



sgem

Smart Grids and Energy Markets

- 1 -

MIKES Three-Phase Power Digitizer

Demonstration of LV measurements

CLEEN SGEM Task 6.3

Deliverable 6.3.10



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Introduction

This report describes the deliverable from MIKES for task 6.3 FP2 of CLEEN Smart Grids and Energy Markets program. The report contains voltage measurement results from laboratory mains outlets in MIKES.

Measurement setups

Measurements are done with a single voltage channel of the power digitizer described in Deliverable 6.3.6. A 100:1 attenuator is used in front of the digitizer analog input. The attenuator is also described in the deliverable report. Sampling is done at 3000 samples per second.

Floating mains supply

The electricity laboratories in MIKES have symmetrical power supplies in order to keep any external signals from interfering with measurements. Voltages in the outlet are 180 degrees out of phase and 115V towards ground. Thus 230V is available from the mains. When measuring, this leaves coax shields in hazardous voltages. Care was thus taken to not get electrocuted. The digitizer has floating inputs, which are able to take a several kilovolt potential difference to the chassis. Measurement setup is shown in Figure 1.

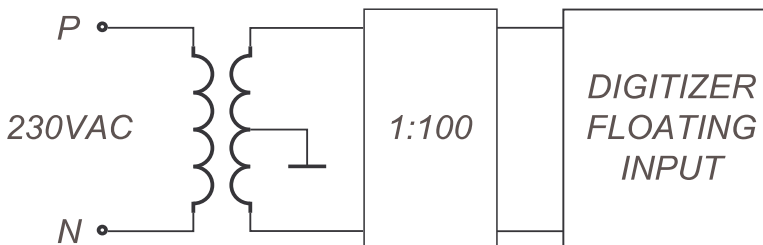


Figure 1. Measurement setup from floating laboratory mains supply.

Normal mains supply

Electricity laboratories in MIKES are also equipped with “cleaning” sockets, which are connected normally. For comparison purposes, same measurements were done for the normal supplies as for floating ones. Measurement setup is shown in Figure 2.

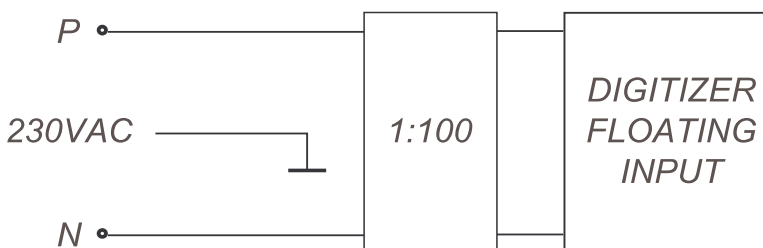


Figure 2. Measurement setup from normal mains supply.



Measurement results

Floating mains supply

Figure 4 shows the measured waveform of the balanced floating laboratory supply. A Fourier transform of the signal is shown in Figure 5. The digitizer does not have an anti-alias filter, which can be seen in the spectrum. Some folded content lies on non-harmonic frequencies. All harmonics are attenuated by at least 40dB, folded content even more. Even harmonics are all but missing due to signal symmetry with respect to x-axis. A calculated THD of the supply is around 0.04% as can be seen in the recording in Figure 6.

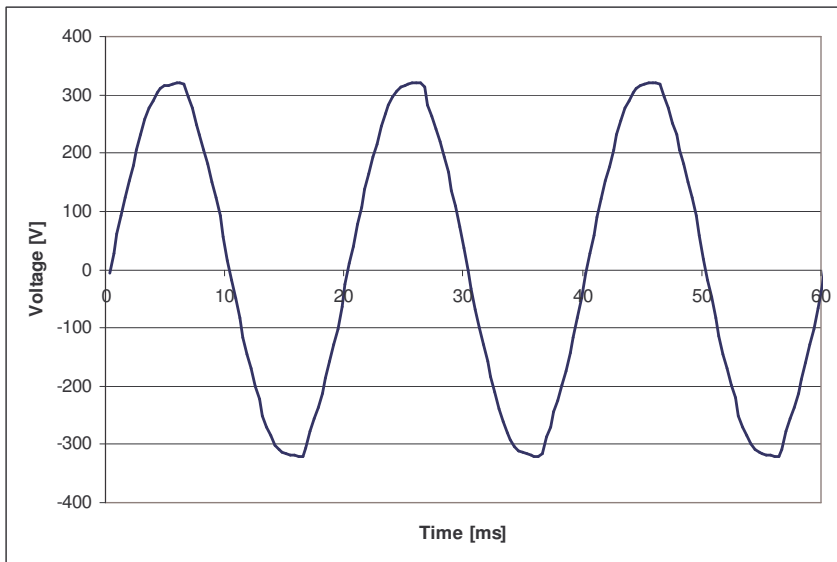


Figure 3. A Snapshot of the floating mains voltage.

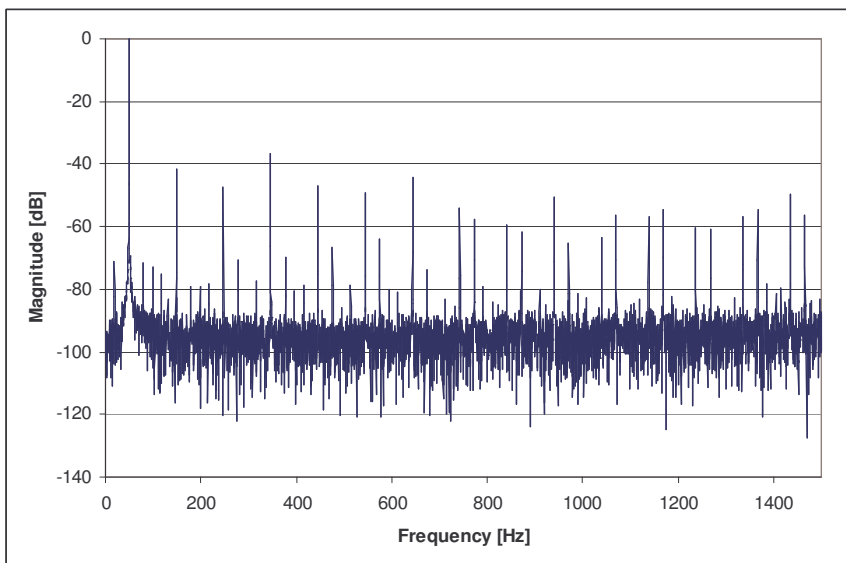




Figure 4. FFT of the floating mains voltage.

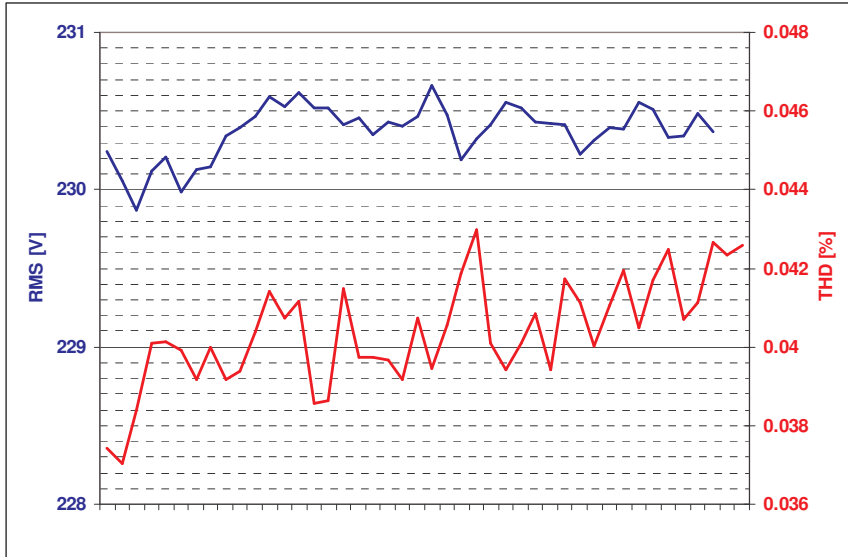


Figure 5. 10 minute recording of RMS voltage and THD of floating mains voltage.

Normal mains supply

It's interesting to compare the floating mains voltage to a normal one. A waveform of the normal mains is shown in Figure 7. It can be seen that it is slightly cleaner than the floating supply. This is most likely due to the fact that the floating voltage is loaded heavily by all laboratory equipment, while the normal supply has only a very small loading. The spectrum in Figure 8 is indeed cleaner, although similarly folded content is present. It still seems that there exists less frequency content beyond the Nyquist frequency. THD in Figure 9 shows a value of around 0.026%.

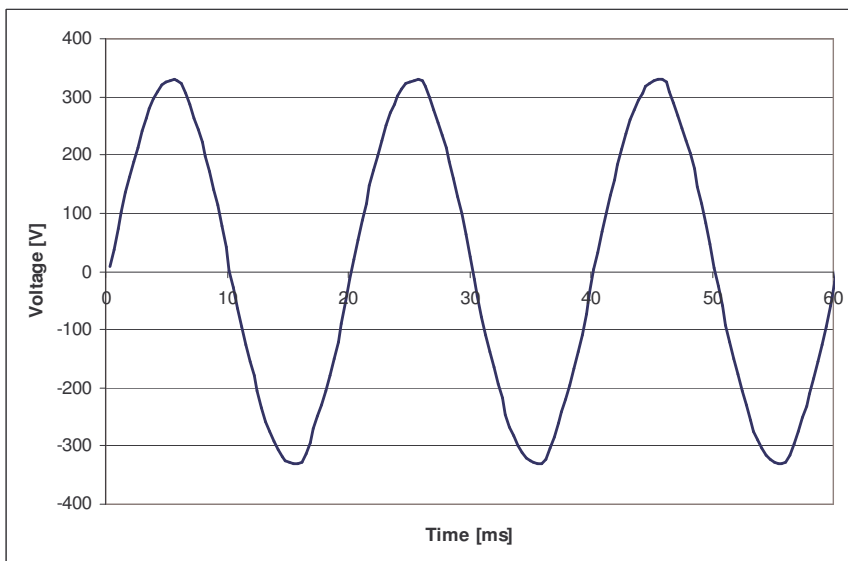


Figure 6. A Snapshot of the normal mains voltage.

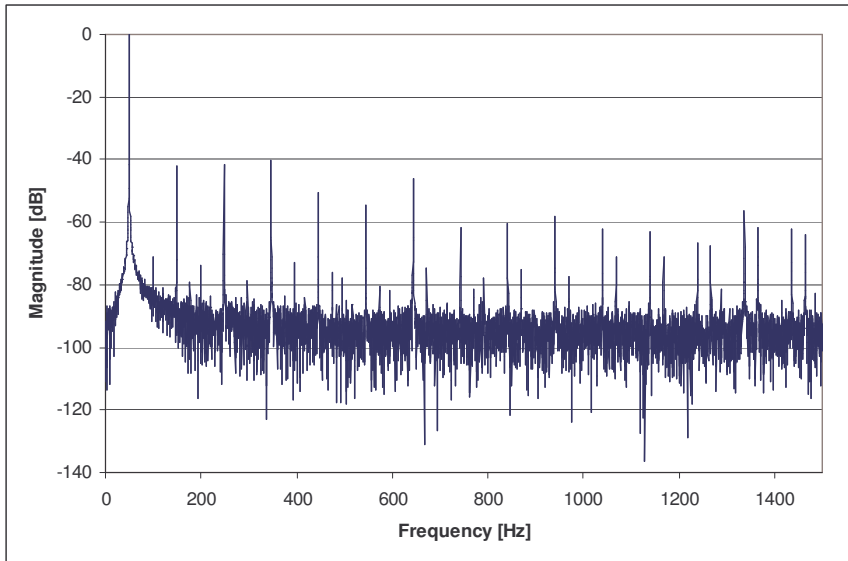


Figure 7. FFT of the normal mains voltage.

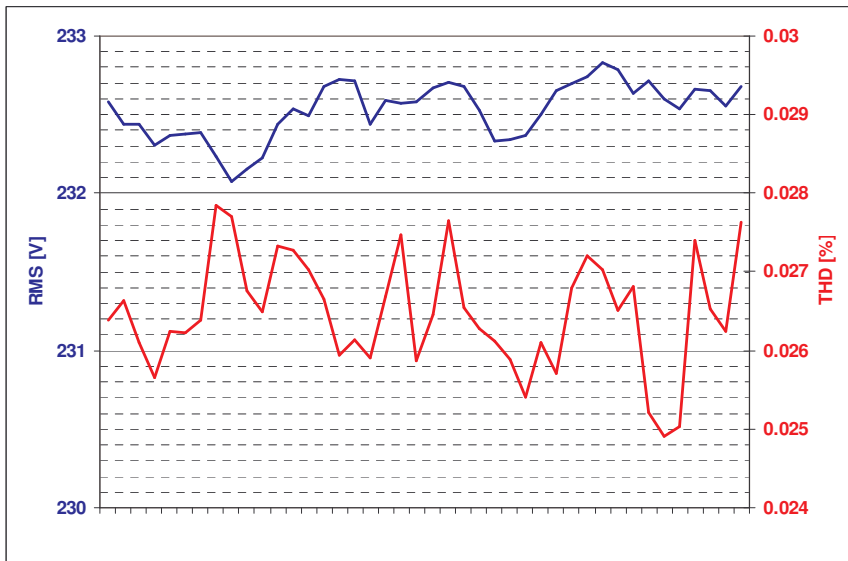


Figure 8. 10 minute recording of RMS voltage and THD of normal mains voltage.