

Synthetic Signals for the Evaluation of Low-Voltage Grid's Measurement Methods

Alexander Gallarreta, Jon González-Ramos, Igor Fernández, David de la Vega, Amaia Arrinda, Itziar Angulo.

University of the Basque Country (alexander.gallarreta@ehu.es)

Introduction

- There is no regulatory framework for supraharmonic measurements (2-150 kHz) in the LV grid.
- Measurement methods with different specifications have been standardized: CISPR 16-1-1, IEC 61000-4-7, IEC 61000-4-30
- These measurement methods provide non-comparable results for the same input signals.
- To calibrate the measurement methods, research and standard test signals have been defined, but they do not contain PSD values for the whole band (9-150 kHz) to evaluate the accuracy of the methods.

Objectives

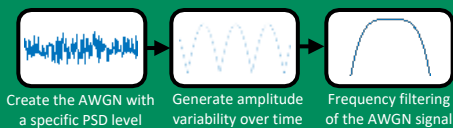
- Define a methodology to generate synthetic test signals similar to the disturbances present in the LV grid.
- Describe the mathematical model to obtain the PSD 'reference levels' of the synthetic test signals for the whole frequency range (2-150 kHz).

Methodology to generate test signals

Two techniques to generate synthetic test signals with known PSD levels have been defined.

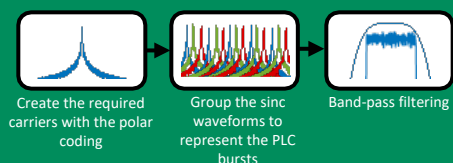
AWGN-based synthetic test signals

It takes advantage of the homogeneous spectral amplitude of the AWGN.



Test signals based on polar coding

It is used to generate synthetic PLC bursts of different protocols: PRIME, G3-PLC, etc.



Reference values of PSD

The 'reference levels', or the theoretical PSD values, are calculated

AWGN-based synthetic test signals

Considering the AWGN power is homogeneously distributed in the spectrum, the reference values are calculated as the PSD multiplied by the frequency response of the filter.

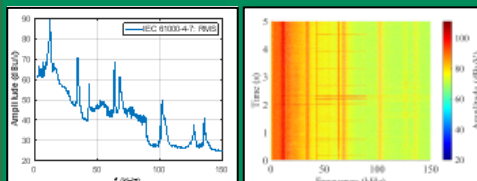
Test signals based on polar coding

As the PSD of the polar coding is a sinc function, the reference levels are calculated multiplying the amplitudes in the spectrum by the frequency response of the filter.

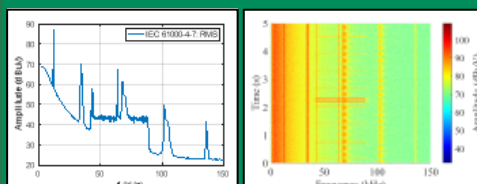
Combining emissions

Signals similar to those recorded in the LV grid can be generated by combining different types of test synthetic signals.

LV grid's real signal



Synthetic test signal



Conclusions

Two techniques to generate synthetic signals with known PSD reference levels have been created. They provide flexibility to generate ad-hoc waveforms with special particularities. The synthetic test signals are useful allow to evaluate the accuracy of the measuring methods.