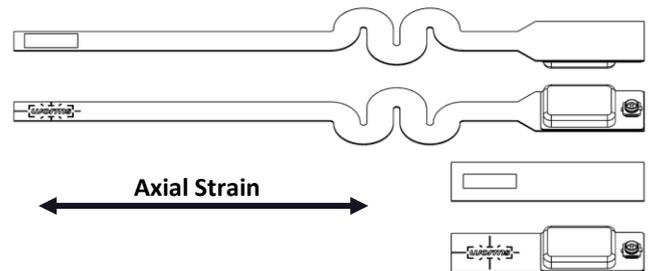


worms

Dragonfly® DGF-UNI-Wx204xx-10 Piezoelectric unidirectional IEPE 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
- Compatible with all IEPE acquisition systems
- Low noise operation over long cable length
- Lead-free

Sectors

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

Applications

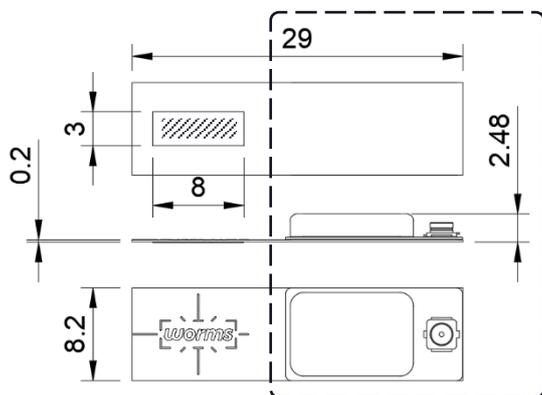
- Vibration analysis: diagnosis, modal analysis, product development, design validation, material characterization
- Monitoring (SHM, CBM): life-span optimization, predictive maintenance, decision making, tension rod surveillance, wear monitoring
- Event detection: shocks, crack initiation, fatigue failure, 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

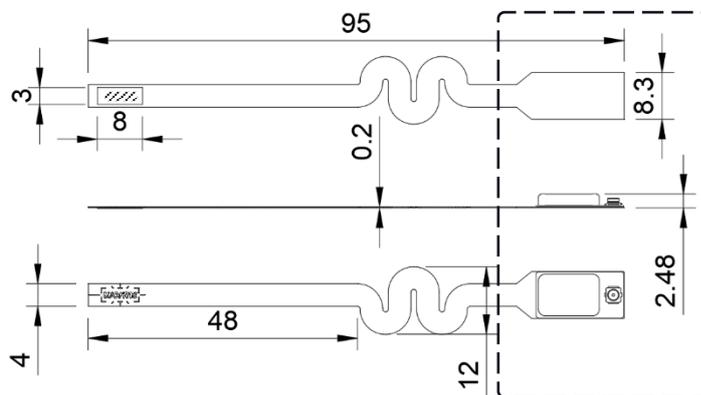
	Conditions	Parameter	DGF-UNI-	DGF-UNI-	DGF-UNI-	Units
			W1204xx-10	W2204xx-10	W3204xx-10	
Piezo & Electrical	Temperature 25°C	Sensitivity	+1.08 ±10%	+10.8 ±10%	+108 ±10%	mV/με
	Temperature [-55°C to +40°C]	Temperature sensitivity	210±150	240±150	500±150	ppm/K
		Transverse sensitivity Kt	<4	<4	<4	%
	±500 με	Measurement range	±3000	±500	±50	με
		Non-linearity	<1	<1	<1	%
		Operating temperature range	[-55 to +125]	[-55 to +125]	[-55 to +125]	°C
	sinus @1kHz, 0.1Vp-p, 25°C	Bandwidth	[0.02 to >100k]	[0.04 to >100k]	[0.4 to 80k]	Hz
		Discharge time constant	50	25	2.5	s
		Constant current bias	[2 to 20]	[2 to 20]	[2 to 20]	mA
		Voltage compliance	[18 to 24]	[18 to 24]	[18 to 24]	V
		Equivalent capacitance Ceq	4.53 ±14%	1.255 ±4%	0.1607 ±0.4%	nF
		RMS noise [0.02 to 10] Hz	27 ⁽¹⁾	12 ⁽¹⁾	4 ⁽¹⁾	nε
		RMS noise [10 to 20k] Hz	15 ⁽¹⁾	5 ⁽¹⁾	4 ⁽¹⁾	nε
		Spectral noise (1 Hz)	5300 ⁽¹⁾	1900 ⁽¹⁾	1500 ⁽¹⁾	pε/VHz
		Spectral noise (10 Hz)	1700 ⁽¹⁾	570 ⁽¹⁾	460 ⁽¹⁾	pε/VHz
		Spectral noise (100 Hz)	520 ⁽¹⁾	180 ⁽¹⁾	150 ⁽¹⁾	pε/VHz
	Constant current bias 4 mA	Spectral noise (1 kHz)	170 ⁽¹⁾	60 ⁽¹⁾	50 ⁽¹⁾	pε/VHz
Spectral noise (10 kHz)		52 ⁽¹⁾	18 ⁽¹⁾	15 ⁽¹⁾	pε/VHz	
Output bias voltage		12.0 ±2	12.0 ±2	12.0 ±2	V	
Output impedance (>1 kHz)		<30	<30	<30	Ω	
General parameters	±1000 με	Fatigue life		>8x10 ⁶	Cycles	
		Weight		0.7	g	
		Connector		UFL / IPEX1		
Absolute Max. ratings		Maximum voltage		30	V	
		Maximum current		30	mA	
	Exposure duration 4h	Maximum temperature		150	°C	
	Sensing area	Minimum bending radius		2	cm	

(1) Noise has been measured in a controlled environment. Measured values could vary depending on DAQ and measurement environment.

Dimensions (mm)



DGF-UNI-Wx20405-10



DGF-UNI-Wx20406-10

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.

Signal conditioning & bandwidth

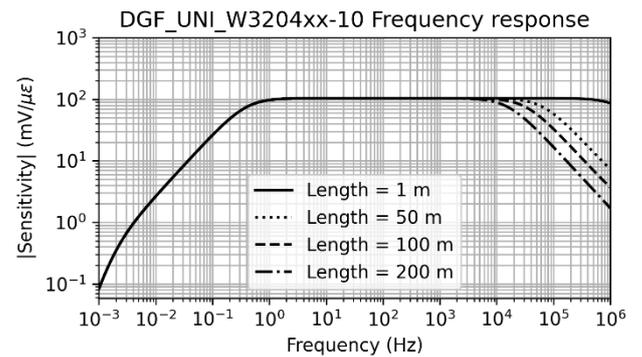
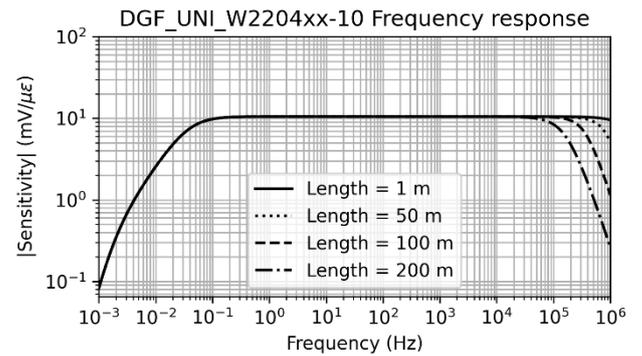
Dragonfly® IEPE complies with all acquisition systems with IEPE inputs. For acquisition systems without IEPE inputs, external IEPE conditioners are available on the market.

Dragonfly® IEPE extends the passive Dragonfly® frequency response to very low frequencies with efficient immunity to EMI and triboelectric noise over long cable lengths.

Unlike the passive version, the Dragonfly® IEPE bandwidth does not depend on the acquisition system impedance.

The bandwidth is still influenced by two elements:

- The acquisition system low cutoff frequency: the highest cutoff frequency between Dragonfly® IEPE and the acquisition system will determine the bandwidth's lower bound.
- Coaxial cable length: very long cables will reduce the bandwidth's higher bound. Refer to the plot below to determine the Dragonfly® IEPE frequency response vs. cable length.



Sensitivity

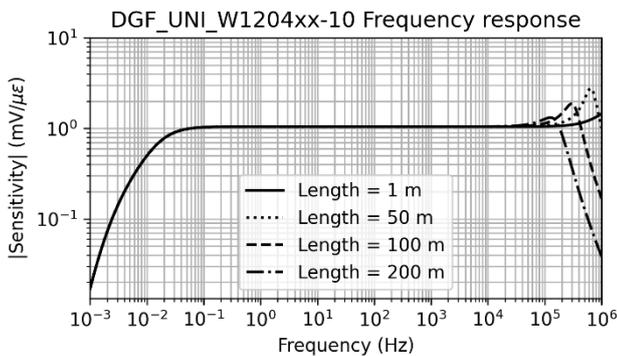
The Dragonfly® sensitivity is calibrated by a 4-point bending test on a steel bar with a Poisson's ratio $\nu_0 = 0.27$.

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

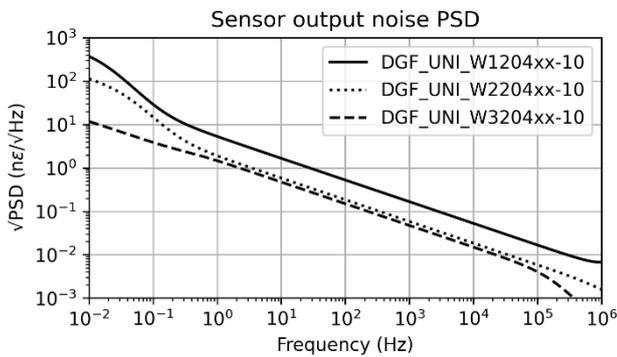


Minimal measurable strain

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.

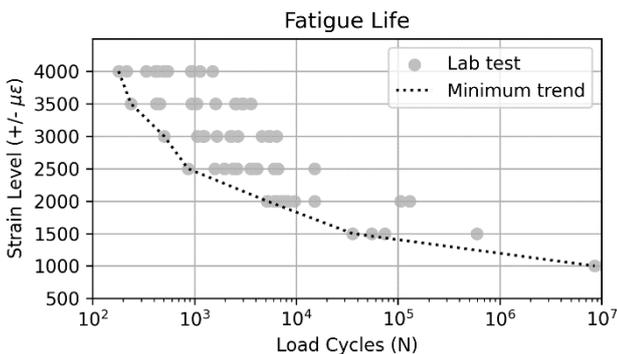
- The wider the bandwidth, the higher the RMS noise.
- The lower the cutoff frequency, the higher the RMS noise.

Refer to the plot below to determine the Dragonfly® IEPE output noise PSD:



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.

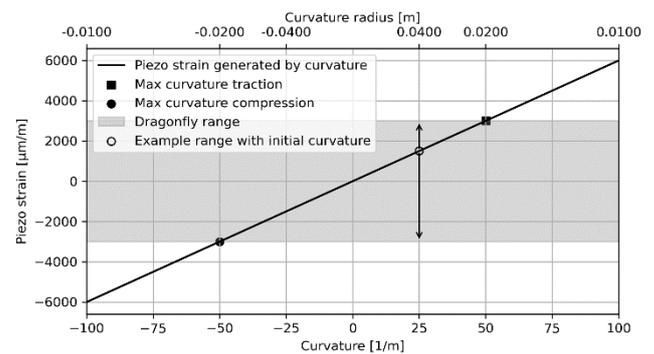


Bending radius

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

