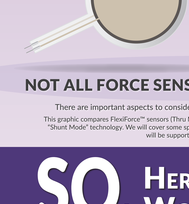
FlexiForce™ VS Shunt Mode
FORCE SENSING TECHNOLOGIES
How Do They Compare On Key Performance Aspects?



NOT ALL FORCE SENSORS ARE CREATED EQUAL!

There are important aspects to consider before making your tactile force sensor investment.

This graphic compares FlexiForce™ sensors (Thru Mode technology) against a similar tactile force sensor referred to as "Shunt Mode" technology. We will cover some specific differentiating aspects between these two technologies that will be supported by verifiable, third-party data.

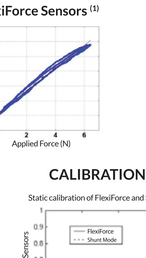
SO, HERE'S WHAT WE'RE WORKING WITH.

FlexiForce Sensors (AKA, "Thru Mode Technology," or "Piezoresistive Technology")

Ultra-thin and flexible printed circuits consisting of two flexible substrates (polyester film).

Silver circles with traces are positioned above and below a pressure-sensitive layer. This is the sensing area.

Conductive polymer is applied on each layer, followed by a pressure sensitive layer. Adhesive is used to laminate the two layers of substrate.



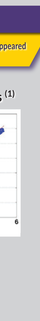
Shunt Mode Sensors

Polymer thick-film devices consisting of two membranes separated by a thin air gap.

Membrane 1 has two sets of interlaced traces electrically isolated from one another.

Membrane 2 is coated with a special textured, resistive ink.

When pressed, the ink shorts the traces together with a resistance that depends on the applied force.



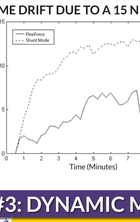
WHEN UNLOADED, RESISTANCE IS HIGH – WHEN PRESSED, RESISTANCE DROPS

#1: LINEARITY

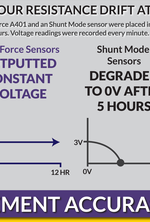
SUMMARY: FlexiForce produced a more linear relationship in the two calibration tests. The Shunt Mode sensor appeared particularly non-linear within the 0-4 N force ranges.

CALIBRATION TEST 0-4 N (1)

FlexiForce Sensors (1)

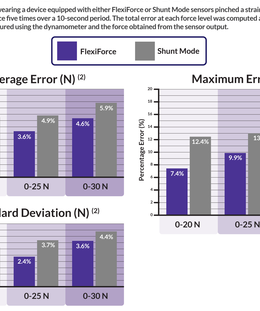


Shunt Mode Sensors (1)



CALIBRATION TEST 0-30 N (2)

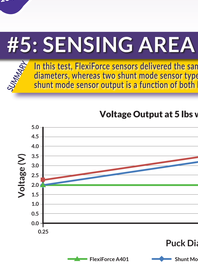
Static calibration of FlexiForce and Shunt Mode sensors (with substrates)



#2: SENSOR DRIFT

SUMMARY: FlexiForce was less susceptible to drift compared to the Shunt Mode sensor, whether loaded or placed into a controlled environment.

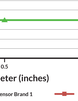
TIME DRIFT DUE TO A 15 N LOAD (2)



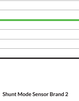
12-HOUR RESISTANCE DRIFT AT 3V (3)

A FlexiForce A401 and an Shunt Mode sensor were placed in a tube for 12 hours. Voltage readings were recorded every minute.

FlexiForce Sensors
OUTPUTTED CONSTANT VOLTAGE



Shunt Mode Sensors
DEGRADED TO 0V AFTER 5 HOURS



#3: DYNAMIC MEASUREMENT ACCURACY

SUMMARY: FlexiForce was significantly more accurate than Shunt Mode sensor at all three force ranges.

REHABILITATION GRIP DEVICE TEST (2)

In this test, the subject wearing a device equipped with either FlexiForce or Shunt Mode sensors pinched a strain gauge dynamometer varying the exertion force five times over a 10-second period. The total error at each force level was computed as the difference between the force measured using the dynamometer and the force obtained from the sensor output.

Average Error (N) (2)

Maximum Error (N) (2)

Standard Deviation (N) (2)

#4: DYNAMIC RANGE

SUMMARY: According to manufacturer specs, FlexiForce can capture a wider range of force with greater accuracy than a majority of Shunt Mode force sensing resistors. The force range of FlexiForce sensors can also be adjusted to match the needs of the application.

FlexiForce Sensors
~0 N - 444.8 N (0 lb - 100 lb)
with some sensors reaching up to 44,482 N!

Most Shunt Mode Sensors
~0.2 N - 20 N
(0 lb - 5 lb)

#5: SENSING AREA DEPENDENCE

SUMMARY: In this test, FlexiForce sensors delivered the same force output when step loaded with three different puck diameters, whereas two shunt mode sensor types showed inconsistent output. This data indicates that shunt mode sensor output is a function of both load area and applied force.

Voltage Output at 5 lbs with Different Puck Diameters

CHOOSE WISELY.

While FlexiForce proved to be the better alternative in these tests, every application has its own unique challenges and may produce different results. Whether as a standard sensor or custom solution, our team of expert engineers is standing by to find the right FlexiForce solution to achieve your needs.

See the full summary of data by visiting
www.tekscan.com/shunt-comparison

REFERENCES:

[1]Sadun, A.S., et. al. "Force Sensing Resistor (FSR): A Brief Overview and the Low Cost Sensor for Active Compliance Control." (2016) Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, Malaysia.

[2]Vecchi, F. et. al. "Experimental Evaluation of Two Commercial Force Sensors for Applications in Biomechanics and Motor Control." Advanced Robotics Technology and Systems Laboratory. Scuola Superiore di Sant'Anna via Carducci 40, 56127 Pisa, Italy.

[3]Benbourenane, I. "Design of Nasal Endoscopy Simulator with Force Feedback" (2014) Human Movement and Balance Lab of the University of Pittsburgh.]

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