

### General Description

This demonstration board utilizes the AL9901 high voltage PWM LED Buck controller with integrated MOSFET 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 LEDs string. The demonstration board can be modified to adjust the LED output current (140mA) and the number of series connected LEDs that are driven.

### Key Features

- Integrated 650V/2A MOSFET
- High output voltage, 50V
- ~ 86% efficiency
- <5% line regulation (100V<sub>AC</sub> to 240V<sub>AC</sub>)
- Universal AC input voltage (100V<sub>AC</sub> to 240V<sub>AC</sub>)
- No electrolytic capacitor
- Low BOM cost

### Applications

- A60 Type LED light bulb
- Other LED lighting

### AL9901 EV2 Specifications

| Parameter       | Value                            |
|-----------------|----------------------------------|
| Input Voltage   | 100 to 240V <sub>AC</sub>        |
| Output Power    | 6 – 8W                           |
| LED Current     | 140mA (Adjustable)               |
| LED Voltage     | 51V                              |
| Efficiency      | ~86%                             |
| Number of LEDs  | 17 LEDs in series (Under Tested) |
| XYZ Dimension   | 0.6" x 2.4" x 0.6"               |
| ROHS Compliance | Yes                              |

### Evaluation Board



Figure 1: Top View



Figure 2: Bottom View

### Connection Instructions

Input Voltage: 100 to 240V<sub>AC</sub> (AC+, AC-)  
 LED Outputs: LED+ (Red), LED- (Black)

### Evaluation Board Schematic

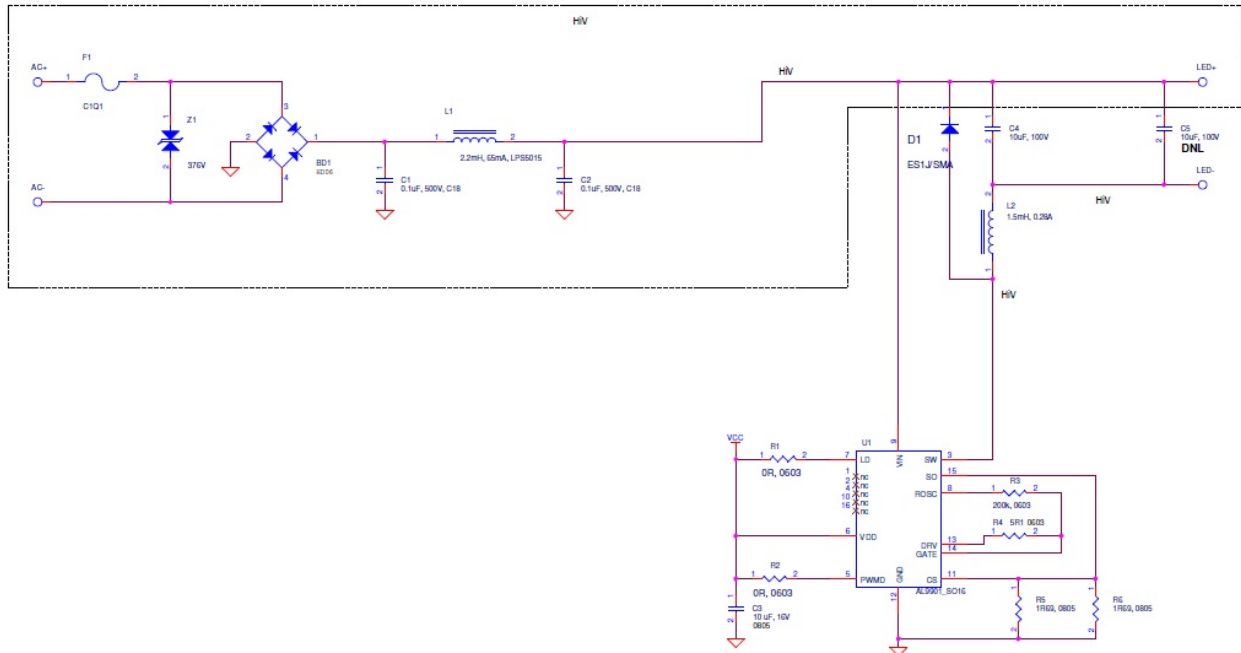


Figure 3: Evaluation Board Schematic

### Evaluation Board Layout

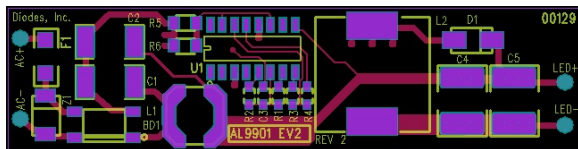


Figure 4: PCB Board Layout Top View



Figure 5: PCB Board Layout Bottom View

### Quick Start Guide

1. By default, the evaluation board is preset at 140mA LED Current by R5 and R6. Non-Dimmable by R2, remove R2 to allow PWM Dimming input.
2. Ensure that the AC source is switched OFF or disconnected.
3. Connect the AC line wires of power supply to "AC+ and AC-" on the left side of the board.
4. Connect the anode wire of external LED string to LED+ output test point.
5. Connect the cathode wire of external LED string to LED- output test point.
6. Turn on the main switch. LED string should light up.

### Bill of Material

| #  | Name   | QTY | Part number         | Manufacturer | Description  |
|----|--------|-----|---------------------|--------------|--|
| 1  | U1     | 1   | AL9901SO16          | Diodes Inc   | LED Driver   |
| 2  | BD1    | 1   | HD06-T              | Diodes Inc   | Bridge Rectifiers 0.8A 600V                              |
| 3  | D1     | 1   | ES1G-13-F           | Diodes Inc   | DIODE Super FAST 1A 400V SMA                             |
| 4  | Z1     | 1   | SMBJP6KE440CA       | Diodes Inc   | TVS bidirectional diode 600W 602V                        |
| 5  | L1     | 1   | LPS5015-225ML       | Coilcraft    | 2.2mH 64mA   |
| 6  | L2     | 1   | 13R155C             | Murata       | IND Power 1.5mH  |
| 7  | C1, C2 | 2   | VJ1812Y104KXEAT5Z   | Vishay       | CAP CER (MLCC) - SMD/SMT<br>1812 0.1uF 500V X7R 10%      |
| 8  | C3     | 1   | C1608X7R1A105K      | TDK          | CAP CER 1.0uF 10V X7R 0603                               |
| 9  | C5     | 1   | GRM32ER71J106MA12L  | Murata       | Multilayer Ceramic Capacitors (1210)<br>10uF 63V X7R 10% |
| 10 | R1,R2  | 2   | RC0603JR-070RL      | Yageo        | JMPR 0.0Ω 1/4W 0603 SMD                                  |
| 11 | R3     | 1   | RC0603FR-07200KL    | Yageo        | RES 200KΩ 1/10W 1% 0603 SMD                              |
| 12 | R4     | 1   | RC0603FR-0722RL     | Yageo        | RES 22Ω 1/10W 1% 0603 SMD                                |
| 13 | R5, R6 | 2   | RL0805FR-071R69L    | Yageo        | RES 1.69Ω 1/8W 1% 0805 SMD                               |
| 14 | F1     | 1   | 2410SFV1.00FM/125-2 | Bel Fuse     | Fuse, 1A, 250V, 1810                                     |

### Functional Performance (No Electrolytic Capacitor across output LEDs)

| Board Type             | VIN (VAC) | PFC   | I <sub>IN</sub> (mA) | P <sub>IN</sub> (W) | V <sub>LED</sub> (V) | I <sub>LED</sub> (mA) | P <sub>LED</sub> (W) | I <sub>LED</sub> Ripple (%) | Efficiency (%) | A <sub>thd</sub> (%) |
|------------------------|-----------|-------|----------------------|---------------------|----------------------|-----------------------|----------------------|-----------------------------|----------------|----------------------|
| AL9901EV2 Module Board | 100       | 0.752 | 101.33               | 7.62                | 48.50                | 128.5                 | 6.23                 | 100                         | 81.82          | 58.58                |
|                        | 110       | 0.731 | 96.49                | 7.76                | 48.57                | 131.7                 | 6.40                 | 100                         | 82.48          | 62.81                |
|                        | 120       | 0.710 | 92.77                | 7.89                | 48.64                | 134.4                 | 6.53                 | 100                         | 82.79          | 66.28                |
|                        | 130       | 0.693 | 89.32                | 8.03                | 48.70                | 136.8                 | 6.66                 | 100                         | 82.95          | 70.55                |
|                        | 200       | 0.610 | 73.39                | 8.90                | 49.03                | 147.9                 | 7.25                 | 100                         | 81.51          | 99.69                |
|                        | 210       | 0.603 | 71.50                | 9.04                | 49.04                | 149.2                 | 7.32                 | 100                         | 81.00          | 98.15                |
|                        | 220       | 0.591 | 70.72                | 9.18                | 49.06                | 150.9                 | 7.41                 | 100                         | 80.66          | 102.73               |
|                        | 230       | 0.591 | 68.58                | 9.29                | 49.07                | 151.7                 | 7.44                 | 100                         | 80.16          | 101.11               |
|                        | 240       | 0.576 | 68.19                | 9.43                | 49.08                | 153.3                 | 7.52                 | 100                         | 79.80          | 101.22               |

### Functional Performance (optional 68μF Electrolytic Capacitor across output LEDs to reduce ripple)

| Board Type             | VIN (VAC) | PFC   | I <sub>IN</sub> (mA) | P <sub>IN</sub> (W) | V <sub>LED</sub> (V) | I <sub>LED</sub> (mA) | P <sub>LED</sub> (W) | I <sub>LED</sub> Ripple (%) | Efficiency (%) | A <sub>thd</sub> (%) |
|------------------------|-----------|-------|----------------------|---------------------|----------------------|-----------------------|----------------------|-----------------------------|----------------|----------------------|
| AL9901EV2 Module Board | 100       | 0.740 | 100.40               | 7.44                | 48.56                | 129.4                 | 6.28                 | 50                          | 84.46          | 58.18                |
|                        | 110       | 0.718 | 95.55                | 7.57                | 48.62                | 132.9                 | 6.46                 | 50                          | 85.39          | 64.70                |
|                        | 120       | 0.701 | 91.18                | 7.69                | 48.67                | 135.8                 | 6.61                 | 50                          | 86.02          | 73.67                |
|                        | 130       | 0.685 | 87.44                | 7.80                | 48.71                | 138.5                 | 6.75                 | 50                          | 86.54          | 72.29                |
|                        | 200       | 0.605 | 71.20                | 8.58                | 48.92                | 152.1                 | 7.44                 | 50                          | 86.68          | 95.44                |
|                        | 210       | 0.600 | 69.34                | 8.70                | 48.94                | 153.9                 | 7.53                 | 50                          | 86.60          | 99.18                |
|                        | 220       | 0.591 | 68.06                | 8.82                | 48.96                | 155.5                 | 7.61                 | 50                          | 86.33          | 100.02               |
|                        | 230       | 0.580 | 67.04                | 8.93                | 48.96                | 157.0                 | 7.68                 | 50                          | 86.07          | 103.91               |
|                        | 240       | 0.581 | 64.94                | 9.05                | 48.97                | 158.6                 | 7.76                 | 50                          | 85.85          | 100.78               |

**Functional Performance**

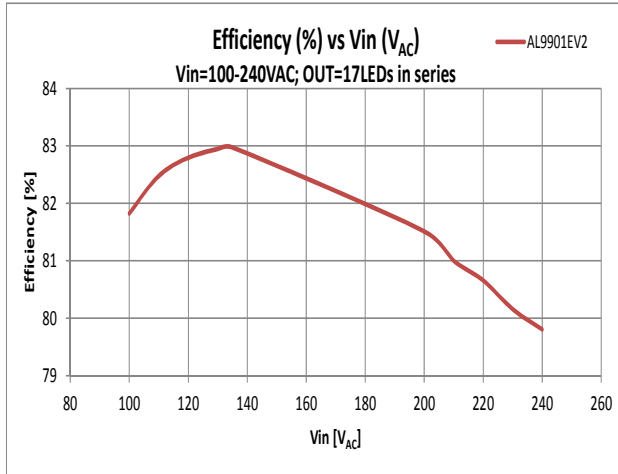


Figure 1. Efficiency vs. Vin

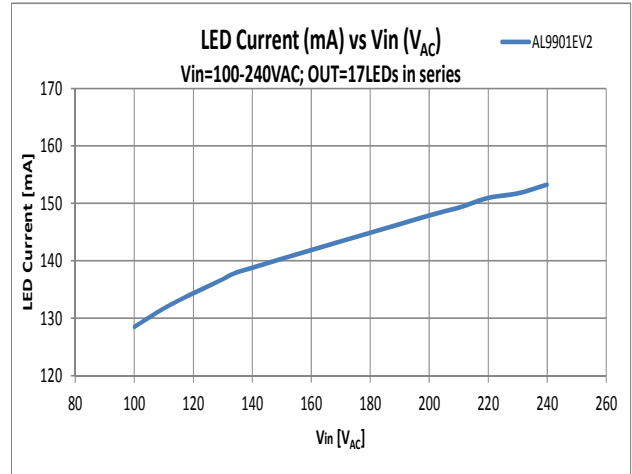


Figure 2. LED Current vs. Vin

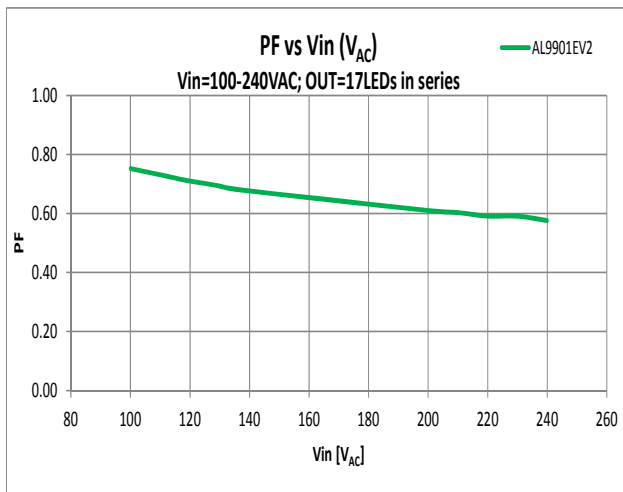
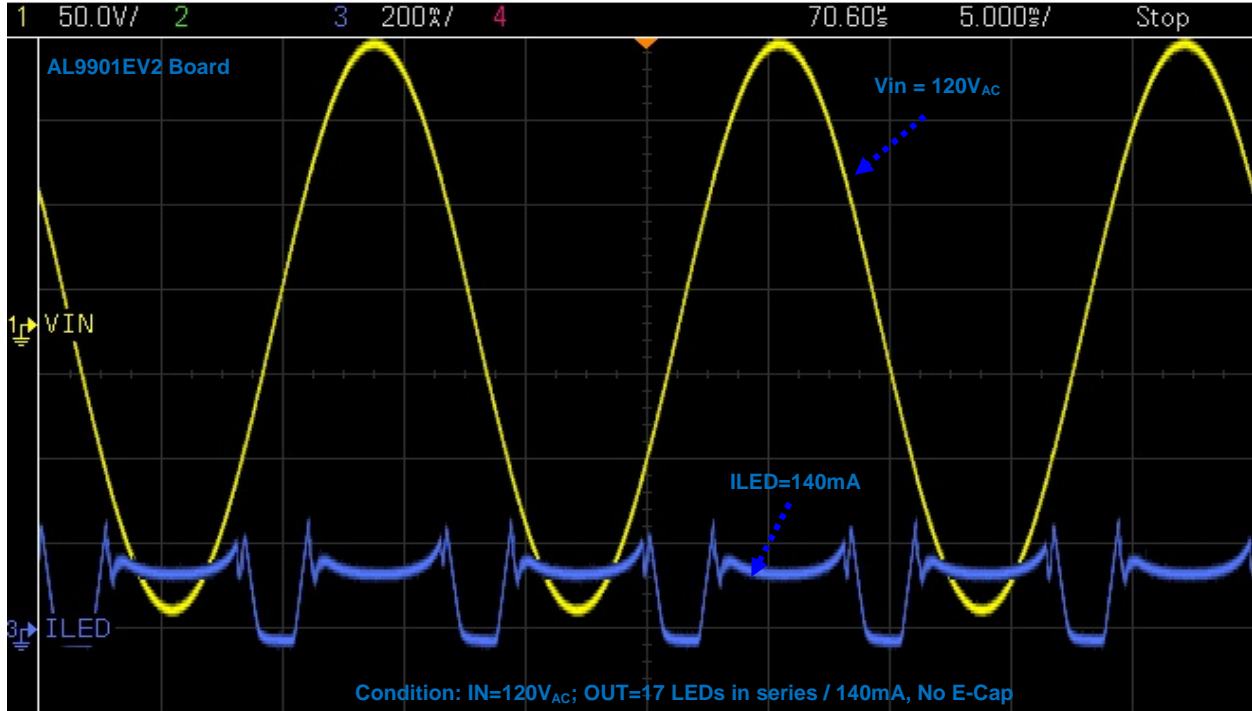
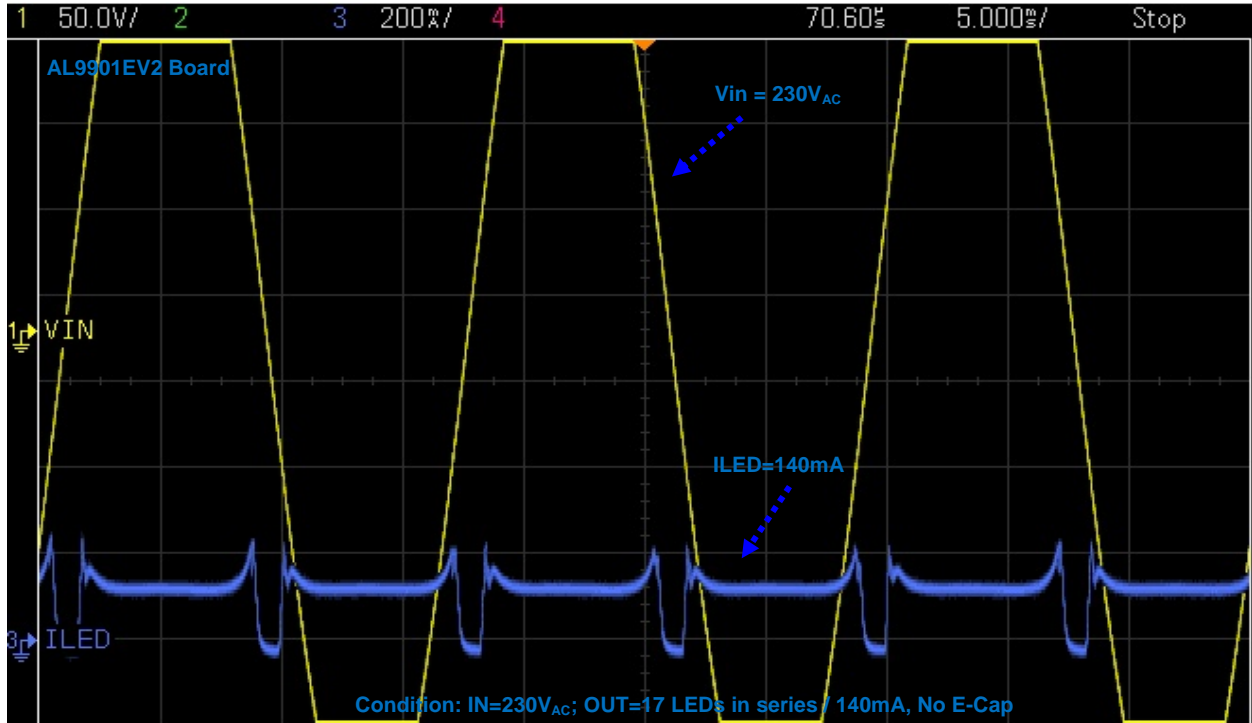


Figure 3. PFC vs. Vin

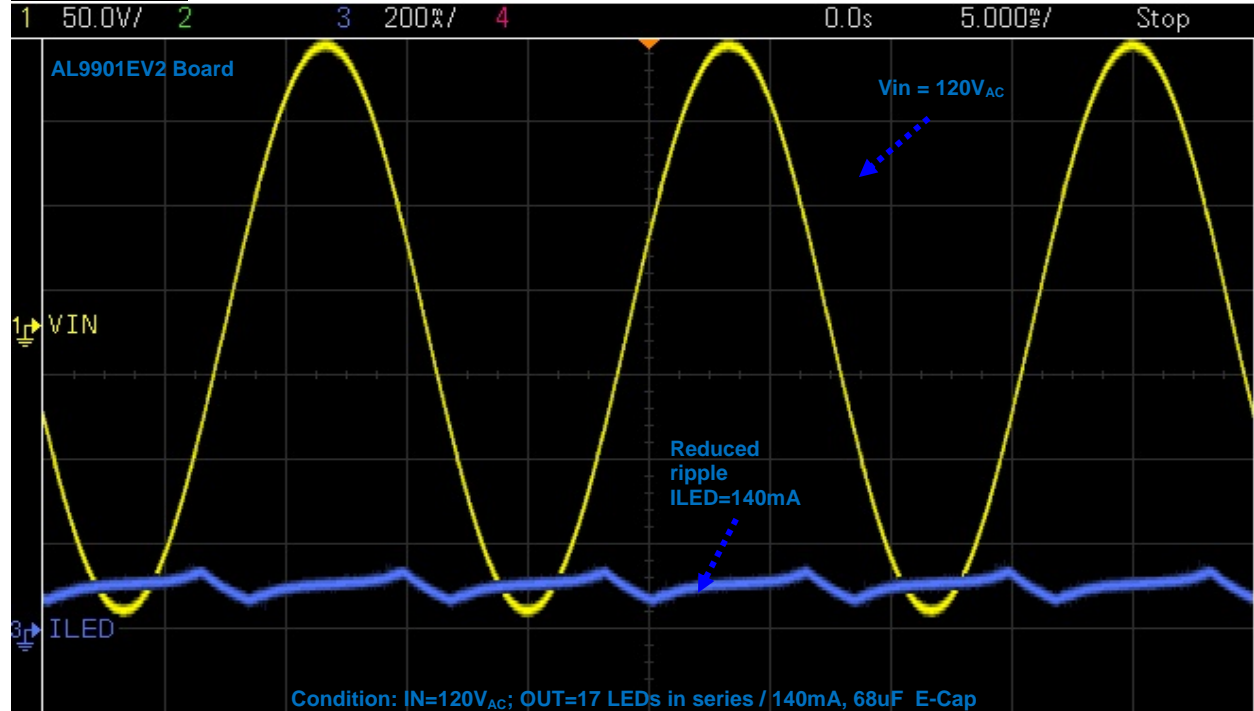
Waveform #1=> Channel 1: Vin = 120V<sub>AC</sub>, Channel 3: ILED



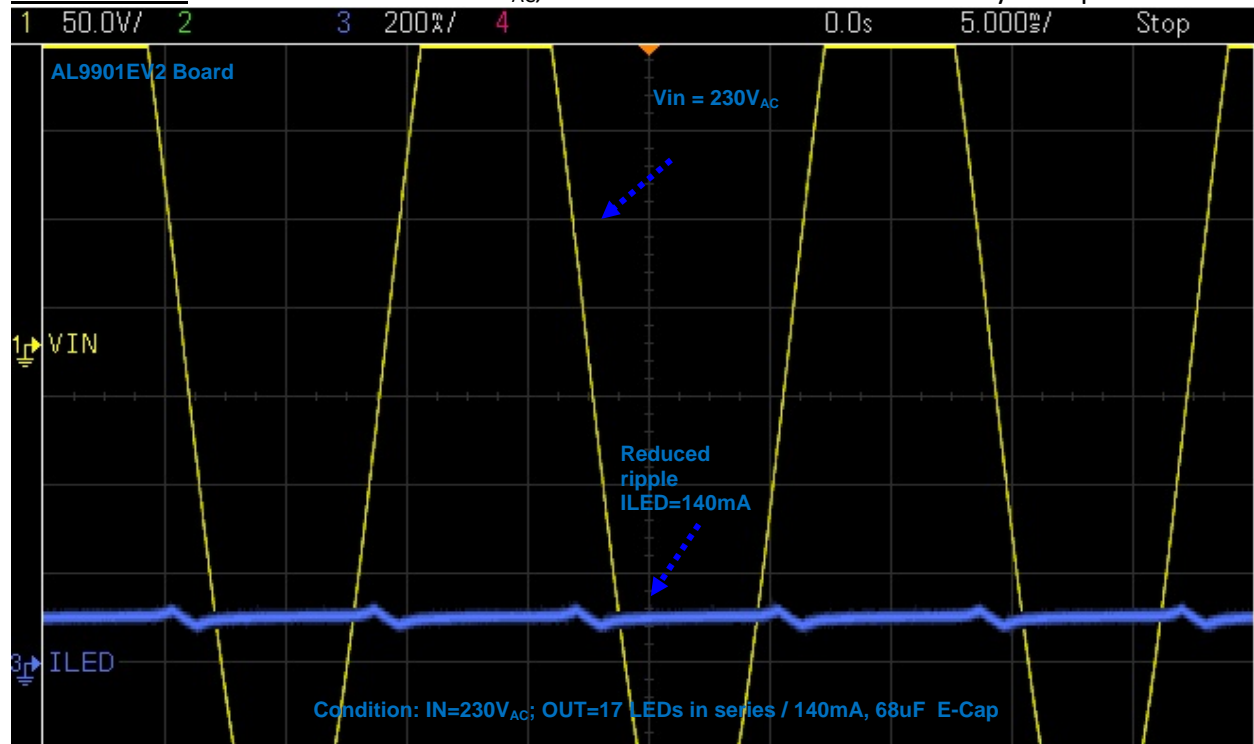
Waveform #2=> Channel 1: Vin = 230V<sub>AC</sub>, Channel 3: ILED



Waveform #3=> Channel 1: Vin = 120V<sub>AC</sub>, Channel 3: ILED with 68uF Electrolytic Capacitor



Waveform #4=> Channel 1: Vin = 230V<sub>AC</sub>, Channel 3: ILED with 68uF Electrolytic Capacitor



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