AL1697-Buck-Boost-24V145mA User Guide
230VAC Evaluation

General Description

This demonstration board utilizes the AL1697 Buck-boost LED driver-controller providing a cost effective solution for dimmable in offline high brightness LED applications. This user-friendly evaluation board provides users with quick connection to their different types of LEDs string. The demonstration board can be modified easily to adjust the LED output current and the number of series connected LEDs that are driven.

A bill of materials is included that describes the parts used on this demonstration board. A schematic and layout have also been included along with measured performance characteristics. These materials can be used as a reference design for your products improving your product's time to market.

Key Features

- Dimmable
- Active PFC with power factor >0.85
- High efficiency >75%
- Sing winding
- Low THD
- Good dimmer compatibility
- Low BOM cost

Applications

- Mains dimmable application

AL1697 Buck-Boost Specifications

Parameter	Value
AC Input Voltage	230V
Output Power	3.48W
LED Current	145mA
LED Voltage	24V
Power Factor	>0.85
Efficiency	75%
XYZ Dimension	32 x 29 x 10mm
ROHS Compliance	Yes

Evaluation Board

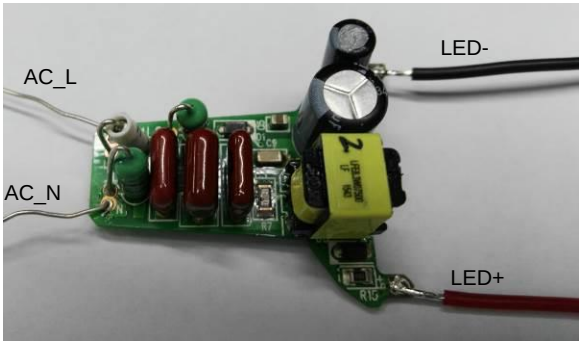


Figure 1: Top View

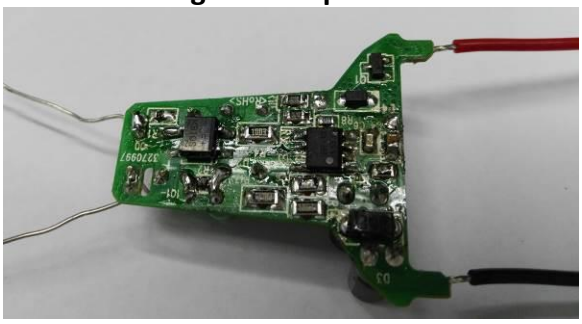


Figure 2: Bottom View

Connection Instructions:

AC+ Input: AC_L
AC- Input: AC_N
DC LED+ Output: LED+ (Red)
DC LED- Output: LED- (Black)

Board Layouts

Figure3: PCB Layout Top View

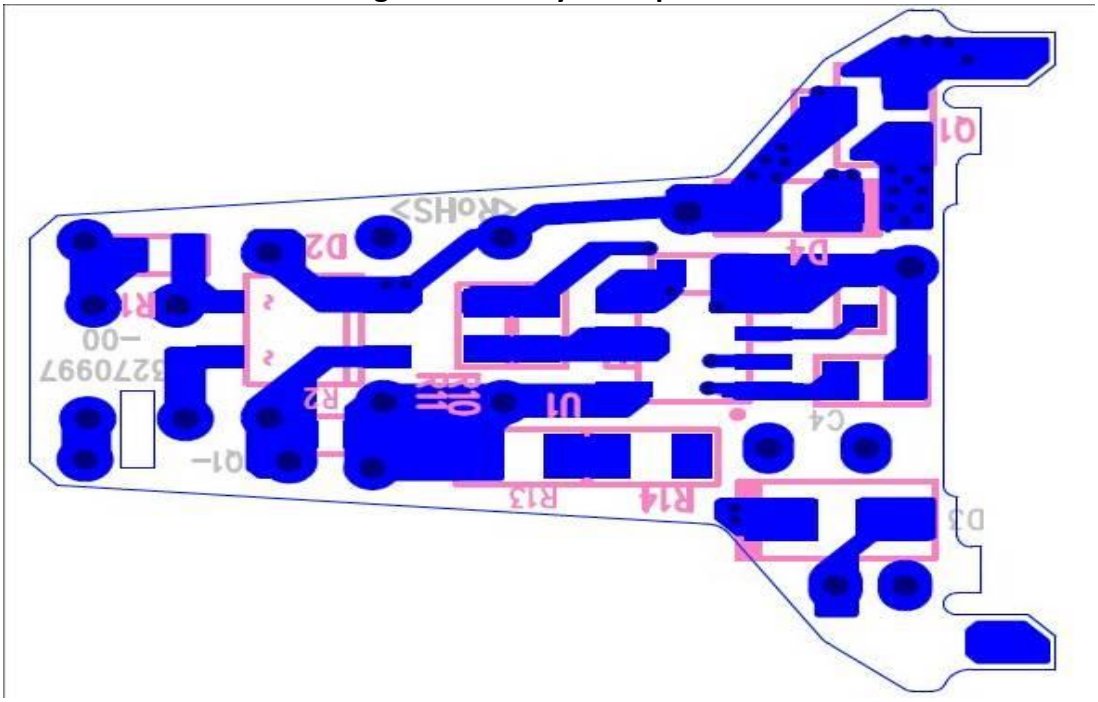


Figure 4: PCB Layout Bottom View

Quick Start Guide

1. Preset the isolated AC source to 230VAC.
2. Ensure that the AC source is switched OFF or disconnected.
3. Connect the anode wire of the LED string to the LED+ of the evaluation board.
4. Connect the cathode wire of the LED string to the LED- terminal of the evaluation board.
5. Connect two AC line wires to the AC_L and AC_N terminals on the evaluation board.
6. Ensure that the area around the board is clear and safe, and preferably that the board and LEDs are enclosed in a transparent safety cover.
7. Turn on the main switch. LED string should light up.
   DO NOT TOUCH THE BOARD, LEDs OR BARE WIRING.

Caution: This AL1697 evaluation board is a non-isolated design. All terminals carry high voltage during operation!

Schematic

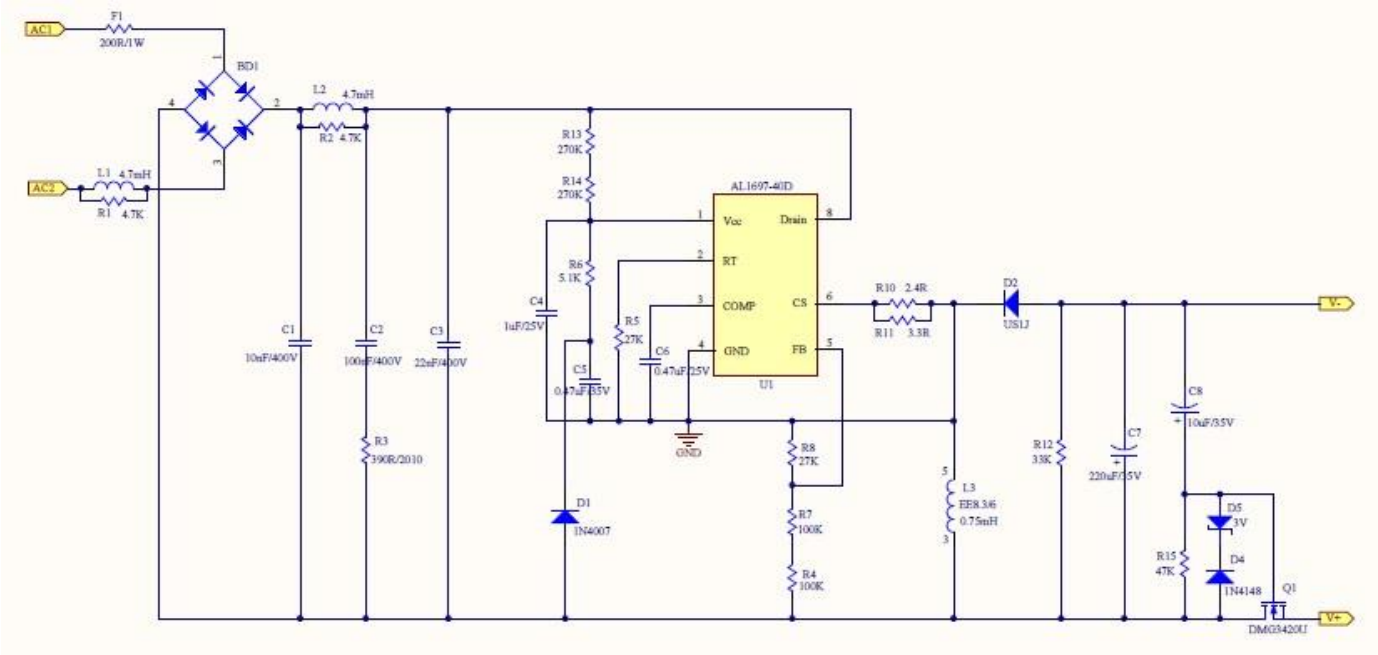


Figure 5: Schematic Circuit

Transformer Design

Bobbin and Core

EE8.3/6 Vertical **3+3 pin**

Transformer Parameters

1. Single winding (Pin5-Pin3)：Lp=0.75mH, ±5%@1kHz

Transformer Winding Construction Diagram

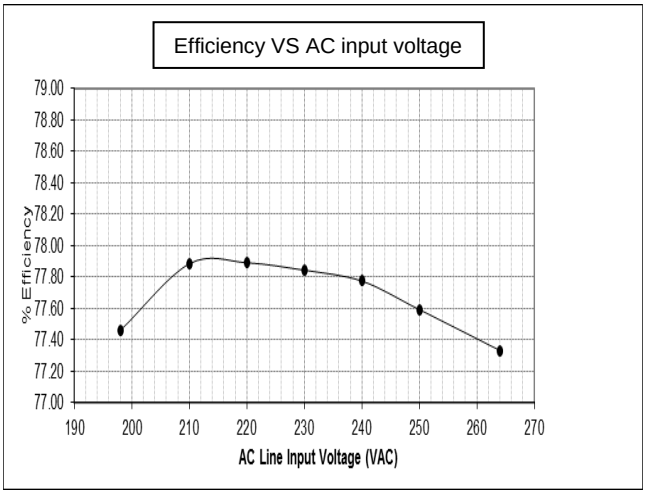
Item	Winding name	Description
1	Single winding	Start at Pin 5, Wind 120 turns of Φ0.2mm wire and finish on Pin 3
2	Insulation	3Layers of insulation tape

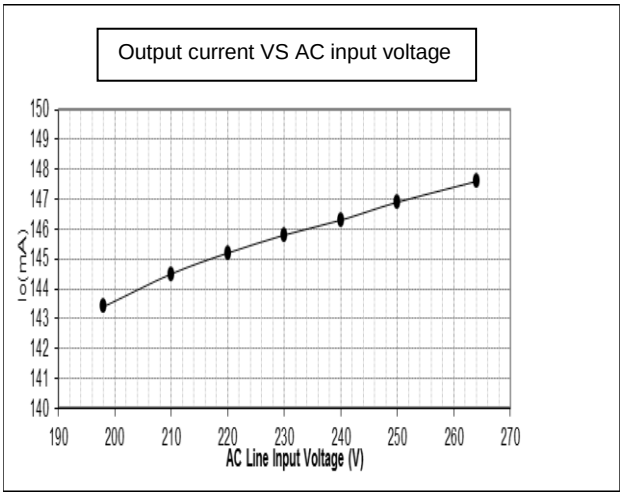
Bill of Material

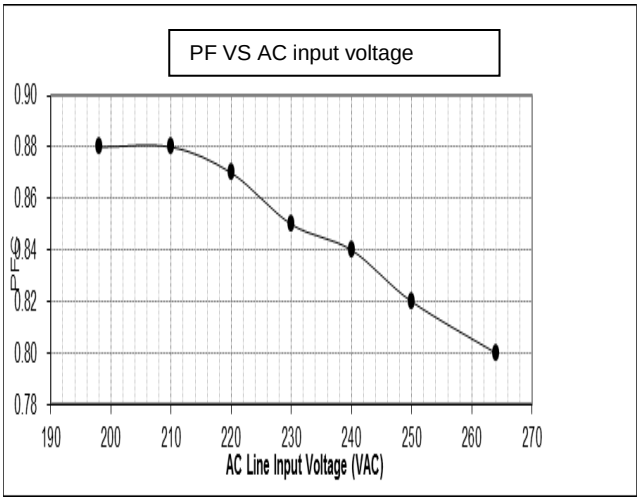
#	Item	Quality	Package	Description
1	C1	1	DIP	10nF/400V, CL21, Pitch=7.5mm
2	C2	1	DIP	100nF/400V, CL21, Pitch=7.5mm
3	C3	1	DIP	22nF/400V, CL21, Pitch=7.5mm
4	C4	1	0805	Ceramic Cap, 1uF/25V,X7R
5	C5	1	0805	Ceramic Cap, 0.47uF/35V,X7R
6	C6	1	0603	Ceramic Cap, 0.47uF/25V,X7R
7	C7	1	DIP	E-Cap, 130℃,220uF/35V, 8*13mm
8	C8	1	DIP	E-Cap, 105℃,10uF/35V, 5*7mm
9	BD1	1	SOPA-4	Rectifier Bridge,MB10S,1A/1000V
10	D1	1	SOD-123	1N4007, 1A/1000V,Diodes Inc
11	D2	1	SMA	Fast Recovery Diode, US1J, 1A/600V
12	D4	1	SOD-123	Switching diode, 1N4148,Diodes Inc
13	D5	1	SOD-123	DDZ9683,3V Zener, Diodes Inc
14	RF1	1	DIP	Fuse Resistor,200R, 5%, 1W
15	R1, R2	2	0805	Resistor, 4.7K, 5%, 1/8W
16	R3	1	2010	Resistor,390R, 5%, 1W
17	R5	1	0603	Resistor,27K, 5%, 1/8W
18	R6	1	1206	Resistor,5.1K, 5%, 1/8W
19	R4,R7	2	1206	Resistor,100K, 5%, 1/4W
20	R8	1	0805	Resistor,27K, 5%, 1/8W
21	R10	1	0805	Resistor,2.4R, 1%, 1/8W
22	R11	1	0805	Resistor,3.3R, 1%, 1/8W

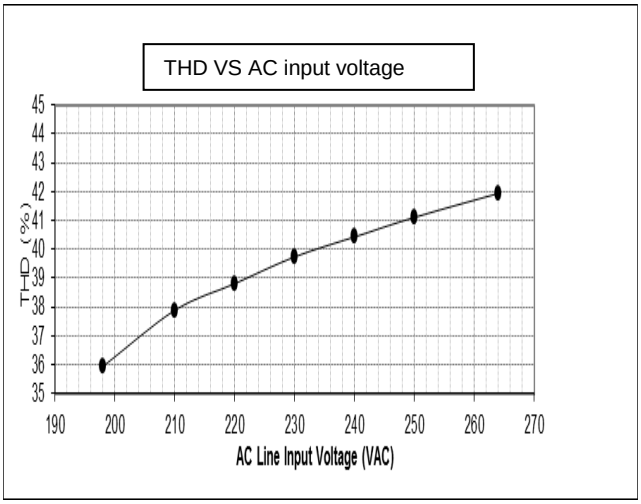
23	R12	1	1206	Resistor,33K, 5%, 1/4W
24	R13,R14	2	1206	Resistor,270K, 5%, 1/4W
25	R15	1	0805	Resistor,47K, 5%, 1/8W
26	L1, L2	2	DIP	Color Code Inductor 4.7mH, 0510
27	L3	1	DIP	EE8.3/6,Vertical,3+3pin,SingleWinding,0.75mH
28	Q1	1	SOT-23	Mosfet,DMG3420U, 20V/4A,Diodes Inc
29	U1	1	SOIC-7	AL1697-40D,Diodes Dimmable IC
30	PCB	1	FR4	FR4 Double layer,32*29mm

Functional Performance









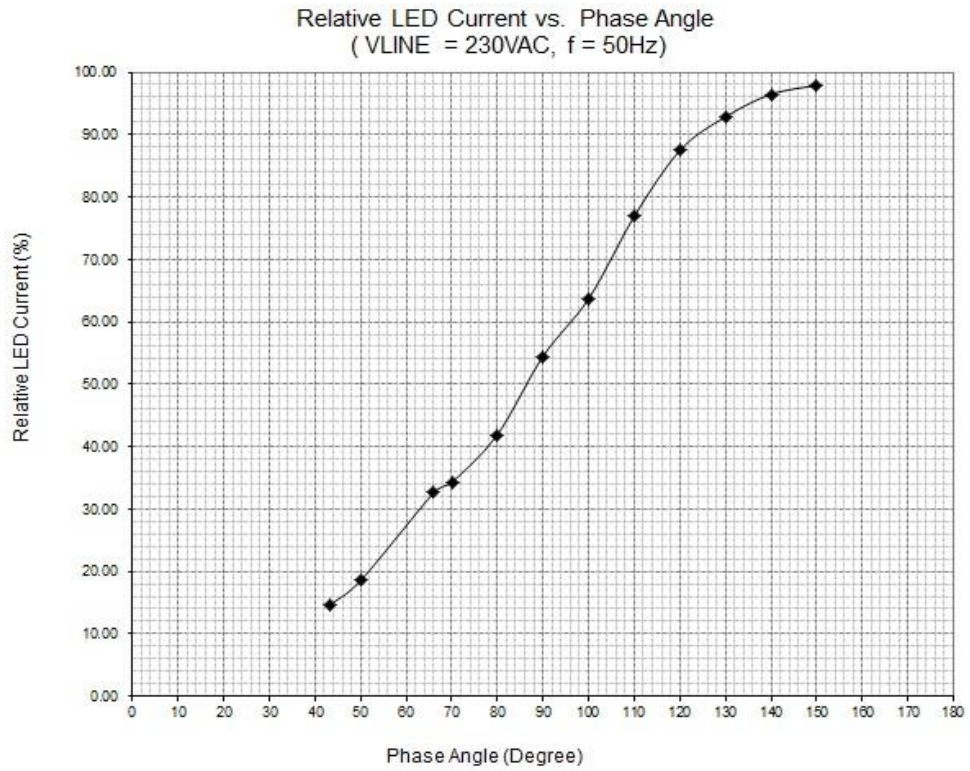
Dimming Test

Dimmer compatibility and dimming range

BOX Type	Dimmer Type	Io(A)		Dimming percentage(%)		Flicker or not
		min	max	min	max	
Box1	Gira 030700 T 20-525W	40.3	143.3	27.79%	98.83%	No
	Busch Jaeger 6519U T 40-550W					Flicker
	Busch Jaeger 6517 U-101 L 60-400W	7.7	142.1	5.31%	98.00%	Flicker
	PEHA D 80 433 V L 60-300W	6.1	143	4.21%	98.62%	Flicker
	Berker 281902 L 20-315W	0	143.2	0.00%	98.76%	No
	Gira 030000 I01 L60-400W	0	143	0.00%	98.62%	No
	Merten 5771-99 T 20-315W	59.3	142.8	40.90%	98.48%	No
	PEHA 433HAB T 20-315W	41.8	142.7	28.83%	98.41%	No
	ABB STD 50-3 L 60-500W	44.1	143.4	30.41%	98.90%	No
	Berker 2874 T 20-250W	85.6	143.7	59.03%	99.10%	No
Box2	Busch Jaeger 6513U-102 T 40-420W	58.4	145.2	40.28%	100.14%	No
	Busch Jaeger 6523U-LED L 2-100W	27.1	141.9	18.69%	97.86%	No
	Berker 2875 L 60-600W	27.1	143.2	18.69%	98.76%	No
	Legrand 775903 T 420W	65.5	142.9	45.17%	98.55%	No
	Merten 5771-99 T 20-315W					Flicker
	Siamens 5TCB 284 T 20-525W	63.4	145.1	43.72%	100.07%	No
	Gira 117600 U 50-420W	54.2	144.3	37.38%	99.52%	No
	Busch-Jae 2247U L 500W	21.2	143.3	14.62%	98.83%	No
	KOPP/Sicherung 8033 L 40-400W					Flicker
	He T46 T 20-315W	48.8	143.2	33.66%	98.76%	No

Box3	Berker 2861 10 U50-420W	53.1	141.9	36.62%	97.86%	No
	Busch-Jaeger 2250U L 60-600W	12.1	143.9	8.34%	99.24%	Flicker
	Jung 254 UDIE1 U50-420W	53.3	142.7	36.76%	98.41%	No
	Jung 1254 UDE U50-420W	42.7	139.3	29.45%	96.07%	No
	Gira 030200/I01 L60-600W	30.3	143.1	20.90%	98.69%	No
	EVERFLOURISH EFM700DC T 25-150W	60.5	141.8	41.72%	97.79%	No
	IKEA E0902-DIM L25-150W	20.7	143.5	14.28%	98.97%	No
	Busch-Jaeger 2200 L60-400W	42.8	143	29.52%	98.62%	No
	ELSO ATD315 T40-315W	46.6	141	32.14%	97.24%	No
	CLIPSAL 32E450LM L 20-450W					Flicker

Dimming Curve



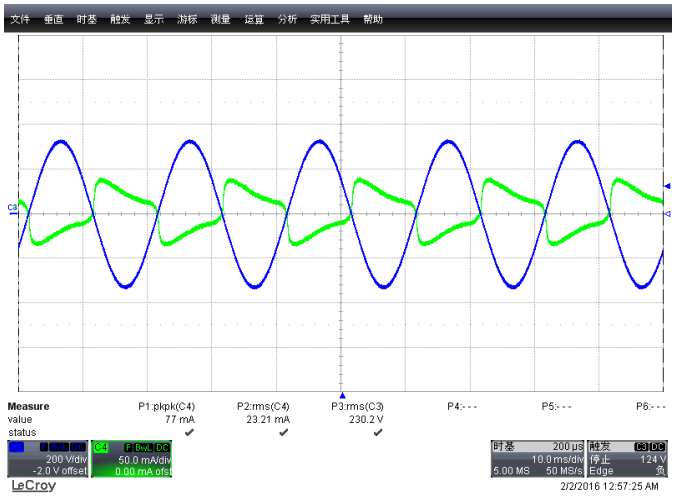
Functional Waveform

Waveforms:

Input Voltage & Input Current

Vin=230V/50Hz

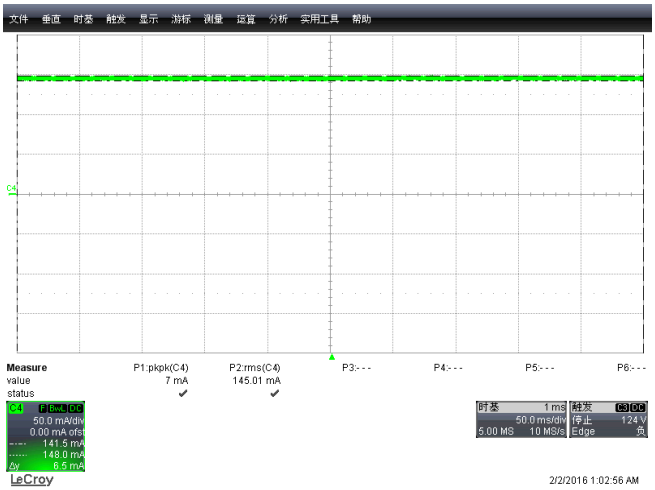
Input Voltage **Input Current**



LED Current Ripple

Vin=230VAC/50Hz Ripple=7mA

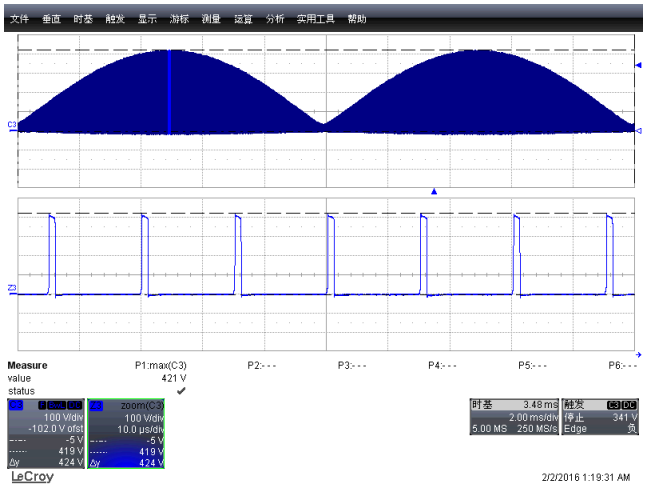
LED Current



Output Diode V_R Waveform

Vin=265VAC/50Hz V_{RRM_MAX}=424V

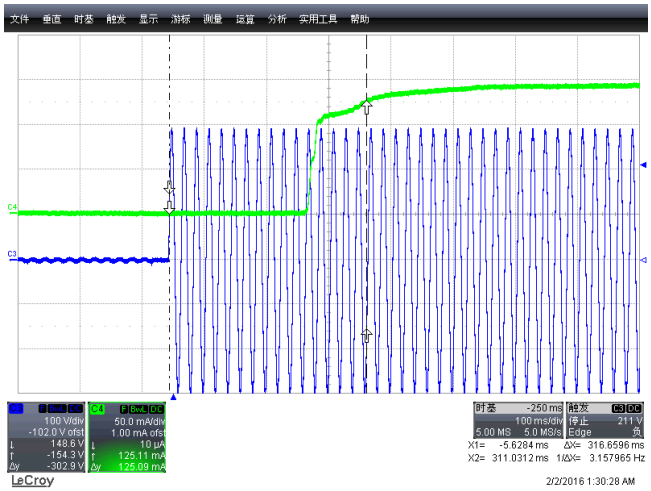
Output Diode V_R



Start time

Vin=208VAC/50Hz Start time=250ms

Input Voltage Output Current

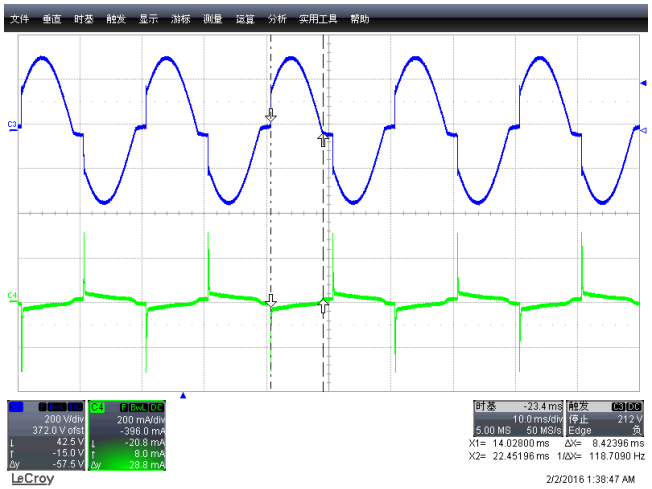


Input AC Current vs Dimmer Phase

Vin=230VAC/50Hz

Max Conduction Angle 151deg

Input Voltage Input Current

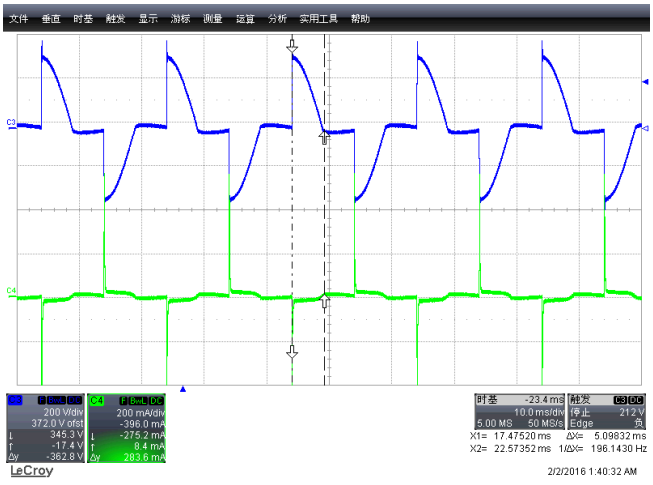


Input AC Current vs Dimmer Phase

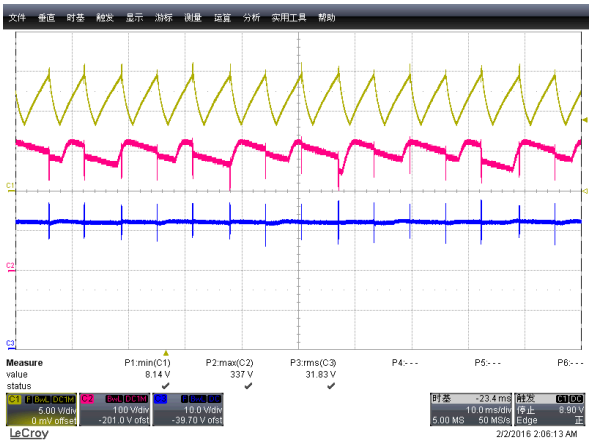
Vin=230VAC/50Hz

Mid Conduction Angle 90deg

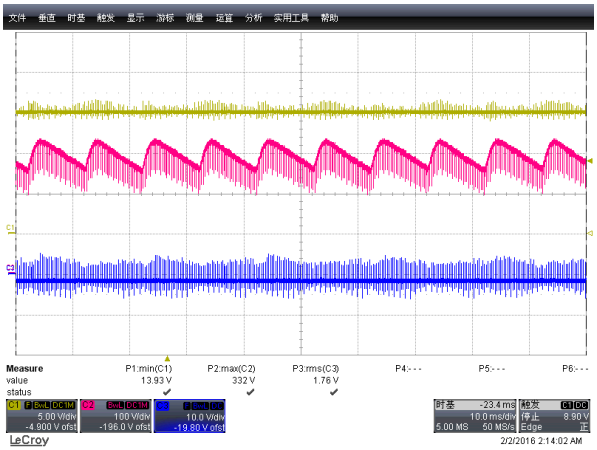
Input Voltage Input Current



LED Open Protection
(Vin=230VAC, Y-VCC, R-Drain, B-Vout)



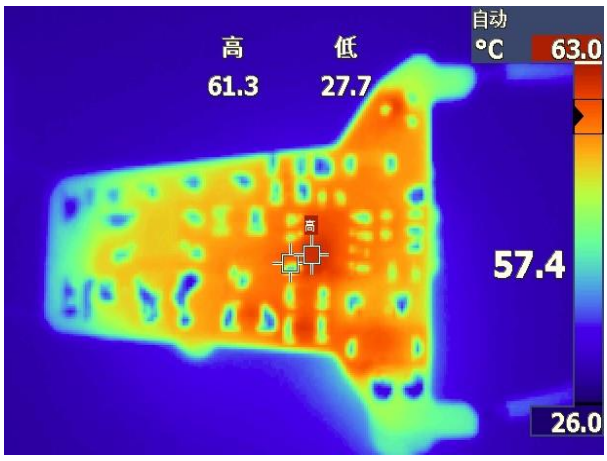
LED Short Protection
(Vin=230VAC, Y-VCC, R-Drain, B-Vout)



Thermal Test

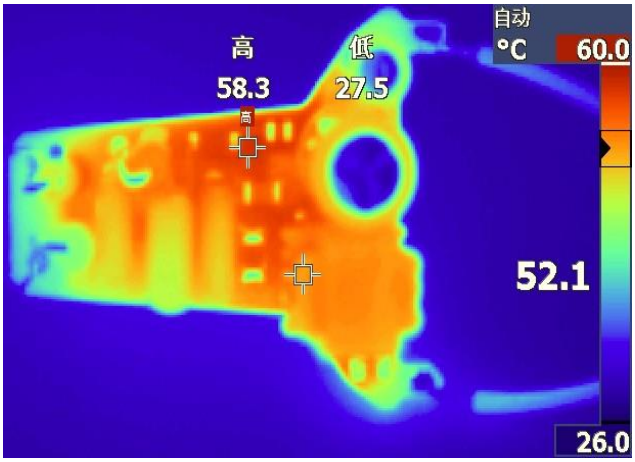
Top

Vin=230VAC/50Hz Test time=60min



Bottom

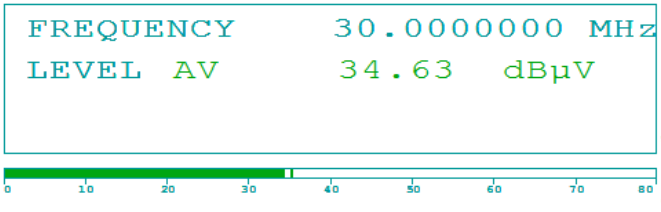
Vin=230VAC/50Hz Test time=60min



EMI Conduction Test

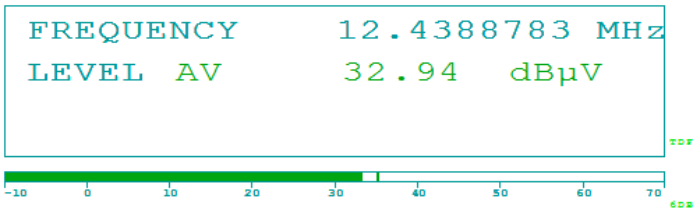
Line Terminal

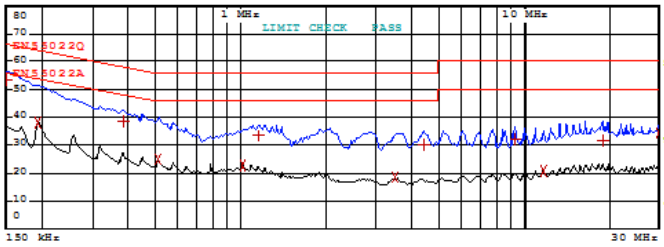
Vin=230VAC/50Hz LIMIT CHECK PASS

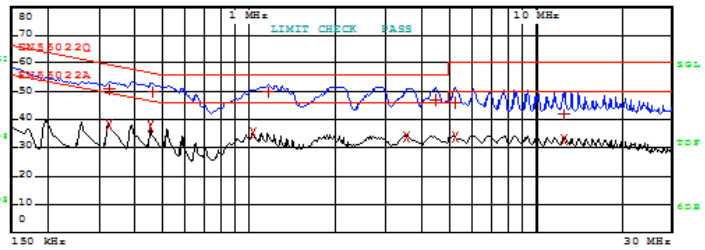


Neutral Terminal

Vin=230VAC/50Hz LIMIT CHECK PASS







Line Terminal

Vin=230VAC/50Hz Margin>12dB

EDIT PEAK LIST (Final Measurement Results)

Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	150 kHz	53.77	-12.22
2	Average	192.364799253 kHz	38.22	-15.70
1	Quasi Peak	386.030632509 kHz	38.60	-19.54
2	Average	510.05878768 kHz	25.25	-20.74
2	Average	1.01343296123 MHz	22.73	-23.27
1	Quasi Peak	1.15338124335 MHz	33.30	-22.70
2	Average	3.48052994318 MHz	18.58	-27.41
1	Quasi Peak	4.41934946411 MHz	30.31	-25.68
1	Quasi Peak	9.22868887759 MHz	32.19	-27.80
2	Average	11.7179860284 MHz	20.80	-29.19
1	Quasi Peak	18.8920426529 MHz	31.72	-28.27
2	Average	30 MHz	34.57	-15.42

Neutral Terminal

Vin=230VAC/50Hz Margin>6dB

EDIT PEAK LIST (Final Measurement Results)

Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	325.955575511 kHz	50.95	-8.60
2	Average	325.955575511 kHz	38.14	-11.41
2	Average	452.651275966 kHz	37.44	-9.38
1	Quasi Peak	461.749566613 kHz	50.04	-6.61
2	Average	1.03380296375 MHz	35.14	-10.85
1	Quasi Peak	1.16491505578 MHz	49.70	-6.29
2	Average	3.51533524261 MHz	34.12	-11.88
1	Quasi Peak	4.46354295875 MHz	47.00	-8.99
1	Quasi Peak	5.23385515413 MHz	46.13	-13.86
2	Average	5.23385515413 MHz	33.79	-16.20
1	Quasi Peak	12.4388782936 MHz	41.79	-18.21
2	Average	12.4388782936 MHz	33.05	-16.94

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