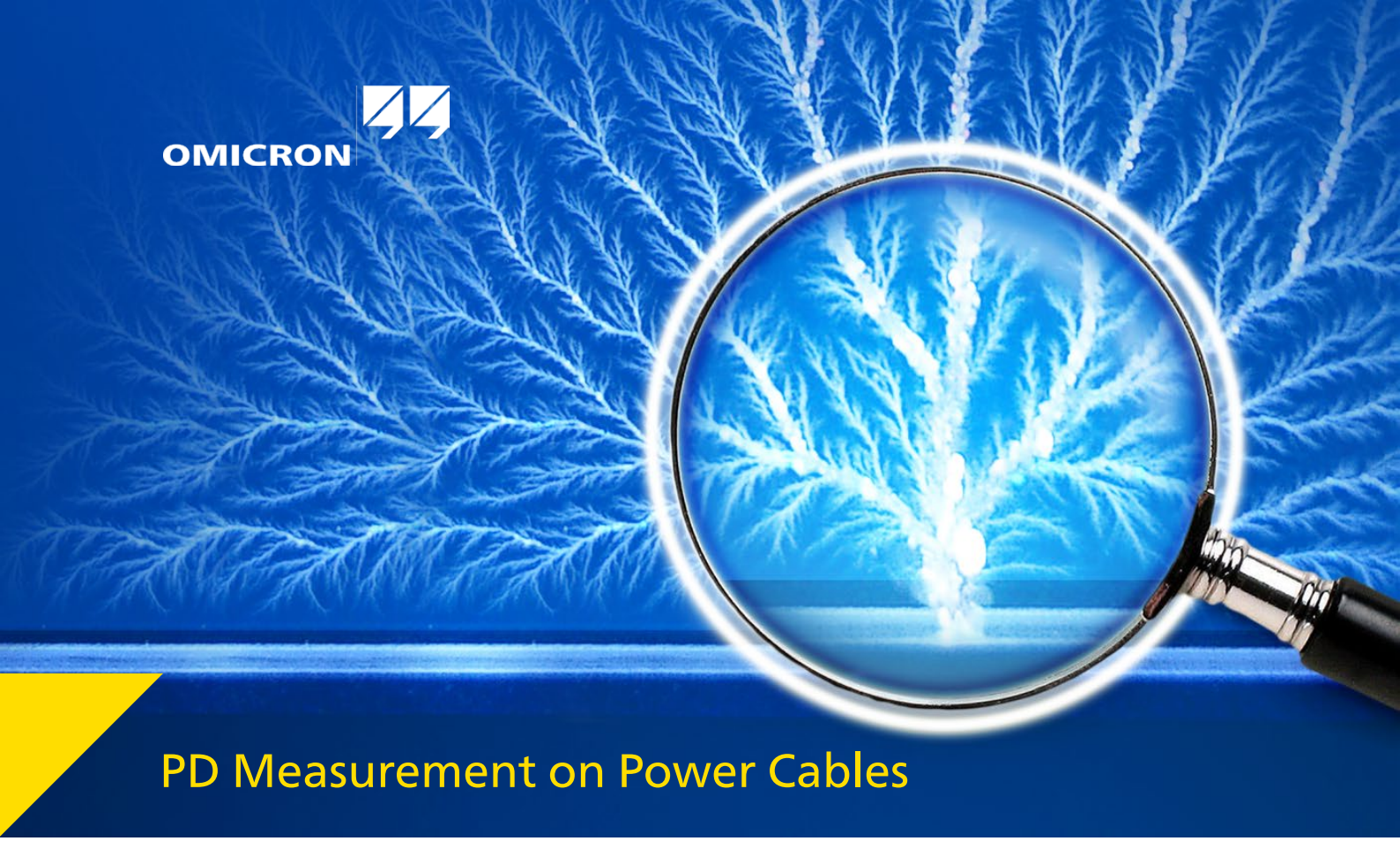


PD Measurement on Power Cables

There are three main failure mechanisms that exist in XLPE cables. These include cavities, water/electrical trees and protrusions.

In that case of a cavity, the lower permitivity within the gas-filled cavity leads to a higher electric field strength in this specific area within the insulation. Once the local electric field strength exceeds the dielectric strength of the insulation, the insulation is overstressed, leading to partial discharge (PD).

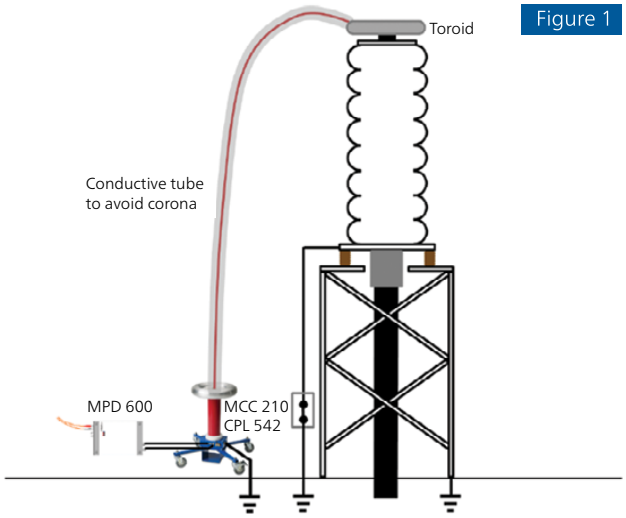
Water can enter into the insulation system once the increased water protection is damaged. Due to the water vapor pressure, water can diffuse into the XLPE. A water tree will start growing towards the core conductor as the water molecules are polarized. It will grow in the direction of the electrical field. The field increases due to the higher electrical conductance and the decreased insulation distance. A water tree cannot be detected via a PD measurement, however it can lead to an electrical tree once the electric field strength is too high.

A defect in the inner or outer semi conductive layers, like a tip, leads to an inhomogeneous electrical field. Once exceeding the dielectric strength of the insulation, the elevated field strength will cause PD and the evolution of an electrical tree with this protrusion.

PD measurement on power cables can be performed in three different ways, using either a coupling capacitor, a High Frequency Current Transformer (HFCT) on grounding or sheath cable, or a UHF sensor on the cable end termination.

Use of a coupling capacitor is mainly done with the power source during the factory acceptance test (FAT) or site acceptance test (SAT) as shown in Figure 1.

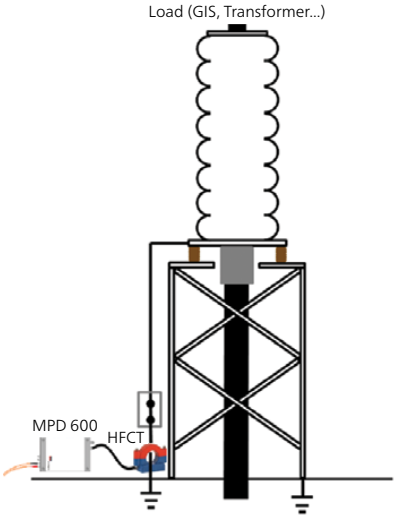
Figure 1



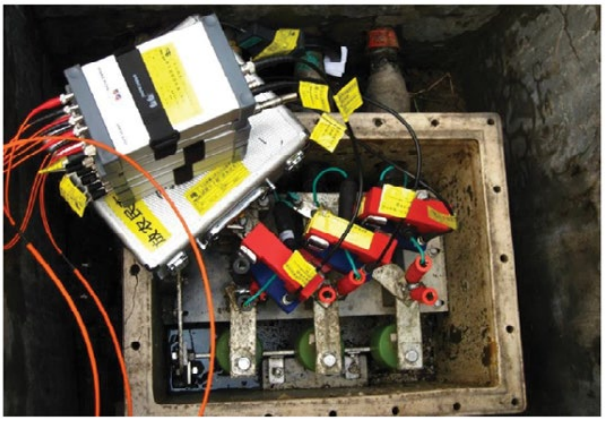
Basic connection diagram of a coupling capacitor at a cable end termination

For on-line PD measurements on cables, an HFCT is normally used on the sheath cable of the joints and on the grounding point on the end terminations. The signal propagation can be very complex, therefore it is beneficial to have a straight-through connection. The HFCTs should be connected around the cross-bonding links as shown in Figure 2.

Figure 2



Basic connection diagram of HFCT at a cable end termination



Connection inside cross-bonding link box

The UCS1 is a UHF PD sensor designed to measure and monitor cable end terminations. The directional sensor detects PD signals as transient voltage drops across the insulation of HV cable terminations. It can be used with or without parallel installed grounding connections. In order to achieve the best response characteristic, the UCS1 should be installed as close as possible to the termination, using short and low inductive braids as shown in Figure 3.

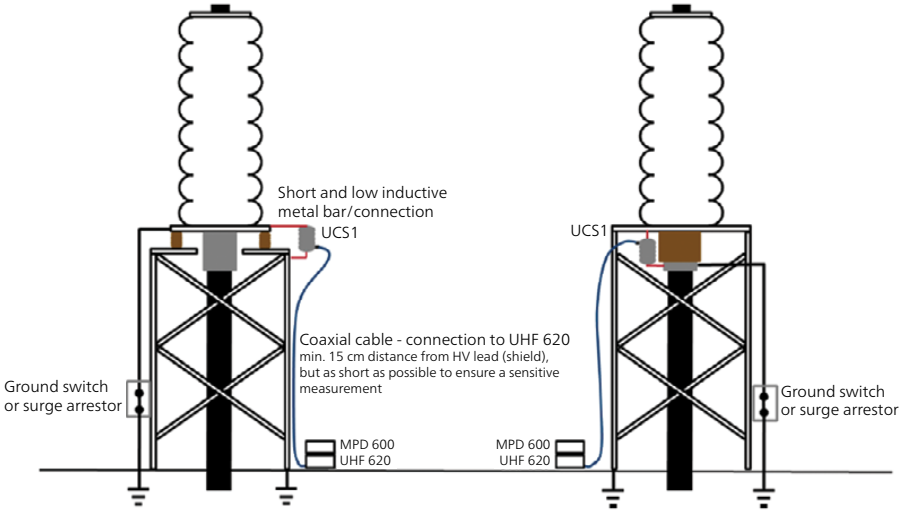


Figure 3

Basic connection diagram of UHF sensor at a cable end termination

The UHF approach ensures a very sensitive (local) PD measurement in environments with high disturbance levels.

More information about PD measurement and analysis on power cables is available HERE.

Hands-on training is also available from OMICRON Academy, where you can learn how to perform PD measurement and analysis on a variety of electrical assets. Please click HERE for more information.