

# Continuous power quality monitoring

## At a glance

Power quality is a critical parameter for the smooth operation of all connected loads and resources. It is often impossible to determine the causes of faults after the fact, as they frequently only occur briefly, often only for fractions of seconds. Continuous recording of the power quality makes it easier to draw a relationship between an outage (e.g. the failure of a machine) and its cause.

Siemens PTI offers:

- Continuous monitoring and analysis of power quality
- Consulting services and recommendations for improving the grid

## The Challenge:

On one hand, industrial grids are themselves a regular source of disturbances due to the increasing number of power converters. On the other, the growing distribution of electronic components is rendering the connected loads increasingly sensitive to all disturbances in the power supply, which can range from brief voltage drops to voltage components superimposed on the fundamental-frequency wave.

In most cases, exact data on the disturbances are essential for the selection and dimensioning of solutions to eliminate specific recurring sources of interference. Furthermore, detailed data can help identify interference sources outside of one's own area of influence (e.g. at the utility or neigh-

boring companies) and in supporting with having the responsible parties implement corresponding measures.

## Our solution

### Measurements and analyses

First, standard values are continuously recorded, such as fundamental frequency currents and voltages, power levels and harmonics. These are saved with an averaging time of a minute, for example, and are used to provide a rough overview of the electrical landscape. In addition, triggers are set to detect abrupt changes in power quality or transient events and to then record these in detail at a high sampling rate.

The combination of long-term recordings with high-resolution snapshots of potentially problematic events then yields an overall picture for the evaluation of power quality and for the rapid investigation of disturbances. One or

more highly sensitive points are equipped with measuring devices that continuously record the data and transfer them to the analyzer at regular intervals.

The measured data are evaluated by experts with many years experience in measurement, evaluation and resolution of power quality issues. In a regular short report, e.g. on a monthly basis, the results of the continuous measurements are presented, potential problems are described and recommendations are made for further steps to improve power quality if this proves necessary.

Independently from this, in the event of faults in operating equipment, a hotline can be called where a staff member immediately examines the corresponding data and evaluates the fault from the perspective of the measurement results and power quality.

Before the start of the measurements, an audit is performed in which the operator submits grid data to the analyzer and explains the operational processes.

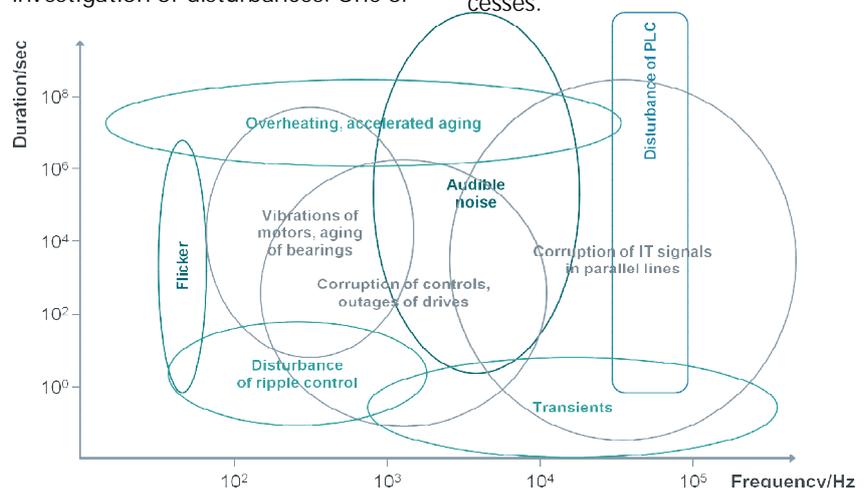


Figure 1: Overview of interference phenomena

Over the course of the measurements and in close cooperation with the grid operator, relationships are derived successively between power quality and operating processes. It is also useful if the grid operator maintains a log of key switching operations and changes in production processes or can at least reconstruct such changes in retrospect for a specific point in time.

**Data Access – Different Variants**  
There are various possibilities for downloading the data:

- Customer provides measured data  
One variant is to connect the measuring instruments to the operator's data network. The operator then downloads the data at regular intervals and sends them to the specialists for analysis.
- External access to measured data  
As an alternative, the analyzer can also be provided for external access to the company's internal data network so that they can then download the data themselves.
- LTE access to measured data  
Access to the measured data via the mobile wireless network (LTE) is also possible, so that the customer's data network remains completely unaffected.

The optimum variant must be determined based on local conditions and the needs of the operator.

The data are treated as confidential by Siemens, are never transmitted to third parties and are only used for the contractually agreed purpose.

The costs vary depending on the number of measuring points, the hardware used and the agreed depth of service. Considering that outages in production facilities, for example, can quickly entail costs running into four or five figures, continuous monitoring of power quality pays for itself when only one or a few faults have been prevented by fast detection and elimination of sources of disturbances.

**Consulting services for power quality issues**

If problems in power quality are detected and the course of events involving the faults can be sufficiently reconstructed, the solution to the problem is often only a step away.

Siemens PTI supports customers with its entire expertise in the selection of

suitable measures. In some individual cases, problems can be solved by simple grid reconfigurations, for example, with absolutely no additional equipment or costs. In other cases, it will be necessary to replace possible disturbance-inducing equipment or to install filter systems. If necessary, we can provide support for this process up to the design or up to the request for proposals for equipment, for example.

### Example Applications

#### Failure of operating equipment

At irregular intervals, systems, controls, electrical equipment or other operating equipment fail – the cause is uncertain. The specific failed unit is replaced, but nobody knows when the next failure will occur.

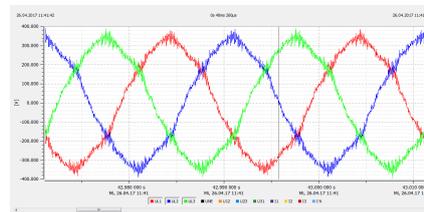


Figure 2: High-frequency oscillations often result in faults in electronic equipment (in this example: voltage in an industrial grid with 100% power converter load – 400 V)

Continuous monitoring of power quality helps to identify the causes for outages and to derive corrective measures from this.

#### Voltage drops

At irregular intervals, faults occur due to brief voltage drops in the supply grid, which can specifically cause variable speed drives to fail.

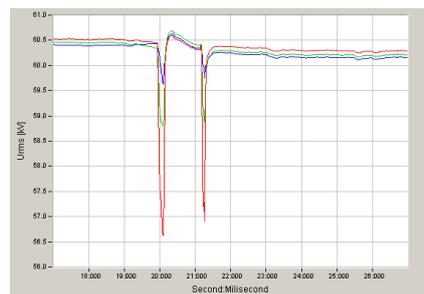


Figure 3: Voltage drops due to faults in the supply grid often result in the failure of variable speed drives (in this example: short interruption after a fault in the high-voltage grid)

Detailed statistics over an extended timeframe help as a targeted approach for the grid operator as well as in planning suitable corrective measures.

**Damage to operating equipment**  
A resonance point in the grid impedance can result in continuous high harmonic levels that do not directly result in disturbances and are therefore not detected. These result in premature aging of all installed equipment over a period of months, with a subsequent elevated failure rate.

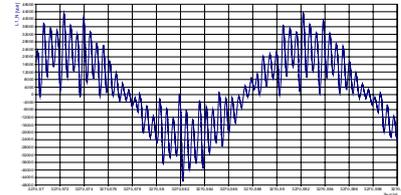


Figure 4: Large distortions in voltages and currents are often caused by resonances in the grid and are often not manifested until the connected equipment is permanently damaged (in this example: voltage in an industrial grid, 34.5 kV)

Continuous power quality monitoring helps to detect problems at an early stage and to take corrective actions before greater damage occurs.

#### Inadequate power quality

Disturbances due to inadequate power quality often occur only sporadically and cannot be reconstructed with pointwise measurements, as the cause lies in a special combination of the grid configuration and/or of the operating mode of individual operating equipment. Parallel simulation of the grid can help in the detection of relationships of this type.

Long-term monitoring of the power quality makes it easier to localize interference phenomena.

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