

## TUTORIALS

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### Tutorial Title

Recent findings on EMC issues related to the harmonic behaviour of modern power electronic devices

### Abstract

High efficiency, controllability and flexibility in operating electric appliances and networks are considered as key enablers for the future electricity distribution. As a consequence, the numbers of modern power electronic (PE) devices based on self-commutating circuit topologies with switching frequencies well above 2 kHz have already vastly increased and will continue to increase even more in the future. Inverters for photovoltaic applications, converters for battery storage systems or active power factor corrected rectifiers for electric vehicle chargers are only a few examples. In many cases, due to existing requirements and regulations, the design of these devices is optimized for their performance at power frequency only. This is a non-holistic approach, which often results in less robust modern PE devices and in a range of adverse interactions with the network at frequencies other than the power frequency. Due to the utilized switching frequencies, the impact of those devices especially in the frequency range below 2 kHz is often underestimated or even unknown.

This tutorial aims to provide an overview of some recent findings and state-of-the-art on EMC issues in the frequency range below and, for some aspects, also above 2 kHz related to modern PE devices in distribution networks. After a brief introduction, including an update on some relevant standardization activities, different issues will be presented from both equipment and system perspectives, emphasizing the mutual importance and close relationship between emission and impedance. The key findings will be illustrated using laboratory tests and field measurements.

### Speakers

Speaker 1 (Organiser)	Name	Jan Meyer
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### Additional Info

Content:

1. Welcome and introduction
2. Background
  - Basics and definitions
  - EMC concepts
  - Current state of standardization activities
3. Harmonic emission, immunity and interactions
  - Performance assessment for power electronic (PE) devices
  - Modelling of PE devices
  - Example measurements
4. Harmonic impedance and resonances
  - Frequency-dependent impedance
  - Characteristics of equipment and networks
  - Case studies of a resonance below 2 kHz and above 2 kHz



**V** : Università  
degli Studi  
della Campania  
*Luigi Vanvitelli*

