

Piezoelectric Charge Accelerometer Types 4505-001 and 4505-A

Types 4505-001 and 4505-A are piezoelectric accelerometers that provide low sensitivity to extraneous environmental effects through the ThetaShear™ design. Both types have a top-mounted Microdot (10–32 UNF) connector for attaching cables and a 10–32 UNF mounting stud on the base.



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Features and Applications

Features

General

- Low weight
- Low sensitivity to environmental factors
- High resonance frequency
- Electrically insulated for ground-loop protection
- High transverse resonance frequency: >20 kHz
- Operating temperature range: –54 to +230 °C (–65 to +446 °F),

Type 4505-001

- High linearity
- Long-term stability

Type 4505-A

- High sensitivity
- Low noise floor

Applications

Type 4505-001

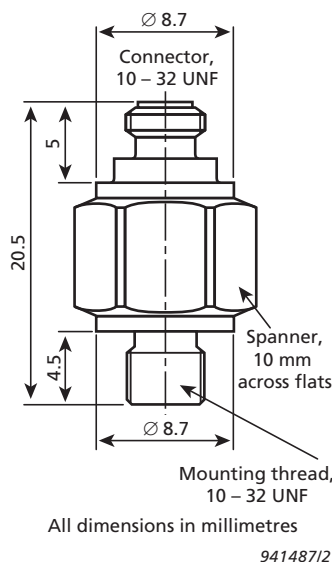
- Measurements with impacts, such as transmissions, gearboxes and valve trains
- Jet engines
 - Blade out testing
 - High linearity reduces the sidebands from blade-pass
- Suitable for reference transducer for calibration
- Shock response spectrum (SRS)

Type 4505-A

- Vibration with significant transverse vibration

Characteristics

Fig. 1
Dimensions of
Type 4505-001 and
Type 4505-A



Types 4505-001 and 4505-A are piezoelectric accelerometers and may be treated as a charge source. Their sensitivities are expressed in terms of charge per unit acceleration (pC/ms^{-2} , pC/g).

The ThetaShear design provides a combination of high measurement stability, excellent sensitivity-to-weight ratio and low sensitivity to extraneous environmental effects. It consists of a slotted cylindrical post that holds a central seismic mass flanked by two piezoelectric plates and clamped rigidly by the cover. No bonding agent other than molecular adhesion holds the assembly together to ensure optimum accuracy and reliability.

Type 4505-001 uses single-crystal PZ 101, which is less sensitive and does not show the zero-shift effect. Non-linearities associated with zero-shift are absent in Type 4505-001, giving it much better linearity performance at higher acceleration levels, such as transients and shock. Find more information about the zero-shift effect in [Piezoelectric Amplifiers and Vibration Preamplifiers: Theory and Application Handbook](#).

Type 4505-A uses PZ 23 ceramic, which shows the zero-shift effect but produces high sensitivity.

A remarkable feature of the ThetaShear principle is that the transverse resonance frequency is always outside the 10% frequency limit. This ensures minimal interference from orthogonal vibration components in the useful frequency range of the accelerometer. The ThetaShear design is also resistant to other environmental effects such as base strains, magnetic sensitivity and acoustic fields.

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.

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. 2 Individual frequency response curve (left) and typical high-frequency response curve (right) of Type 4505-001

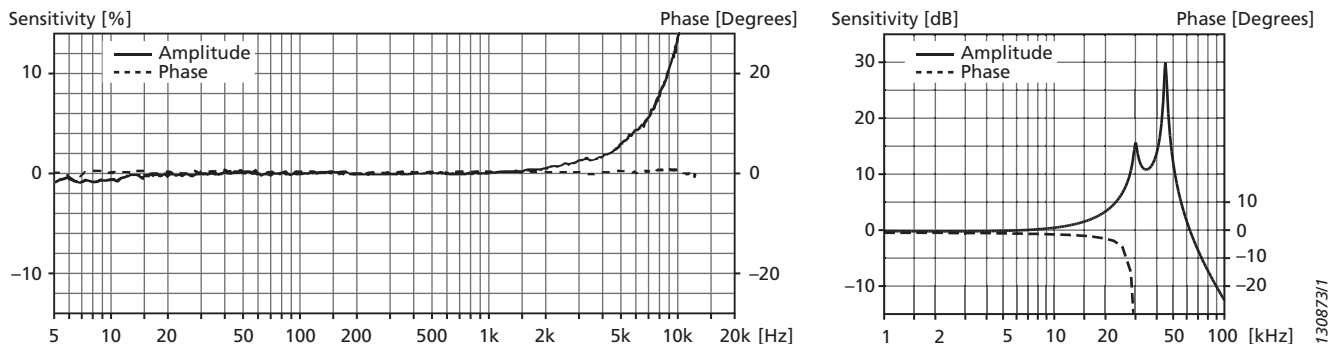
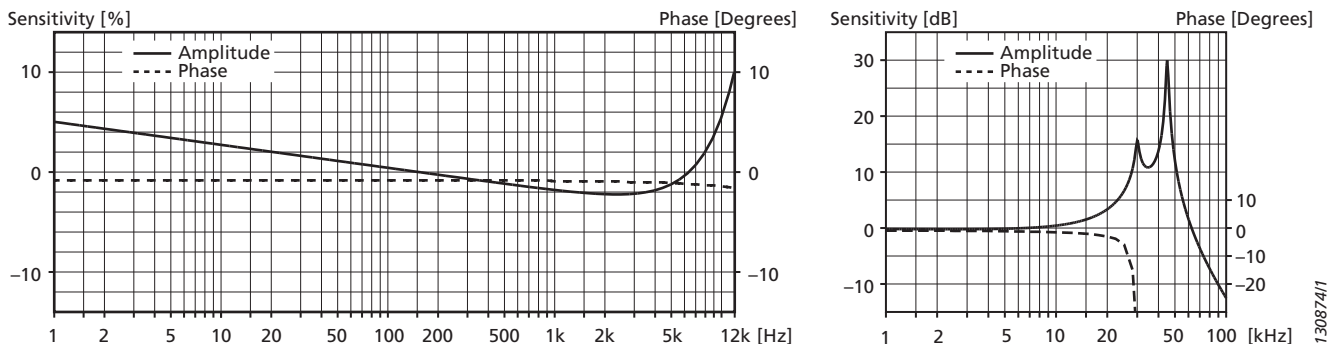


Fig. 3 Typical frequency response curve (left) and typical high-frequency response curve (right) of Type 4505-A



Specifications* – Piezoelectric Charge Accelerometer Types 4505-001 and 4505-A

Type No.			4505-001		4505-A	
General						
Weight			gram	4.9		
			oz	0.17		
Charge Sensitivity (at 159.2 Hz)			pC/ms ⁻²	0.067 ± 25%	0.3 ± 25%	
			pC/g	0.657 ± 25%	2.94 ± 25%	
Frequency Range	±10% limit	Hz	1 to 9000	1 to 12000		
	±5% limit		1 to 5000	1 to 9000		
Mounted Resonance Frequency			kHz	45		
Phase (± 5%)			Hz	10000		
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		
Output Linearity				<1% full range	<3% per 1000 g	
Electrical						
Residual Noise Level (measured with NEXUS Type 2692-001 in the specified frequency range)			mms ⁻²	–	7.6	
			mg	–	0.76	
Capacitance (excluding cable)			pF	80	1000	
Case (signal ground) Insulation to Base			MΩ	>10		
Min. Leakage Resistance (at 20 °C)			GΩ	>20		
Environmental						
Operating Temperature Range			°C	–55 to +230		
			°F	–67 to +446		
Temperature Coefficient of Sensitivity			%/°C	0.03	0.05 [†]	
Temperature Transient Sensitivity (3 Hz Low. Lim. Freq. (–3 dB, 6 dB/octave))			ms ⁻² /°C	4	1	
			g/°F	0.227	0.055	
Base Strain Sensitivity (at 250 µε in the base plane)			ms ⁻² /µε	0.02		
			g/µε	0.002		
Magnetic Sensitivity (50 Hz, 0.038 T)			ms ⁻² /T	5		
			g/kG	0.05		
Max. Non-destructive Shock (± peak)			kms ⁻²	30		
			g	3000		
Mechanical						
Housing Material				Titanium ASTM Grade 2		
Piezoelectric Sensing Element				PZ 101	PZ 23	
Construction				ThetaShear		
Sealing				Welded		
Electrical Connector				10–32 UNF-2A		
Mounting				Integral 10–32 UNF stud		
Mounting Torque	Max.	Nm (lbf-in)	4 (35.2)			
	Min.		0.5 (4.4)			

† In the temperature range –25 to +125 °C

* All values are typical at 25 °C (77 °F) unless measurement uncertainty is stated
Brüel & Kjær reserves the right to change specifications without notice

Compliance with Standards

   	The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME 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 WEEE mark indicates compliance with the EU WEEE Directive
Safety	EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use. ANSI/UL 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use.
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. This ISM device complies with Canadian ICES–001 (standard for interference-causing equipment)
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. EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements. Note: The above is only guaranteed using accessories listed in this Product Data sheet.

Ordering Information*

Type 4505-A Charge Accelerometer
Type 4505-001 Charge Accelerometer
 Both types include the following accessories:

- Calibration Chart
- Carrying Box

OPTIONAL ACCESSORIES

AO-0038-x-yyy[†] Low-noise coaxial cable, 10–32 UNF connectors, 250 °C (482 °F)
 AO-0122-x-yyy[†] Super low-noise cable, 10–32 UNF connectors, 250 °C (482 °F)
 AO-0231-x-yyy[†] Super low-noise cable, 10–32 UNF to TNC, 180 °C (356 °F)

AO-0406-x-yyy[†] Light and flexible cable, 10–32 UNF to BNC, 250 °C (482 °F). Includes adaptor JP-0145
 AO-1382-x-yyy[†] Flexible double-screened coaxial cable, 10–32 UNF connectors, 250 °C (482 °F)
 AO-1419-x-yyy[†] Very flexible low-noise coaxial cable, 10–32 UNF to 10–32 UNF, 250 °C (482 °F)
 JJ-0032 Extension connector, 10–32 UNF connectors
 JP-0145 Plug adaptor, 10–32 UNF to BNC
 UA-1243 Red/green/yellow cable markers for cable jacket diameter 1.6 mm, 3 × 30 pieces
 UA-0130 Microdot connectors, 10–32 UNF (set of 25)
 UA-0186 Extension connector JJ-0032 (set of 25)
 Type 4294 Calibration Exciter

CALIBRATION SERVICES

4505-CAF Accredited calibration
 4505-CAI Accredited initial calibration
 4505-CFF Factory standard calibration

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

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