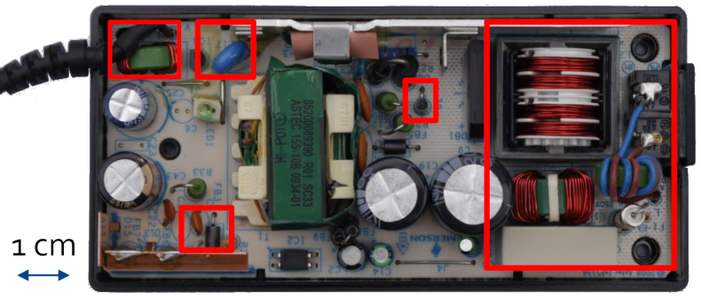
Piezoelectric EMI Filter

Switched-mode power supplies are ubiquitously used to power or charge low-voltage devices such as computers and smartphones. However, their high-frequency switching also creates electro-magnetic interference (EMI) that may disturb other components or devices if released back into the electric grid. As a result, EMI filtering components must be added to the power supply, noticeably increasing its overall size. By specifically targeting the most critical disturbance peaks, this invention enables a significant reduction in size, weight and cost of unavoidable EMI filters.



Selectively target disturbance peaks with piezoelectric resonance

IP RIGHTS
US, JP granted
EP, CN, KR
pending
2024

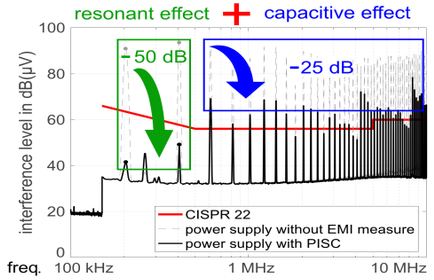
The invention consists of a piezoelectric interference suppression component (PISC) integrated into an EMI filtering circuit in place of a regular X- or Y-capacitor. The PISC's electromechanical resonance is thereby employed to suppress EMI disturbances:

01 By tuning the resonance to the most critical disturbance peaks, these are the most strongly attenuated.

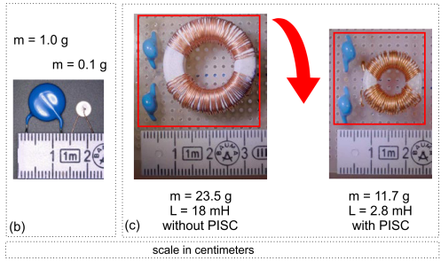
02 At the same time, the PISC attenuates other, especially higher frequencies just like a regular capacitor.

03 As a result, the same required attenuation levels can be achieved by a smaller EMI filter.

04 This saves material costs and reduces the overall space requirements of the power supply.



Exemplary disturbance spectrum: The piezo-electric resonance of the PISC strongly attenuates two select disturbance peaks (green box). At the same time, the other peaks are capacitively damped (blue box).



Not only can the PISC prototype replace a larger capacitor. The size and mass of necessary complemental chokes is even more strongly reduced (above). Due to the extent of filtering components in a typical power supply (left, red boxes), the savings potential is significant.

REFERENCES:

Patent appl. EP3815229A1

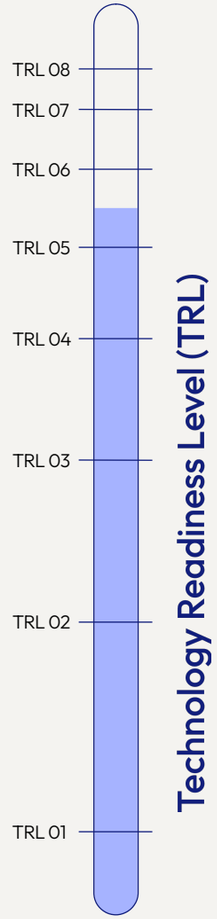
Hubert et al. IEEE TPEL vol. 36 (6), 6624-43 (2021)

CHALLENGE

Due to the potential negative effects of EMI on neighboring components or devices, manufacturers have legal responsibilities to fulfil strict EMI standards, such as the CISPR 22 standard. This is typically addressed by means of filters consisting of capacitors and chokes. These cannot selectively target specific disturbance peaks and are rather ineffective at low frequencies. Thus, conventional EMI filters lead to a considerable increase in the cost and size of an electric device.

INNOVATION

As EMI typically arises at higher harmonics of the switching frequency of an electric device, its frequency composition is largely predictable. The geometry of the PISC, and thereby its resonance frequency, can thus be tuned to fit a desired disturbance peak. By specific design, several peaks can even be resonantly attenuated by the same element or group of elements. Thereby, the PISC will typically be smaller than the regular capacitor it replaces. Moreover, the choke used to reduce residual high-frequency EMI not sufficiently addressed by the PISC to below the CISPR 22 boundary can also be smaller than for a regular capacitor.



01 Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstrated in operational environment · **08** System complete and qualified

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