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Integrated CMC & DMC Inductor: A Two-in-One Solution for Enhanced EMC Performance

DESIGN NOTE

Introduction

As the demand for compact, cost-effective, and high performance components grows in automotive and e-mobility applications, engineers are under pressure to optimize designs without compromising reliability. Electromagnetic Compatibility (EMC) compliance remains a key design challenge, typically requiring both Common Mode (CMC) and Differential Mode (DMC) filtering. Traditionally, this involves separate inductors for each function, which increases component count, affects PCB space requirements, and raises overall system cost.

This design note introduces an innovative two-in-one inductor design that offers common mode inductance (L_{cm}: 1.51 mH), differential mode inductance (L_{dm}: 13 µH) capabilities and a rated current of 15 A. This design integrates CMC and DMC noise suppression into a single magnetic component. By combining two filtering functions within the same structure, the solution reduces size, cost, and layout complexity—without requiring new equipment investment or additional tooling.

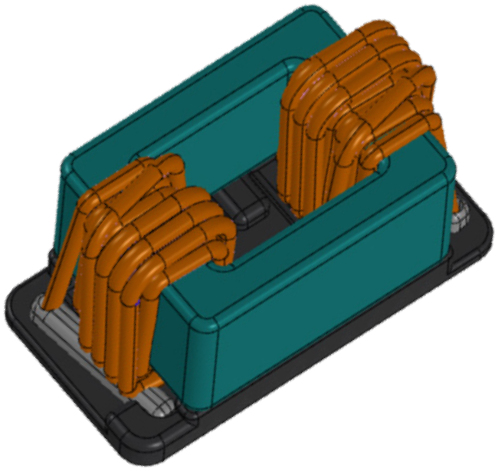

Figure 1. | *3D Render of CMC+ DMC Inductor*

Design Details

The key design concept is a carefully engineered magnetic circuit structure that enables a single set of coils and a shared magnetic core to perform both filtering functions. This approach leverages the natural leakage inductance of a common mode choke when the windings are not fully coupled, utilizing this inherent characteristic as the differential inductance. This eliminates the need for a separate DMC component, resulting in a smaller, more efficient solution.

The design was created to solve two main challenges: space constraints on densely populated PCBs and the need to lower overall system costs. By integrating two components into one, the solution frees valuable board real estate while reducing assembly complexity and material usage.

One of the most notable benefits of this approach is its impact on cost and size. Compared to traditional separate CMC and DMC solutions, the integrated design achieves a 35 % cost reduction and a 15 % reduction in component volume. These advantages make it particularly suitable for applications where both cost and size are critical constraints.

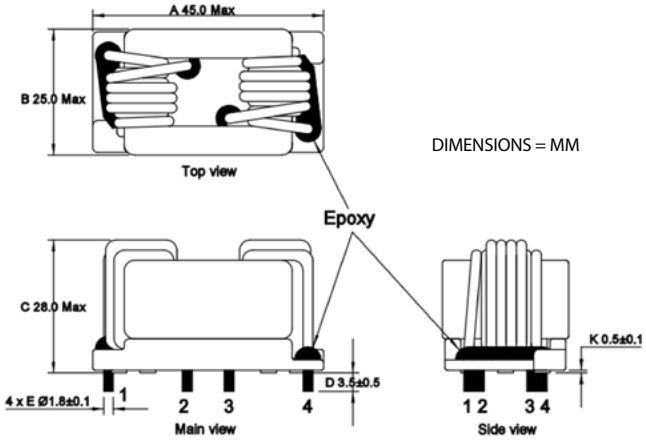

Figure 2. | *Mechanical Specifications of CMC+ DMC Inductor*

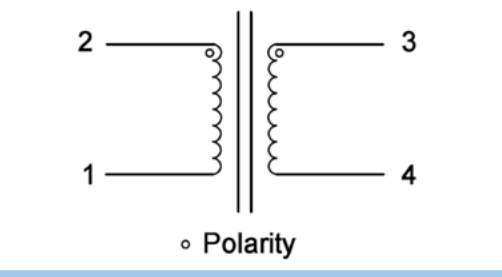

Figure 3. | *Schematic for CMC+ DMC Inductor*

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Design Considerations

However, the integration of two filtering functions into a single device introduces design complexity. Parameters such as common mode inductance (L_{cm}), differential mode inductance (L_{dm}), DC Resistance (DCR), and saturation current (I_{sat}) are all interdependent, meaning that optimizing one can affect the others. For instance, increasing L_{dm} to enhance differential mode suppression may require more winding turns or changes in the winding pattern, but these adjustments can increase parasitic capacitance and degrade high frequency common mode performance.

Customization flexibility is another consideration. In traditional designs using discrete inductors, it is possible to replace either the CMC or DMC independently to meet late-stage design changes. With an integrated solution, any change to one parameter often requires a complete redesign of the component.

Summary

The integrated CMC and DMC inductor offers a streamlined, cost-effective solution to meet modern automotive and e-mobility design challenges. By consolidating two filtering functions into one, it provides a significant **35 % cost reduction, 15 % smaller footprint**, and improved PCB design flexibility—all while utilizing existing manufacturing infrastructure. For applications where every millimeter of board space and every dollar of cost matters, this innovative design presents a compelling alternative to traditional solutions.

To learn more about how this integrated inductor can be tailored to your specific application requirements, contact your local Bourns representative or use the contact button below to contact us.

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