General Description
This demonstration board utilizes the AL1676 Buck LED driver-converter with single winding inductor providing a cost effective non-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 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
- Non-Dimmable
- Single winding inductor
- High efficiency >88%
- Non-isolate buck LED driver

Applications
- Retrofit LED Lamps
- High Voltage DC-DC LED Driver
- General Purpose Constant Current Source

Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Input Voltage</td>
<td>100-265V</td>
</tr>
<tr>
<td>Output Power</td>
<td>8.6W</td>
</tr>
<tr>
<td>LED Current</td>
<td>120mA</td>
</tr>
<tr>
<td>LED Voltage</td>
<td>72V</td>
</tr>
<tr>
<td>Power Factor</td>
<td>&gt;0.97(Vin=120V&lt;sub&gt;AC&lt;/sub&gt;)</td>
</tr>
<tr>
<td></td>
<td>&gt;0.92(Vin=230V&lt;sub&gt;AC&lt;/sub&gt;)</td>
</tr>
<tr>
<td>Efficiency</td>
<td>&gt;88%</td>
</tr>
<tr>
<td>XYZ Dimension</td>
<td>45x 24 x 13mm</td>
</tr>
<tr>
<td>ROHS Compliance</td>
<td>Yes</td>
</tr>
</tbody>
</table>

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)
Quick Start Guide

1. Preset the isolated AC source to 120VAC/230VAC.
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.

**Caution:** The AL1676 is a non-isolated design. All terminals carry high voltage during operation!
Figure 5: Schematic Circuit

Transformer Design
Bobbin and Core
EE10 Vertical 4+4 pin

Transformer Parameters
1. Primary Inductance (Pin2-Pin5, all other windings open): \( L_p = 1.67 \text{mH}, \pm 5\% @ 1\text{kHz} \)
2. Primary Winding Turns (Pin2-Pin5): \( N_p = 257 \text{Ts} \)

Transformer Winding Construction Diagram

<table>
<thead>
<tr>
<th>Item</th>
<th>Winding name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WD1-Primary Winding</td>
<td>Start at Pin 2, Wind 257 turns of ( \Phi 0.15 \text{mm} ) wire and finish on Pin 5</td>
</tr>
<tr>
<td>2</td>
<td>Insulation</td>
<td>2 Layers of insulation tape</td>
</tr>
</tbody>
</table>
## Bill of Material

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Description</th>
<th>Package</th>
<th>QTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C1</td>
<td>68nF/400V, CL21, Pitch=7.5mm</td>
<td>DIP</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>C2</td>
<td>150nF/400V, CL21, Pitch=7.5mm</td>
<td>DIP</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>C3</td>
<td>Ceramic Cap, 0.33uF/25V,X7R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>C4</td>
<td>Ceramic Cap, 1uF/25V,X7R</td>
<td>0805</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>C5</td>
<td>E-Cap, 130°C,100uF/100V,10*16mm</td>
<td>DIP</td>
<td>1</td>
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<tr>
<td>6</td>
<td>C6</td>
<td>NC</td>
<td></td>
<td>0</td>
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<td>7</td>
<td>BD1</td>
<td>Rectifier Bridge,HD06,0.8A/600V,Diodes Inc</td>
<td>SOPA-4</td>
<td>1</td>
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<tr>
<td>8</td>
<td>D1</td>
<td>Fast Recovery Diode, RS1J, 1A/600V,Diodes Inc</td>
<td>SMA</td>
<td>1</td>
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<tr>
<td>9</td>
<td>VR1</td>
<td>Varistor, 07D431</td>
<td>DIP</td>
<td>1</td>
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<tr>
<td>10</td>
<td>RF1</td>
<td>Fuse Resistor,10R, 5%, 1W</td>
<td>DIP</td>
<td>1</td>
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<tr>
<td>11</td>
<td>R1</td>
<td>SMD Resistor,30K, 5%, 1/8W</td>
<td>0805</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>R2</td>
<td>SMD Resistor,180K, 5%, 1/4W</td>
<td>1206</td>
<td>1</td>
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<tr>
<td>13</td>
<td>R3</td>
<td>SMD Resistor,180K, 5%, 1/4W</td>
<td>1206</td>
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<tr>
<td>14</td>
<td>R4</td>
<td>SMD Resistor,3.0R, 1%, 1/8W</td>
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<tr>
<td>15</td>
<td>R5</td>
<td>SMD Resistor,3.6R, 1%, 1/8W</td>
<td>0805</td>
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<tr>
<td>16</td>
<td>R6</td>
<td>SMD Resistor,47K, 5%, 1/8W</td>
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<td>17</td>
<td>R8</td>
<td>SMD Resistor,100K, 5%, 1/4W</td>
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<tr>
<td>18</td>
<td>L1</td>
<td>Inductor 4.7mH, 6*8mm</td>
<td>DIP</td>
<td>1</td>
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<tr>
<td>19</td>
<td>T1</td>
<td>EE10, Vertical, 4+4 pin,Single Winding,1.67mH</td>
<td>DIP</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>U1</td>
<td>AL1676-10B, high PFC Buck IC, Diodes Inc</td>
<td>SOIC-7</td>
<td>1</td>
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<tr>
<td>21</td>
<td>PCB</td>
<td>FR4 Single layer, 45*24mm</td>
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</table>

**Total** 19
Electrical Performance

- **Efficiency vs Input Voltage**
- **ILED vs Input Voltage**
- **PF vs Input Voltage**
- **THD vs Input Voltage**

The graphs show the performance metrics of the AL1676EV1 LED driver under varying input voltages from 100 to 265VAC.
Functional Waveform

LED Current Ripple
(Vin=230V<sub>AC</sub>, Ripple=58mA)

Start-up Time
(Vin=100V<sub>AC</sub>, Start-up time=481mS)

IC V<sub>DRAIN</sub> Waveform
(Vin=265V<sub>AC</sub>, V<sub>DRAIN</sub> MAX=400V)

Output Diode V<sub>R</sub> Waveform
(Vin=265V<sub>AC</sub>, V<sub>R</sub> MAX=393V)

LED Open Protection
(Vin=230V<sub>AC</sub>, Y-VCC, R-Drain, B-Vout, G-I<sub>LED</sub>)

LED Short Protection
(Vin=230V<sub>AC</sub>, Y-VCC, R-Drain, B-Vout)
**Thermal Test**

- **Top**
  
  (Vin=230V\textsubscript{AC}, Burn-in time=30min)

- **Bottom**
  
  (Vin=230V\textsubscript{AC}, Burn-in time=30min)

**EMI Conduction Test**

- **Line Terminal**
  
  (Vin=120V\textsubscript{AC}, Margin>14dB)

- **Neutral Terminal**
  
  (Vin=120V\textsubscript{AC}, Margin>14dB)
Line Terminal
(Vin=230VAC, Margin>10dB)

- Frequency: 12.4388783 MHz
- Level: 23.76 dBµV

Neutral Terminal
(Vin=230VAC, Margin>10dB)

- Frequency: 15.4828691 MHz
- Level: 33.77 dBµV
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