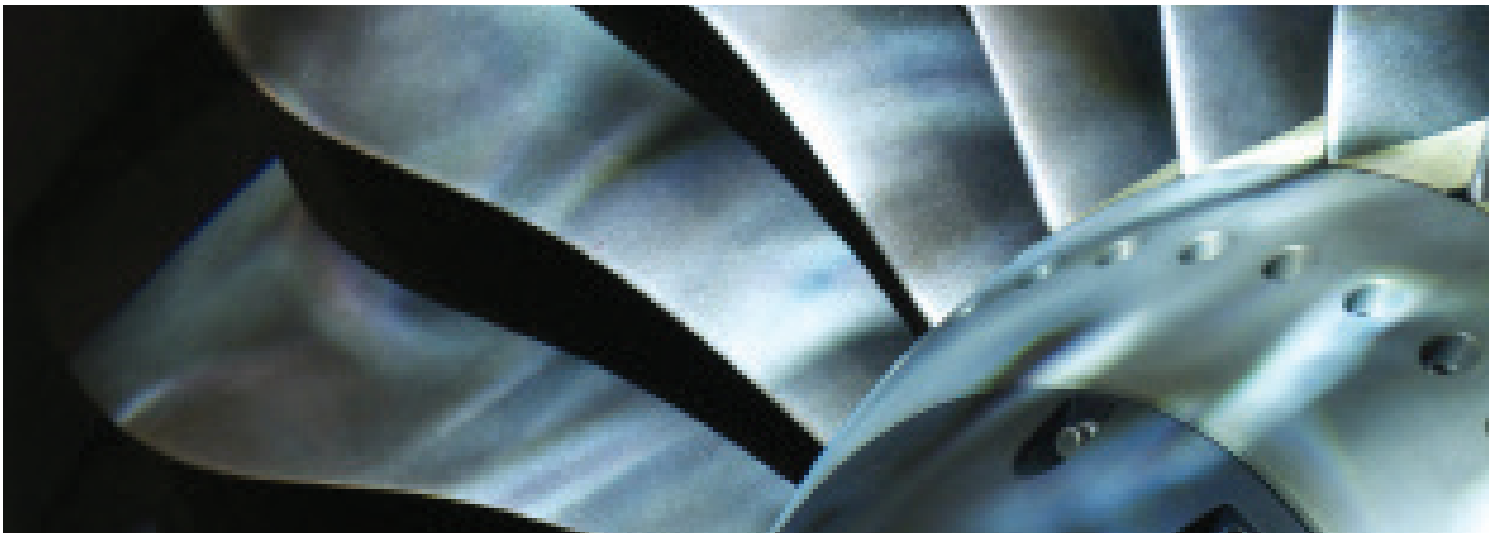
CHARGE MODE PRESSURE SENSORS

IMI SENSORS
A PCB PIEZOTRONICS DIV.

pcb.com/imi-sensors | 1 800 959 4464



CHARGE MODE PRESSURE SENSORS

Unlike ICP® pressure senors, charge mode pressure sensors do not contain any internal microelectronics. This allows charge mode pressure sensors to be used in far hotter environments than ICP® pressure sensors (1200 °F [649 °C] vs 250 °F [121 °C]).

Charge mode pressure sensors for power generation applications are used for on-turbine combustion instability monitoring. Lean-burn and dry low NOx turbines, designed by gas turbine manufacturers to meet nitrogen oxide emission regulations, operate with low fuel-to-air ratios. The low fuel-to-air ratio makes the turbines more prone to coupled acoustic/heat release pressure oscillations as a result of minor operational instabilities. While the magnitude of these oscillations may be low, even small fluctuations less than 1 psi (0.069 bar) can cause structural vibrations that result in high cycle fatigue in metal parts downstream of the combustors such as nozzles, baskets, transition pieces and blades. On-turbine pressure sensors can be mounted directly on the combustor basket to provide 24/7, consistent, reliable combustion dynamics data so that tuning changes can be made at any time.

UHT-12™ ELEMENT

UHT-12™ is a new crystal designed for more accurate, lower noise measurements during large temperature variations. UHT-12™ technology reduces the effects of temperature variation. Pyroelectricity phenomenon may occur during large temperature fluctuations, generating “spikes” and disrupting behavior of the accelerometer and the test results. Pressure sensors made with UHT-12™ technology have an improved data quality and features:

- Proprietary crystal technology sealed in a hermetic package provides long-term reliability.
- No pyroelectric output provides accurate low-frequency measurements.
- More consistent sensitivity over a wide temperature change provides greater accuracy.

HIGH IMPEDANCE CHARGE SIGNAL

Charge mode pressure sensors do not require an external power source like ICP® pressure sensors. When mechanical stress is applied, a high impedance charge signal is generated from the piezoelectric sensing element. The high impedance charge signal can be easily corrupted by cable noise and dirty environmental conditions. It is important to use low noise cables and keep electrical connections as clean as possible. A charge amplifier or in-line charge converter is needed for signal conversion before sending the signal to a data acquisition system or readout device. Charge amplifiers typically include settings that allow for gain/range adjustment. Other options may include filtering, signal integration and time constant adjustment for low frequency measurements.

Unlike ICP® sensors, charge sensors are not limited to a maximum 5 VAC full scale output range. Charge sensors can operate anywhere within the linear measurement range listed on the specification sheet. The charge output (pC/g) can then be converted by a charge amplifier or charge converter (mV/pC). Laboratory amplifiers typically have the ability to adjust gain (mV/pC) and measurement range. Charge converters typically have a fixed gain and measurement range.

FREQUENCY RESPONSE

Low frequency and discharge time constant specifications are not included on charge mode pressure sensors spec sheets. These are electrical characteristics that are determined by the charge amplifier or in-line charge converter.

Every charge mode pressure sensor has a natural frequency that will restrict the frequency response to some upper limit. The natural frequency (resonance) is a mechanical characteristic imposed on the pressure sensor by its physical design characteristics. Sensitivity rises rapidly as the natural frequency is approached which can often result in an overload of signal output.

EXTREME TEMPERATURE, DIFFERENTIAL OUTPUT

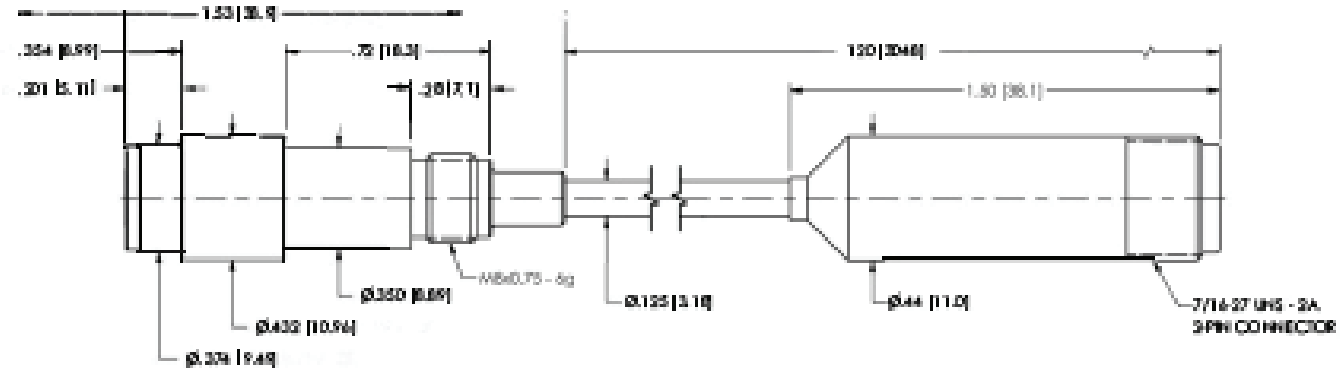
Model 176A02

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	6.0 pC/psi 87.0 pC/bar
Measurement Range	725 psi 50.0 bar
Maximum Pressure (Total)	2000 psi 137.9 bar
Resonant Frequency	≥100 kHz
Transverse Resonance	≥17 kHz
Frequency Response (±5.0%)	Up to 20 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.0036 psi/g ≤0.00025 bar/g
Temperature Range (Continuous)	-94 to +1200 °F -70 to +649 °C
Temperature Range (Connector)	-76 to +500 °F -60 to +260 °C
Hazardous Area Approval	ATEX, CSA, IECEx
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin, with cable)	150 pF
Internal Resistance (Room Temperature)	≥10^{12} Ohms
Insulation Resistance (Room Temperature)	≥10^{12} Ohms
Internal Resistance (High Temperature)	≥50,000 Ohms
Insulation Resistance (High Temperature)	≥100,000 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	UHT-12™
Housing Material	Nickel 600
Sealing	Hermetic
Cable Length	10.0 ft 3.0 m
Cable Type	Hardline
Termination Connector	7/16-27 2-Pin
Weight (With cable and clamp nut)	4.6 oz 130 gm

SENSOR CHAIN COMPONENTS

Sensor	 176A02		
Hardline Cable	N/A		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X



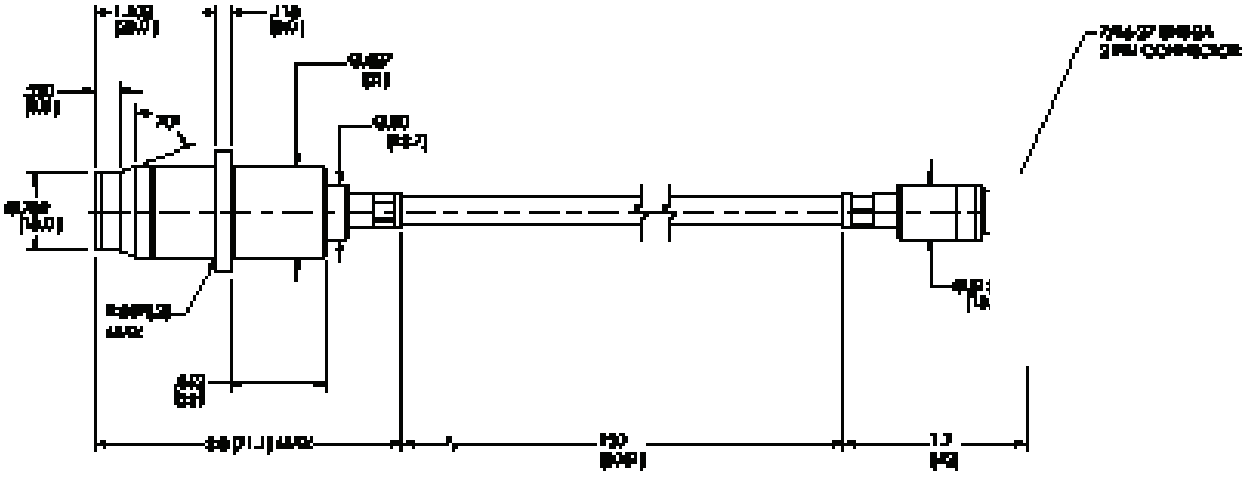
EXTREME TEMPERATURE, DIFFERENTIAL OUTPUT

Model 176A03

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	16.0 pC/psi 232.0 pC/bar
Measurement Range	290 psi 20.0 bar
Maximum Pressure (Total)	2000 psi 137.9 bar
Resonant Frequency	≥50 kHz
Transverse Resonance	≥10 kHz
Frequency Response (±5.0%)	Up to 10 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.0030 psi/g ≤0.00021 bar/g
Temperature Range (Continuous)	-94 to +1200 °F -70 to +649 °C
Temperature Range (Connector)	-76 to +500 °F -60 to +260 °C
Hazardous Area Approval	ATEX, CSA, IECEx
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin, with cable)	170 pF
Internal Resistance (Room Temperature)	≥10^{12} Ohms
Insulation Resistance (Room Temperature)	≥10^{12} Ohms
Internal Resistance (High Temperature)	≥50,000 Ohms
Insulation Resistance (High Temperature)	≥100,000 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	UHT-12™
Housing Material	Nickel 600
Sealing	Hermetic
Cable Length	10.0 ft 3.0 m
Cable Type	Overbraided Hardline
Termination Connector	7/16-27 2-Pin
Weight (With cable)	17.6 oz 500 gm

SENSOR CHAIN COMPONENTS			
Sensor	 176A03		
Hardline Cable	N/A		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X



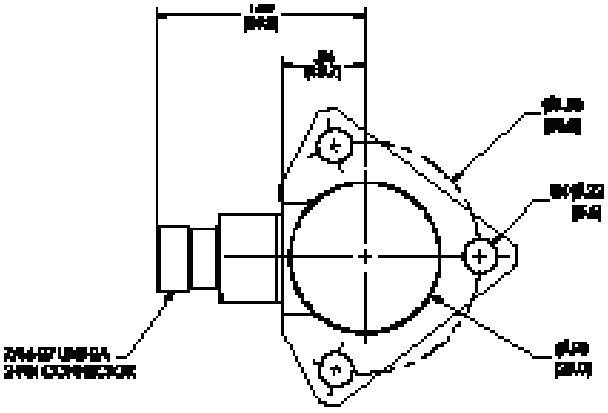
HIGH TEMPERATURE, DIFFERENTIAL OUTPUT

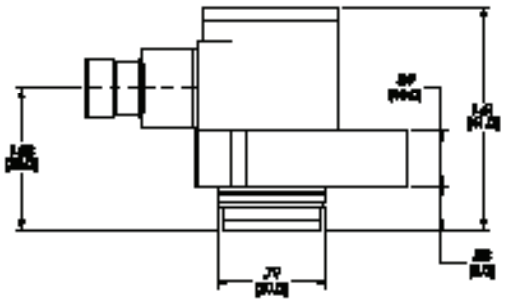
Model 176A04

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	15.5 pC/psi 224.8 pC/bar
Measurement Range	300 psi 20.7 bar
Maximum Pressure (Total)	1450 psi 100.0 bar
Resonant Frequency	≥50 kHz
Transverse Resonance	≥ 10 kHz
Frequency Response (±5.0%)	Up to 10 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.01 psi/g ≤0.00069 bar/g
Temperature Range (Continuous)	-65 to +662 °F -54 to +350 °C
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin)	45 pF
Internal Resistance (Room Temperature)	≥10^9 Ohms
Insulation Resistance (Room Temperature)	≥10^9 Ohms
Internal Resistance (High Temperature)	≥10^7 Ohms
Insulation Resistance (High Temperature)	≥10^7 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	UHT-12™
Housing Material	Nickel 600
Sealing	Hermetic
Termination Connector	7/16-27 2-Pin
Weight	3.9 oz 122 gm

SENSOR CHAIN COMPONENTS			
Sensor	 176A04		
Hardline Cable	 013GNXXXGP		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X





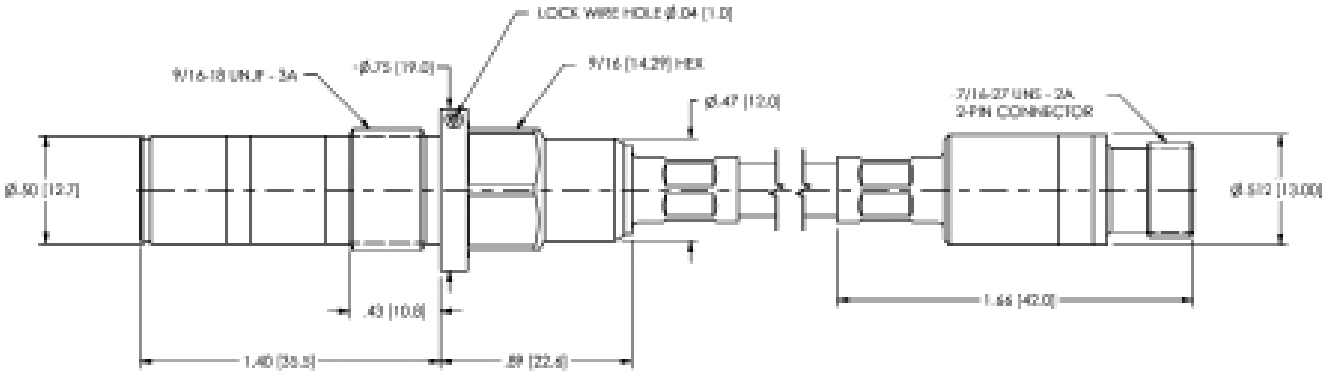
VERY HIGH TEMPERATURE, DIFFERENTIAL OUTPUT

Model 176A05

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	65.0 pC/psi 942.5 pC/bar
Measurement Range	75 psi 5.2 bar
Maximum Pressure (Total)	1450 psi 100.0 bar
Resonant Frequency	≥40 kHz
Transverse Resonance	≥13 kHz
Frequency Response (±5.0%)	Up to 8 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.0030 psi/g ≤0.00021 bar/g
Temperature Range (Continuous)	-94 to +968 °F -70 to +520 °C
Temperature Range (Connector)	-76 to +500 °F -60 to +260 °C
Hazardous Area Approval	ATEX, CSA, IECEx
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin, with cable)	650 pF
Internal Resistance (Room Temperature)	≥10^9 Ohms
Insulation Resistance (Room Temperature)	≥10^{12} Ohms
Internal Resistance (High Temperature)	≥50,000 Ohms
Insulation Resistance (High Temperature)	≥100,000 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	Ceramic
Housing Material	Nickel 600
Sealing	Hermetic
Cable Length	6.6 ft 2.0 m
Cable Type	Overbraided Hardline
Termination Connector	7/16-27 2-Pin
Weight (With cable)	9.3 oz 265 gm

SENSOR CHAIN COMPONENTS			
Sensor	 176A05		
Hardline Cable	N/A		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X



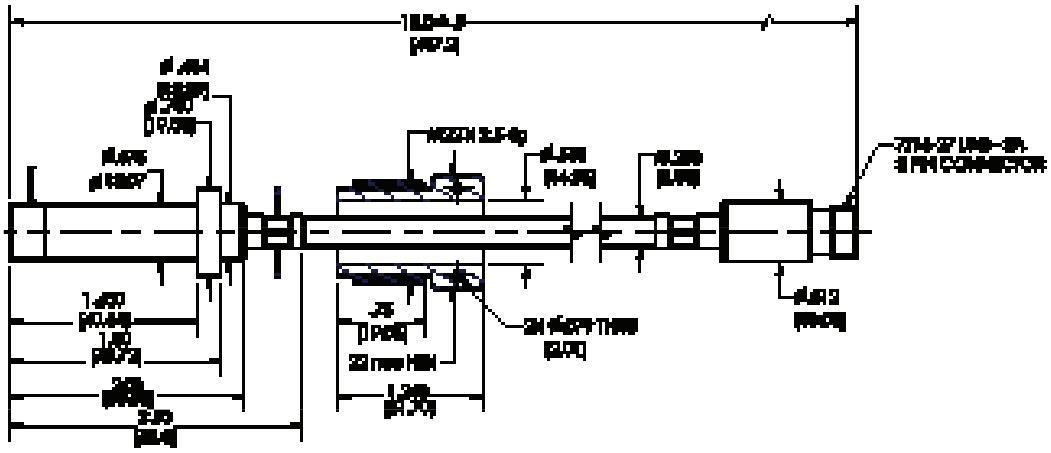
VERY HIGH TEMPERATURE, DIFFERENTIAL OUTPUT

Model 176M03

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	17.0 pC/psi 246.5 pC/bar
Measurement Range	20 psi 1.4 bar
Maximum Pressure (Total)	400 psi 27.6 bar
Resonant Frequency	≥50 kHz
Transverse Resonance	N/A
Frequency Response (±5.0%)	Up to 10 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.0100 psi/g ≤0.00069 bar/g
Temperature Range (Continuous)	-94 to +986 °F -70 to +530 °C
Temperature Range (Connector)	-76 to +500 °F -60 to +260 °C
Hazardous Area Approval	ATEX, CSA, IECEx
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin, with cable)	165 pF
Internal Resistance (Room Temperature)	≥10^{12} Ohms
Insulation Resistance (Room Temperature)	≥10^{12} Ohms
Internal Resistance (High Temperature)	≥50,000 Ohms
Insulation Resistance (High Temperature)	≥100,000 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	UHT-12™
Housing Material	Nickel 600
Sealing	Hermetic
Cable Length	1.3 ft 0.4 m
Cable Type	Overbraided Hardline
Termination Connector	7/16-27 2-Pin
Weight (With cable and clamp nut)	4.9 oz 140 gm

SENSOR CHAIN COMPONENTS			
Sensor	 176M03		
Hardline Cable	N/A		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X



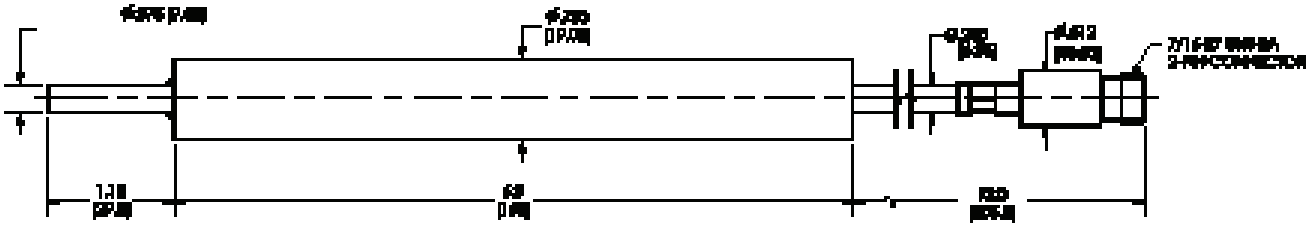
VERY HIGH TEMPERATURE, DIFFERENTIAL OUTPUT

Model 176M07

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	17.0 pC/psi 246.5 pC/bar
Measurement Range	20 psi 1.4 bar
Maximum Pressure (Total)	400 psi 27.6 bar
Resonant Frequency	≥30 kHz
Transverse Resonance	N/A
Frequency Response (±5.0%)	Up to 6 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.0100 psi/g ≤0.00069 bar/g
Temperature Range (Continuous)	-94 to +986 °F -70 to +530 °C
Temperature Range (Connector)	-76 to +500 °F -60 to +260 °C
Hazardous Area Approval	ATEX, CSA, IECEx
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin, with cable)	165 pF
Internal Resistance (Room Temperature)	≥10^{12} Ohms
Insulation Resistance (Room Temperature)	≥10^{12} Ohms
Internal Resistance (High Temperature)	≥50,000 Ohms
Insulation Resistance (High Temperature)	≥100,000 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	UHT-12™
Housing Material	Nickel 600
Sealing	Hermetic
Cable Length	1.0 ft 0.3 m
Cable Type	Overbraided Hardline
Termination Connector	7/16-27 2-Pin
Weight (With cable)	11.1 oz 315 gm

SENSOR CHAIN COMPONENTS			
Sensor	 176M07		
Hardline Cable	N/A		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X



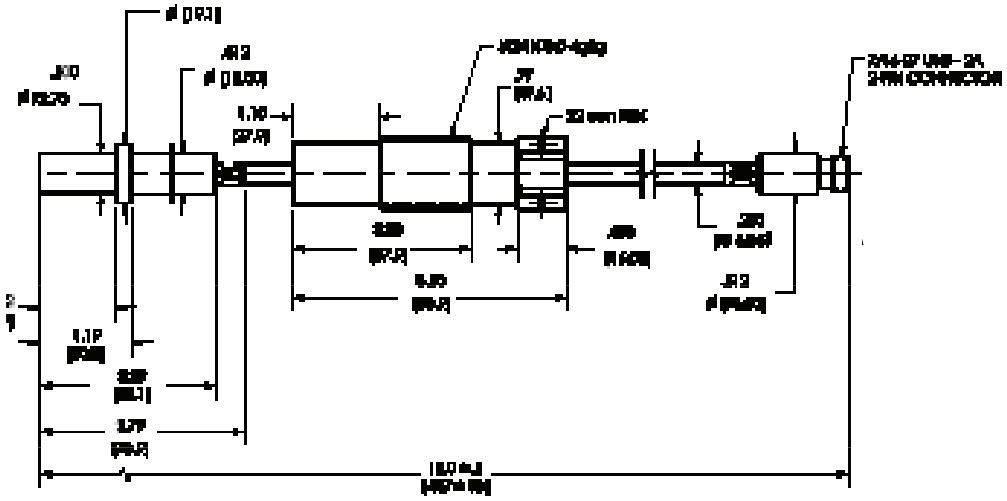
VERY HIGH TEMPERATURE, DIFFERENTIAL OUTPUT

Model 176M09

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	17.0 pC/psi 246.5 pC/bar
Measurement Range	20 psi 1.4 bar
Maximum Pressure (Total)	400 psi 27.6 bar
Resonant Frequency	≥50 kHz
Transverse Resonance	N/A
Frequency Response (±5.0%)	Up to 10 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.0100 psi/g ≤0.00069 bar/g
Temperature Range (Continuous)	-94 to +986 °F -70 to +530 °C
Temperature Range (Connector)	-76 to +500 °F -60 to +260 °C
Hazardous Area Approval	ATEX, CSA, IECEx
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin, with cable)	165 pF
Internal Resistance (Room Temperature)	≥10^{12} Ohms
Insulation Resistance (Room Temperature)	≥10^{12} Ohms
Internal Resistance (High Temperature)	≥50,000 Ohms
Insulation Resistance (High Temperature)	≥100,000 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	UHT-12™
Housing Material	Nickel 600
Sealing	Hermetic
Cable Length	1.3 ft 0.4 m
Cable Type	Overbraided Hardline
Termination Connector	7/16-27 2-Pin
Weight (With cable and clamp nut)	8.3 oz 235 gm

SENSOR CHAIN COMPONENTS			
Sensor	 176M09		
Hardline Cable	N/A		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X



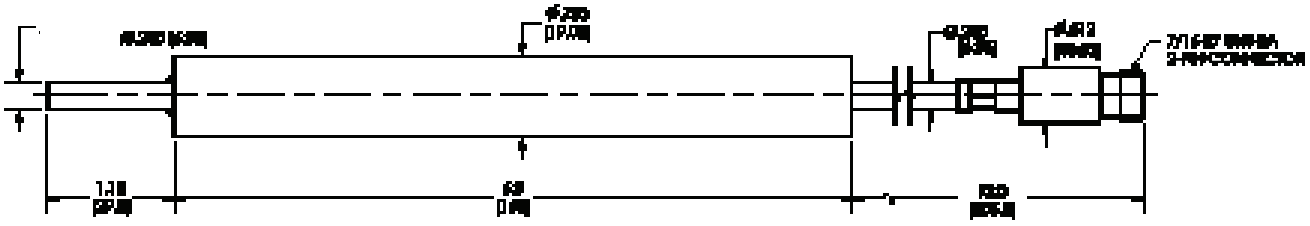
VERY HIGH TEMPERATURE, DIFFERENTIAL OUTPUT

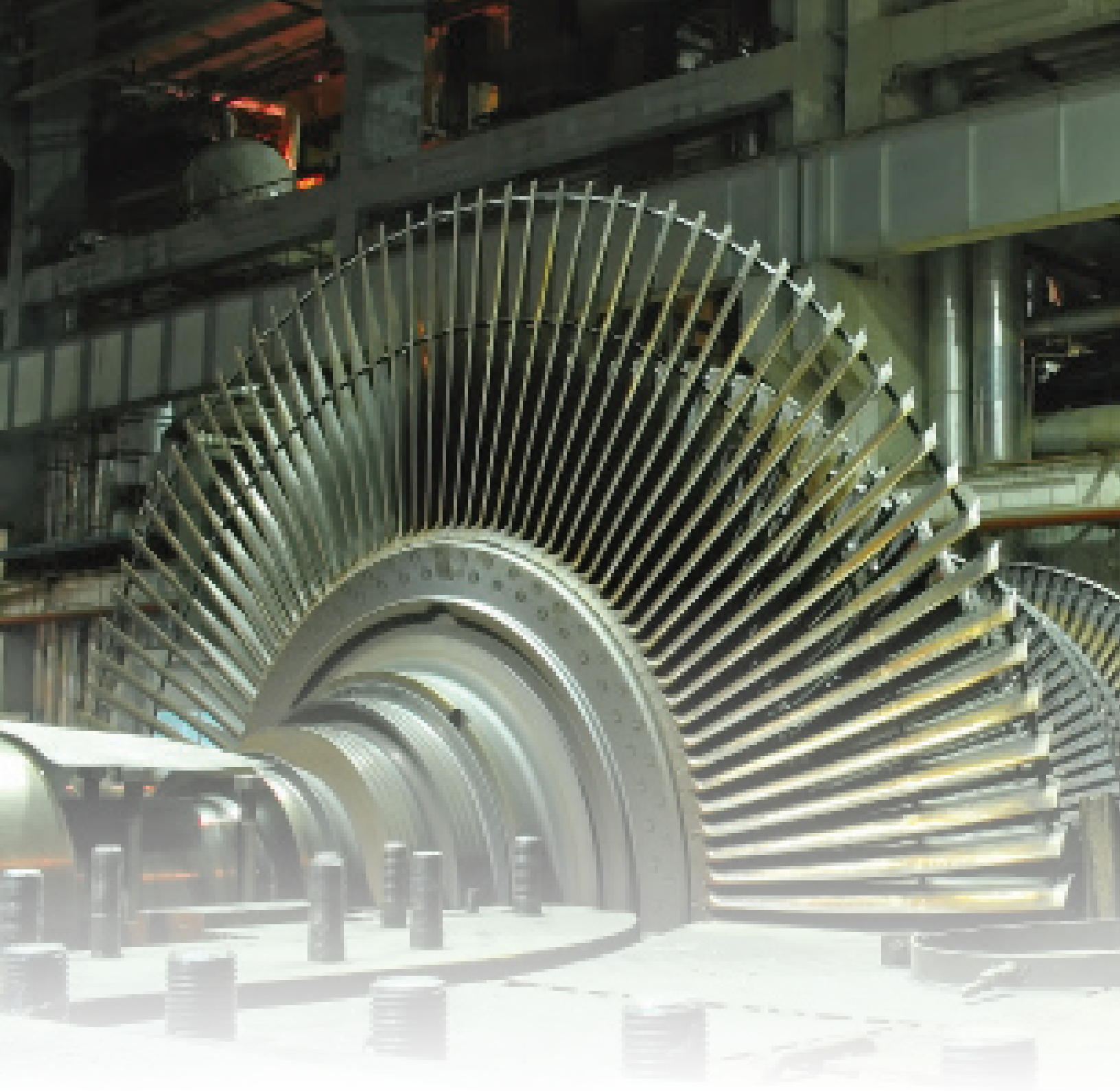
Model 176M12

TECHNICAL SPECIFICATIONS	
PERFORMANCE	
Sensitivity (±20%)	17.0 pC/psi 246.5 pC/bar
Measurement Range	20 psi 1.4 bar
Maximum Pressure (Total)	400 psi 27.6 bar
Resonant Frequency	≥30 kHz
Transverse Resonance	N/A
Frequency Response (±5.0%)	Up to 6 kHz
Non-Linearity	≤1% FS
ENVIRONMENTAL	
Acceleration Sensitivity	≤0.0100 psi/g ≤0.00069 bar/g
Temperature Range (Continuous)	-94 to +986 °F -70 to +530 °C
Temperature Range (Connector)	-76 to +500 °F -60 to +260 °C
Hazardous Area Approval	ATEX, CSA, IECEx
Radiation Exposure Limit (Integrated Neutron Flux)	1E10 N/cm^2
Radiation Exposure Limit (Integrated Gamma Flux)	1E8 rad
ELECTRICAL	
Output Polarity	Differential
Capacitance (Pin-to-pin, with cable)	165 pF
Internal Resistance (Room Temperature)	≥10^{12} Ohms
Insulation Resistance (Room Temperature)	≥10^{12} Ohms
Internal Resistance (High Temperature)	≥50,000 Ohms
Insulation Resistance (High Temperature)	≥100,000 Ohms

TECHNICAL SPECIFICATIONS	
PHYSICAL	
Sensing Geometry	Compression
Sensing Element	UHT-12™
Housing Material	Nickel 600
Sealing	Hermetic
Cable Length	1.0 ft 0.3 m
Cable Type	Overbraided Hardline
Termination Connector	7/16-27 2-Pin
Weight (With cable)	11.1 oz 315 gm

SENSOR CHAIN COMPONENTS			
Sensor	 176M12		
Hardline Cable	N/A		
Softline Cable	 045M19B	 045M21B	
Charge Amplifier	 422M182	 EX682A40	 421B3X





IMI SENSORS
A PCB PIEZOTRONICS DIV.

3425 Walden Avenue, Depew, NY 14043-2495 USA
Toll-Free in the USA: **1 800 959 4464**
Phone: **1 716 684 0003** | Email: **imi@pcb.com**

PCB Piezotronics, Inc. is a designer and manufacturer of microphones, vibration, pressure, force, torque, load, and strain sensors, as well as the pioneer of ICP® technology used by design engineers and predictive maintenance professionals worldwide for test, measurement, monitoring, and control requirements in automotive, aerospace, industrial, R&D, military, educational, commercial, OEM applications, and more. With a worldwide customer support team, 24-hour SensorLine℠, and a global distribution network, PCB® is committed to Total Customer Satisfaction. Visit www.pcb.com for more information. PCB Piezotronics, Inc. is a wholly owned subsidiary of MTS Systems Corporation. Additional information on MTS can be found at www.mts.com.

IMI-PRS-Series176-0520

MTS SENSORS

MTS Sensors, a division of MTS Systems Corporation (NASDAQ: MTSC), vastly expanded its range of products and solutions after MTS acquired PCB Piezotronics, Inc. in July, 2016. PCB Piezotronics, Inc. is a wholly owned subsidiary of MTS Systems Corp.; IMI Sensors and Larson Davis are divisions of PCB Piezotronics, Inc.; Accumetrics, Inc. and The Modal Shop, Inc. are subsidiaries of PCB Piezotronics, Inc.