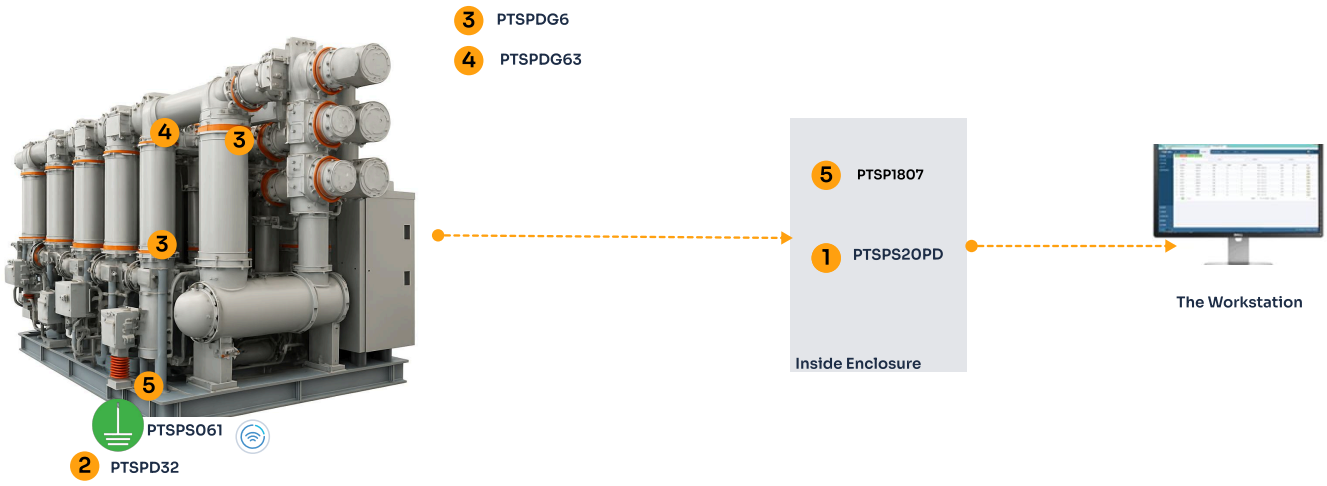
PTSGIS Gas Insulated Switchgear AI Partial Discharge Monitoring Solutions

Product Overview

The PTSenR™ PTSGIS Gas Insulated Switchgear AI Partial Discharge Monitoring Solutions is an advanced AI-driven Partial Discharge Monitoring Solution designed specifically for Gas Insulated Switchgear (GIS) and Gas Insulated Transmission Lines (GIL). These systems are vital to the control and protection of high-voltage power infrastructure, and their reliability is paramount to grid stability. Partial discharge (PD) is a common fault type that can compromise insulation integrity and lead to severe equipment failure.

PTSGIS provides real-time monitoring, fault localization, and intelligent diagnostics to detect PD events early, assess insulation health, and guide maintenance planning. By integrating ultra-high frequency (UHF) sensors, intelligent data acquisition unit (iDAUs), and expert analysis software, the system ensures safe, efficient, and cost-effective operation of GIS/GIL assets

System Architecture



Characteristics

PTSGIS combines high-sensitivity UHF sensors with robust signal processing and AI-powered analytics to deliver precise and actionable insights. The system supports both built-in and external sensor configurations, enabling flexible deployment across various GIS/GIL architectures. It features modular iDAUs for scalable monitoring, supports IEC 61850 communication protocols, and offers intuitive software interfaces for real-time visualization and fault prediction.

With its ability to differentiate PD signals from background noise, generate diagnostic maps, and provide trend analysis, PTSGIS empowers utilities to transition from reactive to predictive maintenance strategies—minimizing downtime, reducing costs, and enhancing grid reliability.

Technical Background

GIS and GIL systems are metal-sealed, gas-insulated components that play a dual role in power systems: control and protection. Due to their enclosed nature, partial discharge faults can be difficult to detect until significant damage has occurred.

The PTSGIS monitoring solution addresses this challenge by continuously capturing PD signals, analyzing their characteristics, and generating real-time insulation status reports. This enables operators to proactively schedule maintenance, prevent cascading failures, and maintain optimal system performance with minimal intervention.

Detection Principle

The system detects PD events by capturing electromagnetic wave signals in the 300 MHz to 1500 MHz range using UHF sensors installed on critical GIS/GIL components. These sensors measure key parameters such as:

- Amplitude (Q)
- Phase (Φ)
- Frequency (N)
- Time Sequence (t)

Signals that meet trigger conditions are processed through detection circuits, frequency reduction modules, and high-speed sampling units. The resulting data is cached, compiled into event files, and transmitted to the host computer for expert analysis. Noise sensors are also deployed to capture ambient interference, allowing the system to isolate genuine PD signals during data interpretation.

System Composition

The PTSGIS Partial Discharge Monitoring System for GIS/GIL is a fully integrated solution comprising three core components:

- UHF Partial Discharge Sensors
- Local Radio Monitoring iDAUs
- Expert Analysis Software

When deployed in a networked configuration, the system includes a centralized monitoring server cabinet equipped with high-performance industrial computers, display units, input devices, UPS power supplies, switches, and diagnostic software. This architecture ensures seamless data acquisition, processing, visualization, and decision-making across the entire substation.

Server Cabinet Diagram

1. **PTSPDG63 PTSenR Intelligent UHF Bushing PD Sensor**: PTSenR's proprietary UHF sensors are engineered for high sensitivity and noise immunity. They are available in two configurations—built-in and external—to suit different installation environments and monitoring needs.

1.1 Built-in Partial Discharge Sensor

- **Design & Installation:** Installed during GIS/GIL manufacturing, the built-in sensor features a capacitive antenna positioned inside the air chamber via a hand hole. Signal output is routed through an L16-N RF terminal.

- **Performance:** The sensor leverages the metal coaxial structure of GIS/GIL as a conductive path for electromagnetic waves generated by PD events. These signals are transmitted to the monitoring iDAU for frequency mixing, detection, and diagnostic mapping.

PTSPDG63 UHF

- **Environmental Adaptability:** Designed for high-interference substation environments, the sensor integrates seamlessly with GIS internals. Its placement does not disrupt the electric field distribution and offers excellent noise shielding.

- **Sealing & Protection:** Equipped with EPDM O-rings and traditional sealing rings to prevent air leakage. Optional waterproof enclosures are available for outdoor applications.

1.2 PTSPDG6 PTSenR Intelligent UHF Spacer Sensor

- **Design & Installation:** Mounted externally on the GIS/GIL shell, bus basin, or side panels, the sensor uses a capacitive antenna encased in an iron shell and sealed with electronic compound and shielding cotton.

- **Protection Features:** Includes an internal overvoltage protection module that activates upon signal overload, safeguarding both the sensor and the iDAU host.

- **Signal Integrity:** The metal coaxial structure of GIS/GIL enables undistorted propagation of PD signals. Multiple sensors can be installed across intervals for localized monitoring.

- **Noise Filtering:** The sensor shell is grounded and works in tandem with iDAU filter circuits to eliminate ambient noise and ensure accurate PD signal acquisition.

PTSPDG6

2. **PTSPS20PD AI DAU**: PTSGIS offers two types of PD monitoring IEDs:

    - Online Monitoring Devices
    - Multi-functional Portable Devices

Form Factors: Available in two configurations:

- 2U Sub-box Type: Designed for indoor/outdoor control cabinets.

- Outdoor Hanging Box: Constructed from 304 stainless steel for waterproof and dustproof protection.

Monitoring Capacity: Each acquisition control unit supports 8–16 UHF sensors with independent channels for uninterrupted monitoring. Channel count is customizable based on site layout.

Networked Architecture: Multiple iDAUs can be interconnected to monitor all GIS/GIL intervals across a station. Data is centralized in the monitoring host and diagnostic system for analysis and visualization.

Power & Synchronization: Powered by a dedicated, stable supply. Equipped with external synchronization interfaces to accept signals from PT secondary outputs, frequency modulation sources, and signal generators.

Data Handling: Generates PD characteristic spectra and supports standardized communication protocols and data formats for compliance testing and system integration.

Specifications

Technical indicators of GIL/GIS partial discharge online monitoring iDAUs

Indicator type	Metric value	Remark
Operating Temperature	-25 ~ +65 ℃	-
Operating Humidity	‹ 95%	-
Power Input	AC 120 ~ 240 V	-
Power Consumption	‹ 30 W	-
Self-test function	Yes	Turn on the machine and check yourself
Access Sensors	Built-in and external	-
Monitor Bandwidth	300 ~ 1500 MHz	-
Measurement Range	-80 ~ -20 dBm	-
Measurement Accuracy	0.1 dB	-
Monitoring Sensitivity	- 80 dBm	-
Monitor Channels	4 ~ 16 road	Expandable 32 ways
Synchronous Scanning Channels	All access	-
Sampling Rate	≥100 MHz	-
Refresh Rate	≤1 second	-
Sampling Mode	24h uninterrupted	-
Sampling Time Override	100%	-
Discharge Type Identification	More than 5 typical discharge types	-
Monitoring Content	Discharge amplitude (Q), phase (Φ), number of times (N), discharge rate	-
PD Fault Localization	In the tank	-
Synchronized Signals	Power supply or others	-
Noise Cancellation Capabilities	Very strong	-
Overvoltage Protection	In the tank	-
Signal Input Interface	N-type RF terminals	-
Communication Interface	RJ45, Fiber SC or ST	-
Cabinet Form	2U/19-inch sub-box aluminum profile chassis; outdoor hanging box type (304 stainless steel);	-
Design Life	20 years	-
Applicable Voltage Levels	Full voltage level	-
Scaled Performance	Maximum access to 1000 points	Distributed networking is adopted
EMC Test	Pass (highest level)	-

Technical specifications of GIL/GIS partial discharge monitoring sensor

Indicator type	Metric value	Remark
Operating Temperature	-25 ~ +65 ℃	-

Specifications

Indicator type	Metric value	Remark
Operating Humidity	‹95%	-
Measurement Sensitivity	-80 dBm (built-in); -75 dBm (external);	-
Measure Bandwidth	300 ~ 2000 MHz	-
Measurement Accuracy	0.1 dB	-
Average Equivalent Height	›10 mm	-
Overvoltage Protection	Yes	-
Signal Interface	N-type RF terminals	-
Material	6061 Aluminum Alloy (Built-in) 304 Stainless Steel (External Type)	316 stainless steel can be used in salt spray seaside areas
Dimensions (Built-In)	Multiple size options (mm)	Customization is supported
Water Resistance	good	-
Design Life	›50 years	-
Applicable Voltage Levels	Full voltage level	-

PTSPDG6 PTSenR Intelligent UHF Spacer Sensor	
Type	Built-in/External
Operating Humidity	RH ‹ 95% non-condensing
Measurement Sensitivity	-80 dBm
Measurement Bandwidth	300 MHz ~ 1500 MHz
Operating Temperature	-25°C ~ +65°C
Material	Stainless steel
PTSPDG63 PTSenR Intelligent UHF Bushing PD Sens…	
Dynamic Range	≥40 dB
Detection Bandwidth	300 MHz ~ 1500 MHz
Average Equivalent Height	≥12 mm
Connector Type	N-Type
Material	Aluminium

PC	
Operating System (OS)	Microsoft Windows
Specification	Regular
VizionEye AI Software Partial Discharge System Software	
Measuring Mode	Real time, Event, Trend
Display	Real time data display (PRPD / PRPS / 2D / 3D) Event data display (PRPD / PRPS / 2D /3D) Trend data graph (daily / weekly / monthly)
Expert PD Analysis	Programmable alarm criteria Warning of PD activity Automatic communication of warning/alarm condition Report generation (daily/weekly/ monthly) Data stored on local or could

Installed Sensors

PTSPDG63 UHF

PTSPDG6

PTSPDG63 UHF

VizionEye AI Diagnostic Software Suite

VizionEye™ windows-based software enables full configuration of instrumentation, automated data downloads, historical analysis, and visual insight tools. Designed for switchgear, cables, and transformers, it supports intuitive PD signal interpretation and real-time fault classification making it a versatile solution for continuous insulation health management.

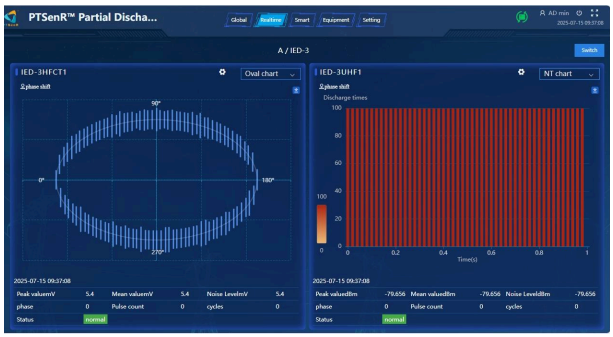
Partial Discharge Analysis

- PD trending and pps (pulse-per-second) metrics
- PRPD and PRPS pattern recognition
- Spectrum-based diagnostics
- Deep learning–driven instant analysis
- Failure mechanism recommendations
- Comprehensive risk assessment

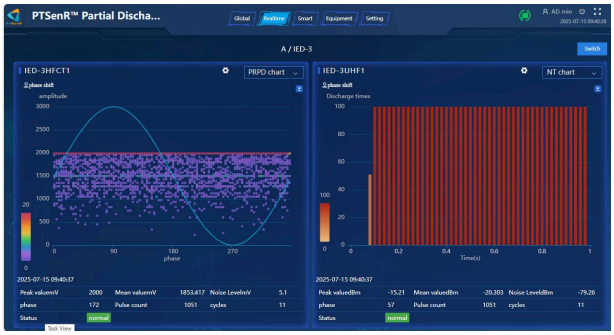
Reporting Features

- Periodic reports with operational statistics and diagnostics
- Event-based reporting with visual patterns and risk forecasts
- Cloud-enabled data synchronization and access

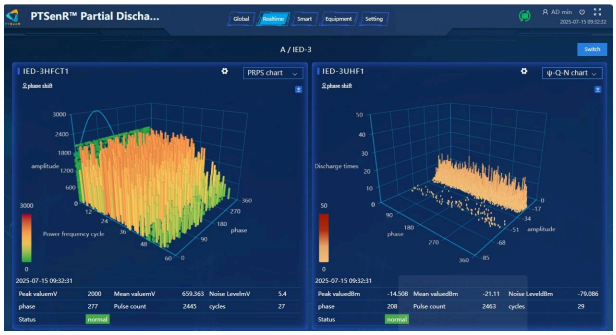
Discharge Rate & QT Chart



Oval & NT Chart



PRPD & NT Chart



PRPS & Q-N & chart

Applications

Power Plants

Utilities Stations

Data Centers