

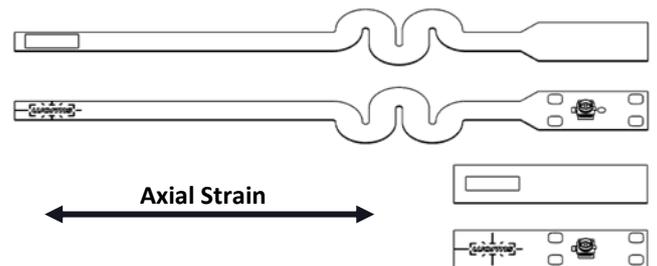
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Dragonfly[®] DGF-UNI-AA204xx-10

Piezoelectric unidirectional passive strain sensor

Description

The piezoelectric Dragonfly[®] sensor measures dynamic and quasistatic strain. The large bandwidth and high dynamic range enable an exceptionally wide scope of characterization with a single sensor.



Features

- Unidirectional strain sensor
- High sensitivity
- Low noise
- High dynamic range
- Wide frequency range
- Flexible & conformable
- Plug & Play
- No power supply required
- Lead-free

Sectors

- Energy
- Aerospace
- Automotive
- Robotics
- Civil Engineering
- Food Industry
- Healthcare
- Transportation
- Naval Industry
- Mining Industry

Applications

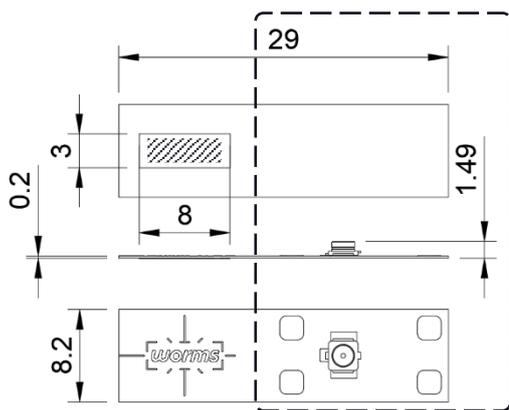
- Vibration analysis: diagnosis, modal analysis, product development, design validation, material characterization
- Monitoring (SHM, CBM): life-span optimization, predictive maintenance, decision making, tension rod surveillance, wear monitoring
- Event detection: shocks, crack initiation, fatigue failure, leaks, cavitation
- Quality and process control: in-operation control, safety, yield optimization
- Dynamic weighing, counting, load identification,
- Human-Machine Interfaces: touch sensitive hard surfaces, gesture recognition

Technical data

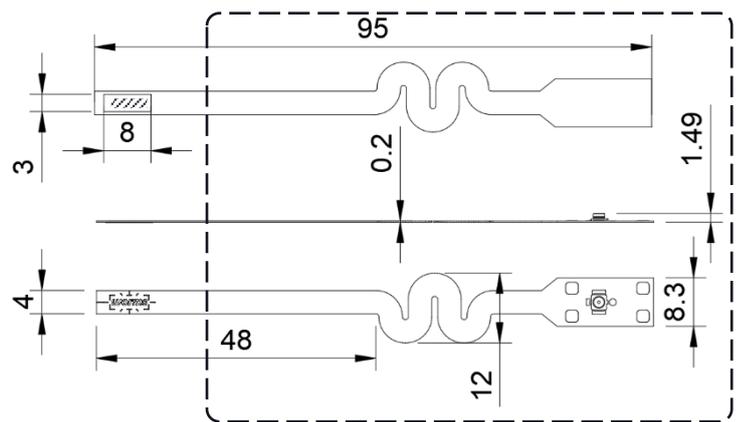
Conditions	Parameter	DGF-UNI-AA204xx-10	Units	
Piezo & Electrical	Temperature 25°C	Charge sensitivity	-17.0 ±10%	pC/με
	Temperature [-55°C to +40°C]	Temperature sensitivity	200±150	ppm/K
		Transverse sensitivity Kt	<4	%
		Measurement range	± 3000	με
	±500 με	Non-linearity	<1	%
	sinus @1kHz, 1Vp-p, 25°C	Operating temperature range	[-55 to +140]	°C
		Capacitance Cp	6.3 ±20%	nF
		Parallel resistance Rp	>50	MΩ
		Series resistance Rs	<1	Ω
	DAQ: Kistler 5167A charge amplifier	Bandwidth	[<0.01 to >45k]	Hz
RMS noise [0.1 to 10] Hz		3.4 ⁽¹⁾	nε	
RMS noise [10 to 20k] Hz		5.0 ⁽¹⁾	nε	
General parameters	±1000 με	Fatigue life	>8x10 ⁶	Cycles
		Weight	0.1	g
		Connector	UFL / IPEX1	
Absolute Max. ratings		Maximum voltage	30	V
	Exposure duration 4h	Maximum temperature	150	°C
	Sensing area	Minimum bending radius	2	cm

(1) Dragonfly® noise is several orders of magnitude below DAQ noise. Thus, the measured noise corresponds to the DAQ input noise. Noise has been measured in a controlled environment. Measured values could vary depending on DAQ and measurement environment.

Dimensions (mm)



DGF-UNI-AA20405-10



DGF-UNI-AA20406-10

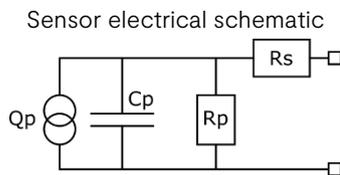
□ Handling area ▨ Sensing area

Handling Recommendations

- It is highly recommended to refer to the Dragonfly® User Manual for the installation: <https://www.wormsensing.com/downloads>
- Avoid contact with the sensing area before mounting. Manipulate the device using the recommended handling area.
- Avoid bending or applying localized pressure to the sensor.

Electrical model

The sensor behaves as a charge generator Q_p , in parallel with a capacitor C_p and a leakage resistor R_p . The internal wiring adds a small series resistor R_s .



Signal conditioning & bandwidth

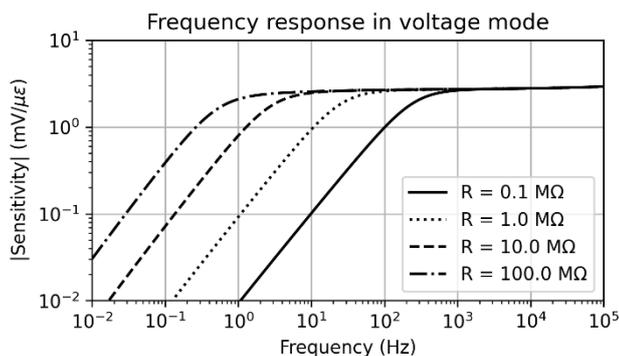
The sensor is passive and does not require any power supply. It can be operated either in charge or voltage mode depending on the application.

Charge mode (using a charge amplifier):

Charge mode is highly recommended for very low frequency measurements. The cut-off frequency is determined by the charge amplifier itself and can be as low as 0.01 Hz.

Voltage mode (direct measurement):

The acquisition device's finite input impedance R will limit the minimum measurable frequency.



Sensitivity

The Dragonfly® sensitivity is calibrated by a 4-point bending test on a steel bar with a Poisson's ratio $\nu_0 = 0.27$.

The transverse sensitivity ratio K_t is the ratio of the sensitivity in the transverse direction over the sensitivity in the axial direction.

The Dragonfly® output signal in a bi-axial strain used either in charge or voltage mode is given by the following equation:

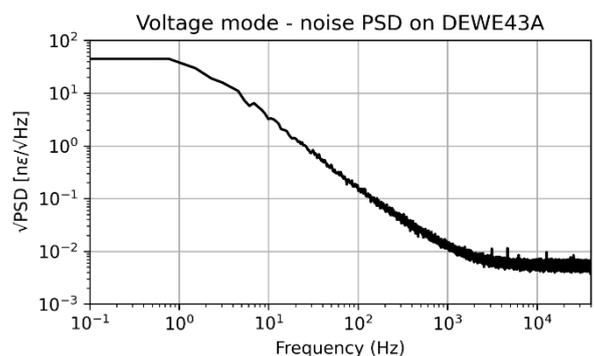
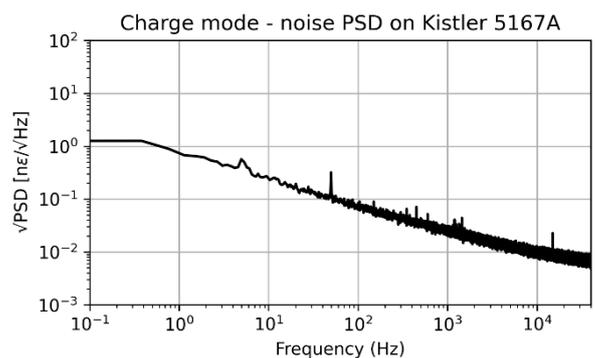
$$\text{output} = \frac{s}{1 - K_t \nu_0} (\epsilon_a + K_t \epsilon_t)$$

- s = sensitivity
- K_t = transverse sensitivity ratio
- $\nu_0 = 0.27$
- ϵ_a = axial strain
- ϵ_t = transverse strain

Minimal measurable strain

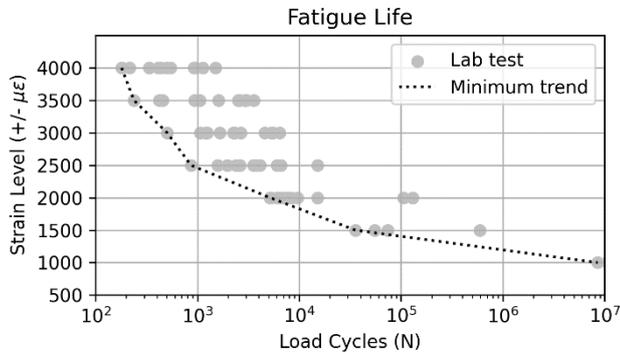
The minimal measurable strain depends on the acquisition system noise PSD integrated over its bandwidth. In both charge and voltage mode, the noise at low frequency is driven by 1/f flicker noise.

- The wider the bandwidth, the higher the RMS noise.
- The lower the cutoff frequency, the higher the RMS noise.



Fatigue life

The minimal number of load cycles that Dragonfly® can withstand depends on the applied dynamic strain level. The sensor is considered to have failed if its sensitivity is outside of the specifications.

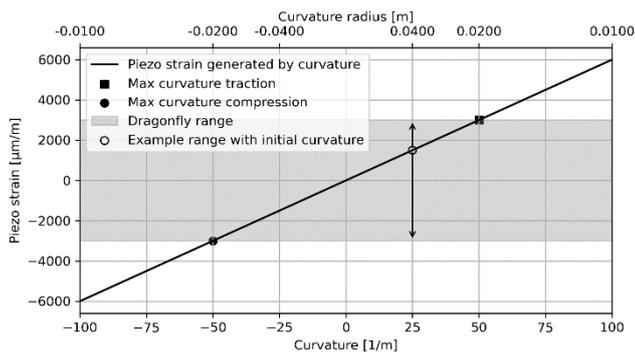


Bending radius

Static bending applied to Dragonfly® impacts its measurement range. The sensitive element is designed to sustain ±3000 µε and static bending induces a static strain which added to the dynamic strain must not exceed ±3000 µε.

The following figure shows static strain vs. bending radius with an example of the available measurement range for a 40 mm static bending radius.

Positive bending radius means Dragonfly® is glued on a concave surface.



Reference selection

The below nomenclature helps you select the correct reference among all Dragonfly® product family:

DGF-UNI-iic04ff-xx

