

Online Transformer Insulation Monitoring System
BushingGard
Product Focus

Maximizing Transformer Uptime and Reliability

EATON

Powering Business Worldwide

Critical Energy Transfer...

Large power transformers are found around the world at utility, industrial, and commercial sites. You know their importance and their common applications.

- Generator step-up (GSU)
- Substation or switchyard
- Industrial and commercial

You trust that they will work flawlessly since you understand how critical energy transfer is.

But what if they fail? How disruptive is it?

An unexpected transformer bushing or insulation failure can disrupt an industrial process, shutdown a commercial site, cripple a power plant or cause area-wide power outages. Depending on the extent of the damage caused, the disruption could last for weeks.

Eaton Electrical's Predictive Diagnostics (CHPD) has a world-wide reputation for online monitoring technology. Eaton diagnoses and evaluates the insulation of high voltage electrical equipment:

- Power transformers
- Shunt reactors
- Bushings
- Current and potential transformers
- Switchgear
- Isophase and busduct assemblies
- MV circuit breakers
- MV electric motors and generators
- MV cables

The basic technology used in online insulation monitoring is partial discharge detection. Eaton also provides monitoring of the power frequency current through the bushing insulation system.

Eaton continuously strives to develop new methods of non-invasive monitoring, necessary sensors, recording equipment and diagnostic software, as well as provides expert consulting services and on-site evaluation of the equipment conditions.

BushingGard Maximizes Uptime and Reliability

When insulation breakdown accounts for 84 percent* of transformer failures and up to 92 percent of electrical failures are random**, ensuring uptime and reliability may seem like an impossible task... but not any longer. The BushingGard is an online, continuous testing tool designed to monitor bushing insulation integrity on large power transformers. It allows you to evaluate the condition of your equipment at any time, in a cost-effective manner.

How BushingGard Operates

Changes in bushing capacitance and power factor are indicative of insulation deterioration. The BushingGard detects these changes by summarizing and balancing the currents of a three-phase bushing set at the time of commission. It then generates a complex calculated number (Gamma). If there's an imbalance, it generates an output signal that is proportional to the relative change in the bushings' currents due to insulation deterioration. The output signal reflects changes in both power factor and capacitance of the monitored bushing set.

Display Panel

The monitor is designed to indicate insulation status in several ways. The display panel has a multi-function LED that will glow a different color depending on the severity of the problem. Alerts are classified in three categories: green (normal), warning (yellow), and alarm (red). The parameters are programmable and the device can be programmed at the panel or remotely through a computer link up (optional). The panel also contains a second multi-function LED to show monitor status: normal (green), setup mode (yellow) or error (red). The unit performs self-diagnostics to ensure proper operation and will indicate any malfunction locally as well as remotely.

Three additional LEDs indicate whether each of three bushings are currently being monitored—given they can easily be taken off line for other testing purposes.

The last visual element on the display monitor is an alphanumeric display panel which indicates the actual Gamma reading expressed as a percent change and the location of the phase angle of the imbalanced vector. The phase angle vector will indicate which of the three bushings is defective.

Communication

The BushingGard is also designed to communicate with a Digital Control System (DCS) or Supervisory Control and Data Acquisition (SCADA) system. Both a warning level alarm and the error status relay will notify the operations center when and if a problem occurs. .



Sensor installed in capacitor tap on bushing

The BushingGard comes standard with an RS-485 Modbus RTU port so you can communicate with it on site. Or, it is available with a commercial-grade modem for remote communication. Diagnostic software comes standard as part of the BushingGard system.

Bushing Sensors

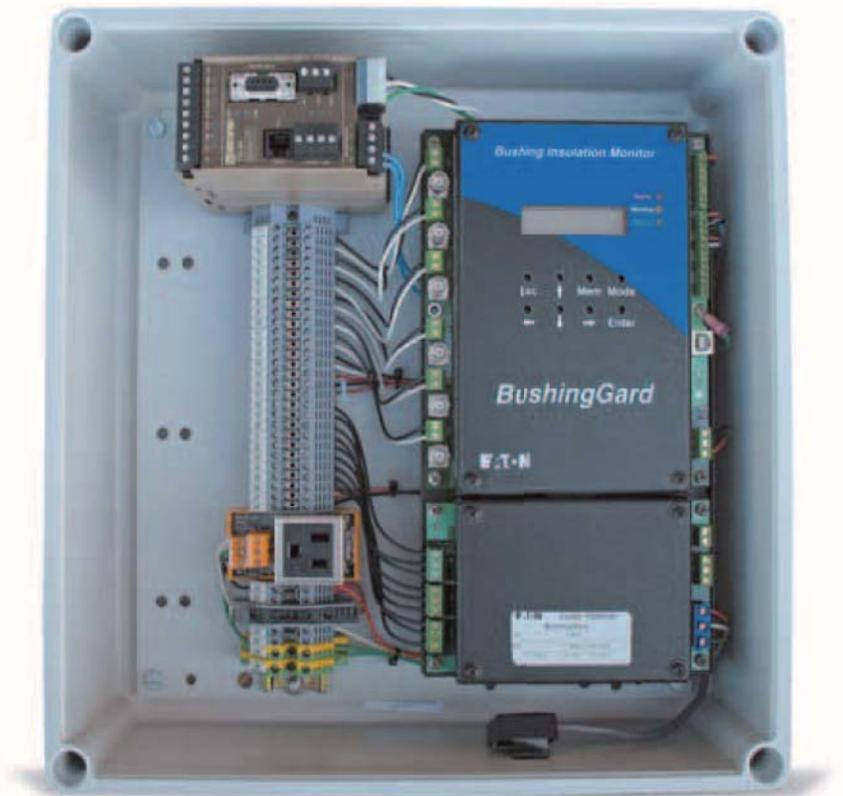
A three or six bushing sensor set is available with the BushingGard package. A large variety of thread sizes/configurations allow compatibility with virtually all large power transformer bushings. Customized bushing sensors are available with appropriate lead-time. Our standard sensors are designed for bushings with rated voltage of 69 – 500 kV. An optional 800 kV is available.

* IEEE Std. 493-1997

** University of Tennessee - Asset Management Seminar
November 1999

What the Package Includes

- Three or six universal bushing sensors, mounted on bushing capacitor taps, which condition both the power frequency, capacitance and partial discharge signals to the monitor
- Oil temperature sensor
- The BushingGard monitor
- BushingGard software



BushingGard installed in NEMA 4 enclosure

BushingGard Allows Partial Discharge Measurements

The BushingGard offers a unique and superior testing methodology because it allows you to monitor partial discharge activity in both bushings and transformer using the same sensor set. Like power factor and capacitance changes, partial discharges are also indicative of insulation breakdown. The BushingGard houses six BNC connectors—one for each phase of each winding—which allow connection to our Universal Partial Discharge Analyzer (UPDA). Online periodic monitoring of partial discharge (arcing or sparking) can help provide a root-cause analysis of internal gassing or other discharge activity related to the winding insulation, internal connections, bushings, or magnetic core iron.

Instrumentation

Unparalleled in accuracy and noise suppression capabilities, the portable Cutler-Hammer Universal Partial Discharge Analyzer (UPDA) is specifically developed for field detection and analysis of partial discharge activity. The UPDA features eight differential input channels, preamplifiers with a range of more than 80-dB and data acquisition/analysis software with a library of five independent

noise cancellation algorithms. It is capable of detecting PD signals as low as 20-30 pC. The detection of such low signal levels is accomplished even in extremely noisy environments like those that occur in substations or power plants. Such sensitivity and signal resolution has been historically accomplished under laboratory conditions only. The UPDA software operates on a PC. It stores the "raw" data, analyzes it, calculates main PD statistical indices, presents them in a graphical form and generates a report.

Maximize Your Uptime

For more information about online diagnostic systems and sensors, call 1-952-912-1358 or visit our Web site: www.eatonelectrical.com.

Keep Your Power Flowing!

The Cutler-Hammer BushingGard from Eaton Corporation is a continuous, online insulation integrity monitoring system for large power transformers. It offers the following benefits:

- **Maximizes Uptime**

The BushingGard conducts testing online. Therefore, unnecessary maintenance outages are eliminated. The productivity of your transformer is enhanced.

- **Eliminates Inherent Flaws of Interval-Based Testing**

Interval testing is fine if you do it regularly. Yet, too often, the interval between tests is too long to detect an impending failure. Trusting this “hit or miss” method is not ideal because you won’t know when a problem started and how rapidly it is progressing. The BushingGard conducts tests continuously and notifies you of impending problems in advance.

- **Provides More Accurate Information – Enhances Risk Management**

Off-line testing methods can differ considerably from real operating conditions: the temperature is different, the voltage stresses are much lower and vibration is nonexistent. Moreover, typical power factor testing is conducted at 10 kV—usually well below real operating conditions. Consequently, it is possible to underestimate the dielectric losses (power factor) in the bushing insulation. BushingGard eliminates these issues through continuous online monitoring.

- **Reduces Labor Costs**

Since the device conducts the tests, you won’t have to use personnel to conduct the tests. Their time can be redirected to solving problems rather than uncovering them.

- **Prevents Surprises**

An unexpected transformer bushing failure can disrupt an industrial process, shutdown a commercial site, cripple a power plant, or cause area-wide power outages. Depending on the extent of the damage, the disruption could last for weeks. The BushingGard can help you avoid surprises by providing continuous information.

- **Easy to Install**

The BushingGard is easy to install and requires minimum resources and outage time. It’s a self-contained unit that only requires connection to the sensors, input power and optional remote communication. Its robust construction provides reliable operation given extreme elements or electrical interference. It comes standard with a NEMA 4 enclosure.

Eaton is dedicated to ensuring that reliable, efficient and safe power is available when it's needed most. With unparalleled knowledge of electrical power management across industries, experts at Eaton deliver customized, integrated solutions to solve our customers' most critical challenges.

Our focus is on delivering the right solution for the application. But, decision makers demand more than just innovative products. They turn to Eaton for an unwavering commitment to personal support that makes customer success a top priority. For more information, visit www.eaton.com/electrical.

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