FLEXKYS

Product Model: FSR FA402

FSR FA402 Thin-Film Force-Sensitive Resistor

Force Sensing Resistor

Product Specification and User Manual

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This document contains the product technical specifications, application circuits, and operating instructions. Please read it carefully before use.

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1 Product Overview

FSR FA402 is a flexible thin-film pressure sensor, also referred to as an FSR (Force Sensing Resistor). Its resistance decreases as the pressure applied to the sensing area increases. It can be used for press detection, force-variation detection, and relative pressure measurement.

Typical applications include:

- Smart keypads
- Robotic grip-force detection
- Rehabilitation training equipment
- Smart insoles
- Seat pressure detection
- Game controllers
- Electronic musical instruments
- Non-precision weighing devices

2 Product Model and Basic Information

Item	Parameter
Product Model	FSR FA402
Product Name	Thin-film force-sensitive resistor / thin-film pressure sensor
Operating Principle	Resistance decreases as the applied force increases
Sensing Area	Round sensing area (14.68 mm)
Output	Resistance-change signal
Mounting	Flat surface mounting, clamping, or pressure plate
Output method	Flexible tail with two contacts

3 Outline and Dimensions

The typical dimensions of FSR FA402 are shown below:

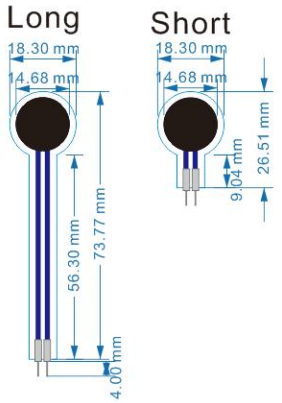


Figure 1 — Outline and dimensions (typical)

Dimension	Typical Value
Sensing area diameter	approx. 14.68 mm
Total length	approx. 73.77 mm (long version); 26.51 mm (short version)
Maximum width	approx. 18.3 mm
Film thickness	approx. 0.3 – 0.35 mm (no adhesive)

Note: Pressure should be applied as vertically as possible to the center of the round sensing area to obtain the best sensitivity and repeatability.

4 Technical Specifications

The main technical specifications of FSR FA402 are listed below (typical values):

Preload note: apply 2× the full-scale force to the working area for 3 cycles, each cycle no less than 10 seconds.

Parameter	Typical Value / Range
Effective force range	approx. 50 g – 20 kg, or customized
Recommended working force range	approx. 50 g – 10 kg, or customized
Unloaded resistance	> 1 MΩ
Loaded resistance range	1 kΩ – 1 MΩ
Response time	< 3 ms
Substrate	PET, thickness ≤ 0.3 mm
Force repeatability (single unit)	After preloading, at 80 % of full scale, deviation < ±5 %
Hysteresis	After preloading, at 80 % of full scale, ≤ 5 % of full scale
Drift	< 5 % per log time scale
Operating voltage	3 – 5 V DC (rated current 10 – 100 mA)
Operating temperature	−20 °C to +65 °C
Storage temperature / humidity	−20 °C to +65 °C (RH < 70 %)
Service life	typically > 1 million press cycles
Output characteristic	Non-linear, relative pressure output

Note: Parameters may vary between production batches. Before mass production, please confirm the required force range and the corresponding resistance change with the FLEXKYS sales team. The terms “approx.”, “typical”, and “recommended” indicate that the values are not guaranteed to be exact.

5 Operating Principle

FSR FA402 uses a pressure-sensitive conductive material internally. When no force is applied, few conductive paths exist and the resistance is high. When force is applied, the contact area of the conductive material increases and the resistance decreases.

$$F \uparrow \rightarrow R_{FSR} \downarrow$$

Note: The greater the force, the lower the resistance of FSR FA402. This characteristic allows the sensor to convert pressure changes into voltage signals through a simple voltage-divider circuit, which can be read directly by a microcontroller.

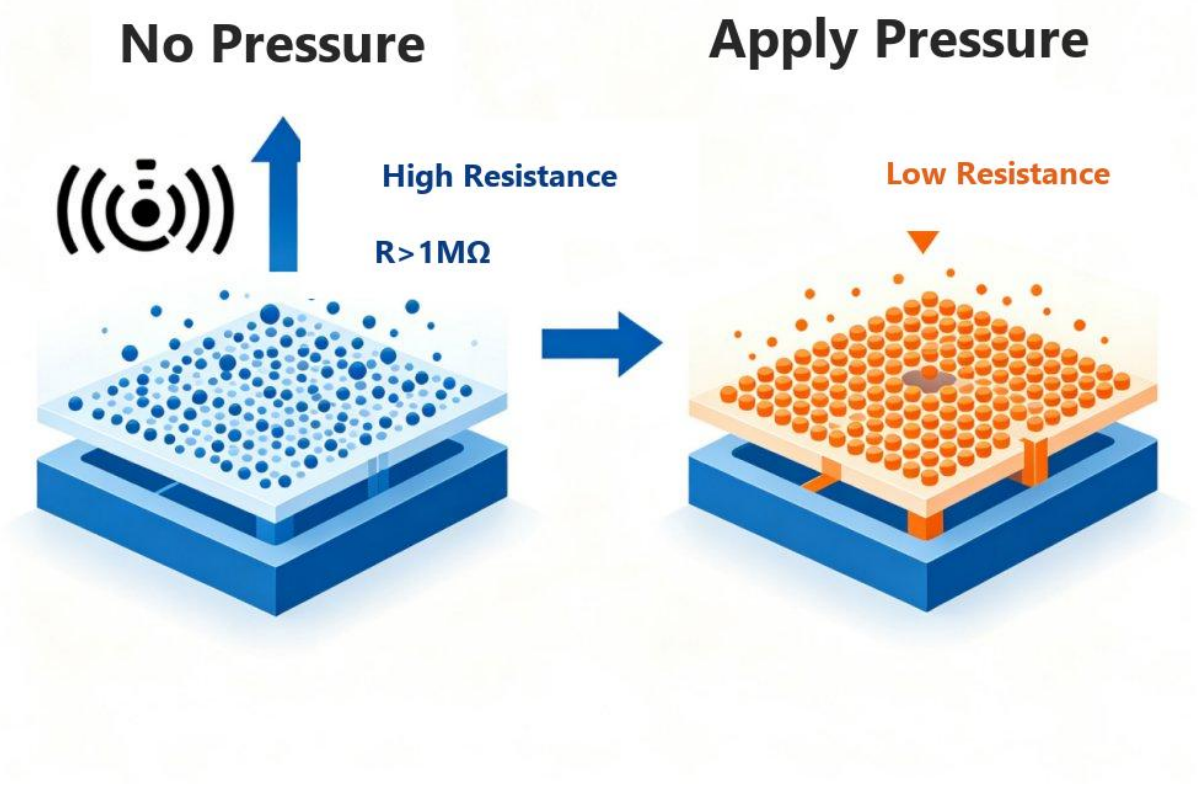


Figure 2 — Operating principle schematic

6 Force vs. Resistance Characteristics

The resistance of FSR FA402 decreases as the applied force increases, but the relationship is typically non-linear. In the low-force region the resistance drops rapidly; as the force continues to grow, the change in resistance becomes more gradual.

The following factors affect the output and should be considered in real applications:

- Magnitude and direction of the applied force
- Contact area and pressure-plate geometry
- Mounting method and contact uniformity
- Ambient temperature
- Duration of sustained loading
- Batch-to-batch variation between units

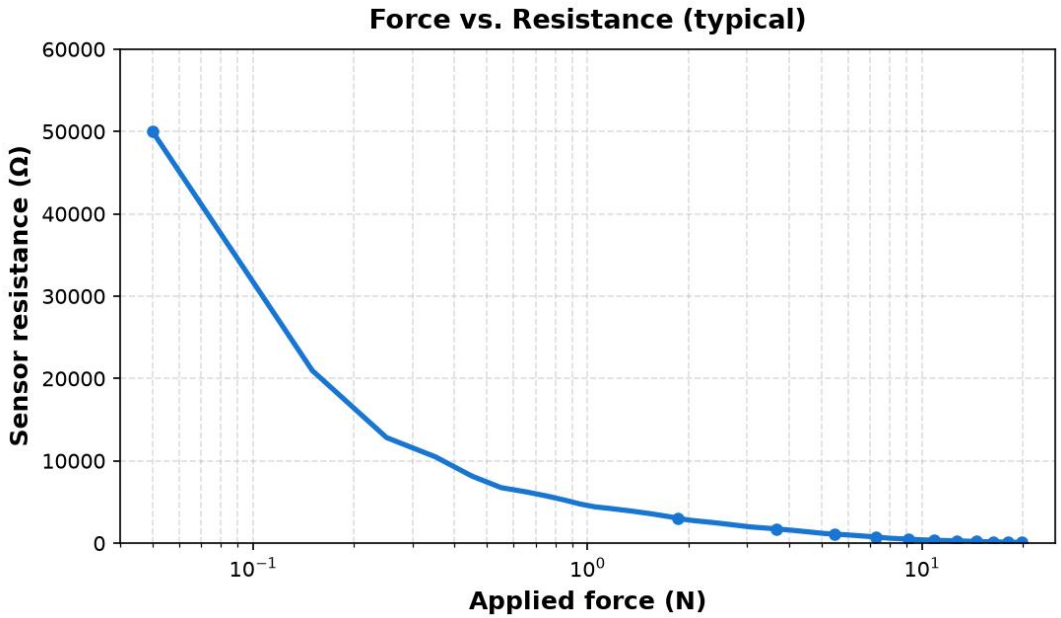


Figure 3 — Force vs. resistance curve

7 Typical Application Circuit

Connect FSR FA402 to the ADC input of a microcontroller through a simple resistor voltage-divider circuit. The circuit requires no additional amplification to produce a usable voltage signal.

Circuit topology:

VCC (3.3 V / 5 V) → FSR FA402 → ADC node → fixed resistor R → GND

Output voltage equation:

$$V_{out} = V_{CC} \times R / (R + R_{FSR})$$

Note: As the force increases, RFSR decreases and Vout increases. The applied force can therefore be inferred indirectly by reading the ADC voltage.

Reference-resistor (RM) selection guide:

Application Scenario	Recommended R	Description
Light touch / small force	47 kΩ – 100 kΩ	Improves sensitivity in the low-force region
Standard press	10 kΩ – 47 kΩ	Balanced range and sensitivity for general use
Higher force	1 kΩ – 10 kΩ	Extends the range in the high-force region

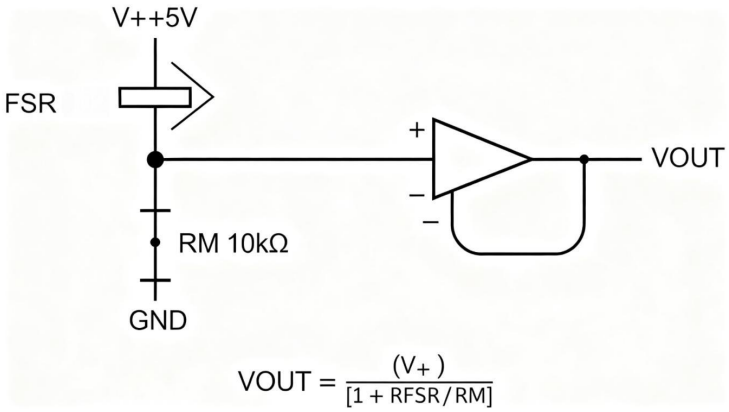


Figure 4 — Standard voltage-divider circuit

8 Microcontroller Connection Example

Using Arduino Uno as an example, the wiring is as follows:

Circuit Node	Arduino Uno Pin	Description
VCC	5V	Power supply +
GND	GND	Power supply ground
Vout (divider node)	A0	Analog input, reads the voltage signal

Arduino sample code:

```
const int fsrPin = A0;

void setup() {
  Serial.begin(115200);
}

void loop() {
  int fsrValue = analogRead(fsrPin);
  Serial.print("FSR ADC Value: ");
  Serial.println(fsrValue);
  if (fsrValue > 100) {
    Serial.println("Pressure detected");
  }
  delay(100);
}
```

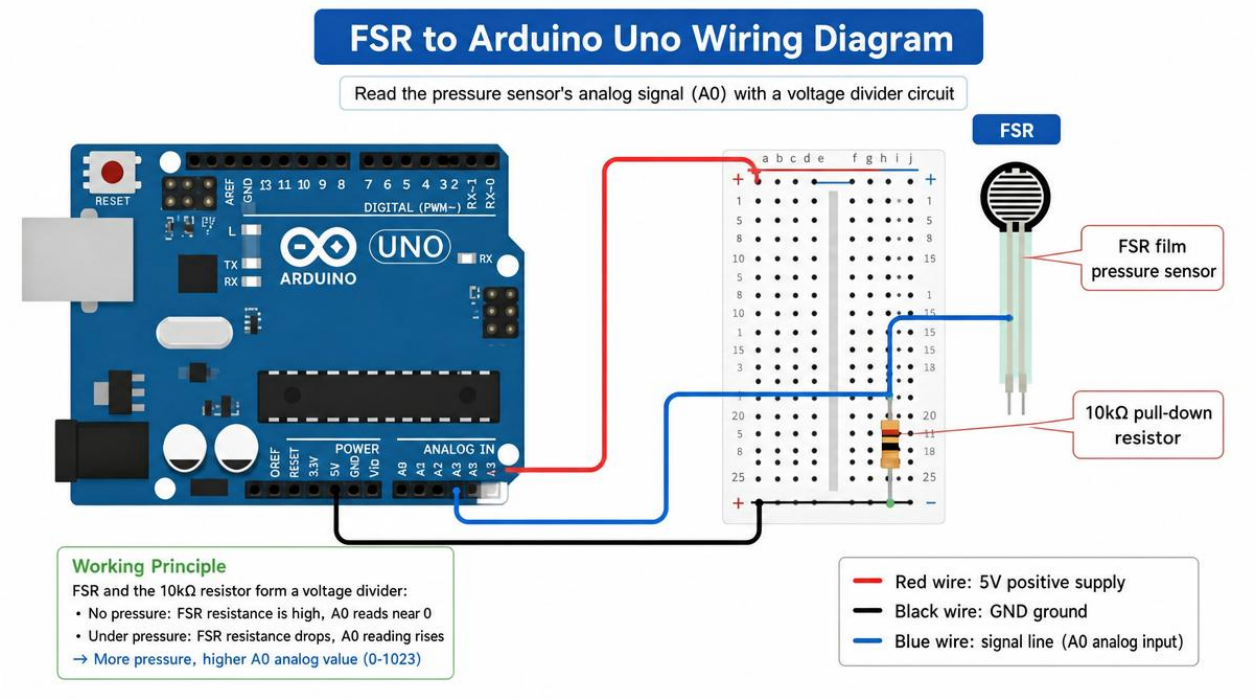


Figure 5 — FSR FA402 wiring to Arduino Uno

9 Installation and Operating Instructions

9.1 Installation Requirements

- Mount the sensor flat against the installation surface; avoid air bubbles and wrinkles.
- Apply force on the round sensing area to keep the contact footprint stable.
- Add a soft pad, silicone pad, or flat pressure plate to distribute the load more evenly.
- Avoid sharp, rough, or angular objects directly contacting the sensor.
- Avoid excessive bending, folding, or pulling of the flexible tail.

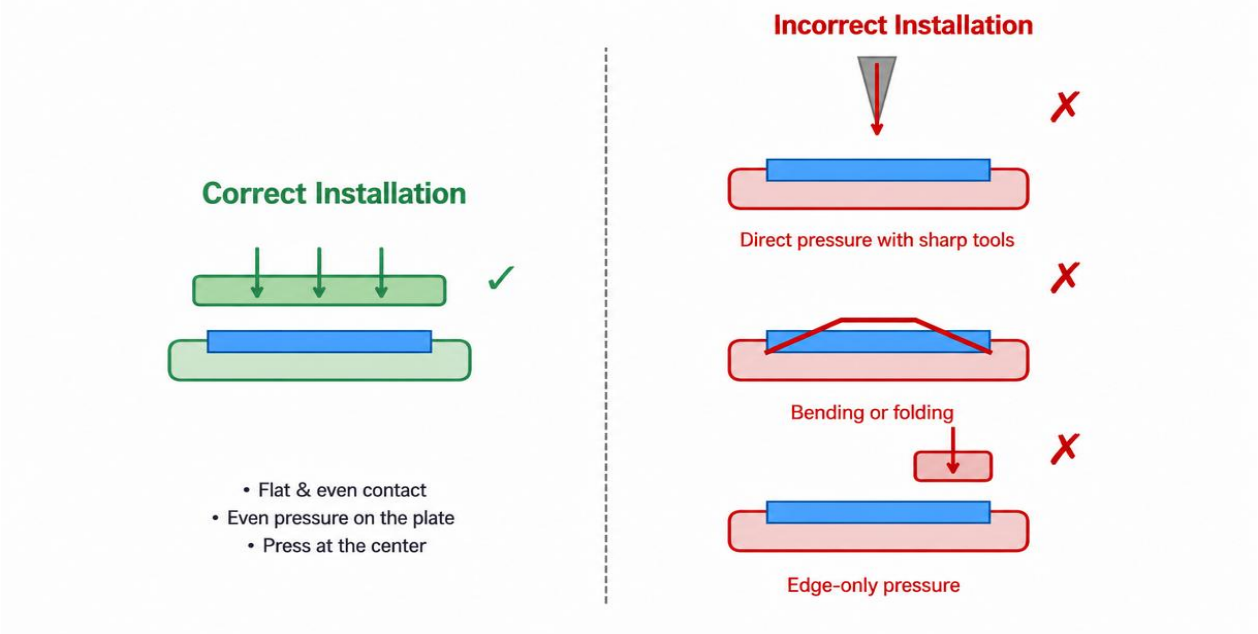


Figure 6 — Correct vs. incorrect installation

9.2 Operating Steps

1. Connect the sensor according to the voltage-divider circuit and confirm the wiring is correct.
2. Read and record the zero-load ADC value with no force applied.
3. Apply different levels of known force and record the corresponding ADC output.
4. Set the press threshold or build a calibration curve according to the application.
5. Apply averaging or median filtering to the collected data to improve stability.
6. Periodically check the mounting state and output stability to ensure long-term reliable operation.

10 Software Filtering Example

To improve ADC reading stability, averaging filtering in software is recommended. The function below takes the average of multiple samples and effectively suppresses random noise and supply interference.

Sample code (Arduino C++):

```
int readFSRAverage(int pin, int samples) {
  long sum = 0;
  for (int i = 0; i < samples; i++) {
    sum += analogRead(pin);
    delay(2);
  }
  return sum / samples;
}
```

Usage tip: The number of samples (samples) can be tuned to the required response speed — typically 5 to 20. For fast-changing force signals, reduce the number of samples; for static pressure measurement, increase the number of samples to improve accuracy.

11 Calibration Method

Because the FSR FA402 output is non-linear and is affected by mounting method and contact area, calibration is required in applications that need quantitative pressure measurement. The calibration procedure is as follows:

1. Fix the sensor and pressure plate to ensure that the mounting conditions match the actual application.
2. Record the ADC value under no-load (zero force) as the zero point.
3. Apply standard weights or known forces in steps, covering the full measurement range.
4. Record the ADC value for each force point after the reading has stabilized.
5. Build a correspondence table between ADC values and force values (calibration table).
6. Use table lookup or linear interpolation to estimate the actual force value.

Example calibration table:

Applied Force (N)	ADC Sample Value
0	5
1	120
2	245
5	520
10	780

Note: The data in this table only illustrates the calibration method and does not represent the actual output of every FSR FA402 unit. Use the measured data from the specific sample in real applications.

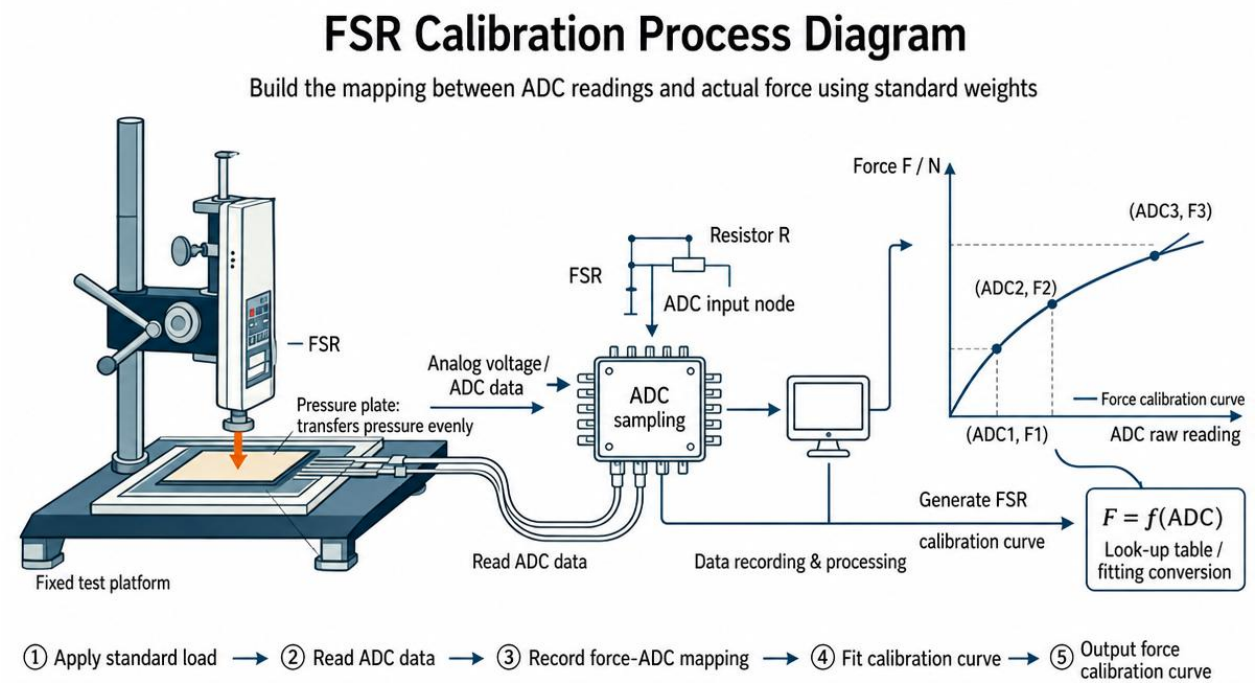


Figure 7 — FSR FA402 calibration workflow

12 Precautions

- FSR FA402 is a relative-pressure sensor and is not suitable for high-precision metrology.
- Avoid sustained high-force loading to prevent drift or sensitivity loss.
- Keep the sensor away from water, oil, solvents, high humidity, and corrosive media.
- Do not scratch, puncture, or impact the sensing area with sharp metal objects.
- Recommended to use 3.3 V or 5 V low-voltage circuits.
- Zero-point calibration is recommended before use; for high-accuracy applications, perform multi-point calibration.

⚠ **Safety warning:** When used in medical, safety, or personal-protection equipment, perform an independent reliability and safety verification. Do not rely solely on this sensor as the only safety detection means.

13 Frequently Asked Questions

The following table lists common issues and troubleshooting methods:

Problem	Possible Cause	Solution
Abnormal ADC value with no force applied	Sensor under pressure, wrong wiring, or moisture ingress	Check mounting, wiring, and environment
No signal change after pressing	Poor contact, sensor damaged, or wrong ADC wiring	Inspect the divider node and connectors
Large output fluctuation	Supply noise, mechanical vibration, or unstable contact	Add filtering and check the mounting
Insufficient sensitivity	Reference-resistor value unsuitable, or load position offset	Adjust the reference resistor or the pressure plate
Inaccurate weight measurement	FSR non-linearity and changing contact area	Perform calibration or use a load cell instead

14 Packaging and Storage

- Store the sensor in the original packaging or an anti-static bag to prevent ESD damage.
- Keep the storage environment dry and clean, and avoid direct sunlight.
- Do not place heavy objects on the sensing area for extended periods to prevent permanent deformation.
- After long-term storage, re-check the zero point and sensitivity before use.



Figure 8 — Proper storage

About FLEXKYS

FLEXKYS is the brand of Momao Electronic Technology Co., Ltd. (默茂电子科技), a manufacturer specializing in thin-film force-sensitive resistors, membrane switches, thin-film pressure switches, and functional PCBA. Our products serve global customers in robotics, medical, consumer electronics, and industrial HMI applications.

Contact: sales@flexkys.com | www.flexkys.com