

# Intelligent Sensors for Smart Grids

7. October 2014 @ AGH

Test and Measurement Solutions

## Agenda

- Introduction DEWETRON
- Industries/Application areas
- Evolution of the sensors
- Use in eMobility
- Use in energy supply grids

## DEWETRON - Test & Measurement Solutions

- Company
  - Founded 1989
  - 200+ employees worldwide



- Headquarter near Graz in Austria
  - Product Management, R&D, Production
- Offices in Germany, China, US
- A company of

/// AUGUSTA  
Technologie AG



Re-inventing Data Acquisition

side  
DEWETRON

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## Industries / Application areas



Automotive



Energy &  
Power Analysis



Aerospace &  
Defense



Transportation



General Test &  
Measurement



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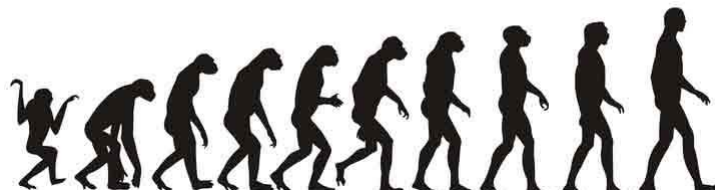
## Evolution of the sensors

- The Sensor

*A sensor is a device capable of detecting certain physical or chemical properties qualitatively, or as a measure of quantity. These variables are acquired by means of physical or chemical effects and converted into an electrical signal.*

- Evolution

- Sensor and signalconditioning
- Sensor, signalconditioning and ADC
- Intelligent sensor including analysis / calculation
- Composite of intelligent sensors in the network



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## E-Mobility (EM)

### Applications

- Power Measurement
- Battery Test
- E-Drive System Test
- Hybrid Testing



Measurements on a battery electric car during real driving conditions



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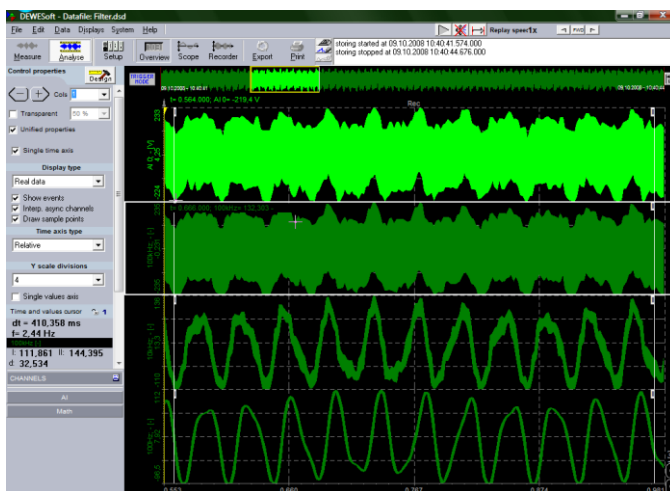
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## Measure on eCars



## Bandwidth



2 Mhz (today)

100 kHz (10 years ago)

10 kHz (15 years ago)

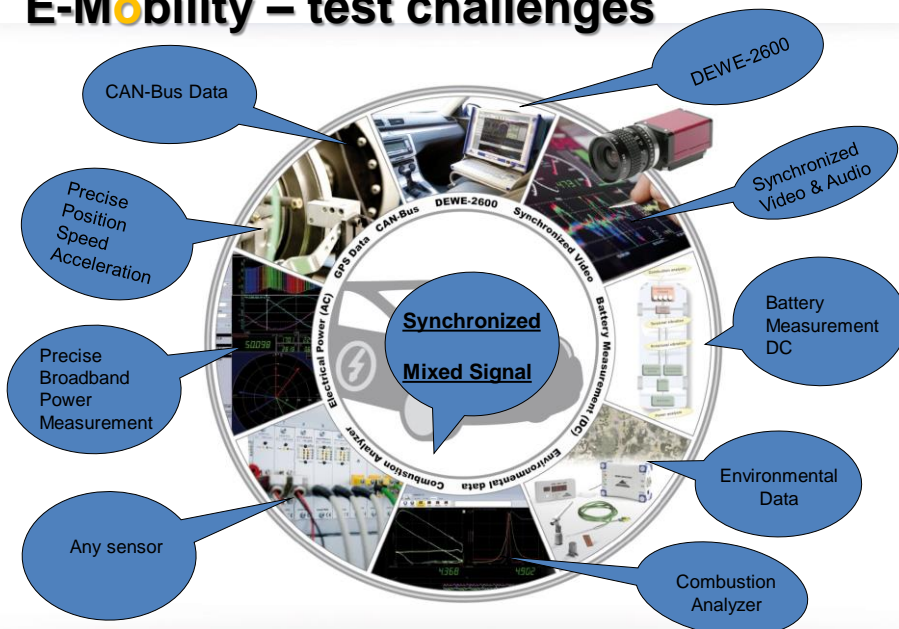
100 Hz (20 years ago)

## Measurements on eCars

- High Bandwidth
- High Accuracy
- High Sampling rate

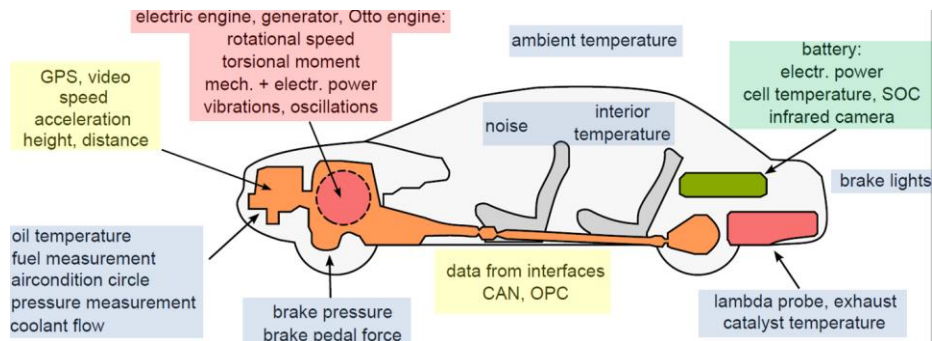


## E-Mobility – test challenges



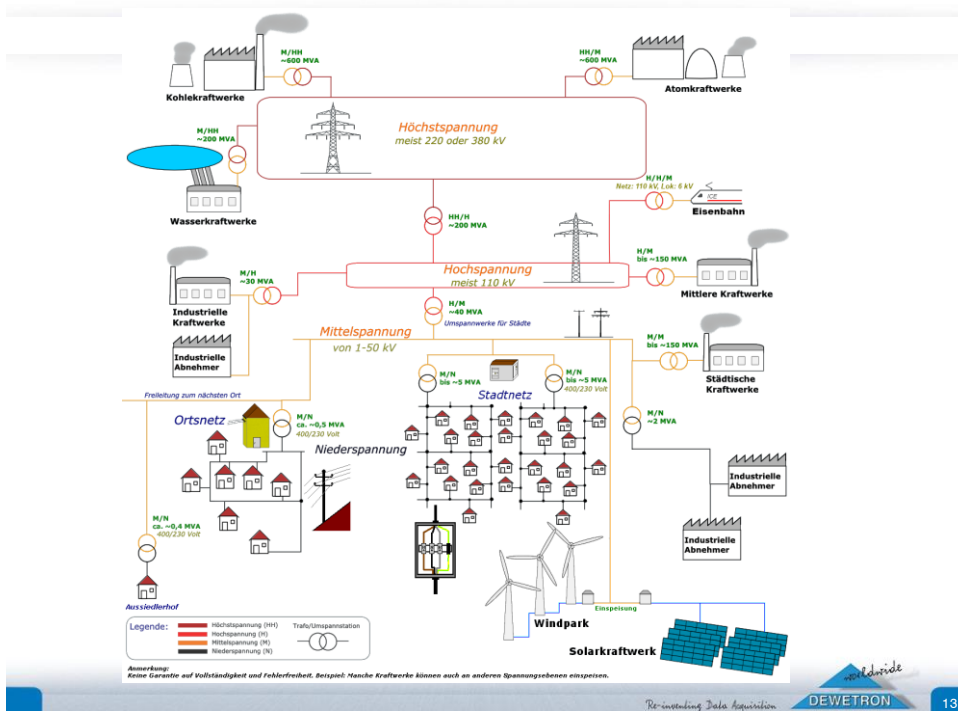
## E-Mobility - Example

Project at University of Technology Vienna



- *more than 100 signal inputs*
- *more than 100 Calculations in Math*
- *E-Motor, Generator, Otto engine*

## Energy supply grids



## Requirements

- Power Quality monitoring
  - Frequency, Voltage, ...
- Load flow monitoring
- Fault recording and analysis
- Data for simulations
- Reporting against standards
- Integration in SCADA systems
- Increasing dynamics and complexity





The diagram illustrates a power distribution network with the following components and labels:

- Kohlekraftwerke** (Coal power plants) at the top left, connected to a **H/MH ~600 MVA** transformer.
- Höchstspannung** (Ultra-high voltage) section with a line labeled **meist 220 oder 380 kV** and **Netz: 11kV**.
- Hochs** (High voltage) section with a line labeled **meist ~200 MVA**.
- Mittelspannung** (Medium voltage) section with a line labeled **von 1-50 kV** and **M/M ~40 MVA Umspanner**.
- Niederspannung** (Low voltage) section at the bottom, labeled **5 MVA 0 Volt**, showing residential houses.

Measurement devices shown include:

- DEWE-438** (top left)
- pink-box** (bottom left)
- A yellow ruggedized laptop (top right)
- A rack-mounted device (bottom right)

**Anmerkung:** Keine Garantie auf Vollständigkeit und Fehlerfreiheit. Beispiel: Manche Kraftwerke können auch an anderen spannungsebenen koppeln.

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# Monitoring, Reporting

### Power Quality Report EN50160

User: Administrator  
Date: 13.02.2009 Time: 11:39:21

Feeder: DEWE Graz 230V  
Report Start: 08.02.2009 11:38:18  
Report End: 09.02.2009 11:38:18

Signature: \_\_\_\_\_

Page 1 of 7

This report shows the voltage quality parameters of the standard EN 50160. The following values are described:

- Height
- Waveform
- Frequency
- Symmetry of the three-phase system
- Availability

The following table shows each parameter and the quantil value (95%). Green values indicate that the quality is okay. Red indicates a value out of the limits. x... Values in limit

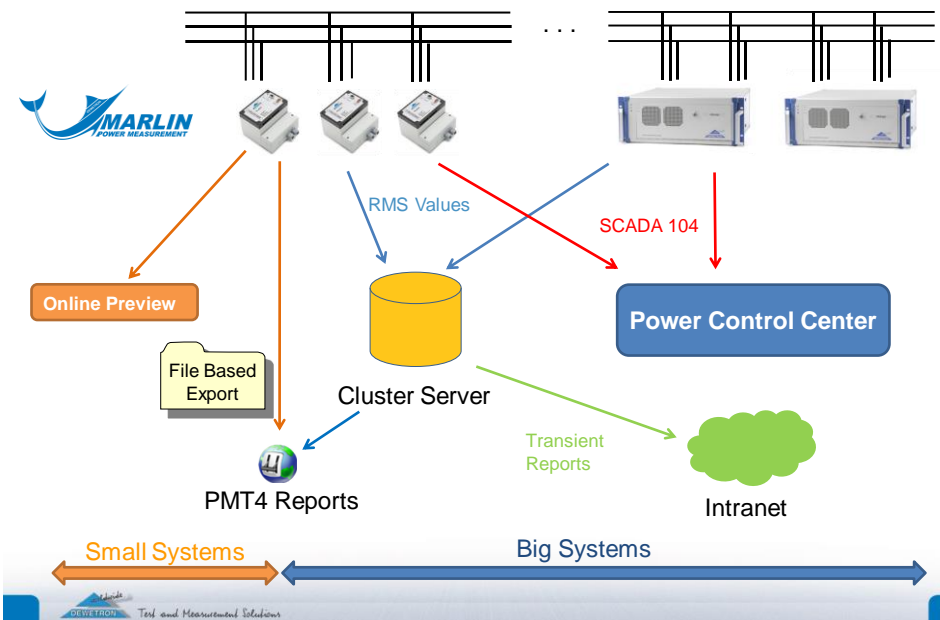
Value	Unit	Quantil	Limit Min / Max	Value	Limit okay
U <sub>rms_L1</sub>	V	95 %	207,00 / 253,00	236,91	x
U <sub>rms_L2</sub>	V	95 %	207,00 / 253,00	235,63	x
U <sub>rms_L3</sub>	V	95 %	207,00 / 253,00	235,61	x
THD <sub>U_L1</sub>	%	95 %	0,00 / 8,00	2,10	x
THD <sub>U_L2</sub>	%	95 %	0,00 / 8,00	1,92	x
THD <sub>U_L3</sub>	%	95 %	0,00 / 8,00	2,00	x
PL <sub>L1</sub>	-	95 %	0,00 / 1,00	0,61	x
PL <sub>L2</sub>	-	95 %	0,00 / 1,00	0,57	x
PL <sub>L3</sub>	-	95 %	0,00 / 1,00	0,60	x
w2_1	%	95 %	0,00 / 2,00	0,20	x
Frequency	Hz	99 %	49,50 / 50,50	50,06	x

The report shows both: the harmonics in total and each value (page 3 ff).

Harmonics overview:  
U<sub>L1\_H1</sub>  
U<sub>L2\_H1</sub>

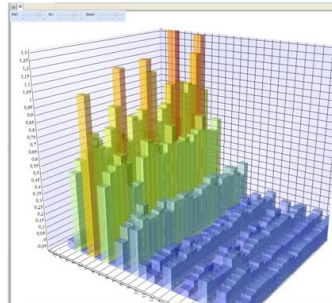
The screenshot shows a software window titled 'Statistics - U\_rms\_3 [V]'. It contains a bar chart with 12 bars representing different voltage quality parameters. The y-axis ranges from 0 to 130. Below the chart is a waveform plot showing three-phase voltage waveforms over time. The software interface includes various menu options and a data table at the bottom.

# Power Fault Recording - Possibilities

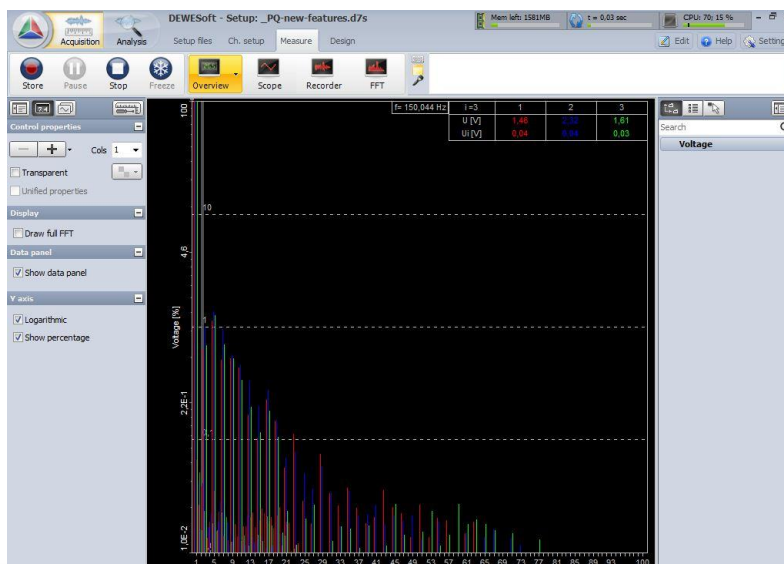


## Harmonics

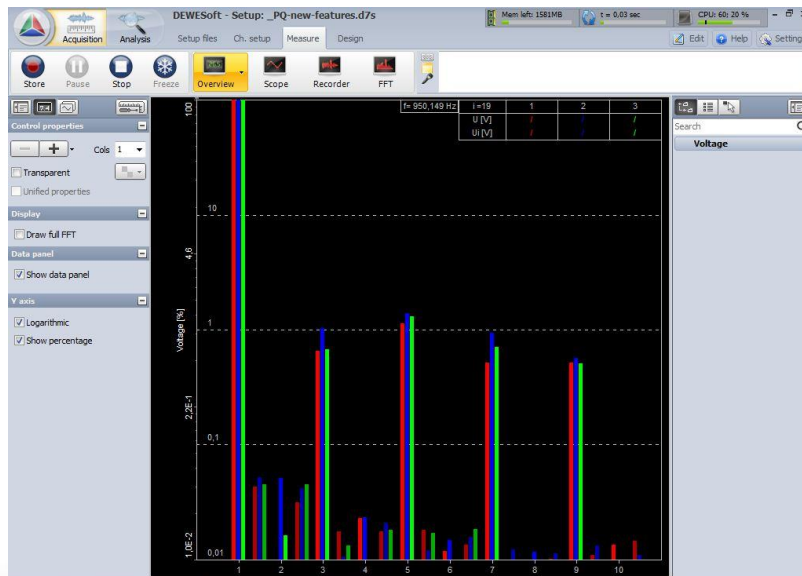
- Up to 50 Harmonics
- .... more than 50?
- .... Interharmonics
- .... Variable sidebands?
- .... 2-9kHz@200Hz



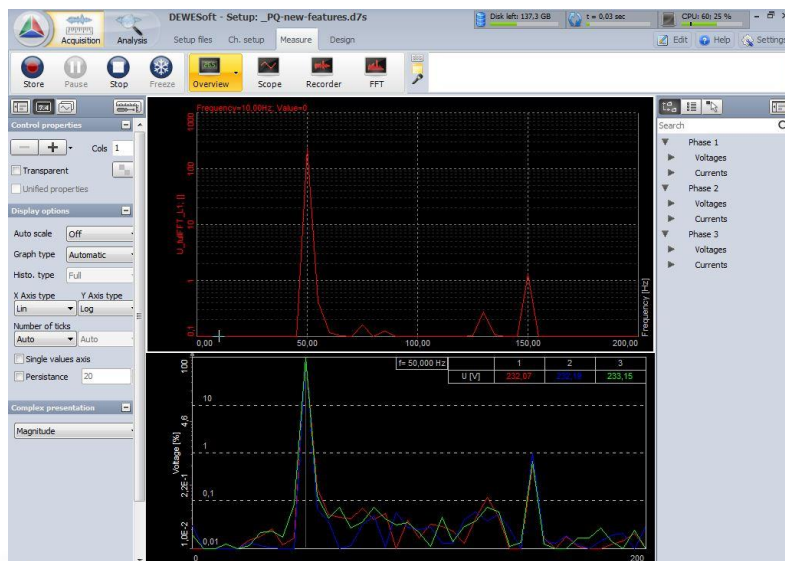
## Measure Harmonics



## Measure Interharmonics



## Measure Full FFT



## Higher Frequencies

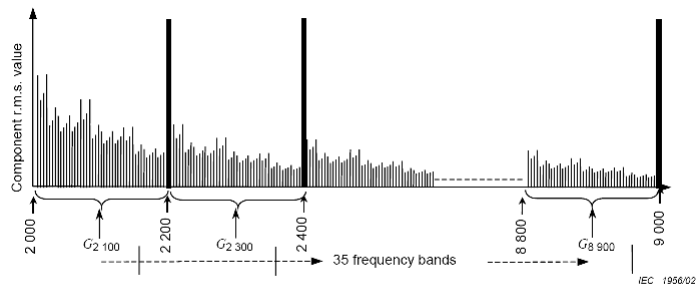
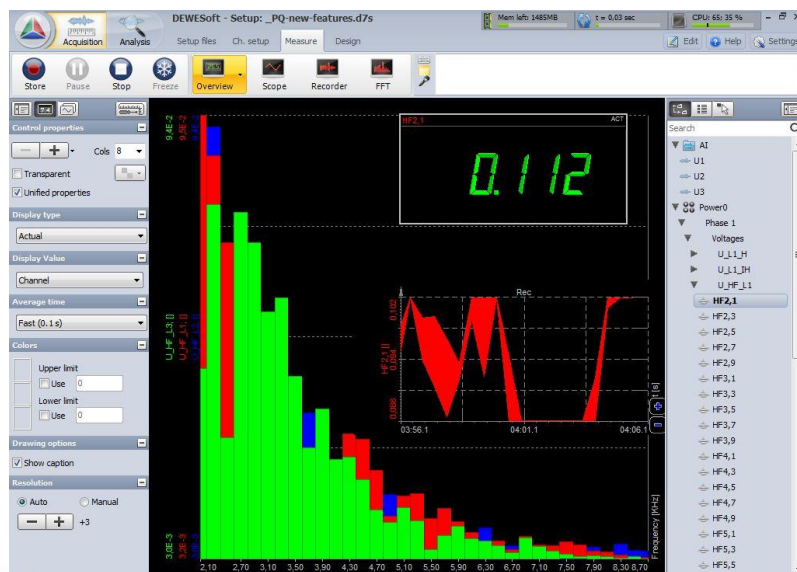


Figure B.1 – Illustration of frequency bands for measurement, in the range 2 kHz to 9 kHz

Source: IEC 61000-4-7

## Measure Higher Frequencies



## Online Demo available

- Open your browser and connect to:

<http://pna838.dewetron.com>

User: admin

PW: admin



## Thank you for your attention!

Ing. Oliver SEIDELMANN

Business Developer  
**DEWETRON Ges.m.b.H.**  
Parkring 4  
8074 Grambach  
AUSTRIA

Tel.: +43 (0) 316 / 3070 - 249  
Fax: +43 (0) 316 / 3070 - 90  
E-Mail: [oliver.seidelmann@dewetron.com](mailto:oliver.seidelmann@dewetron.com)

<http://www.dewetron.com>

