

DMS PDMG-RH

Partial discharge monitor for GIS



Enhanced continuous, real-time detection, alarming and analysis of partial discharge events

- Automatic PD fault classification
- High resolution
- Selectable UHF filters and gain on a per coupler basis
- Robust design allows for reliable operation in almost any environment
- Flexible installation options
- Enhanced noise gating features for elimination of interference
- IEC 61850 certified

Product Summary

Description Utilizing advanced UHF technology, the PDMG-RH system, a member of the highly successful PDMG-R family, is designed for GIS installations. It collects PD data from UHF sensors (couplers) installed on the GIS and transmits the information to software for automatic interpretation and analysis by Expert Software, allowing incipient faults to be avoided and the condition of the long term health of the insulation system to be simply and effectively monitored over the life of the GIS.

Application The PDMG-RH system is used for continuous, online partial discharge monitoring and analysis on permanently installed applications on all makes of GIS in transmission installations and on critical systems such as in power plants and large industrial consumers. It provides digital and analog (SCADA) outputs for remote alarm and warning as well as remote data access to all diagnostic information.



QUALITROL®
Defining Reliability

DMS PDMG-RH Partial discharge monitor for GIS

Enhanced continuous, real-time detection, alarming and analysis of partial discharge events

- Continuous monitoring and detection of partial discharge events enhances system reliability and reduces risks
- The PDMG-RH system enables the ability to detect incipient faults in real-time before failure, asset damage or loss of power occurs
- Extends GIS life and improves the preventative maintenance of the GIS
- Remote access software allows multiple users to view partial discharge status in real-time and acknowledge alarms on all monitored substations

Automatic PD fault classification

- The expert software automatically classifies the PD fault so that a better risk assessment can be made, even by persons who are not PD measurement specialists
- A reference library of PD patterns captured on many types of GIS is also available to confirm the fault characteristics

High resolution

- Capturing max resolution of 256 samples of data at 10 bit resolution per cycle up to 220 Hz per channel. With up to 24 channels live streaming in HV test mode

Selectable UHF filters and gain on a per coupler basis

- Filters and gain are selectable on a per channel basis

Robust design allows for reliable operation in almost any environment

- The electronic circuits of the monitoring system are protected against transient over-voltages and surges arising from lightning or switching operations
- Filtering is applied to the sensors signals to reject interference resulting from broadcast signals or discharges in adjacent air-insulated equipment

Flexible installation options

- Sensors (couplers) can be retrofitted to existing GIS with external couplers attached to inspection windows or the exposed edges of insulating spacers
- The retrofit sensors can be mounted without degassing the chambers and have high sensitivity to UHF signals
- DMS can custom design all types of UHF couplers for particular applications and calibrate them to ensure they meet the users specification for sensitivity and bandwidth

Enhanced noise gating features for elimination of interference

- Antenna based noise elimination is integrated into each OCU facilitating the removal of sporadic external noise signals from the data captured by the couplers

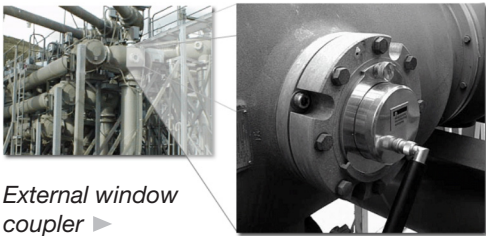
IEC 61850 certified

- KEMA Certified IEC 61850 interfacing available, with logging, reporting (buffered and unbuffered), alarm acknowledgement, file services and full data exposure from the PDM

Unrivalled features, enhanced benefits...



System components



UHF sensor (coupler)

- PD pulses induce multiple broadband resonances in the GIS chamber. These resonant UHF signals are detected by sensitive UHF sensors (couplers) which are installed on each of the phases.
- In new GIS the sensors are usually fitted internally, on the inside of the hatch cover plates (internal couplers). These internal sensors pick up high transient over-voltages when disconnect switches or circuit breakers operate. Complete protection for the PDMG-RH systems sensitive electronics is assured by fitting an external DMS protector which shunts dangerous voltages to earth.
- For retrofitted systems, external sensors are attached to inspection windows or the exposed edges of insulating spacers. They can be mounted without degassing the chambers and can have sensitivity levels approaching internal sensors.
- Qualitrol DMS can custom-design all types of UHF sensors for particular applications and calibrate them to ensure they meet the users specification for sensitivity and bandwidth.

Optical Converter Unit (OCU)

- Each OCU takes the signal from the UHF sensors and applies filtering to reject interference (noise) that can result from broadcast signals, discharges in nearby air-insulated equipment and other sources. The characteristic of the UHF pulse is then sent to the Equipment Cabinet.
- An additional channel connected to an external antenna measures the presence of external interfering signals and removes the interfering signal from the coupler signal by a gating function.
- Additional fibres within the cable are used for OCU control and to initiate an integrated self-test procedure that automatically checks and logs the condition of each channel.
- The OCUs are totally protected against high-voltage transients and are suitable for use in harsh environments.

Equipment Cabinet

- The Equipment Cabinet is typically located in the relay or control room and receives the optical data streams from the OCUs and transmits control signals back to the OCU (i.e. for the self test).
- The data is formatted and stored in a central server, giving a real-time display of the partial discharge activity.
- The PC interfaces to an IEC 61850 network for transfer of alarms, status and data summary, acting as an IED on the network.

...from the world leader in PDM

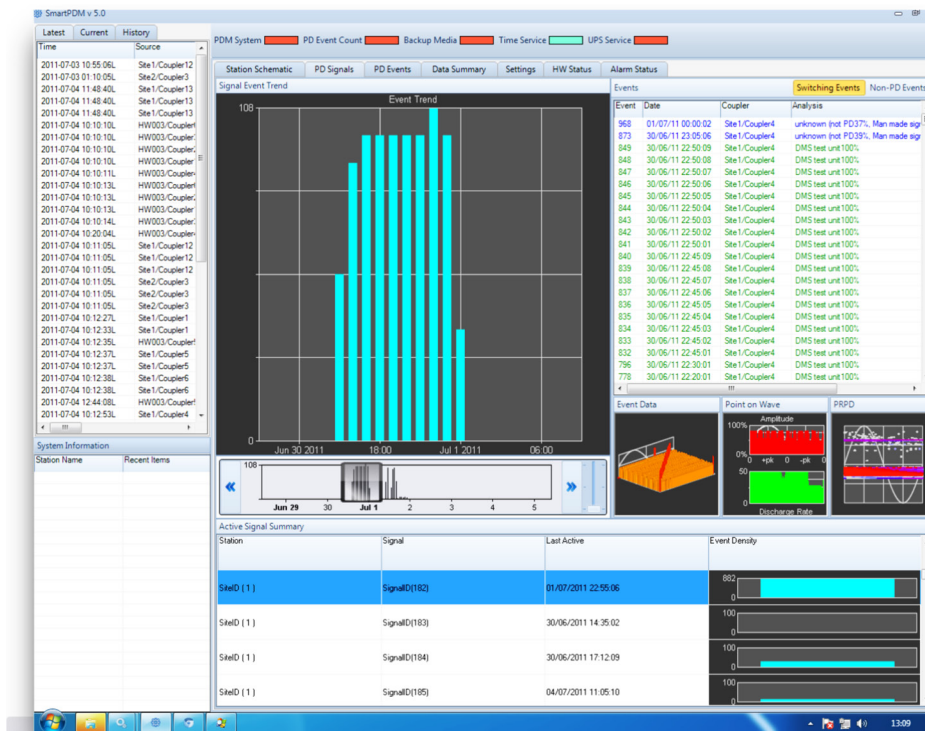
System software

Data handling, display and interpretation

- All single-cycle event data gathered by the sensors is automatically classified by a range of sophisticated analytical and statistical techniques such as multiple artificial neural networks, genetic algorithms and fuzzy logic. A system of redundancy then assesses the analytical results and gives the probability that a particular type of defect is present, i.e. a floating particle, protrusion, insulator void, etc. At the same time, sources of interference such as lights, radar, mobile phones, motors, etc, are identified and rejected.
- In addition, trend analysis searches for any regular changes in the parameter levels defining the PD activity and alerts the operator should a defect start showing signs of insulation breakdown.
- The PDMG-RH system operates simultaneously in different modes and will capture isolated PD events even while displaying the current on-line data. The data can be viewed in a number of ways including point-on-wave (2D) or in single-cycle (3D) format to give an instant impression of the PD characteristics.
- For the remote operation of the system, a PC, modem and LAN interface can be installed off-site. This enables the PDMG-RH system to be operated, controlled and data received in a similar way to being present at the substation. In addition, the system can interface to IEC61 850 network for alarms, status and data summary transfer.

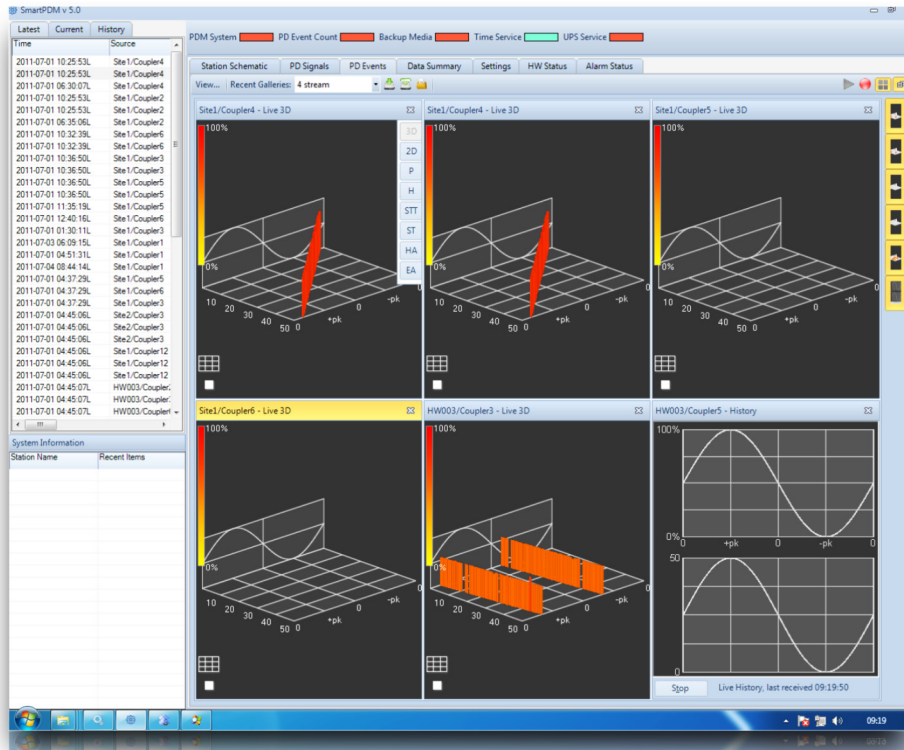
In-service operation

- 2D, real time point-on-wave (PRPD) and PRPS data display and analysis
- 3D, real time single-cycle (PRPS) and PRPD display and analysis
- Time PRPD, STT real time displays



- Periodic storage of point-on-wave displays for trend analysis
- Event Mode captures single events
- Data stored on hard disk for up to five years
- Data library of typical defects
- Automatic continuous backup of data
- Automatic self-check of PDM with faults logged and alarmed
- Automatic synchronization with bus bar voltage
- Transfer of data to remote site by company LAN or modem

SMARTPDM - PD signals display



SMARTPDM - PD events display

Interpretation

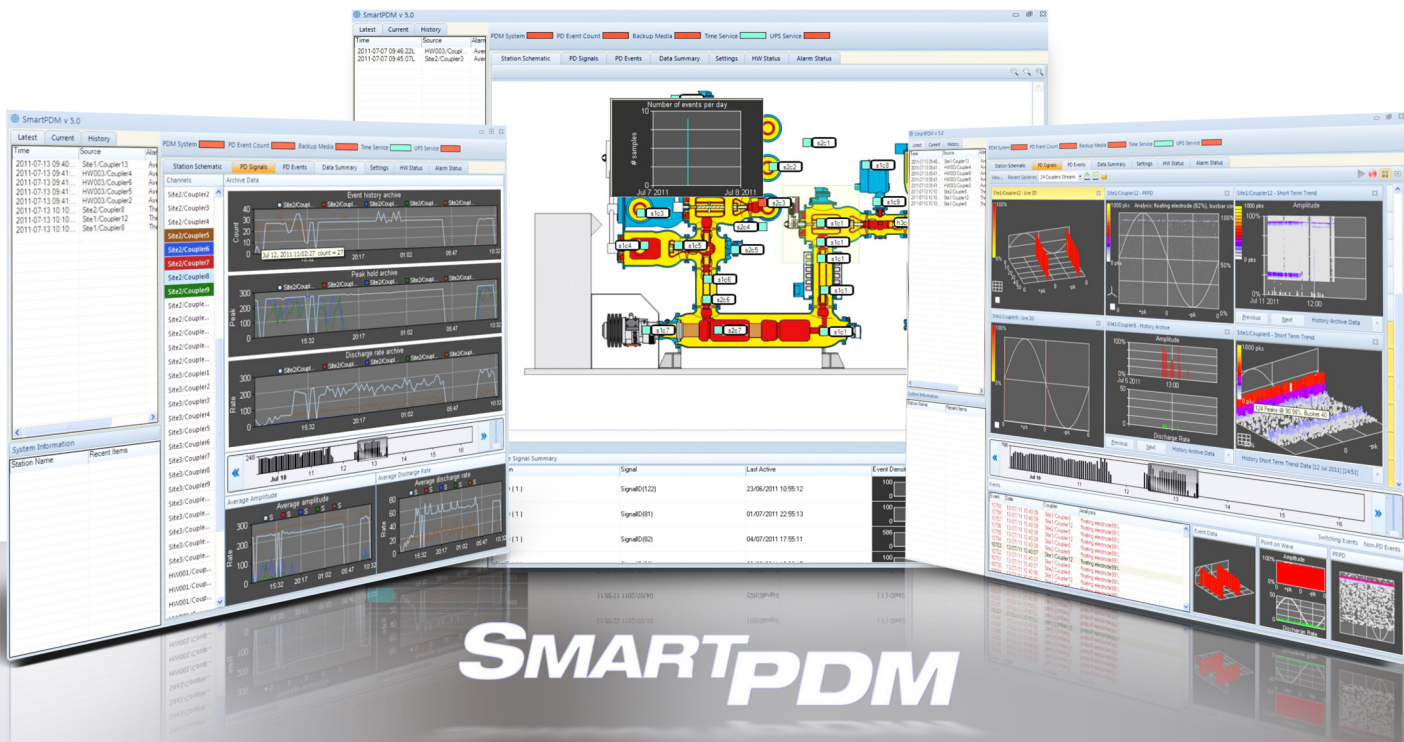
- Trend analysis
- Multiple artificial neural network (ANN) classification of events
- Fuzzy logic
- Genetic algorithms

PD alarms

- Programmable alarm criteria
- Warning of PD activity
- Alarm of high or increased PD activity
- Automatic communication of warning/alarm condition to headquarters PC
- Alarm notification using IEC 61850

Reporting

- Automatic report generation on daily, weekly and monthly activity



SMARTPDM

DMS PDMG-RH Partial discharge monitor for GIS

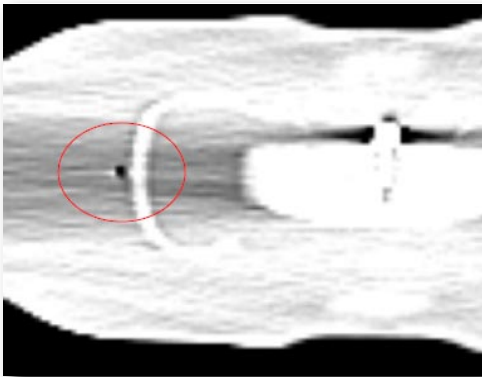
Performance / case studies

No. of monitored bay-years	No. of in-service break-downs	No. of in-service break-downs prevented	No. of break-downs prevented per 100 bay-years	No. of break-downs prevented per 100 coupler-years
8030	3	84	1.05	0.35

▲ Performance statistics

Performance in the field

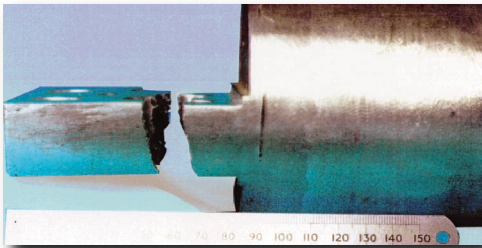
- The PDMG-R system has proved to be sensitive and reliable in service. On numerous occasions it has detected potentially dangerous defects in GIS before failure could occur. Qualitrol DMS have installed PDMG-R systems in over 200 GIS, at voltages from 66 -1000 kV and data is currently being received from more than 10,000 UHF couplers. During the past 15 years, outages were obtained to remove 84 defects that would almost certainly have caused complete breakdown had no action been taken.
- An in-service breakdown in a GIS typically takes more than a week to repair, and the costs of this, the consequent circuit disruption and loss of supply in a single outage usually far outweigh the initial cost of the PDMG-RH.



▲ Problem detected - void

Discharge in a 230 kV GIS spacer after 5 months of service

- In a 230 kV GIS, a sudden increase in partial discharge activity was detected by the installed PDMG-R system approximately five months after first energization. Prior to this time, the GIS had not shown any PD activity.
- The partial discharge grew rapidly over a period of only 24 hours. The operators personnel were alerted and responded to the PD event alarm by immediately isolating the corresponding section of plant. The partial discharge patterns recorded by the PDMG-R system had the characteristics of an insulation defect in one of the spacer insulators.
- Upon examination by X-ray, the cause of the partial discharge was confirmed to be a 3.2mm void in the epoxy material. After the spacer was replaced the GIS was retested and went back into service without any detectable PD.



▲ Problem detected - broken palm joint

Broken conductor joint detected in a 400kV GIS

- A 400 kV GIS was retrofitted with a PDMG-R as part of a lifetime extension program. The existing levels of PD were monitored for change. The PDMG-R detected and correctly warned of a developing defect.
- An outage was taken and the GIS was inspected and a broken palm joint in the conductor was found.
- The use of the PDMG-R System enabled this serious defect to be found and repaired before any serious damage to the GIS occurred.



▲ Problem detected - bushing defects

Defects in 400 kV GIS/ transformer interfaces

- After the commissioning of a 400 kV GIS substation, PD signals were recorded by the PDMG-R close to the transformer / GIS interfaces on several circuits. The PD signals started within a few hours and up to several days after the first energizing. The recorded 100-day-history showed the start point of the discharges and that the magnitude of the PD signals in the first stage were increasing up to a stable level. The signals were in the range of up to several hundred pC.
- The phase resolved patterns indicated the presence of defects in the insulation of the oil to gas bushings. The bushings were removed and retested in the works where they were found to have a systemic defect that would have lead to eventual failure.
- After replacement of the bushing with new ones, the PD was completely eliminated.



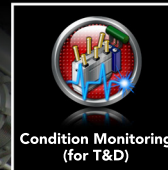
TECHNICAL SPECIFICATIONS

Equipment Cabinet	Input	2000 channels max
	Local MMI interface	Central control computer 19" monitor
	Additional MMI interfaces	GPS / backup system
	Output	Three SCADA/SCS alarm contacts and five auxiliary: - PD warning - PD alarm - System fault Ethernet, IEC 61850 or modem communications 8 x LED status indicators Extensive automatic self test with logging
OCU	Power supply	110 V 50/60 Hz
	Supply current	200 mA
	Input	7 UHF channels (2 x 3 UHF coupler inputs + 1 external antenna)
	UHF bandwidth	100 - 2000 MHz
	Gating antenna	100 - 3000 MHz
	Dynamic range	-75 to -30 dBm (logarithmic)
	Ambient operating temperature	-25 to +55°C (-13 to +131°F) (BS EN 60068-2-1, 60068-2-21)
Humidity	100% condensing	
Interference filtering	Methods	Per channel: Software selectable gating, coincidence, bandpass filtering or software filtering
UHF sensors	Compatible	Internal or external
SMARTPDM and SMARTHQ software	Operating system	Windows 7
	Max monitoring locations	256 sites
	System alarms	System fault
	PD warning / alarm	Event or PD trend
Alarm status notification	Alarm status notification	IEC 61850 Email SMS (text message)
	Web	HTML based WEB pages
GIS HV testing	Compatible	Ability to monitor and record PD during testing
Compliance	EMC compliance	Tested to Industrial Generic Immunity and Industrial Emission standards at enhanced levels



PDMG-RH

Unrivalled PDM feature set



- Enhances system reliability and reduces risks
- Detects faults in real-time before failure, damage or loss of supply
- Increases safety for personnel
- Determines condition of GIS insulation
- Implementation of efficient, condition-based maintenance strategies
- Extends residual life of aging plant and defers capital costs
- Reduces insurance premiums
- Retrofits to most major GIS systems

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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