



KISTLER

measure. analyze. innovate.

Acceleration

Short Form Catalog

Providing quick,
accurate and reliable
measurements



Kistler Has a Wide Acceleration Product Offering

This catalog provides comprehensive information on all Kistler products for the measurement of acceleration. The overview of the Kistler range is followed by detailed information on our products in a tabular format.

As Kistler measuring instruments are used in a great variety of fields, separate brochures are also available for the following applications:

- Engines
- Vehicles
- Manufacturing
- Plastics processing
- Biomechanics
- Torque

Please contact us for any brochures you require. You will find the address of your nearest Kistler branch on the back page of this catalog. Alternatively, you can e-mail us at info@kistler.com. We wish you success with Kistler measurement instruments and thank you for your confidence and interest.

The aim of this series of brochures is to help you make the right choice from our wide range of products and to suggest ways of optimizing your application.



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Kistler Measures Acceleration

Accelerometers are used in every avenue of the dynamic test environment, and Kistler has developed families of products covering this expansive range of applications. From ultra low motion encountered in wafer fabrication technology to shock spectra reconstruction experienced in pyrotechnic separation event studies, and everywhere in between, an optimal sensor solution is available. Static events are captured with the K-Beam® static and low frequency product offerings. Very high frequency activity is routinely measured using any of several miniature piezoelectric single axis or triaxial types. Many sensing technologies including piezoceramic, natural quartz and variable capacitance approaches have been extensively explored and are employed as needed to accommodate the demands of the applications. Some applications include:

Structural testing

Mechanical devices, assemblies and constructions of all types are investigated using accelerometers to measure their dynamic response when subjected to a known input. The deformation pattern, when the specimen experiences resonance, can be computed from the measured data. Known as Experimental Modal Analysis (EMA), this field of study often uses a member of the PiezoBeam family or ceramic shear family where their general characteristics have been adapted to accommodate most requirements of common tests. Typical features include high output from a low weight sensor, ground isolation, and an inexpensive package providing an economical solution for large channel count applications.

Aerospace and military

Very demanding applications are encountered in the military and aerospace industry where any error may present a life-threatening situation. This category also covers a tremendous range of applications and nearly all accelerometer product offerings have been used in these important investigations. Flutter testing, rocket launch pad dynamics, aircraft EMA, ammunition investigations, helicopter rotor reactions, etc. are a few of the common measurements performed.





Automotive/Transportation

Ride quality has been receiving tremendous attention in recent years. Noise Vibration Harshness (NVH) is a common term in the automotive test field. New vehicle designs are presenting less noise to the occupants and the subtle details of the intricacies of road/tire interaction, bump & jar response and the overall feel of the ride, are important to even the common customer. The K-Beam family covers the low to mid frequency range of applications, and the many piezoelectric offerings extend into the higher frequency areas of interest.

Civil engineering

Very low frequency activity is of interest when studying extremely large structures such as bridges, buildings or dams. These specimens require DC capable accelerometers since most dynamic activity is in the very low frequency realm often in the range of a few Hz. The K-Beam product family is commonly used to measure vibration and acceleration in this arena.

Environmental stress screening

Computer components, automotive electronics, and miniature mechanical assemblies are often exposed to an aggressive life test or actual functional tests under extreme environmental conditions. This may involve multiple impact drop testing or wide range thermal cycling and many of the PiezoStar® and K-Shear® product offerings have been tailored to survive and perform extremely well even under incredibly abusive conditions. The M5 and M8 product type number suffixes provide extreme high and low temperature capabilities respectively and the shear shock Types 8742A... and 8743A... survive after many exposures to high-level cyclic inputs.

Kistler measures acceleration

Remarkable lifetime under any condition



Precise, ultra low frequency measurements are common using a K-Beam solution



Modal studies easily accomplished using an array of inexpensive accelerometers



Tilt and comfort controlled using K-Beam feedback



Space quality measurements are routine



Flight safety issues measured accurately with K-Beam family



Harsh environments present negligible concern when using K-Shear accelerometers



On site or factory calibration solutions available



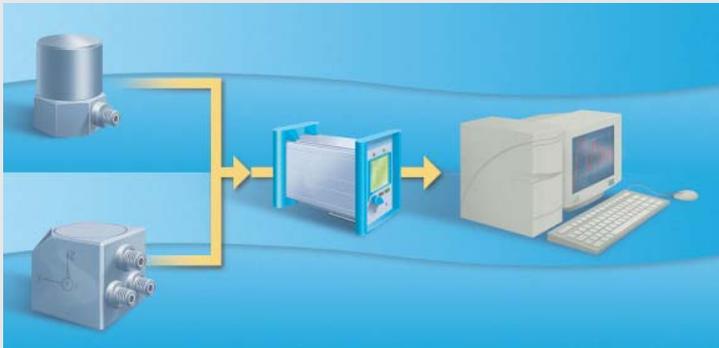
Acceleration Measuring Systems

Measuring systems

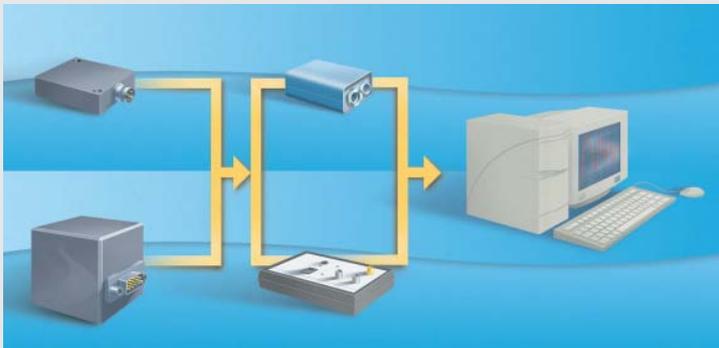
Economical measurement solutions offered by the low impedance approach



Versatile system configurations provided through charge amplifier functionality



DC acceleration system easily configured



Low impedance piezoelectric system (IEPE)

- Low output impedance, $<100 \Omega$
- Low noise output signal
- Fixed accelerometer range and voltage sensitivity
- Simple two-wire system for power and signal with no special cable conductor requirements
- Lower cost per channel
- Simple and inexpensive signal conditioning; power supply/coupler and standard cables
- Coupler for setting of gain, range, filtering and time constant
- Frequency response 0,5 ... 20 000 Hz
- Sensors having operational temperature ranges of $-195 \dots 165 \text{ }^\circ\text{C}$
- PiezoStar, Quartz, Piezoceramic

High impedance piezoelectric system (charge mode)

- Wide measuring range
- One accelerometer can be used over its entire measuring range by selecting an appropriate charge amplifier range
- Push-button, electronic or computer controlled resetting of charge amplifier.
- Sensors having operational temperature range up to $250 \text{ }^\circ\text{C}$ or higher
- Charge amplifier for setting of range, filtering and time constant
- Frequency response 0,5 ... 20 000 Hz
- Quartz, Piezoceramic

MEMS Variable Capacitance System

- True static and dynamic measuring response
- Frequency response 0 ... 1 000 Hz
- Both acceleration and inclination information possible using AC or DC coupled output
- Output signals can be either single ended, bipolar, differential voltages or current
- Sensors having operational temperature ranges of $-55 \dots 120 \text{ }^\circ\text{C}$
- Silicon micromachined element

Kistler calibration

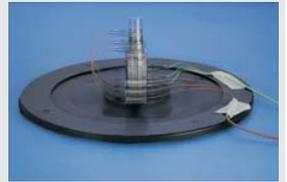
Kistler accelerometers are calibrated in the factory and delivered with a calibration certificate. The reference sensors are cross-referenced to national standards. Kistler operates a NIST traceable calibration center and the calibration laboratory No. 049 of the Swiss Calibration Service for the measurands: force, pressure, acceleration and electric charge. Kistler and some of its group companies offer a recalibration service and the company records in its archives the details of when and how often a particular sensor was calibrated.

Kistler offers an on-site service for recalibrating built-in sensors, thereby helping to keep downtimes to a minimum. In addition, Kistler offers a whole range of instruments for use in calibration laboratories.

Our calibration service receives the highest marks. The calibration of your instruments, manufactured by Kistler or someone else, is performed with the utmost care and precision. Our standard prompt service is exceptional. The Kistler Calibration Laboratory is in conformance with the requirements of ANSI/NCSL Z540-1-1994, MILSTD-45662A, ISO 9001:2000 and ISO/IEC 17025.

Calibration

On site, traceable, calibration systems



National referenced calibration services available



Product Overview

Charge Accelerometers																					
Type	Range	Sensitivity	Frequency response	Operating temperature	Mass	Ground isolated	Connector	Features						Mounting				page			
	g	pC/g	Hz	°C	grams		Location	triaxial	high g shock	modal	mini	TEDS	high temp	cryo	stud	adhesive	clip		magnetic	screw	
8278A500	±500	-1,3	1 ... 10 000	-75 ... 180	0,7	yes	10-32 neg. l side						x			x					12
8203A50	±1 000	-50	5 ... 4 000	-70 ... 250	44,5	with pad	10-32 neg. l side						x		x				x		12
8290A25M5	±1 000	-25	5 ... 4 000	-70 ... 250	53	no	10-32 neg. l side	x					x		x						22
8202A10	±2 000	-10	5 ... 10 000	-70 ... 250	14,5	with pad	10-32 neg. l side						x		x				x		12
8274A5	±2 000	-5,5	1 ... 12 000	-55 ... 165	4	with pad	10-32 neg. l top						x		x						12
8276A5	±2 000	-5,5	1 ... 7 000	-55 ... 165	4	no	10-32 neg. l side						x			x					12
8044	-20 000 ... 30 000	-0,3	1 ... 8 000	-195 ... 200	7	no	10-32 neg. l top		x				x	x	x	x			x		12

Low Frequency Accelerometers																					
Type	Range	Sensitivity	Frequency response	Operating temperature	Threshold	Mass	Ground isolated	Connector	Features						Mounting				page		
	g	mV/g	Hz	°C	grms	grams		Location	triaxial	high g shock	modal	mini	TEDS	high temp	cryo	stud	adhesive	clip		magnetic	screw
8315A2D0	±2	2 000	0 ... 250	-55 ... 125	0,00035	15	Yes	4-pin pos. l side									x		x	x	13
8395A2D0	±2	2 000	0 ... 250	-55 ... 125	0,00035	30	Yes	9-pin pos. l side	x							x	x		x	x	22
8330B3	±3	1 200	0 ... 500	-40 ... 85	0,0000057	95	Yes	4-pin pos. l side									x			x	13
8315A010	±10	400	0 ... 1 000	-55 ... 125	0,0018	15	Yes	4-pin pos. l side									x		x	x	13
8395A010	±10	400	0 ... 1 000	-55 ... 125	0,0017	30	Yes	9-pin pos. l side	x							x	x		x	x	13
8315A030	±30	133,3	0 ... 1 000	-55 ... 125	0,0039	15	Yes	4-pin pos. l side									x		x	x	13
8395A030	±30	133,3	0 ... 1 000	-55 ... 125	0,0039	30	Yes	9-pin pos. l side	x							x	x		x	x	13
8315A050	±50	80	0 ... 1 000	-55 ... 125	0,0088	15	Yes	4-pin pos. l side									x		x	x	13
8395A050	±50	80	0 ... 1 000	-55 ... 125	0,0088	30	Yes	9-pin pos. l side	x							x	x		x	x	22
8395A100	±100	40	0 ... 1 000	-55 ... 125	0,018	30	Yes	9-pin pos. l side	x							x	x		x	x	22
8315A100	±100	40	0 ... 1 000	-55 ... 125	0,017	15	Yes	4-pin pos. l side									x		x	x	13
8315A200	±200	20	0 ... 1 000	-55 ... 125	0,035	15	Yes	4-pin pos. l side									x		x	x	13
8395A200	±200	20	0 ... 1 000	-55 ... 125	0,035	30	Yes	9-pin pos. l side	x							x	x		x	x	22

IEPE Accelerometers																					
Type	Range	Sensitivity	Frequency response	Operating temperature	Threshold	Mass	Ground isolated	Connector	Features						Mounting				page		
	g	mV/g	Hz	°C	grms	grams		Location	triaxial	high g shock	modal	mini	TEDS	high temp	cryo	stud	adhesive	clip		magnetic	screw
8640A5	±5	1 000	0,5 ... 3 000	-40 ... 55	0,00014	3,5	with pad	10-32 neg. l side				x	x	x			x	x	x	x	14
8688A5	±5	1 000	0,5 ... 3 000	-40 ... 55	0,00014	6,7	with pad	4-pin pos. l side	x			x	x	x			x	x	x		23
8712A5M1	±5	1 000	0,5 ... 8 000	-55 ... 100	0,0004	51	yes	10-32 neg. l side									x	x		x	17
8762A5	±5	1 000	0,5 ... 6 000	-55 ... 80	0,0003	23	yes	4-pin pos. l side					x				x	x			23
8772A5	±5	1 000	1 ... 5 000	0 ... 55	0,0004	8	yes	10-32 neg. l side				x						x			20
8784A5	±5	1 000	1 ... 6 000	-55 ... 80	0,0004	21	with pad	10-32 neg. l top									x	x		x	21
8786A5	±5	1 000	1 ... 6 000	-55 ... 80	0,0004	21	with pad	10-32 neg. l side									x	x		x	21
8640A10	±10	500	0,5 ... 3 000	-40 ... 65	0,00016	3,5	with pad	10-32 neg. l side				x	x	x			x	x	x	x	14
8688A10	±10	500	0,5 ... 3 000	-40 ... 65	0,00016	6,7	with pad	4-pin pos. l side	x			x	x	x			x	x	x	x	23
8762A10	±10	500	0,5 ... 6 000	-55 ... 80	0,00035	23	yes	4-pin pos. l side					x				x	x			23
8772A10	±10	500	1 ... 5 000	0 ... 55	0,0005	8	yes	10-32 neg. l side				x						x			20
8702B25	±25	200	1 ... 8 000	-55 ... 100	0,002	8,7	pad/M1	10-32 neg. l side						x			x	x		x	15
8704B25	±25	200	1 ... 8 000	-55 ... 100	0,002	7,5	pad/M1	10-32 neg. l top						x			x	x		x	16
8792A25	±25	200	1 ... 5 000	-55 ... 100	0,002	29	yes	4-pin pos. l side	x					x				x			25
8640A50	±50	100	0,5 ... 5 000	-40 ... 65	0,00036	3,5	with pad	10-32 neg. l side				x	x	x			x	x	x	x	14
8688A50	±50	100	0,5 ... 5 000	-40 ... 65	0,00036	6,5	with pad	4-pin pos. l side	x			x	x	x			x	x	x		23
8702B50	±50	100	0,5 ... 10 000	-55 ... 100	0,004	8,7	pad/M1	10-32 neg. l side						x			x	x		x	15
8703A50M1	±50	100	0,5 ... 10 000	-55 ... 165	0,0012	10	yes	10-32 neg. l side						x			x	x		x	16

Product Overview

IEPE Accelerometers																					
Type	Range	Sensitivity	Frequency response	Operating temperature	Threshold	Mass	Ground isolated	Connector	Features							Mounting			page		
	g	mV/g	Hz	°C	grms	grams		Location	triaxial	high g shock	modal	mini	TEDS	high temp	cryo	stud	adhesive	clip		magnetic	screw
8703A50M8	±50	100	0,5 ... 10 000	-195 ... 100	0,004	7,5	pad/M1	10-32 neg. l top							x	x	x		x		16
8704B50	±50	100	0,5 ... 10 000	-55 ... 100	0,004	7,5	pad/M1	10-32 neg. l top					x			x	x		x		16
8705A50M1	±50	100	0,5 ... 10 000	-55 ... 165	0,0012	7,6	pad/M1	10-32 neg. l top						x		x	x		x		16
8762A50	±50	100	0,5 ... 6 000	-55 ... 80	0,0012	23	yes	4-pin pos. l side					x			x	x				23
8763B050	±50	100	0,5 ... 7 000	-55 ... 100	0,0003	4,5	with pad	4-pin pos. l side	x			x	x			x	x				24
8766A50	±50	100	0,5 ... 5 000	-55 ... 120	0,001	16	with pad	4-pin pos. l side	x			x	x	x		x	x				25
8772A50	±50	100	1 ... 5 000	0 ... 55	0,002	8	yes	10-32 neg. l side			x		x				x				20
8774A50	±50	100	1 ... 10 000	-55 ... 120	0,0025	4	with pad	10-32 neg. l top			x					x	x				20
8776A50	±50	100	1 ... 7 000	-55 ... 120	0,0025	4	no	10-32 neg. l side			x						x				20
8792A50	±50	100	0,5 ... 5 000	-55 ... 100	0,004	29	yes	4-pin pos. l side	x				x				x			x	25
8795A50M8	±50	100	1 ... 4 000	-195 ... 120	0,001	32	with pad	4-pin pos. l side	x						x		x				26
8702B100	±100	50	0,5 ... 10 000	-55 ... 100	0,006	8,7	pad/M1	10-32 neg. l side					x			x	x		x		15
8704B100	±100	50	0,5 ... 10 000	-55 ... 100	0,006	7,5	pad/M1	10-32 neg. l top					x			x	x		x		16
8714B100M5	±100	50	1 ... 10 000	-55 ... 165	0,002	5	yes	10-32 neg. l side					x	x			x			x	17
8763B100	±100	50	0,5 ... 7 000	-55 ... 100	0,0006	4,5	with pad	4-pin pos. l side	x			x	x			x	x				24
8792A100	±100	50	0,5 ... 5 000	-55 ... 100	0,006	29	yes	4-pin pos. l side	x				x				x			x	25
8763B250	±250	20	1 ... 10 000	-55 ... 100	0,001	4,1	with pad	4-pin pos. l side	x			x	x			x	x				24
8765A250M5	±250	20	1 ... 9 000	-55 ... 165	0,002	6,4	yes	4-pin pos. l side						x			x			x	24
8766A250	±250	20	0,5 ... 10 000	-55 ... 120	0,006	16	with pad	4-pin pos. l side	x			x	x			x	x				25
8703A250M1	±250	20	0,5 ... 10 000	-55 ... 165	0,006	8,1	yes	10-32 neg. l side						x		x	x		x		15
8705A250M1	±250	20	0,5 ... 10 000	-55 ... 165	0,006	6,7	pad/M1	10-32 neg. l top						x		x	x		x		16
8702B500	±500	10	1 ... 10 000	-55 ... 120	0,01	8,2	pad/M1	10-32 neg. l side					x			x	x		x		15
8704B500	±500	10	1 ... 10 000	-55 ... 120	0,01	7,1	pad/M1	10-32 neg. l top					x			x	x		x		16
8714B500M5	±500	10	1 ... 10 000	-55 ... 165	0,003	4,2	yes	10-32 neg. l side					x	x			x			x	17
8720A500	±500	10	1 ... 10 000	-55 ... 120	0,01	4,9	yes	10-32 neg. l side									x				17
8728A500	±500	10	2 ... 10 000	-55 ... 120	0,02	1,6	no	10-32 neg. l side					x				x				18
8730A500	±500	10	2 ... 10 000	-55 ... 120	0,01	1,9	with pad	10-32 neg. l top					x			x	x				18
8730A500M8	±500	10	2 ... 10 000	-195 ... 120	0,01	1,9	with pad	10-32 neg. l top					x		x	x	x				18
8763B500	±500	10	1 ... 10 000	-55 ... 100	0,002	4,1	with pad	4-pin pos. l side	x			x	x			x	x				24
8766A500	±500	10	0,5 ... 10 000	-55 ... 165	0,01	4	with pad	4-pin pos. l side	x			x	x	x		x	x				25
8778A500	±500	10	2 ... 9 000	-55 ... 120	0,01	0,4	yes	10-32 neg. l side					x				x				21
8792A500	±500	10	1 ... 5 000	-55 ... 120	0,01	27	yes	4-pin pos. l side	x				x				x			x	25
8793A500	±500	10	2,5 ... 10 000	-55 ... 120	0,002	11	with pad	4-pin pos. l side	x				x	x			x			x	26
8793A500M8	±500	10	2,5 ... 10 000	-195 ... 120	0,002	11	with pad	4-pin pos. l side	x				x	x			x			x	26
8794A500	±500	10	2,5 ... 10 000	-55 ... 120	0,002	7,6	with pad	4-pin pos. l side	x					x			x			x	26
8763B1K	±1 000	5	1 ... 10 000	-55 ... 120	0,003	4,5	with pad	4-pin pos. l side	x			x	x			x	x				24
8763B2K	±2 000	2,5	1 ... 10 000	-55 ... 120	0,006	4,5	with pad	4-pin pos. l side	x			x	x			x	x				24
8704B5000	±5 000	1	1 ... 10 000	-55 ... 120	0,13	7,1	pad/M1	10-32 neg. l top		x						x	x		x		16
8715A5000M5	±5 000	1	2 ... 10 000	-55 ... 165	0,04	2,1	yes	5-44 neg. l side		x		x	x	x			x			x	17
8742A5	±5 000	1	1 ... 10 000	-55 ... 120	0,13	4,5	M1	10-32 neg. l top		x						x	x				19
8743A5	±5 000	1	1 ... 10 000	-55 ... 120	0,13	4,5	with pad	10-32 neg. l top		x						x	x				19
8742A10	±10 000	0,5	1 ... 10 000	-55 ... 120	0,25	4,5	M1	10-32 neg. l top		x						x	x				19
8743A10	±10 000	0,5	1 ... 10 000	-55 ... 120	0,25	4,5	with pad	10-32 neg. l top		x						x	x				19
8742A20	±20 000	0,25	1 ... 10 000	-55 ... 120	0,5	4,5	M1	10-32 neg. l top		x						x	x				19
8743A20	±20 000	0,25	1 ... 10 000	-55 ... 120	0,5	4,5	with pad	10-32 neg. l top		x						x	x				19
8742A50	±50 000	0,1	1 ... 10 000	-55 ... 120	1,3	4,5	M1	10-32 neg. l top		x						x	x				19
8743A50	±50 000	0,1	1 ... 10 000	-55 ... 120	1,3	4,5	with pad	10-32 neg. l top		x						x	x				19
8743A100	±100 000	0,05	0,5 ... 10 000	-55 ... 120	2,6	4,5	pad/M1	10-32 neg. l top		x						x	x				19

Product Overview

IEPE Impedance Head														
Type	Range Vibration	Sensitivity	Force range	Sensitivity	Operating temperature	Threshold	Mass	Connector	Mounting					page
									Location	stud	adhesive	clip	magnetic	
8770A5	5	1 000	±6,8	230	-55 ... 80	0,00018	34	10-32 neg. l side	x			x	x	28
8770A50	50	100	±68	23	-55 ... 120	0,0018	34	10-32 neg. l side	x			x	x	28

IEPE Impact Hammers									
Type	Range	Sensitivity	Frequency response	Operating temperature	Mass	Connector	Mounting		page
							Location		
9722A500	100	50	8 200	-20 ... 70	35	BNC neg. l bottom			35
9722A2000	500	10	9 300	-20 ... 70	35	BNC neg. l bottom			35
9724A2000	500	10	6 600	-20 ... 70	35	BNC neg. l bottom			35
9724A5000	1 000	5	6 900	-20 ... 70	35	BNC neg. l bottom			35
9726A5000	1 000	5	5 000	-20 ... 70	35	BNC neg. l bottom			35
9726A20000	5 000	1	5 400	-20 ... 70	35	BNC neg. l bottom			35
9728A20000	5 000	1	1 000	-20 ... 70	35	BNC neg. l bottom			35

Charge Force Sensors												
Type	Range Compression	Range Tension	Sensitivity	Operating temperature	Mass	Connector	Mounting					page
							Location	stud	adhesive	clip	magnetic	
9212	+6 780	-68	-12	-195 ... 150	18	10-32 neg. l side	x				x	29
9222	+6 780	-68	-4,4	-195 ... 150	19	10-32 neg. l side	x				x	29

* Threshold depends on charge amp settings

IEPE Force Sensors												
Type	Range Compression	Range Tension	Sensitivity	Operating temperature	Threshold	Connector	Mounting					page
							Location	stud	adhesive	clip	magnetic	
9712B5	+6,8	-6,8	184	-50 ... 120	0,00014	10-32 neg. l side	x					29
9712B50	+68	-68	23	-50 ... 120	0,0014	10-32 neg. l side	x					29
9712B250	+340	-340	4,6	-50 ... 120	0,0068	10-32 neg. l side	x					29
9712B500	+680	-680	2,3	-50 ... 120	0,014	10-32 neg. l side	x					29
9712B5000	+6 780	-6 780	0,23	-50 ... 120	0,14	10-32 neg. l side	x					29

Product Overview

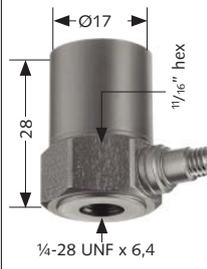
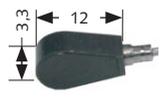
Rotational Accelerometers														
Type	Range	Sensitivity	Frequency response	Operating temperature	Threshold	Mass	Ground Isolated	Connector	Mounting			page		
	krads/s ²	μV/rad/s ²	Hz	°C	rads/s ²	grams		Location	stud	adhesive	clip		magnetic	screw
8838	±150	34	1 ... 2 000	-50 ... 120	4	18,5	yes	4-pin pos. l side					x	28
8840	±150	34	1 ... 2 000	-50 ... 120	4	18,5		4-pin pos. l side					x	28

Acoustic Emission Sensors													
Type	Sensitivity	Frequency response	Operating temperature	Mass	Ground Isolated	Connector	Mounting			page			
	dB ref 1V/(m/s)	Hz (±10 dB)	°C	grams		Location	stud	adhesive	clip		magnetic	screw	
8152B211/221	48	100 000 ... 900 000	-40 ... 60	29	yes	integral cable pigtailed l side						x	27
8152B111/121	57	50 000 ... 400 000	-40 ... 60	29	yes	integral cable pigtailed l side						x	27

Cables					
Type	Connection A	Connection B	Length (m) sp = customer specified length	Diameter (in)	page
1511	BNC pos.	BNC pos.	1/sp	0,25	38
1576	¼-28, 4-pin neg.	(3x) BNC pos.	0,20	0,07	38
1578	¼-28, 4-pin neg.	¼-28, 4-pin neg.	2/sp	0,10	38
1592A	¼-28, 4-pin neg.	¼-28, 4-pin neg.	2/4/sp	0,10	38
1592M1	¼-28, 4-pin neg.	pigtail	2/sp	0,10	38
1601B	BNC pos.	BNC pos.	sp	0,12	38
1603B	BNC neg.	BNC pos.	sp	0,12	38
1631C	10-32 pos.	BNC pos.	1/2/3/5/8/sp	0,08	39
1635C	10-32 pos.	10-32 pos.	1/2/3/5/8/sp	0,08	39
1641	10-32 pos.	BNC pos.	sp	0,08	38
1734A...K03	¼-28, 4-pin neg.	(3x) BNC pos.	1/3/5/10	0,07	38
1756C...K03	¼-28, 4-pin neg.	(3x) BNC pos.	0,5/3/10/sp	0,10	38
1761B	10-32 pos.	BNC pos.	1/2/3/5/sp	0,08	38
1762B	10-32 pos.	10-32 pos.	1/2/3/5/sp	0,08	38
1766AK01	5-44 pos.	10-32 neg.	sp	0,06	38
1768A...K01	10-32 pos.	BNC pos.	1/2/3/5/sp	0,08	39
1768A...K02	10-32 pos.	10-32 pos.	1/2/3/5/sp	0,08	39
1534A...K00	¼-28, 4-pin neg.	pigtail	2/5/10/sp	0,10	39
1784AK02	M4,5, 4-pin neg.	¼-28, 4-pin pos.	0,50/sp	0,06	39
1784B...K03	M4,5, 4-pin neg.	(3x) BNC pos.	1/3/5/10	0,06	39
1786C	¼-28, 4-pin neg.	(3x) Banana Jacks for power, (2x) BNC pos. signal out	2/5/10	0,1	38
1788A	¼-28, 4-pin neg.	(3x) Banana Jacks for power, BNC pos. signal out	2/5/10	0,1	38
1792A...K01	9-pin circular	9-pin D-Sub	2/5/10/sp	0,18	38
1792A...K00	9-pin circular	pigtail	2/5/10/sp	0,18	39
1794A	9-pin D-Sub neg.	(2x) Banana Jacks for power, (3x) BNC pos. signal out	2	0,1	39

Vibration

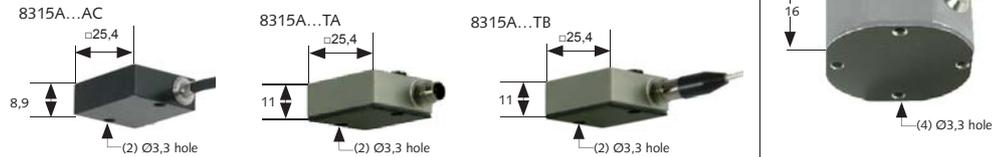
Ceramic Shear, Charge Accelerometers - Single Axis

							
		Type 8044	Type 8202...	Type 8203...	Type 8274...	Type 8276...	Type 8278...
Technical data		...A10	...A10	...A50	...A5	...A5	...A500
Range	g	-20 000 ... 30 000	±2 000	±1 000	±2 000	±2 000	±500
Sensitivity, ±5 %	pC/g	-0,3	-10 (±15 %)	-50 (±15 %)	-5,5	-5,5	-1,3
Frequency response, ±5 %	Hz	1 ... 8 000	5 ... 10 000	5 ... 4 000	1 ... 12 000	1 ... 7 000	1 ... 10 000
Threshold	g _{rms}	depends on charge amp settings					
Transverse sensitivity	%	≤5	1,5	1,5	1,5	1,5	3
Non-linearity	%FSO	±1	±1	±1	±1	±1	±1
Temp. coeff. sensitivity	%/°C	-0,018	0,13	0,13	0,11	0,11	0,18
Operating temperature	°C	-195 ... 200	-70 ... 250	-70 ... 250	-55 ... 165	-55 ... 165	-75 ... 180
Connector		10-32 neg.	10-32 neg.	10-32 neg.	10-32 neg.	10-32 neg.	10-32 neg.
Housing/base	material	17-4 PH St, StI,	Stainless steel	Stainless steel	Titanium	Titanium	Anodized Al,
Sealing	Type	epoxy	Hermetic/ceramic	Hermetic/ceramic	Hermetic	Hermetic	epoxy
Mass	grams	7	14,5	44,5	4	4	0,7
Ground isolated		no	with pad	with pad	with pad	no	yes
Data Sheet		000-209	000-212	000-212	000-213	000-213	000-611
Properties		Wide measuring range, stable quartz element, lightweight, miniature package.	High temp. (250 °C), ceramic shear sensing element, low transverse sensitivity.		Ceramic shear sensing element, wide frequency response, low transverse sensitivity, lightweight, rugged connector, ideal for OEM applications.		Ultra low base strain, wide Frequency response, ground Isolated, high sensitivity, -1,3 pC/g, integral cable (user specified length), high temperature.
Application		Measuring and analyzing shock and vibration with high amplitudes.	Automotive, aerospace and environmental testing where low impedance sensors are limited by Operating temperature.		Impact and vibration related Applications including condition monitoring and vehicle testing.		Precision vibration measurements; modal analysis on small, thin walled structures or where space is limited and mass loading is of primary concern.
Accessories		Cable: Type 1631C Charge amp.: Type 5000 series	Cable: Type 1631C Charge converter: Type 5050 Coupler: Type 5100 series Mounting pad: Type 8436		Cable: Type 1631C Charge converter: Type 5050 Coupler: Type 5100 series Adh. mounting pad: Type 8436 Mounting magnet: Type 8452A Mounting cube: Type 8524		Extension Cable: Type 1631C Charge converter: Type 5050 Coupler: Type 5100 series

Static and Low Frequency Vibration

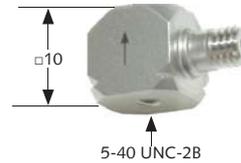
K-Beam® MEMS Capacitive, Low Frequency Accelerometers - Single Axis

		Type 8315...						Type 8330...
Technical data		...A2D0	...A010	...A030	...A050	...A100	...A200	...B3
Range	g	±2	±10	±30	±50	±100	±200	±3
Sensitivity, ±5 % (±4V FSO version) (2,5±2V FSO version) (±8V FSO differential version)	mV/g	2 000	400	133,3	80	40	20	1 200 (±10 %)
	mV/g	1 000	200	66,6	40	20	10	
	mV/g	4 000	800	266,6	160	80	40	
Zero g output (±4V FSO version) (2,5±2V FSO version) (±8V FSO differential version)	mV	0 ± 60	0 ± 60	0 ± 60	0 ± 60	0 ± 60	0 ± 60	0 ±260
	mV	2 500 ±60	2 500 ±60	2 500 ±60	2 500 ±60	2 500 ±60	2 500 ±60	
	mV	0 ±120	0 ±120	0 ±120	0 ±120	0 ±120	0 ±120	
Frequency response, ±5 %	Hz	0 ... 250						0 ... 500
Non-linearity	%FSO	±1						±0,1
Resolution/threshold	grms	0,00035	0,0018	0,004	0,0088	0,018	0,035	0,0013
Transverse sensitivity	%	1						0,4
Shock half sine	gpk	±0,0055 (200 µs)						1 500 (500 µs)
Temp. coefficient bias	mg/°C	±0,09	±0,50	±1,5	±2,5	±5,04	±9,9	0,1
Temp. coefficient sensitivity	%/°C	0,0099						0,1
Operating temperature	°C	-55 ... 125						-40 ... 85
Phase shift max., @ 100 Hz	degree	20	10					-0,25
Current nom.	mA	1,6						12
Voltage	VDC	6 ... 50						±6 ... ±12
Connector		4-pin pos.						4-pin pos.
Housing/base	material	Titanium (TA, TB housing), Aluminum (AC housing)						Aluminum hard anodized
Sealing	Type	environmental (AC housing)/Hermetic (TA, TB housing)						Hermetic
Mass	grams	15						95
Data Sheet		000-859						000-897
Properties		Small, lightweight variable capacitance sensing element, CE compliant. Integral cable and connector options						Closed loop servo accelerometer, zero volt output at zero g, ultra low noise.
Application		Low frequency vibration measurements for automotive ride quality and aerospace structural testing.						Low frequency, low amplitude vibration measurements such as background vibration and seismic measurements.
Accessories		Power supply: Type 5210 Mounting cube: Type 8516						Cable: Type 1592M1, 1788A
Versions		...A0: 0±4 V FSO ...AT: 0±4 V FSO, with temp. output ...B0: 2,5±2 V FSO ...BT: 2,5±2 V FSO, with temp. output ...D0: 0±8 V FSO differential ...AC: Aluminum, with integral cable ...TA: Ti., with 4-pin connector ...TB: Ti., with integral cable						



Vibration

IEPE Accelerometers - Single Axis



		Type 8640...		
Technical data		...A5	...A10	...A50
Range	g	±5	±10	±50
Sensitivity, ±5 %	mV/g	1 000	500	100
Frequency response, ±5 %	Hz	0,5 ... 3 000		0,5 ... 5 000
Threshold	grms	0,00014	0,00016	0,00036
Transverse sensitivity	%	1,5		
Non-linearity	%FSO	±1		
Shock (1 ms pulse)	gpk	7 000		10 000
Temp. coefficient sensitivity	%/°C	0,13	0,16	
Operating temperature	°C	-40 ... 55		-40 ... 65
Power supply current	mA	2 ... 20		
Power supply voltage	VDC	22 ... 30		
Connector		10-32 neg.		
Housing/base	material	Titanium		
Sealing	Type	Hermetic		
Mass	grams	3,5		
Ground isolated		with pad		
Data Sheet		000-842		
Properties		High sensitivity, low mass, low noise, low Transverse sensitivity and ground isolated, CE compliant.		
Application		Modal analysis or structural investigations.		
Accessories		Cable: Type 1761B Coupler: Type 5100 series Mounting clip: Type 800M156 Mounting base, ground isolated: Type 800M158 Mounting magnetic base: Type 800M160		
Versions		...T: TEDS option		

Vibration

IEPE Accelerometers - Single Axis

							
		Type 8702...			Type 8702...	Type 8703...	
Technical data		...B25	...B50	...B100	...B500	...A50M1	...A250M1
Range	g	±25	±50	±100	±500	±50	±250
Sensitivity, ±5 %	mV/g	200	100	50	10	100	20
Frequency response, ±5 %	Hz	1 ... 8 000	0,5 ... 10 000		1 ... 10 000	0,5 ... 10 000	
Threshold	grms	0,002	0,004	0,006	0,01	0,0012	0,006
Transverse sensitivity	%	1,5				3	
Non-linearity	%FSO	±1				±1	
Shock (1 ms pulse)	gpk	2 000			5 000	2 000	
Temp. coefficient sensitivity	%/°C	-0,054				0,0036	
Operating temperature	°C	-55 ... 100			-55 ... 120	-55 ... 165	
Power supply current	mA	2 ... 20			2 ... 20		
Power supply voltage	VDC	20 ... 30			20 ... 36		
Connector		10-32 neg.				10-32 neg.	
Housing/base	material	Titanium				Titanium	
Sealing	Type	Hermetic				Hermetic	
Mass	grams	8,7			8,2	10	8,1
Ground isolated		with pad/M1				yes	
Data Sheet		000-239			000-238	000-557	
Properties		Ultra low base strain, low thermal transient response, quartz-shear sensing elements, CE compliant.				Low impedance voltage output, ultra low base strain, ultra low temp. coefficient of sensitivity with PiezoStar, CE compliant	
Application		General purpose vibration measurement, vehicle or environmental testing, ESS and modal analysis.				Dynamic temperature environments. General purpose vibration measurement, vehicle or environmental testing, ESS and modal analysis.	
Accessories		Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8436				Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8436	
Versions		...T: TEDS option			...M1: ground isolated ...M5: high temp. (165 °C) ...M8: cryo temp. (-195 °C) ...T: TEDS option	...M1: ground isolated ...M5: high temp. (165 °C) ...M8: cryo temp. (-195 °C)	

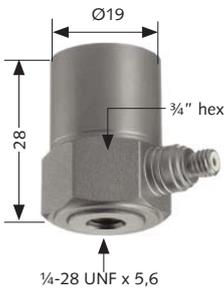
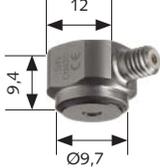
Vibration

IEPE Accelerometers - Single Axis

									
		Type 8704...				Type 8705...			
Technical data		...B25	...B50	...B100	...B500	...B5000	...A50M1	...A250M1	
Range	g	±25	±50	±100	±500	±5 000	±50	±250	
Sensitivity, ±5 %	mV/g	200	100	50	10	1	100	20	
Frequency response, ±5 %	Hz	1 ... 8 000	0,5 ... 10 000		1 ... 10 000		0,5 ... 10 000		
Threshold	grms	0,002	0,004	0,006	0,01	0,13	0,0012	0,006	
Transverse sensitivity	%	1,5					3		
Non-linearity	%FSO	±1					±1		
Shock (1 ms pulse)	gpk	2 000			5 000	10 000	2 000		
Temp. coefficient sensitivity	%/°C	-0,054					0,0036		
Operating temperature	°C	-55 ... 100			-55 ... 120		-55 ... 165		
Power supply current	mA	2 ... 20							
Power supply voltage	VDC	20 ... 30					20 ... 30		
Connector		10-32 neg.				10-32 neg.			
Housing/base	material	Titanium					Titanium		
Sealing	Type	Hermetic					Hermetic		
Mass	grams	7,5			7,1		7,6	6,7	
Ground isolated		with pad/M1					with pad/M1		
Data Sheet		000-239			000-238	000-240	000-557		
Properties		Ultra low base strain, low thermal transient response, quartz-shear sensing elements, CE compliant.				Low impedance voltage output, ultra low base strain, low thermal transient response, ultra low temp. coefficient of sensitivity with PiezoStar, CE compliant			
Application		General purpose vibration measurement, vehicle or environmental testing, ESS and modal analysis, shock measurement.				Dynamic temperature environments. General purpose vibration measurement, vehicle or environmental testing, ESS and modal analysis.			
Accessories		Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8436				Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8436			
Versions		...T: TEDS option			...M1: ground isolated ...M5: high temp. (165 °C) ...M8: cryo temp. (-195 °C) ...T: TEDS option	...M1: ground isolated ...M5: high temp. (165 °C)			

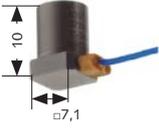
Vibration

IEPE Accelerometers - Single Axis

						
		Type 8712...	Type 8714...	Type 8715...	Type 8720...	
		...A5M1	...B100M5	...B500M5	...A5000M5	...A500
Technical data		...A5M1	...B100M5	...B500M5	...A5000M5	...A500
Range	g	±5	±100	±500	±5 000	±500
Sensitivity, ±5 %	mV/g	1 000	50	10	1	10
Frequency response, ±5 %	Hz	0,5 ... 8 000	1 ... 10 000		2 ... 10 000	1 ... 10 000 (±10 %)
Threshold	grms	0,0004	0,002	0,003	0,04	0,01
Transverse sensitivity	%	1,5	3		3	1,5
Non-linearity	%FSO	±1	±1		±1	±1
Shock (1 ms pulse)	gpk	1 000	5 000		8 000	5 000
Temp. coefficient sensitivity	%/°C	-0,054	-0,14	-0,16	-0,009	-0,054
Operating temperature	°C	-55 ... 100	-55 ... 165		-55 ... 165	-55 ... 120
Power supply current	mA	2 ... 20	2 ... 20		2 ... 20	2 ... 20
Power supply voltage	VDC	20 ... 30	18 ... 30		18 ... 30	20 ... 30
Connector		10-32 neg.	10-32 neg.		5-44 neg.	10-32 neg.
Housing/base	material	Stainless steel	Titanium/ Aluminum		Titanium	Titanium
Sealing	Type	Hermetic	Hermetic		Hermetic	Hermetic
Mass	grams	51	5	4,2	2,1	4,9
Ground isolated		yes	yes		yes	yes
Data Sheet		000-244	000-602		000-603	000-246
Properties		Very high sensitivity, quartz-shear accuracy & stability, high immunity to thermal transients, welded Hermetic construction, ground isolated, CE compliant.	Low profile, high temperature ceramic annular shear accelerometer. CE compliant.		Unique PiezoStar element, ultra low temperature sensitivity, ground isolated, lightweight, Hermetically sealed, CE compliant.	Quartz-shear sensing element, ultra low base strain sensitivity, lightweight, small size, ground isolated, CE compliant.
Application		Applications involving low amplitude vibrations over a wide frequency range, including heavy structures, suspension vibration building and machines.	Provides measurement solutions in hard to mount locations when cable orientation is important or height restrictions apply.		Shock and vibration measuring in dynamic temperature conditions. General applications include: environmental testing (ESS) product acceptance/qualification, and aviation testing.	Shock and vibration measurement on light structures. The small size allows for installation on items with limited mounting space.
Accessories		Cable: Type 1761B Coupler: Type 5100 series	Cable: Type 1761B Coupler: Type 5100 series		Cable: Type 1766A Coupler: Type 5100 series	Cable: Type 1761B Coupler: Type 5100 series
Versions			...T: TEDS option		...T: TEDS option	

Vibration

IEPE Accelerometers - Single Axis

			
		Type 8728...	Type 8730...
Technical data		...A500	...A500
Range	g	±500	±500
Sensitivity, ±5 %	mV/g	10	10 (±10 %)
Frequency response, ±5 %	Hz	2 ... 10 000	2 ... 10 000
Threshold	grms	0,02	0,02
Transverse sensitivity	%	1,5	1,5
Non-linearity	%FSO	±1	±1
Shock (1 ms pulse)	gpk	5 000	5 000
Temp. coefficient sensitivity	%/°C	-0,054	-0,054
Operating temperature	°C	-55 ... 120	-55 ... 120
Power supply current	mA	2 ... 20	2 ... 20
Power supply voltage	VDC	20 ... 30	20 ... 30
Connector		10-32 neg.	10-32 neg.
Housing/base	material	Titanium	Titanium
Sealing	Type	welded/epoxy	Hermetic
Mass	grams	1,6	1,9
Ground isolated		no	with pad
Data Sheet		000-247	000-248
Properties		Small, lightweight, 2 m integral cable, quartz-shear stability and precision, CE compliant.	Quartz-shear sensing element, low impedance output, ultra low base strain sensitivity, CE compliant.
Application		Precision measurements on small, thin-walled structures or where space is limited, ideal for high frequency vibration measurements.	Precision measurements on small, thin-walled structures and environmental testing.
Accessories		Extension Cable: Type 1761B Coupler: Type 5100 series	Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8434
Versions			...AE: metric thread. (M3x0,5) 8 mm hex ...M1: ground isolated ...M8: cryo temp. (-195 °C)

Vibration

IEPE Accelerometers - Single Axis

											
		Type 8742...					Type 8743...				
Technical data		...A5	...A10	...A20	...A50	...A5	...A10	...A20	...A50	...A100	
Range	g	±5 000	±10 000	±20 000	±50 000	±5 000	±10 000	±20 000	±50 000	±100 000	
Sensitivity, ±5 %	mV/g	1	0,5	0,25	0,1	1	0,5	0,25	0,1	0,05	
Frequency response	Hz	1 ... 10 000 (±10 %)				1 ... 10 000 (±7 %)				0,5 ... 10 000 (±7 %)	
Threshold	grms	0,13	0,25	0,5	1,3	0,13	0,25	0,5	1,3	2,6	
Transverse sensitivity	%	1,5				1,5					
Non-linearity	%FSO	±1				±1					
Shock (1 ms pulse)	gpk	50 000	50 000	100 000	100 000	50 000			100 000	120 000	
Temp. coefficient sensitivity	%/°C	-0,054				-0,054					
Operating temperature	°C	-55 ... 120				-55 ... 120					
Power supply current	mA	2 ... 20				18 ... 30					
Power supply voltage	VDC	18 ... 30				2 ... 20					
Connector		10-32 neg.				10-32 neg.					
Housing/base	material	Titanium/Stainless steel				Stainless steel					
Sealing	Type	Hermetic				Hermetic					
Mass	grams	4,5				4,5					
Ground isolated		with pad				with pad					
Data Sheet		000-250									
Properties		Unique quartz-shear sensing element, low transverse sensitivity, wide bandwidth, high resonant frequency, CE compliant,				Unique quartz-shear sensing element, low transverse sensitivity, wide bandwidth, high resonant frequency, CE compliant,					
Application		Impact and vibration related applications including shock and vehicle testing.				Impact and vibration related applications including shock and vehicle testing.					
Accessories		Cable: Type 1761B Coupler: Type 5100 series				Cable: Type 1761B Coupler: Type 5100 series					

Vibration

IEPE Accelerometers - Single Axis

						
		Type 8772...			Type 8774...	Type 8776...
Technical data		...A5	...A10	...A50	...A50	...A50
Range	g	±5	±10	±50	±50	±50
Sensitivity, ±5 %	mV/g	1 000	500	100	100	100
Frequency response, ±5 %	Hz	1 ... 5 000			1 ... 10 000	1 ... 7 000
Threshold	grms	0,0004	0,0005	0,002	0,0025	0,0025
Transverse sensitivity	%	<5			1,5	1,5
Non-linearity	%FSO	±1			±0,5	±1
Shock (1 ms pulse)	gpk	5 000	7 000		5 000	5 000
Temp. coefficient sensitivity	%/°C	-0,14	-0,11		-0,14	-0,14
Operating temperature	°C	0 ... 55			-55 ... 120	-55 ... 120
Power supply current	mA	2 ... 20			2 ... 20	2 ... 20
Power supply voltage	VDC	20 ... 30			18 ... 30	18 ... 30
Connector		10-32 neg.			10-32 neg.	10-32 neg.
Housing/base	material	Aluminum hard anodized			Titanium	Titanium
Sealing	Type	epoxy			Hermetic	Hermetic
Mass	grams	8			4	4
Ground isolated		yes			with pad	with M1 or M3 option
Data Sheet		000-253			000-255	000-255
Properties		Lightweight, ceramic shear sensing element, cube shaped for mounting flexibility, CE compliant.			High sensitivity, high resolution ceramic shear sensing element, CE compliant.	
Application		Modal analysis applications exposed to environmental factors.			General purpose vibration measurement.	Modal/structural analysis
Accessories		Cable: Type 1761B Coupler: Type 5100 series Mounting clip: Type 8474			Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8436 Mounting cube: Type 8524	Cable: Type 1761B Coupler: Type 5100 series Mounting cube: Type 8526
Versions		T: TEDS option				M1: ground isolated M3: extended low frequency and ground isolated M6: integral stud

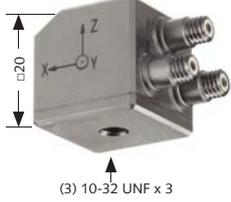
Vibration

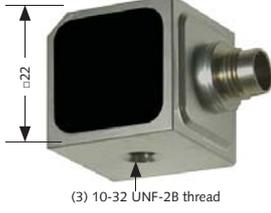
IEPE Accelerometers - Single Axis

				
		Type 8778...	Type 8784...	Type 8786...
		...A500	...A5	...A5
Technical data				
Range	g	±500	±5	±5
Sensitivity, ±5 %	mV/g	10	1 000 (±10 %)	1 000 (±10 %)
Frequency response, ±5 %	Hz	2 ... 9 000	1 ... 6 000	1 ... 6 000
Threshold	grms	0,01	0,0004	0,0004
Transverse sensitivity	%	3	1,5	1,5
Non-linearity	%FSO	±1	±1	±1
Shock (1 ms pulse)	gpk	5 000	2 500	2 500
Temp. coefficient sensitivity	%/°C	-0,14	-0,054	-0,054
Operating temperature	°C	-55 ... 120	-55 ... 80	-55 ... 80
Power supply current	mA	2 ... 20	2 ... 20	2 ... 20
Power supply voltage	VDC	18 ... 30	18 ... 30	18 ... 30
Connector		10-32 neg.	10-32 neg.	10-32 neg.
Housing/base	material	Aluminum/Titanium	Titanium	Titanium
Sealing	Type	epoxy	Hermetic	Hermetic
Mass	grams	0,4	21	21
Ground isolated		yes	with pad	with pad
Data Sheet		000-256	000-257	000-257
Properties		Ultra low base strain, low mass ground isolated, CE compliant, integral cable (user specified length).	Ceramic shear sensing element, low impedance, voltage mode, high sensitivity, high resolution, CE compliant.	Ceramic shear sensing element, low impedance, voltage mode, high sensitivity, high resolution, CE compliant.
Application		Environmental/product testing on small, thin walled structures or where space is limited and mass loading is of primary concern.	Low level vibration and impact testing for applications including condition monitoring and vehicle testing.	Low level vibration and impact testing for applications including condition monitoring and vehicle testing.
Accessories		Extension Cable: Type 1761B Coupler: Type 5100 series Removal tool: Type 1378	Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8436	Cable: Type 1761B Coupler: Type 5100 series Mounting pad: Type 8436
Versions		M14: twisted pair cable		

Vibration

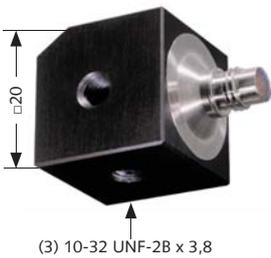
Charge/Low Frequency Accelerometers - Triaxial

 <p>(3) 10-32 UNF x 3</p>	
Type 8290...	
Technical data	
...A25M5	
Range	g ±1 000
Sensitivity, ±15 %	pC/g -25
Frequency response, ±5 %	Hz 5 ... 4 000
Threshold	grms reference charge amplifier
Transverse sensitivity	% 1,5
Non-linearity	%FSO ±1
Temp. coefficient sensitivity	%/°C 0,13
Operating temperature	°C -70 ... 250
Connector	10-32 neg.
Housing/base	material Stainless Steel
Sealing	Type Hermetic/ceramic
Mass	grams 53
Ground isolated	no
Data Sheet	000-215
Properties	Ceramic Shear sensing element, low Transverse sensitivity, extended temperature operation.
Application	General vibration measurements with varying test conditions, vehicle vibration and NVH testing, general lab/R&D and ESS.
Accessories	Cable: Type 1631C Charge converter: Type 5050 Coupler: Type 5100 series Mounting stud: Type 8402, 8411

 <p>(3) 10-32 UNF-2B thread</p>	
Type 8395...	
Technical data	
...A2D0 ...A010 ...A030 ...A050 ...A100 ...A200	
Range	g ±2 ±10 ±30 ±50 ±100 ±200
Sensitivity, ±5 %	mV/g 2 000 400 133,3 80 40 20
Zero g output, ±5	mV ±60
Frequency response, ±5 %	Hz 0 ... 250 0 ... 1 000
Non-linearity	%FSO ±1 ±1 ±1 ±1 ±1 ±1
Resolution/threshold	grms 0,00035 0,0018 0,0039 0,0088 0,018 0,035
Transverse sensitivity	% 1
Shock half sine	gpk 6 000
Temp. coeff. bias	mg/°C ±0,090 ±0,504 ±1,5 ±2,5 ±5,0 ±9,9
Temp. coefficient sensitivity	%/°C ±0,11
Operating temperature	°C -55 ... 125
Phase shift max., @ 100 Hz	degree 20 10
Current nom.	mA 4,2
Voltage	VDC 6 ... 50
Connector	9-pin pos. circular
Housing/base	material Titanium
Sealing	Type Hermetic
Mass	grams 30
Data Sheet	000-860
Properties	Bipolar output, 0 ±4 V FS, zero volt output at zero g, ground isolated, low noise, operating from voltage supply. CE Compliant.
Application	Instrument grade triaxial accelerometer well suited for automotive, aerospace, civil engineering, R&D, OEM and structural analysis.
Accessories	Cable: Type 1792A...K00, Type 1792A...K01 Mounting: adhesive mounting base Type 8466K01 Mounting: stud mounting base Type 8466K02 Mounting: magnetic mounting base Type 8466K03
Versions	...AT: 0±4 V FSO, with temp. output ...TA: Titanium, Hermetic, 9-pin pos. circular

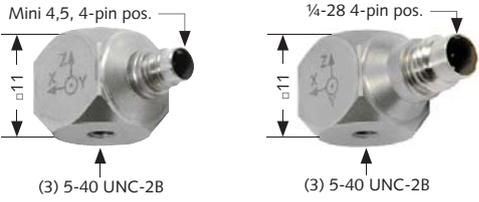
Vibration

IEPE Accelerometers - Modal Triaxial

		 10-32 UNF-2B			 (3) 10-32 UNF-2B x 3,8		
		Type 8688...			Type 8762...		
Technical data		...A5	...A10	...A50	...A5	...A10	...A50
Range	g	±5	±10	±50	±5	±10	±50
Sensitivity, ±5 %	mV/g	1 000	500	100	1 000	500	100
Frequency response, ±5 %	Hz	0,5 ... 3 000		0,5 ... 5 000	0,5 ... 6 000		
Threshold	grms	0,00014	0,00016	0,00036	0,0003	0,00035	0,0012
Transverse sensitivity	%	1,5			<5		
Non-linearity	%FSO	±1			±1		
Shock (1 ms pulse)	gpk	7 000		10 000	5 000	7 000	
Temp. coefficient sensitivity	%/°C	0,16	0,23		-0,054	-0,018	
Operating temperature	°C	-40 ... 55		-40 ... 65	-55 ... 80		
Power supply current	mA	2 ... 20			2 ... 20		
Power supply voltage	VDC	20 ... 30			20 ... 30		
Connector		4-pin pos.			4-pin pos.		
Housing/base	material	Titanium			Aluminum hard anodized		
Sealing	Type	Hermetic			welded/epoxy		
Mass	grams	6,7		6,5	23		
Ground isolated		with pad			yes		
Data Sheet		000-843			000-456		
Properties		Miniature high sensitivity, low mass, low transverse and ground isolated, CE compliant.			High sensitivity, low noise, triaxial cube, ground isolated, (3) 10-32 thread mounting holes.		
Application		Modal analysis or structural testing.			Modal analysis, automotive bodies and aircraft structures, general vibrations.		
Accessories		Cable: Type 1756C Extension cable: Type 1734A Coupler: Type 5100 series Mounting clip: Type 800M15...			Cable: Type 1756C Extension cable: Type 1578A Coupler: Type 5100 series		
Versions		...T: TEDS option			...T: TEDS option		

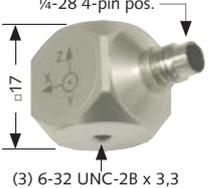
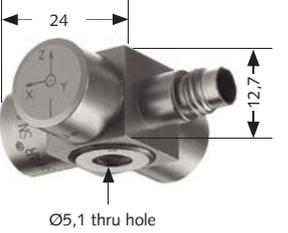
Vibration

IEPE Accelerometers - Triaxial

								
		Type 8763...						Type 8765...
Technical data		...B050	...B100	...B250	...B500	...B1K0A...	...B2K0A...	...A250M5
Range	g	±50	±100	±250	±500	±1 000	±2 000	±250
Sensitivity, ±15 %	mV/g	100	50	20	10	5	2,5	20
Frequency response, ±5 %	Hz	0,5 ... 7 000		1 ... 10 000			1 ... 9 000	
Threshold	grms	0,0004	0,0006	0,002	0,003	0,004	0,005	0,002
Transverse sensitivity	%	2,5						2,5
Non-linearity	%FSO	±1						±1
Shock (1 ms pulse)	gpk	5 000						5 000
Temp. coefficient sensitivity	%/°C	0,054		0,018		0,16		-0,0036
Operating temperature	°C	-55 ... 100		-55 ... 120		-55 ... 120		-55 ... 165
Power supply current	mA	2						2 ... 20
Power supply voltage	VDC	2 ... 20						18 ... 30
Connector		Mini 4,5 4-pin pos. (8763B...A), 1/4-28 4-pin pos. (8763B...B)						M4,5 4-pin pos.
Housing/base	material	Titanium						Titanium
Sealing	Type	Hermetic						Hermetic
Mass	grams	4,5 (8763B...A) 5 (8763B...B)		4,1 (8763B...A) 4,6 (8763B...B)		3,6		6,4
Ground isolated		with pad						yes
Data Sheet		000-928						000-472
Properties		Mini cube design, (3) 5-40 thread holes, low mass, mini 4-pin connector, CE compliant, ceramic element.						PiezoStar ultra low thermal sensitivity variation, Hermetic, ground isolated, mini 4-pin connector. CE compliant.
Application		Dynamic vibration, shock measurement, lightweight structures. Including automotive and aerospace R&D						Modal analysis, automotive and aircraft structures, with dynamic temperatures.
Accessories		Cable: Type 1784B...K03, Type 1756C...K03, Type 1734A Coupler: Type 5100 series Mounting pad: Type 8434 Mounting stud: Type 8400K04, ground isolated 5-40 stud to M6 stud Mounting stud: Type 8400K06, ground isolated 5-40 stud to 10-32 stud Mounting stud: Type 8440K01, adhesive mounted, ground isolated, 5-40 stud						Adhesive mounting base: Type 8462K01, 8462K02 Cable: Type 1784BK03 Coupler: Type 5100 series
Versions		...T: TEDS option ...B...A...: M4,5 4-pin pos. ...B...B...: 1/4-28 4-pin pos.						

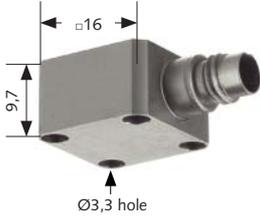
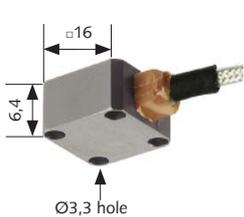
Vibration

IEPE Accelerometers - Triaxial

								
		Type 8766...	Type 8766...	Type 8766...	Type 8792...			
Technical data		...A50	...A250	...A500	...A25	...A50	...A100	...A500
Range	g	±50	±250	±500	±25	±50	±100	±500
Sensitivity, ±5 %	mV/g	100	20	10	200	100	50	10
Frequency response, ±5 %	Hz	0,5 ... 5 000	0,5 ... 10 000	0,5 ... 10 000	1 ... 5 000	0,5 ... 5 000		1 ... 5 000
Threshold	grms	0,001	0,006	0,01	0,002	0,004	0,006	0,01
Transverse sensitivity	%	1,5	1,5		1,5			
Non-linearity	%FSO	±1	±1		±1			
Shock (1 ms pulse)	gpk	5 000	5 000		2 000			5 000
Temp. coeff. sensitivity	%/°C	-0,0036	-0,0005	-0,0004	-0,054			
Operating temperature	°C	-55 ... 120	-55 ... 120		-55 ... 100			-55 ... 120
Power supply current	mA	2 ... 20	2 ... 20		2 ... 20			
Power supply voltage	VDC	18 ... 30	18 ... 30		20 ... 30			
Connector		1/4-28 4-pin pos.	Mini 4,5 4-pin pos. (8766A...A), 1/4-28 4-pin pos. (8766A...B)		4-pin pos.			
Housing/base	material	Titanium	Titanium		Stainless steel			
Sealing	Type	Hermetic	Hermetic		Hermetic			
Mass	grams	16	4		29			27
Ground isolated		with pad	with pad		yes			
Data Sheet		000-472	000-607		000-260			
Properties		PiezoStar element, +165 °C operation, TEDS, Hermetic, titanium construction, low temperature and base strain sensitivity, low impedance voltage output, CE compliant.			Center hole quartz shear triaxial, low base strain sensitivity, wide frequency range, ground isolated, low profile, CE compliant.			
Application		Applications include automotive under the hood and under the vehicle testing as well as subsystem vibration testing for aerospace applications.			Center hole mounting capability allows orientation of exit cable or axis alignment. The low profile package accommodates restricted space environments.			
Accessories		Cable: Type 1756C Coupler: Type 5134B series, 5100 series Mounting stud: Type 8400K02, ground isolated 6-32 stud to 10-32 stud Type 8400K04, ground isolated 5-40 stud to M6 stud Type 8400K05, ground isolated 6-32 stud to M6 stud Type 8400K06, ground isolated 5-40 stud to 10-32 stud Type 8440K01, adhesive, ground isolated, 5-40 stud Type 8440K02, adhesive, ground isolated, 6-32 stud			Socket cap screw: 10-32x0,75, M5x20 mm Cable: Type 1578A, 1756C Coupler: Type 5100 series			
Versions		...M5: high temp. (165 °C) ...T: TEDS option	...T: TEDS option ...A...A: M4,5 4-pin pos. ...A...B: 1/4-28 4-pin pos. ...H: High temperature, 165 °C		...T: TEDS option			

Vibration

IEPE Accelerometers - Triaxial

				
		Type 8793...	Type 8794...	Type 8795...
		...A500	...A500	...A50M8
Technical data				
Range	g	±500	±500	±50
Sensitivity, ±5 %	mV/g	10	10	100 (±10 %)
Frequency response, ±5 %	Hz	2,5 ... 10 000	2,5 ... 10 000	1 ... 4 000
Threshold	grms	0,002	0,002	0,001
Transverse sensitivity	%	1,5	1,5	1,5
Non-linearity	%FSO	±1	±1	±1
Shock (1 ms pulse)	gpk	5 000	5 000	5 000
Temp. coefficient sensitivity	%/°C	-0,036	-0,036	-0,036
Operating temperature	°C	-55 ... 120	-55 ... 120	-195 ... 120
Power supply current	mA	2 ... 20	2 ... 20	2 ... 20
Power supply voltage	VDC	20 ... 30	20 ... 30	20 ... 30
Connector		4-pin pos.	4-pin pos.	4-pin pos.
Housing/base	material	Stainless steel	Stainless steel	Titanium
Sealing	Type	Hermetic	welded/epoxy	Hermetic
Mass	grams	11	7,6	32
Ground isolated		with pad	with pad	with pad
Data Sheet		000-261	000-263	000-264
Properties		Low profile design, quartz shear stability, Hermetically sealed, CE compliant.	Low profile design, quartz shear stability, CE compliant, 2 m integral cable.	Quartz triaxial, Hermetically sealed, CE compliant.
Application		Useful for measuring vibration and shock on small and lightweight structures, extreme temperature applications.	The low profile design provides an aerodynamic advantage for in-flight flutter testing as well as general shock and vibration.	Vehicle vibration and noise harshness (NVH) testing, general lab/R&D and modal testing, extreme temperature applications.
Accessories		Cap screws 4-40x½, M2,5x12 mm Cable: Type 1756C, 1734A Coupler: Type 5100 series Mounting pad: Type 800M144	Cable: Type 1756C, 1734A Extension cable: Type 1578A Coupler: Type 5100 series Mounting screw: 4-40x3/8" and M2,5x10 mm Mounting pad: Type 800M144	Cable: Type 1756C Extension cable: Type 1578A Coupler: Type 5100 series Mounting stud: Type 8402, 8411 Mounting pad: Type 8436
Versions		...T: TEDS option ...M5: high temp. (165 °C) ...M8: cryo temp. (-195 °C)	...M5: high temp. (165 °C)	

Acoustic Emission

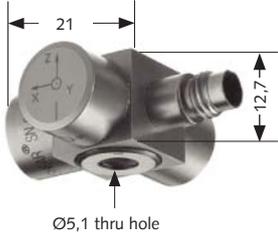
Acoustic Emission Sensors/Conditioning

		Type 8152...	
Technical data		...B1...	...B2...
Frequency range, ±10 dB	kHz	50 ... 400	100 ... 900
Sensitivity, nom.	dBref 1V (m/s)	57	48
Shock (0,5 ms pulse)	g	2 000	
Operating temperature	°C	-40 ... 60	
Supply: power supply	mA	3 ... 6	
Voltage (coupler)	VDC	5 ... 36	
Output voltage (full scale)	V	±2	4
Output bias	VDC	2,2	2,5
Mass	grams	29	
Case material		Stainless steel	
Sealing		Hermetic	
Ground isolated		yes	
Data sheet		000-204	
Properties		High sensitivity and wide frequency range, inherent highpass characteristic, robust, suitable for industrial use (degree of protection IP 65 PUR or IP 67 Viton), ground isolated, CE compliant, 2 m integral cable	
Application		Measurement of very high frequency phenomena particularly on machine structures. Crack formation investigations, fatigue studies and machine tool diagnostics.	
Accessories		Magnet clamp: Type 8443B AE Coupler: Type 5125B...	
Versions		PUR Cable: Type 8152B...1 Viton® Cable: Type 8152B...2	

		Type 5125	
Technical data			
Sensor excitation voltage	VDC	20	
Sensor excitation current	mA	4	
Frequency response	Hz	0,1 ... 30 000	
Output signal voltage	V	0 ... 10	
Gain		1, 10	
Power	Type	115/220	
Operating temperature	°C	0 ... 60	
Dimensions (WxHxD)	mm	114x64x36	
Mass	kg	0,27	
Connector		Input: BNC neg. or cable gland Output: 8-pin round connector DIN 45326	
Data sheet		000-322	
Properties		Built-in RMS converter and limit monitor, plug-in filter modules, rugged case, vibration-proof construction, CE compliant.	
Application		Vibration and acoustic emission (AE) sensors.	
Accessories		Plug-in Low/high pass filters 8-pin round connector: Type 1500A57	
Versions		request data sheet for all options	

Rotational Accelerometers and Impedance Head

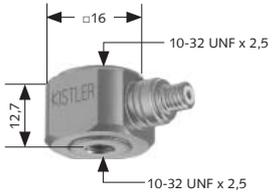
Rotational Accelerometers, IEPE Impedance Head

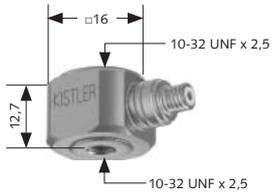
		Type 8838	Type 8840
			
Technical data			
Range	krad/s ²	±150	±150
Sensitivity, ±10 %	µV/rad/s ²	35	35
Frequency response, ±5 %	Hz	1 ... 2 000	1 ... 2 000
Threshold	rad/s ²	4	4
Transverse sensitivity	%	1,5	1,5
Non-linearity	%FSO	±1	±1
Shock (1 ms pulse)	g _{pk}	5 000	5 000
Temp. coeff. sensitivity	%/°C	0,054	0,054
Operating temperature	°C	-55 ... 120	-55 ... 120
Power supply current	mA	4	4
Power supply voltage	VDC	20 ... 30	20 ... 30
Connector		4-pin pos.	4-pin pos.
Housing/base	material	Titanium	Titanium
Sealing	Type	Hermetic	Hermetic
Mass	grams	18,5	18,5
Ground isolated		yes	yes
Data Sheet		000-271	000-271
Properties		Shear quartz piezoelectric, axial oscillations, Hermetic construction, lightweight and convenient thru hole mount, CE compliant.	Shear quartz piezoelectric, axial oscillations, Hermetic construction, lightweight and convenient thru hole mount, CE compliant.
Application		Axial or shaft type measurements on an oscillating but non-rotating specimen.	Lateral type measurements on an oscillating but non-rotating specimen.
Accessories		Cable: Type 1592M1, 1578A, 1786C	Cable: Type 1592M1, 1578A, 1786C

		Type 8770...	
			
Technical data		...A5	...A50
ACCELERATION			
Range	g	±5	±50
Sensitivity, ±10 %	mV/g	1 000	100
Frequency response, ±5 %	Hz	1 ... 4 000	
Threshold	grms	0,0004	0,001
Transverse sensitivity, typ.	%	1,5	
Temp. coefficient sensitivity	%/°C	0,14	
FORCE			
Range	N·m	±6,8	±68
Sensitivity, ±10 %	mV/N·m	230	23
Threshold	N·m	0,00018	0,0018
Temp. coefficient sensitivity	%/°F	0,03	
Operating temperature	°C	-55 ... 80	-55 ... 120
Power supply	mA	2 ... 20	
	VDC	20 ... 30	
Housing/base	type	Titanium	
Sealing	type	Hermetic	
Mass	gram	34	
Connector		10-32 neg.	
Data Sheet		000-252	
Properties		Low impedance voltage mode, sensitivity unaffected by mounting torque, wide frequency range, CE compliant.	
Application		Modal analysis, typically installed on a test article and connected by a threaded stinger to a shaker. Measures input force and acceleration simultaneously.	
Accessories		Cable: Type 1761B Coupler: Type 5100 series	

Force

Charge and IEPE Force Sensors

			
		Type 9212	Type 9222
Technical data			
Range compression	N·m	6 780	6 780
Range tension	N·m	-680	-680
Threshold	N·m	*	*
Sensitivity	pC/N·m	-12	-4,4
Non-linearity	%FSO	±1	±0,5
Rigidity	N·m/μm	>0,88	>0,88
Temp. coeff. sensitivity	%/°C	0,018	0,036
Operating temperature	°C	-240 ... 150	-195 ... 150
Insulation resistance	Ω	10 ¹³	10 ¹³
Capacitance	pF	58	23
Connector		10-32 neg.	10-32 neg.
Housing/base	material	Stainless steel	Stainless steel
Sealing	Type	welded/epoxy	welded/epoxy
Mass	grams	18	19
Data Sheet		000-418	000-418
Properties		High impedance, charge mode output, rugged quartz sensor, wide measuring ranges for compression and tension, quasi-static response.	
Application		Force applications such as press fit assembly, crimping and impact force testing; can be used with shakers for modal analysis, machine tool measurements or various automotive, aerospace and robotic testing.	
Accessories		Cable: Type 1631C Charge amp.: Type 5000 series Impact mounting pad: Type 900A1	

						
		Type 9712...				
Technical data		...B5	...B50	...B250	...B500	...B5000
Range compression	N·m	6,8	68	339	678	6 779
Range tension	N·m	-6,8	-68	-339	-678	-678
Threshold	N·m	0,00014	0,001	0,007	0,014	0,136
Sensitivity	mV/N·m	184	23	4,6	2,3	0,23
Non-linearity	%FSO	±1				
Rigidity	N·m/μm	>0,88				
Temp. coeff. sensitivity	%/°C	0,036				
Operating temperature	°C	-50 ... 120				
Power supply current	mA	4				
Power supply voltage	VDC	20 ... 32				
Connector		10-32 neg.				
Housing/base	material	Stainless steel				
Sealing	Type	Hermetic				
Mass	grams	19				
Data Sheet		000-417				
Properties		Low impedance voltage mode, rugged quartz sensor, wide measuring range, uses standard low impedance cables, CE compliant.				
Application		Force applications where high sensitivity, high rigidity and fast responses are required.				
Accessories		Cable: Type 1761B Charge amplifier: Type 5100 series Impact pad: Type 900A1				

* Threshold depends on charge amp settings

Electronics

IEPE Sensor Power Supply

					
		Type 5108A	Type 5110	Type 5114	Type 5118B2
Technical data		IEPE	IEPE	IEPE	IEPE
Sensor excitation voltage	VDC	20	20	20	22
Sensor excitation current	mA	4	2	2	2
Frequency response	Hz	0,02 ... 87 000	0,07 ... 60 000	0,07 ... 60 000	0,02 ... 40 000
Output signal voltage	V	20	18	20	20
Gain		1	1	1	1, 10, 100
Power	Type	Banana jacks	battery: 9 V alkaline (IEC 6LR61)	battery: 9 V alkaline (IEC 6LR61)	4x1,5 V AA, alkaline
Operating temperature	°C	0 ... 50	-9 ... 55	-9 ... 55	-20 ... 50
Dimensions (WxHxD)	mm	97x43x28	109x61x25	81x150x36	97x48x178
Mass	kg	0,064	0,15	0,25	0,50
Connector		Input: BNC neg. Output: BNC pos. Power: banana jacks, polarity (+ red, - black)	Input/output: BNC neg.	Input/output: BNC neg.	Input/output: BNC neg.
Data sheet		000-328	000-329	000-330	000-331
Properties		Simple to operate, AC coupled, reverse polarity protection, CE compliant. Use with low impedance Piezotron sensors with built-in electronics.	Turn a digital multimeter into a hand-held relative vibration measurement system or verify sensor and cable integrity with this portable, low cost, battery operated coupler.	Provides constant current excitation, monitors condition of sensors and cables, 3,5" digital LCD display AC-DC or battery powered, CE compliant.	Selectable gain and low pass, plug-in filters, panel selectable, high pass filtering, exclusive "Rapid Zero" feature AC-DC or battery powered, CE compliant.
Application		Provide DC power to sensors that contain miniature impedance converting circuits and to couple the signal generated in each to an electronic measurement instrument.	Transforms an ordinary digital voltmeter into a simple measuring tool, ideal for troubleshooting sensors, cable or vibration problems in an industrial environment for low impedance sensors.	Power and monitor Piezotron, low impedance sensors.	Powering low impedance sensors where test conditions require flexible signal conditioning
Accessories		Cable: Type 1761B		AC-DC power adapter: Type 5752 (120 V), Type 5757 (230 V)	AC-DC power adapter: Type 5752 (120 V), Type 5757 (230 V) Panel mounting kit: Type 5702 Plug-in low pass filters: Type 5326A..., 5327A...
Versions			Type 5110S1 kit: with case, mounting wax and 9 V battery	Type 5114: 9 V alkaline battery Type 5114S1: 9 V alkaline battery, 115 VAC power adapter and carrying case Type 5114S1(E): as S1 with 230 VAC power adapter	

Electronics

IEPE/MEMS Capacitive Sensor Power Supply

					
		Type 5134B...	Type 5148	Type 5210	Type 5127
Technical data		IEPE	IEPE	MEMS Capacitive	IEPE
Sensor excitation voltage	VDC	24	24	9	20
Sensor excitation current	mA	0 ... 15	2 ... 4	25	4
Frequency response	Hz	0,1 ... 68 000	0,05 ... 50 000	0 ... 750	0,1 ... 30 000
Output signal voltage	V	±5/±10 selectable	20	±8	0 ... 10
Gain		0,5 ... 150	1	1, 2, 10, 20	1, 10
Power	Type	115/230	115/230	9 V Battery	115/220
Operating temperature	°C	0 ... 50	0 ... 50	-9 ... 55	0 ... 60
Dimensions (WxHxD)	mm	94x150x196	427x43x203	147x91x33	114x64x36
Mass	kg	1,8	2,5	0,26	0,27
Connector		Input/output: 4 BNC neg.	Input/output: 16 BNC neg.	Sensor: 4-pin, Microtech pos. Output signal: BNC neg. External DC input: 2,1 mm jack (tip+)	Input: BNC neg. or cable strain relief Output: 8-pin round connector DIN 45326
Data sheet		000-605	000-333	000-334	000-323
Properties		Multidrop USB 2.0 for remote control and monitoring. Front panel LEDs for fault/status of each channel, non volatile memory to store settings, vernier gain and selectable 4-pole low pass filters, TEDS compatible, CE compliant.	Provides constant current excitation for Piezotron and voltage mode piezoelectric sensors, LED's indicate circuit integrity, convenient front/rear BNC connectors, standard rack mountable, CE compliant.	Adjustable offset control for higher resolution measurements, battery or external power, gain and filtering options, low battery indicator, complete kit available/R&D, CE compliant.	Built-in RMS converter and limit monitor, plug-in filter modules, rugged case, vibration-proof construction, CE compliant.
Application		General vibration lab/R&D use with single axis or triaxial accelerometers.	Multi-channel low impedance sensor power at economical price per channel.	Power single axis K-Beam accelerometer from a casual check to an in-depth study.	Vibration and acoustic emission (AE) sensors.
Accessories			AC-DC power adapter: Type 5754 (115 V) Type 5764 (230 V)	AC-DC power adapter: Type 5752 (120 V), Type 5757 (230 V)	Plug-in Low/high pass filters 8-pin round connector: Type 1500A57
Versions		With case: Type 5134B1 Without case: Type 5134B0		Type 5210: 9 V battery Type 5210S1: 9 V battery, 115 V power adapter Type 5752 and carrying case Type 5210S1(E): as S1 with 230 V power adapter Type 5757	request data sheet below for all ordering options

Electronics

Charge Amplifiers



		Type 5015A
Technical data		Dual Mode Optional
Measuring range	pC	$\pm 2 \dots 2\,200\,000$
Sensor sensitivity	pC	
Scale	mV/MU	
Frequency response (standard filter)	Hz	0 ... 200 000
Output voltage	V	$\pm 10 \dots \pm 2$
Output current	mA	2
Accuracy	%	$< \pm 3 \dots < \pm 0,5$
Power	VAC	115/230
Temperature range	°C	0 ... 50
Remote control	Type	6-pin; DIN 45322 RS-232C: 9-pin D-Sub
Dimensions (WxHxD)	mm	104x142x252 (with case)
Mass	kg	2,3
Connector		Input/output: BNC neg.
Data sheet		000-297
Properties		Single-channel charge amplifier, LCD menu as well as read out for signal evaluation optional Piezotron input, CE compliant.
Application		Measure dynamic pressure, force, strain and acceleration from piezoelectric sensors.
Accessories		
Versions		see data sheet: 000-297

Signal Conditioning

In-line IEPE Signal Conditioning

								
		Type 5050...			Type 557		Type 558	
Technical data		...A0.1	...A1	...A10				
Output signal voltage	V _{pp}	10			10		10	
Gain	mV/pC	0,1	1	10	0,97		0,97	
Noise (broadband 1 ... 10 kHz)	μV _{rms}	5	10	70	25		25	
Input resistance min.	kΩ	100			5x10 ⁸		5x10 ⁸	
Input capacitance	pF	30 000			3		3	
Frequency response, -5 %	Hz	1 ... 20 000			0,1 ... 100 000		0,1 ... 100 000	
Constant current	mA	2 ... 20			4		4	
Compliance voltage	VDC	20 ... 30			20 ... 30		20 ... 30	
Operating temperature	°C	-40 ... 80			-55 ... 120		-55 ... 120	
Signal polarity		inverted						
Sealing	Type	welded/epoxy			welded/epoxy			
Housing/base	material	Stainless steel			304 Stainless steel		304 Stainless steel	
Mounting	Type	in-line			on sensor		in-line	
Input connector	Type	10-32 neg.			10-32 pos.		10-32 neg.	
Output connector	Type	BNC neg.			10-32 neg.		10-32 neg.	
Dimensions (WxDia.)	mm.	71x16			20x6,4		24x6,4	
Mass	grams	28			2,1/2,6		2,6	
Data sheet		000-452			000-388		000-388	
Properties		Two wire, single-ended charge converter, rugged, stainless steel case, wide Frequency response, three gain versions, CE compliant. Ideal for ceramic high impedance accelerometers.			Compatible with high impedance, quartz sensors used with optional range capacitance (Type 571A) to tailor the output signal. Requires constant current source for operation. Ideal for quartz sensors.			
Application		In line charge converter for high impedance ceramic accelerometers ideal for remote signal conditioning for high temperature vibration measurements.			Conversions of charge signals from quartz piezoelectric sensors into proportional voltage signals. Ideal for remote signal conditioning for high temperature, high impedance sensors.			
Accessories		Cable: Type 1635C.... Coupler: Type 5100 series			Range capacitor: Type 571A...			

Ancillary Electronics

Equipment Calibration and Test

		Type 8921				
Technical data		...Y26	Properties	Application	Accessories	Versions
Frequency	Hz (rads)	159,2 (1 000)	Test measurement system integrity, convenient self-contained and portable, rechargeable battery, tests sensors up to 300 grams, CE compliant.	The Type 8921 reference shaker can be used to confirm the sensitivity of acceleration, velocity, and displacement sensors.	10-32 to M5 stud: Type 8451 ¼-28 to M5 stud: Type 8453	Type 8921Y26: with 115 VAC battery charger Type 8921: with 230 VAC battery charger
Acceleration rms, ±3 %	g	1,019				
Velocity rms ±3 %	in/sec	0,394				
Displacement rms, ±3 %	mils	0,394				
Mass	grams	300				
Operating temperature	°C	10 ... 40				
Power supply current	mA	300				
Power supply voltage	VDC	12				
Battery	Type	built-in rechargeable				
Mass	kg	2,0				
Dimensions (WxHxD)	mm	107x76x178				
Data Sheet		000-362				



		Type 5493		
Technical data			Properties	Application
Measuring range	Ω	10 ¹¹ ... 4x10 ¹³	Small, robust, for measuring high insulation resistance on the spot; low measuring voltage of 5 V, logarithmic indication avoids the need for range switching, automatic switch-off, CE compliant.	Measure insulation resistance of cables and equipment.
Measuring voltage	V	5		
Admissible voltage, max.	V	700		
Measurement display		logarithmic		
Battery power	VDC	9		
Dimensions (WxHxD)	mm	79x150x36		
Mass	kg	0,29		
Connector		pigtails		
Data Sheet		000-354		



Impulse

IEPE Impulse Hammers

									
		Type 9722...		Type 9724...		Type 9726...		Type 9728...	
Technical data		...A500	...A2000	...A2000	...A5000	...A5000	...A20000	...A20000	
Force range	N·m	0 ... 136	0 ... 680	0 ... 680	0 ... 1 355	0 ... 1 355	0 ... 6 780	0 ... 6 780	
Frequency response, -10 dB	Hz	8 200*	9 300*	6 600*	6 900*	5 000*	5 400*	1 000	
Resonant frequency	kHz	27		27		27		20	
Sensitivity	mV/N·m	12	2,3	2,3	1,2	1,2	0,23	0,23	
Rigidity	N·m/μm	0,88		0,88		0,88		2,7	
Time constant	sec	500		500		500		500	
Operating temperature	°C	-20 ... 70		-20 ... 70		-20 ... 70		-20 ... 70	
Power supply current	mA	2 ... 20		2 ... 20		2 ... 20		2 ... 20	
Power supply voltage	VDC	20 ... 30		20 ... 30		20 ... 30		20 ... 30	
Length of handle	mm	188		231		236		343	
Hammer head: diameter	mm	18		23		32		51	
Hammer head: length	mm	61		89		94		155	
Mass	grams	100		250		500		1 500	
Connector		BNC neg.		BNC neg.		BNC neg.		BNC neg,	
Data Sheet		000-272		000-273		000-274		000-275	
Properties		Low impedance voltage mode, quartz force sensing element integrated to hammer handle, CE compliant.		Low impedance voltage mode, quartz force sensing element integrated to handle of hammer, CE compliant.		Low impedance voltage mode, quartz force sensing element integrated to hammer handle, CE compliant.		Low impedance voltage mode, quartz force sensing element integrated to handle of hammer, CE compliant.	
Application		Modal analysis		Modal analysis		Modal analysis		Modal analysis	
Accessories		Cable: Type 1601B... Coupler: Type 5100 series		Cable: Type 1601B... Coupler: Type 5100 series		Cable: Type 1601B... Coupler: Type 5100 series		Cable: Type 1601B... Coupler: Type 5100 series	

* Low frequency point depends upon the system time constant and tip in use, call Kistler for details

Accessories

Mounting and Cables

Common accessories extend the flexibility of the accelerometer families often adapting to less than optimal conditions.

For instance, the variety of adhesive mounting pads provide ground isolation while permitting a reasonable attachment in situations where tapping a threaded hole is unacceptable. A series of magnet mounts

provides an alternate solution if the structure is a ferrous material. Also included in this section are a variety of conversion studs to accommodate a previous mounting site to a different accelerometer with different threads. Mounting cubes provide a means of obtaining accurate orthogonal measurements at a reasonable cost.



Magnetic mounting - see Data sheet 000-281

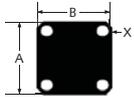
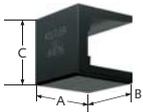
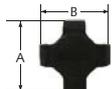
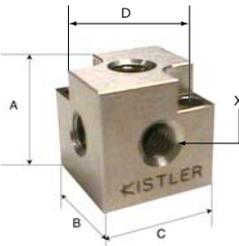
	Technical data	A (mm)	B (mm)	C (mm)	Thread X	Holding force (N·m)	Material
	8450A	7,6	12,7	11,2	5-40	8	17-4 PH Stainless steel
	8452A	11,2	17,8	16,0	10-32	16	17-4 PH Stainless steel
	8456	11,2	24,9	-	¼-28 stud	40	17-4 PH Stainless steel
	8458	26,9	47,2	-	¼-28 hole	55	17-4 PH Stainless steel

Mounting - see Data sheet 000-281

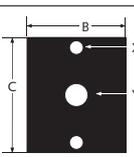
	Technical data	A (mm)	B (mm)	C (mm)	Thread X	Thread Y	Material
	8402	7,1	2,5	2,5	10-32	10-32	BeCu
	8404	7,1	2,5	2,5	10-32	10-32	17-4 PH St. Stl.
	8410	6,4	2,0	3,3	¼-28	10-32	BeCu
	8411	10,9	6,4	3,3	10-32	M6	BeCu
	8416	6,6	3,3	2,3	5-40	10-32	316 St. Stl.
	8418	7,1	3,8	2,3	5-40	M6	316 St. Stl.
	8421	13,2	6,4	4,6	M8	¼-28	BeCu
	8451	8,9	5,1	2,8	10-32	M5	BeCu
	8412	9,7	-	-	¼-28	¼-28	18-8 St. Stl.
	8420	9,7	-	-	5-40	5-40	18-8 St. Stl.
	8414	8,9	8,1	-	¼-28	10-32	17-4 PH St. Stl.
	8434	4,8	12,4	11,2	5-40	-	Al. anodized
	8436	4,8	15,7	14,2	10-32	-	Al. anodized
	8438	7,9	21,1	19,1	¼-28	-	Al. anodized

Accessories

Mounting - see Data sheet 000-281

	Technical data	A (mm)	B (mm)	C (mm)	D (mm)	Thread X	Material
	800M144	16,0	16,0	-	-	4-40	Aluminum hard anodized, for Types 8793A, 8794A
	8474	19,6	17,8	18,5	-	-	Delrin, for Type 8772A
	800M156	16,3	16,3	0,0	0,0		Poly carbonate, for Type 8640A
	800M155	20,1	20,1	0,0	0,0		Poly carbonate, for Type 8688A
	8522	26,9	26,9	26,9	15,0	4-40	Aluminum hard anodized, for Type 8315A
	8530K01	39,6	39,6	39,6	25,4	4-40	Aluminum hard anodized, for Type 8330B3
	8502	25,4	25,4	25,4	25,4	10-32	303 Stainless steel
	8504	14,5	14,5	14,5	14,0	10-32	303 Stainless steel
	8506	28,7	28,7	28,7	29,2	1/4-28	303 Stainless steel
	8508	6,4	6,4	6,4	-	-	17-4 PH Stainless steel
	8510	14,5	14,5	14,5	14,2	5-40	316 Stainless steel
	8514	17,3	17,3	17,3	18,5	10-32	303 Stainless steel
	8524	11,2	11,2	11,2	-	10-32	Aluminum hard anodized
	8526	11,2	11,2	11,2	-	-	Aluminum hard anodized

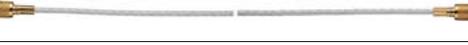
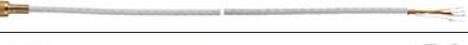
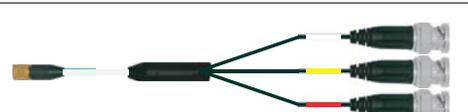
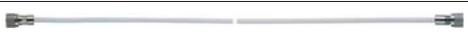
Mounting - see Data sheet 000-281

	Technical data	A (mm)	B (mm)	C (mm)	D (mm)	Hex (mm)	Thread X	Thread Y	Material
	8400K01	3,4	-	11,6	14,0	12,7	87,1	10-32	Al. hard anodized
	8400K02	5,9	-	12,4	20,8	19,1	150,3	6-32	Al. hard anodized
	8400K03	5,5	-	12,8	20,8	19,1	140,6	M6	Al. hard anodized
	8400K04	5,2	-	12,3	14,0	12,7	132,3	M6	Al. hard anodized
	8400K05	5,9	-	13,3	20,8	19,1	150,3	M6	Al. hard anodized
	8400K06	5,3	-	11,4	14,0	12,7	135,5	5-40	Al. hard anodized
	8440K01	5,2	-	8,0	14,0	12,7	132,3	5-40	Al. hard anodized
	8440K02	5,7	-	9,0	20,8	19,1	143,9	6-32	Al. hard anodized
	8440K03	5,0	-	8,3	15,7	14,3	125,8	10-32	Al. hard anodized
	8462K01	4,8	-	-	20,6	19,1	122,6	-	Al. hard anodized, for Types 8715, 8765
	8462K02	4,8	-	-	20,8	19,1	122,6	-	Al. hard anodized, for Types 8715, 8765
	8464K01	7,6	21,6	25,4	-	-	193,5	-	Al. hard anodized
	8464K02	7,6	21,6	25,4	-	-	193,5	10-32(1)	Al. hard anodized
	8464K03	7,6	21,6	25,4	-	-	193,5	-	17-4 PH St. Stl.
	8466K01	6,4	-	8,9	24,6	22,2	161,3	-	Al. hard anodized
	8466K02	6,4	-	8,9	24,6	22,2	161,3	10-32	Al. hard anodized
	8466K03	6,4	-	8,9	24,6	22,2	161,3	-	303 St. Stl., with magnet
	800M158	2,5	-	5,1	9,4	-	64,5	-	Al. anod., Type 8640A
	800M157	3,8	-	6,4	11,1	-	96,8	-	Al. anod., Type 8688A

Accessories

Cables

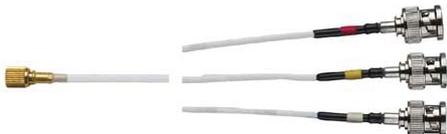
Cables - See Data sheet 000-471

	Types	Connection A	Connection B	Length (m)	Dia, (in)	Use
	1511	BNC pos.	BNC pos.	1/sp	0,25	Used for charge amplifier and coupler output signals
	1576	¼-28, 4-pin neg.	(3x) BNC pos.	0,20	0,07	Distribution cable, Teflon jacket
	1578	¼-28, 4-pin neg.	¼-28, 4-pin neg.	2/sp	0,10	Extension cable, Teflon
	1592A	¼-28, 4-pin neg.	¼-28, 4-pin neg.	2/4/sp	0,10	General purpose extension cable, Teflon
	1592M1	¼-28, 4-pin neg.	pigtail	2/sp	0,10	Teflon jacketed cables
	1601B	BNC pos.	BNC pos.	sp	0,12	High impedance charge mode cables, commonly used as extension cables
	1603B	BNC neg.	BNC pos.	sp	0,12	High impedance charge mode cables, commonly used as extension cables
	1631C	10-32 pos.	BNC pos.	1/2/3/5/8/sp	0,08	High impedance charge mode cables, Teflon
	1635C	10-32 pos.	10-32 pos.	1/2/3/5/8/sp	0,08	High impedance charge mode cables, Teflon
	1641	10-32 pos.	BNC pos.	sp	0,08	High impedance charge mode cables, Teflon
	1734A...K03	¼-28, 4-pin neg.	(3x) BNC pos.	1/3/5/10	0,07	High temperature, ultra flexible IEPE triaxial cable with silicone jacket
	1756C...K03	¼-28, 4-pin neg.	(3x) BNC pos.	0,5/3/10/sp	0,10	High temperature, triaxial accelerometer breakout cable, Teflon jacket
	1761B	10-32 pos.	BNC pos.	1/2/3/5/sp	0,08	Teflon® insulated, voltage mode cables
	1762B	10-32 pos.	10-32 pos.	1/2/3/5/sp	0,08	Teflon® insulated, voltage mode cables
	1766AK01	5-44 pos.	10-32 neg.	sp	0,06	8715A... mating cable
	1768A...K01	10-32 pos.	BNC pos.	1/2/3/5/sp	0,08	Flexible PVC jacketed cables
	1768A...K02	10-32 pos.	10-32 pos.	1/2/3/5/sp	0,08	Flexible PVC jacketed cables
	1534A...K00	¼-28, 4-pin neg.	pigtail	2/5/10/sp	0,10	Flexible silicon jacketed cables

Accessories

Cables

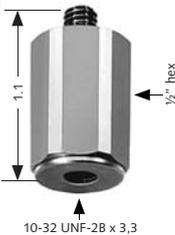
Cables - See Data sheet 000-471

	Types	Connection A	Connection B	Length (m)	Dia. (in)	Use
	1784AK02	M4,5, 4-pin neg.	1/4-28, 4-pin pos.	0,50/sp	0,06	Sensors with the Kistler M4,5, 4-pin connector (Types 8763,8765,8766)
	1784B...K03	M4,5, 4-pin neg.	(3x) BNC pos.	1/3/5/10	0,06	Sensors with the Kistler M4,5, 4-pin connector (Types 8763,8765, 8766), in triaxial applications, Teflon
	1786C	1/4-28, 4-pin neg.	(3x) Banana Jacks for power, (2x) BNC pos. signal out	2/5/10	0,1	Breakout power supply cable, Teflon jacketed
	1788A	1/4-28, 4-pin neg.	(3x) Banana Jacks for power, BNC pos. signal out	2/5/10	0,1	Breakout power supply cable, Teflon jacketed
	1792A...K01	9-pin circular	9-pin D-Sub	2/5/10/sp	0,18	Mating cable: Type 8395A
	1792A...K00	9-pin circular	pigtail	2/5/10/sp	0,18	Mating cable: Type 8395A
	1794A	9-pin D-Sub neg.	(2x) Banana Jacks for power, (3x) BNC pos. signal out	2	0,1	Breakout power supply cable, Teflon jacketed

Calibration

Sensors and Signal Conditioning

			
		Type 8802A1	Type 8804A1
Technical data			
Acceleration range	g	±250	±250
Acceleration limit	g	±1 000	±1 000
Threshold	grms	0,02	0,01
Ref. voltage sensitivity (@ 100 Hz, 75 °F ±10 g)	mV/g	10 ±0,01	10 ±0,01
Frequency response	Hz	10 ... 10 000	10 ... 10 000
Transverse sensitivity, @ 100 Hz	%	2	2
Time constant	s	1	1
Non-linearity	%	±0,5	±0,5
Operating temperature	°C	4 ... 40	4 ... 40
Temp. coefficient sensitivity	%/°C	-0,036	-3,6
Output signal voltage, FSO	V	±2,5	±2,5
Ground isolated		no	yes
Output impedance	Ω	<15	<15
Power supply voltage	VAC	115/230	115/230
Connector		10-32 neg. BNC neg.	10-32 neg. BNC neg.
Mass (sensor)	grams	20	80
Data Sheet		000-520	000-521
Properties		This calibration system features unique stability, linearity and repeatability. The Type 8802 includes Type 8002K and Type 5022 charge amp calibrated as a system, CE compliant.	This calibration system features unique stability, linearity and repeatability. The Type 8804 includes Type 8076K and Type 5022 charge amp calibrated as a system, CE compliant.
Application		System for lab/R&D primary calibration.	System for back-to-back calibration.

			
		Type 8002K	Type 8076K
Technical data			
Range	g	±1 000	±1 000
Sensitivity, ±0,1	pC/g	-1	1
Frequency response	Hz	0 ... 6 000 (-1, ±5%)	0,5 ... 5 000 (±4 %)
Threshold	grms	0,02	0,01
Transverse sensitivity	%	≤ 2	≤2
Non-linearity	% FSO	±0,5	±0,5
Temp. coeff. sensitivity	%/°C	-0,036	0,018
Operating temperature	°C	-70 ... 120	-20 ... 65
Connector		10-32 neg.	10-32 neg.
Housing/base	material	Stainless steel	Stainless steel
Sealing	Type	epoxy	epoxy
Mass	grams	20	80
Sensing element	Type	Quartz	Quartz
Data Sheet		000-205	000-210
Properties		High impedance, charge mode, quartz stability and repeatability, with wide operating temperature.	High impedance charge mode, quartz accuracy and stability, rugged design, low base strain sensitivity, ground isolated.
Application		Used with Type 5022 to form a complete calibration primary standard.	Used with Type 5022 to form a complete back-to-back calibration transfer standard.
Accessories		Mounting stud: Type 8402 Cable: Type 1631C Charge amp.: Type 5022	Mounting stud: Type 8410 Cable: Type 1631C Charge amp.: Type 5022
Versions			8767K IEPE style version of 8076K

Piezoelectric Theory

Piezoelectric effect

Although the piezoelectric effect was discovered by Pierre and Jacques Curie in 1880, it remained a mere curiosity until the 1940's. The property of certain crystals to exhibit electrical charges under mechanical loading was of no practical use until very high input impedance amplifiers enabled engineers to amplify their signals. In the 1950's, electrometer tubes of sufficient quality became available and the piezoelectric effect was commercialized.

Walter P. Kistler patented the charge amplifier principle in 1950 and gained practical significance in the 1960's. The introduction of highly insulating materials such as Teflon and Kapton greatly improved performance and propelled the use of piezoelectric sensors into virtually all areas of modern technology and industry.

Piezoelectric measuring systems are active electrical systems. That is, the crystals produce an electrical output only when they experience a change in load. For this reason, they cannot perform true static measurements. However, it is a misconception that piezoelectric instruments are suitable for only dynamic measurements. Quartz transducers, paired with adequate signal conditioners, offer excellent quasi-static measuring capability. There are countless examples of applications where quartz based sensors accurately and reliably measure quasi-static phenomena for minutes and even hours.

Applications of piezoelectric instruments

Piezoelectric measuring devices are widely used today in the laboratory, on the production floor and embedded within as original equipment. They are used in almost every conceivable application requiring accurate measurement and recording of dynamic changes in mechanical variables such as pressure, force and acceleration. The list of applications continues to grow and now includes:

- Aerospace: Modal testing, wind tunnel and shock tube instrumentation, landing gear hydraulics, rocketry, structures, ejection systems and cutting force research
- Ballistics: Combustion, explosion, detonation and sound pressure distribution
- Biomechanics: Multi-component force measurement for orthopedic gait and posturography, sports, ergonomics, neurology, cardiology and rehabilitation
- Engine Testing: Combustion, gas exchange and injection, indicator diagrams and dynamic stressing
- Engineering: Materials evaluation, control systems, reactors, building structures, ship structures, auto chassis structural testing, shock and vibration isolation and dynamic response testing
- Industrial/Factory: Machine systems, metal cutting, press and crimp force, automation of force-based assembly operations and machine health monitoring
- OEMs: Transportation systems, plastic molding, rockets, machine tools, compressors, engines, flexible structures, oil/gas drilling and shock/vibration testers.

Piezoelectric sensors (quartz based)

The vast majority of Kistler sensors utilize quartz as the sensing element. As discussed in other sections of this catalog, Kistler also manufactures sensors which utilize piezoceramic elements and micro machined silicon structures. However, the discussion in this section will be limited to quartz applications. Quartz piezoelectric sensors consist essentially of thin slabs or plates cut in a precise orientation to the crystal axes depending on the application. Most Kistler sensors incorporate a quartz element, which is sensitive to either compressive or shear loads. The shear cut is used for patented multi-component force and acceleration measuring sensors. Other specialized cuts include the transverse cut for some pressure sensors and the patented Polystable cut for high temperature pressure sensors. See figures 1 and 2 (on next page).

Although the discussion which follows focuses on acceleration applications, the response function for force and pressure sensors has essentially the same form. In fact, many force applications are closely related to acceleration. On the other hand, pressure sensors are designed to minimize or eliminate (by direct compensation of the charge output) the vibration effect. Call Kistler directly for more information on this subject or refer to the inside back cover which lists available technical articles.

Piezoelectric Theory

The finely lapped quartz elements are assembled either singularly or in stacks and usually preloaded with a spring sleeve. The quartz package generates a charge signal (measured in pico Coulombs) which is directly proportional to the sustained force. Each sensor type uses a quartz configuration which is optimized and ultimately calibrated for its particular application (force, pressure, acceleration or strain). Refer to the appropriate section for important design aspects depending on application.

Quartz sensors exhibit remarkable properties which justify their large scale use in research, development, production and testing. They are extremely stable, rugged and compact. Of the large number of piezoelectric materials available today, quartz is employed preferentially in sensor designs because of the following excellent properties:

- High material stress limit, approximately 20,000 psi
- Temperature resistance up to 930 °F
- Very high rigidity, high linearity and negligible hysteresis
- Almost constant sensitivity over a wide temperature range
- Ultra high insulation resistance

High and low impedance

Kistler supplies two types of piezoelectric sensors: high and low impedance. High impedance units have a charge output which requires a charge amplifier or external impedance converter for charge-to-voltage conversion. Low impedance types use the same piezoelectric sensing element as high impedance units and also incorporate a miniaturized built-in charge-to-voltage converter. Low impedance types require an external power supply coupler to energize the electronics and decouple the subsequent DC bias voltage from the output signal.

Dynamic behavior of sensors

Piezoelectric sensors for measuring pressure, force and acceleration may be regarded as under-damped, spring mass systems with a signal degree of freedom. They are modeled by the classical second order differential equation whose solution is:

$$\frac{a_o}{a_b} \cong \frac{1}{\sqrt{\left[1 - \left(\frac{f}{f_n}\right)^2\right]^2 + \left(\frac{1}{Q}\right)^2 \left(\frac{f}{f_n}\right)^2}}$$

Where:

- f_n undamped natural (resonant) frequency (Hz)
- f frequency at any given point of the curve (Hz)
- a_o output acceleration
- a_b mounting base or reference acceleration ($f/f_n = 1$)
- Q factor of amplitude increase at resonance

Quartz sensors have a Q of approximately 10 ... 40 and therefore the phase angle can be written as:

$$\text{phase lag (deg)} \cong \frac{60}{Q} \left(\frac{f}{f_n}\right) \text{ for } \frac{f}{f_n} \leq \frac{2}{5}$$

A typical Frequency response curve is shown in figure 3. As shown, about 5 % amplitude rise can be expected at approximately 1/5 of the resonant frequency (f_n). Low-pass (LP) filtering can be used to attenuate the effects of this. Many Kistler signal conditioners (charge amplifiers and couplers) have plug-in filters for this purpose.

Piezoelectric theory

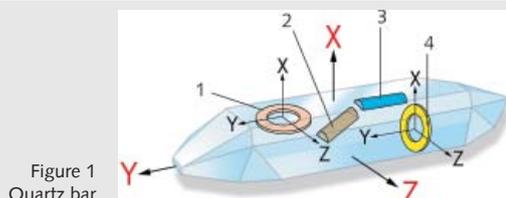


Figure 1
Quartz bar

- 1 = compression cut
- 2 = Polystable® cut
- 3 = transverse cut
- 4 = shear cut

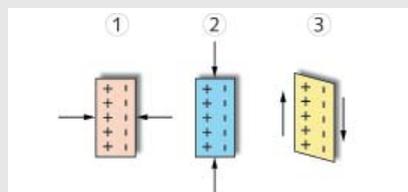


Figure 2
Piezoelectric effect

- 1 = longitudinal effect
- 2 = transverse effect
- 3 = shear effect

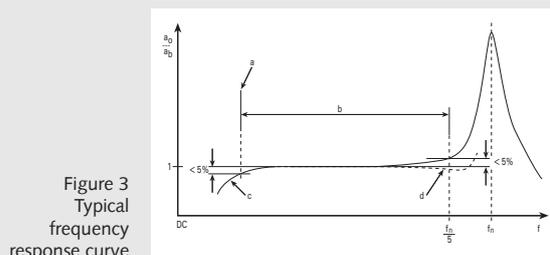


Figure 3
Typical frequency response curve

- a = low frequency limit determined by RC roll-off characteristics
- b = useable range
- c = HP filter
- d = with LP filter

Piezoelectric Theory

Charge amplifiers

Basically the charge amplifier consists of a high-gain inverting voltage amplifier with a MOSFET or J-FET at its input to achieve high insulation resistance. A simplified model of the charge amplifier is shown in figure 4.

The effects of R_t and R_j will be discussed below. Neglecting their effects, the resulting output voltage becomes:

$$V_o = \frac{-q}{C_r} \times \frac{1}{1 + \frac{1}{AC_r} (C_t + C_r + C_c)}$$

For sufficiently high open loop gain, the cable and sensor capacitance can be neglected and the output voltage depends only on the input charge and the range

$$V_o = \frac{-q}{C_r}$$

In summary, the amplifier acts as a charge integrator which compensates the sensor's electrical charge with a charge of equal magnitude and opposite polarity and ultimately produces a voltage across the range capacitor. In effect, the purpose of the charge amplifier is to convert the high impedance charge input (q) into a useable output voltage (V_o).

Time constant and drift

Two of the more important considerations in the practical use of charge amplifiers are time constant and drift. The time constant is defined as the discharge time of an AC coupled circuit. In a period of time equivalent to one time constant, a step input will decay to 37% of its original value.

Time Constant (TC) of a charge amplifier is determined by the product of the range capacitor (C_r) and the time constant resistor (R_t):

$$TC = R_t C_r$$

Drift is defined as an undesirable change in output signal over time, which is not a function of the measured variable. Drift in a charge amplifier can be caused by low insulation resistance at the input (R_t) or by leakage current of the input MOSFET or J-FET.

Drift and time constant simultaneously affect a charge amplifier's output. One or the other will be dominant. Either the charge amplifier output will drift towards saturation (power supply) at the drift rate or it will decay towards zero at the time constant rate.

Many Kistler charge amplifiers have selectable time constants which are altered by changing the time constant resistor (R_t). Several of these charge amplifiers have a "Short", "Medium" or "Long" time constant selection switch. In the "Long" position, drift dominates any time constant effect. As long as the input insulation resistance (R_t) is maintained at greater than $10^{13} \Omega$, the charge amplifier (with MOSFET input) will drift at an approximate rate of 0,03 pC/s. Charge amplifiers with J-FET inputs are available for industrial applications but have an increased drift rate of about 0,3 pC/s.

In the "Short" and "Medium" positions, the time constant effect dominates normal leakage drift. The actual value can be determined by referring to the appropriate operation/instruction manual which is supplied with the unit. Kistler charge amplifiers without "Short", "Medium" or "Long" time constant selection, operate in the "Long" mode and drift at the rates listed above. Some of these units can be internally modified for shorter time constants to eliminate the effects of drift.

Frequency and time domain considerations

When considering the effects of time constant, the user must think in terms of either frequency or time domain.

The longer the time constant, the better the low-end Frequency response and the longer the useable measuring time. When measuring vibration, time constant has the same effect as a single pole, highpass (HP) filter whose amplitude and phase are:

$$\frac{V_o}{V_{in}} = \frac{2\pi f (TC)}{\sqrt{1 + [2\pi f (TC)]^2}}$$

$$\text{phase lead (deg)} = \arctan \frac{1}{2\pi f (TC)} \cong 80 \sqrt{\frac{V_{in} - V_o}{V_{in}}}$$

For example, the output voltage has declined approximately 5 % when $f \times (TC)$ equals 0,5 and the phase lead is 18 degrees.

When measuring events with wide (or multiple) pulse widths the time constant should be at least 100 times longer than the total event duration. Otherwise, the DC component of the output signal will decay towards zero before the event is completed.

Selection matrix

Other design features incorporated into Kistler charge amplifiers include range normalization for whole number output, low-pass filters for attenuating sensor resonant effects, electrical isolation for minimizing ground loops and digital/computer control of setup parameters.

Low impedance piezoelectric sensors

Piezoelectric sensors with miniature, built-in charge-to-voltage converters are identified as low impedance units throughout this catalog. These units utilize the same types of piezoelectric sensing element(s) as their high impedance counterparts. Piezotron, Picotron, PiezoBeam, Ceramic Shear and K-Shear are all forms of Kistler low impedance sensors.

Piezoelectric Theory

In 1966, Kistler developed the first commercially available piezoelectric sensor with internal circuitry. This internal circuit is a patented design called Piezotron. This circuitry employs a miniature MOSFET input stage followed by a bipolar transistor stage and operates as a source follower (unity gain). A monolithic integrated circuit is utilized which incorporates these circuit elements. This circuit has very high input impedance ($10^{14} \Omega$) and low output impedance (100Ω) which allows the charge generated by the quartz element to be converted into a useable voltage. The Piezotron design also has the great virtue of requiring only a single lead for power-in and signal-out. Power to the circuit is provided by a Kistler coupler (Power supply), which supplies a source current (2 ... 18 mA) and energizing voltage (20 ... 30 VDC). Certain (extreme) combinations of other manufacture's supply current and energizing voltage (i.e. 20 mA and 18 VDC, respectively), together with actual bias level, may restrict Operating temperature range and voltage output swing. Call Kistler for details. Connection is as shown in figure 5. A Kistler coupler and cable is all that is needed to operate a Kistler low impedance sensor.

The steady state output voltage is essentially the input voltage at the MOSFET gate plus any offset bias adjustment. The voltage sensitivity of a Piezotron unit can be approximated by:

$$V_o \cong \frac{q}{C_q + C_r + C_G}$$

The range capacitance (C_r) and time constant resistor (R_t) are designed to provide a predetermined sensitivity (mV/g) and upper and lower useable frequency. The exact sensitivity is measured during calibration and its value is recorded on each unit's calibration certificate.

Since its invention, the Piezotron design has been adapted by manufactures worldwide and has become a widely used standard for design of sensors which measure acceleration, force and pressure. The concept has become known by many names besides Piezotron such as low impedance or voltage mode. Also, a number of "brand names" have emerged by other manufactures. Picotron is a miniature accelerometer whose circuitry is very similar to the Piezotron. PiezoBeam incorporates a bimorph ceramic element and a miniature hybrid charge amplifier for the charge-to-voltage conversion. K-Shear is the newest member of the Kistler low impedance family and utilizes a shear quartz element together with the Piezotron circuitry.

Time constant

The time constant of a Piezotron or Picotron sensor is:

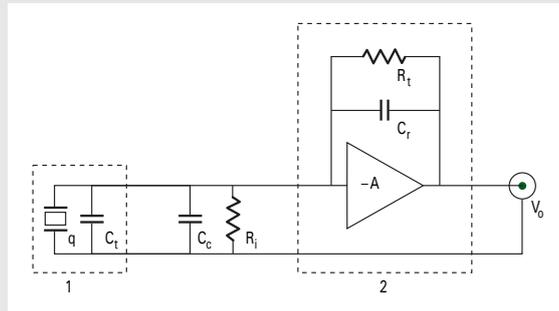
$$TC = R_t (C_q + C_r + C_G)$$

A PiezoBeam's time constant is the product of its hybrid charge amplifier's range capacitor and time constant resistor.

Time constant effects in low impedance sensors and in charge amplifiers are the same. That is, both act as a single pole, highpass filter as discussed previously.

Piezoelectric theory

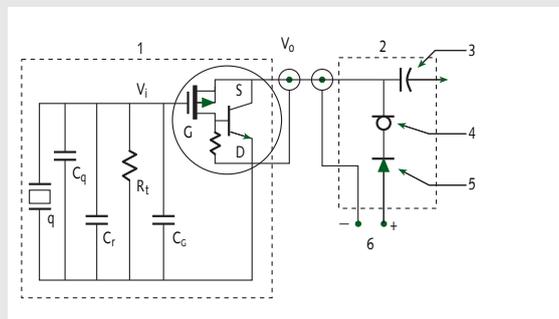
Figure 4
Simplified charge amplifier model



- 1 = piezoelectric accelerometer
- 2 = charge amplifier
- V_o = output voltage
- A = open loop gain
- C_q = sensor capacitance
- C_c = cable capacitance

- C_r = range (or feedback) capacitor
- R_t = time constant resistor (or insulation of range capacitor)
- R_i = insulation resistance of input circuit (cable and sensor)
- q = charge generated by the sensor

Figure 5
Piezotron circuit & coupler



- 1 = accelerometer
- 2 = coupler
- 3 = decoupling capacitor
- 4 = constant current diode
- 5 = reverse polarity protection diode
- 6 = DC source
- q = charge generated by piezoelectric element

- V_i = input signal at gate
- V_o = output voltage (usually bias decoupled)
- C_q = sensor capacitance
- C_r = range capacitance
- C_G = MOSFET GATE capacitance
- R_t = time constant resistor

Capacitive Accelerometer Theory

The fundamental principle of operation for a capacitive accelerometer is the property that a repeatable change in capacitance exists when a sensing structure is deflected due to an imposed acceleration.

The acceleration creates a force (F) acting on a suspended flexure of known mass (m). The flexure moves predictably and in a controlled manner dictated by its stiffness (k). A gas filled gap exists between surrounding electrodes as shown in figure 1. The inertial force can be calculated from Newton's Second Law of Motion as:

$$F = ma \quad [\text{Eq. 1}]$$

Knowing the force, a displacement of the flexure can be estimated using a simple spring calculation:

$$x = F/k \quad [\text{Eq. 2}]$$

However, in practice, Finite Element Analysis (FEA) is employed to model the complicated spring designs. This displacement alters the gaps on either side of the flexure in an equal but opposite proportion. The distance between the flexure and surrounding electrodes (l), is then the nominal [zero g] spacing (d) ± the spring deflection (x) or:

$$l_1 = d + x \quad \& \quad l_2 = d - x \quad [\text{Eq. 3}]$$

Knowing the electrode area (A) and the permittivity constant of the gas (E), the capacitance formed by the gaps can be determined from:

$$C_1 = A \epsilon / l_1 \quad \& \quad C_2 = A \epsilon / l_2 \quad [\text{Eq. 4}]$$

This capacitance difference causes an imbalance in a bridge network of the internal electronic circuit. Internal signal conditioning incorporates AC excitation and synchronous demodulation. In addition, it provides power for the accelerometer element and outputs an analog voltage proportional to the acceleration signal.

The key operating principle of figure 2 is that a variable capacitive element unbalances a bridge relative to applied acceleration. The electronic action is summarized as follows:

- A voltage regulator stabilizes the accelerometer sensitivity and assures internal functions remain constant despite the supply voltage level
- A square wave generator produces excitation for the bridge circuit
- A capacitive bridge produces two signals with amplitudes relative to the applied acceleration
- The opposing signals are summed by the synchronous demodulator, to form a voltage proportional to applied acceleration
- A preamplifier provides gain
- A built-in low pass filter attenuates unwanted signals above the operating frequency range

Kistler micromachined K-Beam accelerometer sensing elements consist of very small inertial mass and flexure elements chemically etched from a single piece of silicon. The seismic mass is supported by flexure elements between two plates, which act as electrodes. As the mass deflects under acceleration, the capacitance between these plates changes. Under very large accelerations (or shocks), the motion of the mass is limited by the two stationary plates thereby limiting the stress placed on the suspension and preventing damage. The typical design is shown in figure 3.

The damping of the mass by an entrapped gas creates a "squeeze film" providing an optimized Frequency response over a wide temperature range. Additionally, its differential capacitive design assures immunity to thermal transients. The affect of damping is shown in figure 4a and appropriate damping is tuned with a specific spring mass system to achieve optimal Frequency response (figure 4b).

Capacitive theory

1 = top electrode 3 = mass
2 = spring 4 = bottom electrode

Figure 1: Typical capacitive accelerometer arrangement

Figure 2: Electrical schematic

1 = top electrode 4 = mass
2 = frame 5 = bottom electrode
3 = spring 6 = glass layer

Figure 3: MEMS variable capacitance accelerometer

Capacitive theory

Figure 4a
Effect of damping

Figure 4b
Tuned system

Glossary

Bias voltage

DC (no load or quiescent) output level of a low impedance sensor powered by constant current excitation.

Ceramic Shear

Kistler piezoelectric accelerometer family which utilizes ceramic shear sensing elements.

Charge amplifier

Electronic unit which utilizes a high-gain voltage amplifier with negative, capacitive feedback for converting a charge from a piezoelectric sensor into a low impedance output voltage.

Charge output

Output in pico Coulombs (pC) from a piezoelectric sensor without a built-in charge-to-voltage converter (see High impedance).

Circuit integrity indication

A quick-look reference on couplers or dual mode charge amplifier for identifying whether a low impedance system has the proper bias voltage. Analog meters and multi-color LEDs are the most commonly used indicators.

Constant current excitation

Method of powering low impedance sensors to insure minimal sensitivity variation over a wide voltage range. A Piezotron coupler or any other ICP type power supply may be used for this purpose.

Coupler

Electronic unit which supplies constant current excitation to low impedance sensors and decouples the subsequent bias voltage.

Cross talk

Another term for cross axis or transverse sensitivity; used on Kistler triaxial accelerometers to describe the output on one axis caused by inputs on the others.

Drift

An undesirable change in output signal, over time, which is not a function of the measurand.

Dual mode

Refers to a charge amplifier which can be used either with high impedance, charge output or with low impedance, voltage output sensors.

Ground isolation

The electrical resistance between the signal return/common and mounting ground of a sensor, or between an electrical connector shield and power ground of a charge amplifier/coupler.

High impedance

Another term for a piezoelectric sensor with charge output (i.e. pC/mechanical unit).

Hysteresis

The maximum difference in output, at any measured value within the specified range when the value is approached first with increasing and then decreasing measurand.

IEPE

Integrated Electronic PiezoElectric

Impedance converter

A miniature electronic unit with MOSFET input and bipolar output for converting high impedance, charge outputs (from a sensor) into low impedance, voltage outputs. Impedance converters can be built into the sensor (see Low impedance) or can be used externally for special applications.

Impedance head

Sensor that simultaneously measures both force and acceleration during modal analysis testing.

Insulation resistance

The leakage resistance of a high impedance sensor, cable or charge amplifier measured between the signal lead and connector ground.

K-Beam®

Kistler's solid-state, variable capacitance based line of accelerometers, which are suitable for measuring low frequencies or even steady-state conditions.

K-Shear®

Kistler's piezoelectric accelerometer family. Low impedance accelerometer, which utilizes quartz shear sensing element.

Linearity

The closeness of a calibration curve to a specified straight line. Kistler uses "Best straight line through zero" which is defined as follows: two parallels are sought, as close together as possible but enclosing the entire calibration curve. In addition, the median parallel must pass through zero (no measurand, no output signal). The slope of this median parallel is the sensitivity of the sensor. Half the interval between the two parallels, expressed as a percentage of Full-Scale Output (FSO), is the linearity.

Low impedance

Another name for a piezoelectric sensor with a miniature, built-in charge to voltage converter. Output is typically in mV/mechanical unit. K-Shear, Piezotron, Picotron and PiezoBeam are all forms of low impedance sensors.

Low pass filter

An electronic network for passing low and attenuating high frequencies. Many plug-in types are available for Kistler charge amplifiers and power supply/couplers.

Measurand

A physical quantity, property or condition which is measured (i.e. pressure, force or acceleration).

Multi-component force sensor

Kistler design utilizing compressive and shear quartz elements for measuring up to three force components.

Natural frequency

The frequency of free (not forced) oscillations of the sensing element of a fully assembled sensor.

Newton (N)

A metric unit of force measurement equivalent to 0,305 N·m.

Glossary

pico Coulomb (pC)

A unit of electrical charge equivalent to 1×10^{-12} ampere second.

Picotron

Mini accelerometer with Piezotron circuitry.

PiezoBeam®

Low impedance accelerometer. Incorporates a bimorph ceramic element that generates an electrical charge when mechanically loaded.

Piezoelectric sensor

Sensor with element that generates an electrical charge when mechanically loaded.

PiezoStar®

Kistler proprietary crystal used with IEPE accelerometers to provide ultra low sensitivity with temperature.

Piezotron®

Patented Kistler piezoelectric sensors with miniature, built-in impedance converters (see Impedance converter).

Polystable

Patented Kistler quartz element incorporated into pressure sensor designs for operating temperatures up to 660 °F.

Quasi-static

Term which denotes Kistler's ability to make short-term static or near DC measurements with high impedance sensors and charge amplifiers.

Resonant frequency

The measurand frequency at which a sensor responds with maximum output amplitude.

Rise time

The length of time for the output of a sensor to rise from 10 % to 90 % of its final value as a result of a step-change of measurand.

Sealing

The degree of sealing as per EN60529 is IP 66 (commonly denoted as "Epoxy" sealing) IP 67 ("epoxy/welded"), and IP 68 ("Hermetic").

Sensitivity

The ratio of the change in sensor output to a change in the value of the measurand. Expressed in pC or mV per mechanical unit.

TEDS

Transducer Electronic Data Sheet. Characteristic data stored digitally internal to sensor, IEEE 1451.4 compliant.

TEDS Versions

T	Default, IEEE 1451.4 V0.9 Template 0 (UTID 1)
T01	IEEE 1451.4 V0.9 Template 24 (UTID 116225)
T02	LMS Template 117, Free format Point ID
T03	LMS Template 118, Automotive Format (Field 14 Geometry = 0)
T04	LMS Template 118, Aerospace Format (Field 14 Geometry =1)
T05	P1451.4 v1.0 template 25 - Transfer Function Disabled
T06	P1451.4 v1.0 template 25 - Transfer Function Enabled

Temperature coefficient of sensitivity

The change in sensitivity of a sensor at different (constant) Operating temperatures. Typically expressed as a percent change per unit temperature change (%/°F).

Time constant (TC)

Refers to the discharge time of an AC coupled circuit. In the time domain, a DC signal will decay to 37 % of its original value in a period of time equivalent to one time constant.

In high impedance systems, the time constant is the product of the charge amplifier's range capacitor and time constant resistor. In low impedance systems, the system time constant can be approximated by taking the product of sensor and coupler time constants and dividing by their sum.

In frequency domain, time constant can be related to a high pass filter network with a low frequency cutoff (-5 % point) equal to $0,5/TC$.

Threshold

The smallest change in the measurand that will result in a measurable change in sensor output.

For charge output sensors, threshold denotes the equivalent noise level in a standard charge amplifier. For voltage output sensors, threshold denotes the equivalent noise level of its built-in charge to voltage converter.

Transverse sensitivity

The output of an accelerometer caused by acceleration perpendicular to the measuring axis.

Voltage output

Output (in mV) from a piezoelectric sensor with a built-in charge-to-voltage converter (see Low impedance).

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