8 PD Measurements on Rotating Machines

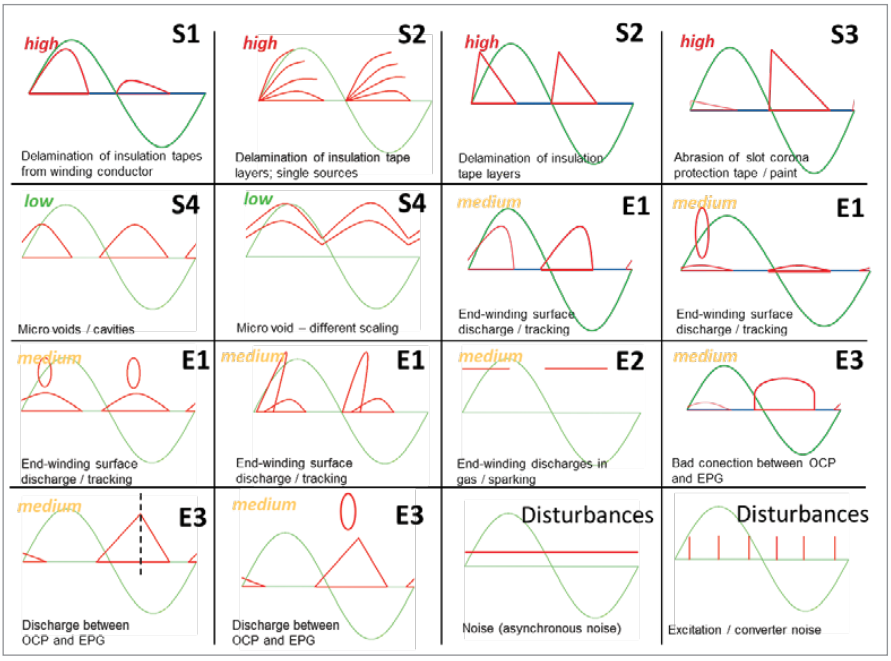
Stator insulation faults are the second most common cause of failure in large rotating machines. Partial discharge (PD) is a reliable measurement parameter used to assess the condition of insulation in rotating machines. PD occurs in the insulation system of rotating machines, where the local electric field stress exceeds the local electrical strength. The insulation materials typically used for rotating machines are resistant to a certain level of PD. An increase of PD activity can indicate insulation degradation caused by overheating, load cycling or mechanical stress.

Successful PD measurement in stator windings is often based on the separation of parallel PD sources, and the distinction between harmful PD, normal PD occurrences and external noise inevitably present in industrial surroundings. To achieve this, the following separation and advanced noise suppression techniques are applied:

- **Synchronous multi-channel data acquisition**
  3PARD (3-Phase Amplitude Relation Diagram)
- **Multi-spectral evaluation**
  3CFRD (3-Center Frequency Relation Diagram)
- **Automated cluster separation**

For interpretation of the measured and separated pattern, a list of typical patterns can be helpful, as shown in Figure 1.

Figure 1



Classification of PD patterns for rotating machines

The accessibility of the star point determines the measurement setup to be used for PD measurement. Figure 2 shows a basic measurement setup for an applied voltage, single-channel PD measurement on the open star point of a rotating machine. The test voltage (no specific voltage source) is applied at the open star point. Using an MCC 117 coupling capacitor with the MPD 800 measurement device, the PD measurements are performed phase by phase (Phase U1 in Figure 2) where the unused terminals are grounded. The setup is as described in IEC 60034-27: open star point. This measurement setup aims to achieve an assessment of the winding insulation between the phase and the laminated core.

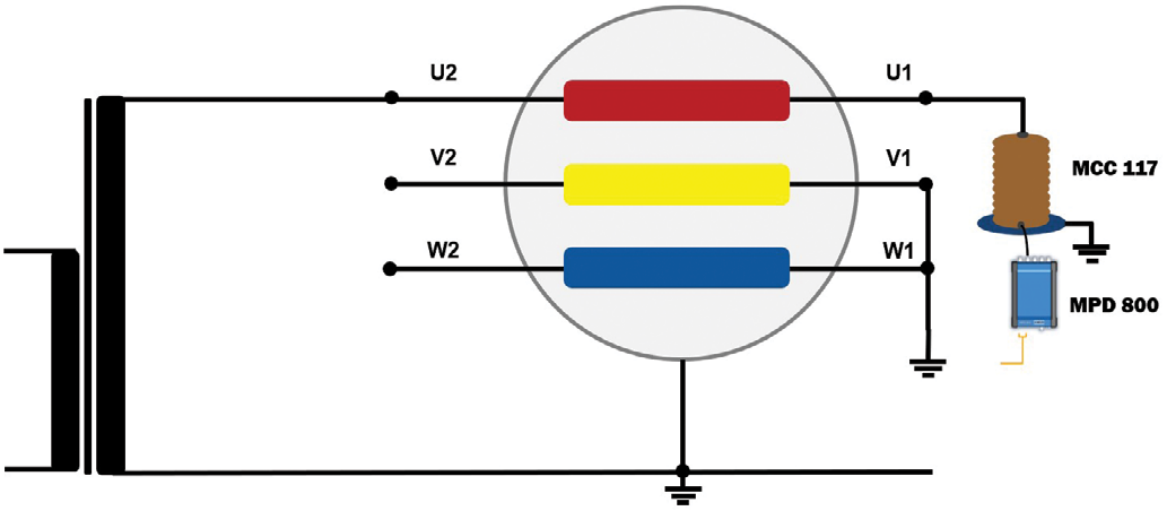


Figure 2

Basic setup for PD measurement on the open star-point of a rotating machine.

OMICRON even supports the setup of a combined measurement system using 3 channels as shown in Figure 3. This enables the measurement of winding insulation capacitance, Power Factor/Dissipation Factor (PF/DF) and PD in one setup using the CPC 100 and CP TD15 as the voltage source and the CP CR 600 for reactive power compensation with the open star point (if accessible). The additional BLI2 on top of the coupling capacitor is used as a blocking impedance to filter undesired PD from the voltage supply (CP TD15) in the standard IEC measurement frequencies of 100 - 500 kHz.

This measurement setup offers many advantages. It is lightweight with a portable voltage source due to the compensation of losses. The parallel measurement of capacitance, PF/DF and PD is possible with no additional setup. Complete information about the condition of winding insulation can also be obtained. As a result, this combined measurement saves a lot of time.

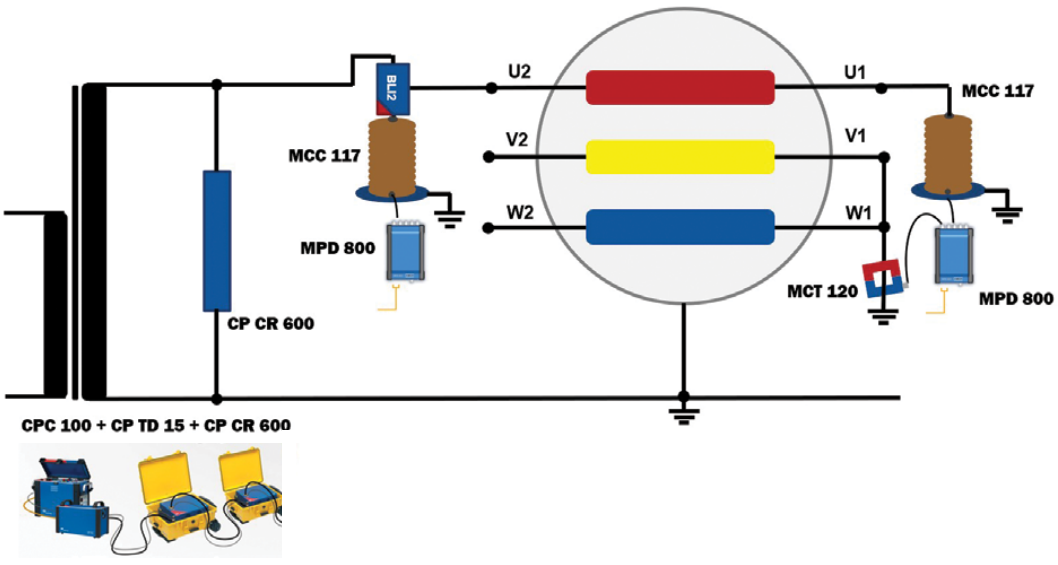


Figure 3

Combined measurement setup for capacitance, tan(δ) and PD