

# Wind Generator Condition monitoring WCM Detection & Monitoring



integrated



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*Pioneering the future of power testing and monitoring*

# Wind Generator Condition monitoring WCM Detection & Monitoring



## The most versatile wind generator monitoring tool available on the market today

Monitors 3 axial vibrations, with FFT and compares at similar load, monitors ground leakage current, monitors load and stator and bearing temperature



## Proven Technology

ANALOG DEVICES and Bruel & Kajer Vibration sensors inside



## Alarms, notifications and reporting

Fully customizable alarms, email and SMS notification and trending

## Wind Generator faults

Wind Generators are prone to failures due to poor craftsmanship, improper maintenance, material imperfection stress etc. One of the most common failure on wind generators are the gearbox failure, generator insulation failure, bearings failure, joints and support failures

The WCM monitors:

- Relative vibrations on the rotor blade side
- Leakage currents (current flows through insulation in all types of insulation failures)
- 3 axial vibrations with FFT (for bearings, diagnostics, magnetic related problems diagnostics, reductor or gearbox diagnostics, coupling diagnostics and fans and pump diagnostics)
- stator temperature (for detecting insulation and overloading failures in the earliest stage)
- Bearings temperature (for detecting bearings failure at the earliest stage)
- Load current (for overloading detection and service life extension)

## Description

The basic version of the POWER VIEW WCM includes absolute vibration sensors measuring on 2 measurement points (measuring vibrations in 3 axis x, y and z) plus 2 leakage current sensors with harmonic analysis (for insulation current analysis), generation current monitoring and FFT analysis and bearings temperature and stator temperature monitoring.

The advanced version includes 10 vibration sensors (3 sensors on gearbox, 1 rotor blade, 2 on main bearing and 2 on generator and 2 on tower and nacelle). All sensors come in metal housings with magnetic support. System also includes 3 Leakage current sensors, 1 generation current sensor (for monitoring generated current) and 18 temperature sensors 10 for monitoring bearings temperature and 8 for monitoring stator temperature.

The rotating machines lifetime and cost of ownership is a function of the on-time problems solving.

One of common most common rotating machine failure reasons is: Vibration- can cause damage to the motor bearings, windings, and other components, and accounts for approximately 10-15% of failures. Causes: Misalignment, Imbalance, Bearing defects, Rotor eccentricity, Looseness, Mechanical resonance, External forces  
Electrical unbalance, Gear meshing issues  
Monitoring has been proven as best option for fault prevention and prevent all types of failures from escalating.



## Ultra long wireless communication And low power consumption

Wireless communication at ultra long range of several tenths of kilometers



## Most cost-effective Wind generator monitoring solution

Most advanced software with notification and diagnostics

Easy installation (takes less than 15 minutes to completely integrate the system)



## Installation

The relative vibration sensors are installed on special stands on the bearing housing and monitor the shaft movements in X and Y axis inside the bearing. The absolute vibration and temperature sensors are magnetic, but they can also be installed using special adhesive. This wirelessly connects the monitoring device to advanced cloud maintenance Scada system which offers various alarm notification options.

The system comes with preset alarms according such as Daily, weekly, monthly ROC limit, Absolute value. All alarms are editable by users.

The system is compatible with all Bruel & Kajer relative vibration sensors as well as Bentley Nevada sensors.

# Technical specification

## Load current sensor

Generation Current	1A~600A/2000A
CT Inside Diameter	φ35.5mm
Applicable Frequency	10Hz~5kHz
Phase Accuracy	±0.5° (600A/10Ω)
Withstanding Voltage	AC2200V/1 minute (between output terminal and outer case)
Operation Temperature	-25~60°C, less than 80%RH w/o condensation
Standard	Compliant with RoHS directive

## Leakage current sensor

Leakage current monitoring	10mA - 10A
CT Inside Diameter	φ22mm
Applicable Frequency	10Hz~5kHz
Rated Voltage	Less than AC600V for low voltage circuit of coated wires
Withstanding Voltage	AC2200V/1 minute (between output terminal and CT)
Operation Temperature	-25~60°C, less than 80%RH w/o condensation
Standard	Compliant with RoHS directive

## Absolute Vibration sensor

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

## Temperature Sensor

Temperature Range	-5 °C to +125 °C
Accuracy	+ - 0.5 °C
Resolution	12 bit

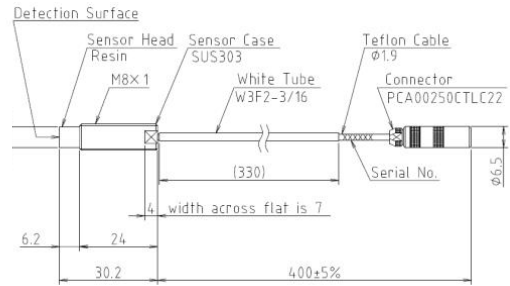
## Acquisition and Communication System

Processor	ARM Cortex-M7 at 600 MHz
Resolution	8,10,12 bits
Operating Voltage	5 V
Sampling Rate	Up to 400 kHz
Housing	EMI shielded heavy duty outdoor -aluminum diecast enclosure with enhanced impact resistance. Neoprene seal and IP-65 Protection

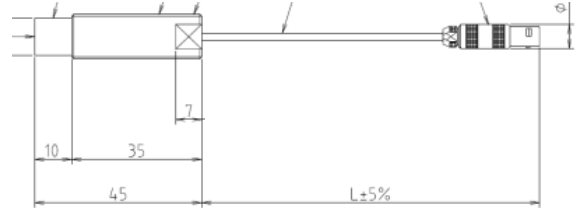
# Technical specification

## Relative and axial Vibration sensor sensor (10mm )

<b>Frequency</b>	<b>5-10.000 Hz</b>
<b>Displacement (GAP)</b>	
1) Measuring range	0 to 2.4mm
2) Setting GAP	1.2mm
3) Accuracy	3%/full scale
4) Resolution	0.5 μ m
5) Resultant noise	5mV(peak to peak) of power noise
6) Frequency characteristics	(Converter) DC to 10kHz
7) Output	0 to 2.4mm/1 to 5V
8) Output impedance	51ohms
9) Zero point adjustment	Controlling by the operator
<b>Vibration (VIB)</b>	
9) Measuring range	200 μ m
10) Setting GAP	1.2mm
11) Conversion accuracy	1.5%
12) Resolution	0.5 μ m
13) Frequency characteristics	5 to 10kHz -3dB (Other optional frequency is possible.)
14) Output	0 to 2000 μ m/4 to 20m A (Other optional output is possible.)
15) Failure diagnosis of sensors	The permissible load resistance:0 to 300ohm. In case of sensor malfunction (Disconnection · Short · GAP OUT 1.08-4.92V out of range), VIB output will be below 3.6mA and PU LED changed from Green light to Red light.
16) ZERO set function	Pressing ZERO set SW makes current vibration value to zero μ m. Pressing ZERO SW again will release the function.
17) Temperature range	Sensor -20 to 180°C (Humidity:30 to 100%RH) The sensors should not be immersed in water Sensor cable -20 to 105°C (Humidity:30 to 90%RH)
18) Storage temperature	Converter 0 to 50°C (Humidity:30 to 90%RH ) Sensor -40 to 180°C Sensor cable -40 to 105°C
19) power supply	Converter -10 to 85°C DC24V±2V 120mA



6mm eddy current displacement sensor

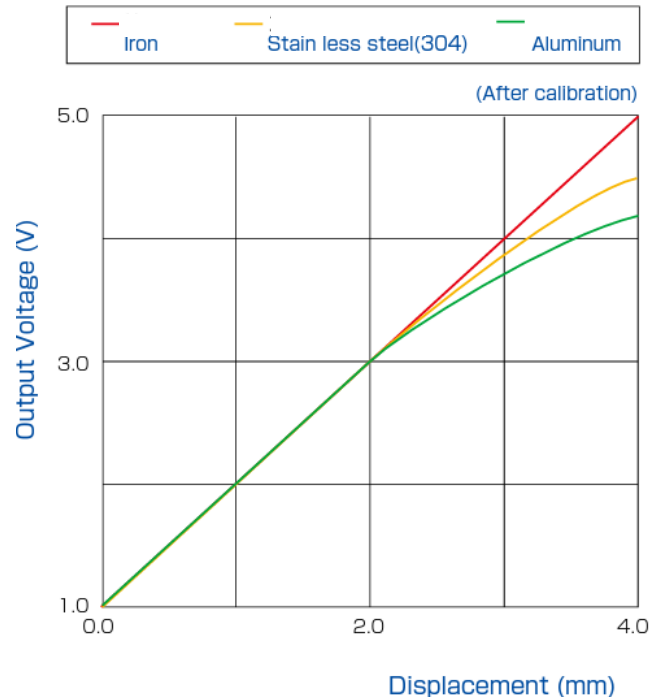
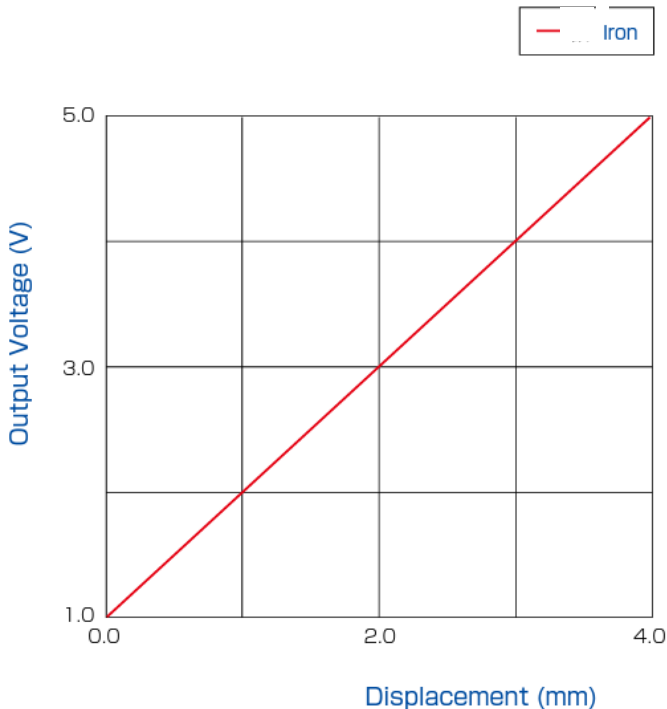


10mm eddy current displacement sensor



10mm eddy current displacement sensor

## Output characteristics / linearity Variation depending on target materials





## Compliance and Certifications

The PWT meets the following standards:

- CE Certification
- RoHS Compliance

The PWT Wireless Temperature Sensor is designed for quick and simple installation. Its compact size and wireless capabilities make it suitable for both new and retrofit projects. Configuration can be completed using a user-friendly interface, accessible via a mobile app or desktop software (Substation Digital.)

# Correlated thermal monitoring with other inspections and electrical tests in SUBSTATION DIGITAL – Asset management and risk assessment software



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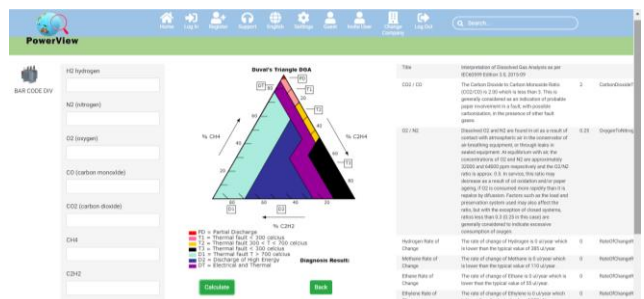
Comprehensive risk =  $\int$  electrical test + visual + thermal + monitoring + corona inspection

## 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

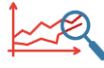




Build your digital substation



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



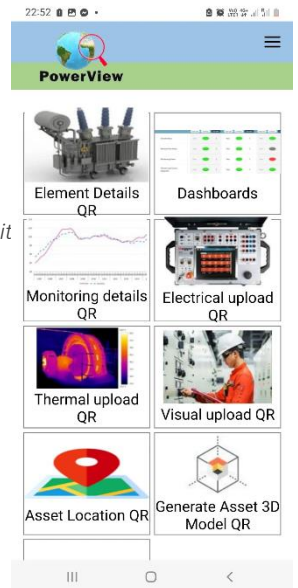
Preset editable lists for visual, thermal and corona and electrical tests



Integrated 3rd party limited or unlimited substation data analysis

## Mobile app

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



The screenshot shows the PowerView web application interface. At the top is a navigation bar with icons for Home, Settings, User Management, Invite User, Change Company, and Log Out. Below the navigation bar is a header for 'Electrical Tests - Transformer TR1'. The main content area displays a table of test results with columns for PowerPlan electric tests, Temp, Test Results, Test Field 2, Test Conditions, Value with Temp correction, Trend, Test Files, Alarm Status, and various alarm status indicators. Two test sections are expanded: 'Polarization index test PI' and 'Tan delta test'. The PI test shows results for HV to LV, HV to E, LV to E, and HV + LV to E. The Tan delta test shows results for CHG + CHL and CHL. Each test result is accompanied by a status indicator (green or yellow) and a percentage value.

PowerPlan electric tests	Temp	Test Results	Test Field 2	Test Conditions	Value with Temp correction	Trend	Test Files	Alarm Status	Present in Relation to ROC Alarm	Percent in Relation to Limit Alarm	Test Field 2 Alarm Status	Present in Relation to ROC Alarm Test Field 2	Percent in Relation to Limit Alarm Test Field 2
<b>Basic</b>													
<b>Insulation resistance test</b>													
<b>Polarization index test PI</b>													
Temp correction: <input type="checkbox"/> Temp Value: <input type="text"/>													
HV to LV	1.5	Gi		5000V	1.5GΩ			LIMIT 1	89%	65%	N/A	0%	0%
HV to E	2.3	Gi		5000V	2.3GΩ			LIMIT 1	0%	42%	N/A	0%	0%
LV to E	1.9	Gi		2000V	1.9GΩ			LIMIT 1	53%	51%	N/A	0%	0%
HV + LV to E	1.7	Gi		5000V	1.7GΩ			LIMIT 1	20%	57%	N/A	0%	0%
<b>Tan delta test</b>													
Temp correction: <input type="checkbox"/> Temp Value: 20													
CHG + CHL	0.54	%		10000V	0.6%			LIMIT 2	33%	20%			
CHL	0.33	%		2000V	0.3%			LIMIT 1	33%	66%			



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 , type of inspection , monitoring



Editable access list and online 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 is divided into several tabs: Set Alarms, Erase all stored data, Lost communication notification, Electrical tests, Visual inspection, Thermal & corona, Summary view, and Asset view. The 'Summary view' tab is active, displaying data for 'T2'. On the left is a photo of a substation. The main area shows 'Hydrogen monitoring' with a green status indicator. Below this 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 is a line graph titled 'Hydrogen' showing a sharp peak. At the bottom, there is a 'Rate of Change Alarm Status' section with five circular indicators: '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%).

## 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.

The screenshot shows a detailed view of the 'Alarm Limits' section in the PowerView software. It features a table with columns for 'ROC Change Alarm', 'ROC Rate Alarm', 'Change Limit Alarm', 'ROC Limit Alarm', 'Test Due Alarm (Months)', and 'Last Test By'. The table lists various equipment types such as 'Insulation resistance test', 'IR to E', 'IR to LV', 'IR to HV', 'IR to E', 'IR to E', and 'IR to E'. Each row contains numerical values and units for the different alarm types. For example, for 'IR to E', the ROC Change Alarm is 0.01, ROC Rate Alarm is 0.05, Change Limit Alarm is 0.05, ROC Limit Alarm is 0.05, Test Due Alarm is 12 months, and Last Test By is Bob B. Boby.

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





**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.





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