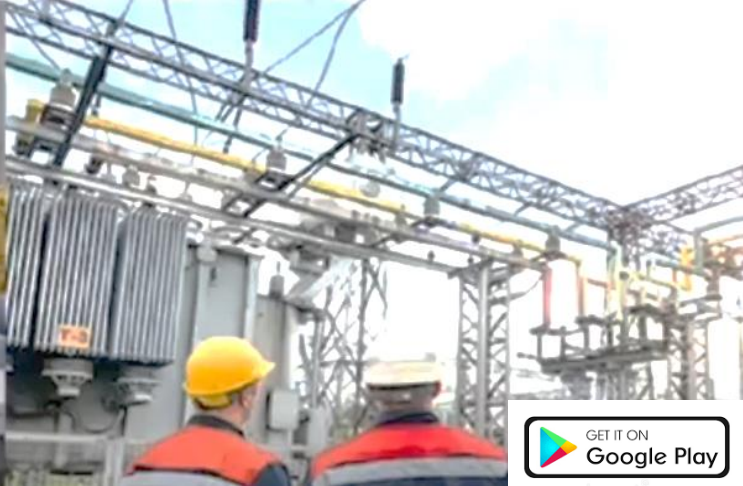




# Complex Transformer Monitoring Systems

## Complete Transformer Web Cloud Scada



[www.powerview-energy.com](http://www.powerview-energy.com)



*Pioneering the future of power testing and monitoring*





## Wireless communication

Long range Wireless communication



## Complete Transformer Cloud SCADA

All the measurement results are shown on wireless cloud SCADA



## Transformer diagnostics

On-site and smart cloud diagnostics using the most advanced Artificial Intelligence algorithms.



## High Accuracy

Using the most accurate sensors and transducers on the market



## PT100 Temperature sensors

Using highest quality Platinum (PT) 100 sensors. The sensors are made from special die-cast aluminum intended for a usage in oil filled HV transformers. The PT100 sensors can be used to measure the oil temperature in different parts of the transformer, depending on the transformer construction. This sensors can be easily connected to SCADA, monitoring devices, monitoring and protective IEDs, and a cloud SCADA.



## Optical Thermometers

This thermometers are used for winding temperature monitoring and hotspot detection. This sensors are connected to a special monitoring unit that analyzes the optical signals, shows the results, and can produce appropriate 4-20 mA output and relay output. The optical sensors have high dielectric strength, and long lifespan of 50 years. The sensors are in compliance with ASTM D149 - 10 kV/mm, IEC 60270 – less than 10pC standards. This outputs can be sent to SCADA, other monitoring devices, protective IEDs and a Cloud SCADA.



## Bushings Monitoring

Permanently installed bushings monitoring, that monitors, tan delta, cosp, capacitance, bushing leakage current, voltages. Even tough bushing replacement is cheap, failed bushing can make hundreds of thousands of dollars in transformer damages. This monitoring can prevent bushing failures from happening in the earliest stages. This monitoring devices produces alarm and output that can be connected to SCADA, monitoring devices, protective IEDs and a cloud SCADA



## Complete DGA

The most advance maintenance free DGA sensors that calculate full DGA. The measured gasses are:

- Hydrogen (H<sub>2</sub>);
- Carbon monoxide (CO);
- Carbon dioxide (CO<sub>2</sub>);
- Methane (CH<sub>4</sub>);
- Acetylene (C<sub>2</sub>H<sub>2</sub>);
- Ethane (C<sub>2</sub>H<sub>6</sub>);
- Ethylene (C<sub>2</sub>H<sub>4</sub>);

Also there are options available for single gas DGA, and Hydrogen Moisture monitoring. This sensors can be connected to the IED or SCADA, and directly connected to the cloud SCADA



## Leakage Current

The transformer insulation leakage current is measured via a highly accurate leakage current clamp on transformer. This leakage current can indicate the start of a failure of the transformer insulation system. Also frequency analysis is applied on the current data so the insulation aging and contamination is asseet. This sensor is connected directly to the cloud SCADA.



## IED

Intelligent electronic Devices (IED) are the newest generation of protection and monitoring. This devices provide detailed diagnostics of the transformer, taking in consideration all the sensors, monitoring devices, voltages, currents etc. The statuses of the IED can be sent directly to the cloud SCADA.



## Programmable alarm trips

All the mentioned monitoring devices have programmable alarm trips according to the users needs and application. This alarms trips are implemented via relay or analog outputs outputs which can be sent to the cloud SCADA, or read locally.



## Field upgradable

Completely configurable and field upgradable



## Parallel Scada with Internet Browser access and SMS / email notifications

Possibility to connect to a conventional SCADA while at the same time being connected to the cloud SCADA



## Compete substation solution

Extendable system to all HV assets inside a substation



### Transformer vibrations for core and windings deformations detection

The transformer vibrations are monitored in 9 locations on the transformer core in combination with the load current. This monitoring can detect core magnetic problems, and most importantly winding deformations.



### PD Monitoring

PD Monitoring with the most advanced ultrasonic technology. These precise sensors give great insight about the state of the transformer insulation.



### Risk assessment software Built in

Complete substation maintenance application software with all electrical tests with diagnosis , all inspections and wireless monitoring cloud SCADA with diagnosis for complete reliable HV asset risk assessment.



### Monitoring voltages, current Active, reactive power

State of the art voltage and current transducer that the outputs of the Voltage and Current transformers of the power transformer. This transducer calculates the active, reactive power, active, reactive energy, quadrant representation, cosp. This transducer has MODBUS output which can be sent to a cloud SCADA.



### OLTC DGA fault gasses monitoring with diagnostics

The OLTC Fault gas monitoring is a early fault detection and monitoring unit which is designed on load tap changer , plan outage and repair and evaluate asset condition It is capable of monitoring hydrogen gas generation, methane generation, ethane and ethylene moisture and complete gas pressure.



### All Electrical test analysis

Possibility to import test results from different manufactures. Detailed database model of all type of substation equipment. Smart algorithm that analyzes the electrical test and performs diagnostics.



### Complete monitoring analysis

All the monitoring results are post analyzed with the most advanced smart, artificial intelligence algorithms. All the data of the all the sensors for a respective asset is used to diagnostics the condition of the asset, for the most accurate condition assessment.



### Thermal visual corona and other inspections analysis and management

Uploading photos of visual and thermal inspections, triggering alarms, writing comments.



### Fans Monitoring and Control

The monitoring devices have integrated Smart Fan control, that can control the transformer fans, depending on the oil and winding temperature.



### OLTC position and current monitoring

Advanced OLTC analysis, switching operations, OLTC working interval, number of OLTC operations, OLTC working current.



## ⌚ Wireless communication

Complete wireless communication on all monitoring devices

## ✓ Complete Transformer Cloud Scada

Access all relevant information (complete monitoring, electrical tests and all inspections from web browser with key permissions

## ✓ Most comprehensive asset risk assessment with complete analysis

Analyzes more than 100 monitoring parameters, more than 1.000.000 individual element electrical tests results and all inspections.

The POWER VIEW complete transformer monitoring system is a wireless versatile transformer monitoring system which exists as parallel Scada on a Cloud platform deployed either on local premises on AWS cloud Server of the International Organization of Digital Substation Development

It uses wireless communication for all monitoring devices with back up power supply (1 long range router covers the entire Substation.

## Typical combinations

Combination 0	Standalone Chassis 0	NO IED INCLUDED. Standalone power analysis monitor, monitors current, voltages, powers via VT and CT. PT100 with 4-20 mA are connected to third party IED.
Combination 1	Standalone Chassis 1	RTD and optical thermometers connected to Chassis 1
Combination 2	Chassis 1+IED	Alarm outputs are connected to the IED, The IED measures voltages and current. Additional sensors, e.g DGA are connected to the IED.
Combination 3	Chassis 2+IED	Optical Thermometers are connected to the chassis 2. The RTDs via a transducer are connected to the IED as analog inputs. The additional sensors are connected to the IED via serial protocol



## Basic built in functionalities

✓ Default ✓ Additional ✗ Not included

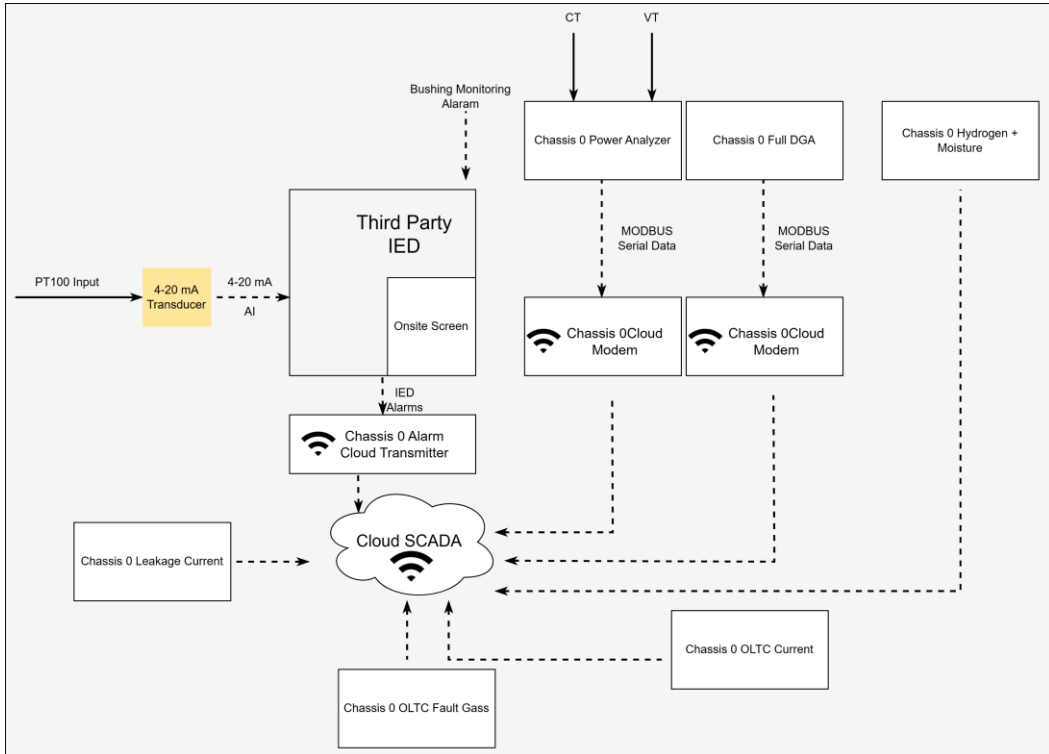


Specification	Chassis 0	Chassis 1	Chassis 2	IED
Avarams Integrated to IED for diagnostics	✗	✓	✓	
RTD Inputs	✓	✓	✗	✗
Analog Inputs	✓	✓	✗	✓
Analog Outputs	✗	✗	✓	✗
Digital Inputs	✓	✓	✗	✓
Programmable Alarm Relay Outputs	✗	✓	✓	✓
Fiber Optics Thermometer Input built in	✗	✓	✓	✗
OLTC switching analysis	✗	✓	✗	✓
Loss of life monitoring	✗	✓	✗	✓
GIC Core Saturation	✗	✓	✗	✗
Smart Cooling Control	✗	✓	✗	✓
Hotspot Diagnostics	✗	✓	✓	✓
Working Hours Monitor	✗	✗	✗	✓
Programmable Event Logging	✗	✓	✗	✓
CT Inputs	✓	✓	✗	✓
VT Inputs	✓	✗	✗	✓
Bushing Monitoring	✗	✓	✗	✗
Voltage Control	✗	✗	✗	✓
Power Compensation	✗	✗	✗	✓
SCADA Connectivity	✓	✓	✓	✓

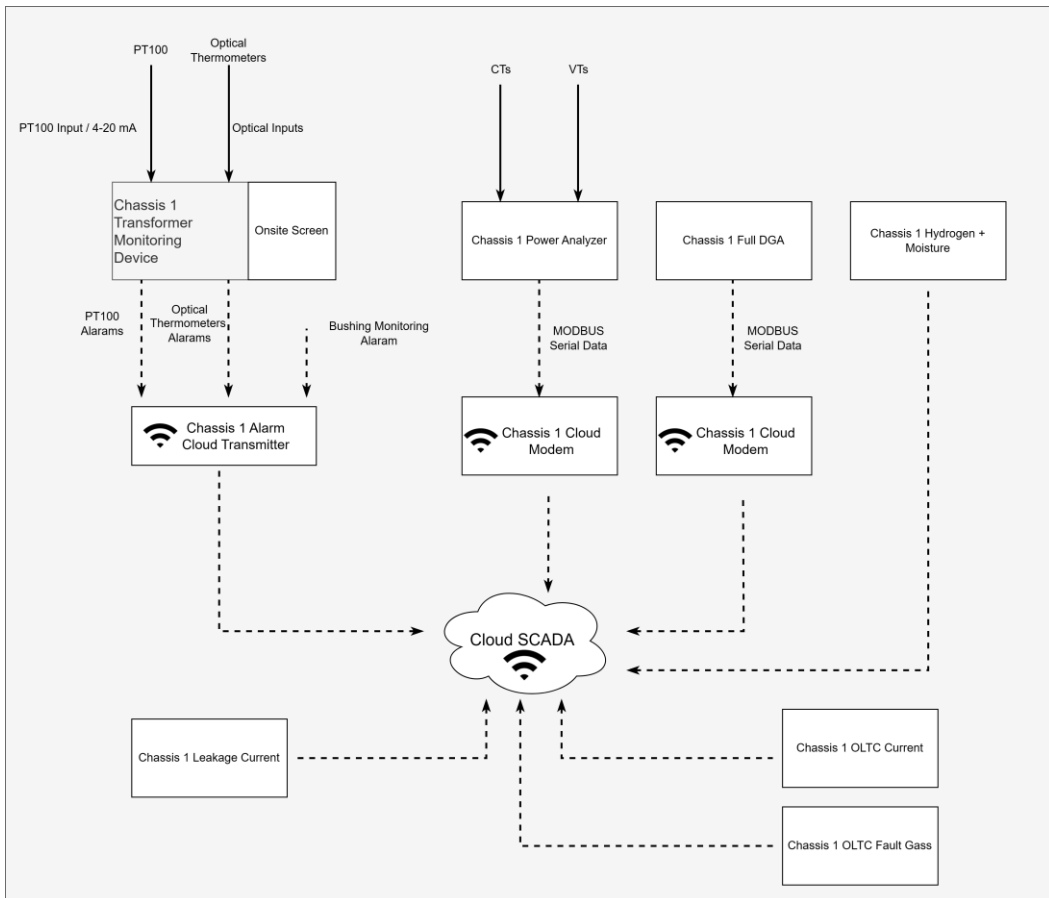
## Field upgrade options

Field upgrade options	To Chassis 0	To Chassis 1	To Chassis 2	To IED
Single gas DGA	✓	✓	✓	✓
Fully diagnostic DGA	✓	✓	✓	✓
Hydrogen + moisture	✓	✓	✓	✓
Bushings leakage current, capacitance and tan delta	✓	✓	✓	✓
Voltages Primary and Secondary	Already built in	✓	✓	Already built in
Currents Primary and Secondary	Already built in	✓	✓	Already built in
Optical Thermometers	Update to Chassis 1 or Chassis 2	Already built in	Already built in	Combine with Chassis 1 or Chassis 2
PT100 temperature sensor	Already built in	Already built in	Already built in	Already built in
Relay statuses and alarms cloud transmission, 16 channel	Already built in	Already built in	Already built in	Already built in
Core leakage current and harmonics analysis	✓	✓	✓	✓
OLTC fault gas monitoring	✓	✓	✓	✓
OLTC current monitoring	✓	✓	✓	✓

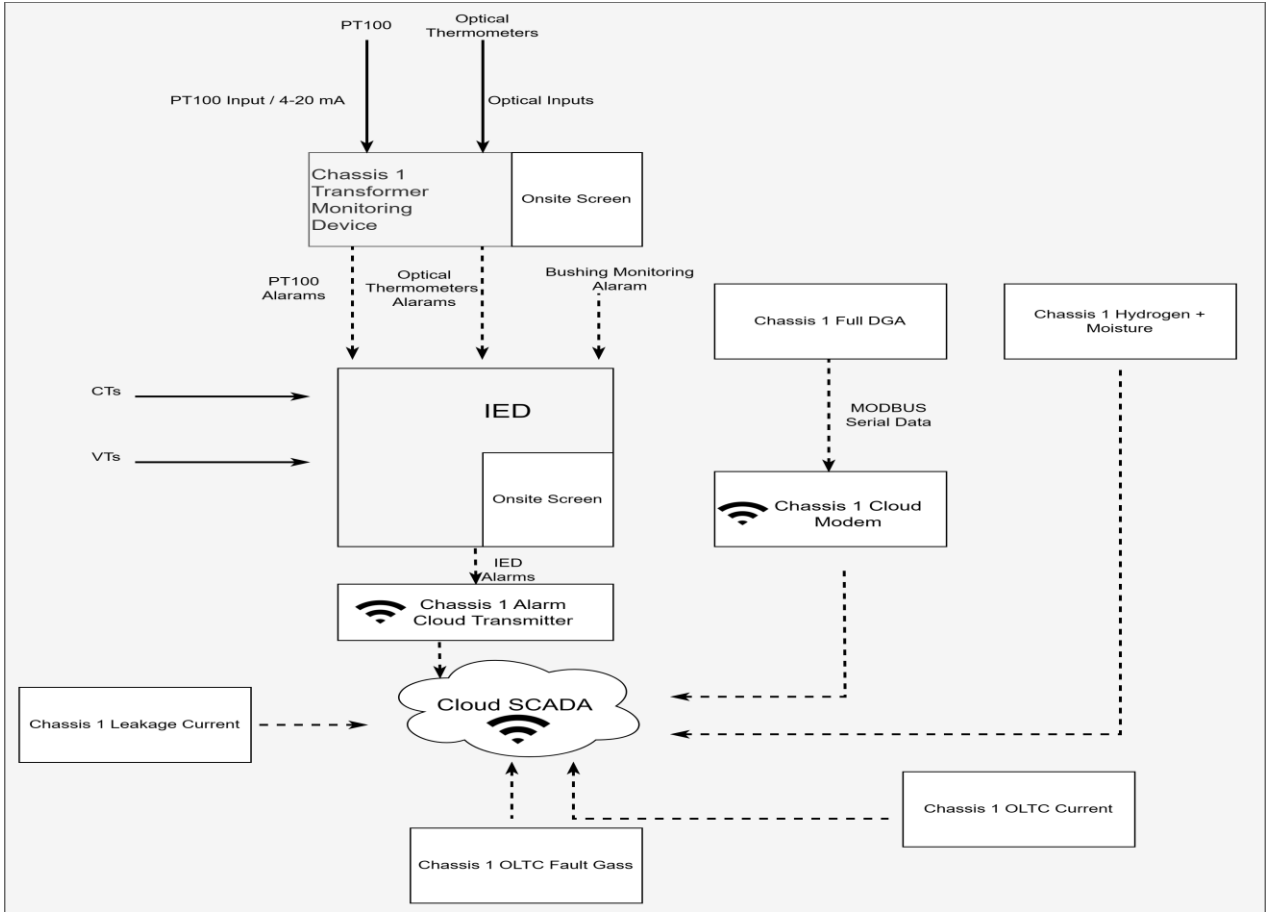
## Chassis 0



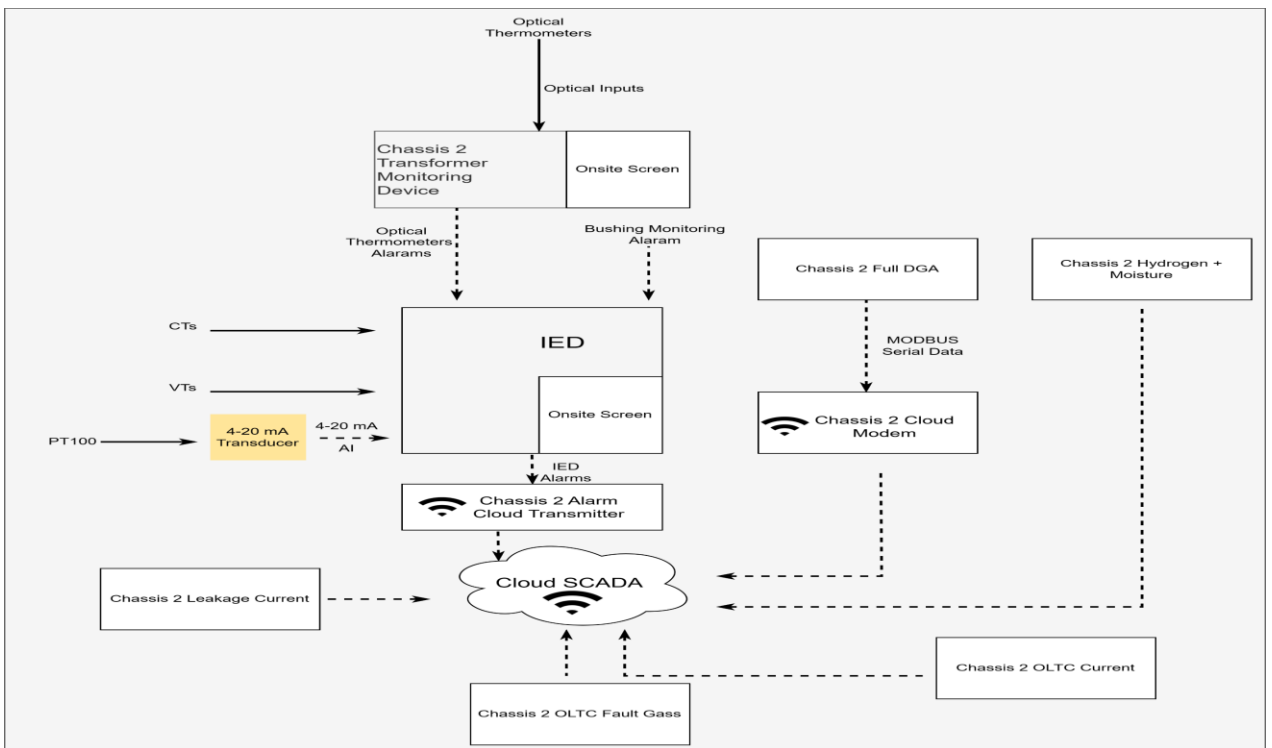
## Chassis 1



## Chassis 1+IED



## Chassis 2+IED





## World's fastest response time to fault

Immersed Tank DGA Sensor gives world's fastest fault reaction on key fault gas H<sub>2</sub>



## Proven Hydrogen monitoring sensor and technology

ABB, SIEMENS, use the identical sensors and measurement technology.



## Description

The Immersed Tank Sensor is a DGA monitoring unit. It is capable of monitoring hydrogen, temperature, moisture, and oil degradation directly from the transformer tank by permanently mounting on a flange. It has no moving parts (like pumps, membranes, gears, etc.) and uses solid state nickel palladium sensor for H<sub>2</sub> measurement. No spare parts, maintenance, or recalibration are required in the min 15-year lifetime.



## Different sensors and technologies

Various types of sensors have been used for Hydrogen monitoring.

Some had very limited lifetime (about 5 years) due to gel saturation, some had very large cross sensitivity to other gases and drifting results.

Our solid-state Nickel palladium sensor is most widely used today for hydrogen monitoring as it has no requirements for recalibration, no maintenance and spare parts and minimum lifetime of 15 years.



## The importance of probe type and installation

There are absolutely no limitations and no moving parts (such as membranes and pumps) needed for Immersed Tank Sensor installation. It can be installed on a flange on any transformer valve, and it measures the dissolved hydrogen directly in the transformer tank.

This is the key advantage as the sensor technology requires moderate oil movement for better measurement and fast response. That is why the Power View ITS Monitor has the fastest response to fault development.



## No spare parts consumables or recalibration

Absolutely no consumables or spare parts are needed for Immersed tank sensor and diagnostic (all fault gas) DGA.



## Fully configurable and field upgradable

This online monitoring system is fully configurable onsite upgradable. Users can start as hydrogen + temperature monitoring as a fault indication unit only.

Not all transformers fail. No need for expensive all fault gas DGA on all transformers. Start with key parameters and upgrade only if necessary.

This onsite upgrade is extremely valuable and money saver as Customers can start from fault indication unit and if fault is detected upgrade just the faulty transformer monitoring with fully fault diagnostic (according Cigre TB783 recommendation).

This monitoring system has no consumable, moving parts, spare parts, parts with a limited-service life (less than 15 years), no need for recalibration.



## Immersed Tank DGA Sensor



### Worlds first Field upgradeable from single gas to full DGA

Not all transformers fail. No need for expensive all fault gas DGA on all transformers. Start with key parameters and upgrade only if necessary.

#### Technical specification

<b>Measurement range (in oil)</b>	<b>0 ... 5000 ppm<sub>v</sub></b>
<b>Accuracy (in oil temperature range)</b>	±10 % of reading or ±25 ppm <sub>v</sub> (whichever is greater)
<b>-20 ... +60 °C (-4 ... +140 °F)</b>	
<b>Repeatability</b>	±10 % of reading or ±15 ppm <sub>v</sub> (whichever is greater)
<b>Minimum detection limit</b>	25 ppm <sub>v</sub>
<b>Typical long-term stability</b>	3 % of reading / year
<b>Cross sensitivity to other gases</b>	< 2 % (CO <sub>2</sub> , C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , CO)
<b>Response time</b>	63 % of full response: 2.5 h (when sensor is not in reference cycle) 90 % of full response: 17 h
<b>Warm-up time</b>	2 h, 12 h for full specification
<b>Sensor</b>	Catalytic palladium-nickel alloy film solid-state sensor
<b>Oil type</b>	<b>Mineral oil / Natural ester oil / Synthetic, ester oil</b>
<b>Operating temperature (electronics)</b>	-40 ... +60 °C (-40 ... +140 °F)
<b>Storage temperature</b>	-40 ... +60 °C (-40 ... +140 °F)
<b>Operating humidity</b>	0 ... 100 %RH, condensing
<b>Pressure tolerance (probe, short-term)</b>	Max. 10 bara
<b>Pressure tolerance (probe, continuous)</b>	Max. 4 bara
<b>Temperature tolerance, sensor head</b>	-40 ... +120 °C (-40 ... +248 °F)
<b>Integrated protection for short power outages</b>	> 3 s
<b>EMC standard EN61326-1, Industrial environment;</b>	Fulfills the requirements of IEC
<b>CISPR22 class B emission limits when DC powered</b>	61000-6-5 in the following tests:  IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11, IEC 61000-4-12, IEC 61000-4-16, IEC 61000-4-17.



### Advanced reporting and communication

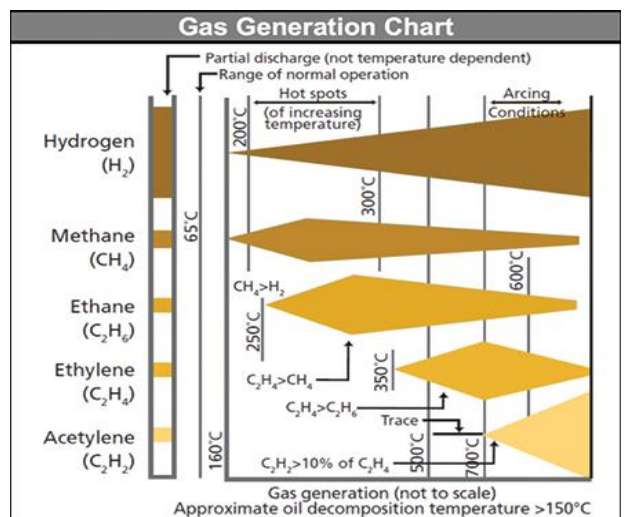
Most advanced reporting and communication Protocols.

#### Oil Humidity Sensor

- Continual condition monitoring of transformer oils
- Relative moisture and temperature
- High pressure rating
- Quick installation via process connection

<b>Application:</b>	mineral oils; synthetic esters; biodegradable oils
<b>Measuring range relative saturation</b>	0-100% RS
<b>Accuracy [%] :</b>	± 3 %
<b>Tank pressure [bar]</b>	50 bar
<b>Oil Medium temperature [°C]</b>	-40...105
<b>Operating voltage [V]</b>	9...33 DC
<b>Current consumption [mA]</b>	< 25 mA

<b>Communication</b>	Modbus RS485, Substation digital web interface IEC 61850 ( option) 4 Analog outputs (option) 6 Relays (option)
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# Transformer oil complete DGA monitoring

## Why transformers fail

Transformers, like any other equipment, are susceptible to faults caused by the factor of imperfection and premature aging of materials, imperfection in making human errors in maintenance and manipulation.

Depending on the value of the transformer, these faults, if not detected on time, develop into more expensive faults ( more expensive repair and lost production if the fault is not repaired in early stage).

Yearly maintenance lab DGA addresses slowly developing faults .

When it has been indicated ( by Lab testing or fault monitor ) that a fault is developing inside a transformer a fully diagnostic all fault gasses DGA is the best solution which helps faulty transformer stay in service (until repaired) .

With the FDM the fault development is monitored 24/7 and any significant change in the fault can be noted in an early stage.

This monitoring solution saves money , helps better understand fault and helps preventing expensive faults , and helps planning and optimizing service intervals.

An additional limitation of laboratory analysis is the time required to sample, analyze and obtain results (for example if a decision needs to be made to re-enable a transformer after an outage.

This monitoring system has no consumable, moving parts, spare parts, parts with a limited-service life (less than 15 years), no need for recalibration or any maintenance.



## No spare parts consumables or recalibration

Absolutely no consumables or spare parts for diagnostic complete fault gas DGA



## Fast response to fault

Fast response time most of quick developing faults due to immersed tank sensor technology

## Measured parameters

Online DGA on diagnostic fault gases

This system provides online measurement of all 7-transformer fault diagnostic gases:

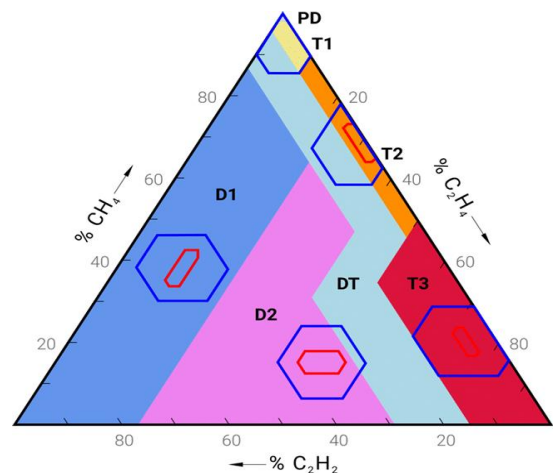
- Hydrogen (H<sub>2</sub>);
- Carbon monoxide (CO);
- Carbon dioxide (CO<sub>2</sub>);
- Methane (CH<sub>4</sub>);
- Acetylene (C<sub>2</sub>H<sub>2</sub>);
- Ethane (C<sub>2</sub>H<sub>6</sub>);
- Ethylene (C<sub>2</sub>H<sub>4</sub>);

Additionally, the system detects tank sealing problems (air leaking problems) (N<sub>2</sub> , O<sub>2</sub> gasses) by measuring total tank pressure.



## No scheduled maintenance or consumables needed

Completely maintenance and consumables free, long life fully diagnostic DGA Monitoring system



# Transformer DGA and Oil Quality Monitoring

## Technology

This monitoring system uses the Vaisala NDIR Sensor and Tunable filters technology for detection of 6 fault gases while hydrogen is measured directly at the oil tank ( for best response) .

It connects with external hoses to 2 flanges and uses Vacuum extraction ( which is proven as the most effective extraction technology for getting the dissolved gasses outies the oil.

The gasses are than exposed to NDIR sensor with tunable filters which require absolutely no need for recalibration or spare parts replacement in full lifecycle.

The Immersed Tank Sensor is a DGA monitoring unit. It is capable of monitoring hydrogen, temperature, moisture and oil degradation directly from the transformer tank by permanently mounting on a flange. It has no moving parts (like pumps membranes gears etc. and uses solid state nickel palladium sensor for H2 measurement .

No spare parts maintenance or recalibration are required in the min 15-year lifetime.

## Technical Specification

Parameter	Range	Accuracy	Repeatability
<b>Methane (CH4)</b>	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
<b>Ethane (C2H6)</b>	0 ... 10 000 ppm <sub>v</sub>	±10 ppm or ±5 % of reading	10 ppm or 5 % of reading
<b>Ethylene (C2H4)</b>	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
<b>Acetylene (C2H2)</b>	0 ... 5000 ppm <sub>v</sub>	±0.5 ppm or ±5 % of reading	1 ppm or 5 % of reading
<b>Carbon monoxide (CO)</b>	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
<b>Carbon dioxide (CO2)</b>	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
<b>Moisture (H2O)</b>	0 ... 100 ppm <sub>w</sub>	±2 ppm or ±10 % of reading	Included in accuracy

Hydrogen Measurement range (in oil)	0 ... 5000 ppm <sub>v</sub>	Oil type	Mineral oil / Natural ester oil /Synthetic, ester oil
Accuracy (in oil temperature range -20 ... +60 °C (-4 ... +140 °F))	±15 % of reading or ±25 ppm <sub>v</sub> (whichever is greater)	Operating temperature (electronics)	-40 ... +60 °C (-40 ... +140 °F)
Repeatability	±10 % of reading or ±15 ppm <sub>v</sub> (whichever is greater)	Storage temperature	-40 ... +60 °C (-40 ... +140 °F)
Minimum detection limit	25 ppm <sub>v</sub>	Operating humidity	0 ... 100 %RH, condensing
Typical long-term stability	3 % of reading / year	Pressure tolerance (probe, short-term)	Max. 10 bara
Cross sensitivity to other gases	< 2 % (CO2, C2H2, C2H4, CO)	Pressure tolerance (probe, continuous)	Max. 4 bara
Response time	63 % of full response: 2.5 h (when sensor is not in reference cycle) 90 % of full response: 17 h	Temperature tolerance, sensor head	-40 ... +120 °C (-40 ... +248 °F)
Warm-up time	2 h, 12 h for full specification	Integrated protection for short power outages	> 3 s
Sensor	Catalytic palladium-nickel alloy film solid-state sensor	EMC standard EN61326-1, Industrial environment;	Fulfills the requirements of IEC
		CISPR22 class B emission limits when DC powered	61000-6-5 in the following tests:
			IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11, IEC 61000-4-12, IEC 61000-4-16, IEC 61000-4-17.

## Measurement operation

Total dissolved combustible gases (TDCG)	Combined total of H <sub>2</sub> , CO, CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>2</sub> H <sub>4</sub> , and C <sub>2</sub> H <sub>2</sub>
24 h average	Available for single gases, moisture, TDCG, and total gas pressure
Rate of change (ROC)	Available for single gases and TDCG for 24 h, 7 d, and 30 d periods
Gas ratios	Available ratios: CH <sub>4</sub> /H <sub>2</sub> , C <sub>2</sub> H <sub>2</sub> /C <sub>2</sub> H <sub>4</sub> , C <sub>2</sub> H <sub>2</sub> /CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> /C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> /C <sub>2</sub> H <sub>6</sub> , CO <sub>2</sub> /CO

### Trigger type

### Gas alert with user selectable limits

Galvanic isolation	2 kV RMS, 1 min
Max. switching current	6 A (at 250 VAC) 2 A (at 24 VDC) 0.2 A (at 250 VDC)
User interface	

### Interface type

Web based user interface, can be operated with standard web browsers

### Transformer oil type

### Mineral oil

Required minimum fire point of transformer oil	+125 °C (+257 °F)
Transformer oil pressure at oil inlet	Max. 2 bar <sub>abs</sub> continuous Burst pressure 20 bar <sub>abs</sub>
Transformer oil temperature at oil inlet	Max. +100 °C (+212 °F)
Ambient humidity range	0 ... 100 %RH, condensing
Ambient temperature range in operation	-40 ... +55 °C (-40 ... +131 °F)
Storage temperature range	-40 ... +60 °C (-40 ... +140 °F)
Measurement cycle duration	1 ... 1.5 h (typical)
Response time (T63)	One measurement cycle

Warm-up time until first measurement data available Two measurement cycles

## Outputs RS-485 Interface

### Supported protocols

Modbus RTU, DNP3 (optional feature)

Galvanic isolation

2 kV RMS, 1 min

### Ethernet Interface

Supported protocols

Modbus TCP, HTTP, HTTPS, DNP3 (optional feature), IEC 61850 (optional feature)

Galvanic isolation 4 kV AC (50 Hz, 1 min)

4 kV AC (50 Hz, 1 min)

Relay outputs

Number of relays

3 pcs, normally open (NO) or normally closed (NC), user selectable

## Power supply

Operating voltage	100 ... 240 VAC, 50 ... 60 Hz, ±10 %
Overvoltage category	III
Maximum current consumption	10 A
Maximum power consumption	500 W
Typical power consumption at +25 °C (+77 °F)	100 W

## Mechanical specifications

Oil fitting	Stainless steel Swagelok fitting for 10 mm (0.39 in) outer diameter tubing. See list of accessories for adapters available.
Max. length of oil pipe to transformer	Max. 10 m (33 ft) with 7 mm (0.28 in) inner diameter tubing Max. 5 m (16 ft) with 4 mm (0.15 in) inner diameter tubing
Material	Marine aluminum (EN AW-5754), stainless steel AISI 316

## Transformer windings optical temperature monitoring

**ASTM D149 and IEC 60076-2 compliant**

**Highest Electromagnetic Immunity and high accuracy**

**Durable FBG technology with no need for maintenance and calibration**

Power transformers are critical components in electrical systems, and accurate temperature monitoring of their windings is essential to ensure reliable operation and prevent overheating. The technology used leverages fiber-optic sensors to provide real-time and accurate temperature measurements, overcoming the limitations of traditional methods such as RTDs (Resistance Temperature Detectors) and thermocouples, have limitations in terms of accuracy, sensitivity, and susceptibility to electromagnetic interference.

The Optical Temperature Monitoring technology employs fiber-optic sensors based on the principle of Fiber Bragg Grating (FBG). FBGs are periodic variations in the refractive index of an optical fiber that act as wavelength-specific reflectors. Temperature changes induce strain in the fiber, altering the wavelength of reflected light, which correlates with temperature variations. The sensors are embedded in the transformer winding to provide distributed temperature data along the entire length.

The system has very high accuracy with deviations as low as  $\pm 0.5^{\circ}\text{C}$ .

The distributed nature of FBG sensors allows for fine spatial resolution, detecting hotspots and localized temperature variations.

**Electromagnetic Immunity:** Unlike traditional methods, FBG sensors are immune to electromagnetic interference, ensuring accurate readings in high-voltage environments.

**Real-time Monitoring:** The technology provides real-time temperature data, enabling prompt response to temperature anomalies.

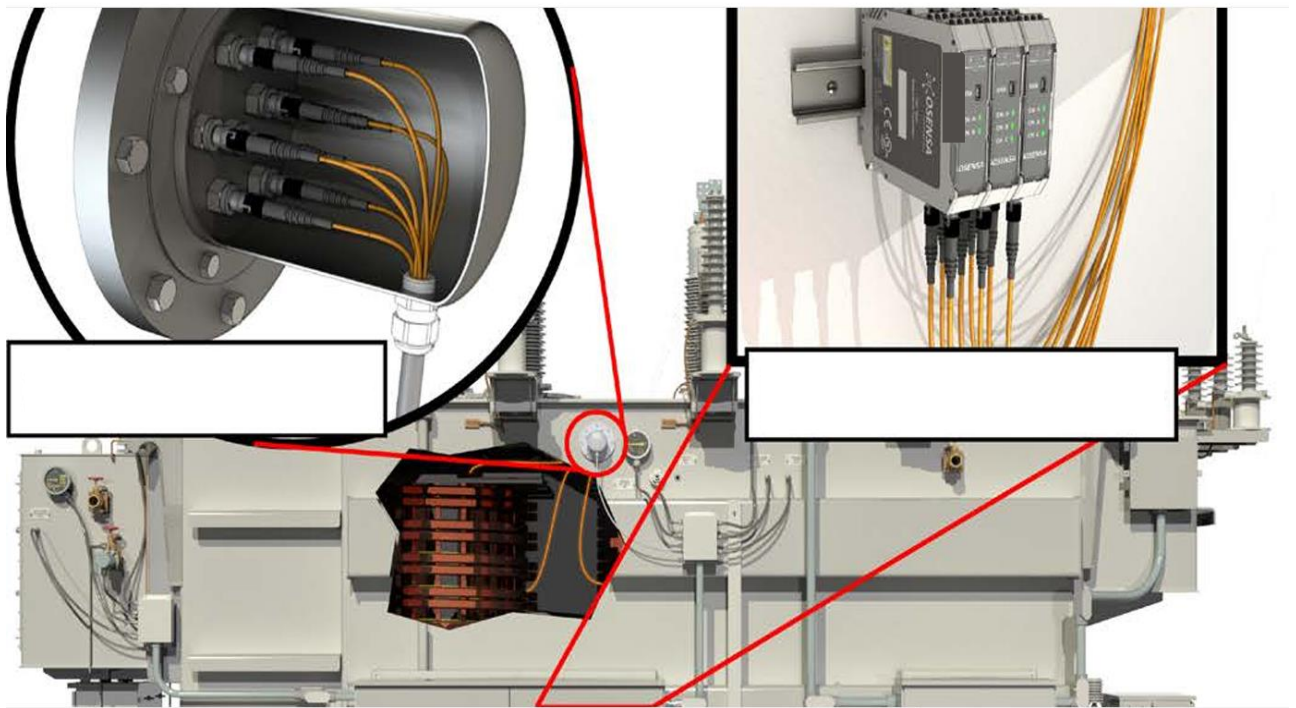
Optical fibers are robust and can withstand harsh environmental conditions, ensuring long-term reliability.

**Maintenance:** The non-intrusive nature of FBG sensors eliminates the need for frequent maintenance.

Multiple sensors can be multiplexed on a single fiber, enabling comprehensive temperature mapping.

It showcases the benefits gained, such as early fault detection, improved asset management, and enhanced system reliability.

Durable solution for accurate and real-time temperature monitoring of power transformer windings. Its advantages in terms of accuracy, immunity to electromagnetic interference, and distributed temperature sensing make it a valuable tool for ensuring the reliability and longevity of power transformers.



## Transformer windings optical temperature monitoring

Feedthrough is a hermetically sealed stainless steel ¼ inch male NPT fitting designed for use with the fiber optic temperature sensing systems. The feedthrough can provide a leak-free optical path between the tank walls of power transformers. The ST-to-ST connection provides a reliable, vibration resistant connection for the fiber optic temperature sensing probes.

Tank Wall Feedthrough



PWTX is fiber optic temperature transmitters in a compact 35mm DIN-rail mountable format. Each transmitter accepts from one to six optical fiber sensor inputs. The PWTX transmitters are powered by 12-24V DC and include isolated RS-485 serial connectivity over industry standard Modbus RTU protocol. Multiple transmitters can be connected in series on a standard 35mm DIN rail with power and RS-485 communication supplied by the five-pin T-Bus connector



Tank Wall Plate allows for up to 25 optical feedthroughs to pass through an oil-filled transformer tank wall. The tank wall plate can be mounted to the transformer either by welding (CRS) or bolting (stainless steel with O-Ring). Optional mounting holes can be added for an IP rated junction box.



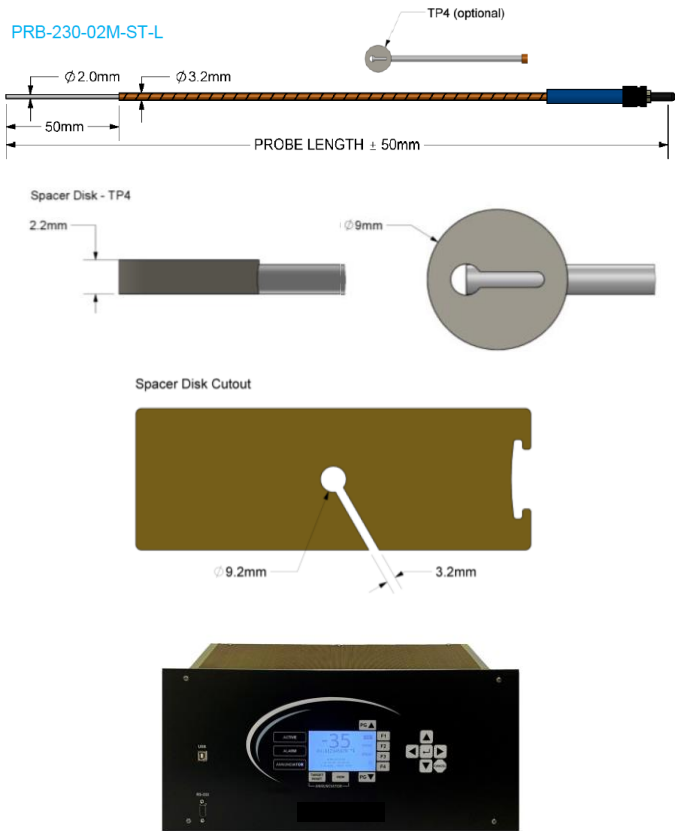
- PRB-730 fiber optic temperature probes are specifically designed for oil-filled transformer applications where long life and accuracy are paramount. Not only are these probes stable and repeatable over the life of the transformer (no calibration required), they also offer industry leading accuracy, precision, and reliability. The PRB-730 style probes are fully compatible with all transformer oil types and kerosene desorption processes. PRB-730 temperature probes, together with the EXT-730 extension cables, can support installation lengths up to 50m.



HMI-RELAY touch panel additionally includes 8 standard user programmable form C relay outputs, one configurable fail-safe system relay, and 12 analog outputs. The intuitive touch interface enables easy configuration of the relays for alarms and hardware control.

# Temperature Sensors Specifications

<b>Optical Sensor</b>	
Range	-40°C to 230°C
Accuracy	± 1.0°C
Dielectric Strength	10 kV/mm
Compliance	ASTM D149 - 10 kV/mm, IEC 60270 – less than 10pC
<b>Expected sensor lifetime</b>	Min 50 years
<b>Chassis 1</b>	
RTD Inputs	7
Optical Inputs	16
Analog Outputs	X
Analog Inputs	MAX 32
Digital Inputs	MAX 84
Programmable Relay Output	MAX 16
OLTC Analysis	✓
Loss of Life analysis	✓
GIC Core Saturation	✓
Hotspot Diagnostics	✓
Smart Cooling	✓
Maximum Voltage	765 kV
Power Supply	38 VDC to 290 VDC or 120 VAC
Event Logging	✓
email notification	✓
Protocols	DNP 3.0 or MODBUS TCP/IP Wired RS-485 for DNP 3.0 or MODBUS RS-232 and USB B Serial Communications
<b>Chassis 2</b>	
Conditioner	
Channel Numbers	6
Range	-50°C to 250°C
Resolution	0.1°C
Accuracy	±2.0°C
Communication	MODBUS RTU
HMI	
Touch Screen	✓
Analog Outputs	12
Programmable Relay Output	8
Communication	RS-232, RS-485
Conditioner connectivity	Modbus Slave (over TCP/IP, RS485,USB)
SD Card Memory	16 GB
RAM	1 GB
Power Supply	24 V
<b>RTD Sensor</b>	
Technology	PT100
Integrated 4-20 mA Conditioner	✓
Power Supply	24 VDC
Special Design for Oil Filled Transformer	✓



Protection Relay



3-rd party RTD Sensor typically delivered with the system



## Proven BMC technology

The same Bushing sensors and components are used in the SIEMENS Bushing monitoring system



## Key advantages

- Simultaneous measurement of up to six bushing leakage currents, providing following data:
- Relative capacitance in percentage to the start-up value
- Relative power factor (%PF) for each bushing
- Magnitude of imbalance currents for two three phase sets of bushings
- Phase angles of the imbalance currents
- Alarm in case the measured values exceed the threshold
- Complete on-line transformer monitoring and bushing monitoring system in conjunction with other POWER VIEW products

## Description

Bushings are relatively cheap (comparing to transformer value). Unfortunately, bushings breakdown failure often leads to catastrophic transformer failure like windings deformations. Due to materials imperfection weather conditions and stress bushings are prone to failure. Unfortunately, sometimes that failure escalates very quickly. Historically bushings were tested off-line to measure the capacitance and the dissipation / power factor. The Bushing BMC Monitor is a permanently installed on-line bushing monitoring system. It continuously measures up to six leakage currents, tests the power factor and capacitance values and monitors the condition of bushings, CCVT's 1) and free-standing CT's.

The bushing monitoring system incorporates three measurement modes for standard and two for optional configurations.

Standard configuration with 6 current inputs:

- Sum of three current test
- Adjacent phase reference test
- Phase comparison

Optional configuration with 3 voltage and 3 current inputs:

- Reference test (3 bushings and 3 CCVT's 1))

Optional configuration with 6 voltage inputs:

- CCVT 1) Reference test (6 CCVT's 1))

The bushing sensors / adapters are connected to the capacitor taps designed for all types of bushings to allow measurement of the leakage current up to 140 mA AC.



## Advanced reporting

Most advanced reporting and communication protocols

## Bushing monitoring setup

The Bushing Monitoring system POWER VIEW BLC Monitor can be ordered in different versions with 3, 6, 9 2), 12 2) or 16 2) bushing sensors according to the specification.

The system contains following parts:

- Bushing sensors with connection cable
- Bushing Monitor Power View BLC including cabinet, power supply, circuit breaker, terminals and wiring
- Communication cable

The adapters are designed for bushings with grounded and un-grounded capacitor taps. The adapter is designed to prevent a voltage developing on the equipment, in case that the sensor becomes disconnected from the bushing monitoring system.





# Transformer Bushing Monitoring with PD



## Key advantages PD

When the utmost in transformer reliability is required for critical transformer assets, partial discharge detection must be part of the monitoring strategy.

The POWER VIEW BLC Monitor PD plus performs all the test methods of the POWER VIEW BLC Monitor but also monitors for partial discharge (PD). The PD activity in the bushings is monitored in parallel with the power factor calculations.

PD is detected using the same bushing sensor as with the POWER VIEW BLC Monitor, there are no other sensors or Rogowski coils.

PD is caused by defective insulation in high-stress areas, movement of energized parts, or design errors where low level discharges occur.

Some types of PD may not present a problem, but others can develop into surface tracking or insulation failure, which can lead to bushing or transformer failure.

The POWER VIEW BLC Monitor PD plus also has the unique capability of monitoring GIC events and trends which potentially could damage the transformer.



## Additional Specifications POWER VIEW BLC Monitor PD plus

Power Supply Input 85-264 VAC, 120-370 VDC, 50 VA

Operating Range

PD Frequency HF <20 MHz

PD Resolution 1.0°

Time Resolution 10 nS

Dynamic Range 65 dB

PD Intensity 0 – 5000

mW

PD Amplitude 0.02-100

nC ± 10 V

Top oil temperature sensor input

Three load current CT sensor inputs

Ambient Temperature and Humidity sensor inputs

### Outputs

PF, C1, leakage current for each bushing

Imbalance for each group of 3 bushings

PD power, PD amplitude, PD pulse count for each channel

PRPD plots for each channel

Top oil temperature

Load currents

Hot-Spot temperature

Ambient temperature and humidity



## Online Bushing Monitoring

### Technical Specification

Measurements		Accuracy
Measuring quantity	Range	
Leakage current	0 ... 140 mA AC	± 1.5 % of reading
Power factor / Dissipation factor	0 ... 100 %	± 0.045 % absolute
Capacitance	100 ... 5000 pF	± 1.0 % of reading
Phase angle of imbalance current	0 ... 360	± 1.0 % of reading
<b>Supply voltage</b>	<b>85 ... 264 V AC / 47 ... 63 Hz or 120 ... 370 V DC</b>	

Power consumption:	Max. 24 VA
Dimensions:	
Cabinet:	Stainless steel 304
3 and 6 channels	W 420 x H 595 x D 153 mm
9 and 12 channels	W 610 x H 686 x D 229 mm
Weight:	
3 and 6 channels	approx. 15 kg
9 and 12 channels	approx. 23 kg
Operation temperature:	-40 °C ... +65 °C
Storage temperature:	-40 °C ... +85 °C
AD converter	16 Bit
Sampling rate	10 kHz
Safety	
Electrostatic discharge:	IEC 801-2

### Technical Specification

#### Additional Specifications POWER VIEW BLC Monitor PD plus

#### Top oil temperature sensor input

Three load current CT sensor inputs

Ambient Temperature and Humidity sensor inputs

#### Outputs

PF, C1, leakage current for each bushing

Imbalance for each group of 3 bushings

PD power, PD amplitude, PD pulse count for each channel

PRPD plots for each channel

Top oil temperature

Load currents

Hot-Spot temperature

Ambient temperature and humidity

### Digital outputs

- Bushing sensor - Resistive bridge / capacitive bridge

### Communicatio

- RS 232 – Screw terminals and RJ45 (Proprietary protocol) Communication interface**

- DNP3 serial or MODBUS® RTU Controller (Option)

### Operation

- Bushing sensor - Resistive bridge / capacitive bridge

<b>Voltage range: (Bushing primary)</b>	<b>69 ... 765 kV AC</b>
60 Hz voltage: (on the tap at monitoring)	max. 2.5 kV AC
60 Hz voltage: (on the tap at opened or mistakenly cut coax cable)	max. .5 kV AC
Dimensions:	Size is different depending on the voltage
Weight:	approx. no more than 1 kg
Operating temperature:	-55°C ... +90°C, 95 % relative humidity (non condensing)
Storage temperature:	-50 °C ... +55 °C
Installation environment:	Outdoor, no corrosive agents in the air
Type of capacitor tap:	Any manufacturer
Connector to test tap:	¾" / 1 ¼" / 2 ¼" others on request

## Transformer Bushing Monitoring with PD

Power Supply Input 85-264 VAC, 120-370 VDC, 50 VA

Operating Range	
PD Frequency HF	<20 MHz
PD Resolution	1.0°
Time Resolution	10 nS
Dynamic Range	65 dB
PD Intensity	0 – 5000 mW
PD Amplitude	0.02 – 100 nC ± 10 V



## Reliable and powerful

Industry proven sensors in combination with the most advanced software for diagnostics and monitoring .

Partial discharge (PD) monitoring in power transformers is a critical aspect of their maintenance and reliability. UHF (Ultra-High Frequency) PD monitoring and traditional electrical PD monitoring are two common techniques used to detect and assess PD activity in power transformers.

### 1. Detection Method:

- UHF PD Monitoring: UHF PD monitoring relies on detecting the electromagnetic emissions generated by PD events in the ultra-high frequency range (typically several hundreds of MHz to several GHz). Antennas or sensors are placed on the transformer to capture these signals.
- Electrical PD Monitoring: Electrical PD monitoring involves measuring the electrical impulses produced by PD events. This method typically uses capacitive or resistive couplers to capture the signals.

### 2. Sensitivity:

- UHF PD Monitoring: UHF monitoring is highly sensitive and can detect PD events at their early stages. It can identify PD sources in various transformer components, such as winding, oil, or insulation.
- Electrical PD Monitoring: Electrical PD monitoring may have limited sensitivity compared to UHF monitoring, as it primarily focuses on electrical signals.

### 3. Location of PD Sources:

- UHF PD Monitoring: UHF can pinpoint the location of PD sources more accurately. It can distinguish between different types of PD sources within the transformer.
- Electrical PD Monitoring: Electrical PD monitoring may provide less precise localization information about PD sources.



## Early fault detection and notification

Measures PD inside transformer tank (where the external noise is minimal)



### 4. Interference and Noise:

- UHF PD Monitoring: In substation UHF signals can be affected by external interference, but as the transformer tank is closed box it is relatively immune to external interferences .
- Electrical PD Monitoring: Electrical PD monitoring is less susceptible to external interference from the surrounding but is far more affected by system noise and careful and experienced gating is required to eliminate the system noise.

5. Frequency Range:

- UHF PD Monitoring: UHF monitoring covers a higher frequency range, making it capable of detecting a wider range of PD events.
- Electrical PD Monitoring: Electrical monitoring typically operates at lower frequencies, limiting its ability to detect certain types of PD events.

6. Complementary Use:

Both UHF and electrical PD monitoring can be used together to provide a more comprehensive understanding of the transformer's condition. They complement each other, as UHF can detect certain types of PD events that electrical monitoring might miss. The choice between UHF and electrical PD monitoring depends on factors like the specific transformer, its design, budget constraints, and the desired level of sensitivity and accuracy. Some utilities and industries may opt for a combination of both methods to ensure thorough monitoring and early detection of potential issues in power transformers.

Cigré Working Group WG A2-27 recommends to install DN50 valves or dielectric windows for later fitting of UHF probes. (Recommendations for condition monitoring and condition assessment facilities for transformers, TB 343). The dielectric window sensor is designed according to Cigré Working Group WG D1-37 (Guidelines for partial discharge detection using conventional and unconventional methods, TB 662).

- Retrofit possible at DN50 and DN80 valves
- For oil-filled transformers
- Bandwidth: 100 MHz ... 3000 MHz
- Integrated LF grounding



Technical Data Bandwidth	100 MHz - 3000 MHz
Oil pressure	5 bar (max.)
Oil temperature	120°C (max.)
Connection	Type N connector female
Dimensions	(H x D) 630 mm x 180 mm
Antenna	diameter 44 mm

Weight	2.6 kg
IP protection	class IP 65
Operation temperature	-40°C ... +100°C
Insertion depth of UHF antenna	50 mm ... 450 mm (laser scaled)
Type Tests	CE conformity EMC, RoHS EMC EN IEC 61326-1
Emission:	CISPR 11 / EN IEC 55011 Immunity: EN IEC 61000-4-2 / EN IEC 61000-4-3 / EN IEC 61000-4-4 / EN IEC 61000-4-5 / EN IEC 61000-4-6 / EN IEC 61000-4-8 / EN IEC 61000-4-11 Environmental EN IEC 60068 EN IEC 60068-2-1 / EN IEC 60068-2-2

# Transformer Vibrations Monitoring and leakage current



## Reliable and powerful

Analog devices sensors in combination with the most advanced software for diagnostics and monitoring .



## Transformer Winding Losseness and Deformation Detection

Traditionally Winding deformation can be detected in non-operating condition using frequency response or electrical tests. Using online monitoring method saves time and trends the condition easier. The system uses a matrix of vibration accelerometer sensors and load current monitoring to detect winding deformations while the transformer is in operating condition. Transformer vibrations occur under normal working conditions, which are caused by the load current and the leakage flux. The vibration can be transmitted through liquid and solid pathways. The dependencies of the acceleration from the square of the load current and frequency analysis are used to differentiate failures from the normal working condition and detect the following:

- Clamping Force Looseness
- Global Looseness
- Radial Deformation



## Description

The POWER VIEW TVM is permanently installed on a Transformer. A matrix of a vibration sensor are placed on the transformer tank and the load current is monitored on the current transformers. The system monitors and analyzes real time transformer vibration,  $g=f(I^2)$  for transformer winding deformation detection.

The monitoring system is available in several configurations and versions with IP protection classes starting from IP65. The power supply needed is 180-250 V, 50 Hz



## Early fault detection and notification

Measures on-load vibrations, detects winding deformations at the earliest stages



## Ultra-long wireless communication and low power consumption

Wireless communication at ultra-long-range of several tenths of kilometers



The POWER VIEW TLM is permanently installed on the transformer grounding terminal. Monitors real time insulation leakage currents on the grounding terminal. This helps in early detection of all transformer's insulation problems. Using smart algorithm and additional sensors integrated- the interferences and outdoor discrepancies are eliminated and the sensors measure true insulation leakage current.

The monitoring system is available is available in several configurations. All versions are available in various IP protection classes starting from indoor to outdoor IP65 installation. The power supply is 5V DC and it can be either network, solar or battery supply unit. The power consumption is less than 1mA!



## Easy fault management

The Transformer Vibrations Monitoring comes with powerful wireless software which integrates all substation elements. Users can view history and trending and be notified by individual alarms once fault is detected. All the alarms are fully configurable according to users needs.



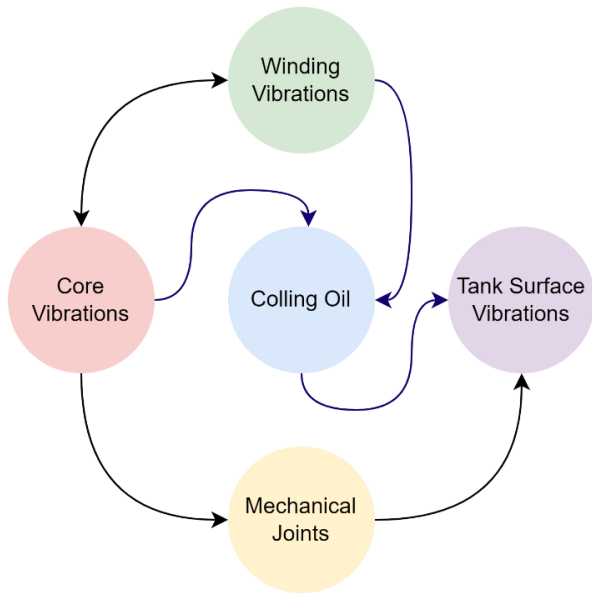
## Mobile app

The software comes with a powerful Mobile app (Android IOS) for a complete substation analysis, monitoring and inspection .



**PowerView**  
Testing & Monitoring Equipment

## Technical specification



### Accelerometer Sensors

Accelerometer Range	+16 g for all 3 Axes
Resolution	13 bit
Accelerometer Rating	10000 g
Bandwidth	3200 Hz
FFT Analysis	10 frequencies with the biggest contribution
Operating Voltage	2-3.6 V DC
Operation Temperature	-40~85 °C
Standard	Compliant with RoHS directive

### Acquisition and Communication System

Processor	ARM Cortex-M7 at 600 MHz
Resolution	8,10,12,16,24 bits
Operating Voltage	5 V
Sampling Rate	Up to 400 kHz

#### ■ Alarms, notifications and reporting

Fully customizable alarms , email and SMS notification and trending

#### ■ Low ownership Smart substation integration

Easy installation ( takes less than 2 hours to completely integrate the system.

#### ■ Advance Measurement Technology

#### ■ Open circuit protection and nonflammable material CT

■ Aluminum diecast enclosures with more impact resistance then ABS enclosures

#### ■ Neoprene seal to obtain IP-65 Protection class

■ IP-65 protection class enclosures protects your PCB from dust, liquid, impact and moisture which are needed for durability on outdoor conditions

#### ■ EMI shielded housing

#### ■ Heavy duty outdoor

### Core ground current sensor

**Rated Primary Current<sub>06</sub>** Max 100A (50/60Hz)

**Measurement range** 1mA -100A

**Max. Capable Current** 100A

**Nominal CT Ratio** 4500:1

**CT Inside Diameter** Ø22mm

**Applicable Frequency** 10Hz~5kHz

**Output Example** AC19.1mV ± 5% ( 200mA/430Ω)

**Output Part** Lead Wire : Approx. 4000mm (with Y Terminal: V1.25-B3A)

Housing	EMI shielded heavy duty outdoor -aluminum diecast enclosure with enhanced impact resistance. Neoprene seal and IP-65 Protection
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## Multi Fault gas detection

Detection of Hydrogen ,Methane, Acetylene Ethane, Ethylene for fault detection and classification plus moisture

## Easy installation and powerful software for data analysis

Less than 1 hour installation, ultra long-range wireless communication and most advanced software

## Description

The OLTC Fault gas monitoring is an early fault detection and monitoring unit which is designed for natural breathing On load tap changer to prevent serious faults in the earlier stage , plan outage and repair and evaluate asset condition It is capable of monitoring hydrogen gas generation, methane generation, ethane and ethylene moisture and complete gas pressure



## Gasses

### formation

Gasses in oil are created by breaking the molecular bonds of oil molecules caused by electrical stress, partial discharges, hot spots, oxidation, decomposition of insulation, etc.).

Molecules of insulating oil in high voltage equipment break down under the influence of the thermal and electrical stresses to produce gases

In OLTC Hydrogen (H<sub>2</sub>) is generated by partial discharges, arcing and in normal service caused by stress from electrical field,

Acetylene (C<sub>2</sub> H<sub>2</sub>) is generated by arcing. Methane (CH<sub>4</sub>) is generated at higher temperatures though generation starts at relatively low temperature (approx. 150 °C). Ethylene, (C<sub>2</sub> H<sub>4</sub>) is generated by higher temperatures (300 °C and higher). Ethane (C<sub>2</sub> H<sub>6</sub>) is also generated by higher temperatures (300 °C and higher).

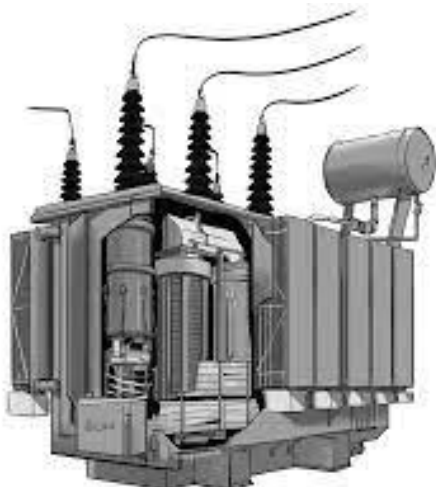
## Ultra long wireless communication And low power consumption

Wireless communication at ultra long range of several tenths of kilometers



In non vacuum type Acetylene and hydrogen are normally generated between switching operations but Methane, ethane and Ethylene are generally indicating thermal fault. In the arching spot the center temperature can reach thousand degrees Celsius. The oil molecules on this spot are totally degraded. After finishing of the arching molecules are regrouped and hydrogen and acetylene are the bypass product. Few millimeters from the plasma arch the temperature reduces. This relation between the gases is constant if the gases are generated by the arcs only. If there is another source of thermal fault gases, such as an overheated contact, the relation will change, and a fault can be detected in an early stage before any severe faults occur.

Gas generation in Vacuum types is extremely small compared to non-vacuum types since the main gassing source, the arc, is isolated in the vacuum interrupters. Only sparking from commutating contacts and heating from transition resistors and, for some types, also change-over selectors produces gases. This makes also faults such as arcing and high PD-levels possible to detect. Overheating will also be possible to detect at an earlier stage.



## Measurement Technology

Generally, fault gases are normally present in some levels in OLTC (due to arching). Increased gas generation above limit thresholds is generally related to oil is imposed to excessive electrical and thermal stress (due to evolving fault). As the fault generation accelerates more gases are released. Some small portion of the gases gets dissolved in the oil ( depending on the oil solubility coefficient).

There complete installation can be completed in couple of hours without any permanent modifications of the OLTC tank.

After the mechanical installation, the system can be easily integrated in a central monitoring. The sensor can be powered form network or batteries which should be replaced every 5 years, The monitoring is completely wireless, and no cable installations are necessary for power supply or data communication .

The system was designed to operate at extremely cold and warm environments and is shock and vibration resistant.





## Alarms, notifications and reporting

Fully customizable alarms, email and SMS notification and trending



## Technical specification



## Low ownership smart substation integration

Cheapest ownership cost and installation due to ultra low power consumption and wireless communication.

Most advanced reporting and communication protocols

<b>Detection and measurement range H2</b>	<b>Up to 40000 ppm</b>
<b>Detection and measurement range Methane</b>	<b>Up to 50.000 ppm</b>
<b>Measurement range Ethane and Ethylene</b>	<b>Up to 30.000 ppm</b>
<b>Accuracy</b>	±5 % of range for H2 and methane and , ±10 % of range for Ethane / Ethylene
<b>Min resolution</b>	±50ppm
<b>Minimum detection limit</b>	50 ppm <sub>v</sub>
<b>Cross sensitivity</b>	No cross sensitivity to T, P and RH
<b>Response time</b>	20 sec
<b>Warm-up time</b>	5 sec
<b>Total gas pressure monitoring range</b>	gas Sensor with moisture and pressure analyzer
<b>Operating temperature (electronics)</b>	-40 ... +70 °C
<b>Storage temperature</b>	-50 ... +80 °C
<b>Operating humidity</b>	0 ... 100 %RH, condensing
<b>Pressure tolerance</b>	80-120 HPa
<b>Power supply</b>	Batteries 3.5 V
<b>Batteries lifetime with factory settings (1 sample/h)</b>	5 years
<b>IECEX Quality Assessment Report</b>	<b>IEC 80079-34:2018</b>
<b>ATEX Quality Assurance Notification</b>	2014/34/EU
<b>RoHS (2 &amp; 3) Compliant</b>	2011/65/EU & 2015/863
<b>China RoHS Compliant</b>	SJT/T 11363 & 11364
<b>REACH Compliant</b>	EC 1907/2006 (33 & 67)

Test	Specification	Summary of Test Conditions
High Temperature Operating	IEC 60068-2-2	1000 Hours @ 85°C
Low Temperature Operating	IEC 60068-2-1	1000 Hours @ - 50°C
Drop	IEC 60068-2-31	1-meter drop onto concrete
Shock	IEC 60068-2-27	50G peak/11ms half sine pulse, 3 axes (positive and negative pulses)
Vibration	IEC 60068-2-6	31 Hz – 150 Hz (2G acceleration) 1 hour per axis, 3 axes
Sand/Dust	MIL-STD-810G Method 510.5	Sand: 150-600 um SO2 particle size, 23 m/s nom, velocity, 5 hrs @70°C per axis, 3 axes Dust: Red China Clay, 1.5 m/s nom, velocity, 6 hrs @ 70°C per axis, 3 axis

EMC: Radiated Immunity	IEC/EN 61000-4-3	80 MHz – 2.7 GHz up to 10 V/m
EMC: Magnetic Immunity	IEC/EN 61000-4-8	30 A/m, 3 axes
EMC: Electrostatic Discharge	IEC/EN 61000-4-2	Up to 4kV on ground plane, up to 8kv corona discharge

## Ordering information

Ordering code	Description
101-1626	Battery powered
101-1627	Mains supply

# Comprehensive Risk assessment and diagnostic software

Complete substation maintenance application software with all electrical tests with diagnosis, all inspections and wireless monitoring cloud SCADA with diagnosis for complete reliable HV asset risk assessment

 **User editable alarms with log history**

 **6 individual preset monitoring alarms according international standards**

 **Automatic diagnostics and test reports**

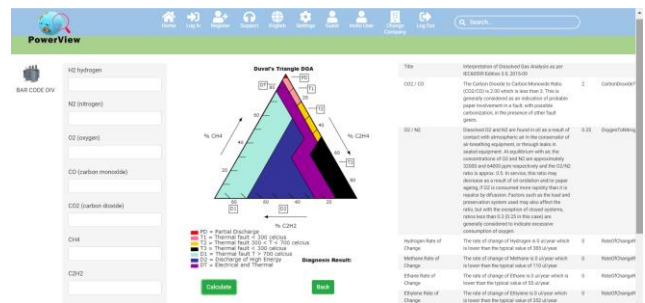


## Risk assessment and automated asset Diagnostics

Risk assessment and digitalization of all data includes analysis and manages all substation data such as electrical tests, monitoring, visual and thermal inspections for the most comprehensive asset assessment. It includes trending each individual parameter of the Electrical tests and analyzing the results of electrical tests performed on each element (comparing them with preset editable limits) depending on the element characteristics (like voltage level, type of insulation media etc.). It also includes managing of all other types of inspections and analyzes all the possible monitoring values (and compares to preset editable limits).

Predictive maintenance stands for knowing your high voltage assets condition while it is still in service. Smart substation maintenance is based on smart decisions. Smart decisions are based on individual elements condition holistic evaluation (monitoring electrical tests and other inspections such as thermal and corona). This kind of evaluation of your substation results in asset performance at its optimal maximum with minimum downtime. Comprehensive risk assessment means analyzing all important parameters in advance so actions can be taken at the optimal timing with minimal. repair and downtime costs .

The test reports and inspections data are processing and automatic results analysis is performed with recommendations using artificial intelligence for further tests ( if needed) or course actions



## Limits

Preset limits are assigned in the software for each element type according International standards (having in mind elements nominal characteristics such as operating voltage, type of insulation, connection type etc.) These limits are automatically assigned to each new element. Users with adequate permissions can edit these limits. There are several million different models (with different limits which can be assigned to an element.





**Build your digital substation**



**QR codes containing all the relevant data for all electrical elements**



**True Digital Electrical Substation with all existing substation element real electrical test, visual inspection, thermal and corona inspection and monitoring.**



Substation Digital is integrated smart substation maintenance web application for digital HV asset management , risk assessment, inspections management , electrical tests management, processing and automated analysis according international standards and records keeping. A wireless maintenance Scada is also integrated in the app capable of connecting more than 1000 existing monitoring devices with alarms distribution . The app also features notification and access management for all elements. Everything can be arranged digitally as existing originally in HV substations. The features are also available as IOS and Android mobile app . The application functionalities are being divided as electrical tests, monitoring , visual, thermal and corona inspection on a cloud platform or on premises installation . This application allows power and big industrial companies to set up a virtual substation, assign authorizations within the company (staff can have different authorizations similar to the ones they have in maintenance such as: upload electrical tests, analyze tests, change limits, connect monitoring devices, analyze monitoring data, upload visual , thermal or corona status, comments and pictures, arrange meetings, edit inspection lists,

### **SMART decision making**

Access for all the relevant information to the relevant people anytime anywhere. This app makes all information related to substation maintenance, inspections and monitoring available on web and mobile app from server access. This helps decision making , records keeping , information availability and ease of access .

### **Costs reduction**

Cost reduction in monitoring installations, and HV assets life extension.

### **Down time reduction**

The system evaluates all the data in a matter of seconds and does the most advanced artificial intelligence analysis and limits comparison to international standards.

The Smart affordable wireless monitoring enables commercially viable monitoring on all relevant parameters on one platform irrelevant of the equipment manufacturer with integrated alarms and notifications with single click and virtual intelligence data evaluation

## Cloud digital substation

**True Digital Electrical Substation with all existing substation element real electrical test, visual inspection, thermal and corona inspection and monitoring and asset monitoring issues history**

The first system offering one click specific element data upload, the first system which integrates different parameters (electrical, monitoring, visual ,thermal and corona inspections).

### Electrical tests

This software can directly import test reports from existing manufacturers, process the test reports and analyze test results and compare to preset limits against international standards. For each element there is a complete list for all possible electrical tests created according nameplate information ( example voltage category , vector group and connections type etc) . All tests are divided depending on importance and the system only trends ones that user actually tests.

Special algorithms do most accurate temperature correction of the results and on import results from test reports. The software automatically compares all test results against international standards recommendations , rate of change limits , testing intervals performs risk assessment and automatically suggests further tests ( if necessary)

Results upload permissions are arranged in the most natural way and are editable by account administrator.

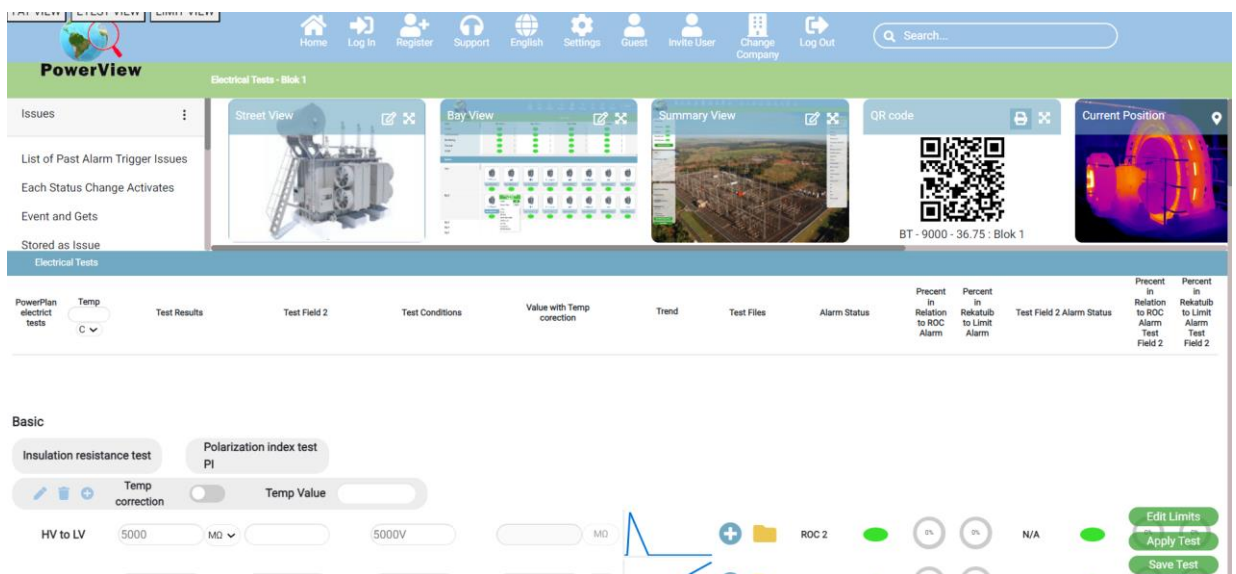
## Integrated diagnostic tools

**Integrated automatic element analysis And data evaluation**

**Preset editable lists for visual, thermal and corona and electrical tests**

**Integrated 3rd party limited or unlimited substation data analysis**

TEST REPORTS INTEGRATED  
Test Instruments whose Test Reports can be imported on the platform





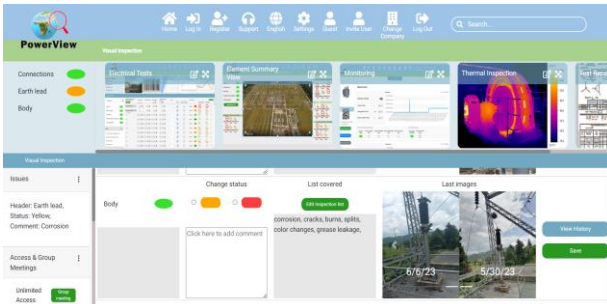
**Thermal and corona inspection**  
**With history, comparison, meeting options, comments, predefined inspection lists and recommendations due, alarming and meeting options .**



**Mobile application for IOS and Android**



**Direct thermal pictures upload from existing thermal and corona cameras .**



## Visual inspection

A smart visual inspection app (integrated into the web app and mobile app) offers users the ability to keep track of visual inspection , and integrate the data into the asset records. With simple QR code scan user can directly upload a picture , change status and report an issue for visual inspection directly from the field . This application has dynamic preset editable list of visual inspections for each particular HV element in relation to it's nameplate (such as voltage level insulation type etc). There is also help for each inspection which guides operators with suggestions and recommendations.

## Monitoring

Centralized wireless monitoring, data management alarms and notifications. This feature currently integrates over 1000 different commercially available monitoring units from different manufacturers into the software.

The wireless electronic devices communication includes one router which covers the entire substation and reads data from up to 1000 devices installed in the substation (area of several square kilometers).

This dramatically reduces expensive installations from several thousand EUR per unit to several hundred of thousand EUR per unit in terms of shielded cabling, expensive SCADA RTU's, and installation costs and reduces waist.

## Thermal and corona inspection

A smart thermal and corona inspection app (integrated into the web and mobile app) offers users the ability to keep track of thermal and corona inspection and integrate the data into the asset records. With simple QR code scan user can directly upload a picture, change status and report an issue for thermal and corona inspection directly from the field.

This application has dynamic preset editable list of visual inspections with help for each particular HV element in relation to it's nameplate (such as voltage level insulation type etc) . There is also help for each inspection which guides operators with suggestions and recommendations.





Combined monitoring view on all existing elements



Simple 3 step monitoring connection in less than 10 minutes



Monitoring integration of more than 1000 existing monitoring devices from various manufacturers such as ABB, Siemens, Iris POWER, Doble, POWER VIEW with alarms integrated



Simple notification divided by elements



Types of inspection, Editable access list and online monitoring meeting platform



Most advanced integrated power grids evaluation monitoring reporting, management and remote support solution

The screenshot shows the PowerView software interface. At the top is a navigation bar with icons for Home, Log In, Register, Support, English, Settings, Guest, Invite User, Change Company, and Log Out. Below this is a search bar. The main dashboard area has several tabs: Set Alarms, Erase all stored data, Lost communication notification, Electrical tests, Visual inspection, Thermal & corona, Summary view, and Asset view. The 'Visual inspection' tab is active, showing a photo of a substation on the left and a data panel on the right. The data panel is titled 'T2' and includes 'Hydrogen monitoring' with a green status indicator. It lists 'Current H2 value' as 3 ppm, 'Average yearly H2 value' as 4.85 ppm, and 'Maximum yearly H2 value' as 23 ppm. Below this is a 'Rate of Change Alarm Status' section with four circular gauges: 'ROC Alarm Status' (green), 'Percent to Daily ROC Alarm' (1.1%), 'Percent to Weekly ROC Alarm' (0%), 'Percent to Monthly ROC Alarm' (0%), and 'Percent to Yearly ROC Alarm' (0%). To the right of the data panel is a line graph titled 'Hydrogen' showing a sharp peak in the data.

MANUFACTURERS WHO'S

### Monitoring units integrated in the Software



and many more....

This software can also integrate and communicate with big number of existing monitoring devices. This was particularly important for users that already have monitoring equipment from different manufacturers. The software was developed in a way which made it possible for them to continue using the equipment that they already use .

## SUBSTATION DIGITAL

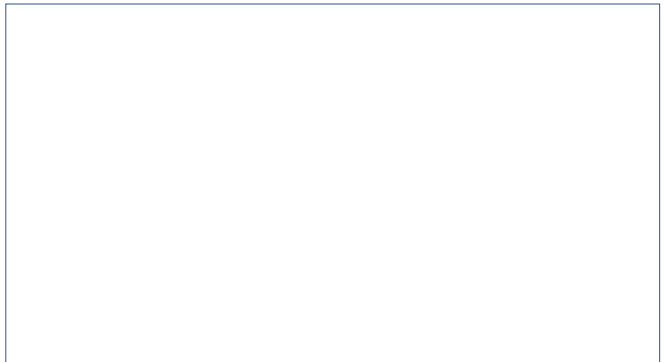
Complete substation maintenance application software with all electrical tests with diagnosis, all inspections and wireless monitoring cloud SCADA with diagnosis for complete reliable HV asset risk assessment



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