

## K-Beam Accelerometer

Type 8396A...

### Capacitive MEMS, Triaxial Accelerometer

Type 8396A... is a high-sensitivity, low noise triaxial accelerometer which simultaneously measures acceleration and/or low-frequency vibration in three mutually perpendicular axes (x, y, z). The accelerometer features include:

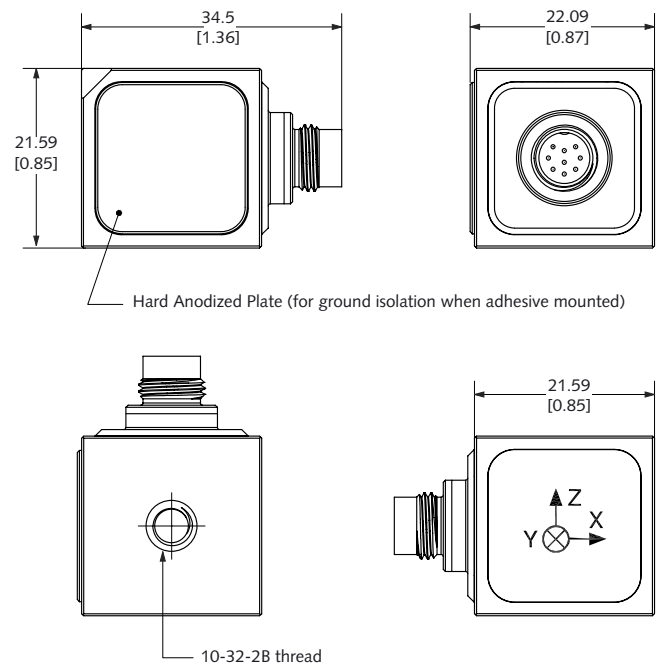
- Measuring ranges:  $\pm 2$  g,  $\pm 10$  g,  $\pm 30$  g,  $\pm 50$  g,  $\pm 100$  g,  $\pm 200$  g
- Frequency response: 0 ... 2,000 Hz (5 %) (except  $\pm 2$  g)
- Output Options:  $0 \pm 4$  V or  $2.5 \pm 2$  V single ended,  $0 \pm 4$  V or  $0 \pm 8$  V differential
- Operating temperature:  $-55$  ...  $125$  °C [ $-65$  ...  $260$  °F]
- Low noise
- Excellent thermal stability
- Small cube, 30 grams mass
- Wide supply voltage range, 6 ... 50 VDC
- 6,000  $g_{pk}$  shock rated
- Conforming to CE

#### Description

Type 8396A... triaxial capacitive accelerometer family utilizes a silicon Micro-Electro-Mechanical System (MEMS) variable capacitance sensing element. The sensing element of each axis consists of a very small inertial mass and a flexure element cantilever positioned between two plates. As the mass deflects under acceleration, the capacitance between these plates changes. AC excitation and synchronous amplitude demodulation circuitry contained in the accelerometer's internal signal conditioner provides an analog output signal proportional to the applied acceleration. This output signal is scaled as a voltage which is proportional to the applied acceleration.

The output signal format is available as bipolar  $0 \pm 4$  V, single-ended  $2.5 \pm 2$  V and  $0 \pm 4$  V or  $0 \pm 8$  V differential. The accelerometer is powered by a single regulated supply between 6 and 50 VDC. Temperature output is provided if external compensation of the output signal is desired. The sensing element and electronics are contained in a lightweight, welded titanium housing with either a circular 9 pin connector or an integral cable\* terminated by pigtail or 9 pin D-Sub connector. Ground isolation is obtained by mounting the sensor using one of the off-ground accessories or by adhesively mounting the sensor to the test object using the side of the sensor with the integral hard anodized plate.

\* braided shield protection option also available upon request



### Technical data

| Type   | Unit                    | 8396A2D0          | 8396A010         | 8396A030         | 8396A050         | 8396A100         | 8396A200         |
|--|-------------------------|-------------------|------------------|------------------|------------------|------------------|------------------|
| Acceleration range   | g                       | ±2                | ±10              | ±30              | ±50              | ±100             | ±200             |
| Frequency response, ±5 %, min.                                     | Hz                      | 0 ... 250         | 0... 1,000       | 0... 1,500       | 0... 1,500       | 0... 1,500       | 0... 1,500       |
| ±5 %, typ.   | Hz                      | 0 ... 900         | 0 ... 2 000      | 0 ... 2 300      | 0 ... 2 700      | 0 ... 3 000      | 0 ... 3 500      |
| ±10 %, typ.  | Hz                      | 0 ... 1,000       | 0... 2,400       | 0... 3,000       | 0... 3,000       | 0... 3,500       | 0... 4,500       |
| ±3 dB, typ.  | Hz                      | 0 ... 1,150       | 0... 3,200       | 0... 4,000       | 0... 4,500       | 0... 5,000       | 0... 7,000       |
| Damping ratio, nom.  |                         | 0.7               |                  |                  |                  |                  |                  |
| Sensitivity, ±5 % (ref 100 Hz),<br>Output Type A, 0±4 V FSO output | mV/g                    | 2,000             | 400              | 133.3            | 80               | 40               | 20               |
| Output Type B, 2.5±2 V FSO output                                  | mV/g                    | 1,000             | 200              | 66.6             | 40               | 20               | 10               |
| Output Type C, 0±4 V FSO differential                              | mV/g                    | 2,000             | 400              | 133.3            | 80               | 40               | 20               |
| Output Type D, 0±8 V FSO differential                              | mV/g                    | 4,000             | 800              | 266.6            | 160              | 80               | 40               |
| Resonant frequency, nom.   | kHz                     | 1.2               | 3.2              | 5.2              | 6.5              | 8.5              | 11               |
| Transverse sensitivity, typ. (max.)                                | %                       | 1.0 (3.0)         |                  |                  |                  |                  |                  |
| Sensitive axis misalignment, typ. (max.)                           | mrاد                    | 10 (30)           |                  |                  |                  |                  |                  |
| Amplitude linearity, max.  | % FSO                   | ±0.3              |                  |                  |                  |                  |                  |
| Amplitude linearity, typ.  | % FSO                   | ±0.1              |                  |                  |                  |                  |                  |
| Phase shift (max.) @ 0 Hz  | degrees                 | 0                 |                  |                  |                  |                  |                  |
| @ 10 Hz  | degrees                 | 2                 |                  |                  |                  |                  |                  |
| @ 100 Hz   | degrees                 | 10                |                  |                  |                  |                  |                  |
| Noise density, 0 ... 100 Hz, typ. (max)                            | mg <sub>rms</sub> /√ Hz | 0.007<br>(0.0085) | 0.035<br>(0.042) | 0.105<br>(0.125) | 0.175<br>(0.210) | 0.350<br>(0.420) | 0.700<br>(0.840) |
| Noise 0 ... 100 Hz, typ.   | mg <sub>rms</sub>       | 0.070             | 0.350            | 1.050            | 1.750            | 3.500            | 7.000            |
| Resolution (threshold), typ.                                       | mg <sub>rms</sub>       | 0.100             | 0.500            | 1.470            | 2.450            | 4.900            | 9.800            |

### Electrical

|                                      |        |   |  |  |  |  |  |
|--------------------------------------|--------|---|--|--|--|--|--|
| 0 g output, output Type (A; B; C; D) | mV     | 0 ±60 (A); 2,500±30 (B); 0±60 (C); 0 ±120 (D)   |  |  |  |  |  |
| Capacitive load, max.                | μF     | 0.5   |  |  |  |  |  |
| Load resistance, min.                | kΩ     | 30  |  |  |  |  |  |
| Output impedance, typ.               | ohm    | 300   |  |  |  |  |  |
| Supply current, nom.                 | mA     | 12  |  |  |  |  |  |
| Supply voltage, temperature          | VDC    | 6 ... 50 (≤ 100 °C [210 °F]); 6 ... 35 (≤ 110 °C [230 °F]); 6 ... 20 (≤ 120 °C [250 °F]);<br>6 ... 12.5 (125 °C [260 °F]) |  |  |  |  |  |
| Reverse polarity protection          | yes/no | yes   |  |  |  |  |  |

### Environmental

|                                       |                    |                                     |                            |                             |                            |                          |                           |
|---------------------------------------|--------------------|-------------------------------------|----------------------------|-----------------------------|----------------------------|--------------------------|---------------------------|
| Shock, (half sine, 200 μs)            | g                  | 6,000                               |                            |                             |                            |                          |                           |
| Random, (20 ... 2,000 Hz)             | g <sub>rms</sub>   | 20                                  |                            |                             |                            |                          |                           |
| Storage temperature range             | °C [°F]            | -55 ... 125 [-65 ... 260]           |                            |                             |                            |                          |                           |
| Operating temperature range           | °C [°F]            | -55 ... 125 [-65 ... 260]           |                            |                             |                            |                          |                           |
| Temp. coeff. sensitivity, typ. (max.) | ppm/°C<br>[ppm/°F] | ±100 (±300)<br>[±55 (±165)]         |                            |                             |                            |                          |                           |
| Temp. coeff. sensitivity, typ. (max.) | %/°C<br>[%/°F]     | ±0.01 (±0.030)<br>[±0.006 (±0.017)] |                            |                             |                            |                          |                           |
| Temp. coeff. bias, typ. (max.)        | mg/°C<br>[mg/°F]   | ±0.1 (±0.8)<br>[±0.06 (±0.4)]       | ±0.5 (±4)<br>[±0.3 (±2.2)] | ±1.5 (±12)<br>[±0.8 (±6.6)] | ±2.5 (±20)<br>[±2.5 (±11)] | ±5 (±40)<br>[±2.8 (±22)] | ±10 (±80)<br>[±5.5 (±44)] |

NOTE: Operation of the sensor with supply voltage exceeding stated values at indicated temperatures will cause permanent damage to the sensor.  
 1 g = 9.80665 m/s<sup>2</sup>, 1 in = 25.4 mm, 1 gram = 0.03527 oz, 1 lbf-in = 0.1129 N·m

**Technical data (continued...)**

| Type  | Unit                   | 8396A2D0 | 8396A010 | 8396A030 | 8396A050             | 8396A100 | 8396A200 |
|---|------------------------|----------|----------|----------|----------------------|----------|----------|
| <b>Temperature sensor</b>                             |                        |          |          |          |                      |          |          |
| Output @ 20 °C<br>[68 °F]                             | V (E.U.)<br>[V (U.S.)] |          |          |          | 1.23<br>[1.23]       |          |          |
| Sensitivity   | mV/°C<br>[mV/°F]       |          |          |          | -4<br>[-2.2]         |          |          |
| Accuracy  | °C [°F]                |          |          |          | ±5 [±9]              |          |          |
| <b>Physical</b>                                       |                        |          |          |          |                      |          |          |
| Case  | type                   |          |          |          | Titanium             |          |          |
| Mounting  | type                   |          |          |          | 10-32 stud/adhesive  |          |          |
| Sealing   | type                   |          |          |          | Hermetically sealed  |          |          |
| Ground isolation                                      | yes/no                 |          |          |          | yes                  |          |          |
| Weight (excluding cable),<br>output type (A, B, C, D) | grams                  |          |          |          | 31 (A, B); 33 (C, D) |          |          |
| Cable length tolerance                                | m                      |          |          |          | ±0.1                 |          |          |

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### Application

Type 8396A... is an instrument grade triaxial accelerometer. As such, Type 8396A... is well-suited for a wide variety of R&D and OEM applications requiring precision measurements and packaging for demanding application and handling needs.

In particular, the sensor design is optimized for low frequency applications common to Aviation/Aerospace, Automotive, Civil Engineering Structures, Seismic, Railway and other R&D studies. In particular, Aviation/Aerospace ground and flight testing often evaluates dynamics and structural vibration to assess performance parameters, reliability and integrity. Automotive laboratory and road testing often evaluates system parameters such as vehicle ride, dynamics and structural analysis to assess performance parameters, reliability and durability. Civil engineering structures, such as bridges, often are evaluated for structural response to assess the integrity of the bridge to ensure safety. Seismic ground and structural testing is often performed to measure the effect of earthquakes and other natural phenomena. The differential versions are being used for railway comfort or conditional maintenance monitoring applications where halogen free cables are requested as well. Other R&D studies include human motion, robotics and platform motion control systems for example.

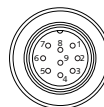
### Mounting

Reliable and accurate measurements require that the mounting surface be clean and flat. The accelerometer can be directly attached to the test structure with the supplied stud. Alternately, a ground isolated adhesive mount is obtained by mounting the hard anodized aluminum side of the sensor to the test object. Several optional accessories are offered to mount Type 8396A... Type 8466K01 has an integral 10-32 stud and screws into threaded hole on the sensor to provide a ground isolated adhesive mount. Type 8466K02 is similar to Type 8466K01 except it has a threaded 10-32 hole to provide a ground isolated stud mount. Type 8466K03 has an integral 10-32 stud and screws into threaded hole on the sensor and provides a magnetic mount for the sensor. The instruction manual for Type 8396A... provides detailed information regarding mounting surface preparation.

### Wiring - mating cable

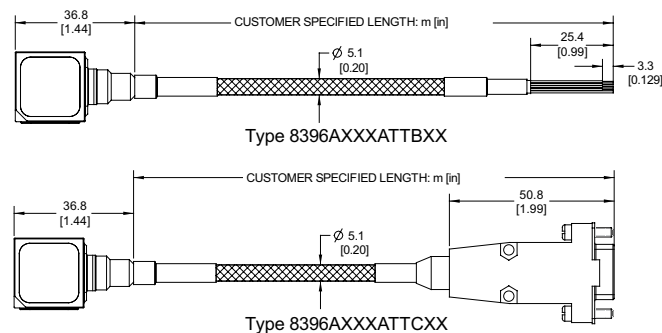
| Sensor connector | Function output |                 | Integral cable TB vrs. or cable Type 1792A... K00/KB00 | Integral cable TC vrs. or cable Type 1792A... K01/KB01 |
|------------------|-----------------|-----------------|--|--|
|                  | AT, BT version  | CT, DT versions | pigtail (color)  | 9 pin D-Sub  |
| 1                | Power           | Power           | Red  | 1  |
| 2*               | Ground          | Ground          | Black  | 2  |
| 3                | X DC output     | X DC output +   | White  | 3  |
| 4                | Y DC output     | Y DC output +   | Yellow   | 4  |
| 5                | Z DC output     | Z DC output +   | Blue   | 5  |
| 6                | Temp. output    | Temp. output    | Orange   | 9  |
| 7                | N/C             | X DC output -   | Brown  | 6  |
| 8                | N/C             | Y DC output -   | Green  | 7  |
| 9                | N/C             | Z DC output -   | Violet   | 8  |
| -                | Case            | Case            | Shield   | Shield   |

\* not connected to cable shield



9 pin circular male connector sensor view

### Integral cable solution



Dimensions specified in mm [in]

8396A\_003-325a-7.18

**Measuring chain**

| Measure                     | Connect   | Connect   | Analyze      |
|-----------------------------|---|---|--------------|
| Type 8396A... MEMS          | Type 1792A...K01<br>9 pin neg. circular<br>9 pin pos. D-Sub | Type 1794, 9 pin neg. D-Sub<br>(3) BNC pos. I (2) banana jacks<br>for output AT and BT only                   | not supplied |
| Type 8396A... MEMS          | Type 1792A...K00<br>9 pin neg. circular<br>pigtail          | customer supplied   | not supplied |
| Type 8396A...<br>15 up to 5 | Type 1792A...K01<br>9 pin neg. circular<br>9 pin pos. D-Sub | Type 5146A15<br>15 channels<br>power supply<br><br>Type 1511<br>BNC pos.<br>BNC pos.<br><br>customer supplied | Read-out     |

**Included accessories**

- 10-32 mounting stud
- Mounting wax

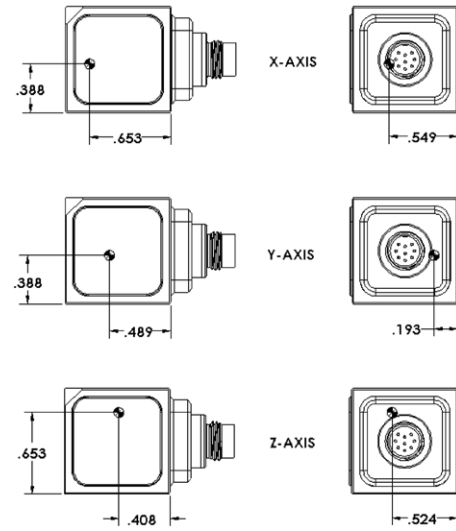
**Type/Art. No.**

- 8402
- 8432

**Optional accessories**

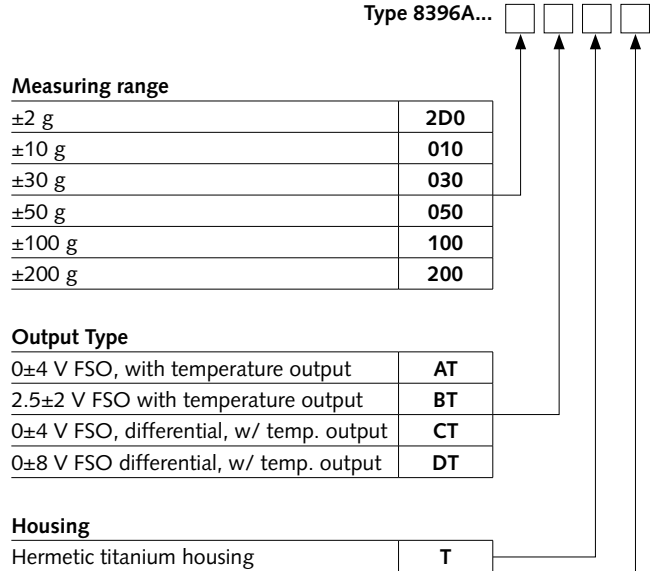
- Adhesive mounting base (off-ground) with 10-32 male sensor side **8466K01**
- Mounting base (off-ground) with 10-32 male sensor side to 10-32 female mounting side **8466K02**
- Magnetic mounting base **8466K03**
- Interface plate for compatibility with legacy Type 8393 mounting hole pattern **8466K04**
- Cable – mini 9 pin circular connector female, silicone jacket to pigtail (xx = length: 2, 5, or 10 meters – For other special length requests use 1792AK00sp) **1792AxxK00**
- Cable – mini 9 pin circular connector female, silicone jacket to 9 pin D-Sub (xx = length: 2, 5, or 10 meters – For other special length requests use 1792AK01sp) **1792AxxK01**
- 9 pin neg. D-Sub, (3) BNC pos. I (2) banana jacks (x = length: 2 meters – For other special length requests use 1794Asp) **1794Ax**
- Halogen-free cable – mini 9 pin circular connector female to pigtail (Length to be specified upon order) **1792AK10sp**
- Braided cable – mini 9 pin circular connector female, silicone jacket to pigtail (xx = length: 2, 5 or 10 meters – For other special length requests use 1792AKB00sp) **1792AxxKB00**
- Braided cable – mini 9 pin circular connector female, silicone jacket to 9 pin D-Sub (xx = length: 2, 5, or 10 meters – For other special length requests use 1792AKB01sp) **1792AxxKB01**

**Center of sensing elements**



Dimensions specified in mm [in]

**Ordering key**



**Electrical interface/cable length (m)**

|  |            |
|--|------------|
| Integral 9 pin connector   | <b>A00</b> |
| Integral PET cable, braided shield protection, pigtail (specify length up to 20 m)                           | <b>Bxx</b> |
| Integral PET cable, braided shield protection, 9 pin D-Sub connector termination (specify length up to 20 m) | <b>Cxx</b> |
| Integral silicone cable, pigtail termination (specify length up to 20 m)                                     | <b>Dxx</b> |
| Integral silicone cable, 9 pin male D-Sub connector termination (specify length up to 20 m)                  | <b>Exx</b> |

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