

Electromagnetic Interference on Static Energy Meters

Master thesis project

Summary:

Find the relation between certain waveform parameters and static energy meter errors, such as under estimations or over estimations of the energy bill, or completely freezing of the static energy meter.

Problem definition:

Static energy meters, which are used to measure the energy consumption in modern households, can be forced to give misreadings resulting in over or under billing consumers. Research shows that when a commercially available water pump is used static meter deviations between -61% and +2675% arise [1]. With different loads a perceived energy generation of 600 W is measured by a smart meter while power is only being consumed in a household [2]. From all these findings a root cause for these errors in static energy meter utilizing a Rogowski coil has been found and elaborated on [3]. Recently a seemingly unconnected new problem arose with freezing of smart meters due to pulsed currents. We are interested in the effect certain waveform parameters like rise time, fall time, current slope (di/dt), voltage spikes, crest factor (CF), phase firing angle (FA), power factor (PF), peak current, total harmonic distortion (THD) and the energy (pulse width) have on the freezing. Almost every household has a static energy meter, or will get a static energy meter, which makes this research highly impactful on society.

Method:

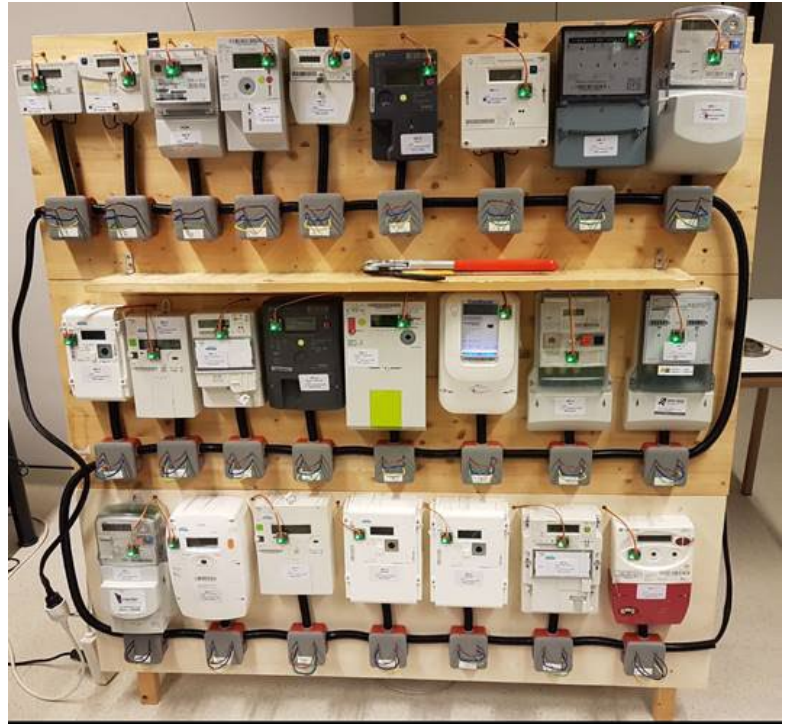
A measurement setup exists at the University of Twente with 24 static energy meter and reference meters. This setup can be used in combination with an AC adjustable load, or our Cinergia Grid Emulator and Electronic Load. A lot of measurements should be performed after which a strong conclusion can be made about certain relations between waveform parameters, or combinations of waveform parameters, and the static energy meter errors.

Research objectives:

Create a big dataset from which conclusions about the relationship of certain waveform parameters and the freezing can be made.

Courses and supervision:

No specific courses are needed as a background. A good affinity with Matlab and Mathematics is very beneficial for doing this assignment.



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- [1] B. Have, T. Hartman, N. Moonen, C. Keyer, and F. Leferink, "Faulty Readings of Static Energy Meters Caused by Conducted Electromagnetic Interference from a Water Pump," *Renew. Energy Power Qual. J.*, 2019.
- [2] T. Hartman, B. ten Have, N. Moonen and F. Leferink, "How to Earn Money with an EMI Problem: Static Energy Meters Running Backwards," 2021 IEEE International Joint EMC/SI/PI and EMC Europe Symposium, Raleigh, NC, USA, 2021, pp. 788-793, doi: 10.1109/EMC/SI/PI/EMCEurope52599.2021.9559376.
- [3] T. Hartman, B. t. Have, J. Dijkstra, R. Grootjans, N. Moonen and F. Leferink, "Susceptibility of Static Energy Meters due to Amplifier Clipping Caused by a Rogowski Coil," in *IEEE Transactions on Electromagnetic Compatibility*, vol. 64, no. 6, pp. 2024-2032, Dec. 2022, doi: 10.1109/TEMC.2022.3204391.

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