

# EXTREME ENVIRONMENTS

## TEST & MEASUREMENT SENSOR CATALOG

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Accelerometers  
Pressure transducers  
Signal conditioners  
Inertial sensors  
Cable assemblies  
Supporting instrumentation  
Calibration equipment



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# Product technology



## Variable capacitance accelerometers

Variable capacitance (VC) accelerometers are DC-response sensors for measuring low frequency vibration, motion (constant acceleration) and tilt. With gas damping and internal over-range stops, Endevco VC accelerometers are capable of measuring whole body motion immediately after being subjected to a shock motion, even in the presence of severe vibrational inputs and variable temperatures.



## Piezoresistive accelerometers

Piezoresistive (PR) accelerometers are ideal for measuring impacts and shock events. Typical applications include automotive crash testing, commercial drop testing and high g weapons testing. These highly specialized MEMS sensing elements are micro-machined at the facility in Sunnyvale, California. Some units are damped to prevent ringing, while others are undamped to provide high bandwidth. Multiple package configurations support the mounting requirements of a variety of applications.



## Inertial sensors

Angular rate sensors measure relative rotational motion directly and provide an output in degrees per second. This measurement of angular velocity offers great improvement over the previous method of using three accelerometers and doing complex calculations. Multiple ranges are provided to enable measurement of slow or fast moving events.



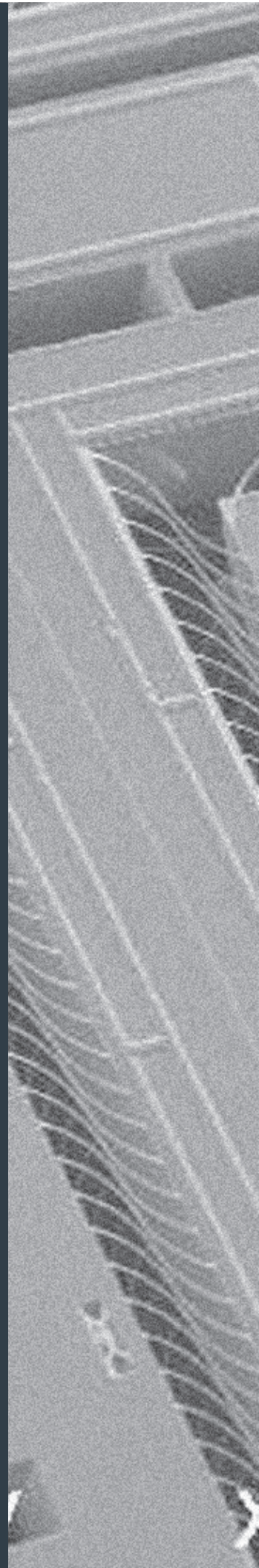
## Piezoresistive pressure sensors

Miniature piezoresistive pressure sensors measure both dynamic and static pressure in process control applications, blast testing, automotive airbag testing, rocket motor analysis, jet engine inlet pressure measurements, transmission testing and hydraulics measurements. A four-arm strain gage bridge MEMS sensing element, implanted into a sculpted diaphragm, offers wideband frequency response with exceptional sensitivity for improved resolution, high resonance frequency, exceptional linearity and hysteresis performance.

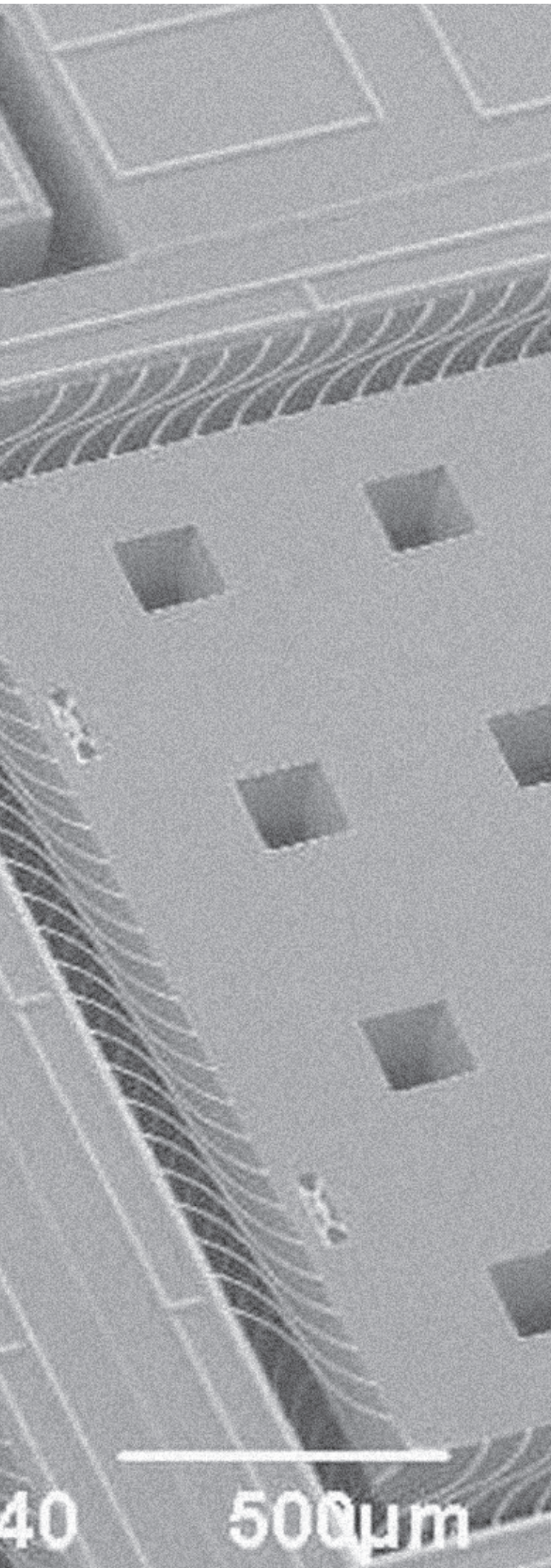


## Signal conditioners and supportive instrumentation

Endevco offers a comprehensive family of high-performance electronics, ranging from simple battery operated signal conditioners to computer-controlled laboratory quality instrumentation. They are compatible with Endevco's own IEPE, PE, VC and PR accelerometers and pressure sensors, as well as those commonly available in industry.







### **Piezoelectric accelerometers**

Piezoelectric (PE) accelerometers are charge-mode accelerometers that require the use of an external charge amplifier. This allows for long term, reliable operation over wide temperature and amplitude ranges. These accelerometers are ideal for use in extreme environment conditions, from cryogenic to extreme-high temperatures and in radiation environments. They are offered in a wide variety of sizes and configurations.



### **IEPE accelerometers**

Integrated Electronics Piezo-Electric (IEPE) accelerometers feature an integral electronic charge converter. Integrated electronics eliminate the need for in-line amplifiers and specialty cable.



### **High intensity microphones**

Piezoelectric microphones measure high-intensity acoustic noise parameters and very low pressure fluctuations. Hermetically sealed units operate over a wide temperature range and are insensitive to altitude changes and ambient vibration.



### **Cable assemblies**

For optimal performance, Endevco relies upon in-house expertise to design and manufacture its own cables and connectors. Off-the-shelf and custom assemblies include low-noise treated, high-temperature and multi-conductor options.

# There is more than one type of accelerometer!

Endevco designs and manufactures a variety of accelerometers for measurements of vibration, shock and inertial motion. To meet various testing requirements, several types of accelerometer technologies are available each differing in terms of their recommended usage, performance specifications, power requirements and signal conditioning characteristics. The following is a general overview of accelerometer technology types and their application considerations.

### Piezoelectric (PE) accelerometers

All mechanical accelerometer designs are based on a simple spring-mass principle in which strain is generated in relation to amplitude and frequency of the dynamic motion. In a PiezoElectric (PE) accelerometer, this strain is applied directly to the PE element, which develops an electrical charge proportional to mechanical motion. Different material and configurations of PE accelerometer elements are used to support specific applications.

#### Advantages of PE sensors

- The dynamic range of PE accelerometers can be greater than 130dB. When used with a proper charge converter/amplifier, it offers unmatched performance in terms of total measurement range and reliability. Transduction efficiency may also be optimized with PE crystals to allow for the miniaturization of accelerometer within a given physical envelope.
- Single-ended compression type is optimum for low level measurements because of the high sensitivity that can be achieved by stacking multiple PE crystals and connecting them in parallel.
- A shear mode design allows for the construction of miniature, lightweight sensors suitable for monitoring of small components and test articles. A key advantage of the shear design is the isolation of the sensing element from the base, which provides excellent protection from base strain and temperature transients.

- Due to the broad temperature range of most piezoelectric materials, PE accelerometers are often specified for extreme high or low temperature applications, from cryogenic conditions in rocket engines to the extreme heat environment of a turbine generator.
- PE accelerometers are available in a wide range of shapes and sizes, from micro-miniature in electronics component testing to larger sizes used in seismic or engine applications.

### Piezoresistive (PR) accelerometers

Strain gauge accelerometer designs based on a Wheatstone bridge arrangement consist of a rugged monolithic assembly with solid-state MEMS resistors that change in resistance in proportion to applied mechanical strain.

#### Advantages of PR sensors

- PR accelerometers feature DC response which makes it useful for measuring long duration pulses. Its acceleration outputs can therefore be integrated to yield velocity and displacement accurately.
- Monolithic MEMS sensors exhibit high sensitivity with an excellent signal-to-noise ratio and outstanding stability.
- The simplicity and miniature size of MEMS PR element lend itself to broad bandwidth (>100,000Hz) and wide dynamic range (>100,000g) designs.



## Integrated electronics piezoelectric (IEPE) accelerometers

The acronym IEPE refers to a type of piezoelectric (PE) accelerometer with internal electronics (IE) that allows it to convert charge to a low-impedance voltage output. Its temperature response is somewhat limited due to its onboard electronics. This type of accelerometer is primarily specified for applications in which environmental conditions permit its use, including HALT/HASS/ESS testing, industrial vibration monitoring and general purpose vibration and shock testing.

Since both PE and IEPE types are AC-coupled designs, the acceleration output of these accelerometers cannot be used to yield correct velocity and displacement information by numerical integration.

### Advantages of IEPE sensors

- Less operator attention, training and installation expertise required.
- Uses standard coaxial cable.
- Drives long cables without noise increase or loss of resolution.
- Operates directly into many data collectors with built-in constant current input.

## Variable capacitance (VC) accelerometers

Feature a silicon MEMS capacitive sensing element that is anodically bonded to a lid and base to form a parallel plate, differential capacitor pair. The accelerometers feature DC response, gas damping for good frequency coverage and rugged construction. Integral electronics with DC excitation provide a high-level, low-impedance output signal that is stable.

### Advantages of VC sensors

- Designed for low-g measurement, yet can also withstand very high g shocks.
- Suitable for trajectory monitoring, modal analysis, flutter testing, vehicle dynamics measurements for automotive suspensions and ride quality.



# Accelerometer performance characteristics

To obtain meaningful acceleration data, one must fully understand the performance characteristics of the accelerometers under consideration.

## Parameters include:



### Sensitivity

Higher sensitivity typically results in a higher signal-to-noise ratio. Interfering electrostatic and electromagnetic noise will be less bothersome with a higher-sensitivity device. Higher sensitivity, however, may bring two disadvantages: greater accelerometer mass and a lower resonance frequency.



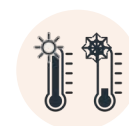
### Low-frequency response

With a PE accelerometer, the low-end response can only be assessed together with the charge converter as a system. With IEPE sensors, the charge converter is built into the sensor, which has a preset low frequency cutoff. The cutoff in a typical charge converter is often set at 1 to 5 Hz to reject any pyroelectric output. PR and VC accelerometers offer DC response and have no roll-off characteristics at low frequency.



### Temperature sensitivity

Accelerometer sensitivity varies with temperature. Many models are optimized for stable sensitivity over a wide temperature range. Typically, the higher the temperature, the higher the degree of measurement error potential, unless compensated. Temperature sensitivity compensation may be passive (capacitors and resistors) or active (ASIC), both have advantages and disadvantages in their executions.



### Transient temperature effects

Compression mode PE and IEPE accelerometers can produce an output with rapid temperature changes, also known as pyroelectric output. This problem has been virtually eliminated with the advent of shear mode accelerometers (most Endevco accelerometers are shear mode types). Thermal transient response errors tend to manifest themselves as low frequency signals and often go undetected. PR and VC devices have no significant response to rapid temperature changes.





### High-frequency response

This is a function of both mechanical characteristics and the method used to attach the device. Most accelerometers exhibit an undamped single degree-of-freedom response when securely mounted. Response is relatively flat, to about 20% of the mounted resonant frequency. Correction factors can be derived for data obtained at higher frequencies. Electronic filtering can increase flat response to 50% of the mounted resonant frequency.



### Transverse sensitivity

Also known as crosstalk. The sensor must not produce any significant response when motion is applied in the lateral axes. Sensitivity to lateral motion can be held to less than 5% of normal sensitivity on an Endevco device.



### Amplitude linearity

PE accelerometers have a predictable nonlinearity that can be expressed as a percentage increase in sensitivity as acceleration increases, such as 1% per 500 g. The upper limit can be determined and expressed for each model. With most Endevco PE and PR models, the output of the device can still be usable at two to three times its rated full scale range if the higher non-linearity is acceptable to the application.



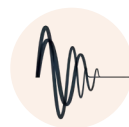
### Strain effects

The test item may flex, stretch, or bend at the point where an accelerometer is mounted, causing it to produce an erroneous output due to the deformation. The situation may be improved by using mounting adapters but at the expense of reduced transmissibility. Shear type PE/IEPE accelerometers are much less sensitive to such errors than conventional compression types. The output of PR and VC types are less susceptible to strain effect in general.



### Mass loading

Frequency response of the unit under test can be appreciably changed if the dynamic mass of the accelerometer approaches the dynamic mass of the test article. Consequently, it is recommended to use an accelerometer which weighs no more than 10% of the unit under test.



### Damping

Most commonly used accelerometers are undamped which may be excited into resonance in applications where it is exposed to mechanical impact. When an accelerometer resonates, it runs a risk of amplifier overload, offset error, or even damage to the device. A more suitable approach incorporates damping such that high frequency content above the passband of interest is directly mitigated. Certain PR and VC sensor use gas or fluid damping built into the sensing element design to control resonance.

## APPLICATION

# Automotive design & test

Endevco has sensors for all your automotive development applications. Our IEPE accelerometers are best for vehicle dynamic testing of engines, exhaust systems, and other components due to their miniature packaging, high temperature performance and rugged construction. Endevco VC accelerometers feature high stability, low frequency measurement suited to suspension and ride quality testing. Our PR pressure sensors are used in the testing of automotive systems such as Anti-Lock Brake Systems (ABS), transmissions, fuel and oil due to their wide frequency response and high level of output in a miniature housing.

## Applications

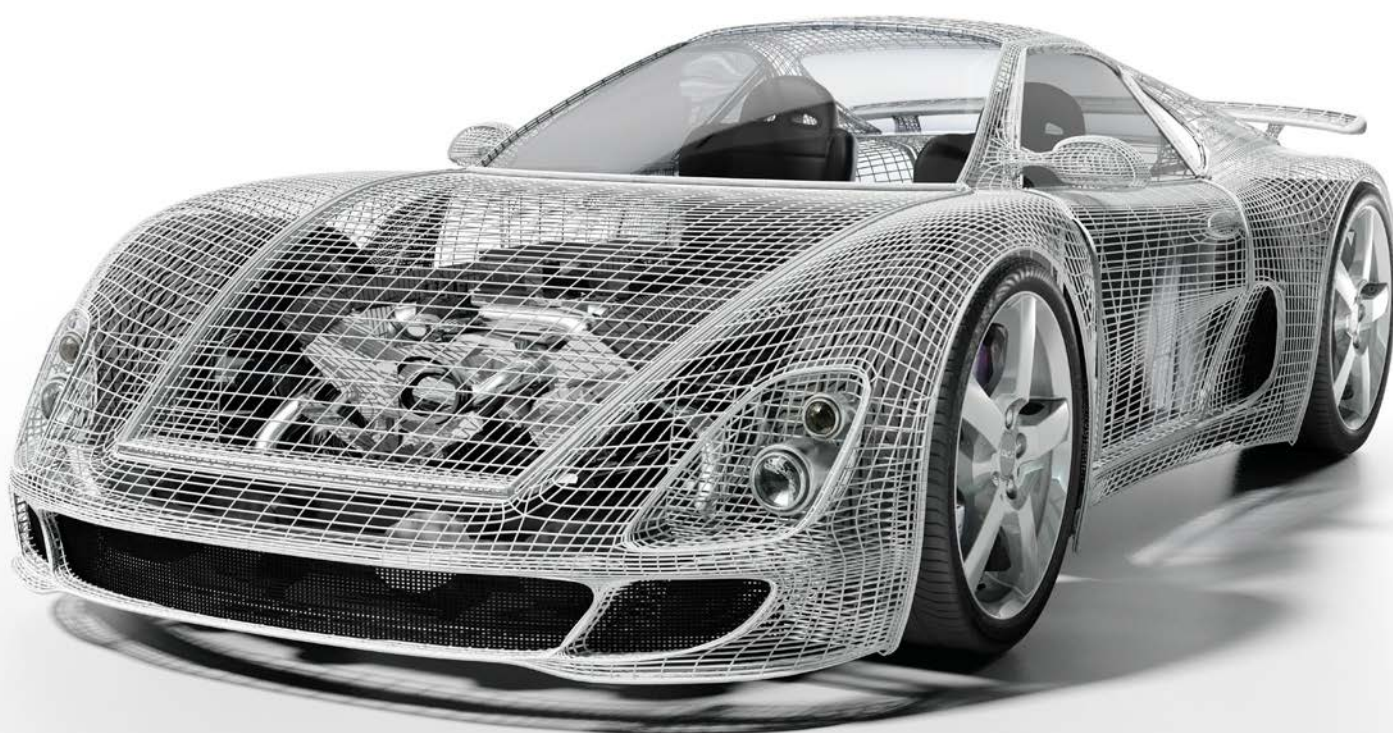
- Road load
- Powertrain
- Transmission testing
- Modal/chassis design
- Component qualification testing
- Noise, Vibration, and Harshness (NVH)

## Features

- TEDS enabled for high channel count applications
- Static and dynamic pressure measurements
- Miniature size



| Model       | Application attributes  | Find on page       |
|-------------|---|--------------------|
| 65HT        | Small high temperature triaxial accelerometer   | <a href="#">33</a> |
| 65HTLPF     | Small high temperature triaxial accelerometer. Integral low pass filter for attenuation of high-frequency, high-g signals that can obscure the required low-frequency information | <a href="#">33</a> |
| 770A - 770F | Low g DC accelerometer for suspension testing   | <a href="#">19</a> |
| 773         | Triaxial low g DC accelerometer for suspension testing  | <a href="#">19</a> |
| 7250B       | High frequency, miniature single axis accelerometer with versatile mounting configuration   | <a href="#">33</a> |
| 8510B       | Pressure sensor in high and low ranges for automotive development   | <a href="#">27</a> |



# Automotive safety testing

Since the earliest days of vehicle safety testing, Endevco has worked with OEMs, test laboratories and ATD manufacturers' design and test personnel to ensure accurate measurements of front, side and rear impact; crush zones; in-vehicle occupant and pedestrian safety. High-precision, DC responding Endevco piezoresistive accelerometers are widely specified within these applications due to their high-output, low mass designs and compact size for mounting within difficult-to-reach areas. Their survivability, miniature size and DC response measurement capabilities offer solutions for a diverse set of automobile testing requirements.

### Applications

- Anthropomorphic Test Device (ATD)
- Pedestrian safety study
- Frontal, rear and side impact
- Vehicle roll-over test
- Global regulatory compliance testing
- Vehicle crush zones and crash sleds

### Features

- SAE J211, J2570 and ISO 6487 compliant
- Standard equipment on all ATDs
- Exceptional frequency response
- Small and lightweight
- Rugged to 10,000g
- Multi-mode damping



| Model       | Application attributes  | Find on page       |
|-------------|---|--------------------|
| 701AH-701FH | Damped, rugged accelerometer for on-vehicle crash testing         | <a href="#">21</a> |
| 713-713F    | Damped triaxial accelerometer for on-vehicle crash testing        | <a href="#">20</a> |
| 726CH       | Damped accelerometer for ATD, cg meets NHTSA standard             | <a href="#">21</a> |
| 757AH-757FH | Damped, miniature accelerometer for on-vehicle crash testing      | <a href="#">21</a> |
| 758H        | Damped, rugged accelerometer for on-vehicle crash testing         | <a href="#">21</a> |
| 7264B       | Undamped accelerometer for ATD, cg between the screws             | <a href="#">21</a> |
| 7264C       | Undamped accelerometer for ATD. Meets NHTSA SA-572                | <a href="#">21</a> |
| 7264H       | Multi-mode damped accelerometer for pedestrian head form studies  | <a href="#">21</a> |
| 7268C       | Undamped triaxial accelerometer for World SID ATD                 | <a href="#">20</a> |
| 7310A       | Angular rate sensor for whiplash and rollover measurements        | <a href="#">25</a> |
| 8510B       | Pressure sensor in high and low ranges for automotive development | <a href="#">27</a> |
| 8530BM37    | Pressure sensor in high ranges for airbag and ABS                 | <a href="#">27</a> |





## APPLICATION

# Aircraft / spacecraft design & test

As the leading sensor provider for development and flight test of aircraft and spacecraft, Endevco's advanced measurement devices are proven to withstand the challenges of extreme environments. Our accelerometers, pressure sensors and electronics are trusted solutions found in hundreds of flight tests worldwide and have provided the industry performance and reliability for several decades.

### Applications

- Flutter testing
- Turbulent airflow measurements
- Rocket engine testing
- Vibroacoustic testing
- Vehicle dynamics studies
- Missile and rocket launches

### Features

- Cryogenic temperatures (-452°F, -269°C)
- Flight / space qualified electronics
- High thermal stability
- Low frequencies down to DC



| Model       | Application attributes  | Find on page       |
|-------------|---|--------------------|
| 65HT        | Small triaxial accelerometer. Hermetically sealed, high temperature IEPE (175°C, 347°F)                           | <a href="#">33</a> |
| 2262B       | Highest damping, stud mount for ship shock  | <a href="#">22</a> |
| 2510        | High temperature microphone for high intensity acoustic measurements  | <a href="#">36</a> |
| 2680MX      | Compact and lightweight charge amplifier with gain and filter options   | <a href="#">35</a> |
| 4830B       | Handheld accelerometer simulator. A highly configurable tool for verification and troubleshooting of test systems | <a href="#">44</a> |
| 7290G       | DC response accelerometer for low frequency flight and flutter measurements                                       | <a href="#">19</a> |
| 7722 / 7724 | Cryogenic accelerometer (-268°C, 452°F) with grounded or isolated designs available                               | <a href="#">30</a> |
| 8510B       | General purpose pressure in high and low ranges for aircraft development  | <a href="#">27</a> |
| 8515C       | 0.03 inch thin surface mount pressure for aerodynamic studies   | <a href="#">27</a> |



## APPLICATION

# High g shock testing

Endevco's high g accelerometers have long been the industry standard for reliable shock measurements in extreme environments. Our piezoresistive accelerometers are DC responding with minimal zero shift to avoid integration errors which is critical to the quality of your measurements. In-house MEMS capability enables compact size, high sensitivity and exceptional over-range while ensuring the repeatability and reliability required for mission critical applications. Our newest generation of gas damped accelerometers are the world's most survivable and come in multiple packages including single axis or triaxial configurations; screw, stud and surface mounting options, with our newest products fully SMT compatible.

### Applications

- Weapons and rocket testing
- High-shock data recorders
- Shock wave monitoring
- Drop and impact testing
- Portable electronic device testing
- Near- and far-field pyroshock testing
- Fuze/safe and arm
- Mechanical shock testing

### Features

- Undamped for broad frequency response or damped for exceptional survivability
- Multiple mounting configurations
- Minimal zero shift after shock
- High survivability in overrange environments
- DC response for long duration transient events
- Ranges up to 200,000 g
- Miniature SMT versions for embedded applications



| Model   | Application attributes                                     | Find on page       |
|---------|--|--------------------|
| 71M     | High bandwidth surface mount for missiles, fuzes           | <a href="#">22</a> |
| 72      | High survivability surface mount for missiles, fuzes       | <a href="#">22</a> |
| 74      | Damped triaxial, surface mount for data recorders, fuzes   | <a href="#">22</a> |
| 75      | Undamped triaxial, surface mount for data recorders, fuzes | <a href="#">22</a> |
| 7270A   | Highest bandwidth, screw mount for weapons testing         | <a href="#">23</a> |
| 7270AM4 | Highest bandwidth, stud mount for weapons testing          | <a href="#">23</a> |
| 7270AM6 | Mechanical damping for pyroshock                           | <a href="#">23</a> |
| 7270AM7 | Highest bandwidth, ruggedized for blast conditions         | <a href="#">23</a> |
| 7274A   | Undamped triaxial, screw mount for weapons testing         | <a href="#">23</a> |
| 7280A   | Highest survivability, screw mount for weapons testing     | <a href="#">23</a> |
| 7280AM4 | Highest survivability, stud mount for weapons testing      | <a href="#">23</a> |
| 7280AM7 | Highest survivability, ruggedized for pyroshock            | <a href="#">23</a> |
| 7284A   | Damped triaxial, screw mount for pyroshock                 | <a href="#">23</a> |



## APPLICATION

# Pressure testing

Endevco's miniature piezoresistive pressure sensors offer accurate and reliable performance at pressure extremes. For several decades, Endevco's pressure sensors have been addressing demanding test environments for automobiles, trains, aircraft and weapons. The MEMS sensing elements are designed for extremely high output and high resonance combined with exceptional linearity and hysteresis performance. Whether your application calls for measurement of 1 psi or 20,000 psi, a light wind or an explosive blast, Endevco has a pressure sensor that will give you the data you need.

## Applications

- Hypersonic, transonic and "quiet flow" wind tunnel testing
- Blast testing
- Automotive airbag inflation testing
- Jet airflow fields and inlet pressure
- Rocket acoustics
- Turbulent airflow measurements
- Vehicle transmission testing
- Hydraulics measurements

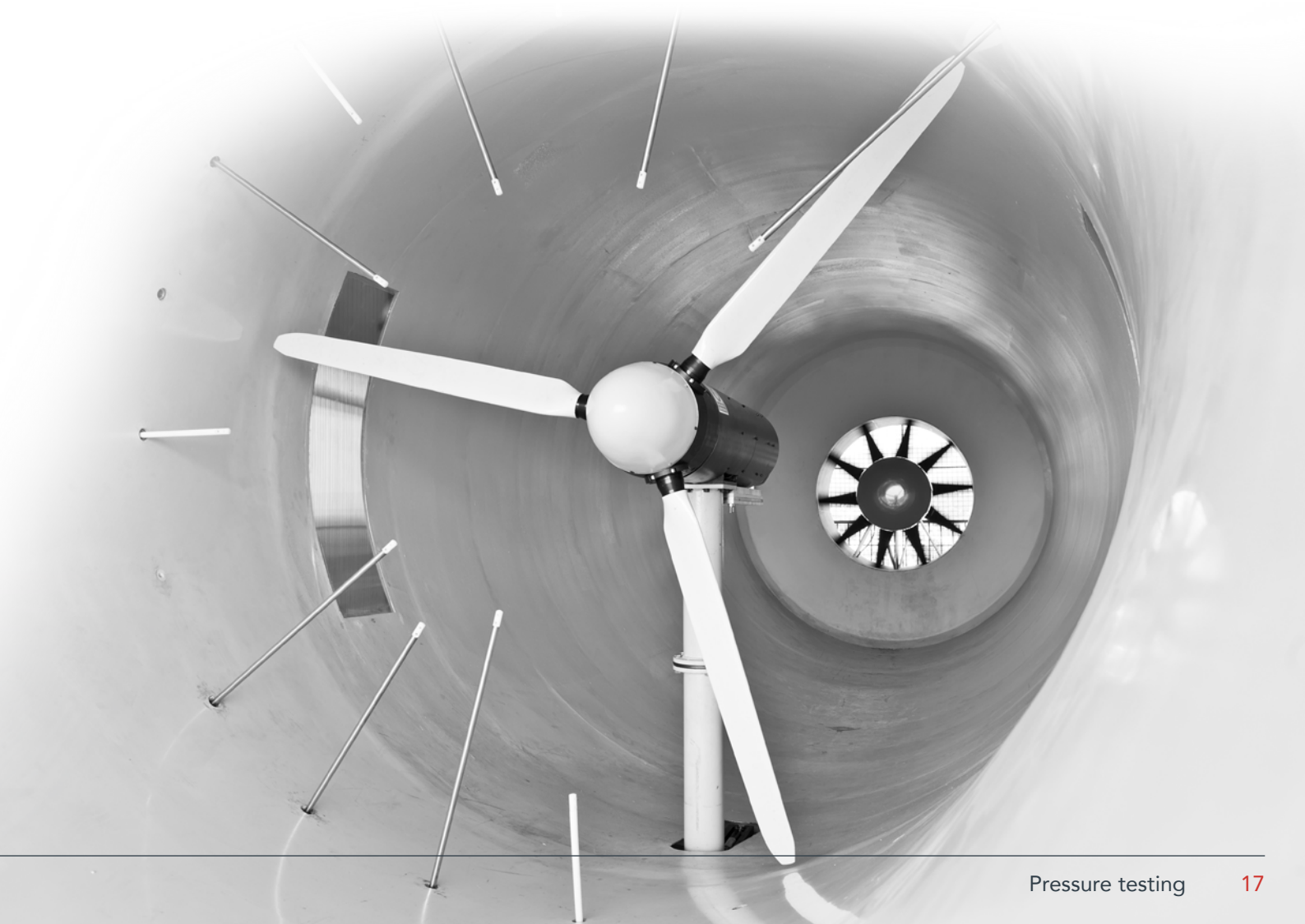
## Features

- Gage and absolute models
- High sensitivity for better signal-to-noise ratio
- High resonance frequency for fast response time
- Industry leading over-range (3x) and burst pressure
- Excellent linearity (to 3x full scale on some models)
- Insensitive to vibration
- Many special modifications available including metric threads, integral connectors, and special protections against humidity or photo-flash





| Model | Application attributes  | Find on page       |
|-------|---|--------------------|
| 8507C | 0.092 diameter for wind tunnel, scale models                      | <a href="#">27</a> |
| 8510B | General purpose in high and low ranges for automotive development | <a href="#">27</a> |
| 8510C | General purpose in mid ranges for launch vehicle                  | <a href="#">27</a> |
| 8511A | Rugged, high pressure for blast testing                           | <a href="#">27</a> |
| 8515C | 0.03 inch thin surface mount for flight testing                   | <a href="#">27</a> |
| 8530B | General purpose in high ranges for airbag and ABS                 | <a href="#">27</a> |
| 8530C | General purpose in mid ranges for rail and launch vehicle         | <a href="#">27</a> |



# Variable capacitance accelerometers

## Applications

- Aircraft flight and flutter testing
- Automotive ride quality testing
- Train ride quality testing
- Engine load cycle
- Road Load Data Acquisition (RLDA)



## Variable capacitance (VC) accelerometers

Feature a silicon MEMS capacitive sensing element that is anodically bonded to a lid and base to form a parallel plate, differential capacitor pair. The accelerometers feature DC response, gas damping for good frequency coverage and rugged construction. Integral electronics with DC excitation provide a high-level, low-impedance output signal that is stable.

### Advantages of VC sensors

- Designed for low-g measurement, yet can also withstand very high g shocks.
- Suitable for trajectory monitoring, modal analysis, flutter testing, vehicle dynamics measurements for automotive suspensions and ride quality.



| Model number                     | 770A-770F  | 771  | 773   |
|----------------------------------|--|--|---|
| Description                      | Low g DC measurement<br>Rugged Al housing<br>28 AWG cable                    | Low g DC measurement<br>Hermetic SS package<br>Military temperatures | Triaxial Low g DC<br>Rugged Al housing<br>Separate power & ground |
| Linear range g                   | $\pm 2/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$                                 | $\pm 2/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$                         | $\pm 2/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$                      |
| Sensitivity mV/g typical         | 1,000/200/66/40/20/10  | 1,000/200/66/40/20/10  | 1,000/200/66/40/20/10   |
| Frequency response $\pm 5\%$     | 0-200/0-900/0-900/0-900/<br>0-1500/0-1500                                    | 0-200/0-900/0-900/0-900/<br>0-1,500/0-1,500                          | 0-200/0-750/0-750/0-750/<br>0-1,000/0-1,000                       |
| Non linearity % FSO typical      | 0.5  | 0.5  | 0.5   |
| Shock limit g                    | 10,000   | 10,000   | 10,000  |
| Operating temperature<br>°C (°F) | -40 to +100 (-40 to +212)  | -55 to +125 (-67 to +257)  | -40 to +100 (-40 to +212)   |
| Dimensions mm (in)               | 15.24 (0.6) cube (A)<br>15.24 x 22.88 x 15.24<br>(0.600 x 0.885 x 0.600) (F) | 15.88 hex base x 24.89<br>(0.625 hex base x 0.980)                   | 22.86 x 22.86 x 19.56<br>(0.900 x 0.900 x 0.770)                  |
| Weight grams                     | 6  | 29   | 24  |
| Excitation voltage Vdc           | 7 to 36 or 5V (R option)   | 7 to 36 or 5V (R option)   | 7 to 36 or 5V (R option)  |
| Mounting method                  | Adhesive (A); 2-56 screws (F)  | Stud   | 4-40 screws   |



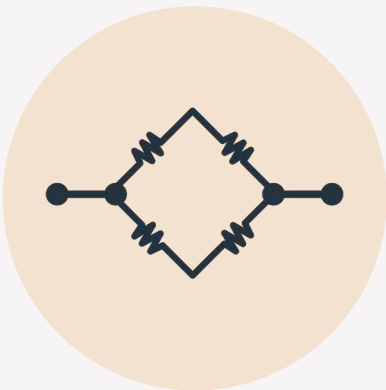
| Model number                     | 7290G  | 7290GM5   |
|----------------------------------|--|---|
| Description                      | Wide bandwidth<br>DC response<br>High stability                | DC accelerometer<br>Watertight to IP67<br>Temperature compensated |
| Linear range g                   | $\pm 2 / \pm 5 / \pm 10 / \pm 30 / \pm 50 / \pm 100 / \pm 200$ | $\pm 2 / \pm 5 / \pm 10 / \pm 30 / \pm 50 / \pm 100 / \pm 200$    |
| Sensitivity mV/g typical         | 1,000 / 400 / 200 / 66 / 40 / 20                               | 1,000 / 400 / 200 / 66 / 40 / 20                                  |
| Frequency response $\pm 5\%$     | 0-15 / 0-30 / 0-500 / 0-1000 / 0-2000 /<br>0-2,000             | 0-15 / 0-30 / 0-500 / 0-1000 / 0-2000 /<br>0-2,000                |
| Non linearity % FSO typical      | 0.2 / 1.0 (100g and 200g)                                      | 0.2 / 1.0 (100g and 200g)   |
| Shock limit g                    | 5,000 (2g / 5g / 10g) / 10,000                                 | 5,000 (2g / 5g / 10g) / 10,000                                    |
| Operating temperature<br>°C (°F) | -55 to +125 (-67 to +257)                                      | -55 to +125 (-67 to +257)   |
| Dimensions mm (in)               | 25.4 x 21.6 x 7.6<br>(1.00 x 0.85 x 0.30)                      | 25.4 x 21.6 x 7.6<br>(1.00 x 0.85 x 0.30)                         |
| Weight grams                     | 10   | 10  |
| Excitation voltage Vdc           | 8 to 40  | 8 to 40   |
| Mounting method                  | 4-40 screws  | 4-40 screws   |

# Piezoresistive accelerometers

Piezoresistive  
accelerometers

### Applications

- Vehicle crush zones, crash sleds and rollover
- Anthropomorphic Test Devices (ATD)
- Pedestrian safety
- Weapons and rocket testing
- High-shock data recorders
- Drop and impact testing
- Fuze/safe and arm



### Piezoresistive (PR) accelerometers

Strain gauge accelerometer designs based on a Wheatstone bridge arrangement consist of a rugged monolithic assembly with solid-state MEMS resistors that change in resistance in proportion to applied mechanical strain.

### Advantages of PR sensors

- PR accelerometers feature DC response which makes it useful for measuring long duration pulses. Its acceleration outputs can therefore be integrated to yield velocity and displacement accurately.
- Monolithic MEMS sensors exhibit high sensitivity with an excellent signal-to-noise ratio and outstanding stability.
- The simplicity and miniature size of MEMS PR element lend itself to broad bandwidth (>100,000Hz) and wide dynamic range (>100,000g) designs.



| Model number                  | 713 - 713F   | 7268C   |
|-------------------------------|--|---|
| Description                   | Triaxial<br>Multi-mode damping<br>High sensitivity | Triaxial<br>Undamped<br>World SID ATD         |
| Linear range g                | ±2,000   | ±500 / ±2,000                                 |
| Sensitivity mV/g typical      | 0.30   | 0.80 / 0.20                                   |
| Frequency response ±5%, Hz    | 0 to 1500  | 0-3,000 (Z) / 0-1500 (X&Y)                    |
| Shock limit g                 | 10,000   | 5,000 / 10,000                                |
| Operating temperature °C (°F) | -40 to +100 [-40 to +212]                          | -18 to +66 [0 to +150]                        |
| Dimensions mm (in)            | 16.0 x 16.0 x 10.29 [0.4630 x 0.630 x 0.405]       | 12.70 x 14.73 x 10.67 [0.500 x 0.580 x 0.420] |
| Weight grams                  | 7.5  | 8   |
| Mounting method               | Adhesive or 2-56 screws                            | M2 screw                                      |



| Model number                  | 701AH-701FH   | 726CH  | 757AH-757FH   | 758H   |
|-------------------------------|---|--|---|--|
| Description                   | Rugged Al housing<br>Damped for survivability<br>28 AWG cable               | SAE J211/J2570 Compliant<br>Multi-mode damping<br>Broad frequency response | Small and lightweight<br>Damped for survivability<br>Flexible cable                                 | Rugged<br>Mounting flexibility<br>28 AWG cable |
| Linear range g                | ±1,000  | ±2,000   | ±2,000  | ±2000  |
| Sensitivity mV/g typical      | 0.3   | 0.3  | 0.3   | 0.3  |
| Frequency response ±5%, Hz    | 0-4,000   | 0-5,000  | 0-3,000   | 0-4000   |
| Shock limit g                 | 10,000  | 10,000   | 10,000  | 10,000   |
| Operating temperature °C (°F) | -40 to +100 (-40 to +212)   | -40 to +100 (-40 to +212)  | -40 to +100 (-40 to +212)   | -40 to +100 (-40 to +212)                      |
| Dimensions mm (in)            | 8.90 [0.350] cube (A)<br>8.90 x 15.88 x 9.65<br>[0.350 x 0.625 x 0.380] (F) | 10.16 x 10.16 x 5.13<br>[0.400 x 0.400 x 0.202]                            | 9.7 x 4.8 x 3.3<br>[0.380 x 0.190 x 0.130] (A)<br>11.18 x 10.2 x 3.8<br>[0.440 x 0.400 x 0.150] (F) | 13.97 x 6.35 x 6.35<br>[0.550 x 0.250 x 0.250] |
| Weight grams                  | 1.4 (A); 1.7 (F)  | 1.8  | 0.5 (A); 1 (F)  | 2  |
| Mounting method               | Adhesive (A); 2-56 screws (F)   | 0-80 screws  | Adhesive (A); 0-80 screws (F)   | Adhesive                                       |



| Model number                  | 7264B  | 7264C   | 7264D  | 7264H   |
|-------------------------------|--|---|--|---|
| Description                   | Crash test<br>Undamped<br>Meets SAE J211 / J2570 | Industry standard<br>Undamped<br>Meets SAE J211 / J2570 | High resonance<br>Undamped<br>Meets SAE J211 / J2570 | Extremely rugged<br>Multi-mode damping<br>Pedestrian safety testing |
| Linear range g                | ±500/±2,000                                      | ±500/±2,000   | ±2,000   | ±2,000  |
| Sensitivity mV/g typical      | 0.80/0.20  | 0.80/0.20   | 0.20   | 0.20  |
| Frequency response ±5%, Hz    | 0-3,000/0-5,000                                  | 0-3,000/0-5,000   | 0-6,000  | 0-6,000   |
| Shock limit g                 | 5,000 / 10,000                                   | 5,000 / 10,000  | 10,000   | 10,000  |
| Operating temperature °C (°F) | -40 to +93 (-40 to +200)                         | -18 to +66 [0 to +150]                                  | -18 to +66 [0 to +150]                               | -18 to +66 [0 to +150]  |
| Dimensions mm (in)            | 12.2 x 10.2 x 4.7<br>[0.48 x 0.4 x 0.185]        | 10.16 x 10.16 x 5.13<br>[0.400 x 0.400 x 0.202]         | 10.16 x 10.16 x 5.08<br>[0.400 x 0.400 x 0.200]      | 10.16 x 10.16 x 5.13<br>[0.400 x 0.400 x 0.202]                     |
| Weight grams                  | 1  | 1.4   | 1.4  | 1.4   |
| Mounting method               | 0-80 screws                                      | 0-80 screws   | 0-80 screws  | 0-80 screws   |



## Piezoresistive accelerometers

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| Model number                  | 727   | 728  | 2262B  |
|-------------------------------|---|--|--|
| Description                   | Lightweight<br>Broad frequency response<br>Drop testing | Small and lightweight<br>Broad bandwidth<br>Adhesive mount | High Sensitivity<br>Multi-mode damping<br>Rugged to 10000 g shocks |
| Linear range g                | ±2,000 / ±6,000 / ±20,000 / ±60,000                     | ±2,000 / ±10,000   | ±1,000 / ±2,000 / ±6,000   |
| Sensitivity mV/g typical      | 10 / 3 / 1 / 0.3 uV/V/g                                 | 0.20 / 0.016   | 0.45 / 0.3 / 0.015   |
| Frequency response ±5%, Hz    | 0-10,000 / 0-20,000 / 0-50,000 / 0-100,000              | 0 to 8,000 ±1dB  | 0 to 3,000   |
| Shock limit g                 | 3,000 / 9,000 / 30,000 / 90,000                         | 10,000 / 30,000  | 10,000   |
| Operating temperature °C (°F) | 0 to +70 (+32 to +158)                                  | 0 to +70 (-32 to +158)                                     | -67 to 257 °F<br>-55 to 125 °C                                     |
| Dimensions mm (in)            | 7.11 (0.28) 0.3 diameter                                | 10.67 x 6.1 x 3.3<br>(0.420 x 0.240 x 0.130)               | 0.935 x 0.625 x 0.79<br>23.68 x 15.88 x 20.1                       |
| Weight grams                  | 0.3   | 0.5  | 22   |
| Mounting method               | Adhesive  | Adhesive   | 10-32 detachable stud  |

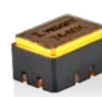
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| Model number                  | 71M                                   | 72   | 74                                      | 75  |
|-------------------------------|---------------------------------------|--|---|---|
| Description                   | Surface mount<br>Undamped<br>Low mass | Lightly damped<br>Rugged<br>ESD protection | Triaxial<br>Damped<br>Surface mount LCC | Triaxial<br>Undamped<br>Surface mount LCC |
| Linear range g                | ±2,000 / ±6,000 / ±20,000 / ±60,000   | ±2,000 / ±20,000 / ±60,000                 | ±2,000 / ±20,000 / ±60,000              | ±2,000 / ±6,000 / ±20,000 / ±60,000       |
| Shock limit g                 | 10,000 / 18,000 / 60,000 / 120,000    | 10,000 / 80,000 / 240,000                  | 10,000 / 60,000 / 180,000               | 10,000 / 18,000 / 60,000 / 80,000         |
| Operating temperature °C (°F) | -54 to +66 (-65 to +150)              | -54 to +71 (-65 to +160)                   | -55 to +121 (-67 to +250)               | -55 to +121 (-67 to +250)                 |
| Weight grams                  | 0.06                                  | 0.16                                       | 1.2                                     | 1.2                                       |
| Mounting method               | Adhesive                              | SMT or adhesive                            | SMT or adhesive                         | SMT or adhesive                           |

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| Model number                                      | 7270A   | 7270AM4   | 7270AM6   | 7270AM7   | 7274A   |
|---|---|---|---|---|---|
| Description                                       | High resonance<br>Undamped<br>Shock standard                    | High resonance<br>Undamped<br>Stud mount                        | Rugged<br>Mechanical filter<br>Stud mount         | Extremely rugged<br>Undamped<br>Low noise cable                 | Triaxial<br>Undamped<br>High resonance            |
| Linear range g                                    | $\pm 2,000 / \pm 6,000 / \pm 20,000 / \pm 60,000 / \pm 200,000$ | $\pm 2,000 / \pm 6,000 / \pm 20,000 / \pm 60,000 / \pm 200,000$ | $\pm 2,000 / \pm 6,000 / \pm 20,000 / \pm 60,000$ | $\pm 2,000 / \pm 6,000 / \pm 20,000 / \pm 60,000 / \pm 200,000$ | $\pm 2,000 / \pm 6,000 / \pm 20,000 / \pm 60,000$ |
| Sensitivity $\mu V/g$                             | 100/30/10/3/1   | 100/30/10/3/1   | 100/30/10/3                                       | 100/30/10/3/1   | 50/15/5/1.5                                       |
| Frequency response kHz $\pm 5\%$                  | 0-10k / 0-20k / 0-50k / 0-100k / 0-150k                         | 0-10k / 0-20k / 0-50k / 0-100k / 0-150k                         | 0-10,000 ( $\pm 10\%$ )                           | 0-10 / 0-20 / 0-50 / 0-100 / 0-150                              | 0-18k / 0-36k / 0-70k / 0-140k                    |
| Shock limit g                                     | 10,000 / 18,000 / 60,000 / 180,000 / 200,000                    | 10,000 / 18,000 / 60,000 / 180,000 / 200,000                    | 10,000 / 18,000 / 60,000 / 100,000                | 10,000 / 18,000 / 60,000 / 180,000 / 200,000                    | 10,000 / 18,000 / 60,000 / 180,000                |
| Operating temperature $^{\circ}C$ ( $^{\circ}F$ ) | -55 to +121 (-67 to +250)                                       | -55 to +66 (-67 to +150)  | -34 to +66 (-30 to +150)                          | -55 to +121 (-67 to +250)                                       | -55 to +66 (-67 to +150)                          |
| Dimensions mm (in)                                | 14.22 x 7.1 x 2.79<br>(0.560 x 0.280 x 0.110)                   | 7.92 (0.312)<br>Hex x 8.9 (0.350)                               | 17.15 x 14.73 x 15.78<br>(0.675 x 0.580 x 0.621)  | 14.2 x 8.9 x 4.06<br>(0.560 x 0.350 x 0.160)                    | 14.22 x 7.72 x 6.22<br>(0.56 x .304 x .245)       |
| Weight grams                                      | 1.5   | 1.5   | 8.4   | 4   | 2.9   |
| Mounting method                                   | Screw   | 1/4-28 integral stud  | 1/4-28 integral stud                              | 4-40 screws   | Screw   |

Piezoresistive  
accelerometers

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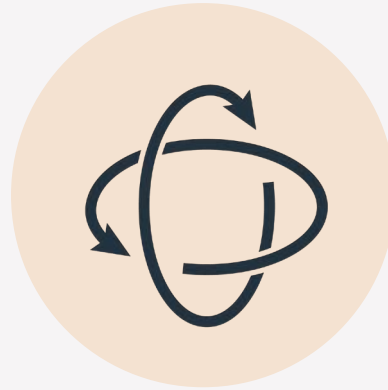


| Model number                                      | 7280A   | 7280AM4   | 7280AM7   | 7284A   |
|---|---|---|---|---|
| Description                                       | Extremely rugged<br>Lightly damped<br>Low power consumption | Extremely rugged<br>Lightly damped<br>Low power consumption | Extremely rugged<br>Lightly damped<br>Low noise cable | Triaxial<br>Lightly damped<br>Low power consumption |
| Linear range g                                    | $\pm 2,000 / \pm 20,000 / \pm 60,000$                       | $\pm 2,000 / \pm 20,000 / \pm 60,000$                       | $\pm 2,000 / \pm 20,000 / \pm 60,000$                 | $\pm 2,000 / \pm 20,000 / \pm 60,000$               |
| Sensitivity $\mu V/g$                             | 300 / 16 / 5  | 300/16/5  | 300 / 16 / 5  | 150 / 8 / 2.5                                       |
| Frequency response kHz $\pm 5\%$                  | 0-10k / 0-10k / 0-13k                                       | 0-10k / 0-10k / 0-13k                                       | 0-10k / 0-10k / 0-13k                                 | 0-10 / 0-10 / 0-20 ( $\pm 1$ dB)                    |
| Shock limit g                                     | 10,000 / 80,000 / 240,000                                   | 10,000 / 80,000 / 240,000                                   | 10,000 / 80,000 / 240,000                             | 10,000 / 60,000 / 180,000                           |
| Operating temperature $^{\circ}C$ ( $^{\circ}F$ ) | -55 to +121 (-67 to +250)                                   | -55 to +121 (-67 to +250)                                   | -55 to +121 (-67 to +250)                             | -55 to +121 (-67 to +250)                           |
| Dimensions mm (in)                                | 14.22 x 7.1 x 3.18<br>(0.560 x 0.280 x 0.125)               | 7.92 (0.312)<br>Hex x 9.1 (0.360)                           | 14.2 x 8.9 x 4.06<br>(0.560 x 0.350 x 0.160)          | 14.22 x 7.76 x 6.22<br>(0.560 x 0.304 x 0.245)      |
| Weight grams                                      | 1.4   | 2.1   | 4   | 3.6   |
| Mounting method                                   | 4-40 screws   | 1/4-28 UNF-3A stud  | 4-40 screws   | 4-40 screws   |

# Inertial sensors

## Applications

- Vehicle dynamics
- Automotive rollover
- Whiplash
- Aircraft flight testing
- Spacecraft and satellite
- Motion studies



In typical dynamic measurements, both acceleration and angular rate data are essential parameters needed to fully characterize the complex behavior of a moving object. Until recently, engineers could only conveniently gather information using linear accelerometers because the massive array of sensors required to collect rotational data was impractical due to the expense and space required. With Endevco's new angular rate and six degree of freedom (6DoF) sensors, professionals in automotive and aircraft development are now able to measure linear and rotational dynamics that previously required multiple sensors and much more space. Rather than having to make assumptions about these dynamic interactions, these analog output sensors provide reliable, empirical data to support the analytical results. What makes our sensors truly unique is that we offer the low acceleration ranges and low angular rate ranges that are most suitable for accurately characterizing motion.

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| Model number                  | 7310A   |
|-------------------------------|---|
| Description                   | Angular rate<br>2V full scale<br>Rugged   |
| Range deg/sec                 | $\pm 100 / \pm 500 / \pm 1,500 / \pm 6,000 / \pm 8,000 / \pm 12,000 / \pm 18,000$ |
| Sensitivity mV/g/sec +/-15%   | 20 / 4 / 1.333 / 0.333 / 0.25 / 0.167 / 0.111                                     |
| Frequency response Hz +1/-3dB | 0-1,000 (100 / 500) / 0-2,000   |
| Non linearity % FSO           | $\pm 0.5$   |
| Shock limit g                 | 5000  |
| Operating temperature °C (°F) | -40 to +105 (-40 to +221)   |
| Dimensions mm (in)            | 14.6 x 10.2 x 7.62 (0.580 x 0.400 x 0.300)  |
| Weight grams                  | 3   |
| Rate excitation voltage Vdc   | 5 to 16   |
| Mounting method               | 0-80 screws   |

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| Model number                            | 7360A   |
|---|---|
| Description                             | 6DoF measurement<br>Compact package with 2 cables<br>Rugged to 5000 g shocks      |
| Accelerometer ranges g                  | $\pm 2 / \pm 10 / \pm 50 / \pm 200 / \pm 500$                                     |
| Range deg/sec                           | $\pm 100 / \pm 500 / \pm 1,500 / \pm 6,000 / \pm 8,000 / \pm 12,000 / \pm 18,000$ |
| Accelerometer sensitivity mV/g typical  | 1,000 / 200 / 40 / 10 / 4   |
| Sensitivity mV/g/sec +/-15%             | 20 / 4 / 1.333 / 0.25 / 0.167 / 0.111   |
| Accelerometer frequency response +/-1dB | 0-300/0-1,500/0-1,800/0-1,800/0-1,800   |
| Frequency response Hz +1/-3dB           | 0-1,000 / 0-1,000 / 0-1,000 / 0-1,000 / 0-2,000 / 0-2,000                         |
| Non linearity % FSO                     | 0.5   |
| Shock limit g                           | 5,000   |
| Operating temperature °C (°F)           | -40 to +100 (-40 to +212)   |
| Dimensions mm (in)                      | 30.5 x 30.5 x 27.9 (1.2 x 1.2 x 1.1)  |
| Weight grams                            | 35  |
| Accelerometer excitation voltage Vdc    | 7 to 36 or 5V (M1 option)   |
| Rate excitation voltage Vdc             | 5 to 16   |
| Mounting method                         | 4-40 screws   |

# Piezoresistive pressure transducers

## Applications

- Jet airflow fields and inlet pressure
- Hypersonic, transonic and “quiet flow” wind tunnel testing
- Turbulent airflow measurements
- Blast testing
- Automotive airbag inflation testing
- Rocket motor analysis
- Vehicle transmission testing
- Hydraulics measurements



Miniature piezoresistive pressure transducers are designed to measure both dynamic and static pressure to a high degree of accuracy. MEMS sensing elements feature a unique diaphragm design manufactured at Endevco's US based MEMS facility, resulting in a range of pressure sensors with an extremely high output signal and high resonant frequency, as well as extraordinary linearity and repeatability, and virtually no hysteresis.

All models feature internal temperature compensation to provide stable performance over temperature. Absolute pressure sensors are available in ranges as low as 0–15 psia and as high as 0–2,000 psia, with gage/differential sensor models available in ranges as low as 0–1 psig and as high as 0–20,000 psig. All units are shipped in specially designed electrostatic discharge (ESD) packaging, to reduce the potentially harmful effects of static electricity on critical components, as well as to further support customer in-house ESD control procedures. Many modifications to our standard pressure transducers are available on request.



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## Gage pressure transducers

| Model number                  | 8507C   | 8510B                                    | 8510C                                       | 8511A                           |
|-------------------------------|---|--|---|---------------------------------|
| Description                   | Gage<br>High sensitivity<br>Temp compensation | Gage<br>Vent tube<br>Temp compensation   | Gage<br>High resonance<br>Temp compensation | Rugged<br>Gage<br>High pressure |
| Full scale pressure psi       | 1 / 2 / 5 / 15                                | 1 / 2 / 5 / 200 / 500 / 2,000            | 15 / 50 / 100                               | 5,000 / 10,000 / 20,000         |
| Sensitivity mV/psi            | 200 / 100 / 60 / 20                           | 200 / 100 / 60 / 1.5 /<br>0.6 / 0.15     | 15 / 4.5 / 2.25                             | 0.1 / 0.05 / 0.025              |
| Resonance frequency kHz       | 55 / 70 / 85 / 130                            | 55 / 70 / 85 / 320 / 500<br>/ 900        | 180 / 320 / 500                             | <1000                           |
| Non linearity (typ) %FSO      | 1.5 / 1.0 / 0.5 / 0.2                         | 1.0                                      | 0.15 / 0.1 / 0.1                            | 1.2 / 2.5 / 2.5                 |
| Operating temperature °C (°F) | -54 to +107 (-65 to +225)                     | -54 to +121 (-65 to +250)                | -54 to +121 (-65 to +250)                   | -54 to +121 (-65 to +250)       |
| Burst pressure psi            | 20 / 40 / 100 / 150                           | 25 / 40 / 100 / 1000 /<br>2,500 / 10,000 | 75 / 250 / 400                              | 20,000 / 30,000 / 40,000        |
| Face diameter mm (in)         | 2.34 [0.092]                                  | 3.86 [0.152]                             | 3.86 [0.152]                                | 8.13 [0.320]                    |
| Weight grams                  | 0.3   | 2.3                                      | 2.3   | 11                              |
| Mounting method               | RTV bond                                      | 10-32 UNF-2A                             | 10-32 UNF-2A                                | 3/8-24 UNF-2A                   |

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## Absolute pressure transducers

| Model number                  | 8515C                                       | 8530B   | 8530BM37  | 8530C   |
|-------------------------------|---|---|---|---|
| Description                   | Absolute<br>0.03 inch thin<br>Surface mount | Absolute<br>High resonance<br>Temp compensation | Absolute<br>Detachable cable<br>ABS braking studies | Absolute<br>High sensitivity<br>Temp compensation |
| Full scale pressure psi       | 15 / 50                                     | 200 / 500 / 1,000 / 2,000                       | 200 / 500 / 1,000 / 2,000                           | 15 / 50 / 100                                     |
| Sensitivity mV/psi            | 13.3 / 4.0                                  | 1.5 / 0.6 / 0.3 / 0.3                           | 1.5 / 0.6 / 0.3 / 0.3                               | 15 / 4.5 / 2.25                                   |
| Resonance frequency kHz       | 180 / 320                                   | 750 / 1,000 / >1,000 / >1,000                   | 750 / 1,000 / >1,000 / >1,000                       | 180 / 320 / 500                                   |
| Non linearity (typ) %FSO      | 0.2   | 0.2   | 0.2   | 0.15 / 0.1 / 0.1                                  |
| Operating temperature °C (°F) | -54 to +121 (-65 to +250)                   | -54 to +121 (-65 to +250)                       | -54 to +121 (-65 to +250)                           | -54 to +121 (-65 to +250)                         |
| Burst pressure psi            | 75 / 250                                    | 800 / 2,000 / 4,000 / 4,000                     | 800 / 2,000 / 4,000 / 4,000                         | 75 / 250 / 400                                    |
| Face diameter mm (in)         | 6.35 [0.25]                                 | 3.86 [0.152]                                    | 3.86 [0.152]  | 3.86 [0.152]                                      |
| Weight grams                  | 0.08  | 2.3   | 2.3   | 2.3   |
| Mounting method               | Adhesive                                    | 10-32 UNF-2A                                    | 10-32 UNF-2A  | 10-32 UNF-2A                                      |

# Piezoelectric accelerometers

## Applications

- Satellite
- Turbine development
- HALT & HASS testing
- Quality assurance
- Nuclear power plant monitoring
- Cryogenic testing
- Automotive engine testing

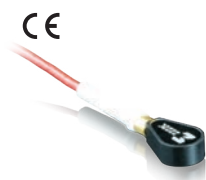


## Piezoelectric (PE) accelerometers

All mechanical accelerometer designs are based on a simple spring-mass principle in which strain is generated in relation to amplitude and frequency of the dynamic motion. In a PiezoElectric (PE) accelerometer, this strain is applied directly to the PE element, which develops an electrical charge proportional to mechanical motion. Different material and configurations of PE accelerometer elements are used to support specific applications.

### Advantages of PE sensors

- The dynamic range of PE accelerometers can be greater than 130dB. When used with a proper charge converter/amplifier, it offers unmatched performance in terms of total measurement range and reliability. Transduction efficiency may also be optimized with PE crystals to allow for the miniaturization of accelerometer within a given physical envelope.
- Single-ended compression type is optimum for low level measurements because of the high sensitivity that can be achieved by stacking multiple PE crystals and connecting them in parallel.
- A shear mode design allows for the construction of miniature, lightweight sensors suitable for monitoring of small components and test articles. A key advantage of the shear design is the isolation of the sensing element from the base, which provides excellent protection from base strain and temperature transients.
- Due to the broad temperature range of most piezoelectric materials, PE accelerometers are often specified for extreme high or low temperature applications, from cryogenic conditions in rocket engines to the extreme heat environment of turbine generators.
- PE accelerometers are available in a wide range of shapes and sizes, from micro-miniature in electronics component testing to larger sizes used in seismic or engine applications.



## Miniature

| Model number                     | 2222C  | 2226C                              |
|----------------------------------|--|------------------------------------|
| Description                      | Miniature teardrop                             | Lightweight Miniature              |
| Sensitivity pC/g typical         | 1.4  | 2.8                                |
| Sinusoidal limit g               | 1000   | 1000                               |
| Shock limit g                    | 10,000   | 2000                               |
| Frequency response $\pm 1$ dB Hz | 1–10,000                                       | 0.1–7000                           |
| Operating temperature °C (°F)    | -73 to +177 (-100 to +350)                     | -55 to +177 (-67 to +350)          |
| Signal/ground isolation          | Yes  | No                                 |
| Hermetic seal                    | No   | No                                 |
| Weight grams (without cable)     | 0.5  | 2.8                                |
| Dimensions mm (in)               | 9.53 hex x 4.8<br>( $\varnothing$ 0.25 x 0.13) | 9.53 hex x 5.8<br>(3/8 hex x 0.19) |
| Mounting method                  | Adhesive                                       | Adhesive                           |
| Cable included                   | 3090C/120                                      | 3060D/120                          |



## Precision lab testing

| Model number                     | 2224C                                | 2228C  |
|----------------------------------|--------------------------------------|--|
| Description                      | Precision lab testing                | Triaxial<br>Ground isolated                      |
| Sensitivity pC/g typical         | 12                                   | 2.8  |
| Sinusoidal limit g               | 1,000                                | 1,000  |
| Shock limit g                    | 2,000                                | 2,000  |
| Frequency response $\pm 1$ dB Hz | 0.1–10,000                           | 0.1–6,000  |
| Operating temperature °C (°F)    | -55 to +177 (-67 to +350)            | -55 to +177 (-67 to +350)                        |
| Signal/ground isolation          | No                                   | Yes  |
| Hermetic seal                    | No                                   | No   |
| Weight grams (without cable)     | 16                                   | 15   |
| Dimensions mm (in)               | 14.2 hex x 13.7<br>(9/16 hex x 0.54) | 18.72 x 18.72 x 11.68<br>(0.737 x 0.737 x 0.460) |
| Mounting method                  | Stud                                 | Screw  |
| Cable included                   | 3090C/120                            | 3060D/120 (3)                                    |

## Piezoelectric accelerometers

Cryogenic  
-269°C (-452°F)

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| Model number                     | 7722 / 7724                      | 2271A / 2271AM20                            |
|----------------------------------|----------------------------------|---|
| Description                      | Immune to thermal transients     | High sensitivity side or top exit connector |
| Sensitivity pC/g typical         | 3.7                              | 11.5  |
| Sinusoidal limit g               | 500                              | 1,000                                       |
| Shock limit g                    | 2500                             | 10,000                                      |
| Frequency response $\pm 1$ dB Hz | 1-6000                           | 1-8,000                                     |
| Operating temperature °C (°F)    | -269 to +177 [-452 to +350]      | -269 to +260 [-452 to +500]                 |
| Signal/ground isolation          | 7722 - No / 7724 - Yes           | Yes   |
| Hermetic seal                    | Yes                              | Yes   |
| Weight grams (without cable)     | 29                               | 27  |
| Dimensions mm (in)               | 16.0 hex x 23.1 [5/8 hex x 0.91] | 15.9 hex x 19.8 [5/8 hex x 0.78]            |
| Mounting method                  | Stud                             | Stud  |
| Cable included                   | 3090C/120                        | 3090C/120                                   |

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+260°C (+500°F)

| Model number                     | 2220E  | 2221F                                     | 2230E                                       | 2230EM1                                      | 6222S                                   |
|----------------------------------|--|---|---|--|---|
| Description                      | Thru-hole mount<br>360° cable orientation<br>Lightweight | Thru-hole mount<br>360° cable orientation | Triaxial<br>Adhesive mount                  | Triaxial<br>Flange mount                     | ARINC mount<br>Differential output      |
| Sensitivity pC/g typical         | 3.0  | 10  | 3   | 3  | 20 / 50 / 100                           |
| Sinusoidal limit g               | 1,000  | 1,000                                     | 1,000                                       | 1,000  | 2,000 / 1,000 / 500                     |
| Shock limit g                    | 5,000  | 3,000                                     | 2,000                                       | 2,000  | 4,000 / 2,000 / 1,000                   |
| Frequency response $\pm 1$ dB Hz | 1 to 12,000  | 0.1-12,000                                | 1-10,000                                    | 1-10,000                                     | 1-12,000 / 1-9,000 / 1-9,000            |
| Operating temperature °C (°F)    | -55 to +260 [-67 to +500]                                | -55 to +260 [-67 to +500]                 | -55 to +260 [-67 to +500]                   | -55 to +260 [-67 to +500]                    | -54 to +260 [-65 to +500]               |
| Signal/ground isolation          | Yes  | Yes                                       | No  | No   | Yes                                     |
| Hermetic seal                    | Yes  | Yes                                       | Yes   | Yes  | Yes                                     |
| Weight grams (without cable)     | 3.1  | 11  | 17  | 22.5   | 91                                      |
| Dimensions mm (in)               | Ø 9.53 x 5.8 (Ø 0.375 x 0.23)                            | Ø 15.24 x 8.9 (Ø 0.60 x 0.35)             | 17.15 x 11.68 x 15.24 (0.675 x 0.46 x 0.60) | 17.15 x 11.68 x 15.24 (0.675 x 0.460 x 0.60) | 41.4 x 30.2 x 20.3 (1.63 x 1.19 x 0.80) |
| Mounting method                  | Screw  | Screw                                     | Adhesive                                    | Screw  | Screw                                   |
| Cable included                   | 3053V/120  | 3090C/120                                 | 3053V/120 (3)                               | 3053V/120 (3)                                | No                                      |

+260°C/+288°C  
(+500°F/+550°F)

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| Model number                     | 7240C                             | 7201                              | 7703A   | 7704A                               |
|----------------------------------|-----------------------------------|-----------------------------------|---|-------------------------------------|
| Description                      | Very high frequency               | General purpose                   | General purpose<br>Radiation tested   | General purpose<br>Radiation tested |
| Sensitivity pC/g typical         | 3.0                               | 10 / 50 / 100                     | 50 / 100 / 200 / 300 / 1,000  | 50 / 100                            |
| Sinusoidal limit g               | 1,000                             | 2,000                             | 2,000 / 1,000 / 850 / 675 / 500   | 2,000 / 1,000                       |
| Shock limit g                    | 5000                              | 20,000 / 10,000 / 5000            | 10,000 / 5,000 / 2,000 / 1,600 / 1,000  | 10,000 / 5,000                      |
| Frequency response $\pm 1$ dB Hz | 1–20,000                          | 1–15,000 / 1–10,000 / 1–8000      | 1–9,000 / 1–8,000 / 1–6,000 /<br>1–5,000 / 1–3,000  | 1–9,000 / 1–8,000                   |
| Operating temperature<br>°C (°F) | -55 to +260 (-67 to +500)         | -73 to +260 (-100 to +500)        | -55 to +288 (-67 to +550)   | -55 to +288 (-67 to +550)           |
| Signal/ground isolation          | No                                | No                                | Yes   | Yes                                 |
| Hermetic seal                    | Yes                               | Yes                               | Yes   | Yes                                 |
| Weight grams (without cable)     | 4.8                               | 18 / 20 / 25                      | 25 / 29 / 62 / 70 / 120   | 25 / 29                             |
| Dimensions mm (in)               | 9.53 hex x 11.68 (3/8 hex x 0.46) | 15.88 hex x 19.8 (5/8 hex x 0.78) | for -50 / -100:<br>16.0 hex x 19.8 (5/8 hex x 0.78)<br>for -200 / -300 / -1000:<br>25.4 hex x 23.1 (1.0 hex x 0.91) | 16.0 hex x 21.1 (5/8 hex x 0.83)    |
| Mounting method                  | Stud                              | Stud                              | Stud  | Stud                                |
| Cable included                   | 3053V/120                         | 3090C/120                         | 3090C/120   | 3090C/120                           |

# IEPE accelerometers

## Applications

- Aircraft flight testing
- Ground vibration testing
- Modal analysis
- Quality assurance
- Product R & D
- Heavy machinery maintenance
- Powertrain development
- OEM design and test applications



## Integrated electronics piezoelectric (IEPE) accelerometers

The acronym IEPE refers to a type of piezoelectric (PE) accelerometer with internal electronics (IE) that allows it to convert charge to a low-impedance voltage output. Its temperature response is somewhat limited due to its onboard electronics. This type of accelerometer is primarily specified for applications in which environmental conditions permit its use, including HALT/HASS/ESS testing, industrial vibration monitoring and general purpose vibration and shock testing.

Since both PE and IEPE types are AC-coupled designs, the acceleration output of these accelerometers cannot be used to yield correct velocity and displacement information by numerical integration.

### Advantages of IEPE sensors

- Less operator attention, training and installation expertise required.
- Uses standard coaxial cable.
- Drives long cables without noise increase or loss of resolution.
- Operates directly into many data collectors with built-in constant current input.



## IEPE accelerometers

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### Small single axis

| Model number                  | 2256B-R                          | 256HX-R                          | 7250B                                   | 7251A-R                      |
|-------------------------------|----------------------------------|----------------------------------|---|------------------------------|
| Description                   | Lightweight<br>General purpose   | Lightweight<br>General purpose   | Ultra wide bandwidth<br>Thru-hole mount | Thru-hole mount              |
| Sensitivity mV/g, typical     | 10 / 100                         | 10 / 100                         | 2 / 10                                  | 10 / 100                     |
| Linear range g                | ±500 / ±50                       | ±500 / ±50                       | ±2,500 / ±500                           | ±500 / ±50                   |
| Shock limit g                 | 2,000                            | 2,000                            | 10,000                                  | 5,000                        |
| Frequency response ± 1dB Hz   | 1-10,000 (±10%)                  | 1-10,000 (±10%)                  | 1 to 40,000 (±3 dB)                     | 2-10,000 (±10%)              |
| Broadband noise (µg rms)      | 1,000 / 300                      | 1,000 / 300                      | 3,500 / 1,000                           | 1,000 / 250                  |
| Operating temperature °C (°F) | -55 to +125 (-67 to +257)        | -55 to +125 (-67 to +257)        | -55 to +125 (-67 to +257)               | -55 to +125 (-67 to +257)    |
| Signal/ground isolation       | Yes                              | Yes                              | Yes                                     | Yes                          |
| Hermetic seal                 | Yes                              | Yes                              | Yes                                     | Yes                          |
| Weight grams (without cable)  | 4                                | 4                                | 1.9                                     | 10.5                         |
| Dimensions mm (in)            | 11.2 hex x 7.4 (0.44 hex x 0.29) | 11.2 hex x 9.4 (0.44 hex x 0.37) | Ø 9.65 x 6.2 (Ø 0.381 x 0.25)           | Ø 15.2 x 8.9 (Ø 0.60 x 0.35) |
| Mounting method               | Adhesive                         | Stud                             | Screw                                   | Screw                        |
| Cable included                | None                             | None                             | 3091F/120                               | None                         |

IEPE accelerometers

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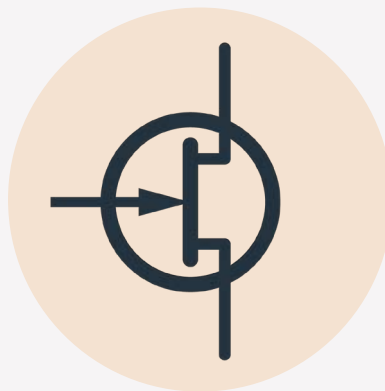
### Small triax

| Model number                  | 65 / 65M1  | 65HT / 65HTM1  | 65HTLPF / 65HTLPM1                                      |
|-------------------------------|--|--|---|
| Description                   | Industry standard                                      | Triaxial<br>High temperature                               | Triaxial High temperature<br>Integrated low-pass filter |
| Sensitivity mV/g, typical     | 10 / 100   | 10   | 10  |
| Linear range g                | ±500 / ±50   | ±500   | ±500  |
| Shock limit g                 | 10,000   | 10,000   | 10,000  |
| Frequency response ± 1dB Hz   | 0.4-10,000 / 1.5-6,000                                 | 0.5-8,000  | 0.5-1,400 (2 kHz filter)                                |
| Broadband noise (µg rms)      | 800 / 400  | 600  | 4,000   |
| Operating temperature °C (°F) | -55 to +125 (-67 to +257)                              | -55 to +175 (-67 to +347)                                  | -55 to +175 (-67 to +347)                               |
| Signal/ground isolation       | 65: No / 65M1: Yes                                     | 65HT: No / 65HTM1: Yes                                     | No  |
| Hermetic seal                 | Yes  | Yes  | Yes   |
| Weight grams (without cable)  | 5  | 65HT: 5 / 65HTM1: 6  | 5   |
| Dimensions mm (in)            | 65: 10 cube (0.39 cube)<br>65M1: 11.2 cube (0.44 cube) | 65HT: 10 cube (0.39 cube)<br>65HTM1: 11.2 cube (0.44 cube) | 10 cube (0.39 cube)                                     |
| Mounting method               | Stud / adhesive  | 65HT: Stud<br>65HTM1: Adhesive                             | Stud  |
| Cable included                | 3027AM3/120  | 3027AVM13/84 / 3027AM3/36                                  | 3027AVM13/84 / 3027AM3/36                               |

# Signal conditioners

## Configurations

- Bench top
- Rack mounted
- In-line, remote
- Airborne installation
- Battery operated



Endevco offers a comprehensive family of high performance electronic instruments from simple battery operated signal conditioners to computer controlled laboratory quality instruments that measure vibration, shock and pressure. Endevco electronic instruments support piezoelectric (charge-mode), variable capacitance, IEPE (voltage-mode) and piezoresistive sensors.

## Single channel in-line signal conditioners



| Model number                  | 2680MX                                      | 2685MX                                      | 2777A   | 2771C                                 | 2771CM2   |
|-------------------------------|---|---|---|---------------------------------------|---|
| Features                      | Airborne applications<br>Small, lightweight | Airborne applications<br>Small, lightweight | 2 gain options<br>Airborne applications<br>Acceleration and velocity<br>outputs | 4 gain options<br>Supports TEDS       | Designed for use with<br>extreme high temp<br>sensors, 1200°F [650°C] |
| Input                         | PE  | IEPE  | DIFF PE   | PE                                    | PE  |
| Channels                      | 1   | 1   | 1   | 1                                     | 1   |
| Gain                          | 0.1–100 mV/pC                               | 0.1–100 mV/mV                               | 2 / 10 mV/pC  | 0.1 / 1 / 5 / 10 mV/pC                | 1 mV/pC   |
| Broadband noise rms           | 1.5 mV                                      | 1.5 mV                                      | 1/5 mV (RT0)  | 5 / 30 / 50 / 50 µV                   | 10 µV   |
| Lower cutoff freq Hz [-3 dB]  | 3   | 0.7   | 5.73 / 8.59 / 11.5 / 14.3<br>/ 113  | 0.4 / 0.4 / 2 / 2                     | 2   |
| Upper cutoff freq Hz [-3 dB]  | Selectable                                  | Selectable                                  | 17,500  | 8 / 30,000 / 50,000 /<br>50,000 (±5%) | 30  |
| Power requirements VDC        | 20–32                                       | 20–32                                       | 22–31   | 24–30                                 | 24–30   |
| Operating temperature °C (°F) | -67 to +212 (-55 to 100)                    | -67 to +212 (-55 to 100)                    | -5 to +185 (-15 to 85)  | -40 to +257 (-40 to 125)              | -40 to +257 (-40 to +125)   |
| Weight grams                  | 34  | 34  | 227   | 57                                    | 57  |

## Single channel programmable signal conditioners



| Model number                 | 4416C   | 4418  |
|------------------------------|---|---|
| Features                     | IEPE power supply<br>Portable and compact<br>Rechargeable battery | Bridge signal conditioner<br>Portable and compact<br>ZMO adjustment |
| Input                        | IEPE  | PR, VC  |
| Channels                     | 1   | 1   |
| Gain                         | 1, 10, 100 selectable   | 1, 10, 100 selectable   |
| Broadband noise rms          | < 20 µV   | <20 uV  |
| Lower cutoff freq Hz [-3 dB] | 0.1   | DC  |
| Upper cutoff freq Hz [-3 dB] | 100,000   | 10,000  |
| Power requirements           | Battery powered, rechargeable                                     | Battery powered, rechargeable                                       |
| Type of control              | Manual  | Manual  |
| Rack mount                   | N/A   | N/A   |

## PRODUCTS

# High intensity microphones

Piezoelectric microphones measure high intensity acoustic noise and very low pressure fluctuations over a frequency range of 1 Hz to 10 kHz with a measurement range of 100 to >180 dB SPL. These hermetically sealed microphones are designed for operation in harsh environments and operate over a temperature range of -55°C to +260°C (-67°F to +500°F). Other outstanding features include insensitivity to altitude changes and ambient vibration.



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| Model number                  | 2510  | 2510M4A   |
|-------------------------------|---|---|
| Description                   | High intensity sound<br>High temperature<br>Vibration compensated | High intensity sound<br>High temperature<br>Vibration compensated |
| Type                          | Pressure  | Pressure  |
| Sensitivity pC rms@140 dB SPL | 31  | 31  |
| Frequency range $\pm 1$ dB Hz | 2–4,000   | 2–4,000   |
| Temperature range °C (°F)     | -55 to +260 (-67 to +500)   | -55 to +260 (-67 to +500)   |
| Dynamic range dB              | 100–180   | 100–180   |
| Diameter mm (in)              | 20.70 (0.815)   | 20.70 (0.815)   |
| Cable included                | 3090C/120   | 3090C/120   |

# Cable assemblies

Endevco designs and manufactures many of its own cables and connectors, specializing in custom cables, lengths, and connectors for dynamic testing. In these tough and challenging environments, accuracy depends as much on cables and connectors as it does on transducers. Our engineers are well versed in all the critical parameters in cable and connector designs that can affect signal transmission. As a result, these parameters are carefully optimized in our products to ensure data quality and reliability. When it comes to this kind of in-house custom capability, ordinary commercial cable and transducer companies don't compare.



## Cable assemblies

### Miniature

|                           | CE                            | CE                         | CE                             | CE                           |
|---------------------------|-------------------------------|----------------------------|--------------------------------|------------------------------|
| Model number              | 3003C                         | 3006                       | 3053V                          | 3053VM1                      |
| Connector 1               | 1.00 UNM jack                 | 1.20 UNM jack              | M3 male plug, hex end          | M3 male plug, hex end        |
| Connector 2               | 1-64 UNC-2A, female plug      | 10-32 male plug            | 10-32 male plug, hex end       | BNC male plug                |
| Cable type                | Coaxial                       | Coaxial                    | Coaxial, shielded              | Coaxial, shielded            |
| Capacitance pF/ft, max    | 25                            | 43                         | 32                             | 32                           |
| Conductor size AWG        | Solid, 40                     | Stranded, 36               | Solid, 33                      | Solid, 33                    |
| Jacket material           | ETFE                          | PTFE                       | Extruded ETFE, TPE             | Extruded ETFE, TPE           |
| Overall diameter in, max  | 0.024                         | 0.040                      | 0.054                          | 0.054                        |
| Bend radius in, min       | 0.1                           | 0.12                       | 0.5                            | 0.5                          |
| Temperature range °C (°F) | -73 to +177<br>[-100 to +350] | -50 to 125<br>[-58 to 257] | -254 to +260<br>[-432 to +500] | -55 to +200<br>[-67 to +392] |
| Low noise treated         | No                            | No                         | Yes                            | Yes                          |

|                           | CE                             | CE                            | CE                             |
|---------------------------|--------------------------------|-------------------------------|--------------------------------|
| Model number              | 3091F                          | 3093M10                       | 3095A                          |
| Connector 1               | 6-40 UNF-2B female plug        | 10-32 female socket           | 1-64 UNC                       |
| Connector 2               | 10-32 male plug                | 1-64 UNC                      | 10-32 male plug                |
| Cable type                | Coaxial, shielded              | Coaxial, shielded             | Coaxial, shielded              |
| Capacitance pF/ft, max    | 40                             | 30                            | 30                             |
| Conductor size AWG        | Solid, 33                      | Solid, 33                     | Solid, 33                      |
| Jacket material           | Wrapped ETFE                   | Wrapped ETFE                  | Wrapped ETFE                   |
| Overall diameter in, max  | 0.06                           | 0.06                          | 0.06                           |
| Bend radius in, min       | 0.12                           | 0.12                          | 0.12                           |
| Temperature range °C (°F) | -184 to +260<br>[-300 to +500] | -73 to +177<br>[-100 to +350] | -184 to +177<br>[-300 to +350] |
| Low noise treated         | Yes                            | Yes                           | Yes                            |



## Standard coaxial

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| Model number              | 3090C                       | 3090CM12                    | 3090CM67  | 3060D                      |
|---------------------------|-----------------------------|-----------------------------|---|----------------------------|
| Connector 1               | 10-32 male plug             | 10-32 male plug             | 10-32 male plug, hex  | 10-32 male plug            |
| Connector 2               | 10-32 male plug             | BNC male plug               | 10-32 male plug, hex  | 10-32 male plug            |
| Cable type                | Coaxial, shielded           | Coaxial, shielded           | Coaxial, shielded   | Coaxial, shielded          |
| Capacitance pF/ft, max    | 40                          | 32                          | 35  | 50                         |
| Conductor size AWG        | Stranded, 30                | Stranded, 30                | Stranded, 30  | Solid, 28                  |
| Jacket material           | Wrapped ETFE                | Wrapped ETFE                | Wrapped ETFE with Heat-resistant para-aramid synthetic fiber reinforcement and protective metal overbraid | Extruded silicon           |
| Overall diameter in, max  | 0.08                        | 0.08                        | 0.12  | 0.092                      |
| Bend radius in, min       | 0.85                        | 0.85                        | 0.85  | 0.95                       |
| Temperature range °C (°F) | -269 to +260 (-452 to +500) | -185 to +260 (-300 to +500) | -55 to +260 (-67 to +500)   | -73 to +260 (-100 to +500) |
| Low noise treated         | Yes                         | Yes                         | Yes   | Yes                        |

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| Model number              | 3061                        | 3096   |
|---------------------------|-----------------------------|--|
| Connector 1               | 10-32 male plug             | 10-32 male plug, hex   |
| Connector 2               | BNC male plug               | 10-32 male plug, hex   |
| Cable type                | Coaxial, shielded           | Coaxial, shielded  |
| Capacitance pF/ft, max    | 28                          | 35   |
| Conductor size AWG        | Stranded, 30                | Stranded, 30   |
| Jacket material           | Extruded ETFE               | Wrapped Teflon with Heat-resistant para-aramid synthetic fiber reinforcement |
| Overall diameter in, max  | 0.08                        | 0.115  |
| Bend radius in, min       | 0.85                        | 0.85   |
| Temperature range °C (°F) | -100 to +260 (-148 to +500) | -55 to +260 (-67 to +500)  |
| Low noise treated         | No                          | Yes  |

## Multi conductor

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| Model number              | 6917B                          | 6917D                                       | 3024                           | 3027M8                         | 3024M1                         |
|---------------------------|--------------------------------|---|--------------------------------|--------------------------------|--------------------------------|
| Connector 1               | 7/16-27 female plug (2 socket) | 7/16-27 female plug w/Viton boot (2 socket) | 10-32 male plug                | 10-32 male hex plug            | 10-32 male plug                |
| Connector 2               | Pigtail                        | Pigtail                                     | Pigtail                        | Pigtail                        | Pigtail                        |
| Cable type                | Twisted pair, shielded         | Twisted pair, shielded                      | Twisted pair                   | Twisted pair                   | Twisted pair, shielded         |
| Capacitance pF/ft, max    | 80                             | 80  | N/A                            | N/A                            | N/A                            |
| Conductor size AWG        | Stranded, 20                   | Stranded, 20                                | Stranded, 28                   | Stranded, 26                   | Stranded, 28                   |
| Jacket material           | Wrapped ETFE                   | Wrapped ETFE                                | No overall jacket              | Tefzel                         | Extruded ETFE                  |
| Overall diameter in, max  | 0.21                           | 0.21  | 0.055                          | 0.086                          | 0.094                          |
| Bend radius in, min       | 0.6                            | 0.6   | 0.75                           | 0.75                           | 0.75                           |
| Temperature range °C (°F) | -54 to +260<br>[-65 to +500]   | -54 to +288<br>[-65 to +550]                | -184 to +176<br>[-300 to +350] | -184 to +176<br>[-300 to +350] | -184 to +176<br>[-300 to +350] |
| Low noise treated         | Yes                            | Yes   | No                             | No                             | No                             |

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| Model number              | 3027B                          | 3027AM3                     | 3027AVM13                      | 3915                         |
|---------------------------|--------------------------------|-----------------------------|--------------------------------|------------------------------|
| Connector 1               | 4 socket plug                  | 4 socket plug               | 4 socket plug                  | 4-socket plug                |
| Connector 2               | Pigtail                        | 3x BNC male plug            | 4 pin receptacle               | Pigtail                      |
| Cable type                | 4 conductor, shielded          | 4 conductor, shielded       | 4 conductor, shielded          | 4-conductor, shielded        |
| Capacitance pF/ft, max    | 16                             | 30                          | 16                             | -                            |
| Conductor size AWG        | Stranded, 32                   | Stranded, 28                | Stranded, 28                   | Stranded, 28                 |
| Jacket material           | Extruded silicone              | Extruded PVC                | Extruded ETFE, TPE             | Silicone rubber              |
| Overall diameter in, max  | 0.108                          | 0.105                       | 0.105                          | 0.097                        |
| Bend radius in, min       | 0.5                            | N/A                         | N/A                            | 1.0                          |
| Temperature range °C (°F) | -100 to +125<br>[-148 to +257] | -55 to +85<br>[-67 to +185] | -100 to +200<br>[-148 to +392] | -60 to +121<br>[-76 to +250] |
| Low noise treated         | No                             | No                          | No                             | Yes                          |

# Accessories

Endevco manufactures a complete range of accessories designed and fully tested to be directly compatible with our sensors, transducers and related instrumentation. To ensure high-reliability sensor performance and repeatable results, appropriately selected mounting studs, blocks, bases, adapters and other accessories are highly recommended. These tools are used to properly affix a sensor to the test structure or mounting surface with minimum additional mechanical stress and optimize the frequency response. When selecting an accessory for a given measurement requirement, it is important to note that selection of and adherence to proper sensor mounting techniques, as well as preparation of the mounting surface, is absolutely critical.

## Mounting accessories

Mounting blocks



| Model number       | 2950   | 2950M3  | 2950M18  |
|--------------------|--|---|--|
| Description        | Triaxial mounting block<br>10-32 threaded holes<br>4-40 screw mount provided | Triaxial mounting block<br>6-32 threaded holes<br>4-40 Screw mount provided | Triaxial mounting block<br>2-56 threaded holes<br>4-40 mounting screw provided |
| Material           | Anodized aluminum  | Anodized aluminum   | Anodized aluminum  |
| Compatibility      | Accelerometers with<br>10-32 stud  | 2221F, 7221A, 7251A   | 2220E, 7250A, 7250AM1  |
| Dimensions mm (in) | 25.4 x 25.4 x 17.0<br>(1.0 x 1.0 x 0.67)                                     | 22.22 x 22.22 x 15.88<br>(0.875 x 0.875 x 0.625)                            | 12.7 x 12.7 x 10.16<br>(0.50 x 0.50 x 0.40)                                    |
| Weight grams       | 20.5   | 20.5  | 3.7  |



Mounting blocks

| Model number       | 7930   | 7953A  | 7964B  |
|--------------------|--|--|--|
| Description        | Triaxial and 6DOF Block<br>2-56 screws for mounting<br>0-80 threaded holes | Triaxial mounting block<br>2-56 screws for mounting<br>0-80 threaded holes | Triaxial mounting block<br>2-56 screws for mounting<br>0-80 threaded holes |
| Material           | Aluminum alloy   | Magnesium alloy  | Aluminum alloy   |
| Compatibility      | 7310 (rate), 7264C, 7264H, 726C (accels)                                   | 7264-2000, 7264C, 7264D, 7264H, 726C, 757F                                 | 7264B  |
| Dimensions mm (in) | 21.72 x 21.72 x 11.56<br>(0.855 x 0.855 x 0.455)                           | 16.51 x 16.51 x 10.92<br>(0.650 x 0.650 x 0.430)                           | 16.51 x 16.51 x 10.92<br>(0.650 x 0.650 x 0.430)                           |
| Weight grams       | 9.7  | 5.1  | 7.9  |



## Mounting blocks

| Model number       | 7980   | 7970   | 7990   |
|--------------------|--|--|--|
| Description        | Triaxial mounting block<br>6-32 screws for mounting<br>4-40 threaded holes | Triaxial mounting block<br>6-32 screws for mounting<br>4-40 threaded holes | Triaxial mounting block<br>6-32 screws for mounting<br>4-40 threaded holes |
| Material           | Titanium   | Titanium   | Aluminum alloy   |
| Compatibility      | 7270AM7, 7280AM7   | 7270A, 7280A   | 7290D  |
| Dimensions mm (in) | 27.94 x 15.24 x 10.16<br>(1.100 x 0.600 x 0.400)                           | 20.32 x 15.24 x 10.39<br>(0.800 x 0.6.00 x 0.409)                          | 26.04 x 25.40 x 25.40<br>(1.025 x 1.0 x 1.0)                               |
| Weight grams       | 21   | 10.6   | 40   |



## Adapters

| Model number  | 2980M4  | 2980M12   | 2985  | 2986B   | 2986M3  |
|---------------|---|---|---|---|---|
| Description   | Isolated mounting adapter<br>10-32 stud<br>.495 inch diameter | Isolated mounting adapter<br>10-32 stud to 10-32 stud<br>3/8 inch hex | Isolated mounting adapter<br>10-32 stud to 10-32 stud<br>5/8 inch hex | Isolated mounting adapter<br>10-32 stud to 10-32 stud<br>5/8 inch hex | Isolated mounting adapter<br>10-32 stud to M5 stud<br>14 mm hex |
| Material      | Stainless steel   | Anodized aluminum   | Stainless steel   | Stainless steel   | Stainless steel   |
| Compatibility | 10-32 threaded hole<br>accelerometers                         | 10-32 threaded hole<br>accelerometers                                 | 10-32 threaded hole<br>accelerometers                                 | 10-32 threaded hole<br>accelerometers                                 | 10-32 threaded hole<br>accelerometers                           |

## Accessories



## Mounting bases

| Model number       | 2988   | 30042  |
|--------------------|--|--|
| Description        | Adhesive mounting base to 10-32 stud<br>1/2 inch hex | Aerodynamic mounting pad                     |
| Material           | Anodized aluminum                                    | Urethane                                     |
| Compatibility      | 10-32 threaded hole accelerometers                   | 8515C  |
| Dimensions mm (in) | 12.7 hex (0.5 hex)                                   | 111.76 OD; 0.79 thick (4.400 OD; 0.03 thick) |



## Mounting studs

| Model number  | 2981-3  | 2981-4   | 2981-12  |
|---------------|---|--|--|
| Description   | Mounting stud<br>10-32 stud to 10-32 stud<br>Slotted head | Mounting stud<br>10-32 stud to M5 stud<br>Slotted head | Mounting stud<br>10-32 stud<br>Hex socket head |
| Material      | Stainless steel   | Stainless steel  | Stainless steel                                |
| Compatibility | 10-32 threaded hole<br>accelerometers                     | 10-32 threaded hole<br>accelerometers                  | 10-32 threaded hole<br>accelerometers          |

## Miscellaneous accessories

| Model      | Description  |
|------------|--|
| EDV21997   | Plug accessory kit for 2680 and 2685                 |
| 26574      | Plug assembly for 6917B cable                        |
| EDV30279   | PR/VC mounting fixture                               |
| EDVEHM2107 | Power adaptor, 12VDC, for 4416C                      |
| EDVEJ1085  | 4 socket plug, used on 3027A series cable assemblies |
| EDVEJ1183  | 10-32 Microdot to BNC adaptor                        |
| EJ34       | 10-32 to 10-32 in-line adaptor                       |

| Model      | Description   |
|------------|---|
| EDVEJ600   | 25 pin D connector                                    |
| EJ66       | Feed-thru bulkhead microdot connector                 |
| EDVEJ720   | Input connector, Bendix 2 pin straight plug for 2777A |
| EDVEJ721   | Output connector, Bendix 6 pin socket plug for 2777A  |
| EDVEJ724-U | 9 Pin D-sub connector for 126                         |
| EP171      | Adaptor, 10-32 to female BNC                          |
| EDVEP31    | Potting sleeve for 2680 and 2685                      |
| EP310      | Adaptor, 10-32 plug to 10-32 receptacle, right angle  |
| EDVEP316   | Twinax BNC Plug                                       |
| EDVEP35    | Connector hood for 2680 and 2685                      |
| EDVEP38    | Mating plug for 2680 and 2685                         |
| EDVEP685   | 10-32 plug  |
| EDVEP686   | BNC plug  |
| EDVEP695   | 10-32 to BNC adaptor for 4830B                        |
| EDVEW1196  | D-sub cable, DB25 male / female, 2.5 ft               |
| EDVEW1400  | USB cable for 4830B                                   |

## Reference accelerometers

CE



CE



| Model number                     | 2270   | 2270M8                           |
|----------------------------------|--|----------------------------------|
| Description                      | Back-to-back calibration                     | Transfer standard accelerometer  |
| Sensitivity pC/g typical         | 2.2  | 2.2                              |
| Sinusoidal limit g               | 1,000  | 1,000                            |
| Shock limit g                    | 15,000                                       | 15,000                           |
| Frequency response $\pm 1$ dB Hz | 2–20,000 (for accelerometers up to 35 grams) | 2 – 10,000 (+/-5%)               |
| Operating temperature °C (°F)    | -55 to +177 [-67 to +350]                    | -54 to +177 [-65 to +350]        |
| Signal/ground isolation          | Switchable                                   | Yes                              |
| Hermetic seal                    | No   | Yes                              |
| Weight grams (without cable)     | 40   | 16.5                             |
| Dimensions mm (in)               | 15.88 hex x 28.4 [5/8 hex x 1.12]            | 15.88 hex x 17.8 [5/8 hex x 0.7] |
| Mounting method                  | Stud   | Stud                             |
| Cable included                   | 3090C/120                                    | 3090C/120                        |

CE



CE



## Portable system verification instruments

| Model number       | 4830B  |
|--------------------|--|
| Description        | Handheld accelerometer simulator   |
| Outputs            | Single-ended charge<br>Differential charge<br>Single-ended voltage<br>Tachometer<br>IEPE   |
| Frequency range Hz | 1–20,000, resolution 0.5   |
| Amplitude          | Adjustable up to 10,000 pC or mV pk  |
| Amplitude accuracy | $\pm 1\%$  |
| Broadband noise    | < 2 mV or 2 pc   |
| Battery            | Rechargeable battery   |
| Features           | <ul style="list-style-type: none"> <li>• FFT input function</li> <li>• User defined simulation profiles</li> <li>• Utility software for profile setup</li> <li>• Front panel calibration</li> <li>• USB interface</li> </ul> |

| Model number           | 394C06   |
|------------------------|--|
| Description            | Handheld shaker  |
| Operating frequency Hz | ( $\pm 1\%$ ) 159.2  |
| Acceleration output g  | ( $\pm 3\%$ ) 1.00 g rms (9.81 m/s <sup>2</sup> rms)   |
| Distortion             | (0 to 99 grams load) $\approx 2\%$<br>(100 to 149 grams load) $\approx 5\%$<br>(150 to 210 grams load) $\approx 9\%$ |
| Load grams             | 2 – 210  |
| Power                  | Internal 4 AA batteries<br>Accepts external DC power supply  |
| Dimensions             | 2.2" [56 mm] Dia. x 7.8" [200 mm] H  |
| Mounting thread        | 10–32 female   |
| Provided by            | PCB Piezotronics   |

# Calibration services

## Features

- Full range of sensor calibration services available
- Comprehensive calibration reports
- A2LA accredited, National Metrology Institute traceable
- Custom calibration services available
- Fast turnaround



Endevco offers complete calibration services to regularly calibrate sensors and maintain a high level of precision and accuracy. Many types of calibrations are available, including absolute vibration calibration for the lowest uncertainty, as well as comparison techniques for shock and vibration. Endevco can also perform customized calibrations including environmental calibrations to verify amplitude linearity or frequency, or high shock impact testing. Our calibration team is committed to providing the most accurate calibrations available with conformance to the National Metrology Institute (NMI: NIST, PTB, etc.). All calibration services are A2LA accredited.

## What we calibrate

- Piezoelectric accelerometers (PE and IEPE)
- Piezoresistive accelerometers
- Variable capacitance accelerometers
- Pressure transducers
- Both Endevco and non-Endevco transducers
- System calibration (sensor + amplifier/signal conditioner)



Annual calibration is recommended for accelerometers and their associated instrumentation to ensure the continued accuracy of your dynamic measurements. Accelerometer calibration is available from the same people who design, build, and calibrate hundreds of accelerometers on a daily basis. Calibration is conducted by qualified technicians who are under the supervision of our experienced Engineering staff. Endevco offers a wide selection of calibration services to meet your needs. These include simple back-to-back calibrations and highly accurate absolute calibrations.

For those that require the highest levels of reporting, services are available with comprehensive reports that include a description of methods used, the reference standards used and their current calibration dates, report numbers and traceability to the National Metrology Institute (NMI: NIST, PTB, etc.), the estimated uncertainty of the calibrations, the temperature and humidity during the calibrations. The report also includes measurement data points and a graphical display of output data. Additionally, fast turnaround services are available that supply a standard one page calibration certificate.

For vibration services, Endevco uses precision, low noise air bearing shakers with a beryllium armature to ensure the highest accuracy with high frequency capabilities. We can also perform a resonance search to further determine the condition of the sensor. Endevco designed equipment is used to test cross-axis sensitivity, another important test of the accelerometers performance. For shock services, Endevco equipment is used for testing up to 100,000 gs.

## What we do

When we receive your sensor, it will be fully inspected and tested. Once your sensor is determined to be operating properly, we will proceed with the requested calibration. If during inspection and testing we determine that the unit is defective, we will advise you regarding the repair or replacement alternatives. In the event we are unable to make the necessary repairs, we can offer an attractive trade-in on a new Endevco product. Contact your local Representative to discuss other options or alternatives.

## Traceability and accreditation

Accelerometer calibrations are conducted in our A2LA accredited laboratory. The methods used are in accordance with

ANSI/NCSL Z540-1-1994 and ISO/IEC 17025-2005. Traceability to the National Metrology Institute (NMI: NIST, PTB, etc.) is shown as required by military quality control standards.

## Calibration services

### Primary calibration with frequency sweep

Primary Calibration by Laser Interferometer. Includes frequency sweep in the specified range below.

| Calibration service number      | CS120A          | CS120AH         | CS120AL        | CS120ALH       | CS120AS         | CS120ALH-S     | CS120ALS       |
|---------------------------------|-----------------|-----------------|----------------|----------------|-----------------|----------------|----------------|
| Frequency range                 | 20 Hz to 10 kHz | 20 Hz to 20 kHz | 1 Hz to 10 kHz | 1 Hz to 20 kHz | 20 Hz to 10 kHz | 1 Hz to 20 kHz | 1 Hz to 10 kHz |
| System cal <sup>3</sup>         | No              | No              | No             | No             | Yes             | Yes            | Yes            |
| Transverse sensitivity          | Yes             | Yes             | Yes            | Yes            | Yes             | Yes            | Yes            |
| Report/certificate <sup>1</sup> | Full report     | Full report     | Full report    | Full report    | Full report     | Full report    | Full report    |
| Capacitance Measurement         | Yes             | Yes             | Yes            | Yes            | Yes             | Yes            | Yes            |

### Primary calibration, single point

Primary Calibration by Laser Interferometer. Measurement taken at a single frequency, customer defined.

| Calibration service number      | CS120B           |
|---------------------------------|------------------|
| Frequency range                 | Single Frequency |
| System cal <sup>3</sup>         | No               |
| Transverse sensitivity          | Yes              |
| Report/certificate <sup>1</sup> | Full report      |
| Capacitance Measurement         | Yes              |

### Comparison calibration

Secondary calibration by comparison provides a measurement uncertainty of  $\pm 1.2\%$  (100 Hz),  $\pm 1.5\%$  (20 Hz to 2500 Hz),  $\pm 2.5\%$  (>2500 Hz to 10,000 Hz), and 5 % (>10,000 Hz to 20,000 Hz).

| Calibration service number      | CS130           | CS130H          | CS130L         | CS130LH        | CS130S                  | CS130LH-S      |
|---------------------------------|-----------------|-----------------|----------------|----------------|-------------------------|----------------|
| Frequency range                 | 20 Hz to 10 kHz | 20 Hz to 20 kHz | 1 Hz to 10 kHz | 1 Hz to 20 kHz | 20 Hz to 10 kHz         | 1 Hz to 20 kHz |
| System cal <sup>3</sup>         | No              | No              | No             | No             | Yes                     | Yes            |
| Transverse sensitivity          | Yes             | Yes             | Yes            | Yes            | Yes                     | Yes            |
| Report/certificate <sup>1</sup> | Full report     | Full report     | Full report    | Full report    | Full report             | Full report    |
| Sensor manufacturer             | Endevco         | Endevco         | Endevco        | Endevco        | Endevco/<br>Non-Endevco | Endevco        |
| Resonance search <sup>2</sup>   | Yes             | Yes             | Yes            | Yes            | Yes                     | Yes            |

| Calibration service number      | CS130LS        | CS130T <sup>4</sup> | CS135           | CS135L         | CS135LH        | CS410           |
|---------------------------------|----------------|---------------------|-----------------|----------------|----------------|-----------------|
| Frequency range                 | 1 Hz to 10 kHz | 20 Hz to 10 kHz     | 20 Hz to 10 kHz | 1 Hz to 10 kHz | 1 Hz to 20 kHz | 20 Hz to 10 kHz |
| System cal <sup>3</sup>         | Yes            | No                  | No              | No             | No             | No              |
| Transverse sensitivity          | Yes            | Yes                 | No              | No             | No             | Yes             |
| Report/certificate <sup>1</sup> | Full report    | Full report         | Full report     | Full report    | Full report    | Standard cert   |
| Sensor manufacturer             | Endevco        | Endevco             | Endevco         | Endevco        | Endevco        | Endevco         |
| Resonance search <sup>2</sup>   | Yes            | Yes                 | Yes             | Yes            | Yes            | Yes             |

| Calibration service number      | CS415           | CS410TEDS <sup>5</sup> | CS420           | CS425           | CS420L         | CS210 <sup>6</sup> |
|---------------------------------|-----------------|------------------------|-----------------|-----------------|----------------|--------------------|
| Frequency range                 | 20 Hz to 10 kHz | 20 Hz to 10 kHz        | 20 Hz to 10 kHz | 20 Hz to 10 kHz | 1 Hz to 10 kHz | 20 Hz to 10 kHz    |
| System cal <sup>3</sup>         | No              | No                     | No              | No              | No             | No                 |
| Transverse sensitivity          | No              | Yes                    | Yes             | No              | Yes            | Yes                |
| Report/certificate <sup>1</sup> | Standard cert   | Standard cert          | Standard cert   | Standard cert   | Standard cert  | Standard cert      |
| Sensor manufacturer             | Endevco         | Endevco                | Non-Endevco     | Non-Endevco     | Non-Endevco    | Endevco            |
| Resonance search <sup>2</sup>   | Yes             | Yes                    | Yes             | Yes             | Yes            | Yes                |

## Calibration services

### Shock calibration

Half-sine shock calibration by comparison provides a measurement uncertainty of  $\pm 1.9\%$  (20 to 2000 g) and 2.7% (2000 to 10,000 g).

| Calibration service number   | CS110                   | CS110S                  | CS220                   | CS220S                  | CS111                     | CS115                     |
|------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|---------------------------|---------------------------|
| Shock range                  | 20 g to 10 Kg, 5 levels | 20 g to 10 Kg, 5 levels | 20 g to 10 Kg, 5 levels | 20 g to 10 Kg, 5 levels | 10 Kg to 100 Kg, 5 levels | 10 Kg to 100 Kg, 5 levels |
| Frequency range <sup>7</sup> | 20 Hz to 10 kHz         | 20 Hz to 10 kHz         | NA                      | NA                      | NA                        | NA                        |
| System cal <sup>2</sup>      | No                      | Yes                     | No                      | Yes                     | No                        | No                        |
| Transverse sensitivity       | Yes                     | Yes                     | Yes                     | Yes                     | Yes                       | No                        |

### Environmental calibration

Sensitivity calibration at temperature.

| Calibration service number | CS310  | CS315  | CS330  |
|----------------------------|--|--|--|
| Description                | Sensitivity measurement at single frequency, at customer specified temperature | Sensitivity measurement at single frequency, at customer specified temperature | Sensitivity measurement at single frequency, at customer specified temperature |
| Temperature range °C (°F)  | -55 to +175 (-67 to +345)  | -55 to +175 (-67 to +345)  | -173 to +760 (-280 to +1400)   |
| Transverse sensitivity     | No   | Yes  | Customer specified   |

1. Full report includes a 5+ page comprehensive report. Standard Cert includes a 1 page calibration certificate
2. Resonance search is performed up to 50,000 Hz or the sensor's highest specification frequency
3. System cal performs the calibration procedure on the measurement system including a transducer and its associated cable and signal conditioning
4. For triaxial accelerometers
5. Includes TEDS (Transducer Electronic Data Sheet) verification and update
6. Amplitude linearity (5 g levels from 1 g to 100 g, specified by customer)
7. Includes standard frequency sweep

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