Combustion Dynamics Instrumentation

For the Most Demanding Gas Turbine Measurement & Monitoring Requirements

IMI SENSORS
A PCB PIEZOTRONICS DIV.

visit us at www.imi-sensors.com ☎ Toll-free in the USA 800-959-4464 ☎ 716-684-0003

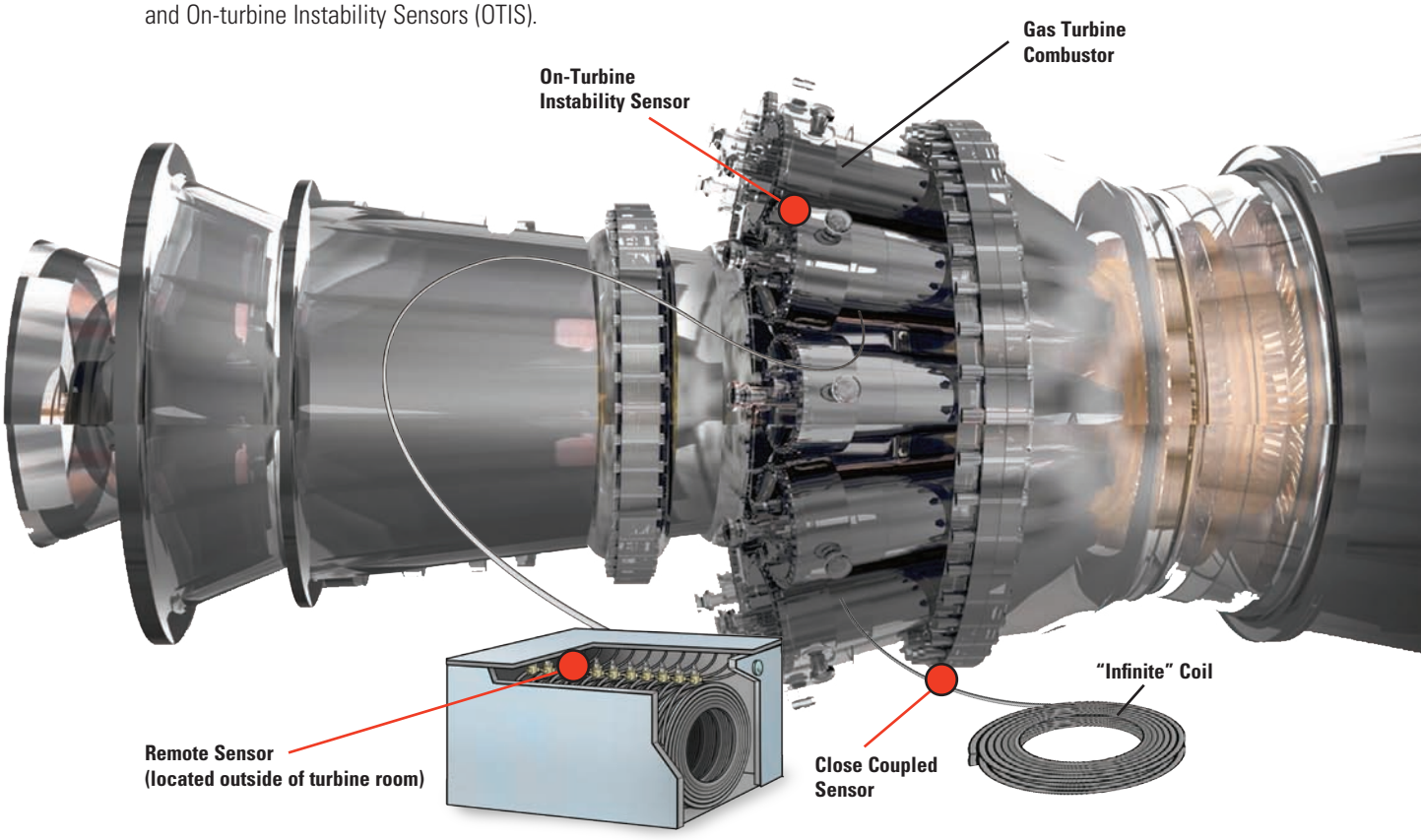
Energy & Power Generation

Combustion Dynamics Instrumentation

For more than 40 years, PCB® has specialized in the design and manufacture of innovative sensors and measurement systems for the gas turbine market. In those four decades, our expertise in combustion dynamics instrumentation has met the industry's most demanding requirements for dynamic combustion measurement and turbine engine monitoring.

With the move toward increased fuel efficiency and lower exhaust emissions, today's gas turbine engines are based on technological innovation yet also bring potential problems. Burning a leaner flame keeps NOx emissions low but at the same time increases instability (combustion dynamics) in the gas turbine engine. This instability can damage components in the combustion chamber such as nozzles, baskets and transition pieces, as well as downstream components such as blades, resulting in downtime and loss of revenue.

IMI's instrumentation is designed to detect and measure dynamic pressure spikes, pulsations and surges in gas turbine engines. Our pressure sensors have three basic applications for detecting and measuring dynamic pressure phenomena and combustion instability in gas turbine engines: remote sensors, close coupled sensors and On-turbine Instability Sensors (OTIS).



The diagram above shows a typical setting for a gas turbine in a power generation plant. Shown within the illustration are the three standard methods of measuring pressure; Remote, Close Coupled and On-Turbine Instability Sensor (OTIS). The red bullets indicate the location of the actual sensor for each different method.

Suggested Sensor Placement

Remote Sensors - Energy & Power Generation

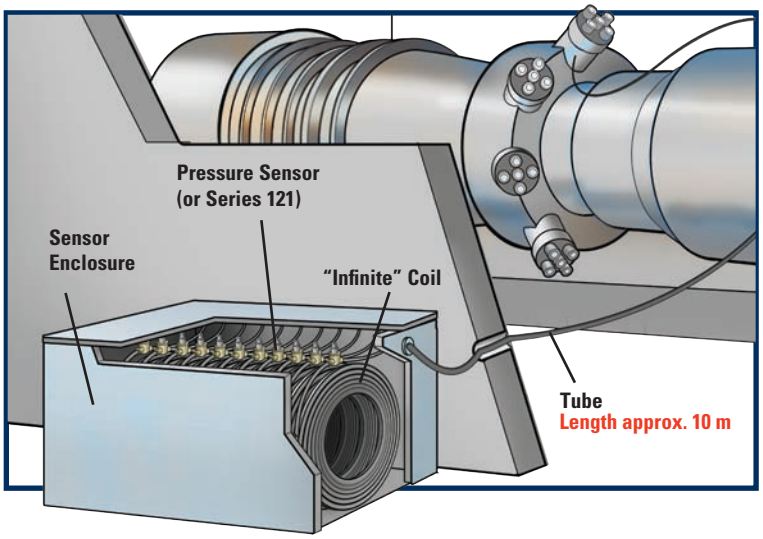
ICP® Pressure Sensor
Model 102M205

- Sensitivity: 50 mV/psi
- Measurement Range: 100 psi pk
- 316 stainless steel diaphragm
- 3/8-24 UNF fitting

ICP® Pressure Sensor
Model 121A44

- Sensitivity: 100 mV/psi
- Measurement Range: 50 psi pk
- 316 stainless steel diaphragm
- 1/4" NPT fitting

These pressure sensors have either a portable or permanent configuration. Portable systems consist of pressure sensors that are connected to sensing lines running to some or all of the combustors. Similar to the portable systems, permanent systems provide sensors mounted outside the turbine enclosure.



The sensors are then connected through sensing lines (tubing) to each combustor. Because of the long sensing lines involved, the ability to "purge" condensation is required. There are advantages to this simple, low cost approach. Because the sensors are mounted outside the turbine enclosure, the conditions the sensors must endure are relatively mild, thus allowing for the use of less expensive sensors with longer life expectancy. In addition, these sensors can be serviced while the turbine is online.

Energy & Power Generation

Combustion Dynamics Instrumentation

Close Coupled Sensors - Energy & Power Generation

Close coupled sensors permanently mounted to a gas turbine are ideal for monitoring combustion dynamics (instability). Operating at a wider frequency range than remote sensors, the high sensitivity and higher-temperature capability of these sensors allow for precision measurement in turbine locations where the application of other instrumentation is not possible.

Close coupling of the sensors to the combustor enables the measurement and detection of dynamic pressure phenomena such as high frequency events that can cause damage to downstream components such as blades. Like the portable and permanent remote sensors, close coupled sensors also require a purging system to eliminate condensation.

500°F (260 °C)

High Temperature Pressure Sensor

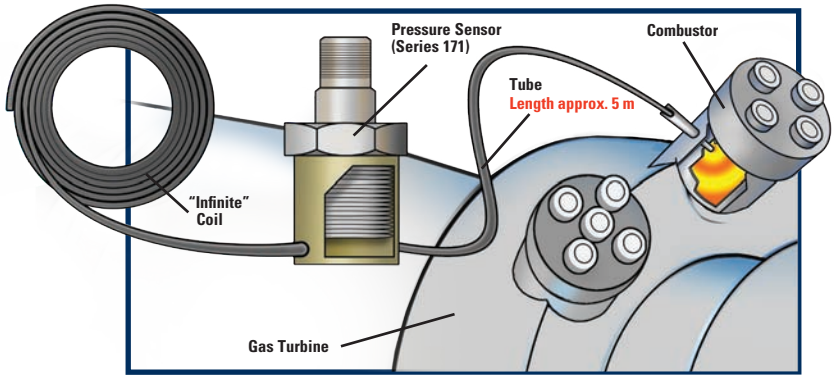
Model EX171M01

- Sensitivity: 1100 pC/psi
- Measurement Range: 10 psi
- 2-pin connector, 1-1/8"-12 UNF-2A port

In-Line Charge Converter

Model 422E55/D

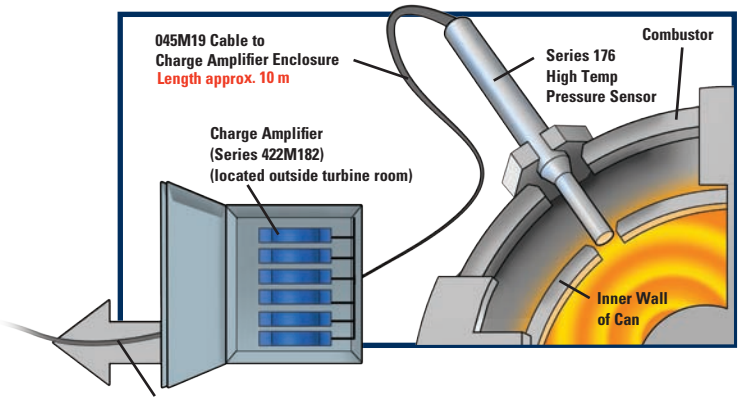
- Sensitivity: 0.5 mV/pC
- Voltage Output: ±2.5 V pk
- Temperature Range (Operating): -65 to +250 °F
- Housing Material: Stainless steel



IMI SENSORS
A PCB PIEZOTRONICS DIV.

Complete specifications available at www.imi-sensors.com

☎ Toll-free in the USA 800-959-4464 ☎ 716-684-0003



On-Turbine Instability Sensors (OTIS) - Energy & Power Generation

986°F (530 °C)

High Temperature Pressure Sensor
Series 176M0X

- Sensitivity: 17 pC/psi
- Measurement Range: 20 psi pk

986°F (530 °C)

High Temperature Pressure Sensor
Series 176MXX

- Sensitivity: 17 pC/psi
- Measurement Range: 20 psi pk

1200°F (649 °C)

High Temperature Pressure Sensor
Model 176A02

- Sensitivity: 6pC/psi
- Measurement Range: 725 psi pk
- Integral hardline cable

High temperature sensors directly mounted to the combustor basket provide 24/7, consistent, reliable combustion dynamics data monitoring so that tuning changes can be made at anytime. On-Turbine Instability Sensors allow for diagnostics, part fatigue analysis and the ability to continuously monitor and control emissions. The higher frequency capability of the OTIS sensors enable the use of auto-tuning and online diagnostic monitoring systems. In addition, these sensors provide an output that can easily connect to legacy combustion dynamics monitoring systems. By having sensors directly mounted to the combustor, operators save time during combustion analysis.

Differential Charge Amplifier
Model 422M182

- Sensitivity: 4 mV/pC
- Voltage Output: ±5 V pk
- Temperature Range (Operating): -60 to +185 °F

Differential Charge Amplifier
Model 421A3X

- Sensitivity: Configurable
- Voltage Output: ±5 V pk
- Temperature Range (Operating): -22 to +185 °F

Differential Charge Amplifier
Model EX682A40

- Sensitivity: 10 mV/pC
- Voltage Output: ±2.5 V pk
- Temperature Range (Operating): -40 to +176 °F

Energy & Power Generation

Combustion Dynamics Instrumentation

High Temperature Accelerometers - Energy & Power Generation

Vibration monitoring of gas turbines can provide crucial information to diagnose potential problems, leading to an increase in uptime and a decrease in unplanned maintenance, catastrophic failures and accidents.

500°F (260 °C)

High Temperature Charge Accelerometer

Model EX615A42

- Sensitivity: 100 pC/g
- Measurement Range: ±200g
- Frequency Range: 5 kHz
- Electrical Connector: Integral cable

550°F (288 °C)

High Temperature Charge Accelerometer

Model 612A01

- Sensitivity: 26 pC/g
- Measurement Range: ±100g pk
- Frequency Range: 5 kHz
- Electrical Connector: 2-Pin MIL-C-5015

900°F (482 °C)

Very High Temperature Charge Accelerometer

Model EX619A11

- Sensitivity: 50 pC/g
- Measurement Range: ±500g
- Frequency Range: 3 kHz
- Electrical Connector: Integral cable

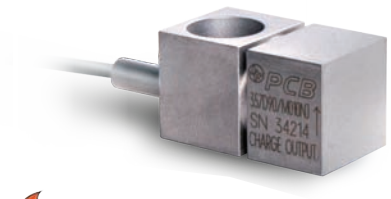
900°F (482 °C)

Very High Temperature Charge Accelerometer with Integral ICP® Amplifier

Series EX600B1X

- Sensitivity:
  10 mV/g (EX600B14)
  or 100 mv/g (EX600B13
- Measurement Range:
  ±50 g (EX600B13)
  or 500 g (EX600B14) pk
- Frequency Range: 3.5 kHz
- Mounting: Through holes

Innovations in high temperature accelerometer technology for gas turbine monitoring now enable vibration measurement in extreme heat environments up to +1200 °F (+649 °C). IMI's high temperature accelerometers come in a variety of frequencies, temperature ranges and configurations. Integral charge amplifiers allow for use with standard data acquisition equipment.



1200°F (649 °C)

Extreme Temperature Charge Accelerometer

Series 357D9X

- Sensitivity: 2.3 pC/g (357D92 and 357D93)
  or 5 pc/g (357D90 and 357D91)
- Measurement Range: ±1000 g pk
- Frequency Range: 2.5 kHz
- UHT-12™ element

1200°F (649 °C)

Extreme Temperature Charge Accelerometer

Model EX611A00

- Sensitivity: 10 pC/g
- Measurement Range: ±200 g pk
- Frequency Range: 2.8 kHz
- UHT-12™ element

IMI SENSORS
A PCB PIEZOTRONICS DIV.

Complete specifications available at www.imi-sensors.com

☎ Toll-free in the USA 800-959-4464 ☎ 716-684-0003

Combustion Dynamics Instrumentation

Accessories

Accessories - For Remote Sensors

Low Noise, TFE Jacketed, Coaxial Cable 10-32 Coaxial Plug to BNC Plug
003CXX Cabling

Polyurethane, Twisted Pair Cable with Composite 2-Socket MIL-style Connector to BNC Plug
052FVXXXAC Cabling

For Close Coupled Sensors

Low noise, PFA Jacketed,Twisted Pair Cable 2-Socket MIL to BNC Plug
045ERXXXAC Cabling

Accessories - For On-Turbine Instability Sensors

Polyurethane Cable, BNC Plug to Pig Tails
052ACXXXAD Cabling

Low Noise, PFA Jacketed Cable, 2-socket 7/16 MIL to 2-Socket MIL-C-5015
045M19 Cabling

Polyurethane Cable, Composite 2-Socket MIL-style Connector to BNC Plug
052BRXXXAC Cabling

Low Noise, PFA Jacketed Cable, ET Connector to Pigtails
045M21 Cabling

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)

Corporate Headquarters - Depew, NY

The Global Leader in Sensors & Instrumentation
For All Your Industrial Applications!

- Motor Vibration
- Pumps & Submersible Pumps
- Paper Machines & Conveyors
- Combustion Dynamics Instrumentation
- Cooling Towers & HVAC
- Gearboxes
- Wind Turbine Condition Monitoring
- Oil & Gas Wells and Pipelines
- Vibration Screens & Feeders
- Reciprocating Machinery
- Machine Tool Spindles
- Steel Rolling & Annealing
- Rotary Screw Compressors
- Nuclear Power Instrumentation
- Shock Monitoring

Over 10,000 Sensors In Stock and Ready to Ship!

IMI Sensors Platinum Stock Products represent some of our most popular models and can be used in a wide range of applications. As you browse this brochure, you will find Platinum Products indicated with the "Platinum Shield" icon (right).

Our Platinum Products are available with our Lifetime Warranty and fast delivery. If for any reason you are not 100% satisfied with your IMI Sensors Platinum Stock Product, we will repair, replace or exchange the product at no charge. For U.S. customers, all IMI Sensors Platinum Stock Products will ship within 24 hours. IF NOT, YOUR SHIPPING IS FREE!

Visit www.imi-sensors.com for complete details.

IMI SENSORS
A PCB PIEZOTRONICS DIV.

Corporate Headquarters 3425 Walden Avenue Depew, NY 14043-2495 USA
Toll-free in the USA 800-959-4464 ■ **24-hour SensorLine℠** 716-684-0003
Fax 716-684-3823 ■ **Email** imi@pcb.com ■ **Website** www.imi-sensors.com

AS9100 CERTIFIED ■ ISO 9001 CERTIFIED ■ A2LA ACCREDITED to ISO 17025

IMI-App-Combustion-1115 Printed in U.S.A.

Platinum Stock Products LIFETIME WARRANTY Delivery Now! Over 10,000 Sensors In-Stock Ready to Ship

sure We Do!

Total Customer Satisfaction IMI SENSORS