QCM-C-PDP

Portable partial discharge monitor for cables

Ensuring reliable continued operation of power cables and termination boxes of metal clad switchgear, rotating machines and transformers

- **Highly accurate periodic PD survey of HV/MV power cables eliminates risk of unplanned outages**
- **Precise PD localization (within 0.2% to 1% of cable length) minimizes maintenance expenditure**
- **Accurate categorization of different activities captured by system**
- **Robust and rugged design to maximize portable operation life and support inspections / testing for extended period of time**
- **Advanced denoising and filtering help to remove background noise efficiently**

Product Summary

Description The **QCM-C-PDP** portable system can be used to measure partial discharges in power cables and terminations boxes of metal clad switchgear, rotating machines and transformers. PD can be localized within 0.2% to 1% of the cable length. The **QCM-C-PDP** can be applied to measure PD on-line on cables and their termination boxes while the system is energized. There is no need to de-energize the cables if some requirements are met.

Application The QCM-C-PDP cable online PD measurement system can be successfully used for measuring partial discharge in cables with confidence. Used for low-cost, high performance periodic online and offline PD testing on HV insulating system of power cables and their terminations in transmission installations, power plants and large industrial consumers. The information gained may be used for condition based maintenance decisions

QUALITROL®
Defining Reliability

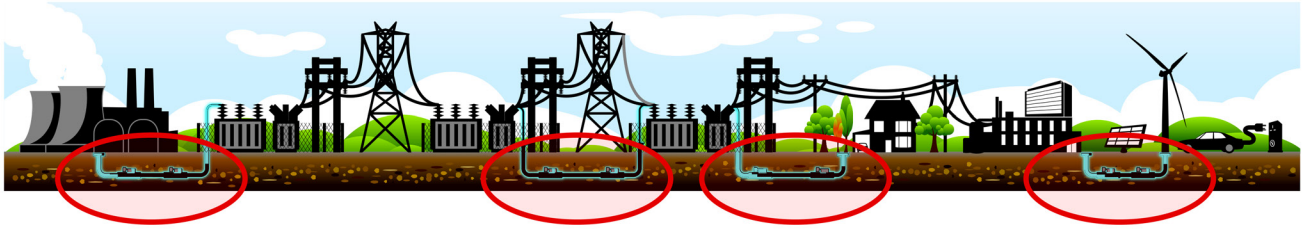
Ensuring reliable continued operation of power cables and termination boxes of metal clad switchgear, rotating machines and transformers	• Failure in cable insulation is generally preceded by partial discharge and subsequent degradation phase • Detecting partial discharge at the early stage of degradation helps in preventing sudden failure • The QCM-C-PDP system makes sure that there is no PD in the installed power cables
Highly accurate periodic PD survey of HV/MV power cables eliminates risk of unplanned outages	• HFCTs (High Frequency Current Transformers) used in the systems are sensitive to a wide range of frequency (200 kHz - 15 MHz) • TEV (Transient Earth Voltage) sensors to differentiate between PD and local discharge (Corona, surface discharge) • Advanced de-noising based on proven noise gating technology - Wavelet Filtering • Categorization of different activities captured during acquisition • Prioritizing corrective actions or replacements can be decided based upon analysis and reports
Precise PD localization (within 0.2% to 1% of cable length) minimizes maintenance expenditure	• Highly accurate location algorithms based on “Time Domain Reflectometry” (TDR) • Higher acquisition rate and dynamic threshold selection improves definition on PD events • Transponder is used for longer cables to improve the accuracy of detecting PD location along the length of cable • More than 25 years of experience in PD analysis into HV apparatus
Accurate categorization of different activities captured by the system	• The most important stage before data analysis is the separation of different activities captured during acquisition • Expert analysis software successfully categorizes the different activities captured • Categories can then be easily marked as Cable PD, External PD, Noise or Interference • Localization of cable PD can be done easily by examining a few segments inside the category
Robust and rugged design to maximize portable operation life and support inspections / testing for extended period of time	• IP66 rated highly protective case • System integrated with filters and surge protection • Online support by researchers and experts from Qualitrol DMS, Glasgow
Online and non-intrusive PD measurement	• HFCTs can be clamped on the energised cable earth • TEVs can be attached magnetically to the metal clad switchgear (even when the cables are operational) • HFCTs are passive and do not have any impact on the electric field of cable • Easy to connect with the data acquisition unit and analysis system

Why partial discharge measurement in power cables?

- **Failure in cable insulation is generally preceded by a degradation phase which may last for months or several years**
- **Any insulation degradation results in the inception of partial discharges (PD) at degradation site(s)**
- **PD analysis and localisation helps in determining the insulation health and subsequently the life of power cables**

Why QUALITROL Expert diagnostic and testing services?

- **More than 25 years of experience in providing PD monitoring systems and services to utilities across the world**
- **World wide presence provides quick turn around times**
- **Long term serviceability assurance helps in formulating longer service contracts**
- **Cross team integration increases the accuracy of results and confidence of operator / asset manager**
- **Highly accurate PD detection and localisation system for power cables**
- **Greater emphasis on health and safety during PD measurements surveys**



System overview

Sensors

- HFCT sensors detect the high frequency signals induced from any PD pulse inside the cable insulation and send to data acquisition unit for further analysis. TEV sensors are used to detect the corona and surface discharge. It helps in differentiating PD activity inside the insulation from corona and surface discharge

Data Acquisition Unit

- The DAU takes the signal from sensors and applies filtering and noise gating to reject interference. The digitised high frequency pulse is then sent to the Analysis System for further analysis

Analysis System

- The PD analysis system determines if the high frequency signal is a PD signal or not. It stores all PD signals with their parameters for trend analysis. The PD analysis system also locates the fault along the cable with an accuracy of less than 0.2% to 1% of the total cable length

Transponder

- The Transponder is used for PD localization in cases of long cables > 3 km (1.8 miles). It injects the pulse back after receiving the actual PD signal in order to make comparison simpler for the system

PD analysis system (installed in Laptop)

Transponder

Accessories kit

Software overview

Data storage

- All information about the test as well as acquisition and analysed results are saved in a database so that personnel using the system can retrieve the data later on when required without fear of losing test files. Data can be easily exported and imported

Self testing

- Self testing of the system can be performed to ensure the proper working of internal circuitry

Offline calibration

- Representing the values in picocoulombs (pC) requires the calibrated HFCTs or offline calibration. The later is the most accurate. Software provides facility to perform offline pC calibration in order to show the magnitude of HFCT accurately in pC

Return time measurement

- In order to locate PD along the length of cable accurately, return time measurement of the pulse along the length of the cable is important. The software enables the user to record return time of pulse along with the help of a transponder

Denoising

- The software performs noise rejection and filtering automatically if activated. Recorded data is stored in the database for further analysis by the Expert Analysis section

Expert Analysis

- The complete recorded data is analysed and all the activities are separated out as different categories. Each category contains pulses of the same characteristics. Trend plots, maximum, average and pulse count phase resolved cumulative distributions, pulse shapes, localization pulse, PD localization mapping and 3D plots can be viewed for each category on each channel or as cumulative activity at each channel

Reporting

- Reports can be generated after Expert Analysis to include the following:
  - Test Information
  - Plots for each channel
  - Trend plot of each channel versus external sensor
  - Maximum, average and pulse count phase resolved distributions of each channel versus external sensor
  - 3D plot of phase, magnitude and acquisition Index
  - Plots for each category of each channel
  - Trend plot
  - Maximum, average and pulse count phase resolved distributions of each channel versus external sensor
  - Pulse shape of category and simultaneous pulses on other channels
  - Localization pulse
  - PD localization mapping
  - 3D plot of phase, magnitude and acquisition index

The measuring method

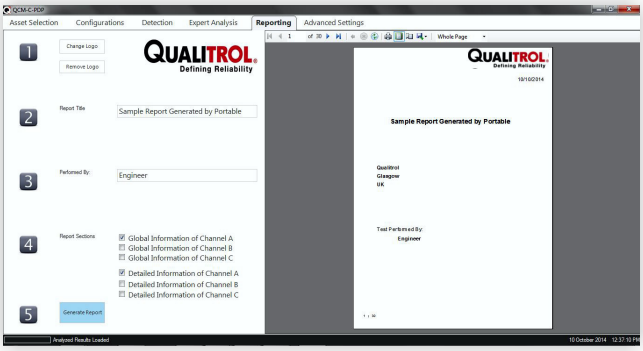
- The system is capable of detecting and locating partial discharge in all kind of HV/MV cables:
  - XLPE, EPR, PVC, PILC, etc. cable
  - Single core and multi core cable
  - Cables of any length or any number of joints
- PD measurements are made using HFCT and TEV sensors that are clamped over the earth screen. HF Signals are captured synchronously enabling the test engineer to observe phase-related patterns of discharge, online and in real-time
- The Expert analysis system provides an automatic PD detection and criticality level for the cable based on magnitude and number of PD pulses per power cycle. Qualitrol experts and the PD analysis system together are capable of differentiating PD activity from external noise and local discharges, e.g. corona, surface discharge, switchgear PD, etc
- The “Time Domain Reflectometry” (TDR) algorithm is used to accurately locate the PD to an accuracy of less than 0.2% to 1% of the cable length
- The Transponder is used at the other end of the cable section to keep the similar accuracy of localisation in the longer cable sections (greater than 3 km)

Case studies / examples

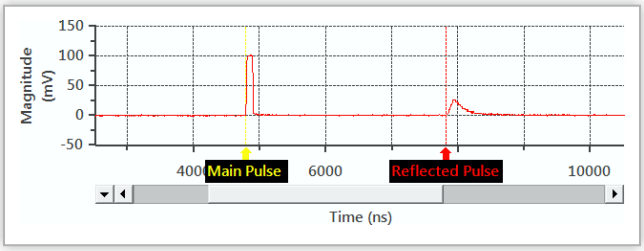
Expert Analysis

Expert Analysis

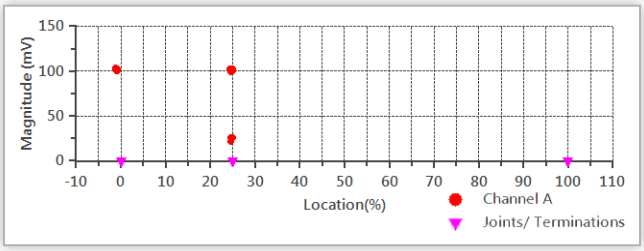
Self test



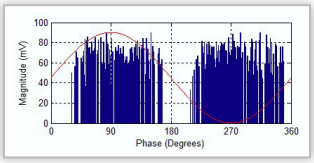
Reporting



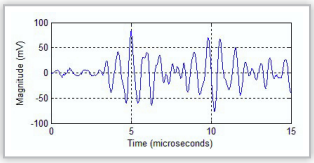
PD location pulse



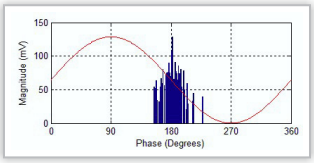
PD localization map



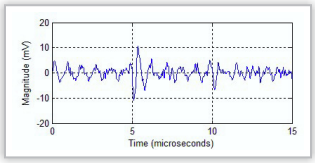
Extracted noise pulse



Extracted noise pulse



Extracted PD pulse



Extracted PD pulse

System components

System

Item	Quantity
4 channel portable system (Integrated with hardware filters, protection, acquisition, power supply and synchronization)	1

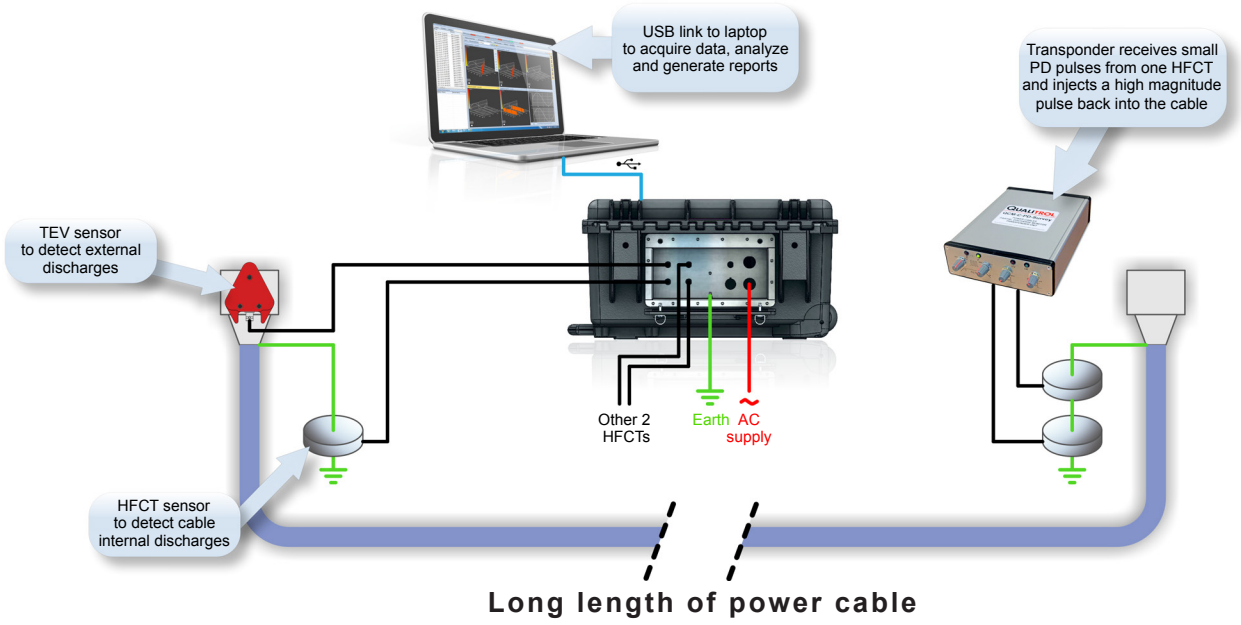
Options

Item	Quantity
pC calibrator	1
Transponder (needed when cable lengths are greater than 5 km)	1
HFCT (set of 2)	1
Coaxial cables	2

Accessories

Item	Quantity
10m coaxial cables	4
Power cable	1
Earth cable	1
High Frequency Current Transformers	3
Noise antenna	1
Laptop, with installed software	1
Accessory case	1

Outline Of QCM-C-PDP System Components



TECHNICAL SPECIFICATIONS

C-PDP system	Voltage range	90 to 264 V AC; 47 to 63 Hz
	Supply power	70 W
	Input	4 channels (can take output from HFCT, TEV, noise antenna)
	Surge protection	> 90V
	Sampling rate	125 MS/s
Transponder	Input	1 Channel (captured PD pulse >10 mV from HFCT)
	Output	2 outputs: 1 - HV pulse 180 V (out into HFCT). 2 - trigger pulse 5 V
	Modes of operation	Free running mode and trigger mode
	Power	Rechargeable battery, runs for 8 hours
HFCT sensors	Mounting	Clamped around cable earth
	Output	Coaxial analog output (BNC type)
	Bandwidth	200 kHz - 15 MHz
	Sensitivity	up to 10 mV/mA
TEV sensors	Mounting	Magnetically attached to metal clad
	Output	Coaxial analog output (BNC type)
	Bandwidth	1 MHz - 50 MHZ
	Sensitivity	Up to 100 mV/V
Noise sensor	RF antenna	100 - 3000 MHZ
HV testing	Compatible	Ability to monitor and record PD during testing
Optional	Calibrator	Calibration can be supplied to perform offline pC calibration
	Sync unit	External sync unit can be used to synchronize the system to external trigger
Mechanical	Dimensions	800 mm x 600 mm x 350 mm [31.5” x 23.6” x 13.8”]
	Weight	Main unit:15 kg [33 lbs] Accessory box:16 kg [35.3 lbs]

- Online PD measurement at power cables without disrupting plants / facilities - offline factory testing
- Excellent interference immunity for PD measurement under difficult conditions
- Highest level of reliability of PD inspection
- Highly accurate fault location and PD severity analysis
- Power cables are not exposed to higher voltage stresses
- PD measurement and analysis with total confidence
- Unbiased diagnosis and assessment of critical power cables
- Expert consulting services during acceptance testing and maintenance planning are available
- Overall insulation health assessment and extension of life time of power cable
- Implementation of efficient condition based maintenance strategies

About QUALITROL®

Established in 1945, with continual improvement at the core of our business, QUALITROL® provides smart utility asset condition monitoring across the globe. We are the largest and most trusted global leader for partial discharge monitoring, asset protection equipment and information products across generation, transmission and distribution. At QUALITROL® we are redefining condition monitoring technology for Electric utilities assets.

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