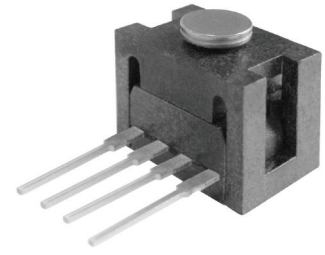


## Force Sensors Line Guide



**Leadership, in full force.** Whether it's critical applications such as IV drips or dialysis, or serious engineering like robotic end-effectors, Honeywell Sensing and Internet of Things (Slot) offers an unbeatable line of force sensor options. These sensors measure the addition or backup of force — meaning, the resistance of silicon-implanted piezoresistors increases when flexed under applied force. Each sensor concentrates force

directly to the silicon-sensing element through a stainless steel plunger, with the amount of resistance changing in proportion to the amount of force applied. This change in circuit resistance results in a corresponding output level. Honeywell Slot force sensors also deliver built-in stability and flexibility to provide enhanced performance in most applications.

### FEATURES

#### FSA Series.

**Features:** Multiple force ranges  
 • Total Error Band:  $\pm 5\%$  FSS • Accuracy:  $\pm 3\%$  FSS • Ratiometric analog or SPI- or I<sup>2</sup>C-compatible digital output  
 • Fully calibrated and temperature compensated over 5°C to 50°C [41°F to 122°F] • Overforce: 6804 g [15 lb]  
 • Supply voltage: 3.3 Vdc typ. or 5.0 Vdc typ. • Low power consumption: 13 mW (analog) or 20 mW (digital) • Excellent part-to-part repeatability • Enhanced reliability • Stable interface plunger  
 • Internal diagnostic functions available  
 • REACH and RoHS compliant

**Benefits:** Choice of force ranges maximizes sensitivity and improves system resolution/performance. Total Error Band enhances system performance. Enhanced accuracy includes all errors due to force non-linearity, force hysteresis, and non-repeatability. Digital output enhances performance through reduced conversion requirements and convenience of direct interface to microprocessors. Overforce provides enhanced durability in applications where overforce may exist. Supply voltage provides customers flexibility of design within the application.

Diagnostics functions allow user to determine if sensor is working correctly by detecting if electrical paths are broken or shorted inside the sensor. Potential medical applications include ambulatory non-invasive pump pressure, infusion pumps, kidney dialysis machines, and occlusion detection. Potential industrial applications include load and compression sensing.

#### FSG Series.

**Features:** Extremely low deflection (approx. 30  $\mu\text{m}$  typical at Full Scale)  
 • Low repeatability error:  $\pm 0.2\%$  span  
 Low linearity error:  $\pm 0.5\%$  span • Low off-center loading errors • Resolution to 0.0098 N • Fast response time  
 • Low power consumption • High ESD resistance of 8 kV

**Benefits:** Extremely low deflection helps reduce measurement error. Low repeatability error improves overall system accuracy. Low linearity error improves system accuracy over the entire force range. Low off-center loading errors improve system accuracy due to mechanical misalignment. Low resolution improves customer's system accuracy. Fast response time allows system to make faster decisions

which may improve system accuracy. Low power consumption allows use in battery applications. High ESD resistance reduces special handling during assembly. Potential medical applications include infusion pumps, ambulatory non-invasive pumps, occlusion detection, kidney dialysis machines, and enteral pumps; potential industrial applications include load and compression sensing, variable tension control, robotic end-effectors, and wire bonding equipment.

#### FSS Series.

**Features:** RoHS-compliant materials  
 • Low deflection • Direct mechanical coupling • Product rating of 20 million MCTF at 25°C [77°F] (subject to application variation) • Small size  
 • Enhanced sensitivity without compromising signal integrity  
 • Electrically ratiometric output • Low voltage supply • High resistance to electrostatic discharge (ESD) Classification Level 3B (8 kV) • Sensor output has low sensitivity to many mounting stresses

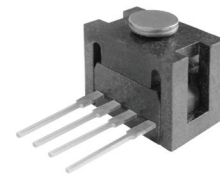
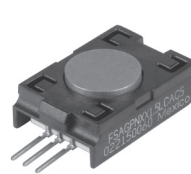
**Benefits:** RoHS-compliant materials allow use in industries requiring regulation compliance. Low deflection

# Force Sensors Line Guide

## Your applications, our engineering: A powerful force.

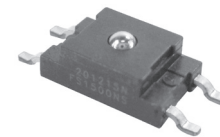
The Honeywell force sensor design incorporates a patented modular construction. What's more, our innovative elastomeric technology and engineered molded plastics result in load capacities of up to 67 N [15 lb] overforce. This unique design also provides a variety of mounting options, including application-specific requirements — plus other valuable benefits: stainless steel ball actuator provides enhanced, stable mechanical performance and application adaptability.

Potential applications for Honeywell Slot force sensors include medical equipment such as infusion and ambulatory non-invasive pumps, occlusion detection, kidney dialysis machines, and enteral pumps. Industrial potential applications include load and compression sensing, variable tension control, robotic end effectors, and wire bonding equipment.



### Force Sensors

|                                      | FSA Series  | FSG Series  |
|--------------------------------------|---|---|
| <b>Signal conditioning</b>           | amplified   | unamplified   |
| <b>Technology</b>                    | silicon die (piezoresistive)  | silicon die (piezoresistive)                            |
| <b>Output</b>                        | ratiometric analog<br>SPI- or I <sup>2</sup> C-compatible digital           | 360 mV typ.   |
| <b>Force range</b>                   | N: 5, 7.5, 10, 15, 20, 25<br>lb: 1, 1.5, 2, 3, 5<br>g: 500, 750<br>kg: 1, 2 | 0 N to 5 N<br>0 N to 10 N<br>0 N to 15 N<br>0 N to 20 N |
| <b>Overforce</b>                     | 15 lb [6804 g]  | 60 N max. (range dependent)                             |
| <b>Operating temperature range</b>   | 0°C to 70°C [32°F to 158°F]   | -40°C to 85°C [-40°F to 185°F]                          |
| <b>Compensated temperature range</b> | 5°C to 50°C [41°F to 122°F]   | -   |
| <b>Storage temperature range</b>     | -40°C to 85°C [-40°F to 85°F]   | -40°C to 100°C [-40°F to 212°F]                         |



### Force Sensors

|                                      | FSS Series  | FSS-SMT Series  |
|--------------------------------------|---|---|
| <b>Signal conditioning</b>           | unamplified   | unamplified   |
| <b>Technology</b>                    | silicon die (piezoresistive)                            | silicon die (piezoresistive)                            |
| <b>Output</b>                        | 360 mV typ.   | 360 mV typ.   |
| <b>Force range</b>                   | 0 N to 5 N<br>0 N to 10 N<br>0 N to 15 N<br>0 N to 20 N | 0 N to 5 N<br>0 N to 10 N<br>0 N to 15 N<br>0 N to 20 N |
| <b>Overforce</b>                     | 60 N max. (range dependent)                             | 60 N max. (range dependent)                             |
| <b>Operating temperature range</b>   | -40°C to 85°C [-40°F to 185°F]                          | -40°C to 85°C [-40°F to 185°F]                          |
| <b>Compensated temperature range</b> | -   | -   |
| <b>Storage temperature range</b>     | -40°C to 100°C [-40°F to 212°F]                         | -40°C to 100°C [-40°F to 212°F]                         |

## Force Sensors



**TBF Series Basic**

**1865 Series**

|                                      |  |  |
|--------------------------------------|--|--|
| <b>Signal conditioning</b>           | unamplified  | unamplified  |
| <b>Technology</b>                    | silicon die (piezoresistive)   | silicon die (piezoresistive)   |
| <b>Output</b>                        | mV   | current excitation: 100 mV typ.<br>voltage excitation: 40 mV typ.                          |
| <b>Pressure range</b>                | 1 bar to 10 bar<br>100 kPa to 1 MPa<br>15 psi to 150 psi   | 0 psi to 5 psi<br>0 psi to 10 psi<br>0 psi to 15 psi<br>0 psi to 25 psi<br>0 psi to 30 psi |
| <b>Overpressure</b>                  | 17 bar max. (range dependent)<br>1.70 MPa max. (range dependent)<br>245 psi max. (range dependent) | 60 psi max. (range dependent)  |
| <b>Operating temperature range</b>   | 0°C to 50°C [32°F to 122°F]  | -28°C to 54°C [-18°F to 129°F]   |
| <b>Compensated temperature range</b> | 0°C to 50°C [32°F to 122°F]  | -1°C to 54°C [30°F to 129°F]   |
| <b>Storage temperature range</b>     | -40°C to 125°C [-40°F to 257°F]  | -28°C to 54°C [-18°F to 129°F]   |

helps reduce measurement error. Direct mechanical coupling of the actuation ball to the sense element reduces coupling errors and keeps mechanical hysteresis to a minimum. 20 million MCTF provides for consistent output over time and reduces repairs or replacements. Small size minimizes space on the PCB. Enhanced sensitivity results in low system noise and reduced measurement errors. Electrically ratiometric output accommodates supply voltage variations, leading to low ratiometricity error. Low voltage supply allows for use in many battery powered applications. High resistance to electrostatic discharge reduces special handling during assembly. Sensor output has low sensitivity to many mounting stresses. Potential medical applications include infusion pumps, ambulatory non-invasive pumps, occlusion detection, kidney dialysis machines, and enteral pumps; potential industrial applications include load and compression sensing, variable tension control, robotic end-effectors, and wire bonding equipment.

#### **FSS-SMT Series.**

**Features:** Surface Mount Technology • RoHS-compliant materials • Low deflection (approx. 30 µm typical at full scale) • Direct mechanical coupling of the actuation ball to the sense element • 20 million MCTF at 25°C [77°F] (subject to application variation) • Small size • Enhanced sensitivity without compromising signal integrity • Electrically ratiometric output • Low voltage supply • High resistance to electrostatic discharge (ESD) Classification Level 3B (8 KV) • Sensor output has low sensitivity to many mounting stresses

**Benefits:** Surface Mount Technology allows for automated assembly and may eliminate hand soldering. RoHS-compliant materials allow use in industries requiring regulation compliance. Low deflection helps reduce measurement error. Direct mechanical coupling of the actuation ball to the sense element reduces coupling errors and keeps mechanical

hysteresis to a minimum. 20 million MCTF for consistent output over time and reduces repairs or replacements. Small size minimizes space on PCB. Enhanced sensitivity results in low system noise and reduces measurement errors. Electrically ratiometric output accommodates supply voltage variations, leading to low ratiometricity error. Low voltage supply allows for use in many battery powered applications. High resistance to ESD reduces special handling during assembly. Sensor output has low sensitivity to many mounting stresses. Potential medical applications include infusion pumps, ambulatory non-invasive pumps, occlusion detection, kidney dialysis machines, enteral pumps; and potential industrial applications such as load and compression sensing, variable tension control, robotic end-effectors, and wire bonding equipment.

#### **TBF Series.**

**Features:** Cost-effective, plastic, gage sensor • Compensated/unamplified • Wide operating temperature range of -20°C to 85°C [-4°F to 185°F] • Low power consumption • Stable offset voltage • Wide pressure range (1 bar to 10 bar | 100 kPa to 1 MPa | 15 psi to 150 psi) • Tight silicon rubber diaphragm allows compatibility with some liquid media applications • Accuracy of ±0.15 %FSS • Not sensitive to mounting orientation • Smallest package size in its class (7 mm x 7 mm x 3.89 mm) • RoHS2 compliance

**Benefits:** Designed for customers who require a simple, high quality, cost-effective, mV output, unamplified, temperature compensated sensor for potential use in medical applications. Sensor is ideal for customers who want to do their own amplification in order to make use of the maximum resolution of the bare sensor output, leveraging any algorithm needed for the application. Special silicone gel transmits applied

pressure to a silicon piezoresistive MEMS die mounted on a robust ceramic substrate. Gel's precision height provides long life. Reliable replacement for older force or load cell transducers. Potential medical applications include those where force is applied by a flexible membrane to the sensor, such as infusion pumps.

#### **1865 Series.**

**Features:** Silicon pressure/force interface diaphragm • Force measurement for potential infusion pump applications • Pressure measurement for liquid media • Medical-grade materials • 8-pin DIP electrical connection • Laser trimmed • Choice of voltage or constant current excitation • Temperature compensated

**Benefits:** Enhanced performance force/pressure transducers specifically designed to address needs of potential medical and specialized OEM applications such as infusion and syringe pumps, blood pressure equipment, and drug delivery systems. Reliable replacement for older force or load cell transducers. Silicon rubber diaphragm allows sensor to be compatible with some potential liquid media applications. Laser-trimmed compensation may be specified to operate with a constant current or voltage supply.

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