

Power Inductor design improvements with new Nanomet® soft magnetic low loss high saturation material

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Power inductors play a vital role in state of the art power electronic circuits. Their parameters dictate switching frequencies and mechanical sizes, with material improvements size and weight of power electronics can be significantly reduced or efficiencies increased.

Keywords: Boost, PFC, high power, miniaturization

1. Introduction

Soft magnetic power materials typically are a trade off between permeability and maximum magnetic flux density capabilities and build a straight line:

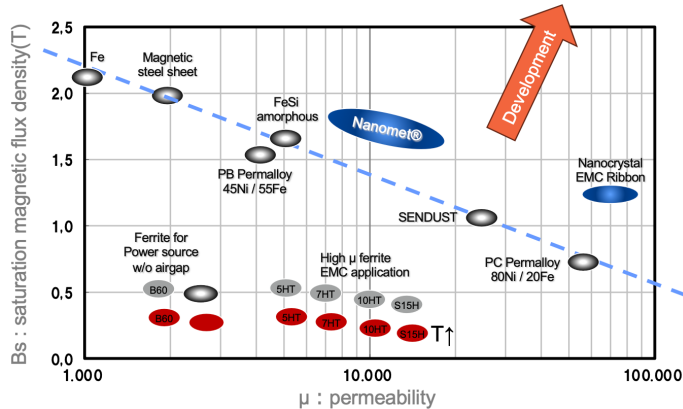


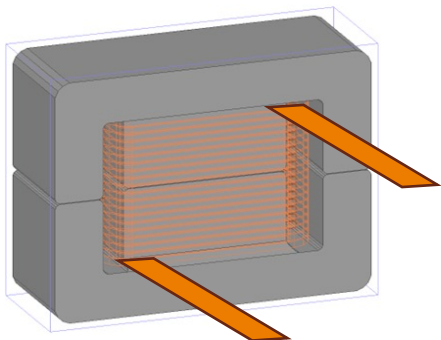
Figure 1: Typical distribution of soft magnetic materials Bs / μ_r

Nanocrystal based materials are crossing boundaries and take electronics to the next level.

2. Results and discussion

Through simulation and measurements the performance differences become visible taken an example of a PFC inductor with the following parameters:

- 150μH(0A), 100μH(50A), 200kHz (10A_{p-p}), 45A_{DC}:



Comparing different soft magnetic materials, where these parameters will be discussed:

- Core loss

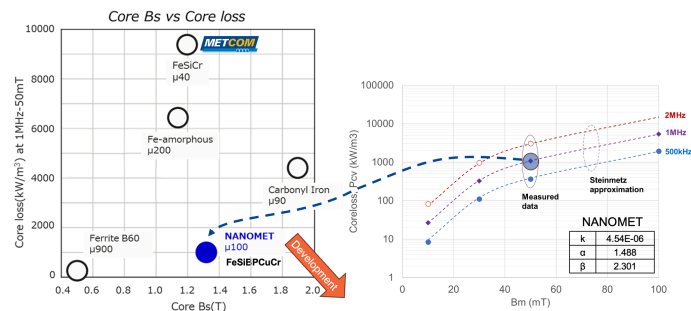


Figure 2: Core loss examples and Steinmetz coefficients

- Hard and soft magnetic saturation, temperature dependence, Permeability, impact of discrete air gaps

measured ring core OD13 x ID8 x h5mm				
Material	Ferrite	Metal composite	FlakeComposite	NANOMET®
composition	Mn-Zn	FeSiCr	FeSiAl	FeSiBPCuCr
Permeability	900 (100 w/gap)	25	100 / 200	100
Bs(T)	0.5	1.2	0.7	1.3
μ-Temp.	Fluctuate	Stable	Stable	Stable
Core loss	Small (relative loss :1)	High (relative loss :50)	High (relative loss: 25)	Medium (relative loss :5)
Core's Resistivity (reference)	10 ¹² Ωcm	10 ¹⁰ Ωcm	10 ¹⁰ Ωcm	10 ¹⁰ Ωcm
Cross Section of core				

Figure 3: Soft magnetic material key parameters

References

[1]
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