

Introduction

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Purpose

- Provide an overview of Würth Electronics Midcom's product line for LED lighting applications

Objectives

- Discuss the features and benefits of using Würth Electronics Midcom's passive magnetic solutions for LED lighting projects

Content

- 14 pages

Learning time

- 10 minutes

Welcome to Würth Electronics' product training module.

This module overviews the available magnetics solutions for various LED lighting applications, their key features, and their various applications.

Benefits of Würth Electronics Midcom Transformers for LED applications

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- Use of standard components in transformer designs
- High manufacturability of the transformers
- Highly efficient designs for optimal performance with excellent EMI behavior
- Transformers on Reference Designs of the leading IC manufacturers available from stock at www.digikey.com

Before going into detail about the individual LED drivers, Würth Electronics would like to point out the benefits of using their transformers in LED applications. From the use of standard components to the custom build transformers for reference designs, Würth Electronics puts a large focus on their work with the industry's leading IC manufacturers. The advantages of this focus is the excellent availability of the materials, which leads to a short lead time for prototyping and production. This, and over 30 years of experience in designing and manufacturing magnetics, leads to a high manufacturability of components and offers you, as a customer, the most „economical“ transformer solution. Würth Electronics Midcom's transformers are designed to an optimal performance in your offline LED driver application by offering an optimum built in EMI protection. Würth Electronics is offering transformers from the original reference design of the leading manufacturers of LED Driver ICs at digikey.com.

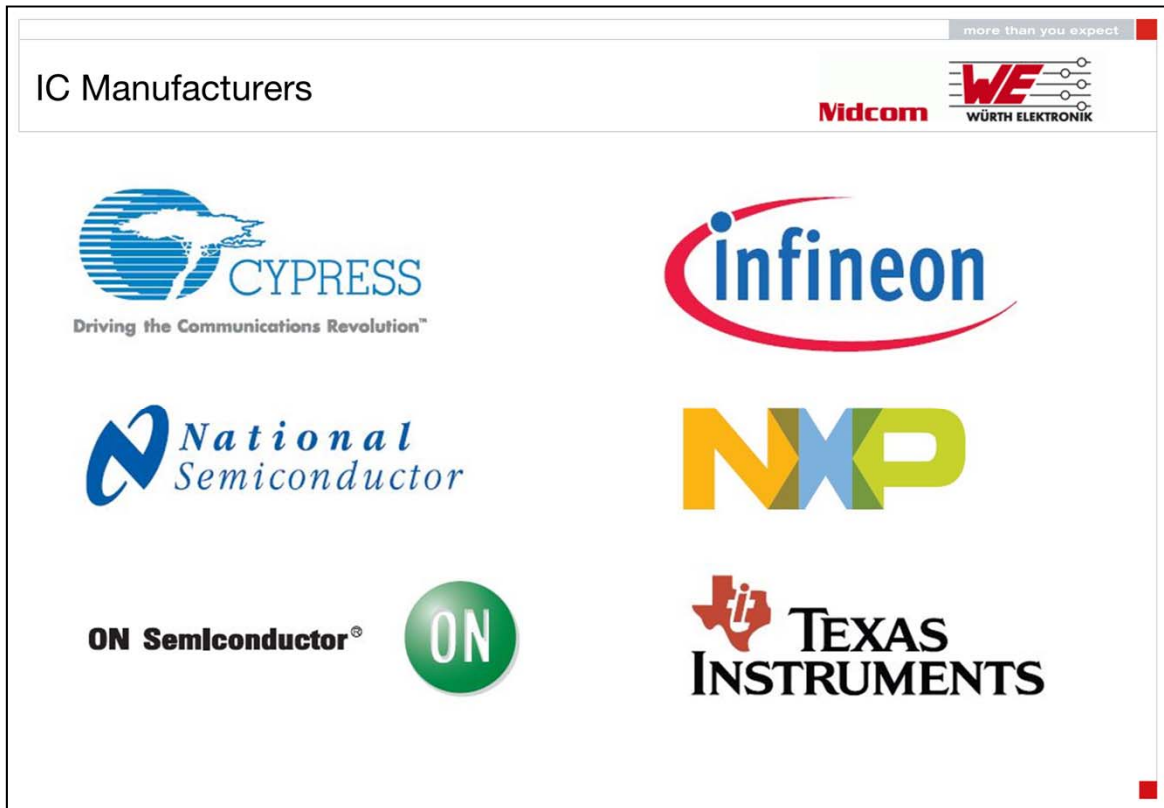
LED Power Supply Requirements



- Input Voltages
- Output Voltages and Currents
- Isolation and Safety Requirements
- Dimming Requirements
- Operating Temperature Range
- EMI Requirements

In order to determine the optimum magnetics solution for any LED power supply application, a clear definition of the following requirements is imperative:

- Input Voltages
- Output Voltages and Currents
- Isolation and Safety Requirements
- Dimming Requirements
- Operating Temperature Range
- EMI Requirements



Würth Electronics continuously engages in the forefront of LED lighting development by working closely with IC manufacturers such as Cypress, Infineon, National Semiconductor, NXP, ON Semiconductor, Texas Instruments, and many others.

As LEDs behave like constant voltage loads with low equivalent series resistance, a switch-mode power supply with constant current output is the generally preferred “driving” method for LED lighting. This is due to its compact design, economy, and efficiency levels up to 90%. These high efficiency levels are achieved with minimal cost by employing a flyback or similar topology, which also features the necessary electrical isolation to meet the safety requirements in different regions. The following are examples of the implementation of Würth Electronic Midcom’s transformer products in different LED lighting applications.

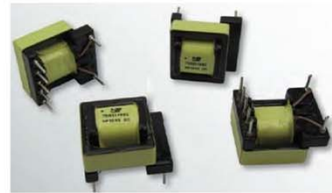
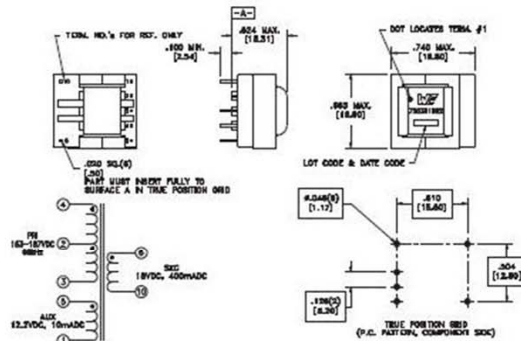
Cypress CY8CLEDAC02

8W Low-Line Dimmable LED Driver

- LED retro-fit of incandescent bulbs
- Input voltage: 108-132V_{RMS}
- 16.5V at 500mA
- Capable of driving 5 white LEDs
- Phase-cut and PWM dimming
- Leading- or trailing-edge dimming detection

750311992 Flyback Transformer for 108-132V_{RMS}

- High energy storage in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- UL1310 compliant
- Package style: EE16/7/5



In Cypress's CY8CLEDAC02 retrofit solution for incandescent bulbs, Würth's 750311992 flyback transformers offer a highly compact design, while maintaining high efficiency and compliance to UL 1310 specification. The transformers are also designed for noise-free operation, especially when utilizing the controller's dimming functions.

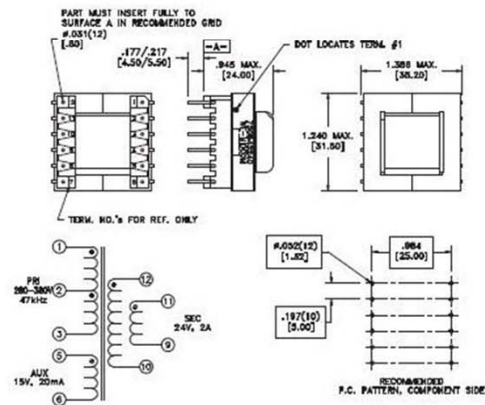
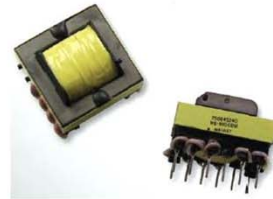
Infineon BCR450, TDA4863

40W LED Street and Indoor Lighting

- LED street and indoor lighting applications
- Up to 40W for 180-270V_{RMS}
- Up to 20W for 90-270V_{RMS}
- 15-26V output
- Power factor correction up to 0.98 and low THD
- Efficiency up to 90%

750845240 Flyback Transformer

- 24V output up to 2A
- Low copper losses
- Operating temperature: -40°C to 125°C
- Primary to secondary isolation of 4500VAC
- Package style: EE30/15/7



For Infineon’s BCR450 street and indoor lighting solution, Würth’s 750845240 flyback transformer offers low distortion and high efficiency performance. It also has a rated isolation of 4500 VAC.



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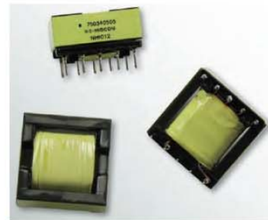
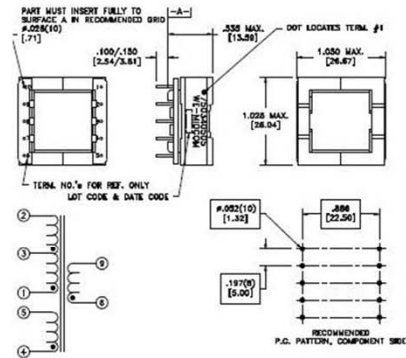
NXP SSL210X

12 to 22W Dimmable LED Driver

- UM10341 for 12W LED applications
- UM10386 for 22W LED applications
- Retro-fit lamps up to 150W
- Shelf and down lighting applications
- Input voltage: 85-276V_{RMS}
- Output voltage of 9-23V and output current of 400-1050mA
- TRIAC dimming compatible

750340505 Flyback Transformer

- Design for varying loads
- Very low AC and DC copper losses
- Operating temperature: -40°C to 125°C
- Primary to secondary isolation of 4000V_{AC}
- Package style: EFD25



NXP's 12-22 Watt Dimmable LED driver replaces lamps with a power rating up to 150 Watts. For this solution, Würth Electronics Midcom offers the 750340505 flyback transformer, which features a universal input voltage capability of 85 Volts to 276 Volts; it also features a low-profile and high-efficiency design.

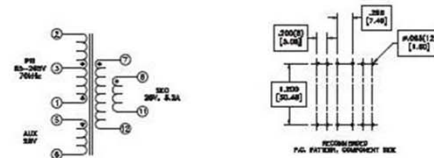
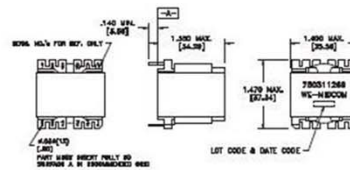
NCL30001, AND8427/D

55V Single State Power Factor Corrected LED Power Supply

- Street and low bay LED lighting
- Reduces EMI signature
- High efficiency, up to 92%
- Input voltage: 90-265V_{RMS}
- Optional dimming function available
- Power factor > 0.9

750311269 Flyback Transformer for 28V Output

- 75W output
- Low copper losses
- Operating temperature: -40°C to 125°C
- Package style: PQ3230



ON Semiconductor's NCL30001 solution for street and low bay LED lighting uses Würth's 750311269 flyback transformers. The 75-Watt output capability of the transformer allows for a high LED illumination for outdoor applications. The transformer enables the system to have an efficiency up to 92%, a power factor of more than 0.9, and a universal input of 90 – 265 Vrms.

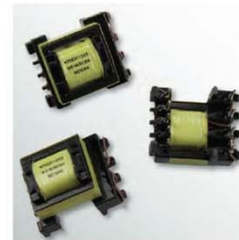
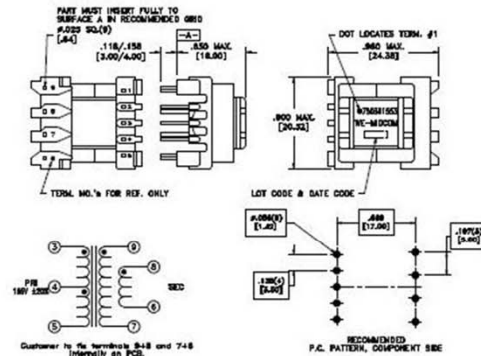
LM3445, AN-2034

120V_{AC} 8W Isolated Flyback LED Driver

- Input voltage: 90-135V_{RMS}
- $V_{OUT} = 12V-30V$
- $I_{LED} = 350mA$
- Line injection circuitry enables PFC > 0.99
- Adjustable LED current and switching frequency
- Non-dimmable

750311553 Flyback Transformer

- High energy in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Design to meet IEC61558-2-17 for reinforced insulation
- Package style: EE16/8/5

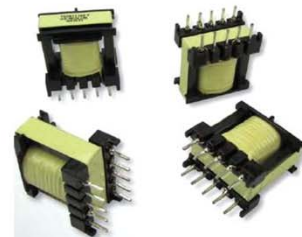


National Semiconductor's 8-Watt driver utilizes Würth's 750311553 flyback transformer. The transformer is designed to exceed a power factor correction of 0.99 for line injection circuits. The transformer is also designed to have reinforced insulation as specified by IEC 61558-2-17.

TPS92210-PMP6001

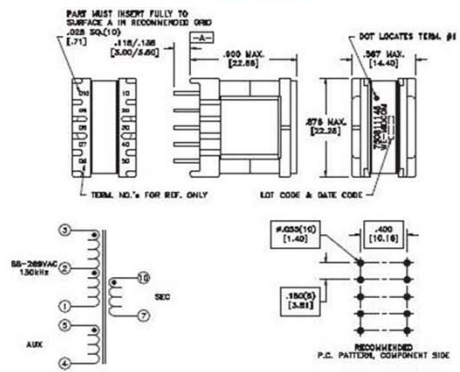
38V, 350mA Non-Dimmable LED Driver

- Non-dimmable light bulb replacement
- Input voltage: 90-265V_{RMS}
- 38V output at 350mA
- Single stage power factor correction
- Isolated discontinuous flyback topology



750811146 Flyback Transformer

- Compact high energy design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation to IEC60950-1 requirements
- Package style: EE20/10/6



Texas Instruments' low-cost **TPS92210-PMP6001** employs Wurth's 750811146 flyback transformer. The transformer has reinforced insulation per IEC 60950-1, while maintaining a relatively low PCB footprint. The transformer allows for a constant LED illumination function with a universal input of 90-265 V_{rms}.

Safety Requirements

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Standards Applicable to LED Lighting

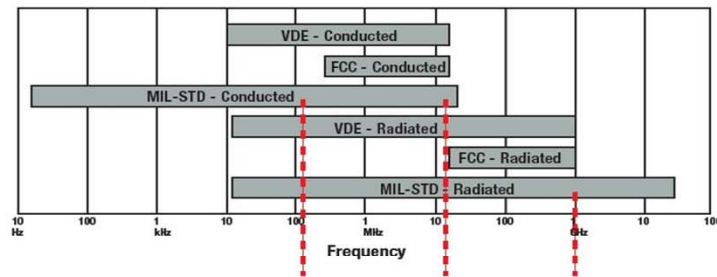
- UL8750 – Specifies the safety requirements for LED light sources and their components.
- UL60950 – Specifies the safety requirements for information technology Equipment.
- UL1310 – Specifies the safety requirements for Class 2 power supplies
- EN61347-2-13 – Specifies safety requirements for DC or AC control gear for LED modules.

	Functional	Basic/ Reinforced
Size	+	-
Pinout flexibility	+	-
Efficiency	+	-
Coupling	+	-
Manufacturing capacity/leadtime	+	-
Cost	+	-
Safety	-	+
Dielectric withstand	-	+

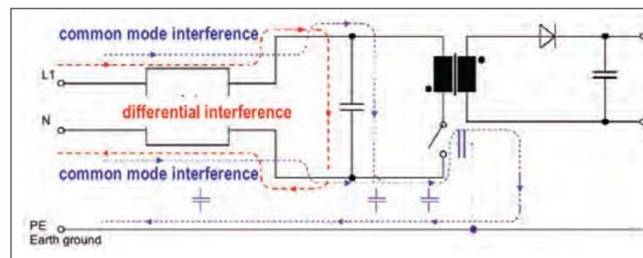
Functional Insulation	Insulation that is necessary only for the functioning of the equipment
Reinforced Insulation	Single insulation system that provides a degree of protection against electric shock equivalent to double insulation
Double Insulation	Insulation comprising both basic insulation and supplementary insulation.
Working Voltage	Highest voltage to which the insulation or the component under consideration is, or can be, subjected when the equipment is operating under conditions of normal use
Creepage Distance	Shortest distance through air along the surface of an insulation material between two conductive parts
Clearance Distance	Shortest distance in air between two conductive parts

The insulation and safety requirements can have a significant impact on the size, performance, cost, and reliability of the transformer. It is therefore critical to select the correct governing standard for the specific design, as well as the level of insulation that will be needed. In general, Functional Insulation is the least stringent type of insulation, in which there are no creepage and clearance requirements – the insulation strength is only verified by a simple hipot test.

Basic and Reinforced Insulation are commonly used for offline input voltages (85-265 Vrms). The difference between the two is Reinforced Insulation holds a more stringent requirement as far as creepage and clearance distance are concerned. These distance requirements are specified within the guidelines of the applicable governing standard. These safety standards include UL8750, UL60950, UL1310, and EN61347-2-13.



Common Mode and Differential Mode Interference



Electromagnetic Interference (EMI) or unwanted noise, is a byproduct of most high-frequency switching devices, such as the drivers needed to operate LED lamps. Noise can be generated by both radiated and conducted emissions.

For radiated noise interference, the solution is to shield certain components, or the entire circuit. Shielding the device blocks the unwanted signals, which are usually over 30MHz. The shielding is usually performed by copper shields to divert, or ferrite shields to absorb, the unwanted signals.

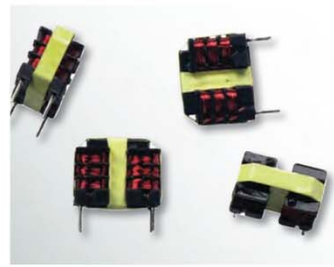
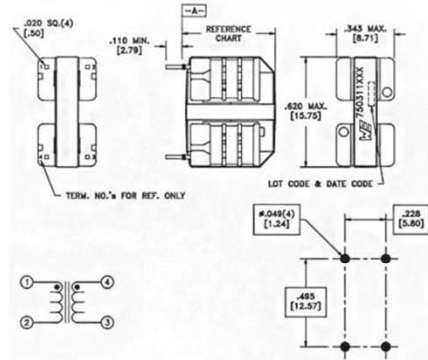
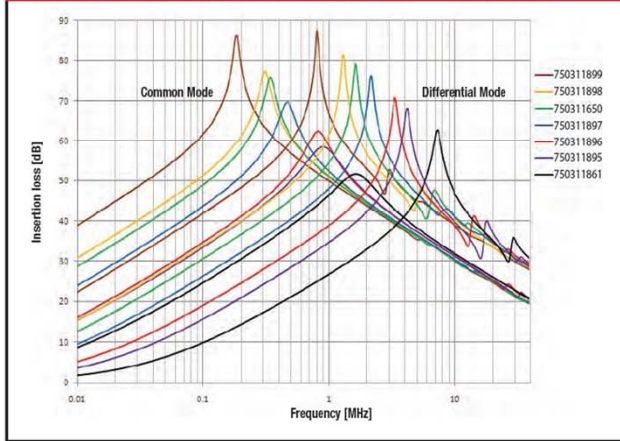
For conducted noise, the problem is from differential mode (symmetrical) interference or common mode (asymmetrical) interference, as seen in the circuit. Differential mode interference can be corrected by adding an inductive component on the Neutral and Line side of the input. On the other hand, common-mode interference can be corrected by using a common-mode choke – this choke has two windings on a common core such that each set of windings create an equal and in-phase magnetic fields; this causes high impedance to the common-mode signal.

Dual Coil Chokes

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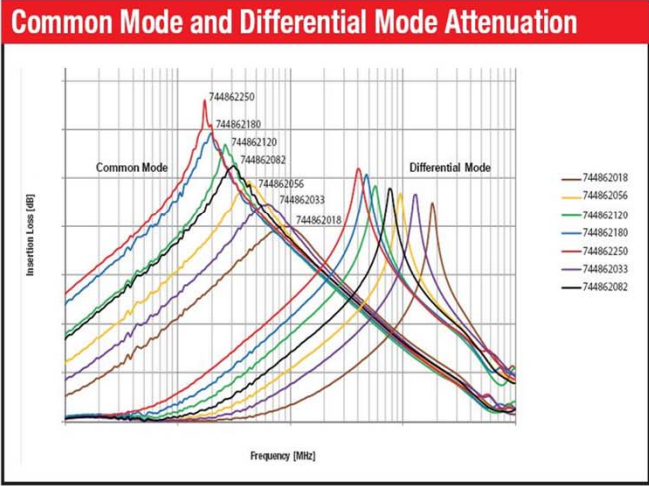
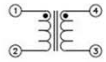
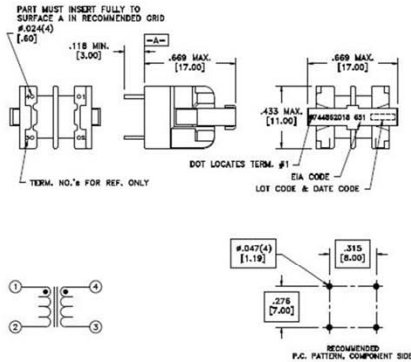


Common Mode and Differential Mode Attenuation



Recognizing the need for a single component solution that would effectively tackle both common-mode and differential-mode noise, Würth Electronics developed the “Dual Coil Chokes Series,” which is a cost effective inductor that would combine the advantages of both a common-mode choke and a differential-mode choke into one device. By utilizing the nature of stray magnetic fields in a coupled winding, Würth Electronics Midcom was able to create a common-mode choke that exhibited a high differential-mode inductance as well.

WE-TFC Chokes



Similar to the “Dual Coil Series,” the WE-TFC chokes also combine the characteristics of both the common-mode and differential-mode chokes into one package, but with different attenuation levels across the frequency range. The WE-TFC chokes also utilize the stray nature of magnetic fields in a coupled winding to maximize differential-attenuation capabilities.

Summary...

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In summary, Wurth Electronics offers a full magnetics solution for your LED Driver with supplying an efficient Offline Transformer in combination with the correct line filter for EMI noise suppression. All products shown are conveniently available from stock at www.digikey.com