The Analog Mixed Signal Company

Application Note

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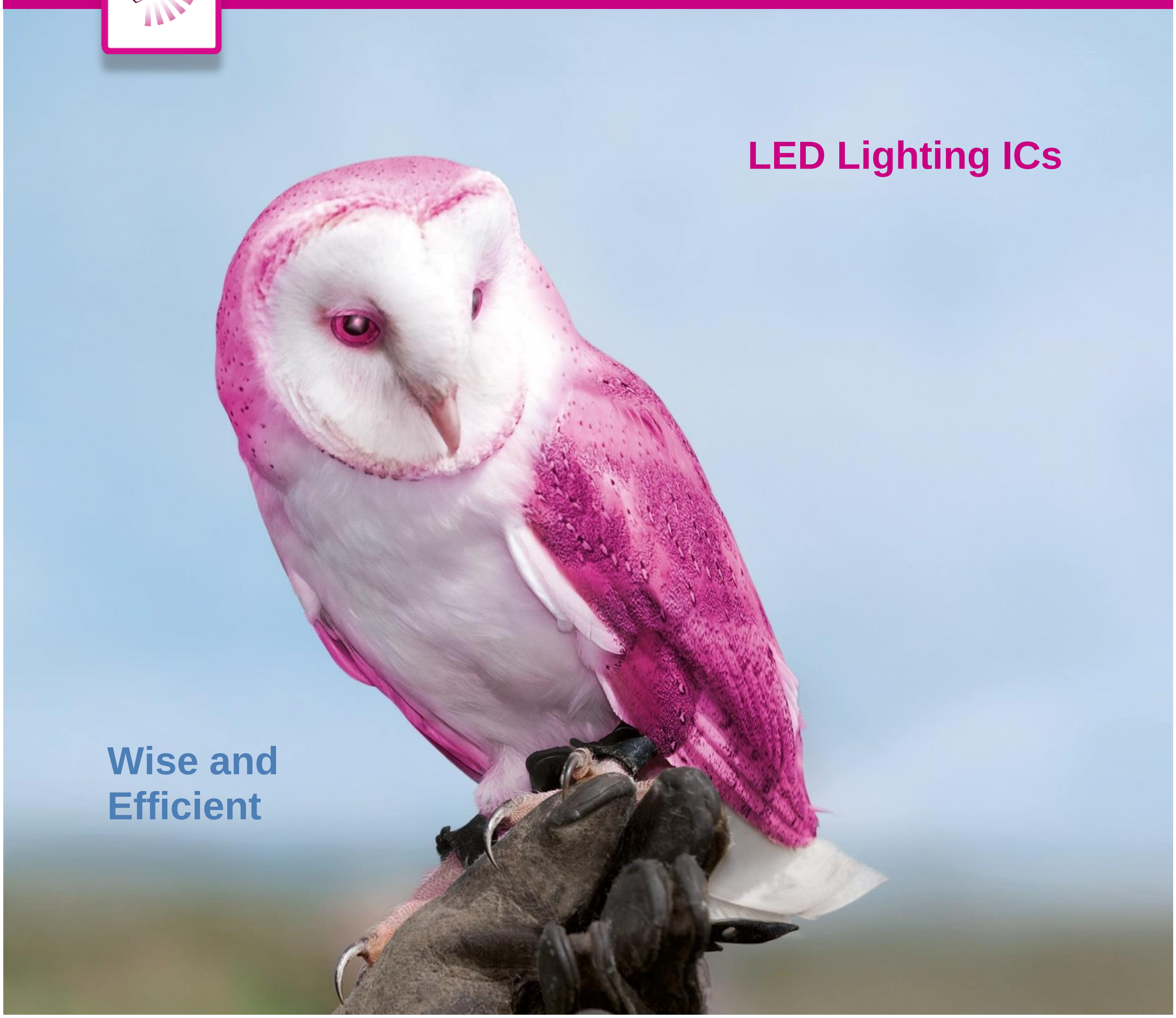
ZSLS7031

230VAC Buck-Boost Converter for 45 LEDs



ZSLS7031

Application Note – 230VAC Buck-Boost Converter for 45 LEDs

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Brief Application Description

The ZSLS7031 is a high-brightness LED driver that supports both isolated and non-isolated LED lighting designs with active power factor correction (PFC). The ZSLS7031 functions in primary-side controlled peak-current-mode without requiring an optocoupler or any other type of additional secondary-side feedback device.

The device operates at a constant frequency in discontinuous conduction mode (DCM) to provide constant power to the output. It operates from a wide input voltage range; e.g., from 85VAC to 265VAC.

The ZSLS7031 integrates over-current and over-voltage protection, as well as a thermal shutdown to halt the switching action in the event of abnormally high operating temperatures.

The ZSLS7031 is designed for isolated flyback and non-isolated buck-boost applications but also has applications in PFC buck operation in special conditions.

Refer to the *ZSLS7031 Data Sheet* for details for additional features.

Benefits

- High efficiency 90%
- No optocoupler or secondary-side feedback device required
- Safety features including thermal shutdown and over-current and over-voltage protection

Available Support

- ZSLS7031 Demonstration Board

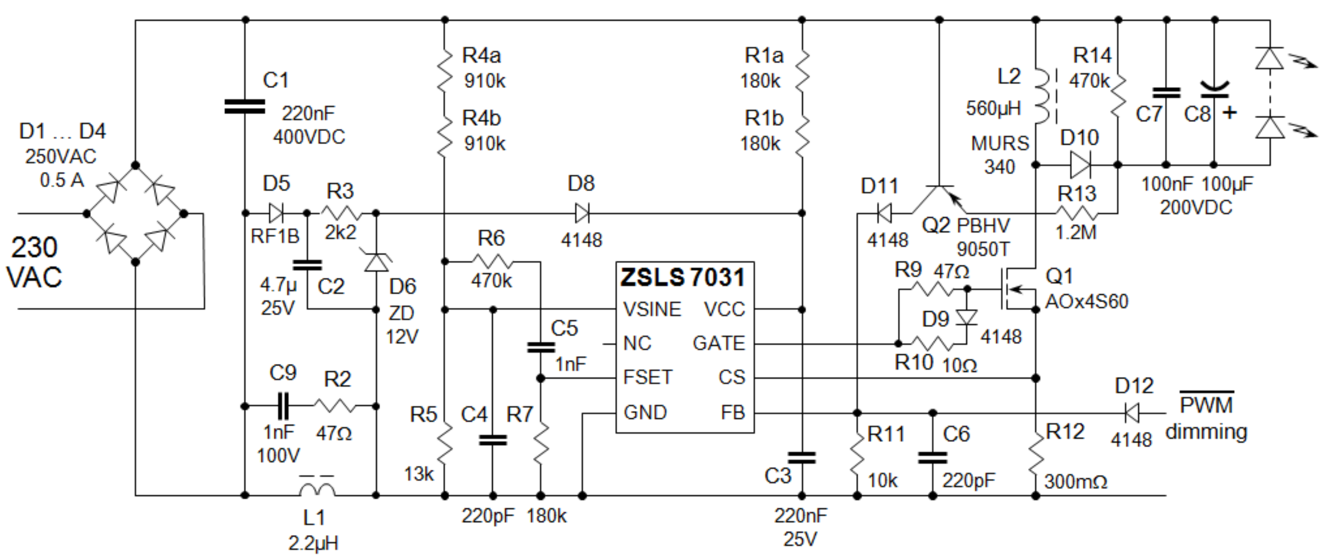
Typical Applications

- Street Lighting with remote management
- Indoor lighting for home automation

Application Physical Characteristics

- Supply voltage: 230 to 240 VAC
- Output: 45 LEDs (nominal 135V) at 350mA
- Power factor >0.9
- Total harmonic distortion (THD) < 20%

Application Schematic



For more information, contact ZMDI via LED_Drivers@zmdi.com.

1 Introduction

The purpose of a buck-boost converter is to provide a constant output even if the input supply changes from lower to higher than the required output voltage. Like a flyback converter, the buck-boost converter can be active during the entire rectified sinusoid, allowing continuous power factor correction (PFC) and low total harmonic distortion (THD).

The buck-boost topology provides better efficiency when the LED forward voltage is relatively high and the current is reasonably low as in the example given in this application note for a string composed of 45 LEDs in series at a current of 350mA. The schematic is given on page 2. This circuit results in a peak current in the inductors and the MOSFET in the order of a few amperes. The dimensioning of the inductors, the MOSFET, and the buck-boost diode (D10) should take into count these current values.

2 The Buck-Boost Configuration

The following example demonstrates the design process for a buck-boost converter using the ZSLS7031.

Note: This example circuit is designed for a 230VAC input and an output string of 45 LEDs in series with an LED current of 350mA.

2.1. Dimensioning

The buck-boost converter can be considered to be a special case of a flyback converter, where the transformer's primary/secondary ratio equals 1, and the secondary is simply not used, which of course sacrifices isolation. This topology is advantageous in terms of efficiency when the LED voltage is reasonably high; i.e., in the region where the flyback voltage would be with a transformer present. Since a single inductor does not have leakage inductance, a snubber dissipating the related energy is not needed. Considering this, all equations for calculating the transformer's primary inductance in a flyback converter are also valid for a buck-boost inductor by simply assuming equations (1) through (3).

$$n_{prim} = n_{sec} \tag{1}$$

$$I_{prim} = I_{sec} \tag{2}$$

$$V_{fb} = V_{LED} + V_D \tag{3}$$

The operating supply current for the ZSLS7031 in a buck-boost converter can be provided from an auxiliary winding on the inductor (i.e., it functions as a complete transformer again) but without needing a snubber, *or the operating current can be provided by an alternative supply concept as shown in the schematic.*

2.2. Protection

2.2.1. Output Over-Voltage Protection

With proper dimensioning of components in the buck-boost converter application circuit, an overvoltage condition in the output will be detected. Q2, R11, and R13 operate as an inverting amplifier with a gain of R11/R13, providing a fraction of the LED voltage to the overvoltage detection input FB, referenced to ground. R11 and R13 in the output divider must be dimensioned so that the voltage across R11 is 1.25 V when VLED reaches the overvoltage shutdown level.

2.2.2. Over-Current Protection

The ZSLS7031 has an integrated overcurrent protection circuit that switches off the driver for 60 clock cycles of the oscillator if a voltage > 700mV is detected across R12 at the end of the blanking time (typically 500ns after the MOSFET is turned on).

2.2.3. Under-Voltage Lockout

If the input voltage on the VCC pin on the ZSLS7031 falls below the under-voltage threshold of 8V (typical), the under-voltage lockout (UVLO) will be triggered and the ZSLS7031 will stop.

3 Ordering Information

Ordering Code	Description	Package
ZSLS7031ZI1R	ZSLS7031 Flyback LED Driver, 3mm x 3mm MSOP-8, 40 to 105 °C	Tape on Reel
ZSLS7031KIT-D1	ZSLS7031PCB-D1 Evaluation Board, 5 sample ZSLS7031 ICs	Kit

4 Related Documents

Note: X_xy refers to the current revision of the document.

Document	File Name
ZSLS7031 Data Sheet	*ZSLS7031_Data_Sheet_RevX_xy.pdf*

Visit the ZSLS7031 product page at www.zmdi.com/zsls7031 on ZMDI's website www.zmdi.com or contact your nearest sales office for the latest version of these documents.

5 Glossary

For this table, only list acronyms that occur in your data sheet.

Term	Description
FB	Feedback
PFC	Power Factor Correction
THD	Total Harmonic Distortion
UVLO	Under-Voltage Lockout

6 Document Revision History

Revision	Date	Description
1.00	November 26, 2013	First release.

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