RUGGED MONITORING

MONITORING SIMPLIFIED

Discover Rugged Performance of Dry Type Transformers

with our advanced comprehensive monitoring solutions.

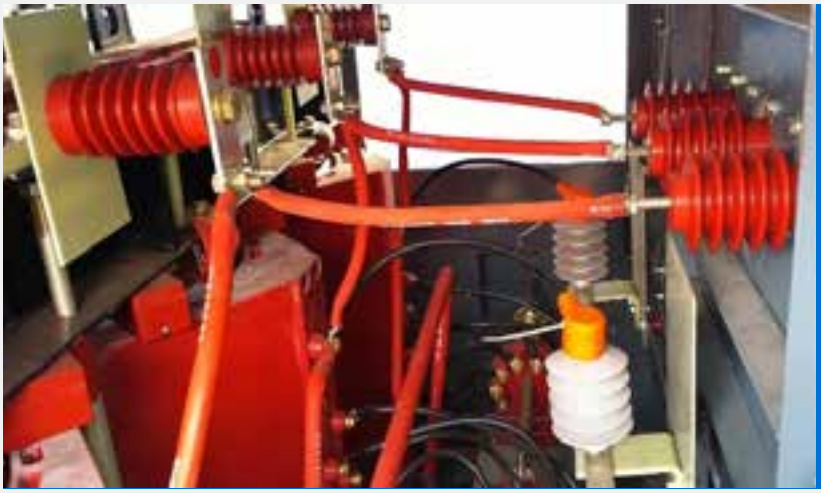
Dry Type Transformers

The reliability of electrical distribution relies heavily on the functionality of transformers. In the event of transformer failure, there is a significant risk of causing electrical outages, leading to unforeseen downtime and potentially costly repair efforts for the infrastructure.

While designing of dry type transformers, main aim is to decrease the internal power losses. The losses influence the entire machine's temperature system, which straightforwardly diminishes the effectiveness and the transformer's lifespan. Thermal stress emerges as a substantial contributing factor to the failure of dry-type transformers, primarily due to its detrimental impact on the protective materials. This stress induces a weakening effect on the materials intended to safeguard the transformer components, thereby diminishing their structural integrity and overall performance.

Monitoring dry-type transformers is crucial to ensure their proper functioning, prevent potential issues, and maximize their lifespan. Results from monitoring are most effective when they are used to inform a preventative maintenance programme which will avoid unplanned downtime.

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



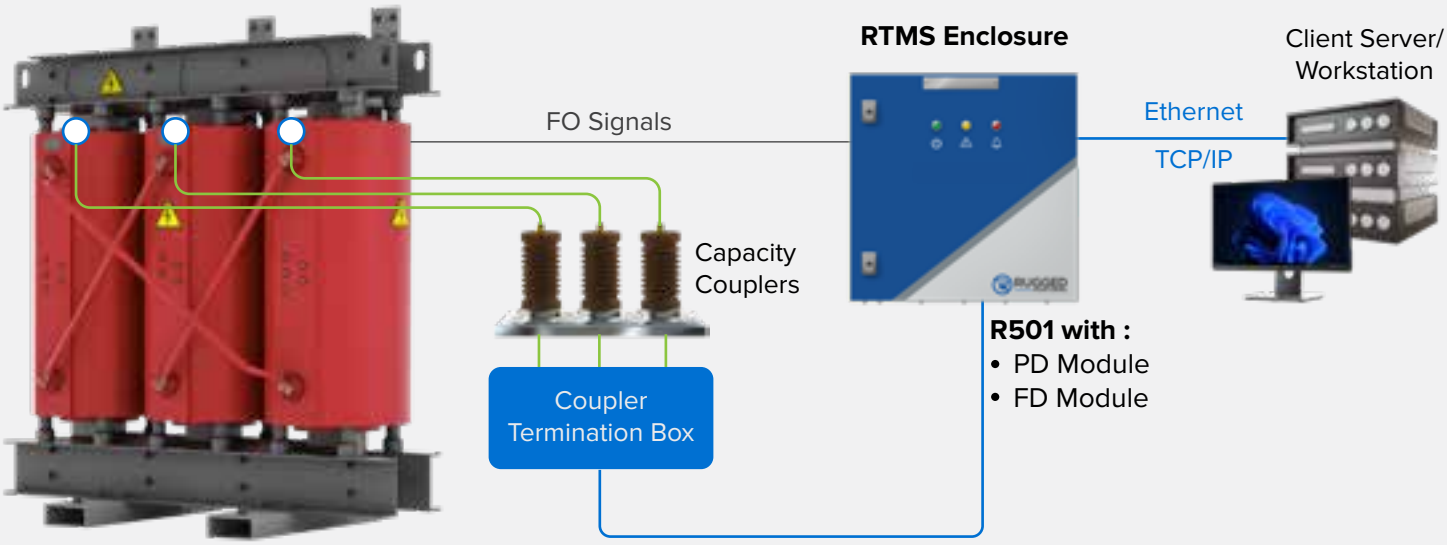
Strategic testing and monitoring strategies for dry type transformers are key to maintaining optimal performance and preventing widespread failures.

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.

What Can be Monitored?

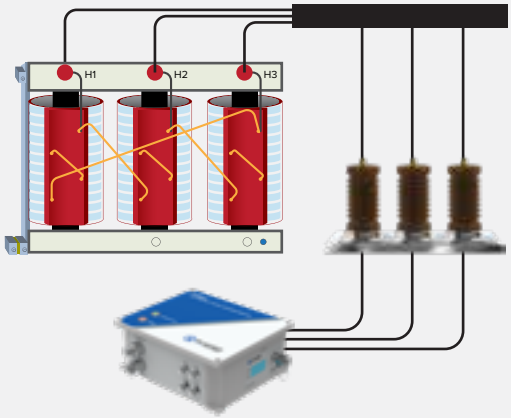
- Winding Temperature Monitoring
- Partial Discharge Monitoring
- Bus Bar Termination Monitoring
- Power Monitoring

Schematic Diagram of Dry Type Transformer



Features

- Early signs of any issues that might lead to equipment failure.
- Most accurate hot spot measurement of all Windings and Core temperature
- Maintenance alerts for proactive intervention and downtime reduction
- Fast temperature variation diagnostics enables informed decision making
- Maintenance Free; No Recalibration required
- Suitable for new or retrofit solutions.
- Constant assessment of the transformer's vitals
- Ensures a reliable, efficient, and safe operation
- Most accurate solution for PD testing and monitoring on site



Benefits

- Increased reliability and reduced downtime
- Reduced risk and catastrophic failures
- Reduced unplanned maintenance
- Cost savings from reduced outages
- Avoid unscheduled outages and increase Asset utilization

  Ready access to historical data for Root cause analysis

Our comprehensive dry-type transformer condition monitoring solution is designed to enhance reliability, ensure operational safety, and minimize the risk of disruptions. With real-time tracking of critical parameters, early fault detection, and proactive maintenance alerts, our system contributes to increased uptime, reduced operational costs, and an extended transformer lifespan.

LSENS-P Fiber Optic Temperature Sensor

A multiple use fiber optic temperature sensor for measurement in a wide range of demanding applications, where immunity to electromagnetic fields is mandatory.

A multiuse fiber optic temperature sensor designed for a wide range of applications, especially for the use in demanding applications. The sensor offers complete immunity to RFI, EMI, NMR and microwave radiation. The standard temperature sensor has a response time of 0.2 s. With a standard deviation of +/-0.2 °C it allows precise and repeatable measurements. The coating of the temperature sensor is made of PTFE, and the fiber tip has 0.3 mm x 0.3 mm area with a Polyimide coating.

The fiber optic probe consists of a PTFE protected glass fiber and a GaAs-crystal (Gallium Arsenide) at the sensor tip. It is totally free of metal and is immune to external fields. Therefore, the probes are explicitly suitable for use in large temperature ranges as well as in aggressive operating environments. The sensor length can be from several meters to 1 kilometer in length without impacting the accuracy of the measurement result. Other sensor lengths and connector types are available upon request.

Applications

- Electric Vehicle and Battery Testing
- High voltage environments
- Nuclear and hazardous environments
- Medical applications
- Chemical and Process Industries
- RF and Microwave drying applications
- Cryogenic and vacuum environment available (Optional)

Benefits

- Sensors do not require any recalibration
- No shift over time, high stability
- Optional spiral wrap
- Robust fiber optic temperature sensor
- Available in different cables and sheath options
- Customizable according to customer specific applications
- Suitable for OEM-type applications

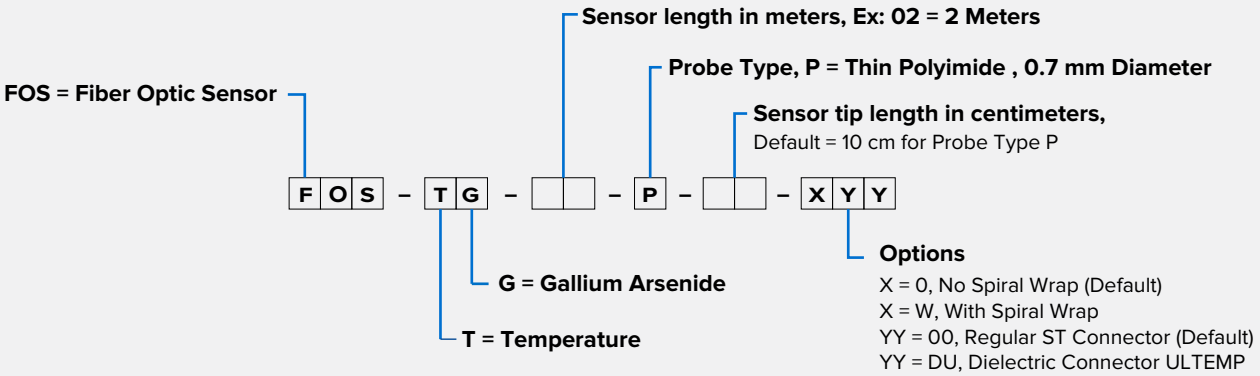
Feature

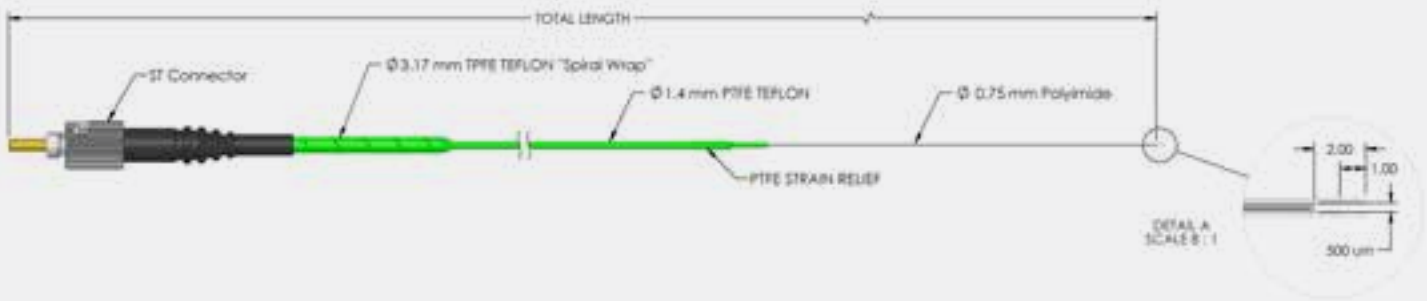
- Small tip Polyimide, protected
- Outstanding repeatability with high flexibility
- Complete immunity to RFI, EMI, NMR and microwave radiation
- Does not require recalibration or complex inputs to operate
- Cryogenic temperature range available (as low as 4 °Kelvin)

Technical Specifications

Temperature range	-200 °C to +250 °C
Temperature range (Optional Range extensions)	Down to 4 °K / Up to +300 °C
Repeatability	0.2 °C
Accuracy absolute temperature	+/- 0.8 °C
Accuracy relative temperature	+/- 0.2 °C
Probe sheathing material	Teflon Coated, with Polyimide protection for sensor tip
Connector	Stainless Alloy / Optional - Dielectric
Response time	Up to 0.2 Sec
Probe sensitive area - Diameter	0.7 mm
Protective Tube - Diameter	Teflon / 1.4 mm
Longevity	Probe accuracy & repeatability constant over time

Ordering Code





LSENS-C Fiber Optic Temperature Sensor

A multiple use fiber optic temperature sensor for measurement in a wide range of demanding applications, where immunity to electromagnetic fields is mandatory.

A multiuse fiber optic temperature sensor designed for a wide range of applications, especially for the use in demanding applications. The sensor offers complete immunity to RFI, EMI, NMR and microwave radiation. The standard temperature sensor has a response time of 0.2 s. With a standard deviation of +/-0.2 °C it allows precise and repeatable measurements. The coating of the temperature sensor is made of PTFE, and the fiber tip has 0.3 mm x 0.3 mm area with a Polyimide coating.

The fiber optic probe consists of a PTFE protected glass fiber and a GaAs-crystal (Gallium Arsenide) at the sensor tip. It is totally free of metal and is immune to external fields. Therefore, the probes are explicitly suitable for use in large temperature ranges as well as in aggressive operating environments. The sensor length can be from several meters to 1 kilometer in length without impacting the accuracy of the measurement result. Other sensor lengths and connector types are available upon request.

Applications

- Electric Vehicle and Battery Testing
- High voltage environments
- Nuclear and hazardous environments
- Medical applications
- Chemical and Process Industries
- RF and Microwave drying applications
- Cryogenic and vacuum environment available (Optional)

Benefits

- Sensors do not require any recalibration
- No shift over time, high stability
- Optional spiral wrap
- Robust fiber optic temperature sensor\
- Available in different cables and sheath options
- Customizable according to customer specific applications
- Suitable for OEM-type applications

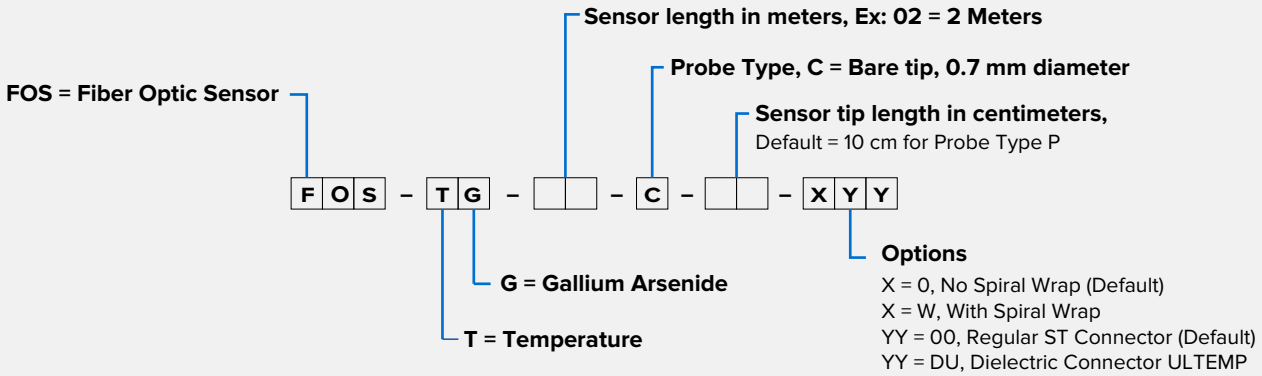
Feature

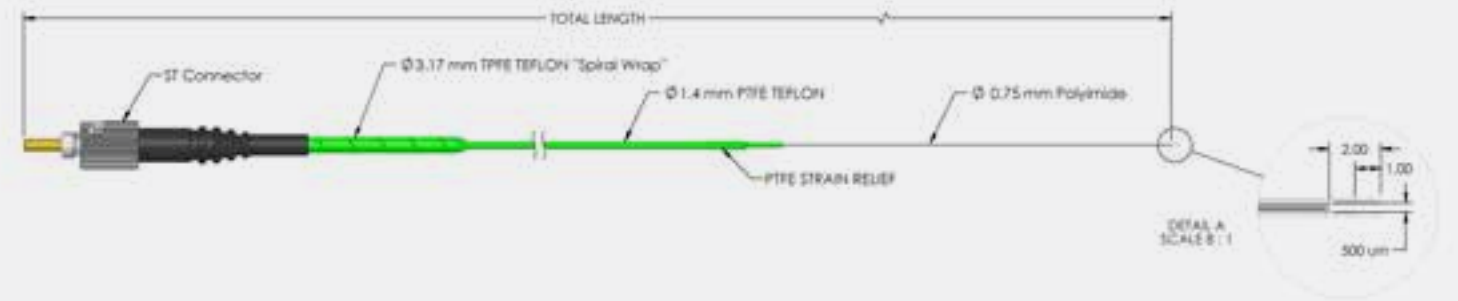
- Small tip Polyimide, protected
- Outstanding repeatability with high flexibility
- Complete immunity to RFI, EMI, NMR and microwave radiation
- Does not require recalibration or complex inputs to operate
- Cryogenic temperature range (as low as 4 °Kelvin)

Technical Specifications

Temperature range	-200 °C to +250 °C
Temperature range (Optional Range extensions)	Down to 4 °K / Up to +85 °C
Repeatability	0.2 °C
Accuracy absolute temperature	+/- 0.8 °C
Accuracy relative temperature	+/- 0.2 °C
Probe sheathing material	Teflon Coated, with Polyimide protection for sensor tip
Connector	Stainless Alloy / Optional - Dielectric
Response time	Up to 0.2 Sec
Probe sensitive area - Diameter	0.7 mm
Protective Tube - Diameter	Teflon / 1.4 mm
Longevity	Probe accuracy & repeatability constant over time

Ordering Code





HFCTA High Frequency Current Transformer-Active

Rugged design, designed for reliability, PD measurement at cable terminations and joints

- Rugged, Compact Design
- Split core design for easy installation
- Rugged and robust material used
- Different options of internal diameter dimensions
- Multicore high noise immunity cable
- Multi-pin high frequency connector for reliable connection
- System self test capability

An HFCT sensor is a split core and an inductive type sensor that can be clamped around the cable earth shield to measure PD signals. Based on the termination type, an HFCT sensor can also be clamped around cable insulation without earth shield or around the cable with earth shield looped back.

For HFCT clamped around the cable insulation or cable with earth shield looped back, high current variant can be used Active-Type of HFCT sensor has facility to inject self test pulse into the cable and being detected by same HFCT again. Thisfunctionality is compatible with portable system. This helps system health check from Sensor to Server.

Applications

- Online periodic partial discharge monitoring
- Online PD measurement during HV AC Resonant testing
- Multiple point PD monitoring
- Cable joints and terminations
- Rotating machines cables termination boxes
- Cables connected to AIS/GIS switchgear
- Cables connected to Transformers

Benefits

- Rugged sensors
- Noise immunity
- Robust packaging
- Rigorously tested
- Split core for easy installation
- Stainless steel robust latch to keep split core closed
- System self test capability
- Suitable for Online or O ine PD measurements

Technical Specifications

SENSOR	Type	Split core
	Frequency Response	100 kHz - 25 MHz
	Material	Acetal, Aluminum (optional)
	Current Ratings	50A for standard Up to 1000A for high current variant
SELF TEST	Active Sensor	Yes. Self test pulses are injected into the sensor and acquired to confirm sensor functionality
MODELS	HFCT-3	170mm (L) x 80mm (W) x 35mm (H) (ID = 30mm)
	HFCT-5	170mm (L) x 125mm (W) x 30mm (H) (ID = 50mm)
	HFCT-9	215mm (L) x 160mm (W) x 40mm (H) (ID = 90mm)
	HFCT-14	280mm (L) x 230mm (W) x 40mm (H) (ID = 140mm)
CONNECTION CABLE	Type	Cat6 (Active type)
	Connectors	Cable Gland (Sensor End) and Multi-pin connector (Monitor End)
	Cable Length	10m as standard
	Temperature	-40C – 70C (Operating) -40C - 90C (Storage)
	Customisation	For any different requirement, please consult

ASENS

Modular design for partial discharge monitoring in electrical assets

Partial Discharge activity is an indicator of increasing defects in insulation. PD is a discharge or spark that partially bridges the gap between conducting electrodes. The discharge may be in oil filled equipment or in a gas filled environment.

RM's ASENS with acquisition system is specifically designed to detect partial discharge using portable measurement/ continuous monitoring methods and is also capable to locate PD position by studying the PD amplitude and phase delay of the acoustic waves propagating through the discharge activity. The location of the PD can be estimated by measuring the time of arrival of the acoustic wave, and PD localization is ascertaine by using sensors at multiple locations of assets. This makes acoustic emission sensing a preferable measuring tool in real time PD signal detection.

RM's advanced acoustic measurement has an additional advantage of possessing better- signal to noise ratio for real-time applications. To avoid the damage to high voltage equipment, detecting and locating PD is crucial both in industries and utilities. Acoustic waves are measured by ASENS, and the AE System will identify the real PD and their location based on ML/Time Difference of Arrival (TDOA) algorithm with the highest percentage of location accuracy to fault location.

The highly sensitive ASENS can be used for measurement of PD on Transformer Tanks, GIS, Reactors, Large Pressure Vessels, and for Leak Detection. Depending on the application and environment the sensors are available with three different resonant frequencies of 40 KHz, 80 KHz and 150 KHz.

Benefits

- PD localization with multiple sensors
- High noise immunity for online partial discharge detection
- Integrated amplifier for better SNR
- Significant time saving through fast localization of the fault
- Quick and easy application
- Good return on investment

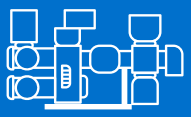
Features

- Built in pre-amplifier
- Narrow band resonant sensor with highest signal to noise ratio
- Simple and rugged sensor
- Easy to use, light weight
- Plug and play connections
- Highly sensitive

Applications

Oil Filled Reactors

Oil Filled Transformers



Gas Insulated Switchgears and Gas Insulated Lines

Technical Specifications

Specifications	Gas Insulated Switchgear (GIS)	Oil Filled Transformer/ Reactors	Oil Filled Transformers
Resonant Frequency	50 KHz	80 KHz	150 KHz
Frequency Range	15 KHz - 70 KHz	20 KHz - 180 KHz	60 KHz - 400 KHz
Sensitivity Peak	>115 dB	>70 dB	>115 dB
Built in Preamplifier	40 dB 28 V	-	40 dB 28 V
Size mm	Φ30 x 57	Φ19 x 19.5	Φ30 x 36.5
Applicable Temperature °C	-20 to 50°C	-20 to 80°C	-20 to 50°C
Housing Material	SUS-504	SUS-304	SUS-304
Receiving Surface Material	Ceramic	Ceramic	Ceramic
Protection Grade	IP62	IP62	IP62
Connector Type	BNC	M5	BNC
Connector Position	Side Face	Side Face	Side Face
Product Features	Built in Pre-Amplifier	Low Frequency	Built in Pre-Amplifier

HSENS-CC Capacitive Coupler Partial Discharge Sensor

- **Compact Size, Highly Sensitive, Capacitive Coupler for PD Testing and Monitoring**
- **High Dielectric, Rugged, and Reliable design**
- **Built-in overvoltage (transient) protection**
- **Available for wide range of voltage levels 6kV to 45kV**
- **1pC PD Sensitivity (ASTM D1868 and IEC 60270)**
- **Suitable for extreme environment, Hazardous (ATEX) applications**
- **PD Free Sensor: No PD signals because of Sensor**

Capacitive Couplers with wide range of nominal voltage ratings are designed for Partial Discharge (PD) Testing and PD Monitoring as per IEC60270. The sensors are designed for different capacitance levels from 1nF to 80pF meeting requirements of various customers.

HSENS-CC is a Capacitive Coupler specially designed for capturing High Frequency Partial Discharge (PD) signals. The compact size and high dielectric properties of sensor makes it ideal for installation at busbar and within terminal boxes.

The sensor can be installed vertically and horizontally depending on the space limitations. The HSENS-CC sensors come with built-in overvoltage protection with different output connections (BNC/TNC). The sensors can be connected to any HF (High Frequency) PD monitoring system regardless of manufacturers.

Compact sized, Highly dielectric and accurate Partial Discharge sensor for temporary and permanent monitoring of Generators, Motors, Switchgears and Transformers.

Applications

- Continuous Online Partial Discharge Monitoring
- Periodic Partial Discharge Testing and Measurements
- High Voltage Testing during Commissioning
- Generator and Motor PD Testing and Monitoring
- MV Switchgear and Isolated Phase Bus PD Testing and Monitoring
- Transformer PD Testing and Dry Type Transformer PD Monitoring

HSENS-CC

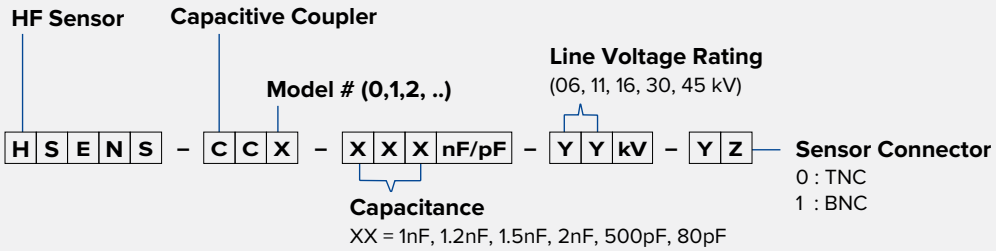
Benefits

- Higher sensitivity 1pC increases accuracy of PD detection
- Allow PD testing and Monitoring without the need for outage
- Easy installable, and High Dielectric strength, Safest Sensors
- Shielded Sensor, Noise Immunity
- Built in overvoltage protection keeps the PDM electronics safer
- Suitable for indoor and outdoor installations
- Wider Nominal Voltage and Capacitance levels for different Applications

Technical Specifications

Capacitance	1nF, 1.2nF, 1.5nF, 2nF, 500pF, 80pF (Custom designed - Optional)
PD Sensitivity	1pC
Line Voltage Rating	6kV, 11kV, 16kV, 30kV, 45kV
Line Voltage Frequency	50Hz - 60Hz
Capacitor Type	Mica and Ceramic
Body Material	Epoxy Resin
Output Connection Type	TNC-Type connector; Customized option available
Vibration Testing	Suitable for Generator, Motor and Transformer applications
Withstand Voltages	20kV, 35kV, 70kV, 120kV
Ambient (Operating Temperature)	-40 °C to +85 °C
Storage Temperature	-40 °C to +85 °C
Operating Humidity	95% humidity at 50 °C
Dimensions (in mm)	As per Line Voltage rating; from 125(W) x 95(D) x 90(H) to 250(W) x 165(D) x 450(H)
Weight	As per Line Voltage rating; from 0.5Kg. to 5.5Kg
Install Position	Installed on the study cast aluminum enclosure and connected to the Busbar
Signal Cable	Very low attenuation Coax cable, RG58

Ordering Code



T301 Rugged Monitoring Temperature Monitor

The Rugged Monitoring T301 is a multi-channel fiber optic temperature monitor with precision measurement for Industrial and Laboratory applications. The T301 fiber optic monitor combines compact form factor and user-friendly interface in the monitor and software.

It is designed to operate reliably in extreme EMI, RFI, Microwave and high voltage environments. The T301 has a measuring range from -271°C to +300°C. The system offers complete immunity to RFI, EMI, Chemical, microwave radiation, and high voltages making it an optimal choice for environments where the limitations of conventional temperature sensors / monitors impact usage in extreme conditions. The system is based on proven zero-drift GaAs technology and designed for Plug and Play operation.

The T301 is designed to collect data and to easily integrate into existing systems through serial communication like RS-485 or Gigabit Optical Ethernet. The T301 monitor comes with Rugged Connect software which is designed with the needs of Test Platform or Industrial Process monitoring integration needs. It has the data integration capability of multiple test platforms. Rugged Connect software is designed to collect data from 256 channels simultaneously. Plug and Play functionality provides the flexibility to interchange sensors without the inconvenience / concerns of calibration.

Rugged Monitoring has a dedicated team for application specific customizations for fiber optic sensors, monitor configuration and software integration to simplify the data collection of testing and monitoring applications.

Applications

- Transformer Hot Spot monitoring
- Industrial process control and monitoring
- Electric Vehicle and Battery Testing
- Medical Equipment testing (MRI, PETSCAN, NMR)
- Commercial Grade Microwave Radiation
- Food and Beverage Processes

Features

- Rugged, Compact Design
- 4 to 24 Channels, Expandable
- Plug and Play, No field calibration
- Best in class EMI, ESD Immunity
- 8 Programmable relays, Form - C
- Software designed to be interfaced with other testing platforms

Benefits

- No shift over time, high stability
- Robust packaging
- Each Monitor comes with a complete NIST calibration Certificate
- Software designed for integration into test platforms
- Robust datalogging and analytics
- Customizable according to customer specific applications
- Suitable for OEM-type applications.

Ordering Code

Number of Channels
Ex: 08 = 8 Channels

Number of Analog Outputs
0 = No Analog Outputs
8 = 8 Analog Outputs

T 3 0 1 – [ ][ ] E [ ] A [ ] R [ ] M [ ]

Memory Size
0 = None
4 = 4 GB
8 = 8 GB

Number of Relays
0 = No Relays
8 = 8 Relays

Ethernet Protocols
0 = No Ethernet
1 = Ethernet (1x RJ45, 1x SFP port auto)
2 = Ethernet (1x RJ45, 1x SFP module 1Gbps)
3 = Ethernet (1x SFP port 1Gbps, 1x SFP port auto)
4 = Ethernet (2x SFP modules 1Gbps)
5 = Ethernet (1x RJ45, 1x SFP module 100 Mbps)
6 = Ethernet (1x SFP port 100 Mbps, 1x SFP port auto)
7 = Ethernet (2x SFP modules 100 Mbps)

Technical Specifications

Measurement Range	-80 °C to +300 °C (cryogenic 4 °K range optional)
Measurement range (Optional Range extensions)	Down to 2 °K / Up to +300 °C
Power Supply	24V to 48V DC, 30 W
Resolution	0.1 °C
Accuracy	±1.0 °C (±0.2 °C in relative temperature)
Scan rate	200 ms / channel
Memory	MicroSD external memory slot (Up to 2 TB)
Logging	10 years at 10 sec interval rate (8 GB)
Serial Port	RS-485 with Modbus
Ethernet Option	RJ-45 or Fiber Ethernet; Optional PRP support built-in 2 x RJ-45 or Fiber Ethernet; With advance communication protocols (IEC 61850, Modbus over Ethernet, IEC 60870-5-104 and DP3)
Fiber Optic Communication	SFP module can be added to the Ethernet option; the standard SFP module is compatible with LC fiber connectors (850 nm multimode communication with a distance capability of 550 meters)
Analog Outputs	8 fully configurable 0-10 V / 4-20 mA optional module available - Optional
Max # of Channels	256 Channels, Daisy chain up to 32 units (with Modbus)
Relays	8 Programmable Form-C Relays (5A) plus 1 system fault relay - Optional
Operating temp	-40 to 72 °C
Storage temp	-40 to 85 °C
Number of Channels	4 - 24 channels
Dimensions	10.5” x 7.4” x 2.8” 26.7W x 18.7D x 7.2H cm
Humidity	95% Non Condensing

T401 Fiber Optic Temperature Monitors

Recommended for increased asset lifetime with highly reliable performance and reduced operational risks.

The Rugged Monitoring T401 is specifically designed for real time monitoring of electrical assets. The configurable T401 comes with a user-friendly monitor and software interface. With its advanced monitoring functions T401 can provide accurate measurements for various electrical assets. The system offers complete immunity to RFI, EMI, Chemical, Microwave Radiations, and High Voltages, making it an optimal choice for environments where the limitations of conventional temperature sensors / monitors cannot be used in extreme conditions. It has the data integration capability to integrate with third party systems.

The T401 is designed to collect data and to easily integrate with existing systems through serial communication like RS-485/ SFP (Gigabit Optical Ethernet). The T401 monitor comes with Rugged Connect/RM EYE software which is designed to cater the needs of various commercial, industrial, and utility applications. It allows remote monitoring by sending alert to operators about fault conditions at an early stage and provides vital health information before any serious fault occurs.

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.

Features

- Expandable up to 8 channels
- No field calibration
- Plug and play connections
- Compact and rugged design
- Best in class EMI and ESD immunity
- Up to 8 programmable Form-C relays

Applications

- Oil filled Rotating Machines
- Dry type Rotating Machines
- Switchgears
- Cables
- Variable Frequency Drives
- Industrial Process Control and Monitoring

Benefits

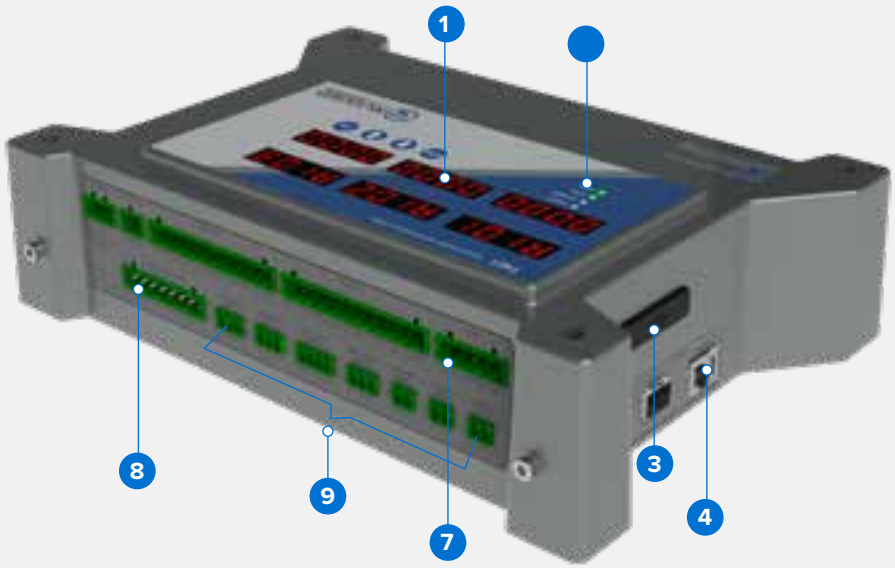
- Avoid unplanned outages
- Reduced risk of catastrophic failure
- Increased asset lifetime
- Reduced Maintenance Costs
- Ensuring reliable operation

Technical Specifications

POWER SUPPLY	Input Power Requirement	24/48 VDC ± 10%
	Power Consumption	20 Watts
ANALOG/DIGITAL INPUT MODULE	# of Input Channels	08/04 Channels
	Input Channel Types	Configurable from a range of input options, RTD, AC/DC current, AC/DC voltage, Potentiometer, Dry/Powered contact switch
	Accuracy of Channels	±0.5% full scale input range
	Input Channel Sample Rate	1 Hz
ANALOG OUTPUT MODULE	# of Output Channels	04 Channels
	Output format	4-20 mA or 0-5Vdc / 0-10Vdc (Configurable for any measured / calculated value)
OUTPUT RELAY MODULE	# of Output Channels	08 Form C relays (5A)
	User Programmable	Yes, from Rugged Connect Software or webserver, if present
DATA STORAGE & CONFIGURATION	Data Storage Capacity	4 or 8 GB, Industrial Grade micro-SD, extendable to 2TB
	Logging Rate	User Configurable, 1 sec interval on USB
	System Fault Indication	1 System Fault Relay, with Local LED light
	Config port	USB (to use with Rugged connect windows software)
COMMUNICATION	Serial Communication	01 x RS-485 (RS-232 optional converter)
	Ethernet Communication	02 Ethernet Ports, configurable to RJ-45 or SFP (Gigabit Optical)
	Redundancy	Support PRP Redundancy
	Protocol Supported	Modbus, DNP3.0, IEC60870-104, IEC61850, Other protocols provided on request
EMC TYPE TESTING	Conducted & Radiated Emissions	ICES-003 (2016), CISPR32 (2015), CISPR11 (2015)
	ESD and EM Field Immunity	IEC61000-4-2, C37.90-3, IEC61000-4-3, C37.90.2v
	Fast Transient & Surge Immunity	IEC61000-4-4, IEC61000-4-5, C37.90.2
	Magnetic Field Immunity	IEC61000-4-8, IEC61000-4-10
	Immunity from Conducted Disturbances	IEC61000-4-6, IEC61000-4-16
	Ripple, Dips & Damped Oscillatory	IEC61000-4-17, IEC61000-4-18, IEC61000-4-29
	Safety	IEC60255-26 and CE Certified
ENVIRONMENTAL AND MECHANICAL	Operating Temperature	-40 to 72 °C
	Operating Humidity	95% Non Condensing
	Storage Temperature	-40 to 85 °C
	Dimensions	W26.7 cm x H7.2 cm x D18.7 cm (10.5'' x 2.8" x 7.4")
	Weight	App. 1.5 to 2.0 Kg. (based on number of configuration)

T401 **FEATURES**

Comprehensive Features to Meet Market Demand



1. Local Display

- Industrial Grade LED
- Current Values of all Parameters

2. LED Indicators

- Power ON/OFF
- System Fault
- Alarm & Log

3. USB Port

- Configuration & Troubleshooting
- Data Export
- MicroSD Card

4. Ethernet Ports

- 02 x configurable Ports (RJ-45/SFP)
- Full Redundancy
- PRP Protocol
- Modbus, DNP3.0, IEC60870-104 and IEC 61850

5. Power Input

- 24 / 48 Vdc
- Power Supply Unit / Adaptor provided as Accessories (OPTIONAL)

6. Relay Outputs

- 08 x Form C Relay contacts
- NO-C-NC
- Cooling control
- Alerts / Alarms

7. Serial Port (Rs-485)

- Data Input/Output Integration
- Modbus Protocol
- DNP3.0 Protocol
- IEC60870-104 Protocol

8. Analog Outputs

- 04 x User Programmable
- Current Output (4-20mA)
- Voltage Output (0-5V/0-10V)

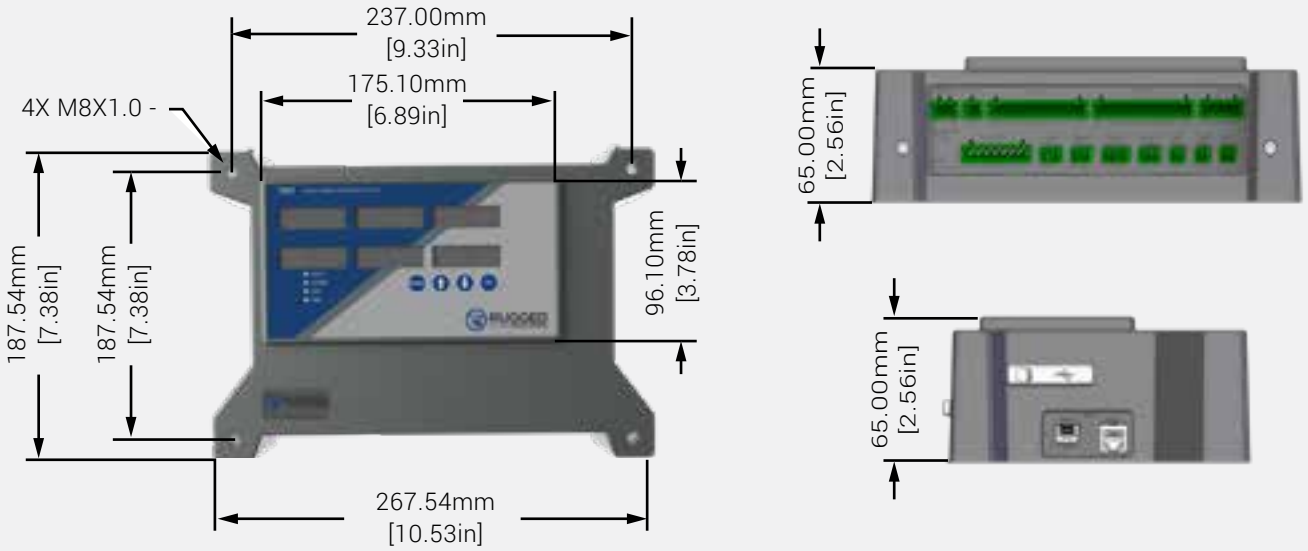
9. Analog / Digital Inputs

- 08 x Configurable Inputs
- RTD (PT-100), Potentiometer
- AC Current (Clamp-On CT), DC current (4-20mA)
- Digital (Dry Contacts)
- AC/DC Voltage

Rugged Software

- Desktop and Web Client
- Remote Configuration
- Advanced Visualization
- Data Logging, Reporting
- Supports Industry Standard Protocols
- Customization available on request
- Secure access to data & Configuration
- Multiple Language Support

Product Drawing



Weight : 2 Kilograms

Ordering Code

Model Number
Based on Input Channel Configuration

Number of Analog Outputs
0 = No Analog Outputs
4 = 4 Analog Outputs

T 4 0 1 – [ ][ ] E [ ] A [ ] R [ ] M [ ]

Memory Size
4 = 4 GB
8 = 8 GB

Ethernet Protocols
0 = No Ethernet
1 = Ethernet (1x RJ45, 1x SFP port auto)
2 = Ethernet (1x RJ45, 1x SFP module 1Gbps)
3 = Ethernet (1x SFP port 1Gbps, 1x SFP port auto)
4 = Ethernet (2x SFP modules 1Gbps)
5 = Ethernet (1x RJ45, 1x SFP module 100 Mbps)
6 = Ethernet (1x SFP port 100 Mbps, 1x SFP port auto)
7 = Ethernet (2x SFP modules 100 Mbps)

Number of Relay Outputs
0 = No Relay Outputs
8 = 8 Relay Outputs

T501

Rugged Monitoring Temperature Monitor

Power transformers play a vital role in the electrical system and undergo critical stress most of the times. Rugged Monitoring T501 offers a whole range of functions designed to let the utilities use their transformers to the greatest limit by accurately monitoring all parameters required to calculate health index in order to maximize asset life.

Our advanced transformer monitoring system T501 is capable to perform but not limited to data logging, event recording, dynamic loading analysis, remote communication including IEC 61850. Keeping an eye on your transformer, the monitoring system can be integrated with various fiber optic sensors for direct winding temperature monitoring, H2Sens and any other third party online dissolved Gas Analyzer for measurement of gas in oil.

A monitoring system must be Robust, Reliable and Responsive, Our system meets all these features and is competent to perceive.

Options

- Integrated data logging (up to 20 parameters) and Event recording (up to 8 events)
- Ethernet port and/or fiber optic communications output (RS485)
- Weather proof enclosure with or without heater, 19” rack mount or control cabinet panel mount
- Oil RTD, Ambient RTD, clamp on CT, pressure transducer, oil level transmitter along with various other input modules.

Benefits

- Proactive Risk Monitoring
- Improved asset protection and utilization
- Simplified analysis for condition-based maintenance
- Intervention before failure and Malfunctioning
- Optimize loading and equipment life

Features

- 8 relays (1 dedicated for system status) for alarm and control based on up to 8 modular inputs of various types.
- 4 magnetically isolated current loop outputs (0-1 or 4-20mA selectable)
- RS 485 remote communication, fiber optics (Rs-485) communications and Ethernet ports
- Transformer monitor for condition based, continuous online monitoring of asset health (CBM).
- Interfaces with a variety of Rugged
- Monitoring and third party smart sensors, as well as traditional gauges to accurately measure transformer parameters vital to asset management.
- Web based software is specifically designed for ease of unit commissioning, setup and daily use.

Technical Specifications

POWER SUPPLY	Input Power Requirement	24/48 VDC ± 10%
	Power Consumption	20 Watts
ANALOG/DIGITAL INPUT MODULE	# of Input Channels	08/04 Channels
	Input Channel Types	Configurable from a range of input options, RTD, AC/DC current, AC/DC voltage, Potentiometer, Dry/Powered contact switch
	Accuracy of Channels	±0.5% full scale input range
	Input Channel Sample Rate	1 Hz
FIBER OPTIC MODULES	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)
	Number of Channels	2 to 24 channels
ANALOG OUTPUT MODULE	# of Output Channels	04 Channels
	Output format	4-20 mA or 0-5Vdc / 0-10Vdc (Configurable for any measured / calculated value)
OUTPUT RELAY MODULE	# of Output Channels	08 Form C relays (5A)
	User Programmable	Yes, from Rugged Connect Software or webserver, if present
DATA STORAGE & CONFIGURATION	Data Storage Capacity	4 or 8 GB, Industrial Grade micro-SD, extendable to 2TB
	Logging Rate	User Configurable, 1 sec interval on USB
	System Fault Indication	1 System Fault Relay, with Local LED light
	Config port	USB (to use with Rugged connect windows software)
COMMUNICATION	Serial Communication	01 x RS-485 (RS-232 optional converter)
	Ethernet Communication	02 Ethernet Ports, configurable to RJ-45 or SFP (Gigabit Optical)
	Redundancy	Support PRP Redundancy
	Protocol Supported	Modbus, DNP3.0, IEC60870-104, IEC61850, Other protocols provided on request
EMC TYPE TESTING	Conducted & Radiated Emissions	ICES-003 (2016), CISPR32 (2015), CISPR11 (2015)
	ESD and EM Field Immunity	IEC61000-4-2, C37.90-3, IEC61000-4-3, C37.90.2
	Fast Transient & Surge Immunity	IEC61000-4-4, IEC61000-4-5, C37.90.2
	Magnetic Field Immunity	IEC61000-4-8, IEC61000-4-10
	Immunity from Conducted Disturbances	IEC61000-4-6, IEC61000-4-16
	Ripple, Dips & Damped Oscillatory	IEC61000-4-17, IEC61000-4-18, IEC61000-4-29
	Safety	IEC60255-26 and CE Certified
ENVIRONMENTAL AND MECHANICAL	Operating Temperature	-40 to 72°C
	Operating Humidity	95% Non Condensing
	Storage Temperature	-40 to 85°C
	Dimensions	W26.7 cm x H7.2 cm x D18.7 cm (10.5'' x 2.8" x 7.4")
	Weight	App. 1.5 to 2.0 Kg. (based on number of configuration)

R501 Rack Mount Comprehensive and Customizable Transformer Monitoring Solution

Rugged, Most Versatile and Multi Channel monitoring solution capable of monitoring one or multiple transformers for :

Basic Transformer Monitoring, Fibre Optic temperature monitoring, Partial Discharge, Bushing, OLTC, Cooling System, Load, Power, and more...

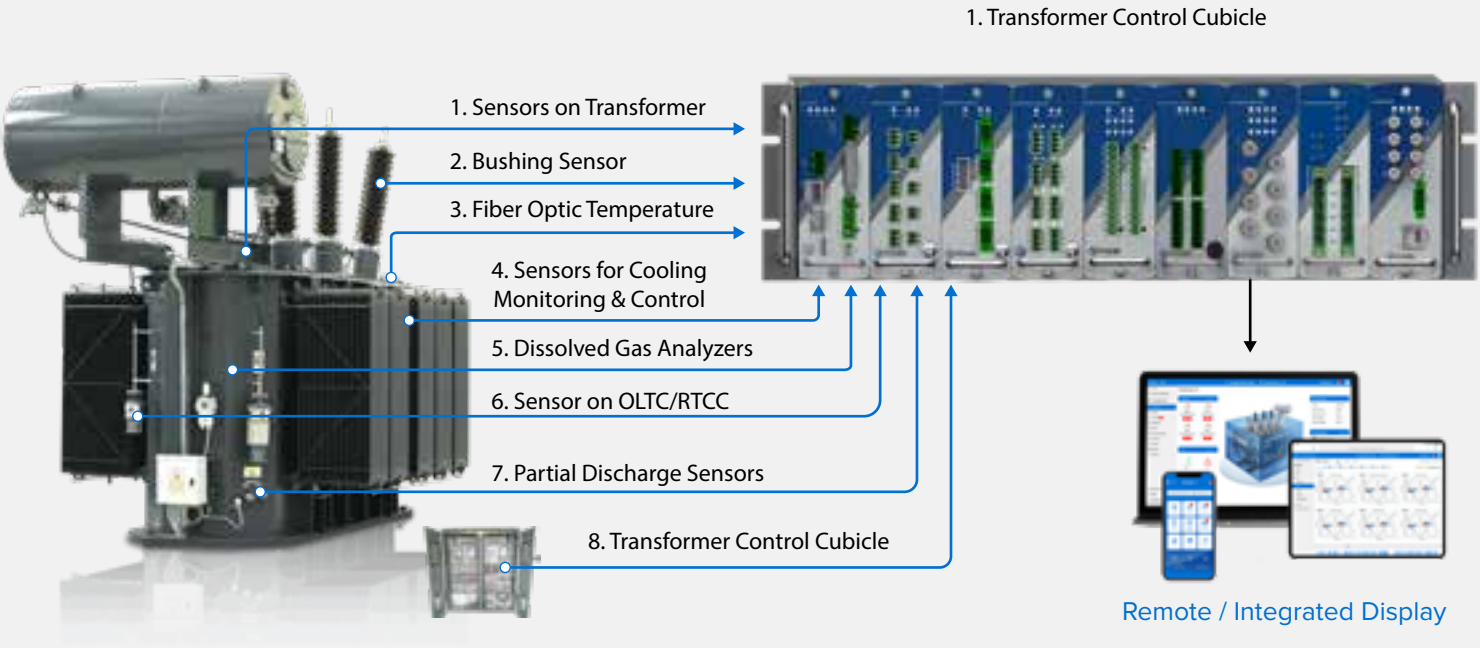
Key Features

- Fully flexible rack mount and distributed architecture support
- Expandable & Field upgradable to add different transformer monitoring modules
- Highly secure, web server based visualisation and configuration software.
- Equipped with most accurate & advance transformer health assessment analytics
- Range of communication options and protocol support; Ethernet redundancy (PRP)
- Complies with the latest IEC/IEEE standards for Emission, Immunity, Safety and Environment.

Benefit

- Increased transformer availability
- Improved grid reliability
- Transformer lifetime extension
- Remote monitoring solution for various transformer parameters
- Lower cost of installation and maintenance - Higher RoI
- Faster integration with central condition monitoring system (On-Prem or Cloud)

R501 **SYSTEM ARCHITECTURE**



1. Sensors on Transformer

2. Bushing Sensor

3. Fiber Optic Temperature

4. Sensors for Cooling Monitoring & Control

5. Dissolved Gas Analyzers

6. Sensor on OLTC/RTCC

7. Partial Discharge Sensors

8. Transformer Control Cubicle

Sensors that can be **connected to R501**

1. OTI,WTI, RTD, PRD, Breather, Buchholz Relay, LLG/OLI, Pressure Sensor etc.
2. Range of Fibre Optic temperature monitoring sensors
3. Cooling System and Control Cabinet
4. Dissolved Gas Analyzer
5. Bushing adaptors and sensors
6. Range of Partial Discharge sensors

Certifications

ATEX

Lloyds

CE / RoHs

Variants

Offshore / Marine

Ethernet Redundancy: PRP

Enterprise Monitoring Software

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

8. Bushing Monitoring Module

- 03 or 06 Channels
- Leakage Current
- Tan Delta / Power Factor
- Capacitance
- Phase Voltage
- Custom Tap Adaptor for Different Bushing

HF UHF

9. 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 - 48 V DC (Default), 120 W, 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
BUSHING MONITORING MODULE	# of Input Channels	03 or 06 Channels
	Leakage Current Range	1mA to 200mA
	Monitoring Parameters	Tan Delta (PF), Capacitance, Phase Voltage, Overvoltage, Overcurrent
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
COMMUNICATION OPTIONS	Ethernet Ports (RJ-45 & FO Ethernet)	Modbus, DNP3.0, IEC 60870-5-104, MQTT, IEC61850, PRP
	Serial Port	RS485 with Modbus support
	CANBUS Port	CANBUS Master/Slave support for Can Dataloggers

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 notificaions
- 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 9001

ISO 14001

ISO 45001/
OHSAS 18000

Llyod's
Register

ATEX
Certification

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