Characterization of radiated noise on flexible magnetic film EMI filters

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Recently, in accordance with rapid progress of the digital electronic equipment which is capable of high speed image data transmission, the electro-magnetic interference (EMI) becomes more serious. Most of the radiated emission noise is due to the common mode noise current in the data cables connected to digital equipment. To provide an effective solution for the problem, Mn-Zn or Ni-Zn soft ferrite beads are conventionally used as the common-mode noise filter to reduce a type of electrical noise [1]. When the ferrite beads surrounded a data cable, the bead cores can be used to reduce the radiated magnetic wave generated from the common-mode noise current. However, permeability values of the ferrite materials are too small to fabricate a small bead core over the MHz ~ GHz frequency range because of Snock's limit [2]. Moreover, the large volume of the ferrite bead on the data cable poses a severe problem for miniaturized device design. Although several amorphous materials with high permeability have been proposed as a candidate material for the smaller EMI noise filter [3], the bead filters have still difficulties in the application of the miniaturized devices or the flexible devices.

In our study, impedance characteristics were investigated for the possibility of employing the flexible magnetic film as a noise filter over the frequency range from MHz to GHz. The effective impedance was determined by the dimensions of filters and the intrinsic material properties, including complex permeability. The impedance was mainly due to the inductance for the flexible magnetic film but to the inductance and resistance for the conventional ferrite bead core in a frequency range of 100 to 800 MHz. Although the inductance of the flexible magnetic film was much lower than that of the ferrite bead until 40 MHz because of lower initial real permeability, the inductance exceeded the level of the ferrite bead in the frequency range of 40 to 800 MHz. The higher inductance at the frequency range was attributed to the area dimension of the magnetic thick film as well as the initial imagery part of permeability. The higher inductance was, the better the effect was reached to filter out the common-mode noise. As a result, the noise emission from a data signal cable was effectively attenuated by employing the flexible type magnetic film as a common-mode noise filter.

Keywords : soft magnetic materials; electromagnetic noise; magnetic composites; inductance; noise filter

References

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