AL1692EV1 User Guide

120VAC Dimmable LED Driver

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 >0.96
- Low THD
- High efficiency >84%
- Single winding
- Good dimmer compatibility
- Low BOM cost

Applications

- Retrofit Bulb, Par lamps

Specifications

Parameter	Value
AC Input Voltage	108~132V
Output Power	14.08W
LED Current	220mA
LED Voltage	64V
Power Factor	>0.96
Efficiency	84%
XYZ Dimension	54.5x37x18mm
ROHS Compliance	Yes

Evaluation Board

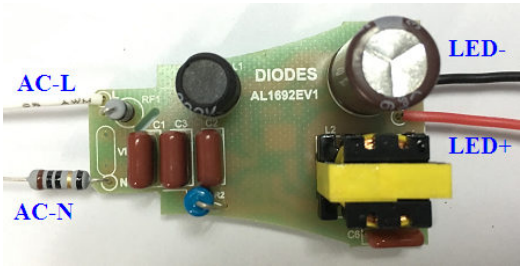


Figure 1: Top View

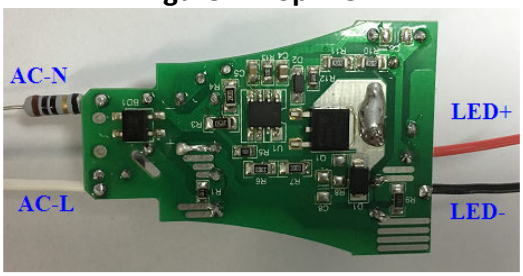


Figure 2: Bottom View

Connection Instructions:

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

Board Layouts

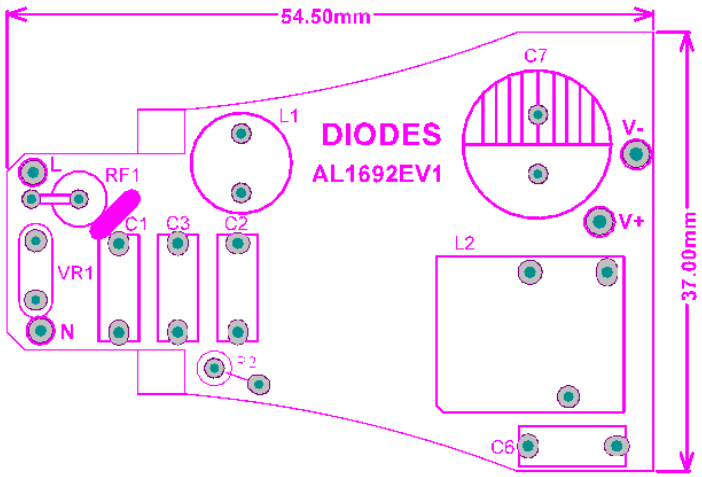


Figure 3: PCB Layout Top View

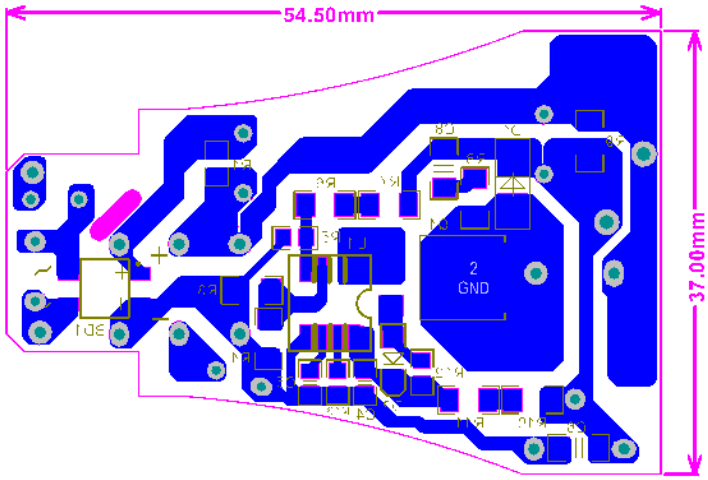


Figure 4: PCB Layout Bottom View

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

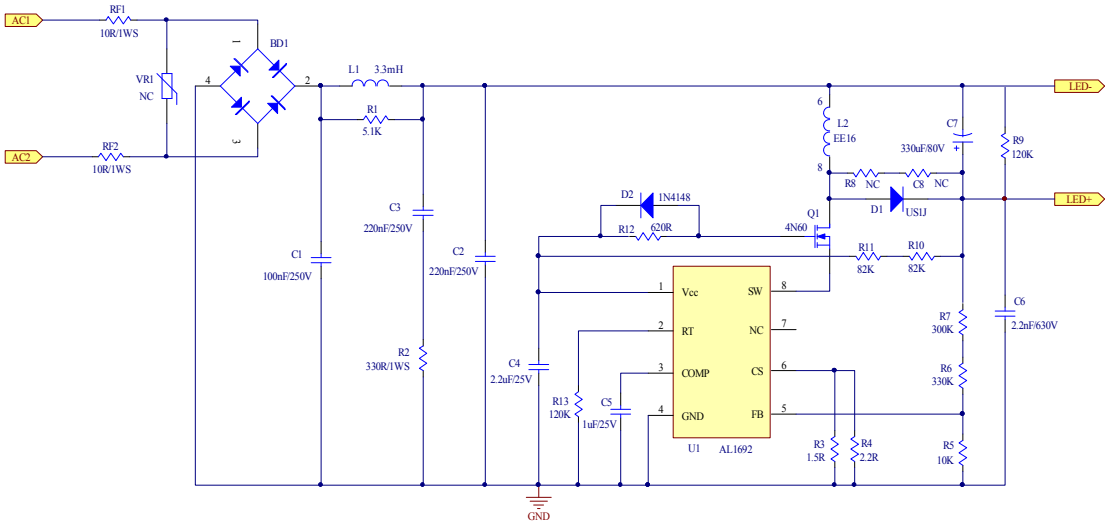


Figure 5: Schematic Circuit

Transformer Design

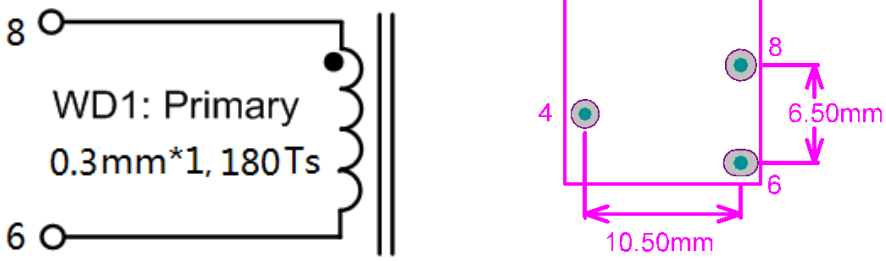
Bobbin and Core

EE16 Vertical 5+5 pin

Transformer Parameters

1. Primary Inductance (Pin8-Pin6)：Lp=0.68mH, ±5%@10kHz
2. Primary Winding Turns (Pin 8-Pin 6): N_P=180Ts

Transformer Winding Construction Diagram

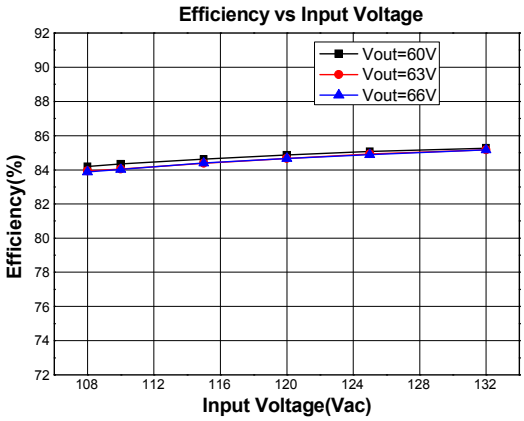


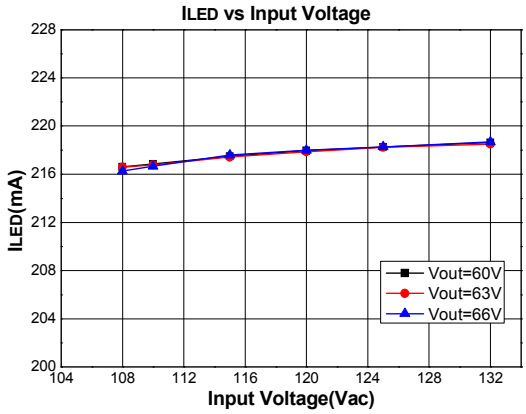
Item	Winding name	Description
1	WD1-Primary Winding	Start at Pin8, Wind 180 turns of Φ0.3mm wire and finish on Pin6.
2	Insulation	2 Layers of insulation tape

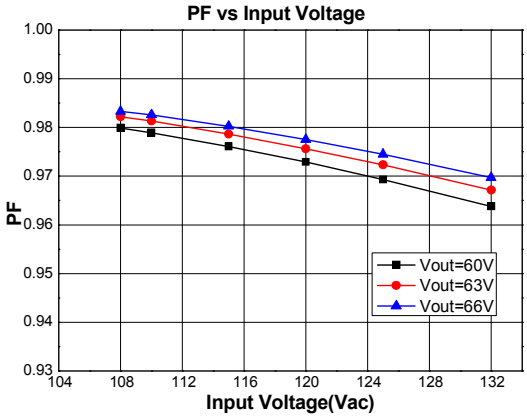
Bill of Material

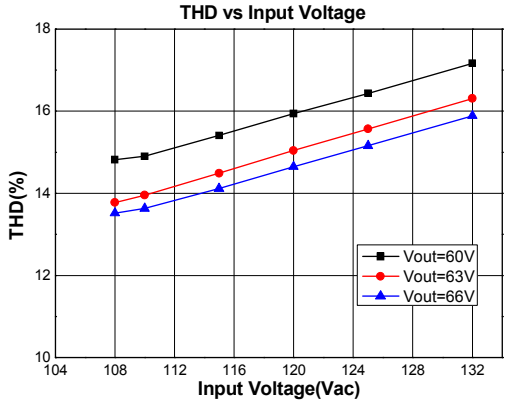
No	Item	Description	Package	Quantity
1	C1	100nF/250V, CL21, Pitch=7.5mm	DIP	1
2	C2	220nF/250V, CL21, Pitch=7.5mm	DIP	1
3	C3	220nF/250V, CL21, Pitch=7.5mm	DIP	1
4	C4	Ceramic Cap, 2.2uF/25V,X7R	0805	1
5	C5	Ceramic Cap, 1uF/25V,X7R	0805	1
6	C6	2.2nF/630V, CL21, Pitch=7.5mm	DIP	1
7	C7	E-Cap,105℃,330uF/80V,13*16mm	DIP	1
8	C8	NC	1206	0
9	BD1	Rectifier Bridge,HD06,0.8A/600V,Diodes Inc	SOPA-4	1
10	D1	Fast Recovery Diode,US1J,1A/600V,Diodes Inc	SMA	1
11	D2	Switching diode, 1N4148,Diodes Inc	SOD-123	1
12	RF1	Fuse Resistor, 10R/1WS	DIP	1
13	RF2	Fuse Resistor, 10R/1WS	DIP	1
14	R1	Resistor, 5.1K, 5%, 1/8W	0805	1
15	R2	Power Resistor,330R, 5%, 1WS	DIP	1
16	R3	SMD Resistor,1.5R, 1%, 1/4W	1206	1
17	R4	SMD Resistor,2.2R, 1%, 1/4W	1206	1
18	R5	SMD Resistor,10K, 5%, 1/8W	0805	1
19	R6	SMD Resistor,330K, 5%, 1/4W	1206	1
20	R7	SMD Resistor,300K, 5%, 1/4W	1206	1
21	R8	NC	1206	0
22	R9	SMD Resistor,120K, 5%, 1/4W	1206	1
23	R10,R11	SMD Resistor,82K, 5%, 1/4W	1206	2
24	R12	Resistor, 620R, 5%, 1/8W	0805	1
25	R13	SMD Resistor,120K, 5%, 1/8W	0805	1
26	VR1	NC	DIP	0
27	L1	Drum Inductor 3.3mH, 8*10mm	DIP	1
28	L2	EE16, Vertical, 5+5pin,Single Winding,0.68mH	DIP	1
29	Q1	N-Mosfet, 4N60, DPAK	DPAK	1
30	U1	AL1692,Diodes Dimmable IC	SOIC-8	1
Total BOM				**28**

Electrical Performance







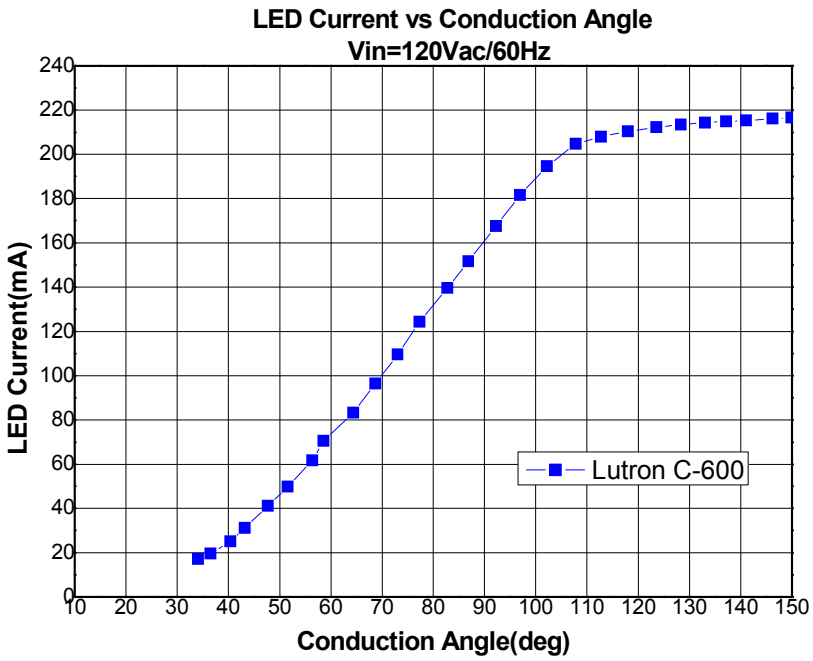


Dimming Test

Dimmer compatibility and dimming range

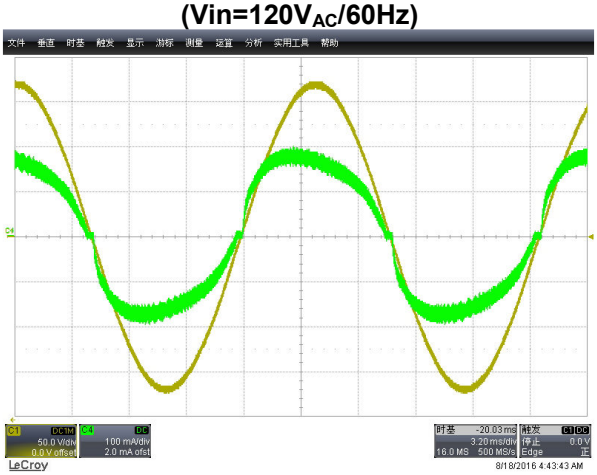
Num	Dimmer Type	ILED(mA)		Dimming Percentage(%)		Flicker or not
		Min	Max	Min	Max	
1	Lutron D-600P L 600W	0	214	0.00	98.21	Shimmer
2	Lutron D600PH-WH L 600W	0	213.6	0.00	98.03	No
3	Lutron C-600 L 600W	16.3	216.6	7.48	99.40	No
4	Lutron NLV-600	26.8	215.7	12.30	98.99	No
5	Lutron NTELV-600	37.8	216.1	17.35	99.17	No
6	Lutron DVELV-300P	22.9	214.8	10.51	98.58	No
7	Lutron DV-600P	16.5	214.8	7.57	98.58	No
8	Lutron SELV-300P	22.9	216.1	10.51	99.17	No
9	Lutron CTELV-303P	24.1	214.7	11.06	98.53	No
10	Lutron MACL-153M	25.4	212.9	11.66	97.71	No
11	Lutron S-600P	3.7	214.8	1.70	98.58	No
12	Lutron LXLV-600PL	21.9	214.9	10.05	98.62	No
13	Lutron MAW-603	13.9	215.8	6.38	99.04	No
14	Lutron MIR-600	14.4	216.1	6.61	99.17	No
15	Lutron DV-603PG	16.5	209.6	7.57	96.19	No
16	Lutron NTLV-600	30.3	216.7	13.91	99.45	No
17	Lutron AY-600P	24.1	215.5	11.06	98.90	No
18	Lutron TGCL-153P	64.5	214.9	29.60	98.62	No
19	Lutron DVLV-603P	26.8	214.8	12.30	98.58	No
20	Lutron MAELV-600	34.9	216	16.02	99.13	No
21	Cooper 9538	13.2	216.6	6.06	99.40	No
22	Cooper 9539	30.6	212.7	14.04	97.61	No
23	Cooper SI06P	10.6	216.1	4.86	99.17	No
24	Cooper SI061	7.6	216.4	3.49	99.31	No
25	Cooper TAL06P	88.3	217.5	40.52	99.82	No
26	Cooper DLC03P	23.5	217.2	10.78	99.68	No
27	Lutron TT-300	0	216.1	0.00	99.17	No
28	Leviton TBL03	24.6	217.1	11.29	99.63	No

Dimming Curve

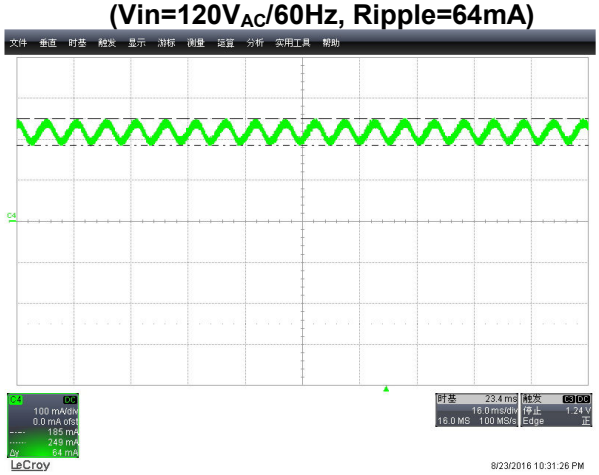


Functional Waveform

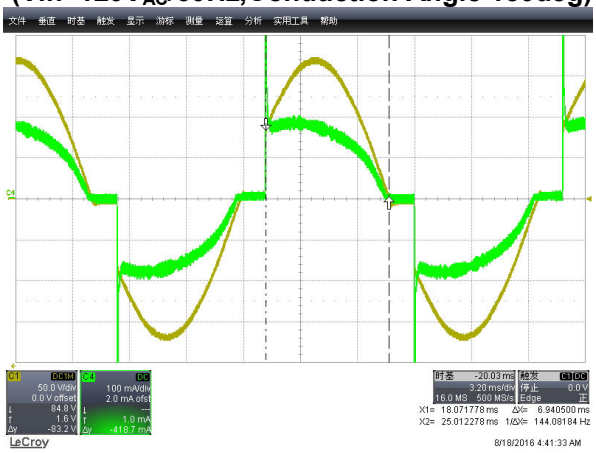
Input Voltage & Input Current (Vin=120VAC/60Hz)



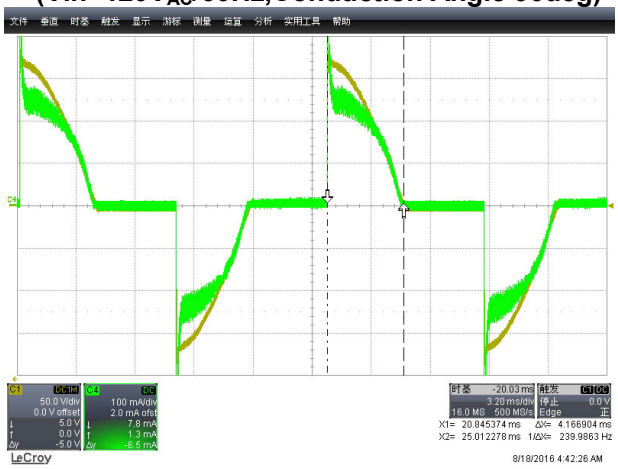
LED Current Ripple (Vin=120VAC/60Hz, Ripple=64mA)



Input AC Current vs Dimmer Phase (Vin=120V_{AC}/60Hz,Conduction Angle 150deg)

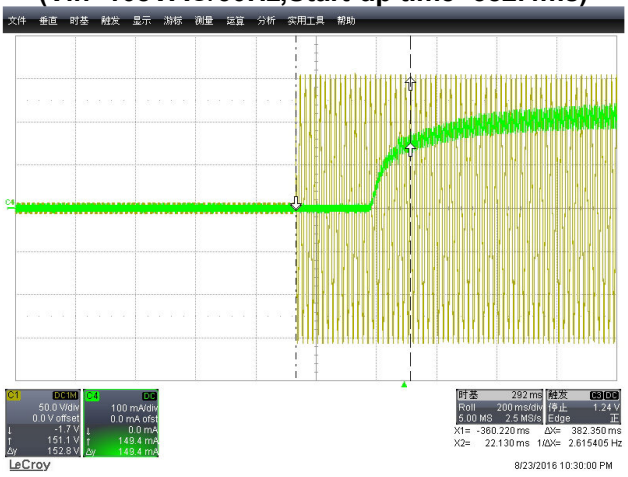


Input AC Current vs Dimmer Phase (Vin=120V_{AC}/60Hz,Conduction Angle 90deg)

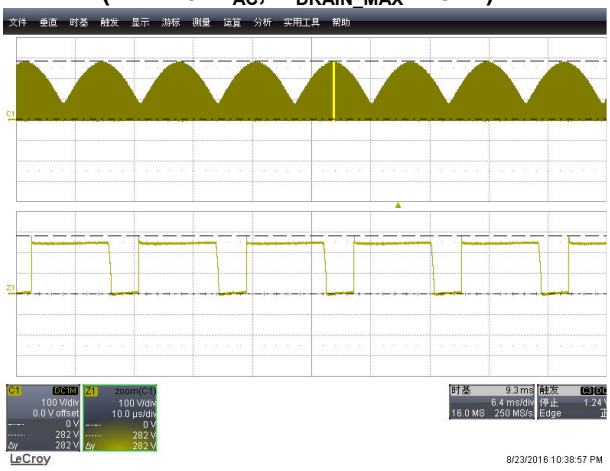


Input AC Current vs Dimmer Phase (Vin=120VAC/60Hz,Conduction angle 45deg)

Start-up time (Vin=108VAC/60Hz,Start-up time=382.4ms)

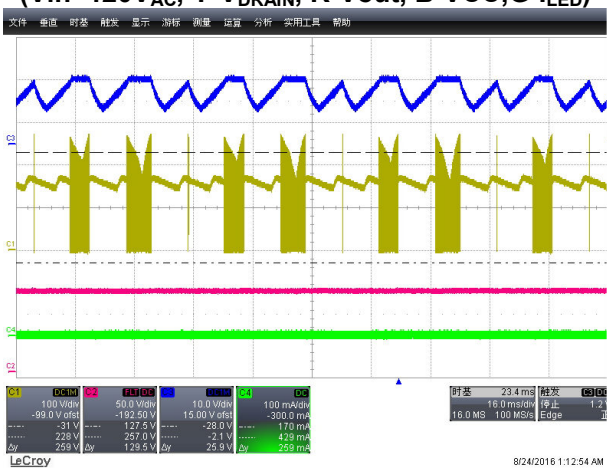


IC V_{DRAIN} Waveform (Vin=132V_{AC}, V_{DRAIN_MAX}=282V)

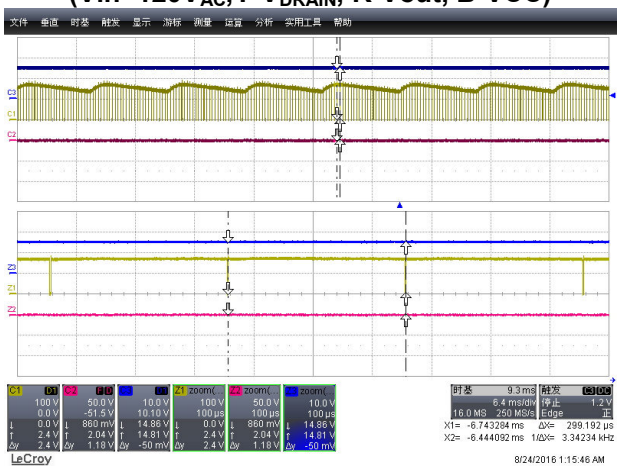


Output Diode V_R Waveform (Vin=132V_{AC}, V_{R_MAX}=297V)

LED Open Protection (Vin=120V_{AC}, Y-V_{DRAIN}, R-Vout, B-VCC,G-I_{LED})

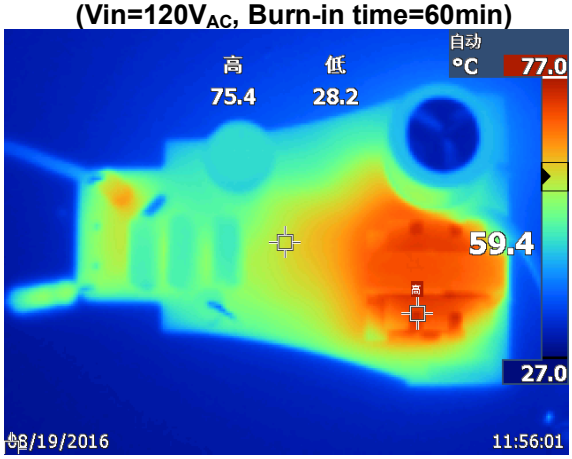


LED Short Protection (Vin=120V_{AC},Y-V_{DRAIN}, R-Vout, B-VCC)

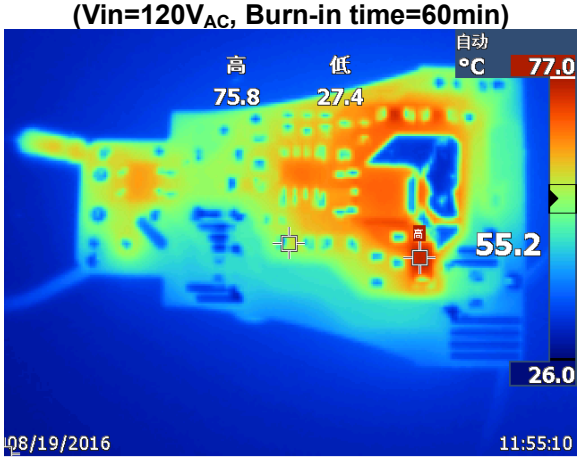


Thermal Test

Top
(Vin=120V$_{AC}$, Burn-in time=60min)

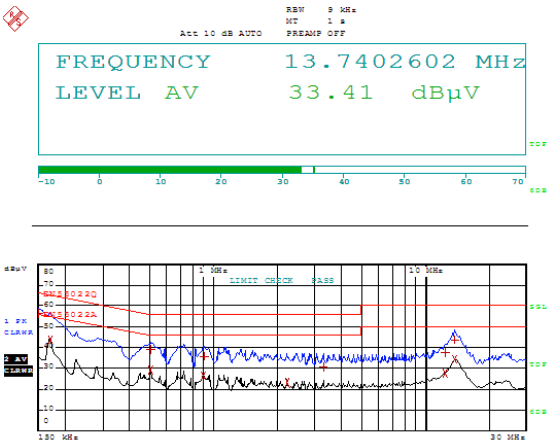


Bottom
(Vin=120V$_{AC}$, Burn-in time=60min)



EMI Conduction Test

Line Terminal
(Vin=120VAC, Margin>9dB)



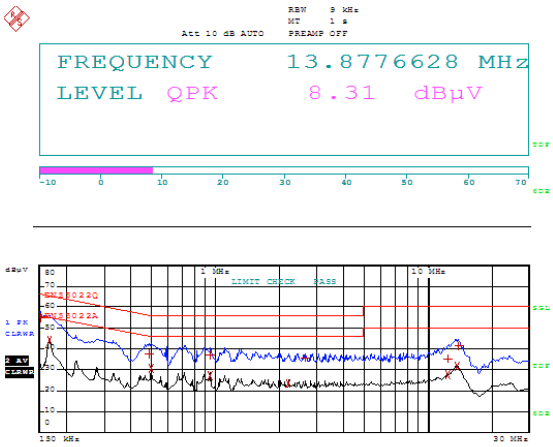
Date: 26.AUG.2016 14:28:56

EDIT PEAK LIST (Final Measurement Results)

Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	150 kHz	56.18	-9.81
2	Average	169.02375452 kHz	43.72	-11.28
1	Quasi Peak	300.008614528 kHz	39.27	-16.72
2	Average	300.008614528 kHz	29.30	-16.69
2	Average	890.465639904 kHz	26.39	-19.60
1	Quasi Peak	899.370296303 kHz	35.72	-20.27
2	Average	2.22424976908 MHz	23.23	-22.76
1	Quasi Peak	3.27881664913 MHz	30.83	-25.16
1	Quasi Peak	12.3157210828 MHz	37.44	-22.55
2	Average	12.3157210828 MHz	27.73	-22.26
1	Quasi Peak	13.7402601784 MHz	43.90	-16.09
2	Average	13.7402601784 MHz	34.23	-15.76

Neutral Terminal
(Vin=120VAC, Margin>11dB)



Date: 26.AUG.2016 14:32:31

EDIT PEAK LIST (Final Measurement Results)

Trace1: EN55022Q
Trace2: EN55022A
Trace3: ---

TRACE		FREQUENCY	LEVEL dBµV	DELTA LIMIT dB
1	Quasi Peak	151.5 kHz	54.86	-11.05
2	Average	165.693318812 kHz	43.99	-11.17
1	Quasi Peak	485.30343514 kHz	37.44	-18.80
2	Average	485.058034186 kHz	30.61	-15.46
1	Quasi Peak	935.888336808 kHz	37.37	-18.62
2	Average	935.888336808 kHz	27.45	-18.54
2	Average	2.20222748414 MHz	23.71	-22.28
1	Quasi Peak	2.634188838 MHz	35.75	-20.24
1	Quasi Peak	12.3157210828 MHz	35.46	-24.53
2	Average	12.3157210828 MHz	27.79	-22.20
2	Average	13.7402601784 MHz	31.57	-18.42
1	Quasi Peak	13.8776627802 MHz	41.25	-18.74

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