

General Description

This demonstration board utilizes the AP1676 Buck LED driver-controller providing a cost effective 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 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

- Active PFC with power factor > 0.9
- High efficiency >90%
- Low THD

Applications

- LED Lighting

AP1676 Buck Specifications

Parameter	Value
AC Input Voltage	100-265V
Output Power	15.84W
LED Current	220mA
LED Voltage	72V
Power Factor	>0.9
Efficiency	90%
ROHS Compliance	Yes

Evaluation Board

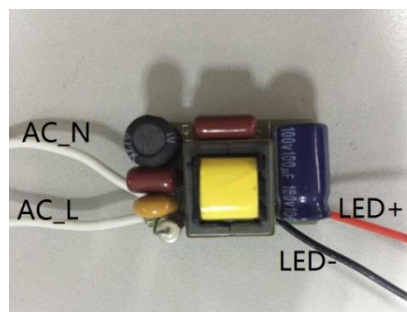


Figure 1: Top View

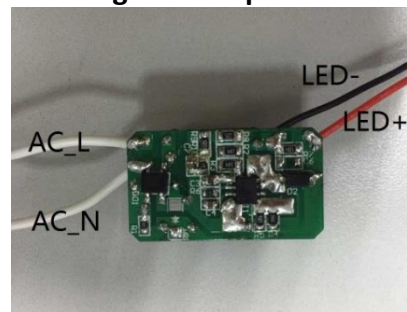


Figure 2: Bottom View

Connection Instructions:

- AC+ Input: AC_L
- AC- Input: AC_N
- DC LED+ Output: LED+
- DC LED- Output: LED-

Board Layouts

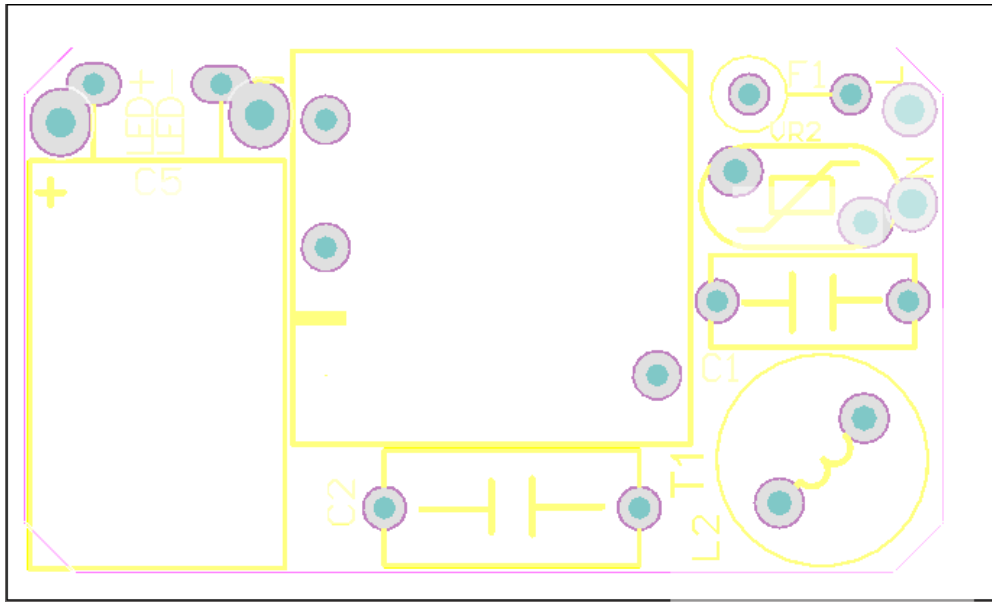


Figure 3: PCB Layout Top View

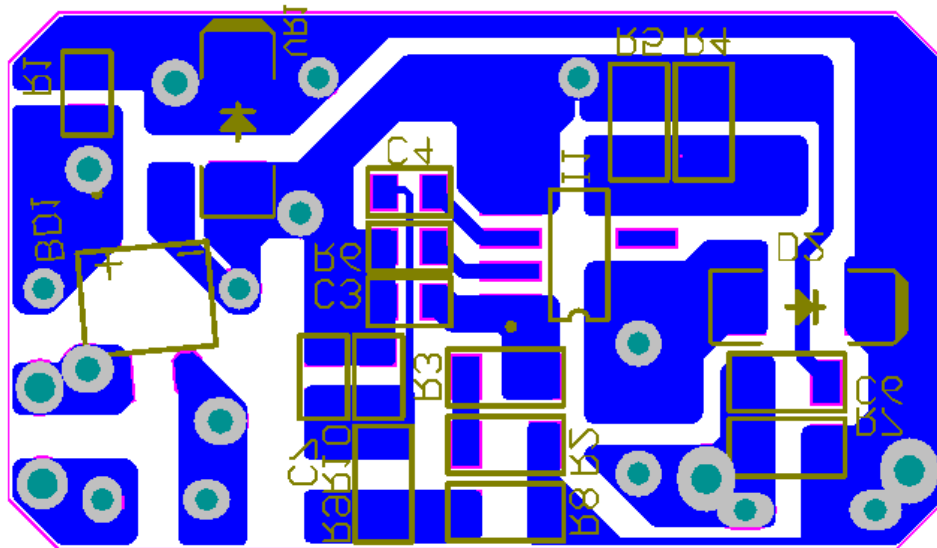


Figure 4: PCB Layout Bottom View

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 AL1676 evaluation board is a non-isolated design. All terminals carry high voltage during operation!

Schematic

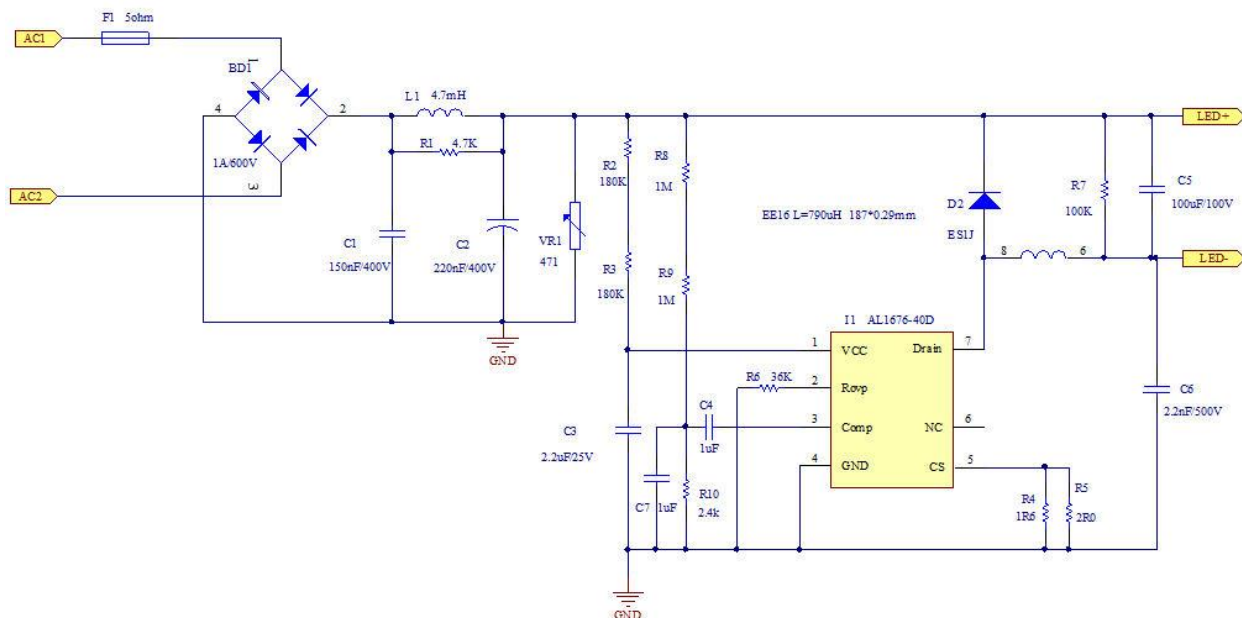


Figure 5: Schematic Circuit

Transformer Design

Bobbin and Core

EE16 Vertical 5+5 pin

Transformer Parameters

1. Single winding (Pin8-Pin6): $L_p=790\mu\text{H}$, $\pm 5\% @ 1\text{kHz}$

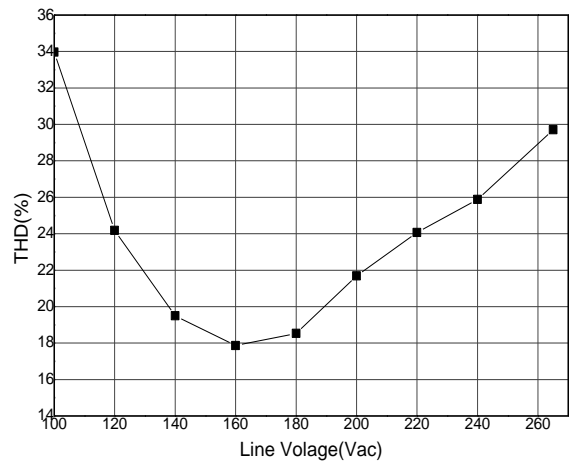
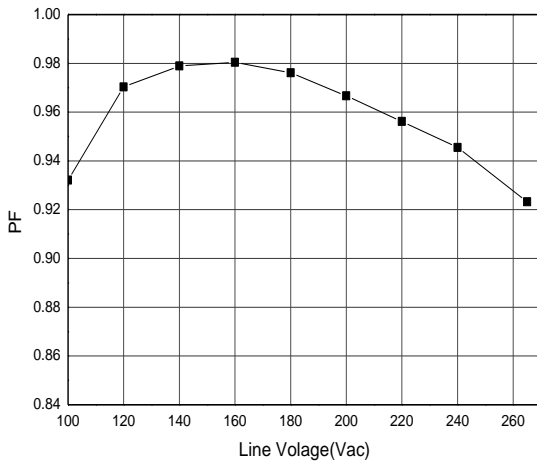
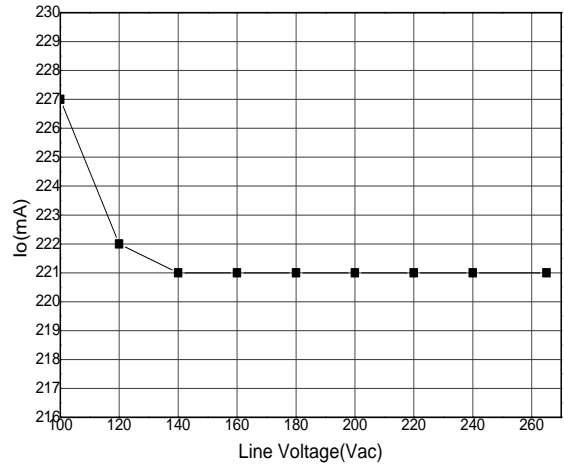
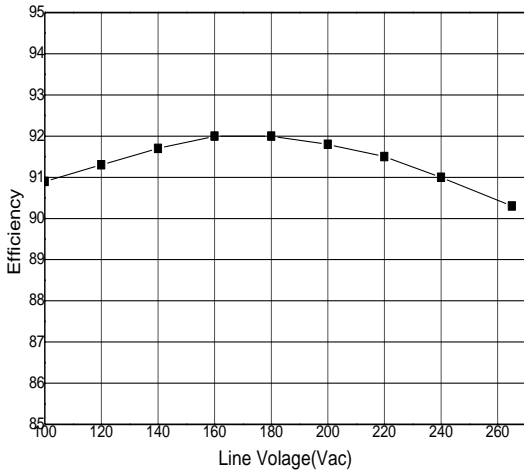
Transformer Winding Construction Diagram

Item	Winding name	Description
1	Single winding	Start at Pin 8, Wind 187 turns of $\Phi 0.29\text{mm}$ wire and finish on Pin 6
2	Insulation	3 Layers of insulation tape

Bill of Material

#	Item	Quality	Package	Description
1	BD1	1	SOPA-4	Rectifier Bridge, HD06,1A/600V,Diodes Inc
2	C1	1	DIP	150nF/400V, CL21,Pitch=7.5mm
3	C2	1	DIP	220nF/400V,CL21,Pitch=7.5mm
4	C3	1	0805	Ceramic Cap,2.2uF/25V,0805
5	C4, C7	2	0805	Ceramic Cap, 1uF/25V,0805
6	C5	1	DIP	E-Cap, 130°C,100uF/100V
7	C6	1	1206	Ceramic Cap, 2.2nF/500V
8	D2	1	SMA	Fast Recovery Diode, US1J, 1A/600V,Diodes Inc
9	T1	1	DIP	EE16,Horizontal,5+5pin,Single Winding,790uH
10	F1	1	DIP	Resistor,5R, 2W
11	U1	1	SOP-7	AL1676_40D,Diodes IC
12	L1	1	DIP	Inductor 4.7mH, 6*8mm
13	R1,	1	0805	Resistor 4.7K, 5%, 1/8W
14	R2, R3,	2	1206	Resistor 180K, 5%, 1/4W
15	R4,	1	1206	Resistor 1R6, 5%, 1/4W
16	R5	1	1206	Resistor 2R0, 5%, 1/4W
17	R6	1	0805	Resistor 36K, 5%, 1/8W
18	R8, R9	2	1206	Resistor 1M,5%,1/4W
20	R7	1	1206	Resistor 100k, 5%, 1/4W

Functional Performance



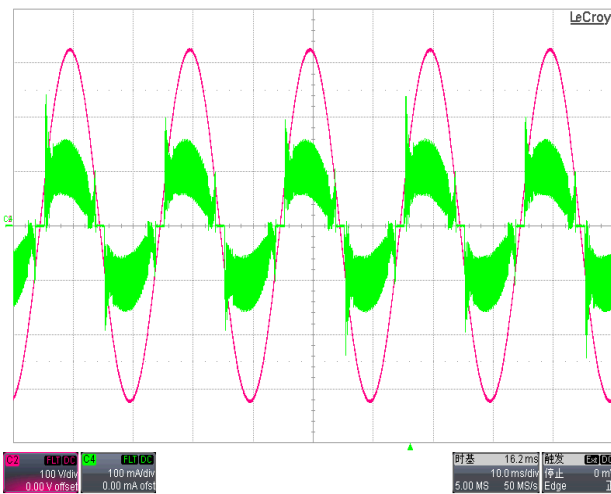
Functional Waveform

Waveforms:

Input Voltage & Input Current

Vin=230V/50Hz

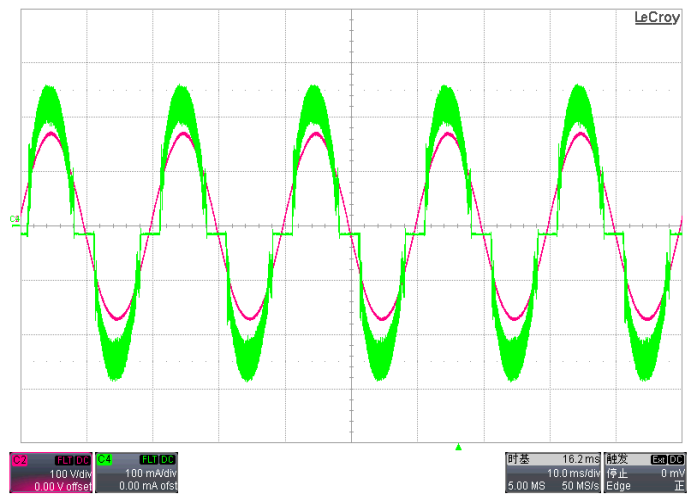
(Red: Input Voltage Green: Input current)



Input Voltage & Input Current

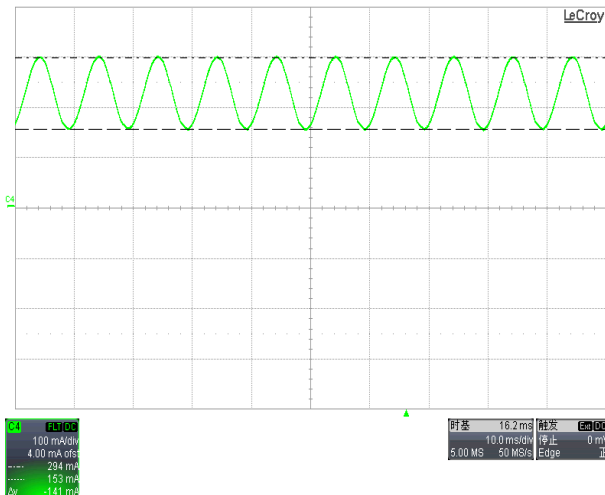
Vin=120V/50Hz

(Red: Input Voltage Green: Input current)



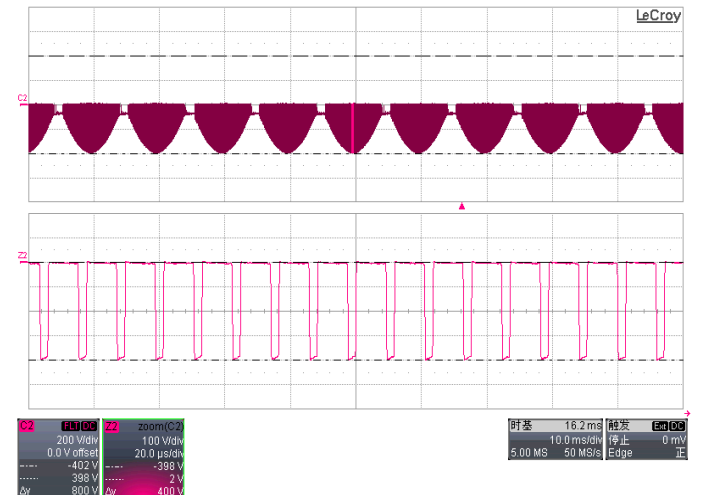
LED Current Ripple

Vin=230VAC/50Hz Ripple=141mA



Output Diode V_R Waveform

Vin=265VAC/50Hz V_{RRM_MAX}=400V

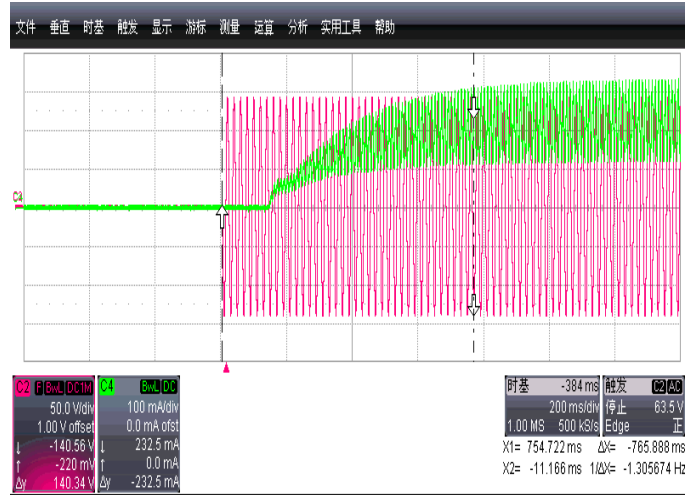
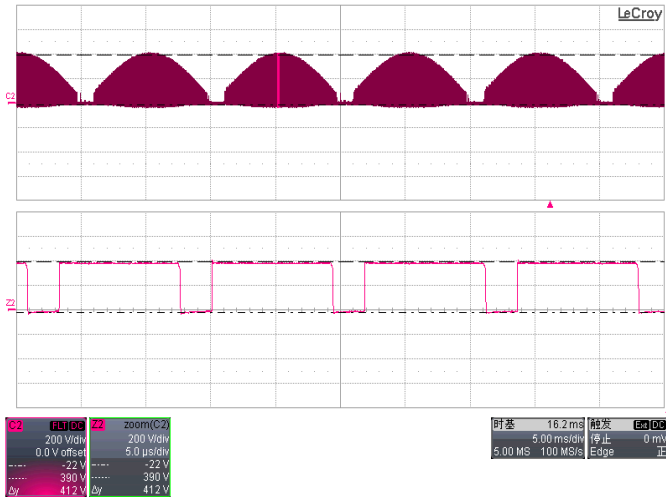


Output Diode V_R Waveform

$V_{in}=265VAC/50Hz$ $V_{DRAIN_MAX}=412V$

Start time

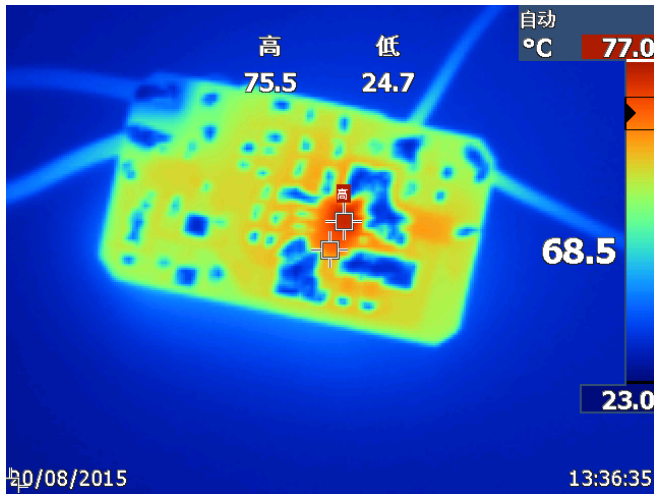
$V_{in}=208VAC/50Hz$ Start time=765ms
(Red: Input Voltage Green: Output current)



Thermal Test

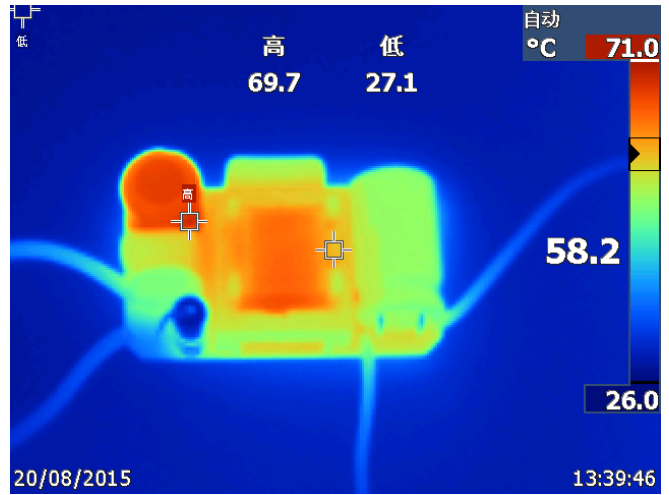
Top

V_{in}=100V_{AC}/50Hz Test time=30min



Bottom

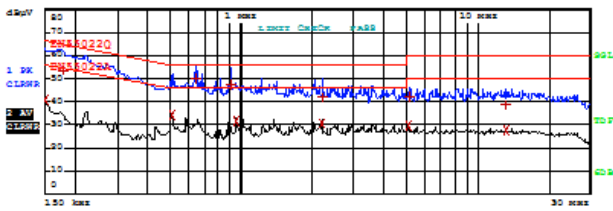
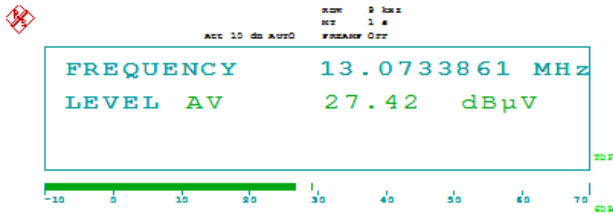
V_{in}=100V_{AC}/50Hz Test time=30min



EMI Conduction Test

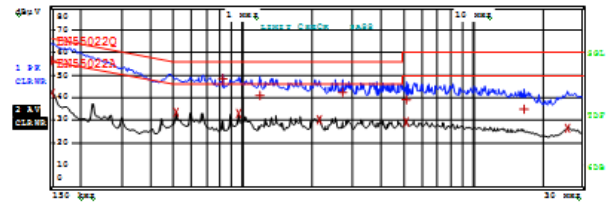
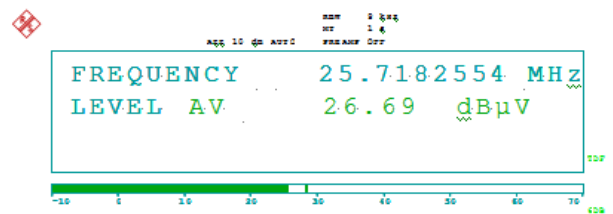
Line Terminal

Vin=230VAC/50Hz LIMIT CHECK PASS



Neutral Terminal

Vin=230VAC/50Hz LIMIT CHECK PASS



Line Terminal

Vin=230VAC/50Hz Margin>6dB

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LIMIT
2 Average	150 kHz	40.74	-15.25
1 Quasi Peak	175.886796739 kHz	53.68	-10.99
2 Average	510.05878768 kHz	34.43	-11.56
1 Quasi Peak	641.227045055 kHz	49.71	-6.28
1 Quasi Peak	899.370296303 kHz	47.55	-8.44
2 Average	945.247220176 kHz	31.56	-14.43
1 Quasi Peak	2.18042326152 MHz	41.78	-14.21
2 Average	2.18042326152 MHz	30.76	-15.23
1 Quasi Peak	5.13072753076 MHz	42.44	-17.55
2 Average	5.13072753076 MHz	29.48	-20.51
1 Quasi Peak	13.0733860985 MHz	38.59	-21.40
2 Average	13.0733860985 MHz	27.91	-22.08

Neutral Terminal

Vin=230VAC/50Hz Margin>7dB

EDIT PEAK LIST (Final Measurement Results)			
Trace1:	EN55022Q		
Trace2:	EN55022A		
Trace3:	---		
TRACE	FREQUENCY	LEVEL dBµV	DELTA LI
1 Quasi Peak	150 kHz	58.45	-7.54
2 Average	167.350252 kHz	40.02	-15.06
1 Quasi Peak	367.294901197 kHz	45.08	-13.48
2 Average	500.008614528 kHz	30.44	-15.56
1 Quasi Peak	899.370296303 kHz	42.13	-13.86
2 Average	908.363999266 kHz	28.07	-17.92
1 Quasi Peak	2.55671775336 MHz	40.80	-15.20
2 Average	2.55671775336 MHz	26.05	-19.94
1 Quasi Peak	11.7179860284 MHz	36.38	-23.61
2 Average	12.3157210828 MHz	26.64	-23.35
1 Quasi Peak	24.2277599493 MHz	50.33	-9.67
2 Average	24.4700375488 MHz	38.71	-11.28

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