1. 弊社製品番号
   Product No.
   HSFPAR004A

2. 製品概要
   General description
   本製品は、シリコンダイアフラム上にピエゾ抵抗が形成されており、荷重が加わるとダイアフラムが撓むことでピエゾ抵抗に応力が発生し、抵抗率が変化するピエゾ抵抗効果を利用した荷重センサ。

   • This product is a force sensor using effect of piezo resistive bridge circuit formed on silicon diaphragm.
   • Piezo resistance is changed according to strain by applying force to the diaphragm.

3. 製品の特徴
   Feature
   • 小型低背です。
     PKGサイズが小さくスペースを取らないため、様々な製品デザインに対応出来ます。
   • 感度が高く、直線性に優れます。
     0.01Nレベルの小さな応力から検出可能です。
   • 信頼性に優れます。
     100万回の荷重試験後で、特性の変化は有りません。

   • Small Footprint and Low Profile
     User design flexibility by small package.
   • High Sensitivity and Good Linearity
     Precisely detect micro force less than 0.01 N.
   • High Durability
     No characteristics change after 1 million cycles.
4. Sensor structure and measurement principle

(1) Diaphragm is strained by getting force from outside.

(2) Resistance of Piezo element on the diaphragm is changed by getting the strain diaphragm deformation

(3) Analog voltage is outputted in response to the force change.
   \( V_{\text{out}} = V_{\text{out1}} - V_{\text{out2}} \)
5. ブロック図
Functional block diagram

![Block Diagram](image1)

No1 Vdd
No2 V2
No3 GND
No4 V1

6. 外形図
Full view

![Full View](image2)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Vdd</td>
<td>Vdd</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>V2</td>
<td>-Output(-)</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>V1</td>
<td>+Output(+)</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>GND</td>
</tr>
</tbody>
</table>

*Output = V1 - V2
7. 推奨回路
Recommended circuit
7-1. アナログ回路例
Example circuit for analog output.

推奨値 Recommended value

<table>
<thead>
<tr>
<th>電源電圧</th>
<th>Vcc [V]</th>
<th>3.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>計装アンプ</td>
<td>Instrumentation amplifier</td>
<td>-</td>
</tr>
<tr>
<td>増幅率調整抵抗</td>
<td>Gain adjustment Resistance</td>
<td>RG [kΩ]</td>
</tr>
<tr>
<td>オフセット調整抵抗</td>
<td>Offset adjustment Resistance</td>
<td>R1 [kΩ]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R2 [kΩ]</td>
</tr>
<tr>
<td>コンデンサ</td>
<td>Capacitance</td>
<td>C [μF]</td>
</tr>
<tr>
<td>感度</td>
<td>Sensitivity</td>
<td>Sens [mV/N]</td>
</tr>
</tbody>
</table>

*1 記載アンプは一例です。
上記リストの製品は当社にて動作を保証するものではございません。
動作は回路設計に依存しますので事前に確認をお願いします。
The listed amplifier is an example.
Our company does not guarantee the operation for the products listed above.
These are depend on the circuit design, please check in advance.

参考 Reference
増幅率 Gain = ( 1 + 100kΩ / RG )
オフセット Offset voltage = R2 / ( R1+R2 ) * Vcc
出力 OUTPUT = Gain*Vin + Offset voltage
7-2. デジタル回路例
Example circuit for digital output.

*1 システムの要求に合致するように適切なADコンバータを選択下さい。
Please select the appropriate AD converter to meet the requirements of the system.

*2 必要により計装アンプ及びその他の部品を追加下さい。
Please add the Instrumentation amplifier or some components as needed.
8. 評価方法例
   Evaluation example

   Notes
   • When the gauge is touched to the sensor, it does slowly.
   • The gauge is vertically touched to the sensor.
   • Force more than the maximum ratings is not added.
9. Design guide

9-1 Precautions

- Please do not apply the static force and the impact force of 55N or more to this sensor.

![Force Sensor](Image)

Recommendation:
SUS440C, t=0.2mm

- Please do not apply force at an angle to the sensor.

- The dust such as sand must not enter.
- Something that corrode solder must not enter.
This structure detects load force of pen tip as opposite direction. Therefore impact stress doesn’t apply directly to the sensor projection.

Spring is recommended below.
- **Coil spring**

Displacement is limited to X[mm] by the stopper.

Limit the impact force applied to the sensor by the stopper. Recommendation: Limit force \( F < 8[N] \)
- Spring constant: \( k[N/mm] \), Displacement: \( X[mm] \)
  \[
  F = kX < 8[N]
  \]
- Pre-tension - \( F > 0[N] \)

Metal plate is recommended stainless steel.
- e.g.) Metal plate: SUS440C

The output of sensor is changed as below figures.
Package dimensions

<table>
<thead>
<tr>
<th>Ref</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.90</td>
<td>2.00</td>
<td>2.10</td>
</tr>
<tr>
<td>B</td>
<td>1.50</td>
<td>1.60</td>
<td>1.70</td>
</tr>
<tr>
<td>C</td>
<td>0.38</td>
<td>0.40</td>
<td>0.42</td>
</tr>
<tr>
<td>D</td>
<td>0.62</td>
<td>0.66</td>
<td>0.70</td>
</tr>
<tr>
<td>E</td>
<td>0.15</td>
<td>0.20</td>
<td>0.25</td>
</tr>
<tr>
<td>F</td>
<td>0.35</td>
<td>0.40</td>
<td>0.45</td>
</tr>
<tr>
<td>G</td>
<td>0.51</td>
<td>0.56</td>
<td>0.61</td>
</tr>
<tr>
<td>H</td>
<td>0.51</td>
<td>0.56</td>
<td>0.61</td>
</tr>
<tr>
<td>I</td>
<td>1.10</td>
<td>1.20</td>
<td>1.30</td>
</tr>
<tr>
<td>J</td>
<td>1.30</td>
<td>1.40</td>
<td>1.50</td>
</tr>
<tr>
<td>P</td>
<td>0.90</td>
<td>1.00</td>
<td>1.10</td>
</tr>
<tr>
<td>Q</td>
<td>0.70</td>
<td>0.80</td>
<td>0.90</td>
</tr>
</tbody>
</table>

Dimension in millimeters

Top view

Side view

Bottom view
### 11. 電気特性
**Electrical specifications**

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Unit.</th>
<th>Specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>min.</td>
<td>Typ.</td>
</tr>
<tr>
<td><strong>最大定格 Absolute Maximum Ratings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>定格電源電圧 Absolute limits supply voltage</td>
<td>Vlim</td>
<td>[V]</td>
<td>-4.0</td>
<td>-</td>
</tr>
<tr>
<td>最大定格荷重 Max Load Rating</td>
<td>Llim</td>
<td>[N]</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>保存温度範囲 Storage temperature</td>
<td>Tstr</td>
<td>[ºC]</td>
<td>-55</td>
<td>-</td>
</tr>
<tr>
<td>ESD耐圧 ESD</td>
<td>HBM</td>
<td>[V]</td>
<td>-1000</td>
<td>-</td>
</tr>
<tr>
<td>寿命 Durability</td>
<td>Drbl</td>
<td>[Cycles]</td>
<td>1000k</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>使用条件 Operating conditions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>動作荷重範囲 Force range</td>
<td>Frng</td>
<td>[N]</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>電源電圧 Supply voltage</td>
<td>Vdd</td>
<td>[V]</td>
<td>1.5</td>
<td>-</td>
</tr>
<tr>
<td>動作温度範囲 Operating temperature</td>
<td>Topr</td>
<td>[ºC]</td>
<td>-40</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>電気的仕様 Electrical specifications (T=25ºC)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>感度 Sensitivity</td>
<td>Sens</td>
<td>[mV/V/N]</td>
<td>1.6</td>
<td>2.3</td>
</tr>
<tr>
<td>リニアリティー Linearity</td>
<td>Lin</td>
<td>[%FS]</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>オフセット電圧 Null Offset</td>
<td>V0</td>
<td>[mV/V]</td>
<td>-5.6</td>
<td>-2.6</td>
</tr>
<tr>
<td>ブリッジ抵抗 Bridge Resistance</td>
<td>Rbrg</td>
<td>[kΩ]</td>
<td>4.5</td>
<td>5.5</td>
</tr>
</tbody>
</table>

**Linear fitting curve**:

\[
\text{Output} = \text{Force} \times \text{Vdd} \times \alpha + \text{Vdd} \times \beta
\]

* **Sensitivity** : \( \alpha \)
* **Null Offset** : \( \beta \)
* **Linearity** : \( (A+B)/FS \times 100 \)

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**HSFPAR004A_ Datasheet**

Rev.2.3
Mar/26/2019
12. 推奨ランドパターン
Recommended land pattern

Basically devices shall be mounted by the mounting machine.
In case of manual mounting, do not touch knob.
13. 推奨温度プロファイル
Recommended soldering conditions

ピーク温度：250℃以下、10sec以内
Peak temperature: 250 ℃ or less, within 10 seconds.
14. Laser marking specifications

<table>
<thead>
<tr>
<th>Laser Mark No</th>
<th>Indication item</th>
<th>Content of indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2</td>
<td>Manufacturing No.</td>
<td>0 ~ 9, A ~ Z (00 ~ ZZ)</td>
</tr>
<tr>
<td>3 4</td>
<td>Production month</td>
<td>1~9, A, B, C</td>
</tr>
<tr>
<td>5</td>
<td>Identification number</td>
<td>A~Z</td>
</tr>
<tr>
<td></td>
<td>1pin mark</td>
<td>[●] Fix</td>
</tr>
</tbody>
</table>

Unit: mm
15. **Tape & Reel specifications**

15-1. Storage direction of the products

![Diagram](image1)

15-2. Direction of tape drawing out

![Diagram](image2)

15-3. Taping

![Diagram](image3)

15-4. Peel strength

- Peel strength of cover tape shall be 0.1N(10g)～0.7N(70g) for 300mm/min.

![Diagram](image4)

15-5. Top cover tape offset

![Diagram](image5)

- Overlay of cover tape to the hole (A) is allowed by 0.5mm
- Bulge of top cover tape (B) is allowed by 0.5mm
15-6. Emboss Tape Dimensions (Unit mm)

15-7. Reel Dimensions (Unit : mm)
15-8. Packing

● For overseas
  • This product is packed by tape wrapping (3,000 pcs/reel).
  • The barcode label is put on each reel.
  • One reel is stored in one Bag.
  • 15 bags are put in 1 carton (max. 45,000 pcs/carton)
  • The cushion is stored in the top and bottom of the carton.

● For Japan
  • This product is delivered by the taping wrapping (3,000 pcs/reel).
  • This product is delivered by a non damp-proof packing.
  • The barcode label is put on each reel.
  • 1 reel stored in the carton box. (carton/with 3,000pcs)

● Recommended storage condition
  MSL1

● Damp-proof packing
  None

● Stacking height of carton
  • For overseas: Maximum 5 cartons
  • For Japan: Maximum 10 cartons

● Minimum Order Quantity
  Standard Packing Quantity
  3,000 pcs
16. Legal Disclaimer

1. For the export of products which are controlled items subject to foreign and domestic export laws and regulations, you must obtain approval and/or follow the formalities of such laws and regulations.

2. Products must not be used for military and/or antisocial purposes such as terrorism, and shall not be supplied to any party intending to use the products for such purposes.

3. Unless provided otherwise, the products have been designed and manufactured for application to equipment and devices which are sold to end-users in the market, such as AV (audio visual) equipment, home electric equipment, office and commercial electronic equipment, information and communication equipment or amusement equipment. The products are not intended for use in, and must not be used for, any application of nuclear equipment, driving control equipment for aerospace or any other unauthorized use.

With the exception of the above mentioned banned applications, for applications involving high levels of safety and liability such as medical equipment, burglar alarm equipment, disaster prevention equipment and undersea equipment, please contact our company's sales representative and/or evaluate the total system on the applicability. Also, implement a fail-safe design, protection circuit, redundant circuit, malfunction protection and/or fire protection into the complete system for safety and reliability of the total system.

4. Before using products which were not specifically designed for use in automotive applications, please contact our company's sales representative.
17. Notes concerning patent

Except for the structure of this product, our company will not indemnify, defend and hold harmless you from and against any third party’s intellectual properties rights such as patents even if examples of use for this product are shown in this documents, you shall do patent clearance search for your product incorporating this product.