



Introduction to:
LLC Transformers





Purpose

- Discuss key benefits of LLC transformers and present Precision capabilities in this area.

Topics

- Introduction to LLC transformers
- Applications
- Benefits
- Technology Options

Content

- 12 Pages

Learning Time

- 5 Minutes

Welcome to the Precision LLC transformer training module. This module will present a general introduction to LLC transformer technology with emphasis on technology benefits and applications. It will also outline Precision's custom and standard product offerings in this area.



What is a LLC Transformer?



- *LLC is one of several types of switch mode topologies for general power supply and battery charging applications.*
- *The LLC transformer is key to determining efficiency of the entire LLC resonant converter.*
- *An optimized LLC topology can provide up to 98% overall efficiency*

LLC is one of several types of switch mode topologies for general power supply and battery charging applications. The LLC transformer is a key component in determining the efficiency of an LLC resonant converter. A LLC resonant power conversion topology minimizes switching losses by promoting zero voltage switching (ZVS), minimizing unnecessary power dissipation in switches. Power dissipation can be lowered to as little as 2%, ensuring 99% transformer efficiency and 98% overall efficiency.



Why is enhanced efficiency important?



Cost Savings



Regulation
Compliance



Environmental
Impact

Energy efficiency plays a key role in reducing environmental impact as well as generating cost savings. Even an enhancement of one or two percent in overall efficiency can dramatically impact energy costs. With federal Energy Star specifications growing tighter, LLC transformers in general and the Precision LLC transformer in particular are well-suited to ensure maximum efficiency. This is an example of a highly-engineered product and market-leading technical support coming together to deliver both cost savings and performance enhancements.



Applications:



**LED & LCD
Televisions**



**Computer &
Laptop**



**Industrial LED
Lighting**



Military



High-end Audio



Appliance

Any AC/DC power converter with a PFC front end

The Precision LLC transformer is ideally suited for use in converters for a wide range of energy-sensitive applications including LED and LCD televisions, industrial LED lighting, high-end audio, computer and laptop power supply, military, appliance and any AC/DC power converter with a PFC front end.



Precision LLC Transformer: **BENEFITS**

Optimized Design

**Optimized
Performance**

Speed to Market

The Precision LLC transformer is unique in the market due to its unique combination of optimized design (resonant inductor and transformer in single package), optimized performance and speed to market.



BENEFITS: Optimized Design



- Two discrete components in a single package
 - Resonant inductor/leakage inductance
 - Transformer
- Up to 75% cost savings
- Up to 50% real estate savings

The Precision LLC transformer combines two discrete components – a resonant inductor and a transformer into a single package. This reduces costs by as much as 75% and real estate by as much as 50%.



BENEFITS: Optimized Performance

Bobbin and
Litz Wire
Optimization



Finite
Element
Analysis



Up to 30% reduction
in losses and cost
with *precise leakage
inductance*

Market-Leading Technical Support

The Precision LLC transformer is backed by market-leading technical support. Experienced engineers study the LLC transformer design to obtain the correct leakage inductance through bobbin and litz wire optimizations and also perform finite element analysis. Their expertise in this area can be applied to each unique application **to reduce transformer losses and costs by as much as 30%.**



BENEFITS: Speed to Market

Extensive stock of Litz wire and bobbins

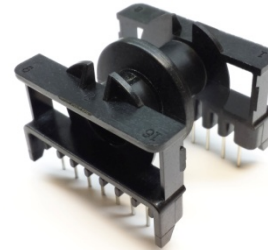
Litz Wire



Sizes Available:

- 36 AWG to 48 AWG individual strand
- 2AWG to 41AWG equivalent wire gauge

Bobbins



Options Available:

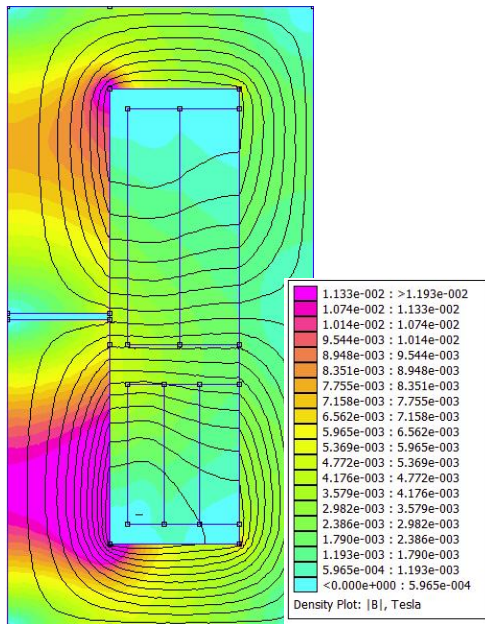
- Support power levels from 50 Watts to 1,000 Watts

Precision's expert technical support is enhanced by the company's extensive stock of litz wire and bobbins. This combination ensures that Precision customers can get the most optimized product, in the shortest amount of time.

The LLC transformer is the heart of a converter's operation and any delay in delivery can add weeks or months to the design cycle. Samples of the Precision LLC transformer can be provided in as little as three days depending on design complexity, speeding time to market.



BENEFITS: Speed to Market



Finite Element Analysis

Speeds time to market by ensuring performance is optimized from the beginning- eliminating the need for design reiterations.

Finite Element Analysis is used to analyze magnetic flux distribution. It can be used to analyze leakage inductance and losses due to skin and proximity effects. In addition to ensuring optimal performance, finite element analysis speeds time to market by ensuring performance is optimized from the beginning- eliminating the need for design reiterations.



Technology Options



Standard
Packages

- 100 to 800W

Custom
Packages

- 800 W and higher

Precision offers both standard and custom packages for LLC transformers. The power ranges of standard packages are between 100 and 800W. High power custom designs are also available. Lead times are as short as three days for samples and as little as 6-8 weeks for production quantities (dependent on technology complexity).



Thank you.

For more information on the Precision LLC Transformer please call 877-892-7107 or email customerservice@precision-inc.com

