Low losses at high frequencies

The new EPCOS N59 ferrite material is particularly suitable for power supplies and inverters whose design is based on GaN semiconductors with very high switching frequencies. Optimum power is reached at a frequency of 2 MHz.

The latest generation of switch-mode power supplies and inverters has to fulfill high demands: low system costs, high power density, low volume and high efficiency. A dramatic increase in the switching frequencies is one possibility for fulfilling these key criteria. Such high frequencies can be achieved with GaN-based circuit breakers. But with the new designs, increasing demands are also being made on the passive components. This applies in particular to the ferrite materials used, which must feature low losses, especially in the MHz range. The new EPCOS N59 ferrite material was developed specifically for these requirements and is optimized for a frequency range from 700 kHz to 2 MHz. The maximum transmissible power is reached at a switching frequency of 2 MHz and an operating temperature of 100 °C. The ferrite material’s Curie temperature is in excess of 280 °C.

The N59 ferrite material is particularly suitable for transformers based on toroidal core topologies. The outstanding properties of this material enable the design of considerably more compact power supplies. At the same time, its efficiency is improved due to the low losses of the ferrite material, which is why the use of N59 contributes to significantly greater energy savings. The graph shows the power factors of the existing N87 and N49 ferrite materials in comparison with the new N59 material as a function of the frequency. Measurements were made on toroidal cores with an operating temperature of 100 °C.

Figure 1:
Power factors of different ferrite materials: At 2 MHz the new EPCOS N59 ferrite material offers a power factor of around 60,000, making it clearly superior to other ferrite materials.
Main applications

- Transformers in power supplies and converters that operate with fast-switching power semiconductors on a GaN basis.

Main features and benefits

- Low power dissipation in the frequency range from 700 kHz to 2 MHz; maximum transmissible power at 2 MHz.

Key data for N59

<table>
<thead>
<tr>
<th>Initial permeability $[\mu_l], 25 , ^\circ C$</th>
<th>Flux density $[mT]$</th>
<th>Frequency range $[kHz]$</th>
<th>Losses $[kW/m^3]$</th>
<th>Curie temperature $[°C]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>800 ±25%</td>
<td>380 to 470</td>
<td>25 to 3000</td>
<td>300 to 330</td>
<td>&gt;250</td>
</tr>
</tbody>
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