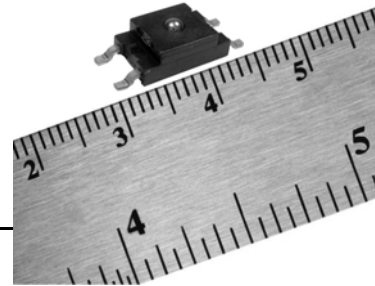


## FSS-SMT Series

### Low Profile Force Sensor



#### DESCRIPTION

Honeywell's FSS-SMT Series force sensors are designed to be one of the most reliable force sensors available as illustrated by 20 million Mean Cycles To Failure (MCTF) at 25 °C [77 °F] rating. This low profile Surface Mount Technology (SMT) sensor allows for automated assembly on a printed circuit board, often helping the customer to reduce assembly costs.

The FSS-SMT Series force sensor is designed to provide precise and reliable force sensing performance in a compact commercial-grade package. The sensor incorporates Honeywell sensing technology that uses a specialized piezoresistive micromachined silicon sensing element. The low power, unamplified, uncompensated Wheatstone bridge circuit design provides inherently stable millivolt output over the force range.

Force sensors operate on the principle that the resistance of silicon-implanted piezoresistors will change when the resistors flex under applied force. The sensor concentrates force from the applications, through the stainless steel ball, 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 change.

The sensor package design incorporates patented modular construction. The use of innovative elastomeric technology and engineered molded plastics results in load excitation capacities of 44 N over-force. The stainless steel ball provides excellent mechanical stability, and is suitable for a variety of potential medical and commercial applications.

#### FEATURES/BENEFITS

- Surface Mount Technology allows for automated assembly and may eliminate hand soldering
- RoHS-compliant materials meet Directive 2002/95/EC
- Low deflection (30 microns typical at full scale) help reduce measurement error
- Direct mechanical coupling of the actuation ball to the sense element reduces coupling errors and keeps mechanical hysteresis to a minimum
- Product rating of 20 million MCTF at 25 °C [77 °F], subject to application variation, provides for consistent output over time and reduces repairs or replacements
- Small size minimizes space on the printed circuit board (PCB)
- Provides enhanced sensitivity without compromising signal integrity, resulting in low system noise and reducing 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 (ESD) (8 KV) meets ESD Sensitivity Classification Level 3, reducing special handling during assembly
- Sensor output has low sensitivity to many mounting stresses

# FSS-SMT Series

## POTENTIAL APPLICATIONS

### Medical

- Infusion pumps
- Ambulatory non-invasive pumps
- Occlusion detection
- Kidney dialysis machines
- Enteral pumps

### Commercial

- Load and compression sensing
- Variable tension control
- Wire bonding equipment

**Table 1. Absolute Maximum Ratings<sup>1</sup>**

Parameter	Min.	Max.	Unit
Electro-Static Discharge (ESD)	-	8	kV
Storage temperature <sup>2</sup>	-40 [-40]	100 [212]	°C [°F]
Solderability <sup>3</sup>	-	260 [500] for 10 s	°C [°F]

**Table 2. Operating Specifications** (Performance characteristics at 5.0 ± 0.01 Vdc excitation, 25 °C [77 °F])

Parameter	Min.	Typical	Max.	Unit
Supply voltage <sup>4</sup>	3.0	5.0	6.0	V
Operating force	0	-	14.7	N
Operating temperature <sup>5</sup>	-40 [-40]	-	85 [185]	°C [°F]
Offset <sup>6</sup>	-15	0	15	mV
Span <sup>7</sup>	150	180	210	mV
Sensitivity <sup>8</sup>	10.2	12.2	14.3	mV/N
Force non-linearity (BFSL) <sup>9</sup>	-	±0.7	±1.5	%FSS
Repeatability at 2.9 N <sup>10</sup>	-	±1.5	-	mV
Mechanical hysteresis <sup>11</sup>		±0.5		%FSS
Thermal effect on offset <sup>12</sup> 25 °C to 0 °C [77 °F to 32 °F], 25 °C to 50 °C [77 °F to 122 °F]	-	±0.5	-	mV
Thermal effect on span <sup>13</sup> 25 °C to 0 °C [77 °F to 32 °F], 25 °C to 50 °C [77 °F to 122 °F]	-	±5.5	-	%FSS
Input resistance	4.0	5.0	6.0	kOhm
Output resistance	4.0	5.0	6.0	kOhm
Over force <sup>14</sup>	44	-	-	N

# Low Profile Force Sensor

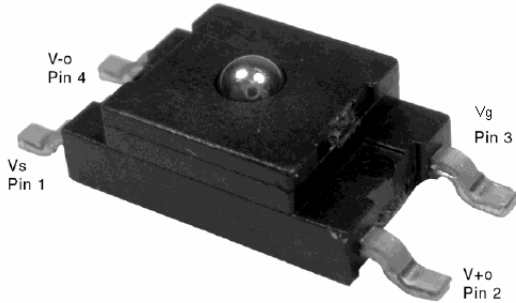
**Table 3. Environmental Specifications**

Parameter	Characteristics
Shock	Qualification tested to 150 G
Vibration	Qualification tested to 0 to 2 kHz, 20 G sine
Mean Cycles To Failure (MCTF) <sup>15</sup>	20 million at 25 ° C [77 ° F]

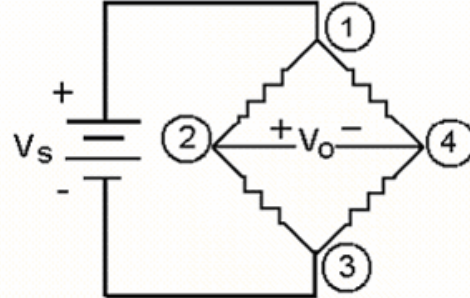
**Notes:**

1. Absolute maximum ratings are the extreme limits that the device can withstand without damage to the device.
2. The temperature range over which the product may safely be exposed without excitation or force applied. Under these conditions the product will remain in specification after excursion to any temperatures in this range. Exposure to temperatures beyond this range may cause permanent damage to the product.
3. The maximum temperature and time for which the product can be exposed to for processing of solder electrical connections.
4. The range of voltage excitation which can be supplied to the product to produce an output which is proportional to Force but due to Ratiometricity errors may not remain within the specified performance limits.
5. The temperature range over which the product will produce an output proportional to force but may not remain within the specified performance limits.
6. The output signal obtained when the zero force is applied to the sensor. Also known as "null" or "zero".
7. The algebraic difference between output signal measured at the upper and lower limits of the Operating Force Range. Also known as "full scale output" or simply "span".
8. The ratio of output signal change to the corresponding input force change. Sensitivity is determined by computing the ratio of Span to the specified Operating Force Range.
9. Force Non-Linearity (Best Fit Straight Line): The maximum deviation of product output from a straight line fitted to output measured over the operating force range. The straight line through a set of points which minimizes the sum of the square of the deviations of each of the points from the straight line.
10. The maximum difference between output readings when the same force is applied consecutively, under the same operating conditions, with force approaching from the same direction within the operating force range.
11. The maximum difference between output readings when the same force is applied consecutively, under the same operating conditions, with force approaching from opposite directions within the operating force range.
12. The maximum deviation in Offset due to changes in temperature over the Operating Temperature Range, relative to Offset measured at 25 °C.
13. The maximum deviation in Full Scale Span due to changes in temperature over the Operating Temperature Range, relative to Full Scale Span measured at 25 °C.
14. The maximum force which may safely be applied to the product for it to remain in specification once force is returned to the Operating Force Range. Exposure to higher forces may cause permanent damage to the product. Unless otherwise specified this applies to all temperature within the Operating Temperature Range.
15. MCTF is a basic measure of reliability for a non-repairable device. It is the mean number of cycles to maximum operating force over which a sensor can be expected to operate until failure. The mean value is determined statistically from a probability distribution for failures based upon test data. MCTF may vary depending on the specific application in which a sensor is utilized.

**Figure 1. Sensor Pinout**



**Figure 2. Excitation Schematics – Excitation 5 Vdc Typ., 6 Vdc max.**



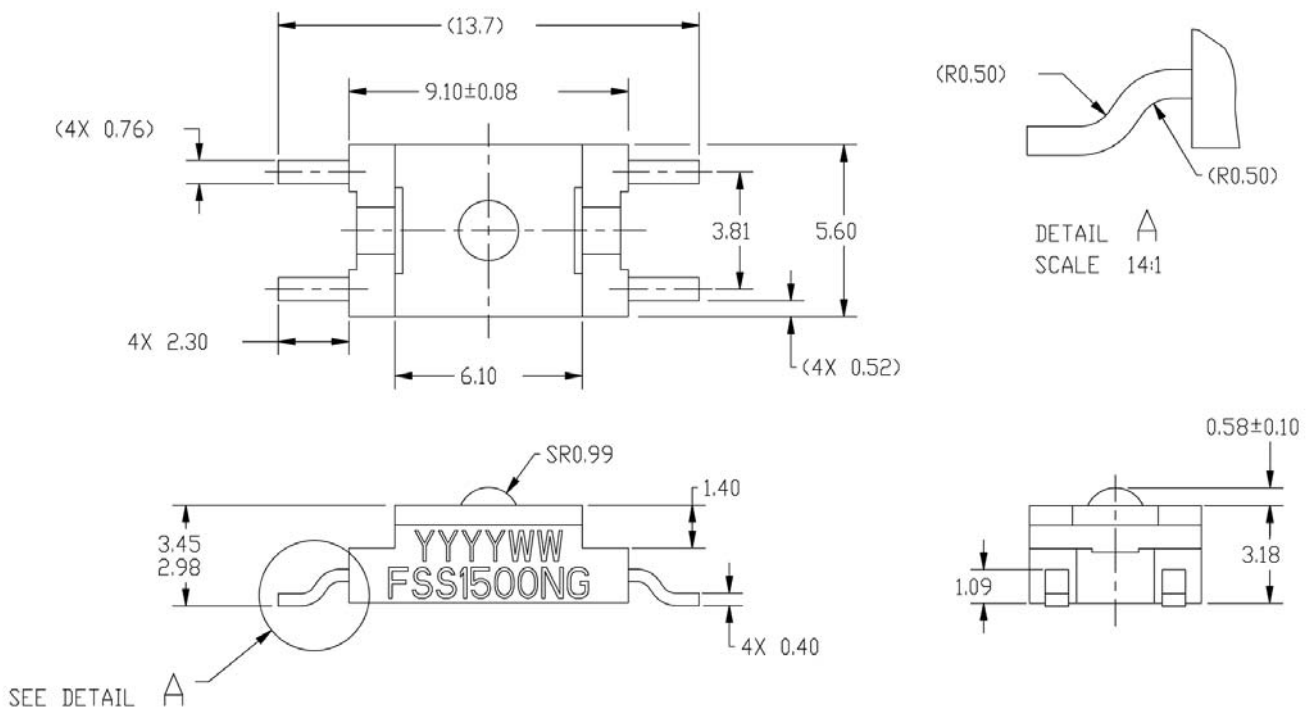
**FS Series Circuit**

1. Circled numbers refer to sensor terminals (pins).

- Pin 1 = Supply  $V_s$  (+)
- Pin 2 = Output  $V_o$  (+)
- Pin 3 = Ground  $V_g$  (-)
- Pin 4 = Output  $V_o$  (-)

- 2. The force sensor may be powered by voltage or current. Maximum supply voltage is not to exceed 6 V. Maximum supply current is not to exceed 1.2 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 ( $V_o = V_o(+)-V_o(-)$ ). 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.

**Figure 3. Mounting Dimensions (for reference only) in mm**



# Low Profile Force Sensor

Figure 4. Suggested Land Pattern in mm

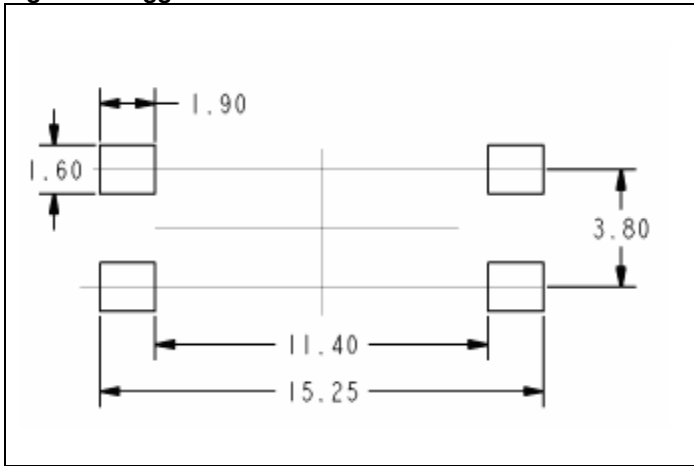


Table 4. Order Guide

Catalog Listing	Packaging*
FSS1500NGT	Tube
FSS1500NGR	Tape and reel (1,000 units)

\* Tape and reel packaging in development