

# 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.



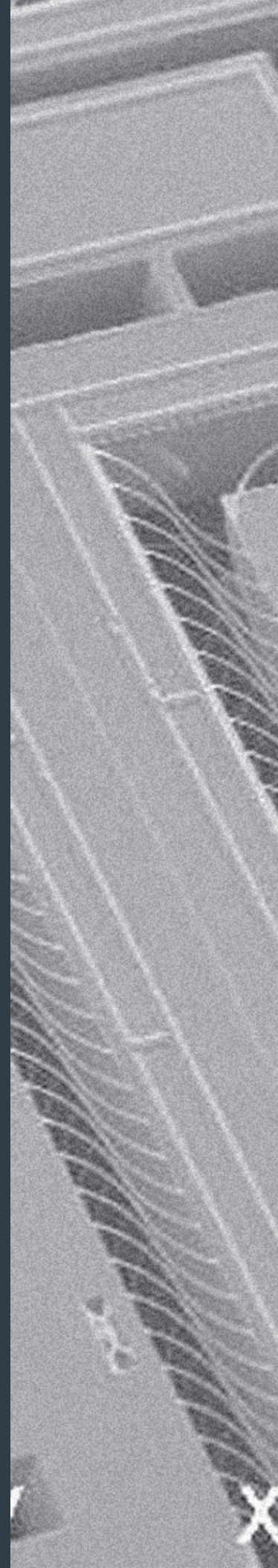
## Piezoresistive pressure sensors

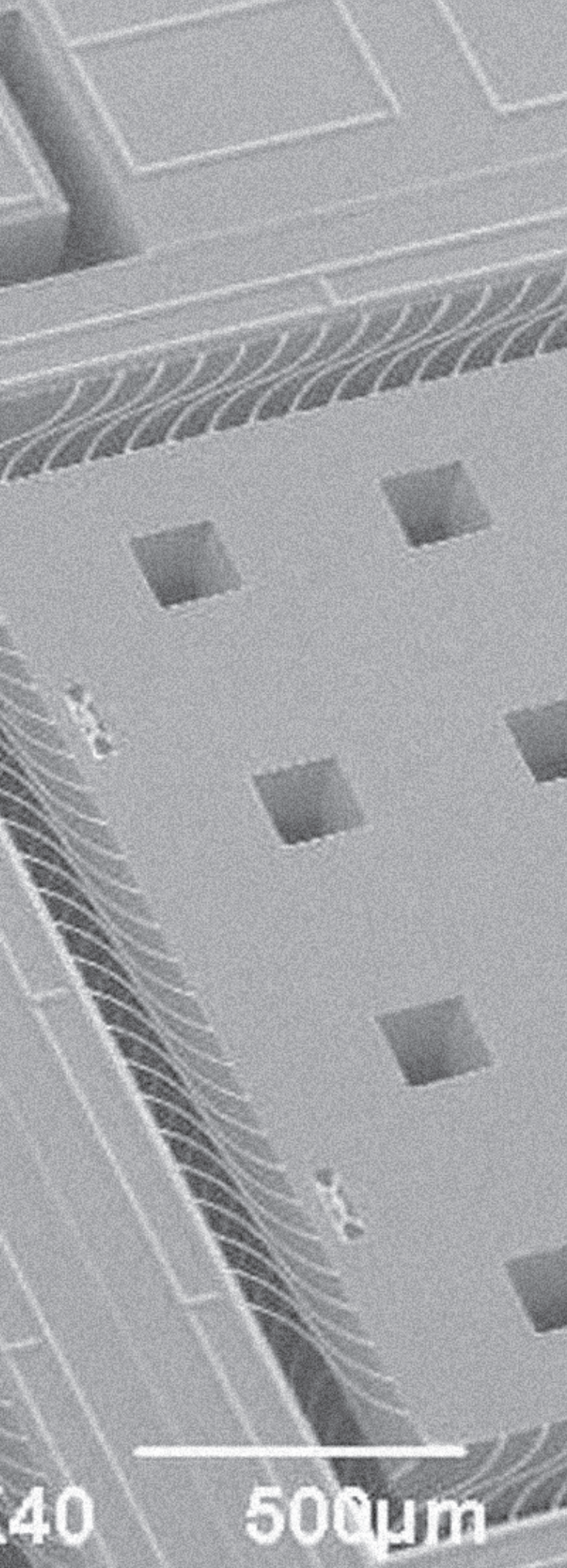
Miniature piezoresistive pressure sensors measure both dynamic and static pressure in process control applications, blast testing, automotive airbag testing, rocket motor analysis, jet engine inlet pressure measurements, transmission testing and hydraulics measurements. A four-arm strain gage bridge 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.



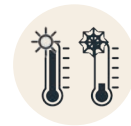
### Low-frequency response

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.



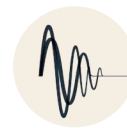
### Strain effects

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

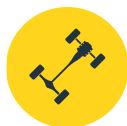
Endevco has sensors for all your automotive development applications. Our IEPE accelerometers are best for vehicle dynamic testing of engines, exhaust systems, and other components due to their miniature packaging, high temperature performance and rugged construction. Endevco VC accelerometers feature 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

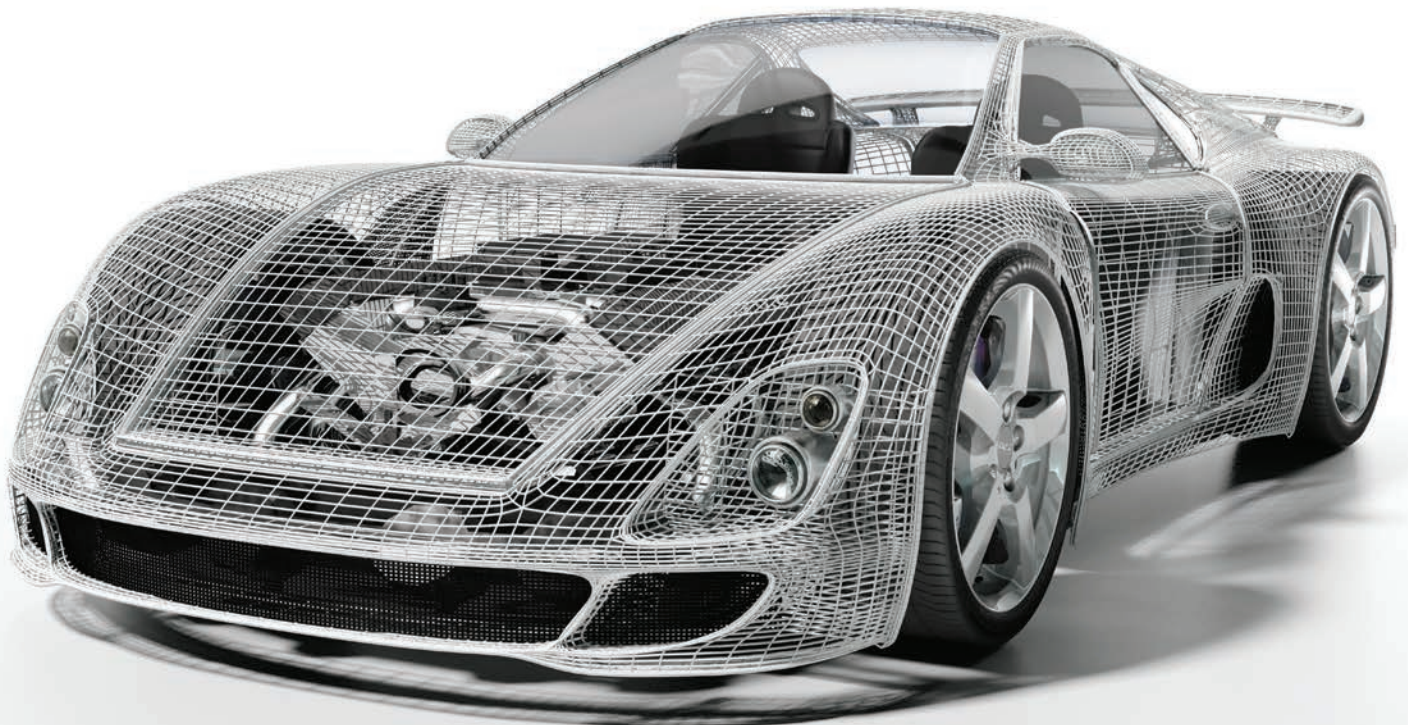
- Road load
- Powertrain
- Transmission testing
- Modal/chassis design
- Component qualification testing
- Noise, Vibration, and Harshness (NVH)

## Features

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



Model	Application attributes	Find on page
27BLPF	Miniature high temperature accelerometer. Integral low pass filter for attenuation of high-frequency, high-g signals that can obscure the required low-frequency information	<a href="#">36</a>
35C	Miniature triaxial accelerometer. Fits in tight spaces and minimizes mass loading on small components	<a href="#">33</a>
44A	General purpose triaxial accelerometer with TEDS	<a href="#">35</a>
45A	General purpose triaxial accelerometer with TEDS. High sensitivity for a higher signal to noise ratio	<a href="#">35</a>
65HT	Small high temperature triaxial accelerometer	<a href="#">37</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="#">37</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="#">34</a>
7290G	Low g DC accelerometer for ride quality testing	<a href="#">19</a>
7290GM5	Low g DC accelerometer, IP67 for weathertight performance	<a href="#">19</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	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>
7231C	Undamped accelerometer for ATD	<a href="#">20</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>
7268D	Damped triaxial accelerometer for 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>



# 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.

Aircraft / spacecraft  
design & test

## 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
- Low outgassing cables
- 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="#">37</a>
2510	High temperature microphone for high intensity acoustic measurements	<a href="#">41</a>
2680MX	Compact and lightweight charge amplifier with gain and filter options	<a href="#">39</a>
3090CM71	Low noise, low outgassing, high reliability coaxial cable assembly	<a href="#">45</a>
4830B	Handheld accelerometer simulator. A highly configurable tool for verification and troubleshooting of test systems	<a href="#">53</a>
7722 / 7724	Cryogenic accelerometer (-268°C, 452°F) with grounded or isolated designs available	<a href="#">30</a>
7290GM5	Low g DC accelerometer for flutter, IP67 for weathertight performance	<a href="#">19</a>
7298A	Hermetic triaxial low g DC accelerometer for airframe structural integrity	<a href="#">19</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>



# 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.

High g shock testing

## 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

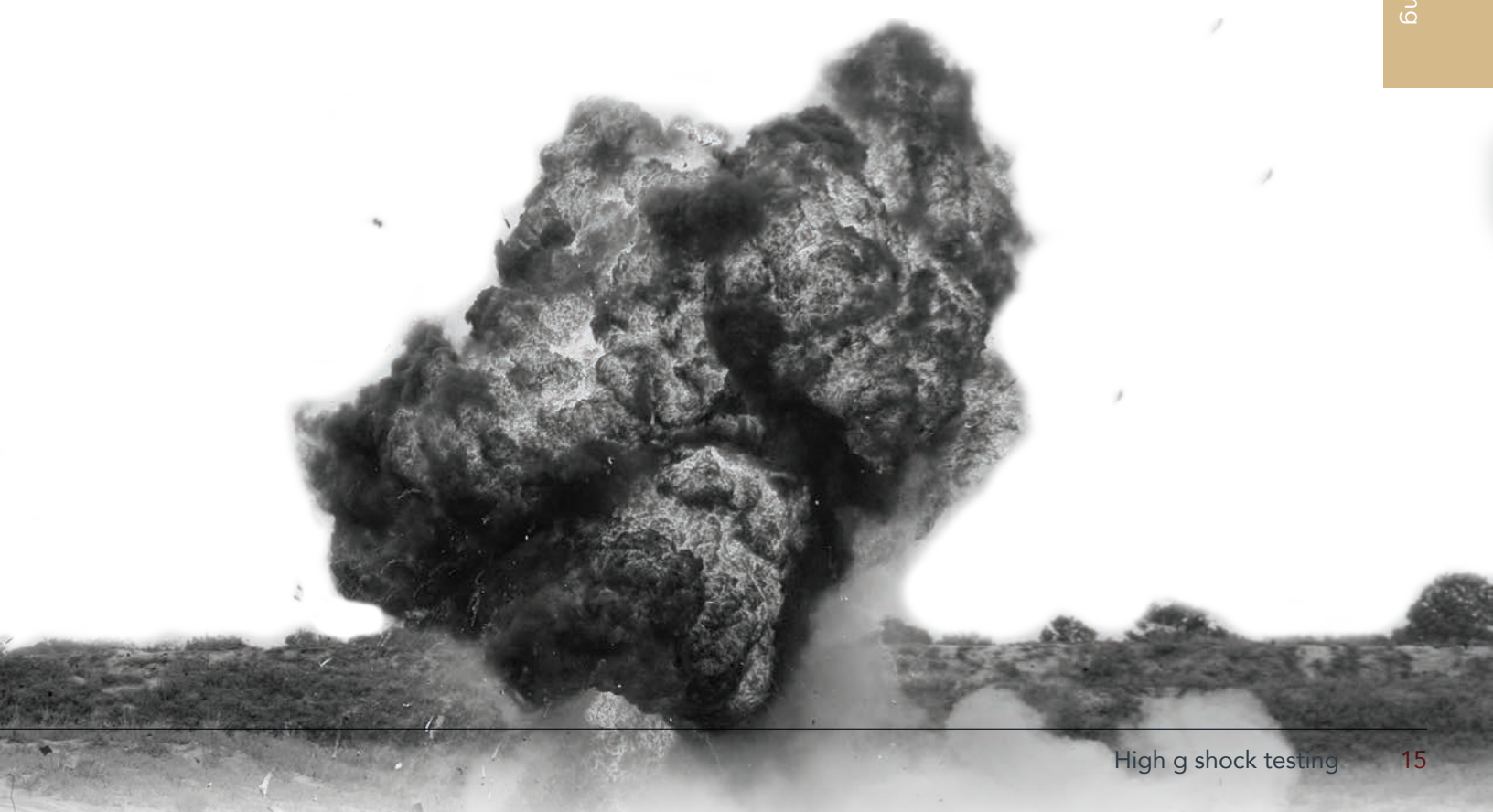
- Undamped for broad frequency response or damped for exceptional survivability
- Multiple mounting configurations
- Minimal zero shift after shock
- High survivability in overrange environments
- DC response for long duration transient events
- Ranges up to 200,000 g
- Miniature SMT versions for embedded 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>
2255B	Strain isolated, low pass filter for far field shock measurements	<a href="#">36</a>
7255A	Lightweight, integral mechanical filter for near field shock	<a href="#">37</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>
7274	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>
7284	Damped triaxial, screw mount for pyroshock	<a href="#">23</a>

High g shock testing



## 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>
8523	High temperature gage sensor for engines	<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>
8540	High temperature absolute sensor for engines	<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.

CE



CE



CE



Model number	770A-770F	771	773
<b>Description</b>	Low g DC measurement Rugged Al housing 28 AWG cable	Low g DC measurement Hermetic SS package Military temperatures	Triaxial Low g DC Rugged Al housing Separate power & ground
<b>Linear range</b> g	$\pm 2/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$	$\pm 2/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$	$\pm 2/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$
<b>Sensitivity</b> mV/g typical	1000/200/66/40/20/10	1000/200/66/40/20/10	1000/200/66/40/20/10
<b>Frequency response</b> $\pm 5\%$	0-200/0-900/0-900/0-900/ 0-1500/0-1500	0-200/0-900/0-900/0-900/ 0-1500/0-1500	0-200/0-750/0-750/0-750/ 0-1000/0-1000
<b>Non linearity</b> % FSO typical	0.5	0.5	0.5
<b>Shock limit</b> g	10,000	10,000	10,000
<b>Operating temperature</b> °C (°F)	-40 to +100 (-40 to +212)	-55 to +125 (-67 to +257)	-40 to +100 (-40 to +212)
<b>Dimensions</b> mm (in)	15.24 (0.6) cube (A) 15.24 x 22.88 x 15.24 (0.600 x 0.885 x 0.600) (F)	15.88 hex base x 24.89 (0.625 hex base x 0.980)	22.86 x 22.86 x 19.56 (0.900 x 0.900 x 0.770)
<b>Weight</b> grams	6	29	24
<b>Excitation voltage</b> Vdc	7 to 36 or 5V (R option)	7 to 36 or 5V (R option)	7 to 36 or 5V (R option)
<b>Mounting method</b>	Adhesive (A); 2-56 screws (F)	Stud	4-40 screws

 Variable capacitance  
accelerometers

CE



CE



CE



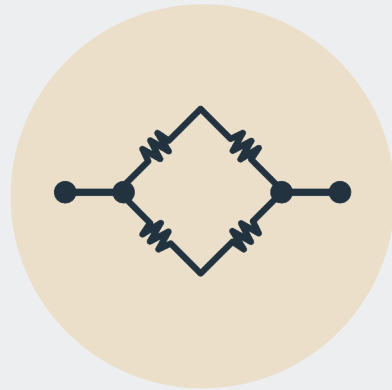
COMING SOON

Model number	7290G	7290GM5	7298A
<b>Description</b>	Wide bandwidth DC response High stability	DC accelerometer Watertight to IP67 Temperature compensated	Triaxial DC response Hermetic
<b>Linear range</b> g	$\pm 2/\pm 5/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$	$\pm 2/\pm 5/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$	$\pm 2/\pm 5/\pm 10/\pm 30/\pm 50/\pm 100/\pm 200$
<b>Sensitivity</b> mV/g typical	1000 / 400 / 200 / 66 / 40 / 20	1000 / 400 / 200 / 66 / 40 / 20	1000 / 400 / 200 / 66 / 40 / 20 / 10
<b>Frequency response</b> $\pm 5\%$	0-15 / 0-30 / 0-500 / 0-1000 / 0-2000 / 0-2000	0-15 / 0-30 / 0-500 / 0-1000 / 0-2000 / 0-2000	0-15 / 0-30 / 0-500 / 0-1000 / 0-1500 / 0-1500 / 0-1500
<b>Non linearity</b> % FSO typical	0.2 / 1.0 (100g and 200g)	0.2 / 1.0 (100g and 200g)	0.5 / 1.0 (50g / 200g)
<b>Shock limit</b> g	5000 (2g / 5g / 10g) / 10,000	5000 (2g / 5g / 10g) / 10,000	5000 (2g / 10g) / 10,000
<b>Operating temperature</b> °C (°F)	-55 to +121 (-67 to +250)	-55 to +121 (-67 to +250)	-55 to +125 (-67 to +257)
<b>Dimensions</b> mm (in)	25.4 x 21.6 x 7.6 (1.00 x 0.85 x 0.30)	25.4 x 21.6 x 7.6 (1.00 x 0.85 x 0.30)	31.5 x 21 x 14.2 (1.24 x 0.825 x 0.56)
<b>Weight</b> grams	10	10	22
<b>Excitation voltage</b> Vdc	8 to 40	8 to 40	6.0 to 45.0
<b>Mounting method</b>	4-40 screws	4-40 screws	4-40 screws

# 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

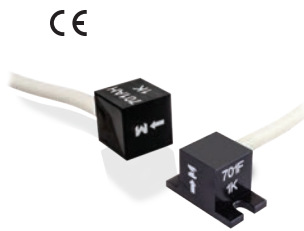
Strain gauge accelerometer designs based on a Wheatstone bridge arrangement consist of a rugged monolithic assembly with solid-state MEMS resistors that change in resistance in proportion to applied mechanical strain.

### 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	7268C	7268D	7231C
<b>Description</b>	Triaxial Multi-mode damping High sensitivity	Triaxial Undamped World SID ATD	Miniature triaxial Multi-mode damping World SID ATD	ATD standard Undamped Optional cable
<b>Linear range</b> g	±2000	±500 / ±2000	±2000	±750
<b>Sensitivity</b> mV/g typical	0.30	0.80 / 0.20	0.20	0.20
<b>Frequency response</b> ±5%, Hz	0 to 1500	0-3000 (Z) / 0-1500 (X&Y)	0-3000 (Z) / 0-1500 (X&Y)	0-2000
<b>Shock limit</b> g	10,000	5000 / 10,000	10,000	2500
<b>Operating temperature</b> °C (°F)	-40 to +100 (-40 to +212)	-18 to +66 (0 to +150)	-18 to +66 (0 to +150)	-40 to +125 (-40 to +257)
<b>Dimensions</b> 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]	12.70 x 14.73 x 10.67 [0.500 x 0.580 x 0.420]	12.7 x 19.05 x 22.9 [0.500 x 0.750 x 0.900]
<b>Weight</b> grams	7.5	8	8	24
<b>Mounting method</b>	Adhesive or 2-56 screws	M2 screw	M2 screw	10-32 detachable stud



Model number	701AH-701FH	726CH	757AH-757FH	758H
<b>Description</b>	Rugged Al housing Damped for survivability 28 AWG cable	SAE J211/J2570 Compliant Multi-mode damping Broad frequency response	Small and lightweight Damped for survivability Flexible cable	Rugged Mounting flexibility 28 AWG cable
<b>Linear range</b> g	±1000	±2000	±2000	±2000
<b>Sensitivity</b> mV/g typical	0.3	0.3	0.3	0.3
<b>Frequency response</b> ±5%, Hz	0-4000	0-5000	0-3000	0-4000
<b>Shock limit</b> g	10,000	10,000	10,000	10,000
<b>Operating temperature</b> °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)
<b>Dimensions</b> mm (in)	8.90 (0.350) cube (A) 8.90 x 15.88 x 9.65 (0.350 x 0.625 x 0.380) (F)	10.16 x 10.16 x 5.13 (0.400 x 0.400 x 0.202)	9.7 x 4.8 x 3.3 (0.380 x 0.190 x 0.130) (A) 11.18 x 10.2 x 3.8 (0.440 x 0.400 x 0.150) (F)	13.97 x 6.35 x 6.35 (0.550 x 0.250 x 0.250)
<b>Weight</b> grams	1.4 (A); 1.7 (F)	1.8	0.5 (A); 1 (F)	2
<b>Mounting method</b>	Adhesive (A); 2-56 screws (F)	0-80 screws	Adhesive (A); 0-80 screws (F)	Adhesive



Model number	7264B	7264C	7264D	7264H
<b>Description</b>	Crash test Undamped Meets SAE J211 / J2570	Industry standard Undamped Meets SAE J211 / J2570	High resonance Undamped Meets SAE J211 / J2570	Extremely rugged Multi-mode damping Pedestrian safety testing
<b>Linear range</b> g	±500/±2000	±500/±2000	±2000	±2000
<b>Sensitivity</b> mV/g typical	0.80/0.20	0.80/0.20	0.20	0.20
<b>Frequency response</b> ±5%, Hz	0-3000/0-5000	0-3000/0-5000	0-6000	0-6000
<b>Shock limit</b> g	5000 / 10,000	5000 / 10,000	10,000	10,000
<b>Operating temperature</b> °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)
<b>Dimensions</b> mm (in)	12.2 x 10.2 x 4.7 (0.48 x 0.4 x 0.185)	10.16 x 10.16 x 5.13 (0.400 x 0.400 x 0.202)	10.16 x 10.16 x 5.08 (0.400 x 0.400 x 0.200)	10.16 x 10.16 x 5.13 (0.400 x 0.400 x 0.202)
<b>Weight</b> grams	1	1.4	1.4	1.4
<b>Mounting method</b>	0-80 screws	0-80 screws	0-80 screws	0-80 screws

## Piezoresistive accelerometers

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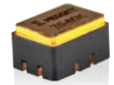
Model number	727	728
<b>Description</b>	Lightweight Broad frequency response Drop testing	Small and lightweight Broad bandwidth Adhesive mount
<b>Linear range</b> g	±2000 / ±6000 / ±20,000 / ±60,000	±2000 / ±10,000
<b>Sensitivity</b> mV/g typical	10 / 3 / 1 / 0.3 uV/V/g	0.20 / 0.016
<b>Frequency response</b> ±5%, Hz	0-10,000 / 0-20,000 / 0-50,000 / 0-100,000	0 to 8000 ±1dB
<b>Shock limit</b> g	3000 / 9000 / 30,000 / 90,000	10,000 / 30,000
<b>Operating temperature</b> °C (°F)	0 to +70 (+32 to +158)	0 to +70 (-32 to +158)
<b>Dimensions</b> mm (in)	7.11 (0.28) 0.3 diameter	10.67 x 6.1 x 3.3 (0.420 x 0.240 x 0.130)
<b>Weight</b> grams	0.3	0.5
<b>Mounting method</b>	Adhesive	Adhesive

Piezoresistive  
accelerometers

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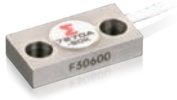
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Model number	71M	72	74	75
<b>Description</b>	Surface mount Undamped Low mass	Lightly damped Rugged ESD protection	Triaxial Lightly damped Surface mount LCC	Triaxial Undamped Surface mount LCC
<b>Linear range</b> g	±2000 / ±6000 / ±20,000 / ±60,000	±20,000 / ±60,000	±20,000 / ±60,000	±2000 / ±6000 / ±20,000 / ±60,000
<b>Shock limit</b> g	10,000 / 18,000 / 60,000 / 120,000	80,000 / 240,000	60,000 / 180,000	10,000 / 18,000 / 60,000 / 80,000
<b>Operating temperature</b> °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)
<b>Weight</b> grams	0.06	0.16	1.2	1.2
<b>Mounting method</b>	Adhesive	SMT or adhesive	SMT or adhesive	SMT or adhesive



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Model number	7270A	7270AM4	7270AM6	7270AM7	7274
<b>Description</b>	High resonance Undamped Shock standard	High resonance Undamped Stud mount	Rugged Mechanical filter Stud mount	Extremely rugged Undamped Low noise cable	Triaxial Undamped High resonance
<b>Linear range g</b>	±2000 / ±6000 / ±20,000 / ±60,000 / ±200,000	±2000 / ±6000 / ±20,000 / ±60,000 / ±200,000	±2000 / ±6000 / ±20,000 / ±60,000	±2000 / ±6000 / ±20,000 / ±60,000 / ±200,000	±2000 / ±6000 / ±20,000 / ±60,000
<b>Sensitivity uV/g</b>	100/30/10/3/1	100/30/10/3/1	100/30/10/3	100/30/10/3/1	50/15/5/1.5
<b>Frequency response kHz +/-5%</b>	0-10k / 0-20k / 0-50k / 0-100k / 0-150k	0-10k / 0-20k / 0-50k / 0-100k / 0-150k	0-10,000 (±10%)	0-10 / 0-20 / 0-50 / 0-100 / 0-150	0-18k / 0-36k / 0-70k / 0-140k
<b>Shock limit g</b>	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
<b>Operating temperature °C (°F)</b>	-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)
<b>Dimensions mm (in)</b>	14.22 x 7.1 x 2.79 (0.560 x 0.280 x 0.110)	7.92 (0.312) Hex x 8.9 (0.350)	17.15 x 14.73 x 15.78 (0.675 x 0.580 x 0.621)	14.2 x 8.9 x 4.06 (0.560 x 0.350 x 0.160)	14.22 x 7.45 x 6.22 (0.560 x 0.294 x 0.245)
<b>Weight grams</b>	1.5	1.5	8.4	4	2.9
<b>Mounting method</b>	Screw	1/4-28 integral stud	1/4-28 integral stud	4-40 screws	Screw

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Model number	7280A	7280AM4	7280AM7	7284
<b>Description</b>	Extremely rugged Lightly damped Low power consumption	Extremely rugged Lightly damped Low power consumption	Extremely rugged Lightly damped Low noise cable	Triaxial Lightly damped Low power consumption
<b>Linear range g</b>	±2000 / ±20,000 / ±60,000	±20,000 / ±60,000	±2000 / ±20,000 / ±60,000	±20,000 / ±60,000
<b>Sensitivity uV/g</b>	300 / 16 / 5	16 / 5	300 / 16 / 5	8 / 2.5
<b>Frequency response kHz +/-5%</b>	0-10k / 0-10k / 0-13k	0-10k / 0-13k	0-10k / 0-10k / 0-13k	0-10k / 0-13k
<b>Shock limit g</b>	80,000 / 240,000 / 10,000	80,000 / 240,000	80,000 / 240,000 / 10,000	60,000 / 180,000
<b>Operating temperature °C (°F)</b>	-55 to +121 (-67 to +250)	-55 to +121 (-67 to +250)	-55 to +121 (-67 to +250)	-55 to +121 (-67 to +250)
<b>Dimensions mm (in)</b>	14.22 x 7.1 x 3.18 (0.560 x 0.280 x 0.125)	7.92 (0.312) Hex x 9.1 (0.360)	14.2 x 8.9 x 4.06 (0.560 x 0.350 x 0.160)	14.22 x 7.45 x 6.22 (0.560 x 0.294 x 0.245)
<b>Weight grams</b>	1.4	2.1	4	3.6
<b>Mounting method</b>	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
<b>Description</b>	Angular rate 2V full scale Rugged
<b>Range deg/sec</b>	$\pm 100 / \pm 500 / \pm 1500 / \pm 6000 / \pm 8000 / \pm 12,000 / \pm 18,000$
<b>Sensitivity mV/g/sec +/-15%</b>	20 / 4 / 1.333 / 0.333 / 0.25 / 0.167 / 0.111
<b>Frequency response Hz +/-3dB</b>	0-1000 (100 / 500) / 0-2000
<b>Non linearity % FSO</b>	$\pm 0.5$
<b>Shock limit g</b>	5000
<b>Operating temperature °C (°F)</b>	-40 to +105 (-40 to +221)
<b>Dimensions mm (in)</b>	14.6 x 10.2 x 7.62 (0.580 x 0.400 x 0.300)
<b>Weight grams</b>	3
<b>Rate excitation voltage Vdc</b>	5 to 16
<b>Mounting method</b>	0-80 screws

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Model number	7360A
<b>Description</b>	6DoF measurement Compact package with 2 cables Rugged to 5000 g shocks
<b>Accelerometer ranges g</b>	$\pm 2 / \pm 10 / \pm 50 / \pm 200 / \pm 500$
<b>Range deg/sec</b>	$\pm 100 / \pm 500 / \pm 1500 / \pm 6000 / \pm 8000 / \pm 12,000 / \pm 18,000$
<b>Accelerometer sensitivity mV/g typical</b>	1000 / 200 / 40 / 10 / 4
<b>Sensitivity mV/g/sec +/-15%</b>	20 / 4 / 1.333 / 0.25 / 0.167 / 0.111
<b>Accelerometer frequency response +/-1dB</b>	0-300/0-1500/0-1800/0-1800/0-1800
<b>Frequency response Hz +/-3dB</b>	0-1000 / 0-1000 / 0-1000 / 0-1000 / 0-2000 / 0-2000
<b>Non linearity % FSO</b>	0.5
<b>Shock limit g</b>	5000
<b>Operating temperature °C (°F)</b>	-40 to +100 (-40 to +212)
<b>Dimensions mm (in)</b>	30.5 x 30.5 x 27.9 (1.2 x 1.2 x 1.1)
<b>Weight grams</b>	35
<b>Accelerometer excitation voltage Vdc</b>	7 to 36 or 5V (M1 option)
<b>Rate excitation voltage Vdc</b>	5 to 16
<b>Mounting method</b>	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. The 8540 offers high temperature operation to +260°C (+500°F). Absolute pressure sensors are available in ranges as low as 0–15 psia and as high as 0–2000 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.

Gage  
pressure transducers

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Model number	8507C	8510B	8510C	8511A	8523
Description	Gage High sensitivity Temp compensation	Gage Vent tube Temp compensation	Gage High resonance Temp compensation	Rugged Gage High pressure	Gage High temperature Temp compensation
Full scale pressure psi	1 / 2 / 5 / 15	1 / 2 / 5 / 200 / 500 / 2000	15 / 50 / 100	5000 / 10,000 / 20,000	15 / 50 / 100 / 200 / 500
Sensitivity mV/psi	200 / 100 / 60 / 20	200 / 100 / 60 / 1.5 / 0.6 / 0.15	15 / 4.5 / 2.25	0.1 / 0.05 / 0.025	20 / 6 / 3 / 1.5 / 0.6
Resonance frequency kHz	55 / 70 / 85 / 130	55 / 70 / 85 / 320 / 500 / 900	180 / 320 / 500	<1000	140 / 240 / 350 / 450 / 900
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	0.25 / 0.25 / 0.25 / 0.4 / 0.4
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)	-54 to +260 (-65 to +500)
Burst pressure psi	20 / 40 / 100 / 150	25 / 40 / 100 / 1000 / 2500 / 10,000	75 / 250 / 400	20,000 / 30,000 / 40,000	30 / 100 / 200 / 400 / 1000
Face diameter mm (in)	2.34 (0.092)	3.86 (0.152)	3.86 (0.152)	8.13 (0.320)	3.86 (0.152)
Weight grams	0.3	2.3	2.3	11	8.5
Mounting method	RTV bond	10-32 UNF-2A	10-32 UNF-2A	3/8-24 UNF-2A	10-32 UNF-2A

 Absolute  
pressure transducers

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Model number	8515C	8530B	8530BM37	8530C	8540
Description	Absolute` 0.03 inch thin Surface mount	Absolute High resonance Temp compensation	Absolute Detachable cable ABS braking studies	Absolute High sensitivity Temp compensation	Absolute High temperature Temp compensation
Full scale pressure psi	15 / 50	200 / 500 / 1000 / 2000	200 / 500 / 1000 / 2000	15 / 50 / 100	15 / 50 / 100 / 200 / 500
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	20 / 6 / 3 / 1.5 / 0.6
Resonance frequency kHz	180 / 320	750 / 1000 / >1000 / >1000	750 / 1000 / >1000 / >1000	180 / 320 / 500	140 / 240 / 350 / 450 / 900
Non linearity (typ) %FSO	0.2	0.2	0.2	0.15 / 0.1 / 0.1	0.25 / 0.25 / 0.25 / 0.4 / 0.4
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)	-54 to +260 (-65 to +500)
Burst pressure psi	75 / 250	800 / 2000 / 4000 / 4000	800 / 2000 / 4000 / 4000	75 / 250 / 400	30 / 100 / 200 / 400 / 1000
Face diameter mm (in)	6.35 (0.25)	3.86 (0.152)	3.86 (0.152)	3.86 (0.152)	3.86 (0.152)
Weight grams	0.08	2.3	2.3	2.3	8.5
Mounting method	Adhesive	10-32 UNF-2A	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	22	2222C	2222D	2226C	2229C
Description	Micro-miniature teardrop	Miniature teardrop	Miniature teardrop Hermetic	Lightweight Miniature	Miniature Stud mount
Sensitivity pC/g typical	0.4	1.4	1.1	2.8	2.8
Sinusoidal limit g	2500	1000	1000	1000	1000
Shock limit g	10,000	10,000	10,000	2000	2000
Frequency response ±1 dB Hz	3 to 12,000	1–10,000	0.1–12,000	0.1–7000	0.1–7000
Operating temperature °C (°F)	-73 to +150 (-100 to +300)	-73 to +177 (-100 to +350)	-55 to +175 (-67 to +347)	-55 to +177 (-67 to +350)	-55 to +177 (-67 to +350)
Signal/ground isolation	Yes	Yes	No	No	Yes
Hermetic seal	No	No	Yes	No	No
Weight grams (without cable)	0.14	0.5	1.0	2.8	4.9
Dimensions mm (in)	Ø 3.76 x 2.79 (Ø 0.148 x 0.110)	9.53 hex x 4.8 (Ø 0.25 x 0.13)	Ø 6.35 x 4.1 (Ø 0.25 x 0.16)	9.53 hex x 5.8 (3/8 hex x 0.19)	11.13 hex x 5.5 (7/16 hex x 0.22)
Mounting method	Adhesive	Adhesive	Adhesive	Adhesive	Stud
Cable included	3095A-120	3090C-120	3053V-120	3060D-120	3060D-120



## Precision lab testing

Model number	2221D	2224C	2228C
Description	Thru-hole mount 360° cable orientation	Precision lab testing	Triaxial Ground isolated
Sensitivity pC/g typical	17	12	2.8
Sinusoidal limit g	1000	1000	1000
Shock limit g	5000	2000	2000
Frequency response ±1 dB Hz	0.1–10,000	0.1–10,000	0.1–6000
Operating temperature °C (°F)	-55 to +177 (-67 to +350)	-55 to +177 (-67 to +350)	-55 to +177 (-67 to +350)
Signal/ground isolation	Yes	No	Yes
Hermetic seal	No	No	No
Weight grams (without cable)	12	16	15
Dimensions mm (in)	Ø 15.24 x 8.0 (Ø 0.6 x 0.315)	14.2 hex x 13.7 (9/16 hex x 0.54)	18.72 x 18.72 x 11.68 (0.737 x 0.737 x 0.460)
Mounting method	Screw	Stud	Screw
Cable included	3090C-120	3090C-120	3060D-120 (3)

## Piezoelectric accelerometers

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### Shock

Model number	2225M5A	2225
Description	Very high g shock	High g shock
Sensitivity pC/g typical	0.025	0.75
Sinusoidal limit g	NA	10,000
Shock limit g	100,000	20,000
Frequency response $\pm 1$ dB Hz	NA	1–10,000
Operating temperature °C (°F)	-18 to +66 (0 to +150)	-55 to +177 (-67 to +350)
Signal/ground isolation	No	No
Hermetic seal	No	No
Weight grams (without cable)	13	13
Dimensions mm (in)	14.2 hex x 13.7 (9/16 hex x 0.54)	14.2 hex x 13.7 (9/16 hex x 0.54)
Mounting method	Stud	Stud
Cable included	3060D-120	3090C-120

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### Cryogenic -269°C (-452°F)

Model number	7722 / 7724	2271A / 2271AM20	2272
Description	Immune to thermal transients	High sensitivity side or top exit connector	Wide frequency response
Sensitivity pC/g typical	3.7	11.5	13
Sinusoidal limit g	500	1000	1000
Shock limit g	2500	10,000	2000
Frequency response $\pm 1$ dB Hz	1-6000	1-8000	1-9000
Operating temperature °C (°F)	-269 to +177 (-452 to +350)	-269 to +260 (-452 to +500)	-269 to +269 (-452 to +500)
Signal/ground isolation	7722 - No / 7724 - Yes	Yes	No
Hermetic seal	Yes	Yes	Yes
Weight grams (without cable)	29	27	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)	15.9 hex x 19.8 (5/8 hex x 0.78)
Mounting method	Stud	Stud	Stud
Cable included	3090C-120	3090C-120	3090C-120





+260°C (+500°F)

Model number	2220E	2221F	2230E	2230EM1	6222S
<b>Description</b>	Thru-hole mount 360° cable orientation Lightweight	Thru-hole mount 360° cable orientation	Triaxial Adhesive mount	Triaxial Flange mount	ARINC mount Differential output
<b>Sensitivity</b> pC/g typical	3.0	10	3	3	20 / 50 / 100
<b>Sinusoidal limit</b> g	1000	1000	1000	1000	2000 / 1000 / 500
<b>Shock limit</b> g	5000	3000	2000	2000	4000 / 2000 / 1000
<b>Frequency response</b> ±1 dB Hz	1 to 12,000	0.1–12,000	1–10,000	1–10,000	1–12,000 / 1–9000 / 1–9000
<b>Operating temperature</b> °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)
<b>Signal/ground isolation</b>	Yes	Yes	No	No	Yes
<b>Hermetic seal</b>	Yes	Yes	Yes	Yes	Yes
<b>Weight</b> grams (without cable)	3.1	11	17	22.5	91
<b>Dimensions</b> 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)
<b>Mounting method</b>	Screw	Screw	Adhesive	Screw	Screw
<b>Cable included</b>	3053V-120	3090C-120	3053V-120 (3)	3053V-120 (3)	No



+260°C/+288°C  
(+500°F/+550°F)

Model number	7240C	7201	7703A	7704A
<b>Description</b>	Very high frequency	General purpose	General purpose Radiation tested	General purpose Radiation tested
<b>Sensitivity</b> pC/g typical	3.0	10 / 50 / 100	50 / 100 / 200 / 300 / 1000	50 / 100
<b>Sinusoidal limit</b> g	1000	2000	2000 / 1000 / 850 / 675 / 500	2000 / 1000
<b>Shock limit</b> g	5000	20,000 / 10,000 / 5000	10,000 / 5000 / 2000 / 1600 / 1000	10,000 / 5000
<b>Frequency response</b> ±1 dB Hz	1–20,000	1–15,000 / 1–10,000 / 1–8000	1–9000 / 1–8000 / 1–6000 / 1–5000 / 1–3000	1–9000 / 1–8000
<b>Operating temperature</b> °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)
<b>Signal/ground isolation</b>	No	No	Yes	Yes
<b>Hermetic seal</b>	Yes	Yes	Yes	Yes
<b>Weight</b> grams (without cable)	4.8	18 / 20 / 25	25 / 29 / 62 / 70 / 120	25 / 29
<b>Dimensions</b> 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: 16.0 hex x 19.8 (5/8 hex x 0.78) for -200 / -300 / -1000: 25.4 hex x 23.1 (1.0 hex x 0.91)	16.0 hex x 21.1 (5/8 hex x 0.83)
<b>Mounting method</b>	Stud	Stud	Stud	Stud
<b>Cable included</b>	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.

## Miniature

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Model number	25A	27F11 / F12	27AM1	35C
<b>Description</b>	Ultra miniature	Lightweight teardrop TEDS	Lightweight teardrop	Ultra-miniature triaxial Hermetically sealed
<b>Sensitivity</b> mV/g, typical	5	10 / 100	10 / 100	2 / 5 / 10
<b>Linear range</b> g	±740	±500 / ±50	±500 / ±50	±2800 / ±1400 / ±700
<b>Shock limit</b> g	2000	5000	5000	5000
<b>Frequency response</b> ± 1dB Hz	1-12,000	2-10,000 / 3-10,000 (±10%)	2-10,000 / 3-10,000 (±10%)	2-8000 / 2-8000 / 2-6000 (±5%)
<b>Broadband noise</b> (µg rms)	7000	2000 / 400	2000 / 400	2000 / 1600 / 2700
<b>Operating temperature</b> °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)
<b>Signal/ground isolation</b>	Yes	No	No	No
<b>Hermetic seal</b>	No	Yes	Yes	Yes
<b>Weight</b> grams (without cable)	0.2	0.8 / 1.0	0.8 / 1.0	0.76
<b>Dimensions</b> mm (in)	Ø 0.381 x 2.54 (Ø 0.15 x 0.10)	Ø 6.35 x 6.6 (Ø 0.25 x 0.26)	Ø 6.35 x 4.8 (Ø 0.25 x 0.19)	5.97 cube (0.235 cube)
<b>Mounting method</b>	Adhesive	Adhesive	Adhesive	Adhesive
<b>Cable included</b>	Integral with 3024-120	3053VM1-120	3053VM1-120	Integral

## IEPE accelerometers

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### Small single axis

Model number	2256B	256HX	7250B	7250BM1
Description	Lightweight General purpose	Lightweight General purpose	Ultra wide bandwidth Thru-hole mount	Ultra wide bandwidth Thru-hole mount Solder pins with attached cable
Sensitivity mV/g, typical	10 / 100	10 / 100	2 / 10	2 / 10
Linear range g	±500 / ±50	±500 / ±50	±2500 / ±500	±2500 / ±500
Shock limit g	2000	2000	10,000	10,000
Frequency response ± 1dB Hz	1-10,000 (±10%)	1-10,000 (±10%)	1 to 40,000 (±3 dB)	1 to 40,000 (±3 dB)
Broadband noise (µg rms)	1000 / 300	1000 / 300	3500 / 1000	3500 / 1000
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	1.9
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 9.65 x 6.2 (Ø 0.381 x 0.25)
Mounting method	Adhesive	Stud	Screw	Screw
Cable included	3061A-120	3061A-120	3091F-120	3024-120 (attached)

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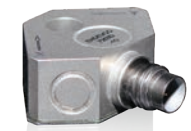
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### Small triax

Model number	65 / 65M1	66F50 / F11 / F12	66N5 / N6	7253C	7253D
Description	Industry standard	Triaxial TEDS	TEDS Isolated	Triaxial Wide bandwidth Lightweight	Triaxial Thru hole mount Lightweight
Sensitivity mV/g, typical	10 / 100	5 / 10 / 100	10 / 100	10	10 / 100
Linear range g	±500 / ±50	±1000 / ±500 / ±50	±500 / ±50	±500	±500 / ±50
Shock limit g	10,000	10,000	10,000	2000	5000
Frequency response ± 1dB Hz	0.4-10,000 / 1.5-6000	0.4-7000 / 0.4-14,000 / 1.5-10,000	0.4-14,000 / 1.5-10,000	2-15,000	2-10,000 / 3-10,000 (±10%)
Broadband noise (µg rms)	800 / 400	6000 / 800 / 400	800 / 400	2000	2000 / 400
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)	-55 to +125 (-67 to +257)
Signal/ground isolation	65: No / 65M1: Yes	No	Yes	Yes	Yes
Hermetic seal	Yes	Yes	Yes	No	Yes
Weight grams (without cable)	5	5	5.7	3.6	10
Dimensions mm (in)	65: 10 cube (0.39 cube) 65M1: 11.2 cube (0.44 cube)	10 x 10 x 13 (0.39 x 0.39 x 0.52)	11.2 x 11.2 x 14.2 (0.44 x 0.44 x 0.56)	15.2 x 15.2 x 7.1 (0.60 x 0.60 x 0.28)	17.8 x 17.8 x 9.5 (0.70 x 0.70 x 0.375)
Mounting method	Stud / adhesive	Stud	Adhesive	Screw	Screw
Cable included	3027AM3-120	3027AM3-120	3027AM3-120	3027AM3-120	3027AM3-120

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## General purpose

Model number	7251A	2258A	44A	45A
Description	Thru-hole mount	Triaxial Three 10-32 connectors	Triaxial TEDS	High sensitivity Triaxial TEDS
Sensitivity mV/g, typical	10 / 100 / 500	10 / 100	10 / 100	1000
Linear range g	±500 / ±50 / ±10	±500 / ±50	±500 / ±50	±5
Shock limit g	5000	2000	5000	5000
Frequency response ± 1dB Hz	2-10,000 (±10%)	1-7000 (±10%)	0.3-6000	0.3-7500
Broadband noise (µg rms)	1000 / 250 / 150	1000 / 300	200 / 50	40
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	No	No
Hermetic seal	Yes	Yes	Yes	Yes
Weight grams (without cable)	10.5	15	13	40
Dimensions mm (in)	∅ 15.2 x 8.9 (∅ 0.60 x 0.35)	18.7 x 18.7 x 11.7 (0.74 x 0.74 x 0.46)	13.7 cube (0.54 cube)	20 cube (0.79 cube)
Mounting method	Screw	Screw	Stud	Stud
Cable included	3061A-120	3061A-120 (3)	None	None

## IEPE accelerometers

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### Specialty

Model number	27BLPF	7250A	7250AM1	7251F11 / F12	7251HT
<b>Description</b>	Lightweight teardrop Integrated low-pass filter High temperature	Thru-hole mount Lightweight Wide bandwidth	Thru-hole mount Wide bandwidth Solder pins	Thru-hole mount TEDS	Thru-hole mount High temperature
<b>Sensitivity</b> mV/g, typical	10	2 / 10	2 / 10	10 / 100	10 / 100 / 500
<b>Linear range</b> g	±500	±2500 / ±500	±2500 / ±500	±500 / ±50	±500 / ±50 / ±10
<b>Shock limit</b> g	5000	10,000	10,000	5000	5000
<b>Frequency response</b> ± 1dB Hz	1-1400 (2 kHz filter) / 1-7000 (10 kHz filter)	3-20,000 / 4-20,000	3-20,000 / 4-20,000	2 - 10,000 (+/-10%)	0.2 - 12,000 (+/-10%)
<b>Broadband noise</b> (µg rms)	8000	3500 / 1000	3500 / 1000	2000 / 300	300 / 120 / 120
<b>Operating temperature</b> °C (°F)	-55 to +175 [-67 to +347]	-55 to +125 [-67 to +257]	-55 to +125 [-67 to +257]	-55 to +125 [-67 to +257]	-55 to +150 [-67 to +302]
<b>Signal/ground isolation</b>	No	Yes	Yes	Yes	Yes
<b>Hermetic seal</b>	Yes	Yes	Yes	Yes	Yes
<b>Weight</b> grams (without cable)	0.8	1.8	1.8	10.5	14
<b>Dimensions</b> mm (in)	Ø 6.35 x 6.6 (Ø 0.25 x 0.26)	Ø 9.78 x 5.8 (Ø 0.385 x 0.23)	Ø 9.78 x 5.8 (Ø 0.385 x 0.23)	Ø 15.2 x 8.8 (Ø 0.60 x 0.35)	Ø 15.2 x 10.7 (Ø 0.60 x 0.42)
<b>Mounting method</b>	Adhesive	Screw	Screw	Screw	Screw
<b>Cable included</b>	3053VM1-120	3091F-120	3024-120	3061A-120	3061A-120

IEPE accelerometers

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### Specialty

Model number	7259B	7255A	2255B
<b>Description</b>	Very high frequency Lightweight	Near-field shock Integral mechanical filter	High g shock Far field
<b>Sensitivity</b> mV/g, typical	10 / 25 / 100	0.1 / 1	0.1 / 1
<b>Linear range</b> g	±500 / ±200 / ±50	±50,000 / ±5000	±50,000 / ±5000
<b>Shock limit</b> g	10,000 / 5000 / 2000	300,000 / 25,000	50,000
<b>Frequency response</b> ± 1dB Hz	5-10,000	3-10,000 (± 3 dB)	2-20,000 / 0.5-20,000
<b>Broadband noise</b> (µg rms)	1500 / 1500 / 200	500,000 / 50,000	500,000 / 50,000
<b>Operating temperature</b> °C (°F)	-55 to +125 [-67 to +257]	-18 to +66 [0 to +150]	-55 to +125 [-67 to +257]
<b>Signal/ground isolation</b>	Yes (with 2980M12)	Yes	Yes
<b>Hermetic seal</b>	Yes	Yes	No
<b>Weight</b> grams (without cable)	4.4	5	2
<b>Dimensions</b> mm (in)	9.53 hex x 11.68 [3/8 hex x 0.46]	9.52 hex x 15.5 [3/8 hex x 0.610]	7.92 hex x 10.2 [0.312 hex x 0.40]
<b>Mounting method</b>	Stud	Stud	Stud
<b>Cable included</b>	3053VM1-120	3024-120	3024-120

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## Specialty

Model number	2250A / 2250AM1	67	65HT / 65HTM1
<b>Description</b>	Small teardrop Wide bandwidth Removable cable/solder pins	Triaxial High temperature High sensitivity	Triaxial High temperature
<b>Sensitivity</b> mV/g, typical	10	10 / 100	0.5 / 1 / 10
<b>Linear range</b> g	±500	±500 / ±50	±10,000 / ±5000 / ±500
<b>Shock limit</b> g	2000	5000	15,000 / 10,000 / 10,000
<b>Frequency response</b> ± 1dB Hz	2 - 15,000	0.15-10,000 / 0.5-10,000	0.5-8000
<b>Broadband noise</b> (µg rms)	1500	1400 / 450	8000 / 4000 / 600
<b>Operating temperature</b> °C (°F)	-55 to +125 (-67 to +257)	-55 to +175 (-67 to +347)	-55 to +175 (-67 to +347)
<b>Signal/ground isolation</b>	Yes	No	65HT: No / 65HTM1: Yes
<b>Hermetic seal</b>	No	Yes	Yes
<b>Weight</b> grams (without cable)	0.4	14	65HT: 5 / 65HTM1: 6
<b>Dimensions</b> mm (in)	Ø 5.84 x 4.06 (Ø 0.23 x 0.16)	14.81 cube (0.58 cube)	65HT: 10 cube (0.39 cube) 65HTM1: 11.2 cube (0.44 cube)
<b>Mounting method</b>	Adhesive	Stud	Stud
<b>Cable included</b>	3006-120 / 3024-120	3027AVM13-84 / 3027AM3-36	3027AVM13-84 / 3027AM3-36

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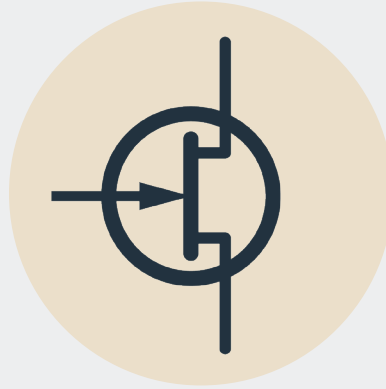
## Specialty

Model number	65HTLPF / 65HTLPM1	65L
<b>Description</b>	Triaxial High temperature Integrated low-pass filter	Triaxial Miniature Low frequency response
<b>Sensitivity</b> mV/g, typical	10	100
<b>Linear range</b> g	±500	± 50
<b>Shock limit</b> g	10,000	10,000
<b>Frequency response</b> ± 1dB Hz	65HTLPF: 0.5-1400 (2 kHz filter) 65HTLPM1: 0.5-7000 (10 kHz filter)	0.5-8000
<b>Broadband noise</b> (µg rms)	4000	400
<b>Operating temperature</b> °C (°F)	-55 to +175 (-67 to +347)	-55 to +125 (-67 to +257)
<b>Signal/ground isolation</b>	65HTLPF: No / 65HTLPM1: Yes	No
<b>Hermetic seal</b>	Yes	Yes
<b>Weight</b> grams (without cable)	5	5
<b>Dimensions</b> mm (in)	65HTLPF: 10 cube (0.39 cube) / 65HTLPM1: 11.2 cube (0.44 cube)	10 cube (0.39 cube)
<b>Mounting method</b>	Stud	Stud
<b>Cable included</b>	3027AVM13-84 / 3027AM3-36	3027AM3-120

# 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
<b>Features</b>	Airborne applications Small, lightweight	Airborne applications Small, lightweight	2 gain options Airborne applications Acceleration and velocity outputs	4 gain options Supports TEDS	Designed for use with extreme high temp sensors, 1200°F (650°C)
<b>Input</b>	PE	IEPE	DIFF PE	PE	PE
<b>Channels</b>	1	1	1	1	1
<b>Gain</b>	0.1–100 mV/pC	0.1–100 mV/mV	2 / 10 mV/pC	0.1 / 1 / 5 / 10 mV/pC	1 mV/pC
<b>Broadband noise rms</b>	1.5 mV	1.5 mV	1/5 mV (RTO)	5 / 30 / 50 / 50 µV	10 µV
<b>Lower cutoff freq Hz (-3 dB)</b>	3	0.7	5.73 / 8.59 / 11.5 / 14.3 / 113	0.4 / 0.4 / 2 / 2	2
<b>Upper cutoff freq Hz (-3 dB)</b>	Selectable	Selectable	17,500	8 / 30,000 / 50,000 / 50,000 (±5%)	30
<b>Power requirements VDC</b>	20-32	20-32	22–31	24-30	24-30
<b>Operating temperature °C (°F)</b>	-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]
<b>Weight grams</b>	34	34	227	57	57

## Single channel programmable signal conditioners



Model number	2721B	6634C	4416C	4418
<b>Features</b>	Charge amplifier Ideal for very high temperature PE sensors	Acceleration, velocity and displacement outputs Optional programmable filter Alarm outputs	IEPE power supply Portable and compact Rechargeable battery	Bridge signal conditioner Portable and compact ZMO adjustment
<b>Input</b>	PE	SEPE / DIFF PE / IEPE / Velocity coil / RCC	IEPE	PR, VC
<b>Channels</b>	1	1	1	1
<b>Gain</b>	1-100 mV/pC	Selectable	1, 10, 100 selectable	1, 10, 100 selectable
<b>Broadband noise rms</b>	100	1 mV	< 20 µV	<20 µV
<b>Lower cutoff freq Hz (-3 dB)</b>	1	2 (±5%)	0.1	DC
<b>Upper cutoff freq Hz (-3 dB)</b>	10,000	20,000 (±5%)	100,000	10,000
<b>Power requirements</b>	±15 VDC	90–240	Battery powered, rechargeable	Battery powered, rechargeable
<b>Type of control</b>	Manual	Manual / RS-232	Manual	Manual
<b>Rack mount</b>	N/A	4948	N/A	N/A

## Signal conditioners

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3-channel  
programmable  
signal conditioners

Model number	133	136
Input	PE / IEPE / RCC	PR / VC
Channels	3	3
Gain	0-1000	0-1000
Display	DPM	DPM
Broadband noise rms	20 $\mu$ V RTI and 400 $\mu$ V RTO	20 $\mu$ V RTI and 1 mV RTO
Lower cutoff freq $\pm$ 5 Hz	0.1	DC
Upper cutoff freq $\pm$ 5 Hz	50,000	50,000
Power requirements VAC	90-264 133-1 version: 12-18 VDC	90-264 136-1 version: 9-18 VDC
Type of control	Manual / RS-232	Manual / RS-232
Rackmount part number	31979	31979
Features	<ul style="list-style-type: none"> <li>• Optional HP and LP filters</li> <li>• Sensor fault indicators</li> <li>• User selectable current excitation</li> <li>• Control software</li> <li>• Programmable gain</li> </ul>	<ul style="list-style-type: none"> <li>• Programmable excitation voltage</li> <li>• Programmable gain</li> <li>• Auto-zero</li> <li>• Optional LP filter</li> <li>• Remote sense</li> <li>• Control software</li> </ul>

# 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 High temperature Vibration compensated	High intensity sound High temperature Vibration compensated
Type	Pressure	Pressure
Sensitivity pC rms@140 dB SPL	31	31
Frequency range ±1 dB Hz	2-4000	2-4000
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.



## Model C

The model C cable assembly family allows for user selectable cable configurations to meet a wide variety of applications. The family is specifically designed for use with single axis accelerometers, as well as other transducers. Users can specify the sensor side connector, cable type, instrumentation side connector, and overall cable assembly length in inches.

### Cable assembly ordering guide

#### Part number configuration

C - WWW - XX - YYY - ZZZZ



#### Four steps to creating a cable assembly

- WWW** 1. Select sensor side connector
- XX** 2. Select cable type
- YYY** 3. Select instrumentation side connector
- ZZZZ** 4. Select cable assembly length (inches)

## Connectors specifications

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	WWW	YYY	001	002	006
Physical	<b>Connector type</b>		10-32 plug	BNC plug	Pigtails (leads stripped and tinned)
	<b>Weight</b> oz (g)		0.11 (3.0)	0.36 (10.3)	NA
	<b>Temperature</b> °C (°F)		-55 to +260 (-67 to +500)	-55 to +200 (-67 to +392)	NA
	<b>Strain relief</b>		Silicone molded boot	Silicone molded boot	NA
	<b>Connector OD</b> in (mm)		6.8 (0.27)	18.8 (0.54)	NA

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	XX	AA	AB	AC	AD	
Physical	<b>Cable type</b>		Coaxial Low noise	Coaxial Low noise	Coaxial General purpose	Coaxial General purpose
	<b>Min bend radius</b> in (mm)		0.850 (21.59)	0.950 (24.13)	0.850 (21.59)	0.850 (21.59)
	<b>Conductor size</b> AWG		30	28	30	30
	<b>Conductor material</b>		Silver-plated annealed copperweld	Silver-plated annealed copperweld	Silver-plated annealed copperweld	Silver-plated annealed copperweld
	<b>Conductor style</b>		Stranded	Solid	Stranded	Stranded
	<b>Shield material</b>		Silver-plated copper	Silver-plated copper	Silver-plated copper	Silver-plated copper
	<b>Jacket material</b>		Wrapped Teflon®	Extruded silicone	Extruded Teflon®	Extruded silicone
	<b>Jacket color</b>		Red	Red	White	Natural
	<b>Weight</b> grams/ft		3.1	3.1	2.7	2.7
	<b>Diameter</b> in (mm), max		0.09 (2.29)	0.097 (2.47)	0.085 (2.16)	0.09 (2.29)
Electrical	<b>Capacitance</b> pF/ft		35	40	30	30
	<b>Conductor resistance</b> Ω/ft, max		0.3	0.2	0.25	0.25
Environmental	<b>Temperature</b> °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)
	<b>Noise</b> pC pk-pk, max		1.5	1.5	NA	NA
	<b>Pull strength</b> lbs		20	20	20	20

## Examples of our most popular assemblies

- C-001-AC-002-0120: 10-32, general purpose, Teflon® jacket, BNC, 120 inches (10 ft)
- C-001-AA-001-0240: 10-32, low noise, Teflon® jacket, 10-32, 240 inches (20 ft)

## Cable assemblies

### Miniature

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Model number	3003C	3053V	3053VM1	3091F	3093M10	3095A
Connector 1	1.00 UNM, male receptacle	M3 male plug, hex end	M3 male plug, hex end	6-40 UNF-2B female plug	10-32 female socket	1-64 UNC
Connector 2	1-64 UNC-2A, female plug	10-32 male plug, hex end	BNC male plug	10-32 male plug	1-64 UNC	10-32 male plug
Cable type	Coaxial	Coaxial, shielded	Coaxial, shielded	Coaxial, shielded	Coaxial, shielded	Coaxial, shielded
Capacitance pF/ft, max	25	32	32	40	30	30
Conductor size AWG	Solid, 40	Solid, 33	Solid, 33	Solid, 33	Solid, 33	Solid, 33
Jacket material	Teflon®	Extruded Teflon®, VersaFlex	Extruded Teflon®, VersaFlex	Wrapped Teflon®	Wrapped Teflon®	Wrapped Teflon®
Overall diameter in, max	0.024	0.054	0.054	0.06	0.06	0.06
Bend radius in, min	0.1	0.5	0.5	0.12	0.12	0.12
Temperature range °C (°F)	-73 to +177 (-100 to +350)	-254 to +260 (-432 to +500)	-55 to +200 (-67 to +392)	-184 to +260 (-300 to +500)	-73 to +177 (-100 to +350)	-184 to +177 (-300 to +350)
Low noise treated	No	Yes	Yes	Yes	Yes	Yes

### Standard coaxial

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Model number	3090C	3090CM12	3090CM67	3090DV	3060D
Connector 1	10-32 male plug	10-32 male plug	10-32 male plug, hex	10-32 male plug, hex end	10-32 male plug
Connector 2	10-32 male plug	BNC male plug	10-32 male plug, hex	10-32 male plug, hex end	10-32 male plug
Cable type	Coaxial, shielded	Coaxial, shielded	Coaxial, shielded	Coaxial, shielded	Coaxial, shielded
Capacitance pF/ft, max	40	32	35	32	50
Conductor size AWG	Stranded, 30	Stranded, 30	Stranded, 30	Stranded, 30	Solid, 28
Jacket material	Wrapped Teflon®	Wrapped Teflon®	Wrapped Teflon® with Kevlar® reinforcement and protective metal overbraid	Extruded Teflon®, VersaFlex	Extruded silicon
Overall diameter in, max	0.08	0.08	0.12	0.08	0.092
Bend radius in, min	0.85	0.85	0.85	0.75	0.95
Temperature range °C (°F)	-269 to +260 (-452 to +500)	-185 to +260 (-300 to +500)	-55 to +260 (-67 to +500)	-254 to +260 (-432 to +500)	-73 to +260 (-100 to +500)
Low noise treated	Yes	Yes	Yes	Yes	Yes

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Model number	3061	3061A	3096	3097M1
Connector 1	10-32 male plug	10-32 male plug	10-32 male plug, hex	10-32 male plug
Connector 2	BNC 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	28	28	35	39
Conductor size AWG	Stranded, 30	Stranded, 30	Stranded, 30	Stranded, 30
Jacket material	Extruded Teflon®	Extruded silicone	Wrapped Teflon with Kevlar® reinforcement	Extruded Tefzel
Overall diameter in, max	0.08	0.08	0.115	0.09
Bend radius in, min	0.85	0.85	0.85	0.85
Temperature range °C (°F)	-100 to +260 (-148 to +500)	-55 to +200 (-67 to +392)	-55 to +260 (-67 to +500)	-55 to +150 (-67 to +302)
Low noise treated	No	No	Yes	Yes

Multi conductor

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Model number	6917B	6917D	3024	3024M1	3027A	3027AM3
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 plug	4 socket plug	4 socket plug
Connector 2	Pigtail	Pigtail	Pigtail	Pigtail	Pigtail	3x BNC male plug
Cable type	Twisted pair, shielded	Twisted pair, shielded	Twisted pair	Twisted pair, shielded	4 conductor, shielded	4 conductor, shielded
Capacitance pF/ft, max	80	80	N/A	N/A	16	30
Conductor size AWG	Stranded, 20	Stranded, 20	Stranded, 28	Stranded, 28	Stranded, 32	Stranded, 28
Jacket material	Wrapped Teflon®	Wrapped Teflon®	No overall jacket	Extruded Teflon®	Extruded silicone	Extruded PVC
Overall diameter in, max	0.21	0.21	0.055	0.094	0.108	0.105
Bend radius in, min	0.6	0.6	0.75	0.75	0.5	N/A
Temperature range °C (°F)	-54 to +260 (-65 to +500)	-54 to +288 (-65 to +550)	-184 to +176 (-300 to +350)	-184 to +176 (-300 to +350)	-100 to +125 (-148 to +257)	-55 to +85 (-67 to +185)
Low noise treated	Yes	Yes	No	No	No	No

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Model number	3027AM17	3027AVM13	3090CM71	3907	6907M2	6917M169	6923M18
Connector 1	4 socket plug, IP67, hex end	4 socket plug	10-32 male plug	Mighty Mouse female plug	3 socket plug	3 socket plug	MIL 5015C, female plug (2 socket)
Connector 2	3x BNC male plug	4 pin receptacle	10-32 male plug	Pigtail	Pigtail	Pigtail	BNC male plug
Cable type	4 conductor, shielded	4 conductor, shielded	Coaxial, shielded	6 conductor, shielded	3 conductor, shielded	Twisted pair, shielded	Twisted pair, shielded
Capacitance pF/ft, max	30	16	40	12	N/A	80	20
Conductor size AWG	Stranded, 28	Stranded, 28	Stranded, 30	Stranded, 30	Stranded, 22	Stranded, 20	Stranded, 20
Jacket material	Extruded PVC	Extruded Teflon®, VersaFlex	Wrapped Teflon®, Low outgassing	Wrapped Teflon®	Extruded Teflon®	Wrapped Teflon®	Extruded Teflon®
Overall diameter in, max	0.105	0.105	0.08	0.13	0.15	0.21	0.17
Bend radius in, min	N/A	N/A	0.85	1	0.5	0.6	0.52
Temperature range °C (°F)	-55 to +85 (-67 to +185)	-100 to +200 (-148 to +392)	-269 to +260 (-452 to +500)	-55 to +150 (-67 to +302)	-55 to +125 (-67 to +257)	-54 to +260 (-65 to +500)	-54 to +200 (-65 to +392)
Low noise treated	No	No	Yes	No	No	Yes	No

# 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	2950M16	2950M18
<b>Description</b>	Triaxial mounting block 10-32 threaded holes 4-40 screw mount provided	Triaxial mounting block 6-32 threaded holes 4-40 Screw mount provided	Triaxial mounting block Adhesive mount	Triaxial mounting block 2-56 threaded holes 4-40 mounting screw provided
<b>Material</b>	Anodized aluminum	Anodized aluminum	Anodized aluminum	Anodized aluminum
<b>Compatibility</b>	Accelerometers with 10-32 stud	2221D, 2221F, 7221A, 7251A	25A, 25B	2220E, 7250A, 7250AM1
<b>Dimensions mm (in)</b>	25.4 x 25.4 x 17.0 (1.0 x 1.0 x 0.67)	22.22 x 22.22 x 15.88 (0.875 x 0.875 x 0.625)	7.24 x 7.87 x 6.0 (0.285 x 0.310 x 0.236)	12.7 x 12.7 x 10.16 (0.50 x 0.50 x 0.40)
<b>Weight grams</b>	20.5	20.5	0.5	3.7

### Mounting blocks



Model number	7930	7953A	7957	7964B
<b>Description</b>	Triaxial and 6DOF Block 2-56 screws for mounting 0-80 threaded holes	Triaxial mounting block 2-56 screws for mounting 0-80 threaded holes	Triaxial mounting block Adhesive mounting	Triaxial mounting block 2-56 screws for mounting 0-80 threaded holes
<b>Material</b>	Aluminum alloy	Magnesium alloy	Stainless steel	Aluminum alloy
<b>Compatibility</b>	7310 (rate), 7264C, 7264H, 726C (accels)	7264-2000, 7264C, 7264D, 7264H, 726C, 757F	757A	7264B
<b>Dimensions mm (in)</b>	21.72 x 21.72 x 11.56 (0.855 x 0.855 x 0.455)	16.51 x 16.51 x 10.92 (0.650 x 0.650 x 0.430)	15.75 x 13.97 x 7.62 (0.620 x 0.550 x 0.300)	16.51 x 16.51 x 10.92 (0.650 x 0.650 x 0.430)
<b>Weight grams</b>	9.7	5.1	6.8	7.9



## Mounting blocks



Model number	7980	7970	7990
<b>Description</b>	Triaxial mounting block 6-32 screws for mounting 4-40 threaded holes	Triaxial mounting block 6-32 screws for mounting 4-40 threaded holes	Triaxial mounting block 6-32 screws for mounting 4-40 threaded holes
<b>Material</b>	Titanium	Titanium	Aluminum alloy
<b>Compatibility</b>	7270AM7, 7280AM7	7270A, 7280A	7290G, 7290GM5, 7290D
<b>Dimensions mm (in)</b>	27.94 x 15.24 x 10.16 (1.100 x 0.600 x 0.400)	20.32 x 15.24 x 10.39 (0.800 x 0.6.00 x 0.409)	26.04 x 25.40 x 25.40 (1.025 x 1.0 x 1.0)
<b>Weight grams</b>	21	10.6	40

## Adapters



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

## Adapters



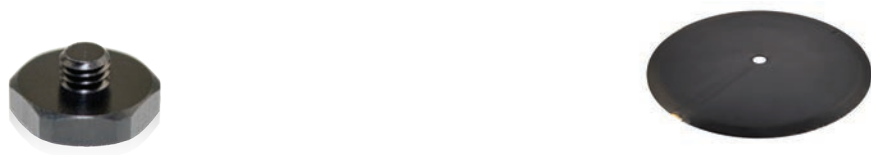
Model number	42673-1	42673-2	42673-3	42673-4
<b>Description</b>	Isolated mounting adapter 10-32 stud to 10-32 stud 1 inch hex	Isolated mounting adapter 10-32 stud to 1/4-28 stud 1 inch hex	Isolated mounting adapter 10-32 stud to M6 stud 1 inch hex	Isolated mounting adapter 10-32 stud to M5 stud 1 inch hex
<b>Material</b>	Anodized aluminum	Anodized aluminum	Anodized aluminum	Anodized aluminum
<b>Compatibility</b>	41A, 42A, 45A	41A, 42A, 45A	41A, 42A, 45A	41A, 42A, 45A

## Accessories



### Adapters

Model number	42674-1	42674-2	42674-3	42674-4	42675
<b>Description</b>	Isolated mounting adapter 6-32 stud to 10-32 stud 3/4 inch hex	Isolated mounting adapter 6-32 stud to 1/4-28 stud 3/4 inch hex	Isolated mounting adapter 6-32 stud to M6 stud 3/4 inch hex	Isolated mounting adapter 6-32 stud to M5 stud 3/4 inch hex	Adhesive mounting adapter -1 has 10-32 stud -2 has 6-32 stud
<b>Material</b>	Anodized aluminum	Anodized aluminum	Anodized aluminum	Anodized aluminum	Anodized aluminum
<b>Compatibility</b>	44A	44A	44A	44A	-1 for 41A, 42A, 45A -2 for 44A



### Mounting bases

Model number	2988	30042
<b>Description</b>	Adhesive mounting base to 10-32 stud 1/2 inch hex	Aerodynamic mounting pad
<b>Material</b>	Anodized aluminum	Urethane
<b>Compatibility</b>	10-32 threaded hole accelerometers	8515C
<b>Dimensions</b> 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
<b>Description</b>	Mounting stud 10-32 stud to 10-32 stud Slotted head	Mounting stud 10-32 stud to M5 stud Slotted head	Mounting stud 10-32 stud Hex socket head
<b>Material</b>	Stainless steel	Stainless steel	Stainless steel
<b>Compatibility</b>	10-32 threaded hole accelerometers	10-32 threaded hole accelerometers	10-32 threaded hole accelerometers



### Mounting studs

Model number	42677-1	42677-2	42677-3	42677-4
<b>Description</b>	Mounting stud 6-32 to 10-32 stud Slotted head	Mounting stud 6-32 to 1/4-28 Slotted head	Mounting stud 6-32 to M6 stud Slotted head	Mounting stud 6-32 to M5 stud Slotted head
<b>Material</b>	Stainless steel	Stainless steel	Stainless steel	Stainless steel
<b>Compatibility</b>	44A	44A	44A	44A

## Mounting studs



Model number	42676-1	42676-2	42676-3	42676-4
<b>Description</b>	Mounting stud 10-32 to 10-32 stud Slotted head	Mounting stud 10-32 to 1/4-28 stud Slotted head	Mounting stud 10-32 to M6 stud Slotted head	Mounting stud 10-32 to M5 stud Slotted head
<b>Material</b>	Stainless steel	Stainless steel	Stainless steel	Stainless steel
<b>Compatibility</b>	41A, 42A, 45A	41A, 42A, 45A	41A, 42A, 45A	41A, 42A, 45A

## Miscellaneous accessories

Model	Description
16678	Blank panel for 4948 rack
17180	Power cord assembly for 6634C, for 120V operation
21997	Plug accessory kit for 2680 and 2685
26574	Plug assembly for 6917B cable
30279	PR/VC mounting fixture
31979	Rack mount kit for 133 and 136, holds 3 units
33268	10-32 to 10-32 in-line adaptor, +900F
40150	Blank panel for 4948A rack
17180V	Power cord assembly for 6634C, 230V operation
4948	Rack mount kit for 6634C, holds 6 units
EHM2107	Power adaptor, 12VDC, for 4416C
EHM1409	Automotive power plug, for 133-1 and 136-1
EHM1413	Desktop DC power supply, for 133-1 and 136-1
EHM1471	Blank panel for 31979 rack mount kit
EJ1085	4 socket plug, used on 3027A series cable assemblies
EJ1183	10-32 Microdot to BNC adaptor
EJ34	10-32 to 10-32 in-line adaptor

Model	Description
EJ600	25 pin D connector
EJ66	Feed-thru bulkhead microdot connector
EJ720	Input connector, Bendix 2 pin straight plug for 2777A
EJ721	Output connector, Bendix 6 pin socket plug for 2777A
EJ724-U	9 Pin D-sub connector for 126 and 136
EJ807	Serial DB9F to RJ-11 adapter for 133 and 136
EJ822	Modular splitter adapter, 1 (6x4) male to 3 (6x4) female for 133 and 136
EJ847	RJ11 (6x4) straight wired inline coupler for 133 and 136
EP171	Adaptor, 10-32 to female BNC
EP31	Potting sleeve for 2680 and 2685
EP310	Adaptor, 10-32 plug to 10-32 receptacle, right angle
EP316	Twinax BNC Plug
EP35	Connector hood for 2680 and 2685
EP38	Mating plug for 2680 and 2685
EP685	10-32 plug
EP686	BNC plug
EP695	10-32 to BNC adaptor for 4830B
EW1196	D-sub cable, DB25 male / female, 2.5 ft
EW1400	USB cable for 4830B

# Calibration systems and instrumentation

## Accelerometer Calibration Systems

The Modal Shop Inc. (TMS), a wholly-owned subsidiary of PCB Piezotronics (PCB), designs, manufactures, and supports precision sensor calibration systems. With installations around the globe, The Modal Shop, PCB, and Endevco are dedicated to the metrology community and committed to delivering quality, performance, and reliability in calibration. The Accelerometer Calibration Workstation is the result of decades of investment by PCB and its affiliates in calibration technology, helping you ensure the accuracy of your sensors and, ultimately, your measurements.

### Applications

- Vibration Calibration
- Shock Calibration
- Low Frequency Calibration



Provided By



The Accelerometer Calibration Workstation Model 9155 from The Modal Shop delivers accurate back-to-back comparison calibration of ICP®/ Isotron® (IEPE), charge mode (PE), piezoresistive (PR), and capacitive (VC) accelerometers in accordance with ISO 16063-21: 2003. Calibration of velocity, 4-20 mA and dynamic pressure transducers, visual output meters, and instrumented force hammers are also supported. A range of vibration and shock exciter options bring you a wide scope of capabilities. Each system provides all the necessary components 'out-of-the-box' – from precision actuators to state-of-the-art data acquisition hardware paired with a Windows® PC software controller.

Model 9155 offers a streamlined calibration process delivering efficient throughput. Cost reducing automation is built in to the easy-to-use software, offering a streamlined approach to calibration procedures, as test parameters are stored and recalled automatically for each accelerometer. This makes for 'hands-off' operation once the sensor is mounted. Calibration are typically performed in a minute per axis – a substantial time savings over older, more traditional systems.

Model 9155 will serve as a replacement for the Endevco Commercial Automated Accelerometer Calibration System (CAACS). For information or support related to an existing CAACS, contact The Modal Shop at [calibration@modalshop.com](mailto:calibration@modalshop.com).

### Features

- Vibration calibration 0.1 Hz to 20 kHz
- Shock calibration: 20 g to 10 000 g
- Calibrate ICP®/ Isotron® (IEPE), charge (PE), piezoresistive (PR), capacitive (VC), and voltage mode accelerometers
- Assures accurate, NIST and PTB traceable calibrations
- Calibration typically performed in under a minute per axis
- Setup tests, acquire data, save results, and archive data quickly
- Customizable calibration certificates comply with ISO 17025 and ISO 16063-21 requirements
- Configurable system fits range of applications

Specifications				
Frequency range	5 Hz - 15 kHz with 9155D-830 Air Bearing Shaker 5 Hz - 20 kHz with 9155D-831 Air Bearing Shaker		0.5 Hz - 500 Hz with 9155D-771 Low Frequency Shaker 0.1 Hz - 500 Hz with 9155D-779 Low Frequency Shaker	
Typical measurement uncertainty <sup>1,2</sup>	2.0% (5 Hz - 10 Hz) 1.2% (10 Hz - 100 Hz)	0.8% (100 Hz) 1.0% (100 Hz - 1,000 Hz)	1.4% (1,000 Hz - 5,000 Hz) 1.9% (5,000 Hz - 10,000 Hz)	2.2% (10,000 Hz - 15,000 Hz) 2.8% (15,000 Hz - 20,000 Hz)
Calibration method	Back-to-back comparison per ISO 16063-21			
Measurements	Sensitivity, Amplitude, Phase, Bias, Resonance <sup>3</sup> , Linearity <sup>3</sup> , Shock <sup>3</sup>			
Accelerometers supported	DC Offset, Bridge Resistance, DC Sensitivity, ICP®/ Isotron® (IEPE), Charge (PE), Voltage, Capacitive <sup>4</sup> (VC), Piezoresistive <sup>5</sup> (PR), CVLD			
TEDS sensor support	IEEE 1451.4, IEEE P1451.4			
Excitation type	Stepped Sine, Multi-sine			
Acceleration Levels <sup>6</sup>	0.1 to 10 gpk			
Calibration data management	Yes			
Automatic pass/fail classification	Yes			

1. Random component estimates significantly affected by shaker selection and environmental conditions
2. Best measurement uncertainty available with option -C83XP
3. Optional features.
4. Capacitive sensors supported in base s/w. Capacitive sensor signal conditioning available as -445 option

5. Piezoresistive sensors supported in base s/w. Signal conditioning available as -478 option
6. Shaker dependent, limited by stroke and load capacity. -501 option supports 40 gpk sinusoid, -525 option with PneuShock actuator supports impulse to 10 kgpk.

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## Available exciters

### Air Bearing Shaker

### Shock Exciter

### Low Frequency Air Bearing Shaker

#### System Options 9155D-830 or 9155D-831

#### System Option 9155D-525

#### System Options 9155D-771 or 9155D-779

- Wide frequency range of 5 Hz to 50 kHz (calibration from 5 Hz to 15 or 20 kHz)
- Drastically reduces uncertainty by virtually eliminating transverse motion
- Integral quartz ICP® reference ensures low noise operation with long-term stability
- Lorentz force coil enables rapid centering of sensors with varying mass
- High stiffness beryllium insert yields high frequency calibration

- Easy amplitude linearity calibration of shock and crash sensors from 20 to 10 000 g
- Controlled and consistent impacts using state-of-the-art pneumatic actuator
- Easy refinement of impulse shape and frequency content using a wide variety of impact anvils
- Superior impact control through drive pressure and impulsive duration control

- Achieves significantly faster calibration times with SmartStroke™ technology
- Improves signal to noise ratio at low frequency with 10 in (25 cm) stroke length
- Both options utilize a stable, quartz ICP® low frequency reference accelerometer
- Option 9155D-779 offers improved ultra-low frequency using patented optical encoder reference technology from 0.1 – 10 Hz (Patent 8,577,641)

## Service options

Service Options for Model 9155 Calibration Systems extend the warranty of every system component for the life of the contract, effectively creating a lifetime warranty. Both Service Contracts and Service Plans include annual calibration for your entire system, software upgrades, emergency loaner equipment, and participation in our Interlaboratory Comparison Program. A Service Contract adds a facility visit from a TMS engineer to service your system, validate performance, and conduct a training class to refresh the skills of your existing team or to train new staff. TMS is also committed to supporting current Endevco CAACS installations. Contact us at [calibration@modalshop.com](mailto:calibration@modalshop.com).

## Portable Vibration Calibrators

Capable of creating NIST-traceable calibration reports per ISO 16063-21 methodology and compliant to ISO 17025, Portable Vibration Calibrators are also an ideal tool for system testing and troubleshooting at specific amplitudes and frequencies of interest before and after a critical test.

**Model 9110D:** Offers wide frequency response from 5 Hz to 10 kHz with amplitudes up to 20 g's.

**Model 9210D:** Features incredible low frequency performance down to 0.7 Hz. Ideal for calibrating high-sensitivity Variable Capacitance (VC) and ICP®/Isotron® (IEPE) accelerometers.

### Applications

- Create Calibration Reports for Vibration Instrumentation In-House
- Ensure Accuracy & Setup of Sensors, Cabling and Data Acquisition Prior to Critical Tests
- Troubleshoot Accelerometers Utilizing Real-Time Sensitivity Display



9110D



9210D

Provided By

**THE MODAL SHOP**  
MTS SYSTEMS CORPORATION

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Model 9110D and 9210D are compact, battery-powered, and completely self-contained vibration reference sources, which can be conveniently used to calibrate individual sensors, as well as to validate the entire measurement channel.

An integral precision quartz reference accelerometer and closed loop level control gives the Portable Vibration Calibrators enhanced stability and superior vibration calibration over their respective frequency ranges. Packaged in a rugged Pelican® Storm case, the 9110D & 9210D are always ready for travel to test sites, bringing laboratory accuracy to the field.

Each unit's internal memory capability can store up to 500 calibration records. Data is easily transferred to a PC via a USB flash drive, allowing for the creation and printing of ISO 17025-compliant, customizable calibration certificates for both frequency response and linearity. CALROUTE firmware permits technicians to program repetitive calibration test points and pass/fail tolerances.

Model number	Model 9110D	Model 9210D
Frequency Range	5 Hz to 10 kHz	0.7 Hz to 2 kHz
Maximum Amplitude	20 g pk	2 g pk
Vibration Amplitude Scales	g pk, g RMS, ips pk, ips RMS, mils p-p, m/s <sup>2</sup> pk, m/s <sup>2</sup> RMS, mm/sec pk, mm/sec RMS, microns p-p	
Supported Sensor Types	ICP®/Isotron® (IEPE), Voltage, Single-Ended Charge(PE)*, Differential Charge*, Piezoresistive (PR)*, Variable Capacitance (VC)*, Modulated Current*	ICP®/Isotron® (IEPE), Voltage, Variable Capacitance (VC)*, Modulated Current*
Acceleration Accuracy of Readout	10 Hz to 10 kHz: ± 3% 5 Hz to <10 Hz ± 5%	2 Hz to 2 kHz: ± 3% 0.7 Hz to <2 Hz: ± 10%
Battery Life	18 hours	14 hours
Features	<ul style="list-style-type: none"> <li>• Creates calibration certificates with three mouse clicks utilizing supplied Microsoft Excel® macro-enabled calibration workbook</li> <li>• Programmability with instant pass/fail notification after each test point</li> <li>• Direct connection to internal reference accelerometer utilized for confirmation of shaker accuracy</li> <li>• Lightweight and durable, easy to transport to sensor</li> <li>• Supplied with A2LA accredited calibration certificate</li> <li>• Vibration accuracy independent of Sensor Under Test mass</li> </ul>	

\* = external signal conditioning required

## Reference accelerometers

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Model number	2270	2270M8
Description	Back-to-back calibration	Transfer standard accelerometer
Sensitivity pC/g typical	2.2	2.2
Sinusoidal limit g	1000	1000
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

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## Portable system verification instruments

Model number	4830B
Description	Handheld accelerometer simulator
Outputs	Single-ended charge Differential charge Single-ended voltage Tachometer 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) =2 % (100 to 149 grams load) =5 % (150 to 210 grams load) =9 %
Load grams	2 - 210
Power	Internal 4 AA batteries 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/ 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

# Incentive programs

To make it even easier to do business with us, Endevco offers a number of customer incentive programs, ranging from comprehensive 2-year product line warranties, to stocking and availability guarantees, to competitor trade-in allowances and test fixture upgrade discounts. All are designed to provide even greater confidence, reliability and performance when choosing Endevco sensors and instrumentation for your application requirements.

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## Two-year product line warranty

This warranty is without hidden loopholes or “fine print.” It is simply the confidence we have placed in our own product performance, and in turn, the same trust we invite our customers to place in us. As this warranty accompanies each of our products, it is simply another value added reason for choosing Endevco products. For full warranty details, visit [www.endevco.com](http://www.endevco.com)

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## Competitive Trade-in program (CTi)

Get added reliability and value for your application by making the switch to Endevco brand sensors and instrumentation. Send us your working or non-working competitive product, let us help you to find the best Endevco standard product replacement for your application, and receive a 15% trade-in discount, issued simultaneously with your product purchase. It’s as easy as that. Purchases under the CTi program are also still covered by Endevco’s 2-year product warranty.

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## University discount

Endevco offers a 10% Endevco brand product discount to university customers. To qualify, “university” must be in the name of the ordering account. Government funded projects are not eligible.

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[www.endevco.com](http://www.endevco.com) | Tel: +1 (866) ENDEVCO [+1 (866) 363-3826] | 10869 NC-903, Halifax, NC 27839 USA

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EDV-Catalog-1020



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