

## **SHORT FORM CATALOG**

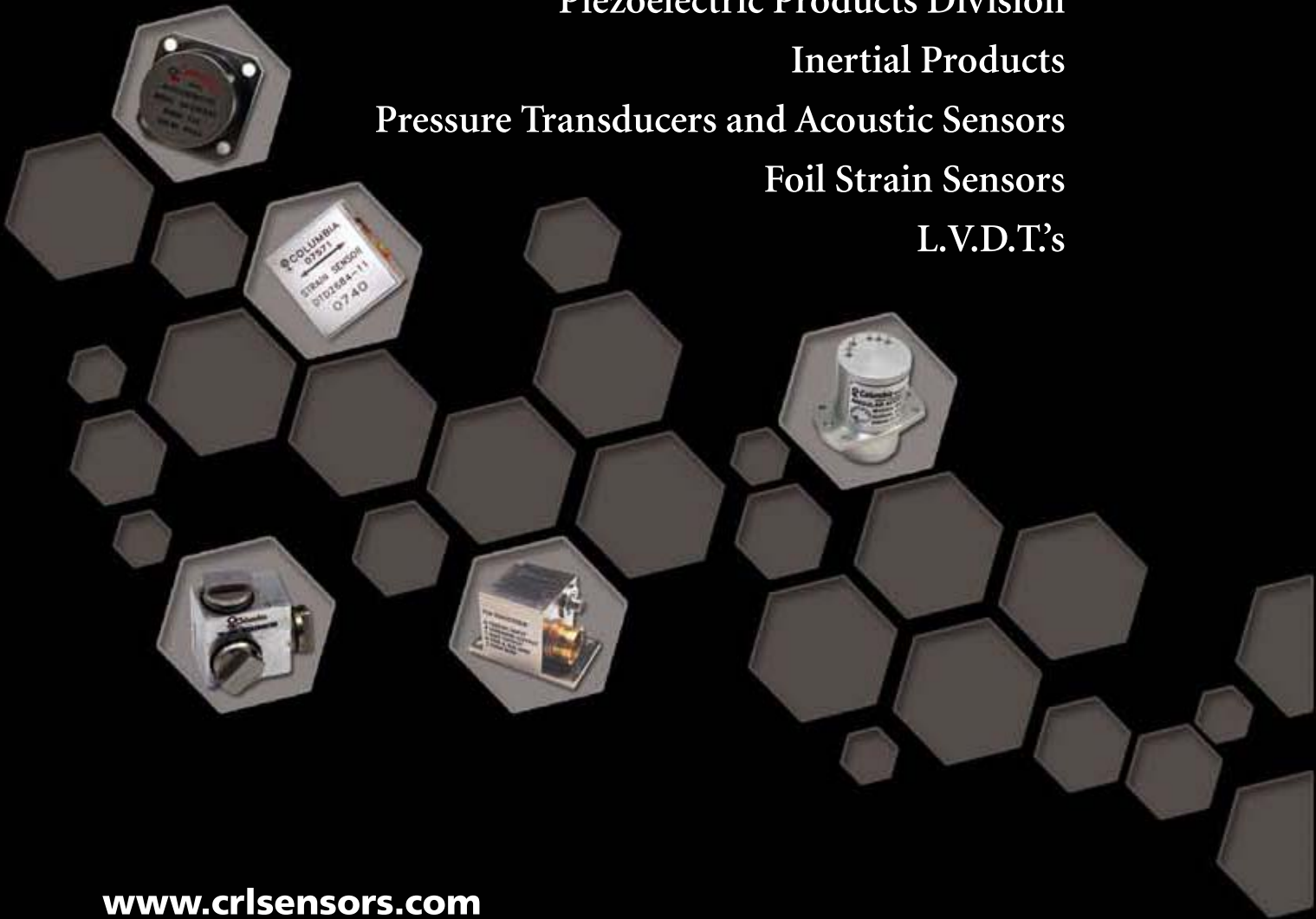
Piezoelectric Products Division

Inertial Products

Pressure Transducers and Acoustic Sensors

Foil Strain Sensors

L.V.D.T.'s



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## HISTORY OF COLUMBIA RESEARCH LABORATORIES, INC. WOOLDYN, PA



For over fifty years, Columbia Research Laboratories, Inc. has been committed to designing and manufacturing advanced technology, cost-effective products. Each product is designed to withstand hard use over long periods of time. Precision manufactured and tested to the most exacting quality standards, Columbia's products frequently exceed customer specifications.



Columbia offers a diversified product line with a wide selection of instruments. Columbia's continually growing product line includes, but is not limited to, Piezoelectric Accelerometers, Pressure Transducers, Force Balance Inertial Grade Accelerometers and Inclinometers, Standard Linear Variable Differential Transducers, Flight Qualified Fatigue Load monitoring Foil Strain Sensors, Charge Amplifiers for signal conditioning of Piezoelectric Accelerometers and Pressure Transducers, Force Balance Technology Inclinometer Systems, Hand Held Vibration Meters and Solid State Sensors. Columbia specializes in manufacturing to customers specifications.



Columbia's involvement in designing and manufacturing specialized products for the U.S. Government's Aerospace Programs and Commercial Aviation programs goes back many years as noted below:



Columbia provided the AS16-321 Vibration Measurement System for the LEM Spacecraft launched in 1974 and the Vibration Measurement Set model 123101 designed for the 1<sup>st</sup> M1T500 Flight Vehicle launched March 6, 1975. In more recent years, Columbia has designed and provided instrumentation for the Mark-12, GBU-15, AGM-130, AMRAM, HELLFIRE, ALCM, SLCM, Trident I & II, ASROC, Atlas II, Pershing II, MX, SICBM, P-3, DC-10, T-45 Trainer, Atlas-Titan, Atlas-Centaur, Shuttle Columbia, Cruise Missile, Lance Missile, ASAT Program, Killer Satellite, Captor Program, F-18 Fighter Aircraft, A-10 Fighter Aircraft, mark 21 HIT, AV-8, B-52, F-16 and JPATS.



Columbia was also involved in the recently retired venerable F117 Stealth Fighter Plane that served the U.S. so well for many years. However currently Columbia has participated in the Space X, F-22(test units), 787 Dream Liner (test units), C130 Hercules and MH-60 Black Hawk Helicopter.



This program history is typical of Columbia's performance. Columbia delivers quality products at competitive costs.



Visit our web-site [www.crlsensors.com](http://www.crlsensors.com)  
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## GENERAL PURPOSE ACCELEROMETERS

This group of accelerometers is made up of the **3000** and **5000 Series**. The **3000 Series** are standard size units, including many with all welded construction, that are hermetically sealed for use in dirty and humid environments. The **5000 Series** are smaller and lighter in weight than standard units. Characteristics are almost identical except that with miniature units higher natural frequencies and shock levels can be obtained due to their inherently reduced mass. Sensitivities however are somewhat lower. High Temperature models are available that operate to +500°F. For best performance use with the Columbia **Model 4601** Charge Amplifier or **Model 5810** Inline Charge Converter.



## MINIATURE ACCELEROMETERS

This group is made up of the **6000** and **7000 Series** Accelerometers. Both series offer a special inverted seismic element for mechanical isolation and other features normally available only on standard size accelerometers. The 7000 Series are true “shear mode” accelerometers that offer performance characteristics and accuracies usually only available on standard size units. Series 7000 offers a low profile accelerometer with a center screw for ease of installation. High temperature models of these series are available and will operate to +500°F. For best performance use with Columbia **Model 4601** Charge Amplifier or **Model 5810** Inline Charge Converter.



## TRIAxIAL ACCELEROMETERS

Tri-axial Accelerometers measure acceleration in three mutually perpendicular directions. Columbia offers five models with three mounting configurations, detachable cable assemblies, standard and high temperature models with exceptional mechanical and electrical isolation. High temperature models are available that operate to +500°F. For best performance use with the Columbia **Model 4601** Charge Amplifier or **Model 5810** Inline Charge Converter.



For complete specifications on any of the Piezoelectric Accelerometer series on this page  
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## INTEGRATED ACCELEROMETERS

Integrated accelerometers are completely self-contained vibration measuring systems having a built-in amplifier within the housing. Low output impedance allows these units to operate directly into standard readout equipment without auxiliary signal conditioning. This type of accelerometer must be powered by a constant current power supply, like the compact battery powered **5425** or the miniature **5421**.



## SPECIAL PURPOSE ACCELEROMETERS



Need an accelerometer to work in the cold to  $-400^{\circ}\text{F}$ ? Or maybe one that will work just fine at over  $+700^{\circ}\text{F}$ ? How about a light weight, bi-axial, waterproof accelerometer with integral cable for use inside a pipe or tube? Over the years Columbia has developed many special - application accelerometers to meet the demand of our customers. These special purpose accelerometers are widely used in industry today. If you have a requirement, please give us a call, we would be happy to make something "special" for you.

## MOUNTING ACCESSORIES AND CABLE ASSEMBLIES



Columbia manufactures many and varied Accelerometer mounting accessories, isolated and non-isolated adapters, stud, adhesive and magnetic mounts. Tri-axial blocks and clamp assemblies.

Columbia's standard cable assemblies are the **LNHT**(Low Noise High Temperature) Co-axial with #10-32 to #10-32 Connectors and the **MMHR** (Micro-miniature Low Noise)Cable with #2-56 to #10-32 Connectors. Special order assemblies: **LNHT** with right angle connectors or #10-32 to MS3106A-10SL-4S, TNC to BNC or #10-32 to BNC connectors are available.



For complete specifications on any of the Piezoelectric Accelerometer or Accessories on this page  
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## ACOUSTIC SENSORS AND PRESSURE TRANSDUCERS



Columbia manufactures an extensive line of High Intensity Acoustic Sensors to measure a wide range of varying sound pressure levels. Like the **Model P-308C** designed to measure sound pressure from 100dB to 190dB, it incorporates a unique opposing seismic system design which make it insensitive to external vibration environments. The **Models 938 and 989** are true High Intensity Acoustic Sensors



designed to measure gas-borne sound in the frequency range from 2Hz to 15KHz. Both the body and diaphragm are constructed of type 316 Stainless steel for use in corrosive environments.



The Columbia **765 Series** of High Intensity Acoustic Sensors built on the success of the **Models 938 and 939**. Like them the **Series 765** is constructed of type 316 stainless steel for use in corrosive environments. This series offers a variety of connector and mounting options, all of them when combined with the all welded construction provide a true hermetic seal. Electrically, these devices comprise sensing elements of piezoceramic material in a balanced and floating



configuration to provide enhanced rejection of electrical noise associated with many industrial environments.



Columbia's line of Dynamic Pressure Sensors can also serve as Acoustic Sensors (Microphones). They are designed to measure Pressure variations, surges and dynamic blasts. The **Models 100-P and P-200** have been industry standards for years. Their low cost, small size and lightweight make them excellent choices for a wide range of applications. The **Models P-742 and P-766** are High Pressure (to 10,000psi) units, with all-welded construction for extreme ruggedness.



The **Models 954M and 957M** are Integrated Dynamic Pressure Gages designed to measure dynamic pressure events, such as explosive blast and high level pressure pulses in frequency ranges of 1Hz to 15KHz. Machined from Series 300 Stainless Steel, with a stainless steel connector and all welded construction, these units will sustain continuous operating temperatures up to +500 degrees F.

The Columbia **Series 950** are completely self-contained pressure measuring systems. This allows direct readout and recording of pressure surges or blasts without additional signal conditioning equipment. This design has a long history in down-hole oil drilling applications and is capable of measuring small dynamic changes in pressure while withstanding high static pressure.



**For complete specifications on any of the Pressure and Acoustic Sensors on this page**  
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## FORCE BALANCE LINEAR ACCELEROMETERS



Columbia makes an extensive line of Linear Accelerometers like the low cost general purpose SA-107B, which comes in single and tri-axial configurations and can be up-graded with the addition of the Columbia patented “HP” torquer system to improve accuracy and repeatability. The Model SA-107LN is an ultra low noise high output sensor for use in seismic and low level, low frequency motion studies. Columbia’s Miniature linear

Accelerometers like the SA-120R offer small size and lightweight for sensing in extreme shock and vibration. The SA-120R Series can also be up-graded with the addition of the “HP” torquer system to be used in borehole mapping, the SA-120RHT operates to 200°C. Columbia’s High Performance and Airborne units like the SA-101HP/SA-102BHC and the SA-102MFTA have been in use on many demanding missile and airborne Applications. The SA-302MFTA is a compact tri-axial version, which like all of the models in this group offer exceptional performance and reliability in the most severe vibration and shock environments.

## FORCE BALANCE ANGULAR ACCELEROMETERS



Models SR-100RFR and SR-107RFR are high accuracy precision Angular Accelerometers designed to make use of the fluid rotor concept of sensing angular acceleration. They provide excellent bias stability and rejection of linear acceleration, and both operate from +/-15VDC power. The Models SR-200RFR and SR-207RFR operate from +24 to +32VDC Aircraft power. Columbia’s model SR-107VFR is a Variable Range Angular Accelerometer allowing the customer to change the measurement



range of the sensor to meet their requirements. The Model FR-220RNP is a Miniature Angular Accelerometer which is electrically damped for exceptional high frequency characteristics.

## INCLINOMETERS



Columbia’s **SI-701** Series of Inclinometers are electronic tilt sensors based on Force Balance Accelerometer technology. They produce high level low impedance output proportional to the sine of the tilt angle. Model **SI-701B** is a low cost general purpose sensor that can be up-graded with the addition of the Columbia “HP” torquer system (**SI-701BI**)



for greater accuracy and ruggedness. A bi-axial version of both units (**SI-702B**) is also available. The Model **SI-701BI** is designed with an output circuit made for 4-20mA data transmission systems for industrial applications. The model **SI-701FND** is a fluid dampened premium performance inclinometer designed to produce accurate tilt data in extreme shock and vibration environments. The latest addition in the line is Model **SI-701WPBI**, a waterproof (to 150 feet) inclinometer which operates from a +15 volt supply with 4-20mA output. A single power supply powers both the sensor and the 4-20mA line driver.

For complete specifications on any of the Inertial Products on this page  
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## FLIGHT QUALIFIED FOIL STRAIN SENSORS FOR FATIGUE LOAD MONITORING

Columbia's self-temperature compensating Foil Strain Sensors measure the fatigue loading experienced by aircraft under various conditions of speed, weight and mission configurations. They do this more accurately than the older, less accurate counting accelerometer methods. These sensors allow critical undercarriage structures and control surfaces to be more accurately monitored for potential fatigue damage induced by extended number of flight hours, high-g maneuvers and the extreme stress of carrier landings. The unique construction and small size of these sensors permits easy application with a new higher level of accuracy and mechanical integrity. Different models are available to be compatible with all metallic and composite structures commonly used in aircraft structural fabrication. The simplicity and reliability of these sensors also make them suitable for routine use in the laboratory.



The two most popular series of these sensors are the DTD-2684 and the DT-3625. Series DTD2684 have been the flight qualified industry standard since its introduction in the early 90s and measures 0.56" square by 0.15" thick. In response to a need for a smaller unit for confined areas the Series DT3625 was introduced, measuring 0.45" L x .025"W x 0.14" Thick.

Our Series DT3747 was designed to accurately measure strain on curved mounting surfaces. Similar devices have been utilized to monitor rocket motor expansion. They can also be used in many industrial and military applications involving pipe expansion measurements, explosive body application, aircraft surface load, and engine monitoring of all types.

Also available is Columbia's DT-3617 Strain Sensor which is designed for measurement of planer shear strain forces when the axes of the principal strain are identified. The sensor consists of two, 1000 ohm precision strain gage grids orthogonally on a one mil polyimide substrate and a matching pair of 1000 ohm bridge completion elements.

Columbia's newest Strain Sensors are the Series DT-3715 and DT-3716, these sensors offer all the accuracy, ruggedness and ease of installation of the flight qualified Series DTD-2684 sensors and incorporates a DIN standard 1000 ohm platinum RTD which provides accurate temperature measurements at the exact point of sensor mounting. The Series DT-3716 is for straight mounting surfaces while the Series DT-3715 is customized to measure circumferential strain around the diameter of the surface to which it is mounted.

Columbia now offers the Model 5804 Military-Grade Strain Gage Amplifier, designed to amplify signals from Columbia's DT and DTD Series Full-Bridge Strain Sensors. The system will provide both strain and temperature outputs. The strain output incorporates a microprocessor driven auto zeroing circuit capable of compensating for input offsets of up to +/- 3000 $\mu\epsilon$  equivalent and will automatically drive the output to 0.00 VDC in the presence of input offset equivalent strains within that range. This feature allows the operator to correct for any strain offsets resulting from gage mounting, material fatigue or deformation.



**For complete specifications on any of the Strain Sensors on this page**

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## LINEAR VARIABLE DIFFERENTIAL TRANSFORMERS (L.V.D.T.'s)

Differential transformers are wound coils, electromagnetic devices which are used to translate the linear movement of a ferromagnetic armature into AC voltage which is linearly proportional to the armature position. L.V.D.T.'s are constructed with primary and secondary coils wound on an air core and contained within a protective metal tube, a separate, movable armature controls the electrical coupling between them. The amplitude of the resultant output voltage is proportional to the armature position, while the phase sense of the voltage indicates direction of movement from a reference zero position.

Columbia's L.V.D.T.'s are designed for the most demanding high temperature military and industrial applications where maximum life under adverse conditions is required. The corrosion resistant stainless steel housing provides effective shielding to contain the magnetic flux within the transformer, as well as providing protection against external magnetic fields. Conservative design permits the use of these transducers well beyond their specific linear range with minimum loss of accuracy.



The Columbia **"M" Series** features small size (0.375" Dia.) and a low mass movable core, permitting use in small high speed mechanisms. Ranges available for **"M" Series** are +/-0.005" to +/- 0.150". The **"S" Series** is excellent for high temperature (+500°F) military and industrial applications. Ranges available for **"S" Series** are +/- 0.04" to +/- 0.300". The **"H" Series** feature an exceptionally high stroke to length ratio. It is used extensively in position sensing and displacement measurements on large valves and remotely operated process controls. The **"H" Series** is available in ranges +/- 1.0" to +/- 3.0".



The Columbia **Series LMT-50** Linear Motion Tandem Transducer is a rugged package consisting of tandem L.V.D.T.'s with probe assembly. Designed primarily for use in aircraft and missile control systems where redundant systems are required. The **Series LMT-50** offers flight proven performance in the most severe environments.

The **DDCP Series** of Displacement Transducers are complete self-contained displacement measurement systems. They combine the reliable linear differential transformer with a miniature solid state exciter-demodulator to provide a compact measurement system. They operate from a low voltage DC power supply or battery and provide low impedance output directly proportional to the linear movement of the spring loaded shaft assembly relative to the transducer body.



**For complete specifications on any of the L.V.D.T.'s on this page  
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## CONSTANT CURRENT POWER SUPPLIES



Columbia offers an extensive line of power supplies / amplifiers specifically designed to be used with Constant Current Mode Transducers. The Model 5421 is a single channel power supply that provides a convenient unity gain interface between a Columbia 8000 Series Accelerometer and a variety of display or analyzing type instruments. The BNC output jack provides a convenient and universally available interconnection system for displaying or recording the signals from the accelerometer. Model 5421 is also used with

Columbia's Model 5810 Inline Charge Converter. Requirements for model 5421 include a supplied source of DC voltage between +12 and +32 Volts. The 4.0 milliamp current source permits the use of output cables up to 500 feet long.

A four channel constant current power supply is available in Columbia's model 5425 which was specifically designed for use with Constant Current Mode Transducers and electronics.

## IN-LINE CHARGE CONVERTERS



Columbia's Series of In-Line Charge Converters are specifically designed to convert the charge signals from a high impedance piezoelectric sensor into a voltage signal output with low output impedance, eliminating the need

for costly charge amplifiers in many applications. These devices can be used with all Columbia non-integrated piezoelectric accelerometers and pressure sensors. The series 5810 is a single channel device and requires a constant current power source as provided by Columbia model 5421. The series 5812 is a three channel device with three individual 4mA current sources powered from a common external standard DC power



supply. Power is applied through two binding posts. Both the 5810 and 5812 series are available in three fixed gain factory setting of either, 0.1, 1.0 and 10.0 mV/pC.

## CONSTANT CURRENT POWER SUPPLY/SIGNAL CONDITIONER



The Columbia model 5648-X Single Channel Power Supply/Signal Conditioner provides a ruggedized utility gain interface between Columbia's 8000 or 900 Series Sensors or any competitors Acceleration, Pressure or Acoustic Sensors with built in constant current powered electronics. The 5648-X provides a precision 4.0mA constant current to the signal conditioning circuitry with the selected sensor. It also provides a 2 pole 12dB/Octave low pass filter and low impedance

AC coupled signal output stage capable of driving up to 2000pF cable capacity. A second signal output is provided that is biased at +2.50VDC. The 5648-X eliminates the need for a complex and costly current power supply and charge amplifier.

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## CHARGE AMPLIFIER



The model 4601 is a low cost, high performance instrument for general purpose use with piezoelectric transducers to measure acceleration, force and dynamic pressure.

The model 4601 features wide bandwidth, low noise, low output offset and gain control calibrated directly in transducer sensitivity for easy setup.

Gain ranges are 1, 3, 10, 30, 100 and 300 g full scale with transducer sensitivity of 10-100 pcmb per g and 10, 30, 100, 300, 1000 and 3000 g with transducer sensitivity of 1-10 pcmb per g. Frequency response is from 2Hz to 20KHz, +/- 5%.

## AIRBORNE AND MINIATURE CHARGE AMPLIFIERS

Columbia's line of Airborne and Miniature Charge Amplifiers are designed for use with virtually all piezoelectric transducers to form various airborne vibration and shock data acquisition systems. They feature small package size and extremely low power consumption. Model 5624 provides both Acceleration and Velocity outputs from

an individual signal conditioning amplifier. Series 5820 provide dual signal outputs, one biased around +2.5VDC and one unbiased capacitance coupled, and are available in seven standard charge



conversion ranges, each offering a 10:1 tandem gain adjustment capability.

Columbia's model 5840 is a Differential Charge Amplifier that has been specifically designed to operate with differential output piezoelectric vibration sensors typically used in aircraft engine condition monitoring systems. This model also features a small size, low power consumption and provides both Acceleration and Velocity outputs from an individual signal conditioning amplifier.

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## HAND HELD VIBRATION METER



Columbia introduces the Model VM-300 hand held vibration meter, a general purpose vibration measuring instrument for the periodic routine checks of industrial machinery and general field use where portability and ease of use are required.

Model VM-300 operates from a rugged precision piezoelectric accelerometer and incorporates a charge amplifier input stage for stability and minimizing errors. Operation is controlled by an internal integrated micro-controller, acting under direction of splash resistant 7-key membrane keypad.

The sensor probe contains Columbia's piezoelectric accelerometer which outputs an electric charge proportional to the instantaneous value of the applied acceleration. This charge signal is communicated to the VM-300 instrument through a low-noise coaxial cable.

## FIBER OPTIC PRESSURE SEALS

The Columbia Series of Fiber Optic Pressure Seals are primarily designed to provide a safe, convenient, reliable method of exiting fiber optic data lines thru a structure while preserving the integrity of either a pressure or vacuum environment. The optical fibers are permanently sealed with no leakage permitted anywhere in the assembly including the optical connectors. They are available in a wide variety of standard and custom configurations. The pressure seal housing is available in brass or 316 stainless steel which

simply thread into your structure via a common N.P.T. thread or via a hole with our o-ring face seal configuration. Columbia's pressure seals can be configured with, from 1-25 fibers per single housing, utilizing step index fibers ranging in diameters from 50 to 400 microns. You may specify a variety of optical connectors, ranging from un-terminated to standard epoxy polished FSMA type. Our customers may specify fiber lengths on either side of the pressure seal to meet your exact requirements. The standard units are capable of operation from -10°C to +80°C with wider temperature ranges available.



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Other product bulletins available from:



Bulletin 100: "Piezoelectric Products Division,  
Pressure Transducers and Acoustic Sensors"

Bulletin 103: "Inertial Products"

Bulletin 106: "Foil Strain Sensors"

Bulletin 107: "L.V.D.T.'s"

Bulletin 108: "Short Form Catalog"

Request these informational bulletins from your local Representative or directly from Columbia.  
Visit Columbia on the web: [www.crlsensors.com](http://www.crlsensors.com)

## SHORT FORM CATALOG

Specifications definitions are consistent with accepted industry standards.

All Columbia Accelerometers are supplied with standard Columbia Test and Calibration Data. Other test data can be supplied at additional cost.

Continued product improvements necessitate that specifications are subject to change without notice. Please consult our website for the latest specifications.



ISO 9001:2000 with Design & AS 9100

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