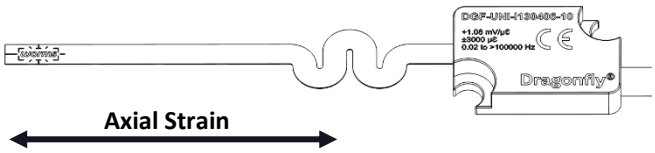
Dragonfly® IO DGF-UNI-Ix304xx-10
Industrial grade
piezoelectric unidirectional strain sensor

Description

Dragonfly® IO offers the same exceptional features as Dragonfly® IEPE products, while also being robust enough for industrial environments. Dragonfly® IO's exceptional bandwidth and dynamic range makes it an undeniable asset for monitoring machines and processes in Industry 4.0.



Axial Strain

REACH RoHS CE IP67

Features

- Unidirectional strain sensor
- High sensitivity
- Low noise
- High dynamic range
- Wide frequency range
- Plug & Play
- IP67
- Compatible with all IEPE acquisition systems
- Sustain long cable length
- Lead-free

Sectors

- Industry 4.0
- Manufacturing
- Transportation
- Food Industry
- Energy
- Mining Industry
- Naval Industry
- Aerospace
- Civil Engineering
- Pharmaceutical Industry
- Robotics

Applications

- Quality and process control: milling, turning, drilling, load monitoring, yield optimization
- Monitoring (SHM, CBM): life-span optimization, predictive maintenance, decision making, wear monitoring
- Event detection: shocks, crack initiation, fatigue failure, leaks, cavitation
- Dynamic weighing, counting, load identification

Technical data

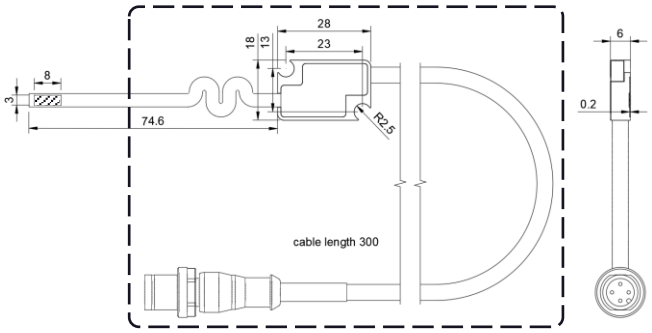
	Conditions	Parameter	DGF-UNI-I1304xx-10	DGF-UNI-I2304xx-10	DGF-UNI-I3304xx-10	Units
Piezo & Electrical	Temperature 25°C	Sensitivity	+1.08 ±10%	+10.8 ±10%	+108 ±10%	mV/με
	Temperature [-55°C to +40°C]	Temperature sensitivity	210±150	240±150	500±150	ppm/K
		Transverse sensitivity |Kt|	<4	<4	<4	%
		Measurement range	±3000	±500	±50	με
	±500 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	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/√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 (>1 kHz)	<30	<30	<30	Ω

General parameters	±1000 με	Fatigue life	>8x10⁶	Cycles
		Weight	36	g
		Connector	M12 coding A	
		IP rating	IP67	

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

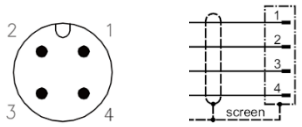
(1) Noise has been measured in a controlled environment. Measured values could vary depending on DAQ and measurement environment.

Dimensions (mm)



Handling area Sensing area

Pinout



Shielded M12 - 4 pins male - coding A

Pin N°	Function	Wire color
1	Not connected	Brown
2	IEPE signal	White
3	IEPE ground	Blue
4	Not connected	Black

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

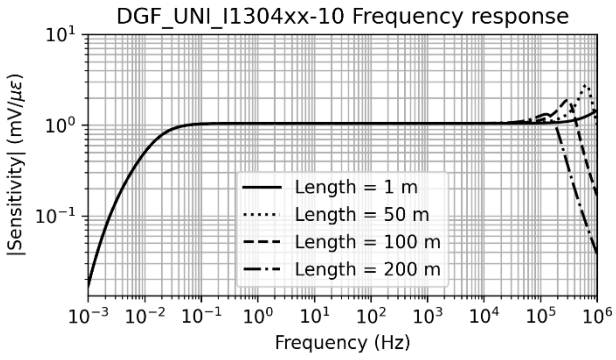
Dragonfly® IO complies with all acquisition systems with IEPE inputs. For acquisition systems without IEPE inputs, external IEPE conditioners are available on the market.

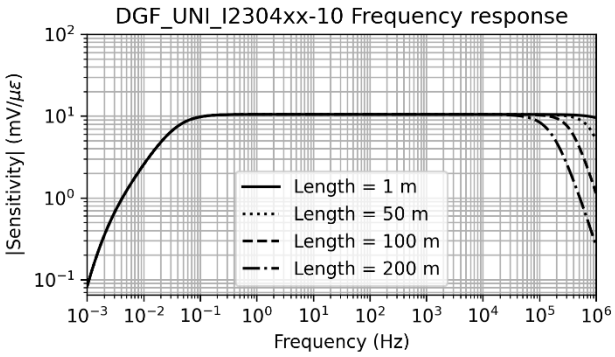
Dragonfly® IO extends the passive Dragonfly® frequency response to very low frequencies with efficient immunity to EMI and triboelectric noise over long cable lengths.

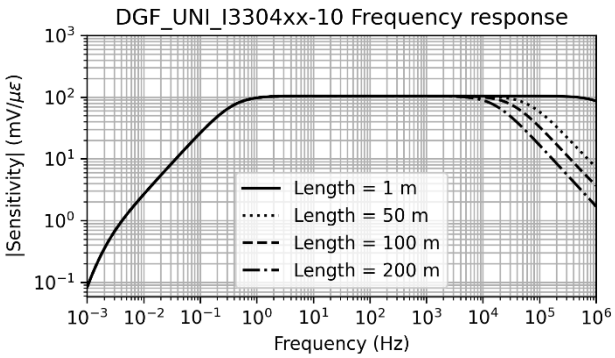
Unlike the passive version, the Dragonfly® IO bandwidth does not depend on the acquisition system impedance.

The bandwidth is still influenced by two elements:

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

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

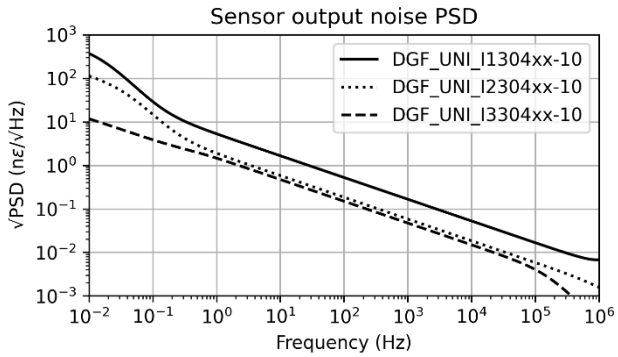
s = sensitivity
Kt = transverse sensitivity ratio
ν_0 = 0.27
ϵ_a = axial strain
ϵ_t = transverse strain

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.

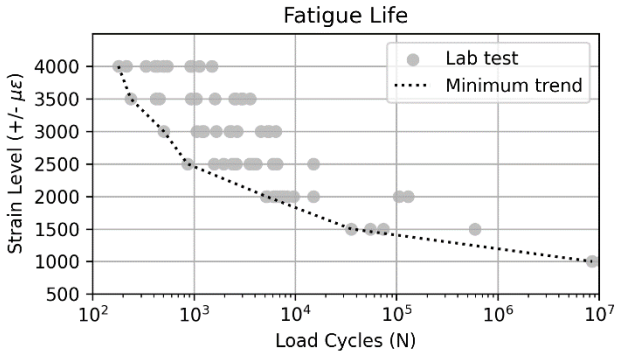
- The wider the bandwidth, the higher the RMS noise.
- The lower the cutoff frequency, the higher the RMS noise.

Refer to the plot below to determine the Dragonfly®IO 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.

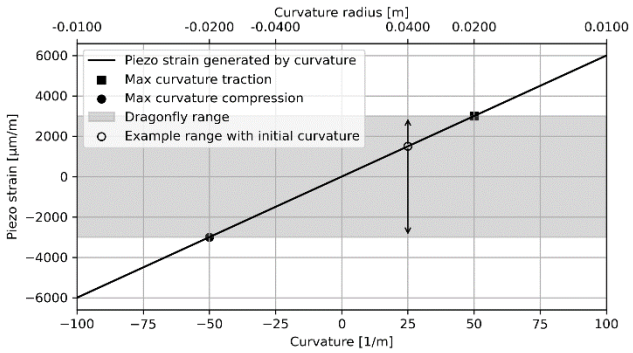


Bending radius

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

ii		c		ff	
Interface type		**Connector type**		**Flex size**	
AA	Passive	2	U.FL	05	short
W1	IEPE 1.08 mV/με	3	M12	06	long
W2	IEPE 10.8 mV/με				
W3	IEPE 108 mV/με				
I1	Industrial IEPE 1.08 mV/με				
I2	Industrial IEPE 10.8 mV/με				
I3	Industrial IEPE 108 mV/με				