Piezoelectric electromagnetic interference filter

Reference No: B78011

CHALLENGE

Electromagnetic interferences (EMI) are caused by high-frequency switching within an electric device and can negatively affect the performance of neighboring components or devices. As a consequence, manufacturers have legal responsibilities to fulfill strict EMI standards, such as the CISPR 22 standard. EMI arise at harmonics of the operation frequency of the electric device and are typically attenuated by means of conventional EMI filters. Such filters consist of capacitors and chokes and, therefore, work in a relatively broad frequency range. A selective attenuation of disturbance peaks is not possible. Especially at low frequencies, conventional EMI-filters lead to a considerable increase of the cost and size of an electric device.

INNOVATION

The present invention consists of a piezoelectric EMI suppression component (PISC), which is based on the piezoelectric effect. In particular, the electro-mechanical resonance of a piezoelectric element is utilized to suppress EMI-disturbances. The invention provides the following advantages:

- **Selective attenuation of specific peaks** of a disturbance spectrum (see figure below) by utilizing the resonant effect of the piezoelectric element. As a result, the geometric dimensions and cost of the EMI-filter can be considerably decreased.
- Besides the resonance frequency, the piezoelectric element behaves like a capacitor. It can therefore **fully substitute a conventional filter capacitor.**
- **By a specific design** of the piezoelectric element or by connecting multiple piezoelectric elements, **more disturbance peaks can be attenuated at the same time.**
- PISCs can **substitute conventional X- and Y-capacitors,** as many piezoelectric materials exhibit **favorable properties regarding insulation and break-down voltages.**

COMMERCIAL OPPORTUNITIES

The invention enables a reduction in size, weight and cost of unavoidable EMI-filters. It can be integrated in different kinds of electric circuits and can be used for switched-mode power supplies, line filters, electric power circuits and motor drives.

DEVELOPMENT STATUS

Prototypes have been built and successfully tested.

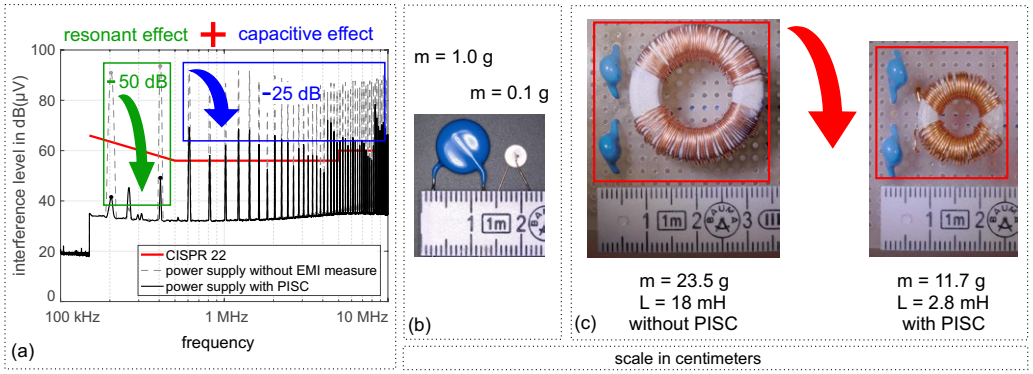

Figure: (a) Exemplary disturbance spectrum; the implementation of piezoelectric elements (PISC) as an EMI measure enables an improved attenuation of two disturbance peaks (green box). The piezoelectric elements are chosen that their resonance frequencies coincide with the disturbance peaks. Besides their resonance frequencies, PISCs behave like regular filter capacitors (blue box).

(b) Size and weight comparison of a conventional filter capacitor (left) and a PISC-prototype (right).

(c) Size and weight reduction of a conventional EMI-filter.

REFERENCES:

1 F. Hubert et al., „Novel EMI-Suppression Method for Galvanically Isolated Converters“, 10th International Conference on Power Electronics and ECCE Asia (ICPE 2019), Busan, South Korea, 2019, pp. 2080-2087.

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