# Continuous monitoring and network analysis of energy supply networks

Fig. 1: Power poles

For evaluating interactions within a distribution network and for assessing the supply quality, continuous monitoring and analysis of medium and low-voltage power supply networks is necessary. Using the example of an auxiliary demand analysis in the bus bar network of a power plant, it is shown how the intelligent imc miniPolares measurement module and the special imc POLARES software can be used to achieve a continuous evaluation and analysis of the functionality and safety of an energy supply network.

## Measurements at network nodes

E.ON Kernkraft GmbH uses the following information to formulate a concrete task:

- Continuous, synchronous measurement. Calculation and monitoring of electrical characteristic values on approx. 80 busbars and network nodes in the medium and low voltage level of the power plant's own supply network.
- Synchronization of the measurement devices via central timers.
- Complete, network-wide recording and archiving of events and faults.
- Recording of the instantaneous values in the event of a fault or event with variable recording duration.
- Device-specific trigger options:
  - Periodic waveform evaluation of the instantaneous current and voltage values.
  - Threshold value trigger for RMS values and frequency (e.g., for NEA).
  - Mains trigger, external triggering via TCP/IP.
  - External triggering via digital inputs.
  - Measurement and calculation of power and energy at the defined node.
  - Continuous recording of mean values, minima and maxima.
  - Determination of the power and energy balance in the overall system, in parameterizable sub-sections or busbar-related over freely definable periods.

## Networkable universal measurement devices for decentralized acquisition and processing

With imc miniPolares, a universal measurement device is available that combines a variety of energy-related measurement functions immediately ready for operation. The device is specially designed for control cabinet installation and operates completely independently with its own flexible data memory.

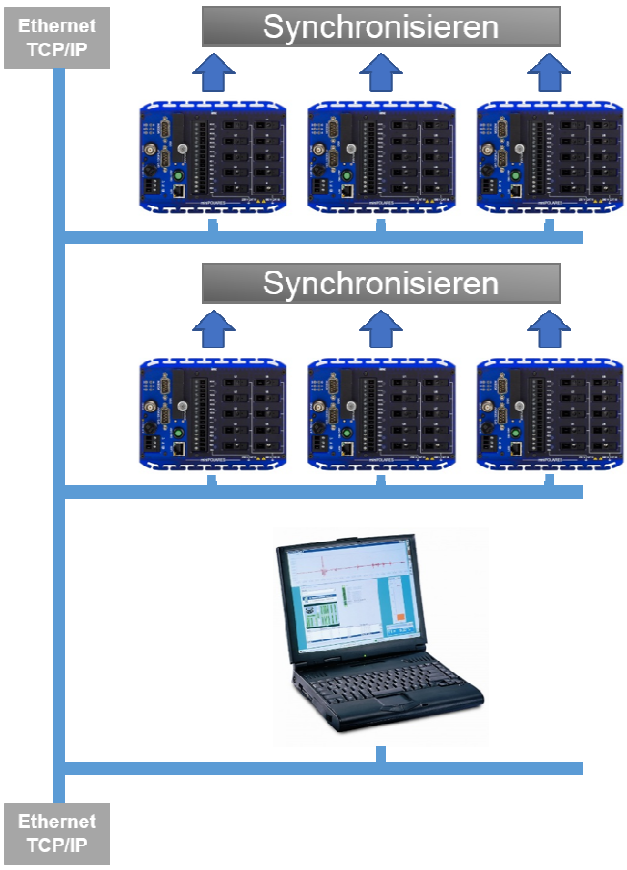


Fig. 2: The networkability of all devices and the operation and analysis with standard software enable the decentralized measurement and evaluation of a complete distribution network.

The networking of individual measurement devices enables a central parameterization and administration as well as a complete, time-accurate recording of events and malfunctions of all systems defined in the network. The task is solved with the imc POLARES

standard user software and supplemented by a database module.

## Standard software for operation and analysis

With the imc POLARES user software, central parameterization of all measurement devices is possible without special metrological or PC knowledge. Basically, the selection of a few parameters is sufficient to describe the measurement task.

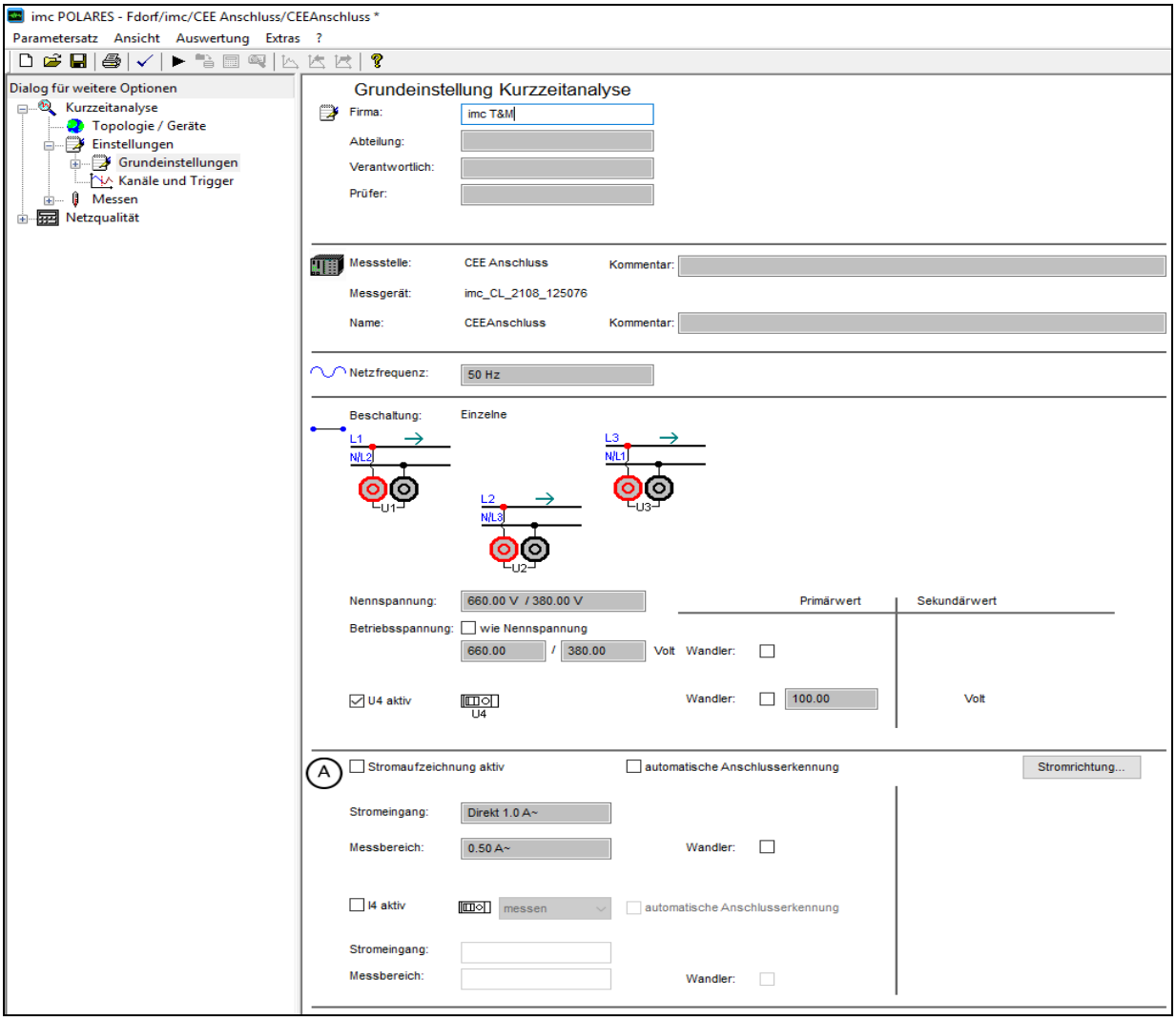


Fig. 3: Defining of the measurement device for testing – selection of circuit, voltage level and transformer ratio.

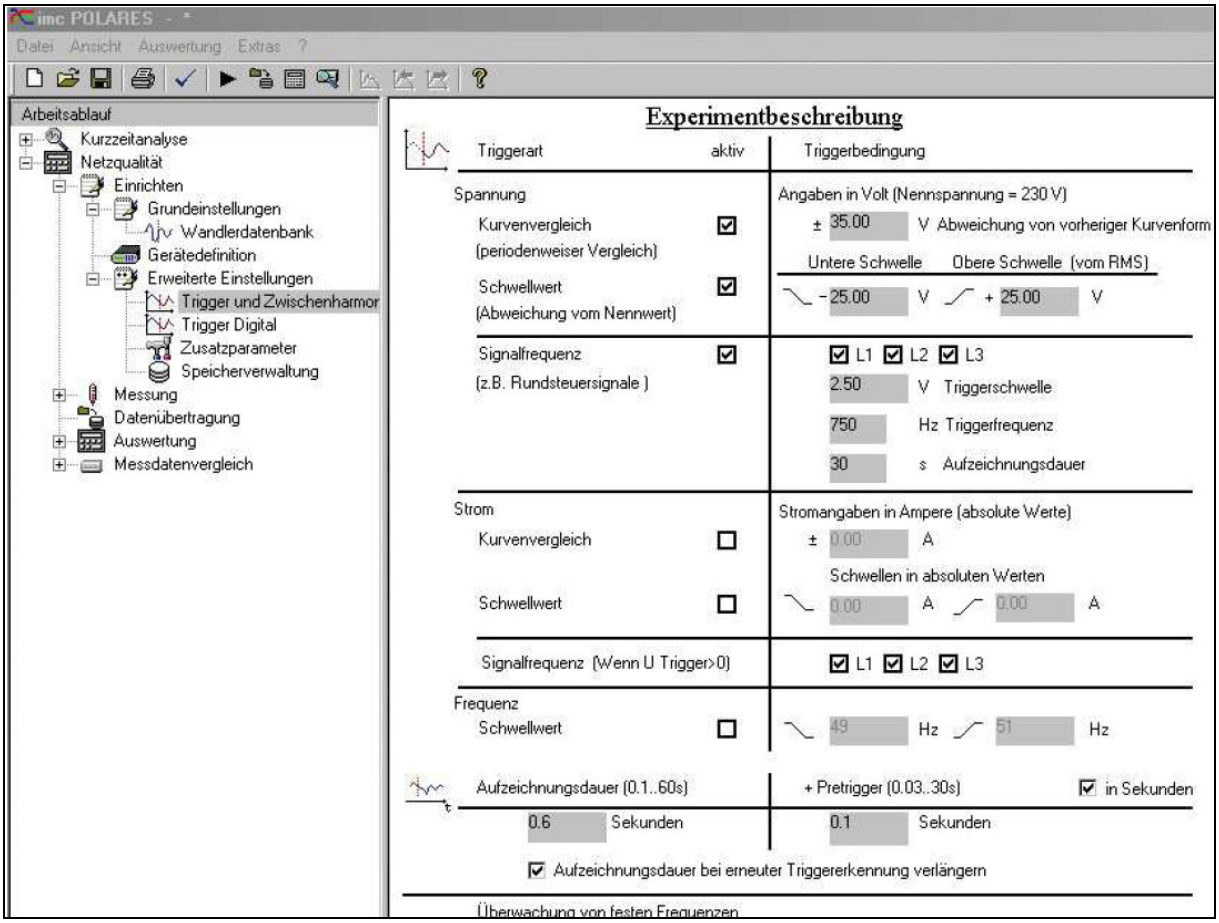


Fig. 4: Setting the triggers by clicking and setting values

## "Mains trigger" for fault recording and analysis throughout the network

A special feature within the trigger settings is the possibility to forward trigger messages via Ethernet to other connected imc miniPolares measurement devices. Other encoders configured to receive this message process it as triggers and react accordingly.

An event and a fault at one network node lead to the recording of the instantaneous values at all other network nodes. This makes it possible to analyze the effect of this disturbance on the entire network, since in the present configuration all measurement devices are operated synchronously.

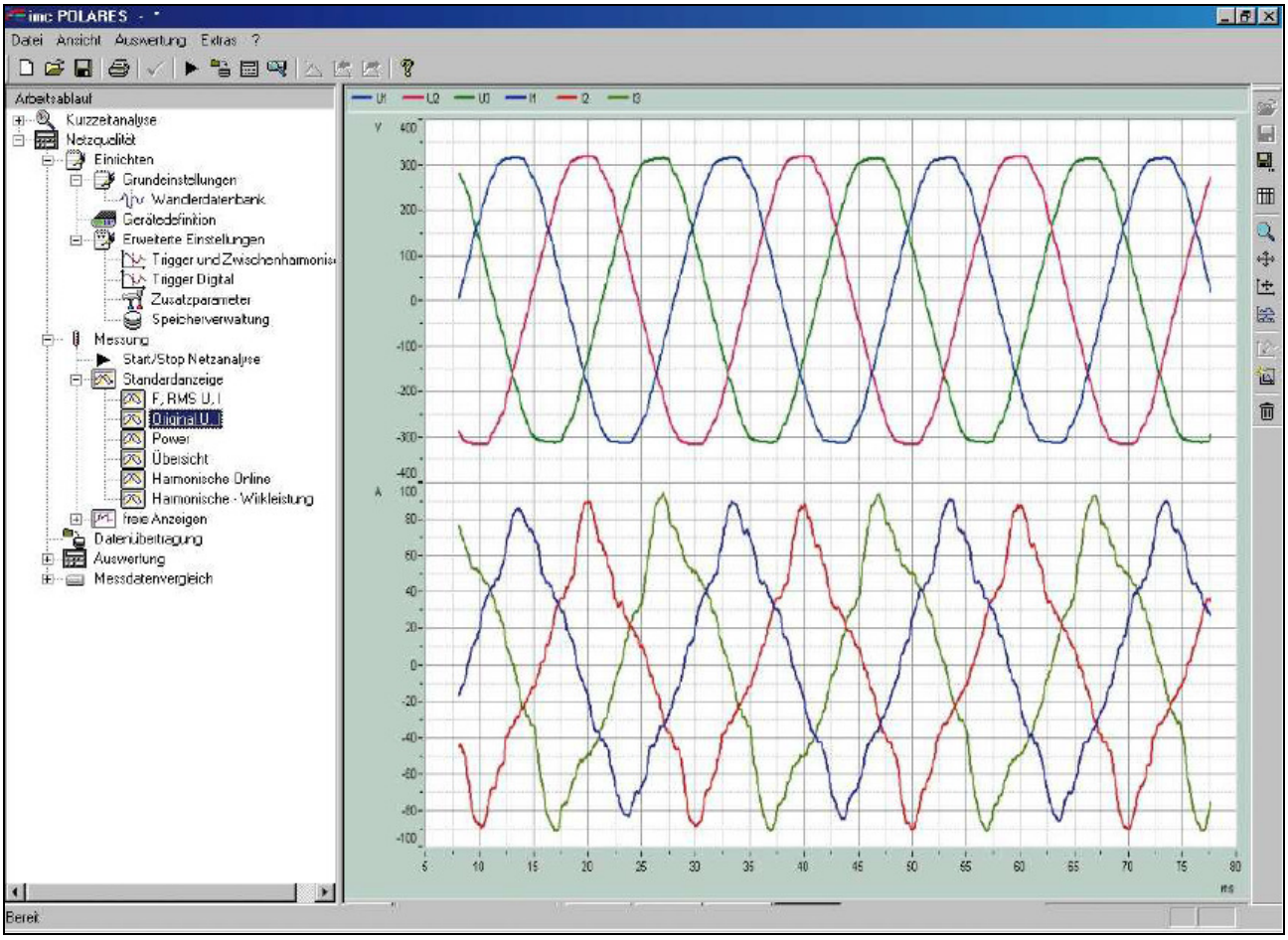


Fig. 5: Display of the instantaneous values u(t) and i(t)

## Online monitoring

Using the same software, it is possible at any time to connect to a measurement device via the network from a central PC in order to view and monitor measurement data online.

Further possibilities of online display are:

- Display of currents and voltages in a vector diagram
- Display of the harmonics of the current, the voltage and the power with direction determination
- Performance of each phase, as well as total performance
- Effective value curve
- Registered Events

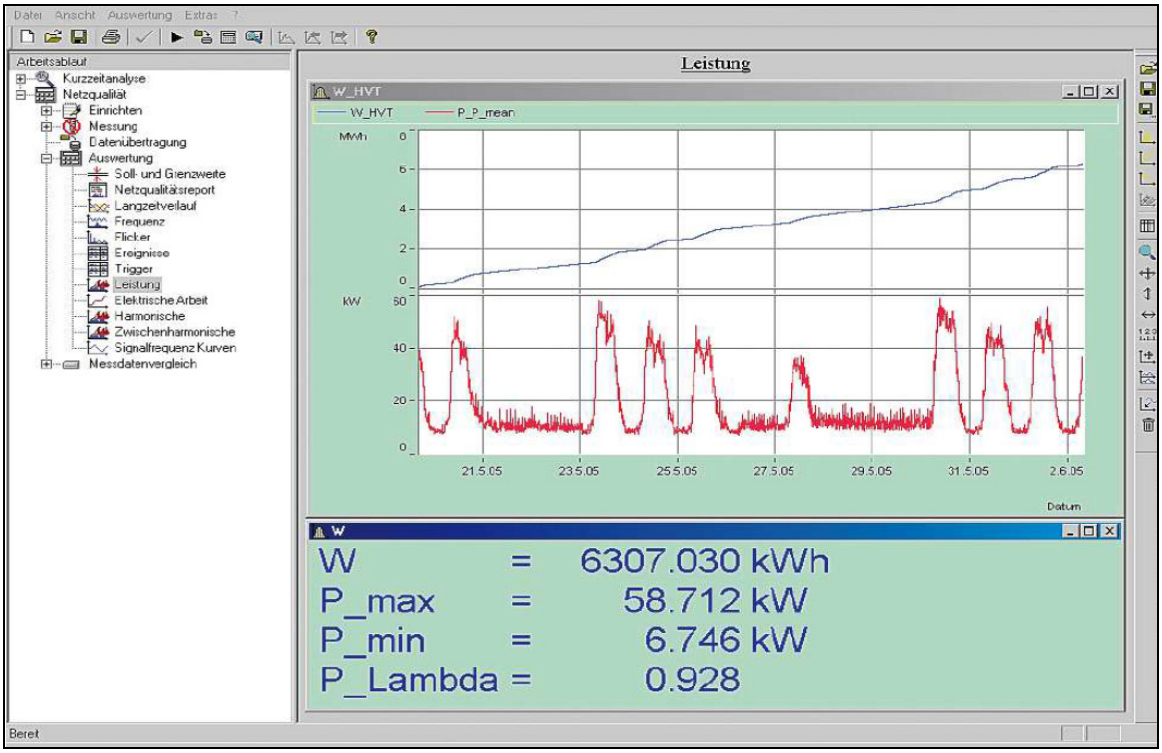


Fig. 6: Curve representation: work (curve above), corresponding power curve (curve in the middle), corresponding numerical values (below)

## Comprehensive evaluations and analyses

For evaluation and analysis, the imc miniPolares provides far more than 500 data sets.

The evaluation shown above refers to only one measurement device. Much more interesting and adapted to the task is the evaluation of several measurement points according to user-defined criteria. The database module can be used to search for any events, measurement channels or standard violations in all measurements performed. The data are displayed and compared.

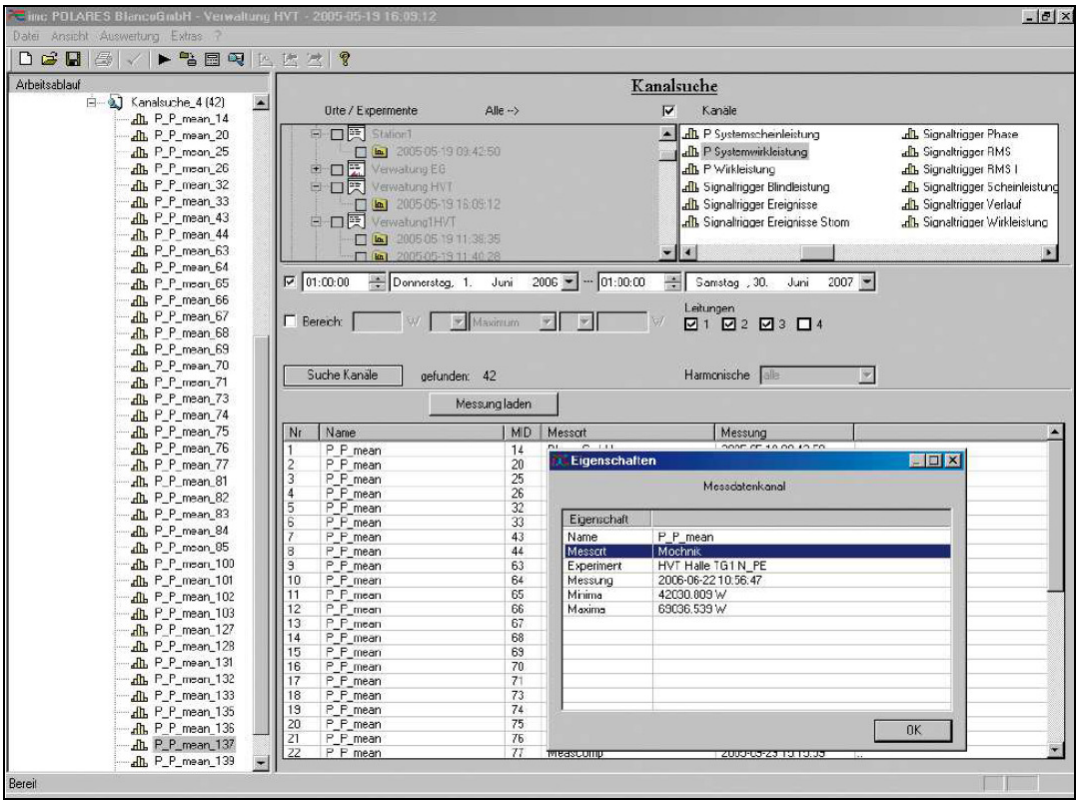


Fig. 7: Search for the measurement channel “System Performance” in all measurements performed, restricted to a period of one month.

The display of the found and selected measurement channels takes place at the push of a button:

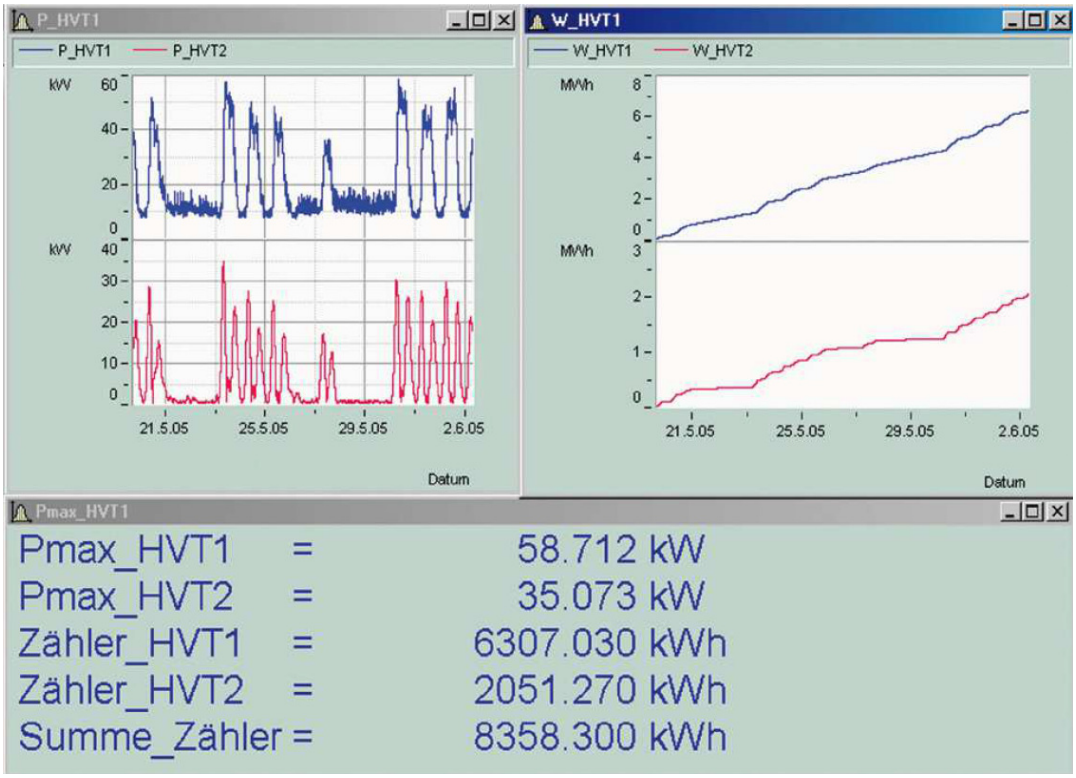


Fig. 8: Comparison of two measurement points, measurement channels “System performance” and “Work”. Display shown as opposite

## Conclusion

The use of imc miniPolares universal measurement devices in conjunction with the imc Polares application software enables the acquisition of electrical data at various energy supply nodes. Extensive trigger options also allow the complete, network-wide detection of anomalies in the power supply network. And the database module can be used to carry out cross-device and comparative measurement value analyses in addition to the user software.

**Author:**

Dipl. Ing. Peter Grund (†), imc

## Additional information:

**imc Test & Measurement GmbH**
Voltastr. 5
13355 Berlin, Germany

Telephone: +49 (0)30-46 7090-0
Fax: +49 (0)30-46 31 576
E-mail: hotline@imc-tm.de
Internet: http://www.imc-tm.com

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