



UfEGS

UfE Grid Simulator & Grid Recorder System

description of the system

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Introduction

UfE GmbH is a German company in the electronics sector engaged for more than 20 year in the development of technology for the integration of renewable energy sources.

UfE introduced one of the first grid connected PV inverters in Germany, then UfE introduced an inverter which used grid frequency step detection to detect uncontrolled islanding, later the company specialized on islanding control systems for PV inverters and developed the ENS islanding control devices.

Now UfE is developing a multifunctional grid monitoring, load and generation control relay based on frequency and voltage patterns analysis (**ANRE**) and a 3-Phase recording and simulation system (**UfEGS**).

The UfEGS

The UfEGS is a system (hardware and software) that has been designed and conceived in order to have a powerful tool to record and simulate the low voltage network. For that reason our system can be used for several purposes:

- Measurement campaigns
- Laboratory tests
- Load profile logger
- Disturbances recorder
- Electrical failure investigation

Etc.

Having in mind these situations, two special versions of the UfEGS has been developed:

- UfEGSmc
- UfEGSlt

The UfEGS^{mc}

It is a 4-Channel voltage/current waveform recorder with remote access capabilities that makes it ideal for measurement campaigns.

In its default configuration^[1] it provides:

- A 3-channel (up to 270 V_{rms}) analog input
- A 1-channel (up to 20/200 A) analog input

The voltage waveform is recorded and analyzed continuously. RMS voltage and frequency are logged every 20ms and in case a disturbance occurs a trigger function keeps and stores the voltage waveform for a later use (analyze or simulate).

Using the fourth channel is also possible to record current waveform and therefore other measurements like power and energy can be calculated.

[1] Other channel configurations are possible

Advantages

The idea of the UfEGSmc is to make available a high-quality, high-resolution, low-cost, portable and powerful tool to perform ***measurements*** not only as data logger but also as waveform recorder.

Some advantage of the UfEGSmc system are:

Portable

With this instrument is possible to go anywhere like a factory, power plant, building complex, etc. where there is an internet connection available and make mains voltage/current recording on site. Then using the UfEGSIIt you are able to reproduce these records in the laboratory for testing or analysis purposes.

Auto time synchronization

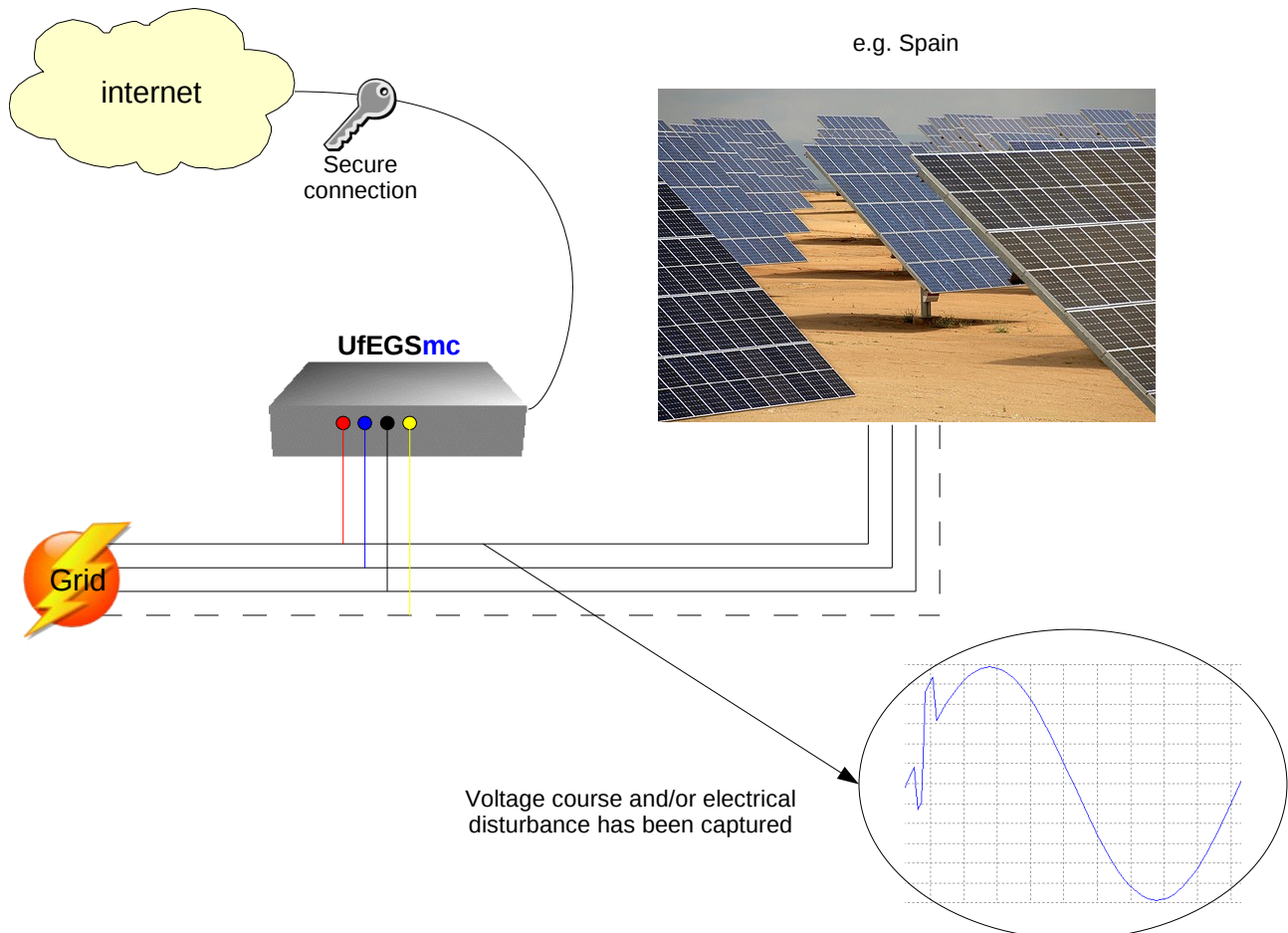
No need to do time synchronization. Once you connect the instrument to internet it synchronizes time automatically.

Intelligent trigger function

No need to do trigger thresholds setting. The voltage waveform is analyzed continuously and when a disturbance occurs the intelligent trigger function makes its job.

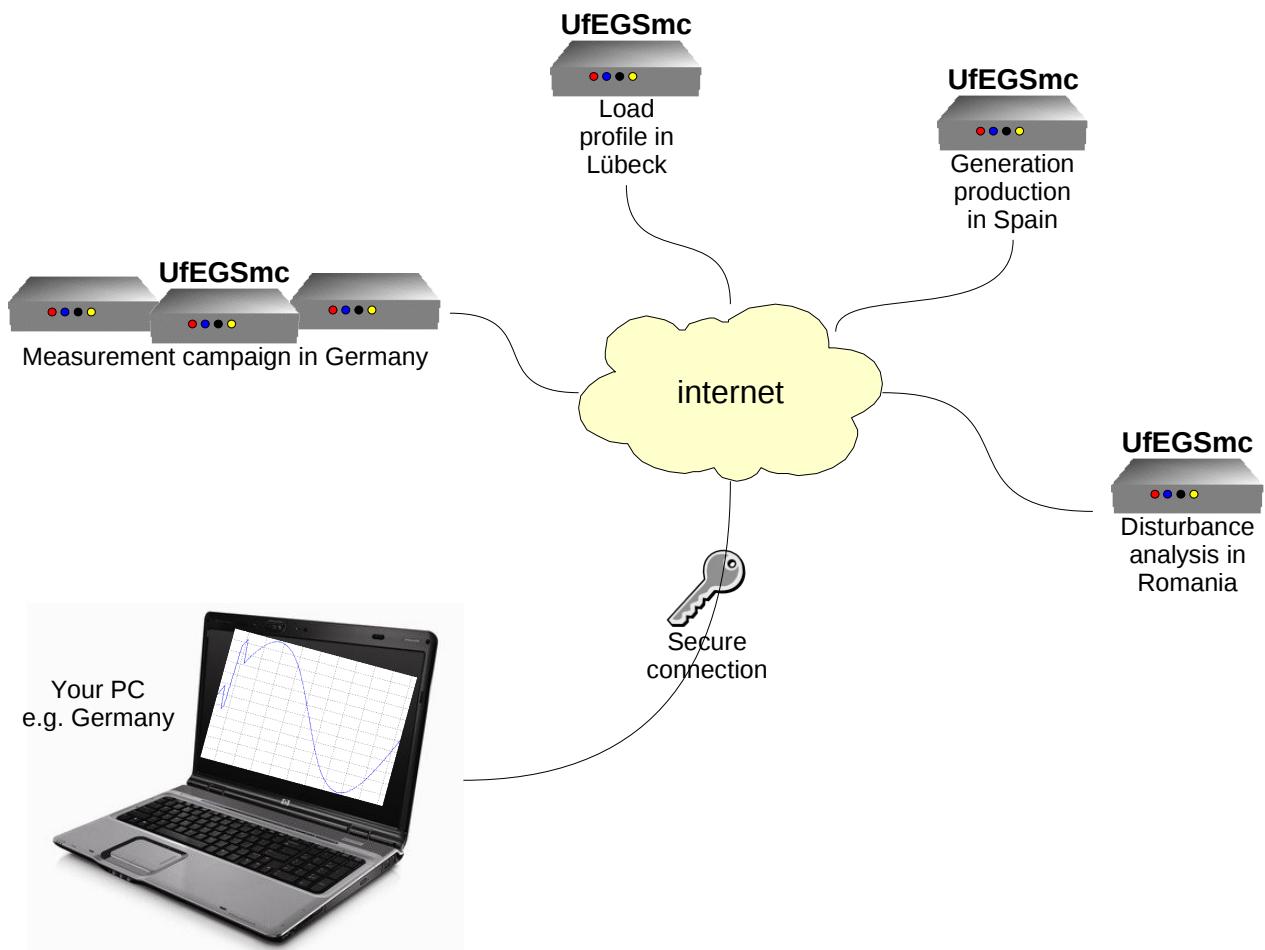
How UfEGS_{mc} works

First, just connect the UfEGS_{mc} to the mains and to the internet^[2] and let the instrument record the grid.



[2] If there is not internet connection available at the measurement location, the UfEGS_{mc} can be later picked and connected to internet from other location for data retrieving.

Then, using an account provide by us, you are able to retrieve data from any PC connected to internet. Using your account info you get access to the instrument. Once you are logged in you can visualize in a easy way the records. You are also able to download the signal and data you want.



Application example

UfE takes part in several projects related with the development of technologies for the integration or renewable energy sources (RES). It is clear that RES together with “new generation” inverters can not only feed energy into the grid but also perform frequency and voltage support tasks. In order to investigate how to integrate RES and how these “new generation” inverters should be designed, is important to have reliable measurements of the low voltage network that let us to investigate how the inverter reacts specially when disturbances occurs.

One UfEGSmc is going to be used as DAQ system in Romania in order to investigate voltage conditions at point of connection in future test place for a Virtual Synchronous Generator^[3]. Other UfGGSmc is permanently recording voltage conditions in Lübeck.

[3] VSYNC – Virtual Synchronous Machines (VSG's) For Frequency Stabilisation In Future Grids With A Significant Share Of Decentralized Generation. - www.vsync.eu - sixth framework programme.

Capturing disturbances

Here you can see directly the advantages of the instrument.

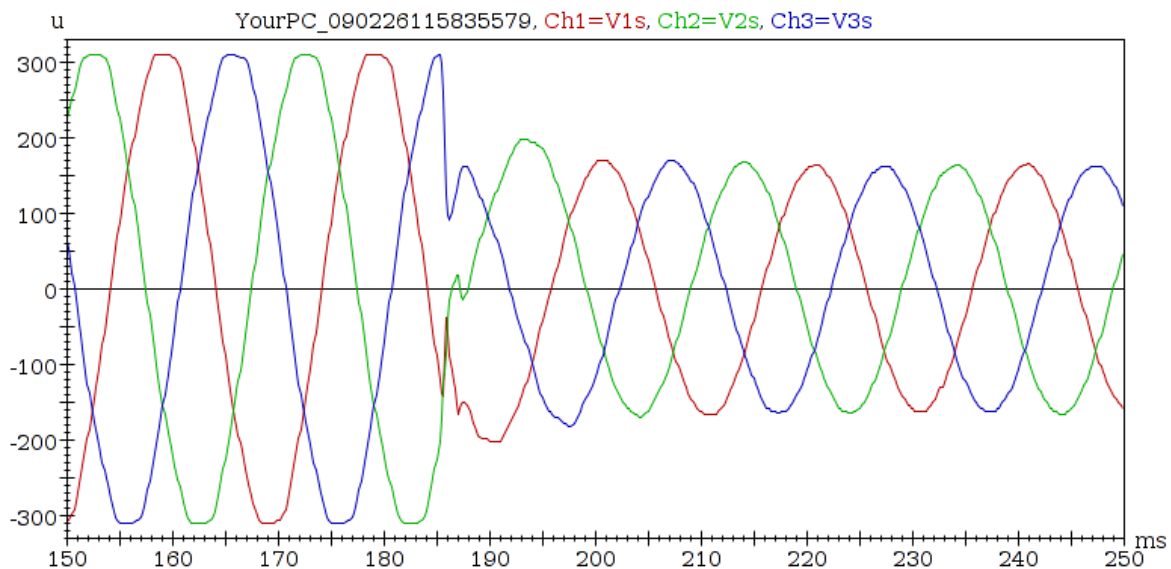
Using the UFEgSmc located in our laboratory was possible to log and record a disturbance.

A voltage dip was detected and captured (Intelligent trigger function).

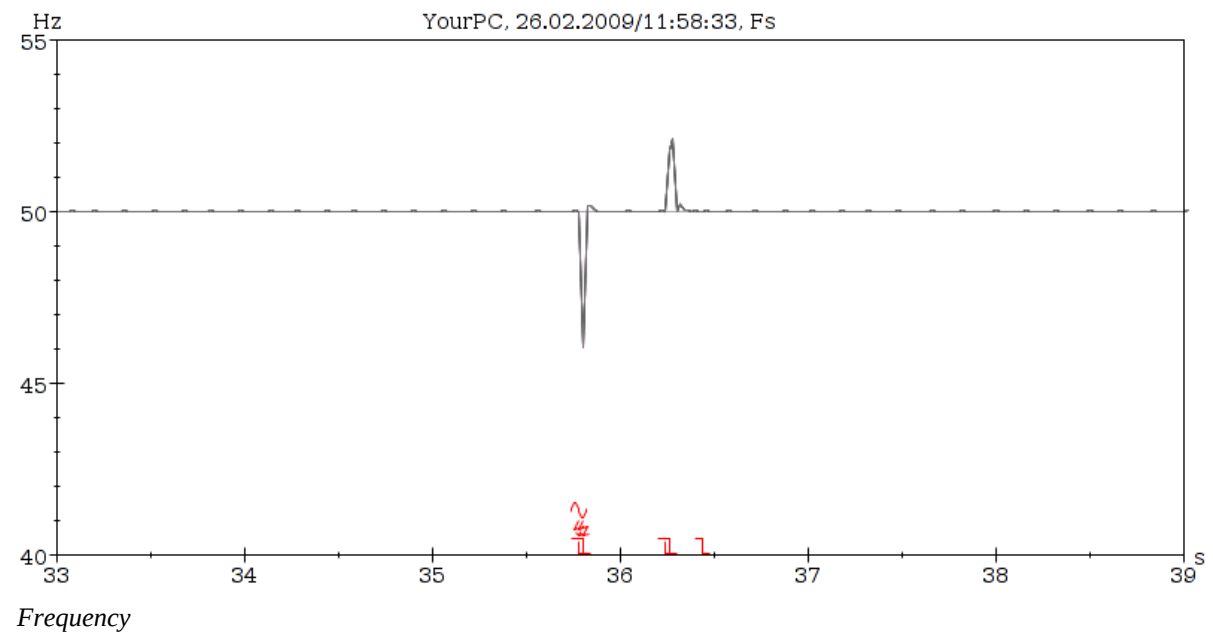
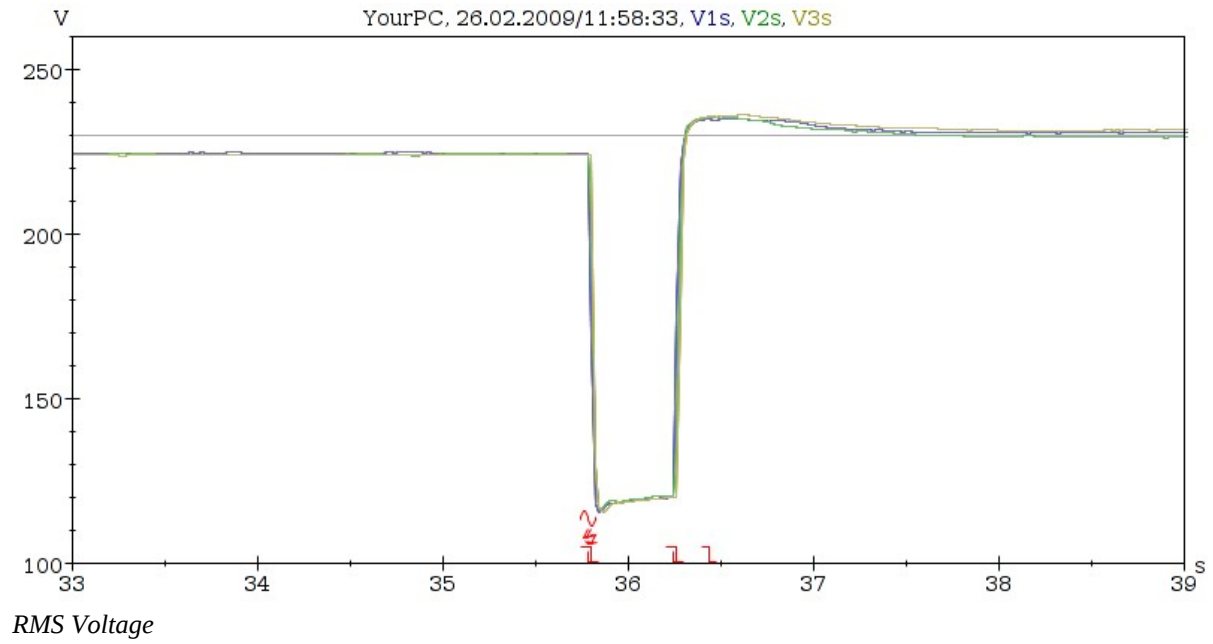
It was recorded exactly on 26 February 2009 at 11:58:33 (Auto time synchronization).

This voltage dip was caused by a short circuit in a electrical substation (“Umspannwerk Zentrum”) on the medium voltage network (10 kV). According to a report given by the local Electric Utility (Stadtwerke Lübeck GmbH) the problem was perceived in certain zones of the city, in the center particularly.

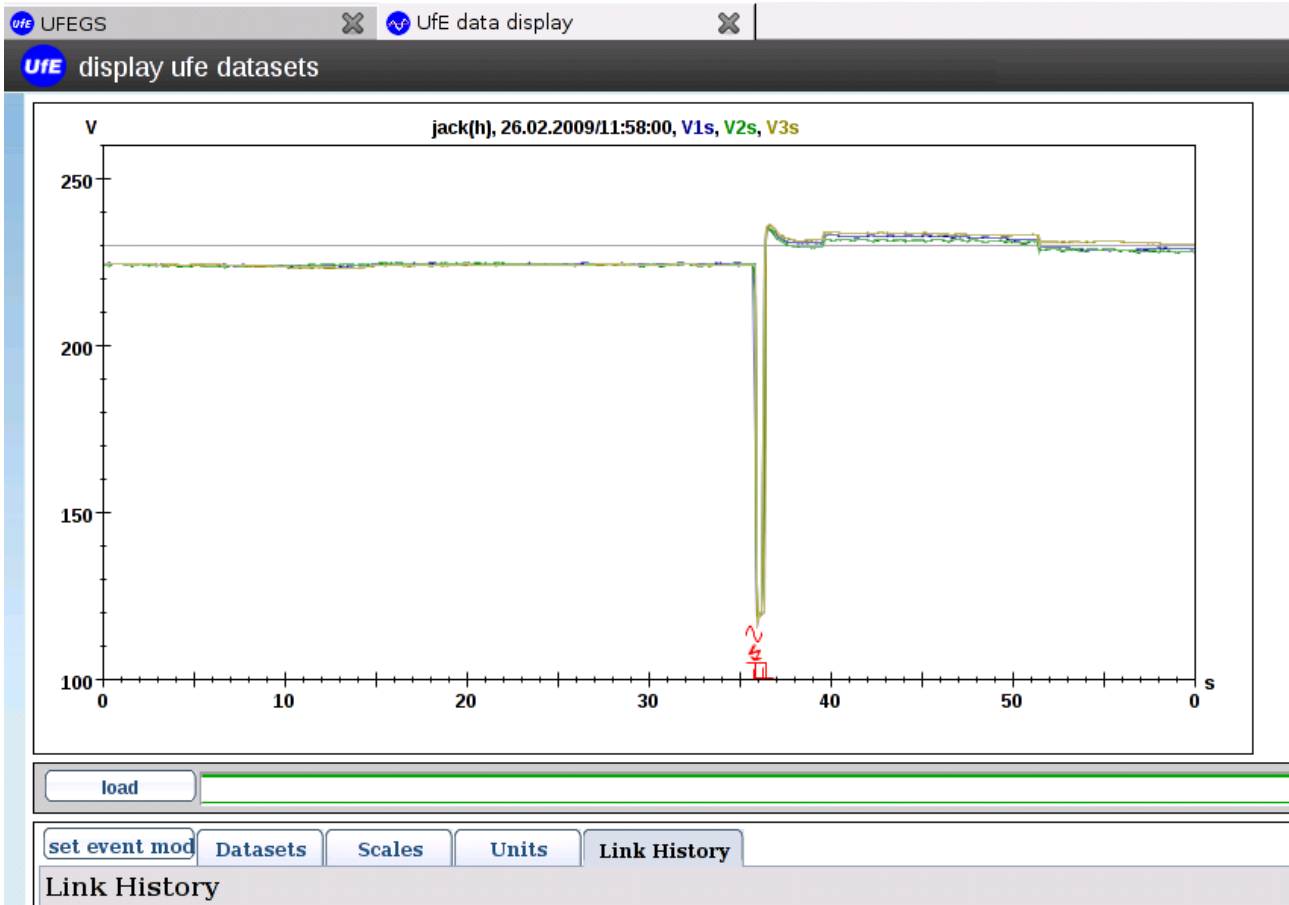
Here you can see Voltage Waveform, RMS Voltage and Frequency.



Voltage Waveform



This is an snapshot of the UFEGS browser-based program for signal/data visualization.



UfEGS/lt

It is a 3-Channel voltage waveform playback and simulation system that makes it ideal for lab tests.

It provides:

- A 3-channel (± 5 Vp) analog output making possible to control up to 3 amplifiers in order to have a 3-Phase simulation system. Any power amplifier equipped with single or multiple (± 5 Vp) external analog inputs is suitable. There are several on the market e.g. Spitzenberger & Spies, Omicron, ET, etc.

Advantages

All grid simulation systems have their own simulation software allowing to “reproduce” the most common electrical disturbance like over voltages, interruptions, dips, flickers, frequency variations, transients, etc. But they neither represent nor look like real conditions of voltage course or electrical disturbance.

The idea of the UfEGSIt is to make available a high-quality, high-resolution, low-cost, portable and powerful tool to perform ***grid simulation*** under more real conditions in a convenient way.

Some advantage of the UfEGSIt system are:

Interchangeable file format

With this instrument is possible to perform test under voltage waveforms that were collected (using the UfEGSmc) by you or by other persons or companies on different places each one having its own voltage conditions.

Independent

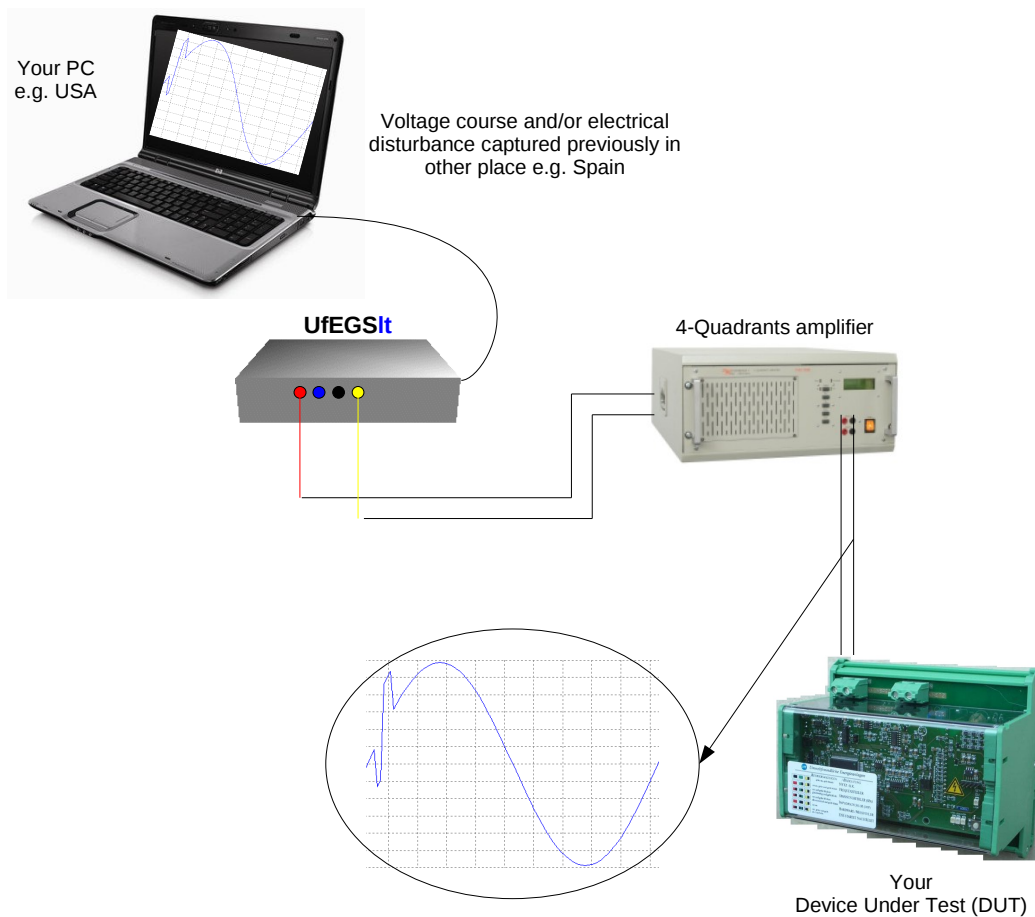
You can use any available software^[4] (licensed or open source) for all related with signal and data processing in order to analyze the records you got.

[4] R or Matlab are software able to process .wav file format. Open Office and Excel are software able to process .csv

How UfEGSIt works

First, just connect the UfEGSIt to the external analog input of a power amplifier and to a PC.

Then, using a software provided by us you are able to reproduce voltage course and/or electrical disturbance that has been previously captured (using the UfEGSmc) in other places.



Application example

Any device, intended to be integrated in the electrical grid and aimed to perform grid stabilization, regulation and related tasks, must operate properly and perform as expected in response to fluctuations in frequency and voltage. Such equipments are inverters, measurement instruments, battery management systems, etc.

In order to develop these equipments it is necessary to have adequate tools for testing them. A key aspect to carry out performance tests is to have a good system to make mains simulation that allows tests not only under hypothetical but also under real conditions.

When testing devices there are some difficulties:

- Sometimes it is not easy to bring the Device Under Test (DUT) at the location where you want to perform the test.
- It is impractical to wait until a real electrical disturbance happens.

A solution is to make a real “copy” of a long-time (up to 6 hours) voltage course or a real “copy” of a electrical disturbance (milliseconds, seconds or minutes) using the UfEGSmc. Once you have “captured” the desired voltage course or electrical disturbance your are able to reproduce it in your laboratory with the combination of the UfEGSlt plus a power amplifier.

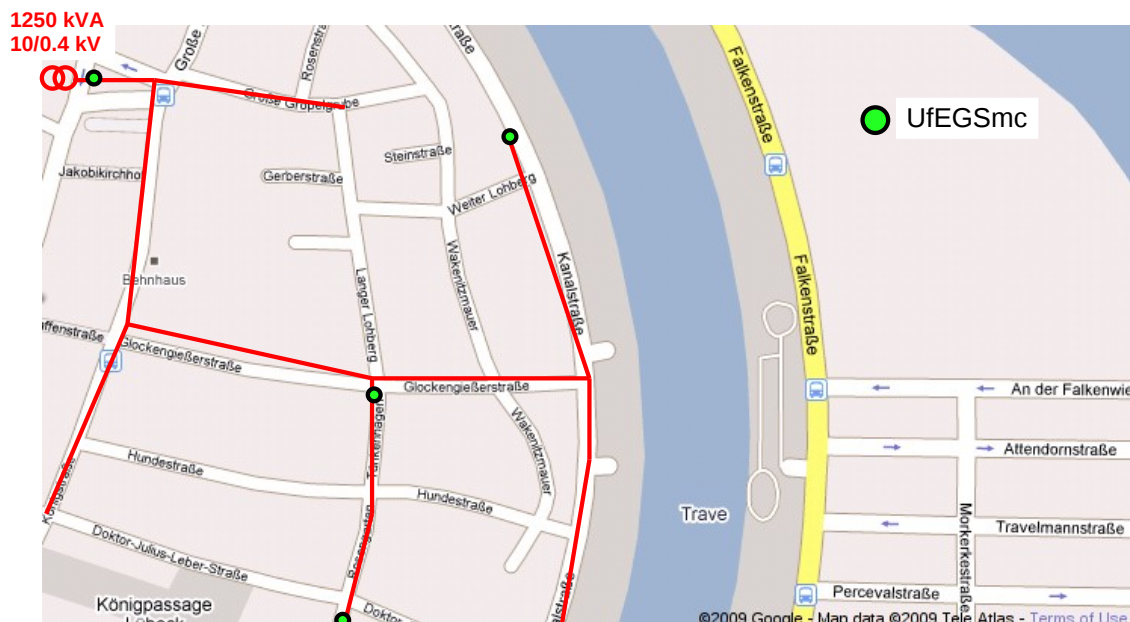
UfEGS technical data

Analog inputs ^[1]	3 channels, 230 Vrms (up to 270 Vrms) 1 channels, current A (up to 20/200 A)
Analog outputs	3 channels, ± 5 Vp
Bandwidth	20 Hz - 10 kHz
Accuracy	< 0.5 % (230 V / 50 Hz) @ 25°C < 1.5% (50 V – 270 V / 20 Hz – 1000 Hz) @ up to 60°C
Sample frequency	44.1 kHz
ADC/DAC resolution	16 Bits
Communication interface	Ethernet
Recording signal capability	To .wav/.uwav file
Playback signal capability	From .wav/.uwav file
Signal/data visualization capability	Web browser-based program with multiple options
Power supply	230 V / 50 Hz

[1] Other channel configurations are possible

Conclusion

The UfEGS is a versatile system not only to log and record the low voltage network but also to simulate it based on what had been recorded in the measurement location. (voltage courses and/or electrical disturbances). Besides that and making use of internet technology it is possible to perform measurements at different places simultaneously and to have direct and fast access to this data from a remote place. These features make it ideal for measurement campaigns and a perfect complement of a grid simulation system.



Example of how several UfEGSmc could be installed in a measurement campaign

Please don't hesitate to contact us if you need more information or a quotation