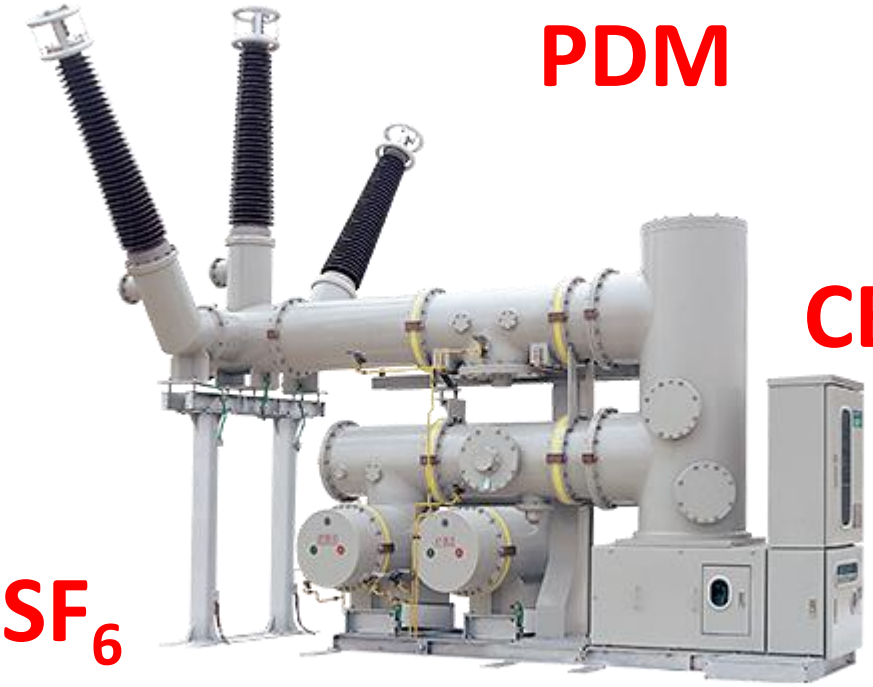
ALTANOVA



PDM

CBM

SF_6

Battery

GLOBAL MONITORING FOR GIS

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The first Fully Integrated Permanent GIS Monitoring System from one supplier !!!

- Partial Discharge activity
- Circuit Breaker operation
- SF_6 – leakage
- Battery
- others

Defects are a result of:

- Errors in manufacturing
- Shipping
- Assembly
- Ingress of moisture
- Gas leakages
- CB malfunctions
- Battery malfunction

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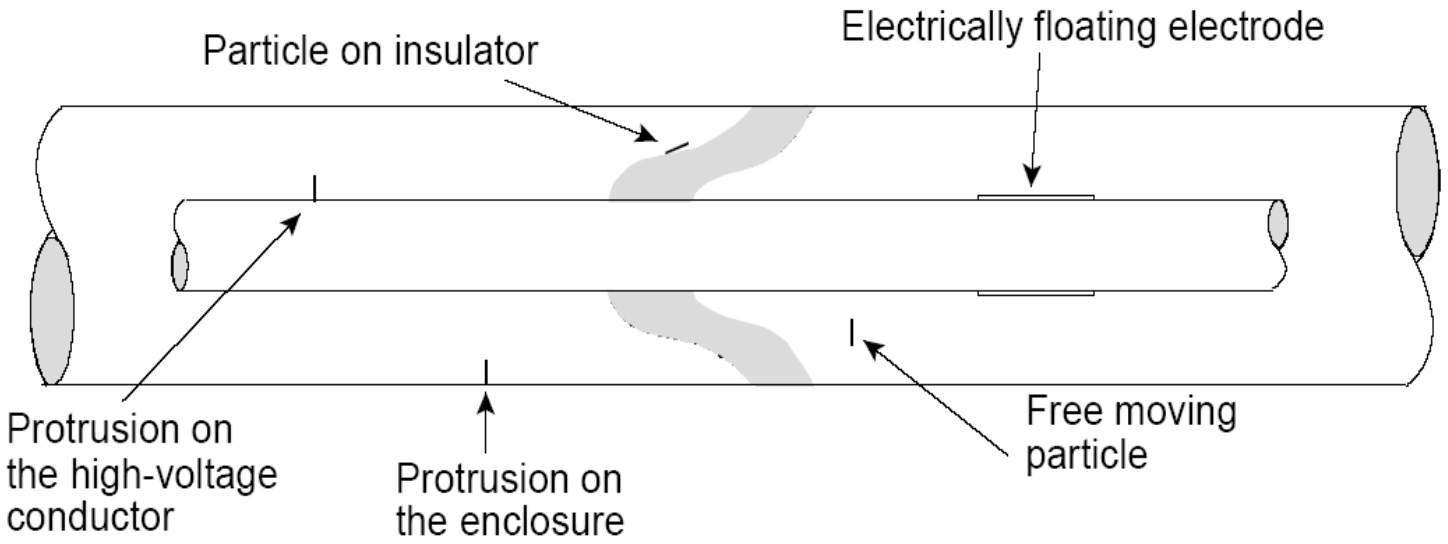
Typical defects:

- Moving particles;
- Electrode protrusions/scratches;
- Fixed particles on insulating surfaces;
- Floating electrodes (stress shields);
- Forgotten tools
- Loose, non-floating electrodes;
- Voids in solid insulation, delaminations.

- Protrusions;
- Particles fixed to an insulator surface;
- Free moving particles;
- Electrically floating parts



Little PD activity can be tolerated in GIS:

PD ⇨ SF6 decomposition ⇨ corrosion of dielectric surfaces.

The precise level of tolerable PD activity remains a subject of research.

Past experience indicates that:

- a small amount of PD from free conducting particles is harmless
- strong PD activity from a floating component will result in failure in a matter of weeks to months.

Properly designed GIS exhibits very low levels of PD, typically associated with a few remaining free conducting particles ⇨ characteristic PD signature.

Floating Electrodes:

large PD between a floating electrode (generally, disconnected stress shields) and an adjacent electrode produce acoustic pressure waves of great energy.

Easily detected using acoustic sensors. Electrical detection is also very simple as a result of a PD magnitude which ranges up to 1000 nC.

Loose, non-floating Electrodes:

usually generates PD pulses which are correlated to twice the frequency of the test voltage.

Acoustic signals propagate from the defect to the enclosure where they can be detected

Voids, delaminations:

filled epoxy absorbs high frequency acoustic energy strongly

- Acoustic partial discharge detection not effective
- The PD magnitude can be a few pC, depending on the size and position of the void
- Electrical detection is generally effective

Moving particles:

the impact of a free conducting particle on the enclosure or on an insulating surface causes an easily detectable acoustic signal. Essentially all types of dangerous particles can be detected.

The range of PD is 2-10pC

Electrode protrusions:

a corona from a protrusion on an electrode generates a pressure which can be detected

by an acoustic sensor Acoustic partial discharge detection not effective

Sensitivity: generally better than 2 pC (If the sensor is near the defect).
Electrical detection is also effective

Fixed particles on insulating surfaces:

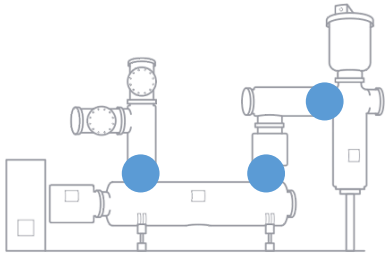
Such defects can be detected if they produce corona.

Sensitivity is generally in the range of 2 pc

PD SENSORS:

TECHIMP provides ONLINE PD measurements on GIS and GIL with one of the following measurement points available:

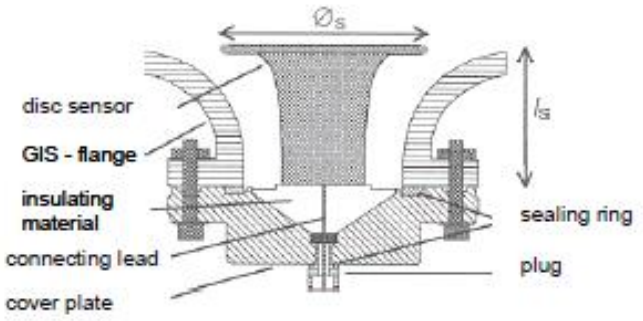
- Pre-existing internal UHF sensors
- Unshielded epoxy spacers
- Shielded epoxy spacers with small dielectric aperture
- Unshielded epoxy spacers at cable terminations
- Circular dielectric glass windows



Internal UHF sensors

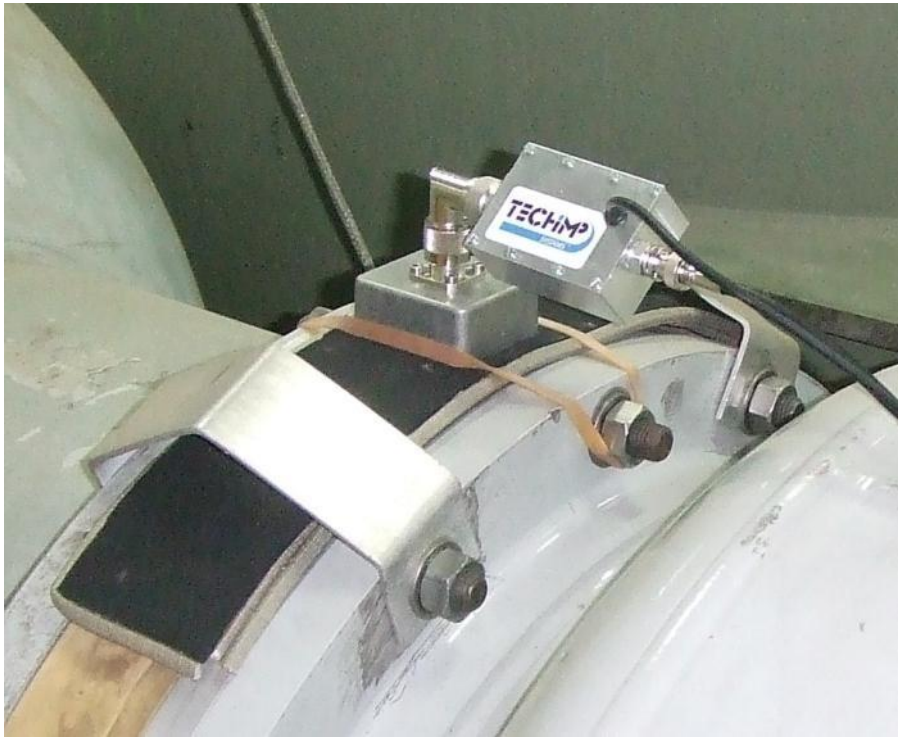
Modern GIS are provided with internal UHF sensors.

TECHIMPs PD DAQ system is fully compatible with all internal UHF sensor regardless of the OEM.



Unshielded epoxy spacers

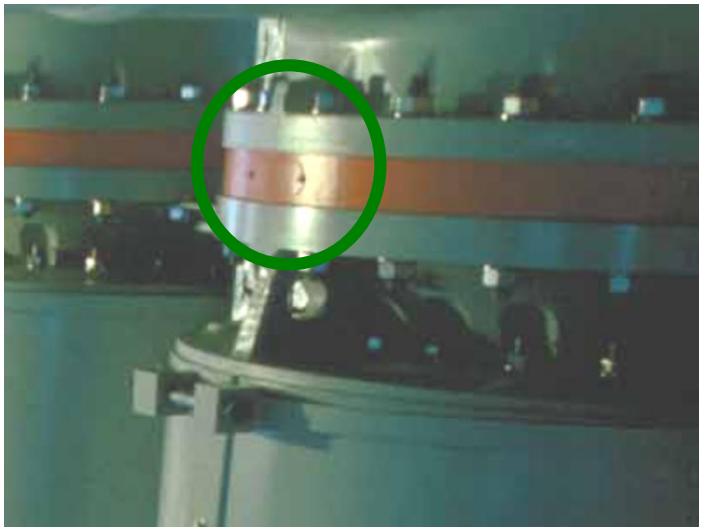
In the absence of internal sensors TECHIMPs UHF Horn-Antenna can be placed at at non-shielded GIS epoxy insulators.



Shielded epoxy spacers with small dielectric aperture

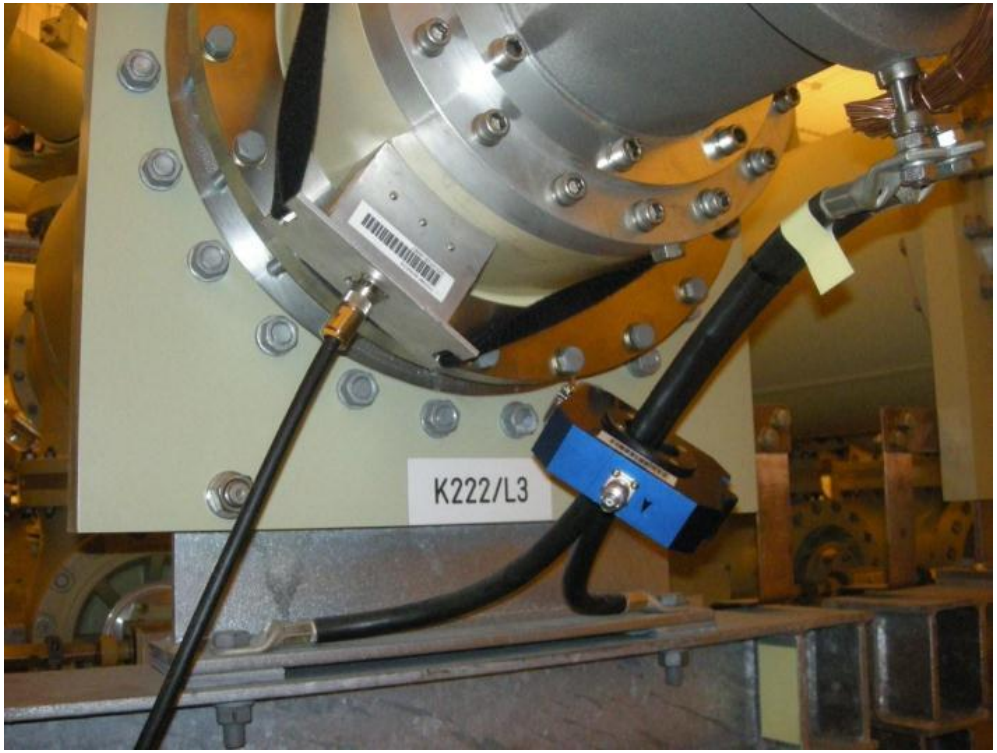
Many GIS breakers and GIL are provided with completely shielded spacers. In such cases PD detection is difficult.

However, some of these (e.g. ABB ELK modules) are endowed with small dielectric apertures (marked in Green in the figure below)



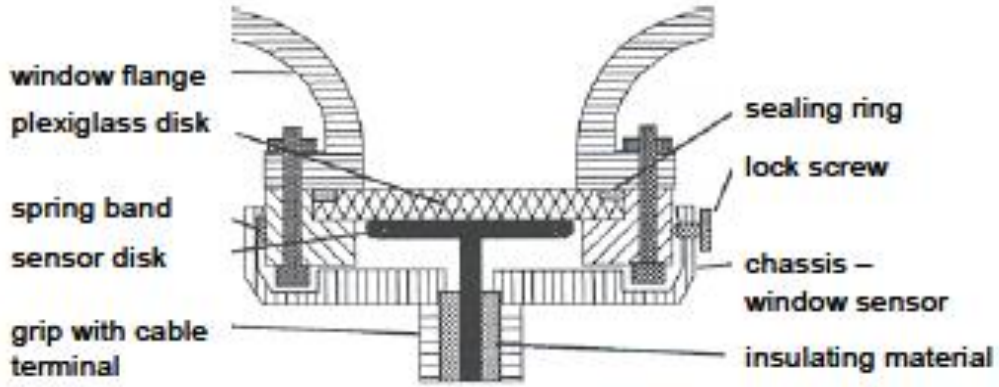
Unshielded epoxy spacers at cable terminations

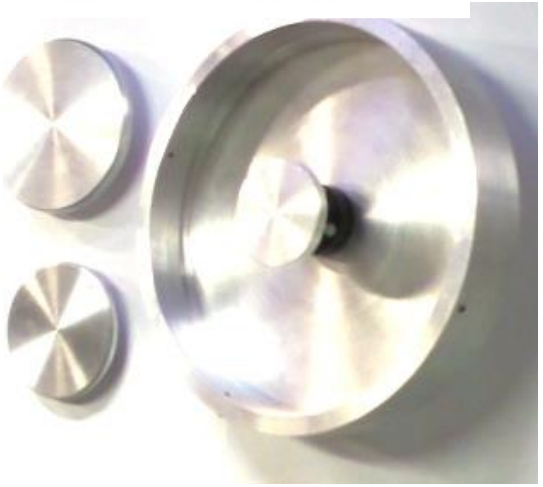
PD detection can be carried out through proper UHF sensors in correspondence of dielectric unshielded spacers at cable termination, achieving good sensitivity both in the cable termination and in the GIS connected to the cable.



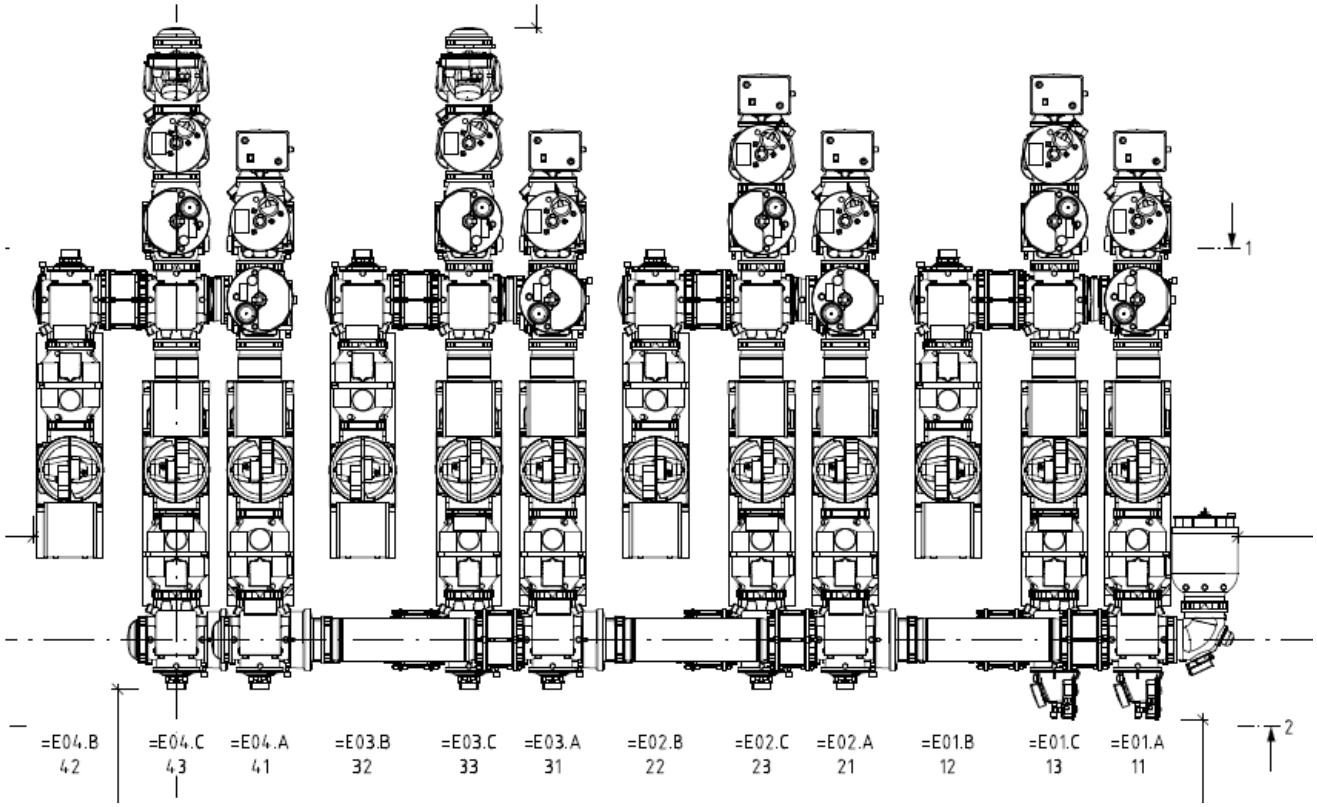
Circular dielectric glass window

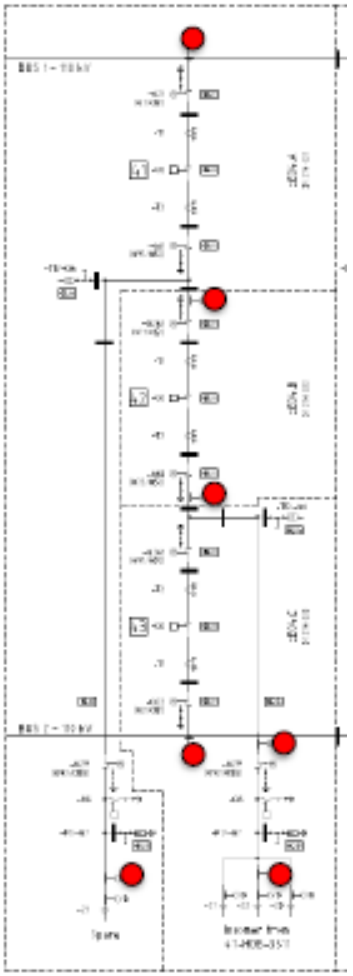
When circular glass windows are available, proper designed UHF sensors can be used fitting the circular aperture achieving good sensitivity.





PERMANENT MONITORING – TYPICAL LAYOUT





Typical Bay with 7 PD Sensors and 15 SF6 Sensors

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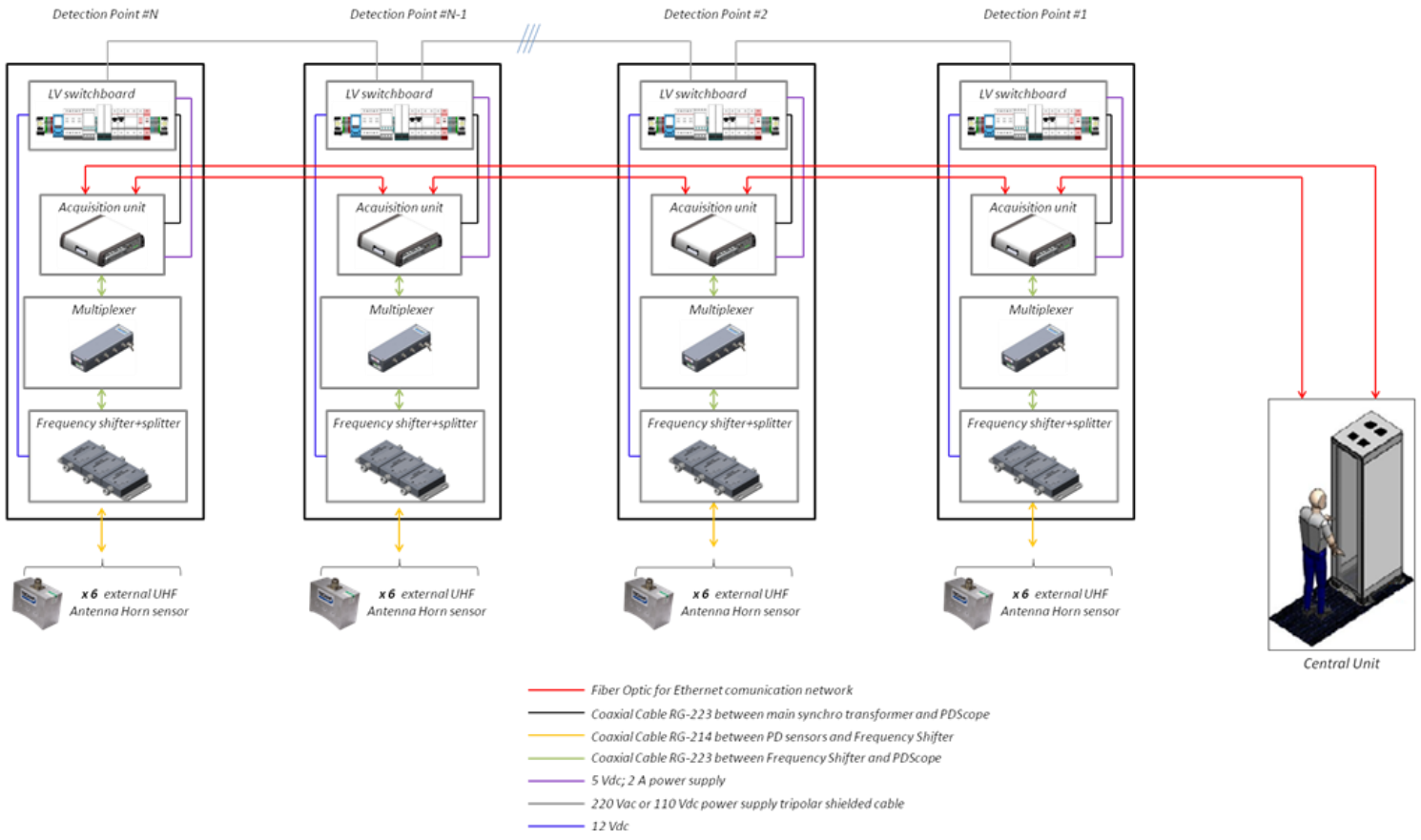
GLOBAL MONITORING OF GIS
PD MONITORING OF GIS



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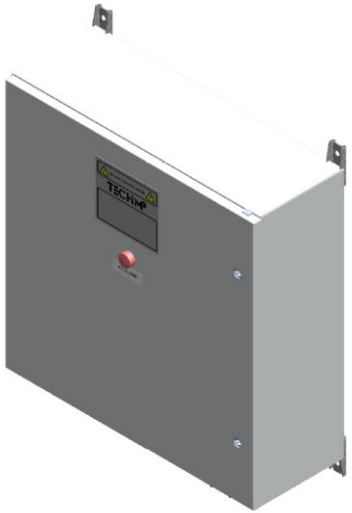

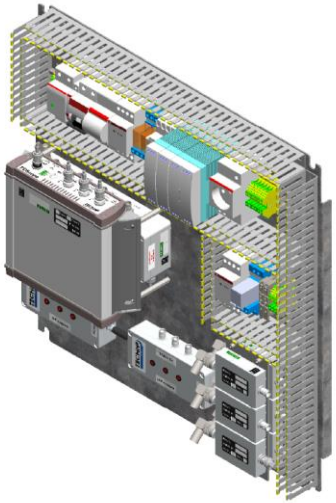

The **Acquisition Box** is the core of the PD monitoring system.
It collects the Partial Discharge signals coming from the UHF internal/external PD sensors.

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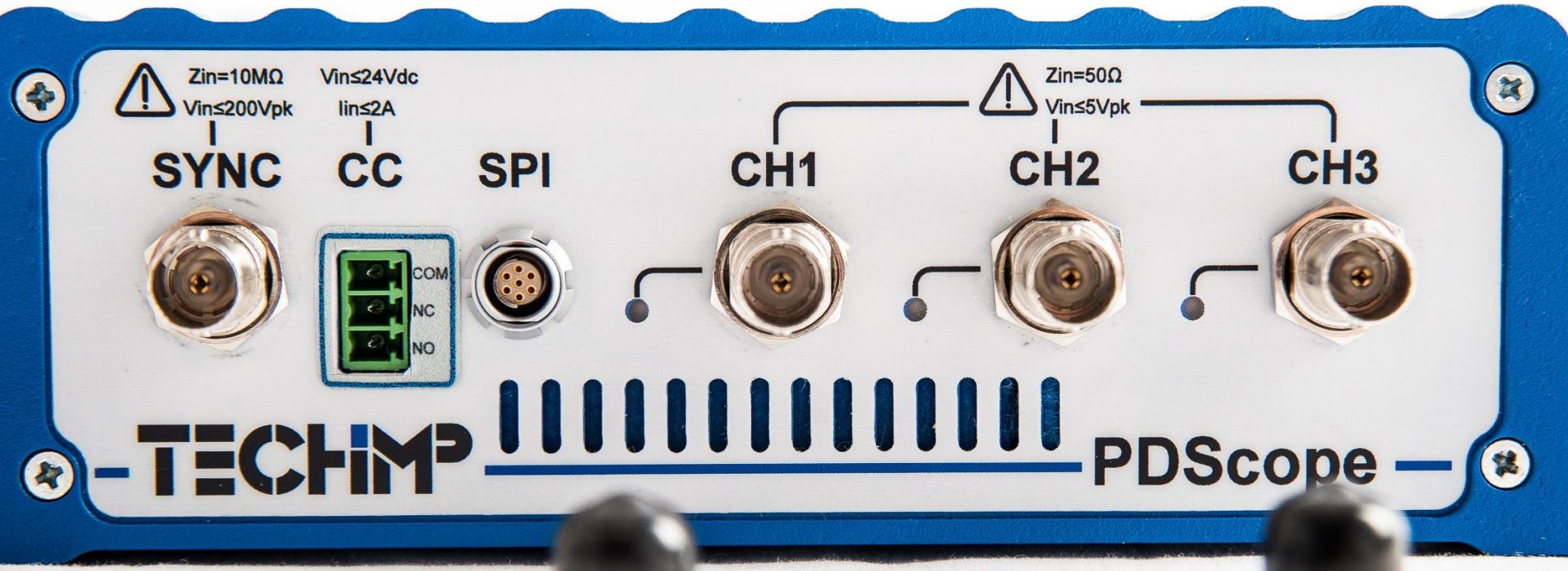
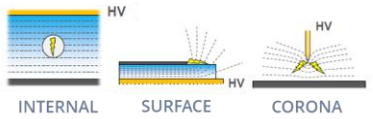


TF MAP®



Bandwidth 16 kHz ÷ 30 MHz

Fast sampling rate 100 MS/s

Channels up to 6

Fiber Optic connection

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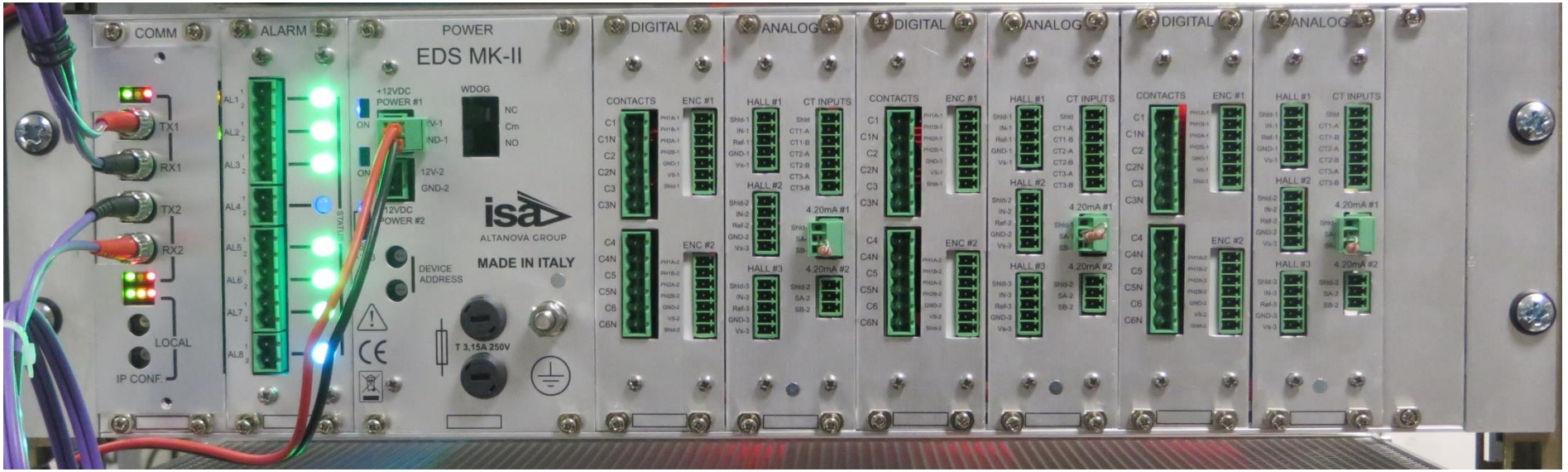
Open coils
Close coils
Feeder Current
Motor Current
Heater Current
Travel Sensor
Time Delay Measurement
SF6 pressure/density
SF6 trend

Radiography of a GIS circuit breakers
(Source ABB)

EDS MKII for GIS - features – overview

This new system it's designed to monitor the most important parameters of a GIS.
Grants to its flexibility EDS MKII can be survey other substation assets, as Transformers, Dischargers, CVT etc…

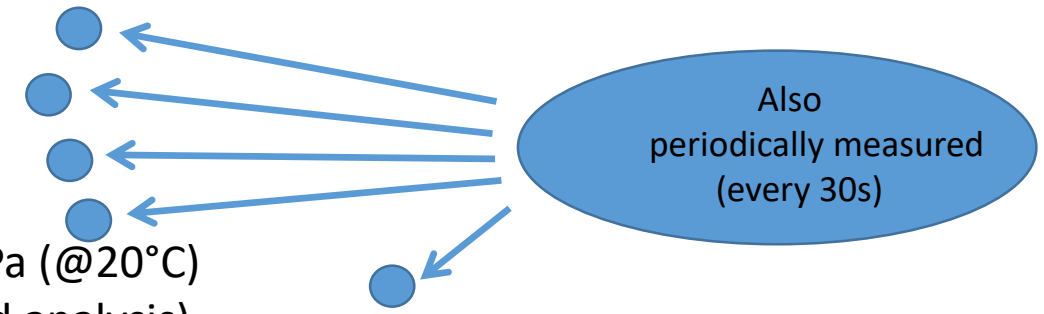


EDS MKII for GIS – key points

- Flexible : the rack can be configured with different boards depending the specific application
- Flexible : alarms thresholds (and measurements!) can be easily defined and modified
- Flexible : measurements can be performed accordingly to the customer requirement and sent to a central unit
- Comtrade files are saved when an event (open, close etc..) occurs
- Measurements, alarms and event files can be sent to our sw TSCADA or to a substation protocol
- Due to its powerful processor, different custom applications may be developed if required
- Different protocols : IEC104 native, other available on demand (DNP3, 61850..)

EDS MKII for GIS – measurements

- Open time delays (single and three phases)
- Close time delays (single and three phases)
- Coil current peak (Open 1st circuit, Open 2nd circuit and Close)
- Breaker velocity (for open and close events)
- Feeder current
- Motor current
- Heater current
- Beaker status
- SF6 pressure in kPa (@20°C)
- SF6 leakage (trend analysis)



- On demand CO , OC and OCO time delay can be calculated

EDS MKII for GIS – measurements - time delay

- This measurement will be taken by means of 2 digital (binary) contacts and coil current profiles.
- These digital contacts represent the status of the breaker (open or closed).
- The other contacts (close or open commands) are taken in account in order to have a recording starting trigger

EDS MKII for GIS – alarms

In faulty condition, the circuit breaker:

- Requires more time to complete the changing status
- command coil current stays for longer time
- velocity is slower than the nominal

EDS MKII for GIS – alarms

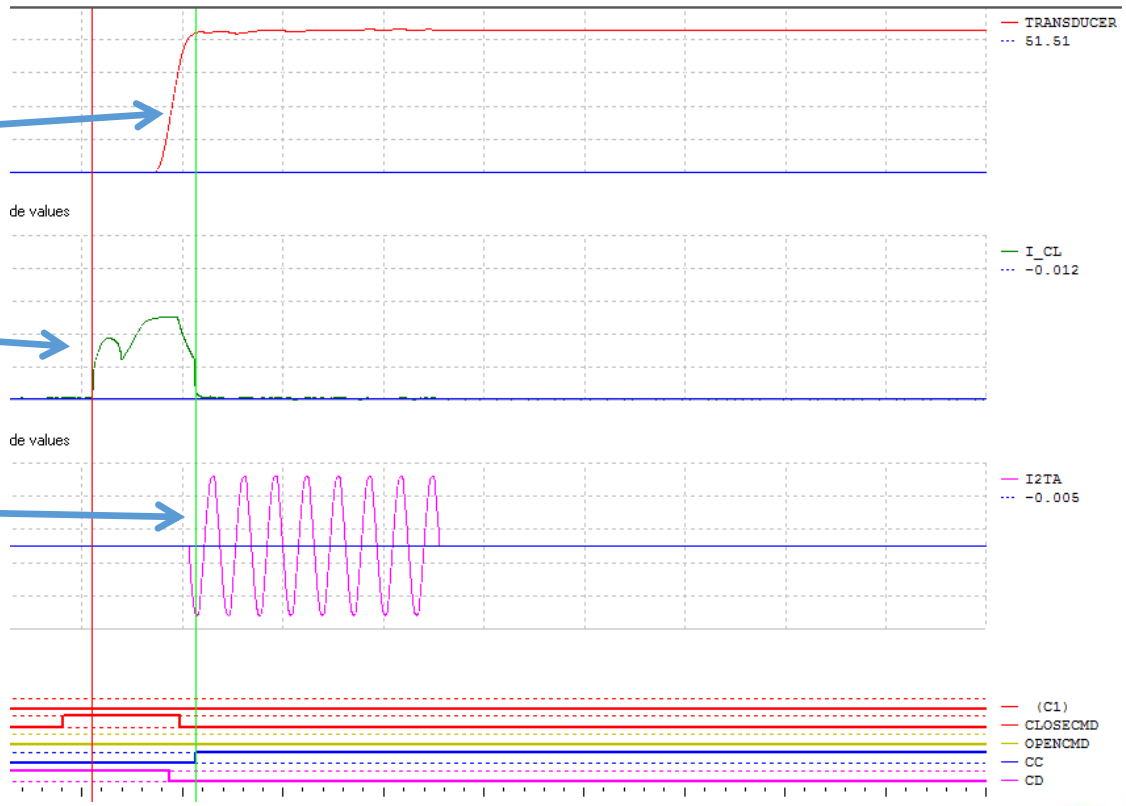
.. And so, basing upon settings and conditions (events and free running measurements) many alarms may be raised.

- Open time delays (max value)
- Close time delays (max value)
- Coil currents (max and min values)
- Feeder current (max value)
- Breaker velocity , for open and close events. (min value)
- Motor current (max value)
- Heater current (min value)
- SF6 pressure in kPa (min value)
- SF6 leakage (trend analysis) if the leakage per year it’s greater of a certain percentage

EDS MKII for GIS – profiles

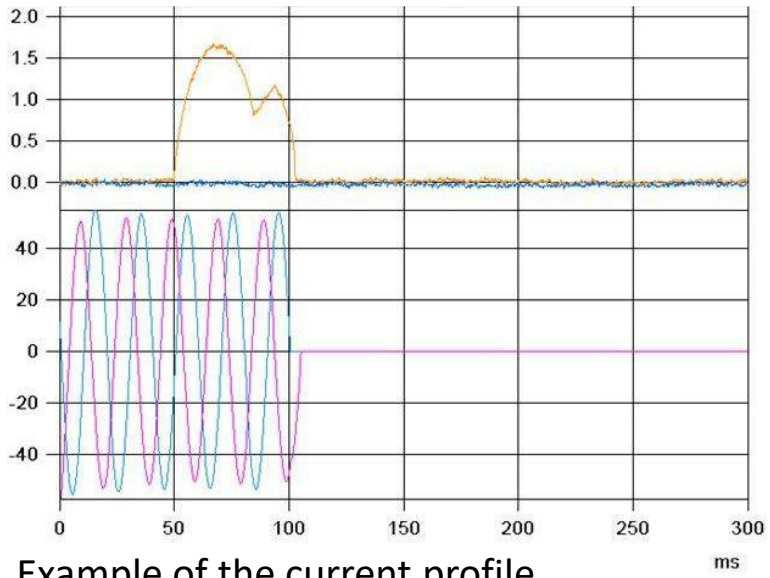
An “event” it’s a “not steady” condition of the device (GIS) under monitor. Typically it’s a close or open operation or a motor start to compress springs . During an event some profiles are recorded as :

- Travel movement
- Coil currents
- Feeder currents
- Breaker contacts



EDS MKII for GIS – profiles – coil current

Measure will be carried out through a “DC current sensor”, hence ensuring the acquisition of the DC component of the current.
These sensors will be powered through the acquisition board. Six channels for each BAY will allow the acquisition of both the primary coil and the secondary coil.
The accuracy will be: ± 2% of measure and ± 1.5% of range (approximately).



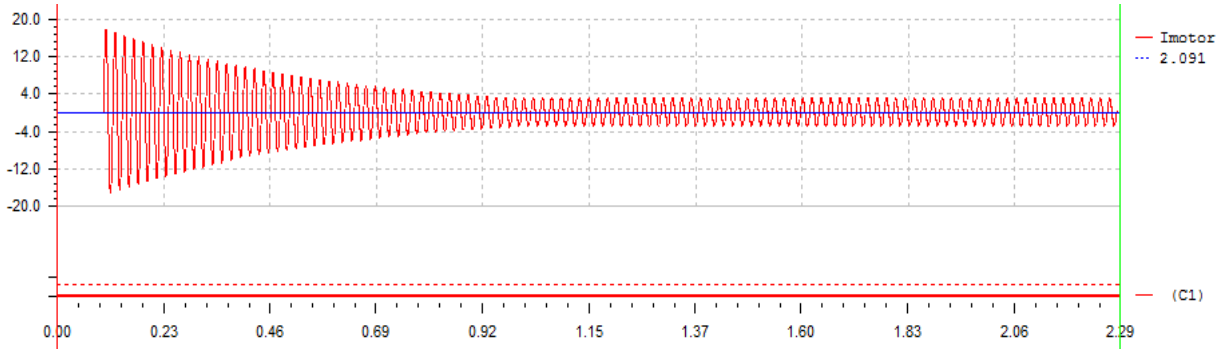
Example of the current profile
Yellow trace: open coil current
Blue trace: close coil current
Violet and Cyan trace : feeder currents

EDS MKII for GIS – profiles – feeder, motor and heater

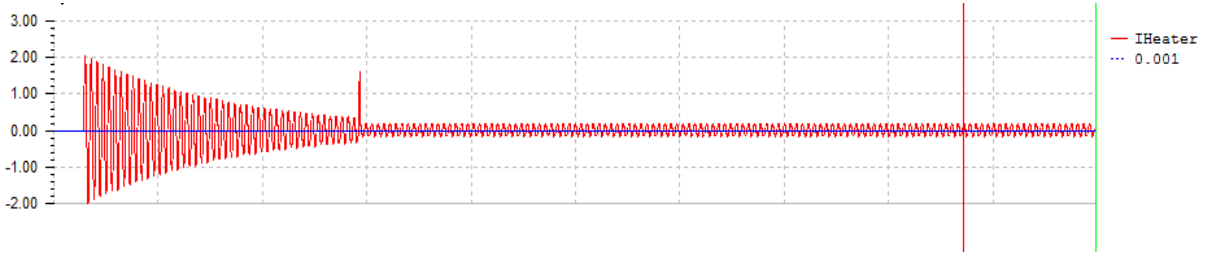
- The measure will be carried out through a toroidal current transformer inserted on the secondary side of the CTs.
- The output of this transformer is terminated into the acquisition board by means of a low impedance.
- The transformer ratio is 1000:1.
- The overall accuracy (transformer + converter) is: ± 2% of measure and ± 2% of range (approximately)
- Warning: All values exceeding a user definable thresholds are summed in a “current total amount” variable. Above a “maintenance value” threshold, a warning will be given.

EDS MKII for GIS – profiles

- Motor current



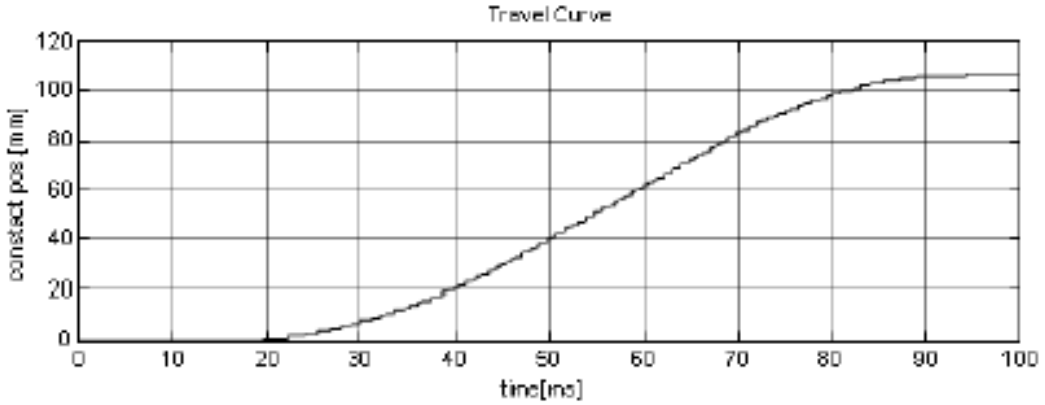
- Heater current



EDS MKII for GIS – profiles – travel sensor

This measurement will be taken through the digital position transducer which is integrated in the breaker.
Each input is designed to get signals coming from a digital encoder (HP HEDR8000).

The pulses coming from the travel transducer will be calculated by the EDS unit in order to create a curve similar to the figure below:

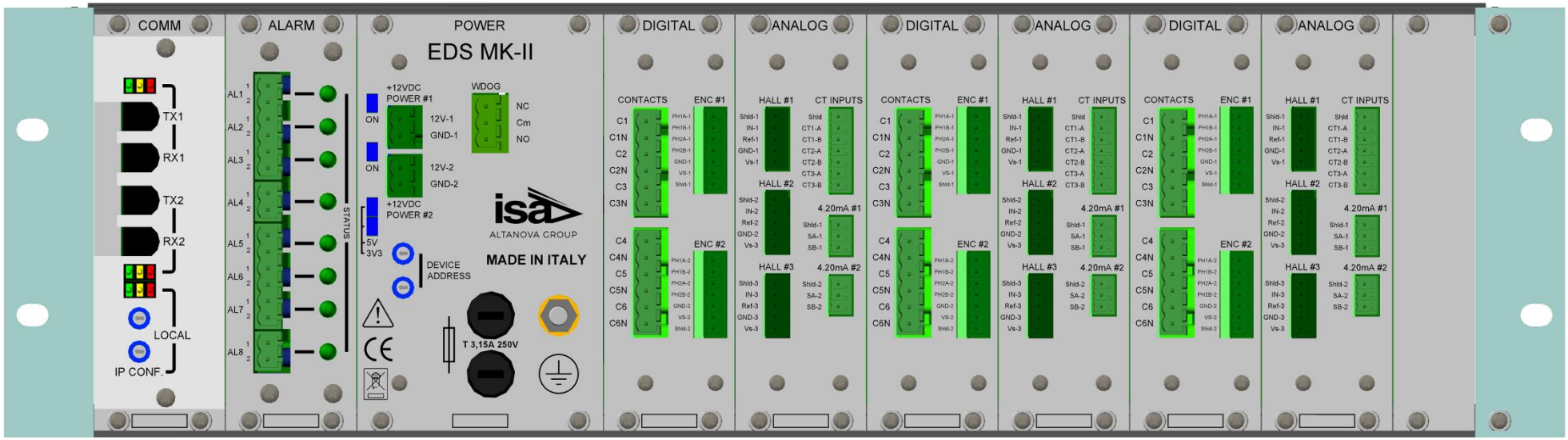


These data will be used by the EDS unit to measure position, velocity and acceleration of the breaker during a transition from a status to an other one (close to open or viceversa)

EDS MKII for GIS – HW – front panel

The device is included in 19” 3U aluminum rack.

Each EDS MKII can monitor all the parameters of three single-phase GIS or a three phases GIS. A “bay” it’s composed by three single phase GIS (or by a 3-phases GIS)



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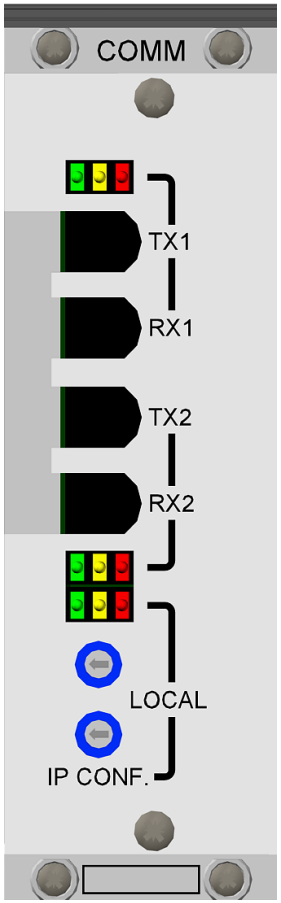
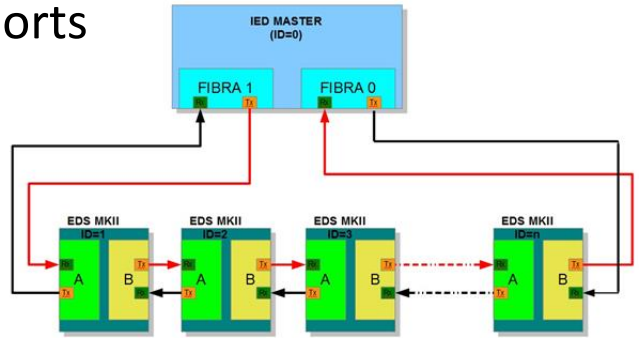
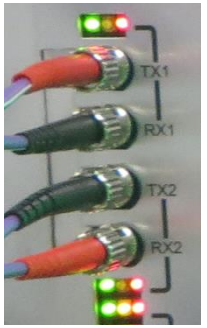
EDS MKII for GIS – HW – communication card



This card includes :

• two <u>different</u> fiber ports in order to support a ring connection to the server



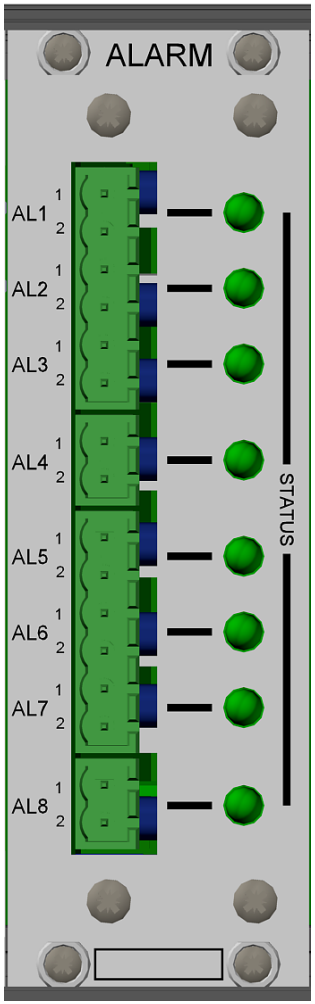


• the IP address setup

• the PC board

• monitor, ethernet and USB ports for diagnosis and commissioning

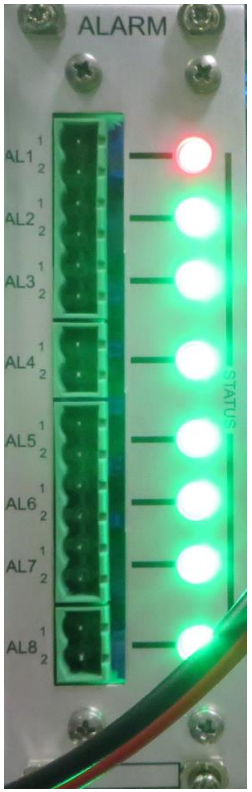
EDS MKII for GIS – HW – relays and alarms



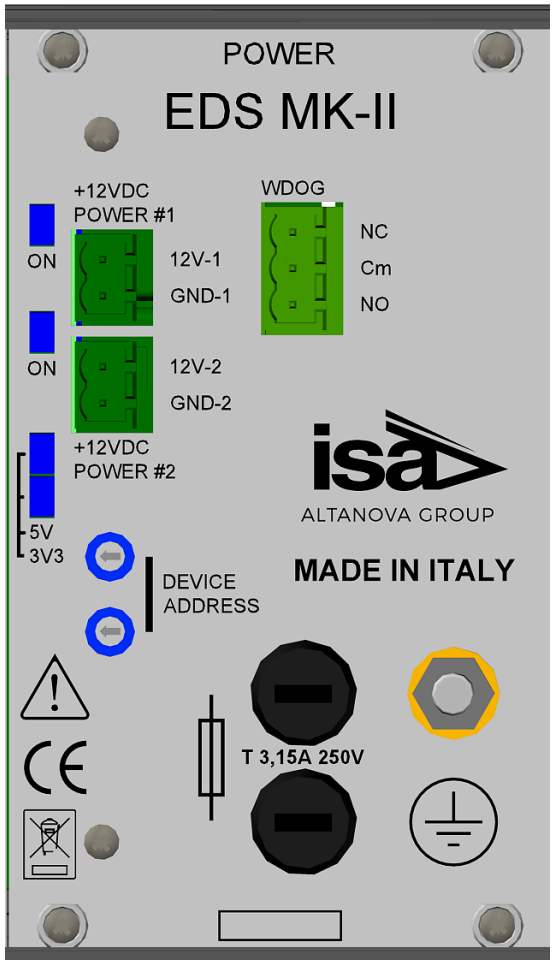
Basing upon defined conditions, local alarms can be activated, closing the corresponding relay.

A local led highlights if an alarm occurred

Different colors on conditions can be defined (i.e. white, blue, red , green , cyan, magenta)



EDS MKII for GIS – HW – power supply

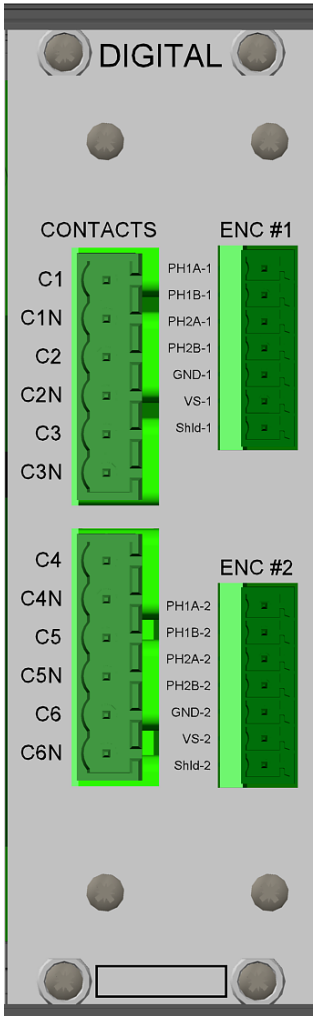


The device can be supplied from two different power 12V sources. The switch from main to the backup supply it's automatic

Some led show if some supplies are present

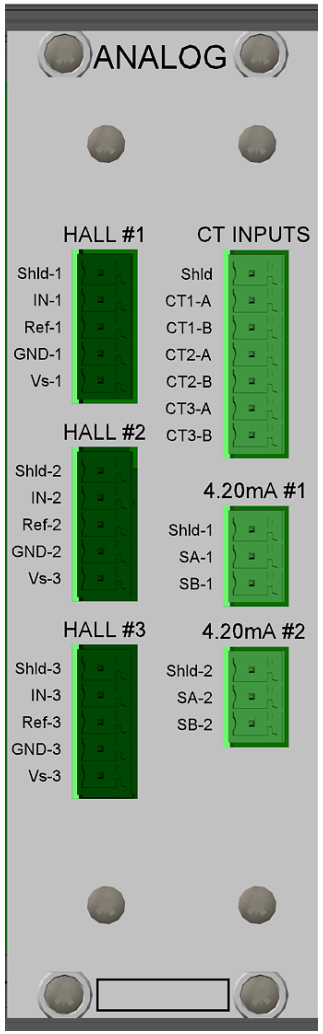
The Common Address setup for IEC104 protocol is selected through the selectors on this panel

EDS MKII for GIS – HW – digital card

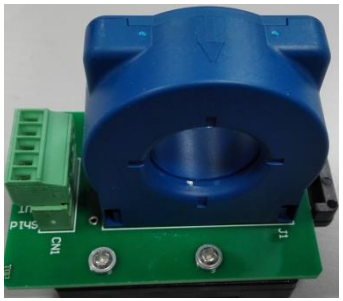


- 6 digital inputs (110 or 220 Vdc) for breakers commands and status detection for time delays measure (open, close, close open, open close)
- all the digital inputs have independent neutrals
- 2 different encoders for reading pulses (up to 100 kHz) coming from travel digital transducers
- optionally, these inputs can be configured for reading SF6 measurement digital transducers as Trafag 8774
- the encoders supply (coming from EDS) may be selected as 5V , 12 V or 24 V
- sampling frequency : 2, 4, 5 or 8 kHz (selectable)

EDS MKII for GIS – HW – analog card – Hall inputs



- up to 3 analog inputs connected to hall effects transducers to get coil current profiles.

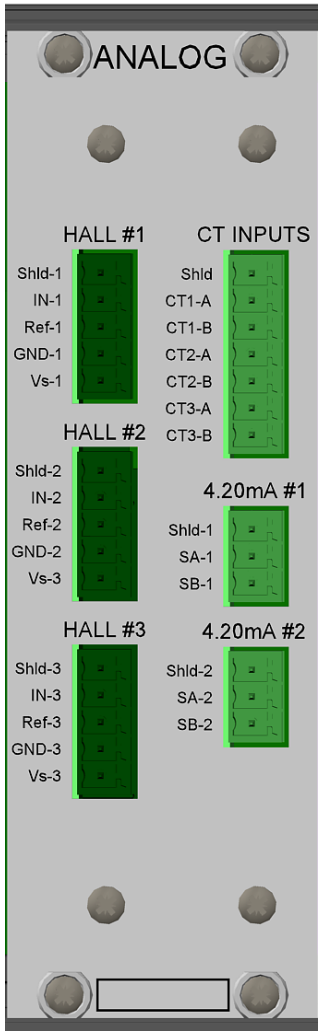


- maximum current for hall effect transducers : 2A . Other transducers available on demand (i.e. 20 A max)

- optionally, these inputs can be configured for reading analog travel transducers as Novotechnik IP6000

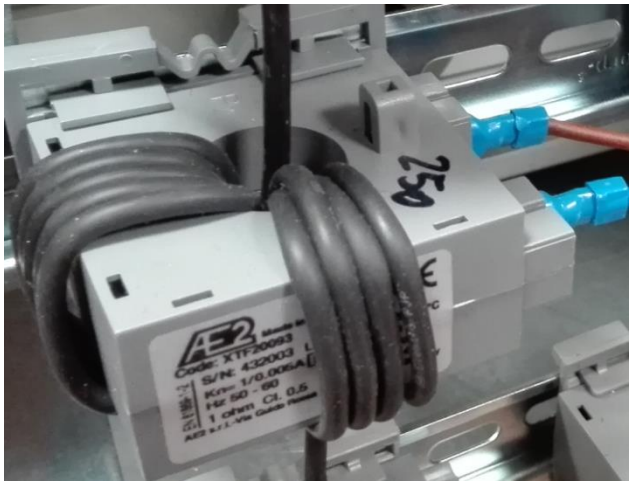
- sampling frequency : 2, 4, 5 or 8 kHz (selectable)

EDS MKII for GIS – HW – analog card – CT inputs



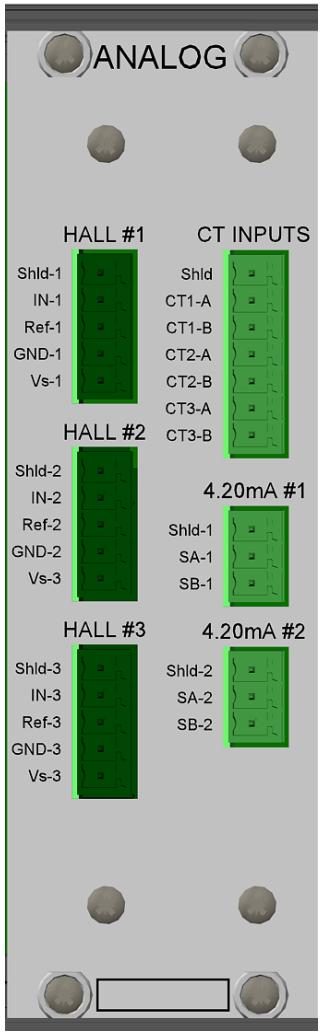
- up to 3 analog inputs for AC current measuring

- CTs must be connected to these inputs. Maximum current flowing in CTs : 40A.



- optionally, other CTs can be used or these inputs can be configured for reading other analog inputs (max 300 mV)
- sampling frequency : 2, 4, 5 or 8 kHz (selectable)

EDS MKII for GIS – HW – analog card – 4..20 mA inputs



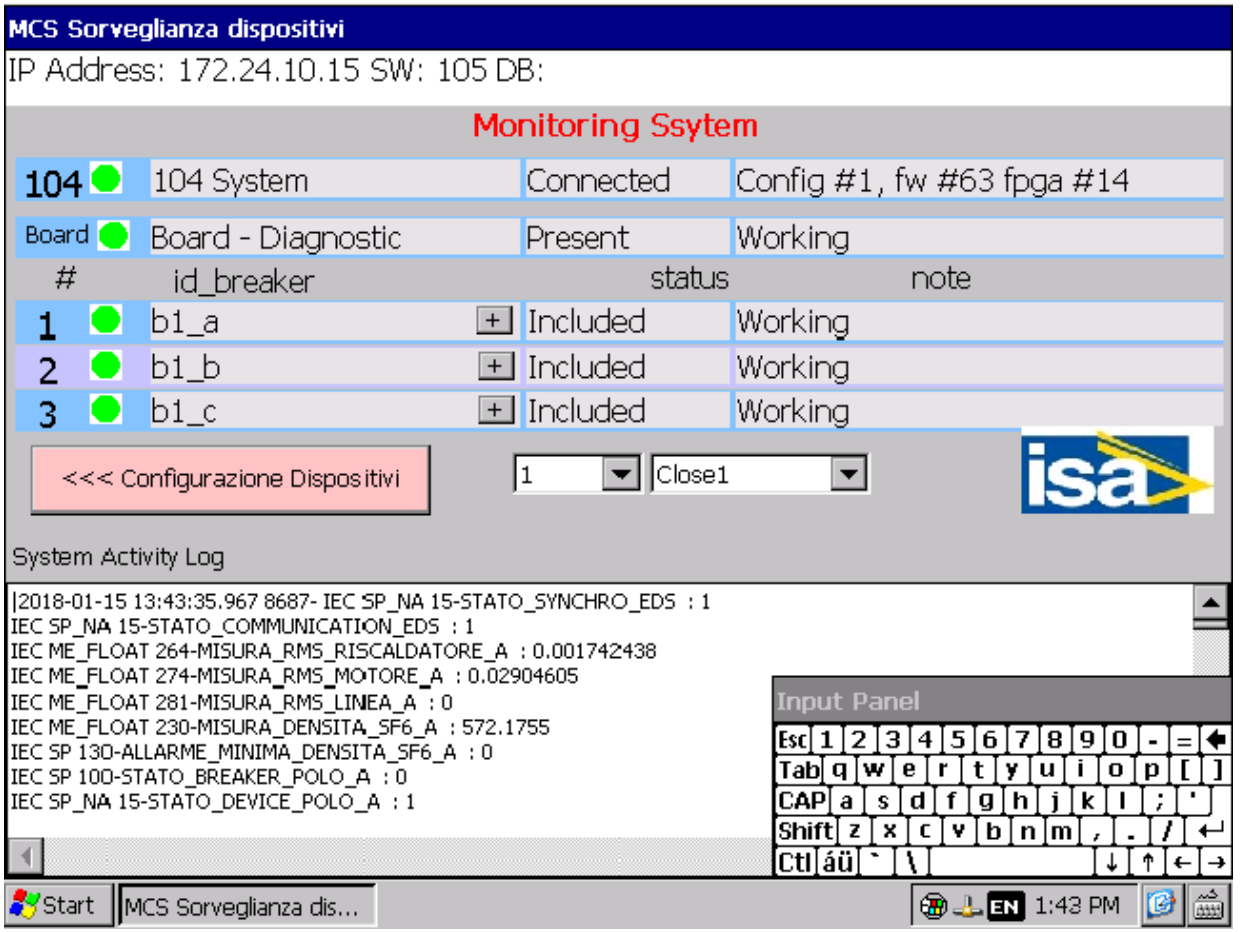
- up to 2 analog inputs for current loop measuring 4..20 mA

- these inputs are typically used for measuring SF6 density sensors , but they can be used also for other purposes (i.e. thermal sensors)

- the current loop bandwidth it's limited (basically for DC inputs). Maximum sampling rate 100 Hz.

EDS MKII for GIS – Local control panel

Connecting a mouse and a monitor on monitor and usb ports it is possible to configure locally the unit and watch at the device status



ALTANOVA

PDM

CBM

SF_6

Battery

GLOBAL MONITORING FOR GIS

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SF_6 Monitoring

Electric utilities decide to permanently monitor the SF_6 gas level in gas insulated switchgear mainly because of two reasons:

1. The optimization of their maintenance strategy and
2. environmental awareness associated with greenhouse gas emissions.

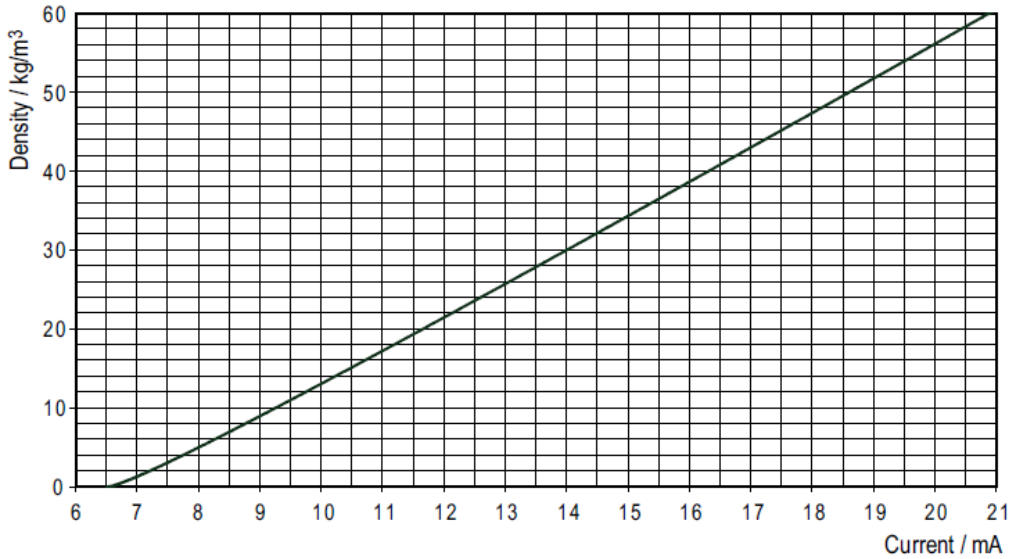
- Sensors provided by third parties e.g. TRAFAG or WIKA
- System Integration by TECHIMP

WIKA Gas density monitor, model GDM-100-TI-D with Modbus® output

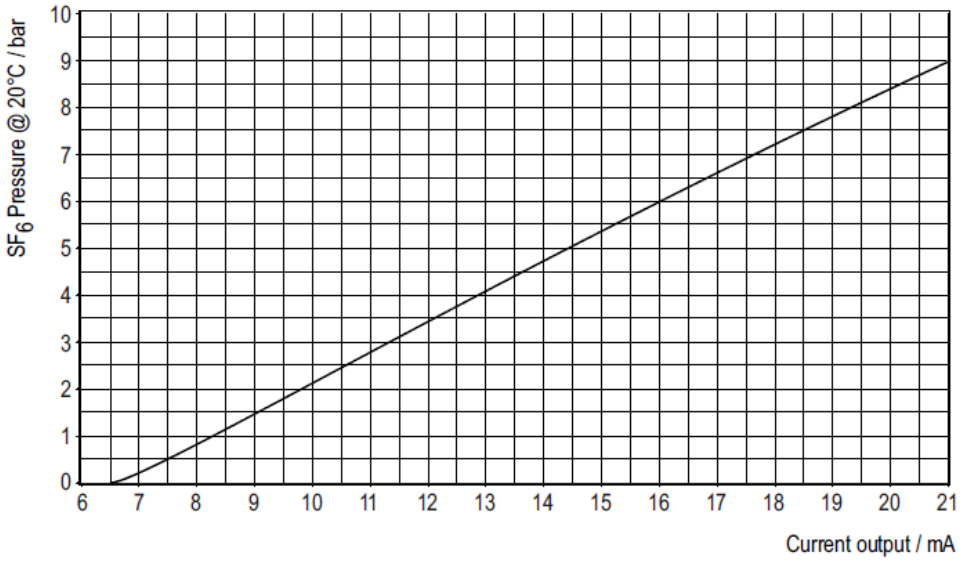
TRAFAG 8781/82/83 HYBRID GAS DENSITY MONITOR

OUTPUT SIGNAL ANALOGUE

- Gas density



- Gas pressure @ 20°C



SF6 gas information

The measurement is taken on a periodic basis, hence not related to the open/close commands or other events.

An current loop converter will convert the 4-20mA signal through a Modbus (Ethernet) protocol.

Following measurements are transmitted to the central collector:

- pressure trends (day, month, year)
- gas density
- alarm status
- System status

ALTANOVA

Battery

GLOBAL MONITORING FOR GIS

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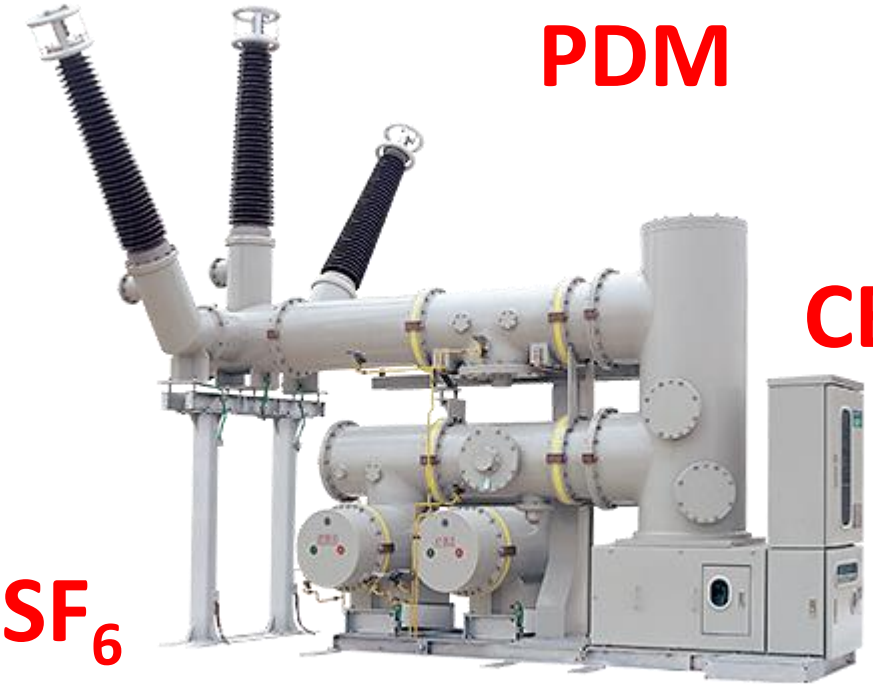
Battery voltage measurement

The Global Monitoring System can be configured to accept also DC voltages, such as the battery voltage present in the substation.

The nominal battery voltage must remain in the range 48 – 240VDC

Measurements provided	Range	Comment
Battery voltage trend	0 - 240 VDC	Alarm thresholds are definable by the user. Measurement period can be defined by the user.
Battery voltage max and min values	0 - 240 VDC	

ALTANOVA



PDM

CBM

SF_6

Battery

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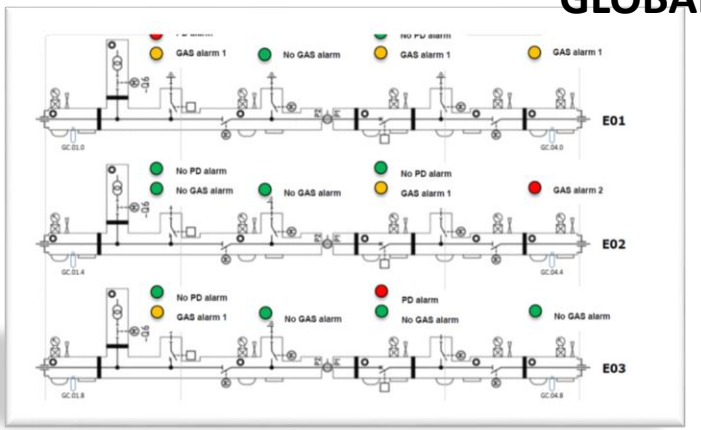
GLOBAL MONITORING OF GIS

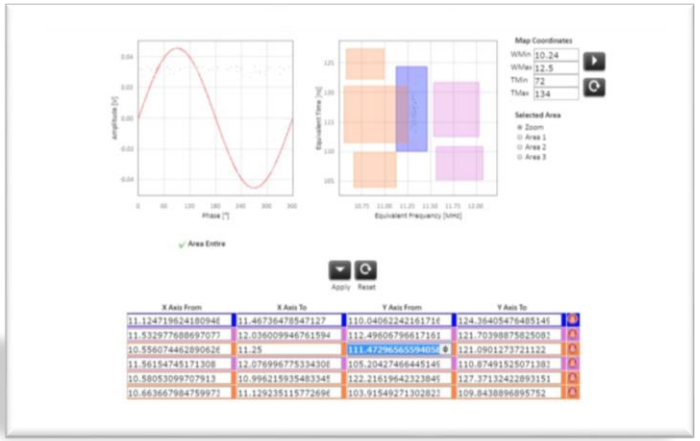
TiSCADA

Dashboard



Asset view

Trendings



Data analysis

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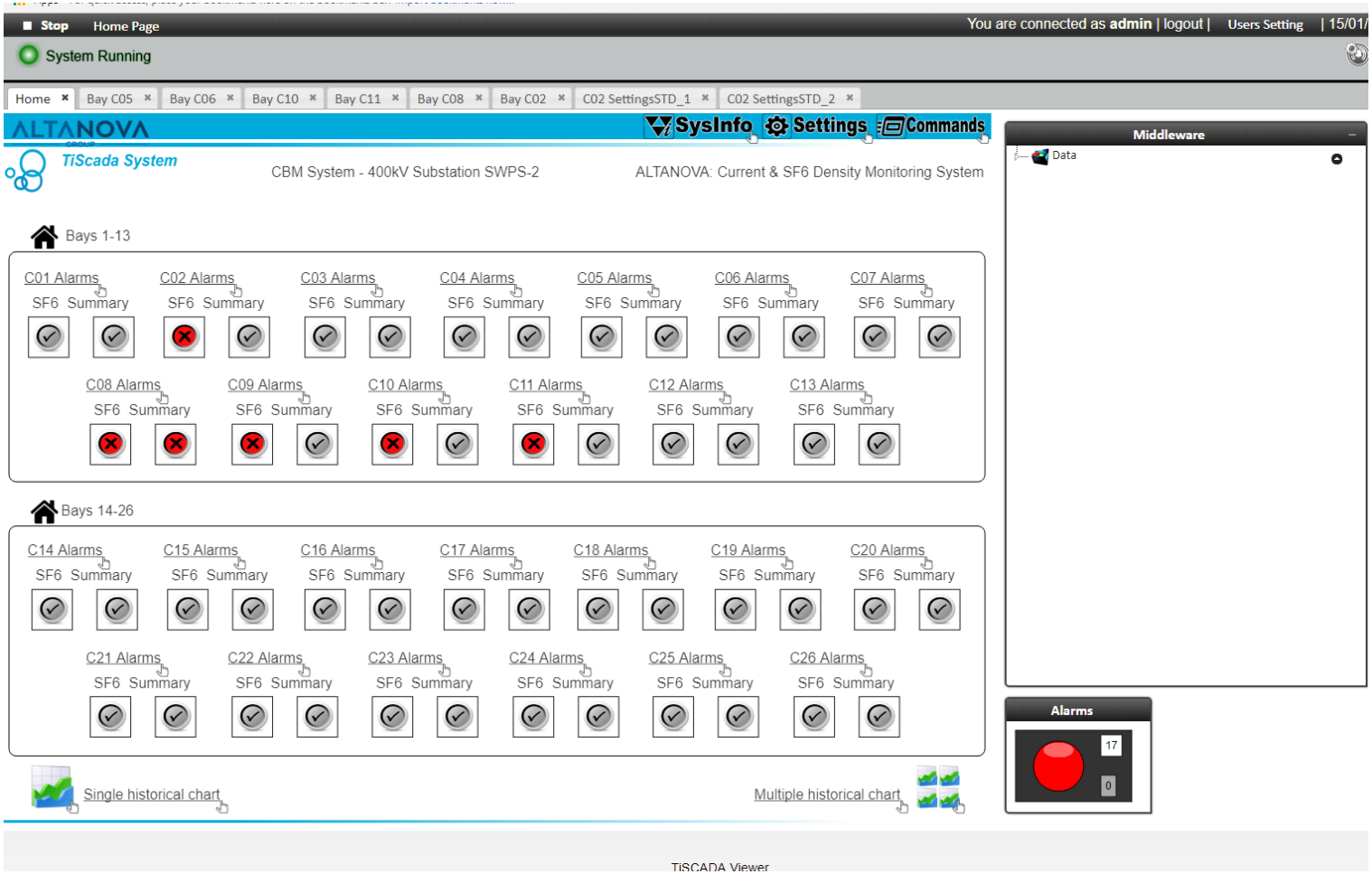
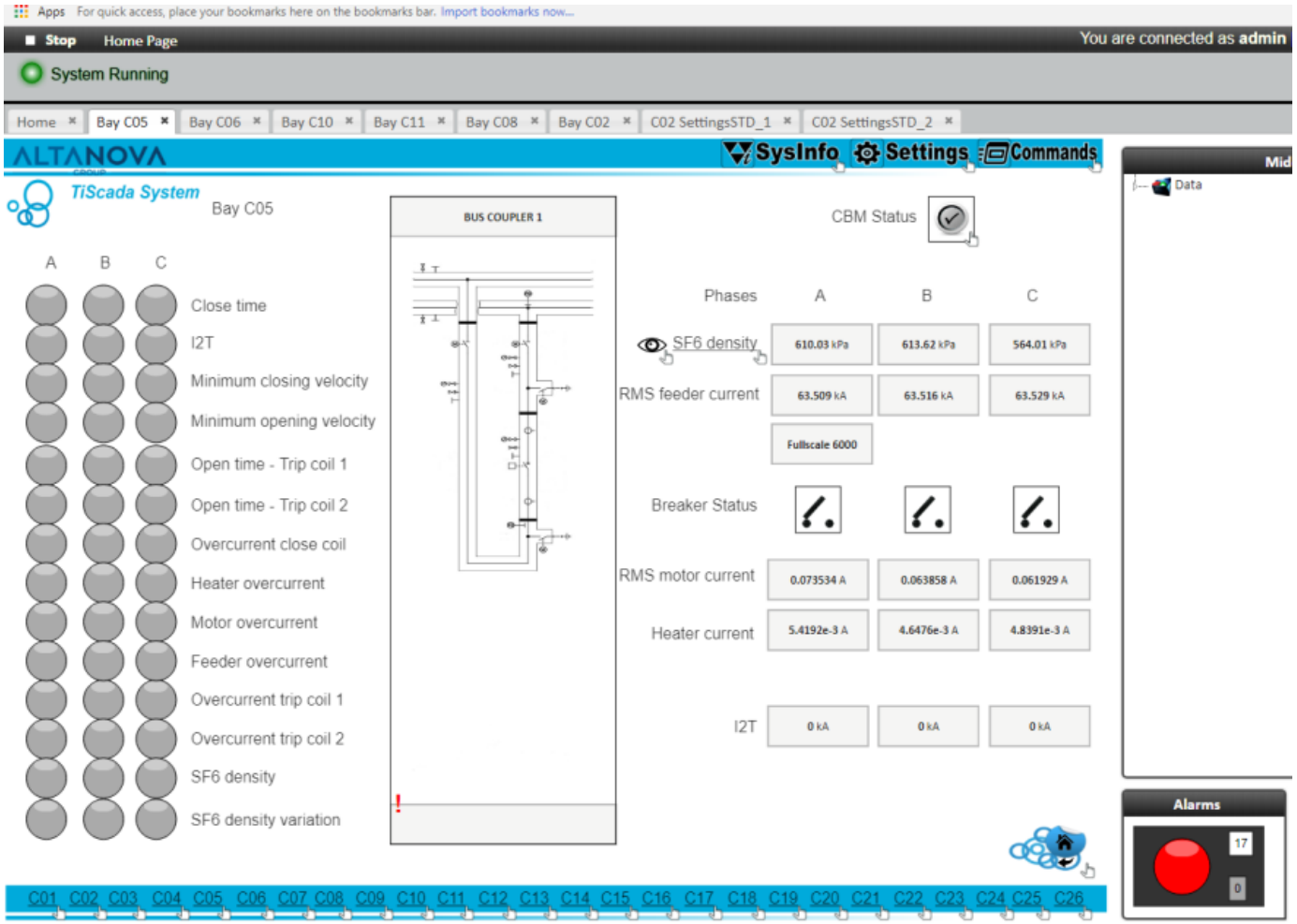
TiScada for EDS MKII for GIS- server control panel – main page



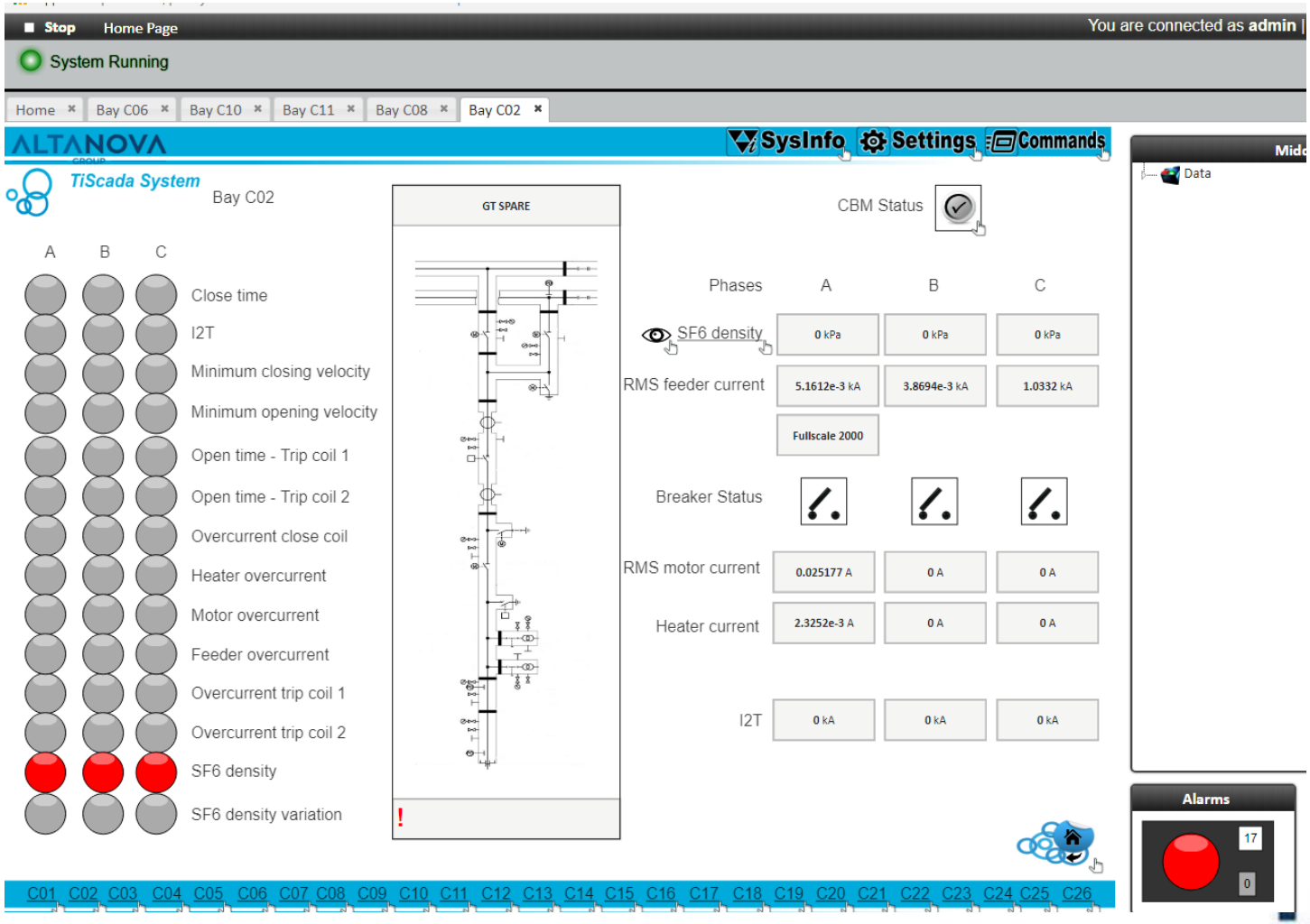
On the main page of TSCADA the user has an overview of all peripherals. If an alarm it's present, it is highlighted in red

TiScada for EDS MKII for GIS – bay panel

The status of each bay it's displayed in a page that includes all the measurements and alarms that belong to the bay

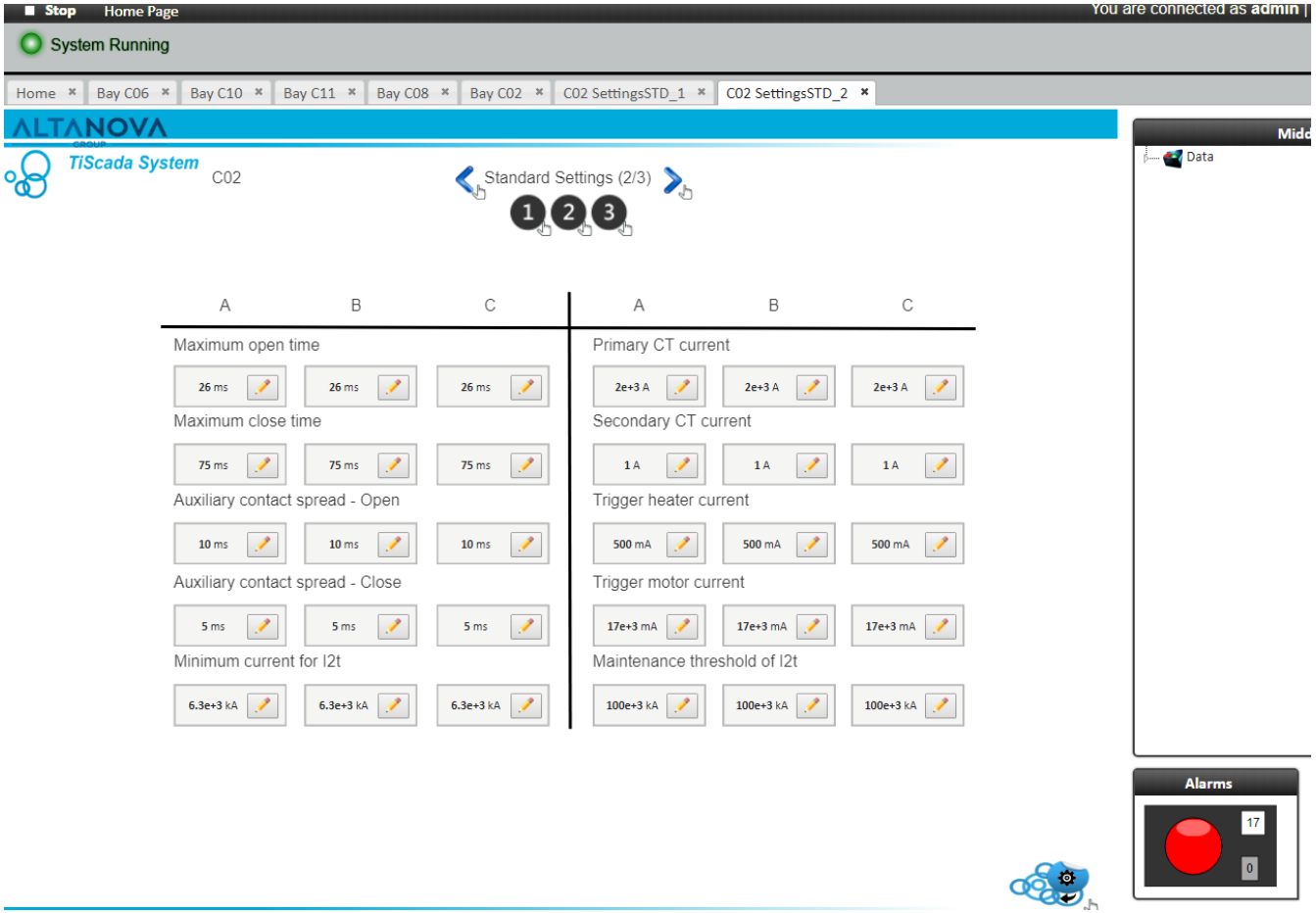


TiScada for EDS MKII for GIS – bay panel with alarms



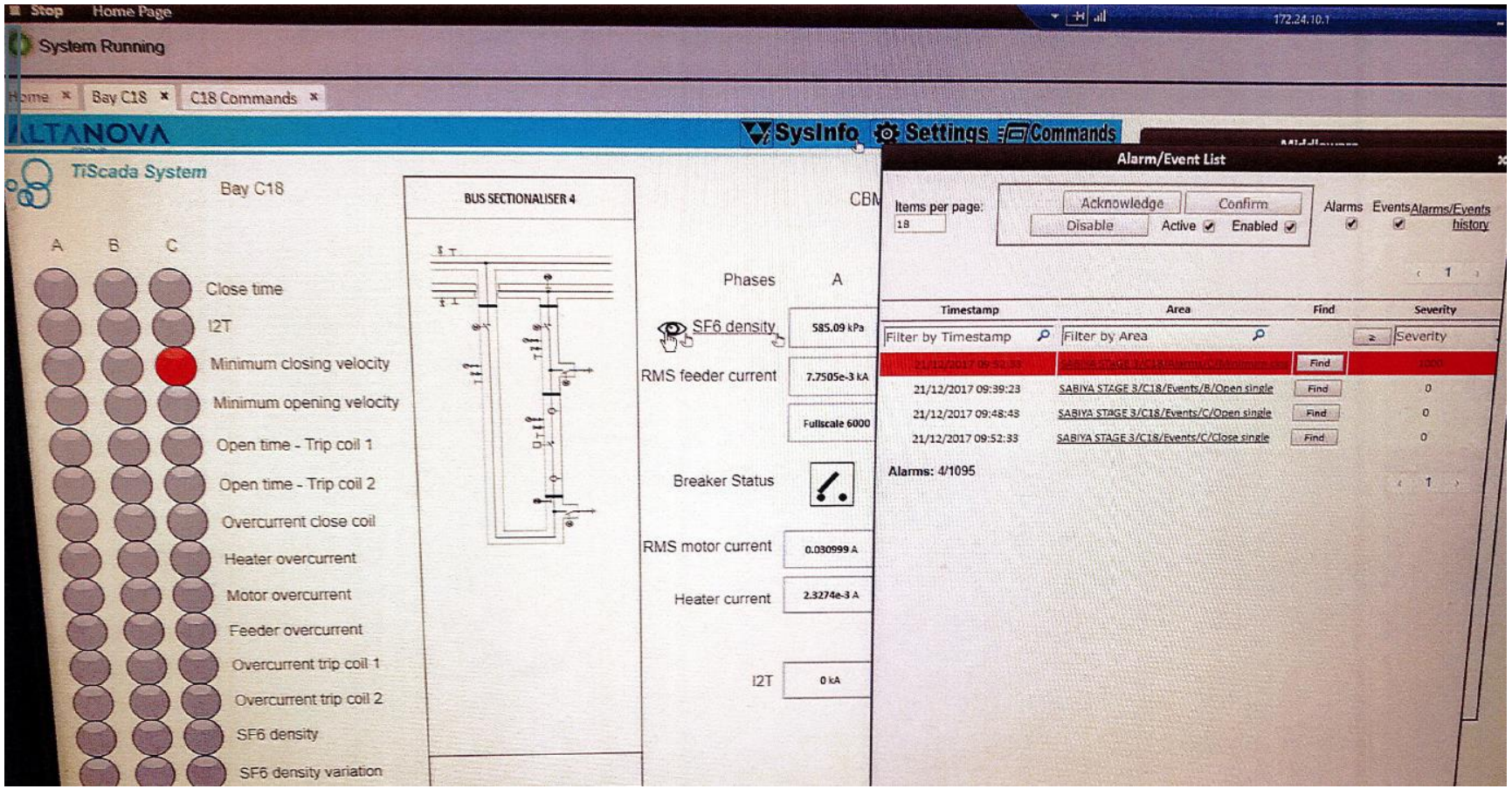
TiScada for EDS MKII for GIS – settings panel

For each bay (that is, for each EDS MKII) must be defined settings in order to define alarms thresholds and some parameters for calculations



TiScada for EDS MKII for GIS – events and alarms list (example)

For each bay it's possible to look at the events list. For each event alarms are highlighted



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TiScada for EDS MKII for GIS – events and alarms list (example)

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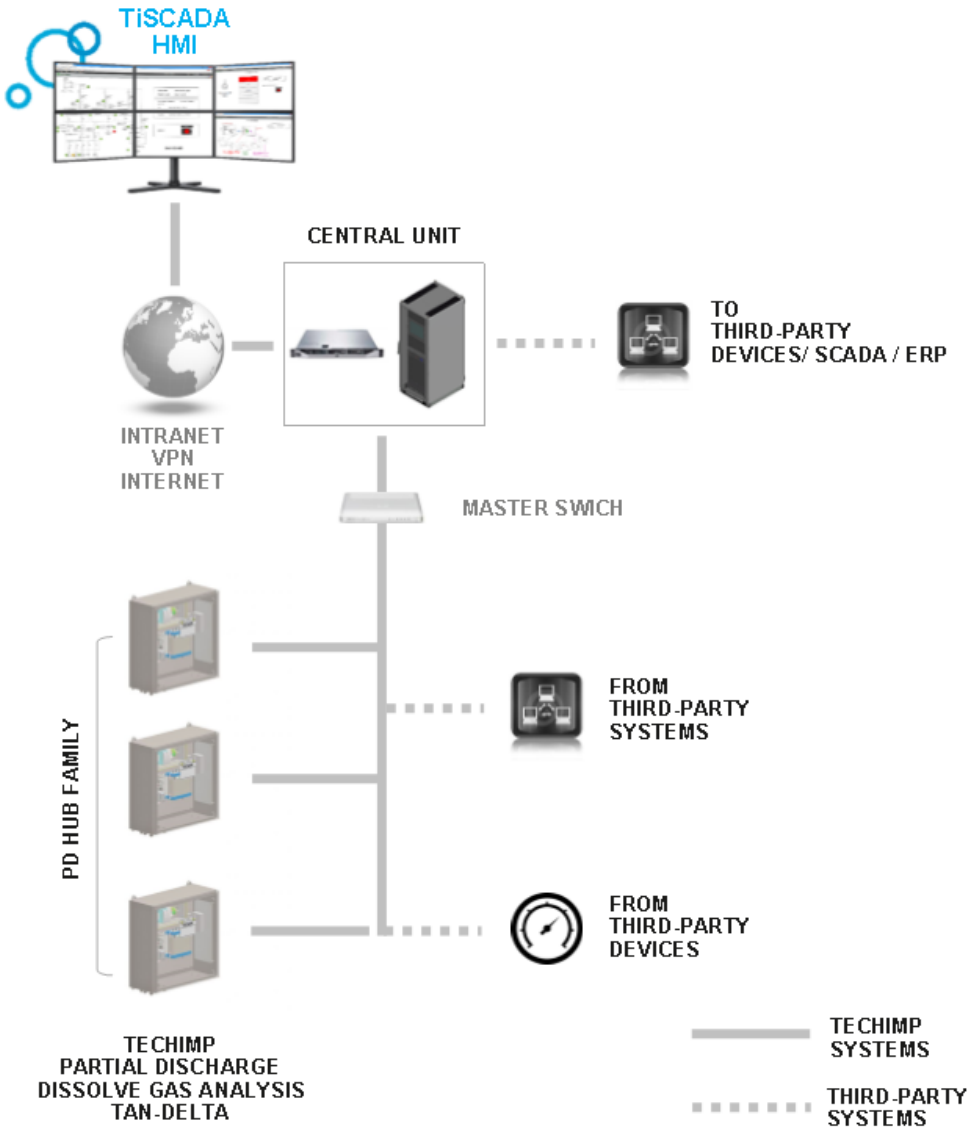

TISCADA Complete Network Monitoring

- Trending of condition parameters
- Expandable at any time in future
- Warning signal through e.g. SCADA system once threshold has been reached
- Additional services, e.g. data analysis

GLOBAL MONITORING OF GIS
Required Information

Information required for offering:

General:
- Retrofit or new
- Rated voltage
- Number of bays
- Layout dwgs available
- Location of GIS and control room
- OEM (if applicable)
- Type (if applicable)

PD
- internal sensors Y/N ➡ if
  - Y : number of internal sensors per bay
  - N: disc bushings capable for external UHF sensors (Horn-Antenna) Y/N ➡ if
  - Y: number of disc bushings
  - N: other means of PD measurement (inspection windows / FMC / HFCT) - tbd with PM

SF_6 - Monitoring
- Type, model and make of sensor
- Available communication protocol
- Total number of sensors on complete GIS

CBM
- Type and model of CB
- Details of CB Drive

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the leading company for

- Condition Monitoring
- Condition Assessment
- Testing Equipment

of

- MV & HV Cable
- HV GIS and MV Switchgear
- Power & Distribution Transformer
- Rotating Machines (Motors and Generators)
- Overhead Transmission Lines
- Instrument Transformer
- Circuit Breaker
- Batteries
- Relays

Contact: sales@altanova-group.com

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