PRODUCT DATA

Centre Bolt CCLD Type 4511-001

Piezoelectric Accelerometer

Type 4511-001 is a CCLD accelerometer specifically designed for health usage monitoring of gearboxes on helicopters. The primary design objective has been reliability under extreme conditions yielding very high robustness versus mechanical, electrical and environmental influences.*

Type 4511-001 has been thoroughly tested according to DO-160, Environmental Conditions and Test Procedures for Airborne Equipment. In addition, all processes and materials comply with MIL-STD-11268.

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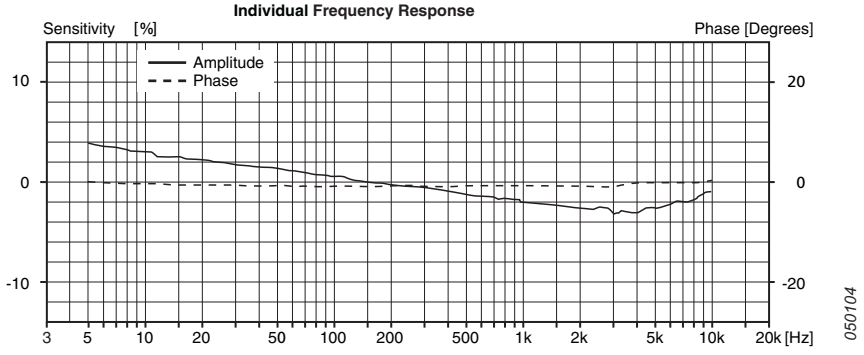
Uses and Features

Uses

- Flight-test applications
- Measurement in harsh environments
- Health usage monitoring systems (HUMS)
- Gearboxes

Features

- Case insulated and internally shielded
- Hermetically sealed
- High frequency (15 kHz)
- High temperature (150 °C)
- Low-impedance output
- EMI and radiation resistant
- Centre bolt (360° orientation)



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* CCLD: Constant current line drive, also known as DeltaTron® (ICP and IEPE compatible)

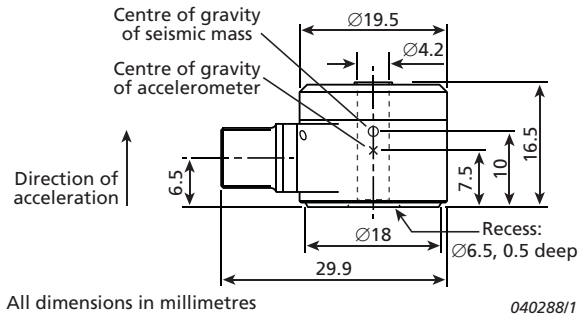
Brüel & Kjær

Description

Type 4511-001 is a piezoelectric CCLD accelerometer constructed using the Annular Shear design. It features a rugged Glenair, Inc.® Series 800 connector (male), is made of Stainless Steel AISI 316-LS and is hermetically sealed, making them well suited to harsh industrial applications.

The central mounting hole accommodates an M4 or 6−32 UNC mounting bolt. The mounting hole also features 10−32 UNF threading for stud mounting.

Fig. 1 *Dimensions of Type 4511-001*



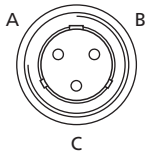
For maximum safety, the accelerometer and included mounting bolt have holes for threading safety wires.

Electrical Connection

Fig. 2 *Accelerometer pin configuration, front view*

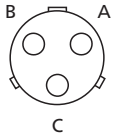
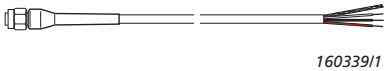
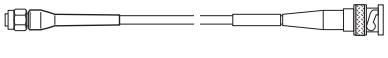
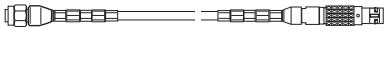
The accelerometers feature a 3-pin, male connector with the following pin designation:

- **A:** Signal/power supply
- **B:** Ground, insulated from case
- **C:** Not connected



Brüel & Kjær cables AO-0642, AO-0642-W-002 and WL-3418 are recommended for use with Type 4511-001. The cables have MIL-C-5015 3-pin, female connectors for connection to the accelerometer, but each have a different terminal.

Table 1 *Connectors and pin designation for cables compatible with Type 4511-001*

Cable No.	Connector A	Cable	Connector B		Temperature	Notes
AO-0642	MIL-C-5015, 3-pin (F)  160338	 160339/1	Open end	White = A Black = B Red = C	−75 to +250 °C (−103 to +482 °F	• 3-wire (twisted) shielded • PTFE insulated • Low-smoke • Halogen-free
AO-0642-W-002		 160340/1	BNC (M)	Centre pin = A Housing = B Not connected = C Not connected = housing	−60 to +250 °C (−76 to +482 °F	• PTFE insulated • Low-smoke • Halogen-free
WL-3418		 160341/1	LEMO*	Centre pin = A Housing = B Not connected = C Housing = Housing	−75 to +250 °C (−103 to +482 °F	• Low-smoke • Halogen-free

* The LEMO connector is ideal for sound level meters and Hand-held Analyzer Types 2250, 2250-L and 2270

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 metres (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)

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 ±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 ±10%.

Specifications – Accelerometer Type 4511-001

All values typical at 25 °C (77 °F) unless measurement uncertainly is specified

			Unit	Type 4511-001
General Characteristics				
Weight			g (oz)	35 (1.23)
Voltage Sensitivity (at 159.2 Hz and 20 ms^{-2} rms)			mV/ ms^{-2}	1.0 ±10%
			mV/*g*	10 ±10%
Frequency Range	Amplitude (±10%)		Hz	1 to 15,000
	Phase (±5°)			2 to 10,000
Mounted Resonance Frequency			kHz	43
Transverse Sensitivity (at 30 Hz, 100 ms^{-2})			%	<5
Measuring Range			ms^{-2} (*g*)	±5000 (±500)
Electrical Characteristics				
Bias Voltage	at 25 °C and 4 mA		V DC	11 ±0.5
	at full temperature and current range		V DC	8.5 to 14
Power Supply	constant current		mA	2 to 20
	unloaded supply voltage		V	18 to 30
Output Impedance			Ω	<100
Start-up Time (to final bias ±10%)			s	<2
Inherent Noise (rms)	Broadband	1 to 10 kHz	µV (µ*g*)	7 (700)
	Spectral	10 Hz	$ms^{-2}/\sqrt{Hz}$ (µ*g*/√Hz)	6×10^{-4} (60)
		100 Hz		2×10^{-4} (20)
		1000 Hz		1×10^{-4} (10)
Insulation Resistance (body to mounting surface)			MΩ	>100

		Unit	Type 4511-001
Environmental Characteristics			
Operating Temperature Range		°C (°F)	−54 to +125 (−65 to +257)
Temperature Coefficient of Sensitivity		%/°C	0.09
Magnetic Sensitivity (at 50 Hz, 0.038 T)		ms^{-2}/T	20
		g/kG	0.2
Base Strain Sensitivity (at 250 με in base plane)		$ms^{-2}/\mu\varepsilon$	0.05
		g/με	0.005
Max. Non-destructive Shock (± peak)		kms^{-2} (*g*)	51 (5000)
Mechanical Characteristics			
Case Material			Stainless steel AISI 316-L
Sealing			Hermetic
Sealing Class (Helium leak rate)		Pa·m^3/s (mbar·l/s)	$<10^{-7}$ ($<10^{-6}$)
Connector			3-pin hermetic, all pins insulated from case
Mounting			
Centre Bolt Hole			Fits an M4 or 6−32 UNC (DIN 912) bolt
Threading			10−32 UNF-2B, depth 3.2 mm
Torque	10−32 UNF stud	Nm (lbf-in)	**Max:** 3.5 (31), **Min:** 0.5 (4.4)
	M4 bolt		**Max:** 1.5 (12), **Min:** 1.1 (9.5)
	6−32 UNC bolt		**Max:** 1.5 (12), **Min:** 1.1 (9.5)

Ordering Information

Type 4511-001 **Industrial Centre Bolt Accelerometer**, Sensitivity: 1.0 mV/ms^{-2}

Includes the following accessories in carrying box:

- Calibration chart
- 1 × M4 stainless steel bolt (DIN 912) with safety wire hole, length 22 mm (0.87 in)

Brüel & Kjær Calibration Services

ACC-M-CAF	Accredited calibration, monoaxial accelerometer
ACC-M-CAI	Initial accredited calibration, monoaxial accelerometer
ACC-M-CTF	Traceable calibration, monoaxial accelerometer

Supported Brüel & Kjær Hardware

CABLING

AO-0642-D-030	Cable, 3-pin MIL-C-5015 (F) to open end (pigtail), max. 250 °C (482 °F), 3 m (10 ft)
AO-0642-D-050	Cable, 3-pin MIL-C-5015 (F) to open end (pigtail), max. 250 °C (482 °F), 5 m (16.4 ft)
AO-0642-W-002	Cable, 3-pin MIL-C-5015 (F) to BNC (M), max. 250 °C (482 °F), 5 m (16.4 ft)
WL-3418-D-025	Cable, 3-pin MIL-C-5015 (F) to LEMO (M), max. 250 °C (482 °F), 2.5 m (8.2 ft), reinforced at the accelerometer
WL-3418-D-050	Cable, 3-pin MIL-C-5015 (F) to LEMO (M), max. 250 °C (482 °F), 5 m (16.4 ft), reinforced at the accelerometer

MOUNTING

UA-0021	Bolt, M4 × 22 mm (0.87 in), hex socket cap (DIN 912), safety wire hole, stainless steel, set of 10
UA-0022	Bolt, 6−32 UNC × 22 mm (0.87 in), fully threaded, hex socket cap (DIN 912), stainless steel, set of 10
UA-2063	Stud, 10−32 UNF × 7.9 mm (0.31 in), fully threaded, steel, set of 10
UA-2064	Stud, 10−32 UNF × 5.3 mm (0.21 in), double ended with flange, steel, set of 10
QS-0007	Tube of cyanoacrylate adhesive
YJ-0216	Beeswax for mounting

CALIBRATION

Type 4294	Vibration Calibrator

BP 2064 – 13 2018-09

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