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Flexiforce Demo Kit (#28017) Single Element Pressure Sensor

Tekscan's FlexiForce[®] sensor measures force between two surfaces. The sensor output exhibits a high degree of linearity, low hysteresis and minimal drift compared to other thin-film force sensors. The Flexiforce single element sensor acts as a resistor in an electrical circuit. When the sensor is unloaded, its resistance is very high. Resistance decreases when force is applied to the sensor. The resistance can be read by connecting an ohmmeter to the outer two pins of the sensor and applying a force to the round tab sensing area at the end of the film.

The resistance of the Flexiforce sensor is proportional to weight. The sensor included in your kit is rated at 1.6 lbs.¹ The purpose of the Parallax example circuit is only to demonstrate the resistive nature of the sensor with a resistor/capacitor discharge time measurement circuit; no correlations to weight are made in these examples.

Packing List

Verify that your Flexiforce Demo Kit has the following components:

- (1) Flexiforce thin-film sensor
- (1) 220 ohm resistor
- (1) 0.1 uF capacitor
- (1) 0.01 uF capacitor

The sample code and circuit uses the Parallax BASIC Stamp 2 module. With a change of directive at the top of each PBASIC program the code may also be used in BASIC Stamp 2SX, 2e, 2p, and 2pe modules. The second sample program uses StampDAQ, an Excel add-on which receives real-time data into an Excel spreadsheet. StampDAQ works with Excel 2000 or higher and can be downloaded for free from www.parallax.com.

¹ Based on resistor values in the Tekscan "Flexiforce Sample Drive Circuit" drawing on the manufacturer's web site <http://www.tekscan.com>. Standard force range of this sensor can be changed to have a full-scale 1 lb – 1,000 lb response by changing driving voltage and feedback resistors and driving voltage in their sample circuit.

Flexiforce Specifications

Physical Properties	
Thickness	0.005" (0.127 mm)
Length	8.000" (203 mm)
Width	0.55" (14 mm)
Active Sensing Area	0.375" (9.53 mm) diameter
Connector	3 pin post connector

Typical Performance	
Linearity (error)	< ±5% (Line drawn from 0 to 50% load)
Repeatability	< ±2.5% of Full Scale (Conditioned Sensor, 80% of Full Force Applied)
Hysteresis	< 4.5 % of Full Scale (Conditioned Sensor, 80% of Full Force Applied)
Drift	< 3% / logarithmic time (Constant Load - 25 lb.)
Rise Time	< 20 µsec (Impact load - recorded on Oscilloscope)
Operating Temperature	15°F - 140°F (-9°C - 60°C)*

Figure 1: Flexiforce Specifications

The force response of this sensor is approximately 1.6 lbs. using the Flexiforce Sample Drive Circuit on www.tekscan.com. However, the best way to determine the correlation is by placing known weights on the end of the sensor and recording your RCTime values from the sample BASIC Stamp programs.

Example Circuit

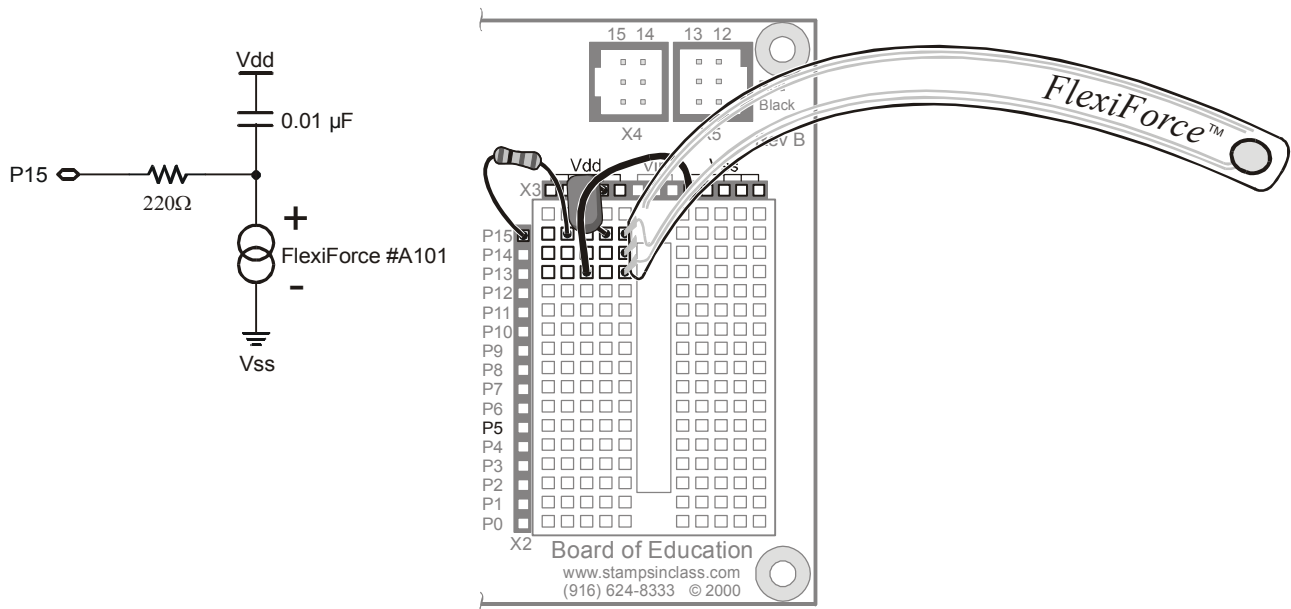


Figure 2: Example Schematic and Pictorial

BASIC Stamp Examples

Example #1: Simple Output Example

The first example demonstrates the Flexiforce sensor in a BASIC Stamp resistor/capacitor time-discharge measurement circuit. For higher accuracy, replace the 0.01 uF capacitor with the 0.1 uF capacitor.

```
' Flexiforce Simple.bs2
' Displays R/C Discharge Time in BASIC Stamp DEBUG Window
' {$STAMP BS2}
' {$PBASIC 2.5}

' -----[ Declarations ]-----
rawForce      VAR      word      ' Stores raw output
sensorPin     CON      15        ' Flexiforce sensor circuit

' -----[ Main Routine ]-----

Measure:
  HIGH sensorPin      ' Discharge the capacitor
  PAUSE 2
  RCTIME sensorPin,1,rawForce  ' Measure RC charge time
  DEBUG Home, "Flexiforce raw output = ", dec rawForce,CR
GOTO Measure
```

Example #2: StampDAQ Real-Time Data Acquisition with Excel

The Flexiforce sensor provides quick, dynamic feedback. In a laboratory setting it would be helpful to obtain real-time streaming data from the sensor. Parallax has made available a free download called StampDAQ. StampDAQ is an Excel 2000 (or greater) add-on that lets you receive real-time data into a spreadsheet. To use StampDAQ follow this order of operation:

1. Download StampDAQ from www.parallax.com and install on your PC.
2. Run the sample code in your BASIC Stamp 2 module. Leave the Board of Education (or whatever experimental circuit you have made) connected to your PC with a serial cable.
3. Open Excel and press ctrl-S to start StampDAQ.
4. Reset the BASIC Stamp and data will stream into Excel.

The StampDAQ "Help" files provide detailed information about serial communication and baud rates, configuration and parameters required to setup the program.

```
' Flexiforce StampDAQ.bs2

' Example with the Flexiforce sensor and StampDAQ
' {$STAMP BS2}
' {$PBASIC 2.5}

' -----[ Declarations ]-----

rawForce      VAR      word      ' Stores raw output
sensorPin     CON      15         ' Flexiforce sensor circuit
sPin          CON      16         ' Serial transmit pin
Baud          CON      84         ' 9600, 8-bit, no polarity, true

' -----[ Main Routine ]-----

Initialize:
  PAUSE 1000
  SEROUT sPin,Baud,[CR]           'prep StampDAQ buffer
  SEROUT sPin,Baud,[CR,"LABEL,rawForce",CR]
                                   'Label column with rawForce
  SEROUT sPin,Baud,["CLEARDATA",CR] 'Clear all data

Display:
  HIGH 15                          'Discharge capacitor
  PAUSE 2
  RCTIME sensorPin,1,rawForce      'Measure R/C charge time
  SEROUT sPin,Baud,["DATA,rawForce,",DEC rawForce,CR]
                                   'Send data to StampDAQ

GOTO Display
```

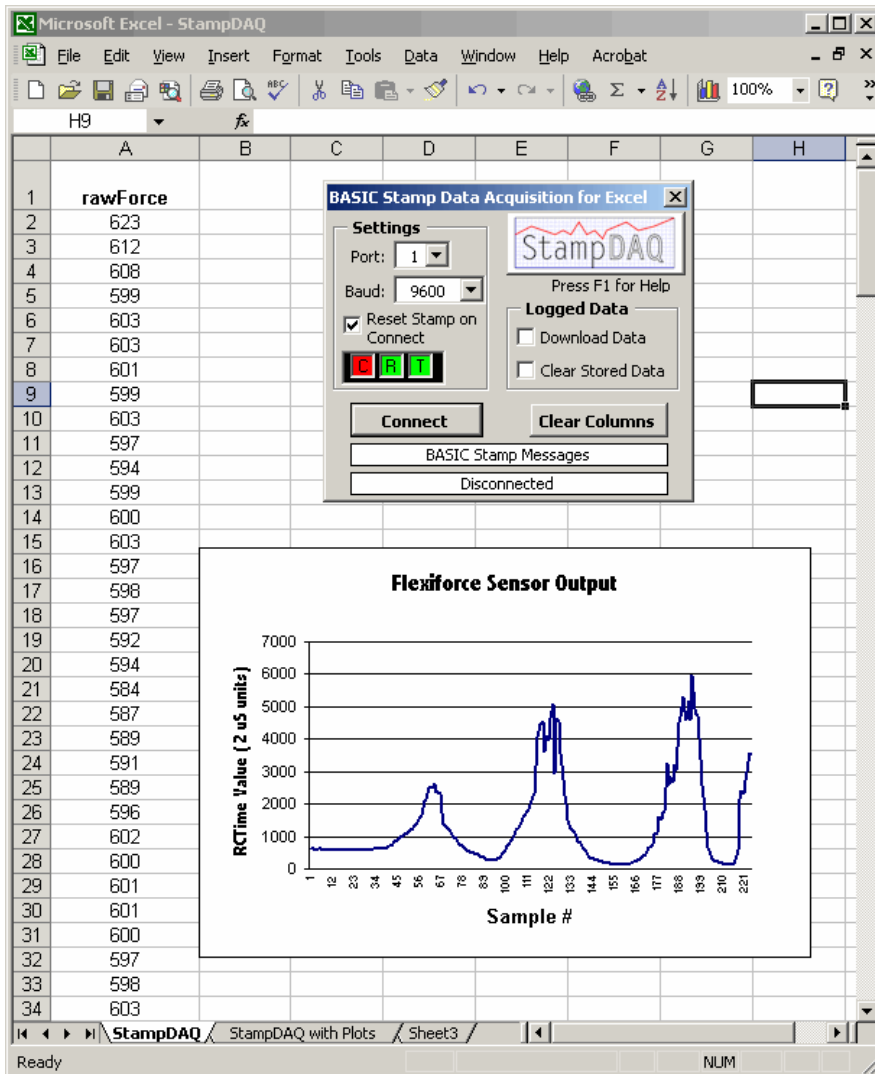


Figure 3: Example StampDAQ Output

Technical Data Sheet (Model #A101)

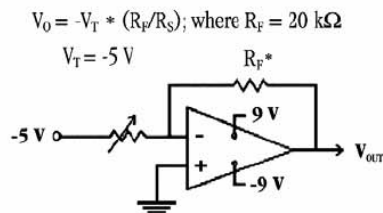
This data sheet provides technical performance characteristics for *FlexiForce*® Sensors.

Physical Properties

Thickness	.005" (0.127 mm)
Length	8.00" (203 mm), 6.00", 4.00", or 2.00"
Width	0.55" (14 mm)
Sensing Area	.375" diameter (9.53 mm)
Connector	3-pin Male Square Pin



Recommended Excitation Circuit



*The range for R_F is 1 $\text{k}\Omega$ to 100 $\text{k}\Omega$
 **Resistance at no load is 20 $\text{M}\Omega$

Typical Performance

Linearity (Error)	< $\pm 5\%$
Repeatability	< $\pm 2.5\%$ of Full Scale
Hysteresis	< 4.5 % of Full Scale
Drift	< 3% per Logarithmic Time
Rise Time	< 20 μsec
Operating Temperature	15°F - 140°F (-9°C - 60°C)*

*Force reading change per degree of temperature change = $\pm 0.2\%/^{\circ}\text{F}$ (0.36%/°C)

**For loads less than 10 lbs., the operating temperature can be increased to 165°F (74°C)

Evaluation Conditions

Line drawn from 0 to 50% load
 Conditioned Sensor, 80% of Full Force Applied
 Conditioned Sensor, 80% of Full Force Applied
 Constant Load of 25 lbs. (111 N)
 Impact Load, Output recorded on Oscilloscope

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