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TECHNICAL DATASHEET

plyon® flex sensors
Version 4.1, October 2021

1. Introduction

Key Features

- Resistive (Force), Capacitive (Touch) and Hybrid Readout
- Excellent Signal Integrity under Bending
- Highly Customizable Layers
- Small, Thin and Durable
- Simple Electrical Interface

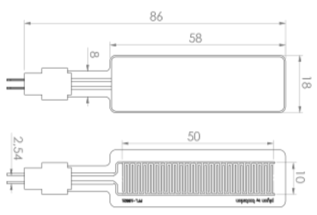
The plyon® platform is a capacitive-resistive, touch and force sensor based on a versatile layered architecture. It is a new approach to how physically and functionally unique sensor modules can be designed, produced, and integrated.

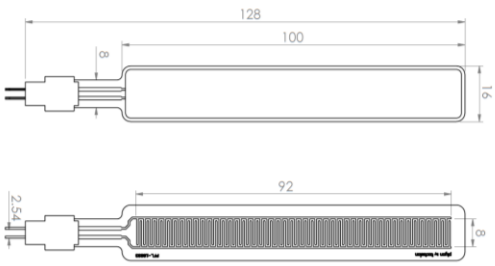
Our modules offer an incredible range of problem-solving potential in the fields of robotics, body tracking and direct human-machine-interactions.

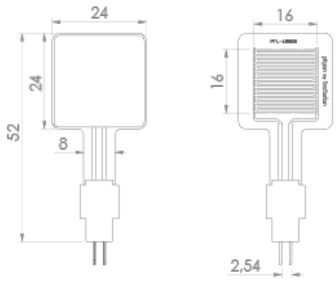
The technical information contained herein is believed to be accurate as of the date hereof. Please note that the delivered sensor is a pre-series model. Hence, its characteristics may vary from the ones shown in this datasheet.
As conditions and methods of use of the product are beyond our control, and since the information contained herein may to a certain extent differ depending on the respective conditions of use and/or measurement methods applied, we expressly disclaim any and all liability as to any results obtained or arising from any use of the product or reliance on the information contained herein. No warranty of fitness for any particular purpose, warranty of merchantability or any other warranty, express or implied, is made concerning the products described or the information provided herein.

2. General Specifications

Physical properties	Value
Product line:	plyon® flex
Sensor generation:	Tiger
Size of tactile elements[a]:	Min 3 x 3 mm I 0.12 x 0.12 in Max 100 x 100 mm I 3.94 x 3.94 in
Sensor thickness[b]:	~0.5 mm I 0.0197 in
Surface materials:	Silicone Elastomer / PET
Electrical termination:	Exposed flex tail – 1 mm I 0.02 in pitch FFC Connector – 2.54 mm I 0.1 in pitch
Material compatibility:	Typical material compatibility of PET films and silicones needs to be considered.

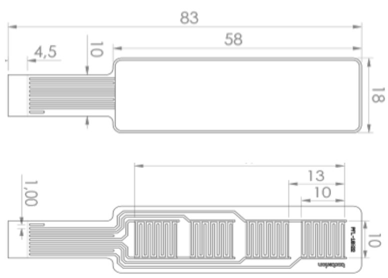


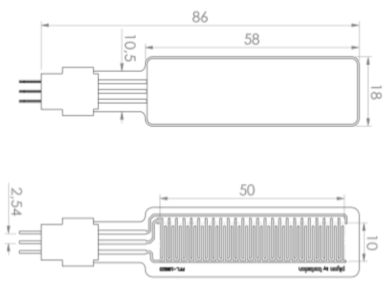




Dimensions reported in mm

plyon® Medium PFL-10021	plyon® Stripe PFL- 10033	plyon® Square PFL-10020





Dimensions reported in mm

plyon® Array PFL-10022	plyon® Slider PFL-10023

[a] *For custom size and shape please contact us.*
[b] *This document reports the results for a standard sensor with a ~0.5 mm thickness.*

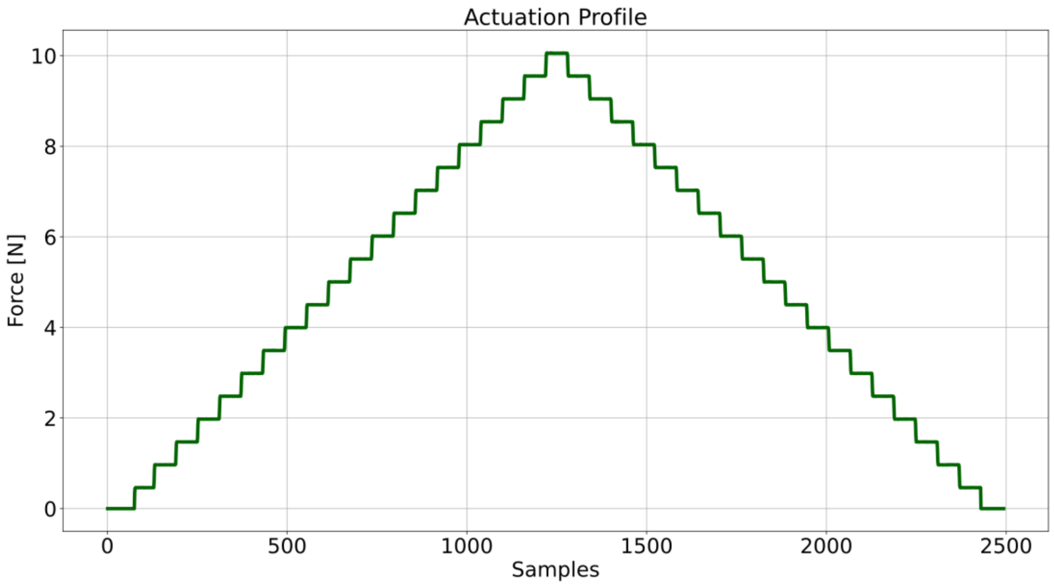
3. Sensor Characteristics

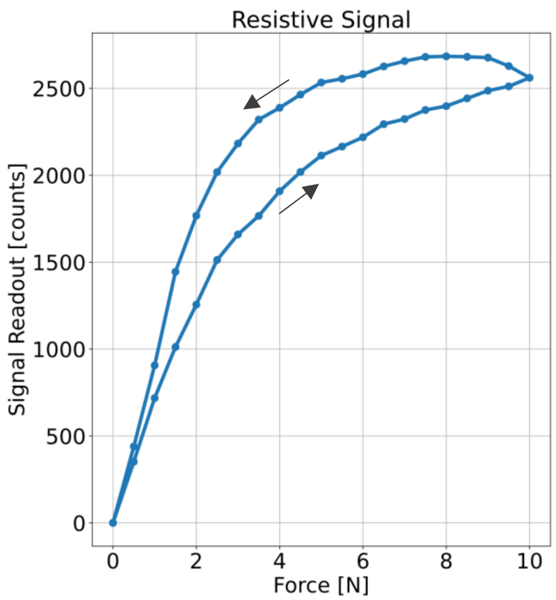
Device Characteristics[c]	Resistive	Hybrid	**Notes**
Minimal detectable force[d]:	0.5 N cm^{-2}	0.1 N cm^{-2}	
Measurement range[d]:	[0.5, 20] N cm^{-2}	[0.1, 20] N cm^{-2}	
Overforce tolerance[d]:	1 kN cm^{-2}	-	
Non-actuated resistance:	>50 MΩ	-	
Resistance range[d]:	[1, 5000] kΩ	-	
Operating voltage range:	≤5 V	≤5 V	Higher voltage capable with potential reduction of lifetime
Rise time:	≤5 µs	-	Measured with drop of steel ball and recorded with oscilloscope
Single-point repeatability:	±12.2 %	±2.0 %	Variation in response (std. dev. / mean) for 5000 actuation cycles at 4 N
Part-to-part repeatability:	9.1 %	-	Variation in response (std. dev. / mean) at 4 N
Durability:	>5 M Cycles	>5 M Cycles	Indentation with 5 N at a frequency of 2.5 Hz. Actuation area of 0.8 cm^2
Static loading:	-5.8 %	+4.3 %	Change in response after 10 h at 4 N
Hysteresis:	13.3 %	2.9 %	Calculated at 80 % of the full-scale range
Drift:	<20% log_{10}(min)	<0.2% log_{10}(min)	Average change in response, calculated for 10 h at 4 N
High temperature storage:	+39.8 %	-20.5 %	Change in response after 120 h at 85 °C
Low temperature storage:	-31 %	-3.2 %	Change in response after 120 h at -40 °C
High humidity / high temperature storage:	+49.3 %	+34.9 %	Change in response after 120 h at 85 °C and 85 %RH
Thermal shock:	-33.6 %	-20.3 %	Change in response after 10 cycles [-20 °C to 70 °C]
Temperature sensitivity[e]:	+1.10 %/°C	+0.34 %/°C	Change in response in the operating range [-5 °C to 80 °C]

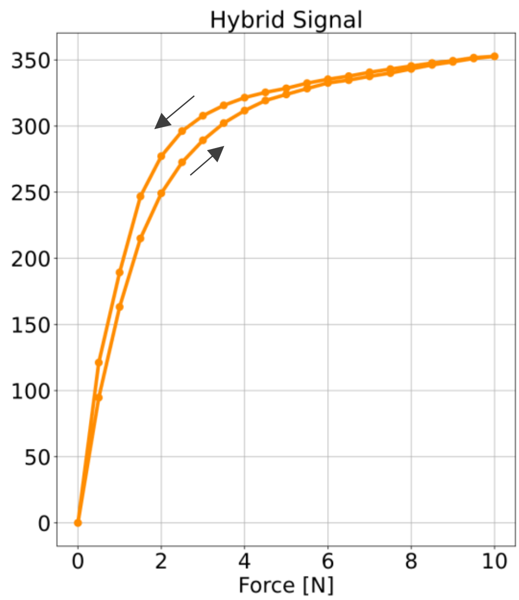
[c] *Tests were conducted with a cylindrical Nylon (MC901) contact part of 8 mm diameter, resulting in an actuation area of 0.5 cm^2.*
[d] *Dependent on several factors, such as geometry and readout electronics.*
[e] *Calculated in the stated operating range, operating temperatures outside this range require further characterization.*

4. Sensor Performance

a. Signal Readout-Force





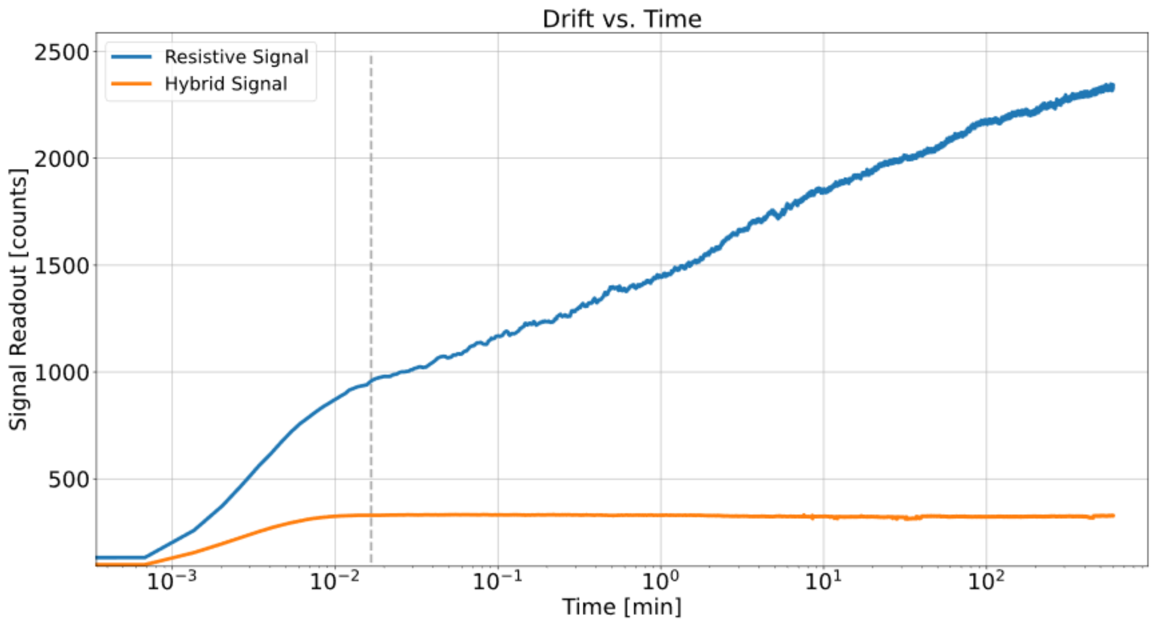


The sensor signal is determined for stepwise increasing/decreasing force levels ranging from 0 N to 10 N with 0.5 N force steps according to the depicted actuation profile.

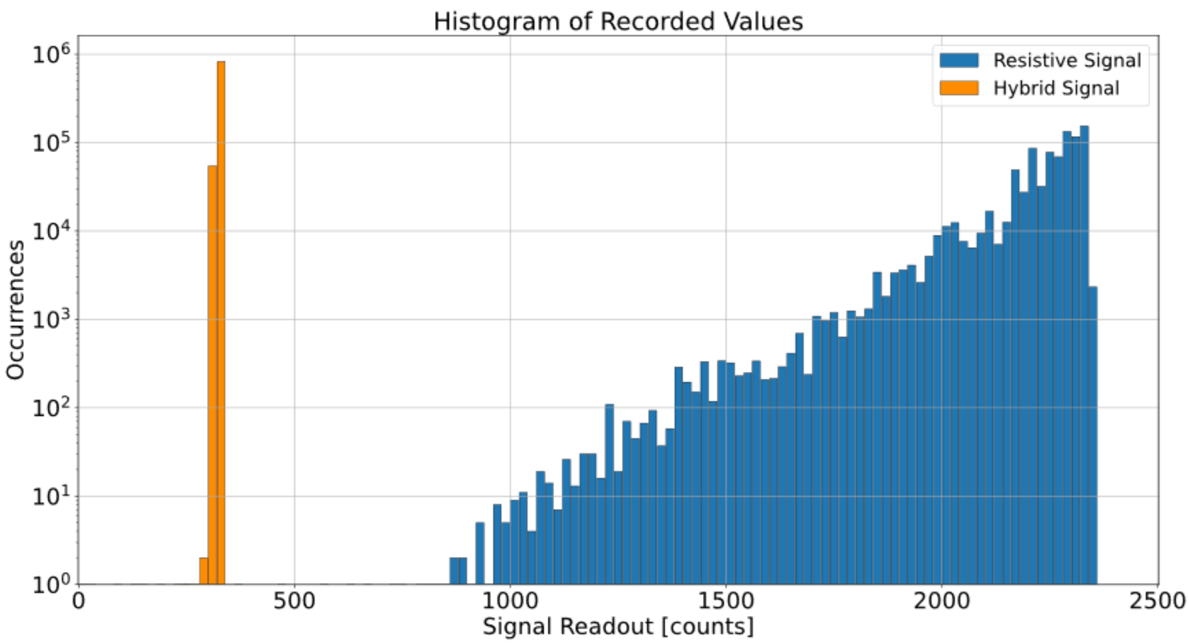
The sensor response is measured through the EBS-10010 electronics and the readout values obtained are plotted against the force exhibited at each step. For this purpose, an average of the readout values recorded within each force step is determined.

b. Signal Drift

The resistive as well as the hybrid readout signals have been recorded for 10 hours of actuation with a constant load of 4 N. The results are shown in the following plot, where the 1 second mark is indicated by a vertical dashed line.



The values of both readout signals are furhter depicted as histograms with identical bin sizes. Only samples recored 1 second after the actuation is initiated are included in the plot.

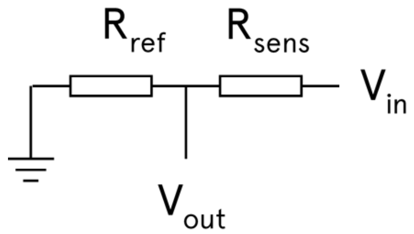


5. Readout Circuits

In the following two possible sensor readout circuits are suggested.

Note that all measurements presented in this datasheet were recorded using the EBS-10010 electronics, which is based on the voltage divider configuration.

a. Voltage divider

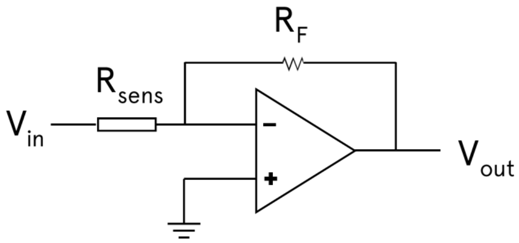


A voltage divider configuration is the simplest readout circuit to determine sensor resistance. Given that R_{ref} and V_{in} are known, the sensor resistance R_{sens} can be calculated by measuring the voltage drop V_{out} across the reference resistor R_{ref}.

The output voltage can be expressed as:

$$V_{out} = \frac{V_{in} \cdot R_{ref}}{R_{ref} + R_{sens}}$$

b. Transimpedance Amplifier (I-V converter)



A transimpedance amplifier (TIA) converts the current flowing through the sensor (V_{in}/R_{sens}) to a voltage signal (V_{out}), providing a more ideal transfer function than a voltage divider.

Under the assumption of an ideal op-amp, the output voltage is calculated as:

$$V_{out} = -V_{in} \cdot \frac{R_F}{R_{sens}}$$