

Piezoelectric Charge Accelerometer Types 4500-A, 4501-A and 4501-A-001

Types 4500-A, 4501-A and 4501-A-001 are general purpose piezoelectric accelerometers that feature the ThetaShear™ design, giving them low sensitivity to environmental factors. These accelerometers are suitable for applications that require a large number of accelerometers such as structural and modal testing.



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Uses and Features

Uses

- General purpose vibration and shock measurements
- Structural and modal analysis

Features

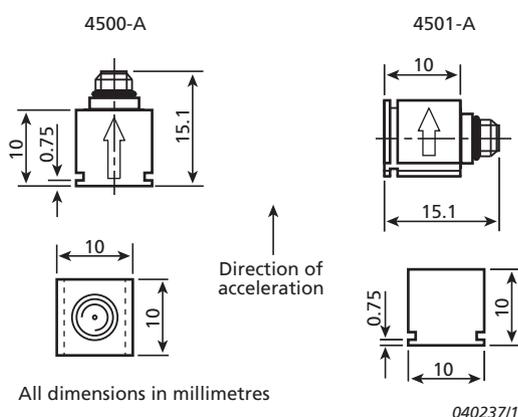
- Low sensitivity to environmental factors
- Electrically insulated for ground-loop protection
- High resonance frequency

Description

Fig. 1

Left: Dimensions of Type 4500-A

Right: Dimensions of Type 4501-A



Types 4500-A, 4501-A and 4501-A-001 are piezoelectric charge accelerometers with ThetaShear design.

The accelerometers feature a 10–32 UNF connector. On Type 4500-A, the connector is on the top surface, perpendicular to its main sensitivity axis. On Types 4501-A and 4501-A-001, it is on the side surface, parallel to its main sensitivity axis.

The piezoelectric element used in Types 4500-A, 4501-A and 4501-A-001 is PZ 23 and the housing is made of anodized aluminium.

Ground Insulation

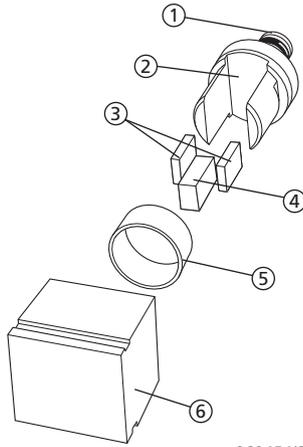
Types 4500-A, 4501-A and 4501-A-001 feature an inner and outer housing. The sensor is mounted to the inner housing with glue, providing electrical insulation. This avoids ground-loop noise, which can be a problem in multichannel measurements. The accelerometers are electrically insulated with respect to signal ground and have a resistance of more than 10 MΩ.

Characteristics

Types 4500-A, 4501-A and 4501-A-001 are piezoelectric accelerometers and may be treated as charge sources. Their sensitivity is expressed in terms of charge per unit acceleration (pC/ms^{-2} , pC/g).

Fig. 2
Exploded view of the ThetaShear design.

Components are as follows:
 (1) 10–32 UNF connector
 (2) Top
 (3) Piezoelectric plates
 (4) Seismic mass
 (5) Clamping ring
 (6) Housing



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Types 4500-A, 4501-A and 4501-A-001 have high measurement stability and excellent sensitivity-to-weight ratio due to the ThetaShear design. In addition, the transverse resonance frequency is always outside the 10% frequency limit. This ensures minimum interference from orthogonal vibration components in the useful frequency range of the accelerometer. The ThetaShear design also provides excellent immunity to environmental effects such as base strains, magnetic sensitivity and acoustic fields.

ThetaShear Design

The ThetaShear design consists of a slotted cylindrical frame that holds a central seismic mass flanked by two piezoelectric plates and clamped rigidly by a ring. To ensure optimum accuracy and reliability, no bonding agent other than molecular adhesion holds the assembly together.

Note that Fig. 2 uses a generic accelerometer to display the ThetaShear design and does not show the inner housing of Types 4500-A, 4501-A and 4501-A-001.

Calibration

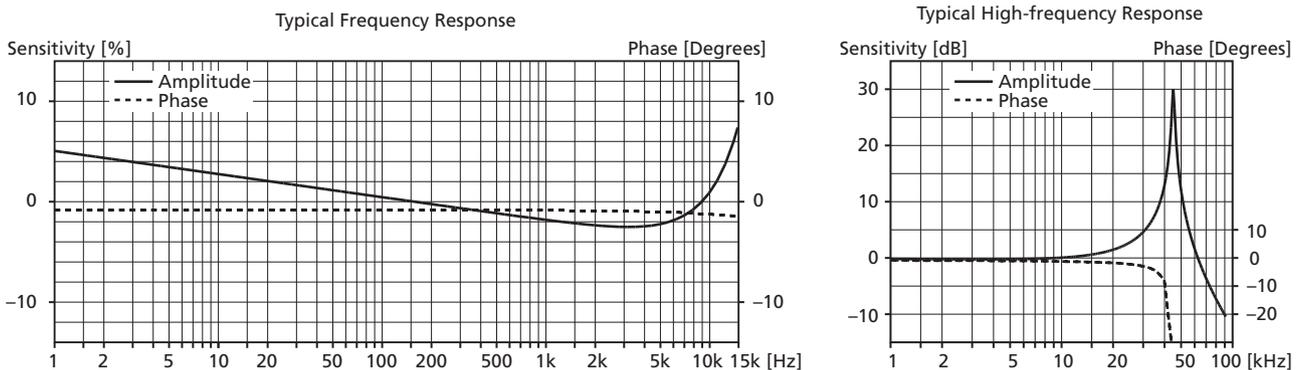
Each accelerometer is calibrated using random excitation and 1600-line FFT transformation to provide a high-resolution (amplitude and phase) frequency response. This yields a unique characterization and secures the integrity of your vibration measurements.

The sensitivity given on the calibration chart is measured at 159.2 Hz with 95% confidence level using coverage factor $k = 2$.

The upper frequency limits given on the calibration chart are frequencies where the deviation from the reference sensitivity at 159.2 Hz is within $\pm 10\%$. The upper frequency limit is approximately 30% of the mounted resonance frequency. This assumes that the accelerometer is correctly mounted on the test structure – poor mounting can have a marked effect on the mounted resonance frequency.

The lower frequency limits and phase response are determined by the built-in preamplifiers. The lower frequency limits are given in the specifications for deviations from reference sensitivity within $\pm 10\%$.

Fig. 3 Frequency response curves for Types 4500-A, 4501-A and 4501-A-001



Clip for Calibration

For field checking and system calibration, Calibration Clip DV-0459 can be used in combination with Calibration Exciter Type 4294.

Fig. 4
Calibration Clip
DV-0459



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Material:

Base: Hardened stainless steel
Spring: Stainless steel

Mounting surface diameter: 21 mm

Mounting thread: 10–32 UNF

Weight: 17 g (0.59 oz)

Mounting

Types 4500-A, 4501-A and 4501-A-001 are mounted with adhesive, with or without the use of mounting clips.

The various mounting clips are designed to suit a variety of mounting surfaces and are attached to the test object with glue or double-sided adhesive tape. The accelerometer is mounted in a clip via grooves in its housing, making the accelerometer easy to fit or remove.

Common Specifications for Mounting Clips

Temperature range: –54 to +50 °C (–65 to +122 °F)
For brief use (<1 hour): –54 to +80 °C (–65 to +176 °F)
Maximum acceleration: 10 g peak
Perpendicular to mounting surface: 70 g peak
Material: Glass reinforced polycarbonate

Fig. 5
Mounting Clip
UA-1407 (set of 100)



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Upper limiting frequency (±10%):

Type 4500-A mounted with grease: 3.0 kHz
Type 4500-A dry mounting: 1.5 kHz
Type 4501-A mounted with grease: 4.0 kHz
Type 4501-A dry mounting: 2.0 kHz

Weight: 0.4 g

Fig. 6
Mounting Clip with
Thick Base UA-1475
(set of 100). The base
can be filed down to
suit the mounting
surface



150070

Upper limiting frequency (±10%):

Type 4500-A mounted with grease: 3.0 kHz
Type 4500-A dry mounting: 1.5 kHz
Type 4501-A mounted with grease: 4.0 kHz
Type 4501-A dry mounting: 2.0 kHz

Weight: 0.7 g

Fig. 7
Mounting Clip with
Swivel Base UA-1478
(set of 100)



Upper limiting frequency ($\pm 10\%$):

Types 4500-A and 4501-A are mounted with grease and excited along accelerometer's main axis of sensitivity with the mounting surface of the hemisphere:

Perpendicular to the direction of excitation: 2.3 kHz

At 45° to the direction of excitation: 1.7 kHz

Weight: 0.8 g

Fig. 8
Spirit Level UA-1480.
Use to align and
maintain multichannel
coordinate system



Max. dimensions: 85 × 23 × 17 mm

Material: Black, anodized aluminium

Cabling

When using miniature accelerometers, the cable can affect the measurement result. Forces exerted on the connector by the cable can cause amplitude irregularities in the output at frequencies up to approximately 200 Hz. This can be reduced by using a flexible cable.

To effectively reduce the problem at low frequencies, it is recommended to clamp the cable. One way of doing this is to make a small loop in the cable close to the accelerometer (max. diameter 30 mm) and clamp the cable beside the base of the accelerometer with mounting wax or double-sided tape. This also reduces the possibility of dynamically induced noise generated by the cable.

Brüel & Kjær's Uniaxial Charge Accelerometers

Types 4500-A, 4501-A and 4501-A-001 are part of a family of uniaxial charge accelerometers. To find the uniaxial accelerometer that fits your needs, visit www.bksv.com.

Table 1
Comparison of
Brüel & Kjær
uniaxial charge
accelerometers for
clip mounting

		4500-A	4501-A	4501-A-001	4507-C	4508-C
Temperature	°C (°F)	175 (347)			250 (482)	
Number of connectors		1				
Weight	g	4.1	4		4.5	
Isolated		Yes			No	
Capacitance	pF	1000			360	
Frequency range	Hz	1 to 15000	1 to 10000		0.1 to 6000	1 to 8000
Mounting		Mounting clip or adhesive				
Sensitivity	pC/ms ⁻²	0.316			0.45	
Product Data		BP 1427			BP 1841	

Specifications – Piezoelectric Charge Accelerometer Types 4500-A, 4501-A and 4501-A-001

Type No.		4500-A	4501-A	4501-A-001
General				
Weight	g	4.100	4.000	
	oz	0.145	0.141	
Charge Sensitivity (at 159.2 Hz)	pC/ms ⁻²	0.316 ± 20%		
	pC/g	3.10 ± 20%		
Frequency Range	±10% limit	Hz	1 to 15000	1 to 10000
	±5% limit		1 to 8000	
Mounted Resonance Frequency	kHz	45	30	
Max. Transverse Sensitivity (at 30 Hz, 100 ms⁻²)	%	<5		
Transverse Resonance Frequency	kHz	>20		
Max. Operational Continuous Sinusoidal Acceleration (peak)	kms ⁻²	30		
	g	3000		
Electrical				
Residual Noise Level (measured with NEXUS Type 2692-001 in the specified frequency range)	mms ⁻²	7.60		
	mg	0.77		
Capacitance (excluding cable)	pF	1000		
Case (signal ground) Insulation to Base	MΩ	>10		
Min. Leakage Resistance (at 20 °C)	GΩ	>20		
Environmental				
Operating Temperature Range	°C	-55 to +175		
	°F	-67 to +347		
Temperature Coefficient of Sensitivity	%/°C	0.05*	0.1*	
Temperature Transient Sensitivity (3 Hz Low. Lim. Freq. (-3 dB, 6 dB/octave))	ms ⁻² /°C	0.4		
	g/°F	0.02		
Base Strain Sensitivity (at 250 µε in the base plane)	ms ⁻² /µε	0.001 [†]		
	g/µε	0.0001		
Magnetic Sensitivity (50 Hz, 0.038 T)	ms ⁻² /T	2		
	g/kG	0.02		
Max. Non-destructive Shock (± peak)	kms ⁻²	30		
	g	3000		
Mechanical				
Housing Material		Anodized Aluminium		
Piezoelectric Sensing Element		PZ 23		
Construction		ThetaShear		
Sealing		Welded		
Electrical Connector		10-32 UNF-2A		
Mounting		Mounting clip or Adhesive		Adhesive

* In the temperature range -25 to +125 °C (-13 to +257 °F)

† Mounted in mounting clip

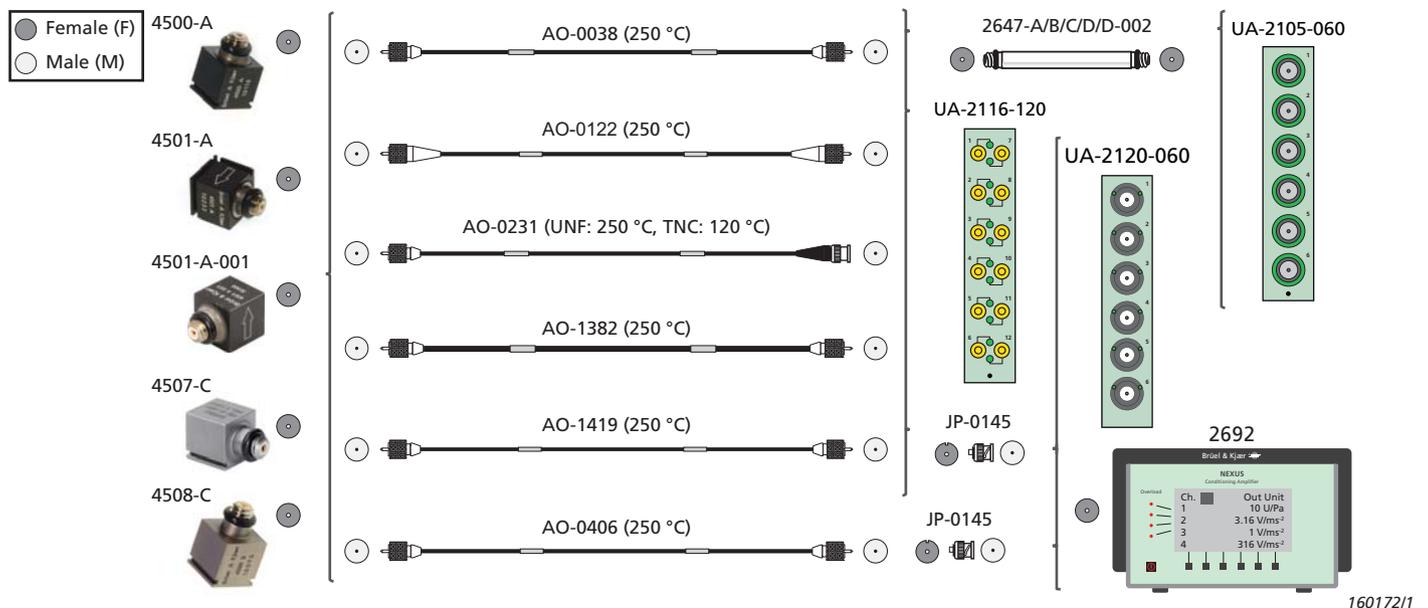
All values are typical at 25 °C (77 °F) unless measurement uncertainty is specified.

Compliance with Standards

   	<p>The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives</p> <p>RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME</p> <p>China RoHS mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China</p> <p>WEEE mark indicates compliance with the EU WEEE Directive</p>
Safety	EN 61010–1 and IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use UL 3111–1: Standard for Safety – Electrical measuring and test equipment
EMC Emission	EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments EN/IEC 61000–6–4: Generic emission standard for industrial environments CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits FCC Rules, Part 15: Complies with the limits for a Class B digital device
EMC Immunity	EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments EN/IEC 61000–6–2: Generic standards – Immunity for industrial environments Note 1: The above is only guaranteed using accessories listed in this Product Data sheet Note 2: The above is only guaranteed when the AC output is not in use
Temperature	IEC 60068–2–1 & IEC 60068–2–2: Environmental Testing. Cold and Dry Heat Operating Temperature: –55 to +175 °C (–67 to +347 °F) Storage Temperature: –25 to +70 °C (–13 to +158 °F)
Humidity	IEC 60068–2–78: Damp Heat: 90% RH (non-condensing at 40 °C (104 °F))

Configuration Examples

Fig. 9 Cabling, signal conditioning and data acquisition hardware options for uniaxial piezoelectric charge accelerometers



Ordering Information

Type 4500-A	Piezoelectric charge accelerometer with top connector
Type 4501-A	Piezoelectric charge accelerometer with side connector
Type 4501-A-001	Piezoelectric charge accelerometer with side connector (without grooves in housing)

Each accelerometer includes the following accessories:

- Carrying box
- Calibration chart
- One mounting clip

Optional Accessories

CABLING

AO-0038-x-yyy *	Super low-noise cable, 2 × 10–32 UNF (M), 250 °C (482 °F)
AO-0122-x-yyy *	Super low-noise, robust double-screened cable, 2 × 10–32 UNF (M), 250 °C (482 °F)
AO-0231-x-yyy *	Super low-noise cable, 10–32 UNF (M) to TNC (M), 180 °C (356 °F)
AO-0406-x-yyy *	Low-noise double-screened cable, 10–32 UNF (M) to BNC (M), 250 °C (482 °F). Includes JP-0145
AO-1382-x-yyy *	Low-noise, double-screened cable, 10–32 UNF, 250 °C (482 °F)
AO-1419-x-yyy *	Very light and flexible low-noise coaxial cable with 2 × 10–32 UNF (M), 250 °C (482 °F)
JP-0145	Plug adaptor, 10–32 UNF (F) to BNC (M)
QA-0035	Cable accessory set, tools for cable and connector assembly
QA-0220	Tool, cable connecting and removal
UA-0130	Connector, 10–32 UNF (M) for Ø 1 mm to 3 mm cable jacket (set of 25)
UA-0186	Extension connector, 10–32 UNF (F) (set of 25)
UA-1243	Red/green/yellow cable markers for Ø 1.6 mm cable jacket (3 × 30 pieces)
UA-1244	Red/Green/Yellow Cable markers for Ø 1.9 mm to 2.2 mm cable jacket (3 × 30 pieces)

MOUNTING

QS-0007	Tube of cyanoacrylate adhesive
UA-1407	Mounting clip, small (set of 100)
UA-1475	Mounting clip with thick base, small (set of 100)
UA-1478	Mounting base with swivel base, small (set of 100)
UA-1480	Spirit level for all swivel bases
UA-1564	High-temperature mounting clip, small (set of 5)
YJ-0216	Beeswax for mounting

CONDITIONING AND DATA ACQUISITION HARDWARE

Type 3053-B-120	12-ch. Input Module LAN-XI 25.6 kHz (CCLD, V)
UA-2116-120	LAN-XI Front Panel, 12-channel Charge, 12 × 10–32 UNF (F) microdot connectors (Gain: 1 mV/pC)
Type 3050-A-060	6-ch. Input Module LAN-XI 51.2 kHz (Mic, CCLD, V)
UA-2105-060	LAN-XI Front Panel, Charge Accelerometer, 6-ch. for the family of Charge to CCLD Convertor Type 2647
Type 2647-A/B	Charge to CCLD Convertor
Type 2692	NEXUS Conditioning Amplifier

CALIBRATION

Type 4294	Calibration exciter
DV-0459	Calibration clip, small

Calibration Services

SERVICES FOR UNIAXIAL ACCELEROMETERS

ACC-M-CAF	Accredited calibration
ACC-M-CAI	Accredited initial calibration
ACC-M-CFF	Factory standard calibration
ACC-M-CTF	Traceable calibration

* x = D (decimetres) or M (metres)
yyy = length in decimetres or metres
Please specify cable length when ordering

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Brüel & Kjær Sound & Vibration Measurement A/S
DK-2850 Nærum · Denmark · Telephone: +45 77 41 20 00 · Fax: +45 45 80 14 05
www.bksv.com · info@bksv.com
Local representatives and service organizations worldwide

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