



IntelliSAW

Temp, Partial Discharge and Humidity Monitoring solutions



Temperature, PD and Humidity Monitoring Overview

Why Monitor your Electrical Equipment?

- Assets are subject to overheating due to overload, corrosion, loose connections and challenging environmental conditions
- One of the most important contributors of the electrical insulation aging
- The increase in heat will escalate until complete thermal failure of the connection or nearby insulation



Applications

Remote Substations



MV Switchgear Lineup



ISO-Phase Bus Ducts



Generator PT Cabinets



Transformers



Generator Circuit Breakers



Additional assets

- LV switchgear
- LV distribution panel
- Motor Control Center (MCC)
- Motors
- Rectifier stacks
- Capacitor banks

Ideal for Enclosed, air insulated assets up to 40kV operating voltage.

Temperature Measurement Methods

Traditional Methods

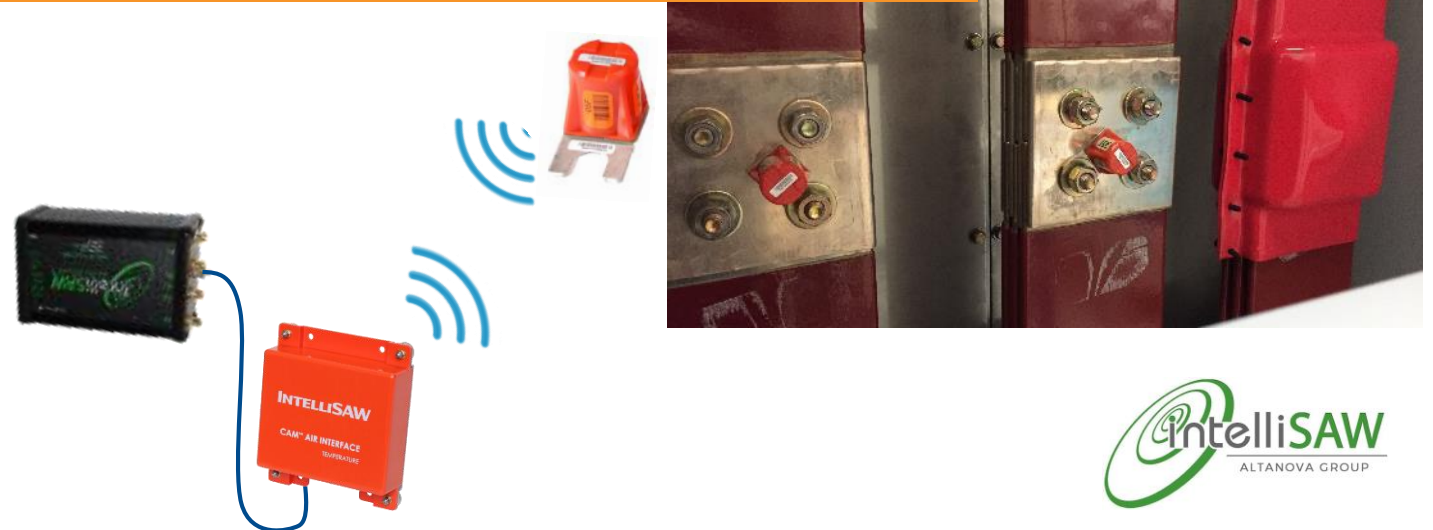
- Periodic, 1 or 2 times a year
- Can not see all asset locations
- Requires an engineer
- Dangerous if measuring with live power
- Expensive



IntelliSAW Method

- **Highest Safety:** Directly mount wireless sensors to critical measuring points while ensuring the asset safety requirements are maintained.
- **No Maintenance:** Passive sensor has a 20+ year life expectancy
- **Easy to Install:** Sensors do not require line of sight and can be mounted under insulation boots or tape
- **Rugged:** Sensors were designed to be installed in harsh environments

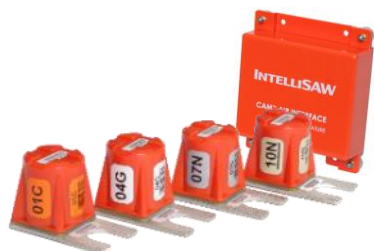
PASSIVE sensors are powered by RF signals through monitoring unit and antenna



Critical Asset Monitoring (CAM) Platform

Real-time, Continuous Monitoring for the 3 Primary Failure Modes of Electrical Power Critical Assets

SENSORS



Temperature

Addresses overheating



Partial Discharge

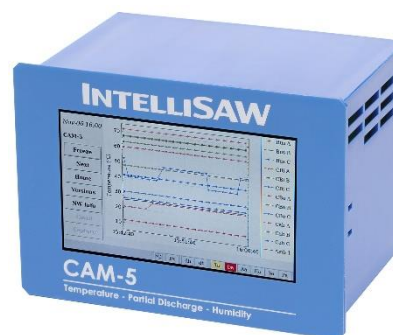
Addresses conductor insulation breakdown



Humidity

Addresses air dielectric breakdown

MONITORING UNITS



CAM-5

- Touch panel HMI
- Monitoring capabilities: SAW
 - SAW & Ambient Temp,
 - PD (Trend)
 - Humidity
- Display and log data for up to 9 external Readers. Onboard data storage
- Multiple communication protocols

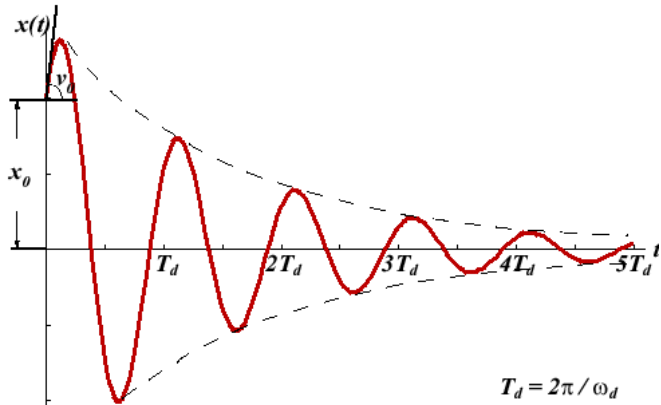


Reader

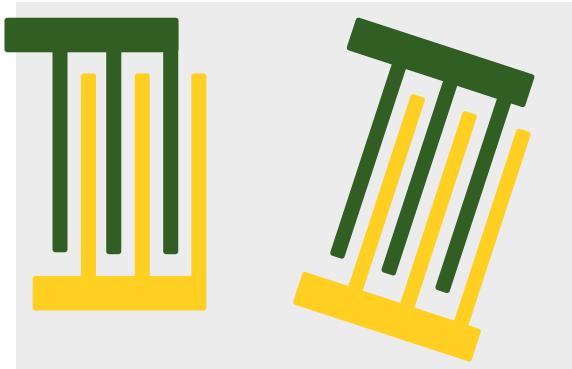
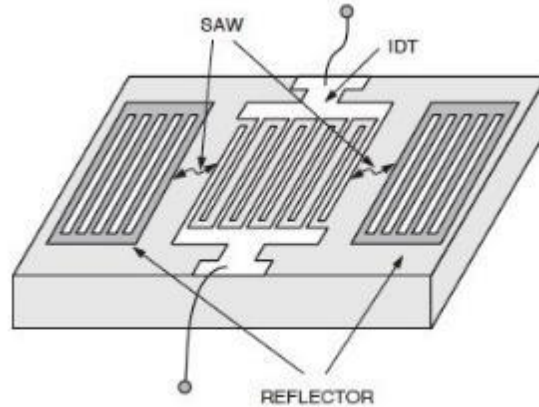
- Remote Monitoring
- Modbus RTU (RS485)



SAW Operations



Damped harmonic waveform



IDTs deposited on crystal substrate

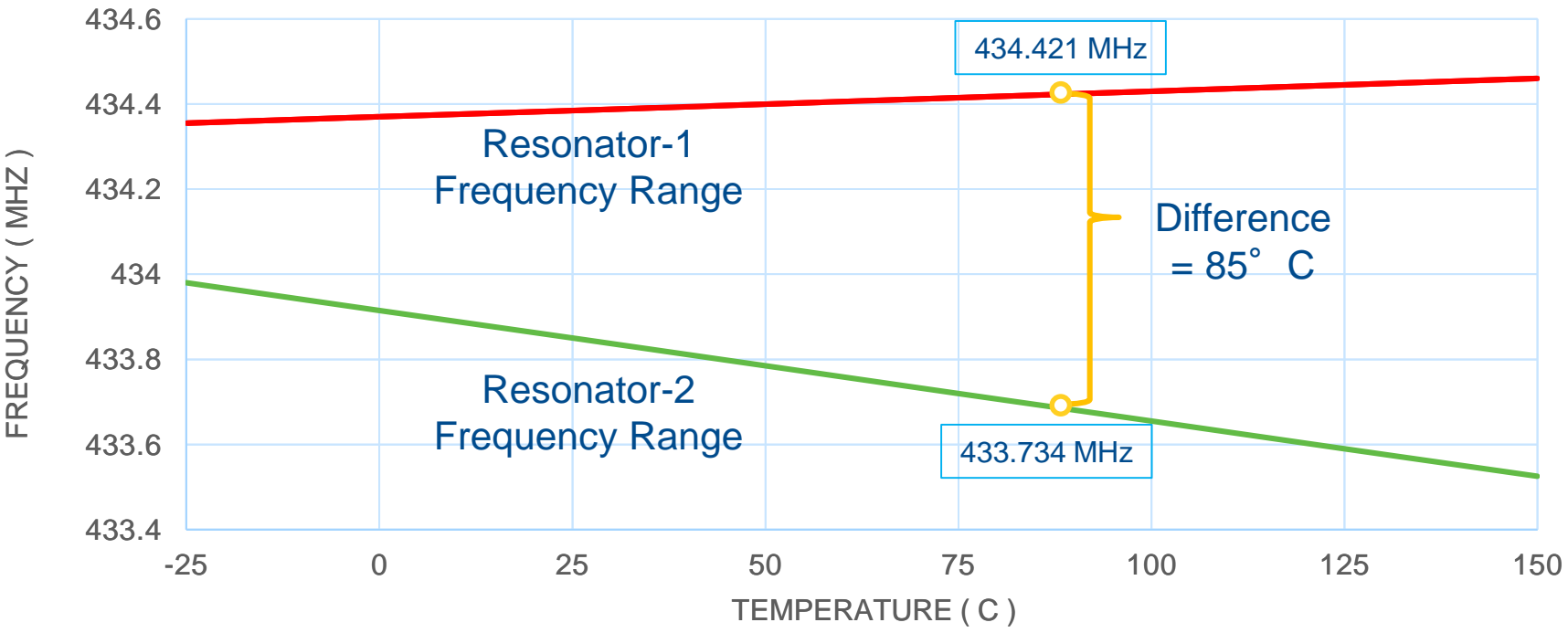
Cold Temperature:

- Contracts
- Frequency is higher

Hot Temperature:

- Expands
- Frequency is lower

SAW Operations



Surface Acoustic Wave (SAW) Temperature Sensors

- **PASSIVE** sensor modules – **NO** power wiring or battery required

- Enabled via Radio Frequency signals (425 to 442 MHz)
- 12 unique sensor frequency bands
- Range: -25°C to +155°C (Accuracy: $\pm 2^{\circ}\text{C}$, Resolution: $\pm 0.2^{\circ}\text{C}$)

- **20+ year sensor life expectancy**

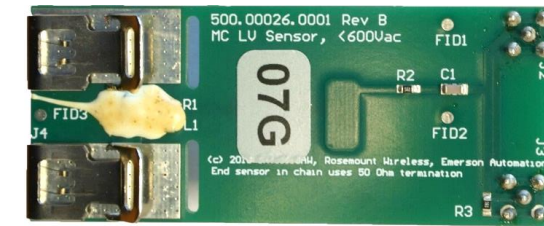
- Crystal Resonator Technology, no moving parts or electronics.

- **Multiple designs and mounting options**

- IS: IntelliSAW MV+LV; Bolt Mount (13mm or $\frac{1}{2}$ "), or any LP option
- LP: Low Profile MV+LV; Cable tie, high-temperature tape, shrink wrap
- CC; Close Coupled LV; Clip-on / bolt mount / Cable tie

- **Each designed for respective electrical power rating**

- IEC 62271-1 Withstand voltage: 95kV/1m and 185kV imp
- IEC 62271-200 Short circuit withstand: 63kA/3s, 171kA peak
- IEC 61010-1 <600Vac, CAT IV, <1000Vac, CAT III



SAW Sensor Types

IntelliSAW (IS) Sensor

- Designed for MV or LV assets
- Typically bolt-mounted install



Low Profile (LP) Sensor

- Addresses height and space constrained MV or LV assets.
- Suitable for installation directly on breaker arms.



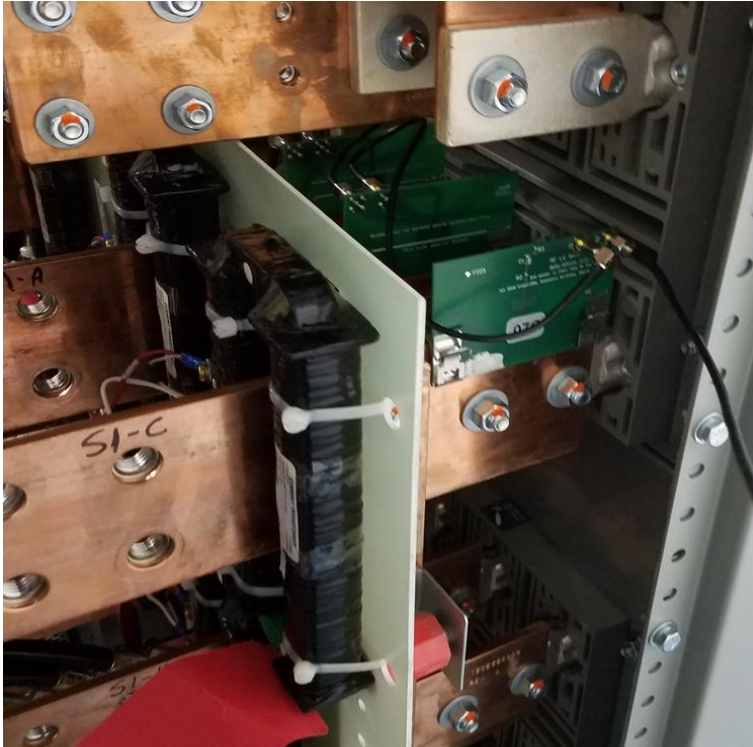
Close-Coupled (CC) Sensor

- Addresses space constraints of low-voltage assets.
- Supports high-density deployments
- Multiple physical designs



Low Voltage Switchgear Installation Example

Mounting Method - Clip



Molded Case Breaker Cables



Mounting Method – Zip Tie



High Density Compartments

Air Interfaces (RF Antenna's)

- Each air interface can read 3 temp sensor (3 to 1 ratio).
- Our PD sensor also monitors Temp as well (2 in one solution).
- Each Reader/CAM support 4 air interfaces which give you a total of 12 temp sensor per reader/CAM



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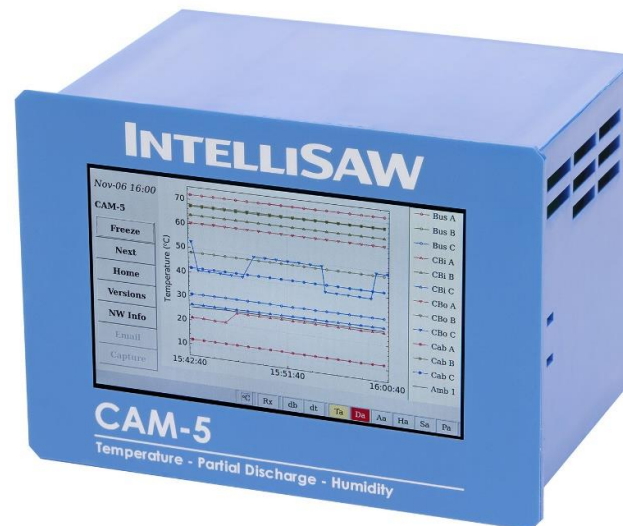
Monitoring Units



READER: Remote Monitoring

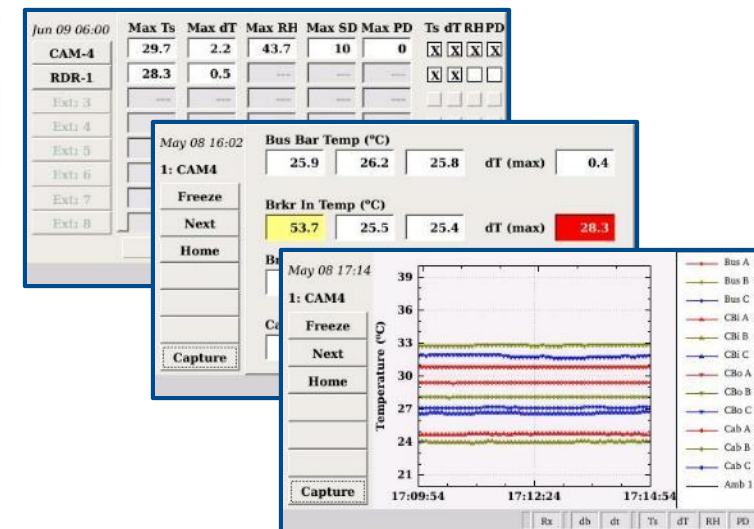
Monitoring capabilities (temp, PD, and humidity)

- **Up to 4 air interfaces**
 - Temperature and/or PD
- **Up to 12 Temperature sensors**
 - Read range: ~1.75m
 - Redundant antenna configuration
- **Up to 8 Humidity sensors**
- Modbus RTU (RS485) communications
- Input Voltage: 24V to 60V DC



CAM-5: Touch Panel HMI with Monitoring

- Monitoring capability (temp, PD, and humidity)
- Universal Input Power (100 – 250V ac/dc)
- **Alarms:** 6 configurable dry contact relays
- **Data storage:** 32GB USB
- **Multiple unit interface:** Display data for 9 additional readers
- **Communications:** Modbus TCP, DNP3, IEC-61850



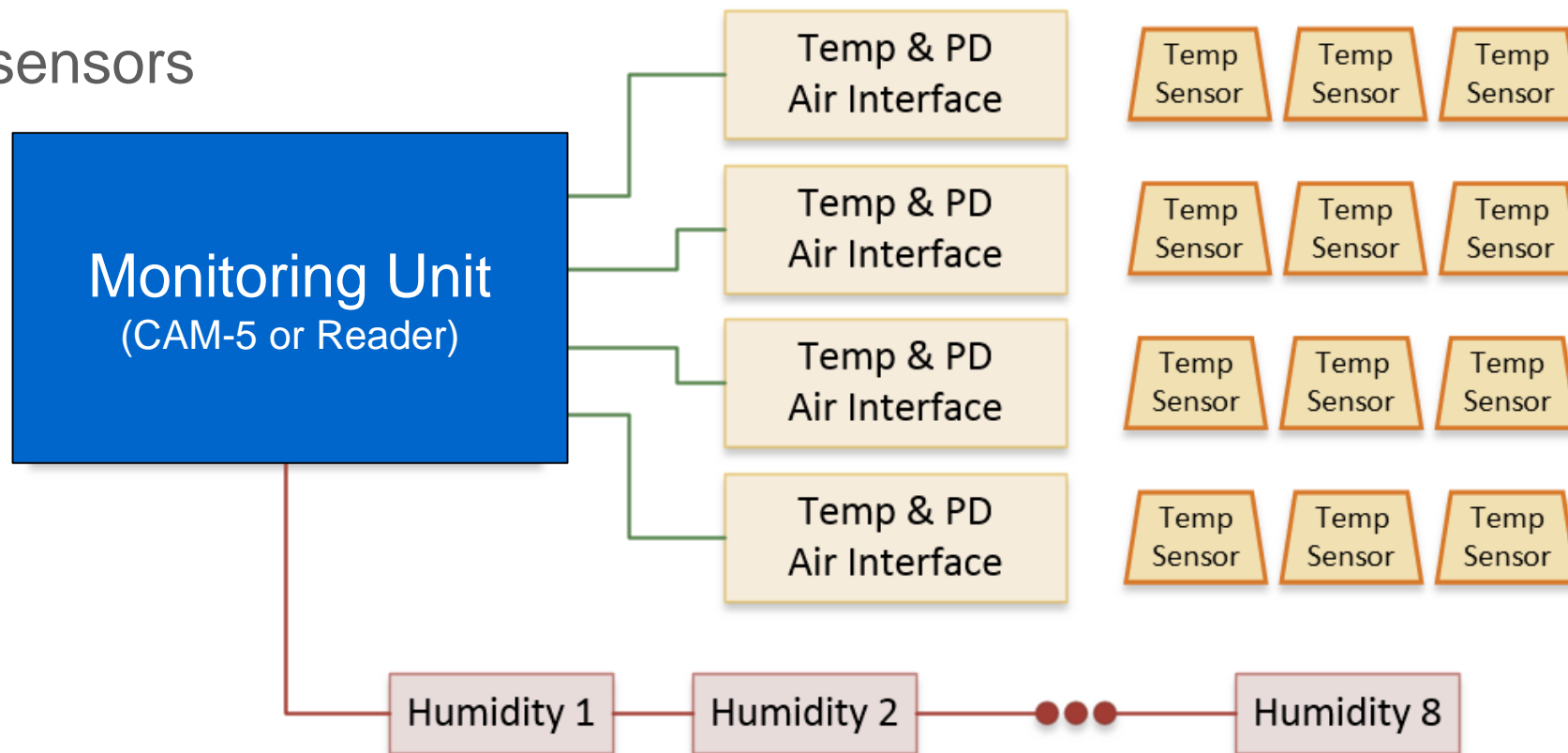
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Monitoring Capabilities

- 12 Temperature sensors
- 4 PD air interfaces
- 8 humidity sensors



System Architecture



CAM-5

- Local HMI
- Local alarming (contact closure)
- Interfaces to SCADA / Historian
- Monitoring (temp / PD / humidity)
- Data concentrator



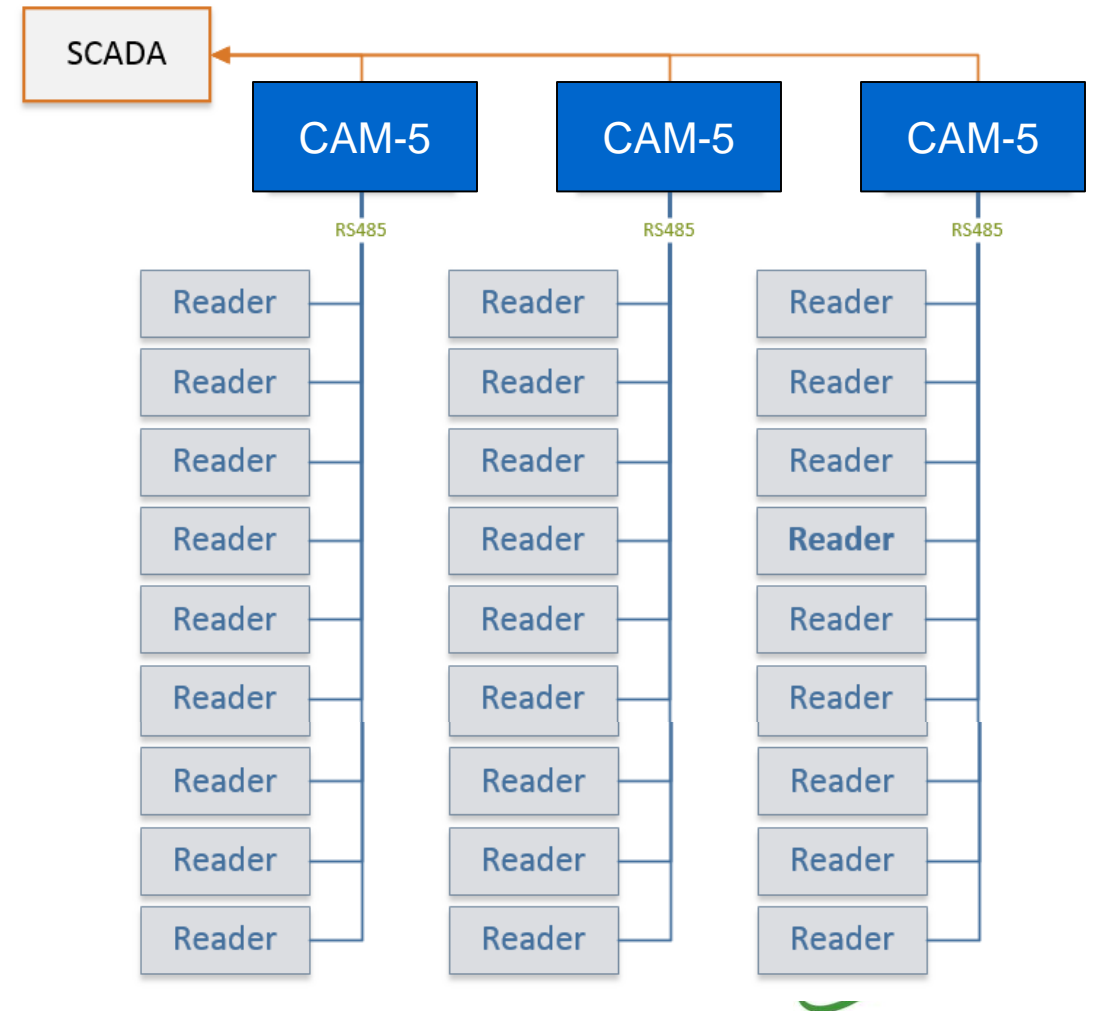
Reader

- Monitoring (temp / PD / humidity)
- Communications back to CAM-5



Sensors

- Each monitoring unit can have unique sensor configuration



Band-Pass UHF PD Monitoring

- **Highest Safety:** Does not require direct connection to the power phase conductors
- **Immune to nearby noise:** Band-pass filtered UHF PD detection methods are capable of avoiding strong interfering signals at close proximity.
- **Optimized for Trending:** Distills an overwhelming amount of complex data down to a concise piece of information without requiring a highly trained operator.



Partial Discharge (PD) Monitoring Overview

What is Partial Discharge?

- Localized breakdown of insulation
- Arcs within or along surface of insulator
- The breakdown causes emissions:
 - Current spikes between conductors
 - Electromagnetic (radio or light)
 - Acoustic
 - Ozone

Why measure PD?

- A leading indicator of cable damage and insulation failure.
- PD Magnitude is linked to the rate of deterioration



PD Air Interface Installation Example

PD Monitoring Only



PD and Temperature Monitoring



PD & Temperature Monitoring Installation Example



CAM Air Interfaces
are used for PD
monitoring and
temperature sensor
measurements.

Humidity & Ambient Temperature Monitoring

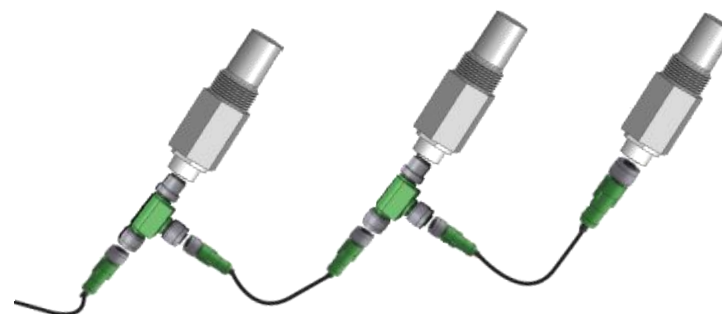
Why measure Humidity ?

Humidity contamination and moisture on the insulation surface results in long term insulation damage and metallic corrosion:

- Leads to elevated heating
- Partial discharge / Surface tracking
- Potential for shorts and flashover

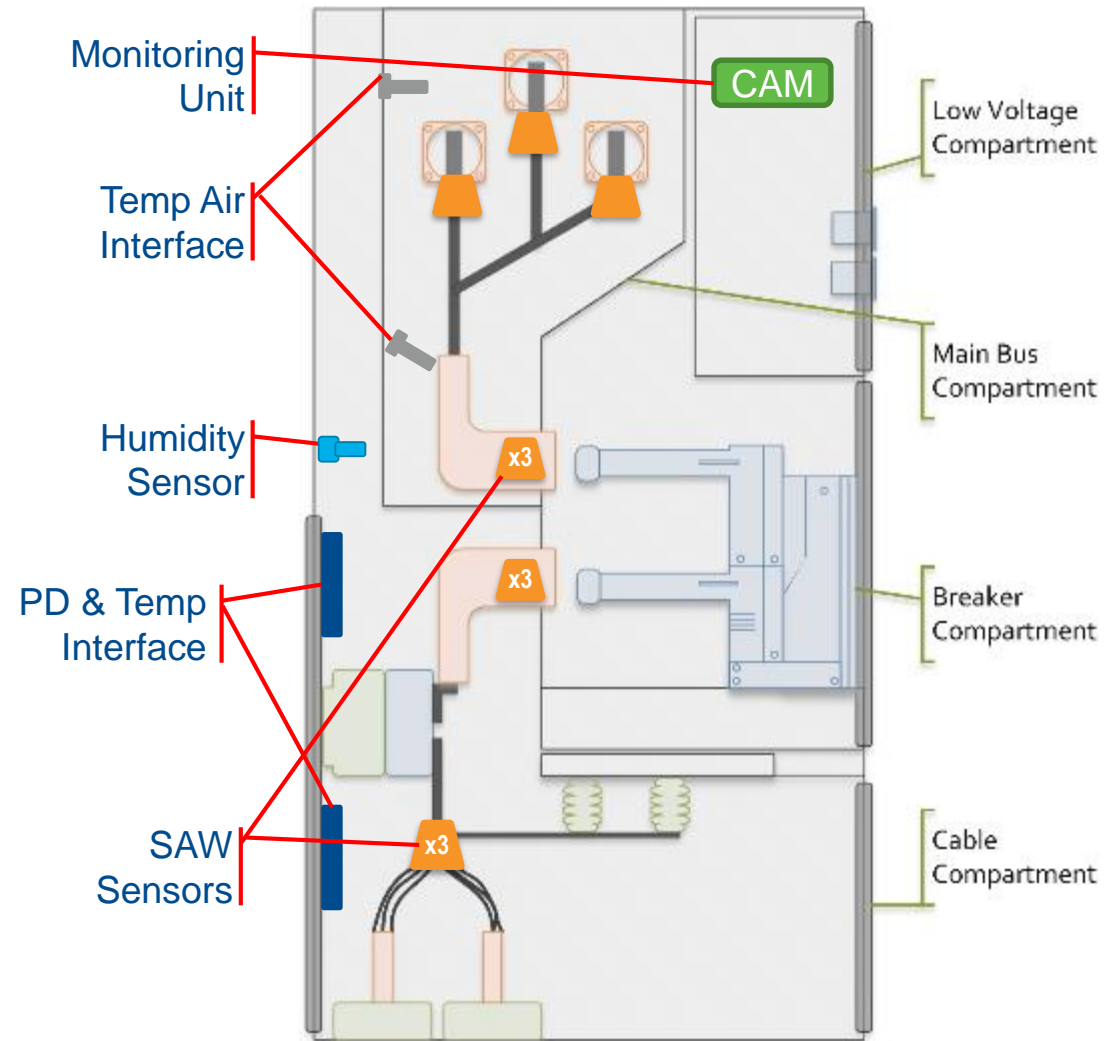
Sensor Overview:

- Humidity & Ambient Temperature
- Ideal for bus ducts and asset compartments
- Multi-drop for up to 8 series sensors
- Rugged construction



Installation Example (MV Switchgear)

- SAW Temperature Sensors
 - Bus connections
 - Breaker Input
 - Breaker Output
 - Cable Connections
- Air Interfaces
 - Temperature only (mast)
 - PD and Temperature
- Humidity Sensor
- Monitoring unit



Medium Voltage Switchgear Cross Section

Selling IntelliSAW Temp, PD and Humidity Monitoring System.

- Cost of IntelliSAW Solutions:
- Temp Only (6 Temp Sensors, 2 Antenna's and 1 Reader)= **\$2,300.00**
- Temp and PD (6 Temp Sensor, 2 Antenna's, 1 PD Sensor, and 1 Reader)= **\$3,000.00**
- Temp, PD & Humidity (6 Temp Sensor, 2 Antenna's, 1 PD sensor, 1 Humidity, and 1 Reader)= **\$3,800.00**
- Compared to 1 IR window which cost the end customer roughly \$1,000.00 Dollar per window and they usually purchase 3 of them. Most companies only perform IR scans 1's a year.
- For the same price if not less they can receive a monitoring system that runs 24/7 365 days a year and will alert them before there is a problem.

OEM's Working with IntelliSAW

- GE
 - Siemens
 - Schneider/Square D
 - Eaton
 - Power Secure
 - S&C
 - M&I
 - IEM
 - AZZ
 - REV
 - Jordan Transformers
 - Delta Star
 - Switch Gear Solution
 -
- CE Power
 - Point Eight
 - Crown Technologies
 - ABB
 - Powell Delta UniBus



Thank You Very Much

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