

PTSPDMG Integrated AI Monitoring System for Motor Generator

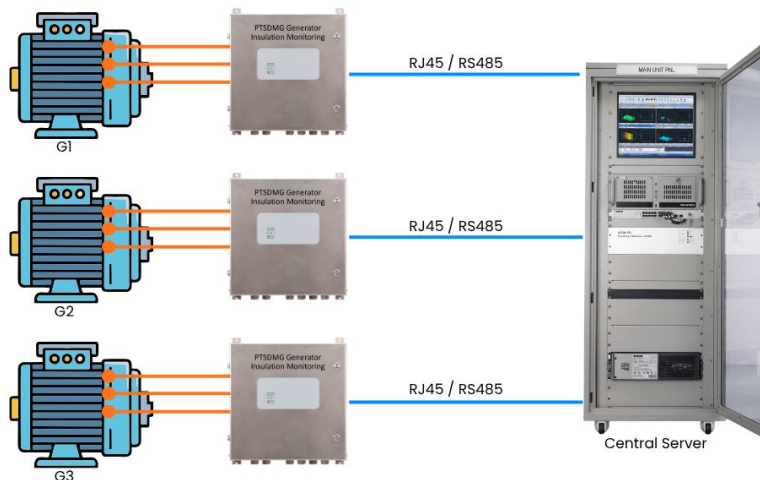
Product Overview

The PTSenR™ PTSPDMG is an advanced, permanently installed online Partial Discharge (PD) monitoring system engineered for high-voltage rotating machinery, including turbine generators, hydrogenerators, and large industrial motors. Designed for single- or multi-machine installations, the system provides continuous, non-intrusive dielectric health assessment without requiring asset downtime.

Stator winding degradation accounts for up to 40% of all rotating machine failures. Continuous exposure to thermal, electrical, ambient, and mechanical (TEAM) stresses progressively compromises insulation integrity, leading to premature breakdown. The PTSPDMG mitigates this operational risk through automated, real-time data acquisition, digital filtering, and trend analytics, identifying early-stage internal insulation defects well before catastrophic failure occurs.

Powered by automated Time-of-Flight (ToF) pulse separation technology, the PTSPDMG precisely isolates genuine internal stator discharge activity from external grid disturbances, cross-coupling, and busbar interference. The platform and its measurement methodologies strictly comply with recognized international standards, including IEC 60270 / GB/T 7354, IEEE 286, and IEC 60034-27-2 / IEC 60034-27-3.

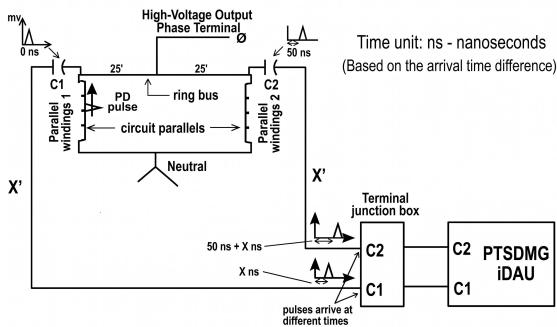
System Architecture



The PTSPDMG topology integrates field sensors, high-speed acquisition hardware, and central server diagnostics:

- **Dual-Coupler Primary Sensing:** Utilizes high-voltage epoxy-mica capacitive couplers (80 pF) installed in pairs on each phase of the generator high-voltage stator output busbars (6 sensors total for 3 phases). Each pair is spaced 2.5 m to 4 m apart (minimum 2 m).
- **Intelligent Data Acquisition Unit (iDAU):** Core local signal-processing iDAU mounted in a shielded stainless steel cabinet. It features 6 synchronous nanosecond-level channels connecting to the couplers via matched-length RF coaxial cables.
- **Central Server & Network Scheme:** Data is transmitted to a central backend server cabinet via industrial Ethernet, fiber optics, self-organized Wi-Fi, or cellular network modems.
- **Modular Multi-Physical Expansion:** Includes an optional 8-channel acoustic and vibration voiceprint acquisition module to correlate structural and mechanical degradation with electrical discharge.

Characteristics

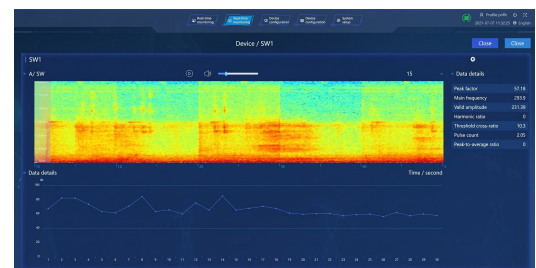


1. Time-of-Flight Noise Separation: Exploits nanosecond-level arrival sequence resolution (down to 6 ns) between sensor pairs (C1 and C2). Pulse delays ($T_s - T_m = T$ vs. $T_m - T_s = T$) filter out external interference and busbar disturbances, ensuring accurate internal PD identification.

2. Synchronous Multi-Channel Sampling: Single-board 6-channel synchronous nanosecond-level acquisition maintains phase-locked capture across phases A, B, and C simultaneously.

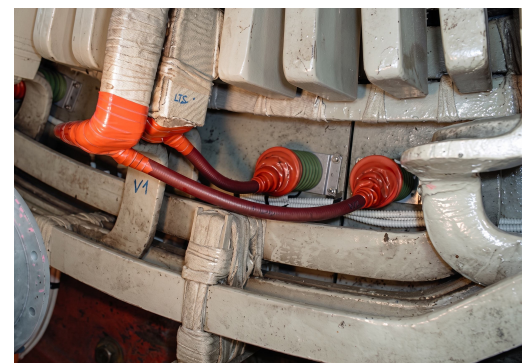
3. Industrial Shielding & Reliability: Enclosed in high-grade stainless steel housings providing shielding against high-frequency transients and power-frequency electromagnetic interference.

4. Multi-Modal Diagnostic Support: Combines high-frequency electrical PD monitoring with acoustic signature analysis (MEMS bone-conduction and ultrasonic)



Benefits at Glance

- 1. Condition-Based Maintenance (CBM):** Extends planned maintenance cycles and transitions plants from calendar-based maintenance to condition-driven intervention.
- 2. Unplanned Outage Prevention:** Identifies localized overheating, copper-insulation delamination, void discharge, and slot wear before catastrophic dielectric breakdown occurs.
- 3. Multi-Year Early Warning Horizons:** Table 1 highlights the advance defect warning window based on system voltage class:



Generator Voltage Level	Advantages Defect Warning Horizon
24 kV	Up to 6 years
13.8 kV	3 to 4 years
6.9 kV	1 to 2 years
< 4 kV	Server weeks

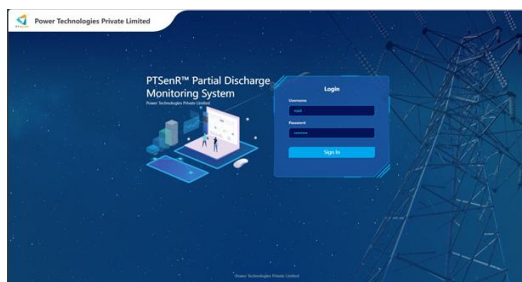
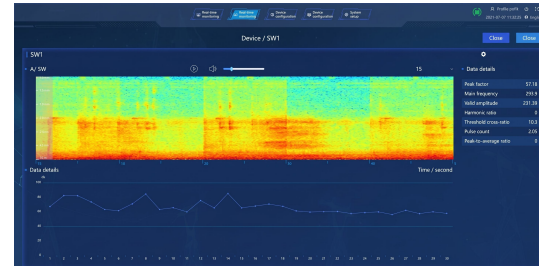
Table 1: Advance defect warning windows

VizionEye™ AI Diagnostic Software Suite

At the heart of PTSPDMG's intelligence is the VizionEye™ windows-based software, a powerful configuration-based system for data acquisition, analysis, and reporting. Designed with anti-interference technologies and intuitive user interfaces, Vizion Eye transforms raw sensor data into actionable insights.

The software includes modules for parameter setting, real-time data acquisition, spectrum and trend analysis, and automated reporting. Data is collected based on user-defined sampling intervals and processed through background anti-jamming algorithms. The main interface provides dynamic alerts and clickable diagnostics, while the database supports advanced queries, charting, and early warning analytics.

VizionEye™ also offers robust operation and maintenance tools, including system parameter management, log tracking, and communication diagnostics. Its scalable architecture allows for easy integration of new monitoring items and expansion of business processes. Detailed log management ensures traceability of user actions and system events, supporting both compliance and operational transparency.

The VizionEye™ AI platform translates raw high-frequency waveforms into actionable asset management insights:

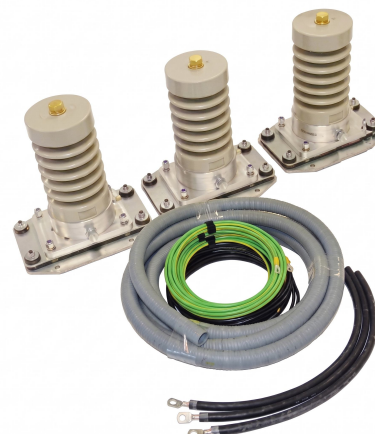
- **Core Metric Quantification:** Continuously calculates Q_m (peak discharge intensity / magnitude) and NQN (normalized pulse quantity / frequency density).
- **Visual Spectral Displays:** Generates 2D pulse amplitude-versus-phase distribution plots and 3D Phase-Resolved Partial Discharge (PRPD/PRPS) patterns.
- **Automated Level-3 Trending Alarms:**
 - Normal / Good Condition: Q_m is low and stable.
 - Stable Deterioration: Q_m annual increase remains under 25%.
 - Accelerated Risk: Q_m doubles within a 6- to 12-month interval, triggering emergency inspection protocols.
- **Acoustic Voice-print Correlation:** Maps acoustic and vibration spectra against an integrated voice-print database to diagnose loosened slot wedges and mechanical structural vibrations.

Specifications

Components	Parameters	Specifications
PTSPDMG Intelligent DAU	Channels	6 synchronous acquisition channels
	Power Supply	AC 110V ~ 220V 50/60Hz
	Consumption	60W
	Pulse Dynamic Range	-30,000mV ~ +30,000mV
	Measurable Discharge	5pC (minimum)
	Discharge Pulse	10μs
	Phase Resolution	0.18°
	Time Resolutions	≤ 6 ns
	Communication	RJ45, RS485/Modbus TCP
	Enclosure	Stainless Steel (Wall-Mount)
	Dimensions	600 x 600 x 178 (mm)
	Optional Interface	Vibration and Acoustic Monitoring

Components	Parameters	Specifications
PD Coupling Capacitor	Dielectric Material	Epoxy-mica laminate
	Capacitance	80pF (±4pF)
	Sensitivity	1pC
	Frequency Bandwidth	40 Mhz ~ 350 MHz
	Voltage Ratings	3.3kV ~ 25kV
	Operating Temperature	-45°C ~ +125°C
	Storage Temperature	-55°C ~ +125°C
	Withstand Voltage	Withstand voltage test at >2 times the generator line Voltage +1kV
	Withstand Duration	≥ 1,000 h
	Size	Customizable
	Output Connection	BNC

Components	Parameters	Specifications
Acoustic / Vibration Module	Channels	4 ~ 8 channel simultaneous sampling
	Sampling Rate	Up to 192 kHz
	Frequency Response	20 Hz ~ 80 kHz
	SNR / Sensitivity	65 dB / -38 dBV/Pa
	Support Sensor Type	MEMS voiceprint, bone-conduction, and ultrasonic sensors



Central Diagnostic System Cabinet

The Central Diagnostic System Cabinet functions as the central aggregation and communication gateway between on-site data acquisition units (iDAUs) and the plant-level supervisory network (SCADA/DCS). Engineered for control room or server room installation, it integrates centralized data storage, high-speed optical-to-electrical signal routing, expert diagnostic processing, and conditioned power distribution into a standardized industrial enclosure.

System Architecture & Core Subsystems

- **Industrial Processing Server (Advantech IPC-510):** High-reliability 19" rack-mount industrial computer hosting the database, expert partial discharge (PD) diagnostic algorithms, localization software, and real-time visualization suites
- **Managed Ethernet Switch:** Aggregates multi-channel from distributed field acquisition units for back-end processing.
- **Uninterruptible Power Supply (UPS):** Provides online conditioned power backup to maintain uninterrupted diagnostic logging and prevent data corruption during main bus voltage dips or outages.
- **Environmental Climate Control:** Continuously regulates cabinet internal temperature and humidity to prevent condensation and thermal degradation of sensitive computing hardware.
- **Power Distribution Unit (PDU) & Circuit Breakers:** Independent miniature circuit breakers (MCBs) providing branch protection for the main input, IPC/ server, field acquisition loop supply, maintenance service socket, and auxiliary systems.



Server Cabinet



IPC

Parameter	Specification
Model Platform	Advantech IPC-510 Series (4U 19" Rackmount) Windows
Operating System (OS)	Windows Server / Industrial Linux Enterprise
Software Suite	VizionEye™
Functions	Continuous data logging, multi-parameter trend tracking, acoustic/vibration correlation, and remote SCADA/DCS reporting
Software Suite	VizionEye™
Enclosure Type	Standard 19-inch industrial server cabinet
Dimension (W*D*H)	Standard 19-inch industrial server cabinet
Power	AC 220V 50/60Hz
Support Protocols	Modbus TCP/RTU, IEC 61850, TCP/IP

