*Automotive*
*Energy & Power Analysis*
*Aerospace & Defense*
*Transportation*
*General Test & Measurement*


# Power Network Analysis

## DEWE-PNA

*The DEWE-PNA systems are energy net analyzers which can persecute power quality analysis following exact standards and a lot more beyond that. The combination of high-capacity measurement software and flexible report generators enables the user to solve nearly every task in the field of energy measurement.*

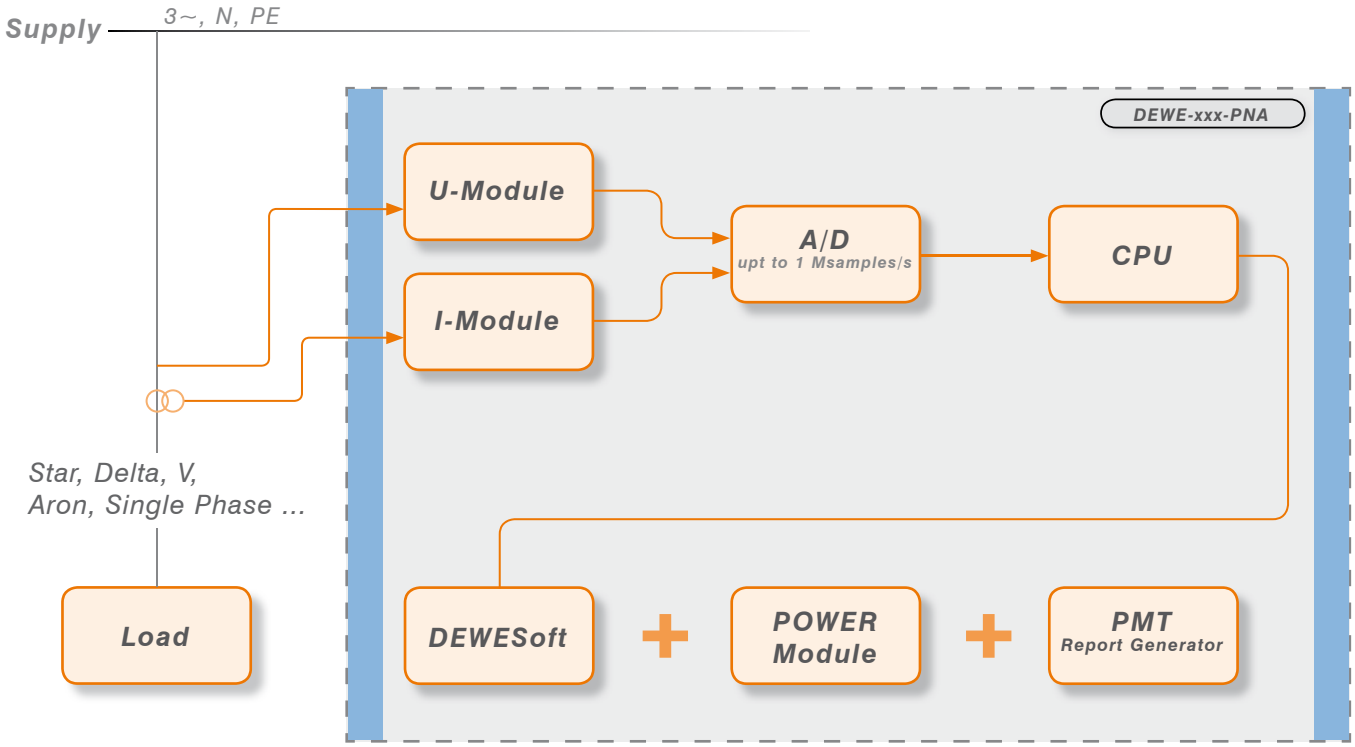
*Another advantage is the configuration of the instruments. On the one side, we have the type DEWE-570 developed for the technician on site - stable, isolated and easy to operate. On the other side, there is the DEWE-module-based instrument such as the DEWE-2600-PNA. Its perfect flexibility of the hardware also allows complex applications in the fields of engineering and development.*

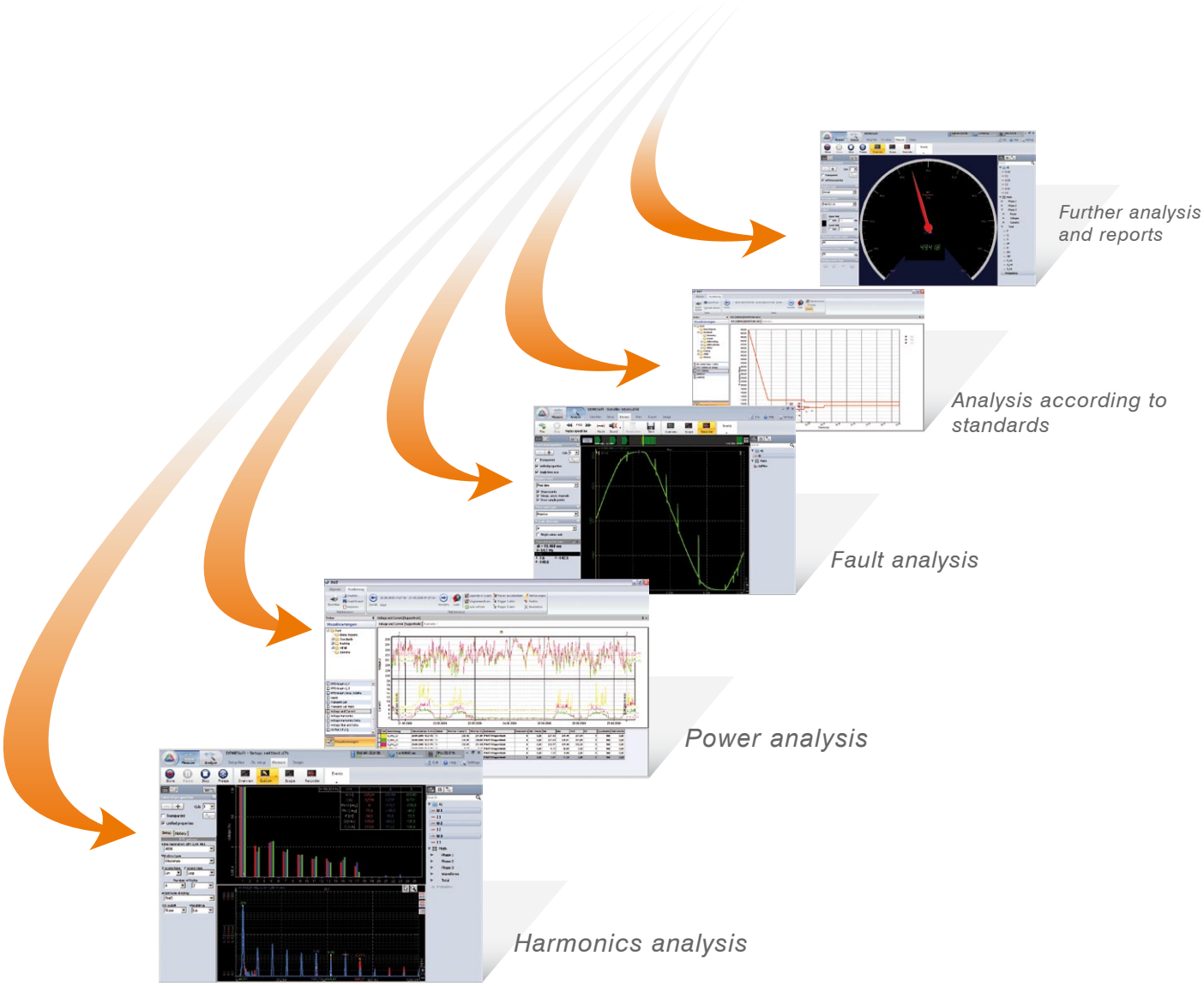
*Exact measurements according to IEC-61000-4-30 Class A, the power quality measurement standard, are also an absolute necessity and characteristics of our instruments.*

### Key Functions

- *EN50160*
- *IEC61000-4-30 Class A*
- *Power rating*
- *Harmonics, including 2-9 kHz*
- *Interharmonics*
- *Flicker*
- *Symmetrical components*
- *Frequency*
- *DISDIP/Unipede statistics*
- *CBEMA/ITIC curve*

worldwide DEWETRON

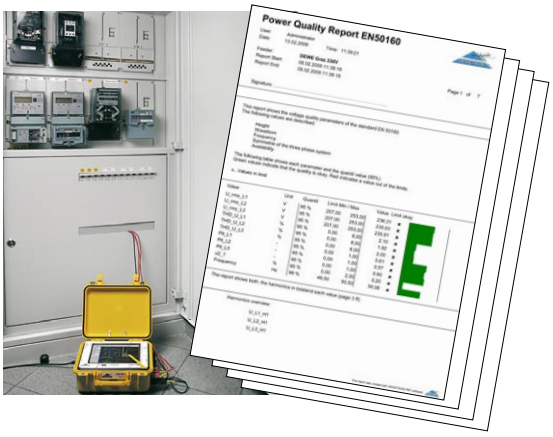

Supply
3~, N, PE
DEWE-xxx-PNA
U-Module
I-Module
A/D
upt to 1 Msamples/s
CPU
Star, Delta, V,
Aron, Single Phase ...
Load
DEWESoft
POWER
Module
PMT
Report Generator


Further analysis
and reports
Analysis according to
standards
Fault analysis
Power analysis
Harmonics analysis

# The DEWETRON Power Quality Analyzers

## EN50160 and other Norms

*Due to the changing market power quality analyzes are getting more and more important. On the one side, the increasing use of electronic consumers causes system perturbations. On the other side, the number of blackouts has grown recently. Early detection of shortages is therefore necessary and trend analyzes of various parameters can be helpful. Additionally, the obligation to prove the quality of the power supply system has changed and commercial aspects are also getting more and more important.*




## Disturbance Analysis

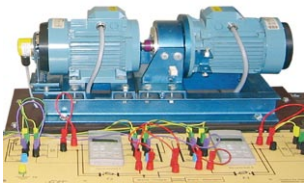
*Simple recordings of voltage are source for the interpretation of power supply. In order to be able to be more precise and find solutions, it is not sufficient to calculate the voltage by means of average values of 10 minutes. Transient recorders with acquisition rates of Mega Hz even detect fastest disturbance peaks and are essential for the exact analysis.*

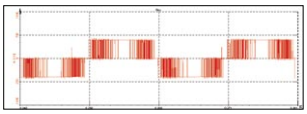
## Flicker and More

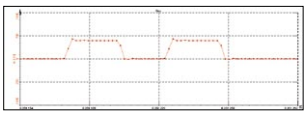
*The standard software package includes flicker, unbalance, calculation of power and frequency etc. as well as a report generator with which one can print pre-defined reports (e.g. EN50160) on the one side and create individual reports on the other side.*

## Harmonics Analysis

*The topic harmonics also becomes a new important aspect. If you have done the analysis of up to the 25th or even 50th harmonics, you can now go far beyond that. The frequency spectrum of 2-9 Hz has been redefined and in the future it will be analyzed in 200 Hz bands. The combination of this new standard and the formerly used harmonics standards is the main task of up-to-date power quality analyzers. DEWETRON has acted on this subject by creating the very latest generation of software and covering the whole spectrum of harmonics, interharmonics, frequency bands and grouping methods. Standard measurements with pre-defined and standardised setups are included or individual settings can be done by the users themselves.*







## Energy Analysis

*The consumption of energy as well as the energy costs are rising. The reduction of energy costs is hence one major topic of interest. Treaties and prices are relevant – the effective consumption as well. In order to be able to reduce the consumption, one has to know the exact energy consumption and the internal power flow.*

*In order to be able to measure this, multi-channel measurement instruments are necessary. Using these instruments one can measure the consumption on several lines at the same time. This can also be done in parallel ways in different distribution boxes or even buildings.*

*With the help of the report generator one can create simple reports on power flow and distribution of energy consumption. The export interfaces support a quick exchange of data with other analysis software packages.*

# PNA Instruments

*Nothing is required to complete these instruments.*

PRELIMINARY

| | | DEWE-571-PNA<br>DEWE-571-PNA-1MS | DEWE-571-PNA-4U12I | DEWE-638-PNA |
|---|---|---|---|---|
| Dynamic analog input channels | | 4 voltage<br>4 current | 4 voltage<br>12 current | 4 voltage<br>4 current |
| Signal conditioning | | Internal | | |
| Current clamps / coils included | | 4x PNA-FLEX-300-45 | - | - |
| External quasi-static channel expansion | | PAD-BOX | | - |
| **Input specifications** | | | | |
| Voltage range | | ± 1400 V peak | ± 1400 V peak | ± 1400 V peak |
| Bandwidth of input amplifiers | | DC to 300 kHz | DC to 300 kHz | DC to 300 kHz |
| Direct current input | | 5 A | - | 5 A |
| Maximum input current via clamps | | Depending on clamps | | |
| Maximum input current via flexible coils | | 10000 A | | |
| **A/D conversion** | | | | |
| Sampling rate | | **DEWE-571-PNA:** 250 kS/s aggregate<br>**DEWE-571-PNA-1MS:** 1 MS/s/ch | 250 kS/s aggregate | 10 kS/s |
| Resolution | | 16 bit | | |
| **Digital I/O** | | | | |
| Digital I/O, TTL level | | 2x DIN (24 V max.) and 1x DOUT (Relais, normal open, 60 V / 1 A AC max) | | 3 |
| Counters | | - | | |
| **Functions** | | | | |
| Multiple 3 phase systems | | ✓ | | ✓ |
| Voltage, current | | ✓ | | ✓ |
| Power, frequency | | ✓ | | ✓ |
| Harmonics, Interharmonics, THD | | ✓ | | ✓ |
| Symmetrical components | | ✓ | | ✓ |
| Period values, disturbance rec. | | ✓ | | ✓ |
| Fast transient recorder | | ✓ | | ✓ |
| Report generator & Flicker | | ✓ | | ✓ |
| Network Monitoring | | ✓ | | ✓ |
| EN50160 | | With PMT reporting tool (DEWESOFT-OPT-DB included) | | With PMT reporting tool |
| Wide band power analysis | | - | ✓ | - |
| **EMC** | | | | |
| **Power supply** | Surge | IEC 61000-4-5: 4 kV | | |
| | Burst | IEC 61000-4-4: 4 kV | | |
| **Voltage inputs** | Surge | IEC 61000-4-5: 4 kV | | |
| | Burst | IEC 61000-4-4: 4 kV | | |
| **Direct current inputs** | Surge | IEC 61000-4-5: 4 kV | | |
| | Burst | IEC 61000-4-4: 4 kV | | |
| **Shock and vibration** | | | | |
| Shock | | EN 60068-2-27 | | |
| Vibration | | EN 60068-2-6, EN 60721-3-2 class 2M2 | | |
| **Environmental** | | | | |
| Operating temperature | | 0 to +50 °C (0 to +45 with batteries) | 0 to +50 °C (0 to +45 with batteries) | -20 to +50 °C |
| Storage temperature | | -20 to +70 °C | | |
| Humidity | | 10 to 80 % non cond., 5 to 95 % rel. humidity | | |
| **Data storage** [1] | | | | |
| Technology | | Solid State Disk | Solid State Disk | SD Card |
| Capacity | | 32 GB | 32 GB | 2 GB |
| **Main system** [1] | | | | |
| Display | | 12“ TFT (1280 x 800) | 12“ TFT (1280 x 800) | - |
| Processor | | Intel® Core™2 Duo 2 GHz | Intel® Core™2 Duo 2 GHz | Low power CPU |
| Current transducer power supply 9V | | - | - | - |
| Interfaces | | 2x USB, 1x Ethernet, 1x RS-232 | 2x USB, 1x Ethernet, 1x RS-232 | 1x USB, 1x Ethernet, 1x RS-232 |
| **Power supply** | | | | |
| Standard | | Battery powered, 2 battery slots [2], incl. 2 batteries for ~2 hrs. operation, incl. external AC power supply | Battery powered, 2 battery slots [2], incl. 2 batteries for ~2 hrs. operation, incl. external AC power supply | 85 to 265 $V_{AC}$ 50 / 60Hz<br>internal 10 - 36 $V_{DC}$ |
| Optional | | - | - | - |
| **Dimensions** | | | | |
| Housing | | Portable instrument | Portable instrument | Portable instrument |
| Dimensions (W x D x H) | | 360 x 300 x 150 mm<br>(14.2 x 11.8 x 5.9 in.) | 360 x 300 x 150 mm<br>(14.2 x 11.8 x 5.9 in.) | 200 x 150 x 75 mm<br>(7.9 x 5.9 x 3 in.) |
| Weight without batteries | | Typ. 5 kg (11 lb.) | Typ. 5 kg (11 lb.) | Typ. 2.5 kg (5.5 lb.) |

[1] Please find current specifications in the latest price list

[2] Weight of one battery: 660 g (1.45 lb.)



| DEWE-3020-PNA | DEWE-2600-PNA | DEWE-5000-PNA |
|---|---|---|
| 8 slots for DAQP modules and 8 direct inputs on Sub-d-44 | 16 slots for DAQP modules | 16 slots for DAQP modules |
| Modular, 4x DAQP-HV and 4x DAQP-LV-B included | | |
| 3x CLAMP-20-B | | |
| EPAD interface, up to 16 EPAD2 modules = 128 ch | | |
| | | |
| ± 1400 V peak | | |
| DC to 300 kHz | | |
| - | | |
| Depending on clamps | | |
| 3000 A (10000 A) | | |
| | | |
| 250 kS/s | | |
| 16 bit | | |
| | | |
| 8 | | |
| 2 | | |
| | | |
| ✓ | | |
| ✓ | | |
| ✓ | | |
| ✓ | | |
| ✓ | | |
| ✓ | | |
| ✓ | | |
| ✓ | | |
| ✓ | | |
| With PMT reporting tool (DEWESOFT-OPT-DB included) | | |
| With DEWE-ORION series boards | | |
| | | |
| IEC 61000-4-5: 2 kV | IEC 61000-4-5: 4 kV | IEC 61000-4-5: 2 kV |
| IEC 61000-4-4: 2 kV | IEC 61000-4-4: 4 kV | IEC 61000-4-4: 2 kV |
| IEC 61000-4-5: 4 kV | | |
| IEC 61000-4-4: 4 kV | | |
| n.a. | | |
| n.a. | | |
| | | |
| EN 60068-2-27 | EN 60068-2-27 | MIL-STD 810F 516.5, procedure I |
| EN 60068-2-6, EN 60721-3-2 class 2M2 | EN 60068-2-6, EN 60721-3-2 class 2M2 | MIL-STD 810F 514.5, procedure I |
| | | |
| 0 to +50 °C | 0 to +50 °C (0 to +45 with batteries) | 0 to +50 °C |
| -20 to +70 °C | | |
| 10 to 80 % non cond., 5 to 95 % rel. humidity | | |
| | | |
| Hard disk | | |
| 1000 GB | 600 GB | 1000 GB |
| | | |
| 15“ TFT (1024 x 768) | 15“ TFT (1024 x 768) | 17“ TFT (1280 x 1024) |
| Intel® Core™2 Duo 2 GHz | | |
| 4x Binder 712 socket | | |
| 4x USB, 2x Ethernet, 1x RS-232 | | |
| | | |
| 95 to 260 $V_{AC}$ 50 / 60Hz | Battery powered, 3 battery slots [2], 2 batteries for ~2 hrs. operation incl., incl. external AC power supply | 95 to 260 $V_{AC}$ 50 / 60Hz 110 / 220 $V_{DC}$ |
| - | 95 to 260 $V_{AC}$ 50 / 60Hz or 110 / 220 $V_{DC}$ | - |
| | | |
| Portable instrument | Portable instrument | Portable instrument |
| 377 x 168 x 284 mm (14.8 x 6.6 x 11.2 in.) | 417 x 246 x 303 mm (16.4 x 9.6 x 11.9 in.) | 460 x 351 x 192 mm (18.1 x 13.8 x 7.7 in.) |
| Typ. 8 kg (17.6 lb.) | Typ. 14 kg (31 lb.) | Typ. 17 kg (37.4 lb.) |


## *The DEWESoft Power Measurement Software*

*(All Models except DEWE-638-PNA)*

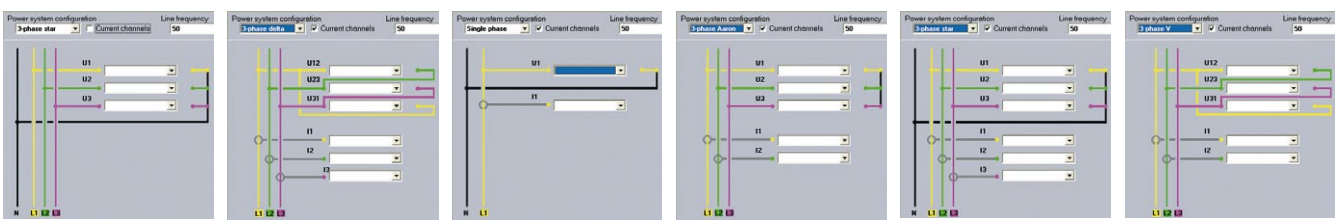
*The option POWER for the DEWESoft (DEWESoft-OPT-POWER) is an absolutely high-performance tool for the calculation of power and other similar parameters – the capacity to multiply current and voltage is not the only feature it has. This toolbox is an excellent combination of many features and nearly all applications can be realised by using DEWETRON equipment.*

*Beside the exact calibration the frequency calculation is a central feature of this software. 50 Hz and 60 Hz are a must – for us also 16 2/3, 400 and 800 Hz as well as DC software and variable frequencies (driver) are a necessity. Due to the high acquisition rate (mainly dependent on the AD card in use, up to 1 MS/s) and the DAQP-HV module there is no limitation of the acquisition of PWM drivers (300 kHz electrical band width) and the calculation of active and reactive power, power factor etc ... The toolbox with the power quality parameters such as harmonics, interharmonics, THD, symmetric components, flicker and its combination with the numerous trigger possibilities make the equipment a power analyzer with nearly no limitations. Several screen elements such as vector scopes, harmonics monitor, oscilloscope and diagrams allow a perfect online visualisation of the data.*

*The integration of counter inputs, video and CAN-Bus offers additional data sources. The mathematical library additionally offers the possibility to calculate parameters such as torque and angular velocity or even determine the efficiencies online.*

### *Wiring Schematics*

*Various wiring schematics allow the following connections of instruments: single-phase connection, star-connection, delta-connection, V-connection, Aron-connection, two-phase-connection and a combined star-/delta-connection – of course all with or without electric current.*

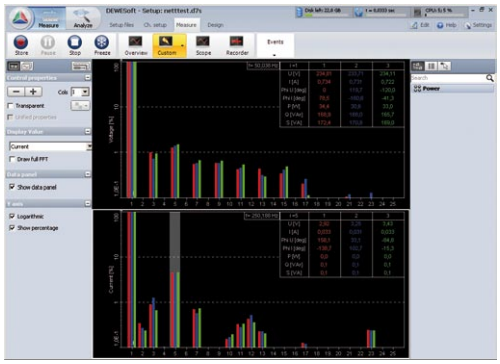


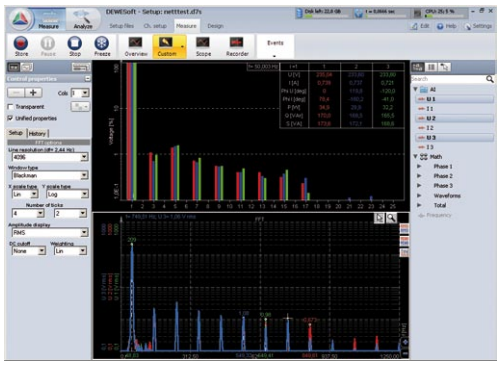
# Harmonics Analysis

## Measure

### FFT – Harmonics Analysis

- *U, I, P and Q*
- *Individual setup of the number of harmonics including DC-component (Example: 20 kHz sampling rate = 200 harmonics @ 50 Hz)*
- *Interharmonics, groups or single values*
- *According to IEC 61000-4-7*
- *Calculation corrected to the actual real frequency*
- *THD, THD even, THD odd, K-Factor, TIHD*
- *Trigger on each parameter*
- *Background harmonics*
- *Grouping methods for harmonics and interharmonics free configurable: for examle the number of pins and the frequency groups „200 Hz“ according to IEC 61000-4-7*





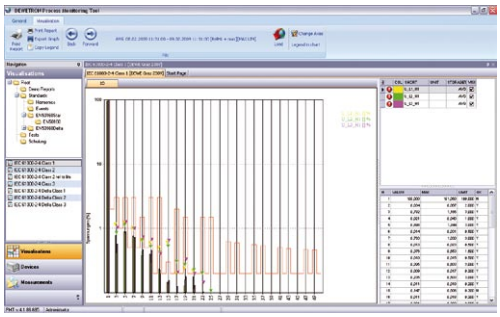
### Full FFT

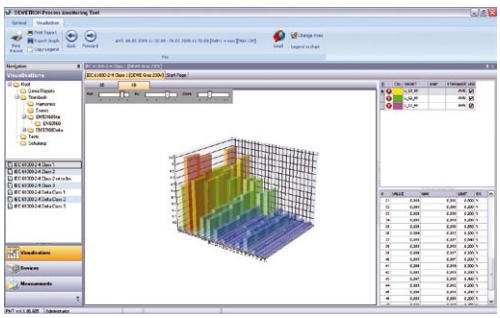
- *In addition to the harmonics FFT a full frequency based FFT is available.*
- *All frequencies can be analyzed with this function*
- *Trigger on FFT patterns*
- *Selectable Filters (Hanning, Haming, Flat Top, Rectangle, ...)*

## Analyze

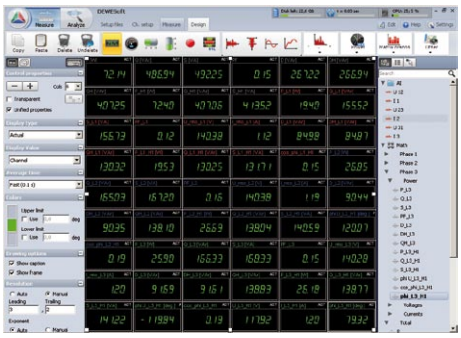
### FFT – Spectra

- *Individual number of harmonics (25, 50, ...)*
- *Voltage, current, active power, reactive power, phase angle, impedance*
- *Limits according standards (EN50160, IEC61000-2-4, individual definition)*
- *Max / Avg / 95% calculation and comparison against limits*
- *Timestamp or intervals of data presentation*
- *More subgraphs per page possible*
- *More datalines in one graph*
- *Direct comparison of different locations*
- *Zoom In / Zoom Out Function*
- *Report Printing function*
- *3D graph*





# Power Analysis



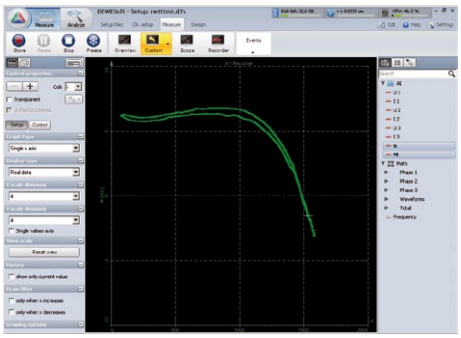
## Measure

### Power Calculation

- *P, Q, S, D*
- *Cos Phi, power factor*
- *P, Q, cos Phi for each harmonic*
- *Symmetrical components (positive, negative and zero sequence components); U, I, P, Q, cosPhi; from 10 period values and period values*
- *Period values (½ cycle, cycle, overlapping, 1 ms sliding, ...)*

### Recorder

- *Recording of all parameters in individual intervals*
- *Individual screens can be defined*
- *Zoom in and out*
- *Storing fast (full sampling rate) or reduced (e.g. 600 sec.)*
- *Detailed zoom-in to pulse width!*



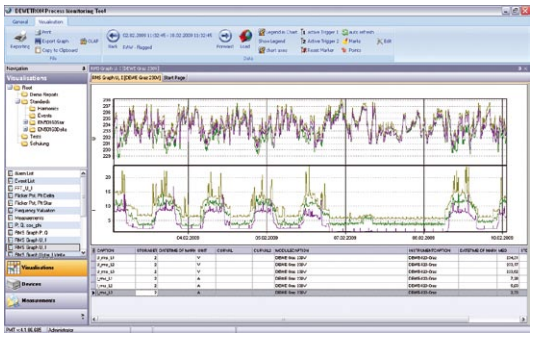
### X/Y Recorder

- *Orbitals can be generated online*
- *N over M as example for this function*

## Analyze

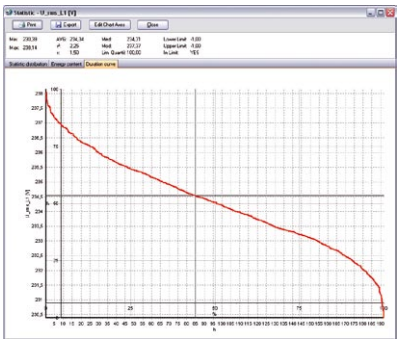
### Diagrams

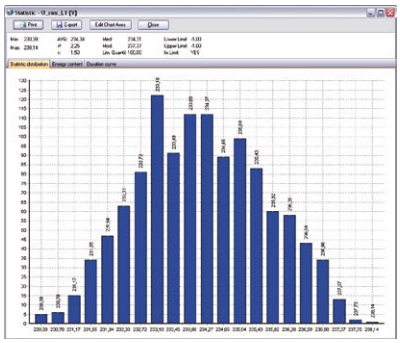
- *Single diagrams or multiple diagrams on one page*
- *Individual number of channels per diagram*
- *Graphical view or statistical view in a table*
- *Table individual configurable*
- *Min / Max / Avg calculation*
- *Up to 5 percentage calculations (eg 95% value) per channel*
- *Direct comparison of different locations*
- *Direct comparison of different days*
- *Zoom in / zoom out function*
- *Report printing function*
- *Math channels*



### Histograms

- *Histogram calculation*
- *Med / Stddev / Var / Mod calculation*
- *Individual definition of sidebands*
- *Report printing function*
- *Energy line*



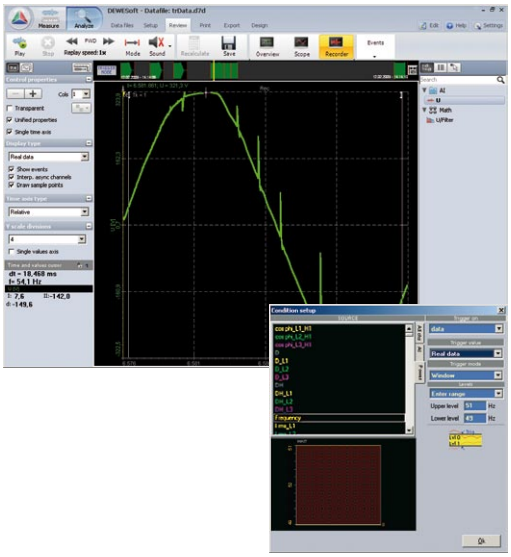


### Energy consumption diagram

### Energy duration line

# Fault Analysis

## Measure



### Fault recorder

- *Trigger on all parameters of the power module!*
- *U, I, P, Q, S, D, cos Phi, power factor, ...*
- *Each harmonic!*
- *Pos-, neg-, zero-sequence systems*
- *Very fast glitch detection (MS/s)*

### Edge-, filtered edge- and window-trigger


*Trigger on rising edge when the threshold has been crossed*

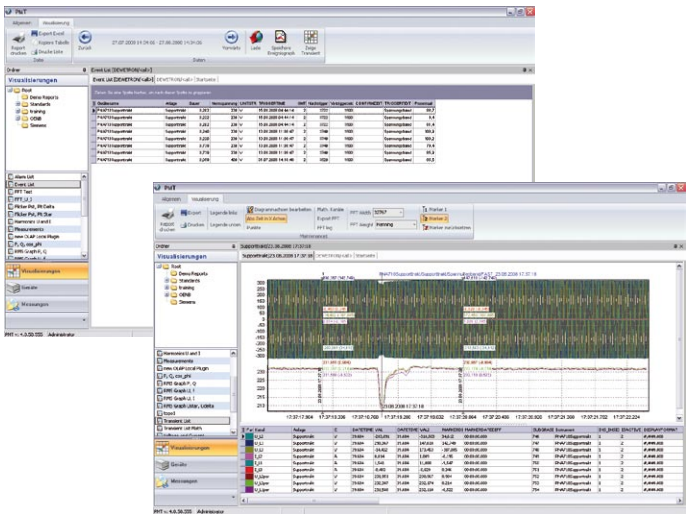

*Trigger on falling edge when the threshold has been crossed*


*Trigger when signal enters the range between two definable threshold levels*


*Trigger when signal leaves the range between two definable threshold levels*

***Further trigger functions:*** *pulse width, window and pulse width, slope, FFT and time*

## Analyze

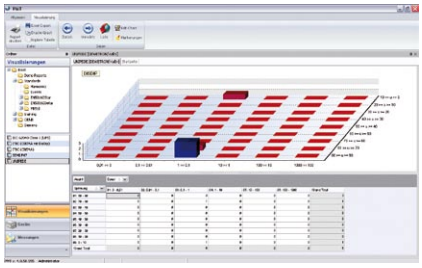


### Fault Lists

- *Listings of faults*
- *Filters like time, channel, type etc..*
- *Automatic update function*
- *Confirmation support*
- *Report printing function*

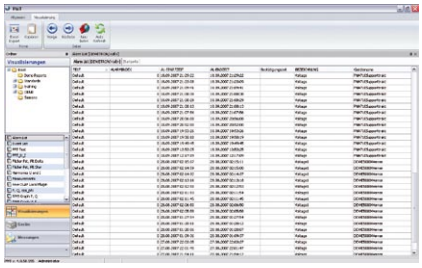
### Fault Diagrams

- *Waveform presentation of faults*
- *RMS shape calculation*
- *Different setups for different faults*
- *Math channels & Report printing function*
- *FFT*



### DIS DIP Statistics

- *Statistics like DISDIP / Unipede etc..*
- *Individual limits*
- *Individual time settings*
- *Graphical or table element*
- *Report printing function*



### Alarm Lists

- *Alarm list definition*
- *Automatic update function*
- *Confirmation support*
- *Report printing function*

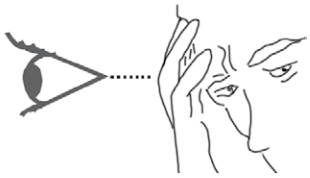
# Analysis according to Standards


## Measure

- Setups according to certain standards
- prepared or user-definable
- PQ according to EN501610
- Harmonics according to IEC 61000-4-7
- Flicker according to IEC 61000-4-15
- Measurement according to IEC 61000-4-30 class A

### Flicker

- According to IEC 61000-4-15
- $P_{ST}$ and $P_{LT}$ with flexible intervals
- Individual recalculation intervals
- $P_{F5}$, du, $du_{max}$
- Flicker emission (current flicker)



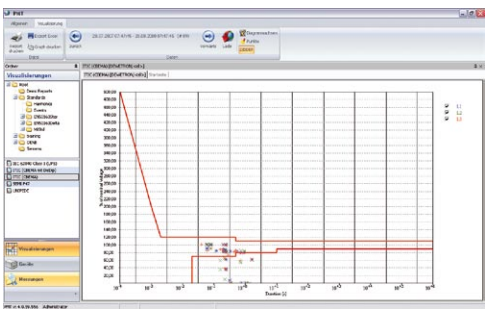



## Analyze

- EN-50160
- IEC 61000-2-4 class 1, 2, 3
- IEC 61400-21
- Harmonics freely adjustable (for example: IEC 61000-3-x)
- Built in report generator for flexible reports
- Combination of certain diagrams in one report
- Tables
- FFT spectra
- Fault statistics
- CBEMA curve
- All other visualization-elements are supported
- Summary report for more instruments
- Automated report generation and print support

### CBEMA/ITIC curve

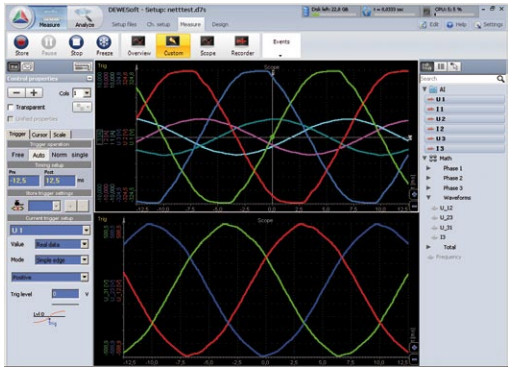
- Statistics like CBEMA, SEMI F47 etc..
- Individual limits
- Individual time settings
- Combination with DISDIP possible
- Graphical view
- Report printing function



# Further Analysis

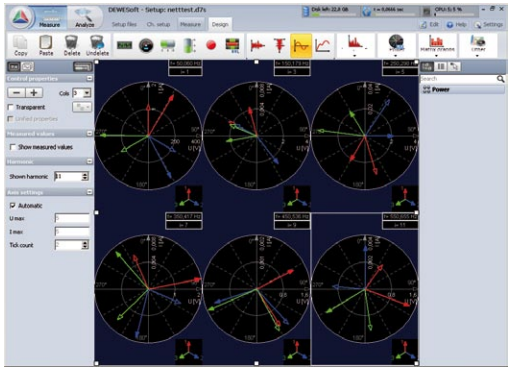
## Scope

- *Selectable graphs*
- *U1, U2, U3, U12, U23, U31: Line to line and line to earth voltages are supported*
- *Up to 8 graphs in one diagram*
- *Zoom in and out are supported online*
- *Waveforms can be stored*



## Vector Scope

- *Vector scope for 3 phase systems*
- *Each individual harmonic can be shown*
- *More vector scopes can be displayed on one screen*
- *Different power systems can be shown on one screen*
- *With the "transparent" function direct comparisons of phasors are possible*

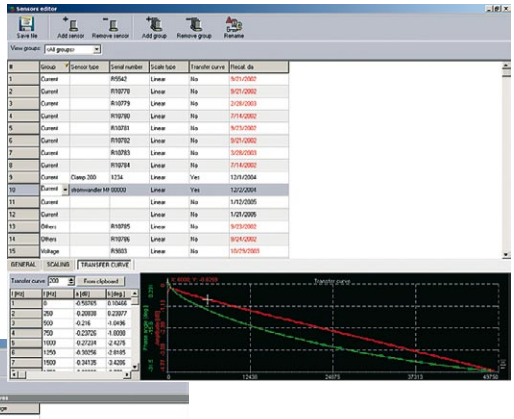


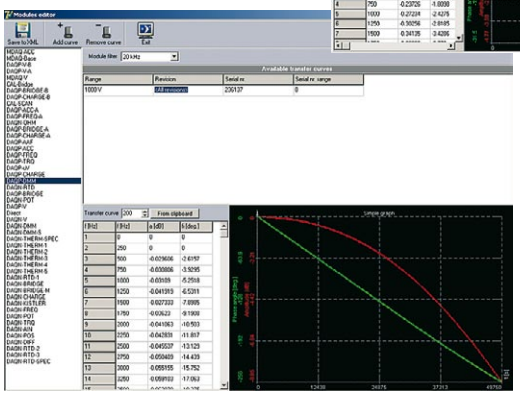
## Frequency Calculation

*The software PLL guarantees a very accurate frequency calculation (mHz). On one system multiple power systems can be measured and each can have its own frequency. With the use of the different instruments from DEWESoft the values can be shown in several ways.*

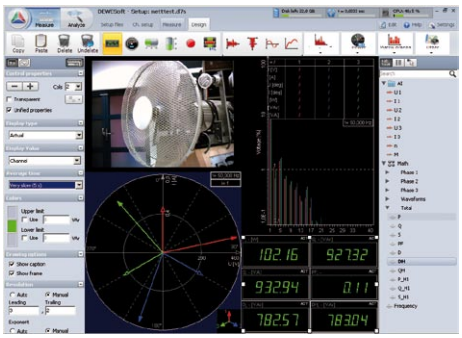
## Calibration/Accuracy

*The high accuracy of the calculation can be reached because of the calibration function in the frequency domain. With this unique technology amplitude and phase can be corrected for the full frequency range from DC up to whatever the hardware can sample (kilosamples up to megasamples per second). All internal curves like filter response or multiplexer shift are corrected inside the software and the sensor database includes correction curves for each clamp, Rogowski coil, transformer or which sensor ever is used.*



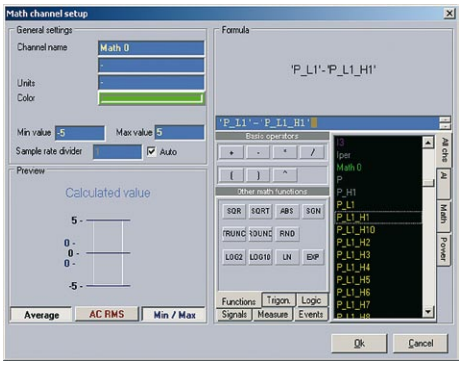


# Other Functions



## Video

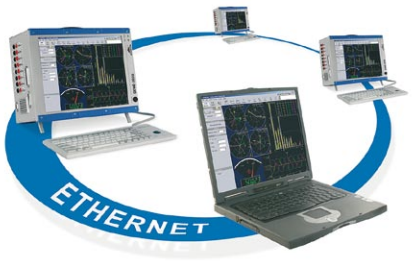
*The parallel usage of the synchronous DEWESoft VIDEO function allows the user to store videos in parallel with the data recording and opens a wide range of applications – whenever optical information is needed!*




## Math Functions

*With the additional MATH function of DEWESoft calculations of for example efficiency, difference of input, output and phase angle differences can be implemented easily. Use all POWER parameters as input value!*

- *Arithmetic functions*
- *Trigonometric functions*
- *Logic function*
- *Signal generator*
- *Event functions*
- *d/dt, integration*
- *Highpass-, lowpass- and bandpass-filters*
- *Transfer curve function*

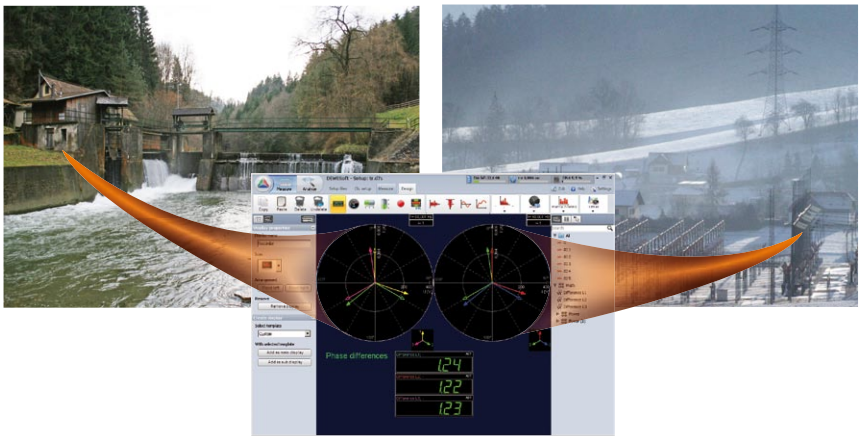



## Remote Control

*With the remote control ability the instrument can be configured and the data can be evaluated from your office or wherever you are.*

## GPS and NET

*With the use of the GPS function a comparison of different units on different locations is possible. Phasor measurement and angle comparisons are a typical application of this function.*





## Reporting Function

- *Direct report printout*
- *Data export for enhanced post analysis in other applications*
- *PMT as reporting and analysis tool*

## Notification (for permanent installed systems)

- *E-Mail*
- *SNMP*

# Clamps & Ampflex

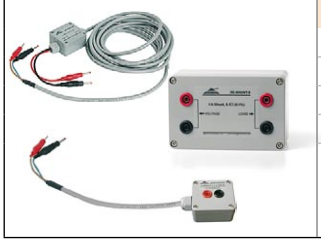
| PNA-CLAMP-5 | | | | | | |
|---|---|---|---|---|---|---|
|  | AC input range | 0.04 to 6 A | | | | |
| | Output | 60 mV/A | | | | |
| | % accuracy | 0.04 to 6 A | ≤ 0.5 % | Phase shift | 0.04 to 6 A | ≤ 0.5° |
| | Bandwidth | 40 Hz ... 10 kHz | | | | |
| | Working temperature | -10° to +55°C | | Temperature drift | ≤ 0.2 % of output signal per 10K | |
| | Connector type | C16-1, 6+PE | | | | |
| | Fits to following systems | DEWE-5xx-PNA | | | | |

| PNA-CLAMP-10 | | | | | | |
|---|---|---|---|---|---|---|
|  | AC input range | 0.01 to 12 A | | | | |
| | Output | 100 mV/A | | | | |
| | % accuracy | 0.01 to 0.1 A | ≤ 3 % +0.1 mV | Phase shift | 0.01 to 0.1 A | not specified |
| | | 0.1 to 1 A | ≤ 2.5 % | | 0.1 to 1 A | ≤ 5° |
| | | 1 to 5 A | ≤ 1 % | | 1 to 5 A | ≤ 3° |
| | | 5 to 12 A | ≤ 1 % | | 5 to 12 A | ≤ 3° |
| | Bandwidth | 40 Hz ... 10 kHz | | | | |
| | Working temperature | -10° to +55°C | | Temperature drift | ≤ 0.2 % of output signal per 10K | |
| | Connector type | C16-1, 6+PE | | | | |
| | Fits to following systems | DEWE-5xx-PNA | | | | |

| PNA-CLAMP-20 / PNA-CLAMP-20-B | | | | | | |
|---|---|---|---|---|---|---|
|  | AC input range | 0.1 to 24 A | | selectable | 0.5 to 240 A | |
| | Output | 100 mV/A | | | 10 mV/A | |
| | % accuracy | 0.1 to 20 A | ≤ 1 % +50 mV | | 0.5 to 10 A | ≤ 3 % +5 mV |
| | | | | | 10 to 40 A | ≤ 2.5 % +5mV |
| | | | | | 40 to 100 A | ≤ 2 % +5mV |
| | | | | | 100 to 240 A | ≤ 1 % +5mV |
| | Bandwidth | 40 Hz ... 10 kHz | | | | |
| | Phase shift | 0.1 to 20 A | not specified | | 0.5 to 10 A | not specified |
| | | | | | 10 to 40 A | ≤ 5° |
| | | | | | 40 to 100 A | ≤ 3° |
| | | | | | 100 to 240 A | ≤ 2.5° |
| | Working temperature | -10° to +55°C | | Temperature drift | ≤ 0.15 % of output signal per 10K | |
| | Connector type | C16-1, 6+PE for PNA-CLAMP-20 | | Safety banana jacks (4 mm) for CLAMP-20-B | | |
| | Fits to following systems | DEWE-5xx-PNA, DEWE-5xx-PNA-1MS for PNA-CLAMP-20 | | | | |
| | | All systems with DAQ series amplifiers for PNA-CLAMP-20-B | | | | |

| PNA-CLAMP-1000 | | | | | | |
|---|---|---|---|---|---|---|
|  | AC input range | 0.001 to 1200 A | | | | |
| | Output | 1 mA/A | | | | |
| | % accuracy | 1 to 100 mA | ≤ 3 % +5 µA | Phase shift | 1 to 100 mA | not specified |
| | | 0.1 to 1 A | ≤ 2 % +3 µA | | 0.1 to 1 A | not specified |
| | | 1 to 10 A | ≤ 1 % | | 1 to 10 A | ≤ 2° |
| | | 10 to 100 A | ≤ 0.5 % | | 10 to 100 A | ≤ 1° |
| | | 100 to 1200 A | ≤ 0.3 % | | 100 to 1200 A | ≤ 0.7° |
| | Bandwidth | 30 Hz ... 5 kHz | | | | |
| | Working temperature | -10° to +50°C | | Temperature drift | ≤ 0.2 % of output signal per 10K | |
| | Connector type | C16-1, 6+PE | | | | |
| | Fits to following systems | DEWE-5xx-PNA | | | | |

# Shunts

| Shunts | | DAQ-SHUNT-3 | DAQ-SHUNT-4 | DAQ-SHUNT-5 |
|---|---|---|---|---|
|  | Application | Power grid analysis | Power grid analysis | Power grid analysis |
| | Type of current | AC + DC | AC + DC | AC + DC |
| | Impedance | 0.1 Ohm | 0.1 Ohm | 0.1 Ohm |
| | Accuracy | 0.1 % | 0.1 % | 0.1 % |
| | Temperature drift | <±10ppm/K (20 °C to 60 °C) | <±10ppm/K (20 °C to 60 °C) | <±10ppm/K (20 °C to 60 °C) |
| | Connectors | Input: 2 m cable with banana plugs<br>Output: 30 cm cable with banana plugs | Input: built-in banana jacks<br>Output: 30 cm cable with banana plugs | Input: built-in banana jacks<br>Output: built-in banana jacks |

## PNA-A100-200-45 / PNA-A100-200-80

| | | | | | |
|---|---|---|---|---|---|
| AC input range | 0.5 to 200 A | | selectable | 0.5 to 2000 A | |
| Output | 10 mV/A | | | 1 mV/A | |
| % accuracy | 0.5 to 5 A | not specified | | 0.5 to 5 A | not specified |
| | 5 to 200 A | ≤ 1 % | | 5 to 2000 A | ≤ 1 % |
| Bandwidth | 10 Hz ... 20 kHz | | | | |
| Phase shift | 0.5 to 5 A | ≤ 0.7° | | 0.5 to 5 A | ≤ 0.7° |
| | 5 to 200 A | ≤ 0.7° | | 5 to 2000 A | ≤ 0.7° |
| Working temperature | -10° to +55°C (maximum temperature for sensor is 90°C) | | | | |
| Temperature drift | ≤ 0.5 % of output signal per 10K | | | | |
| Connector type | Safty banana jacks (4 mm) | | Length of coil | 45 cm for PNA-A100-200-45 | |
| Fits to following systems | All systems with DAQ series amplifiers | | | 80 cm for PNA-A100-200-80 | |

## PNA-A100-300-45 / PNA-A100-300-80

| | | | | | |
|---|---|---|---|---|---|
| AC input range | 0.5 to 200 A | | selectable | 0.5 to 2000 A | |
| Output | 10 mV/A | | | 1 mV/A | |
| % accuracy | 0.5 to 5 A | not specified | | 0.5 to 5 A | not specified |
| | 5 to 200 A | ≤ 1 % | | 5 to 2000 A | ≤ 1 % |
| Bandwidth | 10 Hz ... 20 kHz | | | | |
| Phase shift | 0.5 to 5 A | ≤ 0.7° | | 0.5 to 5 A | ≤ 0.7° |
| | 5 to 200 A | ≤ 0.7° | | 5 to 2000 A | ≤ 0.7° |
| Working temperature | -10° to +55°C (maximum temperature for sensor is 90°C) | | | | |
| Temperature drift | ≤ 0.5 % of output signal per 10K | | | | |
| Connector type | Safty banana jacks (4mm) | | Length of coil | 45 cm for PNA-A100-300-45 | |
| Fits to following systems | All systems with DAQ series amplifiers | | | 80 cm for PNA-A100-300-80 | |

## PNA-A100-1000-120

| | | | | | |
|---|---|---|---|---|---|
| AC input range | 0.5 to 1000 A | | selectable | 0.5 to 10000 A | |
| Output | 10 mV/A | | | 1 mV/A | |
| % accuracy | 0.5 to 5 A | not specified | | 0.5 to 5 A | not specified |
| | 5 to 1000 A | ≤1 % | | 5 to10000 A | ≤ 1 % |
| Bandwidth | 10 Hz ... [45 ... 65] ... 20 kHz | | | | |
| Phase shift | 0.5 to 5 A | ≤ 0,5° | | 0.5 to 5 A | ≤ 0,5° |
| | 5 to 1000 A | ≤ 0,5° | | 5 to10000 A | ≤ 0,5° |
| Working temperature | -10° to +55°C (maximum temperature for sensor is 90°C) | | | | |
| Temperature drift | ≤ 0.5 % of output signal per 10K | | | | |
| Connector type | Safty banana jacks (4 mm) | | Length of coil | 120 cm | |
| Fits to following systems | All systems with DAQ series amplifiers | | | | |

## PNA-FLEX-MINI-300-70

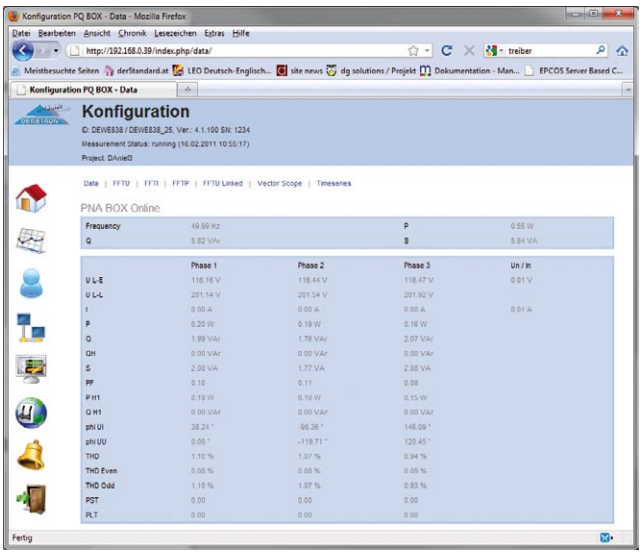
| | | | | | |
|---|---|---|---|---|---|
| AC input range | 0.5 to 300 A | | selectable | 0.5 to 3000 A | |
| Output | 10 mV/A | | | 1 mV/A | |
| % accuracy | 0.5 to 5 A | not specified | | 0.5 to 5 A | not specified |
| | 5 to 300 A | ≤ 1 % | | 5 to 3000 A | ≤ 1 % |
| Bandwidth | 10 Hz ... 20 kHz | | | | |
| Phase shift | 0.5 to 5 A | ≤ 0.7° | | 0.5 to 5 A | ≤ 0.7° |
| | 5 to 300 A | ≤ 0.7° | | 5 to 3000 A | ≤ 0.7° |
| Working temperature | -10° to +55°C (maximum temperature for sensor is 90°C) | | | | |
| Temperature drift | ≤ 0.5 % of output signal per 10K | | | | |
| Connector type | C16-1, 6+PE | | Length of coil | 69 cm | |
| Fits to following systems | DEWE-5xx-PNA<br>DEWE-5xx-PNA-1MS | | | | |

## PNA-FLEX-300-45 / PNA-FLEX-300-45

| | | | | | |
|---|---|---|---|---|---|
| AC input range | 0.5 to 300 A | | selectable | 0.5 to 3000 A | |
| Output | 10 mV/A | | | 1 mV/A | |
| % accuracy | 0.5 to 5 A | not specified | | 0.5 to 5 A | not specified |
| | 5 to 300 A | ≤ 1 % | | 5 to 3000 A | ≤ 1 % |
| Bandwidth | 10 Hz ... 20 kHz | | | | |
| Phase shift | 0.5 to 5 A | ≤ 0.7° | | 0.5 to 5 A | ≤ 0.7° |
| | 5 to 300 A | ≤ 0.7° | | 5 to 3000 A | ≤ 0.7° |
| Working temperature | -10° to +55°C (maximum temperature for sensor is 90°C) | | | | |
| Temperature drift | ≤ 0.5 % of output signal per 10K | | | | |
| Connector type | C16-1, 6+PE | | Length of coil | 45 cm for PNA-FLEX-300-45 | |
| Fits to following systems | DEWE-5xx-PNA<br>DEWE-5xx-PNA-1MS | | | 80 cm for PNA-FLEX-300-80 | |

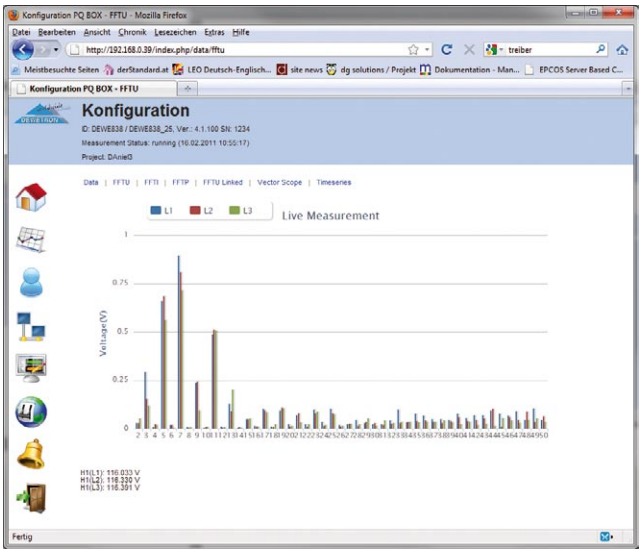
# Software DEWE-638-PNA / DEWE-838-PNA

*The software is a web application which you can access with any browser (e.g. Microsoft Internet Explorer, Apple Safari, Mozilla Firefox,...)*



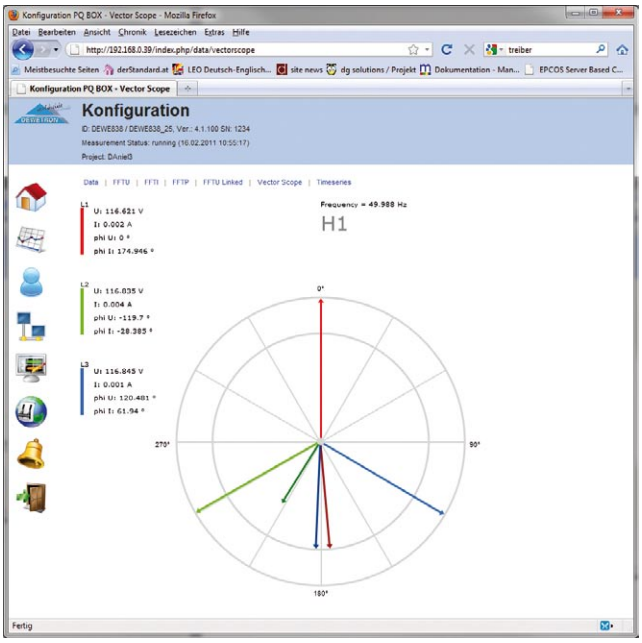

### Online data

- *U, I of phases, lines and neutral*
- *f*
- *Power of phases and total*
- *P, Q, S, PF*
- *Fundamental values of power*
- *Flicker (IEC 610004-15)*
- *THD*



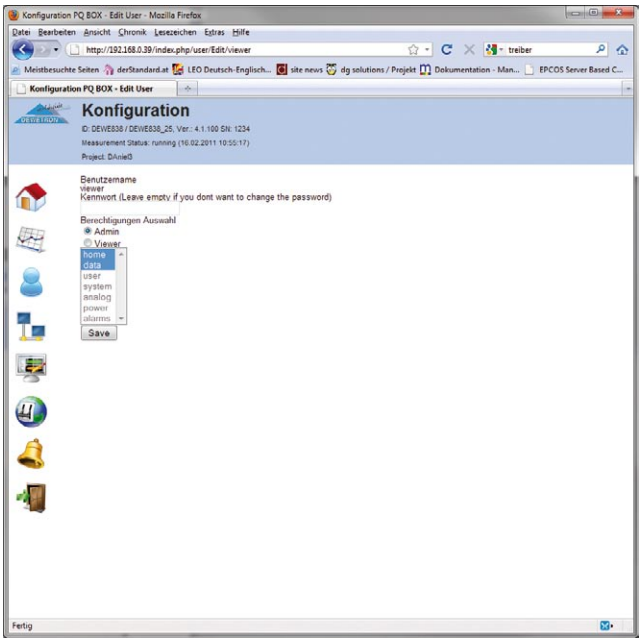

### Harmonics screen (IEC 61000-4-7)

- *U, I, P, Q, Uline*




### Vector scope

- *U,I*
- *Selectable order of harmonic*

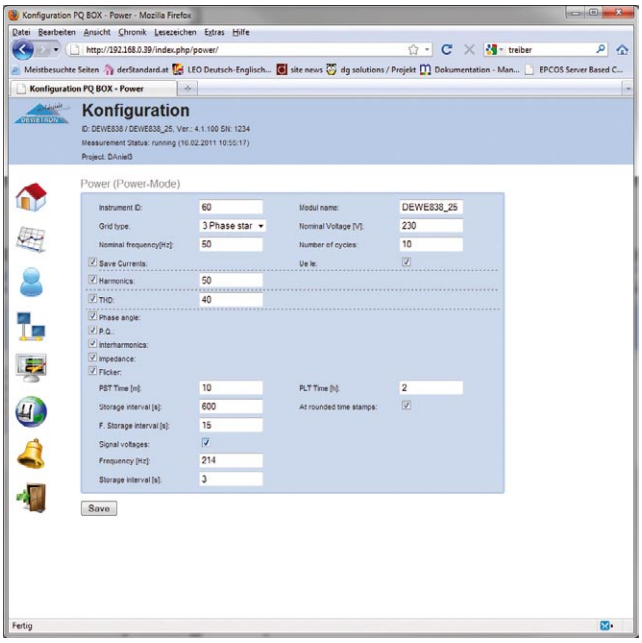



### Access to the instrument

*Different users have different access to the instrument.*

*Basic access:*

- *Viewer (only data can be shown)*
- *Admin (administrator access to the instrument)*



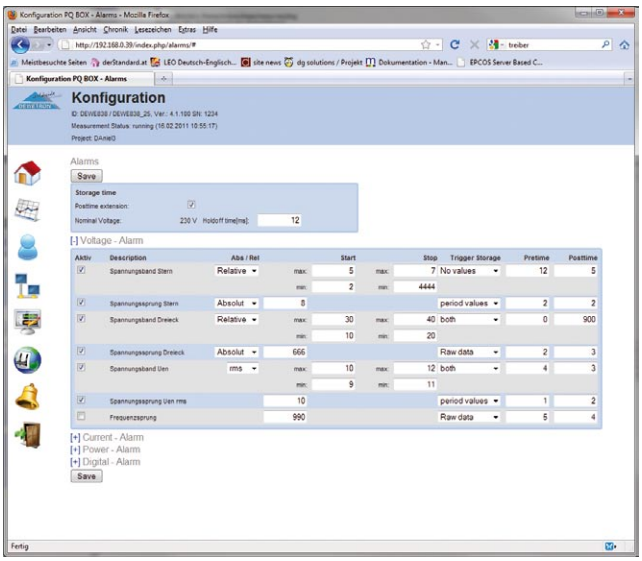

### PQ and POWER monitor

*Configure the storing options for the PQ recorder:*

- *Harmonics, flicker, voltage, THD,...*

*Configure the POWER meter:*

- *P, Q, S, PF, cos Phi, I, f,...*




### Fault recorder

*Trigger options for:*

- *External (DIOs)*
- *Voltage (level, rate of change, line + phase and neutral)*
- *Current (level, rate of change)*
- *Power (level, rate of change)*
- *Frequency (level, rate of change)*

# Power Quality Analysis - Power Quality Measurements

*Application Example for Power Network Analysis*

## Introduction

*Power quality, also known as keywords like grid quality, grid voltage quality and service reliability, is a topic that is directly linked to energy supply and is certainly a highly topical issue in this field.*

*Due to the liberalization of power markets, grid-bound energy sources, such as electrical current, became freely tradable products and thus have to obey product liability law as do other tradable products. The corresponding parameters were constituted in the product standard EN 50160 in Europe.*

- *$U_{rms}$*
- *Wave form*
- *Frequency*
- *3~ phases; symmetry*
- *Availability*

*Additionally, there are many other tasks: e.g. special harmonics evaluations, long-term measurements, and the identification of fastest transient processes or only power flow measurements in four quadrants.*

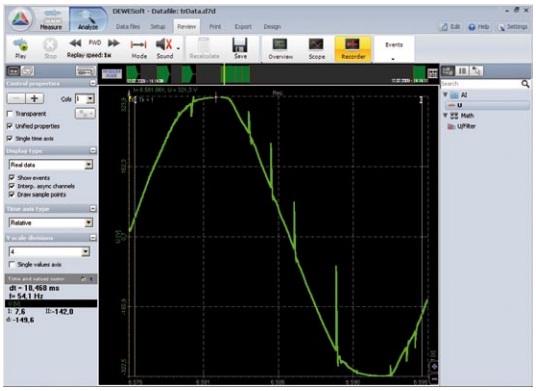
## Task

*The identification of limit values that are constituted in the EN 50160 or in another power quality standard is nowadays not a big challenger anymore. Several millimeters can measure these, compare their values with limit values and reflect them in well-formatted reports.*

*The task becomes more specialized when you want to find the reasons for off-limit conditions; that is when you want to make exact analyses of the national grid.*

*For very fast transient processes as they can appear in low voltage grids, sampling rates of 6,4 kHz are not sufficient. 1 million data points per second are necessary in this case.*

- *1 Msamples/sec*

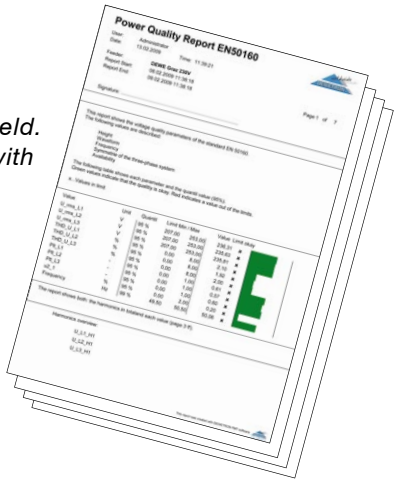


*The analysis of harmonics up to the 25th is sufficient for the EN 50160 but other standards demand 50 or even 100. Latest standards even proceed to the range of 9 kHz in order to identify disturbances of electrical instruments (200 Hz bands of 2 to 9 kHz).*

- *Harmonics up to 50 / 100 or higher*
- *2 to 9 kHz @ 200 Hz*
- *Flexible grouping method for interharmonics and harmonics*
- *Determination of power flow direction of the individual power harmonics*

*Flicker as the impact of voltage fluctuation is widely known. But what about the sources of flicker (identification of flicker emission)? What about adjustment of filters (faster re-calculation periods and sliding flicker windows)?*

- *Flicker 10 min Pst, Plt*
- *Identification of flicker emission (current flicker)*
- *Shorter re-calculation periods, sliding flicker windows*




*Beside the EN 50160, there exist many other standards and regulations in this field. Only some may be listed that imply exact measurement and can be analyzed with DEWETRON-instruments:*

- *EN 50160*
- *IEC 61000-3-x; IEC 61000-2-2; IEC 61000-2-4; ...*
- *IEC 62040*
- *ITI / CBEMA curve*
- *DISDIP statistics (Unipede)*
- *TOR D2 (D A CH CZ regulation)*
- *etc.*

*For medium-voltage power grids analyses are not only necessary for line voltage/earth potential but also for line/line voltage. Short circuits display differently compared to earth faults. Flicker and harmonics should be evaluated for the line/line voltage, the voltage transformers are mostly installed between line and earth. Flexible connection possibilities and internal conversions may remedy.*

- *3 ~ star (e.g. low voltage)*
- *3 ~ star with conversion to delta (e.g. mean and high voltage)*
- *Delta connection (e.g. industrial grids)*
- *Aron- und V-connection*
- *2 ~ (e.g. traction supply systems)*
- *1 ~ (e.g. household)*

*Conventional instruments for power quality analysis obviously prove to be at the end of their possibilities. With a concept for measurement instruments that is as flexible as possible and that complies with official standards we try to provide the perfect solution.*

# Solution

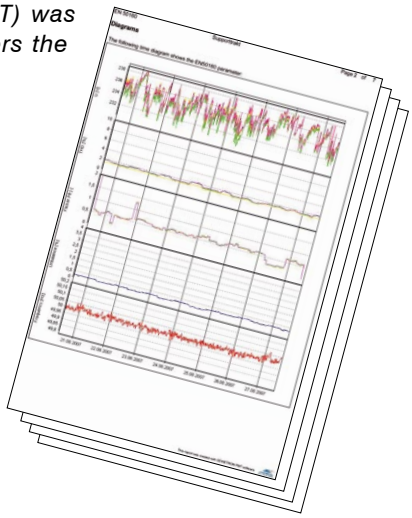
## Hardware

*The product DEWE-571-PNA was especially designed and developed for measurements in distributors and central control rooms. Completely isolated, highest EMC protection and a stable case characterize this instrument. If more channels are needed then the ELOG model can help. 4 voltages and 12 currents at the same time are its specific feature.*

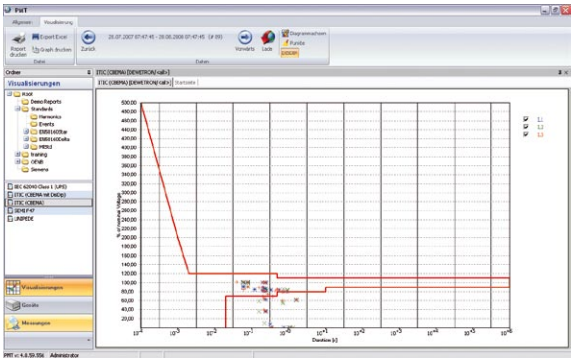
*Besides, also other products in a conventional DEWETRON box and completely installed systems are available. The requirements of analysis instruments for power quality were constituted in the standard IEC 61000-4-30. Our instruments comply with this standard.*

## Software

*The software of DEWESoft with its options POWER and DB (report generator PMT) was especially designed for exact normative analyses and, among other features, offers the following functions for analysis:*



- *Voltage curve, voltage jumps, voltage fluctuations*
- *Disturbance statistics (Unipede, CBEMA, ITI, SEMI F47, ...)*
- *Flicker (IEC 61000-4-15)*
- *Power quality analysis, load curve analysis*
- *Reports according to standards (e.g. EN 50160, IEC 61000,...)*
- *Flexibility of configuration of measurement*
- *Flexible screen settings*
- *Flexible reports (according to standards or user-defined)*
- *Integration in permanent monitoring systems possible (please, also see DEWE-PFR)*



## Customers

- *Energy supply companies*
- *Grid operators*
- *Service technicians*
- *Energy consultants and engineering offices*
- *Facility management*
- *Constructors of electrical plants*
- *Research institutions in schools and universities*

# Energy Consumption Measurements - Load Curve Analyses

*Application Example for Power Network Analysis*

## Introduction

*Energy consumption, its chronological course, the proportion of active and reactive power and the subsequent costs are a big issue nowadays. Of great interest are on the one side, savings capacity both for the consumption and the electricity bill and on the other side, the greenhouse gas emissions in combination with the energy consumption. Furthermore, the load curve is interesting as regards the reduction of peak power and load management systems.*


## Task

*Load curve analyses are typically carried out in the main distributors in business enterprises and industrial plants. Transformer stations and the circuits behind them can also be added as typical measurement locations. Of great interest are currents, voltages, active and reactive power – not only the instantaneous value but also as regards their chronological sequence with adjustable averaging interval. Such an analysis usually takes 1 week to 1 month.*

*In order to be able to configure load management systems efficiently, it is not only obligatory to know the total load curve but also the individual branches. Multi-phase measurements on several consumers, in parallel and if possible with only one instrument is therefore the challenge for measurement technology.*

*In transformer stations it is important to identify the distribution of energy on the different circuits in order to optimally adjust the operation and identify shortages.*

## Solution

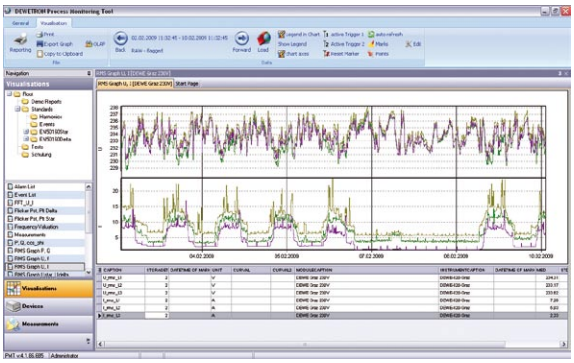
### Hardware

*The product DEWE-571-PNA was especially designed and developed for measurements in distributors and central control rooms. Completely isolated, highest EMC protection and a stable case characterize this instrument.*

*If more channels are needed then the ELOG model can help. 4 voltages and 12 currents at the same time are its specific feature. Besides, also other products in a conventional DEWETRON box and completely installed systems are available.*

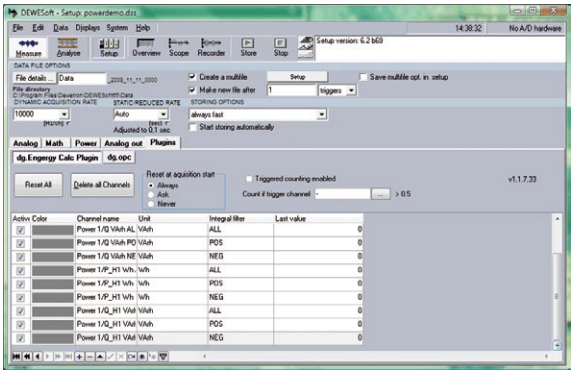
## Software

*Our software DEWESoft with its POWER option is the perfect tool for these requirements. Power measurement calculations, several 3~ systems at the same time - even with different frequencies, multi-allocation of voltage, sensor scaling etc. are the necessary features.*



*PMT as a supplement for report generation is the icing on the cake. Load curves, energy growth curves, sorted out load curve analysis (load curve management), statistic functions and the report generator are the functions offered.*

*A special energy calculation tool (plug-in) moreover offers the possibility to distinguish between consumed and transmitted energy, inductive and capacitive reactive energy, entire energy, and self-configurable energy channels.*



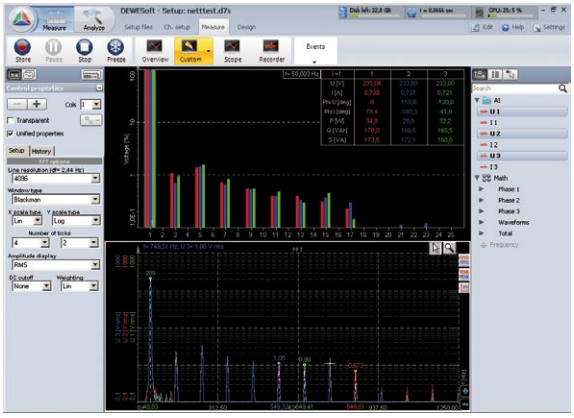
# Further Functions

## PQ Parameter

*Beside the energy data, all power quality parameters such as harmonics, flicker, unbalances, frequencies and disturbances can be measured.*

## Mathematics Library

*You can program arbitrary formula in an online system. The calculation of total power and identification of losses can thus also be done online.*



# Customers

- *Service technician*
- *Facility management*
- *Constructors of electrical systems*
- *Constructors of load management systems*
- *Research institutions in schools and universities*
- *Energy consultants and engineering offices*
- *ISO 16001 certifier*

# Measuring Wind Power and other Renewable Energy Sources

*Application Example for Power Network Analysis*

## Introduction

*Renewable Energy sources are already integrated in power grids and the amount of enerrgy is becoming more and more. Wind power plants are mostly operated in wind power plants or as single plants. Photovoltaic systems with a total power of some Megawatts are already a part of the townscape in some countries and bio gas plants are no longer the hobby of some farmers anymore. Each of these plants acts as an independent power plant and must have special features concerning stabilised voltage and electromatgnetic influences respectively.*

*On one hand side these electrical characteristics have to be verified and carried out as individual tests or sample testing (IEC 61400-21)*

*On the other hand side the behaviour of large renewable plants an the grid has to be monitored according to the actual power quality standards (for example EN50160) as there is a provider/ customer relationship on the connection point to the power grid.*

## Task

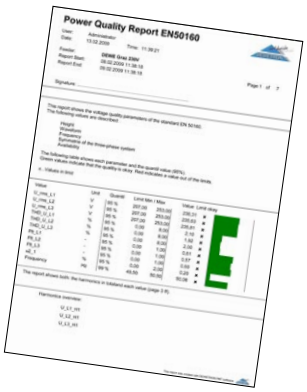
*Power plants with renewable sources are thus independent power plants within the grid which they can positively or negatively influence as much as any other supplier or consumer. These influencing parameters (voltage fluctuation, harmonics, frequency, etc.) underlie certain limit values. They have to be especially evaluated according to certain basic requirements such as e.g. wind speed for wind turbines and short-circuit power (IEC 61400-21). If the limit values are kept, then all parties of the energy supply system (customer, supplier, plant operator) can expect to have the maximal operation reliability.*

*Up to 2003, it was required that wind power plants should immediately be disconnected from the grid in case of any disturbances. Today, the amount of energy generated by wind power plants is so high in some regions that plant operators themselves would not be able to switch off wind power plants in case of grid disturbances. Therefore, wind power plants must support the voltage in case of a voltage drop triggered off by e.g. an error in the pre-located power grid, in order to avoid an area-wide switch-off. In open air test sites the entire wind power plant can be tested with the DEWE-PNA/PFR as regards its capacity to detect a disturbance and support the voltage. Other renewables are a subject to similar regulations and have to be tested according the same standard.*

## Solution

*Beside the standard functions of fault recorders and power quality monitors several additional measurements are necessary in order to perform a complete analysis of a renewable energy plant:*

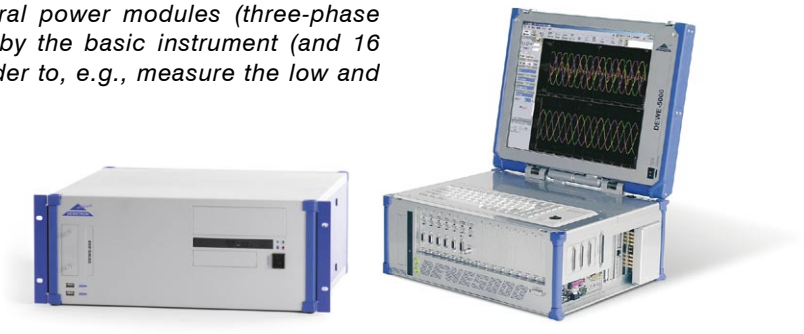
- *Fault recorders and transient recorders (PFR, DFR)*
- *Power quality monitor and voltage recorders (PQM, VR)*
- *Power curve and automatic controller action*
- *Electrical features such as harmonics, flicker, reactive power, switching frequencies, identification of voltage drops*
- *Frequencies up to 1 MHz*
- *DC-measurements in the frequency converter*
- *Analysis on the side of the grid and the generator*
- *Voltages up to 1400 Vpeak directly measurable (DAQP-HV module)*



- *Long-term analysis with data base storage system and evaluation according to norms of wind energy plants and grids with automated reporting system (IEC 61400-21, EN 50160)*
- *Measuring wind power (wind speed, wind direction, altitude profile, turbulences, etc.)*
- *Mechanical parameters such as rotation and oscillation of the rotor*
- *Forces and impacts (rotors, blades, turbine towers, power train, etc.)*
- *Acoustic emission (sound power level, frequency spectrum)*
- *Luminance, temperature*

## Hardware

*Only one DEWETRON measurement instrument is necessary to perform all these measurements. Based on the new DEWE-PM/PFT-series it is quite easy to define the appropriate hardware solution for you. Several power modules (three-phase systems) with up to 16 input channels supplied by the basic instrument (and 16 extra channels as an upgrade) can be used in order to, e.g., measure the low and mean voltage at the same time.*



*Additionally, wind speed, temperature and acoustic/noise level can be measured as well. Great emphasis was placed on stability and interference resistance when developing this instrument. The frequency converter benefits the strong common-mode rejection voltage.*

## Software

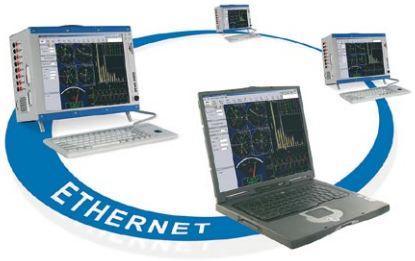
*In addition to the common power quality functions (flicker, harmonics, voltage fluctuation, imbalance), the evaluation of wind power plants requires some special measurement methods. Beside the flicker emission values (current flicker) these are primarily the evaluation of power and harmonics at different wind speed. Especially when evaluating the frequency not only the harmonics and interharmonics are required but also the 200 Hz groups between 2 and 9 kHz. A comprehensive reporting function makes the software perfect (Plugin Wind).*

*DEWETRON's software packages PMT, DEWESoft POWER and the plugin "Wind" meet all the requirements and thus offer a comprehensive solution for measurement, evaluation, reporting and completely automised measuring and test procedure.*

# Some Details

## Various Power Modules

*With the DEWESoft power module an arbitrary number of power lines can be measured simultaneously. E.g. wind energy plant: UNV / UMV / UHV / UDC*




## FFT– Harmonics Analysis

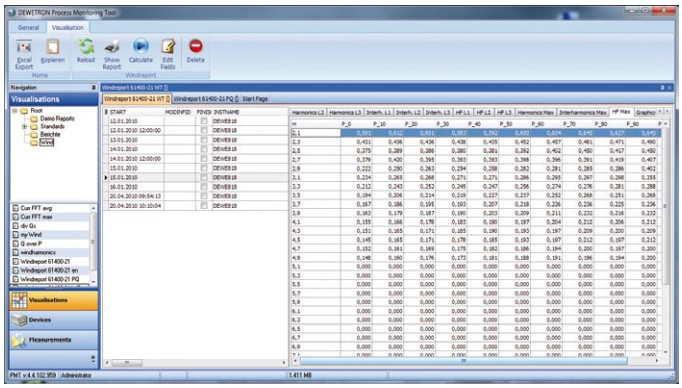
- *U, ULine, I, P, cos ρ and Q*
- *Individual setup of the number of harmonics including DC (Example: sampling rate 20 kHz = max. 200 harmonics @ 50 Hz)*
- *Values adjusted to the actual power frequency*
- *Evaluation of 2-9 kHz in 200 Hz bands*

## Flicker

- *According to IEC 61000-4-15*
- *PST and PLT with adjustable intervals*
- *Individual recalculation intervals*
- *Flicker emission (current flicker) according to IEC 61400-21*

## IEC 61400-21 Plugin (Plugin-Wind)

- *According to IEC 61400-21 (PQ measurement)*
- *Automatic report generation*
- *Flicker coefficient factors*
- *Harmonics, interharmonics and higher harmonics up to 9 kHz @ 200 Hz*



## Remote Control

*By using the remote control, instruments can be configured and data evaluated without being on site. You can do this when being in the office for example.*

## Acoustic/Noise Level Measurement

*The residents in whose surroundings these wind power plants have been constructed must not be affected by any noise of the power plants exceeding the legally accepted limit values – noise level measurement is also made possible with the help of the DEWE-PNA/PFR: Accurate and high-resolution noise level measurements following IEC 60651, 60804, 61672. DEWESoft and its user-friendly interface convince and bring the sophisticated noise-/acoustic analysis to the customer.*

## GPS Sync

*With the help of the GPS function several measuring instruments, that are a few kilometers away from each other (e.g. off-shore wind park and on-shore substation), can be synchronized. The highly accurate clock (100 ns) is even available in case of interference with reception. Phase measurements and angle comparisons are a typical application for this function.*


## Customers

- *Producers of wind energy plants*
- *Non-productive industries in the field of wind power plants*
- *Companies responsible for maintenance and energy supply*
- *Operators of wind power plants*