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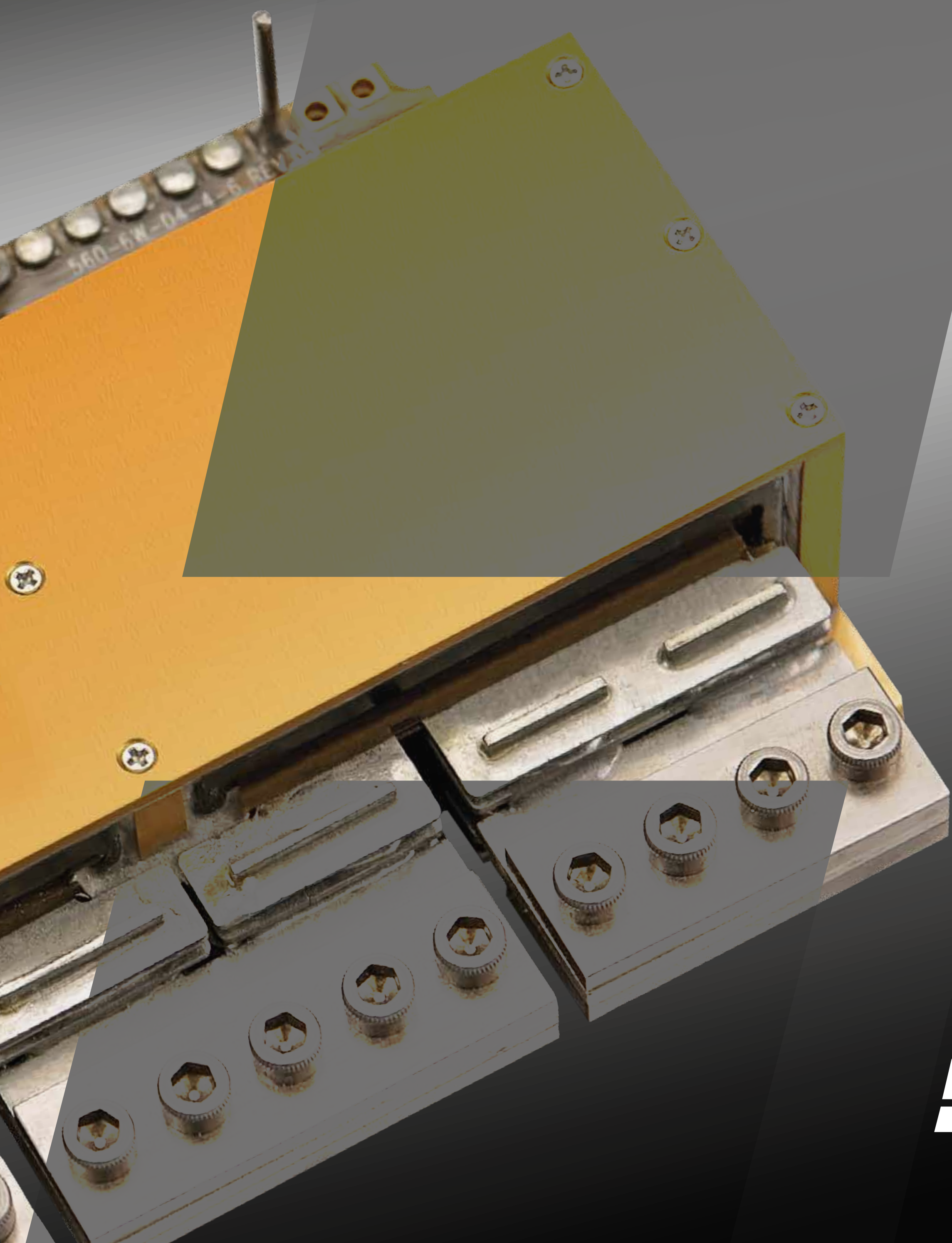
MINIMIZING FRINGING EFFECTS

Gapped Transformers and Inductors



Standex Electronics

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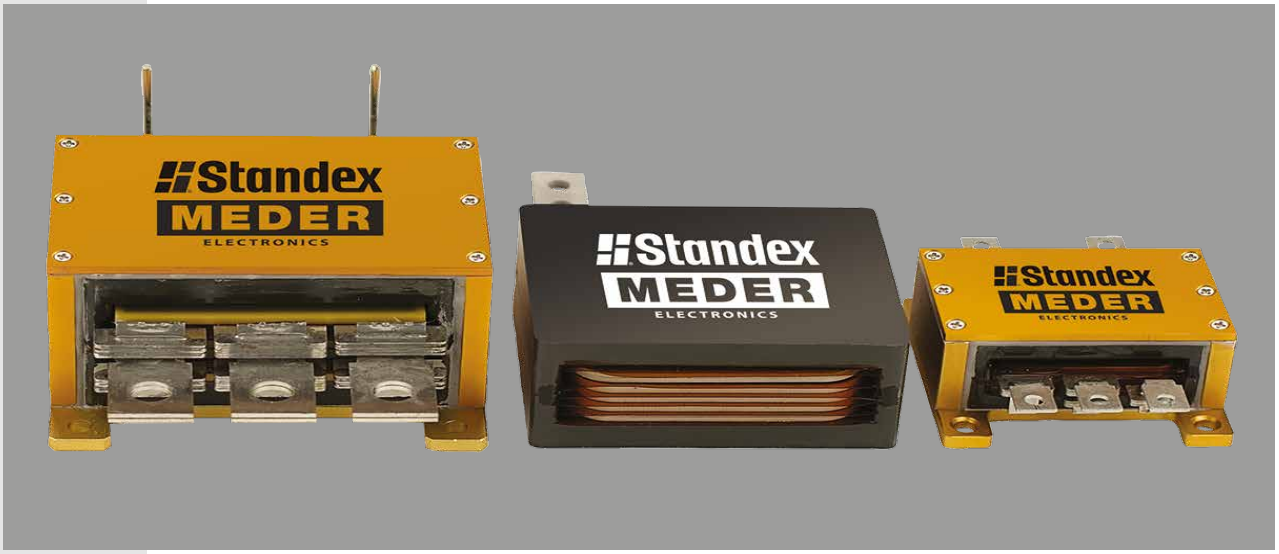

Fringing effects in gapped transformer and inductor designs can lead to unwanted variations in performance and efficiency. These effects occur due to the magnetic field lines spreading out into the surrounding air, causing non-uniformity and energy loss. Minimizing fringing effects is essential for achieving accurate and efficient operation in these components. Here are some strategies to mitigate fringing effects:

1. Core Shape and Gap Design

Choose a core shape that minimizes the path length for magnetic flux lines to traverse. Additionally, the gap in the core should be designed carefully to ensure that the magnetic field lines are concentrated within the core material as much as possible.

2. Gap Material

Select a gap material with magnetic properties that help confine the magnetic field lines. This material should have low permeability to reduce fringing effects. Some common gap materials include air, plastics, or non-magnetic alloys.

3. Proper Gap Placement:

Position the gap in a way that reduces the length of the magnetic path around the gap. Placing the gap closer to the center of the magnetic circuit can help minimize the fringing effects.

4. Use of Magnetic Shields: Employ magnetic shields or screens around the transformer or inductor to redirect the magnetic field lines back into the core material. Magnetic shields can help confine the magnetic flux and reduce fringing.

5. Ferrofluids: Introduce ferrofluids (magnetic fluids) into the gap region. These fluids have magnetic properties that can help channel the magnetic flux lines and reduce fringing.

6. Field Confinement Techniques: Utilize design techniques such as shaping the core to funnel the magnetic flux lines into the desired path, thereby minimizing their spread into the surrounding air.

7. Increased Core Permeability: Select core materials with higher permeability to concentrate the magnetic field lines within the core. However, this needs to be balanced with other factors like saturation and core losses.

8. Tapered Gap Design: Gradually taper the gap width as it approaches the center of the core. This can help guide the magnetic flux lines back into the core material.

9. Simulation and Analysis: Use electromagnetic simulation software to model the magnetic field distribution and fringing effects in your design. This can help you optimize the gap dimensions and core shape to minimize fringing.

10. Iterative Testing and Optimization: Build and test prototypes with different gap configurations and materials. Experimentation can help you identify the best combination of design parameters to minimize fringing.

11. Consideration of Component Dimensions: Make sure the component dimensions are suitable for the intended application. Smaller gaps and more compact designs can help reduce fringing effects.

12. Multi Layer Windings: Make sure the component dimensions are suitable for the intended application. Smaller gaps and more compact designs can help reduce fringing effects.

Minimizing fringing effects requires a combination of thoughtful design, material selection, and testing. It's important to strike a balance between reducing fringing and meeting other performance requirements such as core saturation, efficiency, and thermal considerations.

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Standex Electronics

Standex Electronics
Worldwide Headquarters
4150 Thunderbird Lane
Fairfield, OH 45014 USA
+1.866.STANDEX (782.6339)
info@standexelectronics.com

Agile Americas (NH)
+1.800.805.8991
info@agilemagco.com

Northlake Americas (WI)
+1.262.857.9600
sales@northlake-eng.com

Renco Americas (FL)
+1.800.645.5828
sales@rencousa.com

StandexMeder Europe (Germany)
+49.7733.9253.200
salesemea@standexelectronics.com

StandexMeder Asia (Shanghai)
+86.21.37606000
salesasia@standexelectronics.com

Standex Electronics India (Chennai)
+91.98867.57533
salesindia@standexelectronics.com

Standex Electronics Japan (Kofu)
+81.42.698.0026
sej-sales@standex.co.jp

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