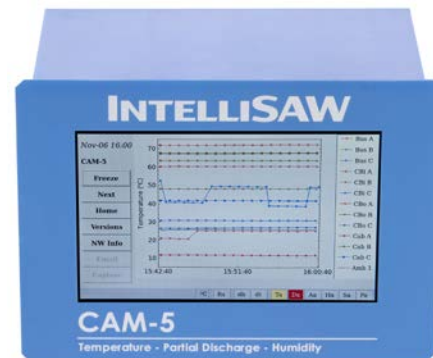# CAM™-5 HMI

Critical Asset Management

Features

- 5" touch panel HMI
- Up to 12 SAW (passive) Temperature sensors
- Up to 4 PD air interfaces
- Up to 8 Humidity sensors
- Total up to 10 monitoring units
- 6 configurable alarm outputs
- Industry standard communication interfaces

A Comprehensive Solution

The IntelliSAW CAM™-5 unit provides the required measurements (temperature, partial discharge, and humidity) 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, which extends to support up to 9 connected IntelliSAW Readers. The CAM™-5 unit can easily integrate into substation SCADA systems with industry standard communications.

Generation

- Hydroelectric
- Fossil Fuels (Oil, Natural Gas)
- Renewables (Wind, Solar)

Transmission & Distribution

- Step-up Substations
- Step-down Substations
- Collector Substations

Customers

- Heavy Industrial
- Steel and Aluminum Plants
- Mining
- Petrochemical
- Data Centers

Applications

- Switchgear
  - Incomers
  - Feeders
  - Bus Ties
- Bus Ducts
- ISO Phase Bus Ducts
- Ring Main Units
- Transformers
- Generator Circuit Breakers
- Load Tap Changers
- Rectifier Stacks
- Capacitor Banks

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Typical Installation

A medium voltage switchgear cabinet is a typical application where the CAM™-5 is installed in the low voltage compartment while the sensors and air interfaces are installed in the high potential compartments.

Medium Voltage Switchgear

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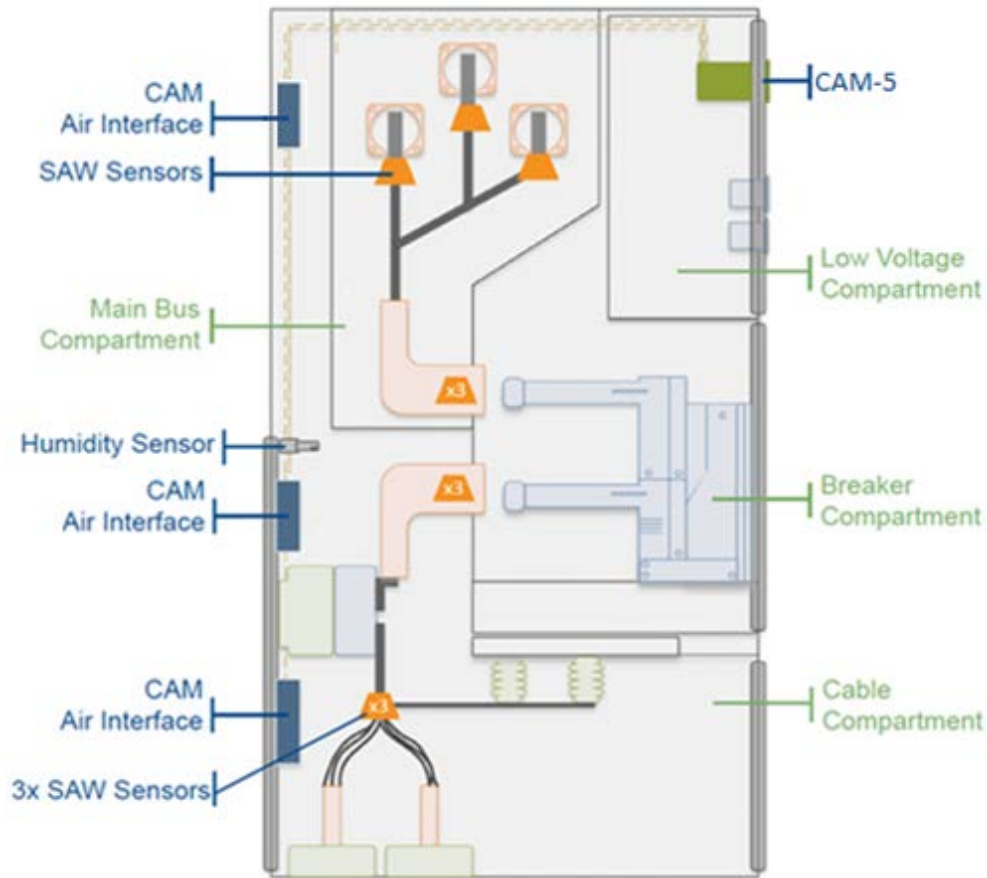
Multiple Unit Integration

The CAM™-5 supports connectivity for an internal monitoring unit and up to 9 IntelliSAW Readers, allowing each unit (CAM™-5 and Readers) to have unique temperature, partial discharge, and humidity display and alarm configurations. Data from all units can be viewed in real-time, stored to a local USB drive, and transferred to a SCADA system over open industry communication protocols. Multiple CAM™-5 units can be connected to the SCADA system providing a scalable and fully integrated solution.
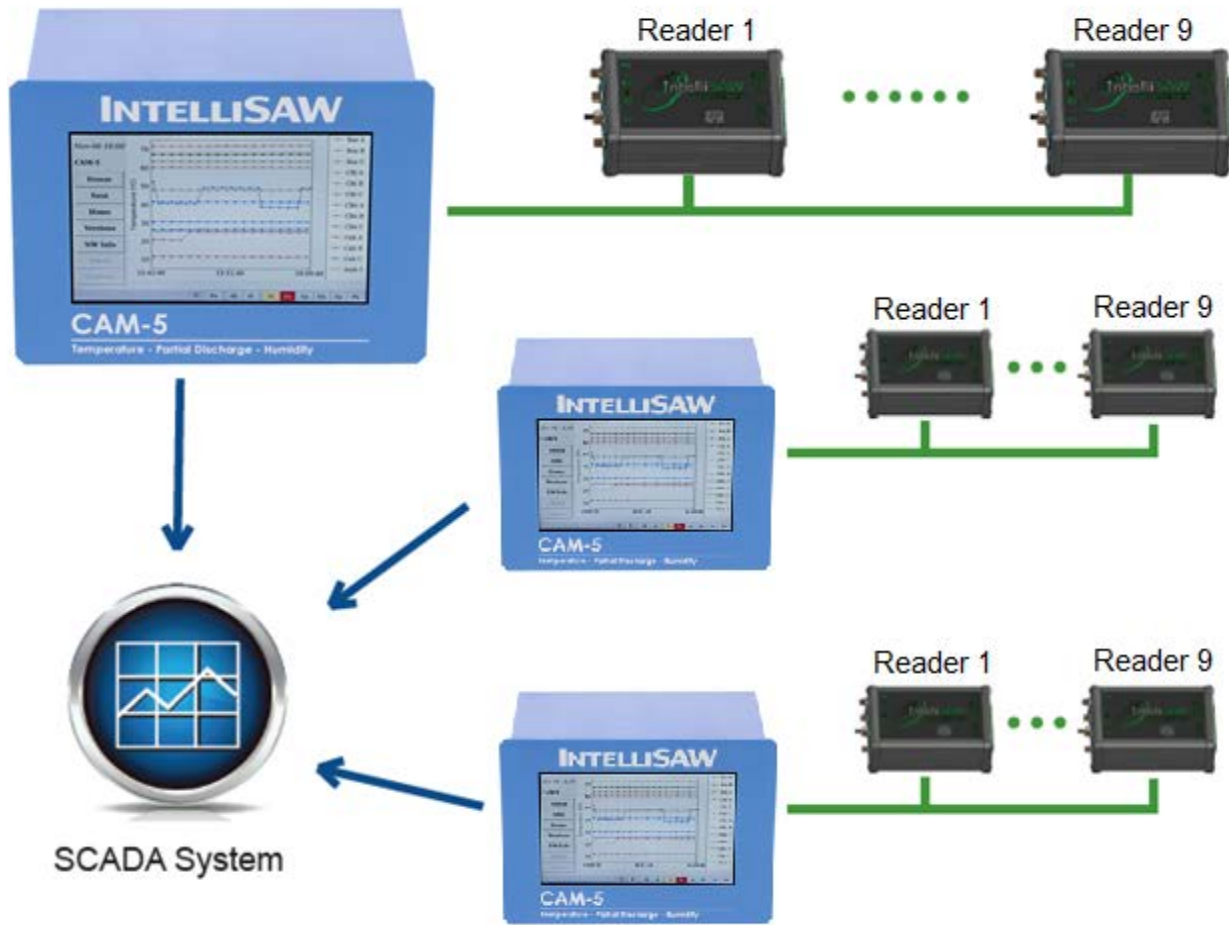
Mechanical
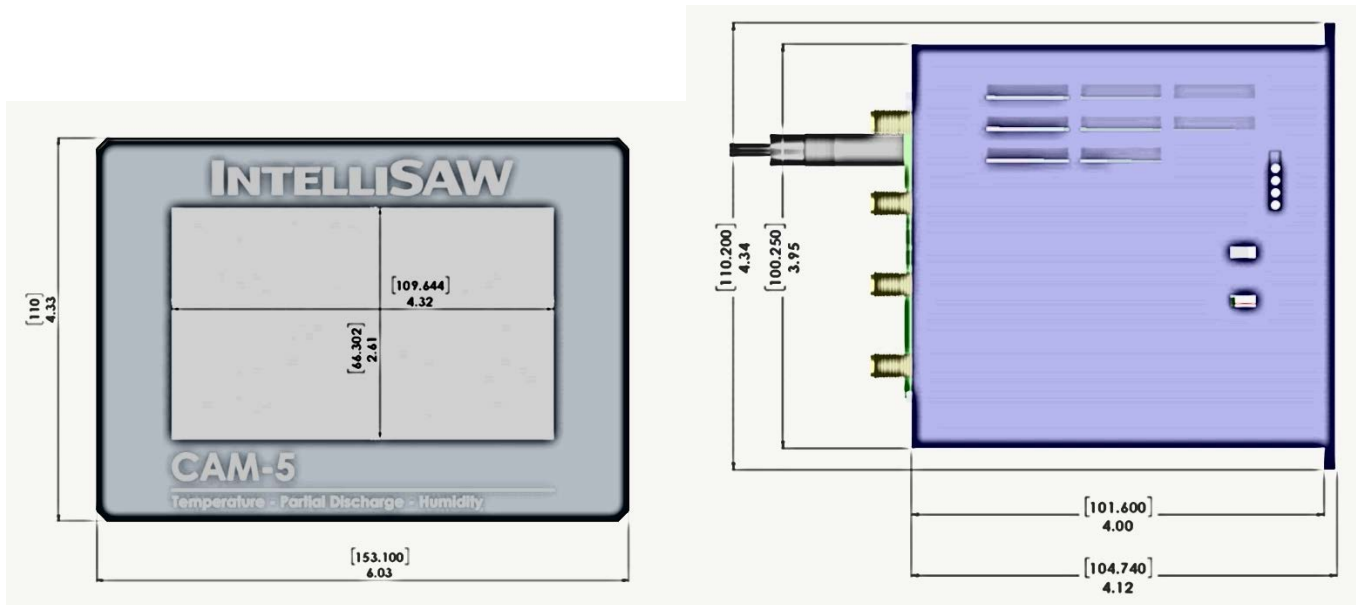
Specifications

TEMPERATURE	
Operating Frequency	425 to 443 MHz
SAW Sensors	0 to 12
Redundancy Model	Up to 4 air interfaces
RF Transmit Power	Pulsed, -6 to + 10 dBm (compliance mode dependent)
RF Receive Sensitivity	-86 dBm
RF Receive Frequency Stability	± 700 Hz
RF Interrogation Distance	Up to 1.75 m (2.5 m with TPD air interface at full power)
RF Interrogation Time	≤ 160 mSec

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PARTIAL DISCHARGE

Number of Channels	4
Sensor Type	IntelliSAW TPD CAM Air Interfaces
Measurement Method	Band-pass Ultra-High Frequency (UHF)
Measurement Frequency Bands	300MHz (270 – 330 MHz) 600MHz (550 – 650 MHz) 1200MHz (1050 – 1400 MHz)
Measurement Classification	- Noise Floor - SD – Surface Discharge (Tracking, Treeing, Corona, etc.) - PD – Internal / Partial Discharge
Measurement Units	Q_{UHF}
Measurement Scale	Nonlinear, capability of normalizing to reference source
Sensitivity	100pC Q_{pk} demonstrated in 24kV switchgear. Installation dependent
Response Time	200 mSec
Calculated Data	- Max SD - Max PD Calculated based on Signal to Noise Ratio (SNR)
Trending Algorithms	- Fast averaging function (α) - Long averaging function (β) – used as baseline - PD acceleration trend function (Φ)

HUMIDITY / AMBIENT TEMPERATURE

Number of Channels	Up to 8
Sensor Types	IntelliSAW IH-10 sensors
Measurement Types	Relative Humidity, Ambient Temperature
Response Time	500 mSec

ALARM OUTPUT CHANNELS

Contact Type	Dry Contact, Form C relays
Number of Channels	6 output pairs (NO/NC pairs with shared common)
Rated Voltage	250 V AC/DC
Continuous Withstand Capacity	10A
Make and Carry for 4s	15A
Breaking Capacity (AC)	2500VA
Breaking Capacity (DC)	24V, 5A / 125V, 0.45A DC
Contact Material	AgNi 90/10
Mechanical Operations (40°C)	
Full Load	30×10^3
No Load	$> 30 \times 10^6$
Open Contact Dielectric Strength	$1000V_{RMS}$; 5000V contacts to coil isolation

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COMMUNICATION INTERFACES

RS485 (Device)	
Port	2-Wire (half-duplex) plus common (optional)
Data Bus Baud Rate	1200 to 38400 baud (9600 default)
Data Protocol	Modbus RTU Master
Response Time	500 ms (typ.), 1 second polling intervals (typ)
Supported Devices	IntelliSAW IRM readers (up to 10 devices; baud rate dependent)
Optional RS485 (SCADA)	
Port	2-Wire (half-duplex) plus common (optional)
Data Bus Baud Rate	1200 to 38400 baud (9600 default)
Data Protocols	• Modbus RTU Slave • DNP 3 Outstation
Response Time	500 ms
Ethernet (ETH-1 & optional ETH-2)	
Port	10/100 BASE-T copper (RJ45 connector)
Data Protocols	• Modbus TCP • DNP3 Outstation • IEC 61850 • SFTP, SSH
Isolation	5kVpk
Ethernet (optional ETH-2 FIBER)	
Port	100 BASE-FX of IEEE802.3u
Wavelength	1300 nm
Optical Connector	LC duplex connector
Type	Multimode
Fiber Size	62.5/125 µm
Output (TX) Power	Min: -19 dBm avg Typical: -15.7 dBm avg Max: -14 dBm avg
Receive (RX) Sensitivity	Min: -30 dBm avg Max: -31 dBm avg
Data Protocols	• Modbus TCP • DNP3 Outstation • IEC 61850 • SFTP, SSH

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COMMUNICATION INTERFACES

Measurement Configuration (CNFG)	
Port	USB 2.0 Mini; Windows COM port with FTDI drivers, 115200 baud.
Data Protocols	IntelliSAW Native Protocol
Protection	Type 1 (protected area); light industrial protection, configuration only
Extended Memory (USB)	
Port	USB 2.0 Type A host
Use	Extended Memory – Required for Trending
Data Storage	CSV file format extension
Protection	Type 1 (protected area); light industrial protection, memory only
Micro SD	**Factory only.** Type 1 (protected area); light industrial protection, configuration only

OPERATING POWER

AC input	100 to 250V AC 50 / 60 Hz
DC input	120 to 250V DC (functional, no FCC, UL, or IEC tests)
Power Consumption	20W

PHYSICAL / ENVIRONMENTAL

HMI	Resistive Touch Panel (5" / 800 x 480 resolution)
Dimensions:	Body: 143.6 mm W x 100.25 mm H x 101.6 mm D Panel: 153.4 mm W x 110.2 mm H x 3.14 mm D
Weight Will vary with model	Typical: 0.98 kg (2.16 lbs.)
Mounting Style	Panel Mount, Cutout: 144.9 mm W x 101.65 mm H
Operating Environment	
Pollution Degree	2
Overvoltage Category	Cat III Mains < 300V
International Protection (IEC 60529)	Panel (IP 62), Body (IP 20)
Temperature	-20°C to +70°C @ 120VAC +55°C @ 250VAC
Indoor Use	Max altitude: 5000 m Max humidity: 95% RH

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ENVIRONMENTAL TESTING	
Environment testing (IEC-60721-3-3) for High Voltage Switchgear and Control Gear (IEC-62271) – Category C1	
IEC 60068-2-1	**Cold Test** -25C for 16 hours minimum
IEC 60068-2-2	**Dry Heat** + 75C for 16 hours minimum
IEC 60068-2-3	**Damp Heat** +38C 95% RH for four days.
IEC 60255-21-1	**Vibration** Class 1 Test is based on the IEC-60225-21-1 Powered 0.035mm 10Hz to 60Hz, 0.5g 60 to 150Hz Unpowered 1g 10 to 150Hz

Product Certifications

Compliance Testing

Compliance Testing	
Radiated Emissions	Radiated Emissions Transmitter FCC Part 15.231 Digital Device FCC Part B IEC 61000-6-4
Conducted Emissions	AC Mains Conducted Emissions (FCC Part 15 Subpart B: 09/2017, FCC 15.231: 09/2017, IEC 61000-6-4: 02/2011)
UL / cUL / IEC 61010-1 Registered Component	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1 Cat III MAINS < 300V to 5000m altitude (Unless otherwise specified)
IEC 61000-6-5	Immunity for Power Station and Substation Environments **Type 4** (All ports, unless otherwise specified)
IEC 61000-4-2	**ESD immunity** Severity Level: • Front (LCD): ±8kV contact & ±15kV air discharge (level 4) • Back (Connectors): ±6kV contact & ±8kV air discharge (level 3)
IEC 61000-4-3	**Radiated Field Immunity (rEMI)** Severity Level: 10V/m (class A) 30V/m (class B)

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Compliance Testing	
IEC 61000-4-4	**Electrical Fast Transient immunity (EFT)** Severity Level: 4kV
IEC 61000-4-5	**Surge Immunity** Severity Level: • 250VAC: ±2kV line-line (A), ±4kV line-Earth • 120VAC: ±2kV line-line (A), ±4kV line-Earth (A) • IO modules: ±4kV line-Earth (A)
IEC 61000-4-6	**CRFI - Immunity to conducted RF disturbances** Severity Level: 10Vrms (class A)
IEC 61000-4-8	**Power frequency magnetic field immunity** Relevant modules: 100A/m cont. 1kA/m 1s. (class A)
IEC 61000-4-11	**Voltage dips and interrupts** input current not exceeding 16 A • 70%/1 cycle Pass (class A) • 40%/50 cycles Pass (class A)
IEC 61000-4-16	**Immunity to conducted, common mode 0 to 150 kHz** • 300 Vrms 1 second (class A) • 30 Vrms Continuous (class A) • Level 3 Sweep (class A)
IEC 61000-4-18	**Damped oscillatory wave immunity** • Slow wave 1MHz 2.5kV (class A) • Fast Wave 10MHz 1.0kV (class A)

Safety

IntelliSAW systems are installed in close proximity to the energized compartments of medium and high voltage electric power equipment. Qualified personnel need to observe industry standard safety practices that will protect the systems and operators from harm due to induced voltages. Proper antenna installation and system safety grounding is crucial to operator safety and system reliability.

Homologation

System Integrators and installers are responsible for adhering to all regional regulations concerning the import, installation and operation of IntelliSAW Critical Asset Monitoring systems.

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Model Numbers

Not all model combinations are stocked, please contact sales before ordering.

CAM5B-TPH-XDCW

Model (B)		
B	BASE	
Temperature (T)		
0	No Temp	
T	Temp Monitoring	
Partial Discharge (P)		
0	No PD	
P	PD Monitoring	
Humidity (H)		
0	No Humidity	
H	Humidity Monitoring	
Auxiliary (X)		
0	No Auxiliary	
A	6 Alarm Relays (NO / NC)	
Device Interface – RS485 Master (D)		
0	No Multiunit interface	
M	IntelliSAW Multiunit Device interface (RS485)	
Communication Interface (C)		
0	No Interface	
E	Ethernet Port (TCP/IP) – (4kV)	
F	Fiber (100base FX)	
S	RS485 Slave Device interface (Modbus RTU)	
Input Power (W)		
U	Universal - 100 to 250 VAC; 120 to 250VDC	

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CAM™-5 Standard Units

Model Number	Description
CAM5B-000-AMEU	**CAM5 Base:** - No Monitoring - Alarm outputs – 6 ch. (NO/NC) - Multiunit Device Interface (RS485) - Communication interface: Ethernet - Standard communication: Modbus TCP - Universal Input Power (100 to 250 VAC; 120 to 250VDC)
CAM5B-T00-AMEU	**CAM5 Base:** - Monitoring: Temperature - Alarm outputs – 6 ch. (NO/NC) - Multiunit Device Interface (RS485) - Communication interface: Ethernet - Standard communication: Modbus TCP - Universal Input Power (100 to 250 VAC; 120 to 250VDC)
CAM5B-T0H-AMEU	**CAM5 Base:** - Monitoring: Temperature, Ambient Temp &Humidity - Alarm outputs – 6 ch. (NO/NC) - Multiunit Device Interface (RS485) - Communication interface: Ethernet - Standard communication: Modbus TCP - Universal Input Power (100 to 250 VAC; 120 to 250VDC)
CAM5B-TPH-AMEU	**CAM5 Base:** - Monitoring: Temperature, PD, Ambient Temp &Humidity - Alarm outputs – 6 ch. (NO/NC) - Multiunit Device Interface (RS485) - Communication interface: Ethernet - Standard communication: Modbus TCP - Universal Input Power (100 to 250 VAC; 120 to 250VDC)
CAM5B-TPH-AMFU	**CAM5 Base:** - Monitoring: Temperature, PD, Ambient Temp & Humidity - Alarm outputs – 6 ch. (NO/NC) - Multiunit Device Interface (RS485) - Communication Interface: Fiber Optic (100 base FX) - Standard communication: Modbus - Universal Input Power (100 to 250 VAC; 120 to 250VDC)

CAM™-5 Options

Option	Description
CAM5-INTP-DNP3	Interface Protocol - DNP3
CAM5-INTP-61850	Interface Protocol - IEC 61850

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