

Technology market
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Offer № 025PA

A method for measuring the electrical properties of soft magnetic ferrite materials

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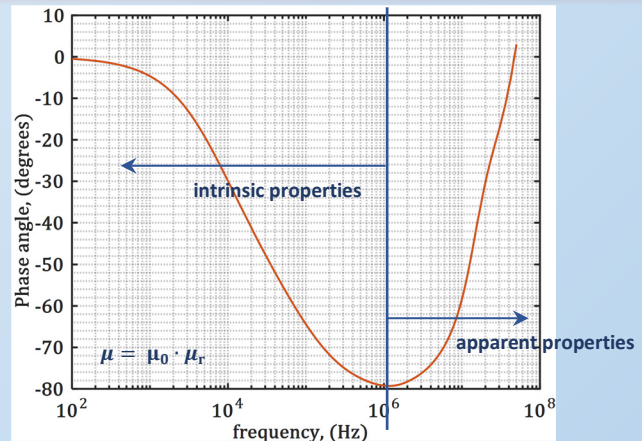
A method to wide-frequency measurements of the electrical properties of soft magnetic ferrite materials used for magnetic cores of high-frequency magnetic components has been developed at TU – Sofia, for which an application for a patent for an invention has been filed in Bulgaria.

Application № **113742**

An example illustrating the prior art:

Phase angle of measured impedance of a sample with parameters as follows

- material: Mn-Zn ferrite
- cross-section: 18 x 2 mm
- height: 10 mm



With a new method from TU – Sofia, the frequency-dependent intrinsic electrical properties (electrical conductivity and relative permittivity) of soft magnetic ferrite materials can be measured in an extended frequency range.

The challenge is to avoid non-uniformity of the electromagnetic field within the sample's volume during the measurement. This is usually achieved by using a sample with the smallest cross-sectional dimension of 1-2 mm. Measurements with such a sample, however, are characterized by difficulties in implementation. In addition, even with a sample of this dimension, due to field non-uniformity, the intrinsic electrical properties are practically unmeasurable above 2-3 MHz.

Technical solution

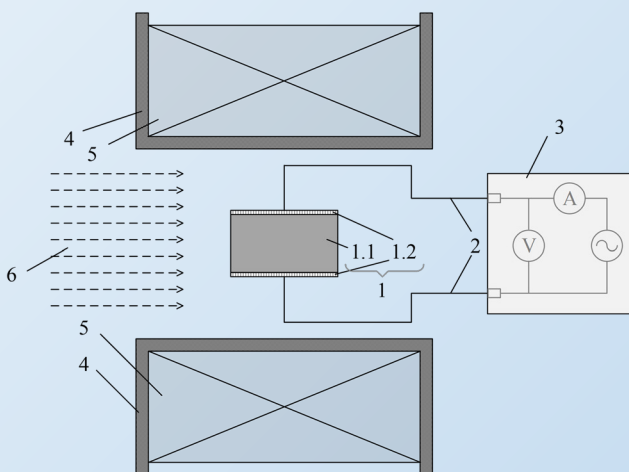
A researcher from TU-Sofia has invented a method for measuring the intrinsic electrical properties of soft magnetic ferrite materials, which provides an upper frequency limit of the measurement, higher than the maximum achievable, characteristic of the prior art (2-3 MHz). The method is implemented by measuring the impedance of a capacitor formed by the sample and parallel electrodes with which it is in ohmic contact, and during the measurement the sample is placed in the conditions of an externally applied static magnetic field. In doing so, the permeability of the sample is suppressed to a value close to that of free space, through which the wavelength within the volume of the sample as well as the skin depth, increase. The latter leads to an increase of the frequency at which the field within the sample acquires a non-uniformity significant for the measurement. The method can be applied by placing the sample in the hollow part of a spool around which a wire is wound, through which a direct current flow, which creates a static magnetic field propagating within the hollow part of the spool and within the sample's volume.

Application and advantages

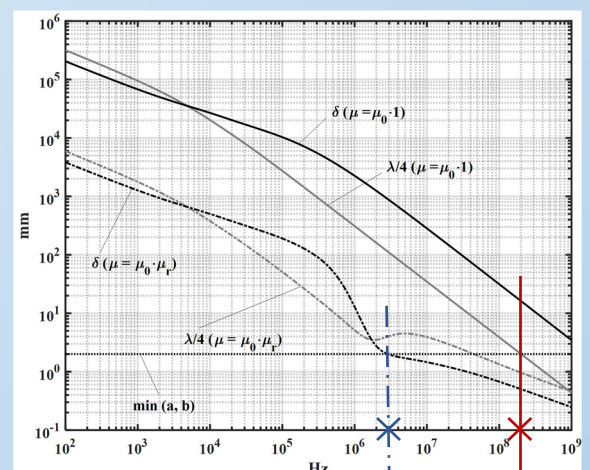
Soft magnetic ferrites are the dominant material for making magnetic cores for high-frequency magnetic components for switching converters of electrical energy. The developed method allows for the characterization of the electrical properties of these materials in a wide frequency range, which data ferrites' manufacturers do not provide currently in the technical sheets of the offered materials. Knowledge of the inherent frequency dependences of the electrical properties of ferrites is necessary to estimate the losses in the magnetic component's core, especially when operating at high frequencies, which is a trend in the development of switching converters, as well as when working with large cores, which is a necessity in high power transfer.

The invented method allows measuring the intrinsic electrical properties of soft magnetic ferrites with large values of permeability and permittivity in a frequency range with an upper limit higher than that of the prior art. Another advantage of the method is that for measuring the intrinsic electrical properties, samples with larger cross-sectional dimensions can be used compared to the prior art for the same frequency range, which presents convenience for the measurement implementation.

Technological images



- 1.1 – sample of the soft magnetic material under test
- 1.2 – electrically conductive plates
- 2 – electrical conductors
- 3 – apparatus for measuring electrical impedance
- 6 – static magnetic field with intensity H_{bc}



intrinsic properties when $\mu = \mu_0 \cdot \mu_r$

intrinsic properties when $\mu = \mu_0 \cdot 1$

min (a,b) – smallest cross-sectional dimension of an example sample

$\delta (\mu = \mu_0 \cdot \mu_r)$ and $\lambda/4 (\mu = \mu_0 \cdot \mu_r)$ – the skin depth and quarter wavelength within the example sample volume in case of normal magnetic properties of the sample

$\delta (\mu = \mu_0 \cdot 1)$ and $\lambda/4 (\mu = \mu_0 \cdot 1)$ – the skin depth and quarter wavelength within the example sample volume when the magnetic properties of the sample are identical to those of free space

Contact for this offer



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