# Diagnostics with EM emissions in supraharmonic frequency range

## Summary

*This PhD study builds upon the investigation of power supplies' operating fingerprints, targeted for improvement of the diagnostic methods of electronic power supply units. The main target of the investigation includes analysis of the conducted disturbances in frequency ranges below 150 kHz.*

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| Research field: | Electrical power engineering and mechatronics |
| Supervisor: | Dr. Lauri Kütt |
| Availability: | This position is available. |
| Offered by: | School of Engineering<br>Department of Electrical Power Engineering and Mechatronics |
| Application deadline: | Applications are accepted between May 03, 2021 00:00 and May 31, 2021 23:59 (Europe/Zurich) |

## Description

Supraharmonic frequency rages (9 kHz - 150 kHz) are rather occupied with different transients and noise, induced by and originating from different power supplies. While the frequency ranges above 150 kHz are rather well regulated by standards, the lower frequency areas are more of a "wild west" area, without even filters available to address these frequencies. On the other hand, the below-150-kHz range is subjected to several different traces of the switching power supplies, prone to change in characteristics as the power supply components age.

This research will focus on the potential failure mechanisms in power supplies, including main functional component failures but also failures of filters. Aging and wearout of the components will be analyzed theoretically and in physical operating conditions. The identified operation characteristic variations will be mapped onto the conducted EM emissions, with targets to forecast potential critical failures. EM-emissions characterization will be focused on the assumption of connectivity to the distribution networks (both AC and DC supply included).

Besides power converters, the research will also address filtering aspects of the supraharmonic frequency range for limiting the EM-emissions to the distribution grids. Different emission and propagation characterization methods will be included to define possible failure mechanisms locating options. Measurement and processing methods of the sensed data for the appropriate quantities in storage and complexity on the physical application levels, optimized data transmission will be proposed.

**Qualifications of applicants**

**Required:**

- MSc in Electrical or Electronics engineering
- Very good comprehension of electromagnetics (courses in physics and electromagnetics passed with high grades)
- Previous knowledge of (courses passed with high grades): power supply converters, power networks, measurements

**Preferred:**

- Courses passed in electronic product design, electromagnetic compatibility
- Good comprehension of (courses passed with high grades): wideband signal analysis, data communication, database engineering, multiphysical modeling (FEM)

**Notable:**

- Industrial experience with applied electromagnetics, product design, electric power grids and/or electronics

- Previous connections to electromagnetic compatibility aspects related engineering practice

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