

Force Sensitive Resistor (FSR) Sensor Data Sheet

FSR 19022019

TECHNICAL SPECIFICATIONS

- > **Range¹:** 0.1 – 150 Kg
- > **Repeatability:** $\pm 2.5\%$ (full scale)
- > **Consumption:** ~ 0.4 mA
- > **Device rise time:**
1-2ms (Mechanical)
- > **Force accuracy:**
 $\pm 5\%$ - $\pm 25\%$
(Depends on consistency of measurement & actuation system)
- > **Signal-to-noise ratio:**
Type 1: 19.3 ± 0.1 dB
Type 2: 17.4 ± 0.1 dB
Type 3: 31.7 ± 0.1 dB
Type 4: 48.7 ± 0.1 dB
- > **Temperature range¹:**
[-30; 60] °C

SPECIAL FEATURES

- > **Life time:** +10 million actuations
- > **Force resolution:**
 $\pm 0.5\%$ (of full-scale force)
- > **Thin film technology:**
0.2-0.4 mm
(Depending upon the type of sensor)
- > **Ready-to-use form factor**
- > **Shielded miniaturized cables**

AREA OF APPLICATIONS

- > Biomechanics
- > Robotic interaction control
- > Biomechanical
- > Kinematics
- > Ergonomics
- > Reaction time measurement
- > Gait analysis
- > Load distribution assessment
- > Human-Computer Interaction
- > Robotics & Cybernetics

Example: <http://bit.ly/1FnY0aJ>



Fig. 1: Type 3 FSR sensor with a arrange up to 10 Kg

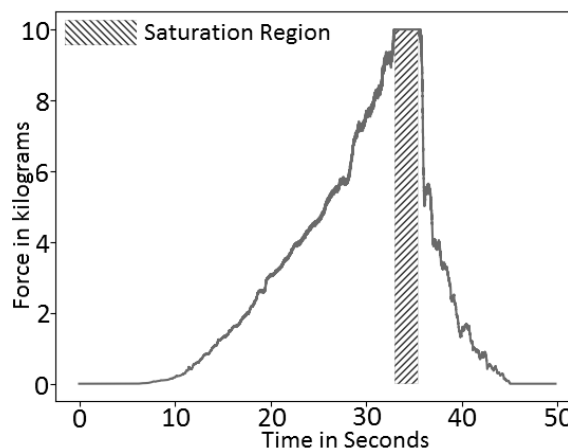


Fig. 2: Response from a Type-2 FSR (Range up to 10Kg)
Force applied by Thumb

¹ Depends on Type, for more detail, please, check Table-1

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GENERAL DESCRIPTION

Force Sensing Resistors (FSR) sensors are devices that allow measuring static and dynamic forces applied to a contact surface. Their range of responses is basically depending on the variation of its electric resistance. From reaction time measurement to load distribution in shoe insoles, our thin film force Sensors offer good performance in most of the applications. The low-profile membrane (0.2-0.4 mm thickness) and miniaturized signal conditioning circuitry is ideal for minimally intrusive setups. Multiple sensing area dimensions and measurement ranges are available, enabling forces up to 150 Kg, although other options are also available upon request.

APPLICATION NOTES

FSR sensor comes with high accuracy, speed of response (rise time:1-2ms), low thickness (0.2-0.4 mm thickness) and durability (>10 million actuations) makes it a suitable candidate for force sensing applications ranging from robotic interaction control and biomechanical fields. Plux Force sensors, based on FSR technology, were mainly designed for research in bio-mechanics and for applications involving the study of the pressure distribution in objects and infer critical pressure points on the human body while performing daily tasks (gait and rest), etc. To extract best response from the sensor, keep the actuator area, shape and compliance constant.

TRANSFER FUNCTION

The sensor requires frequent calibrations to provide reliable measurement, therefore a fixed transfer function does not exist and you need to calibrate the sensor in order to convert the acquired data into force. The calibration of the sensor can be done easily by using the following steps.

Step 1: Calculate voltage output of the sensor

[Type 1]

$$V_{out} = \frac{ADC \times VCC}{2^n}$$

[Types 2, 3 and 4]

$$V_{out} = \frac{ADC \times VCC}{2^n - 1}$$

VCC: 3 V (Operating Voltage)

V_{out}: Voltage output of the sensor (V)

ADC: Value sampled from the channel

n: Number of bits of the channel²

Step 2: Calculate sensor conductance

$$G = \frac{V_{out}}{(Gain \times VCC - V_{out}) \times R2}$$

Gain: 2

R2: 47 kΩ (Type-1) and 10 kΩ (Types 2, 3 and 4)

G: Sensor conductance (mS)

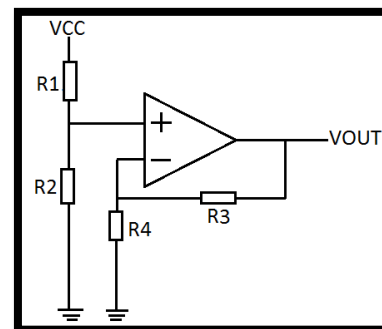


Fig. 3: Amplifier Circuit

² The number of bits for each channel depends on the resolution of the Analog-to-Digital Converter (ADC); in biosignalsplux the default is 16-bit resolution ($n = 16$), although 12-bit ($n = 12$) and 8-bit ($n = 8$) may also be found.

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Step 3: Acquire calibration signal

Compute the slope of the acquired signal using the sensor conductance computed in step 2.

Step 4: Convert data

The conductance is approximately proportional to the applied force. The force can be calculated by using the equation given below.

$$F_{lb} = \frac{G}{S}$$

F_{lb} : Force weight equivalent in pounds (lb)

S : Slope of the calibration signal

PHYSICAL CHARACTERISTICS

Table 1: Physical Characteristics of all available FSR sensors

Physical Parameters	Type 1	Type 2	Type 3	Type 4
Full scale Range (kg)	0.1 - 150 kg	0.1 - 10 kg	0.1 - 10 kg	0.1 - 10 kg
Sensing Area Width W_1 (mm)	9.53 ± 0.10 mm (diameter)	38.10 ± 0.01 mm (square side)	12.70 ± 0.01 mm (diameter)	5.00 ± 0.01 mm (diameter)
Sensor Width W_2 (mm)	14.0 ± 0.5 mm	43.7 ± 0.5 mm	18.3 ± 0.5 mm	7.6 ± 0.5 mm
Strip Length L_2 (mm)	170 ± 10 mm	40.1 ± 0.5 mm	35.8 ± 0.1 mm	30.5 ± 0.1 mm
Sensor Length L (mm)	182 ± 0.5 mm	80.0 ± 0.5 mm	54.0 ± 0.5 mm	36.0 ± 0.5 mm
Sensor Thickness (mm)	0.20 ± 0.01 mm	0.46 ± 0.01 mm	0.46 ± 0.01 mm	0.30 ± 0.01 mm
Temperature Range	-9 to 60 °C	-30 to 60 °C	-30 to 60 °C	-30 to 60 °C
Cable Length (A)	105 ± 0.5 cm			

Note: $L = L_1 + L_2$

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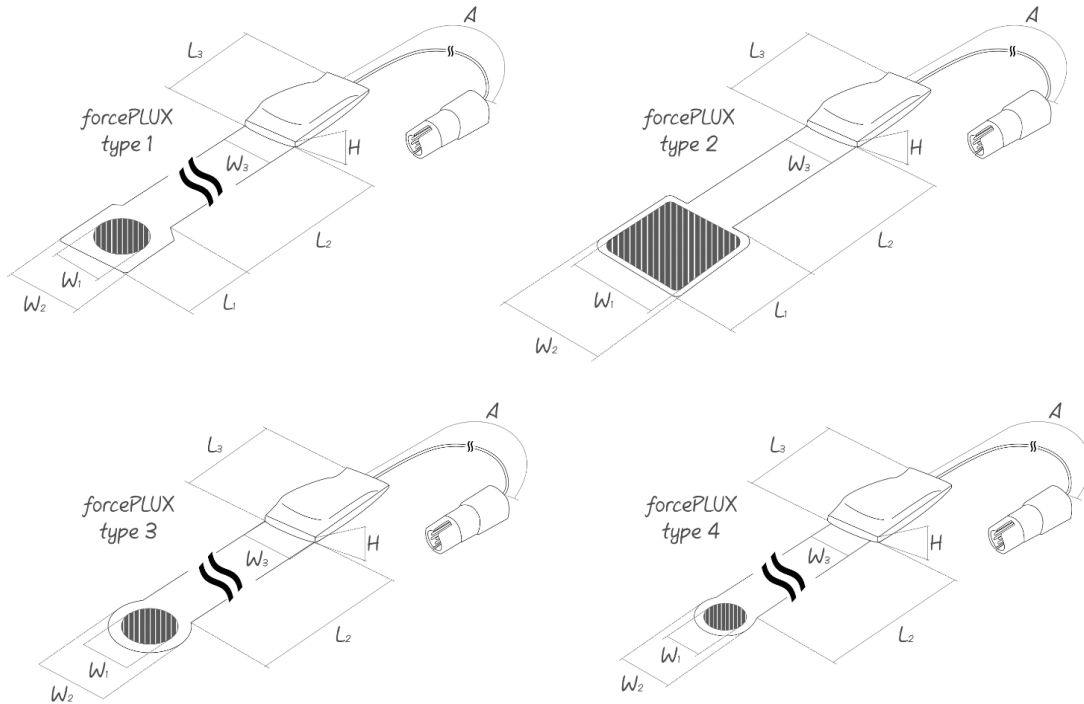


Fig. 4: Available types of FSR sensors (Technical Schemes)

FSR 1



FSR 2



FSR 3



FSR 4



Fig. 5: Available types of FSR sensors (Images)

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ORDERING GUIDE

Reference	Package Description
SENSPRO-FSR	Type 3 Force Sensitive Sensor (FSR) sensor (Fig. 1) with standard Physical characteristics and a random cable sleeve color.
SENSPRO-FSR1-A1-T-S	Force Sensitive Resistor (FSR) sensor of type T built with custom length A1 and custom sleeve color S; for standard physical Characteristics in A1 or S use 0. Examples: > FSR1-200-0-0: Type 3 FSR with 200cm cable A1 and a random sleeve color > FSR1-0-1-Yellow: Type 1 FSR with yellow cable sleeve