

DMS PDMG-R

Partial discharge monitor for EHV GIS



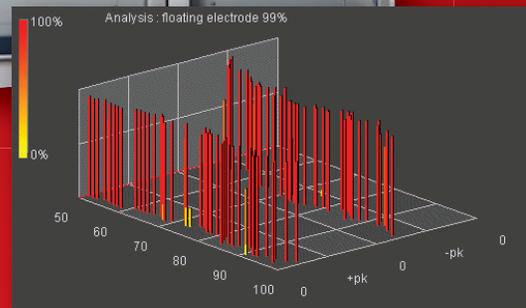
Continuous, real-time detection, alarming and analysis of partial discharge events

- Automatic PD fault classification
- Robust design allows for reliable operation in almost any environment
- Flexible installation options

Product Summary

Description Utilizing advanced UHF technology, the PDMG-R system is designed for large EHV 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 propriety HQ 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-R system is used for continuous, online partial discharge monitoring and analysis on permanently installed applications. For use on all makes of GIS in EHV transmission installations and on critical systems such as in power plants and large industrial consumers. Provides digital and analog (SCADA) outputs for remote alarm as well as remote data access to all diagnostic information.



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DMS PDMG-R partial discharge monitor for EHV GIS

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-R 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

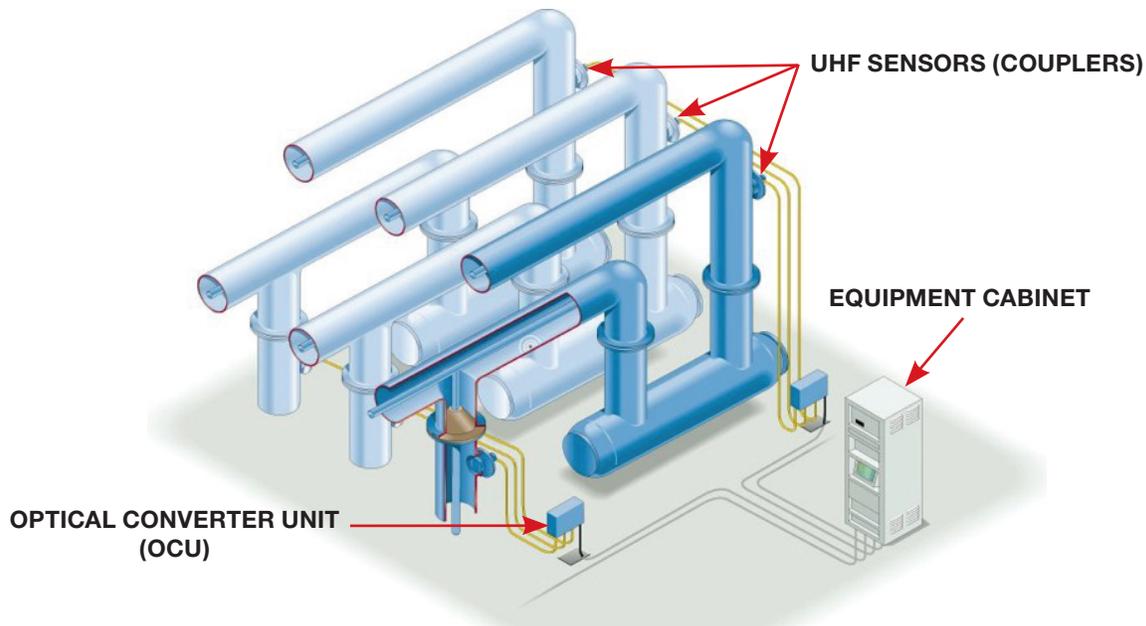
- The expert software automatically classifies the PD fault so that a better risk assessment can be made, even by persons who are not PD measurement specialists
- A reference library of PD patterns captured on many types of GIS is also available to confirm the fault characteristics

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 that can be fixed over either windows or the exposed edges of insulating spacers
- The retrofit sensors can be mounted without degassing the chambers and have the same high sensitivity as the internal sensors
- DMS can custom design all types of UHF couplers for particular applications and calibrate them to ensure they meet the user's specification for sensitivity and bandwidth

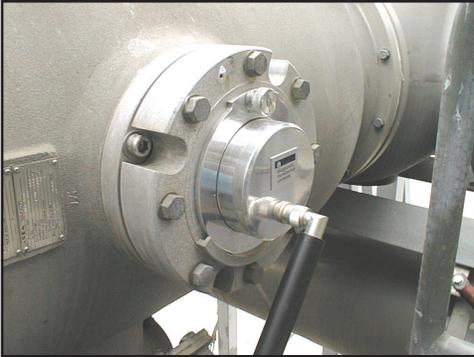


System Description

UHF couplers installed throughout the gas insulated switchgear (GIS) detect partial discharge events and transmit these to an Optical Converter Unit (OCU) where the signal is conditioned and digitized before being transmitted to the Equipment Cabinet. Here proprietary algorithms are applied to correctly identify partial discharge events and reject interference from broadcast signals or discharges in adjacent air-insulated equipment. Detected partial discharge events are stored, flagged and alarmed allowing for timely corrective actions to be initiated. Remote access to all data allows GIS experts to assist in analysis and planning of actions at short notice.

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 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-R System's sensitive electronics is assured by fitting an external DMS protector which shunts dangerous voltages to earth.

For retrofitted systems, external sensors are fixed over either windows or the exposed edges of insulating spacers. They can be mounted without degassing the chambers and can have sensitivity as high as internal sensors.

DMS can custom-design all types of UHF sensors for particular applications and calibrate them to ensure they meet the user's specification for sensitivity and bandwidth.

Optical Converter Unit (OCU)



Each OCU takes the signal from a 3-phase set of sensors (couplers) 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.

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 OCU's are totally protected against high-voltage transients and are suitable for use in harsh environments.

Equipment Cabinet

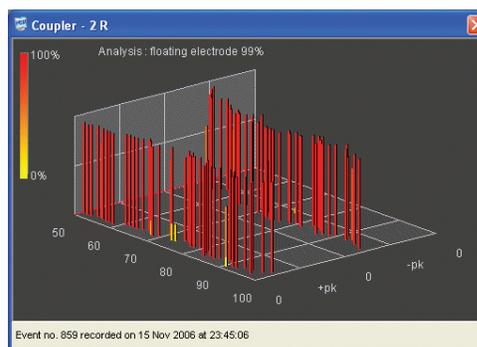


The Equipment Cabinet is typically located in the relay or control room and receives the optical data streams from the OCU's and transmits control signals back to the OCU (i.e. for the self test).

Embedded processors format the data and send to a central, industrial-grade PC; giving a real-time display of the partial discharge activity.



Trend History



Single-cycle PD display

Software - Data Handling, Display and Interpretation

All single-cycle data gathered by the sensors is automatically classified by a range of sophisticated analytical and statistical techniques such as multiple 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-R 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 either in 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 duplicate PC, modem and LAN interface can be installed off-site. This enables the PDMG-R System to be operated, controlled and data received in a similar way to being present at the substation.

In-service operation

- online point-on-wave & single-cycle data lifespan
- periodic storage of point-on-wave displays for trend analysts
- Event Mode captures single events
- data stored on hard disk for up to 1 year
- data library of typical defects
- automatic continuous backup of data
- automatic self-check of POM. with faults logged and alarmed
- automatic synchronization with bus bar voltage
- transfer of data to remote site by company LAN or Modem

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



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TECHNICAL SPECIFICATIONS

Equipment cabinet	Input	300 channels max
	Local interface	Central control computer w/ 17" monitor
	Remote interface	GPS/ backup system
	Output	Two SCADA/SCS Alarm contacts (PD alarm, system fault) Ethernet or modem communications LED status indicators
Optical convertor unit (OCU)	Power supply	110-240V 50/60 Hz
	Supply current	110 mA
	Input	3 UHF channels
	Ambient operating temperature	-25 to +55°C (-13 to +131°F) (BS EN 60068-2-1,60068-2-21)
	Humidity	100% condensing
UHF sensors	Mounting	Internal or external
	Output	Communicates to OCU or equipment cabinet
	Bandwidth according to NGC/TGN(T) 121	500-1500 MHz
Smart HQ software	Operating system	Windows XP compatible
	Max monitoring locations	256 sites
	Memory	512 MB
	Min size for installation	5 MB (excludes database)
	System alarms	System fault, channel fault
	PD alarms	Gradient, PD trend
	PD trend indicators	Criticality rate of change
	Bi-weekly system status notification	Email, SMS (text message)
Compliance	EMC compliance	Tested to Industrial Generic Immunity and Industrial Emission standards



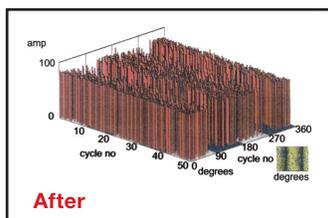
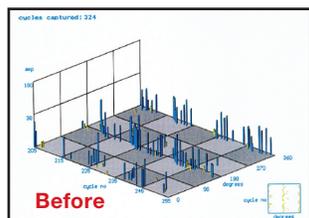
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Case Studies

Broken conductor joint detected in a 400kV GIS

A 400kV 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. After a planned shutdown, 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.

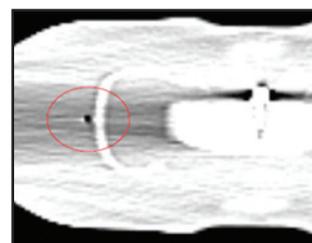
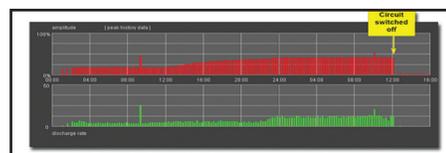


Discharge in a 220kV GIS spacer after 5 months of service

In a 230kV 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 operator's 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.



Defects in 400kV GIS/ transformer interfaces

After the commissioning of a 400kV 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.



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