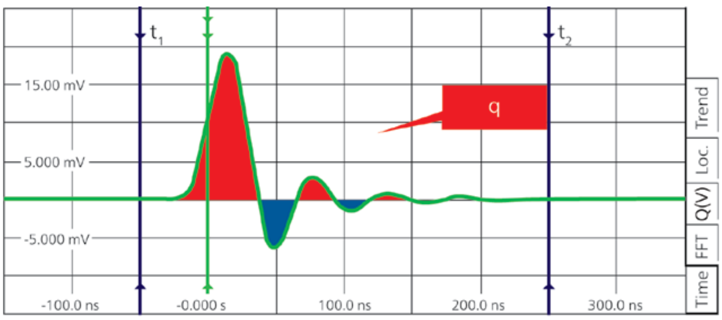
OMICRON

# How to Measure Partial Discharge

Since charge is calculated by integral current over time, the partial discharge (PD) data acquisition unit detects the voltage drop across the known effective resistor of the coupling devices (CD) in the test circuit. This resistor will be R, $t_1$ and $t_2$, which are defined by the user of the measurement system.

Figure 1




$$q = \int_{t1}^{t2} i(t)dt = \frac{1}{R} \int_{t1}^{t2} u(t)dt$$

Measured Pulse – Typical classification of partial discharge sources

In addition to time domain integration, the traditional method integration in the frequency domain can be used. The integration in the frequency domain is done by a frequency filter, typically by a band-pass and a peak detection system. The link between the time domain Integration and frequency domain can be shown physically by using the Fourie Transformation:

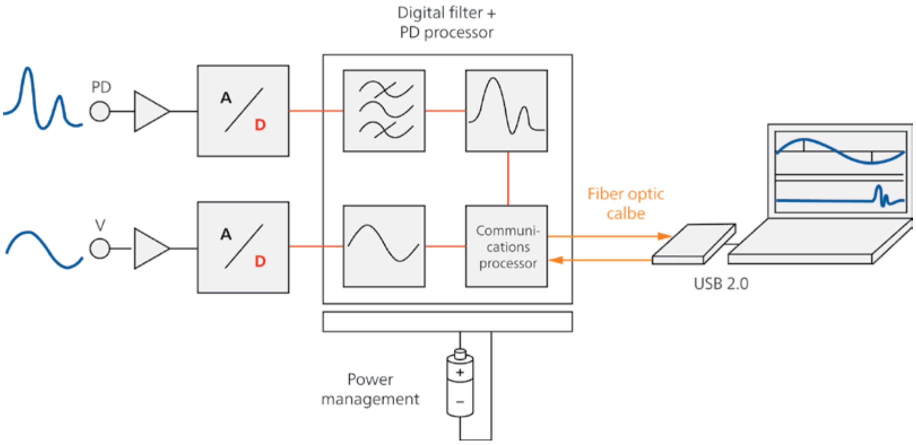
$$F(\omega) = F\{i(t)\} = \int_{-\infty}^{\infty} i(t)e^{-j\omega t}dt$$

In modern PD measurement systems, the input signal including the PD pulse gets pre-amplified and digitized by an analog/digital converter. The further processing is done by digital filters, digital detection and a computer. Because of their digital nature, these subunits are stable and reproducible and do not change their behavior over time and temperature.

Furthermore, the user is able to switch the measuring frequency and alter the bandwidth. The PD impulses are evaluated by maintaining their amplitude and point of time when they occurred, which allows precise measurement of the PD pulse regarding the charge value, the phase position of test voltage and other methods.

Measured Pulse – Typical classification of partial discharge sources

Figure 2



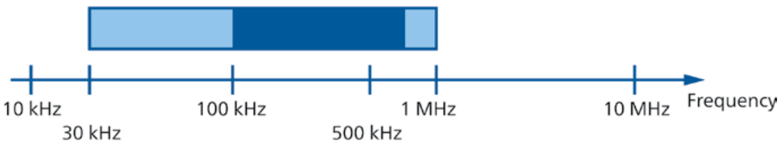

In case of the MPD PD measurement and analysis system, more PD processing functions are included in the hardware, such as thresholds and adjustable pre-amplifiers. The voltage signal is digitized as well. All of this information is transmitted via fiber optical cables. These fiber optic cables and the external rechargeable battery allow the user to use the measurement system safety in the high-voltage (HV) area and even on high-voltage potential. The information about PD and voltage is processed further in the computer. A recording of the entire measurement is possible.

The IEC 60270 recommends two different filter settings. These include wide band measurement and narrow band measurement.

For a wide band measurement, the recommendation is:

- Lower frequency limit and above or equal to 30 kHz and below or equal to 100 kHz
- Higher frequency limit below or equal to 1 MHz
- Bandwidth of 100 kHz to 900 kHz
- Polarity detection can be possible

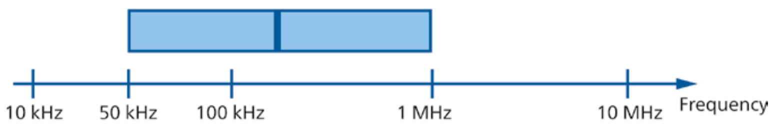
Figure 3




For a small band measurement, the recommendation is:

- Center Frequency range between 50 kHz and 1 MHz
- Bandwidth of 9 kHz to 30 kHz

Figure 4




The PD Measurement according IEC 60270 is the basis for many applications, different assets and different voltage levels. This is reflected in a variety of IEC, CIGRE and IEEE guides and standards which refer to the IEC 60270 standard. Therefore, the IEC 60270 standard is very important for acceptance measurements in the test fields of manufacturers as part of their type and routine tests on high-voltage equipment.

The on-site partial discharge measurement is often conducted with a filter setting out of the recommended range by IEC 60270 to avoid a high noise condition. The MPD data acquisition unit allows users to adjust the filter setting to find out the optimized SNR (Signal-to-Noise-Ratio) to ensure high sensitivity for the PD measurement and a high robustness against noise for further analysis.