Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

Electronic Transformer Compatible Step-down Converter for 3W MR16 Lamp with **ILD4035**

Application Note AN214

Revision: 1.0
Date: 2011- 09- 02

Power Management & Multimarket

Edition 2011-09-02
Published by
Infineon Technologies AG
81726 Munich, Germany

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

Application Note AN214
Revision History: 2011-09-02

Previous Revision: Previous_Revision_Number	
Page	**Subjects (major changes since last revision)**

1 Introduction

1.1 Features

- Driver number of LED, 3 in series
- Output Power, 3 Watt
- 12 Volt AC operation
- Stable LED current vs. input voltage
- Termerature protection

1.2 Brief Description

The ILD4035 provides a low-cost solution for driving 1W LEDs with a LED current up to 400mA. The supply voltage of this LED driver IC is up to 22V; hence this IC is suitable for MR16 application at 12VAC operation.

2 LED Driver PCB Design

The 3W MR16 control board has 2 input pins, it connect to 12 VAC input power supply. There are 2 LED terminal pins, it allow use connect to 3 LED in series. The demo board is configured with 350mA LED current.

2.1 Calculation of Rsense resistance

The internal voltage reference for the R_{sense} resistors is typically (V_S-V_{sense}) = 0.114V

To set the LED current to near 0.35 A, the effective resistance between V_S and V_{sense} pin is calculated as:

R_{sense} =0.114V/0.35A =0.33 Ω

This R_{sense} can be achieved by paralleling three physical resistor, R1=R2=R3=1.0 Ω (Or one piece of 0.33 Ω resistor).

2.2 Calculation of the L1 inductance

Given the following data:

Buck-switching frequency f = 200 kHz,

Duty-on-cycle of V_{switch} of ILD4035, D = 90%,

Voltage drop of LEDs, V_{fLEDS} = 3.3V x 3 pcs in series = 9.9V,

Voltage drop of schottky diode, V_{fD}= 0.3V,

Voltage drop of Vswitch to ground when internal switch is on, V_{drop} = 1.1V,

Average LED current, I_{LED} = 0.35A,

Inductance of L1 can be calculated approximately as:

$$L_1 = \frac{10 \cdot (1-D) \cdot (V_{fLED} + V_{fD} + V_{drop})}{2 \cdot f \cdot I_{LED}} = 80.7\ \mu H$$

The next higher practical value for SMD inductance is 100 µH.

2.3 PCB schematic and layout

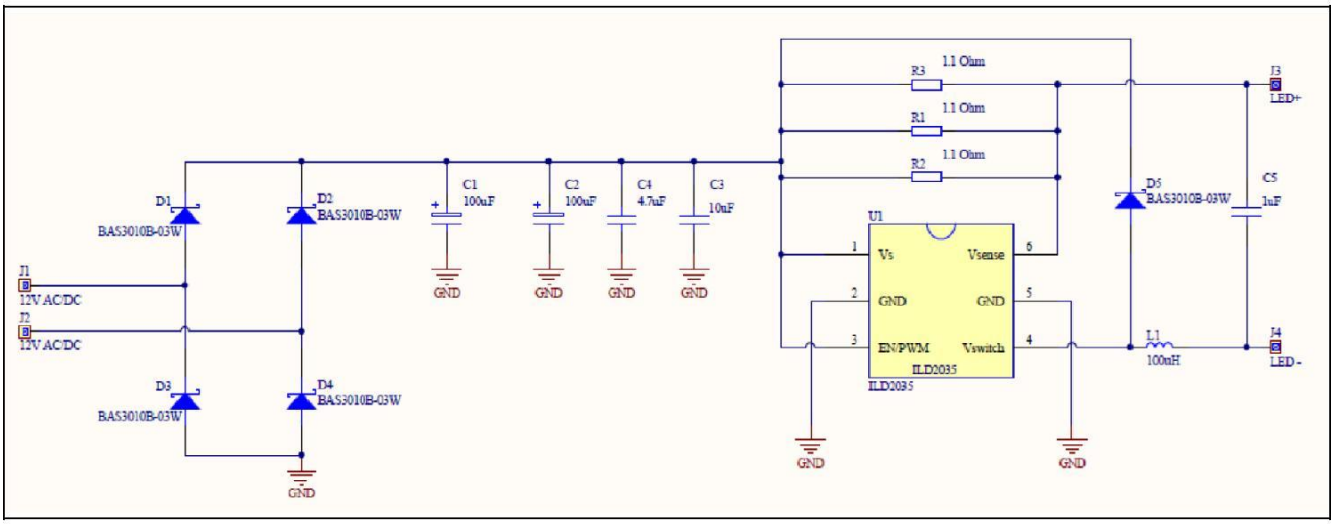


Figure 1 Schematic LED Driver Design

Table 1 Bill-of-Materials

Symbol	Value	Size	Manufacturer	Comment
J1, J2	Solder pad			12 VAC input connector
R1, R2, R3	1.0 Ohm	0603		For setting 0.35A of LED current
C3	4.7µF	0805		35V SMD ceramic capacitor
C4	10µF	0805		optional
D1 – D5	BAS3010B-03W	SOD323	INFINEON	Schottky Diode
C1, C2	100µF			25V, Electrolytic Capacitor
U1	ILD4035	SC74	INFINEON	Buck Hysteretic LED current controller
L1	100µH		Wuerth	SMD Inductor
J3	Hole			LED+ terminal (Red)
J4	Hole			LED- terminal (Black)

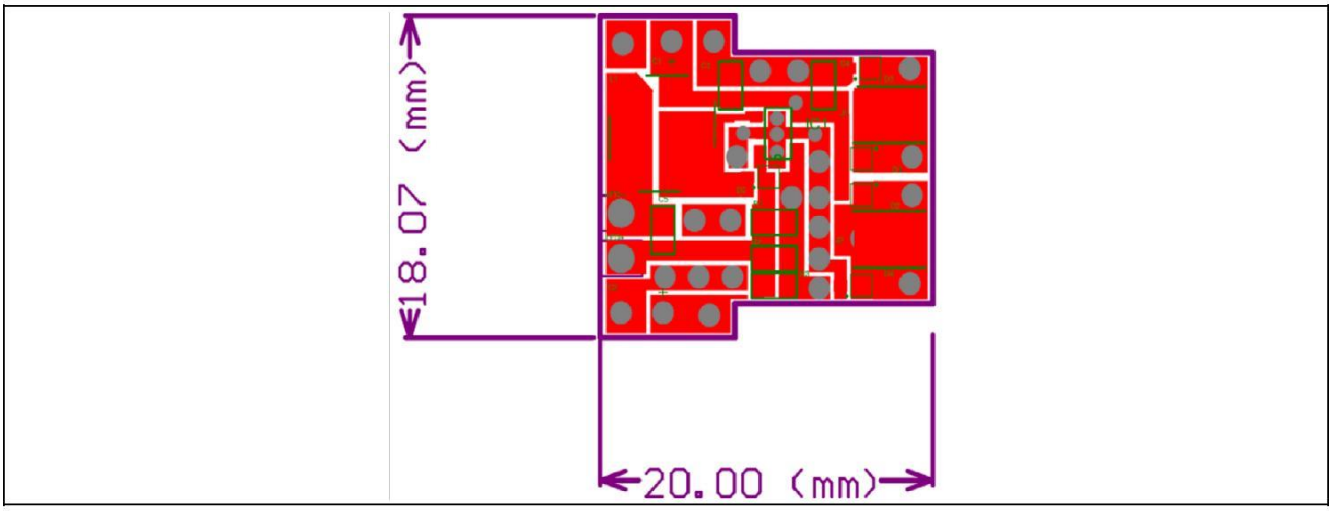


Figure 2 PCB Layout Top View of Driver Board.

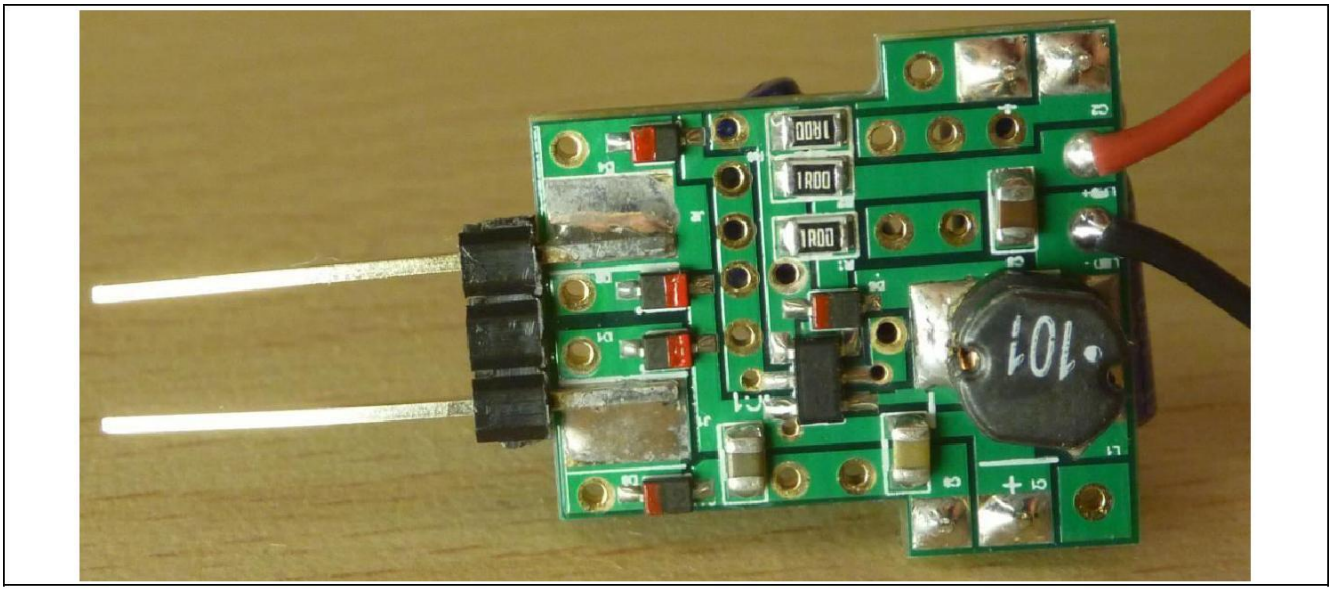
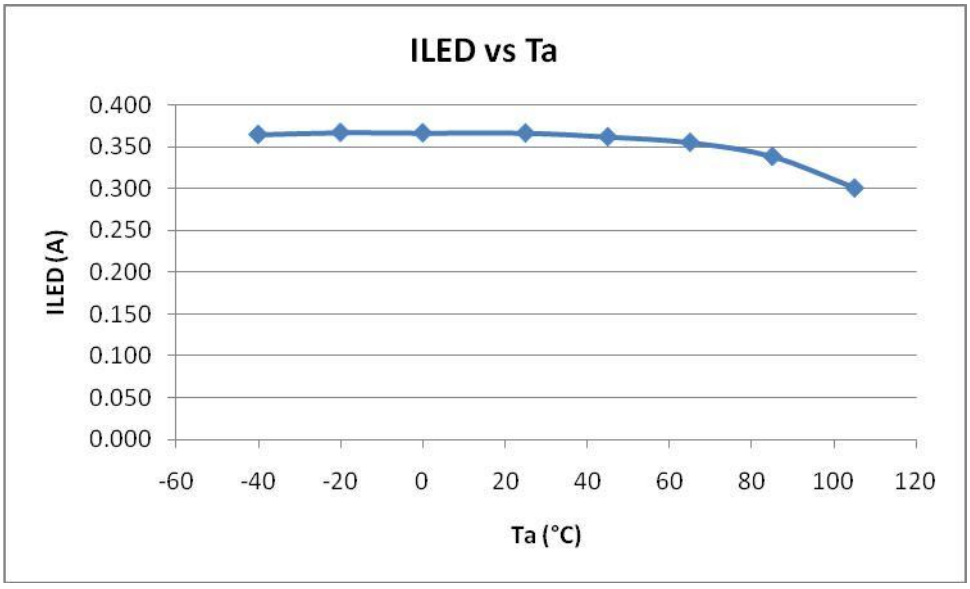


Figure 3 Picture of MR16 3W control board

3 Performance and measurement

3.1 Temperature Protection

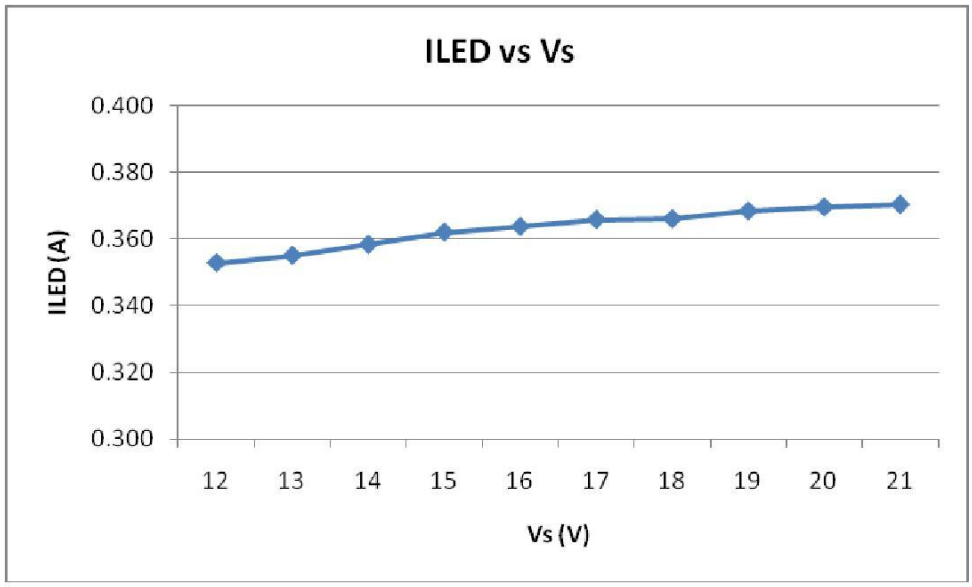
ILD4035 incorporates a temperature protect ion circuit referring to the junction temperatu re of the IC.The higher junction temperature the lower current of the LEDs. This feature helps to reduce the power dissipation of ILD4035 and the LEDs.

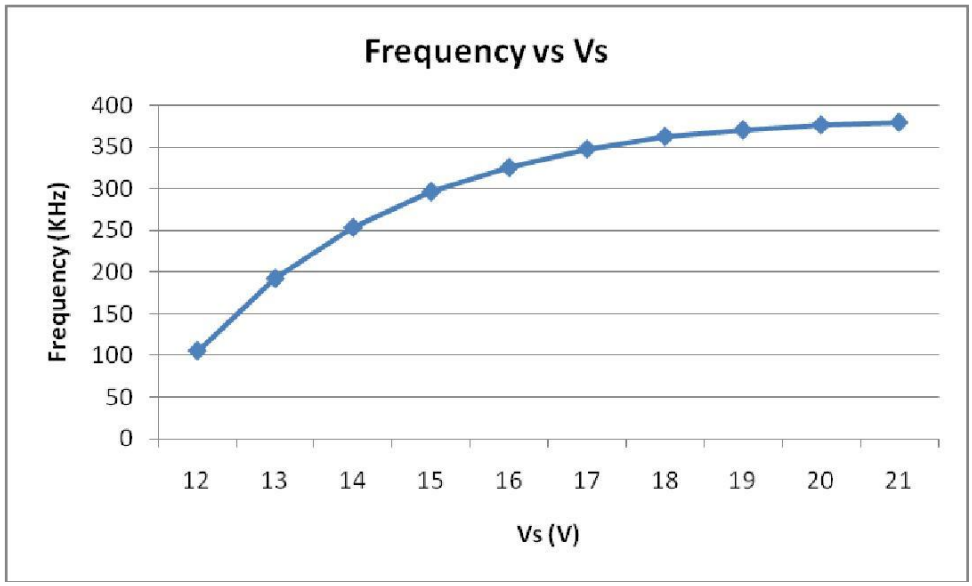


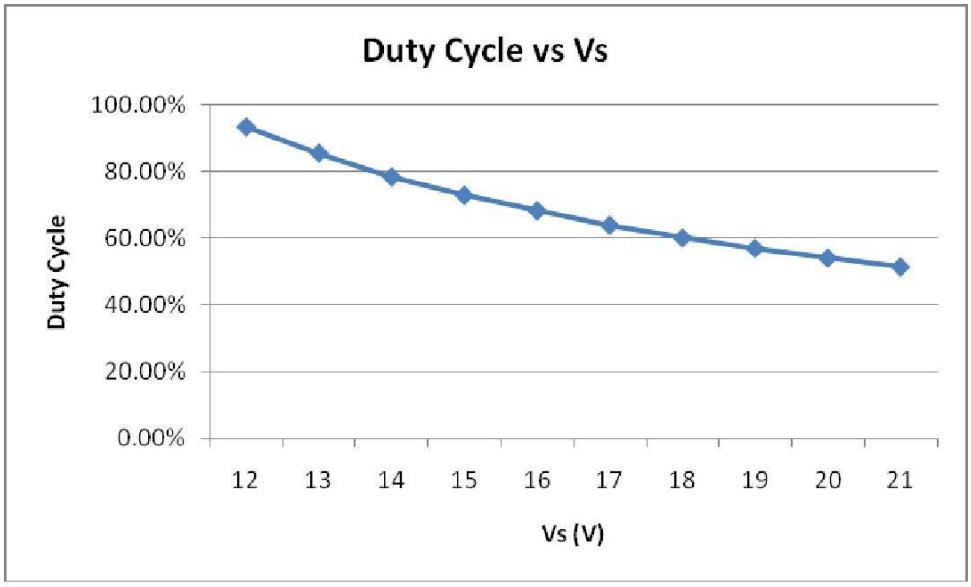
3.2 Stable LED current control with input voltage variations

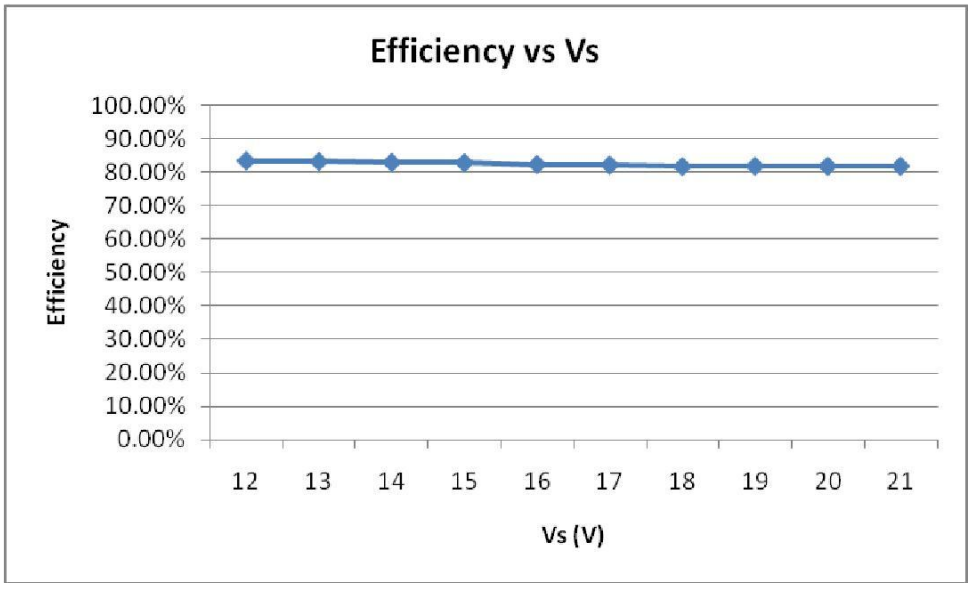
ILD4035 provides less than 5% LED current variation in an input voltage range from 12V to 21V.

Below figures show the measurement results for the ILED, switching frequency, duty cycle and efficiency versus Vs.









Note: This is demo board efficiency with DC input voltage

4 Flickering Free driving with Electronic Transformer

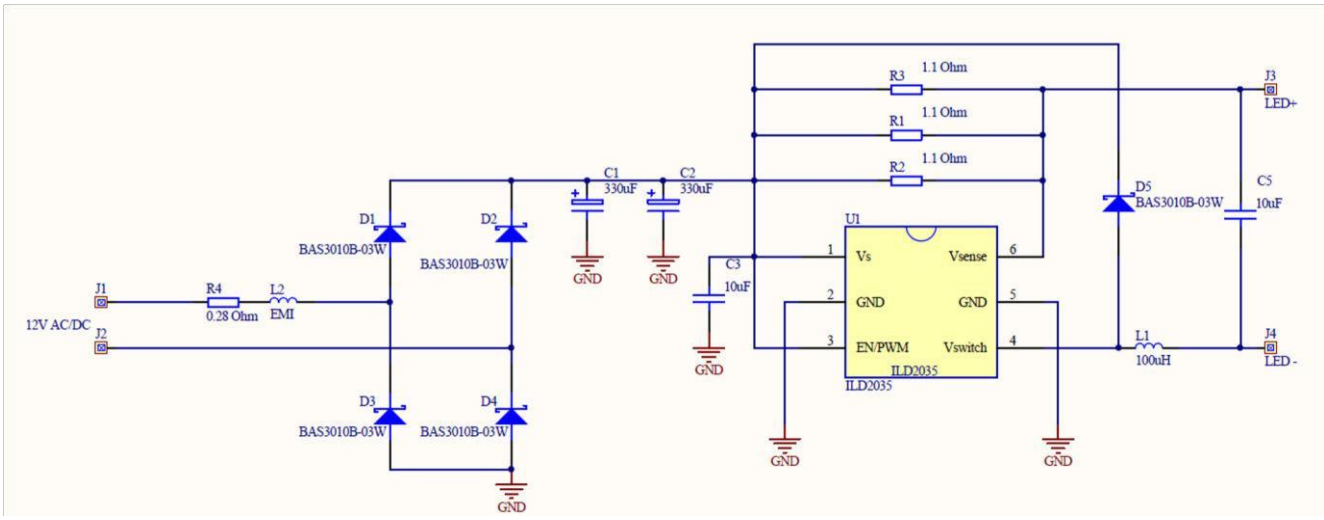


Figure 4 Schematic LED Driver Design (Flickering free)

Table 2 Bill-of-Materials

Symbol	Value	Size	Manufacturer	Comment
J1, J2	Solder pad			12 VAC input connector
R1, R2, R3	1.0 Ohm	0603		For setting 0.35A of LED current
C3	4.7µF	0805		35V SMD ceramic capacitor
C4	10µF	0805		optional
D1 – D5	BAS3010B-03W	SOD323	INFINEON	Schottky Diode
C1, C2	100µF			25V, Electrolytic Capacitor
U1	ILD4035	SC74	INFINEON	Buck Hysteretic LED current controller
L2	100µH		Wuerth	SMD Inductor
L1	27µH		Wuerth	SMD Inductor
R4	0.28 OHm	SMD_2512		Resistor

This solution can be configured to be compatible with electronic transformer and there is not flickering and shimmering.

Below is electronic transformer:

- **OSRAM Halotronic® HTM 105/230**-240
- OSRAM ET-A 60/220-240
- Philips ET-E60 220-240
- GE SET110LVA
- GE SET60LS
- Tridonic TE-0060 BASIC 112

www.infineon.com

Published by Infineon Technologies AG

AN214