

MICRO SWITCH Force Sensors

Force Sensor

FS Series

FEATURES

- Robust performance characteristics
- Precision force sensing
- Adaptable product design
- Highly reliable
- Signal conditioning available
- Electrically ratiometric output
- Extremely low deflection (30 microns typical @ Full Scale)
- Low repeatability errors ($\pm 0.2\%$ Span)
- Low linearity errors ($\pm 0.5\%$ Span)
- Low off-center loading errors
- Resolution to 1.0 gram force
- Fast response time
- Low power consumption
- High ESD resistance - 10 KV

TYPICAL APPLICATIONS

- Medical infusion pumps
- Kidney dialysis machines
- Robotic end-effectors
- Variable tension control
- Load and compression sensing
- Contact sensing



The FS Series Force Sensor provides precise, reliable force sensing performance in a compact commercial grade package. The sensor features a proven sensing technology that utilizes a specialized piezoresistive micro-machined silicon sensing element. The low power, unamplified, non-compensated Wheatstone bridge circuit design provides inherently stable mV outputs over the 1,500 gram force range.

The force sensor operates on the principle that the resistance of silicon implanted piezoresistors will increase when the resistors flex under an applied force. The sensor concentrates force from the application through the stainless steel plunger directly to the silicon sensing element. The amount of resistance changes in proportion to the amount of force being applied. This change in circuit resistance results in a corresponding mV output level.

The sensor package design incorporates a patented modular construction. The use of innovative elastomeric technology and engineered molded plastics results in load capacities of 5.5 Kg over-force. The stainless steel plunger provides excellent mechanical stability and is adaptable to a variety of applications. Various electrical interconnects can accept pre-wired connectors, printed circuit board mounting, and surface mounting. The unique sensor design also provides a variety of mounting options including mounting brackets, as well as application-specific mounting requirements.

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FS Series

PERFORMANCE CHARACTERISTICS @ 10 ± 0.01 VDC, 25°C

Preliminary, based on limited test data

Parameter	Min.	Typ.	Max.	Units
Excitation*	—	10	12	VDC
Null shift, 25 to 0°, 25 to 50°C	—	± 0.5	—	mV
Null offset	-30	0	+30	mV
Linearity (BFSL)	—	± 0.5	—	% Span
Sensitivity	—	0.24	—	mV/grf
Sensitivity shift 25 to 0°, 25 to 50°C	—	± 5.0	—	% Span
Repeatability	—	± 0.2	—	% Span
Response time	—	—	1.0	msec
Input resistance	—	5.0 K	—	ohms
Output resistance	—	5.0 K	—	ohms
Plunger deflection	—	30	—	microns
Weight	—	2.0	—	grams
ESD (direct contact - terminals and plunger)	10	—	—	kVolts

* Non-compensated force sensors, excited by constant current (1.5 mA) instead of voltage, exhibit partial temperature compensation of Span.

ENVIRONMENTAL SPECIFICATIONS

Operating temperature	-40 to +85°C (-40 to +185°F)
Storage temperature	-55 to +105°C (-67 to +221°F)
Shock	Qualification tested to 150 g
Vibration	Qualification tested to 0 to 2 kHz, 20 g sine

Note: All force related specifications are established using dead weight or compliant force.

ORDER GUIDE

Catalog Listing	Force Range (grams)	Span, mV			Overforce grams Max.
		Min.	Typ.	Max.	
FSG-15N1A	1,500	290	360	430	5,500

MOUNTING

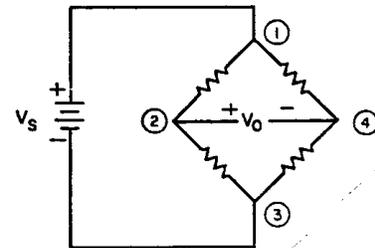
The sensor output characteristics do not change with respect to mounting orientation. Care should be taken not to obstruct the vent hole in the bottom of the sensor housing. Improper venting may result in unstable output.

Mounting bracket mounting torque: 2-5 in. lb. (.21-.56 Nm).

APPLYING FORCE

Evaluation of the sensor is to be performed using dead-weight or compliant force. Application of a rigid, immobile force will result in output drift (decrease) as elastomeric seals relax. Off-center plunger loading has minimal effect on sensor performance and maintains operation within design specifications.

EXCITATION SCHEMATIC



FS SERIES CIRCUIT

1. Circled numbers refer to sensor terminals (pins). Pin 1 is designated with a notch. Pin 1 = Supply V_s (+) Pin 2 = Output, (+) Pin 3 = Ground, (-) Pin 4 = Output, (-)
2. The force sensor may be powered by voltage or current. Maximum supply voltage is not to exceed 12 volts. Maximum supply current is not to exceed 1.6 mA. Power is applied across Pin 1 and Pin 3.
3. The sensor output should be measured as a differential voltage across Pin 2 and Pin 4 ($V_o = V_2 - V_4$). The output is ratiometric to the supply voltage. Shifts in supply voltage will cause shifts in output. Neither Pin 2 nor Pin 4 should be tied to ground or voltage supply.

MICRO SWITCH Force Sensors

Force Sensor

FS Series

SALES AND SERVICE

Honeywell's MICRO SWITCH Division serves its customers through a worldwide network of sales offices and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact a nearby sales office. Or call:

1-800-537-6945 USA
1-416-293-8111 Canada
1-815-235-6847 International

INTERNET

<http://www.sensing.honeywell.com>
info@micro.honeywell.com

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

While we provide application assistance, personally and through our literature, it is up to the customer to determine the suitability of the product in the application.

Honeywell

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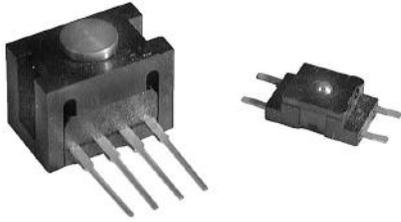
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Helping You Control Your World

Force Sensors

FSG and FSL Series

FS Series



FEATURES

- Compact commercial grade package
- Robust performance characteristics
- Adaptable product design
- Precision force sensing
- Electrically ratiometric output
- Extremely low deflection (30 microns typ. @ Full Scale)
- High ESD resistance 10 KV
- Available signal conditioning
- Optional terminal configurations

The FS Series Force Sensors provide precise, reliable force sensing performance in a compact commercial grade package. The sensor features a proven sensing technology that utilizes a specialized piezoresistive micro-machined silicon sensing element. The low power, unamplified, noncompensated Wheatstone bridge circuit design provides inherently stable mV outputs over the force range.

Force sensors operate on the principle that the resistance of silicon implanted piezoresistors will increase when the resistors flex under any applied force. The sensor concentrates force from the application, through the stainless steel plunger, directly to the silicon sensing element. The amount of resistance changes in proportion to the amount of force being applied. This change in circuit resistance results in a corresponding mV output level.

The sensor package design incorporates a patented modular construction. The use of innovative elastomeric technology and engineered molded plastics results in load capacities of 4.5 Kg over-force. The stainless steel plunger provides excellent mechanical stability and is adaptable to a variety of applications. Various electrical interconnects can accept pre-wired connectors, printed circuit board mounting, and surface mounting. The unique sensor design also provides a variety of mounting options including mounting brackets, as well as application specific mounting requirements.

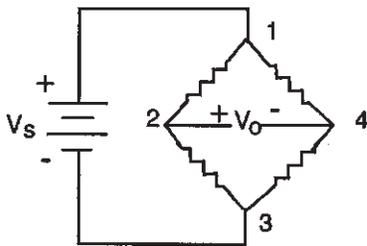
MOUNTING

Sensor output characteristics do not change with respect to mounting orientation. Care should be taken not to obstruct the vent hole in the bottom of the housing. Improper venting may result in unstable output.

APPLYING FORCE

Evaluation of the sensor is to be performed using deadweight or compliant force. Application of a rigid, immobile force will result in output drift (decrease) as elastomeric seals relax. Off-center plunger loading has minimal effect on sensor performance and maintains operation within design specifications.

ELECTRICAL CONNECTIONS



TYPICAL APPLICATIONS

1. Medical infusion pumps
2. Kidney dialysis machines
3. Load and compression sensing
4. Variable tension control
5. Robotic end-effectors
6. Wire bonder equipment

FS SERIES CIRCUIT NOTES

1. Circled numbers refer to Sensor Terminals (interface pins).
 Pin 1 = V_s (+)
 Pin 2 = Output, (+)
 Pin 3 = Ground, (-)
 Pin 4 = Output, (-)
2. The force sensor may be powered by voltage or current.
 Maximum supply voltage is not to exceed 12 volts.
 Maximum supply current is not to exceed 1.6 mA. Power is applied across Pin 1 and Pin 3.
3. The sensor output should be measured as a differential voltage across Pin 2 and Pin 4 ($V_o = V_2 - V_4$). The output is ratiometric to the supply voltage. Shifts in supply voltage will cause shifts in output. Neither Pin 2 nor Pin 4 should be tied to ground or voltage supply.

Force

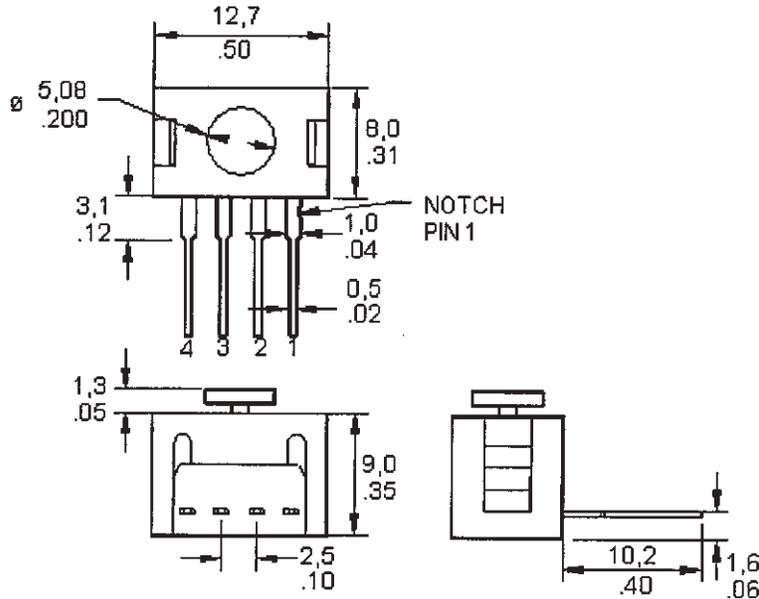
Force Sensors

FSG and FSL Series

FS Series

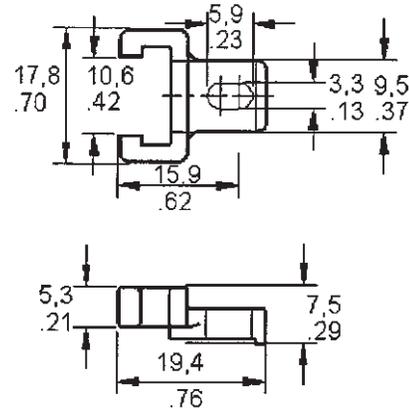
MOUNTING DIMENSIONS (for reference only)

FSG15N1A



ACCESSORY (FSG Sensor only)

PC-15132 Plastic Mounting Bracket



PERFORMANCE CHARACTERISTICS @ 10.0 ±0.01 VDC, 25°C

Parameter	Min.	Typ.	Max.	Units
Excitation*	—	10.0	12.0	VDC
Null offset	-30	0	30	mV
Operating Force	0	—	1500	grams
Sensitivity	0.20	0.24	0.28	mV/gram
Linearity (B.F.S.L.)**	—	±22.5	45	grams
Null Shift				
+25°C to 0°C, +25°C to +50°C	—	±1.0	—	mV
Sensitivity Shift				
+25°C to 0°C	—	0.012	—	mV/gram
+25°C to +50°C	—	-0.012	—	mV/gram
Hysteresis	—	45	180	grams
Repeatability (@ 1500 grams)	—	30	120	grams
Input Resistance	4.0 K	5.0 K	6.0 K	Ohms
Output Resistance	4.0 K	5.0 K	6.0 K	Ohms
Overforce	—	—	4,500	grams

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	-40° to 85°C (-40° to +185°F)
Storage Temperature	-55° to +105°C (-131° to +221°F)
Vibration	Qualification tested to 10 Hz to 2 kHz, 20 g sine
Shock	Qualification tested to 150 g, 6 ms, half-sine
Solderability	5 sec at 315°C per lead
Output ratiometric	Within Supply Range

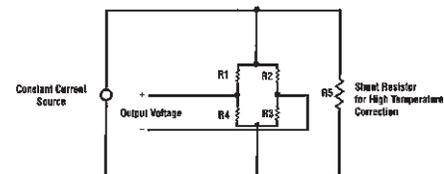
**B.F.S.L.—Best Fit Straight Line

Note: All force related specifications established using dead weight or compliant force.

Constant Current Excitation Schematic

* Non-compensated force sensors, excited by constant current instead of voltage, exhibit temperature compensation of Span. Application Note #1 briefly discusses current excitation.

Constant current excitation has an additional benefit of temperature measurement. When driven by a constant current source, a silicon pressure sensor's terminal voltage will rise with increased temperature. The rise in voltage not only compensates the Span, but is also an indication of die temperature.



FS SERIES ORDER GUIDE

Catalog Listing	Force Range (grams)	Sensitivity mV/V/gram			Span mV	Over Force grams
		Min.	Typ.	Max.	Typ.	Max.
FSG15N1A	1,500	.02	.024	.028	360 (at 10 VDC)	4,500

Force Sensors

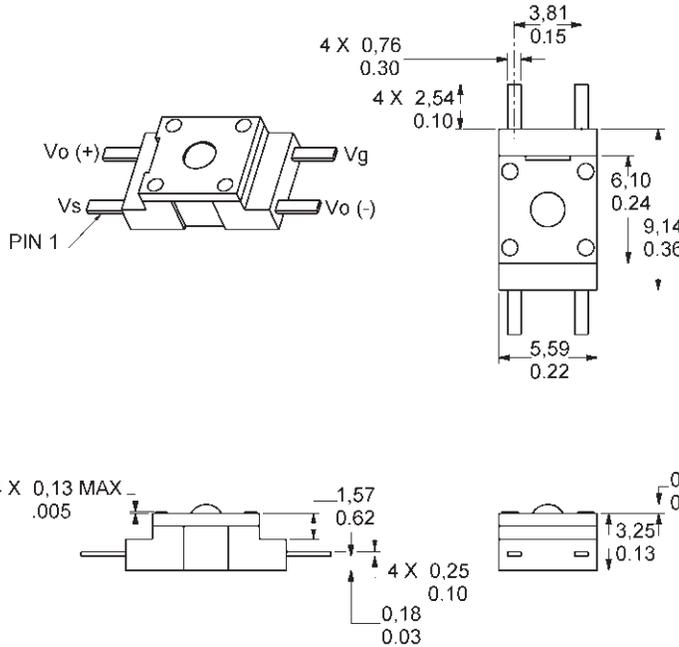
FSG and FSL Series

FS Series



MOUNTING DIMENSIONS (for reference only)

FSL05N2C



PERFORMANCE CHARACTERISTICS @ 5.0 ±0.01 Excitation, 25°C

Parameter	Min.	Typ.	Max.	Units
Excitation*	—	5.0	12	VDC
Null offset	-15	0	15	mV
Operating Force	0	—	500	grams
Sensitivity	0.1	0.12	0.14	mV/gram
Linearity (B.F.S.L.)**	—	±10	—	grams
Repeatability @ 300 g	—	±10	—	grams
Null Shift				
+25°C to 2°C, +25°C to +40°C	—	±0.5	—	mV
Sensitivity Shift				
+25°C to 2°C	—	0.012	—	mV/gram
+25°C to +40°C	—	-0.012	—	mV/gram
Input Resistance	4.0 K	5.0 K	6.0 K	Ohms
Output Resistance	4.0 K	5.0 K	6.0 K	Ohms
Overforce	—	—	4,500	grams
ESD (Direct contact, terminals and plunger)	10	—	—	kVolts

ENVIRONMENTAL SPECIFICATIONS

Operating Temperature	+2°C to +40°C (+36°F to +104°F)
Storage Temperature	-40° to +70°C (-40° to +158°F)
Vibration	Qualification tested to 10 Hz to 2 kHz, 20 g sine
Shock	Qualification tested to 150 g, 6 ms, half-sine
MCTF	7 million
Solderability	5 sec at 315°C per lead
Output ratiometric	Within Supply Range

**B.F.S.L.—Best Fit Straight Line

Note: All force related specifications established using dead weight or compliant force.

FS SERIES ORDER GUIDE

Catalog Listing	Force Range (grams)	Sensitivity mV/V/gram			Span mV	Over Force grams
		Min.	Typ.	Max.	Typ.	Max.
FSL05N2C	500	.02	.024	.028	60 (at 5 VDC)	4,500

Force

Constant Current Excitation Schematic

* Non-compensated force sensors, excited by constant current instead of voltage, exhibit temperature compensation of Span. Application Note #1 briefly discusses current excitation.

Constant current excitation has an additional benefit of temperature measurement. When driven by a constant current source, a silicon pressure sensor's terminal voltage will rise with increased temperature. The rise in voltage not only compensates the Span, but is also an indication of die temperature.

