Product Data

Cubic Accelerometers — Types 4500 and 4501

USES:

- ❍ General purpose vibration and shock measurements on low-mass structures and in confined spaces
- ❍ Vibration and structural analysis in automotive, aerospace and general machinery applications, especially where a large number of accelerometers is required

FEATURES:

- ❍ Low-weight ThetaShear® design giving high sensitivity/weight ratio and very low sensitivity to environmental factors
- ❍ Choice of five mounting surfaces
- ❍ High resonance frequency giving a (+10%) frequency range up to 16 kHz
- ❍ Electrically insulated for ground loop protection

Description

Cubic Accelerometers Types 4500 and 4501 are piezoelectric accelerometers providing a low sensitivity to extraneous environmental effects which is achieved through the ThetaShear®* design.

Both types consist of a ThetaShear® accelerometer in a lightweight aluminium housing. The only difference is the position of the M3 sub-miniature coaxial connector which is positioned on the top surface which is perpendicular to the main axis for Type 4500 and on the side surface parallel to main axis for Type 4501.

Both types have been designed with particular emphasis on low-mass and small physical dimensions, combined with relatively high sensitivity and the greatest possible flexibility in mounting.

ThetaShear®

The ThetaShear® design is illustrated in Fig. 1. A slotted cylindrical stanchion (3) holds a central seismic mass (1) flanked by two piezoelectric disks (2). This assembly is clamped rigidly by the cover (4). The parts are firmly held together without the use of any bonding agent other than molecular adhesion, a principle which has proved extremely reliable in the Brüel & Kjær DeltaShear® Accelerometers.

* Patented

Environmental Sensitivity

One of the most troublesome environmental factors encountered when using piezoelectric accelerometers is temperature transients. Careful choice of materials and mechanical design has reduced this to a minimum.

The ThetaShear® design also provides excellent immunity to other environmental effects such as base strains, magnetic sensitivity and acoustic fields.

Calibration

Each 4500/4501 is individually calibrated and supplied with a comprehensive calibration chart. Long-term stability and reliability is ensured by artificial ageing during the production process. Field checking and system calibration is straightforward using the Brüel & Kjær hand-held Vibration Calibrator Type 4294.

Mounting

Special effort has been put into making mounting as flexible as possible. Five of the six surfaces can be used for mounting with adhesive cement, mounting wax or double-sided adhesive tape.

Ground Insulation

The base of the accelerometer is insulated and has a ground insulation of 10 MΩ. Ground loops, which can be particularly troublesome in multichannel measurements, are avoided by electrically insulating the sensor from the aluminium body and thus from the test piece. Furthermore, all mounting surfaces are hard anodized, providing additional insulation.

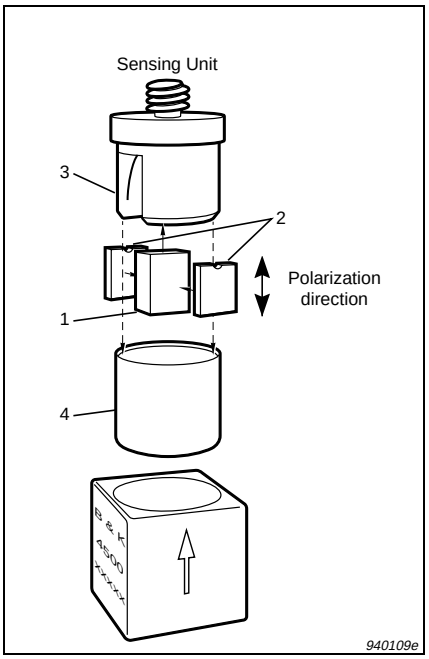

Fig.1 Exploded view of Cubic Accelerometer Type 4500 showing the ThetaShear® design

Cables and Connectors

For use at low frequencies the 1.2 m flexible low-noise cable AO 0339 is recommended. This cable has a Brüel & Kjær M3 sub-miniature coaxial connector to match the accelerometer output at one end, and a 10–32 UNF miniature connector at the other end. A special cable mounting tool (QA 0220) is available to enable easy cable fitting in confined spaces.

Extension cables of virtually any length can be supplied to order, or alternatively you can make your own, using cable AC 0005 and a Connector Set UA 0130. Extension Adaptor Set UA 0186 is used to couple the extension cable with cable AO 0283 (for detailed information about these options see the Ordering Information). In order to distinguish the individual accelerometers in a multichannel measurement set-up, coloured cable markers are available to fit both the AO 0283 cable and the thicker AC 0005 cable.

Cable Clamping

When using miniature accelerometers, the accelerometer cable can affect the measurement result because of forces exerted by the cable on the accelerometer connector. This causes amplitude irregularities in the output from the accelerometer at frequencies up to approximately 200 Hz. The problem can be reduced by using a flexible cable. However, 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 clamping 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.

Specifications 4500 and 4501

General Specifications

CHARGE SENSITIVITY (at 159.2 Hz):
0.3 pC/ms^{-2}, 3 pC/g
MOUNTED RESONANCE FREQUENCY: 50 kHz
TRANSVERSE RESONANCE FREQ.: 20 kHz
TRANSVERSE SENSITIVITY: <5% of sensitivity
CAPACITANCE: 1000 pF
FREQUENCY RESPONSE (10%):
3 Hz to 16.6 kHz
Note: The frequency tolerance is only valid if the cable is clamped as described in this Product Data
UNDAMPED NATURAL FREQ: 70 kHz

Electrical

CASE INSULATION TO GROUND (at 100 V):
>10 MΩ

Environmental

MAX. NON-DESTRUCTIVE SHOCK (±PEAK):
30 kms^{-2}; 3000 g
AMBIENT TEMPERATURE:
–55 to +175 °C (–67 to +347 °F)
HUMIDITY: Sealed
ACOUSTIC SENSITIVITY: 0.035 ms^{-2}@154 dB
TEMP. TRANSIENT SENSITIVITY (3 Hz lower limiting frequency): 1 ms^{-2}/°C
BASE STRAIN SENSITIVITY:
0.055 ms^{-2}/με; 0.0055 g/με
MAGNETIC SENSITIVITY (50 Hz): 12 ms^{-2}/tesla

Physical

CASE MATERIAL: Aluminium/Anodized
BASE MATERIAL: Titanium
PIEZOELECTRIC ELEMENT:
Material: Type PZ 23

Design Construction: ThetaShear®
CONNECTOR: M3 coaxial
MOUNTING SURFACE FLATNESS: <10 μm
SEISMIC MASS: 0.8 gram (0.03 oz.)
CENTRE OF GRAVITY OF ACCELEROMETER: 4.9 mm (0.2″) from the connector surface on the rotationally symmetrical axis
DIMENSIONS (H×W×L):
10×10×10 mm (0.39″)
WEIGHT: 3.5 gram (0.12 oz.)

Note: All values are typical at 25°C (77°F), unless measurement uncertainty is specified. All uncertainty values are specified at 2σ (i.e. expanded uncertainty using a coverage factor of 2)

Ordering Information

Optional Accessories

AO 0339:	1.2 m (4 ft) flexible low-noise cable with 10–32 UNF/M3 connectors
AO 0283:	1.2 m (4 ft) super low-noise cable, 10–32 UNF/M3 connectors, (available in any length on request)
QA 0220:	Cable connecting/removal tool
UA 1243:	3×30 pieces of red/green/yellow cable markers for AO 0238
UA 1244:	As above, for cable AC 0005
AC 0005:	Teflon insulated low-noise cable (excl. connectors; available per metre)
UA 0130:	Connector Set, consisting of 25 connectors JP 0012 for cable AC 0005.
QA 0035:	Connector Assembly Tool for cable AC 0005 and connector JP 0012
UA 0186:	Extension Adaptor Set, consisting of 25 extension adaptors (JJ 0032) for cables with connector JP 0012
YJ 0216:	Mounting Wax
QS 0007:	Cyanoacrylate Adhesive

Brüel&Kjær reserves the right to change specifications and accessories without notice

Brüel & Kjær

WORLD HEADQUARTERS:
DK-2850 Naerum · Denmark · Telephone: +45 45 80 05 00 · Fax: +45 45 80 14 05 · Internet: http://www.bk.dk · e-mail: info@bk.dk
Australia (02) 9450-2066 · Austria 00 43-1-865 74 00 · Belgium 016/44 92 25 · Brazil (011) 246-8166 · Canada: (514) 695-8225 · China 10 6841 9625 / 10 6843 7426
Czech Republic 02-67 021100 · Finland 90-229 3021 · France (01) 69 90 69 00 · Germany 0610 3/908-5 · Holland (0)30 6039994 · Hong Kong 254 8 7486
Hungary (1) 215 83 05 · Italy (02) 57 60 4141 · Japan 03-3779-8671 · Republic of Korea (02) 3473-0605 · Norway 66 90 4410 · Poland (0-22) 40 93 92 · Portugal (1) 47114 53
Singapore (65) 275-8816 · Slovak Republic 07-37 6181 · Spain (91) 36810 00 · Sweden (08) 71127 30 · Switzerland 01/94 0 09 09 · Taiwan (02) 713 9303
United Kingdom and Ireland (0181) 954-236 6 · USA 1 - 800 - 332 - 2040
Local representatives and service organisations worldwide

BP 1427 – 12

96/12