



VIBROSYSTEM

# FOA



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FIBER OPTIC ACCELEROMETER



**Safe to Personnel  
Transparent to  
Machine Operation**

**Fully Tested and  
Field Proven**

*Early detection of winding vibration is key in preventing forced outages caused by insulation failures. Our ATEX Certified Fiber Optic Accelerometer (FOA™) sensor is designed to address this concern.*

**M**any winding problems originate from vibration of end-windings or stator bars in the slots. Voltage stress, mechanical forces and thermal effects continuously undermine insulation integrity, end-winding bracing and stator wedging. As shrinkage and looseness develop, winding vibration may begin to occur. Over time, other destructive effects such as partial discharge can result. Being able to easily detect and monitor winding vibration from the onset permits prevention of such destructive effects. On-line monitoring of end-winding vibration and in-slot bar vibration clearly shows looseness has begun. Analysis and trending of vibration allows mitigation of the aging process before serious damage and breakdown occur. Appropriate follow-up can be planned to optimize plant productivity and availability.

- Broken Binding Ties and Ripple Springs;
- Delamination;
- Reduced Electrical and Mechanical Strength of Insulation;
- Discharges (Slot, Partial, End-windings);
- Puncture of Insulation;
- Overheating;
- Material Powdering;
- Cooling Leaks in Windings (Water or Hydrogen).

**COMMON PROBLEMS ASSOCIATED WITH  
WINDING VIBRATION :**

**Vibration is a symptom of:**

- Operating Conditions: Mechanical Stress (RPM), Electrical Stress (100 or 120 Hz), Thermal Cycling;
- Bad Wedging of Bars and Blocking/Bracing of End-windings;
- Gravitational Force acting on End-winding Baskets;
- Fatigue of End-winding Support System;
- Moisture Contamination.

**Vibration is both Symptom and Cause of:**

- Loosening of Stator Bar Wedging and Side Packing Systems;
- Loosening of End-winding Blocking and Bracing Systems;
- Abrasion and Reduction of Insulation.

**Vibration is Direct or Indirect Cause of:**

- Fatigue of Components;
- Loss of Ground Contact between Bars and Stator Core;
- Insulation Cracking;



**Abrasion of a bar insulation from in-slot vibration (radial) against stator lamination compared to a new bar.**



**Paint flaking on end-windings caused by vibration contacts against laminations.**



**Deposit of oil mist on end-windings and stator core at extremities contributing to bar vibration.**

# *Breakthrough for Electrically Hostile, High Voltage & Explosive Environments: FOA™: High Insulation & High Temperature (up to 180°C/356°F) End-Winding Vibration Measuring System.*

The FOA™ optical accelerometer is ideal for all high voltage applications where conventional metallic accelerometers are not suitable. Ideal applications include end-winding and iso-phase bus vibration measurement in turbogenerators, hydroelectric pump/generators and large electric motors. Long end-windings are especially prone to vibration induced by electromagnetic, mechanical and gravitational forces occurring at twice the synchronous frequency (100 or 120 Hz). High vibration leads to deterioration and failure of the support and insulation systems, which ultimately cause forced outages or extensive out-of-service repairs.

The FOA unibody design (sensing head, fiber optic cable, sealed feedthrough connector) and optical signal channel ensure **excellent electrical insulation**, immunity to interference, unobtrusiveness to machine operation, and safety of personnel. Its calibrated bias voltage output allows quick and easy evaluation of the vibration levels. Typical FOA installation on turbogenerator includes identical layouts of accelerometers at both turbine and exciter ends: one per phase circuit in radial OR tangential axis (SINGLE AXIS) or one per phase circuit in radial AND tangential axis (DUAL-AXIS).

## **FOA-100E & FOA-200 FEATURES**

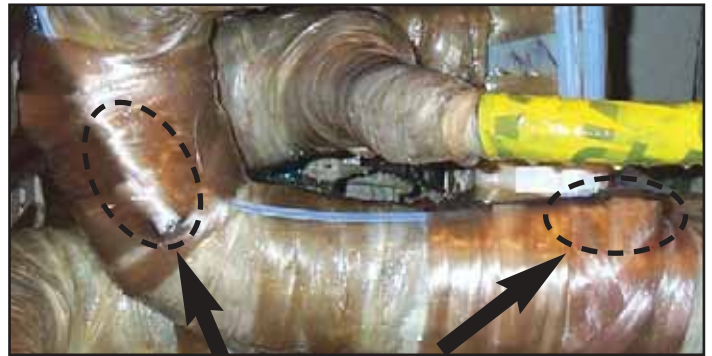
- **Excellent electrical insulation:** 3 kVAC/mm @ 25°C/77°F, 25 % of relative humidity between sensor head and instrumentation.
- Light weight sensor head made of NON-METALLIC AND ELECTRICALLY NON-CONDUCTING MATERIALS, fiber optic signal channel, feedthrough connector with built-in conditioner.
- Unresponsive to magnetic and electrical fields.
- Low transversal sensitivity, very good thermal stability.
- Frequency ranges: FOA-100 standard: 30-350 Hz  
FOA-100E & FOA-200: 10-1000 Hz
- Up to 180°C (356°F)
- Dynamic range: 0 to 40 g
- Sensitivity: 100 mV/g
- Bias voltage output: +6 VDC ±4 VAC
- Standard fiber optic cable length: 10 m (32.8 ft)
- Minimum bending radius: 80 mm (3.15 in.)
- **Individually tested** for conformity to specifications
- **ATEX certified**

*For safety reason as well as avoiding high level of partial discharges (white powder deposit), be sure to use non-metallic and electrically non-conductive sensors.*

Please visit our web site: [www.vibrosystem.com](http://www.vibrosystem.com)



VibroSystM dual-axis optical accelerometer FOA-200™



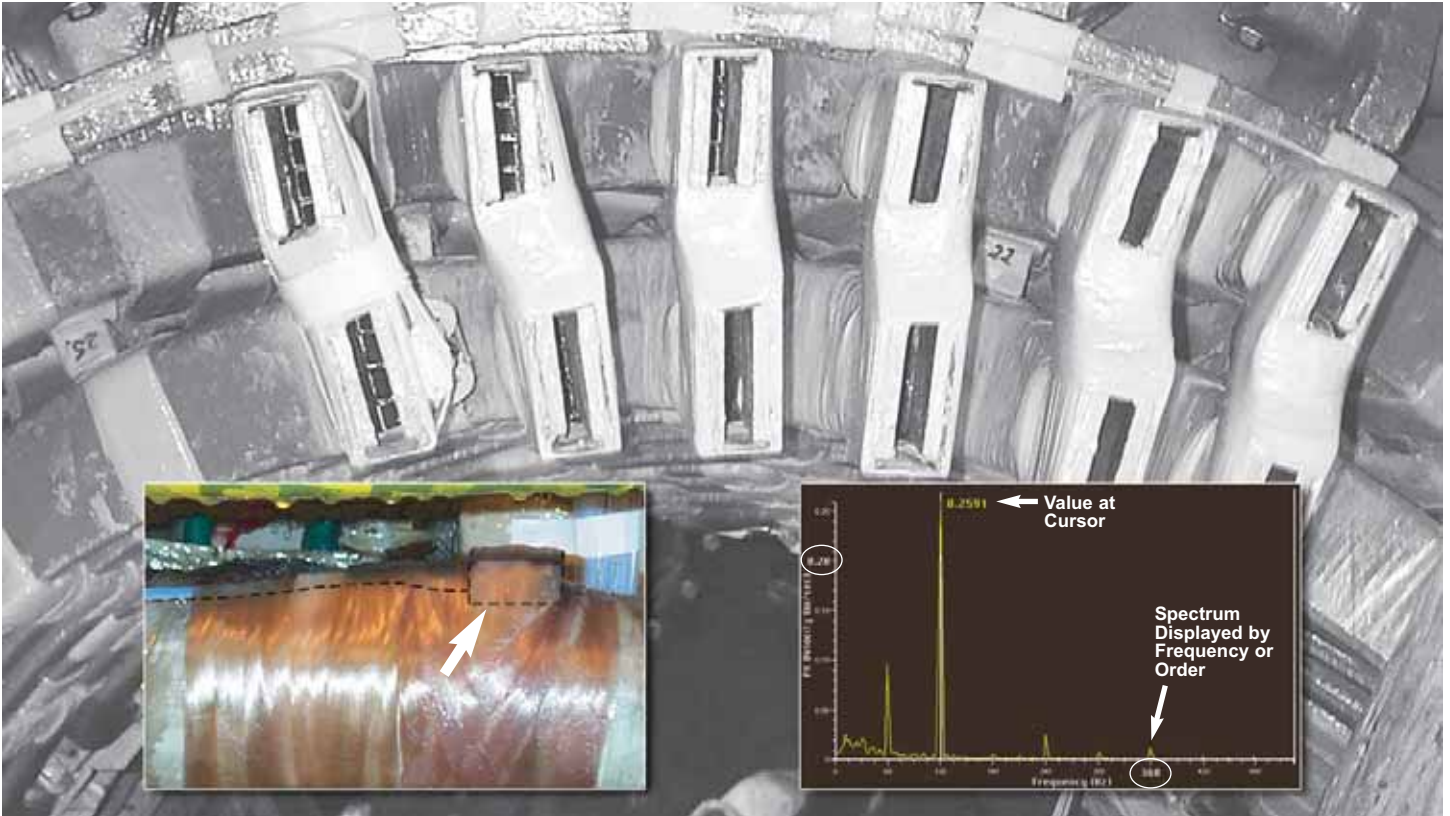
VibroSystM FOAs-100™ installed on a 707 MW hydrogen-cooled generator



FOA-200, dual-axis, at start of installation procedure. The sensor is being installed on a 540 MW hydrogen-cooled generator.



FOA-100E™ (Extended Bandwidth 10-1000 Hz) : small-size and light weight sensor head for an easier installation.



Fiber optic accelerometer (embedded)

Spectrum analysis of end-winding vibration, 10-1000 Hz

**W**hat distinguishes *VibroSystM* from other instrumentation suppliers is our wide range of exclusive on-line monitoring solutions for hydrogenerators, turbogenerators and large electric motors. *VibroSystM's solutions are based on four key elements:*

**INNOVATIVE TECHNOLOGIES**

Parameters in the heart of the machine that could not be accessed on-line are now available thanks to our unique sensors.

**POWERFUL SOFTWARE**

Our monitoring and analysis software tools are easy to use with comprehensive graphs and advanced analysis capabilities.

**RENOWNED EXPERTISE**

Our broad experience in interpreting machine results, delivering sound advice and proposing monitoring solutions tailored to your needs make us the ideal partner.

**CUSTOMER SATISFACTION**

VibroSystM takes pride in going above and beyond the call of duty when it comes to customer service and quality control. Our dedicated specialists ensure that our products and services fully meet our customer expectations.

*Our solutions provide users with valuable information to:*

- Verify tolerances and enforce warranty terms
- Implement and perform condition-based maintenance
- Detect and diagnose anomalies to prevent forced outages
- Extend operation of ageing and problematic machines

At VibroSystM, we supply you with solutions to help you optimize asset management, improve productivity, save money, increase revenues, and defer expenses.

*To inquire about the full extent of benefits from winding vibration monitoring and products, contact us.*



**VIBROSYSTM**

**YOUR MACHINE CONDITION MONITORING PARTNER**

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