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Special Publication

Power Quality is the Key.

Volkswagen (VW) banks on A. Eberle's PQI-D solution to monitor its grid.

Volkswagen VW Kraftwerk GmbH, based in Wolfsburg – a fully owned subsidiary of Volkswagen AG – provides power generation, trade and management services as well as engineering and facility management services to the Volkswagen Group, municipalities, industry and businesses. Energy security is vital to its distribution. To ensure that energy is continuously available, VW Kraftwerk GmbH banks on the intelligent hardware and know-how of the energy security specialist A. Eberle GmbH & Co. KG in Nuremberg.

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Figure 1: VW Factory Wolfsburg

VW Kraftwerk GmbH in Wolfsburg and other Volkswagen sites in Germany have been using A. Eberle GmbH & Co. KG's PQI-D (Digital Power Quality Interface) power quality and fault recording system for well over a decade. The devices are so reliable that they have become a standard part of the failure analysis and evaluation system used in high and medium voltage grids at VW.

'VW Kraftwerk GmbH really liked the way the devices work, which is why we decided to install A. Eberle's solutions in all existing and future switching stations as part of our extensive grid renewal project', says Friedhelm Wolf, grid operation technician at VW Kraftwerk GmbH. Over 100 of these devices are installed in all voltage levels of the factories' internal high and medium voltage grid (110 kV to 6.3 kV).

Connection to the power control system

'Connecting the switching stations to the power control system with fibre optical technology enabled us to connect the PQI-D power quality and failure recording devices over TCP/IP,' explains Friedhelm Wolf. This standalone network is made up of standard IT components. Since only one PQI-D needs to be connected for each system or substation through a COM server and fibre optical converters, very few additional components are needed. The individual PQI-Ds in a system are connected through the standard E-LAN (double RS485) interface.

The IT engineers at VW Kraftwerk can connect a number of devices to each

other and then to the whole system through one channel (COM server). The time synchronization runs through another interface (RS232). The DCF signal runs straight from a central time model to this input. The experts also use the E-LAN connection (time bus) to move the information between the devices wirelessly.

Depending on the system, the data cables run straight to the communication room or into a node and are connected through fibre optic switches. The data are processed and visualized by a PC server that is securely connected to the same network.

All measuring and monitoring tasks under control

The PQI-D for medium and high voltage grids is the heart of a system that VW-Kraftwerk GmbH uses to perform measuring and monitoring tasks in its power grid. The device can be used as a PQI in accordance with DIN EN 50160 (IEC 61000-4-30), as a fault recorder or as a measuring device for all physically defined measured quantities in three-phase grids. The component is primarily designed to monitor, record, evaluate and store particular supply qualities or quality agreements between the energy supplier and the customer so they can be used in reports.

Modern power quality measuring devices work in accordance with the IEC 61000-4-30 standard. This standard defines methods that enable the user to compare information. Devices produced by different manufacturers that work in accordance with this standard produce similar results. This Directive distinguishes two system classes: Class A measuring devices are used mainly for measurements related to customer-supplier contracts, while Class B measuring devices are used to determine quality statistical quantities. Additional distributed PQI-Ds now enable the evaluation of the effect of connecting photovoltaic systems to certain grid connection points.

PQI-D measured value monitoring and data visualization VW Kraftwerk GmbH in Wolfsburg

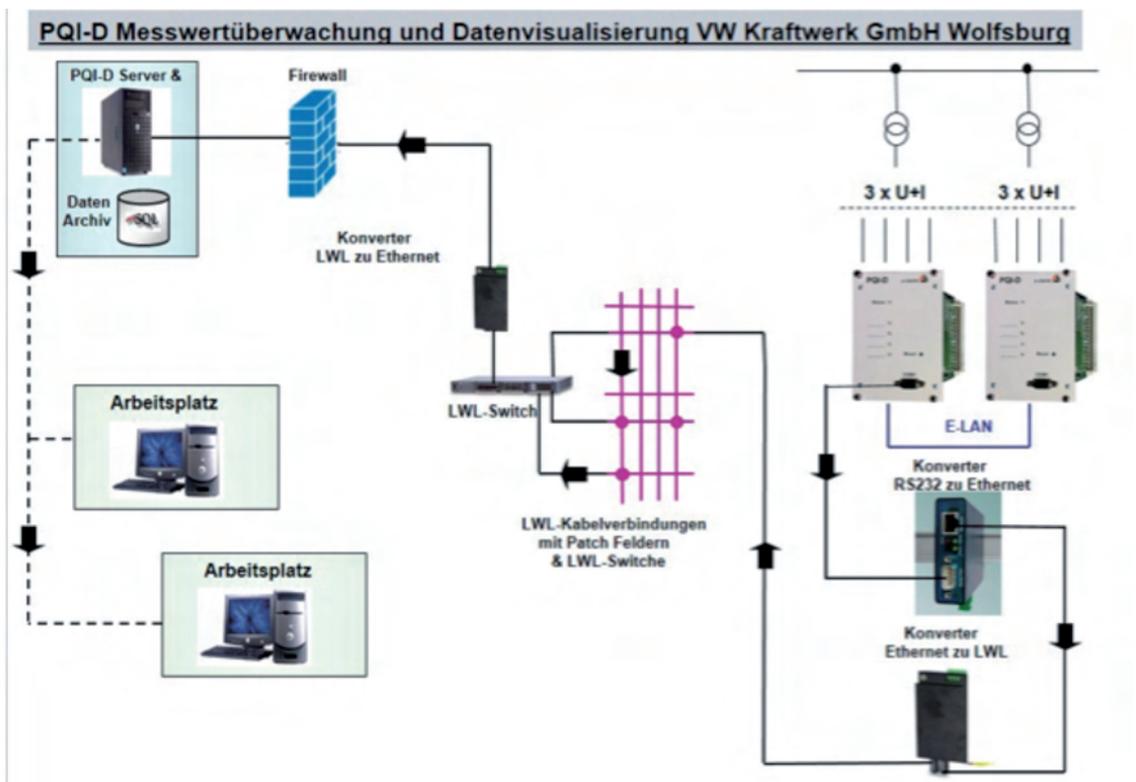


Figure 2: Connecting the fault recording system

All A. Eberle GmbH & Co. KG's power quality devices meet all of the high requirements for a Class A measurement device. ¹

This is also true of the new PQI-DA smart, a 160 mm x 90 mm x 58 mm small, compact and cost-effective component that functions as fault recorder, power quality interface, transient recorder and performance analyser for low and medium voltage grids. This device has 1 GB of storage space that can be extended to 32 GB with an SD card. It also has a sampling frequency of 40.96 kHz and records the power quality in accordance with DIN EN 50160, IEC610000-2-2 and IEC61000-4-30. The evaluation is done through a MYSQL database or with easy-to-use free software.

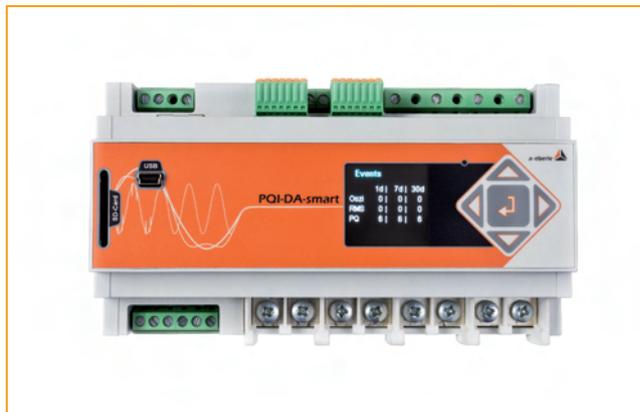


Figure 8: PQI-DA smart

Fault resolution made easy

In terms of grid analysis, the power quality solution can generate a PDF file and immediately email it to the responsible employee in the event of a failure.

The employee does not need any special software to evaluate the analysis.

The fault recorder (Figure 3) shows the curve for the measured quantities. The nominal values, limit values and the percentage deviation from the nominal value are displayed in a table. The progression and the duration of the fault are immediately visible. In most cases, employees can accurately determine the fault and initiate the appropriate measures.

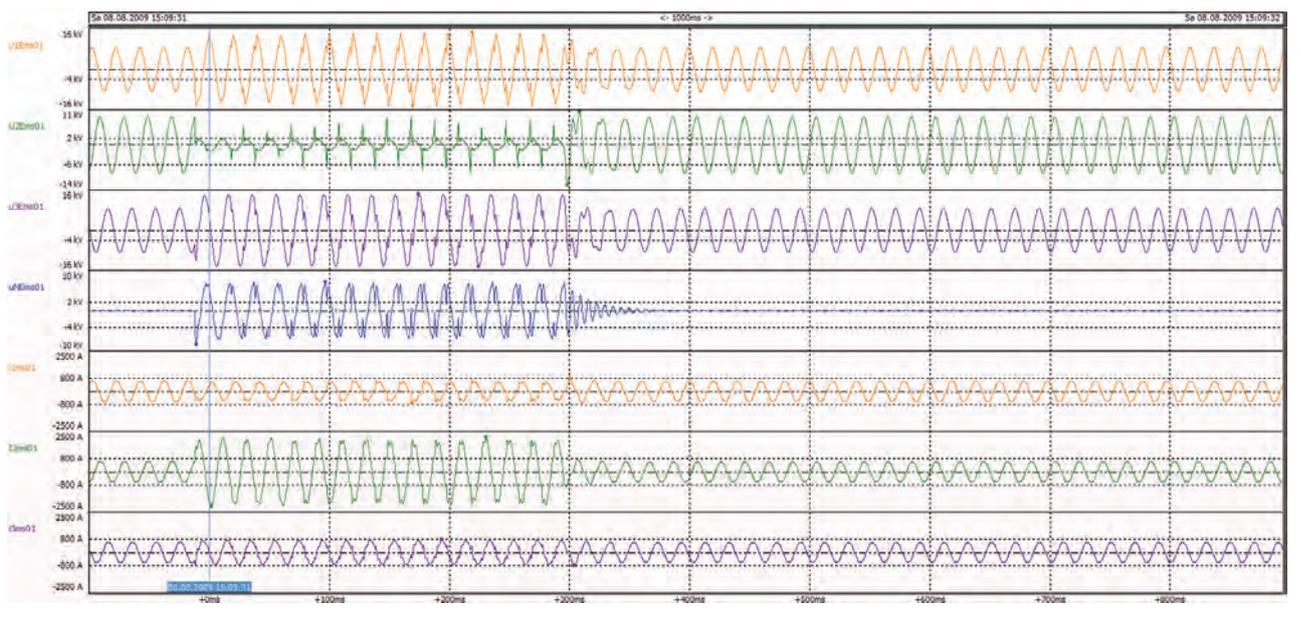


Figure 3: Fault record sent by email as PDF file

¹ PSL certificates prove that the standards are exceeded in all regarded categories for Class A.

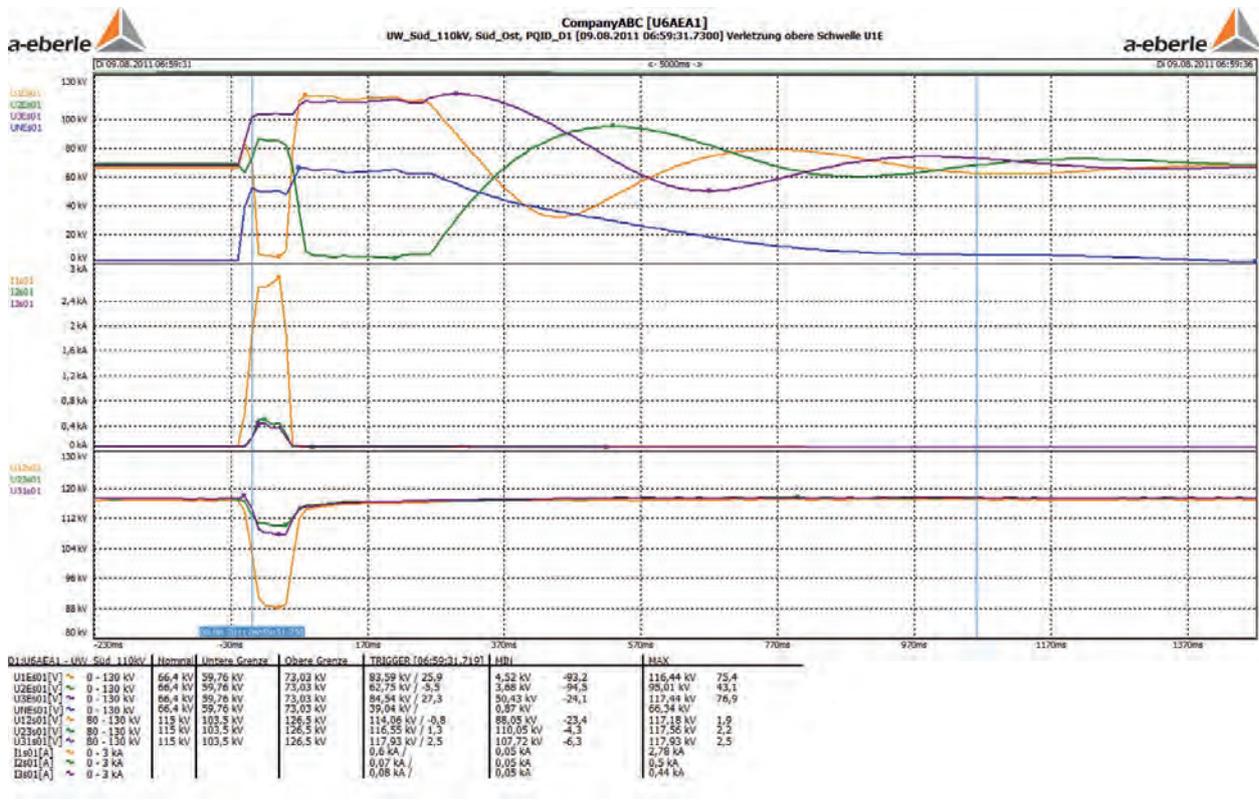


Figure 4 Example: Double earth fault sent by email as PDF file

The fault recorder can even help resolve more complex faults in the grid.

Figure 4 shows the curve of a double earth fault in the 110 kV grid. In this case, two earth faults occurred at quite a distance from each other. Because of this double fault, the fault direction indicators in the grid protection system were incapable of providing clear information on the fault location.

Fortunately, the event record contained information about the fault that helped to resolve it. The technicians were able to trace the development of a simple earth fault in Phase L2 up to the next earth fault in Phase L1 using the voltage curves recorded by the PQI-D devices.

The two earth faults that occurred at different times in the two affected 110 kV grid areas could also be resolved because

of the voltages that occurred 80 ms and 280 ms after the fault. Fault recorders provide a lot more than information about a grid fault. The flexible PQI-D's recording parameters also enable high resolution power and voltage curves to be recorded, (e.g. when a motor is starting up, when transformers are switched on or when something is switched on or switching in the grid.) As such, an additional recorder is not required.

User friendliness is very important

WinPQ, the software which accompanies the PQI-D devices, generates an overview of the values measured for VW's power plant. This program is very user friendly and enables users to personalize the home screen and use templates. Users can select to display a list of devices based on a short description or a graphic (Figure 5).

WinPQ automatically and continuously communicates with all of the other devices on the grid. In the event that a connection between the server and the module

fails, the data in the respective PQI-D is stored in memory and transferred as soon as the connection is restored. The devices' self-monitoring function reports failures to the central power control system through a binary output.

Data logging function pays off

The importance of accurate and high-resolution grid data is constantly increasing, which is why the PQI-Ds have a data logging function (Figure 6). Information about power, voltage, frequency, active, blind and apparent power and their averages are available automatically or at the

press of a button. All of the values are stored in a database and therefore available at any time in the future.

Energy analysis with virtual channels

For deeper evaluations, users can create virtual channels (Figure 7), which can be used to mathematically connect several measured quantities. (e.g. to sum up performances) These data can then be used to evaluate the grid load or for planning purposes. They also enable the effects of energy saving measures to be verified..

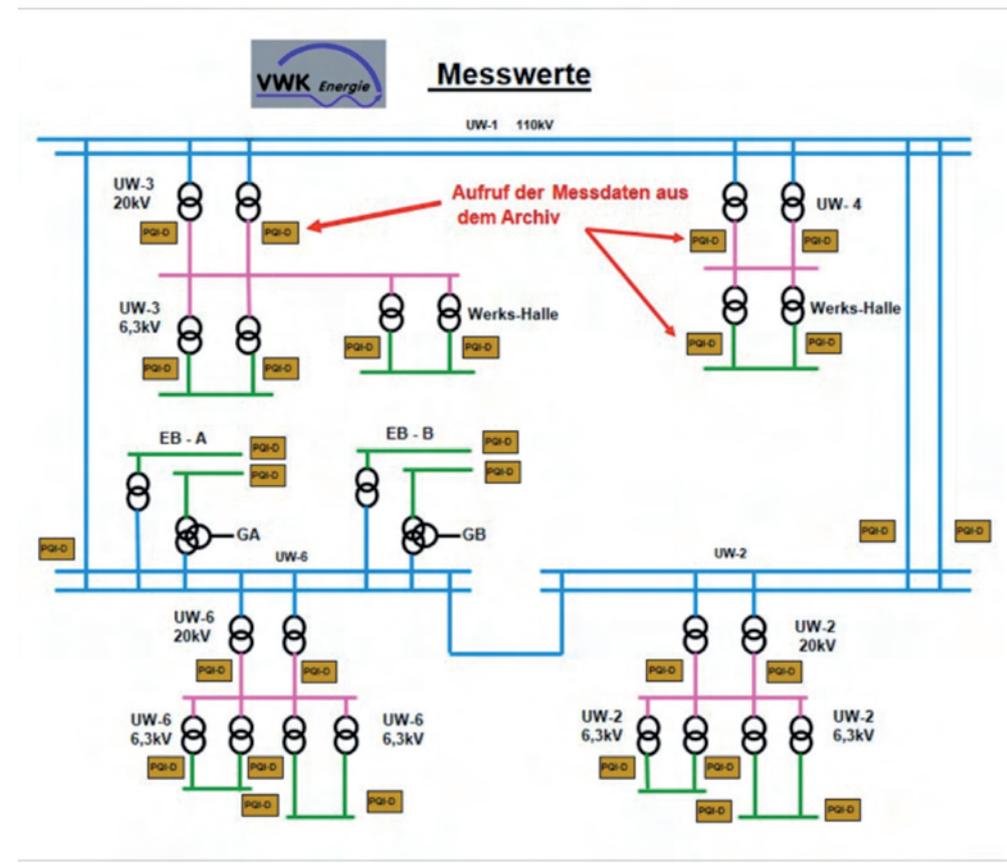


Figure 5 Example: Graphical display of the software the customer is using

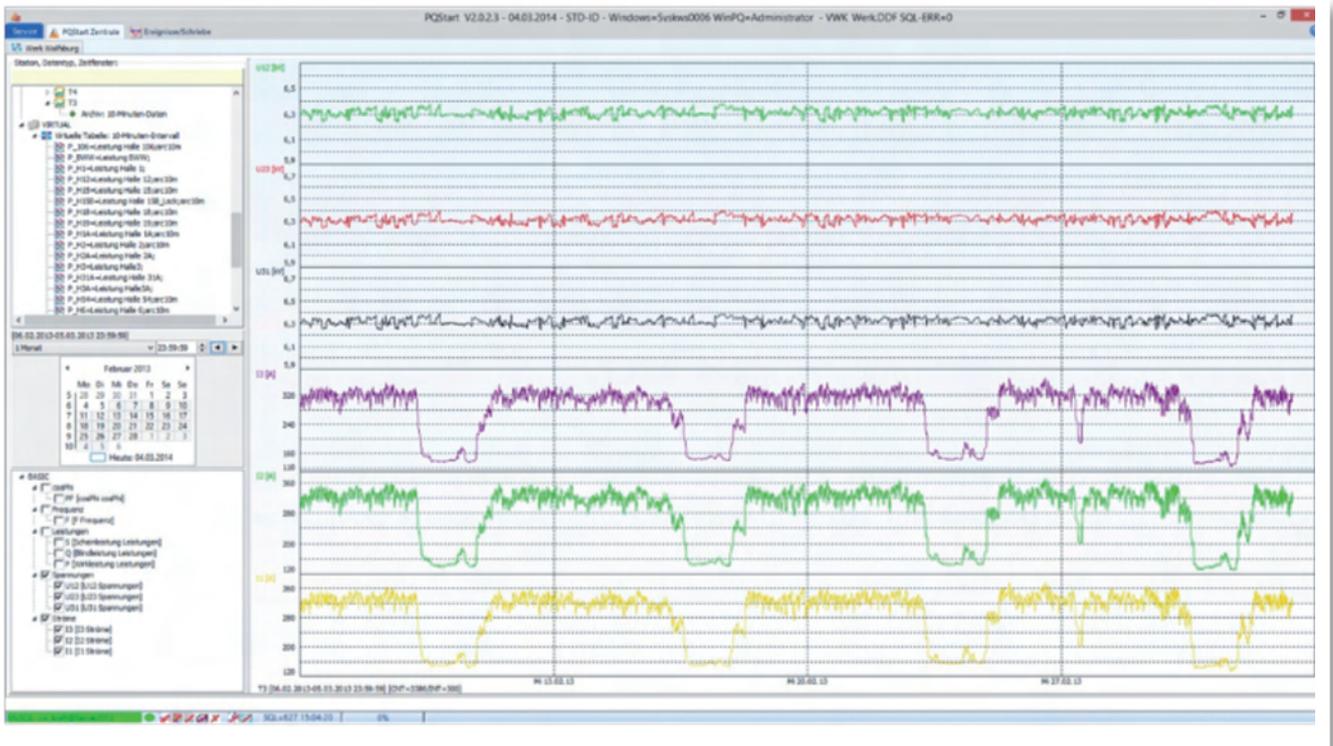


Figure 6: Data logger for UI,P;Q,S

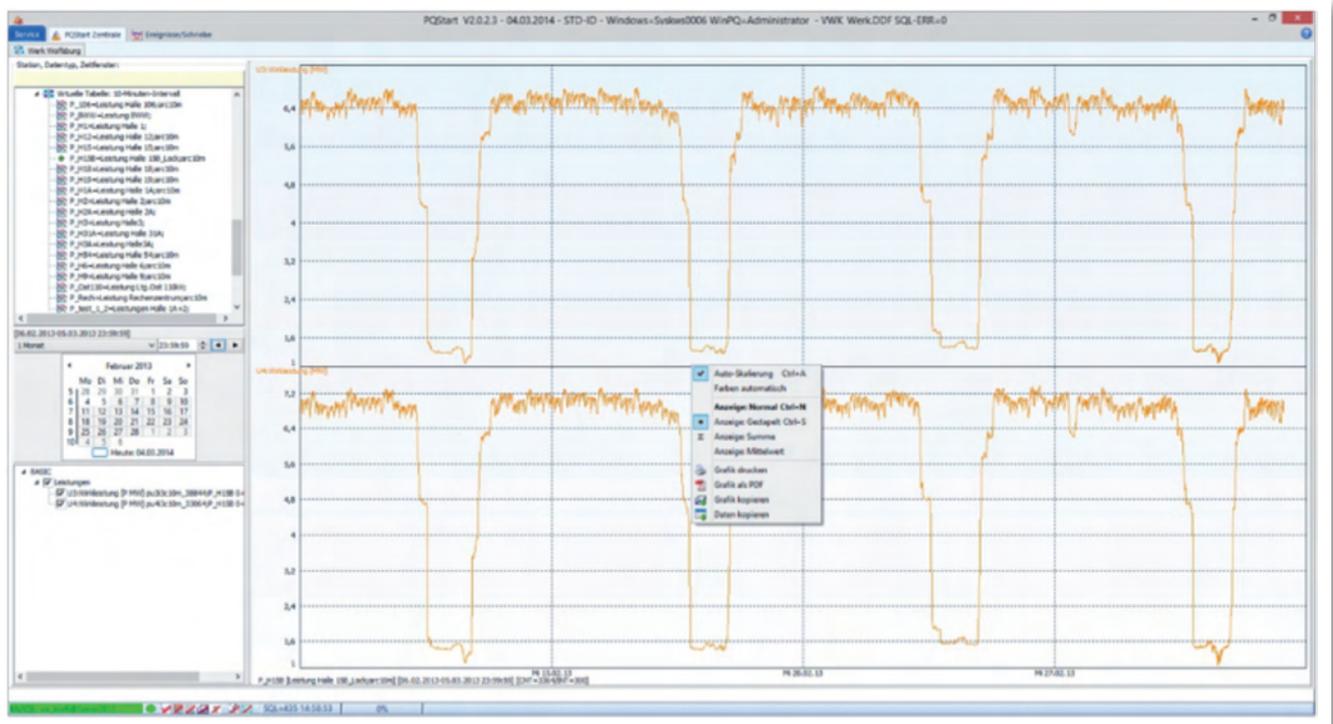


Figure 7: Global view across virtual channels

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