



# SOLUTIONS FOR SAFETY AND UPTIME

MONITOR, MEASURE & TROUBLESHOOT:  
VIBRATION, COMBUSTION PRESSURE, NOISE & GROUND FAULTS

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 **THE MODAL SHOP**  
AN AMPHENOL COMPANY

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# SERVING THE ENERGY SECTOR

Safety and uptime – critical concerns at every energy facility. Our teams are focused on delivering solutions designed specifically for Power Generation applications – from sensors to precision instrumentation. We believe there is strength in numbers – with wide ranging application experience, a global 24 / 7 support team, and 50+ years solving complex problems, The Modal Shop, PCB Piezotronics, Larson Davis, and Accumetrics are here to support you. Our specialist teams offer expertise in each area below – all solutions are available through our global sales and service network:

- **Calibration Systems & Digital Sensing**  
The Modal Shop
- **Industrial Vibration & Pressure Sensors**  
PCB Piezotronics
- **Noise & Vibration Industrial Hygiene**  
Larson Davis
- **Generator Ground Fault Protection**  
Accumetrics



## SENSING TO MEET YOUR NEEDS

### DIGITAL VIBRATION MEASUREMENTS

Harness the power of your smartphone to make simple, accurate and reliable vibration level measurements on critical machinery using the **Digital Vibration Meter Kit Model K333D01-VM**. The USB Digital Accelerometer’s wide range and accuracy captures machinery vibration events from imbalance to misalignment to bearing faults, gear mesh, and pump cavitation. With a hermetically sealed, stainless steel housing, the Digiducer is built to survive in tough environments.

- Turns your smartphone into a portable vibration meter
- Turn-key kit includes mounting hardware and connections
- Pre-programmed ISO vibration severity scales provide instant exceedance feedback
- PDF report generation with images of critical assets

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### USB-PROGRAMMABLE ELECTRONIC VIBRATION SWITCH

The **Series 686 Smart Vibration Switch** is highly versatile, fully user programmable via USB, low cost, and a drop-in replacement for most popular mechanical vibration switches. The Smart Vibration Switch provides the reliability not found in mechanical switches. It is a lower cost alternative when single relay action is required vs. higher cost dual relay models.

- Fully USB programmable for consistent results
- 2-wire operation uses existing mechanical switch wires
- Eliminates false trips with programmable delays
- Remote Reset Anywhere™ for safety and convenience
- Exclusive MAVT™ sets alarm threshold automatically
- Hazardous area approvals available

**IMI SENSORS**  
A PCB DIVISION



## HIGH TEMP, HIGH ACCURACY ACCELEROMETERS



When monitoring vibration in power generation turbines, gas turbines, or turbine/compressor sets in oil and gas pipelines, highly specialized sensors are required. Accelerometers must withstand high temperatures while continuously monitoring in harsh environments. Second to none, **Intrinsically Safe Differential Charge Accelerometers** from PCB Piezotronics offer top performance and are quick to ship, all at a fraction of OEM sensor pricing.

- Rugged, accurate sensors with quick delivery
- Validated via full frequency sweep – not just a single point
- Hazardous Area and Intrinsic Safety Approvals
- Backed by 24/7 support and Total Customer Satisfaction



EX615A42  
260 °C (500 °F)

EX619A11  
482 °C (900 °F)

EX357C71  
482 °C (900 °F)

## ULTRA HIGH TEMP ACCELEROMETERS



PCB's Ultra High Temperature UHT-12™ differential charge sensors offer accurate, reliable, lower noise measurements through large temperature variations. **Extreme Temperature Differential Charge Accelerometer Model EX611A20** can be used in continuous monitoring applications and withstand temperatures up to 650 °C (1200 °F).

- Eliminates false trips due to signal spiking
- Shear mode sensing element prevents false alarms due to base strain



EX611A20  
650 °C (1200 °F)

## ON TURBINE COMBUSTION INSTABILITY PRESSURE SENSORS



High temperature pressure sensors directly mounted to the gas turbine combustor basket provide 24 / 7, consistent, reliable combustion dynamics data monitoring so that tuning changes can be made at any time. Both intrinsically safe **Extreme Temperature Pressure Sensors** – up to 650 °C (1200 °F) – and **Very High Temperature Pressure Sensors** – up to 520 °C (968 °F) – from PCB allow for diagnostics, part fatigue analysis, and the ability to continuously monitor and control emissions.

- Enable the use of auto-tuning and online diagnostic monitoring systems
- Save time by connecting to legacy combustion dynamics monitoring systems



176M03 &  
176M09  
520 °C (968 °F)

176A03  
649 °C (1200 °F)

176A02  
649 °C (1200 °F)

## THE SWEEPING DIFFERENCE: CALIBRATION

Accelerometers from PCB Piezotronics are calibrated using a full frequency sweep prior to leaving the factory. This entails taking measurements from 10 Hz to 4 kHz or 5 kHz, and from 10 Hz to 2800 Hz for UHT-12 sensors. This ensures the sensor's stability and performance across a wide range. Other manufacturers' typical factory calibrations only test a single point. ISO 16063-21, the principle standard for piezoelectric accelerometer calibration, states at least "six frequencies...equally covering the transducer range" shall be chosen for calibration.

Combustion instability pressure sensors from PCB Piezotronics receive a five-point linearity test through the relevant amplitudes within the turbine's combustion chamber. Other manufacturers provide a single calibration point at 1 bar (14.5 psi).

# ON-SITE VIBRATION CALIBRATION & VERIFICATION

## CONFIRMING VIBRATION PROTECTION SYSTEM OPERATION

Reliability, Instrumentation & Controls, and Maintenance Teams need to answer a slew of questions: If a problem develops, will we receive advanced warning? Are we safe around the machinery? Is the instrumentation wired correctly and working? Is it protecting the machinery? Are vibration alarms real, or nuisance?

The answer to these questions lies in bringing vibration loop checks and calibration into the plant. With 30+ years of expertise in vibration transducer calibration, The Modal Shop is here to support you with a range of Portable Vibration Calibrator solutions.

## PORTABLE VIBRATION CALIBRATION

The **Portable Vibration Calibrator Model 9110D** is the industry leading battery-powered vibration shaker table – capable of field testing a diverse range of vibration instrumentation used in energy facilities from sensor, through cabling, to displayed vibration, alarms, programming, and scaling. An extended 5 Hz to 10 kHz frequency range and a powerful shaker with 800-gram max payload make it an ideal solution for a wide range of sensors. Turbines and compressors are too critical for unplanned outages. As the first line of defense against downtime, vibration monitoring systems are just as essential as the machinery they protect.

Output sensitivity of vibration instrumentation is automatically calculated on the display screen. CALROUTE firmware allows technicians to program repetitive test routines with pass/fail notification displayed after every data point for both frequency response and linearity. From data collected, it is easy to create professional, NIST-traceable, and ISO-17025 compliant calibration certificates by importing results from the device's memory into Microsoft Excel® via supplied workbook and USB drive. Portable Calibrators from The Modal Shop help:

- Prevent and troubleshoot false alarms
- Pass audits, while reducing insurance risk and instrumentation costs
- Build trust in the condition monitoring system
- Promote safety, reduce downtime

The energy industry uses a myriad of vibration monitoring solutions. Model 9110D has the payload capability and mounting flexibility to system test – from sensor to alarms – instrumentation and systems prevalent in the industry such as:

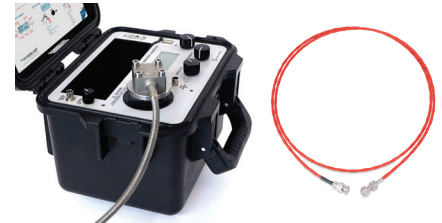
- Proximity probes (eddy current probes) used for radial or axial gas and steam turbine vibration as well as centrifugal compressor monitoring in the fluid-film bearings
- 4-20 mA loop powered vibration transmitters protecting critical air compressors, motors, and pumps
- Turbine accelerometer signal conditioners with AC current output
- Case mounted velocity sensors
- Accelerometers detecting bearing faults and gear box malfunctions
- High temperature charge, differential charge, or modulated current vibration sensors
- DCS, PLC, SCADA control system scaling, display and alarms
- SIL-rated systems with redundant high alarm shutdown logic



# CHARGE, PROXIMITY PROBE CALIBRATION, AND LOOP CHECKS

## CALIBRATE CHARGE MODE ACCELEROMETERS

Similar in operation to Model 9110D, the **Portable Vibration Calibrator with Charge Amplifier Input Model C9110D** supports the calibration of both single-ended and differential charge accelerometers. The unit is supplied with a 7/16-27 2-pin MIL to BNC cable for the calibration of high temperature turbine vibration sensors that have a differential output. Device is also supplied with multi-hole mounting pads that accommodate popular turbine accelerometer bolt patterns.



## LOOP CHECK PROXIMITY PROBES

**Proximity Probe Stinger Holder Model 9100-PPASH** simplifies the process of proximity probe calibration and loop checks. With Model 9100-PPASH, reverse mount proximity probes installed inside a long probe housing (also known as a stinger or sleeve) can be validated without disassembly. The 9100-PPASH is the first product designed to allow technicians to perform a complete dynamic loop check on such proximity probes – even heavy units with signal conditioning housings on top of the design – while maintaining their mounting integrity.



9100-PPASH

**Proximity Probe Adaptor Kit Model 9100-MPPA01** (metric) or **9100-PPA01** (English) offers the ability to easily mount proximity probes for validation on a Portable Vibration Calibrator. The kit includes a micrometer in mils or microns and 1/4", 3/8", 6 mm, 8 mm, and 10 mm brackets that clamp to the probe case threads to simplify testing, shown here. Other proximity probe testing options include:



9100-PPA01

- Adaptor kits for larger proximity probes with 1/2", 5/8", 14 mm, or 16 mm case threads
- Custom calibration target materials for modified probe drivers
- Cabling that connects directly to the probe driver to permit testing without disconnecting wiring to the monitoring system

## TROUBLESHOOT & VALIDATE VIBRATION ALARMS

**Portable Shaker Table Model 9100D** is an ideal tool to field check accelerometers, velocity transducers, and proximity probes over a wide operating frequency and amplitude range. Designed to withstand the harsh conditions of the industrial environment, the Portable Shaker Table can be taken directly to the location of installed sensors – eliminating downtime via functional loop checks and making regular calibration a viable option. As the precursor to The Modal Shop's Portable Vibration Calibrator Model 9110D, which offers real-time sensitivity display coupled with the ability to store calibration records, Model 9100D is designed for facilities to use in troubleshooting and validation applications.

## PROGRAM REPETITIVE TESTS

Are you currently running the same calibrations or loop checks on multiple sensors & channels? Do you need a straightforward way to set up these tests and hand them off to a technician to run? CALROUTE firmware – included on every Model 9100D, 9110D, and C9110D – makes this process easy, displaying pass/fail results for each data point on the screen of the Portable Calibrator. Users can program repetitive test points such as alert and shutdown thresholds at machine running speed via the supplied Microsoft Excel® CALROUTE Generation Workbook. Verify system linearity, accuracy, output sensitivity, and shutdown logic in seconds. No additional software needed.

# PERSONAL NOISE EXPOSURE

## WORKER NOISE EXPOSURE MEASUREMENTS

For Industrial Hygienists, EHS Consultants, and Safety Managers, knowledge of a worker's daily noise exposure is critical in mitigation of hearing loss risk. Larson Davis offers Noise Dosimeters designed to help you comply with guidelines established by OSHA, ISO, and other global directives while providing exposure levels in an easy-to-understand format.

## WIRELESS NOISE DOSIMETRY

With the mobile-capable line of **Spartan Wireless Noise Dosimeters Models 730 and 730IS**, control test setup, timers, and measurements for up to four virtual dosimeters on a single device. Spartan Noise Dosimeters include preprogrammed parameters for NIOSH, ISO, ACGIH, and OSHA regulations. Perform tasks via Bluetooth from a PC or the LD Atlas™ app. Spartan facilitates faster, simpler, consistent operation designed to save time and money.

Use LD Atlas to perform essential tasks – viewing real-time exposure data, exceedances, battery life, and measurement metrics – via your phone or tablet. Spartan Noise Dosimeters are configured with built-in wireless charging pads in a robust travel case and available in 1-, 3-, 5-, and 10-packs. **Intrinsically Safe Noise Dosimeters** are available as Model 730IS.

- Produce reports and email results via mobile device
- Programmable (on/off) LED alarm for exceedances or actions
- Built-in bump detection and motion detection
- 730IS is ATEX, UL 913, IECEx, FCC, CAN/CSA C22.2 approved



## WORKPLACE NOISE MEASUREMENT

Designed for the Occupational Safety professional, **Spartan Sound Level Meter Model 821** includes everything needed to simplify workplace noise level and noise exposure measurements. Spartan's rugged packaging makes it ideal for measurements in a wide range of environments. The Spartan Model 821 includes a large, responsive touch display with all of the essentials for measuring workplace noise.

- Long battery life
- Automatic data transfer
- Wireless charging
- Built-in noise dose metrics



## EQUIPMENT RENTAL

Need a Portable Vibration Calibrator during your next outage? Want your technicians to try out a Digiducer? Need a batch of Noise Dosimeters for short-term monitoring?

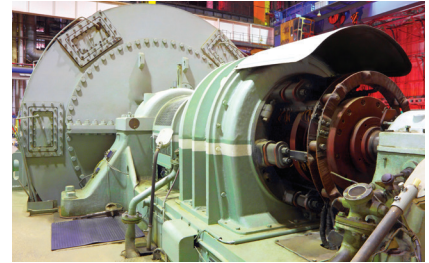
**The Modal Shop's Rental Program** is an ideal way to access state-of-the-art technology at a fraction of the cost. Contact our team of experts, tell us about your testing needs, and we'll set up a schedule: [rentalteam@modalshop.com](mailto:rentalteam@modalshop.com) or 1 513 351 9919.



# GROUND FAULT PROTECTION

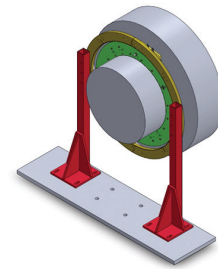
## MONITOR ROTOR WINDING INSULATION & PREVENT COSTLY REPAIRS

Ground faults caused by the breakdown of insulation within brushless generator rotor windings cost power generation companies millions of dollars in lost production and repairs. Installing the Accumetrics Ground Fault Detection System on your brushless generator and exciter will make this problem a thing of the past. Installed on the rotor for continuous monitoring, the system provides plants with early warning and location of the breakdown of insulation resistance on the generator rotor, allowing subsequent repairs to be scheduled for the next planned outage.



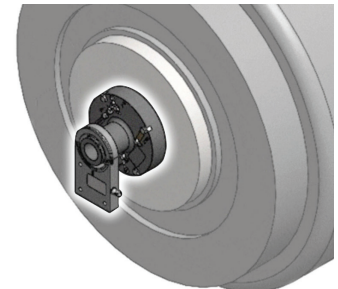
## EARTH FAULT RESISTANCE MONITORING

Accumetrics' Earth Fault Resistance Monitoring (EFREM) Systems monitor deterioration of rotor winding insulation to protect synchronous machines. Robust and reliable, EFREM Systems offer active, continuous monitoring for ground faults in the field windings of generators or motors with brushless exciters, no matter if your system is running or not. Systems detect a fault prior to rotor damage – identifying both the location and severity of the fault for simple resolution.



EFREM Mid-Shaft

Whether you need to outfit a new generator or retrofit an existing one, EFREM Systems are designed to gather objective data on the condition of your equipment to help prevent unplanned downtime. More than just a ground fault alarm, Accumetrics systems provide a continuous measurement of fault resistance, providing an early warning of insulation degradation and advanced notice of the need for field coil rewind.



EFREM End-of-Shaft

### Continuous Data Trending

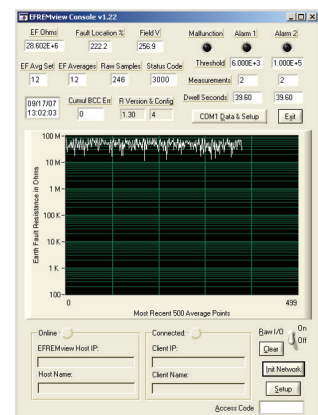
- Provides data 24 / 7 – whether the system is rotating or at a standstill
- Automatically alerts operators of any system errors

### Easy Installation and Retrofit

- Installs with little to no shaft modification
- Available in end-of-shaft or mid-shaft mounting configurations
- Eliminates the need to remove the exciter or decouple from generator for installation
- Interfaces directly to PLC, DCS, or SCADA systems, providing two relay alarms and 4-20 mA current loop resistance trending

### Low Maintenance

- Provides a rugged, reliable data stream – unlike slip rings or optical systems
- Offers peace of mind – unlike older systems, which are often no longer supported



EFREM Software



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