

General Description

This demonstration board utilizes the AL1692 Buck-boost LED driver with single winding inductor providing a cost effective triac dimmable solution for 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 BOM, schematic and layout are included that describes the parts used on this demonstration board, along with measured performance characteristics. These materials can be used as a reference design.

Key Features

- Triac Dimmable
- Active PFC with power factor >0.91
- Low THD
- High efficiency >82%
- Single winding
- Good dimmer compatibility
- Low BOM cost

Applications

- Retrofit Bulb, Par lamps

Specifications

Parameter	Value
AC Input Voltage	108~132V
Output Power	4.95W
LED Current	110mA
LED Voltage	45V
Power Factor	>0.91
Efficiency	82%
XYZ Dimension	44.03x23.24x15mm
ROHS Compliance	Yes

Evaluation Board



Figure 1: Top View

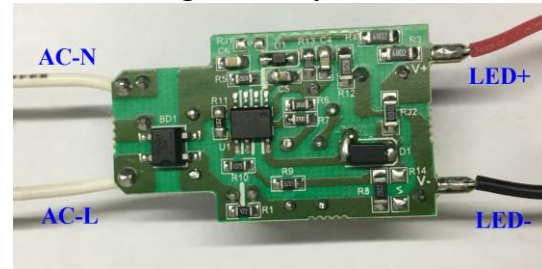


Figure 2: Bottom View

Connection Instructions:

- AC-L Input: White – Hot
- AC-N Input: White– Neutral
- DC LED+ Output: LED+ (Red)
- DC LED- Output: LED- (Black)

Board Layouts

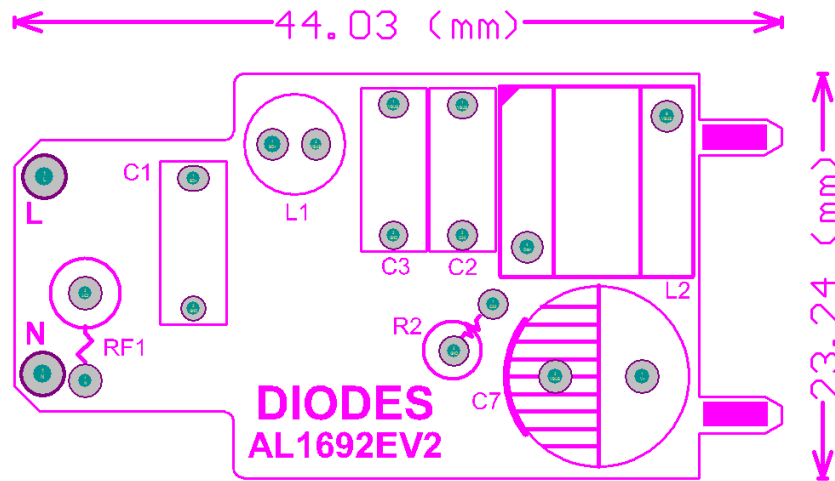


Figure 3: PCB Layout Top View

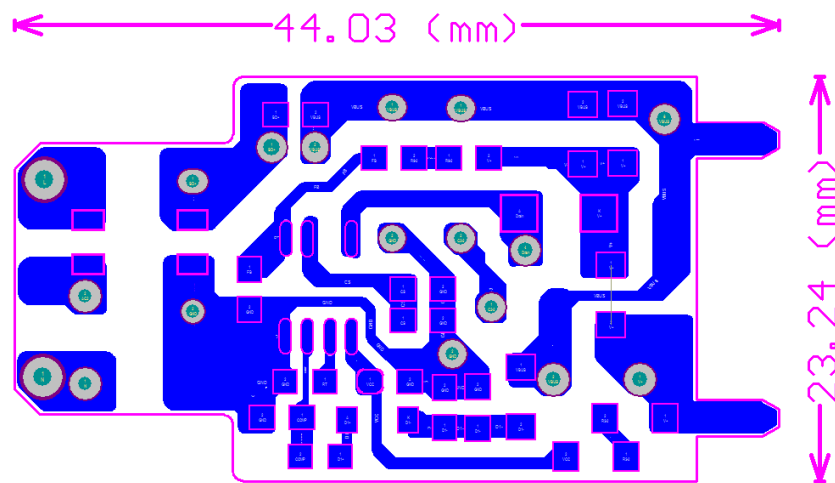


Figure 4: PCB Layout Bottom View

Quick Start Guide

1. Preset the isolated AC source to 120VAC.
2. Ensure that the AC source is switched OFF or disconnected.
3. Connect the anode wire of the LED string to the LED+ terminal 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 with LED.
DO NOT TOUCH THE BOARD, LEDs OR BARE WIRING.

Caution: The AL1692 is a non-isolated design. All terminals carry high voltage during operation!

Schematic

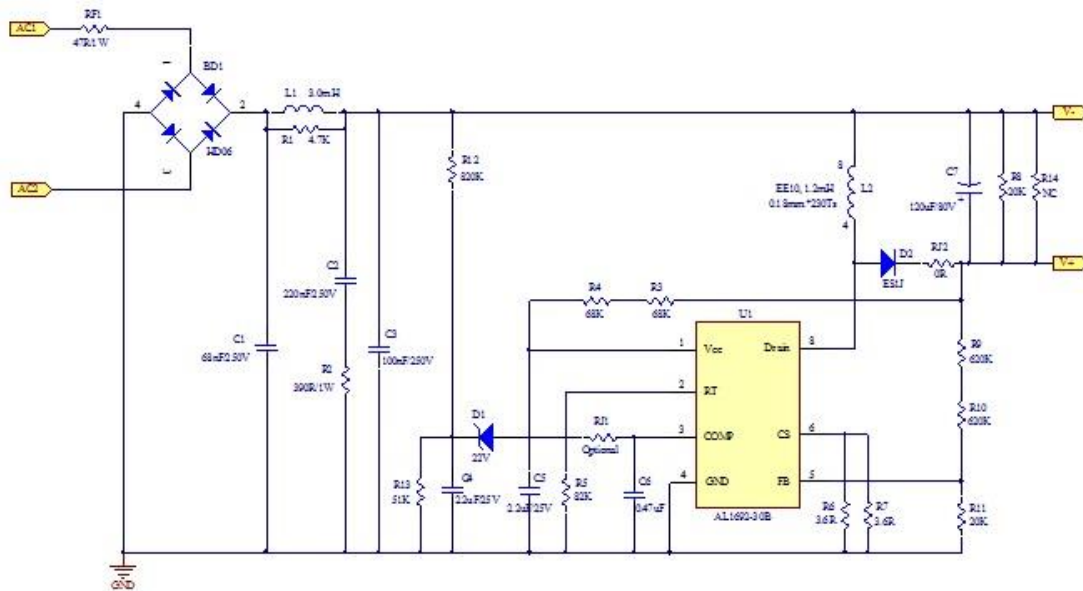


Figure 5: Schematic Circuit

Transformer Design

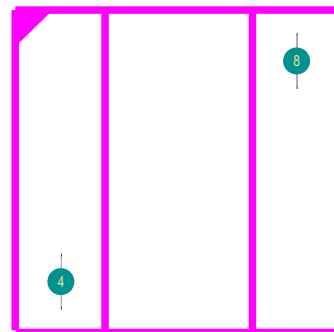
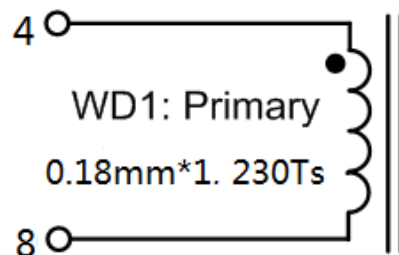
Bobbin and Core

EE10 Vertical 4+4 pin

Transformer Parameters

1. Primary Inductance (Pin4-Pin8, all other windings open): $L_p=1.2\text{mH}$, $\pm 5\%$ @1kHz
2. Primary Winding Turns (Pin4-Pin8): $N_p=230T_s$

Transformer Winding Construction Diagram

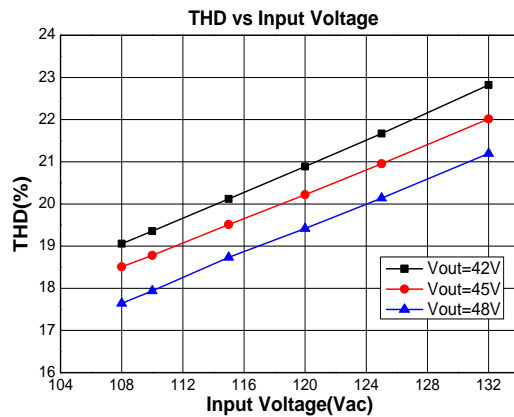
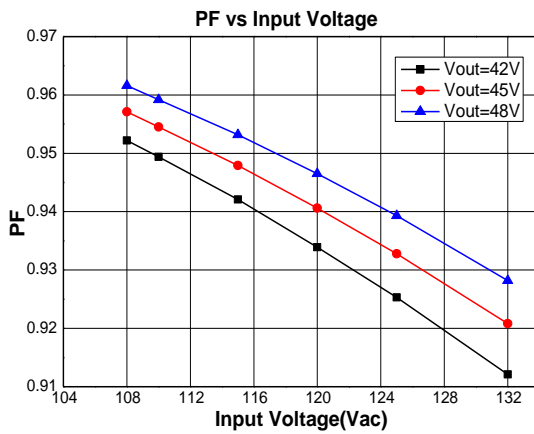
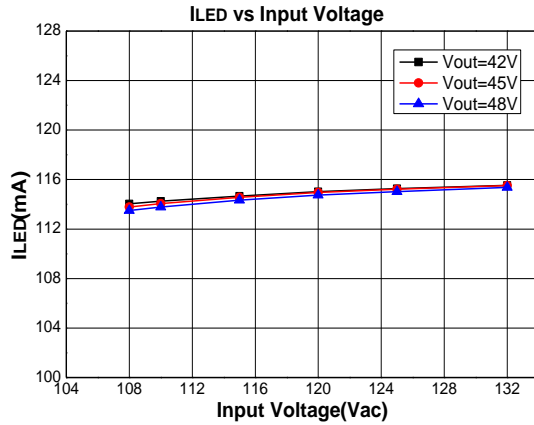
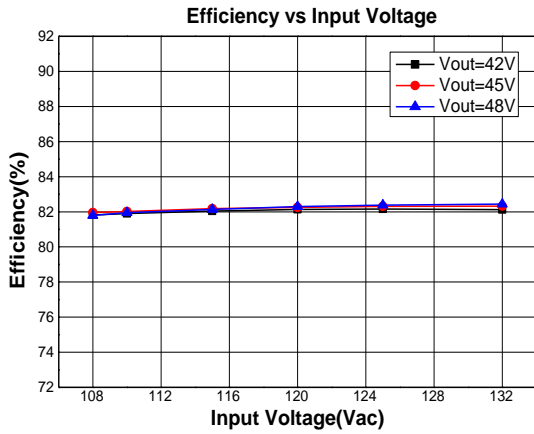


Item	Winding name	Description
1	WD1-Primary Winding	Start at Pin4, Wind 230 turns of $\Phi 0.18\text{mm}$ wire and finish on Pin8.
2	Insulation	2 Layers of insulation tape

Bill of Material

No	Item	Description	Package	Quantity
1	C1	68nF/250V, CL21, Pitch=7.5mm	DIP	1
2	C2	220nF/250V, CL21, Pitch=7.5mm	DIP	1
3	C3	100nF/250V, CL21, Pitch=7.5mm	DIP	1
4	C4	Ceramic Cap, 2.2uF/25V,X7R	0805	1
5	C5	Ceramic Cap, 2.2uF/25V,X7R	0805	1
6	C6	Ceramic Cap, 0.47uF/16V,X7R	0805	1
7	C7	E-Cap,130°C,120uF/80V,10*12.5mm	DIP	1
8	BD1	Rectifier Bridge,HD06,0.8A/600V,Diodes Inc	SOPA-4	1
9	D1	22V, zener	SOD-123	1
10	D2	Fast Recovery Diode,ES1J,1A/600V	SMA	1
11	RF1	Fuse Resistor, 47R/1WS	DIP	1
12	R1	Resistor, 4.7K, 5%, 1/8W	0805	1
13	R2	Power Resistor,390R, 5%, 1WS	DIP	1
14	R3	SMD Resistor,68K, 5%, 1/4W	1206	1
15	R4	SMD Resistor,68K, 5%, 1/4W	1206	1
16	R5	SMD Resistor,82K, 5%, 1/8W	0805	1
17	R6	SMD Resistor,3.6R, 1%, 1/8W	0805	1
18	R7	SMD Resistor,3.6R, 1%, 1/8W	0805	1
19	R8	SMD Resistor,20K, 5%, 1/4W	1206	1
20	R9	SMD Resistor,620K, 1%, 1/8W	0805	1
21	R10	SMD Resistor,620K, 1%, 1/8W	0805	1
22	R11	SMD Resistor,20K, 1%, 1/8W	0805	1
23	R12	SMD Resistor,820K, 5%, 1/4W	1206	1
24	R13	SMD Resistor,51K, 5%, 1/8W	0805	1
25	R14	NC		0
26	RJ1	0R, Optional	0805	0
27	RJ2	SMD Resistor, 0R, 5%, 1/4W	1206	1
28	L1	Drum Inductor 3.0mH, 6*8mm	DIP	1
29	L2	EE10, Vertical, 4+4pin,Single Winding,1.2mH	DIP	1
30	U1	AL1692-30B,Diodes Dimmable IC	SOIC-7	1
Total BOM				28

Electrical Performance

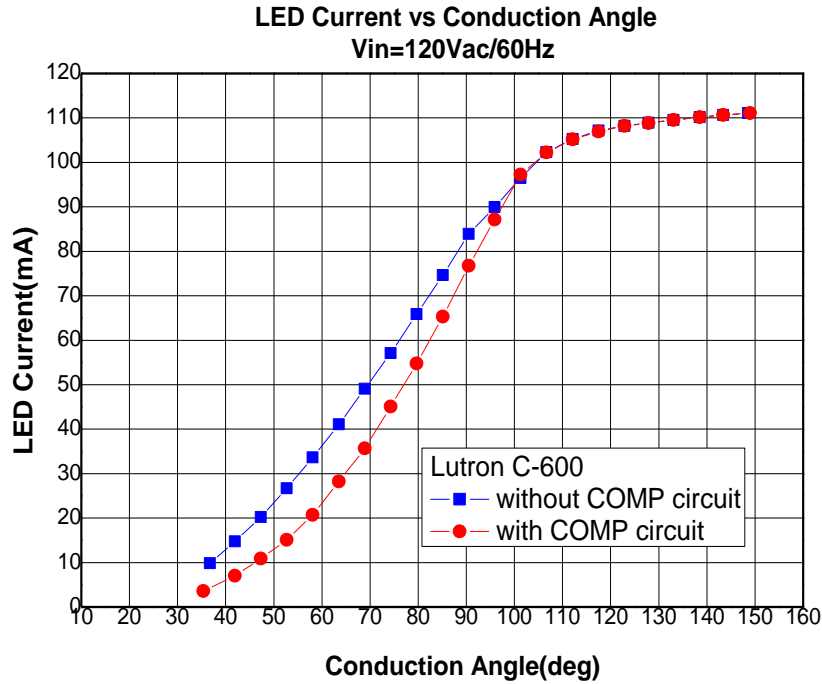


Dimming Test

Dimmer compatibility and dimming range

Num	Dimmer Type	ILED(mA)		Dimming Percentage(%)		Flicker or not
		Min	Max	Min	Max	
1	Lutron D-600P L 600W	0.0	111.9	0.00%	97.34%	Shimmer
2	Lutron D600PH-WH L 600W	0.0	111.6	0.00%	97.08%	Shimmer
3	Lutron C-600 L 600W	8.7	113.6	7.57%	98.82%	No
4	Lutron NLV-600	12.9	113.0	11.22%	98.30%	No
5	Lutron NTELV-600	20.1	113.4	17.48%	98.64%	No
6	Lutron DVELV-300P	12.0	112.8	10.44%	98.12%	No
7	Lutron DV-600P	9.5	112.4	8.26%	97.77%	No
8	Lutron SELV-300P	11.9	113.4	10.35%	98.64%	No
9	Lutron MACL-153M	11.5	110.9	10.00%	96.47%	No
10	Lutron S-600P	1.8	112.4	1.57%	97.77%	No
11	Lutron LXLV-600PL	13.7	112.5	11.92%	97.86%	No
12	Lutron MAW-603	12.6	113.5	10.96%	98.73%	No
13	Lutron MIR-600	14.0	113.6	12.18%	98.82%	No
14	Lutron DV-603PG	8.1	108.5	7.05%	94.38%	No
15	Lutron NTLV-600	19.6	113.6	17.05%	98.82%	No
16	Lutron AY-600P	13.8	113.1	12.00%	98.38%	No
17	Lutron TGCL-153P	39.2	112.3	34.10%	97.69%	No
18	Lutron DVLV-603P	16.4	112.5	14.27%	97.86%	No
19	Lutron MAELV-600	19.0	113.6	16.53%	98.82%	No
20	Cooper 9538	6.8	109.0	5.92%	94.82%	No
21	Cooper 9539	14.6	111.0	12.70%	96.56%	No
22	Cooper SI06P	5.7	113.1	4.96%	98.38%	No
23	Cooper SI061	4.9	108.4	4.26%	94.29%	No
24	Cooper TAL06P	10.0	114.1	8.70%	99.25%	No
25	Cooper DLC03P	15.7	114.1	13.66%	99.25%	No
26	Lutron TT-300	0.0	113.0	0.00%	98.30%	Shimmer
27	Leviton TBL03	18.6	113.8	16.18%	98.99%	No
28	ZING EAR ZE-04	0.0	114.5	0.00%	99.60%	No

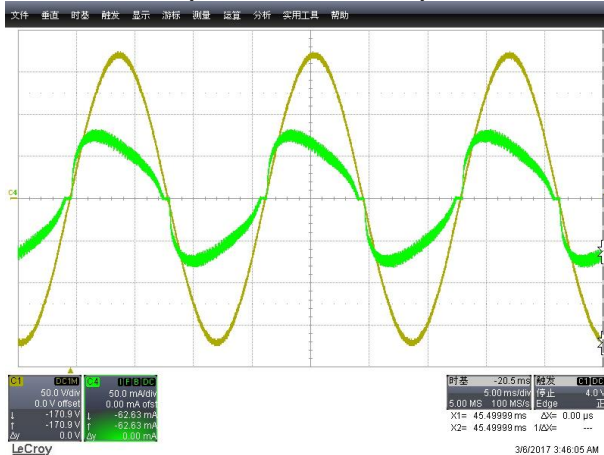
Dimming Curve



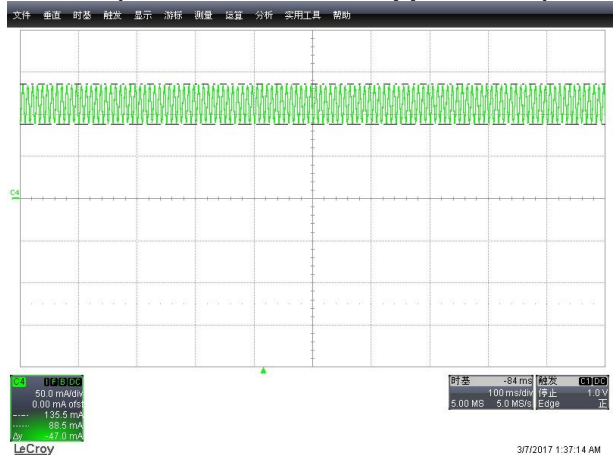
Note: RJ1 is optional. Customer can solder RJ1 with a 0R resistor to connect the COMP circuit to the system; it can help to improve the dimming compatibility and dimming depth.

Functional Waveform

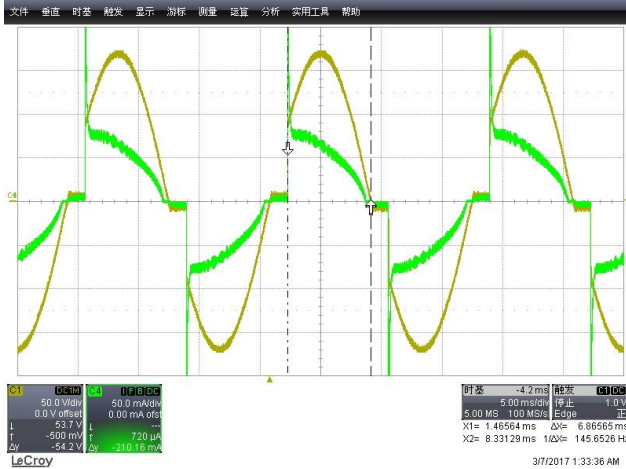
Input Voltage (Yellow) & Input Current (Green)
(V_{in}=120V_{AC}/60Hz)



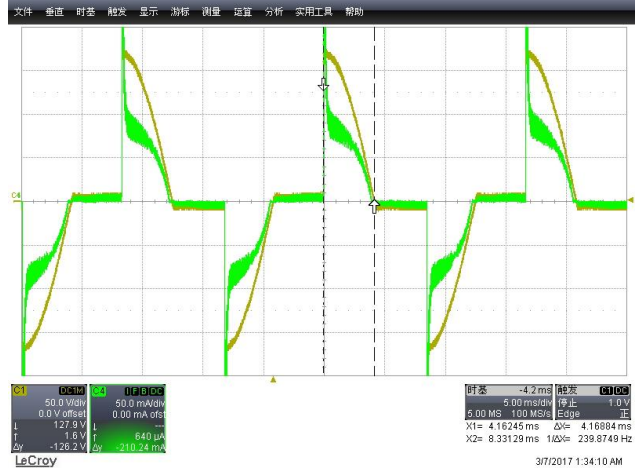
LED Current Ripple
(V_{in}=120V_{AC}/60Hz, Ripple=47mA)



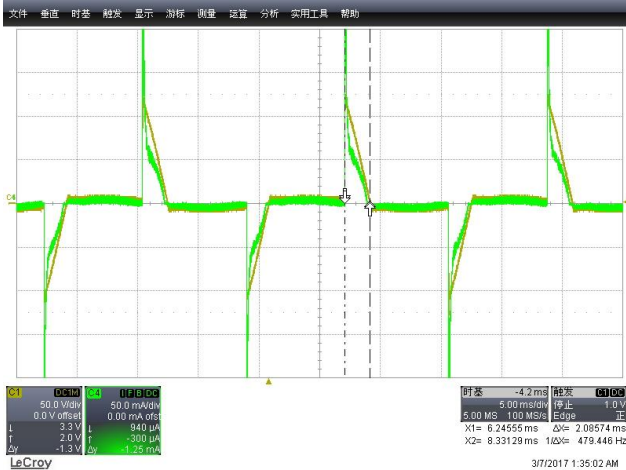
Input AC Current(Green) vs. Dimmer Voltage (Yellow)
(Vin=120V_{AC}/60Hz,Conduction Angle 148deg)



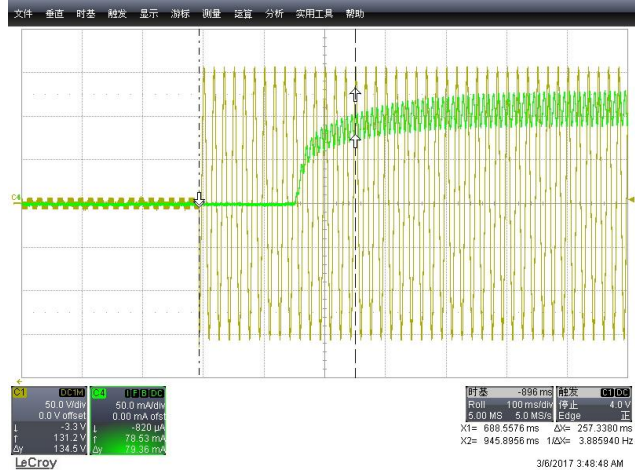
Input AC Current(Green) vs. Dimmer Voltage (Yellow)
(Vin=120V_{AC}/60Hz,Conduction Angle 90deg)



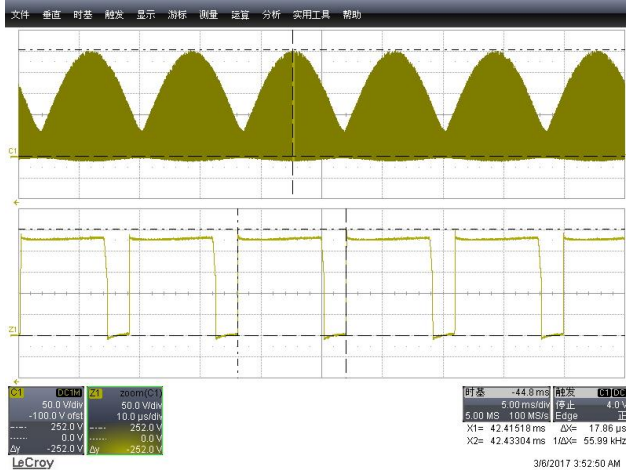
Input AC Current(Green) vs. Dimmer Voltage (Yellow)
(Vin=120V_{AC}/60Hz,Conduction angle 45deg)



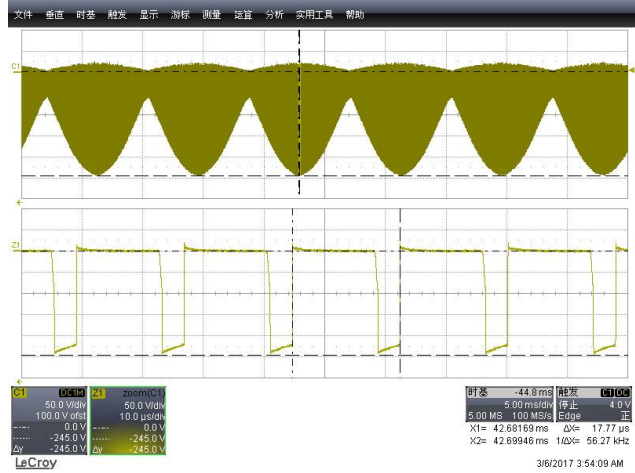
Start-up time(Input AC Voltage-Yellow, LED current-Green)
(Vin=108V_{AC}/60Hz,Start-up time=257.3ms)



IC V_{DRAIN} Waveform
(V_{in}=132V_{AC}, V_{DRAIN_MAX}=252V)



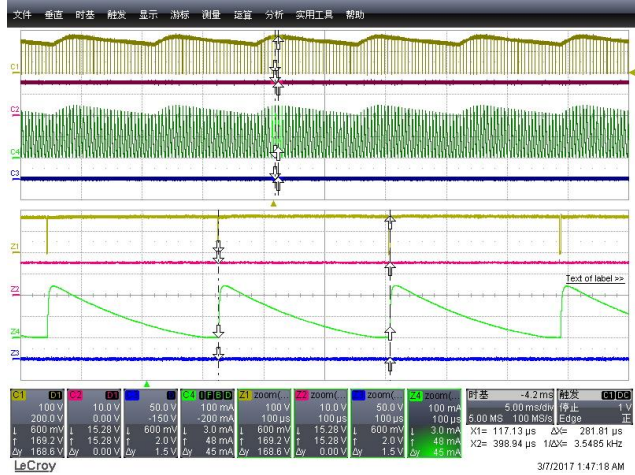
Output Diode V_R Waveform
(V_{in}=132V_{AC}, V_{R_MAX}=245V)



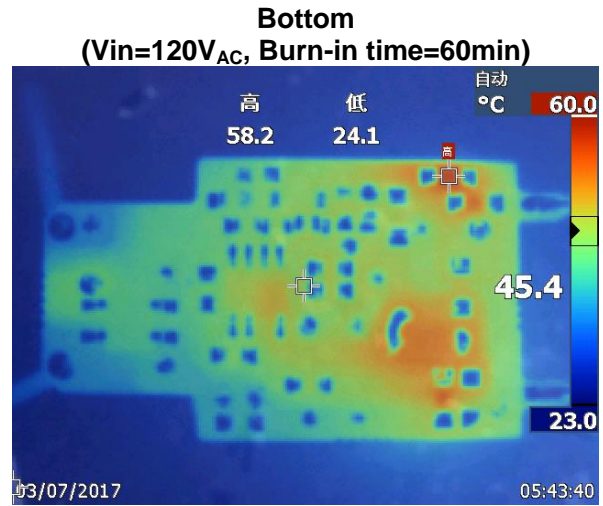
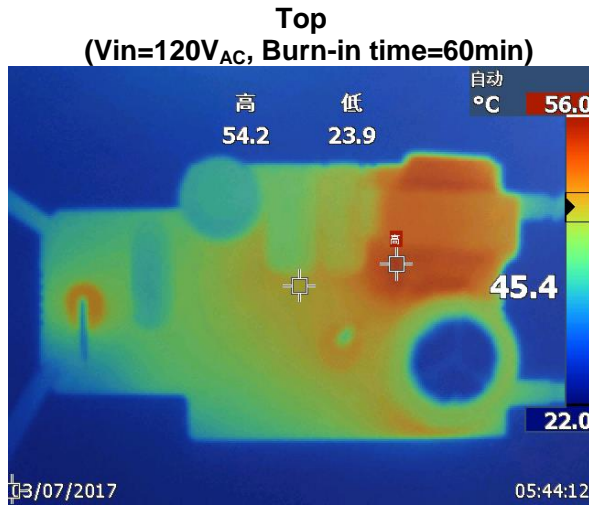
LED Open Protection
(V_{in}=120V_{AC}, Y-V_{DRAIN}, R-V_{CC}, B-V_{out}, G-I_{LED})



LED Short Protection
(V_{in}=120V_{AC}, Y-V_{DRAIN}, R-V_{CC}, B-V_{out}, G-I_{LED})

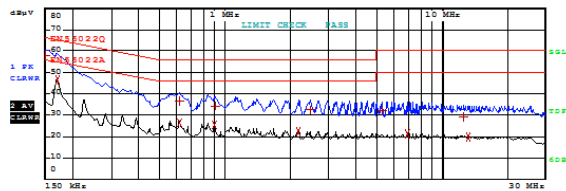
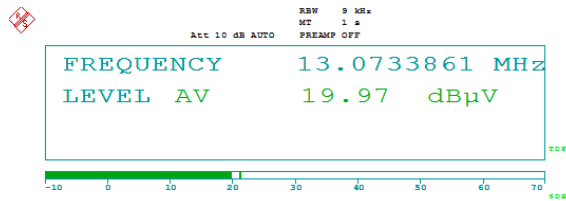


Thermal Test



EMI Conduction Test

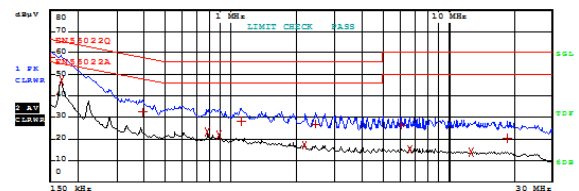
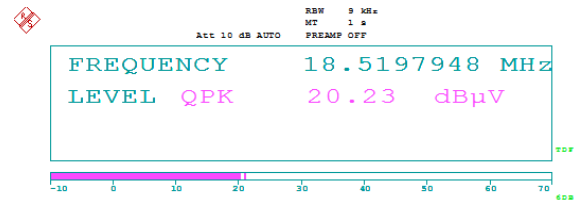
Line Terminal
(Vin=120V_{AC}, Margin>8dB)



Date: 7.MAR.2017 08:38:39

EDIT PEAK LIST (Final Measurement Results)			
TRACE	FREQUENCY	LEVEL dBμV	DELTA LIMIT dB
1 Quasi Peak	150 kHz	58.00	-8.00
2 Average	169.02375452 kHz	46.78	-8.22
1 Quasi Peak	616.206586648 kHz	36.87	-19.12
2 Average	616.206586648 kHz	26.30	-19.69
2 Average	890.465639904 kHz	25.29	-20.70
1 Quasi Peak	899.370296303 kHz	34.34	-21.65
2 Average	2.1588349124 MHz	22.34	-23.65
1 Quasi Peak	2.45695550736 MHz	32.55	-23.44
1 Quasi Peak	5.28619370567 MHz	32.08	-27.91
2 Average	6.84697577941 MHz	21.05	-28.94
1 Quasi Peak	12.4389782936 MHz	29.16	-30.83
2 Average	13.0733860985 MHz	19.95	-30.04

Neutral Terminal
(Vin=120V_{AC}, Margin>8dB)



Date: 7.MAR.2017 08:41:36

EDIT PEAK LIST (Final Measurement Results)			
TRACE	FREQUENCY	LEVEL dBμV	DELTA LIMIT dB
1 Quasi Peak	150 kHz	57.75	-8.24
2 Average	167.350252 kHz	47.06	-8.02
1 Quasi Peak	393.789848222 kHz	32.59	-25.39
2 Average	774.672132397 kHz	22.95	-23.05
2 Average	881.64914842 kHz	21.63	-24.36
1 Quasi Peak	1.10837670455 MHz	28.19	-27.80
2 Average	2.1588349124 MHz	16.88	-29.11
1 Quasi Peak	2.43262921521 MHz	26.97	-29.02
1 Quasi Peak	6.07634335085 MHz	26.33	-33.66
2 Average	6.57980914316 MHz	15.23	-34.76
2 Average	12.5632670765 MHz	13.79	-36.20
1 Quasi Peak	18.5197947779 MHz	20.56	-39.43

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