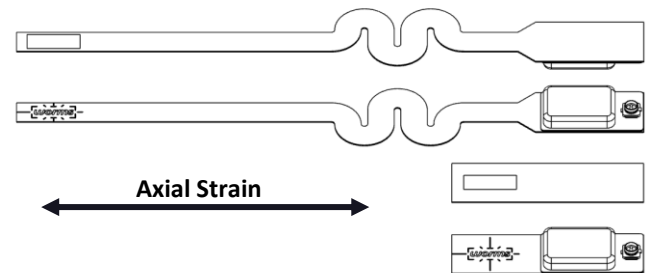# worms

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.

Axial Strain

REACH   RoHS   CE

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
- Industry 4.0
- 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-W1204xx-10	DGF-UNI-W2204xx-10	DGF-UNI-W3204xx-10	Units
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	%
	Measurement range	±3000	±500	±50	µε
	Non-linearity	<1	<1	<1	%
	Operating temperature range	[−55 to +125]	[−55 to +125]	[−55 to +125]	°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
sinus @1kHz, 0.1Vp-p, 25°C	Check capacitance Ceq	4.53 ±8%	1.255 ±3%	0.1607 ±1.5%	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/√Hz
	Spectral noise (10 Hz)	1700[1]	570[1]	460[1]	pε/√Hz
Constant current bias 4 mA	Spectral noise (100 Hz)	520[1]	180[1]	150[1]	pε/√Hz
	Spectral noise (1 kHz)	170[1]	60[1]	50[1]	pε/√Hz
	Spectral noise (10 kHz)	52[1]	18[1]	15[1]	pε/√Hz
	Output bias voltage	12.0 ±2	12.0 ±2	12.0 ±2	V
	Output impedance (>1kHz)	<30	<30	<30	Ohms

(Piezo & Electrical)

Conditions	Parameter	Value	Units
±1000 µε	Fatigue life	>8M	Cycles
	Weight	0.7	g
	Connector	UFL / IPEX1	

(General parameters)

Conditions	Parameter	Value	Units
	Maximum voltage	30	V
	Maximum current	30	mA
Exposure duration 4h	Maximum temperature	150	°C
	Minimum bending radius	2	cm

(Absolute Max. ratings)

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

Dimensions (mm)
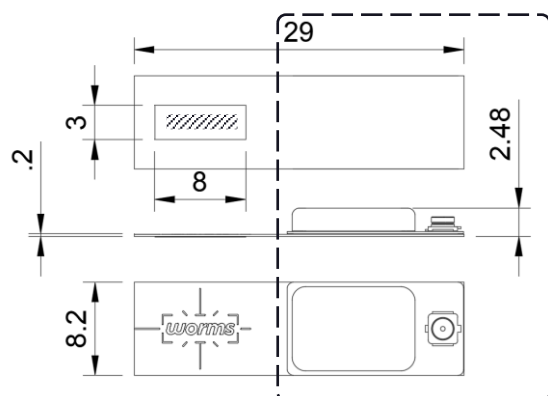
DGF-UNI-Wx20405-10
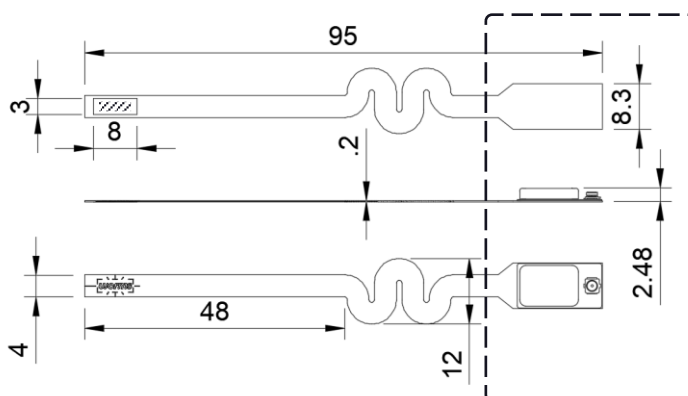
DGF-UNI-Wx20406-10

⌷ Handling area   ▨ Active area

Handling Recommendations

- It is highly recommended to refer to the Dragonfly® User Manual for the installation: http://www.wormsensing.com/downloads
- Avoid contact with the active 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.

DGF_UNI_W2204xx-10 Frequency response

DGF_UNI_W3204xx-10 Frequency response

DGF_UNI_W1204xx-10 Frequency response
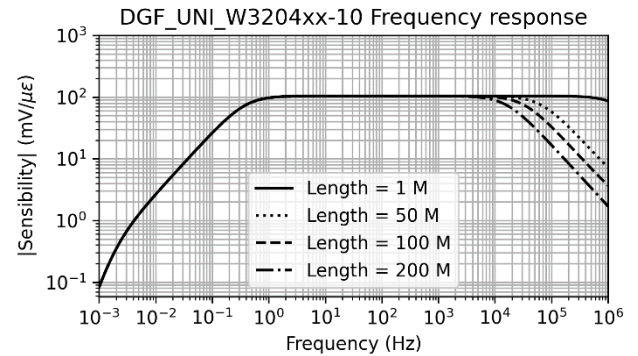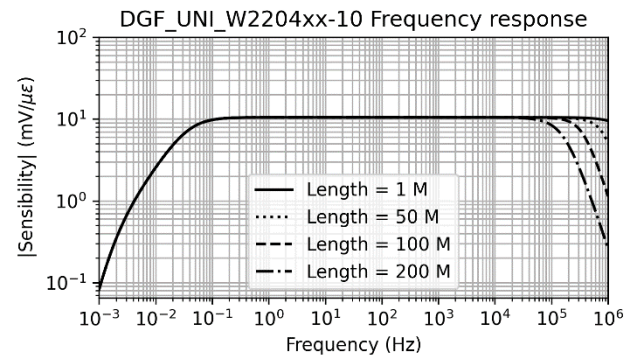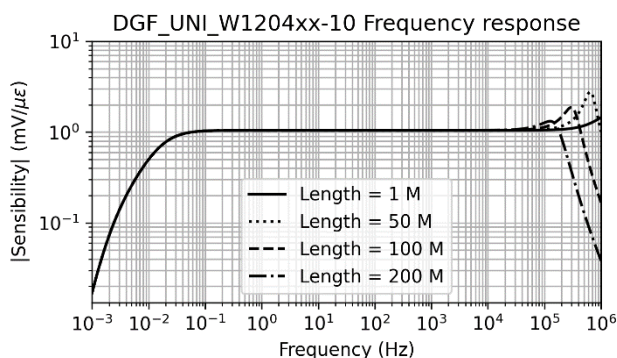
Sensitivity

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 Kt 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
Kt = transverse sensitivity ratio
ν_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:
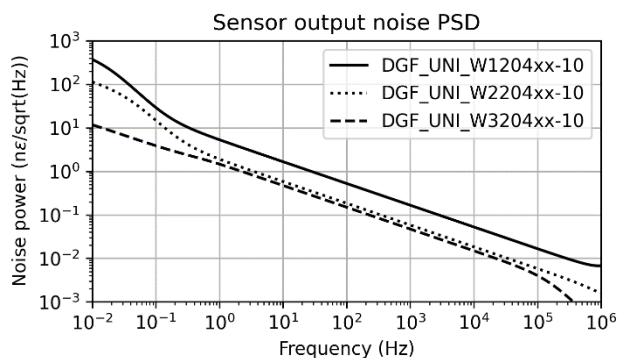
Fatigue life

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.
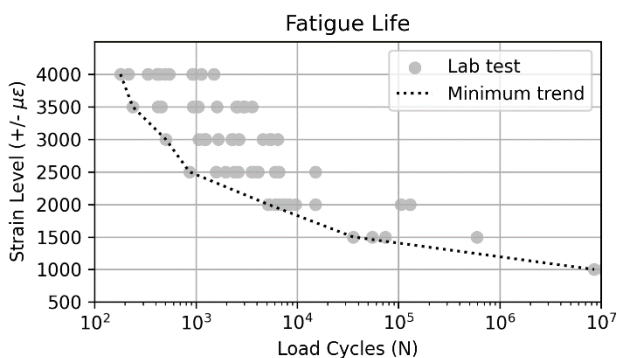

Bending radius

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 40mm static bending radius.

Positive bending radius means Dragonfly® is stuck on a concave surface.
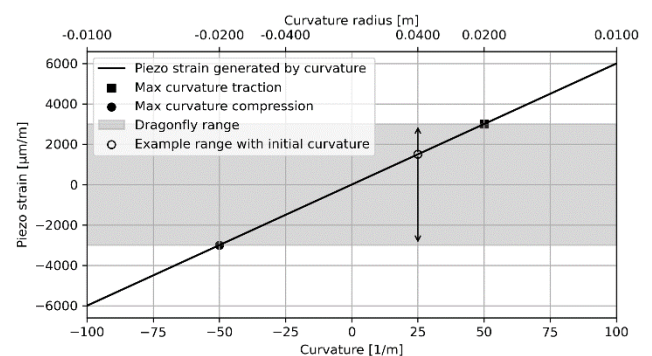
Reference selection

The below nomenclature helps you select the correct reference:

DGF-UNI-ii204ff-10

ii		ff	
Interface type		**Flex size**	
AA	Passive	05	short
W1	IEPE 1mV/µε	06	long
W2	IEPE 10mV/µε		
W3	IEPE 100mV/µε		