

# AL9910EV5 BUCK LED DRIVER USER GUIDE

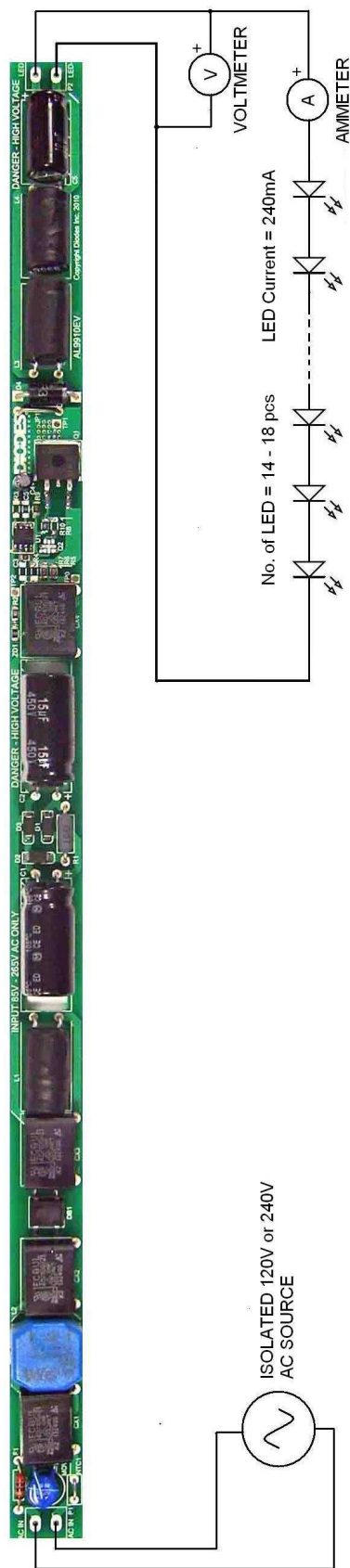


Fig. 1 AL9910EV5 evaluation board connection diagram

## **DESCRIPTION**

The AL9910EV5 is an offline non-isolated LED driver Evaluation board designed to work on both 115V and 230V AC line voltages. It provides a constant LED current output which drives a single string of between 14 and 18 LEDs, with a LED current of 240mA.

The evaluation board is designed with a footprint to fit inside a T8 LED fluorescent replacement lamp tube. It will provide a total LED power ranging from 10W to 13W.

## **AL9910EV5 SETUP AND TESTING PROCEDURE**

### **Prerequisite**

1. AL9910EV5 evaluation board.
2. A set of 240mA LEDs strings with 14 to 18 series-connected LEDs. The LEDs should be mounted on a heatsink capable of a power dissipation of 10 to 13W.
3. For safety reasons during testing, please use an isolated 115V or 230V AC source from the output of an isolation transformer. For public demonstration, the evaluation board and LEDs should be fitted into a transparent case with sufficient insulation to meet the local safety requirements.

### **Connections and Power up**

1. Preset the isolated AC source to either 115VAC or 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 which is located at the right hand side of evaluation board.
4. Connect the cathode wire of the LED string to the LED - terminal which is located at the right hand side of the evaluation board.
5. Connect a voltmeter & ammeter according to the connection diagram in Figure 1 if LED current and voltage measurements are required.
6. Connect the two AC line wires to the AC1 and AC2 terminals which are located at the left hand side of evaluation board.
7. 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.
8. Turn on the mains switch. LED string should light up with LED current of 240mA +/-15%. **DO NOT TOUCH THE BOARD, LEDs OR BARE WIRING.**

**Caution: The AL9910EV5 is a non-isolated design. All terminals carry high voltage during operation!**

## **OPERATION**

The AL9910A device is a PWM high-efficiency LED driver control IC. It allows efficient operation of High Brightness (HB) LEDs from voltage sources ranging from 85VAC up to 265VAC. The AL9910A can be configured to work in either fixed frequency or constant OFF-time mode. In fixed frequency mode, the AL9910A controls an external MOSFET at a fixed switching frequency up to 300kHz, which can be programmed using a single resistor. The LED string is driven at a constant current rather than at a constant voltage, thus providing constant light output and enhanced reliability. The output current can be programmed between a few milliamps and more than 1.0A.

### **Input filter and Rectifier section**

In order to meet the EMI requirement, Cx1, Cx2, CX3, CX4, L1 and L2 are used to provide sufficient filtering for both differential-mode and common-mode noise generated from the switching converter circuit after the bridge rectifier.

The rectified line voltage from the bridge rectifier DB1 is fed into a valley-filled passive power factor correction stage to provide a high power factor for the AC line input. The passive PFC stage comprises of C11, C2, D1, D2, D3 and R1. This design gives power factors of greater than 0.9 at low line voltage.

### **Constant Current Buck Converter section**

The buck converter section consists of LED controller AL9910A (U1), Ultra-fast free-wheeling rectifier SF30JG (D4), Inductor (L3 and L4) and a high voltage MOSFET switch (Q1). On this evaluation board, the AL9910A is configured to operate in the constant OFF-time mode to provide the best LED current regulation. The constant OFF-time of the AL9910A's gate output is set to approximately 14 $\mu$ s using resistor R9. Please refer to the product datasheet for more details on how to configure the constant OFF-time mode.

The circuit values have been designed to provide an output current of 240mA. The LED current level is set by resistors R5-R7. For detailed applications information please refer to the AL9910/A datasheet.

There is also provision for an optional gate transistor pair (Q2) to drive a MOSFET with a higher gate charge if a higher LED current is required. Q2 is a high current gate driver in a SOT23-6 package.

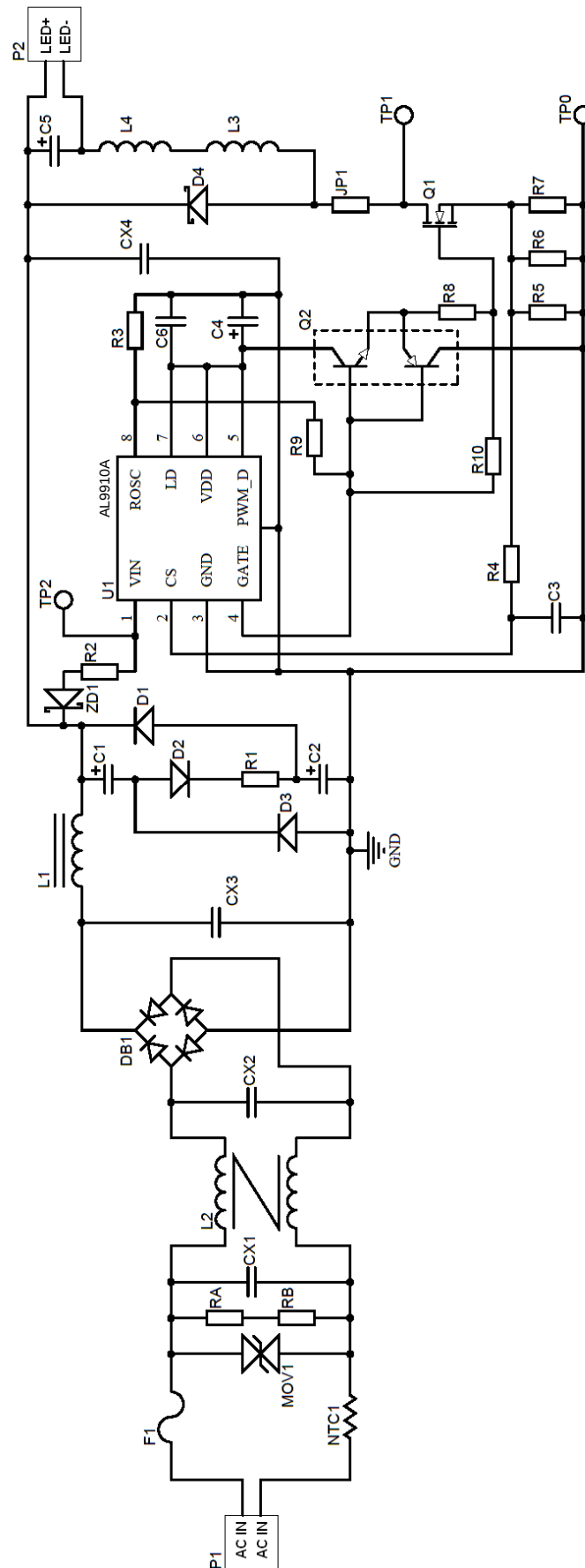
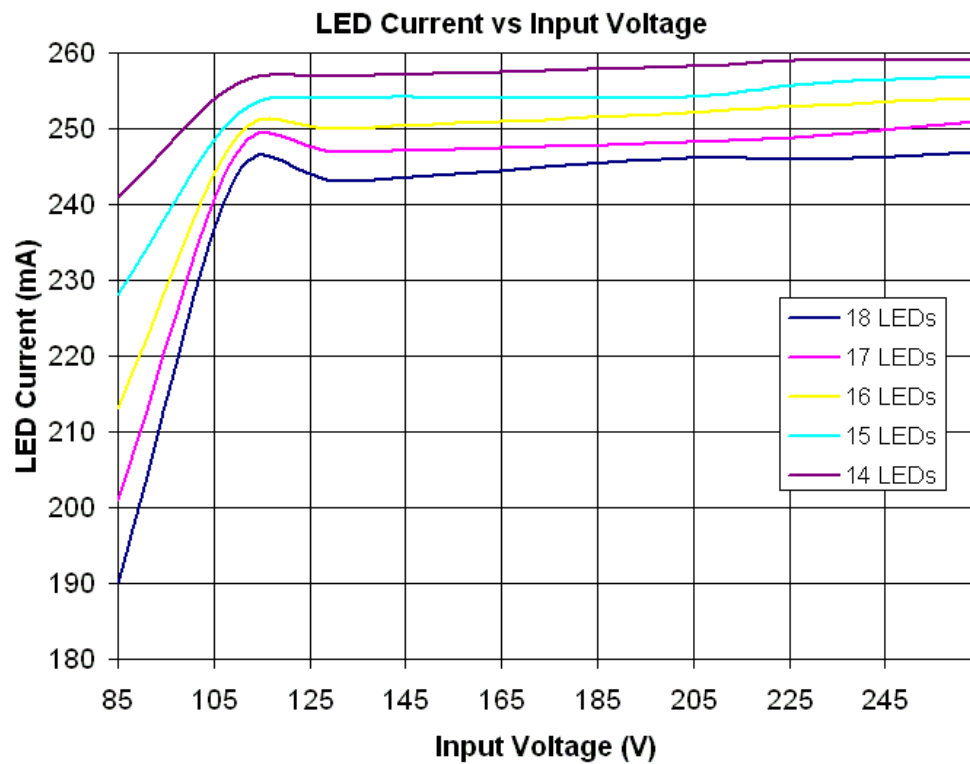
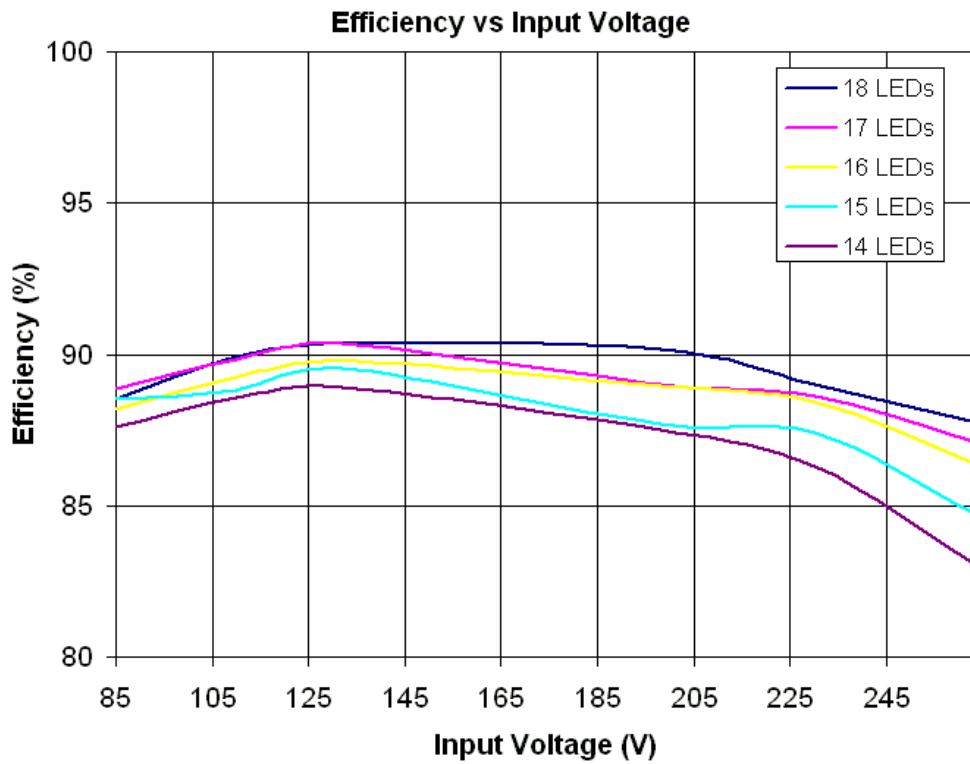


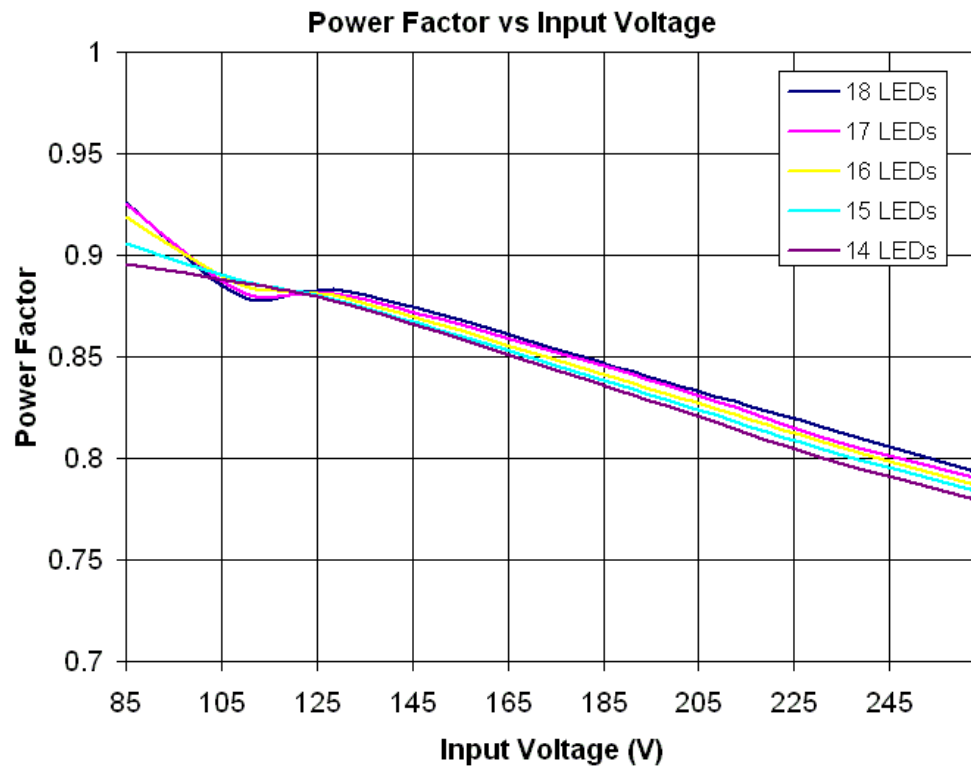
Fig. 2 AL9910EV5 Schematic Diagram

## PARTS LIST

| Ref                | Description                                                                 | P/N                                         | Package            | Manufacturer                     |
|--------------------|-----------------------------------------------------------------------------|---------------------------------------------|--------------------|----------------------------------|
| U1                 | Universal high brightness LED driver                                        | AL9910A                                     | SO8                | Diodes Inc                       |
| D1 D2 D3           | 1A 1KV diode $t_{RR}=1.8\mu s$                                              | S1M-13-F                                    | SMA                | Diodes Inc                       |
| D4                 | Ultra-fast-recovery diode 3A 600V $t_{RR}=50ns$                             | SF30JG-B                                    | DO201AD            | Diodes Inc                       |
| DB1                | 1A, 600V bridge rectifier                                                   | DF06S                                       | DF-S               | Diodes Inc                       |
| C1 C2              | 15 $\mu$ F 450V electrolytic capacitor +/-20% 1000hrs @ 105C                | EEUED2W150<br>400KXW27M10X30<br>UCY2G150MPD | 5mm pitch          | Panasonic<br>Rubycon<br>Nichicon |
| C3 C6              | OMIT                                                                        |                                             | 1206               |                                  |
| C4                 | 4.7 $\mu$ F 50V electrolytic capacitor +/-20% 1000hrs @ 105C                | ECE-A1HKG4R7                                | 1.5mm pitch        | Panasonic                        |
| C5                 | 10 $\mu$ F 450V electrolytic capacitor +/-20% 1000hrs @ 105C, 10mm diameter | EEUEE2W100U                                 | 5mm pitch          | Panasonic                        |
| CX1 CX2<br>CX3 CX4 | 100nF, 275VAC, Film, X2                                                     | ECQU2A104ML                                 | 15mm pitch         | Panasonic                        |
| F1                 | 10Ohm 1W fusible resistor +/-200ppm                                         | NFR0100001009JR500                          | Through-hole axial | Vishay                           |
| JP1                | Link with 22 to 26 SWG tinned copper wire                                   |                                             |                    |                                  |
| L1                 | 6.8mH inductor +/-10% 290mA radial                                          | 19R685C                                     | 6mm pitch          | Murata                           |
| L2                 | 22mH or 30mH common mode inductor, 8mm height                               | B82791G2351N001<br>B82791G2301N001          |                    | EPCOS<br>EPCOS                   |
| L3 L4              | 3.3mH inductor +/-10% 420mA radial                                          | 19R335C                                     | 6mm pitch          | Murata                           |
| MOV1               | 275V, 21J, 9mm, Radial                                                      | B72207S0271K101                             | 5mm pitch          | EPCOS                            |
| NTC1               | Wire link                                                                   |                                             |                    |                                  |
| Q1                 | N-ch 600V MOSFET 3.2A, $Q_{g(max)}=16nC$                                    | SPB03N60S5                                  | TO263              | Infineon                         |
| Q2                 | NOT FITTED                                                                  |                                             | SOT23-6            |                                  |
| R1                 | 10R 3W wirewound resistor, +/-50ppm/C, +/-1%                                | UB3C-10RF1                                  | Through-hole axial | Riedon                           |
| R2                 | 3K 0.25W resistor +/-5%                                                     | Any                                         | 1206               | Any                              |
| R4                 | 0R 0.125W resistor +/-5%                                                    | Any                                         | 0805               | Any                              |
| R5                 | 1R2 0.25W +/-1%                                                             | Any                                         | 1206               | Any                              |
| R6                 | 2R7 0.25W +/-1%                                                             | Any                                         | 1206               | Any                              |
| R7                 | 100R 0.25W +/-1%                                                            | Any                                         | 1206               | Any                              |
| R3 R8 RA<br>RB     | NOT FITTED                                                                  |                                             | 1206               |                                  |
| R9                 | 330K 0.25W resistor +/-1%                                                   | Any                                         | 1206               | Any                              |
| R10                | 10R 0.25W +/-5%                                                             | Any                                         | 1206               | Any                              |
| ZD1                | 0R 0.25W +/-5%                                                              | Any                                         | 1206               | Any                              |

## PERFORMANCE





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