Advanced Monitoring Solutions for Critical Electric Power Transmission & Distribution Assets

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SAW (Surface Acoustic Wave) technology provides an ideal solution

- Non-invasive
- No power required to sensors
- Highly scalable
- Real-time, continuous monitoring

The Case for Critical Asset* Monitoring

- The vast majority of critical assets in the field today are greater than 25 years old.
- Less than 5% of installed critical assets have continuous monitoring integrated.
- Temperature is the leading indicator of critical asset failure.
- Critical asset failure is one of the leading causes of power outages.
- The average cost of critical asset failure is greater than $500K per event.
- The ROI for implementing continuous critical asset monitoring is less than 12 months.
- Critical asset failure often involves injury to humans, and is known to cause deaths.

*Critical Assets include switchgear, transformers, RMU's, LV Distribution Panels, Bus Ducts (poly-phase & uni-phase), Motor Controllers, etc.

Critical Asset Monitoring Technology Comparison

Wired	Infrared	Wireless	IntelliSAW
Invasive	Non-invasive	Non-invasive	Non-invasive
Continuous monitoring	Non-continuous monitoring	Continuous monitoring	Continuous monitoring
Arcing problems due to use of copper wire	Requires viewing windows costs ~ $1k per window	Electrically isolated solves arcing issues	Wireless
Flashover problems if using fiber optics	Dirty environment cause conductive issues	Active battery powered	Passive SAW technology no batteries required solves access & disposal issues
	Expensive equipment	Battery maintenance issue Life typically < 2 years Requires shutdown to replace	Multi-protocol RS485, CAN, Modbus & IEC 61850
	Trained operator required with associated costs		Electrically isolated solving arcing issue
			Plug & Play implementation no maintenance required

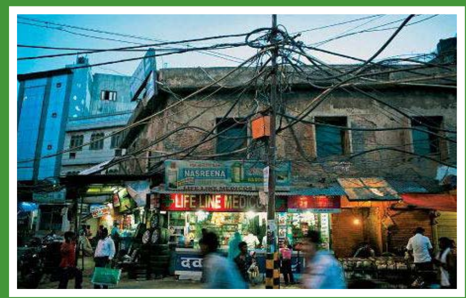
Smartgrid

The Challenge: Vulnerability of Electric Power Transmission & Distribution Infrastructure

These critical assets serve as the critical link between the power generation source and the end-user. As such, these pieces of equipment determine the ultimate reliability of the power grid.

When any of these critical assets malfunction the consequences are often catastrophic. Damage to these assets can be extremely expensive, but that pales in comparison to corollary damage and the potential hazards to people.

The risk of loss is high including personnel injury or death, equipment damage, and lost production.



The Paradox: Aging Equipment & Increased Power Demand

Developing and developed countries alike are continually increasing their demand for power.

Dynamic: aged equipment (the vast majority of installed base is greater than 25 years old) is being increasingly tasked with higher load requirements as grid demand continues to increase.

The Solution:

Smart grids will modernize every facet of the electric power delivery system including generation, transmission, distribution and consumption. The focus will be on the integration of intelligence into the existing critical assets. Intelligent critical assets will significantly enhance the efficiency and reliability of a grid and help utilities avoid blackouts and equipment failure. Monitoring the temperature of key electrical connection points within the critical assets provides a leading indicator of potential fault/failure of the equipment.

UNTIL NOW there has been no satisfactory solution which readily provides continuous monitoring of temperature within these critical assets while not introducing other potential fault conditions such as arcing, flashover, shorting, etc.

SAW technology provides an ideal solution as it is non-invasive, no power is required to the sensors, highly scalable, real-time, and provides continuous 24/7 monitoring.

IntelliSAW Family of Critical Asset Monitoring Systems for tough industrial applications

Designed for critical asset protection & continuous smart grid monitoring

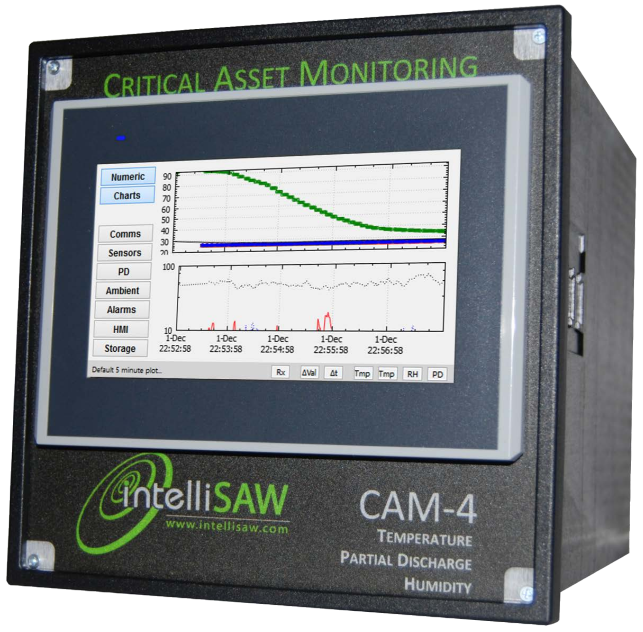
IS485

- Designed for continuous monitoring of critical assets through measurement of temperature, humidity and partial discharge detection
- Capable of measuring all relevant hot-spots simultaneously: bus bars, breaker inputs, breaker outputs and cables
- Up to 12 temperture sensors, 4 partial discharge air interfaces and 8 humidity sensors can be used
- Industry standard Modbus RTU communications
- CE Certified

CAM-4

Real-Time Continuous Monitoring to avoid the primary causes of asset failure:

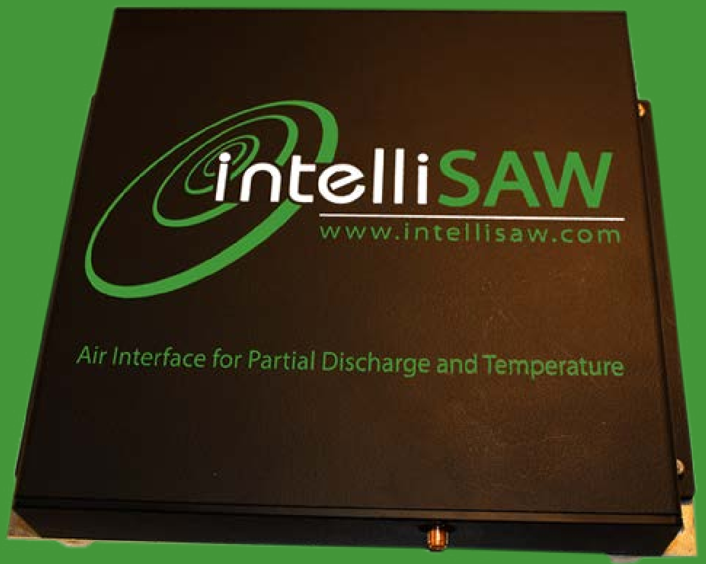
- **Temperature:** compromised connections
- **Partial Discharge:** insulation degradation
- **Humidity:** air dielectric breakdown



- **Up to 12 SAW (passive)Temperature sensors**
- **Up to 4 Partial Discharge sensors**
- **Up to 8 Humidity sensors**
- **4.3” touch panel HMI for real-time viewing of system data**
- **Up to 4 Alarm / Trip outputs with configurable limits**
- **Industry standard communication interfaces**

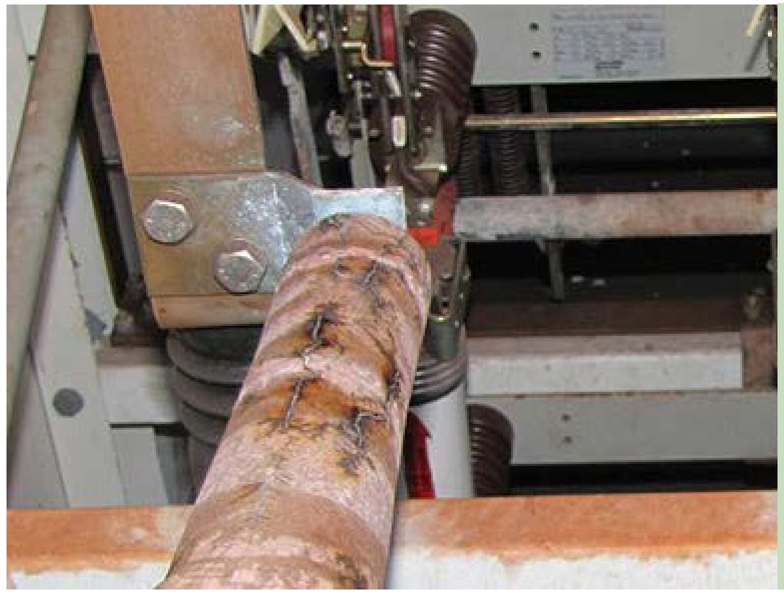
The IntelliSAW Critical Asset Monitoring (CAM) unit provides the vital measurements required for predictive condition-based monitoring of electrical power critical assets such as switchgear, circuit breakers, and bus ducts. Immediate measurement feedback is available on the local HMI, or through an industry standard communication interface (Modbus-RTU) for easy substation SCADA integration.

Partial Discharge Detection



Continuous, real-time, early warning partial discharge monitoring for electrical power applications

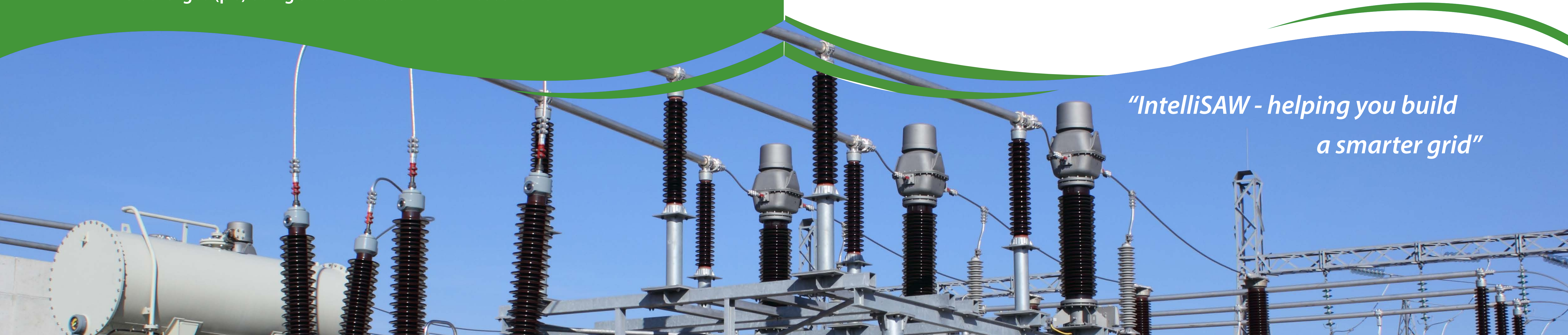
- Wireless and Passive operation
- Ultra-high Frequency (UHF) detection with real time noise cancellation algorithms
- Integrates with existing temperature and humidity monitoring platform
- Selectable frequency bands for monitoring unique asset components, including:
    - Cable compartments
    - Bus ducts
    - ISO bus ducts
- Reports noise floor, surface discharge, and internal discharges (pC) using a calibrated UHF dB measurement



Partial Discharge (PD) Damage

In electrical engineering, partial discharge (PD) is a localised dielectric breakdown of a small portion of a solid or fluid electrical insulation system under high voltage stress, which does not bridge the space between two conductors.

- **IntelliSAW has developed a continuous real-time, online solution for early warning and trending of internal and surface discharges.**
- **The system does not require an 'as installed' baseline measurement like other UHF methods and has real-time algorithms to classify the UHF signals as noise, internal, and surface discharge.**
- **The system is calibrated to a reference source at a reference location; however the UHF signal received by an antenna varies with the actual PD source position.**
- **The system will provide early warning detection of PD events affording the customer the opportunity to take corrective action to prevent failure.**



"IntelliSAW - helping you build a smarter grid"

Humidity Sensor

Preventing Bus Duct Flashover

The IntelliSAW Humidity Sensor was designed to provide real-time, continuous monitoring of electrical power critical asset bus ducts to identify flashovers due to high humidity. The sensor's sintered cap, threaded body, water resistant M12 connector, and 4kV surge protection provides the robust assembly required for harsh environments. The IntelliSAW Critical Asset Monitoring systems allows up to 8 humidity sensors to be bussed together for full length bus duct monitoring.

Features:

- Relative humidity, ambient temperature, and dew point measurements
- Designed for electrical critical asset environments
- 4kV surge protection
- Addressable, multi-drop bus for up to 8 series sensors

IntelliSAW Reader Air Interface

Optimum Performance
Designed to maximize performance of IS485 readers

Dual Mounting Options
Either magnetic or bolt mounting

Multiple Mast Options
Optimized for different asset classes

Small Size
Easy to mount in restricted access compartments

Optimal impedance match for best range and performance

Magnetic mount: 4 magnets, each greater than 67N or 15 lbf pull strength

Bolt Mount: Metric M3 or ANSI #6 bolt

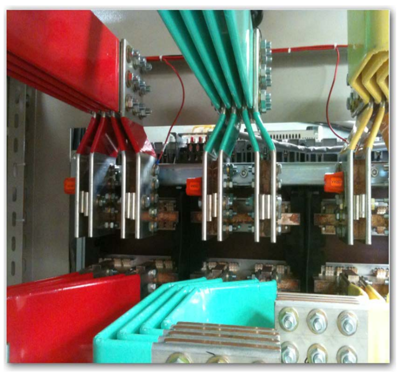
52mm x 52mm (2″ x 2″) footprint

Case Study - Fuxin Steel

The Fuxin Special Steel Company Ltd, a division of Taiwan based Formosa Plastic Group (FPG) is completing a large stainless steel manufacturing plant in the Xiamen area of China's Fujian Province.

This is the largest stainless steel project in Fujian and the first steel works constructed by FPG.

The plant is designed for an annual output capacity of 1.8M metric tons of hot rolled stainless steel coils and cold rolled stainless steel products with an output value of RMB 30 billion (US $5 billion).



The new steel plant is approximately 1km in length and is served by a 220kV underground electrical feed that is transformed down to multiple 35kV feeds which are distributed to numerous substations within the plant.

A total of 340 cabinets are being commissioned at Fuxin Special Steel, each with a 6-sensor IS485 system to monitor the temperature of critical points in the switchgear.

The cabinets arrive at the Fuxin Steel Plant with the IS485 Readers and Sensor Modules pre-installed.

Final commissioning of the IS485 systems is completed by IntelliSAW's regional integration partner PQClean

Case Study - Companhia Brasileira de Alumínio (CBA)

Challenges:

Metals refining is an energy intensive operation and shrinking profit margins. In order to optimize profits, equipment utilization and lifetimes must be maximized. CBA was operating their rectifier stacks well below the rated 100kA because of operating temperature uncertainty due to periodic IR thermography monitoring. To improve their throughput an, CBA wanted to instrument continuous temperature monitoring.

Solutions:

Nine rectifier stacks were each instrument with an IntelliSAW IS485 critical asset monitoring unit and six temperature sensors; 3 sensors on the control switch incoming bus, and 3 sensors on the outgoing bus. The IS485 units were bussed together and the data was delivered to the control room using industry standard MODBUS-RTU communications protocol. The control system software afforded quick and simple data integration.

Results:

Despite the plant's high magnetic fields, the IS485 systems operated flawlessly in an environment often debilitating to computers and other electronics. Once integrated into the control system, data trending was used directly by the operations engineers to validate that the rectifiers stayed at safe temperatures over repeated cycles, even while increasing system currents. The system continues to be used for process control and optimization.

The IntelliSAW system allowed a 10% increase in operating current and total material throughput without fear of catastrophic failure.

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