3-Axis Force Sensor

pressure and shear in one thin sensor

A printed piezoresistive sensor, 0.8–1.5 mm thin, that measures normal force and the sideways shear force at the same time. Its four sensing regions give the force vector (Fx, Fy, Fz) and the centre of force from one part, read straight into any microcontroller ADC.



3 axes
Fx, Fy, Fz + centre of force

0.8–1.5 mm
total thickness

0.1–140 N
standard range, up to 200 N custom

2 ms
response time

2 Million +
load cycles tested

R² 0.99
linearity, ≤ 5% hysteresis

HOW IT WORKS

1 · Four regions
Four printed regions share one active area. Each region's resistance falls as force on it rises.

2 · Force vector
Normal force loads all regions; shear loads them unevenly. The difference gives the direction and size of the shear.

3 · Any chip
Five wires (four regions + common) into a voltage divider and the ADC of any microcontroller. No camera, no PC.

FEATURES

- Measures shear as well as pressure, so a slip can be seen before the object moves
- Thin and flexible: fits fingertips, gripper pads, insoles and footplates
- Linear output with repeatable readings (2% single part)
- Custom size, thickness, force range and connector
- Low cost to make: printed in our own line in Cyprus

APPLICATIONS

- **Robotics:** slip detection and grip control for grippers and robot hands
- **Feet:** smart insoles, exoskeleton and humanoid footplates
- **Human–machine interfaces:** tell an intended touch from an accidental one by its shear
- **Research:** gait, balance and contact-force studies
- **Presence and position** on beds, seats and devices

29 / 29 **Proven on a robot gripper.** On an OnRobot 2FG14 gripper read by an Infineon PSOC™ Edge E84, the sensor caught 29 of 29 slips, a median 460 ms before the object moved, with the detection running on the chip.

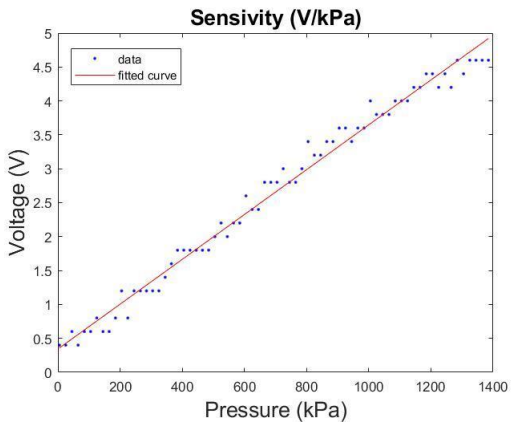
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SPECIFICATIONS

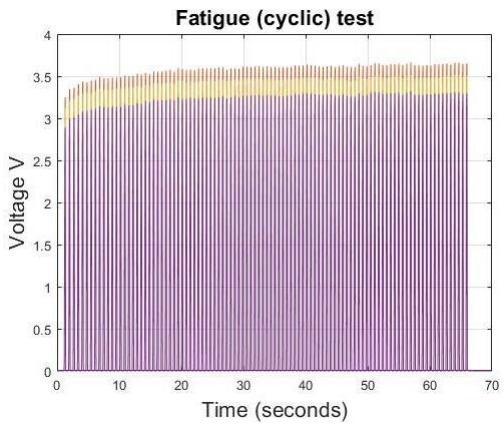
Parameter	Condition	Value
SENSING		
Measured quantities	4 regions, one active area	**Fx, Fy, Fz, centre of force**
Force range	Standard	**0.1–140 N**
Force range	Custom	**up to 200 N**
Pressure range	Standard / custom	**1–1,400 kPa / up to 2,000 kPa**
Pressure sensitivity		**350 Pa/mV**
Linearity (R^2)		**0.99**
ACCURACY AND STABILITY		
Hysteresis		**≤ 5%**
Repeatability	Single part	**2%**
Reproducibility	Part to part	**5%**
Zero drift	Unloaded	**0.5% / h**
Relaxation (creep)	Loaded	**5% / 30 min**
Response / recovery time		**2 ms / 5 ms**
Durability	Tested lifetime	**2M+ cycles**
PHYSICAL AND ELECTRICAL		
Thickness	Custom within range	**0.8–1.5 mm**
Active area	Custom	**4–40 mm diameter (4–2,500 mm²)**
Wires	4 regions + common	**5**
Non-actuated resistance		**10 kΩ**
Supply	Voltage divider	**0.9 - 5 V**
Operating temperature	Recommended	**−30 to +100 °C**

Typical values measured at 100 N (10 kg) and room temperature. Custom sensors can have a different maximum force, size and thickness; ask us for the values of your design.

TEST RESULTS

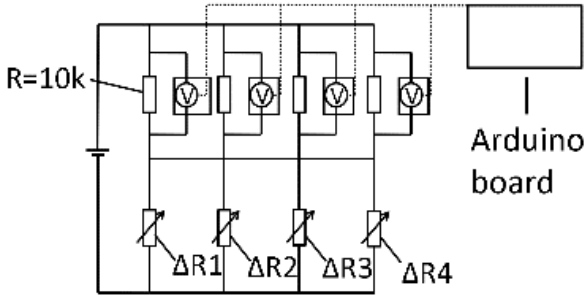


Sensitivity. Output voltage rises linearly with pressure up to 1,400 kPa.



Fatigue. Stable output over repeated loading cycles.

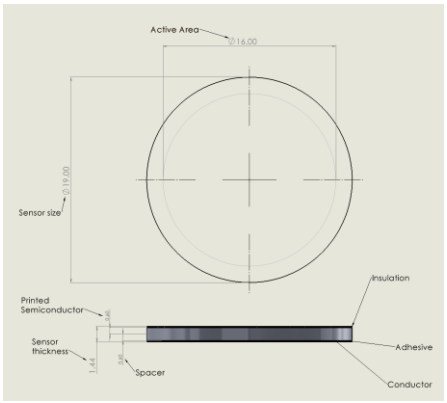
ELECTRICAL INTERFACE



Connect the common terminal to 3.3 V or 5 V. Put each of the four region terminals in a voltage divider with a 10 kΩ resistor to ground, and read the four divider outputs with the microcontroller's ADC. Voltage rises as force on that region rises.

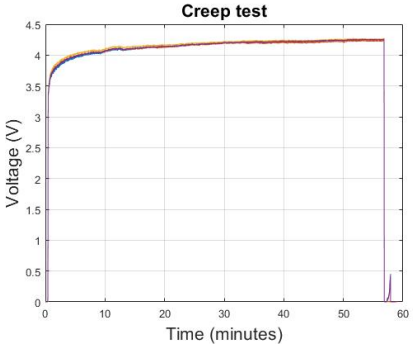
From the four readings: **Fz** is their sum, **Fx** and **Fy** come from the left–right and front–back differences, and the centre of force from their weighted position. PodiSense supplies calibration and example code.

MECHANICAL

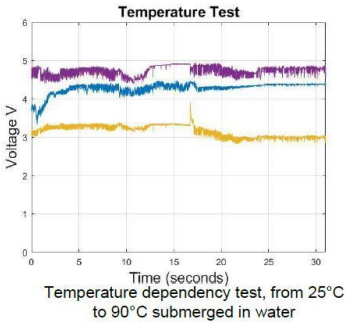


Layer stack (top to bottom): insulation, printed semiconductor, spacer, conductor, adhesive. The adhesive back lets the sensor be stuck onto a fingertip, gripper pad or insole.

MORE TEST RESULTS



Creep. Output under constant load for one hour.



Temperature. Submerged in water from 25 °C to 90 °C.

CUSTOM OPTIONS

Size and shape
Active area from 4 to 40 mm diameter, round or shaped to your part.

Force range
Tuned from 0.1 N up to 200 N for your load.

Thickness
0.8–1.5 mm, set by the force range and mounting.

Connector
Flat tail with your connector, or pads for direct soldering.

Arrays
Several sensors on one sheet for fingertips, insoles or mats.

Electronics
Readout board, calibration and SDK on request.

Evaluation and samples. Sensor samples, evaluation kits and custom designs are available for robot makers, research teams and product developers. Contact **info@podisensetech.com** with your application, size and force range.

PodiSense sensors are sold for research, development and integration. They are not medical devices. Specifications are typical and may change without notice. Patent pending: WO 2023/237887 A1, EP 23732653.3, US 18/872,094 (PodiSense Ltd).