Bushing Monitoring

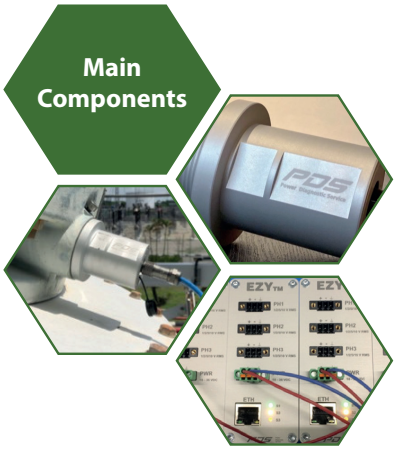
Bushings are vital components in high-voltage equipment. They transmit from one insulation medium into another. The bushing itself performs an essential task and is submitted to the same stresses as the equipment. If a bushing fails, the cost can be substantially higher for the equipment than the small price of the bushing itself. The EZY on-line **Bushing Monitor** measures the relevant parameters in situ with bushings energized, and **measures** the **current phasor** of each bushing, and the **harmonics** of each current. EZY **Bushing** monitoring **covers** a substantial percentage of **potential problems** in the insulation of large transformers. Bushing design means, finding an optimal design of concentric conductive foils for lower maximum and well-distributed electrical stress, and also for a constant voltage drop for different layers.

Key features of Bushing Monitoring

- They are designed to acquire and **evaluate multiple major condition parameters**, thus preventing major failures.
- Wear and tear on your high voltage equipment is inevitable. Still, the **detection** of almost any type of problem **at an early stage** of development can be achieved with EZY monitoring instruments.
- **You can** take remedial action to **prevent a breakdown**.
- The EZY on-line monitoring system is **highly modular**.
- The unit is also the gateway to PDS's distributed wireless sensor network, which is IOT and AI-based.

Main components of Bushing Monitoring

- The connecting plug has a thread which is adapted to the bushing tap and an O-Ring – IP68 spec seals it.
- The plug contains:
  - A precision shunt resistor adapted to the bushing capacitance and voltage (measuring the capacitive current).
  - A ZnO varistor that is designed to limit stresses from lightning impulse and switching impulse level of the respective bushing.
  - A thread that has been adapted for the bushing brand.
- The EZY BM data acquisition module is designed for time-synchronous digitizing for up to four transformers and three analogue inputs each.
- The time synchronizing allows a phase precision of up to 0.01° @ 100kHz sampling rate. It can be synchronized over the whole LAN: It can be powered over Ethernet (PoE) or be integrated into a LAN.
- It has a data display and MMI run either by PC software or EZY-PAD (option).



Why is Bushing Monitoring so important

- Bushings are key components of high-voltage equipment.
  They transmit energy from one insulation medium into another.
- EZY Bushing monitoring covers a substantial percentage of potential problems of the insulation of large transformers.
- Many catastrophic failures of machine and power transmission transformers can be attributed to bushing failures.
- If a bushing fails, the cost can be substantially higher than the small price of the bushing itself.
- The EZY on-line Bushing Monitor measures the relevant parameters in situ, on-line with bushings energised. It precisely measures the dielectric current phasor of each bushing as well as its harmonics. The current phasors relate directly to the change of the insulation properties of the bushing, dielectric loss and capacitance.
- The unique EZY timing features, allow instantaneous and time synchronized comparison of several devices in a plant, allowing to identify and separate network events from bushing specific events, and subsequently transient overvoltage detection.
- Sophisticated signal spectrum treatment allows for tracking non-linear effects, which are process-related.

Capacitance change

- Function of the phase-ground voltage and the impedance of the insulation.
- Any change in the impedance of the insulation will be reflected in a corresponding alteration in the value of the leakage current that, in theory, could be used in detecting the change that occurred in the impedance.
- The main reason for a capacitance change is the breakdown of one or more layers.
- This can be due to partial discharge and maybe some manufacturing defect.

Typical Installation on Site

- An initial reference set of currents (or bushing capacitances obtained from an offline test) must be defined for the system, to be compared with future measurements.
- In case of alarms, not just one, but all three bushings in the three-phase set must be checked, for instance, by way of offline measurements for capacitance and tangent delta.
- It is generally assumed, that the failure of condenser bushings is slow, happening over days, and this would allow enough time for the user to take action when a defect is detected. Periodic offline measurement of capacitance and tangent delta support this opinion.
- The most efficient and stable way to catch tan delta and capacitance effects at the same time is the determination of the phase sum of the three bushing currents.
- The immediate effect when bushing insulation short-circuits and evolves toward complete failure is an increase in the leakage, due to the equivalent increase in capacitance when insulation layers are short-circuited.
- Threshold values are programmed in the bushing monitor for an alarm to trigger in case of high and very high leakage. This provides two levels of alarm with different severity levels. Alarms are set at adjustable times to prevent spurious alarms as a result of transient overvoltage.

Monitoring On-Line

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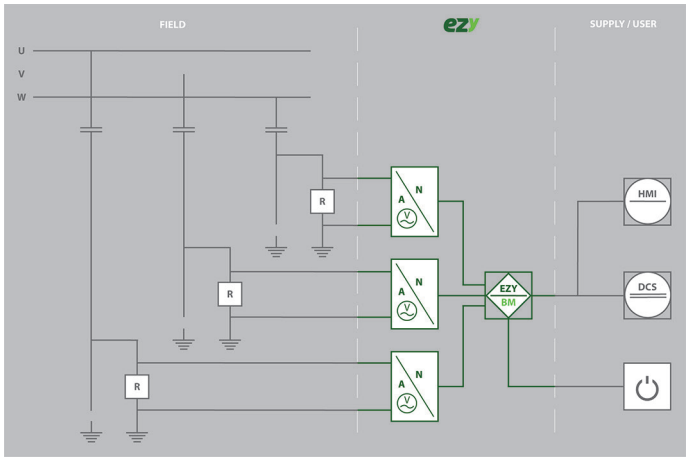
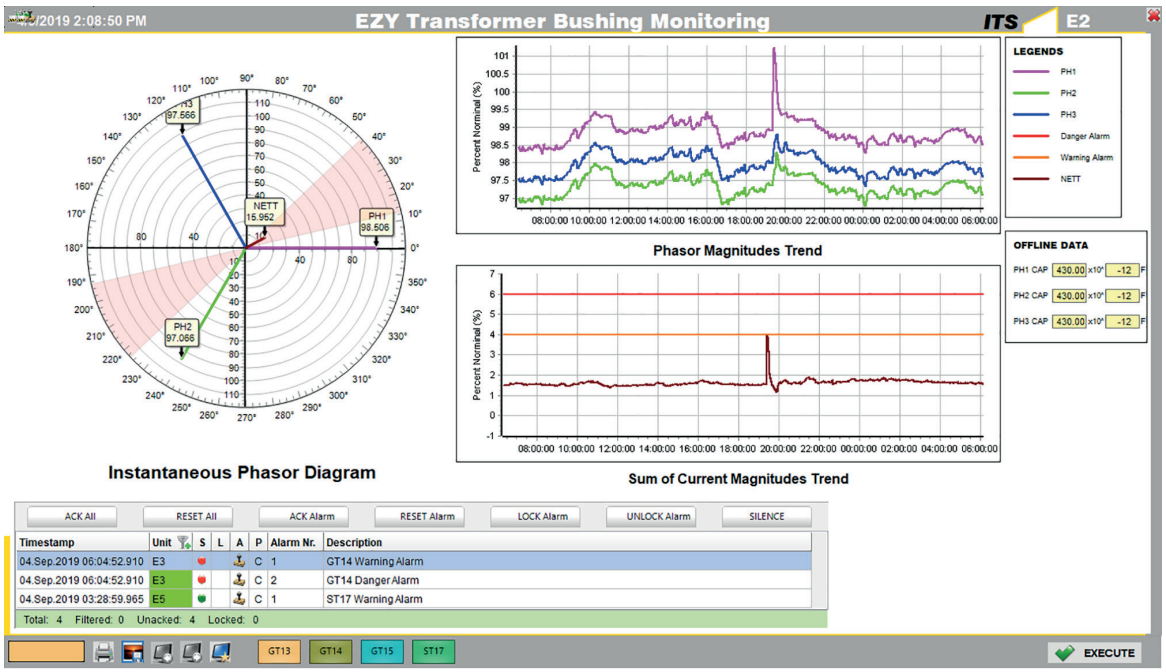
Functional Drawing

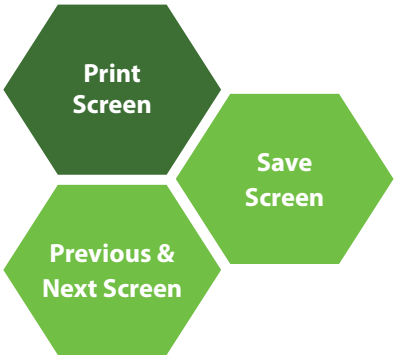


Bushing Monitoring Example Screens



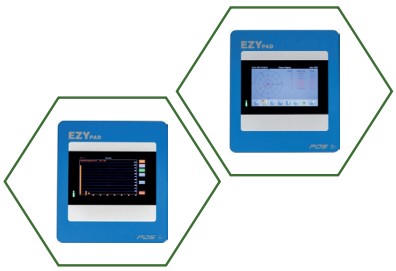
Basic Displays

1. Phasors Diagram: It shows the instantaneous currents of each phase and the summed currents in the angular domain. Note: The NETT (sum of current) vector shown is post multiplied ten times for visual amplification purpose.
2. Phasor Magnitudes Trend: It shows the magnitude trends of the current of each phase over the last hour.
3. Sum of Current Magnitude Trend: It shows the magnitude trend of the unbalanced current and the alarm thresholds.
4. Alarm Table: Shows the active and inactive alarms, and allows user to act on them. Button functions are listed in the table below.
5. Offline Data: It shows the initial bushing capacitances of each phase.

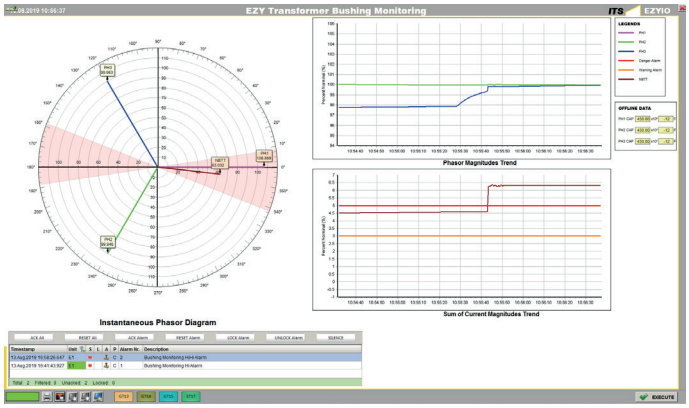


Alternative Display Unit

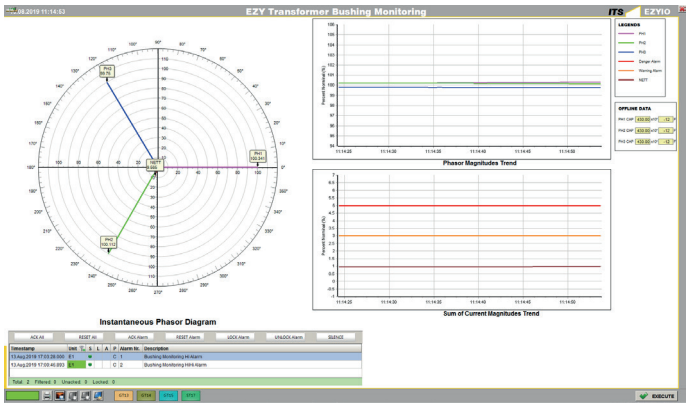
- High Resolution Touch Screen
- High Security through proprietary software
- Powerful Processor
- Door/Rackmount
- Communicates with satellite units



Alarm Announced & Acknowledged



Column	Explanation
Timestamp	Time when the alarm appears
Unit	The Unit Number from which the alarm is generated
S	Alarm state. Red ● = active; Green ● = inactive but not acknowledged
L	Alarm Lockout status. When it is locked 🔒 will appear
A	Acknowledged, 🔔 means not acknowledged. Blank cell means acknowledged
P	Processor that generates the alarm.
Alarm Nr	Alarm Number
Description	Alarm Description



ACK ALL	Acknowledge all alarms in the list.
RESET ALL	Reset all inactive alarms in the list.
ACK ALARM	Acknowledge only the selected alarm
RESET ALARM	Reset the selected alarm
LOCK ALARM	Locking a selected alarm so that when it changes state in the future, it will not trigger any alarm horn. This is useful when there is nuisance alarm but unable to solve at the moment
UNLOCK ALARM	Reset the Locking out status
SILENCE	To silence alarm buzzer or horn.

GO BEYOND

EZY Family devices allow you to analyze your data down to the moment, enabling a range of new possibilities to monitor and manage your utility.

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