Current)



LED Short Fault Steady State
(CH1-VCC, CH2-VOUT, CH4-Inductor Current)



LED Open Fault Happen
(CH1-VCC, CH2-VOUT, CH4-Inductor Current)

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.

Kiwi Instruments Corporation

US Headquarter:

Add: 2060 Walsh Ave, Suite 244, Santa Clara, CA, 95050
Tel: 1-+86-18681585060
Fax: 1-408-905-6912
Email: marketing@kiwiinst.com

China office:

Marketing/Field Support
Add: B302-B303, University Creative Park, Xili Rd., Nanshan District, Shenzhen, P.R.C
Tel: (86)755-8204-2689
Fax: (86)755-82042192
Email: marketing@kiwiinst.com.cn