PRODUCT DATA

Brüel&Kjær® Vibration Transducers

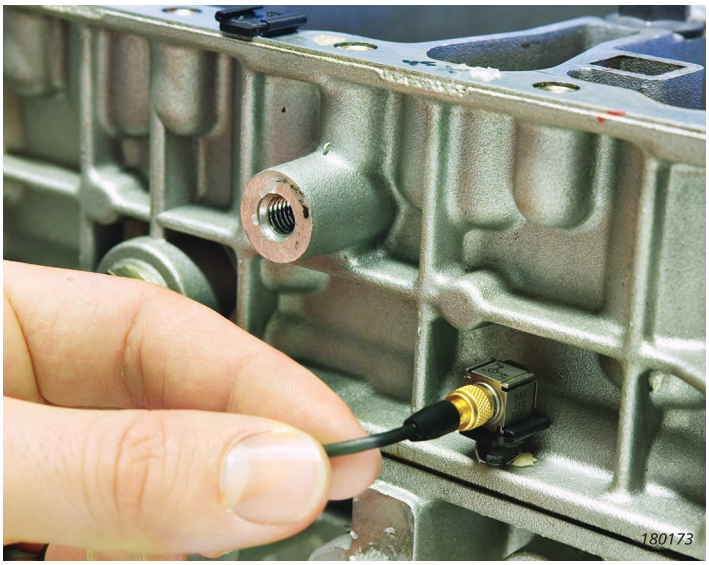
Cubic Triaxial CCLD Accelerometer Types 4524-B and 4524-B-001

Types 4524-B and 4524-B-001 are lightweight triaxial piezoelectric OrthoShear™ accelerometers, each with three independent outputs for simultaneous measurements in three mutually perpendicular directions.

Each accelerometer is engraved with a data matrix code. Scan the matrix code with your smartphone to:

- *Together with the Transducer Smart Setup app, simplify and automate multichannel test setups*
- *Quickly access the individual accelerometer's specifications, calibration information, etc.*

The accelerometer's clip mounting facility combined with the ability to mount the transducer on five of its six surfaces, makes mounting on structures very flexible and quick and thus ideal for structural and modal analysis measurements.



Uses

- Structural analysis measurements
- Multichannel modal analysis measurements
- Modal measurements for automotive body and power train applications
- Hand and arm measurements (Type 4524-B-001)

Features

- High sensitivity-to-weight ratio
- Light weight (<5 grams)
- Excellent low-frequency response
- Electrically insulated
- Hermetically sealed
- Easy mounting on five of six surfaces
- Transducer electronic data sheet (TEDS)
- 4-pin connector
- Data matrix code providing Web-based transducer-specific information and enabling Transducer Smart Setup

CCLD: Constant Current Line Drive, also known as DeltaTron®. ICP® and IEPE compatible. CCLD is a generic name for Brüel & Kjær accelerometers and signal-conditioning products. It identifies products that operate on a constant-current power supply and give output signals in the form of voltage modulation on the power supply line. One of the advantages of this system is that it allows you to use inexpensive cables.

Description

Types 4524-B and 4524-B-001 are piezoelectric accelerometers that feature a built-in preamplifier. The sensitivity is expressed in terms of voltage per unit acceleration (mV/g).

The OrthoShear design used in the accelerometers (Fig. 1) is built around a common seismic mass. This uni-mass design results in a very compact triaxial accelerometer where all the axes have the same point of reference and ensures accurate and consistent measurements, even when the accelerometer is exposed to complex vibration patterns. The seismic mass is surrounded by a piezoelectric ring, which is surrounded by three individually suspended, curved arms. Because of the suspension pins, different sections are exposed to shear forces for different directions of acceleration. By appropriate summation of the signals, the outputs for the X-, Y- and Z-axes are obtained.

TEDS

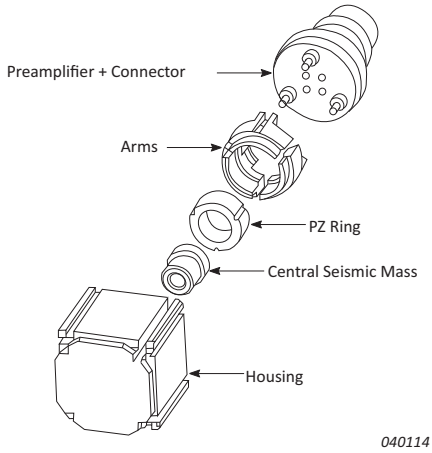
Types 4524-B and 4524-B-001 include a transducer electronic data sheet (TEDS) containing sensor- and application-specific information, including frequency response compensation.

CCLD Power Supply

All three axes must be powered for operation. Single- or dual-axial supply is not possible. The accelerometers can be used with any constant current (2 to 10 mA) power supply setup.

For a cost-effective and reliable power supply, the optional CCLD Power Supply WB-1453 is a 3-channel, battery-operated power supply for CCLD accelerometers. The frequency range covers the full frequency range for the accelerometers and the transducer current is 3 mA ±20%. Both input and output are supplied with 4-pin, Microtech-compatible connectors.

Fig. 1 *Exploded view of Type 4524-B/4524-B-001*



Frequency Compensation with REq-X

REq-X stands for Response Equalisation Extreme, which is a technique that allows you to flatten the frequency response of a transducer in real time. This flattening is done by filtering the time signal of a transducer by the inverse of the frequency response.

The calibration chart includes individual TEDS values that, together with a general formula, best fit the measured frequency response. The expression can be used for frequency response compensation in the specified frequency range. The relative frequency response, including amplitude and phase is:

$$S_{rel}(f,T) = (Sign) \times (1 + b(T - T_{ref})) \times \frac{j\frac{f}{f_{hp}}}{\left(1 + j\frac{f}{f_{hp}}\right)} \times \frac{1}{\left(1 + j\frac{f}{f_{lp}}\right)} \times \frac{1}{\left(1 + \left(j\frac{f}{f_{res}}\right)^2 + j\frac{f}{Qf_{res}}\right)} \times \left(j\frac{f}{f_{ref}}\right)^{\frac{a}{\ln 10}}$$

Where:

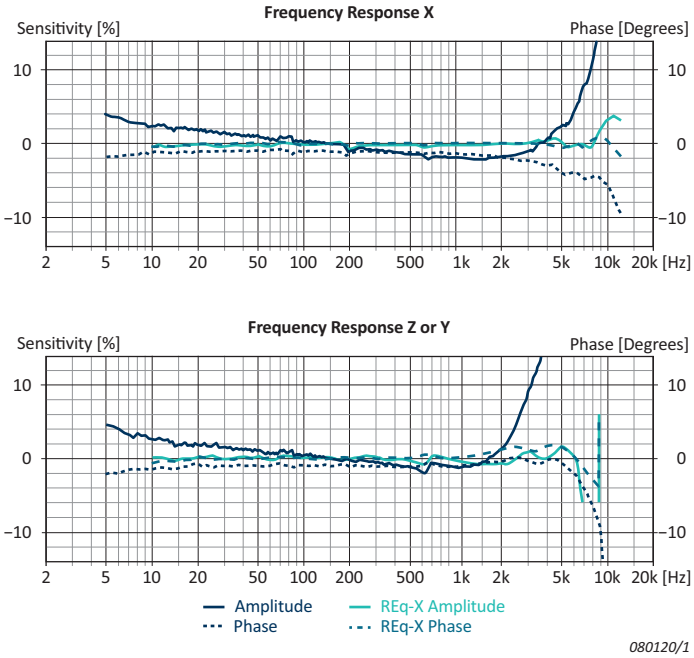
Sign = Polarity	b = Temperature coefficient
T = Temperature	T_{ref} = Reference temperature
f = Frequency	f_{hp} = High-pass cut-off frequency
f_{lp} = Low-pass cut-off frequency	f_{res} = Resonance frequency
f_{ref} = Reference frequency	Q = Quality factor
a = Amplitude slope/decade	

Combining this equation with the amplitude sensitivity S_{ref} and f_{ref} and T_{ref} we have:

$$S(f,T) = S_{ref} \times \frac{S_{rel}(f,T)}{\left|S_{rel}(f_{ref},T_{ref})\right|}$$

Implementation of this formula in real-time measurement and post-processing systems, such as with BK Connect, will extend the usable frequency range, improve accuracy or allow a combination of the two.

Fig. 2 *Typical frequency responses with and without REq-X applied*



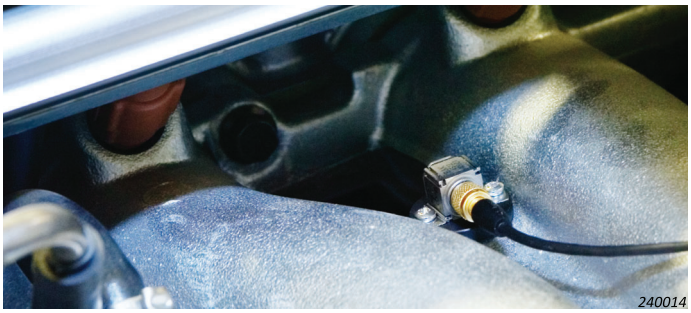
Mounting

Special effort has been put into making mounting as flexible as possible. The accelerometers can be easily fitted to or removed from a number of different test objects. In addition to adhesive mounting directly on the test object, the accelerometer housing has slots that allow the use of mounting clips.

Mounting Clips

There are four clip-mounting possibilities:

High-temperature clip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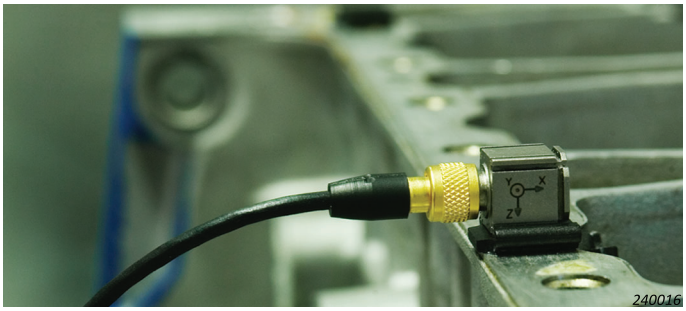
For mounting in high temperatures, use High-temperature Mounting Clip UA-1564.

- **Temperature range:** Full operating range of Types 4524-B and 4524-B-001
- **Maximum acceleration:**
  - With a 5 g accelerometer: 50 g peak
  - Perpendicular to mounting surface: 250 g peak
- **Base material:** Anodised aluminium
- **Spring material:** Stainless steel
- **Weight:** 5.7 g


240015

Thin, polycarbonate clip


240016

For mounting on planes and similar surfaces, use Mounting Clip UA-1407.

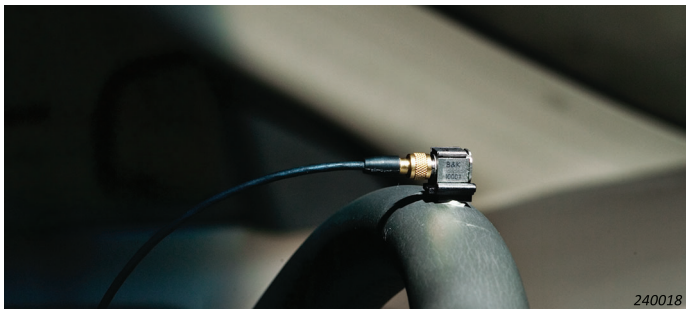
- **Upper limiting frequency (10%):**
  - **X-axis:** 2.7 kHz
  - **Y- and Z-axes:** 2.0 kHz
- **Weight:** 0.4 g


240017

Common Specifications: UA-1407, UA-1475 and UA-1478

- **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

Thick-base clip


240018

To shape and customize the mounting to fit your needs, use Mounting Clip with Thick Base UA-1475. The thick base can be filed down as needed.

- **Upper limiting frequency (10%):**
  - **X-axis:** 2.7 kHz
  - **Y- and Z-axes:** 2.0 kHz
- **Weight:** 0.7 g


240019

Swivel-base Mounting Clip


240020

To align and realign the accelerometer without changing the coordinate system, use Swivel Base Clip UA-1478. Together with Spirit Level UA-1480, you can change the accelerometer's direction and still maintain the coordinate system.

Excitation must be along one of the accelerometer's axes of sensitivity with the mounting surface of the hemispherical part of the clip at 45° to the direction of the excitation.

Swivel Base Clip

- **Upper limiting frequency (10%):**
  - **X-axis:** 2.5 kHz
  - **Y- and Z-axes:** 1.9 kHz
- **Weight:** 0.8 g


240021

Spirit Level

- **Max. dimensions:** 85 × 23 × 17 mm (3.35 × 0.9 × 0.67 in)
- **Material:** Black, anodised aluminium


240022

Calibration

Calibration Clip DV-0459

- **Mounting surface diameter:** 21 mm
- **Mounting thread:** 10 – 32 UNF
- **Base material:** Stainless steel (hardened)
- **Spring material:** Stainless steel
- **Weight:** 17 g

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The transducers are individually calibrated and supplied with a comprehensive calibration chart, using state-of-the art, random FFT technology, providing an 1600-point high-resolution calibration (magnitude and phase) ultimately giving a unique characterization and securing the integrity of the vibration measurement.

The sensitivity given on the calibration chart has been measured at 159.2 Hz with a 95% confidence level, using a coverage factor k = 2.

Transducer Smart Setup

Transducer Smart Setup is a mobile app that works in combination with the data matrix code engraved on the transducer. With the Transducer Smart Setup app, you can scan the data matrix code using your smartphone's camera. It will then recognize the transducer and allow you to add associated data such as location and orientation, minimizing the risk of data entry errors. The data can be imported into BK Connect™ as hardware setup tables for easy front-end configuration. If you change connections, just reimport the setup and the configuration will align as necessary – no need to trace cables.

The Transducer Smart Setup app is available for free in the App Store℠.

Use the Data Matrix Code for Transducer Information

Even without the app, scanning the data matrix code on the transducer provides fast and easy access to detailed product information such as:

- Specifications
- Technical documentation
- Specific calibration data
- Information about Transducer Smart Setup

Fig. 3 *Labelled symbols indicate the orientation of the triaxial accelerometer*

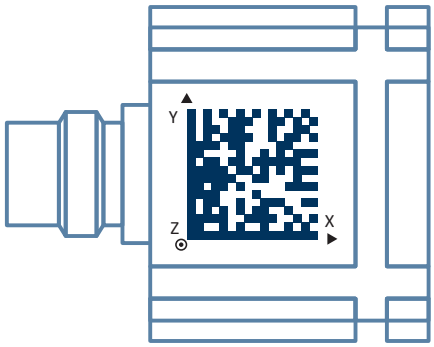

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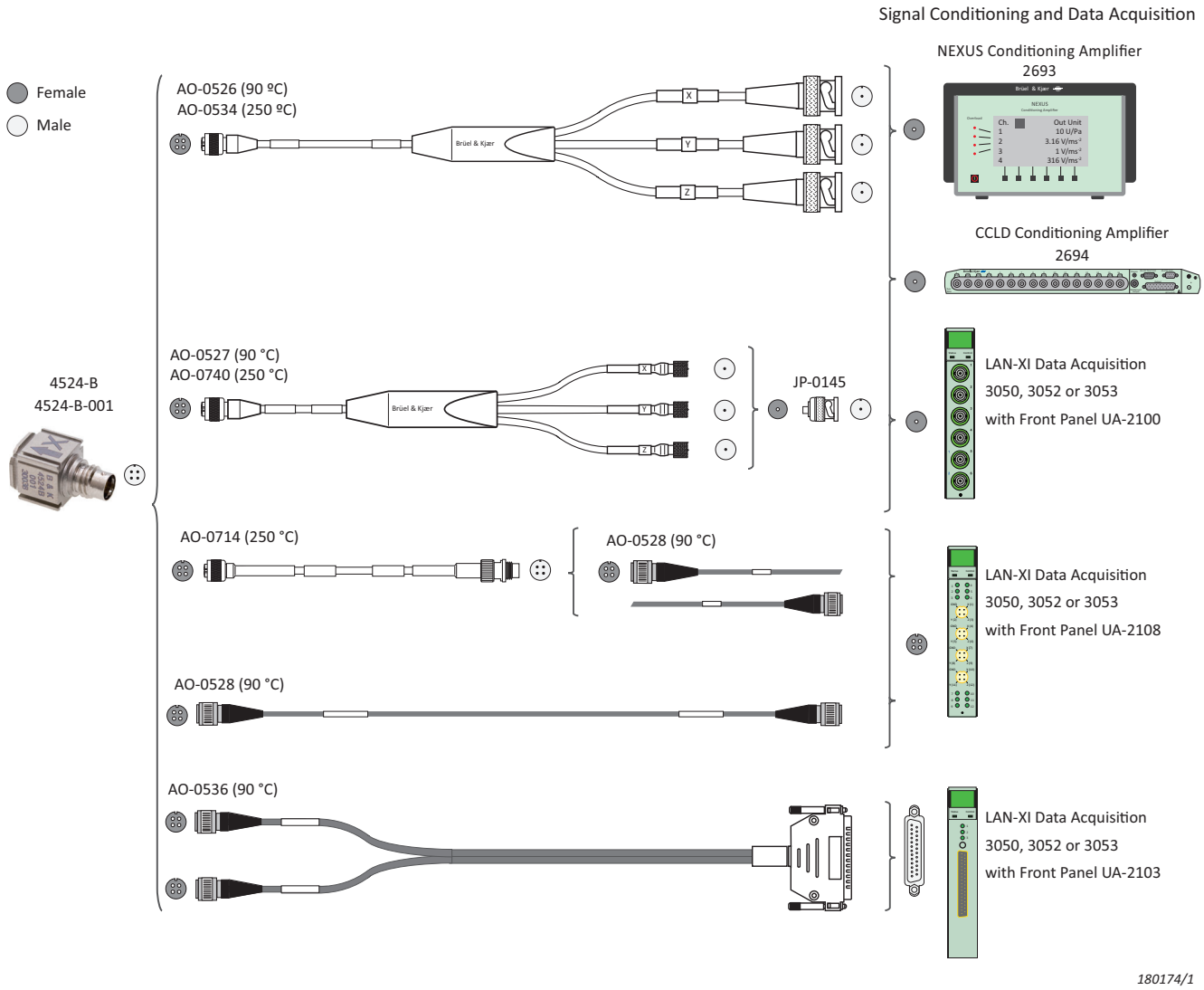
Table 1 *Cables compatible with Types 4524-B and 4254-B-001*

CABLE NO.	CONNECTOR A	CONNECTOR B	TEMPERATURE	NOTES
AO-0526	¼″ – 28 UNF 4-pin (F)	BNC (M)	90 °C (194 °F)*	• Flexible • Single cable to 3 × super low-noise cables
AO-0527		10 – 32 UNF (M)	90 °C (194 °F)*	• Flexible • Single cable to 3 × super low-noise cables
AO-0534		BNC (M)	250 °C (482 °F)*	• Flexible • Single cable to 3 × super low-noise cables
AO-0740		10 – 32 UNF (M)	250 °C (482 °F)	• Flexible • Four-wire cable • Single-screened, coaxial
AO-0528		¼″ – 28 UNF 4-pin (F)	90 °c (194 °F)	• Flexible
AO-0714		¼″ – 28 UNF 4-pin (M)	250 °C (482 °F)	• Flexible • Four-wire cable • Single-screened, coaxial
AO-0536		D-sub 37-pin (F)	90 °c (194 °F)	• Flexible • Connects two triaxial accelerometers

* This cable has a splitter with an operating temperature range of – 40 to +150 °C (– 40 to +302 °F)

Fig. 4 *Typical configurations with Types 4524-B and 4524-B-001*

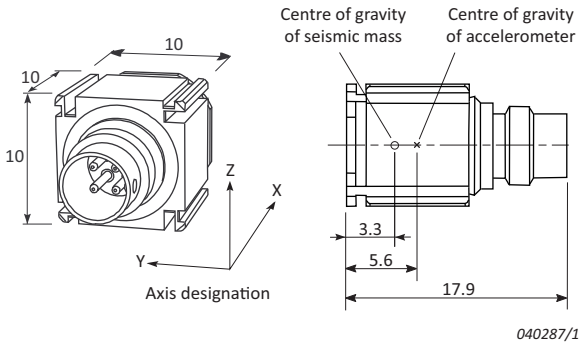


All values are typical at 25 °C (77 °F) unless measurement uncertainty is specified. All values are valid with 4 mA supply current and all three axes powered.

	UNITS	4524-B	4524-B-001
DYNAMIC CHARACTERISTICS			
Voltage Sensitivity (@ 159.2 Hz)	mV/ms^{-2} (mV/g)	10 ±5% (100^{+3}_{-7}%)	1 ±10% (10^{+3}_{-7}%)
Measuring Range	ms^{-2} (g)	±500 (±50)	±5000 (±500)
Frequency Response		See Typical Frequency Response (Fig. 2)	
Mounted Resonance Frequency	kHz	**X:** 18 **Y:** 9 **Z:** 9	
Amplitude Response ±10%	Hz	**X:** 0.2 to 5500 **Y:** 0.25 to 3000 **Z:** 0.25 to 3000	
Amplitude Response ±10% with REq-X	Hz	**X:** 0.2 to 10000 **Y:** 0.25 to 5000 **Z:** 0.25 to 5000	
Phase Response ±5°	Hz	1.5 to 3000	
Temperature Response	%/°C (%/°F)	0.14 (0.08)	0.11 (0.05)
Residual Noise (1 to 6000 Hz) Broadband	mg	**X:** <0.4 **Y:** <0.2 z: <0.2	**X:** <0.7 **Y:** <0.7 **Z:** <0.9
Transverse Sensitivity	%	<5	
ELECTRICAL CHARACTERISTICS			
DC Output Bias Voltage	V DC	+13 ±1	
Output Impedance	Ω	<30	
Grounding		Insulated from case	
POWER REQUIREMENTS*			
Supply Voltage (Unloaded)	V DC	24 to 30	
Constant Current Supply	mA	2 to 10	
Warm-up Time (90% of stabilised bias)	s	10	
ENVIRONMENTAL CHARACTERISTICS			
Temperature Range	°C (°F)	−54 to +100 (−65 to +212)	
Humidity		Hermetic	
Max. Operational Sinusoidal Vibration (peak)	ms^{-2} (g)	5000 (500)	
Max. Operational Shock (± peak)	ms^{-2} (g)	50,000 (5000)	
Base Strain Sensitivity	Equiv. ms^{-2}/μ strain (g/μ strain)	Mounted in clip: 0.0005 (0.00005) Cemented to measuring object: 0.02 (0.002)	
Thermal Transient Sensitivity	Equiv. ms^{-2}/°C (g/°F)	0.1 (0.005)	
Magnetic Sensitivity (50 Hz – 0.03 tesla)	ms^{-2}/T (g/T)	20 (2)	30 (3)
PHYSICAL CHARACTERISTICS			
Dimensions		See outline drawing (Fig. 5)	
Weight	g (oz)	4.8 (0.17)	
Case Material		Titanium	
Connector		Hermetic 4-pin receptacle ¼–28 UNF-2A	
Mounting		Adhesive or clip	

* NOTE: All three axes must be powered during operation

Fig. 5 Dimensions (millimetres) of Types 4524-B and 4524-B-001



MAXIMUM CABLE LENGTH

The maximum output voltage of a CCLD accelerometer when driving long cables depends on the supply current at which it is operating, and on the capacitive load due to the connecting cable. The maximum cable length in meters (for distortion ≤1%) is given by:

$$L = 140000 \times \frac{I_s - 1}{f \times V_o \times C_m}$$

where:
I_s = supply current (mA)
f = frequency (kHz)
V_o = output voltage (V_{peak})
C_m = cable capacitance (pF/m)

Type 4524-B	**Cubic Triaxial CCLD Accelerometer with TEDS, 10 mV/ms^{-2}**
Type 4524-B-001	**Cubic Triaxial CCLD Accelerometer with TEDS, 1 mV/ms^{-2}**

All accelerometers include the following accessories:
- Carrying Box
- Calibration Chart
- One Mounting Clip

Optional Accessories

CABLES AND ADAPTERS

AO-0526-D-xxx*	Cable with circular 4-pin to 3 × BNC connectors, 90 °C (194 °F)
AO-0526-M-100	Cable with circular 4-pin to 3 × BNC connectors, 100 m (333 ft), 90 °C (194 °F)
AO-0527-D-xxx*	Cable with 4-pin to 3 × 10 – 32 UNF connectors, 90 °C (194 °F)
AO-0528-D-xxx*	Cable with circular 4-pin (F) to 4-pin (F) connectors, 90 °C (194 °F)
AO-0534-D-xxx*	Cable with circular 4-pin to 3 × BNC connectors, 250 °C (482 °F)
AO-0536-D-050	Cable with to 2 × circular 4-pin to 37-pin D-sub-connectors, 5 m (16.7 ft), 90 °C (194 °F)
AO-0536-D-100	Cable with to 2 × circular 4-pin to 37-pin D-sub-connectors, 10 m (33 ft), 90 °C (194 °F)
AO-0714-D-xxx*	Cable with circular 4-pin (F) to 4-pin (M) connectors, 250 °C (482 °F)
AO-0740-D-xxx*	Cable with 4-pin to 3 × 10 – 32 UNF connectors, 250 °C (482 °F)
JP-0145	Plug Adapter, 10 – 32 UNF (F) to BNC (M)
WA-1705	Plug Adapter, 10 – 32 UNF (F) to SMB (F)

TRANSDUCER SMART SETUP

Free download from the App Store (requires iOS 8.0 or later)

CALIBRATION

DV-0459	Calibration Clip
Type 4294	Vibration Calibrator

* Available in various lengths. D = decimetres, xxx = length. Please specify when ordering

MOUNTING

UA-1407	Set of 100 Mounting Clips
UA-1418	Set of 25 Dummy Accelerometers for mass loading
UA-1475	Set of 100 Mounting Clips with thick base
UA-1478	Set of 100 Swivel Base Clips
UA-1480	Spirit Level Set (including 100 Swivel Base Clips)
UA-1564	Set of 5 High-temperature Mounting Clips
UA-3015	Hand Adapter (clip) T-shaped
UA-3016	Handle Adapter (clip) L-shaped
UA-3017	Mounting Adapter with strips (clip)
YJ-0216	Mounting Wax

POWER SUPPLY

WB-1453	CCLD Power Supply

SIGNAL CONDITIONING AND DATA ACQUISITION†

Type 2693	NEXUS Conditioning Amplifier
Type 2694-A/B/C/D	16-channel CCLD Conditioning Amplifier
Type 3050	LAN-XI 4/6-ch. Input Module, 51.2 kHz
Type 3052	LAN-XI 3-ch. Input Module, 102.4 kHz
Type 3053	LAN-XI 12-ch. Input Module, 25.6 kHz
Type 3160	LAN-XI Generator, Input/Output Module, 51.2 kHz
UA-2100-0xy	LAN-XI General Purpose Front Panel, BNC connectors (2 to 6 channels: x = no. of input channels, y = no. of output channels)
UA-2103	LAN-XI 6-ch. D-sub Connector Front Panel
UA-2107-120	LAN-XI 12-ch. High-density Front Panel, SMB connectors
UA-2107-A-120	LAN-XI 12-ch. High-density Front Panel, Microdot (10 – 32 UNF) connectors
UA-2108-xx0	LAN-XI Triaxial Accelerometer Front Panel, 4-pin connectors (6 or 12 input channels, x = number of channels)

Calibration Services

ACC-T-CAF	Accredited Calibration
ACC-T-CAI	Accredited Initial Calibration
ACC-T-CFF	Factory Standard Calibration with calibration chart
ACC-T-CTF	Traceable calibration

† For more information, see the individual product data: NEXUS conditioning amplifier, see BP 1702; CCLD conditioning amplifiers, see BP 1882; LAN-XI data acquisition modules, see BP 2215; and LAN-XI interchangeable front panels, see BP 2421

BP 2076 – 15 2024-05

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