



Noise suppression and source separation techniques

While measuring partial discharges (PD) in a noisy environment you need to deal with external pulse-like disturbances, which interfere with the PD signals from the test object. Often, these external disturbances dominate the PD signal from the test object, so that the apparent charge value (QIEC) indicated by the PD measurement system according to IEC 60270 is increased compared to the actual apparent charge value from the test object.

In this case, a suppression of these disturbances is needed to perform a mostly undisturbed and sensitive PD measurement. This begins with various gating methods that can be set up prior to performing the measurement.

Gating Techniques for Active Noise Suppression

For example, the OMICRON MPD PD measurement and analysis system enables the following gating methods to filter out surrounding interferences.

Channel gating

To reduce the effect of disturbances, such as inverter noise on the measurement results, you can use the second MPD 800 input channel as a gating channel. The underlying method uses the (gating) signal of a sensor or other coupling close to the source of the disturbance, which is dominated by the interfering signals. The signal of the measurement channel is not used for the measurement result if an impulse of a certain size is measured on the gating channel.

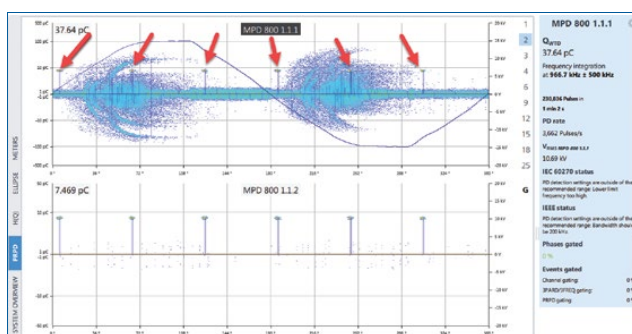


Figure 1

Unfiltered PRPD with 6-pulse disturbances.

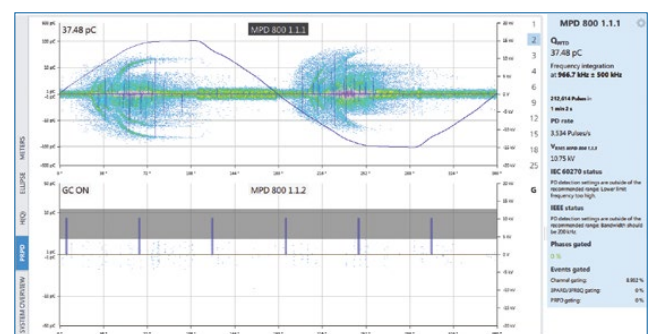


Figure 2

The 2-channel PRPD overview shows the filtered measurement channel (upper PRPD) and the gating channel (marked as GC ON) in real-time.

Window gating of phase and amplitude

Phase/amplitude gates allow you to eliminate frequency-stable signals with a certain amplitude and fixed phase position, for example converter or rectifier pulses and irrelevant PD. You can easily define the gating areas by marking them with the mouse. These areas will be excluded during the subsequent PD measurement.

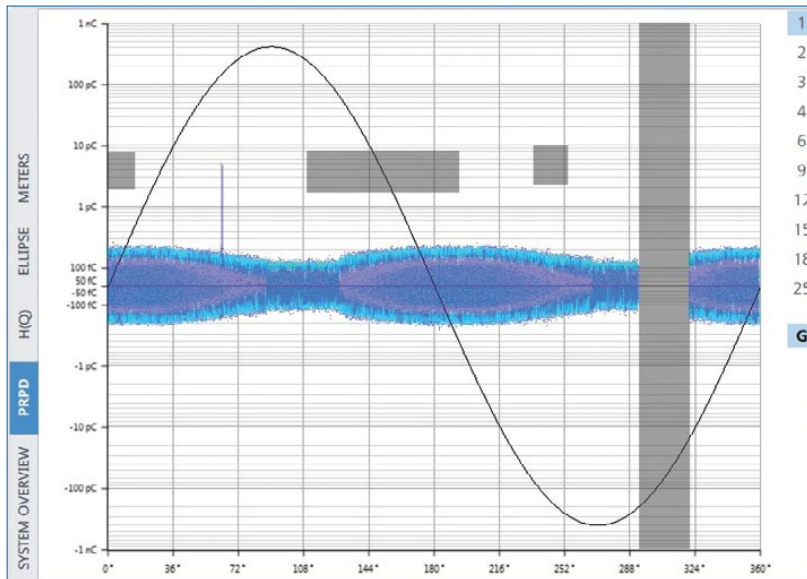


Figure 3

Measurement example using phase/amplitude window gating in the PRPD diagram.

Useful filtering tools for separating PD sources from interference

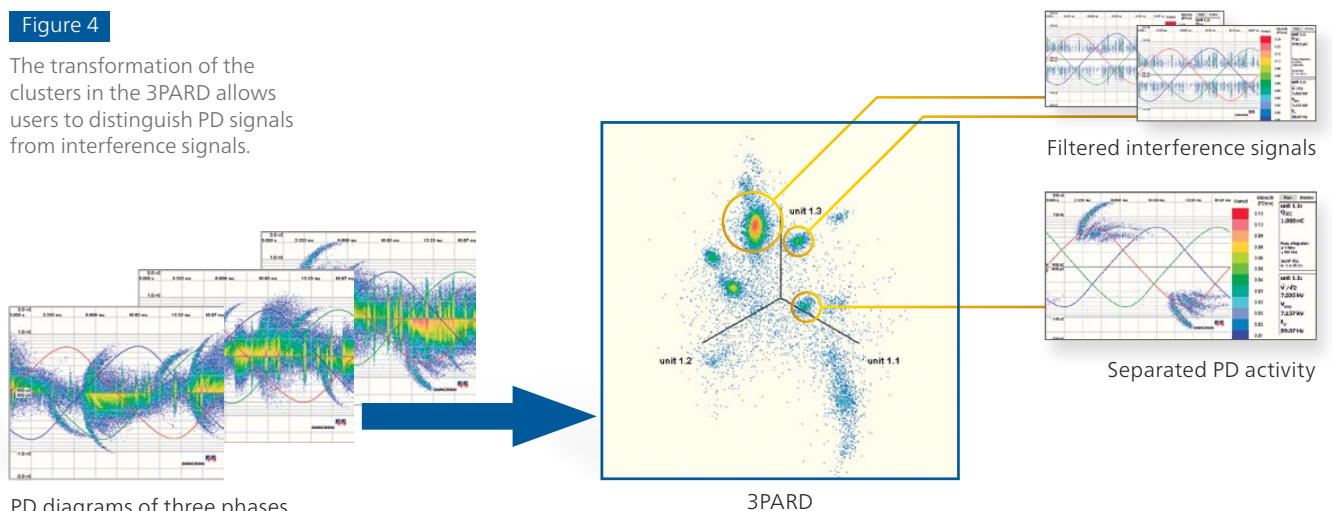
In addition to various gating methods, OMICRON PD measurement and analysis systems also provide you with powerful tools you can use to distinguish various PD sources from interferences for easy visualization and reliable analysis.

3PARD – three-phase filtering tool

Partial discharge (PD) events closer to one phase can also be detected on the other phases. The 3PARD (3-phase amplitude relation diagram) tool simplifies the differentiation of various PD sources and PD interferences. It relies on a synchronous three-phase measurement of a test object.

Figure 4

The transformation of the clusters in the 3PARD allows users to distinguish PD signals from interference signals.



PD diagrams of three phases with interference signals

3PARD

Filtered interference signals

Separated PD activity

The combined results of three measurement channels are displayed in a single 3PARD star diagram, which facilitates result comparison and separation of impulse sources. To further increase the testing reliability, clusters are selected in the 3PARD and the resulting PRPD diagrams show the filtered-out pulses in real time while graying out the residual pulses in the background (Figure 5).

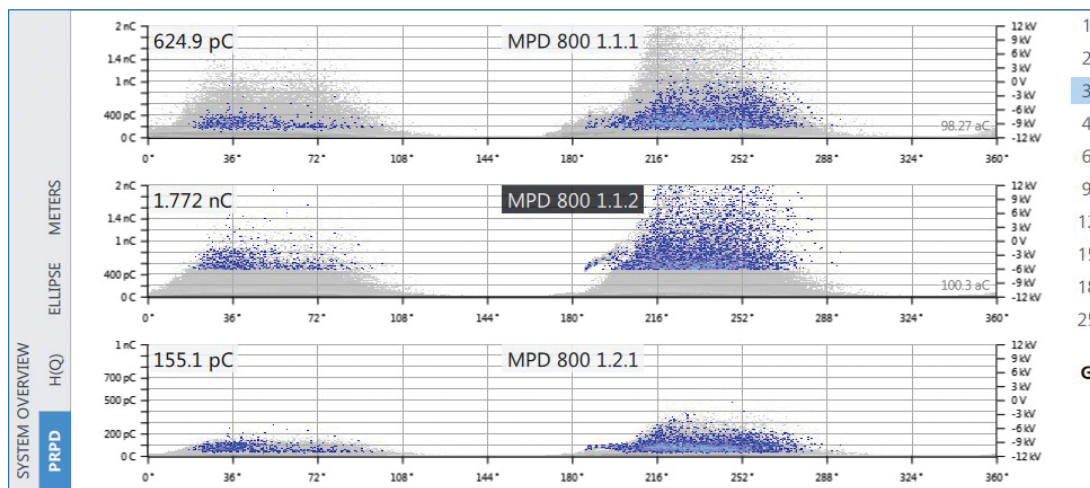


Figure 5

Filtered PRPD diagrams based on a 3PARD back transformation and the gray residual pulses.

3FREQ – single-phase filtering tool

The 3FREQ diagram, also known as 3CFRD (3-center frequencies relation diagram), is a one-channel filtering tool that uses three digital filter frequencies to characterize PD sources by their frequency signature.

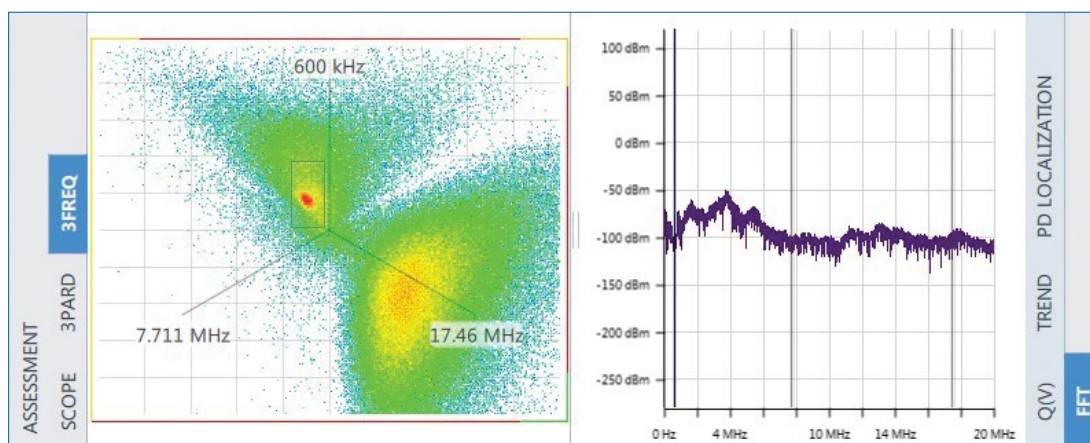


Figure 6

The 3FREQ filter uses three different center frequencies for PD analysis. You only need one PD measurement channel for this approach.

Using a 3FREQ diagram, you can separate PD events such as surface discharge, corona and internal voids from disturbances. Just as with the 3PARD, the resulting PRPD diagram shows filtered out pulses while graying out the residual pulses in the background to improve the testing reliability.

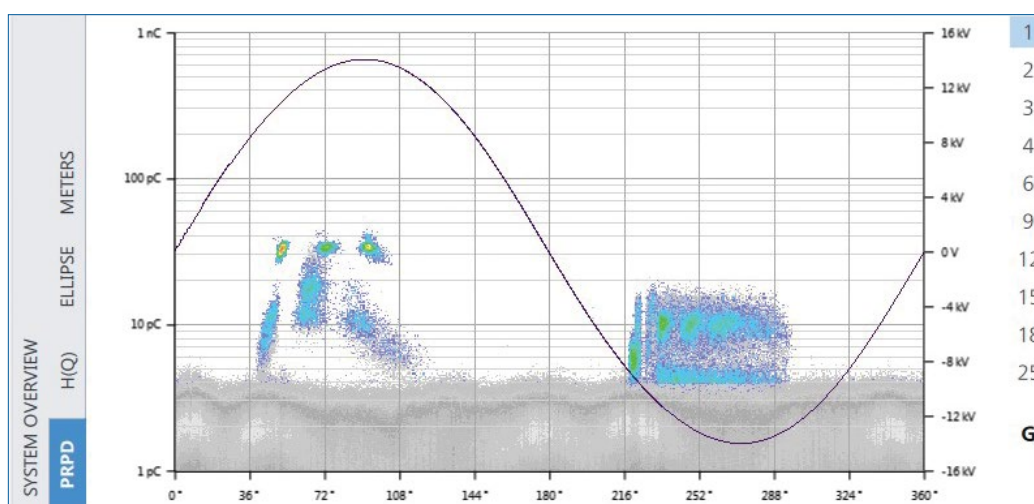


Figure 7

The resulting PRPD with the filter impulses (by cluster in 3FREQ) and the gray residual pulses.