

RM's PD Solution for Cables

PD Monitoring system for monitoring Partial Discharge
in Power Cables, Cable Terminations and Joints

RM's PD Solution for Cables

Partial discharge or PD is caused by local electrical stress in the insulation or on the surface of the insulation in electrical assets. PD testing and monitoring solutions help in detecting and assessing insulation defects which can lead to failures in electrical system.

Rugged Monitoring (RM's) PD monitoring solution with sensors, monitors and software are highly sensitive to PD activity, it can effectively identify weak points in the insulation system and help in diagnosing the insulation condition of cables. Automatic warnings and alarms will immediately alert the users when pre-set PD activity thresholds have been violated.

PD activity can be measured at critical points such as terminations and joints of the cable system. An application of High Frequency Current Transformer- Active (HFCT) along with Transient Earth Voltage (TEV) sensor and Ultra High Frequency (UHF) sensor can help in PD diagnostic and confirmation of internal versus external faults. Noise elimination and PD source separation algorithms are used to reliably localize harmful PD development in the cable system.

We at Rugged Monitoring are motivated to provide innovative and exceptional quality products. Our vision remains focused on meeting customer requirements while anticipating and exceeding the needs of a continuously changing dynamic market.

Cables are extensively operated under stress as they are exposed to extremely high and low temperatures, thermal, mechanical, and electrical stresses with high voltage surges. These activities consequently emerge into the degradation of insulation leading to partial discharge activity.

What can be tested



Cable Terminations



Cable Joints



Insulation

Features

- Portable System for periodic testing and measurement
- Continuous Online Monitoring system for Cable Terminations, Joints and Insulation
- Enterprise Software for multiple assets
- Expert Reporting Service for customers
- Totally automatic and unsupervised approach to PD detection and interpretation.
- For any kind of HV, MV and LV device: early detection of insulation failure and trend
- Available with health index evaluation and end-of-life prediction (for monitoring mode)
- Ultra-wide band, fast processing and large memory acquisition and storage unit
- Innovative approach to PD and noise recognition/rejection and PD source identification,
- Fuzzy logic diagnostic tools and statistical processing for PD identification.
- Single or Multi-channel, multi-sensors. Endowed with any type of sensor able to couple with any electrical asset component,
- Innovative approach based on multi-dimensional map, principal component analysis and automatic clustering, automatic recognition of PD and noise. In AC, DC and under power electronics supply.

In Practice

The PD detector/monitoring system can be connected to any type of sensor, from HFCT to TEV or antennas. Depending on the best techno-commercial match, single-phase or multi-phase detectors can be installed.

The major issue to be faced is extracting useful diagnostic data from noisy measurements (this holds especially for PD) and having available global health condition/residual life algorithms.

As regards noise recognition, while techniques are available for filtering out noise under AC sinusoidal voltage, that are based on the capability to distinguish noise from PD pulses in measurement records and, particularly, resorting to phase-resolved PD (PRPD) patterns, the same does not apply for DC and pulse-modulated (PWM) voltage waveforms.

The RM innovative approach allows noise to be rejected and PD identified also under DC and power electronics waveforms. Then the identification of the type of source generating PD must be carried out, being related to PD harmfulness and, thus, maintenance action. These procedures come automatic and unsupervised, to have fast and low-cost interaction with asset and maintenance managers.

This has to be coupled with tools for web data transfer, where e.g. cloud media may offer residual life and failure probability calculation.

System Architecture for Cable



Partial Discharge Monitoring

- PD Detection
- Fault Characterization
- PD Localization
- PD Severity Analysis
- PD Test and Measurement Services

HSENS-T

Sensors for Cable termination



- **Transient Earth Voltage Sensor**
- **Rugged, compact design**
- **Strong magnets to attach sensor**
- **IP65 rated**
- **Transient overvoltage protection**
- **integrated inside Sensor**
- **RG223 high noise immunity cable**
- **TNC connector for reliable connection**

Hsens-T is a Transient Earth Voltage Sensor that can be used to detect external partial discharges inside metal clad switchgear or power cables termination box of rotating machines and power transformers. An application of HFCT along with TEV can help in PD diagnostic and confirmation of internal versus external PD.

Sensor is IP65 rated and features integrated transient overvoltage protection inside sensor. Transient protection will help in minimizing transients that can be expected during PD monitoring.

TEV sensor has strong magnets that help it to attach to the walls of metal clad switchgear. TEV forms a capacitive coupling with grounded metal switchgear to detect transients of external PD happening inside metal clad switchgear at termination

Rugged design, IP65 rated, overvoltage protected, PD measurement at Cables (and their accessories)

Applications

- Online periodic partial discharge monitoring
- Online PD measurement during HV AC testing
- Multiple point PD monitoring
- Cables, joints and terminations
- Rotating machines
- AIS/GIS switchgear
- Power transformers

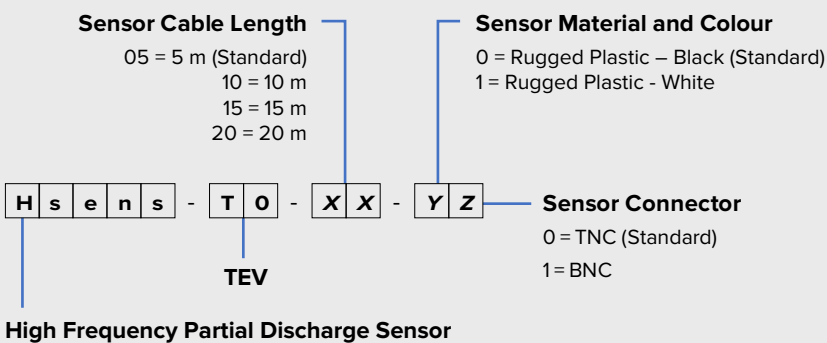
Benefits

- Rugged sensors
- Noise immunity
- IP65 rated
- Rigorously tested
- Transient overvoltage protected
- Strong magnets to help sensor attach
- Customizable according to customer specific applications
- Suitable for Online or Online PD measurements

Technical Specifications

SENSOR	Type	Integrated magnets help it to attach to metal clad switchgear
	Frequency Response (-6dB):	1 MHz - 100 MHz
	Material	Rugged Plastic (Black), other options available
SIGNAL CABLE	Type	RG223
	Connectors	Cable Gland (Sensor End) and TNC connector (Monitor End), other options available
	Cable Length	5m as standard, other options available
IP RATING	IP65	
TEMPERATURE	Ambient	-30 °C – 70 °C
	Storage	-40 °C – 85 °C
DIMENSIONS	70mm (L) x 70mm (W) x 33 mm (H)	
CUSTOMIZATION	For any different requirement, please consult	

Ordering Code



HSENS-H

Provides automated continuous partial discharge monitoring



- High Frequency Current Transformer
- Rugged, reliable design
- IP65 rated
- Split core design for easy installation
- Transient overvoltage protection integrated inside Sensor
- Different options of internal diameter dimensions
- RG223 high noise immunity cable
- TNC connector for reliable connection

Hsens-H is a High Frequency Current Transformer sensor. It is a split core and an inductive type of sensor that can be clamped around the earth (ground) shield to measure PD signals. Based on power cable termination condition, an HFCT sensor can also be clamped around cable insulation without earth shield or around the cable with earth shield looped back for the purpose of PD measurements. For HFCT clamped around the cable insulation without earth shield or cable with earth shield looped back, high current variant can be used for rated load current of cable.

Sensor is IP65 rated and features integrated transient overvoltage protection inside sensor. Transient protection will help in minimizing transients that can be expected during PD monitoring

Applications

- Online periodic partial discharge monitoring
- Online PD measurement during HV AC testing
- Multiple point PD monitoring
- Cables, joints and terminations
- Rotating machines
- AIS/GIS switchgear
- Power transformers

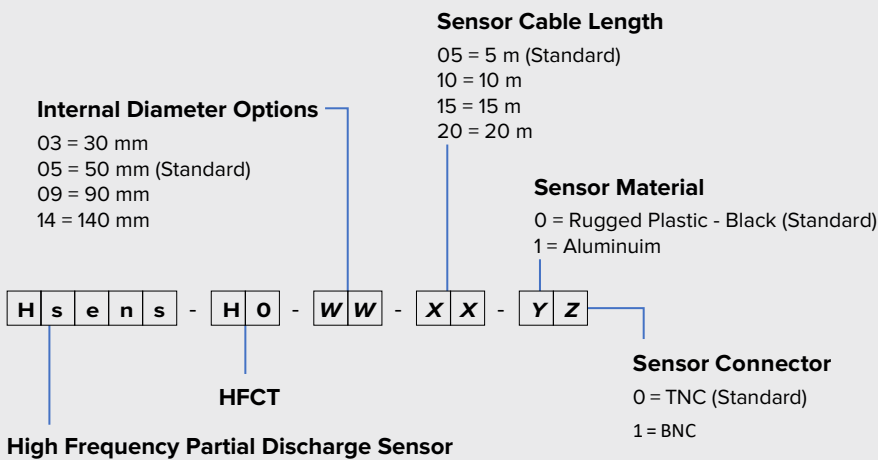
Benefits

- Transient overvoltage protected
- Noise immunity
- IP65 rated
- Rigorously tested
- Split core for easy installation
- Stainless steel robust latch to keep split core closed
- Customizable according to customer specific applications
- Suitable for Online or Online PD measurements

Technical Specifications

SENSOR	Type	Split core
	Frequency Response (-6dB):	100 kHz - 25 MHz
	Material	Rugged Plastic (Black), other options available
	Current Ratings	50A, other options available
MODELS	HFCT-3	220mm (L) x 118mm (W) x 33mm (H) (ID = 30mm)
	HFCT-5	220mm (L) x 163mm (W) x 28mm (H) (ID = 50mm)
	HFCT-9	265mm (L) x 200mm (W) x 38mm (H) (ID = 90mm)
	HFCT-14	330mm (L) x 275mm (W) x 38mm (H) (ID = 140mm)
SIGNAL CABLE	Connectors	RG223
	Type	Cable Gland (Sensor End) and TNC connector (Monitor End), other options available
	Cable Length	5m, other options available
IP RATING	IP65	
TEMPERATURE	Ambient	-30 °C – 70 °C
	Storage	-30 °C – 70 °C
	Customization	For any different requirement, please consult

Ordering Code



USENS-C PARTIAL DISCHARGE SENSOR



- Rugged, reliable design
- IP65 rated
- Transient overvoltage protection
- Easy to Install
- Different options of internal diameter dimensions

USENS-C is Ultra High Frequency (UHF) PD sensor for Power cables, Switchgears. The sensor can be installed directly on the power cable and switchgears.

The IP65 rated Sensor has integrated transient overvoltage protection inside. Transient protection will help in minimizing transients that can be expected during PD monitoring.

Ultra High Frequency PD sensors for Cables and switchgears

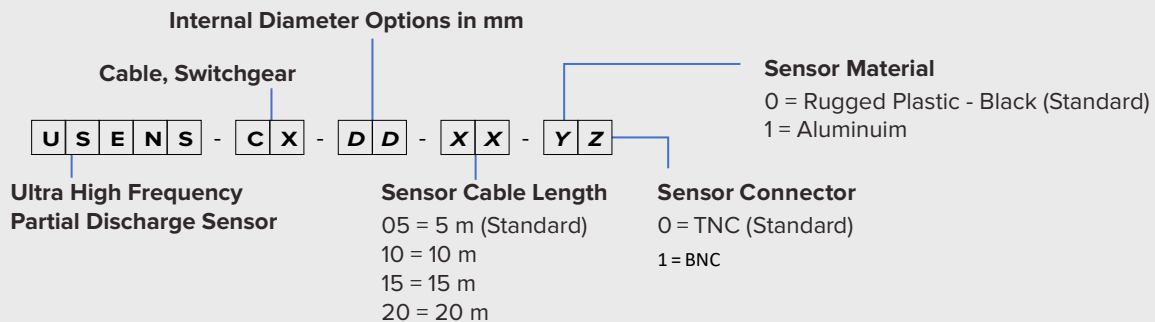
Applications

- Online periodic partial discharge monitoring
- Online PD measurement during HV AC testing
- Multiple point PD monitoring

Benefits

- Transient overvoltage protected
- Noise immunity
- IP65 rated
- Rigorously tested

Ordering Code



Technical Specifications

Frequency Response	30MHz - 1GHz
Sensitivity	up to -70 dBm
Withstand Voltage	up to 1500 kV
Output	N-Type connector; Customized option available
Connector Circuit Impedance	50Ω
Vibration Testing	Suitable for HV - GIS and Transformer applications
Ingress Protection (IP)	IP-65
Ambient (Operating Temperature)	-60 °C to +100 °C
Storage Temperature	-60 °C to +100 °C
Operating Humidity	95% humidity at 50 °C
Dimensions	Customized as per customer requirements
Weight	Customized as per customer requirements
Install Position	Power Cables, Terminations, Switchgears, Rotating Machines
Signal Cable	Very low attenuation UHF (Coax) cable

SYNC-EF Synchronization Sensor



Rugged design, designed for reliability, synchronization.

- Rugged, compact design
- Safe and reliable operation
- Captures the electric field of high voltage asset near termination
- Used when acquisition system (PD Monitor) is energized with external supply which is not in synchronization with device under test
- No outage required for installation
- IP65 rated

A synchronization signal is required during Partial Discharge measurement in power cables and other high voltage assets. SYNC-EF utilises the benefits of Electric Field to capture the field generated AC voltage in a power cable or low voltage cables. This sensor is well suited to the application where AC mains synchronised with cable under test is not available and PD Monitor is being powered by using external AC generator or UPS.

Applications

- Online periodic partial discharge monitoring
- Synchronization of PD measurements
- Multiple point PD monitoring
- Cables and their accessories
- Rotating machines
- AIS/GIS switchgear/switchboards
- Power transformers

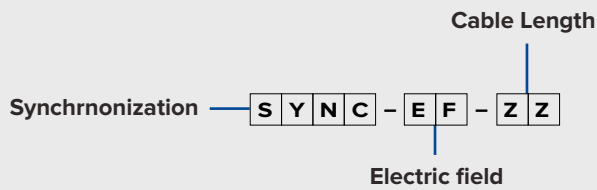
Benefits

- No direct connection to any live conductor
- Can be used temporarily or mounted permanently
- Enhanced noise rejection
- Rugged and reliable design

Technical Specifications

SENSOR	Technology	Electric Field
	Frequency	50 Hz / 60 Hz
	Material	Anodized Aluminum
	Cable	10m shielded cable from Sensor to PD Monitor
	Output	Up to 10m shielded cable with 8 pin connector on other end Compatible with Rugged Monitoring PD Monitors Compatible
IP RATING	IP65	
TEMPERATURE RATING	Ambient	-25C - 70C
	Storage	-40C - 85C
POWER RATING	Input Power	1W

Ordering Code



SYNC-MF Synchronization Sensor



Rugged design, designed for reliability, Synchronzation.

A synchronzation signal is required during Partial Discharge measurement in power cables and other high voltage assets. SYNC-MF utilises the benefits of Rogowski Coil technology to capture the magnetic field generated by load or circulating currents in a power cable or ground loop. This sensor is well suited to the application where PD monitor is power up using external generator, renewable energy or UPS and is not synchronised with asset under test.

Applications

- Online periodic partial discharge monitoring
- Synchronzation of PD measurements
- Multiple point PD monitoring
- Cables and their accessories
- Rotating machines
- AIS/GIS switchgear/switchboards
- Power transformers

Features

- Rugged, compact design
- Safe and reliable operation
- Captures the magnetic field of conductor load current or sheath circulating current to generate synchronzation pulses for PD Monitor
- Used when acquisition system (PD Monitor) is energized with external supply which is not in synchronzation with device under test
- No outage required for installation
- IP65 rated

Benefits

- No direct connection to any live conductor
- Can be used temporarily or mounted permanently
- Enhanced noise rejection
- Rugged and reliable design
- Software packed with useful tools for reliable and interactive
- PD measurements
- Robust recording and analytics
- Customizable according to customer specific applications
- Suitable for Online or Offline PD measurements

Technical Specifications

SENSOR	Technology	Rogowski Coil
	Frequency	10 Hz - 1 MHz
	Current	1A - 2000A
	Material	Thermoplastic Rubber
	Dimensions Sensor	150mm Internal Diameter
	Dimensions Cable	10m shielded cable from Sensor to Junction Box
TERMINATION	Connectors	Cable Glands
	Material	Anodized Aluminum
	Output	1m shielded cable with 8 pin connector on other end Compatible with Rugged Monitoring PD Montors 3.3V synchronization pulses for load or circulating current of 1A and above
IP RATING	IP65	
TEMPERATURE RATING	Ambient	-25C - 70C
	Storage	-40C - 85C
POWER RATING	Input Power	1W

Ordering Code



R501 Rack Mount Comprehensive and Customizable Cable Monitoring Solution



Most Versatile, Multi Channel, Comprehensive Transformer Monitoring Solution

Single Monitoring Solution for: Temperature, Partial Discharge, Load, Power, Losses and more...

Key Features

- Fully flexible rack mount and distributed architecture support
- Expandable to add different analog and (or) digital inputs and outputs
- Best in class EMI, ESD Immunity; range of communication options and protocol support
- Range of communication options for third party system integration
- Complies with the latest IEC/IEEE standards for Emission, Immunity, Safety and Environment.

Benefit

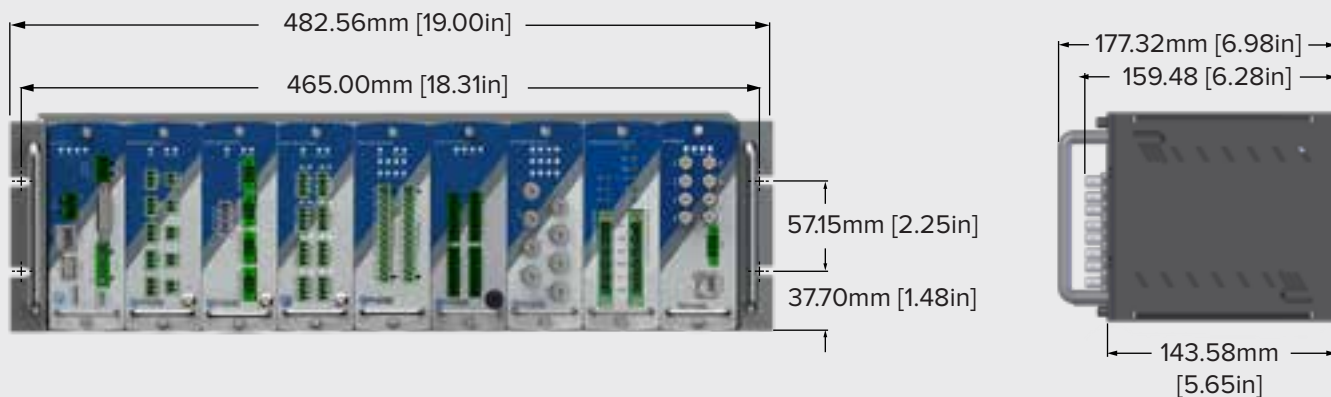
- Improved reliability
- Accurate predictive analysis
- Access asset data from anywhere
- One monitoring solution for various parameters
- Increased lifetime
- Highest Return on Investment
- Field upgradable with no device downtime



Sensors that can be connected to R501

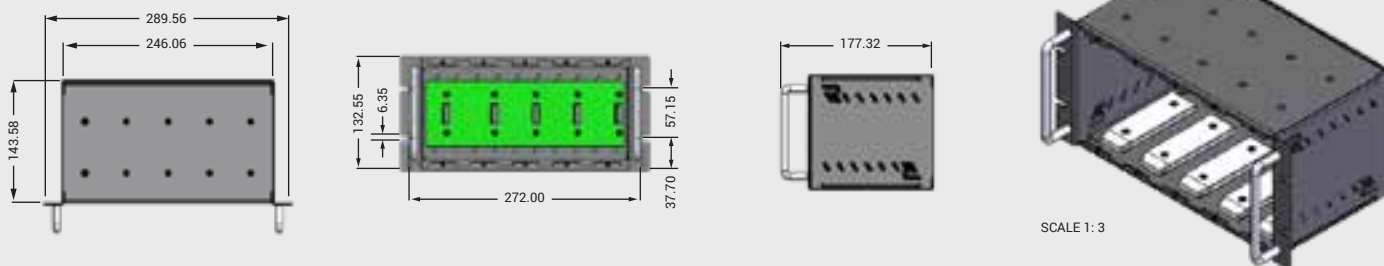
1. OTI,WTI, RTD, PRD, Breather, Buchholz Relay, LLG/OLI, Pressure Sensor etc.
2. Direct winding Hot Spot Monitor
3. Cooling System and Control Cabinet
4. Dissolved Gas Analyzer
5. Partial Discharge Monitor

Product Drawing



Weight : 5 Kilograms

Optional Smaller 3U Chassis



Ordering Code

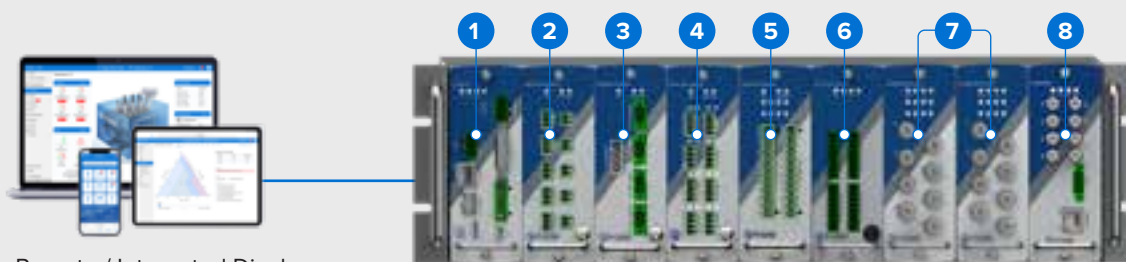
Contact our sales team for Ordering Code

**One Solution for Multi-Site
Multi Asset Monitoring**



R501 Monitoring Modules

Comprehensive Features to Meet Market Demand



Remote / Integrated Display

1. CPU/GTW Module



Option A. CPU Module

- Data Processing & Storage
- System Fault Relay
- 01 x Serial (RS485) ports
- 02 x Ethernet (PRP support)
- Health Assessment Analytics

Option B. CPU with GTW

- Main rack with CPU, Slave rack with GTW
- Provides power to all modules
- Up to 4 Racks can be daisy chained
- 01 x Serial (RS485) ports

Option C. GTW without CPU

- Main rack and slave racks with GTW
- Provides power to all modules
- Supports FOM and FLM modules
- Up to 4 Racks can be daisy chained
- 01 x Serial (RS485) ports

2. Analog Input Module



- 05 or 10 channels
- AC/DC current input
- RTD / Potentiometer
- Built-in LED indicators

3. Power Monitoring Module



- 03 Current & 03 Voltage Inputs
- Active, Reactive & Apparent Power
- Transformer Power Factor
- Through-Fault Monitoring (I2T)
- Current Signature Analysis
- OLTC Motor Torque

4. Digital Input Module



- 08 or 16 channels
- Input Voltage 75 - 250Vdc
- Threshold Voltage > 60V
- Built-in LED indicators

5. Relay Output Module



- 04 or 08 Form C Relays
- Dry contact (NO-C-NC)
- User Programmable
- Built-in LED indicators



6. Analog Output

- 08 or 16 Analog output
- DC Current Loop (4-20mA / 0-1mA)
- Dc Voltage (0-5V / 0-10V)
- User Programmable
- Built-in LED indicators



7. Fiber Optic Module

- 02, 04, 06 and 08 Channels
- GaAs (200u and 62.5u) Module
- Fluro Module
- Built-in LED indicators



HF



UHF

8. Partial Discharge Module

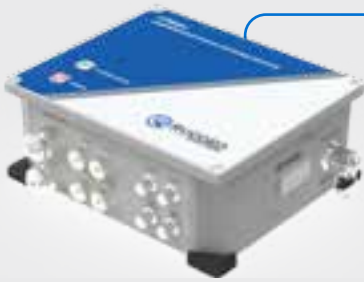
- 04 or 08 Channels Continuous Monitoring
- Wide Range (HF and UHF)
- Sampling 100 MS/s
- Vertical Resolution 12bit
- Advanced PD Analysis
- UHF, Acoustic, Bushing PD Sensors available

Technical Specifications

POWER SUPPLY	Input Power Requirement	24 Vdc (Default), Optional 48 Vdc, 125 Vdc, and any other (upon request)
CPU MODULE	Data Storage Capacity	MicroSD external memory slot (up to 2 TB)
	Logging Rate	1 sec interval on USB
	Config port	USB (to use with Rugged connect windows software)
SYSTEM CAPACITY	Maximum number of Channels	Expandable to 256 Channels, Daisy chain up to 32 units (with Modbus, Canbus)
FIBER OPTIC MODULES	# of Channels	2, 4, 6 and 8 channels
	Measurement Range	-80 °C to +300 °C (cryogenic 4 °K range optional)
	Resolution	0.1 °C
	Accuracy	±1.0 °C (±0.2 °C in relative temperature)
	Scan Rate	200 ms / channel (Optional: Faster scanning rates available)
ANALOG INPUT MODULE	# of Input Channels	05 or 10 Channels
	AC Current Input	Clamp-on CT with different ranges: 5Amp, 10Amp, 20Amp, 100Amp and others available
	DC Current Input	4 - 20 mA
	Temperature Input	100 ohm platinum (Pt100)
	Potentiometer	up to 20,000 ohms
POWER MONITORING MODULE	# of Input Channels	03 Current and 03 Voltage
	Current Input Range	0 - 5A
	Voltage Input Range	0 - 250V
	Sampling Rate	32 KS/s
	Measurement Parameters	Power, Through-Fault, Motor Torque etc.
DIGITAL INPUT MODULE	# of Input Channels	08 or 16 Channels
	Dry Contact	Resistance between the contact < 100 Ω
	Powered Contact	75 - 250Vdc
ANALOG OUTPUT MODULE	# of Input Channels	08 or 16 Channels
	Output format	4-20 mA or 0-5V or 0-10V Configurable for any measured / calculated value
PARTIAL DISCHARGE MODULE	# of Input Channels	04 or 08 Channels
	Acquisition Bandwidth	HPM: 0.01 - 100Mhz UPM: 100 MHz - 2 GHz
	Monitoring Parameters	PD Amplitude, Discharge Rate and PRPD
OUTPUT RELAY MODULE	# of Output Channels	04 or 08 Form C relays

CPM601-P

One Device for a wide range of assets and testing applications



Rugged Monitoring presents most advanced Partial Discharge Monitor CPM601 to perform PD measurements in dual frequency range i.e., in the range of 0.01MHz - 100MHz as well as 300MHz - 2GHz.

With the help of advanced electronics embedded inside CPM601, user can perform PD measurement using various sensors without the need of using external frequency down converters. This presents All-in-One solution to perform PD measurements using Acoustic, Ultrasonic, HFCT, TEV, Coupling Capacitors as well as UHF Sensors on all assets, GIS, Power Transformers, Rotating Machines and Power Cables.

CPM 601 is a Compact and sturdy enclosure with electronics making it portable, easy to carry, while enabling the user to perform PD measurements with less hassle. Monitor can directly transfer the data to PD Connect software installed on laptop else data can be temporarily stored (optional) in the device enabling the user to record PD pulses with higher sampling rate. Thousands of pulses per second can be transferred to the laptop enabling the user to generate fast and reliable Phase Resolved Partial Discharge (PRPD) graphs. PRPD patterns help the user to identify type of PD. CPM 601 and Software are packed with all necessary tools that help to perform effective PD measurements. Integrated variable amplifiers and onboard denoising features help during onsite testing in case of any huge noise.

We at Rugged Monitoring have a dedicated team for application specific customizations for sensors, monitor configuration and software integration to simplify data collection of testing and monitoring applications.

Applications

- Online periodic partial discharge monitoring
- Online PD measurement during HV AC testing (Resonant test set, VLF, OWTS)
- Multiple point PD monitoring
- Cables and their accessories
- Rotating machines
- AIS/GIS switchgear/switchboards
- Power transformers

Features

- Rugged, compact design
- Dual Frequency Ranges; 0.01MHz - 100MHz as well as 300MHz - 2GHz
- Compatible with Acoustic, Ultrasonic, HFCT, TEV, Coupling Capacitors as wells as UHF Sensors
- An interactive and comprehensive software PD Connect for reliable PD measurement and analysis
- Gigabit ethernet copper Cat5e communication link between monitor and laptop
- Optional rugged laptop with installed software suite
- IP65 rated

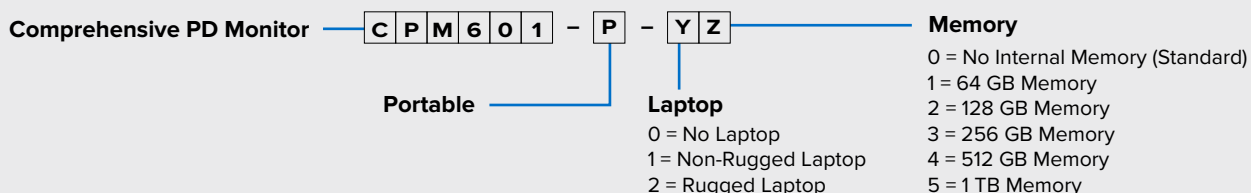
Benefits

- Rugged sensors, monitor and laptop
- Gigabit ethernet communication between monitor and laptop
- Enhanced noise rejection
- Realtime denoising
- Software packed with useful tools for reliable and interactive PD measurements
- Robust recording and analytics
- Customizable according to customer specific applications
- Suitable for Online PD measurements

Technical Specifications

INPUT CHANNELS	Channels	8 Multiplexed (4x HF and 4x UHF)
	Sampling Rate	250 MS/s
	Amplification	up to 50 dB, software selectable
	Filtering	Software configurable band pass filters
HF CHANNELS	Bandwidth	0.01 - 100 MHz
	Sensitivity	-50dBm
	Dynamic Range	50dB
UHF CHANNELS	Bandwidth	300 MHz - 2 GHz
	Sensitivity	-80 dBm
	Dynamic Range	70 Db
DATA TRANSFER	High Resolution (pulses data on simultaneous channels)	10,000 pulses per second for 4 simultaneous channels
	Low Resolution (pulse amplitude on simultaneous channels)	50,000 pulses per second for 4 simultaneous channels
	Transfer Rate	400 Mbps (depending on operating system and connection)
MEMORY	SSD	up to 1 TB (Optional)
COMMUNICATION LINK	Type	Ethernet Copper
	Cable	Cat5e
SYNCHRONISATION INPUTS	2 Inputs, software	Internal
	External	selectable
IP RATING	IP 65	
TEMPERATURE RATING	Ambient	-30°C - 60°C
	Storage	-40°C - 85°C
POWER RATING	Input Power	45 W
DIMENSIONS	260mm(L)x310mm(W)x120mm(H)	
LAPTOP	Rugged Laptop	(Optional)

Ordering Code



HPM601-C High Frequency Partial Discharge Monitor



"Rugged Monitoring High Frequency Partial Discharge (PD) monitoring solution is a platform that enables HV asset owners to keep monitoring PD round the clock due to insulation defects.

System can also be used to perform online PD measurement during HV AC testing. Solution can communicate with its user over IEC61850 or using Rugged Monitoring proprietary Rugged Enterprise software suite. Shielded monitor with small dimensions make it easy to get installed and start.

Enhanced and newly added hardware and software features ensure highly sensitive multi-channel PD measurements for reliable, industry-standard PD testing on a variety of electrical equipment and components. System simple design enables it to get interfaced to third party protocols. Thousands of pulses per second can be transferred to the Server enabling the user to generate fast and reliable Phase Resolved Partial Discharge (PRPD) graphs. PRPD graphs help the user to identify type of PD in HV assets. Monitoring solution is packed with all necessary tools that help to perform effective PD measurements. Integrated variable amplifiers and on-board noise suppression features help during onsite testing even in case of presence of huge noise.

Rugged Monitoring's team of experienced condition monitoring specialists provide innovative testing, Diagnosis and Customized Monitoring Solutions.

Applications

- Online PD measurement during HV AC testing (Resonant test set, VLF, OWTS)
- Multiple point PD monitoring
- Cables and their accessories
- Rotating machines
- AIS/GIS switchgear/switchboards
- Power transformers

Features

- Rugged, simple design
- 4 synchronous input channels allow 3 phase synchronous measurement with additional external synchronous channel to enable the use of other type of sensor
- Rugged Enterprise, a complete software suite for analyzing the data and generating reports
- Indicator LEDs to alert in case of PD alarm or warning
- Gigabit ethernet copper Cat5e or multimode fiber communication link between monitor and server

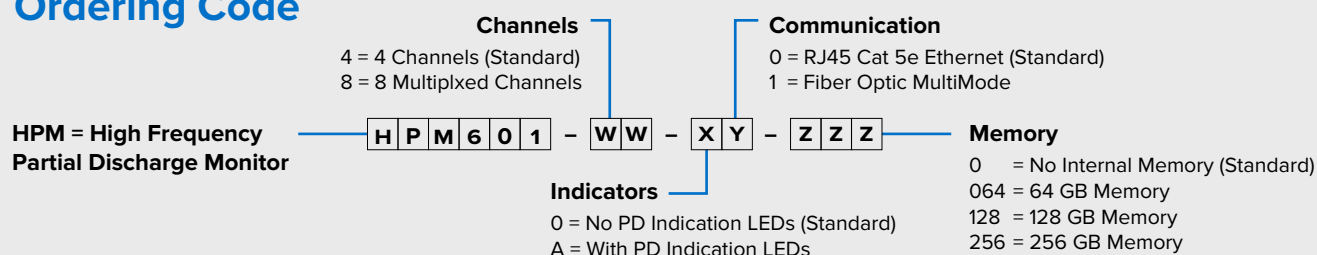
Benefits

- Highly Efficient sensors, monitor and server
- Gigabit ethernet communication between monitor and Server
- Robust design parameters
- Each device is tested rigorously
- Software packed with useful tools for reliable and interactive PD measurements
- Robust recording and analytics
- Customizable according to customer specific applications
- Suitable for Online PD measurements

Technical Specifications

MONITOR	Channels	4 simultaneous channels 8 & 12 channel options available with multiplexer
	Sampling Rate	250 MS/s
	Bandwidth	0.01-100 MHz
	Amplification	up to 28 dB, software selectable
	Filtering	Software configurable band pass filters
MEMORY	SSD	upto 256 GB (Optional)
DATA TRANSFER	High Resolution (Pulses data on simultaneous channels)	10,000 pulses per second for 4 simultaneous channels
	Low Resolution (Pulse amplitude on simultaneous channels)	50,000 pulses per second for 4 simultaneous channels
	Transfer Rate	400 Mbps (depending on operating system and connection)
REMOTE COMMUNICATION	IEC61850 (Optional)	
	Proprietary Rugged Connect for remote communication	
	Customized third party interface on request	
COMMUNICATION LINK	Type	Ethernet Fiber / Copper
	Cable Multimode	Fiber / Cat5e
	IP Rating	IP65
TEMPERATURE RATING	Ambient	-30°C - 60°C
	Storage	-40°C - 85°C
POWER RATING	Input Power	35 W max
SYNCHRONISATION INPUTS	2 Inputs, software	Internal
	Selectable	External
DIMENSIONS	260mm(L)x310mm(W)x120mm(H)	
SOFTWARE	Rugged Enterprise	

Ordering Code



HPM601-P High Frequency Partial Discharge Monitor



Rugged design, designed for reliability, 3 Phase synchronous partial discharge monitoring equipment.

Rugged Monitoring High Frequency Partial Discharge (PD) Portable Monitor is a compact and rugged device enabling the user to perform periodic offline and online PD measurements in power cables and accessories, switchgears and rotating machines. Compact size and rugged enclosure and electronics make it portable, easy to carry and enabling the user to perform PD measurements with less hassle.

Monitor is capable of transferring the data directly to Rugged Enterprise software installed on laptop or data can be temporarily stored (optional) in the device enabling the user to record PD pulses with higher sampling rate. Thousands of pulses per second can be transferred to the laptop enabling the user to generate fast and reliable Phase Resolved Partial Discharge (PRPD) graphs. PRPD patterns help the user to identify type of PD. Monitor and Software are packed with all necessary tools that help to perform effective PD measurements. Integrated variable amplifiers and on board denoising features help during onsite testing in case of presence of huge noise.

There is a dedicated team for application specific customizations for sensors, monitor configuration and software integration to simplify data collection of testing and monitoring applications.

Applications

- Online periodic partial discharge monitoring
- Offline PD measurement during HV AC testing (Resonant test set, VLF, OWTS)
- Multiple point PD monitoring
- Cables and their accessories
- Rotating machines
- AIS/GIS switchgear/switchboards
- Power transformers

Features

- Rugged, compact design
- 4 synchronous input channels allow 3 phase synchronous measurement with additional external synchronous channel to enable the use of other type of sensor
- An interactive and comprehensive software Rugged Enterprise for reliable PD measurement and analysis
- Gigabit ethernet copper Cat5e communication link between monitor and laptop
- Optional rugged laptop with installed software suite IP65 rated

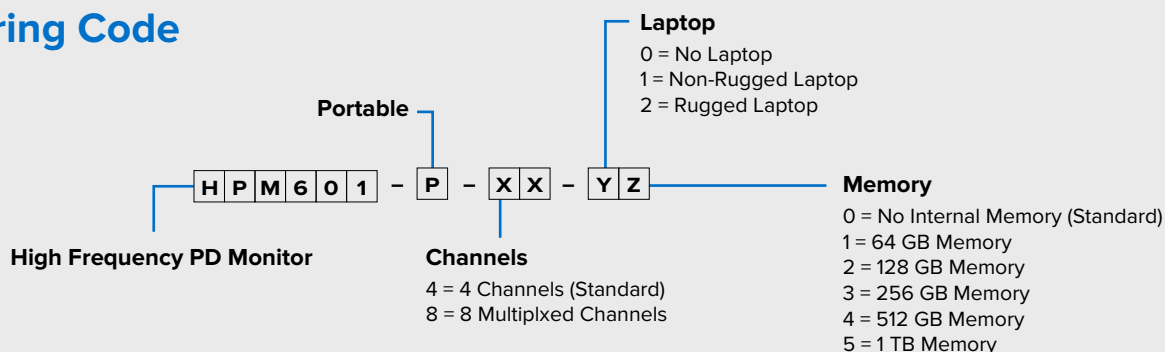
Benefits

- Rugged sensors, monitor and laptop
- Gigabit ethernet communication between monitor and laptop
- Enhanced noise rejection
- Realtime denoising
- Software packed with useful tools for reliable and interactive PD measurements
- Robust recording and analytics
- Customizable according to customer specific applications
- Suitable for Online or Offline PD measurements

Technical Specifications

INPUT SIMULTANEOUS CHANNELS	Channels	4 simultaneous channels 8 & 12 channel options available with multiplexer
	Sampling Rate	250 MS/s
	Bandwidth	0.01-100 MHz
	Amplification	up to 28 dB, software selectable
	Filtering	Software configurable band pass filters
MEMORY	SSD	up to 1 TB (Optional)
DATA TRANSFER	High Resolution (Pulses data on simultaneous channels)	10,000 pulses per second for 4 simultaneous channels
	Low Resolution (Pulse amplitude on simultaneous channels)	50,000 pulses per second for 4 simultaneous channels
	Transfer Rate	400 Mbps (depending on operating system and connection)
COMMUNICATION LINK	Type	Ethernet Copper
	Cable	Cat5e
TEMPERATURE RATING	Ambient	-30°C - 60°C
	Storage	-40°C - 85°C
POWER RATING	Input Power	35 W
SYNCHRONISATION INPUTS	2 Inputs, software	Internal & xternal
	IP Rating	IP65
DIMENSIONS	260mm(L)x310mm(W)x120mm(H)	
SOFTWARE	Rugged Enterprise	

Ordering Code



PD211

Rugged Partial Discharge Monitoring Module for OEMs



Rugged Monitoring PD211 is a compact design, designed for reliable Partial Discharge (PD) Monitoring Module for Transformers, Switchgears, GIS and Power Cable Terminations.

PD211 is based on the UHF (Ultra High Frequency) technology for PD signal acquisition and analysis. The Monitor is a combination of reliability and user-friendly configuration software. It has two variants with 04 channel and 08 channels, that can connect to 4 and 8 UHF-PD sensors respectively. The system can be integrated with any UHF PD sensors that are having response between 100MHz to 2000MHz.

The PD211 connects to the UHF PD sensors installed at the MV/HV assets. It measures the Ultra High Frequency (UHF) signals emitted by the PD Faults in HV/MV assets. The UHF signals are then analyzed for PD activity and categorization of Internal PD, External PD and Noise Signals. Internal PD signals are captured and stored for further analysis such as PRPD, PD Amplitude, Discharge Rate and trending. The PD amplitude and discharge rate is sent to the third-party system via Modbus (RTU) protocol using built-in serial (RS-485) port. The PRPD data is stored into the module and sent to third party system via CANBUS protocol using built-in CAN port.

Applications

- Online continuous partial discharge monitoring
- Online PD measurement during HV AC testing
- Multiple point PD monitoring
- PD monitoring in Transformer using UHF PD Sensors
- PD Monitoring in GIS using UHF PD Sensors
- PD Monitoring in MV Switchgear using UHF PD Sensors
- PD Monitoring in Power Cables Terminations UHF PD Sensors

Benefits

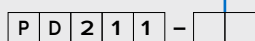
- Suitable for OEM-type applications (TMS, Gateways)
- Multiple mounting options - Din-Rail and Direct (Bare-board)
- Cost optimized solution for Partial Discharge monitoring
- Software designed for integration into monitoring systems /gateways
- Robust datalogging and Analytics
- Customizable according to customer specific applications
- Most accurate PD analysis with advanced noise gating
- Highly robust and safe monitoring systems

Technical Specifications

Number of Channels	04 or 08 (Simultaneous acquisition, No Multiplexing)
Sampling Rate	125 Ms/s
Acquisition Bandwidth	300Mhz - 2000Mhz
Vertical Resolution	12-Bit
PD Sensitivity	-80dBm
Noise Elimination	
- Bad Pass Filters	Tuneable for different frequencies including but not limited to 440Mhz, 800Mhz, 1100Mhz, and 1600Mhz
- Software Noise Gating	Advanced denoising algorithms
Data Storage (Memory)	MicroSD external memory slot (Up to 2 TB)
Compatible PD Sensors	Any Ultra High Frequency (UHF) PD Sensors with sensitivity 100Mhz - 2000MHZ.
Synchronization Inputs	2 Inputs (Internal and External)
Serial Port	RS-485 with Modbus RTU and Can Port with CANBUS protocol
Configuration Port	Ethernet Port for configuration
Operating Temperature	-30 to 75 °C
Storage Temperature	-40 to 85 °C
Dimensions	4.92" x 4.92" x 1.89" (125mm x 125mm x 48mm)
Humidity	95% Non Condensing
Power Input	12 - 24V DC (Default)
Power Consumption	15W
# of Relays Outputs	01 x Fail Safe Relay for System Failure

Ordering Code

Number of Channels
 04 = 4 Channels;
 08 = 8 Channels



Memory

- 0 = No Internal Memory
- 1 = for 64GB Memory
- 2 = for 128GB Memory
- 3 = for 256GB Memory
- 4 = for 512GB Memory

PD201 Rugged Partial Discharge Monitoring Module for OEMs



The Rugged Monitoring PD201 is a compact design, designed for reliability Partial Discharge (PD) Monitoring Module for Transformers, Switchgears, Power Cables and Rotating Machines.

PD201 combines accuracy and easy to use software. It has two variants, 04 channel and 08 channels, that can connect to 4 and 8 PD sensors respectively. The system can be integrated with wide range of PD sensors such as HFCT, TEV, Bushing Adaptors, Capacitive Couplers, Acoustic, and Ultrasonic PD sensors.

The PD201 connects to the HF PD sensors installed at the MV/HV assets. It measures the High Frequency (HF) signals emitted by the PD Faults in HV/MV assets. The HF signals are then analyzed for PD activity and Module categorizes pulses as Internal PD, External PD and Noise Signals. Internal PD signals are captured and stored for further analysis such as PRPD, PD Amplitude, Discharge Rate and trending. The PD amplitude and discharge rate is sent to the third-party system via Modbus (RTU) protocol using built-in serial (RS-485) port. The PRPD data is stored in the module and sent to third party system via CANBUS protocol using built-in CAN port.

Applications

- Online continuous partial discharge monitoring
- Online PD measurement during HV AC testing
- Multiple point PD monitoring
- PD Monitoring in Transformer using Bushing
- Adaptors/Sensors
- PD Monitoring in Dry Type Transformers
- PD Monitoring in MV Switchgear using TEV / HFCT
- PD Monitoring in Power Cables using HFCT
- PD Monitoring in Generators and Motors using
- Capacitive Couplers and HFCT

Features

- Rugged, Compact Design with multiple mounting options - Din-Rail, Direct
- 4 or 8 Synchronous Input Channels for monitoring Partial Discharge
- Monitors Partial Discharge into the Insulation of MV/HV assets
- Best in class EMI, ESD Immunity
- Modbus (Serial-RS485) and Canbus integration with third party systems
- Advance noise gating with built-in filters and software algorithms
- Built-In Fail Safe Relay for System Failure

Benefits

- Suitable for OEM-type applications (TMS, Gateways)
- Multiple mounting options - Din-Rail and Direct (Bare-board)
- Cost optimized solution for Partial Discharge monitoring
- Software designed for integration into monitoring systems / gateways
- Robust datalogging and Analytics
- Customizable according to customer specific applications
- Most accurate PD analysis with advanced noise gating
- Highly robust and safe monitoring systems

Technical Specifications

Number of Channels	04 or 08 (Simultaneous acquisition, No Multiplexing)
Sampling Rate	100 MS/s per channel
Acquisition Bandwidth	0.01 - 100Mhz
Vertical Resolution	12-Bit
Noise Elimination	
- Bad Pass Filters	User selectable integrated filters with 5Mhz to 25Mhz bandwidth range
- Software Noise Gating	Advanced denoising algorithms
Data Storage (Memory)	MicroSD external memory slot (Up to 2 TB)
Compatible PD Sensors	Any High Frequency (HF) PD Sensors (Bushing Adaptors, HFCT, TEV, Capacitive Couplers, Acoustic, Ultrasonic etc.)
Synchronization Inputs	2 Inputs (Internal and External)
Serial Port	RS-485 with Modbus RTU and Can Port with CANBUS protocol
Configuration Port	Ethernet Port for configuration
Operating Temperature	-30 to 75 °C
Storage Temperature	-40 to 85 °C
Dimensions	4.92" x 4.92" x 1.89" (125mm x 125mm x 48mm)
Humidity	95% Non Condensing
Power Input	12 - 24V DC (Default)
Power Consumption	15W
# of Relays Outputs	01 x Fail Safe Relay for System Failure

Ordering Code

Number of Channels
04 = 4 Channels;
08 = 8 Channels

P D 2 0 1 - [] []

[M] x

Memory

- 0 = No Internal Memory
- 1 = for 64GB Memory
- 2 = for 128GB Memory
- 3 = for 256GB Memory
- 4 = for 512GB Memory

Asset Monitoring : Enterprise Architecture

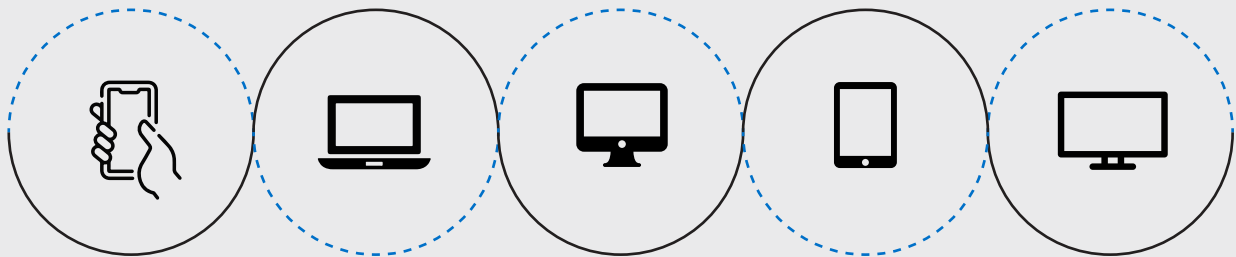
Compatible with Rugged Monitoring Enterprise Solution

UI UX



- Data Layer
- Analytics
- User Interface
- Custom Dashboards
- Reporting
- Email/SMS Notifications

RM EYE



Private Cloud (Customer Cloud),
Rugged Monitoring Cloud

IEC 60870-104

IEC 61850

FTP/SFTP

- XML, JSON

- CSV, COMTRADE

Data Collection

ODBC

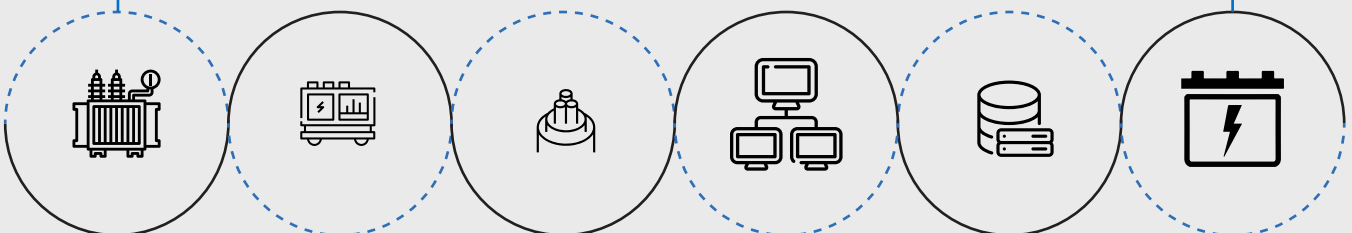
MODBUS

DNP 3.0

HTTPS

MQTT

Asset Data



Transformer
Monitoring
System

Switchgear
Monitoring
System

Power Cable
Monitoring
System

- Offline Test Results
- Inspection Records
- Name Plate

- Historian
- CMMS
- SCADA/ DCS

Power Electronics
(Battery, UPS,
VFD, Relay)

One Solution for Multi-Site Multi Asset Monitoring

Manage different industrial assets on one platform without human intervention

Features

- **Advanced and Exceptional Reporting**
Technology with automated alerts
- **Modern remote monitoring solutions** provide valuable insights to Multiple Assets at Multiple Sites on real-time
- **Robust asset health monitoring** with analysis and recommendations support asset effectiveness in addition to maximizing equipment uptime
- **Establish a real time and consistent monitoring** by getting the right information into right hands
- **An efficient, reliable partial discharge monitoring** for all the assets
- **A detailed comprehensive DGA Analysis**
- **Lifetime Consumption details.**
- **Built on well-established remote and cloud-based monitoring technology**
- **Simple user-friendly interface** providing fast access to all the features and commands
- **Quick and easy 1 step configuration setup**
- **Encompasses a secure access to data and configuration**
- **Advanced asset algorithms** based on standard ones with new ideas
- **Systematic fleet management and analysis**
- **Extended multilingual support** to handle product inquires or troubleshoot problems proactively
- **Up System Level Reporting**
- **Industrial IoT**

Features Specific to PD Monitoring

- Partial Discharge monitoring and Analysis
- PRPD : Phase resolve partial discharge
- Partial Discharge Amplitude and Discharge rate trend analysis
- Partial Discharge Fault localization
- Artificial Intelligence based PD fault Identification
- Realtime PD Alarm system
- Get Alarm notifications for individual bushing parameters over Email, sms and push notifications
- Analytics on Online, and offline partial discharge test data

Why Customers Choose Us?

RM solution, the trusted monitoring solution for over 10000+ assets across 50+ countries. We are a leading High Value Electrical Asset Monitoring Company integrating fibre optic technology to the assets.



Attention to Details

It's our attention to the small stuff, scheduling of timelines and keen project management that makes us stand out from the rest.



A plan for Success

Our Customers are well satisfied with the advisory services that we offer to help them with best in class technological performance and a long durable life.



Experts only

We bring in our diversified experienced team with over 100+ years of experience in Asset Monitoring



Meeting Deadlines

Work with us, and you'll work with seasoned professionals – vigilant of deadlines, and committed to exceeding client expectations.



Money Matters

We protect you against currency fluctuation with competitive and fair market prices



Rugged Monitoring Services

Rugged Monitoring provides customization of sensors, monitors & software. In addition we offer on-site commissioning services, maintenance contracts and technical support to all customers worldwide.

About Rugged Monitoring

Industry's leading team of asset condition monitoring experts with 100+ years of combined experience committed to delivering customizable solutions for challenging applications. We offer a range of reliable, high performance, customizable sensors and monitoring solutions that are immune to external influence.

Certification



ISO 9000



ISO 14000



ISO 45001/
OHSAS 18000



Lloyd's
Register



ATEX
Certification

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