



# Complex Transformer Monitoring Systems

Maintenance free fully diagnostic DGA Monitoring system



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



*Pioneering the future of power testing and monitoring*

## 🕒 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



# 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 gases 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:

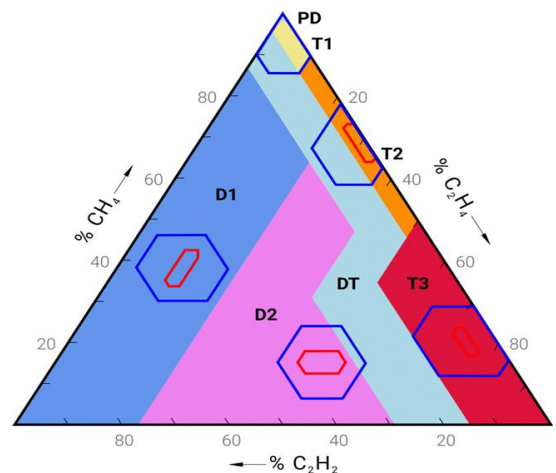
- Hydrogen (H<sub>2</sub>);
- Carbon monoxide (CO);
- Carbon dioxide (CO<sub>2</sub>);
- Methane (CH<sub>4</sub>);
- Acetylene (C<sub>2</sub>H<sub>2</sub>);
- Ethane (C<sub>2</sub>H<sub>6</sub>);
- Ethylene (C<sub>2</sub>H<sub>4</sub>);

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
Methane (CH4)	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Ethane (C2H6)	0 ... 10 000 ppm <sub>v</sub>	±10 ppm or ±5 % of reading	10 ppm or 5 % of reading
Ethylene (C2H4)	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Acetylene (C2H2)	0 ... 5000 ppm <sub>v</sub>	±0.5 ppm or ±5 % of reading	1 ppm or 5 % of reading
Carbon monoxide (CO)	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Carbon dioxide (CO2)	0 ... 10 000 ppm <sub>v</sub>	±4 ppm or ±5 % of reading	10 ppm or 5 % of reading
Moisture (H2O)	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

# 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**



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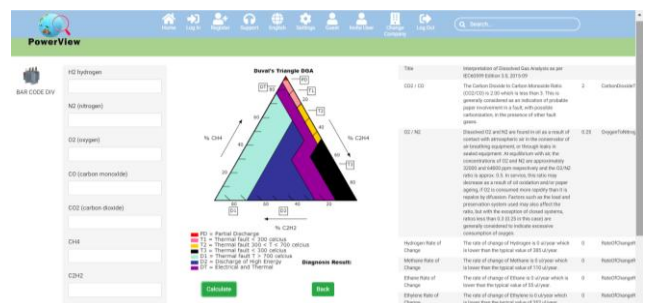
Comprehensive risk =  $\int$  electrical test + visual + thermal + monitoring + corona inspection

## 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



Insulation resistance test	RIS Change Alarm	RIS Roll Alarm	Storage Limit Alarm	Roll Limit Alarm	Test Run Alarm (Warning)	Limit Test No.
10kV + 10kV E	100	100	100	100	100	10
10kV + 10kV EF	100	100	100	100	100	10
10kV + 10kV to E	100	100	100	100	100	10
10kV + 10kV to EF	100	100	100	100	100	10
10kV E	100	100	100	100	100	10
10kV EF	100	100	100	100	100	10

## 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

Megger.

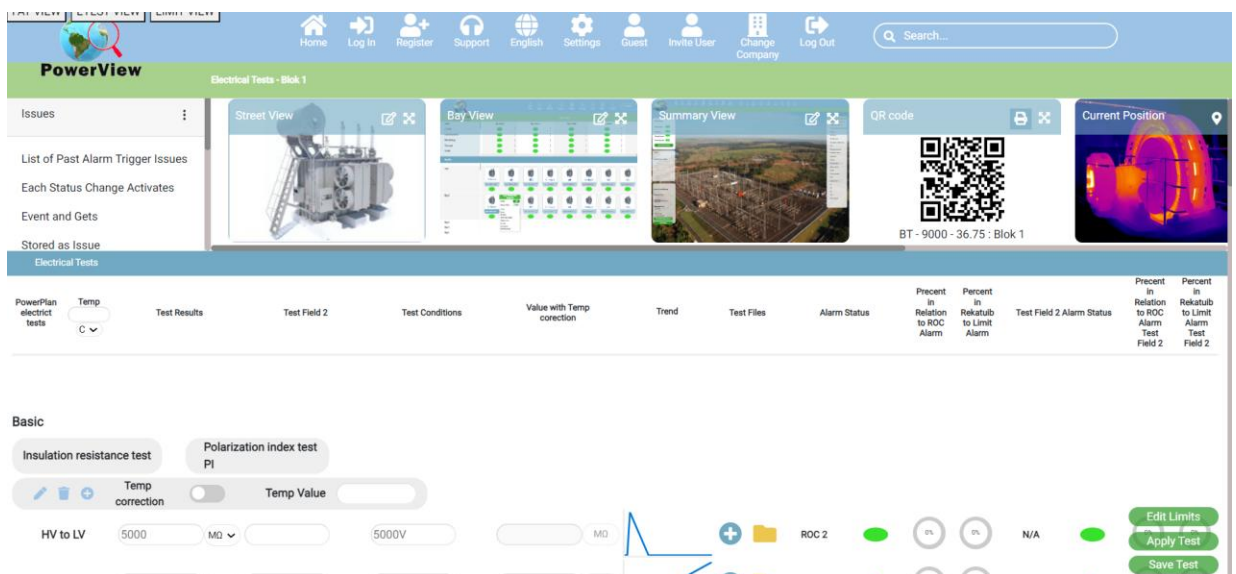
TRAX

CPC 100

CHAUVIN ARNOUX

doble

OMICRON







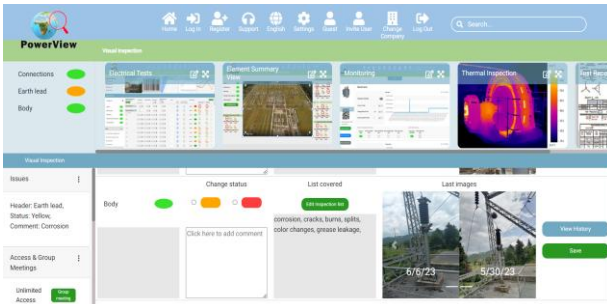
**Thermal and corona inspection**  
**With history, comparison, meeting options, comments, predefined inspection lists and recommendations**  
**due, alarming and meeting options .**



**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

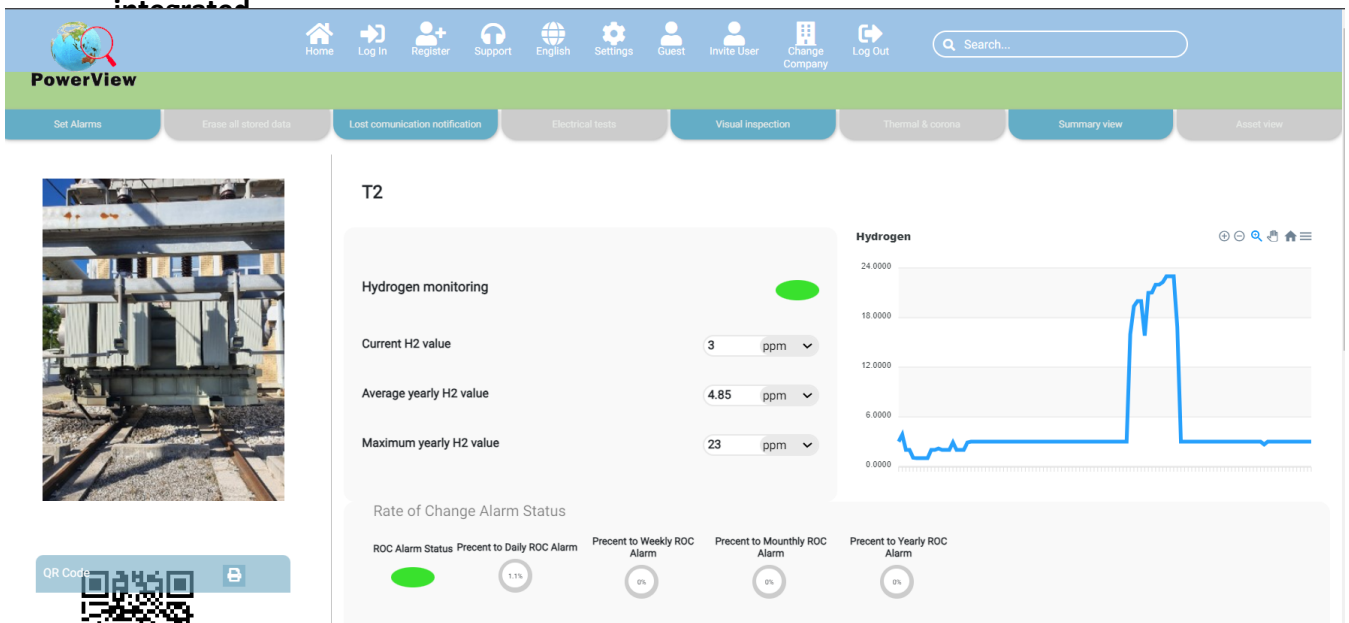
 Simple 3 step monitoring connection in less than 10 minutes

 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 displays the PowerView software interface. At the top, there 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 features 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 detailed view for a transformer labeled 'T2'. On the left, there is a photo of the transformer and a QR code. The central part of the dashboard is titled 'Hydrogen monitoring' and shows a green status indicator. Below this, there are three input fields for 'Current H2 value' (3 ppm), 'Average yearly H2 value' (4.85 ppm), and 'Maximum yearly H2 value' (23 ppm). To the right, a line graph titled 'Hydrogen' shows a sharp peak in the data. At the bottom, the 'Rate of Change Alarm Status' section displays five circular indicators for different alarm types, all showing 0%.

— 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***

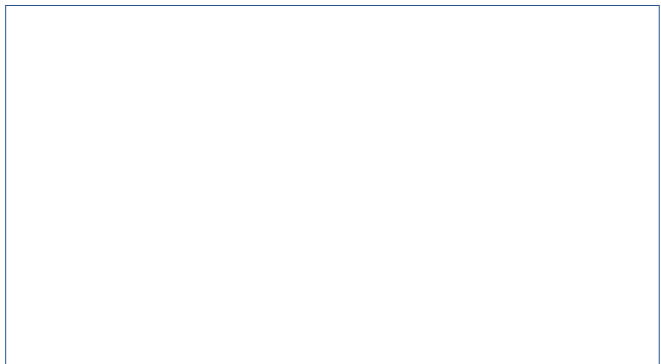
*Complete substation maintenance application software with all electrical tests with diagnosis, all inspections and wireless monitoring cloud SCADA with diagnosis for complete reliable HV asset risk assessment*



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*pioneering the future of power testing and monitoring*

